March 9, 2017. Section III(d) "Cost Sharing or Matching" has been updated to more accurately reflect the requirements in 14 CFR §1274, the POC for CubeSats at the end of Section V(b) has been updated, and Table 1 has been updated to indicate that a letter of support is not required for a facility or resource under the direct control of a Co-I. New text is in bold and deleted text is struck through.
This National Aeronautics and Space Administration (NASA) Research Announcement (NRA), Research Opportunities in Space and Earth Sciences (ROSES) –2017, solicits basic and applied research in support of NASA’s Science Mission Directorate (SMD). ROSES is an omnibus NRA, with many individual program elements, each with its own due dates and topics. All together these cover the wide range of basic and applied supporting research and technology in space and Earth sciences supported by SMD. Awards range from under $100K per year for focused, limited efforts (e.g., data analysis) to more than $1M per year for extensive activities (e.g., development of specialized science experimental hardware). The funds available for awards in each program element offered in this NRA range from less than one to several million dollars, which allow selection from a few to as many as several dozen proposals, depending on the program objectives and the submission of proposals of merit. Awards will be made as grants, cooperative agreements, contracts, and inter- or intra-agency transfers, depending on the nature of the work proposed, the proposing organization, and/or program requirements. The typical period of performance for an award is three years, but some programs may allow up to five years and others specify shorter periods. Organizations of every type, domestic and foreign, Government and private, for profit and not-for-profit, may submit proposals without restriction on teaming arrangements. Note that it is NASA policy that all investigations involving non-U.S. organizations will be conducted on the basis of no exchange of funds.

Details of the solicited program elements are given in the Appendices of this NRA. Proposal due dates are given in Tables 2 and 3 of this NRA, which will be posted on the web at http://nspires.nasaprs.com/ and direct links to the tables of due dates are provided below. Interested proposers should monitor http://nspires.nasaprs.com/ and subscribe to the SMD electronic notification system there for additional new program elements or amendments to this NRA through February 2017, at which time release of a subsequent ROSES NRA is planned. A web archive (and RSS feed) for amendments, clarifications, and corrections to ROSES-2017 will be available at: http://science.nasa.gov/researchers/sara/grant-solicitations/ROSES-2017/. This NRA will be available upon its release at http://solicitation.nasaprs.com/ROSES2017.

Potential proposers should also be aware of the Guidebook for Proposers Responding to a NASA Funding Announcement (hereafter referred to as the NASA Guidebook for Proposers or simply the Guidebook).
# ROSES–2017 SUMMARY OF SOLICITATION
## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>I. Funding Opportunity Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Strategic Objectives of NASA’s Research Program</td>
<td>1</td>
</tr>
<tr>
<td>(b) Research Programs of NASA’s Science Mission Directorate</td>
<td>1</td>
</tr>
<tr>
<td>(c) Significant Changes from Recent ROSES</td>
<td>3</td>
</tr>
<tr>
<td>(d) NASA-Provided High-End Computing (HEC) Resources</td>
<td>5</td>
</tr>
<tr>
<td>(e) Availability of Funds for Awards</td>
<td>6</td>
</tr>
<tr>
<td>(f) Successor, Resubmitted, Multiple and Duplicate Proposals</td>
<td>7</td>
</tr>
<tr>
<td>(g) Order of precedence: ROSES vs. Guidebook vs. Program Elements</td>
<td>7</td>
</tr>
<tr>
<td>(h) Access to NASA Facilities/Systems</td>
<td>8</td>
</tr>
<tr>
<td>(i) Citizen Science</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II. Award Information</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Funding and Award Policies</td>
<td>8</td>
</tr>
<tr>
<td>(b) Award Period of Performance</td>
<td>9</td>
</tr>
<tr>
<td>(c) Increasing Access to the Results of Federally Funded Research</td>
<td>9</td>
</tr>
<tr>
<td>(d) Rephasing of Award Budgets</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>III. Eligibility Information</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Eligibility of Applicants</td>
<td>11</td>
</tr>
<tr>
<td>(b) Number of Proposals and Teaming Arrangements</td>
<td>11</td>
</tr>
<tr>
<td>(c) Restrictions involving China</td>
<td>12</td>
</tr>
<tr>
<td>(d) Cost Sharing or Matching</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV. Proposal and Submission Information</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Proposal Instructions and Requirements</td>
<td>13</td>
</tr>
<tr>
<td>(b) Content and Form of the Proposal Submission</td>
<td>14</td>
</tr>
<tr>
<td>(i) Electronic Proposal Submission</td>
<td>14</td>
</tr>
<tr>
<td>(ii) Proposal Format and Contents</td>
<td>15</td>
</tr>
<tr>
<td>(iii) Budget Rules with Redaction of Salaries and Indirect Costs</td>
<td>17</td>
</tr>
<tr>
<td>(iv) Submission of Proposals via NSPIRES</td>
<td>18</td>
</tr>
<tr>
<td>(v) Submission of Proposals via Grants.gov</td>
<td>21</td>
</tr>
<tr>
<td>(vi) Notice of Intent to Propose</td>
<td>23</td>
</tr>
<tr>
<td>(vii) The Two-Step Proposal Process</td>
<td>23</td>
</tr>
<tr>
<td>(viii) The Two-Phase Proposal Process</td>
<td>24</td>
</tr>
<tr>
<td>(c) Proposal Submission Due Dates and Deadlines</td>
<td>25</td>
</tr>
<tr>
<td>(d) Proposal Funding Restrictions</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>V. Suborbital-Class Investigations</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Overview of Suborbital-Class Platforms</td>
<td>27</td>
</tr>
<tr>
<td>(b) Points of Contact for Suborbital-Class Platforms</td>
<td>28</td>
</tr>
<tr>
<td>(i) NASA-provided Sounding Rocket Services</td>
<td>28</td>
</tr>
<tr>
<td>(ii) NASA-provided Balloon Services</td>
<td>29</td>
</tr>
<tr>
<td>(iii) Suborbital Reusable Launch Vehicles</td>
<td>30</td>
</tr>
<tr>
<td>(iv) Research Investigations utilizing the International Space Station</td>
<td>32</td>
</tr>
<tr>
<td>(v) Use of Short Duration Orbital Platforms, including CubeSats</td>
<td>34</td>
</tr>
<tr>
<td>(c) General Guidelines for Suborbital Investigation Proposals</td>
<td>36</td>
</tr>
</tbody>
</table>
VI. Proposal Review Information 37
   (a) Evaluation Criteria 37
   (b) Review and Selection Processes 39
   (c) Selection Announcement and Award Dates 39
   (d) Processes for Appeals 39
      (i) Reconsideration by SMD 39
      (ii) Ombudsman Program 40
      (iii) Protests 40
   (e) Service as a Peer Reviewer 40

VII. Award Administration Information 40
    (a) Notice of Award 40
    (b) Administrative and National Policy Requirements 41
    (c) Award Reporting Requirements 41

VIII. Points of Contact for Further Information 42

IX. Ancillary Information 42
    (a) Announcement of Updates/Amendments to Solicitation 42
    (b) Electronic Submission of Proposal Information 43
    (c) Electronic Notification of SMD Research Solicitations 43
    (d) Further Information on SMD Research and Analysis Programs 43
    (e) Archives of Past Selections 44
    (f) Meeting Geospatial Standards 44

X. Concluding Statement 44

TABLE 1. Checklist for Proposers 45

TABLE 2. Program Elements (ordered by due date)  see note

TABLE 3. Program Elements (ordered by appendix and number)  see note

Note: Table 2 and Table 3 of this NRA are posted and updated as separate html documents on the web and can be reached either by following the hypertext links above embedded in the electronic version of this document, or at http://solicitation.nasaprs.com/ROSES2017table2 and http://solicitation.nasaprs.com/ROSES2017table3, respectively, or by going to http://solicitation.nasaprs.com/ROSES2017 and following the links there.

Any amendments to the program elements will be indicated as bold and red in Table 2 and Table 3 of this NRA. Potential proposers may receive notification of amendments to ROSES-2017 by signing up for the SMD NSPIRES mailing list and/or by signing up for the ROSES-2017 RSS feed at https://science.nasa.gov/researchers/sara/grant-solicitations/roses-2017/.
## Appendix A. Earth Science Research Program

<table>
<thead>
<tr>
<th>A.x</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1</td>
<td>Earth Science Research Program Overview</td>
<td>A.1-1</td>
</tr>
<tr>
<td>A.2</td>
<td>Land Cover/Land Use Change</td>
<td>A.2-1</td>
</tr>
<tr>
<td>A.3</td>
<td>Ocean Biology and Biogeochemistry</td>
<td>A.3-1</td>
</tr>
<tr>
<td>A.4</td>
<td>Terrestrial Ecology</td>
<td>A.4-1</td>
</tr>
<tr>
<td>A.5</td>
<td>Carbon Cycle Science</td>
<td>A.5-1</td>
</tr>
<tr>
<td>A.6</td>
<td>Biodiversity</td>
<td>A.6-1</td>
</tr>
<tr>
<td>A.7</td>
<td>Carbon Monitoring System</td>
<td>A.7-1</td>
</tr>
<tr>
<td>A.8</td>
<td>Supporting UN Sustainable Development Goals 14 and 15 in the Context of Climate Variability and Change</td>
<td>A.8-1</td>
</tr>
<tr>
<td>A.9</td>
<td>ECOSTRESS Science Team</td>
<td>A.9-1</td>
</tr>
<tr>
<td>A.10</td>
<td>Physical Oceanography</td>
<td>A.10-1</td>
</tr>
<tr>
<td>A.11</td>
<td>Ocean Salinity Science Team</td>
<td>A.11-1</td>
</tr>
<tr>
<td>A.12</td>
<td>Sea Level Change Science Team</td>
<td>A.12-1</td>
</tr>
<tr>
<td>A.13</td>
<td>Ocean Surface Topography Science Team</td>
<td>A.13-1</td>
</tr>
<tr>
<td>A.14</td>
<td>Ocean Vector Winds Science Team</td>
<td>A.14-1</td>
</tr>
<tr>
<td>A.15</td>
<td>Modeling, Analysis, and Prediction</td>
<td>A.15-1</td>
</tr>
<tr>
<td>A.16</td>
<td>Cryospheric Science</td>
<td>A.16-1</td>
</tr>
<tr>
<td>A.17</td>
<td>IceBridge Research</td>
<td>A.17-1</td>
</tr>
<tr>
<td>A.18</td>
<td>Studies with ICESat and CryoSat-2</td>
<td>A.18-1</td>
</tr>
<tr>
<td>A.19</td>
<td>Solar Irradiance Science Team</td>
<td>A.19-1</td>
</tr>
<tr>
<td>A.20</td>
<td>Atmospheric Composition: Laboratory Research</td>
<td>A.20-1</td>
</tr>
<tr>
<td>A.21</td>
<td>Atmospheric Composition: Radiation Sciences Program</td>
<td>A.21-1</td>
</tr>
<tr>
<td>A.22</td>
<td>Atmospheric Composition Modeling and Analysis</td>
<td>A.22-1</td>
</tr>
<tr>
<td>A.23</td>
<td>Fire Impacts on Regional Emissions and Chemistry</td>
<td>A.23-1</td>
</tr>
<tr>
<td>A.24</td>
<td>DSCOVR Science Team</td>
<td>A.24-1</td>
</tr>
<tr>
<td>A.25</td>
<td>Terrestrial Hydrology</td>
<td>A.25-1</td>
</tr>
<tr>
<td>A.26</td>
<td>NASA Energy and Water Cycle</td>
<td>A.26-1</td>
</tr>
<tr>
<td>A.27</td>
<td>Atmospheric Dynamics</td>
<td>A.27-1</td>
</tr>
<tr>
<td>A.28</td>
<td>Earth Surface and Interior</td>
<td>A.28-1</td>
</tr>
<tr>
<td>A.29</td>
<td>Rapid Response and Novel Research in Earth Science</td>
<td>A.29-1</td>
</tr>
<tr>
<td>A.30</td>
<td>Airborne Instrument Technology Transition</td>
<td>A.30-1</td>
</tr>
<tr>
<td>A.31</td>
<td>Earth Science U.S. Participating Investigator</td>
<td>A.31-1</td>
</tr>
<tr>
<td>A.32</td>
<td>Interdisciplinary Research in Earth Science</td>
<td>A.32-1</td>
</tr>
<tr>
<td>A.33</td>
<td>Science Team for the OCO Missions</td>
<td>A.33-1</td>
</tr>
<tr>
<td>A.34</td>
<td>Earth System Science Pathfinder (ESSP) Venture-class Science</td>
<td>A.34-1</td>
</tr>
<tr>
<td>A.34</td>
<td>Investigations: Earth Venture Suborbital-3</td>
<td>A.34-1</td>
</tr>
<tr>
<td>A.35</td>
<td>NASA Data for Operation and Assessment</td>
<td>A.35-1</td>
</tr>
<tr>
<td>A.36</td>
<td>New (Early Career) Investigator Program in Earth Science</td>
<td>A.36-1</td>
</tr>
</tbody>
</table>
A.37 The Science of Terra, Aqua, Suomi NPP, and JPSS
A.38 Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) Science Team
A.39 Earth Science Applications: Health and Air Quality Applications
Earth Science Applications: Disaster Risk Reduction and Resilience
A.41 Ecological Forecasting
A.42 Advancing Collaborative Connections for Earth System Science
Making Earth System Data Records for Use in Research
A.43 Environments
A.44 Citizen Science for Earth Systems Program
A.45 Computational Modeling Algorithms and Cyberinfrastructure
A.46 Advanced Information Systems Technology
A.47 Instrument Incubator Program
A.48 Advanced Component Technologies
A.49 In-Space Validation of Earth Science Technologies
A.50 Sustainable Land Imaging Technology

APPENDIX B. HELIOPHYSICS RESEARCH PROGRAM
B.1 Heliophysics Research Program Overview
B.2 Heliophysics Supporting Research
B.3 Heliophysics Technology and Instrument Development for Science
B.4 Heliophysics Guest Investigators – Open
B.5 Heliophysics Grand Challenges Research - Theory, Modelling and Simulations
B.6 Heliophysics Living With a Star Science
B.7 Heliophysics Data Environment Enhancements
B.8 Magnetospheric Multiscale Guest Investigators
B.9 Heliophysics Grand Challenges Research – Science Centers

APPENDIX C. PLANETARY SCIENCE RESEARCH PROGRAM
C.1 Planetary Science Research Program Overview
C.2 Emerging Worlds
C.3 Solar System Workings
C.4 Habitable Worlds (now in E.4)
C.5 Exobiology
C.6 Solar System Observations
C.7 Planetary Data Archiving, Restoration, and Tools
C.8 Lunar Data Analysis
C.9 Mars Data Analysis
C.10 Cassini Data Analysis
C.11 Discovery Data Analysis
C.12 Planetary Instrument Concepts for the Advancement of Solar System Observations C.12-1
C.13 Maturation of Instruments for Solar System Exploration C.13-1
C.14 Planetary Science and Technology Through Analog Research C.14-1
C.15 Planetary Protection Research C.15-1
C.16 Early Career Fellowship Start-up Program for Named Fellows C.16-1
C.17 Planetary Major Equipment C.17-1
C.18 Laboratory Analysis of Returned Samples C.18-1
C.19 New Frontiers Data Analysis C.19-1
C.20 Rosetta Data Analysis Program C.20-1
C.21 Small Innovative Missions for Planetary Exploration C.21-1
C.22 OSIRIS REx Participating Scientists Program C.22-1
C.23 New Early Career Fellowship Program C.23-1
C.24 Instruments for Gondola for High-Altitude Planetary Science C.24-1

APPENDIX D. ASTROPHYSICS RESEARCH PROGRAM
D.1 Astrophysics Research Program Overview D.1-1
D.2 Astrophysics Data Analysis D.2-1
D.3 Astrophysics Research and Analysis D.3-1
D.4 Astrophysics Theory D.4-1
D.5 Swift Guest Investigator – Cycle 14 D.5-1
D.6 Fermi Guest Investigator – Cycle 11 D.6-1
D.7 K2 Guest Investigator – Cycle 6 D.7-1
D.8 Strategic Astrophysics Technology D.8-1
D.9 Nancy Grace Roman Technology Fellowships for Early Career Researchers D.9-1
D.10 NuSTAR Guest Observer – Cycle 4 D.10-1
D.11 Transiting Exoplanet Survey Satellite – Cycle 1 D.11-1
D.12 Theoretical and Computational Astrophysics Networks D.12-1
D.13 SOFIA Next Generation Instrumentation D.13-1

APPENDIX E. CROSS-DIVISION RESEARCH
E.1 Cross Division Research Overview E.1-1
E.2 Topical Workshops, Symposia, and Conferences E.2-1
E.3 Exoplanets Research Program E.3-1
E.4 Habitable Worlds E.4-1
I. FUNDING OPPORTUNITY DESCRIPTION

(a) Strategic Objectives of NASA’s Research Program

The National Aeronautics and Space Administration (NASA) is chartered in the National Aeronautics and Space Act [51 U.S.C. § 20101 et seq.] with, among other objectives, the expansion of human knowledge of the Earth and of phenomena in the atmosphere and space. Working from this Congressional authorization, U.S. National Space Policy directs NASA to execute a sustained and affordable human and robotic space exploration program and develop, acquire, and use civil space systems to advance fundamental scientific knowledge of our Earth system, solar system, and the universe. This direction allows the science objectives of the NASA Science Mission Directorate (SMD) to be clearly defined as the orderly pursuit of the Agency’s strategic direction. The 2014 NASA Strategic Plan identifies the following strategic objectives as those to be pursued by SMD:

- Understand the Sun and its interactions with Earth and the solar system, including space weather;
- Ascertained the content, origin, and evolution of the solar system and the potential for life elsewhere;
- Discover how the universe works, explore how it began and evolved, and search for life on planets around other stars; and,
- Advance knowledge of Earth as a system to meet the challenges of environmental change and to improve life on our planet.

Further insight into SMD’s Strategic Goals and Objectives (from the 2014 Strategic plan) and the Questions and Goals in the 2014 Science Plan, are given in the documents at http://science.nasa.gov/about-us/science-strategy/. All program elements in this NASA Research Announcement (NRA) are relevant to NASA’s Strategic Goals and Objectives. Each proposal to this NRA demonstrates its relevance of the proposed research to NASA by demonstrating relevance to the particular program element to which it was submitted (further instructions concerning relevance and the other evaluation criteria are provided in Section VI(a) below).

(b) Research Programs of NASA’s Science Mission Directorate

The NASA Science Mission Directorate (SMD) pursues NASA’s strategic objectives using a wide variety of space flight programs that enable the execution of both remote sensing and in situ investigations. These investigations are carried out through flight of space missions in Earth orbit, as well as to or beyond objects in the solar system, and also through ground-based research activities that directly support these space missions. This ROSES NASA Research Announcement (NRA) solicits proposals for both flight investigations, using suborbital-class platforms (including aircraft, balloons, sounding rockets, CubeSats, commercial suborbital reusable launch vehicles, and small International Space Station (ISS) payloads), and all kinds of ground-based supporting research and technology (SR&T) investigations that seek to understand naturally occurring space and Earth phenomena, human-induced changes in the Earth system,
and Earth and space science-related technologies and to support the national goals for further robotic and human exploration of space. These ground-based investigations include, but are not limited to: theory, modeling, and analysis of SMD science data; development of concepts, techniques and advanced technologies suitable for future SMD space missions; development of methods for laboratory analysis of both extraterrestrial samples returned by spacecraft and terrestrial samples that support or otherwise help verify observations from missions; determination of atomic and composition parameters needed to analyze space data, as well as returned samples from the Earth or space; Earth surface observations and field campaigns that support SMD science missions; development of integrated Earth system models; development of systems for applying Earth science research data to societal needs; and development of applied information systems applicable to SMD objectives and data.

Proposals in response to this NRA should be submitted to the most relevant science program elements described in Appendices A, B, C, D, and E. Table 2 lists these program elements in the order of their calendar deadlines for the submission of proposals, while Table 3 lists them in the order in which they appear in the appendices of this NRA. Questions about each specific program element should be directed to the Program Officer(s) identified in the Summary of Key Information section that concludes each program element description.

In order to pursue NASA's strategic objectives, SMD research activities are organized into four Research Programs:

- The Earth Science Research Program sponsors research to explore interactions among the major components of the Earth system — continents, oceans, atmosphere, ice, and life — to distinguish natural from human-induced causes of change and to understand and predict the consequences of change.
- The Heliophysics Research Program sponsors research to understand the Sun as a magnetic variable star and its effects on the Earth and other planets and the dynamics of structures in the solar system.
- The Planetary Science Research Program sponsors research to explore the solar system to study its origins and evolution, including the origins of life within it.
- The Astrophysics Research Program sponsors research to explore the universe beyond, from the search for planets and life in other solar systems to the origin, evolution, structure, and destiny of the universe itself.

Appendices A, B, C, and D describe program elements of these four science research programs, respectively, while Appendix E describes cross-division program elements relevant to two or more of these science research programs. Each of these appendices is prefaced with an Overview section that provides an introduction to the research program content that all interested applicants to this NRA are encouraged to read. The program elements described in these appendices also provide any clarifications or modifications to the general guidelines contained in this Summary of Solicitation.
(c) Significant Changes from Recent ROSES

(i) Proposers should be aware of the following significant changes in this NRA from last year:

- Awards deriving from ROSES-2017 will include terms and conditions requiring that as accepted manuscript versions of peer-reviewed publications (hereinafter "manuscripts") that result from ROSES awards be uploaded into NASA’s part of the PubMed Central (PMC) repository called NASA PubSpace, see Section II(c).
- Information about requesting High-End Computing resources has changed since last year. Please see Section I(d), below.
- Section V(b) on the Use of Short Duration Orbital Platforms, including CubeSats has been updated to include the CubeSat Mission Parameters Table, more clearly indicate which launch services are fully covered by NASA/HEOMD CubeSat Launch Initiative, and other small clarifications and updates.
- The wording in Section IV(b) on proposal formatting and Section IV(b) on proposal budgets have been updated slightly since last year to make it more clear and precise.
- The first paragraph of Section VI(a) has been slightly revised since last year to make it more clear and we have added a note regarding intermediate adjectival ratings to the bullet list.
- As always, small changes have been made throughout this document and changes to program elements. In Appendix A two programs have been added: FIREChem (A.23) and a science team for ECOSTRESS (A.9). Also, this year Land Cover/Land Use Change (A.2) is focused on multi-source land imaging and not using two-step process. Appendix C has added the Rosetta Data Analysis program (C.20) and an OSIRIS-REx Participating Scientist opportunity in program (C.22), and ROSES may solicit Instruments for Gondola for High-Altitude Planetary Science, which was released as draft text last year (C.24). Moreover, Planetary Science is has split its Early Career Fellowship Program into two ROSES program elements: applications to be named an Early Career Fellow will be made via program element C.23, and applications for start-up funds for those already named fellows are to be submitted in response to program element C.16. There have been three major changes in Appendix D: A new guest investigator program for the Transiting Exoplanet Survey Satellite (TESS) mission has been added in program element D.11, Nancy Grace Roman Technology Fellowship (RTF) program in Astrophysics (D.9) has been revamped, and the Theoretical and Computational Astrophysics Networks (TCAN) has returned after many years in program element D.12. Other changes will occur throughout the year announced by Amendments, corrections, and clarifications. Subscribe to the NSPIRES mailing lists and the ROSES-2017 RSS feed for updates.
- All proposers are urged to carefully read the latest edition of the NASA Guidebook for Proposers, which has been reorganized since last year.

(ii) Individuals who did not propose last year should be aware of the following, most of which are changes made in recent years:

- Salaries for all participants and overhead from all types of organizations must be included in the NSPIRES web cover page budget and a separately uploaded Total
Budget PDF file. This applies to all funded participants, including NASA civil servants. See Section IV(b)iii.

- For all participants and all types of organizations, salaries and overhead may not be included anywhere in the body of the main proposal PDF, this information is relegated to the NSPIRES cover pages and the separately uploaded Total Budget PDF. See Section IV(b)iii.

- Starting in 2015, the Guidebook for Proposers moved the mandatory table of personnel and work effort out of the budget section. This required table of work effort, which is not in either the page limited technical/scientific section nor in the budget, is merely a reporting of all of the planned work commitment, funded by NASA or not, see Section IV(b)iii. This table is distinct from, and may not include anything that should be in, the page-limited technical/scientific proposal, which must describe what work each team member will be doing. See the Guidebook for Proposers, and Table 1.

- Section I(h) describes which instructions proposers should follow when there are discrepancies among the ROSES Summary of Solicitation vs. the Guidebook vs. program elements.

- Table 1 indicates that CVs for collaborators are permitted, though discouraged in general.

- Table 1 indicates that Current and Pending Support are not required for Students or Foreign Co-Investigators (Co-Is) since their organization already provides a letter attesting to their availability.

- Table 1 indicates that Current and Pending Support is required only for funded Co-Is at or above 10% of that person’s time (0.1 FTE).

- ROSES requires submission of Data Management Plans (DMPs) along with almost all proposals, see Section II(c) and the FAQ on this subject. For select instrument development programs DMPs are not required under the presumption that no significant research data will be generated. However, if those awards do result in peer reviewed publications, then those must still meet the requirement that the data behind figures and tables be available electronically at the time of publication, ideally in supplementary material with the article. The default is for the data management plan to be put into a required text box on the NSPIRES cover pages, but some program elements (e.g., Appendix C) require the DMP to be part of the uploaded proposal PDF and have special instructions. Please read C.1 carefully if proposing to Planetary Science Division programs, including Habitable Worlds (E.4).

- All program elements in Appendix B, most program elements in Appendix C and a few in Appendixes A and D use a two-step proposal process in which the Notice of Intent (NOI) is replaced by a mandatory Step-1 proposal, see Section IV(b)viii on the Two-Step Proposal Process.

(d) NASA-Provided High-End Computing (HEC) Resources

SMD provides a specialized computational infrastructure to support its research community, managed on its behalf by NASA’s High-End Computing (HEC) program (see the HEC website at https://www.hec.nasa.gov/). Two major computing facilities are offered, namely, the NASA Center for Climate Simulation (NCCS) at the Goddard
Space Flight Center (GSFC), and the NASA Advanced Supercomputing (NAS) facility at the Ames Research Center (ARC).

The HEC program facilities maintain a range of computing systems with significant data storage resources. These offerings are summarized at https://www.hec.nasa.gov/about/overview.html. Augmentation and refreshment of these central systems occur on a periodic basis. The HEC program also provides assistance in code porting, performance tuning, scientific data visualization, and data transfer.

(i) Generate Request for HEC Resources

Any need for computing time and other HEC program resources for the proposed research must be explicitly justified by completing a request form in the HEC eBooks system (https://hec.reisys.com/hec/computing/index.do). The form includes a written justification of how the computational resources would support the investigation as well as a multi-year resource-phasing plan, in annual increments, identifying the computing time and data storage requirements and the preferred location (facility) for where the computational project will be accomplished for the duration of the proposed award period.

Computing time must be described in the request using Standard Billing Units (SBUs), a common unit of measurement employed by the HEC program for allocating and tracking computing usage across its various architectures. The eBooks system has a built-in calculation feature to assist with conversion from processor (CPU) hours to SBUs. SBU Conversion Factors are also available at https://www.hec.nasa.gov/user/policies/sbus.html, or proposers may contact HEC support staff for further assistance calculating SBUs; contact information can be found at https://www.nas.nasa.gov/hecc/support/user_support.html for NAS User Support, and https://www.nccs.nasa.gov for NCCS User Services Group.

(ii) Upload Request for HEC Resources

The HEC eBooks system will generate a PDF version of your completed computing time request for download, as well as send the PDF via email as an attachment. During your proposal submission in the NSPIRES system:

- Upload the PDF version of your computing time request as a separate file from your proposal; select "Appendix" as the document type when uploading;
- On the NSPIRES Cover Page
  - Check the box indicating that a request for HEC resources is included in the proposal; and
  - Enter the HEC Request Number (specified in the email and on the PDF itself).

For proposals submitted via Grants.gov, it should be attached as an appendix to any appropriate form location. This requirement for a separate document supersedes the general rule that proposals are only two PDF files: the proposal and the Total Budget. As they review the proposed investigation, science peer review panels will be asked to consider whether the computing time request is an appropriate utilization of the highly constrained resources dedicated for each program element under this NRA. Negotiations may be necessary to allow adjustments to computing time requests given resource constraints.
(iii) Submit Detailed Requirements for Allocation of HEC Resources

If the proposal is selected for funding, allocation of HEC resources will also be awarded based on the multi-year phasing plan confirmed during the selection process. Once award letters are issued, Principal Investigators (PIs) will be required to log in to the HEC eBooks system to submit detailed requirements (e.g., data security, data transfer, application information, etc.) to finalize allocation of the award. In addition, PIs will have the opportunity to submit requests for minor modifications to their plan (e.g., allocation of additional HEC resources) on a semi-annual basis. The HEC website at https://www.hec.nasa.gov/request/science.html provides the mechanism for PIs to formally request changes to computing time requested in their funded proposals. Requests for modifications cannot be guaranteed, but SMD will make every attempt to satisfy the needs in the context of the overall set of requirements, resource constraints, and science priorities.

To expedite initiation of new projects where PI and/or users are foreign nationals (whose accounts will require additional documentation and longer processing), the HEC program will consider providing a minimal allocation to such projects which have been notified of pending funding soon after the PI submits an allocation request in e-Books (accessed through the HEC website). PIs should identify this foreign national status in their request abstract.

For further information about NASA provided High-End Computing resources contact:
Tsengdar J. Lee
Earth Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
E-mail: Tsengdar.J.Lee@nasa.gov
Telephone: 202-358-0860

(e) Availability of Funds for Awards

Prospective proposers to this NRA are advised that, in general, funds are not available for new awards for all of its solicited program elements at the time of its release. The Government’s obligation to make awards is contingent upon the availability of sufficient appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this NRA.

(f) Successor, Resubmitted, Multiple and Duplicate Proposals

PIs holding awards under any program element of any prior NRA are welcome to submit "successor" proposals that seek to continue a previously funded line of research. However, as described in the NASA Guidebook for Proposers such successor proposals will be considered with neither advantage nor disadvantage along with new proposals that are submitted for that same program.

Generally, proposers are welcome to resubmit proposals (or tasks) that were not funded under a prior program element or solicitation. Such submissions will be peer reviewed and considered with neither advantage nor disadvantage along with new proposals that
are received by NASA. However, some Appendices and program elements in ROSES may limit submissions in a couple of ways.

The first limitation on submission prevents "multiple" proposals to a given program element. Some program elements in Appendix B (Heliophysics) will not allow a particular individual to be the PI on more than one proposal to those program elements. The first proposal identifying a particular PI will be evaluated, but any subsequent proposal to the same program element that identifies the same PI will not be evaluated or considered.

The second limitation bars submission of "duplicate" proposals. Planetary Science will not accept duplicate (the same or essentially the same) proposals submitted to any of its program elements (Appendix C, or its parts of cross-division programs in Appendix E). See C.1 for more information.

In either case, the order of receipt of the proposals will be determined by the time stamp generated automatically by the proposal submission system. Please carefully read the program elements and propose to Heliophysics and Planetary Science with this in mind.

(g) Order of Precedence: The Guidebook vs. ROSES Summary of Solicitation vs. program elements

Any inconsistency among authorities or agency instructions stated in or referenced in this solicitation shall be resolved by giving precedence in the following order:

Statutes and regulations
Program elements
The Summary of Solicitation of the ROSES NRA (i.e., this document)
Guidebook for Proposers Responding to a NASA Funding Announcement

There may be cases when the instructions in more than one of these documents are contradictory. In cases of contradictions between texts, individual program elements take precedence over this Summary of Solicitation, and this Summary of Solicitation takes precedence over the Guidebook for Proposers.

An example where individual program elements occasionally contradict and supersede the Guidebook is "letters of affirmation" (sometimes called letters of endorsement). The Guidebook states that letters that endorse the value or merit of a proposal will not be considered in the evaluation of the proposal, but a few individual program elements in ROSES do allow such letters of affirmation or endorsement.

Moreover, this Summary of Solicitation may include instructions that are more specific or detailed than the Guidebook, and program elements often include instructions that are more specific or detailed than this Summary of Solicitation or the Guidebook. An example of a case where individual program element differs from this Summary of Solicitation is in how Relevance is evaluated. Section VI(a) lays out a general approach to evaluating relevance, but a few individual program elements in Appendix C require explicit statements of relevance through mandatory text boxes on the NSPIRES cover pages.

Finally, answers to questions may appear in FAQs. The FAQ for the ROSES NRA appears at http://science.nasa.gov/researchers/sara/faqs/. Any FAQs for individual
program elements will appear under "other documents" on the NSPIRES web page for
the program element. FAQs merely present clarification, they do not contradict
instructions in the Guidebook, ROSES Summary of Solicitation or program elements.

Questions about differences between ROSES Summary of Solicitation and the
Guidebook should be directed to sara@nasa.gov. Questions about a difference
between either of those and an individual program elements, should be directed to the
point of contact for the particular program element and cc sara@nasa.gov.

(h) Access to NASA Facilities/Systems

For any awards where individuals need access to NASA facilities and/or systems, all
award recipients must work with NASA program staff to ensure proper credentialing.
Such individuals include U.S. citizens, lawful permanent residents ("green card"
holders), and foreign nationals (those who are neither U.S. citizens nor permanent
residents).

(i) Citizen science

"Citizen science" activities, in which the public contributes to the scientific process, can
advance science investigations through activities that include formulating research
questions, conducting scientific experiments, collecting and analyzing data, interpreting
results, making new discoveries, developing technologies and applications, and solving
complex problems. Proposers to any ROSES program element are invited to
incorporate citizen science and crowdsourcing methodologies into their submissions,
where such methodologies will advance the objectives of the proposed investigation.
Proposers considering the use of these methodologies should be aware of the Federal
Crowdsourcing and Citizen Science Toolkit, which gives prospective citizen science
project developers tips for designing, carrying out, and sustaining their projects. Such
activities are, like the rest of the proposal, subject to the announced evaluation factors,
including relevance and merit.

II. AWARD INFORMATION

(a) Funding and Award Policies

NASA may support an award as outlined in the proposal budget, or may offer to fund
only selected tasks, or all tasks for a shorter duration (e.g., a one-year pilot study), or a
combination. Awards may depend on acceptable revised versions of budgets,
statements of work, data management plans, or other elements of proposals described
in ROSES or in the NASA Guidebook for Proposers.

The amount of funds expected to be available for new awards for proposals submitted
in response to this NRA is given in the Summary Table of Key Information at the end of
each program element in the appendices. An estimate of the number of awards that
might be made for each program element is also given in this Table, contingent on
budget allocation to that program element and availability of funding and presuming the
submission of sufficient highly rated proposals.

In all cases, NASA’s goal is to initiate new awards as rapidly as possible after the
selection of proposals is announced for each program element. However, the workload
experienced by NASA, the availability of appropriated funds, and any necessary post-
selection negotiations with the proposing organization(s) needed for the award(s) in question can all cause delays. Regarding this last item, every proposer is especially encouraged to submit full and detailed explanations of the requested budget to help expedite the processing of the award, should their proposal be selected.

Unless otherwise stated in a particular Appendix or program element, ROSES allows the full range of award types: grants, cooperative agreements, contracts, and intra- or interagency transfers. The budget narrative need not state the type of award instrument that is anticipated. A NASA awards officer will determine the appropriate award instrument for the selections resulting from this solicitation. Contract awards will be subject to the provisions of the Federal Acquisition Regulations (FAR) and the NASA FAR Supplement (see https://prod.nais.nasa.gov/cgi-bin/nais/nasa_ref.cgi).

Several program elements exclude contracts because it does not seem appropriate for the nature of the work solicited. If contracts are excluded, the program element will indicate that explicitly. At the time of this writing, some of the program elements that exclude contracts include (but are not limited to) most of Appendix C and A.15, A.26, A.39, B.2, and B.4. If a prospective proposer to a program element that excludes contracts thinks that their work should be a contract, they should communicate with the point of contact for that program element and cc sara@nasa.gov.

(b) Award Period of Performance

The maximum period of performance (duration) for new awards for proposals submitted in response to this NRA is given in the Summary of Key Information that concludes each program element description in the appendices. The usual maximum period of performance ranges from one year for activities of limited scope to five years for extensive, comprehensive studies. Award durations may be longer in special cases, such as teams of long duration space missions. Whatever the proposed period of performance it must be justified in the proposal. The appropriateness of the proposed period of performance will be evaluated by peer review. NASA may offer to support an award of shorter duration than was proposed.

(c) Increasing Access to the Results of Federally Funded Research

In keeping with the NASA Plan for Increasing Access to Results of Federally Funded Research, most proposals to ROSES will be required to provide a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed. Unless otherwise stated the data management plan will be collected on the NSPIRES web cover pages and limited to 8000 characters. Any program element that doesn't require a DMP via the cover pages will say so explicitly. Even where DMPs are not required with the proposal, if those awards do result in peer reviewed publications, grantees must still meet the mandatory minimum requirement that the data behind figures and tables be available electronically at the time of publication, ideally in supplementary material with the article. The kind of proposal that requires a data management plan is described in the SARA FAQs on this subject. The appendices and individual program elements of ROSES may specify preferred archives and may require more than is outlined here for all proposers or just those that generate certain kinds of data. Please read the individual program elements carefully, especially Appendix C, which has its own instructions in Section 3.6 of C.1 and even templates. Proposers that
include a plan to archive data should allocate suitable time for this task. For information about data rights, and other aspects of intellectual property such as invention rights resulting from awards see the file entitled "Award and Intellectual Property Information" under the section called "Grant and Cooperative Agreement Guidance" at https://prod.nais.nasa.gov/pub/pub_library/srba/.

Awards deriving from ROSES-2017 will include terms and conditions requiring that as accepted manuscript versions of peer-reviewed publications (hereinafter "manuscripts") that result from ROSES awards be uploaded into NASA’s part of the PubMed Central (PMC) repository called NASA PubSpace. This applies only to peer reviewed manuscripts. Patents, publications that contain material governed by personal privacy, export control, proprietary restrictions, or national security law or regulations will not be covered by this requirement. For more details on public access to scientific publications and digital scientific data resulting from NASA-funded research, please see: https://www.nasa.gov/open/researchaccess.

(d) Rephasing of Award Budgets

Occasionally the schedule for a research project changes, and this will change the phasing of the funding requirement. "Rephasing" funding may be initiated either at the request of the PI or NASA.

In keeping with NASA’s policy (in 2 CFR 1800.903), SMD will accommodate all reasonable requests from the PI or Authorized Organization Representative (AOR) to rephase ROSES awards to accommodate a PI’s need to care for family and health (e.g., for family or medical leave), as long as it does not compromise previously agreed upon project goals, timelines, or deliverables associated with a NASA requirement described in the contract (grants are not used for NASA requirements). NASA policy allows grantee initiated first time no-cost extensions (NCEs) of up to 12 months. Use the form at https://www.nssc.nasa.gov/nocostextension to request NCEs.

SMD program officers may engage in active grant management to facilitate carrying forward unobligated funds from one fiscal year to the next fiscal year (carryover). Program Officers may invite the PI to rephase their funding requirement where funds for a year or more are being carried forward. In this way, the awarding of future year funds can more closely align with the timing of project activities. The total funds disbursed over the period of performance would not change, only the fiscal year (FY) in which they arrive.

SMD policy is that work on continuing awards should not be deferred because of a delay in receipt of funds. If an award is rephased, NASA will make every reasonable effort to provide the next fiscal year funding in a timely manner. Honoring commitments and ensuring the continuation of existing projects is a high priority of SMD.

III. ELIGIBILITY INFORMATION

(a) Eligibility of Applicants

Prospective investigators from any category of organizations or institutions, U.S or non-U.S., are welcome to respond to this solicitation. Specific categories of organizations and institutions that are welcome to respond include, but are not limited to, educational,
industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies. Historically Black Colleges and Universities (HBCUs), Other Minority Universities (OMUs), small disadvantaged businesses (SDBs), veteran-owned small businesses, service disabled veteran-owned small businesses, HUBZone small businesses, and women-owned small businesses (WOSBs) are encouraged to apply.

Moreover, NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects that such values will be reflected in the composition of all panels and teams including peer review panels (science, engineering, and technology), proposal teams, science definition teams, and mission and instrument teams.

Participation by non-U.S. organizations in this program is welcome, but subject to NASA’s policy of no exchange of funds, in which each government supports its own national participants and associated costs (further information on foreign participation is provided in the NASA Guidebook for Proposers). NASA does not normally fund foreign research proposals or foreign research efforts that are part of U.S. research proposals. Rather, cooperative research efforts are implemented via international agreements between NASA and the sponsoring foreign agency or funding/sponsoring institution under which the parties agree to each bear the cost of discharging their respective responsibilities. NASA funding may not be used for subcontracted foreign research efforts, including travel. The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted.

(b) Number of Proposals and Teaming Arrangements

There is no restriction on the number of proposals that an organization may submit to this solicitation, or on the teaming arrangements for any one proposal, including teaming with employees of NASA’s Centers and the Jet Propulsion Laboratory. However, some Appendices limit the number of proposals that may be submitted by an individual PI to a program element or bar duplicate proposals, see Section I(f). Moreover, other than the Total Budget and HEC request, each proposal must be a separate, stand-alone, complete PDF document for evaluation purposes.

(c) Restrictions Involving China

Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no exchange of funds arrangement.

In accordance with restrictions in Appropriation Acts, NASA is prohibited from funding any work that involves the bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no exchange of funds arrangement.

Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company, whether funded or performed under a no exchange of funds arrangement, may be ineligible for award.
For more information please see the ROSES FAQ on the SARA web page at [http://science.nasa.gov/researchers/sara/faqs/prc-faq-roses/](http://science.nasa.gov/researchers/sara/faqs/prc-faq-roses/)

As stated in 2 CFR 1800 Appendix A, NASA requires Certifications, Assurances, and Representations, including Certifications and Assurances to implement restrictions in Appropriation Acts, that are applicable to all awards. By submission of a proposal, proposers are certifying that the proposing organization has read and is in compliance with all the Certifications, Assurances, and Representations, including that they are not China or a Chinese-owned company, and that they will not participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level or at any subrecipient level, whether the bilateral involvement is funded or performed under a no exchange of funds arrangement.

An Assurance of Compliance with restrictions in Appropriation Acts herein after referred to as "the Acts" whereas:

1. NASA is restricted from using funds appropriated in the Acts to enter into or fund any grant or cooperative agreement of any kind to participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level and at all subrecipient levels, whether the bilateral involvement is funded or performed under a no exchange of funds arrangement.

2. Definition: "China or Chinese-owned Company" means the People’s Republic of China, any company owned by the People’s Republic of China, or any company incorporated under the laws of the People’s Republic of China.

3. The restrictions in the Acts do not apply to commercial items of supply needed to perform a grant or cooperative agreement.

4. By submission of its proposal, the proposer represents that the proposer is not China or a Chinese-owned company, and that the proposer will not participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level or at any subrecipient level, whether the bilateral involvement is funded or performed under a no exchange of funds arrangement.

(d) Cost Sharing or Matching

Unless otherwise specified, cost sharing is not required for an institution of higher education or other not-for-profit organization to receive a grant or cooperative agreement, although NASA can accept cost sharing if it is voluntarily offered (see 2 CFR 200.306, 2 CFR 1800.306, [Grants and Cooperative Agreement Manual (GCAM) 5.6 Funding](#)).

If a commercial organization wants to receive a grant or cooperative agreement, cost sharing is required unless the commercial organization can demonstrate that it does not expect to receive substantial compensating benefits for performance of the work. If this demonstration is made, cost sharing is not required, but may be offered voluntarily.

For a commercial organization to receive a cooperative agreement, cost sharing (equal to 50% of the total) is required if the project has commercial applications and profit generating potential. Proposals from commercial organizations for cooperative agreements that do not include cost sharing must demonstrate that potential commercially marketable products are not expected to result from the
project. (see references in parenthesis above and 14 CFR §1274.102 (c) 4 and 14 CFR §1274.204, "Costs and Payments" (b) Cost sharing). [Corrected March 9, 2017]

Each proposal must include a summary table of personnel and work effort with names and planned work of all personnel necessary to perform the proposed effort, regardless of whether that work effort requires funding or not. As this is outside of the budget section, any work planned that is not funded by NASA listed in this table is not considered cost sharing as defined in 2 CFR § 200.29. Level of effort estimates for unfunded team members are not intended to represent voluntary committed cost sharing. Collaborators should be listed on the table, but their level of effort may be simply given as "de minimis." See Section IV(b)iii for an example.

IV. PROPOSAL AND SUBMISSION INFORMATION

(a) Proposal Instructions and Requirements

All information needed to apply to this solicitation is contained in this ROSES NRA and in the companion document, the NASA Guidebook for Proposers, located at http://www.hq.nasa.gov/office/procurement/nraguidebook. By reference, the latest edition of the NASA Guidebook for Proposers is incorporated into this NRA. We also include 48 CFR 1852.235-72 by reference and it appears in the NASA Guidebook for Proposers. Proposers are responsible for understanding and complying with its procedures for the successful, timely preparation and submission of their proposals. Proposals that do not conform to its standards may be declared noncompliant and rejected without review.

Questions regarding a program element should be directed to the program officer identified in the Summary Table of Key Information at the end of each program element or on the list of program officers on the SARA web page. Any clarifications or questions and answers that are published will be posted on the relevant program element's index page in NSPIRES.

The introductory material, as well as the appendices, of the NASA Guidebook for Proposers provides additional information about the entire NRA process, including NASA policies for the solicitation of proposals, guidelines for writing complete and effective proposals, and NASA’s general policies and procedures for the review and selection of proposals and for issuing and managing the awards to the institutions that submitted selected proposals. A group of Frequently Asked Questions (FAQs) provides additional miscellaneous information about a variety of the NASA proposal and award processes, policies, and procedures.

NASA is implementing a process to collect demographic data from grant applicants for the purpose of analyzing demographic differences associated with its award processes. Information collected will include name, gender, race, ethnicity, and disability status. Submission of the information is voluntary, only available to NASA in aggregate form, and is not a precondition of award.

Comments and suggestions of any nature about the NASA Guidebook for Proposers are encouraged and welcome and may be directed at any time to the point of contact identified in Section VIII below.
(b) Content and Form of the Proposal Submission

(i) Electronic Proposal Submission

All proposals submitted in response to this ROSES NRA must be submitted electronically by one of the officials at the PI’s organization who is authorized to make such a submission; electronic submission by the authorized organization representative (AOR) serves for the proposal as the required original signature by an authorized official of the proposing organization. No hard copy of the proposal is permitted. Proposers may opt to submit proposals in response to this ROSES NRA via either of two different electronic proposal submission systems: either via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at http://nspires.nasaprs.com; see Section IV(b)(iv) below, or via Grants.gov at http://www.grants.gov; see Section IV(b)(v) below.

Note carefully the following requirements for submission of an electronic proposal, regardless of the intent to submit via NSPIRES or Grants.gov.

• Every organization that intends to submit a proposal to NASA in response to this NRA, including educational institutions, industry, not-for-profit institutions, the Jet Propulsion Laboratory, NASA Centers, and other U.S. Government agencies, must be registered in NSPIRES. This applies equally for proposals submitted via Grants.gov, as well as for proposals submitted via NSPIRES. Every organization that intends to submit a proposal through Grants.gov must also be registered in Grants.gov, as well as in NSPIRES. Registration for either proposal data system must be performed by an organization’s electronic business point-of-contact (EBPOC) in the System for Award Management (https://www.sam.gov/portal/SAM/).

• Any organization requesting NASA funds through the proposed investigation must be listed on the Proposal Cover Page. NASA will not fund organizations that do not appear on the Proposal Cover Page.

• Each individual team member (e.g., PI, Co-Investigators, etc.), including all personnel named on the proposal’s electronic cover page, must be individually registered in NSPIRES. This applies equally for proposals submitted via Grants.gov, as well as for proposals submitted via NSPIRES.

• Unless specifically allowed by an individual program element appendix, multiple PIs are not permitted. The use of other categories of participation described in the NASA Guidebook for Proposers, including Science PI, Institutional PI, and Co-PI (from a non-U.S. organization under specific circumstances), are permitted.

• Each individual team member (e.g., PI, co-investigators, etc.), including all personnel named on the proposal’s electronic cover page, must confirm their participation on that proposal (indicating team member role) and specify an organizational affiliation. For proposals submitted via NSPIRES, this confirmation is via NSPIRES (see Section IV(b)(iv), below). For proposals submitted via Grants.gov, this confirmation is via "Letters of Commitment" included within the proposal. The organizational affiliation specified on the cover page must be the organization through which the team member would work and receive funding while participating in the proposed investigation. If the individual has multiple affiliations, then this organization may be different from the individual’s primary employer or preferred mailing address. Team members are asked to ensure that their contact information in NSPIRES is up to
date. Changes can be made using the "Account Management" link on the "NSPIRES Options" page.

Typically, an electronic proposal consists of electronic forms (i.e., the NSPIRES cover pages) and two or more attachments. The electronic forms contain data that will appear on a proposal's cover pages and will be stored with the proposal in the NSPIRES database. A proposal submitted in response to this NRA must have two attachments: the main proposal PDF and the Total Budget PDF. The main proposal PDF contains all ten sections of the proposal listed in Table 1, including the Table of contents, main Science/Technical/Management section, References, Biographical sketches/CVs, Summary Table of work effort, Current and Pending Support, any Statements of Commitment or Letters, Budget Justification, Facilities and Equipment, and Detailed Budget (excluding any salary, fringe or overhead). The separately uploaded Total Budget PDF contains the full and complete budget, including salary, fringe and overhead (see Section IV(b)iii). If there is an accompanying HEC request (see Section I(d) above) then a HEC Appendix is uploaded as a separate third PDF.

Submission of proposals via either NSPIRES or Grants.gov is a two-part process. When the PI has completed entry of the data requested in the required electronic forms and attachment of the allowed PDF attachments, including the Science/Technical/Management section, an official at the PI's organization who is authorized to make such a submission, referred to as the Authorized Organizational Representative (AOR), must submit the electronic proposal (forms plus attachments). Coordination between the PI and his/her AOR on the final editing and submission of the proposal materials is facilitated through their respective accounts in NSPIRES and/or Grants.gov.

(ii) Proposal Format and Contents

All proposals submitted in response to this NRA must include any specified required electronic forms available through either of two proposal submission systems, NSPIRES or Grants.gov. Submission via NSPIRES requires responding to questions on the NSPIRES submission page.

The Science/Technical/Management section and other required sections of the proposal must be submitted as a single, searchable, unlocked PDF file that is attached to the electronic submission using one of the proposal submission systems. Proposers must comply with all format requirements specified in this NRA (see below and Table 1 for a summary) and in the NASA Guidebook for Proposers. Only appendices that are specifically requested in the NASA Guidebook for Proposers and allowed by this NRA or a program element will be permitted; proposals containing unsolicited appendices may be declared noncompliant. The NASA Guidebook for Proposers provides detailed discussions of the content and organization of proposals suitable for all program elements in this NRA, as well as the default page limits of a proposal's constituent parts. Note that some of the program element descriptions in Appendices A through E of this NRA may specify different page limits for the main body of the proposal; if so, these page limits will be prominently given in the Summary of Key Information subsection that concludes each program element description. In the event the information in this NRA is different from or contradictory to the information in the NASA Guidebook for Proposers, the information in this NRA takes precedence.
Unless otherwise stated in the Appendix or program element, proposals submitted in response to ROSES must follow these rules for formatting: The body text and captions may not, on average across a solid block of text, exceed 15 characters per horizontal inch, including spaces, though text within figures and tables may be smaller if still judged by the reviewers to be readable. Easily read sans serif fonts (e.g., Arial, Helvetica, Verdana) are encouraged but not required. Proposals may not have more than 5.5 lines per vertical inch of text, must have at least one-inch margins, be set for US letter size (8.5x11) paper, and expository text necessary for the proposal may not be located solely in figures, tables, or their captions. Moving images are not allowed unless explicitly permitted by the program element.

Important note on creating PDF files for upload: It is essential that all PDF files generated and submitted meet NASA requirements. This will ensure that the submitted files can be ingested by NSPIRES regardless of whether the proposal is submitted via NSPIRES or Grants.gov. At a minimum, it is the responsibility of the proposer to: (1) ensure that all PDF files are unlocked and that edit permission is enabled – this is necessary to allow NSPIRES to concatenate submitted files into a single PDF document; and (2) ensure that all fonts are embedded in the PDF file and that only Type 1 or TrueType fonts are used. TeX and LaTeX users are strongly cautioned to ensure that their settings conform with the paper size, font size, margins etc., listed above. In addition, any proposer who creates files using TeX or LaTeX is required to first create a DVI file and then convert the DVI file to Postscript and then to PDF. See http://nspires.nasaprs.com/tutorials/PDF_Guidelines.pdf for more information on creating PDF documents that are compliant with NSPIRES. PDF files that do not meet NASA requirements cannot be ingested by the NSPIRES system; such files may be declared noncompliant and not submitted to peer review for evaluation. There is a 20 MB size limit for proposals. Large file sizes can impact the time it takes for NASA and peer reviewers to download and access the proposal. In order to increase the ease in reviewing the proposal, the proposer should crop and compress any embedded photos and graphic files to an appropriate size and resolution.

(iii) New Budget Requirements: Redaction, Salary, Fringe and Overhead Costs

Peer reviewers do not need salaries or overhead rates to evaluate the cost reasonableness of ROSES proposals. Thus, proposals should not include costs of salary, fringe, or overhead anywhere in the uploaded proposal PDF, including the budget detail or justification sections in the main proposal, which will be seen by peer reviewers. Unless otherwise specified by the program element, all proposers must include all costs, including salary, fringe and overhead of NASA civil servants, all subawards, and any separate Co-I awards in two places outside of the uploaded proposal PDF: the NSPIRES web page budgets and the separately uploaded "Total Budget" PDF file, see below and the walkthrough on this subject. The only exceptions to this rule are Phase-2 proposals for the astrophysics Observing programs: Swift Guest Investigator (D.5), Fermi Guest Investigator (D.6), NuSTAR Guest Observer (D.10) and the TESS Guest Observer Program (D.11). These are cost (only) proposals for NASA and are not peer reviewed. See Section IV(b)(viii).
However, peer reviewers certainly do need to see the costs of everything other than salary, fringe, and overhead. Thus, all proposals must include as much budget detail and justification as is required for the peer reviewers to evaluate whether costs of things (other than team members) are reasonable. For example, let’s say your Co-I says she needs to purchase a Tektronix MDO4000C digital oscilloscope, which costs ~ $6.5K. In the detailed budget you must give this price and in the budget justification you would explain why she needs such an expensive oscilloscope, when simple ones can be purchased for only ~$450.

Moreover, peer reviewers need to see the person time that will be spent on the project, whether at the proposing organization or not, whether or not NASA is paying for it. Thus, every proposal is required to include a summary table of work effort that simply lists all of the planned work commitment, by person or role without any technical details. Note, this table is outside of and is distinct from budget and the page limited main part of proposal, which must describe what work each team member will be doing. That

<table>
<thead>
<tr>
<th>Person or Role</th>
<th>Time charged to this proposal</th>
<th>Time not charged to this proposal</th>
<th>Total Time per person/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bernstein, PI</td>
<td>3 months/year</td>
<td>N/A</td>
<td>3 months/year</td>
</tr>
<tr>
<td>Co-I Dr. West</td>
<td>1.5 months/year</td>
<td>N/A</td>
<td>1.5 months/year</td>
</tr>
<tr>
<td>Collaborator Bill Dyer</td>
<td>N/A</td>
<td>5 days per year</td>
<td>5 days per year</td>
</tr>
<tr>
<td>NESSF Grad Student fellow*</td>
<td>N/A</td>
<td>12 months/year</td>
<td>12 months/year</td>
</tr>
</tbody>
</table>

* The Graduate student has been awarded an NESSF fellowship, at no cost to this proposal.

doesn't belong here. This example table presumes a simple case for which all investigators are working the same amount of time on the project each year. The reality is typically more complicated, and your table should reflect the reality. Templates have been provided by the Planetary Science Division for those proposing to Appendix C.

In the budget justification in the main proposal PDF you should refer to the time in a subaward, e.g., "1.5 months/year are allocated for Co-I Dr. Herbert West, as can be seen in the summary table of work effort. Dr. West will be funded via a subaward to the Miskatonic foundation in Arkham, Mass. The total cost for that subaward is given in the NSPIRES cover page budget in Section F line 5 and is included in the separately uploaded Total Budget PDF file but is not included here in the proposal."

Almost all ROSES program elements are set up to allow proposers to fill out the NSPIRES web page budgets. These NSPIRES web page budgets are not required for Step-1 proposals. Unless otherwise specified in the ROSES program element, these NSPIRES web page budgets should include all costs, including salary, fringe and overhead of all participants. The full NSPIRES web page budgets will not be seen by peer reviewers. Where more than one organization is involved then the total cost for the Co-I organization is simply given as a single number in row 5, 8, or 9 of Section F. When funds are going to Co-I organizations funded directly by NASA, such as NASA
centers and other government labs then lines 8 or 9 should be used and customized. Row 10 in Section F is reserved for reporting any subaward that does not have any salary component. Proposers are strongly encouraged to read the FAQs with a walkthrough on this subject.

Almost all ROSES program elements are set up to allow proposers to separately upload a "Total Budget" PDF along with their proposal. Unless otherwise specified in the ROSES program element, all proposers are required to include this separate Total Budget PDF. The Total Budget should simply include the full and complete budget spreadsheets from your proposing organization and that of your Co-Is. This means that proposers need to get this information from their Co-Investigators whether or not they are Civil Servants. Budgets are generally laid out by project year but since NASA Civil Servant salaries must be charged to present fiscal year dollars, proposals that include NASA Civil Servant salaries may need to phase the funds for NASA Centers by fiscal year. The Total Budget PDF must lay out clearly how much is going to each organization, indicating whether the funds are passing through the proposing organization and which are not. Where the funds are passing through the proposing organization to a Co-I organization, the Total Budget PDF must specify any overhead charged on funds passing through. Such charges never apply to funds sent directly to Co-I organizations such as NASA centers and other government labs. The Total Budget PDF is uploaded in exactly the same way that the proposal PDF is uploaded, but by choosing document type "Total Budget". This Total Budget file will not be seen by peer reviewers. These budget files are not required for Step-1 proposals.

Proposers from JPL should not include the JPL award fee in the funds requested via ROSES, nor should the budgets of JPL Co-Investigators on proposals from other institutions include the JPL award fee in their budgets. JPL award fees are paid for and accounted for by a different mechanism than that used to fund awards from ROSES.

(iv) Submission of Proposals via NSPIRES, the NASA Proposal Data System

Proposals may be submitted electronically via NASA’s master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES). The only exceptions are occasional joint calls with the National Science Foundation (NSF) that use FastLane and the programs in Astrophysics that use the two-phase process, such as Swift, Fermi and TESS Guest Investigator programs and the NuSTAR Guest Observer program. See Section IV(b)viii on the two-phase process and those program elements for details. In order to submit a proposal via NSPIRES, this NRA requires that the proposer register key data concerning the intended submission with NSPIRES at http://nspires.nasaprs.com. Potential applicants are urged to access this site well in advance of the Notice of Intent (NOI) and proposal due dates of interest to familiarize themselves with its structure and enter the requested identifier information.

It is especially important to note that every individual named on the proposal’s electronic Cover Page form (see below) as a proposing team member in any role, including Co-investigators and collaborators, must be individually registered in NSPIRES and that such individuals must perform this registration themselves; no one may register a second party, even the PI of a proposal in which that person is committed to participate. It is also important to note that every named individual must be identified with the organization through which they are participating in the proposal, regardless of their
place of permanent employment or preferred mailing address. This data site is secure and all information entered is strictly for NASA's use only.

Every individual identified on the NSPIRES proposal cover page as a team member must indicate their commitment to the proposed investigation through NSPIRES prior to proposal cover page submission. Team members must additionally confirm the organization through which they are participating on this proposal. A team member will receive an email from NSPIRES indicating that he/she has been added to the proposal and should log in to NSPIRES.

- Once logged in, the team member should follow the link in the "Reminders and Notifications" section of his NSPIRES homepage, titled "Need <role> confirmation for proposal <title> for Solicitation <<solicitation number>>." On the "Team Member Participation Confirmation" page, the proposal team member should read language about the Organizational Relationship, then click the "Continue" button.

- If the contact information then displayed on the "Team Member Profile" screen is out of date, the proposal team member should update this information later using the "Account Mgmt" link in the NSPIRES navigation bar across the top. Prior to making that update, however, the team member should follow the on-screen prompts to identify the organization through which he/she is participating on this proposal. Click the "Link Relationship" button to the right side of the "Organizational Relationship" banner. Select the organization from the "Link Proposal to an Association" part of the page. If the correct organization is not displayed here, try using the "Add Association" button to add the organization to this list. Then click the "Save" button at the bottom of the page. If the team member cannot find the organization when searching in the "Add Association" area (i.e., the organization is not registered), type in the formal name in the space provided (or select "Self," if appropriate). Once the organization is selected and the "Save" button is clicked, there is a confirmation page that allows the team member to edit that relationship if it was chosen incorrectly. Click "Continue".

- Note that the organization through which the proposal team member is participating in the proposal might not be the proposal team member's primary employer or primary mailing address. If the address information is accurate (or once it has been edited to be accurate), the proposal team member may log out of NSPIRES.

- NSPIRES will send an email to both the team member and the PI confirming that the commitment was made and the organization was identified. The PI may additionally monitor the status of proposal team member commitments by examining the "Relationship Confirmed" column on the Team Member page of the NSPIRES proposal cover page record. Note that the proposal cannot be submitted until all identified team members have confirmed their participating organizations.

All proposals submitted via NSPIRES in response to this NRA must include a required electronic Cover Page form that is accessed at http://nspires.nasaprs.com/. This form is comprised of several distinct sections: a Cover Page that contains the identifier information for the proposing institution and personnel; a Proposal Summary that provides an overview of the proposed investigation that is suitable for release through a publicly accessible archive should the proposal be selected; Business Data that provides the proposed start and end dates, as well as other proposal characteristics; a
A budget form that contains a budget summary of the proposed research effort; Program Specific Data that includes required questions specific to ROSES and that particular program element; and Proposal Team that provides the co-investigators and other participants in the proposal. This Cover Page form is available for access and submission well in advance of the proposal due dates given in Tables 2 and 3 of this NRA and remains open until the proposal due date for each program element. Unless specified in the program element description itself, no other forms are required for proposal submission via NSPIRES. See the NASA Guidebook for Proposers for further details.

Although NSPIRES has the ability to accept many, separate proposal documents, the required elements of any proposal submitted in response to this NRA must be submitted as a single, searchable, unlocked PDF document that contains the complete proposal, including the Science/Technical/Management section and budget justification, assembled in the order provided in the NASA Guidebook for Proposers and uploaded as a single attachment using the tools in NSPIRES. The proposer is responsible for assembling the complete proposal document for peer review. All required and permitted appendices must be included in the PDF file and should not be uploaded as separate attachments, unless specified otherwise in the program element description in the appendices to this NRA, in Section I(d), if an HEC request is being made, or in Section IV(b)(iii), for the Total Budget file. Including any part of the proposal twice creates an additional burden on the peer reviewers. Documents such as team member biographical sketches, letters of commitment, and current and pending support, as well as the proposal abstract (proposal summary) should not be uploaded to NSPIRES as separate files.

NSPIRES generates error and warning messages as part of the element check concerning possibly missing data. An error (designated by a red X) will preclude proposal submission to NASA by the AOR. A warning (indicated by a ! on a yellow field) is an indication that data may be missing; a warning can be ignored after verifying that the material is included in the single attachment containing the complete proposal. Any actions taken because of warnings are at the PI’s discretion.

In addition, it is unnecessary to download the Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the parts of the proposal (Cover Page form, proposal document, and any HEC appendix, but not the Total Budget file) to the reviewers.

Proposers are encouraged to begin their submission process early. Tutorials and other NSPIRES help topics may be accessed through the NSPIRES online help site at http://nspires.nasaprs.com/external/help.do. For any questions that cannot be resolved with the available online help menus, requests for assistance may be directed by email to nspires-help@nasaprs.com or by telephone to (202) 479-9376, Monday through Friday, 8:00 a.m. – 6:00 p.m. Eastern Time.

(v) Submission of Proposals via Grants.gov

Grants.gov may be used in place of NSPIRES to submit proposals in response to this ROSES NRA. Grants.gov requires that the PI download an application package and an instruction package from Grants.gov. Identifying the appropriate application package
requires the funding opportunity number for that program element; the funding opportunity number may be found in the Summary of Key Information subsection that concludes each program element description in the appendices of this NRA. Proposals submitted via Grants.gov must be submitted by the AOR.

Submitting a proposal via Grants.gov requires the following steps:

• Grant researchers (PIs) do not need to register with Grants.gov. However, every individual named in the proposal as a proposing team member in any role, including PI, Co-Investigators, and collaborators, as well as the PI’s organization, must be registered in NSPIRES (http://nspires.nasaprs.com) and such individuals must perform this registration themselves; no one may register a second party, even the PI of a proposal in which that person is committed to participate. This data site is secure and all information entered is strictly for NASA’s use only.

• Follow Grants.gov instructions provided at the website to download any software tools or applications required to submit via Grants.gov.

• Download the application package from Grants.gov by selecting "Select package" under "Package" for the specific Funding Opportunity at http://www.grants.gov. Each program element described in an appendix of ROSES requires a different application package and has a different Funding Opportunity Number; the Funding Opportunity Number may be found in the Summary of Key Information at the end of the program element description in each appendix of ROSES. Enter the appropriate Funding Opportunity Number to retrieve the desired application package. All ROSES application packages may be found by searching on CFDA Number 43.001.

• Note that Grants.gov proposers must additionally download the "Instructions" document, in addition to the "Package", as this includes the Program Specific Data form that contains the mandatory data management plan as well as important questions about, for example, China and ITAR.

• Complete the required NASA specific forms including NASA Other Project Information, NASA PI and Authorized Representative Supplemental Data Sheet, and NASA Senior/Key Person Supplemental Data Sheet (this form is only required if there are Senior/Key Persons other than the PI).

• Complete any NASA program-specific form that is required for the specific program element. This form, which is usually required for all ROSES program element submissions, is included as a PDF form within the proposal instruction package downloaded from Grants.gov. The form, once completed, is attached to the NASA Other Project Information form.

• Create a proposal in PDF, including the Science/Technical/Management section and all other required proposal sections (see the NASA Guidebook for Proposers). Attach sections as separate PDF documents as prompted by Grants.gov. Do not duplicate materials; if a document must be provided as a separate attachment, do
not also include it as part of the proposal narrative PDF file. Even though Grants.gov permits the attachment of non-PDF documents, NASA requires that all attached documents be PDF files, which conform to the specifications outlined in Section IV (b)(ii) above.

- Because Grants.gov does not support the electronic commitment of team members, statements of commitment from all team members must be provided as letters attached to the proposal application at the place(s) specified by Grants.gov. This statement must include confirmation of both the team member role in the proposed effort (e.g., Co-Investigator, collaborator) and the identification of the organization through which the team member will be participating. Here is an example of a statement of commitment: "I acknowledge that I am identified by name as <<role>> to the investigation, entitled <<name of proposal>>, that is submitted by <<name of Principal Investigator>> to the NASA Research Announcement <<alpha-numeric identifier>>, and that I intend to carry out all responsibilities identified for me in this proposal. I understand that the extent and justification of my participation as stated in this proposal will be considered during peer review in determining in part the merits of this proposal. I have read the entire proposal, including the management plan and budget, and I agree that the proposal correctly describes my commitment to the proposed investigation. For the purposes of conducting work for this investigation, my participating organization is <<insert name of organization>>."

- Submit the proposal via the Authorized Organization Representative (AOR); the PI may not submit the application to Grants.gov unless he/she is an AOR.

Potential applicants are urged to access Grants.gov site well in advance of the proposal due date(s) of interest to familiarize themselves with its structure and download the appropriate application packages and tools.

Additional instructions for formatting and submitting proposals via Grants.gov may be found in the NASA Guidebook for Proposers. Instructions for the use of Grants.gov may be found in the Grants.gov Applicant User Guide at http://www.grants.gov/help/html/help/index.htm - t=Get_Started%2FGet_Started.htm. Instructions for NASA-specific forms and NASA program-specific forms may be found in the application. For any questions that cannot be resolved with the available online help menus and documentation, requests for assistance may be directed by email to support@grants.gov or by telephone to (800) 518-4726 twenty-four hours a day, seven days a week, except Federal holidays when the support center is closed.

(vi) Notice of Intent to Propose

For most of the program elements in Earth Science (Appendix A) and Astrophysics (Appendix D), a brief Notice of Intent (NOI) to propose is encouraged, but not required, for the submission of proposals to this solicitation. The information contained in an NOI is used to help expedite the proposal review activities and, therefore, is of considerable value to both NASA and the proposer. To be of maximum value, NOIs should be submitted by the PI via NSPIRES (located at http://nspires.nasaprs.com) by the dates given in Tables 2 or 3 of this NRA. Note that NOIs may be submitted within NSPIRES directly by the PI; no action by an organization’s AOR is required to submit an NOI.
Grants.gov does not provide NOI capability; therefore, when requested by a program element, NOIs should be submitted via NSPIRES, whether or not the proposal will be submitted via NSPIRES or Grants.gov. Interested proposers must register with NSPIRES before it can be accessed for use. NSPIRES is open for the submission of NOIs for typically 30 days, starting about 90 days in advance of the due date for the proposals themselves. Since NOIs submitted after these deadlines may still be useful to NASA, late NOIs may be submitted by email to the main point of contact given in the Summary Table of Key Information at the end of the individual program element.

(vii) The Two-Step Proposal Process

Some ROSES program elements require that proposals be submitted using a two-step process in which the NOI is replaced by a required Step-1 proposal. This Step-1 proposal is an abbreviated presentation of the intended research and, as a proposal, it must be submitted by the Step-1 due date given in Tables 2 and 3 of this NRA by the organization Authorized Organizational Representative (AOR). The Step-1 proposal is a prerequisite for submission of a full Step-2 proposal, but it does not obligate the offerors to submit a Step-2 (full) proposal later.

For some program elements, the purpose of the Step-1 proposal is simply to avoid conflicts in the assembly of the review panel and no response will be provided to proposers. For other program elements, the Step-1 proposal may be evaluated to determine if the anticipated research project exhibits sufficient programmatic relevance and responsiveness to the program element to permit or encourage submission of a full Step-2 proposal. The two-step process can be structured in two ways: 1) Nonbinding two-step process in which a Step-2 proposal may be submitted even if the preceding Step-1 was discouraged or 2) A binding two-step process in which a Step-2 proposal cannot be submitted if it was not invited after the evaluation of the preceding Step-1. In any case those who submitted Step-1 proposals will be informed no later than four weeks prior to the Step-2 due date whether they are, or are not, encouraged or invited to submit a full Step-2 proposal.

The required Step-1 proposal is typically just the contents of the 4000-character limited Proposal Summary field in the cover pages but rarely also requires a PDF document upload. The required contents for the Step-1 proposal will be specified in the program element description. In some cases, the investigation team is not considered binding for Step-1 (i.e., it can be adjusted between the Step-1 and Step-2 proposal), but in other cases (e.g., Appendix B, Heliophysics), the Step-1 team is binding.

All of Appendix B and some other program elements limit the number of Step-2 proposals on which an individual may be PI. Please read the program element carefully. Budget data will not be requested as part of the Step-1 proposal. Unlike a Notice of Intent, which may be submitted by an individual, the Step-1 proposal must be submitted by an Authorized Organizational Representative of the proposing organization. Step-2 proposals are to be submitted in full compliance with the NASA Guidebook for Proposers discussed in Section IV(a) above. Proposers are encouraged to read the instructions document on Submitting Step-1 proposals that appears under "Other Documents" on the NSPIRES web page of any program element that requires a Step-1 proposal.
At the time of release of this ROSES-2017 NRA, the program elements that solicit proposals using a two-step process include all of the Heliophysics program elements (Appendix B), most program elements in Planetary Science (Appendix C), the K2 Guest Observer call in Appendix D, and E.3, the Cross-Division Exoplanets Research Program and E.4 the Cross-Division Habitable Worlds Program.

(viii) The Two-Phase Proposal Process
On occasion, NASA will solicit proposals using a two-phase proposal process for which Phase-1 is a request for an observation to be performed by a NASA space observatory as part of a NASA guest investigator/guest observer program element. Phase-2 is a proposal for funding from NASA only that is not peer reviewed. As such the Phase-2 proposals are not subject to the requirements in Section IV(b)iii to omit salary, fringe and overhead. An NOI may or may not be requested, and the Phase-1 observing request must be submitted to the observatory web page by the proposal due date in Tables 2 and 3 of this NRA.

At the time of release, this ROSES-2017 NRA contains four guest investigator/guest observer program elements using the two-phase proposal process: Swift Guest Investigator (D.5), Fermi Guest Investigator (D.6), NuSTAR Guest Observer (D.10) and the TESS Guest Observer Program (D.11).

Phase-1 observing requests for these programs cannot be submitted via either NSPIRES or Grants.gov. They must be submitted via the URL given in the Summary Table of Key Information given at the end of program element description. The Phase-2 proposal for funding must be submitted via NSPIRES by a proposal due date that will be announced when NASA announces the disposition of the Phase-1 observing requests. The process and requirements for the submission of Phase-1 observing requests and Phase-2 proposals may differ for each program element; proposers should read carefully the relevant program element Appendix to this ROSES NRA.

(c) Proposal Submission Due Dates and Deadlines
For each program element in Appendices A through E of this NRA, the electronic proposal must be submitted in its entirety by an Authorized Organizational Representative (AOR) no later than the proposal deadline on the appropriate proposal due date given in Tables 2 or 3 of this NRA. Unless stated otherwise in the relevant appendix to this NRA, the proposal deadline is 11:59 p.m. Eastern Time. Unless otherwise specified, all proposals must be submitted electronically using either NSPIRES or Grants.gov (see Sections IV(b)(i–iii) above).

Proposals submitted after the proposal due date and deadline will be labeled "late" by the NSPIRES system and will be handled in accordance with the SMD Policy on Late Proposals. The vast majority of proposals received after the due date are rejected without review. If a late proposal is rejected, it is entirely at the discretion of the proposer whether or not to resubmit it in response to a subsequent appropriate solicitation. It is not possible to submit a late proposal electronically via NSPIRES unless the electronic Cover Page was initially created prior to the proposal due date.
(d) Proposal Funding Restrictions

In addition to the funding restrictions and requirements given in the NASA Guidebook for Proposers and the NASA GCAM, the following restrictions are applicable to this ROSES NRA.

- The estimated funding and number of proposals anticipated to be funded, as shown in the Summary of Key Information at the end of each program element, are subject to the availability of appropriated funds, as well as the submission of a sufficient number of proposals of adequate merit.

- Unless specifically noted otherwise in the specific ROSES Appendix and/or program element, the proposing PI organization must subaward the funding of all proposed Co-Is who reside at other non-Government organizations, even though this may result in a higher proposal cost because of subawarding fees. Potential exceptions to this rule include, but are not limited to, the awards that stem from the Suborbital-Class Platforms (see Section V). Other rare exceptions will be considered on a case by case basis when requested in the proposal and found to be in the interest of the Government and consistent with appropriate law, regulation, policy, and practice.

- Unless otherwise noted in a program element, SMD will send funds directly to Co-Is at NASA centers and other Government laboratories, including JPL. Thus, if a proposal submitted by a university has a Government Co-I, the funds will not pass through the university, so the university (or other institution that receives a grant) should not include overhead or any other pass through charges on those funds. Funds for Co-Is who do not work for the Government would pass through the university and those charges may be applied. Regardless of whether a Co-I will be funded through a subaward via the proposing institution or funded directly by NASA, the cover page budget for the proposal must include all funding requested from NASA for the proposed investigation, including salaries for NASA civil servants, see Section IV(b)iii. Time for Co-Is and costs of procurements (not labor or overhead) at NASA centers and other Government laboratories should be justified in the proposal’s Budget Narrative. No indirect burden from non-governmental organizations should be applied to funds for Co-Is at NASA centers and other Government laboratories. (See the NASA Guidebook for Proposers).

- Allowable costs are governed by 2 CFR Part 200. All proposed costs, including matching or cost sharing, must be allowable, allocable, and reasonable. Funds may only be used for the project. Unless otherwise directed in 2 CFR 200, for changes to the negotiated indirect cost rate that occur throughout the project period, you must apply the rate negotiated for that year, whether higher or lower than at the time of the initial award. All activities charged under indirect costs must be allowed under the cost principles in 2 CFR Part 200. In general, the construction of facilities is not an allowed activity for any of the program elements solicited in this NRA. As described in the GCAM Section 4 (Limitations), facilities are different and distinct from equipment, which may be an allowable expense.

- Travel, including foreign travel, is allowed as may be necessary for the meaningful completion of the proposed investigation, as well as for publicizing its results at appropriate professional meetings. Proposers from NASA Centers should consult
the latest NASA policy document regarding restrictions on travel funding. Note that selection of a proposal and approval of a proposed budget that includes travel for civil servants does not guarantee that a NASA Center has sufficient travel authority to approve the proposed travel under NASA’s reduced travel budget.

- In general, proposals for sponsorship of topical conferences, workshops, consortia, or symposia meeting certain criteria are solicited through the ROSES program element Topical Workshops, Symposia, and Conferences (Appendix E.2).

- Regardless of whether a conference is sponsored by NASA, individual conference travel by grantees is permitted and proposers from universities may include a budget for travel to conferences and workshops. Proposers from NASA Centers should consult their Center implementing policy on the latest NASA guidance on conference spending and reporting requirements. Note that selection of a proposal and approval of a proposed budget that includes travel for civil servant does not guarantee that a NASA Center has sufficient travel authority under NASA’s reduced travel budget to approve the proposed travel.

- Profit for commercial organizations is not allowable under grant or cooperative agreement awards, but is allowable under contract awards. Costs for managing the project may be allowed. These costs, whether direct charges or part of the indirect cost agreement, must be consistent with 2 CFR 200 Subpart E.

- NASA funding may not be used for subcontracted foreign research efforts. U.S. research award recipients may directly purchase supplies and/or services from non-U.S. sources that do not constitute research, but award funds may not be used to fund research carried out by non-U.S. organizations. However, a foreign national may receive remuneration through a NASA award for the conduct of research while employed either full- or part-time by a U.S. organization. Special restrictions apply to collaboration with China, see Section III(c).

- Travel by a participant in the research investigation, whether for the purpose of conducting the research, for collaboration, or for attending a conference, is considered to be a research expense. NASA conducts its collaborations with foreign institutions on a no exchange of funds basis. NASA funding may not be used for research efforts by foreign organizations at any level. Therefore, NASA funding may not be used for travel expenses by any team member who is not participating as a member of a U.S. organization.

- As noted in the NASA Guidebook for Proposers, costs of preparing, publishing, and disseminating the results of NASA funded research (e.g., page charges, open access fees, etc.) may be included in research proposals and are allowable charges against the grant, as long as the charges are levied impartially on all research papers published by the journal.

- Non-NASA U.S. Government organizations should propose based on full-cost accounting, unless no such standards are in effect; in that case such proposers should follow the Managerial Cost Accounting Standards for the Federal Government as recommended by the Federal Accounting Standards Advisory Board. Proposal budgets must include all costs that will be paid out of the resulting award.
Regardless of whether functioning as a team lead or as a team member, personnel from NASA Centers must propose budgets consistent with the current NASA accounting implementation for the requested year of performance. All NSPIRES cover page budgets must include all costs that will be paid out of the resulting award, including salaries and overhead for NASA civil servants. Costs that will not be paid out of the resulting award, but are paid from a separate NASA budget (e.g., center management and overhead; CM&O) and are not based on the success of this specific proposal, should not be included in the proposal budget. For example, CM&O should not be included in the proposal budget while other direct charges (including procurements and labor) to the proposed research task should be included. NASA civil servant Co-Is must provide their costs to the proposing organization so that the proposing organization may complete the cover page budgets in NSPIRES.

V. SUBORBITAL-CLASS INVESTIGATIONS

(a) Overview of Suborbital-Class Platforms

In each SMD Research Program (Earth Science, Heliophysics, Planetary Science, Astrophysics), flight investigations that require access to space or near-space are solicited. Flight investigations solicited through ROSES generally have modest costs and reduced mission assurance requirements appropriate for the research program, and these investigations are referred to as suborbital-class investigations. Platforms for suborbital-class investigations include aircraft, balloons, sounding rockets, suborbital reusable launch vehicles, CubeSats, and small International Space Station (ISS) payloads. General requirements for proposals to use any of these platforms, with the exception of aircraft, are discussed in this section of ROSES. Requirements for proposals using aircraft are discussed within the description of the Earth Science Research Program found in Appendix A.

Generally, proposals for investigations that are carried out through development, launch, and operation of a short duration orbital experiment, such as one on a CubeSat or ISS-based project, are permitted in any ROSES program element that solicits investigations for use on suborbital-class platforms. In this sense, a CubeSat or an ISS-based investigation is a "suborbital class" investigation, even though it will be placed into orbit. CubeSat or ISS-based "suborbital class" investigations are subject to the same cost constraints to which traditional suborbital investigations are subject. Proposals for life and microgravity science investigations are not solicited through ROSES. Life and microgravity science investigations are solicited by the Human Exploration and Operations Mission Directorate. For further information, contact David Tomko, Human Research Program and Fundamental Space Biology, NASA Headquarters, Washington, DC 20546; Tel.: 202-358-2211; email: dtomko@nasa.gov.

(b) Points of Contact for Suborbital-Class Platforms

NASA provides some limited avenues for procurement of suborbital launch vehicle services, including: sounding rockets provided by the NASA Sounding Rockets Program Office (SRPO) at the NASA Goddard Space Flight Center/Wallops Flight Facility (NASA/GSFC/WFF), balloons provided by the NASA Balloon Program Office (BPO) at
the NASA/GSFC/WFF, and suborbital reusable launch vehicle (sRLV) services provided by the NASA Space Technology Mission Directorate’s (STMD) Flight Opportunities Program (FOP). SMD also solicits investigations as CubeSats and as small International Space Station payloads. Regardless of which launch vehicle service is anticipated, all prospective PIs are required to demonstrate the capacity, availability, and commitment of the suborbital-class platform to support their investigation. PIs are strongly urged to discuss prospective investigations with NASA program personnel (see below) prior to submitting their proposal to ensure that probable operational costs are properly anticipated.

(i) NASA-provided Sounding Rocket Services
Information on the capabilities of current available sounding rocket vehicles is available at http://sites.wff.nasa.gov/code810/vehicles.html. Proposers are encouraged to consider these capabilities in designing their investigations, but the Sounding Rockets Program Office (SRPO) has the final authority in the choice of which vehicle is to be used.

The nominal U.S. launch sites for sounding rockets are White Sands Missile Range (WSMR) in New Mexico, Wallops Island in Virginia, Poker Flat Rocket Range (PFRR) in Alaska, and Reagan Test Site (RTS) in the Kwajalein Atoll. The SRPO also conducts launches from the established non-U.S. launch sites at Andoya, Norway; Kiruna, Sweden (Esrange); or Woomera, Australia; subject to science community requirements and the availability of SRPO operations funding to conduct the campaign.

Investigators proposing payloads to be flown on sounding rockets should answer the program-specific questions on the NSPIRES proposal cover pages. This information is needed by the SRPO to generate a rough order of magnitude cost estimate for the operational requirements associated with a proposed investigation and is used for planning purposes. The required information includes the envisioned vehicle type, payload mass, trajectory requirements, launch site, telemetry requirements, attitude control, or pointing requirements, and any plans for payload recovery and reuse. Investigators proposing sounding rocket payloads should contact the SRPO to obtain technical information related to SRPO launch vehicle capabilities, services, and the latest planned campaign schedules. Questions concerning sounding rockets may be addressed to:

Philip Eberspeaker
Sounding Rockets Program Office
Code 810
GSFC/Wallops Flight Facility
National Aeronautics and Space Administration
Wallops Island, VA 23337
Telephone: (757) 824-2202
Email: Philip.J.Eberspeaker@nasa.gov

(ii) NASA-provided Balloon Services
Information on the capabilities of current available balloon vehicles is available at http://sites.wff.nasa.gov/code820/operations.html and at http://www.csbf.nasa.gov/balloons.html. Proposers are encouraged to consider these
capabilities in designing their investigations, but the Balloon Program Office (BPO) has the final authority in the choice of which vehicles to be used. The nominal U.S. launch sites for Balloons are Fort Sumner, New Mexico, and at the Columbia Scientific Balloon Facility in Palestine, Texas. The BPO also conducts launches from established non-U.S. launch sites at McMurdo, Antarctica; Alice Springs, Australia; Kiruna, Sweden (Esrange); or Wanaka, New Zealand, subject to science community requirements and the availability of BPO operations funding to conduct the campaign.

Proposers needing investigation unique engineering, flight support systems, and/or technical support services from NASA, such as the Wallops Arc-Second Pointing System (WASP), should contact the BPO directly for an estimate of the Government Furnished Equipment (GFE) cost of the desired support. Investigators proposing balloon payloads should contact the BPO to obtain technical information related to BPO balloon capabilities, services, and the latest planned campaign schedules.

Questions concerning balloons may be addressed to:

Debora Fairbrother  
Balloon Program Office  
Code 820, GSFC/Wallops Flight Facility  
National Aeronautics and Space Administration  
Wallops Island, VA 23337  
Telephone: (757) 824-1453  
Email: debora.a.fairbrother@nasa.gov

(iii) Suborbital Reusable Launch Vehicles

Suborbital Reusable Launch Vehicles (sRLV) offer newly developed commercial capabilities for the conduct of NASA scientific research, education, and technology advancement.

Proposals to ROSES program elements using sRLVs as platforms must be for complete investigations and must describe a complete suborbital science investigation, including payload construction, vehicle integration, launch and flight operations, data analysis, and publication of results. Proposers interested in using sRLVs as platforms to conduct an Earth or space science investigation must identify a vehicle that can provide the technical capabilities that are required to conduct the proposed investigation.

Proposals using sRLVs as platforms must specify the technical requirements that their investigation places on the vehicle. Proposals for investigations using sRLVs as platforms must provide a description of the instrument; its current status; a clear assessment of what it will take to develop, modify, and integrate the instrument onto the sRLV; and include a plan to provide calibrated, research grade data. SMD will conduct an sRLV continuing investigation review (CIR) for all sRLV-based projects. The CIR will take place following maturity of the sRLV-based project to the equivalent of a Phase A concept study report or a systems requirement review. The CIR will include payload description, flight performance assessment, proposed payload configuration and interfaces, mission success criteria, requirements matrix, operational requirements, launch vehicle, and project schedule. Once the sRLV-based project
reaches that level of design maturity, the CIR will be held at NASA Headquarters. The
SMD Associate Administrator (or designee) is the decision authority for approval to
proceed beyond the CIR. It is expected that sRLV-based projects will spend no more
than approximately $100K prior to CIR approval. A proposal for a sRLV-based project
must describe the proposed schedule for CIR and the proposed funding required to
reach CIR.

Proposals for sRLV-based investigations must be submitted to the appropriate ROSES
program element, depending on the science to be addressed by the proposed
investigation. The proposed sRLV-based investigation must meet the constraints of the
program element to which it is being proposed. This explicitly includes any constraints
on the areas of science that are solicited, on the available funding, and on the
requirement for a complete science investigation.

All proposals will be evaluated with respect to the criteria specified in the NASA
Guidebook for Proposers. In addition to the factors specified in the Guidebook, the
intrinsic merit of a proposal shall include the following additional factors:

• The extent that the proposed sRLV offers an advantage (e.g., scientific,
technical, or cost) over other suborbital-class platforms (including sounding
rockets, balloons, and aircraft);

• The likelihood that the proposed vehicle will be available at the proposed time for
flight and that it will be capable of providing the required technical capabilities;

• The feasibility of the proposed technical investigation, including the concept for
conduct of the experiment during the suborbital flight and the plans for calibrating
and analyzing the data obtained to accomplish the proposed science objectives;
and

• The quality of the plans for completing the preliminary design prior to the
investigation confirmation review.

The cost to SMD for the flight and all other services provided by the sRLV vendor must
be clearly stated in the proposal and included the NSPIRES cover page budget (in
Section F, line 10 labeled appropriately) and also the separately uploaded "Total
Budget" PDF. See Section IV(b)iii for information about the new requirements for the
separately uploaded "Total Budget" PDF.

In addition to the factors specified in the Guidebook, the evaluation of cost
reasonableness of a proposal shall include:

• The affordability to SMD of the proposed vehicle vendor cost for the flight and
other required services.

Proposers from Government Laboratories and NASA centers (including JPL) may avail
themselves of STMD’s Flight Opportunities Program (FOP) contracts to sRLV flight
service providers. Information on sRLV vehicles, including general vehicle capabilities
and contact information for some vendors, is available at
https://www.nasa.gov/directorates/spacetech/flightopportunities/flightproviders. Until
NASA establishes a policy to sponsor spaceflight participants onboard sRLVs, the FOP
will not sponsor participants to fly on commercial balloon or suborbital reusable launch
vehicles. The payloads to be flown on FOP contracted sRLV flights must either be
automated or remotely operated. The remote operation capability should be confirmed with the flight operator. For payloads to be flown on FOP contracted sRLV flights, the flight and all other services provided by the sRLV vendor will be procured directly by the FOP rather than through the award. FOP does not currently have a contract to provide parabolic flight.

Investigators proposing FOP contracted sRLV flight service payloads are strongly urged to discuss prospective investigations with operations personnel in the Flight Opportunities Program and/or a potential vendor to ensure that probable integration, safety and mission assurance, and operational costs are properly anticipated.

Proposals from non-governmental organizations, and government proposers who are not planning to use STMD’s Flight Opportunities Program (FOP) contracts to sRLV flight service providers, must include a Letter of Endorsement from a commercial vendor that (i) describes how that vendor’s vehicle will meet the investigation requirements and provides technical information on how the vehicle will meet the investigation requirements, (ii) states that the vehicle will be available for use at the time proposed for flight and provides information showing a plan for getting from the current vehicle status to flight status, and (iii) provides a quoted cost for the flight and all other services that are required from the vehicle vendor to enable and conduct the proposed investigation.

Questions concerning potential sRLV investigations may be addressed to:

Robert Yang  
Flight Opportunities Program  
Space Technology Mission Directorate  
NASA Headquarters  
Washington, DC 20546  
Telephone: (202) 358-0143  
Email: robert.l.yang@nasa.gov

(iv) Research Investigations utilizing the International Space Station

NASA has determined that there may be payload opportunities for small, suborbital-class space and Earth science research investigations, including both science and technology development, that utilize the International Space Station (ISS). Available external attach points include both zenith and nadir pointing locations and internal attach points, including nadir pointing locations. NASA has available annual external launch opportunities after 2017 on the Japanese HTV launch vehicle and the SpaceX vehicle. NASA also has regular opportunities on a suite of vehicles to launch pressurized cargo for use in the Window Observational Research Facility (WORF). Information on opportunities and constraints for ISS attached payloads may be found at http://www.nasa.gov/mission_pages/station/research/research_information.html.

Proposals seeking use of the ISS must take advantage of the Station’s unique capabilities. In order to be compliant, a proposal must include a clear and convincing scientific and/or technical argument that use of the ISS is required to produce the needed results in ways that could not be accomplished through the use of other platforms. Investigations that make use of the ISS may be proposed for periods of performance of up to five years.
Proposers interested in using the ISS to conduct an Earth or space science investigation must identify a specific accommodation location that can provide the technical capabilities required to conduct the proposed investigation. The proposal must include a letter of feasibility from the NASA Space Station Payload Office. This letter of feasibility must contain: (1) a preliminary assessment of the feasibility for proposed provisions for access to and accommodation at the Space Station, (2) identification of any significant challenges or conditional provisions for access and accommodation, and (3) a description of the level of technical interchange or negotiation required to mature the proposed provisions for access and accommodation. Transportation and accommodation will be provided by NASA at no cost to the proposed research investigation, and costs for transportation to and accommodation on the ISS should not be included in the proposed budget. However, the PI’s cost for all accommodation, safety, and other reviews that are conducted and supported by the PI must be included in the PI’s proposed investigation budget.

In addition to proposal requirements specified in the appropriate ROSES program element, proposals for investigations utilizing the ISS must provide a description of the instrument; its current status; a clear assessment of what it will take to develop, modify, and integrate the instrument onto the ISS; and include a plan to provide calibrated, research grade data in SI traceable units. Proposals must be for complete investigations that include payload construction, ISS integration, launch and flight operations, data analysis, and publication of results.

The ISS Customer Integration Office will provide integration services, launch services, on-orbit operations and services, as well as safety and mission assurance reviews for all ISS investigations.

Proposals must be submitted to the appropriate ROSES program element depending upon the science addressed by the proposed investigation. The proposed investigation must meet the constraints of the program element to which it is being proposed. This explicitly includes any constraints on the areas of science that are solicited, on the available funding, and on the requirement for a complete science investigation. Investigations proposed for the ISS will be approved for the first year only. During the first year, in addition to beginning the proposed investigation, a detailed transportation and accommodation study will be undertaken with the ISS Customer Integration Office. Approval for continued funding beyond the first year will be contingent on the ISS Program making a firm commitment for transportation and accommodation on the ISS that is compatible with the requirements of the proposed investigation.

All proposals will be evaluated with respect to the criteria specified in the NASA Guidebook for Proposers. In addition to the factors specified in the Guidebook, the intrinsic merit of a proposal shall include the following additional factors:

- The extent that the advantages (e.g., scientific, technical, or cost) of the International Space Station’s capabilities and location will be utilized; and
- The feasibility of the proposed technical investigation, including the concept for conduct of the experiment during the flight and the plans for calibrating and analyzing the data obtained to accomplish the proposed science objectives.
External accommodations for payloads include Express Logistics Carriers (ELCs) mounted to the ISS truss structure, the Japanese Experiment Module-Exposed Facility (JEM-EF), and the Columbus Orbiting Facility-Exposed Facility (COF-EF). Internal accommodations are also available in the pressurized environment via the Window Observational Research Facility (WORF). More detailed information can be found at www.nasa.gov/stationfacilities.

Attached payloads must be certified for transportation and use in a human tended vehicle. External payloads would be required to complete PDR approximately 36 months before launch, CDR approximately 24 months before launch, and be delivered for certification and integration approximately nine months before launch. Pressurized cargo for the WORF would be required to complete PDR approximately 12 months before launch, CDR approximately nine months before launch, and be delivered for certification and integration approximately four months before launch.

Investigators proposing ISS payloads are strongly urged to discuss International Space Station payload constraints, launch opportunities, and other technical matters with the ISS Research Integration Office.

For further information, please contact:

George Nelson
ISS Research Integration Office/OZ
Johnson Space Center
National Aeronautics and Space Administration
Houston, TX 77058

Telephone: 281.244.8514
Email: George.Nelson-1@nasa.gov

(v) Use of Short Duration Orbital Platforms, including CubeSats

Short duration orbital platforms, such as CubeSats (built in increments of 10 centimeter cubes), have historically been used as teaching tools and technology demonstrations, and now may offer newly developed capabilities for the conduct of NASA scientific research and technology advancement. CubeSats can be built as a single unit (1U), weighing less than 1.33 kg, or combined in units of two, three or six.

CubeSats: Proposals for science investigations utilizing short duration orbital platforms, such as CubeSats, must be for complete investigations, and must describe a complete science investigation, including CubeSat construction, payload integration and test, launch vehicle integration, communications, mission operations, data analysis, and publication of results.

Launch: The CubeSat Launch Initiative (CSLI) program regularly provides launch opportunities for small satellites to fly as secondary (auxiliary) payloads on rockets planned for upcoming U.S. Government missions. Under the CSLI process, an Agency-wide selection recommendation committee considers candidate CubeSats for selection from among those proposed from organizations both internal and external to NASA. At an appropriate time following selection, SMD will provide direction for being considered for manifest on a launch vehicle going to an appropriate orbit.
CubeSats are typically launched as secondary payloads to low-Earth orbit or from the International Space Station. Further, additional commercial opportunities to leave Earth orbit as a secondary payload may arise on future mission launches. Information on the EM-1 stand-alone CubeSat opportunity, can be found by contacting the CubeSat points of contact listed below.

For more information about the CSLI, including previously-selected respondents, see [http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html](http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html).

As a result of their secondary status, CubeSats are placed into orbits that are dictated by the primary. Therefore, in any given year a finite number of specific orbits (e.g., inclinations and altitudes) will be available for CubeSats, and the types of orbits available will vary from year to year. Thus, CubeSat-based missions requiring very specific orbital parameters may be at a disadvantage for securing a timely launch. Proposals should include the CubeSat Mission Parameters Table (below) and clearly indicate both the required and the acceptable range of orbital parameters needed to meet mission objectives.

<table>
<thead>
<tr>
<th>Mission Name</th>
<th>Mass</th>
<th>Cube Size</th>
<th>Desired Orbit</th>
<th>Acceptable Orbit Range</th>
<th>Ready Date</th>
<th>Desired Mission Life</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>400 km @ 51.6 degree incl. Acceptable – Yes or No</td>
<td></td>
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<tr>
<td>Altitude</td>
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<tr>
<td>Inclination</td>
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</tbody>
</table>

NASA's CubeSats are deployed from the ISS via NanoRacks or from an expendable launch vehicle via a dispenser on contract at the time of manifesting. CubeSats must be compliant with Launch Services Program, Program Level Dispenser and CubeSat Requirements Document (LSP-Req-317.01) and CubeSat Requirements Document and the Compliance and Reference Documents referenced therein. That document may be found at: [http://www.nasa.gov/pdf/627972main_LSP-REQ-317_01A.pdf](http://www.nasa.gov/pdf/627972main_LSP-REQ-317_01A.pdf)

Investigators proposing CubeSats in response to this solicitation are expected to comply with the requirements of NASA Procedural Requirement (NPR) 7120.8, NASA Research and Technology Program and Project Management Requirements, and should appropriately tailor these requirements, depending on the project size, complexity, and scope.

Proposals for CubeSat investigations should note the following:

- The cost of launch for a single, ≤ 3U, spacecraft to Low Earth Orbit (LEO) will be provided under the NASA/HEOMD CubeSat Launch Initiative (CSLI) at no cost to the investigation. Proposals to go beyond LEO, more than one spacecraft or >3U must contact CSLI representatives (see below) to obtain a cost estimate. Proposals shall state explicitly in the budget justification that there will be additional costs for launch within the proposed budget, and give those costs in the NSPIRES cover page budget and the separately uploaded Total Budget file.
- The proposed CubeSat investigation must meet the constraints of the program element to which it is being proposed. This explicitly includes any constraints on
the areas of science that are solicited, on the available funding, and on the requirement for a complete science investigation.

- Proposals will be evaluated with respect to the criteria specified in the NASA Guidebook for Proposers. In addition to the factors specified in the Guidebook, the proposal will be evaluated against any additional factors called out in the program element to which it is being proposed.
- Proposals for investigations using CubeSats must satisfy the constraints for a standard CubeSat and the NASA CubeSat deployer.
- Proposals must specify any constraints placed on the required orbit and orbital lifetime. The likely availability of NASA launches satisfying any constraints in the time period contemplated will be a consideration for the ROSES evaluation. The less stringent the orbital constraints, the more probable it will be that NASA can manifest the CubeSat investigation for launch.
- Proposals must demonstrate knowledge of the requirements for limiting orbital debris and must address how the mission will meet the requirements of NPR8715.6 NASA Procedural Requirement for Limiting Orbital Debris.
- Proposals must address the approach to downlink and uplink communications licensing, frequency band selection, and frequency coordination for operations between space and ground within the RF spectrum.
- All costs for preparing, testing, and delivering the CubeSat for launch must be included in the proposal. No launch service charges should be included in the proposal cost request.
- Proposals for short duration orbital experiments other than CubeSats must include provisions for access to space as part of the proposal.

Investigators proposing CubeSats are strongly urged to discuss prospective investigations with personnel listed below regarding constraints, launch opportunities, and other technical matters.

For further information on SMD CubeSats, please contact:

Larry Kepko
Phone: 202-358-0362,
Email: larry.kepko@nasa.gov [Updated March 9, 2017]

For further information on CSLI, please contact:
Anne E Sweet,
Launch Services Program Executive,
Phone: 202-358-3784,
Email: anne.sweet-1@nasa.gov

or

Jason C Crusan,
Director, Advanced Exploration Systems,
Phone: 202-358-0635,
Email: jason.c.crusan@nasa.gov
ROSES supports science investigations and/or technology development utilizing payloads flown on suborbital-class platforms, or as flights of opportunity. Suborbital-class payloads may be recovered, refurbished, and reflown, in order to complete an investigation. A discussion of the plans for management and for reduction and analysis of the data must be given in the proposal. Although most awards are for three or four years’ duration, a five-year proposal may be accepted to develop a completely new, highly meritorious investigation through its first flight. Please read the individual ROSES program element for program specific requirements.

Budgets are expected to cover complete investigations, including payload development and construction, instrument calibration, launch, data analysis, and publication of results. The number of investigations that can be supported is limited and heavily dependent on the funds available to the relevant research program. Note that NASA does not carry reserves to accommodate any cost overrun incurred by a particular investigation, including the damage and/or loss of the payload owing to a suborbital-class platform system failure. Therefore, failure to achieve the proposed goals within the proposed time and budget could require either descoping the initially proposed investigation, delaying it, canceling a particular launch date opportunity, or canceling the investigation altogether. Unlike most other ROSES investigations where the proposing PI organization must subcontract funding to non-Government investigators, suborbital-class investigations will sometimes be split into multiple awards, depending on circumstances. Please read the individual ROSES Appendix and consult with the POC.

VI. PROPOSAL REVIEW INFORMATION
(a) Evaluation Criteria

As stated in the NASA Guidebook for Proposers, proposals are ordinarily evaluated on three criteria: intrinsic merit, relevance, and cost. Despite the implication of some kind of average when the guidebook states that the three criteria are of approximately equal weight, a ROSES proposal that is not relevant is not selectable, no matter what the scores for Merit or Cost, or mean or median of all three criteria scores. Indeed, SMD may return without peer review a proposal deemed to be not relevant. The manner in which SMD evaluates ROSES proposals for relevance, and cost varies from program to program. ROSES proposals may be scored by peer reviewers for all three criteria on a full scale, or the proposal may be scored on a full scale only for merit, with relevance and/or cost evaluated on an abridged scale, or with only comments provided for relevance and/or cost, or the peer review panel may not be asked to comment on relevance and cost at all.

Note the following specific points:

• Some of the program elements discussed in Appendices A through E will give specific factors, based on the solicited research objectives, which will be considered when evaluating a proposal’s science and/or technical merits and/or its relevance to program objectives.

• Unless otherwise stated, relevance will be judged by whether the proposal addresses goals and objectives for that ROSES Appendix and/or specific program
element, rather than NASA’s broader goals. This focus on relevance to the program element supersedes the instructions in the NASA Guidebook for Proposers. Unless otherwise stated in the program element, relevance of the proposed work is judged based on whether the work proposed is deemed to be relevant, independent of whether or not it includes an overt, clear and direct statement of relevance. That is, unless otherwise stated in the program element, no proposal will be returned as noncompliant for lack of a relevance section or statement, and inclusion of a relevance section or statement is no guarantee that the proposal will be judged relevant. Please read the program elements carefully. See also Section I(h).

- Cost data for U.S. proposals may be evaluated both by peer review (for reasonableness) and by NASA program personnel (vs. the available budget). Proposers must follow the budget requirements in Section IV (b) iii and Table 1 of this document. When evaluating the cost reasonableness of the proposals, reviewers will assess whether the proposed level of effort (i.e., labor FTEs) and the proposed other direct costs (i.e., supplies, equipment, travel) are commensurate with those required to accomplish the goals of the investigation. Salary levels, fringe benefit rates, and overhead rates are not part of that evaluation, and will be hidden from peer reviewers.

- Except in rare instances where it is explicitly acknowledged in the program element, neither the existence of proposed voluntary cost sharing nor the lack thereof or the magnitude of such cost sharing will be used as evaluation criteria or as a precondition for award. If voluntary cost sharing is proposed, the proposer should describe, in detail, any proposed cost sharing arrangements (see Section III(d) above). Please note that the Summary of Proposal Personnel and Work Effort is no longer in the budget section and the Guidebook explicitly notes that any planned work commitment not funded by NASA is not considered cost sharing as defined in 2 CFR § 200.29.

- The NASA Guidebook for Proposers gives definitions for five adjectival ratings from Excellent down to Poor. NASA may provide decision letters and or evaluations with intermediate scores such as "Excellent/Very Good" and/or may employ numerical scores.

- A NASA awards officer will conduct a pre-award review of risk associated with the proposer as required by 2 CFR 200.205. For all proposals selected for award, the awards officer will review the submitting organization’s information available through the Federal Awardee Performance and Integrity Information System (FAPIIS) and the System for Award Management (SAM) to include checks on entity core data, registration expiration date, active exclusions, and delinquent federal debt.

- Prior to making a Federal award with a total amount of Federal share greater than the simplified acquisition threshold (currently $150,000), NASA is required to review and consider any information about the applicant that is in the designated integrity and performance system (currently FAPIIS) accessible through the System for Award Management (SAM, https://www.sam.gov/portal/SAM/) (see 41 U.S.C. 2313). An applicant, at its option, may review information in FAPIIS and comment on any information about itself that NASA previously entered and is currently in FAPIIS.
NASA will consider any comments by the applicant, in addition to the other information in FAPIIS, in making a judgment about the applicant's integrity, business ethics, and record of performance under Federal awards when completing the review of risk posed by applicants as described in 2 CFR 200.205 Federal awarding agency review of risk posed by applicants.

- For proposal evaluation and other administrative processing, NASA may find it necessary to release information submitted by the proposer to individuals not employed by NASA. Business information that would ordinarily be entitled to confidential treatment may be included in the information released to these individuals. Accordingly, by submission of this proposal, the proposer hereby consents to a limited release of its confidential business information (CBI). Except where otherwise provided by law, NASA will permit the limited release of CBI only pursuant to non-disclosure agreements signed by the assisting contractor or subcontractor, and their individual employees and peer reviewers who may require access to the CBI to perform the assisting contract.

(b) Review and Selection Processes

Review and selection of proposals submitted to this NRA will be consistent with the policies and provisions given in the NASA Guidebook for Proposers, the SMD Peer Review Policy and the SMD policy on avoidance of Peer Review Conflicts of Interest. In deciding which proposals submitted to this NRA are selected, the desire to achieve a balance of efforts across the solicited program objectives may play a role in the selections.

Unless otherwise specified, the SMD Division Director responsible for a research program (or a delegate, such as the R&A lead in the Earth Science and Planetary Science Divisions) is its Selection Official.

(c) Selection Announcement and Award Dates

SMD’s goal is to announce selections within 150 days of the proposal due date and within 60 days after the conclusion of the peer review. Selections are typically announced between 150 days and 220 days after the proposal due date. Although there are many reasons why selections are not announced earlier, the most common are the uncertainty in the NASA budget at the time selection decisions could be made and the time required to conduct an appropriate peer review and selection process. NASA does not usually announce new selections until the funds needed for those awards are approved through the Federal budget process. Therefore, a delay in the budget process for NASA usually results in a delay of the selection announcement date. After 150 days have passed since the proposal due date, proposers may contact the responsible Program Officer listed at the conclusion of that program element and on the SARA web page (see Section VIII). If the program officer does not respond proposers may send an inquiry to SARA@nasa.gov.

In order to announce selection decisions as soon as is practical, even in the presence of budget uncertainties, the Selection Official may make and announce selection decisions about some proposals and defer decisions on others. If a Selection Official uses this option, then proposers may be told that a proposal has been "selected," "declined," or
that a decision has not yet been made. If a decision has not yet been made, then those proposals remain "selectable" and will be considered for a supplemental selection if circumstances allow. Eventually proposers will be notified whether their proposal is selected or is no longer being considered for selection. All proposers will be notified via NSPIRES and provided with a written review (usually the panel evaluation) of the proposal. Proposers may contact the Program Officer for a "debriefing," e.g., to clarify something that is unclear in the evaluation or for an explanation of whether there were factors other than the peer review that played a role in the decision.

(d) Processes for Appeals

(i) Reconsideration by SMD
SMD has a process for requesting reconsideration of the declination of a proposal submitted in response to an SMD NASA Research Announcement. Reconsideration may be requested if the PI believes that the proposal was not handled correctly. This process may be found at in the SMD Reconsideration Policy document available in the Library section of the SARA website at https://science.nasa.gov/researchers/sara/library-and-useful-links (the SARA website is at http://sara.nasa.gov).

(ii) Ombudsman Program
The NASA Procurement Ombudsman Program is available under this NRA as a procedure for addressing concerns and disagreements. The clause at NASA FAR Supplement (NFS) 1852.215-84 ("Ombudsman") is incorporated into this NRA. The cognizant ombudsman is
Director, Contract and Grant Policy Division
Office of Procurement
NASA Headquarters
Washington, DC 20546-0001
Telephone: 202-358-4483
Email: agency-procurementombudsman@nasa.gov

(iii) Protests
Only contract awards are subject to bid protest, either at the Government Accountability Office (GAO) or with the Agency, as defined in FAR 33.101. The provisions at FAR 52.233-2 (Service of Protest) and NFS 1852.233-70 (Protests to NASA) are incorporated into this NRA. Under both of these provisions, the designated official for receipt of protests to the Agency and copies of protests filed with the GAO is
Assistant Administrator for Procurement
Office of Procurement
NASA Headquarters
Washington, DC 20546-0001
Telephone: 202-358-2090

(e) Service as a Peer Reviewer
The success of NASA’s research program rests on the quality of peer review. NASA will contact expert investigators and ask them to serve as peer reviewers. Since those whose proposals were selected in prior competitions are highly qualified and may not be
submitting a proposal to the current competition, they are highly encouraged to serve on SMD peer review panels. Potential reviewers are encouraged to volunteer to be reviewers by filling out one of the review forms at https://science.nasa.gov/researchers/volunteer-review-panels or by sending an email to one of the program officers or to sara@nasa.gov. It is good experience for early-career scientists, and the influx of new reviewers is healthy for the process.

VII. Award Administration Information

(a) Notice of Award

All proposers will be officially notified via NSPIRES from which they will be able to retrieve their official decision letter and evaluation. If a proposal is selected, the business office of the offeror will be contacted by a NASA Grants Officer from the NASA Shared Services Center (NSSC), who is the only official authorized to obligate the Government. Any costs incurred by the offeror in anticipation of an award will be subject to 2 CFR Section 1800.209 Preaward costs. NASA waives the approval requirement for preaward costs of 90 days or less.

(b) Administrative and National Policy Requirements

This solicitation does not invoke any special administrative or national policy requirements: 2 CFR 1800, 14 CFR 1274, and the Grants and Cooperative Agreement Manual will apply to any awards that derive from this NRA, as applicable. All award requirements are posted at https://prod.nais.nasa.gov/pub/pub_library/srba/index.html.

(c) Award Reporting Requirements

The reporting requirements for awards made through this NRA will be consistent with 2 CFR 1800.902.

Award recipients may also be subject to reporting requirements under the NASA Plan for Increasing Access to Results of Federally Funded Research. Such requirements include reporting of final peer-reviewed manuscripts in annual and final progress reports. All requirements will be identified in the Notice of Award.

If the Federal share of any award issued under this NRA is more than $10M over the period of performance, additional reporting requirements will apply. See 2 CFR 200 Appendix XII—Award Term and Condition for Recipient Integrity and Performance Matters.

All awards made in response to proposals to this solicitation must comply with the National Environmental Policy Act (NEPA). While most research awards will not trigger action specific NEPA review, there are some activities, including international actions, that will. For example, the following activities would likely require NEPA analysis: suborbital-class flights as described in Section V, especially flights not conducted by a NASA Program Office; activities involving construction/fieldwork that would involve groundbreaking or the installation of a field station; and, activities involving the use of expendable weather reconnaissance devices (dropsondes). Proposers should plan and budget accordingly if environmental impacts are anticipated. Questions concerning environmental compliance requirements may be addressed to Tina Norwood, NASA NEPA Manager, at tina.norwood-1@nasa.gov or (202) 358-7324.
Proposals that include flight activities (not normal passenger travel) such as aircraft or helicopter flight services, including Unmanned Aircraft Systems (UAS)/Drones operations or the acquisition or construction of such flight vehicles, must comply with NASA Policy Directive 7900.4. Questions concerning flight compliance requirements may be addressed to Norman Schweizer at norman.s.schweizer@nasa.gov.

For science projects that receive assistance from the U.S. Antarctic Program, the acknowledgement should include: "Logistical support for this project in Antarctica was provided by the U.S. National Science Foundation through the U.S. Antarctic Program." Any additional requirements will be specified in the program element description.

VIII. POINTS OF CONTACT FOR FURTHER INFORMATION

General questions and comments about the policies of this NRA may be directed to:

Max Bernstein
SMD Lead for Research
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
   Email: sara@nasa.gov (preferred)
   Telephone: (202) 358-0879

Note: Proposals must not be submitted to this address. Proposals must be submitted electronically, as described in Section IV above.

Specific questions about a given program element in this NRA should be directed to the Program Officer(s) listed in the Summary Table of Key Information at the end of each program element appendix. Up-to-date contact information for program officers can also be found online at the SARA web page’s Program Officers List at https://science.nasa.gov/researchers/sara/program-officers-list.

Inquiries about accessing or using the NASA proposal submission web interface located at http://nspires.nasaprs.com should be directed by an email that includes a telephone number to nspires-help@nasaprs.com or by calling (202) 479-9376. This help center is staffed Monday through Friday, 8:00 a.m. – 6:00 p.m. Eastern Time.

Inquiries about accessing or using Grants.gov located at http://www.grants.gov should be directed by an email to support@grants.gov or by calling (800) 518-4726 twenty-four hours a day, seven days a week, except Federal holidays when the center is closed.

IX. ANCILLARY INFORMATION

(a) Announcement of Updates/Amendments to Solicitation

Because this NRA is released far in advance of many of the deadlines given in Tables 2 and 3, additional programmatic information for any of its programs may develop before their proposal due dates. If so, such information will be added as a formal amendment to this NRA no later than 30 days before the proposal due date, or, if that is not possible, the proposal due date will be extended to allow 30 days for proposal submission from the date of the amendment. All amendments are posted on the main ROSES webpage at http://solicitation.nasaprs.com/ROSES2017 (or by going to
http://solicitation.nasaprs.com/open and selecting "NNH17ZDA001N"). Also, an RSS feed for amendments, clarifications, and corrections to ROSES can be found in one place (and there is an RSS feed) at http://science.nasa.gov/researchers/sara/grant-solicitations/roses-2017/. NASA SMD will also send an electronic notification of any such amendments to all subscribers of its electronic notification system (see Section IX(c) below), it is the responsibility of the prospective proposer to check this NRA’s homepage for updates concerning the program(s) of interest. Any clarifications or questions and answers that are published will be posted on the relevant program element’s web page, which can be found as described above.

(b) Electronic Submission of Proposal Information

On-time electronic submission over the Internet is required for every proposal. While every effort is made to ensure the reliability and accessibility of the electronic proposal submission systems (NSPIRES and Grants.gov) and to maintain help centers via email and telephone, difficulty may arise at any point, including the user’s own equipment. Therefore, prospective proposers are urged to familiarize themselves with the submission system(s) and to submit the required proposal materials well in advance of the deadline of the program of interest. Difficulty in registering with or using a proposal submission system is not, in and of itself, a sufficient reason for NASA to consider a proposal that is submitted after the proposal due date (see Section IV(c) above). After submission via NSPIRES, proposers can verify proposal delivery by logging into NSPIRES and selecting "proposals" and "Submitted Proposals/NOIs." Additionally, the proposal PI and the submitting organization’s AOR(s) will receive an email from NSPIRES confirming that the submission has been completed.

(c) Electronic Notification of SMD Research Solicitations

SMD maintains an electronic notification system to alert interested researchers of its research program announcements. Subscription to this service is free to all registered users of the NASA proposal database system at http://nspires.nasaprs.com. To add or change a subscription to the electronic notification system, users should login to the database system and select "Account Management" then "email Subscriptions." Owing to the increasingly multidisciplinary nature of SMD programs, this email service will notify all subscribers of (i) all NASA SMD research program solicitations regardless of their type or science objectives; (ii) amendments to all SMD solicitations that have been released for which the proposal due dates have not passed; and (iii) special information that SMD wishes to communicate to those interested in proposing to its sponsored research programs. Altogether, a subscriber may receive 50–75 notifications per year. SMD maintains this subscription list in confidence and does not attempt to discern the identity of its subscribers. Regardless of whether or not this service is used, all SMD research announcements may be accessed at http://solicitation.nasaprs.com/open by selecting "NNH17ZDA001N" as soon as they are posted (typically by ~9:00 a.m. Eastern Time on their release date).

Note: Automated spam filtering software may identify SMD’s electronic notifications as spam or junk mail. Subscribers are advised to ensure that email received from "NSPIRES-help@nasaprs.com" or "nspires@nasaprs.com" are not identified by any automated email filtering system as unwanted email.
NRAs issued by SMD are synopsized on Grants.gov (http://www.grants.gov) at the time they are released. This ROSES NRA will be synopsized upon its release.

(d) Further Information on SMD Research and Analysis Programs

SMD maintains a website for improving communication with the research community. This site is maintained by the SMD Research Lead, is referred to as the SARA website, and is located at http://sara.nasa.gov. The SARA website contains information related to NASA's Science Research Programs, including the solicitations, selections, an RSS feed for changes to ROSES, and contact information for program officers.

(e) Archives of Past Selections

For more information about the types of research supported by the program elements solicited in previous editions of this NRA and other predecessor NRAs, the titles and abstracts of all investigations selected through previous solicitations (issued after January 1, 2005) are available by solicitation by year at http://nspires.nasaprs.com: click "Solicitations" and then "Closed/Past Solicitations and Selections," choose the year from the pop-down menu, and click the find button to see the abstracts in a PDF file. One can search the grants (only) that resulted from all NASA programs at http://www.research.gov/ by selecting "Search awards" and then using the "Advanced Search" to search for NASA awards only. One can also search the grants (only) that resulted from all NASA programs, but not abstracts at https://www.nssc.nasa.gov/grantstatus.

(f) Meeting Geospatial Standards

NASA pioneered the development of metadata and the accessibility and interoperability of space and Earth science data. When grants result in the development of data that NASA both identifies as geospatial and intends to distribute, then NASA awards will require that documentation (metadata) meet Federal Geographic Data Committee standards. NASA will assure that this documentation is electronically accessible to the Clearinghouse network (http://www.fgdc.gov/dataandservices/) and discoverable through Geospatial One Stop (http://geo.data.gov/).

X. CONCLUDING STATEMENT

Through this ROSES NRA, NASA encourages the participation of the space and Earth science communities in its Science Mission Directorate research and technology programs. These programs, while quite diverse in objectives and types, in fact form the foundation of both the basic and applied research that allows NASA's space and Earth science programs to be properly planned and carried through to the successful interpretation of data and its application to the needs of end users. Comments about this NRA are welcome and may be directed to the point of contact for general questions and comments identified in Section VIII above.
Table 1: Checklist for ROSES-2017 Proposals

| Team | All investigators must indicate participation via NSPIRES, except proposals submitted via grants.gov. If any team member doesn’t confirm their participation the AOR will get an error that prevents submission. |
| Team | Paid team members may not be collaborators, they should be given a role permitted to receive funds, such as Co-I. |
| Team | A critical partner with a sustained, continuing role is a Co-I, not a collaborator, even if unpaid. |
| Project Summary | Project Summary (abstract) must be in the text box in the cover pages, not the main body of the proposal. It has a built in 4000-character limit. |
| DMP | For most programs, the Data Management Plan (DMP) or explanation of why it is not needed must be provided in the 4000-character text boxes in the cover pages, unless otherwise stated in the program element. See Section II(c) and the ROSES FAQ for important information. |
| Budget | List all costs. Include all salary and indirect costs in the NSPIRES cover page budgets. |
| Submission | Both the author must "release" the proposal and the AOR must "submit" prior to the due date. |
| Other | There are cover page questions that must be answered and there may be other required content, e.g., some program elements in Appendix C collect a relevance statement here, see VI (a). |

Proposal document

| Table of contents | First component of proposal. One page only and optional. |
| Scientific/Technical/Management Section | Second component and the main part of the proposal. The sequence for science content here is recommended, but proposers may order the elements as they prefer. |
| Length restriction | Typically, 15 pages (except for a Step-1 proposal) and more may be permitted for some (e.g., suborbital) programs and less for others (e.g., Planetary Major Equipment). Please read the program element and refer to the summary table of key information. |
| Format | 8.5" x 11.0" paper size |
| Format | Single spaced, single column text (unless otherwise specified). |
| Format | One-inch margins on all four sides. No reviewable content in margins. |
| Format | No more than 5.5 lines per vertical inch |
| Format | No more than 15 characters per horizontal inch, including spaces |
| Format | Font size 12 consistent with rules above, sans serif font recommended |
| Figure Format | Text and content on/in figures must be easily legible without magnification. |
| Captions Format | Figure captions follow the same font restrictions as body of proposal. Don’t put anything crucial only in the captions. |
| Table Format | Text and content on/in Tables must be easily legible without magnification. |
| Content | Discuss objectives and their significance. |
| Content | Discuss perceived impact of the work. |
| Content | Discuss relevance of the work to the solicitation. See VI (a) |
| Content | Explain the technical approach and methodology. |
| Content | Discuss potential sources of uncertainty |
| Content | Present mitigation strategy or alternate approach given obstacles |
| Content | Present roles of all team members so it’s clear what they are doing |
| Content | Present a work plan, with milestones, management structure |
| Content | Present a data sharing and/or archiving plan here in the text only if it is required by program element. |
| Special Content | Provide other special requirements of program element, e.g., special statements for participating scientists, team leads, etc. |

References: Third component of proposal

| Length | No page limit |
| Excluded | No references to documents (e.g., unpublished manuscripts) unavailable to reviewers. No links to personal websites. |

Biographical sketches/Curriculum Vitae (CVs): fourth component of proposal

| Required | One for the PI and each Co-I |
| Length restriction | CV for PI - two pages or fewer, unless otherwise specified. |
| Length restriction | CVs for anyone other than the PI are limited to one page |
| Not required | CVs for collaborators are typically not needed, but may be included |

Summary Table of work effort: This is the fifth component of the proposal. Note, location may differ from that given in Guidebook. See Section IV(b)iii

| General | Note this table has been moved from the budget Section. Where names are not known, include the position, such as postdoctoral fellow or technician. |
| Required | Names and/or titles of all personnel to perform the proposed effort |
Table 1 Continued: Checklist for ROSES-2017 Proposals

<table>
<thead>
<tr>
<th>Required</th>
<th>Planned work commitment (e.g., in fractions of a work year) to be funded by NASA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td>Planned work commitment (e.g., in fractions of a work year) that will not be funded by NASA, if any. Note: time commitment included here that is not funded by NASA is not considered cost sharing, as defined in 2 CFR § 200.29.</td>
</tr>
</tbody>
</table>

Current and Pending Support: Sixth component of the proposal, not page limited.

| Required | Desired for the PI and funded team members who are proposed to devote >10% of their time to the proposed work. |
| Required | For each current project or pending proposal list the level of effort for that one team member (only) per year. Award values are not required. |
| Excluded | Do not include Current and Pending for collaborators. |
| Discouraged | Current and Pending for students is discouraged. |
| Discouraged | Current and Pending for Foreign Co-Is is discouraged. |
| Excluded | Do not self-reference this proposal in the current and pending |

Statements of Commitment and Letters of Support, feasibility and Endorsement, the Seventh component of the proposal.

| General | Statements of Commitment by team members have been replaced by an indication of participation via the NSPIRES web interface. |
| Statements of Commitment | Statements of Commitment must be included for proposals that were submitted via grants.gov since web confirmation is not possible. |
| Letter of Endorsement – only permitted in special cases. | In general, not permitted. Special cases include 1) Foreign Co-Is must include letters of endorsement from their government agency or funding/sponsoring institution in their country and 2) Letters from commercial vendor are required for proposals for investigations using sRLVs not contracted by the Flight Opportunities Program. See Section V(b)iii. |
| Letter of Support | A letter of support is required from the owner of any facility or resource that is not under the direct control of the PI or a Co-I, acknowledging that the facility or resource is available for the proposed use during the proposed period. [Corrected March 9, 2017] |
| Letter of feasibility | A letter of feasibility from the NASA Space Station Payload Office must be included with proposals to use ISS. |
| Letter of affirmation | In general, letters of affirmation are not permitted for normal research proposals, but letters from the community may be included only where explicitly allowed, e.g., for C.17 PME and E.2 TWSC. |
Table 1 Continued: Checklist for ROSES-2017 Proposals

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget Justification</td>
<td>The eighth component of the proposal, no page limit overall.</td>
</tr>
<tr>
<td>General</td>
<td>Please explain in words what is being purchased and why it is reasonable. See the <em>Guidebook for Proposers</em>.</td>
</tr>
<tr>
<td>Required</td>
<td>Budget Narrative: justify each proposed component of cost, including subcontracts/subawards, consultants, other direct costs (including travel), and facilities and equipment. Give the &quot;basis of estimate;&quot; quotes need not be provided, but the proposal should indicate that the cost was based upon a quote, prior experience, etc.</td>
</tr>
<tr>
<td>Excluded</td>
<td>Do not include any values for salary, fringe, or overhead.</td>
</tr>
<tr>
<td>Optional</td>
<td>Proposers need not specify anticipated award type (i.e., grant vs. contract), see Section II(a).</td>
</tr>
<tr>
<td>Facilities and Equipment</td>
<td>The ninth component of the proposal, no page limit.</td>
</tr>
<tr>
<td>Length restriction</td>
<td>None, as needed</td>
</tr>
<tr>
<td>Excluded content</td>
<td>Does not add scientific or technical information beyond a description of the facilities and equipment, i.e., don't add here what should be in the page-limited Scientific/technical Section.</td>
</tr>
<tr>
<td>Detailed Budget</td>
<td>The tenth and final component of the main proposal document.</td>
</tr>
<tr>
<td>Strongly Recommended</td>
<td>Detailed budget, itemizing expenses.</td>
</tr>
<tr>
<td>Strongly Recommended</td>
<td>Separate detailed budget from each subaward organization.</td>
</tr>
<tr>
<td>Excluded</td>
<td>Do not include any $ or % values for salary, fringe, or overhead. This is reported only in the cover page budget and &quot;Total&quot; Budget separate from the main proposal document, which is peer reviewed.</td>
</tr>
<tr>
<td>PDF Appendices</td>
<td>Separate from the main proposal document</td>
</tr>
<tr>
<td>&quot;Total&quot; Budget Document (separate PDF file attached as document type &quot;Total Budget&quot;).</td>
<td>Separately uploaded &quot;Total&quot; Budget PDF file see Section IV(b)(iii).</td>
</tr>
<tr>
<td>Required</td>
<td>HEC Appendix Document (separate PDF file attached as document type &quot;Appendix&quot;)</td>
</tr>
<tr>
<td>If necessary</td>
<td>If the Program Specific Data Question about the use of HEC was answered in the affirmative, a required appendix document must be provided. See Section I(d) for information.</td>
</tr>
</tbody>
</table>

## TABLE 2: SOLICITED RESEARCH PROGRAMS
(In Order of Proposal Due Date) [1]

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Program Element</th>
<th>NOI/Step-1 Due Date [2]</th>
<th>Proposal Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.28</td>
<td>Earth Surface and Interior</td>
<td>03/31/2017</td>
<td>05/15/2017</td>
</tr>
<tr>
<td>D.2</td>
<td>Astrophysics Data Analysis</td>
<td>03/28/2017</td>
<td>05/19/2017</td>
</tr>
<tr>
<td>A.43</td>
<td>Making Earth System Data Records for Use in Research Environments</td>
<td>04/21/2017</td>
<td>05/22/2017</td>
</tr>
<tr>
<td>E.3</td>
<td>Exoplanets Research Program</td>
<td>03/30/2017</td>
<td>05/25/2017</td>
</tr>
<tr>
<td>A.20</td>
<td>Atmospheric Composition: Laboratory Research</td>
<td>N/A</td>
<td>05/26/2017</td>
</tr>
<tr>
<td>C.2</td>
<td>Emerging Worlds [4]</td>
<td>03/30/2017</td>
<td>06/01/2017</td>
</tr>
<tr>
<td>A.2</td>
<td>Land-Cover/Land-Use Change</td>
<td>04/03/2017</td>
<td>06/08/2017</td>
</tr>
<tr>
<td>C.10</td>
<td>Cassini Data Analysis</td>
<td>04/06/2017</td>
<td>06/08/2017</td>
</tr>
<tr>
<td>A.16</td>
<td>Cryospheric Science</td>
<td>05/16/2017</td>
<td>06/16/2017</td>
</tr>
<tr>
<td>A.23</td>
<td>Fire Impacts on Regional Emissions and Chemistry</td>
<td>N/A</td>
<td>06/16/2017</td>
</tr>
<tr>
<td>B.4</td>
<td>Heliophysics Guest Investigators – Open</td>
<td>04/14/2017</td>
<td>06/16/2017</td>
</tr>
<tr>
<td>A.48</td>
<td>Advanced Component Technology</td>
<td>04/19/2017</td>
<td>06/19/2017</td>
</tr>
<tr>
<td>C.18</td>
<td>Laboratory Analysis of Returned Samples [4]</td>
<td>04/26/2017</td>
<td>06/29/2017</td>
</tr>
<tr>
<td>A.10</td>
<td>Physical Oceanography</td>
<td>05/30/2017</td>
<td>06/30/2017</td>
</tr>
<tr>
<td>C.7</td>
<td>Planetary Data Archiving, Restoration, and Tools</td>
<td>05/11/2017</td>
<td>07/12/2017</td>
</tr>
<tr>
<td>B.3</td>
<td>Heliophysics Technology and Instrument Development for Science</td>
<td>05/17/2017</td>
<td>07/20/2017</td>
</tr>
<tr>
<td>B.7</td>
<td>Heliophysics Data Environment Enhancements</td>
<td>05/17/2017</td>
<td>07/20/2017</td>
</tr>
<tr>
<td>Category</td>
<td>Title</td>
<td>Start Date</td>
<td>End Date</td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td>C.22</td>
<td>OSIRIS REx Participating Scientists Program</td>
<td>05/04/2017 (Step-1)</td>
<td>07/25/2017 (Step-2)</td>
</tr>
<tr>
<td>A.45</td>
<td>Computational Modeling Algorithms and Cyberinfrastructure</td>
<td>05/25/2017</td>
<td>07/27/2017</td>
</tr>
<tr>
<td>D.4</td>
<td>Astrophysics Theory</td>
<td>06/01/2017</td>
<td>07/27/2017</td>
</tr>
<tr>
<td>A.25</td>
<td>Terrestrial Hydrology</td>
<td>06/28/2017</td>
<td>08/03/2017</td>
</tr>
<tr>
<td>A.37</td>
<td>The Science of TERRA, AQUA, and SUOMI NPP</td>
<td>06/19/2017</td>
<td>08/17/2017</td>
</tr>
<tr>
<td>A.11</td>
<td>Ocean Salinity Science Team</td>
<td>07/31/2017</td>
<td>09/27/2017</td>
</tr>
<tr>
<td>A.33</td>
<td>Science Team for the OCO Missions</td>
<td>N/A</td>
<td>09/28/2017</td>
</tr>
<tr>
<td>D.5</td>
<td>Swift Guest Investigator – Cycle 14</td>
<td>N/A</td>
<td>09/28/2017</td>
</tr>
<tr>
<td>A.36</td>
<td>New (Early Career) Investigator Program in Earth Science</td>
<td>08/14/2017</td>
<td>10/05/2017</td>
</tr>
<tr>
<td>D.11</td>
<td>Transiting Exoplanet Survey Satellite – Cycle 1</td>
<td>N/A</td>
<td>10/06/2017</td>
</tr>
<tr>
<td>A.19</td>
<td>Solar Irradiance Science Team</td>
<td>08/04/2017</td>
<td>10/06/2017</td>
</tr>
<tr>
<td>B.2</td>
<td>Heliophysics Supporting Research</td>
<td>07/06/2017 (Step-1)</td>
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<td>02/02/2018</td>
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<td>Heliophysics Space Weather Operations-to-Research Program</td>
<td>02/23/2018 - 03/30/2018</td>
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<td>Nancy Grace Roman Technology Fellowships for Early Career Researchers (new fellows)</td>
<td>See APRA, Appendix D.3</td>
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<td>Earth System Science Pathfinder (ESSP) Venture-class Science Investigations: Earth Venture Suborbital-3</td>
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<td>Maturation of Instruments for Solar System Exploration</td>
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<td>New Early Career Fellowship Program</td>
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Notes:

[1] Amended due dates and new program elements will be indicated with bold red text as ROSES-2017 is amended through the year.

[2] See Sections IV(b)(vi) and IV(b)(vii) of the Summary of Solicitation for a discussion of Notice of Intent (NOI) vs. a Step-1 proposal.

[3] Current fellows should consult program element C.16 for instructions on submitting requests for start-up funds. Applications via program element C.23 to become new fellows are not being solicited this year.

[4] The proposals for program element Planetary Major Equipment (C.17) may be submitted only in conjunction with program elements Emerging Worlds (Appendix C.2); Solar System Workings (Appendix C.3); Exobiology (Appendix C.5); Solar System Observations (Appendix C.6); Planetary Science and Technology Through Analog Research (Appendix C.14); Planetary Protection Research (Appendix C.15); Laboratory Analysis of Returned Samples (Appendix C.18); and Habitable Worlds (Appendix E.4).
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<td>Advanced Component Technology</td>
<td>04/19/2017</td>
<td>06/19/2017</td>
</tr>
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<td>A.49</td>
<td>In-space Validation of Earth Science Technologies</td>
<td>02/02/2018</td>
<td>03/26/2018</td>
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<td>A.50</td>
<td>Sustainable Land Imaging – Technology</td>
<td>Not Solicited This Year</td>
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<tr>
<td>A.51</td>
<td>SAGE III/ISS Science Team</td>
<td>09/14/2017</td>
<td>11/07/2017</td>
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<td>A.52</td>
<td>CYGNSS Competed Science Team</td>
<td>09/15/2017</td>
<td>11/08/2017</td>
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<td>B.1</td>
<td>Heliophysics Research Program Overview</td>
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<td>Heliophysics Supporting Research</td>
<td>07/06/2017</td>
<td>10/12/2017</td>
</tr>
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<td>B.3</td>
<td>Heliophysics Technology and Instrument Development for Science</td>
<td>05/17/2017</td>
<td>07/20/2017</td>
</tr>
<tr>
<td>B.4</td>
<td>Heliophysics Guest Investigators – Open</td>
<td>04/14/2017</td>
<td>06/16/2017</td>
</tr>
<tr>
<td>B.5</td>
<td>Heliophysics Grand Challenges Research - Theory, Modelling and Simulations</td>
<td>Not solicited this year</td>
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<tr>
<td>B.6</td>
<td>Heliophysics Living With a Star Science</td>
<td>12/05/2017</td>
<td>02/06/2018</td>
</tr>
<tr>
<td>B.7</td>
<td>Heliophysics Data Environment Enhancements</td>
<td>05/17/2017</td>
<td>07/20/2017</td>
</tr>
<tr>
<td>B.8</td>
<td>Magnetospheric Multiscale Guest Investigators</td>
<td>11/09/2017</td>
<td>01/11/2018</td>
</tr>
<tr>
<td>B.9</td>
<td>Heliophysics Grand Challenges Research – Science Centers</td>
<td>Not Solicited This Year</td>
<td></td>
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<tr>
<td>B.10</td>
<td>DRAFT 2018 Heliophysics Early Career Investigator Program</td>
<td>Comments due by 01/20/2018</td>
<td></td>
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<td>B.11</td>
<td>Heliophysics Space Weather Operations-to-Research Program</td>
<td>02/23/2018</td>
<td>03/30/2018</td>
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<td>Planetary Science Research Program Overview</td>
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<td>-----</td>
<td>---------------------------------------------</td>
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<tr>
<td>C.2</td>
<td>Emerging Worlds [4]</td>
<td>03/30/2017 (Step-1)</td>
<td>06/01/2017 (Step-2)</td>
</tr>
<tr>
<td>C.3</td>
<td>Solar System Workings [4]</td>
<td>11/16/2017</td>
<td>02/22/2018</td>
</tr>
<tr>
<td>C.4</td>
<td>Habitable Worlds - moved to E.4 in ROSES 2017</td>
<td>See E.4</td>
<td></td>
</tr>
<tr>
<td>C.5</td>
<td>Exobiology [4]</td>
<td>08/17/2017 (Step-1)</td>
<td>10/24/2017 (Step-2)</td>
</tr>
<tr>
<td>C.6</td>
<td>Solar System Observations [4]</td>
<td>04/06/2017 (Step-1)</td>
<td>06/08/2017 (Step-2)</td>
</tr>
<tr>
<td>C.7</td>
<td>Planetary Data Archiving, Restoration, and Tools</td>
<td>05/11/2017 (Step-1)</td>
<td>07/12/2017 (Step-2)</td>
</tr>
<tr>
<td>C.8</td>
<td>Lunar Data Analysis</td>
<td>11/30/2017 (Step-1)</td>
<td>03/01/2018 (Step-2)</td>
</tr>
<tr>
<td>C.9</td>
<td>Mars Data Analysis</td>
<td>08/24/2017 (Step-1)</td>
<td>10/26/2017 (Step-2)</td>
</tr>
<tr>
<td>C.10</td>
<td>Cassini Data Analysis</td>
<td>04/06/2017 (Step-1)</td>
<td>06/08/2017 (Step-2)</td>
</tr>
<tr>
<td>C.11</td>
<td>Discovery Data Analysis</td>
<td>09/21/2017 (Step-1)</td>
<td>11/21/2017 (Step-2)</td>
</tr>
<tr>
<td>C.12</td>
<td>Planetary Instrument Concepts for the Advancement of Solar System Observations</td>
<td>09/22/2017 (Step-1)</td>
<td>11/16/2017 (Step-2)</td>
</tr>
<tr>
<td>C.13</td>
<td>Maturation of Instruments for Solar System Exploration</td>
<td>Not Solicited this year</td>
<td></td>
</tr>
<tr>
<td>C.16</td>
<td>Early Career Fellowship Start-up Program for Named Fellows [3]</td>
<td>N/A</td>
<td>Rolling submissions through 03/29/2018</td>
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<tr>
<td>C.17</td>
<td>Planetary Major Equipment [4]</td>
<td>See Program of Interest</td>
<td></td>
</tr>
<tr>
<td>C.18</td>
<td>Laboratory Analysis of Returned Samples [4]</td>
<td>04/26/2017 (Step-1)</td>
<td>06/29/2017 (Step-2)</td>
</tr>
<tr>
<td>C.19</td>
<td>New Frontiers Data Analysis</td>
<td>Not Solicited This Year</td>
<td></td>
</tr>
<tr>
<td>C.20</td>
<td>Rosetta Data Analysis Program</td>
<td>09/21/2017 (Step-1)</td>
<td>11/21/2017 (Step-2)</td>
</tr>
<tr>
<td>C.21</td>
<td>Small Innovative Missions for Planetary Exploration</td>
<td>Not Solicited This Year</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>---------------------------------------------------</td>
<td>------------------------</td>
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<td>OSIRIS REx Participating Scientists Program</td>
<td>05/04/2017 (Step-1)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>07/25/2017 (Step-2)</td>
<td></td>
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<tr>
<td>C.23</td>
<td>New Early Career Fellowship Program</td>
<td>Not Solicited This Year</td>
<td></td>
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<tr>
<td>C.24</td>
<td>Instruments For Gondola For High-Altitude Planetary Science</td>
<td>Not Solicited This Year</td>
<td></td>
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<tr>
<td>C.25</td>
<td>InSight Participating Scientist Participating Scientist Program</td>
<td>01/18/2018 (mandatory)</td>
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<td></td>
<td></td>
<td>02/22/2018</td>
<td></td>
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<td>03/28/2017</td>
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<td>05/19/2017</td>
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<td>D.3</td>
<td>Astrophysics Research and Analysis</td>
<td>01/26/2018 (mandatory)</td>
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<td></td>
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<td>Astrophysics Theory</td>
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<td>07/27/2017</td>
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<td>Fermi Guest Investigator – Cycle 11</td>
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<td></td>
<td>02/23/2018 (Phase-1 via ARK RPS)</td>
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<tr>
<td>D.7</td>
<td>K2 Guest Observer – Cycle 6</td>
<td>10/12/2017 (Phase-1)</td>
<td></td>
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<td></td>
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<td>04/19/2018 (Phase-2)</td>
<td></td>
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<tr>
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<td>Strategic Astrophysics Technology</td>
<td>01/26/2018 (mandatory)</td>
<td></td>
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<td></td>
<td>03/19/2018</td>
<td></td>
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<td>Nancy Grace Roman Technology Fellowships for Early Career Researchers (new fellows)</td>
<td>See APRA, Appendix D.3</td>
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<td>Nancy Grace Roman Technology Fellowships for Early Career Researchers (proposals for fellowship funds)</td>
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<td>NuSTAR Guest Observer – Cycle 4</td>
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<td>Transiting Exoplanet Survey Satellite – Cycle 1</td>
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<td></td>
<td>10/06/2017</td>
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<td>D.12</td>
<td>Theoretical and Computational Astrophysics Networks</td>
<td>12/07/2017</td>
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<td>01/26/2018</td>
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<td>D.13</td>
<td>SOFIA Next Generation Instrumentation</td>
<td>Comments due by 01/12/2018</td>
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<td>Program Element</td>
<td>Due Dates</td>
<td>Notes</td>
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<td>10/24/2017 (Step-1)</td>
<td>12/13/2017 (Step-2)</td>
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<td>D.15</td>
<td>System-Level Segmented Telescope Design</td>
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<td>Cross Division Research Overview</td>
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<td>Topical Workshops, Symposia, and Conferences</td>
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<td>Exoplanets Research Program</td>
<td>03/30/2017 (Step-1)</td>
<td>05/25/2017 (Step-2)</td>
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<td>E.4</td>
<td>Habitable Worlds [4]</td>
<td>11/16/2017 (Step-1)</td>
<td>01/17/2018 (Step-2)</td>
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<td>Juno Participating Scientist Program</td>
<td>03/01/2018 (Step-1)</td>
<td>04/26/2018 (Step-2)</td>
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Notes:

[1] Amended due dates and new program elements will be indicated with bold red text as ROSES-2017 is amended through the year.

[2] See Sections IV(b)(vi) and IV(b)(vii) of the Summary of Solicitation for a discussion of Notice of Intent (NOI) vs. a Step-1 proposal.

[3] Current fellows should consult program element C.16 for instructions on submitting requests for start-up funds. Applications via program element C.23 to become new fellows are not being solicited this year.

[4] The proposals for program element Planetary Major Equipment (C.17) may be submitted only in conjunction with program elements Emerging Worlds (Appendix C.2); Solar System Workings (Appendix C.3); Exobiology (Appendix C.5); Solar System Observations (Appendix C.6); Planetary Science and Technology Through Analog Research (Appendix C.14); Planetary Protection Research (Appendix C.15); Laboratory Analysis of Returned Samples (Appendix C.18); and Habitable Worlds (Appendix E.4).
1. Introduction

NASA’s Earth Science Research Program supports research activities that address the Earth system to characterize its properties on a broad range of spatial and temporal scales, to understand the naturally occurring and human-induced processes that drive them, and to improve our capability for predicting its future evolution. The focus of the Earth Science Research Program is the use of space-based measurements to provide information not available by other means. NASA’s program is an end-to-end one that starts with the development of observational techniques and the instrument technology needed to implement them; tests them in the laboratory and from an appropriate set of *in situ*, surface-, ship-, balloon-, aircraft-, and/or space-based platforms; uses the results to increase basic process knowledge; incorporates results into complex computational models that can be used to more fully characterize the present state and future evolution of the Earth system; and develops partnerships with other national and international organizations that can use the generated information in environmental forecasting and in policy, business, and management decisions.

The scientific documentation underlying the Earth Science Research Program provides a comprehensive background for the science addressing its objectives. The science carried out addresses NASA’s Strategic Goal 2.1 to “Advance Earth System Science to meet the challenges of climate and environmental change.” (See the most recent NASA Strategic Plan (see [http://science.nasa.gov/about-us/science-strategy/](http://science.nasa.gov/about-us/science-strategy/))). In particular, it addresses the more specific Science Goals (see the Science Plan for NASA’s Science Mission Directorate (hereafter the NASA Science Plan), also available at [http://science.nasa.gov/about-us/science-strategy/](http://science.nasa.gov/about-us/science-strategy/)), which are to:

- Advance the understanding of changes in the Earth’s radiation balance, air quality, and the ozone layer that result from changes in atmospheric composition;
- Improve the capability to predict weather and extreme weather events;
- Detect and predict changes in Earth’s ecological and chemical cycles, including land cover, biodiversity, and the global carbon cycle;
- Enable better assessment and management of water quality and quantity to accurately predict how the global water cycle evolves in response to climate change;
- Improve the ability to predict climate changes by better understanding the roles and interactions of the oceans, atmosphere, land, and ice;
- Characterize the dynamics of the Earth’s surface and interior, improving the capability to assess and respond to natural hazards and extreme events; and
• Further the use of Earth system science research to inform decisions and provide benefits to society.

The most up-to-date description of the Earth Science Research Program may be found in Section 4.2 of the NASA Science Plan at http://science.nasa.gov/about-us/science-strategy. A decadal study for the satellite component of NASA’s Earth science activities has been carried out by the National Academy of Sciences (NAS); the report Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond is available at http://www.nap.edu/catalog.php?record_id=11820; more recently, NAS released a midterm assessment of NASA’s implementation of the Decadal Survey (http://www.nap.edu/catalog.php?record_id=13405). A description of the most recent plans by the Earth Science Division (ESD) to implement a series of climate-oriented missions beyond those suggested by the decadal survey (Responding to the Challenge of Climate and Environmental Change: NASA’s Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space) was released in June 2010, and may be found at https://science.nasa.gov/about-us/science-strategy/. An earlier study by the NAS documenting the advances in the study of Earth from space, which draws significantly on NASA-produced results, was also released in the same time frame as the Decadal Survey and is available at http://dels.nas.edu/Report/Earth-Observations-from-Space-First/11991.

NASA’s Earth Science Research Program is a major contributor to several interagency efforts within the U.S. Government, most notably the U.S. Global Change Research Program (USGCRP, see http://www.globalchange.gov), to which NASA is the major contributor. This program released its strategic plan in 2012, the National Global Change Research Plan 2012-2021: A Strategic Plan for the U. S. Global Change Research Program (http://www.globalchange.gov/browse/reports/national-global-change-research-plan-2012–2021-strategic-plan-us-global-change). Similarly, there are interagency programs related to Oceans and the Arctic. In addition, there are several other subgroups of the Committee on the Environment, Natural Resources and Sustainability (CENRS) that serve to provide interagency coordination in areas covered by NASA’s Earth Science Research Program. NASA’s Earth Science Research Program has focused bilateral efforts with other Federal agencies on transitioning knowledge and approaches from research to operations, most notably with the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS).

Research is solicited in four major areas for the Earth Science Research Program: research and analysis, satellite missions, applied sciences, and enabling capabilities, with the bulk of the solicited research coming in the first of these. Research and analysis (R&A) emphasizes the development of new scientific knowledge, including the analysis of data from NASA satellite missions and the development and application of complex models that assimilate these science data products and/or use them for improving predictive capabilities. Within the Earth Science Research Program, the research and analysis activities include those historically coming under R&A, mission science team, interdisciplinary science, and calibration/validation activities. The applied sciences area supports efforts to discover and demonstrate innovative and practical uses of NASA Earth science observations and research through applications projects.
carried out in partnership with end user organizations (http://AppliedSciences.nasa.gov/). Applied sciences, thus, serves as a bridge between the data, modeling, and knowledge generated by NASA Earth science and the information required by Government agencies, companies, and organizations to improve their products, services, and decision making.

Enabling capabilities include those programmatic elements with sufficient breadth to contribute to a broad range of activities within the Earth Science Research Program and typically involve the development of some kind of capability whose sustained availability is considered to be important for the Program’s future. These include focused activities in support of education; data, information, and management; and airborne science, as well as some broadly based technology-related elements (others which are very focused towards a single scientific area of the Earth Science Research Program will be solicited through the research and analysis area).

Most proposals to ROSES-2017 will require a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed. Proposers will satisfy this requirement by responding to the compulsory NSPIRES cover page question about the DMP, unless otherwise specified in a specific program element. The kinds of proposals that require a data management plan are described in the NASA Plan for increasing access to results of Federally funded research and in the SARA DMP Frequently Asked Questions (FAQs) for ROSES. Proposals to instrument development programs (Advanced Information Systems Technology, The Instrument Incubator Program, Advanced Component Technology, and In-Space Validation of Earth Science Technologies) do not require a DMP. Moreover, select calls, such as Making Earth System data records for Use in Research Environments (MEaSUREs) and Advancing Collaborative Connections for Earth System Science (ACCESS), include data requirements in the text that make redundant the cover page DMP.

The overarching goal of NASA’s Earth Science program is to develop a scientific understanding of Earth as a system. Scientific knowledge is most robust and actionable when resulting from transparent, traceable, and reproducible methods, requiring open access to not only the data used in scientific analysis, but the software used to arrive at results as well. Additionally, software developed to be openly accessible, without restrictions on modification and distribution, enables reuse across Federal agencies, reduces overall costs to the Government, removes barriers to innovation, ensures consistency through the application of uniform standards, and facilitates collaboration between agencies and non-Federal institutions. NASA addresses these goals by encouraging the open development, access, and distribution of the source code used to generate, manipulate, and analyze science data and results.

Toward that end, NASA encourages software developed in response to Appendix A program elements be designated, developed, and distributed to the public as Open Source Software (OSS). This includes all software developed with ESD funding used in the production of data products, as well as software developed to discover, access, visualize, and transform NASA data. OSS is defined as software that can be accessed, used, modified, and shared by anyone. The definition of OSS, along with examples of OSS licensing and public code repositories, can be found on the Earthdata web site.
Program elements will give preference to proposals that include a plan for committing software as OSS, beginning at the inception of the proposed work. This plan will include the identification of software components developed as part of the proposed work, and designate a permissive, widely accepted OSS license and a public repository hosting service for these components. Please read the individual appendices and associated amendments carefully and contact the program officers if you have any questions regarding OSS development for a given call.

2. Earth Science Research and Analysis Focus Areas

The Earth Science R&A activity is built around the creation of new scientific knowledge about the Earth system. The analysis and interpretation of data from NASA’s satellites form the heart of the R&A program in the Earth Science Research Program, although a full range of underlying scientific activity needed to establish a rigorous base for the satellite data and their use in computational models, including those for assimilation and forecasting, is also included. The complexity of the Earth system, in which spatial and temporal variability exists on a range of scales, requires that an organized scientific approach be developed for addressing the complex, interdisciplinary problems that exist, taking good care that, in doing so, there is a recognition of the objective to integrate science across the programmatic elements towards a comprehensive understanding of the Earth system.

In the Earth system, these elements may be built around aspects of the Earth that emphasize the particular attributes that make it stand out among known planetary bodies. These include the presence of carbon-based life and their associated ecology; water in multiple, interacting phases; a fluid atmosphere and ocean that redistribute heat over the planetary surface; an oxidizing and protective atmosphere, albeit one subject to a wide range of fluctuations in its physical properties (especially temperature, moisture, and winds); a solid but dynamically active surface that makes up a significant fraction of the planet’s surface; and an external environment driven by a large and varying star whose magnetic field also serves to shield the Earth from the broader astronomical environment. The resulting structure is comprised of six interdisciplinary science Focus Areas:

- Carbon Cycle and Ecosystems,
- Water and Energy Cycle,
- Climate Variability and Change,
- Atmospheric Composition,
- Weather, and
- Earth Surface and Interior.

These Focus Areas form the basis around which R&A activity is solicited for the Earth Science Research Program. Given the interconnectedness of these science Focus Areas, research that crosses individual Focus Areas is also sought, and a number of specific cases of such connectivity will be identified in the specific research opportunities identified below. In particular, several instrument science teams for NASA satellite missions are solicited through this NRA. These can contribute to scientific
advances in several areas, and potential investigators may want to look carefully at all such teams for opportunities that may be relevant to them. In addition, there are several cross-cutting elements included within this appendix, most notably one that solicits proposals that address rapid response to significant Earth system events, as well as truly novel work that doesn’t easily fit the active ROSES-2017 elements this year or in the recent past (Rapid Response and Novel Research in Earth Science – Program Element A.29).

Several elements solicited in prior years are not being solicited this year, but have program-specific ROSES-2017 elements for completeness, as well as to provide potential proposers with plans about the anticipated dates of the next solicitation.

- Ocean Biology and Biogeochemistry (Program Element A.3);
- Terrestrial Ecology (Program Element A.4);
- Carbon Cycle Science (Program Element A.5);
- Biodiversity (Program Element A.6 – however, please note the very closely related element A.8);
- Carbon Monitoring System (Program Element A.7);
- Sea Level Change Science Team (Program Element A.12);
- Ocean Surface Topography Science Team (Program Element A.13);
- Modeling, Analysis, and Prediction (Program Element A.15);
- Studies with ICESat and CryoSat-2 (Program Element A.18);
- Radiation Sciences (Program Element A.21);
- Atmospheric Chemistry Modeling and Analysis (Program Element A.22);
- Atmospheric Dynamics (Program Element A.27);
- Airborne Instrument Technology Transition (Program Element A.30);
- US Participating Investigator (Program Element A.31);
- Interdisciplinary Science (Program Element A.32);
- NASA Data for Operation and Assessment (Program Element A.35);
- Science of Terra, Aqua, Suomi-NPP, and Joint Polar Satellite System (Program Element A.37);
- PACE Science Team (Program Element A.38);
- Ecological Forecasting (Program Element A.41 - however, please note the very closely related element A.8);
- Citizen Science (Program Element A.44);
- Advanced Information Systems Technology (Program Element A.46);
- Instrument Incubator (Program Element A.47);
- In-Space Validation of Earth Science Technologies (Program Element A.49);
- Sustainable Land Imaging Technology (Program Element A.50).

Elements for which it has not yet been decided whether or not to solicit during the period of applicability of ROSES-2017 are not included in this list, but are included by focus area and/or program component later in Appendix A. Note that not all elements which have been solicited in previous ROSES are included this year; some will reappear in future solicitations at an appropriate time that should allow for smooth
transition between the currently funded tasks and those that would come out of the next solicitation.

2.1 Carbon Cycle and Ecosystems

The carbon cycle is the basis for the food, fiber, and energy that sustain life on planet Earth. The cycling of carbon dioxide and methane into the atmosphere contributes to the planetary greenhouse effect and global climate. Ecosystems provide a wide variety of essential goods and services to humans and also affect the climate system by exchanging energy, momentum, trace gases, and aerosols with the atmosphere. Earth’s carbon cycle and ecosystems are being subjected to human intervention and environmental changes on an unprecedented scale, in both rate and geographical extent. Our ability to ameliorate, adapt to, or benefit from these rapid changes requires fundamental knowledge of the responses of the carbon cycle and terrestrial and marine ecosystems to global change. Also required is an understanding of the implications of these changes for food production, biodiversity, sustainable resource management, and the maintenance of a healthy, productive environment.

The Carbon Cycle and Ecosystems Focus Area addresses: (1) the distribution and cycling of carbon among the active terrestrial, oceanic, and atmospheric reservoirs and (2) ecosystems as they are affected by human activity, as they change due to their own intrinsic biogeochemical dynamics, and as they respond to climatic variations and, in turn, affect climate. Research activities focus on providing data and information derived from remote sensing systems to answer the following science questions:

- How are global ecosystems changing?
- What changes are occurring in global land cover and land use, and what are their causes?
- How do ecosystems, land cover, and biogeochemical cycles respond to and affect global environmental change?
- What are the consequences of land cover and land use change for human societies and the sustainability of ecosystems?
- What are the consequences of climate change and increased human activities for coastal regions?
- How will carbon cycle dynamics and terrestrial and marine ecosystems change in the future?

Frequent, repeat observations from space, at both moderate and high spatial resolutions, are required to address the heterogeneity of living systems. Complementary airborne and in situ observations, intensive field campaigns and related process studies, fundamental research, data and information systems, and modeling are employed to interpret the satellite observations and answer the science questions.

The goal of the Carbon Cycle and Ecosystems Focus Area is to:

- Quantify, understand, and predict changes in Earth’s ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity.
Anticipated products and payoffs include:

- Assessments of ecosystem response to climatic and other environmental changes and the effects on food, fiber, biodiversity, primary productivity, and other ecological goods and services;
- Quantitative carbon budgets for key ecosystems along with the identification of sources and sinks of carbon dioxide and other greenhouse gases;
- Documentation and prediction of land-cover and land-use change, as well as assessments of consequences to society and for resource sustainability;
- Understanding of ecosystem interactions with the atmosphere and hydrosphere leading to comprehensive modeling of the exchange of gases, aerosols, water, and energy among the components of the Earth system; and
- Improved representations of ecosystem and carbon cycling processes within global climate models leading to more credible predictions of climate and other Earth system functions.

Interdisciplinary collaborations with other Earth Science Research Program Focus Areas include:

- Work with the Water and Energy Cycle Focus Area on land-atmosphere exchanges of water and energy and the effects of land-cover and land-use change on water resources;
- Work with the Atmospheric Composition Focus Area on surface emissions and atmospheric transport of trace gases and aerosols and on measurement of carbon-containing greenhouse gases;
- Work with the Climate Variability and Change and Weather Focus Areas on air-sea CO₂ exchange and to share the observations of climate, weather, ecosystems, and land cover that are needed to drive Earth system models; and
- Coordinate with the Earth Surface and Interior Focus Area to advance and/or exploit radar, lidar, and hyperspectral remote sensing technologies for surface properties.

The ROSES elements most closely directed towards the Carbon Cycle and Ecosystems Focus Area that are or may be soliciting proposals in ROSES-2017 are:

- Land-Cover and Land-Use Change (Program Element A.2);
- Supporting UN Sustainable Development Goals 14 and 15 in the Context of Climate Variability and Change (Program Element A.8); and
- ECOSTRESS Science Team (Program Element A.9).

Topics relevant to the Carbon Cycle and Ecosystems Focus Area that are actively or potentially soliciting in ROSES-2017 include the following program elements:

- Tropospheric Composition: FIRECHEM (Program Element A.23);
- Rapid Response and Novel Research in Earth Science (Program Element A.29);
- OCO Science Team (Program Element A.33);
- Earth Venture Suborbital (Program Element A.34);
- New Investigator Program (Program Element A.36);
- Earth Science Applications: Disasters (Program Element A.40);
• Advancing Collaborative Connections for Earth System Science (Program Element A.42);
• Making Earth System data records for Use in Research Environments (Program Element A.43); and
• Computational Modeling and Cynberinfrastruture (Program Element A.45);
• Advanced Component Technology (Program Element A.48).

2.2 Climate Variability and Change

Climate change is one of the major themes guiding Earth System Science today. NASA is at the forefront of quantifying forcings and feedbacks of recent and future climate change. Our comprehensive end-to-end program goes from global high-resolution observations to data assimilation and model predictions. Recently, the Climate Variability and Change Focus Area has directed its research toward addressing five specific questions:

• How is global ocean circulation varying on interannual, decadal, and longer time scales?
• What changes are occurring in the mass of the Earth’s ice cover?
• How can climate variations induce changes in the global ocean circulation?
• How is global sea level affected by natural variability and human-induced change in the Earth system?
• How can predictions of climate variability and change be improved?

Climate-variability and change research is now not just a global issue, but also a research problem that directly impacts regional to local environments. In fact, local-to-regional anthropogenic-induced changes are having global impacts whose magnitudes are expected to increase in the future. Climate models have moved toward higher and higher spatial resolution as computer resources have improved. During the next decade, climate models are expected to approach the spatial resolution of weather and regional models as more details of Earth System processes are incorporated.

The oceans are a major part of the climate system and a unique NASA contribution to climate science is the near-global coverage of observations from space of selected ocean properties every two to ten days. Additionally, NASA provides observations of the vast expanses of polar ice, including both ice sheets and sea ice, on the temporal and spatial scales necessary to detect change and sampling of the other critical elements of the climate system that link climate to other Focus Areas, such as cloud distribution, snow cover, surface temperatures, humidity characteristics, etc.

NASA makes substantial investments to characterize and understand the nature and variability of the climate system. As part of those investments, NASA maintains an active research program to utilize data from satellites to both improve our understanding of these components of the Earth system and the interactions between them and to assess how satellite observations can be used to improve predictive capability. Current capabilities include global measurements of sea-surface topography, ocean-vector winds, ice topography and motion, and mass movements of the Earth’s fluid envelope and cryosphere.
Understanding interactions within the climate system also requires strong modeling and analysis efforts. The climate system is dynamic and complex, and modeling is the only way we can effectively integrate the observations and current knowledge of individual components fully to characterize current conditions and underlying mechanisms, as well as to project the future states of the climate system. This modeling requires a concerted effort both to improve the representation of physical, chemical, and biological processes and to incorporate observations into climate models through data assimilation and other techniques. The ultimate objective is to enable a predictive capability of climate change on time scales ranging from seasonal to multidecadal.

The ROSES elements most closely directed towards the Climate Variability and Change Focus Area that are or may be soliciting proposals in ROSES-2017 are:

- Physical Oceanography (Program Element A.10);
- Ocean Salinity Science Team (Program Element A.11);
- Ocean Vector Winds Science Team (Program Element A.14);
- Cryospheric Science (Program Element A.16);
- Ice Bridge Research (Program Element A.17); and
- Solar Irradiance Science Team (Program Element A.19).

Topics relevant to the Climate Variability and Change Focus Area that are actively or potentially soliciting in ROSES-2017 include the following program elements:

- DSCOVER Science Team (Program Element A.24);
- Rapid Response and Novel Research in Earth Science (Program Element A.29);
- OCO Science Team (Program Element A.33);
- Earth Venture Suborbital (Program Element A.34);
- New Investigator Program (Program Element A.36);
- Earth Science Applications: Disasters (Program Element A.40);
- Advancing Collaborative Connections for Earth System Science (Program Element A.42);
- Making Earth System data records for Use in Research Environments (Program Element A.43);
- Computational Modeling and Cyberinfrastructure (Program Element A.45); and
- Advanced Component Technology (Program Element A.48).

2.3 Atmospheric Composition

Atmospheric composition changes affect air quality, weather, climate, and critical constituents, such as ozone and aerosols. Atmospheric exchange links terrestrial and oceanic pools within the carbon cycle and other biogeochemical cycles. Solar radiation affects atmospheric chemistry and is, thus, a critical factor in atmospheric composition. Atmospheric composition, in turn, affects in coming solar and outgoing long wave radiation. Atmospheric composition is central to Earth system dynamics, since the atmosphere integrates surface emissions globally on time scales from weeks to years and couples several environmental issues. NASA’s research for furthering our understanding of atmospheric composition is geared to providing an improved prognostic capability for such issues (e.g., the recovery of stratospheric ozone and its impacts on surface ultraviolet radiation, the evolution of greenhouse gases and their
impacts on climate, the impact of clouds and aerosol particles on the Earth’s energy budget and the evolution of aerosols and tropospheric ozone and their impacts on climate and air quality). Toward this end, research within the Atmospheric Composition Focus Area addresses the following science questions:

- How is atmospheric composition changing?
- What trends in atmospheric composition and solar radiation are driving global climate?
- How does atmospheric composition respond to and affect global environmental change?
- What are the effects of global atmospheric composition and climate changes on regional air quality?
- How will future changes in atmospheric composition affect ozone, climate, and global air quality?

NASA expects to provide the necessary monitoring and evaluation tools to assess the effects of climate change on ozone recovery and future atmospheric composition, improved climate forecasts based on our understanding of the forcings of global environmental change, and air quality forecasts that take into account the feedbacks between regional air quality and global climate change. Achievements in these areas via advances in observations, data assimilation, and modeling enable improved predictive capabilities for describing how future changes in atmospheric composition affect ozone, climate, and air quality. Drawing on global observations from space, augmented by airborne, balloon, and ground-based measurements, NASA is uniquely poised to address these issues. This integrated observational strategy is furthered via studies of atmospheric processes using unique suborbital platform-sensor combinations to investigate, for example: (1) the processes responsible for the emission, uptake, transport, and chemical transformation of ozone and precursor molecules associated with its production in the troposphere and its destruction in the stratosphere; and (2) the formation, properties, and transport of aerosols in the Earth’s troposphere and stratosphere, as well as aerosol interaction with clouds. NASA’s research strategy for atmospheric composition encompasses an end-to-end approach for instrument design, data collection, analysis, interpretation, and prognostic studies.

The ROSES elements most closely directed towards the Atmospheric Composition Focus Area that are or may be soliciting for proposals in ROSES-2017 are:

- Atmospheric Composition Laboratory Studies (Program Element A.20);
- Tropospheric Composition: FIRECHEM (Program Element A.23);
- DISCOVER Science Team (Program Element A.24).

Topics relevant to the Atmospheric Composition Focus Area are also included in the following program elements that are actively or potentially soliciting in ROSES-2017 include the following program elements:

- Solar Irradiance Science Team (Program Element A.19);
- Rapid Response and Novel Research in Earth Science (Program Element A.29);
- OCO Science Team (Program Element A.33);
- Earth Venture Suborbital (Program Element A.34);
• New Investigator Program (Program Element A.36);
• Health and Air Quality Applications (Program Element A.39);
• Advancing Collaborative Connections for Earth System Science (Program Element A.42);
• Making Earth System data records for Use in Research Environments (Program Element A.43);
• Computational Modeling and Cyberinfrastructure (Program Element A.45); and
• Advanced Component Technology (Program Element A.48).

2.4 Water and Energy Cycle

Earth is a unique, living planet in our Solar System due to the abundance of water and the vigorous cycling of that water throughout its global environment. The global water cycle represents the transport and transformation of water within the Earth system, and, as such, distributes fresh water over the Earth’s surface. The water cycle operates on a continuum of time and space scales and exchanges large amounts of energy as water undergoes phase changes and is moved from one part of the Earth system to another. Through latent heat release from condensation and sublimation, the water cycle is a major driving agent of global atmospheric circulation. Clouds play a critical role in modulating the flow of energy into and out of the Earth system, while at the same time modulating the continuous supply of solar energy that keeps the water cycle in motion. So while the water cycle delivers the hydrologic consequences of climate changes, the global water cycle is both a consequence of, and influence on, the global energy cycle.

The global water and energy cycles maintain a considerable influence upon the global pathways of biogeochemical cycles. The cycling of water and energy and nutrient exchanges among the atmosphere, ocean, and land help determine the Earth’s climate and cause much of the climate’s natural variability. Natural and human-induced changes to the water and energy cycle have major impacts on industry, agriculture, and other human activities. For example, increased exposure and density of human settlements in vulnerable areas amplify the potential loss of life, property, and commodities that are at risk from intense precipitation events. Improved monitoring and prediction of the global water and energy cycle enable improved knowledge of the Earth system that must be nurtured to proactively mitigate future adversities. Current and forthcoming projections of such impacts will remain speculative unless fundamental understanding is assimilated into global prediction systems and effective decision-support tools applicable to local conditions.

Additional information on the Water and Energy Cycle Focus Area can be found at http://nasa-news.org/. Within this Focus Area are the following R&A programs: Precipitation and Atmospheric Dynamics and Terrestrial Hydrology. Also, the Radiation Sciences and Land-Cover Land-Use Change programs are shared with, respectively, the Atmospheric Composition and Carbon Cycle and Ecosystems Focus Areas. In brief, the Water and Energy Cycle Focus Area seeks to address the topics discussed above by enhancing our understanding of the transfer and storage of water and energy in the Earth system. For the water cycle, the Focus Area’s emphasis is on atmospheric and terrestrial stores, including seasonal snow cover. Permanent snow and ice, as well as ocean dynamics, are studied within the Climate Variability and Change Focus Area. The
Water and Energy Cycle Focus Area aims to resolve all fluxes of water and the corresponding energy fluxes involved with the water changing phase.

In addition to the study of the individual components of the water and energy cycle, this Focus Area places a high priority on integrating these components in a coherent fashion as is pursued by the NASA Energy and Water Cycle Study (NEWS), for which more information can be found at http://nasa-news.org/. NEWS has been established to create a mechanism to export and import information, results, and technology to and from other U.S. agencies and international partners concerned with the study and observation of water and energy cycles, such as the Global Energy and Water Cycle Exchanges project (GEWEX; http://www.gewex.org/).

All of the Focus Area’s activities should enhance the community’s ability to answer these research questions:

- How are global precipitation, evaporation, and the cycling of water changing?
- What are the effects of clouds and surface hydrologic processes on Earth’s climate?
- How are variations in local weather, precipitation, and water resources related to global climate variation?
- What are the consequences of land cover and land use change for human societies and the sustainability of ecosystems?
- How can weather forecast duration and reliability be improved?
- How can prediction of climate variability and change be improved?
- How will water cycle dynamics change in the future?

Pursuit of answers to these questions should lead to research products, such as satellite data and model outputs, that are useful to activities sponsored by the Applied Sciences Program, in particular, the Applications areas of water resources, disasters, and ecological forecasting (see Section 3 for more details on the Applied Sciences Program). Ultimately, Water and Energy Cycle Focus Area-sponsored activities will lead to the fulfillment of its goal: "Models capable of predicting the water cycle, including floods and droughts, down to tens of kilometers resolution."

The ROSES elements most closely directed towards the Water and Energy Cycle Focus Area that are or may be soliciting for proposals in ROSES-2017 are:

- Terrestrial Hydrology (Element A.25).

Topics relevant to the Water and Energy Cycle Focus Area are included in the following program elements that are actively or potentially soliciting in ROSES-2017 include the following program elements:

- Rapid Response and Novel Research in Earth Science (Program Element A.29);
- Earth Venture Suborbital (Program Element A.34);
- New Investigator Program (Program Element A.36);
- Earth Science Applications: Disasters (Program Element A.40);
- Advancing Collaborative Connections for Earth System Science (Program Element A.42);
• Making Earth System data records for Use in Research Environments (Program Element A.43);
• Computational Modeling and Cyberinfrastructure (Program Element A.45); and
• Advanced Component Technology (Program Element A.48).

2.5 Weather

The Weather Focus Area represents the cooperation among NASA programs for Atmospheric Dynamics, Weather Forecast Improvement, and Ocean and Land Remote Sensing. It has strong ties to other Focus Areas, especially Climate Variability and Change and Water and Energy Cycle, and it has a supporting role in Carbon Cycle and Ecosystems and the Atmospheric Composition Focus Areas.

The Weather Focus Area is primarily designed to apply NASA scientific remote sensing expertise to the problem of obtaining accurate and globally distributed measurements of the atmosphere and the assimilation of these measurements into research and operational weather forecast models in order to improve and extend U.S. and global weather prediction. This Focus Area is implemented in coordination with other U.S. agencies’ programs and it is guided by the question from the 2003 Earth Science Enterprise Strategy:

• How can weather forecast duration and reliability be improved?

NASA sponsored research continues to gain new insight into weather and extreme-weather events by the utilization of data obtained from a variety of NASA- and partner satellite platforms and hurricane field experiments. Major numerical weather prediction (NWP) centers both outside (European Centre for Medium Range Weather Forecasts (ECMWF) and in the U.S. – NOAA/National Centers for Environmental Prediction (NCEP), NASA Global Modeling and Assimilation Office (GMAO), and the U.S. Navy – have shown notable improvements from the assimilation of Atmospheric Infrared Sounder (AIRS) data into their operational forecast systems.

An extra benefit of AIRS data assimilation at NWP centers is its use in establishing readiness to assimilate data from other current and future operational instruments, as has been demonstrated for the Crosstrack Infrared Sounder (CrIS) on the Suomi National Polar-orbiting Partnership (NPP) satellite launched in October 2011.

Through collaborations in the Joint Center for Satellite Data Assimilation (JCSDA) (https://www.star.nesdis.noaa.gov/jcsda/), observations from Suomi-NPP were assimilated into the operational weather forecast systems in a record seven months after the satellite launch. Observation impact analyses conducted with NASA Goddard Earth Observing System model, version 5 (GEOS-5) in the NASA Global Modeling and Assimilation Office, showed that, in concert with other observations, the Advanced Technology Microwave Sounder (ATMS) makes a significant impact on a global integrated forecast metric. Preparatory work and channel selection for the assimilation of the CrIS data and tests of the impact of that sensor have been completed. The preparations involved modifications to the Community Radiative Transfer model, passive monitoring of systematic and random errors in the CrIS data products,
observation minus forecast residuals, and finally preoperational data assimilation/forecast experiments.

The NASA Short-term Prediction Research and Transition (SPoRT) (http://weather.msfc.nasa.gov/sport/) program is an end-to-end research-to-operations (R2O) activity focused on improving short-term weather forecasts through the use of unique high-resolution, multispectral observations from NASA and NOAA satellites, nowcasting tools, and advanced modeling and data assimilation techniques. The SPoRT program has established a successful R2O paradigm in which the end-users (mainly forecasters at NOAA/NWS forecast offices and National Centers) are involved in the entire process. SPoRT also partners with universities and other Government agencies to develop new products that are transitioned to applicable end user decision support systems. SPoRT has recently succeeded in broadening its activities to other National Weather Service (NWS) Regions and its active participation in NOAA Proving Ground activities and Testbeds.

NASA periodically provides opportunities for participation in the JCSDA and SPoRT programs. The most recent such activity was ROSES-16 element A.29 (NASA Data for Operation and Assessment (https://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={7BA4BC85-71ED-7C0B-074D-42EF39DB8E6F}&path=closedPast)).

NASA also has a long history of conducting airborne field campaigns in support of hurricane research (https://ghrc.nsstc.nasa.gov/home/field-campaigns). Most recently, the Hurricane and Severe Storm Sentinel (HS3) Mission, a five-year Earth Venture Class Suborbital mission that was awarded in 2010, has obtained data from its base at the Wallops Flight Facility (WFF) on the coastline of Virginia during the hurricane seasons of 2012-2014 (https://espo.nasa.gov/missions/hs3/). This campaign used two Global Hawk (GH) unmanned aircraft systems (UAS) with distinct payloads to address both over-storm and near-storm environmental issues. The HS3 Mission was designed to investigate some basic questions regarding changes in hurricane intensity:

1. What impact does the large-scale environment, particularly the Saharan Air Layer (SAL), have on intensity change?
2. What is the role of storm internal processes such as deep convective towers?
3. To what extent are these intensification processes predictable?

In June 2012, NASA selected the Cyclone Global Navigation Satellite System (CYGNSS) satellite mission under its Earth Venture program. CYGNSS data will enable scientists, for the first time, to probe key air-sea interaction processes that take place near the inner core of the storms, which are rapidly changing and play large roles in the genesis and intensification of hurricanes. The CYGNSS Mission satellites launched in 2016. While this is a Principal-Investigator led mission, NASA provided an opportunity for community members not part of the original proposal to be involved with the mission in ROSES-2013 (Program element A.22 – Weather; see http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={6E74C972-BD4C-2286-AF21-D6B43CF3BA4C}&path=closedPast).
Topics relevant to the Weather Focus Area are included in the following program elements that are actively or potentially soliciting in ROSES-2017 include the following program elements:

- Rapid Response and Novel Research in Earth Science (Program Element A.29);
- Earth Venture Suborbital (Program Element A.34);
- New Investigator Program (Program Element A.36);
- Earth Science Applications: Disasters (Program Element A.40);
- Advancing Collaborative Connections for Earth System Science (Program Element A.42);
- Making Earth System data records for Use in Research Environments (Program Element A.43);
- Computational Modeling and CynberInfrastructure (Program Element A.45); and
- Advanced Component Technology (Program Element A.48).

2.6 Earth Surface and Interior

The Earth Surface and Interior Focus Area promotes the development and application of remote sensing to better understand core, mantle, and lithospheric structure and dynamics, and interactions between these processes and Earth’s fluid envelopes. ESI studies provide the basic understanding and data products needed to inform the assessment, mitigation, and forecasting of natural hazards, including phenomena such as earthquakes, tsunamis, landslides, and volcanic eruptions. These investigations also exploit the time-variable signals associated with other natural and anthropogenic perturbations to the Earth system, including those associated with the production and management of natural resources. Space-based remote sensing is vital to forecasting in the solid Earth sciences, providing a truly comprehensive perspective for monitoring the entire solid Earth system. ESI seeks to address the questions:

1. What is the nature of deformation associated with plate boundaries and what are the implications for earthquakes, tsunamis, and other related natural hazards?
2. How do tectonic processes and climate variability interact to shape Earth’s surface and create natural hazards?
3. How does the solid Earth respond to climate-driven exchange of water among Earth systems and what are the implications for sea-level change?
4. How do magmatic systems evolve, under what conditions do volcanoes erupt, and how do eruptions and volcano hazards develop?
5. What are the dynamics of Earth’s deep interior and how does Earth’s surface respond?
6. What are the dynamics of Earth’s magnetic field and its interactions with the rest of Earth’s systems?
7. How do human activities impact and interact with Earth’s surface and interior?

ESI's Space Geodesy Program (SGP) produces observations that refine our knowledge of Earth’s shape, rotation, orientation, and gravity, advancing our understanding of the motion and rotation of tectonic plates, elastic properties of the crust and mantle, mantle-core interactions, solid Earth tides, and the effects of surface loading resulting from surface water, ground water, glaciers, and ice sheets. SGP infrastructure enables the
establishment and maintenance of a precise terrestrial reference frame that is foundational to many Earth missions and location-based observations.

Modeling, calibration, and validation are essential components in advancing the above solid-Earth science objectives. ESI views natural laboratories as a critical component for the validation and verification of remote sensing algorithms. For example, NASA joins with the National Science Foundation (NSF) and U.S. Geologic Survey (USGS) in support of the EarthScope initiative to apply modern observational, analytical, and telecommunications technologies to investigate the structure and evolution of the North American continent and the physical processes controlling Earthquakes and volcanic eruptions.

Among the many activities carried out by ESI are the following:

- Geodetic and thermal imaging of the precise metrology of Earth’s surface and its changes through GNSS, lidar, radar constellations, and optical arrays, coupled with geopotential field measurements to understand the dynamics of the Earth’s surface and interior;
- Development of a stable terrestrial reference frame, highly precise realization of topography and topographic change, and understanding of changes in the Earth’s angular momentum and gravity fields, which can be applied to issues such as sea-level change, polar mass balance, and land subsidence;
- Use of gravitational and magnetic observables for studying the inner dynamics of the Earth, as well as for studies of how the ionosphere responds to changes in the Earth’s surface; and
- Improved forecasts and early warnings for earthquakes, tsunamis, landslides, and volcanic eruptions through the use of a broad range of Earth surface remote sensing and space geodesy approaches.

The ROSES elements most closely directed towards the Earth Surface and Interior Focus Area that are or may be soliciting for proposals in ROSES-2017 are:

- Earth Surface and Interior (Element A.28).

Topics relevant to the Earth Surface and Interior Focus Area are included in the following program elements:

- Rapid Response and Novel Research in Earth Science (Program Element A.29);
- Earth Venture Suborbital (Program Element A.34);
- New Investigator Program (Program Element A.36);
- Earth Science Applications: Disasters (Program Element A.40);
- Advancing Collaborative Connections for Earth System Science (Program Element A.42);
- Making Earth System data records for Use in Research Environments (Program Element A.43);
- Computational Modeling and Cyberinfrastructure (Program Element A.45); and
- Advanced Component Technology (Program Element A.48).
2.7 Cross-Cutting and Interdisciplinary

There are several cross-cutting and interdisciplinary elements in ROSES-2017, all of which have been identified as related elements to specific research focus areas in Sections 2.1 through 2.6 (and also briefly summarized in the overview to Section 2). These elements, all of which are being actively solicited in ROSES-2017 or are being evaluated for possible solicitation, are:

- **Rapid Response and Novel Research in Earth Science** (Program Element A.29) – This program element allows for two types of proposals not normally solicited through ROSES – (a) immediate research activity to take advantage of a target of opportunity due to an unforeseen event in the Earth system, and (b) exceptionally novel and innovative ideas to advance Earth remote sensing that do not fit within ESD’s current slate of solicitations and or programs;

- **OCO Science Team** (Program Element A.33) – Proposals are solicited for participation in the Science Team for the Orbiting Carbon Observatory-2 (OCO-2) and Orbiting Carbon Observatory-3 (OCO-3) Missions. NASA launched the OCO-2 mission in July 2014, and it has been operating on orbit producing precise column average CO2 concentration data globally with validated precision and accuracy of better than 0.5% globally since September 2014.

- **Earth Venture Suborbital** (Program Element A.34) - This Earth Venture Suborbital-3 program element solicits proposals for complete suborbital, principal investigator-led investigations to conduct innovative, integrated, hypothesis or scientific question driven approaches to pressing Earth system science issues. These new investigations will be competitively selected to provide an opportunity for investment in innovative Earth system science to enhance our capability to better understand the current state of the Earth and predict future change.

3. Applied Sciences

The Applied Sciences Program supports efforts to discover and demonstrate innovative and practical uses of NASA Earth science data, knowledge, and technology. The program ([http://AppliedSciences.NASA.gov/](http://AppliedSciences.NASA.gov/)) develops applications knowledge and understanding of how Earth science can be applied to serve society, increasing the benefits of the nation’s investments in NASA Earth science. The Program funds applied science research and applications projects to enable near-term uses of Earth science, transition applied knowledge to public and private organizations, and integrate Earth science and satellite observations as inputs to organizations’ decision-making and services. The projects are carried out in partnership with end user organizations. The Program, thus, serves as a bridge between the data and knowledge generated by NASA Earth science and the information needs and decision making of Government agencies, companies, regional associations, international organizations, not-for-profit organizations, and others.

The Program’s applications themes align with the U.S. Group on Earth Observations (USGEO) Societal Benefit Areas, with current emphasis on Water Resources, Health and Air Quality, Disasters, and Ecological Forecasting. Applied Sciences projects leverage products, knowledge, and outcomes of Research and Analysis activities.
described in Section 2.

The ROSES elements most closely directed towards Applied Sciences that are or may be soliciting for proposals in ROSES-2017 are:

- Health and Air Quality Applications (Program Element A.39); and
- Earth Science Applications: Disasters (Program Element A.40).

In addition, topics relevant to the Applied Sciences Program that are actively or potentially soliciting in ROSES-2017 include the following program elements:

- Supporting UN Sustainable Development Goals 14 and 15 in the Context of Climate Variability and Change (Program Element A.8)
- Rapid Response and Novel Research in Earth Science (Program Element A.29);
- Earth Venture Suborbital (Program Element A.34);
- New Investigator Program (Program Element A.36);
- Advancing Collaborative Connections for Earth System Science (Program Element A.42);
- Making Earth System data records for Use in Research Environments (Program Element A.43);
- Computational Modeling and Cyberinfrastructure (Program Element A.45); and
- Advanced Component Technology (Program Element A.48).

4. Technology

Advanced technology plays a major role in enabling Earth research and applications. The Earth Science Technology Program (ESTP) enables previously infeasible science investigations, improves existing measurement capabilities, and reduces the cost, risk, and/or development times for Earth science instruments.

As the implementer of the ESTP, the Earth Science Technology Office (ESTO) performs strategic technology planning and manages the development of a range of advanced technologies to enable new science observations or reduce the cost of current observations. ESTO employs an open, flexible, science-driven strategy that relies on competitive solicitations and peer-review to produce a portfolio of cutting-edge technologies for NASA Earth science endeavors. This is done through:

- Planning investments by careful analyses of science requirements
- Selecting and funding technologies through competitive solicitations and partnership opportunities
- Actively managing the progress of funded projects
- Facilitating the infusion of mature technologies into science measurements

from Space: National Imperatives for the Next Decade and Beyond by the National Research Council (NRC) of the National Academies (http://www.nap.edu/catalog.php?record_id=11820).

The Earth Science Technology Office (http://esto.nasa.gov/) maintains several program lines through which technology investments are regularly competed through ROSES, and that cover a range of technology readiness levels (TRLs). Currently, the Advanced Component Technology Program will be solicited in ROSES-2017:

• ACT (Program Element A.48): The Advanced Component Technology program develops a broad array of components and subsystems for instruments and observing systems.

Other ESTO programs that are periodically solicited are NOT being solicited in ROSES-2017:

• AIST (Program Element A.46): The Advanced Information Systems Technology program advances information systems that are used to process, archive, access, visualize, and communicate science data; and
• IIP (Program Element A.47): The Instrument Incubator Program funds technology development that leads directly to new Earth observing instruments, sensors, and systems. From concept through field demonstrations and infusion, IIP developments yield smaller, less resource intensive, and easier-to-build flight instruments;
• InVEST (Program Element A.49): The In-Space Validation of Earth Science Technologies program provides a path for some new technologies to be validated in space prior to use in science mission; and
• SLI-T (Program Element A.50): The Sustainable Land Imaging Technology program develops technologies leading to new Sustainable Land Imaging (SLI) instruments, sensors, systems, components, data systems, measurement concepts, and architectures in support of the nation’s future SLI activities.

5. Enabling Capability

Enabling capabilities include those programmatic elements that are of sufficient breadth that they contribute to a broad range of activities within the Earth Science Research Program. They typically involve the development of some kind of capability whose sustained availability is considered to be important for the Earth Science Research Program’s future. These include focused activities in support of education; data, information, and management; and airborne science, as well as some broadly based technology-related elements (others which are very focused towards a single scientific area of the Earth Science Research Program will be solicited through the research and analysis area).

5.1 Education

The Earth Science Research Program also recognizes its essential role in NASA’s mission to inspire the scientists and engineers of tomorrow. The Earth system science
concept pioneered by NASA is changing not only how science research is conducted, but also the way Earth and space science education is taught at elementary through postgraduate levels, as well as the way space exploration is presented to the public by the media and informal learning communities.

In 2015, SMD announced selections from the Science Education Cooperative Agreement Notice. These organizations will collaborate with SMD in the execution of its science education efforts. The desired outcome is to increase the overall coherence of the SMD science education program leading to more effective, sustainable, and efficient utilization of SMD science discoveries and learning experiences to meet overall SMD science education objectives. Fundamental to achieving this outcome is to enable NASA scientists and engineers to engage more effectively with learners of all ages. In addition, SMD is moving away from mission-by-mission products and services and towards aggregating efforts into science-based disciplines aligned with SMD Divisions.

The Earth Science Research Program will continue its management of the Global Learning and Observations to Benefit the Environment (GLOBE) Program and oversight of the GLOBE Implementation Office that is responsible for the coordination of the worldwide community in relation to GLOBE science, education, evaluation, communication, and other common functions.

5.2 Graduate and Early-Career Research

With a focus on continued workforce enrichment, the Earth Science component of the NASA Earth and Space Science Fellowship (NESSF) program, which supports the training of graduate students in Earth system science and/or remote sensing, is solicited outside of ROSES with new applications due February 1 of each year (NESSF is posted at http://nspires.nasaprs.com/ in November). The New (Early Career) Investigator Program in Earth Science (Program element A.36), which is directed towards scientists and/or engineers within five years of their receipt of a Ph.D. degree, is solicited every two years, and is solicited as part of ROSES-2017.

5.3 Data and Information Management

NASA’s space observation capabilities are a central part of the Agency’s contribution to Earth system science, along with the science information systems that compile and organize observations and related data for research purposes. The Earth Science Research Program has established a number of strategic principles for the development and deployment of its observing and information systems, recognizing the importance of providing active and informed stewardship for the large volumes of data that are returned to Earth every day. The broad range of uses to which the data are put and the large and diverse user community require multiple temporal and spatial scales, emphasize the need for having a range of data products, and place stringent requirements on NASA for its data processing, archival, and data dissemination activities. These products and services will be variously useful to multiple classes of users, from sophisticated scientific users to other Government and private sector entities that use NASA’s information for policy and resource management decisions and
including scientifically attentive members of the public who utilize data and information for general information and recreation.

Two program elements have been solicited periodically by the Data and Information Management programs of the Earth Science Division – The Advancing Collaborative Connections for Earth System Science (ACCESS) and the Making Earth System Data Records for Use in Research Environments (MEaSUREs). Both are being solicited as part of ROSES-2017.

Unless otherwise specified, any data proposed to be analyzed in response to Appendix A program elements from any source, including NASA and other satellite data, ancillary data, and data from commercial sources, must use publicly available data, in the sense that they are openly accessible. Commercial data need not be free, but it must be purchasable by all potential investigators. Proposals that utilize any data that is not, or not yet, publicly available will not be considered unless permitted by the call for proposals or associated Frequently Asked Questions. Please read the individual appendices and associated amendments to ROSES carefully and contact the program officers if you have any questions regarding whether a restricted dataset is permissible for a given call.

Data, model results and other information created is subject to NASA’s Earth Science Data policy (see http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/ for the policy). All data will be released along with the source code for algorithm software, coefficients, and ancillary data used to generate products.

5.4 High-End Computing, Networking, and Storage

High-end computing, networking, and storage are critical enabling capabilities for Earth system science. Satellite observations must be converted into scientific data products through retrieval and/or data assimilation processes. Long-term data sets must be synthesized together and become a physically consistent climate-research quality data set through reanalysis. These data products, in turn, provide initial and boundary conditions, validation and verification references, and internal and external constraints to the models that describe the behavior of the Earth system. None of the above will be possible without advanced techniques in high-end computing, networking, and storage.

SMD recognizes the need of such an enabling capability and maintains the high-end computing, networking, and storage within its programs. Computing resources are provided through various program elements. Over the past several years, computational resources have become significantly constrained. Starting in ROSES-2016, SMD began implementing a more rigorous resource allocation process. Proposals should include up to a one-page justification (not counted against the technical proposal page limit) for the computational resource requirement and this will be used during the proposal evaluation and selection processes. This justification should include how the computational resources may support the investigation and a multiyear resource-phasing plan, in annual increments, identifying the computing system and facility location where the computational project will be accomplished for the duration of the proposed award period. Proposers to this NRA must follow the instructions in Section I(d) of the
Summary of Solicitation of this NRA to request computing resources, including explicit descriptions of computing resource needs.

NASA also supports computational science research and development, including parallelization of codes to an advanced computing architecture for the advancement of Earth system modeling and data assimilation.

In ROSES-2017, one program element specifically targeted towards High End Computing, Networking, and Storage will be solicited. This element, Computational Modeling Algorithms and Cyberinfrastructure appears as program element A.45. This element provides research and development opportunities for new or improved computational modeling algorithms; the exploitation of new computing, storage, and networking architectures; or the development of programming and analysis environments relevant to NASA’s modeling and data assimilation systems.

5.5 NASA Earth Exchange

For large-scale global high resolution Earth science data analysis and modeling projects, especially in areas of land surface hydrology, land cover, land use, carbon management, and terrestrial ecosystems, NASA encourages using the new NASA Earth Exchange (NEX) collaboration facility. The NEX facility includes a state-of-the-art Earth system modeling and data analytics system for the use of remote sensing data from NASA and other agencies. It is supported by a world-class supercomputing and data storage system. Much of the global Landsat, MODIS, AVHRR and related data have been staged online for easy access. NEX (http://nex.nasa.gov) represents a scientific collaboration platform to deliver a complete work environment, in which users can explore and analyze large Earth science data sets, run modeling codes, collaborate on new or existing projects, and share results.

Since it is a unique platform for large-scale data analyses that cannot be easily accommodated by a single Principal Investigator (PI) or small research group-based data analysis system, PIs who require the use of such a system are encouraged to register on the NEX Website at https://nex.nasa.gov/nex/auth/register/. Proposals should include a section that justifies the need for using NEX, specifies the data storage and processing needs, and includes a data management plan. The resource availability will be considered during the proposal review and selection process.

Proposals that involve the use of NEX must be submitted to the appropriate ROSES program element depending on the science addressed by the proposed investigation. Additional constraints and requirements for proposals to use NEX are available at https://nex.nasa.gov/nex/resource_updates.

In ROSES-2017, one program element includes the enhancement of NEX. This element, Computational Modeling Algorithms and Cyberinfrastructure appears as Program element A.45. This element provides research and development opportunities for new or improved computational modeling algorithms; the exploitation of new computing, storage, and networking architectures; or the development of programming and analysis environments relevant to NASA’s modeling and data assimilation systems.
5.6 **Airborne Science**

The Earth Science Research Program airborne science program provides access to airborne platforms that can be used to obtain measurements of the Earth. Airborne platforms may be used to test new measurement approaches, collect detailed *in situ* and remote sensing observations that are needed to better document and test models of Earth system processes, and/or provide calibration/validation information for satellites. Airborne platforms can also be an important part of training the next generation of scientists, because students can be engaged in all aspects of scientific investigations, from sensor development, through utilization, to completing analysis of data obtained.

Aircraft have proven to be of significant value in Earth system science research, particularly for investigation into atmospheric processes. NASA makes use of several existing aircraft, including the NASA-owned DC-8, G-III, ER-2, P-3B, and Global Hawk, as well as several independently owned aircraft, including, but not limited to, those operated by other Federal agencies and commercial aircraft providers. **Proposers that utilize commercial aircraft service providers must ensure real time position tracking of the aircraft and provide flight reports after the completion of flights.** Information regarding the utilization and reporting requirements of airborne assets to support proposals can be found at [https://airbornescience.nasa.gov/](https://airbornescience.nasa.gov/).

[Corrected March 9, 2017]

Proposals that require the acquisition of new airborne data may be submitted in response to other active ROSES elements, unless otherwise specified in the element. In any such cases, proposers are encouraged to contact the program manager indicated prior to submitting such proposals.

The NASA Headquarters science concurrence is provided by the manager of the NASA Research Program under which the grant or contract is issued. User fees are paid by the investigator's funding source’s research program or directly from the investigator's grant funds.

Any airborne science experiment using NASA assets, personnel, instruments, or funds, must be in compliance with NASA Policy Directive 7900 and NASA Procedural Requirement Series 7900. It is NASA policy that when utilizing other than NASA aircraft, including foreign owned or leased aircraft, those aircraft are subject to the same compliance requirements.
A.2  LAND-COVER/LAND-USE CHANGE

NOTICE: The emphasis of this ROSES-2017 Land-Cover/Land-Use Change call is Multi-Source Land Imaging Science. This year only, this program element will not use a two-step proposal process. Notices of intent are requested by April 3, 2017, and the due date for proposals is June 8, 2017.

1. The LCLUC Program

The Land-Cover/Land-Use Change (LCLUC) program is developing interdisciplinary research combining aspects of physical, social, and economic sciences, with a high level of societal relevance, using remote sensing tools, methods, and data. One of its stated goals is to develop the capability for periodic satellite-based inventories of land-cover and monitoring and characterizing land-cover and land-use change. To learn more about the program please look at http://lcluc.hq.nasa.gov or contact Dr. Garik Gutman, the NASA Land-Cover/Land-Use Change Program Manager, see Section 3 below.

2. The Scope of this Solicitation: Multi-Source Land Imaging

To get the most out of current remote sensing capabilities to study land surface, estuarine, and coastal processes as related to land-use change, NASA solicits for efficient use of satellite sensor data from different moderate resolution sources (Landsat-class observations) that can provide continental to global coverage. The use of data from different satellites provides the opportunity for increased frequency of observations, which is important for a number of science questions and applications. A primary focus is on developing algorithms and products using data from Landsat (http://landsat.gsfc.nasa.gov/) and Sentinel-2 (https://earth.esa.int/web/guest/missions/esa-future-missions/sentinel-2) for global land monitoring. However, we also welcome proposals combining Landsat with non-U.S. sources of moderate resolution optical data which provide continental coverage. Proposals fusing optical sensor data as listed above with radar observations, such as Sentinel-1 (https://earth.esa.int/web/guest/missions/esa-future-missions/sentinel-1), as well as those combining innovative use of thermal infrared data to improve LCLUC monitoring, are also welcome. The ultimate goal is to develop multisensor methods based on increased temporal-spatial coverage to advance the virtual constellation paradigm for moderate resolution land imaging systems with continental to global scale coverage (http://ceos.org/ourwork/virtual-constellations/lsi/).

The use of observations and data products from more than just the Landsat system, i.e., including non-U.S. Earth-observing satellites with moderate (10-60m) resolution, is a requirement for each proposal. This solicitation does not require the incorporation of a socio-economic research component normally requested by the LCLUC program. Selections of this solicitation will enhance the Multi-Source Land Imaging (MuSLI) Science component of LCLUC with new products and will constitute the next phase for those products that have gone through the prototyping phase. Recognizing the
synergy between MuSLI and the U.S. Geological Survey (USGS)/NASA Landsat Program, funded investigators will be expected to attend one meeting of the USGS/NASA Landsat Science Team each year, as well as one NASA MuSLI meeting each year (to be held in conjunction with a NASA LCLUC Program Science Team Meeting).

Through this announcement two specific types of proposals are being solicited:

Type-1 (MuSLI Science Data Products). Proposals responding to the Science Data Products portion of the solicitation are expected to deliver continental or global-scale land science products, derived from multiple, international sources of data. Products on inland and coastal waters will also be considered. These products would be analogous to MODIS standard products in that they must satisfy a demonstrated science and/or applications need and be of broad interest within the science community. Examples would include products that meet Group on Earth Observations needs or Climate Data Records that must be provided at moderate resolution. Proposed products must have a high level of maturity and be based on published algorithms. By the end of the three years of proposed research, a product proposed as Type-1 in this call, is expected to be at least 'Provisional.' As defined in the MODIS Land Product lexicon, "provisional" means that the product is only partially validated (e.g., Stage 1) (https://lpvs.gsfc.nasa.gov/). Proposals can include hardware for product testing. It is anticipated that separate funds will be made available for data processing using either NASA computational facilities or commercial services. Thus, proposers should not include data processing costs in their project budgets. However, proposals should include sufficient information on required data volumes and throughput to enable program management to allocate resources for data processing. Program management will also work with selected Principal Investigators (PIs)/teams to implement appropriate long-term archival of Type-1 data products.

Type-2 (MuSLI Prototyping). Proposals responding to the Prototyping portion of the solicitation should specify algorithm development and prototyping activities that will result in novel data products using multiple sensing systems. Proposed products should make unique use of multiple, national/international sensors for benefitting from the improved temporal repeat afforded by multiple optical sensing systems and/or data fusion of radar and optical data. Proposals should demonstrate a strong science and/or applications need for the information product. As a result of the proposed research, the algorithms and products should be matured to the point at which they could be implemented in a production environment, although Type-2 proposers are not expected to implement routine, large-area processing. The algorithm and prototype products should, however, be suitable for eventual implementation in a production environment. Some initial validation of the proposed product should be included as part of a Type-2 proposal. Although it is desirable for Type-2 prototype products to be applicable to global science questions, Type-2 products need only be demonstrated at regional scales or through a global set of test sites.

Regardless of which type of proposal is submitted (Type-1 "MuSLI Science Products" or Type-2 "MuSLI Prototyping"), proposers should explicitly describe the rationale for and the intended use of their algorithm/product for improved LCLUC science and/or applications. Proposals might address science and/or applications that require more
frequent observations than are available than from a single moderate resolution system, e.g., in the areas of agriculture, forestry, land-use change or some aspect of natural resource management. This call will also entertain funding a small number of proposals addressing estuarine and coastal processes, as related to land use. Proposals should make the case for using multisource data, for example, providing higher temporal frequency data or expanded measurement capabilities. Proposals will need to include a description of the algorithm approach and describe preliminary validation (accuracy assessment) of the product.

2.1 International collaboration

Proposals should identify an explicit collaboration with one or more non-U.S. partners, i.e., those working on the non-U.S. sensor data included in the proposal. The non-U.S. partners should provide letters signed by the authorities of the collaborating institution, which would indicate agreement to participate in the project as proposed, with the necessary institutional support to participate in the collaborative research and attend team meetings. All else being equal, preference will be given to proposals that include partnerships with international investigators. The rationale for the latter is that U.S. PIs would benefit from the partners’ experience in using non-NASA data.

NASA’s policy welcomes the opportunity to conduct research with non-U.S. organizations on a cooperative, no-exchange-of-funds basis. Although Co-Principal Investigators (Co-Is) or collaborators employed by non-U.S. organizations may be identified as part of a proposal submitted by a U.S. organization, NASA funding may not normally be used to support research efforts by non-U.S. organizations at any level. The NASA Guidebook for Proposers states "NASA funding may not be used for foreign research efforts at any level, whether as a collaborator or a subcontract. The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted…" Note that travel by a non-U.S. participant in the research investigation, whether for the purpose of conducting the research, for collaboration, or for attending a conference, is considered to be a research expense. Therefore, NASA funding may not be used for research efforts by foreign organizations at any level, including payment of travel expenses by any participant who is not employed either full-time or part-time by a U.S. organization (see the NASA Guidebook for Proposers and Section III (c) of the Summary of Solicitation for restrictions involving China).

2.2 Expected deliverables

Given the continental to global scale focus of this solicitation, we are not considering the merging of moderate-resolution and high-resolution data (e.g. < 5m) in routine product generation. However, use of high-resolution satellite data for moderate-resolution product calibration or validation would be welcome. Proposals using high-resolution data for product calibration or validation should, as appropriate, consider obtaining high-resolution imagery through the NASA NGA Commercial Data Archive (http://cad4nasa.gsfc.nasa.gov).
Type-1 proposals are expected to deliver validated algorithms and continental-to-global-scale data products ready to support science and/or applications or that these products could be used by Earth system and land-use models. Although this solicitation includes three years of funding, Type-1 products should be able to be generated routinely as future opportunities evolve. Type-2 proposals are expected to deliver preliminary algorithms demonstrated at regional-to-continental scales or across a range of training sites, as well as science results demonstrating the utility of these products. Both Type I and Type II products are supposed to be delivered by the end of the project performance, i.e., at the end of the third year.

2.3 Programmatic Information

2.3.1 Period of Performance for Selected Proposals

Research awards will be for three-year period of performance (or less) with annual funding contingent upon satisfactory progress reporting and available funding.

2.3.2 Funding Available for Support of Selected Proposals

About $2M per year is expected to be available for new awards. Support can be anticipated for about three Type-1 ("MuSLI Data Products") investigations with a budget around $350K per year per project, and four Type-2 ("MuSLI Prototyping") investigations with a budget of around $200K per project. NASA will make selections for this announcement in September-October of 2017. Anticipated starting date for selected projects is Jan 15, 2018.

A budget for travel to at least one MuSLI Science Team session per year, which will be a part of the LCLUC Science Team meeting, and travel to one USGS/NASA Landsat Science Team meeting, is required in the proposal. In addition, sufficient international travel should be included in the proposal budget for productive collaboration between U.S. PI's and the non-U.S. partners. See Section 2.1 on what is and what is not allowed in the budget concerning non-U.S. participation.

2.3.3 Evaluation of Proposals

All proposals will be submitted to the NASA peer review process in accordance with the guidelines provided in this NRA and the NASA Guidebook for Proposers. This peer review will be followed by a programmatic review in which NASA will assess program balance across the competitive range of proposals and evaluate any logistical, implementation, cost, and/or management concerns. The funding recommendations will then be forwarded to a Selecting Official for confirmation. NASA then will announce the official selection of proposals for award.

3. Summary of Key Information

<p>| Expected annual program budget for new awards | ~ $2M |</p>
<table>
<thead>
<tr>
<th><strong>Number of new awards pending adequate proposals of merit</strong></th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum duration of awards</strong></td>
<td>3 years</td>
</tr>
<tr>
<td><strong>Due date for NOI</strong></td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td><strong>Due date for Proposals</strong></td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td><strong>Planning date for start of investigation</strong></td>
<td>January 15, 2018</td>
</tr>
<tr>
<td><strong>Page limit for the central Science-Technical-Management section of proposal</strong></td>
<td>15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Relevance</strong></td>
<td>This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA</td>
</tr>
<tr>
<td><strong>General information and overview of this solicitation</strong></td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td><strong>Detailed instructions for the preparation and submission of proposals</strong></td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Submission medium</strong></td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Web site for submission of proposals via NSPIRES</strong></td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td><strong>Web site for submission of proposals via Grants.gov</strong></td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
<td>NNH17ZDA001N-LCLUC</td>
</tr>
</tbody>
</table>
| **NASA point of contact concerning this program**          | Garik Gutman  
Earth Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: 202-358-0276  
Email: ggutman@nasa.gov |
NOTICE: NASA will not solicit proposals under the Ocean Biology and Biogeochemistry program element in ROSES-2017. All funds currently available are committed to the support of awards selected through previous Ocean Biology and Biogeochemistry and related announcements. Ocean Biology and Biogeochemistry funds will be competed again in ROSES-2018.

1. Scope of Program

NASA's Ocean Biology and Biogeochemistry program focuses on describing, understanding, and predicting the biological, ecological, and biogeochemical regimes of the upper ocean, as determined by observation of aquatic optical properties using remote sensing data, including those from space, aircraft, and other suborbital platforms.

Overarching programmatic goals include:
1. Understanding and quantifying the impacts and feedbacks of Earth System processes, particularly oceanographic mechanisms, on the global and regional spatial and temporal variability of ocean biology and ecology, including phytoplankton and organisms from other trophic levels;
2. Understanding and quantifying the impacts and feedbacks of Earth System processes, particularly oceanographic mechanisms, on the global and regional spatial and temporal variability of ocean biogeochemistry, including carbon sources and sinks and the fate of other chemical species or components in the ocean;
3. Exploring the development of new biological, ecological, and biogeochemical observations beyond traditional ocean color (e.g., phytoplankton chlorophyll a) from space-based assets, as well as furthering the climate research enabled by existing time series of climate observations (Earth System Data Records); and
4. Improving future climate predictions (impacts and feedbacks) by incorporating a dynamic understanding of ocean biology, ecology, and biogeochemistry into global biogeochemical and ecological models to understand the ocean's role in the Earth System.

Ocean Biology and Biogeochemistry research mainly supports the Carbon Cycle and Ecosystem Focus Area (http://cce.nasa.gov/cce/index.htm). NASA's Ocean Biology and Biogeochemistry program utilizes remotely sensed observations from land, ocean, and atmosphere, as well as field studies and campaigns, and interdisciplinary data assimilation and modeling efforts to better understand the ocean's role in the Earth System and to predict future causes of change and feedbacks on ocean biology and biogeochemistry within the Earth System.
In support of the Carbon Cycle and Ecosystems Roadmap, scientific questions of interest to the Ocean Biology and Biogeochemistry Program include (but are not limited to):

1. How are ocean ecosystems and the biodiversity they support influenced by climate and environmental variability and change, and how will these changes occur over time?
2. How do carbon and other elements transition between ocean pools and pass through the Earth System, and how do biogeochemical fluxes impact the ocean and Earth’s climate over time?
3. How (and why) are the diversity and geographical distribution of coastal marine habitats changing, and what are the implications for the well-being of human society?
4. How do hazards and pollutants impact the hydrography and biology of the coastal zone? How do they affect us, and can we mitigate their effects?


Questions or comments may be directed to the Ocean Biology and Biogeochemistry Program Managers at the addresses given below:

Paula Bontempi  
Earth Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: (202) 358-1508  
E-mail: Paula.Bontempi@nasa.gov

Laura Lorenzoni  
Earth Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: (202) 358-0917  
E-mail: laura.lorenzoni@nasa.gov
A.4 TERRESTRIAL ECOLOGY

NOTICE: The Terrestrial Ecology program does not currently plan to solicit proposals in ROSES-2017. All funds available for Terrestrial Ecology research have been reserved for support of awards to be selected through the ROSES-2016 Terrestrial Ecology solicitation and the 2016 Carbon Cycle Science solicitation. This program will be competed again in ROSES-2018.

1. Scope of Program

NASA Terrestrial Ecology research addresses changes in Earth’s carbon cycle and ecosystems using space-based observations. The goals of NASA’s Terrestrial Ecology research are to improve understanding of the structure and function of global terrestrial ecosystems, their interactions with the atmosphere and hydrosphere, and their role in the cycling of the major biogeochemical elements and water. This program of research addresses variability in terrestrial ecosystems, how terrestrial ecosystems and biogeochemical cycles respond to and affect global environmental change, and future changes in carbon cycle dynamics and terrestrial ecosystems. The research approach combines (i) use of remote sensing to observe terrestrial ecosystems and their responses; (ii) field campaigns and related process studies to elucidate ecosystem function; and (iii) ecosystem and biogeochemical cycle modeling to analyze and predict responses. Research to establish a theoretical and scientific basis for measuring Earth surface properties using reflected, emitted, and scattered electromagnetic radiation and to develop the methodologies and technical approaches to analyze and interpret such measurements is an important component of the Terrestrial Ecology research program.

Priorities for new research within NASA’s Terrestrial Ecology program continue to derive from the goals and objectives for Earth Science in NASA’s Strategic Plan (https://science.nasa.gov/about-us/science-strategy/), the research agenda of the U.S. Global Change Research Program (USGCRP) (http://www.globalchange.gov/), and the science priorities of the U.S. Carbon Cycle Science Program (https://www.carboncyclescience.us). A major emphasis within the Terrestrial Ecology program is a field and airborne campaign, the Arctic-Boreal Vulnerability Experiment (ABoVE) (http://above.nasa.gov). The ABoVE Study Area encompasses much of the boreal and tundra area of Alaska and western Canada. The overarching science question for ABoVE is: How vulnerable or resilient are ecosystems and society to environmental change in the arctic and boreal region of western North America? Our most recent focus is on the application of innovative airborne remote sensing tools to better understand northern ecosystems at regional scales.
For further information on this program, contact:

Hank Margolis, Program Manager
NASA Terrestrial Ecology Program
Earth Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-4760
E-mail: Hank.A.Margolis@nasa.gov
NOTICE: The Carbon Cycle Science program will not solicit proposals in ROSES-2017. All funds currently available for a dedicated carbon cycle science opportunity are committed to the support of awards selected through the 2016 carbon cycle science solicitation. These carbon cycle science funds will be competed again in ROSES-2019. NASA expects to continue to solicit some carbon cycle research through its core research and analysis programs, in particular, the Terrestrial Ecology, Ocean Biology and Biogeochemistry, Land-Cover and Land-Use Change, and Atmospheric Composition programs. Interested researchers are encouraged to consult these other program elements for potential funding opportunities.

NASA’s carbon cycle science research opportunity is offered every three years and usually in partnership with one or more U.S. government agencies, most recently with the U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA), the U.S. Department of Energy (DOE) Terrestrial Ecosystem Sciences Program, and the Ocean Acidification Program within NOAA. Proposals were sought to improve understanding of changes in the distribution and cycling of carbon among the active land, ocean, and atmospheric reservoirs and how that understanding can be used to establish a scientific foundation for societal responses to global environmental change.

The goals of the NASA Earth Science Program for carbon cycle science are to improve understanding of the global carbon cycle and to quantify changes in atmospheric CO2 and CH4 concentrations, as well as terrestrial and aquatic carbon storage in response to fossil fuel combustion, land use and land cover change, and other human activities and natural events. NASA carbon cycle research encompasses multiple temporal and spatial scales and addresses atmospheric, terrestrial, and aquatic carbon reservoirs, their coupling within the global carbon cycle, and interactions with climate and other aspects of the Earth system. A focus on observations from space pervades carbon cycle research by NASA and is a basis for partnerships with other U.S. Government agencies and institutions. NASA carbon cycle research contributes toward the goals of major U.S. Global Change Research Program (USGCRP) activities, including the Carbon Cycle Science Program’s U.S. North American Carbon Program (NACP) and the Ocean Carbon and Climate Change Program (OCCC) (http://www.globalchange.gov/, http://www.nacarbon.org/nacp/, and the Ocean Carbon and Biogeochemistry Program (OCB) http://www.us-ocb.org/about/projects.html). NASA carbon cycle research also contributes toward the National Ocean Council’s National Ocean Policy and its associated recommendations.

For further information on this program, contact:
Paula Bontempi
Earth Science Division
Science Mission Directorate

A.5-1
NOTICE: For ROSES-2017, the Biodiversity program element will be competed in program element A.8 Supporting United Nations Sustainable Development Goals 14 and 15 in the Context of Climate Variability and Change.

1. Scope of Program

Biodiversity is the variety of life on Earth at all levels of organization, from ecosystems to species to genes. It incorporates the compositional, structural, and functional aspects of life at these different levels. Biodiversity both enables and represents life’s responses to the changing environments of our dynamic planet, while also serving as a driver of environmental change. Biodiversity encapsulates life’s evolutionary history. In doing so, it provides humanity, indeed all life, with a tremendous resource of opportunities to survive and thrive in an uncertain future.

Recent efforts to track the status of biodiversity globally have consistently reported significant declines throughout its levels of organization. A growing scientific consensus posits that we are losing biodiversity at rates comparable to those seen in the major extinction events documented in the geologic record. Humanity’s role in this decline and our concerns over the subsequent loss of the many benefits, goods, and services we derive from biodiversity demand efforts to understand the condition of biodiversity and its changes in space and time. In addition, there is a need to understand biodiversity because it drives changes in the wider Earth system. Thus, NASA seeks tools to understand the condition of biodiversity and how it is changing over time.

Biodiversity is often studied and addressed locally, especially with regard to the spatial scales at which we seek to understand the causes and consequences of change. To address biodiversity loss as a global issue requires integrating research efforts across multiple spatial and temporal scales and observing biodiversity at all of its levels of organization. Accomplishing this integration of dynamic biodiversity patterns and processes across multiple scales is easier said than done and continues to be one of the major challenges for all of the biological sciences.

The NASA Earth Science Division approaches biodiversity science from the standpoint of two of its key aspects: pattern and process. Using observations from satellites, airborne and seaborne platforms, and in situ efforts, NASA explores patterns of biodiversity extant upon the land and within the water. Our tools are ideally suited for detecting many of biodiversity’s patterns, especially at the ecosystem level, but also at finer levels such as species. Biodiversity pattern often follows process. Thus, we also seek to understand the geophysical and ecological processes that result in the patterns of biodiversity our observations detect. Understanding these processes requires observations, with some of these observations at finer spatial scales than available from NASA satellites. It also requires models, essentially simplified representations of our knowledge of how certain systems work that in turn allow us to test the validity of this knowledge. Process-oriented research offers the additional benefit of connecting the Biodiversity program to the activities of other NASA Earth Science programs.
2. **Description of Solicited Research**

Please see program element A.8 for the Biodiversity solicitation in ROSES-2017.

3. **Programmatic Information**

Questions or comments may be directed to the Biodiversity Program Manager using the information below:

Woody Turner  
Earth Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
   Telephone: (202) 358-1662  
   E-mail: woody.turner@nasa.gov
A.7 CARBON MONITORING SYSTEM: CONTINUING PROTOTYPE PRODUCT DEVELOPMENT, RESEARCH, AND SCOPING

NOTICE: The Carbon Monitoring System program will not solicit proposals in ROSES-2017. All funds currently available for The Carbon Monitoring System are committed to the support of awards selected through the ROSES-2015 and ROSES-2016 Carbon Monitoring System solicitations. The Carbon Monitoring System is expected to be competed again in ROSES-2018.

1. Scope of Program

The NASA Carbon Monitoring System (CMS) is designed to make significant contributions in characterizing, quantifying, understanding, and predicting the evolution of global carbon sources and sinks through improved monitoring of carbon stocks and fluxes.

NASA's approach toward its contribution to a carbon monitoring system emphasizes exploitation of current and future satellite remote sensing resources, computational capabilities, integrated ecosystem and atmospheric modeling, scientific knowledge, airborne science capabilities, and end-to-end system expertise that are major strengths of the NASA Earth Science program. The emphasis has been on regional, national, and global satellite-based carbon monitoring products relevant to national needs for completely transparent carbon and biomass inventory processes that provide a robust statistical framework for reporting precision and accuracy in a geospatially explicit manner. Significant effort is being devoted to rigorous evaluation of the carbon monitoring products being produced, as well as to the characterization and quantification of errors and uncertainties in those products.

NASA's approach takes into account data and expertise that are the domain of other U.S. Government agencies and anticipates continuing close communications and/or partnerships with those agencies and their scientific and technical experts as U.S. national efforts toward integrated carbon monitoring mature, especially as coordinated through the Carbon Cycle Interagency Working Group of the U.S. Global Change Research Program (https://www.carboncyclescience.us/). NASA also recognizes a need for complementary local-scale (airborne and in situ) information to demonstrate quantitative remote sensing methods; to aid in scaling up from project, county, and/or state levels; and for essential evaluation of regional-, national-, and global-scale products. Such work is critically important for advancing Monitoring Reporting and Verification (MRV) system capabilities in support of Reducing Emissions from Deforestation and Forest Degradation (REDD, REDD+) in developing nations.

The current CMS activities take advantage of currently available space-based remote sensing observations like from the MODerate-resolution Imaging Spectroradiometer (MODIS) on Terra and Aqua, Landsat, and Orbiting Carbon Observatory-2 (OCO-2). Additionally, the current approach lays the groundwork for CMS-related applications of future NASA satellite sensors now in development (i.e., Global Ecosystem Dynamics Investigation (GEDI), Orbiting Carbon Observatory-3 (OCO-3), Ice, Cloud, and Land
Elevation Satellite-2 (ICESat-2), and the NISAR (NASA-Indian Space Research Organization L- and S-band synthetic aperture radars)).

In a first phase of activities, NASA initiated two CMS pilot studies and several scoping efforts focused on end-user utilization of satellite data:

- A Biomass and Carbon Storage Pilot Product
- An Integrated Emission/Uptake ("Flux") Pilot Product
- Scoping studies and research to understand the needs of end users and scope potential new carbon monitoring products

Since that time, multiple solicitations have been released to continue these activities. These solicitations can be found at:

ROSES-2011 CMS call

ROSES-2013 CMS call

ROSES-2014 CMS call

ROSES-2015 CMS call

A NASA Carbon Monitoring System Science Team (CMS ST) has been established to include members from all NASA CMS investigations. The CMS ST is responsible for providing broad research community involvement in the development and evaluation of NASA CMS products; coordinating their NASA-funded CMS activities to ensure maximum returns for science, management, and policy and providing scientific, technical, and policy-relevant inputs to help set priorities and directions for future NASA CMS activities.

Additional information on these initial activities, progress reports, the CMS ST, and links to available data and data products are provided at [http://carbon.nasa.gov](http://carbon.nasa.gov). The work conducted in this prototyping effort to date has leveraged the much larger investment currently made by NASA in remote sensing observations of carbon-related properties of the Earth system that are pertinent to understanding carbon stocks and fluxes, as well as to carbon cycle science and carbon management research. This work leverages highly off of research funded by NASA’s Carbon Cycle and Ecosystem focus area, data analysis research from many of NASA’s operating Earth Science satellites, NASA’s Applied Science program, and NASA’s Interdisciplinary Science activities.

For further information on this program, contact:

Kenneth W. Jucks
Earth Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546
    Telephone: (202) 358-0476
    E-mail: kenneth.w.jucks@nasa.gov

or
Hank Margolis
Earth Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
    Telephone: (202) 358-4760
    E-mail: Hank.A.Margolis@nasa.gov

or

Kathleen Hibbard
Earth Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
    Telephone: (202) 358-0245
    E-mail: Kathleen.A.Hibbard@nasa.gov
A.8 SUPPORTING UN SUSTAINABLE DEVELOPMENT GOALS 14 AND 15 IN THE CONTEXT OF CLIMATE VARIABILITY AND CHANGE

NOTICE: Amended December 19, 2017. The Earth Science Division had planned to offer Supporting UN Sustainable Development Goals 14 And 15 in the Context of Climate Variability and Change as program element A.8 of ROSES-2017, but scheduling issues prevented it from being released in 2017 so it will be solicited in ROSES-2018.

1. Overview

In 2015, the United Nations (UN) promulgated 17 Sustainable Development Goals (SDGs) as an agenda for global implementation by 2030. These goals include two that address the conservation and sustainable use of Earth’s biodiversity. Goal 14, given the short title of "Life Below Water," seeks to conserve and sustainably use the oceans, seas and marine resources. Goal 15, with the short title "Life On Land," calls upon humanity to sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss. Each of these two Goals has a number of associated SDG Targets. Countries are to align national planning with the SDGs and targets. Implementation of SDGs and targets will take place within the context of ongoing climate variability and change. A changing climate complicates this implementation and raises a concomitant need for improved understanding of the impacts of climate variability and change on species and ecosystems.

This program element seeks proposals supporting the implementation of selected targets under SDGs 14 and 15, which lend themselves to satellite remote sensing. Moreover, it calls for proposals to do so within the context of climate variability and change. Thus, proposals must use satellite remote sensing and other tools to address a specific SDG 14 or 15 target or targets in a manner that explores the implications of climate variability and change for addressing that target(s).

Two NASA Earth Science Division program elements are providing funding for this call: the Biological Diversity program element of the Research and Analysis Program and the Ecological Forecasting program element of the Applied Sciences Program. Therefore, the solicitation is open to two types of proposals: (a) basic research proposals and (b) applications proposals. Both types must apply NASA satellite remote sensing products and other observations and models to support implementation of SDGs 14 and 15 through a lens of climate variability and change.

This program element has been moved to ROSES-2018. [Added 12/19/17]

2. Point of Contact for Further Information

Woody Turner
Earth Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: (202) 358-1662
Email: woody.turner@nasa.gov
A.9  **ECOSTRESS SCIENCE TEAM**

**NOTICE:** Amended on October 19, 2017. Program element A.9 ECOSTRESS Science Team will not be solicited in ROSES-2017. NASA anticipates that it will be included in ROSES-2018.

1. **ECOSTRESS Science Team**


The ECOSTRESS instrument is a multispectral thermal radiometer with 5 spectral bands for research. ECOSTRESS will address important scientific questions on plant-water dynamics and how ecosystems respond to climate variability and change. As this is an Earth Venture instrument, the ECOSTRESS Principal Investigator (PI) is responsible for achieving the mission science objectives. The ECOSTRESS science objectives are:

1. Identify critical thresholds of water use and water stress in key climate sensitive biomes;
2. Detect the timing, location, and predictive factors leading to plant water uptake decline and/or cessation over the diurnal cycle; and,
3. Measure agricultural water consumptive use over the contiguous United States (CONUS) at spatiotemporal scales applicable to improve drought estimation accuracy.

This program element will seek proposals for membership on the ECOSTRESS Science Team. The focus of these proposals will likely be utilization of ECOSTRESS Level 2 (Surface Temperature and Emissivity), Level 3 (Evapotranspiration), and/or Level 4 (Water Use Efficiency and Evaporative Stress Index) data products for basic and applied research of importance to Earth system science. However, the solicitation will likely also be open to the production of alternative data products to those produced by funding to the ECOSTRESS Principal Investigator team. In addition, it will likely support proposals for enhanced calibration/validation activities that may be important for some classes of mission products.
2. **Point of Contact for Further Information**

Woody Turner  
Earth Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: (202) 358-1662  
Email: woody.turner@nasa.gov.
1. Scope of Program

NASA’s Physical Oceanography program supports basic research and analysis activities that enable development of NASA’s current and future physical oceanography satellite missions and the scientific interpretation of data from them. The primary centers of support for the Physical Oceanography program are the NASA Jet Propulsion Laboratory Earth Science Directorate and the external (non-NASA) scientific community. This announcement serves as the vehicle for participation in the Physical Oceanography program for all institutions.

The primary scientific thrust for physical oceanography at NASA is toward understanding the ocean’s role in climate variability and its prediction. Since the general ocean circulation plays a critical role in the global heat balance and materially changes atmospheric properties through air-sea exchange, understanding and modeling the state of the coupled ocean-atmosphere system are fundamental to climate studies. NASA utilizes the unique vantage point of space to enable rapid collection of global ocean data sets and intends to contribute significantly to the World Climate Research Program’s Climate Variability and Predictability (CLIVAR) Program.

The Physical Oceanography Program encompasses science teams supporting satellite altimetry (Ocean Surface Topography Science Team), ocean surface salinity via radiometry (Ocean Surface Salinity Team), sea surface temperature (Sea Surface Temperature Science Team), and ocean vector winds (Ocean Vector Winds Science Team). Proposals focused on one of these variables are better submitted to those competitions. In this program element, NASA is looking for work that cuts across multiple variables and focuses on the ocean’s role in climate.

While NASA’s focus remains global in nature, it is recognized that many of the practical problems with respect to human interaction with the ocean lie within the coastal seas. Compelling proposals that address the physical oceanographic characteristics of coastal seas in a global context are, therefore, welcome. Three research themes are identified in the Physical Oceanography program and represent priority areas for proposals solicited through this announcement:

- Analysis and interpretation of the ocean circulation using satellite and in situ data. NASA will support modest proposals undertaking analysis of satellite altimetry, surface wind stress, and other relevant data in support of the U.S. CLIVAR Program (http://www.usclivar.org). NASA recommends that proposals focused on a single variable (e.g., sea level, ocean vector winds, salinity) that is already supported by a dedicated science team be submitted to those science team elements in ROSES.
- Development of novel remote sensing techniques for physical oceanography. NASA has successfully developed remote sensing techniques for ocean surface winds, sea level, sea surface temperature, and sea surface salinity. Each of these variables has a science team and dedicated research activity. NASA will support modest proposals that explore new concepts for remote sensing of interest to physical oceanography. This opportunity is NOT for technology or instrument development, but for concept articulation and exploration.
• The intensity and location of mixing in the ocean remains an area of active research. The third priority area for this year’s announcement is seeking proposals that expand our spatial and temporal estimates of ocean mixing through the use of remote sensing and likely the joint analysis of satellite data sets with in situ ocean mixing (microstructure) data.

2. Programmatic Information

Total funds available for work selected under this solicitation are approximately $1.5M per year for three years.

Programmatic priority will be given to those proposals making the strongest links to analysis of satellite data and addressing oceanographic problems at basin or global scale. Modeling of the Earth system, including physical oceanography aspects, is ably covered but not annually by NASA’s Modeling, Analysis and Prediction Program (Program Element A.15 of ROSES-2017) and thus proposers should articulate special circumstances or situations where modeling-dominated proposals should be considered for Physical Oceanography Program funding.

Based on the quality of proposals received, awards will be distributed across the three research themes identified in Section 1. Proposals outside these research themes may be considered but must be highly meritorious.

3. Summary of Key Information

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<tr>
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</tr>
<tr>
<td>General information and overview of this solicitation</td>
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<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
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Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.

Web site for submission of proposal via NSPIRES: [nspires.nasaprs.com](http://nspires.nasaprs.com) (help desk available at nspires-help@nasaprs.com or (202) 479-9376)

Web site for submission of proposal via Grants.gov: [grants.gov](http://grants.gov) (help desk available at support@grants.gov or (800) 518-4726)

Funding opportunity number for downloading an application package from Grants.gov: NNH17ZDA001N-PO

NASA point of contact concerning this program: Eric Lindstrom
Earth Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-4540
E-mail: eric.j.lindstrom@nasa.gov
NOTICE: Amended on August 29, 2017. To give more time to proposers who are without power because of Hurricane Harvey, this amendment delays the due date for a number of program elements including this one. Please see Table 2 or Table 3 for the latest due dates.

1. **Scope of Program**

The NASA Ocean Salinity Science Team (OSST) supports basic research and analysis activities associated with production, improvement, and understanding of sea surface salinity data. The objective of this program element is to renew or select additional members for the OSST to support the salinity science within NASA’s Physical Oceanography Program and contribute to NASA’s Climate Variability and Change Focus Area and Global Water and Energy Cycle Focus Area.

The overall goals of the OSST are to provide the scientific underpinning for production of the best possible satellite-derived ocean salinity data sets and to demonstrate the Earth science and applications arising from analyses of the ocean surface salinity data. The team assures that data made available are of the highest quality and validated for scientific exploitation. It also conducts ocean science investigations that are possible only through exploitation of remotely sensed sea surface salinity.

NASA’s Aquarius satellite ([https://aquarius.nasa.gov](https://aquarius.nasa.gov)) completed a nearly four-year mission (June 2011-June 2015), providing global measurements of sea surface salinity (SSS). SSS is also being retrieved from NASA’s Soil Moisture Active-Passive (SMAP) satellite ([http://smap.jpl.nasa.gov/](http://smap.jpl.nasa.gov/); launched in January 2015) to provide continuity of NASA’s SSS measurements. Version 2 of the SMAP SSS product is slated for public release in January 2017. These data products are complemented by SSS measurements from the European Space Agency’s Soil Moisture and Ocean Salinity (SMOS) mission and by *in situ* salinity measurements (e.g., from the Argo array of profiling floats). NASA has also supported two major SSS process studies under the name of Salinity Processes in Upper Ocean Regional Studies (SPURS; [http://spurs.jpl.nasa.gov/](http://spurs.jpl.nasa.gov/)). SPURS investigators and science are also part of the Ocean Salinity Science Team.

Previous announcements for the OSST (in 2009, 2012, 2013, and 2016) have emphasized the calibration/validation and production of SSS products from Aquarius, as well as applications of Aquarius SSS products for ocean science investigations. The current announcement solicits proposals that address the following topics:

1. Exploitation of NASA satellite SSS measurements to investigate SSS variability, its influence on ocean circulation, and the linkage with climate and water cycle.
2. Synergistic use of NASA SSS measurements with other satellite and *in situ* measurements (including salinity measurements from SMOS and Argo, as well as satellite measurements of other oceanic parameters) for the aforementioned science investigations.
3. Evaluation and improvement of Aquarius and SMAP SSS products. The Aquarius
Project is working to produce Version 5.0 of mission data set by late 2017. There is still much to be learned and improved in the Aquarius retrievals. Likewise, salinity retrievals from SMAP are scheduled for wide public release in early 2017, and much work will be required to evaluate and improve these products. Also, work to assure the continuity and consistency of the SSS products across the two missions is a high priority. SMAP salinity products may also provide a unique opportunity to carefully examine salinity fronts in the surface ocean and this avenue of research is encouraged.

4. Near-surface salinity stratification (in the upper few meters) and the underlying physical processes continue to need attention. *In situ* upper ocean salinity measurements and remote sensing of sea surface salinity sample different levels of the water column. Precipitation and evaporation drive near surface salinity signals. Assimilation of SSS data into global models remains a challenge because of unresolved physics in the near surface layer. In particular, SPURS-2 data will be available in 2018 and beyond and its use and synthesis with respect to near-surface stratification is encouraged.

2. Programmatic Information

Total funds available for work selected under this solicitation are approximately $2M per year for three years. The NASA Physical Oceanography Program is working toward the goal of an annual consideration of proposals for the Ocean Salinity Science Team. Programmatic priority will be given to those proposals making the strongest links to analysis of satellite data and addressing oceanographic problems at basin or global scale. It is expected that all proposals will use satellite SSS in a fundamental way (so that it is not perceived to be peripheral to the proposed work).

Based on the quality of proposals received, awards will be distributed across the four research themes identified in Section 1. Proposals outside these research themes may be considered but must be highly meritorious.

3. Summary of Key Information

<p>| Expected program budget for first year of new awards | ~ $2.0M |
| Number of new awards pending adequate proposals of merit | ~ 10-15 |
| Maximum duration of awards | 3 years |
| Due date for Notice of Intent to propose (NOI) | See Tables 2 and 3 in the <em>ROSES Summary of Solicitation</em>. |
| Due date for proposals | See Tables 2 and 3 in the <em>ROSES Summary of Solicitation</em>. |
| Planning date for start of investigation | 1 April 2018 |</p>
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<td><strong>General information and overview of this solicitation</strong></td>
<td>See the <em>ROSES Summary of Solicitation</em>.</td>
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<tr>
<td><strong>Detailed instructions for the preparation and submission of proposals</strong></td>
<td>Please see <em>ROSES Summary of Solicitation</em> Section I(g) Order of Precedence and the <em>NASA Guidebook for Proposers</em>.</td>
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<td><strong>Submission medium</strong></td>
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<tr>
<td><strong>Web site for submission of proposal via NSPIRES</strong></td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
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<td><strong>Web site for submission of proposal via Grants.gov</strong></td>
<td><a href="http://grants.gov/">http://grants.gov/</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
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<tr>
<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
<td>NNH17ZDA001N-OSST</td>
</tr>
</tbody>
</table>
| **NASA point of contact concerning this program** | Eric Lindstrom  
Earth Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-4540  
Email: eric.j.lindstrom@nasa.gov |
A.12  **SEA LEVEL CHANGE SCIENCE TEAM**

**NOTICE:** NASA does not intend to offer this program element in ROSES this year.

This solicitation calls for proposals to improve the accuracy and spatial resolution of sea level change estimates and communicate these results in a simplified manner to the scientific community and general public. It serves to continue the work of the NASA Sea Level Change Team initiated in 2014 and continued in 2017. It also serves as a mechanism for the U.S. to make a substantial contribution to the World Climate Research Program (WCRP) Grand Challenge on Regional Sea Level Change and Coastal Impacts.

| NASA point of contact concerning this program | Eric Lindstrom  
| Earth Science Division  
| Science Mission Directorate  
| NASA Headquarters  
| Washington, DC 20546-0001  
| Telephone: (202) 358-4540  
| E-mail: eric.j.lindstrom@nasa.gov |

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A.12-1
The joint NASA/National Oceanographic and Atmospheric Administration (NOAA)/Centre National D’Etudes Spatiales (CNES) Ocean Surface Topography Science Team (OSTST) supports basic research and analysis activities associated with joint satellite altimetry missions (TOPEX/Poseidon (TP), Jason-1, Ocean Surface Topography Mission/Jason-2, and Jason-3) and other ocean altimetry data sets. The team is recompeted every four years.

The goals of the OSTST are to provide the scientific underpinning for production of the best possible satellite-derived altimetry data sets and to demonstrate the Earth science and applications arising from analyses of ocean surface topography data. The team is also involved in the calibration and validation of the cooperative altimetry mission between NASA, CNES, NOAA, and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and the European Space Agency.

<table>
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<tr>
<th>NASA point of contact concerning this program</th>
<th>Eric Lindstrom</th>
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<td>Earth Science Division</td>
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<td>Science Mission Directorate</td>
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<td>NASA Headquarters</td>
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<td>Washington, DC 20546-0001</td>
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<td></td>
<td>Telephone: (202) 358-4540</td>
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<td></td>
<td>E-mail: <a href="mailto:eric.j.lindstrom@nasa.gov">eric.j.lindstrom@nasa.gov</a></td>
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<tr>
<th>NOAA point of contact concerning this program</th>
<th>Laury Miller</th>
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<tr>
<td></td>
<td>NESDIS/STAR Laboratory for Satellite Altimetry</td>
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<td>NOAA Center for Weather &amp; Climate Prediction</td>
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<td>5830 University Research Court</td>
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<td></td>
<td>College Park, Maryland 20740</td>
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<tr>
<td></td>
<td>Telephone: (301)683-3331</td>
</tr>
<tr>
<td></td>
<td>E-mail: <a href="mailto:laury.miller@noaa.gov">laury.miller@noaa.gov</a></td>
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</table>
NOTICE: Amended October 17, 2017. The due date for proposals to this program element has been delayed for 2 weeks. Proposals are now due November 13, 2017. Moreover, Nadya Vinogradova-Shiffer (nadya.vinogradova-shiffer@nasa.gov) has been added as an additional point of contact for this program element.

1. Scope of Program

The Ocean Vector Winds Science Team (OVWST) supports the analysis and interpretation of ocean vector winds and other applications derived from Earth-observing missions carrying scatterometers and polarimetric radiometers. Every four years, this program element solicits scientific investigations that require the accurate and extensive vector wind and backscatter measurements provided by a range of NASA and international missions that provide such data. Notable NASA data sets for research analysis include:

- NASA launched the QuikSCAT satellite instrumented with the SeaWinds scatterometer on June 19, 1999. This instrument is a copy of the dual conically-scanning pencil beam Ku-band SeaWinds scatterometer that flew on JAXA’s Midori-2 mission. QuikSCAT is no longer fully functional, but still collects Ku-band backscatter measurements to assist in calibration of other Ku-band scatterometers.

- NASA RapidScat mission (http://winds.jpl.nasa.gov/missions/RapidScat/), was installed on the International Space Station (ISS) in September 2014 and suffered a mission ending power anomaly in August 2016. RapidScat’s unique non-Sun-synchronous sampling from the ISS can be used to characterize diurnal and subdiurnal wind variability.

- The Compact Ocean Wind Vector Radiometer (COWVR) is a new U.S. Air Force mission built by the NASA Jet Propulsion Laboratory (JPL) to provide ocean vector winds from a small satellite microwave radiometer system. COWVR is a fully polarimetric conically imaging radiometer operating at 18.7, 23.8 and 33.9 GHz with a full fore/aft viewing geometry providing observations at two azimuth angles for each point on the ground. It is designed to provide wind vector data over a 1200km swath, at 35km spatial resolution, with an uncertainty at least equivalent to data produced by the Naval Research Laboratory WindSat sensor. COWVR is planned to be launched in the fourth quarter of Calendar Year (CY) 2017. Investigators wishing to use the data will be able to acquire it from the Jet Propulsion Laboratory.

Extensive background on NASA’s ocean vector winds science team and missions are available at http://winds.jpl.nasa.gov/.
This program element solicits scientific investigations that require the accurate and extensive vector wind and backscatter measurements provided by QuikSCAT, RapidScat, COWVR, and other international scatterometers, such as ASCAT (from the European Organisation for the Exploitation of Meteorological Satellites; EUMETSAT) and OSCAT (from the Indian Space Research Organization; ISRO). Proposals that focus on the following areas are particularly encouraged:

a) Oceanographic, meteorological, climate, and/or interdisciplinary research that addresses the Earth System science goals and utilizes (in a fundamental way) the multiyear time series of QuikSCAT, SeaWinds, ASCAT, and RapidScat standard backscatter and vector wind products, including development of techniques for improving surface wind stress and/or wind vector estimates; estimation of wind stress and/or wind vector biases in the climatological data record and technique to reduce these biases is sought;

b) Focused geophysical analyses that exploit the frequent sampling or complimentary information obtained through combining observations from multiple wind sensors;

c) Development, refinement, and application of advanced validation techniques that quantify the accuracy of remotely sensed ocean vector wind measurements and derived products (e.g., stress, curl, Ekman transport), including dependence on spatial averaging scale;

d) Development, validation, and scientific application of advanced (nonstandard) backscatter and vector wind products that have increased temporal resolution (multisensor products) and/or spatial resolution and/or accuracy, based on Ku-band scatterometer data and other measurements and models. Proposals are especially encouraged that address issues associated with producing and quantitatively characterizing products based on multiple measurement types having different accuracies and spatial resolutions, and that address how natural variability impacts on error characteristics;

e) Development of techniques that exploit differences in intercalibrated Ku-band and C-band or passive microwave observations to understand physical processes related to rain and the ocean surface;

f) Development, refinement, and application of assimilation and analysis techniques that improve the impact and effectiveness of scatterometer and related ocean surface vector wind measurements for operational uses, including weather, marine hazard, and short-term climate forecasting;

g) Development, validation, and scientific application of data or validation products from the data collected by the NASA RapidScat mission (http://winds.jpl.nasa.gov/missions/RapidScat/), with special emphasis on the use of RapidScat as a cross-calibrator for the international scatterometer/radiometer ocean vector winds constellation and on the exploitation of the unique non-Sun-synchronous sampling of the ISS to characterize diurnal and sub-diurnal wind variability; and

h) Studies performing calibration/validation and scientific utilization of the baseline COWVR data provided JPL, as well as those evaluating new processing techniques to fully exploit the two-look radiometry will be considered.
2. Programmatic Information

Total funds available for work selected under this solicitation are approximately $3.0M per year for four years.

Based on the quality of proposals received, awards will be distributed across the eight research themes identified in Section 1. Proposals outside these research themes may be considered but must be highly meritorious.

3. Summary of Key Information

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| NASA points of contact concerning this program, both of whom share the following postal address: | Eric Lindstrom  
Telephone: (202) 358-4540  
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Nadya Vinogradova-Shiffer  
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[Added October 17, 2017] |
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Science Mission Directorate  
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A.15  **MODELING, ANALYSIS, AND PREDICTION**

NOTICE: NASA does not intend to offer this program element in ROSES this year.

1. Overview

NASA’s Science Mission Directorate (SMD) supports a broad portfolio of research in the Earth Science Research Program. Key questions that drive the core research efforts of the Earth Science Division within SMD include:

- How is the Earth system changing?
- What are the sources of change in the Earth system and their magnitudes and trends?
- How will the Earth system change in the future?
- How can Earth system science improve mitigation of and adaptation to global change?

Within Earth Science Research, the Modeling, Analysis, and Prediction (MAP) program seeks to develop an understanding of the Earth as a complete, dynamic system. In order to accomplish this objective, the program funds the development of comprehensive, physically-based models of the Earth system, observation/model syntheses, and supporting research.

The modeling and data assimilation supported by the MAP program is observation-driven. That is, the direction of the modeling/assimilation work is guided by available and anticipated observations and its goal is to extract from the observations as much value as possible. This involves rigorous examination and utilization of observations in a global Earth system context. The modeling integrates across all the research activities in NASA’s Earth Science Research Program and spans and connects the spatial and temporal scales that characterize satellite observations and observations from ground and air based campaigns. This approach facilitates the validation of the satellite observations and observationally-based improvements of Earth system model components, leading to models that accurately represent the Earth system with diagnostic and predictive skill. MAP strives to generate models and model components that are well documented, thoroughly evaluated, interoperable, robust, and consistent with current coding standards and practices.

2 Background

MAP funds two primary projects and/or functional organizations that comprise the core activities of the program. These efforts are:

NASA Goddard Institute for Space Studies (GISS [http://www.giss.nasa.gov/projects/gcm/]). GISS engages in research on global Earth system change occurring on the decadal to centennial timescales. GISS makes use of analyses of comprehensive global datasets and develops and utilizes integrated global models of the Earth system. The research includes the study of paleoclimate and the study of other planets as an aid to prediction of future evolution of Earth on a
GISS has a long-term involvement in the Coupled Model Intercomparison Project (CMIP) that forms the basis of International Panel on Climate Change (IPCC) assessments of climate change. The primary GISS modeling tool supported by the MAP program is the GISS Model E (http://www.giss.nasa.gov/tools/modelE/), a coupled atmosphere-ocean Earth system model (ESM).

NASA Goddard Global Modeling and Assimilation Office (GMAO: http://gmao.gsfc.nasa.gov). GMAO addresses the optimal use of satellite and in situ observations to generate research quality data sets for analyses and reanalyses, and also for weather, climate, and air quality forecasts. The modeling and assimilation research includes coupling to and assimilation of atmospheric aerosols and chemistry and ocean biology and carbon. GMAO focuses on developing and maintaining world-class data assimilation systems in order to maximize satellite data utility and serve as a centralized resource for testing and validating as wide a range of modeling and observational efforts as possible. The goal is to undertake modeling and assimilation as components of an end-to-end process, from defining an instrument, characterizing its in-flight performance, through to the development of algorithms and forward models for data assimilation, integrating the data into assimilation products, and finally assessing the impact of the data on the products of the assimilation system. GMAO is supported by MAP to develop and utilize the Goddard Earth Observing System, version 5 (GEOS 5). GEOS 5 includes both a coupled atmosphere-ocean GCM and a data assimilation system (DAS). More information is available at: http://gmao.gsfc.nasa.gov/systems/geos5/.

MAP also funds several smaller, but still substantial projects that further core program interests. These efforts include:

NASA Global Modeling Initiative (GMI: http://gmi.gsfc.nasa.gov). GMI develops, maintains, and utilizes a state-of-the-art modular global 3D chemistry and transport model (CTM) that includes full chemistry for both the troposphere and stratosphere, as well as a coupled representation of stratospheric aerosols. The GMI model serves as a testbed for different meteorological fields, emissions, chemical mechanisms, deposition schemes, and other processes determining atmospheric composition, both gas-phase and aerosols. In this role, GMI seeks to understand and constrain the uncertainties in model results through intercomparison of simulations and testing with observations. Since many of these processes are included in general circulation models (GCMs), GMI is also a tool to expand the parameter space in sensitivity studies and test the parameterizations in GCMs with measurements of atmospheric composition.

NASA Unified Weather Research Forecast Model (NU-WRF: http://nuwrf.gsfc.nasa.gov). The NU-WRF model is an effort to unify the Weather Research and Forecasting (WRF) model, a next-generation multiagency supported mesoscale NWP system, with NASA's existing weather models and assimilation systems, such as GEOS-5 and the Land Information System (LIS). Several parameterizations of physical processes developed by NASA scientists have been implemented into NU-WRF to better represent/simulate cloud/aerosol/precipitation/land surface processes. The goals for this effort are to robustly connect the global scale to the regional and mesoscale, while maintaining the focus on comprehensive Earth
system modeling, as well as the use of NASA high-resolution satellite data for research into short-term climate, weather, and integrated Earth system processes.

3. Programmatic Priorities

Characterizing the limits of validity of models and model components and identifying the sources of uncertainties is important to realizing the goal of enabling whole Earth system models. Therefore, preference will be given to proposals that: 1) characterize and/or help reduce uncertainties in the models and products; 2) extend the range of model or product validity by using new components; 3) exploit these products to address NASA Earth Science Division (ESD) research questions; 4) are in alignment with the goals and objectives of the core MAP elements described above; and 5) enable independent community validation and characterization of the core MAP elements leading to improvement of the models or products. Proposals must explicitly discuss the observations that will either be used in the proposed investigation (including the manner of their use), or whose use will be facilitated by the proposed investigation. Preference will be given to proposals utilizing or enabling analysis of NASA satellite and suborbital observations. A discussion of how the proposed investigation will interact with or inform the core modeling efforts discussed in Section 2 is also required.

New model components that are proposed shall be Earth System Modeling Framework (ESMF) compliant and make use of ESMF utilities where appropriate. A discussion of the software engineering aspects of the proposed work should be included in the proposal. Components shall be "seamless" in the sense that they are capable of spanning the weather to climate continuum of time scales. Proposals to develop and implement new parameterizations in MAP-supported models should demonstrate awareness of the parameterization to be replaced (if there is one), the code that implements it, and how it interacts with other parts of the model. They should discuss why the new parameterization is expected to improve model simulations relative to the existing parameterization, include an implementation plan, and propose observationally-based metrics based on NASA data that will diagnose the improvement. They should discuss the nature and extent of the interaction with the core model team. Proposals for new model component capabilities must include an evaluation activity that characterizes its limits of validity by comparing to observational data.

In all cases, the proposer must explain how the validation methodology will help identify the source of uncertainty within the model or analysis product. Proposals for new or improved model components for NASA MAP supported models and proposals that utilize NASA MAP-supported models or model output will be preferred over those that do not. Proposed evaluations of the MAP-supported models mentioned in Section 2 should consider the use of appropriate existing simulations, including those contained in the CMIP (Coupled Model Intercomparison Project) archives or simulations that have already been conducted by the NASA modeling teams. If new simulations are required, resources to support those simulations should be included in the proposal, as well as the agreement of the modeling team to provide the needed simulations (if the proposing team is unwilling or unable to conduct the simulations themselves).
4. MAP Infrastructure

As mentioned above, a MAP program goal is a set of models and model components that are well documented, thoroughly evaluated, interoperable, robust, and consistent with current coding standards and practices. Therefore, code development proposals should adhere to the multiagency Earth System Modeling Framework (https://www.earthsystemcog.org/projects/esmf), which provides a robust software infrastructure for coupling model elements. Proposals should identify resources to provide software engineering and interface support necessary to assure that the final product meets ESMF standards and investigator verification that the ESMF-compatible product yields desired results.

High-end computing (HEC) support is available from the NASA Center for Computational Sciences (NCCS, https://nccs.nasa.gov/) and the NASA Advanced Supercomputing facility (NAS, http://www.nas.nasa.gov/) (see Section I(d) of the ROSES Summary of Solicitation). Proposers who require computing time at NCCS or NAS must provide an accurate estimate (including the basis of the estimate) of the number of node-hours required each year of the proposal by completing the HEC template and answering the NSPIRES cover page question. See Section I(d) of the ROSES Summary of Solicitation for instructions. Note that the availability of computing resources will be considered in the evaluation process.

| NASA point of contact concerning this program | David B. Considine  
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<table>
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A.16 CRYOSPHERIC SCIENCE

1. Background

NASA’s Cryospheric Sciences Program supports remote sensing research on the Earth’s polar ice sheets to understand their connections to the global system. Increases in ice loss from the glaciers of Antarctica, Greenland, and the Arctic are contributing to sea level rise, while similarly dramatic changes are occurring in sea ice of the Arctic and Southern Oceans. Characterizing these changes to understand the processes controlling them is required to improve our understanding of the Earth system and forecast the impacts of continued change.

The Earth’s polar ice sheets cover continent-sized areas in the most inaccessible and inhospitable regions of the globe. NASA’s capabilities in satellite and aircraft remote-sensing are critical tools for understanding the changes occurring there.

2 Scope of Program

This program element supports investigations that use remote sensing to study the land-based ice sheets of Antarctica, Greenland, and the Arctic, and the sea ice of the Arctic and Southern oceans. Supported studies are based on satellite and aircraft remote sensing observations to understand the factors controlling changes in the ice and its interaction with the ocean, atmosphere, solid Earth, and solar radiation.

The polar ice sheets represent one of the best time-integrated records of change in the Earth system that can be quantitatively characterized. New for this year, this program element seeks proposals that exploit the polar ice sheets as unique records of the global system that can improve understanding of poorly constrained aspects of the polar oceans and atmosphere. The program is open to proposals in any area, but proposers are reminded that their work must be founded upon remote sensing observations of the ice.

In addition, the program seeks to continue its longer term goals to:

- Determine the mechanisms controlling sea-ice cover, such as quantification of the connections between sea ice and the ocean and atmosphere;
- Characterize sea ice properties—such as ice and snow thickness, roughness, melt ponds, and albedo—and physical processes—such as deformation and rifting—such that they can be incorporated into sea ice models;
- Use remote sensing products to validate and improve models of changes in sea-ice cover to elucidate connections to the global system;
- Determine the mechanisms controlling mass balance and dynamics of the Greenland and Antarctic ice sheets, including studies aimed at improving fundamental understanding of the connections to the ocean, sea-ice cover, and atmosphere;
- Characterize land ice properties—such as thickness, surface mass balance, englacial and surface water, layering, bed and grounding line properties, and albedo—and physical processes—such as flow, crevassing, ice shelf behavior, melt water fate, and calving—such that they can be incorporated into models;
• Use remote sensing data to validate and improve models of land-based ice and their contributions to sea-level change; and
• Study of polar and nonpolar mountain glaciers and small ice caps to understand systemic impacts of global change and contributions to sea-level rise.

NASA expects synergy among observations, modeling, and field campaigns, and encourages all projects to consider recommendations identified by the various polar research organizations in their white papers and reports. Some recent examples are as follows:

• SEARCH 5-year Science Goals from The Study of Environmental Arctic Change (SEARCH), available at http://www.arcus.org/search/goals
• Climate and Cryosphere (CLiC) of the World Climate Change Research Program, available at http://www.climate-cryosphere.org/
• IARPC Research Plan from the Interagency Arctic Policy Committee (IARPC), available at http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp

Proposers are reminded that use of satellite and or airborne remote sensing is required. Data from any NASA or non-NASA satellite or aircraft mission is appropriate. Proposers are encouraged to consider the extensive data holdings of NASA’s Distributed Active Archive Centers (DAAC), including the:

• National Snow and Ice Data Center (NSIDC, https://nsidc.org/), which hosts a wide range of data and products from satellite and aircraft missions, including those from NASA’s ICESat (https://nsidc.org/data/icesat) and Operation IceBridge (OIB) (http://www.nasa.gov/mission_pages/icebridge/index.html). The OIB mission collects altimetry, radar, gravity, bathymetry and other data over ice in the Arctic and Antarctic.
• Alaska Satellite Facility (https://www.asf.alaska.edu/), which hosts satellite radar data.
• Oceans Melting Greenland (OMG) mission portal (https://omg.jpl.nasa.gov/portal/). OMG is a new NASA Earth Ventures Suborbital mission collecting radar altimetry, gravity, bathymetry and other oceanographic data in and around Greenland.
• MEaSUREs Program (https://earthdata.nasa.gov/community/community-data-system-programs/measures-projects). MEaSUREs (Making Earth System Data Records for Use in Research Environments) supports the development of satellite radar records of land ice flow velocities and sea ice motion. Finally, while this program element is open to the utilization of any form of remote sensing, proposers should note that NASA prioritizes unique contributions and has two other ROSES program elements that specifically support remote sensing research over the polar ice sheets using airborne and satellite altimetry, as follows:

A.17 IceBridge Research focusses on altimetry from the IceBridge Mission, and is competed this year; and

A.18 Studies with ICESat and CryoSat-2 focusses on satellite altimetry using ICESat and CryoSat-2, and was competed in 2016 with selected proposals posted in NSPIRES.

2.1 Arctic Studies

For Arctic sea ice, the program’s focus is to characterize and understand sea ice processes and the observed changes—in extent, concentration, thickness, character, and dynamics—in the context of their couplings to the Earth system. Extensive remote sensing records of Arctic sea ice extent extend back to the 1970s. Understanding the feedback mechanisms associated with sea ice—and the atmosphere, ocean, land, and incident sunlight—is intended to improve models of the Arctic, and potentially support other projects linking high- and low-latitude climates. NASA’s OIB mission has performed extensive studies of Arctic sea ice (https://nsidc.org/data/icebridge).

For Arctic land ice, characterizing the Greenland ice sheet and other northern hemisphere glaciers is essential to understanding and modeling their mass balance, dynamics, and contributions to sea level. The program’s focus is to advance understanding of land-ice processes, especially connections among the warming ocean and increases in glacial flow rates; determining how the ice sheet interior is tapped by outlet glaciers; and determining the connections between glacial dynamics, bed characteristics, and melt water. The program also focuses on determining surface mass balance and the fate of surface melt to support overall ice sheet and Arctic glacier mass balance estimates. Some unique data resources available to support this work include the altimetry, radar, and other data collected by NASA’s Operation IceBridge mission, as well as data available from ICESat, GRACE, and various international radar satellites.

Projects requiring Arctic fieldwork in Greenland, utilizing the National Science Foundation’s (NSF’s) Arctic Program resources, must obtain a cost estimate as discussed in NSF’s Arctic Sciences research solicitation (http://www.nsf.gov/div/index.jsp?div=ARC).

2.2 Antarctic Studies

For the Southern Ocean and the Antarctic ice sheet, the program focuses on the dynamics and mass balance of the overall ice sheet, the potential instability of the West
Antarctic ice sheet, the interaction of the warming ocean with ice shelves, characteristics and changes of the glacial grounding lines, subice-sheet hydrology, and changes in the extent of sea ice. There is also a need to assess the likelihood of rapid ice-sheet response to large changes in elevation and mass loss observed in some outlet glaciers and ice shelves – by ICESat, GRACE, Operation IceBridge, and radar satellites – and how changes in these outlet glaciers may affect the stability of the interior ice sheet.

Projects requiring Antarctic fieldwork are required to review the information at [http://www.usap.gov/proposalInformation/](http://www.usap.gov/proposalInformation/) and provide enough information to allow for adequate review of the plan, its utility, and expected costs. For projects that receive assistance from the U.S. Antarctic Program, acknowledgements should include: "Logistical support for this project in Antarctica was provided by the U.S. National Science Foundation through the U.S. Antarctic Program."

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Washington, DC 20546  
Telephone: (202) 358-4682  
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NOTICE: Amended on August 9, 2017. A.17 IceBridge Research will not be solicited in ROSES-2017. It has been deferred until no earlier than ROSES-2018.

1. Background

IceBridge (http://www.nasa.gov/mission_pages/icebridge/) is a NASA airborne science mission collecting altimetry, radar, and other geophysical observations to monitor and characterize the Earth’s polar sea ice, glaciers, and continental ice sheets. Begun in 2009, the mission’s primary goal is to extend the record of ice altimetry begun by NASA’s Ice, Cloud and land Elevation Satellite (ICESat) that was in operation 2003-2009. The mission will continue for at least one year past the launch of ICESat-2, currently estimated for late 2018.

The Earth’s cryosphere is in a period of rapid change. Research using data collected under the IceBridge mission increases our understanding of these changes, their causes, and their connections to the global system. This work improves our knowledge of the contribution of the world’s major ice sheets and glaciers to current and future sea level rise and makes fundamental contributions to understanding changes occurring in the thickness of sea ice in the Arctic and Southern Oceans.


In general, the IceBridge mission’s approach is to survey various areas in the Arctic and Antarctic each year prior to the onset of springtime melting. Specific flight lines are selected to meet the mission goals based on detailed planning by the IceBridge Project Office and Science Team. In the Arctic, the coverage includes: Greenland, Arctic sea ice, and select Alaskan glaciers and Canadian ice caps. The mission has also occasionally undertaken postmelt-season altimetry measurements in the Arctic, and this activity may continue.

In the Antarctic, the mission has and will generally operate from Punta Arenas, Chile, with Antarctic coverage that includes: the Antarctic peninsula and nearby sea ice, the Amundsen Sea Embayment, and select areas of both West and East Antarctica, including both the interior and outlet glaciers. The mission is planned to operate from McMurdo Station, Antarctica, for at least one more season, and has in the past supported various campaigns based out of McMurdo and other parts of Antarctica.

The instrument suite varies by campaign, but generally includes some or all of the following: lidar, ice and snow penetrating radar, gravimeter, magnetometer, and other instruments.

2 Programmatic Information

Results from investigations supported under this solicitation are expected to advance the goals articulated in NASA’s Strategic Plan 2014 to understand the Earth system.
Furthermore, NASA encourages projects to incorporate appropriate recommendations identified by Federal agencies and polar research organizations in their white papers and reports. These plans and others address the importance of understanding the role of glaciers, ice sheets, and sea ice within the Earth system. Some recent examples are as follows:


- **SEARCH 5-year Science Goals** from The Study of Environmental Arctic Change (SEARCH), available at [http://www.arcus.org/search/goals](http://www.arcus.org/search/goals)


3. NASA point of contact concerning this program

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A.18 STUDIES WITH ICESAT AND CRYOSAT-2

NOTICE: Due to changes in the ICESat-2 launch date, this program element will not be competed in ROSES-2017. The program is tentatively scheduled to next solicit proposals in ROSES-2018.

1. Background

NASA solicits investigations to derive geophysical information from NASA’s Ice, Cloud, and land Elevation Satellite (ICESat) and the European Space Agency’s CryoSat-2, and link these records with the initial data stream from ICESat-2, scheduled for launch in FY 2018. These altimetry missions were optimized to characterize changes in the continental ice sheets of Antarctica and Greenland and the sea ice of the Arctic and Southern Oceans. The missions’ primary goals are to understand the contributions of polar ice to current and future sea level rise and the coupling of changes in polar sea ice cover to the Earth system. Investigations are encouraged that:

- create long term, integrated records of change in the polar ice sheets;
- characterize processes of change in polar ice, especially couplings to climate forcings and insight into physical processes that improves predictive models; and
- as a lower priority, any other innovative investigations using ICESat and CryoSat-2 observations for Earth science research, such as studies of ecosystem structure and biomass, inland and ocean water heights, and clouds.

1.1 ICESat, ICESat-2, and IceBridge

The NASA Ice, Cloud, and land Elevation Satellite (ICESat) was launched in January 2003 and ceased operations in 2009. The instrument on ICESat was the Geoscience Laser Altimeter System (GLAS) with precise ranging capability. With an orbital inclination of 94 degrees, ICESat observations provided critical insight into the thinning of the Arctic sea ice cover, the ice loss from the continental ice sheets of Greenland and Antarctica, and the global distribution of above-ground biomass. Limitations of the laser lifetime led to a revised measurement strategy from the intended continuous operation in a 91-day repeat orbit to a set of discrete campaigns. These campaigns were based on a 33-day near-repeat subcycle of the 91-day orbit that was surveyed twice a year at six-month intervals. Details of the mission are available at http://icesat.gsfc.nasa.gov/.

Data can be accessed from the NASA Distributed Active Archive Center (DAAC) at the National Snow and Ice Data Center through http://nsidc.org/data/icesat/.

ICESat’s planned successor is ICESat-2, which is currently under development and expected to be on orbit and providing data in 2018. Details of the mission and instrument are available at http://icesat.gsfc.nasa.gov/icesat2/ and http://icesat.gsfc.nasa.gov/icesat2/instrument.php. ICESat-2 will be in a near-polar orbit and have a multibeam, photon counting instrument that enables direct measurement of both surface elevation and slope. It makes measurements every 70-cm along track with 6 beams arranged in 3 pairs with 3.3 km between pairs.

The gap in space-based laser altimetry observations is being bridged by NASA’s IceBridge Mission (http://www.nasa.gov/mission_pages/icebridge/index.html), a series
of aircraft campaigns over land and sea ice in both polar regions. The instrument suite and flights plans are based on lidar measurements that extend the record of ICESat and offer calibration and validation of CryoSat-2. The aircraft also have radars for mapping snow cover and the underlying bed, as well as gravimeters and other instruments. Data and instrument descriptions can be accessed from http://nsidc.org/data/icebridge/.

1.2 CryoSat-2
CryoSat-2, launched in April 2010, is a radar altimetry mission of the European Space Agency (ESA). It is designed primarily to measure sea ice thickness with sophisticated radar processing techniques. Its measurements of sea ice freeboard complement those of ICESat and have been validated with IceBridge observations. CryoSat-2 also has the potential to measure ice sheet elevation and make other geophysical measurements. Details on the Cryosat-2 mission are at http://www.esa.int/esaMI/Operations/SEM36Z8L6VE_0.html.

1.3 Scope of Program
The primary goal of this program is to continue the use of satellite altimetry for the study of polar ice sheets.

These measurements are expected to improve knowledge of the contribution of Greenland and Antarctica’s ice sheets to current and future sea level rise and to determine the coupling of changes in polar sea ice to the Earth system. Investigations must be based on observations made by ICESat, CryoSat-2, and ICESat-2 as well as exploit the complementary nature of these missions to produce extended records. Proposers are also encouraged to use IceBridge measurements to connect and fill gaps between ICESat and CryoSat-2 and establish pathways to link these time series to ICESat-2.

Scientific studies based on ICESat, CryoSat-2, and ICESat-2 observations outside of the polar ice sheets are encouraged, but will also be considered at a lower priority.

Specific goals of the program are as follows:

For the Greenland and Antarctic ice sheets, the program seeks to:

- Measure and understand elevation change in the context of improved mass balance to understand couplings to the Earth system and contributions to sea level rise
- Gain insight into the surface mass balance, especially to improve models of polar precipitation and surface melting
- Characterize the dynamic processes controlling ice flow and related changes in ice sheet elevation and mass balance, especially to improve ice sheet models useful for prediction of sea level rise
- Use satellite altimetry to determine any other properties of the ice sheets critical to improved models of their contributions to current and future sea level rise.
For the sea ice of the Arctic and Southern oceans, the program seeks to:

- Measure and understand changes in the thickness of sea ice cover as derived from measurements of sea ice freeboard
- Characterize the physical processes controlling Arctic sea ice loss and Antarctic sea ice expansion, especially to improve sea ice models for hind and forecasting
- Gain insight into surface melting, snow accumulation, age and flooding of sea ice, especially to improve models of polar precipitation and surface melting
- Use satellite altimetry to determine any properties of polar sea ice to understand the physical processes that control their growth and retreat, especially their connections to climate forcings and couplings to the Earth system.

Other areas of research based on ICESat, CryoSat-2, and ICESat-2 satellite altimetry will also be considered at a lower priority. Proposals are welcome on any topic, but studies should make a specific effort at improving understanding of the Earth system and prepare for integration with ICESat-2 data when it becomes available. Potential topics include, but are not limited to the following:

- Ecosystem structure and estimation of biomass
- Change in the major glacial systems of the Alaska, Canada, and High Mountain Asia to understand their contributions to global sea level rise and or couplings to the Earth system
- Atmospheric processes, especially precipitation and cloud properties relevant to interpretation of polar processes and affecting interpretation of ICESat and ICESat-2 observations
- Land surface studies, snow volume estimates, and hydrologic information derived from water surface heights.

2. Programmatic Information

Results from investigations supported under this ROSES element are expected to advance the Earth Science goals articulated in the 2014 Science Mission Directorate Science Plan available at [http://science.nasa.gov/about-us/science-strategy/](http://science.nasa.gov/about-us/science-strategy/), as well as the goals and objectives of other relevant Federal research plans; such as the Interagency Arctic Research Policy Science Plan (https://www.nsf.gov/geo/plr/arctic/larpc/arc_res_plan_index.jsp) that addresses the role of glaciers, ice sheets, and sea ice within the Arctic and Earth systems.

3. Summary of Key Information

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| **NASA point of contact concerning this program** | Thomas Wagner  
Earth Science Division  
Science Mission Directorate  
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Telephone: (202) 358-4682  
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A.19  SOLAR IRRADIANCE SCIENCE TEAM

1. Scope of Program

1.1 Overview

Solar irradiance represents the primary external forcing that operates on the Earth and contributes to variability and change in the Earth’s climate and atmospheric composition. It can only be measured above the atmosphere given the significant absorption that takes place within it. The Earth system is sensitive to variations in both the Total Solar Irradiance (TSI), as well as the spectral dependence of any variation, given the fact that different wavelengths have their greatest absorption at different altitudes in the atmosphere. Variations in TSI are quite small – the typical variation over the 11-year solar cycle is on the order of ±0.15%. Variations in the solar irradiance as a function of wavelength increase with decreasing wavelength, potentially being of the order of a few percent at the short wavelength ultraviolet radiation responsible for photodissociation of oxygen and a factor of order unity at wavelengths near Lyman Alpha (121.6 nm).

1.2 Science Team Activities

The primary purpose of the Solar Irradiance Science Team (SIST) is to support the development of consistent multiinstrument/multiplatform space-based data sets of solar irradiance (both total and spectrally resolved). The data sets should be useful as input to global models (e.g., general circulation models, atmospheric chemistry/transport models) and data assimilation systems, so that the effects of variations in solar output can be properly represented and their impacts on the Earth system investigated. The efforts carried out in this area will be expected to involve components such as:

• Rigorously accounting for drifts in instrument operation over their respective lifetimes,
• Determining calibration offsets that can be applied to one or more data sets to create a consistent data record,
• Reprocessing data sets for previously operating satellites using newly obtained calibration information
• Analyzing and/or interpreting laboratory or other (balloon, rocket, etc.) calibration data that can be used to recalibrate existing data records,
• Intercomparing total solar irradiance and spectrally resolved solar irradiance observations to describe changes in the relationships between them that may provide a mechanism for establishing relative consistency or inconsistency of different approaches for connecting disparate data sets,
• Comparing solar irradiance data sets with those of proxies to help define the range of relationships between them and support the inference of longer-term solar irradiance records that can be used to force models as described above.

The SIST is not intended to support fundamental research in solar physics, or irradiance observations at the shorter wavelengths (< 100nm). At those wavelengths the primary impact is to drive changes in atmospheric composition at altitudes above those
commonly represented in the climate and atmospheric composition models used by the research community of NASA’s Earth Science Division. The SIST is also not intended to carry out research on the impacts of solar irradiance on the Earth’s climate and/or atmospheric composition. Research in those areas is periodically solicited by other NASA research programs from the Heliophysics Division and the Earth Science Division, respectively. Proposals submitted to this program that are focused in those areas will be deemed nonresponsive and returned to the proposer without review.

2. Programmatic Information

2.1 Data Sets

Proposers are free to include any mix of solar irradiance data sets, including those from currently operating missions e.g., Solar Radiation and Climate Experiment (SORCE), and Total Solar Irradiance Calibration Transfer Experiment (TCTE), those no longer taking data, e.g., Active Cavity Radiometer Irradiance Monitor Satellite (ACRIMSAT), and also those likely to be launched in the future. Examples of such future missions include solar irradiance instruments such as the Total Solar and Spectral Solar Irradiance Sensor-1 (TSIS-1), scheduled to be launched by NASA to the International Space Station in 2017. Data from NASA and non-NASA sources are fully appropriate for inclusion, subject to the restriction that all data being used in the proposal must be publicly available to the entire proposing community. Proposals involving the use of data sets that are not publicly available will be returned to the proposer as nonresponsive. Data sets from free flying satellites, as well as human-occupied platforms (including the International Space Station and the Space Shuttle), may also be included.

2.2 Science Team Leader

In addition to proposals for SIST membership, there is also the opportunity to propose for the position as Team Leader for the SIST. The SIST Leader will be responsible for providing scientific leadership and direction to the SIST and scientific inputs regarding solar irradiance issues to NASA management. In consultation with the Headquarters program scientist(s) for the relevant missions, he/she will be responsible for calling and organizing science team meetings and related activities.

Team Leader proposals should include a separate section of up to three additional pages in the Scientific/Technical/Management section that describes only the activities to be undertaken as SIST Leader and addresses the following aspects of team leadership:

• The solar irradiance qualifications and leadership skills of the proposing Team Leader;
• A clear articulation of the proposed Team Leader’s vision for the NASA SIST and its contribution to NASA’s Earth Science research goals; and
• A management plan that describes the approach to science team leadership, how interactions with the SIST and NASA management will be conducted, and how science team business and meetings will be organized and conducted.

In addition, the Budget Justification: Narrative and Details section of the proposal must include a detailed budget for only the Team Leader activities and a narrative and justification for the Team Leader work that are separate from those for their SIST
member activities. Proposers who wish to be considered for SIST Leader also should indicate their candidacy by answering the relevant cover sheet question.

NASA reserves the option to select a Team Leader from among the SIST members should proposals of adequate merit and suitability not be received for the Team Leader role.

2.3 Science Team Meeting
All proposers should budget for one three-day annual meeting to be held on the East Coast of the United States each year (for costing purposes, assume that the meeting will take place in the Washington, DC area).

3. Summary of Key Information

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| NASA point of contact concerning this program | David B. Considine  
Earth Science Division  
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Tel: 202-358-2277  
Email: david.b.considine@nasa.gov |
1. **Scope of Program**

Atmospheric composition determines air quality and affects weather, climate, and critical constituents such as ozone. Exchanges with the atmosphere link terrestrial and oceanic pools within the carbon cycle and other biogeochemical cycles. Solar radiation affects atmospheric chemistry and is, thus, a critical factor in atmospheric composition. Atmospheric chemistry and associated composition are a central aspect of Earth system dynamics, since the ability of the atmosphere to integrate surface emissions globally on time scales from weeks to years couples several environmental issues. NASA’s research for furthering our understanding of atmospheric composition is geared to providing an improved prognostic capability for such issues (e.g., the recovery of stratospheric ozone and its impacts on surface ultraviolet radiation, the evolution of greenhouse gases and their impacts on climate, and the evolution of tropospheric ozone and aerosols and their impacts on climate and air quality). Toward this end, research within the Atmospheric Composition Focus Area addresses the following science questions:

- How is atmospheric composition changing?
- What trends in atmospheric constituents and solar radiation are driving global climate?
- How do atmospheric trace constituents respond to and affect global environmental change?
- What are the effects of global atmospheric chemical and climate changes on regional air quality?
- How will future changes in atmospheric composition affect ozone, climate, and global air quality?

NASA expects to provide the necessary monitoring and evaluation tools to assess the effects of climate change on ozone recovery and future atmospheric composition, improved climate forecasts based on our understanding of the forcings of global environmental change, and air quality forecasts that take into account the feedbacks between regional air quality and global climate change. Achievements in these areas via advances in observations, data assimilation, and modeling enable improved predictive capabilities for describing how future changes in atmospheric composition affect ozone, climate, and air quality. Drawing on global observations from space, augmented by suborbital and ground-based measurements, NASA is uniquely poised to address these issues. This integrated observational strategy is furthered via studies of atmospheric processes using unique suborbital platform-sensor combinations to investigate, for example: (1) the processes responsible for the emission, uptake, transport, and chemical transformation of ozone and precursor molecules associated with its production in the troposphere and its destruction in the stratosphere, and (2) the formation, properties, and transport of aerosols in the Earth’s troposphere and stratosphere. NASA’s research strategy for atmospheric composition encompasses an end-to-end approach for instrument design, data collection, analysis, interpretation, and prognostic studies.
2. Atmospheric Composition Laboratory Research Activities

The principal area of research solicited through this program element is for laboratory investigations that supply basic spectroscopic, chemical, and physical measurements that are currently needed to interpret NASA-generated atmospheric composition data sets. In particular, laboratory studies that contribute to a process level understanding of atmospheric variability as discerned from space-based measurements, such as performed by the Aura suite of instruments, as well as from the broad range of complementary suborbital measurements, are solicited. Proposed investigations that will be given priority may include, but are not limited to:

- Laboratory kinetic and photochemical studies over the range of Earth atmospheric (tropospheric and stratospheric) temperature and pressure that describe the atmospheric transformations of trace species involved in ozone chemistry or directly affecting climate. Proposals that support the activities of the NASA Panel for Data Evaluation (http://jpldataeval.jpl.nasa.gov/) or address priority needs identified by this panel in the chemical kinetics and photochemistry areas are of particular interest. Selected proposals relating to kinetics and photochemistry will be funded primarily by the Upper Atmosphere Research Program and secondarily by the Tropospheric Composition Program.

- Laboratory spectroscopic studies that directly improve the precision and accuracy of data products from NASA Atmospheric Composition satellites, such as Aura, or from suborbital and ground network atmospheric observations supported by NASA. Of particular interest are measurements of the spectral properties of observed quantities or of any interfering quantity, emphasizing the temperature and pressure conditions needed to assure the accuracy of retrievals. Selected proposals relating to this spectroscopy will be funded by the Upper Atmosphere Research Program.

- The Aerodyne Aerosol Mass Spectrometer (AMS) has become an important part of the suite of sensors commonly used to characterize aerosol particle properties. Recently, some issues surrounding the calibration of the AMS have been published in the scientific literature. The overall goal is to improve data to be collected in the future and, if possible, improve the calibration of measurements made in the past. Therefore, NASA solicits proposals to address two approaches to these issues. First, NASA solicits the analysis of existing AMS data, especially data not yet published; and second, laboratory experiments to characterize the calibration of the AMS. We expect to select two to four proposals for funding. Selected proposals in this area will be funded by the Tropospheric Composition and Radiation Sciences Programs, which will allocate at least $400K per year towards resolving these calibration issues.

3. Summary of Key Information

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NASA points of contact concerning this program, all of whom share the following mailing address:

Earth Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001

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<th>Name</th>
<th>Program</th>
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<tr>
<td>Kenneth W. Jucks</td>
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<td>(202) 358-0476</td>
<td><a href="mailto:Kenneth.W.Jucks@nasa.gov">Kenneth.W.Jucks@nasa.gov</a></td>
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<td>Barry Lefer</td>
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<tr>
<td>Hal Maring</td>
<td>Radiation Science Program</td>
<td>(202) 358-1679</td>
<td><a href="mailto:hal.maring@nasa.gov">hal.maring@nasa.gov</a></td>
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NOTICE: The Radiation Sciences program will solicit proposals via program element A.20 Atmospheric Composition: Laboratory Research in ROSES-2017. The remaining funds currently available in Fiscal Year 2017 for the Radiation Sciences Program are committed to the support of awards selected from previous solicitations. The Radiation Sciences Program expects to solicit proposals for an airborne campaign data analysis in ROSES-2019. Interested researchers are encouraged to consult other program elements for potential funding opportunities.

1. Scope of Program
The Radiation Sciences Program (RSP) strives to develop a quantitative and predictive understanding of how aerosols, clouds, and radiatively active gases scatter and absorb radiation (including both solar and terrestrially originated radiation) in the Earth’s atmosphere, especially as it relates to climate variability and change. The program supports studies to improve the theoretical understanding of radiative transfer, as well as field measurements of aerosol and cloud particle concentration, composition, microphysics, and optical properties. These measurements include both airborne and surface-based remote and in situ measurements. The program also supports the analysis of satellite remote sensing and field data, as well as the development of process models, which contribute to an Earth system modeling capability.

For further information on this program, contact:
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Science Mission Directorate
NASA Headquarters
Washington, DC 20546
Telephone: (202) 358-1679
Email: hal.maring@nasa.gov
NOTICE: The Atmospheric Composition Modeling and Analysis program will not be competed in ROSES-2017. The Atmospheric Composition Modeling and Analysis program is tentatively scheduled to next solicit proposals in ROSES-2018.

The Atmospheric Composition Modeling and Analysis program (ACMAP) addresses the issues of tropospheric air quality and oxidation efficiency, pollution sourced aerosol and its impact on cloud properties, stratospheric chemistry and ozone depletion, and chemistry/climate interactions. Studies of long-term trends in atmospheric composition (potentially using both current and past mission data sets) are also of interest to the program, where the connection between cause and effect is elucidated using models. The program is interested in studies that integrate observations from multiple instruments with models to address attribution and predictions. The use of satellite and suborbital data sets and ground based measurements are encouraged for modeling constraints and verification where applicable. Proposals were last received in August 2016, and it is anticipated that proposals will be solicited again in ROSES-2018.

For information on this program, contact:
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Earth Science Division
Science Mission Directorate
National Aeronautics and Space Administration
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Telephone: (202) 358-2567
Email: Richard.S.Eckman@nasa.gov
Amended March 10, 2017. One of the aircraft associated with the NASA FIREChem campaign needs to be re-winged in the summer of 2018, so the FIREChem campaign is now planned for July – September, 2019. Under the revised schedule, awards begin December 1, 2017, PIs will have a year to prepare for the field campaign, participate in the mission in year 2, and have the third year for data analysis. Proposals are now due June 16, 2017. Notices of intent are not requested for this program.

1. Scope of Program

Atmospheric composition changes affect air quality, weather, climate, and critical constituents, such as ozone. Atmosphere-biosphere exchange links terrestrial and oceanic pools within the carbon cycle and other biogeochemical cycles. Solar radiation affects atmospheric chemistry and is, thus, a critical factor in atmospheric composition. Atmospheric composition is central to Earth system dynamics, since the atmosphere integrates surface emissions globally on time scales from weeks to years and couples many environmental issues. NASA’s research for furthering our understanding of atmospheric composition is geared to providing an improved prognostic capability for such issues (e.g., the recovery of stratospheric ozone and its impacts on surface ultraviolet radiation, the evolution of greenhouse gases and their impacts on climate, and the evolution of tropospheric ozone and aerosols and their impacts on climate and air quality). Toward this end, research within the Atmospheric Composition Focus Area addresses the following science questions:

- How is atmospheric composition changing?
- What trends in atmospheric composition and solar radiation are driving global climate?
- How does atmospheric composition respond to and affect global environmental change?
- What are the effects of global atmospheric composition and climate changes on regional air quality?
- How will future changes in atmospheric composition affect ozone, climate, and global air quality?

NASA expects to provide the necessary monitoring and evaluation tools to assess the effects of climate change on ozone recovery and future atmospheric composition, improved climate forecasts based on our understanding of the forcings of global environmental change, and air quality forecasts that take into account the feedbacks between regional air quality and global climate change. Achievements in these areas via advances in observations, data assimilation, and modeling enable improved predictive capabilities for describing how future changes in atmospheric composition affect ozone, climate, and air quality. Drawing on global observations from space, augmented by suborbital and ground-based measurements, NASA is uniquely poised to address these issues. This integrated observational strategy is furthered via studies of atmospheric processes using unique suborbital platform-sensor combinations to
investigate, for example: (1) the processes responsible for the emission, uptake, transport, and chemical transformation of ozone and precursor molecules associated with its production in the troposphere and its destruction in the stratosphere and (2) the formation, properties, and transport of aerosols in the Earth’s troposphere and stratosphere, as well as aerosol interaction with clouds. NASA’s research strategy for atmospheric composition encompasses an end-to-end approach for instrument design, data collection, analysis, interpretation, and prognostic studies.

2. Description of Solicited Research

The NASA Tropospheric Composition Program (TCP) is soliciting proposals for participation in an airborne campaign to be conducted in the continental U.S. during July, August, and into mid-September of 2019 to improve our understanding of the transport of and chemical transformations in biomass burning plumes and their impact on air quality. A single comprehensively instrumented research aircraft is required to accomplish this research. In this airborne campaign, the NASA DC-8 will **may** provide observations from near surface up to ~12.5 km.

Aircraft measurements of atmospheric trace gas mixing ratios and aerosol particle properties and meteorological parameters provide a comprehensive suite of observations to understand these processes during the focused experiment period. They are also useful for calibration and validation of the longer-term observations of Earth observing satellite sensors and the retrieved data products generated from those observations. In particular, these measurements will be useful in the calibration and validation of NASA satellites (A-Train, Terra, Suomi-National Polar-orbiting Partnership), as well as European satellites (MetOP-A/B and Sentinel-5P). The measurements made during this campaign will also be useful in the planning of future satellite missions, especially the Tropospheric Emissions: Monitoring of Pollution (TEMPO) instrument, currently under construction.

2.1 Fire Impacts on Regional Emissions and Chemistry (FIREChem)

The NASA FIREChem mission is a cooperative biomass burning and air quality field study to be conducted in the continental U.S. from late July to mid-September 2019. NASA FIREChem will focus on the links between satellite and ground-based measurements of both fresh and aged biomass burning plumes generated from both wildfires and prescribed burns (e.g., agriculture and forest management). The FIREChem mission will include in situ measurements and remote sensing observations from the NASA DC-8 to sample upwind and downwind of natural and managed fires.

A FIREChem white paper, which describes the scientific background, science questions, and experimental approach, can be found at: [https://espo.nasa.gov/FIREChem_White_Paper](https://espo.nasa.gov/FIREChem_White_Paper). FIREChem primary observations will emphasize in situ measurements of trace gas and aerosol composition mixing ratios, aerosol particle properties, and meteorological parameters, as well as remotely sensed lidar observations of ozone and aerosol optical depth. The primary goal of this mission is to improve our understanding of the detailed composition of fire emissions, factors affecting their transport, and chemical transformations in biomass burning plumes and their impact on air quality.
The specific science questions to be addressed by the FIREChem mission include:

1) What are the emissions of gases, aerosols, aerosol precursors, and greenhouse gases from North American fires? How variable are these emissions due to fuel and fire conditions?

2) How does the composition of fire plumes change as primary species are converted to secondary gas and aerosol tracers?

3) How is local air quality impacted by North American fires? How well do local air quality forecast models work?

4) What are the regional and long-term impacts of North American fires?

5) What are the climate-relevant properties of biomass burning aerosols? What role does brown carbon and coatings on black carbon particles play in the optical properties? What is the composition of PM2.5?

6) How can satellite measurements help with questions one-five above? And how can we obtain better satellite estimates of plume height and fire intensity (e.g., fire radiative power)?

3. Programmatic Information

3.1 Programmatic Priorities

Highest priority will be given to instrument proposals consistent with mission objectives (as described in the mission white paper) and with proven performance heritage. It is not appropriate to propose for significant new instrument development under this call; however, consideration will be given for minor modifications and improvements to existing instruments as may be required to address campaign goals and objectives.

Program resources for campaign support activities will be limited; however, proposals for support roles essential for conducting the measurement phase of the campaign will be considered. Support activities that will be considered include: Satellite observational support to provide near real-time observations and interpretation to guide flight planning; Model support to provide forecasts of fire activity, fire weather, and plume transport; Ground-based information collected directly or through state and local agencies on regions of expected or impending fire activity, prescribed burns (locations and schedules), fuel characterization, area burned, and other relevant information for fires sampled by the DC-8. Proposals for activities that are primarily analysis focused will not be considered in this call.

A solicitation for additional postcampaign data analysis and modeling proposals using FIREChem observations will be published at a later time.

3.2 Funding Guidelines

Proposals may request funding to cover the costs of preparation, integration (shipping to NASA Armstrong Flight Research Center, Building 703, Palmdale, CA), field deployment, data processing, data analysis, and interpretive modeling. Personnel support at an appropriate and justifiable level related to these activities will be considered. Because it is not possible to accurately budget field campaign travel costs until deployment details are finalized, proposers should not include travel costs for science team meetings, integration, and deployment in the proposal budget. Rather,
proposers should submit a workforce plan for integration and deployment, including the total
number of personnel and their respective schedules consistent with programmatic
priorities. Proposals may include travel to conferences taking place after the field
campaign to present results.

4. Summary of Key Information

<table>
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<tr>
<th>Expected annual program budget for new awards.</th>
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<td>Maximum duration of awards</td>
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<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-FIRECHM</td>
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| NASA point of contact concerning this program: | Barry Lefer  
Earth Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: (202) 358-3857  
E-mail: barry.lefer@nasa.gov |
|---|---|
1. Scope of Program

The Deep Space Climate Observatory (DSCOVR) mission is a multiagency (National Oceanic and Atmospheric Administration [NOAA], U.S. Air Force, and NASA) mission launched on February 11, 2015, with the primary goal of making unique space weather measurements from the first Sun-Earth Lagrange point (L1). The L1 point is on the direct line between Earth and the Sun located 1.5 million km sunward from Earth. The spacecraft is orbiting this point in a six-month Lissajous orbit with a spacecraft-Earth-Sun angle varying between 4 and 12 degrees. While the primary science objective of the DSCOVR mission is to provide solar wind thermal plasma and magnetic field measurements to enable space weather forecasting by NOAA, the secondary goal is to provide Earth measurements.

NASA has integrated two Earth-observing instruments, the Earth Polychromatic Imaging Camera (EPIC) and the National Institute of Standards and Technology (NIST) Advanced Radiometer (NISTAR) to the DSCOVR satellite. User guides and descriptions for these two instruments are available at https://eosweb.larc.nasa.gov/project/dscovr/dscovr_table.

The previous ROSES-14 DSCOVR element solicited algorithm development to develop additional products from EPIC synoptic sunrise to sunset observations, such as global ozone, aerosol optical depth, cloud height, and vegetation index, as well as using the NISTAR measurements to determine the Earth reflected and radiated irradiance.

It is anticipated that this program element will seek proposals to use EPIC and NISTAR measurements to exploit both the publicly-available Level 1 products and experimental Level 2 products generated by these algorithms to address one or more of the science questions articulated in the 2014 Science Plan for NASA’s Science Mission Directorate. While some continuing algorithm and calibration activities are envisaged, the future focus will be on the analysis and validation of geophysical measurements and other derived quantities.

2. NASA point of contact concerning this program

Richard Eckman
Earth Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: 202-358-2567
Email: Richard.S.Eckman@nasa.gov
NOTICE: Amended May 2, 2017. This amendment delays the due dates for this Program Element to allow more time for SnowEx data collected in February 2017 to be prepared and released to the community. Notices of Intent are now requested by June 28, 2017, and proposals are now due August 3, 2017.

1. Scope of Program

The NASA Terrestrial Hydrology program (THP) has the scientific objective to use remote sensing to develop a predictive understanding of the role of water in land-atmosphere interactions and to further the scientific basis of water resources management. The NASA THP is a component of the Global Water and Energy Cycle Focus Area (see Section 2.4 of program element A.1).

THP uses NASA’s unique view from space to study hydrologic processes associated with runoff production, hydrologic fluxes at the land-air interface, and terrestrial water stores. THP works in concert with other Earth Science Division (ESD) programs, also studying the global water cycle (e.g., precipitation, physical oceanography), to describe and understand the connections between the cycle’s different parts. THP fosters the development of hydrologic remote sensing theory, the scientific basis for new hydrologic satellite missions, hydrologic remote sensing field experiments, and the interface of hydrology with other disciplines, such as those addressed by the Terrestrial Ecology program and Modeling Analysis and Prediction (see ROSES-2017 elements A.4 and A.15, respectively). Particular emphasis is placed on the application of satellite-based remotely sensed data for characterizing, understanding, and predicting the terrestrially linked components of the hydrologic cycle and the dynamics of large-scale river basins. THP furthers study of the relationship between satellite interferometric measurements of surface deformation and changes in underground water stores. THP is currently focused on research relating to multiple missions, either currently operating, such as Global Precipitation Measurement (GPM) and Soil Moisture Active Passive (SMAP); or in planning and development, such as Gravity Recovery and Climate Experiment Follow-On (GRACE-FO) and Surface Water Ocean Topography (SWOT). THP projects are also extensively using data collected at previous or current field campaigns and projects, such as SMAPVEX (http://smap.jpl.nasa.gov), AirMOSS (http://airmoss.jpl.nasa.gov), SnowEx (https://snow.nasa.gov/snowex) or numerous others, both national and international.

THP continues to encourage use of NASA investments to improve the use of remote sensing information in weather and climate models, primarily through data assimilation approaches involving land surface models. The Land Information System (LIS; http://lis.gsfc.nasa.gov) provides a modeling test bed for potential investigations of this domain, along with an entrée into activities of other U.S. agencies.

THP is one of the nation’s programs supporting the U.S. Global Energy and Water Cycle Exchanges Project (U.S. GEWEX) and the U.S. Global Research Program (USGCRP), especially its annual priorities related to Water Cycle extremes.

2. Description of Solicited Research

The importance of water requires no preamble. As a nation and a global community, our ability to measure and predict water in all its forms and locations must improve to better assess and understand our changing environment and demands of human society and ecosystems. Research is sought to make such improvements on our understanding of the land-oriented portion of the water cycle, either by improving and/or exploiting current satellite data, describing requirements of future satellite systems, or improving and/or creating new remote sensing algorithms with an eye towards future satellites. Proposed research must fall into one of the following three categories.

2.1 Snow Remote Sensing

NASA has funded multiple large scale field campaigns to simultaneously collect snowpack measurements and other related environmental properties. These, along with existing in situ and satellite observations of snow, the land surface, and the atmosphere, can be exploited to reveal current gaps in our global snow observations. NASA solicits research to suggest, create, and improve snow remote sensing methods, especially addressing the inadequacies of current remote sensing systems to make accurate snow water equivalent observations over multiple types of terrain (e.g., fields, hills, forests, etc.). Proposers are strongly encouraged to leverage the data collected during the SnowEx'17 field campaign ([https://snow.nasa.gov/snowex](https://snow.nasa.gov/snowex)) and to prioritize improving existing or generating new methods that are implementable with current space-ready technology.

NASA satellite missions are required to have Algorithm Theoretical Basis Documents (ATBDs) to explain the motivation and proposed implementation for each science-enabling data product to be created. Responders to this section of the solicitation are strongly encouraged to review existing satellite mission documents, especially ATBDs (e.g., SMAP Handbook – [http://smap.jpl.nasa.gov/mission/description](http://smap.jpl.nasa.gov/mission/description)). While proposers do not need to include a plan to generate an entire new ATBD, they should explain how their efforts will produce information relevant to sections of a new ATBD for a hypothetical snow mission data product.

2.2 Other Hydrological Variables

The program encourages proposals that seek to improve remote sensing algorithms, and their performance, that produce these land-surface hydrology data products: groundwater, root-zone soil moisture, evapotranspiration (or transpiration), surface water, and river discharge. Other variables may be acceptable if they address a gap in the current land-surface hydrology observing system, however, in light of recent solicitations, surface soil moisture, water quality, and precipitation will be deemed noncompliant to this section.
2.3 Multivariate Hydrological Simulation

Satellite data may be best exploited when used in conjunction with a model through data assimilation. Proposals are encouraged to develop approaches which will yield a large increase in data product quality for land hydrology. Proposed approaches must incorporate at least two hydrology remote sensing information sources that employ different approaches (i.e., active vs. passive; microwave vs. visible-infrared; or microwave vs. time-varying gravity). For purposes of this solicitation section, variables such as temperatures, vegetation status (e.g., NDVI), land-cover type/change should NOT be counted as a hydrological variable. Acceptable variables would include soil moisture (surface or root-zone), surface freeze/thaw state, groundwater (or change in groundwater), evapotranspiration, transpiration, runoff, river discharge, surface water, and precipitation. Raw remote sensing data products, such as microwave brightness temperature and radar backscatter, are acceptable if they are strongly correlated with an accepted land-surface hydrology variable.

Proposals to this section may employ any model and/or data assimilation approaches, however, the program will favor in its evaluation those that are adequately aligned to current LIS tools and capabilities such that future LIS project activities could easily incorporate the output of the proposal. Thus, the program would assign a higher priority to proposals involving nonproprietary models and approaches that could be easily incorporated into LIS. Note that regardless of model and approaches used, any data products produced by the proposed project should be made readily available and accessible (which should be addressed in the proposal’s data sharing plan).

3. Programmatic Information

Total funds available for work selected under this solicitation are approximately $2.5M per annum for three years.

The program anticipates making approximately 18 selections. It is anticipated that project start dates will be no earlier than January 1, 2018.

4. Table of Key Information

<p>| Expected annual program budget for new awards | ~ $2.5M |
| Number of investigator awards pending adequate proposals of merit | ~18 |
| Maximum duration of awards | 3 years |
| Due date for Notice of Intent to propose (NOI) | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Due date for proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Planning date for start of investigation | January 2018 |
| Page limit for the central | 15 pp; see also Table 1 of ROSES and the |</p>
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<td>NASA point of contact concerning this program</td>
<td>Jared Entin [Earth Science Division] [Science Mission Directorate] NASA Headquarters Washington, DC 20546-0001 [Tel: 202-358-0275] Email: <a href="mailto:jared.k.entin@nasa.gov">jared.k.entin@nasa.gov</a></td>
</tr>
</tbody>
</table>
NOTICE: The NASA Energy and Water Cycle Study (NEWS) program will not be competed in ROSES-2017.

1. Scope of Program

The current state and evolution of the environment are critically intertwined with the water and energy cycles of the climate system. Progress towards comprehensive understanding of both cycles is enabling a better description of the current state of the climate, as well as the subtle shifts that may be going on. While global warming is often summarized as an index of mean temperatures, it is alterations of the water cycle that may be most relevant to life on Earth, especially human society. Water is fundamentally within the center of what all life needs to survive and thrive on the planet and it is no different for human society whose agriculture, energy production, recreation, etc., all require water.

Accomplishing any goals related to better understanding these two cycles requires, in part, an accurate accounting of the key reservoirs and associated fluxes, including their spatial and temporal variability. To accomplish this, integration of existing observations and research tools is a requirement. To achieve this, the NASA Energy and Water Cycle Study (NEWS) grand challenge can be summarized as documenting and enabling improved, observationally based, predictions of water and energy cycle consequences of Earth system variability and change. This challenge requires documenting and predicting trends in the rate of the Earth’s water and energy cycling that corresponds to climate change and changes in the frequency and intensity of naturally occurring related meteorological and hydrologic events, which may vary as climate may vary in the future. The cycling of water and energy has obvious and significant implications for the health and prosperity of our society. The importance of documenting and predicting water and energy cycle variations and extremes is necessary to accomplish this benefit to society.

A coordinated team effort is required that will integrate NASA’s global water and energy cycle resources to directly address the NEWS challenge. More information on NEWS is available at http://nasa-news.org. Interested collaborators with NEWS are specifically recommended to review progress and plans of current NEWS activities that are available at this web location.

Through national and international relationships, NEWS will ultimately facilitate NASA providing added value to the Earth observations resulting from NASA research and development, assist in bringing in added satellite calibration/evaluation data sources, and deliver independent observationally-based data sets for evaluating 4-dimensional data assimilation (4DDA) and prediction capabilities on a regional and global basis.

The overarching goal of NEWS investigations is to integrate Earth Science Research Program components to make decisive progress toward the NEWS challenge. To achieve this objective, the NEWS investigations will integrate and interpret past, current, and future space based and in situ observations into assimilation and prediction products and models that are global in scope. These activities will serve efforts to
improve understanding, modeling, and information for global prediction systems. To achieve these goals, the NEWS investigations must recognize that accurate prediction of not only trends in the mean, but also extremes and abrupt changes, is a key step toward useful applications. The critical feedbacks within the overall NEWS strategy are the lessons that scientific analysis, modeling, prediction, and consequences can guide and identify the technological and observational requirements of future NASA missions.

2. Point of Contact for Further Information

Jared K. Entin  
Earth Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: (202) 358-0275  
Email: Jared.K.Entin@nasa.gov
NOTICE: The Atmospheric Dynamics program will not be competed in ROSES-2017. It is tentatively scheduled to next solicit proposals in ROSES-2018.

1. Scope of Program

The study and analysis of the dynamics of the atmosphere and its interaction with the oceans and land is an important component of the Weather Focus Area. Improvement of our understanding of weather processes and phenomena is crucial in gaining an understanding of the Earth system. This component of the Weather Focus Area is primarily designed to apply NASA scientific remote sensing expertise to the problem of obtaining accurate and globally distributed measurements of the atmosphere and the assimilation of these measurements into research and operational weather forecast models in order to improve and extend U.S. and global weather prediction. NASA-sponsored research continues to gain new insight into weather and extreme-weather events by the utilization of data obtained from a variety of satellite platforms (Tropical Rainfall Measuring Mission (TRMM), Global Precipitation Measurement (GPM), Aqua, Terra, Suomi National Polar-orbiting Partnership (Suomi NPP), CloudSat, Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO), Soil Moisture Active Passive (SMAP), and Cyclone Global Navigation Satellite System (CYGNSS)) and hurricane-themed tropical field experiments. This involves remote sensing and utilization of meteorological parameters such as temperature and moisture profiles, precipitation and 3-D winds and also the interaction of these parameters with the oceans and land.

2. Point of Contact for Further Information

Ramesh K. Kakar
Earth Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: (202) 358-0240
Email: ramesh.k.kakar@nasa.gov
1. Scope of Program

NASA’s Earth Surface and Interior focus area (ESI, http://science.nasa.gov/earth-science/focus-areas/surface-and-interior) supports research and analysis of solid-Earth processes and properties from crust to core. The overarching goal of ESI is to use NASA’s unique capabilities and observational resources to better understand core, mantle, and lithospheric structure and dynamics and interactions between these processes and Earth’s fluid envelopes.

ESI studies provide the basic understanding and data products needed to inform the assessment, mitigation, and forecasting of natural hazards, including earthquakes, tsunamis, landslides, and volcanic eruptions. These investigations also exploit the time-variable signals associated with other natural and anthropogenic perturbations to the Earth system, including those connected to the production and management of natural resources.

ESI’s Space Geodesy Program (SGP) produces observations that refine our knowledge of Earth’s shape, rotation, orientation, and gravity; advancing our understanding of the motion and rotation of tectonic plates, elastic properties of the crust and mantle, mantle-core interactions, solid Earth tides; and the effects of surface loading resulting from surface water, ground water, glaciers, and ice sheets. SGP infrastructure enables the establishment and maintenance of a precise terrestrial reference frame that is foundational to many Earth missions and location-based observations.

2. Description of Solicited Research

Priorities for new research within ESI continue to derive from the goals and objectives for Earth science presented in several strategic documents listed below. ESI sponsored the NASA Challenges and Opportunities for Research in ESI (CORE) Workshop, held November 2-3, 2015, in Arlington, VA. The purpose of the workshop was to convene the community to assess progress towards meeting the goals of the 2002 Solid Earth Science Working Group (SESWG) report Living on a Restless Planet and to revisit challenges and opportunities for NASA solid-Earth science in light of scientific progress and new capabilities realized over the past decade. The recently released CORE Report synthesizes the discussions from the workshop and serves as the latest comprehensive input to ESI’s vision:

- The NASA report highlighting future pathways for GRACE, Responding to the Challenge of Climate and Environmental Change: NASA’s Plan for a Climate-
The ESI strategy is founded on the seven scientific challenges identified in the CORE Report: 1) what is the nature of deformation associated with plate boundaries and what are the implications for earthquakes, tsunamis, and other related natural hazards; 2) how do tectonic processes and climate variability interact to shape Earth's surface and create natural hazards; 3) how does the solid Earth respond to climate-driven exchange of water among Earth systems and what are the implications for sea-level change; 4) how do magmatic systems evolve, under what conditions do volcanoes erupt, and how do eruptions and volcano hazards develop; 5) what are the dynamics of Earth’s deep interior and how does Earth’s surface respond; 6) what are the dynamics of Earth’s magnetic field and its interactions with the rest of Earth system; and 7) how do human activities impact and interact with Earth’s surface and interior?

Guided by these core questions, ESI requests the following types of research investigations in 2017. Pending sufficient availability of funds, it is NASA’s intent to update these foci and compete this element on an annual basis to best address scientific and programmatic priorities:

1. **High-End Computing for ESI:** Research advancing the use of High-End Computing (HEC) resources to answer specific questions in solid-Earth science. This subsection welcomes proposals addressing observational network design and augmentation, automated processing of large datasets, and advanced analysis and simulation. Proposals that demonstrate a clear need and robust plan for use of NASA HEC resources are especially encouraged.

2. **Geomagnetic Research:** Research that utilizes remotely sensed geomagnetic observations to further advance our understanding of the solid Earth.

3. **Strengthening ESI Community Knowledge and Skills:** New ESI-relevant activities that strengthen knowledge and skills of graduate students and/or postdoctoral researchers and broaden community awareness of the ESI mission. Prospective proposers are encouraged to contact the program point of contact to discuss the relevance of their proposal.

2.1 **High-End Computing for ESI**

Rapid growth in the number of observational platforms, increased data sampling rates and real-time data streaming, and improved telemetry are greatly accelerating the
collection and availability of high spatial and temporal resolution solid-Earth science datasets. Optimizing acquisition strategies and exploiting the resulting voluminous and complex datasets to advance our understanding of the solid Earth is placing an increasing need on, and the opportunity for the application of, high-performance computing.

Space-based and airborne platforms, in combination with geodetic ground networks, are the foundation of the ESI research program. Developing an effective data collection strategy requires careful consideration of the spatial and temporal nature of the anticipated signals of interest, availability of historical and/or ongoing observations, and practical limitations on acquisition strategies, geographic distribution, and resources. Modeling studies can explore the tradeoffs between different data collection strategies, and the viability of those schemes for capturing the processes of interest. Akin to the Observing System Simulation Experiments (OSSEs) common to atmospheric data assimilation studies, this subsection welcomes proposals that consider real and simulated observations and errors associated with specific solid-Earth science questions, and inform future remote-sensing observational strategies for solid-Earth research.

The increasing number of large datasets also demands the development of modeling and analysis tools to process and interpret these observations. Observational datasets include those leveraged from international partners through ongoing Synthetic Aperture Radar (SAR) missions such as ALOS-2, Sentinel-1, TerraSAR-X, and COSMO-SkyMed, which form a growing constellation that SAOCOM and NISAR will join. The proliferation of Global Positioning System (GPS) and Global Navigation Satellite System (GNSS) satellites and associated receivers builds on an already extensive and complex network of networks, on land and perhaps in the future offshore. Modeling and analysis tools are needed to enable the production of higher-level scientific products from low-level data, and advance low-latency data processing. Similarly, high-resolution 4D data series should be exploited in forward and inverse modeling of dynamic processes and properties. Advances in automated data mining, quantification of uncertainty in data, integration of diverse data types into models, and data visualization and product curation are all needed to advance understanding of the solid Earth. To this end, this subsection also welcomes proposals to develop software tools for the analysis of large and diverse datasets, and to exploit these data in models of complex processes and properties of the solid Earth.

This subsection strongly encourages the utilization of computational resources through NASA’s High-End Computing (HEC) program. Interested proposers should consult ROSES-2017 Appendix A.1 Earth Science Research Overview, Section 4.4 High-End Computing, Networking, and Storage; and the Summary of Solicitation, Section I(d), for a summary of HEC offerings and guidance on requesting computing time. Proposals that demonstrate a clear need and robust plan for use of advanced computing resources will be given higher priority under this topic. While the use of non-NASA computing resources is welcomed, leveraging NASA HEC is preferred to outside computing support that would incur additional costs.

2.2 Geomagnetic Research

A.28-3
For nearly two decades, satellite geomagnetic research has been driven by data from international missions (with NASA partnerships) including Ørsted, CHAMP, SAC-C, and the current European Space Agency (ESA) Swarm triplet of satellites. These measurements have led to an improved understanding of complex processes contributing to geomagnetic signals across a wide range of timescales, including improved separation of more external and internal magnetic sources, recognition of subannual secular variation, and rapid core field variations. Opportunities exist to further exploit legacy datasets in combination with the growing Swarm archive. This includes further quantifying individual contributions of magnetic field sources on a wide range of temporal and spatial scales, improved forecasts of decadal and shorter changes in the field, insights into flow in the core and conductivity of the mantle, and understanding the links between lithospheric magnetization and near-surface properties and processes, including as Swarm potentially descends to altitudes below 300–400 km with unrivaled sensitivity to lithospheric fields. This subtopic welcomes proposals that utilize remotely sensed geomagnetic observations to further advance these and other scientific objectives focused on advancing understanding of the solid Earth. Collaboration between educational institutions and NASA Centers is strongly encouraged.

2.3 Strengthening ESI Community Knowledge and Skills

NASA observations enable unique contributions towards advancing our understanding of the solid Earth, but only a small cross section of Earth scientists exploit these data. Broadening awareness of and access to the ESI mission and associated resources, coupled with scientific, technical, and/or communications training, is essential for sustainability of the community and could stand to grow the scientific impact of NASA investments.

This subsection calls for new activities that strengthen knowledge and skills of graduate students and/or postdoctoral researchers in the domain of ESI research. Topical foci must be relevant to ESI. Critical challenges include awareness of how NASA contributes to scientific goals of interest to the broader community, the steep learning curve for accessing and utilizing NASA data, and lack of documentation for tools and workflows that facilitate the latter. Online tutorials, social media as a dissemination platform, short courses, and workshops targeting students are examples of activities that can help to meet these goals. Proposals may consider leveraging existing educational platforms or other community activities, but in doing so must present a strong case for wholly new ESI-oriented impacts for graduate students and/or postdoctoral fellows.

Proposals should, at a minimum, include details on the types of activities and/or materials envisioned, selection processes for outside participants, leadership and oversight, logistics, and a detailed budget for all efforts. Proposals must also include a plan for developing, collecting, and assessing metrics that inform the impact of the proposed activities. Prospective proposers are encouraged to contact the program point of contact to discuss the relevance of their proposal. NASA anticipates making one to two awards under this subsection, depending on proposal quality and relevance. Collaboration between educational institutions and NASA Centers is strongly encouraged.
3. Programmatic Guidelines

3.1 Solid-Earth Research Focus

A clear focus on advancing scientific understanding of solid-Earth processes and/or properties is required in all proposals.

3.2 Remote Sensing Focus

Substantive connection to remote sensing data is required in all proposals. Proposers are encouraged to utilize existing or planned ground-, airborne-, and space-based observational capabilities and their associated data sets. These resources include the existing high-resolution SRTM dataset, ongoing satellite and airborne Light Detection and Ranging (LIDAR), and spectral imaging, such as ASTER and MODIS that provide structural and compositional models to inform tectonic and climatic influences on evolving terrains. Geodetic observations utilizing GNSS, SAR, and Interferometric SAR (InSAR) provide insights into dynamic processes. Ongoing and future missions such as ALOS-2, Sentinel-1, TerraSAR-X, COSMO-SkyMed, SAOCOM, and NISAR provide additional and upcoming opportunities in this realm. Magnetic and gravity missions, such as the historical Ørsted, CHAMP, SAC-C, and GOCE, ongoing Swarm and GRACE, and future GRACE-FO, offer long-term records that inform models of the geodynamo and the structure, composition, and dynamics of the Earth's mantle, lithosphere, and fluid envelopes. These and other NASA datasets are cataloged in the Earth Observing System Data and Information System (EOSIDS) and provided by the Distributed Active Archive Centers (DAACs).

3.3 Requirement for Proposals Requesting Acquisition of New Airborne Data

Proposals requiring data from airborne sensors must detail in their cost plan all costs for acquiring the new data sets, including costs for aircraft hours, deployment costs, mission peculiar costs, data processing costs, and other costs associated with deploying the sensors and aircraft (this includes NASA and non-NASA sensors and platforms). In addition, for any proposed activities requiring NASA aircraft or NASA facility sensors, proposers should submit a Placeholder Flight Request to the Airborne Science Flight Request system at https://airbornescience.nasa.gov/. If the instrument or aircraft are not NASA facilities, proposers must take responsibility for making all arrangements to secure the availability of the needed sensors and aircraft and explain these plans in the proposal.

4. Summary of Key Information

| Expected annual program budget for new awards | ~$3M |
| Number of new awards pending adequate proposals of merit | ~15-20 |
| Maximum duration of awards | 3 years |
| **Due date for Notice of Intent to propose (NOI)** | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| **Due date for proposals** | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| **Planning date for start of investigation** | January 1, 2018 |
| **Page limit for the central Science-Technical-Management section of proposal** | 15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers. |
| **Relevance** | This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| **General information and overview of this solicitation** | See the ROSES Summary of Solicitation. |
| **Detailed instructions for the preparation and submission of proposals** | Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers. |
| **Submission medium** | Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. |
| **Web site for submission of proposal via NSPIRES** | http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376) |
| **Web site for submission of proposal via Grants.gov** | http://grants.gov (help desk available at support@grants.gov or (800) 518-4726) |
| **Funding opportunity number for downloading an application package from Grants.gov** | NNH17ZDA001N-ESI |
| **NASA point of contact concerning this program** | Benjamin R. Phillips Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-5693 E-mail: ben.phillips@nasa.gov |
NOTICE: Before any work is begun on a proposal to this program, potential proposers should read the first section entitled Important Caveat to Potential Proposers.

Important Caveat to Potential Proposers

Before any effort is expended in preparing a proposal, potential proposers should:

- Read this solicitation in its entirety. It has a number of specific requirements. Failure to meet them will result in a proposal being returned without review.
- Understand that NASA reserves the right to return or decline proposals to this solicitation based on internal review with limited feedback to the proposers.
- The Earth Science Division (ESD) has not reserved any funds dedicated to this solicitation, but anticipates that its individual programs will consider support of a very small number of meritorious proposals each year.
- Prior to proposal submission, contact the most relevant NASA program officer (http://science.nasa.gov/researchers/sara/program-officers-list/#earth) and the current Rapid Response and Novel Research in Earth Science (RRNES) program officer (listed below). Proposers that forego this step run an increased risk of having their proposals declined or returned without review.
- Proposals should normally be for support of one year or less, under the assumption that further work will be proposed to another program.
- This solicitation is not intended to support mitigation of active disasters or immediate hazards. Contact the Disasters Program Manager in NASA’s Applied Sciences Division and/or the other most relevant NASA program manager directly to discuss expedited options (http://science.nasa.gov/researchers/sara/program-officers-list/#earth).
- While the ESD does its best to review proposals quickly, because of the funding nature of this solicitation sometimes a response may take longer than anticipated.
- Note that support for "limited duration opportunity for an unanticipated research collaboration," which had been included in earlier versions of the RRNES solicitation, has been eliminated. Proposers interested in support for such activities should contact their NASA program manager directly to see if support can be arranged by another method.

1. Introduction

In order to address its strategic goals and objectives (see Section I of the ROSES Summary of Solicitation), the ESD of the Science Mission Directorate (SMD) acknowledges that there are important and highly relevant research topics and opportunities that cannot be anticipated in the annual ROSES solicitation. In particular, it is usually not possible to solicit the following two types of activities:

- Immediate research activity to take advantage of a target of opportunity due to an unforeseen event in the Earth system,
• Exceptionally novel and innovative ideas to advance Earth remote sensing that
do not fit within ESD’s current slate of solicitations and/or programs.

ESD has not reserved any funds dedicated to this solicitation, but anticipates that its
individual programs will consider support of a very small number of meritorious
proposals each year.

2. Scope of Program
This program element solicits proposals that advance the goals and objectives of
NASA’s Earth Science Division by conducting unique research to investigate 1) unforesen or unpredictable Earth system events and opportunities that require a rapid
response, and 2) novel ideas of potential high merit and relevance for ESD science to
advance Earth remote sensing that have not otherwise been solicited by NASA in the
past three years.

2.1 Rapid Response to Earth System Events
This subelement is focused on research proposals having great urgency for action
involving quick-response research on natural or anthropogenic extreme events and/or
similar unanticipated or unpredictable events that fall outside the norm. Examples are
major fires, volcanic eruptions, 100-year floods, episodes of severe and large-scale
environmental pollution, harmful algal blooms, coral bleaching events, and other
unexpected large-scale events causing rapid environmental change.

The research activities proposed must require rapid, near-term data acquisition, field
work, and/or other such research activities. Given the significance of these events, rapid
sharing of data and results are expected. Proposers are strongly encouraged to contact
the NASA program officer(s) whose expertise best matches the proposal topic before
submitting a proposal, in order to determine whether the proposed work is appropriate
for this ROSES program element and if funding is likely to be available for a meritorious
proposal.

The proposal must include clear statements as to 1) why the proposed research is of an
urgent nature, 2) why the proposed research is of high significance and likely to have a
long-lasting impact, 3) why this ROSES program element is the only feasible
mechanism to request NASA support for the proposed work, and 4) a detailed plan on
data dissemination and sharing.

Please note that this element is not intended to support mitigation of active disasters or
immediate hazards. Please contact the Disasters Program Manager in NASA’s Applied
Sciences Division and or the other most relevant NASA program manager directly to
discuss expedited options (http://science.nasa.gov/researchers/sara/program-officers-
list/#earth).

2.2 Novel Ideas in Earth Remote Sensing
This subelement is intended to provide an open, systematic, competitive process for
NASA’s ESD to consider proposals for exceptionally novel scientific research that
include remote sensing of the Earth which cannot be considered relevant to any other
NASA solicitation. ESD recognizes that such proposals offer the possibility for major scientific breakthroughs and new approaches to remote sensing and knowledge of the Earth system. ESD offers this subelement as a mechanism for researchers to develop their ideas and justify near-term investment through an important new capability or scientific application that will advance ESD goals and objectives.

Proposals must focus on topics that offer fundamental scientific research to advance Earth remote sensing, including new ways of interpreting remote sensing data or improving knowledge of the Earth system and its processes. Proposals may include calibration and validation work, as appropriate.

Proposals that focus on instrument or technology development, data and information systems research, or educational activities are strongly discouraged.

If the topic is relevant to any other ESD ROSES program element(s), it should not be submitted here, but should be submitted to the relevant element. In addition, in order for a proposal to be considered responsive as novel Earth science, the topic and approach must not have been solicited or have been considered responsive under any NASA solicitations during the past three years (this includes ROSES-2014–ROSES-2016, NASA Announcements of Opportunity, etc.). Any proposal that contains research that in the view of cognizant NASA managers violates one or both of these requirements will be considered as nonresponsive and declined without further review.

NASA anticipates that only a very small number of proposals will meet these criteria each year and that selection and funding of such proposals will be a rare, but a strategically important occurrence.

3. Relevance to SMD’s Goals and Objectives

Proposals submitted in response to this solicitation must demonstrate the relevance of the proposed activity to ESD by showing how the Scientific/Technical area(s) to be covered will advance not only high-level ESD goals and objectives, but also specific (existing or anticipated) outcomes identified in ROSES program elements, ESD roadmaps, other ESD program documents, the NASA Science Plan, findings in decadal surveys, or the reports of NASA advisory bodies or groups relevant to NASA. Proposers must explicitly state from what source (e.g., ROSES program element, roadmap, or decadal survey) the claim of relevance derives. Proposers are referred to the Earth Science Overview in Appendix A.1 of this solicitation for a description of the scope of NASA Earth Science activities and the research programs areas and topics of interest.

To be relevant under this program element, proposals must take into consideration ESD’s defined scope and its focus on the use of airborne and/or space-based measurements to provide information about the Earth system.

4. Programmatic Information and Additional Requirements

4.1 Proposal Structure, Content, and Budget Requests

Prior to any submission, proposers are encouraged in the strongest possible terms to contact the ESD program managers (http://science.nasa.gov/researchers/sara/program-
officers-list/) whose expertise are most germane to the proposal topic to determine the appropriateness of the work for consideration under this program element. This may include consideration of whether funding is potentially available.

4.1.1 Proposals for Rapid Response to Earth System Events

The Technical Plan for proposals submitted for rapid response is limited to a maximum of five pages and must include clear statements as to why the proposed research is of an urgent nature and why this solicitation is the only feasible mechanism to request NASA support for the proposed work, as well as the other requirements listed in the text of the subelement. The bulk of the Technical Plan should be devoted to describing the core scientific objectives and anticipated scientific return, the research work to be done, and the timetable for rapid actions. If NASA facilities will be required to conduct the research (e.g., NASA aircraft or airborne sensors), proposers should contact the relevant facility managers to develop feasibility and cost estimates in parallel with the preparation of their proposal. Feasibility and cost estimates should be submitted as part of the budget justification.

Questions regarding the NASA flight request system or processes should be addressed to Marilyn Vasques, Flight Request Manager (Marilyn.Vasques@nasa.gov or 650-604-6120).

To ensure timely processing of the submitted proposal, "Rapid Response" must be selected as the Primary Investigation Type on the proposal cover sheet. On the cover sheet, the relevant program manager/program under which the proposal should be considered should also be indicated.

NASA will initially conduct an internal review of each proposal that may result in a decision, and there may be limited feedback to the proposer. Some proposals may be declined simply for lack of available funding. However, proposals may also be subject to external peer review at the discretion of NASA. The larger the requested funding, the more comprehensive (e.g., the use of external mail review) the review is likely to be.

Budget requests should be commensurate with the nature of the rapid response work to be conducted and, if no other research projects are being leveraged, include sufficient funding for processing of the data and its public distribution, as well as minimal data analysis to achieve the core, near-term objectives of the rapid response. Full exploitation of a successfully acquired data set can be included in future competitive ROSES disciplinary program elements and should not be requested here.

Proposals should normally be for support of one year or less, under the assumption that further work will be proposed to one of the ongoing research programs or one of the other periodic ROSES elements (e.g., competed mission science teams, Interdisciplinary Science, etc.). Up to three years of funding may be requested, but proposals requesting more than one year of funding must provide specific and compelling justifications as to why the core, rapid response science objectives require a longer duration for completion.
4.1.2 Proposals for Novel Ideas in Earth Remote Sensing

The Technical Plan for Novel Ideas in Earth Remote Sensing proposals is limited to a maximum of 15 pages and must include clear statements as to why the proposed scientific research is novel and not responsive to any other NASA solicitations released in the past three years. The technical plan should emphasize the initial research activities needed to explore the feasibility of the new idea, prove the concept, and/or provide a first demonstration of the potential utility and benefits to NASA Earth science, as well as the other requirements listed in the text of the subelement. Potential proposers are encouraged to pay close attention to the types of research that are discouraged for this area as noted in Section 2.2 (“instrument or technology development, data and information systems research, or educational activities”).

It is anticipated that most such studies will be conducted in one year at modest cost (e.g., ~$75-$150K), and that continued funding would be sought from proposals submitted to open research programs or periodic ROSES elements (e.g., competed mission science teams, Interdisciplinary Science, etc.). However, up to three years may be requested, but the proposal must fully justify the need for that length of time. In addition, all proposals must describe plans for the publication/documentation/dissemination of their results at the earliest possible date.

NASA will initially conduct an internal review of each proposal that may result in a decision, and there may be limited feedback to the proposer. Some proposals may be declined simply for lack of available funding. In some cases, NASA will, at its discretion, conduct a full peer-review of the proposal, most likely involving individual evaluations submitted through NSPIRES. However, if sufficient proposals are received, NASA reserves the right to convene a peer review panel. NASA’s standard evaluation criteria will be used in reviewing these proposals. The uniqueness of the research proposed and the degree of innovation will be weighed heavily under the intrinsic merit criterion, as well as under relevance.

4.2 Availability of Funding

No specific budget is identified for this program element; selected proposals will be funded by the ESD program managers in the disciplines most closely related to or benefitting from the proposed work. The number of proposals selected will be dependent on the availability of funds, as well as the number and quality of proposals submitted.

Potential proposers should contact both the NASA Point of Contact for this solicitation and the ESD Program Officers in the disciplines and programs most germane to the proposed investigations to discuss the proposed work and the availability of funds. Contact information for SMD Program Officers is available at http://science.nasa.gov/researchers/sara/program-officers-list/#earth or in the Summary Information table at the end of a ROSES program element description.
4.3. **Award Instruments**

Awards selected under this solicitation will only be supported as a grant, a cooperative agreement, an interagency agreement, or internal funding to a NASA Center. Contracts will not be used for these awards.

5. **Summary of Key Information**

<table>
<thead>
<tr>
<th>Expected annual program budget for new awards</th>
<th>No specific budget is identified; selected proposals will be funded by the relevant program(s).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>The number of proposals selected will be dependent on the availability of funds from the relevant program(s), as well as the number and quality of proposals submitted.</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>3 years (but see sections 4.1.1 and 4.1.2)</td>
</tr>
<tr>
<td>Due date for Notice of Intent to propose (NOI)</td>
<td>No Notices of Intent are requested for this program element.</td>
</tr>
<tr>
<td>Due date for proposals</td>
<td>Proposals may be submitted at any time until 11:59 PM (Eastern time) on March 29, 2018.</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>No sooner than 1 ½ months after proposal receipt for Rapid Response, and 6 months after proposal receipt for Novel Earth Science.</td>
</tr>
<tr>
<td>Page limit for the central Science/Technical/Management section of proposal</td>
<td>5 pp for Rapid Response and 15 pp for Novel Earth Science; see also Table 1 of ROSES and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Relevance</td>
<td>See section 3. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
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<td>Submission medium</td>
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<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
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<td>Web site for submission of proposal via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
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<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
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</tr>
</tbody>
</table>
| NASA point of contact concerning this program | Laura Lorenzoni  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-0917  
Email: laura.lorenzoni@nasa.gov |
NOTICE: The Airborne Instrument Technology Transition program will not be competed in ROSES-2017. The program may next solicit proposals no earlier than ROSES-2018.

1. Scope of Program

NASA’s Earth Science Research Program is a comprehensive effort that develops observational techniques and instrument technologies needed to implement them. These instruments are operated in the laboratory and from suborbital (i.e., surface, balloon, and aircraft) and space-based platforms to support science investigations. In many cases, airborne data are used to increase basic process knowledge and, in other applications, airborne data products are incorporated into complex computational models that characterize the present state and future evolution of the Earth System.

Within the Earth Science Division, the Airborne Science Program is responsible for providing airborne instrument systems capable of delivering data products that advance science and that complement other observing assets, such as satellites. This is accomplished primarily through focused field experiments for process studies, evaluation and risk retirement of new instrument concepts, and calibration and validation of space-based sensors.

This announcement seeks to upgrade mature instruments developed under NASA’s Instrument Incubator Program, or by similar NASA programs or activities, for operation from various platforms supported by the Airborne Science Program. This opportunity provides for engineering activities leading to the integration of instruments to airborne platforms that will deploy them as part of organized airborne science campaigns which typically involve multiple instruments and/or platforms. The goal is to upgrade existing operating instruments to campaign-ready airborne configuration(s). No funding is available for research and development of new instrumentation.

Proposals submitted to this announcement shall support the objectives of one or more of the Earth science focus areas. Earth science focus areas include: Carbon Cycle and Ecosystems, Climate Variability and Change, Water and Energy Cycle, Atmospheric Composition, Weather, and Earth Surface and Interior (see Appendix A.1 for descriptions of the focus areas). Relevance to these focus areas is indicated by the degree to which instrument products (i.e. science and engineering data) support the goals and activities of existing and future field campaigns sponsored by the NASA Research and Analysis program; it may also be demonstrated by relevance to the goals and activities of NASA’s Applied Science Program. Examples of previous field campaigns can be found at the Airborne Science Website.

The following documents identify the relevant missions and programs for this program:

1. *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* may be accessed on the web at [http://www.nap.edu/catalog/11820.html](http://www.nap.edu/catalog/11820.html). This report is hereinafter referred to as the "Decadal Survey."


2. **Point of Contact for Further Information**

   Barry Lefer  
   Earth Science Division  
   Science Mission Directorate  
   National Aeronautics and Space Administration  
   Washington, DC 20546-0001  
   Telephone: (202) 358-3857  
   Email: Barry.Lefer@nasa.gov
NOTICE: The Earth Science U.S. Participating Investigator (USPI) program will not be competed in ROSES-2017. The Earth Science USPI program is tentatively scheduled to next solicit proposals in ROSES-2018.

The Earth Science U.S. Participating Investigator (USPI) program facilitates participation on a foreign space mission as a Co-Investigator (Co-I) for an instrument, experiment, or technology demonstration that is being built and flown by a sponsor agency other than NASA. The Co-I role can include, but is not limited to, instrument design, modeling, and simulation of the instrument’s operation and measurement performance; calibration of the instrument; and/or development of innovative data analysis techniques. A USPI may also serve as a member of a foreign space mission science or engineering team and participate in science team activities, such as mission planning, mission operations, data processing, data analysis, and data archiving. No matter what the nature of the USPI role, an investigation proposed under this category must be for a science or technology investigation and must include a meaningful contribution to the development of products, including, but not limited to, algorithm development and/or testing, calibration/validation, and/or requirements definition (especially as may be carried out in Observing System Simulation Experiments). Proposals were last received in August 2016, and it is anticipated that proposals will be solicited again in ROSES-2018.

For information on this program, contact:
Richard S. Eckman
Earth Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: (202) 358-2567
Email: Richard.S.Eckman@nasa.gov
NOTICE: Interdisciplinary Research in Earth Science will not be competed in ROSES-2017. This program is tentatively scheduled to next solicit proposals no earlier than ROSES-2019.

1. Scope of the Program

This solicitation is issued periodically for new and successor interdisciplinary research investigations within NASA’s Interdisciplinary Research in Earth Science (IDS) program. Proposed research investigations must meet the following criteria: a) offer a fundamental advance to our understanding of the Earth system; b) be based on remote sensing data, especially satellite observations, but including suborbital sensors as appropriate; c) go beyond correlation of data sets and seek to understand the underlying causality of change through determination of the specific physical, chemical, and/or biological processes involved; d) be truly interdisciplinary in scope by involving traditionally disparate disciplines of the Earth sciences; and e) address at least one of the specific themes listed in the specific solicitation.

As an example, in ROSES-2016, the themes were:

- Understanding the Global Sources and Sinks of Methane
- Ecology at Land/Water Interfaces - Human and Environmental Pressures
- Understanding the Linkages Among Fluvial and Solid Earth Hazards
- Life in a Moving Ocean
- Partitioning of Carbon Between the Atmosphere and Biosphere

It is expected that the themes in any subsequent IDS solicitation will differ significantly from those from ROSES-2016 or other prior solicitations.

The results of these investigations will improve our capability for both prognostic predictions and retrospective simulations of the Earth system. They will also advance our understanding of the vulnerabilities in human and biogeophysical systems, and their relationships to climate extremes, thresholds, and tipping points.

Meeting these goals requires approaches that integrate the traditional disciplines of the Earth sciences, as well as innovative and complementary use of models and data.

2. Context and History

Since its inception more than a decade ago, NASA’s IDS program has advanced the goal of understanding the Earth system by promoting interdisciplinary research and exploiting the vast wealth of data from NASA satellite and airborne sensors. The program’s focus has generally aligned with the goals of the U.S. Global Climate Change Research Program (http://globalchange.gov/). Substantial contributions have also been made to Earth system model development, training the next generation of interdisciplinary scientists, and developing the necessary infrastructure to take full advantage of NASA satellite data.
The specific topics of the program have varied through time (see prior solicitations and awards at nspires.nasaprs.com), and this solicitation represents the development of new elements and the continuation of others.

The specific scientific topics and questions identified by the subelements in a future solicitation will constitute the priorities for that solicitation. Proposals submitted in response to a future IDS element MUST address at least one of the identified subelements, and proposals MUST identify clearly which subelement or subelements are addressed.

Proposed research investigations must also meet all of the following criteria, and each of these should be specifically addressed in the proposal:

- offer a fundamental advance to our understanding of the Earth system;
- be based on remote sensing data, especially satellite observations, but including suborbital sensors as appropriate;
- go beyond correlation of data sets and seek to understand the underlying causality of change through determination of the specific physical, chemical, and/or biological processes involved;
- be truly interdisciplinary in scope by involving traditionally disparate disciplines of the Earth sciences; and
- address at least one of the five specific subelements listed below.

Proposals developing significant new datasets must include a data management plan.

In future solicitations, NASA expects to have separate peer review panels for each subelement, and proposals will be assigned to one or more panels based on the proposer’s identification of the appropriate subelement, as well as NASA’s assessment of proposal content. While NASA expects to select proposals in each of the identified subelements, NASA reserves the right to select proposals in none, some, or all of them depending on the nature and distribution of proposals received and the outcome of the peer review process.

3. Point of Contact

General questions about the IDS Program may be directed to:

Jack A. Kaye
Associate Director for Research, Earth Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: 202-358-2559
E-mail: Jack.A.Kaye@nasa.gov
NOTICE: Amended on August 29, 2017. To give more time to proposers who are without power because of Hurricane Harvey, this amendment delays the due date for a number of program elements including this one. Please see Table 2 or Table 3 for the latest due dates.

1. Scope of Program

Proposals are solicited for participation in the Science Team for the Orbiting Carbon Observatory-2 (OCO-2) and Orbiting Carbon Observatory-3 (OCO-3) Missions.

NASA launched the OCO-2 mission in July 2014, and it has been operating on orbit producing precise column average CO2 concentration data globally with validated precision and accuracy of better than 0.5% globally since September 2014. Given that the OCO-2 project did not require use of the flight spare instrument built as part of that project, it has been made available for a mission of opportunity on a NASA selected platform as a successor project to the OCO-2 mission. That mission, OCO-3, calls for the flight spare to be deployed on the International Space Station (ISS) in late 2018, and is now in development.

Both of these missions are following the successful Greenhouse gases Observing Satellite (GOSAT) mission from the Japanese Aerospace Exploration Agency (JAXA), which launched in 2009. The OCO-2 project, and currently existing science team, have been working closely with the GOSAT project to best assure accuracy and consistency in the data products from all three missions (GOSAT, OCO-2, OCO-3).

The primary goal of both OCO missions is to make global observations of column abundances of atmospheric CO2 to better understand the processes that control this important greenhouse gas. These processes include exchange between the atmosphere and oceans and terrestrial biosphere, and emissions from anthropogenic sources. Global observations from a satellite are desired because they provide a significantly more dense set of data over a much wider range of conditions than can be provided by surface observations alone. These observations of abundances of CO2 require precisions and accuracies of better than 0.3% (or 1 ppm), which are significantly lower than variations seen both globally and regionally, and with sensitivity to the boundary layer of the atmosphere.

These observations are obtained through retrievals from high precision, high resolution, near infrared spectra of two CO2 channels and one channel of the O2 A-band in nadir viewing solar reflection geometries. The latter is to ensure knowledge of the dry air column of the same air mass as observed by the co-aligned CO2 channels. Dividing the CO2 column by the dry air mass column provides average column dry air mixing ratios (XCO2). These observations produce narrow swath (10.3 km), narrow footprint (3 km²) observations around the globe with an observational repeat cycle of 16 days. The small footprint was chosen to reduce the influences of cloud and aerosol contamination in the observed spectra to better ensure reduced systematic uncertainties in the retrieved abundances.
Additional information on the OCO-2 and OCO-3 missions can be found at the OCO-2 website: http://oco.jpl.nasa.gov.

OCO-2 operates in a Sun synchronous orbit and coordinated with many other Earth observing satellites as part of the A-Train constellation. Information on the A-Train, and the other observations being made, can be found at http://atrain.nasa.gov/. This orbit allows for near-global coverage, with the observations at any latitude occurring at roughly the same solar time each orbit. OCO-3 on the ISS (orbital inclination of 51.5 degrees) will be in a precessing orbit. This orbit does not allow for observations over high latitude regions and the solar times of the observations at any latitude will change with each orbit. This provides both limitations and opportunities in using the data for understanding CO₂ exchange processes. Plus, OCO-3 will have a more agile (faster) scene selection mechanism, allowing for more focused mapping of regions of interest when scientifically appropriate.

2. Science Team for the OCO-2 and OCO-3 Missions

The OCO-2 mission has now been operating for more than the two years of prime mission, and is now in extended operations. A number of versions of the data products have been made available to the research community through the NASA Goddard Earth Science Data and Information Services Center (GES DISC), and a new version is expected to be available in the middle of 2017. Hence, most of the desired contributions to the OCO-2 team will be for science analysis of the data sets to effectively advance the science goals of OCO-2. There are some focused activities being solicited that have the goal of allowing the production of improved data products in the future, and in the future that can also be applied to OCO-3. The OCO-3 project should complete its development during the three years of this program element and be deployed roughly 18 months after the selected projects begin. OCO-3 specific tasks will focus on ensuring the taking advantage of the unique observational characteristics of OCO-3 relative to OCO-2, and to ensure consistent data quality between the two missions. These tasks include:

- Performance of flux inversion analysis using OCO-2 data (GOSAT data may be included, as appropriate), including the assessment of retrieval errors on flux inversions in order to significantly advance the understanding of carbon cycle processes;
- New research and innovative analyses using data from OCO-2, combined with other sensors (e.g., GOSAT, other A-Train sensors, SMAP) to advance the science goals of OCO-2 in order to significantly advance our understanding of carbon cycle processes (both ocean and terrestrial) and/or anthropogenic emissions;
- Studies that take full advantage of the Solar Induced Fluorescence data product from OCO-2/OCO-3 in combination with the Level 2 CO₂ product and other satellite based observations to significantly advance our understanding of carbon cycle processes;
- Significant improvements to OCO-2/OCO-3 relevant spectroscopy, particularly of the O₂ A-band, that can be shown to reduce biases in the level 2 data sets to a level that will advance OCO science objectives;
• Assessing retrieval biases, errors and covariances in the OCO-2 and OCO-3 Level 2 products relative to key variables such as observational geometries, clouds, aerosols, and surface reflections that will ensure better scientific interpretation of the Level 2 data product;
• Validation strategies for Level 2 products (including XCO₂, cloud detection, solar induced fluorescence) beyond the current validation plan of the OCO-2 and OCO-3 projects. That plan can be found at https://co2.jpl.nasa.gov//static/docs/OCO-2_SciValPlan_111005_ver1_0_revA_final_signed.pdf. Validation activities include possible new sources of validation data traceable to WMO standards and useful to OCO-2 and OCO-3, with primary interest in undersampled regions of the globe (South America, Africa, etc);
• Analysis of OCO-2 and OCO-3 data sets for understanding discrete sources of CO₂ emissions, particularly considering OCO-3 capabilities.

The available budget for OCO-3 related activities is $1.0M per year, with the rest available for OCO-2 specific activities. Proposal teams should indicate budgets that are consistent with the available funds if they are proposing activities that are partially or entirely related to OCO-3 activities.

3. Proposal Requirements

Proposals for Science Team (ST) membership should include a 15-page description of the proposer’s interest and the expertise the proposer would contribute to the ST. Proposals will be evaluated on the basis of the principal investigator’s proven capabilities, as well as the approaches and activities proposed to address topics that will ensure maximizing the science return for OCO-2 and OCO-3.

Non-U.S. organizations are welcome to submit proposals on a no-exchange-of-funds basis and within the constraints described in the NASA Guidebook for Proposers (http://www.hq.nasa.gov/office/procurement/nrauidebook/). For such proposals, it is critical that the proposal contains a certification that a sponsoring foreign government agency or foreign institution commits to bear the cost of the research proposed to be performed by the non-U.S. organization should the proposal be selected by NASA.

4. Summary of Key Information

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected annual program budget for new awards</td>
<td>~ $3.5M/year</td>
</tr>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>~ 15-20</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>3 years.</td>
</tr>
<tr>
<td>Due date for Notice of Intent to propose (NOI)</td>
<td>Not requested.</td>
</tr>
<tr>
<td>Due date for proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>6 months after proposal due date.</td>
</tr>
<tr>
<td><strong>Page limit for the central Science-Technical-Management section of proposal</strong></td>
<td>15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Relevance to NASA</strong></td>
<td>This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td><strong>General information and overview of this solicitation</strong></td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td><strong>Detailed instructions for the preparation and submission of proposals</strong></td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Submission medium</strong></td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Web site for submission of proposal via NSPIRES</strong></td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td><strong>Web site for submission of proposal via Grants.gov</strong></td>
<td><a href="http://grants.gov/">http://grants.gov/</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
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<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
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</tr>
</tbody>
</table>
| **NASA point of contact concerning this program** | Kenneth W. Jucks  
Earth Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: (202) 358-0476  
Email: kenneth.w.jucks@nasa.gov |
NOTICE: Amended on December 8, 2017. This amendment releases final text for this program element. Proposers are strongly encouraged to submit a NOI by January 31, 2018. Proposals are due April 12, 2018.

Unlike the rest of ROSES this program does not use the standard NSPIRES budget forms, nor a separately uploaded "total budget" file. Instead proposers must include in the proposal a filled out budget template downloadable here. These awards are cost capped. The cap includes (and the proposal must display) salary fringe and overhead for all participants (including NASA civil servants).

Proposers to this program must use the templates for the Table of work effort and Current and Pending Support for PI and Co-Is downloadable here.

NASA sincerely appreciates the comments and questions received related to the DRAFT version of this program element. Potential proposers are encouraged to download the Comments and Frequently Asked Questions (FAQs) PDF documents from the A.34 ROSES NSPIRES page, these documents contain all of the community feedback we have received so far. These documents will be updated as new questions and comments are submitted. The major changes between the DRAFT and FINAL versions of this program element include: 1) no longer any differences in the prescribed costs for international and domestic investigations, 2) Appendix I has been expanded to describe which costs should be included in each category, 3) a new appendix contains the Proposal Feasibility Assessment Criteria, and 4) changed and clarified the science management roles.

1. Earth Venture Suborbital-3: Venture-class Investigations


Building on and evolving programmatically from previous Earth Venture Suborbital solicitations in 2009 and 2013, this Earth Venture Suborbital-3 (EVS-3) program element solicits science proposals for multi-year, Principal Investigator-led, suborbital campaign-based investigations to advance Earth system science objectives in order to better understand the current state of the Earth and to predict future change.
The intent of this EVS-3 program element is to focus the evaluation of the proposal on scientific merit by dramatically reducing the level of detail requested for logistics, management, and costs for implementation related aspects of the proposed investigations. An additional objective is to encourage greater and more timely scientific output.

As in the previous Earth Venture Suborbital solicitations, successful competitively selected proposals to this opportunity will describe investigations that:

- advance Earth system science objectives through temporally sustained acquisition of large-scale (regional or larger) measurements sufficient and necessary to prove/disprove a scientific hypothesis or address scientific questions;
- employ mature technology where, at a minimum, any critical instrument system/subsystem model or prototype will have already been demonstrated in a relevant environment by the time of proposal submission (Technology Readiness Level (TRL) of 6 or greater) (https://airbornescience.nasa.gov/sites/default/files/documents/TRL%20Levels.pdf);
- are led by a single Principal Investigator (PI) responsible for achieving all scientific objectives of the investigation: data acquisition, data set production and transfers to a NASA-identified archive and distribution center, scientific analysis, and dissemination of results;
- are schedule-constrained such that all necessary data acquisition and science analysis activities will be completed within 5 years of the project start (when initial funding starts); and
- are cost-constrained such that completion of all necessary data acquisition and science analysis activities will require NASA funding not to exceed the amount agreed at the post-selection Investigation Confirmation Review (see Sections 2.3.1.4 and 2.3.2 below).

Based on programmatic lessons learned from previous Earth Venture Suborbital solicitations and implementations, this EVS-3 opportunity introduces changes to key aspects of the proposal including focus, quantitative cost constraints, and management approaches for campaign planning and execution, as well as mandatory post-selection decisional reviews required for continuation of the investigation through its lifetime. Proposals must:

- be science-focused, concentrating on detailed descriptions of the science to be achieved including goals and objectives, identification of science team members and their specific data acquisition and analysis responsibilities and deliverables;
- include a discussion of data product generation, and a data analysis and publication plan;
- include the governance structure for the science portion of the investigation;
- include a Science Traceability Matrix;
- include discussion of any partner arrangements; and
- include the general campaign and flight requirements, a milestone schedule and a general discussion of execution and risk.
This EVS-3 solicitation provides opportunities for 2 different classes of investigations, differentiated by their overall cost constraints: "Large" investigations with overall NASA cost constraint of $30 million (M) over the lifetime of the investigation, and "Small" investigations with overall NASA lifetime cost constraints of $15M. NASA intends to select at least one investigation in each class, consistent with proposal quality and focus, and funding availability. The total funds awarded will be approximately $120M.

The associated complex, detailed campaign execution planning, including management planning, logistics, costs, risks, and the other issues necessary for all suborbital airborne platform deployments and flights will be carried out after selection by the PI and a Field Deployment Management (FDM) team. The FDM will be determined jointly by NASA and the investigation PI after selection. The cost of the FDM is to be included in the investigation cost cap. See section 2.3.1.4 below.

The ESSP Program Office (ESSP PO) will manage the EVS-3 investigations in accordance with chapter 5 of NPR 7120.8 as well as other NASA policies and procedures. In addition to other reviews a mandatory Investigation Confirmation Review (ICR), conducted within 1 year of selection, will formally finalize investigation science requirements and cost constraints. Mandatory Flight Readiness Reviews/Operational Readiness Reviews (FRR/ORR) for all suborbital operations, including those involving non-NASA platforms, will be carried out in accordance with NASA NPR 7900.3. A NASA HQ/ESD-convened Midterm Review, to assess overall progress including data analysis and publication status, must be passed successfully no later than three years after investigation award/initiation. See section 2.3.1.4 below.

Proposers are encouraged to describe the relationships between their proposed investigation and the recommendations of the most recent decadal survey at the time of proposal submission.

2. Earth Venture Suborbital-3 Programmatic Requirements

2.1 Science Objectives and Goals

The overall objective of this EVS-3 program element is to substantially advance Earth system science and NASA’s Earth science goals through innovative science investigations involving sustained aircraft and/or other suborbital data acquisition campaigns. This overall objective can be met in several ways, including but not limited to:

- acquiring measurements that address weaknesses in current Earth system models leading to improvement in modeling capabilities and accuracy;
- producing data sets that identify and characterize important phenomena and/or detecting and characterizing changes in the Earth system; and/or
- making measurements that contribute to the scientific goals of multiple Earth Science focus areas and/or disciplinary programs.

Investigations must be relevant to the science priorities, goals, and objectives of NASA’s Earth Science Research Program. NASA’s Earth science goals can be found in the 2014 Science Plan for NASA’s Science Mission Directorate, available at https://smd-
NASA expects to select a balanced set of EVS-3 investigations addressing scientific goals applicable to as many Earth science focus areas as possible (see program elements A.1.-A.52 of ROSES-2017 for descriptions of the Earth science focus areas and disciplinary programs).

Preference will be given to proposed suborbital investigations that address one or more of the following:

- make use of, complement, and/or augment current NASA and non-NASA satellite observational capabilities;
- cover multiple objectives spanning the range from exploratory to more refined quantification of known processes;
- complement current projects in the NASA Earth Science Research Program;
- contribute to and/or provide data products useful to NASA’s Applied Sciences Program (https://appliedsciences.nasa.gov/); and/or
- contribute to planning for future satellite observations and/or enhanced Earth system models.

2.2 Detailed Science Investigations

2.2.1 Types of Investigations Solicited

This EVS-3 program element solicits proposals for suborbital science investigations that propose innovative and integrated approaches to address pressing Earth system science issues. For the purpose of this solicitation, a suborbital investigation is one that relies primarily – although not necessarily exclusively – on acquisition of new measurements from airborne and/or balloon-borne platforms. Investigations which rely primarily on measurements obtained from surface-based instruments, sounding rockets, the International Space Station, or CubeSats will not be considered responsive. Investigations may propose acquisition of remote sensing and/or in situ observations from suborbital platform(s) and may also utilize additional measurements from surface and/or subsurface observing systems as well as from existing satellite missions.

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1 Links to all NASA Earth science missions may be found at https://science.nasa.gov/missions-page?field_division_tid=103&field_phase_tid=All.

2 Selected and funded projects in the Earth Science Research Program may be found at https://nspires.nasaprs.com/ (select "Solicitations" then select "Past Solicitations and Selections" then select the research program element of interest).

3 Earth science proposals for CubeSats will be solicited under Earth Venture Instrument and/or Earth Venture Mission calls.
The detailed science investigation proposals solicited by this call must include descriptions, explanations and justifications of:

- all activities of a PI-identified science team;
- the governance structure for the science portion of the investigation; which can include naming a Science Investigation Manager, if desired;
- science management approaches and activities related to determining investigation-wide, deployment-wide, and individual flight requirements;
- the number, location, timing, and scope of field deployments throughout the lifetime of the investigation;
- access to required observation platform(s);
- the layout of instrument(s) onto the observation platforms;
- general integration requirements (i.e., whether aircraft modification is required to accommodate the instrument suite);
- all phases of any required instrument development;
- any proposed domestic and/or international partnering arrangements;
- data analyses, publication plans and open data workshops; and
- plans for science team meetings.

For purposes of proposal cost evaluation, and in contrast with previous EVS solicitations, the requested budget is limited to the science portion of the investigation, and is constrained to a maximum of 55% of the investigation cost cap (see Section 2.3.2 and Appendix I). The remaining 45% (at a minimum) is prescribed to costs for the FDM team, Mission Peculiar Costs (MPCs) and Investigation Reserves (see Appendix I):

- 25% for Mission Peculiar Costs (i.e., aircraft costs, all travel, shipping, logistics, etc.);
- 10% for Field Deployment Management; and
- 10% for Reserves.

In addition to the science-only budget information, the mandatory Operations Summary (Appendix II of this program element) must be completed. Proposer questions should be addressed to the appropriate Points of Contact (POC) listed in Section 5.

2.2.2 Excess Capacity in Selected Investigations

NASA reserves the right to utilize excess capacity on measurement platforms in selected investigations. NASA might add measurements, flight hours, sampling locations, and/or times, etc., to any selected and funded investigation. Any additions will be coordinated with the PI and negative impacts will be minimized. Any costs associated with these additions will be covered by NASA outside the investigation’s cost-capped funding.

2.3 Investigation Requirements

Successful responses to this EVS-3 solicitation shall specify and justify the scientific scope and objectives of the proposed investigation, detail baseline and threshold science requirements, explain the full instrument suite to be assembled, identify the
measurement platform(s) and systems to be used, and describe the experimental approach to be pursued for scientific analysis and data acquisition.

For the purpose of this solicitation, "Baseline Science Requirements" are the investigation performance requirements necessary to achieve the full science objectives of the investigation. "Threshold Science Requirements" detail the capabilities and results necessary to achieve the minimum science acceptable for the investment.

2.3.1 Science Management

2.3.1.1 Single Principal Investigator (PI)

A single PI, who has overall authority and responsibility for the investigation, must be identified in the proposal. The PI defines the governance structure for the investigation.

2.3.1.2 Deputy PI(s), Co-Investigators and other Science Management Roles

Deputy PI(s) and their responsibilities may be identified in the proposal. A science team of Co-Investigators (Co-Is) must be identified, by name and responsibility, in the proposal. The PI team is made up of the investigation’s science leadership as defined by the PI. A Science Data Analysis Lead, with primary responsibility for data analysis and publication, must be identified in the proposal. This function can be performed by the PI or by a separate person. Roles and responsibilities should be clearly stated in the proposal. The funding for these roles should be accounted for in the science budget.

A Science Investigation Manager, responsible for coordinating instrument, theory and flight planning activities, may be identified if desired. If included, labor should be accounted for in the science costs (see Appendix I). This function can be performed by the PI or by a separate person. An additional science management role of science financial management and reporting responsibilities, may be identified if desired.

When constituting the PI team and science team, the PI is encouraged to consider expertise and diversity in all its forms, such as under-represented and early-career scientists.

2.3.1.3 Post Selection Investigation Planning and Documentation

The implementation of the Earth Venture Suborbital-3 investigations will be managed in accordance with NASA NPR 7120.8 (https://nodi3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7120_0008&page_name=main). After selection, the PI will be responsible for all planning and documentation for the Data Management Plan and the Investigation Implementation Plan (IIP). These plans are to be completed prior to ICR. The IIP will include, but is not limited to:

- Investigation schedule;
- Science Goals and Objectives;
- Baseline and Threshold Science Requirements;
- Science Management Plan;
- Risk Management Plan; and
- Data Analysis and Publication Plan (including plans for, and the scope(s) of, open data workshops).

Following a successful ICR, the investigation planning documentation shall be made available to all investigation and NASA program personnel on an access-controlled website. Additionally nonproprietary information describing the investigation shall be made available on a publicly accessible website. As a result no data management plan will be collected on the NSPIRES cover pages.

2.3.1.4 Management Processes and Reviews

NASA’s experiences with the EVS-1 and EVS-2 investigations have highlighted the complexity of the full set of tasks required to plan, cost, and implement a sustained, multi-year and multi-deployment suborbital field campaign. NASA recognizes that many investigators at smaller institutions may not have access to the suite of resources required for managing the full investigation.

To enhance the pool of applicants able to respond to this opportunity while continuing to ensure field deployment success, the FDM team will be chosen after selection. NASA will join with the PI to identify a suitable FDM team to work with the selected investigations. The FDM team will be composed of the Investigation Manager (called the Project Manager in past solicitations) and the logistics and project coordinating staff and will provide detailed, expert field campaign planning and execution management capabilities to complement the scientific and overall investigation expertise and responsibility provided by the PI team. The FDM team should not be identified in the proposal. The cost of the FDM team falls within the full investigation cost cap budget. In preparation for the ICR, the FDM team will work with the PI to finalize the full mission budget and to formalize the management processes, procedures and methods required for planning and executing the field deployments within the full mission cost-cap. After successful completion of these initial tasks, the FDM team will work with the PI to manage the investigation, implement the field deployments and coordinate relevant aspects of programmatic reporting at investigation status reviews as listed in Table A.34-1.

The Data Manager (who operates the field archive and works with the Distributed Active Archive Center (DAAC) to facilitate the migration of the data, metadata and data products from the field archive to the DAAC) is also included in the FDM team for the proposal. Individuals in this group are not identified in the proposal and their roles need not be in any organization charts. All labor costs for this team will be part of the prescribed FDM costs (10% of the total proposal costs).

After proposal selection, the PI will state their preference for an FDM team for the investigation. The preference must be justified and is subject to approval by NASA. Because of its expertise and significant heritage in facilitating complex airborne science investigations, the default FDM team will be the NASA Ames Research Center Earth Science Project Office (ESPO).
Each selected investigation will be conducted in accordance with NPR 7120.8 ([https://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7120_0008&page_name=main](https://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7120_0008&page_name=main)). The PI team and the FDM team are responsible for providing all materials required for the reviews defined in this ROSES element, and, if applicable, shall provide support for a NASA Airworthiness and Flight Safety Review Board and other NASA Center preflight reviews. If significant changes to the investigation are necessary after selection, NASA may require additional reviews and documentation.

Table A.34-1. Investigation Reviews

| Investigation Confirmation Review (ICR) | Successful investigation confirmation must occur after selection and prior to the first field deployment – and in any event less than 1 year after award. The ICR is the gate at which the PI, the Field Deployment Management (FDM) team, and NASA have finalized investigation scope, requirements and costs. The ICR, convened by the Earth Science Division (ESD) Director or designee, will consider: the proposal and any post-selection updates; detailed cost and schedule estimates developed by the PI team and FDM team; the updated detailed Investigation Implementation and Data Management Plans; and PI team responses to any pre-ICR assessments conducted by the ESSP PO, Program Scientist, and their supporting experts. The Terms of Review (ToR) for the ICR can be found in Appendix IV. The date for the Midterm Review will be determined at the ICR.

The ICR will be complete when the ESD Director, or designee, approves the investigation to proceed with implementation. NASA reserves the right to descope or terminate the investigation upon failure to pass the ICR.

| Flight Readiness Review (FRR)/Operational Readiness Review (ORR) | Per NASA policies, at least one FRR/ORR must be conducted prior to suborbital data acquisition campaigns. All aircraft operations, including those using commercially acquired aircraft, will be reviewed in accordance with NPR 7900.3 ([https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7900&s=3D](https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7900&s=3D)). |
Midterm Review

At this critical midterm assessment, the PI, with appropriate team member(s), will present the progress of their investigation including data analysis, archive, and publication status to the Earth Science Division (ESD) Director or designee. After a successful Midterm Review, the investigation will receive permission to continue the investigation to completion as defined in the implementation plan. NASA reserves the right to descope or terminate the investigation upon failure to pass the Midterm Review.

Investigation Status Review (ISR)

ISR, convened by the ESSP PO, will be conducted at least quarterly to examine the PI and FDM teams’ progress against the approved cost, schedule, science performance/requirements, and data/publication status of the investigation.

As an ESSP PO Earth Venture investigation, selected investigations must attend and participate in the biennial ESSP Program Forums for the duration of the investigation; these are typically hosted at NASA’s Langley Research Center.

2.3.2 Cost Information and Management

Each selected investigation will be cost-constrained and must be fully executed within a specific total NASA cost cap. "Small" and "Large" investigations shall not have total NASA costs that exceed $15M and $30M, respectively. The cost cap (real-year dollars) for all phases of the investigation contains all costs, including NASA Civil Servant salaries and overhead.

The proposal shall present a science budget in accordance with the items in Section 2.2.1. Unlike other ROSES program elements, the proposal budgets for this program element should not be redacted, nor is there any separately uploaded "total budget" file. All science costs, including salary, fringe and overhead, including those of NASA Civil Servants shall be presented in the proposal. The budget must include all funding required to conduct the investigation’s science, instrumentation and data acquisition. The budget presented in the proposal shall include only the science costs and these costs shall represent a maximum of 55% of the total cost.

If a proposer is concerned that their investigation will require more than the allocated 25% for MPCs, the PI may reduce the percentage allotted for science to account for the difference.

After selection, a detailed, refined cost summary and budget including basis of estimate (BOE) documentation (https://www.nasa.gov/sites/default/files/files/CEH_AppC.pdf) will be created jointly by the PI and the FDM team, to be presented and approved at the ICR. Full and detailed budgets for investigation science, MPCs, FDM and reserves will be presented at ICR and may differ from the prescribed percentages in Appendix I.

Costs can change within the cost cap between proposal selection and ICR; however baseline science requirements must be met within the cost cap while maintaining suitable reserves. The ICR budget caps will be $30M and $15M for Large and Small Investigations, respectively.
After selection, adjustments to aircraft/suborbital deployments and science can include increasing flight hours, number of deployments, and/or number of scientific instruments should they be able to do so within the cost cap. These adjustments can be made in preparation for the ICR. In contrast, any significant descoping of the baseline science or allocation of insufficient reserves at ICR could be considered a compromised selection and grounds for termination.

2.3.3 Milestones

The proposal shall provide milestones for the accomplishment of all major elements of the investigation, with emphasis on the science-related aspects that are fully under the control of the PI and his/her team and that relate to satisfying the investigation requirements. The investigation milestones should be chosen at intervals sufficient to demonstrate steady progress leading to significant events.

All investigators shall complete their investigation – including all data acquisition and baseline scientific analyses – within five years from the date of award.

2.3.4 Science Risk Management

Each proposal shall identify potential significant risks to successful achievement of investigation objectives within resource and schedule constraints. Proposals shall describe how the team will manage (examine, monitor, evaluate, minimize or mitigate) risk, briefly identify major risks foreseen, and address potential mitigation strategies (including descope options) and associated milestone schedule impacts.

Proposals shall include letters of commitment from the providers of any required suborbital platform including NASA-owned aircraft (https://airbornescience.nasa.gov/), as well as any other required platforms or key partner organizations. Proposals shall also include letters of commitment for key contributed resources, including science hardware, and science personnel. A letter of commitment must contain a statement of commitment for the effort assigned in the proposal to that participant. The required elements in a letter of commitment are:

- a description of what is being provided;
- the level of effort;
- a signature by someone authorized to make the commitment.

Letters of commitment are also required from platform providers. These platform letters must include hourly costs (specify if these hour costs are with or without fuel) as well as any significant stand up costs. A full cost estimate from the platform provider may be attached to the letter of commitment, if desired. NASA may confirm the availability of required resources prior to selection (e.g., aircraft platforms, instruments, etc.).

In the case of a proposed "Large" or "Small" international deployment, only NASA can make official requests of foreign governments for overflight and/or basing clearances, and the pursuit of such formal requests and agreements will only commence after selection.
2.3.5 Data Management

Each EVS-3 science team will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the acquired observations and to analyze those measurements to achieve the investigation’s science objectives and requirements. In addition, the data manager (part of the FDM team) will operate the field archive and work with the DAAC to facilitate the migration of the data, metadata, and data products from the field archive to the DAAC. The science team shall publish scientific findings and communicate results to the public.

Each PI shall be responsible for managing all data produced as a result of the investigation in accordance with the NASA Earth Science Data Policy (https://science.nasa.gov/earth-science/earth-science-data/data-information-policy). The Science Data Analysis Lead is responsible for data analysis and publication. Each proposal shall include a data analysis and publication plan. Each investigation shall conduct open data workshops to facilitate collaboration and publication. Open data workshops are typically part of the annual science team meeting. At least one open data workshop must be completed prior to the midterm review. The PI is encouraged to allow all interested non-investigation scientists to attend the data analysis and discovery portion of the meeting. The science team meeting may include a closed portion of the meeting for investigation business.

All data acquired or used by EVS-3 investigations are considered public. NASA requires prompt public disclosure of the results of its sponsored research and, therefore, expects significant findings from supported research to be promptly submitted for peer reviewed publication with authorship(s) accurately reflecting the contributions of those involved. No period of exclusive access is allowed for any new scientific data acquired through the execution of an award; instead, all data collected through any of the funded EVS-3 investigations are to be placed in the public domain at the earliest possible time following their calibration, validation and quality assurance/control. Conference presentations (or manuscripts) that use EVS-3 acquired data should not be presented (or submitted for review or publication) until after these data are publicly available to all members of the community through the designated DAAC.

Within 2 months after selection, each investigation will be assigned to a NASA Earth Science DAAC by NASA Headquarters. The cost of using the DAAC is not included in the proposal cap. The PI will be provided a point of contact at the assigned DAAC who will work with the PI and the NASA Earth Science Data Systems (ESDS) Program to ensure that the investigation’s primary data and metadata are delivered to the DAAC in formats that meet NASA requirements. Investigations will use the NASA archive and distribution capabilities and infrastructure at the assigned DAAC for the public release of the data sets.

NASA will require the delivery of all data products, along with scientific algorithm software, coefficients, and ancillary data used to generate these products, to NASA-assigned DAAC as soon as possible, typically within 3-6 months of data acquisition. In addition, the PI must deliver all appropriate algorithm and calibration
documentation and updates. Required archival data products include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data, documentation, related software, and/or other tools or parameters that are necessary to interpret the data.

After selection and before ICR, the PI will develop a comprehensive, schedule-based, data management plan, including approaches for data retrieval, validation, quality assurance/control, preliminary analysis, metadata generation and delivery to the assigned NASA DAAC for public distribution and archiving. In the data management plan, the science products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for generating and updating the data products during the lifetime of the investigation. The plan shall identify the formats and standards to be used, selected from the published list of approved NASA Earth Science Data System Standards ([https://earthdata.nasa.gov/user-resources/standards-and-references](https://earthdata.nasa.gov/user-resources/standards-and-references)). The plan shall conform to the NASA Earth Science Data and Information Policy (see [http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/](http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/)). The PI is encouraged to ask the NASA ESDS Program for advice and guidance in the development of the data management plan.

3. **Proposal Submission Requirements**

3.1 **Notices of Intent**

A Notice of Intent (NOI) to propose is strongly encouraged. The purpose of the NOI is to enable NASA to prepare for the review process. The EVS-3 NOI is limited to 4 pages.

The NOI should include:
- the science questions or hypothesis(es),
- the relevance to NASA’s science goals,
- the investigative approach including:
  - measurements and techniques;
  - location(s);
  - investigation timeline of major milestones;
  - measurement platform(s); and
- identities of PI, Deputy PI(s), and, to the full extent possible, all Co-Investigators.

NOIs can be submitted as a PDF file to the NSPIRES website at [https://nspires.nasaprs.com/](https://nspires.nasaprs.com/) (see the ROSES Summary of Solicitation).

3.2 **Further Information about this Solicitation**

3.2.1 **Questions and FAQ**

Questions concerning this EVS-3 program element should be addressed to the EVS-3 Program Scientist identified in Section 5. Questions related to Data Management
should be addressed to the appropriate POC (See Section 5). All questions and responses will be posted, with identifying information removed, in a Frequently Asked Questions (FAQ) posted under on the NSPIRES index page for this EVS-3 program element under "other documents" at https://nspires.nasaprs.com/external/solicitations/summary.do?solId=%7BD36BA13F-53FC-BC87-B43D-FB08673CD6EE%7D&path=open&method=init. Proprietary information must be clearly identified in all correspondence and will not be conveyed in any manner to the public.

3.3 Awards

NASA intends to select at least one Large and one Small investigation. The total funds awarded will be approximately $120M. Additional investigations may be selected consistent with the availability of proposals of appropriate scientific and programmatic merit and available funds allocated for this solicitation, as well as contingent on the availability of other needed resources (e.g., aircraft platforms, instruments, etc.). The NASA-funded cost for all phases of an investigation – including costs of NASA Civil Servants – must not exceed $30M for a Large investigation (including reserves) and $15M for a Small investigation (including reserves). NASA reserves the right to make no selection if no proposals of appropriate merit are received.

3.3.1 Award Administration and Management

The NASA Langley Research Center will award all primary contracts and grants associated with this solicitation. The ESSP PO will manage the EVS-3 investigations in accordance with NASA policies and procedures. Prior to ICR, selected proposals shall constitute the initial basis for agreement between the ESSP PO and the PI. After ICR, the approved Investigation Implementation Plan (IIP) will become the new foundation of the agreement. All funding prior to ICR is included within the overall investigation cost caps.

3.4 Research Platform Services Information

Observational platform(s) from a wide variety of sources can be included in an EVS-3 investigation. Information on NASA’s airborne observation platforms can be found at https://airbonescience.nasa.gov. The Airborne Science Program provides a subsidized rate for the DC-8, P-3, ER-2, G-V, C-20A, and JSC GIII. PIs with any proposed activities requiring any aircraft should submit a Flight Request to the Airborne Science Flight Request system (SOFRS) at https://airbonescience.nasa.gov/sofrs/. Proposers should be sure to include the ROSES EVS-3 solicitation number (NNH17ZDA001N-EVS3) in the form where prompted. Questions regarding the flight request system or process should be addressed to Vidal Salazar, Flight Request Lead, at vidal.salazar@nasa.gov or telephone 650-604-5313.

3.5 Proposal Content

Proposal content must conform to the guidelines set forth in this EVS-3 program element, Table 1 of the ROSES-2017 Summary of Solicitation (SOS), and the 2017
Guidebook for Proposers, in that order, i.e., this amended EVS-3 program element, takes precedence over the more general guidance in SOS, which takes precedent over the Guidebook. See Section 1(g) of the ROSES-2017 Summary of Solicitation.

Proposals must adhere to the page guidelines and order in Table A.34-2. The page limit for the total of sections 1-6 of the proposal is 33 pages. The section sizes are suggested and can be modified but the total page limit for sections 1-6 is constrained to 33 pages.

Table A.34-2. Proposal Guideline and Suggested Section Sizes

<table>
<thead>
<tr>
<th>Section</th>
<th>Suggested Page Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Executive Summary (in addition to the web cover page)</td>
<td>2</td>
</tr>
<tr>
<td>2.0 Table of Contents</td>
<td>1</td>
</tr>
<tr>
<td>3.0 Science Investigation</td>
<td>8</td>
</tr>
<tr>
<td>4.0 Science Implementation</td>
<td>11</td>
</tr>
<tr>
<td>5.0 Investigation Implementation</td>
<td>8</td>
</tr>
<tr>
<td>6.0 Science Management</td>
<td>3</td>
</tr>
<tr>
<td>7.0 Science Budget (use xl spreadsheet) and Science Budget Justification (including any external contributions)</td>
<td>as needed</td>
</tr>
<tr>
<td>7.1 Science Investigation Budget Form available here (not included in page limit)</td>
<td>as needed</td>
</tr>
<tr>
<td>7.2 Investigators’ budgets (not included in page limit but is limited to 4 pages total per investigator)</td>
<td>≤4 each</td>
</tr>
<tr>
<td>8.1 Curriculum Vitae: Principal Investigator (not included in page limit)</td>
<td>≤2</td>
</tr>
<tr>
<td>8.2 Curriculum Vitae: Deputy PI(s) and each Co-Investigator or other key personnel (not included in page limit but is limited to 1 page total per person)</td>
<td>≤1 each</td>
</tr>
<tr>
<td>8.3 Current and Pending Support for PI and Co-Is (not included in page limit). Must use the form available here</td>
<td>as needed</td>
</tr>
<tr>
<td>8.4 Letters of Commitment (not included in page limit)</td>
<td>as needed</td>
</tr>
<tr>
<td>9.0 References and citations (not included in page limit)</td>
<td>as needed</td>
</tr>
<tr>
<td>10.0 Operations Summary Table</td>
<td>1</td>
</tr>
</tbody>
</table>

3.5.1 Executive Summary

This section shall explicitly provide a brief summary of the proposed investigation including the following:

- baseline and threshold science objectives (including the importance of the science to NASA Earth Science research programs, goals, and objectives);
- investigation overview;
- instrument complement;
- key suborbital platform(s) characteristics;
- schedule summary;
• total estimated cost to NASA; and
• total investigation cost estimate (including a breakdown of any contributed costs by contributing organization).

Other relevant information, including figures or drawings, may be included at the proposer's discretion and as space allows. Foldout pages are not allowed.

This 2-page Executive Summary in the proposal is distinct from the "Proposal Summary" in the NSPIRES cover pages. The NSPIRES system will give an error that prevents proposal submission if something is not typed into the "Proposal Summary" box in the NSPIRES cover pages, but that content will not be evaluated.

3.5.2 Table of Contents

Every proposal shall contain a table of contents that conforms to the guideline in Table A.34-2.

3.5.3 Science Investigation

3.5.3.1 Science Goals and Objectives

This section shall describe the goals and objectives of the investigation, the compelling nature of the investigation, and the investigation's value to advancing NASA's Earth science objectives as described in Section 1 and Section 2.1 of this EVS-3 program element. The driving science question(s) or hypothesis(es) shall be described. This section shall describe the need for sustained measurements, and provide an explanation of how the scientific hypothesis(es) or science question(s) will be addressed and the allocation of functional and performance characteristics necessary to address the hypothesis(es) or question(s).

3.5.3.2 Baseline and Threshold Science Requirements

This section shall describe the Baseline and Threshold Science Requirements. Baseline Science Requirements are the investigation performance requirements necessary to achieve the full science objectives of the investigation. Threshold Science Requirements are the investigation requirements necessary to achieve the minimum science acceptable for the investment.

3.5.4 Science Implementation

This section shall describe the investigation to be performed; the types of measurements to be made; and the characteristics, precision, and accuracy of the measurements required to attain the scientific objectives. This section shall include a Science Traceability Matrix, which maps individual scientific measurement requirements into functional requirements. The example matrix given below in Table A.34-3 may be appropriately modified for this purpose.
This section shall discuss in detail the science observing profile, including all investigation-relevant parameters; such as example flight plans, required coverage and navigation accuracy, and operational milestones needed to address the science goals. This section should also include the proposed observing periods, data analysis periods, and any other time-critical events. Proposals shall also include a plan for closing out the investigation, including plans for final hardware disposition.

3.5.4.1 Science Team

This section shall identify each key member (i.e., one whose participation is essential to the success of the investigation) of the PI team and science team and their role and responsibilities (including measurements, modeling, mission planning, data management, data analysis, publication, etc.).

3.5.4.2 Science Data

This section shall discuss the quality and quantity of data to be generated by each instrument and how they relate to the proposed science investigation goals and objectives. At a minimum, proposals shall include a list of measurements/parameters, and data latency. Algorithms and calibration procedures should be listed, but not described in detail. This section will include a data analysis and publication plan.

3.5.5 Investigation Implementation

3.5.5.1 Measurement Platform System Capabilities

This section shall address the suborbital platform capabilities to the extent that they are applicable to the proposed mission. This section shall also summarize performance margins of all key flight systems (mass, volume, power) and contingency plans, as applicable. All EVS-3 airborne platforms are required to comply with NPR7900 NPR 7900.3 (https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7900&s=3D).

3.5.5.2 Logistics

This section shall describe a brief overview of deployment plans and locations. More detailed logistical plans shall be developed by the PI team and the FDM team prior to the ICR.
The Operations Summary, shall include information such as desired aircraft, number of flight hours, and deployment locations (see Appendix II).

3.5.5.3 Instrumentation
This section shall describe and justify the proposed instrumentation in detail. Important performance and platform integration characteristics of the proposed instrumentation shall be described.

3.5.5.4 Instrumentation Development Approach
This section shall describe any development efforts associated with the investigation. This section shall identify and justify that each proposed instrument is at or above Technical Readiness Level (TRL) 6 at the time the proposal is submitted. This section shall also include an illustration and brief discussion of the time-phased flow of any instrument development necessary for the investigation. The platform layout (including platform diagram with instruments) and an explanation of instrument/sampling inlets/view ports needed must be presented in this section.

3.5.5.5 Modeling and Data Analysis Approach(es)
This section shall describe the proposed modeling efforts, including any model development necessary for the investigation. In addition, novel analysis techniques should be explained.

3.5.6 Science Management
3.5.6.1 Science Management Approach
This section shall describe the investigation’s proposed management approach to the risk, the milestone schedule, and the overall cost. The names of the investigation's key science team members, their organizations and reporting relationships shall be provided in an organizational chart.

3.5.6.2 Science Risk Management
This section shall describe significant risks to successful accomplishment of science investigation goals, potential mitigation strategies (including descope options) and associated milestone schedule impacts. After selection, a refined and appropriately tailored risk management plan shall be delivered as part of the ICR. The plan shall be coordinated with the ESSP PO and NASA Headquarters.

3.5.6.3 Milestone Schedule
A list of milestones covering all phases of the investigation shall be provided, with emphasis on the science-related aspects that are fully under the control of the PI and his/her team and that relate to satisfying the investigation requirements (including the review events included in Table A.34-1). After selection, a refined schedule shall be delivered as part of the ICR.
3.5.7 Science Budget and Science Budget Justification

Detailed costs for science staffing, activities and support must be provided in the proposal. A detailed budget justification is required for the science budget only. Science team costs will include all labor and procurement costs. All budgets must be complete, including all indirect costs. The EVS investigations do not pay for the DAAC and these costs are not included in the proposal cap. The total cost-constrained funding requirements for the proposed investigation include the complete set of "science costs" described above, and the additional funding requirements for MPCs, FDM team costs, and Reserves as defined earlier and in Appendix I. Also be sure to describe all external contributions to the investigation in this section.

3.5.7.1 Science Investigation Budget Form

This section of the proposal shall include the science investigation costs presented in the format of a year-by-year breakdown of the full science investigation budget. The annual detailed budget shall be entered into the EVS-3 specific budget form found on the SARA EVS-3 webpage at https://science.nasa.gov/researchers/sara/earth-venture-suborbital-3. Do not use the standard budget forms which are part of the NSPIRES/ROSES proposal cover sheets. The detailed and prescribed costs shall encompass all proposed activities described in section 2.2.1.

3.5.7.2 Investigators’ budgets

This section of the proposal shall include an investigator specific budget, brief Statement of Work (SOW), and detailed budget justification for each investigator. These budgets should not include investigator travel or shipping. All travel and shipping will be included in the MPC prescribed percentages for the proposal process and will be described in detail after selection.

After selection, a detailed cost summary including Work Breakdown Structure (WBS) and Basis of Estimate (BOE) documentation shall be delivered as input to the ICR. Adjustments can be made to the percentage of funds in each category in preparation for the ICR. However, any significant descoping of the baseline science or allocation of insufficient reserves at ICR could be considered a compromised selection and grounds for termination.

3.5.8 Additional Information

- Curriculum Vitae
- Letters of Commitment
After selection, compliance with U.S. Export Laws and Regulations as described in the NASA Guidebook for Proposers will be addressed at the ICR.

4. Proposal Evaluation

4.1 Evaluation Process

The EVS-3 proposals will be evaluated by a Scientific Merit Evaluation Panel. This panel will also examine the proposal, including the operations summary information (Appendix II), to determine whether the proposed mission operations are feasible (see Appendix III). The panel may be divided into subpanels according to the number and disciplinary distribution of proposals received. Each subpanel will be responsible for evaluating specific criteria to identify major and minor strengths and weaknesses and overall adjectival ratings according to the evaluation criteria. All subpanels will report their findings to the Program Officer’s Evaluation Executive Committee to incorporate their findings, add programmatic considerations, and assemble a recommendation for the Program Officer to present to the Selection Official. In making the final selection, the Selecting Official will look to be sure that the overall group of selected proposals can indeed be implemented using resources available to NASA (examining conflicts across platforms, instruments, etc.).

4.2 Evaluation Criteria

The primary basis for selection will be the science evaluation. In addition to the factors given in Section VI(a) of the ROSES Summary of Solicitation the NASA Guidebook for Proposers, the evaluation criteria specifically include the following factors.

4.2.1 Relevance

The relevance evaluation criterion includes the following factors:

- The relevance of the proposed investigation to NASA’s Earth science research program, its science priorities, and the specific research objectives and goals of this program element; and
- The degree to which the investigation will contribute to Earth system science (e.g., contributing to an improved modeling capability, producing data sets suitable for identifying and characterizing important phenomena and/or detecting and characterizing changes in the Earth system, and/or having a multidisciplinary/multi focus area impact).

Additional factors for consideration include:

- The degree to which the investigation will augment and/or complement current projects in the NASA Earth Science Research Program and/or current satellite observational capabilities, as well as provide a path forward to future satellite observations; and
- The degree to which the investigation contributes to and/or provides data products useful to NASA’s Applied Sciences Program (https://appliedsciences.nasa.gov/).
4.2.2 Intrinsic Merit

In addition to the factors given in the NASA Guidebook for Proposers, the evaluation criterion "intrinsic merit" specifically includes the degree to which the proposal demonstrates the adequacy and completeness of the following factors:

- the degree to which the Baseline and Threshold Science Objectives address innovative, integrated, and hypothesis-science question-driven methods, approaches, concepts, or advanced technologies evaluated against the state of the art;
- the degree to which the Threshold Science Objectives represent an adequate and complete scientific investigation;
- the science management approach and the science costs, milestone schedule, and risk;
- the technology maturity, design heritage, developmental approach (if required), instrument interfaces and platform integration plans;
- the feasibility as determined by evaluation of the Operations summary table and the general deployment plans; and
- the plan for data analysis and publication.

4.2.3 Science Cost Risk and Cost Realism Evaluation Factors

The "cost realism" evaluation criterion specifically includes the degree to which the science costs in the proposal demonstrate adequacy and completeness.

5. Summary of Key Information

<table>
<thead>
<tr>
<th>Maximum funding per investigation</th>
<th>$30M (large) or $15M (small) over life cycle (real year dollars).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>NASA intends to select at least 1 Small ($15M) and 1 Large ($30M) proposal. Total number of awards will be determined by the number of small and large proposals selected. The total funds awarded will be approximately $120M.</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>5 years</td>
</tr>
<tr>
<td>Due date for (optional) NOI to propose</td>
<td>January 31, 2018</td>
</tr>
<tr>
<td>Page limit for NOIs</td>
<td>4 page maximum</td>
</tr>
<tr>
<td>Page limit for the central portion of proposal (sections 1-6)</td>
<td>33 pages, see Section 3.5</td>
</tr>
<tr>
<td>Due date for proposals</td>
<td>April 12, 2018</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>No sooner than January 1, 2019</td>
</tr>
<tr>
<td>Mission end date no later than</td>
<td>Five years from the project start (when initial funding starts).</td>
</tr>
<tr>
<td>Relevance to NASA</td>
<td>This program is relevant to the Earth science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>See the NASA Guidebook for Proposers at <a href="https://www.hq.nasa.gov/office/procurement/nraguidebook/">https://www.hq.nasa.gov/office/procurement/nraguidebook/</a>.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of electronic proposals via NSPIRES</td>
<td><a href="https://nspires.nasaprs.com/">https://nspires.nasaprs.com/</a> (help desk available at 202-479-9376 or <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a>)</td>
</tr>
<tr>
<td>Web site for submission of electronic proposals via Grants.gov</td>
<td><a href="https://www.grants.gov/">https://www.grants.gov/</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td>POC concerning Data Archive issues</td>
<td>Jennifer Olson (<a href="mailto:jennifer.r.olson@nasa.gov">jennifer.r.olson@nasa.gov</a> / 757-864-5327)</td>
</tr>
<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-EVS3</td>
</tr>
</tbody>
</table>
| NASA point of contact concerning this ESSP Earth Venture-S solicitation | Barry Lefer  
Earth Science Division  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-3857  
Email: [barrlefer@nasa.gov](mailto:barrlefer@nasa.gov) |
APPENDIX I

Prescribed Percentages

Detailed science and instrumentation costs are required. The percentages of total costs assigned to specific categories are prescribed below.

Costs for staffing by the FDM team should not be included in the proposal. After selection, a detailed cost summary including basis of estimate (BOE) documentation will be created and presented at the ICR. Cost adjustments to the prescribed percentages can be made at that time.

• Science costs will include:
  ➢ All science team labor (including data analysis and modeling)
  ➢ If the proposal team chooses to identify the Science Investigation Manager or Financial Manager, their labor costs should be included here
  ➢ Science team procurement
  ➢ Science data procurement and publication costs
  ➢ Instrumentation, instrument materials and supplies (including spares, equipment, computers, consumables, and shipping crates) and instrument testing

• The prescribed value for FDM team includes:
  ➢ All of the FDM team’s labor
  ➢ Investigation Manager (formerly project manager) labor
  ➢ Data manager labor

• The prescribed value for MPCs includes:
  ➢ All travel costs (science, platform personnel and FDM) including travel to and from science meetings, conference travel and all site visit, integration and deployment travel
  ➢ All flight hour costs (including any sat com costs associated with the platform)
  ➢ All aircraft/ship/other vessel costs (crew labor, procurement, fuel, integration/engineering)
  ➢ All shipping costs (shipping costs to and from investigator’s lab to integration site and integration site to deployment site)
  ➢ All deployment costs; site support (ground support equipment and services, airport fees, site set up (space, IT, badging), embassy support, deployment supplies, science meeting set up, and transportation services)

Percentage of investigation costs devoted to different investigation categories

<table>
<thead>
<tr>
<th>Investigation Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>55% (maximum)</td>
</tr>
<tr>
<td>Field Deployment Management (FDM)</td>
<td>10% (minimum)</td>
</tr>
<tr>
<td>MPCs</td>
<td>25% (minimum)</td>
</tr>
<tr>
<td>Reserve</td>
<td>10% (minimum)</td>
</tr>
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</table>
APPENDIX II

Operations Summary

Provide the information below in the form of a table. Add extra lines as needed.

<table>
<thead>
<tr>
<th>Aircraft/Platform</th>
<th>Type</th>
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<tr>
<td></td>
<td>Owner /Source</td>
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<tr>
<td></td>
<td>Base of operations</td>
</tr>
<tr>
<td></td>
<td>Cost per hour (specify with or without fuel)</td>
</tr>
<tr>
<td></td>
<td>Platform stand up costs (if any)</td>
</tr>
<tr>
<td></td>
<td># of Flight hours</td>
</tr>
<tr>
<td></td>
<td># of Test flight hours</td>
</tr>
<tr>
<td></td>
<td># of Transit flight hours</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Integration</th>
<th>Integration site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deployment</td>
<td># of deployments</td>
</tr>
<tr>
<td></td>
<td>Locations (each site)</td>
</tr>
</tbody>
</table>
## Proposal Feasibility Assessment Criteria

### Success Criteria

#### (1) Adequacy of requirements
- Is the aircraft suitable for the investigation goals?
- Are the instruments selected appropriate for the aircraft?
- Is the integration site appropriate for the aircraft?
- Are there significant integration/aircraft modification requirements?
- Is the deployment site appropriate for the NASA operations?
- Is the deployment site appropriate for the aircraft?
- Are the number of flight hours appropriate for the investigation goals?

#### (2) Adequacy of Management Approach
- Are external agreements in place? (Letters of commitment for platform providers)

#### (3) Adequacy of Margins
- Is the instrument complement stable? (e.g., are there new instruments?)
- Are platform margins sufficient?

#### (4) Adequacy of Risk Management
- Has the proposal identified all high risk elements?
- Are the number of deployments reasonable?
- Are the deployment sites high risk?
- Do descope options adequately address the risk?

#### (5) Adequacy of cost and milestone estimates
- Does it seem reasonable that the operations can be successfully completed within the proposed schedule?
- Do the platform letters of commitment include flight hour and stand up costs?

### Guidance

(This is not a checklist)
## APPENDIX IV

Terms of Review (ToR) for EVS-3 Investigation Confirmation Review (ICR) Process

<table>
<thead>
<tr>
<th>Success Criteria</th>
<th>Guidance (This is not a checklist)</th>
</tr>
</thead>
</table>
| (1) Adequacy of requirements, management of requirements, resiliency of implementation approach | How stable are the investigation requirements?  
Is there adequate flow down of requirements?  
Is there any technology development or redesign that is required?  
Is there adequate resiliency in the implementation approach to address the challenges inherent in the proposed mission? (e.g., descopes, backup plans, reserves use) |
| (2) Adequacy of Management Approach | Does the investigation have effective program planning and control to assess its performance against requirements and baselines in a timely manner? (i.e., what management tools and practices are used?).  
Are external agreements in place? (e.g., flight authorizations)  
Are adequate resources assigned to the investigation?  
Is the investigation using, capturing and sharing lessons learned?  
Are the people in key positions experienced?  
Are responsibilities well defined and aligned with expertise/experience?  
Does the Organization Chart and discussion of the management approach demonstrate clear lines of reporting/accountability/decision making |
| (3) Adequacy of Margins (Technical Approach) | Is the instrument complement stable? (e.g., are there new instruments?)  
Are platform margins sufficient? |
<table>
<thead>
<tr>
<th>Success Criteria</th>
<th>Guidance (This is not a checklist)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4) Adequacy of Risk Management</td>
<td>Has the investigation identified and quantified all the known risks to mission success and is the generic uncertainty in the cost and schedule estimates appropriate?</td>
</tr>
<tr>
<td></td>
<td>What are the risks that can be mitigated to complete the investigation on time and within budget/cost-cap?</td>
</tr>
<tr>
<td></td>
<td>Is the investigation actively managing their risks?</td>
</tr>
<tr>
<td>(5) Adequacy of cost and schedule estimates and funding strategy</td>
<td>Is the basis for the investigation’s cost and schedule estimate credible?</td>
</tr>
<tr>
<td></td>
<td>What is the likelihood of completing the schedule by the target date and within budget?</td>
</tr>
<tr>
<td></td>
<td>Are the investigation-proposed funds for reserves sufficient and held in the years when it will be needed?</td>
</tr>
<tr>
<td></td>
<td>Does the planned funding profile adequately support the investigation? Will the investigation’s funding be available when needed, including reserves and schedule margin?</td>
</tr>
<tr>
<td></td>
<td>Has team developed a reasonable baseline and are they tracking plan vs. actuals against that baseline?</td>
</tr>
</tbody>
</table>
A.35 NASA DATA FOR OPERATION AND ASSESSMENT

NOTICE: NASA does not intend to offer this program element in ROSES-2017.

1. Scope of Program

NASA’s Earth Science Research Program aims to use global measurements to understand the Earth system and its interactions as steps toward ultimately enabling prediction of Earth system behavior. To achieve this goal, a combination of shorter-term process-oriented measurements is complemented by longer-term satellite measurements of a limited number of environmental properties. For these measurements, NASA’s Earth Science Research Program sponsors algorithm development, calibration/validation activities, and modeling studies to produce high-quality data products for scientific research and operational use.

This program element recognizes the advances already made by investigations which were solicited by prior NASA Research Announcements and/or National Oceanic and Atmospheric Administration (NOAA) Announcements of Opportunity and which focused in the areas of sensor calibration, algorithm development and refinement, product validation, and scientific data analysis. This solicitation offers investigators an opportunity to analyze, assess, and increase the impact of NASA data in research and operational environments, particularly in the areas of weather prediction, climate projection assessment, and global carbon cycle modeling in anticipation of carbon management regulations.

2. Points of Contact

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Earth Science Division
Science Mission Directorate
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Email: paula.bontempi@nasa.gov
NOTICE. Amended on September 26, 2017. Section 2.4 has been clarified and expanded to remove any apparent redundancy between the additional "institutional commitment" evaluation criterion and the last bullet of the Merit evaluation criterion given in the guidebook for proposers. New text is in bold. Although no new requirement has been added, the due date for proposals has been delayed by one week to October 5, 2017 to allow proposers to modify their submissions, if needed.

Amended on August 29, 2017. To give more time to proposers who are without power because of Hurricane Harvey, this amendment delays the due date for a number of program elements including this one. Please see Table 2 or Table 3 for the latest due dates.

Amended July 18, 2017. Section 2.3 has been clarified and corrected to make clear the limitations on the kind of salaries NASA will cover in response to successful proposals to this program element. New text is shown in bold; deleted text is struck through. Notices of intent are now requested by August 14, 2017 and proposals are now due September 14, 2017.

1. Scope of Program

1.1 Introduction

The New (Early Career) Investigator Program (NIP) in Earth Science is designed to support outstanding scientific research and career development of scientists and engineers at the early stage of their professional careers. The program aims to encourage innovative research initiatives and cultivate scientific leadership in Earth system science. The Earth Science Division (ESD) places particular emphasis on the investigators' ability to promote and increase the use of space-based remote sensing through the proposed research.

The NIP supports all aspects of scientific and technological research aimed to advance NASA's mission in Earth system science (http://science.nasa.gov/about-us/science-strategy/). In research and analysis, the focus areas are:

- Carbon Cycle and Ecosystems,
- Climate Variability and Change,
- Water and Energy Cycle,
- Atmospheric Composition,
- Weather, and
- Earth Surface and Interior.

In Applied Sciences, the ESD encourages efforts to discover and demonstrate practical uses of NASA Earth science data, knowledge, and technology (see http://appliedsciences.nasa.gov). In technological research, the ESD aims to foster the creation and infusion of new technologies into space missions in order to enable new
scientific observations of the Earth system or reduce the cost of current observations (see http://esto.nasa.gov). The ESD also promotes innovative development in computing and information science and engineering of direct relevance to ESD. See Appendix A.1 for more detailed descriptions of the Focus Areas, themes in applied sciences, and related research topics of high priority to the ESD.

The proposed research project must be led by a single, eligible (see further description below for eligibility) investigator serving as the Principal Investigator (PI). Indeed, this individual must be the only essential team member; no Co-Investigators (Co-Is), paid or unpaid, are permitted. The NIP does not accept proposals with Co-PIs nor two types of PIs, such as Science PI and Institutional PI. Students and postdoctoral fellows may participate as paid team members. The proposed research may include collaborations. See the Guidebook for Proposers at http://www.hq.nasa.gov/office/procurement/nraguidebook/ for the definitions of Collaborator vs. Co-Investigator and descriptions of China-related restrictions.

This early career program, NIP in Earth Science, was established in 1996. The frequency of solicitation is currently every two years.

1.2 Eligibility

A NIP proposal PI must be a U.S. citizen or have lawful status of permanent residency (i.e., holder of a U.S. Permanent Resident Card, also referred to as the Green Card)\(^1\). He/she must be a recent Ph.D. recipient, defined as having graduated on or after January 1 of the year that is no more than five years before the issuance date of this ROSES NASA Research Announcement (NRA) (i.e., after January 1, 2012; but see also third bullet below).

Institutions and organizations are encouraged to submit proposals under the NIP on behalf of their outstanding new faculty members or employees in Earth system science and associated applications, as long as the individuals are the proposed PIs.

To be eligible for an NIP award, proposed PIs must meet the following requirements:

1. Be employed at an institution in the U.S., its territories, or possessions, or the Commonwealth of Puerto Rico, which awards a baccalaureate or advanced degree in a field supporting the objectives of NASA Earth system studies, or be employed at any nonprofit research institution or other nonprofit organization that performs a significant amount of work in fields of research supporting the objectives of NASA’s Earth Science Program. Such organizations could include museums, observatories, Government or nonprofit research laboratories, as well as nonprofit entities in the private sector.

2. Be in tenure- or nontenure-track positions in either teaching or research or both, as long as the employing institution assumes the responsibility of submitting the proposal with the individual as the proposed PI.

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\(^1\) The prospective PI may submit a proposal to NIP if he or she is reasonably certain that the Green Card will be in hand soon after the proposal submission. The evaluation of proposals takes approximately five months, and awards are made within a couple of weeks after the announcement of selections. NASA will not award a grant if the submitting institution cannot certify the PI’s eligibility.
3. Despite being more than five years beyond the receipt of their Ph.D. degrees, individuals who have interrupted their careers for reasons such as family leave or serious health problems may also be eligible. These applicants should make a written request for prior concurrence from NASA before the due date for Notices of Intent to propose. NASA will provide a written response within three weeks. Such exception is not intended for individuals who have had successful employment in technical fields in science and engineering, even though the employment is not a direct continuation of their Ph.D. research, nor is it intended for individuals with a recent Ph.D. degree after having already established a successful career in Earth system science and related disciplines.

4. Not hold or have held tenure (or equivalent) on or before the submission deadline of this program.

5. Not be a current or former recipient of the NIP or Presidential Early Career Award for Scientists and Engineers (PECASE) (see further below) award.

2. Programmatic Information

2.1 Funding
Proposals to the NIP are openly solicited approximately every two years. The anticipated average award is $80-90K per year for a period of up to three years, subject to satisfactory progress and availability of funds.

2.2 Proposal Preparation
The NIP proposals should be prepared in accordance with the instructions given in the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. The Science/Technical/Management section of the proposal should contain a detailed statement of the proposed research of no more than 15 single-spaced pages including figures and tables.

2.3 Budget Requirements and Restrictions [Clarified and Corrected July 18, 2017]
The NIP awards are typically three years in duration. The award amount for each is judged according to the scope of the proposed work and the overall competition. Salary for up to three months per year of PI time is allowable. NASA will not reimburse the salary if the PI is a Civil Service employee at a Federal agency other than NASA.

For individuals who are civil servants, NASA will only pay portions of their salary that are not normally fully covered as part of agency budgets. NASA will cover salary (up to three months) for scientists whose compensation must be won through competitive proposals to their employing agency or other agencies. NASA salary support for scientists at other agencies is NOT intended to be provided "in lieu of" salary that would normally be paid by the employing agency. If civil servant salary for other agency personnel is requested as part of the proposal, the budget page must specifically outline the compensation approach that the agency uses to cover its civil servants and verify that any NASA salary support would not be replacing that normally paid by the employing agency.
Funds may be used for support of students (undergraduate or graduate) and/or postdoctoral fellows who are involved in the proposed research or for research expenses, such as costs incurred in field experiments, purchase of equipment and/or supplies, computing, travel, etc. If research collaboration is a component of the proposal, it is presumed that the collaborator(s) have their own means of research support; that is, a NIP award may not include expenses for personnel or activities at collaborating institutions, nor salary costs for senior personnel, consultants, or subcontractors.

2.4 Proposal Review and Evaluation

As stated in Section VI(a) of the ROSES Summary of Solicitation, proposals are ordinarily evaluated on three criteria: intrinsic merit, relevance, and cost. Because of the unusual nature of this program element, institutional commitment will also be an additional evaluation criterion. Institutional commitment includes those aspects of existing or proposed infrastructure that will contribute in a substantial way to the success of the proposed research. Examples of contributions by institutions that may be considered by peer reviewers include: Offices, laboratories, engineering, computational, or other facilities; or technology planning and development capabilities that are of direct and substantive benefit to the proposed project.

The additional "institutional commitment" evaluation criterion described above renders redundant the fourth bullet in the definition of the Merit evaluation criterion ("Facilities, instruments, equipment and other resources or support systems...") in Appendix D of the NASA Guidebook for Proposers. These factors will not be evaluated twice; the fourth bullet will be removed from the evaluation of merit for this program element.

Resources and or facilities that are under the direct control of the PI or a Co-I may be described in the Facilities and Equipment section (See Table 1 of ROSES). Letters of resource support (described in Section 3.17 of the NASA Guidebook for Proposers) must be provided for facilities or resources essential to the proposal not under the control of the PI or a Co-I. [Added September 26, 2017]

Cost sharing is not required for an institution of higher education or other nonprofit organization to receive a grant or cooperative agreement, nor is it part of the evaluation criteria. However, support of student, postdoctoral fellow, and/or staff time or other forms of cost sharing may be considered by the selection official.

3. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected annual program budget for new awards</th>
<th>~ $1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of investigator awards pending adequate proposals of merit</td>
<td>~12</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>3 years</td>
</tr>
<tr>
<td>Due date for Notice of Intent to propose (NOI)</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Due date for proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>6 months after proposal due date</td>
</tr>
<tr>
<td>Page limit for the central Science/Technical/Management section of proposal</td>
<td>15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Relevance to NASA</td>
<td>See section 2.5 above. This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposal via Grants.gov</td>
<td><a href="http://grants.gov/">http://grants.gov/</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-NIP</td>
</tr>
</tbody>
</table>
| NASA point of contact concerning this program | Lin Chambers  
Earth Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: 202-358-1667  
Email: lin.h.chambers@nasa.gov |
NOTICE: Corrected July 7, 2017. In response to questions from proposers on the handling of the SIPS funding, NASA has removed the requirement for proposers to include the SIPS funding in the proposal. Instead, proposers must merely state whether the proposal is Category 1 or 2 and provide pertinent information needed to estimate increased production capacity (see Section 2.7). New text is in bold and deleted text is struckthrough. The proposal due date is unchanged.

Amended May 18, 2017. This amendment releases final text for this program element. Please note that this announcement combines the historical research competitions the Terra and Aqua missions, as well as research associated with the Suomi NPP mission. Notices of intent are requested by June 17, 2017. Proposals are due August 17, 2017.

1. Scope of Program element

NASA’s Earth Science Research Program aims to utilize global measurements to understand the Earth system and interactions among its components as steps toward prediction of Earth system behavior. To achieve this goal, a combination of shorter-term process-oriented measurements is complemented by longer-term satellite measurements of certain environmental properties. A key requirement for the latter is the provision of well-calibrated, multi-year and multi-satellite data and product series.

The Earth Observing System (EOS) was intended to provide global observations needed to advance Earth System Science and to initiate a number of improved long-term global data sets. NASA has completed the development and implementation of the EOS satellites, and successfully operates a comprehensive EOS Data and Information System (EOSDIS) to acquire, process, archive, and distribute these observations and data products (https://earthdata.nasa.gov/about). Among the EOS satellites that were most critical in initiating new, high quality long-term Earth system data records were the Terra and Aqua satellites, launched in 1999 and 2002, respectively.

The Suomi National Polar-orbiting Partnership (Suomi NPP, formerly the NPOESS Preparatory Project) satellite was launched on October 28, 2011, to extend more than 30 high-quality time series data records initiated by earlier NASA satellites (most notably Terra and Aqua, but also Aura, launched in 2004). Its observations should allow scientists to extend a continuous record of satellite data of sufficient quality to detect and quantify global environmental changes. For example, Suomi NPP continues measurements of land surface vegetation, sea surface temperature, and atmospheric ozone that began more than 25 years ago with earlier satellites and which were enhanced with the new instrumentation aboard the EOS satellites. The NASA time series of global observations is continued for certain data records by the on-orbit Suomi NPP program sensors (https://jointmission.gsfc.nasa.gov).
Suomi NPP serves as a bridge between NASA's Earth Observing System (EOS) of satellites and the next-generation Joint Polar Satellite System (JPSS), a National Oceanic and Atmospheric Administration (NOAA) program that will collect data for both weather and climate. NASA is bridging the mission capabilities to continue a set of the Earth System Data Records begun with the EOS missions using the Suomi NPP mission data.

From 2006-2013, the work of the NASA Suomi NPP Science Team (ST) focused primarily on evaluating the suitability of the sensor data records and environmental data records produced by the JPSS Program for Earth system science. The NASA Suomi NPP ST selected in 2013 evolved their focus to research in support of NASA’s creation, production, and analysis of EOS continuity data products from Suomi NPP, as well as science data analysis. Historical and current Suomi NPP ST evaluations (https://jointmission.gsfc.nasa.gov/teaminfo.html) indicate that, for most Earth observations, the Suomi NPP instruments are making quality measurements that can be used to create data products suitable for Earth system science and applications. However, the standard data products generated by the SNPP operational system vary greatly in their quality and suitability for Earth system science – some are of high quality and ready for production and use, while others would benefit from modest algorithm improvements and reprocessing; others require more analysis or different approaches to ensure an acceptable continuity data record.

This program element follows on from the A.41 The Science of Terra and Aqua (NNH09ZDA001N-EOS) in Research Opportunities in Space and Earth Science (ROSES)-2009 and A.28 The Science of Terra and Aqua (NNH13ZDA001N-TERAQ) in ROSES-2013). The present solicitation provides an opportunity for scientists to undertake studies responsive to NASA, the Science Mission Directorate’s science objectives (https://science.nasa.gov/about-us/science-strategy), and the NASA Earth Science Research objectives (https://science.nasa.gov/earth-science) and to provide answers to NASA’s Earth Science Research questions ((https://science.nasa.gov/earth-science/big-questions) through the use of data and derived products from Terra and Aqua and their measurement sensors, as well as the Suomi NPP satellite and its measurement sensors. It represents a continuation of the research aspects of the EOS and Suomi NPP Instrument Teams for these satellites, and emphasizes opportunities for scientists to analyze and exploit EOS and Suomi NPP data. It also provides an opportunity to develop new products by combining multi-sensor and multi-platform data, or by developing innovative approaches to data retrievals. This program element offers investigators an opportunity to conduct integrative research using the data and products resulting from these satellites (Terra, Aqua, Suomi NPP). Additionally, this program element welcomes the opportunity to fuse multiple sensors and data streams, including Terra, Aqua, and Suomi NPP, to conduct interdisciplinary and multi-disciplinary Earth System Science.

This program element defines and calls for the future work of an integrated NASA EOS (including but not limited to Terra and Aqua) and Suomi NPP ST. All collective instrument, mission, and measurement STs should direct their attention to developing the refined and/or alternative data products needed to ensure high-quality data records for Earth system science and applications that enable continuity with EOS data.
products. Thus, the primary data product-related activities of the EOS (Terra and Aqua) and NASA Suomi NPP ST solicited under this ROSES program element will continue the work of the Terra, Aqua, and Suomi NPP ST members solicited and selected under past ROSES program elements. In addition, NASA will continue applications-relevant Terra, Aqua, and Suomi NPP research under this program element. It is unlikely that NASA will have sufficient resources to support the development of all worthwhile Terra, Aqua and Suomi NPP data products; therefore, meritorious proposals offering data products that extend the traditional, standard EOS time series data products (see Section 6.0 for the list of relevant EOS standard products) will be accorded priority. If resources permit and scientific priority is clearly established in a meritorious proposal, NASA plans to support, as a secondary priority, research to develop and/or advance new Suomi NPP data products in support of NASA relevant research.

The Terra, Aqua, and Suomi NPP STs have been supported in their work by the Science Investigator-led Processing Systems (SIPS). NASA has transitioned the production of standard science products from Suomi NPP to the SIPS (see Section 2.7 for a description of the SIPS). SIPS will not be competed at this time; therefore, current SIPS will support the newly selected projects from this program element.

**To support accurate estimation of data system capacity to produce and archive products selected through this solicitation, proposals must be categorized based on whether or not they seek to develop new products or substantially modify existing products and, if so, must provide pertinent information needed to estimate increased production capacity (see Section 2.7).**

This program element does not request proposals for the continued support of Science Investigator-led Processing Systems (SIPS), but the previously selected SIPS PIs should integrate and submit any requests for SIPS funding to their program managers if increased SIPS capacity (above and beyond the data products a given SIPS already supports) is needed to support production of additional (or modified) data products from any proposal that may be selected by this program element. Terra, Aqua, and Suomi NPP ST members should expect to work with NASA’s Earth Science Data and Information System (ESDIS) Project and Program Offices and the appropriate SIPS to have their data product implemented (see Section 2.7) and identify any budgetary requirements. [These paragraphs were changed on July 7, 2017]

This program element recognizes the advances already made by investigations solicited in prior NASA Research Announcements and ROSES program elements, which focused in the areas of sensor calibration, algorithm development and refinement, data product validation, and scientific data analysis. As these EOS and the Suomi NPP missions continue to mature and continue in the extended mission phase, less emphasis will be placed upon algorithm refinement and more emphasis will be directed to multi-sensor product development accompanied by active utilization of these data and products in scientific research, modeling, synthesis, and diagnostic analysis to answer Earth science questions.
2. **Types of Proposals Solicited**

This program element integrates the historical research program elements associated with the Terra, Aqua, and Suomi NPP missions. This element contains changes from the previous competitions, and proposers should read it in its entirety. For these topics, the scientific scope is required to fall within the breadth of NASA Earth science (see Appendix A.1 of this ROSES-2017 NRA) and its embraced challenges while being an appropriate use of EOS (Terra and Aqua), and/or Suomi NPP mission observations. NASA’s selected Science Team (ST) is responsible for the scientific algorithms and software necessary to create science quality NASA data products, supporting calibration and validation activities, and ultimately analysis and interpretation of the data and data products for science and applications. NASA’s Flight Program and ESDIS Project are responsible for the systems and capabilities to perform the data processing and product generation and to archive and distribute the NASA data products. Section 2.6.2 addresses uncertainty or error analysis requirements, and Section 2.3 addresses the former topic regarding Algorithms – Existing Data Product Refinement.

PIs from non-US institutions are free to propose to this program element on a no-exchange-of-funds basis. PIs from institutions outside the U.S. who were selected under previous announcements (e.g., Earth System Science Research using Data and Products from Terra, Aqua and ACRIMSAT Satellites from 2003 or 2006 or ROSES 2009 A.41 or 2013 A.28 The Science of Terra and Aqua, or ROSES 2013 A.29 Suomi National Polar-orbiting Partnership (NPP) Science Team and Science Investigator-led Processing Systems for Earth System Data Records From Suomi NPP) are not required to propose here, but, as interested, should indicate to the Points-of-Contact below their desire for continued participation in a measurement and/or instrument team.

This program element requests proposals from members of the scientific community to participate in NASA Science Team(s) by self-identifying an interest in Science Team membership. Proposers are asked to self-identify clearly in each proposal’s Statement of Work to which Science Team(s) (e.g., MODIS, Suomi NPP, Sea Surface Temperature, etc.) they wish to belong (see sections 3.0 and 4.0 for more information). NASA will continue to sponsor or hold instrument(s) (e.g., MODIS-VIIRS), mission (e.g., Suomi NPP), and/or disciplinary science team meetings and workshops, as identified by the mission Project Scientists, instrument scientists, Science Team Leaders and Discipline Leaders (Section 2.5) working with NASA Headquarters program scientists, to focus on scientific issues. Please carefully review Section 2.6.1 on Science Team Meetings and follow the guidance for all proposals.

Following historical program subelements, five types of research proposals are solicited, and they are described in Sections 2.1-2.5. This program element blends subelements from the aforementioned/historical program elements in some cases, and identifies subelements specific to Suomi NPP in other cases. Specifically, this program element requests proposals for:

- **2.1 Science Data Analysis**
  - **2.1.1 Multi-Platform and Sensor Data Fusion**
- **2.2 Algorithms – New Data Products**
2.3 Algorithms – Existing Data Product (Terra and Aqua) and EOS Continuity Data Product (Suomi NPP) Refinement

2.4 Real- or Near-Real-Time Data Algorithms

2.5 NASA Suomi NPP Science Team Leader and Terra, Aqua, Suomi NPP Discipline Leads

The emphasis for all types of investigations is on taking the next steps toward securing continuous, well characterized, long time series measurements of sufficient quality to answer critical Earth system science, global change, and/or applied sciences questions. In this program element, development of data products using Suomi NPP measurements that can be used to extend the time series records of the traditional EOS standard data products is accorded higher priority than development of other new science data products using Suomi NPP. In this light, proposers MUST show how the research proposed is relevant to NASA and cannot be supported by another federal agency or department. New data products will be supported based on scientific priority and to the extent funding permits.

All proposals submitted to this program element may involve a single or multiple data products and/or instruments.

Note: the current Sounder Team is evaluating different competing L2 algorithms and data products. This competition will select a single L2 sounder algorithm to be implemented as the NASA standard product.

2.1 Science Data Analysis

Science Data Analysis proposals will be considered for analysis of Terra and/or Aqua and/or Suomi NPP data to answer disciplinary, interdisciplinary, or multi-disciplinary Earth science research questions. Proposed efforts must make scientific use of the data or products from those NASA EOS, Suomi NPP research sensors listed in Section 4.0. Terra, Aqua, or Suomi NPP sensor data and/or products can be used individually for disciplinary or interdisciplinary or multi-disciplinary research, or in combination with those from other Terra, Aqua, and Suomi NPP sensors for disciplinary, interdisciplinary, or multi-disciplinary research within the Earth System.

Proposals addressing Terra and Aqua instrument-specific algorithm/data product refinement, and Suomi NPP instrument-specific algorithm/data product maintenance/refinement that require research efforts for maintenance and refinement should be submitted as Science Data Analysis proposals. An example of such a proposal would be one that offers to deliver major algorithm improvements enabling new research, combined with a plan to undertake the research. In this case, the proposal would contain a plan for improvements to the algorithm(s) or data product(s), as well as clear scientific objectives and science questions to be addressed. PIs planning to submit proposals addressing Terra and/or Aqua and Suomi NPP instrument-specific algorithm/data product refinement proposals that require research efforts for maintenance and refinement are asked to read the additional requirements for benchmarking progress on Suomi NPP instrument-specific algorithm/data products contained in Section 2.3 (under "Requirements for Suomi NPP EOS Continuity data product proposals").
For all proposals submitted to this program subelement, minimum calibration/validation (cal/val) activities tied to a given existing algorithm/data product that represent minor investments (e.g., do not include dedicated field campaigns involving multiple instruments and platforms), given the maturity of the existing algorithms (minimal cal/val efforts needed to maintain the quality of the existing data products), are welcome.

For proposals seeking to undertake research in conjunction with Terra and/or Aqua and Suomi NPP, the level of leveraged effort among research, investigator time and other resources relative to each mission must be made clear in the Statement of Work, budget, and budget justification.

As already discussed, PIs of proposals responsive to this category may request to become members of one or more instrument, mission, or measurement science teams (see the explanation of the Instrument and Science Measurement Teams in Section 3.0), but must budget for the annual meetings of the respective teams to which they endeavor to join.

2.1.1 Multi-platform and Sensor Data Fusion

NASA requests studies utilizing Terra, Aqua, and Suomi NPP data in conjunction with appropriate data from other satellites (including non-NASA satellites) for interdisciplinary and multi-disciplinary studies of the Earth System. Successful proposals should pose science questions that cross traditional NASA Earth Science disciplinary program boundaries (interdisciplinary or multi-disciplinary). NASA solicits multimission and multisensor innovative research that can be used to quantify change, characterize processes, and examine function within the Earth System over time. In the context of this program subelement, "mission" is defined as a satellite mission and “sensor” is defined as satellite sensor. "Data" must include satellite sensor data products from at least two satellite sensors, one of which must be on the Terra and/or Aqua and/or Suomi NPP platform, and the other data source must be from a different sensor on another satellite platform. However, while there is a MODIS sensor and CERES sensor on both Terra and Aqua, use of the two MODIS or two CERES sensor’s data will not fulfill the subelement requirement of two independent data streams. Furthermore, model output, including data assimilation and reanalysis output, does not qualify as an independent satellite sensor data source.

Proposals responding to this program subelement must utilize two or more remote sensing data sets, as defined above, in a greater than marginal application. The use of the multiple remote sensing data sets must enable significant new applications/science or substantially improve upon the value and capabilities of existing products. Proposals must clearly justify the compelling and substantial advances enabled by the new application(s).

2.2 Algorithms – New Data Products

Terra, Aqua, and Suomi NPP instrument-specific proposals will be considered from prospective new or continuing science team members who wish to a) advance to implementation as either a core or experimental EOS or Suomi NPP data product, a new data product that has passed through an Algorithm Theoretical Basis Document
(ATBD) review or equivalent process; or b) to introduce a new data product/algorithm development that will yield a new ATBD or equivalent for peer-review from Terra, Aqua, and Suomi NPP. Proposals that address new data products/algorithms must detail the instrument-specific algorithm, significant science, supporting and calibration/validation activities (see Section 2.6.3), and, depending on the maturity of the data product, a timeline or path to delivery of an ATBD or initial data product release to the community before the end of the award period.

Proposed calibration and validation activities may involve a single or multiple data products and/or instruments. The scientific justification and need for the improved calibration and validation must be compelling and should be the focus of the proposed data product, algorithm, suite of algorithms, or instrument(s). New field validation campaigns are not solicited.

Proposals responsive to this category must specify the instrument or measurement science teams on which they would like to become members (see the explanation of the Instrument and Science Measurement Teams in Section 3.0).

2.3 Algorithms for Terra and Aqua Existing Data Product and Suomi NPP EOS Continuity Data Product Creation and Refinement

To summarize, this ROSES-2017 program subelement (Section 2.3) addresses proposals for:

- Refinement of algorithms/data product(s) selected under the former ROSES-2013 A.46 Terra and/or Aqua Algorithms-Existing Data Products topic area that have gone through ATBD review and will be or have been submitted to the 2017 Terra and Aqua Senior Review (Submit to Section 2.1 Science Data Analysis)
- Refinement of algorithms/data product(s) selected under the former ROSES-2013 A.29 Suomi National Polar-orbiting Partnership (NPP) Science Team and Science Investigator-led Processing Systems for Earth System Data Records From Suomi NPP topics NASA Suomi NPP Data Products for EOS Continuity (if leveraging research for Terra and/or Aqua algorithms/data product(s)) (Submit to Section 2.1 Science Data Analysis)
- Refinement of algorithms/data products to address “orphan” existing data products from Terra, Aqua, or Suomi NPP that went without support in 2013 or earlier (Submit to Section 2.1 Science Data Analysis).

In ROSES 2013 (A.46 Terra and Aqua – Algorithms – Existing Data Products), NASA solicited proposals focused on maintaining or modestly refining Terra and Aqua instrument-specific algorithm(s) or data product(s) that had existing, approved ATBD algorithms. The algorithm/data maintenance activities in the proposals selected under that ROSES 2013 A.46 program element were transitioned to the Senior Review in 2017 as planned, as were Terra and Aqua core algorithm/data product maintenance activities. The Terra and Aqua algorithm/data product maintenance proposals submitted to the Senior Review in 2017 did not include modest-to-major algorithm/data product refinement or research.

The present ROSES 2017 program element welcomes proposals to refine and improve algorithms/data products included in the 2017 Senior Review proposals for Terra and/or
Aqua beyond the level of core algorithm/data product maintenance. We also welcome proposals related to development or refinement of EOS continuity data products, either alone or in conjunction with refinement of an algorithm/data product for Terra and/or Aqua. However, as detailed in section 2.3.1 below, proposals involving EOS continuity data products must address specific additional benchmarking requirements.

As such:

- If the proposer plans to refine an algorithm/data product for a Terra and/or Aqua Existing Algorithm or data product(s) only (e.g., selectees from the ROSES 2013, A.46 Terra and Aqua – Algorithms – Existing Data Products), the proposal for this and any associated research should be submitted to Section 2.1 Science Data Analysis following the instructions provided in that Section.

- If the proposer plans to refine an algorithm/data product for a Suomi NPP EOS continuity algorithm or data product(s) only (e.g., Suomi NPP EOS Continuity data products selected under the ROSES 2013 A.29 Suomi National Polar-Orbiting Partnership (NPP) Science Team and Science Investigator-Led Processing Systems for Earth System Data Records from Suomi NPP program element), the proposal for this and any associated research should be submitted to Section 2.1 Science Data Analysis; in addition, read section 2.3.1 below (“Requirements for Suomi NPP EOS Continuity data product proposals”) to ensure the proposal fulfills the requirements for benchmarking progress on Suomi NPP EOS continuity data product refinement.

- If the proposer plans to refine an algorithm/data product for a Terra and/or Aqua and Suomi NPP EOS continuity algorithm or data product, the proposal for this and any associated research should be submitted to Section 2.1 Science Data Analysis following the instructions provided in that section; in addition, read section 2.3.1 below (“Requirements for Suomi NPP EOS Continuity data product proposals”) to ensure the proposal fulfills the requirements for benchmarking progress on Suomi NPP EOS continuity data product refinement.

2.3.1 Requirements for Suomi NPP EOS Continuity data product proposals

In 2013, NASA solicited proposals for NASA Suomi NPP Science Team members to develop refined, modified, or alternative Level 2 and Level 3 data products (see http://observer.gsfc.nasa.gov/sec3/ProductLevels.html for definitions of these levels) using observations from Suomi NPP’s VIIRS, CrIS, ATMS, and OMPS instruments that were of suitable quality to extend the time series of the high-priority, traditional EOS standard data products listed below in Section 6. All proposed investigations were required to include a plan to develop an Algorithm Theoretical Basis Document (ATBD) prior to scientific coding of the algorithm and transition of the code to a NASA-designated SIPS for implementation and data product production.

This will again be a requirement if a PI/team wishes to continue with refinement of a previously selected data product; specifically, the progress toward the ATBD must be reported. Additionally, any proposals wishing to continue or refine existing EOS Continuity Data Products must include the plan for generating and submitting an ATBD as well, along with plans to transition the code. As in 2013, NASA will conduct a review of the ATBD within three to six months of receipt and prior to committing to
implementation of the algorithm. Proposals should include plans for 1) maintenance and refinement of the algorithm once it has been implemented at the SIPS and 2) evaluation (i.e., validation) of the data product as it is produced. It is expected that periodic reprocessing of the data collections will be required to maintain the time series and to capture improvements in algorithms and understanding of instrument performance. Proposers should expect to coordinate reprocessing activities with other Suomi NPP ST members, the NASA Suomi NPP Project Science Office, ESDIS, and the relevant SIPS.

As a point of clarification, NASA is requesting proposals for the development of standard data products from the Ozone Mapping and Profiling Suite (OMPS) Nadir and OMPS Limb instruments. When the OMPS Limb instrument was restored to the Suomi NPP payload, NASA assumed responsibility for the OMPS Limb products and assembled resources for this work from a variety of sources, including the Suomi NPP ST budget. Therefore, any additional work required to refine science algorithms and data production software for OMPS Limb standard products (i.e., profiles of ozone and aerosols) must be proposed for consideration under this program element.

For the Suomi NPP Sounder instruments, NASA is requesting proposals for the refinement or modifications to the Level 2 and Level 3 data products which resulted from the A.29 Sounder user community evaluation/down selection; not the original selection.

NASA is not requesting proposals for standard data products from the Suomi NPP CERES instrument in this program element because other arrangements for NASA support and oversight are already in place for these data products, specifically through the Earth Radiation Budget Science (ERBS) project.

If a prospective PI wishes to propose refinement to a new algorithm, or an algorithm that has not been selected as an EOS continuity data product (whether it has been through ATBD review or not), the proposal should be submitted to Section 2.2 Algorithms – New Data Products of this program element.

2.4 Real- or Near-Real-Time Data Algorithms

Some of the Terra, Aqua, and Suomi NPP observations have been utilized for operational purposes such as emergency response and/or weather forecasting. Ongoing activities include Direct Broadcast and the Land, Atmosphere Near-real-time Capability for EOS (LANCE) (https://earthdata.nasa.gov/earth-observation-data/near-real-time). Proposals to enhance, refine, or develop near real time algorithms for application and operational usage will be considered.

Development of variants of Terra, Aqua, and Suomi NPP algorithms that are related but suitable for implementation with direct broadcast data and/or LANCE low latency data may be proposed if clear evidence of a near-real time need and user(s) is documented and well justified in the proposal. Such proposers should plan to work closely with the NASA Direct Readout Laboratory (DRL; https://directreadout.sci.gsfc.nasa.gov/) and the Land Atmosphere Near Real-time Capability for EOS (LANCE; https://earthdata.nasa.gov/earth-observation-data/near-real-time) and participate in the LANCE User Working Group (UWG). All data products must be focused on an application that can be justified as meeting NASA’s applied science goals or a unique
unmet operational data need that fits within the NASA program objectives and mission. For Suomi NPP, to prevent duplication of efforts pursued by NOAA, NASA will only support the upgrade, refresh and operation and maintenance of EOS Continuity algorithms and supporting systems.

2.5 NASA Suomi NPP Science Team Leader and Terra, Aqua, Suomi NPP Discipline Leads

NASA seeks requests from scientists proposing to become Suomi NPP science team (ST) members to also serve in scientific leadership roles for NASA Suomi NPP ST activities. An overall NASA Suomi NPPST Leader and five Discipline Leads (Land, Ocean, Atmosphere, Sounder, and Ozone; see Section 2.5.2 below) are sought.

2.5.1 NASA Suomi NPP Science Team Leader

Proposers who wish to be considered for the NASA Suomi NPP Science Team Leader position must indicate their candidacy by answering the relevant cover sheet question and including a Team Leader section within their proposal. NASA reserves the option to appoint the NASA Suomi NPP Science Team Leader from team member proposals, should proposals of adequate merit not be received for the Team Leader position.

The Team Leader section may not exceed five pages in length, and these five pages may be in addition to the 15 pages allowed for team member proposals. The Team Leader section of the technical plan should include:

- The scientific qualifications and leadership skills that make the proposer a prime candidate for NASA Suomi NPPST Leader;
- A clear articulation of the proposed Team Leader’s understanding of NASA’s role in the Suomi NPP mission and vision for Suomi NPP’s contributions to science and society;
- Documentation of the experience and interests that enable the proposer to represent the interests of the NASA science and applications communities in the Suomi NPP mission, including an ability to represent the scientific data products and their uses for all five Suomi NPP instruments: ATMS, CERES, CrIS, OMPS, and VIIRS; and
- A management plan that describes the proposer’s approach to science team leadership and interactions among the five Discipline Groups, the NASA Suomi NPP Program and Project Science Offices.

In addition, the budget section of the proposal must include a budget and justification for the Team Leader work separate from the budget and budget justification for proposed team member activities. The supplement should be discussed as a separate section within the budget justification and/or Total Budget file, as appropriate to the type of costs (ODCs or salary) being discussed. NASA desires to track the budget request for a leadership role separately from that for ST membership. Therefore, the total budget associated with the Team Leader work should be given on the cover page in section F line 8 or 9, and called out separately in the separately uploaded total budget file as well.
Because the team member aspects of this program element do not include CERES data products, NASA will consider stand-alone five-page proposals for Suomi NPP Science Team Leader (to not include any other team member activities) from the CERES science community.

2.5.2 NASA Terra, Aqua, Suomi NPP Discipline Leads

Discipline leads are sought to coordinate and represent the interests of the following subset of Terra, Aqua, and Suomi NPP “disciplines”:

• Land: MODIS and VIIRS Land Products and Applications
• Ocean: MODIS and VIIRS Ocean Products and Applications
• Atmosphere: MODIS and VIIRS Atmosphere Products and Applications
• Sounder: Sounder (ATMS and CrIS) Products and Applications
• Ozone: Ozone (OMPS) Products and Applications

Proposers who wish to be considered for a NASA Terra/Aqua/Suomi NPP Discipline Lead position must indicate their candidacy by answering the relevant cover sheet question and including a Discipline Lead section within their proposal. NASA reserves the option to select NASA Terra/Aqua/Suomi NPP Discipline Leads from team member proposals should proposals of adequate merit not be received for the Discipline Lead positions.

The Discipline Lead section may not exceed five pages in length, and these five pages may be in addition to the 15 pages allowed for team member proposals. The Discipline Lead section of the technical plan should include:

• The scientific qualifications and leadership skills that make the proposer a prime candidate to lead one of the five Terra/Aqua/Suomi NPP Discipline Groups;
• A clear articulation of the proposed Discipline Lead’s understanding of NASA’s role in the Terra/Aqua/Suomi NPP mission and the scientific and societal importance of that discipline’s Terra/Aqua/Suomi NPP data products;
• Documentation of the experience and interests that enable the proposer to represent the interests of their discipline’s science and applications communities; and
• A management plan that describes the proposer’s approach to discipline leadership and interactions with the Terra/Aqua/Suomi NPP ST Leader, the NASA Suomi NPP Program and Project Science Offices (https://jointmission.gsfc.nasa.gov/suomi.html)
• A management plan for working with selected investigators, project and program scientists, and Team Leaders, as needed, to update all instrument, Science Team, and mission web sites with data product, ATBD, and any other relevant information.

In the case of the VIIRS sensor on board Suomi NPP, there will be a need to bridge the individual Land, Ocean, and Atmosphere disciplinary continuity to the Land, Ocean, Atmosphere disciplines for the MODIS sensor on board Terra and Aqua. An explanation of the discipline lead’s plans to bridge the various sensors and platforms communities must be addressed.
In addition, the budget justification section of the proposal must include a budget and
budget justification for the Discipline Lead work that are separate from the budget and
budget justification for proposed team member activities. The supplement should also
be discussed as a separate section within the budget justification and/or Total Budget
file, as appropriate to the type of costs (ODCs or salary) being discussed. NASA desires
to track the budget request for a leadership role separately from that for ST
membership. Therefore, the total budget associated with the Discipline Lead work
should be listed under "Other" in the budget information provided with the proposal
cover page.

2.5.3 Requests for NASA Suomi NPP Team Leader and Terra/Aqua/Suomi NPP
Discipline Leads

Proposers may request to be considered for both NASA Suomi NPP Science Team
Leader and a Discipline Lead role, but in all such cases the total length of the proposal’s
technical plan may not exceed 20 pages. In the budget justification section of such
proposals, separate budgets and justifications should be provided for each role
requested. It is unlikely that NASA would select a single Principal Investigator to serve
in both the NASA Suomi NPP Science Team Leader role and as a Discipline Lead, but
it is recognized that some proposers may wish to be candidates for both roles.

2.6 Other Considerations and Requirements for NASA Terra, Aqua, Suomi NPP ST
Member Proposals

2.6.1 Science Team Meetings

This program element requests proposals from members of the scientific community to
participate in NASA Science Team(s) by self-identifying an interest in Science Team
membership. Proposers are asked to identify clearly in each proposal’s Statement of
Work to which Science Team(s) (e.g., MODIS, Suomi NPP, Sea Surface Temperature,
etc.) they wish to belong (please see sections 3.0 and 4.0 for more information). NASA
will continue to sponsor or hold instrument(s) (e.g., MODIS-VIIRS), mission (e.g., Suomi
NPP), and/or disciplinary science team meetings and workshops, as identified by the
mission Project Scientists, instrument scientists, Science Team Leaders and Discipline
Leaders (Section 2.5) working with NASA Headquarters program scientists, to focus on
scientific issues. Face to face meetings are essential to ensure that the activities
required to address the science program subelements are conducted. To this end,
proposers should budget for a total of two three-day NASA Science Team Meetings
and/or workshops in each year. Proposers should assume a mix of meeting locations
(East Coast and West Coast) within the United States, but should budget meeting travel
costs to the farthest US coast. The frequency and timing of respective science team
meetings will be determined by the respective instrument and mission Science Team
Leaders and discipline leads, plus the associated mission and instrument Project
Scientists and Program Scientists. It is expected that the participation at all NASA
(MODIS-VIIRS, Suomi NPP, etc.) ST meetings will be by the selected Principal
Investigator or a designated co-Investigator to be named in advance of the ST meeting
not attended by the Principal Investigator.


2.6.2 Requirements - Error and Uncertainty Analysis

All proposals submitted in response to this program element must quantify errors and uncertainties associated with the proposed efforts (e.g., data products, scientific data analysis, etc.). The error and uncertainty discussion must be clearly identifiable in a separate section within the proposal body.

2.6.3 Calibration and Validation Research

Proposals should include appropriate calibration and/or validation activities and describe them within a separate section of the technical plan.

The JPSS Program is responsible for Suomi NPP spacecraft and instrument operations and the calibration and validation of NOAA operational data products. The NASA Suomi NPP Project Science Office also conducts certain calibration and validation activities supporting the NASA Suomi NPP Level 1 algorithms, maintaining the accuracy of OMPS Limb and CERES, and the calibration and validation activities of the Suomi NPP ST (see Section 3.2 and http://npp.gsfc.nasa.gov/teaminfo.html). These activities will continue, and ST members should plan to interact and coordinate with – and leverage – the NASA Suomi NPP Project Science Office in conducting calibration and validation research. ST members should also plan to interact with the JPSS Program and the NOAA STAR operational product teams, as appropriate, in Suomi NPP calibration and validation activities.

It is expected that almost all calibration and validation activities of the ST will be modest in scope, making use of existing observational networks and involving a relatively small fraction of the total budget request and conducted as part of data product development or research. However, it is possible that some stand-alone research in support of Suomi NPP instrument calibration may be warranted – research that is not a part of data product development. Proposals for such calibration and validation activities should respond to the 2.1 Science Data Analysis and provide strong justification for why the additional, stand-alone calibration work is essential to the development of NASA Suomi NPP science-quality products.

Proposers must avoid duplicating calibration/validation work that is the responsibility of the JPSS Program or the NASA Suomi NPP Project Science Office, and should offer studies that complement and add value to those efforts (see https://ncc.nesdis.noaa.gov/index.php) while maintaining a tight focus on activities essential for support of NASA Suomi NPP data products. Major airborne and in situ (land and ocean) validation campaigns will not be considered responsive.

2.6.4 NASA Policies Regarding Data and Software

All data and the standard science data products, along with the scientific source code for algorithm software, coefficients, and ancillary data used to generate these products must be delivered to the NASA-assigned DAAC or Data Center in accordance with the NASA Earth Science Data and Information Policy specified at http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/. Additionally, full-resolution browse products shall be generated and delivered for all standard products, as defined in https://earthdata.nasa.gov/about/science-system-description/eosdis-components/global-imagery-browse-services-gibs. Public release of
these data shall conform to the NASA Earth Science Data and Information Policy. There shall be no period of exclusive access.

Science algorithms used to generate the standard science data products shall be documented in Algorithm Theoretical Basis Documents (ATBDs).

A tailored, alternate Data Rights section will be applied to the resultant award document, under which scientific data and scientific software (software used for processing raw Earth observation remote sensing instrument data into scientific data and products) will be exchanged without restriction as to its disclosure, use, or duplication.

2.7 Science Investigator-lead Processing Systems (SIPS) POCs

Five Science Investigator-led Processing Systems (SIPS) have been established by NASA for the Suomi NPP mission; the SIPS and their POCs include:

- A NASA Suomi NPP Land SIPS - Edward Masuoka/NASA Goddard Space Flight Center - edward.j.masuoka@nasa.gov
- A NASA Suomi NPP Ocean SIPS – Gene Feldman/NASA Goddard Space Flight Center - gene.c.feldman@nasa.gov
- A NASA Suomi NPP Atmosphere SIPS - Liam Gumley/University of Wisconsin-Madison - Liam.Gumley@ssec.wisc.edu
- A NASA Suomi NPP Ozone SIPS - Edward Masuoka/NASA Goddard Space Flight Center - edward.j.masuoka@nasa.gov
- A NASA Suomi NPP Sounder SIPS - Ruth Monarrez/NASA Jet Propulsion Laboratory - ruth.monarrez@jpl.nasa.gov

These SIPS provide full data processing and production facilities needed to generate standard and experimental Suomi NPP science products developed by the Suomi NPP Science Team.

To support accurate estimation of data system capacity to produce and archive products selected through this solicitation, all proposers must categorize their proposal into one of the following types:

1. Proposals that continue the generation of existing products.
2. Proposals that seek to develop new products or substantially modify existing products.

For Category 1 proposals PIs must merely state that it is a Category 1 proposal. No additional information is necessary to estimate production capacity.

For Category 2 proposals PIs must, in the NSPIRES cover page text boxes for the data management plan, explicitly state "This is a Category 2 proposal" and provide all pertinent information needed to estimate increased production capacity - for example, daily archive volume, processing cycles, ancillary data and software. Terra, Aqua, and Suomi NPP PIs of selected proposals will work with NASA’s Earth Science Data System Program and Earth Science Data and Information System (ESDIS) Project to develop accurate production and archival
sizing estimates. PIs on selected proposals will then work with ESDIS and the SIPS to implement the proposed products.

[These paragraphs were changed on July 7, 2017]

All proposals to the present solicitation involving creation of EOS Continuity products or any other new data products must demonstrate that the appropriate SIPS have been contacted and that the proposal budgets contain funding for all SIPS costs/resources needed to generate the proposed products.

Note that this program element does not include major data processing and production work that is conducted by the Terra and Aqua Projects (under their "Data Analysis" budgets provided by the Senior Review) or at the EOSDIS Distributed Active Archive Centers (DAACs).

3. Instrument and Measurement Science Teams

NASA has established a group of measurement teams to support the transition from a mission/instrument focus to a measurements focus for its long-term Earth system data records. These measurement teams are taking responsibility for the quality and integrity of several suites of related time series data products. They are:

- Land Measurements Team
- Ocean Biology and Biogeochemistry Measurements Team
- Cryospheric Sciences Measurement Team
- Atmospheric Science Measurement Team
- Biodiversity and Ecological Forecasting Team
- Sea Surface Temperature Science Team

The following subsections describe in detail the scope and responsibilities of each of these measurement teams. All those proposing to be members of the Terra, Aqua, and/or Suomi NPP ST may also request membership on one of the above measurement teams. While it is recognized that proposed studies may be relevant to more than one measurement team, proposers should request membership in the single measurement team that they deem most relevant to their activities. Proposers should budget for travel to one or two domestic measurement team meetings (for budget planning purposes, budget travel to the furthest U.S. coast for each meeting) in addition to their annual mission or instrument ST meetings. Additional detailed guidance for the Instrument and Science Measurement Teams is provided below.

NASA strongly encourages team members who lead projects with a modeling component to participate in the development of the Earth System Modeling Framework (ESMF) (https://www.earthsystemcog.org/projects/esmf/), and to take advantage of the ESMF to couple models, data, and analyses required to support any proposed science data analysis investigation.

3.1 Land Measurements Team

NASA’s Land Measurements Team is responsible for the quality and integrity of measurements of vegetation, land cover, temperature, land surface dynamics and hydrological properties, and fire. It integrates the responsibilities of the ecological and
hydrological components of the MODIS, Suomi NPP, ASTER, MISR, AMSR-E, and VIIRS, Science Teams and the former Landsat Science Team, as well as PIs who use or have used Earth Observing-1 (EO-1) data. The Land Measurements Team addresses: 1) algorithm development, refinement, and maintenance for systematic time series measurements of the Earth’s land surface, including land cover, snow cover, vegetation properties, hydrological properties, temperature, reflectance, albedo, and fire; 2) algorithm development, refinement, and maintenance for new, exploratory or one-time measurements of the Earth’s land surface; 3) calibration and validation of land measurements, including cross-calibration and intercomparison of systematic measurements and data products from the different sensors used to produce a time series; 4) data processing, production, and distribution for land measurements; and 5) scientific utilization of the land measurements and data products to understand Earth’s carbon cycle, ecosystems, terrestrial biodiversity, water cycle, energy balance, as well as scientific utilization of land measurements in combination with measurements of the atmosphere, oceans, and solid Earth to understand Earth system function.

The Land Measurements Team does not itself fund or manage major data processing and production work that is conducted by the Terra and Aqua Projects (under their "Data Analysis" budgets provided by the Senior Review) or at the EOSDIS Distributed Active Archive Centers (DAACs).

3.2 Ocean Biology & Biogeochemistry Measurements Team

NASA’s Ocean Biology and Biogeochemistry Measurements Team (synonymous with the Ocean Color Research Team) is responsible for the quality and integrity of measurements of ocean biological, ecological, and biogeochemical properties, as well as for refining and maintaining existing high quality time series of systematic observations of ocean biological and biogeochemical properties. The team is responsible for integration of ocean biological, ecological, and biogeochemical measurements for scientific analysis and modeling. It replaces former instrument science teams, specifically the ocean color components of the MODIS and Suomi NPP Science Teams (VIIRS in particular), including researchers utilizing Sea-viewing Wide Field-of-view Sensor (SeaWiFS) and other ocean color data. The Ocean Biology and Biogeochemistry Measurements Team addresses 1) algorithm development, refinement, and maintenance for systematic time series measurements of the Earth’s sunlit upper ocean layer, including biological, biogeochemical properties, encompassing, as needed, sea surface temperature from MODIS and Suomi NPP VIIRS; 2) algorithm development, refinement, and maintenance for new, exploratory or one-time measurements of ocean biological or biogeochemical properties; 3) calibration and validation of the ocean measurements, as well as cross-calibration and intercomparison of systematic measurements and data products from different sensors used to produce a time series, including implementation of all sampling and data analysis protocols; 4) data processing, production, and distribution for ocean measurements; and 5) scientific utilization of the ocean biological and biogeochemical measurements and data products to understand the oceans and Earth’s elemental cycles, ecology, biodiversity, chemistry, and other aspects of biology, as well as air/sea or land/sea processes and exchanges that give some understanding to Earth System function.
Proposers should be aware of the continued evolution of NASA’s research objectives that will enable improved quantification of ocean biological and biogeochemical properties within optically complex (coastal) waters. Investigators should be prepared to interface with existing investments that will improve NASA’s capability to undertake vicarious calibration of satellite data within a range of optical water masses. Proposers should also be aware of the broader efforts by the modeling, analysis, and prediction investigations currently underway, and will be encouraged to integrate with these efforts where synergies are clear.

3.3 Cryospheric Sciences Measurement Team

NASA’s Cryospheric Sciences Measurements Team is responsible for the quality and integrity of measurements of ice in the Earth’s polar regions with a focus on sea ice and the ice sheets of Greenland and Antarctica. Measurements of polar and non-polar mountain glaciers are also considered. This team replaces former instrument science teams, specifically the ice components of the MODIS, Suomi NPP, ASTER, MISR, AMSR-E, and VIIRS Science Teams including researchers using relevant Landsat and EO-1 data products. The Cryospheric Sciences Measurements Team addresses measurements of sea- and land-based ice, snow, meltwater, temperature, albedo, and other surface properties as follows; 1) algorithm development, refinement, and maintenance for systematic time series and new, exploratory or one-time measurements; 2) calibration and validation of measurements, including cross-calibration and intercomparison of systematic measurements and data products from the different sensors used to produce a time series; 3) data processing, production, and distribution for measurements; and 4) scientific utilization of measurements and data products to understand changes in the Earth’s polar sea and land-based ice, as well as scientific utilization of these measurements in combination with measurements of the atmosphere, oceans, and solid earth to understand their connection to the global system.

3.4 Atmospheric Science Measurement Team

NASA’s Atmospheric Science team is responsible for 1) refining and maintaining the various atmospheric products; 2) algorithm development, refinement, and maintenance for new, exploratory, or one-time measurements; 3) calibration and validation of atmospheric data products; 4) data processing, production, and distribution of atmospheric data products; 5) scientific utilization of atmospheric data products to enhance our understanding of Earth System Science. The atmospheric observations include trace gas, aerosol, cloud, and precipitation measurements.

For the trace gas retrievals, numerous instruments obtain significant data sets. AIRS produces products for atmospheric water vapor, CO, O₃, CO₂, CH₄, SO₂, N₂O and HNO₃. MOPITT retrieves global atmospheric CO products. AMSR-E produced water vapor columns. This team maintains and refines scientifically useful data sets not part of the satellite core data products. This team also conducts studies that combine Aqua and Terra with trace gas products retrieved by Aura and other international satellites in unique scientific data analysis and modeling. The Stratospheric Aerosol and Gas Experiment III (SAGE III) instrument launched to the International Space Station (ISS) in
February, 2017 will retrieve water vapor, O₃, NO₂ in the stratosphere and SAGE III data could be used, where appropriate.

For aerosols, data products exist from both MODIS instruments, MISR, and AIRS. Studies that maintain and improve non-core aerosol products will be considered. Also, studies that perform unique and scientifically interesting scientific analysis of these aerosol products, either individually or combined with other Aqua/Terra instruments or data from other satellites (e.g., Aura, CALIPSO, etc.) will be considered.

For clouds, data products exist from both MODIS instruments, MISR, and AIRS. All these products provide a unique global view of clouds. Again, this team will support the maintenance and refinement of data sets that provide important data records for Aqua and Terra cloud products not supported by the core mission project. This team will also include unique data analysis studies that use these data sets, either individually or in combination with other data sets, to better utilize the scientific return of these instruments.

Both AMSR-E and AIRS provide unique data that are used for Earth science studies. These include atmospheric temperature retrievals, instantaneous and monthly rainfall, land surface wetness, snow water equivalent and sea ice variables (sea ice concentration, snow depth on sea ice, and drift). Validation of the products is an ongoing process. Updating the algorithm using the latest validation data shall be done anytime new validation data becomes available. The scientists responding to this ROSES program element may also be required to respond to requests from the AMSR-E DAAC for anomaly resolution. Scientists are also encouraged to propose new algorithms for any of the AMSR-E products if they are justifiably better than existing algorithms.

Similarly, we need to improve the accuracy of AIRS temperature and water vapor products in the boundary layer, upper troposphere, stratosphere, and over land for both weather and climate studies. This task also includes algorithm improvements to AIRS retrieved surface temperature and emissivity. Improvements must be based on the AIRS "Unified Team Algorithm". This task includes improvements to estimates of information content (e.g. error covariance matrix and averaging kernels). This task requires generation of algorithms that do not require the use of the AMSU instrument. This task does not include validation of these products, which is an AIRS Project Task. We also need to enable assimilation of AIRS cloud cleared radiance into the operational forecast systems.

The CERES instruments on board the Terra and Aqua satellites measure solar reflected and Earth emitted radiation from the top of the atmosphere to the Earth’s surface. As noted in section 2.3 above, the ERBS project has responsibility for activities associated with the generation of the radiation budget-related data products produced utilizing the Terra and Aqua CERES instruments. However, activities funded through this program element for the scientific utilization of CERES data to address Atmospheric Science issues (e.g., cloud radiative effects, etc.) will be organized within the Atmospheric Science Measurement Team.
3.5  Biodiversity and Ecological Forecasting Team

The NASA Biodiversity program element, in close partnership with the NASA Terrestrial Ecology, Ocean Biology and Biogeochemistry, Land Cover and Land Use Change, and other program elements, supports research into the role of living systems within the broader Earth System. In particular, Biodiversity projects focus on the use of NASA products to improve our understanding of biodiversity patterns extant upon the land and within aquatic environments and to enhance our knowledge of the processes resulting in these patterns. While a number of data products derived from MODIS, ASTER, MISR, and AMSR-E, and VIIRS are especially relevant in this regard, information from all Terra and Aqua instruments are potentially pertinent given the strong role of climate in establishing biodiversity patterns and driving related processes. Proposals seeking to establish time series of systematic observations for Biodiversity research using Terra, Aqua, and Suomi NPP data should seek membership in the appropriate Measurement Team(s) described in this section, and should also plan on participating in the ongoing NASA Biodiversity and Ecological Forecasting Team.

3.6  Sea Surface Temperature Science Team

The Sea Surface Temperature (SST) Science Team is responsible for the quality and integrity of NASA’s measurements of global sea surface temperature. This team replaces former instrument science teams, specifically the SST components of MODIS, Suomi NPP, ASTER, and AMSR-E Science Teams. The SST Science Team addresses activities associated with estimates of SST as follows; 1) algorithm development, refinement, and maintenance for the systematic time series and new, exploratory or one-time measurements; 2) calibration and validation of measurements, including cross-calibration and intercomparison of systematic measurements and data products from different sensors used to produce a time series; 3) data processing, production, and distribution for measurements; and 4) scientific utilization of measurements and data products to understand the SST uncertainty budget, as well as utilization of these measurements in combination with other ocean and atmosphere measurements to understand the general circulation of the ocean and air-sea coupling in the global climate system.

4. Available Data and Products

This program element encourages research proposals that make use of the Terra, Aqua, and Suomi NPP satellite data, including measurements from sensors on the Terra and Aqua platforms that are no longer functioning. For those sensors that have met their demise, the focus should necessarily be on historical data. Not all important science questions can be answered with measurements from Terra, Aqua, and Suomi NPP alone. Other in situ and/or satellite data may be used in conjunction with these three platforms’ data; however, data from the EOS and Suomi NPP platforms must play a primary role in answering the questions addressed in the proposals. Questions defined in the Earth Science Research Strategy as part of the NASA Science Plan (https://science.nasa.gov/earth-science) show a clear focus on systematic observations, which are best addressed with a series of interrelated measurements, of which the Terra, Aqua, and Suomi NPP observations provide a crucial part. For such long-term
In general, a good reference for learning about the types of available data products for particular sensors that are part of EOS is the Web page for the Earth Observing System Project Science Office (EOSPSO) at http://eospso.gsfc.nasa.gov/. Information on obtaining Suomi NPP data can be found here (https://jointmission.gsfc.nasa.gov).

A description of instruments and data from Terra and Aqua follow here (note that data from SNPP begin with section 4.9).

4.1 Moderate-Resolution Spectroradiometer (MODIS)

MODIS is a facility-class instrument that has generated many global data products, including surface temperature over land and oceans, vegetation indices and land-surface cover, phytoplankton characteristics, snow cover, cloud cover/properties, aerosol properties, fire occurrence, and global total precipitable water. MODIS produces dozens of standard, interim, special, and validation products, some with multiple variants. These are detailed at https://modis.gsfc.nasa.gov/data/dataprod/.

MODIS has many products, which can be used to help answer key science questions. Disciplinary MODIS data may be obtained through the GSFC Distributed Active Archive Center (DAAC) at http://daac.gsfc.nasa.gov/.

Supporting data for MODIS Land Validation can be obtained through the Oak Ridge National Laboratory (ORNL) DAAC for biogeochemical dynamics at http://www.daac.ornl.gov/.

Snow and ice products from MODIS can be obtained through the National Snow and Ice Data Center at https://nsidc.org/data/modis/data_summaries.

MODIS sensors are on both the Terra and Aqua satellites.

4.2 Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)

ASTER is a facility-class instrument provided by Japan. It provides high-spatial resolution images of the Earth’s surface and clouds. The data have been designed to study processes like topography and topographic change, land use, deforestation, desertification, land and playa water-level changes, and other changes in regional vegetation, glaciers, and volcanic processes. ASTER is an on-demand instrument. This means that data will only be acquired over a location if a request has been submitted to observe that area. Additional information concerning acquiring ASTER data can be found at http://asterweb.jpl.nasa.gov/gettingdata/default.htm.
This ROSES program element can be used to initiate or renew membership on the U.S. ASTER Science Team and to acquire funding to conduct science studies based upon ASTER data.

The ASTER sensor is only on the Terra satellite. ASTER SWIR channels have been lost, so analyses here should focus on historical data.

4.3 Measurements of Pollution in the Troposphere (MOPITT)

MOPITT is a facility-class instrument measuring emitted and reflected infrared radiation that can then be interpreted in terms of CO profiles and total column CO and CH₄. The instrument was supplied by the Canadian Space Agency and the data are available through the NASA Langley Atmospheric Science Data Center at https://eosweb.larc.nasa.gov/project/mopitt/mopitt_table.

The MOPITT data can be used in answering questions about Earth system forcings produced by variability in atmospheric constituents and the related climatic and air quality responses and will also contribute to studies of the Earth’s carbon cycle. MOPITT generated many products and variants. These are described at http://eosweb.larc.nasa.gov/PRODOCS/mopitt/table_mopitt.html.

The MOPITT sensor is only on the Terra satellite.

4.4 Multiangle Imaging SpectroRadiometer (MISR)

The MISR instrument is a PI-class instrument that looks at the Earth in four spectral bands for each of nine angular views. Its many views and spectral channels make it appropriate for the study of multilayered clouds, aerosols, and their interaction with incoming and outgoing atmospheric radiation. The instrument can be used both as a global survey instrument to study cloud and aerosol variability and also to better understand radiation forcing and its relationship to climate variability. The instrument also images the Earth’s surface and it can measure land surface characteristics like bidirectional reflectance properties, leaf area index, surface cover type, and atmospheric effects in the interpretation of ocean color.

Data from the MISR sensor are available at the NASA Langley Atmospheric Science Data Center http://eosweb.larc.nasa.gov/.

MISR generates many data products and variants. These are described at https://www-misr.jpl.nasa.gov/getData/accessData/.

The MISR sensor is only on the Terra satellite.

4.5 Clouds and the Earth's Radiant Energy System (CERES)

CERES is a PI-class, three-channel, scanning broadband radiometer to measure the Earth’s radiant energy fluxes and to relate them to cloud distributions and climate variability. The overall goal is to determine the atmospheric energy budget and its variations over the globe and time. It is long-term and globally oriented; however, it is also the intent to relate its measurements to the cloud, aerosol, and surface properties determined by higher-resolution imagers on other spacecraft.
Data from the CERES sensor are available at the NASA Langley Atmospheric Science Data Center [http://eosweb.larc.nasa.gov/](http://eosweb.larc.nasa.gov/).

CERES Level 2 and 3 data are also available from https://ceres.larc.nasa.gov/order_data.php.

Each of the Terra and Aqua satellites deploy two CERES sensors, and Suomi NPP carries one. A single CERES instrument also functioned aboard the Tropical Rainfall Measuring Mission (TRMM) and studies that utilize data from multiple platforms, including TRMM, may be proposed in response to this program element.

4.6  Atmospheric Temperature and Moisture Sounding (AIRS/AMSU-A)

AIRS/AMSU-A is a set of two instruments operating in the infrared and microwave regions to determine the vertical profiles of temperature and water vapor in the Earth's atmosphere. Taken together, they provide unprecedented spectral resolution and hence finer vertical resolution than ever before. Their data will be used in forecast assessments in order to determine the impact of the improved sounding resolution and accuracy.

There are many AIRS products. These are described at [http://disc.gsfc.nasa.gov/AIRS/data_products.shtml](http://disc.gsfc.nasa.gov/AIRS/data_products.shtml).

The AMSU sensor has two data products. These also are included in AIRS data and are described at the above link. The AMSU sensor has currently lost five channels, although historical data can be of use.

The AIRS/AMSU sensors are only on the Aqua satellite.

4.7  Advanced Microwave Scanning Radiometer (AMSR-E)

The AMSR-E instrument was provided by Japan, but there are both Japanese and U.S. Science Teams. The instrument had six microwave bands from 7 to 89 GHz and mapped atmospheric total precipitable water, cloud liquid water, sea-surface wind speed, precipitation estimates, soil moisture categories (wet-dry), sea-ice parameters, and snow water equivalent. Its data are useful for variability studies of key water cycle moisture variability studies. The instrument stopped functioning in nominal scan mode in October 2011. Limited scan capability was achieved in December 2012, and was operated with a limited scan until December 2015. All operations ceased in December 2015, and the instrument was permanently shutdown shortly afterwards.

There are many categories of AMSR-E products and they may be found at [https://nsidc.org/data/amsre](https://nsidc.org/data/amsre).

The AMSR-E sensor is only on the Aqua satellite. As the sensor is no longer functioning, historical analyses are still welcome.

4.8  EOS Direct Broadcast (DB) and Land and Atmosphere Near-real-time Capability for EOS (LANCE) as a Data Source

It should be noted that some of the data described by this ROSES program element are also available in real-time through EOS Direct Broadcast reception sites around the world. Currently, there are many locations for this data access. Many are independent
of NASA. Within the U.S., there is a NASA-sponsored network of sites. These sites receive all of the Level-0 data from Terra-MODIS, and Aqua-MODIS, AIRS/AMSU, AMSR-E, and CERES. The sites process MODIS, AIRS/AMSU, and AMSR-E data to Level-1B, i.e., calibrated, navigated radiances of all bands, and they will produce a limited number of products valuable for real-time validation, intercomparisons, and applications. All data and products will be available on the Internet; see https://directreadout.sci.gsfc.nasa.gov/.

Additionally, some data may be obtained through the Land, Atmosphere Near real-time Capability for EOS (LANCE). LANCE supports application users interested in monitoring a wide variety of natural and man-made phenomena. Near Real-Time (NRT) data and imagery from the AIRS, AMSR2, MISR, MLS, MODIS, OMI and VIIRS instruments are available much quicker than routine processing allows. Most data products are available within 3 hours from satellite observation. NRT imagery are generally available 3-5 hours after observation; see https://earthdata.nasa.gov/earth-observation-data/near-real-time.

The Suomi NPP satellite platforms host the following five sensors:
• Advanced Technology Microwave Sounder (ATMS),
• Clouds and the Earth's Radiant Energy System (CERES),
• Cross-track Infrared Sounder (CrIS),
• Ozone Mapping and Profiler Suite (OMPS), and
• Visible Infrared Imaging Radiometer Suite (VIIRS).

4.9 Advanced Technology Microwave Sounder (ATMS)

The Advanced Technology Microwave Sounder (ATMS), a cross-track scanner with 22 channels, provides sounding observations needed to retrieve profiles of atmospheric temperature and moisture for civilian operational weather forecasting, as well as continuity of these measurements for climate monitoring purposes. Like the long heritage of its predecessors, ATMS combines all the channels of the preceding AMSU-A1, AMSU-A2, and AMSU-B sensors into a single package with considerable savings in mass, power, and volume. ATMS measures 96 across-track fields-of-view over a 2600 km swath.

ATMS observations, when combined with observations from the CrIS infrared sounder, provide daily global atmospheric temperature, moisture, and pressure profiles. Together, CrIS and ATMS constitute the CrMSS (Cross-track Infrared Microwave Sounding Suite) to provide global 3-D soundings of atmospheric temperature, moisture, and pressure profiles. ATMS provides the high spatial resolution microwave data to support temperature and humidity sounding generation in cloud covered conditions. See also CrIS description below. For more information about ATMS, see http://npp.gsfc.nasa.gov/atms.html.

4.10 Clouds and the Earth's Radiant Energy System (CERES)

The Clouds and the Earth's Radiant Energy System (CERES) instrument measures the reflected shortwave (SW) and Earth emitted radiances – essentially Earth’s energy budget. The objectives are to continue a consistent database of accurately known fields of Earth’s reflected solar and Earth’s emitted thermal radiation, including net solar radiation at the top of the atmosphere, downward longwave radiation at the surface,
downward shortwave radiation at the surface, and outgoing longwave radiation at the top of the atmosphere. CERES builds on the highly successful ERBE (Earth Radiation Budget Experiment) scanners flown on both NASA and NOAA spacecraft. CERES instruments are also flown on NASA’s TRMM, Terra, and Aqua missions.

A CERES instrument consists of a scanning broadband radiometer designed to measure the emitted thermal and reflected solar radiative energy from the surface of the Earth and the atmosphere using thermistor bolometers. Each instrument has three sensor assemblies, or channels. A shortwave channel measures reflected sunlight (0.3 to 5 microns) to 1 percent accuracy; a longwave channel measures Earth-emitted radiation (8 to 12 microns) to 0.5 percent accuracy; and a total channel (0.3 to > 100 microns) accurate to 0.5 percent. Each instrument has the three sensor assemblies and their individual telescopes mounted on a gimbaled, biaxial scan platform that continuously scans across the Earth in a 6.6-second cycle. This biaxial gimbal allows the sensor assemblies to scan either fixed relative to the orbital plane (typically cross track) or to rotate in azimuth relative to the orbital plane as they scan across the Earth surface. The rotating scan provides complete angular sampling for more accurate modeling of the scattering of reflected energy from target areas. The CERES shortwave, longwave, and total sensor channels are very precisely calibrated. For more information about CERES, see http://npp.gsfc.nasa.gov/ceres.html and http://ceres.larc.nasa.gov/npp_ceres.php.

4.11 Cross-track Infrared Sounder (CrIS)

The Cross-track Infrared Sounder (CrIS), of Polar-orbiting Operational Environmental Satellite (POES) High-resolution Infrared Radiation Sounder/4 (HIRS/4) and EOS Aqua’s Atmospheric Infrared Sounder (AIRS) heritage, is a high-spectral and high-spatial resolution infrared sounder for atmospheric profiling applications. It is a Fourier transform spectrometer with 1305 spectral channels in three wavelength ranges: longwave infrared (LWIR) (9.14 - 15.38 µm); medium-wave infrared (MWIR) (5.71 - 8.26 µm); and shortwave infrared (SWIR) (3.92 - 4.64 µm). CrIS scans a 2200 km swath width (+/- 50 degrees), with 30 Earth-scene views. Each field consists of nine fields of view, arranged as a 3x3 array of 14 km diameter spots (nadir spatial resolution). Each scan (with an eight-second repeat interval) includes views of the internal calibration target (warm calibration point), and a deep space view (cold calibration point). Only photovoltaic detectors are used in the CrIS instrument. The detectors are cooled to approximately 81K using a four-stage passive cooler.

CrIS was designed to work in unison with ATMS (Advanced Technology Microwave Sounder); together they create CrIMSS (Cross-track Infrared Microwave Sounding Suite). The objective of CrIMSS is to provide global 3-D soundings of atmospheric temperature, moisture and pressure profiles. See ATMS description above. For more information about CrIS, see http://npp.gsfc.nasa.gov/cris.html.

4.12 Ozone Mapping and Profiler Suite (OMPS)

The Ozone Mapping and Profiling Suite, OMPS, an advanced suite of three hyperspectral instruments, extends the 25-plus year total-ozone and ozone-profile records. These records are used by ozone-assessment researchers and policy makers to track the health of the ozone layer.
The Nadir sensor uses a wide field-of-view push-broom telescope to feed two separate spectrometers. The Nadir total column spectrometer (mapper) measures the scene radiance between 300 and 380 nanometers (nm) with a resolution of 1 nm sampled at 0.42 nm and a 24-hour ground revisit time. Measurements from this spectrometer are used to generate total column ozone data with better than 50 km by 50 km resolution at nadir. The Nadir profile spectrometer measures between 250 and 310 nm with the same spectral sampling in a single ground pixel of 250 by 250 km. The Nadir mapper continues the Total Ozone Mapping Spectrometer (TOMS) and Ozone Monitoring Instrument (OMI) total ozone data records and the nadir profiler continues the Solar Backscattered Ultra Violet (SBUV/SBUV2) data record.

The OMPS Limb Profiler (LP) instrument measures the Earth’s limb radiance from the scattering of solar photons by air molecules, aerosols, and Earth’s surface in the ultra-violet (UV), visible and near infrared, from 285 to 1000 nm. The OMPS LP simultaneously images the whole vertical extent of the Earth’s limb through three vertical slits, each covering a vertical tangent height range of 100 km and each horizontally spaced by 250 km in the cross-track direction. The OMPS LP instrument measures ozone and aerosol vertical profiles with a vertical resolution of 1.5 km. The OMPS LP instrument continues the Stratospheric Aerosol and Gas Experiment/Halogen Occultation Experiment (SAGE1 - SAGE2/HALOE) through Aura Microwave Limb Sounder (MLS) ozone profile record and overlaps with the new SAGE-III record on ISS. Suomi NPP has both OMPS-limb and OMPS-nadir.

For more information about OMPS, see http://npp.gsfc.nasa.gov/omps.html and http://ozoneaq.gsfc.nasa.gov/omps/.

4.13 Visible Infrared Imaging Radiometer Suite (VIIRS)

The Visible Infrared Imaging Radiometer Suite (VIIRS) collects visible and infrared imagery and radiometric measurements of the land, atmosphere, cryosphere, and oceans. It extends and improves upon a series of measurements initiated by the Advanced Very High Resolution Radiometer (AVHRR) and the Moderate Resolution Imaging Spectroradiometer (MODIS). VIIRS data are used to measure cloud and aerosol properties; ocean color; sea, ice, and land surface temperature; vegetation properties; fires; and the Earth's albedo.

The VIIRS instrument is a whiskbroom scanning radiometer with a field of regard of 112.6° in the cross-track direction. At a nominal altitude of 824 km, the swath width is 3040 km, providing full daily coverage both in the day and night side of the Earth. VIIRS has 22 spectral bands covering the spectrum between 0.412 μm and 12.01 μm, including 16 moderate resolution bands (M-bands) with a spatial resolution of 750 m at nadir, five imaging resolution bands (I-bands) of 375 m at nadir, and one panchromatic day-night band (DNB) with a 750 m spatial resolution throughout the scan. The M-bands include 11 reflective solar bands (RSB) and 5 thermal emissive bands (TEB). The I-bands include three RSB bands and two TEB bands. VIIRS uses six dual-gain RSB bands with a wide dynamic range needed for ocean color applications, at the same time without saturating the sensor when observing high reflectance surfaces such as land and clouds. The dynamic range of the dual gain bands in high gain is comparable to that of the MODIS ocean color bands, while the dynamic range in the low-gain state is
comparable to those of the similar MODIS land bands. The dynamic ranges across all other bands are similar to their MODIS counterparts. VIIRS also has a dual-gain TEB band for fire detection.

VIIRS uses a unique approach of pixel aggregation, which controls the pixel growth towards the end of the scan – an attribute that exists for MODIS, AVHRR, and other instruments. As a result, the VIIRS spatial resolutions for nadir and edge-of-scan data are more comparable. To save transmission bandwidth, VIIRS also uses a "bow-tie removal" approach that removes duplicated pixels in the off-nadir areas where there is an overlap of several pixels between adjacent scans. This, however, does introduce visual artifacts in the raw image due to the aggregation and removal of duplicated pixels beyond midscan on each side. These artifacts can be removed through interpolation when the image is displayed. For more information about VIIRS, see http://npp.gsfc.nasa.gov/viirs.html.

5. NASA Suomi NPP Project Science Office

The NASA Suomi NPP Project Science Office provides support to the Suomi NPP mission and the Suomi NPP ST. The Office is led by the NASA Suomi NPP Project Scientist, Dr. James Gleason (contact information: 301.614.5736 or james.f.gleason@nasa.gov). It coordinates the activities of the Suomi NPP ST and convenes ST meetings, as needed. The Office supports the Suomi NPP project and instrument scientists. Both ATMS and the OMPS Limb instruments are NASA-provided instruments requiring instrument science support to ensure instrument performance, calibration, and anomaly resolution. To ensure continued OMPS Limb support, the office works with the JPSS Flight project to have access to the OMPS Limb vendor. The office supports the VIIRS Characterization Support Team (VCST). VCST provides updated time-dependent calibration tables for the VIIRS instrument. This enables the Suomi NPP ST working with the SIPS to experimentally produce consistent VIIRS data products without known calibration artifacts for evaluation purposes. The VCST also provides lunar ephemeris data needed for planning and executing Suomi NPP spacecraft maneuvers needed to provide lunar observations for maintenance of the VIIRS calibration.

6. EOS Standard Data Products Relevant to this Program Element

This section lists many of the high-priority Level 2 and Level 3 EOS standard data products that NASA is interested in extending through development of science-quality Suomi NPP data products.

6.1 Land Data Products

NASA is interested in having science-quality Suomi NPP data products developed, to enable extension of the records of the following EOS land data products:

- Surface Reflectance
- Snow Cover
- Land Surface Temperature and Emissivity
- Land Cover and Dynamics
• Vegetation Indices
• Fire and Thermal Anomalies
• Leaf Area Index (LAI) and Fraction Absorbed Photosynthetically Active Radiation (FPAR)
• Sea Ice Cover and Ice Surface Temperature
• BRDF (Bi-directional Reflectance Distribution Function) / Albedo
• Vegetation Continuous Fields
• Burned Area


6.2 Ocean Data Products

NASA is interested in having science-quality Suomi NPP data products developed, to enable extension of the records of the following EOS ocean data products:

• Sea Surface Temperature
• Aerosol Angstrom Exponent
• Aerosol Optical Thickness
• Subsurface Chlorophyll a Concentration
• Diffuse attenuation at 490 nm
• Photosynthetically Available Radiation
• Particulate Inorganic Carbon
• Particulate Organic Carbon
• Remote Sensing Reflectance

For more information about these EOS products, see: http://oceancolor.gsfc.nasa.gov/ and https://modis.gsfc.nasa.gov/data/.

6.3 Atmosphere Data Products

6.3.1 Atmosphere data products that enable continuity of MODIS-derived data records

NASA is interested in having science-quality Suomi NPP data products developed, to enable extension of the records of the following EOS MODIS atmosphere data products:

• Aerosol Product
• Total Precipitable Water (Water Vapor)
• Cloud Product
• Atmosphere Profiles (total column ozone, water vapor)
• Atmosphere Gridded Product
• Cloud Mask

For more information about these EOS products, see: http://modis-atmos.gsfc.nasa.gov/products.html and http://disc.sci.gsfc.nasa.gov/.
6.3.2 Atmosphere data products that enable continuity of data records derived from EOS’s Atmospheric Infrared Sounder (AIRS), Advanced Microwave Sounding Unit (AMSU), and Tropospheric Emission Spectrometer (TES)

NASA is interested in having science-quality Suomi NPP data products from ATMS and CrIS developed, to enable extension of the records of the following EOS data products:
- Atmospheric Temperature (vertical profiles)
- Atmospheric Moisture (vertical water vapor profiles, total precipitable water, total cloud liquid water)
- Atmospheric Pressure (vertical profiles)
- Surface Temperature
- Cloud Properties (fractional cover, cloud top temperature, cloud top height)

For more information about these EOS products, see: https://airs.jpl.nasa.gov; and https://eosweb.larc.nasa.gov.

6.3.3 Atmosphere data products that enable continuity of data records derived from EOS’s Ozone Monitoring Instrument (OMI) and Microwave Limb Sounder MLS instruments on the Aura satellite

NASA is interested in having science-quality Suomi NPP data products from OMPS developed, to enable extension of the records of the following EOS data products:
- Total Column Ozone
- Ozone Concentration Vertical Profiles
- Aerosol Concentration Vertical profiles
- Nitrogen Dioxide Total Column
- Sulfur Dioxide Total Column
- Aerosols Total Column

For more information about these EOS products, see: https://mls.jpl.nasa.gov/data/ and https://disc.sci.gsfc.nasa.gov/Aura/data-holdings/OMI.

7. Summary of Key Information

<p>| Expected annual program budget for new awards | ~ $14M |
| Number of investigator awards pending adequate meritorious proposals | ~50-60 |
| Maximum duration of awards | 3 years |
| Due date for Notice of Intent to propose (NOI) | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Due date for proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Planning date for start of investigation | December 2017 |
| Page limit for the central Science/Technical/Management section of proposal | 15 pp plus 5 pages for team leaders and discipline leads, see Section 2.5; see also Table 1 of ROSES and the NASA Guidebook for |</p>
<table>
<thead>
<tr>
<th><strong>Proposers.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relevance to NASA</strong></td>
</tr>
<tr>
<td><strong>General information and overview of this solicitation</strong></td>
</tr>
<tr>
<td><strong>Detailed instructions for the preparation and submission of proposals</strong></td>
</tr>
<tr>
<td><strong>Submission medium</strong></td>
</tr>
<tr>
<td><strong>Web site for submission of proposal via NSPIRES</strong></td>
</tr>
<tr>
<td><strong>Web site for submission of proposal via Grants.gov</strong></td>
</tr>
<tr>
<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
</tr>
<tr>
<td><strong>NASA point of contact concerning this program</strong></td>
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NOTICE: NASA will not solicit research proposals under the PACE Science Team program element in ROSES-2017. All funds currently available are committed to the support of awards selected through the previous PACE Science Team announcement. PACE Science Team funds will be competed again in ROSES-2018.

1. Scope of the Program

The Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission is a strategic Climate Continuity mission and is included in NASA’s 2010 plan: Responding to the Challenge of Climate and Environmental Change: NASA’s Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space (hereafter referred to as the “Climate Initiative”) sponsored by NASA’s Earth Science Division. The Climate Initiative can be found at http://science.nasa.gov/earth-science/. The Climate Initiative plan complements NASA’s implementation of the National Research Council’s (NRC) Decadal Survey of Earth Science at NASA, NOAA, and USGS, entitled “Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond” (the NRC’s Earth Science Decadal Survey, is available at http://www.nap.edu/catalog.php?record_id=11820).

In 2011, NASA issued a Dear Colleague Letter to compete a PACE Science Definition Team (SDT) to develop the scientific foundation of the mission following the guidance given in the Climate Initiative. The PACE SDT has completed a report regarding science priorities of the PACE mission. The report has undergone a public comment period and been finalized; the final version of the report can be found on the PACE web site (https://pace.gsfc.nasa.gov).

In 2014, NASA released a PACE Science Team program element that formulated a Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) Science Team (ST) for a three-year period. Proposals from prospective Science Team members pursued theoretical and analytical studies associated with one of two sets of measurements, Inherent Optical Properties and Atmospheric Correction.

PACE will be a polar-orbiting mission with an ocean color sensor for ocean color, aerosols, and cloud data products, with an aerosol-cloud polarimeter. The mission will be capable of performing radiometric and polarimetric ocean and atmosphere surveys, returning a range of geophysical data from which properties of the ocean and atmosphere can be produced to add to other critical climate and Earth system variables. As currently envisioned, the Pre-Aerosol, Clouds, and ocean Ecosystem (PACE) mission has multiple scientific and applications goals, including making climate-quality global ocean color measurements that are essential for understanding the carbon cycle and global ocean ecology and determining how the ocean’s role in global biogeochemical (carbon) cycling and ocean ecology both affects and is affected by climate change. The ocean color instrument capabilities will include bands for aerosols and clouds, and, therefore, extend key observations of aerosols and clouds, focusing on reducing the largest uncertainty in radiative forcing of the Earth System. The ocean
color instrument will thus extend the ocean and (some) of the atmosphere data records from Sea-viewing Wide Field-of-view Sensor and Moderate Resolution Imaging Spectroradiometer (MODIS). Polarimetry measurements would complement the aforementioned observations, providing better quantitative estimates of aerosol type and height, improving our understanding of atmospheric dynamics and radiative sciences, and improve the atmospheric correction for ocean color remote sensing. If a polarimeter flies, those measurements would provide extended data records on clouds and aerosols, focusing on reducing the largest uncertainty in radiative forcing of the Earth system. The current PACE Launch Readiness Date is 2022/2023.

2. Points of Contact

Questions related to this program may be directed to:
Paula Bontempi
Ocean Biology and Biogeochemistry Program
Earth Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
   Telephone: (202) 358-1508
   Email: paula.bontempi@nasa.gov

Hal Maring
Radiation Sciences Program
Earth Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
   Telephone: (202) 358-1679
   Email: hal.maring@nasa.gov
NOTICE: Amended on September 28, 2017. To give more time to proposers who are without power because of hurricanes, proposals are now due November 17, 2017.

Amended on August 29, 2017. To give more time to proposers who are without power because of Hurricane Harvey, Notices of Intent to propose are now requested by September 18, 2017.

Amended on August 2, 2017. This amendment presents the final text for this Program Element. Notices of Intent to propose are requested by September 1, 2017 and proposals are due November 3, 2017.

1. Overview

The NASA Earth Science Division (ESD) seeks proposals for projects that apply Earth observations that will improve/develop decision-making activities and enable transition and adoption by public- and/or private-sector organization(s) for sustained use in decision making and services to end users. The specific focus is on applications and decision support in the areas of public health and air quality.

Through the integration of Earth observations, the overall objective of these projects is to enhance the performance of existing decision-making activities or to develop new capabilities for decision making where the need and activity can be clearly defined. The organizations that will implement improvements and operate the decision-making activity are expected to be substantially involved in the project and to be expressly committed to maintain, support, and sustainably use the Earth observations application resulting from the project in their decision-making activity.

2. Scope of Program

2.1 Program Objectives

The ESD Applied Sciences Program promotes efforts to discover and demonstrate innovative and practical uses of Earth observations. The Program funds applied science research and applications projects to enable near-term uses of Earth observations, formulate new applications, integrate Earth observations and related products in practitioners' decision-making, and transition the applications. The projects are carried out in partnership with public- and private-sector organizations to achieve sustained use and sustained benefits from the Earth observations¹. For more information visit the Applied Sciences Program website at http://AppliedSciences.NASA.gov/.

The Program supports projects that develop and demonstrate improvements to decision-making from the use of an array of Earth observations and related products. The Program considers that Earth observations broadly include a range of products and capabilities, including

¹ Examples include companies, humanitarian organizations, regional associations, international organizations, government agencies, multinational financial institutions, philanthropic institutions, tribal organizations, and not-for-profit organizations.
Earth-observing satellite measurements (NASA in-orbit and planned satellites, as well as foreign, commercial, and other U.S. Government satellites), outputs and predictive capabilities from Earth science models, algorithms, visualizations, knowledge about the Earth system, and other geospatial products. Hereinafter, this set is referred to collectively as "Earth observations".

The Applied Sciences Program has three primary lines of business: Applications, Capacity Building, and Satellite Mission Planning. The Applications themes are currently focused on five of the eight Societal Benefit Areas (SBA) of the international Group on Earth Observations (GEO): Health (including Air Quality), Disasters, Ecological Forecasting, Food Security and Sustainable Agriculture, and Water Resources. The Program includes the influences, risks, and impacts of a changing climate within each of these themes.

2.2 Health and Air Quality Applications Area

The Health and Air Quality application area is managing this program element. This application area supports the use of Earth observations in air quality management and public health, particularly regarding infectious disease and environmental health issues. The area addresses issues of toxic and pathogenic exposure and health-related hazards and their effects for risk characterization and mitigation. The area promotes uses of Earth observing data and models regarding implementation of air quality standards, policy, and regulations for economic and human welfare. The Health and Air Quality Applications area also addresses risks and effects of climate change on public health and air quality to support managers and policy makers in their planning and preparations.

The Health and Air Quality applications area website is available at https://appliedsciences.nasa.gov/programs/health-air-quality-program.

3. Scope of Program Element

Through this program element, the Applied Sciences Program supports projects that apply Earth observations in decision-making activities for health and air quality.

3.1 Project Scope and Purpose

The Applied Sciences Program seeks results-oriented projects focused on the integration of Earth observations into decision making activities related to health and air quality. The objectives of a proposed project must be to a) develop and prove the potential enhancements of an application of specific Earth observations to one or more decision-making activity and b) transfer and enable the adoption of this application by one or more specific end user organizations in a sustainable manner (i.e., without continued NASA financial support post-project).

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2 The eight GEO SBAs are: Agriculture, Ecosystems/Biodiversity, Disasters, Energy/Minerals, Health, Infrastructure/Transportation, Urban Development, and Water Resources.
Applicants may propose concepts that would:

- Enhance the performance of existing decision-making activities and processes through the integration of Earth observations; or
- Develop new capabilities for decision making, provided that the need and activity can be clearly defined, and that end users are strongly involved.

This program element is for applications projects and applied research to improve specific decision-making activities. Proposals that aim to conduct fundamental Earth science research will be considered noncompliant. For research pursuits, the reader is referred to other Earth Science appendices.

The Applied Sciences Program has instituted a nine-stage Applications Readiness Level (ARL) as an index to track the maturity of applications and applied research projects. This program element is open to proposals for projects beginning at ARL 2 or above. The Program is primarily seeking projects that have a realistic plan and commitment to achieve ARL 7-9 within the three-year timeframe of the project.

3.2 Priority Topics

Applicants may propose projects in the areas of health and air quality. Proposals may address issues and challenges across the full scope of the Health & Air Quality Applications area’s mission (Section 2.2).

New applications ideas and proposals are strongly encouraged. The program will accept proposals that investigate the expansion and integration of previously-funded work into new or different decision-making systems and tools.

3.3 Project Guidelines

The program element expects substantial involvement and partnership with the organization(s) that will ultimately adopt the application in their decision-making activities and/or in their products and services to end users. The explicit overarching goal is transitioning feasible, beneficial applications to a sustained, operational status by the partner organization(s) and/or end users.

The program element allows projects at any level – multinational, national, regional, tribal, U.S. states, and substate (e.g., a U.S. county or international equivalent). Proposals at State and substate levels must include activities to enable and deliver impact beyond the specific, limited location so the project results accrue broadly. Proposal teams wishing to work internationally must involve one or more established public or private organization with an international mandate.  

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3 Application Readiness Level (ARL) is a nine-stage metric used in applications of Earth observations. The ARL assesses the maturity of applications projects and the advancement along a continuum from fundamental research to application and sustained operations. More information at: https://www.nasa.gov/sites/default/files/files/ExpandedARLDefinitions4813.pdf

4 For example, US Government organizations with a foreign-service mandate and appropriation (e.g., USAID, USDA), nongovernmental organizations (e.g., United Nations, Conservation International), international financial institutions (e.g., The World Bank), humanitarian organizations (e.g., International Red Cross), and philanthropic foundations (e.g., Moore Foundation).
The Program allows and strongly encourages private sector companies (and teams of companies) to submit proposals and/or be involved in project teams.

The Program expects to support projects across a range of risks and a range of expected returns and rewards.

The Program is pursuing efforts to quantify and substantiate the benefits and impacts from Earth observation applications. In ROSES-15, ESD/Applied Sciences selected a consortium focused on socioeconomic impact assessments. Since the Program expects to achieve measurable impacts on health and air quality practices through this call, the Program expects that awardees from this Health & Air Quality program element will coordinate with that socioeconomic consortium, to an extent that will be determined post-award.

### 3.4 Specific Suggestions and Considerations

The Applied Sciences Program strongly encourages projects to use an array of Earth observations. At least one NASA Earth observation product must be used. The Program encourages project teams to consider and use products from recently launched NASA missions as well as planned products from upcoming, near-term missions such as the Tropospheric Emissions: Monitoring Pollution mission (TEMPO) and the Multi-Angle Imager for Aerosols mission (MAIA). Proposals can include data products from non-NASA satellites, including foreign and commercial satellites, if used in conjunction with some NASA Earth observations.

The Program strongly encourages the use of Earth system science models and coupled models (e.g., physical-biological-ecological models) in projects.

The Program strongly encourages multiorganizational, multidisciplinary, and multisectoral teams. Projects are strongly encouraged to have team members familiar with health and air quality management, business, or policymaking activities and end users’ needs. The Program encourages early interaction with personnel knowledgeable of NASA Earth science missions, data, models, and sensors (e.g., NASA science teams and instrument scientists) to understand capabilities and limitations. Teams should consider including experts in the areas of statistics, economics, planning, management, policy analysis, or evaluation to support assessments of the performance and decision-making improvements resulting from the project.

Project teams might consider having the Principal Investigator (PI) be someone who is very familiar with the needs of the practitioners and decision-making organization(s). Project teams might also consider having Co-Principal Investigators— for example, one to lead technical aspects of the project and one to lead the decision-making and application aspects of the project. In this case, the proposal needs to specify a PI and a Co-PI. For administrative purposes, the proposal must specify only one PI, yet the proposal can describe the project leadership arrangements for Co-PIs.

Projects should engage and involve existing business, agency, state, and intergovernmental structures addressing health and air quality issues, policies, and other activities to determine priority, tractable topics to address.
The public health and air quality communities have developed networks and websites to share information. Proposal teams are encouraged to utilize these resources to gather information, make contacts with community representatives, understand key needs and issues, understand existing decision support tools, etc. Examples include:

- CDC National Center for Emerging and Zoonotic Infectious Diseases, [http://www.cdc.gov/ncezid/](http://www.cdc.gov/ncezid/);
- Air and Waste Management Association, [http://www.awma.org](http://www.awma.org);
- American Society for Tropical Medicine and Hygiene, [http://www.astmh.org](http://www.astmh.org);
- California Air Resources Board, [http://www.arb.ca.gov/homepage.htm](http://www.arb.ca.gov/homepage.htm);
- Grand Challenges in Global Health, [http://www.grandchallenges.org/Pages/Default.aspx](http://www.grandchallenges.org/Pages/Default.aspx);
- EPA AirNow, [http://airnow.gov](http://airnow.gov);

In addition, the remote sensing and Earth science communities have developed numerous resources to support the application of Earth observations to health and air quality issues. Examples include:

- USGCRP Metadata Access Tool for Climate and Health, [http://match.globalchange.gov](http://match.globalchange.gov);
- Group on Earth Observations (GEO) Health and Environment Community of Practice, [http://geohealthcop.org](http://geohealthcop.org);
- Interagency Cross Cutting Group on Climate Change and Human Health (part of the US Global Climate Research Program (USGCRP)), [http://www.globalchange.gov/what-we-do/link-climate-health](http://www.globalchange.gov/what-we-do/link-climate-health);
- NASA Health and Air Quality Applied Sciences Team, [http://haqast.org](http://haqast.org);
- CDC WONDER, [http://wonder.cdc.gov](http://wonder.cdc.gov);

The NASA Science Mission Directorate has adopted purchases of commercial data, where available, as a mainstream way of acquiring research-quality data. The inclusion and use of commercially available data sets is an allowable expense, as long as the data meets the technical requirements. Proposals should identify any commercial data sources intended for use and details on the associated cost.
4. Programmatic Information

<table>
<thead>
<tr>
<th>Expected program budget for new awards</th>
<th>$2.75M total per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticipated number of awards pending adequate proposals of merit</td>
<td>8-10 projects</td>
</tr>
<tr>
<td>Expected Range of Award per project</td>
<td>$250-350K per year</td>
</tr>
<tr>
<td>Period of Performance</td>
<td>3 years</td>
</tr>
<tr>
<td>Expected Project Start Date</td>
<td>6 months after proposal due date</td>
</tr>
<tr>
<td>Contributions from Partner Organizations</td>
<td>Encouraged; however, partner funding does not count toward funding level guidelines.</td>
</tr>
</tbody>
</table>

5. Amendments and Clarifications to the ROSES Summary of Solicitation and the Guidebook

The following information provides clarifications or amendments to the ROSES Summary of Solicitation. The information below supersedes direction provided in the respective sections of the ROSES Summary of Solicitation.

5.1 Eligibility of Applicants

Consistent with Section III(a) of the ROSES Summary of Solicitation, all organizational sectors are eligible to apply, including academia, private, government, military, intelligence community, and nonprofit sectors, as well as companies supporting them. Multi-organizational, multi-disciplinary, and multi-sectoral teams are strongly encouraged.

5.2 Cost Sharing or Matching: Changes to Section III(d) of the Summary of Solicitation

Contributions and cost sharing from proposing institutions and partner organizations are encouraged, but not required. The Program accepts in-kind contributions during the course of the project as cost sharing. Relevant past work, prior results, or previous support and accomplishments may be described, but the Program does not consider these as cost sharing or in-kind contributions for proposals to this solicitation.

5.3 Proposal Format and Contents: Changes to Section IV(b)(ii) of the Summary of Solicitation

Proposals should adhere to the following page guidelines and order. Content descriptions, if specified below, modify those of the NASA Guidebook for Proposers.

- Proposal Cover Page..................As found on NSPIRES site or Grants.gov (includes budget summary)
- Proposal Summary.................................4000 characters (included in NSPIRES cover page)
- Table of Contents.........................................................1
- Decision-making Activity – Description ..................................2
Proposal Summary

As a summary, this section should briefly describe the project concept. This section should state why the project should be done and how the project relates to the topics identified in Section 2.2 and 3.2 of this program element. The section must include and briefly state the application proposition to be tested and developed in the project.

Decision-Making Activity

This section explicitly identifies and describes the decision-making activity/action to be addressed, created, and/or enhanced in the project. The description should identify the management, business, policy topic or other issue that it serves, including any quantitative information regarding its use. This section must identify and describe the partner/end-user organization(s) and their responsibility and/or mandate to address the topic/issue. This section must provide statement(s) from the practitioner(s) describing the health or air quality related challenge and the need and opportunity to improve the decision-making activity. This section must quantify the pre-project, baseline performance of the decision-making activity using the metrics of partner/end-user organization(s).

Earth Observations

This section describes the specific Earth observations, derived products and/or models (see Section 3.4 of this program element) that the proposal seeks to apply to improve the decision-making activity. This section should describe non-NASA data sets, if any, and models that are expected to play an important role in the application.

Technical/Scientific/Management

As the main body of the proposal, this section should cover the following material:

- How the project responds and relates to the priority topics identified in Sections 2.2 and 3.2;
- Application of the Earth observations to the decision-making activity, including rationale;
• Methodology to be employed in the application, including discussion of the innovative aspects;
• Systematic approach to integrate Earth observations into the decision-making activity (existing or new) and to develop and test the integrated system and address integration problems (technical, computational, organizational, etc.);
• Estimate of the ARL of the application, including the expected improvements throughout the project;
• Challenges and risks impacting project success (technical, policy, operations, management, etc.) and the approach to address the challenges and risks; and
• Relevant tables/figures that demonstrate key points of the proposal.

Performance Measures
This section must articulate the metrics and measures (both quantitative and qualitative) the team will use to determine the outcomes, results, and value of the project. The measures should, at a minimum, include those that the partner/end user/decision-making organization(s) employ to assess their decision making and services as well as those used to establish the baseline performance.

Anticipated Results/Improvements
This section describes the expected results and improvements to the decision-making activity from the application and integration of Earth observations. This section should articulate the expected improvement(s) over the "baseline" performance of the decision-making activity.

Transition and Sustainability Plan
This section should identify major issues (e.g., management, organization, technical) affecting the adoption and sustained use of the application. Accounting for these items, this section should articulate the proposed transition plan, including specific activities within the timeframe of the project to enable the end-user organization(s) to adopt the enhancements in their decision support activity (or new decision support activity). The section should describe activities (e.g., training, workshops) to support and enable the sustained use of the Earth observations and enhanced decision making.

Project Management & Schedule
This section should articulate the management approach and structure; plan of work; partnership arrangements; and the expected contribution, roles, and responsibilities of the team members. Proposals using Co-PIs should describe the project leadership arrangements.

Project schedule and project milestones must be included. Projects are strongly encouraged to use ARL advancements as part of their project milestones. Note: Project team meetings (number of, frequency of, etc.) do not qualify as project milestones.

Letters of Support from End-User Organizations
This section must include one-page letter(s) (up to four) from end-user organizations that will be strongly involved in the proposal; the set of letters can include other end-user organizations that will tangentially benefit from the proposed project. The letters may include input from the community and beneficiaries served by the end-user organizations. All letters must be addressed to the PI and included in the proposal (i.e., not sent to NASA).

**Budget Justification: Narrative and Details**

Budgets should include sufficient travel funds for one annual meeting of the Health and Air Quality Applications area, as well as for appropriate end-user site visits and project team meetings. Budgets should include sufficient annual travel funds for at least one technical conference/workshop (including NASA Science Team meetings) and at least one health or air quality user/management-oriented conference/workshop to disseminate and demonstrate results.

5.4 **Evaluation Criteria**

The evaluation criterion "Relevance" specifically includes the following factors:

- Intent and ability to demonstrate the applicability of Earth observations to address a topic of importance;
- Intent and ability to determine the utility of Earth observations for potentially substantive improvements to health and air quality challenges and decision-making activities;
- Potential impact of the project.

In addition to the factors given in the NASA Guidebook for Proposers, the evaluation criterion "Intrinsic Merit" specifically includes the following factors:

- Ability to develop, test, demonstrate, achieve, and transition the proposed application;
- Approach, methodology, and ability to apply Earth observations and related products;
- Ability to characterize the decision-making activities and needs for improvement;
- Quality of teaming across appropriate sectors and areas of expertise and the involvement of end-user organization(s) in the project and,
- Ability to enable a transition of project results to a sustained (e.g. cost realistic solution, well-integrated solution, etc.). See Sections 3.1, 3.2, and 3.3.

In addition to the factors given in the NASA Guidebook for Proposers, the evaluation criterion "Cost Realism" specifically includes the following factors:

- Overall approach, ability, and level of effort to manage the project and achieve stated objectives;
- Quality of performance measures and overall plan and ability to use them;
- Overall feasibility of the proposed work to cost-effectively meet identified needs and enable sustained results following completion of the project.

Cost sharing is not part of the proposal evaluation criteria. At the time of project selection when deciding between proposals of otherwise equal merit, NASA may
consider the extent to which the proposed project includes funds or in-kind contributions from non-Federal sources and Federal agencies, consistent with Section 5.2 of this program element and Section III(d) of the \textit{Summary of Solicitation}.

5.5 Award Reporting Requirements: Changes to Section VII(c) of the \textit{Summary of Solicitation}

If a team of organizations or subcontractors exists, consolidated project reports, including financial records, must be submitted and are the responsibility of the lead organization. The proposed budget should provide for these reporting requirements.

The awardee(s) will be responsible for timely maintenance (via an online system) of information, status updates, highlights, and milestone achievements. NASA will coordinate with the PI at the time of the award to provide the necessary information for the online system.

During award negotiation, NASA representatives will discuss methods, including electronic reporting, to transmit the reports and presentation packages. The NASA Shared Services Center (NSSC) will also solicit and archive the annual progress reports and final report.

The following reports are required of the awardee(s). The specific reporting requirements will be laid out in the award.

- **Quarterly Summary**
  The awardee(s) will produce brief written reports on a quarterly basis. These brief reports should provide a summary of activities from the past quarter; key highlights and achievements; progress or adjustments to milestones; major activities, events, and milestones in the next two quarters; and issues, problems, risks, and plans of action to address them. Key members of the team may have a quarterly telecon with an Applied Sciences Program representative to discuss the quarterly report and any actions to be taken.

- **Annual Progress Report**
  The awardee(s) will produce an annual written summary of its activities, using information from the quarterly summaries and additional materials to highlight achievements for the year and changes in plans. The Applied Sciences Program will post a version on its website and will incorporate information into its own Annual Report. (Note: This item satisfies the requirement for Annual Progress Reports in Appendix D of the Guidebook for proposers) The Program may request a virtual presentation of the annual summary.

- **NASA Outreach and Inreach**
  Periodically, the Applied Sciences Program and Earth Science Division request information about projects, achievements, and key events to support communications and outreach both internal and external to NASA. The awardee(s) is expected to support such requests and should budget for these accordingly.

- **Literature Review and Publications**
  On a semiannual basis, the awardee(s) will produce an annotated bibliography of all relevant publications (scholarly, grey, popular literature) from the previous half year.
The team is expected to produce articles for scholarly, grey, and popular literature. By the end of each calendar year, the team will provide a compiled list of the publications directly associated with the award from the prior year.

- **Applied Sciences Program Reviews**
  Applied Sciences conducts program-wide reviews six times a year to review status, progress, achievements, and financial situations within the applications areas, capacity building, and selected projects. The awardee(s) is expected to provide information on request to support the program reviews where this venture is covered, which is planned to occur twice a year. If desired, a representative from the team can participate (physically or virtually) in the program reviews.

- **Annual Results Event**
  Awardee representative(s) should plan to travel and participate in one Program-sponsored results workshop/conference per year. The Applied Sciences Program will coordinate this activity with the awardee(s) during the course of the project; the proposal teams should budget accordingly to attend these annual events. (While the location will likely rotate, teams can use Washington, D.C., as a domestic location for budgetary purposes). The Awardee or their representative(s) is also expected to report progress and disseminate results at one or more technical conference/workshop and one or more health or air quality user/management-oriented conference/workshop over the course of the project.

- **Final Report**
  The Final Report summarizes the overall activities of the award, including achievements, progress, impacts, smart practices, findings and conclusions, remaining issues to address, and other information to provide an appropriate documentation of the award. The report should also explain any variations in the anticipated results and a discussion of major problems (technical or other). The report should describe the state-of-practice at the end of the venture, and it should include lessons learned and recommendations. (Note: This final report, with the additions mentioned, is the same item referred to in Appendix D of the Guidebook for proposers) The Program may request a presentation of the report, findings, recommendations, and achievements.

6. **Summary of Key Information**

<table>
<thead>
<tr>
<th>Expected program budget for first year of new awards</th>
<th>$2.75M per year total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>8-10 projects</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>3 years</td>
</tr>
<tr>
<td>Due date for Notice of Intent to propose (NOI)</td>
<td>September 18, 2017 [Changed August 29, 2017]</td>
</tr>
<tr>
<td>Due date for proposals</td>
<td>November 17, 2017 [Changed September 28, 2017]</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>6 months after proposal due date.</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposal</td>
<td>12 pp; see Section 5.3 of this document and also the NASA Guidebook for Proposers</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Relevance to NASA</td>
<td>This program is relevant to the Earth science strategic goals and subgoals in NASA’s Strategic Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>See the NASA Guidebook for Proposers at <a href="http://www.hq.nasa.gov/office/procurement/nraguidebook/">http://www.hq.nasa.gov/office/procurement/nraguidebook/</a></td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required. See also Section IV in the ROSES Summary of Solicitation and Chapter 3 of the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposal via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
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<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-HAQ</td>
</tr>
</tbody>
</table>
| NASA points of contact concerning this program | John Haynes  
Applied Sciences Program  
Earth Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-4665  
Email: jhaynes@nasa.gov |
NOTICE: The Earth Science Division had planned to offer Earth Science Applications: Disaster Risk Reduction and Resilience as program element A.40 of ROSES-2017, but scheduling issues prevented it from being released in 2017 so it will be solicited in ROSES-2018.

1. Applied Sciences Program Objectives

The Applied Sciences Program supports efforts to discover and demonstrate innovative and practical uses of NASA Earth science data, knowledge, and technology. The Program funds applied science research and applications projects to enable near-term uses of Earth science, transition applied knowledge to public and private organizations, and integrate Earth science with satellite observations in organizations’ decision making and services. The projects are carried out in partnership with end user organizations. The Program thus serves as a bridge between the data and knowledge generated by NASA Earth science and the information needs and decision making of Government agencies, companies, regional associations, international organizations, not-for-profit organizations, and others. The Program allows and encourages private sector companies to submit proposals and/or be involved in project teams. For more information, visit the Applied Sciences Program website at http://AppliedSciences.NASA.gov.

2. Scope of Program Element

This program element encourages, but is not limited to, proposals that use NASA Earth science products and information to improve disaster management and policy decisions for one or more functional and phenomenological topic areas:

Functional Topic Areas:
- Disaster Risk Assessment, Monitoring, and Preparedness
- Disaster Incident and Emergency Response
- Disaster Damage Assessment and Recovery
- Resiliency

Mature applications ideas and proposals for integrating tools for assessment and response are strongly encouraged. The program will accept proposals that investigate the expansion and integration of previously funded work into new or different decision-making systems and tools. For example, the program will accept proposals expanding work through full transition, integration, and sustainability with previous end users awarded through ROSES-2011 Earth Science Applications Feasibility Studies: Disasters, as well as through Rapid Responses or in partnership with other parts of the Earth Science Divisions.

This program element has been moved to ROSES-2018. [Added 12/19/17]
3. **Point of Contact**

David S. Green  
Applied Sciences Program  
Earth Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
   Telephone: (202) 358-0032  
   Email: david.s.green@nasa.gov
A.41 ECOLOGICAL FORECASTING

NOTICE: The Ecological Forecasting program element will be competed in program element A.8 Supporting United Nations (UN) Sustainable Development Goals 14 and 15 in the Context of Climate Variability and Change.

1. Scope of Ecological Forecasting Applications Area

The Ecological Forecasting Applications area promotes the use of Earth observations and models to analyze and forecast changes that affect ecosystems and to develop effective resource management strategies. Primary user communities are natural resource managers (both land and marine) and those involved in conservation and ecosystem management. The Applications area operates through the development, improvement, and application of predictive tools, with associated uncertainties, for assessing alternative approaches and designing effective decision support strategies for managers. It applies current scientific understanding and modeling capabilities to determine how ecosystems and their components (e.g., species, genes) are changing and likely to change over time. More information is at: http://appliedsciences.nasa.gov/programs/ecological-forecasting-program.

2. NASA point of contact concerning this program

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1. Scope of the Program

The Earth Science Data System (ESDS) Program is soliciting proposals for Advancing Collaborative Connections for Earth System Science (ACCESS). The primary goal of ACCESS is to develop and implement technologies to effectively manage, discover and use NASA’s archive of Earth observations for scientific research and applications. This program complements NASA’s Earth Observing System Data and Information System (EOSDIS) by engaging researchers and software developers external to EOSDIS in NASA’s mission to "drive advances in science, technology, aeronautics, space exploration, economic vitality, and stewardship of the Earth" and furthers Strategic Goal 2.2 to "advance knowledge of Earth as a system to meet the challenges of environmental change and to improve life on our planet" (http://science.nasa.gov/about-us/science-strategy/). ACCESS aims to improve and expand the use of NASA's Earth science data by leveraging modern techniques for discovering, managing and analyzing large and complex Earth science data sets.

Over the past 20 years NASA’s EOSDIS has significantly evolved capabilities to process, archive and distribute data from satellites, airborne missions and field campaigns. Since inception, data from EOSDIS have been fully and openly available to anyone. In 2016, over 3 million users downloaded science data from the EOSDIS Distributed Active Archive Centers (DAACs). Today EOSDIS archives contain over 24 petabytes (PBs) of Earth observations. Within 5 years, as new missions are launched and instruments commissioned, the archive is projected to be over 150 PB with an annual growth rate of nearly 50 PB per year. This long-term, continuously updated global environmental record presents unique opportunities for science and significant challenges for data management and access. For more on EOSDIS and its components, please see https://earthdata.nasa.gov/about.

The focus of this solicitation is to help EOSDIS address data management, discoverability, and utilization challenges faced by users and curators of NASA’s Earth science data. Although focused on information technology development and deployment, the ACCESS program is targeted at addressing existing and anticipated future needs of the research and applied science communities. Proposal teams must include both information technology and Earth science expertise, and must be tied directly to specific issues facing Earth science and applied science users interacting with EOSDIS.

The ACCESS program awards are intended to develop and implement technology – not to be an ongoing funding source for the operations and maintenance of existing tools. Proposers therefore should assume funding will be for one term only. Previously funded ACCESS projects may be selected for follow-on awards only if they propose significant enhancements and have clearly demonstrated progress during previous awards.
2. Types of Proposals Solicited

NASA is seeking proposals that significantly advance discovery, management, use and analysis of large and complex Earth science data sets from EOSDIS. Key components of EOSDIS include the Common Metadata Repository (CMR), a spatial and temporal metadata registry and order broker for all NASA Earth science data (https://cmr.earthdata.nasa.gov/search/); the Earthdata Search Client (ESDC) (https://search.earthdata.nasa.gov/search), a search tool for CMR and other repositories; the Global Imagery Browse Services (GIBS) image repository (https://earthdata.nasa.gov/gibs); and the Worldview visualization client (https://worldview.earthdata.nasa.gov/). These fully open sourced components have been designed for scalability, extensibility, and reuse with well-designed, stable interfaces. They currently support many broad, discipline-oriented, and interdisciplinary communities of users at the NASA DAACs. Proposers are strongly encouraged to leverage and reuse these and other components where appropriate.

Proposals must clearly identify user communities that will benefit from technology and demonstrate linkages to pressing Earth science or data management problems. In furtherance of ACCESS Program goals, proposers should focus technology developments on one or a combination of the following areas: Machine Learning (see 2.1.1 below), Advanced Search Capabilities (see 2.1.2 below) and Cloud Optimized Preprocessing and Data Transformation (see 2.1.3 below).

2.1. ACCESS Technology Focus Areas

2.1.1. Machine Learning

NASA seeks innovative and practical applications of Machine Learning (ML) to improve discovery, categorization and event detection from EOSDIS’s data, imagery and/or metadata. Proposers should identify use cases that support NASA’s Earth Science research objectives or demonstrate how the proposed ML approach will improve access to NASA’s near-real-time or standard science data products (https://earthdata.nasa.gov/community/community-data-system-programs/access-projects/ACCESS17). Proposals in this area must identify training data, a trained classifier, testing protocol, and a final software application.

2.1.2. Advanced Search Capabilities

NASA seeks novel approaches for improving search relevancy from the CMR and GIBS. Proposals may address overall search performance and/or target specific user communities (e.g. atmospheric scientists, geographic information system users, airborne campaigns, etc.). Diverse techniques to improve search relevancy are encouraged, such as keyword-based, natural language processing, semantic, and other methods. A description of available open source software, Application Programming Interfaces (APIs) and other resources is available from (https://earthdata.nasa.gov/community/community-data-system-programs/access-projects/ACCESS17). Proposals in this area must demonstrate improved search relevancy compared to Worldview or Earth Data Search Client (EDSC) and
demonstrate enhancements that can be integrated into the open source Worldview, EDSC, GIBS and/or CMR software.

2.1.3. **Cloud Optimized Preprocessing and Data Transformation**

NASA seeks proposals for cloud-native storage and software systems to support high performance preprocessing close to data, rather than at the user’s location. Users of NASA’s Earth science data often perform multiple preprocessing steps to prepare data for ingest into analysis systems. For example, these steps might consist of normalizing data by subsetting, quality screening, re-gridding, reformatting, mosaicking, and aggregating variables. Performing preprocessing activities close to data reduces volumes of data distributed by EOSDIS and improves the usability of products by users. Services should work on a broad range of EOSDIS data from multiple science disciplines, instruments, and processing levels (e.g. Level 1, 2, and 3). All services should be available as an API and link back to source data. Services should also identify any errors introduced during pre-processing (e.g. errors introduced after reprojection and resampling). Resultant products should be formatted in a manner that make them easily usable by popular Commercial-Off-The-Shelf (COTS) software such as Geographic Information Systems (GIS), scientific analysis packages, and cloud platforms. Proposals in this area must utilize a commercial cloud environment and implement cloud cost controls. Finally, proposals must provide expected service performance throughput, identify input products from different instruments, and time to perform pre-processing or transformation on specific data volumes.

3. **Policies and Requirements**

3.1. **Earth Science Data Information Policy and Rights in Data**

All proposers should review and must adhere to the Earth Science Data and Information Policy ([http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/](http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/)).

3.2. **ESDS Open Source Software Policy**

NASA’s ESDS requires that all software developed through research and technology awards (ROSES or unsolicited proposals) or in-house, government funded development is to be made available to the public as Open Source Software (OSS). This includes all ACCESS awarded software developed with ESDS funding used in the production of data products, as well as software developed to discover, access, analyze, visualize and transform NASA data. Please see [https://earthdata.nasa.gov/earth-science-data-systems-program/policies/esds-open-source-policy](https://earthdata.nasa.gov/earth-science-data-systems-program/policies/esds-open-source-policy) for details on the ESDS OSS policy including preferred licenses.

3.3. **Participation in Earth Science Data Systems Working Groups**

Proposals selected by the ACCESS program are required to plan and budget for .25 Full Time Employee (FTE) representation on at least one of the Earth Science Data Systems Working Groups (ESDSWG). Proposals should include a brief statement outlining which of the working groups the team will be participating with, and detailing
what expertise the member(s) will bring. Participation in an ESDSWG is an ACCESS program requirement and not subject to project waivers or negotiation (https://earthdata.nasa.gov/esdswg). Selected projects are required to submit reports on ESDSWG activities.

3.4. **Use of 3rd Party Software**

NASA recognizes that the use of COTS and GOTS (Government-off-the-shelf) software, software developed through open source licensing, and other "freeware," are of equal consideration for use in ACCESS projects. While it is not always possible to plan with certainty the life cycle of these technologies, proposers must understand and address the risks and benefits associated with their selection.

3.5. **Leveraging of Past Development Efforts**

ACCESS encourages the leveraging of technologies developed under past funding from NASA, e.g., NASA's Advanced Information Systems Technology (AIST), as well as funding from other agencies or organizations. ACCESS discourages small or incremental improvements to existing technologies. Incremental improvements are generally regarded as sustaining engineering and do not meet the objectives of this call. Proposals that choose to leverage or enhance past AIST, ACCESS or other previously awarded projects must show how ACCESS funding will support the development of new capabilities and benefits for the targeted user community.

3.6. **Deploying Technologies to EOSDIS**

For deployments intended for NASA’s EOSDIS DAACs (https://earthdata.nasa.gov/about/daacs) proposers should note that NASA has processes involving DAAC managers, DAAC User Working Groups, and Headquarters Program Scientists to evaluate the long-term worthiness of technologies in terms of support, costs, and usefulness for the community.

3.7. **Utilizing Cloud Computing Resources**

ACCESS encourages proposals to use commercial cloud environments. NASA, along with other government agencies, has increasingly been looking to commercial cloud vendors for secure, maintainable, cost-effective and versatile computing infrastructure. Recent NASA EOSDIS prototype efforts look to leverage commercial cloud resources for such activities as data storage, processing, and simple data analysis. Proposers should research ongoing activities in this space (https://earthdata.nasa.gov/cloud) and consider how best to leverage or build upon these efforts in the cloud to ensure their submission will be well-positioned for future integration and adoption by the ESDS program. Proposals using private cloud infrastructures are discouraged.

3.8. **Utilizing Automated Testing and Continuous Integration Methodologies**

An important component of successful, maintainable, modern software development efforts is a robust automated testing infrastructure and continuous integration tools. Employing these best practices ensures that any development activity can proceed
without fear of breaking earlier functionality. ACCESS encourages proposals that use such technologies.

4. Proposal Evaluation

The general information provided in Section 3 of the 2017 NASA Proposers Guidebook – Proposal Preparation and Organization, applies to this solicitation. A "Program-specific Questionnaire" will accompany the cover page where the proposer must specify the type of proposal being submitted, scientific focus area(s) described in section 2.1 and the relevant issues facing the use of NASA Earth science data from EOSDIS.

Proposals must address all phases of the project, and shall:

- Clearly identify user communities that will benefit from technology and demonstrate linkages to pressing Earth science or data management problems.
- Clearly identify team members and relevant Earth and computer science expertise.
- Clearly explain how technology developed under an ACCESS award will address identified challenge(s).
- Clearly describe the software development approach and lifecycle.
- Include a work plan and schedule for technology development, testing, and deployment. Work plans and deliverables described must be completed within 24 months of project award. By the end of the two-year award period, the project should be able to demonstrate operational deployment for all technologies.
- Provide a data management plan https://science.nasa.gov/researchers/sara/faqs/dmp-faq-roses.
- Budget a quarter-time (.25 FTE) for one or more members of the proposed team to participate in the Earth Science Data System Working Groups activities and travel to the annual ESDSWG meetings (see Section 3.3).

Data, results, and other information created for this proposal are subject to NASA's Earth Science Data policy (see http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/). All data will be released, along with the source code for algorithm software, coefficients, and ancillary data used to generate products.

5. Award Type and Funding

Awards to government labs, including JPL, will be made by the normal funds transfer process. The funding vehicle for awards to non-governmental organizations will be a Cooperative Agreement (CA). Commercial organizations are encouraged to review Section III.(d) of the ROSES-2017 Summary of Solicitation. Proposers should make themselves aware of the differences between a CA and a grant. For additional information review the NASA Grant and Cooperative Agreement Handbook (http://prod.nais.nasa.gov/pub/pub_library/grcover.htm). Proposers are also encouraged
to discuss this form of agreement with their institutions prior to submission of an ACCESS proposal.

6. Summary of Key Information

| Expected total program budget for new awards | ~ $4.5M |
| Number of new awards pending adequate proposals of merit | ~4-7 |
| Maximum duration of awards | 2 years |
| Due date for Notice of Intent to propose (NOI) | See Tables 2 and 3 in the Summary of Solicitation of this NRA. |
| Due date for Proposals | See Tables 2 and 3 in the Summary of Solicitation of this NRA. |
| Planning date for start of investigation | 3 months after proposal due date. |
| Page limit for the central Science-Technical-Management section of proposal | 15 pp; see also Table 1 of ROSES and Chapter 3 of the 2017 NASA Guidebook for Proposers. |
| Relevance to NASA | See Section 2. This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| General information and overview of this solicitation | See the Summary of Solicitation of this NRA. |
| Detailed instructions for the preparation and submission of proposals | See the 2017 NRA or CAN Proposers Guidebook at http://www.hq.nasa.gov/office/procurement/nraguidebook/ |
| Submission medium | Electronic proposal submission is required; no hardcopy is required. See also Section IV in the Summary of Solicitation of this NRA and Chapter 3 of the NASA Guidebook for Proposers. |
| Web site for submission of proposal via NSPIRES | http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376) |
| Web site for submission of proposals via Grants.gov | http://grants.gov (help desk available at support@grants.gov or (800) 518-4726) |
| Funding opportunity number for downloading an application | NNH17ZDA001N-ACCESS |
| Point of contact concerning this program | Kevin Murphy  
Program Executive for Earth Science Data Systems  
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1. **Scope of Program**

In pursuit of NASA’s Strategic Goal 2.1 to "Advance Earth System Science to meet the challenges of climate and environmental change" (NASA 2014 Strategic Plan), the Earth Science Division (ESD) develops unique capabilities in remote sensing to implement a broad suite of space-based Earth observations which, together with many other data, are utilized to advance knowledge of the integrated Earth system, the global atmosphere, oceans (including sea ice), land surfaces, ecosystems, and interactions between all elements, including the impacts of humans. Sustained, simultaneous observations of many geophysical parameters are needed to understand the complexity of the global Earth system.

The quantitative determination of global trends in the Earth’s atmosphere, ocean, cryosphere, biosphere, and land surface and interior depends significantly on the availability of multiinstrument/multiplatform data sets, which extent to time periods of a decade or longer. The ability to enhance Earth system component models and advance predictive capabilities relies on dynamically consistent global observational data sets.

The overall objective of Making Earth System Data Records for Use in Research Environments (MEaSUREs) solicitations is to select projects providing Earth science higher level data products and services driven by NASA’s Earth science goals. MEaSUREs may include infusion or deployment of applicable science tools that contribute to data product quality improvement, consistency, merging or fusion, or understanding. An Earth System Data Record (ESDR) is defined as a unified and coherent set of observations of a given parameter of the Earth system, which is optimized to meet specific requirements in addressing science questions. These data records are critical to understanding Earth System processes; are critical to assessing variability, long-term trends, and change in the Earth System; and provide input and validation means to modeling efforts. Emphasis is placed into linking together multiple satellites into a constellation, developing the means of utilizing a multitude of data sources to form coherent time series, and facilitating the use of extensive data in the development of comprehensive Earth system models.

This ROSES element provides an opportunity for the research community to participate in the development and generation of data products, which complement and augment the NASA produced and distributed Earth science data products available to the research community and other stakeholders. Proposals responsive to this call MUST utilize at least one satellite data set, preferably NASA sponsored data set.

NASA, through its Earth Science Data Systems (ESDS), supports the NASA Earth Science research community by providing Earth science data products and services driven by NASA’s Earth Science goals. The Earth Observing System Data and Information System (EOSDIS) is a key core capability in NASA’s Earth Science Data Systems Program. It provides end-to-end capabilities for managing NASA’s Earth science data from various sources – satellites, aircraft, field measurements, and various other programs. For the EOS satellite missions, EOSDIS provides capabilities for command and control, scheduling, data capture and initial (Level 0) processing. These
capabilities, constituting the EOSDIS Mission Operations. NASA network capabilities transport the data to the science operations facilities.

The remaining capabilities of EOSDIS constitute the EOSDIS Science Operations, which are managed by the Earth Science Data and Information System (ESDIS) Project. These capabilities include: generation of higher level (1-4) science data products for EOS missions; archiving and distribution of data products from EOS and other satellite missions, as well as aircraft and field measurement campaigns. The EOSDIS science operations are performed within a distributed system of many interconnected nodes (Science Investigator-led Processing Systems, or SIPS, and distributed, discipline-specific, Earth science Distributed Active Archive Centers, or DAACs) with specific responsibilities for production, archiving, and distribution of Earth science data products. The DAACs serve a large and diverse user community (as indicated by EOSDIS performance metrics) by providing capabilities to search and access science data products and specialized services. The MEaSUREs program expands these capabilities with competitively selected data products meeting research community priority needs, allowing the research community to contribute in development and production of the data sets that will be hosted and distributed by the DAACs.

Data products created from multiple instruments, and from "data fusion," remain a challenge, and full utilization of complementary satellite data requires focused research efforts. NASA synergistic packages intended for creation of products, e.g., operational Level 1B - L3 products of the AIRS/AMSU instrument suite on the EOS Aqua spacecraft, provide a guide for further innovative data products to be introduced. Here "data fusion" could be low level fusion, the combining of several sources of raw data to produce new raw data, or data integration, the combining of diverse data sets into a unified data set which includes all of the data points and time steps from the input data sets. Sophisticated understanding of the contributing instruments’ characterization and correct application of the various contributing data must be performed for such records to achieve the expectation that fused data is more informative than the original inputs, while retaining their underlying accuracy.

Emphasis is placed into taking advantage of the opportunities presented by the currently operating satellites constellations, providing the means of utilizing a multitude of data sources to form coherent time series, and facilitating the use of consistent clusters of geophysical measurement in the advancement of comprehensive Earth system models.

NASA currently develops several new missions as recommended by the 2007 Decadal Survey, expected to be launched in this decade. ESDRs that provide precursor products that allow to baseline geophysical parameters that will be produced from these satellites would be valuable and will optimize NASA’s investment in these missions.

NASA’s Earth Science currently operates an unprecedented number of missions, most of which are past their prime phase and some have operated longer than a decade. Data product developers have matured mission instrument products through refinement of instrument calibration/validation and algorithms. Accordingly, there is increasingly greater focus on research and data production on measurement-based data products,
beyond single mission instrument products. In order to create these basic records, a science measurement focus brings together expertise in multiple instrument characterization and calibration, data processing, science-based product generation and distribution, science tools, and interactive relationships with the broader science community.

Projects selected through this solicitation will work to afford a solution for utilization of NASA assets and capabilities by:
- providing or adding to mature data records needed for NASA Earth System research, and potentially product science tools and services capabilities;
- applying ESD principles regarding community involvement, product life cycle planning, and standards and interfaces for interoperability and exchange of data and information;
- supporting ongoing data system evolution efforts through participation in one or more Earth Science Working Groups, which include Standards and Interfaces, Technology Infusion, Architecture and Reuse, and Metrics Planning and Reporting.

2. Types of Proposals

This MEaSUREs call continues the 2012 MEaSUREs Program focus on these particular Earth science research measurement needs, and the creation of Earth System Data Records (ESDRs), including Climate Data Records (CDRs).

Selected MEaSUREs projects will be focused on product generation, availability, and utility. Maturity of algorithm and calibration/validation activity research is a prerequisite for selection as a MEaSUREs project to embark on large-scale data production.

In addition, proposals may be submitted by previously selected MEaSUREs (2006 or 2012) projects to continue the production of previously developed and delivered data to NASA. This type of proposal must document that the previously selected project has fully met its development and delivery milestones to NASA DAACs and will strictly continue production and delivery of products, assuming the input data sets are still acquired. It is expected that these projects will require significantly lower funding resources. A limited number of “continuation” projects may be selected.

3. Programmatic Information

The majority of awards will commence with Fiscal Year 2018 funds.

3.1 Proposal Submission and Evaluation

In addition to the evaluation criteria given in NASA Guidebook for Proposers, these MEaSUREs proposals must address these additional factors:
- Identify the Earth Science research needs, potential utility and expected scientific impact for the ESDR/CDR. Proposers should cite documentation of key measurement needs found in NASA or NASA-participating (e.g., U.S. Global Change Research Program, Group on Earth Observations (GEO) Reports) related strategic plans, documents, roadmaps, or other materials.
• Document ESDR/CDR community establishment and maturity level, citing established calibration/validation, peer reviewed publications for algorithms, and product quality and usage summaries.

• "Continuation" projects must document the utility and scientific impact of the produced ESDRs/CDRs, citing peer reviewed publications and a quantitative assessment of the data utilization by the research community and other stakeholders.

• Identify all challenges in the development and production of the proposed ESDR/CDR and describe the effort required. Characterize uncertainties and quantify errors associated with the proposed ESDRs.

• Document ESDR/CDR community establishment and maturity level, citing established calibration/validation, peer reviewed publications for algorithms, and product quality and usage summaries.

• Proposals must address the delivery of developed code to NASA. In particular, proposers must address the feasibility of transitioning their proposed data production, via delivering the developed code and auxiliary information, to a NASA processing system, other institution and other investigators.

• The period of award for these projects is up to five years. Proposal plans and deliverables described must state the length of effort and provide milestones and deliverables within the timeline. Five year proposals must be fully justified.

3.2 Other Requirements

All MEaSUREs projects will meet the following requirements:

• Maintain a public WWW-compliant presence.

• Data and information shall be publicly available, preferably via Internet transfer. A tailored, alternate Data Rights section will be applied to resultant Cooperative Agreements (CA), under which scientific data and scientific software (software used for processing raw Earth Observation remote sensing instrument data into scientific data and products) will be exchanged without restriction as to its disclosure, use, or duplication.

• Cooperative Agreement project management will seek community scrutiny and review of product quality and acceptability.

In addition, proposals selected by the MEaSUREs Program will be asked to have representation on one or more Earth Science Data System Working Groups (DSWGs). MEaSUREs proposals must include to which DSWG(s) they wish to have representation. Proposers should budget between one tenth (0.1) and a quarter time (0.25) FTE, depending on the project, and adequate travel budget for these activities (see http://earthdata.nasa.gov/our-community/esdswg for additional information).

3.3 Award Type and Funding

The vehicle for projects selected through this solicitation will be a Cooperative Agreement (CA). Proposers should be aware of the differences between a CA and other vehicles, such as grants. See NASA’s Guidebook for Proposers for further information.
3.4 Relationship to Other NASA Program Elements

MEaSUREs is envisioned to complement and build upon the results of other NASA funded activities, in particular those of the competitively selected mission and measurement science teams, which are often focused algorithm development or refinement. In addition, proposed MEaSUREs projects may benefit from analysis and results by investigators selected in response to the Satellite Calibration Interconsistency Studies Program elements in ROSES-2011 and ROSES-2015.

MEaSUREs does not solicit proposals for systems and information technology. Information technology deployment of data and information systems and services and tools that enhance NASA’s data and information systems infrastructure, increase the interconnection of services for research, and enable freer movement of data and information within the distributed system of users and providers are invited to apply to the Advancing Collaborative Connections for Earth System Science (ACCESS) Program.

4. Summary of Key Information

<p>| Expected annual program budget for new awards | ~ $15M/year |
| Number of new awards pending adequate proposals of merit | ~ 20 |
| Maximum duration of awards | 5 years |
| Due date for Notice of Intent to propose (NOI) | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Due date for proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Planning date for start of new investigation | December 1, 2017 |
| Page limit for the central Science-Technical-Management section of proposal | 20 pp; see also see also Table 1 of ROSES and the NASA Guidebook for Proposers. |
| Relevance to NASA | This program is relevant to the Earth science strategic goals and subgoals in NASA’s Strategic Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| General information and overview of this solicitation | See the ROSES Summary of Solicitation. |
| Detailed instructions for the preparation and submission of proposals | Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers. |
| Submission medium | Electronic proposal submission is required; no hard copy is required. See also Section IV in the Summary of Solicitation of this NRA and the NASA Guidebook for Proposers. |</p>
<table>
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<th><strong>Web site for submission of proposal via NSPIRES</strong></th>
<th><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</th>
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<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
<td>NNH17ZDA001N-MEASURES</td>
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| **Point of contact concerning this program** | Lucia Tsaoussi  
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**NOTICE:** NASA does not intend to offer this program element in ROSES-2017.

1. Scope of the Program

The primary goal of the Citizen Science for Earth Systems Program is to develop and implement capabilities to harness voluntary contributions from members of the general public to advance understanding of the Earth as a system. The program complements NASA’s capability of observing the Earth globally from space, air, land, and water by engaging the public in NASA’s mission to "drive advances in science, technology, aeronautics, space exploration, economic vitality, and stewardship of the Earth" and Strategic Goal 2.2 to "advance knowledge of Earth as a system to meet the challenges of environmental change and to improve life on our planet" ([http://science.nasa.gov/about-us/science-strategy/](http://science.nasa.gov/about-us/science-strategy/)). The program aims to advance the use of citizen science in scientific research about the Earth by directly supporting citizen science activities, as well as by deploying technology to further citizen science research.

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A.44  **CITIZEN SCIENCE FOR EARTH SYSTEMS PROGRAM**

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A.44-1
1. **Scope of Program**

The Earth Science Division (ESD) within NASA’s Science Mission Directorate (SMD) pioneers the scientific use of remotely sensed measurements to advance understanding of the Earth as an integrated system and to provide direct societal benefits. Numerical models represent key achievements in NASA’s Earth science endeavors, as the models codify consistently our quantitative knowledge about selected portions of the Earth system. Coupled with data assimilation systems, models are used to synthesize diverse arrays of information from satellite and *in situ* measurements; high-fidelity models driven and constrained by sufficient data can yield accurate predictions and essential insights into a wide range of complex Earth system processes and interactions, spanning many space and time scales and involving many aspects of our environment. NASA considers the use of data-driven models to be central to our approach to Earth system science.

Because the most advanced models are run on supercomputers available only at computing centers, the Computational Modeling Algorithms and Cyberinfrastructure (CMAC) program funds research and development activities to optimize the products and services at high-end computing (HEC) centers to increase the productivity of the users who use HEC to produce modeling products and the users who need to analyze the modeling results using the HEC resources. CMAC builds advanced modeling infrastructure used at NASA computing centers to support Earth system science investigations while fundamentally utilizing both models and data.

2. **Description of Solicited Research and Development**

In this funding cycle, the CMAC program is focusing on the following two challenges: (1) creating a high-performance, service-based cyberinfrastructure to support large-scale Earth science analytics, and (2) adapting an atmospheric model to a distributed heterogeneous multicore computing architecture. Specific solicited areas are described below.

2.1 **Earth Science Analytic Services Cyberinfrastructure**

The National Academy study "*Frontiers in Massive Data Analysis*" discussed the challenges to the analysis of massive data ([https://www.nap.edu/catalog/18374/frontiers-in-massive-data-analysis](https://www.nap.edu/catalog/18374/frontiers-in-massive-data-analysis)), which include:

- Centralization of large-scale infrastructure,
- Data sizes at the petabyte to Exabyte scale,
- Architectures that are highly fault-tolerant, and
- Computing that is collocated with the data.

The CMAC program objective in this topic area is to leverage existing high-performance computing capabilities to build a comprehensive and coherent portfolio of Earth science data analytic services. The resulting cyberinfrastructure is intended to support a wide range of Earth science research and applications activities. NASA envisions the cyberinfrastructure is comprised of two large-scale data analysis capabilities at the two
NASA supported supercomputing facilities (http://www.hec.nasa.gov). At Goddard Space Flight Center, the NASA Center for Climate Simulation (NCCS) has built a platform upon which Climate Analytics-as-a-Service (CAaaS) capabilities can be deployed: the Advanced Data Analytics Platform (ADAPT; http://www.nccs.nasa.gov/services/adapt) supported by the Data Analytics and Storage System (https://www.nccs.nasa.gov/services/dass). At NASA Ames Research Center, the High-End Computing Capability (HECC) project has built the NASA Earth Exchange (NEX; https://nex.nasa.gov/nex/) platform and its public cloud version known as OpenNEX (https://nex.nasa.gov/opennex/).

The objective of the solicitation is to select applications, services, or tools that can be integrated into the new cyberinfrastructure as participating services. Proposed services must be sufficiently mature to deploy operationally and must currently serve an existing customer base. Proposed services must significantly reduce the amount of time needed for scientists and engineers to prepare data and execute analysis workloads.

The solicitation expects that work on proposed web service applications will focus on integration of the service(s) into the cyberinfrastructure. Work on proposed applications that are not currently implemented as a web service will focus on refactoring and integration. Investigator teams will be responsible for refactoring their applications into a service-oriented approach before integration into the cyberinfrastructure. In all cases, the investigator teams will provide the necessary methods and means for regression testing, documentation, and user support. Investigator teams must perform a security audit on their applications prior to being installed on NASA systems. In addition, all applications will undergo a full security audit once on NASA infrastructure, and the investigator teams will be responsible for mitigating any findings prior to the service being operational.

The solicitation is not intended to support the development of new end-user tools. The solicitation expects work to focus on the refactoring and integration of existing, well-documented and widely used tools into the web service architecture of either the ADAPT or NEX. Preference will be given to applications that can leverage existing services and the parallel processing capabilities of the cyberinfrastructure. Single processor sequential processing technologies will not be considered for funding.

Computing resources for construction of the Earth science analytic services cyberinfrastructure are available to investigator teams at the two NASA supercomputing centers. Proposals are expected to be able to support data analysis on the following representative data sets:

- Earth system science data-model intercomparison and data analysis processes such as Obs4MIPs, Ana4MIPs, and CMIP5 (https://esgf.nccs.nasa.gov/),
- Large modeling products including GEOS-5 FP, GEOS-5 Seasonal Forecast, MERRA-2, 7km-G5NR (https://gmao.gsfc.nasa.gov/GMAO_products/),
- Climate projection downscaling products such as NEX-GDDP, NEX-DCP30, BCCA and LOCA (https://nex.nasa.gov/nex/resources/127/).

It is expected that additional data sets will be integrated into the systems, including relevant satellite observations.
Collaboration with NASA computing centers is required. Two points of contacts are identified: Dr. Daniel Duffy (daniel.q.duffy@nasa.gov) for the ADAPT platform and Dr. Ramakrishna Nemani (Rama.Nemani@nasa.gov) for the NEX.

2.2 Strategy to restructure GEOS model to distributed heterogeneous multicore computing architecture

NASA’s high-end computing systems are constantly changing with the latest technology development. Legacy Earth science models will need to be restructured to take advantage of the latest information technology. This is a very manpower intensive process and the knowledge gained through the restructuring exercise cannot be easily transformed to other model developers.

The latest high-end computing architecture includes the heterogeneous usage of multicore Central Processing Unit (CPU) and multicore accelerators, such as NVIDIA Graphics Processing Unit (GPU) or Intel Phi. In addition, many distributed computing nodes are tightly interconnected with a high-speed communication network. This architecture is commonly called "distributed heterogeneous multicore architecture."

The Global Modeling and Assimilation Office (GMAO) at GSFC has developed the Goddard Earth Observing System Model (GEOS) in support of NASA’s Earth Science research into data analysis, observing system modeling and design, climate and weather prediction, and basic research (https://gmao.gsfc.nasa.gov/GEOS_systems/). The GMAO has identified a number of challenges when moving GEOS toward an increase in a factor of 10x in resolution for research runs, which is expected to be near an Exascale problem (more information about these challenges can be found https://gmao.gsfc.nasa.gov/pubs/docs/Putman902.pdf. To address these challenges, proposals must aim to develop a strategy for the continued development of GEOS toward Exascale computing that takes into account the rapidly changing HPC ecosystem (both hardware and software). It is highly desirable that the proposals develop strategies that address portability and maintainability while being agile and more adaptive to future HPC architectures.

The target resolution for this study is approximately 100-meter global resolution with a run time of one simulation day per wall clock day within the next ten years. Efforts have been made in the past and are currently being made to port parts of the model to the latest heterogeneous multicore CPUs and multicore accelerators (GPUs and Phis). However, these efforts have all started with the existing application without considering future requirements (such as increased resolution, additional components, or coupled models) or changes in hardware and software that are expected on Exascale platforms. Therefore, NASA is not interested in funding additional porting efforts of the existing code to these emerging platforms.

NASA is interested in a detailed study of the GEOS model and recommendations for a path to extremely high-resolution research runs on future Exascale platforms. This study could include, but not necessarily be limited to, the following aspects:

- Roadmap of components for the GEOS atmospheric model and coupled components.
• Comparison of the GEOS model to other similar research models. This comparison would include such aspects as programming language, algorithms, tools, roadmap, performance (if available), etc.
• Detailed analysis of the current performance and scaling of the GEOS model, including current and potential future bottlenecks.
• Analysis of alternatives of existing and future programming languages and methods to reach the target resolution. This must take into account the current trajectory of the information technology landscape being proposed for Exascale systems, which includes both hardware and software.
• Analysis of continuing to develop the legacy code or the need to refactor the application to take advantage of emerging systems, including recommendations to execute any continued development or refactoring.
• Potential strategies to improve performance, such as a co-model approach.
• Analysis and optimization of the full cycle workflow (data assimilation through forecast) with the inclusion of ensemble runs.

The GMAO will work closely with any awarded proposal and will provide a point of contact as a GEOS consultant for the project. No other models or codes will be considered, and NASA encourages collaboration with other organizations that use the Finite Volume version 3 (FV3) dynamical core (such as the National Oceanic and Atmospheric Administration National Centers for Environmental Prediction (NOAA NCEP), Geophysical Fluid Dynamics Laboratory (GFDL), and National Center for Atmospheric Research (NCAR)) and with the Department of Energy’s (DOE’s) Exascale Computing project.

3. Programmatic Information

This section provides additional details governing the proposed activities that supersede the general guidelines announced in the ROSES Summary of Solicitation (SOS). Any need for NASA provided HEC computing should follow the guideline in Section I-d of the SOS.

3.1 Evaluation and Selection of Proposals

Proposers are reminded that the evaluation criteria for this solicitation are given in the NASA Guidebook for Proposers. One or more peer review panels will evaluate all the proposals. Additional evaluation requirements are listed below:

3.1.1 Expansion from previous CMAC funded efforts
CMAC is making every attempt to reuse the results from prior funded projects. The titles and abstracts of projects previously funded by CMAC (under ROSES-2011 and 2014) may be found at: http://tinyurl.com/ovjg9nw and http://tinyurl.com/huexffx. All else being equal, proposals including credible plans to build upon and expand previous CMAC funded efforts will be preferred. For reference, an overall CMAC common architecture is documented and available at: http://www.hec.nasa.gov/user/funding/CMAC_Data_System_Architecture.pdf.
3.1.2 Software Engineering Plan

Proposals must include a software engineering and testing plan to describe the software engineering practice to be used by the project, including the use of software engineering standards and procedures. The proposal will be considered unresponsive without this plan. The plan should minimally include the design and architecture documents to facilitate future expansion and maintenance of the software.

While the development of above software and tools is important, the quality and sustainability of the software is also critical. This solicitation addresses the long-term scientific software quality and sustainability challenges by requiring the use of a more mature software engineering practice. Examples may include software project planning, design and architecture document production, online code development, the use of community code repository (e.g., integration with Git; http://en.wikipedia.org/wiki/Git_(software)), nightly build and regression testing, and packaging and deployment.

3.1.3 Open source software

Because scientific software is typically built piece by piece over multiple funding cycles and with different teams, the software developed under this program element must be designated and distributed to the public as open source software. The use of Apache License 2.0 is required.

Any proposal responding to Section 2.1 of this solicitation to build and expand a server side information system supporting the climate model evaluation and data analysis processes is required to contribute the project to the Apache Open Climate Workbench, and deliver to NASA a copy of such software with sufficient rights for use as Open Source Software under this Apache License 2.0.

Therefore, each proposal shall:
- Identify any proprietary software, software owned by a non-Federal entity, or open source software that is incorporated into the software being proposed;
- Indicate whether a license has been obtained in situations where proprietary software, software owned by a non-Federal entity, or open source software has been incorporated into the software that is the subject of the proposal and attach a copy of the license to the proposal, along with evidence of permission obtained from the software owner to release improvements or derivative works to the software as Open Source under the Apache License, Version 2.0.

NASA will evaluate proposals for compliance with the above open source software requirements. A proposal that does not include documentation sufficient to satisfy NASA that the developed software will be open source may not be selected.

3.2 Period of Performance

Because of the rapidly changing computing and computational technology environment, awards resulting from this call are limited to a performance period of 24 months.
3.3 Reporting

Annual progress reports are required. Proposals must define clear, measurable milestones to be achieved for each year of performance and must address those in annual reports in order to warrant continuation of the second and subsequent years.

In addition, all CMAC projects are required to attend a review meeting at least annually, which focuses on the preceding period’s efforts. Each review shall address:

- Technical status: The Principal Investigator (PI) shall summarize accomplishments for the preceding period, including technical accomplishments (trade study results, requirements analysis, design, etc.), technology development results, and results of tests and/or demonstrations.
- Schedule status: The PI shall address the status of major tasks and the variance from planned versus actual schedule, including tasks completed, tasks in process, tasks expected to complete later than planned, and tasks that are delayed in starting, with rationale for each, and recovery plans, as appropriate.
- Software engineering status: The PI shall cover how the software engineering and testing plans have been followed, including software engineering documents generated during the performing period, issues tracking, continuous integration, configuration management, and software testing status.
- Financial status: The PI shall report the financial status (e.g., invoicing the Government against the budget) and compare to the budget plan.

3.4 Travel

One meeting per year at a NASA center on the opposite coast for project coordination is encouraged. The cost for traveling to the coordination meetings may be included in the budget. Otherwise, using online telecommunication tools for video conferencing is highly encouraged.

4. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected program budget for first year of new awards</th>
<th>~$1.5M</th>
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</thead>
<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>~ 6 - 10 projects</td>
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<tr>
<td>Maximum duration of awards</td>
<td>2 years</td>
</tr>
<tr>
<td>Due date for Notice of Intent to propose (NOI)</td>
<td>See Tables 2 and 3 in the Summary of Solicitation of this NRA.</td>
</tr>
<tr>
<td>Due date for proposals</td>
<td>See Tables 2 and 3 in the Summary of Solicitation of this NRA.</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>6 months after proposal due date.</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposal</td>
<td>15 pages; see also Table 1 of ROSES and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Relevance to NASA</strong></td>
<td>This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>General information and overview of this solicitation</strong></td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td><strong>Detailed instructions for the preparation and submission of proposals</strong></td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Submission medium</strong></td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Web site for submission of proposal via NSPIRES</strong></td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td><strong>Web site for submission of proposal via Grants.gov</strong></td>
<td><a href="http://grants.gov/">http://grants.gov/</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
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<tr>
<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
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</tr>
</tbody>
</table>
| **NASA point of contact concerning this program** | Tsengdar Lee  
Earth Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: (202) 358-0860  
E-mail: tsengdar.j.lee@nasa.gov |
NOTICE: The Advanced Information Systems Technology (AIST) program will not be competed in ROSES-2017. NASA expects to continue to solicit Earth science information systems technology through future AIST solicitations. The next opportunity that the Advanced Information Systems Technology program is expected to be competed again is in ROSES-2018.

1. Objectives

The objectives of the Advanced Information Systems Technology (AIST) program are to identify, develop, and (where appropriate) demonstrate advanced information system technologies which:

- Reduce the risk, cost, size, and development time of Earth Science Division (ESD) space-based and ground-based information systems;
- Increase the accessibility and utility of science data; and
- Enable new observation measurements and information products.

2. Program Description

Advanced information systems are used to process, archive, access, visualize, and communicate science data. Advanced computing and communications concepts that permit the transmission and management of terabytes of data are essential to our vision of a unified observational network. Information provided to a nationwide community of users will result in significant leaps of knowledge of Earth science dynamics that benefit the global community.

ESTO’s AIST program employs an end-to-end approach to evolve technologies – from the space segment, where the information pipeline begins, to the end user, where knowledge is advanced.

3. Programmatic Information

Michael M. Little  
Earth Science Technology Office  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: (301) 286-7404  
Email: Michael.M.Little@nasa.gov
INSTRUMENT INCUBATOR

NOTICE: The Instrument Incubator Program (IIP) will not be competed in ROSES-2017. NASA expects to continue to solicit Earth science instrument technology through future IIP solicitations. The next opportunity is currently anticipated to be included in ROSES-2019.

1. Objectives

The Instrument Incubator Program (IIP) funds innovative technologies that lead directly to new Earth observing instruments, sensors, and systems in support of SMD's Earth Science Division. The technologies and measurement concepts developed under the IIP may extend up through field demonstrations, with a longer-term aim for infusion into future ESD research and flight programs. The objectives of the IIP are to research, develop, and demonstrate new measurement technologies that:

- Enable new or greatly enhance Earth observation measurements and
- Reduce the risk, cost, size, mass, and development time of Earth observing instruments.

2. Program Description

The IIP is designed to reduce the risk of new, innovative remote-sensing instrument systems so that they can be successfully used in future science missions to reduce overall development time.

3. Programmatic Information

For further information about the Instrument Incubator program, contact:

Parminder Ghuman
Earth Science Technology Office
National Aeronautics and Space Administration
Washington, DC 20546
Telephone: 301-286-8001
Email: p.ghuman@nasa.gov
1. Introduction

The Advanced Component Technology (ACT) program seeks proposals for technology development activities leading to new component- and subsystem-level space-based and airborne measurement techniques to be developed in support of the Science Mission Directorate's Earth Science Division. The ACT program is managed by the NASA’s Earth Science Technology Office (ESTO). ESTO supports the development of a range of advanced technologies to meet future Earth science measurements and activities addressing the full science measurement process, from instruments needed to make observations, to data systems and information products that make those observations useful.

The goals of the ACT program are to research, develop, and demonstrate component- and subsystem-level technology development that:

- Enable new Earth observation measurements, and
- Reduce the risk, cost, size, volume, mass, and development time of Earth observing instruments.

The ACT program brings instrument components and subsystems to a maturity level that allows their integration directly into mission designs by NASA flight projects, while others “graduate” into other technology programs for further development, such as the Instrument Incubator Program (IIP; see Program element A.47 of ROSES-2017). For the purpose of this program element components are defined as one of the parts that make up an instrument subsystem. Subsystems are defined as a series of interconnecting components that are part of an overall instrument system. Examples of previously funded ACT awards can be found at https://esto.nasa.gov/obs_technologies_act.html.

1.1 Proposal Research Topics

This ACT program element solicits new component- and subsystem-level technologies that support future instrument developments addressing any of the science focus areas in NASA’s Earth Science program (see ROSES-2017, Program element A.1 for descriptions of the focus areas). These new technologies may enable new types of observations and measurement techniques that will improve NASA’s Earth Science program. Technologies may target any Earth science measurement or issue in order to advance the strategic goals, questions, and future missions outlined in Program element 1 of the NASA 2014 Science Plan, which can be accessed on the web at, http://science.nasa.gov/about-us/science-strategy. In addition, technologies may target
those summarized in recent ESTO community workshops on lidar and microwave
technologies in support of the 2017-2027 Decadal Survey for Earth Science and
Applications from Space. A summary of the workshop results can be found at

The ACT program element seeks advances in any of the component technologies that
advance the performance of current remote sensing instrument systems, enable new
measurement capabilities, or allow current systems to increase their science utility by
providing enhanced or new capabilities. The component technologies should
demonstrate their viability to advance remote sensing measurement system
performance with a clear understanding of their eventual path to space implementation.

This program element also seeks miniaturization of key instrument components or
subsystems that enable or significantly improve new Earth sensing systems. Rapid
advances in Earth science instrument technology are enabling considerably smaller
instruments that may be able to meet many science needs in the future. Proposers are
asked to consider rapidly emerging technologies such as photonics integrated circuits,
subsystem on a chip solutions, and other compact electronic and optical architectures.

Along with components and subsystem technologies to support improvements to
traditional instrumentation and measurement techniques, this program element seeks
low recurring cost, and potentially mass producible, technologies that can be infused
into instruments. This would enable innovative measurement techniques, such as those
that could employ multiple sensors in formation or use alternative platforms, including
small satellites, U-class, uninhabited aerial vehicles, or co-manifested opportunities, and
including hosted payloads and ride-share programs that will be launched to orbits
appropriate for observations of the Earth system.

ESTO encourages proposers to investigate teaming and leveraging of emerging
technologies developed under Internal Research and Development activities, current
and recent Small Business Innovative Research awards (http://sbir.gsfc.nasa.gov/), as
well as other research programs.

The proposed ACT activity is expected to have an entry Technology Readiness Level
(TRL) between 2 and 3 with an exit TRL between 3 and 4. It is the responsibility of the
proposer to justify the entry and exit level TRL of the proposed technology. This
program will permit appropriate funding to be applied at this early stage to develop and
demonstrate key and enabling new technologies for Earth science missions, such as
concept formulation, proof of concept, laboratory demonstrations, and advanced
component technology development.

TRL definitions can be found at http://esto.nasa.gov/files/TRL.pdf.

2. Programmatic Information

This document provides requirements and details tailored to this specific program
element that supplement or may supplant the general guidelines of the ROSES-2017
Summary of Solicitation or Guidebook for Proposers. See Section I(h) of the ROSES-
2017 Summary of Solicitation regarding the order of precedence.
2.1 Proposal Content and Submission

2.1.1 Notice of Intent to Propose

A Notice of Intent (NOI) to propose is encouraged, but not required, for submission of proposals to this program element. The information contained in the NOI is used to help expedite proposal review activities and, therefore, is of considerable value to both NASA and the proposer. NOIs shall be submitted electronically via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at http://nspires.nasaprs.com by the due date given in Section 7. Since NOIs submitted after the deadline may still be useful to NASA, late NOIs, as well as retraction of an earlier NOI submission, may be submitted by email to the point of contact for this program element in Section 7.

2.1.2 Questions and Answers

Prospective proposers are requested to submit any questions in writing to p.ghuman@nasa.gov no later than 30 days before the proposal due date. Questions and answers may be posted in a Frequently Asked Question (FAQ) on the NSPIRES page for this program element under "other documents." It is the proposer's responsibility to check the NSPIRES page for this program element for possible updates to any FAQ document or clarifications to the solicitation. Proposers who subscribe to the SMD email distribution list in NSPIRES will receive an email if this solicitation is amended.

3 Proposal Content

3.1 Proposal Summary (Abstract)

The NSPIRES web page requires proposers to fill in a text box with a proposal summary of no more than 4000 characters. The proposal summary includes: (a) objectives and benefits; (b) an outline of the proposed work and methodology; (c) the period of performance; and (d) entry and planned exit Technology Readiness Level (TRL).

3.2 Scientific/Technical/Management Section (Project Description)

This section of the proposal must include the following content information in subsections that use the same titles. Failure to provide any of this material may be cause for the proposal to be judged as noncompliant and returned without further review. The Project Description is limited to 12 non-reduced, single-spaced typewritten pages. Standard proposal style formats shall be in accordance with the Guidebook for Proposers. Proposals that exceed the 12-page limit may be returned without review. The Project Description Section includes:

1. Applicability to Earth Science Measurements – Describe the benefits to future Earth science missions. (e.g., Satellite Missions, Small Sat Missions (U-Sats), or Airborne Missions). Describe how the component or subsystem will improve the science measurement (e.g., spectral, spatial, accuracy, precision, etc.) and
describe why this is important. Include a one-page relevancy scenario showing how the proposed technology contributes to one or more Earth science measurements.

2. Description of Proposed Technology – Provide a description of the proposed new technology for an instrument system or subsystem. Describe the technical approach and include an operational concept for the proposed technology that shows how it addresses Earth science needs. Explain and justify how the proposed choice of measurement platform enables science. Discuss any possible benefits to other NASA Earth or Space Science activities or societal and commercial benefits.

3. Comparative Technology Assessment – Describe anticipated advantages of this technology compared to those currently in use - e.g., reduction of size, mass, power, volume, cost, improved performance, or enabling of a new capability not previously possible. Reference the current state of the art and relate it to the proposed work.

4. TRL Assessment – Proposers must define the starting point for the component and subsystem technology or measurement technique and the exit or success criteria for the proposed activity. The TRL must advance by at least one level during the period of performance of the activity. If proposed activity duration is for multiple years, advancement of one TRL per year is desirable.

5. Research Management Plan – Proposer must provide a statement of work that concisely describes each task and milestone to be accomplished in the course of the research and development. Define the success criteria associated with each task or milestone. Also, include a schedule chart that identifies critical milestones. At least two milestones per twelve-month period must be defined.

Subcontracting portions of the research project is acceptable, but overall management and reporting are the responsibility of the proposing organization.

6. Personnel – Provide a list of key personnel and identify experience related to the proposed activity. Proposers should be sure to include technology and instrument development skills on the team. The key personnel list is included in the overall page count and must include, as a minimum, the Principal Investigator (PI). Optionally, one-page resumes for Key Personnel may be supplied; these resumes are not included in the 12-page limit for the Project Description Section.

7. Facilities and Equipment – Describe significant facilities and equipment required to complete the work. Before requesting funding to purchase a major item of capital equipment, the proposer should determine if sharing or loan of equipment already available within the proposing organization is a feasible alternative.

8. Special Matters – Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. This is also where any other relevant special concern that NASA should be aware of is identified.
9. **Quad Chart** – Provide a summary chart (quad chart) that contains the following information:
   - Upper Left Quadrant: “Objectives"
   - Lower Left Quadrant: "Approach" and "Co-Is/Partners"
   - Upper Right Quadrant: A visual, graphic, or other pertinent information
   - Lower Right Quadrant: "Key Milestones " and "Entry TRL"

   A template and example of the quad chart can be downloaded from [http://esto.nasa.gov/files/EntryQuad_instructions_template.ppt](http://esto.nasa.gov/files/EntryQuad_instructions_template.ppt). Note: This quad chart is not included in the 12-page limit for the Project Description Section.

4. **Evaluation Criteria**

The three basic evaluation criteria are given in the *ROSES Summary of Solicitation* Section VI (a) and the *NASA Guidebook for Proposers* and they are Relevance, Merit, and Cost. Clarifications and additions specific to this program element are listed below.

The first criterion, Relevance, includes the applicability of the proposed investigation to Earth Science Focus Area(s) and other science measurement and technology needs and specifically includes:

- The proposal’s relevance and potential contribution to NASA’s scientific and technical areas of emphasis and to the ACT program, including the potential to contribute to future Earth science instruments and the degree to which the proposed investigation specifically supports the objective of at least one of the Earth Science Focus Areas (see Program element A.1 for a description of Earth Science Focus Areas);
- The potential for the component or subsystem level technology development to significantly reduce the risk, cost, size, and development time of Earth science instruments or to enable new Earth science measurements. Potential cost reductions should be clearly stated and substantiated to the extent possible with supporting analysis that indicates scalability;
- The potential of the component or subsystem level technology to be integrated, once matured, into an Earth science instrument system; and
- The potential for the component or subsystem technology development to have cross-cutting or commercial benefits.

The second evaluation criterion, Intrinsic Merit, includes:

- Impact, significance, and feasibility of the proposed technical approach to achieve the technology development objectives;
- Degree of innovation of the proposed technology development concepts and approach;
- Qualifications of key personnel and adequacy of facilities, staff, and equipment to support the proposed activity as demonstrated by past performance and related experience in the proposed area of technology development, to ensure that the team has strong technology development and instrument development skills, as well as any leveraging/teaming such as recent SBIR awards/awardees;
- Substantiated justification and appropriateness of the entry and exit technology
readiness level (TRL); and

- Feasibility of making the newly enabled measurement, with the proposed component or subsystem; and feasibility of making a demonstrable TRL increase. The TRL must advance by at least one (1) level during the performance period of the project.

The third criterion, Cost Reasonableness, includes:

- Adequacy and realism of proposed milestones and associated success criteria;
- Reasonableness of the proposed cost;
- Adherence to sound and consistent management practices appropriate to the TRL level of the proposed task; and
- Commitment of the organization’s management to the proposed technology development (evidenced by prior teaming arrangements, etc.). Proposers should identify previous relevant investments by the organization/program and provide supporting documentation.

Cost sharing is not part of the cost criteria, but cost sharing may be considered at the time of selection when deciding between proposals of otherwise equal scientific, technical, and cost realism merit.

5 Award Information

The Government’s obligation to make award(s) is contingent upon both the availability of appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this program element. No additional funds beyond the negotiated award value will be available. NASA does not allow for payment of profit or fee to commercial firms under grant awards, and few fees are permitted (See http://science.nasa.gov/researchers/sara/faqs#16 for more information).

5.1 Funding

The total funding available for this sub-element will limit the number and magnitude of the proposals awarded. It is anticipated that a total of 12 to 14 proposals will be selected and the value of each will be approximately $400K per year per proposal for a 3-year proposal and approximately $600K per year for a 2-year proposal.

Proposers are encouraged to offer cost sharing. If a cost sharing arrangement is proposed, appropriate data rights that recognize the proposer’s contributions, as well as the Government’s rights to access, will be negotiated prior to award.

5.2 Period of Performance

The expected period of performance is 12-36 months. Proposals must define clear, measurable milestones to be achieved for each year of performance in order to warrant continuation in the second and third years.
5.3 **Type of Award**

All selected proposals will result in the award of grants, cooperative agreements, or intra- or inter-Government transfers, as appropriate. Grants and cooperative agreements will be subject to the provisions of the *Grants and Cooperative Agreement Manual (GCAM)* and the *NASA Guidebook for Proposers*. In the case of any conflict, the GCAM takes precedence. If a commercial organization wants to receive a grant or cooperative agreement, cost sharing is required, unless the commercial organization can demonstrate that it does not expect to receive substantial compensating benefits for performance of the work. If this demonstration is made, cost sharing is not required, but may be offered voluntarily (see references in Section III (d) of the *ROSES Summary of Solicitation*).

6. **Technical Reporting Requirements**

Once awarded, submit all status information, presentation material, and report deliverables applicable to the ACT program to the web-based ESTO Reporting System (ERS). A user account on the ERS will be provided to the PI upon award. Due to NASA IT security requirements, all PIs must register with the Identity Management and Account Exchange (IdMAX) system before a user account on ERS will be established. To create an IdMAX account, some personal information will be required.

The following deliverables are required of awarded proposals. In cases where subcontract arrangements exist, consolidated project reports are the responsibility of the PI. The proposed budget should provide for these reporting requirements. In this context, "Annual" refers to a twelve-month task effort that commences at award.

6.1 **Initial Plans and Reports**

Within 15 days of award, provide an updated Project Plan, initial Quad Chart, and initial TRL assessment. Also, provide a monthly cost plan for the entire period of performance. The project plan, initial (entry) Quad Chart, cost plan, and initial TRL assessment (and supporting data) should be created in the ERS.

The project plan shall identify plans for all technical, schedule, and resource activities for the proposed life of the project.

The Quad Chart should contain the following information:

- Upper Left Quadrant: "Objective."
- Lower Left Quadrant: "Approach" and "Co-Is/Partners."
- Upper Right Quadrant: A visual, graphic, or other pertinent information.
- Lower Right Quadrant: "Key Milestones" and "TRLin."

Proposers are required to update the Quad Chart and TRL assessment at least annually and more often, if appropriate. This can be done on the ERS under the "Quad Chart" section and "TRL" section respectively.
6.2 Quarterly Technical Reports

The quarterly technical report shall focus on the preceding three month’s efforts. Each report shall address:

- Technical status: Summarize accomplishments for the preceding three months, including technical accomplishments (trade study results, requirements analysis, design, etc.), technology development results, and results of tests and/or demonstrations.
- Schedule status: Address the status of major tasks and the variance between planned versus actual schedule, including tasks completed, tasks in process, tasks expected to complete later than planned, and tasks that are delayed in starting, with rationale for each and recovery plans, as appropriate.

Upload the Quarterly Technical Reports to the appropriate location in the ERS at three-month intervals, starting on the third-month anniversary date of the start date specified in the award vehicle. In months for which the PI is providing interim or annual review, the requirement for a quarterly report is superseded by the interim or annual review requirements discussed in the next two sections.

Reports may be submitted in PDF, Microsoft Word, or Microsoft PowerPoint compatible file formats by the required due date, or by close of business of the first workday following the due date if the due date falls on a weekend or a holiday. A teleconference or brief meeting may be conducted between the ESTO and the PI to review and discuss each report.

6.3 Interim Reviews

An Interim Review occurs at the end of the first six-month calendar period commencing from the date of award and at twelve-month intervals thereafter. The PI must provide a presentation summarizing the work accomplished and results leading up to this Interim Review and must:

- Describe the primary findings, technology development results, and technical status, e.g., status of design, construction of breadboards or prototype implementations, results of tests and/or proof-of-concept demonstrations, etc.;
- Describe the work planned for the remainder of the project and critical issues that need to be resolved to successfully complete the remaining planned work;
- Summarize the cost and schedule status of the project, including any schedule slippage/acceleration. Create and maintain a schedule milestone chart of all major task activities and show at all reviews. Also, create and main a cost data sheet that shows total project costs obligated and costed, along with a graphical representation of the project cost profile to completion;
- Provide a summary of anticipated results at the end of the task; and
- At the second review and subsequent reviews, address the comments and recommendations prepared by the reviewers participating in the most recent review.

The Interim Review will be conducted via teleconference. Presentation slides shall be uploaded to the appropriate location in the ERS at least three (3) working days prior to
the review. Following the review, the presentation, updated in accordance with comments and discussion resulting from the review, shall be uploaded to the appropriate location in the ERS within ten days after the review.

6.4 Annual Review

An Annual Review occurs at the end of each twelve-month calendar period commencing from the date of award. The Annual Reviews are similar to the Interim Reviews and include all of the products required at an Interim Review with the following exceptions:

- The review is held at the PI’s facility or a mutually agreed location;
- An independent technical reviewer from an organization separately funded by ESTO may participate in the review;
- The PI may provide a laboratory demonstration, if appropriate, to show technical results and status;
- Report any educational and outreach components of the project, e.g., graduate degrees, educational activities; technology infusion, or patents applied for or granted; journal or conference publications; presentations at professional conferences, seminars and symposia; demonstrations; media exposure; and, other activities that contributed to the overall success of the research project; and
- The Annual Review should be comprehensive and should include a discussion of the planned content of the written report.

Upload the review package to the appropriate location in the ERS at least three (3) working days prior to the review. The presentation, updated in accordance with comments and discussion resulting from the review shall be uploaded to the appropriate location in the ERS within ten days after the review.

6.5 Final Review and Final Report

The Final Review occurs at the completion of the activity. The Final Review is similar to the Annual Reviews and includes all of the products required at an Annual Review. In addition, the final review must provide conclusions of the work performed and make recommendations for follow-on activities that should be pursued, with estimates of the cost and schedule to advance the TRL to the next level.

Include the following in the written Final Report:

1. Background of the project, including the science rationale for conducting this technology development;
2. Results of all analyses, element, subsystem, or system designs, breadboards, and/or prototyping implementations and designs;
3. Performance analysis results of tests and/or demonstrations; estimation of reduction(s) in size, mass, power, volume and/or cost; improved performance; description of newly enabled capability; and documentation of technology dependencies;
4. Tables, graphs, diagrams, curves, sketches, photographs, and drawings in sufficient detail to comprehensively explain the results achieved;
5. An updated TRL assessment, including a rough order of magnitude cost estimate, as well as a description and estimate of the duration of the follow-on activities necessary to advance the TRL to the next level; and

6. At the end of the period of performance, the PI shall provide a final Accomplishments Chart which contains the following information (a template is available in the ERS):
   - Upper Left: "Objectives."
   - Upper Right: A visual, graphic, or other pertinent information.
   - Middle: "Accomplishments."
   - Bottom: "Co-Is/Partners" (name and affiliation), "TRLin," and "TRLout."

The Final Report and updated Final Review presentation shall be uploaded to the appropriate locations in the ERS within thirty days of the final review. Also, update the Accomplishment Chart and TRL assessment on the ERS under the "Quad Chart" section and "TRL" section respectively.

6.6 Earth Science Technology Forum

The awardee is encouraged to participate in the Earth Science Technology Forum (ESTF), if held. The ESTF is an opportunity for NASA planners, managers, technologists, and scientists to review the research funded by ESTO. It is also an opportunity for researchers from NASA, academia, and industry to meet with their peers and to better understand NASA Earth science requirements. Awardees are encouraged to include one trip per year in their travel budget for one person to attend the ESTF. The ESTF typically alternates its location from east coast to west coast (e.g., Greenbelt, MD, and Pasadena, CA).

7. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected program budget for first year of new awards</th>
<th>Up to $4.6M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>~ 12 – 14</td>
</tr>
<tr>
<td>Duration of awards</td>
<td>Minimum 1-year / Maximum 3-year</td>
</tr>
<tr>
<td>Due date for Notice of Intent to Propose (NOI)</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Due date for delivery of proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Page length for the central Science-Technical-Management section of proposal</td>
<td>12 pp; See Section 3.2 of this program element; See also the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Relevance to NASA</td>
<td>This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to the ACT Program are, by definition, relevant to NASA. (See Section 4 of this program element.)</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(h) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and Chapter 3 of the NASA Guideline for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposals via Grants.gov</td>
<td><a href="http://grants.gov/">http://grants.gov/</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-ACT</td>
</tr>
</tbody>
</table>
| NASA point of contact concerning this program | Parminder Ghuman  
Science Mission Directorate  
Earth Science Technology Office  
National Aeronautics and Space Administration  
Washington, DC 20546  
Telephone: (301) 286-8001  
E-mail: p.ghuman@nasa.gov |
NOTICE: Amended December 21, 2017. This amendment announces that InVEST is Solicited in Program Element A.49 of ROSES-2017. Responses to questions submitted no less than 30 days before the proposal due date to sachidananda.r.babu@nasa.gov will be posted in a Frequently Asked Question (FAQ) on the NSPIRES page for this program element under "other documents". No data management plan will be collected for this program element.

Notices of Intent are requested by February 2, 2018, and proposals are due by March 26, 2018.

1. **Scope of the Program**

1.1 **Introduction**

The Earth Science Division (ESD) in NASA’s Science Mission Directorate (SMD) supports research activities that address the Earth system to characterize its properties on a broad range of spatial and temporal scales, to understand the naturally occurring and human-induced processes that drive them, and to improve our capability for predicting its future evolution. The focus of the Earth Science Research Program is the use of space-based measurements to provide information not available by other means.

Within ESD the Earth Science Technology Office (ESTO) manages the development of a range of advanced technologies to meet future Earth science measurements and operational requirements. ESTO technology investments attempt to address the full science measurement process: from instruments needed to make observations to data systems and information products and tools that make those observations useful. Current ESTO program lines generally advance technologies to TRL-6: system/subsystems prototype demonstration in the relevant environment (ground, airborne or space).

1.2 **Goals of In-Space Validation of Earth Science Technologies (InVEST) Program**

There has been and continues to be a desire for new technologies and measurement concepts/techniques to be validated in space prior to use in a science mission. This is important because the space environment imposes stringent conditions on components and systems, some of which cannot be fully tested on the ground or in airborne systems.

The validation of new technologies and measurement concepts/techniques in space could significantly reduce the risk to future Earth science missions. The In-Space Validation of Earth Science Technologies (InVEST) program element is intended to overcome these limitations. ESTO’s InVEST program line will flight qualify technologies and/or new measurement concepts through successful spaceborne demonstrations to TRL-7. Examples of previously funded InVEST awards can be found at: [https://esto.nasa.gov/techval_space.html](https://esto.nasa.gov/techval_space.html).
1.2.1 InVEST 2017 Solicitation Constraints and Considerations

ESTO’s In-Space Validation of Earth Science Technologies (InVEST) program element enables new technologies and measurement concepts to be validated in space prior to use in a science mission.

This ESTO program element is focused on in-space, orbital demonstration and validation only. Program constraints and consideration for this program element are described below:

- This program does not develop any new technologies, but rather seeks to advance technology and/or measurement technique readiness by space flight demonstration and validation, in order to reduce risk to future space missions.
- Technologies and/or measurement techniques must be ready for launch within two years after award. Once on-orbit, the maximum time for validation of the technology should be one year.
- The InVEST program is focused on in-space, orbital technology demonstration and validation. No science measurement demonstration is required. Demonstration of a science measurement is permitted if it is required to validate the measurement concept or technology.
- This solicitation is exclusively targeted towards the demonstration of new technologies and/or Earth science measurements from "U-Class" small satellites that are of the 1U to 6U form-factor.
  - A U-Class satellite is a type of nanosatellite that is compliant with the CubeSat standard. The base dimension is 10 cm x 10 cm x 10 cm (one “Unit” or “1U”). A 6U satellite is 10 cm x 20 cm x 30 cm and typically has a mass of 12 kg. The final mass is dependent upon the selected launch dispenser.
  - No U-Class form factors larger than 6U will be considered under the present call.
  - Up to two U-Class satellites may be proposed in any combination of 1U, 2U, 3U and 6U-Class satellites, including two 6U-Class satellites.
  - Due to cost constraints, no more than one investigation proposing two 6U-Class satellites will be selected in this call. Additionally, it is anticipated that one or two single U-Class satellite awards will be made, depending on the size and cost.
  - Proposals including more than one U-Class satellite will only be considered relevant if a strong justification is made that multiple satellites are required to validate the technology, measurement technique or concept – which must itself be demonstrated to be of high scientific value and relevance.
- This program element does not invite proposals that primarily advance and validate bus or spacecraft technologies. Only instruments, instrument subsystems, onboard processing, autonomy or other relevant information system technologies that can advance the technology to enable relevant Earth science measurements will be accepted.
- Only proposals to validate complete subsystems will be accepted. Complete subsystems shall have a well-defined interface to the spacecraft bus.
  - Proposer’s instrument subsystems, small instruments, or any relevant Advanced Information Systems Technology (AIST) to be validated must be at a minimum TRL of 5, or a maximum TRL of 6, at the time of proposal submission to the
InVEST program. Proposers must clearly provide evidence of the claimed entry TRL of the subsystem, instrument and/or measurement technique proposed for the technology validation.

- No funding will be provided for new technology development or miniaturization of technology under these awards. The intent of this program element is only technology maturation through on-orbit validation. Funds are for form/fit/function to the spaceflight environment, launch, operations and post-flight evaluation of the demonstration only.
- Spacecraft bus technologies are excluded.
- Airborne, balloon or sounding rocket flight validations are excluded from this program element. Selected technologies and measurement concepts will only be those that require validation in space for several months not to exceed one year.

Proposers should review APPENDIX 1 InVEST Project Development Guidelines.

1.2.2 InVEST Launch Opportunities

For access to space, it is highly recommended that proposers submit a proposal to the Annual NASA CubeSat Launch Initiative: see: https://www.nasa.gov/content/announcement-of-opportunity-for-cubesat-launch-initiative

Non-CSLI options for gaining access to space may be proposed, however there must be a compelling reason for not pursing the CSLI opportunity.

An example of general compliance of the proposed 1U to 6U satellite(s), with the launch opportunity, can be found in the LSP Requirements Document (see: “Launch Services Program, Program Level Dispenser and CubeSat Requirements Document (LSP-Req-317.01).”). Several launch options are possible with CSLI including NASA procured ELV, other US government entity procured ELV, Commercial ELV (includes VCLS), and NASA Cargo Resupply Services (CRS) (ISS deploy and external CRS delivery vehicle deploy, post undock). Each launch opportunity will have specific guidelines to follow after launch manifest is established. The LSP-Req-317.01 guide does not currently address the specific configuration requirements for a 6U form factor U-Class satellite. Upon selection investigations must work closely with the CSLI team to define the interface requirements to ensure the proposed satellite will be compatible with the 1U, 2U, 3U or 6U standard that KSC/LSP adopts.

1.3 Background and Program Element Justification

The following documents identify the relevant missions, measurements and programs for this program element:


- **Earth Science and Applications from Space: A Midterm Assessment of NASA’s Implementation of the Decadal Survey** may be accessed on the web at http://www.nap.edu/catalog/13405.html. This report is hereafter referred to as the "Midterm Assessment."
New technologies play a key role in enabling many of the measurements recommended in the Decadal Surveys and the Climate-Centric Architecture and helping to reduce the cost of other measurements. This InVEST Program program element will facilitate the implementation of the recommended measurements by carefully choosing where to invest in flight validation of systems, including other relevant information system technologies, and small instruments using U-Class satellites to ensure the greatest benefit from NASA’s technology development funds.

1.4 Proposal Research Topics

The Decadal Survey and Climate-Centric Architecture recommend an integrated strategy for Earth science and applications from space. This InVEST Program program element focuses on flight validation of subsystems, small instruments, measurement techniques and concepts, and other relevant information system technologies to enable Earth science measurements that are included in the Decadal Survey and Climate-Centric Architecture studies. The measurements called out in these two documents include such things as radiation balance; soil moisture; ice sheet height; surface deformation; vegetation structure; land surface composition; carbon dioxide column integrals; ocean, lake, and river water levels; atmospheric gas columns; ocean color; aerosol and cloud profiles; land surface topography, temperature and humidity sounding; gravity fields; snow accumulation; ozone and trace gas profiles; and tropospheric winds. This list is illustrative only; proposers should refer to the Decadal Survey and Climate-Centric Architecture for clarification of the exact measurements desired. In addition, the midterm assessment of NASA’s implementation of the decadal survey identifies recommendations to NASA in implementing Decadal Survey priorities. One of those recommendations is to seek "alternative" remote sensing platforms and observing strategies that are emerging and being proven. These include but are not limited to small satellites, such as U-Class, and the flight of multiple sensor(s) in formation rather than on a single bus. These alternative mission concepts can offer considerable mission flexibility. This InVEST program element welcomes the demonstration of alternative measurement concepts that can offer flexibility in implementing future Earth science measurements.

Priority will be given to those proposals that most clearly address technology validation for one or more of these science measurements and their associated missions.

2. Programmatic Information

The required proposal contents follow the format prescribed in Section 3 of the NASA Guidebook for Proposers Responding to a NASA Funding Announcement (hereinafter "The Guidebook" except where superseded by this program element, see below. The most recent edition of this Guidebook may be accessed on the web at https://www.hq.nasa.gov/office/procurement/nraguidebook/.
This section provides additional details governing the proposed activities that supersede the general guidelines announced in *The Guidebook*.

2.1 Proposal Content and Submission

2.1.1 Notice of Intent to Propose

A Notice of Intent (NOI) to propose is encouraged, but not required, for submission of proposals to this program element. The information contained in the NOI is used to help expedite the proposal review activities and, therefore, is of considerable value to both NASA and the proposer. We request that NOIs be submitted electronically via NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) by the due date given in Section 3.

2.1.2 Questions and Answers

Prospective proposers are requested to submit any questions in writing to sachidananda.r.babu@nasa.gov no later than 30 days before the proposal due date. Questions and answers will be posted in a Frequently Asked Question (FAQ) on the NSPIRES page for this program element under "other documents". It is the proposer's responsibility to check the NSPIRES page for this program element for possible updates to any FAQ document or clarifications to the program element. Proposers who subscribe to the SMD email distribution list in NSPIRES will receive an email if this program element is amended.

2.1.3 Proposal Content and Formatting

2.1.3.1 Proposal Summary

The NSPIRES web page requires proposers to fill in a text box with a proposal summary of no more than 4000 characters. The proposal summary shall include: (a) objectives and benefits; (b) an outline of the proposed work and methodology; (c) the period of performance; and (d) entry and planned exit TRL.

2.1.3.2 Scientific/Technical/Management Section

This section completely has unique additional requirements that differ from Section 3 of *The Guidebook*.

The Scientific/Technical/Management Section, or Project Description, must include the following content information in subsections that use the same titles. Failure to provide any of this material may be cause for the proposal being judged as noncompliant and returned without further review.

The Project Description shall be limited to 15 non-reduced, single-spaced typewritten pages. Standard proposal style formats shall be in accordance with Section IV(b)ii of the ROSES Summary of Solicitation and 3.6 of *The Guidebook*. Proposals that exceed the 15-page limit or violate any formatting rules may be returned without review.

1. **Applicability to Earth Science Measurements** – Describe the benefits to future Earth Science missions or measurements that could utilize the technology proposed for flight validation. Proposers shall include a one-page relevancy scenario showing how the proposed technology and flight validation
contributes to one or more Earth Science measurements. Proposals that fail to include a relevancy scenario may be considered noncompliant and will be returned without review.

2. **Description of Proposed Technology and Flight Validation** – Provide a justification for why this particular technology or science measurement approach requires space flight validation. Describe the subsystem, or instrument to be flown, including spacecraft accommodation. Provide estimates of the mass, power, and data rate for the proposed subsystem or instrument.

3. **Launch and Operations Plan** - Technologies must be ready for launch within two years of award. Once on-orbit, the maximum time for validation of the technology should be one year or less. No science measurement is required; however, a demonstration of a science measurement is permitted if it is needed to validate the technology.

Since these awards will be limited to only in-space validation, proposers must clearly describe their approach for access to space (e.g. dedicated launch, secondary payload, CSLI, non–CSLI, etc.) as well as the orbit required. A description of the success criteria for flight validation and how they will be evaluated is required. This information will be evaluated for realism (technical, schedule and cost). It is understood that an exact launch date will not necessarily be known at the time of proposal submission. However, details regarding the exact procedures, processes and steps that will be required to be ready for launch in two years after award initiation must be provided in the proposal. Proposers must describe the contingency plan for the spacecraft between the period after which the build is completed and when the launch provider is willing to accept delivery of the spacecraft.

4. **Comparative Technology Assessment** – Describe the anticipated advantages of the technology to be flight validated compared to those currently in use - e.g., reduction of size, mass, power, volume or cost, improved performance, or enabling of a new capability not previously possible. Reference the current state of the art and relate it to the proposed work.

5. **TRL Assessment** – Define the starting point for the instrument technology or measurement technique and the exit or success criteria for the proposed activity. The TRL shall advance by at least one level during the period of performance of the activity. For this program element, the entry TRL shall be between 5 and 6. TRL definitions can be found at [http://esto.nasa.gov/files/TRL.pdf](http://esto.nasa.gov/files/TRL.pdf). The proposer shall identify the entry TRL, the planned exit TRL, and success criteria in their proposal. The proposer shall substantiate the entry TRL in the proposal. Proposals that fail to include and substantiate the entry TRL may be considered noncompliant and may be returned without review.

6. **Research Management Plan** – Provide a statement of work that concisely describes each task and milestone to be accomplished in the course of the flight validation project. Define the success criteria associated with each task or milestone. Also include a schedule chart that identifies critical milestones.
The schedule should indicate any dependencies, a critical path and margins, and must be consistent with the proposed budget. A sufficient number of milestones per twelve-month period must be defined to ensure understanding of the effort for the performance period.

Subcontracting portions of the research project is acceptable, but overall management and reporting are the responsibility of the proposing organization.

7. **Facilities and Equipment** – Describe significant facilities and equipment required to complete the work. Before requesting funding to purchase a major item of capital equipment, the proposer should determine if sharing or loan of equipment already available within the proposing organization is a feasible alternative.

8. **Special Matters** – Include a brief description of the organization, its facilities, and previous work experience in the field of the proposal.

9. **Quad Chart** – Proposers shall also provide a summary chart (Quad Chart) that contains the following information. This quad chart is not included in the overall page count.

   - **Upper Left Quadrant:** "Description and Objectives"
   - **Lower Left Quadrant:** "Approach" and "Co-Is/Partners"
   - **Upper Right Quadrant:** visual, graphic, or other pertinent information
   - **Lower Right Quadrant:** "Milestone Schedule" and "Entry TRL."

Proposers are required to update the Quad Chart at least annually and more often, if appropriate. A template is available in the ESTO ERS under "Information" and "File Templates" or the template and example of the quad chart can be downloaded from [http://esto.nasa.gov/files/EntryQuad_instructions_template.ppt](http://esto.nasa.gov/files/EntryQuad_instructions_template.ppt)

Proposers will provide an initial TRL assessment, and the basis for that assessment, within the critical technology developments of the activity.

2.1.4 **Proposal Submission**

Proposals shall be submitted electronically via NSPIRES using the procedures described in Chapter 4 of the *NASA Guidebook for Proposers* or via Grants.gov using the funding opportunity number provided in Section 3, the summary table of key information. Proposals submitted after the due date will not be evaluated or selected.

2.2 **Award Information**

2.2.1 **Funding**

The Government’s obligation to make award(s) is contingent upon both the availability of new appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this program element. No additional funds beyond the negotiated award value will be available. NASA does not allow for payment of profit under grant awards and fees are restricted, see [http://science.nasa.gov/researchers/sara/faqs/](http://science.nasa.gov/researchers/sara/faqs/) for further information.
The funding available for this program element will limit the number and magnitude of the proposals awarded. Based on the availability of funding, the ESTO expects that a total of 2 to 3 proposals will be selected. The ESTO anticipates total InVEST program funding of approximately $5 Million in year one and up to $7 Million in years two and three, to be spread over four fiscal years. Any reserves (schedule and funding) must be expressly noted and will be evaluated in the context of the complete proposal.

2.2.2 Period of Performance

The minimum period of performance is 12 months. The total proposed period of performance must not exceed 36 months (subject to launch availability). Grants may be awarded for up to a three-year performance period. Annual reviews will be held, see Section 2.4.4 Annual Review. Proposals must define clear, measurable milestones to be achieved for each year of performance in order to warrant continuation in the second and third years.

2.2.3 Type of Award

All selected proposals will result in the award of grants, cooperative agreements, or intra- or inter-Government transfers, as appropriate. Contracts are specifically excluded as an award vehicle for this program element. Grants and cooperative agreements will be subject to the provisions in accordance with 2 CFR Part 200 and the Grants and Cooperative Agreement Manual (GCAM). For a commercial organization to receive a cooperative agreement, cost sharing (equal to 50% of the total) is required if the project has commercial applications and profit generating potential. Proposals from commercial organizations for cooperative agreements that do not include cost sharing must demonstrate that potential commercially marketable products are not expected to result from the project. (see the Grants and Cooperative Agreement Manual (GCAM) 5.6 Funding and 14 CFR §1274.102 (c) 4 and 14 CFR §1274.204, "Costs and Payments" (b) Cost sharing). If a cost sharing arrangement is proposed, appropriate data rights that recognize the proposer’s contributions, as well as the Government’s rights to access, will be negotiated prior to award.

2.3 Evaluation Criteria

Evaluation criteria are given in Appendix D of the NASA Guidebook for Proposers and Section VI(a) of the ROSES Summary of Solicitation, which specifies that for ROSES relevance is determined by the text of this program element.

The first criterion, relevance, includes the applicability of the proposed investigation for in-orbit technology validation needs in support of Earth Science measurements. In addition, the evaluation criterion "relevance" specifically includes the following factors:

- The proposal’s potential to enable new measurements which are part of the NASA Earth Science needs;
• The potential for the subsystem, instrument technology, onboard processing or other relevant information system technology development to reduce the risk, cost, size, and development time of Earth science instruments or to enable new Earth science measurements. Potential cost reductions should be clearly stated and substantiated to the extent possible, with supporting analysis that indicates scalability;
• The potential of the subsystem, instrument, onboard processing or other relevant information system technology to be integrated, once matured, into future NASA Earth Science missions;
• The potential for the technology to have commercial benefits that pertain directly to Earth Science.

In addition to the factors given in the NASA Guidebook for Proposers, the second evaluation criterion "intrinsic merit" specifically includes the following factors:

• Feasibility and merit of the proposed technical approach to achieve the technology validation objectives;
• Feasibility and technical merit of the proposed acquisition of launch services; Compatibility with proposed launch services;
• Justification for not using CSLI services if applicable;
• Degree of innovation of the proposed technology validation concepts and approach;
• Feasibility of obtaining the potential reduction in risk, cost, size, and development time, or making the newly enabled measurement, with the proposed sensor(s) or instrument(s); and feasibility of making a demonstrable TRL increase. The TRL must advance by at least one (1) level during the performance period of the project;
• Substantiated justification and appropriateness of the entry and exit TRL. For this program element, the entry TRL is constrained to be 5 or 6, with the exit TRL no higher than 7; NASA’s Technology Readiness Level (TRL) is an ordinal classification system that allows comparison of the degree of maturity of technologies under development. TRLs range from 1 to 9 (see Section 2.1.3.2, for a link to TRL definitions document), and indicate completion of increasingly demanding proof-of-performance criteria at various stages of a technology development.
• Qualifications of key personnel and adequacy of facilities, staff, and equipment to support the proposed activity. This factor includes evaluation to ensure that the team has strong subsystem and instrument development skills; and
• Past performance and related experience in the proposed area of technology development.

In addition to the factors given in the NASA Guidebook for Proposers, the third evaluation criterion, "cost", specifically includes the following factors:

• Adequacy and realism of proposed milestones and associated success criteria;
• Adequacy and realism of proposed acquisition of launch services;
• Adherence to sound and consistent management practices appropriate to the TRL of the proposed task;
• Commitment of the organization’s management to the proposed technology development. Proposers should identify any previous investment by the organization that bears directly on the proposed project and provide supporting documentation.

Assessment of the comparison of proposed costs to available funds will be performed by NASA program personnel and is not part of the peer review process.

Cost sharing is not part of the cost criteria but cost sharing may become a factor at the time of selection when deciding between proposals of otherwise equal scientific and technical merit.

2.4. Technical Reporting Requirements

Once awarded, submit all status information, presentation material, and report deliverables applicable to the InVEST program to the web-based ESTO Reporting System (ERS). A user account on the ERS will be provided to the PI upon award. Due to NASA IT security requirements, all PIs must register with the Identity Management and Account Exchange (IdMAX) system before a user account on ERS will be established. To create an IdMAX account, some personal information will be required.

The following deliverables are required of awarded proposals. In cases where subcontract arrangements exist, consolidated project reports are the responsibility of the PI. The proposed budget should provide for these reporting requirements. In this context, "Annual" refers to a twelve-month task effort that commences at award.

2.4.1 Initial Plans and Reports

Within 15 days of award, provide an updated Project Plan, initial Quad Chart, and initial TRL assessment. Also, provide a monthly cost plan for the entire period of performance. The project plan, initial (entry) Quad Chart, cost plan, and initial TRL assessment (and supporting data) should be created in the ERS.

The project plan shall identify plans for all technical, schedule, and resource activities for the proposed life of the project.

The Quad Chart should contain the following information:
  • Upper Left Quadrant: "Objective"
  • Lower Left Quadrant: "Approach" and "Co-Is/Partners"
  • Upper Right Quadrant: A visual, graphic, or other pertinent information
  • Lower Right Quadrant: "Key Milestones" and "TRLin."

Proposers are required to update the Quad Chart and TRL assessment at least annually and more often, if appropriate. This can be done on the ERS under the "Quad Chart" section and "TRL" section respectively.
2.4.2 Bimonthly Technical Reports

The bimonthly technical report shall focus on the preceding two months’ efforts. Each report shall address:

1. Technical status: Summarize accomplishments for the preceding two months, including technical accomplishments (trade study results, requirements analysis, design, etc.), technology development results, and results of tests and/or demonstrations.

2. Schedule status: Address the status of major tasks and the variance between planned versus actual schedule, including tasks completed, tasks in process, tasks expected to complete later than planned, and tasks that are delayed in starting, with rationale for each and recovery plans, as appropriate.

Upload the Bimonthly Technical Reports to the appropriate location in the ERS at two-month intervals, starting on the second-month anniversary date of the start date specified in the award vehicle. In months for which the PI is providing interim or annual review, the requirement for a bimonthly report is superseded by the interim or annual review requirements discussed in the next two sections.

Reports may be submitted in PDF, Microsoft Word, or Microsoft PowerPoint compatible file formats by the required due date, or by close of business of the first workday following the due date if the due date falls on a weekend or a holiday. A teleconference or brief meeting may be conducted between the ESTO and the PI to review and discuss each report.

2.4.3 Interim Reviews

An Interim Review occurs at the end of the first six-month calendar period commencing from the date of award and at twelve-month intervals thereafter. The PI must provide a presentation summarizing the work accomplished and results leading up to this Interim Review and must:

1. Describe the primary findings, technology development results, and technical status, e.g., status of design, construction of breadboards or prototype implementations, results of tests and/or proof-of-concept demonstrations, etc.;

2. Describe the work planned for the remainder of the project and critical issues that need to be resolved to successfully complete the remaining planned work;

3. Summarize the cost and schedule status of the project, including any schedule slippage/acceleration. Create and maintain a schedule milestone chart of all major task activities and show at all reviews. Also, create and maintain a cost data sheet that shows total project costs obligated and costed, along with a graphical representation of the project cost profile to completion;

4. Provide a summary of anticipated results at the end of the task; and

5. At the second review and subsequent reviews, address the comments and recommendations prepared by the reviewers participating in the most recent review.

The Interim Review will be conducted via teleconference. Presentation slides shall be uploaded to the appropriate location in the ERS at least three (3) working days prior to the review. Following the review, the presentation, updated in accordance with
comments and discussion resulting from the review, shall be uploaded to the appropriate location in the ERS within ten days after the review.

2.4.4 Annual Review

An Annual Review occurs at the end of each twelve-month calendar period commencing from the date of award. The Annual Reviews are similar to the Interim Reviews and include all of the products required at an Interim Review with the following exceptions:

1. The review is held at the PI’s facility or a mutually agreed location.
2. An independent technical reviewer from an organization separately funded by ESTO may participate in the review.
3. The PI may provide a laboratory demonstration, if appropriate, to show technical results and status.
4. Report any educational and outreach components of the project, e.g., graduate degrees, educational activities; technology infusion, or patents applied for or granted; journal or conference publications; presentations at professional conferences, seminars and symposia; demonstrations; media exposure; and, other activities that contributed to the overall success of the research project.
5. The Annual Review should be comprehensive and should include a discussion of the planned content of the written report.

Upload the review package to the appropriate location in the ERS at least three (3) working days prior to the review. The presentation, updated in accordance with comments and discussion resulting from the review shall be uploaded to the appropriate location in the ERS within ten days after the review.

2.4.5 Final Review and Final Report

The Final Review occurs at the completion of the activity. The Final Review is similar to the Annual Reviews and includes all of the products required at an Annual Review. In addition, the final review must provide conclusions of the work performed and make recommendations for follow-on activities that should be pursued, with estimates of the cost and schedule to advance the TRL to the next level.

Include the following in the written Final Report:

1. Background of the project, including the science rationale for conducting this technology development;
2. Results of all analyses, element, subsystem, or system designs, breadboards, and/or prototyping implementations and designs;
3. Performance analysis results of tests and/or demonstrations; estimation of reduction(s) in size, mass, power, volume and/or cost; improved performance; description of newly enabled capability; and documentation of technology dependencies;
4. Tables, graphs, diagrams, curves, sketches, photographs, and drawings in sufficient detail to comprehensively explain the results achieved;
5. An updated TRL assessment, including a rough order of magnitude cost estimate, as well as a description and estimate of the duration of the follow-on activities necessary to advance the TRL to the next level; and
6. At the end of the period of performance, the PI shall provide a final Accomplishments Chart which contains the following information (a template is available in the ERS):
   - Upper Left: "Objectives."
   - Upper Right: A visual, graphic, or other pertinent information.
   - Middle: "Accomplishments."
   - Bottom: "Co-Is/Partners" (name and affiliation), "TRLin," and "TRLout."

The Final Report and updated Final Review presentation shall be uploaded to the appropriate locations in the ERS within thirty days of the final review. Also, update the Accomplishment Chart and TRL assessment on the ERS under the "Quad Chart" section and "TRL" section respectively.

3. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected total program budget for first year of all new awards</th>
<th>Up to $5M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected number of new awards pending adequate proposals of merit</td>
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</tr>
<tr>
<td>Maximum duration of awards</td>
<td>Minimum 1-year / Maximum 3-year awards (subject to launch availability)</td>
</tr>
<tr>
<td>Due Date for Notice of Intent to Propose (NOI)</td>
<td>2/02/18</td>
</tr>
<tr>
<td>Question and Answers</td>
<td>See Section 2.1.2</td>
</tr>
<tr>
<td>Due date for proposals</td>
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</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>9/15/18</td>
</tr>
<tr>
<td>Page length for the Science-Technical-Management section of proposal</td>
<td>15 pages; see also Chapter 3 of the NASA Guidebook for Proposers. See Section 2.1.3.2.</td>
</tr>
<tr>
<td>Relevance to NASA</td>
<td>This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this Program are, by definition, relevant to NASA. (See Section 1.3 of this program element.)</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>See the ROSES Summary of Solicitation and the Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted.</td>
</tr>
<tr>
<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or</td>
</tr>
<tr>
<td><strong>Web site for submission of proposals via Grants.gov</strong></td>
<td><strong>(202) 479-9376)</strong></td>
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<td>--------------------------------------------------------</td>
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<tr>
<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
<td><strong><a href="http://grants.gov">http://grants.gov</a></strong> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td><strong>NASA points of contact concerning this program</strong></td>
<td><strong>NNH17ZDA001N-INVEST</strong></td>
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<tr>
<td></td>
<td>Sachidananda R. Babu</td>
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<td></td>
<td>Science Mission Directorate,</td>
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<td></td>
<td>Earth Science Technology Office</td>
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<tr>
<td></td>
<td>Telephone: (301) 286-7304</td>
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<tr>
<td></td>
<td>Email: <a href="mailto:sachidananda.r.babu@nasa.gov">sachidananda.r.babu@nasa.gov</a></td>
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<td></td>
<td>and</td>
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<tr>
<td></td>
<td>Pamela Millar</td>
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<tr>
<td></td>
<td>Flight Validation Lead</td>
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<tr>
<td></td>
<td>InVEST Program Manager</td>
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<tr>
<td></td>
<td>NASA Earth Science Technology Office</td>
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<tr>
<td></td>
<td>Telephone: (301) 286-0016</td>
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<tr>
<td></td>
<td>Email: <a href="mailto:pamela.s.millar@nasa.gov">pamela.s.millar@nasa.gov</a></td>
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</tbody>
</table>
APPENDIX 1

InVEST Project Development Guidelines

To maximize the likelihood of successfully delivering the flight experiments to space the following guidelines are strongly recommended.

1. **Safety and Mission Assurance:**

Where practical appropriate SMA personnel should be part of the project team to ensure that all necessary and relevant institutional guidelines and best practices are followed to maximize mission success. As a technical and independent advisor and authority, SMA personnel can provide critical guidance to the PI team, as well as contractors supporting the development effort.

2. **Technical Personnel:**

Although InVEST projects are PI-led, the team should assign a project manager and project systems engineer to lead the day-to-day development activities from requirements definition through flight delivery, operations, validation data product generation, and documentation. These personnel should also have lead roles in all reviews and review preparation as called via the ESTO required reviews, self-imposed internal reviews, and reviews externally led by other organizations such as NASA LSP (launch services program) and/or others.

3. **Reviews:**

In addition to the ESTO required reviews, as good project practice and as may be required by the CSLI program (or others), the team should minimally hold a PDR (preliminary design review), CDR (critical design review), MRR (mission readiness review), and FRR (flight readiness review) as part of the project development lifecycle. Whenever possible, these reviews can be held in conjunction with, or in-lieu of, ESTO required reviews. A robust operational readiness plan, allowing for contingencies should anomalies arise on-orbit, should be in place and reviewed as part of the FRR to minimize additional future reviews.

4. **System Development:**

While ESTO does not impose any requirements on how systems must be developed it is highly recommended, when practical, that teams favor testing over analysis, develop a FlatSat and/or engineering model (EM) for ground-based analysis in addition to the flight model (FM), favor “buy” over “make” when considering “make vs. buy” decision making for critical components such as the flight system bus, radios, ADCS, and other relevant subsystems where a good commercial track record has been established. A good interface control document (ICD) owned and managed by both the team and key partners is essential.
5. Requirements Development:

There should be a clear distinction between threshold and baseline requirements that should drive all design trades and decision making. The team should also think carefully about the minimal launch profile that will satisfy the technology validation requirements as ease of access to space varies pending the destination.

6. Costing:

Costs must be managed continuously as part of the development lifecycle. While the PI may choose to apply a grass-roots, top-down, comparison against actuals from prior experience, or other method to develop an estimate it is strongly recommended that projects establish a standard WBS, with full-time equivalent (FTE) level of effort, to validate their costs. Note that WBS item #8 might not be fully covered should the team receive a manifest via the CSLI program as there may be additional expenses for larger flight systems. Also, WBS item #11 should be considered as models, animations, or other outreach products may need to be produced. There will invariably be launch delays and issues that arise during I&T that are unexpected so teams should protect against such issues as the costing profile is developed.

<table>
<thead>
<tr>
<th>WBS Element</th>
<th>WBS Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project Management</td>
</tr>
<tr>
<td>2</td>
<td>Systems Engineering</td>
</tr>
<tr>
<td>3</td>
<td>Safety and Mission Assurance</td>
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<tr>
<td>4</td>
<td>Science/Technology</td>
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<tr>
<td>5</td>
<td>Payload(s)</td>
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<tr>
<td>6</td>
<td>Spacecraft</td>
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<td>7</td>
<td>Mission Operations</td>
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<td>8</td>
<td>Launch Vehicle Services</td>
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<tr>
<td>9</td>
<td>Ground Systems</td>
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<tr>
<td>10</td>
<td>Systems Integration and Testing</td>
</tr>
<tr>
<td>11</td>
<td>Education and Public Outreach</td>
</tr>
</tbody>
</table>

7. Regulations:

As part of the flight development the team will be guided through most regulatory issues by the auxiliary payload integration team and/or ESTO. Nevertheless, it is important to understand, know and accept which organizations are responsible for any actions taken by the team notwithstanding ITAR/EAR, CRADA, radio frequency issues, and so on. It is also essential to make decisions and address any regulatory issues early in the project lifecycle, such as planning for RF licenses to be approved no later than the FM delivery date.
8. **Communication:**

While there are standard times during the development lifecycle where project status must be communicated to ESTO the teams should reach out to ESTO immediately at any time the moment an issue of concern arises.
NOTICE: The Sustainable Land Imaging Technology (SLI-T) Program will not be competed in ROSES-2017. NASA expects to continue to solicit sustainable land imaging technology development through future SLI-T solicitations. The next opportunity is currently anticipated to be included in ROSES-2018.

1. Objectives
The Sustainable Land Imaging – Technology (SLI-T) program seeks proposals to develop and demonstrate new measurement technologies and architectures that improve upon the Nation’s current land imaging capabilities while also reducing the overall program cost for future SLI measurements in support of the Science Mission Directorate’s Earth Science Division. The SLI-T program seeks to:

- Reduce the risk, cost, size, volume, mass, and development time for the next generation SLI instruments, while still meeting or exceeding the current land imaging program capabilities.
- Enable new types of observations that improve the temporal, spatial and spectral resolution of SLI measurements.
- Enable new SLI measurements, and architectures, which can improve the program’s operational efficiency, and reduce the overall costs of the Nation’s land imaging capabilities.

The SLI-T program is envisioned to be flexible enough to accept new instruments, sensors, systems, components, architectures, data systems and measurement concepts that offer flexibility in implementing and enhancing future SLI measurements.

2. Program Description
The Sustainable Land Imaging – Technology (SLI-T) program funds innovative technology development activities leading to new Sustainable Land Imaging (SLI) instruments, sensors, systems, components, data systems, measurement concepts, and architectures in support of the nation’s future SLI activities. The technologies, measurement concepts, and architectures developed under the SLI-T may extend up through field demonstrations with a longer-term aim for infusion into future SLI flight programs.

3. Point of Contact for Further Information
Pamela Millar
Earth Science Technology Office
National Aeronautics and Space Administration
Washington, DC 20546
Telephone: (301) 286-0016
Email: Pamela.s.millar@nasa.gov
NOTICE: Amended on August 29, 2017. To give more time to proposers who are without power because of Hurricane Harvey, Notices of Intent to propose are now requested by September 14, 2017.

Amended on August 7, 2017. This amendment presents a new opportunity in program element A.51, the SAGE III/ISS Science Team. Notices of Intent to propose are requested by September 14, 2017 and proposals are due November 7, 2017.

1. Introduction

Atmospheric composition changes affect air quality, weather, climate, and critical constituents such as ozone. Atmospheric exchange links terrestrial and oceanic pools within the carbon cycle and other biogeochemical cycles. Solar radiation affects atmospheric chemistry and is thus a critical factor in atmospheric composition. Atmospheric composition is central to Earth system dynamics, since the atmosphere integrates surface emissions globally on time scales from weeks to years and couples several environmental issues.

NASA’s research for furthering our understanding of atmospheric composition is geared to providing an improved prognostic capability for key processes and issues such as the recovery of stratospheric ozone and its impacts on surface ultraviolet radiation, the evolution of greenhouse gases and their impacts on climate, and the evolution of tropospheric ozone and aerosols and their impacts on climate and air quality. Toward this end, research within the Atmospheric Composition Focus Area addresses the following science questions:

- How is atmospheric composition changing?
- What trends in atmospheric composition and solar radiation are driving global climate?
- How does atmospheric composition respond to and affect global environmental change?
- What are the effects of global atmospheric composition and climate changes on regional air quality?
- How will future changes in atmospheric composition affect ozone, climate, and global air quality?

Objectives of NASA’s Atmospheric Composition Focus Area include monitoring and assessing the coupled effects of changes in ozone depleting substance emissions and climate variations on ozone recovery and future atmospheric composition; enabling more accurate climate forecasts based on improved understanding of the forcings of global environmental change; and developing and refining better air quality forecasts that take into account the feedbacks between regional air quality and global climate variations. Achievements in these areas via advances in observations, data assimilation, and modeling enable improved descriptions and predictions of how changes in atmospheric composition affect ozone, climate, and air quality.
An integrated observational strategy involving global observations from space augmented by suborbital and ground-based measurements is key to NASA’s scientific approach to analyzing and predicting atmospheric composition. This integrated observational strategy is furthered via studies of atmospheric processes using unique suborbital platform-sensor combinations to investigate, for example: (1) the processes responsible for the emission, uptake, transport, and chemical transformation of ozone and precursor molecules associated with its production in the troposphere and its destruction in the stratosphere and (2) the formation, properties, and transport of aerosols in the Earth’s troposphere and stratosphere, as well as aerosol interaction with clouds. NASA’s research strategy for atmospheric composition encompasses an end-to-end approach for instrument design, data collection, analysis, interpretation, and prognostic studies.

2. Programmatic Information

The Stratospheric Aerosol and Gas Experiment III (SAGE III) was launched to the International Space Station (ISS) on 19 February 2017. The SAGE III instrument’s primary objective is to monitor the vertical distribution of aerosols, ozone, and other trace gases in the Earth’s stratosphere and troposphere to enhance our understanding of ozone recovery and climate change processes in the stratosphere and upper troposphere (https://sage.nasa.gov/missions/about-sage-iii-on-iss/). SAGE III/ISS will provide data necessary for:

- Assessing long-term, vertically resolved changes in upper atmospheric composition, e.g. ozone, aerosol, water vapor, and temperature;
- Identifying and modeling geophysical variability influencing the distributions of ozone and other atmospheric constituents, such as the quasi-biennial oscillation, El Niño–Southern Oscillation, solar variability, and volcanic eruptions;
- Developing accurate, multi-source products that draw on the respective strengths of different techniques for measuring aerosols in the upper troposphere and stratosphere by integrating SAGE III aerosol observations with those of other space-based and/or surface or airborne sensors; and
- Generating spatial/temporal fields of key chemical species observed by SAGE III/ISS and using such fields for quantitative scientific study.

SAGE III is the third generation of solar occultation instruments operated by NASA. SAGE I was flown from 1979 through 1981 as a follow-up to the Stratospheric Aerosol Measurement (SAM) on the July 1975 Apollo-Soyuz mission. SAGE II, launched aboard the Earth Radiation Budget Satellite (ERBS), operated from 1984 through 2005. The first SAGE III instrument was launched in 2001 on a Russian satellite, Meteor-3M, and provided data through 2005 (https://eosweb.larc.nasa.gov/project/sage3/sage3_table). For the current SAGE III mission, the ISS inclined orbit of 51.6° is ideal because the orbit permits solar occultation measurement coverage everywhere between approximately 70° N and 70° S latitudes. In addition to solar occultation measurements, SAGE III/ISS, in common with SAGE III/Meteor-3M, is making measurements using both lunar occultation and limb scattering measurement techniques.
Following its launch in February 2017, SAGE III/ISS has been undergoing on-orbit commissioning, performance characterization, and initial calibration. Initial release of well-calibrated and –characterized geophysical data from SAGE III/ISS will occur no later than the end of calendar year 2017. After the initial data release, ongoing measurements will be provided with minimal lag.

The SAGE III/ISS instrument and processing are quite similar to those of SAGE III/Meteor-3M. With the exception of the experimental cloud presence profile product generated for SAGE III/Meteor-3M but not produced for SAGE III/ISS, the major SAGE III/ISS data products are the same as those for SAGE III/Meteor-3M and are expected to have quantitatively similar characteristics and accuracies as did products from the earlier Meteor-3M mission. For the purposes of proposals to this solicitation, Table 1 in the SAGE III/Meteor-3M Data Product User’s Guide (https://eosweb.larc.nasa.gov/sites/default/files/project/sage3/guide/Data_Product_User_Guide.pdf) can be used as a guide to the products that will be produced by SAGE III/ISS (excepting the cloud presence product, as noted above).

3. Research Themes

This program element seeks proposals for members of the SAGE III Science Team. Proposals are sought in the following topical areas, which are presented in no particular priority order. While NASA is soliciting proposals in all of the areas, it is not committing to funding proposals in each of these areas.

3.1 Independent validation

Continuous validation during the 3-year prime mission is essential for assessing the stability of the datasets. The project will rely on Network for the Detection of Atmospheric Composition Change (NDACC) sites for routine correlative measurements of ozone and aerosol vertical profiles using lidars (http://www.ndsc.ncep.noaa.gov/). Frost-point sonde measurements are expected to be used in water vapor validation, while National Institute of Water and Atmospheric Research (NIWA) (http://www.ndsc.ncep.noaa.gov/sites/stat_reps/lauder/) and Pandora ground based differential optical absorption spectroscopy (DOAS) (https://acd-ext.gsfc.nasa.gov/Projects/Pandora/index.html) measurements will be used for nitrogen dioxide validation.

Proposals are sought for activities that will complement those conducted by the project and contribute to the validation of the accuracy and precision of the SAGE III/ISS standard science products (see Table 1 in the SAGE III/Meteor-3M Data Product User’s Guide), particularly through the acquisition of correlative measurements. The scientific justification for such activities must be compelling and must quantitatively state how the work proposed will reduce uncertainty and/or deal with recognized limitations of current algorithms. Proposed validation activities may involve a single or multiple data products.

New field validation campaigns are not solicited. Proposers may make use of existing field-based observations.
3.2 Limb scatter retrieval algorithm development or adaptation

Proposals are sought that adapt proven algorithms or develop new algorithms for retrieving profiles of atmospheric constituents/parameters utilizing SAGE III/ISS limb scatter observations, e.g., ozone and wavelength-dependent aerosol scattering. Proposals should include a methodology for evaluating the validity of each retrieval product.

The proposed activities are expected to produce algorithms that will run on the SAGE III/ISS Science Computing Facility at the NASA Langley Atmospheric Science Data Center. The SAGE III/ISS project would be responsible for the implementation of the algorithm, performing routine production processing, and maintaining product distribution. The proposer would be responsible for the development of the algorithm, verifying and documenting its implementation and performance in an Algorithm Theoretical Basis Document (ATBD), and validating the retrieval products. The SAGE III/ISS project would maintain any codes developed.

3.3 Assessing long-term changes in atmospheric composition

Proposals are sought that identify and quantify trends in constituents and atmospheric variables where SAGE III/ISS observations can play a significant role; specifically, ozone, aerosol extinction, water vapor, and nitrogen dioxide. For decadal-scale trend detection, it is necessary to link the SAGE III/ISS measurements with earlier missions in a rigorous manner and to provide quantitative uncertainty estimates. Applicable missions include, but are not limited to, other solar occultation experiments (including the earlier SAGE missions), as well as limb-sounding profile, emission-based profile, and column-based measurements.

3.4 Aerosol and cloud studies

The 2014 NASA Atmospheric Composition Focus Area workshop on "Outstanding Questions in Atmospheric Composition, Chemistry, Dynamics and Radiation for the Coming Decade" (https://espo.nasa.gov/home/sites/default/files/documents/SMDWorkshop_report_final.docx) identified key findings and research recommendations with respect to stratospheric aerosol and cloud morphology and trends. Proposals are sought that address one or more of these research questions, focusing on aerosols, clouds, and/or their interactions, using SAGE III/ISS observations.

3.5 Data Analysis and modeling efforts using SAGE datasets

Proposals are sought that utilize SAGE III/ISS and possibly other satellite-derived profile measurements to advance Earth system modeling/prediction capability, create products to facilitate the analysis of noncoincident satellite occultation measurements, or that use SAGE III/ISS observations in chemical data assimilation studies.

3.6 Multi-sensor data product development

Proposals are sought that integrate data from SAGE III/ISS and other contemporary spaceborne platforms, as well as surface and airborne observations (as appropriate), to
develop and utilize self-consistent global products to investigate phenomena for which SAGE III/ISS observations, alone, are not sufficient (e.g., ozone diurnal variability, mesospheric ozone structure, aerosol speciation and single scattering albedo). The Committee on Earth Observation Satellites (CEOS) Earth Observation Handbook online database provides information on currently operating space-based measurement capabilities that could be used in these studies (http://database.eohandbook.com/measurements/overview.aspx); proposers must explicitly identify the non-SAGE III/ISS data products that they plan to use, and must present a realistic plan for obtaining any non-SAGE III/ISS data that is not available from the NASA EOSDIS.

4. Science Team

NASA is not planning to select a team lead.

All proposers should budget for one two-day annual meeting to be held on the East Coast of the United States each year (for costing purposes, assume that the meeting will take place in the Hampton, VA area).

5. Summary of Key Information

<p>| Expected program budget for first year of new awards | ~ $1.5M |
| Number of new awards pending adequate proposals of merit | ~8-10 |
| Maximum duration of awards | 3 years |
| Due date for Notice of Intent | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Due date for Proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Planning date for start of investigation | 6 months after proposal due date |
| Page limit for the central Science/Technical/Management section of proposal | 15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers. |
| Relevance to NASA | This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| General information and overview of this solicitation | See the ROSES Summary of Solicitation. |
| Detailed instructions for the preparation and submission of proposals | See the NASA Guidebook for Proposers at <a href="http://www.hq.nasa.gov/office/procurement/nraguidebook/">http://www.hq.nasa.gov/office/procurement/nraguidebook/</a>. |</p>
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<td>Web site for submission of proposal via NSPIRES</td>
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| NASA point of contact concerning this program         | Richard S. Eckman  
Earth Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: 202-358-2567  
Email: Richard.S.Eckman@nasa.gov |
NOTICE: Amended on August 29, 2017. To give more time to proposers who are without power because of Hurricane Harvey, Notices of Intent to propose are now requested by September 15, 2017.

Amended on August 8, 2017. This amendment creates a new opportunity in this program element, A.52, the CYGNSS Competed Science Team. Notices of Intent to propose are requested by September 15, 2017 and proposals are due November 8, 2017.

1. Background

The Cyclone Global Navigation Satellite System (CYGNSS) was successfully launched into low Earth orbit on 15 December 2016. CYGNSS consists of a constellation of eight satellites, each carrying a four-channel bistatic radar receiver that measures GPS signals scattered by the Earth’s surface. The common orbit plane of the constellation is inclined by 35 degrees from the equator, resulting in Earth coverage from 38 N to 38 S latitude. The satellites produce three primary science data products. A Level 1 product is the scattering cross section of the surface over both the ocean and land, with 10-15 km spatial resolution; a Level 2 product is the 10 m referenced neutral stability wind speed over the ocean, with 25 km spatial resolution; and a Level 3 product is a gridded version of the Level 2 winds, with 0.25 deg lat/lon resolution. In each case, temporal sampling is characterized by a median revisit time of 3 hours and a mean revisit time of 7 hours. Use of the GPS L1 navigation signal at 1575 MHz (19 cm wavelength) scattered from the ocean surface results in wind measurements that are largely insensitive to scattering or attenuation by intervening precipitation. Further details about the CYGNSS mission are available at http://cygnss-michigan.org. The CYGNSS level 1, 2 and 3 data are being archived at the Physical Oceanography Distributed Active Archive Center at the NASA Jet Propulsion Laboratory https://podaac.jpl.nasa.gov/CYGNSS. At the present time, the CYGNSS data are being released with a latency of approximately 6 days. Here, data latency is defined as the elapsed time from the downlink of raw data to the public availability of processed Level 2 data products.

2. Scope of Program

The CYGNSS mission was originally conceived to support improved sampling of ocean surface winds in tropical cyclones, by reducing the revisit time and lowering the sensitivity to precipitation relative to previous satellite-based wind observations, such as those from scatterometers. This ROSES element seeks to expand the utility of the CYGNSS measurements by demonstrating other scientific uses and end-user applications of the mission’s science data products; successful proposers will become members of the Competed CYGNSS Science Team.

This program element has eligibility requirements involving the type of data that may (and must) be used in the proposed activities and there are special requirements on
current CYGNSS science team members and proposers from federal agencies other than NASA. All proposers are strongly encouraged to carefully read Section 4 Eligibility and Evaluation Criteria.

Selected examples of research foci that are relevant to this call are provided in Section 3. Please note that this is not an exclusive list. As the amount of funding available for this opportunity is limited, it is unlikely that the set of proposals selected for funding will address all of the example areas listed in Section 3.

Proposals to develop retrieval methods based upon CYGNSS bistatic radar measurements must include:
- An assessment of retrieval uncertainty and the associated error budget; and
- Plans for the development of an algorithm theoretical basis document (ATBD) and an associated algorithm specification document to support the production of new Level 2 science data products (ATBD examples are provided at https://eospso.gsfc.nasa.gov/content/algorithm-theoretical-basis-documents);

Proposals relating to atmospheric and/or oceanographic scientific studies or applications must clearly address the unique contributions made possible by the improved spatial and temporal sampling of the CYGNSS constellation.

3. Example Research Areas

3.1 Quantitative Data Products and/or Analyses Focusing on Surface Wind and/or Air-Sea Interactions

This includes the development of expanded, new, or alternative atmospheric or surface products from the CYGNSS data (such as ocean surface vector wind estimates). Atmospheric or oceanographic studies related to these new products will also be considered. Even though the study of tropical cyclones is the focus of the original CYGNSS mission proposal, NASA will consider additional meritorious studies.

3.2 Physical Oceanography via Altimetry

The CYGNSS Level 1 measurements of scattering cross section also include metadata related to the timing of the signal propagation from the GPS transmitter to the Earth’s surface, and from the surface to the CYGNSS receiver. This timing information permits a modified type of ocean surface altimetry. The vertical accuracy of such an approach is significantly coarser than that of conventional satellite radar altimeters, but the temporal sampling and spatial coverage from the CYGNSS constellation are significantly better. The ability of such a bistatic radar to operate as an altimeter and map the sea surface height (SSH) of the ocean has also been demonstrated experimentally [Clarizia et al., 2016]. The improvement in spatial and temporal sampling properties provided by a CYGNSS-like constellation of altimeters is expected to enable investigations of mesoscale oceanic eddies [Ruffini et al., 2004]. Proposals to develop SSH retrieval methods applicable to the CYGNSS bistatic radar measurements are solicited. Proposals that carry out scientific investigations enabled by the improved spatial and temporal sampling of SSH using CYGNSS-derived altimetric data are also of interest.
3.3 Storm surge

Most numerical weather prediction and storm surge models use ocean surface wind data assimilation schemes developed to accommodate the sampling properties of wide swath, low-Earth orbiting instruments such as scatterometers. The sampling properties of the CYGNSS constellation are significantly different than those provided by these traditional low-Earth orbiting wind-measuring instruments. Data assimilation schemes adapted to, and optimized for, the unique spatial and temporal sampling characteristics of the CYGNSS constellation data are expected to be required in order to maximize the impact of CYGNSS data. In particular, storm surge modeling proposals which make best use of the unique spatial and temporal sampling properties of the CYGNSS ocean surface wind speed science data products are of interest.

3.4 Land Process Studies, Soil Moisture and Freeze/Thaw

Ground and airborne field campaigns have demonstrated the sensitivity of GPS-based bistatic radar measurements to sub-surface soil moisture [Katzberg et al., 2006]. More recently, spaceborne measurements by the TechDemoSat mission have also demonstrated sensitivity to soil moisture [Chew et al., 2016]. Significant differences between CYGNSS and previous soil moisture-sensing spaceborne missions include CYGNSS's high temporal sampling rate and the constellation's ability to resolve the complete diurnal cycle. Proposals that develop soil moisture retrieval methods applicable to the CYGNSS bistatic radar measurements are of interest.

The ability to sense the changes in the Earth's permafrost and the freeze/thaw patterns of seasonally frozen land are critical to understanding the Earth's climate system. The transition of the dielectric properties of the underlying soil from freeze to thaw state has been examined theoretically and demonstrated experimentally using GPS-based bistatic radar measurements [Cardellach et al., 2011]. Proposals that develop freeze/thaw detection methods applicable to the CYGNSS bistatic radar measurements are of interest.

3.5 References


Katzberg, S. J., Torres, O., Grant, M. S., & Masters, D. (2006). "Utilizing calibrated GPS reflected signals to estimate soil reflectivity and dielectric constant: Results from


4. Eligibility and Evaluation Criteria

The proposal must be focused on the use of CYGNSS data. The use of any other publically available satellite (US/ non-US) and in situ data that is relevant to the proposal is allowed. Studies that are not based on the use of on-orbit CYGNSS data products will be considered nonresponsive to this announcement and may be returned without review.

The only CYGNSS data that may be used for the proposed activities are those that are publicly available at or through the Physical Oceanography Distributed Active Archive Center at the NASA Jet Propulsion Laboratory https://podaac.jpl.nasa.gov/CYGNSS. Proposals that rely on data products that do not meet this public availability requirement will be considered nonresponsive and may be returned without review.

For all proposals from all categories of organizations, proposed projects that complement rather than duplicating work being done by the existing team may be given programmatic preference. A list of the current projects may be found at: http://clasp-research.engin.umich.edu/missions/cygnss/science-investigations.php.

Current CYGNSS science team members who propose to this ROSES element must explain how the proposed work is distinct from, and/or extends, activities included as part of the original CYGNSS mission proposal. Furthermore, in proposing to this announcement, current CYGNSS science team members should only use the CYGNSS data products that are publicly available to all potential proposers.

Employees of federal agencies other than NASA and their associated cooperating entities, must document clearly how the work proposed to NASA goes beyond the work that they would be doing for their present employer in the absence of any potential NASA support.

Consistent with Section VI(a) of the ROSES Summary of Solicitation, proposals will be evaluated on intrinsic merit, relevance, and cost. The evaluation of relevance will be based on the extent to which proposers would use CYGNSS data products for uses and applications that are consistent with the Earth science questions and goals in the NASA Science Plan.

5. Summary of Key Information

<p>| Expected annual program budget for new awards | ~ $2.0 M/year |
| Number of new awards pending adequate proposals of merit | ~ 14 |
| Maximum duration of awards | 3 years |</p>
<table>
<thead>
<tr>
<th>Due date for Notice of Intent to propose (NOI)</th>
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| NASA point of contact concerning this program | Ramesh K. Kakar  
Earth Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: (202) 358-0240  
Email: ramesh.k.kakar@nasa.gov |
APPENDIX B. HELIOPHYSICS RESEARCH PROGRAM

B.1 HELIOPHYSICS RESEARCH PROGRAM OVERVIEW

1. Overview

NASA’s heliophysics strategic objective is to understand the Sun and its interactions with the Earth and the solar system, including space weather. In this framework, the Heliophysics Research Program is guided by goals defined in the NASA 2014 Science Plan (available at https://science.nasa.gov/about-us/science-strategy) and the 2013 National Research Council Decadal Strategy for Solar and Space Physics report, Solar and Space Physics: A Science for a Technological Society (www.nap.edu/catalog.php?record_id=13060) and its purpose is to enable achieving these goals, which are:

1. Determine the origins of the Sun’s activity and predict the variations in the space environment;
2. Determine the dynamics and coupling of Earth’s magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs;
3. Determine the interaction of the Sun with the solar system and the interstellar medium;
4. Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.

The Heliophysics Research Program seeks to understand phenomena, on a broad range of spatial and temporal scales, the fundamental processes that drive them, how these processes combine to create space weather events, and to enable a capability for predicting future space weather events. In concert with the other NASA science divisions (Planetary Science, Astrophysics, and Earth Science), the program shares responsibility for learning about the Earth, our solar system, the universe, and their interrelationships.

The program supports investigations of the Sun, including processes taking place throughout the solar interior and atmosphere and the evolution and cyclic activity of the Sun. It supports investigations of the origin and behavior of the solar wind, transient structures, energetic particles, and magnetic fields in the heliosphere and their interaction with the Earth and other planets, as well as with the interstellar medium. The program supports investigations of the physics of magnetospheres, including fundamental interactions of plasmas and particles with fields and waves, and coupling to the solar wind and ionospheres. It supports the physics of the terrestrial mesosphere, thermosphere, ionosphere, including the coupling of these phenomena to the lower atmosphere and magnetosphere.

The program elements are as follows:

- B.2 Heliophysics Supporting Research (H-SR)
- B.3 Heliophysics Technology and Instrument Development for Science (H-TIDeS)
- B.4 Heliophysics Guest Investigators (H-GI/Open)
• B.5 Heliophysics Grand Challenges Research – Theory, Modeling and Simulations (H-GCR/TMS)
• B.6 Heliophysics Living With a Star Science (H-LWS)
• B.7 Heliophysics Data Environment Enhancements (H-DEE)
• B.8 Heliophysics Guest Investigators – Magnetospheric Multiscale (MMS) Opportunity (H-GI/MMS)
• B.9 Heliophysics Grand Challenges Research – Science Centers (H-GCR/SC)

It is the overall purpose of each of the program elements to contribute as effectively and directly as possible to the achievement of the NASA Heliophysics strategic objective. Priority for selection is given to those proposals that most clearly demonstrate the potential for such contributions.

1.1 Data Management
All proposals to Appendix B will have to address data management. For all programs, but B.7 H-DEE, proposers must present a data management plan (DMP), or an explanation of why one is not necessary given the nature of the work proposed, by responding to the compulsory NSPIRES cover page question about the DMP. The kinds of proposals that require a data management plan on the cover pages are described in the NASA Plan for increasing access to results of Federally funded research and in the Service and Advice for Research and Analysis (SARA) Frequently Asked Questions (FAQs) about Data Management Plans (DMPs). For proposers to B.7 H-DEE, the minimum DMP requirement is superseded by instructions in the program element that place more detailed descriptions into the body of the Scientific/Technical/Management section of proposals. See, Section 2 of B.7 H-DEE.

1.2 Data Eligibility
NASA spacecraft mission data to be used in proposed work must be available in the Solar Data Analysis Center (SDAC), Space Physics Data Facility (SPDF), or an equivalent, publicly accessible archive at least 30 days prior to the full proposal submission deadline, unless otherwise specified in the program call. This is applicable to ROSES-2017 Heliophysics elements B.2 (H-SR), B.4 (H-GI Open), B.6 (H-LWS), B.8 (H-GI/MMS), and B.9 (H-GCR/SC).

1.3 Two-Step Process and Duplication
Proposal submission to all elements in Heliophysics will continue using a two-step process, in which a Step-1 proposal is required. The title, science goals, and investigators cannot be changed between the Step-1 and Step-2 proposals. All Heliophysics programs will continue reviewing Step-1 proposals for compliance and will require a description that is limited to the 4000 character text box on the NSPIRES cover page that includes (1) the science goals and objectives, and (2) the proposed methodology. The Encourage/Discourage evaluation of Step-1 proposals will not be in effect in ROSES-2017. All compliant proposals submitted to these calls will be invited to submit a Step-2 proposal. Proposers to H-GI and H-SR are limited to one Step-1
proposal per Principal Investigator (PI) per program element, i.e., they can submit one and only one proposal as PI to each.

Proposers may not submit Step-2 proposals for the same or essentially the same work to more than one program element concurrently. This covers all program elements in Appendix B and also all cross-divisional ROSES program elements (Appendix E) supported by the Heliophysics Division. This prohibition is active for a particular submitted proposal until the PI is notified through NSPIRES that the proposal was declined or until the proposal is withdrawn. The prohibition on duplicate proposals applies across ROSES years as well (e.g., a duplicate of a pending ROSES-2016 proposal may not be submitted in response to ROSES-2017).

If a second proposal is submitted while a duplicate proposal is still pending in another program element, only the first proposal will be evaluated; the duplicate proposal may not be evaluated or considered and may be returned without review.

2. Recent Trends in Proposal Selection Rates

The Heliophysics research budget that supports analysis of Heliophysics System Observatory (HSO) data is competed through ROSES and continues to experience high demand through increased numbers of proposals submitted by the community. As a result, the success rate of proposals submitted to the ROSES portfolio that Heliophysics offers has declined (Figure 1) in the period of ROSES-2007 to ROSES-2013 and has stabilized since at a low level. A contributing cause of this trend is Heliophysics research funding not keeping up with inflation.

Figure 1 shows the selection rates over the ROSES years 2007-2015 and an initial estimate for ROSES-2016.
At the time of writing, complete data on submissions for ROSES-2016 is not available, but initial indications are that proposal submission numbers are not declining as compared to the rates seen in the ROSES-2013 through ROSES-2015 solicitations. Possible causes for continuing high submission rates are sustained success rates under 25% since ROSES-2010.

The Encourage/Discourage approach, i.e., peer review of three-page Step-1 proposals, for H-GI and H-SR program elements in ROSES-2014 and ROSES-2015 has been analyzed and found not to be as meaningful and effective as hoped for in identifying proposals with insufficient scientific merit. It, therefore, has been discontinued.

Figure 2 shows Step-1 and full proposals submitted by ROSES year along with selections, where available. In the bar chart, green indicates the awards, dark blue shows Step-2 proposals, and light blue shows the Step-1 proposals.

Beginning in ROSES-2016, the H-SR program scope has been expanded, requiring higher levels of commitment of the PI (or science lead) to funded projects than before with the goal of increasing the science return. This approach is continued in ROSES-2017. While it was observed that this larger scope led to a reduction of proposal submissions, due to a larger cost per proposal the H-SR success rate is expected to be slightly lower in ROSES-2016 than it was in ROSES-2015.

On a positive note, the outlook for success rates in ROSES-2017, which competes Fiscal Year 2018 funds, is expected to improve from the full implementation of the 2013 Decadal Survey "Diversify, Realize, Integrate, Venture, and Educate" (DRIVE) initiative. The Heliophysics Division is committed to strengthening the Heliophysics Research Program.

3. Program Elements

A brief description of each program element offered in the Heliophysics Research Program is given below. Note that the program elements underwent major restructuring between ROSES-2012 and ROSES-2013. The ROSES-2013 structure is generally maintained in ROSES-2017. Please note also that there are opportunities added this
The intent of the following summaries is to give the prospective proposer some insight into the element’s purpose within the context of the overall program structure. Detailed descriptions of each element are to be found in Program Elements B.2 through B.9.

**Heliophysics Supporting Research (H-SR):**

In order to increase the science return from funded investigations and to avoid duplication and overlap of proposal opportunities, in particular between H-GI and H-SR, a larger scope, introduced in ROSES-2016, will be maintained also in ROSES-2017. Heliophysics SR awards are research investigations that employ a variety of techniques, including theory, numerical simulation, modeling, analysis, and interpretation of space data. This increased scope of investigations must be of sufficient breadth as to require approximately one full time equivalent (FTE) per year to achieve successful completion of the project. As a result, the anticipated average award size has been increased, as well. The investigations that will be of highest priority to the H-SR program will be those that use data from current or historical NASA spacecraft, together with theory and/or numerical simulation to address one of the four Heliophysics Decadal Survey goals. Proposals focused on non-NASA data are now allowed. However, such proposals must demonstrate that the proposed work is necessary to make a significant contribution to addressing one or more Decadal Survey questions. Moreover, all data used must be in a publicly accessible archive at least 30 days before the Step-2 submission deadline.

H-SR supports investigations of the solar interior, solar photosphere, solar chromosphere, transition region, and corona; particle acceleration, transport, modulation in the heliosphere, heliospheric plasma processes, turbulence, waves, composition, interplanetary coronal mass ejections/magnetic clouds and of the outer heliosphere and the interstellar boundary; solar wind – magnetosphere coupling, dayside outer magnetosphere, inner magnetosphere, magnetosphere-ionosphere coupling and magnetotail; ionosphere – atmosphere coupling, neutral atmosphere and solar output-ionosphere/atmosphere coupling; and other planetary magnetospheres. The Heliophysics Supporting Research program is described in Program Element B.2.

**Heliophysics Technology and Instrument Development for Science (H-TIDeS):**

The H-TIDeS program solicits proposals for technology and instrument development investigations that are relevant to NASA scientific goals in Heliophysics. The H-TIDeS program seeks to investigate key Heliophysics science questions by addressing the best possible (i) science and/or technology investigations that can be carried out with instruments flown on suborbital sounding rockets, stratospheric balloons, International Space Station (ISS), CubeSats, or other flights of opportunity; (ii) state-of-the-art instrument technology development for instruments that may be proposed as candidate experiments for future space flight opportunities; and (iii) laboratory research.

The H-TIDeS program element has three separate components:

- Low Cost Access to Space (LCAS) investigations may be science investigations in and of themselves or proof-of-concept experiments for techniques/detectors that enable new Heliophysics science. LCAS includes rides on research balloons, sounding rockets, the
ISS, airborne platforms, commercial reusable suborbital rockets, CubeSats, and other flights of opportunity. LCAS investigations that launch into space in order to return scientific data are expected to make direct contributions to the science of Heliophysics.

Instrument and Technology Development (ITD) investigations have as their objective the development of instrument technologies that show promise for use in scientific investigations on future Heliophysics science missions, including the development of laboratory instrument prototypes, but not of flight hardware. Instrument development proposals are not necessarily expected to apply the results of their efforts to science questions within the time period of the proposed effort. They must, however, demonstrate that there is a (are) specific scientific problem(s), for which the development is a necessary precursor.

The Laboratory Nuclear, Atomic, and Plasma Physics (LNAPP) subelement supports studies that probe fundamental physical processes and produce chemical, spectroscopic, plasma, and nuclear measurements that support spacecraft measurements and atmospheric models.

The Heliophysics Technology and Instrument Development for Science program with subelements Low-Cost Access to Space (LCAS), Instrument and Technology Development (ITD), and Laboratory Nuclear, Atomic and Plasma Physics (LNAPP) are described in Program Element B.3.

**Heliophysics Guest Investigators (H-GI/OPEN and MMS-GI):**
The Heliophysics Guest Investigators (H-GI) program was strongly endorsed by the 2013 Decadal Survey. This program is offered for investigations that draw extensively upon the data sets from the missions of the Heliophysics System Observatory. The focus of the solicited research continuously evolves to ensure that the most important questions identified for recently launched Heliophysics missions are addressed and that high-value data products of currently operating missions of the HSO are created to enable significant advances in Heliophysics science. There are two distinct opportunities in ROSES-2017:

The Heliophysics Guest Investigators open program (H-GI/OPEN) is described in Program Element B.4. Proposals using Magnetosphere Multiscale (MMS) mission observations as primary emphasis are excluded from this program element.

The Heliophysics Guest Investigators MMS Special Opportunity (MMS-GI) is described in Program Element B.8. Proposals that focus on the analysis of MMS observations should be submitted to this Special Opportunity. The MMS observations were publicly released in early 2016, and the prime phase of the mission ends September 1, 2017.

**Heliophysics Grand Challenges Research (H-GCR/TMS and H-GCR/SC):**
Another program that was strongly supported in the Decadal Survey is the Heliophysics Grand Challenges Research program. As recommended, the goals of this program are specifically designed to support investigations of complex problems that fall within the general realm of Heliophysics and whose full resolution has remained elusive. Work on such problems has traditionally been carried out by independent research groups that employ observational, theoretical, and modeling-based approaches. Increasingly, major
advances in the field are taking place as a result of the close interactions among observers, theorists, and modelers. Thus, a coherent attack on the most challenging broad problems requires the efforts of a synergistically interacting group of multidisciplinary teams led by a single Principal Investigator, so as to enable deep and transformative science. The H-GCR program is open for proposals in ROSES-2017. One program element is planned: Heliophysics Science Centers (SC). The Theory, Modeling, and Simulations (TMS) element is not solicited in ROSES-2017 as it currently is fully subscribed. The Heliophysics Grand Challenges Research Science Centers program element (H-GCR/SC) will be offered for the first time as part of the ROSES-2017. The particulars of this program will be described in an amendment later in this ROSES year (see Program Element B.9).

**Heliophysics LWS Science (H-LWS):**
The goal of NASA’s Living With a Star (LWS) Program is to develop the scientific understanding needed to effectively address those aspects of Heliophysics science that affect life and society. To ensure this, the Heliophysics LWS Science program solicits proposals for Focus Teams which coordinate large-scale investigations that cross discipline and technique boundaries, leading to an understanding of the system linking the Sun to the Solar System both directly and via the heliosphere, planetary magnetospheres, and ionospheres. A primary goal of NASA’s LWS Program is the development of first-principles-based models for the coupled Sun-Earth and Sun-Solar System, similar in spirit to the first-principles models for the lower terrestrial atmosphere. Such models can act as tools for science investigations, as prototypes and test beds for prediction and specification capabilities, as frameworks for linking disparate data sets at vantage points throughout the Sun-Solar System, and as strategic planning aids to enable exploration of outer space and testing new mission concepts. The development of these models is generally conducted in terms of Strategic Capabilities, but this component of the LWS program will not be solicited in ROSES-2017. The details of the Living With a Star Science program for ROSES-2017 are described in Program Element B.6.

**Heliophysics Data Environment Enhancements (H-DEE):**
The goal of the H-DEE program is to enable breakthrough research in Heliophysics by providing both a state of the art data environment and necessary supporting infrastructure to maximize the scientific return of the NASA missions. It is essential that observations be properly recorded, analyzed, released to the general public, documented, and rapidly turned into scientific results. These studies are carried out in support of the Heliophysics strategic goals and subgoals in NASA’s 2014 Strategic Plan and Chapter 4.1 of the NASA 2014 Science Plan. The recommended priorities of the Heliophysics community are also discussed in the 2013 National Research Council Decadal Strategy for Solar and Space Physics report, Solar and Space Physics: A Science for a Technological Society. Note particularly the sections dealing with the "DRIVE" initiative, more specifically "R" and "I," and the discussion in Appendix B.
The H-DEE program encompasses the data environment needs throughout Heliophysics, including Solar, Heliospheric, and Geospace Sciences (Magnetosphere and Ionosphere/Thermosphere/Mesosphere [ITM]).

As part of a mission-oriented agency, the Heliophysics Research Program seeks to fund those efforts that directly impact NASA missions or interpretation of their data. Therefore, investigations that are judged to be more appropriate for submission to other Federal agencies, even if of considerable merit, will not be given high priority for funding through this solicitation. In turn, the "Infrastructure" subelement of the former "H-IDEE" program has been dropped.

Proposers should take into account the special needs driven by the increasing complexity of missions, the associated increasing complexity and volume of data, and the need for innovative and enabling technologies. For proposers to B.7 H-DEE there will be no NSPIRES cover page question about a data management plan. This is superseded by instructions in the program element that place more detailed descriptions into the body of the Scientific/Technical/ Management section of proposals. See Sections 2. of B.7 H-DEE.

The Heliophysics Data Environment Enhancement program is described in Program Element B.7.
**NOTICE:** Amended on September 21, 2017. The Step-2 proposal due date for this program has been delayed to October 12, 2017 to accommodate proposers affected by hurricane damage.

Clarified June 30, 2017. If there is a Science PI, the one-proposal per PI limit applies to the Science PI, not the person identified as PI by the organization for the purpose of administration.

In order to avoid duplication and overlap of proposal opportunities, in particular between Heliophysics Guest Investigators (H-GI) and Heliophysics Supporting Research (H-SR), the H-SR program continues to solicit investigations with a larger scope than H-GI.

Proposals to this program will continue to be taken by the two-step process in which a Step-1 proposal, submitted by an Authorized Organizational Representative (AOR) is required. See Section 3 for details.

Check for NASA spacecraft mission data compliance as specified in the overview B.1.

1. **Scope of Program**

Heliophysics Supporting Research (SR) awards are research investigations of significant magnitude that employ a combination of scientific techniques. These must include an element of (a) theory, numerical simulation, or modeling, and an element of (b) data analysis and interpretation of NASA-spacecraft observations.

Proposing teams must demonstrate the expertise necessary to cover the combination of techniques required. Awards are expected to be in the range of approximately $200K per year – $250K per year. The Heliophysics Supporting Research program is a component of the Heliophysics Research Program and proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in Appendix B.1 of this ROSES NASA Research Announcement.

1.1 **Overview**


Science investigations are solicited with this Heliophysics SR program. These must include an element of a) theory, numerical simulation, or modeling, and an element of b) data analysis and interpretation of current or historical NASA-spacecraft observations,
and should address one of the four Heliophysics Decadal Survey goals (listed below). Theory/modeling/simulation proposals must be substantiated with and guided by data. It is expected that proposing teams will be composed of investigators that cover the necessary expertise that the combination of techniques requires. Innovative ideas and techniques are welcome.

The four high level science goals from the Heliophysics Decadal survey (Solar and Space Physics: A Science for a Technological Society www.nap.edu/catalog.php?record_id=13060) are:

1. Determine the origins of the Sun’s activity and predict the variations in the space environment;
2. Determine the dynamics and coupling of Earth’s magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs;
3. Determine the interaction of the Sun with the solar system and the interstellar medium;
4. Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.

1.2 Data Usage

Proposals with a major focus on analyzing non-NASA data, but that still include a required substantial NASA data analysis and/or interpretation aspect, must demonstrate that the proposed work is necessary to make a significant contribution to addressing one or more Decadal Survey questions.

All data, whether of NASA or non-NASA origin, must be available in a public archive 30 days prior to the Step-2 (full-proposal) deadline. Proposals that do not contain a substantial NASA data analysis and/or interpretation aspect or that use data that is not archived 30 days prior to the full-proposal deadline will be declared noncompliant and may be returned without review. Proposals for projects that aim to produce (e.g., combined non-NASA and NASA-) data products should explain how those products would be made publicly available through a data management plan.

1.3 Organizing Science Areas

The Heliophysics Supporting Research program has established four broad categories and 13 science areas for the purpose of organizing the evaluation and peer review. The four categories mirroring the four subdisciplines of Heliophysics are Sun, Heliosphere, Magnetosphere, and Ionosphere-Thermosphere-Mesosphere (ITM). The 13 science areas are listed below; some of these science areas fit within more than one broad category. Each proposal must choose one of the four broad categories and one of the 13 science areas.

1. Solar Interior
2. Solar Transient Events
3. Solar Atmosphere
4. Particle Acceleration, Transport, Modulation in the Heliosphere
5. Heliospheric Plasma Processes, Turbulence, Waves, Composition
6. Interplanetary Coronal Mass Ejections / Magnetic Clouds
7. Outer Heliosphere and the Interstellar Boundary
8. Solar Wind – Magnetosphere Coupling
9. Inner Magnetosphere
10. Magnetosphere – Ionosphere Coupling / Magnetotail
11. Ionosphere – Atmosphere Coupling
12. Neutral Atmosphere
13. Solar Output – Ionosphere/Atmosphere Coupling

System science proposals that touch on more than one of these science areas are encouraged; for the purpose of organizing the review, investigators should choose the one that is most relevant. Proposals addressing the magnetospheres or the ionospheres of other planets are permitted, but must not duplicate proposals sent to other programs.

Note: Do not choose Heliosphere meaning Heliophysics; they are not synonymous. This wastes time and resources to redirect; such misdirected proposals may be returned without review.

2. Submission and Evaluation Guidelines

2.1 General Considerations [Clarified June 30, 2017]

Each Principal Investigator (PI), or the Science PI, if applicable, is allowed to submit one and only one Step-1 proposal to this program element. The expectation is that the Principal Investigator (or science lead) will invest a substantial portion of their time, of the order of 30%, to the investigation. The scope and necessary tasks of the investigation must be of sufficient breadth that, in order to achieve successful completion of the project, on the order of an entire full-time equivalent (FTE) per year would be required. Within the proposing team, the PI and Co-Investigators (Co-Is) must each have specific and defined tasks in the project, and the tasks must be essential to the completion of the project. Use of Collaborators is discouraged. Proposals may be declared noncompliant based on either the Step-1 or Step-2 proposal if they are outside the scope of the H-SR program (see Section 2.2 below) or if they fail to meet submission guidelines specified below (Section 3).

2.2 Limitations and Scope

Proposals outside the scope of Heliophysics Supporting Research include the following:

- Proposals for the same or essentially the same work submitted concurrently to other program elements in Appendix B or E, as specified in B.1 Section 1;
- Work for which the proposing organization (or investigators) are already funded by NASA. Currently funded investigators must show how their new proposed effort is different and not duplicative with current awards;
- Model or tool development and/or new data analysis techniques, where this effort constitutes more than 50% of a three-year effort;
- The routine, long-term gathering of observational data;
- Investigations with the main purpose of supporting ground-based infrastructure and facilities
3. Two-Step Submission Guidelines

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in Section IV.(b)vii of the ROSES Summary of Solicitation.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Table 2 and Table 3 of ROSES). The Step-1 proposal must be submitted by the organization Authorized Organizational Representative (AOR). No budget or other elements are required. Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Step-1 proposals will be checked for compliance, but they will not be evaluated.

The Step-1 proposal title, science goals, and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) cannot be changed between the Step-1 and Step-2 proposals. The expected format and evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later.

3.1 Step-1 Proposal Content

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal is restricted to the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages.

The Step-1 proposals must include the following:

- The science goals and objectives to be addressed by the proposal;
- The relevance of the problem to one or more of the four Decadal Survey goals.
- A brief statement of the methodology to be used, including what data, models, and analysis will be used for completing the investigation;

The NSPIRES system for proposal submission requires that Step-1 proposals include a summary (i.e., abstract) describing the proposed work as outlined above. The proposal summary is entered directly into a text field in NSPIRES. No PDF attachment is required or permitted for Step-1 proposal submission. All information will be entered within the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. Proposers will be invited by NSPIRES when they are able to submit their Step-2 proposals.

Step-1 proposals may be declared noncompliant if they fail to meet submission guidelines specified in Sections 3.2 and 3.3 or if they are outside the scope of the H-SR program, as discussed in Section 1. PIs of noncompliant proposals will not be eligible to submit the associated Step-2 proposal and will receive a letter to this effect.

3.2 Step-2 Proposals

A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). The Step-2 proposal must be submitted via NSPIRES or Grants.gov by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title, science goals, and investigators (Principal
Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers that received a noncompliant letter are not eligible to submit a Step-2 proposal.

Proposers are strongly encouraged to provide names and contact information of five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is. This information can be supplied via the SARA web page at http://science.nasa.gov/researchers/suggested-reviewers/.

Proposers are expected to provide mail-in reviews for one to three proposals in this competition. Much of the science expertise lies in the PI/Co-I community, because, increasingly, nearly the entire Heliophysics community proposes. In order to maintain a high caliber review process, it is important to get the additional mail-in reviews to cover all proposals fairly.

3.3 Step-2 Proposal Content

The process for preparation and submission of the Step-2 (full) proposals is the same as that for any other ROSES proposal. Guidelines for content and formatting Step-2 full proposals are specified in the NASA Guidebook for Proposers and the ROSES Summary of Solicitation.

Proposals are restricted to fifteen (15) pages for the Scientific/Technical/Management section and must include the following sections with the preferred order:

- The science objectives and perceived impact of the proposed work to the state of knowledge in the field; references to existing work in the field should be limited to that which is needed to justify the value of the science proposed;
- The data and methodology to be employed in conducting the proposed research; the proposal must demonstrate (1) that the data are appropriate to address the science objectives, and (2) that the methodology is both appropriate and feasible to make substantial progress on the science objectives;
- The relevance of the proposed work to one or more of the four high-level science goals from the most recent Heliophysics Decadal survey listed in Section 1.1 must be demonstrated;
- A general plan of work, the management structure for the proposal personnel, and a description of the expected contribution to the proposed effort by the PI and each person as identified in the proposal, whether or not they derive support from the proposed budget. Postdoctoral fellows and students need not be named.

Historically, proposals that address a single well-focused compelling science objective with a limited set of specific science questions have been more successful at constructing methodologies that are demonstrably feasible and appropriate, as compared with those that propose to address a large number of science questions or that are directed at an overly-broad science topic.
3.4 Step-2 Compliance and Evaluation Criteria

All Heliophysics programs will continue reviewing Step-2 proposals for compliance. Step-2 proposals that are not compliant with formatting requirements (e.g., margins, font sizes, line spacing) may be rejected without review. See Section IV(b)ii of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers for details. In particular, users of LaTeX formatting must specify the appropriate paper size (US letter) and font size.

Proposals that have changed the scientific scope from that of their Step-1 proposal may be declared noncompliant.

Compliant proposals will be evaluated according to the criteria specified the NASA Guidebook for Proposers. These criteria are intrinsic scientific and technical merit, relevance to NASA’s objectives, and cost realism/reasonableness.

The evaluation of scientific and technical merit will include the following:

- Compelling nature and scientific priority of the proposed investigation’s science goals and objectives, including the importance of the problem within the broad field of Heliophysics; the unique value of the investigation to make scientific progress in the context of current understanding in the field, and the importance of carrying out the investigation now.
- Appropriateness and feasibility of the methodology, including the appropriateness of the selected data, models, and analysis for completing the investigation and the feasibility of the methodology for ensuring scientific success.

Based on these two factors, the evaluation will consider the overall potential science impact and probable success of the investigation.

Relevance to and priority within the H-SR program will be assessed based on criteria discussed in Section 1. Each proposal must demonstrate that the investigation is relevant and of high priority.

As indicated in the Guidebook for Proposers, the evaluation of cost realism/reasonableness includes the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. Only necessary Co-Investigators and Collaborators should be included, and their specific tasks and roles in the investigation must be clearly laid out.

4. Available Funds

It is expected that there will be approximately ~$6M available in Fiscal Year (FY) 2018 to support new Heliophysics SR investigations selected through this program element. Due to the increase in the proposed scope and complexity, annual funding is expected to fall into the ~$200-$250K range per investigation.

5. Award Types

As begun in 2013, the Heliophysics SR program will award funds through three vehicles: (1) grants, (2) interagency transfers, and (3) awards to NASA Centers. The
Heliophysics SR program will no longer award contracts. An institution that has received a contract previously can receive funds as a grant by not charging a fee.

6. Summary of Key Information

| Expected program budget for first year of new awards | ~$6M |
| Number of new awards pending adequate proposals of merit | ~25-30 |
| Maximum duration of awards | 3 years |
| Due date for Step-1 proposal | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Due date for full proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Planning date for start of investigation | 6 months after full proposal due date. |
| Page limit for the central Science-Technical-Management section of full proposal | 15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers |
| Relevance | This program is relevant to the Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| General information and overview of this solicitation | See the ROSES Summary of Solicitation. |
| Detailed instructions for the preparation and submission of proposals | Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers. |
| Submission medium | Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. |
| Web site for submission of Step 1 and Step 2 proposal via NSPIRES | [http://nspires.nasaprs.com/](http://nspires.nasaprs.com/) (help desk available at [nspires-help@nasaprs.com](mailto:nspires-help@nasaprs.com) or (202) 479-9376) |
| Web site for submission of Step 1 and Step-2 proposal via Grants.gov | [http://grants.gov](http://grants.gov) (help desk available at [support@grants.gov](mailto:support@grants.gov) or (800) 518-4726) |
| Funding opportunity number for downloading an application package from Grants.gov | NNH17ZDA001N-HSR |
| NASA point of contact concerning this program for Sun and Heliosphere | Arik Posner  
Heliophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358 0727  
Email: arik.posner@nasa.gov |
|-------------------------------------------------------------------|
| NASA point of contact concerning this program for Magnetospheres and ITM | Elsayed Talaat  
Heliophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358 3804  
Email: elsayed.r.talaat@nasa.gov |
NOTICE: Proposal submission to all calls in Heliophysics will be performed by a two-step process, in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an Authorized Organizational Representative (AOR). See Section 2.2 for details.

1. Scope of Program

The Heliophysics Technology and Instrument Development for Science (H-TIDeS) program is a component of the Heliophysics Research Program and proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in Appendix B.1 of this ROSES NASA Research Announcement.

1.1 Overview

The H-TIDeS program combines technology elements previously separated within the old Solar, Heliosphere, and Geospace (Magnetosphere-Ionosphere-Thermosphere-Mesosphere (Mag-ITM)) Science Supporting Research and Technology programs.

Supporting Research studies are found under ROSES Program Element B.2 Heliophysics Supporting Research (H-SR). Guest Investigator studies are found under ROSES Program Element B.4 Heliophysics Guest Investigators.

H-TIDeS seeks to investigate key Heliophysics science questions through three separate subelements. These subelements are also established for the purpose of organizing the evaluation and peer review process.

- Low-Cost Access to Space (LCAS): science and/or technology investigations that can be carried out with instruments flown on suborbital sounding rockets, stratospheric balloons, CubeSats, suborbital reusable launch vehicles, or other platforms, collectively referred to as Low-Cost Access to Space (see Section 1.2 below)
- Instrument and Technology Development (ITD): state-of-the-art instrument technology development for instruments that may be proposed as candidate experiments for future space flight opportunities, called Instrument and Technology Development, which may be carried out in the laboratory and/or observatory (see Section 1.3 below)
- Laboratory Nuclear, Atomic, and Plasma Physics (LNAPP): laboratory research designated as enabling Laboratory Nuclear, Atomic, and Plasma Physics studies (see Section 1.4 below).

Advancement in Heliophysics science requires the development and application of new technologies that will yield the next generation of innovative instruments. Laboratory research can be a relevant supplement to instrumentation and to the science of Heliophysics. The ability to achieve significant progress toward the scientific and technical challenges in Heliophysics in the coming years is greatly enhanced through the H-TIDeS program.
These investigations are carried out in support of NASA’s Heliophysics Science strategic objective "to understand the Sun and its interactions with Earth and the solar system, including space weather" and three overarching science goals, from the *Science Mission Directorate Science Plan for 2014* ([https://science.nasa.gov/about-us/science-strategy](https://science.nasa.gov/about-us/science-strategy)).

Proposals to all H-TIDeS programs shall link the proposed work to the NASA Heliophysics science plan in a three-step process:

1. NASA Heliophysics Science Goal(s);
2. The science questions to be answered in achieving the science goals;
3. The proposed investigation objective(s) required to address the science goals (either technological or observational or both)

The three Heliophysics Science Goals (described in the [2014 NASA Science Plan](https://science.nasa.gov/about-us/science-strategy)) have a broad scope, while a proposed objective is a more narrowly focused part of a strategy to achieve the goal(s) (e.g., identify specific science questions to be addressed and/or demonstrate a new technology is capable of obtaining future measurements that may bring closure to the science questions or goals). Proposed investigations must achieve their proposed objectives (technological and/or observational); however, the investigation might only make progress toward their proposed science question(s) and toward the top science goal(s) without fully achieving them.

The ability to determine whether a proposed investigation is successful depends on a well-formulated articulation of the proposed science question(s) and investigation objectives. Each proposal shall clearly define its science question(s), shall demonstrate how the science questions are derived from the high-level science goals, and shall show how the science question(s) lead to investigation objectives that subsequently map into measurement, data, instrument, and mission (as appropriate) requirements.

### 1.2 Low-Cost Access to Space

The Low-Cost Access to Space (LCAS) component supports investigations addressing NASA Heliophysics Science Goals using investigator-developed instrumentation (with or without new technology development) that must be completed through suborbital or orbital flights. The LCAS and ITD programs are expected to continue to lead the way in the development of a large fraction of the instrument concepts for future solar, heliospheric, magnetospheric, and ionosphere-thermosphere-mesosphere (ITM) missions. LCAS-class investigations provide unique opportunities not only for executing intrinsically meritorious science investigations, but also for advancing the technology readiness levels of future space flight detectors and supporting technologies and for preparing future leaders of NASA space flight missions, such as junior researchers and graduate students.

**LCAS Investigation Characteristics:**

1. The investigation objectives address NASA Heliophysics Science Goals;
2. The investigator develops instrumentation/sensor;
3. Spaceflight is required to achieve investigation objectives;
4. Data acquired is reduced, analyzed, and interpreted in terms of investigation objectives;
5. The reduced (calibrated) data is archived in a NASA on-line facility and the interpretation is published in professional journals;
6. The investigation is completed within a time interval less than or equal to four years;
7. The investigation cost is consistent with the available LCAS program funding (Section 4);
8. The Principal Investigator (PI) manages all the program resources (including schedule and cost) and no reserve is held by NASA.

Suborbital launch vehicle services include those provided by the NASA Sounding Rocket Program Office (SRPO), the NASA Balloon Program Office (BPO), and commercial suborbital Technology Mission Directorate. The Science Mission Directorate also provides launch opportunities for CubeSats and International Space Station payloads. Detailed information, including suborbital and orbital specifications and points of contact, is found in the ROSES Summary of Solicitation, Section V (b), Suborbital-Class Investigations:

(i) NASA-provided Sounding Rocket Services;
(ii) NASA-provided Balloon Services;
(iii) Suborbital Reusable Launch Vehicles (sRLV);
(iv) Research Investigations utilizing the International Space Station;
(v) Use of Short Duration Orbital Platforms (CubeSats and other Flights of Opportunity)

Note: "Short Duration" in (v) above refers to the Suborbital program plan mission assurance level defined by NPR 7120.8.

Note: Any LCAS investigation involving a sounding rocket or balloon flight with unique requirements must obtain a letter of mission feasibility from the relevant program office point of contact (listed in Section V.(b) of the ROSES Summary of Solicitation). Unique requirements include, but are not limited to, remote launch campaigns and phenomenological constraints on the time of launch. The mission feasibility letter must be included in the Step-2 proposal submission, but it does not count against the proposal page limit.

1.2.1 LCAS Step-2 Proposal Content

Proposals for the LCAS program must be for a complete investigation, based on clearly defined investigation objectives that address scientific questions appropriate for (this or future) Heliophysics missions linked back to Heliophysics Science goals. The investigation objectives must be achieved through a process, including payload construction, space or near-space flight, data analysis, data archiving, and publication of results. In addition to the requirements for all H-TIDEs proposals discussed above, LCAS proposals must also provide sufficient information on the flight performance characteristic and the mission requirements in order to demonstrate the feasibility of the investigation.
The Scientific/Technical/Management section of proposals is restricted to twenty pages, except for CubeSats and Flights of Opportunity, which are permitted twenty three pages (see below). The Scientific/Technical/Management section must include the following information:

- The investigation objectives and perceived impact of the proposed work to the state of knowledge in the field; references to existing work in the field should be limited to that which is needed to justify the value of the science proposed;
- A science traceability matrix;
- A mission design traceability
- A general plan of work, the management structure for the proposal personnel, and a description of the expected contribution to the proposed effort by the PI and each person as identified in the proposal - whether or not they derive support from the proposed budget. Postdoctoral fellows and students do not need to be named.
- A discussion of the plan for management, analysis, interpretation, and public dissemination of the data. Note: Level zero observational data from a LCAS flight must be deposited in a NASA-approved data center within 60 days of being obtained and calibrated observational data must be deposited in the same location before the end of the investigation.

Performance characteristics (which shall be considered as requirements on the flight system) shall include mass, power, volume, data rate(s), thermal, pointing (such as control, stability, jitter, drift, accuracy, etc.), spatial and spectral resolution, observable precision, retrieved parameter sensitivity and accuracy, and calibration requirements. This section shall demonstrate that the instrumentation can meet the measurement requirements, including factors such as retrieval results for each remote sensor, error analysis of the information in all sensors, vertical and horizontal resolution, signal-to-noise (S/N) calculations, and any other aspects of the instrumentation upon which the observations depend. The science traceability matrix shall be included as a Table within the S/T/M section. This matrix should summarize how the instrument performance requirements are a direct consequence of the proposed science questions and investigation objectives.

The mission requirements that the science goals and investigation objectives impose on the mission design elements, including mission design, instrument accommodation, platform design, required launch vehicle capability, ground systems, communications approach, and mission operations plan, shall be provided in tabular form and supported by narrative discussion. Specific information that describes how the science investigation imposes unique requirements on these mission design elements shall be included. The mission requirement matrix shall be included within the S/T/M section and demonstrate the investigation objectives can be achieved by the proposed mission design.

All LCAS investigations are conducted under the NASA Suborbital-Class program plan. Reference for management of these investigations is NPR 7120.8. Typically, management compliance of projects conducted under the NASA Sounding Rocket and Balloon Programs is ensured by their respective Program Offices. Proposals for LCAS investigations using other flight opportunities (International Space Station (ISS),

B.3-4
CubeSat, Flight of Opportunity, etc.) must provide a management plan explicitly compliant with NPR 7120.8.

Proposals to the LCAS program must supply information that is needed in order to generate an estimate of the costs associated with the operational requirements for the proposed investigation. For sounding rockets, this information is the envisioned vehicle type and quantity, payload mass, trajectory requirements, launch site, telemetry requirements, attitude control or pointing requirements, and any plans for payload recovery and reuse. For CubeSats, this information is a table specifying the expected mass/size, power, and telemetry budgets, including reserves, the orbit characteristics (perigee, apogee, inclination), and access-to-space methodology. Three additional pages (up to 23 total) are permitted for CubeSat proposals, given the added necessity of describing the CubeSat spacecraft systems (e.g., attitude control, telemetry, power, space environment survivability, etc.). The three additional pages must be in a clearly labeled section that describes only the CubeSat spacecraft systems. Balloon projects needing unique engineering and/or technical support services and/or vehicles and/or the Wallops Arc-Second Pointing System (WASP) should contact the Balloon Program Office directly for an estimate of the Government Furnished Equipment (GFE) cost of the desired support. It is advisable that PIs contact the SRPO or BPO before submitting proposals requesting large amounts of resources (e.g., high number of rocket flights) to determine if the proposed investigation is realistic.

Investigations based on ISS spaceflight must include a statement from the NASA Johnson Space Center ISS Research Integration Office/OZ indicating the feasibility of accommodating the investigation. Investigations using Flights of Opportunity spaceflight must include a statement from the organization providing the flight stating the proposed investigation is manifested on the relevant mission.

Budgets are expected to cover complete investigations, including payload development and construction, instrument calibration, launch, and data analysis. The number of investigations that can be supported is limited and heavily dependent on the funds available to this program. Note that NASA does not carry reserves to accommodate any cost overrun incurred by a particular investigation, including the loss of the payload owing to a rocket or balloon system failure. Therefore, failure to achieve the proposed goals within the proposed time and budget could require either descoping the initially proposed investigation, delaying it, canceling a particular launch date opportunity, or canceling the investigation altogether.

Science support elements, such as science radars, lidars, ionosondes, optical sites, and the associated logistics, can be supported, when appropriate. The funding for these support elements must be included in science proposal budgets.

Data returned from LCAS investigations shall be deposited in a publicly accessible NASA repository, such as the Solar Data Analysis Center (SDAC) or Space Physics Data Facility (SPDF). Quick look data shall be deposited as soon as possible after it is acquired and all reduced data shall be deposited before the end of the investigation. Additional requirements for the proposal content are provided in Section 2.3.1.
1.2.2 Export Control Laws specific to the Sounding Rocket Program

Export licenses are required for all foreign nationals accessing sounding rocket-class hardware. LCAS program Principal Investigators (PIs) should contact the Sounding Rocket Program Office regarding PI responsibilities in this arena. Procuring the required State Department licenses can take some time, and PIs are urged to begin the process well before team members need access to the actual flight hardware. Questions concerning U.S. Export Control Laws and Regulations for sounding rocket-class missions may be addressed to Philip.J.Eberspeaker@nasa.gov of the Sounding Rocket Program Office.

1.2.3 LCAS Proposals from Multiple Institutions

The LCAS program no longer makes separate awards to the Principal Investigator (PI) and Co-Investigators (Co-Is) of the same investigation at different institutions, except in those cases where a Co-Investigator is affiliated with a U.S. Government Laboratory (see the NASA Guidebook for Proposers, Section 2.3.10(c)), in which case NASA separately funds that Co-Investigator through a direct transfer of funds. In all other cases, the PI institution is expected to fund participating Co-I(s). No separate Co-I cost proposals will be accepted.

1.3 Instrument and Technology Development (ITD)

The ITD program supports the development of instrument or detector concepts that show promise for use in scientific investigations on, or give rise to future Heliophysics missions, including the development of laboratory instrument prototypes, detectors, instrument components, etc., but not of major space flight hardware. Proposals for ITD must demonstrate relevance to the Heliophysics program, including clearly defined scientific goals appropriate for future Heliophysics missions. The goal of the program is to define and develop scientific instruments and/or components of such instruments to the point where complete instruments may be proposed in response to future Announcements of Opportunity without significant additional technology development.

Either new measurement concepts or methods to improve the performance of existing instruments or detectors may be proposed, provided they would be candidates for use in space. Among the characteristics typically desirable in space-quality detection systems are high sensitivity to relevant signals, low mass, low vulnerability to particle radiation effects, low power consumption, compactness, ability to operate in a vacuum (such that high-voltage arcing is minimized), vibration tolerance, ease and robustness of integration with instrumentation, and ease of remote operation, including reduced transient effects and ease of calibration.

1.3.1 ITD Step-2 Proposal Content

Proposals to the ITD must demonstrate relevance to the Heliophysics program, including clearly defined scientific goals appropriate for current and/or future Heliophysics missions and linkage to the proposal objectives, and that the proposed development is a necessary precursor to solving specific scientific problems. However,
the proposers are not necessarily expected to apply the results of their efforts to the science problems within the time period of the proposed effort.

Important Note: A science traceability matrix is required for every ITD proposal. The matrix must show the connection between the relevant science goals, the proposal objectives and the measurements required to achieve those objectives. Additional requirements for the proposal content are provided in Section 2.3.1.

1.4 Laboratory Nuclear, Atomic, and Plasma Physics (LNAPP)
The LNAPP program supports studies that probe fundamental nuclear, atomic, and plasma physical processes and produce chemical and spectroscopic measurements that support spacecraft observations and atmospheric models. They provide benchmarks for integrating theory and modeling with observation in solar and space physics. Laboratory experiments allow the use of a controlled environment to perform reproducible measurements that shed light on key processes with the Heliophysics environment. These experiments are directed toward understanding basic processes. Additionally, there are also important experiments that are directly used to facilitate the interpretation of spacecraft observations, e.g., spectroscopic or cosmic ray measurements. As such, LNAPP encompasses measurements of fundamental atomic parameters, e.g., cross sections associated with various processes.

1.4.1 LNAPP Step-2 Proposal Content
Proposals for LNAPP must demonstrate relevance to the Heliophysics program, including clearly defined scientific goals appropriate for current and/or future Heliophysics missions and linkage to the proposal objectives. Proposals to LNAPP must demonstrate that the proposed work is a necessary precursor to solving specific scientific problems. The proposers are not necessarily expected to apply the results of their efforts to the science problem(s) within the time period of the proposed effort. Proposals for projects that aim to produce data products for wide use across the heliophysics community should explain how those products would be made available to the intended users in a stable fashion.

Important Note: A science traceability matrix is required for every LNAPP proposal. The matrix must show the connection between the relevant science goals, the proposal objectives and the measurements required to achieve those objectives. Additional requirements for the proposal content are provided in Section 2.3.1.

2. Submission and Evaluation Guidelines
2.1 General Considerations
Each Principal Investigator is allowed to submit one and only one Step-1 proposal to each subelement (LCAS, ITD, LNAPP) of this solicitation. In that proposal, the Principal Investigator is expected to invest a substantial portion of his/her time, 10-30%, to the investigation. Co-investigators must each have a specific and defined task in the project, and the task must be essential to completion of the project. Use of Collaborators is discouraged. Proposals may be declared noncompliant based on either
the Step-1 or Step-2 proposal if they are outside the scope of the H-TIDeS program or if they fail to meet submission guidelines specified below (2.2 and 2.3).

2.2 Step-1 Proposals

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in Section IV. (b) vii of the ROSES-2016 Summary of Solicitation.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the ROSES-2016 Summary of Solicitation). Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. An Authorized Organizational Representative (AOR) from the PI's institution must submit the Step-1 proposal. No budget is required (see below). Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Full (Step-2) proposals must have the same scientific goals and investigation objectives proposed in the Step-1 proposal. In addition, the Step-1 proposal title and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) may not be changed between the Step-1 and Step-2 proposals. The expected format and compliance evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later. Each Principal Investigator is allowed to submit one and only one Step-1 proposal for each subelement described in Section 1 above.

2.2.1 Step-1 Proposal Format and Content

The Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages. It should include the following information:

- A description of the science goals and investigation objectives to be addressed by the proposal.
- A brief description of the methodology (data, models, facilities, instrumentation, and, if relevant, flight systems) to be used to address the science goals and objectives.

The NSPIRES system for proposal submission requires that Step-1 proposals include a summary (i.e., abstract) describing the proposed work as outlined above. The proposal summary is entered directly into a text field in NSPIRES. No PDF attachment is required or permitted for Step-1 proposal submission. All information will be entered within the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages. Proposers will be notified by E-mail when they are able to submit their Step-2 proposals.

2.2.2 Step-1 Evaluation Criteria

Step-1 proposals will be declared noncompliant if the proposed work is outside the scope of the H-TIDeS program, as described in Section 1. PIs of noncompliant proposals will not be eligible to submit the associated Step-2 proposal and will receive a
letter to this effect. All who submit a compliant Step-1 proposal will be invited to submit a corresponding Step-2 proposal.

2.2.3 Request for Reviewer Names
Proposers are strongly encouraged to provide names and contact information of five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is. The PI can confidentially provide this information through the NASA Science URL http://science.nasa.gov/researchers/suggested-reviewers when submitting a Step-1 proposal.

2.3 Step-2 Proposals
A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). An Authorized Organizational Representative (AOR) from the institution of the PI must submit the Step-2 proposal. A budget and other specified information is required. The Step-2 proposal title, Principal Investigator, and all Co-Investigators, Collaborators, Consultants, and Other Professionals must be the same as those in the Step-1 proposal. Step-2 proposals must contain the same scientific goals and investigation objectives proposed in the Step-1 proposal. Each Principal Investigator is allowed to submit only one proposal for each subelement.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. A Step-2 proposal cannot be submitted if the corresponding Step-1 proposal was deemed noncompliant.

Proposers are expected to respond to requests to conduct mail-in reviews for up to four proposals in this competition. Much of the science expertise lies in the PIs and Co-Is, since nearly the entire Heliophysics community proposes. In order to maintain a high-caliber review process, it is important to get these mail-in reviews to cover all proposals fairly.

2.3.1 Step-2 Proposal Content
Proposers should refer to the PDF entitled "How to submit a Step-2 proposal" that will appear under "Other Documents" on the NSPIRES page for this program after the Step-1 proposal due date. The process for preparation and submission of the Step-2 (full) proposals is that for any other ROSES proposal. Guidelines for content and formatting of Step-2 full proposals are specified in Table 1 of the ROSES Summary of Solicitation.

Proposals to the H-TIDeS program must contain the following elements.

The proposal shall describe the investigation to be performed, the types of measurements to be taken; the characteristics, precision, and accuracy required to attain the investigation objectives; and the projected instrument performance. This section shall describe the data to be returned in the course of the investigation. The quality (e.g., resolution, coverage, pointing accuracy, measurement precision, signal to noise ratio, background identification/removal, etc.) and quantity (bits, images, etc.) of data that must be returned shall be described. The relationship between the proposed data products (e.g., flight data, ancillary or calibration data, theoretical calculations,
higher order analytical or data products, laboratory data, etc.) and the investigation objectives, as well as the expected results, shall be described. How the science products and data obtained will be used to fulfill the scientific requirements shall be demonstrated and supported by quantitative analysis.

Traceability from science goals to measurement requirements to instrument requirements (functional and performance), and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Note that for ITD proposals, the term “mission” refers to future mission(s) envisioned to address the proposed science question and utilizing the technology development being investigated. Projected instrument performance shall be compared to instrument performance requirements. This matrix provides the reference points and tools needed to track overall investigation requirements.

A science data management plan is required for all proposed investigations. All data obtained through H-TiDeS funded efforts shall be made public in a prompt manner. Special requirements for public release of observational data obtained through the LCAS subelement are noted in Section 1.2. ITD and LNAPP proposals must describe the management plan of any science data obtained in the investigation described. ITD proposals must discuss the release of data obtained in an investigation characterizing the performance of an instrument technology, although it is permissible to summarize this data. In addition to the public release of data, proposals must describe the analysis, interpretation, and dissemination in professional meetings and publications of the results of the proposed investigation.

Additional requirements for the proposal content are provided in Sections 1.2, 1.3, and 1.4.

2.3.2 Step-2 Evaluation Criteria

Step-2 proposals that are not compliant with format requirements may be rejected without review. See Section IV (b) ii of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers for details. Proposers must select the subelement that is appropriate for their proposal. Proposals that have changed the scientific scope from that of their Step-1 proposal may be declared noncompliant.

Compliant proposals will be evaluated according to the criteria specified in Section VI. (a) of the ROSES Summary of Solicitation and C.2 of the NASA Guidebook for Proposers. These criteria are intrinsic scientific and technical merit, relevance to NASA’s objectives, and cost realism/reasonableness.

Cost realism/reasonableness includes assessing the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. Only Co-Investigators and Collaborators with specific roles in the investigation should be included and their roles must be clearly laid out. Proposals should not include Collaborators whose only role is advisory.

Proposals will be evaluated for scientific and technical merit based on the following:

1. The importance of the proposed investigation objectives and science question(s)
in relationship to the Heliophysics Science goals, including:

- the unique value of the investigation to make scientific progress in the context of current understanding in the field,
- the importance of carrying out the investigation now;

2. The feasibility of the proposed investigation objectives in answering the science questions and achieving the required technology demonstration and/or observations, including the appropriateness of:

- data and/or models,
- facilities,
- instrumentation,
- flight systems

Based on these two factors, the evaluation will consider the overall potential science impact and probable success of the investigation.

Note: Proposals are not required to obtain full closure on the science question(s) during the investigation. However, if the investigation does not obtain closure on the science question(s), the proposal must demonstrate the viability of answering those science question(s) through subsequent flights and/or future orbital missions relying on the proposed technologies. Closure on the individual investigation objectives (technology development and/or observations) is required.

Additionally, though not required, the degree to which the proposed effort advances the readiness of junior researchers or graduate students to assume leadership roles on future NASA space flight missions will be considered.

2.3.3 Step-2 Proposal Format

All Heliophysics programs will continue reviewing Step-2 proposals for compliance. Step-2 proposals that are not compliant with formatting requirements (e.g., margins, font sizes, line spacing) may be rejected without review.

- The Scientific/Technical/Management section must not exceed the length specified in this Program Element (See Section 7 below).
- Margins: no less than 1 inch on all sides, with a page size of 8.5 × 11 inches.
- Font: Times New Roman, 12-point or larger. If an alternate font is used, it must meet the requirement of having, on average, no more than 15 characters per inch. Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line spacing settings must produce text that contains, on average, no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single spaced.
- Figure captions: Captions must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Expository text necessary for the proposal may not be located solely in figures or tables, or their captions.
3. Available Funds
A total of between $4M and $6M unencumbered program funds next fiscal year is anticipated to allow the selection of twelve or more new awards. ITD and LNAPP proposals of exceptional scientific merit will be considered for funding, within the constraints of the budget.

It is anticipated that at least $3M in next fiscal year funds will be available to support three to eight new selections for LCAS.

It is anticipated that approximately $0.8M in next fiscal year funds will be available to support two to five new selections for ITD.

It is anticipated that approximately $0.4M in next fiscal year funds will be available to support one to three new selections for LNAPP.

4. Maximum Duration of Awards
The maximum duration of ITD and LNAPP awards is three years. Although most LCAS awards are also three years in duration, a four-year proposal may be accepted to develop a new, highly meritorious investigation through its first flight.

5. Summary of Key Information

<table>
<thead>
<tr>
<th>Projected program budget for first year of new awards</th>
<th>~$4M-6M Total, $3M LCAS, $0.8M ITD, $0.4M LNAPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticipated number of new awards pending adequate proposals of merit</td>
<td>12 or more for LCAS, ITD, LNAPP combined</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>LCAS – 4 Years; ITD, LNAPP – 3 years.</td>
</tr>
<tr>
<td>Due date for Step-1 Proposal</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Due date for Step-2 (full) proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>6 months after proposal due date.</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposal. See also Chapter 2 of the NASA Guidebook for Proposers</td>
<td>ITD and LNAPP: 15 pages</td>
</tr>
<tr>
<td></td>
<td>LCAS Sounding Rocket, Balloon, sRLV &amp; ISS: 20 Pages</td>
</tr>
<tr>
<td></td>
<td>LCAS CubeSat &amp; Flight of Opportunity: 23 pages</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and Chapter 3 of the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Web site for submission of proposals via NSPIRES</strong></td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Web site for submission of proposals via Grants.gov</strong></td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
<td>NNH17ZDA001N-HTIDS</td>
</tr>
</tbody>
</table>
| **NASA point of contact concerning this program** | Dan Moses  
Heliophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-0558  
E-mail: dan.moses@nasa.gov |
NOTICE: Amended February 23, 2017. The Step-1 and Step-2 proposal due dates have been delayed to April 14, 2017, and June 16, 2017, respectively, see Tables 2 and 3 of ROSES. There has been no change to the text of this program element.

Step-2 proposals are limited to ten (10) pages. Investigations focused on Magnetospheric Multiscale (MMS) data are not permitted; these investigations should be submitted under element B.8. Check for NASA spacecraft mission data compliance as specified in the overview B.1. This program element has a total cost cap of $525K per proposal. The combined 3-year total budget of a proposal may not exceed this amount. Proposals seeking total funding greater than this amount will be declared non-compliant. Proposals to this program will continue to be taken by a two-step process, in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an Authorized Organizational Representative (AOR), see Section 3.

1. Scope of Program

The Heliophysics Guest Investigator (H-GI) "Open" program is intended to maximize the scientific return from operating missions by providing support for research that is beyond the scope of work of the mission science teams. It also allows scientists who are not associated with a mission team to participate in the mission science. In ROSES-2017, there are two program elements that are part of the GI-program. Proposals that use primarily data from Magnetospheric Multiscale (MMS) Mission are not permitted for this program element. Investigations using primarily data from this mission should submit to element B.8.

1.1 Overview

The H-GI Open (HGIO) program is for investigations whose primary emphasis is the analysis of data from currently operating missions. It provides support for analysis of observations from both extended missions and from missions in their prime phase (Phase E). Proposals should either (1) address the goals of the mission(s) on whose data the investigation is focused, or (2) for investigations that go beyond the mission goals, proposals must address one or more of the four high-level science goals from the most recent Heliophysics Decadal survey (Solar and Space Physics: A Science for a Technological Society: https://www.nap.edu/read/13060/chapter/1):

1. Determine the origins of the Sun’s activity and predict the variations in the space environment;
2. Determine the dynamics and coupling of Earth’s magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs;
3. Determine the interaction of the Sun with the solar system and the interstellar
medium;

4. Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.

In support of any H-GI proposal, investigations may employ theory, models, and data from other sources, as needed, to interpret and analyze data from NASA’s Heliophysics System Observatory (HSO), but only as a secondary emphasis. Additionally, data from non-NASA sources must still follow the guidelines set forth in B.1 and be publicly available 30 days before the Step-2 deadline. In any such instance, the proposal must clearly demonstrate that the theory, models, and/or data in question are necessary for interpretation of the HSO data and are not, themselves the primary object of the investigation. Development of new models and theories is not solicited.

The list of operating HSO missions is found at: https://science.nasa.gov/missions-page?field_division_tid=5&field_phase_tid=29

Proposers should be aware that for many of these missions, the mission science teams and others have already accomplished a substantial amount of research. Proposals must demonstrate that the proposed research will extend the frontier of existing knowledge in a fundamental and important manner.

Additionally, prospective investigators must demonstrate that the proposed effort can be accomplished using data that was publicly available 30 days before the Step-2 submission deadline. Most Heliophysics data may be found through the Heliophysics Data Portal (HDP) found at http://heliophysicsdata.sci.gsfc.nasa.gov/websearch/dispatcher. If an investigation is proposing to use data that cannot be found at this source, it must provide a publicly accessible web address where the data can be accessed to verify that it is publicly available.

1.2 Organizing Science Areas

The Heliophysics Guest Investigator program has established four subdisciplines and 13 science areas for the purpose of organizing the evaluation and peer review. The four subdisciplines of Heliophysics are Sun, Heliosphere, Magnetosphere, and Ionosphere-Thermosphere-Mesosphere (ITM). Each PI will have to choose one of the four as the focus of their investigation. Note: Do not choose Heliosphere meaning Heliophysics; they are not synonymous. This wastes time and resources to redirect; such misdirected proposals may be returned without review.

The 13 science areas are listed below. Some of these science areas fit within more than one broad category. Each proposal must choose one of the four broad categories and one of the 13 science areas:

1. Solar Interior
2. Solar Transient Events
3. Solar Atmosphere
4. Particle Acceleration, Transport, Modulation in the Heliosphere
5. Heliospheric Plasma Processes, Turbulence, Waves, Composition
6. Interplanetary Coronal Mass Ejections/Magnetic Clouds
7. Outer Heliosphere and the Interstellar Boundary
8. Solar Wind – Magnetosphere Coupling
9. Inner Magnetosphere
10. Magnetosphere – Ionosphere Coupling/Magnetotail
11. Ionosphere – Atmosphere Coupling
12. Neutral Atmosphere
13. Solar Output – Ionosphere/Atmosphere Coupling

System science proposals that touch on more than one of these science areas are encouraged, but for the purpose of organizing the review, investigators must choose the one area that is most relevant. Proposals addressing the magnetospheres or the ionospheres of other planets are permitted, but must not duplicate proposals sent to other programs.

2. Submission and Evaluation Guidelines

2.1 General Considerations

Each Principal Investigator (PI) is allowed to submit one and only one Step-1 proposal to this program element. In that proposal, the Principal Investigator or Science PI must invest at least one month of labor to the investigation in order to adequately oversee the investigation. Co-investigators (Co-Is) must each have a specific and defined task in the project, and the task must be essential to completion of the project. Use of collaborators is discouraged. Proposals may be declared noncompliant based on either the Step-1 or Step-2 proposal if they are outside the scope of the H-GI program (see Section 2.2 below) or if they fail to meet submission guidelines specified below (Section 3).

2.2 Limitations and Scope

Proposals outside the scope of H-GI may be declared noncompliant based on either the Step-1 or Step-2 proposal. These include the following:

- Proposals that do not focus on analysis of data from currently-operating HSO missions;
- Proposals for the same or essentially the same work submitted concurrently to other program elements in Appendix B or E, as specified in B.1 Section 1;
- Work for which the proposing organization (or investigators) are already funded by NASA. Where projects might appear to overlap, proposals must show that the proposed effort does not duplicate other awards, including awards as part of operating space flight missions;
- Proposals for model, tool, or theory development (see Section 1.1);
- The routine, long-term gathering of observational data;
- Investigations with the main purpose of supporting ground-based infrastructure or facilities;
- Proposals focused on the use of MMS data. MMS data may be used as a secondary resource (provided they meet the data availability requirements in B.1), but they must not be a primary object of the investigation.
A PI or a Co-I on a qualifying Heliophysics mission may also propose as a PI or Co-I to the H-GI program. However, such Heliophysics mission personnel must include in their proposal a description of their mission duties and clearly distinguish the proposed new activity from their existing responsibilities for mission operations and data analysis.

3. Two-Step Submission Guidelines

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in Section IV. (b) vii of the ROSES Summary of Solicitation.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). The Step-1 proposal must be submitted by the organization Authorized Organizational Representative (AOR). No budget or other elements are required. Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Step-1 proposals will be checked for compliance, but they will not be evaluated. The Step-1 proposal title, science goals, and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) cannot be changed between the Step-1 and Step-2 proposals. The expected format and evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later.

3.1 Step-1 Proposal Content

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal is restricted to the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. References and any other supporting material are not required, but, if included, must fit within the limit. The Step-1 proposal must include the following information:

- The science goals and objectives to be addressed by the proposal;
- A listing of the mission data to be used in the investigation;
- A listing of the data analysis methodology and any models or simulations to be used;
- A brief statement of the relevance of the problem to the goals of the mission(s) on whose data the investigation is focused, or for investigations that go beyond the mission goals, the relevance to one or more of the four Decadal Survey goals.

The NSPIRES system for proposal submission requires that Step-1 proposals include a summary (i.e., abstract) describing the proposed work as outlined above. The proposal summary is entered directly into a text field in NSPIRES. No PDF attachment is permitted for Step-1 proposal submission. All information will be entered within the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. Proposers will be notified by E-mail when they are able to submit their Step-2 proposals.
3.2 Step-2 Proposals

A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). The Step-2 proposal must be submitted via NSPIRES or Grants.gov by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title, science goals, and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) must be the same as those in the Step-1 proposal.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers that received a noncompliant letter are not eligible to submit a Step-2 proposal.

Proposers are strongly encouraged to provide names and contact information of five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is. This information can be supplied via the SARA web page at http://science.nasa.gov/researchers/suggested-reviewers/.

Proposers are expected to provide mail-in reviews for one to three proposals in this competition. Much of the science expertise lies in the PI/Co-I community because, increasingly, nearly the entire Heliophysics community proposes. In order to maintain a high caliber review process, it is important to get the additional mail-in reviews to cover all proposals fairly.

3.3 Step-2 Proposal Format

The process for preparation and submission of the Step-2 (full) proposals is the same for any other ROSES proposal. Guidelines for content and formatting full proposals are specified in Table 1 of ROSES and the NASA Guidebook for Proposers and the ROSES Summary of Solicitation.

Proposals are restricted to ten (10) pages for the Scientific/Technical/Management section and must include the following sections with the preferred order:

- The science objectives and perceived impact of the proposed work to the state of knowledge in the field; references to existing work in the field should be limited to that which is needed to justify the value of the science proposed;
- The data and methodology to be employed in conducting the proposed research; the proposal must demonstrate (1) that the data is appropriate to address the science objectives and (2) that the methodology is both appropriate and feasible to make substantial progress on the science objectives;
- The relevance of the proposed work to the goals of the mission(s) on whose data the investigation is focused; or if the proposed work goes beyond the goals of the mission(s), then relevance to one or more of the four high-level science goals from the most recent Heliophysics Decadal survey listed in Section 1.1 must be demonstrated;
- A general plan of work, the management structure for the proposal personnel, and a description of the expected contribution to the proposed effort by the PI and each person as identified in the proposal whether or not they derive support from the proposed budget. Postdoctorals and students do not need to be
identified by name.

Historically, proposals that address a single well-focused science objective with a limited set of specific science questions have been more successful at constructing methodologies that are demonstrably feasible and appropriate, as compared with those that propose to address a large number of science questions or that are directed at an overly-broad science topic.

3.3.1 Step-2 Proposal Formatting Requirements

All proposals submitted to ROSES must strictly conform to the formatting rules. Proposals that violate the rules may be rejected without review or declined following review if violations are detected during the evaluation process.

- The Scientific/Technical/Management section must not exceed the length specified in this Program Element (See Section 7 below).
- Margins: no less than 1 inch on all sides, with a page size of 8.5 × 11 inches.
- Font: Times New Roman, 12-point or larger. If an alternate font is used, it must meet the requirement of having, on average, no more than 15 characters per inch. Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line spacing settings must produce text that contains, on average, no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single spaced.
- Figure captions: Captions must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Expository text necessary for the proposal may not be located solely in figures or tables, or their captions.

Guidelines for submitting Step-2 full proposals, other than those listed above, are specified in the NASA Guidebook for Proposers. Where they conflict, the guidelines above supersede those found in the Guidebook.

3.4 Step-2 Evaluation Criteria

Step-2 proposals that are not compliant with format requirements may be rejected without review. See Subsection 3.3.1 of this program element, Section IV (b) ii of the ROSES Summary of Solicitation, and the NASA Guidebook for Proposers for details. Proposals that have changed the scientific scope from that of their Step-1 proposal may be declared noncompliant.

Compliant proposals will be evaluated according to the criteria specified in the ROSES Summary of Solicitation Section VI (a) and the NASA Guidebook for Proposers and they are Relevance, Merit, and Cost. Clarifications and additions specific to this program element are listed below.

The evaluation of scientific and technical merit will include the following:

- Compelling nature and scientific priority of the proposed investigation's science
goals and objectives, including the importance of the problem within the broad field of Heliophysics, the unique value of the investigation to make scientific progress in the context of current understanding in the field, and the importance of carrying out the investigation now.

- Appropriateness and feasibility of the methodology, including the appropriateness of the selected data, models, and analysis for completing the investigation and the feasibility of the methodology for ensuring scientific success.

Based on these two science and technical factors, the evaluation will consider the overall potential science impact and probability of success of the investigation.

Relevance to and priority within this H-GI program element will be assessed based on criteria discussed in Section 1. Each proposal must demonstrate that the investigation is relevant and of high priority.

Cost realism/reasonableness includes assessing the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. Only necessary Co-Investigators and Collaborators should be included, and their specific tasks and roles in the investigation must be clearly laid out in the proposal work plan.

4. Available Funds

It is expected that there will be approximately $4.65M available in Fiscal Year (FY) 2018 to support new Heliophysics GI investigations selected through this solicitation. This program element has a cost cap of $525K per proposal. The combined 3-year total budget of a proposal may not exceed this amount. Proposals seeking total funding greater than this amount will be declared non-compliant.

5. Award Types

As begun in 2013, the H-GI program will primarily award funds through three vehicles: (1) grants, (2) interagency transfers, and (3) awards to NASA Centers. The H-GI program will not award contracts. An institution that has received a contract previously can receive funds as a grant by not charging a fee.

6. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected annual program budget for first year of new awards</th>
<th>~$4.65M; See Section 4</th>
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<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>~25-30</td>
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<tr>
<td>Maximum duration of awards</td>
<td>3 years; shorter-term proposals are allowed</td>
</tr>
<tr>
<td>Due date for Step-1 proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Due date for full Step-2 proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td><strong>Page limit for the central Science-Technical-Management section of proposals</strong></td>
<td>10 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers</td>
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<tr>
<td><strong>Planning date for start of investigation</strong></td>
<td>8 months after proposal due date.</td>
</tr>
<tr>
<td><strong>Relevance</strong></td>
<td>This program is relevant to Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td><strong>General information and overview of this solicitation</strong></td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td><strong>Detailed instructions for the preparation and submission of proposals</strong></td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Submission medium</strong></td>
<td>Electronic proposal submission is required; no hard copy is permitted. See also Section IV in the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td><strong>Web site for submission of proposal via NSPIRES</strong></td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
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<tr>
<td><strong>Web site for submission of proposals via Grants.gov</strong></td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
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<tr>
<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
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</tr>
</tbody>
</table>
| **NASA point of contact concerning this program** | Errol J. Summerlin  
Heliophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-1257  
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B.5 **HELIOPHYSICS GRAND CHALLENGES RESEARCH- THEORY, MODELLING AND SIMULATIONS**

**NOTICE:** The Heliophysics Grand Challenges Research – Theory, Modelling and Simulations Program is not being offered in ROSES-2017. All existing Fiscal Year 2018 and Fiscal Year 2019 program funds were competed in ROSES-2016.

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NOTICE: Amended October 20, 2017. The text (primarily in Section 7) has been changed to clarify the expected structure and content of program-specific material within the proposal. The requirement to address potential contribution to the Focused Science Team effort is described in Section 7.2.2. Please note that the proposer’s response to this requirement will be provided in a 4000-character text box on the NSPIRES cover page not in the 15-page main body of the proposal. Section 7.2.3 explains how the evaluation criteria explicitly include assessment of the potential contribution to the Focused Science Team effort. In addition, it is noted (in Section 7.2) that proposers are expected to provide mail-in reviews for one to three proposals to this program element. The Data Use policy for the LWS Element in ROSES 2017 is described in Section 1.1, and small changes have been made in Section 2.1, including estimates of the anticipated number of awards and average award size.

The Step-1 Proposals are now due December 5, 2017 and Step-2 Proposals are due February 6, 2018. New text is in bold and deleted text is struck through.

The Strategic Capabilities and Cross-Discipline Infrastructure Building components are not being competed in ROSES-2017.

Proposal submission to all calls in Heliophysics will be done by a two-step process, in which a Notice of Intent is replaced by a required Step-1 proposal. The proposal title, science goals and objectives, and investigators cannot be changed between the Step-1 and Step-2 proposals. See section 7 for details.

Targeted Science Team proposals, whereby a single large proposal covers the entire breadth of a Focused Science Topic, will not be permitted in ROSES-2017.

All proposals submitted to ROSES must strictly conform to the formatting rules. Proposals that violate the rules may be rejected without review or declined following review. See section 7 for details.

1. Introduction

The Living With a Star (LWS) Program emphasizes the science necessary to understand those aspects of the Sun and Earth's space environment that affect life and society. The ultimate goal of the LWS program is to provide a scientific understanding of the system, almost to the point of predictability, of the space weather conditions at Earth and the interplanetary medium, as well as the Sun-climate connection.
The LWS program objectives are based on these goals and are as follows:

1. Understand solar variability and its effects on the space and Earth environments with an ultimate goal of a reliable predictive capability of solar variability and response.
2. Obtain scientific knowledge relevant to mitigation or accommodation of undesirable effects of solar variability on humans and human technology on the ground and in space.
3. Understand how solar variability affects hardware performance and operations in space.

The LWS Program seeks to make progress in understanding the complex Heliophysics system, focusing on the fundamental science of the most critical interconnections. Further information on the LWS Program can be found at the updated LWS website (http://lwstrt.gsfc.nasa.gov/). The LWS Science program maintains a strategy with three components, namely, Strategic Capabilities, Targeted Investigations, and Cross-Disciplinary Infrastructure Building programs. Because Strategic Capabilities and Cross-Disciplinary Infrastructure Building programs are fully subscribed, only the Targeted Investigations will be competed in this announcement.

Further background material concerning relevant research objectives can be found on the LWS website, and in the following documents:


1.1 Data Use in the Living With a Star Program

This program element has policies on the use of data in proposals that expand upon and supersede those given in B.1 Heliophysics Research Program Overview.

For successful completion of the proposed project, proposals to this program may only use data that is in a publicly available archive at least 30 days prior to the Step-2 deadline (see Section 7.2.3). This applies to both space-based and ground-based observations, as well as any data products derived from them. Any questions about whether a data set qualifies as publicly available must be submitted to the program element’s point of contact at least 10 days before the Step-1 deadline.

After an award is made, projects may incorporate new data that becomes available, provided that their use does not alter the goals and objectives of the selected proposal. Any changes in the data used must be described in the annual progress report submitted by the Principal Investigator.

While the inclusion of useful ground-based observations is allowed, proposals are expected to incorporate space-based observations. Further, the evaluation process will include the consideration of the presence and importance of space-
based or ground-based observations in the proposals (see Section 7.2.3). Regardless of the type of data that would be utilized in the proposed study, space-based, ground-based, or some combination, the proposal must clearly demonstrate why the proposed data set or data sets are sufficient to address the proposed goals and objectives.

2. Scope of Program Element - Targeted Investigations

The stated goal of LWS, that of achieving an understanding of those aspects of the Sun-Solar System that have direct impact on life and society, poses two great challenges for the LWS program. First, the program must tackle large-scale problems that cross discipline and technique boundaries (e.g., data analysis, theory, modeling, etc.); and second, the program must identify how this new understanding will have a direct impact on life and society. Over time, the Targeted Investigations provide advances in scientific understanding to address these challenges.

The Targeted Investigations component this year consists of four Focused Science Topics (FSTs).

2.1 Focused Science Topics

The Focused Science Topics (FST) permitted as the objectives for proposals this year are as follows:

1) Understanding the Onset of Major Solar Eruptions (described in section 3);
2) Toward a Systems Approach to Energetic Particle Acceleration and Transport on the Sun and in the Heliosphere (described in section 4);
3) Ion Circulation and Effects on the Magnetosphere and Magnetosphere - Ionosphere Coupling (described in section 5);
4) Understanding Physical Processes in the Magnetosphere - Ionosphere / Thermosphere / Mesosphere System during Extreme Events (described in section 6).

Detailed descriptions of each FST are listed below. NASA desires a balance of research investigation techniques for each topic, including theory, modeling, data analysis, observations, and simulations. In 2013 and 2014, proposals could be individual proposals that would form part of a team or Targeted Science Teams (TSTs) that form prior to submission under a single Principal Investigator (PI) and submit a single TST proposal that attacks the entire breadth of the Focused Science Topic. However, such TSTs will not be permitted in ROSES-2017 and the FST teams will be formed from the selected individual proposals based on panel evaluations and programmatic considerations. Instead, LWS Science will adopt pursue one of the recommendations in Chapter 10 of the 2013 Heliophysics Decadal Survey that NASA "work toward doubling the size of Individual-Principal-Investigator grants."

Given the strategic nature of LWS, and the fact that strategically feasible tasks require sufficient investment, it is anticipated that FST proposals will have annual budgets in the range of $185K - $225K $200k – $250k. (This includes fully encumbered Civil Servant labor, where appropriate.) It is left to individual PIs to decide whether a strategically feasible award size could be achieved by increased collaborative efforts, greater FTE of
investigators, or a mix of the two. PIs should be cognizant, however, that verification of the level of effort versus the actual work proposed will be part of the review panel process. Given the submission of proposals of adequate number and merit and investigative techniques, up to six selections will be made for each Focused Science Topic. We anticipate NASA anticipates forming teams of 5-6 selections for topics (2) and (4) and teams of 4-5 selections for topics (1) and (3) due to the more focused nature of the latter two topics. The expected duration of FST awards is four years.

Once selected, these investigators will form a team in order to coordinate their research programs. Due to the collaborations that will arise from coordination of these team research efforts, one of the PIs will serve as the Team Leader for the Focused Science Topic for which he/she proposed. This PI will receive supplemental funding, as necessary, to support costs associated with these duties after the selection process is completed. Proposers are encouraged to propose to act as a Team Leader and, if they do so, should include a brief section at the end of their proposal describing how they would lead the team effort. Up to one extra page of the proposal is allowed for this proposed effort. All proposers for Focused Science Topics should include sufficient travel funds in their proposed budgets to cover two team meetings per year to be held on the U.S. coast furthest from their home institutions. This assumes that one meeting per year will be held in conjunction with a major U.S. scientific meeting. Starting with the LWS selections in ROSES-2016 and continuing with ROSES 2017, successful teams will participate in a Kickoff Workshop were all selected teams will meet and develop work plans for the anticipated period of performance, generally 4 years, based on the requirements of the FST and the composition of the selected team.

3. Understanding the Onset of Major Solar Eruptions

3.1 Target Description

The LWS program has the overarching goal to achieve a quantitative understanding of how the Sun influences the Earth’s environment. A key aspect of understanding this interaction is the ability to quantitatively describe – and ultimately predict - the occurrence of major solar eruptions. This topic is essential to nearly all of the LWS Strategic Science Areas (SSAs). For example, Solar Energetic Particle (SEP) events (SSA-3) generated by flares and Coronal Mass Ejections (SSA-0) increase radiation hazards throughout the solar system and adversely impact our space- and ground-based assets (SSA-1). The initial particles can arrive in minutes to hours after an eruption on the Sun.

A key difficulty in achieving the goals of SSA-3 (probabilistic prediction of the spectral intensity of SEP events, and increased time periods for all-clear forecasts) is forecasting the likelihood of a major eruption from active region(s) on the Sun, hours to days prior to the event. Present-day forecasts are empirical. For example, NOAA/SWPC currently relies on qualitative assessments of sunspot groups to produce a 24-, 48-, and 72-hour forecasts. There are statistical methods that could potentially improve these forecasts based on characterization of prior flaring, surface solar magnetic field properties derived
from magnetograms, etc. However, even such techniques typically have little theoretical or modeling insight incorporated into their methodologies.

There has been significant theoretical, modeling and observational work on the eruptive properties of solar magnetic fields, as evidenced by previous LWS Focused Science Teams (FSTs). However, it appears we are still many years away from an entirely first principles approach for predicting major eruptions. The goal of this FST is to directly combine insights from theory, modeling, and observations to improve probabilistic forecasts of major solar eruptions required by the user community.

3.2 Goals and Measures of Success

The goal of this science topic will be to obtain a quantitative understanding of the signatures which indicate the imminent occurrence of a major solar eruption, such as magnetic flux emergence, the interaction of the emerging flux with existing structures, and the degree of non-potentiality in the atmosphere. This requires studies of local and global-scale phenomena as ably demonstrated by the observations of the Solar Dynamics Observatory over the past six years. Measures of success would be:

- The ability to integrate numerical and observational studies across the breadth of temporal and spatial scales to better understand major eruptions.
- The ability to differentiate between minor and major storm eruptions.
- The ability to robustly determine "all-clear" periods for major eruptions.
- Production of critical derived data products such as Poynting flux, helicity flux injection, and free energy build up from the observables with appropriate estimates of uncertainties.
- Identification of comprehensive, consistent, robust extrapolation methods involving magnetic field measurements in photosphere, chromosphere and corona to identify degrees of non-potentiality and the timescales on which it develops.
- The ability to predict the location, timing, and initial velocity of major solar eruptions.

All studies must consider data and model uncertainty and how the sources of error impact the results.

3.3 Types of investigations

Investigations may include, but are not limited to:

- Observational, theoretical, empirical, statistical and/or modeling studies that identify signatures of stability and/or imminent eruption triggering and onset.
- Studies that use these signatures to provide probabilistic forecasts of major solar eruptions that examine
  - the processes by which the emergence of magnetic flux energizes pre-eruptive active regions and / or triggers eruptions.
  - the flux of magnetic energy stored, entering, or leaving solar active regions, and study how this relates to the triggering of eruptions.
Studies that identify signatures of stability and/or imminent eruption by examining
- magnetic reconnection onset or other destabilization mechanisms, as related
to eruption onset, throughout the solar atmosphere and across the broad
range of scales presented therein.
- inferred/measured quantities such as free magnetic energy, non-potentiality,
helicity flux injection, and Poynting flux injection to the likelihood of a major
event.

3.4 Focus on Enabling Predictability and Interaction with User Communities

An important aspect of the FST is to demonstrate responsiveness relevance to user
needs, especially when designating storm onset, assessing all-clear periods, or
differentiating between minor and major solar events. For example, an end user of this
FST would be the operational group at NOAA/SWPC. Individual proposals must identify how they will contribute to the FST and improve understanding of major event
onset and the physical properties of those events that can eventually be transitioned to
user/operational models.

4. Toward a Systems Approach to Energetic Particle Acceleration and Transport on the
Sun and in the Heliosphere

4.1 Target Description

The Radiation Environment Strategic Science Area (SSA-6) and the Geomagnetic
Variability Strategic Science Area (SSA-1) outline broad needs for advancing the
characterization of the science of the radiation environment in a varying environment.
The radiation environment between the troposphere and outer magnetosphere can
change rapidly due to varying galactic cosmic ray (GCR) and solar energetic particle
(SEP) influx. This environment can also be affected by solar wind pressure effects due
to high-speed streams (HSS), coronal mass ejections (CME), and periods of southward
interplanetary magnetic field (IMF). The GCR background is typically variable on the
timescale of days with a long-term trend that changes slowly and is modulated by the
solar IMF varying with the approximate eleven-year solar cycle. The SEP environment
can be highly time variable, with impulsive, order of magnitude changes associated with
solar eruptive events occurring in a matter of seconds to minutes. HSS, CME, and solar
wind pressure increases cause changes to the radiation belt environment on a scale of
ten of minutes to days with the probability of occurrence of these events being
dependent on the solar cycle. Together, the effect of these phenomena on the Earth’s
Magnetosphere–Ionosphere–Thermosphere (M-I-T) system, create the "weather" of the
radiation environment.

Recent observations and modeling developments have permitted substantial progress
in understanding the drivers and responses of the radiation environment. However, the
variability and prediction potential of the coupled systems describing this radiation
environment are not yet well quantified and this remains a long-term community
research goal. First principles and empirically based models, combined with new data
streams, are needed to achieve substantial progress toward future predictability. In the
near-term, there is great value in comparing existing models and observational data
sets for validation, leading to an ability to conduct ensemble modeling so as to
characterize uncertainty in the radiation environment.

4.2 Goals and Measures of Success

The goal of this FST is to take a systems approach to understanding the acceleration and transport of solar energetic particles. The investigations addressing this FST will, as a whole, use a systems approach to integrate investigations covering the different acceleration regions of SEPs from active regions to the corona and through the Heliosphere. These include the need to:

● develop a detailed observational understanding of the properties of the source regions of solar energetic particles;
● understand the composition and evolution of solar energetic particle populations in time and space;
● identify the mechanisms by which impulsive energetic particle events or gradual events of large angular extent occur;
● understand the relative roles of flares and CMEs in producing energetic particles as well as the underlying acceleration mechanisms;
● understand the origin and distribution of seed particles;
● develop advanced systems-based models of the production and transport of solar energetic particles as precursors to predictive capabilities.

Investigations based on observational, theoretical, and/or modeling initiatives are expected to show clearly how they contribute to a broader understanding of the coupled physical processes that underpin the production and transport of solar energetic particles. Observational investigations should show how new methods or techniques will yield insights into the production and transport of energetic particles, and/or how they will lead to data or data products that may be assimilated by models. Theoretical investigations should lead to an understanding of the comparative importance of the coupled physical processes that contribute to the acceleration and transport of solar energetic particles. Modeling efforts should leverage progress in observations and theory to demonstrably improve our understanding of the timing, origin, and properties of solar energetic particles and their potential for affecting the near-Earth environment.

All studies must consider data and model uncertainty and how the sources of error impact the results.

4.3 Types of Investigations

Types of investigations appropriate for this focused topic include, but are not limited to:

● Determination of the relative importance of various particle acceleration mechanisms (e.g., magnetic reconnection, turbulence, and shocks), and particle transport mechanisms, in different physical scenarios.
● Comparative studies of particle populations on the Sun inferred from their electromagnetic radiations and/or those detected in situ.
● Determination of the origin and distribution of seed populations of SEPs, and investigation of the relative importance of contributions to the seed populations of SEPs, such as flare-accelerated particles escaping the Sun and/or relics of a previous CME.
● Investigation of CME evolution and shock formation/evolution and/or flare initiation and evolution in order to determine conditions leading to acceleration of SEPs.
● Investigation of the relative roles of flares and CME-driven shocks in the acceleration of energetic particles, as well as temporally and spatially extended gamma-ray events.
● Determination of the distribution of spectral and isotopic characteristics of SEPs, and characterization of the underlying causes for the distinction between highly impulsive and gradual SEP events.

4.4 Focus on Enabling Predictability and Interaction with User Communities

An important component of the FST is to demonstrate responsiveness to user needs (for example, NASA/SRAG or NOAA/SWPC). Individual proposals must identify how they will contribute to the FST and aid with development of a predictive capability.

5. Ion Circulation and Effects on the Magnetosphere and Magnetosphere - Ionosphere Coupling

5.1 Target Description

Accurate knowledge and understanding of the magnetospheric composition is critical for understanding the space environment. Heavy ions of ionospheric origin become a substantial constituent of the ring current and plasma sheet during storms. In large storms O+ can even dominate the ring current energy density. Heavy ions therefore play a key role in the electrical currents and magnetic field structure of the entire inner magnetosphere. Heavy ions also affect the radiation belt population by controlling the growth and interaction of radiation belt particles with EMIC waves. O+ may also affect the global Solar Wind – Magnetosphere coupling by quenching dayside reconnection rates as well as global magnetospheric convection, and on the night side affecting location and recurrence of reconnection and associated instabilities. Thus, the heavy ion composition, and in particular O+, plays an important role in understanding geomagnetic variability (SSA-1) and the radiation environment (SSA-6).

Understanding and modeling of the magnetospheric composition and all of the associated feedback mechanisms is an extremely challenging task, and an important issue for space weather models. While some progress has been achieved in understanding how O+ is energized and transported from the central plasma sheet to the ring current, there is a gap in our understanding of the source and transport mechanisms in the ionosphere and to the magnetosphere largely as a result of the complex interplay between the solar wind, magnetospheric activity and the ionosphere. Mechanisms include transport of ionospheric material from mid- to high-latitudes, potentially through the cusp region and polar cap, cusp outflow stimulated by precipitation and Poynting flux (in turn stimulated by solar wind variability), outflow from the auroral regions, and outflow directly from subauroral latitudes leading to the warm plasmaspheric cloak.

This topic focuses on how and when ions, and in particular O+, are supplied from the ionosphere to the magnetosphere and where it becomes available for energization.
Newly available data from the Van Allen Probes and MMS satellites as well as older data sets such as Cluster and DMSP sampling both inner and outer magnetosphere, and covering eV to MeV energies provides an unprecedented opportunity to determine the accumulation and energization processes of O+ ions throughout the magnetosphere during geomagnetic storms. A number of other currently-operating spacecraft, as well as new missions soon to launch, support these topics as well, forming a comprehensive suite of observations that can support studies of conductivity, as well as (in many cases) interhemispheric effects. In addition, global models and computational capabilities have reached the level of maturity allowing users to take full advantage of the available data.

5.2 Goals and Measures of Success

The goal of this FST is to understand how heavy ions, and in particular O+ ions, are energized and transported from the ionosphere to the magnetosphere where they become available for further energization up to ring current energies.

Proposals to this FST should aim to determine heavy ion characteristics in the magnetosphere across a wide range of L-shells/geomagnetic latitudes, including the inner magnetosphere that will allow one to identify and differentiate various ionospheric source regions, such as plasmaspheric cloak, auroral outflow, and cusp outflow; identification of what controls heavy ion characteristics in the ionosphere and magnetosphere; and identification of the important sources and transport processes including through wave-particle interactions.

All studies must consider data and model uncertainty and how the sources of error impact the results.

5.3 Types of Investigations

As there is currently an FST which is dedicated to a portion of this topic considering how O+ is energized and transported through the transition region from the plasma sheet to the ring current, proposed investigations should focus on other aspects of the heavy ion circulation throughout the magnetosphere while being aware of, incorporate, and work with the currently funded FST. Suggested types of investigations include, but are not limited to:

- Data analysis seeking to characterize ionospheric and magnetospheric processes that directly or indirectly are critical for the supply of O+ to the magnetosphere. This includes their dependence on solar and solar wind drivers, seasonal changes, and magnetospheric drivers including wave-particle interactions.
- Data analysis that seeks to characterize the spatial and temporal distribution of O+ in the inner magnetosphere to the outer magnetosphere.
- Modeling seeking to understand and confirm the physical mechanisms that directly or indirectly are critical for the supply of O+ to the magnetosphere.
5.4 Focus on Enabling Predictability and Interaction with User Communities

An important component of the FST is to demonstrate responsiveness relevance to user needs. Individual proposals must identify how they will contribute to the FST and improve magnetic data that can eventually be used in user/operational mode.

6. Understanding Physical Processes in the Magnetosphere–Ionosphere / Thermosphere / Mesosphere System during Extreme Events

6.1 Target Description

Detailed observations of heliospheric processes during superstorms are rather limited, and statistics is sparse. Superstorms are unusually strong storms where the Dst index reaches below 300 nT and even below 500 nT in extremely rare circumstances. Evidence that geomagnetic storms can potentially be much stronger than that observed during the space age comes from historical observations of the solar storm in 1859, known as the Carrington event, and recent observations of the very powerful Coronal Mass Ejections (CME) that occurred in July 2012, that largely missed the Earth. Understanding the effects of superstorms and the strongest (e.g., 1 in 100 years) space weather events is a key component of the National Space Weather Action Plan. Such an understanding is required to develop mitigation strategies for worst case Geomagnetically Induced Currents (GIC), spacecraft charging, communication outages and navigation error scenarios. Understanding the coupling processes that occur under extreme conditions presents a challenge, as these processes may be very different than those under the more typical conditions for which existing physics-based models were developed. Saturation processes or nonlinear responses of the systems during extreme driving may preclude extending empirical parameterizations to the more extreme values for drivers that occur during such events. Using available observations of superstorms and historical records of extreme events, this FST will conduct focused investigations of key physical processes needed to extend modeling capabilities to the conditions that occur during extreme events. This proposed topic is relevant to nearly all of the Strategic Science Areas (SSAs).

6.2 Goals and Measures of Success

The goal of this focused topic is to identify the key physical processes that differentiate superstorms from more typical storms by using any and all available observations of superstorms and historical records of extreme events, so that modeling capabilities can be accurately extended to extreme events. The efforts of this FST will be targeted at filling critical gaps in our understanding of the Magnetosphere-Ionosphere/Thermosphere/Mesosphere System dynamics that occur during extreme events. This FST will improve our ability to model superstorms and Carrington-type storms and improve our ability to predict the consequences of the extreme events. The advances made by this FST may feed into a future long-term strategic capability topic on the integrated magnetospheric response to superstorms. Successful investigations will provide quantifiable evidence of progress toward accurate simulation of extreme Space Weather events and their effects in the Magnetosphere-Ionosphere/Thermosphere/Mesosphere System.
All studies must consider data and model uncertainty and how the sources of error impact the results.

6.3 Types of Investigations

Types of investigations appropriate for this focused topic include, but are not limited to:

- Theoretical and modeling studies focused on understanding the physics of solar wind-magnetosphere interaction changes from normal times to superstorms/extreme events (e.g. boundaries, currents, properties of plasma populations, etc.).
- Multipoint and multi-instrument observations of superstorms.
- Studies concerning the response of currents, radiation belt particle fluxes, and magnetospheric electric and magnetic fields to extreme driving.
- Quantifying the limitations of current models in simulating responses (e.g., saturation effects, balance between currents and plasma, topology, etc.).
- Development of the data-driven models and analysis of the response of the Magnetosphere-Ionosphere/Thermosphere/Mesosphere System to extreme driving.
- Development and validation of simulations that can accurately represent the extreme responses that occur in the magnetosphere and ionosphere during superstorms and Carrington-type storms.
- Application of the extreme value theory to understand the extreme behavior of heliophysics systems and making predictions.

7. Submission and Evaluation Process

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process (see the overall description of a two-step process in the ROSES Summary of Solicitation Section IV.b.vii).

In addition to the general requirements and restrictions (e.g., in Table 1 of the ROSES Summary of Solicitation and in Heliophysics Research Program Overview) this program element has specific compliance constraints for both format (e.g., Sections 7.1.1 and 7.2.1) and content, e.g., involving data (see Sections 1.1 and 7.2.3). These compliance rules ensure fairness and are enforced strictly by the Heliophysics Division. Proposals that are deemed non-compliant will typically be returned without review or, if not caught until during or after the review, will typically be declined despite any merits that may have been found by peer review.

7.1 Step-1 Proposals

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program element.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). The Step-1 proposal must be submitted by the organization’s Authorized Organizational Representative (AOR). No budget or other uploaded files are required. Only proposers
who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Step-1 proposals will be checked for compliance, but they will not be evaluated. The Step-1 proposal title, science goals and objectives, and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) cannot be changed between the Step-1 and Step-2 proposals. The expected format and evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal.

7.1.1 Step-1 Proposal Format

The Step-1 proposal is restricted to the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. It should include the following information:

- A description of the science goals and objectives to be addressed by the proposal.
- A brief description of the methodology to be used to address the goals and objectives.
- A brief description of "Proposed Contributions to the Focused Science Team Effort" (see Section 7.2.2 for the material to be summarized).

The NSPIRES system for proposal submission requires that Step-1 proposals include a summary (i.e., abstract) describing the proposed work as outlined above. The proposal summary is entered directly into a text field in NSPIRES. No PDF attachment is required or permitted for Step-1 proposal submission. All information for the proposal summary will be entered within the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. Proposers will be notified by email when they are able to submit their Step-2 proposals.

7.2 Step-2 Proposals

Proposers should refer to the "Instructions for Submitting a Step-2 Proposal" under "Other Documents" on the NSPIRES page for this program element. A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). The Step-2 proposal must be submitted by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title, science goals and objectives, and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) must be the same as those in the Step-1 proposal.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers that have received a noncompliance letter are not eligible to submit a Step-2 proposal.

Proposers are expected to provide mail-in reviews for one to three proposals in this competition. Much of the science expertise lies in the PI/Co-I community, because, increasingly, nearly the entire Heliophysics community proposes. In order to maintain a high caliber review process, it is important to get the additional mail-in reviews to cover all proposals fairly.

B.6-12
7.2.1 Step-2 Proposal Format

All proposals submitted to ROSES must strictly conform to the formatting rules. Proposals that violate the rules may be rejected without review or declined following review if violations are detected during the evaluation process.

- The Scientific/Technical/Management section must not exceed the length specified in this Program Element (see Section 9 below).
- Margins: No less than 1 inch on all sides.
- Page size: The PDF must be set for a standard US letter page size of 8.5 × 11 inches.
- Font: Times New Roman, 12-point or larger. If an alternate font is used, it must meet the requirement of having, on average, no more than 15 characters per horizontal inch, including spaces. Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line spacing settings must produce text that contains, on average, no more than 5.5 lines per vertical inch. Proposers may not adjust line spacing settings for a selected font below single spaced.
- Figure captions: Captions must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Expository text necessary for the proposal may not be located solely in figures or tables, or their captions.

Guidelines for submitting Step-2 full proposals, other than those listed above, are specified in the NASA Guidebook for Proposers. The guidelines above supersede those found in the Guidebook.

In order to be compliant with this ROSES program element, each FST Step-2 proposal submitted must contain a section that must be entitled “Proposed Contributions to the Focus Team Effort” and identified in the proposal's table of contents. Failure to include this section will result in the proposal being judged noncompliant, and the proposal will be returned without review. This section must include the following three items:

- The relevance of the proposal to the scientific objectives of the Focused Topic.
- The potential contributions (e.g., data sets, simulation results, understanding of physical mechanisms, etc.) from the proposed effort to the Focused Science Team's effort.
- Metrics and milestones for determining the successful progress and outcome of the proposed research.

7.2.2 Step-2 Evaluation Criteria

Compliant proposals will be evaluated according to the criteria specified in Section VI(a) of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. These criteria are (1) intrinsic scientific/technical merit and (2) work effort realism/reasonableness. In addition, the relevance of the proposed science goals and objectives to those of the FST will be evaluated.
Work effort realism/reasonableness includes assessing the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. Only necessary Co-Investigators and Collaborators should be included, and their specific tasks and roles in the investigation must be clearly laid out in the proposal work plan. The NASA Guidebook for Proposers states, "NASA strongly encourages PIs to specify only the most critically important personnel to aid in the execution of their proposals."

For Focused Science Topics, the evaluation for relevance is dependent on the particular Focused Science Topic. Each proposal must demonstrate that the investigation is appropriate for the FST selected. This will be strictly enforced. In addition, each proposal submitted must contain a section, entitled "Proposed Contributions to the Focused Science Team Effort" and it must be identified in the proposal's table of contents. Failure to include this section may result in the proposal being returned without review.

### 7.2.2 Step-2 Required Additional Section on Proposed Contribution to the Focused Science Team Effort

Proposals to this program element must address the proposed contribution to the Focused Science Team effort, which is now one of the evaluation criteria (see Section 7.2.3). This text will be provided by proposers in a 4000-character plain text box on the NSPIRES cover page, rather than in the text of the proposal, so it does not count against the 15-page limit for the Scientific/Technical/Management section of the proposal. Failure to complete this section will result in the proposal being judged noncompliant, and the proposal may be returned without review. This section must address the following three topics:

- The relevance of the proposal to the scientific objectives of the Focused Science Topic,
- The potential contributions (data sets, simulation results, understanding of physical mechanisms, etc.) of the proposed effort to the Focused Science Team's effort, and
- Metrics and milestones for determining the successful progress and outcome of the proposed research.

The discussion in this section must describe how the proposed project would fulfill the FST goals. Proposals that identify Types of Investigation(s) listed in Sections 3 through 6 above (see Sections 3.3, 4.3, 5.3, or 6.3) must describe how the proposal addresses those investigations. For proposals that include Types of Investigations not listed in the FST description, the discussion must summarize those proposed investigations and describe how they would meet the Focused Science Topic goals.

Although Living With a Star program elements in previous ROSES announcements required this discussion in the 15-page main body of the proposal (the Scientific/Technical/Management section), this section has now been moved to the proposal front matter. No discussion of these topics is
expected in the 15-page main body and any such discussion in the main body will not be considered in the evaluation of the Potential Contribution to the Focused Science Team Effort.

This section in the front matter will only be used in the evaluation of the Potential Contribution to the Focused Science Team Effort criterion. No discussion in this section will be considered in the evaluation of Intrinsic Merit or Cost Reasonableness.

7.2.3 Step-2 Evaluation Criteria

Compliant proposals will be evaluated according to three criteria: (1) Intrinsic Merit, (2) Potential Contribution to the Focused Science Team Effort, and (3) Cost Reasonableness. The Intrinsic Merit and Cost criteria will be evaluated primarily as specified in the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. The Relevance criterion, as described in the NASA Guidebook for Proposers will be evaluated as part of Potential Contribution to the Focused Science Team (Section 7.2.2) and, based on this evaluation, any proposal that would contribute to an FST objective is, by definition, relevant to this program element.

The Intrinsic Merit evaluation will include consideration of the proposal’s response to the FST’s specific requirements outlined in the FST descriptions (see Sections 3 through 6 above). This includes 1) scientific and technical scope (described under Target Description in the FST section), 2) Goals and Measures of Success, 3) Types of Investigation, and, if required by the FST, 4) Focus on Enabling Predictability and Interaction with User Communities.

The evaluation of Intrinsic Merit will consider only information contained within the 15-page main body of the proposal (the Scientific/Technical/Management section). Most proposals are expected to describe a complete scientific study (i.e. clearly identified science questions and a project that achieves closure on those questions); however, this program element also accepts proposals that lack a complete scientific study but do describe a project that would enable or enhance the FST’s activities (e.g. develop a data set, implement a model).

Regardless of the project, all proposals must identify science questions responsive to the FST’s goals that the proposed work would address.

As part of the review process, the evaluation will include the determination of whether the proposal violates the restrictions in Section 1.1, including the use of data not in a publicly available archive 30 days before the Step-2 deadline. Non-compliant proposals will face the consequences described in Section 7.

The evaluation of the Potential Contribution to the Focused Science Team Effort will only consider the three topics specified in Section 7.2.2: 1) relevance of the proposal to the scientific objectives of the FST, 2) potential contributions of the proposed effort to the FST’s effort, and 3) metrics and milestones for determining the successful progress and outcome of the proposed research. This evaluation will be based on only the discussion contained within the 4000-character text box on the NSPIRES cover page; no discussion of these topics is expected in the 15-
page main body and any such discussion in the main body will not be considered in the evaluation of the Potential Contribution to the Focused Science Team Effort.

8. Award Types

The Heliophysics LWS Science program will primarily award funds through three vehicles: (1) grants, (2) interagency transfers, and (3) awards to NASA centers. This call will not award contracts, as it is not appropriate for the nature of the work. Please also see the ROSES Summary of Solicitation, Section II a.

9. Summary of Key Information

<p>| Expected annual program budget for new awards | ~$4.1 3.75 M |
| Number of new awards pending adequate proposals of merit | ~ 18 – 22 15–20 |
| Maximum duration of awards | Focused Science Topics: 4 years |
| Due date for Step-1 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Due date for Step-2 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Planning date for start of investigation | No earlier than 6 months after the Step-2 proposal due date. |
| Page limit for the central Science-Technical-Management section of proposal | 15 pp; one extra page permitted for proposals to be Team Leader of a Focused Science Topic; see also Table 1 of ROSES and the NASA Guidebook for Proposers |
| Relevance | This program is relevant to the Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to the FSTs in this program element are, by definition, relevant to NASA. See Section 7.2.3 regarding evaluation criteria. |
| General information and overview of this solicitation | See the ROSES Summary of Solicitation. |
| Detailed instructions for the preparation and submission of proposals | See the NASA Guidebook for Proposers at <a href="http://www.hq.nasa.gov/office/procurement/nraguid">http://www.hq.nasa.gov/office/procurement/nraguid</a> ebook/. |
| Submission medium | Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. |
| Web site for submission of proposals via NSPIRES | <a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376) |
| Web site for submission of proposals via Grants.gov | <a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726) |</p>
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| NASA point of contact concerning this program | Jeff Morrill  
Heliophysics Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: (202) 358-3744  
Email: jeff.s.morrill@nasa.gov |
NOTICE: Proposal submission to all calls in Heliophysics will be done by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an Authorized Organizational Representative (AOR). See Section 3 for details.

This year, Resident Archives are not being offered; the data from missions is now flowing directly to Final Archives, and the "ramp-down funding" when a mission ends will be expected to cover any final expenses for transitioning data to a final archive.

Likewise, the Value Added Enhancements portion of the HDEE will not be offered this year while the approach to be taken in this area is being reconsidered. Any thoughts or suggestions should be shared with either J. Hayes or D. A. Roberts.

Proposers to this program element are not required to provide a data management plan via the NSPIRES cover page question. Instead, that is superseded by instructions in the Sections below that place more detailed descriptions into the body of the Scientific/Technical/ Management Section of proposals. See Sections 2.2 and 2.3, below.

1. Introduction

The Heliophysics Data Environment Enhancements (H-DEE) program is a component of the Heliophysics Research Program and proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in B.1 of this ROSES NRA.

The work carried out for this program should be in support of the Heliophysics strategic goals and objectives in NASA’s 2014 Strategic Plan and Chapter 4.1 of the NASA 2014 Science Plan (https://science.nasa.gov/about-us/science-strategy). The recommended priorities of the Heliophysics community are also discussed in the National Research Council Decadal Strategy for Solar and Space Physics report, Solar and Space Physics: A Science for a Technological Society (http://www.nap.edu/catalog/13060/solar-and-space-physics-a-science-for-a-technological-society). Note particularly the sections of the Decadal report dealing with the "DRIVE" initiative, more specifically "R" and "I," and the discussion in Appendix B.

The H-DEE program encompasses the data environment needs throughout Heliophysics, including Solar, Heliospheric, and Geospace Sciences (Magnetosphere and Ionosphere/Thermosphere/Mesosphere [ITM]).

As part of a mission-oriented agency, the Heliophysics Research Program seeks to fund those efforts that directly impact NASA missions or interpretation of their data. Therefore, investigations that are judged to be more appropriate for submission to other Federal agencies, even if of considerable merit, will not be given high priority for funding through this solicitation.
2. Heliophysics Data Environment Enhancements (H-DEE)

The basic building blocks of the NASA Heliophysics Data Environment (HPDE) are well-documented, carefully calibrated, and easily used data products, typically the result of the reduction of numbers from spacecraft telemetry to the physical quantities that enter the equations we use to model space plasmas. Many such datasets were produced before the era of standard formats and inexpensive storage devices, and others have been served more recently in a variety of ways from specialized web sites. This call solicits proposals (Data Upgrades) to upgrade datasets that are of continuing value but that do not currently fit easily into the HPDE. Resident Archives will no longer be supported; these are no longer needed as the data from current missions is flowing directly to Final Archives.

As detailed in the Heliophysics Scientific Data Management Policy (found at http://hpde.gsfc.nasa.gov), which gives further information about the HPDE, the Final Archive for Space Physics data, where the data will be preserved and served for the long-term, is the NASA Space Physics Data Facility (SPDF). Solar data are handled by NASA’s Solar Data Analysis Center (SDAC), although the specific archiving arrangements are currently being dealt with on a case-by-case basis. Proposers working with solar data should expect to work with SDAC, the Heliophysics Data and Model Consortium (HDMC), and NASA Headquarters on a long-term plan. (The HDMC oversees work under the H-DEE grants.)

In recent years, NASA Heliophysics (HP) has developed standard ways of registering data products and thereby enabling searches for HP data. Most HP data products are now described in terms of the Space Physics Archive Search and Extract (SPASE) Data Model (see http://www.spase-group.org/ for information on SPASE and http://heliophysicsdata.gsfc.nasa.gov for a "public face" to the registry) that provides a uniform terminology and an associated registry service. The SPASE description of data products can be done directly by the data provider, but the SPASE group should be able to provide descriptions, as needed. Thus, people undertaking data projects under this call should determine what product(s) will require SPASE descriptions and, as needed, contact the SPASE group via https://hpde.gsfc.nasa.gov/spase_metadata.html for providing SPASE descriptions.

A frequent problem with past data is that it has been stored in a wide variety of idiosyncratic formats for various reasons. A major goal of Data Upgrade proposals will be to put data in uniform, sustainable formats. For solar physics data, this should be Flexible Image Transport System (FITS), and for space physics data Common Data Format (CDF) is generally the format of choice. Some Ionosphere, Thermosphere, Mesosphere (ITM) data are closely allied to Earth Sciences, and thus, NetCDF is appropriate. ASCII is acceptable as a "format," as long as the files are well described, but the self-documenting formats are to be preferred.

In summary, this call solicits proposals designed to upgrade existing Heliophysics data products to improve the quality, utility, and accessibility of datasets relevant to Heliophysics research. Possible upgrades include placing datasets online, translating datasets into more readily accessible formats, improving the data quality, and improving metadata. Note that the term "dataset" as used here can apply only to data products.
derived directly from (primarily) NASA-funded instruments, and not to higher-level datasets derived from the results of data analyses, data assimilation, and modeling. The latter “upgrades” should be done in the context of a standard research proposal and documented in the data plan for that proposal.

2.1 Programmatic Considerations

Proposals must discuss the relationship of the proposed effort to the present, as well as anticipated, state of knowledge in the field, to the relevant datasets that should be available from any related planned missions, and to any related NASA community research efforts.

All proposals to this call should address two general areas:
I. Science Rationale. The science rationale includes:
   a. Key objectives and their scientific importance;
   b. Relationship to NASA strategic plans and the HP data policy; and
   c. Uniqueness or scientific advantages of the proposed approach compared to alternatives.

II. Architecture and Implementation Approach. The architecture and implementation approach includes:
   a. Technical approach and its requirements and feasibility;
   b. Data products or other resources supported or enhanced;
   c. Metadata and documentation of products and required ancillary data or enhancements;
   d. Use of standard data formats; and
   e. Compatibility with the Space Physics Archive Search and Extract (SPASE) Data Model.

The above issues will all be addressed naturally by following the format required in Sec. 2.2.

It is anticipated that approximately $500K will be made available to support new selections for Data Environment Enhancements, all for Data Upgrades, with a typical proposal being for at most $50K and one year. Proposals for more than one year or more than $50K will be considered, but the increased request for resources must be explicitly justified.

Submitting a proposal to this program element implies that if an award is made, a copy of any data product will be made public, preferably via one of the two discipline archives: the Space Physics Data Facility (SPDF), or the Solar Data Analysis Center (SDAC). Other plans for data delivery and archiving must be supported with cogent reasons.

Proposers to this program element are not required to provide a data management plan via the NSPIRES cover page question. Instead, that is superseded by instructions in the sections below that place more detailed descriptions into the body of the Scientific/Technical/Management section of proposals. See Sections 2.2 and 2.3, below.
2.2 Data Upgrades Proposals

Funding is intended to support small, short-term (typically one year) awards to improve the quality, utility, and accessibility of datasets relevant to Heliophysics research. Priority will be given to those proposals from data providers of NASA-sponsored datasets, but other data relevant to HP research will be considered.

A proposal for a Data Upgrade MUST include explicit subheadings as given in each of the bulleted points below, in the order below, with a discussion of each topic indicated (explicitly note if not applicable):

- **Products to be Produced**: A clear description of the products to be produced, including the time span covered; the physical quantities to be included with their temporal and/or spatial resolution; and the format(s), coordinate system(s), and processing level(s) (e.g., calibrated in physical units or not, the former being far preferable).

- **Scientific Utility**: An argument for why the datasets involved were scientifically useful in the past and for how the proposed upgrade will make them more useful in the future. Specific research projects should be mentioned, along with an assessment of whether these will bring qualitatively new insights. This should be supported by, e.g., refereed publications or other citations and uses by people outside the PI team.

- **Method of Production**: How the upgrade will be produced, including a presentation of relevant algorithms.

- **Demonstration of Improvement**: A demonstration that the proposed upgrade represents a significant improvement in the quality and/or utility of the data, its format, and/or its accessibility. “Before and after” graphs are especially helpful, and the validation of techniques and results must be discussed.

- **Current Data Status**: The current status of the data and a demonstration that the data can still be retrieved from their current storage medium.

- **Data Volume**: A statement of the current data volume, the expected data volume after processing, and the fraction of the data expected to be recovered.

- **Metadata Plan**: A plan for providing required metadata and ancillary data and descriptions needed for independent scientific usability. A plan for providing SPASE descriptions of products, usually in conjunction the SPASE group or a NASA HP data center (SPDF or SDAC), should be included.

- **Archive and Dissemination Plan**: A clear discussion of how the resource will be placed in an HP Data Archive for general access or otherwise made easily available, and a description of the documentation to be provided of the dataset as required for scientific use.

- **Need for Resources**: A discussion that demonstrates that the requested resources are necessary and sufficient for success in achieving the proposed upgrade. If the product is ongoing, the plan for supporting the continuation should be stated.

The discussion of each of these points may be brief, but each point must be clearly addressed, and addressing these points is all that is required for a proposal. The
Scientific/Technical/Management section (including figures) of proposals shall be no more than five pages.

3. Submission and Evaluation Process

3.1 Step-1 Proposals

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in Section IV. (b) vii of the ROSES Summary of Solicitation. A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal must be submitted by the organization Authorized Organizational Representative (AOR). No budget or other elements are required. Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Full (Step-2) proposals must contain the same science goals proposed in the Step-1 proposal. In addition, the Step-1 proposal title and investigators (Principal Investigator, and Co-Investigators, Collaborators, Consultants, and Other Professionals) may not be changed in between the Step-1 and Step-2 proposals. The expected format and compliance evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later.

3.1.1 Step-1 Proposal Format and Content

The Step-1 proposal is restricted to the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. It should include the following information:

- A description of the science goals this proposal is enabling and that are appropriate for Heliophysics investigations.
- A brief description of the methodology to be used to address the science goals and objectives. This will include a description of the data products to be upgraded, and an overview of the upgrade that is expected.

The NSPIRES system for proposal submission requires that Step-1 proposals include a summary (i.e., abstract) describing the proposed work as outlined above. The proposal summary is entered directly into a text field in NSPIRES. No PDF attachment is required or permitted for Step-1 proposal submission. All information will be entered within the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. Proposers will be notified when they are able to submit their Step-2 proposals.

3.1.2 Step-1 Evaluation Criteria

NASA may determine Step-1 proposals to be noncompliant based on the requirements listed in Section 2 and its subsections. PIs of noncompliant proposals will not be eligible to submit the associated Step-2 proposal and will receive a letter to this effect.
3.1.3 Request for Reviewer Names
Proposers are strongly encouraged to provide names and contact information for up to five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is or stand to benefit financially from the selection (or otherwise) of the proposal. This information can be supplied via the SARA web page at http://science.nasa.gov/researchers/suggested-reviewers/.

3.2 Step-2 Proposals
A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). The Step-2 proposal must be submitted by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title, Principal Investigator, and all Co-Investigators, Collaborators, Consultants, and Other Professionals must be the same as those in the Step-1 proposal. Step-2 proposals must contain the same scientific goals proposed in the Step-1 proposal.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers that have received a noncompliant letter are not eligible to submit a Step-2 proposal.

Proposers may be asked to provide mail-in reviews for one to three proposals in this competition. Much of the science expertise lies in the PI/Co-I community, because increasingly, much of the Heliophysics community proposes. In order to maintain a high caliber review process, it is important to get the additional mail-in reviews to cover all proposals fairly.

3.2.1 Step-2 Proposal Content
Proposers should refer to the PDF entitled "How to submit a Step-2 proposal" that will appear under "Other Documents" on the NSPIRES page for this program after the Step-1 proposal due date. The process for preparation and submission of the Step-2 (full) proposals is that for any other ROSES proposal. Guidelines for content and formatting of Step-2 full proposals are specified in the NASA Guidebook for Proposers and the ROSES Summary of Solicitation.

Proposals should include the following within their Scientific/Technical/Management section: clear descriptions of (1) specific Heliophysics scientific problems that could be addressed with the ground-based data, upgraded data, or archived data in conjunction with other HP resources (2) the importance of the problems, and (3) the details of the technical approach to providing the promised data or archival enhancements. Proposals should be clear on how data will be made to conform to the Heliophysics Data Policy. The answers to the above points should arise naturally in following the format in Section 2.2.
3.2.2 Step-2 Proposal Format

Step-2 proposals that are not complaint with format requirements may be rejected without review. See Section IV (b) ii of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers for further details.

- The Scientific/Technical/Management section must not exceed five pages.
- Margins: no less than 1 inch on all sides, with a page size of 8.5 × 11 inches.
- Font: Times New Roman, 12-point or larger. If an alternate font is used, it must meet the requirement of having, on average, no more than 15 characters per inch. Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line spacing settings must produce text that contains, on average, no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single spaced.
- Figure captions: Captions must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Expository text necessary for the proposal may not be located solely in figures or tables, or their captions.

Guidelines for submitting Step-2 full proposals, other than those listed above, are specified in the NASA Guidebook for Proposers. The Guidelines above supersede those found in the Guidebook.

3.2.3 Step-2 Evaluation Criteria

Compliant proposals will be evaluated according to the criteria specified in the NASA Guidebook for Proposers. These criteria are intrinsic scientific and technical merit, relevance to NASA’s objectives, and cost realism/reasonableness.

The evaluation of scientific and technical merit will include:

- Compelling nature and scientific priority of science goals enabled by the Data Upgrade, including the importance of the problem within the broad field of Heliophysics; the unique value of the investigation to enable scientific progress in the context of current understanding in the field, and the importance of carrying out the Upgrade now.
- Appropriateness and feasibility of the methodology, including the appropriateness of the selected algorithms for completing the investigation and the feasibility of the methodology for ensuring success.

Based primarily on these two factors within merit, the evaluation will consider the overall potential science impact and probable success of the investigation.

Relevance will be judged by whether the proposal addresses the goals and objectives of a Data Upgrade.

Cost realism/reasonableness will include assessing the amount of work to be accomplished versus the amount of time proposed. Only necessary Co-Investigators
and Collaborators should be included, and their specific roles in the investigation must be clearly laid out. Use of Collaborators whose only role is advisory is discouraged.

4. Available Funds

It is anticipated that approximately $500K will be made available to support new selections for Data Environment Enhancements, all for Data Upgrades, with a typical proposal being for at most $50K and one year. Proposals for more than one year or more than $50K will be considered, but the increased request for resources must be explicitly justified.

5. Summary of Key Information

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<td>Number of new awards pending adequate proposals of merit</td>
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<td>Due date for full Step-2 proposals</td>
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<td>Relevance</td>
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<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
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<td>Detailed instructions for the preparation and submission of proposals</td>
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</tbody>
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| **NASA points of contact concerning this program element.** | Jeffrey J. E. Hayes  
Heliophysics Division  
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Washington, DC 20546-0001  
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B.7-9
NOTICE: January 2, 2018 the point of contact for this program element has changed. See Section 6.

This program will accept proposals by a two-step process, in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an Authorized Organizational Representative (AOR). Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. Step-1 proposals will be checked for compliance, but will not be reviewed. See Section 3 for details. Step-2 proposals will be limited to ten pages. Only investigations focused on Magnetospheric Multiscale (MMS) data are permitted.

1. Scope of Program

The Heliophysics Guest Investigators program is a component of the Heliophysics Research Program. It consists of two program elements in ROSES 2017. The Open Heliophysics Guest Investigator (H-GI) program (B.4) is offered for investigations that draw extensively upon the data sets from the missions of the Heliophysics System Observatory (HSO). This element, the Magnetospheric Multiscale Guest Investigator (MMS-GI) program (B.8), is offered only for investigations that primarily use data from the Magnetospheric Multiscale (MMS) Mission, which was launched in March 2015 and will complete its primary mission by the Step-2 deadline for this opportunity.

1.1 Overview

Five Heliophysics Senior Review panels and the recent Decadal Survey have reviewed the H-GI program in the context of the activities of the operating missions. The reviews have uniformly endorsed a strong H-GI program to complement the mission-sponsored investigations (See http://science.nasa.gov/heliophysics/senior-review/ for the reports of the Senior Review panels). Additionally, the most recent decadal survey (See http://www.nap.edu/catalog.php?record_id=13060) endorsed a substantial increase in resources for mission specific calls under the GI program. Those are and will be solicited through this program element, this year called the MMS-GI program. This call is part of the implementation of the Diversify, Realize, Integrate, Venture, Educate (DRIVE) initiative recommended in the aforementioned decadal survey.

This particular ROSES element supports investigations whose primary focus is the analysis of MMS data. Proposals should use primarily MMS data to address (1) the goals of the MMS mission (found at https://mms.gsfc.nasa.gov/about_mms.html) or (2) any of the relevant goals of the Heliophysics Decadal survey (Solar and Space Physics: A Science for a Technological Society http://www.nap.edu/catalog.php?record_id=13060):

1. Determine the origins of the Sun’s activity and predict the variations in the space environment;
2. Determine the dynamics and coupling of Earth's magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs;
3. Determine the interaction of the Sun with the solar system and the interstellar
medium;

4. Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.

This program is intended to maximize the scientific return from this recently launched mission by providing support for research of a breadth and complexity beyond presently funded investigations. As with the open element of the H-GI program, investigations may employ theory, models, and data from other sources, as needed, to interpret and analyze NASA’s MMS data, but only as a secondary emphasis. That is, in any such instance, the proposal must clearly demonstrate that the theory, models, and/or data in question are necessary for interpretation of the MMS data and are not themselves the primary object of the investigation. Development of new models and theories is not solicited.

The MMS mission relies on four spacecraft with an identical set of 11 instruments comprised of 25 sensors. The four spacecraft fly in an adjustable, pyramid formation that enables them to observe the three-dimensional structure of magnetic reconnection. Four spacecraft give MMS the necessary observational perspectives to determine whether reconnection events occur in an isolated locale, everywhere within a larger region at once, or traveling across space. In addition to crossing the dayside magnetopause in search of reconnection, MMS has captured ~400 crossings of Earth’s bow shock and has spent time in the near magnetotail observing e.g., dipolarization events and injections. See https://mms.gsfc.nasa.gov/ for additional information on the mission.

1.2 Avoidance of Duplicate Investigations

Proposers should be aware that the mission science teams are already funded to do a substantial amount of research. Proposals whose intent or purpose is to duplicate or directly supplement existing investigations already funded for approved space flight missions or other Heliophysics research programs are not appropriate for either element of the H-GI program. However, it should be noted that proposals aiming at providing independent analysis of investigations conducted by the mission team are compliant with all elements of the H-GI program. A Principal Investigator (PI) or a Co-Investigator (Co-I) on MMS may also propose as a PI or Co-I to this program element. However, such Heliophysics mission personnel must include in their proposal a description of their mission duties and clearly distinguish the proposed new activity from their existing responsibilities for mission operations and data analysis.

1.3 Data Availability

The requirements outlined in B.1 regarding data availability apply to this solicitation as well. All data to be used for proposed investigations must exist in a public archive 30 days before the Step-2 deadline. This applies to both the mission data and ancillary data from other sources. This is change from previous years that reflects NASA’s continuing commitment to its open data policy.
2. Submission and Evaluation Guidelines

2.1 General Considerations

Each Principal Investigator (PI) is allowed to submit one and only one Step-1 proposal to this program element. In that proposal, the Principal Investigator or Science PI must invest at least one month of labor to the investigation. Proposals utilizing a Science PI must mark that individual as such in NSPIRES and the individual must be named. Co-investigators (Co-Is) must each have a specific and defined task in the project, and the task must be essential to completion of the project. Use of collaborators is discouraged. Proposals may be declared noncompliant based on either the Step-1 or Step-2 proposal if they a) do not adhere to the requirements outlined above, b) are outside the scope of the MMS-GI program (see Section 2.2 below), or c) fail to meet submission guidelines specified below (Section 3).

2.2 Limitations and Scope

Proposals outside the scope of MMS-GI may be declared noncompliant based on either the Step-1 or Step-2 proposal. These include the following:

- Proposals that do not focus on analysis of data from MMS;
- Proposals for the same or essentially the same work submitted concurrently to other program elements in Appendix B or E, as specified in B.1 Section 1;
- Work for which the proposing organization (or investigators) are already funded by NASA. Where projects might appear to overlap, proposals must show that the proposed effort does not duplicate other awards, including awards as part of operating space flight missions;
- Proposals for model, tool, or theory development (see Section 1.1);
- The routine, long-term gathering of observational data;
- Investigations with the main purpose of supporting ground-based infrastructure or facilities.

3. Two-Step Submission Guidelines

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in Section IV. (b) vii of the ROSES Summary of Solicitation.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). The Step-1 proposal must be submitted by the organization Authorized Organizational Representative (AOR). No budget or other elements are required. Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Step-1 proposals will be checked for compliance, but they will not be evaluated. The Step-1 proposal title, science goals, and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) cannot be changed between the Step-1 and Step-2 proposals. The expected format and evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 proposal.
3.1 Step-1 Proposal Content

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal is restricted to the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. References and any other supporting material are not required, but, if included, must fit within the limit. The Step-1 proposal must include the following information:

- The science goals and objectives to be addressed by the proposal;
- A listing of the mission data to be used in the investigation;
- A listing of the data analysis methodology and any models or simulations to be used.
- A brief statement of the relevance of the problem to the program by using MMS data to address 1) the goals of the MMS mission or 2) the relevant Decadal survey goals.

The NSPIRES system for proposal submission requires that Step-1 proposals include a summary (i.e., abstract) describing the proposed work as outlined above. The proposal summary is entered directly into a text field in NSPIRES. No PDF attachment is permitted for Step-1 proposal submission. All information will be entered within the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. Proposers will be notified when they are able to submit their Step-2 proposals.

3.2 Step-2 Proposals

A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). The Step-2 proposal must be submitted via NSPIRES or Grants.gov by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title, science goals, and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) must be the same as those in the Step-1 proposal.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers that received a noncompliant letter are not eligible to submit a Step-2 proposal.

Proposers are strongly encouraged to provide names and contact information of five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is. This information can be supplied via the SARA web page at http://science.nasa.gov/researchers/suggested-reviewers/.

Proposers are expected to provide mail-in reviews for one to three proposals in this competition. Much of the science expertise lies in the PI/Co-I community because, increasingly, nearly the entire Heliophysics community proposes. In order to maintain a high caliber review process, it is important to get the additional mail-in reviews to cover all proposals fairly.
3.3 Step-2 Proposal Format

The process for preparation and submission of the Step-2 (full) proposals is the same for any other ROSES proposal. Guidelines for content and formatting full proposals are specified in Table 1 of ROSES and the NASA Guidebook for Proposers and the ROSES Summary of Solicitation.

Proposals are restricted to ten (10) pages for the Scientific/Technical/Management section and must include the following sections with the preferred order:

- The science objectives and perceived impact of the proposed work to the state of knowledge in the field; references to existing work in the field should be limited to that which is needed to justify the value of the science proposed;
- The data and methodology to be employed in conducting the proposed research; the proposal must demonstrate (1) that the data is appropriate to address the science objectives and (2) that the methodology is both appropriate and feasible to make substantial progress on the science objectives;
- The relevance of the proposed work to the goals of the program. This section must demonstrate how the proposed work uses MMS data to address 1) the goals of the MMS mission or 2) the relevant Decadal survey goals.
- A general plan of work, the management structure for the proposal personnel, and a description of the expected contribution to the proposed effort by the PI and each person as identified in the proposal whether or not they derive support from the proposed budget. Postdoctorals and students do not need to be identified by name.

Historically, proposals that address a single well-focused science objective with a limited set of specific science questions have been more successful at constructing methodologies that are demonstrably feasible and appropriate, as compared with those that propose to address a large number of science questions or that are directed at an overly-broad science topic.

3.3.1 Step-2 Proposal Formatting Requirements

All proposals submitted to ROSES must strictly conform to the formatting rules. Proposals that violate the rules may be rejected without review or declined following review if violations are detected during the evaluation process.

- The Scientific/Technical/Management section must not exceed the length specified in this Program Element (See Section 7 below).
- Margins: no less than 1 inch on all sides, with a page size of 8.5 × 11 inches.
- Font: Times New Roman, 12-point or larger. If an alternate font is used, it must meet the requirement of having, on average, no more than 15 characters per inch. Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line spacing settings must produce text that contains, on average, no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single spaced.
- Figure captions: Captions must follow the same font and spacing rules as the main text.
• Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Expository text necessary for the proposal may not be located solely in figures or tables, or their captions.

Guidelines for submitting Step-2 full proposals, other than those listed above, are specified in the NASA Guidebook for Proposers. Where they conflict, the guidelines above supersede those found in the Guidebook.

3.4 Step-2 Evaluation Criteria

Step-2 proposals that are not compliant with format requirements may be rejected without review. See Section IV (b) ii of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers for details. Proposals that have changed the scientific scope from that of their Step-1 proposal may be declared noncompliant.

Compliant proposals will be evaluated according to the criteria specified in the ROSES Summary of Solicitation Section VI (a) and the NASA Guidebook for Proposers and they are Relevance, Merit, and Cost. Clarifications and additions specific to this program element are listed below.

The evaluation of scientific and technical merit will include the following:
• Compelling nature and scientific priority of the proposed investigation's science goals and objectives, including the importance of the problem within the broad field of Heliophysics, the unique value of the investigation to make scientific progress in the context of current understanding in the field, and the importance of carrying out the investigation now.
• Appropriateness and feasibility of the methodology, including the appropriateness of the selected data, models, and analysis for completing the investigation and the feasibility of the methodology for ensuring scientific success.

Based on these two science and technical factors, the evaluation will consider the overall potential science impact and probability of success of the investigation.

Relevance to and priority within the MMS-GI program will be assessed based on criteria discussed above. Each proposal must demonstrate that the investigation is relevant and of high priority.

Cost realism/reasonableness includes assessing the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. Only necessary Co-Investigators and Collaborators should be included, and their specific tasks and roles in the investigation must be clearly laid out in the proposal work plan.

4. Available Funds

It is expected that there will be approximately ~$1.6M available in Fiscal Year (FY) 2018 to support new Heliophysics GI MMS investigations selected through this solicitation.
This solicitation has a cost cap of $525K per proposal. The combined 3-year total budget of a proposal may not exceed this amount. Proposals seeking total funding greater than this amount will be declared non-compliant.

5. Award Types

As begun in 2013, the MMS-GI program will primarily award funds through three vehicles: (1) grants, (2) interagency transfers, and (3) awards to NASA Centers. The MMS-GI program will not award contracts, because it is not appropriate given the nature of the work solicited. An institution that has received a contract previously can receive funds as a grant by not charging a fee.

6. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected annual program budget for first year of new awards</th>
<th>~$1.6M; See Section 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>~8-10</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>3 years; shorter-term proposals are allowed</td>
</tr>
<tr>
<td>Due date for Step-1 proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Due date for full Step-2 proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposals</td>
<td>10 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>8 months after proposal due date.</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is permitted. See also Section IV in the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposals via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
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<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-MMSGI</td>
</tr>
</tbody>
</table>
| **[Changed January 2, 2018]** NASA point of contact concerning this program element | **[Changed January 2, 2018]** Terry Onsager  
Heliophysics Division  
Science Mission Directorate  
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Washington, DC 20546-0001  
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B.9 Heliophysics Grand Challenges Research - Science Centers

NOTICE: Amended December 18, 2017. The Heliophysics Division had planned to offer Heliophysics Grand Challenges Research - Science Centers as program element B.9 of ROSES-2017, but scheduling issues prevented it from being released in 2017 so it will be solicited in ROSES-2018. Also, the point of contact has changed, see below.

The 2013 Solar and Space Physics Decadal Survey recommended the creation of "science centers to tackle the key science problems of solar and space physics that require multidisciplinary teams of theorists, observers, modelers, and computer scientists." In order to maximize the potential for these science centers to deliver on innovative and breakthrough science, a recent report by the National Academy of Sciences, Enhancing the Effectiveness of Team Science, recommended that they be designed with aspects that support collaboration and deep knowledge integration across the full range of expertise (scientific, computational, educational) within them. This was the subject of RFI NNH17ZDA008L in 2017.

The Heliophysics Division had planned to offer Heliophysics Grand Challenges Research - Science Centers as program element B.9 of ROSES-2017, but scheduling issues prevented it from being released in 2017 so it will be solicited in ROSES-2018.

The NASA point of contact concerning this program is:
Janet Kozyra,
Heliophysics Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: (202) 358-1258
Email: janet.kozyra@nasa.gov
B.10 HELIOPHYSICS - EARLY CAREER INVESTIGATOR PROGRAM (H-ECIP)

NOTICE: December 7, 2017. This is a DRAFT version of this program element posted for community comment. Comments must be submitted in writing to the point of contact for this Program Element listed in Section 6 by January 19, 2018. Individual responses should not be anticipated. Changes to this Program Element or additions to a Frequently Asked Questions (FAQs) page may be made in response to comments, as appropriate. The final text of this program element will appear in ROSES-2018 when it is released on February 14, 2018. The Step-1 proposal due date is tentatively scheduled as March 23, 2018, and the Step-2 proposal due date as June 15, 2018.

Proposal submission to all calls in Heliophysics will be done by a two-step process, in which a Notice of Intent is replaced by a required Step-1 proposal. The proposal title, science goals and investigators cannot be changed between the Step-1 and Step-2 proposals. Only proposers who are "invited" in response to the Step-1 proposal may submit a Step-2. See Section 3 for details.

All proposals submitted to ROSES must strictly conform to the formatting rules. Proposals that violate the rules may be rejected without review or declined following review if violations are detected during the evaluation process. See Section 3.2.1 for details.

1. Scope of Program

The Early Career Investigator Program (ECIP) in Heliophysics is designed to support outstanding scientific research and career development of scientists and engineers at the early stage of their professional careers. The program aims to encourage innovative research initiatives and cultivate diverse scientific leadership in Heliophysics. This program is designed to foster the E of the DRIVE (Diversify, Realize, Integrate, Venture, Educate) initiative put forward as a high priority recommendation of the 2013 Solar and Space Physics Decadal Survey, to educate, empower, and inspire the next generation of space researchers.

Awards are expected to be in the range of approximately $125K/year – $175K/year. The Early Career Investigator Program is a component of the Heliophysics Research Program and proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in Appendix B.1 of this ROSES NASA Research Announcement. Further background material concerning relevant research objectives can be found in the following documents:


1.1 Overview

The proposed research project must be led by a single, eligible (see further description below in Section 2.2 for eligibility) investigator serving as the Principal Investigator (PI). Indeed, this individual is likely the only essential team member; no paid Co-Investigators (Co-Is) or co-Principal Investigators, are permitted. (A Co-I/Science PI is permissible only for cases where the
institution does not allow research or un-tenured faculty to lead proposals.) Unpaid Co-Is are allowed and their role must be explained. Students and postdoctoral fellows may participate as supported team members. The proposed research may include collaborations. Proposers are strongly encouraged to read the Guidebook for Proposers at http://www.hq.nasa.gov/office/procurement/nraguidebook/, particularly Appendix B for the definitions of Collaborator vs. Co-Investigator and descriptions of China-related restrictions. This Early Career Investigator Program in Heliophysics, was established in 2017. The frequency of solicitation is intended to be every two years. This call represents a pilot program to examine the feasibility of creating an incentive program for top-performing early career heliophysicists. Depending on the outcomes of this call and contingent upon future funding, future calls may be issued through this ROSES element to support early career heliophysicists in future years.

The four high level science goals from the Heliophysics Decadal survey (Solar and Space Physics: A Science for a Technological Society www.nap.edu/catalog.php?record_id=13060) are:

1. Determine the origins of the Sun’s activity and predict the variations in the space environment;
2. Determine the dynamics and coupling of Earth’s magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs;
3. Determine the interaction of the Sun with the solar system and the interstellar medium;
4. Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.

System science and interdisciplinary proposals are encouraged. Proposals addressing the magnetospheres or the ionospheres of other planets are permitted, but must not duplicate proposals sent to other programs.

2. Submission and Evaluation Guidelines

2.1 General Considerations

Each Principal Investigator (PI) is allowed to submit one and only one Step-1 proposal to this program element. The expectation is that the Principal Investigator (or Co-I/Science PI) will invest a substantial portion of their time, of the order of 30% or more, to the investigation. Within the proposing team, the PI and any team members must each have specific and defined tasks in the project, and the tasks must be critical to the completion of the project. Use of Collaborators is encouraged. Proposals may be declared noncompliant based on either the Step-1 or Step-2 proposal if they are outside the scope of the H-ECIP program (see Section 2.2 below) or if they fail to meet submission guidelines specified below (Section 3).

2.2 Limitations and Scope

An ECIP proposal PI must be a recent Ph.D. recipient, defined as having graduated on or after January 1 of the year that is no more than ten years before the issuance date of this ROSES NASA Research Announcement (NRA) (i.e., after TBD, 2007/8; but see also third bullet below). To be eligible for an ECIP award, proposed PIs must meet the following requirements at the time of submission:

1. Be employed at a U.S. institution (see Section III(a) of the ROSES Summary of Solicitation regarding the no exchange of funds policy).
2. Be in a tenure-track or non-tenure-track position in either teaching or research or both, as long as the employing institution assumes the responsibility of submitting the proposal with the individual as the proposed PI or Co-I/Science PI. Research faculty are eligible. Those in temporary positions (like post-doctoral fellowships or other term-limited positions) are not eligible.

3. Despite being more than ten years beyond the receipt of their Ph.D. degrees, individuals who have interrupted their careers for reasons such as family leave or serious health problems may also be eligible. These applicants should make a written request for prior concurrence from NASA before the due date for Step-1 proposals to propose. NASA will provide a written response within three weeks.

4. Not hold or have held tenure (or equivalent) on or before the submission deadline of this program.

5. Not be a current or former recipient of the ECIP or Presidential Early Career Award for Scientists and Engineers (PECASE) (see further below) award.

The ECIP awards are typically up to five years in duration. The award amount for each is judged according to the scope of the proposed work and the overall competition.

For individuals who are civil servants, NASA will only pay portions of their salary that are not normally fully covered as part of agency budgets. NASA will cover salary (up to three months) for scientists whose compensation must be won through competitive proposals to their employing agency or other agencies. NASA salary support for scientists at other agencies is NOT intended to be provided "in lieu of" salary that would normally be paid by the employing agency. If civil servant salary for other agency personnel is requested as part of the proposal, the budget page must specifically outline the compensation approach that the agency uses to cover its civil servants and verify that any NASA salary support would not be replacing that normally paid by the employing agency.

Funds may be used for support of students (undergraduate or graduate) and/or postdoctoral fellows who are directly involved in the proposed research or for research expenses, such as costs incurred in field experiments, purchase of equipment and/or supplies, computing, travel, etc. If research collaboration is a component of the proposal, it is presumed that the collaborator(s) have their own means of research support; that is, an ECIP award may not include expenses for personnel or activities at collaborating institutions. With sufficient justification small costs are allowed for consultants, other professionals, or subcontractors for essential supporting work.

3. Submission and Evaluation Process

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process (see the overall description of a two-step process in the Summary of Solicitation Section IV. (b) vii and the special instructions regarding the Step-1 proposal below).
The ECIP proposals should be prepared in accordance with the instructions given in the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. The Step-2 Science-Technical-Management section of the proposal must contain a detailed statement of the proposed research of no more than 15 single-spaced pages including figures and tables.

3.1 Step-1 Proposals

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program element.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (tentatively planned to be March 23, 2018) given in Tables 2 and 3 of the ROSES-2018 Summary of Solicitation. The Step-1 proposal must be submitted by the organization’s Authorized Organizational Representative (AOR). See below regarding length and content of the Step-1 proposal. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Step-1 proposals will be checked for compliance and peer-reviewed. The Step-1 proposal title, science goals, and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) may not be changed between the Step-1 and Step-2 proposals. The expected format and evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal.

3.1.1 Step-1 Proposal Format

Step-1 proposals must be prefaced by a summary (i.e., abstract) entered directly into the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. The Step-1 proposal must be uploaded as a single PDF file. No appendix PDFs (e.g., a "total budget" or HEC request) are permitted for the Step-1 proposal. The main Science-Technical-Management section of the Step-1 proposal is limited to 3 pages and must include the following information:

- A description of the science goals and objectives to be addressed by the proposal.
- A description of the methodology to be used to address the goals and objectives.
- A brief description of the PI’s demonstrated leadership potential and plan for professional growth.
- In the Step-1 proposal proposers are strongly encouraged to communicate the scientific impact and context of their proposal at a basic level that does not require detailed domain knowledge as unconflicted reviewers may not be familiar with their specific specialty area.

References are also permitted and are outside of the 3-page limit for the Science-Technical-Management section of the Step-1 proposal. The Step-1 proposal must also include a CV for the PI of up to 2 pages. None of the other parts normally included in a Step-2 proposal (e.g., Table of work effort, current and pending support, or budget) are required for the Step-1 proposal. Proposers will be notified via NSPIRES whether or not they are "invited" to submit their Step-2 proposals.

3.2. Step-2 Proposals

Proposers should refer to the "Instructions for Submitting a Step-2 Proposal" under "Other Documents" on the NSPIRES page for this program element. A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the ROSES
Summary of Solicitation). The Step-2 proposal must be submitted by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title, science goals and objectives, and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) must be the same as those in the Step-1 proposal.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers who have not received an "invite" to proceed to Step-2 in response to their Step-1 proposal are not permitted by the NSPIRES system to submit a Step-2 proposal.

3.2.1 Step-2 Proposal Format

All proposals submitted to ROSES must strictly conform to the formatting rules. Proposals that violate the rules may be rejected without review or declined following review if violations are detected during the evaluation process.

- The Scientific/Technical/Management section of a Step-2 proposal must not exceed the 15 pages specified in this Program Element.
- Margins: no less than 1 inch on all sides.
- Page Size: the PDF must be set for a standard US letter page size of 8.5 × 11 inches.
- Font: Times New Roman, 12-point or larger. If an alternate font is used, it must meet the requirement of having, on average, no more than 15 characters per horizontal inch, including spaces. Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line spacing settings must produce text that contains, on average, no more than 5.5 lines per vertical inch. Proposers may not adjust line spacing settings for a selected font below single spaced.
- Figure captions: Captions must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Expository text necessary for the proposal may not be located solely in figures or tables, or their captions.

Guidelines for submitting Step-2 full proposals, other than those listed above, are specified in Table 1 of ROSES and the NASA Guidebook for Proposers. Where they conflict, the Guidelines above supersede those found in the Guidebook.

3.2.2 Evaluation Criteria

Proposals will be reviewed in two phases, Step-1 and Step-2. The H-ECIP Step-1 proposals will be reviewed for intrinsic scientific/technical merit, and leadership potential of the PI by a combination of unconflicted mail-in reviewers from the science community and NASA Headquarters personnel. Due to the anticipated high number of submissions, in the Step-1 proposal proposers are strongly encouraged to communicate the impact and context of their proposal at a basic level that does not require detailed domain knowledge. Also due to the anticipated high number of submissions, only an invited Step-1 proposal is permitted to submit a Step-2 proposal.

Compliant, invited Step-2 proposals will be evaluated according to the criteria specified in
Section VI(a) of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. These criteria are (1) intrinsic scientific/technical merit and (2) cost reasonableness. In addition to the definition of Intrinsic Merit given in the Guidebook, the following additional factors shall be applied to proposals submitted to the ECIP program:

- The potential for scientific leadership of the PI. Scientific leadership can be defined very broadly and can include direct research contributions. How has the PI demonstrated the potential for scientific leadership and creative vision? How has the PI been recognized as a leader?
- The degree to which innovation affects the scientific and technical quality of the proposed work. What is the scientific and/or technical innovation of proposed research? How might the results of the proposed research impact the direction, progress, and thinking in relevant scientific fields of research? What is the likelihood of achieving influential results?

Cost reasonableness includes assessing the amount of work to be accomplished versus the amount of time proposed. Only necessary unpaid Co-Is and Collaborators should be included, and their specific tasks and roles in the investigation must be clearly laid out in the proposal work plan. The NASA Guidebook for Proposers states, "NASA strongly encourages PIs to specify only the most critically important personnel to aid in the execution of their proposals." Cost sharing is not required for an institution to receive a grant or cooperative agreement, nor is it part of the evaluation criteria. However, support of student, postdoctoral fellow, and/or staff time or other forms of cost sharing may be considered by the selection official.

4. Available Funds

Proposals to the ECIP are intended to be openly solicited approximately every two years. The anticipated average award is $150K per year for a period of up to five years, subject to satisfactory progress and availability of funds. We anticipate receiving 60-100 Step-1 proposals and selecting ~10%, but the actual number may vary from this estimate based on number of proposals and budget.

5. Award Types

The Heliophysics ECIP program will primarily award funds through three vehicles: (1) grants, (2) interagency transfers, and (3) awards to NASA centers. This call will not award contracts, as it is not appropriate for the nature of the work. Please also see the ROSES Summary of Solicitation, Section II (a).

6. Summary of Key Information

| Expected annual program budget for new awards | $1.5M |
| Number of investigator awards pending adequate proposals of merit | See Section 4. |
| Maximum duration of awards | 5 years |
| Due date for Step-1 proposals | March 23, 2018. See Tables 2 and 3 in the ROSES-2018 Summary of Solicitation. |
| Due date for invited Step-2 proposals | ~June 15, 2018. See Tables 2 and 3 in the ROSES-2018 Summary of Solicitation. |
| Planning date for start of investigation | 6 months after proposal due date |
| Page limit for the central Science/Technical/Management section of proposal | 15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers. |
| Relevance to NASA | See section 2.5 above. This program is relevant to the Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| General information and overview of this solicitation | See the ROSES Summary of Solicitation. |
| Detailed instructions for the preparation and submission of proposals | Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers. |
| Submission medium | Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation the NASA Guidebook for Proposers. |
| Web site for submission of proposal via NSPIRES | [http://nspires.nasaprs.com/](http://nspires.nasaprs.com/) (help desk available at nspires-help@nasaprs.com or (202) 479-9376) |
| Web site for submission of proposal via Grants.gov | [http://grants.gov/](http://grants.gov/) (help desk available at support@grants.gov or (800) 518-4726) |
| Funding opportunity number for downloading an application package from Grants.gov | NNH18ZDA001N-ECIP |
| NASA point of contact concerning this program | Elizabeth MacDonald  
Heliophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: 202-358-0991  
Email: e.a.macdonald@nasa.gov |

Unlike other program elements in Appendix B of ROSES, submission to this program element does not involve a Step-1 proposal. Although not required, a Notice of Intent (NOI) is strongly encouraged. NOIs are requested by February 23, 2018, and 10-page proposals are due by March 30, 2018.

Proposers to this program element are not required to provide a data management plan via the NSPIRES cover page question. Instead, that is superseded by instructions in Section 3.

1. Introduction

In October 2015, the National Science and Technology Council (NSTC) in the Executive Office of the President released the National Space Weather Strategy (http://sworm.gov/publications/2015/nsws_final_20151028.pdf) and the National Space Weather Action Plan (Action Plan) (http://sworm.gov/publications/2015/swap_final__20151028.pdf). The objectives of the actions described in the Action Plan are to improve the understanding of, forecasting of, and preparedness for space weather events, recognizing the need for close cooperation among the federal agencies.

Action 5.5.2 in the Action Plan directs NASA, National Science Foundation (NSF), and Department of Defense (DOD) to identify and support basic research on space weather. Action 5.5.3 directs NASA, Department of Commerce (DOC), and DOD to identify and support research opportunities that address targeted operational space-weather needs. Actions 5.6.1 and 5.6.2 direct NASA, NSF, DOC, and DOD to facilitate the transition of space weather information and prediction capabilities to the Nation’s space weather service providers (research-to-operations and operations-to-research).

In response to the need to advance and coordinate the Nation’s space weather research and operations capabilities, NASA and NOAA are supporting a pilot funding opportunity to promote space weather operations-to-research (O2R) activities. O2R activities can broadly be defined as the joint pursuit of improvements of operational capabilities and advancements in related fundamental research. This includes the space weather community working to upgrade and enhance: (1) existing operational models and products, (2) the communication of operational priorities and capabilities to the research community, (3) the testing and evaluation of operational model performance by researchers for fundamental scientific discovery and for improved operational services, and (4) the identification of gaps in the fundamental understanding of the physical system that impede operational capabilities.
In order to support operations-to-research efforts, NASA has established the Heliophysics Space Weather Operations-to-Research (H-SWO2R) program, which is a pilot component of the Heliophysics Research Program.

NASA’s role is to implement and support a national research program to understand the Sun and its interactions with Earth and the Solar System to advance space weather modeling and prediction capabilities applicable to space weather forecasting; develop and operate space-weather-related research missions, instrument capabilities, and models; and support the transition of space weather models and technology from research to operations and from operations to research. Proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in B.1 of this ROSES NRA.

NOAA’s role is to provide timely and accurate operational space weather forecasts, watches, warnings, alerts, and real-time space weather monitoring for the government, civilian, and commercial sectors, exclusive of the responsibilities of the Secretary of Defense; and to ensure the continuous improvement of operational space weather services, utilizing partnerships, as appropriate, with the research community, including academia and the private sector, and relevant agencies to develop, validate, test, and transition space weather observation platforms and models from research to operations and from operations to research.

This is a joint NASA/NOAA opportunity. The work carried out for this program should be in support of one or more NASA and/or NOAA goals and objectives described above.

2. Heliophysics Space Weather Operations-to-Research (HSW-O2R)

For the purpose of this pilot opportunity, NASA and NOAA have identified the following focus area for research and development to advance solar wind and solar wind disturbance models:

- Improve forecasts of the background solar wind, solar wind structures, and coronal mass ejections using solar and solar wind data and models, if possible employing data assimilation or machine-learning techniques.

This funding will support research by the grant recipient to improve scientific understanding and to improve numerical models and/or data utilization techniques that could lead to improved forecasting capabilities. This could involve, for example, using observations to improve the initialization of models (e.g., the background solar wind and coronal mass ejections), to update model runs during their execution, or to select from a set of ensemble runs. NOAA currently uses the Wang-Sheeley-Arge (WSA)-Enlil (http://www.swpc.noaa.gov/products/wsa-enlil-solar-wind-prediction) model for its operational forecasts of the solar wind and the propagation of coronal mass ejections from the Sun to Earth. This research could utilize existing versions of these models, available either at NOAA Space Weather Prediction Center or the NASA-NSF funded Community Coordinated Modeling Center (CCMC) (https://ccmc.gsfc.nasa.gov/), as research tools without modifying the model source code, or collaborations potentially could be formed with the WSA and/or Enlil model owners to investigate modifications to the model source code. Proposed research involving modifications to the models must be arranged with the model owners, and the details of the arrangements must be clearly
described in the 10-page proposal. For inquiries on research involving modification of the WSA and/or Enlil codes, contact the agency POC indicated in Section 5 below. Any modifications to the WSA and/or Enlil models must be made available for public use through the CCMC, which is the current repository for the development versions of these models, and for use in NOAA operations.

2.1 Programmatic Considerations

Given the unique nature of this pilot partnership to support operations to research (O2R), proposal reviewers will include both scientific peers and knowledgeable representatives from the space weather operations community. Proposals must discuss the relationship of the proposed effort to the advancement of Space Weather O2R objectives, and specifically to the focus area detailed above.

The total funding available in fiscal year (FY) 2018 for new proposals submitted in response to this solicitation is expected to be about $1.0M with equal contributions from both NOAA and NASA. This funding is expected to support at least four awards depending upon funds available. Proposals for more than one year will not be considered.

NASA and NOAA will jointly manage the review process, the selection process, and the administration of the program. NASA (on behalf of NASA and NOAA) will review the proposals in accordance with their own review processes/criteria connected to a unified O2R objective. The final award selections will be made in consultation with both agencies’ program officers. As per the awarding agency’s guidelines, a final report will be submitted by each selected PI. Proposal selections and the final reports of the research results will be coordinated by NASA and NOAA.

For NOAA awards to be issued, selected proposals will be required to be resubmitted electronically through the NOAA system. Directions for this will be provided post-competition to the selected investigators by the NOAA Program Officer.

3. Submission and Evaluation Process

3.1 Proposal Process

Unlike other program elements in Appendix B of ROSES, proposers may submit a proposal without any prerequisite Step-1 proposal. In order to facilitate the review process, proposers are strongly encouraged but not required to submit an NOI via NSPIRES. No PDF attachment will be requested for the NOI; proposers need only complete the online “proposal summary”, answer any “program specific” questions, and provide a team member list that is as complete as possible. NOIs must be submitted by the deadline indicated in Section 5 below.

A proposal is required to be submitted electronically by the due date (see below and Tables 2 and 3 in the ROSES Summary of Solicitation). Proposers should refer to the Tutorials and User Guides on the NSPIRES tutorial page at https://nspires.nasaprs.com/tutorials/. The proposal must be submitted by the organization Authorized Organizational Representative (AOR). In addition to all of the elements listed in Table 1 of ROSES, a full proposal must contain a coherent correlation
to Space Weather O2R goals, as described in Section 1 above. The expected format and compliance evaluation criteria are described below.

3.2 Proposal Content

Proposals should include a section titled Scientific/Technical/Management which includes clear descriptions of the following:

1. The Space Weather O2R goals this proposal will enable and the appropriateness of the currently existing data sets (ground-based and/or space-based), models (CCMC hosted or other accessible resource), and/or other publicly available and utilized resource;
2. The existing O2R need that is being addressed and its importance relative to current operational and forecasting capabilities;
3. A full description of the methodology, resources needed, and the technical approach to providing the proposed O2R-enabling enhancement;
4. Plans to provide public access to the models, tools, and value-added products developed; and
5. Details of the arrangements made with the model owners and plans to update the model versions at the CCMC, if the proposed effort includes modifications to the WSA and/or Enlil models.

For additional submission guidance, proposers are encouraged to reference the NASA Guidebook for Proposers and the ROSES Summary of Solicitation for further insights on preparation and submission of ROSES proposals which is the most similar in scope to the process required for this pilot program. Otherwise, please contact the NASA/NOAA POC listed in the Section 5 below.

3.3 Proposal Format

Proposals that are not complaint with format requirements below may be rejected without review. See also Section IV(b)ii of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers for further details.

- The Scientific/Technical/Management section must not exceed ten pages.
- Margins: no less than 1 inch on all sides, with a page size of 8.5 × 11 inches.
- Font: Times New Roman, 12-point or larger. If an alternate font is used, it must meet the requirement of having, on average, no more than 15 characters per inch.
- Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line spacing settings must produce text that contains, on average, no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single spaced.
- Figure captions: Captions must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Expository text necessary for the proposal may not be located solely in figures or tables, or their captions.

Where they conflict, the requirements above supersede those found in the Guidebook.
3.4 Evaluation Criteria

Compliant proposals will be evaluated according to the scientific and technical merit, the relevance, and the cost reasonableness. The assessment of relevance will be based on the goals and objectives of the agencies and the O2R objectives, as summarized in this program element.

In addition to the Definition of Merit given in the Guidebook for Proposers, the evaluation of the scientific and technical merit will include one or more of the following:

- The potential for improving forecasts of the background solar wind, solar wind structures, and/or coronal mass ejections;
- The potential for improving fundamental scientific understanding related to the forecasting of the solar wind and/or coronal mass ejections; and
- The potential to combine data and models to improve forecasting capabilities.

Cost reasonableness will include assessing the amount of work to be accomplished versus the amount of time proposed. Only necessary Co-Investigators and Collaborators should be included, and their specific roles in the investigation must be clearly described. Use of Collaborators whose only role is advisory is discouraged.

3.5 Request for Reviewer Names

Proposers are strongly encouraged to provide names and contact information for up to five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is or stand to benefit financially from the selection (or otherwise) of the proposal. This information can be supplied via the SARA web page at http://science.nasa.gov/researchers/suggested-reviewers/.

Proposers who have submitted a proposal that has been deemed non-compliant may be asked to provide mail-in reviews for one or two proposals in this competition. Much of the science expertise lies in the PI/Co-I community, because increasingly, much of the Heliophysics community proposes. In order to maintain a high caliber review process, it is important to get the additional mail-in reviews to cover all proposals fairly.

4. Available Funds

It is anticipated that approximately $1.0M in total from NASA and NOAA will be made available to support this O2R opportunity, with each agency contributing an equal amount.

5. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected program budget</th>
<th>$1.0M, see Section 4.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>Four or more awards are anticipated, see Section 2.1.</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>1 year</td>
</tr>
<tr>
<td>NOI requested by</td>
<td>February 23, 2018</td>
</tr>
<tr>
<td>Due date for full proposals</td>
<td>March 30, 2018</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>6 months after proposal due date</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposal</td>
<td>10 pages</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Relevance</strong></td>
<td>This program is relevant to Heliophysics Space Weather Operations-to-Research in NASA and NOAA. Proposals that are relevant to this program are, by definition, relevant to one or more of the supporting agencies.</td>
</tr>
<tr>
<td><strong>General information and overview of this solicitation</strong></td>
<td>See the ROSES Summary of Solicitation</td>
</tr>
<tr>
<td><strong>Detailed instructions for the preparation and submission of proposals</strong></td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers</td>
</tr>
<tr>
<td><strong>Submission medium</strong></td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers</td>
</tr>
<tr>
<td><strong>Web site for submission of full proposal via NSPIRES</strong></td>
<td><a href="http://nspires.nasaprs.com">http://nspires.nasaprs.com</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td><strong>Web site for submission of proposals via Grants.gov</strong></td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
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<tr>
<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
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</tr>
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</table>
| **Point of contact concerning this program element**         | Terrance Onsager  
Heliophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-1615  
Email: terrance.g.onsager@nasa.gov |

1.1 Changes from Last Year

NASA ROSES (Research Opportunities in Space and Earth Sciences) program element C.1 (Planetary Science Research Overview), this document, has been substantially revised. Proposers are encouraged to read C.1 in its entirety. Several changes to program element C.1 are highlighted here:
• Section 3.1 includes a revised description regarding the prohibition of duplicate proposals.
• Updated information regarding Data Management Plans (DMPs) is provided in Section 3.6.1. Note the addition of software/code for possible inclusion in the DMP and a revised method for submitting DMPs as part of the main proposal.
• Program Elements supporting the publication of geologic maps have been clarified (Section 3.8).
• Information pertaining to Planetary Major Equipment (C.17), Early Career Fellowships (C.16 and C.23), and Topical Workshops, Symposia, and Conferences (E.2) has been added to program element C.1.
• The Habitable Worlds program is now a Cross-Divisional program with the Astrophysics Division (see program element E.4).
• No contracts will be issued for program elements covered by program element C.1, unless otherwise noted in the individual program elements.

1.2 Program Elements Covered by this Overview

This document pertains to all of the program elements in Appendix C of ROSES, as well as to the cross-divisional research program element E.4 Habitable Worlds, but not E.3 the Exoplanet Research Program.

2. Two-Step Proposal Submission Process

To facilitate the early recruitment of a conflict-free review panel and ensure that proposals are submitted to the appropriate program, most program elements covered by program element C.1 will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES Summary of Solicitation).

A Step-1 proposal is required and must be submitted electronically by an Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must address the same broad scientific goals proposed in the Step-1 proposal. The PI cannot be changed and proposers who want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact identified in the summary table of key information and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Additions of funded investigators within two weeks of the Step-2 deadline require explicit permission from the NASA point of contact. Submission of a Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

2.1 Step-1 Proposal

The Scientific/Technical/Management section of a Step-1 proposal is restricted to the 4000-character text box on the NSPIRES web interface cover pages. PDF attachments will not be accepted through NSPIRES for Step-1 proposals submitted to program elements covered by program element C.1.
A Step-1 proposal must cover the following topics:

- The goals and/or objectives to be addressed
- The approach and methodology to be used to address the goals and/or objectives
- The reasons why the work proposed is within the scope of the program element and why this program element is the most appropriate for the work proposed

Following the submission of a Step-1 proposal, most proposers will be notified through NSPIRES whether the Step-1 proposal has been designated as "encouraged" or "discouraged," at which point the proposer will be able to create a Step-2 proposal. No evaluation of intrinsic merit will be performed on Step-1 proposals. The perceived relevance of the proposed work to the particular Program Element will be the main factor in deciding whether submission of a Step-2 proposal will be encouraged. Please note that the Step-2 proposal relevance evaluation is independent of the Step-1 evaluation.

In rare cases, including the cases where the Step-1 proposal was not compliant with the requirements outlined above or the proposed work could not be funded due to NASA, SMD, or Planetary Science Division (PSD) policy, a Step-1 proposal may be declined. In these cases, a Step-2 proposal may not be submitted.

2.2 Step-2 Proposal

Table 1 within the NASA ROSES solicitation provides a checklist of required information to be included in Step-2 proposals. Proposers should also refer to the PDF entitled "Instructions for Submitting a Step-2 Proposal" that appears under "Other Documents" on the NSPIRES page for the program of interest.

All proposals submitted to ROSES must strictly conform to the formatting rules. Proposals that violate the rules may be rejected without review or declined following review if violations are detected during the evaluation process.

Note the order of precedence guidelines described in Section I(g) of the ROSES Summary of Solicitation: Guidebook and ROSES instructions may be superseded or modified by this document (program element C.1) for all covered program elements, and each individual program element may have its own rules that supersede all of the above.

In previous years, problems with the following aspects of proposal formatting have been noted. Planetary Science proposals must adhere to the following formatting rules as outlined in the NASA Guidebook for Proposers:

- Length of the Scientific/Technical/Management section: 15 pages, unless otherwise specified in the program element.
- Margins: 1 inch on all sides, with a page size of 8.5 × 11 inches.
- Font: 12-point or larger. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
• Line spacing: Font and line spacing settings must produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single spaced.
• Figure captions: Captions must follow the same font and spacing rules as the main text.
• Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Expository text necessary for the proposal may not be located solely in figures or tables, or their captions.

3. Requirements for Full Proposals

For the program elements that use the two-step submission process, the full proposals are the Step-2 proposals. For other program elements, full proposals are simply the final proposals submitted for evaluation.

3.1 Prohibition on Duplicate Proposals

Proposers may not submit Step-2 proposals for the same or essentially the same work to more than one program element covered by program element C.1 concurrently. This prohibition is active for a particular submitted proposal until the PI is notified through NSPIRES that the proposal was declined or until the proposal is withdrawn. The prohibition on duplicate proposals applies across ROSES years as well (e.g., a duplicate of a pending ROSES-2016 proposal may not be submitted in response to ROSES-2017).

If a second proposal is submitted while a duplicate proposal is still pending in another program element, only the first proposal will be evaluated; the duplicate proposal may not be evaluated or considered and may be returned without review.

If a second proposal contains substantive changes in areas that are critical to the intrinsic merit evaluation, then it is not considered to be a duplicate proposal. Such areas include:
• The proposing institution
• Funded investigators and unfunded Co-Investigators (Co-Is) who would perform a significant portion of the work
• Concepts, ideas, goals, and objectives
• Implementation (methods, approaches, instrumentation)
• Target (i.e., of measurements, observations, modeling)

Changes to a proposed project or investigation that would not be considered substantive include aspects of the proposal that are not covered by the merit evaluation. Two proposals that differ only in these sections may be considered duplicates:
• Current and pending support section
• Relevance statement
• Budget section
• Data management plan
In addition, minor changes to aspects of a proposal covered by the merit evaluation (team, concepts, implementation, target, etc.) may not be considered substantive.

If it is unclear whether changes to a proposal are substantial enough that it should not be considered a duplicate proposal, or it is unclear to which program a proposal should be submitted, proposers should contact the point of contact for the program element most likely to be appropriate for the proposal.

3.2 **Prohibition on Duplication of Mission-Funded Activities**

Proposals may not request funding for mission team members for work that is within the mission plan of work. Any proposal that is close in scope to a mission’s funded activities, and that involves a mission-funded team member, must demonstrate how the team member’s tasks funded by the proposal do not overlap with any science investigation(s), duties, or responsibilities funded by their mission team. This demonstration should be included in the proposal’s Budget Justification section and does not count against the page limit of the Scientific/Technical/Management section.

This prohibition applies regardless of the proposal team member’s role on the proposal, the specific activities or tasks that they are assigned within the mission team, or to whom the overlapping tasks are assigned within the mission team.

This prohibition does not apply when the mission funding that creates the overlap ends within one calendar year of the Step-2 (full) proposal deadline. This mission funding can end either due to the team member no longer receiving mission funding or the mission no longer receiving funding for the relevant activities or tasks.

3.3 **Award Durations and Types**

The typical award duration is three years. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. For those program elements that permit longer awards, funding for more than three years must be explicitly and sufficiently justified in the proposal, i.e., to allow the completion of individual tasks that require more than three years. In these cases, the proposal must contain an explicit discussion of why it is impractical or impossible to complete such tasks within three years.

Note that no contracts will be issued for awards made under the program elements covered by program element C.1 unless otherwise noted in the individual program element.
3.4 Use of Mission Data

Spacecraft mission data to be used in proposed work must be available in the Planetary Data System (PDS) or an equivalent, publicly accessible archive at least 30 days prior to the full proposal submission deadline, unless otherwise specified in the program call.

3.5 Discussion of Relevance

All proposals will be evaluated for relevance to the individual program element to which the proposal has been submitted (see Section VI (a) of the ROSES Summary of Solicitation).

Some program elements covered by program element C.1 require an explicit relevance statement be placed into a mandatory (4000-character) text box on the cover pages via the NSPIRES web interface. For those program elements that require it, this required relevance text is outside of the 15-page Scientific/Technical/Management section and the relocation of the relevance discussion does not decrease that 15-page limit. This requirement supersedes the default in the NASA Guidebook for Proposers and the ROSES Summary of Solicitation. For these calls, the omission of a relevance statement on the cover pages is sufficient reason for a proposal to be returned without review.

Regardless of whether an explicit statement of relevance is required, all proposals will be evaluated for their relevance to the program element to which they have been submitted. Proposers are urged to consult the appropriate program element to which they are proposing for detailed information on whether an explicit relevance statement is required and/or how relevance will be evaluated.

3.6 Data Management Plans and Archiving

3.6.1 Data Management Plans

In order to broaden access to the results of NASA-funded research, proposals submitted to ROSES are required to include a data management plan (DMP). The guiding philosophy behind this requirement is that all relevant data should be made publicly available (i.e., without fee or restriction of use) at the time of publication, or at the earliest practical time thereafter, through a stable and long-term supported data repository.

Individual program elements may provide instructions that supersede and/or amplify the requirements described here. For example, the Planetary Data Archiving, Restoration and Tools (PDART, program element C.7) program element includes the data management discussion in the body of the proposal. The instrument development, Early Career Fellowship and Planetary Major Equipment calls (Appendices C.12, C.13, C.16, C.17, and C.23) do not require DMPs.

Proposers requiring a Data Management Plan (DMP) are strongly encouraged to use the PSD DMP template, which will appear under other documents on the NSPIRES web page for all of the relevant program elements in Appendix C.

DMPs must be placed in a special section of the proposal, entitled "Data Management Plan." All proposals to program elements that require DMPs must contain this section.
The DMP may not exceed two pages in length, and should immediately follow the
references and citations for the Scientific/Technical/Management (S/T/M) portion of the
proposal. The two-page DMP section does not count against the 15-page limit of the
S/T/M section. Formatting requirements for DMPs are the same as for the S/T/M
section. When appropriate or required, letters of support from data archives (e.g.
Section 3.6.2 of this document) must be included in a Statements of Commitment and
Letters of Support, Feasibility and Endorsement section of the proposal (see ROSES
Summary of Solicitation, Table 1).

The DMP must cover any data needed to validate the scientific conclusions of peer-
reviewed publications, particularly data underlying figures, maps, and tables.

The DMP should also cover any other data and software that would enable future
research or the replication/reproduction of published results. Software, whether a stand-
alone program, an enhancement to existing code, or a module that interfaces with
existing codes, created as part of a NASA award should be made publicly available
when it is practical and feasible to do so and when there is scientific utility in doing so.
Stand-alone code that is not straightforward to implement or whose utility is significantly
outweighed by the costs to share it is not expected to be made available. NASA expects
that the source code, with associated documentation sufficient to enable the code’s use,
will be made publicly available via GitHub (https://github.com/NASA-Planetary-Science),
the PDS (for mission-specific code, when appropriate), or an appropriate community-
recognized depository (for instance, the homepage of the code base for which a module
was developed). Archiving software in a public repository does not require the proposer
to maintain the code. Awards that derive from proposals including plans to post code in
GitHub will contain a Rights in Data clause reflecting this expectation.

For proposals that use non-mission data (e.g., laboratory results, Earth-based
observations) that are not publicly available (in the PDS or other archive, in the
literature, etc.), the project is expected to make the data available following the Data
Management Plan guidelines.

"Data" does not include physical objects (e.g., astromaterials or analog specimens,
experimental run products, etc.), preliminary and other unpublished data, data in
prepublication documents, private communications, or certain other types of information
that have been specifically exempted from the DMP requirement.

In the case of a project that would produce no data, as defined above, or only data
specifically exempted, the DMP should state that no data preservation or data sharing is
needed, but must also explain why. In a case where no appropriate archive exists for a
particular data set, the DMP should discuss alternative methods for making the data
publicly available.

The DMP must contain the following elements, as appropriate to the project, in
adequate detail for review:

- A description of data types, volume, formats, and (where relevant) standards;
- A description of the schedule for data archiving and sharing;
- A description of the intended repositories for archived data, including mechanisms for
  public access and distribution;
- A discussion of how the plan enables long-term preservation of data;
A discussion of roles and responsibilities of team members in accomplishing the DMP. (If funds are required for data management activities, these should be covered in the normal budget and budget justification sections of the proposal.)

DMPs will be reviewed as part of the overall NASA research proposal review process. Proposals that do not address each of these items in their DMP, even if determined to be selected or selectable for funding, may not be funded until an adequate DMP is submitted. Funded researchers, research institutions, and NASA centers are responsible for ensuring and demonstrating compliance with the DMPs approved as part of their awards. Awardees who do not fulfill the intent of their DMPs may have continuing funds withheld and this may be considered in the evaluation of future proposals.

For more information on DMPs, please see the Planetary Science Division Frequently Asked Questions (FAQs) on data management plans in ROSES, which will appear under "Other Documents" on the NSPIRES webpage for the Planetary Science Division Program Elements.

3.6.2 Data Archiving in the Planetary Data System (PDS)

For proposals where derived data products will be deposited in the Planetary Data System, these data products must be in PDS4 format. Guidelines for planning for the submission data in this format to the PDS are available at http://pds.nasa.gov/pds4.

Proposers intending to make use of the PDS should refer to the most recent version of the following documents for information on PDS compliance:

<table>
<thead>
<tr>
<th>Document</th>
<th>Hyperlink</th>
</tr>
</thead>
</table>

Proposers should communicate with the PDS Discipline Node responsible for curating similar data (links to the PDS Discipline Nodes are at http://pds.nasa.gov/) to discuss procedures and requirements prior to proposing to a Planetary Science Division ROSES-2017 program element. Proposers intending to archive data or products in the PDS must obtain and include confirmation, in the form of a letter of support from the appropriate Discipline Node, that the PDS is willing to accept their submission. This letter must be included in the proposal package and placed in a section for Statements of Commitment and Letters of Support, Feasibility and Endorsement (see ROSES Summary of Solicitation, Table 1).

3.7 Table of Personnel and Work Effort

All proposals must include a Table of Personnel and Work Effort. If the program element allows contracts, and it is anticipated by the proposer that the proposal will result in a contract, this table must be within the budget narrative section. All other proposals should include this table as a separate section before the Budget Justification section and follow the instructions presented here.
Proposers are strongly encouraged to use the PSD Table of Personnel and Work Effort template, which will appear under other documents on the NSPIRES web page for all of the program elements in Appendix C.

The Table of Personnel and Work Effort should list the names (if known) and titles of every person who will do work on the proposal, regardless of whether that person would receive money, and regardless of their role on the project. It should cover all personnel, including those covered by any sub-awards, sub-contracts, or who work at any NASA center or federal agency that may receive money separately from the main award. The table must have entries covering each proposed award year (do not provide a separate table divided by federal fiscal years), and should distinguish between the effort to be funded by NASA and non-funded efforts. All work efforts listed in the table should be made in fractions of a work-year.

Note that this section may not contain any narrative description of tasks to be performed by proposal personnel; such information should be placed in the 15-page Scientific/Technical/ Management section of the proposal.

3.8 Publication of Geologic Maps

Geologic mapping is an investigative process designed to go beyond standard image analyses to determine the geologic history of a region of interest, whether it is local, regional, or global. Thus, geologic maps are key tools to aid in identification of this geologic history. Below are some guidelines about where to propose geologic mapping investigations.

3.8.1 Program Elements Supporting Geologic Mapping

If a geologic map would be created as part of a hypothesis-driven science investigation (i.e., to address specific scientific objectives or questions about a region of interest) and uses data from planetary missions identified in a Data Analysis Program (DAP), then the proposal should be submitted to the appropriate DAP. Examples:

- MESSENGER-based Mercury maps: Discovery DAP (Program Element C.11)
- Lunar maps: Lunar DAP (Program Element C.8)
- Mars maps: Mars DAP (Program Element C.9)
- Dawn-based Vesta or Ceres maps: Discovery DAP (Program Element C.11)
- Cassini-based Saturnian satellite maps: Cassini DAP (Program Element C.10)
- Pluto and Charon maps: New Frontiers DAP (Program Element C.19)

If a geologic map would be created as part of a hypothesis-driven science investigation using data from missions not covered by a current DAP (e.g., Venus missions) or as part of a comparative planetology science investigation not responsive to a single DAP, then the proposal should be submitted to whichever of the non-DAP research program elements the proposal is most relevant (e.g., Solar System Workings, Emerging Worlds, Habitable Worlds).

If a geologic map would be created without an accompanying hypothesis-driven science investigation, then the mapping proposal should be submitted to PDART (Program Element C.7).
3.8.2 Maps Published by the U.S. Geological Survey

Proposals that include the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal cover page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. Investigators who choose to produce a geologic map as a USGS product will be required to follow current guidelines for the production and submission of digital products, including the generation of maps that are compatible with Geographic Information System (GIS) software packages for review, edit, and publication. To support this requirement, the USGS will provide a GIS project that contains the projected, geographically rectified, and scaled mapping base or mosaic, as well as other relevant global- or regional-scale data sets (if available and needed). Investigators selected to publish USGS geologic maps will be expected to (1) provide peer reviews for two geologic maps generated by other planetary mappers during their grant period, and (2) attend the annual Planetary Geologic Mappers Meeting to present map status to the mapping community and receive updates on current guidelines. Proposers should include travel funding to attend the Planetary Geologic Mappers Meeting, justifiable because of NASA requirements. Further information pertaining to the production of USGS geologic maps (e.g., map bases, scales, extents, formats, guidelines) is available at [http://planetarymapping.wr.usgs.gov/](http://planetarymapping.wr.usgs.gov/) or by contacting Jim Skinner at the USGS (jskinner@usgs.gov).

Investigators who intend to produce a USGS geologic map are required to include in their Step-2 (full) proposal a Confirmation of Technical Specification document obtained from the USGS Map Coordinator. This document will identify (1) latitude/longitude boundaries of the map region, (2) scale of the proposed map, (3) required base map, (4) projection of the base map, and (5) key supplemental data. This document is only a confirmation and does not fulfill any requirement that the mapping effort be described and justified within the 15-page body of the proposal. Selection of a proposal for funding is contingent upon the inclusion of this document. Investigators are encouraged to contact the USGS early in the proposal preparation process. For the USGS Map Coordinator's contact information, please refer to [http://planetarymapping.wr.usgs.gov/Page/view/Contacts](http://planetarymapping.wr.usgs.gov/Page/view/Contacts).

3.9 Access to the Antarctic

Unless otherwise stated in a program element, Appendix C is no longer accepting proposals for work in Antarctica.

3.10 Additional Funding for Relevant Instrumentation Construction or Upgrade

The Planetary Major Equipment (PME) program element (C.17) allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations for certain programs elements sponsored by the Planetary Science Division Research and Analysis Program. All new analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $40,000, must be requested according to the PME guidelines in C.17. Two types of instrumentation requests are permitted: (1) a PME request may be made as a special section that is appended to a new research proposal in an eligible program element; or
(2) a stand-alone PME proposal may be prepared and submitted to an eligible program element. See C.17 for details on how to prepare both types of PME requests. Programs elements eligible for PME are:
- Emerging Worlds (C.2)
- Solar System Workings (C.3)
- Exobiology (C.5)
- Solar System Observations (C.6)
- Planetary Science and Technology from Analog Research (C.14)
- Planetary Protection Research (C.15)
- Laboratory Analysis of Returned Samples (C.18)
- Habitable Worlds (E.4)

3.11 Planetary Science Division Early Career Fellowship Program

The purpose of the Planetary Science Division (PSD) Early Career Fellowships (ECF) program (described in program elements C.16 and C.23) is to support the development of the individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by PSD. This program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Those seeking to be named fellows should see C.23, The New Early Career Fellowship Program, for information on the new fellowship application process and the criteria for evaluating candidates. Those who have already been named fellows (i.e., received an award letter for the proposal to which the ECF was appended) based on prior applications who are seeking start-up funds should refer to program element C.16 the Early Career Fellowship Start-up Program for Named Fellows.

3.12 Topical Workshops

All proposals for topical conferences, workshops, or symposia related to the Planetary Science Division Research and Analysis Program must be submitted in response to program element E.2, Topical Workshops, Symposia, and Conferences, of this NRA. Proposers to E.2 should specifically identify the PSD research program element to which the conference, workshop, or symposium is most closely related and refer to the goals and objectives of that program element in demonstrating relevance.

4. Resources Available to Proposers

4.1 Data and Information Resources

- The Planetary Data System (PDS)
The Planetary Data System (PDS) archives and distributes scientific data from NASA planetary missions, astronomical observations, and laboratory measurements. The archives can be found through the PDS home page at http://pds.nasa.gov/. PDS is supported by six science discipline nodes (Atmospheres, Geosciences, Imaging, Planetary Plasma Interactions, Rings, and Small Bodies) distributed around the U.S. Each node serves data from NASA’s planetary missions and documentation sufficient to
use those data. Data searches and requests can be initiated from the PDS home page or at any of the science discipline node pages accessible there. Guides and tools for using data, preparing an archive, and archiving data can be found at http://pds.nasa.gov/tools/. Contact the PDS Operator (pds_operator@jpl.nasa.gov) or the appropriate node’s point-of-contact for assistance.

- The National Space Science Data Center (NSSDC)
  NSSDC archives digital and other data from historic and completed flight missions, and its archives are complementary to those of the PDS. Such data include lunar and planetary photographs, digital planetary images, tabular and experiment data from numerous flight missions, and cartographic products. Investigators are responsible for acquiring the data needed for their proposal. Modest requests for data are free of charge, while charges will be incurred for large-volume requests. Requests from U.S. investigators for data products and information may be made through the Coordinated Request and User Support Office at the NSSDC (nssdc-request@lists.nasa.gov). For more information, see http://nssdc.gsfc.nasa.gov/nssdc/obtaining_data.html.

- The Lunar and Planetary Institute (LPI)
  LPI provides one of the most concentrated and easily accessible collections of data and other information in lunar and planetary science, including extensive digital map and imagery collections, computational tools for the lunar community, and a vast collection of educational products and resources. These resources, along with an extensive range of electronic tools to enhance science activities and effective communication within the planetary science community, can be found on the LPI’s website at http://www.lpi.usra.edu.

- Regional Planetary Image Facilities (RPIFs)
  RPIFs contain nearly half a million images of the planets and their satellites taken both from Earth and manned and unmanned spacecraft, as well as topographic and geologic maps produced from these images. The RPIFs, located at institutions worldwide, are intended for use by individuals and groups who use photographic and cartographic materials of the planets and satellites in their research programs. These programs include geologic, photometric, colorimetric, photogrammetric, and atmospheric dynamical studies. Send inquiries to the director of the nearest RPIF. Note that, although these centers may be used for onsite study and selection of planetary and satellite images, they are not facilities for the production of photographs for users. Instead, such materials may be obtained from the NSSDC (see above). Additional information, including a listing of RPIF locations worldwide, can be found on the RPIF home page at http://www.lpi.usra.edu/library/RPIF.

- Planetary Cartography Program
  NASA has a long-term agreement with the USGS to provide a variety of cartographic support functions for NASA researchers through its Planetary Cartography Program. This support includes:
  - Integrated Software for Imagers and Spectrometers (ISIS, http://isis.astrogeology.usgs.gov);
  - Search capability for raw planetary image data (PILOT, http://pilot.wr.usgs.gov);
o Coordination of IAU approval of nomenclature http://planetarynames.wr.usgs.gov/;
o Training in planetary GIS methods (MRCTR GIS Lab, http://astrogeology.usgs.gov/facilities/mrctr);
o Training in the generation of topographic data from stereo images (Photogrammetry Guest Facility, http://astrogeology.usgs.gov/facilities/photogrammetry-guest-facility);

For cartography support beyond what is provided by the Planetary Cartography Program, the USGS is willing to join proposal teams to produce or assist in the production of specific cartographic tools or products. However, the USGS is required to recoup the full cost of such activities in the proposal budget. Visit http://astrogeology.usgs.gov/ or E-mail laz@usgs.gov for further information.

4.2 Astromaterials

NASA’s Astromaterials Acquisition and Curation Office at the NASA Johnson Space Center provides access to all NASA-controlled samples of astromaterials, including those returned by the Apollo program and the Genesis and Stardust missions, a subset of particles returned by the Japan Aerospace Exploration Agency (JAXA) Hayabusa mission, interplanetary dust particles collected by high-altitude aircraft, meteorites collected in Antarctica by U.S. field parties, and a variety of space-flown microparticle impact collectors. Peer review of sample requests are provided by the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM). For information on how to obtain any of the specimens in these collections, see http://curator.jsc.nasa.gov/ or contact:

Office of the Curator
Code KT
Johnson Space Center
National Aeronautics and Space Administration
Houston, TX 77058-3696

4.3 Research Facilities

The following facilities are available to supported investigators. If their use is anticipated, this use must be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the NASA Guidebook for Proposers, a letter of support may be required from any facility required for the proposed effort.

- NASA-provided High-End Computational (HEC) Facilities
  Those investigators whose research requires high-performance computing should refer to the Summary of Solicitation, Section I(d), "NASA-provided High-End Computing Resources." This section describes the opportunity for successful proposers to ROSES to apply for computing time on either of two NASA computing facilities at the NASA
Goddard Space Flight Center’s (GSFC’s) Computational and Information Sciences and Technology Office or at the NASA Ames Research Center’s (ARC’s) Advanced Supercomputing Division. Proposers needing access to these facilities should follow the instructions in Section I(d) of the ROSES Summary of Solicitation. Further information on computing capabilities may be found at the NASA High-End Computing website, http://www.hec.nasa.gov/.

- **Planetary Aeolian Facility (PAL)**
  The Planetary Aeolian Facility at the NASA Ames Research Center consists of wind tunnels to simulate atmosphere-surface interactions on Earth, Mars and Titan. For more information, contact David Williams at David.Williams@asu.edu or find the PAL Guidebook for Proposers at: http://rpif.asu.edu/documents/PAL_Proposers_Guidebook_2015_v6.pdf.

- **Reflectance Experiment Laboratory (RELAB)**
  The RELAB facility at Brown University provides a mechanism for researchers to obtain high quality laboratory spectra of natural or synthetic materials for use in compositional, geologic, and remote sensing applications. RELAB is partially supported by NASA as a multiuser spectroscopy facility, and researchers are invited, but not required, to visit the laboratory in person during sample measurements. Laboratory time and most sample measurements are made available at no charge to investigators funded by NASA. If a proposal to NASA requires acquisition of new spectra via RELAB in the VIS/NIR or mid-IR, then the scope and justification must be provided in the submitted proposal. Data acquired as part of NASA-funded research are made available to the investigator immediately after measurement and are made publicly available three years after measurement. Additional information about this facility, a RELAB user’s manual, sample submittal forms, and access to RELAB spectroscopy data can be found at http://www.planetary.brown.edu/relab/. For further information, contact the Science Manager of RELAB, Ralph Milliken (Ralph_Milliken@brown.edu) or the Operations Manager, Takahiro Hiroi (Takahiro_Hiroi@brown.edu).

- **NASA Ames Vertical Gun Range (AVGR)**
  The NASA AVGR is a national facility funded by the NASA Science Mission Directorate to enable investigations of impact phenomena and processes. Exploratory or proof-of-concept programs requiring a limited number of experiments can be accommodated at no cost. More extensive programs are subject to review in order to assess feasibility and cost effectiveness. Any need for extensive use of the AVGR should be explicitly described in the proposal. The proposal budget should include an estimate of usage costs. A letter of support from the AVGR is required. For more information, potential users of the AVGR should contact John Karcz (john.s.karcz@nasa.gov).

- **NASA Venus In-situ Chamber (VICI)**
  The Venus In-situ Chamber Investigations (VICI) is a NASA pressure chamber that enables testing of components and small instruments under temperatures and pressures that simulate Venus surface conditions. Lower temperatures and pressures can also be accommodated. Exploratory or proof-of-concept programs requiring a limited number of experiments/tests can be accommodated for minimal cost. Extensive use of the chamber should be described in the proposal and is subject to review by VICI
personnel to assess feasibility and cost effectiveness. Any use of the chamber and its corresponding costs should be included in the proposal budget. A letter of support from the VICI facility is required. For additional information, please contact Natasha Johnson (natasha.m.johnson@nasa.gov).

- **NASA Glenn Extreme Environment Rig (GEER)**
  The Glenn Extreme Environment Rig (GEER) is a simulation rig designed to provide the scientific and engineering communities an asset to perform laboratory experiments and/or technology developments or instrument/hardware qualification in extreme environments. When fully operational, GEER can accurately simulate the temperatures, pressures, and chemistry of the atmospheres of planetary bodies, including the conditions found on the surface of Venus. The chamber is of cylindrical shape with interior dimensions of three feet in diameter and four feet long. The chamber is rated for pressures up to 100 bar at 500°C and eight individually controllable gas streams are available. Interested parties should contact Dan Vento (Daniel.M.Vento@nasa.gov) or Tibor Kremic (Tibor.Kremic@nasa.gov) for questions regarding status, availability, and any proposal related intentions. Some additional information on the GEER is available at http://microgravity.grc.nasa.gov/SSPO/SS/Extreme/.
1. Introduction

Research in the area of "Emerging Worlds" aims to answer the fundamental science question of how the Solar System formed and evolved. It helps to advance the strategic science goal to "explore and observe the objects in the Solar System to understand how they formed and evolve" through basic research that supports planetary exploration, aids in the development of missions, and provides context for the interpretation of all Solar System observations that are relevant to its formation and evolution. Major interdisciplinary efforts to solve key questions are particularly valued. A wide range of investigations will be covered, including, but not limited to, theoretical studies, analytical and numerical modeling, sample-based studies of extraterrestrial materials, laboratory studies, and synthesis of previous work.

2. Scope of Program

The Emerging Worlds program solicits research proposals to conduct scientific investigations related to understanding (1.1) the formation of our Solar System; and/or (1.2) the early evolution of our Solar System.

2.1 Formation of our Solar System

For the purposes of this solicitation, the "formation of our Solar System" is considered to begin with the onset of the collapse of the molecular cloud from which the Solar System formed. The following research areas are all within scope of Emerging Worlds:

- Studies of the materials present and processes that led to the onset of Solar System formation.
- Studies of all aspects of materials and processes occurring in and affecting the protoplanetary disk, including those occurring on bodies of any size that may have formed at this stage of Solar System evolution.
- Studies related to the accretion of Solar System bodies after dissipation of the protoplanetary disk.

2.2 Early evolution of the Solar System

For the purposes of this solicitation, "early evolution" is defined as follows. The absolute ages of processes that are considered "early" depend on the context. Please note the usage of the phrase "most prominent" in the bullets below: the intent of Emerging Worlds is to focus on processes that were characteristic of an early epoch of the Solar System and played a role in establishing the structure of the Solar System or the bodies within it.

- For studies of the dynamical evolution of the Solar System, Emerging World focuses on processes that happened and were most prominent between the time
of Solar System formation and the time that large planetary bodies were in or near their modern configuration.

- For studies of the chemistry and physics of collisions and impacts in the Solar System, Emerging Worlds focuses on those processes that occurred and were most prominent during the dynamical evolution of the Solar System up to the time that large planetary bodies were in or near their modern orbital configuration, and which had significant effect on the structure of the target body or its planetary system.

- For studies of the large planetary bodies themselves, Emerging Worlds focuses on the period of planetary evolution through the end of the major period of accretion or the time of global differentiation (the separation into compositionally distinct layers, including their atmospheres, cryospheres, and hydrospheres), whichever is later. Such studies could be about the process of accretion or differentiation, or other processes that occur on or within large Solar System bodies through this period.

- For studies of processes that occurred on small bodies, the intent is to cover processes that can be reasonably inferred to have occurred and were most prominent up to the time that large planetary bodies were in or near their modern configuration.

2.3 Programmatic priorities

Emerging Worlds prioritizes proposals that directly address outstanding problems in the origin and evolution of our Solar System. Proposals should clearly explain the problem(s) to be solved or the hypothesis(es) to be tested, and present a work plan that will allow the investigation to solve these problems or test these hypotheses within the funding period.

The Emerging Worlds program also recognizes that some projects to address outstanding problems in the origin and evolution of our Solar System may require more than a single funding period to bring to completion. Proposals that seek to do this are also acceptable: they must clearly explain the problem(s) to be solved or the hypothesis(es) to be tested, and present a complete work plan that will allow the proposing team to ultimately reach the scientific goals, even if such completion may not be possible within a single award period. The work plan must include detailed milestones to be accomplished during the initial award period, as well as milestones envisioned for future work. Selection of such a proposal does not constitute a guarantee of future funding for the completion of the project, and subsequent peer-reviewed proposals would be required to continue the work past the initial award period.

Proposals that seek to acquire data or otherwise characterize Solar System objects, materials, or processes with the goal of enabling future work not detailed in the proposal will be considered low priority for selection. Proposals to Emerging Worlds should directly address key problems of Solar System formation and early evolution.

2.4 Demonstration of relevance

All proposals must demonstrate how they will advance our understanding of the origin or early evolution of the Solar System, as defined in Sections 2.1 and 2.2. To be
relevant to Emerging Worlds, the primary focus of the proposal must be to advance this understanding.

Proposals to this program element do not require a separate or explicit statement of relevance. As stated in program element C.1, Section 3.5, all proposals, including those submitted to this program element, will be evaluated for relevance to the solicitation. Consequently, proposers are strongly encouraged to address the question of relevance in the Scientific/Technical/Management portion of the proposal.

3. Programmatic Information

3.1 Exclusions

Proposers are advised to read each of the calls referenced below prior to submitting proposals and to contact the appropriate Points of Contact with any questions.

3.1.1 Studies of Exoplanets

Proposals to understand the formation or early evolution of exoplanetary systems are not supported by this program element. Those with ties to observational studies or future NASA missions (either directly or indirectly) should be submitted to the Exoplanet Research Program (see Program Element E.3 for further clarification and restrictions).

3.1.2 Studies of habitability

Research aimed at investigating the habitability of planetary bodies in our Solar System or in other planetary systems should be submitted to the Habitable Worlds program element (program element E.4).

3.1.3 Earth Science Studies

Emerging Worlds does not, in general, support Earth science investigations, including research on terrestrial analog samples, unless relevance to the formation and evolution of other planetary bodies or planetary science in general can be firmly established. Terrestrial research should address: key geochemical processes in early planetary evolution; terrestrial history in terms of general Solar System processes; or the reasons for differences in evolution among the various planetary bodies; including Earth, the Moon, and parent bodies of meteorites. Proposals to analyze terrestrial samples should clearly explain the nature of the planetary connection, since this will be a key factor in determining relevance to Emerging Worlds.

3.1.4 Mission Data Analysis

NASA solicits proposals that use, analyze, and/or enhance the scientific return of certain planetary missions through its data analysis programs (DAPs), listed below. Emerging Worlds does not accept proposals that are eligible for submission to a DAP. The DAP solicitations should be consulted prior to the submission of any proposal that uses planetary mission data.

- **Moon**: Proposals using data from recent lunar missions may be appropriate for the Lunar Data Analysis Program (see program element C.8).
● *Mars*: Proposals using Mars mission data may be appropriate for the Mars Data Analysis Program (see program element C.9).
● *Cassini*: Proposals using data from the Cassini mission may be appropriate for the Cassini Data Analysis Program (see program element C.10).
● *Discovery*: Proposals that use Discovery mission data may be appropriate for the Discovery Data Analysis Program (see program element C.11).
● *New Frontiers*: Proposals that use New Frontiers mission data may be appropriate for the New Frontiers Data Analysis Program (see program element C.19).
● *Rosetta*: Proposals using data from the Rosetta mission may be appropriate for the Rosetta Data Analysis Program (see program element C.20).

### 3.1.5 Returned Sample Analysis

Through the Laboratory Analysis of Returned Samples (LARS) program (program element C.18), NASA solicits proposals focused on the analysis of astromaterials returned by planetary missions (e.g., Stardust, Genesis, Hayabusa), and on the development of analytical methods for samples returned from these or future sample-return missions. The Emerging Worlds program element does not accept proposals that are eligible for submission to LARS. (Note that LARS does not support work on samples returned by the Apollo program; relevant work on Apollo samples may be submitted to Emerging Worlds.)

### 3.1.6 Observations

Emerging Worlds does not fund ground- or space-based surveys. Proposals with an observational component must focus on the analysis and interpretation of the observations in order to understand the formation and early evolution of our Solar System. Observational proposals that are within the scope of the Solar System Observations program (which must have new observations within our Solar System as a primary element) should be submitted to Solar System Observations (program element C.6).

### 3.1.7 Solar System Workings

Investigations into processes that occur late in the history of small bodies and do not satisfy the definition of "early evolution" in Section 2.2, above, should be submitted to Solar System Workings (program element C.3).

### 3.1.8 Planetary Data, Archiving, Restoration, and Tools (PDART)

Some proposals that seek to acquire data or otherwise characterize Solar System objects, materials, or processes with the goal of enabling future work in Emerging Worlds or simply expanding knowledge of the early Solar System, but which do not directly address key problems of Solar System formation and early evolution, may be relevant to the PDART (program element C.7).
3.1.9 Studies of the Sun
Emerging Worlds does not solicit proposals that focus on the formation or early evolution of the Sun (or protosun).

3.2 Interdisciplinary Work
The Emerging Worlds program values the potential of interdisciplinary efforts to solve key scientific questions. To achieve this goal, proposals involving joint research efforts by investigators from different scientific communities are encouraged.

3.3 Duration and Size of Awards
Typical proposals to Emerging Worlds seek three years of funding or fewer. Please refer to program element C.1, Section 3.3, for instructions on submitting requests for more than three years. Projects to demonstrate or develop a new technique or a new application of an established technique, usually for less than three years duration, may also be proposed.

Awards made in Emerging Worlds in the first three years of its existence (selections made from ROSES-2014 though ROSES-2016 proposals) averaged ~$160,000 per year, but with a wide range, depending on the nature of the work proposed. The 2014-2016 Emerging Worlds selections are included in the spreadsheet on the SARA grant stats web page, and abstracts are made available through NSPIRES. Proposers may refer to the Frequently Asked Questions (FAQs) for this program to view a histogram of award sizes for prior years. Proposers should request what they actually need to conduct the research proposed.

Awards resulting from proposals submitted to this program will be funded with Fiscal Year (FY) 2018 dollars.

3.4 Additional Funding for Relevant Instrumentation Construction or Upgrade
Proposers to Emerging Worlds are eligible to request funds for Planetary Major Equipment (PME). See program element C.17 for information on how to append a PME request to a regular Emerging Worlds research proposal or submit a stand-alone PME proposal to supplement an existing Emerging Worlds award.

3.5 Topical Workshops
The Emerging Worlds program does not accept proposals for topical conferences, workshops, or symposia; such proposals may be submitted in response to program element E.2 Topical Workshops, Symposia, and Conferences. Proposers should specifically identify the Emerging Worlds program as the relevant SMD program element and refer to the goals and objectives of the Emerging Worlds program in demonstrating relevance.

3.6 Planetary Science Division Early Career Fellowship Program
See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship
applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

3.7. Mission data, facilities, and resources
Refer to ROSES program element C.1, Section 4, for a detailed list of the data and astromaterials resources, and facilities available to proposers to this program element, and how to use them.

3.8 Use of mission data
Proposals to this program element must follow the rules for use of mission data given in program element C.1, Section 3.4.

3.9 Data Management Plans (DMPs)
Proposals submitted to this program element must include a Data Management Plan (see program element C.1). This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.

3.10 Geologic Maps
Proposers who plan investigations involving geologic mapping should consult program element C.1 for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.

3.11 Access to the Antarctic
The Emerging Worlds program is not accepting proposals for work in Antarctica this year, under ROSES 2017.

4. Proposal Preparation, Submission, and Evaluation

4.1 Two-step proposals
This program element uses a two-step proposal submission process described in program element C.1, Section 2. Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

4.2 Proposal formatting and content
Proposals must follow all formatting and content requirements described program element C.1 and in the NASA Guidebook for Proposers. Violation of these rules is sufficient grounds for a proposal to be rejected. Although you are expected to follow all of the rules outlined above, please be especially aware of these common errors:

- Do not add an extra page containing your abstract prior to the main body of the proposal. The abstract is limited to the cover pages generated by NSPIRES.
• Do not add a table of symbols or abbreviations as an extra page beyond the 15 page Science/Technical/Management (STM) section. Such definitions must fit within the 15 pages.
• Do not describe team members’ roles and responsibilities in the table of work effort or budget sections. Only list job titles in these sections.
• Do not put information on instrument calibration or performance in the Facilities and Equipment section beyond what is needed simply to describe the instrument. If such information is critical to the work, put it in the STM section.
• Do not include work statements from Co-Is in the budget sections covering sub-awards/subcontracts. These may only appear in the STM section.
• Do not set your figure captions in a smaller typeface than the minimum permitted for the body text.

Also, we recommend, but do not require, the following practices for clarity in writing proposals:

• Please do not use numbered callouts to bibliographic references in the STM section. Use the author name(s) and year.
• There is no need to present budgets broken down by federal fiscal years. Budgets should be organized by award years.
• Place clear titles on all subsections of your budget.

4.3 Modular proposals

NASA has the option of funding only part of a proposal, if that part of the proposal receives a significantly better evaluation on intrinsic merit, relevance, or cost, or if only part of the overall project fits within the program budget. In order to be considered for this type of descoping, a proposal must be modular, with clearly identified (numbered), separable "tasks." A descopable task is a self-contained sub-project, which in and of itself is relevant to Emerging Worlds and of high scientific merit. Proposals that do not enumerate modular tasks will not generally be considered for descoped funding. Note that a proposal containing identified tasks does not require presentation of a separate budget for each task.

4.4 Evaluation of proposals

All proposals will be evaluated for Intrinsic Merit, Cost, and Relevance, as specified in the NASA Guidebook for Proposers. In Emerging Worlds, the extent to which proposals directly address key problems in the origin and evolution of our Solar System, and the anticipated impact and significance of the proposed work on the field will be considered a major component of the Intrinsic Merit score.

5. Summary of Key Information

<p>| Expected program budget for first year of new awards | ~$4.6M |
| Number of new awards pending adequate proposals of merit | ~30, see Section 3.3 |
| Maximum duration of awards | 4 years; shorter-term proposals (1-3 years) are |</p>
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<thead>
<tr>
<th>Due date for Step-1 proposals</th>
<th>See Tables 2 and 3 in the <em>Summary of Solicitation</em> of this NRA.</th>
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<td>Relevance</td>
<td>This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the <em>ROSES Summary of Solicitation</em>.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES <em>Summary of Solicitation</em> Section I(g) Order of Precedence and the NASA <em>Guidebook for Proposers</em>.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required. See also Section IV in the <em>ROSES Summary of Solicitation</em> and the NASA <em>Guidebook for Proposers</em>.</td>
</tr>
<tr>
<td>Web site for submission of proposals via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposals via Grants.gov</td>
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<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-EW</td>
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</tbody>
</table>
| NASA point of contact concerning this program | Jeff Grossman  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-1218  
E-mail: HQ-EMERGINGWORLDS@mail.nasa.gov |
C.3 SOLAR SYSTEM WORKINGS

NOTICE: Amended January 12, 2018. In response to community input, as well as professional hardships caused by the recent extreme weather, the proposal due date for this program element has been delayed to February 22, 2018.

Amended July 10, 2017. This program element no longer uses the two-step proposal submission process common in Appendix C. Instead, a Notice of Intent (NOI) is requested by November 16, 2017. Proposals are now due February 1, 2018. The list of Data Analysis Programs (DAPs) following the fourth paragraph in Section 2.1, Exclusions, was deleted to remove the potential implication that this list was exhaustive or completely described what type of proposals each DAP solicited. New text is in bold and deleted text is struck through.

This program element requires an explicit statement of relevance, which will be collected in a mandatory (4000-character) text box on the cover pages via the NSPIRES web interface. See Section 3, below.

This Program Element continues to use a two-step proposal submission process described in Section 2 of C.1 The Planetary Science Division Research Program Overview.

Proposers are expected to read the Data Analysis Program (DAP) solicitations before submitting to this program element any proposal that uses planetary mission data.

1. Scope of Program

The Solar System Workings (SSW) program element supports research into atmospheric, climatological, dynamical, geologic, geophysical, and geochemical processes occurring on planetary bodies, satellites, and other minor bodies (including rings) in the Solar System. This call seeks to address the physical and chemical processes that affect the surfaces, interiors, atmospheres, exospheres, and magnetospheres of planetary bodies. A wide range of investigations will be covered, including theoretical studies, analytical and numerical modeling, sample-based studies of extraterrestrial materials, field work, laboratory studies, and data synthesis relevant to the physical and chemical processes affecting planetary systems.

The Solar System Workings program solicits proposals for innovative scientific research related to understanding the atmospheric, climatological, dynamical, geologic, physical, and chemical processes occurring within the Solar System. This program is open to investigations relevant to surfaces and interiors of planetary bodies, planetary atmospheres, rings, orbital dynamics, and exospheres and magnetospheres. The Solar System Workings program values the potential of interdisciplinary efforts to solve key scientific questions. The program also values research in comparative planetology. Research supported by this call may include data synthesis, laboratory studies that examine physical or chemical properties and processes, studies of sample or analog
materials of other Solar System bodies, field studies of terrestrial analogs of planetary environments, or theoretical and numerical modeling of physical or chemical processes. This program seeks to understand processes that occur throughout the Solar System, as well as those specific to individual objects and systems, but inform our understanding of the fundamental processes at work. A nonexhaustive list of areas of research called for in this program element follows. For conciseness in this list, the term ‘planetary’ refers to Solar System objects other than the Sun (ranging in size from small objects, like comets and asteroids, through natural satellites, and up to planets) and structures (such as atmospheres, ionospheres, and ring systems).

- **Surfaces and Interiors**
  - *Interior structure.* Determine the internal structure, chemistry, and dynamics of Solar System objects and identify and understand the physical and chemical processes that occur within these structures.
  - *Planetary magnetism.* Determine the configuration of planetary magnetic fields and understand how and why they are formed and vary through time. Catalog remnant magnetic fields in order to probe the history of planetary dynamos, as well as core-mantle structures and dynamics.
  - *Mantle Evolution.* Understand the chemical evolution and physical structure of mantles and how they change over time.
  - *Lithospheres.* Identify objects with evidence of active or ancient tectonics and understand the processes and inputs that cause tectonic activity to start or stop. Understand the role that regional and global stress fields play in the formation of large-scale surface features and how those features inform studies of the global structure and dynamics.
  - *Volcanism.* Identify the physical and chemical variations in volcanic activity throughout the Solar System. Investigate how volcanic activity can provide insight into interior processes. Understand how volcanic activity can modify planetary surfaces and atmospheres.
  - *Evolution and modification of surfaces.* Characterize and understand the chemical, mineralogical, and physical features of planetary surfaces (such as geologic formations and impact craters) and fluid inventories that interact with the surface (including hydrospheres, cryospheres, atmospheres, and other volatile reservoirs). Develop theoretical and experimental bases for understanding these features in the context of the varying conditions through time after formation.

- **Planetary atmospheres**
  - *Composition and evolution.* Characterize the chemical composition (including isotope and trace species) of planetary atmospheres and of atmospheric structures (such as haze layers). Understand the vertical mixing, convective profiles, and chemical processes that control the stability of, the losses from, and the evolution of planetary atmospheres. Determine where atmospheric composition deviates from that expected from solar-nebula material and understand alternative sources and their implications for atmospheric evolution.
  - *Dynamics and thermal structure.* Identify and investigate varied features of Solar System atmospheres, such as Venus' greenhouse effect and Martian dust
storms. Accurately describe wind patterns and cloud features; determine their
temporal variability, their role in heat and momentum transfer, and other
atmospheric processes. Characterize vertical structure and the transport of
mass and heat at all scales, including the effects of coupling with planetary
surfaces and with the environment above the atmosphere.

- Climate change. Characterize planetary climates over short and long time
  scales by reconstructing the history of atmospheric volatile inventories and
  understanding the chemical processes that affect them. Resolve the role that
  atmospheric circulation, dynamics, surface (e.g., volcanic activity) and external
  (e.g., solar radiation) conditions, and disruptive events play in providing stability
  for, cyclic modulation of, or perturbations in the global climate. Compare
  climates and atmospheres among different planetary bodies at present and over
time.

- Rings
  - Composition and structure. Determine the three-dimensional structure of ring
    systems and the effects that moons and moonlets have on them. Characterize
    the chemical and size composition of ring system particles, including transient,
    diffuse, and dust rings.
  - Processes and evolution. Understand the physical and chemical processes
    active in ring systems and the interactions these systems have with planetary
    atmospheres, magnetospheres, and planetary bodies. Model the effects these
    interactions have in order to identify temporal changes of the rings on short and
    long timescales.

- Orbital dynamics
  - Orbital characteristics and evolution. Understand the gravitational interactions
    among groups of planetary bodies (e.g., satellites of a planet, an asteroid family,
    planets and other Sun-orbiting objects) and how they affect orbital
    characteristics and stability. Characterize the nongravitational forces acting on
    objects and understand their effect on orbital characteristics. Identify and
    characterize dust populations from planetary sources, and understand their
    dynamics within in the Solar System.
  - Orbital relationships. Characterize the creation, and understand the evolution, of
    asteroid families. Understand the effects of orbital relationships (such as orbital
    resonances between satellites) on planetary interiors, surfaces (including liquids
    and ices), and atmospheres.

- Plasma environments
  - Fundamental plasma processes. Understand the role that localized plasma
    waves and plasma processes (including reconnection and instabilities) have in
    regulating large-scale dynamics; characterize the energy that is produced and
    carried by these phenomena and how they couple distant regions.
  - Sources and sinks of mass and energy. Characterize the neutral and plasma
    sources in planetary magnetospheres (including induced magnetospheres),
    considering the contribution of internal sources (such as moons or rings), the
    solar wind, and planetary atmospheres (including cometary outgassing).
    Understand the relative importance of sources of charged and neutral particle
    energization. Characterize and understand the mass and energy exchange with
other objects or structures (such as the planet, the solar wind, or rings) and the loss from the system.

<p>| | |</p>
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<tr>
<td>o</td>
<td><strong>Magnetospheric processes and dynamics.</strong> Characterize magnetospheric processes and dynamics; determine how they cause mass and energy to flow through the system and couple these processes to the ionosphere and solar wind. Identify similarities and differences in magnetospheric processes and dynamics between the planets. Determine the relative importance of dynamics driven by internal and external energy sources across the magnetospheres, and understand how the different planetary magnetic field configurations affect these dynamics. Refine and exploit our understanding of electromagnetic radiation (e.g., auroral emissions and planetary radio signals) and particle emissions (e.g., dust streams and energetic charged and neutral particles) in order to remotely study dynamics and processes.</td>
</tr>
<tr>
<td>o</td>
<td><strong>Plasma interactions with structures and bodies.</strong> Determine mass and energy exchange with atmospheres and surfaces; understand the physical and chemical processes that this coupling may drive. Describe the interactions between the magnetospheric plasma and planetary objects, dust, and gas populations; characterize the energy flow and chemical processes within these coupled systems. Characterize the processes associated with space weathering and its effects on optical, spectroscopic, physical, and mechanical properties.</td>
</tr>
</tbody>
</table>

Due to the broad nature of this program’s mandate, it is open to a wide range of targets of interest and methods of investigation, but only accepts scientific investigations. Each proposal must present a scientific investigation to be conducted, what data and resources will be used, the investigation’s methodology, and how the investigation will achieve closure of the proposal’s goals. Although this program encourages the utilization of data from planetary missions and studies that produce data products (e.g., cartographic products, calibration data, moments calculations) to inform science investigations, it does not accept proposals eligible for funding by the Data Analysis Programs or the Planetary Data Archiving, Restoration, and Tools Program (see Section 2.1).

2. **Programmatic Information**

2.1 **Exclusions**

Proposers are advised to read each of the calls listed below prior to submitting proposals and to contact the appropriate Points of Contact with any questions.

Early Solar System studies. Proposals to conduct research to understand the formation and early evolution of the Solar System should be submitted to program element C.2, Emerging Worlds. The scope of Solar System Workings covers processes that occur after this period. For evolved bodies, Solar System Workings focuses on processes occurring after the end of global planetary differentiation; for primitive bodies, the focus is on processes that were not mainly active in the early Solar System. Processes that occur on regional or local scales on planetary bodies (such as impact cratering) are generally covered by Solar System Workings, even if they resulted in localized magmatism and/or differentiation.
Studies of habitability. Research aimed at investigating the habitability of planetary bodies in our Solar System or in other planetary systems should be submitted to the Habitable Worlds program element (E.4).

Mission Data Analysis. NASA solicits proposals that use, analyze, and/or enhance the scientific return of certain planetary missions through its data analysis programs (DAPs), listed below. Solar System Workings does not accept proposals that are eligible for submission to a DAP. The DAP program elements should be consulted prior to the submission of any proposal that uses planetary mission data.

- **Moon**: Proposals using data from recent lunar missions may be appropriate for the Lunar Data Analysis Program (see program element C.8).
- **Mars**: Proposals using Mars mission data may be appropriate for the Mars Data Analysis Program (see program element C.9).
- **Cassini**: Proposals using data from the Cassini mission may be appropriate for the Cassini Data Analysis Program (see program element C.10).
- **Discovery**: Proposals that use Discovery mission data may be appropriate for the Discovery Data Analysis Program (see program element C.11).
- **New Frontiers**: Proposals that use New Frontiers mission data may be appropriate for the New Frontiers Data Analysis Program (see program element C.19).
- **Rosetta**: Proposals that use Rosetta mission data may be appropriate for the Rosetta Data Analysis Program (see program element C.20).

[July 10, 2017 this list was deleted to remove the potential implication that this list was exhaustive or completely described what type of proposals each DAP solicited.]

If a proposal is not appropriate for any Data Analysis program element and does fit within the bounds of Solar System Workings, submission to this program element is encouraged.

Studies of Exoplanets. Proposals to understand exoplanetary systems are not supported by this program element. Those with ties to observational studies or future NASA missions (either directly or indirectly) should be submitted to the Exoplanet Research Program (see program element E.3 for further clarification and restrictions).

Earth Science Studies. Investigations that focus primarily on the Earth are not appropriate for the Solar System Workings program element; research opportunities supporting the Earth Science Research Program may be found in Appendix A of this solicitation. However, comparative studies of planetary bodies that apply investigations such as those listed in Section 1 of this call to Earth and one or more other planets, or investigations that use Earth as an analog to another body in our Solar System, are appropriate for this program element.

Data archiving, restoration, and tools. Proposals to Solar System Workings must include a science investigation. Proposals to produce a higher order data product that enhances the science return from one or more missions, but does not include a science investigation, should be submitted to program element C.7, Planetary Data Archiving, Restoration, and Tools (PDART).
Observations. Solar System Workings does not fund ground- or space-based surveys, but proposals that include analysis and interpretation of existing observations of Solar System objects may be submitted to this program. Observational proposals that are within the scope of the Solar System Observations program (which must have new observations within our Solar System as a primary element) should be submitted to Solar System Observations (program element C.6).

Conferences, workshops, and symposia. Proposals for topical conferences, workshops, or symposia related to the Solar System Workings program may not be proposed through this program element. Proposers are encouraged to pursue such submissions through ROSES program element E.2, Topical Workshops, Symposia, and Conferences. Proposers should specifically identify the Solar System Workings program as the relevant SMD program element and refer to the goals and objectives of the Solar System Workings program in demonstrating relevance.

2.2 Duration of Awards

Typical proposals to Solar System Workings seek three years of funding or fewer. Please refer to program element C.1, Section 3.3, for instructions on submitting requests for more than three years. Pilot studies and projects to demonstrate or develop a new technique or a new application of an established technique, usually for less than three years in duration, may also be proposed.

2.3 Additional Funding for Relevant Instrumentation Construction or Upgrade

Proposers to Solar System Workings are eligible to request funds for Planetary Major Equipment (PME). See program element C.17 for information on how to append a PME request to a regular Solar Systems Workings research proposal or submit a stand-alone PME proposal to supplement an existing Solar System Workings award.

2.4 Planetary Science Division Early Career Fellowship Program

See program element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

2.5 Relevance Statement Requirement

Step-2 Proposals to this program must discuss relevance in a (4000-character max) text box on the cover pages via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web interface for this program element. This section is outside of the 15-page Scientific/Technical/Management section and the relocation of the relevance discussion does not decrease that 15-page limit. This requirement supersedes the NASA Guidebook for Proposers and the ROSES Summary of Solicitation, and the omission of this section is sufficient reason for a proposal to be returned without review.

The relevance discussion must explicitly refer to this program element and the section of the program element to which the proposal is responsive. If the proposed work is close in scope to research covered by any other program element, this discussion must also justify why it is more relevant to this program element than that other program.
element. This discussion may not be used to address the proposal’s intrinsic merit, budget justification, or any other factor that remains in the 15-page main body, or any other section, of the proposal.

3. Proposal Submission Process and Formatting

**This program element no longer uses the two-step proposal submission process common in Appendix C. Instead, a Notice of Intent (NOI) is requested November 16, 2017. Proposals are now due February 1, 2018.** This Program Element uses the two-step proposal submission process outlined in Appendix C.1, Section 2. Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization. [Amended July 10, 2017]

Proposals must follow all formatting requirements described in program element C.1 and in the NASA Guidebook for Proposers. Violation of these rules is sufficient grounds for a proposal to be rejected.

4. Resources: Information, Data, and Facilities

4.1 Limits on Use of Mission Data

Proposals to this program element must follow the rules for use of mission data given in program element C.1, Section 3.4. If the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome.

4.2 Facilities and Data Sources Available to Proposers

Please refer to ROSES program element C.1, Section 4, for a detailed list of the data and astromaterials resources, and facilities available to proposers to this program element, and how to use them. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the NASA Guidebook for Proposers, a letter of support may be required from any facility required for the proposed effort.

4.3 Data Management Plans (DMPs)

Proposals submitted to this program element must include a Data Management Plan (see program element C.1, Section 3.6). This must be placed in a special section, no longer than two pages in length, that immediately follows the References and Citations section for the Scientific/Technical/Management portion of the proposal.

4.4 Geologic Maps

Proposers who plan investigations involving geologic mapping should consult program element C.1, Section 3.8, for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.
4.5 Antarctica

The Solar System Workings program is no longer accepting proposals for work in Antarctica.

5. Summary of Key Information

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<thead>
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<th>Expected program budget for first year of new awards</th>
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<td>4 years; shorter-term proposals (1-3 years) are typical; fourth year must be explicitly and well justified.</td>
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<td>Due date for NOIs Step-1 proposals</td>
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<td>NNH17ZDA001N-SSW</td>
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</tbody>
</table>
NASA points of contacts concerning this program, all of whom share the following **email and postal address**:  

**hq-ssw@mail.nasa.gov**

Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001

Email to **hq-ssw@mail.nasa.gov** is strongly preferred.

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[Changed July 10, 2017]
NOTICE: The Habitable Worlds program is now a cross division program between Planetary Science and Astrophysics and may be found in Program Element E.4.

The Planetary Science Division point of contact concerning this program is:

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C.5  **EXOBIOLOGY**

NOTICE: Amended on September 27, 2017. The Step-2 proposal due date for this program element has been delayed to October 24, 2017 to accommodate proposers affected by hurricane damage.

This Program Element continues to use a two-step proposal submission process described in Section 2 of C.1 The Planetary Science Division Research Program Overview.

Proposals to this Program Element are subject to a relevance requirement in addition to and that supersedes those detailed in the ROSES *Summary of Solicitation*, see Section 2.6 of this Program Element. Proposals that do not fulfill these requirements may be returned without review.

1. **Scope of Program**

The goal of NASA’s Exobiology is to understand the origin, evolution, distribution, and future of life in the Universe. Research is centered on the origin and early evolution of life, the potential of life to adapt to different environments, and the implications for life elsewhere. This research is conducted in the context of NASA’s ongoing exploration of our stellar neighborhood and the identification of biosignatures for *in situ* and remote sensing applications. For further information on the science scope of Astrobiology — within which exobiology is located— please refer to the Astrobiology roadmap, which can be found on the Astrobiology web page https://astrobiology.nasa.gov/research/astrobiology-at-nasa/astrobiology-strategy/.

The areas of research emphases in this solicitation are as follows:

- **Prebiotic Evolution**
  Research in the area of prebiotic evolution seeks to understand the planetary and molecular processes that set the physical and chemical conditions within which living systems may have arisen. A major objective is determining what chemical systems could have served as precursors of metabolic and replicating systems on Earth and elsewhere, including alternatives to the current DNA-RNA-protein basis for life. This would also include models of early environments on the Earth in which organic chemical synthesis could occur. Laboratory and theoretical, as well as related data-analysis, studies will be considered.

  Topics not included are the formation and stability of habitable planets, the formation of complex organic molecules in space and their delivery to planetary surfaces. Proposals on these topics should be submitted to C.2 Emerging Worlds.

- **Early Evolution of Life and the Biosphere**
  The goal of research into the early evolution of life and the biosphere is to determine the nature of the most primitive organisms and the environment in which they evolved. The opportunity is taken to investigate two natural repositories of evolutionary history available on Earth: the molecular record in living organisms and the geological record. These paired records are used to: (i) determine when and in what setting life first
appeared and the characteristics of the first successful living organisms; (ii) understand
the phylogeny and physiology of microorganisms, including extremophiles, whose
characteristics may reflect the nature of primitive environments; (iii) determine the
original nature of biological energy transduction, membrane function, and information
processing, including the construction of artificial chemical systems to test hypotheses
regarding the original nature of key biological processes; iv) investigate the
development of key biological processes and their environmental impact; v) investigate
the evolution of genes, pathways, and microbial species subject to long-term
environmental change relevant to the origin of life on Earth and the search for life
elsewhere; and vi) study the coevolution of microbial communities, and the interactions
within such communities, that drive major geochemical cycles, including the processes
through which new species are added to extant communities.

- Evolution of Advanced Life
Research associated with the study of the evolution of advanced life seeks to determine
the biological and environmental factors leading to the origin of eukaryotes and the
development of multicellularity on Earth and the potential distribution of complex life in
the Universe. This research includes studies of the processes associated with
endosymbiosis and the origin and early evolution of those biological factors that are
essential to multicellular life, such as developmental programs, intercellular signaling,
programmed cell death, the cytoskeleton, cellular adhesion control and differentiation, in
the context of the origin of advanced life.

Proposals aimed at identification and characterization of signals and/or properties of
extrasolar planets that may harbor intelligent life are not solicited at this time.

- Large scale environmental change and Macro-evolution
Research associated with the study of the macro-evolution of life on Earth includes an
evaluation of environmental factors such as the influence of latitudinal differences or
extraterrestrial (e.g., bolide impacts, orbital and solar variations, gamma-ray bursts, etc.)
and planetary processes ("Snowball Earth" events, rapid climate change, etc.) on the
large-scale evolution of life on Earth. Of particular interest are mass extinction events.

- Biosignatures and Life Elsewhere
Research in this area focuses on relating what is known about the origin of life on Earth
to the potential for the origin and establishment of life under conditions prevailing on
other planetary bodies and basic research on the formation and retention of
biosignatures under non-Earth conditions (e.g., Mars, Europa). This includes studies
that constrain or extend concepts of possible chemical evolution relevant to the origin,
evolution, and distribution of life. As part of the focus on biosignatures, this area
includes research on the forms in which prebiotic organic matter formed on planetary
surfaces has been preserved and the range of planetary environments amenable to life.
Additionally, research focused on understanding or characterizing nonradio "techno-
signatures" from extrasolar planets that may harbor intelligent life are included in this
area.

Biosignature studies of samples from Earth sites thought to be analogues of other
planetary environments that might potentially harbor life will be considered as part of
NASA’s broader interest in the search for life in the Universe.
2. Programmatic Information

2.1 General Information

Proposals are sought for new projects within the scope of the Astrobiology. Proposals submitted in response to this Program Element should be for new work that is not currently supported by the program or for investigations that would extend to their next logical phase those tasks that have been funded in the Astrobiology program, but whose periods of performance expired in the last year or are expiring in the first half of this year.

2.2 Program Exclusions

Research aimed at investigating the habitability of planetary bodies in our Solar System other than Earth or in other planetary systems should be submitted to the Habitable Worlds program (E.4).

Proposals focused on the formation and stability of habitable planets and the formation of complex organic molecules in space and their delivery to planetary surfaces should be submitted to the Emerging Worlds program (C.2).

Proposals aimed at the identification and characterization of radio signals from extrasolar planets that may harbor intelligent life are not solicited at this time.

2.3 Pilot Studies

Proposals for one to two-year pilot studies to demonstrate or develop a new technique or a new application of an established technique are encouraged. Such proposals may also include the demonstration of a technique new to the proposer, but not new to the field in general.

2.4 Additional Funding for Relevant Instrumentation Construction or Upgrade

Proposers to this program are eligible to request funds for Planetary Major Equipment (PME). See Program Element C.17 for information on how to append a PME request to a regular Exobiology research proposal or submit a stand-alone PME proposal to supplement an existing award.

2.5 Development of Astrobiology Instruments

This solicitation does not request proposals for the development of advanced instrument concepts and technologies as precursors to astrobiology flight instruments. Such proposals should be submitted to the Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) Program (for technology readiness levels [TRLs] 1-3+) or the Maturation of Instruments for Solar System Exploration (MatISSE) Program (for TRLs 4-6). Proposals for science-driven field campaigns that are expected to produce new science results, as well as new operational or technological capabilities, should be submitted to the Planetary Science...
and Technology from Analog Research (PSTAR) program (see C.14 and potential amendments thereto).

2.6 Relevance Statement Requirement
Proposals must discuss relevance to this Program Element in a (4000-character max) text box on the cover pages via the NSPIRES web interface for this Program Element. This section is outside of the 15-page Scientific/Technical/Management Section and the relocation of the relevance discussion does not decrease that 15-page limit. This requirement supersedes the NASA Guidebook for Proposers and the ROSES Summary of Solicitation, and the omission of this section is sufficient reason for a proposal to be returned without review.

The relevance discussion must explicitly refer to this Program Element and the section of the solicitation to which the proposal is responsive. If the proposed work is close in scope to research covered by any other Program Element, this discussion must also justify why it is more relevant to this Program Element than that other Program Element. This discussion may not be used to address the proposal’s intrinsic merit, budget justification, or any other factor that remains in the 15-page main body, or any other section, of the proposal.

2.7 Duration of Awards
Typical proposals to Exobiology seek three years of funding or fewer. Please refer to section 3.3 of C.1, the Planetary Science Research Program Overview, for instructions on submitting requests for more than three years. The appropriateness of the proposed funding period will be reviewed and adjustments may be requested. Programmatic balance may limit the opportunities for funding in some areas.

2.8 Topical Workshops, Symposia, and Conferences
The Exobiology program does not accept proposals for topical conferences, workshops, or symposia; such proposals may be submitted in response to Program Element E.2 Topical Workshops, Symposia, and Conferences. Proposers should specifically identify the Exobiology program as the relevant SMD Program Element and refer to the goals and objectives of the Exobiology program in demonstrating relevance.

2.9 Planetary Science Division Early Career Fellowship Program
See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

2.10 NASA Postdoctoral Program Fellows
Grantees in the program are eligible to serve as mentors to NASA Postdoctoral Program (NPP) Fellows. The tenure of a Fellow must begin before the end of the Exobiology award but may extend beyond it. Proposals from potential Fellows must be submitted through the standard NPP process. The Astrobiology Program expects to
select no more than three Fellows associated with Exobiology research this year. More information about the NASA Postdoctoral Program may be found at http://npp.usra.edu/.

2.11 Antarctica
The Exobiology Program is no longer accepting proposals for work in Antarctica.

3. Resources: Information, Data, and Facilities

3.1 Limits on Use of Mission Data
Proposals to this Program Element must follow the rules for use of mission data given in section 3.4 of C.1, the Planetary Science Research Program Overview. If the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome.

3.2 Facilities and Data Sources Available to Proposers
Refer to section 4 of C.1, the Planetary Science Research Program Overview, for a detailed list of the data and astromaterials resources, and facilities available to proposers to this Program Element, and how to use them. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the NASA Guidebook for Proposers, a letter of support may be required from any facility required for the proposed effort.

3.3 Data Management Plans (DMPs)
Proposals submitted to this Program Element must include a Data Management Plan (see C.1, Section 3.6). This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.

3.4 Geologic Maps
Proposers who plan investigations involving geologic mapping should consult C.1, Section 3.8, for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.

4. Proposal Submission Process
This Program Element uses a two-step proposal submission process described in C.1, Section 2.
Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.
Proposals must follow all formatting requirements that are described C.1 and in the NASA Guidebook for Proposers. Violation of these rules is sufficient grounds for a proposal to be rejected.
## 5. Summary of Key Information

| Expected program budget for first year of new awards | ~$3M |
| Number of new awards pending adequate proposals of merit | ~20 |
| Maximum duration of awards | 4 years; shorter term proposals (1-3 years) are typical; fourth year must be explicitly and scientifically justified. |
| Due date for Step-1 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Due date for Step-2 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Planning date for start of investigation | 6 months after proposal due date. |
| Page limit for the central Science/Technical/Management section of proposal | 15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers. |
| Relevance | This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| General information and overview of this solicitation | See the ROSES Summary of Solicitation. |
| Detailed instructions for the preparation and submission of proposals | Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers. |
| Submission medium | Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. |
| Web site for submission of Step-1 and Step-2 proposals via NSPIRES | [http://nspires.nasaprs.com/](http://nspires.nasaprs.com/) (help desk available at nspires-help@nasaprs.com or (202) 479-9376) |
| Web site for submission of Step-1 and Step-2 proposals via Grants.gov | [http://grants.gov](http://grants.gov) (help desk available at support@grants.gov or (800) 518-4726) |
| Funding opportunity number for downloading an application package from Grants.gov | NNH17ZDA001N-EXO |
| NASA point of contact concerning this program | Michael H. New  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-1766  
Email: michael.h.new@nasa.gov |
|-------------------------------------------------|-------------------------------|
NOTICE: This Program Element continues to use a two-step proposal submission process described in Section 2 of C.1 The Planetary Science Division Research Program Overview.

1. Scope of Program

Solar System Observations (SSO) supports primarily ground-based and limited airborne- and space-based astronomical observations of bodies in our Solar System. Proposals are solicited for observations over the entire range of wavelengths, from the ultraviolet to radio, that contribute to the understanding of the nature and evolution of the Solar System and its individual constituents. Additionally, SSO supports NASA’s commitment to discover and inventory potentially hazardous near Earth objects with sizes down to at least ~100 meters and to characterize that population through determination of their orbital elements. This program element will also consider proposals that characterize a representative sample of these objects by measuring their sizes, shapes, and compositions.

Suborbital investigations involving balloons, sounding rockets, or aircraft are not being solicited until further notice.

SSO contains two primary components: Planetary Astronomy and Near Earth Object Observations.

1.1 Planetary Astronomy (PAST)

Planetary Astronomy proposals must contain as a primary element new observation of Solar System objects (excluding Earth and Sun) during the period of performance. They must also support NASA Solar System exploration objectives that are not being met by current spacecraft missions, or that would directly support specific flight missions, either in development or operations, but have not been planned by those missions. The proposals also must include scientific analysis and publication plans. Ground-based observations that complement NASA missions returning significant amounts of data within the next three years are especially encouraged. Such observations may be made at any currently operating ground-based facility, public or private, including those supported by NASA. Investigations proposing to use existing airborne or space-based assets are only permitted if those missions do not already provide a funded observer program.

Proposals to utilize data to be obtained from large surveys, or other sources where the data are obtained in a continuous routine manner for general use, must include a member of the data collection team as a Co-Investigator (Co-I) or as a Collaborator and must utilize data acquired during the award period of performance in order to meet the requirement for an element of new observation.
1.2 Near Earth Object Observations (NEOO)

1.2.1 NEO Survey and Characterization Proposals

Near Earth Objects (NEOs) are defined as asteroids or comet nuclei whose perihelia are less than 1.3 AU. The NEOO Program has as a goal to discover all potentially hazardous NEOs with sizes down to at least ~100 meters and to characterize that population through determination of their orbital elements, with the goal of detecting more than 90 percent of this population, as soon as is feasible. In support of NASA’s commitment and goal, this program supports NEO investigations whose primary objective is to complete the inventory of the population of NEOs with sizes greater than 100 meters.

In order to help achieve this inventory of NEOs, NASA seeks investigations that promise a sustained, productive search for NEOs and/or obtain follow-up observations of sufficient astrometric precision to allow the accurate prediction of the trajectories of all discovered objects. NASA will also consider within this program proposals that characterize a representative sample of these objects by measuring their sizes, shapes, body dynamics, and compositions.

In addition to this goal, the NASA Human Exploration and Operations Mission Directorate and Planetary Science Division have established an interest for the NEOO Program to search for Near-Earth Asteroid (NEA) targets that provide Human Spaceflight accessible and/or robotic mission destinations. Therefore, investigations that provide capability to detect and more fully characterize the NEAs that are in low delta velocity orbits relative to Earth are of particular interest.

In keeping with NASA data rights policies, all funded NEO search or follow-up programs will be expected to make their data permanently available in a timely manner to the scientific community. Specifically, this requirement shall apply to all astrometric measurements of asteroids and comets made by NEO search and follow-up projects funded under this program. In particular, the internationally recognized archive for these data is the International Astronomical Union (IAU) sanctioned Minor Planet Center, currently located at the Harvard Smithsonian Astrophysical Observatory (see http://minorplanetcenter.net/).

1.2.2 Proposals for Impactor Characterization and Mitigation Studies

A limited amount of funding under this program will be made available for research to determine the parameters necessary to understand the characteristics of Potentially Hazardous Objects (PHOs) which are important for implementation of mitigation actions against a detected impact threat – that is, data supporting the operations designed to disrupt or deflect the trajectory of an asteroid on an impending Earth impact trajectory.
2. Programmatic Considerations

2.1 Additional Funding for Relevant Instrumentation Construction or Upgrade

Proposers to Solar System Observations are eligible to request funds for Planetary Major Equipment (PME). See Program Element C.17 for information on how to append a PME request to a regular Solar System Observations research proposal or submit a stand-alone PME proposal to supplement an existing award.

2.2 Proposals Utilizing Goldstone Planetary Radar

Proposals intending to use the planetary radar capabilities of the Deep Space Network Goldstone complex must contact the JPL Goldstone Solar System Radar (GSSR) Task Manager listed below for information on costs associated with using the Goldstone radar, which must be included in the proposal.

GSSR Task Manager:
Martin Slade
M/S 238-420
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109
Telephone: (818) 354-2765
Email: Martin.A.Slade@jpl.nasa.gov

2.3 Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

3. Resources: Information, Data, and Facilities

3.1 Limits on Use of Mission Data

Proposals to this Program Element must follow the rules for use of mission data given in program element C.1, section 3.4. If the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome.

3.2 Facilities and Data Sources Available to Proposers

Please refer to ROSES program element C.1, section 4, for a detailed list of the data and astromaterials resources, and facilities available to proposers to this Program Element, and how to use them. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions
in the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

3.3 Data Management Plans (DMPs)

Proposals submitted to this Program Element must include a Data Management Plan (see program element C.1, Section 3.6). This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.

3.4 Geologic Maps

Proposers who plan investigations involving geologic mapping should consult program element C.1, Section 3.8, for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.

4. Proposal Submission Process

This Program Element uses a two-step proposal submission process described in program element C.1, Section 2.

Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

Proposals must follow all formatting requirements that are described program element C.1 and in the *NASA Guidebook for Proposers*. Violation of these rules is sufficient grounds for a proposal to be rejected.

5. Summary of Key Information

| Expected program budget for first year of new awards | ~$1M (PAST)  
| Number of new awards pending adequate proposals of merit | ~8-10 (PAST)  
| Maximum duration of awards | Typically 3 years. Up to 5 years permitted.  
| Due date for Step-1 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation.  
| Due date for Step-2 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation.  
| Planning date for start of investigation | ~7 months after Step-2 proposal due date.  
| Page limit for the central Science/Technical/Management section of proposal | 15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers.  
| Relevance | This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.  

C.6-4
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<thead>
<tr>
<th>General information and overview of this solicitation</th>
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<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-SSO</td>
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| NASA point of contact concerning this program | Kelly E. Fast  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-0768  
E-mail: kelly.e.fast@nasa.gov |
1. Scope of Program

1.1 Programmatic Overview

The Planetary Data Archiving, Restoration, and Tools (PDART) program solicits proposals to generate higher-order data products, archive and restore data sets or products, create or consolidate reference databases, generate new reference information, digitize data, and develop or validate software tools.

The objective of this Program Element is to increase the amount and quality of digital information and data products available for planetary science research and exploration, and to produce tools that would enable or enhance future scientific investigations. Although it is expected that a small amount of data analysis, interpretation, or modeling may be performed to validate any generated products, this Program Element does not accept proposals in which the main focus is hypothesis-based science.

For all types of proposals, the products of selected proposals must be made available to the scientific community. Data products must be archived in the NASA Planetary Data System (PDS) or an equivalent archive (see Section 2.2 for a definition of an equivalent archive). All proposals will be evaluated on the perceived impact of the new products, datasets, or tools on future planetary science research and exploration.

Proposers to this Program Element will not provide a data management plan via the NSPIRES cover pages or as a two-page addendum. Instead, that is superseded by instructions in the sections below that place more detailed descriptions into the body of the Scientific/Technical/Management section of proposals.

1.2 Data Product Generation

Proposals to generate new high-order data products or to improve or expand current high-order data products are encouraged. Source data may be derived from NASA or other spaceflight missions, astronomical observations, sample analyses, or other sources. These new data products may include, but are not limited to, cartographic products and calibrated or corrected datasets.

1.3 Data Set Restoration and Archiving

Proposals to archive complete datasets and/or to restore and archive incomplete datasets (e.g., to reextract, rereduce, and/or recalculate data to fill in fragmentary datasets) will be considered. Such proposals must include: 1) an archiving plan (see Section 4.3); 2) a description of how the data will be obtained; 3) a detailed plan for how the data will be restored, if relevant; and 4) a description of documentation, calibration data, and related software necessary to read and interpret the original and new datasets.
1.4 **Reference Database Creation**

Proposals that create and/or consolidate reference databases useful for planetary science research will be considered. These databases may include, but are not limited to, spectral libraries, chemical and physical properties of materials, and photographic catalogs. The burden is on the proposal to demonstrate the demand for a proposed database and its likelihood of advancing the current state of knowledge or resolving a significant planetary question or problem.

1.5 **Generation of New Reference Information**

Proposals to make laboratory measurements, conduct experiments, or otherwise generate new reference information that is intended for general use in planetary science will be considered. Examples may include, but are by no means limited to, spectral data, phase diagrams and equations of state, physical laws, optical constants, partition coefficients, and thermodynamic properties of materials. Where the main product of the proposal is a reference dataset, the proposal must include a plan to deposit the data in the NASA PDS or an equivalent archive. The burden is on the proposal to demonstrate the demand for a proposed reference product and its likelihood of advancing the current state of knowledge or resolving a significant planetary question or problem.

1.6 **Data Digitization**

Proposals to recover datasets that currently are available only on media not readable by modern computing equipment, or to digitize data that are only available in analog form (e.g., printed matter, photographs, and manuscripts) will be considered. PDART will consider proposals that include the rental of specialty equipment and/or the hiring of independent expertise to accomplish those tasks. Regardless of the method, the proposal must demonstrate the capability and provide a plan to recover or digitize the data. The burden is on the proposal to demonstrate the demand for the digitized product and its likelihood of advancing the current state of knowledge or resolving a significant planetary question or problem.

1.7 **Software Tool Development and Validation**

Proposals to develop and disseminate software tools that facilitate the use of existing datasets or that would enable or enhance future science investigations of interest to the Planetary Science Division will be considered. PDART does not support extensive application of these tools, but it is expected that the validity of the tools will be demonstrated during the course of the proposed work. Proposals are expected to include a plan to disseminate the tools for use by the planetary community. In addition to any other dissemination mechanisms, investigators developing software tools are required to archive the source code, and all relevant documentation, at NASA’s PSD Github site ([https://github.com/NASA-Planetary-Science](https://github.com/NASA-Planetary-Science)). It is expected that user interfaces and/or executables will be made publicly available at no cost. Accordingly, awards made under this program element will contain a "Rights in Data" clause reflecting this expectation.

C.7-2
This Program Element will also accept proposals to fund the development or enhancement of numerical models, with the expectation that the funded model will be made publicly available. In these instances, the proposal will be judged on 1) how the enhancement would result in an improvement in the results previously produced by this or similar models, and 2) how the enhancement would enable scientific investigations not currently possible with, or improve investigations relative to, models currently in use.

Proposals to develop tools that would enhance the usability of, and access to, the PDS4 file format are particularly encouraged. Of special interest are tools for converting PDS4-formated files into other popular file formats (e.g., FITS, CDF).

2. Programmatic Information

2.1 Relevance Statement Requirement

Step-2 Proposals to this Program Element must discuss relevance in a (4000-character maximum) text box on the cover pages via the NSPIRES web interface for this Program Element. This section is outside of the 15-page Scientific/Technical/Management Section and the relocation of the relevance discussion does not decrease that 15-page limit. This requirement supersedes the NASA Guidebook for Proposers and the ROSES Summary of Solicitation, and the omission of this discussion is sufficient reason for a proposal to be returned without review.

The relevance discussion must explicitly refer to the objectives of this Program Element and the section of this appendix to which the proposal is responsive. If the proposed work is close in scope to research covered by any other Program Element, this discussion must also justify why it is more relevant to this Program Element than that other Program Element. This discussion may not be used to address the proposal’s intrinsic merit, budget justification, or any other factor that remains in the 15-page main body, or any other section, of the proposal.

2.2 Merit Evaluation Criterion

As PDART’s goals differ from other programs, the review of proposals submitted to this Program Element will include Merit factors not listed in the NASA Guidebook for Proposers. In addition to the Guidebook criteria, all submitted proposals will be evaluated on the following PDART-specific merit factors:

1. The perceived impact of the new products, datasets, or tools on future planetary science research and exploration. This factor includes an evaluation of the proposal’s end products against the state-of-the-art and the demand for the proposed product.
2. The uniqueness and/or time criticality of the proposed new products, datasets, or tools. For this factor, historical significance may also be considered but cannot be the sole justification for the effort.
3. The credibility of the proposed plan for dissemination and archiving. This factor includes both the format that the data products/tools would be in and how they would be made available for the scientific community. For those proposals that would use an archive other than NASA’s PDS or Github sites, this factor includes
an evaluation of whether the repository is a PDS-equivalent archive (Section 2.3).
4. Any applicable factors described in Sections 1.2-1.7.

2.3 Definition of a PDS-equivalent archive

Equivalence of an archive to the NASA PDS is defined by a number of factors that cover accessibility, reliability, usability, and other qualities.

Proposed archives are required to have the following features:

1. The Archive shall be managed by someone other than the major data provider. (Independence)
2. The Archive shall be managed for the long-term (25 years at least). (Sustainability)
3. The Archive shall be accessible to the public (lay and scientific) without preapproval. (Open Accessibility)
4. The Archive shall ensure that data are searchable. (Searchability)
5. The Archive shall ensure that data are citable. (Citability)
6. The Archive shall be considered by its user community as the "standard" archive for the subfield. (Preeminence)
7. The Archive shall require that data products be submitted in standardized formats and file types. (Standardization)

Proposed archives are preferred (but not required) to have the following features:

1. The Archive should conduct independent peer reviews of data to assess usability and completeness of data packages. (Peer Review)
2. The Archive should include documentation for its holdings such as user guides, calibration descriptions, etc. (Documentation).

The following are some examples of PDS-equivalent archives: The HIgh-resolution TRAnsmission molecular absorption database (HITRAN), Infrared Processing and Analysis Center (IPAC) Infrared Science Archive (IRSA), NASA Space Science Data Coordinated Archive (NSSDCA), Coordinated Data Analysis Web (CDAWeb). In addition, the PDS imaging node annex (PDS IMG annex) is considered by PDART to be PDS-equivalent for certain geospatial products which cannot be ingested into the PDS. In addition, the PDS imaging node annex (PDS IMG annex) is considered by PDART to be PDS-equivalent for certain geospatial products which cannot be ingested into the PDS. If a proposed work effort would deliver data products to an archive other than PDS or one of those listed here, the proposal must demonstrate that it meets the requirements above.

2.4 Exclusions

PDART does not support scientific investigations whose primary emphasis is data analysis, fundamental theoretical research, or instrument development. Proposers are encouraged to consult C.1 Planetary Science Research Program Overview for the appropriate Program Element to which they should submit.
Proposals whose primary focus is on data to be used in investigations solicited by the Astrophysics, Heliophysics, or Earth Science Divisions are encouraged to consult Appendices D, B, and A respectively for information on the appropriate Program Elements to which they should be submitted.

The PDART element does not fund proposals whose work effort is primarily to acquire new ground- or space-based observations or surveys; such proposals should be submitted to the Solar System Observations program (see C.6).

Investigators funded by spaceflight missions who wish to apply to this solicitation must clearly demonstrate in their proposal how the proposed research does not overlap and is not redundant with duties or responsibilities already funded by their respective mission(s). See C.1, The Planetary Science Division Research Program Overview, for more information.

Proposals for topical conferences, workshops, or symposia related to this Program Element may not be proposed through this solicitation. Proposers are encouraged to pursue such submissions through ROSES E.2 Topical Workshops, Symposia, and Conferences.

2.5 Duration and Size of Awards

The maximum funded duration of awards from C.7 is three years. Proposals for funding of less than three years are highly encouraged for projects that can be completed on shorter timescales. The appropriateness of the proposed funding period will be reviewed and adjustments may be requested.

The 2016 PDART selections are posted to the spreadsheet on the SARA grant stats web page. The average year-one award size in 2016 was ~$130K, but the award sizes for this program span a very wide range, depending on the nature of the work proposed. Proposers are encouraged to request what is actually needed to conduct the proposed work. As always, the number of new awards will also depend on the available Fiscal Year (FY) 2017 budget.

2.6 Data Management Plans (DMPs)

Because data archiving is an integral part of PDART and evaluated as part of the merit, a data management plan should be integrated as part of the Science/Technical/Management portion of the proposal, no additional DMP section is required for this Program Element.

3. Proposal Submission Process

This Program Element uses a two-step proposal submission process described in C.1, Section 2.

Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.
Proposals must follow all formatting requirements that are described C.1 and in the *NASA Guidebook for Proposers*. Violation of these rules is sufficient grounds for a proposal to be rejected.

4. **Resources: Information, Data, and Facilities**

4.1 **Limits on Use of Data**

For proposals that generate higher-order data products from NASA mission data or otherwise use such mission data in the development or testing of software, the data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. This 30-day rule does not apply to unarchived data from missions prior to the creation of the PDS if the dataset in question will be archived to PDS through the proposed project.

Proposals to digitize and/or archive data not currently available in a public archive must demonstrate that the data to be used are available (such as a letter of support, if they are owned by a private entity, or a detailed plan to locate and obtain the data from a known repository), in a format suitable for the proposed work, and of sufficient quality to achieve the goals set forth in the proposal. The proposal should further demonstrate a familiarity with the data and an understanding of the work required to prepare the data for future analysis and/or delivery to an appropriate public archive.

4.2 **Facilities and Data Sources Available to Proposers**

Proposers are strongly advised to read C.1 The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort that is not under the direct control of the proposal’s PI or Co-I’s.

4.3 **Data Archiving and Map Publication**

Selected investigations are expected to result in data products or tools that are of broad use to the science community, including maps, data with improved calibrations, etc. PDART requires that data produced by selected investigations be archived in the Planetary Data System ([http://pds.nasa.gov/](http://pds.nasa.gov/)), or a PDS-equivalent archive, by the end of the award period. Proposers should communicate with the PDS Discipline Node responsible for curating similar data (links to the PDS Discipline Nodes are at [http://pds.nasa.gov/](http://pds.nasa.gov/)) to discuss procedures and requirements prior to proposing and to help with discerning the most efficient way to archive the proposed data products.
Proposers intending to archive data or products in the PDS must obtain and include a letter of confirmation from the appropriate Discipline Node that the PDS is willing to accept their submission. It is the proposer’s responsibility to conform to PDS standards.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. Investigators that intend to produce a USGS geologic map are required to include in their Step-2 (full) proposal a confirmation of technical specification document obtained from the USGS Map Coordinator. Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for the USGS’ information on and requirements for map production and publication.

5. Summary of Key Information

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</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of proposals via NSPIRES</td>
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<td>Web site for submission of proposals via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
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</tr>
<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-PDART</td>
</tr>
</tbody>
</table>
| Points of contact concerning this program all of whom share the following postal address: | Sarah Noble – Lead Discipline Scientist  
Telephone: (202) 358-2492  
E-mail: [sarah.noble-1@nasa.gov](mailto:sarah.noble-1@nasa.gov) |
| Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001 | Jared Leisner – Discipline Scientist  
Telephone: (202) 358-2016  
E-mail: [jared.s.leisner@nasa.gov](mailto:jared.s.leisner@nasa.gov) |
| Points of contact concerning this program all of whom share the following postal address: | Michael New – Discipline Scientist  
Telephone: (202) 358-1766  
E-mail: [michael.h.new@nasa.gov](mailto:michael.h.new@nasa.gov) |
NOTICE: Amended August 15, 2017. The due dates have been delayed. Required Step-1 proposals are now due November 30, 2017. Step-2 proposals are due March 1, 2018. The purpose of this delay is to help de-cluster the PSD R&A due dates and to provide a more even distribution of R&A due dates throughout the year.

NOTICE: This Program Element continues to use a two-step proposal submission process described in Section 2 of C.1 The Planetary Science Division Research Program Overview.

1. Scope of Program

1.1 Program Overview

The Lunar Data Analysis Program (LDAP) program funds research on the analysis of recent lunar missions in order to enhance their scientific return. LDAP broadens scientific participation in the analysis of mission data sets and funds high-priority areas of research that support planning for future lunar missions.

LDAP supports scientific investigations of the Moon using publicly available (released) data. These include the following missions:

- Lunar Crater Observation and Sensing Satellite (LCROSS),
- Moon Mineralogy Mapper (M3),
- Lunar Reconnaissance Orbiter (LRO),
- Gravity Recovery and Interior Laboratory (GRAIL),
- Acceleration, Reconnection, Turbulence, and Electrodynamics of the Moon’s Interaction with the Sun (ARTEMIS),
- Lunar Atmosphere and Dust Environment Explorer (LADEE),
- Lunar Prospector (LP),
- Deep Impact Lunar Flyby,
- Non-U.S. missions: Kaguya, Chang’e 1, Chang’e 2, Chandrayaan-1, Chang’e 3.

Any proposal may incorporate the investigation of data from more than one mission.

An investigator may propose a study (e.g., scientific, landing site science, cartographic, topographic, geodetic research, etc.) based on analysis of lunar data collected by spacecraft at the Moon (listed above). Proposals may incorporate the analysis of data from more than one mission. Moreover, data analyses that require the use of older mission data sets (e.g., Apollo, Clementine) are allowable in the context of enhancing the analysis and understanding of the data from the missions listed above. The use of older data sets as complementary/supplementary data sets to the missions listed above for the purpose of creating a needed data product (e.g., maps) for analysis is allowable.

Additional information about NASA and other lunar missions can be found at NASA’s National Space Science Data Center (NSSDC) at: http://nssdc.gsfc.nasa.gov/planetary/planets/moonpage.html.
LDAP solicits proposals that enhance the scientific return of lunar missions through the use of mission data. Tasks responsive to this call include 1) data analysis tasks, 2) nondata-analysis tasks that require the use of lunar mission data, and 3) nondata-analysis tasks that significantly enhance the use or facilitate the interpretation of lunar mission data. These tasks may incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research. Nondata-analysis tasks that are responsive to this call are defined as tasks that are necessary to analyze (or help analyze) the lunar mission data. All proposals must include a complete science investigation. Proposals that include nondata-analysis tasks that do not incorporate the results of such tasks in the analysis of lunar mission data will not be deemed responsive to this call. Proposals whose principle objective is the production of data products for use by other researchers are appropriate for submission to C.7 Planetary Data Archiving, Restoration, and Tools (PDART).

Investigations are welcome in the following high priority areas of lunar research:

- Identification and/or characterization of potential landing sites of high lunar science return (e.g., geomorphology, regolith, radiation, and compositional properties);
- Modeling of the lunar gravitational field, global topography, and global lunar figure;
- Enhancement of the lunar geodetic network to enable precision lunar landing;
- Identification, distribution, transport, and characterization of volatiles in and on the Moon;
- Determination of the size and state of the lunar core;
- Determination of lunar lithospheric thickness;
- Lunar "change detection" (i.e., detection of surface or atmospheric changes as a function of time);
- Characterization of the global variability and structure of the lunar exosphere and/or dust environment;
- Identification/characterization of lunar mineralogy as a function of location and depth.


LDAP will consider requests for support of new ground-based observations of the Moon provided that such requests are clearly described and that the observations are essential to the success of the work proposed. Requests to support such tasks are only allowable in the context of enhancing the analysis and understanding of the data from the missions listed above.

Investigators interested in proposing mostly theoretical, modeling, laboratory, or field studies that do not directly use spacecraft data are advised that such studies are not
appropriate for LDAP, but may be suitable for submission to the C.2 Emerging Worlds or C.3 Solar System Workings Programs.

1.2 Sources of Information and Data
The LDAP program supports research investigations relevant to the scientific interpretation of lunar mission data that are now in the public domain. LDAP supports investigations that use only publicly available and released data. Data to be used in proposed investigations must be available in the Planetary Data System (PDS) (http://pds.nasa.gov) or an equivalent publicly accessible archive at least 30 days prior to the submission due date for LDAP Step-2 proposals. Spacecraft data that have not been placed in the public domain may not be proposed for use in LDAP investigations. (Once a proposal has been awarded, investigators are free to augment the proposed dataset under analysis with data deposited in the PDS (or an equivalent publicly available archive) subsequent to 30 days prior to the LDAP submission date.)

Whether from the PDS or another source, if the data to be analyzed are not certified or otherwise have issues that might represent an obstacle to analysis, the obligation is on the proposer to clearly demonstrate that such potential difficulties can be overcome. Likewise, this requirement applies to proposals that make use of planetary data from international missions that do not have their data deposited in the PDS.

In all cases, it is the responsibility of the LDAP investigator to acquire any necessary data; therefore, before submitting a proposal, proposers must demonstrate in their proposal that the necessary data are available. Proposers who wish to use photographic and cartographic materials may access such data through the nearest Regional Planetary Image Facility (RPIF). RPIF locations are listed on the RPIF home page at http://www.lpi.usra.edu/library/RPIF.

1.2.1 Flight Team Member Requirements
Members of current spacecraft flight teams who wish to apply to the LDAP program must clearly demonstrate that their proposed investigation will use only released and publicly available data. Flight team members must scrupulously comply with the 30 days prior to submission rule (above). Additionally, proposals from current flight team members must rigorously demonstrate how the proposed LDAP research does not overlap – and is not redundant with – data analysis duties/responsibilities already funded within their respective mission. This requirement applies to all members of the proposal team.

1.3 Data Products and Data Archiving and Map Publication
Investigators may propose to produce data products (e.g., cartographic products, such as geologic, topographic, or mineral maps, and/or calibration data). Such investigations must have associated scientific tasks. Proposers interested in producing data products that do not have associated scientific tasks are directed to the Planetary Data Archiving Restoration and Tools Program (C.7 PDART). Proposers who plan investigations involving geologic mapping should consult program element C.1, Section 3.8, for guidance on submission and requirements for publication of U.S. Geological Survey
(USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.

A plan for archiving and making products readily available must be included in any proposed investigation that will result in the production of data products. NASA reserves the option to require the archiving in the Planetary Data System (http://pds.nasa.gov/) of any data products resulting from LDAP selected proposals.

Proposals submitted to this Program Element must include a Data Management Plan (see program element C.1, Section 3.6). This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section of the Scientific/Technical/ Management portion of the proposal.

Proposers should refer to the most recent versions of the following documents for information on PDS compliance:

<table>
<thead>
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<th>Document</th>
<th>Hyperlink</th>
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</table>

Additional information on the PDS may be obtained from the following individuals:

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<thead>
<tr>
<th>Contact</th>
<th>Title</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>William Knopf</td>
<td>Program Executive</td>
<td><a href="mailto:william.knopf-1@nasa.gov">william.knopf-1@nasa.gov</a></td>
</tr>
<tr>
<td>Thomas Morgan</td>
<td>Project Manager</td>
<td><a href="mailto:thomas.h.morgan@nasa.gov">thomas.h.morgan@nasa.gov</a></td>
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</tbody>
</table>

2. Programmatic Information

2.1 Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

2.2 NASA Provided High-End Computational (HEC) Facilities

Those investigators whose research requires high-performance computing should refer to the ROSES Summary of Solicitation, Section I(d), "NASA-provided High-End Computing Resources." This section describes the opportunity for successful proposers to this program to apply for computing time on either of two NASA computing facilities at the Goddard Space Flight Center’s Computational and Information Sciences and Technology Office or at the Ames Research Center's Advanced Supercomputing Division.

2.3 The Two-Step Submission Process

This Program Element uses a two-step proposal submission process described in program element C.1, Section 2.
Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

Proposals must follow all formatting requirements that are described program element C.1 and in the NASA Guidebook for Proposers. Violation of these rules is sufficient grounds for a proposal to be rejected.

2.4 Duration and Size of Awards

The maximum duration of awards from C.8 is four years (not including no cost extensions). It is anticipated that most proposals will seek funding for up to three years. Proposals seeking funding for less than three years are highly encouraged for projects that can be completed on shorter timescales. The appropriateness of the proposed funding period will be reviewed and adjustments may be requested. Please refer to program element C.1, section 3.3, for instructions on submitting requests for more than three years.

Since this is a new program with a new scope, the budget and expected number of new awards is somewhat uncertain, as it may depend on the distribution of topics proposed and the number of proposals submitted. As always, the number of new awards will also depend on the available budget for next Fiscal Year.

The average award size from this program in ROSES-2014 was ~$100K per year, and in 2015 it was ~$115K, but with a wide range, depending on the nature of the work proposed. When the 2016 LDAP selections are made, that data will be contained on a spreadsheet on the SARA grant stats web page. Proposers are encouraged to request specifically what is needed to conduct the proposed research.

2.5 Facilities and Data Sources Available to Proposers

Please refer to ROSES program element C.1, section 4, for a detailed list of the data and astromaterials resources, and facilities available to proposers to this Program Element, and how to use them. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the NASA Guidebook for Proposers, a letter of support may be required from any facility required for the proposed effort.

3. Summary of Key Information

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| NASA points of contact concerning this program | Robert A. Fogel  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-2289  
E-mail: rfogel@nasa.gov |
MARS DATA ANALYSIS

NOTICE: This Program Element takes proposals via a two-step proposal submission process described in Section 2 of C.1 The Planetary Science Division Research Program Overview.

1. Scope of Program

The objective of the Mars Data Analysis Program (MDAP) is to enhance the scientific return from missions to Mars conducted by NASA and other space agencies. These include, but are not limited to, the following missions: Mars Pathfinder (MPF), Mars Global Surveyor (MGS), Mars Odyssey (MO), Mars Exploration Rovers (MERs), Mars Express (MEX), Mars Reconnaissance Orbiter (MRO), Phoenix (PHX), Mars Science Laboratory (MSL), and Mars Atmosphere and Volatile EvolutioN (MAVEN). Any proposal may incorporate the investigation of data from more than one mission. Additional information about these missions, as well as references containing preliminary science results, can be found on the Mars Exploration Program (MEP) homepage at: http://mars.jpl.nasa.gov/.

MDAP broadens scientific participation in the analysis of mission data sets and funds high-priority areas of research that support planning for future Mars missions. Investigations that use data derived from other sources (e.g., ground-based radar, Hubble) will also be considered. MDAP supports scientific investigations of Mars using publicly available (released) data.

Investigations submitted to this program must demonstrate how the research to be undertaken will directly improve our understanding of open science questions at Mars relevant to current hypotheses. Tasks responsive to this call include 1) data analysis tasks, 2) nondata-analysis tasks that are necessary to analyze or interpret the data, and 3) nondata-analysis tasks that significantly enhance the use or facilitate the interpretation of mission data. These tasks may incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research. Proposals that include nondata-analysis tasks to enhance the use or facilitate the interpretation of mission data must incorporate the results of such tasks in the analysis or interpretation of mission data to be responsive to this call. MDAP does not support field studies or the acquisition of new astronomical observations.

An investigator may also propose in the following high-priority areas of Mars research that support planning for future Mars missions:

- Improved atmospheric models that further the understanding and forecasting of Mars atmospheric conditions that affect the orbital trajectories of spacecraft and/or the safe passage of spacecraft through the atmosphere, including aerobraking and aerocapture.
- Characterization of potential landing sites for future Mars exploration missions (e.g., geomorphology, distribution and size of rocks, pits, sand dunes, regional and local slopes, surface composition, and texture variability).
- Improved models for the Mars gravity field and global topography and planetary figure.
• Improvement of the geodetic network of Mars for precision landing.
• Analysis and comparison of Mars orbital and surface data to increase the predictive accuracy of surface characteristics of Mars from orbit.

The Mars Data Analysis Program is particularly interested in receiving proposals to analyze the extensive, but underutilized, gamma ray and neutron datasets from the Mars Odyssey mission. Many years worth of data from the neutron detector and the neutron and gamma ray spectrometers are available on the Geosciences Node of the PDS.

For more information about the type of research supported by the MDAP, please refer to the abstracts of currently funded investigations that are available online at: http://nspires.nasaprs.com/.

2. Programmatic Information

2.1 Program Exclusions

Investigators proposing studies that do not focus on the tasks listed in Section 1 are advised that such studies are not appropriate for MDAP, but may be suitable for submission to the other programs in Planetary Science.

Proposals to conduct comparative studies between Mars and other Solar System objects are not responsive to this call and are directed to the most appropriate core program in Planetary Science.

Investigators who wish to propose to produce data products (e.g., cartographic products, such as geologic, topographic, or mineral maps, and/or calibration data) that are not part of a larger science investigation are directed to C.7 Planetary Data Archiving, Restoration and Tools (PDART).

2.2 Relevance Statement Requirement

Step-2 Proposals to this Program Element must discuss relevance in a (4000-character maximum) text box on the cover pages via the NSPIRES web interface for this Program Element. This section is outside of the 15-page Scientific/Technical/Management Section and the relocation of the relevance discussion does not decrease that 15-page limit. This requirement supersedes the NASA Guidebook for Proposers and the ROSES Summary of Solicitation, and the omission of this section is sufficient reason for a proposal to be returned without review.

The relevance discussion must explicitly refer to this Program Element and the section of the solicitation to which the proposal is responsive. If the proposed work is close in scope to research covered by any other Program Element, this discussion must also justify why it is more relevant to this Program Element than that other Program Element. This discussion may not be used to address the proposal’s intrinsic merit, budget justification, or any other factor that remains in the 15-page main body, or any other section, of the proposal.
2.3 Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

2.4 Data Management Plans (DMPs)

Program element C.1, section 3.6, discusses the requirements for DMPs in proposals to this Program Element. Please note that DMPs are mandatory for this Program Element, and must be placed in a special section not to exceed two pages in length, immediately following the References and Citations section of the Scientific/Technical/Management portion of the proposal.

3. Resources: Information, Data, and Facilities

3.1 Limits on Use of Mission Data

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the Step-2 proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations.

Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply, must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see C.1 The Planetary Science Division Research Program Overview, for more information.

3.2 Facilities and Data Sources Available to Proposers

Refer to ROSES program element C.1, section 4, for a detailed list of the data and astromaterials resources, and facilities available to proposers to this Program Element, and how to use them. If their use is anticipated, this should be discussed and justified in the submitted proposal (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the NASA Guidebook for Proposers, a letter of support may be required from any facility required for the proposed effort.

Documents that describe the research priorities for Mars exploration include:

- Mars Exploration Program Analysis Group (MEPAG) reports (http://mepag.jpl.nasa.gov/) including Mars Scientific Goals, Objectives, Investigations, and Priorities [2010 and subsequent updates];
- The recommendations of the Committee on the Planetary Science Decadal Survey of the National Research Council as described in the Space Studies Board

Additional information is available on the MEP web site at: [http://mars.jpl.nasa.gov/](http://mars.jpl.nasa.gov/).

### 3.3 Geologic Maps

Proposers who plan investigations involving geologic mapping should consult program element C.1, Section 3.8, for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps.

### 4. The Proposal Submission Process

This Program Element uses a two-step proposal submission process described in Section 2 of program element C.1.

Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

Proposals must follow all formatting requirements that are described in program element C.1 and in the *NASA Guidebook for Proposers*. Violation of these rules is sufficient grounds for a proposal to be rejected.

### 5. Summary of Key Information

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<th>Expected program budget for first year of new awards</th>
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<td>15 pp; see also Table 1 of ROSES and the <em>NASA Guidebook for Proposers</em>.</td>
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</tr>
</tbody>
</table>
| NASA point of contact concerning this program | Mitch Schulte  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-2127  
E-mail: mitchell.d.schulte@nasa.gov |
NOTICE: This Program Element continues to use a two-step proposal submission process described in Section 2 of C.1 The Planetary Science Division Research Program Overview.

The Cassini Participating Scientist Program’s final year was ROSES 2015 and it is no longer accepting proposals. With this change, those proposal allowances particular to the Cassini PSP (5-page appendix, request for membership on a Cassini science team, ability to use future mission data) are no longer in this call.

The scope of this Program was clarified and slightly modified in ROSES-2016. Proposers are expected to carefully read the solicitation and should E-mail the program point of contact with any questions sufficiently ahead of the Step-1 proposal deadline. In addition, the NSPIRES page has a Frequently Asked Questions (FAQs) section that contains the answers to common questions about this Program.

1. Scope of Program

1.1 Programmatic Overview

The objective of the Cassini Data Analysis Program (CDAP) is to enhance the scientific return of the Cassini mission by broadening the scientific participation in the analysis and interpretation of data returned by this mission. Other mission and nonmission data sets may be used to supplement these data in a supporting role, but all proposals must require the use of data from the Cassini mission.

This Program solicits research proposals to conduct scientific investigations utilizing or enhancing the utilization of data obtained by the Cassini mission. For the purposes of this solicitation, "data" is understood to include both uncalibrated and calibrated data, as well as higher-order data products produced from the mission data. Science investigations may include the use of data from any spacecraft not supported by a separate Planetary Science Division Data Analysis Program and may contain outer solar system comparative planetology studies that require the use of Cassini data for at least one of the bodies of focus.

All proposals to CDAP must identify and address a clear objective with science research that would be a significant, not incremental, advance in the state of knowledge of the research topic. Tasks responsive to this call include 1) data analysis tasks, 2) nondata-analysis tasks that are necessary to analyze or interpret the data, and 3) nondata-analysis tasks that significantly enhance the use or facilitate the interpretation of mission data. These tasks may incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research. Proposals that include nondata-analysis tasks to enhance the use or facilitate the interpretation of mission data must incorporate the results of such tasks in the analysis or interpretation of mission data to be responsive to this call.
1.2 Mission Data and Produced Data Products

Higher-order mission data products produced as part of funded research must be made publicly available, following the guidelines described in Section 3.6 of C.1 Planetary Science Overview ("Data Management Plans and Archiving"). Proposed data products for delivery to the PDS must be clearly described, appropriate time and effort for delivery and ingestion must be budgeted, and the proposal must include a letter from the manager of the appropriate PDS data node. For additional information, refer to the PDS Proposer's Archiving guide at http://pds.nasa.gov/documents/pag/index.html. Data products, including maps, improved calibrations, etc., must be submitted to the PDS or the U.S. Geological Survey (USGS), as appropriate, by the end of the funded research period, unless the investigator explicitly makes a case in the proposal for a later date. Each research proposal must constitute a stand-alone scientific investigation, with stated lines of inquiry, and result in one or more peer-reviewed publications.

2. Programmatic Information

2.1 Exclusions

Proposals to this Program must include a science investigation. Proposals to produce a higher-order data product that enhances the science return from one or more missions, but without a larger science investigation, must be submitted to the C.7. Planetary Data Archiving, Restoration, and Tools (PDART) Program.

Proposals that use non-Cassini mission data that is supported by another Data Analysis Program will be evaluated as not being responsive to this solicitation and must rather be submitted to a more appropriate Program Element. Proposers are encouraged to read the other Program Elements in Appendix C.

2.2 Relevance Statement Requirement

Proposals to this Program must discuss relevance in a (4000-character max) text box on the cover pages via the NSPIRES web interface for this Program Element. This section is outside of the fifteen-page Scientific/Technical/Management Section and the relocation of the relevance discussion does not decrease that fifteen-page limit. This requirement supersedes the NASA Guidebook for Proposers and the ROSES Summary of Solicitation, and the omission of this section is sufficient reason for a proposal to be returned without review. The relevance discussion must explicitly refer to this Program Element and the section of the solicitation to which the proposal is responsive. If the proposed work is close in scope to research covered by any other Program Element, this discussion must also justify why it is more relevant to this Program Element than that other Program Element. This discussion may not be used to address the proposal's intrinsic merit, budget justification, or any other factor that remains in the fifteen-page main body, or any other section, of the proposal.
3. Data, Facilities, and Archiving

3.1 Use of Mission Data

Proposals to this Program Element must follow the rules for use of mission data given in C.1 The Planetary Science Division Research Program Overview, Section 3.4.

- Mission information can be accessed via the NASA website.
  - http://saturn.jpl.nasa.gov/
- Mission data information can be accessed via PDS webpages.
  - http://pds-atmospheres.nmsu.edu/data_and_services/atmospheres_data/Cassini/Cassini.html
  - http://pds-rings.seti.org/cassini/

3.2 Facilities and Data Sources Available to Proposers

Proposers are advised to read Section 4 of C.1 for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the NASA Guidebook for Proposers, a letter of support may be required from any facility required for the proposed effort.

3.3 Data Archiving and Map Publication

Proposals submitted to this Program Element must include a Data Management Plan (see C.1, Section 3.6). This must be placed in a special section, no longer than two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.

Selected investigations may result in data products and software tools that are of broad use to the science community, including maps, data with improved calibrations, etc. NASA strongly encourages that such data be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period.

Proposers are advised to read C.1 The Planetary Science Division Research Program Overview, for information on including an archiving plan in the proposal.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified.

Proposers are advised to read C.1, Section 3.8, for the USGS information on and requirements for map production and publication.
4. The Two-Step Submission Process

This Program Element uses the two-step proposal submission process outlined in C.1, Section 2.

Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

Proposals must follow all formatting requirements that are described C.1 and in the NASA Guidebook for Proposers. Violation of these rules is sufficient grounds for a proposal to be rejected.

5. Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

6. Summary of Key Information

<p>| Expected program budget for first year of new awards | ~ $1.8-2.3 M/Year |
| Number of new awards pending adequate proposals of merit | ~ 15-21 total |
| Maximum duration of awards | 3 years |
| Due date for Step-1 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Due date for Step-2 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Planning date for start of investigation | ~6 months after Step-2 proposal due date. |
| Page limit for the central Science/Technical/Management section of proposal | 15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers. |
| Relevance | This program is relevant to the Planetary Science questions, and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| General information and overview of this solicitation | See the ROSES Summary of Solicitation. |
| Detailed instructions for the preparation and submission of proposals | Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers. |</p>
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Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Email: HQ-CDAP@mail.nasa.gov  
Telephone: (202) 358-2016 |
C.11 DISCOVERY DATA ANALYSIS

NOTICE: Amended on August 29, 2017. To give more time to proposers who are without power because of Hurricane Harvey, this amendment delays the due date for a number of program elements including this one. Please see Table 2 or Table 3 for the latest due dates.

This program element accepts proposals via a two-step proposal submission process described in Section 2 of C.1 The Planetary Science Division Research Program Overview.

1. Scope of Program

The objective of the Discovery Data Analysis Program (DDAP) is to enhance the scientific return of Discovery Program missions and broaden the scientific participation in the analysis of data, both recent and archived, collected by Discovery missions.

1.1. Sources and Analysis of Mission Data

Spacecraft data used in DDAP investigations must be available in the Planetary Data System (PDS; http://pds.nasa.gov/), or equivalent publicly accessible archive(s), at least 30 days prior to the Step-2 submission deadline for DDAP proposals. Spacecraft data that have not been placed in such archives are not eligible for use in DDAP investigations. In all cases, it is the responsibility of the DDAP investigator to acquire any necessary data. Investigators are encouraged to contact the archive for assistance in identifying specifics of available datasets. Datasets to be used in the proposed work must be clearly and specifically identified in the proposal. Regardless of the archive(s) used, if the data to be analyzed have known issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome.

The Discovery Missions for which archived data is available are:

- NEAR
- Stardust
- Genesis
- Deep Impact
- MESSENGER
- Dawn
- Kepler/K2

The Discovery Missions of Opportunity for which archived data is available are:

- EPOXI
- Stardust-NExT

Proposals focusing on data returned from Mars Pathfinder and ASPERA-3 should be submitted to the Mars Data Analysis Program (MDAP, program element C.9). Proposals
focusing on data from GRAIL, Lunar Prospector, and the Moon Mineralogy Mapper (M3) should be submitted to the Lunar Data Analysis Program (LDAP, C.8). Proposals concerning Kepler/K2 observations of objects outside the Solar System should be submitted to the Astrophysics Data Analysis Program (ADAP, D.2). The proposals described in this paragraph are not responsive to the DDAP solicitation.

Proposals to DDAP must include a science investigation. Proposals to produce a higher order data product that enhances the science return from one or more missions, but does not include a science investigation, should be submitted to the C.7. Planetary Data Archiving, Restoration, and Tools (PDART) Program.

Proposed work responsive to this call may include (1) data analysis tasks, 2) tasks that are not data analysis but are necessary to analyze or interpret the data, and 3) tasks that are not data analysis but that significantly enhance the use or facilitate the interpretation of Discovery mission data. These tasks may incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research; however, proposals that include tasks that are not data analysis must also incorporate the results of these tasks into the analysis or interpretation of Discovery mission data in order to be responsive to this call.

It is the responsibility of the proposers to DDAP to specifically identify any needed data and to ascertain that these data are available. Proposals should provide convincing evidence that the data have sufficient quality and are available in sufficient quantity to achieve the goals set forth in the proposal. The proposer should demonstrate a familiarity with the data and an understanding of the work required to refine the data for the purposes of the analysis.

1.2. Archiving of Data Products

Data products produced by funded DDAP investigations must be made publicly available, following the guidelines described in Section 3.6 of C.1 Planetary Science Overview ("Data Management Plans and Archiving"). Proposed data products for delivery to the PDS must be clearly described, appropriate time and effort for delivery and ingestion must be budgeted, and the proposal must include a letter from the manager of the appropriate PDS data node. For additional information, refer to the PDS Proposer’s Archiving guide at http://pds.nasa.gov/documents/pag/index.html. Data products, including maps, improved calibrations, etc., must be submitted to the PDS or the U.S. Geological Survey (USGS), as appropriate, by the end of the funded research period, unless the investigator explicitly makes a case in the proposal for a later date.

1.3 Program Exclusions

The Discovery Data Analysis Program is not intended to overlap other active program elements. Therefore, as noted above, the DDAP does not support the analysis of:

- Lunar data (see LDAP, program element C.8);
- Mars data from Mars missions (see MDAP, C.9);
- Data from Cassini (see CDAP, C.10);
- Data from New Frontiers missions (see NFDAP C.19);
- Data from Rosetta (see RDAP, C.20);
• Data from Kepler/K2 on objects outside the Solar System (see ADAP, D.2).

DDAP also does not support:

• Proposals for organizing and/or hosting scientific meetings (which should be submitted to Topical Workshops, Symposia, and Conferences, E.2);
• Proposals for detector, instrumentation, or technology development (which are supported by other NASA programs); or
• Investigations whose primary emphasis is fundamental theory, the development of numerical models, or laboratory measurements (unless there is a direct and explicitly presented connection to Discovery mission data).

The Planetary Science Division solicits proposals whose work efforts are primarily analysis of planetary mission data through this and other Data Analysis Programs. If a proposal would analyze data within the scope of more than one of the data analysis programs in order to perform comparative studies across the Solar System, but is not appropriate to any one data analysis program, then submission to a Core Research Program is encouraged. If a proposal is not appropriate for one of the Data Analysis programs, but does fit within the bounds of a Core Research Program (i.e., Solar System Workings or Emerging Worlds), it should be submitted to that Core Program.

Spacecraft data that have not yet been obtained (i.e., future mission data), or those that have not been made publicly available in approved archives, as indicated above, may not be proposed for use in DDAP investigations.

Members of Discovery Program mission or instrument teams who wish to apply to DDAP must clearly demonstrate that their proposed investigation will use only released and publicly available data. Flight team members must scrupulously comply with the 30-days-prior-to-submission rule (above). Additionally, team members must clearly demonstrate how the proposed DDAP research does not overlap and is not redundant with activities already funded by their respective mission.

2. The Two-Step Submission Process

This program element uses a two-step proposal submission process described in program element C.1, Section 2.

Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

Proposals must follow all formatting requirements that are described program element C.1 and in the NASA Guidebook for Proposers. Violation of these rules is sufficient grounds for a proposal to be rejected.
3. Programmatic Information

3.1 Progress Reports

An Annual Progress Report will be due no later than 60 days in advance of the anniversary date of the award. Awards to NASA Centers, including the Jet Propulsion Laboratory (JPL), always have an anniversary date of the start of the Federal fiscal year, October 1.

3.2 Duration of Awards

Typical proposals to this program seek three years of funding or fewer. Please refer to program element C.1, Section 3.3, for instructions on submitting requests for more than three years.

3.3 Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

4. Resources: Information, Data, and Facilities

4.1 Limits on Use of Mission Data

Proposals to this program element must follow the rules for use of mission data given in program element C.1, Section 3.4. If the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome.

4.2 Data Management Plans (DMPs)

Proposals submitted to this program element must include a Data Management Plan (see program element C.1, Section 3.6). This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.

4.3 Facilities and Data Sources Available to Proposers

Proposers are advised to read C.1. The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the NASA Guidebook for Proposers, a letter of support may be required from any facility required for the proposed effort.
4.4 Geologic Maps

Proposers who plan investigations involving geologic mapping should consult program element C.1. Section 3.8, for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.

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| NASA point of contact concerning this program                              | Thomas S. Statler  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Email: thomas.s.statler@nasa.gov  
Telephone: 202-358-0272 |
C.12 PLANETARY INSTRUMENT CONCEPTS FOR THE ADVANCEMENT OF SOLAR SYSTEM OBSERVATIONS

NOTICE: Amended on September 15, 2017. To give more time to proposers who are without power because of Hurricane Irma, this amendment delays the Step-1 proposal due date for this program element to September 22, 2017. Please see Table 2 or Table 3 for the latest due dates.

Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. See Section 2, of C.1 Planetary Science Research Program Overview for the most recent guidance on how to submit a Step-1 and Step-2 proposal.

Although the scope of the PICASSO program is not changing, Section 1 has been re-written to clarify the type of proposals solicited. Particular attention should be paid to the differentiation between the requirements of the PICASSO and MatISSE programs.

Planetary protection requirements are imposed on instruments intended to operate in an environment where Earth life could proliferate. See Section 2.1 for more details.

Proposals shall include an entry Summary Chart submitted as a separately uploaded appendix to the Step-2 proposal. See Section 2.1 for more details.

Progress reports are due Semi-Annually. See Section 2.4 for more detail.

1. Scope of Program

The Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) Program supports the development of spacecraft-based instrument components and systems that show promise for use in future planetary missions. The goal of the program is to develop low TRL instruments for use in planetary science missions to the point where they may be proposed in response to the Maturation of Instruments for Solar System Exploration (MatISSE) Program, C.13 of ROSES. Therefore, the proposed instrument component or system must address specific scientific objectives of likely future planetary science missions.

The PICASSO Program seeks proposals for development activities leading to instrument systems in support of the Science Mission Directorate’s (SMD) Planetary Science Division (PSD). The objective of the program is to develop new proof-of-concept instruments or instrument components, including sampling technologies, that enable new science by significantly improving instrument measurement capabilities for planetary science missions (such as Discovery, New Frontiers, Mars Exploration, and
other planetary programs). In most cases that will mean demonstrating that meeting key performance targets is feasible. It is the responsibility of the proposer to demonstrate how their proposed technology addresses significant scientific questions relevant to stated NASA goals and not for NASA to attempt to infer this. Prospective proposers are encouraged to review the most recent Decadal Survey ("Visions and Voyages for Planetary Science in the Decade 2013-2022" available at http://solarsystem.nasa.gov/2013decadal/), the goals of the Planetary Science Division as described in the 2014 Science Mission Directorate Science Plan available at http://science.nasa.gov/about-us/science-strategy/, and the astrobiology strategy at https://nai.nasa.gov/media/medialibrary/2016/04/NASA_Astrobiology_Strategy_2015_FINAL_041216.pdf. Proposed investigations may target any Solar System body except the Earth and Sun, in order to advance the objectives outlined in the Science Plan.

PICASSO is an instrument hardware development program and as such does not support mission operation and system software or platform technologies such as materials and structures, power generation or conditioning, communications, small satellites, landers, rovers, or any spacecraft technology that does not directly address planetary science instrumentation. Integrating multiple existing instrument systems does not generally demonstrate the proof-of-concept of a new instrument element. In addition, PICASSO does not support proposals that seek to develop ground-based laboratory instruments, or Earth orbital instruments for astronomical or astrophysics space observations. Instrument systems that have already demonstrated key performance targets can be proposed to the MatISSE program (C.13) to be matured for fit, form and function, and testing in relevant use environments.

The nature of specific efforts selected for funding will vary, with emphasis given to innovative technologies that improve instrument measurements capabilities. It is anticipated that the science payloads on most future planetary science spacecraft will be limited to small, low-mass, and low power consumption instruments.

2. Programmatic Considerations

2.1 Special Requirements for Proposals

Proposals are solicited under this program element for instrument development only for the mission focus areas described in the Decadal Survey or the Science Plan. All proposals submitted to this program element must specify:

- The mission focus area for which the proposed instrument or component technology is applicable. Instruments that are applicable to more than one mission focus area will be given priority.

- The science objectives of the proposed instrument or component technology. The relationship between the science objectives and the instrumental capabilities must be clearly demonstrated. For those instruments applicable to more than one mission, focus area, or capable of meeting multiple science objectives, examples of science objectives for the proposed mission or missions must be given.

- A quantitative explanation of the key performance metric that is proposed to be advanced, with a quantitative comparison to the state-of-the-art. The state-of-the-art
should be a comparison to a similar flight instrument if possible, otherwise a clear
definition of the state-of-the-art should be described.

• A detailed description and justification for the entry Technology Readiness Level and
a detailed plan for raising the instrument system to the proposed exit Technology
Readiness Level. The plan must include a description of milestones, as well as
discussions of how the proposed research will advance the Technology Readiness
Level of the instrument by a minimum of one TRL. A full description of Technology
Readiness Levels (TRLs) 1-9 appears in Appendix E of NASA Procedural
Requirement 7123.1B and is available on the web at
http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7123_001B&page_n
ame=AppendixE.

• How the proposed instrument system or component technology would address
planetary protection requirements, as described in the NASA Procedural
Requirements document, NPR 8020.12, Version D. Restrictions on operation and
hardware cleanliness apply to all instrument systems that are intended to operate in
environments where Earth life could proliferate – currently that is considered to be
Mars, Europa, Enceladus, and anywhere in the solar system where warm ice or liquid
water is possible and includes instrument systems or component technology
associated with detection of signs of life or biosignatures. To address this
requirement the proposal shall, at a level appropriate to the exit TRL:
  o Establish whether the instrument will require planetary protection protocols.
  o If the instrument requires planetary protection protocols, describe which specific
    components could pose a challenge.
  o Describe possible mitigation strategies to meet planetary protection requirements.

The instrument developer is encouraged to communicate informally with the Office of
Planetary Protection regarding planetary protection categorization and associated
requirements with a future mission interest as they relate to instrument design and
development. For additional information, proposers may contact the NASA Planetary
Protection Officer, Dr. Catharine A. Conley (Telephone: 202-358-3912; E-mail:
cassie.conley@nasa.gov) and cc james.r.gaier@nasa.gov.

• An entry level Summary Chart, not counted in the page limit, shall be submitted as an
appendix to the Step-2 Proposal. A template will be sent to each Step-1 proposer.
The Summary Chart shall contain the following information:
  o Title, PI Name and Institution
  o Target (Mars subsurface, airless body surface, planetary body flyby or orbit, etc.)
  o Bulleted list of science that will be enabled by new instrument
  o Bulleted list of major objectives of proposed work
  o Co-Investigators (Co-Is)/Institutions
  o A figure illustrating and clarifying the proposed concept
  o Top level Milestones
  o Entry and exit technology readiness levels (TRL)
2.2 Additional Selection Considerations

In addition to the criteria specified in Section C.2 of the NASA Guidebook for Proposers, the following will also be considered when formulating PICASSO selection recommendations.

- The extent to which the instrument system or subsystem addresses a priority science goal of the mission or missions for which it would be a candidate for flight;
- The extent to which the proposed instrument system or subsystem is applicable to multiple Planetary Science missions;
- The Planetary Science Division strongly encourages proposers to investigate current and recent Small Business Innovative Research awards (http://sbir.gsfc.nasa.gov/abstract_archives) for possible teaming and leveraging of emerging technologies. Collaborations leveraging SBIR funded technologies will be given preference. In addition, selectable proposals that leverage funding from NASA technology development offices and programs such as those in the Space Technology Mission Directorate, will be given additional consideration.

2.3 Award Duration and Types

The typical award duration is three years. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. All awards will be in the form of Research and Technology Operating Plans (RTOP) to NASA centers, including JPL, or grants to other institutions.

2.4 Technical Reporting Requirements

Once awarded, all Progress Reporting deliverables applicable to this PICASSO solicitation shall be submitted to the web-based Planetary Science (PS) Award Administration eBook. A user account on the PS eBook will be provided to the PI upon award. Due to NASA IT security requirements, all Principal Investigators (PIs) must register with the Identity Management and Account Exchange (IdMAX) system before a user account on eBook will be established. To create an IdMAX account, some personal information will be required. All submissions shall be made in PDF format.

The following deliverables shall be required of institutions that win awards. In cases where subcontract arrangements exist, consolidated project reports are the responsibility of the PI. The proposed budget should provide for these reporting requirements. In this context, "Annual" refers to a twelve-month task effort that commences at award.

2.4.1 Semi-Annual Progress Report Deliverable

The PI shall provide a written Semi-Annual Progress Report at the end of the first six-month calendar period commencing from the date of award and at six-month intervals thereafter. Grant recipients will have additional progress reporting requirements from the NSSC.

The Semi-Annual Report must:
1. Describe the primary findings, technology development results, and technical status, e.g., status of design, construction of prototype implementations, results of tests and/or proof-of-concept demonstrations, etc.;
2. Describe the work planned for the remainder of the project and critical issues that need to be resolved to successfully complete the remaining planned work;
3. Quantitatively summarize the cost and schedule status of the project, including any schedule slippage/acceleration;
4. Include an updated Summary Chart noting changes in team membership, milestones, schedule, and updates to the TRL;
5. Report any educational and outreach components of the project, e.g., graduate degrees, educational activities; technology infusion or patents applied for or granted; journal or conference publications; presentations at professional conferences, seminars, and symposia; demonstrations; media exposure; and, other activities that contributed to the overall success of the research project.

The release of the PI’s annual budget allocation is contingent on the timely submission of the written Semi-Annual Progress Report deliverable.

2.4.2 Final Report

The PI shall provide a written Final Report at the completion of the activity. The Final Report is similar to the Semi-Annual Report and includes all of the products required in the Semi-Annual Report, with the following exceptions:

- The Final Review must provide conclusions of the work performed and make recommendations for follow-on activities that should be pursued;
- As this is the Final Report, there is no need to present future work plans or a cost profile.

The written Final Report shall include the following:

1. Background of the project, including the science rationale for conducting this technology development;
2. Results of all analyses, element, subsystem, or system designs and/or prototyping implementations and designs;
3. Performance analysis results of tests and/or demonstrations; estimation of reduction(s) in size, mass, power, volume, and/or cost; improved performance; description of newly enabled capability; and documentation of technology dependencies;
4. Tables, graphs, diagrams, curves, sketches, photographs, and drawings in sufficient detail to comprehensively explain the results achieved;
5. An updated TRL assessment;
6. At the end of the period of performance, the PI shall provide a final Accomplishments Chart which contains the following information:
   - Title, PI Name and Institution
   - Target (Mars subsurface, airless body surface, planetary body flyby or orbit, etc.)
   - Bulleted list of science that will be enabled by new instrument
   - Bulleted list of instrument development accomplishments
Co-Investigators (Co-Is)/Institutions
- A figure illustrating and clarifying the proposed concept
- Exit technology readiness level (TRL)

The written Final Report, Accomplishments Chart, and updated TRL assessment shall be E-mailed to the NASA Program Officer on or before the designated anniversary date. An Accomplishment Quad Chart template can be obtained from the NASA Program Officer for this program.

2.5 Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

2.6 NASA Postdoctoral Program Fellows

Grantees in the program are eligible to serve as mentors to NASA Postdoctoral Program (NPP) Fellows. The tenure of a Fellow must begin before the end of the award but may extend beyond it. Proposals from potential Fellows must be submitted through the standard NPP process. The PICASSO Program expects to select no more than two Fellows associated with Planetary Science or Astrobiology Instrument Development each year. More information about the NASA Postdoctoral Program may be found at http://npp.usra.edu/.

3. Resources: Information, Data, and Facilities

Proposers to this program are not required to provide a Data Management Plan. However, dissemination of the findings of the effort via conference presentations and journal articles is expected, and the plan for dissemination should be briefly described. Archiving conference presentations and journal articles in eBooks is highly encouraged.

3.1 Facilities Available to Proposers

Proposers are advised to read Section 4 of program element C.1, The Planetary Science Division Research Program Overview, for information on facilities that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the NASA Guidebook for Proposers, a letter of support may be required from any facility required for the proposed effort.

4. Proposal Submission Process

This program element uses a two-step proposal submission process described in program element C.1, Section 2.
Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

Proposals must follow all formatting requirements that are described program element C.1 and in the NASA Guidebook for Proposers. Note that these requirements have been updated in 2017. Violation of these rules is sufficient ground for a proposal to be rejected.

An entry level Quad Chart, not counted in the page limit, shall be submitted as an appendix at the end of the Step-2 Proposal. See section 2.1 for more details regarding the Quad Chart.

5. Summary of Key Information

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</tr>
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</tbody>
</table>
| **Main NASA point of contact concerning this program:** | James R. Gaier  
NASA Program Officer  
Planetary Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington DC 20526-0001  
Telephone: 260-579-3442  
Email: james.r.gaier@nasa.gov |
| **Other NASA points of contact related to this program all of whom share the following postal address:** | Questions concerning Discovery or Astrobiology Program may be addressed to:  
Michael H. New  
Astrobiology Discipline Scientist  
Lead Discovery Program Scientist  
Telephone: 202-358-1766  
Email: michael.h.new@nasa.gov  

Mary A. Voytek  
Senior Scientist for Astrobiology  
Telephone: 202-358-1577  
Email: mary.voytek-1@nasa.gov  

Questions concerning New Frontiers Program may be addressed to:  
Curt Niebur  
New Frontiers Program Discipline Scientist  
Telephone: 202-358-0390  
Email: curt.neibur@nasa.gov  

Questions concerning Mars Exploration Program may be addressed to:  
Michael A. Meyer  
Lead Scientist  
Mars Exploration Program  
Telephone: 202-358-0307  
Email: michael.a.meyer@nasa.gov |
NOTICE: The Maturation of Instruments for Solar System Exploration (MatISSE) Program will not be competed in ROSES-2017. NASA expects to continue to solicit Planetary science instrument technology through future MatISSE solicitations. The next opportunity is currently anticipated to be included in ROSES-2018.

1. Program Description

The Maturation of Instruments for Solar System Exploration (MatISSE) Program supports the advanced development of spacecraft-based instruments that show promise for use in future planetary missions. The goal of the program is to develop and demonstrate planetary and astrobiology science instruments to the point where they may be proposed in response to future announcements of flight opportunity without additional extensive technology development (approximately technology readiness level [TRL] 6). The proposed instrument must address specific scientific objectives of likely future planetary science missions.

2. Program Objectives

The MatISSE Program seeks proposals for development activities leading to instrument systems in support of the Science Mission Directorate’s (SMD) Planetary Science Division. The objectives of the program are to develop new technologies that significantly improve instrument measurement capabilities for planetary science missions (such as Discovery, New Frontiers, Mars Exploration, and other planetary programs).

3. Programmatic Information

For further information about the MatISSE Program contact:
William B. Cook
Acting NASA Program Officer
Planetary Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington DC 20526-0001
Telephone: 202-358-0976
E-mail: william.b.cook@nasa.gov
NOTICE: Amended on September 15, 2017. To give more time to proposers who are without power because of Hurricane Irma, this amendment delays the Step-2 proposal due date for this program element by one week to October 10, 2017. Please see Table 2 or Table 3 for the latest due dates.

This Program Element continues to use a two-step proposal submission process described in Section 2 of C.1 The Planetary Science Division Research Program Overview.

1. Scope of Program

NASA analog missions research addresses the need for integrated interdisciplinary field experiments as an integral part of preparation for future human and robotic missions. Future planetary research associated with solar system exploration requires the development of relevant, miniaturized instrumentation capable of extensive operations on lunar, asteroid, and planetary surfaces throughout the Solar System. To this end, and in collaboration with other Directorates at NASA and other agencies, this Planetary Science and Technology Through Analog Research (PSTAR) program solicits proposals for investigations focused on exploring the relevant environments on Earth in order to develop a sound technical and scientific basis to conduct planetary research on other solar system bodies. The PSTAR program is a science-driven exploration program that is expected to result in new science and operational/technological capabilities to enable the next generation of planetary exploration. Proposals must demonstrate fidelity to at least two of the following three objectives:

1) Science: PSTAR seeks science investigations designed to further planetary research in terrestrial extreme environments that may be analogous to those found on other planets, past or present. Of particular interest are investigations that increase our understanding of the limits of and constraints (or lack thereof) on life in extreme environments and lead to a better understanding of how to seek, identify, and characterize life and life-related chemistry that may exist or have existed on other solar system bodies. Proposals which claim science fidelity are expected to result in publishable-quality planetary or earth science results.

2) Science Operations: PSTAR seeks systems-level terrestrial field campaigns that are conducted with complete systems and in a manner that approximates operations during an actual planetary mission, providing an opportunity to understand the performance, capabilities, and efficiencies associated with the tested systems, while enabling human participants to gain operational experience with those systems in the field. Fidelity in this area means that the constraints placed on the execution of science tasks in the field are functionally similar to those of an actual mission, enabling the development, testing, and validation of new concepts of operations that may impact the design of surface infrastructure or ground support. Some examples of science operations elements include:
a. Decision-making protocols;
b. Traverse planning;
c. Sample acquisition, storage, documentation, and high-grading protocols;
d. Communications and data flow protocols to support science;
e. Navigation unique to science support;
f. Crew scheduling for Intra- and Extravehicular activities; and
g. Science backroom design and support for surface science activities.

Proposals which claim science operations fidelity are expected to describe investigations that rigorously test and evaluate science operations elements, not simply utilize them.

3) Technology: PSTAR seeks the testing and application of technologies that support science investigations, particularly those that enable remote searches for, and identification of, life and life-related chemistry in extreme environments (including lunar and planetary surfaces). These technologies include, but are not limited to:

a. sample acquisition and handling techniques;
b. sample manipulation;
c. the use of mobile science platforms (including planetary rovers and astronauts);
d. techniques for autonomous operations;
e. self-contained deployment systems;
f. intelligent systems and human/robotic interfaces;
g. communication and navigation systems; and
h. instrument packages.

PSTAR is not an instrument development program. Science instrument technology proposals should be submitted to C.12 The Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) or C.13 The Maturation of Instruments for Solar System Exploration (MatISSE) Program. Hardware development to ruggedize instruments or otherwise prepare for field trials is acceptable, but is expected to be a minor part of the overall proposed effort.

In summary, PSTAR is expected to lower the risks of planetary exploration through instrument/technology development aimed at or coupled with systems-level field tests in relevant environments that will obtain scientific data and/or develop operational capability.

The high-visibility field campaigns to the Earth’s extreme environments that are expected to be supported through this Program Element should also provide significant opportunities for student involvement in exploration, thereby inspiring a technologically competent next generation of scientists, engineers, explorers, and citizens. Therefore, proposals to PSTAR that provide for graduate or undergraduate science training are encouraged.
In addition, because field activities, particularly those with a high degree of technology fidelity, tend to attract the attention of the public and the media, proposers must include a plan for engaging with the public and media during their field deployment (see section 2.10).

2. Programmatic Information

2.1 General Information

Proposals submitted in response to this call should be for new work that is not currently supported by the Planetary Sciences research and analysis program or for investigations that would extend to their next logical phase those tasks that have been funded, but whose periods of performance expired in 2016 or are expiring in the first half of 2017.

Proposers are strongly advised to read C.1 The Planetary Science Division Research Program Overview, for information on mandatory data management plans.

2.2 Special Requirements for Proposals

Proposals should follow the guidelines set for all ROSES proposals, as given in the NASA Guidebook for Proposers.

Proposals should also specify:

- **Area(s) of fidelity (Science, Science Operations, and/or Technology, as described in Section 1)** that are addressed by the project.
- **Specific field activity, site(s), and dates being targeted for their investigation(s), as well as a clear schedule for field preparations, training, and deployment strategy.**
- **Justification for field site selection** (see special case for access to Antarctica Section 2.4).
- **If proposed investigation(s) are to be conducted in conjunction with established field campaign(s), proposers must provide evidence of coordination with field campaign leaders.**
- **Field resource requirements:**
  - Duration, timing, and scheduling of investigations
  - Power requirements
  - Communications requirements (bandwidth, type of communications, etc.)
  - Logistics Support Requirements
  - Permits and/or land access/use requirements
- **The science objectives and expected science return of the proposed investigation – type and amount of data, validation of science requirements, expected publications, etc.**
- **Specific deliverables at the conclusion of the field activity.**
- **Source, type, and amount of external funding already received or expected, if any, for the hardware, software, or operational concepts being tested.**
• Risks to the investigation, including weather scrubs, hardware failures, power failures, etc., and a mitigation plan.
• Clear budget, including field deployment costs, logistics support, direct labor, overhead, subcontracts, special equipment, travel, Education and Public Outreach, other costs, General and Administrative Expenses, fees, etc.
• A plan for engaging the public and media during field deployment (see sec 2.10 below).

2.3 Development of Flight Instruments

This solicitation does not request proposals for the development of advanced instrument concepts and technologies as precursors to flight instruments. Such proposals should be submitted to either C.12 Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) or C.13 The Maturation of Instruments for Solar System Exploration (MatISSE) Program.

2.4 Antarctica

The PSTAR program is no longer accepting proposals for work in Antarctica.

2.5 Instrumentation: Construction or Upgrade

Proposers to PSTAR are eligible to request funds for Planetary Major Equipment (PME). See Appendix C.17 for information on how to append a PME request to a regular PSTAR research proposal or submit a stand-alone PME proposal to supplement an existing PSTAR award.

2.6 Topical Workshops

The PSTAR program does not accept proposals for topical conferences, workshops, or symposia; such proposals may be submitted in response to Program Element E.2, "Topical Workshops, Symposia, and Conferences." Proposers should specifically identify the PSTAR program as the relevant SMD Program Element and refer to the goals and objectives of the PSTAR program in demonstrating relevance.

2.7 Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

2.8 NASA Postdoctoral Program Fellows

Grantees of astrobiology-relevant awards in the program are eligible to serve as mentors to Astrobiology NASA Postdoctoral Program (NPP) Fellows. The tenure of a
Fellow must begin before the end of the PSTAR award, but may extend beyond it. Proposals from potential Fellows must be submitted through the standard NPP process. The Astrobiology Program expects to select no more than two Fellows associated with PSTAR research in 2017. More information about the NASA Postdoctoral Program may be found at http://npp.usra.edu/.

2.9 Data Management Plans (DMPs)

Appendix C.1, Section 3.6, discusses the requirements for DMPs in proposals to this Program Element. Please note that DMPs are mandatory for this Program Element, and must be placed in a special section no longer than two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.

2.10 Plan to engage the Media and Public

Because field activities tend to attract the attention of the public and the media, it is important for teams to be prepared to engage and take advantage of these unique experiences. The description of the plan should be no more than one page and included as an addendum to the fifteen-page technical proposal immediately following the DMP. Proposals that incorporate public engagement activities, through telepresence capabilities and involvement of professional educators and students nationwide in the fun and challenges of science and technology are particularly encouraged. Proposers should also state in their proposals whether they are willing to host an outside public engagement activity arranged by NASA. Resources budgeted for engagement activities but should constitute only a minor component of the proposal.

2.11. Proposal Submission Process

This Program Element uses a two-step proposal submission process described in Section 2 of Appendix C.1.

Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

Proposals must follow all formatting requirements that are described in Appendix C.1 and in the NASA Guidebook for Proposers. Violation of these rules is sufficient grounds for a proposal to be rejected.

2.12 Duration and Size of Awards

The standard award duration is three years. NASA anticipates that most proposals will seek three years of funding. However, proposals for less than three years are highly encouraged for projects that can be completed on shorter timescales. On rare occasions, four-year projects can be considered, but appropriate justification must be provided. The appropriateness of the proposed funding period will be reviewed and
adjustments may be requested. Programmatic balance may limit the opportunities for funding in some areas.

A wide range of award sizes is expected, depending on the nature and scope of the work proposed. We anticipate funding several larger-scope awards (typically $500K-1M per year) and several smaller-scope awards (typically $40-100K per year).

3. Summary of Key Information

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</tbody>
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| NASA points of contact concerning this program | Sarah Noble and Mary Voytek  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone for Mary Voytek: (202) 358-1588  
Telephone for Sarah Noble: (202) 358-2492  
Email for Sarah Noble: sarah.noble-1@nasa.gov  
Email for Mary Voytek: mary.voytek-1@nasa.gov |
|---|---|
C.15 PLANETARY PROTECTION RESEARCH

NOTICE: Amended on September 15, 2017. To give more time to proposers who are without power because of Hurricane Irma, this amendment delays the proposal due date for this program element by one week to September 28, 2017. Please see Table 2 or Table 3 for the latest due dates.

1. Scope of Program

Planetary protection involves preventing biological contamination on both outbound and sample return missions to other planetary bodies. Numerous areas of research in astrobiology/exobiology are improving our understanding of the potential for survival of Earth microbes in extraterrestrial environments, relevant to preventing contamination of other bodies by organisms carried on spacecraft. Research is required to improve NASA’s understanding of the potential for both forward and backward contamination, how to minimize it, and to set standards in these areas for spacecraft preparation and operating procedures. Improvements in technologies and methods for evaluating the potential for life in returned samples are also of interest. Many of these research areas derive directly from recent National Research Council (NRC) recommendations on planetary protection for solar system exploration missions (see http://planetaryprotection.nasa.gov/documents/ for online reports and a list of publications).

As a complement to the Exobiology program (see C.5), the Planetary Protection Research (PPR) program solicits research in the following areas:

- Characterize the limits of life in laboratory simulations of planetary environments or in appropriate Earth analogs. Of particular interest are studies on the potential and dynamics of organism survival and reproduction in conditions present on the surface or subsurface of Mars (e.g., gullies and ice-rich environments), or on Europa and other icy satellites – potentially in the presence of a heat source brought from Earth.
- Model planetary environmental conditions and transport processes that could permit mobilization of spacecraft-associated contaminants to locations in which Earth organisms might thrive, for example Mars Special Regions or the subsurface of icy bodies, such as Europa and other outer planet satellites.
- Develop or adapt modern molecular analytical methods to rapidly detect, classify, and/or enumerate the widest possible spectrum of Earth microbes carried by spacecraft (on surfaces and/or in bulk materials, especially at low densities) before, during, and after assembly and launch processing. Of particular interest are methods capable of identifying microbes with high potential for surviving spacecraft flight or planetary environmental conditions (e.g., anaerobes, psychrophiles, radiation-resistant organisms).
- Identify and provide proof-of-concept on new or improved methods, technologies, and procedures for spacecraft sterilization that are compatible with spacecraft materials and assemblies.

It should be noted that the evolving planetary protection requirements of NASA’s planetary exploration programs may affect the priorities for funding among these areas.
2. Programmatic Information

Proposers are strongly advised to read C.1 The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

2.1 Exclusions

Proposals are sought for new projects in planetary protection that are not within the scope of the Habitable Worlds (see E.4), Exobiology (see C.5), or Maturation of Instruments for Solar System Exploration (see C.13) programs. Proposals submitted in response to this program element should be for new work that is not currently supported by NASA or for successor proposals that seek to extend to their next logical phase those tasks performing research in Planetary Protection that are currently funded, but whose periods of performance will expire this year.

2.2 Award Duration and Funding Available

Periods of performance from one to four years may be proposed, as appropriate, to the nature of the contemplated research. Approximately $300K per year of total funding is expected to be available to support approximately two research tasks selected from proposals responding to this solicitation.

2.3 Additional Funding for Relevant Instrumentation Construction or Upgrade

Proposers to Planetary Protection Research are eligible to request funds for Planetary Major Equipment (PME). See Program Element C.17 for information on how to append a PME request to a regular PPR research proposal or submit a stand-alone PME proposal to supplement an existing award.

2.4 Mission data, facilities, and resources

Please refer to ROSES program element C.1, section 4, for a detailed list of the data and astromaterials resources, and facilities available to proposers to this program element, and how to use them.

2.5 Use of mission data

Proposals to this program element must follow the rules for use of mission data given in program element C.1, section 3.4.

2.6 Data Management Plans (DMPs)

Proposals submitted to this program element must include a Data Management Plan (see program element C.1, Section 3.6). This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.
2.7 Geologic Maps

Proposers who plan investigations involving geologic mapping should consult program element C.1, Section 3.8, for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.

3. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected program budget for first year of new awards</th>
<th>~ $300K</th>
</tr>
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<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>~ 2</td>
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<td>Maximum duration of awards</td>
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<tr>
<td>Due date for proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
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<td>Planning date for start of investigation</td>
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<td>Page limit for the central Science/Technical/Management section of proposal</td>
<td>15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers.</td>
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<td>Relevance</td>
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</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
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<tr>
<td>Web site for submission of proposals via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposals via Grants.gov</td>
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<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-PPR</td>
</tr>
</tbody>
</table>
| NASA point of contact concerning this program | Catharine A. Conley  
Planetary Protection Officer  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-3912  
Email: cassie.conley@nasa.gov |
|---|---|

C.15-4
C.16  EARLY CAREER FELLOWSHIP START-UP PROGRAM FOR NAMED FELLOWS

NOTICE: September 1, 2017. The point of contact for this program element has been changed to Mary Voytek. See Section 5. New text is in bold.

This program element is only for those who have already been named early career fellows to submit proposals for start-up funds. For information on how to apply to be named an early career fellow see program element C.23, The New Early Career Fellowship Program.

1. Scope of Program

The Early Career Fellowship (ECF) program supports the development of individual research programs of outstanding scientists early in their careers and stimulates research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, and methods.

This program consists of two components with two different submission procedures: the first is an application to be an "Early Career Fellow" (ECF, see Call C.23, the NEW Early Career Fellowship Program) and the second is the subsequent submission of a seven-page proposal for start-up funds by a previously selected ECF in response to this program element (C.16). Section 2 presents the former, the application to be an ECF. Section 3 presents details on the latter, the proposal in response to this program element by selected ECFs to apply for up to $100K in start-up funds, once they obtain a permanent track position, which is defined in Section 4.3. See Section 3 for eligibility to apply for start-up funds.

Please also refer to the Frequently Asked Questions PDF, which may be downloaded from the NSPIRES web page for this program element.

2. Early Career Fellowship

The Early Career Fellowship Program is being changed in ROSES-17, and as such, this call will only be for those who have already been named fellows (i.e., received an award letter for the proposal to which the ECF appended) in response to proposals submitted in previous ROSES years. Those seeking to be named fellows should see program element C.23, The New Early Career Fellowship Program, for information on the new fellowship application process.

3. Fellowship Start-up Funds

The application for start-up funds is the second component of this program. The request for up to $100K of start-up funds for those who meet the eligibility requirements in
Section 3.1 takes the form of a proposal submitted in response to this program element at any time during the open period for ROSES (i.e., there is no single fixed due date).

3.1 Eligibility for Start-up Funds

To be eligible for start-up funds, the PI must have previously been named an Early Career Fellow, see Section 2, above.

Proposals for start-up funds must be submitted in response to this program element within ten calendar years of the year in which the PI received their Ph.D. (or equivalent degree). However, see also Section 4.2.

To be eligible for start-up funds, the PI may not already be in a permanent position at the time of submission of their proposal for start-up funds. To be eligible for start-up funds, the PI must be in a "permanent track" position at the time of submission of their proposal for start-up funds. The definition of "permanent" position is provided at the end of this program element in Section 4.3.

Please note that this new definition does not affect Fellows who applied under the prior definition. Proposals submitted in advance of the November 17, 2015 change to this program fall under the rules laid out in the ECF program element that was active at the time the proposal was submitted (for more recent ROSES programs this includes the Step-1 proposal). Proposers who applied to be fellows after November 17, 2015, including all ROSES-2016 proposals, are eligible to apply for start-up funds only if they hold a permanent track position that satisfies the new definition. Fellows (or organizations) applying for start-up funds are strongly encouraged to communicate with the point of contact listed below to verify that the position that has been offered to the Fellow satisfies the requirement for award of start-up funds.

3.2 Procedure to Propose for Start-up Funds

The process for submitting proposals for start-up funds is as follows:

1. Receive an award letter explicitly stating that you have been named an ECF.
2. Gain a "permanent track position".
3. Meet the eligibility requirements in Section 3.1 and
4. Submit a proposal to this program element via the organization where you have the permanent track position.

Eligible PIs may submit proposals for up to $100K in start-up funds in response to this program element at any time, via the organization through which they have the permanent track position. The start-up package is intended to aid Fellows in establishing a research group or laboratory in their new permanent track position. This funding is not guaranteed simply based on having been named a Fellow. Rather, it depends on the proposal submitted to this program element passing peer review.

The proposal must clearly describe how the funds will be used to establish their research program and how the proposed research is relevant to the Planetary Science Division (e.g., the Planetary Science questions and goals in the NASA Science Plan). In addition to the immediate use of the start-up funds, the proposal must contain a strategy describing the Fellow’s plans for the research program over the long term.
A detailed budget with a narrative justification is required as part of the proposal. The proposal must provide evidence that the appointment meets the requirements for a "permanent track" position provided in Section 4.3.

Proposals for start-up funds must adhere strictly to the rules for ROSES in general, and this program element in particular. For example, the technical management section of a proposal to this program element is limited to seven pages.

3.3 Evaluation Criteria for Start-Up Proposals

Proposals for start-up funds will be evaluated vs. the three standard criteria given in ROSES: merit, relevance, and cost reasonableness. The evaluation of start-up proposals vs. these criteria will be completely independent of any prior evaluation of the application to be an ECF and its affiliated ROSES proposal (described in Section 2 and program element C.23).

4. Programmatic Information

4.1 Role of Fellow on Proposal vs. Organizational rules

Some institutions do not allow nontenured researchers to independently apply for NASA grants, which might prevent potential PIs from proposing to this program. At either the application for the Early Career Fellowship or the proposal for start-up funds, the proposal may list the Early Career researcher as the Co-I/Science PI and include an organizationally approved individual as the PI to allow the application to be submitted by the Authorized Organizational Representative (AOR).

4.2 Time Since Degree

Potential proposers who took a leave of absence for family leave, military service, or serious health problems may request a waiver to the chronological eligibility restrictions outlined in Sections 2.1 or 3.1. These applicants should write to the ECF point of contact given in Section 5 prior to proposal submission.

4.3. Definition of a Permanent and Permanent Track Position

A permanent position is one in which the organization substantially compensates the PI for his or her salary, without making it conditional on outside funding, nor limiting the term of employment. Examples of permanent positions include, but are not limited to, tenured faculty and permanent civil service appointments.

A permanent track position is one with a clearly defined process and schedule that can lead to a permanent position. Examples of permanent equivalent positions include, but are not limited to, tenure track faculty and certain term civil service appointments.

4.4 Duration of Awards

The application to be named an ECF is affiliated with a ROSES research proposal to a participating program element listed in program element C.23. The duration of that research award varies, depending on that program element, but has no effect on the
duration of the ECF. The fellowship lasts either until the fellow has passed beyond ten years since Ph.D., (stipulated in Section 3 for start-up funds) without having applied for and won start-up funds or, if they have won start-up funds, the end of the start-up award is the end of the Fellowship.

5. Summary of Key Information

| Expected program budget for first year of new awards | N/A; all funds are distributed by the corresponding research program element |
| Number of Fellow appointments pending adequate proposals of merit | 1 to 3 per Planetary research program element |
| Maximum duration of awards | 3 years for start-up funds, see also Section 4.4 |
| Due date for Notice of Intent to propose (NOI) | No Notices of Intent are requested for this program element. |
| Due date for proposals | Proposals from Fellows selected in prior years for start-up funds may be submitted at any time in response to this program element. |
| Planning date for start of investigation | 6 months after proposal receipt |
| Page limit for the central Science/Technical/Management section of proposal | 7 pp, for proposals from current Fellows for start-up funds; see also Table 1 of ROSES and the NASA Guidebook for Proposers |
| Relevance | Proposals must be relevant to the Planetary Science Division. See also Section 2.3.2. |
| General information and overview of this solicitation | See the ROSES Summary of Solicitation. |
| Detailed instructions for the preparation and submission of proposals | Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers. |
| For Additional Information | See the Frequently Asked Questions. |
| Submission medium | Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. |
| Web site for submission of proposal via NSPIRES | http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376) |
| Web site for submission of proposal via Grants.gov | http://grants.gov (help desk available at support@grants.gov or (800) 518-4726) |
| Funding opportunity number for downloading an application package from Grants.gov | NNH17ZDA001N-ECF (only for current Fellow applications for start-up funds; otherwise please see C.23.) |
| NASA point of contact concerning this program | **Mary Voytek**  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-1577  
Email: mvoytek@hq.nasa.gov  
[POC updated September 1, 2017] |
C.17  PLANETARY MAJOR EQUIPMENT

1. Overview

1.1 Scope of Program

This program element allows proposals for the purchase or development of new or upgraded nonflight analytical, computational, telescopic, and other instrumentation required by investigations in the following eligible Planetary Science research programs:

- Emerging Worlds (C.2)
- Exobiology (C.5)
- Habitable Worlds (E.4)
- Laboratory Analysis of Returned Samples (C.18)
- Planetary Protection Research (C.15)
- Planetary Science and Technology from Analog Research (C.14)
- Solar System Observations (C.6)
- Solar System Workings (C.3)

1.2 Types of PME proposals

A proposal to the Planetary Major Equipment (PME) program element may be submitted in one of two ways: as a special section that is appended to a research proposal in one of the eligible programs listed in Section 1.2; or as a stand-alone equipment proposal submitted to one of the eligible programs. In this program element, the term "target program" refers to the eligible program to which a particular PME proposal is submitted.

1.2.1 Appended PME proposals.

Appended PME requests must be part of a normal, full research proposal submitted to the eligible "target program." Appended PME requests may either be integral to the research proposal (i.e., required to perform the research) or they may be presented as enhancement options to the research proposal (see Section 4.3 for more information on this topic).

1.2.2 Stand-Alone PME proposals

Stand-Alone PME requests are self-contained proposals submitted to one of the eligible programs to improve research already being done in that program. In order to submit a stand-Alone PME proposal, the following requirements must be met:

- The principal investigator (PI) of the stand-alone PME proposal must also be the PI of an existing, funded "parent" award in the target program.
- The parent award of the stand-alone PME proposal must not have entered its last funded task year at the time of the step-2 proposal deadline in the target program.

A stand-alone PME proposal that does not meet these criteria is nonresponsive to this program element and will be rejected without review.
1.3 Allowable PME requests

Instrumentation purchases or upgrades that may be requested through the PME program are to be of a substantial nature, with hardware costs over $40,000. A PME proposal must be for purchase of a single instrument or system, or components of a single instrument or system. If a PI wishes to purchase multiple, unrelated equipment items each of which costs less than $40,000, these are not considered to be major equipment purchases under this program element, even if the combined cost exceeds $40,000.

This program element does not allow for the purchase of personal computers or computer peripherals, unless these are integral parts of an instrumentation package. In addition, it does not support the repair of equipment unless the repair involves significant enhancement of the instrument’s basic capabilities. Proposals that seek to design, develop, test, or evaluate new instruments that are intended for commercial sale will be rejected without review.

2. Instrument Management and User Access

All PME requests must specify how the instrument is to be used in terms of one of the three categories defined below:

- An “investigator instrument” is acquired or developed by the proposer to support the PI’s research, where the PI has full authority for its exclusive use, and where there are no commitments to make the instrument available to other investigators.
- An “investigator facility instrument” is acquired or developed to support the PI’s research, where an identified portion of its time is to be reserved for use by the PI, but where an additional specified portion of its time will be made available to other knowledgeable NASA-supported planetary program investigators and where all details or access, method of use, charging, and data rights are determined by the PI in negotiation with potential users.
- A “regional facility instrument” is one of considerable cost or one that is limited to a particular location by virtue of its use on a specific facility, but which has been acquired or developed by a PI to support the PI’s research. An identified portion of a regional facility instrument’s time will be reserved for use by the PI, but a significant, specified portion of its time must also be available to other NASA-supported planetary program investigators. Unlike an investigator facility instrument, however, all details of access, announcement of availability, assistance to be provided on its use and methods of use (whether hands on or by a facility-based operator), charges, and data rights must be documented and agreed to by NASA and the sponsoring institution before NASA support is provided.

Collective use by other members of the scientific community is encouraged. Proposals for both types of facility instruments must include:

(a) A description of the potential user-community.
(b) A management plan for the instrument that includes:
i. A statement of the percentage of the instrument's time that would be available to other users.

ii. A general statement regarding aspects of user access, such as:
   - time of day when access would be granted,
   - whether access would be "hands on" or only by an operator or collaborator in the proposer's group,
   - any costs to be charged for use,
   - how such costing would be handled, and
   - how users would apply to gain access (e.g., by personal communication, formal proposal, or other method).

It is expected that title to any equipment obtained or developed through this program shall vest with the proposing institution in accordance with the provisions of 2 CFR section 200.313. However, in cases where the equipment upgrade is for a facility owned by the U.S. Government, NASA reserves the right to negotiate title of the equipment for the best interests of the user community.

3. Costs

The Planetary Major Equipment program element allows for either the purchase of instrumentation from a commercial vendor or for the acquisition of components and development of new instrumentation. Funds may also be requested for the installation and check out of instrumentation, either by a vendor or by the investigator(s). Only nonflight instruments may be purchased or developed. No funds may be requested for scientific research. In addition, no funds may be requested for support contracts, maintenance, or continued operations of any instrument; costs for maintenance and operation beyond the check-out period must be requested in research proposals submitted to appropriate program elements. Each relevant cost should be fully explained and substantiated, and a quotation should be provided for any major equipment or components purchased from a commercial vendor. If acquisition or development of an instrument or facility will require more than one year, the proposal should cover the complete project, but make a clear distinction between efforts in each year.

It should be noted that cost sharing between NASA and other federal agencies is encouraged to the extent that NASA’s share of the cost will ensure adequate access to the finished instrumentation by NASA investigators; this acquisition/access aspect of any proposed effort involving cost-sharing must be discussed in the proposal. The proposal must document whether any other agency has been approached or has made tentative commitments and provide the name and telephone number of the appropriate officer who can discuss his/her agency’s interest.

Proposals selected for PME support will be funded through augmentation to the science research program proposal. Final reports should be sent to the cognizant science research program officer, with a copy sent to the PME program officer listed in the table below.
4. Programmatic Information

Letters of affirmation from the relevant community are permitted for proposals to this program, but only for investigator facility instruments and regional facility instruments (hereinafter simply "facility instruments").

4.1 Submission of PME proposals

All proposals must include a convincing case for instrument funding, and should address, as applicable:

- Why the instrument is necessary for the investigator's research or how it would enhance that research, citing specific examples;
- For facility instruments, why the enhanced capability is important to planetary science in general;
- For facility instruments, how the enhanced capability would benefit the larger planetary science community;
- How the requested instrument relates to existing capabilities, both in the investigator's own laboratory and elsewhere.

4.1.1 Appended PME proposals

No separate data management plan (DMP) is required for an appended PME proposal. Archiving and release of data produced by the requested instrument should be covered in the DMP associated with the main research proposal.

When filling out the NSPIRES cover page budget for an appended PME proposal, all costs associated with an appended PME request (including any additional salary) should be included as a single rolled up number per year on one of the configurable lines (Section F. Other Direct Costs, lines 8 or 9, and label as "Cost of Appended PME"). In most cases, it is expected that the PME costs will be contained within a single budget year.

The research proposal must contain an appendix entitled, "Planetary Major Equipment Request," which should be the last item in the proposal (subsequent to all of the required sections in the main proposal). This appendix should include:

(a) A single cover page specifying:
   
   i. The title of the PME request
   ii. The name and institution of the PI
   iii. The category of instrument being requested (investigator, investigator facility, or regional facility)
   iv. A brief summary/abstract of the PME request (which will not be evaluated, and therefore should contain only information covered in the body of the PME request)

(b) A maximum of five (5) pages of description of the instrument request, including an explanation of how this purchase will contribute to the research described in the main body of the research proposal to which the PME request is appended, any
cost-sharing arrangements, and, for facility instruments, a management plan as described above in Section 2. If the proposal contains instrument-development efforts, a detailed work plan and schedule for this should also be part of this section; in such cases the work plan, supported by items listed in the Facilities and Equipment section of the proposal, should demonstrate that sufficient capabilities exist to implement the development effort.

(c) A page of instrument specifications;
(d) At least one quote for the instrument or major components;
(e) A budget summary of the costs associated with the PME request alone. This section is independent of the budget section that is part of the full proposal. If there are labor costs associated with the PME request, you should only show the level of effort (FTE) in this section of the PME appendix; in this case, you will also need to break out labor costs associated with the PME request in the separately uploaded “Total Budget” file. Reminder: the full proposal budget must encompass all budget items associated with the PME request; the PME budget summary represents a subset of the full budget.

The PME appendix does not count toward the page limits of any section of the host proposal.

4.1.2 Stand-Alone PME proposals

Stand-alone PME requests, made in conjunction with an existing (previously funded) "parent" award in the target program, should be complete proposals prepared in full compliance with all applicable instructions and deadlines associated with the research program to which the PME proposal will be submitted, except as noted in this section. The proposer should select the PME checkbox on the cover page of this submission. The proposal should include:

(a) The Scientific/Technical/Management section may contain a maximum of seven (7) pages; this supersedes the normal 15-page limit for ROSES-2017. The text should specify the name of the program (in Section 1.2) that made the award, the title of the parent award, the grant number (or, if the PI is at a NASA center, the original proposal number), PI name, and start/end dates. It should contain a description of the instrument request, including the category of instrument being requested (investigator, investigator facility, or regional facility), how this purchase will contribute to the research described in the PI's ongoing program of research funded under the parent award, any cost-sharing arrangements, and, for facility instruments, a management plan as described above in Section 2. The Scientific/Technical/Management section should contain sufficient background information on the parent research award so the PME proposal can be reviewed without any knowledge of the contents of the original parent proposal. If the proposal contains instrument-development efforts, a detailed work plan and schedule for this should also be part of this section; in such cases the work plan, supported by items listed in the Facilities and Equipment section of the proposal, should demonstrate that sufficient capabilities exist to implement the development effort.

(b) A page of instrument specifications should be included in the proposal outside the Scientific/Technical/Management section;
(c) The budget section should include at least one quote for the instrument or major components;
(d) Investigator and regional facility PME proposals may contain a section of letters of affirmation from members of the potential user community;
(e) The stand-alone proposal should follow the target program's instructions for preparation of a relevance section, and if one is required, may simply state, "This is a stand-alone PME proposal based on a parent award that has already been deemed relevant to this program."
(f) The stand-alone proposal should follow the target program's instructions for location of a data management plan (DMP). However, the DMP for a stand-alone PME proposal may simply state, "This is a stand-alone PME proposal which, by definition, does not require a data management plan."

4.2 Evaluation Criteria and Review of PME Proposals

PME proposals will be reviewed as part of the science research-program peer reviews. Appended PME proposals will be reviewed in the context of the full research proposal to which they are appended. Stand-alone PME proposals will be reviewed only on the basis of information in the PME proposal itself; the previous proposal resulting in funding of the parent award will not be available to the review panel. Evaluation factors will be those listed in each science research program element, with the following additions:

- All proposals will be evaluated for the value that the equipment will add to the PI's proposed (for appended PME proposals) or funded (for stand-alone PME proposals) research. All proposals may be evaluated for the value that the new or enhanced capability would add to the planetary science community; however this will be a critical factor in the evaluation of facility instrument proposals.
- For facility instruments, reviewers may also consider the value to science beyond that offered specifically to the planetary science community.
- For facility instruments, review of the proposed facility-management plan may affect either or both the technical merit and cost elements of the evaluation.
- The relevance of an appended PME proposal is determined by the relevance of the research proposal to which it is appended, using evaluation criteria specific to the target program. Stand-Alone PME proposals are automatically deemed to be relevant because they are based on parent awards in the target program that have already been selected for funding.

4.3 Relationship of an appended PME proposal to the main science proposal

Appended PME proposals will only be funded if the main science proposal itself is selected for funding, regardless of the intrinsic merit of the PME request.

In constructing a full research proposal with an appended PME request, the PI should consider whether and how the main part of the proposal could be executed if the PME request were not funded. Proposers are strongly encouraged to present a contingency plan (if one is possible) for the nonselection of the PME request. Such a plan should be part of the Scientific/Technical/ Management section of the main proposal (not in the
PME appendix). This plan might discuss alternative methods of obtaining the required data, the effect that the lack of the instrument would have on the proposed science goals, or tasks that could be descoped from the proposal if the instrument was not available.

In general, the main science proposal will be evaluated under the assumption that the equipment proposed in the PME request will be selected for funding. The proposal may also receive a separate score for intrinsic merit, taking into account any contingency plan that was presented, that would apply if the PME request were to be declined.

4.4 Funding for PME awards

In general, funding for PME awards is drawn from a separate PME-program budget, as noted in Section 5. PME proposals to all PME-eligible target programs may compete for these funds. Some target programs may also contribute to PME awards from their own program budgets, thereby augmenting the amount of PME funds available in a given year. However, if a PME proposal's budget contains any items other than equipment (e.g., funding for labor to conduct development activities), those funds are expected to be supplied by the target program, and the PME proposal will be in competition for these funds with regular research proposals submitted to that program.

5. Summary of Key Information

| Expected annual program budget for new awards | ~ $1.4M, but may be supplemented by target programs |
| Number of new awards pending adequate proposals of merit | ~ 5-9 |
| Maximum duration of awards | Usually only one year. For the maximum number of years permitted, refer to the guidelines of the program element to which the PME proposal is submitted. |
| Due date for proposals | For stand-alone PME proposals, Step-1 and Step-2 proposals should be submitted to the relevant science research program according to the schedule in Tables 2 and 3 in the *ROSES Summary of Solicitation*. For PME proposals appended to new research proposals, no separate Step-1 proposal is required; PME requests may be appended to any Step-2 proposal submitted according to the schedule of the eligible program. |
| Planning date for start of investigation | See the specific science research program element. |
| **Page limit for the central**  
| Science/Technical/Management  
| section of proposal | 7 pp (see section 4.1.2 a) for stand-alone proposals affiliated with an existing parent research award;  
| | 5 pp (See section 4.1.1 b) for PME requests appended to new proposals to programs (listed in Section 1.2); see also Table 1 of ROSES and the NASA Guidebook for Proposers. |
| **Relevance** | This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| **General information and overview of this solicitation** | See the ROSES Summary of Solicitation. |
| **Detailed instructions for the preparation and submission of proposals** | Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers. |
| **Submission medium** | Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. |
| **Web site for submission of proposals via NSPIRES** | [http://nspires.nasaprs.com/](http://nspires.nasaprs.com/) (help desk available at nspires-help@nasaprs.com or (202) 479-9376) |
| **Web site for submission of proposals via Grants.gov** | [http://grants.gov](http://grants.gov) (help desk available at support@grants.gov or (800) 518-4726) |
| **Funding opportunity number for downloading an application package from Grants.gov** | Please refer to the specific science research program element. It will be of the form NNH17ZDA001N-AAA where AAA is the abbreviation for that program. |
| **NASA point of contact concerning this program** | Jeffrey N. Grossman  
| | Planetary Science Division  
| | Science Mission Directorate  
| | NASA Headquarters  
| | Washington, DC 20546-0001  
| | Telephone: (202) 358-1218  
| | Email: HQ-PME@mail.nasa.gov |
1. Scope of Program

The goal of the Laboratory Analysis of Returned Samples (LARS) Program is to maximize the science derived from planetary sample-return missions. Activities supported by LARS fall into two categories: (1) development of laboratory instrumentation and/or advanced techniques required for the analysis of returned samples; (2) direct analysis of samples already returned to Earth.

All proposed work must be in support of the overarching goals of the Planetary Science Research Program to help ascertain the content, origin, and evolution of the Solar System and the potential for life elsewhere, consistent with the strategy for Planetary Science Exploration embodied in the 2014 NASA Science Plan.

1.1 Proposals to Develop Laboratory Instrumentation or Advanced Techniques

Proposals are solicited to develop new analytical instrumentation or combinations of analytical instruments, or new components of analytical instruments, leading to significant improvements in the precision, resolution, or sensitivity of measurements compared to the existing state of the art, and to enable new types of measurements. Also of interest are proposals for the development of new analytical techniques for existing instrumentation that will push the limits of current technology, for example, by the elimination of analytical interferences or contamination problems. In all cases, both the development efforts and the clear relevance to NASA sample-return missions must be documented.

Development proposals may seek to develop instrumentation and techniques that will be used by only a small number of investigators at a single institution, or they may seek to develop facilities to be shared by the entire research community. For shared facilities, proposers must include detailed plans for facility management based on the size of the anticipated user base, including facility oversight, the fraction of time that will be made available to outside users, and the mechanism for allotting such time on a regular basis. In all cases, cost-sharing arrangements in the development of new instrumentation or techniques and evidence of a long-term institutional commitment to the analysis of returned samples will be viewed favorably in the selection process. Collaborations among instrument builders and scientists who understand the samples to be analyzed are encouraged. Ongoing laboratory support (e.g., service contracts) will not be supported.
1.2 Proposals to Analyze Returned Samples

Proposals are solicited to conduct analytical studies of astromaterials already returned by planetary missions. Samples needed to carry out the work plan do not need to be allocated prior to the submission of a LARS proposal. In such cases, the proposal should address the availability of appropriate samples. Selection and funding of proposals may be contingent upon final allocation of the necessary samples.

1.3 Exclusions

1.3.1 Lunar samples

LARS does not support work principally relevant to past lunar sample-return missions:

- Apollo 11, 12, 14, 15, 16, and 17
- Luna 16, 20, and 24

Proposals to work on lunar materials are most likely to be within the scope of the Emerging Worlds (EW, Program element C.2) or Solar System Workings (SSW, Program element C.3) Program Elements.

1.3.2 Space exposed hardware

LARS does not support work to study returned space-flown hardware that has been exposed to micrometeorite impacts, unless associated with one of the missions listed in Section 2.1. For example, work on micrometeorite impacts on the Long Duration Exposure Facility (LDEF) is not supported by LARS. Proposals to work on micrometeorites are most likely to be within the scope of the EW and SSW.

1.3.3 Terrestrial collections

LARS does not support research on astromaterials collected on Earth (e.g., meteorites, micrometeorites, cosmic dust) unless these analyses are directly in support of the interpretation of sample-return mission data.

1.3.4 Spacecraft Instrumentation

LARS does not support efforts to develop instruments for flight on planetary missions. See the instrument development calls for information on this subject (Program element C.12 PICASSO, and Program element C.13 MatISSE).

2. Sample Return Missions

2.1 Completed sample-return missions.

The following completed missions have returned samples, and may be the targets of either Instrument/Method Development or Sample Analysis proposals to LARS:
2.1.1 Genesis
This mission was designed to return samples of the solar wind to provide constraints on the chemical and isotopic composition of the primitive solar nebula; it was launched in 2001 and returned samples to Earth in 2004. Further information may be found at http://genesismission.jpl.nasa.gov/. Failure of the parachute system led to a hard landing in the Utah desert, and many of the fragile collectors were shattered on impact and contaminated. Intensive effort is underway to document the chips of collector materials and to measure and remove contamination from the chips. For information on availability of samples, check the Genesis curation website at http://curator.jsc.nasa.gov/genesis/index.cfm.

2.1.2 Stardust
This mission returned samples of the coma of comet 81P/Wild (Wild 2); it was launched in 1999, encountered the comet in 2004, and returned samples to Earth in 2006. The dust grains that impacted the silica aerogel collectors during a 6.1 km/sec flyby were all small (<100 µm) and fine-grained. In most cases the particles fragmented on impact and interacted strongly with the aerogel. For example, many particles are coated and sometimes penetrated with compressed or melted aerogel. Many particles impacted on the sample collector frame; work on particle residues in impact craters in the aluminum foils that separated the aerogel cells is also solicited. The aft-facing side of the collector was designed to collect interstellar dust particles, which are expected to be ~0.1 µm in size and to have impacted at more than 20 km/sec. Examination of this interstellar collector is extremely challenging (see http://stardustathome.ssl.berkeley.edu/). In addition to investigations involving direct analysis of Stardust materials, proposals to investigate the details of the capture process are solicited. Further information may be found from the mission homepage at http://stardust.jpl.nasa.gov/ and the Stardust curator’s website at http://curator.jsc.nasa.gov/stardust/index.cfm.

2.1.3 Hayabusa1
This mission, run by the Japan Aerospace Exploration Agency (JAXA), returned samples from the S-type Apollo asteroid, 25143 Itokawa; it was launched in 2003, encountered the asteroid in 2005, and its sample capsule was returned to Earth in 2010. In November 2010, JAXA announced that a large number of small particles, most smaller than 10 micrometers, were present in the capsule, with strong evidence of asteroidal origin for many of them. Most of the particles are curated by JAXA, and a subset that will eventually comprise 10% of the mass is curated at the Astromaterials Curation facility at NASA Johnson Space Center. More information and sample catalogs may be found at http://hayabusaao.isas.jaxa.jp/curation/hayabusa/index.html and http://curator.jsc.nasa.gov/hayabusa/.

2.2 Future sample return missions.
LARS supports Method/Instrumentation Development proposals to prepare for future sample-return missions. Such proposals should focus on gaps in current capabilities of ground-based laboratories, and address both the scientific importance of making such
analyses on samples to be returned from these missions, and on the timeliness of initiating the development effort during the proposed performance period. Highest priority will be given to proposals addressing missions already selected for flight and to those which can best demonstrate the timeliness of the effort.

2.2.1 OSIRIS-REx

This mission launched in September 2016 and will encounter 101955 Bennu, a 500-m diameter, B-type Apollo asteroid, in 2018. Following observations of the asteroid, a sample of regolith (<2 cm particles) will be collected. The collected sample, which is expected to have a mass between 60 g and 2 kg, will be returned to Earth in September 2023. The samples will be curated in the Astromaterials Curation facility at NASA Johnson Space Center. The first sample catalog is expected to be published in the spring of 2024. See http://science.nasa.gov/missions/osiris-rex/ for more information.

2.2.2 Hayabusa2

JAXA launched the Hayabusa2 mission in December 2014, and will encounter asteroid 162173 Ryugu, a ~1-km diameter, C-type, Apollo asteroid, in 2018. Small samples of fine-grained regolith (<1 mm particles) will be collected from up to three locations on Ryugu, and returned to Earth in December 2020. Samples will be made available for research by JAXA, and a fraction of the returned material will be transferred to NASA for curation at the Astromaterials Curation facility at NASA Johnson Space Center. See http://global.jaxa.jp/projects/sat/hayabusa2/ for more information.

2.2.3 Other missions and potential missions

Below is a list of some of the types of missions that may return samples to Earth in the distant future. In general, proposals addressing these missions are expected to have low priority for LARS funding.

- Mars sample-return missions
- New Frontiers comet sample-return missions
- New Frontiers lunar sample-return missions
- Future Discovery missions (Discovery >13)
- Asteroid Redirect Mission

3. Programmatic information

3.1. Supplemental Funding for Additional Instrumentation

Proposers to LARS are eligible to request funds for Planetary Major Equipment (PME). See Program element C.17 for information on how to append a PME request to a regular LARS research proposal or submit a stand-alone PME proposal to supplement an existing LARS award.

Appended PME requests to LARS may only be made for significant off-the-shelf purchases of instrumentation needed to directly perform or enhance the proposed research. Because LARS directly solicits the development of laboratory instruments,
proposers to this Program Element may not use appended PME requests for the purpose of acquiring hardware for instrument development. If the main proposal includes a significant effort to enhance or further develop an off-the-shelf instrument, or to develop analytical methods using such an instrument, then the instrument purchase must be part of the main proposal and described within the 15-page limit of the Scientific/Technical/Management portion of the proposal. In these cases, specifications and quotations for significant equipment purchases may be included in the detailed proposal budget.

The rules for stand-alone PME requests to LARS are the same as for other Program Elements, as described in C.17.

3.2 Topical Workshops

The LARS program does not accept proposals for topical conferences, workshops, or symposia; such proposals may be submitted in response to Program Element E.2 Topical Workshops, Symposia, and Conferences. Proposers should specifically identify the LARS program as the relevant SMD Program Element and refer to the goals and objectives of the LARS program in demonstrating relevance.

3.3 Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

3.4 Mission data, facilities, and resources

Please refer to ROSES Program element C.1, Section 4, for a detailed list of the data and astromaterials resources and facilities available to proposers to this Program Element, and how to use them.

3.5 Use of mission data

Proposals to this Program Element must follow the rules for use of mission data given in Program element C.1, Section 3.4.

3.6 Statement of Relevance

Proposals to this Program Element do not require a separate or explicit statement of relevance. As stated in Program Element C.1, Section 3.5, all proposals, including those submitted to this Program Element, will be evaluated for relevance to the program element. Consequently, proposers are strongly encouraged to address the question of relevance in the Scientific/Technical/Management portion of the proposal.
3.7 Data Management Plans (DMPs)

Program element C.1, Section 3.6, discusses the requirements for DMPs in proposals to this Program Element. Please note that DMPs are mandatory for this Program Element, and must be placed in a special section no longer than two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.

4. Proposal Submission Process

Program Element C.1, Section 2, outlines the two-step proposal submission process to be used by this Program Element.

Step-2 (full) proposals must follow all formatting requirements that are described Program element C.1 and in the NASA Guidebook for Proposers. Proposals that violate the rules may be rejected without review or declined following review if violations are detected during the evaluation process.

5. Summary of Key Information

<p>| Expected program budget for first year of new awards | ~$2.6M |
| Number of new awards pending adequate proposals of merit | ~ 10 |
| Maximum duration of awards | 4 years; shorter-term proposals are encouraged for Development proposals. |
| Due date for Step-1 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Due date for Step-2 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Planning date for start of investigation | ~6 months after Step-2 proposal due date |
| Page limit for the central Science/Technical/Management section of proposal | 15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers. |
| Relevance | This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| General information and overview of this solicitation | See the ROSES Summary of Solicitation. |
| Detailed instructions for the preparation and submission of proposals | Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers. |</p>
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| **NASA point of contact concerning this program** | Jeffrey N. Grossman  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-1218  
Email (Preferred): [HQ-LARS@mail.nasa.gov](mailto:HQ-LARS@mail.nasa.gov) |
NOTICE: Amended January 17, 2018. This program element will not be solicited in ROSES-2017. Instead it will be solicited in ROSES-2018. This is being done to better align the New Frontiers Data Analysis Program schedule with the fiscal year calendar without compressing the Planetary Science Division ROSES schedule in the Fall and Winter. The final text and due dates for NFDAP in ROSES-2018 will be released on February 14, 2018 with the ROSES-2018 NRA, but its estimated that the Step-1 due date will be in June 2018 and the Step-2 due date in August, 2018. This move will not affect this program element’s available funds.

Proposals to this program will be taken by a two-step process, in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an Authorized Organizational Representative. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal.

The scope of this program element also differs slightly from the other Planetary Science Division Data Analysis Programs. Proposers are expected to carefully read the solicitation and should email the program point of contact with any questions sufficiently ahead of the Step-1 proposal deadline. In addition, the NSPIRES page has an FAQ that holds answers to common questions about this program.

The link to Juno data, in Section 3.1, will be updated via a clarification after the first full delivery to the PDS (expected in June 2017). That section currently points to the Imaging Node’s page for JunoCam and is intended as a placeholder until a central location for the entire mission is published.

1. **Scope of Program**

   1.1 **Programmatic Overview**

   The objective of the New Frontiers Data Analysis Program (NFDAP) is to enhance the scientific return from New Frontiers missions by broadening scientific participation in the analysis and interpretation of data returned by these missions. Other mission and non-mission data sets may be used to supplement these data in a supporting role, but all proposals require the use of data from at least one New Frontiers mission.

   This program solicits research proposals to conduct scientific investigations utilizing or enhancing the utilization of data obtained by the New Frontiers missions. For the purposes of this solicitation, "data" is understood to include both uncalibrated and calibrated data as well as higher-order data products produced from the mission data. Science investigations may include the use of data from any spacecraft not supported by a separate Planetary Science Division Data Analysis Program.
Investigations using the New Horizons and/or Juno data may also use mission data supported by a separate Data Analysis program for outer Solar System single-body or comparative-planetology studies that require the use of those New Frontiers mission data for at least one of the bodies of focus.

All proposals to NFDAP must identify and address a clear objective with science research that would be a significant, not incremental, advance in the state of knowledge of the research topic. Tasks responsive to this call include 1) data analysis tasks, 2) nondata analysis tasks that are necessary to analyze or interpret the data, and 3) nondata analysis tasks that significantly enhance the use or facilitate the interpretation of mission data. These tasks may incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research. Proposals that include nondata analysis tasks to enhance the use or facilitate the interpretation of mission data must incorporate the results of such tasks in the analysis or interpretation of mission data to be responsive to this call.

1.2 Mission Data and Produced Data Products

Higher-order mission data products produced as part of funded research must be made publicly available, following the guidelines described in Section 3.6 of C.1, Planetary Science Overview ("Data Management Plans and Archiving"). Proposed data products for delivery to the PDS must be clearly described, appropriate time and effort for delivery and ingestion must be budgeted, and the proposal must include a letter from the manager of the appropriate PDS data node. For additional information, refer to the PDS Proposer's Archiving guide at http://pds.nasa.gov/documents/pag/index.html. Data products, including maps, improved calibrations, etc., must be submitted to the PDS or the USGS, as appropriate, by the end of the funded research period, unless the investigator explicitly makes a case in the proposal for a later date. Each research proposal must constitute a stand-alone scientific investigation, with stated lines of inquiry, and result in one or more peer-reviewed publications.

2. Programmatic Information

2.1 Exclusions

Proposals to this program must include a science investigation. Proposals to produce a higher-order data product that enhances the science return from one or more missions, but without a larger science investigation, must be submitted to the Planetary Data Archiving, Restoration, and Tools (PDART) Program, C.7.

2.2 Relevance Statement Requirement

Proposals to this program must discuss relevance in a (4000-character max) text box on the cover pages via the NSPIRES web interface for this program element. This section is outside of the 15-page Scientific/Technical/Management Section and the relocation of
the relevance discussion does not decrease that fifteen-page limit. This requirement supersedes the *NASA Guidebook for Proposers* and the *ROSES Summary of Solicitation*, and the omission of this section is sufficient reason for a proposal to be returned without review. The relevance discussion must explicitly refer to this program element and the section of the solicitation to which the proposal is responsive. If the proposed work is close in scope to research covered by any other program element, this discussion must also justify why it is more relevant to this program element than that other program element. This discussion may not be used to address the proposal’s intrinsic merit, budget justification, or any other factor that remains in the fifteen-page main body, or any other section, of the proposal.

3. **Data, Facilities, and Archiving**

3.1 **Use of Mission Data**

Proposals to this program element must follow the rules for use of mission data given in program element C.1, The Planetary Science Division Research Program Overview, Section 3.4.

- Mission information can be accessed via the NASA website(s).
- Mission data information can be accessed via the PDS webpage(s).

3.2 **Facilities and Data Sources Available to Proposers**

Proposers are advised to read Section 4 of program element C.1 for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

3.3 **Data Archiving and Map Publication**

Proposals submitted to this program element must include a Data Management Plan (see program element C.1, Section 3.6). This must be placed in a special section, no longer than two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.

Selected investigations may result in data products and software tools that are of broad use to the science community, including maps, data with improved calibrations, etc.
NASA strongly encourages that such data be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period. Proposers are advised to read program element C.1, The Planetary Science Division Research Program Overview, for information on including an archiving plan in the proposal.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read program element C.1, Section 3.8, for the USGS’ information on and requirements for map production and publication.

4. The Two-Step Submission Process

This program element uses the two-step proposal submission process outlined in program element C.1, Section 2.

Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

Proposals must follow all formatting requirements that are described program element C.1 and in the NASA Guidebook for Proposers. Note that these requirements were updated in 2016. Violation of these rules is sufficient grounds for a proposal to be rejected.

5. Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

6. Summary of Key Information [Changed January 17, 2018]

<p>| Expected program budget for first year of new awards | ~ $1.5 M/Year |
| Number of new awards pending adequate proposals of merit | ~ 8-12 total |
| Maximum duration of awards | 3 years |
| Due date for Step-1 proposals | Not solicited this year. Moved to 2018. |
| Due date for Step-2 proposals | Not solicited this year. Moved to 2018. |
| Planning date for start of investigation | ~6 months after Step-2 proposal due date. |</p>
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Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Email: HQ-NFDAP@mail.nasa.gov  
Telephone: (301) 286-7036 |
NOTICE: Amended on August 29, 2017. To give more time to proposers who are without power because of Hurricane Harvey, this amendment delays the due date for a number of program elements including this one. Please see Table 2 or Table 3 for the latest due dates.

This Program Element accepts proposals in a two-step proposal submission process described in Section 2 of program element C.1.

1. **Scope of Program**

The objective of the Rosetta Data Analysis Program (RDAP) is to enhance the scientific return of the Rosetta mission and broaden the scientific participation in the analysis of archived data collected from the Rosetta and Philae spacecraft.

1.1 **Sources and Analysis of Mission Data**

Spacecraft data used in RDAP investigations must be available in the Planetary Data System (PDS; [http://pds.nasa.gov/](http://pds.nasa.gov/)), or equivalent publicly accessible archive(s), at least 30 days prior to the Step-2 submission deadline for RDAP proposals. Spacecraft data that have not been placed in such archives are not eligible for use in RDAP investigations. In all cases, it is the responsibility of the RDAP investigator to acquire any necessary data. Investigators are encouraged to contact the archive for assistance in identifying specifics of available datasets. Datasets to be used in the proposed work must be clearly and specifically identified in the proposal. Regardless of the archive(s) used, if the data to be analyzed have known issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome.

Proposals to RDAP must include a science investigation. Proposals to produce a higher order data product that enhances the science return from Rosetta, but does not include a science investigation, should be submitted to the Planetary Data Archiving, Restoration, and Tools (PDART) Program (program element C.7).

Proposed work responsive to this call may include (1) data analysis tasks, (2) tasks that are not data analysis but are necessary to analyze or interpret the data, and (3) tasks that are not data analysis but that significantly enhance the use or facilitate the interpretation of Rosetta data. These tasks may incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research; however, proposals that include tasks that are not data analysis must also incorporate the results of these tasks into the analysis or interpretation of Rosetta mission data in order to be responsive to this call.

It is the responsibility of the proposers to RDAP to specifically identify any needed data and to ascertain that these data are available. Proposals should provide convincing evidence that the data have sufficient quality and are available in sufficient quantity to achieve the goals set forth in the proposal. The proposer should demonstrate a
familiarity with the data and an understanding of the work required to refine the data for the purposes of the analysis.

1.2 Data Archiving into PDS

Data products produced by funded RDAP investigations must be made publicly available, following the guidelines described in Section 3.6 of C.1 Planetary Science Overview ("Data Management Plans and Archiving"). Proposed data products for delivery to the PDS must be clearly described, appropriate time and effort for delivery and ingestion must be budgeted, and the proposal must include a letter from the manager of the appropriate PDS data node. For additional information, refer to the PDS Proposer's Archiving guide at http://pds.nasa.gov/documents/pag/index.html. Data products, including maps, improved calibrations, etc., must be submitted to the PDS or the U.S. Geological Survey (USGS), as appropriate, by the end of the funded research period, unless the investigator explicitly makes a case in the proposal for a later date.

1.3 Program Exclusions

The Rosetta Data Analysis Program is not intended to overlap other active data analysis or Core (see below) research and analysis programs. Therefore, RDAP does not support the analysis of:

- Lunar data (see LDAP, program element C.8);
- Mars data from Mars missions (see MDAP, C.9);
- Data from Cassini (see CDAP, C.10);
- Data from Discovery Missions, including Kepler/K2 observations of Solar System targets (see DDAP, C.11);
- Data from New Frontiers Missions (NFDAP, C.19)
- Data from Kepler/K2 on objects outside the Solar System (see ADAP, D.2).

RDAP also does not support:

- Proposals for organizing and/or hosting scientific meetings (which should be submitted to Topical Workshops, Symposia, and Conferences, E.2);
- Proposals for detector, instrumentation, or technology development (which are supported by other NASA programs); or
- Investigations whose primary emphasis is fundamental theory, the development of numerical models, or laboratory measurements (unless there is a direct and explicitly presented connection to Rosetta data).

The Planetary Science Division uses RDAP and the other data analysis programs (DAPs) to solicit proposals whose work efforts are primarily analysis of planetary mission data. If a proposal seeks to analyze data in the scope of two or more DAPs in order to perform comparative studies across the Solar System, and is not appropriate to any one DAP, then submission to a Core Research Program is encouraged. If a proposal is not appropriate for one of the DAPs, but does fit within the bounds of a Core Research Program (e.g., Solar System Workings or Emerging Worlds), it should be submitted to that Core Program.
Spacecraft data that have not yet been obtained (i.e., future mission data), or those that have not been made publicly available in approved archives, as indicated above, may not be proposed for use in RDAP investigations.

Members of Rosetta mission or instrument teams who wish to apply to RDAP must clearly demonstrate that their proposed investigation will use only released and publicly available data. These team members must scrupulously comply with the 30-days-prior-to-submission rule (above). Additionally, team members must clearly demonstrate how the proposed RDAP research does not overlap and is not redundant with already funded activities.

2. The Two-Step Submission Process

This Program Element uses a two-step proposal submission process described in program element C.1, Section 2.

Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

Proposals must follow all formatting requirements that are described program element C.1 and in the NASA Guidebook for Proposers.

The Planetary Science Division intends that RDAP proposals will be co-reviewed at the same time as proposals to the Discovery Data Analysis Program (DDAP; program element C.11); however, RDAP awards will be funded from a source other than the Discovery Program.

3. Programmatic Information

3.1 Progress Reports

An Annual Progress Report will be due no later than 60 days in advance of the anniversary date of the award. Awards to NASA Centers, including the Jet Propulsion Laboratory (JPL), always have an anniversary date of the start of the Federal fiscal year, October 1.

3.2 Duration of Awards

Typical proposals to this program seek three years of funding or fewer. Please refer to program element C.1, Section 3.3, for instructions on submitting requests for more than three years.

3.3 Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.
4. **Resources: Information, Data, and Facilities**

4.1 **Limits on Use of Mission Data**

Proposals to this Program Element must follow the rules for use of mission data given in program element C.1, section 3.4. If the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome.

4.2 **Data Management Plans (DMPs)**

Proposals submitted to this Program Element must include a Data Management Plan (see program element C.1, Section 3.6). This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.

4.3 **Facilities and Data Sources Available to Proposers**

Proposers are advised to read C.1, Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the NASA Guidebook for Proposers, a letter of support may be required from any facility required for the proposed effort.

4.4 **Geologic Maps**

Proposers who plan investigations involving geologic mapping should consult program element C.1, Section 3.8, for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.

5. **Summary of Key Information**

<table>
<thead>
<tr>
<th>Expected program budget for first year of new awards</th>
<th>~$1.3 M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>~9-12</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>4 years; shorter-term proposals (1-3 years) are typical; fourth year must be explicitly and scientifically justified.</td>
</tr>
<tr>
<td>Due date for Step-1 proposals</td>
<td>See Tables 2 and 3 in the Summary of Solicitation of this NRA.</td>
</tr>
<tr>
<td>Due date for Step-2 proposals</td>
<td>See Tables 2 and 3 in the Summary of Solicitation of this NRA.</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>~Six months after Step-2 proposal due date.</td>
</tr>
<tr>
<td>Topic</td>
<td>Information</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Page limit for the central Science/Technical/Management section of proposal</td>
<td>15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of proposals via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposals via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-RDAP</td>
</tr>
<tr>
<td>NASA point of contact concerning this program</td>
<td>Thomas S. Statler</td>
</tr>
<tr>
<td></td>
<td>Planetary Science Division</td>
</tr>
<tr>
<td></td>
<td>Science Mission Directorate</td>
</tr>
<tr>
<td></td>
<td>NASA Headquarters</td>
</tr>
<tr>
<td></td>
<td>Washington, DC 20546-0001</td>
</tr>
<tr>
<td></td>
<td>Email: <a href="mailto:thomas.s.statler@nasa.gov">thomas.s.statler@nasa.gov</a></td>
</tr>
<tr>
<td></td>
<td>Telephone: 202-358-0272</td>
</tr>
</tbody>
</table>
NOTICE: Amended on August 25, 2017. This program element will not be solicited as part of ROSES-2017. Instead, it will be solicited as a program element appendix of SALMON-3 NNH17ZDA004O. When this occurs, it will be announced as an Amendment to the SALMON-3 AO.

The Planetary Science Division plans to offer the Small Innovative Missions for Planetary Exploration (SIMPLEx) as program element C.21 of ROSES-2017. Final text will be provided via an amendment released at least 90 days prior to the due date for Step-2 proposals.

1. Program Description

This solicitation supports the formulation and development of science investigations that require a spaceflight mission that can be accomplished using small spacecraft. All proposed investigations must be responsive to the goals of the Planetary Science Division, as described in the 2014 NASA Science Plan available at https://science.nasa.gov/about-us/science-strategy/. In order to advance the objectives outlined in the Science Plan, proposed investigations may target any body in the Solar System except for the Earth and Sun. Investigations of extra-solar planets are not solicited in this program element.

CubeSats are small satellites built from a set of standardized subunits that each measure 10x10x10 cm and weight 1.33 kg (designated ‘1U’). Common configurations include 1U, 2U, 3U, and 6U (2Ux3U) satellites, deployers for all of which are commercially available. Due to their standardized form and low-cost disposable nature, these satellites are suitable platforms on which to train students and early career researchers. Proposers may also refer to Section V(b)(v) "Use of Short Duration Orbital Platforms, including CubeSats" of the ROSES Summary of Solicitation.

Proposals to this program element may propose to use 1U, 2U, 3U, and 6U form factors. Larger satellites and hosted payloads are not solicited at this time. This program element encourages, but does not require, the submission of CubeSat investigations that operate in interplanetary space and would, therefore, meet more demanding engineering and environmental requirements than has been experienced by previous CubeSats. While it is expected that proposed investigations would involve some advanced engineering development of instruments and/or spacecraft systems technology, all proposals must include a science investigation that will return and publicly archive usable scientific data and result in the publication of results in refereed scientific journals.

Activities such as extended missions, guest investigator programs, general observer programs, participating scientist programs, and/or interdisciplinary scientist programs, where appropriate, have the potential to broaden the scientific impact of investigations. Such optional activities may be proposed as Science Enhancement Options (SEOs). Flight hardware may not be proposed as SEOs. NASA considers any proposed SEO activities as optional. Inclusion of such optional activities in a proposal does not imply a
commitment from NASA to fund them, even if the baseline investigation is selected. NASA reserves the right to accept or decline proposed SEO activities at any time during the mission; in particular, the decision may not be made at the time the baseline investigation is selected for flight. The process for deciding on SEO activities may involve further reviews (e.g., a "Senior Review" for extended missions). NASA reserves the right to solicit and select all participants (e.g., guest investigators and participating scientists) in such programs.

All SIMPLEx investigations are cost-capped missions; however, optional risk reduction activities will be considered. In the development of any cost-capped mission, trades are performed between different activities. Some of these trades may serve to reduce the implementation risk of the mission (e.g., tests of various types, fabrication of high fidelity simulators). This solicitation encourages proposers to include a description of activities which might reduce the implementation risk of their investigation, but which cannot be accommodated under the cost cap — Risk Reduction Activities. NASA will consider these activities as optional. Inclusion of such optional activities in a proposal does not imply a commitment from NASA to fund them, even if the baseline investigation is selected. NASA reserves the right to accept or decline proposed risk reduction activities at any time during the mission; in particular, the decision may not be made at the time the baseline investigation is selected for flight.

2. Programmatic Information

For further information about the SIMPLEx Program contact:
Doris Daou
Planetary Science Division
National Aeronautics and Space Administration
Washington, DC  20546
   Telephone:  202-358-1686
   Email: Doris.Daou-1@nasa.gov
NOTICE: Amended on July 11, 2017. By the end of the day on July 11, 2017, a change will be made to the Proposal Information Package and two additions will be made to the Questions and Answers, both of which can be found under "Other documents" on the NSPIRES page for this program element. To give time for proposers to make any modifications, if needed, the Step-2 proposal due date has been delayed to July 25, 2017.

May 23, 2017. The estimated start date (in sections 2.4 and 4) and dates of the Participating Scientist Orientation Meeting (in section 2.7) have been delayed by a month. New text is in bold and deleted text is struck through. The Step-2 due date remains unchanged.

Clarified April 25, 2017. If a selected proposal has a Science PI, that person may become the OSIRIS-REx participating scientist. See section 2.1. New text is in bold. The due dates are unchanged.

Amended April 5, 2017. This Amendment releases final text for the OSIRIS-REx Participating Scientist Program. Changes since the draft version include the addition of section 1.3.2 on the use of REXIS data, and revision of the FAQ in response to a wide variety of questions from the community during the comment period.

1. Scope of Program

The objective of the OSIRIS-REx Participating Scientist Program (OREx-PSP) is to enhance the scientific return during the asteroid-operational phase of the OSIRIS-REx mission by expanding participation in the mission through new investigations that broaden and/or complement existing investigations.

1.1 Eligibility

In order to meet the OREx-PSP objective to expand participation in the mission, existing OSIRIS-REx Co-Is may not be the PI or Science PI of a proposal to this program element. See section 2.1 for the implications of selection of a proposal containing work efforts by existing OSIRIS-REx team members.

1.2 Background Information

OSIRIS-REx launched September 8, 2016, with the primary objective of traveling to the near-Earth (Apollo-type, spectral class B) asteroid 101955 Bennu, obtaining a sample containing at least 60 g of regolith material, and delivering this sample back to Earth. Once the spacecraft reaches Bennu, a wide range of observations and measurements will be made to characterize and map the asteroid, identify and characterize in detail sites where samples might be collected, and finally to collect a sample from the optimal site and stow it for delivery to Earth.
The science objectives of the OSIRIS-REx mission are (refer to section 1.3 for priorities):

1) Sample Return: return and analyze a sample of pristine carbonaceous regolith from Bennu in an amount sufficient to study the nature, history, and distribution of its constituent minerals and organic material.

2) Understanding asteroid geology, dynamics, and spectroscopy: map the global properties, chemistry, and mineralogy of Bennu to characterize its geologic and dynamic history and provide context for the returned samples.

3) Select a sample site and provide sample context: document the texture, morphology, geochemistry, and spectral properties of the regolith at the sampling site in situ at scales down to the sub-centimeter.

4) Understand the interaction between asteroid thermal properties and dynamics: measure the Yarkovsky effect on Bennu, a potentially hazardous asteroid, and constrain the asteroid properties that contribute to this effect.

5) Improve asteroid astronomy: characterize the integrated global properties of Bennu to allow for direct comparison with ground-based telescopic data of the entire asteroid population.

To accomplish this, the OSIRIS-REx project has defined the following baseline requirements (summarized, excluding those to be achieved in the sample-analysis phase of the mission, which are not relevant to this solicitation):

1. Deliver ≥60 g of pristine bulk sample to Earth;

2. Document the contamination of the sample acquired from collection, transport, curation, and distribution;

3. Contact ≥26 cm$^2$ of surface material from Bennu and deliver the contact surface to Earth;

4. Document the texture, morphology, geochemistry, and spectral properties of the sample site to sub-cm resolution;

5. Produce a shape model of Bennu with 1-m lateral and vertical resolution;

6. Determine the surface slopes, accelerations, and geopotential of Bennu at 1-m spatial resolution;

7. Determine the bulk density of Bennu to within 1%, determine up to the fourth degree and order gravity harmonic coefficients, and search for and characterize any density inhomogeneities within the asteroid;

8. Measure the number, sizes, spatial distribution, and morphologies of possible craters and boulders, regolith distributions, and search for evidence of surface expression of internal structure on Bennu;

9. Resolve key mineralogical and organic features with spectral absorptions ≥5% to detect the following species: adsorbed water, phyllosilicates, carbonates, sulfates, silicates, oxides, and hydrocarbons, as well as determine mineral, organic, and phase abundances on the surface of Bennu, at a global spatial resolution of 50 m or better;

10. Search for and spectrally and visually characterize any regions of active volatile outgassing from the surface of Bennu;

11. Search for and spectrally and visually characterize any satellites in orbit around Bennu;

12. Search for and characterize the effects of space weathering on Bennu;
13) Constrain the properties of Bennu that contribute to the Yarkovsky effect, and measure the magnitude of the Yarkovsky effect;
14) Measure the astrometric, photometric, and spectroscopic properties of Bennu.

The spacecraft carries an instrument suite consisting of three cameras (OCAMS), a visible-infrared spectrometer (OVIRS), a thermal emission spectrometer (OTES), a scanning LIDAR (OLA), a student contributed X-ray imaging spectrometer (REXIS), as well as its communications system used to perform radio science. In addition, the spacecraft has a variety of specialized cameras, a sampling system (TAGSAM), and two LIDARs used for guidance, navigation, and control. Details about the specifications and capabilities of the instrument suite can be found in NSPIRES as part of the "Proposal Information Package" (PIP) and the preprint "Lauretta et al. (2017)."

The mission timeline during flight, shown in Table 1, includes eight planned operational phases, grouped into three major campaigns during asteroid operations, Navigation,

<table>
<thead>
<tr>
<th>Cmpgn</th>
<th>Phase</th>
<th>Start</th>
<th>End</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outbound Cruise</td>
<td>8 Sept 2016</td>
<td>16 Aug 2018</td>
<td>Includes Earth gravity assist, Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Approach</td>
<td>17 Aug 2018</td>
<td>18 Nov 2018</td>
<td>Natural satellite search; first images</td>
</tr>
<tr>
<td></td>
<td>Preliminary Survey</td>
<td>19 Nov 2018</td>
<td>8 Dec 2018</td>
<td>Mass determination; refine shape/spin models</td>
</tr>
<tr>
<td></td>
<td>Orbital A</td>
<td>9 Dec 2018</td>
<td>22 Feb 2019</td>
<td>Demonstrate orbital flight; begin optical navigation</td>
</tr>
<tr>
<td></td>
<td>Detailed Survey</td>
<td>23 Feb 2019</td>
<td>26 Apr 2019</td>
<td>Spectral mapping; imaging and LIDAR studies for shape and spin models; dust plume search</td>
</tr>
<tr>
<td></td>
<td>Orbital B</td>
<td>27 Apr 2019</td>
<td>31 Jul 2019</td>
<td>Collect LIDAR and radiometric tracking data for high-res topo map and grav model; define 12 potential sample sites and down-select to 4</td>
</tr>
<tr>
<td></td>
<td>Reconnaissance</td>
<td>1 Aug 2019</td>
<td>6 Nov 2019</td>
<td>Sorties to study 2 candidate sites; sample site selection</td>
</tr>
<tr>
<td>TAG</td>
<td>TAG rehearsal</td>
<td>7 Nov 2019</td>
<td>20 Jun 2020</td>
<td>Practice for sample collection; includes 6-month period while asteroid near perihelion</td>
</tr>
<tr>
<td></td>
<td>Sample collection</td>
<td>21 Jun 2020</td>
<td>20 Jul 2020</td>
<td>Collect sample and stow</td>
</tr>
<tr>
<td></td>
<td>Quiessct ops</td>
<td>21 Jul 2020</td>
<td>2 Mar 2021</td>
<td>No planned activities</td>
</tr>
<tr>
<td></td>
<td>Return cruise</td>
<td>3 Mar 2021</td>
<td>23 Jul 2023</td>
<td>Return to Earth</td>
</tr>
<tr>
<td></td>
<td>Earth return</td>
<td>24 Jul 2023</td>
<td>23 Sep 2023</td>
<td>Deliver sample to Earth’s surface</td>
</tr>
</tbody>
</table>

Table 1. Planned phases of the OSIRIS-REx mission during flight. The three asteroid operational campaigns are shown in color.
Site Selection, and TAG (Touch and Go sampling).

Proposals to the OREx-PSP must be for work to be done during these three campaigns, highlighted in color on Table 1 (see section 1.3). Details of the planned observations and science products are also available in the PIP and Lauretta et al. (2017) documents in NSPIRES.

Once the sample is delivered to Earth in Sept 2023, the mission enters a two-year sample analysis phase.

The OSIRIS-REx science team is organized into a Science Executive Council, overseeing a diverse array of working groups, each of which is led by a current OSIRIS-REx Co-I. These include the following 12 science working groups listed in Table 2, below. The document "OSIRIS-REx Science Team Roster" in NSPIRES provides information on the roles of OSIRIS-REx Co-Is on these working groups, as well as contact information for working group leads. Proposers to this program element may affiliate with 11 of these (see section 2.1):

<table>
<thead>
<tr>
<th>Table 2. List of OSIRIS-REx Science Working Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altimetry</td>
</tr>
<tr>
<td>Astronomy</td>
</tr>
<tr>
<td>Carbonaceous meteorites</td>
</tr>
<tr>
<td>Dynamical evolution</td>
</tr>
<tr>
<td>Image processing</td>
</tr>
<tr>
<td>Radio science</td>
</tr>
</tbody>
</table>

*Not eligible for OREx-PSP affiliation

1.3 Solicited Work

1.3.1 General Information

Work proposed in response to this program element should seek to enhance, augment, or complement planned mission activities during the three proximity operations campaigns while the spacecraft is at Bennu. Proposed work should advance the overarching science objectives of the mission given above and/or enhance the ability of the mission to achieve or exceed the baseline requirements given above (excluding those to be accomplished following delivery of the sample to Earth in 2023). Future solicitations are planned to enable OSIRIS-REx data analysis of a general nature and asteroid sample analysis.

Proposals that would conduct analyses, experiments, observations, or modeling for which the primary purpose is to support of science to be done during the asteroid operational campaigns are acceptable. However, such proposals for which the primary purpose is to help understand the asteroid samples to be delivered in 2023 are NOT solicited here. In addition, proposals that seek to develop new analytical methods, or to develop or purchase new instruments, are not solicited here; proposers considering such projects should refer to the Laboratory Analysis of Returned Samples program element (program element C.18). Proposals focusing on data archiving, flight dynamics and navigation, and sample curation methods or procedures are, likewise, not solicited here.
Proposals submitted in response to this program element should clearly explain how the planned work complements or augments current mission plans, enables achievement of the science objectives, and would enhance the scientific return of the mission.

1.3.2 Proposals to use REXIS Data

The X-ray imaging spectrometer (REXIS) was selected as a student collaboration experiment, implemented as part of the OSIRIS-REx mission. Any proposal submitted to the OREx-PSP program element that requires the use of REXIS data must also contain a component of student involvement, with students having a major role in REXIS data analysis. The students associated with the proposal may either be those currently involved with the REXIS experiment, or new students at the same or other institutions.

2. Programmatic Information

2.1 Roles of Proposal Team Members [Clarified, April 25, 2017]

Selected participating scientists (the PI or, if applicable, the Science PI of a selected proposal) will join the OSIRIS-REx science team as "Participating Scientist Co-Investigators," generally for three years, starting in late 2017 and ending in late 2020. Selectees will have the same rights and responsibilities as other OSIRIS-REx co-investigators and will be required to endorse and follow the OSIRIS-REx "Rules of the Road" document, available on the NSPIRES page of this program element under "Other documents". All other personnel in the proposal team, including proposal Co-Is, will become OSIRIS-REx "Participating Scientist Collaborators" and will be subject to these rules of the road as are other OSIRIS-REx Collaborators. Note that the rules of the road require mandatory attendance at the semi-annual science team meetings for Participating Scientist Co-Investigators and include data, publication, and communications policies.

No OSIRIS-REx science team member will have more than a single type of membership role on the mission. If a proposal’s PI/Science PI is currently an OSIRIS-REx collaborator, then their title would change to Participating Scientist Co-Investigator. At the end of their award period under the OREx-PSP, their title may be reverted to OSIRIS-REx collaborator if they are still participating in relevant project activities. If a proposal team member other than the PI/Science PI is a current OSIRIS-REx science team member, then upon selection of the proposal they would retain their present role on the mission and not be designated as a Participating Scientist Collaborator.

2.2 Proposals from Non-U.S. institutions

Proposals from non-U.S. institutions are acceptable and will only be considered on a no-exchange-of-funds basis. The expected program budget listed in section 5 excludes contributions from foreign organizations. Non-U.S. proposals will be reviewed to the same standards as proposals from U.S. institutions and selected solely by NASA. Proposers from non-U.S. institutions should read the Foreign PI Affiliation instructions document, which is downloadable as a PDF file from the NSPIRES web page for this program element. Non-U.S. proposers must include a letter of commitment promising
financial support for all proposed activities. Even though no funds are to be requested from NASA, all non-U.S. proposals must contain all of the required sections outlined in the NASA Guidebook for Proposers, including complete budget information and the required table of time commitments for all proposal team members.

2.3 Sources of Information and Data Used in the Proposal

All information used in the proposal pertaining to OSIRIS-REx or other missions must be available in the public domain (which includes the information available through NSPIRES), or the proposal will not be considered for selection, and may be returned without review. This includes any planetary spacecraft mission data. All data must be available in the Planetary Data System (PDS) or an equivalent, publicly accessible archive at least 30 days prior to the full proposal submission deadline. These restrictions are to prevent those who currently have access to data that are not yet public from having an unfair advantage by presenting these data in the proposal. Selected Participating Scientists will have access to OSIRIS-REx data that are not yet public once they become members of the team; proposed access to and use of such data must be consistent with the OSIRIS-REx Rules of the Road.

2.4 Start Dates, Duration, and Size of Awards [Revised May 23, 2017]

NASA expects to make a single set of selections for this program starting in FY 2018, with investigations running for up to three years. The expected budget for the program is ~$1M per year; the number of selections is expected to be no more than eight, excluding any selections from non-U.S. institutions.

Awards should specify start dates of November December 1, 2017, if feasible, and must start by March 1, 2018.

2.5 Data Management Plans (DMPs)

Proposals submitted to this program element must include a Data Management Plan (DMP) consistent with the requirements outlined in program element C.1. This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal. The DMP does not need to cover archiving of spacecraft data returned by the mission, which is already controlled by the mission-level DMP; however, it must cover new data and software products that would be generated under the proposal, including those derived from spacecraft data.

2.6 Geologic Maps

Proposers who plan investigations involving geologic mapping should consult program element C.1 for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.

2.7 Program-Specific Proposal Content [Revised May 23, 2017]

Budgets should include funds for the proposal PI to travel to the OSIRIS-REx science team Participating Scientist Orientation Meeting in Tucson, Arizona, the week of
Budgets and schedules of all proposals must allow the PI to attend the science team meeting tentatively scheduled in Tucson in late March 2018, and all subsequent semi-annual science team meetings (in Tucson) within the award period.

Proposers should align themselves with one of more of the science working groups in the mission (Table 2), and as selected Participating Scientist Co-Investigators would be expected to take part in the activities of these groups. Final assignment of awardees to working groups will be made upon selection. Contact information for the working group leads is available in the supporting document, “OSIRIS-REx Science Team Roster,” in NSPIRES.

The Science/Technical/Management (STM) section must contain a clear statement of how the proposed work complements or augments OSIRIS-REx planned activities, would enhance the scientific return of the mission, and/or would reduce risk on the mission.

The STM section should also contain a work plan with sufficient detail to show how the proposed schedule and milestones fit within the mission timeline and should fully describe all resources required from the mission in order to accomplish the work.

3. Proposal Preparation, Submission, and Evaluation

3.1 Two-Step Proposals

This program element uses a two-step proposal submission process described in program element C.1, Section 2. Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

3.2 Proposal Formatting and Content

Proposals must follow all formatting and content requirements described program element C.1 and in the NASA Guidebook for Proposers. Violation of these rules is sufficient grounds for a proposal to be rejected. Although proposers are expected to follow all of the rules outlined above, they should be especially aware of these common errors:

- Do not add an extra page containing your abstract prior to the main body of the proposal. The abstract is limited to the cover pages generated by NSPIRES.
- Do not add a table of symbols or abbreviations as an extra page beyond the 15-page Science/Technical/Management (STM) section. Such definitions must fit within the 15 pages.
- Do not describe team members’ roles and responsibilities in the table of work effort or budget sections. Only list job titles in these sections.
- Do not put information on instrument calibration or performance in the Facilities and Equipment section beyond what is needed simply to describe the instrument. If such information is critical to the work, put it in the STM section.
- Do not include work statements from Co-Is in the budget sections covering subawards/subcontracts. These may only appear in the STM section.
• Do not set your figure captions in a smaller typeface than the minimum permitted for the body text.

Also, we recommend, but do not require, the following practices for clarity in writing proposals:
• Please do not use numbered callouts to bibliographic references in the STM section. Use the author name(s) and year.
• There is no need to present budgets broken down by federal fiscal years. Budgets should be organized by award years.
• Place clear titles on all subsections of your budget.

3.3 Modular Proposals
NASA has the option of funding only part of a proposal, if that part of the proposal receives a significantly better evaluation on intrinsic merit, relevance, or cost, or if only part of the overall project fits within the program budget. In order to be considered for this type of descoping, a proposal must be modular, with clearly identified (numbered), separable "tasks." A descopable task is a self-contained sub-project, which in and of itself is relevant to OREx-PSP and of high scientific merit. Proposals that do not enumerate modular tasks will not generally be considered for descoped funding. Note that a proposal containing identified tasks does not require presentation of a separate budget for each task.

3.4 Evaluation and Selection of Proposals
All proposals will be evaluated for Intrinsic Merit, Cost, and Relevance, as specified in the NASA Guidebook for Proposers. In addition, the extent to which the proposed work complements or augments OSIRIS-REx planned activities would enhance the scientific return of the mission, or would reduce risk on the mission, may be considered a major component of the Intrinsic Merit score.

Programmatic factors that may affect selection of proposals include the degree to which the new work broadens participation in the mission and the ability of the mission to accommodate the proposed work in light of spacecraft and instrument capabilities, schedule, and resources.

4. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected program budget for first year of new awards</th>
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<tr>
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<td>Maximum duration of awards</td>
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<td>Due date for Step-1 proposals</td>
<td>See Tables 2 and 3 in the Summary of Solicitation of this NRA.</td>
</tr>
<tr>
<td>Due date for Step-2 proposals</td>
<td>See Tables 2 and 3 in the Summary of Solicitation of this NRA.</td>
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<tr>
<td>Planning date for start of investigation</td>
<td>November \textbf{December} 1, 2017, see Section 2.4 [Revised May 23, 2017]</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
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<tr>
<td>Page limit for the central Science/Technical/Management section of proposal</td>
<td>15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Relevance</td>
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</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
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<td>Web site for submission of proposals via NSPIRES</td>
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<td>Web site for submission of proposals via Grants.gov</td>
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</tbody>
</table>
| NASA points of contact concerning this program | Jeffrey N. Grossman  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-1218  
Email: hq-orexp@maill.nasa.gov  
Christina R. Richey  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-2206  
Email: hq-orexp@maill.nasa.gov |
C.23 NEW EARLY CAREER FELLOWSHIP PROGRAM


1. Program Description

The Early Career Fellowship (ECF) program supports the development of individual research programs of outstanding scientists early in their careers and stimulates research careers in the areas supported by the Planetary Sciences Division (PSD). This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, and methods.

This program consists of two components with two different submission procedures: the first is an application to be an "Early Career Fellow" (via this program element, C.23) and the second is the subsequent submission of a seven-page proposal for start-up funds by an individual previously named a fellow (via C.16 Early Career Fellowship Start-up Program for Named Fellows).

The first component of the ECF program, the application to be an "Early Career Fellow" via this program element, is not being solicited in ROSES 2017. The Planetary Science Division anticipates that it will be included in ROSES-2018.

2. Programmatic Information

For further information about the New ECF Program contact:
Mary Voytek
Planetary Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-1577
Email: mvoytek@hq.nasa.gov
C.24 INSTRUMENTS FOR GONDOLA FOR HIGH-ALTITUDE PLANETARY SCIENCE

NOTICE: Amended July 3, 2017. This amendment announces that this program element will not be solicited in ROSES, as the development of the platform is not being continued at this time.

The Planetary Science Division may solicit proposals for this program element as part of ROSES-2017. Draft text for this program element was released as program element C.26 of ROSES-2016. When the final text for this program element is issued it will be as an amendment to ROSES-2017 at least 90 days in advance of the Step-2 proposal due date.

1. Program Description

NASA’s Planetary Science Division has begun development of the stratospheric balloon-borne platform Gondola for High-Altitude Planetary Science (GHAPS) intended for use by the broad science community. The GHAPS platform will host a 1-meter telescope and is designed to fly a minimum of five missions from any of the six Balloon Program Office (BPO) launch locations, with minimal refurbishment costs between flights. The purpose is to produce significant science returns through observations in the 300 nm to 5 \( \mu \)m range and possibly beyond. As a stratospheric balloon platform flying above 99.5 percent of the atmosphere, GHAPS offers access to wavelengths not possible from the ground or current space assets. Advances in balloon system technology promise long duration flights with day-night cycles, enabling missions that satisfy the objectives in the 2013 Planetary Science Decadal Survey (Vision & Voyages for Planetary Science in the Decade 2013-2022). GHAPS will provide competed guest observer access through the peer review process, allowing the broader science community to accomplish compelling planetary science using this platform.

Draft text for this program element was released as program element C.26 of ROSES-2016.

2. Points of Contact for this program element

For further information about this program please contact:

Rob R. Landis  
GHAPS Program Executive  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-2442  
Email: rob.r.landis@nasa.gov

Kelly E. Fast  
GHAPS Program Scientist  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-0768  
Email: kelly.e.fast@nasa.gov
NOTICE: Amended on December 14, 2017. This amendment removes the restriction on the use of data generated by spacecraft, other than InSight, that were not publically available 30 days prior to the InSight PSP submission date. It is now the obligation of the proposer to clearly demonstrate that the risk of failure to acquire such data is sufficiently low and is offset by the benefit(s) of the proposed task(s). Removal of this restriction allows for a more diverse set of studies to be proposed including - but not limited to - proposals involving concurrent, or simultaneous measurements to be made by InSight and other mission(s). This amendment additionally clarifies the requirements on members of non-InSight Flight Teams who propose to this call (see Section 2.3). Lastly, this amendment adds a section on award termination circumstances (see Section 3.5). New text is in bold and deleted text is struck through. Mandatory NOIs are due January 18, 2018 and proposals are due February 22, 2018.

Amended on November 20, 2017. This program element requires Notices of Intent (NOI) and proposals that are not preceded by an NOI may be returned without review. No feedback will be provided in response to the NOI. This program will not take Step-1 proposals. Additionally, this program element does not collect a data management plan via the NSPIRES cover pages, as some aspects of data archiving must be included in the body of the proposal and will be evaluated as part of merit (see Section 3.3, Evaluation Criteria). Proposers from non-U.S. institutions should refer to Section 2.4 this program element.

1. Scope of Program

1.1 Introduction

The Interior Exploration using Seismic Investigations Geodesy and Heat Transport (InSight) mission (http://insight.jpl.nasa.gov/) is expected to launch in May 2018. The mission’s overall science goals are to understand the formation and evolution of terrestrial planets through investigation of the interior structure and processes of Mars, and to determine the present level of tectonic activity and impact flux on Mars. To accomplish these objectives, a tightly focused payload has been assembled consisting of two instruments, a geodesy experiment, and supporting payload elements. The instruments are the Seismic Experiment for Interior Structure (SEIS) and the Heat Flow and Physical Properties Package (HP3). The Rotation and Interior Structure Experiment (RISE) uses the spacecraft’s X-band communication system and is, thus, not considered an instrument. Additional payload elements support these investigations: the Instrument Deployment System (IDS) which consists of the Instrument Deployment Arm (IDA), the Instrument Deployment Camera (IDC) and the Instrument Context Camera.
(ICC), the radiometer (RAD), which provides surface brightness temperature in support of HP3; and the Auxiliary Payload Sensor Suite (APSS), consisting of the Pressure Sensor (PS), the Temperature and Winds for InSight (TWINS), and the InSight Fluxgate (IFG) Magnetometer. The InSight mission uses the Phoenix lander design to bring these instruments to the Martian surface for a prime mission duration of 730 days (710 sols, just over one Mars year) and an expected science return of over 30 GB of data.

This program element solicits investigations for the InSight Participating Scientist Program (PSP). The objectives of the program are to: a) enhance the scientific return from the InSight mission by broadening participation in the mission, and b) augment the existing InSight science team to include new members conducting investigations that broaden and/or complement the funded InSight Principal Investigator (PI)-led investigations. The goal of the InSight PSP is to maximize the contribution of InSight to the future exploration and scientific understanding of Mars and the other terrestrial-type planets. Because the intention is to enhance and broaden the scientific return and augment the existing science team, investigations submitted by the InSight Principal Investigator (PI), Deputy Principal Investigator (DPI) and Co-Investigators (Co-Is) will not be considered.

Selected Participating Scientists (PSs) will become full members of the InSight science team and will work in a collaborative manner with other InSight science team members after selection. PSs will have the same rights and be required to fulfill many of the same responsibilities as those of current science team Co-Investigators.

All InSight team members, including InSight PSs, will be bound by the InSight "Rules of the Road" document that describes the data access rights, data-sharing responsibilities, and data release policies of the InSight science team. All other personnel in the selected InSight PSP proposal teams, including proposal Co-Is, will be subject to the InSight "Rules of the Road." The current version of the InSight "Rules of the Road" document is available in the Proposal Information Package (see Section 1.4). The selected PS activities and analyses will be coordinated with the InSight science team (including the PI, Deputy PI, Co-I's) and the NASA Program Scientist, to achieve the essential scientific objectives of their PS investigation, within the scope and resources of the InSight project, and to ensure dissemination of the results of the investigation to the scientific community and the general public. In the course of carrying out an InSight PSP scientific investigation, if a PS has to generate higher-level instrument products that the InSight project is not already planning to produce and archive, the Participating Scientist proposal must indicate that the PS will archive these products in the Planetary Data System (PDS). The "InSight Archive Generation, Validation, and Transfer Plan" is available in the Proposal Information Package (see Section 1.4).

Before InSight lands on Mars, each Participating Scientist will:

- Become thoroughly familiar with the spacecraft, its instruments, and investigations.
- Participate in InSight science team meetings.
- Participate, as appropriate, in InSight science team working groups.
- Prepare to analyze data, developing techniques or algorithms if necessary.
- Prepare to archive any data products that will be generated by the PS investigations which are not currently in the InSight Archive Generation, Validation, and Transfer Plan, including participating in the InSight Data Archive Working Group.
- Work with the InSight project to secure any needed clearances for Jet Propulsion Laboratory (JPL) physical access, JPL computer access, JPL software licenses, etc.
- Support Education and Communications efforts of the InSight mission.

During the mission and following the mission’s end, each PS will:
- Participate in InSight science team or working group team meetings.
- Perform data analysis to support operations.
- Perform analyses necessary to complete the proposed scientific investigation.
- Participate in the InSight Data Archive Working Group, as appropriate:
  - Prepare, validate and deliver data products, documentation and other pertinent investigation information for which they are responsible in PDS format to the PDS
- Publish the results in peer-reviewed science journals in accordance with NASA policies, as well as InSight project data release, publication policies and "Rules of the Road."
- Support Education and Communications efforts of the InSight Mission.

1.2 Types of Investigations

As stated previously, InSight has two primary science goals. From these goals, InSight focuses on six science objectives or investigations:

Goal A) Understand the formation and evolution of terrestrial planets through investigation of the interior structure and processes of Mars.
  a. Determine the size, composition and physical state (liquid or solid) of the core
  b. Determine the thickness and structure of the crust
  c. Determine the thickness and structure of the mantle
  d. Determine the thermal state of the interior

Goal B) Determine the present level of tectonic activity and impact flux on Mars.
  a. Measure the magnitude, rate and geographical distribution of internal seismic activity
  b. Measure the rate of meteorite impacts on the surface

Participating Scientists may propose any investigation that expands on or enhances the science return of the InSight project; investigations are not limited to the six listed above. The term "expands on" is defined here as the pursuit of investigations in areas of Mars or planetary science that can be addressed by data acquired by any of the InSight payload elements, including, but not limited to, an improved understanding of the interior structure and evolution of Mars and the terrestrial-type planets. Thus, for example, the use of InSight data to constrain the geochemistry of the Martian interior, or to better understand Martian meteorology, would be valid and welcome Participating
Scientist proposals. The term "enhances" is defined here as the use of InSight data, particularly environmental information, to improve the quality and interpretation of the primary instruments’ data or to enhance operability of the spacecraft. Thus, for example, the use of InSight meteorological data to more effectively remove meteorological noise from the seismic signal would be a valid and welcome proposal. Proposals for investigations that enhance InSight objectives are expected to include scientific investigations which do not necessarily need to address the two InSight goals stated above.

Those proposals that expand on or enhance InSight objectives are viewed as bringing added value to the InSight project and are of particular interest to NASA. In this vein, proposals that focus on extending knowledge gained by InSight to other terrestrial-type planets are also of particular interest to NASA.

Consistent with the goals of the InSight PSP laid out above, NASA is soliciting a broad range of expertise and investigations. These include, but are not limited to, theoretical investigations, numerical modeling of physical or chemical processes, and experimental/laboratory investigations; however, field analog studies are not supported by this program element. Proposed investigations may involve a combination of these activities. The spectrum of planetary sciences funded by this call includes, but is not limited to, the following fields: geology, geomorphology, geochemistry, geophysics, atmospheric science and solar wind environment history/physics.

Although NASA is open to considering any outstanding proposals that meet these criteria, there are a few types of investigations that are particularly desired ("Special Investigations") through this NRA:

1) Investigations that document atmospheric opacity (\(\tau\)) using the cameras onboard InSight: In addition to the meteorology instruments on the lander, InSight carries two cameras, the ICC and IDC; color versions of the Hazcams (Hazard Cameras) and Navcams (Navigation Cameras) on the Mars Exploration Rover and Mars Science Laboratory missions. The InSight project requires regular measurements of \(\tau\) for energy management and prediction, and to allow estimates of dust accumulation on the solar panels during operations. Investigations that derive \(\tau\) from the ICC and IDC are sought for engineering and to provide a record of dust in the modern climate and interannual variations. This investigation would need to provide automated algorithms to determine \(\tau\) from the ICC and IDC images and supply that information to the engineering team in near real time after the images are received on Earth. The method to derive \(\tau\) must be validated against existing surface measurements of \(\tau\) on Mars. Such investigations, which may endeavor to better understand the role of atmospheric dust in surface meteorology, regional and global climate, and comparisons with orbital estimates and their interannual variability are welcome.

2) Investigations that help determine the location of meteoritic impacts detected by SEIS: SEIS can readily distinguish meteoritic impacts on Mars from marsquakes; however, identifying impact locations (in orbital images) that are detected by SEIS adds important information such as impact energy (from diameter and density of single impacts or clusters) and subsurface structure between the impact point and the lander. Initial work suggests SEIS could initially determine the impact azimuth to
~20° and distance to about 25% to aid in targeting orbital images. Investigations can propose to locate impacts via before and after orbital images or some other method. The InSight project is working with the Mars Reconnaissance Orbiter project to coordinate the acquisition of images in locations predicted by SEIS. The selected investigator(s) would need to fill the role of primary detector of impact locations and would work with the SEIS team to help improve future predictions from earlier imaged craters. Impacts detected can help determine the current impact rate, and help calibrate crater age isochrons for small diameter craters.

3) Investigations that characterize the geology of the InSight landing site from surface images: Previous missions have established the basic geologic evolution of the landing site by identifying the geologic materials present, the terrains observed, and quantifying their areal coverage. Of particular need are scientists that can contribute to the Instrument Site Selection Working Group (ISSWG), which will help select the locations where the SEIS and HP3 instruments will be placed in the workspace that can be reached by the Instrument Deployment Arm. The ISSWG will operate immediately after landing and will investigate the surface terrains, aeolian bedforms, rocks and soils and their physical properties to find locations that meet the instrument deployment requirements (smooth, flat, rock-free locations that are load-bearing). To accomplish this, a number of methods will be used including surface images and radiometer estimates of thermal inertia, and interpretations that infer soil cohesion and grain size after removing the rocky component. Because InSight is a long-lived lander, comparisons of aeolian features and possible changes with time can be related to lander meteorology.

4) Investigations that enhance the science return from the Insight Fluxgate Magnetometer (IFG). These can include but are not limited to:
   a. Studies of the propagation of time-varying magnetic fields from satellite altitudes to the surface and
   b. Studies of electrical conductivity structure of the Martian crust and mantle.

5) Investigations of the subsurface thermal and physical environment. These studies can include but are not limited to:
   a. Experimental studies in soil mechanics to complement theoretical studies, in particular compaction and thermal properties
   b. Experimental work on thermal transport properties in soils and porous media
   c. Modeling of the mantle and crustal temperature fields and thermal properties
   d. Multiscale (lander scale, local ~kilometer scale, regional 100s of kilometer scale) thermal analysis. Such studies help to assess the effects of factors such as topography, albedo, shadows, and local/regional subsurface variations in conductivity on the local heat flow, allowing a better estimate of the global heat flow average.

6) Investigations utilizing the many sensors on InSight to investigate atmospheric phenomena and surface-atmosphere interactions: These sensors include the APSS environmental sensors supporting the SEIS experiment, TWINS and Pressure Sensor; however, data from the IDC and ICC cameras, the Radiometer and even possibly SEIS, might be employed in these investigations. Although atmospheric science is not a top-level goal for InSight, the suite of sensors it brings to the surface
has the potential to make significant contributions to areas including, but not restricted to, Martian weather, atmospheric boundary layer processes, infrasound, and dust devils.

7) Seismological investigations that complement the existing science team. Seismology is a broad field, and InSight welcomes investigations that augment those already planned by the science team. Such investigations include, but are not limited to:
   a. Body wave analysis for crustal and upper mantle structure
   b. Single-station seismic event location techniques
   c. Shallow subsurface layer characterization using short period seismic analysis
   d. Infrasound and atmospheric shock waves processes
   e. Seismic atmospheric/ground coupling (e.g., noise analysis for subsurface structure, seismic signals from atmospheric transient events)
   f. Mars seismic source investigations

8) Interdisciplinary investigations that address the InSight mission’s goal of understanding the formation, evolution and current structure of Mars and its deep interior: These include, but are not limited to:
   a. High pressure mineralogy/equations of state for Mars
   b. Seismotectonics and lithosphere stresses
   c. Geophysical properties of shallow crustal layers
   d. Models of Martian magma ocean formation to address interior compositional layering
   e. Comparative studies of planetary structure with those of Earth, Moon, Venus and Mercury

Proposed investigations involving data other than InSight data, such as data from other Mars missions, will be considered and may potentially bring added value to the data generated by InSight. Most importantly, however, such proposals must make use of a significant amount of InSight fundamental or derived data and show how the InSight data, in combination with other Mars or planetary science data, contributes significantly to Mars or planetary sciences (see Section 2.3.2, Non-InSight Planetary Flight Data).

1.3 Operational Roles and InSight Working Groups

1.3.1 *Instrument Deployment and Participating Scientists*

Of particular need for InSight (see Section 1.2, Special Investigation #2), are scientists that can contribute to the Instrument Site Selection Working Group (ISSWG), which will help select the locations for deployment of the SEIS and HP$^3$ instruments within the Martian surface workspace that can be reached by the arm. The ISSWG is planned to be operative for up to two months after landing. Participating Scientists with relevant expertise are encouraged to propose to join the ISSWG. Proposers who wish to assist in this operational role should indicate this explicitly in the proposal and abstract, and should answer in the affirmative in the NSPIRES program specific questions during proposal submission. Such PSs should plan on spending 2 months at the Jet Propulsion Laboratory in Pasadena, California and be on hand from before landing until final deployment of SEIS and HP$^3$. These proposers must include in their budgets sufficient funds to cover their stay at JPL during deployment.
1.3.2 Working Groups, Seismic Services and Participating Scientists

Participating Scientists will be expected to participate in one or more InSight Science Theme Groups (STGs). These groups are organized around scientific themes, rather than instruments, and provide both the primary framework for scientific interactions within the InSight Science Team and the mechanism for interactions between science and operations. In their operational role, each STG will supply a representative to the Science Operations Working Group (SOWG) to support the weekly spacecraft command sequencing cycle. This STG representative will work with the Long-Term Planner (LTP) and SOWG Chair to incorporate activities relevant to the STG objectives. Note that the level of science sequence planning activity is much lower than previous Mars lander missions, as the InSight payload is largely non-interactive (i.e., for the most part instruments are turned on and left to operate; there are very few distinct commandable modes). However, there may be limited opportunities for IDA and IDC science activities, and the science team has the opportunity to request downlink of specific high-resolution data (temporarily stored on the lander for about a month) that would otherwise be overwritten. (See the Section 1.4 Proposal Information Package for a detailed description of the science data downlink strategy). Due to the nature of their investigations, some STGs will have more operational involvement than others.

The following is a list of the current InSight Science Theme Groups:

- Deep Interior Theme Group: Organize efforts with respect to characterizing the deep interior of Mars. Support the primary InSight science goal through tool preparation, promotion of intra-team collaboration, operations support, and science analysis; coordinate efforts among data sets and groups to efficiently achieve mission science goals.

- Crust Theme Group: Provide scientific focus on the aspects of InSight science related to the crust of Mars. Major tasks include: Determine the crustal thickness at the landing site and its relation to global crustal thickness models; develop porosity/density-depth models from seismic velocities; investigate layering of the crust from seismic data; model the abundance of magnetic carriers in the crust near the landing site; investigate the relation of crustal magnetic field at landing site to global magnetic field models.

- Near-Surface Properties Theme Group: Organize efforts with respect to characterizing the near-surface (upper 10s of meters of broken up regolith, including the surface) physical properties at the InSight landing site, particularly those with appreciable effects on the primary seismic and heat flow measurements. Quantities of interest include: emissivity, albedo, thermal inertia, thermal conductivity, density, cohesion, grain size distribution, internal friction angle, S- and P-wave velocities, attenuation factor (Q), elastic moduli, Poisson’s ratio, depth to hard rock below regolith layer.

- Impacts Theme Group: Coordinate all aspects concerning the modeling of impact-generated seismic signals, localization of impact sources, detection of meteors, and modeling of meteor infrasound signals. Major tasks include: Impact detection and localization from seismic data; impact localization and characterization from orbital imagery; seismic source and waveform modeling of
impact events; atmospheric acoustic source and shock wave modeling; modeling of theoretical impact rates; and meteor detection from nighttime campaigns.

- Geology Theme Group: Characterize the geology of the InSight landing site, and provide ground truth for orbital remote sensing data. Major tasks include: establish the basic geologic evolution of the local region; determine the location of the lander in cartographic space; identify the geologic materials present and quantify their areal coverage; coordinate imaging campaigns; collaborate with the Near-Surface Properties Theme Group to investigate the geological aspects of the local regolith.

- Atmosphere Theme Group: Support atmospheres-related InSight science goals through tool preparation, operations support, and science analysis; coordinate efforts among data sets and groups to efficiently achieve atmospheric science goals; identify atmospheric phenomena and acquire high-resolution data to study them.

In addition to the STGs there are two "Seismic Services" that provide products for instrument operations, science analysis and archiving. Although their charters are primarily oriented toward producing products, much of the work done within the services is scientific in nature, and groups from the services will constitute key subgroups of several STGs. The two Services are:

- Mars Quake Service: Conducts analyses of SEIS data to provide the locations and source characteristics of seismic events. Major tasks include: Provide a weekly list of identified seismic events for use in science operational requests for high-resolution data from the lander; determine location, timing, magnitude, and other source characteristics for each recognized seismic event, either tectonic or impact; and maintain a Mars seismic event catalog for eventual archiving in the PDS.

- Mars Structure Service: Conducts analyses of SEIS data to provide seismic structure models for the interior of Mars. Major tasks include: Analyze seismic data, including phase arrival times, surface waves, normal modes, receiver functions, noise spectral and correlation analyses, and other methods as appropriate to develop and refine seismic structure models of the interior of Mars on local, regional and global scales; provide interior seismic structure models to the STGs; and provide updates of global seismic models to the Mars Quake Service on a periodic basis to iteratively improve event locations and, in turn, seismic structure models.

Proposers who wish to be part of one or more of the InSight Science Theme Groups or Services should indicate this explicitly in the proposal and abstract and should check the appropriate boxes in the NSPIRES program-specific questions during proposal submission. Although application to this program does not require participation in a STG or Service, proposers are encouraged to consider proposing to be active participants in one or more STG or Service.

Members of STGs or Services, other than the ISSWG, are not required to be collocated at JPL during operations. STG and Service members are expected to perform their duties via weekly telecoms or web meetings. It is estimated that operational STG/Service duties will consume on average approximately 3 hours per week.
Proposers should include their WG time commitments within their proposed FTE contributions in their budgets.

1.4 Proposal Information Package

The Proposal Information Package (PIP) for the InSight PS Program provides more details about the spacecraft, its science payload and other useful information about the InSight mission and the InSight science team (e.g., Rules of the Road). The InSight PIP is available on the NSPIRES index page for this program element. At this time, the project can provide only limited information about the actual capability and calibration of other mission hardware, beyond what is in the Proposal Information Package.

2. Proposal Submission

A Notice of Intent (NOI) is mandatory for this program element. Any proposal that is not preceded by an NOI may be returned without review. Also, this program element will not collect a data management plan on the NSPIRES cover pages, since data archiving is evaluated as part of merit and must be included in the body of the proposal. Moreover, if peer reviewed publications result from these awards the data behind figures and tables must be available electronically at the time of publication, ideally in supplementary material with the article. See also Section II (c) of the ROSES Summary of Solicitation.

2.1 Proposal Guidelines

All proposals should contain the elements described in Table 1 of the ROSES Summary of Solicitation and Section 2 of the NASA Guidebook for Proposers. Where ROSES differs from the Guidebook ROSES takes precedence (see for example Section I(g) of the ROSES Summary of Solicitation).

Only the principal investigator of each proposal selected through this program will be designated as a Participating Scientist on the InSight mission; any Co-Investigators (Co-Is) or collaborators on the proposal will be designated as InSight Science Team collaborators according to the InSight Rules of the Road. The Participating Scientist principal investigator is expected to be the primary, if not sole, individual contributing to the proposed science and all proposals should indicate a PI commitment level in each of the award years (AY) AY 2018, AY 2019, AY 2020 and AY 2021. Although not encouraged, proposals may include funded Co-Investigators and/or unfunded collaborators only if they are critical to the proposed science investigation; however, participation of graduate students and postdoctoral researchers is encouraged in all proposals. Co-Is and collaborators should also indicate their commitment level in each of the award years AY 2018 through AY 2021. Students, and postdoctoral researchers must be working under the supervision of the PI during the mission. Co-Investigators and collaborators should provide focused contributions to specific tasks and may be from any institution.

Proposals should identify scientific ideas and unique theoretical and analytical capabilities that best meet the scientific objective of the InSight mission, as described in this program element. Key projected milestones, accomplishments, and deliverables during each year of the proposed investigation should be identified.
2.2 Operational Roles
PIs who propose to participate on the ISSWG should be prepared to obtain the necessary pre-landing training for this operational role (see the Proposal Information Package on the NSPIRES web site for a description of ISSWG activities and the approximate schedule of Operational Readiness Tests). Proposals must include two trips in their travel budget to participate in ORTs. For each ORT, the proposer should plan to spend a week at JPL. The requirement for PS members of the ISSWG to be co-located with the science team in Pasadena, CA, for 2 months after landing is noted in Section 1.3. If the proposer will be involved in data analysis only or in operations only through the STGs/Services, then there is no ORT or ISSWG participation required.

2.3 Sources of Information and Data Used in the Proposal [This section was updated December 14, 2017.]

2.3.1 InSight Data
All information and data used in the submitted proposal pertaining to InSight, the InSight science instruments (or testbeds or engineering models belonging to the InSight team), and InSight science data (from instruments, testbeds, or engineering models belonging to the InSight instrument teams) must be available in the public domain (which includes the information available through the NSPIRES web site), or the proposal will not be considered for selection. "Available in the public domain" is herein defined as information that can be found in the published literature, at the InSight website (http://insight.jpl.nasa.gov/), or through the NSPIRES web site. Such information should be referenced in the proposal accordingly.

2.3.1.1 Pre-Release InSight Data
Please note, that Because selected PIs will be Participating Scientists, and thus full members part of the InSight Science Team, proposers selected as Participating Scientists will have access to InSight data prior to its release to the public domain and will be able to use such data in research funded under this program.

2.3.2 Non-InSight Planetary Flight (NIPF) Data
Proposals may make use of other planetary spacecraft flight data in addition to InSight generated data. Such proposals include – but are not limited to - proposals involving concurrent measurements between InSight and other mission(s): those that are acquired routinely or on a predetermined schedule and do not require pre-arrangements with the flight team. Such proposals, however, do not include collaborative measurements between InSight and other mission(s): those that require pre-arrangements with the flight team(s) in order for these measurement to be acquired. Consequently, proposers to this call are prohibited from appending letters of agreement or endorsement from flight team member(s). This PSP will only consider Non-InSight Planetary Flight (NIPF) data that are available from the Planetary Data System (PDS) (http://pds.nasa.gov) or an equivalent publicly accessible archive. Such proposals must make use of a significant amount of InSight fundamental or derived data and show how the InSight data, in combination with NIPF data, contributes significantly to Mars or planetary sciences. Preferably, NIPF data to
be used in proposed investigations must should be available in the PDS, or equivalent publicly accessible archive, at least 30 days prior to the submission due date for InSight PSP proposals ("30-day prior standard"). NIPF data that are not available from the PDS, or equivalent publicly accessible archive, however, may not be proposed for use in this PSP. Proposals that make use of NIPF data that do not comply with the "30-day prior standard" will be evaluated in light of the risk that such data may not ultimately be collected or otherwise available to the proposer on the proposed timeline outlined in the proposal. It is the obligation of the proposer to clearly demonstrate that the risk of failure to acquire NIPF data that does not comply with the "30-day prior standard" is sufficiently low and is offset by the benefit(s) of the proposed task(s).

2.3.2.1 Demonstrating that Future NIPF Data will be Acquired

A proposal using NIPF data to be acquired in the future should optimally demonstrate that the NIPF data to be generated have either an acquisition plan that has been announced publically or are generated on a routine or predetermined schedule. For non-InSight missions, this can be accomplished by reference to official materials found on NASA, ESA or other international space agency mission partner websites, the official website of the particular mission(s), or publically available research papers involving the specific missions team(s). Additionally, demonstration of the existence, in the PDS or other equivalent archive, of routinely collected data and/or data collected on a regular schedule can also serve as evidence that the data to be collected have a reasonable chance of being acquired. The burden is on the proposer to demonstrate that the data required by the proposed investigation have a reasonable chance of being collected.

Proposers using NIPF data that have not yet been acquired should include a risk mitigation plan outlining those steps that will be taken by the PI to continue the proposed research, should the NIPF data not be collected (e.g., due to spacecraft, or instrument disability or failure). If no such risk mitigation strategy is feasible then this should be articulated in the risk mitigation plan.

2.3.2.24 Flight Team Member Requirements

Members of current Non-InSight spacecraft flight teams who wish to apply to this program must scrupulously restrict the demonstration of the acquisition of future NIPF data in their proposals to only publically available sources such as the ones listed in Section 2.3.2.1. Such proposals may not present internal flight team documents, data or agreements as evidence of future spacecraft collection plans. who make use of NIPF data must clearly demonstrate that their proposed investigation will use only released and publicly available NIPF data. Flight team members must scrupulously comply with the 30 days prior to submission rule (above). Additionally, proposals from Non-InSight planetary flight team members must rigorously demonstrate how that the proposed InSight PSP research does not overlap – and is not redundant with – data analysis duties/responsibilities already funded within their
respective missions. This requirement applies to all members of the proposed InSight PSP team.

2.3.2.3 Returned NIPF Data

Once proposals have been awarded, investigators may freely augment the proposed NIPF data with data deposited in the PDS, or equivalent publicly accessible archive, subsequent to 30 days prior to the InSight PSP submission date. **Likewise, once awarded, InSight Participating Scientists are free to advocate within the InSight mission team and other mission team(s) for the collection of collaborative mission data to augment the data they propose to use in their research.**

2.3.2.4 Non-Certified NIPF Data

Whether from the PDS or another source, if NIPF data to be analyzed are not certified or otherwise have issues that might represent an obstacle to analysis, the obligation is on the proposer to clearly demonstrate in the proposal that such potential difficulties can be overcome. Likewise, this requirement applies to proposals that make use of planetary flight data from international missions that do not have their data deposited in the PDS.

2.4 Non-U.S. Proposals

Proposals will be considered from non-U.S. institutions. Proposals are particularly encouraged from institutions located in InSight partner countries (United Kingdom, Spain, Switzerland and Germany). Proposers from institutions in France (an InSight partner country) should not propose to this call; instead, they should propose to the parallel CNES program for French Participating Scientists. Proposals from scientists at non-U.S. institutions will be considered on a no-exchange-of-funds basis. Proposals from non-U.S. institutions will be reviewed to the same standards as those from U.S. institutions and selected solely by NASA.

Proposers from non-U.S. institutions should refer to the "NASA Foreign PI Instructions" on the NSPIRES page for this program element. Proposals from non-U.S. institutions must include a letter of endorsement and financial commitment from the agency or institution that will be providing support for the investigation.

Proposals from non-U.S. institutions must contain all of the required sections outlined Table 1 of the ROSES Summary of Solicitation, including the required table of work effort for all proposal team members. However, Proposals from non-U.S. institutions need not attach the separate "Total Budget" PDF.

3. Programmatic Information

3.1 Duration of Award and Funding

It is expected that selected investigators will be funded beginning approximately in June 2018, through May 2022. This start date is contingent on funding availability. Annual award renewal is contingent upon availability of funds and annual assessment of performance and relevance of the research effort to the InSight mission and program requirements. It is expected that most investigators will propose for the maximum of four years.
3.2 Budget Information

The budget must follow the guidelines described in the NASA Guidebook for Proposers, and the budget must include funding for any training and data analysis to support the proposed science investigation. Budgets should include salary, all page charges for publication and reprints, attendance at conferences, all travel, and other necessary expenses.

The proposal budgets should include adequate funds for the PI to attend three InSight Science team meetings per year for award years (AY) AY 2018 through AY 2021. At least one science team meeting per year will be held in Europe. Additionally, those PIs proposing to participate in the ISSWG during instrument deployment must build into their budgets adequate funds to be collocated at JPL for 2 months starting right before instrument deployment.

The expected total program budget and number of awards are indicated in Section 4 (Summary of Key Information).

3.3 Evaluation Criteria

As stated in Section VI.(a) of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers, the evaluation criteria are intrinsic merit, relevance, and cost realism/reasonableness. In addition to the factors for each criterion given there, this program specifically includes the following factors:

- Intrinsic merit will additionally include:
  - Technical consideration of the capabilities of the InSight spacecraft to reasonably accomplish the proposed investigation
  - Merit of proposed involvement in working groups (ISSWG and STGs/Services)
  - Merit of proposed involvement in improving existing data products
  - The value added to the science mission and the extent to which the proposed investigation complements, expands on, or enhances the currently planned science investigations. (See Section 1.2 for definitions of "expands on" and "enhances.")

- Relevance is defined as the extent to which the proposal meets the objectives of the InSight Participating Scientist Program in Section 1.

Although left up to the Proposer, it may be advantageous to call out these bulleted factors in separate sections within the proposal.

Programmatic factors that may affect selection of proposals include the degree to which the proposed work broadens participation in the mission and the ability of the mission to accommodate the proposed work in light of spacecraft and instrument capabilities, schedule, and resources.

3.4 Progress Reports and Deliverables

After selection, each Participating Scientist shall provide an Implementation Plan to the InSight Program Scientist, including a schedule for deliverables (software, data products, reports, plans) and details regarding plans for data analysis, computing facilities, Ground Data System support, software development, data archiving, and
participation in Education and Communication activities. This information will be shared with the InSight Project for the purpose of coordinating team activities. The Participating Scientist shall provide annual reports to the InSight Principle Investigator and the NASA Headquarters InSight Program Scientist that include: accomplishments over the past year, plans for the next year, issues, concerns, schedule performance, financial performance, recovery plans, and status of publications and other deliverables.

3.5 Termination of Award  [This section was added December 14, 2017]

Any alteration of the InSight mission, or any of its instruments, that renders the Participating Scientist unable to accomplish all of the proposed science tasks (e.g, spacecraft or instrument failure) may be cause for award termination. In such a case, NASA reserves the right to terminate the award after a suitable closeout period is negotiated with the PI. Similarly, NASA may also terminate an award that is based in whole or in part on NIPF data to be collected in the future (see Section 2.3.2) should the NIPF spacecraft or instrument(s) be unable to collect the proposed NIPF data. In both cases, NASA may alternatively choose to engage the PI to conduct a modified or altered research program, for all or part of the remainder of the award period.

4. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected program budget for first year of new awards</th>
<th>~$1.5M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new awards to US PIs pending adequate proposals of merit</td>
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</tr>
<tr>
<td>Maximum duration of awards</td>
<td>4 years</td>
</tr>
<tr>
<td>Due date for Notice of Intent to propose (NOI)</td>
<td>January 18, 2018</td>
</tr>
<tr>
<td>Due date for proposals</td>
<td>February 22, 2018</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>June 2018</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposal</td>
<td>15 pp; see also Table 1 of the ROSES Summary of Solicitation and Section 3 of the NASA Guidebook for Proposers</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the planetary science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>See Section I(g) Order of Precedence and Table 1 of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and Chapter 3 of the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposal via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
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<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
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</tr>
</tbody>
</table>
| NASA point of contact concerning this program          | Robert A. Fogel  
InSight Program Scientist  
Planetary Science Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-2289  
Email: rfogel@nasa.gov |
APPENDIX D. ASTROPHYSICS RESEARCH PROGRAM

D.1 ASTROPHYSICS RESEARCH PROGRAM OVERVIEW

1. Introduction

The objectives of research solicited in program elements described in Program elements D.2 through D.13 of this NASA Research Announcement (NRA) are focused on achieving the goals of the Science Mission Directorate’s Astrophysics Research Program, as defined in the NASA Science Plan (available at http://science.nasa.gov/about-us/science-strategy). Proposers to the elements described in Appendix D are encouraged to read this NASA Science Plan to gauge the relevance of their research to the Astrophysics Research Program.

The NASA Guidebook for Proposers and the ROSES Summary of Solicitation (Section IV) provide clear and specific requirements for the format of proposals submitted in response to this solicitation: page limits, acceptable font sizes, line spacing, margins, etc. See also Table 1 of the ROSES Summary of Solicitation. Some of the program elements listed below also include formatting requirements. These requirements have been developed to ensure a level playing field for all proposers. The Astrophysics Division takes these requirements seriously, and proposals found to violate them will be penalized, even to the extent of not being evaluated or considered for funding. It is the responsibility of the proposer to ensure that a submission complies with all formatting requirements.

Most proposals to ROSES will require a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed (e.g., instrument development proposals, see Sections 3, 6, and 7, below). This requirement will be satisfied by responding to the compulsory NSPIRES cover page question about the DMP. It is expected that the majority of proposals will simply state that the proposer will meet the mandatory minimum requirement by making the data behind figures and tables available electronically at the time of publication, ideally in supplementary material with the article. More information on the data management plan is available in the SARA DMP FAQs.

Proposers are reminded that it is the PDF version of their proposal in NSPIRES that will be judged for compliance. In rare cases, cross-platform translation of PDF documents can alter the formatting of a document. To ensure that they still conform to all formatting requirements, proposers are strongly urged to download copies of all documents after upload to NSPIRES.

The program elements included as of the release date of this ROSES NRA are described below. Abstracts of previously selected investigations may be found online at http://nspires.nasaprs.com/ by choosing "Solicitations" followed by "Closed/Past Selected", searching on the name or abbreviation of the program (e.g., ADAP), and downloading the selections PDF file from the home page of that Program Element.
2. Astrophysics Data Analysis

The Astrophysics Data Analysis Program (ADAP; Program element D.2) supports research with a primary emphasis on the analysis of archival data from current and past NASA space astrophysics missions. The magnitude and scope of the archival data from those missions enables science that transcends traditional wavelength regimes and allows researchers to answer questions that would be difficult, if not impossible, to address through an individual observing program. The program also supports the analysis of data from some approved Guest Observer (GO) programs using Spitzer, even if those observations have yet to be executed, or the data are still within their proprietary period.

3. Astrophysics Research and Analysis

The Astrophysics Research and Analysis program (APRA; Program element D.3) supports suborbital and suborbital-class investigations, development of detectors and supporting technology, laboratory astrophysics, and limited ground based observing. Basic research proposals in these areas are solicited for investigations that are relevant to NASA’s programs in astronomy and astrophysics, including the entire range of photons, gravitational waves, and particle astrophysics. The emphasis of this solicitation is on technologies and investigations that advance NASA astrophysics missions and goals. Projects devoted to technology development efforts (Detector Development and Supporting Technology categories) that do not generate data need not provide a data management plan and proposers may simply cite this statement in response to the NSPIRES cover page question in lieu of presenting a plan.

4. Astrophysics Theory

The Astrophysics Theory Program (ATP; Program element D.4) supports theoretical investigations or modeling of the astrophysical phenomena targeted by past, current, or future NASA astrophysics space missions. Laboratory work related to NASA strategic goals in gravitation and fundamental physics is now supported in the Astrophysics Research and Analysis program (APRA; Program element D.3). Theoretical work pertaining to atomic and molecular astrophysics and other topics directly related to Laboratory Astrophysics should also be proposed to APRA. Beginning in ROSES-2017, ATP proposals will be solicited on a biennial basis. ATP will be offered in ROSES-17 (this solicitation); ATP will not be offered in ROSES-2018 (next year).

5. Astrophysics Guest Investigators

Five program elements support science investigations that require and/or support new data obtained with currently operating NASA astrophysics space missions. Guest investigator programs are included for the Swift gamma-ray burst explorer (Program element D.5), the Fermi Gamma-ray Space Telescope (Program element D.6), the K2 mission with the Kepler spacecraft (Program element D.7), the nuclear spectroscopic telescope NuSTAR (Program element D.10), and the Transiting Exoplanet Survey Satellite (Program element D.11). Guest investigator programs for the Hubble Space Telescope (http://www.stsci.edu/hst/), the Chandra X-ray Observatory (http://cxc.harvard.edu/), Stratospheric Observatory for Infrared Astronomy (SOFIA)
(https://www.sofia.usra.edu/), and the Spitzer Space Telescope (http://www.spitzer.caltech.edu/) are solicited separately by the respective science centers of those missions. The future James Webb Space Telescope Guest Observer call for proposals will also be solicited by its science center (https://jwst.stsci.edu). Please note that D.7, the K2 Guest Observer program, uses a two-step proposal submission process. Please carefully read Section 7 of the K2 Program Element.

6. Strategic Astrophysics Technology

The Strategic Astrophysics Technology program (SAT; Program element D.8) supports focused development efforts for key technologies to the point at which they are ready to feed into major missions in the three science themes of the Astrophysics Division: Exoplanet Exploration, Cosmic Origins, and the Physics of the Cosmos. This program is specifically designed to address middle technology readiness level (TRL) "gaps" between levels 3 and 6: the maturation of technologies that have been established as feasible, but which are not yet sufficiently mature to incorporate into flight missions without introducing an unacceptable level of risk. NASA does not require a data management plan for proposals to SAT.

7. Nancy Grace Roman Technology Fellowship Program

The goals of the Nancy Grace Roman Technology Fellowship (RTF) program in Astrophysics are to provide early-career researchers the opportunity to develop the skills necessary to lead astrophysics flight instrument development projects, including suborbital investigations, in preparation to become principal investigators (PIs) of future astrophysics missions; to develop innovative technologies for space astrophysics that have the potential to enable major scientific breakthroughs; and to foster new talent by putting early-career instrument builders on a trajectory towards long-term positions.

The RTF program, as described in Program element D.9, now consists of two components with two different submission procedures. The first component is a one-page application from an eligible early-career individual to be named a Roman Technology Fellow. The application is submitted as part of a proposal submitted to the Astrophysics Research and Analysis (APRA) Program described in program element D.3 of this ROSES solicitation. The second component is the subsequent submission of a proposal for Fellowship Funding by a previously selected Roman Technology Fellow once that individual obtains a permanent or permanent-track position, in order to start a laboratory or develop a research group at the Fellow’s institution.

8. Exoplanet Research Program

The cross-division program on exoplanets is described in Program element E.3. Investigations related to the detection and characterization of planetary systems that are directly tied to the NASA strategic goal to search for Earth-like planets are of interest to the Astrophysics Division.
9. Habitable Worlds Program

The cross-division program on habitable planets is described in Program element E.4. The Astrophysics Division will consider supporting investigations that are focused upon the characterization of potentially habitable exoplanets and their atmospheres in order to inform targeting and/or operational choices for current NASA Astrophysics missions and/or formulation data for future NASA Astrophysics observatories.

10. SOFIA Next Generation Instrumentation

The Stratospheric Observatory for Infrared Astronomy (SOFIA) consists of a German-built 2.7-meter (2.5-meter useable aperture) telescope mounted in a Boeing 747-SP aircraft supplied and modified by NASA. SOFIA observes primarily at mid- and far-infrared wavelengths with a suite of instruments that have a wide-range of imaging and spectroscopic capabilities. NASA expects to issue a call for proposals for the development of the next generation of instrumentation for SOFIA in the late summer/early fall of 2017, as described in Program element D.13.

11. Theoretical and Computational Astrophysics Networks

The Theoretical and Computational Astrophysics Networks (TCAN; Program element D.12) program supports coordinated efforts in fundamental theory and computational techniques in order to make groundbreaking advances in astrophysics and strengthen theoretical and computational astrophysics in the U.S. by uniting researchers in collaborative networks that cross institutional and geographical divides. NASA expects to issue a call for proposals for TCAN in ROSES-2017.
NOTICE: Amended on May 8, 2017. On the release of ROSES-2017 the proposal due date for this program was set on a Tuesday. Traditionally, the due date for this program has been on a Friday. To avoid any confusion, this amendment delays the proposal due date to Friday May 19, 2017.

1. Scope of Program

Over the years, NASA has invested heavily in the development and execution of an extensive array of space astrophysics missions. The magnitude and scope of the archival data from those missions enables science that transcends traditional wavelength regimes and allows researchers to answer questions that would be difficult, if not impossible, to address through an individual observing program. To capitalize on this invaluable asset and enhance the scientific return on NASA mission investments, the Astrophysics Data Analysis Program (ADAP) provides support for investigations whose focus is on the analysis of archival data from NASA space astrophysics missions.

1.1 Special Considerations for ADAP 2017 Proposers

- The budget justification of any proposal that involves the collection and analysis of new ground-based observations must include (1) an explicit statement that all costs associated with the ground-based portion of the project are less than 25% of the total cost of the investigation and (2) a separate budget breakout detailing the work effort and procurement costs (e.g., travel, equipment, consumables, etc.) associated with executing the ground-based observing component of the investigation (see Sec. 1.3.1). Proposals that do not satisfy this requirement will be penalized, even to the extent of being declined and not considered for funding, regardless of their intrinsic merit rating.

- Most proposals to ROSES will require a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed. For convenience, the NSPIRES proposal cover page now includes a mandatory text box for this purpose. It is expected that the majority of proposals will simply state that the proposer will meet the mandatory minimum requirement by making the data behind figures and tables available electronically at the time of publication, ideally in supplementary material with the article. More information on the data management plan is available in the SARA DMP FAQs. However, ADAP proposals which involve the development of new databases, data products, or data analysis tools must satisfy the more rigorous requirements described in Subsection 1.3.3. Those proposers should simply indicate that the proposal is in one of these categories and refer to the appropriate section of their proposal in the NSPIRES text box where it asks for a data management plan.
1.2 Research Objectives

The Astrophysics Data Analysis Program (ADAP) solicits research whose primary emphasis is the analysis of NASA space astrophysics data that are archived in the public domain at the time of proposal submission. Most of these data have undergone considerable reduction and refinement by way of calibrations and ordering and extensive data analysis software tools often exist for these data. Table 1 below provides a representative - but not exhaustive - list of NASA space astrophysics missions for which suitable archival data are publicly available.

Table 1. A Representative List of Projects/Missions that had a Significant NASA Contribution and may Represent the Primary Data Source for an ADAP 2017 Proposal.

<table>
<thead>
<tr>
<th>Mission/Project</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Satellite for Cosmology and Astrophysics (ASCA; formerly Astro-D)</td>
<td>Keck Interferometer (KI) and Palomar Testbed Interferometer (PTI) Archives</td>
</tr>
<tr>
<td>Beppo Satellite di Astronomia X (BeppoSAX)</td>
<td>Keck Observatory Archive (KOA)</td>
</tr>
<tr>
<td>Chandra X-Ray Observatory**</td>
<td>Kepler and K2</td>
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<tr>
<td>Compton Gamma-Ray Observatory (CGRO)</td>
<td>Midcourse Space Experiment (MSX)</td>
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<tr>
<td>Cosmic Background Explorer (COBE)</td>
<td>Nuclear Spectroscopic Telescope Array (NuSTAR)</td>
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<tr>
<td>Extreme Ultraviolet Explorer (EUVE)</td>
<td>Planck</td>
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<tr>
<td>Far Ultraviolet Spectroscopic Explorer (FUSE)</td>
<td>Roentgen Satellite (ROSAT)</td>
</tr>
<tr>
<td>Fermi Gamma Ray Space Telescope**</td>
<td>Rossi X-ray Timing Explorer (RXTE)</td>
</tr>
<tr>
<td>Galaxy Evolution Explorer (GALEX)</td>
<td>Spitzer Space Telescope*</td>
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<tr>
<td>Herschel Space Observatory</td>
<td>Stratospheric Observatory for Infrared Astronomy (SOFIA)</td>
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<tr>
<td>High Energy Astronomy Observatories (HEAO-1, 2, 3)</td>
<td>Submillimeter Wave Astronomical Satellite (SWAS)</td>
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<td>High Energy Transient Explorer 2 (HETE-2)</td>
<td>Suzaku (Astro E2)</td>
</tr>
<tr>
<td>Hubble Space Telescope**</td>
<td>Swift</td>
</tr>
<tr>
<td>Infrared Astronomical Satellite (IRAS)</td>
<td>Two Micron All Sky Survey (2MASS)</td>
</tr>
<tr>
<td>Infrared Space Observatory (ISO)</td>
<td>X-ray Multi-Mirror-Newton (XMM-Newton)</td>
</tr>
<tr>
<td>International Gamma-ray Astrophysics Laboratory (INTEGRAL)</td>
<td>Wide-field Infrared Survey Explorer (WISE)</td>
</tr>
<tr>
<td>International Ultraviolet Explorer (IUE)</td>
<td>Wilkinson Microwave Anisotropy Probe (WMAP).</td>
</tr>
<tr>
<td>Shuttle-based Astrophysical Observatories, including: Hopkins Ultraviolet Telescope (HUT), Wisconsin Ultraviolet Photopolarimetry Experiment (WUPPE), Ultraviolet Imaging Telescope (UIT), Broad-Band X-Ray Telescope (BBXRT), and ORFEUS-SPAS I and II</td>
<td></td>
</tr>
</tbody>
</table>
Researchers interested in analyzing datasets from missions or projects that are not included in Table 1 should contact the ADAP Program Officer before writing their proposal to confirm that their planned research program is compliant with this program element. Proposals found to be noncompliant will be declined and may be returned without review or adjectival rating.

Most NASA space astrophysics data may be found in one or more of the following NASA astrophysics data centers:

- Infrared Science Archive (IRSA) ([http://irsa.ipac.caltech.edu/](http://irsa.ipac.caltech.edu/));
- Keck Observatory Archive (KOA) ([http://nexsci.caltech.edu/archives/koa/](http://nexsci.caltech.edu/archives/koa/));
- NASA Exoplanet Archive ([http://exoplanetarchive.ipac.caltech.edu/](http://exoplanetarchive.ipac.caltech.edu/));
- NASA/IPAC Extragalactic Database (NED) ([http://nedwww.ipac.caltech.edu/](http://nedwww.ipac.caltech.edu/)); and
- Virtual Astronomical Observatory (VAO; [http://www.usvao.org/](http://www.usvao.org/)).

Prospective proposers should be aware that the Keck Observatory Archive (KOA) has recently been expanded and now includes data from 11 different instruments, including the High Resolution Echelle Spectrograph (HIRES), the Near InfraRed echelle SPECTrograph (NIRSPEC), and the Near Infrared Camera 2 (NIRC2). The data holdings for the three named instruments extend back to 1994 for HIRES, 1999 for NIRSPEC, and 2001 for NIRC2. Data archived in the KOA are allowable as the primary data source for an ADAP proposal.

Analyses of data from non-Astrophysics NASA space missions are eligible for ADAP support, provided the primary scientific goals of the investigation address NASA’s science goals for Astrophysics described in the agency’s 2014 [Science Plan](http://science.nasa.gov/2014scienceplan.pdf) (Section 4.4, p. 74-85) and the 2013 [Astrophysics Roadmap](http://science.nasa.gov/roadmap/2013/2013Roadmap.pdf). In any such case, the onus is on the proposer to clearly establish the relevance of the proposed work to NASA space astrophysics in their proposal.

### 1.3 Scope and Limitations of the Program

As stated in Section 1.2 above, the overarching requirement of the ADAP is that any NASA space astrophysics data involved in a proposed investigation must be available in the public domain at the time of the proposal submission deadline. As a direct consequence of this requirement, proposed investigations may not anticipate future public data releases. The scientific case for any proposed investigation must be based on - and executable with - data that are in the public domain at the time of the original proposal. Moreover, for proposals involving the analysis of higher-level data products...
from a NASA mission, it is NOT sufficient that the level-1 data are publicly available; it is the data products that will actually be used in the investigation that must be publicly available. Any proposal found to violate the capstone data availability requirement of the ADAP will be ruled noncompliant and will not be rated or considered for funding. The only exception to this requirement is described in Section 1.3.4 below.

Several other aspects/limitations of the ADAP are described in Sec. 1.3.1 – 1.3.6 below.

1.3.1 Use of theory, modeling, or other relevant data

In support of any ADAP proposal – but only as a secondary emphasis and only as needed to interpret and analyze NASA’s archival data – the proposed research may include the use and application of: (a) theoretical research or numerical modeling; (b) existing data from ground-based telescopes, suborbital platforms, or non-NASA space missions; and/or (c) available laboratory astrophysics data. However, in any such instance, the onus is on the proposer to clearly establish that the data and/or models in question are used only insofar as necessary to accomplish the analysis of approved NASA archival data and are not themselves the primary object of the investigation.

Requests for the support of new ground-based observations are acceptable under the ADAP provided that the requests are clearly described, that the observations are integral to the success of the proposed ADAP effort, and that the proposal includes an explicit statement that the collection and analysis of those data will account for no more than 25% of the total cost of the proposed investigation by NASA. The budget justification for any such proposals must include a summary of the work effort (in terms of personnel time commitment) and a breakout of the other direct costs, e.g., procurements, equipment, consumables, and travel, allocated to executing the ground-based observing component of the investigation. Furthermore, the degree to which the success of the proposed investigation depends on the collection of new ground-based observations, and the perceived likelihood that the proposer will be able to obtain the needed telescope time through the normal time allocation committee process, will be taken into consideration as part of the evaluation of the scientific merit of the proposal. Consequently, proposers should make clear in their proposal whether access to the necessary facilities has already been granted or, if not, provide a rationale for why such access can reasonably be expected.

1.3.2 Analysis of data solely from Hubble Space Telescope (HST), Chandra X-Ray Observatory (CXO), or Fermi Gamma-Ray Space Telescope

Proposals for archival research based exclusively on the data from HST, CXO, or Fermi are not eligible for funding under the ADAP. Such proposals are solicited through the associated NASA-chartered science operations centers and funded under each mission’s General Observing (GO) program. However, proposals for archival research that involve a combination of data from these observatories, or data from one of these observatories in combination with the data from other NASA missions (e.g., see above list), are eligible for funding under ADAP. In such cases, the onus is on the proposer to clearly establish that the cited additional data set(s) are integral to the success of the proposed investigation and not merely window dressing added only to make what is
essentially a Hubble/Chandra/Fermi archival research program compliant with the ADAP.

1.3.3 Astrophysical databases and development of new data products/analysis tools

Databases of fundamental atomic, molecular, nuclear, and solid-state parameters that are complete, critically evaluated, and readily accessible to the community represent a powerful tool for analyzing NASA space astrophysics data. The ADAP, therefore, accepts proposals for the development of publicly accessible compilations of existing fundamental atomic, molecular, and nuclear parameters (both experimental and theoretical), as well as the associated computational tools necessary to effectively apply those data to the analysis of astronomical observations. This opportunity is intended to support only the development of new databases or significant enhancement/maintenance of existing databases. Proposers are cautioned that new measurements or calculations of fundamental atomic, molecular, nuclear, or solid-state parameters are not eligible for support under the ADAP, and proposals found to include any such work will be declared non-compliant and declined without review. Proposals of this type are more appropriate for the Astrophysics Research and Analysis program (Program element D.3).

In addition, recent years have seen a dramatic growth in both the size and scope of the archival astronomical data from NASA’s space missions. The development of new archival data products through reprocessing or further processing of these datasets, as well as the development of tools for mining the vast reservoir of information locked within them, have the potential to open new areas of investigation and substantially increase the scientific return on those missions. Consequently, such work is also eligible for funding under the ADAP, provided that both the science it will enable and the wider impact/value of the resultant products to the community, is clearly articulated in the proposal.

Of special note, the Astrophysical Databases research area (see Sec. 1.4) accepts proposals for the development of publicly-accessible databases of observational data from NASA-sponsored balloon-borne and sounding rocket astrophysics suborbital experiments. However, proposals for the analysis of data from suborbital missions should be submitted to the Astrophysics Research and Analysis Program (APRA; ROSES-2017 program element D.3). Furthermore, only suborbital experiments funded under the auspices of the APRA program are eligible for this funding opportunity.

An essential component of any activity funded under the Astrophysical Databases research area of the ADAP is the ultimate dissemination of high-value data products and data analysis tools to the astronomical community. Consequently, it is essential that any proposal in this area clearly articulate what the final products of the investigation will be and how the products will be made available to the community. If the products are to be ingested and curated at an existing astrophysics archive (see list in §1.2 above), the cost of any required support for the proposed activity from the relevant archive must be included in the proposal budget. If the proposing team does not include a representative of the relevant data center, proposers are strongly encouraged to include a letter of acknowledgement from that archive in their proposal.
Finally, prospective proposers should also be aware that considerable research has already been done using NASA space astrophysics data sets by the original mission science teams, as well as by previously selected participants in the ADAP (see, for example, abstracts of currently and previously funded ADAP projects by following links to Past Selections and searching for ADAP (or ADP for 2009 and earlier) at http://nspires.nasaprs.com). Therefore, ADAP proposals in the Astrophysical Databases research area must clearly demonstrate how their proposed research extends the frontier of knowledge or how their proposed data products differ from those currently available in a fundamental and important manner. If a new proposal for this program element is itself based on a previously funded research effort, the proposal must identify that work and clearly summarize all significant results from it.

1.3.4 Support for Approved Spitzer Guest Observers

The Spitzer Space Telescope Guest Observer (GO) program has been significantly descoped and now only provides support for U.S. investigators with programs involving ≥ 200 hours of observing time. Therefore, scientists with approved Priority 1 GO observations involving < 200 hours of Spitzer time are eligible to propose for data analysis support under ADAP 2017, even if those observations have yet to be executed or the data are still within their proprietary period at the time of the proposal deadline. Moreover, scientists with approved Priority 2 GO observations involving < 200 hours of Spitzer time are eligible to propose for data analysis support under ADAP 2017, providing that the awarded observations have at least been initiated at the time of the ADAP proposal submission deadline. These eligibility requirements are summarized in Table 2 below. Proposers are reminded that proposals found to incorporate any ineligible GO data whatsoever are subject to being declared noncompliant and declined without review.

Proposers seeking funding support for an approved GO program are not relieved of the responsibility to provide a compelling proposal that meets all of the requirements of the ROSES-2017 NRA and the ADAP program element. It is generally not sufficient to simply submit the approved GO proposal.

<table>
<thead>
<tr>
<th>Class of GO Proposal</th>
<th>Execution Status at ADAP 2017 proposal deadline</th>
<th>Eligibility for ADAP 2017 Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority 1, &lt; 200 hrs</td>
<td>Any</td>
<td>ELIGIBLE</td>
</tr>
<tr>
<td>Priority 2, &lt; 200 hrs</td>
<td>Partially executed or completed</td>
<td>ELIGIBLE</td>
</tr>
<tr>
<td></td>
<td>Yet to be executed</td>
<td>INELIGIBLE*</td>
</tr>
<tr>
<td>Priority 1 or 2, ≥ 200 hrs</td>
<td>Any</td>
<td>INELIGIBLE*</td>
</tr>
<tr>
<td>Priority 3, any duration</td>
<td>Any</td>
<td>INELIGIBLE*</td>
</tr>
</tbody>
</table>

*As with the data from any other NASA space astrophysics mission, these data are eligible for support under the ADAP once they are available in the public domain.
1.3.5 Exclusions

Proposers to this NRA should note that the ADAP is not intended to support:

- Investigations whose primary emphasis is fundamental theoretical research or the development of numerical models without specific application to the analysis of NASA archival data or where archival data are used only to calibrate or benchmark the output of the computations. Such research is supported under NASA’s Astrophysics Theory Program (ATP; D.4);
- Investigations involving new measurements or calculations of fundamental atomic, molecular, or nuclear parameters. This includes analysis or reanalysis of data measured in a laboratory. Such research is supported under the Laboratory Astrophysics element of NASA’s Astrophysics Research and Analysis program (APRA; D.3);
- Investigations with a primary focus on the analysis of datasets from astrophysics projects or space missions that had no significant NASA contribution (e.g., Hipparcos, Gaia, Sloan Digital Sky Survey). Such data may be used to support the analysis of allowed data from a NASA mission, but may not itself be the primary object of the investigation. In any such instance, the onus is on the proposer to clearly establish that analysis of any proscribed data are (1) necessary to the achievement of the scientific goal(s) of the proposed investigation and, (2) not the object of that investigation.
- Investigations with a primary focus on Solar System objects or on the solar-terrestrial interaction (other NASA programs support this kind of research, see Appendices B and C). In particular, proposers are cautioned that studies of Near Earth Objects and other Solar System bodies based on archival WISE and/or K2 data are not eligible for funding under the ADAP. Such research is eligible for funding through the Research and Analysis (R&A) programs of NASA’s Planetary Science Division (see Appendix C).
- Proposals primarily for the general education and/or training of students (Note, however, that this does not preclude the involvement of undergraduate or graduate students in the proposed research);
- Proposals for organizing and/or hosting scientific meetings; or
- Proposals for the acquisition of substantial computing facilities or resources beyond nominal workstation or network requests.

1.3.6 Proposal formatting

In addition to the scientific scope of the ADAP described in the following sections, both the NASA Guidebook for Proposers and Section IV (b) ii of the ROSES Summary of Solicitation provide clear and specific requirements for the format of proposals submitted in response to this program element (e.g., page limits, acceptable font sizes, line spacing, margins, etc.). These requirements have been developed to ensure a level playing field for all proposers. The Astrophysics Division takes these formatting requirements seriously, and proposals found to violate them will be ruled noncompliant and will not be rated or considered for funding. It is the responsibility of the proposer to ensure that their proposal complies with all formatting requirements.
Proposers are reminded that it is the PDF version of their proposal in NSPIRES that will be judged for compliance. Since, in rare cases, translation of PDF documents can alter the formatting of a document, proposers are strongly urged to download copies of any documents they upload to NSPIRES to ensure that they still conform to all formatting requirements.

1.4 Identification of Proposal Data Set(s) and Research Areas

The Cover Page for ADAP proposals provides for designation of the data set(s) proposed for analysis and also for the Research Area, as defined below, which designates the primary focus of the proposal. Identification of the appropriate Research Area is important as it facilitates the assignment of each proposal to the appropriate review panel (a secondary Research Area may also be designated).

NASA reserves the right to reassign a proposal to a different primary or secondary Research Area for the purposes of arranging for the most qualified review. The ten defined ADAP Research Areas are:

1. **Star and Exoplanetary System Formation** —includes studies star-forming clouds, protostars, protoplanetary and debris disks, and formation of exoplanets and exoplanetary systems;
2. **Stellar Astrophysics and Exoplanets** —includes studies of the structure and evolution of main sequence stars, brown dwarfs, and exoplanet detection and characterization;
3. **Post-Main Sequence Stars** —includes studies of the structure and evolution of post-main sequence stars, late circumstellar outflows and mass loss, white dwarfs and cataclysmic variables, and planetary nebulae;
4. **Collapsed Objects and X-ray Astrophysics** —includes studies of neutron stars, stellar-mass and supermassive black holes, X-ray binaries, black-hole binaries;
5. **Supernovae and Gamma Ray Bursts** —includes studies of supernova progenitors, the physics of catastrophic stellar explosions, and supernova-driven nucleosynthesis, but not including studies of supernova remnants and their interaction with the interstellar medium (ISM);
6. **Interstellar Medium** —includes studies of dense clouds, the diffuse ISM, supernova remnants and their interactions with the ISM, interstellar dust, HII regions, and diffuse galactic emission;
7. **Normal Galaxies and Galactic Structure** —includes studies of the structure of the Milky Way and other galaxies);
8. **Active Galaxies and Quasars** —includes studies of interacting galaxies, starburst galaxies, Luminous/ultraluminous infrared galaxies, Seyfert galaxies, radio galaxies, active galactic nuclei, and quasars;
9. **Large Scale Cosmic Structures** —includes studies of clusters of galaxies, galaxy environment and evolution, intracluster medium, diffuse x-ray background, and cosmology); and
10. **Astrophysical Databases** —includes compilations of fundamental atomic, molecular, solid state parameters, development of publicly-accessible databases of observations from NASA suborbital astrophysics projects, higher-level data
products based on existing archival astrophysical data sets, and data analysis tools).

2. Current Profile of the ADAP

2.1 ADAP 2016 Submission statistics

![Figure 1. The distribution of 2016 ADAP proposal submissions, broken down by requested funding duration, across the Research Areas covered by the program. Proposals in the Astrophysical Databases Research Areas were grouped into one of the other Research Areas shown based on their subject matter. Three proposals were declared non-compliant and declined without review.](image-url)

In 2016, a total of 238 proposals were submitted in response to the ADAP program element, a 5.5% decrease in the number of proposals compared to the ADAP 2015 program element. The distribution of those proposals over the various research areas covered by ADAP 2016 is shown in Figure 1 above. Also shown in the figure is the distribution of requested durations of the proposals in each Research Area (i.e. one-, two-, or three-years). Note: proposals in the Astrophysical Databases Research areas (not broken out separately in the figure) were grouped into one of the other Research Areas, as appropriate, based on the subject matter of the proposal.

2.2 Distribution of annual funding levels for ADAP tasks

With an annual budget of around $17.5M, the ADAP typically supports around 130 investigations in any given year (includes new starts, plus continuing investigations). Although the average annual ADAP award is approximately $124,000, actual award
amounts span the range from less than $40,000 per year to more than $200,000 per year. The plot in Figure 2 shows the distribution of annual awards for the ADAP in FY 2017.

![Bar chart showing the distribution of annual awards for ADAP tasks in FY 2017.](image)

**Figure 2.** The distribution of annual awards for funded ADAP tasks in FY 2017. Data include both ADAP 2016 new starts and ongoing tasks from previous solicitations.

### 2.3 Evaluation Criteria

In addition to what is described in the *Guidebook for Proposers* and the *ROSES Summary of Solicitation*, for this program element the merit criterion includes an evaluation of the suitability and perceived impact of the proposed products of the investigation (e.g., data products and data analysis tools) and how and when they will be made available.

### 3. Summary of Key Information

<table>
<thead>
<tr>
<th><strong>Expected program budget for first year of new awards</strong></th>
<th>~$6.5M</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of new awards pending adequate proposals of merit</strong></td>
<td>~50</td>
</tr>
<tr>
<td><strong>Maximum duration of awards</strong></td>
<td>3 years; shorter-term proposals are welcome;</td>
</tr>
<tr>
<td><strong>Due date for Notice of Intent to propose (NOI)</strong></td>
<td>See Tables 2 and 3 in the <em>ROSES Summary of Solicitation</em>.</td>
</tr>
<tr>
<td><strong>Due date for proposals</strong></td>
<td>See Tables 2 and 3 in the <em>ROSES Summary of Solicitation</em>.</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>January 1, 2018</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposal</td>
<td>15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposal via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-ADAP</td>
</tr>
</tbody>
</table>
| NASA point of contact concerning this program | Douglas M. Hudgins  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-0988  
Email: Douglas.M.Hudgins@nasa.gov |
D.3 **ASTROPHYSICS RESEARCH AND ANALYSIS PROGRAM**

NOTICE: Amended on March 14, 2018. This amendment delays due dates in anticipation of power loss to New England as a result of the upcoming storm. The proposal due dates for ROSES-2017 D.3 *Astrophysics Research and Analysis* and ROSES-2017 D.8 *Strategic Astrophysics Technology* have been changed to Monday March 19, 2018.

Amended on January 23, 2018. To account for time lost to the government shut down, this amendment extends by one day the due dates for program elements that were due the week of the shutdown. The mandatory NOI due date for this program element is now Friday January 26, 2018.

Amended November 16, 2017. This amendment makes four changes (1) it excludes technology development for missions with funded technology lines and/or that are in or past Phase A, see the last bullet in the list of Specific Considerations and Exclusions in Section 1.2, (2) mission concept studies are excluded from proposals in the "Supporting Technology" category, see Section 1.2.3, (3) it adds Section 2.5, noting that the MSFC x-ray test facilities are directly supported so PIs may no longer need to include this in their budget, and (4) the due date for mandatory NOIs has been changed to January 25, 2018. The due date for proposals remains March 15, 2018. New text is in bold.

Amended November 6, 2017. This amendment changes the proposal submission process for this program element to make Notices of Intent (NOIs) mandatory. Proposals that are not preceded by an NOI may be returned without review. The due dates are unchanged. The due date for mandatory NOIs is January 18, 2018. The due date for proposals is March 15, 2018.

1. **Scope of Program**

1.1 **Overview**

The Astrophysics Research and Analysis Program (APRA) program solicits basic research proposals for investigations that are relevant to NASA’s programs in astronomy and astrophysics and includes research over the entire range of photons, gravitational waves, and particle astrophysics. Awards may be for up to four years’ duration (up to five years for suborbital investigations), but shorter-term proposals are typical; four-year or five-year proposals must be well justified. Proposals for suborbital investigations are particularly encouraged. APRA investigations may advance technologies anywhere along the full line of readiness levels, from Technology Readiness Level (TRL) 1 through TRL9. The emphasis of this program element is on technologies and investigations that advance NASA astrophysics missions and goals.
1.2 Categories of Proposals

The APRA program seeks to support research that addresses the best possible (i) state-of-the-art detector technology development for instruments that may be proposed as candidate experiments for future space flight opportunities; (ii) science and/or technology investigations that can be carried out with instruments flown on suborbital sounding rockets, stratospheric balloons, or other platforms; and (iii) supporting technology, laboratory research, and/or (with restrictions) ground-based observations that are directly applicable to space astrophysics missions. To meet these goals, proposals are solicited in the following five broad categories:

- Suborbital/Suborbital-class Investigations
- Detector Development
- Supporting Technology
- Laboratory Astrophysics
- Ground-Based Observations.

Specific Considerations and Exclusions:
- Investigators proposing stand-alone detector development should propose to the Detector Development category, whereas proposals for which detector development is integrated into a suborbital/suborbital-class program should be submitted to the Suborbital Investigations category.
- The Laboratory Astrophysics category of this program element includes theoretical investigations in the area of Atomic and Molecular Astrophysics. However, all other theoretical investigations are solicited separately under the Astrophysics Theory Program described in program element D.4 of this NRA.
- The Ground-Based Observations category of APRA will consider proposals only from observers who are ineligible for such support from the National Science Foundation (e.g., scientists employed by NASA or another Federal Agency). In addition:
  - The program element is not intended to support ground-based observational studies of extrasolar planets. Such proposals should instead be submitted to program element E.3 of this NRA. Testing and validation observations conducted at a ground-based facility as part of an exoplanet technology research program are, however, acceptable.
  - Proposals for any ground-based gamma-ray burst investigations are no longer eligible for support within the APRA program element and should be submitted to the relevant mission Guest Investigator program(s).
  - Ground-based particle astrophysics observations are not supported by this program element. Such investigations in support of a NASA Astrophysics mission should be directed to the relevant mission Guest Investigator program(s).
- The Fundamental Physics discipline area supports proposals: 1) to test fundamental laws of physics or 2) to develop experimental concepts and/or related technologies to test fundamental laws of physics. Proposals submitted to this discipline area must be related to an Astrophysics space project (suborbital, orbital, etc.). This discipline area is not intended to support applied physics or laboratory
experiments. Investigations predominantly theoretical in nature should be directed to the Astrophysics Theory Program or to other Federal agencies, as appropriate.

- Projects directed mainly toward the analysis of archival data are solicited under the Astrophysics Data Analysis Program described in ROSES program element D.2.
- If a proposal is offered as a direct successor to a previous NASA award, it should include a description of the predecessor effort, including any significant findings, and describe how the proposed work extends the previous accomplishments. See the NASA Guidebook for Proposers for more details.
- The Principal Investigator (PI) institution is expected to fund participating Co-Investigator(s) (Co-I(s)) via subawards, except where the Co-I is at a Government laboratory, including the Jet Propulsion Laboratory (JPL). The only exception is for Suborbital/Suborbital-class Investigations, see Section 1.2.1.3 below.
- Projects devoted to technology development efforts that do not generate data need not provide data management plans but must note on the NSPIRES cover page that they do not need to provide a data management plan because they are in the Detector Development or Supporting Technology category.
- Proposals to advance technologies in support of missions that have transitioned to having funded technology lines or that are in Phase A or beyond (e.g., Athena, LISA, WFIRST, Euclid, XARM) are excluded from APRA, as these technologies are expected to be supported by the mission funding. [Added November 16, 2017]

1.2.1 Suborbital/Suborbital-class Investigations

This APRA category supports science investigations and/or technology development utilizing payloads flown on sounding rockets, balloons, commercial reusable suborbital rockets, or similar-class payloads flown as flights of opportunity. Suborbital payloads may be recovered, refurbished, and reflown in order to complete an investigation.

Suborbital launch vehicle services include those provided by the NASA Sounding Rocket Program Office (SRPO) and the NASA Balloon Program Office (BPO) and commercial suborbital reusable launch vehicle services through the Flight Opportunities Program of NASA’s Science and Technology Mission Directorate (STMD). The Science Mission Directorate also provides for CubeSats and International Space Station (ISS) payloads. These are described in Section V of the ROSES Summary of Solicitation. Investigators are strongly urged to discuss their proposed payload with the contact person(s) for the appropriate Program, as given in that section. Please pay particular attention to the additional requirements for proposals for the ISS that are described in that section. ISS payloads will be subject to oversight beyond that of a typical sounding rocket or balloon payload.

A discussion of the plans for management and for reduction and analysis of the data should be given. Although most awards are for three or four years’ duration, a five-year proposal may be accepted to develop a completely new, highly meritorious investigation through its first flight. Because of the anticipated greater degree of complexity, the Scientific/Technical/Management section of proposals for these investigations may be 20 pages long, instead of the default 15 pages specified in the NASA Guidebook for Proposers.
Budgets are expected to cover all aspects of the proposed investigation, typically (but not always) including payload development and construction, instrument integration and calibration, launch, and data analysis/dissemination. The number of investigations that can be supported is limited and heavily dependent on the funds available to this program. Note that NASA does not carry reserves to accommodate any cost overrun incurred by a particular investigation, including the loss of the payload owing to a rocket or balloon system failure. Therefore, failure to achieve the proposed goals within the proposed time and budget could require either descoping the initially proposed investigation, delaying it, canceling a particular launch date opportunity, or canceling the investigation altogether.

Suborbital and suborbital-class investigations provide unique opportunities, not only for executing intrinsically meritorious science investigations, but also for advancing the technology readiness levels of future space flight detectors and supporting technologies and preparing future leaders of NASA space flight missions, such as early-career researchers and graduate students. For these proposals, specific factors that will be considered when evaluating a proposal’s intrinsic merit are the scientific merit and the degree to which it advances the technology readiness level of a detector or supporting technology, and secondarily the degree to which it advances the readiness of early-career researchers or graduate students to assume leadership roles on future NASA space flight missions.

1.2.1.1 Sounding Rocket Payloads

Investigators proposing payloads to be flown on sounding rockets should answer the program-specific questions on the APRA proposal cover pages. For planning purposes, the Sounding Rocket Program Office uses this information to generate a rough order-of-magnitude cost estimate for the operational requirements associated with a proposed investigation. The required information includes the envisioned vehicle type, payload mass, trajectory requirements, launch site, telemetry requirements, attitude control, or pointing requirements, and any plans for payload recovery and reuse.

The Sounding Rocket Program is currently planning to provide launches from Australia, in the second or third quarter of 2019, subject to the availability of funds. Investigators responding to this APRA program element may propose sounding rocket flights launched from this southern hemisphere site. Normal payload recovery is anticipated for flights using either the Black Brant IX or Black Brant XI launch vehicles.

1.2.1.2 Balloon Payloads

The Balloon Program is planning to provide a shared platform capable of carrying multiple, independent, piggyback-like instruments in order to offer suborbital flight opportunities to more users. The intent is to support more small instruments for science investigations, technology development, and/or training of early-career scientists and engineers. Investigators should identify, on the proposal cover page, which of these three categories is the main focus of the proposal. The following table summarizes the standard services and anticipated constraints for a flight supporting about six instruments:
<table>
<thead>
<tr>
<th>Balloon Altitude:</th>
<th>Flight Duration:</th>
<th>Per instrument Weight/Size:</th>
<th>Data Rate/Power:</th>
<th>Launch location:</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-37 km</td>
<td>6-24 hours</td>
<td>136 kg; 0.4 cubic meters; Standard interface</td>
<td>&gt; 50 kbs LOS; 50-100 watts, regulated 28 V battery nominal</td>
<td>Ft. Sumner (Spring or Fall) Palestine (Summer)</td>
</tr>
</tbody>
</table>

Projects, including a flight from Antarctica or needing unique engineering and/or technical support services and/or vehicles and/or the Wallops Arc-Second Pointing System (WASP), should contact the Balloon Program Office directly for an estimate of the Government Furnished Equipment (GFE) cost of the desired support.

1.2.1.3 Special Instructions for Multiple-Institution Proposals for Suborbital/Suborbital-class Investigations: Co-Investigator Proposals

Proposals for suborbital and suborbital-class investigations often involve the development of payloads that require major hardware collaborations among several organizations. In such cases, the lead Principal Investigator (PI) may propose a direct subcontracting arrangement between his/her organization and the Co-Investigator (Co-I) organization(s) other than U.S. Government organizations, in which case all the nominal instructions in the NASA Guidebook for Proposers (see further below) apply. The activities of Co-Is at U.S. Government organizations, such as NASA centers, are always funded directly. If the PI is from a U.S. Government organization, Co-Is will be funded by awards from that organization. NASA centers apply no overhead cost to the budgets for Co-I organizations.

Alternatively, for some combinations of collaborating organizations, NASA recognizes that there may be advantages to providing separate awards to some of the collaborating organizations in response to "Co-Investigator Proposals." The lead investigator from the Co-I organization serves as the "Institutional PI" for the award to his/her organization (see the NASA Guidebook for Proposers).

For teams wishing to take advantage of such multiple-award flexibility, the following instructions should be followed:

- Only the "lead proposal" for the overall investigation, submitted by a single PI, will be reviewed. This lead proposal must include:
  - A clear statement in the first sentence of the Proposal Summary that identifies the proposal as the lead proposal.
  - The Cover Page/Proposal Summary/Budget Summary of the lead proposal, showing the summary of the budget requested by the lead organization. This should not include the budgets for those organizations submitting Co-I proposals. Support for Co-Is at organizations that do not submit separate Co-I proposals should be included in the budget summary of the lead proposal in the usual way.
  - A work statement and budget justification (narrative and details) covering the items in the budget summary of the lead proposal, appending the Task Statements and the budget justifications (narrative and details) from each of the Co-I proposals (see further below).
Each organization submitting a Co-I proposal must:
  o Have a Proposal Title that is identical to the title of the lead proposal, except that "[Organization Name] Co-I" is added to the end.
  o Have a Proposal Summary that clearly cross-references the PI of the lead proposal in the first sentence.
  o Complete the Cover Page/Proposal Summary/Budget Summary and include all materials indicated in the NASA Guidebook for Proposers.
  o Contain, in lieu of the Scientific/Technical/Management section, a Task Statement, not to exceed five pages, that describes the contribution of the Co-I organization and the role of the Co-I(s) to the overall investigation. In the case of multiple Co-Is from the same organization, a single Co-I serving as the "Institutional PI" must be identified.
  o Include a budget justification (narrative and details) covering the Co-I organization’s proposed activities.
  o Be submitted electronically through the organization’s Authorized Organizational Representative (AOR), with the Co-I (Institutional PI) from that organization listed as the PI.

1.2.2 Detector Development

This APRA category solicits investigations that either advance our understanding of the fundamental operational aspects of detectors or develop new types of detectors to the point where they can be proposed in response to future announcements of flight opportunities. Either new measurement concepts or methods to improve the performance of existing detectors may be proposed, provided they would be candidates for use in space. Among the characteristics typically desirable in space-quality detection systems are high sensitivity to relevant signals, low mass, low sensitivity to particle radiation, low power consumption, compactness, ability to operate in a vacuum (such that high-voltage arcing is minimized), vibration tolerance, ease and robustness of integration with instrumentation, and ease of remote operation, including reduced transient effects and ease of calibration.

This category does not support development of detectors or instrument subsystems that are intended primarily for ground-based astronomy. However, observing with ground-based facilities may be proposed to verify new detectors or overall system performance, if adequately justified as an integral part of a detector development.

Proposals for new detectors will be evaluated in the context of currently available space astronomy detector technologies. Proposers are encouraged to identify potential mechanisms that could facilitate transfer of these detector technologies to other users, including Homeland Security and/or the private sector, for possible application beyond the immediate goals of NASA’s programs.

1.2.3 Supporting Technology

This APRA category supports investigations of technologies not yet ready for incorporation into new detector or space mission systems, but that offer promise of potential breakthroughs that could lead to future advances in instrumentation useful for NASA’s space astronomy and astrophysics programs. This category includes small
technology efforts for future NASA Astrophysics missions, such as development of optics, mirrors, coatings, or gratings.

This category also supports proposals for development of new data analysis methods for future space missions. These proposals should be mission enabling or mission enhancing and directly applicable to future space flight missions, in particular (but not necessarily limited to) those that have been considered in the most recent decadal survey or Astrophysics roadmap. Missions already funded (pre-Phase A or beyond) are excluded. **Proposals aimed primarily at carrying out mission concept studies are excluded. [Added November 16, 2017]**

1.2.4 Laboratory Astrophysics

The Laboratory Astrophysics category of the APRA program element supports the determination of fundamental atomic, molecular, nuclear, and solid-state parameters that are essential for analyzing and interpreting the data from NASA Astrophysics missions. The category supports both laboratory (experimental) and computational efforts to explore the spectroscopic properties of atoms and molecules and particulate matter, as well as their chemical, physical, and dynamical properties under astrophysical conditions. The resulting data products directly impact our understanding of a wide range of astrophysical phenomena spanning the electromagnetic spectrum, and ranging from the epoch of reionization and the evolution of cosmic structure to the formation and evolution of galaxies, stars, and exo-planetary systems in the current epoch.

Laboratory Astrophysics proposals must be well motivated by a detailed description of the relevance of the proposed investigation to the analysis of measurements from NASA astrophysics missions (past, current, or future). Such proposals pertaining to James Webb Space Telescope (JWST) or the X-ray Astrophysics Recovery Mission (XARM) would be particularly timely. Proposals for projects that aim to produce data products for wide use across the astronomical community should explain how those products would be made available to the intended users in a stable fashion.

1.2.5 Ground-Based Observations

This APRA category will consider proposals for ground-based observations, but only from observers who are ineligible for such support from the National Science Foundation (e.g., scientists employed by NASA or another Federal Agency). Moreover, this element is not intended to support ground-based observations for general scientific objectives. Rather, these observations must be an integral part of a technology development or demonstration project for space astrophysics or directly support the planning and design of future NASA space astrophysics missions.

2. Programmatic Information

2.1 General Information

The following table provides the amount of Year -1 funding and the number of investigations that have been selected for the five APRA categories in five recent
cycles; note that proposals for APRA-11 (denoted A-11) were due in 2012 and funded in FY 2013, etc. If the budget allows, it is expected (but cannot be guaranteed) that that the selections in the coming year will be similar.

<table>
<thead>
<tr>
<th>APRA Category</th>
<th>Total allocated to new selections [M]</th>
<th>Number of New Selections (including Co-I proposals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suborbital Investigations</td>
<td>5.0</td>
<td>6.1</td>
</tr>
<tr>
<td>Detector Development</td>
<td>2.7</td>
<td>3.1</td>
</tr>
<tr>
<td>Supporting Technology</td>
<td>3.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Laboratory Astrophysics</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Ground-Based Observations</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

2.2 Student Participation
The participation of graduate students is strongly encouraged, especially if the project can be concluded within the nominal tenure of graduate training. In such cases, brief details of the educational goals and training of the participants should be included in the proposal.

2.3 Request for reviewer names
Proposers are strongly encouraged to provide names and contact information of up to five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is or stand to benefit financially from the selection (or otherwise) of the proposal. This information should be included in the proposal summary in the Notice of Intent, or E-mailed to the relevant Program Officer listed below.

2.4 New Proposal Submission Requirement: Mandatory NOIs
To facilitate the early recruitment of a conflict-free review panel and ensure that proposals are submitted to the appropriate category, a NOI will be required for all submissions to this Program Element. Proposals that are not preceded by an NOI may be returned without review.

The PI cannot be changed and proposers who want to add funded investigators between the NOI and the proposal submission must inform the point(s) of contact identified in the summary table of key information and cc sara@nasa.gov at least two weeks in advance of the proposal due date. Additions of funded investigators within two weeks of the proposal deadline require explicit permission from the NASA point of contact. Submission of a NOI does not obligate the proposer to submit a full proposal later.

[Section 2.4 was added on November 6, 2017]
### 2.5 Availability of MSFC X-ray Test Facilities

The X-ray optics facilities maintained by MSFC include the X-ray and Cryogenic Facility and Stray Light Facilities as Agency Capabilities. In past cycles PIs wishing to make use of the MSFC Stray Light Facility and/or the X-ray Cryogenic Facility included Co-I funding to MSFC in order to pay for this usage. These facilities are now supported for this work by NASA Internal Scientist Funding Model, so proposals may no longer need to include this in their budget. For more information please contact brian.ramsey@nasa.gov. [Section 2.5 was added on November 16, 2017]

### 3. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected program budget for first year of new awards</th>
<th>See Section 2.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>See Section 2.1</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>4 years (5 years for suborbital investigations)</td>
</tr>
<tr>
<td>Due date for <strong>Mandatory</strong> Notice of Intent to propose (NOI)</td>
<td><strong>January 26, 2018</strong> [Changed January 23, 2018]</td>
</tr>
<tr>
<td>Due date for proposals</td>
<td><strong>March 19, 2018</strong> [Changed March 14, 2018]</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>Between 1 January and 31 March in the year after the proposal due date (except that NASA Centers may plan for a start at the beginning of the fiscal year).</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposal</td>
<td>15 pp (20 pp for suborbital proposals); see also Table 1 of ROSES and the NASA Guidebook for Proposers</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the <strong>ROSES Summary of Solicitation</strong>.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see <strong>Section I(g)</strong> Order of Precedence and <strong>Table 1</strong> of the ROSES <strong>Summary of Solicitation</strong> and the <strong>NASA Guidebook for Proposers</strong>.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the <strong>ROSES Summary of Solicitation</strong> and the <strong>NASA Guidebook for Proposers</strong>.</td>
</tr>
<tr>
<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
</tbody>
</table>
Web site for submission of proposal via Grants.gov | http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)

Funding opportunity number for downloading an application package from Grants.gov | NNH17ZDA001N-APRA

Main NASA point of contact concerning this program | Michael R. Garcia
                                                  Astrophysics Division
                                                  Science Mission Directorate
                                                  NASA Headquarters
                                                  Washington, DC 20546-0001
                                                  Telephone: (202) 358-1053
                                                  Email: Michael.R.Garcia@nasa.gov

Questions about the APRA Program should be directed to the point of contact above. Questions about specific discipline areas may be directed to the relevant Program Officers listed below, along with their areas of expertise. If uncertain about whom to contact, please direct your inquiries to the APRA point of contact listed above.

Astrophysics Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001

<table>
<thead>
<tr>
<th>NAME</th>
<th>PROGRAM RESPONSIBILITY</th>
<th>TELEPHONE</th>
<th>EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eric V. Tollestrup</td>
<td>Infrared, Submillimeter, and Radio Astrophysics</td>
<td>(202) 358-0907</td>
<td><a href="mailto:Eric.V.Tollestrup@nasa.gov">Eric.V.Tollestrup@nasa.gov</a></td>
</tr>
<tr>
<td>Michael R. Garcia</td>
<td>Ultraviolet and Visible Astrophysics</td>
<td>(202) 358-1053</td>
<td><a href="mailto:Michael.R.Garcia@nasa.gov">Michael.R.Garcia@nasa.gov</a></td>
</tr>
<tr>
<td>Stefan M. Immler</td>
<td>X-ray Astrophysics</td>
<td>(202) 358-0615</td>
<td><a href="mailto:Stefan.M.Immler@nasa.gov">Stefan.M.Immler@nasa.gov</a></td>
</tr>
<tr>
<td>Stefan M. Immler</td>
<td>Gamma-ray Astrophysics</td>
<td>(202) 358-0615</td>
<td><a href="mailto:Stefan.M.Immler@nasa.gov">Stefan.M.Immler@nasa.gov</a></td>
</tr>
<tr>
<td>Thomas Hams</td>
<td>Particle Astrophysics and Fundamental Physics</td>
<td>(202) 358-5162</td>
<td><a href="mailto:Thomas.Hams-1@nasa.gov">Thomas.Hams-1@nasa.gov</a></td>
</tr>
<tr>
<td>Douglas M. Hudgins</td>
<td>Laboratory Astrophysics</td>
<td>(202) 358-0988</td>
<td><a href="mailto:Douglas.M.Hudgins@nasa.gov">Douglas.M.Hudgins@nasa.gov</a></td>
</tr>
</tbody>
</table>

D.3-10
Amended on April 25, 2017. This amendment relaxes the restriction on requests for support for the purpose of acquiring computing resources. In addition to applying to the High-End Computing (HEC) Program for access to NASA supercomputers, proposers are now permitted to request support to purchase computing equipment or computing time from non-NASA sources. New text is in bold, and deleted text is struck through. The due dates remain unchanged: Notices of intent are requested by June 1, 2017, and proposals are due July 27, 2017.

Beginning in ROSES-2017, The Astrophysics Theory Program (ATP) element of ROSES will accept proposals on a biennial basis. Thus, ATP is accepting proposals as part of the ROSES-2017 solicitation, but will not in ROSES-2018.

1. Scope of Program

The Astrophysics Theory Program (ATP) supports efforts to develop the basic theory for NASA's space astrophysics programs. Abstracts of previously selected ATP projects may be found online at [http://nspires.nasaprs.com/](http://nspires.nasaprs.com/) (choose "Solicitations" then "Closed/Past Selected" on the left). The periods of performance of investigations for this research element may range from one to four years. Most awards will have a duration of three years, but four-year awards may be made if the need for the longer duration is sufficiently well justified in the proposal.

The Astrophysics Theory Program does not permit multiple Principal Investigators (PIs) (see Section IV(b)i of the Summary of Solicitation). Each proposed investigation must be led by a single PI. The PI institution is expected to fund Co-Investigator(s) (Co-I(s)) participating via subawards, except where the Co-I is at a Government laboratory, including the Jet Propulsion Laboratory (JPL).

Proposals submitted for this program must both:

- Be directly relevant to space astrophysics goals by facilitating the interpretation of data from space astrophysics missions or by leading to predictions that can be tested with space astrophysics observations; and
- Consist predominantly of theoretical astrophysics studies or the development of theoretical astrophysics models.

ATP proposals satisfying both of the above requirements may involve development of data analysis methods for astrophysics missions and may incidentally include actual data analysis as a test of the theory or the method.

Proposals to the ATP program may not:

- Consist primarily of data reduction or data analysis (such proposals should be directed to the mission-specific programs or the Astrophysics Data Analysis Program (ADAP) described in program element D.2 in this solicitation);
- Propose theoretical work pertaining to atomic and molecular astrophysics and other topics directly related to Laboratory Astrophysics (these should be proposed...
to the Astrophysics Research and Analysis (APRA) program element described in program element D.3);

- Develop experimental payloads to test theories of gravitation and fundamental physics (such proposals should be submitted to the APRA program element described in program element D.3);
- Address theoretical topics that are predominantly unrelated to the needs of NASA’s space astrophysics programs (such proposals should be directed to other appropriate Federal agencies);
- Deal strictly or predominantly with Solar System objects or solar-terrestrial interaction studies, including solar energetic particles (see Appendices B and C for appropriate programs);
- Propose to develop technologies or experimental concepts for future NASA missions (these proposals should be submitted to the APRA program element described in program element D.3 or the Strategic Astrophysics Technology program element described in program element D.8);
- Propose to develop new data analysis methods for future space missions (these proposals should be submitted to the APRA program element described in program element D.3);
- Primarily aim at studying new mission concepts; or
- Request support for organizing and/or hosting scientific meetings.

- Request support for substantial computing facilities or resources beyond nominal workstation or network requests. [Deleted April 25, 2017]

2. Proposal Category and Research Areas

ATP proposals will only be accepted from individual Principal Investigators (PIs) whose proposed work has a clear, single focus. Group proposals, i.e., those in which several researchers submit an omnibus proposal of related, but separate, theoretical research investigations under a designated PI, are not solicited for the ATP and will be considered unresponsive to this program element. However, individual theory PIs may include as many Co-Investigators and Collaborators as they wish on their proposals.

Investigators may submit more than one proposal to the ATP if the research program of each proposal is significantly distinct. If a proposal is submitted as a successor to work supported by an earlier proposal, the new proposal must identify the related work and clearly summarize all significant results from it.

For the purposes of conducting the peer review, every proposal for this ATP must identify one (or more, if appropriate) of the Topic Categories from the list below in both its Notice of Intent to propose and in the proposal submission itself. The primary use of these Topic Categories is to facilitate the assignment of the proposal to an appropriate review panel. NASA reserves the right to assign a proposal to a different category. Depending on the mix of proposals received, review panels may not correspond exactly to these categories.

1. Star and Exoplanet Formation (e.g., star forming clouds, protostars, protoplanetary and debris disks, planet formation, astrochemistry);
2. Stellar Astrophysics and Exoplanets (e.g., asteroseismology, convection, stellar evolution, brown dwarfs and exoplanets, mass loss, circumstellar disks);
3. Collapsed Objects and X-ray Astrophysics (e.g., white dwarfs, neutron stars, cataclysmic variables, X-ray binaries, black-hole binaries);
4. Supernovae and Gamma Ray Bursts;
5. Interstellar Medium, Cosmic Rays, and Galactic Structure (e.g., supernova remnants, dark clouds, interstellar dust, HII regions, diffuse galactic emission, planetary nebulae, stellar clusters);
6. Normal Galaxies (e.g., quiescent galaxies, interacting galaxies, starburst galaxies);
7. Active Galaxies and Active Galactic Nuclei (AGNs) (e.g., population studies, accretion discs, jets);
8. Large Scale Cosmic Structures and Dark Matter (e.g., clusters of galaxies, galaxy environment and evolution, intracluster medium, diffuse photon backgrounds);
9. Dark Energy and the Cosmic Microwave Background (e.g., theoretical studies of cosmological observation techniques, theoretical cosmology, dark energy models);
10. Gravitational Astronomy (e.g., gravitational wave sources, computation of gravitational radiation waveforms, data analysis methods for future missions to investigate gravitational radiation); and
11. Other Astrophysics Theory (NASA Headquarters will assign the proposal to what it deems is the most appropriate review panel).

3. Availability of High-End Computational Resources

Those investigators whose research requires high-performance computing should refer to the *Summary of Solicitation*, Section I(d), "NASA-provided High-End Computing Resources." This section describes the opportunity for successful procedure that proposers to the Astrophysics Theory program must follow to apply for computing time on either of two NASA computing facilities at the Goddard Space Flight Center’s Computational and Information Sciences and Technology Office or at the Ames Research Center’s Advanced Supercomputing Division. Because of the current high demand on NASA computing facilities, ATP proposers may instead request support for the purchase of computing equipment or computing time from non-NASA providers of high-performance computing systems and services. In this case, the budget narrative should include a comparison between the cost of the proposed computing solution and that set out for NASA systems at [https://www.hec.nasa.gov/user/policies/sbus.html](https://www.hec.nasa.gov/user/policies/sbus.html). ATP proposers requesting support for non-NASA computing may not also request NASA HEC resources, and vice versa. All computing resource requests will be evaluated under the cost reasonableness criterion by the science peer review panels (see Section VI(a) of the *Summary of Solicitation.*) [Added, April 25, 2017]

4. Summary of Key Information

<p>| Expected program budget for first year of new awards | ~ $4M |</p>
<table>
<thead>
<tr>
<th>Number of new awards pending adequate proposals of merit</th>
<th>~ 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum duration of awards</td>
<td>Four years; shorter term proposals are encouraged; four-year proposals must be well justified.</td>
</tr>
<tr>
<td>Due date for Notice of Intent to propose (NOI)</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Due date for proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>No earlier than 6 months after the proposal due date, but no later than July 1, 2018.</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposal</td>
<td>15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary Of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of proposal via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726).</td>
</tr>
<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-ATP</td>
</tr>
</tbody>
</table>
| NASA point of contact concerning this program | Keith B. MacGregor  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-2463  
Email: [HQ-ATP@mail.nasa.gov](mailto:HQ-ATP@mail.nasa.gov) |
NOTICE: Amended on September 18, 2017. To give more time to proposers who are without power because of Hurricane Irma, this amendment delays the Phase-1 proposal due date for this program element to September 28, 2017. Phase-1 proposals are due by 4:30 PM Eastern time via the via the ARK/RPS web page (see subsection 2.2.1).

Amended on June 19, 2017. Starting from Cycle 14 the Swift Guest Investigator program can award NuSTAR observations through a joint program with the NuSTAR mission. Observing time under this program will be awarded only to proposals that require use of both observatories to meet the primary science goals. Proposers are strongly encouraged to refer to subsection 1.3.2 of this program element and to carefully read the Swift/NuSTAR Memorandum of Understanding, which may be found under other documents on the NSPIRES page for this program element. New text is in bold. The due date remains unchanged. Phase-1 proposals are due on September 21, 2017, via ARK/RPS (see subsection 2.2.1).

1. Scope of Program

1.1 Overview

The Swift Guest Investigator (GI) Program solicits proposals for basic research relevant to the Swift gamma-ray burst mission. The primary goal of this mission is to determine the origin of gamma-ray bursts (GRBs) and use these bursts to probe the early universe. Swift is also a valuable asset for obtaining multiwavelength images, spectra, and light curves on interesting Targets of Opportunity (ToOs) and other nontransient sources.

Cycle 14 observations and funding will commence on or around April 1, 2018, and last approximately 12 months. Further details on the Cycle 14 program will be posted on the Swift web pages (https://swift.gsfc.nasa.gov/proposals) in August 2017. As was the case in Swift GI Cycles 4 through 13, observing time will be made available to scientists at U.S. and non-U.S. institutions to study a wide variety of astrophysical sources. Consistent with Explorer Program policy, there will be no proprietary data rights to observations conducted with Swift. All science data will be made freely available through the Swift Quick Look web site (https://swift.gsfc.nasa.gov/cgi-bin/sdc/ql), as soon as they are received and processed.

Funding through the NASA Swift GI Program is available only to scientists at U.S. institutions who are identified as the Principal Investigators (PIs). U.S. based Co-Investigators (Co-Is) on foreign-led proposals do not qualify for funding. Funding for accepted target proposals will be initiated only after the relevant observations have begun. Proposers from non-U.S. institutions are strongly encouraged to include a letter of commitment promising financial support.
The Swift GI program is intended to provide the following to participating scientists:

1. Funding (U.S. GIs only) for:
   - New Swift projects;
   - Correlative GRB and non-GRB observations;
   - Other correlative GRB projects; and
   - Theoretical investigations that will advance the Swift mission science return.

2. Observations (and funding for U.S. GIs) for:
   - Non-ToO observations of non-GRB targets;
   - ToOs;
   - Large Programs requesting more than 100 targets or more than 100 kiloseconds (ks) total exposure time;
   - "Fill-in" targets; and
   - Key projects.

1.2 The Swift Mission

Swift is a Medium-class Explorer mission developed at the NASA Goddard Space Flight Center. The lead domestic partners include Pennsylvania State University and Los Alamos National Laboratory. Groups in the United Kingdom and Italy made significant contributions to the hardware development and are active participants in the operations, including provision of the Italian ground station at Malindi. The Swift Mission Operations Center (MOC) is at Pennsylvania State University, and the Swift Science Center (SSC) is at the NASA Goddard Space Flight Center.

The Swift mission was launched on November 20, 2004, from Cape Canaveral Air Force Station, Florida. Swift was launched into a low Earth orbit with an inclination of 21 degrees and an altitude of 600 km. The baseline mission duration was two years, but the mission has been extended beyond this initial period because of its continuing scientific productivity. The orbital lifetime of the satellite is estimated to be approximately 20 years.

The Swift spacecraft carries three science instruments: a wide-field gamma-ray Burst Alert Telescope (BAT) and two sensitive, co-aligned narrow-field instruments – the X-ray Telescope (XRT) and the Ultraviolet/Optical Telescope (UVOT). The spacecraft can be autonomously pointed to direct the XRT and UVOT toward events detected by the BAT. The BAT is a wide-field gamma-ray imager that detects GRBs and rapidly sends positions of arcminute accuracy to the spacecraft and to the ground. The BAT operates in the 15–350 keV range and has a 1.4 steradian (half-coded) field-of-view.

The BAT has a GRB detection sensitivity ~2 times better than the Burst and Transient Source Experiment (BATSE) that flew on the Compton Gamma-Ray Observatory (CGRO). In addition to detecting GRBs, the BAT is performing a survey of the hard X-ray sky to a sensitivity of ~1 mCrab (2 × 10^{-11} erg cm^{-2} s^{-1}). The BAT also scans most of the sky each 90-minute orbit and serves as a sensitive monitor for high-energy transients. Positions and spectra of transients detected by the BAT are telemetered to the ground and distributed immediately to the community.
In response to GRB alerts from the BAT, the spacecraft reorients on a time scale of \(~1\) minute to point the XRT and UVOT instruments at a GRB or other transient. These instruments perform multiwavelength measurements of the bright early afterglow (and also later-time afterglow) emission to provide subarcsecond positions, precise photometry, and fine spectroscopy. The XRT is a Wolter 1 grazing incidence telescope that operates in the 0.2–10 keV band and has a field-of-view of 23.6 arcminutes with an angular resolution of 18 arcseconds (Half Power Diameter) and positional determination accuracy of better than 5 arcseconds. The detector is a cooled CCD, providing spectroscopy with a resolution \(E/\Delta E \sim 10\) at 1 keV and an effective area of 120 cm\(^2\). The UVOT is a Ritchey-Chrétien folded-optics telescope operating in the 170–650 nm band. It has a field-of-view of 17 arcminutes \(\times\) 17 arcminutes, with an angular resolution of 2.5 arcseconds and positional determination accuracy of 0.3 arcseconds. UVOT provides a sensitivity to afterglows of 22\(^{nd}\) magnitude for a 1,000 second integration in its V filter, one of six filters for color photometry. It also has a white-light filter and two grisms for fine spectroscopy \((E/\Delta E \sim 300)\) of sources brighter than 17\(^{th}\) magnitude. The narrow-field instruments yield an accurate position and X-ray spectra of the afterglow within a few minutes of the burst. This information is distributed immediately over the Internet.

Data from continued observations of the afterglow are made available via Circulars and Reports on the Gamma-ray bursts Coordinates Network (GCN, \texttt{http://gcn.gsfc.nasa.gov/}) and on a public web site \(\texttt{(https://swift.gsfc.nasa.gov/archive/)}\). Notification of transient source detections is made through IAU Circulars \(\texttt{(http://www.cbat.eps.harvard.edu/services/IAUC.html)}\) and Astronomer’s Telegrams (ATELs, \texttt{http://www.astronomerstelegram.org/}). Data from serendipitous source detections in the field-of-view of both instruments are routinely sent to the ground for analysis.

Further information on the Swift mission may be found at \texttt{https://swift.gsfc.nasa.gov/}.

1.3 Types of Proposals

This Swift GI Program solicits proposals in the following areas:

1. New Swift projects not requiring GI-specified observatory pointing;
2. Correlative GRB observations involving new or enhanced IR ground-based capabilities for investigating high-redshift bursts, and other correlative GRB and non-GRB observations involving non-Swift instruments and observatories;
3. Theoretical investigations that will advance the Swift mission science return;
4. Non-GRB non-ToO observations that benefit from Swift’s unique capability of simultaneous multiwavelength coverage;
5. ToO observations which promise large scientific return and capitalize on Swift’s unique capabilities of rapid repointing and multiwavelength observations;
6. Large Programs requesting more than 100 targets or more than 100 ks total exposure time;
7. Fill-in targets to be observed in what would otherwise be gaps in the planned science timeline; and
8. Key Projects which aim at addressing major, high-impact scientific questions by making use of the strengths of Swift.
1.3.1 New Swift project

GIs may propose to initiate their own Swift projects that supplement or enhance the Swift science return with their unique facilities, missions, capabilities, or methods. The extent to which the proposed research will enhance the science return from Swift and the demands placed upon mission resources by an investigation will be considered in the proposal evaluation process. Proposals in this category can also include changes or additions to current Swift strategies to detect and observe GRBs and other transient events (Swift detected or elsewhere) and can propose innovative data reduction and interpretation methods that increase our understanding of cosmic explosions. Proposals that require changes to Swift onboard capabilities or operational procedures may require special scrutiny during the review process by the Swift team for technical feasibility and may require formal approval by the Swift Configuration Control Board before implementation. Investigators considering such proposals are strongly urged to consult with the Swift team prior to proposal submission.

1.3.2 Swift GRB and non-GRB Correlative Observations [Amended June 19, 2017]

GRB and non-GRB correlative observations substantially augment the science return from Swift. The Swift instruments, for example, make unique measurements of GRB afterglows starting immediately following the burst, supernova (SN) shock breakouts, or tidal disruption events. However, it is not possible to follow up all targets on all time scales, since viewing constraints and scheduling conflicts will preclude some Swift observations. Also, the onboard capability, although significant, does not cover all of the scientifically valuable measurements that need to be made. Candidate correlative observations that will add significantly to the Swift science include radio imaging and photometry, spectroscopy, deep optical imaging and spectroscopy of the afterglow and possible host galaxy, surpassing the capability of the UVOT to reach 22nd V magnitude in 1,000 seconds, and rapid optical observations with time scales shorter than the 1-minute Swift response time.

To foster correlative observations, the Swift project has established joint GI observing programs with other ground- and space-based facilities: The National Radio Astronomy Observatory (NRAO), the Chandra X-ray Observatory, the International Gamma-Ray Astrophysics Laboratory (INTEGRAL), the X-ray Multi-Mirror Mission (XMM-Newton), and the Nuclear Spectroscopic Telescope Array (NuSTAR). Proposals for joint Chandra, INTEGRAL, and XMM-Newton observations should be submitted to those programs and the Swift time will be recommended by those reviews. For NRAO observations, the Swift GI program can award radio observations through the Swift’s joint program with NRAO. There are a number of technical and policy details regarding the Swift/NRAO joint program, and proposers are strongly encouraged to refer to the Memorandum of Understanding: https://swift.gsfc.nasa.gov/proposals/nrao.html.

Starting from Cycle 14, the Swift Guest Investigator program can award NuSTAR observations through a joint program with the NuSTAR mission. Observing time under this program will be awarded only to proposals that require use of both observatories to meet the primary science goals. Proposers are strongly encouraged to refer to the Swift/NuSTAR Memorandum of Understanding, which
may be found under other documents on the **NSPIRES page for this program element**.

By this agreement, NuSTAR permits the Swift GI Program to award up to 300 ks of NuSTAR observing time. The minimum NuSTAR response time to Targets of Opportunity is 48 hours. ToO observations with a turnaround time less than one week must be well justified and of high scientific value. NuSTAR data acquired through the Swift GI Program will have a standard 12-month exclusive-use period commencing at the time of receipt of the processed data by the observer. This period is restricted to 6-months for peer-reviewed ToOs. The Swift Mission Project will make funding available to successful U.S.-based investigators who request NuSTAR observing time through the Swift GI process. **No funds will be awarded from the NuSTAR project for joint investigations proposed to this Swift program element.**

The NuSTAR GI Program will perform feasibility checks on the proposed observations and reserves the right to reject any observation determined for any reason to be technically unfeasible or to jeopardize the NuSTAR mission. Such a rejection would likely affect the entire proposed science program and could impact the award of Swift observing time as well. Selected proposals will be allocated NuSTAR observing time without additional scientific review, if judged technically feasible.

GRBs at high redshift are particularly compelling due to their distance and rely especially on high quality infrared (IR) observations for distance estimates, since the optical counterpart is redshifted out of Swift/UVOT’s wavelength range. To encourage the development of rapid IR ground-based response to potentially high redshift GRBs, special consideration will be given to such projects. Proposals to bring new or enhanced ground-based IR capabilities online may require funding in the range of $100,000 per year. Such budget requests will be considered, provided they are strongly justified. A six-page limit for the scientific justification applies to proposals submitted in this high redshift "Correlative Observations" proposal category.

For all correlative investigations funded by Swift, rapid public availability of the data or results is in the interest of the Swift mission and the astronomical community and is strongly encouraged. Public data availability for correlative studies should be discussed in these proposals and will be considered in the evaluation of proposals.

1.3.3 *Theoretical Investigations*

GRB and non-GRB theoretical studies have the potential to significantly enhance the scientific impact of the Swift mission. GI proposals for such theoretical investigations are also solicited and should specifically address how the anticipated results will advance Swift science objectives.

1.3.4 *Non-GRB, non-ToO observations*

A total of two million seconds of observing time will be made available during Cycle 14 for non-GRB, non-ToO pointed observations. Swift observations in this category will be performed only as the result of an uploaded ground command through the normal
planning process; slewing to the target will not occur autonomously. Non-ToO observations will have a lower scheduling priority than GRBs or ToOs and will be observed on a best-effort basis when time is available in the observing schedule. Hence, successful non-GRB/non-ToO GIs should be aware that they are not assured 100% of the time awarded. Every effort will be made to observe 80% or more of an accepted program within schedule limitations of the mission. A single observation is defined as one requested pointing to a target. Proposers should be aware that, due to Swift's low Earth orbit (95-minute orbit period) and scheduling priorities for other objects, any long observation may be broken up into several different pointings on different orbits. Observations longer than a few kiloseconds (ks) might be split into several days.

Non-ToO proposals are subject to the following limitations:

- The requested time per observation (i.e., a single visit to a target) must be between a minimum of 1 ks and a maximum of 40 ks;
- Monitoring programs are defined as programs requiring two or more observations of the same object, each of which is considered a "visit;" and
- No more than 2,000 visits will be permitted in this Cycle (total for all proposal categories, including both monitoring and nonmonitoring requests).

Time-constrained observations are defined as observations that have to be performed within a certain time window. These can be ToOs or non-ToOs, either monitoring (more than one visit to a source) or nonmonitoring observations, but not "fill-in" observations. This includes phase-constrained proposals, coordinated observing campaigns with ground-based or satellite-based facilities, etc. Note that the unique scheduling requirements of Swift put severe constraints on time-constrained programs. The window duration for time-constrained observations must exceed three hours.

For coordinated and constrained observations, it is the proposer's responsibility to inform the Swift Science Operations Team of the observing time windows at least one week before observations start. Proposers must clearly describe how their proposal capitalizes on the unique capabilities of Swift.

Only "Key Projects" observing programs may be carried over from Cycle 14 to Cycle 15. Regular proposal targets whose observations have commenced in Cycle 14 will be awarded carryover time in Cycle 15 until the proposed observations are substantially complete. GIs whose observing programs have not begun in Cycle 14 will be required to repropose in Cycle 15 if they wish to acquire observing time. Similarly, Cycle-13-accepted proposals that have not been initiated by the start of Cycle 14 will not be carried over. Cycle 13 GIs concerned that their programs may not be started before the end of the cycle should repropose for Cycle 14.

1.3.5 ToO Observations

GIs are allowed to propose for ToOs in response to transient phenomena, including GRBs found by other observatories. A total of at most one million seconds of observing time will be made available to ToO proposals, subject to the constraints listed below. Swift ToO observations will only be performed as the result of an uploaded command by the Mission Operations Center and will not be slewed to autonomously. ToO
observations will have a lower scheduling priority than GRBs and will be observed on a best-effort basis. Because of this restriction, successful ToO GIs should be aware that they are not assured 100% of the time awarded, even if their ToO is triggered. Every effort will be made to observe 80% or more of an accepted program. GIs submitting ToO proposals should note that:

- Each proposal should describe how it capitalizes on the unique capabilities of Swift;
- Proposals must give exact, detailed trigger criteria and a realistic estimate of the probability of triggering the ToO during Cycle 14; and
- Proposals must assign a priority to each ToO target based on the time criticality of the observation. From the time of the trigger, the priorities are defined as:
  - Highest Urgency: Observation should be performed within four hours;
  - High Urgency: Observation should be performed within 24 hours;
  - Medium Urgency: Observation can be performed within days to a week; or
  - Low Urgency: Observations can be performed within weeks.

Because new GRBs are constantly being discovered, the Swift observing schedule is revised on a daily basis. Note that Highest Priority ToOs are particularly difficult to handle at night and on weekends when the Mission Operations Center is not staffed. These should be avoided in all but the most urgent cases (e.g., transient events like a Galactic SN, a very bright GeV gamma-ray burst, or a giant soft gamma-ray repeater flare).

It is the responsibility of the Principal Investigator (PI) of an accepted ToO to alert the Swift Observatory Duty Scientist when trigger conditions for their accepted ToO have been met. This is done through the Swift ToO Request Form at https://www.swift.psu.edu/secure/toop/request.php. It is highly recommended that ToO proposers register as Swift ToO users in advance at https://www.swift.psu.edu/secure/toop/too_newuser.php. Registration is required in order to submit a ToO Request.

ToO proposals must have an astrophysical trigger. Once the trigger criteria have been met for an approved target, the PI should check if the target location is more than five hours in RA from the Sun and more than 20 degrees from the Moon before requesting Swift observations (http://heasarc.gsfc.nasa.gov/Tools/Viewing.html). ToO observations that require more than 6 ks on a given day and are closer to the Sun than five hours RA will be less likely to be approved unless they are of exceptionally high scientific priority. Observations greater than nine hours in RA from the Sun are particularly desirable. The purpose of the anti-Sun restriction for ToOs is to maximize the amount of time Swift is pointed toward the night sky in order to optimize optical follow-up observations of BAT-detected GRBs.

Accepted Cycle 14 ToO proposals may be triggered until March 31, 2019. GIs whose ToO programs do not trigger in Cycle 14 will be required to repropose in later cycles should they wish to acquire observing time on their targets of interest. Only “Key Projects” ToO programs will be carried over from Cycle 14 to Cycle 15, and may be triggered until March 31, 2020.
Note that unsolicited ToO requests for exceptional transients will continue to be possible through the Swift ToO web site, even for those not accepted into the GI Program. The decision on whether or not to observe a ToO of either category will be made by the Swift Principal Investigator or his official designee. Such ToO requests are unfunded.

1.3.6 Large Programs

Proposals requesting more than 100 targets or more than 100 ks total exposure time are defined as Large Programs. A total of up to 1 Megasecond (Ms) of exposure time has been reserved for Large Programs, subject to the submission of proposals of high scientific merit.

Both long-duration observations of single targets, tiling of extended sources that exceed the fields of view of the Swift XRT and UVOT instruments, or shorter duration observations of many targets can be requested in the Large Programs proposal category. Proposers should be aware that, due to Swift’s low Earth orbit (95-minute orbit period) and scheduling priorities for other objects, any long observation exceeding a few kiloseconds will be broken up into several different pointings on different orbits.

The observations proposed for Large Programs must be completed within the 12-month period covered by this Cycle.

1.3.7 Swift "Fill-in" Targets

GIs may submit a list of targets for consideration as "Fill-in" targets. Their purpose is to provide a set of peer-reviewed targets to be used to fill in gaps in the planned science timeline. These must not be ToOs, must have no observational constraints, and can only be observed once (no multiple observations of the same target). UVOT Grism observations are not permitted as “Fill-in” observations because they require a slew-in-place. The minimum total integration time must be 1 ks per target. Accepted targets will be added to the Swift observing program at the discretion of the science operations team. They will be scheduled, as needed, around the higher priority GRB follow-up observations, ToO and non-ToO observations, to maximize the Swift science program. Funding is not provided for Fill-In proposals. Although GIs should have no expectation that their entire list of “Fill-in” targets will be observed, past experience has shown that fill-in proposals are usually undersubscribed and do get done. Due to the nature of Swift science planning, Swift GI “Fill-in” observations will be scheduled only about 24 hours prior to observation, and PIs will not be notified until observations have been completed for a given target. Scheduling information will be available to GIs via the daily observing plan (http://www.swift.psu.edu/operations/obsSchedule.php).

To reiterate:

- Fill-in targets are not ToOs and cannot be triggered;
- Fill-in targets cannot be time constrained;
- No monitoring is allowed with fill-in targets. Proposers cannot request multiple target visits, but they can request more than 100 fill-in targets per proposal;
- No UVOT Grism observations are allowed; and
- Fill-in targets are scheduled at the convenience of the science planners. There is no guarantee that any of the targets in any fill-in program will be scheduled or completely observed in this Cycle.

1.3.8 Swift Key Projects

Key Projects are intended to greatly advance the Swift science program, enhance its breadth of impact, and represent an enduring legacy of Swift results. Proposals in this category may request support for new Swift projects, theoretical investigations, observations of non-GRB non-ToO targets, and observations of ToO targets. The proposed research plans can be carried out in one or two years. Proposals may also request funding in the range of $100,000 per year. Such budget requests will be considered, provided they are strongly justified.

The number of Key Projects funded in any given year will be limited. It is the responsibility of the proposers to strongly justify how the proposed program will address high-impact scientific questions by making use of the strengths of Swift. A six-page limit for the scientific justification applies to proposals submitted in this "Key Projects" proposal category.

Proposers requesting two-year projects that are selected at Phase 1 should not assume that they have been awarded two years of support; this determination will be made at Phase-2 of the review. PIs of approved multiyear Key Projects will be solicited for a progress report that will be reviewed by NASA to determine if appropriate progress is being made toward the proposed objectives. Because of the significant resources allocated to multiyear Key Projects, those that do not make progress consistent with the proposed investigation could be reduced or terminated.

2. Programmatic Information

2.1 General Information

It is anticipated that up to $1.2M will be available through this program element for the support of approximately 35 Guest Investigations of one-year duration each (except for Key Projects). Note that additional unfunded Guest Investigations are likely to be selected (for example, Fill-in proposals). Swift non-GRB pointed observations are open to all scientists at U.S. or non-U.S. institutions. Swift GI funding is open to all individuals who are identified as Principal Investigators and employed at U.S. institutions, including Swift science team members. Scientists participating in the Swift mission, including Associate Scientists and members of the Follow-up Team who are not funded by the Project, are eligible for support under this GI Program. Swift science team members who already receive support from the Project must provide a compelling justification for the award of additional funds under the GI Program.

2.2 Proposal Submission and Evaluation

2.2.1 Submission of Proposals to the Swift GI Program

The Swift GI program uses a two-phase proposal process. A Phase-1 proposal shall comprise the science/technical justification; proposals requesting funds need to include
a budget narrative, describing in sufficient detail how the proposed funds will be used to achieve the goals outlined in the proposal. The science/technical justification should contain a brief description of previous Swift programs carried out by the PI. Only proposers whose Phase-1 proposals are accepted will be invited to submit budget proposals in Phase 2. It is not necessary for the PI of the Phase-2 proposal to be the science PI. Proposal content, including the list of investigators, must remain consistent between Phase-1 and Phase-2 proposals. All proposal materials will be submitted electronically.

Awards are expected to average $35,000 per year. Only proposals in the "Key Projects" category and in the high redshift "Correlative Observations" category may require funding substantially above the average award (i.e., in the $100,000 range per year), and will need to provide a detailed cost justification. The amount of the anticipated funding request must be entered into the box provided for this purpose on the Remote Proposal System (RPS) Cover Form. The detailed cost evaluation will be deferred until Phase 2. The funding amount requested in the Phase-2 cost proposal may not exceed the amount proposed in Phase 1. "Fill-in" proposals will be unfunded.

Proposers to the Swift GI Program must adhere to the following proposal submission procedures:

- All proposers must submit their Phase-1 proposals electronically through the Astrophysics Research Knowledgebase (ARK)/Remote Proposal System (RPS) website at http://heasarc.gsfc.nasa.gov/ark/rps/. Instructions for doing so are provided at the SSC web site, https://swift.gsfc.nasa.gov/;
- Target forms for all observation proposals are to be submitted through ARK/RPS;
- Due to the nature of prospective investigations within the Swift GI program, the Scientific/Technical/Management section of proposals is limited to four pages (six pages for high redshift "Correlative Observations" proposals and "Key Projects" proposals), instead of the default 15 pages specified in the NASA Guidebook for Proposers. The requirement for a table of contents in the body of the proposal is waived. No supporting material (e.g., curriculum vitae (CV), pending/current support) is required or allowed;
- Optional Latex and MS Word templates for the Scientific/Technical/Management section are provided on the SSC web site at https://swift.gsfc.nasa.gov/; and
- The Scientific/Technical/Management section must be uploaded to the RPS website as a PDF file.

All proposal materials must be submitted electronically by 4:30 p.m. Eastern time on the due date for this program given in Section 3 in order to be included in the proposal review for this cycle of the Swift Guest Investigator program. Note that the 4:30 p.m. deadline supersedes the deadline stated in the Guidebook for Proposers and in the ROSES Summary of Solicitation.

Instructions for the submission of ROSES proposals are given in the ROSES summary of Solicitation and for topics not addressed there please refer to the NASA Guidebook for Proposers (http://www.hq.nasa.gov/office/procurement/nraguidebook/). Swift GI Proposers should follow these instructions, except where they are overridden by the instructions given in the ROSES Summary of Solicitation or in this program element.
2.2.2 Evaluation of Proposals submitted to the Swift GI Program

Proposals will be evaluated by a peer evaluation panel with respect to the criteria specified in the NASA Guidebook for Proposers, where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The suitability of using the Swift observatory and data products for the proposed investigation;
- The extent to which the investigation complements and enhances the anticipated science return from the Swift mission;
- The degree to which the proposed investigation places demands upon mission resources;
- The degree to which the proposed investigation capitalizes on the unique capabilities of Swift; and
- For theoretical investigations, the degree to which the investigation directly advances Swift science goals.

2.2.3 Submission and Evaluation of Phase-2 proposals

Subject to the availability of funding, successful Phase-1 proposers will be contacted by the Swift Program Officer and invited to submit a cost proposal in Phase 2. Upon notification of selection of a Phase-1 proposal, a proposer must respond by following the instructions for submitting a Phase-2 proposal given in the selection notification from the Phase-1 review. Phase-2 (cost) proposals must be submitted through the NASA NSPIRES electronic proposal website (http://nspires.nasaprs.com) by an Authorized Organizational Representative (AOR) of the proposing organization according to the instructions in the Summary of Solicitation of this NRA. The cost proposal will consist of a Budget Details (maximum of two pages) section and a Narrative section (maximum of two pages).

NASA program personnel will evaluate the Phase-2 cost proposals against the third evaluation criterion, cost realism, and reasonableness. Comparison of the proposed cost to available funds will be performed as specified in the NASA Guidebook for Proposers. Note that since the Phase-2 proposals will not be peer reviewed, the requirement to redact the budget information (per Section IV(b)(iii) of the Summary of Solicitation) is waived. All costs should be included in the proposal.

2.3 Supplemental Information

Further details concerning the proposal submission requirements and process can be found at the Swift Science Center website https://swift.gsfc.nasa.gov/. This website provides a detailed mission description; technical information about the Swift mission, instruments, and observation feasibility; and instructions for completing the required proposal forms.
### 3. Summary of Key Information

<p>| <strong>Expected program budget for first year of new awards</strong> | ~$1.2M |
| <strong>Number of new awards pending adequate proposals of merit</strong> | ~35 |
| <strong>Maximum duration of awards</strong> | 1 year; 2 years for proposals in the &quot;Key Projects&quot; category |
| <strong>Due date for Notice of Intent to propose (NOI)</strong> | Option not available |
| <strong>Due date for proposals</strong> | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| <strong>Planning date for start of investigation</strong> | Funding will be awarded when the data are made available to the PI. NASA center proposers should use October 1 (6 months after start of Cycle 14 observing) as a planning date for start of observation |
| <strong>Page limit for Phase-1 proposals</strong> | 4 pages for all proposal categories except for proposals submitted in the high redshift &quot;Correlative Observations&quot; category and in the &quot;Key Projects&quot; category, which are allowed up to 6 pages. The budget narrative has a 1-page limit that will not count toward the above page limits. LaTeX templates (available for download at <a href="https://swift.gsfc.nasa.gov/proposals/swiftgi.html">https://swift.gsfc.nasa.gov/proposals/swiftgi.html</a>) can be used for the proposals. No supporting material (e.g., CV, pending/current support) will be considered for Phase 1. Page limits include figures and references. This instruction supersedes the limits given in the NASA Guidebook for Proposers. |
| <strong>Relevance</strong> | This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| <strong>General information and overview of this solicitation</strong> | See the ROSES Summary of Solicitation. |
| <strong>Detailed instructions for the preparation and submission of proposals</strong> | Please see ROSES Summary of Solicitation, Section I(g) Order of Precedence, and the NASA Guidebook for Proposers |
| <strong>Submission medium</strong> | Electronic proposal submission is required in PDF format; no hard copy is required. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. |</p>
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<thead>
<tr>
<th><strong>Web site for submission of Notice of Intent to propose (NOI)</strong></th>
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<tr>
<td>Web site for submission of Phase-1 proposal via NSPIRES or grants.gov</td>
<td>Option not available</td>
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<tr>
<td>Web site for submission of Phase-2 proposals</td>
<td><a href="http://nspires.nasaprs.com">http://nspires.nasaprs.com</a>; See Section 2.2</td>
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| Programmatic information may be obtained from the Swift Program Scientist | Martin Still  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-4462  
Email: martin.still@nasa.gov |
| Technical questions concerning this program element may be directed to the Swift Guest Investigator Program | Eleonora Troja  
Swift Guest Investigator Program Lead  
Code 662  
Goddard Space Flight Center  
National Aeronautics and Space Administration  
Greenbelt, MD 20771-0001  
Telephone: (301) 286-0941  
Email: eleonora.troja@nasa.gov |
1. Scope of Program

1.1 Overview

The Fermi Guest Investigator (GI) program solicits proposals for basic research relevant to the Fermi mission. The primary goal of this mission is to perform 20 MeV to >300 GeV gamma-ray measurements over the entire celestial sphere, with sensitivity a factor of 30 or more greater than that obtained by earlier space missions. A secondary goal includes the study of transient gamma-ray sources with energies extending from 8 keV up to 300 GeV.

The Fermi GI program is intended to encourage scientific participation by providing funding to carry out investigations using Fermi data, to conduct correlative observations at other wavelengths, to develop data analysis techniques applicable to the Fermi data, and to carry out theoretical investigations in support of Fermi observations.

The Fermi GI program also encompasses a number of joint observation program opportunities. Fermi investigators may apply for radio, optical, X-ray, or Gamma-ray observing time through joint programs with the National Radio Astronomy Observatory (NRAO), the National Optical Astronomy Observatory (NOAO), Arecibo Observatory, the VERITAS ground-based Cerenkov telescope facility and, the INTEmational Gamma-Ray Astrophysics Laboratory (INTEGRAL). Please refer to section 1.3.3 for important details. They may also apply for high-end computing resources.

Investigators may propose Fermi pointed observations, but such observations will require strong scientific justification through simulations and exposure calculations because default survey mode observations will satisfy the scientific requirements of most studies.

The Fermi GI program is open to all investigators, but NASA funding is available only to principal investigators (PIs) who are employed at a U.S. institution at the time the Phase-2 proposal is submitted by that institution via NSPIRES.

During this and all future cycles of the GI program, all Fermi gamma-ray data will be nonproprietary and will be publicly released immediately after ground processing.

1.2 The Fermi Mission

Fermi is an international and multiagency observatory-class mission that studies the cosmos in the 10 keV to 300 GeV energy range. The primary instrument, the Large Area Telescope (LAT), has a peak effective area (>8000 cm²), angular resolution (<3.5° at 100 MeV, <0.15° above 10 GeV), field-of-view (>2 sr), and deadtime (<100 µs per event) that provides a factor of 30 or more advance in sensitivity compared to previous
missions. The Fermi Gamma-ray Burst Monitor (GBM) also provides the capability for studying transient phenomena, with a field-of-view larger than the LAT and a spectral range that extends from the LAT’s lower limit down to less than 10 keV. Although pointed observations are possible, the observatory primarily scans the sky continuously because of the LAT’s large field-of-view. In survey mode – the main mode of operation – Fermi provides nearly uniform sky exposure every ~3 hours.

Modifications to this standard sky-survey mode were implemented during mission cycle 7 and may be considered in the future. Those alternative sky-survey strategies were designed to maximize the exposure at the Galactic Center and in turn to optimize the pursuit of several specific scientific objectives. They resulted from a solicitation of ideas from the community leading to an external committee recommendation to the Fermi project. It is anticipated that the resulting non-uniformity of sky exposure leaves Fermi’s monitoring capability largely intact with a tolerable impact on other scientific endeavors. See [http://fermi.gsfc.nasa.gov/ssc/proposals/alt_obs/obs_modes.html](http://fermi.gsfc.nasa.gov/ssc/proposals/alt_obs/obs_modes.html) for details.

Documents providing a more complete description of Fermi can be found at [http://fermi.gsfc.nasa.gov/ssc](http://fermi.gsfc.nasa.gov/ssc).

The product of a collaboration among NASA, the U.S. Department of Energy, and several international partners, the LAT is a pair-conversion telescope. Gamma rays pair-produce in tungsten foils, silicon strip detectors track the resulting pairs, and the resulting particle shower deposits energy in a CsI calorimeter. An anticoincidence detector provides discrimination against the large flux of charged particles incident on the LAT. The anticoincidence detector is segmented to eliminate the self-vetoing problem encountered by previous experiments.

Astrophysical photons are only a small fraction of all the events detected by the LAT on orbit. Most events are primary cosmic rays and their associated secondary charged and neutral particles produced in the surrounding spacecraft and the Earth’s atmosphere. Therefore, event filtering on board reduces the ~3 kHz detected event rate to ~350 Hz. Events that survive the onboard filter are telemetered to the ground. Further ground processing yields a "true" celestial photon average rate of about 1 to 2 Hz.

The GBM detects gamma-ray bursts. Consisting of 12 NaI(Tl) (8–1000 keV) and 2 BGO (0.2–30 MeV) detectors, the GBM extends Fermi’s burst spectral sensitivity from ~8 keV to ~30 MeV and monitors more than 8 sr of the sky, including the LAT’s field-of-view. Bursts are localized by comparing rates in different detectors and rapidly distributed via the Gamma-ray bursts Coordinates Network (GCN). An initial location, computed automatically, is sent within several seconds, and is expected to have an accuracy of 5 to 10 degrees for strong bursts (fluence > ~10 photons cm⁻²). A more accurate location (~3 degrees for strong bursts) is sent within 24 hours. The threshold of the onboard trigger is a flux of about 0.7 photons cm⁻² s⁻¹ (50 to 300 keV band), for a 1-second burst, and uses a variety of energy band and time windows.

Fermi was launched on June 11, 2008, into a circular, initial orbit of ~565 km altitude at an inclination of 25.6°. The mission design lifetime is five years, with a goal of ten years. After a checkout period, science operations began on August 4, 2008. Based upon the results of the NASA 2016 Senior Review, support for mission operations was extended through September 30, 2019.
The GI community is supported by the Fermi Science Support Center (FSSC), which is managed by NASA’s Goddard Space Flight Center. All publicly available data products, software, calibration files, and technical documents that have been developed jointly with the instrument teams are available through the FSSC (see http://fermi.gsfc.nasa.gov/ssc/).

1.3 Types of Proposals

The Cycle 11 Fermi GI program solicits proposals in the following areas:

1. The analysis of LAT or GBM data from the beginning of science operations or development of data analysis techniques. Investigators are encouraged, but not required, to make software or other resources supporting such new analysis techniques publicly available through the FSSC;

2. Requests for LAT pointed observations (but proposers should be aware that compelling science justification and analysis will be required to quantify the additional scientific benefit of such observations – see the Fermi Users’ Group (FUG) analysis at http://fermi.gsfc.nasa.gov/ssc/proposals/pointing_analysis/). The total time allocated to pointed observations will be between 0 and 15% of the total available observing time in Cycle 11. Pointed observations will follow the same open data policy as sky survey data, i.e., they will become public immediately;

3. Analysis of correlative multiwavelength observations with other instruments and observatories (but excluding operation of such facilities) that are directly relevant to Fermi science objectives (see FUG recommendation at http://fermi.gsfc.nasa.gov/ssc/resources/multi/); and

4. Theoretical investigations that will advance the science return of the Fermi mission.

1.3.1 Analysis of all LAT gamma-ray and GBM event data

The LAT team’s science goals are: (1) development of event-reconstruction and background-rejection techniques; (2) production of a comprehensive full-sky catalog of gamma-ray sources; and (3) a description of the diffuse gamma-ray emission. Proposed Fermi investigations should avoid duplication of the first two of these goals. The extent to which the proposed research will enhance the science return from Fermi will be considered in the proposal evaluation process (see Section 2.2 below).

The LAT’s primary science data product is a list of events detected within the LAT’s field-of-view. These events can be used to detect sources and study their temporal and spectral properties. Fermi observes the sky in a survey mode that provides nearly uniform sky exposure every ~3 hours; this mode will suffice for nearly all scientific observations. GIs may request funding to analyze any accumulated data and may receive funding even if they did not request a specific observation.

The GBM provides event lists with measured energies and arrival times, permitting both temporal and spectral studies. In addition, binned background count rates with differing temporal and spectral resolution are also available, enabling background studies and source detection through occultation steps.
The GBM science team is already funded to provide the community with a catalog of GRBs, including localizations and spectra. Proposals construed by peer reviewers as duplicative of this goal may, therefore, be deemed to have lower priority than those perceived as addressing other objectives.

New data analysis techniques that will maximize the mission’s scientific yield are also encouraged. While the Fermi mission will provide a set of analysis tools with which a complete analysis of the data can be accomplished (refer to http://fermi.gsfc.nasa.gov/ssc/data/analysis/ for details), specialized analyses to address specific scientific issues, such as blind pulsar period searches, the discovery of faint transients, or the detection of sources through occultation steps in the GBM background light curves, may require alternative techniques and additional software. GI proposals for such new data analysis techniques must specifically address how the proposed techniques will advance Fermi science objectives.

1.3.2 Requests for LAT pointed observations or modified observation strategies

GI proposals may also request pointed observations, or in exceptional cases modified observation strategies, to accumulate sky exposure of a particular source at a rate higher than provided by survey mode observations. Similarly, GIs may request Target-of-Opportunity observations. Because pointed observations often provide only moderate advantage over survey mode, requests for pointed observations must provide a compelling scientific justification for interrupting survey mode. It will, therefore, be incumbent upon the proposer to demonstrate that a pointed observation is required to achieve the scientific objectives. Proposers thinking of requesting pointed observations are strongly encouraged to contact the FSSC and anyone considering modified observation strategies must do so. (http://fermi.gsfc.nasa.gov/ssc/help/).

1.3.3 Multiwavelength observations

Because correlative observations will substantially augment the science return from Fermi, such proposals are encouraged. Examples of correlative observations that will add significantly to the Fermi science include monitoring of blazars, follow-up observations of gamma-ray bursts, and determination of pulsar ephemerides. To foster correlative observations, the Fermi project has established joint observation programs with other ground- and space-based facilities. The Fermi GI program can award optical, radio, X-ray or high-energy gamma-ray observations through Fermi’s joint programs with NRAO, NOAO, Arecibo, VERITAS, and INTEGRAL. Note that only a single year of joint-program observations can be awarded through the Fermi GI Program regardless of the duration of awarded Fermi support. There are a number of important technical and policy details regarding these joint programs and prospective proposers are strongly encouraged to refer to the respective MOUs:

http://fermi.gsfc.nasa.gov/ssc/proposals/nrao.html,
http://fermi.gsfc.nasa.gov/ssc/proposals/noao.html,
http://fermi.gsfc.nasa.gov/ssc/proposals/arecibo.html,
http://fermi.gsfc.nasa.gov/ssc/proposals/veritas.html, and
http://fermi.gsfc.nasa.gov/ssc/proposals/integral.html
The LAT instrument team will post the light curves (including spectral information) of the sources listed at http://fermi.gsfc.nasa.gov/ssc/data/policy/LAT_Monitored_Sources.html. They will also announce the discovery of high-amplitude variations among these sources or of newly discovered bright transients to the community via Astronomer’s Telegrams and GCN notices. The FSSC will provide light curves and locations for these new sources.

### 1.3.4 Theoretical investigations

Theoretical studies related to the observations conducted with Fermi hold the potential to significantly enhance the scientific impact of the mission. GI proposals for such theoretical investigations are also solicited and must specifically address how the anticipated results will advance Fermi science objectives.

### 1.4 Classes of Proposals

There are two proposal classes: (1) Regular proposals with research plans that can be completed in one year, and (2) Large proposals whose research plans are more expansive and may take up to three years to complete. Large programs will remain prioritized for projects that are inherently resource intensive and large in scope. The number of Large projects funded in any given year will be very limited.

The burden of justifying the need for Large projects is on the proposers. The peer-review committees will not be permitted to descope Large projects and must be recommended for selection (or not) as proposed. Proposing a project in duplication as a single year plus as a Large program is strongly discouraged.

PIs of approved Large projects must submit a progress report annually on the proposal due date, rather than on the anniversary of the award date. The progress report should comply with the page limit and format requirements of Phase-1 Regular proposals. It should list the deliverables (papers, public software, etc.) that have resulted from the ongoing work, as well as an adherence to the schedule specified in the original proposal. Progress reports must be submitted through the Astrophysics Research Knowledgebase Remote Proposal System (RPS) system. Because of the significant resources allocated to large multiyear projects, those that do not make progress consistent with the proposed investigation could be reduced or terminated.

The continuation into year two of Regular Projects that were approved for two years duration will not require a second scientific peer evaluation. The PIs of such projects will however be solicited by the NASA Shared Services Center (NSSC) for a progress report that will be reviewed by NASA prior to the release of year-2 funds.

### 1.5 Proposal Length and Format

The page limit for the Science/Technical/Management section of Phase-1 proposals is four pages for Regular proposals and six pages for Large proposals. These page limits include figures and references. An additional page is required to describe the technical justification for the observation time, as well as the telescope and instrumentation configurations being requested through the joint programs with NOAO, NRAO, Arecibo, INTEGRAL, and VERITAS.
Proposals must be single-spaced, typewritten, English-language text on standard US letter paper, using one column, and using an easily read font size 12-point or larger and having, on average, no more than 15 characters per horizontal inch. No smaller font is permitted in the subsections of the proposal, including references. However, text in figures and their captions may be in fonts as small as 10-point. In addition, the proposal shall have no more than 5.5 lines per inch of text. Pages should have at least one-inch (2.5 cm) margins on all sides. Proposals not conforming to this format will be declared noncompliant and may be rejected without further review.

2. Programmatic Information

2.1 General Information

Awards for Regular (one or two-year duration) proposals are expected to average around $55,000 per year and $125,000 per year for Large proposals. Phase-2 proposals requesting more than the above are unlikely to be approved without an extremely compelling justification.

Awards for triggered analyses (e.g., transients meeting specific criteria) will not be released until after such triggers occur.

Fermi GI funding is open only to individuals employed at U.S. institutions. Only proposals led by a US-based PI will be considered for funding.

Fermi science team members already receiving support from the Project are eligible for support, but must provide a compelling justification for the award of additional funds under the GI Program. It is the intent of this program that most of the available GI funding be awarded to proposers not formally associated with Fermi.

2.2 Proposal Submission and Evaluation

2.2.1 Submission of Phase-1 Proposals to the Fermi GI Program

The Fermi GI program will use a two-phase proposal submission process. The first phase will be the submission and evaluation of the science/technical justification. Proposals must include a management section with a statement of work and an estimate of the resources needed to accomplish the goals of this work. The required proposal forms must be submitted through RPS.

Proposals requiring more than one year of effort (Large proposals) must include a schedule and a list of expected deliverables and/or milestones for each year of the requested support. This schedule will be considered in the peer-evaluation of progress reports prior to years two and three.

Each proposer who anticipates requesting funding must provide a budget estimate, i.e., an estimated maximum of the total cost to NASA (including overhead) of his/her proposed investigation. A field for entering the total budget is provided on the RPS Cover Form.

In the second phase, proposers whose Phase-1 proposals are accepted will be invited to submit a budget for review through their home institution. This is particularly important for multiyear proposals (two-year Regular and Large proposals). Proposers
must append, as an NSPIRES attachment, a budget narrative for each year of proposed work and specify what they expect to accomplish at the end of each of the years proposed. Every line item in the NSPIRES budget needs to be explained in the accompanying text. All proposal materials will be submitted electronically.

Proposers to the Fermi GI Program must adhere to the following procedures for proposal submission:

• Proposers will submit their Phase-1 proposals electronically through the RPS website at: http://heasarc.gsfc.nasa.gov/ark/rps/. Instructions for doing so are provided at the FSSC web site at: http://fermi.gsfc.nasa.gov/ssc/proposals/.
• Target lists are submitted through the RPS form. All proposals involving joint-program correlated observations or Fermi pointed observations, must include a target list.
• Due to the nature of prospective investigations within the Fermi GI program, the Scientific/Technical/Management section of proposals is limited to four pages for Regular proposals and six pages for Large proposals, instead of the default 15 pages specified in the NASA Guidebook for Proposers. Figures and references are included within these four or six page limits. An additional page must be added to describe the technical details of proposed joint program gamma-ray, X-ray, radio, or optical observations.
• The standard ROSES requirement for a table of contents in the body of the proposal is waived.
• The Scientific/Technical/Management section will be uploaded to the RPS website as a PDF file.

All Phase-1 proposal materials must be submitted electronically by 4:30 p.m. Eastern Time on the due date for this program given in Tables 2 and 3 of the ROSES Summary of Solicitation in order to be considered in the proposal review for this cycle of the Fermi Guest Investigator program. Note that the 4:30 p.m. deadline replaces the standard midnight deadline.

NASA uses a single, uniform set of instructions for the submission of ROSES proposals. These instructions are given in the NASA Guidebook for Proposers (http://www.hq.nasa.gov/office/procurement/nraguidebook/). Fermi GI proposers must follow these instructions, except where they are overridden by the instructions given in the ROSES Summary of Solicitation or in this program element.

2.2.2 Evaluation of Phase-1 Proposals Submitted to the Fermi GI Program

A peer review panel will evaluate all proposals with respect to the criteria specified in Section C.2 of the NASA Guidebook for Proposers, where it is understood that the intrinsic merit of a proposal shall include the following factors:

• The suitability of using the Fermi observatory and data products for the proposed investigation;
• The extent to which the investigation enhances the anticipated science return from the Fermi mission;
• The degree to which the proposed investigation places demands upon mission resources (this is particularly relevant for pointed observations); and
In the case of Progress Reports (i.e., requests to continue multiyear projects), demonstrable progress towards the stated milestones of the original science proposal.

For data analysis development and theoretical investigations, the evaluation of relevance of a proposal shall include the degree to which the investigation directly advances Fermi science goals.

2.2.3 Submission and Evaluation of Phase 2 proposals

Subject to the availability of funding, successful Phase-1 proposers will be contacted by the NASA Selecting Official and invited to submit a cost proposal in Phase 2. Upon notification of selection of a Phase-1 proposal, a proposer must respond as follows:

- Follow the instructions for submitting a Phase 2 proposal given in the selection notification from the Phase-1 review. Phase 2 (cost) proposals must be submitted through the NASA NSPIRES electronic proposal website (http://nspires.nasaprs.com/) by an Authorized Organizational Representative (AOR) of the proposing organization.
- The total budget may not exceed the budget estimate the proposer provided in the Phase-1 proposal.
- Budget Details are limited to three pages, and the Budget Narrative is limited to two pages. Any substantive changes from the budget management plan already submitted in Phase-1 must be justified explicitly.

NASA program personnel will evaluate the Phase 2 cost proposals against the third evaluation criterion, cost realism and reasonableness, and will also compare the proposed cost to available funds, as specified in Section C.2 of the NASA Guidebook for Proposers.

2.3 Supplemental Information

Further details concerning the proposal submission requirements and process can be found at the Fermi Science Support Center website http://fermi.gsfc.nasa.gov/ssc/. This website provides a detailed mission description; technical information about the Fermi mission, instruments, and feasibility of different types of observations; and instructions for completing the required proposal forms.

3. Summary of Key Information

<table>
<thead>
<tr>
<th>Number of new awards pending adequate proposals of merit.</th>
<th>The selection of ~30-40 Regular proposals with average awards of $55K and generally less than $60K per year, and 1-2 Large proposals with average awards of $125K per year and generally less than $150K per year). Deviations from these targeted figures are possible.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum duration of awards</td>
<td>1 year for Regular proposals and up to 3 years for Large proposals (see Section 1.3)</td>
</tr>
<tr>
<td>Due date for Notice of Intent to propose (NOI)</td>
<td>Option not available</td>
</tr>
<tr>
<td>Due date for phase-1 proposals</td>
<td>4:30 p.m. eastern time on February 23, 2018 via ARK RPS (see Section 2.2.1).</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>5-10 months after proposal due date.</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of Phase-1 proposal</td>
<td>4 pp for regular proposals, 6 pp for large proposals; 1 additional page is required to describe joint program observations (see Section 1.5). Page limits include figures and references. This instruction supersedes the limits given in the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the Astrophysics questions and goals in the NASA Science Plan (<a href="https://science.nasa.gov/about-us/science-strategy">https://science.nasa.gov/about-us/science-strategy</a>). Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required in PDF format; no hard copy is required. See Section IV of the ROSES Summary of Solicitation and Chapter 3 of the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of Notice of Intent to propose (NOI)</td>
<td>Option not available</td>
</tr>
<tr>
<td>Web site for submission of Phase-1 proposal via NSPIRES</td>
<td>Option not available</td>
</tr>
<tr>
<td>Web site for submission of Phase-1 proposal via Grants.gov</td>
<td>Option not available</td>
</tr>
<tr>
<td>Web site for submission of Phase-2 proposals</td>
<td><a href="http://nspires.nasaprs.com">http://nspires.nasaprs.com</a></td>
</tr>
</tbody>
</table>
| Programmatic information may be obtained from the Fermi Program Scientist | Stefan Immler  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-0615  
Email: Stefan.M.Immler@nasa.gov |
|---|---|
| Technical questions concerning this program element may be directed to the Fermi Science Support Center | Chris Shrader  
Code 661  
NASA Goddard Space Flight Center  
Greenbelt, MD 20771-0001  
Telephone: (301) 286-8434  
Email: Chris.R.Shrader@nasa.gov  
Help Desk: http://fermi.gsfc.nasa.gov/ssc/help/ |
| Questions concerning Fermi capabilities may be directed to the Fermi Project Scientist | Julie McEnery  
Code 661  
NASA Goddard Space Flight Center  
Greenbelt, MD 20771  
Telephone: 301-286-1632  
Email: Julie.E.McEnery@nasa.gov |
K2 GUEST OBSERVER – CYCLE 6

NOTICE: Amended on August 17, 2017. This amendment releases final text for this program element.

This program element will use a new two-phase submission and target selection process (see Section 7.1), since spacecraft fuel is estimated to run out during these observations.

An optional Phase-1 proposal (see Section 7.1.1), for all three campaigns (17-19) combined, will enable targets to be selected ahead of the observing campaigns. Phase-1 proposals, including target lists and a scientific rationale (both submitted via email to keplergo@mail.arc.nasa.gov), are requested by October 12, 2017.

If the spacecraft health and fuel allow, then Phase-2 proposals (see Section 7.1.2) will be due April 19, 2018 (via NSPIRES). Phase-2 proposals are limited to use observations for targets which have been selected as part of Phase-1, the selection results of which will be published in February 2018 at https://keplerscience.arc.nasa.gov.

1. Scope of Program

This program element solicits proposals for the acquisition and analysis of new scientific data from the K2 mission (http://keplerscience.arc.nasa.gov). K2 repurposes the space-borne hardware and ground-based operations of the Kepler mission (http://keplerscience.arc.nasa.gov) for a pointed survey of predetermined locations along the ecliptic plane. The single, visible-wavelength instrument on board K2 provides high-precision photometry capability, with short cadence and long cadence modes (1 minute and 30 minute exposures, respectively), and provides a powerful tool for broadband variability analyses of planetary, stellar, extragalactic, and solar system sources.

1.1 Background

The loss of a second of the four reaction wheels on board the Kepler spacecraft in May 2013 brought an end to its four plus year primary science mission to continuously monitor more than 150,000 stars in the 116 square degree Kepler field for transiting exoplanet candidates. Developed over the months following this failure, the K2 mission represents a new concept for spacecraft operations that enables continued scientific observations with the Kepler space telescope. The K2 mission entails a series of sequential observing "Campaigns" of fields distributed around the ecliptic plane and offers a photometric precision approaching that of the original Kepler mission to within a factor of approximately two (http://keplerscience.arc.nasa.gov/k2-observing.html#fine-point-photometric-precision). Operating in the ecliptic plane minimizes the torque exerted on the spacecraft by solar wind pressure, reducing pointing drift to the point where spacecraft attitude can effectively be controlled through a combination of thrusters and the two remaining reaction wheels. Each ecliptic Campaign is limited by
Sun angle constraints to a duration of approximately 80 days. Therefore, four to five K2 Campaigns can be performed during each future 372-day orbit of the spacecraft. A description of the Campaign field distribution across the sky and the full mission concept is provided at http://keplerscience.arc.nasa.gov/k2-fields.html and http://keplerscience.arc.nasa.gov/k2-observing.html.

2. Scope of this Solicitation

This solicitation is specifically for science utilizing data collected within K2 Campaigns 17, 18, and 19 observing fields. Supporting technical and scientific material is available at the Kepler Science Center website for the K2 mission (http://keplerscience.arc.nasa.gov). A separate solicitation will be released for future Campaigns. There is also expected to be a small, unfunded Director’s Discretionary Targets (DDT) program run by the K2 GO office to allow exceptional targets to be proposed for outside the regular call for proposals. DDT proposals will be handled through the GO Office (http://keplerscience.arc.nasa.gov/k2-ddt.html), outside of ROSES.

3. Changes Since K2 Guest Observer (GO) Cycle 5 in ROSES-2016

This solicitation is for different K2 observing fields, namely Campaigns 17, 18 and 19, described in Sections 2 and 5. Investigations that have broadly similar goals and team members to selected Cycle 1, Cycle 2, or Cycle 3 proposals may use up to an additional 0.5 pages to describe progress they have made to delivering value-added community resources.

Unlike previous cycles, target lists must now be submitted as part of a Phase-1 submission, which is handled by the GO office outside of the NSPIRES submission requirements (for instructions see https://keplerscience.arc.nasa.gov/k2-proposing-targets.html). Phase-2 proposals are limited to use targets which have been proposed and selected, for any team, as part of the Phase-1 process.

4. The K2 Mission

4.1 K2 Mission Science

Unlike the Kepler mission, there are no primary science objectives for the K2 mission in most Campaigns (with the exception of Campaign 9). While K2 continues to further the science goals of the Kepler mission – identifying exoplanet candidates and providing data for the calculation of planet occurrence rates – the spacecraft is now primarily a general-user facility (http://keplerscience.arc.nasa.gov).
4.2 Instrumentation and Technical Capabilities

The Kepler spacecraft is in a heliocentric orbit, which insures a thermally stable environment and provides the ability to remain on a single pointing for the duration of each Campaign. Pointing is maintained by a combination of two reaction wheels and thrusters, reacting to motion data provided by fine guidance sensors (fine-point observing) or star trackers (coarse-point observing). With only two remaining reaction wheels, these operations are only possible while pointing within the orbital plane of the spacecraft, which approximates to the ecliptic. Only this specific family of pointings yields operational configurations where solar pressure is largely mitigated by spacecraft geometry, thereby making viable precision pointing and photometry approaching the quality for the Kepler mission. K2 has demonstrated a benchmark photometric precision on an \( m_v = 12 \) G2V star of \(~170\) parts-per-million (ppm) in 30 minutes of integration, i.e., one long cadence exposure. This corresponds to \(~50\) ppm over a 6.5-hour transit of an Earth-sized body around that star.

While stars brighter than \( m_v = 11.5 \) will saturate some pixels, K2 performs well on stars as bright as \( m_v = 4 \), provided the scientific benefit justifies the large number of pixels needed to capture saturated flux bleeding along CCD columns. Targets brighter than \( m_v = 3 \) will not be observed because they bleed off the CCD. K2 also has many faint-target scientific applications where \( m_v = 20 \) objects yield a photometric precision of a few percent over 30 minutes.

The broad photometric bandpass has a half-maximum transmission range of 430 to 840 nm. The instrument does not have changeable filters, dispersing elements, nor a shutter. The detector has a pixel scale of 3.98 arcseconds. Image quality varies with position in the focal plane, with the 95% encircled energy diameter ranging from 3.1 to 7.5 pixels, with a median of 4.2 pixels. The percentage of point-source flux concentrated in the center pixel is between 20% and 62%, with a median value of 45%.

4.3 Observing Modes and Data Products

Constraints imposed by onboard storage and communications dictate that at most 6% of the data from the full focal plane are saved and downloaded. Instead, data for specific, predetermined targets are saved and transmitted as subimages with a typical area of 160 pixels, depending on source brightness. The brighter a target, the more pixels are required to capture it. Image size can be tailored further to accommodate extended or very bright, saturated objects. The current solicitation requests target proposals for Campaigns 17, 18, and 19. The Kepler Science Center will derive pixel masks for those targets successfully justified by proposers as part of Phase-1 and upload these targets to the spacecraft before each Campaign.

All observations are taken at one of two temporal resolution settings: long (30-minute) or short (1-minute) cadence. It is expected that on the order of 10,000 to 20,000 long cadence targets will be available per Campaign, and approximately 50-100 short cadence targets. Extended or bright objects requiring larger aperture sizes decrease the total number of targets available to the GO program and must be well justified.
Data distribution and archival services will be performed by the Space Telescope Science Institute’s Mikulski Archive for Space Telescopes (MAST) archive (https://archive.stsci.edu). Final data products available to observers will include original and calibrated pixel values and long cadence light curves for each individual target. The calibration will correct for bias level, smear, galactic cosmic rays, flat fielding, dark current, background, and instrument noise. Simple aperture photometry will be used to generate the light curves.

Data will be delivered to the observer in Flexible Image Transport System (FITS) format. A thorough understanding of the noise sources and systematic errors of K2 will be needed by observers in order to generate their own light curves from the original (uncalibrated or calibrated) pixel data or interpret structure found in archived light curves. There is no exclusive use period associated with any K2 GO data.

5 Guest Observer Science

5.1 Permitted GO Science Areas

There are no guaranteed, or predetermined, targets for K2 Campaigns 17, 18, and 19. All K2 targets are proposed by the community through Phase-1 of the GO program or the DDT program.

For Campaign 17, 18, and 19 targets, the K2 GO Program welcomes proposals addressing compelling scientific questions in any area of astrophysics and planetary science providing the required observations are amenable to the operational characteristics and constraints of the mission. These may include, but are not limited to, exoplanet detection, stellar astrophysics, galactic and extragalactic astrophysics, and Solar System science. A single proposal can be used to request targets in more than one campaign. All science proposals must be compelling and well-justified scientifically and technically. Proposers should particularly note that short cadence resources and bright targets are expensive in pixels and onboard storage and have historically been in high demand. Short cadence proposals must justify scientifically and technically the need for higher cadence monitoring relative to long cadence observations.

Proposers must take into account the difference between science that can be achieved exclusively using archived K2 and Kepler data and science that requires new observations by K2. The K2 GO program is specific to the case of science requiring new observations. Funding for archival science is provided through the Astrophysics Data Analysis Program (ADAP; Appendix D.2 of ROSES-2017). This includes all Kepler data and K2 Campaigns 0-16. All proposals to this call must justify the need for new observational data within their program. However, NASA welcomes proposals that build upon data already collected and programs requiring more data to enhance or complete investigations.

5.2 On-source Monitoring Times

Each K2 Campaign has a duration of approximately 80 days and remains fixed upon a single boresight position. The target list remains fixed throughout the full duration of a Campaign; targets cannot be swapped during a Campaign. The locations and observing
windows of Campaigns 17, 18, and 19 are provided at http://keplerscience.arc.nasa.gov/k2-fields.html.

5.3 Target Selection Tools

Pointed observations away from the single stare position of any given field cannot be accommodated by K2; Campaign targets are limited to the objects available in the fixed field of view. Small gaps between the 42 detector CCDs result in additional loss of available objects that would otherwise be within the Kepler field of view. A documented target search tool, http://archive.stsci.edu/k2/epic/search.php, determines if an object of a particular coordinate lies close to the observable field of view. The target search tool accesses the Ecliptic Plane Input Catalog (EPIC), which provides physical data, coordinates, magnitudes, and colors, for sources close to K2 silicon. The EPIC is complete to only $m_v \sim 17$; specifications of the catalog are documented at http://archive.stsci.edu/k2/epic.pdf. It is the proposer’s responsibility to identify targets that are faint or missing from the EPIC. K2 collection of valid data relies on the delivery of accurate celestial positions, proper motions (if needed), and magnitudes of each target. Proposals must state the origin for this information, especially if it does not come from the EPIC. Determining whether or not desired targets fall on active regions of the focal plane is also the responsibility of the proposer. The Kepler Science Center at http://keplerscience.arc.nasa.gov/software.html#k2fov provides a tool to identify which targets fall upon active silicon. Only those targets within the active fields of view should be proposed.

5.4 Target Table

All proposals for targets are required to include a target table with the format shown in Table 1 to specify desired observing modes and other needed parameters. A definition of each column and a template for insertion into the proposal may be downloaded from the Kepler Science Center website at http://keplerscience.arc.nasa.gov/k2-proposing-targets.html. In addition to appearing as text within the proposal, this table must also be submitted electronically to the Kepler Science Center. Table 1 below includes example entries.

<table>
<thead>
<tr>
<th>Object</th>
<th>Right Ascension (deg) J2000</th>
<th>Declination (deg) J2000</th>
<th>Kp (mag)</th>
<th>Cadence (min)</th>
<th>Proper motion (*/yr)</th>
<th>Extant (arcsec)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>204436324</td>
<td></td>
<td></td>
<td>12.6</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>203457483</td>
<td></td>
<td></td>
<td>13.9</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J133853.2+010514.6</td>
<td>174.72172</td>
<td>1.08747</td>
<td>18.3</td>
<td>30</td>
<td></td>
<td></td>
<td>Not in EPIC, Kp estimated from SDSS</td>
</tr>
<tr>
<td>201744789</td>
<td></td>
<td></td>
<td>11.4</td>
<td>30</td>
<td></td>
<td>11</td>
<td>Extended object with radius 11.0 arcsec</td>
</tr>
<tr>
<td>207942562</td>
<td>172.57983</td>
<td>-2.96567</td>
<td>14.5</td>
<td>30</td>
<td>0.13</td>
<td>0.35</td>
<td>High proper motion star</td>
</tr>
</tbody>
</table>

Table 1: Required Format of Target Table.
See http://keplerscience.arc.nasa.gov/k2-proposing-targets.html - target-table for instructions on completing the table.
6. Programmatic Information

6.1 Proposal Submission and Evaluation
There are two categories of K2 guest observer proposals in Cycle 6. They are:
- **Small proposals**—proposals requesting fewer than 1000 targets, with a budget capped at $50,000.
- **Large proposals**—proposals requesting 1000 or more targets, with a budget capped at $150,000. Large proposals must also include the development and dissemination of a value-added community resource product.

The above cost caps are for the total cost of the award, including NASA Civil Servant Salary and overhead. Proposers should not include detailed budget information with either Phase-1 or Phase-2 proposals. NASA will seek detailed budgets from selected proposals after peer review.

Proposals submitted to NASA in response to this solicitation will be evaluated with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*, which are intrinsic merit, relevance to the K2 Cycle 6 GO solicitation, and the realism/reasonableness of the proposed work effort and resources. In addition to the factors for intrinsic merit given in the *NASA Guidebook for Proposers*, intrinsic merit includes the following factors:
- The suitability of using the K2 observatory and data products for the proposed investigation;
- The legacy value of the data collected;
- The degree to which the investigation uses K2’s unique capabilities;
- The feasibility of accomplishing the objectives of the proposed investigation with the requested observations, including the degree to which the proposal satisfies K2’s observational constraints; and
- The feasibility and suitability of the proposed analysis techniques.

6.2 Budget Justification, Period of Performance, and Availability of Funds
For Campaigns 17, 18, and 19, funding amounts will be determined formulaically based on target allocation. Award sizes will range from $30K for a few targets to up to $50K for 999 targets. Proposals of over 1000 targets may receive up to the maximum award amount of $150K.

K2 Cycle 6 Guest Observer (GO) programs will exploit data collected in K2 Campaign 17, Campaign 18, and/or Campaign 19 fields and will begin around March 2018. Funding for selected programs in Campaigns 17, 18, and 19 will start once data is made available through the public archive at the Mikulski Archive for Space Telescopes (MAST), which is anticipated to begin approximately three months after the end of Campaign 17. There is no exclusive use period associated with any K2 GO data. The duration of awards will be one year, not including no-cost extensions.
6.3 Eligibility

Except as described in the following paragraph, application to the K2 GO program is open to all investigators, including those from outside the U.S. under NASA’s no-exchange-of-funds policy. Investigators who are not affiliated with a U.S. institution are not eligible for funding through this program. Co-Investigators (Co-Is) affiliated with a U.S. institution are eligible to receive funding under a proposal led by a foreign Principal Investigator (PI). In this scenario, only a single Co-Investigator per proposal will be considered as a lead PI for funding purposes, and proposals should identify a lead Co-Investigator within the U.S.

However, in accordance with Public Law 113-76, Division B, Title V, Section 532, NASA cannot support bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement. See Section III(c) of the ROSES-2017 NRA and the ROSES FAQ on this subject for more information on these restrictions.

7. Submission of Proposals to the K2 Cycle 6 GO Program

7.1 The Two-Phase Proposal Submission Process

To enable the timely selection of targets, while also facilitating the early recruitment of conflict-free reviewers, and to ensure that proposal concepts are responsive to and compliant with the solicitation, the K2 GO program will use a two-phase proposal submission process (see Section IV(b)(vii) of the ROSES Summary of Solicitation.)

A Phase-1 proposal must be submitted electronically directly by the PI team to the Kepler GO Office at (keplergo@mail.arc.nasa.gov). Unlike prior K2 GO Cycles, Phase-1 proposals must include target lists and a strong scientific justification of the target selection. This is to enable targets to be selected ahead of these Campaigns, allowing the submission of Phase-2 proposals (for funding) to be postponed until after the successful start of Campaign 17 is confirmed in April 2018. The Phase-1 proposal PI, team, title, summary, and text is not binding and can be revised in Phase-2.

Both Phase-1 and Phase-2 proposals will be peer-reviewed and ranked by professional volunteers. The ranking of Phase-1 proposals will only inform the target selection, while the ranking of Phase-2 proposals will only inform the selection of science programs for funding. Phase-2 proposals are restricted to using targets that are selected as part of Phase-1 (regardless of the team that proposed the observations). New targets cannot be requested as part of Phase-2.

Submission of the Phase-1 proposal does not obligate the proposer to submit a Phase-2 (full) proposal later. No budget is required for either the Phase-1 or Phase-2 proposals. The funding level for awards is cost capped, see Section 6.1.
7.1.1 Phase-1 Proposals

Phase-1, for all three Campaigns combined, will consist of up to 2 pages for small programs (less than 1000 targets) and up to 4 pages for large programs (1000 targets or more), including all figures, tables, and references, in a PDF file. The text must be accompanied by separate target tables (one per Campaign), that do not count toward the 2/4-page limit, and must be prepared in the format specified here: https://keplerscience.arc.nasa.gov/k2-proposing-targets.html#target-table. Targets in the target table must be ordered by priority.

The Phase-1 proposal must include a title, team, and summary, followed by a body of text which offers a strong scientific justification of the target list and explains the long-term legacy value of the proposed targets. Large programs must also include a detailed description of the target selection criteria, and explain how the target list may be scoped if required by the spacecraft’s limited on-board storage. The proposal format requirements as explained in Section 7.2 apply. Proposers are encouraged to use the Phase-1 proposal template available from https://keplerscience.arc.nasa.gov/k2-proposing-targets.html.

The Phase-1 proposal (one PDF document) and target tables (one table per campaign) must be submitted via email to keplergo@mail.arc.nasa.gov by October 12, 2017.

The Phase-1 proposals will only determine the selection of targets for Campaigns 17, 18 and 19. To be considered for funding, proposers must submit a Phase-2 proposal following the instructions detailed below. A Phase-1 submission is encouraged, but not mandatory to qualify for Phase-2, however Phase-2 proposals are only permitted to use targets selected as part of the Phase-1 process.

7.1.2 Phase-2 Proposals

The process for preparation and submission of the Phase-2 (full) proposal is essentially identical to that associated with any other ROSES proposal, subject to the following program-specific constraints:

a) Large proposals must include a section of no more than one page in length describing a value-added community resource product that the Large proposal PI will provide at the end of the period of performance of the grant and how that product will be made available to and benefit the community. This product should be greater than simply a published paper. Example products might be delivery of a uniform set of well-produced open cluster star light curves, follow-up ground-based observations of exoplanet host stars, or a catalogue of sources with additional astrophysical information. This information will be used in Large proposal evaluation. Investigations that have broadly similar goals and team members to selected Cycle 1, Cycle 2, and/or Cycle 3 proposals may use up to an additional 0.5 pages to describe progress they have made to delivering value-added community resources. The target list of any Large proposal may be reduced if the need for a large number of targets is not adequately justified in the proposal. If the products are to be ingested and curated at an existing astrophysics archive (e.g., the MAST archive at the Space Telescope Science Institute (STScI) or the NASA Exoplanet Database), the proposal should include a letter of acknowledgement from the relevant archive.
b) The Scientific/Technical/Management section of the Phase-2 proposal, which consists of text, tables (excluding the target table), and figures must not exceed four pages for proposals in the Small category, or six pages for proposals in the Large category. An additional 0.5 pages to describe progress they have made to delivering value-added community resources. References do not count against the page limit.

c) A complete table of targets to be used by the proposed investigation (see Section 5.4) must also be included at the end of the Scientific/Technical/Management section of the proposal, but does not count against the page limit of that section. However, the target table should be truncated in instances where its incorporation will cause the Scientific/Technical/Management section to exceed a length of fifteen-pages. Although Phase-2 proposals cannot request new targets (see Section 7.1), a target list must be included to clarify which observations will be used by the proposed investigation.

d) For the purpose of submitting proposals through NSPIRES, proposers from non-U.S. institutions must affiliate in NSPIRES with the Kepler Guest Observer Office, which will submit the proposal on their behalf. For details, see http://keplerscience.arc.nasa.gov/k2-proposing-targets.html.

e) Complete and submit electronically the proposal through NSPIRES (http://nspires.nasaprs.com). Hard-copy submissions are not permitted.

f) A separate electronic version of the target table must be submitted to the Kepler Science Center by the proposal deadline. An Excel template for the target table, which is suitable for direct insertion into the proposal, instructions about the required file format for submission to the Kepler Science Center, and information regarding the file-naming convention for the target table file are available at http://keplerscience.arc.nasa.gov/k2-proposing-targets.html.

g) All electronic proposal materials (proposal and separate electronic target file submitted to NSPIRES and the Kepler Science Center, respectively) must arrive at the designated destinations by 11:59 p.m. Eastern time on the due date given in Section 8 in order to be included in the proposal review for this cycle of the K2 GO Program.

7.2 Proposal Formatting

This is a reminder that all proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the ROSES Summary of Solicitation and Chapter 2 of the NASA Guidebook for Proposers. Any proposal found to violate these formatting rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: The NASA Guidebook for Proposers requires easily read fonts having, on average, no more than 15 characters per inch (e.g., 12-point Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line-spacing settings for a selected font below single-spaced.
7.3 Sources of Additional Information

The Kepler Science Center (http://keplerscience.arc.nasa.gov), located at the NASA Ames Research Center, provides support to Guest Observers and to proposers of this solicitation, such as technical information about the K2 mission and instrument, and other information supporting proposal preparation, including a Frequently Asked Questions link and template files for proposal preparation. Contact information may be found in Section 8.

8. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected program budget for Campaigns 17, 18, &amp; 19 awards</th>
<th>~$1.5M. The funding level for awards are cost capped (see Section 6.1).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated number of funded investigations selected for observations</td>
<td>~7 Large investigations containing &gt;1,000 observed targets over Campaigns 17, 18, and 19 combined, and ~12 Small investigations containing &lt;1,000 observed targets over Campaigns 17, 18, and 19 combined.</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>1 year</td>
</tr>
<tr>
<td>Due Date for email submission of Phase-1 proposals</td>
<td>October 12, 2017</td>
</tr>
<tr>
<td>Due Date for electronic submission of Phase-2 proposals</td>
<td>April 19, 2018</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>Funds will be awarded when the data are made publicly available. This typically occurs three months after the end of a Campaign. Proposers should use August 31, 2018 as the probable date for receiving data from Campaign 17. For reference, this observing cycle is anticipated to begin around March 1, 2018.</td>
</tr>
<tr>
<td>Page limit for the Phase-2 central Science-Technical-Management section</td>
<td>Small proposals: No more than four pages for the Scientific/Technical/Management section, including text, tables, and figures. Large proposals: No more than six pages for the Scientific/Technical/Management section, including text, tables, and figures. Up to an additional 0.5 pages is allowed to describe progress toward delivery of value-added community resource products by PIs with selected K2 GO Cycle 1, Cycle 2, or Cycle 3</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the Astrophysics strategic goals and subgoals in NASA’s <em>Strategic Plan</em>. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See <em>ROSES Summary of Solicitation</em>.</td>
</tr>
<tr>
<td>Submission medium and number of copies</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the <em>ROSES Summary of Solicitation</em> and Chapter 3 of the <em>NASA Guidebook for Proposers</em>.</td>
</tr>
<tr>
<td>Address for submission of Phase-1 proposals via email</td>
<td><a href="mailto:keplergo@mail.arc.nasa.gov">keplergo@mail.arc.nasa.gov</a></td>
</tr>
<tr>
<td>Web site for submission of Phase-2 proposals via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com">http://nspires.nasaprs.com</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of Phase-2 proposals via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td>Funding opportunity number for downloading a Phase-2 application package from Grants.gov</td>
<td>NNH17ZDA001N-K2GO6</td>
</tr>
<tr>
<td>Mandatory submission of electronic version of target table for both Phase-1 and -2</td>
<td><a href="http://keplerscience.arc.nasa.gov/k2-proposing-targets.html#target-table">http://keplerscience.arc.nasa.gov/k2-proposing-targets.html#target-table</a></td>
</tr>
<tr>
<td>Kepler Science Center</td>
<td>Webpage: <a href="http://keplerscience.arc.nasa.gov">http://keplerscience.arc.nasa.gov</a> Email: <a href="mailto:keplergo@mail.arc.nasa.gov">keplergo@mail.arc.nasa.gov</a></td>
</tr>
<tr>
<td>Technical questions concerning this program element may be directed to the Kepler Science Center</td>
<td>Geert Barentsen Kepler Guest Observer Office NASA Ames Research Center, MS 244-30 Moffett Field, CA 94035-1000 Telephone: (650) 604-2784 email: <a href="mailto:keplergo@mail.arc.nasa.gov">keplergo@mail.arc.nasa.gov</a></td>
</tr>
</tbody>
</table>
| NASA point of contact for programmatic information | Mario Perez  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-1535  
email: mario.perez@nasa.gov |
|--------------------------------------------------|---------------------------------------------------------------|
NOTICE: Amended on March 14, 2018. This amendment delays due dates in anticipation of power loss to New England as a result of the upcoming storm. The proposal due dates for ROSES-2017 D.3 Astrophysics Research and Analysis and ROSES-2017 D.8 Strategic Astrophysics Technology have been changed to Monday March 19, 2018.

Amended on January 23, 2018. To account for time lost to the government shut down, this amendment extends by one day the due dates for program elements that were due the week of the shutdown. The mandatory NOI due date for this program element is now Friday January 26, 2018.

Amended November 16, 2017. This amendment changes the proposal submission process for this program element to make Notices of Intent (NOIs) mandatory. Proposals that are not preceded by an NOI may be returned without review. The due date for mandatory NOIs is January 25, 2018. The due date for proposals is March 15, 2018. In addition, a number of small changes have been made to the text. New text is in bold, deleted text is struck through.

In order to rapidly advance key technologies for future large strategic missions ahead of the next decadal survey, NASA selected a large set of SAT-2016 proposals. This has significantly reduced the funding available for new selections in SAT-2017. Only proposed investigations critical to be started at this time are likely to be selected.

1. Scope of Program

1.1 Overview

Over the next decade and beyond, NASA’s Astrophysics Division expects to undertake space flight missions that will explore the nature of the universe at its largest scales, its earliest moments, and its most extreme conditions; missions that will study how galaxies and stars formed and evolved to shape the universe we see today; and missions that will search and characterize the planets and planetary systems orbiting other stars. To enable implementation of these missions, the NASA Science Mission Directorate’s Astrophysics Division has established the Strategic Astrophysics Technology (SAT) program to support the maturation of key technologies to the point at which they are feasible for implementation in space flight strategic missions.

The 2010 Decadal Survey of Astronomy and Astrophysics (hereafter, Astro2010), strongly endorsed the SAT program (http://www.nap.edu/catalog.php?record_id=12951). The SAT program is a key element of the strategy adopted by the Astrophysics Division in implementing the Astro2010
recommendations (see the Astrophysics Implementation Plan at https://science.nasa.gov/astrophysics/documents).

The focus of the SAT program is described in terms of the Technology Readiness Level (TRL) of the technologies involved. NASA uses a nine-level classification system to rate the readiness of a particular technology for use in a space flight mission. The TRL definitions are articulated in detail in NPR 7123.1B Appendix E (http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7123_001B&page_name=AppendixE). Briefly, TRL levels one to three are generally considered to be basic research on new technologies, while TRL levels seven to nine correspond to the development of flight hardware.

The SAT program is designed to support the maturation of technologies whose feasibility has already been demonstrated (i.e., TRL 3), to the point where they can be incorporated into NASA flight missions (TRL 6-7). Table D.8.1 provides the definitions for the midrange TRLs supported by the SAT program.

<table>
<thead>
<tr>
<th>TRL</th>
<th>Definition</th>
<th>Hardware Description</th>
<th>Software Description</th>
<th>Exit Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>- Analytical and experimental critical function and/or characteristic proof-of-concept</td>
<td>Analytical studies place the technology in an appropriate context and laboratory demonstrations, modeling and simulation validate analytical prediction.</td>
<td>Development of limited functionality to validate critical properties and predictions using nonintegrated software components.</td>
<td>Documented analytical/experimental results validating predictions of key parameters.</td>
</tr>
<tr>
<td>4</td>
<td>Component and/or breadboard validation in laboratory environment.</td>
<td>A low fidelity system/component breadboard is built and operated to demonstrate basic functionality and critical test environments, and associated performance predictions are defined relative to final operating environment.</td>
<td>Key, functionality critical software components are integrated and functionally validated to establish interoperability and begin architecture development. Relevant environments defined and performance in the environment predicted.</td>
<td>Documented test performance demonstrating agreement with analytical predictions. Documented definition of relevant environment.</td>
</tr>
<tr>
<td>TRL</td>
<td>Definition</td>
<td>Hardware Description</td>
<td>Software Description</td>
<td>Exit Criteria</td>
</tr>
<tr>
<td>-----</td>
<td>------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>5</td>
<td>Component and/or breadboard validation in relevant environment.</td>
<td>A medium fidelity system/component brassboard is built and operated to demonstrate overall performance in a simulated operational environment with realistic support elements that demonstrate overall performance in critical areas. Performance predictions are made for subsequent development phases.</td>
<td>End-to-end software elements implemented and interfaced with existing systems/simulations conforming to target environment. End-to-end software system tested in relevant environment, meeting predicted performance. Operational environment performance predicted. Prototype implementations developed.</td>
<td>Documented test performance demonstrating agreement with analytical predictions. Documented definition of scaling requirements.</td>
</tr>
<tr>
<td>6</td>
<td>System/subsystem model or prototype demonstration in a relevant environment.</td>
<td>A high fidelity system/component prototype that adequately addresses all critical scaling issues is built and operated in a relevant environment to demonstrate operations under critical environmental conditions.</td>
<td>Prototype implementations of the software demonstrated on full-scale, realistic problems. Partially integrated with existing hardware/software systems. Limited documentation available. Engineering feasibility fully demonstrated.</td>
<td>Documented test performance demonstrating agreement with analytical predictions.</td>
</tr>
</tbody>
</table>

The Astrophysics Division has three main science programs: Exoplanets Exploration (ExEP), Physics of the Cosmos (PCOS), and Cosmic Origins (COR), which cover, respectively, the search for planets outside the Solar System, the origin and evolution of the universe, and the birth of stars and galaxies. These areas of scientific interest are represented within the SAT program through its three elements:
- Technology Development for Exoplanet Missions (TDEM)
- Technology Development for Physics of the Cosmos (TPCOS)
- Technology Development for the Cosmic Origins (TCOR)
1.2 Requirements for SAT Proposals

This section describes the general requirements for SAT proposals common to TDEM, TPCOS, and TCOR. Proposers are also urged to read Sections 2, 3, and 4 for further details on the requirements specific to each science area.

Proposers shall:

- Identify the SAT element(s) most closely related to the proposed technology (e.g., TDEM, TPCOS, TCOR; Sections 2, 3, and 4, respectively). Proposed technologies may be relevant to more than one of these three areas. Consequently, NASA reserves the right to reassign a proposal to any of the three Programs for the purposes of review and funding;
- Identify a strategic mission or mission concept to which the proposed technology is anchored (competed missions, such as Explorers, are not considered strategic missions);
- Describe the proposed path to achieving the goals of the proposed technology. In particular:
  (a) Provide proof that the technology being proposed is already at TRL=3;
  (b) Specify the expected end TRL at the conclusion of the proposed program. However, it is neither required nor expected that proposers will complete this entire development process (or even advance a full step on the TRL scale) within the two or three year duration of proposals solicited in this call;
  (c) Define at least one objectively verifiable milestone that represents a meaningful advancement of their chosen technology and provide a schedule for achieving that (those) milestone(s) over the course of their proposed project;
  (d) Describe a work plan that fully articulates the technical parameters to be demonstrated for all technical milestones identified. This work plan should include the measurements to be made, analyses to be applied, success criteria, and documentation to be provided. The work plan and associated milestones will be critically evaluated as part of the peer-review process.

In addition, both the NASA Guidebook for Proposers and Section IV(b)ii of the ROSES-2017 Summary of Solicitation provide clear and specific requirements for the format of proposals submitted in response to this solicitation (e.g. page limits, acceptable font sizes, line spacing, margins, etc.). Proposals found to violate these guidelines will be penalized, even to the extent of being declined without review, or not being funded, independent of their intrinsic merit evaluation. Proposers are reminded that it is the PDF version of their proposal in NSPIRES that will be judged for compliance. Since, in rare cases, cross-platform translation of PDF documents can alter the formatting of a document, proposers are strongly urged to download copies of any documents they upload to the NSPIRES system to ensure that they still conform to all formatting requirements. NASA does not require a data management plan for proposals to this program element.
1.3 New Proposal Submission Requirement: Mandatory NOIs
[This Section was added on November 16, 2017]

To facilitate the early recruitment of a conflict-free review panel and ensure that proposals are submitted to the appropriate category, a NOI is required for all submissions to this Program Element. Proposals that are not preceded by an NOI may be returned without review.

The PI cannot be changed and proposers who want to add funded investigators between the NOI and the proposal submission must inform the point(s) of contact identified in the summary table of key information and cc sara@nasa.gov at least two weeks in advance of the proposal due date. Additions of funded investigators within two weeks of the proposal deadline require explicit permission from the NASA point of contact. Submission of a NOI does not obligate the proposer to submit a full proposal later.

1.4 Annual Program Office Presentations

In addition to the annual progress report, successful proposers may also be asked to present orally their results to the Program Office and other relevant officers (See Sections 2, 3, and 4). NASA reserves the right to terminate an award if it deems that achievement of the proposed goals according to the proposed schedule is unlikely to occur.

2. Technology Development for the Exoplanet Exploration Program

NASA’s Exoplanet Exploration Program (ExEP) supports the development of those technologies that will allow us to search and characterize extrasolar planets and planetary systems. As compelling as these future ExEP missions are, implementing them presents many daunting technological challenges. The Technology Development for Exoplanet Missions (TDEM) element of the SAT Program is designed to support the maturation of key technologies that will overcome these challenges and pave the way to ever more ambitious exoplanet exploration missions. Further information on the scope and activities of the ExEP can be found at https://exoplanets.nasa.gov/exep/.

2.1 TDEM Areas of Emphasis
[This Section was changed on November 16, 2017]

The long term goal for NASA’s ExEP envisioned by Astro2010 is a "New Worlds Mission" that would conduct imaging and spectroscopy of rocky planets in the habitable zones of stars in the Solar neighborhood. To meet the challenge of Astro2010 and to prepare for Astro2020, the TDEM element of the SAT program solicits investigations that will advance the technology readiness of key technologies that will enable a future strategic New Worlds Mission, with the near term goal of bringing both coronagraph- and starshade-based systems to TRL 5 by the end of the current decade. Detailed discussion of the current technology needs in the relevant areas can be found in the ExEP Technology Plan Appendix, which can be downloaded at https://exoplanets.nasa.gov/exep/technology/gap-lists/. Prospective SAT/TDEM proposers are strongly encouraged to review this document before preparing their
proposal, as it reflects the programmatic considerations that will be taken into account in the review and selection of TDEM submissions. Proposers are also encouraged to review the list of current and past SAT/TDEM investigations (https://exoplanets.nasa.gov/exep/technology/TDEM-awards/) as these may also influence the programmatic prioritization of potential new investigations.

**With the exception of the specific exclusions listed in Sec. 2.2, proposals will be accepted for all of the technologies listed in the ExEP Technology Gap List, with priority given to the highest-ranked technologies. The 2018 Gap List can be downloaded at [https://exoplanets.nasa.gov/exep/technology/gap-lists](https://exoplanets.nasa.gov/exep/technology/gap-lists).**

Technology activities of particular interest to the ExEP and the TDEM Program are those that undertake milestones in the following areas:

1. **Starlight Suppression Demonstrations**
   Demonstration of technologies that will enable a space observatory to reject scattered starlight to the degree that the light of an exoplanet can be separated from that of its parent star ($10^{-10}$ contrast ratio at visible wavelengths for an earthlike planet orbiting a sunlike star). For coronagraph technologies, this includes interest in demonstrations with obscured and unobscured, segmented apertures suitable for operation with large space telescopes.

2. **Wavefront Stability Demonstrations and Assessments**
   In order to achieve the $10^{-10}$ starlight suppression requirements to directly image and characterize rocky exoplanets in the habitable zone of Sun-like stars, future telescope/coronagraph systems will need to conduct long integration observations requiring sub-nanometer wavefront stability. There are many important component and subsystem contributors to achieving this stability goal such as wavefront sensing and control, mirror segment rigid-body sensing and control, and active and passive dynamic isolation from disturbances. Many of these subsystem performances along with other parameters such as material properties are inter-dependent and can be traded between each other. By taking a systems view, both contrast and stability requirements can be better met while easing some component- and subsystem-level requirements. Therefore, there is particular interest in end-to-end integrated telescope and coronagraph systems-level engineering design and modeling studies that optimize system-level performance. While there is a focus on system-level investigations, component-level investigations that can be shown to have wavefront and structural stability applications across multiple telescope/coronagraph architectures are also of interest.

Relevant technology development activities involving ground-based astronomical facilities are eligible for funding under the TDEM element, providing there is clear and explicit traceability to a future exoplanet mission. Unfortunately, due to budgetary constraints, proposals for suborbital programs are not solicited at this time.

Over the years, the ExEP has developed a number of advanced testing and modeling tools to support the development of exoplanet exploration technologies. These tools are available to the community and proposers are encouraged to take advantage of them, as appropriate. An informational workshop will be held in advance of the proposal deadline to provide information for proposers wishing to take advantage of one or more
of the available ExEP test facilities and/or tools and to provide guidance for developing quantitative, practical technology milestones for their proposed task. Information about the scheduling of the workshop and instructions for participation will be posted at https://exoplanets.nasa.gov/exep/news/. One of the ExEP’s two large High Contrast Imaging Testbeds (HCIT) will be available to support new TDEM investigations in Fiscal Year (FY) 2018.

2.2 TDEM-specific Exclusions

Proposals in the following areas are specifically not solicited under the TDEM element of SAT 2017:

- Investigations that advance starshade technologies (funded through the directed starshade technology activity);
- Investigations that advance technologies for future missions with goals other than the direct detection of extrasolar planets (e.g., astrometry, high-precision photometry, transit spectroscopy);
- Investigations that advance technologies for ancillary measurements that (although they may enhance the scientific capabilities of a future mission) do not directly enhance the ability of the system to isolate and analyze the light emitted or reflected from an exoplanet;
- Investigations that advance technologies leading to the development of infrared interferometry as the basis for a future strategic exoplanet direct detection mission;
- Proposals for the development of technologies for potential competed (e.g., Explorer) exoplanet direct detection missions;
- Investigations that address general technology maturation activities without specific application to the requirements of a future strategic exoplanet direct detection mission;
- Proposals for development and maintenance of testing facilities and/or tools that substantively reproduce the capabilities of existing ExEP infrastructure;
- Proposals for the advancement of technologies in the following specific areas, with the exception of those being part of a systems-wide coronagraph/telescope study: (1) detector technology; (2) mirror technology including adaptive systems associated with wavefront sensing and control in coronagraphs; (3) telescope assembly technology; (4) spacecraft sunshields and thermal control; (5) propulsion systems; (6) vibration isolation systems and (7) spacecraft pointing control;
- Investigations that advance coronagraph technologies to the performance levels being targeted under the WFIRST technology development which include: (1) masks/apodizers for Shaped-pupil and hybrid Lyot coronagraphs; (2) low-order wavefront sensing and control; (3) data post-processing; (4) system-level performance demonstration and modeling of obscured, monolithic aperture systems.
2.3 The TDEM Technology Development Model

The ExEP model for advancement of technologies is founded on the following three interrelated components:

1. Demonstration of milestone performance must be stable and repeatable, thereby demonstrating that the result is not spurious or transient;
2. Modeling of the milestone demonstration must be consistent with the demonstrated result, thereby establishing that the behavior is thoroughly understood; and
3. Error budget for the milestone must be consistent with the models.

Milestones proposed under the auspices of the TDEM element may involve one or all of these elements. In addition, milestones for all SAT/TDEM investigations that make use of ExEP high-contrast imaging testbeds shall incorporate both predictive and post-test validated modeling. In the interests of consistency and comparability, investigators will be expected to make use of the ExEP’s existing modeling capability.

For all technical milestones identified in a proposal, the Principal Investigator (PI) will be expected to prepare a milestone white paper—a work plan that fully articulates the technical parameters to be demonstrated, the measurements to be made, analysis to be applied, success criteria, and documentation to be produced. That white paper will be reviewed by an independent technology assessment committee and may be iterated until an agreement between the technologists, the reviewers, and NASA is reached. When the PI believes that his/her team has achieved all of the requirements set forth in their milestone white paper, they will be required to write a milestone report that addresses all of the aspects identified in the original white paper. The milestone report will then be subject to independent review and interaction by the same groups involved in the initial white paper.

3. Technology Development for Physics of the Cosmos (TPCOS) Missions

The primary science objectives of the Physics of the Cosmos (PCOS) Program are to understand the origin and destiny of the Universe, the physics of phenomena near black holes and other compact objects, and the nature of gravity, addressing the question "How does the Universe work?" (See http://science.nasa.gov/about-us/smd-programs/physics-of-the-cosmos/). Missions that are directed at advancing the fields of cosmology, high-energy astrophysics, and fundamental physics are nominally within the scope of this program. Detailed discussion of the current PCOS technology needs in the relevant areas can be found in the most recent version of the PCOS Program Annual Technology Report, which is available from the PCOS Program web site at http://pcos.gsfc.nasa.gov/. Prospective SAT/TPCOS proposers are urged to review this document before preparing their proposals.

The following technological areas are identified as of particular interest for the TPCOS Program:

- *Technologies for X-ray Astrophysics*, including, but not limited to, high-resolution microcalorimeter arrays, lightweight replicated optics and precision structures, high-resolution gratings (both transmission and reflection).
• *Technologies for Gravitational Wave Astrophysics*, including, but not limited to: dimensionally stable, optical telescopes; frequency-stabilized metrology lasers; high-resolution phasemeters; low-noise microthrusters; ultra-quiet inertial references; and long-distance, laser metrology techniques.

• *Technologies for CMB Polarization Measurements*, including, but not limited to, high-throughput cold mm-wave telescopes and large low-background multiplexed arrays of detectors.

Due to the limited budget available, proposals requiring a dedicated suborbital flight (balloon or rocket) for technology tests or risk reduction are not solicited in this call, but may be included in future solicitations. However, proposals that require suborbital balloon or rocket flights may be considered if they piggyback with a payload of an already approved suborbital mission or a payload on a Suborbital Reusable Launch Vehicle. Questions concerning piggyback payloads may be addressed to the individuals listed in the table below.

<table>
<thead>
<tr>
<th>Piggyback Balloon Payload</th>
<th>Piggyback Sounding Rocket Payload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debora Fairbrother</td>
<td>Philip Eberspeaker</td>
</tr>
<tr>
<td>Balloon Program Office</td>
<td>Sounding Rocket Program Office</td>
</tr>
<tr>
<td>Code 820</td>
<td>Code 810</td>
</tr>
<tr>
<td>Wallops Flight Facility</td>
<td>Wallops Flight Facility</td>
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<tr>
<td>NASA</td>
<td>NASA</td>
</tr>
<tr>
<td>Wallops Island, VA 23337</td>
<td>Wallops Island, VA 23337</td>
</tr>
<tr>
<td>Telephone: (757) 824-1453</td>
<td>Telephone: (757) 824-2202</td>
</tr>
<tr>
<td>Email: <a href="mailto:Debora.A.Fairbrother@nasa.gov">Debora.A.Fairbrother@nasa.gov</a></td>
<td>Email: <a href="mailto:Philip.J.Eberspeaker@nasa.gov">Philip.J.Eberspeaker@nasa.gov</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Piggyback Suborbital Reusable Launch Vehicles (sRLV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Yang</td>
</tr>
<tr>
<td>Flight Opportunities</td>
</tr>
<tr>
<td>Space Technology Program</td>
</tr>
<tr>
<td>NASA Headquarters</td>
</tr>
<tr>
<td>Washington, DC 20546</td>
</tr>
<tr>
<td>Telephone: (202) 358-0143</td>
</tr>
<tr>
<td>Email: <a href="mailto:robert.l.yang@nasa.gov">robert.l.yang@nasa.gov</a></td>
</tr>
</tbody>
</table>

The proposal must address the question of how a potential future strategic mission (see Section 1.2) that primarily addresses PCOS science goals will be enabled or enhanced by the proposed suborbital work.

Annual reports for a selected TPCOS investigation must be submitted to the Program Scientist before funds for the following year of the award are disbursed. The annual report shall contain detailed documentation of the progress towards the milestones identified in the proposal, a description of the plan forward, and its expected outcomes.

In addition, PIs of selected investigations shall submit a short status update on a bimonthly basis and make an annual progress presentation to the PCOS Program.
Office. By the end of the full term of the investigation, the Program Office will convene a technology management board to evaluate the technology readiness level realized during the course of the project.

4. Technology Development for the Cosmic Origins Program (TCOR)  
[This section was changed November 16, 2017]

The Cosmic Origins Program (COR) seeks to investigate how planets, stars, galaxies, and cosmic structure come into being and when and how the elements of life in the Universe arose. In general, areas of astronomy and astrophysics not explicitly called out in the previous program definitions (TPCOS and TDEM) fall within the Cosmic Origins Program. Further information on the scope, activities, and the Program Annual Technology Report (PATR) of the Cosmic Origins theme can be found in the website at https://apd440.gsfc.nasa.gov/technology/patrs/documents/cor/2017_COR_PATR.pdf.

Technology priorities are described in the listed on page 22 of the current Cosmic Origins PATR. Other Most of these technology priorities are traceable to technology gaps identified by the several mission concepts under study for the 2020 Decadal Survey, and that are inherently relevant to the goals and objectives of the COR program are also relevant to the SAT program. Proposers are encouraged to consider both sets of technology priorities in their proposals. Relevant COR priorities include, but are not limited to: next generation detectors, optical devices and coatings, and precision large optics. It is the burden of the proposers to show connection(s) between the value, relevance and urgency of the proposed investigation and the priorities described above. Technologies solicited by TDEM (see Section 2.1) are excluded from this element and should be proposed under TDEM.

COR technologies proposed should fill an important gap for the relevant mission concepts under study in preparation for the 2020 Decadal Survey. The proposed advancements should be part of an explicit maturation path, spanning TRLs and key milestones, that these missions could use to reduce risk and improve readiness. Investigations at a point where modest investments in time and resources could produce maximum benefits, are highly desirable.

Proposals that build on previously funded COR technology development must be justified with new, distinct, objectives for the new investigation. Such proposals should also include a clear description of prior advances, milestones, and TRL achieved. The Proper justification and demonstration of the TRL level 3 or higher of the proposed technologies is an explicit requirement for compliance with this SAT call for proposals. The annual report for selected efforts should contain documentation of the progress towards the milestones identified in the proposal.
4.1 Reporting Requirements for TCOR

An Annual Report for each selected investigation must be submitted, containing detailed documentation of the progress towards the milestones identified in the proposal and a description of the plan forward and its expected outcomes. This Report will be included in the Program Annual Technology Report.

In addition, PIs of selected investigations shall submit a short status update on a bimonthly basis, and make an annual progress presentation to the Program Office. By the end of the full term of the investigation, the Program Office will convene a technology management board to evaluate the technology readiness level realized during the course of the project.

5. Summary of Key Information

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<thead>
<tr>
<th><strong>Expected program budget for first year of new awards</strong></th>
<th>Up to $3M [Added November 16, 2017]</th>
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<tbody>
<tr>
<td>Maximum duration of awards</td>
<td>3 years for TDEM and TCOR elements, 2 years for TPCOS; proposals with a term shorter than 2 years will be accepted, but are not encouraged.</td>
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<td>Due date for mandatory Notice of Intent to propose (NOI)</td>
<td>January 26, 2018 [Changed January 23, 2018]</td>
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<tr>
<td>Due date for proposals</td>
<td>March 19, 2018 [Changed March 14, 2018]</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>January 1 of the year following the proposal due date (except proposers from NASA Centers may plan for a start at the beginning of the fiscal year).</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposal</td>
<td>15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see Section I(g) Order of Precedence and Table 1 of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposal via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
</tbody>
</table>
Funding opportunity number for downloading an application package from Grants.gov

| NNH17ZDA001N-SAT |

NASA points of contact concerning this program:
The relevant Program Officers listed below with their areas of expertise, all share the same mailing address:

- Astrophysics Division
- Science Mission Directorate
- NASA Headquarters
- 300 E Street SW
- Washington, DC
- 20546-0001

<table>
<thead>
<tr>
<th>Name</th>
<th>Science Area</th>
<th>Telephone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas Hudgins</td>
<td>TDEM</td>
<td>(202) 358-0988</td>
<td><a href="mailto:Douglas.M.Hudgins@nasa.gov">Douglas.M.Hudgins@nasa.gov</a></td>
</tr>
<tr>
<td>Rita M. Sambruna</td>
<td>TPCOS</td>
<td>(202) 358-2166</td>
<td><a href="mailto:Rita.M.Sambruna@nasa.gov">Rita.M.Sambruna@nasa.gov</a></td>
</tr>
<tr>
<td>Mario R. Perez</td>
<td>TCOR</td>
<td>(202) 358-1535</td>
<td><a href="mailto:Mario.Perez@nasa.gov">Mario.Perez@nasa.gov</a></td>
</tr>
</tbody>
</table>
D.9 Nancy Grace Roman Technology Fellowships in Space Astrophysics for Early Career Researchers

NOTICE: Amended on September 21, 2017. This program element is being closed for the remainder of ROSES-2017 as the Astrophysics division does not anticipate any further applications for funding this year from its current cohort of Roman Technology Fellows.

1. Overview

The goals of the Nancy Grace Roman Technology Fellowship (RTF) program in Astrophysics are to provide early-career researchers the opportunity to develop the skills necessary to lead astrophysics flight instrument development projects, including suborbital investigations, in preparation to become Principal Investigators (PIs) of future astrophysics missions; to develop innovative technologies for space astrophysics that have the potential to enable major scientific breakthroughs; and to foster new talent by putting early career instrument builders on a trajectory towards long-term positions. NASA is committed to supporting deserving early career researchers by selecting one or more Roman Technology Fellows every year.

This program consists of two components with two different submission procedures. The first component is the one-page application from an early career individual to be named a Roman Technology Fellow (RTF), see Section 2. The second component is the subsequent submission of a proposal for up to $300K in Fellowship Funds by a previously selected RTF once that individual obtains a permanent or permanent-track position, in order to start a laboratory or develop a research group at the Fellow's institution (see Section 3). Please see Section 2.1 for the definition of an early career position, and Section 4.1 for the definition of a permanent or permanent track position.

2. Eligibility and Application to be named a Roman Technology Fellow

The application to become a Nancy Grace Roman Technology Fellow does not involve a separate proposal to this program element. Rather, the RTF application is a one-page application submitted along with a proposal submitted to the Astrophysics Research and Analysis (APRA) Program described in program element D.3 of this ROSES solicitation. The Principal Investigator (PI) of a successful APRA proposal who is designated as a Roman Technology Fellow based on this one-page application has the opportunity to apply for Fellowship Funds in the future, as described in Section 3.

2.1 Eligibility

To be eligible to be named a Nancy Grace Roman Technology Fellow, proposal PIs must meet the following requirements at the time of submission:

- Have received a Ph.D. on or after January 1 of a year that is no more than eight years before the issuance date of the ROSES NASA Research Announcement (NRA) to which the APRA proposal is submitted. Individuals who have interrupted
their careers for substantive reasons, such as family leave or serious health problems, may seek a waiver to this requirement. Applicants who submit a written request for prior concurrence from NASA before the due date for Notices of Intent to propose to APRA will receive a written response from NASA within three weeks of receipt of this request.

- Hold an early career position such as a postdoctoral, tenure-track, term civil service, or an equivalent nonpermanent position, as defined in Section 4.1 below. In the event that a proposer’s institution does not allow nontenured faculty or postdoctoral researchers to apply independently for NASA grants, the proposal may include a mentor as the Institutional PI with the fellowship applicant as the Science PI, as outlined in the *NASA Guidebook for Proposers*.
- Be a U.S. citizen or have lawful status of permanent residency (i.e., holder of a U.S. Permanent Resident Card, also referred to as the Green Card)\(^1\) to be consistent with the RTF goal of fostering new talent by putting early career instrument builders on a trajectory towards long-term positions at a U.S. institution.
- Not hold, or have held, a career civil service, tenure, or other permanent position, as defined in Section 4.1 below on or prior to the submission deadline of this program.
- Not be a current or former recipient of the RTF or a PECASE award.

### 2.2 Fellowship Application

The procedure for applying to become an RTF Fellow is as follows:

1. Submit a technical proposal as PI (or Science PI, if necessary) to the APRA Program element D.3 of this ROSES solicitation.
2. Indicate on the NSPIRES Cover Page of that proposal the desire to be named a Roman Technology Fellow, and meet the eligibility requirements in Section 2.1.
3. Include the required RTF application in the APRA proposal, as described below.
4. Receive an award letter for that APRA proposal.

Selection of the APRA proposal is a prerequisite for consideration as a Roman Technology Fellow, but does not ensure selection. Those who are named as Roman Technology Fellows will receive an award letter from the RTF program explicitly conferring the title.

The RTF application is a free-form narrative limited to a single page in length. It should convey to the review panel and selecting officials an applicant’s qualifications to be named a Roman Technology Fellow, addressing the evaluation criteria in Section 2.3 below. The application should describe the candidate’s current employment position to establish eligibility for the RTF. It should outline career goals and plans and discuss how an RTF will help advance the applicant’s career and achieve those goals. The application should complement, not simply duplicate, the information provided in the Biographical Sketches section of the APRA proposal.

\(^1\) The prospective fellow may submit a proposal to RTF if he or she is reasonably certain that the Green Card will be in hand soon after the proposal submission. The evaluation of proposals and announcement of selection takes approximately three to four months. NASA will not make an award if the submitting institution cannot certify the prospective fellow’s eligibility.
The application should be included in the APRA proposal immediately following the PI’s Biographical Sketch. The one-page RTF application does not count towards the page limits for the Science/Technology/Management section of the APRA proposal.

2.3 Evaluation Criteria for Fellowship Selection

The APRA proposal containing the RTF application will be reviewed along with other proposals in the pertinent APRA review panel, as determined by technical discipline.

The application for the Roman Technology Fellowship will be separately evaluated according to the goals of the RTF program. The fellowship application should demonstrate that through the proposed APRA research, in conjunction with being named a Roman Technology Fellow, the early career researcher will develop the skills necessary to lead astrophysics flight instrument development projects, including suborbital investigations. The fellowship application should also demonstrate how these skills will prepare the Fellow to become a Principal Investigator (PI) of future astrophysics missions or to develop innovative technologies for space astrophysics that have the potential to enable major scientific breakthroughs. It should also illustrate how the fellowship will put the applicant on a trajectory towards a long-term position.

2.4 Timing of Selections and Awards

The announcement of selections for the technical (APRA) proposals will be in accordance with the schedule of program element D.3 of the ROSES solicitation. The naming of the candidate a Roman Technology Fellow will occur within 18 months after the RTF-related APRA proposal is selected. If a candidate is not named a Fellow prior to the end of this period, then the applicant’s eligibility for the RTF ends.

3. Fellowship Funds

Those who have previously been named as Roman Technology Fellows may submit a proposal requesting up to $300K in Fellowship Funds to start a laboratory or develop a research group at their institution. This component of the program is intended to aid Fellows in establishing themselves in a permanent-track position. Accordingly, proposers for Fellowship Funds must be in a permanent-track or permanent position (see Section 4.1), and must submit the proposal to this program element from the organization where the permanent track position is held. Awarding of Fellowship Funds is not guaranteed simply by having been named a Fellow. Awards are contingent upon favorable peer review and available budget.

The proposal may be submitted in response to this program element at any time within ten calendar years of the year in which the PI received their Ph.D. (or equivalent degree). Proposiets must contact the RTF Program Officer prior to submitting a proposal for Fellowship Funds.
3.1 The Fellowship Funds Proposal

The Fellowship Funds proposal must establish that the Fellow's appointment meets the definition of a permanent track or permanent position provided in Section 4.1. The proposal must clearly describe how the funds will be used to establish or develop the PI's research and technology development program, how the proposed program will advance the state-of-the-art in astrophysics-related technologies, and how the proposed program is relevant to NASA’s Astrophysics Program. The proposal should detail the near-term use of the Fellowship Funds, and outline the Fellow's long-term plans for maintaining the research and development program.

NASA encourages, but does not require, the submitting institution to contribute to the project supported by the Fellowship Funds. An example is support by the employing institution that would provide release time to enable the applicant to concentrate more fully on the activities related to the proposal. Institutional support of equipment purchases and co-funding of student and/or postdoctoral support is recognized by NASA as a valuable contribution. Any institutional commitments for laboratory space, matching or startup funds, and other institutional resources required for the proposed work should be included in the proposal.

The technical management section of the proposal is limited to seven pages, and the proposal must contain a detailed budget with a narrative justification. Projects devoted to technology development that are not expected to generate data need not provide data management plans, but must note on the NSPIRES cover page that they are technology projects that will not generate data. However, if the award does result in peer reviewed publications, then those must still meet the requirement that the data behind figures and tables be available electronically at the time of publication, ideally in supplementary material included with the article.

3.2 Evaluation Criteria for Fellowship Funds Proposals

Proposals for Fellowship Funds will be evaluated for merit, relevance, and cost realism and reasonableness. In addition to the factors stated in the NASA Guidebook for Proposers, intrinsic merit will also include the following factors:

- The long-term commitment to the early career researcher's career development by the employing institution.
- The likelihood that the early career researcher will develop the skills necessary to lead astrophysics flight instrument development projects, including suborbital investigations, in preparation to become a Principal Investigator (PI) of future astrophysics missions, or to develop innovative technologies for space astrophysics that have the potential to enable major scientific breakthroughs.

The evaluation against these criteria will be completely independent of any prior evaluation of the affiliated APRA proposal or the one-page fellowship application.

If a Fellowship Funds proposal is not selected for award, the Fellow may propose again for Fellowship Funds if a material change in circumstances mitigates the deficiencies
identified by the review of the prior proposal. Proposal submission is subject to the fellowship duration specified in Section 4.2.

4. Programmatic Information

4.1 Definition of Permanent and Permanent-Track Positions

A permanent position is one in which the organization substantially compensates the PI for his or her salary, without making it conditional on outside funding, nor limiting the term of employment. Examples of permanent positions include, but are not limited to, tenured faculty and permanent civil service appointments.

A permanent-track position is one with a clearly defined process and schedule that can lead to a permanent position. Examples of permanent-track positions include, but are not limited to, tenure track faculty and certain term civil service appointments.

4.2 Duration of Awards

Although the application to be named a Roman Technology Fellow is associated with a technical proposal submitted to the APRA program element, the duration of the APRA award has no effect on the duration of the Fellowship. If a Fellowship is awarded, its duration is for ten years past the date the Fellow received the Ph.D. The fellowship ends at the ten-year threshold or at the end of the subsequent Fellowship Funds award, whichever is later.

5. Summary of Key Information

<table>
<thead>
<tr>
<th>Expected program budget for new awards</th>
<th>See Program element D.3 of this ROSES solicitation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>Approximately 1-3 early-career selections of technical proposals anticipated.</td>
</tr>
<tr>
<td>Maximum duration of awards</td>
<td>For RTF-related technical proposals, see Program element D.3 of this ROSES solicitation. The duration of an RTF ends 10 years after obtaining the Ph.D. Fellowship funds will be awarded over a period of no more than 3 consecutive years.</td>
</tr>
<tr>
<td>Due date for Notice of Intent to propose (NOI)</td>
<td>Initial fellowship applications via program element D.3 APRA, see Section 2.2</td>
</tr>
<tr>
<td>Due date for proposals</td>
<td>Initial fellowship applications via program element D.3 APRA, see Section 2.2. Subsequent proposals for funds may be submitted in response to this program element D.9 of ROSES-18 see Section 3</td>
</tr>
<tr>
<td>Planning date for start of investigation</td>
<td>For initial fellowship applications see Section 2 and D.3 APRA. For subsequent proposals for funds, please contact the POC below.</td>
</tr>
<tr>
<td>Page limit for the central Science-Technical-Management section of proposal</td>
<td>Initial fellowship application is a one-page addition to a proposal to program element D.3 APRA; 7 pp. for subsequent proposals for fellowship funding</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the Astrophysics strategic goals and subgoals in NASA’s Strategic Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary Of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Web site for submission of proposal via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
</tr>
<tr>
<td>Web site for submission of proposal via Grants.gov</td>
<td><a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>Initial fellowship applications via program element D.3 APRA, see Section 2.2</td>
</tr>
</tbody>
</table>
| NASA point of contact concerning this program          | Michael Garcia  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-1053  
Email: Michael.R.Garcia@nasa.gov  
[POC updated September 1, 2017] |
NOTICE: Amended on October 6, 2017. This amendment releases final text for program element D.10 NuSTAR Guest Observer - Cycle 4. Phase-1 proposals are due January 19, 2018 via http://heasarc.gsfc.nasa.gov/ark/nustar/.

New in Cycle 4: proposals for joint NuSTAR/Swift programs will be accepted up to a total of 300 ksec of Swift observing time. Joint proposals must provide a compelling justification of the need for both the NuSTAR and Swift data for achieving the primary science goals and receive a Category A or B rating to be considered for acceptance. Proposers are strongly encouraged to carefully read the Swift/NuSTAR memorandum of understanding.

1. Scope of Program

1.1 Overview

The Nuclear Spectroscopic Telescope Array (NuSTAR) Small Explorer (SMEX) mission is the first orbiting telescope to focus light in the high energy X-ray region of the electromagnetic spectrum (E > 10 keV), with an effective bandpass of 3–79 keV. The observatory provides a combined improvement in sensitivity and spatial/spectral resolution by factors of 10 to 100 over previous missions that have operated at these energies. The NuSTAR Guest Observer (GO) Program solicits proposals for basic research relevant to the NuSTAR mission.

The fourth round of Guest Observations (Cycle 4) will commence on or about June 1, 2018, and last for a nominal period of 12 months. Based upon the outcome of the 2016 NASA Astrophysics Senior Review process, NuSTAR operations are currently funded through September 30, 2019. Further details on the Cycle 4 program may be found on the NuSTAR Guest Observer Program website (http://nustar.gsfc.nasa.gov). Observing time will be made available to scientists at both U.S. and non-U.S. institutions.

Individuals may submit proposals for two general types of observations: "standard-mode" and "Target-of-Opportunity" (ToO) (see Section 1.3.3). In addition to proposals for ToO observations submitted in response to this Call for Proposals, unsolicited requests for ToO observations may be made through the NuSTAR Science Operations Center. Note that unsolicited ToO requests are ineligible for funding under the NuSTAR Guest Observer Program. The data from NuSTAR observations selected under the Cycle 4 Call for Proposals will have a limited exclusive-use period dependent upon the observation type. Data from approved standard-mode GO observations will have a nominal one-year exclusive-use period commencing at the time of receipt of the processed data by the observer. Data from approved ToO observations will have a corresponding six-month exclusive-use period. Note that Principal Investigators (PIs) may waive the exclusive-use period and opt for the observation(s) to be placed directly
into the NuSTAR public archive. Data resulting from unsolicited ToO requests will have no exclusive-use period.

In addition to investigations utilizing NuSTAR observations only, proposals involving coordinated observations with the European Space Agency (ESA)/NASA X-ray Multi-Mirror Mission (XMM)-Newton X-ray observatory and NASA’s Swift mission are also solicited under this Call for Proposals. Prospective proposers of joint NuSTAR/XMM-Newton and joint NuSTAR/Swift observations should refer to Section 1.3.1 for details concerning the evaluation and implementation of such proposals.

Opportunities for carrying out NuSTAR observations in conjunction with NASA’s Chandra X-ray Observatory or ESA’s XMM-Newton and INTEGRAL observatories are also available through the relevant Calls for Proposals for those observatories.

Funding for investigations selected under the NuSTAR GO Program is available only to individuals at U.S. institutions who are identified as Principal Investigators (PIs). U.S.-based Co-Investigators on foreign-led proposals are not eligible for funding. Individuals from non-U.S. institutions desiring to participate in this program should read Sec 1.6.1 of the NASA Guidebook for Proposers. Such individuals are strongly encouraged to include a letter of commitment from their sponsoring foreign institution stating that they will bear the cost of the research.

Proposals for investigations directed primarily towards the conduct of supporting theoretical or laboratory astrophysics research or ground-based observations relevant to the NuSTAR mission are not solicited under this program.

1.2 The NuSTAR Mission

NuSTAR is a PI-led NASA Small Explorer (SMEX) mission. The PI institution is the California Institute of Technology, which is responsible for the overall direction of the program. NASA’s Jet Propulsion Laboratory (JPL) is responsible for the project management. The lead domestic partners include Columbia University, the University of California at Berkeley, and NASA’s Goddard Space Flight Center. The Danish Technical University Space Centre and the Agenzia Spaziale Italiana (ASI) made significant contributions to the hardware and data analysis software development, respectively. ASI is an active participant in mission operations, providing access to the Italian ground station at Malindi, Kenya. The NuSTAR Mission Operations Center (MOC) is at the University of California at Berkeley Space Sciences Laboratory, and the Science Operations Center (SOC) is at the California Institute of Technology.

NuSTAR was launched on June 13, 2012, from the Kwajalein Atoll in the Marshall Islands into a low-Earth orbit with an inclination of 6 degrees and an altitude of 630 km × 610 km. After an initial six-week checkout period and subsequent two-year baseline mission, the NuSTAR GO program was initiated. Based upon the results of the NASA 2016 Senior Review, support for mission operations was extended through September 30, 2019. The observatory has no expendables, and the orbit lifetime is estimated at ~
10–15 years from launch. Currently in its sixth year of operations, the observatory continues to function nominally.

The NuSTAR spacecraft carries two sensitive, co-aligned, narrow-field instruments. Table 1 summarizes the primary performance specifications. Details of the observatory and instrument design can be found at http://nustar.caltech.edu/, as well as the NuSTAR mission paper, Harrison et al. (2013; ApJ, 770, 103).

Table 1: Key Observatory Performance Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy range</td>
<td>3–78.4 keV</td>
</tr>
<tr>
<td>Angular resolution (HPD)</td>
<td>58”</td>
</tr>
<tr>
<td>Angular resolution (FWHM)</td>
<td>18”</td>
</tr>
<tr>
<td>FoV (50% resp.) at 10 keV</td>
<td>10’</td>
</tr>
<tr>
<td>FoV (50% resp.) at 68 keV</td>
<td>6’</td>
</tr>
<tr>
<td>Sensitivity (6–10 keV) (10^6 s, 3σ, ΔE/E = 0.5)</td>
<td>2 x 10^{-15} erg cm^{-2} s^{-1}</td>
</tr>
<tr>
<td>Sensitivity (10–30 keV) (10^6 s, 3σ, ΔE/E = 0.5)</td>
<td>1 x 10^{-14} erg cm^{-2} s^{-1}</td>
</tr>
<tr>
<td>Background in HPD (3–10 keV)</td>
<td>9.0 x 10^{-4} counts s^{-1}</td>
</tr>
<tr>
<td>Background in HPD (10–30 keV)</td>
<td>1.1 x 10^{-3} counts s^{-1}</td>
</tr>
<tr>
<td>Strong source (&gt;10σ) positioning</td>
<td>1.5” (1σ)</td>
</tr>
<tr>
<td>ToO response time</td>
<td>&lt; 24 hr</td>
</tr>
<tr>
<td>Slew rate</td>
<td>0.06° s^{-1}</td>
</tr>
<tr>
<td>Settling time</td>
<td>200 s (typically)</td>
</tr>
</tbody>
</table>

1.3 NuSTAR Cycle 4 General Information

The total amount of time allocated to Guest Observations during the fourth year of the GO phase of NuSTAR is expected to be 8.5 Ms (50% of the total observing time). Of this, it is anticipated that up to 6.5 Ms of observing time will be awarded to selected Cycle 4 investigations; of the remaining time (~ 2Ms), up to 1.5 Ms is expected to be awarded to joint NuSTAR/XMM-Newton proposals submitted to the XMM-Newton Cycle 16 Call for Proposals, up to 0.5 Ms to NuSTAR/Chandra Joint Observing Projects proposals submitted to the Chandra Cycle 19 Call for Proposals, and up to 300 ks to NuSTAR/Swift Joint Observing Projects submitted to the Swift Cycle 15 Call for Proposals. It is anticipated that approximately 40 investigations will be selected for implementation under the NuSTAR Cycle 4 GO program.

The remaining 50% of the observing time will be allocated through the NuSTAR Project as follows: NuSTAR legacy survey observations (~ 25% of the total observing time); NuSTAR PI discretionary time, including unsolicited ToO observations open to the scientific community (~ 15%); and, calibration observations, engineering tasks, and resolution of operational issues (~ 10%).

The NuSTAR legacy surveys represent extensions of the Galactic and Extragalactic surveys conducted during the baseline mission. Community input will continue to be solicited to assist in defining the surveys (see
http://www.nustar.caltech.edu/page/legacy_surveys) for additional information); the NuSTAR science team will perform the detailed planning, execution, and analysis of the surveys. The legacy survey data will be immediately made public, and source catalogs and spectra will be released as soon as they have been processed.

During the baseline mission, the remainders of the fields of view for specific targets were used to create a wide-area serendipitous source survey. This practice is being continued in the GO phase, with the incorporation of non-target background sources in GO fields into the legacy surveys. However, the PI for a particular GO investigation will retain the data rights for the duration of the applicable exclusive-use period to any background source in the field of his/her primary target that is of interest beyond contributing to the wide-area survey statistics.

Proposers to this program must clearly describe how their proposed investigation capitalizes on the unique capabilities of NuSTAR. Proposals for investigations involving targets previously observed or currently planned for observation with NuSTAR must provide a justification of the need for the requested additional data. The "as-flown" observing timeline may be found at http://www.srl.caltech.edu/NuSTAR_Public/NuSTAROperationSite/AFT_Public.php, and lists of the approved NuSTAR Cycles 1–3 Guest Observations are available at http://heasarc.gsfc.nasa.gov/docs/nustar/nustar_prop.html. Observations of targets proposed through this Call for Proposals will take precedence over legacy program observations of those targets that have not been executed as of the submission deadline. The applicable legacy observations will be suspended until the disposition of the proposed GO observations is determined in the Phase 1 review. Proposed GO observations of legacy targets that are not accepted as part of the Cycle 4 program will be restored to the legacy program. A list of legacy observations that are planned to be performed by the end of Cycle 4 will be made available on the NuSTAR website http://www.nustar.caltech.edu/page/legacy_surveys.

For those Phase-1 proposals recommended for implementation, the approved target observations will be assigned a Category (A, B, or C) and a recommended exposure time. Note that for proposals including observations of multiple targets, the priority of each target observation will be separately categorized. Assuming nominal operational efficiency, it is anticipated that observations of all standard-mode Category A and B targets will be carried out during Cycle 4; any standard-mode, non-time-constrained Category A and B observations not observed during Cycle 4 will be carried over to Cycle 5. Time-constrained Category A and B observations not observed during Cycle 4 will be considered for possible scheduling in Cycle 5 (see Section 1.3.2). Observations of Category C targets will be executed on a best-effort basis. Category C targets not scheduled during a particular observing cycle will not be carried over to the succeeding cycle; such observations may be reproposed to a future observing cycle. Finally, note that proposals for observations of Cycle 3 Category C targets that have not been scheduled prior to the Cycle 4 proposal due date may be submitted to Cycle 4. Such proposals will be considered for selection in Cycle 4 only if the corresponding Cycle 3
observation is not executed in Cycle 3. Multiyear observing proposals will not be accepted in Cycle 4.

Proposers should note that NuSTAR’s low-inclination (6°), low-Earth orbit allows, on average, a maximum continuous exposure of ~ 3.2 ksec per 5.7 ksec satellite orbit for targets below a declination of ~ 65°; for targets at high declination, |Dec| > 65°, the unocculted period may be longer. Unless there is a specific reason why the total elapsed time of an observation is important, proposers should specify only the net exposure time required for achievement of the proposed science goals, excluding observational efficiency factors (Earth occultations and South Atlantic Anomaly passages) in the observing time calculation; specification of the total elapsed time requirement will result in the observation being classified as time-constrained (see Section 1.3.2).

1.3.1 Programmatic constraints

Proposals are subject to the following limitations:

- The requested time per observation (i.e., a single "visit" to a target) is constrained to a minimum of 20 ks and a maximum of 500 ks;
- Targets for which time-constrained observations are requested will only be guaranteed scheduling if they are designated Category A (see Section 1.3.2);
- Due to the limited number of ground station passes, observations of high count-rate targets place significant demands upon mission resources. Consequently, it is anticipated that the total time available for observation of bright sources (predicted instrument count rate above 100 counts s⁻¹ for both modules using 50% PSF extraction with no deadtime) during Cycle 4 will be limited to a maximum of 1 Msec. Note that, for very bright sources, the instrument count rate is significantly lower than the incident event rate due to detector deadtime effects. Proposals requesting observations of bright sources with durations > 30 ks are operationally difficult to carry out. Accordingly, such proposals must provide a sufficiently compelling motivation to be considered for acceptance. In addition, proposals requesting observations of bright sources with exposures longer than 75 ks will be considered for implementation only if the total requested time is distributed in multiple observations, each with exposure < 75 ks and separated by more than 1 week;
- Sources with fluxes > 10⁻¹¹ ergs s⁻¹ cm⁻² within 5° of the target may cause increased nonuniform background gradients due to stray light. Users should check observations for potential stray light contributions using the tools available at [http://nustar.caltech.edu/page/researchers](http://nustar.caltech.edu/page/researchers). If a field is designated as ‘heavily contaminated,’ proposers should submit a request for a feasibility analysis to [nustar-help@srl.caltech.edu](mailto:nustar-help@srl.caltech.edu) at least two business days prior to the proposal submission deadline;
- Proposals for joint NuSTAR/XMM-Newton programs in Cycle 4 will be accepted up to a total of 1.5 Msec of XMM-Newton observing time. Joint proposals must provide a compelling justification of the need for both the NuSTAR and XMM-Newton data for achieving the primary science goals and receive a Category A or
B rating to be considered for acceptance. Individuals considering submission of a Cycle 4 proposal for joint NuSTAR/XMM observations should consult the XMM-Newton-17 approved NuSTAR target list prior to submission of their proposal. Duplicate observations of the same targets by NuSTAR will typically not be awarded;

- Proposals for joint NuSTAR/Swift programs in Cycle 4 will be accepted up to a total of 300 ksec of Swift observing time. Joint proposals must provide a compelling justification of the need for both the NuSTAR and Swift data for achieving the primary science goals and receive a Category A or B rating to be considered for acceptance. Proposers are strongly encouraged to carefully read the Swift/NuSTAR memorandum of understanding. Swift data sets obtained through approved joint NuSTAR/Swift proposals will not be proprietary and will be immediately released publicly via the HEASARC data archive. Note that for most NuSTAR pointings, 1–2 ks "snapshot" observations are routinely performed by Swift (unless there are multiple observations of the same target, coordinated NuSTAR observations with other X-ray observatories, and during times of Gamma-Ray Bursts and Swift ToOs) without the need for a specific joint observing proposal. Individuals considering submission of a Cycle 4 proposal for joint NuSTAR/Swift observations should consult the Swift- approved NuSTAR target list prior to submission of their proposal. Duplicate observations of the same targets by NuSTAR will typically not be awarded;

- Proposals requesting coordinated observations with other space- or ground-based observatories will be designated time-constrained and subject to the restrictions described in Section 1.3.2.

1.3.2 Time-Constrained Observations

Time-constrained observations are defined as observations that must be performed within a specific time window. This includes phase-constrained observations and coordinated observing campaigns with ground-based or space-based facilities. Time-constrained observations are subject to the following limitations:

- Time-constrained observations designated Category A or B will be given highest priority for scheduling during Cycle 4. Time-constrained observations of Category C targets will be executed on a best-effort basis. Time-constrained Category A and B observations not scheduled during Cycle 4 may be carried over to Cycle 5 where warranted by scientific or operational circumstances (e.g., in the case of coordinated observations with other space- or ground-based observatories). Category C time-constrained observations not scheduled during Cycle 4 will not be carried over to Cycle 5.

- Monitoring programs are defined as investigations requiring two or more observations of the same target, each of which is considered a “visit.” For such programs, the time interval between successive visits must be ≥ 14 hours. Note that programs in which the time interval between any two successive visits is ≤ 1 week will be designated as time-constrained.

- Note that proposed Swift observing time can include monitoring that precedes, follows and/or (for ToOs) triggers NuSTAR observing time.
For coordinated or time-constrained observations, it is the proposer’s responsibility to inform the NuSTAR SOC of the observing time windows as soon as possible, but at a minimum of one month before initiation of the observations. In cases where observations involve coordination with other space-based observatories, the NuSTAR SOC will be responsible for communicating detailed schedule constraints with the relevant operations team(s).

1.3.3 ToO Observations

A total of up to 500 ks of NuSTAR Cycle 4 observing time will be made available for proposals to observe ToOs, subject to the constraints listed below. Individuals interested in submitting ToO proposals should note the following:

- Proposals must provide exact, detailed trigger criteria and a credible estimate (including justification) of the probability of triggering the ToO during Cycle 4;
- Proposers should indicate on the Astrophysics Research Knowledgebase (ARK)/Remote Proposal System (RPS) proposal submission form (http://heasarc.gsfc.nasa.gov/ark/rps/) the response time required to meet the scientific objectives. Note that the minimum response time that may be specified for NuSTAR observations is 48 hours; proposals will be evaluated based on this criterion. However, a more rapid response time may be requested by the PI; such requests will be accommodated on a best-effort basis;
- The observations must have an astrophysical trigger and be designated as Category A to be eligible for execution;
- Proposals for ToO observations that can be triggered from a class of objects or set of potential targets are permitted;
- Active ToO programs submitted to the Chandra/NuSTAR, XMM-Newton/NuSTAR, or Swift/NuSTAR GO Program Calls for Proposals approved prior to the Cycle 4 solicitation will take precedence over NuSTAR Cycle 4 proposals with the same targets and trigger criteria.

It is the responsibility of the PI of an accepted ToO proposal to alert the NuSTAR SOC when the trigger conditions for their accepted ToO have been satisfied. This is done via submission of a NuSTAR ToO Request Form at http://nustar.caltech.edu/page/too_policy. Prior to submission of this form, the PI should verify the visibility of the target at http://www.srl.caltech.edu/NuSTAR_Public/NuSTAROperationSite/CheckConstraint.php. Accepted Cycle 4 ToO observations may be triggered until the end of the cycle. ToO observations not triggered during Cycle 4 will not be carried over to Cycle 5; such observations may be reproposed to a subsequent cycle.

ToO proposals to observe either a core collapse supernova in the Local Group or a Type 1a event to the distance of the Virgo Cluster will not be accepted. Such observations constitute part of the NuSTAR core science program and can be most expeditiously and effectively planned and executed by the NuSTAR Project; should either event occur, the discoverer(s) are invited to contact the NuSTAR PI concerning participation in the resultant publications.
Note that requests for observations of unsolicited ToOs may be submitted via the NuSTAR ToO web site (http://www.srl.caltech.edu/NuSTAR_Public/GO/GOsSubmit.php). Decisions regarding the disposition of unsolicited ToO requests will be made by the NuSTAR Principal Investigator or official designee. Requests for such unsolicited ToO observations are ineligible for funding under the NuSTAR GO Program.

2. Programmatic Information

2.1 General Information

It is anticipated that up to $2.0M will be available for the support of Guest Observations during Cycle 4. Proposals ranked as Category A or B by the Phase-1 peer review panel will be given the highest priority for funding. However, limited support will be made available for Category C proposals that are executed during Cycle 4. NuSTAR GO funding is open to individuals who are identified as Principal Investigators and employed at U.S. institutions. The amount of funding awarded to PIs of Category A and B proposals will be based upon NASA’s evaluation of the cost realism and reasonableness of the Phase-2 cost proposal. In addition, eligible PIs of proposals with Category C targets that are executed during Cycle 4 will be awarded $7,500 to support the publication of the results. NuSTAR science team members and scientists participating in the NuSTAR mission are eligible for support under this GO Program. Note that GO proposals from NuSTAR team members who receive funding from the Project must clearly demonstrate that the proposed investigation is not redundant with their science team responsibilities. Following the Phase-1 peer review, Phase-2 (cost) proposals will be solicited from eligible PIs and subsequently evaluated for cost realism and reasonableness via the Phase-2 review process. Joint NuSTAR-XMM and NuSTAR/Swift Phase 1 proposals selected through this Call for Proposals are eligible for funding solely through the NuSTAR GO program; the corresponding Phase-2 cost proposals may request support for the analysis of both the NuSTAR and XMM-Newton or Swift data. Such proposals should not be submitted to the U.S. XMM-Newton Guest Observer Facility or to the Swift Project.

2.2 Proposal Submission and Evaluation

The NuSTAR GO program utilizes a two-phase proposal process. Phase-1 proposals shall provide a detailed description of the proposed investigation, including the requested NuSTAR observation(s) and associated scientific/technical justification. U.S. PI’s whose Phase-1 proposals are assigned a Category A/B/C rating by the peer review panel will be invited to submit a Phase-2 (cost) proposal. Subject to acceptance of the associated Phase-2 cost submission, proposals for standard-mode observations (excluding proposals involving ToO or time-constrained observations) assigned a Category A or B rating will be eligible for funding immediately. Due to the uncertainty of their execution, the remaining accepted Phase-2 proposals will become eligible for funding only after the proposed observations have been carried out. Phase-2 proposals must include a detailed budget and accompanying narrative, providing a detailed description of how the requested funds will be used to achieve the goals outlined in the proposal. It is nominally expected that the PI of the Phase-1 proposal will serve as the
Phase-2 proposal PI; however, for administrative purposes, an alternate individual from the Phase-1 PI's institution may serve as PI on the Phase-2 proposal. All proposal materials shall be submitted electronically, as specified below. NASA uses a single, uniform set of instructions for the submission of ROSES proposals. These instructions are given in the NASA Guidebook for Proposers. NuSTAR GO Proposers should follow these instructions, except where they are superseded by the instructions provided in the ROSES Summary of Solicitation or in this Appendix.

2.2.1. Submission and Evaluation of Phase-1 NuSTAR GO Proposals

Individuals submitting Phase-1 proposals to the Cycle 4 NuSTAR GO Program must adhere to the following proposal submission procedures:

- Proposers must submit their Phase-1 proposals (including the accompanying target forms) electronically through the ARK/RPS website at http://heasarc.gsfc.nasa.gov/ark/rps/. Instructions for submitting proposals via ARK/RPS are provided at the HEASARC NuSTAR web site: http://nustar.gsfc.nasa.gov/;
- Due to the nature of prospective investigations within the NuSTAR GO program, the Scientific/Technical/Management section of proposals is limited to four pages, in lieu of the default 15 pages specified in the NASA Guidebook for Proposers. The requirement for a table of contents in the body of the proposal is waived. No supporting material (e.g., Curriculum Vitae, pending/current support) is required or allowed;
- Optional LaTeX and MS Word templates for the Scientific/Technical/Management section are provided at http://nustar.gsfc.nasa.gov/;
- The Scientific/Technical/Management section must be uploaded to the RPS website as a PDF file.

In order to be included in the review of proposals for this cycle of the NuSTAR Guest Observer Program, all proposal materials must be submitted electronically by 4:30 p.m. Eastern Time on the Phase-1 due date provided in Tables 2 and 3 of ROSES.

Proposals will be evaluated by a science peer panel with respect to the criteria specified in Section VI.(a) of the ROSES Summary of Solicitation, where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The suitability of using the NuSTAR observatory and associated data products for the proposed investigation, including the degree to which the investigation exploits the unique capabilities of NuSTAR;
- The feasibility of accomplishing the objectives of the proposed investigation with the requested observations, including the degree to which the proposal satisfies NuSTAR observational constraints and the feasibility of the proposed analysis techniques;
- The extent to which the proposed investigation complements and enhances the anticipated science return from the NuSTAR mission;
The degree to which the proposed observation(s) places demands upon mission resources.

2.2.2 Submission and Evaluation of Phase-2 proposals

Subject to the availability of funding, eligible Phase-1 proposers will be contacted by the NuSTAR Program Scientist and invited to submit a Phase-2 (cost) proposal. Upon notification of selection of a Phase-1 proposal, proposers eligible for Phase-2 must follow the instructions for submitting a Phase-2 proposal given in the selection notification letter from the Phase-1 review. Phase-2 proposals must be submitted through the NASA NSPIRES electronic proposal website (http://nspires.nasaprs.com) by an Authorized Organizational Representative (AOR) of the proposing organization following the instructions in the Summary of Solicitation of this NRA. The cost proposal shall consist of a "Budget Details" section (maximum of two pages) and a "Budget Narrative" section (maximum of two pages).

NASA will evaluate the Phase-2 cost proposals for cost realism and reasonableness. Comparison of the proposed cost to available funds will be performed as specified in Appendix C of the NASA Guidebook for Proposers. Subject to the conditions stated above, proposers will be notified regarding the award amount for their Cycle 4 investigation(s) by NASA upon completion of the Phase-2 review process.

2.3 Supplemental Information

Further details concerning the proposal submission requirements and process can be found at the NuSTAR Guest Observer website (http://nustar.gsfc.nasa.gov/). This website provides instructions for completing the required proposal forms. A detailed description of the NuSTAR mission, including technical information relevant to the observatory, instruments, and observation feasibility can be found at http://nustar.caltech.edu/page/researchers. Answers to frequently asked questions can be found at http://heasarc.gsfc.nasa.gov/docs/nustar/nustar_faq.html.

3. Summary of Key Information

<p>| Expected program budget for Cycle 4 awards | ~ $2.0 M |
| Expected number of new awards pending adequate proposals of merit | 30–50 |
| Maximum duration of awards | 1 year |
| Due date for Notice of Intent to propose (NOI) | Option not available. |
| Due date for Phase-1 proposals | See Tables 2 and 3 of ROSES |</p>
<table>
<thead>
<tr>
<th>Planning date for start of investigation</th>
<th>Funding will be awarded when the data are made available to the PI. NASA Center proposers should use October 1, 2018 (4 months after start of the Cycle 4 observing program) as a planning date for start of observations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page limit for Phase-1 proposals</td>
<td>4 pages. LaTeX and MS Word templates (available for download at <a href="http://nustar.gsfc.nasa.gov/">http://nustar.gsfc.nasa.gov/</a>) can be used for the proposals. No supporting material (e.g., CV, pending/current support) will be considered for Phase-1. Page limits include figures and references. This instruction supersedes the limits given in the <em>NASA Guidebook for Proposers</em>.</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the Astrophysics questions and goals in the NASA Science Plan (<a href="https://science.nasa.gov/about-us/science-strategy">https://science.nasa.gov/about-us/science-strategy</a>). Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the <em>ROSES Summary of Solicitation</em>.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required in PDF format; no hard copy is required. See Section IV of the <em>ROSES Summary of Solicitation</em> and Chapter 3 of the <em>NASA Guidebook for Proposers</em>.</td>
</tr>
<tr>
<td>Web site for submission of Notice of Intent to propose (NOI)</td>
<td>Option not available.</td>
</tr>
<tr>
<td>Web site for submission of Phase-1 proposal via NSPIRES</td>
<td>Option not available.</td>
</tr>
<tr>
<td>Web site for submission of Phase-1 proposal via Grants.gov</td>
<td>Option not available.</td>
</tr>
<tr>
<td>Web site for submission of Phase-2 proposals</td>
<td><a href="http://nspires.nasaprs.com">http://nspires.nasaprs.com</a>; See Section 2.2.2</td>
</tr>
</tbody>
</table>
| Programmatic information may be obtained from the NuSTAR Program Scientist | Stefan Immler  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC  20546-0001  
Telephone: (202) 358-0615  
Email: Stefan.Immler@nasa.gov |
|---|---|
| Technical questions concerning this program element may be directed to the NuSTAR Guest Observer Program Office | Craig Markwardt  
NuSTAR Mission Scientist  
Code 662  
Goddard Space Flight Center  
National Aeronautics and Space Administration  
Greenbelt, MD  20771-0001  
Telephone: (301) 286-1506  
Email: Craig.Markwardt@nasa.gov |
NOTICE: Amended on September 19, 2017. To give more time to proposers who are without power because of Hurricane Irma, this amendment delays the Phase-1 proposal due date for this program element to October 6, 2017. Phase-1 proposals are due by 4:30 PM Eastern time via the ARK/RPS web page (see subsection 2.2.1).

Corrected, July 3, 2017. The reference in Section 1.1 to detection of transiting exoplanets near the ecliptic poles (optimal for JWST follow-up) should have said "with periods up to 120 days." New text is in bold, deleted text is struck through.

Amended June 28, 2017. This Amendment releases final text for TESS Guest Investigator - Cycle 1, which replaces in its entirety the placeholder text, released with ROSES-17 in February. Phase-1 proposals are due by 4:30 pm Eastern time on September 29, 2017 via https://heasarc.gsfc.nasa.gov/ark/rps/.

1. Scope of Program

1.1 Overview

The TESS Guest Investigator (GI) Program solicits proposals for the acquisition and analysis of scientific data from the Transiting Exoplanet Survey Satellite (TESS) mission, a NASA Explorer mission currently scheduled for launch no later than June 2018. In a 2-year, near all-sky survey, TESS will monitor the brightness of nearby, bright F, G, K, and M stars in order to photometrically search for transiting planets smaller than Neptune. (See https://heasarc.gsfc.nasa.gov/docs/tess/ & Ricker et al. (2015, Journal of Astronomical Telescopes, Instruments, and Systems, 1, 014003) for detailed descriptions). TESS will monitor the brightness of more than 200,000 stars spread over the celestial sphere with a photometric sensitivity sufficient to permit detection of transiting planets with a radius less than 2.5 Earth radii. The mission’s high-precision, continuous baseline photometric capability is also well suited for variability and asteroseismology research and analyses of both Galactic and extragalactic astrophysical sources.

The lead institution for TESS is the Massachusetts Institute of Technology (MIT), which hosts the Principal Investigator, Dr. George Ricker.

Observations associated with the TESS Guest Investigator (GI) Cycle 1 solicitation will begin immediately following the successful ~60-day scientific commissioning of the spacecraft. Proposals submitted to this program should be for new science investigations of the southern ecliptic hemisphere and outside the TESS core science program only. The core program consists of 1) the detection of transiting exoplanets with periods up to 10 days around stars on the pre-selected transit candidate target list (CTL; see description of CTL in Section 1.2.2), 2) the detection of transiting exoplanets with periods longer than up to 120 days near the ecliptic poles (optimal for JWST follow-up), and 3) assuring that the masses of fifty planets with radii less than 4 Earth
radii are determined through ground-based follow-up and/or analytical techniques. There will be no exclusive-use period associated with the data from TESS observations. All data will be made available through the Mikulski Archive for Space Telescopes (MAST) public archive once data processing and validation is complete.

Funding through the NASA TESS GI Program is available only to scientists at U.S. institutions who are identified as the Principal Investigators (PIs). U.S. based Co-Investigators (Co-Is) on foreign-led proposals do not qualify for funding. Funding for accepted target proposals will be initiated only after the relevant observations have begun.

1.2 The TESS Mission

A detailed discussion of the TESS mission and its scientific objectives can be found at https://heasarc.gsfc.nasa.gov/docs/tess/.

The TESS instrument consists of four wide field-of-view cameras, each of which observes a 24x24 degree field. The cameras are aligned with their fields adjacent, such that the instantaneous field-of-view is 24x96 degrees. TESS observes a single sector continuously for two spacecraft orbits (2x13.7 days), with the boresight of the four-camera array pointed nearly antisolar, obtaining full-frame images (FFIs) every 30 minutes, and 2-minute cadence sub-image data for ~10,000 pre-selected stars within the field. After two orbits, the FOV is shifted eastward in ecliptic longitude by 27.7 degrees, to observe the next (adjacent) sector.

Adjacent sectors have overlapping regions in proximities close to the ecliptic poles, providing longer-term coverage for stars falling in these regions which in turn provides sensitivity to smaller and longer-period planets; objects within 12 degrees of the ecliptic poles may be observed for ~1 year.

1.2.1 Observing Modes and Data Products

Data for specific targets are saved onboard and transmitted as "postage stamp" subimages, with an area sufficiently large to accommodate the optimal aperture for the astrophysical target. Extended or very bright objects can be accommodated with more appropriately chosen subimage pixels. All postage stamp observations are collected at 2-minute postage-stamp cadence. Additionally, the full 24x96 sq. deg. field-of-view of all four TESS cameras is collected at 30-minute cadence.

A fixed number of postage stamp pixels have been reserved for Cycle 1 GI observations and are available to successful proposers to this Cycle 1 solicitation. Assuming a default target size, this corresponds to 20,000 2-minute cadence GI targets over the duration of the 2-year primary mission, or about 700-800 unique GI targets per Observation Sector. Extended or bright objects requiring larger subimage sizes decrease the total number of targets available to the GI program.

The TESS data will be processed with a data reduction pipeline based on software that was developed for the Kepler mission. This pipeline performs pixel-level calibration, background subtraction, aperture photometry, identification and removal of systematic errors, and the search for transit signals in the 2-minute postage stamp data. All TESS
2-minute cadence targets, regardless of whether they are GI targets or TESS-selected exoplanet targets, will flow through the TESS science processing and analysis pipeline. The calibration will correct for bias level, smear, galactic cosmic rays, flat fielding, dark current, background, and instrument noise.

Data distribution and archival services will be performed through the Space Telescope Science Institute’s MAST. Final data products available to GI observers will include original and calibrated target pixel files, pipeline-produced light curves for each 2-minute postage stamp target, and raw and calibrated images for the FFI data.

Data will be archived in standard FITS formats for images, event lists and light curves. TESS light curves produced through the pipeline software are optimized for the detection of small exoplanets. Proposers should be aware that pipeline-generated light curves may not be optimal for other science programs, and plan their analyses accordingly.

1.2.2 Instrumentation and Technical Capabilities

TESS has neither changeable filters nor dispersing elements. Photometry will be taken through a broad bandpass ranging from 600 to 1000 nm. The bright limit for TESS is expected to be $I_c \approx 4$ or perhaps even brighter.

The TESS Input Catalog (TIC), is intended to contain most optically-persistent objects in the sky down to the limits of available photometric catalogs, to enable the selection of optimal targets for the transit search, and the calculation of flux contamination in the TESS subimage for each target. Based upon the TIC, the TESS team is developing a transiting Candidate Target List (CTL). The CTL is a list of priority-ordered TESS targets for 2-minute cadence monitoring. The TIC and the CTL have been publicly released (v5.0) and are searchable via MAST at http://archive.stsci.edu/tess/. The TIC and CTL are documented by Stassun et al. (2017; https://arxiv.org/abs/1706.00495v1).

The exact locations of the corners of the field of view for Observation Segment 1 (and hence all subsequent Observation Sectors) are a sensitive function of the launch date. For Cycle 1, the impact of the uncertainty in the exact sky locations of the TESS FOVs is that there is no guarantee that any given proposed target won’t fall into a gap between sectors, CCDs, or cameras. To mitigate this uncertainty, Cycle 1 proposers are encouraged to consider target lists that include a number of similar sources distributed across the sky.

1.3 Permitted Guest Investigator Science

The primary purpose of the TESS Guest Investigator Program is to enhance and maximize the science return from TESS. The program facilitates and supports both 2-minute cadence observations with TESS and research undertaken with the FFIs. Any area of astrophysics may be proposed. However, proposals to detect planet transits within the 2-minute cadence data of the one hundred thousand (100,000) top-prioritized, southern hemisphere CTL (version 5.0) targets are not solicited, and will be considered non-compliant. No restrictions are imposed on science using the full frame image data. Proposals for exoplanet detection and characterization using full frame image data are encouraged.
The following science categories are solicited for Cycle 1 Guest Investigator proposals:

1) Proposals for additional 2-minute cadence exoplanet (or potential exoplanet) targets beyond those objects already being observed by the TESS mission.

2) Exoplanet investigations using the FFI data, including ground-based observing components to confirm these planets. While Guest Investigators can expect some basic data analysis tools to be available, special purpose software development may be necessary for individual science investigations, and can be proposed as part of this category.

3) Astrophysics (i.e. non-exoplanet) investigations using TESS 2-minute cadence targets, including new targets and astrophysical investigations of targets already on the TESS transit candidate target list.

4) Non-exoplanet astrophysics investigations using FFI data. While Guest Investigators can expect some basic data analysis tools to be available, special purpose software development may be necessary for individual science investigations, and can be proposed as part of this category.

5) Development of novel planet confirmation techniques and/or algorithms that take advantage of TESS data.

Proposals may be a combination of both 2-minute cadence target requests and FFI analysis.

The scientific justification of a GI proposal should focus on a compelling science investigation, that requires the collection of new TESS data to succeed. For all of the above categories, the proposed TESS Guest Investigation must clearly enhance the science return of the TESS mission. The proposal may include limited theoretical components, limited ground-based follow-up, software development and/or data simulation that strengthens the proposal. At least 70% of the work effort should be focused on exploiting TESS data products. Proposed investigations in which the primary emphasis is theory/modeling, ground-based observing, or archival data analysis will be non-compliant. The ROSES NASA Research Announcement provides alternative opportunities to exploit or support the TESS mission in these areas:

- Investigations for which the primary emphasis is theory and/or modeling may be proposed to the Astrophysics Theory Program (ATP; Appendix D.4), or the Exoplanet Research Program (XRP; Appendix E.3)
- Investigations for which the primary emphasis is analysis of archival data may be proposed to the Astrophysics Data Analysis Program (ADAP; Appendix D.2).
- Investigations for which the primary emphasis is the collection and/or analysis of ground-based data may be proposed to the Exoplanet Research Program (XRP; Appendix E.3), or the NSF Astronomy and Astrophysics Research Grants Program (AAG).

Proposals must clearly describe the plans to make any new software, higher level data products and/or supporting data publicly available. Software developed with TESS GI funds must add value to the TESS science community, be free, and open source. Exoplanet-related ground-based follow-up data collected through TESS GI funding support must be made publicly available in a timely fashion at the NASA Exoplanet Science Institute (NExScI) ExoFOP service (https://exofop.ipac.caltech.edu) - NASA’s repository for supporting exoplanet data. Supporting data for non-exoplanet science
should be archived through a public data archive service such as the MAST higher level data product service (http://archive.stsci.edu/hlsp/).

1.4 Target of Opportunity Observations

The TESS GI program recognizes the category of Target of Opportunity (ToO) Observations of rapidly evolving phenomena whose occurrence is not predictable at the time of the TESS proposal deadline. Due to TESS mission constraints, ToO-triggered target definitions can only be uploaded to the spacecraft during uplinks that occur once every 13.7 days. Details regarding the circumstances in which a ToO is triggered must be included in the scientific justification and on the target form. ToO proposals must also include an estimated duration of the event, as well as an estimated probability for triggering the observations; the latter will be used in the accounting of total allocated targets. ToOs remain active during the cycle; ToOs not carried out during the cycle must be re-proposed to subsequent solicitations. ToO observations would commence after the spacecraft upload following the trigger event, which could be as long as 2 months after the event. The impact to science of such a potential delay must be addressed in proposals requesting ToO observations.

1.5 On-source Monitoring Times

Targets can be observed for the maximum number of sectors for which they are observable. This ranges from 27.4 days for targets with lower ecliptic latitude and up to 356.2 days for targets near the ecliptic poles. All Cycle 1 GI observations terminate one year after the observing cycle begins.

1.6 Target Lists

Proposals requesting 2-minute cadence targets are required to submit a target list. Targets must be submitted electronically, at the same time as the science proposal, via the Remote Proposal System (RPS; https://heasarc.gsfc.nasa.gov/ark/rps/). A definition of each column and a detailed description of the example table can be found at the link to the table template at the TESS Science Support Center website. If a proposed target does not appear in the TIC, the information required to append the target to the TIC must be provided.

2. Programmatic Information

2.1 General Information

It is anticipated that up to $2.5M in Cycle 1 will be available to US-based PIs through this solicitation for the support of approximately ~30 Guest Investigations. The performance period of each award will be 2 years. The Cycle 1 GI program will also include unfunded non-US-based investigations of high merit, as determined by peer review. Additional unfunded Guest Investigation targets may be offered to proposers, if target resources permit. Scientists participating in the TESS mission, including members of the Follow-up Team, are permitted to propose to the GI program and are subject to the same program rules as the rest of the science community.
2.2 Proposal Submission and Evaluation

2.2.1 Submission of Proposals to the TESS GI Program

The TESS GI program uses a two-phase proposal process. All proposal materials will be submitted electronically. A Phase-1 proposal shall comprise the science/technical justification; proposals requesting funds must include a one paragraph budget narrative in the 4-page science/technical section, describing in sufficient detail how the proposed funds will be used to achieve the goals outlined in the proposal. Only proposers whose Phase-1 proposals are accepted will be invited to submit budget proposals in Phase 2. Proposal content, including the list of investigators, must remain consistent between Phase-1 and Phase-2 proposals. It is not necessary for the PI of the Phase-2 proposal to be the science PI.

Awards for the majority of investigations (i.e., focused analysis and/or small numbers of targets) are expected to average $50,000 per award. Proposals requiring more complex analysis, specialized software development, or a large number of targets, may require funding substantially above the average award (i.e., up to $200,000 range per award). Such large proposals will need to provide a compelling argument for the higher funding level. The amount of the anticipated funding request must be entered into the box provided for this purpose on the Remote Proposal System (RPS) Cover Form. The detailed cost evaluation will be deferred until Phase 2. The funding amount requested in the Phase-2 cost proposal may not exceed the amount proposed in Phase 1.

NASA uses a single, uniform set of instructions for the submission of ROSES proposals. These instructions are given in the NASA Guidebook for Proposers (https://www.hq.nasa.gov/office/procurement/nraguidebook/). TESS GI Proposers should follow these instructions, except where they are overridden by the instructions given in the ROSES Summary of Solicitation or in this Appendix. Proposers to the TESS GI Program must adhere to the following proposal submission procedures:

- All Proposers must submit their Phase-1 proposals electronically through the Astrophysics Research Knowledgebase (ARK)/Remote Proposal System (RPS) website at https://heasarc.gsfc.nasa.gov/ark/rps/. Instructions for doing so will be provided at the TESS Science Support Center web site, https://heasarc.gsfc.nasa.gov/docs/tess/;
- Target tables for all observation proposals are to be submitted through ARK/RPS;
- The Scientific/Technical/Management section of proposals is limited to four pages, instead of the default 15 pages specified in the NASA Guidebook for Proposers. The requirement for a table of contents in the body of the proposal is waived.
- Optional Latex and MS Word templates for the Scientific/Technical/Management section will be provided on the TESS Science Support Center web site at https://heasarc.gsfc.nasa.gov/docs/tess/;
- The Scientific/Technical/Management section must be uploaded to the RPS website as a PDF file.

Proposals from non-U.S. institutions are acceptable and will only be considered on a no-exchange-of-funds basis. Non-U.S. proposals will be reviewed to the same
standards as proposals from U.S. institutions and selected solely by NASA. Even though no funds are to be requested from NASA, all non-U.S. proposals must contain all of the required sections outlined in the NASA Guidebook for Proposers, including the required table of time commitments for all proposal team members.

All proposal materials must be submitted electronically by 4:30pm Eastern time on the due date for this program given in Section 3 in order to be included in the proposal review for this cycle of the TESS Guest Investigator program. Note that the 4:30pm deadline supersedes the deadline stated in the Guidebook for Proposers and in the ROSES Summary of Solicitation.

2.2.2 Evaluation of Phase-1 Proposals submitted to the TESS GI Program

Proposals will be evaluated by a peer evaluation panel with respect to the criteria specified in Section C.2 of the NASA Guidebook for Proposers, where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The suitability of using the TESS survey and data products for the proposed investigation;
- The extent to which the investigation complements and enhances the anticipated science return from the TESS mission;
- The degree to which the proposed investigation places demands upon mission resources; and
- The degree to which the proposed investigation capitalizes on the unique capabilities of TESS.

2.2.3 Submission and Evaluation of Phase-2 proposals

Subject to the availability of funding, successful Phase-1 proposers will be contacted by the TESS Program Scientist and invited to submit a budget proposal in Phase 2. Upon notification of selection of a Phase-1 proposal, a proposer must respond as follows:

Follow the instructions for submitting a Phase-2 proposal given in the selection notification from the Phase-1 review. Phase-2 proposals must be submitted through the NASA NSPIRES electronic proposal website (https://nspires.nasaprs.com/) by an Authorized Organizational Representative (AOR) of the proposing organization. The budget proposal will consist of Budget Details (maximum of two pages) section and a Narrative section (maximum of two pages).

NASA program personnel will evaluate the Phase-2 cost proposals against cost realism and reasonableness. Comparison of the proposed cost to available funds will be performed as specified in Section C.2 of the NASA Guidebook for Proposers.

2.3 Supplemental Information

Further details concerning the proposal submission requirements and process can be found at https://heasarc.gsfc.nasa.gov/docs/tess/ the TESS Guest Investigator Program website. This website provides a detailed mission description; technical information about the TESS mission, instrument, and observation feasibility; and instructions for completing the required proposal forms.
### 3. Summary of Key Information

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<tr>
<th>Expected program budget for first year of new awards</th>
<th>~$2.5M</th>
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<td>Number of new awards pending adequate proposals of merit</td>
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</tr>
<tr>
<td>Page limit for Phase-1 proposals</td>
<td>4 pages. LaTeX or MS Word templates (available for download at <a href="https://heasarc.gsfc.nasa.gov/docs/tess/">https://heasarc.gsfc.nasa.gov/docs/tess/</a>) can be used for the proposals. Page limits include figures and references. This instruction supersedes the limits given in the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Relevance</td>
<td>This program is relevant to the Astrophysics questions and goals in the NASA Science Plan (<a href="https://science.nasa.gov/about-us/science-strategy">https://science.nasa.gov/about-us/science-strategy</a>). Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
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<td>General information and overview of this solicitation</td>
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<td>Please see ROSES Summary of Solicitation, Section I(g) Order of Precedence, and the NASA Guidebook for Proposers (<a href="https://www.hq.nasa.gov/office/procurement/nraguidebook/">https://www.hq.nasa.gov/office/procurement/nraguidebook/</a>).</td>
</tr>
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<td>Submission medium</td>
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<td>Web site for submission of Phase-2 proposals</td>
<td><a href="http://nspires.nasaprs.com">http://nspires.nasaprs.com</a>; See Section 2.2</td>
</tr>
</tbody>
</table>
| Programmatic information may be obtained from the TESS Program Scientist | Martin Still  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-4462  
Email: martin.still@nasa.gov |
|---|---|
| Technical questions concerning this program element may be directed to the TESS Guest Investigator Program | Patricia Boyd  
Code 662  
Goddard Space Flight Center  
National Aeronautics and Space Administration  
Greenbelt, MD 20771-0001  
Telephone: (301) 286-2550  
Email: patricia.t.boyd@nasa.gov |
NOTICE: Amended on January 23, 2018. To account for time lost to the government shut down, this amendment extends by one day the due dates for program elements that were due the week of the shutdown. The proposal due date for this program element is now Friday January 26, 2018.

Amended on August 4, 2017. This amendment presents the final text for this Program Element. Notices of Intent to propose are requested by December 7, 2017 and proposals are due January 25, 2018.

1. Scope of Program

The New Worlds, New Horizons report of the Astro2010 Decadal Survey observed that key challenges in theoretical astrophysics "are of a scale and complexity that require sustained, multi-institutional collaborations" but that there was "no mechanism to support these coordinated efforts at the needed level in the U.S." To address these issues, the Theoretical and Computational Astrophysics Networks (TCAN) program was established with the following goals:

- To support coordinated efforts in fundamental theory and computational techniques in order to make groundbreaking advances in astrophysics;
- To strengthen theoretical and computational astrophysics in the U.S. by uniting researchers in collaborative networks that cross institutional and geographical divides; and,
- To advance the training of the future workforce of theoretical and computational scientists.

In ROSES-2017, NASA solicits proposals for new TCAN networks. The period of performance for TCAN investigations will be three years. The TCAN program will support research networks with three or more nodes at distinct institutions. A network is a combination of nodes and connections. A node is a group of researchers at an existing institution, along with the local resources (e.g., computational, educational, communications) that sustain them. A connection is a significant exchange of expertise or capabilities between nodes (e.g., exchange of personnel, web-based training, sharing of access to resources). Multiple connections between nodes, that enable an integrated and focused collaborative effort, constitute a network.

Proposals submitted to the TCAN program must:

- Be directly relevant to space astrophysics goals by facilitating the interpretation of data from space astrophysics missions or by leading to predictions that can be tested with space astrophysics observations;
- Address fundamental issues in theoretical and computational astrophysics, and display a depth and breadth of concept qualitatively beyond those typical of the Astrophysics Theory Program (ATP);
- Consist predominantly of theoretical astrophysics studies and/or the development of theoretical astrophysics models and a significant computational component that involves more than just incremental enhancement of existing codes.

TCAN proposals may address theoretical topics in any of the areas of astrophysics included in the ATP (consult Program Element D.4). Proposers should note, however, that the mix of proposals in a TCAN panel is likely to cover a broader range of topics than a typical ATP panel, and should prepare their proposals accordingly. TCAN proposals satisfying the requirements listed above may involve development of data analysis methods for astrophysics missions and may incidentally include actual data analysis as a test of the theory or the method.

Proposals to the TCAN program may not:

- Consist primarily of data reduction or data analysis (such proposals should be directed to the mission-specific programs or the Astrophysics Data Analysis Program (ADAP) described in Program Element D.2 in this solicitation);
- Propose theoretical work pertaining to atomic and molecular astrophysics and other topics directly related to Laboratory Astrophysics (these should be proposed to the Astrophysics Research and Analysis (APRA) program element described in Program Element D.3);
- Address theoretical topics that are predominantly unrelated to the needs of NASA’s space astrophysics programs (such proposals should be directed to other appropriate Federal agencies);
- Deal strictly or predominantly with Solar System objects or solar-terrestrial interaction studies, including solar energetic particles (see Appendices B and C for appropriate programs);
- Propose to develop new data analysis methods for future space missions (these proposals should be submitted to the APRA program element described in Program Element D.3);
- Primarily aim at studying new mission concepts; or
- Request support for organizing and/or hosting scientific meetings other than network collaboration meetings.

Each proposed TCAN investigation must have a single, clear scientific focus, and be led by a single Principal Investigator (PI), with a Co-I at each of the other nodes designated as the organizational lead at that node. An individual may serve as PI or as an organizational lead on no more than one proposal in response to this solicitation. One proposal should be submitted for each proposed TCAN network; individual proposals for constituent nodes are not required. Group proposals in which several researchers submit an omnibus proposal consisting of related, but separate, investigations under a designated PI, are not solicited for TCAN, and will be considered unresponsive to this program element. For each funded network, one award will be made to the PI organization, with the other node organizations funded through subawards from the PI organization (except in cases of nodes located at Government laboratories). Networks will be required to submit annual progress reports, and to participate in a videoconference review with NASA Program Officers between years 2 and 3 (a pdf version of the materials from this presentation will constitute the year-2 progress report.)
2. Additional Solicitation Specific Review Criteria

A peer evaluation panel will review all proposals with respect to the criteria specified in Appendix D of the NASA Guidebook for Proposers, where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The appropriateness of the roles of the participating nodes and the effectiveness of the connections between nodes in establishing the proposed project as a network for realizing the goals of the proposed investigation;
- The functionality and effectiveness of management structures and procedures for allocating responsibilities, reaching decisions, monitoring progress, correcting errors, resolving conflicts, and assessing results;
- The practicality and efficacy of plans for evaluating the success of the network;
- The practicality and efficacy of plans for the support and maintenance of any software to be developed and released to the community;
- The effectiveness of network activities in contributing to the training and development of the future scientific workforce.

3. Availability of High-End Computational Resources

Those investigators requiring access to high-performance computing should refer to the Summary of Solicitation, Section I(d), "NASA-provided High-End Computing (HEC) Resources." This section describes the procedure that proposers to the TCAN program must follow to apply for computing time at either of the two NASA computing facilities: the Goddard Space Flight Center’s Computational and Information Sciences and Technology Office and the Ames Research Center’s Advanced Supercomputing Division. Because of the current high demand on NASA computing facilities, TCAN proposers may instead request support for the purchase of computing equipment or computing time from non-NASA providers of high-performance computing systems and services. In this case, the budget narrative should include a comparison between the cost of the proposed computing solution and that set out for NASA systems at https://www.hec.nasa.gov/user/policies/sbus.html. TCAN proposers requesting support for non-NASA computing may not also request NASA HEC resources, and vice versa. All computing resource requests will be evaluated under the “cost reasonableness” criterion by the science peer review panels (see Section VI(a) of the Summary of Solicitation.)

4. Summary of Key Information

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| NASA point of contact concerning this program | Keith B. MacGregor  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
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NOTICE: November 3, 2017. This is a DRAFT version of this program element posted for community comment. The scientific community is invited to make comments on this draft solicitation, not only for clarity of the forthcoming solicitation release, but also for inclusion of any ideas, strategies or recommendations that will lead to submission of proposed instruments capable of realizing transformational and compelling science. Similarly, the community is invited to comment on any constraints that may be overly restrictive and preventing the submission of proposals with creative, high-risk / high-return ideas.

NASA solicits questions / feedback about the scope of this program element and requests for clarification. All questions or comments should be emailed to kartik.sheth@nasa.gov by 11:59pm, Eastern time, January 12, 2018. The anticipated date for the release of the solicitation is January 19, 2018 with proposals due 90 days after the release.

Table of Contents

1 HIGHLIGHTS OF NEXT GENERATION SCIENCE INSTRUMENT SOLICITATION 3

2 SOFIA PROJECT OVERVIEW 4

3 OVERVIEW OF THE SOLICITATION 5

3.1 NOTICE OF INTENTS 5
3.2 THE TWO-STAGE SOLICITATION PROCESS 5
3.3 MANAGEMENT OF SOLICITATION 5
3.4 ADDITIONAL DOCUMENTATION NEEDED FOR SOLICITATION 6

4 THE NEXT GENERATION SCIENCE INSTRUMENT (NGSI) 7

4.1 MOTIVATION FOR INSTRUMENT 7
4.2 THE LEGACY SCIENCE PROGRAM (LSP) 7
4.3 ANTICIPATED REQUIREMENTS, ACTIVITIES & TIMELINE FROM DEVELOPMENT TO ACCEPTANCE 8
4.3.1 TOWARDS COMMISSIONING & REQUIREMENTS FOR COMMISSIONING 8
4.3.2 SCIENCE EXPLOITATION PERIOD FOLLOWING COMMISSIONING 9
4.3.3 INSTRUMENT TRANSITION TO SOFIA 9

5 REQUIREMENTS FOR PHASE I 10

5.1 SCIENCE REQUIREMENTS FOR PHASE I 10
5.2 TECHNICAL REQUIREMENTS FOR PHASE I 10

6 ANTICIPATED REQUIREMENTS FOR THE ICS PHASE 13
1 Highlights of Next Generation Science Instrument Solicitation

This solicitation requests proposals for scientific investigations that would develop and use scientific instrumentation capable of achieving the goals of NASA’s Stratospheric Observatory for Infrared Astronomy (SOFIA). The intent is to select and execute development of one or more new SOFIA science instruments and/or upgrades to existing instruments. The anticipated timeline is as follows:

**Philosophy for Solicitation of New SOFIA Instrumentation:**
- The next generation science instruments (NGSI) must be motivated by compelling science
- Selected team(s) must execute and deliver well-defined Legacy Science Program(s)
- Prioritize instruments that enable broad community usage and/or data of high archival value, but also allow for agile, “niche” instruments to solve important / outstanding science questions
- Allow for new instruments or upgrades/modifications to existing instruments; also allow for flexibility for future enhancements and modifications to NGSI
- Allow for a nominal three-year development period after funding begins but also allow for longer or shorter development timescales for optimal science return
- Allow for schedule and budget flexibility; make selections based on science return on investment
- Reduce requirements for the ICS phase compared to previous solicitations
- Make instrument development and acceptance process easier for teams (using lessons learned from past experience)
2 SOFIA Project Overview

The Stratospheric Observatory for Infrared Astronomy (SOFIA) consists of a German-built 2.7-meter (2.5-meter useable aperture) telescope with a suite of imaging, polarimetry and spectroscopy instruments, mounted in a Boeing 747-SP aircraft supplied and modified by NASA. Operations costs and observing time are shared by the United States (80%) and Germany (20%). Flying at altitudes up to 45,000 feet, SOFIA observes from above more than 99 percent of Earth’s atmospheric water vapor, thereby opening up wavelengths for astrophysical observations not available from the ground.

SOFIA is a near-space observatory that returns to base after every flight. Therefore, unlike most space missions, its scientific instruments can be exchanged periodically to accommodate changing science requirements and to incorporate new technologies, which is a tremendous advantage. A key part of the SOFIA project has always been to include an instrumentation program that would periodically introduce new technologies in order to enable new scientific frontiers to be explored. NASA is soliciting proposals for compelling science that ultimately lead to the development of one or more new Science Instruments (SI) and/or upgrades to existing science instruments.

The SOFIA observatory has been designed to support observations at wavelengths from 0.3\(\mu\)m to 1.6 mm. The observatory is capable of high-resolution spectroscopy (R > \(10^7\)) in discrete wavelength bands at wavelengths between 5 and 600\(\mu\)m with its existing instruments. SOFIA produces the sharpest images of any current or planned IR telescope operating at wavelengths from 30 to 320 \(\mu\)m. The current SOFIA suite of instruments (EXES, FIFI-LS, FLITECAM, FORCAST, FPI+, GREAT, HAWC+, HIPO, and HIRMES) has a wide range of imaging, spectroscopy, and polarimetry capabilities (http://www.sofia.usra.edu/Science/instruments/).

A sample of science programs that might be undertaken with SOFIA is described in The Science Vision for the Stratospheric Observatory for Infrared Astronomy, available at http://www.sofia.usra.edu/Science/science_cases/. SOFIA science results in the literature are also available here: https://www.sofia.usra.edu/science/publications/sofia-publications.

SOFIA data are archived and available via the SOFIA Data Cycle system (https://dcs.sofia.usra.edu/). Starting in 2018, the SOFIA data archive will begin a transition to the NASA/IPAC Infrared Science Archive (IRSA). It is anticipated that data from the next generation science instruments will be ingested in and served to the community via IRSA.

SOFIA is a project within the Cosmic Origins theme of the Astrophysics Division of the Science Mission Directorate. The SOFIA Project is managed by Ames Research Center (ARC). The execution of the SOFIA Project is carried out under three management directors, coordinated by the SOFIA Project Manager: the Science Mission Operations (SMO) Director, whose staff is responsible for science observing proposal solicitation and evaluation, science flight planning, pipeline processing of the science data, and operation of the SOFIA Facility Instruments; the Operations Director, whose staff is responsible for the aircraft operations and the Armstrong Flight Research Center (AFRC) ground facilities; and the Observatory Systems Director, whose staff is responsible for observatory improvements and new science instrument development (once science instruments are selected by NASA Headquarters).
3 Overview of the Solicitation

This solicitation specifically requests proposals for compelling scientific investigations that require development and use of a next generation science instrument (see Section 4) for SOFIA, that is aligned with NASA’s astrophysics goals (Appendix A).

This solicitation is specifically not requesting:
- Proposals for only an individual’s scientific research or development projects;
- Proposals for technology development or demonstration projects; and
- Proposals for ground-based technology test beds.

3.1 Notice of Intents

A brief Notice of Intent (NOI) to propose is encouraged, but not required, for the submission of proposals to this solicitation. The information contained in an NOI is used to help expedite the proposal review activities and, therefore, is of considerable value to both NASA and the proposer. To be of maximum value, NOIs should be submitted by the PI via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES, located at https://nspires.nasaprs.com) by the date defined in the Summary Table of Key Information (Section 12). It is understood that PIs may need to update their co-investigators after the submission of the NOI and this is allowed under this solicitation. Changes to the co-investigator list after the submission of the NOI may be emailed to the main point of contact listed in the Summary Table of Key Information (Section 12).

3.2 The Two-Stage Solicitation Process

Proposals submitted in response to this solicitation will be evaluated and selected through a two-phase competitive process:

- **Phase I:** In this phase all compliant proposals submitted in response to this solicitation will be subject to a scientific and a top level technical peer review. Requirements for Phase I are listed in Section 5. Evaluation criteria for this phase are listed in Section 7. Based on the results of that review, one or more proposals may be selected for a funded Instrument Concept Study (ICS) phase.
- **Phase II:** Through the rest of this document we refer to Phase II as the ICS Phase. Requirements for the ICS phase are listed in Section 6. Evaluation criteria for the ICS phase study evaluations are listed in Section 8. At the end of the ICS Phase, there will be a second review which will focus primarily on the technology, management and cost aspects of the instrument. At that point, one or more instruments may be selected for further development following the approximate timeline shown above in Section 2 (see also Figure 1 and 2).

3.3 Management of Solicitation

This solicitation and review of the proposals submitted to it (including Instrument Concept Study (ICS) phase reports) are managed by the Astrophysics Division within the Science Mission Directorate (SMD) at NASA Headquarters, with programmatic and technical support from the SOFIA staff at the NASA
Ames Research Center (ARC), SOFIA Mission Operations (SMO), and the NASA Armstrong Flight Research Center (AFRC). In accordance with this role, a conflict avoidance plan (see also Section 9) has been implemented to prevent any ARC, SMO and AFRC personnel involved in the evaluation process from having had any involvement with proposers and proposing teams.

The SOFIA Science Instrument Development (SI Dev) team has a key role in the development and delivery of new science instruments and upgrades to the SOFIA observatory. The SI Dev team consists of approximately eight scientists, astronomers, and engineers within the SOFIA project who provide critical support in the solicitation process and later in the instrument development, commissioning and acceptance process.

3.4 Additional Documentation Needed for Solicitation

NASA intends to maintain an essential degree of insight into instrument development to ensure that the implementation is responsive to requirements and constraints. NASA requirements and constraints will be spelled out in a *SOFIA Instrument Developer’s Handbook* which will be part of a final and complete set of documentation (collectively called “the SOFIA Project Library”) and will be provided at [http://www.sofia.usra.edu/](http://www.sofia.usra.edu/) with the release of the solicitation anticipated in January 2018.

Proposers to this solicitation are strongly encouraged to review the contents of the SOFIA Project Library as it will contain the safety, reliability and quality assurance requirements, as well as Observatory policies and requirements for the next generation instrument.
4 The Next Generation Science Instrument (NGSI)

4.1 Motivation for Instrument

The proposed SOFIA instrument must fundamentally be motivated by a compelling science case. The proposing team must propose a Legacy Science Program (LSP, see section 4.2) of high scientific value that the team will execute with the instrument they build and deliver. Instruments that will be of use to a broad scientific community and promise to deliver data of high archival value are encouraged. Niche, less capable but agile instruments that may be developed on a shorter time scale, presumably at a lower cost, to address specific, if narrow, scientific questions may also be proposed.

4.2 The Legacy Science Program (LSP)

The LSP is a scientifically ambitious investigation with long-lasting and impactful science that motivates the proposed instrument. It may comprise of one or more scientific objectives that significantly advance NASA’s strategic objective in astrophysics (see Appendix A). The science program should be akin to major coherent observing programs that have been carried out at other observatories (e.g. Spitzer Legacy Programs, see http://irsa.ipac.caltech.edu/data/SPITZER/docs/spitzermision/observingprograms/legacy/, or Hubble Treasury Programs, see http://archive.stsci.edu/hst/treasury.html).

The LSP must contain a detailed scientific justification and an observing plan which clearly describes the science targets, instrument modes and the time required to achieve the scientific goals, as well as the roles and expertise of the science team that will execute the LSP.

It should be executable within a two year period following commissioning. If LSP investigations are not fully executed within two years after commissioning, the decision of whether to carry the residual observing hours into the future will be negotiated between the PI and the SMO director, with concurrence from NASA.

Nominally LSP data have no period of exclusive use and the data will be made immediately public and available to the community via IRSA. If there is a strong justification for a short period of exclusive use, the proposals must fully describe such a request.

In the ICS phase, the proposing team(s) may refine the needed observing time (possibly based on a better understanding of the instrument) but may not change the scope of the scientific investigation. In this phase, the teams may add any other details to clarify the scope of the work to execute the LSP. The ICS report must also fully describe the funding and any other resources needed to execute the LSP with adequate justification.

Following commissioning, upon better understanding of the instrument performance (and to allow for changes in the scientific landscape), the team(s), or NASA, or the SMO Director may re-visit and request a re-negotiation of the LSP request. All such requests should be aimed at increasing science return from SOFIA within any programmatic constraints at the time.
4.3 Anticipated Requirements, Activities & Timeline from Development to Acceptance

4.3.1 Towards Commissioning & Requirements for Commissioning

- The Next Generation Science Instrument(s) (NGSIs) developed by the selected team(s) should plan for commissioning approximately three years after the development funding starts.
  - Instruments that require a longer or shorter development time scale may be proposed with an adequate and compelling justification.
- The funds available for instrument development are anticipated to be ~$15M over three years (total for all NGSIs) which may be adjusted for the selected instrument(s) funding and schedule profile.
- Each instrument team must deliver a commissioning report immediately following the commissioning flights.
- The commissioning report must describe the instrument status and performance, operational modes, expected sensitivities in all modes and best practices for the use of the instrument for science.
- A “Users Guide” for the general community must be delivered at the end of commissioning.
- The team(s) must also provide a functional pipeline and/or algorithms for science-ready data products at the end of commissioning.

The final requirements for successful commissioning, the commissioning report and timeline for delivery will be negotiated between the PI, NASA and the Science Missions Operations (SMO) Director towards the end of the instrument development process.
4.3.2 Science Exploitation Period Following Commissioning

Following commissioning, for up to two years, the team(s) will exploit the NGSI for science as follows:

- The team(s) must execute and deliver on their Legacy Science Programs.
- The team(s) must make their instrument available for general community use, which may be on a collaborative basis, i.e.
  - The team(s) must provide needed support for the community’s use of the instrument
  - In return, the team(s) may request reasonable participation in the community’s proposed science GO programs with the NGSI.
- It is understood that the NGSI data reduction pipeline may evolve and become more refined over these two years as the instrument is exercised for science.
- At any time during this two-year period, the PI may propose to enhance, modify and make upgrades to the instrument to improve / optimize its performance. The SOFIA project may choose to conduct an independent review of such a request to determine the potential impact on science (e.g. non-availability of instrument while being enhanced/upgraded versus community demand). Such a request will also be evaluated within constraints of the budget and other programmatic considerations.

4.3.3 Instrument Transition to SOFIA

At the end of the Science Exploitation Period, the NGSI must formally transition to the SOFIA project following the formal acceptance process that will be detailed in the SOFIA Project Library. After this point, the instrument will become a facility class instrument. As described in Section 2, the intention is to make this process smoother and easier by allowing for the transition to occur over a two year period following commissioning and with support from the project as follows:

- Throughout the entire instrument development process but especially towards the end of the development process and through the transition period, the selected team(s) are expected to work closely with the SI Dev team and the SMO with the goal of having common shared knowledge about the instrument hardware and performance, and the software needed for operations and the associated data reduction and analysis pipeline.
- At any time during development or after commissioning, the selected team(s) may request support from the SI Dev and/or the SMO team. For instance, the teams may request support to help with such things as airworthiness certification or other documentation.
- Especially during the transition period after commissioning, the SI Dev and SMO team will work closely with the selected team(s) for the needed documentation and certifications to ensure a smooth transition of the instrument from the proposing teams to SOFIA.
5 Requirements for Phase I

Although the discussion above has described some of the necessary information needed for selection, this section lays out the requirements for Phase I. Section 6 lays out the anticipated requirements for Phase II, the ICS Phase. Requirements on standard proposal content and format are provided in the ROSES-2017 NASA Research Announcement (NRA) Summary of Solicitation.

Proposals submitted in response to this solicitation must address all aspects of this next generation instrument, including, but not limited to, the following requirements listed in Sections 5.1 and 5.2. These requirements will be considered in the evaluation as described in Section 7.

5.1 Science Requirements for Phase I

The proposal must include, but not be limited to, the following elements:

1. Substantial and compelling science that drives the need to develop the next generation science instrument on SOFIA. Describe how the science fits into the Astrophysics Division’s efforts towards fulfilling one or more of NASA’s strategic objectives (Appendix A).
2. A LSP plan, consistent with Section 4.2, that clearly describes the team’s scientific objectives for the requested LSP time and a plan for achieving these scientific goals. As part of this plan, provide a realistic description of the necessary observations (i.e. a high level observing plan estimating the needed number of flights, number of targets, etc.) and a rough estimate of the funding and other resource requirements.
3. A discussion of other scientific investigations that may be undertaken by the general scientific community with the new instrument assuming it shall be available for at least ~5 years after commissioning. Connect these plausible investigations to NASA’s strategic objectives (Appendix A) and discuss whether the investigations enabled by the NGSI could be preparatory or complementary to those possible with current or upcoming astrophysics facilities such as JWST, WFIRST, TESS, ALMA, etc.
4. A discussion of the potential usage of the archival scientific data that may be collected by the proposed instrument.
5. A high-level community usage plan describing how the team will support science with the instrument by the general community and needed resources for this effort during the two year time period after commissioning and before the formal transition of the instrument to the project (consistent with Section 4 and see specifically sections 4.3.1 and 4.3.2)

5.2 Technical Requirements for Phase I

The phase I proposals must contain enough technical detail to provide sufficient confidence that the preliminary instrument design can meet the required performance to meet the science goals, and that the final instrument can be successfully completed within the technical, schedule, and cost goals proposed. Proposals may accomplish this task by explicitly identifying the areas that will be the topic of further development in the ICS phase, i.e. the phase I proposal can be less detailed on technical, management, and cost, as these aspects are to be defined and detailed in the report provided at the end of the ICS phase.

The proposal must include, but not be limited to, the following elements:
1. A list of performance requirements that the science instrument shall achieve in order to enable the LSP and broader scientific investigations. These minimum performance requirements will form the basis of the top-level science and technical performance requirements.

2. Instrument design & fabrication, including a high-level preliminary schedule and cost estimate for the NGSI and/or enhancements/upgrades to a current instrument.
   - If modifying or upgrading an existing instrument, indicate the down time when that instrument would not be available for observations on SOFIA
   - A description of what components or aspects of the design are subject to further definition or identification during the funded ICS phase concept study
   - Development of instrument control software and data reduction and analysis pipeline software
   - If applicable, a discussion of possible future upgrades / continued improvement of the instrument capabilities to push the scientific boundaries and discovery space.

3. Identify all enabling technologies and define and justify the claimed NASA Technology Readiness Level (TRL), establishing confidence that the instrument design can be adequately developed within the proposed budget and timescale of the concept study. Details of the technical architecture will be further developed in the ICS phase.

4. A detailed cost plan with justification for conducting the ICS concept study to not exceed $500K over five months (see Section 6 below for requirements).

5. A high-level cost plan with an appropriate funding profile that does not exceed ~$15--20M over three years from the start of instrument development (i.e., from the end of the ICS phase). If the cost is higher than this, adequate justification must be provided in the proposal. Note that this is the total anticipated funding for one or more instrument(s) selected for development.

6. Potential, high-level de-scope options to the instrument, when such de-scopes could be exercised, along with the associated anticipated science impacts.

7. A high-level development, implementation and commissioning plan with estimates for all costs associated through commissioning. The commissioning plan will be further developed in the ICS phase.

8. A high-level estimate of the scope of work and funding required to support the community usage (consistent with Section 4.3.2). The proposing team(s) are required to provide the needed support for broad community use as well as the data reduction pipeline and/or algorithms that will provide users with science-ready data and data products. The community usage plan may be refined in the ICS phase upon better understanding of the instrument.

9. A high-level plan for the scope of work in transitioning the instrument to the SOFIA project for formal acceptance within the (up to two year) transition period after commissioning. This plan must detail how the team(s) propose to collaborate with SI Dev team and the SMO to smooth the transition of the instrument for acceptance by the project.

10. Proposals including costs for NASA Centers shall conform to the full cost policy stated in the ROSES-2017 NRA.
11. Brief discussion of the methodology and rationale used to develop the proposed estimated cost of the instrument development (including a brief discussion of sources of cost uncertainties) and provide a discussion on the proposed management approaches for controlling cost growth.

12. If a proposal includes contributions from other institutions that are essential to the success of the proposed instrument development or are in the critical path, the proposal must include: (i) demonstrations of clear and simple technical and management interfaces in the proposed cooperative arrangements, (ii) explicit evidence that the proposed contributions are within the contributor’s scientific and technical capabilities, and (iii) contingency plans for coping with potential failures of proposed cooperative arrangements or, where no mitigation is possible, an explicit acknowledgment to that effect and an explicit rationale for accepting the risk. A letter of commitment clearly describing the partner institutions role and commitment must be included in the proposal.
6 Anticipated Requirements for the ICS Phase

The ICS phase is expected to last approximately 5 months. Teams will be required to include the following items in their final ICS report:

1) A list of the science requirements and their flow-down to SI performance requirements including sensitivity/error budgets. The requirements do not need to be flowed down at the level of a System Requirements Review (SRR) but they should be specified in enough detail that the technical evaluation is able to judge the scope of the development effort. The SRR will be described in more detail in the SOFIA Project Library (see Section 3.4).

2) A proposed design, including hardware, electronics, software, and data analysis that could achieve these requirements, given in enough detail that the technical review panel can evaluate whether this design would be adequate. This does not, however, have to be at a Preliminary Design Review (PDR) level of design. The PDR will be described in more detail in the SOFIA Project Library (see Section 3.4). The report should present enough information of the design and its required reviews to demonstrate to the technical review panel that the proposal team fully understands what is necessary to have an airworthy and reliable instrument flying on SOFIA.

3) Any technology development work that would be needed before a final design can be developed (e.g., raising TRLs of enabling technology).

4) Any outstanding design trades.

5) Possible de-scopes and their consequences.

6) A detailed work breakdown structure (WBS), with accurate labor and the required skill-set estimates for each WBS element.

7) Apportionment of the WBS elements among the different institutions in the proposal, with detailed letters of commitment from each institution.

8) An integration and test plan in enough detail that the technical review panel can judge its feasibility, including any required documentation submissions to the SOFIA Project for their review.

9) A plan for developing the data reduction pipeline in collaboration with the SMO that will be ready for use at the end of commissioning. A clear plan with milestones must be provided on how the pipeline will be developed, tested, verified and delivered. The plan should also include any anticipated modifications and/or refinement in the two-year period of science exploitation following commissioning.

10) A plan for management of data products (commissioning, GO and LSP data) so that they are immediately available for ingestion into IRSA, which will serve the data to all users. The data products must conform to standard requirements used by IRSA for serving the data to the scientific community for analysis.

11) A schedule for the development effort, explicitly showing the location and duration of any funded schedule reserve, as well as the times and locations of any reviews.
12) A Master Equipment List (MEL) including the costs, supported by quotes, of all of the major procurements.

13) Identification of the key personnel, with statements of commitment for their time as specified in the WBS.

14) A risk plan for those items that are threats to the successful completion of the development effort on time and within cost.

15) A cost plan, broken down into enough detail with skill-sets and rates so that the technical review panel can gain confidence that the final costs are realistic.

16) A description of the facilities that will be used in the development program, enclosing any test facilities, with letters of commitment that they will be available during the time periods shown in the development schedule.

17) A description of the organizational structure, include authority and lines of reporting.

18) A concept of operations for the instrument.

19) A detailed commissioning plan with an estimate of the number of flight research hours required to verify their instrument’s performance, commission the instrument for use by general observers (GOs), and obtain any required generic calibration data. Observing time estimates do not need to include observatory overhead values (for telescope set-up and initial source acquisition), but should include observation overheads (time on target, time off-target for background subtraction via chop and/or nod, etc.). The estimated number of ‘line operations observing hours’ (observations with the aircraft parked on the ground) required to commission the instrument shall also be estimated during the ICS. The number of hours proposed for commissioning the instrument and for line operations should be kept as small as practical and should be well-justified. Commissioning data that can also lead to publication of scientific results will be viewed as a strength of the proposal - therefore a carefully crafted commissioning plan at the end of the ICS is recommended. Proposals which offer to provide the larger astrophysics community with commissioning data and/or other help for full exploitation of the instrument will be regarded more positively in the review process.

20) Any minor refinements of the needed observing time for the LSP (based only on a better understanding of the instrument) but without changing the scope of the scientific investigation. Any other details to clarify the scope of the work to execute the LSP such as the funding to execute the LSP.

21) Refinement of the community usage plan from Phase I describing how the proposing team will ensure the maximum exploitation of science for programs from the broader science community. The plan should describe how the team plans to support the community and describe with justification their request for any desired participation in the community’s proposed science GO programs with the NGSI. The funding needed to support the community should be described with adequate justification.

22) If applicable, a discussion of any possible future upgrades / updates to the instrument or software, estimated cost of the upgrades and their impact on the observatory and the science.
6.1 Reporting / Status updates / Q&A during the ICS Phase

During the ICS phase, the selected instrument teams should anticipate providing the project with a monthly progress/status. All teams may ask questions or clarifications during this phase - answers will be posted for all teams on a public web page since the ICS phase is a competitive phase.
7 Proposal Evaluation Criteria for Phase I

The evaluation of proposals submitted in response to this solicitation will be in accordance with the evaluation criteria stated in the NASA Guidebook for Proposers, as well as consideration of the requirements described above.

- The evaluation criterion "intrinsic merit" will include consideration of the scientific merit of the proposed investigation and feasibility of technical success. The greatest weight will be placed on the compelling nature of the proposed LSP, the clarity of its goals and objectives, and the potential for fundamental progress, as well as filling gaps in our knowledge relative to the current state of art. Additional factors that will be evaluated are the appropriateness of the instrument to address the goals and objectives, scientific potential of the instrument for the broader community including the community usage plan, data reduction and analysis pipeline plan, the archival value of data expected from the instrument, technical feasibility of the instrument, and the overall science return on the investment.
- The evaluation criterion "programmatic relevance" will include consideration of the programmatic value to NASA of the proposed LSP and broader science enabled by the NGSI, with an emphasis on the degree to which the proposed instrument is able to uniquely advance the scientific capabilities of SOFIA.
- The evaluation criterion "cost realism and cost reasonableness" will include consideration of the implementation and cost risks factors such as: the feasibility and maturity of the design, the probability of technical success including de-scope options, the technology readiness level, the probability of meeting cost and schedule, the adequacy and costs of the ICS phase study plan. Also included in this criterion will be factors such as the proposed management plan and schedule, probability to conform and meet SOFIA Observatory requirements, the merits of the implementation and commissioning plans as well as the team’s plan for transitioning the NGSI to SOFIA. The adequacy of the costs for executing the LSP and the community usage effort will also be considered in this criterion.

The evaluations will be used for the development of a selection recommendations for presentation to the selecting official (the Director, Astrophysics Division, Science Mission Directorate). The selection recommendations and selection decision may also include consideration of other factors, such as the availability of funds, total cost, anticipated operational date, implementation and management risk, and potential benefit to other NASA missions.

8 Evaluation of the ICS Phase Reports

The evaluation of the ICS Phase reports will be done by a technical review panel. The science case will not be judged again unless changed from what was originally proposed. The review will focus on the technical feasibility of the instrument as well as the feasibility and adequacy of its planned development schedule, costs and risks.

9 Eligibility & Conflicts of Interest.

Proposals from any category of organizations or institutions, U.S or non-U.S. (but not German, see below), are welcome to respond to this solicitation. Specific categories of organizations and institutions
that are welcome to respond include, but are not limited to, educational, industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies.

SOFIA is a joint US-German partnership. Co-Investigators (Co-Is) at German institutions are allowed to participate on a no exchange of funds basis in proposals submitted by non-German institutions. Since the Memorandum of Understanding (MOU) between NASA and Deutsches Zentrum für Luft und Raumfahrt (DLR), the German Aerospace Center, gives the authority for selection of German participants in the SOFIA Project to DLR, German institutions are not eligible to submit proposals as PI to NASA in response to this solicitation.

Any non-U.S. participation in this solicitation is subject to the requirements set forth in the ROSES-2017 NASA Research Announcement (NRA).

NASA ARC is eligible to submit and participate in proposals in response to this solicitation. In order to manage ARC’s two potential roles as both proposers and in its role as SOFIA Science Center, SMD has established functional and organizational firewalls between the SOFIA Project and its associated Science Center, and those components of ARC that might participate in proposals. These firewalls ensure that personnel identified as supporting SMD in the solicitation process will protect all nonpublic information from all proposers, including those at ARC, and will be free of financial and other conflicts of interest with proposers.

NASA contracts for the services of outside, non-Governmental organizations for support in evaluating proposals. Organizational conflicts of interest (OCI) between proposing, evaluating, and executing organizations must be avoided. The approach to avoiding organizational conflicts of interest depends on the unique characteristics and roles of each evaluating organization. For non-Governmental organizations, this requires limiting the extent to which the outside evaluating organizations can participate in proposal development and/or execution of the work proposed.

The NASA contract with Universities Space Research Association (USRA) for SOFIA science and mission operations includes technical evaluation support under this solicitation. In the event that any business unit of USRA has a proposed role as prime contractor, subcontractor, or participating organization, this support creates an organizational conflict of interest for USRA that cannot be mitigated. Because of this organizational conflict of interest, USRA personnel are precluded from participating in any capacity in support of a respondent under this solicitation.

Although NASA’s Postdoctoral Project (NPP) is now managed by USRA, NPP fellows are not formally employees of USRA and therefore eligible to participate in any capacity as principal or co-investigators, or in support of a respondent under this solicitation. NPPs should not propose as being affiliated with USRA, but instead should participate through another organization (such as their NASA center).

USRA is a private, nonprofit corporation whose current membership consists of 105 universities in the U.S. and abroad that have graduate programs in space-related sciences and/or engineering. NASA has determined that there is a need for USRA employees to perform technical evaluations of proposals for new science instruments due to their unique qualifications. In order to address any apparent or actual organizational conflict of interest that arises between USRA employees and the 105 member universities of USRA, the NASA Assistant Administrator for Procurement has approved a waiver in accordance with FAR 9.504(e) to permit peer review evaluation by USRA employees for all proposals received, including proposals received from the USRA member universities.
10 Public Engagement and Communications

Successful media relation activities require close cooperation between NASA and the selected investigations. All selected investigations shall coordinate media relations and/or public affairs with the SOFIA public affairs office. NASA is to be informed in a timely manner of any newsworthy mission event or issue before public release of information. Strategies for using new and social media shall also be developed collaboratively to insure that common and consistent messaging will occur in a timely manner. NASA and the selected investigation will establish and maintain a detailed coordination media relations plan and communication process.

11 Remediation, Termination, or Cancellation

For the ICS report, each selected Principal Investigator (PI) must include a commitment by the PI for the PI-managed instrument development cost, schedule, and award associated with the instrument. To maximize the efficiency of the concept study investment, the selected PI shall work with NASA to develop top-level science and technical performance requirements, including a set of performance metrics for evaluation with NASA. These metrics shall include cost, schedule, and others, as appropriate.

Once an investigation has been selected for implementation following down-select after the ICS phase, failure of the PI to maintain reasonable progress within the committed schedule and cost, and/or failure to operate within other applicable constraints, will require a review by NASA to ascertain if the development should continue. If, at any time, the cost, schedule, or scientific performance commitments made in the ICS concept study report appear to be in peril, the instrument development will be subject to cancellation, accompanied by appropriate award action, which may involve termination of the award.

Overall oversight of the instrument development will be provided by the SI Dev Manager at ARC. Additional independent oversight will be conducted by the SOFIA Chief Engineer’s staff and the SOFIA Safety and Mission Assurance staff.

12 Submission Process and Requirements

Proposers should refer to the PDF entitled "How to submit a Phase 1 proposal" under "Other Documents" on the NSPIRES page for this program. The process for preparation and submission of the Phase 1 proposals is essentially identical to that associated with any other ROSES proposal, subject to the following program-specific constraints:

a) The Scientific/Technical/Management section of the Phase 1 proposal, which consists of text, tables, and figures, must not exceed 25 pages. References do not count against the 25-page limit.

b) Proposals must be completed and submitted electronically through NSPIRES (https://nspires.nasaprs.com). Hard-copy submissions are not permitted.

c) All electronic proposal materials must be submitted by 11:59 p.m. Eastern time on the due date given in Section 14 in order to be included in the proposal review for this solicitation.
Instructions provided in this program element supersede the instructions in the ROSES-2017 NRA and in the Guidebook for Proposers.

12.1 Pre-Proposal Workshops

NASA will provide two opportunities to the community to participate in a preproposal workshop, which it will hold on Thursday, Feb 1, 2018 at 2 pm EST and Tuesday, Feb 20, 2018 at 4pm EST. The workshop will cover the scope and intent of the solicitation, as well as expectations for the Instrument Concept Study, and NASA oversight of the development and commissioning process, and the characteristics of SOFIA. Detailed information on how to connect to the video/teleconference workshop will be provided with the release of this solicitation. There will be a question and answer session at the workshop which will be recorded and also put on a webpage.

12.2 Proposal Formatting

Formatting of the proposal must conform to the stylistic requirements described in the 2017 NASA Guidebook for Proposers and the ROSES-2017 NRA. There is no minimum requirement for fonts used within figures and tables but all text in figures and tables shall be legible; fonts smaller than 8-point are often illegible. Proposals that do not conform to the page limits and formatting requirements described or referenced in this solicitation will be subject to penalty up to and including decline without review.

12.3 International Agreements

Proposals from scientists employed at non-U.S. institutions will be considered on a no-exchange-of-funds basis. Non-U.S. proposals will be reviewed to the same standards as proposals from U.S. institutions. All foreign investigators, whether proposing as PI from a foreign organization or Co-Is participating on proposals from U.S. organizations, must be endorsed by a funding/sponsoring institution or agency in the foreign country to demonstrate that resources are available to support the proposed investigation. Proposals from non-US participants should adhere to the NASA Guidebook for Proposers.

13 Award Administration & Funding

For those proposals selected for ICS phase and beyond, the award types depend on the nature of the work proposed, but it is anticipated that ICS Phase awards to non-Federal institutions will be grants and any subsequent (full) awards will be made as contracts. Awards made through this solicitation for the SI development following ICS phase will follow the policies stated in the ROSES-2017 NRA. The initiation of the selected award(s) will take place as soon as possible after notification of selection. If the proposing organization of the instrument selected for implementation is external to the Federal Government, funding for the development, installation, and commissioning of the instrument may be issued as a contract from ARC. If the proposing organization is a NASA Center or other Government Laboratory, funding will be issued through normal internal NASA or interagency processes.

Once an instrument is selected for implementation (following the ICS phase), the technical oversight and management of the selected next generation SI development will be assigned to the SI Dev manager located at ARC. The responsibilities of this manager include the overall oversight of the design, development, and implementation of the next generation science instrument. The SOFIA Project will provide system engineering methodology to assist the PI-led team in tracking progress against milestones,
decision key points, budget and schedule, and goals and objectives, as well as the program plan, and specific aspects unique to SOFIA, such as airworthiness considerations.
# 14 Summary of Key Information

<table>
<thead>
<tr>
<th><strong>Anticipated Date for Solicitation</strong></th>
<th>January 19, 2018 (tentative)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected total program budget</strong></td>
<td>$15M-$20M over three years (higher values need adequate justification)</td>
</tr>
<tr>
<td><strong>Number of new awards</strong></td>
<td>One or more proposals selected to conduct ICS</td>
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<td><strong>Maximum duration of awards</strong></td>
<td>ICS phase to be approximately 5 months. The schedule for implementation and delivery of the selected instrument will be determined during the ICS</td>
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<tr>
<td><strong>Dates for Pre-proposal Workshop</strong></td>
<td>2 PM EST / Feb 1, 2018; 4 PM EST / Feb 20, 2018</td>
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<tr>
<td><strong>Submission of NOIs (not required)</strong></td>
<td>Preferably by March 1, 2018</td>
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<tr>
<td><strong>Due Date for Phase 1 (90 days after solicitation)</strong></td>
<td>11:59 PM Eastern Time on April 19, 2018 (tentative)</td>
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<tr>
<td><strong>Due Date for Phase 2 Proposals (ICS)</strong></td>
<td>11:59 PM Eastern Time on December 15, 2018</td>
</tr>
<tr>
<td><strong>Planning date for Instrument Concept Study start</strong></td>
<td>~3 months after Phase-1 due date</td>
</tr>
<tr>
<td><strong>Page limit for the Scientific, Technical, and Management section of proposal</strong></td>
<td>25 pages. See Section 12 above and Section 2 of the <em>NASA Guidebook for Proposers</em> for information.</td>
</tr>
<tr>
<td><strong>SOFIA Project Library</strong></td>
<td>Will be made available with release of this solicitation</td>
</tr>
<tr>
<td><strong>SOFIA Project web site</strong></td>
<td><a href="http://www.sofia.usra.edu/">http://www.sofia.usra.edu/</a></td>
</tr>
<tr>
<td><strong>Web site for submission of electronic proposals via NSPIRES</strong></td>
<td><a href="https://nspires.nasaprs.com/">https://nspires.nasaprs.com/</a> (help desk available at 202-479-9376 or <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a>)</td>
</tr>
<tr>
<td><strong>Relevance</strong></td>
<td>This program is relevant to the Astrophysics strategic goals and sub-goals in NASA’s Strategic Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td><strong>General information for this solicitation</strong></td>
<td>See ROSES Summary of Solicitation</td>
</tr>
<tr>
<td><strong>Detailed instructions for the preparation and submission of proposals</strong></td>
<td>See NASA Guidebook for Proposers at <a href="https://www.hq.nasa.gov/office/procurement/nraguidebook/">https://www.hq.nasa.gov/office/procurement/nraguidebook/</a></td>
</tr>
<tr>
<td><strong>Web site for submission of proposals via Grants.gov</strong></td>
<td><a href="https://grants.gov/">https://grants.gov/</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)</td>
</tr>
<tr>
<td><strong>Funding opportunity number for downloading an application package from Grants.gov</strong></td>
<td>NNH17ZDA001N-SFNXGNI</td>
</tr>
</tbody>
</table>
| **NASA point of contact**            | Kartik Sheth  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Tel: 202-358-4805  
Email: Kartik.sheth@nasa.gov |
Appendix A. NASA Astrophysics Goals

The 2014 Science Plan for NASA’s Science Mission Directorate (http://science.nasa.gov/about-us/science-strategy/) articulates NASA’s strategic objective in astrophysics as "discover how the universe works, explore how it began and evolved, and search for life on planets around other stars." Three broad scientific questions emanate from this objective:

• How does the universe work?
• How did we get here?
• Are we alone?

Each of these questions is accompanied by a science goal that shapes the Astrophysics Division’s efforts towards fulfilling NASA’s strategic objectives:

• Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter and gravity.
• Explore the origin and evolution of the galaxies, stars and planets that make up our universe.
• Discover and study planets around other stars, and explore whether they could harbor life.

NASA’s astrophysics program seeks to be responsive to scientific priorities articulated in reports from the National Academy of Science’s National Research Council, especially decadal surveys. The most recent decadal survey in astronomy and astrophysics is New Worlds, New Horizons in Astronomy and Astrophysics (NRC, 2010), available at http://www.nap.edu/catalog.php?record_id=12951.
NOTICE: Corrected November 21, 2017. In Section 2.4 an erroneous reference in the text to Section 1.2 has been corrected to Section 1.1.

Corrected October 30, 2017. In Section 2.6, Budget Preparation Instructions for Step-2 Proposals, the end date has been changed from February 1, to February 28, 2023. New text is in bold and deleted text is struck through.

Clarified on October 13, 2017. Proposers to this program element are reminded that an individual (e.g., a postdoctoral researcher) who is not formally permitted to serve as a Principal Investigator by their institution may still be appointed as a XARM Participating Scientist, as clarified in Section 2.1 of this element.

1. Scope of Program

1.1 Overview of XARM

NASA and JAXA have jointly agreed to participate in the X-ray Astronomy Recovery Mission (XARM), in order to restore the soft X-ray spectroscopic capability lost with the Hitomi mission in March 2016. The key scientific objective of XARM is to “Pioneer a new horizon of the Universe with unprecedented high-resolution X-ray spectroscopy.” This objective is addressed in the following aspects:

- Structure formation of the Universe and evolution of clusters of galaxies.
- Circulation history of baryonic matter in the Universe.
- Transport and circulation of energy in the Universe.

XARM has two complementary instruments. The instruments will be functionally identical to the Hitomi Soft X-ray Spectrometer (SXS) and Soft X-ray Imager (SXI). A brief description of these instruments can be found in Takahashi et al. Proc. SPIE 99050U (2016).

The SXS, renamed Resolve on XARM, is being developed jointly by a team led by NASA and JAXA, with additional participation by ESA. The Resolve SXS is a high-resolution, non-dispersive X-ray microcalorimeter. It represents the core instrument on XARM, covering the 0.3–12 keV energy band, where many astrophysically abundant elements have characteristic emission and absorption lines that can be used to study matter under extreme conditions. Its performance will be similar to that of the Hitomi SXS: spectral resolution of 7 eV across 0.3–12 keV energy band; effective area of ~300 cm² at 6 keV; a square field of view of roughly 3 arc minutes on a side; and angular resolution of roughly 1.3 arc minutes (half power diameter).

The SXI, renamed Xtend, is being developed by JAXA and covers the same energy band as the SXS. Xtend expands the field of view of the observatory with its Charge Coupled Device (CCD) camera. It is expected to have similar performance to that of the Hitomi SXI: typical CCD spectral resolution of approximately 170 eV at 6 keV; a square...
field of view approximately 40 arc minutes on a side; and roughly the same angular
resolution and effective area as Resolve.

The X-ray mirror assemblies (XMA) for Resolve and Xtend will be provided by NASA.
The US Principal Investigator of the NASA contribution to XARM is Dr. Richard Kelley of
NASA’s Goddard Space Flight Center.

1.2 XARM Mission Key Dates

XARM is planned to launch in Japanese Fiscal Year 2020, which ends in March 2021.
After an initial activation and calibration phase, the first six to nine months of XARM
observations will consist of the Performance Verification (PV) phase, in which a set of
high-value scientific targets will be observed, as determined by the XARM Science
Team. After the PV phase, most observations will be selected competitively through an
international General Observer program. All data will reside in a public archive after
expiration of any exclusive use period.

1.3 The XARM Science Team

In order to optimize the scientific utilization of the mission, NASA, JAXA, and ESA will
appoint a XARM Science Team. This team primarily consists of scientists involved in
the development of XARM (a full list of US individuals may be found in the "US XARM
Membership" document, available on the NSPIRES page of this program element under
"Other documents"), plus a small number of external Participating Scientists, the US
members of which are solicited in this ROSES element. The total membership of the
Science Team is expected to be around 100.

The objective of the XARM Science Team is to optimize the scientific use of XARM,
particularly during the PV phase. The key tasks of the XARM Science Team are to:

- Make recommendations regarding scientific aspects of the mission to the XARM
  Project Manager;
- Communicate and coordinate with the astronomical community regarding the
  science capabilities of XARM.
- Specify, oversee the development of, and beta test XARM simulation, data
  analysis, and user tools, including preparatory laboratory astrophysics activities;
- Demonstrate the performance of XARM and its instruments by planning,
  performing, and publishing the results from the PV phase observations;
- Ensure the scientific instruments are well calibrated and their operation is
  understood.

As full members of the XARM Science Team, Participating Scientists will have access
to all PV phase data.

Participating Scientists will be appointed to the XARM Science Team in early 2018 and
will serve a five-year term. This term is based upon the anticipated start of NASA
mission implementation (Phase C) and ends with the anticipated publication of the PV
phase data.
1.4 XARM Science Team Discipline Groups

The mission-related activities of the XARM Science Team will be organized into multiple discipline groups. Presently, the following Discipline Groups and associated research activities are envisaged:

- Physics of the largest objects in the Universe: "What is the structure in the Universe on the largest scales, and how does this structure form and evolve?"

  One of the remarkable capabilities of Resolve is the non-dispersive high-resolution spectroscopy for extended objects, which can be utilized for observations of galaxy clusters, galaxies and the Galactic center (the central regions of the Milky Way) to reveal:

  o The large-scale evolution of galaxy clusters and galaxies;
  o Feedback between galactic nuclei and host galaxies or clusters;
  o Density and temperature distributions in the interstellar medium (ISM) and intra-cluster medium (ICM);
  o The energy budget in the ICM: turbulence, bulk velocity, non-thermal energy, etc.; and
  o The nature of dark matter and dark energy.

- Chemical evolution of the Universe: "How were the heavy elements in the Universe created and distributed in space?"

  The excellent energy resolution of Resolve enables detection of emission lines from various heavy elements, providing the key to understanding the circulation history of baryonic matters in the Universe. These may be used to understand:

  o Chemical enrichment in the ICM and ISM through observations of galaxy clusters, galaxies, star forming regions, etc.;
  o Nucleosynthesis in stars and supernovae through observations of supernova remnants and diffuse X-ray emission in star-forming regions;
  o Star formation mechanisms and the environment in which exoplanets form through observations of protostars;
  o Dust composition in the ISM via absorption studies; and
  o Chemical evolution in the high-z Universe through observations of gamma-ray burst afterglows.

- Physics in the most extreme environments in the Universe: "How is energy and matter transported and circulated in the regions of strong gravity, electromagnetic fields, and/or shock waves?"

  High-resolution X-ray spectra allow us to determine the energy, width, and shape of emission/absorption lines, which will help understand:

  o What happens in the regions where relativity becomes important, such as active galactic nuclei (AGN), stellar mass black holes (SMBHs), neutron stars (NSs) and white dwarfs (WDs);
  o Mass evolution of BHs, NSs, and WDs;
  o Shock physics in both high- and low-density environments including particle acceleration;
- Energy transport in extremely low-density gas (non-equilibrium plasma);
- Past activity of the Galactic center BH and its effect on its surroundings; and
- Mechanisms of stellar flares.

- Unexpected discoveries
  - New science with unprecedented high-resolution X-ray spectroscopy.
  - Studies that support observational astrophysics, such as laboratory astrophysics, atomic physics calculation and database, and theoretical astrophysics (e.g., numerical simulations of hydrodynamics, magnetohydrodynamics, radiative transfer, etc.).

1.5 Timeline of XARM Science Team Activities

A timeline of the high-level activities Participating Scientists will perform, together with an approximate percentage effort, is shown below.

Years 1-5: March 2018 – February 2023 (ongoing)
- Make recommendations regarding scientific aspects of the mission to the XARM Project Manager.
- Communicate and coordinate with the astronomical community regarding the science capabilities of XARM.

Year 1: March 2018 – February 2019 (5% of total effort):
- Refine XARM science objectives based on Astro-H white papers and Hitomi data.
- Specify XARM simulation, data analysis, and user tools.

Year 2: March 2019 – February 2020 (5% of total effort):
- Develop PV phase observing program.
- Oversee the development of XARM simulation, data analysis, and user tools.

Year 3: March 2020 – February 2021 (10% of total effort):
- Plan PV phase observations.
- Oversee the development of XARM simulation, data analysis, and user tools.

Year 4: March 2021 – February 2022 (40% of total effort):
- Beta test XARM simulation, data analysis, and user tools.
- Assist with calibration of the instruments and observatory during PV phase observations.
- Begin analysis of PV phase data.

Year 5: March 2022 – February 2023 (40% of total effort):
- Continue assisting with calibration of the instruments and observatory, and analysis of PV phase observations.
- Publish first XARM results.
- Present results at first XARM science conference.
2 Proposal Submission and Evaluation

2.1 Eligibility to Propose

Participation in this solicitation is open to individuals from all categories of U.S. organizations, including educational, industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies.

XARM Participating Scientist proposals will be accepted only from individual Principal Investigators, without Co-Investigators. However, it is allowable for limited funds from this call to be used for additional personnel, such as postdoctoral researchers or support staff, to enable the efficient discharge of the responsibilities described in Section 1.3. Such additional personnel will not serve as members of the XARM Science Team and have no access to XARM PV phase data.

One exception to the above rule is in the case where the institutional rules of a proposing organization prevent assigning the Principal Investigator role to the individual applying to serve as the XARM Participating Scientist (e.g., postdoctoral researchers, etc.). Here, the institution must designate the intended XARM Participating Scientist as the "Co-I/Science PI" in NSPIRES, and assign another individual to serve as the Principal Investigator. More information may be found at https://science.nasa.gov/researchers/sara/faqs#9. [Clarified October 13, 2017]

2.2 Two-Step Proposal Submission Process

To facilitate the early recruitment of a conflict-free review, this program element uses a two-step proposal submission process (see Section IV. (b) vii of the ROSES Summary of Solicitation).

A Step-1 proposal is required and must be submitted electronically by an Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must address the same broad scientific goals proposed in the Step-1 proposal. The PI cannot be changed and proposers who want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact identified in the summary table of key information and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Additions of funded investigators within two weeks of the Step-2 deadline require explicit permission from the NASA point of contact. Submission of a Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

2.3 Step-1 Proposal

The Scientific/Technical/Management section of a Step-1 proposal is restricted to the 4000-character text box on the NSPIRES web interface cover pages. PDF attachments will not be accepted through NSPIRES for Step-1 proposals submitted to this program element.
A Step-1 proposal must cover the following topics:

- The goals and/or objectives to be addressed;
- The approach and methodology to be used to address the goals and/or objectives;
- The reason(s) why the work proposed is within the scope of this program element.

Following the submission of a Step-1 proposal, most proposers will be notified through NSPIRES whether the Step-1 proposal has been designated as "encouraged" or "discouraged," at which point the proposer will be able to create a Step-2 proposal. The Step-1 review will be an internal review by NASA staff, and no evaluation of intrinsic merit will be performed on these proposals. The perceived relevance of the proposed work to this Program Element will be the main factor in deciding whether submission of a Step-2 proposal will be encouraged. Please note that the Step-2 proposal relevance evaluation is independent of the Step-1 evaluation.

In rare cases, including the cases where the Step-1 proposal was not compliant with the requirements outlined above, a Step-1 proposal may be declined. In these cases, a Step-2 proposal may not be submitted.

2.4 Step-2 Proposal

All Step-2 proposals must describe a candidate sample science investigation, or set of sample investigations, to be notionally executed in the PV phase of the XARM mission. The goals and objectives of the investigation must address one or more of the XARM mission science objectives listed in Section 1.2 above, and must be aligned with the activities of one or more of the Discipline Groups listed in Section 1.4 above. The proposed candidate investigation(s) can be analytical, observational, or theoretical in nature. NASA does not commit that selected candidate investigations will be included in the PV phase of XARM. [Reference to Section 1.2 corrected November 21, 2017]

In addition, all proposals must address the proposed contribution of the PI to the XARM Science Team, particularly in fulfilling the tasks described in Section 1.3.

In order to facilitate the submission of feasible candidate science investigations a set of simulation tools is being made available. These tools are based on the required performance of Resolve. The tools, general information about XARM, and links to the science white papers written for Hitomi, can be found at https://heasarc.gsfc.nasa.gov/docs/xarm.

2.5 Modifications to ROSES-2017 for Step-2 XARM Participating Scientist Proposals

Proposers should be aware that the combined page limit for the Science/Technical/Management section of the proposal is 6 pages.

No data management plan is being collected for this program element. Data management for XARM is governed by a NASA-JAXA MOU, and all Participating Scientists will adhere to the policies set forth in that document. However, XARM Participating Scientists must comply with NASA’s mandatory minimum requirement that
data behind figures and tables in papers must be made available at the time of publication. See Section II(c) of the ROSES-2017 Summary of Solicitation.

2.6 Budget Preparation Instructions for Step-2 Proposals

Proposers should provide budgets and an accompanying justification with a period of performance beginning on March 1, 2018. This start date is contingent on funding availability. It is expected that investigators will propose for five years of support running through February 28, 2023. [Corrected October 30, 2017]

Proposers are required to phase their annual budgets to be commensurate with the percentage level of efforts indicated in Section 1.5.

Each proposal shall provide a budget justification for each year of the proposed effort, which shall be supported by appropriate narrative material and budget details in compliance with Section IV.(b)(iii) of the ROSES-2017 Summary of Solicitation. A required element of the proposal is a table of Personnel and Work Effort, summarizing the work effort required to perform the proposed investigation.

For planning purposes, proposers should assume that the PI will take two annual week-long trips to Japan in order to attend XARM Science Team meetings. These costs must be included in the Budget of the proposal.

2.7 Evaluation of Step-2 Proposals

Step-2 proposals will be evaluated by a science peer review panel with respect to the criteria specified in Appendix D of the NASA Guidebook for Proposers, see also Section VI.(a) of the ROSES-2017 Summary of Solicitation. The evaluation of the intrinsic merit shall also include the following factors:

1. The extent to which the proposed goals and objectives address XARM mission science objectives as listed in Section 1.1 above;
2. The extent to which the PI will contribute to the tasks of the XARM Science Team as listed in Section 1.3 above;
3. The extent to which the proposed goals and objectives are complementary and synergistic with the envisaged activities of the XARM Discipline Groups as listed in Section 1.4 above;
4. The ability of the PI, as demonstrated in the proposal, to lead successful research or community teams, particularly those using consensus-based decision-making strategies.

2.8 Selection of XARM Participating Scientists

The selection of XARM Participating Scientist investigations is the responsibility of the Astrophysics Division of the Science Mission Directorate at NASA Headquarters. The XARM Program Scientist will be responsible for organizing the evaluation of proposals, including the convening of the peer review panel. The selection decisions are made by the Astrophysics Division Director, with the cognizance of the JAXA XARM Principal Investigator.
### 3. Summary of Key Information

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<thead>
<tr>
<th>Expected average cumulative award amount</th>
<th>~ $250,000 distributed as described in Section 1.5</th>
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<tr>
<td>Number of new awards pending adequate proposals of merit</td>
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<tr>
<td>Maximum duration of awards</td>
<td>5 years; shorter term proposals are not accepted.</td>
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<td>Due date for Step-1 proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Due date for Step-2 proposals</td>
<td>See Tables 2 and 3 in the ROSES Summary of Solicitation.</td>
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<td>Planning date for start of investigation</td>
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<td>Page limit for the central Science-Technical-Management section of the Step-2 proposal</td>
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<tr>
<td>Relevance</td>
<td>This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers.</td>
</tr>
<tr>
<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers.</td>
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<td>Web site for submission of proposal via NSPIRES</td>
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<td>Web site for submission of proposal via Grants.gov</td>
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<tr>
<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-XARM</td>
</tr>
</tbody>
</table>
| NASA point of contact concerning this program | Daniel A. Evans  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-3883  
Email: Daniel.A.Evans@nasa.gov |
NOTICE: Amended December 1, 2017. This announcement creates a new opportunity in D.15 System-Level Segmented Telescope Design. Responses to this solicitation are limited to for-profit U.S. industrial organizations. A Preproposal Conference will occur on January 5, 2018, 3-5 PM Eastern Time. 1-844-467-4685 Passcode = 981671. Proposals are due February 1, 2018. This program element does not require a data management plan nor a separately uploaded "total" budget file - the NSPIRES cover page budget is adequate.

1. Introduction

NASA is soliciting industry proposals to carry out one-year end-to-end system-level engineering design and modeling studies and associated testbed demonstrations of large (10-meter class or larger) segmented-aperture telescopes, with integrated coronagraphs that will lead to the identification of priority technology investments and subsequent support to start developing and maturing these technologies.

2. Scope of Program

In early 2016, NASA identified four large mission concepts and chartered study teams to develop compelling science cases and the associated mission architectures for consideration and prioritization as large missions by the 2020 Astronomy and Astrophysics Decadal Survey. These concepts are likely candidates for development to follow the James Webb Space Telescope (JWST) and Wide-Field Infrared Survey Telescope (WFIRST). Three of the four concepts may require precise, stable, segmented opto-mechanical systems to achieve the large apertures required for their scientific priorities: the Origins Space Telescope (OST), the Habitable Exoplanet (HabEx) Imaging Mission, and the Large Ultraviolet/Optical/InfraRed (LUVOIR) Surveyor. More information about these studies can be found at:

- HabEx: https://www.jpl.nasa.gov/habex/
- LUVOIR: https://asd.gsfc.nasa.gov/luvoir/
- OST: https://asd.gsfc.nasa.gov/firs/

NASA is interested in developing end-to-end integrated telescope/coronagraph systems-level engineering designs, modeling studies, and associated testbed demonstrations. These studies and demonstrations would identify and substantiate error budgets leading to a specific hardware technology development roadmap intended to be funded in subsequent years.

Two types of segmented-aperture observatory concepts have been identified for consideration. For missions focusing on advancing astronomy at ultraviolet, visible, and near-infrared wavelengths (i.e., HabEx and LUVOIR), particularly for directly imaging and spectroscopically characterizing exo-Earth candidates, a key technology priority is to show a path to achieve the needed sub-nanometer wavefront stability. For missions focusing on UVOIR and Exoplanet Science, either on-axis or off-axis architectures may be considered. For missions focusing on advancing astronomy at mid- and far-infrared
wavelengths (i.e., OST), a key technology priority is to dramatically reduce mirror manufacturing and verification costs to enable future missions to have larger and less-expensive telescope primary mirrors.

Should NASA choose to develop a mission that flows from any selected study, the responsibility for the development of that mission will be assigned by NASA. There is no expectation that the mission concept study team, participating organizations, or responding groups to this solicitation will necessarily participate in the eventual mission development.

If NASA receives questions about this program element they will be answered in writing in a FAQ that will be posted on the NSPIRES web page for this program element under "Other Documents".

3. Programmatic Information

Proposals in response to this solicitation are limited to for-profit U.S. industrial organizations of any size, although partnerships with and/or subcontracts to other types of organizations are permitted. As described below, coordination with NASA-funded design studies of future major astronomy missions is expected.

3.1 Proposal Evaluation Factors

The evaluation criteria considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost. The failure of a proposal to be rated highly in any one of these elements is sufficient cause for the proposal to not be selected.

The evaluation of intrinsic merit includes the consideration of the following factors, as applicable to the proposal:

- Overall technical quality of the proposed work, including, but not limited to, the quality of the management plan, cost reasonableness, the breadth and resilience of the proposed assessment, methods, techniques, and approaches for the assessment.

- The qualifications, capabilities, past performance, and related experience of personnel demonstrated by the proposal (e.g., publications, delivered products, and other measures of productivity and/or expertise) that would affect the likelihood of achieving the objectives.

- Facilities, instruments, equipment and other resources or support systems presented in the proposal that would be contributed to the study and would affect the likelihood of achieving the proposed objectives, including prior or current successful technology development programs.

Evaluation criteria are to be compared against the state-of-the-art of engineering designs of comparable concepts (e.g., public presentations of the designs for one of the three NASA strategic astrophysics concepts referred to above). Review panels will be instructed not to compare proposals to each other. Evaluation of the cost of a proposed effort may include the reasonableness of the proposed cost, as well as whether costs are allowable and allocable to the project.
3.2 Award Type and Budget

The total budget available for this solicitation is approximately $2.5M for one year, which may support up to three candidate studies (see section 4.0). The government reserves the right to not select any responses to this solicitation.

Successful responses to this solicitation are likely to result in Cooperative Agreement awards, which will be made according to the NASA Grant and Cooperative Agreement Manual, in Accordance with 2 CFR Part 200 (issued on December 26, 2014 and revised on September 16, 2016), available at https://prod.nais.nasa.gov/pub/pub_library/srba/. For a commercial organization to receive a cooperative agreement, cost sharing (equal to 50% of the total) is required if the project has commercial applications and profit generating potential. Proposals from commercial organizations for cooperative agreements that do not include cost sharing must demonstrate that potential commercially marketable products are not expected to result from the project (see 14 CFR §1274.102 (c) 4 and 14 CFR §1274.204, "Costs and Payments" (b) Cost sharing).

Responses to this solicitation shall describe proposed coordination with the current NASA-funded study teams for the three concepts specifically to ensure that the product of the funded studies are relevant to the science requirements defined by each team.

3.3 Solicited Technical Scope

Based on responses to this solicitation, NASA may select and fund one-year studies delivering one or both of the following.

(1) End-to-end systems-level engineering design and modeling of large (10-meter class or larger), highly stable, segmented-aperture, UV/optical/IR telescope with sub-nm wavefront stability, optimized both for general astrophysics and for directly imaging and spectroscopically characterizing exo-Earth candidates using an integrated coronagraph. The final deliverable of the first year study will include:

   a. Integrated system-level design/architectures including subsystems such as structural, thermal, optical, and control that enable the HabEx and LUVOIR study science priorities.
   b. A list of drivers for development of the error budgets.
   c. Documentation and a list of major trades needed, specifying for each trade study the major options, metrics, and high-level risks. The trades shall include, although are not limited to:
      i. Integrated system architecture;
      ii. Vibration reduction and isolation;
      iii. Mirror materials for mechanical, thermal, and moisture stability;
      iv. Support-structure materials for mechanical, thermal, and moisture stability;
      v. Mirror and structure deployment and latching;
      vi. Metrology and sensing architectures, including thermal sensing; and
      vii. Actuation and control architectures, including thermal control.
   d. A technology development plan that includes a list of required technologies and fabrication advances, with requirements flowing down from system-level requirements and error budgets.
   e. Subscale verification techniques.
f. Testbed demonstrations of key technologies to address key risks and questions posed by the system studies.

(2) End-to-end systems-level engineering design and modeling of large (10-meter class), highly stable, segmented-aperture, telescope with integrated coronagraph that advances astronomy at mid- and far-infrared wavelengths and associated testbed and focused technology demonstrations to substantiate that work. The final deliverable of the first year study will include:

a. Integrated system-level design/architectures including subsystems such as structural, thermal, optical and control that enable the OST study science priorities.

b. A system-level optical design that could lower the cost and mass per unit area of the primary mirror.

c. A list of drivers for error budgets development.

d. Documentation and a list of major trades needed, specifying for each trade study the major options, metrics, and high-level risks. The trades shall include, but are not limited to:
   i. Integrated system architecture;
   ii. Vibration reduction and isolation;
   iii. Mirror materials for mechanical, thermal, and moisture stability;
   iv. Support-structure materials for mechanical, thermal, and moisture stability;
   v. Cryogenic (4 K) far-IR mirror fabrication and verification techniques;
   vi. Mirror actuators for low-temperature operation (4 K);
   vii. Sunshade design;
   viii. Mirror deployment and latching;
   ix. Metrology and sensing architectures, including thermal sensing; and
   x. Actuation and control architectures, including thermal control.

e. A technology development plan that includes a list of required technologies and fabrication advances, with requirements flowing down from system-level requirements and error budgets.

f. Subscale verification techniques

3.4 Proposal Format

Table 1 in the ROSES solicitation provides a checklist of required information to be included in proposals. Except as noted in this solicitation, proposals submitted to ROSES must strictly conform to the formatting rules outlined in Sections 3.6 through 3.23 of the NASA Guidebook for Proposers Responding to a Funding Announcement (https://www.hq.nasa.gov/office/procurement/nraguidebook/proposer2017.pdf).

Proposals that violate the rules may be rejected without review or declined following review if violations are detected during the evaluation process.

3.5 Reporting Requirements

Semi-annual progress reports will be required. A final report, due at the expiration of this award, will be submitted to the NASA point of contact for this solicitation. The proposers should assume that the product of their work will be treated as both competition sensitive and restricted following the requirements of the International Trade in Arms Regulations (ITAR), unless the proposers request otherwise. Successful teams are encouraged to
make presentations of unrestricted material derived from this activity at suitable public conferences or workshops that could be coordinated with the NASA point of contact. The final restricted report should include elements described in Section 3.1.

In coordination with the NASA point of contact, a more sensitive and restrictive presentation of the results of the study may be requested.

3.6 Planned Follow-on Activities

NASA plans to continue maturing these technologies beyond these one-year studies. Following review of the results of these one-year studies, NASA plans a subsequent Request for Proposal (RFP) to be issued soliciting two year efforts at a level of $5M per year that build on the results of these one-year studies and are responsive to NASA’s programmatic priorities.

NASA’s plans for follow-on efforts will build upon the design and modeling efforts of these one-year studies. Follow-on activities are planned to begin investment in items identified above in 1d (a technology development plan for large UV/optical/IR telescopes that includes a list of required technologies and fabrication advances, with requirements flowing down from system-level requirements and error budgets) and 1f (testbed demonstrations of key technologies for large UV/optical/IR telescopes to address key risks and questions posed by the system studies) and/or 2e (a technology development plan for large mid- and far-infrared wavelength telescopes that includes a list of required technologies and fabrication advances, with requirements flowing down from system-level requirements and error budgets).

4. Summary of Key Information

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<tr>
<th>Expected program budget for awards</th>
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<td>Maximum duration of awards</td>
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<td>Preproposal Conference</td>
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<td>Due date for electronic submission of proposal</td>
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<td>Anticipated selection date</td>
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</tr>
<tr>
<td><strong>General information and overview of this solicitation</strong></td>
<td>See the ROSES Summary of Solicitation.</td>
</tr>
<tr>
<td><strong>Detailed instructions for the preparation and submission of proposals</strong></td>
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</tr>
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<td><strong>Submission medium</strong></td>
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<td><strong>Web site for submission of proposals via NSPIRES</strong></td>
<td><a href="http://nspires.nasaprs.com">http://nspires.nasaprs.com</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
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</tbody>
</table>
| **NASA point of contact concerning this program** | Mario R. Perez  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
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APPENDIX E: CROSS-DIVISION RESEARCH

E.1 CROSS-DIVISION RESEARCH OVERVIEW

1. Introduction

The Science Mission Directorate (SMD) sponsors program elements that apply across more than one of its four science research areas as defined in Section I of the ROSES Summary of Solicitation. Such cross-division program elements are listed here in Appendix E of the ROSES-2017 NASA Research Announcement (NRA). At the time of the initial release of this NRA, there are three such programs, see below.

2. Data Management Plans

Most proposals to ROSES-2017 require a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed. The three program elements in Appendix E handle this quite differently. The kinds of proposals that require a data management plan are described in the NASA Plan for increasing access to results of Federally funded research and in the SARA Frequently Asked Questions (FAQs) for ROSES. Proposers to E.2 Tropical Workshops, Symposia, and Conferences (TWSC) will not be asked for a data management plan, because those are not research proposals. However, any peer reviewed publications that come out of awards from E.2 (such as conference proceedings) must still meet the requirement that the data behind figures and tables be available electronically at the time of publication, ideally in supplementary material with the article. Proposers to E.3 The Exoplanets Research Program, must satisfy the DMP requirement by responding to the compulsory NSPIRES cover page question about the DMP. Proposers to E.4 The Habitable Worlds Program, must meet the more involved requirements described in Appendix C.1.

3. Program Elements

The Topical Workshops, Symposia, and Conferences program element (E.2) solicits proposals for topical workshops, symposia, conferences, and other scientific/technical meetings that advance the goals and objectives of the Earth Science, Heliophysics, and Planetary Science Divisions. This program has no fixed due date or budget; proposals may be submitted at any time, but are dependent on the availability of funds in the specific program or focus area.

The Exoplanets Research Program (E.3) solicits basic research proposals to advance our knowledge and understanding of exoplanetary systems. This program is shared between the Planetary Science Division and the Astrophysics Division. Its objectives are the detection and characterization of planets and planetary systems outside of our Solar System, including the determination of their compositions, dynamics, energetics, and chemical behaviors. Research supported by this call may include observations, theoretical studies, and modeling.
The Habitable Worlds Program (E.4) solicits basic research proposals about processes and conditions that create and maintain potentially habitable environments. This Program includes elements of the Astrobiology Program, the Mars Exploration Program, the Outer Planets Program (all in the Planetary Science Division) and Exoplanet research in the Astrophysics Division. A common goal of these programs is to identify the characteristics and the distribution of potentially habitable environments in the Solar System and beyond.

Any other cross-division programs that are defined during the calendar year will be issued as amendments to ROSES-2017, typically 90 days in advance of their established Proposal Due Dates.
NOTICE: Potential proposers to this program are strongly advised to visit http://science.nasa.gov/researchers/sara/program-officers-list/ and contact the appropriate SMD Program Officer there to ascertain the availability of funds for funding proposals to this program element prior to submitting a proposal to this program element.

1. Introduction

In order to address its strategic goals and objectives (see Section I of the ROSES Summary of Solicitation), the Science Mission Directorate (SMD) acknowledges the need to bring together members of scientific communities relevant to NASA in order to:

- encourage and facilitate the use of mission data,
- increase the efficiency of investigators through advanced scientific/technical training,
- increase the efficiency of investigators through the open exchange of ideas, and
- expose investigators to new subject areas.

The scope of this program element across SMD is described in Section 2. Section 3 describes how proposals submitted in response to this program element must convincingly connect the proposed content of the event to specific goals, e.g., in SMD program elements or the NASA Science Plan. Section 4 describes principles and constraints that constrain proposals in response to this program element; in particular, the proposed participants, logistics, and level of NASA support must be, and appear to be, appropriate given NASA’s science goals and objectives.

2. Scope of Program

This program element solicits proposals for topical workshops, symposia, conferences, and other scientific/technical meetings (herein referred to as "events") that advance the goals and objectives of only the following SMD Divisions: Earth Science, Heliophysics, and Planetary Science.

Proposals are not limited to traditional in-person meetings of scientists, but may also include requests for support of other methods of bringing together members of the scientific communities relevant to NASA, such as online discussion forums and web-based collaboration portals, especially in support of a traditional event. Proposals for multiple related events should be well justified.

This program element is directed at and strictly limited to scientific and technical events of interest to SMD, not education, public outreach, or administrative conferences. Moreover, this program element may not support research or fellowship programs of any type.

Where other ROSES program elements specifically solicit for events, proposals must be submitted in response to those program elements instead of this one.
3. Relevance to SMD’s Goals and Objectives

Proposals submitted in response to this program element must demonstrate the relevance of the event to SMD by showing how the scientific/technical area(s) to be covered will advance not only high-level SMD goals and objectives, but also specific (existing or anticipated) outcomes identified in ROSES program elements, SMD roadmaps, other SMD program documents, the NASA Science Plan, findings in decadal surveys, or the reports of NASA advisory bodies or groups relevant to NASA. Proposers are not constrained to show relevance to the program elements that appear in ROSES; some calls do not appear every year, but research in that area continues and proposals would still be considered relevant. The subjects of the proposed events are not limited to the targeted science itself (or data analysis that leads to science), but also include technologies, methods, and capabilities that enable the attainment of relevant goals, such as (but not limited to) code development, data compression algorithms, higher order data products, model intercomparisons, the enhancement and/or application of new equipment to make pertinent measurements, etc.

Proposers must explicitly state from what source (e.g., ROSES program element, roadmap, or decadal survey) the claim of relevance derives.

3.1 Additional Information on Earth Science Relevance

Proposals for workshops, symposia, conferences, or scientific/technical meetings in Earth Science should be carried out in support of NASA Science Questions and Goals from the 2014 Science Plan for NASA’s Science Mission Directorate. NASA’s Earth science research is conducted in four major areas: research and analysis, satellite missions, applied sciences, and enabling capabilities (e.g., data and information systems, high-end computing, airborne science, and technology development). Proposals for events under any of these four Earth science areas will be considered under this program element. NASA Earth Science’s research and analysis programs emphasize interdisciplinary topics and interagency collaboration and coordination through the U.S. Global Change Research Program (http://www.globalchange.gov/). NASA’s applied sciences area supports efforts to discover and demonstrate innovative and practical uses of NASA Earth science observations and research through applications projects carried out in partnership with end user organizations (http://AppliedSciences.nasa.gov/). NASA’s enabling capabilities area supports efforts that engage the broader Earth science community to encourage partnerships and collaborations among data providers, users, and information technology experts to improve data and data system interoperability (http://science.nasa.gov/earth-science/earth-science-data/). Thus, events proposed to address the goals of NASA Earth Science research must, in many cases, involve substantial participation by interagency partners and/or end user organizations, and such participation will be considered as a positive factor in establishing relevance to NASA.
4. Program Principles and Proposal Constraints

4.1 Allowable Focus of Proposals
The goal of any proposed activity must be to enable science, and the support to pay for person time and/or logistics, which may be funded as a result of the proposed activity, are merely an incidental means to achieve that goal. Proposals to this program must be written so that the objective of the proposed activity is clearly focused on the desired effect that is to be achieved (e.g., science), rather than the means to that end (e.g., logistics). It is acceptable to have a goal of developing an output that is a prerequisite to achieving a target laid out in a ROSES program element, roadmap, decadal survey, etc., and to pay for the support for person time and/or logistics as an expense on the way to accomplishing that goal. However, a proposal with a stated goal of simply paying for logistics in support of an event would not be considered responsive to this program element.

4.2 Competition and Criteria for Selecting Event Participants
SMD principles include the use of competition to increase the effectiveness of awarded funds. Although SMD may provide only a small fraction of the total funds required for an event, SMD expects the individuals participating in the event to be identified through competition; exceptions require adequate justification. If funds are requested for limited participants to attend an event, then an open call for abstracts is expected where their evaluation would play a role in selecting participants. The merit rating of the science abstract need not be the only factor; consideration of other factors, such as diversity, is to be expected. There may be compelling reasons to justify selecting certain participants without competition in order to attain the stated scientific or technical aim of the event; in such cases, the justification must be provided in the proposal.

4.3 Availability of Funding
No specific budget is identified for this program element; selected proposals will be funded by the benefitting program. The number of proposals selected will be dependent on the number and quality of proposals submitted and on the availability of funds from the benefitting program. Potential proposers are encouraged to contact the appropriate SMD Program Officer to investigate the availability of funds in that specific program for funding proposals to this program element. Contact information for SMD Program Officers is available at http://science.nasa.gov/researchers/sara/program-officers-list/.

4.4 Constraints on Logistics
The logistics of the event must be, and appear to be, appropriate for accomplishing the stated purpose. This includes the size, location, duration, scheduling, and cost of the event for both sponsors and attendees. Proposers are discouraged from choosing what might appear to be a resort location. Similarly, proposers are discouraged from choosing a foreign location; proposed events outside of the U.S. must be adequately justified.
The funding request, whether a small grant to subsidize student participation or full sponsorship of a large symposium, must be commensurate with (a) the role of NASA in stewarding the subject science and the benefiting science community, and (b) the importance of the event to NASA in attaining its goals and objectives.

Proposers to this program element are strongly encouraged to review the guidelines found in the SMD memo on "Priorities for Conference Spending" of April 27, 2009, which can be found at https://smd-prod.s3.amazonaws.com/science-green/s3fs-public/atoms/files/SMD2009memo.pdf.

4.5 Award Duration

Most awards from this program element are expected to be one year in duration. Under certain circumstances, and if properly justified, it may be permissible to propose multiple meetings that span across a period of more than a year. For example, a pair of meetings before and after fieldwork, targets of opportunity (oil spills, comet appears, etc.) or another large project, make sense to plan and propose together. Otherwise, proposers should plan on a single meeting.

5. Other Factors

The amount that NASA can spend on conferences is limited. Support for administrative conferences is not solicited within this program element, which is exclusively for scientific/technical subjects, see Section 1.

This program element cannot result in the award of a contract, only a grant, cooperative agreement, an interagency agreement, or internal funding to a NASA Center.

Letters of affirmation from the relevant community are permitted for proposals to this program.

Not all proposals to this program element are necessarily peer reviewed. Depending on the availability of appropriately knowledgeable SMD staff and the size of the request, some submissions may be reviewed only by program managers at NASA Headquarters.

Events that are proposed in response to this call must have the benefit of the event flow directly to the recipient and its members, not to NASA. The principal purpose of the event will be to advance the research or other purposes of the recipient. Thus, NASA may not direct a recipient in arranging the event or in providing other services for NASA’s benefit. The proposed event must be run by the recipient, not by NASA. NASA projects that would satisfy a NASA requirement or provide a crucial deliverable (such as a decadal survey) through an event cannot be supported through this call. Events sponsored or initiated by NASA primarily to meet a specific NASA need or obtain information for the direct benefit of NASA must be supported by means of a contract and may not be proposed in response to this program element.

NASA Interim Directive (NID) 9700.1 provides the financial management requirements for conference planning, approval, attendance, and reporting for NASA. The NID notes that it is applicable to recipients of grants and cooperative agreements only to the extent specified or referenced in the award. Specifically, Section 4.3.2. (b) Non-Reportable
Expenses indicates that "Conference costs paid by a recipient of financial assistance (i.e., using grant or cooperative agreement funds from NASA)" are not subject the reporting requirements. However, it goes on to note: "To ensure proper use, cooperative agreements should limit the use of funds for conference activities directed at a public purpose, like technical assistance to presenters. To the extent a proposed grant or cooperative agreement also supports NASA mission needs and objectives related to hosting or assisting another to host a conference, the proposed use shall be reviewed with procurement and legal to determine whether a procurement contract should be used in lieu of all or part of the proposed grant or cooperative agreement."

If the proposer anticipates that the resulting award will not be a grant or cooperative agreement (i.e., if the proposing institution is a Government laboratory, including the Jet Propulsion Laboratory) and the result of the award is that NASA will be the primary sponsor of a conference (see FAQ 4-2 of NID 9700.1 for a discussion of when NASA is a primary sponsor), then the proposal must clearly state this fact, because NASA must provide detailed reports for NASA-sponsored conferences. In addition, there are other constraints imposed by both statute and regulation that limit options for NASA-sponsored conferences (e.g., use of non-Federal facilities, charging of registration fees).

No NSPIRES cover page question on data management plans will be posed for proposals to this program element, but you may present one or NASA may require one, if appropriate. In order to assist in routing a proposal to appropriate personnel, proposers are asked to provide on the NSPIRES cover page the name of a NASA Headquarters point of contact and to identify the relevant science program(s).

6. Summary of Key Information

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<th>Expected annual program budget for new awards</th>
<th>No specific budget is identified; selected proposals will be funded by the benefitting program.</th>
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<td>Number of new awards pending adequate proposals of merit</td>
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<td>Maximum duration of awards</td>
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<td>Due date for proposals</td>
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<td>General information and overview of this solicitation</td>
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</tbody>
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| NASA point of contact concerning this program | Max Bernstein  
Science Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001  
Telephone: (202) 358-0879  
E-mail: sara@nasa.gov |
NOTICE: March 6, 2017. In the summary table of key information an erroneous reference to section 2.5 was changed to 2.4.

Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required or permitted for Step-1 proposals. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 3 for details.

1. Scope of Program

The Exoplanets program element solicits basic research proposals to conduct scientific investigations related to the research and analysis of extrasolar planets (exoplanets). Its broad objectives include the determination of compositions, dynamics, energetics, chemical behaviors of extrasolar planets, and the detection and characterization of other planetary systems. This program element is shared between the Planetary Science Division and the Astrophysics Division.

Research supported by this call may include observations, laboratory studies, theoretical studies, and modeling. Investigations that incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research that would greatly increase the use of, or significantly facilitate the interpretation of, observational studies of exoplanetary systems are eligible for the Exoplanets Research Program. Such proposals that don’t directly contain observational studies will be judged upon the perceived impact of the proposed work upon the interpretation of observations of exoplanetary systems.

Investigations are expected to directly support the goal of understanding exoplanetary systems, by doing one or more of the following:

- detect exoplanets and/or confirm exoplanet candidates in order to provide high-value targets for current and future NASA observatories or support NASA’s ongoing exoplanet surveys;
- observationally characterize exoplanets, their atmospheres, or specific host star properties that directly impact our understanding of the exoplanetary system, in order to support NASA’s ongoing exoplanet surveys, inform target and operational choices for current NASA missions, or deliver targeting, operational, and formulation data for future NASA observatories;
- understand the chemical and physical processes of exoplanets (including the state and evolution of their surfaces, interiors, and atmospheres);
- improve understanding of the origins of exoplanetary systems.

For administrative purposes, the Astrophysics Division will manage investigations aimed primarily at observations to detect and/or characterize exoplanetary systems. Proposals
to understand the chemical and physical processes of exoplanets and/or to improve the understanding of the origins of exoplanetary systems (including all theory, laboratory, and modeling proposals) will be managed by the Planetary Science Division. Programs that combine two or more divisional disciplines to investigate exoplanet properties (Astrophysics, Planetary Science, Heliophysics, and Earth Science) are especially encouraged.

Proposed investigations may include ground-based observations made at any ground-based facility, public or private, including those supported by NASA. If new observations are to be made, the facility, including all instrumentation specific to the investigation, must be in scientific operation at the time of submission of the proposal and the proposal must state whether or not observing time to support the proposed investigation has been awarded. Proposals are expected to provide evidence of current instrument performance and data quality. The observations must directly support the goals of the Exoplanet Research Program (XRP) call and must also include scientific analysis and publication. Observationally-based proposals are required to provide their relevance to NASA by referencing which past, current or planned mission the proposed program is augmenting or preparing for, and describing how the proposed work benefits that mission.

Proposed investigations whose main focus are stellar objects (including host star atmospheres) or brown dwarfs will be graded specifically upon the impact of the proposed work upon our understanding of exoplanets. The onus is upon the investigation team to argue convincingly that the main benefit of their program is the advancement of exoplanet science.

For investigations with theoretical and modeling components, it is imperative that proposals provide the observable consequences of their investigations and indicate the observational tests that can be employed to test the validity of theory and models.

The scientific impact of XRP investigations must be near-term. Proposal reviewers will be requested to assess the impact of investigations over a 5-year timeframe. A failure to provide convincing evidence that an investigation will impact NASA’s mission over the next five years will be considered a major weakness of a proposal.

2. Programmatic Information

2.1 Exclusions

The breadth of this call inevitably results in overlap in subject matter between this and other ROSES-2017 program elements.

Proposals to investigate the formation, early evolution, and structure of our Solar System are not solicited. Investigations to develop the theory of planets or planetary systems as they relate directly to our Solar System should instead be submitted to the Emerging Worlds program element (C.2).

Proposals aimed at identification and characterization of signals and/or properties of extrasolar planets that may harbor intelligent life are not within the scope of this program. Research aimed at investigating the habitability of an exoplanet should be
submitted to the Habitable Worlds program element (E.4). Proposals in these research areas are not solicited in this program element.

Investigations with a primary focus on analysis of NASA space astrophysics data from a public domain archive (including the Kepler and K2 missions) are not solicited in this program element. If there is an archival data analysis aspect to the proposed program, then the proposal is required to provide justification for why it is not compliant with the Astrophysics Data Analysis Program (ADAP) element of ROSES (program element D.2).

Proposed programs containing major work elements of collecting and analyzing data from currently operating or future space missions that have Guest Investigator programs will not be considered for grant funding through the XRP. Such proposals should respond directly to the Guest Investigator programs of the relevant missions.

Investigations with the primary objective of maintaining and operating observing facilities, or developing, commissioning, or determining the integrated performance of instrumentation are not solicited in this program.

2.2 Facilities Available to Proposers

Those investigators whose research requires high-performance computing should refer to the *Summary of Solicitation*, Section I(d), "NASA-provided High-End Computing Resources." This section describes the opportunity for successful proposers to the Exoplanets Research program to apply for computing time on either of two NASA computing facilities at the Goddard Space Flight Center’s Computational and Information Sciences and Technology Office or at the Ames Research Center’s Advanced Supercomputing Division.

2.3 Fellowship Programs

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

2.4 Duration of Awards

We anticipate that most proposals will seek three years of funding. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. Four-year proposals may be selected if the need for the longer duration is sufficiently well justified.

2.5 Selecting Officials

The Selecting Official for investigations that are managed by the Planetary Science Division is the Research and Analysis Lead for the Planetary Science Division. The Selecting Official for investigations that are managed by the Astrophysics Division is the Director of the Astrophysics Division.
3. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES Summary of Solicitation.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal title and PI cannot be adjusted. To add funded investigators between the Step-1 and Step-2 proposals, proposers must write to the point(s) of contact below and cc sara@nasa.gov at least four weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

3.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Step-1 proposal should identify the PI and team members on the proposal. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4,000 character text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the correct program element. No evaluation of intrinsic merit will be done on Step-1 proposals.

The proposal is entered directly into a text field in NSPIRES, and no attachment is required or permitted. Proposers will be notified when they are able to submit their Step-2 proposals. NSPIRES will notify proposers whether their Step-1 proposal is encouraged or not, at which point they will be able to create Step-2 proposals.

3.2 Step-2 Proposal

Proposers should refer to the document entitled "How to submit a Step-2 proposal" under "Other Documents" on the NSPIRES page for this program. The process for preparation and submission of the Step-2 (full) proposals is essentially identical to that associated with any other ROSES-2017 proposal. This is a reminder that all proposals submitted to ROSES-2017 must strictly conform to the formatting rules in Section IV of the Summary of Solicitation and the NASA Guidebook for Proposers. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages
4. Summary of Key Information

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<td>Maximum duration of awards</td>
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<td>15 pp; see also Table 1 of ROSES and the NASA <em>Guidebook for Proposers</em>.</td>
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<td>Relevance</td>
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</tr>
<tr>
<td>General information and overview of this solicitation</td>
<td>See the <em>ROSES Summary of Solicitation</em>.</td>
</tr>
<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see <em>ROSES Summary of Solicitation</em> Section I(g) Order of Precedence and the NASA <em>Guidebook for Proposers</em>.</td>
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<td>Submission medium</td>
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<td><strong><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a></strong> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
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<td><strong>Web site for submission of proposals via Grants.gov</strong></td>
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| **NASA points of contact concerning this program** | Christina Richey  
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NOTICE: Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required or permitted for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 2.6 for details.

1. Scope of Program

The goal of the Habitable Worlds program is to use knowledge of the history of the Earth and the life upon it as a guide for determining the processes and conditions that create and maintain habitable environments and to search for ancient and contemporary habitable environments and explore the possibility of extant life beyond the Earth.

NASA's Habitable Worlds Program includes elements of the Astrobiology Program, the Mars Exploration Program, the Outer Planets Program (all in the Planetary Science Division) and Exoplanet research in the Astrophysics Division. A common goal of these programs is to identify the characteristics and the distribution of potentially habitable environments in the Solar System and beyond. This research is conducted in the context of NASA’s ongoing exploration of our stellar neighborhood and the identification of biosignatures for in situ and remote sensing applications. For further information on the science scope of Astrobiology, please refer to the Astrobiology roadmap, which can be found on the Astrobiology web page [http://astrobiology.nasa.gov/](http://astrobiology.nasa.gov/). Information on the habitability-related goals of the Mars Exploration Program can be found in the "Mars Science Goals, Objectives, Investigations and Priorities: 2010" document, available on the Mars Exploration Program Analysis Group web page ([http://mepag.jpl.nasa.gov](http://mepag.jpl.nasa.gov)). For the Outer Planets Program, refer to the document “Scientific Goals and Pathways for Exploration of the Outer Solar System,” found on the Outer Planets Assessment Group web site ([http://www.lpi.usra.edu/opag](http://www.lpi.usra.edu/opag)).

Theoretical and experimental studies will be considered, as well as quantitative terrestrial field experiments that improve scientific understanding of how in situ measurements at analog sites can or will improve our understanding of the potential for the environment to support life. Research areas include, but are not limited to, the presence of water and/or exotic solvents, sources of energy for life, presence of organics and their reactivity, and water body physics and chemistry as they pertain to habitability and habitability over time. The target bodies for this program element include, but are not limited to:

- Mars - the astrobiological potential of past or present environments on or in the Martian surface or subsurface.
• Icy Worlds - the astrobiological potential of icy worlds in the outer solar system, including Europa, Ganymede, Enceladus, and Titan.
• Habitable Exoplanets and/or their moons - A potentially habitable exoplanet implies a planet with conditions roughly comparable to those of Earth (i.e., an Earth analog) and thus potentially favorable to the presence of life.

2. Programmatic Information

Proposals are sought for new projects within the scope of the Habitable Worlds. Proposals submitted in response to this Program Element should be for new work that is not currently supported by the program or for investigations that would extend to their next logical phase those tasks that have been funded in the Astrobiology, Mars Fundamental Research, and Outer Planets (or other) programs.

The Habitable Worlds element will be administered primarily by the Planetary Science Division. As such, this solicitation is governed by information contained in program element C.1. However, highly-rated programs of strong programmatic relevance to the Astrophysics Division will be considered for funding by the Astrophysics Division. The Astrophysics Division will consider supporting investigations that are focused upon the characterization of potentially habitable exoplanets and their atmospheres in order to:

• inform targeting and/or operational choices for current NASA Astrophysics missions, or
• provide targeting, operational, and/or formulation data for future NASA Astrophysics observatories.

2.1 Relevance Statement Requirement

Step-2 Proposals to this program element must discuss relevance in a (4000-character maximum) text box on the cover pages via the NSPIRES web interface for this program element. This section is outside of the 15-page Scientific/Technical/Management Section and the relocation of the relevance discussion does not decrease that 15-page limit. This requirement supersedes the NASA Guidebook for Proposers and the ROSES Summary of Solicitation, and the omission of this section is sufficient reason for a proposal to be returned without review.

The relevance discussion must explicitly refer to this program element and the section of the solicitation to which the proposal is responsive. If the proposed work is close in scope to research covered by any other program element, this discussion must also justify why it is more relevant to this program element than that other program element. This discussion may not be used to address the proposal's intrinsic merit, budget justification, or any other factor that remains in the 15-page main body, or any other section, of the proposal.
2.2 Program Exclusions

Proposals focused on the formation of complex organic molecules in space and their delivery to planetary surfaces in the Solar System should be submitted to C.2 Emerging Worlds. Proposals focused on the formation and stability of habitable planets should be submitted to either C.2 Emerging Worlds or E.3 Exoplanet Research Program, depending on the nature of the study. Refer to those solicitations for more information.

Biosignature studies of samples from sites thought to be analogs of other planetary environments that might potentially harbor life should be directed to C.5 Exobiology. Models of environments in which organic chemical synthesis could occur and the forms in which prebiotic organic matter has been preserved in planetary materials should be directed to C.5 Exobiology. Work to understand the phylogeny, physiology, and adaptations of extant terrestrial organisms to extreme environments should be directed to C.5 Exobiology.

Field-based investigations focused on exploring the relevant environments on Earth in order to develop a sound technical and scientific basis to conduct planetary research on other Solar System bodies should be directed to C.14 PSTAR (Planetary Science and Technology from Analog Research) program.

Through its data analysis programs, C.8 Lunar Data Analysis Program (LDAP), C.9 Mars Data Analysis Program (MDAP), C.10 Cassini Data Analysis Program (CDAP), C.11 Discovery Data Analysis Program (DDAP), C.19 New Frontiers Data Analysis Program (NFDAP), and C.20 Rosetta Data Analysis Program (RDAP) the Planetary Science Division solicits proposals for work that are primarily analysis of planetary mission data. This program element does not accept proposals that are eligible for submission to one of those data analysis programs. If a proposal is not appropriate for one of the data analysis programs, but does fit within the bounds of this program, then it should be submitted to this program.

2.3 Pilot Studies

Proposals for one to two year pilot studies to demonstrate or develop a new technique or a new application of an established technique will be considered. Such proposals may also include the demonstration of a technique new to the proposer, but not new to the field in general.

2.4 Instrumentation: Construction or Upgrade

Proposers to Habitable Worlds are eligible to request funds for Planetary Major Equipment (PME). See Program Element C.17 for information on how to append a PME request to a regular Habitable Worlds research proposal or submit a stand-alone PME proposal to supplement an existing Habitable Worlds award.
2.5 Development of Instruments

This solicitation does not request proposals for the development of advanced instrument concepts and technologies as precursors to astrobiology flight instruments. Such proposals may be submitted to C.12 Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) Program, for technology readiness levels (TRLs) 1-3 or C.13 Maturation of Instruments for Solar System Exploration (MatISSE) Program for TRLs 4-6. Proposals for science-driven field campaigns that are expected to produce new science results, as well as new operational or technological capabilities, should be submitted to the C.14 Planetary Science and Technology Analogs Research (PSTAR) program.

2.6 The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, given the nature of the new calls, and to ensure proposals are submitted to the appropriate program, this program uses a two-step proposal submission process (see Section IV. (b) vii of the ROSES Summary of Solicitation.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The Principal Investigator (PI) cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

2.6.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal has been submitted to the appropriate program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

NSPIRES will notify proposers whether their Step-1 proposal has been designated as encouraged or not, at which point they will be able to create Step-2 proposals.
2.6.2 Step-2 Proposal

This is a reminder that all proposals submitted to ROSES must strictly conform to the formatting rules in Chapter IV of this announcement and the NASA Guidebook for Proposers. Those that violate the rules may be rejected without review. In previous years, problems with the formatting of the Scientific/Technical/Management section proposals have been noted. Please pay particular attention to:

- **Length:** 15 pages
- **Margins:** 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- **Font:** The NASA Guidebook for Proposers requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- **Line spacing:** Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Do not adjust line-spacing settings for your selected font below single-spaced.
- **Figure captions:** must follow the same font and spacing rules as the main text.
- **Figures and tables:** for text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

2.7 Duration and Size of Awards

NASA anticipates that most proposals will seek three years of funding. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. In rare cases, funding for the proposed fourth year may be provided, if the need for the longer duration is sufficiently well justified. The appropriateness of the proposed funding period will be reviewed, and adjustments may be requested. Programmatic balance may limit the opportunities for funding in some areas.

In response to proposals submitted to this program element in ROSES-2014 and 2015 10-15 awards were made. The average size of awards resulting from Step-2 proposals submitted to Habitable Worlds was ~$150-160 K per year per award, but with a wide range, depending on the nature of the work proposed. When selections are made for proposals submitted in January of 2017 in response to ROSES-2016 those data will be included in the grant stats spreadsheet on the SARA grant stats web page. Proposers are encouraged to request what they actually need to conduct the research proposed.

2.8 Planetary Science Division Early Career Fellowship Program

See Program Element C.23 for the application process for the New Early Career Fellowship Program in the Planetary Science Division. Early Career Fellowship
applications will now be submitted as stand-alone proposals rather than tied to the submission of a parent science proposal.

2.9 Antarctica

The Habitable Worlds Program is no longer accepting proposals for work in Antarctica.

2.10 Resources: Information, Data, and Facilities

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see C.1, The Planetary Science Division Research Program Overview, for more information.

2.10.1 Facilities and Data Sources Available to Proposers

Proposers are advised to read C.1 Planetary Science Division Research Program Overview, and D.1 Astrophysics Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in the NASA Guidebook for Proposers, a letter of support may be required from any facility required for the proposed effort.

2.10.2 Geologic Maps

Proposers who plan investigations involving geologic mapping should consult program element C.1, Section 3.8, for guidance on submission and requirements for publication of U.S. Geological Survey (USGS) maps. The scientific goal of such a geologic map product should be clearly explained and justified.

2.11 NASA Postdoctoral Program Fellows

Grantees in the program are eligible to serve as mentors to NASA Postdoctoral Program (NPP) Fellows. The tenure of a Fellow must begin before the end of the award, but may extend beyond it. Proposals from potential Fellows must be submitted through the standard NPP process. This Program expects to select no more than two Fellows
this year. More information about the NASA Postdoctoral Program may be found at http://npp.usra.edu/.

2.12 Data Management Plans

Proposals submitted to this program element must include a Data Management Plan (DMP, see program element C.1, Section 3.6). This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal.

3. Summary of Key Information

<p>| Expected program budget for first year of new awards | ~$2M |
| Number of new awards pending adequate proposals of merit | See section 2.7 |
| Maximum duration of awards | 4 years; shorter-term proposals (1-3 years) are typical; fourth year must be explicitly and scientifically justified. |
| Due date for Step-1 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Due date for Step-2 proposals | See Tables 2 and 3 in the ROSES Summary of Solicitation. |
| Planning date for start of investigation | 6 months after proposal due date. |
| Page limit for the central ScienceTechnicalManagement section of proposal | 15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers. |
| Relevance | This program is relevant to the Planetary Science and Astrophysics Divisions questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. |
| General information and overview of this solicitation | See the ROSES Summary of Solicitation. |
| Detailed instructions for the preparation and submission of proposals | Please see ROSES Summary of Solicitation Section I(g) Order of Precedence and the NASA Guidebook for Proposers. |
| Submission medium | Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the ROSES Summary of Solicitation and the NASA Guidebook for Proposers. |
| Web site for submission of proposals via NSPIRES | <a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376) |
| Web site for submission of proposals via Grants.gov | <a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726) |</p>
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<td>Mitch Schulte</td>
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<td>Washington, DC 20546</td>
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<td>Telephone: (202) 358-4462</td>
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<td>E-mail: <a href="mailto:Martin.Still@nasa.gov">Martin.Still@nasa.gov</a></td>
<td></td>
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</tbody>
</table>
NOTICE: January 25, 2018. Consistent with Amendment 61 to ROSES-2017, a reference in Section 3.2 to the New Frontiers Data Analysis program has been updated to point to ROSES-2018, rather than 2017.

Amended December 20, 2017. This amendment releases final text for this program element which was previously released as draft for community comment. Step-1 Proposals are due by March 1 2018 and Step-2 Proposals are due April 26, 2018.

The Juno Participating Scientist Program is jointly solicited by the NASA Planetary Science and Heliophysics Divisions. All proposals will be solicited through this program element and will be reviewed together. Proposers do not need to include any Division-relevant information in the proposal except where specified in this program element. This program element is governed by information contained in Appendix C.1, Planetary Science Research Overview, except where superseded by this document.

To ensure a fair competition between proposals from proposers with connections to the Juno mission team and those without, proposals are forbidden from using information, including mission science data, not publicly available (see Section 2.2).

1. Scope of Program

The objective of the Juno Participating Scientist Program (Juno PSP) is to enhance the scientific return during the science phase of the Juno mission by expanding participation in the mission through new investigations that broaden and/or complement existing mission investigations. The Principal Investigator (PI) of a selected proposal, and that person alone, will be added to the Juno Science Team as a Participating Scientist and will be given all of the rights and responsibilities of Juno Co-Is, as per the Juno Rules of the Road. In the case that a proposal names a Science PI, that individual (and not the named Principal Investigator) will be added to the Juno Science Team as a Participating Scientist; for these proposals, "Principal Investigator" means "Science PI" and the proposal Principal Investigator will be considered a Co-Investigator.

This program element briefly describes the Juno mission and its science investigation. Further, and more detailed, information is available in the Proposal Information Package, which includes the Juno Rules of the Road, for this program element, posted on the NSPIRES page under "Other Documents". Proposers are expected to read that document because not all relevant information about the mission is included in this program element.

The Juno Participating Scientist Program is jointly solicited by the NASA Planetary Science and Heliophysics Divisions, but will be administered primarily by the Planetary Science Division. As such, this program element is governed by information contained
in Appendix C.1, Planetary Science Research Overview, except where superseded by this document.

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects that such values will be reflected in the composition of all panels and teams including peer review panels (science, engineering, and technology), proposal teams, science definition teams, and mission and instrument teams.

1.1 Background Mission Information

Juno entered Jupiter orbit on July 4, 2016. As of June 2017, the spacecraft is in a 53.5-day polar orbit that has apoapsis in the far Jovian magnetosphere and periapsis within approximately 5000 km of Jupiter. Primary science observations are obtained within three hours of closest approach, but occasional remote sensing and magnetospheric science observations and calibrations are planned through the orbits.

Juno’s primary science goal is to inform the understanding of the formation, evolution and structure of Jupiter, which is directly related to the conditions in the early solar system which led to the formation of our planetary system. The mission addresses this goal through its specific science objectives regarding Jupiter’s atmospheric structure, gravitational field, magnetic field, and polar magnetosphere. In no particular order, those objectives are:

1. Atmospheric composition: Investigate the formation and origin of Jupiter’s atmosphere and the potential migration of planets through the measurement of Jupiter’s global abundance of oxygen (water) and nitrogen (ammonia).
2. Atmospheric structure: Investigate variations in Jupiter’s deep atmosphere related to meteorology, composition, temperature profiles, cloud opacity, and atmospheric dynamics.
3. Magnetic field: Investigate the fine structure of Jupiter’s magnetic field, providing information on its internal structure and the nature of the dynamo.
4. Gravity field: Explore the distribution of mass inside the planet.
5. Polar magnetosphere: Explore Jupiter’s three-dimensional polar magnetosphere and aurorae.

The Juno mission includes nine instruments and one investigation available for use in proposals to this program element:

1. Gravity Science
2. Magnetometer (MAG)
3. Microwave Radiometer (MWR)
4. Juno Energetic particle Detector Instrument (JEDI)
5. Jovian Auroral Distributions Experiment (JADE)
6. Juno Waves Investigation
7. Ultraviolet Spectrograph (UVS)
8. Jovian Infrared Auroral Mapper (JIRAM)
9. Radiation Monitoring
10. JunoCam
The Juno PSP Proposal Information Package (PIP), found on the NSPIRES page for this program element, has more detailed information about the mission. The more-detailed sub-objectives and measurement requires are given for each of the science objectives. The description of the science instruments and investigations are briefly described and links to instrument papers with more information are provided. It is expected that information in the PIP will be incorporated into submitted proposals to demonstrate feasibility of those studies.

1.2 Solicited Investigations

NASA invites proposals that address outstanding science questions about or related to the Jupiter system and that require the use of Juno mission data not yet publicly available. NASA expects the submission of proposed science investigations that fall within the scope of the Juno science objectives but also strongly encourages proposals that leverage Juno’s anticipated mission data to conduct studies not within the scope of the mission.

Due to Juno’s current 53-day orbit, science investigations not originally planned are now feasible and NASA encourages proposals on these topics. These investigations include but are not limited to:

2. Gravity field: Explore the motions inside the planet.
3. Global magnetosphere: Explore Jupiter’s three-dimensional global magnetosphere away from the polar regions.

Although this Participating Scientist Program focuses on the Juno mission, NASA does solicit the submission of comparative studies between Jupiter and other planets, including studies of processes that occur elsewhere in the Solar System and in exoplanetary systems.

Proposed studies may incorporate theory, modeling, laboratory studies, ground-based observations, correlative analyses, and/or other research, but the results of those non-data-analysis tasks must be incorporated into the analysis or interpretation of mission data. Proposals that would only execute these tasks and make the results available to other investigators are not responsive to this program element.

1.3 Proposal Team Roles and Responsibilities

The PI of a selected proposal, and that person alone, will be added to the Juno Science Team as a Participating Scientist and will be given all of the rights and responsibilities of Juno Co-Is, as per the Juno Rules of the Road. In the case that a proposal names a Science PI, that individual (and not the named Principal Investigator) will be added to the Juno Science Team as a Participating Scientist; for these proposals, all further uses of the term "Principal Investigator" mean "Science PI" in this program element.

While Co-Is and other funded team members are necessary components to many science investigations, it is expected that the PI will execute the majority, if not all, of the proposed project. The inclusion of funded Co-Investigators, unfunded collaborators,
graduate students, and postdoctoral researchers is discouraged, although not prohibited. Proposal Co-Is, collaborators, and other team members will have no official status with the Juno Science Team and will only have access to not-publicly available Juno mission data for use on the selected proposal through the Participating Scientist they are affiliated with. The Participating Scientist takes responsibility for ensuring that their proposal team members follow the Juno Rules of the Road.

1.4 Future Mission Timeline

The Juno mission will need to continue science operations into 2021 to complete 32 orbits. If the mission ends prior to completion of the 32 orbits, then awards selected through this solicitation will be terminated at the end of that current task year.

2. Programmatic Information

The Juno Participating Scientist Program is jointly solicited by the NASA Planetary Science and Heliophysics Divisions. All proposals will be solicited through this program element and will be reviewed together. Proposals do not need to discuss relevance to either Division, but rather just to this program element (see Section 2.4).

The Juno Participating Scientist Program will be administered primarily by the Planetary Science Division. As such, this program element is governed by information contained in Appendix C.1, Planetary Science Research Program Overview, except where superseded by this document.

2.1 Eligibility to Propose

The Juno PI and current Juno Co-Is are not eligible to be named a Juno Participating Scientist.

Other individuals, whether from U.S or non-U.S. institutions, that are funded by the Juno mission or by their institution (and/or funding agencies) for their participation in the Juno mission are not eligible to be named a Juno Participating Scientist if a majority of the proposed work is within the scope of Juno’s mission-funded activities. The determination of whether a proposal exceeds this restriction will be made based upon the relative importance of the mission-funded tasks to the Participating-Scientist project and the overlap of the science objectives with the mission objectives. Individuals funded to participate in the Juno mission must address non-duplication of funding for mission-funded activities in the Budget Narrative section of the proposal, but may not argue about whether the proposal exceeds this majority-within-scope restriction. While the peer review panel may be asked to comment on this topic, the decision will be made by NASA.

Individuals who are funded by the Juno mission are eligible for funding through a Participating Scientist award but must follow Section 3.2, Prohibition on Duplication of Mission-Funded Activities, from Appendix C.1, Planetary Science Research Program Overview. These individuals may not request funding for any work within the scope of the mission’s funded activities and must demonstrate the lack of duplication of mission funding in the Budget Narrative section of the proposal. In situations where a proposal
includes both work within and without the scope of mission-funded activities, funding may be requested for the work outside the scope of mission-funded activities.

Non-U.S. institutions may submit proposals to this program element, but those proposals will only be considered on a no-exchange-of-funds basis. Non-U.S. proposals will be reviewed to the same standards as proposals from U.S. institutions and will be selected solely by NASA. Proposers from non-U.S. institutions should read the Foreign PI Affiliation instructions document, which is downloadable as a PDF file from the NSPIRES web page for this program element. Non-U.S. proposals must include a letter of commitment promising financial support for all proposed activities for each team member.

As non-U.S. institutions may submit proposals to this program element on a no-exchange-of-funds basis, any proposal that requests funding for a U.S. proposal team member must be submitted by a U.S. institution that has a funded investigator on the proposal. The non-U.S. investigator requesting to be a named a Participating Scientist must have the proposal role Co-I/Institutional PI and must be identified as the potential Participating Scientist in the roles and responsibilities discussion in the 15-page Scientific/Technical/Management Section of the proposal. In the case that a proposal requests that multiple U.S. institutions receive funding and that one of those institutions is a NASA Center, or JPL, NASA requests that the proposal be submitted by the NASA Center. These proposals will be reviewed to the same standards as other proposals from U.S. institutions and will be selected solely by NASA. Proposals must include a letter of commitment promising financial support for all proposed activities for each non-U.S. team member.

2.2 Sources of Information and Data Used in the Proposal

Information on the Juno instruments and anticipated data is in the Proposal Information Package, located on the NSPIRES page for this program element.

All information used in the proposal document that pertains to Juno or other missions must be available in the public domain at least 30 days before the Step-2 deadline. For the purposes of this restriction, the public domain includes publication in a publicly accessible archive (e.g. Planetary Data System), final publication in a scientific journal, and posting on the NSPIRES pages for this program element.

The requirement on the public availability of spacecraft mission data to be used in the proposed project (Appendix C.1, Planetary Science Research Program Overview, Section 3.4) does not apply to the Juno mission data for this program element. Proposals must use and must require the use of future Juno mission data.

The requirement on the public availability of spacecraft mission data to be used in the proposed project does not apply to missions that the PI is currently funded to participate in. Proposals may use future mission data from a spacecraft mission that is currently or will be undergoing senior review, but the outcome of that mission’s review will be considered by NASA in selection decisions.

The requirement on the public availability of spacecraft mission data to be used in the proposed project does not apply to certain data from the Heliophysics Systems Observatory, regardless of science team membership of the PI. In order to facilitate
studies where the solar wind is a factor, proposals may include the use of future mission data from the ACE, Wind, and STEREO missions. Proposals may use future mission data from these spacecraft missions, but the outcome of these missions' senior review will be considered by NASA in selection decisions.

2.3 Data Management Plans (DMPs)

Proposals submitted to this program element must include a Data Management Plan (DMP) consistent with the requirements outlined in Appendix C.1. This must be placed in a special section, not to exceed two pages in length, immediately following the References and Citations section for the Scientific/Technical/Management portion of the proposal. The DMP does not need to cover archiving of spacecraft data returned by the mission, which is already controlled by the mission-level DMP; however, it must cover new data and software products that would be generated under the proposal, including those derived from spacecraft data.

Any higher-order data products derived from the Juno mission data is anticipated to be archived with the PDS, with exceptions rare. DMPs that do not commit to archiving mission-data-derived higher-order data products in the Planetary Data System (PDS) must justify why an exception is appropriate for that data product.

Unless infeasible or unreasonable, all data produced through a proposal to this program element must be made publicly available through an online archive. This may be a long-term repository hosted by the PI’s institution or by another institution or agency that accepts external submissions. When a proposal would produce a significant number of large files that are impractical to deposit as a complete set, the DMP must commit to depositing a reasonable subset (e.g. those that directly fed into the analysis that shown in the publication) and making the rest available upon at-cost to a requestor.

Proposers, especially those not experienced in archiving with the PDS, are strongly encouraged to begin planning their archiving process as soon as possible. The PDS’s documentation for proposers seeking to archive data sets may be found at https://pds.nasa.gov/pds4/about/portal.shtml and http://atmos.nmsu.edu/proposal_assist.html.

The lead PDS Node for the Juno mission is the Atmospheres Node and they are available to provide guidance to those proposers as needed; proposers not already preparing to archive into another PDS node should contact Dr. Lynn Neakrake (lneakras@nmsu.edu) for the PDS letter of support as well as for assistance with questions about the process (including anticipated scheduling and costs).

2.4 Required Participating Scientist Request Appendix

The Step-2 proposal must include a "Participating Scientist Request Appendix" after the Data Management Plan. This appendix may be up to two pages in length and the information provided in this appendix will only be considered in the evaluation of the Potential Enhancement of the Juno Mission Science Return criterion.

This appendix must lead with a section titled "Acknowledgement of the Terms of the Participating Scientist Award" that contains the following text:
"This proposal acknowledges that, if selected, [name of Participating Scientist applicant] will be added to the Juno Science Team as a Participating Scientist (PS). As part of this role, the PS will follow the Juno Rules of the Road and ensure that any Co-Is, collaborators, and other proposal team members also follow those rules. While the PS is responsible to NASA HQ for successfully executing the funded science investigation, [name of Participating Scientist applicant] commits to following the Juno leadership’s management of the Juno Science Team. It is also acknowledged that NASA reserves the right to shorten the period of performance or terminate this award 1) if a member of this proposal team (or one added to the project after selection) violates the Juno Rules of the Road, or 2) for any mission-related reason, including but not limited to mission end."

The appendix must demonstrate how the proposed effort would expand or enhance the scientific return of the Juno mission. This discussion may reference material within the 15-page Scientific/Technical/Management section of the proposal and may include references to material outside of the proposal in order to clearly demonstrate the relation of the proposed work to the funded mission scope.

The appendix must demonstrate that the proposed work can not be successfully completed without the use of Juno mission science data not yet publicly available. For proposals where the use of Juno mission science data not yet publicly available would produce significantly improved or impactful results compared to the use of just data currently publicly available, this appendix must clearly describe and justify the expected enhanced science return.

2.5 Required Budget for Juno Science Team Travel

All proposals to this program element must budget for travel to the Juno Science Team meetings. These meetings are held four times a year and last for three days. For budgeting purposes, proposals must assume that the meetings will all be held in San Antonio, Texas, United States. Travel support to these meetings may only be requested for the named Participating Scientist.

2.6 Potential Shortened Award Period of Performance

If a mission event occurs post-selection that would prevent a significant fraction of an award from being completed, NASA reserves the right to shorten the award’s period of performance, including terminating the award.


3.1 General Information

This program element uses the two-step proposal submission process outlined in Appendix C.1, Section 2. Step-1 proposals are mandatory and must be submitted by the proposing organization.
Proposals must follow all formatting requirements that are described Appendix C.1 and in Chapter 3.6 of the NASA Guidebook for Proposers. Violation of these rules is sufficient grounds for a proposal to be rejected.

3.2 Evaluation Criteria

Proposals submitted to this program element will be evaluated based on five criteria: Scientific Merit, Scientific Implementation and Feasibility Merit, Data Management Plan, Potential Enhancement of the Juno Mission Science Return, and Cost Reasonableness. In addition to the factors given in the NASA Guidebook for Proposers, evaluation of proposals for this program element includes the following factors, based upon the material within the 15-page main body, the DMP, the 2-page appendix, and the Budget Narrative, as appropriate:

- **Scientific Merit** includes the aspects of the Intrinsic Merit evaluation criterion (the NASA Guidebook for Proposers, Appendix D) related to the scientific quality of the proposed project. This includes, but is not limited to, the scientific rationale and the expected significance and/or impact of the proposed work.

- **Scientific Implementation and Feasibility Merit** includes the aspects of the Intrinsic Merit evaluation criteria (the NASA Guidebook for Proposers, Appendix D) not covered by the Scientific Merit criterion above. This includes, but is not necessarily limited to, the technical quality of the proposal, qualifications of the proposal team, and facilities or other resources used in the proposal.

- **Scientific Implementation and Feasibility Merit** will include an evaluation of whether 1) the proposed instruments are capable of providing the needed data and 2) whether the anticipated tour would provide observations in the appropriate regions of space. This evaluation will be based upon information published in journals, available on the NSPIRES page for this program element, or provided by the Juno PSP Proposal Information Package.

- **Data Management Plan** will include evaluation of the appropriateness of the archive(s) specified as the destination for data sets and data products resulting from the proposed project. This includes the evaluation of any justification given for not archiving mission-data-derived higher-order data products in the PDS.

- **Potential Enhancement of the Juno Mission Science Return** will include evaluation of whether the proposal requires, for achieving successful closure on the science objectives, the use of Juno mission data that is not yet archived in the PDS. This evaluation will include consideration of whether the science objectives, as proposed, would be achievable with publicly available mission data sets (including those available for use in the New Frontiers Data Analysis Program element of ROSES-2018 2017) [Updated consistent with Amendment 61 to ROSES-2017].

- **Potential Enhancement of the Juno Mission Science Return** will additionally include evaluation of the extent to which the proposed investigation and the expertise of the
proposer complements or extends the existing investigations and expertise of the science team.

- Cost Reasonableness will additionally include evaluation of the budget to ensure that participation in science team activities and meetings is sufficiently supported.

In the case that a proposal includes the acquisition of observations or the generation of data products significantly outside the scope of Juno standard operations, NASA reserves the right to conduct a second technical feasibility review. This second review would be performed with the direct cooperation of the Juno mission team, and it is anticipated that any findings produced by that review would be delivered to the proposer outside of the panel evaluation form.

3.3 Selection Process

The selection process for this Participating Scientist Program will largely follow that in the documentation governing this program element. While a meritorious proposal will remain a necessary condition for selection, programmatic concerns in this Participating Scientist Program will play a more dominant role in selection decisions than in other program elements solicited in the ROSES NRA.

The selection process for this Participating Scientist Program will also consider a proposal’s distribution of tasks among the proposal team members. While Co-Is and other funded team members are necessary components to many science investigations, it is expected that the PI will execute the majority, if not all, of the proposed project. This expectation is for both the proposal as a whole and for those tasks that involve analyzing the Juno mission data.

Upon selection, the PI of a selected proposal will be added to the Juno Science Team as a Participating Scientist and will be given all of the rights and responsibilities of Juno Co-Is, as per the Juno Rules of the Road. Proposal Co-Is and collaborators will have no official status with the Juno Science Team and will only have access to Juno mission data not already publicly available through the Participating Scientist with which they are affiliated.

4. Summary of Key Information

<p>| Expected program budget for first year of new awards | $0.5-1M |
| Number of new awards pending adequate proposals of merit | 7-10 |
| Maximum duration of awards | 3 years |
| Due date for Step-1 proposals | See Tables 2 and 3 in the Summary of Solicitation of this NRA. |
| Due date for Step-2 proposals | See Tables 2 and 3 in the Summary of Solicitation of this NRA. |
| Planning date for start of investigation | September 2018 |</p>
<table>
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<th>Page limit for the central Science/Technical/Management section of proposal</th>
<th>15 pp; see also Table 1 of ROSES and the NASA Guidebook for Proposers.</th>
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<tr>
<td>Relevance</td>
<td>Proposals that are relevant to this program are, by definition, relevant to NASA. See Section 2.4.</td>
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<tr>
<td>General information and overview of this solicitation</td>
<td>See the ROSES Summary of Solicitation.</td>
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<tr>
<td>Detailed instructions for the preparation and submission of proposals</td>
<td>Please see Table 1 of the ROSES Summary of Solicitation and Section I(g) Order of Precedence and Appendix C.1, Planetary Science Research Program Overview.</td>
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<td>Submission medium</td>
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<td>Web site for submission of proposals via NSPIRES</td>
<td><a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)</td>
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<td>Web site for submission of proposals via Grants.gov</td>
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<td>Funding opportunity number for downloading an application package from Grants.gov</td>
<td>NNH17ZDA001N-JUNOPSP</td>
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</tbody>
</table>
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