

NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)
NNH12ZDA0060-APEXMO3
PROGRAM ELEMENT APPENDIX (PEA) R
ASTROPHYSICS EXPLORERS MISSION OF OPPORTUNITY

On or about October 21, 2016, NASA amended this Announcement of Opportunity as follows:

The deadline for the submission of a Notice of Intent (NOI) to propose has been changed to October 27, 2016.

Note the Deadline for Proposal Submission has not changed from December 15, 2016.

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1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) issues this Second Stand Alone Missions of Opportunity Notice (SALMON-2) Program Element Appendix (PEA) for the purpose of soliciting proposals for Astrophysics Mission of Opportunity (MO) science investigations to be implemented through its Explorers Program.

Three Mission of Opportunity types may be proposed in response to this PEA: (1) Partner Missions of Opportunity (PMOs), (2) New Missions using Existing Spacecraft (NMESs), and (3) Small Complete Missions (SCMs). SCMs include investigations on the International Space Station (ISS), suborbital-class missions (an investigation requiring flight on a high-altitude scientific balloon platform or on a suborbital Reusable Launch Vehicle (sRLV), or as a CubeSat investigation – see Section 4.5.1 and Requirement R-10), investigations launched as secondary payloads, or investigations launched as hosted payloads. A fourth type of investigation, U.S. Participating Investigators (USPIs), may be proposed in response to Appendix D.13, Astrophysics Explorers U.S. Participating Investigators, of the NASA Research Announcement, Research Opportunities in Space and Earth Sciences 2016 (ROSES-2016), which is being released simultaneously with this PEA.

Investigations may target any astrophysics scientific investigation that advances the objectives outlined in Section 2.1 of this PEA. Investigations that address NASA goals in other areas, such as heliophysics, Earth science, or planetary science, are not solicited.

1.2 Explorers Program Background

The Explorers Program is the oldest continuous program in NASA. It is comprised of a longstanding series of space science missions that are independent, but share a common funding and NASA oversight/insight management structure. Initiated with the Explorer 1 launch in 1958 and including the Nobel Prize recognized Cosmic Background Explorer (COBE) mission, the Explorers Program has launched over 90 missions.

Though historically not always this way, the program currently administers only Principal Investigator (PI)-led science investigations for the Heliophysics and Astrophysics Divisions of NASA's Science Mission Directorate (SMD). Competitive selection by peer review ensures that the best and most current science affordable within the Cost Cap will be accomplished.

Since the early 1990s, the Explorers Program has provided several types of flight opportunities for addressing astrophysics and heliophysics science objectives. These mission types are defined

by their Cost Caps and are designed to increase the number of flight opportunities in response to recommendations from the scientific community. The Explorers Program currently consists of two types: larger stand-alone “full missions,” for which NASA offers a dedicated launch vehicle, and smaller investigations called “missions of opportunity.”

An Explorers MO is an investigation generally characterized by being part of a host space mission other than a strategic SMD mission, or by being a small complete mission with its own identified access to space, or by being a new science investigation utilizing an existing operating spacecraft that has completed its prime mission. For each Explorers AO, full mission or MO, the budget available varies, as do the types of investigations that may be proposed.

Explorers MOs are solicited through the SALMON-2 AO (NNH12ZDA006O) by amending it with a specific Program Element Appendix. This solicitation for Astrophysics Explorers Mission of Opportunity is one such PEA.

1.3 Overview of this Program Element Appendix

The SALMON-2 AO is an omnibus solicitation that provides the overall structure, guidelines and requirements for several types of MO solicitations. Each new opportunity is announced through a PEA that details the solicitation and may include additional guidelines and requirements. This document is one such PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/> or at <http://go.nasa.gov/SALMON2-AO>.

NASA issues this PEA as an appendix of the SALMON-2 AO for the purpose of soliciting proposals for Astrophysics Explorers MO investigations to be managed under the NASA Explorers Program. All investigations proposed in response to this solicitation must support NASA’s astrophysics science goals (Section 2.1 of this PEA) and the goals and objectives of the Explorers Program (Section 2.2 of this PEA), must be implemented by Principal Investigator (PI)-led investigation teams (Sections 4.2.4 and 5.4.1 of the SALMON-2 AO), and must result in the provision of complete space investigations (Section 5.3.2 of the SALMON-2 AO).

Proposals submitted in response to this PEA will be selected for flight nominally through a two-step competitive process. Proposals submitted in response to this PEA will undergo the first step evaluation. As the outcome of the first step evaluation, NASA intends to fund one or more MO investigations to proceed to a nine month Phase A concept study. In the second step, NASA will conduct an evaluation of the Phase A concept study reports. From this evaluation, NASA expects to select one or more MOs to proceed into Phase B and subsequent mission phases.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO contains additional requirements on the format and content of the proposals. Documents available through the Astrophysics Explorers Mission of Opportunity Program Library at <http://explorers.larc.nasa.gov/APMIDEX2016/MO/programlibrary.html> (hereafter referred to as the Program Library) are intended to provide guidance for investigations selected; they are specifically not intended to impose requirements on proposals.

1.4 NASA Online Document Information System

NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>. Once the final PEA is released, copies of appropriate versions of NPD and NPR documents referenced in the PEA will be placed in the Program Library. Those copies should be used to prepare proposals since documents in NODIS are subject to change.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Astrophysics Science Objective and Goals

One of NASA's strategic goals is to expand the frontiers of knowledge, capability, and opportunity in space. Further information on NASA's strategic goals may be found in NASA Policy Directive (NPD) 1001.0B, the *NASA 2014 Strategic Plan*, available through the Program Library or at <http://science.nasa.gov/about-us/science-strategy/>.

NASA SMD addresses this NASA strategic goal through four broad strategic objectives. One of these strategic objectives is to “discover how the universe works, explore how it began and evolved, and search for life on planets around other stars.” SMD addresses this objective by conducting astrophysics investigations designed to address the following science goals:

- 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.

Further information on the goals and objectives of NASA's astrophysics programs may be found in the *NASA 2014 Science Plan*, available at <http://science.nasa.gov/about-us/science-strategy/> or through the Program Library, and in the Astrophysics roadmap, *Enduring Quests Daring Visions, NASA Astrophysics in the Next Three Decades*, available through the Program Library.

2.2 Explorers Program Goals and Objectives

The goal of NASA's Explorers Program is to provide frequent flight opportunities for high quality, high value, focused astrophysics science investigations that can be accomplished under a not-to-exceed Cost Cap and that can be developed relatively quickly, generally in 36 months or less, and executed on-orbit in less than three years.

The Explorers Program accomplishes these world-class space science investigations utilizing efficient management approaches to contain mission cost through commitment to, and control of, design, development, and operations costs.

The Explorers Program provides an effective means of timely achievement of strategic goals. By conducting a rapid series of science investigations, NASA is responsive to new knowledge, technology, and science priorities. Pressing questions in astrophysics science are addressed, permitting a steady improvement in our understanding of astronomical systems and the processes that affect them. The frequent, steady nature of the investigations ensures a continuing stream of

fresh scientific data to the broader science community, thus maintaining the excellence of the U.S. space science program and the inspiration of a new generation of investigators.

The Explorers Program strives to:

- advance scientific knowledge of astrophysics and heliophysics processes and systems;
- add scientific data and other knowledge-based products to data archives for all scientists to access;
- lead to scientific progress and the publishing of results in the peer-reviewed literature to encourage, to the maximum extent possible, the fullest commercial use of the knowledge gained;
- implement technology advancements prepared in related programs; and
- announce scientific progress and results in popular media, scholastic curricula, and materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

2.3 NASA Management of the Explorers Program

The selected investigation(s) will be managed by the Explorers Program. The Associate Administrator for SMD has established the Explorers Program Office at the NASA Goddard Space Flight Center (GSFC) to be responsible for project oversight. The Explorers Program Manager at NASA GSFC reports to the Astrophysics Explorers Program Director at NASA Headquarters. Additional details about the program office staffing, structure, and goals can be found in the *Explorers Program Plan*, available through the Program Library. There are appropriate protective firewalls between the Explorers Program Office and the rest of NASA GSFC, allowing investigators from GSFC to propose in response to this PEA. The Explorers Program Office will manage the Astrophysics Explorers Mission of Opportunity investigations under the requirements of NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO. Safety, reliability, and mission assurance requirements for Astrophysics Explorers Mission of Opportunity investigations will be consistent with the *Standard Mission Assurance Requirements* document found in the Program Library.

All references to NPR 7120.5D NID in SALMON-2 should be interpreted as referencing NPR 7120.5E.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA SALMON-2 AO. The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>

The following schedule applies to this PEA.

- A Preproposal teleconference/WebEx will take place in association with this solicitation. Further information will be available at the Astrophysics Explorers Mission of Opportunity

Acquisition website (<http://explorers.larc.nasa.gov/APMIDEX2016/MO/index.html>) prior to the Preproposal teleconference/WebEx. The purpose of this Conference will be to address questions about the proposal process for this PEA. Questions should be sent to the Astrophysics Explorers Program Scientist at the address given in Section 6.1.5. NASA personnel will address all questions that have been received no later than five working days prior to the Conference. Questions submitted after this date may be addressed at the Conference as time permits and as appropriate answers can be generated. Anonymity of the authors of all questions will be preserved.

- Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date. Answers will be provided no later than ten days before the proposal due date.
- A Notice of Intent (NOI) to propose to this announcement is required. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES. Submitting an NOI does not commit the team to submitting a proposal.
- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- Evaluation and selection for flight will be done using a two-step selection process.
- NASA funded Phase A activities will be conducted by the investigation team(s) selected as a result of the first step of this solicitation.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four weeks following receipt of the Statement of Work, as set forth in Section 6.3.2 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Participate in this Proposal Opportunity

Refer to Section 4.2 of the SALMON-2 AO for the policies on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC is subject to the “Full Limitation” as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on the Aerospace Corporation.

4.1.1 NASA Center Role in Communications and Outreach

Each flight mission must utilize the communications office of a NASA center or JPL to manage the communications plan and activities. Missions managed by a NASA center or JPL will assign the management role to that center’s communications office. For missions not managed by a NASA center or JPL, Goddard Space Flight Center, the center where the Explorers Program Office resides, will fill the communications management role.

These communications offices will be responsible for leading, coordinating, and executing mission communications activities – in coordination with the PI – and with approval of Headquarters SMD and Office of Communications.

NASA's Principal Investigators (PIs) fill a challenging, multidisciplinary role, which demands excellent communication, team building, and management skills. The PI is a key spokesperson for the mission – along with NASA officials – and is integral in communicating mission updates, science, and new discoveries.

The PI provides content, analysis, and context for communication campaigns and news stories. In keeping with NASA's communications goals, this content should convey an understanding of the mission, its objectives, and benefits to target audiences, the public, and other stakeholders.

The PI will coordinate with the designated NASA center communications office for all mission-related communications activities. The PI, or his or her designee, shall review all news releases issued for the mission. In case of incompatible views, NASA will have final decision on release of public products, while ensuring that scientific and technical information remains accurate and unfiltered.

Selected PIs also must work with NASA to ensure their mission website follows NASA requirements for providing content on the agency's primary public website at <http://www.nasa.gov/>. NASA, and through NASA the selected investigation, is required under the Information Quality Act (44 U.S.C. 3504(d)(1) and 3516) and associated guidelines to maximize the quality, objectivity, utility, and integrity of information and services provided to the public.

A Communications and Outreach (previously referred as Public Outreach) program is required. Mission-related communications are funded directly through the NASA Center and are not within the PI-Managed Mission Cost. The communications plan must be developed during Phase B of the mission. The plan must include topline messaging, target audiences, and media processes linked to reaching target audiences and associated detailed budgets, milestones, metrics and timelines, and reporting requirements.

4.2 Types of Mission of Opportunity

Three Mission of Opportunity types may be proposed in response to this solicitation: (1) Partner Missions of Opportunity (PMOs), (2) New Missions using Existing Spacecraft (NMESs), and (3) Small Complete Missions (SCMs). SCMs include investigations on the International Space Station (ISS), suborbital-class missions (an investigation requiring flight on a high-altitude scientific balloon platform or on a suborbital Reusable Launch Vehicle (sRLV), or as a CubeSat investigation), investigations launched as secondary payloads, or investigations launched as hosted payloads. See Section 5.1 of the SALMON-2 AO for complete descriptions of these types of MOs, as well as constraints and requirements for proposals.

A fourth type of investigation, U.S. Participating Investigators (USPIs), may be proposed in response to ROSES-2016 Appendix D.13. A USPI proposes to participate as a Co-I for an instrument, experiment, or technology demonstration that is being built and flown by a sponsor agency other than NASA. NASA will release simultaneously with this PEA a solicitation for Astrophysics Explorers U.S. Participating Investigators through the ROSES-2016 NASA

Research Announcement (NRA) (NNH16ZDA001N). The Astrophysics Explorers USPI program element appendix of the ROSES-2016 NRA is available at <http://nspires.nasaprs.com/> or at <http://solicitation.nasaprs.com/ROSES2016>. USPI proposals submitted to that solicitation will be due at the same time as the Astrophysics Explorers MOs. USPI NOIs and proposals will be submitted in response to the ROSES-2016 amendment, will be subject to the proposal guidelines specified in ROSES-2016, will be subject to the constraints (cost, schedule, technical) and requirements specified in ROSES-2016, and will be reviewed and selected using the proposal criteria specified in ROSES-2016.

4.3 Science Requirements and Constraints

The science goals are described in Section 2 of this PEA. Any appropriate science question relevant to NASA's astrophysics science goals may be addressed with the proposed investigations. Section 2 of this PEA provides the basis for the evaluation of intrinsic science merit, as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside astrophysics science goals, as described in Section 2 of this PEA, are not solicited.

Requirement R-1. Proposals shall address appropriate science questions relevant to the NASA astrophysics science goals described in Section 2 of this PEA.

Requirements for documentation in the proposal of the flow-down of requirements from the proposed science goals are described in Section 5.2.2 of the SALMON-2 AO.

Requirement R-2. Each proposal shall clearly define its science question or questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into measurement, data, instrument, and mission requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement R-3. Each proposal shall clearly state the baseline and threshold requirements for the mission and the baseline and threshold mission lifetime.

Investigation Co-Investigators and collaborators are defined in Section 5.6 of the SALMON-2 AO.

Requirement R-4. Each proposal shall explicitly define the role of the PI, each Co-Investigator (Co-I), and each collaborator, the necessity of that role for the proposed investigation shall be justified, and the funding source (NASA or contributed) shall be noted.

NASA expects each proposal to fully describe the requirements for calibration and validation of the instruments and the data returned. Other data policies and requirements are given in Section 4.4 of the SALMON-2 AO and Section 4.6.6 of this PEA.

Requirement R-5. Each proposal shall fully describe the requirements for calibration and validation of the instruments and the data returned.

4.4 Telecommunications, Tracking, and Navigation

This section provides addition information for section 5.3.6 of the SALMON-2 AO.

It is SMD policy that only one DSN 34 meter antenna will be scheduled at the same time during normal operations of the selected Astrophysics Explorers mission. It is SMD policy that none of the DSN 70 meter antennas may be proposed to support normal operations of the selected Astrophysics Explorers mission. These restrictions do not apply to station hand-offs, critical event coverage, emergency services, radio science measurements, or navigation observations (e.g., delta differential one-way ranging or delta-DOR).

NASA intends to transition all space missions to the use of Ka-band for science data return (telemetry, tracking, and commanding (TT&C) data may still be transmitted using X-band or S-band). In order to better manage the Agency's transition to Ka-band service, proposed investigations are required to baseline the use of Ka-band for science data return, unless it is inappropriate.

Radio frequency spectrum for telecommunications is allocated by service (e.g., Earth Exploration-Satellite, Space Research, and Space Research (Deep Space)) and may be further constrained by maximum channel bandwidth limits (see the *Available Spectrum and Channel Limits By Allocated Service* document in the Program Library). Proposals are required to address conformance to applicable maximum channel bandwidth limit(s).

Requirement R-6. Proposals shall baseline the use of Ka-band for science data return, unless it is inappropriate for the proposed investigation; proposal of an alternative communications approach shall be justified.

Requirement R-7. Proposals shall address conformance to applicable maximum channel bandwidth limit(s).

Requirement R-8. Proposals that propose the use of the DSN shall baseline the use of only one DSN 34 meter at any time for normal operations (not including periods of station hand-off).

4.5 Cost and Schedule Requirements and Constraints

4.5.1 Cost Requirements and Constraints

The PI-Managed Mission Cost is defined in Section 4.3.1 of the SALMON-2 AO. Except for suborbital-class missions (a high-altitude scientific balloon mission, a mission on an sRLV, or a CubeSat mission), the PI-Managed Mission Cost Cap for an Astrophysics Explorers Mission of Opportunity, including all mission phases and the cost of accommodation on and/or delivery to the host mission, if applicable, is \$70 million in NASA Fiscal Year (FY) 2017 dollars. The PI-Managed Mission Cost Cap is \$35 million in FY 2017 dollars for suborbital-class missions.

NASA expects to select one or more Astrophysics Explorers Missions of Opportunity. If multiple selectable missions are proposed with combined costs within the available funding, anticipated to be approximately \$70 million, NASA may select more than one proposed investigation.

Requirement R-9. Proposals shall be for complete investigations including Phases A-F.

Requirement R-10. The proposed PI-Managed Mission Cost for the Astrophysics Explorers Missions of Opportunity shall be no more than \$70 million in FY 2017 dollars, except for suborbital-class missions (defined as (a) a high-altitude scientific balloon mission, (b) a mission on an sRLV, or (c) a CubeSat mission), for which it shall be no more than \$35 million in FY 2017 dollars.

Requirement R-11. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Mission Cost).

4.5.2 Schedule Requirements and Constraints

For a PMO, the proposing PI must provide evidence that the sponsoring organization intends to fund the primary host mission, including currently-not-yet-selected missions from an identified mission opportunity of another agency, and that the NASA commitment for U.S. participation is required by the sponsoring organization prior to January 2022. The launch date itself for a PMO is not constrained. For a NMES, the proposing PI must provide evidence that a decision by NASA on whether or not to conduct the proposed new mission extension is required prior to January 2022.

For Small Complete Mission (SCM) MOs, proposers must specify the launch readiness date in the proposal, which is to be no later than December 31, 2022. Astrophysics Explorers SCM MO investigations with an anticipated launch readiness date requirement later than December 31, 2022, should be proposed in response to a subsequent opportunity.

For balloon missions planned for launch from Antarctica during the December 2022 - January 2023 campaign, "launch readiness" per this requirement is considered to be the same as being at the Columbia Scientific Balloon Facility (CSBF) and ready to complete predeployment integration and testing with the CSBF support systems. June is the normal month to begin predeployment integration and testing at the CSBF for Antarctic balloon missions, which in the case of this MO, must be completed no later than August 20, 2022.

Proposers should be aware that it may be necessary for NASA to adjust the launch date and definition phasing of selected investigations from that proposed in order to conform to the available Astrophysics Explorers Program budget profile and/or NASA's ability to negotiate a launch opportunity to the International Space Station, for a high-altitude scientific balloon mission, for launch opportunities on reusable launch vehicles, or for CubeSat launches; therefore, the degree of launch date flexibility must be indicated in the proposal.

It is intended that proposed investigations be evaluated and selected through a two-step competitive process. Step 1 is the solicitation, submission, evaluation, and selection of proposals prepared in response to this PEA. The Step 1 evaluation and selection process is described in Section 7 of the SALMON-2 AO. As the outcome of Step 1, NASA intends to select one or more Step 1 proposals for Phase A study and evaluation, if their perceived value to the Astrophysics Explorers Program is significant. NASA will issue awards (provide funding to NASA Centers and the Jet Propulsion Laboratory (JPL), award contracts to non-NASA institutions, or utilize other funding mechanisms, as applicable) to the selected proposers to conduct Phase A concept studies and submit Concept Study Reports to NASA. Step 2 is the preparation, submission, evaluation, and continuation decision (downselection) of the Concept Study Reports. As the outcome of Step 2, NASA may continue one or more investigations into the subsequent phases of mission development for flight and operations.

Proposers selected through this AO will be awarded a contract to conduct a Phase A concept study with duration of approximately nine months and capped at \$500,000 FY 2017 dollars.

A proposal may be selected for development without first completing a Phase A concept study. The proposal must make the case that it is not only necessary, but also that it is also technically feasible for the project to be selected for development without a competitive Phase A concept study. The proposer must recognize that NASA would only make such a decision without a Phase A competition if the MO proposal were especially compelling.

Requirement R-12. Proposals shall include a detailed development schedule (including integration plans) and an associated budget that for a SCM secures the launch before December 31, 2022, or for a PMO or a NMES is consistent with the documented launch and operations schedule of the primary host mission.

4.5.3 Access to Space Cost Requirements

The following classes of platforms are provided by NASA for access to space, or near space, at no cost to the PI-Managed Mission Cost (see Section 4.6.2 and Section 4.6.3 of this PEA for additional information).

- Access to space will be provided by NASA for a mission on the International Space Station (ISS).
- NASA will provide the balloon vehicle and balloon launch services for a mission on a high-altitude scientific balloon.
- The platform is provided by NASA to host a payload on an sRLV.
- NASA will provide launch and deployment services for a CubeSat mission.

For SCMs larger than a CubeSat that require launch and deployment from an Expendable Launch Vehicle (ELV), the proposal must specify whether the access to space is to be provided by NASA, for which a charge against the PI-Managed Mission Cost must be included, or secured by the PI. The charge for NASA-provided access to space varies by size and whether a dedicated launch is required; see the *Launch Services Program Small Payload Access to Space Catalog* in the Program Library. If the PI secures access to space, including as a hosted payload, any costs for access to space must be included in the PI-Managed Mission Cost.

Requirement R-13. With the exception of small complete missions to the International Space Station or suborbital-class missions, any costs for access to space must be included in the PI-Managed Mission Cost.

4.5.4 Full Cost Accounting for NASA Facilities and Personnel

This Section supersedes Section 5.5.5 of the SALMON-2 AO.

For the purpose of calculating the full cost of NASA-provided services, proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, are to include within the PI-Managed Mission Cost all costs normally funded by an SMD Project under NASA's full cost accounting practices, including civil servant labor (salaries and benefits), civil service travel, and procurements. All of these costs must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) overhead costs must also be included within the Cost Cap, to enable a level playing field for all proposers. Per HQ policy guidance signed in June 2010 by the Associate Administrator, Mission Support Directorate and by the Agency Chief Financial Officer, all Centers shall use an identical CM&O burden rate of \$45K (FY 2017) per "equivalent head." For years after FY 2017, this number must be inflated. Per Agency policy, this rate must be applied as a "cost per equivalent head" to all Civil Service full time equivalents (FTEs) plus on/near site contractor work year equivalents (WYEs) associated with the proposal. The estimated FTEs and WYEs per fiscal year, and the resulting CM&O burden, must be identified in a separate table within the budget justification section of the proposal.

The CM&O burden costs must be clearly denoted in all budget tables. These costs may not be included or rolled into any other budget lines in such a way that they become unidentifiable.

Do not include within the cost proposal, or within the PI-Managed Mission Cost, any estimate for Agency Management and Operations (AM&O, a.k.a. NASA Headquarters overhead).

Table 1: Cost Elements for NASA Center Budget Proposals in response to SMD AOs

	Identify in proposal?	Include in PI-managed mission cost?	Funding source	Comments
Civil Service Labor	Yes	Yes	SMD Program	Includes salaries and benefits
Civil Service Travel	Yes	Yes	SMD Program	
Other Direct/Procurements	Yes	Yes	SMD Program	Includes procurements as typically identified by flight projects in the NASA N2 budget database
CM&O	Yes	Yes	CASP	Applied to NASA provided labor, including Center civil servants and on-site contractors

AM&O	No	No	CASP	Includes NASA provided independent technical authority
NASA Contributed Costs	Yes	No	Identify	Must be non-SMD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	SMD Program	If NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	Includes all non-NASA contributions

Requirement R-14. Proposals including costs for NASA Centers shall conform to the full cost policy stated in this Section. Each of the elements of the NASA Center costs (direct labor, travel, procurements) shall be separately identified by year.

If any NASA funded item(s) or services are to be considered as contributed costs, then the contributed item(s) must be separately funded by a non-SMD effort complementary to the proposed investigation, the value of the contribution(s) must be estimated, and the funding source(s) must be identified.

Requirement R-15. If any NASA funded item(s) or services are considered as contributed costs, then the proposal shall estimate the value of the contribution(s) and shall identify the funding source(s).

Any non-NASA Federal Government costs must follow the appropriate agency accounting standards for full cost. If no standards are in effect, the proposers must follow the *Managerial Cost Accounting Concepts and Standards for the Federal Government*, as recommended by the Federal Accounting Standards Advisory Board and available in the Program Library.

Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

4.6 Technical Requirements and Constraints

4.6.1 New Technologies/Advanced Engineering Development

This Section intends to clarify the requirement for New Technologies and/or Advanced Engineering Developments and supersedes Section 5.3.4 of the SALMON-2 AO.

This PEA solicits PMOs, NMESs, and SCMs for flight missions, not technology or advanced engineering development projects. Proposed investigations are generally expected to have mature technologies, with systems at a Technology Readiness Level (TRL) of 6 or higher. For the purpose of TRL assessment, systems are defined as level 3 Work Breakdown Structure (WBS) payload developments (i.e., individual instruments) and level 3 WBS spacecraft elements (e.g., electrical power system); see Figure 3-7 of the *NASA WBS Handbook*, NASA/SP-2010-3404, which can be found in the Program Library. TRLs are defined in NPR 7123.1B NASA

Systems Engineering Processes and Requirements, Appendix E, which can be found in the Program Library.

Proposals with a limited number of less mature technologies and/or advanced engineering developments are permitted, as long as they contain a plan for maturing systems to TRL 6 (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*, <http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080008301.pdf>) by no later than Preliminary Design Review (PDR) and adequate backup plans that will provide mitigation in the event that the systems cannot be matured as planned. The TRL state of systems will be validated by an independent team at PDR.

Requirement R-16. Proposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR and a backup plan in the event that the proposed systems cannot be matured as planned (see Section 5.1 of this PEA, for additional detail).

4.6.2 Additional Requirements for Partner Mission of Opportunity Investigations

The following requirements are in addition to those given in Section 5.1.1 of the SALMON-2 AO.

Requirement R-17. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations must also demonstrate: (1) their formal relationship with the sponsoring agency's host mission (e.g., already selected contribution, invited contribution, or proposed contribution); and (2) the status of the host mission within the sponsoring agency (i.e., Pre-Phase A, Phase A, or Phase B), including the level of commitment that the sponsoring agency has made to complete the mission.

Requirement R-18. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations requiring flight on the ISS must also provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA Space Station Research Integration Office. This ISS Letter of Feasibility Assessment must contain: (1) a description of the formal relationship with the sponsoring agency's host mission for access and accommodation at the space station, (2) identification of known challenges and/or conditional provisions for access or accommodation of the host mission, and (3) a description of the level of technical interchange and negotiation required to mature the host mission's provisions for access and accommodation.

Section 4.6.3.1 contains additional information related to investigations requiring flight on the ISS.

PMOs may be proposed for participation in nonstrategic NASA missions. A PMO may be proposed for participation in a PI-led NASA mission from a program other than Astrophysics Explorers (an Astrophysics Explorers MO may not be proposed for an Astrophysics Explorers mission).

Requirement R-19. A proposal for a PMO hosted by a PI-led mission from a program other than the Astrophysics Explorers Program must satisfy the following requirements: (1) The proposal must include a Letter of Commitment from the PI of the host mission endorsing the partnership and (2) the feasibility assessment of the host mission, i.e., the technical, management, and cost (TMC) evaluation in Step 1 and Step 2, must include the accommodations for the proposed PMO instrument.

4.6.3 Additional Requirements for Small Complete Mission of Opportunity Investigations

The following requirements are in addition to those in Section 5.1.3 of the SALMON-2 AO.

Requirement R-20. In addition to the requirements given in the SALMON-2 AO, all proposed SCM investigations, with the exception of investigations requiring flight on the ISS, suborbital-class missions, or NASA-provided launch vehicles (see Section 4.6.3.5), must also provide a Letter of Commitment from the program or agency providing access to space. This Letter of Commitment must contain: (1) a detailed description of the proposed provisions for access to space (e. g., launch to orbit provided by industrial or non-U.S. partner, secondary ride on another U.S. sponsored mission, etc.), and (2) the status of those proposed flight provisions within the sponsoring program or agency (i.e., conditional, confirmed, conceptual, etc.) including the level of commitment that the sponsoring program/agency has made to support that flight opportunity.

4.6.3.1 Investigations Hosted on the ISS

SCMs may be proposed for the ISS. Investigations requiring flight on the ISS must provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA Space Station Research Integration Office.

Requirement R-21. In addition to the requirements given in the SALMON-2 AO, all SCM investigations requiring flight on the ISS must also provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA Space Station Research Integration Office demonstrating that the proposed payload to be flown aboard the ISS can meet the access and accommodation requirements for ISS payloads. This ISS Letter of Feasibility Assessment must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to and accommodation on the ISS, (2) identification of known technical interface challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring an ISS Letter of Technical Interface and Resource Accommodation Feasibility Assessment should contact:

Dr. George C. Nelson
ISS Research Integration Office/Mail Stop OZ
Johnson Space Center
National Aeronautics and Space Administration
Houston, TX 77058
Telephone: 281-244-8514
E-mail: george.nelson-1@nasa.gov

Note that the issuance of the ISS Letter of Technical Interface and Resource Accommodation Feasibility Assessment can take several weeks; therefore, proposers are urged to contact the ISS Research Integration Office as early as possible for such request.

Additional information is found through the *International Space Station Capabilities and Payload Accommodations* document link in the Program Library. For any selected investigations, flight commitment to the ISS will be negotiated with NASA's Human Exploration and Operations Mission Directorate during Phase A. Selection of any investigation to be flown aboard the ISS is conditional until negotiations for ISS access and accommodation are successfully completed.

An Astrophysics Explorers MO investigation that is a SCM to the International Space Station should plan to complete its primary mission investigations by the end of FY 2024. NASA currently plans to operate ISS thru FY 2024, and while the agency is taking no action that would preclude operation beyond FY 2024, no commitment has yet been made either way.

4.6.3.2 *Investigations on High-Altitude Scientific Balloons*

SCMs may be proposed for flight on high-altitude scientific balloons. SCMs on high-altitude scientific balloons must be proposed for flight on Long Duration Balloons (LDBs) or Super Pressure Balloons (SPBs).

Requirement R-22. Proposals for SCM investigations on high-altitude scientific balloons must be proposed for flight on Long Duration Balloons (LDBs) or Super Pressure Balloons (SPBs).

Investigations requiring flight on LDBs or SPBs must provide a Letter of Feasibility from the NASA Balloon Program Office.

Requirement R-23. In addition to the requirements given in the SALMON-2 AO, all SCM investigations requiring flight on high-altitude scientific balloons must also provide a Letter of Feasibility from the NASA Balloon Program Office demonstrating that the proposed payload to be flown aboard LDBs or SPBs can meet the access and accommodation requirements for balloon payloads. This Letter of Feasibility must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to and accommodation on LDBs or SPBs, (2) identification of known challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring a NASA Balloon Program Office Letter of Feasibility should contact:

Debora Fairbrother
National Aeronautics and Space Administration
Balloon Program Office/Code 820
Wallops Flight Facility
Wallops Island, VA 23337

Telephone: 757-824-1453

E-mail: debor.a.fairbrother@nasa.gov

Additional information is found through the *Scientific Balloon Missions of Opportunity* document link in the Program Library. For any selected investigations, flight commitment to LDBs or SPBs will be negotiated with the NASA Balloon Program Office during Phase A. Selection of any investigation to be flown aboard LDBs or SPBs is conditional until negotiations for access and accommodation are successfully completed.

4.6.3.3 *Investigations as a CubeSat*

A SCM may be proposed for flight as a CubeSat. NASA has a CubeSat Launch Initiative (CSLI) and regularly provides launch opportunities for CubeSats as secondary payloads on U.S. Government missions. The CubeSat Launch Initiative (CSLI) is managed by the NASA Human Exploration and Operations Mission Directorate. See http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

For CubeSat proposals, all instruments/small satellites are recommended to comply with Cal Poly CubeSat Developer's specifications, found at <http://www.cubesat.org/resources/>. Concepts that do not comply with the Cal Poly CubeSat and Poly Picosat Orbital Deployer (P-POD) standards should clearly describe how their designs are packaged and deployed. NASA Launch Services Program has issued a *Program Level Dispenser and CubeSat Requirements Document* with requirements for CubeSats sized up to 6U (2U x 3U). All proposals for CubeSats sized up to 6U shall be compliant with these requirements. These documents can also be found in the Program Library. No CubeSat form factors larger than 6U will be considered under the present solicitation. Qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U, and 6U. Refer to the *LSP Small Payload Access to Space Catalog* in the Program library for the mass limitations.

Requirement R-24. All proposals involving sizes 1U through 6U CubeSats shall be compliant with the requirements in the NASA Launch Services Program's *Program Level Dispenser and CubeSat Requirements Document*. No CubeSat form factors larger than 6U will be considered under the present solicitation. Qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U, and 6U. Refer to the *LSP Small Payload Access to Space Catalog* in the Program library for the mass limitations.

For further information, please contact:

Anne E. Sweet
Launch Services Program Executive
NASA Headquarters
Washington, DC 20546
Phone: 202-358-3784
E-mail: anne.sweet-1@nasa.gov

or

Jason C. Crusan
Director, Advanced Exploration Systems
NASA Headquarters
Washington, DC 20546

Phone: 202-358-0635

E-mail: jason.crusan@nasa.gov

4.6.3.4 *Investigations on suborbital Reusable Launch Vehicles*

SCMs may be proposed for flight on suborbital Reusable Launch Vehicles (sRLVs). Access to sRLV platforms is managed by the Flight Opportunities Program within the Space Technology Mission Directorate. Information about sRLVs is available from the Flight Opportunities Program website at <http://flightopportunities.nasa.gov>. Additional information on sRLV vehicles, including general vehicle capabilities and contact information for some vendors, is available at <http://flightopportunities.nasa.gov/platforms>. The Flight Opportunities Program may advise proposers on the use of sRLV platforms, including the potential integration, safety and mission assurance, and operational costs. Proposers interested in using sRLVs must identify a vehicle that can provide the technical capabilities required to conduct the proposed investigation. SCMs to be flown on sRLVs must either be automated or remotely operated. Remote operation capability must be confirmed with the flight operator.

Requirement R-25. Proposals for investigations using sRLVs as platforms must specify the technical requirements that their investigation places on the vehicle. The proposal must include a Letter of Endorsement from a commercial vendor that (i) 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. Note that the Flight Opportunities Program is available to assist with (i) – (iii).

Questions concerning potential sRLV investigations may be addressed to:

Robert L. Yang
Flight Opportunities
Space Technology Mission Directorate
NASA Headquarters
Washington, DC 20546
Telephone: 202-358-0143
E-mail: robert.l.yang@nasa.gov

4.6.3.5 *Investigations on Expendable Launch Vehicles*

SCMs larger than CubeSats may be proposed for flight on an ELV. The proposal must specify whether the access to space is to be provided by NASA, for which a charge against the PI-Managed Mission Cost must be included, or secured by the PI. Accommodations on NASA-provided access to space could come in various forms, including as a secondary payload on an Evolved Expendable Launch Vehicle (EELV) Secondary Payload Adapter (ESPA) ring, ESPA Grande, Aft Bulkhead Carrier (ABC), and C-Adapter Platform (CAP), or as a primary payload utilizing Venture Class Launch Services. Compatibility to multiple platforms is encouraged to provide flexibility in manifesting. For additional information on the applicable platforms and charges to the PI-Managed Mission Cost for this solicitation, see the *Launch Services Program Small Payload Access to Space Catalog* in the Program Library.

4.6.4 Risk Classification

This opportunity solicits proposals for science investigations requiring the development and operation of space-based investigations. The projects are designated as Category 3 as defined in NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*. The payloads are designated as Class D as defined in NPR 8705.4, Risk Classification for NASA Payloads, except for PMOs, which depend on host mission's risk classification requirements.

Requirement R-26. If any requirements to the proposed hardware that are more stringent than Class D (as appropriate) are needed, they must be clearly described in the proposal.

4.6.5 End-of-Mission Spacecraft Disposal

[Any requirements in this section or the referenced section of the SALMON-2 AO will apply to Step 2 Concept Study Reports, but do not apply to Step 1 proposals.] Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for PMOs and hosted payloads where the PI is not responsible for the host mission. For these proposals, information shall be included regarding the plan for instrument passivation at the end of operations or in preparation for end-of-mission disposal. In addition, information shall be provided identifying instrument system components expected to survive Earth reentry if this is the postmission disposal method. This will allow NASA to remain in compliance with NPR 8715.6A, NASA Procedural Requirements for Limiting Orbital Debris, and NASA-STD-8719.14A, Process for Limiting Orbital Debris.

Requirement R-27. Proposals shall describe the instrument passivation plan at the end of the mission. In addition, proposals shall identify instrument components anticipated to survive Earth reentry if this is the disposal method. This supersedes Requirement 39 in the SALMON-2 AO. However, Requirement 39 in the SALMON-2 AO shall be met for CubeSat proposals.

4.6.6 Science Data Policy

4.6.6.1 Data Analysis

The PI will be responsible for analysis of the investigation data necessary to achieve the proposed science objectives, for archiving the data in the relevant NASA astrophysics data archive for public use, and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) or postmission (Phase F) activities. Proposals must allocate sufficient resources for this data analysis and archiving. Science studies with the archived data sets beyond the PI-led teams proposed science investigation will be solicited and selected by NASA in subsequent NASA solicitations through ROSES NRAs.

Requirement R-28. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements. In accordance with the SMD requirement for open data and related software, any specialized software and algorithms required for basic data

analysis and processing will be made available by the PI to the science community and public.

Requirement R-29. Proposals shall clearly present a plan for analysis of the mission data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.6.6.2 *Data Rights*

By NASA policy, all science data returned from NASA investigations led by a NASA-funded PI are made available immediately in the public domain. Following a postflight checkout period, all data will be made available to the user community. There shall be no period of exclusive access. The Principal Investigator will propose the data product latency period for standard products listed in the proposal, and a justification for it must be demonstrated. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement R-30. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.6.6.3 *Delivery of Data to Archive*

Mission data will be made fully available to the public by the investigator team in usable form, in the minimum time necessary and, in any case, within the proposed data latency period not to exceed six months following data receipt from the spacecraft. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to making it fully available. By the investigation closeout, the investigation will deliver to the appropriate astrophysics data center all final data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in flight), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large and provided within the proposed data latency period, not to exceed six months following data receipt from the spacecraft.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the appropriate NASA data archive.

Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Investigation Cost.

[The following requirement will apply to the Step 2 Concept Study Report, but does not apply to Step 1 proposals.]

Requirement R-31. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The science products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used. It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community.

4.6.6.4 Sharing of Data from Partner Mission of Opportunity Investigations

The data that are returned from Partner Mission of Opportunity (PMO) investigations, at least from those aspects of the mission in which NASA is involved, shall be made available to the U.S. scientific community in a timely manner.

Requirement R-32. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations must also provide: (1) a detailed description of the proposed provisions for sharing of science data, plans for returned scientific data, at least from those aspects of the mission in which NASA is involved, shall be made available to the U.S. scientific community in a timely manner, and the status of the host mission sponsoring agency's commitment to enter into an appropriate agreement with NASA for data sharing; and (2) a detailed explanation of how the U.S. astrophysics science community benefits from the proposed investigation.

4.7 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are referenced in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.5.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirements and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the Cost Cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the Cost Cap is specified in Section 4.5.1, and the schedule constraint is specified in Section 4.5.2.

- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. For this PEA, the NASA Center for program office and the safety, reliability, and quality assurance document applicable to selected investigations are specified in Section 2.3.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classification is specified in Section 4.6.4.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation by Aerospace in proposals. For this PEA, Section 4.1 states that there are no additional restrictions on participation by Aerospace in proposals.
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Mission Cost, the Total Mission Cost, and the Enhanced Mission Cost. For this PEA, that information is specified in Section 4.5.1. Only the PI-Managed Mission Cost is capped.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.5.1 and 4.5.2.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 4.5.3.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Sections 1.3 and 3 that a two-step competitive process is being used.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an Education and Public Outreach program that is consistent with SMD policy is required. This PEA does not require an Education and Public Outreach program; therefore, Requirements 69 and 70 of the SALMON-2 AO do not apply to this PEA. However, NASA may impose Education and Communications requirements during or subsequent to the Phase A concept study phase.
- Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA.
- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

4.8 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Requirement R-40 states that proposals or portions of proposals requesting NASA funding shall report proposal costs in FY 2017 dollars. This is for determining compliance with the

PI-Managed Mission Cost Cap requirement. This instruction supersedes the request for costs only in RY dollars described in Appendix B of the SALMON-2 AO including Table B3b.

- Section 4.1.1 concerning the NASA Center role in communications and outreach supersedes Section 4.1.3 of the SALMON-2 AO.
- Requirement R-6, Requirement R-7, and Requirement R-8 are additional requirements to those of Section 5.3.6 of the SALMON-2 AO concerning telecommunications, tracking, and navigation.
- Section 4.5.4 concerning full cost accounting for NASA facilities and personnel supersedes Section 5.5.5 of the SALMON-2 AO.
- Section 4.6.5 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO. Any proposal requirements for a detailed disposal plan will apply to the Step 2 Concept Study, but do not apply to Step 1 proposals.
- Section 4.6.6 provides data policies and requirements that supersede those in Section 4.4 of the SALMON-2 AO. Any proposal requirements for a schedule-based end-to-end data management plan will apply to the Step 2 Concept Study, but do not apply to Step 1 proposals.
- Requirement R-35 supersedes Requirement B-4 of the SALMON-2 AO and clarifies the information requested on page limits.
- The Heritage Appendix is limited in length. See Requirement R-35. This supersedes the table on Proposal Structure and Page Limits on page B-2 of the SALMON-2 AO.
- Section 5.2.5 of the SALMON-2 AO describes Science Enhancement Options (SEOs) for proposed investigations. Any proposal requirements for SEOs will apply to the Step 2 Concept Study, but do not apply to Step 1 proposals.

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement R-33. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export-controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, ITAR sensitive material should be organized into separate clearly marked sections.

Requirement R-34. All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO.

The following Requirement supersedes Requirement B-4 of the SALMON-2 AO and clarifies the information concerning page limits.

Requirement R-35. Proposals shall conform to the page limits specified in the *Proposal Structure and Page Limits* table, except that the Heritage Appendix is limited to 30 pages. Two extra pages each are allotted for each additional separate nonidentical science instrument in the Science Section (Sections D and E), two extra pages each are allotted for each additional separate, nonidentical flight element (e.g., additional spacecraft are allotted two extra pages, but only nonidentical spacecraft) in the Mission Implementation and Management Sections (Sections F and G), and two extra pages are allotted for all science enhancement options (SEOs) combined in the Science Implementation Section (Section E). The total number of such extra pages in the Science and Mission Implementation sections combined shall not exceed a maximum of ten extra pages regardless of the number of science instruments and unique flight elements. Every page upon which printing appears will count against the page limits and, unless specifically exempted (e.g., Requirement B-30 and Requirement B-53 of the SALMON-2 AO), each foldout page will count as two pages against the page limits as appropriate for its area (e.g., a fold-out with the total area of two standard pages counts as two pages, etc.).

The following Requirement supersedes Requirement B-15 of the SALMON-2 AO. It clarifies the information requested on the traceability of the proposed investigation, e.g., instrument performance requirements. A modified template is available in the Program Library to assist proposers on presentation of the investigation traceability.

Requirement R-36. Traceability from science goals to measurement requirements to instrument functional and performance requirements and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Instrument projected performance shall be compared to the instrument performance requirements.

The following Requirement supersedes Requirement B-23 of the SALMON-2 AO and clarifies the information requested on instrument resource margins.

Requirement R-37. Instrument Contingencies and Margins: This section shall summarize contingencies and margins of all instrument resources. It shall provide estimates of implementation design margins with respect to the required performance or allocations for mass, power, data storage, telemetry, and any other resource requirements. Discuss the allocation of contingency and margin to the instrument and/or suite (see SALMON-2 AO for definitions of contingency and margin).

The following Requirement supersedes Requirement B-24 of the SALMON-2 AO and clarifies the information requested on instrument performance margins.

Requirement R-38. Performance Margins: For each instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements as compared to projected performance estimates and shall justify that these performance margins are appropriate.

The following Requirement supersedes requirement B-27 of the SALMON-2 AO and clarifies the information requested on new technologies and/or advanced engineering development.

Requirement R-39. This section shall describe any proposed new technologies and/or advanced engineering developments and the approaches that will be taken to reduce associated risks. Descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed system (level 3 WBS payload developments and level 3 WBS spacecraft elements) incorporating new technology and/or advanced engineering development at the time the proposal is submitted (for *TRL definitions*, see NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, in the Program Library);
- Rationale for combining the TRL values of components and subsystems to derive each full system TRL as proposed, appropriately considering TRL states of integration (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*);
- Rationale for the stated TRL value of an element that is an adaptation of an existing element of known TRL;
- The approach for maturing each of the proposed systems to a minimum of TRL 6 by PDR:
 - Demonstration (testing) in a relevant environment can be accomplished at the system level or at lower level(s);
 - If applicable, justify what demonstration(s) in a relevant environment at lower level(s) (subsystem and/or subsystem-to-subsystem) would be sufficient to meet system level TRL 6, considering (i) where any new technology is to be inserted, (ii) the magnitude of engineering development to integrate elements, (iii) any inherent interdependencies between elements (e.g., critical alignments), and/or (iv) the complexity of interfaces – see the Program Library for examples;
 - Include discussion of simulations, prototyping, demonstration in a relevant environment, life testing, etc., as appropriate;
- An estimate of the resources (manpower, cost, and schedule) required to complete the technology and/or advanced engineering development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

If no new technologies or advanced engineering development is required, system TRL 6 or above at the time of proposal submission shall be clearly demonstrated.

Requirement R-40. Proposals or portions of proposals requesting NASA funding shall report proposal costs in FY 2017 dollars.

5.2 Proposal Submission Requirements

Requirement R-41. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES), at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement R-42. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

Requirement R-43. In addition to electronic submission, two identical, clearly labeled CD-ROMs that contain electronic proposal file(s) and Microsoft Excel files of tables (B1, B2, B3b and B5) and the Proposal Conflicted Party List (see Requirement R-44), shall be delivered to the following address by the proposal submittal deadline specified in Section 7.

NASA Research and Education Support Services (NRESS)
Suite 500
2345 Crystal Drive
Arlington, VA 22202

Telephone for commercial delivery: 202-479-9030

Requirement R-44. A table of Proposal Participants shall be provided. The table shall include all individuals and organizations named in the proposal or who have participated in the proposal preparation, including participation as a proposal writer, Red Team member, reviewer, etc. Additionally, the table shall include all institutions with interests in the mission, including major partners, contributors, or vendors. The primary purpose of the table is to aid NASA in avoiding conflicts of interest during the evaluation of the proposal. A secondary purpose is to provide material helpful for the evaluation and selection process. The Proposal Participants information shall be provided as a Microsoft Excel spreadsheet document on each CD-ROM submitted with the proposal. The Microsoft Excel spreadsheet template that has been posted to the Program Library with the name *Proposal Conflicted Party List* shall be used.

5.3 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this PEA, or in the documents available through the Program Library, should be sent to the E-mail address for questions listed in Section 7 of this PEA. Responses that are helpful and informative to proposers will be posted on the website listed in Section 7 of this PEA. Anonymity of the authors of all questions will be preserved.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

In addition to the evaluation criteria given in Section 7.2.3 of the SALMON-2 AO, the evaluation of the *Experiment Science Implementation Merit and Feasibility of the Investigation* also includes the following additions to Factors B-2 and B-3:

- Factor B-2, Probability of technical success, also includes the maturity and technical readiness of the instruments or demonstration of a clear path to achieve the necessary maturity.
- Factor B-3, Merit of the data analysis, data availability, and data archiving plan. This factor includes the merit of plans for data analysis and data archiving to meet the goals and objectives of the investigation.

In addition to the evaluation criteria given in Section 7.2.4 of the SALMON-2 AO, the evaluation of the *TMC Feasibility of the Investigation Implementation, including Cost Risk* also includes the following additions to Factors C-1 and C-3:

- Factor C-1, an assessment of plans for the development and use of new instrument technology, plans for advanced engineering developments, and the adequacy of backup plans to mature systems within the proposed cost and schedule when systems having a TRL less than 6 are proposed.
- Factor C-3, plans for the development and use of new technology, plans for advanced engineering developments, and the adequacy of backup plans to ensure success of the mission when systems having a TRL less than 6 are proposed.

6.2 Selection Process

After the review by the SMD AO Steering Committee, the evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the final selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency, including the Director of the Astrophysics Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among top-rated proposals, including, but not limited to, planning and policy

considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate(s).

6.3 Implementation Activities

Proposal selection and award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO with the following amendments.

6.3.1 Principal Investigator-led Team Masters Forum

One step toward successful execution of PI-led missions is to ensure that PI-led mission management teams receive the instruction necessary to enable them to better execute their missions for NASA. SMD, in conjunction with the NASA Academy of Program, Project, and Systems Engineering Leadership (APPEL), has established a 2.5 day PI-led Team Masters Forum for newly selected PI-led mission management teams. The purpose of the PI-led Team Masters Forum is to facilitate knowledge sharing in areas that are deemed necessary to successfully execute PI-led SMD science missions. Course attendance by the leaders of newly selected PI-led mission management teams (PI, Project Manager, Project Scientist, and Project Systems Engineer) and the NASA Headquarters Program Scientist and Program Executive (where assigned) is required as soon as practical after proposal selection.

6.3.2 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Explorers Program Office at the Goddard Space Flight Center. The responsibilities of the Program Office will include oversight of investigation implementation; coordination of Government-furnished services, equipment and facilities; and contract management for selected investigations.

It is anticipated that the Program Office will provide funding to each selected investigation. This award to perform a Phase A concept study is to be initiated as soon as possible after notification of selection. NASA Centers will receive funding via intraagency funding mechanisms. In order to place Phase A awards in place, Statements of Work (SOWs), certified cost and pricing data, and small business subcontracting plans will be required for the Phase A concept studies.

Proposals are not required to include SOWs, cost and pricing data for Phase A concept studies and subsequent phases, or small business subcontracting plans. These will be required only for investigations that are selected at the outcome of the Step-1 competition. If more than one contractual arrangement between NASA and the proposing team is required, a separate SOW will be required for each organization.

For those investigations that are selected, it will be in the best interest of their PI-led mission management teams to provide SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed.

SOWs will be required for selected investigations regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the requirement for a Phase A Concept Study Report as described in the *Guidelines and Criteria for the Phase A Concept Study* document available in the Program Library, as well as general task statements for Phases B through F. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). SOWs need not be more than a few pages in length.

Each Phase A contract will contain a priced option for a Bridge Phase, to be exercised upon investigations down-selected to proceed into Phase B. The Bridge Phase option will allow work to be continued uninterrupted under the contract after a Step-2 downselection decision is made. The Bridge Phase is intended to cover a four-month period of Phase B effort to provide program continuity while negotiations are completed to modify the contract to include Phases B, C/D, and E/F. The Bridge Phase Option will be exercised only on the contract for the investigation that is chosen during the Step-2 downselection process to continue beyond the Phase A concept study. The Bridge Phase option will allow the Government to continue work under the contract after a Step-2 downselection decision is made. Additional phases will be added to the contract after each phase has been approved through the program review process. The four-month Bridge Phase period will be used to begin the negotiation of the remaining phases of the contract with the successful PI downselected following Phase A.

6.3.3 Conduct of the Phase A Concept Study

The concept studies are intended to provide NASA with more definitive information regarding the cost, risk, and feasibility of the investigations, as well as a detailed plan for the conduct of any optional student collaboration, before final selection for implementation. The product of the concept studies is a Phase A Concept Study Report to be delivered by each selected investigation team nine months following the establishment of initial contracts. The content and format of the study reports are specified in the *Guidelines and Criteria for the Phase A Concept Study* document in the Program Library.

The PI will provide in the Phase A Concept Study Report a proposed set of Level 1 requirements, including the criteria for full investigation success satisfying the Baseline Science Investigation and the criteria for minimum investigation success satisfying the Threshold Science Investigation. The PI will also provide in the Phase A Concept Study Report the allocation of the proposed cost reserves among the appropriate WBS elements. The PI-Managed Mission Cost will not increase by more than 20% from that in the Step-1 proposal to that in the Phase A Concept Study Report, and, in any case, will not exceed the AO Cost Cap. The NASA review of the completed Concept Study Report will include all investigation facets. Risk reduction that has been accomplished during Phase A will be closely reviewed. NASA may request presentations and/or site visits to review the final concept study results with the investigators.

Each investigation's Concept Study Report must conclude with a commitment by the PI for the cost, schedule, and scientific performance of the investigation. For each Phase B selection, and unless otherwise stated in the selection letter, the selected investigation's cost will be set at the Concept Study Report's proposed cost.

NASA cannot guarantee that the proposed funding profile can be accommodated within the Astrophysics Explorers Program's budget. A funding profile for the selected investigation will be negotiated during Phase B.

6.3.4 Downselection of Investigations

The SMD Associate Administrator will make downselection decisions based on the evaluation of the Phase A Concept Study Reports and on programmatic considerations. The criteria for evaluating the concept study are as follows:

1. Scientific merit of the proposed investigation;
2. Science implementation merit and feasibility of the investigation;
3. Technical, management, and cost feasibility of the investigation implementation, including cost risk; and
4. Quality of plans for small business subcontracting plans and optional student collaboration, if proposed.

The evaluation criteria and downselection factors are described in the *Guidelines and Criteria for the Phase A Concept Study* document that will be available in the Program Library. Any substantial changes to science contained in the Phase A Concept Study Report will result in its reevaluation: if no substantial changes are found to have been made to science, the Step-1 evaluation of the first criterion will be maintained.

Proposers may be asked for specific information at the time of selection for a competitive Phase A. This requested information will need to be included in the Phase A Concept Study Report and will be considered at the time of downselection for flight.

At the conclusion of Phase A, it is anticipated that the Selecting Official will continue one or two investigations into the subsequent phases of mission development for flight and operation. The target date for this continuation decision (i.e., downselection) is given in Section 7.

An investigation may be downselected to enter Phase B or may be downselected for a funded Extended Phase A so they can retire one or more risks before they are allowed to proceed to Phase B. There is no guarantee that an investigation downselected for an Extended Phase A will be approved to enter Phase B, even if all risks have been retired during the Extended Phase A.

Upon a continuation decision, NASA will execute the Bridge Phase option and begin to provide additional funding for the project that is continued beyond the Phase A concept study. During the Bridge Phase, NASA and the continued project will negotiate and sign a contract modification necessary for the remaining portion of mission phases. Deliverables will be negotiated during the Bridge Phase, on the basis of information provided in the Concept Study Report.

In no case is NASA required to exercise any option. NASA will not exercise any contract option nor continue funding those investigations not selected to proceed. For those investigations that are not continued, the contracts will be allowed to terminate without further expense to NASA.

Every investigation team will be offered a debriefing of the evaluations of its Concept Study Report.

6.3.5 *International Agreements*

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, the Science Division of NASA's Office of International and Interagency Relations will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail an exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency MOU. For additional policies and requirements, see Section 5.9 of the SALMON-2 AO.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.5.1 of this PEA
Community Announcement	December 15, 2015
Release of Draft PEA Date	July 21, 2016
Comments Due on Draft PEA	August 11, 2016
Final PEA Release Date	September 15, 2016
Date for Preproposal Conference	October 6, 2016
[Amended October 21, 2016]	
Due Date for NOI (notice of intent to propose)	October 27, 2016
Due Date for NOI (notice of intent to propose)	October 13, 2016
Due Date for Proposals	December 15, 2016
Due Date for Receipt of CD-ROMs with Proposal and Tables	December 20, 2016, 5:00 p.m. Eastern Time
Selection Date for Competitive Phase A Studies	Summer 2017
Concept Study Reports Due	Spring 2018
Down-Selection Date	Early 2019
Web site for additional information for the Astrophysics Explorers MO PEA	http://explorers.larc.nasa.gov/APMIDEX2016/MO/index.html

Program Library for the Astrophysics Explorers PEA	http://explorers.larc.nasa.gov/APMIDEX2016/MO/programlibrary.html
Proposal Submission Medium	Electronic submission via NSPIRES, see Section 5.2 of this PEA; also two copies via CD-ROM, see Section 5.2 of this PEA.
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)
NASA point of contact	Dr. Wilton Sanders Astrophysics Explorers Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-1319 E-mail: wilton.t.sanders@nasa.gov

END OF PEA R