

## A.42 INSTRUMENT INCUBATOR

**NOTICE: Amended April 7, 2016. This Amendment releases the final text for this program element. Notices of Intent are requested by May 31, 2016, and proposals are due July 11, 2016. Proposers to this program element do not need to submit a data management plan.**

### 1. Scope of Program

#### 1.1 Introduction

NASA's Earth Science Division (ESD) in the 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. 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 surface-, balloon-, aircraft-, and/or space-based platforms; and uses the results to increase basic process knowledge.

Within ESD, the Earth Science Technology Office (ESTO) demonstrates and provides technologies that can be reliably and confidently applied to a broad range of science measurements and missions, as well as to practical applications that benefit society at large. As NASA's lead Earth Science technology organization, ESTO is focused on the technological challenges inherent in space-based investigations of our planet's dynamic, interrelated systems and technological advances that enable improved understanding of and/or new insights into the highly complex Earth system.

The Instrument Incubator Program (IIP) funds innovative technologies that lead directly to new Earth observing instruments, sensors, and systems in support of SMD's ESD. 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.

#### 1.2 Goals of the Instrument Incubator Program

The goals 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.

Rapid advances in Earth science instrument technology are enabling significantly smaller instruments that may be able to meet many science needs in the future when using modularized subsystem architecture ("plug and play"), and/or architectures that allow increased flexibility and adaptability to multiple measurement objectives. Also, rapid evolution of spacecraft bus technology toward smaller satellites, when combined with increased launch opportunities on a

more diverse set of platforms and launch vehicles, opens the possibility for many new approaches to Earth science mission implementation.

As discussed in more detail in Section 2 below, this program element requests proposals for technology development activities aimed specifically at: (1) development and demonstration of new innovative Earth Science remote sensing instruments; and (2) demonstration of new instrument concepts and/or measurements.

## 2. Proposal Research Topics

This IIP solicits new instrument and measurement technologies addressing any of the science focus areas in NASA's Earth Science program (see Appendix A.1 for descriptions of the focus areas) to enable new types of observations that improve: (i) temporal and spatial resolution, and/or (ii) cost-effectiveness of Earth science measurements. Technologies may target any Earth science question or issue in order to advance the strategic goals, questions, and research objectives outlined in Appendix 1 of the *2014 Science Plan for NASA's Science Mission Directorate* (hereafter the *2014 Science Plan*; available at <http://science.nasa.gov/about-us/science-strategy/>). In addition, recent ESTO community workshops were held that focused 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 <https://esto.nasa.gov/files/2016CommunityWorkshops.pdf>.

This program element actively seeks instruments that enable new remote sensing measurements and/or provide improvement to traditional instrumentation and measurement techniques that: (i) enable increased flexibility and adaptability to measurement objectives; and/or (ii) provide cost-effective instruments enabling innovative measurement techniques, including those that could employ multiple sensors in formation or use alternative platforms. These alternative platforms could be small satellites or co-manifested opportunities, including hosted payloads and ride-share programs appropriate for observations of the Earth system. This program element also seeks instruments that demonstrate innovative ways to combine both passive and active measurement capabilities to generate multiple science measurements.

Proposals are sought that advance the goals and objectives of IIP through technology developments in two distinct subelement topic areas:

- 1) Instrument development and demonstration and
- 2) Instrument concept demonstration (a new program subelement seeking shorter duration, lower cost, earlier stage measurement or instrument demonstrations designed as proof of principle for a future remote sensing measurements)

### 2.1 Instrument Development and Demonstration (IIP-IDD)

This subelement covers the entire instrument development process that includes instrument design, breadboard, prototype, and engineering model construction, laboratory, and/or airborne demonstrations for innovative measurement techniques that have the highest potential to meet the objectives of the IIP and substantially improve the state-of-the-art Earth science measurements.

The proposed IIP-IDD activity is expected to have an entry Technology Readiness Level (TRL) between 3 and 4 with an exit TRL between 4 and 6.

## 2.2 Instrument/Measurement Concept Demonstration (IIP-ICD)

This subelement seeks demonstration of innovative concepts that have high potential to meet the objectives of the IIP and substantially improve the state-of-the-art Earth science measurements.

The IIP-ICD is intended to advance development and maturity level of these concepts, which are typically at the early stage of formulation, through detailed analytical studies, model simulation, and/or breadboarding of critical functions or instrument subsystems. Also, proposals can include innovative ways in which the instrument can be controlled or the output processed to improve the quality of the measurement, extend the life of the instrument or to create new uses of the measurements.

The proposed IIP-ICD activity is expected to have an entry TRL between 1 and 2 with an exit TRL between 3 and 4.

## 3. 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-2016 Summary of Solicitation](#) or [Guidebook for Proposers](#). See Section I(h) of the ROSES-2016 Summary of Solicitation regarding the order of precedence.

### 3.1 Proposal Content and Submission

#### 3.1.1 *Notice of Intent to Propose*

A Notice of Intent (NOI) to propose is encouraged, but not required, for the 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. Submit NOIs electronically via NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) by the due date given in Section 3. Since NOIs submitted after the deadline may still be useful to NASA, late NOIs, as well as indications of intent NOT to propose on an earlier NOI submission, may be submitted by E-mail to the point of contact for this program element (see Section 3).

#### 3.1.2 *Questions and Answers*

Prospective proposers are requested to submit any questions in writing to [p.ghuman@nasa.gov](mailto: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.

#### 4. Proposal Content

##### 4.1 Proposal Summary (abstract)

The NSPIRES web page requires proposers 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).

##### 4.2 Scientific/Technical/Management Section (Project Description)

This section 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 is limited to 15 nonreduced, single-spaced typewritten pages. Standard proposal style formats shall be in accordance with Section 2.2 of the *Guidebook for Proposers*. Proposals that exceed the 15-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 that utilize the proposed technology. 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 commercial benefits.
3. Comparative Technology Assessment – Describe the anticipated advantages of this technology 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.
4. TRL Assessment – Proposers must 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. If proposed activity duration is for multiple years, advancement of one TRL per year is desirable.

TRL definitions can be found at <http://esto.nasa.gov/files/TRL.doc>. Identify the entry TRL, the planned exit TRL, and success criteria in their proposal and substantiate the entry TRL in the proposal.

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 science, technology development, and instrument development skills on the team. The key personnel list is included in the overall page count and must include, at a minimum, the Principal Investigator (PI). Optionally, one-page resumes for Key Personnel may be supplied; these resumes are not included in the 15-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 relevant to the proposal.
9. Quad Chart – Provide a summary chart (quad chart) that contains 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 "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 15-page limit for the Project Description Section.

## 5. Award Information

### 5.1 Funding

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).

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.

#### *5.1.1 Instrument Development and Demonstration Funding*

The total funding available for the Instrument Development and Demonstration subelement of the program element will limit the number and magnitude of the proposals awarded. It is anticipated that a total of 14-18 proposals will be selected and the value of each will be approximately \$1.5M per year.

#### *5.1.2 Instrument/Measurement Concept Demonstration Funding*

The total funding available for the Instrument/Measurement Concept Demonstration subelement of the program element will limit the number and magnitude of the proposals awarded. It is anticipated that a total of 3-5 proposals will be selected and the value of each will be approximately \$500K per year.

### 5.2 Period of Performance

#### *5.2.1 Instrument Development and Demonstration 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.

#### *5.2.2 Instrument/Measurement Concept Demonstration Period of Performance*

The expected period of performance is 12-18 months. Proposal must define clear, measurable milestones to be achieved for the first 12 months of performance in order to warrant continuation of an additional six months.

### 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 Appendix D of 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. Evaluation Criteria

The three basic evaluation criteria are given in the *ROSES Summary of Solicitation* Section VI (a) and Section C.2 of the *NASA Guidebook for Proposers* and they are Relevance, Merit, and Cost. Clarifications and additions specific and to this program element are listed below.

The first criterion, relevance, is the applicability of the proposed investigation to Earth Science Focus Area(s) and other Earth Science measurements and technology needs and specifically includes:

- The degree to which the proposed investigation specifically supports the objective of at least one of the Earth Science Focus Areas (see Appendix A.1 for a description of Earth Science Focus Areas);
- The potential for the sensor or instrument 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 sensor or instrument technology to be integrated, once matured, into future Earth Science NASA missions; and
- The potential for the sensor or instrument technology development to have commercial benefits.

The second evaluation criterion "intrinsic merit" specifically includes:

- Feasibility and merit of the proposed technical approach to achieve the technology development objectives;
- Degree of innovation of the proposed technology development concept and approach;
- Past performance and related experience in the proposed area of technology development;
- Qualifications of key personnel and adequacy of facilities, staff, and equipment to support the proposed activity 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 TRL; and
- Feasibility of obtaining the potential reduction in risk, cost, size, and development time, or making the newly enabled measurement with the proposed sensor or instrument; 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 realism and reasonableness, includes:

- Adequacy and realism of proposed milestones and associated success criteria;
- Realism and reasonableness of the proposed cost and comparison of costs to available funds;
- Adherence to sound and consistent management practices appropriate to the TRL 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 any previous investment by the organization/program and provide supporting documentation.

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.

## 7. Technical Reporting Requirements

Once awarded, submit all status information, presentation material, and report deliverables applicable to this IIP program element to the web-based ESTO Reporting System (ERS). A user account on the ESTO 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.

### 7.1 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 ESTO 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 "Entry TRL."

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 ESTO ERS under the "Quad Chart" section and "TRL" section respectively.

### 7.2 Bimonthly Technical Reports

The bimonthly technical report shall focus on the preceding two months' efforts. Address the following in each report:

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 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.

Upload the Bimonthly Technical Reports to the appropriate location in the ESTO 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.

### 7.3 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 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;
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 and uploaded to the appropriate location in the ESTO 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 ESTO ERS within ten days after the review.

#### 7.4 Annual Reviews

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 to location.
2. An independent technical reviewer from an organization separately funded by ESTO participates 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 cover the progress over the previous twelve months.

Upload the review package to the appropriate location in the ESTO 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 ESTO ERS within ten days after the review.

#### 7.5 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 and a description and estimate of the duration of the follow-on activities necessary to advance the TRL to next level;
6. Updated Quad Chart; and

7. At the end of the period of performance, the PI shall create a final Accomplishments Chart which contains the following information (a template is available in the e-Book):
- Upper Left: "Objective"
  - Upper Right: A visual, graphic, or other pertinent information.
  - Middle: "Accomplishments."
  - Bottom: "Co-Is" (name and affiliation), "Entry TRL" and "Exit TRL."

The Final Report and updated Final Review presentation shall be uploaded to the appropriate locations in the ESTO ERS within thirty days of the final review. Also, update the Accomplishment Chart and TRL assessment on the ESTO ERS under the “Quad Chart” section and "TRL" section respectively.

7.6 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 the 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.

8. Summary of Key Information

Expected program budget for first year of new awards	IIP-IDD: Up to \$22M IIP-ICD: Up to \$4M
Number of new awards pending adequate proposals of merit	IIP-IDD: ~ 14-18 IIP-ICD: ~ 3-5
Maximum duration of awards	IIP-IDD: Minimum 1-year / Maximum 3-year awards IIP-ICD: Minimum 1-year/ Maximum 18- month awards
Due Date for Notice of Intent to Propose (NOI)	See Tables 2 and 3 in the <i>ROSES Summary of Solicitation</i> .
Due date for delivery of proposals	See Tables 2 and 3 in the <i>ROSES Summary of Solicitation</i> .
Page length for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the <i>NASA Guidebook for Proposers</i> . See Section 4.2 of this appendix.
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. See Section 4.2 of this program element.
General information and overview of this solicitation	See the <i>ROSES Summary of Solicitation</i> .
Detailed instructions for the preparation and submission of proposals	See the <i>NASA Guidebook for Proposers</i> at <a href="http://www.hq.nasa.gov/office/procurement/nraguidebook/">http://www.hq.nasa.gov/office/procurement/nraguidebook/</a> .

Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the <i>ROSES Summary of Solicitation</i> and Chapter 3 of the <i>NASA Guideline for Proposers</i> .
Web site for submission of proposal 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)
Funding opportunity number for downloading an application package from Grants.gov	NNH16ZDA001N-IIP
NASA point of contact concerning this program	Parminder Ghuman Science Mission Directorate Earth Science Technology Office Telephone: (301) 286-8001 E-mail: <a href="mailto:p.ghuman@nasa.gov">p.ghuman@nasa.gov</a>