C.12 PLANETARY INSTRUMENT CONCEPTS FOR THE ADVANCEMENT OF SOLAR SYSTEM OBSERVATIONS

NOTICE: Amended on April 15, 2016: "Ocean Worlds" are especially of interest for this program element and will be considered for separate funding from the Outer Planets and Ocean Worlds Program, see Section 1.

This Program Element continues to use a two-step proposal submission process described in Section 2 of Appendix C.1. Planetary protection requirements are imposed on instruments intended to operate in an environment where Earth life could proliferate. See Section 2.1 for more details. Proposals shall include an entry Summary Chart placed at the end of the proposal. See Section 2.1 for more details. Progress reports are due semiannually. See Section 2.4 for more detail. No data management plan is requested for this Program Element.

1. Scope of Program

The Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) Program supports the development of spacecraft-based instrument systems that show promise for use in future planetary missions. The goal of the program is to conduct planetary and astrobiology science instrument feasibility studies, concept formation, proof of concept instruments, and advanced component technology development to the point where they may be proposed in response to C.13. Maturation of Instruments for Solar System Exploration (MatISSE) Program Therefore, the proposed instrument system or advanced components must address specific scientific objectives of likely future planetary science missions.

The PICASSO Program seeks proposals for development activities leading to instrument systems in support of the Science Mission Directorate's (SMD's) Planetary Science Division (PSD). The objective of the program is to develop new technologies that significantly improve instrument measurement capabilities for planetary science missions (such as Discovery, New Frontiers, Mars Exploration, and other planetary programs). It is the responsibility of the proposer to demonstrate how their proposed technology addresses significant scientific questions relevant to stated NASA goals and not for NASA to attempt to infer this.

While proposals relevant to all of the Planetary Science Division's strategic goals and objectives will be considered for this program element, instruments focused on the detection of extant life in the "Ocean Worlds" of the outer Solar System (e.g., Enceladus, Europa, and Titan) are especially of interest and will be considered for separate funding from the Outer Planets and Ocean Worlds Program. [added 04/15/2016]

The PICASSO Program is intended to enable timely and efficient technology infusion into the MatISSE Program and eventually into flight missions. As such, the entry technology readiness level (TRL) that PICASSO supports is 1-3**.** Proposals where the entry TRL is 4 or higher are not appropriate for the PICASSO, but should be submitted to Program Element C.13. MatISSE. It is the responsibility of the proposer to justify the entry and exit level TRL of the proposed

technology. This program will permit appropriate funding to be applied at this early stage to develop and demonstrate key and enabling new technologies for planetary science missions, such as instrument feasibility studies, concept formulation, proof of concept, laboratory demonstrations, and advanced component technology development.

A full description of Technology Readiness Levels (TRLs) 1- 9 appears in Appendix E of NASA Procedural Requirement 7123.1B and is available on the web at http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7123_001B_&page_name=AppendixE.

Prospective proposers are encouraged to review the most recent Decadal Survey ("*Visions and Voyages for Planetary Science in the Decade 2013-2022*" http://solarsystem.nasa.gov/2013decadal/) and goals of the Planetary Science Division as described in the 2014 Science Mission Directorate Science Plan available at http://science.nasa.gov/about-us/science-strategy/. Proposed investigations may target any Solar System body except the Earth and Sun, in order to advance the objectives outlined in the Science Plan.

Proposals not appropriate for PICASSO are brassboarding and testing of complete instruments in a relevant environment. These proposals should be submitted to C.13. MatISSE Program. In addition, PICASSO does not support proposals that seek to develop ground-based laboratory instruments, astronomical or astrophysics space observations, auxiliary instrumentation; such as spectrometers for ground based telescopes, mission operation and system software, platform technologies; such as materials and structures, Small Satellites or any spacecraft technology that does not directly address planetary science instrumentation.

The nature of specific efforts selected for funding will vary, with emphasis given to innovative technologies that improved instrument measurements capabilities. It is anticipated that the science payloads on most future planetary science spacecraft will be limited to small, low-mass, and low power consumption instruments.

2. Programmatic Considerations

2.1 Special Requirements for Proposals

Proposals are solicited under this Program Element for instrument development only for the mission focus areas described in the Decadal Survey or the Science Plan. All proposals submitted to this Program Element must specify:

- The mission focus area for which the proposed instrument or component technology is applicable. Instruments that are applicable to more than one mission focus area will be given priority.
- The science objectives of the proposed instrument or component technology. The relationship between the science objectives and the instrumental capabilities must be clearly demonstrated. For those instruments applicable to more than one mission focus area or capable of meeting

multiple science objectives, examples of science objectives for the proposed mission or missions must be given.

- A detailed description and justification for the entry technology readiness level (TRL) and a detailed plan for raising the instrument system to the proposed exit technology readiness level. The plan must include a description of milestones, as well as discussions, of how the proposed research will advance the technology readiness level of the instrument by a minimum of one TRL.
- How the proposed instrument system or component technology would address planetary protection requirements, as described in the NASA Procedural Requirements document, NPR 8020.12, Version D. Restrictions on operation and hardware cleanliness apply to all instrument systems that are intended to operate in environments where Earth life could proliferate – currently that is considered to be Mars, Europa, Enceladus, and anywhere in the solar system where warm ice or liquid water is possible and includes instrument systems or component technology associated with detection of signs of life or biosignatures. To address this requirement, the proposal shall, at a level appropriate to the exit TRL:

  - Establish whether the instrument will require planetary protection protocols.
  - If the instrument requires planetary protection protocols, describe which specific components could pose a challenge.
  - Describe possible mitigation strategies to meet planetary protection requirements.

  The instrument developer is encouraged to communicate informally with the Office of Planetary Protection regarding planetary protection categorization and associated requirements with a future mission interest, as they relate to instrument design and development. For additional information, proposers may contact the NASA Planetary Protection Officer, Dr. Catharine A. Conley (Telephone: 202-358-3912; E-mail: cassie.conley@nasa.gov) and cc james.r.gaier@nasa.gov.
- An entry level Summary Chart, not counted in the page limit, shall be submitted as an appendix on the last page of the Step-2 Proposal. A template will be sent to each Step-1 proposer. The Summary Chart shall contain the following information:

  - Title, PI Name, and Institution
  - Target (Mars subsurface, airless body surface, planetary body flyby or orbit, etc.)
  - Bulleted list of science that will be enabled by new instrument
  - Bulleted list of major objectives of proposed work
  - Co-Investigators (Co-Is)/Institutions
  - A figure illustrating and clarifying the proposed concept
  - Top level Milestones
  - Entry and exit technology readiness levels (TRLs)

2.2 Additional Evaluation Considerations

In addition to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*, the following will also be considered when evaluating the relevance, merit, and cost reasonableness, and when formulating PICASSO selection recommendations.

- The extent to which the proposed instrument system or subsystem is applicable to multiple Planetary Science missions;
- The extent to which the instrument system or subsystem addresses a priority science goal of the mission or missions for which it would be a candidate for flight;
- The necessity of embarking on a long lead-time development of a very important instrument contemplated for flight on a mission that is of high priority;
- The evaluation of cost will include the extent to which proposers leverage technology investments including, but not limited to, NASA programs such as the Planetary Instrument Definition and Development Program (PIDDP), Astrobiology Science and Technology for Instrument Development (ASTID), NASA Small Business Innovation Research (SBIR), and Game Changing Technologies.

2.3 Award Duration and Types

The typical award duration is three years. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. While, in most cases, awards will be in the form of grants, when appropriate fixed price contracts will be issued.

2.4 Technical Reporting Requirements

Once awarded, all Progress Reporting deliverables applicable to this PICASSO solicitation shall be submitted to the web-based Planetary Science (PS) Award Administration e-Book. A user account on the PS e-Book will be provided to the Principal Investigator (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 e-Book will be established. To create an IdMAX account, some personal information will be required. All submissions shall be made in PDF (preferred), Microsoft Word, Microsoft Excel, or Microsoft PowerPoint.

The following deliverables shall be required of institutions that win awards. In cases where subcontract arrangements exist, consolidated project reports are the responsibility of the PI. The proposed budget should provide for these reporting requirements. In this context, "annual" refers to a twelve-month task effort that commences at award.

2.4.1 *Semiannual Progress Report Deliverable*

The PI shall provide a written Semiannual Progress Report at the end of the first six-month calendar period commencing from the date of award and at six-month intervals thereafter. Grant recipients will have additional progress reporting requirements from the NSSC.

The Semiannual Report must:

1. Describe the primary findings, technology development results, and technical status, e.g., status of design, construction of prototype implementations, results of tests and/or proof-of-concept demonstrations, etc.;
2. Describe the work planned for the remainder of the project and critical issues that need to be resolved to successfully complete the remaining planned work;

3. Summarize the cost and schedule status of the project, including any schedule slippage/acceleration;
4. Provide a summary of accomplishments and anticipated results at the end of the task;
5. Include an updated Summary Chart noting milestone changes, if any, and updates to the TRL;
6. Report any educational and outreach components of the project, e.g., graduate degrees, educational activities; technology infusion or patents applied for or granted; journal or conference publications; presentations at professional conferences, seminars, and symposia; demonstrations; media exposure; and, other activities that contributed to the overall success of the research project.

The release of the PI's annual budget allocation is contingent on the timely submission of the written Semiannual Progress Report deliverable.

2.4.2 *Final Report*

The PI shall provide a written Final Report at the completion of the activity. The Final Report is similar to the Semiannual Report and includes all of the products required in the Semiannual Report, with the following exceptions:

- The Final Review must provide conclusions of the work performed and make recommendations for follow-on activities that should be pursued;
- As this is the Final Report, there is no need to present future work plans or a cost profile.

The written Final Report shall include the following:

1. Background of the project, including the science rationale for conducting this technology development;
2. Results of all analyses, element, subsystem, or system designs and/or prototyping implementations and designs;
3. Performance analysis results of tests and/or demonstrations; estimation of reduction(s) in size, mass, power, volume, and/or cost; improved performance; description of newly enabled capability; and documentation of technology dependencies;
4. Tables, graphs, diagrams, curves, sketches, photographs, and drawings in sufficient detail to comprehensively explain the results achieved;
5. An updated TRL assessment;
6. At the end of the period of performance, the PI shall provide a final Accomplishments Chart which contains the following information:

    - Upper Left: "Description and Objectives."
    - Middle: "Accomplishments."
    - Upper Right: A visual, graphic, or other pertinent information.
    - Bottom: "Co-Is" (name and affiliation), "Entry TRL," and "Exit TRL".

The written Final Report, Accomplishments Chart, and updated TRL assessment shall be

E-mailed to the NASA Program Officer on or before the designated anniversary date. An Accomplishment Quad Chart template can be obtained from the NASA Program Officer for this program.

2.5 Planetary Science Division Early Career Fellowship Program

Proposals to this Program Element may include an application for an Early Career Fellowships (ECF). See Program Element C.16 for a description of the application and evaluation process.

2.6 NASA Postdoctoral Program Fellows

Grantees in the program are eligible to serve as mentors to NASA Postdoctoral Program (NPP) Fellows. The tenure of a Fellow must begin before the end of the award, but may extend beyond it. Proposals from potential Fellows must be submitted through the standard NPP process. The PICASSO Program expects to select no more than two Fellows associated with Planetary Science or Astrobiology Instrument Development each year. More information about the NASA Postdoctoral Program may be found at http://npp.usra.edu/.

3. Resources: Information, Data, and Facilities

Proposers to this program are not required to provide a data management plan. However, dissemination of the findings of the effort via conference presentations and journal articles is expected, and the plan for dissemination should be briefly described.

3.1 Facilities Available to Proposers

Proposers are advised to read Section 4 of Appendix C.1. The Planetary Science Division Research Program Overview, for information on facilities that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

4. Proposal Submission Process

This Program Element uses a two-step proposal submission process described in Appendix C.1. §2.

Proposers are reminded that Step-1 proposals are mandatory and must be submitted by the proposing organization.

Proposals must follow all formatting requirements that are described Appendix C.1 and in Chapter 2 of the *NASA Guidebook for Proposers*. Note that these requirements have been updated in 2016. Violation of these rules is sufficient grounds for a proposal to be rejected.

An entry level Quad Chart, not counted in the page limit, shall be submitted as an appendix at the end of the Step-2 Proposal document. See Section 2.1 for more details regarding the Quad Chart.

5. Summary of Key Information

Expected program budget for first year of new awards	~$3.5M
Number of new awards pending adequate proposals of merit	~12 awards
Maximum duration of awards	3 Years
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after the Step-2 proposal due date
Page limit for the central Science/Technical/Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step-1 and Step-2 proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and Step-2 proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH16ZDA001N-PICASSO

Main NASA point of contact concerning this program:	James R. Gaier NASA Program Officer Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington DC 20526-0001 Telephone: 260-579-3442 E-mail: james.r.gaier@nasa.gov
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