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**RESEARCH OPPORTUNITIES IN SPACE SCIENCE - 2002
(ROSS-2002)**

NASA Research Announcement
Soliciting Basic Research Proposals

NRA 02-OSS-01
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Proposals Due
Starting March 21, 2002,
through February 14, 2003

Office of Space Science
National Aeronautics and Space Administration
Washington, DC 20546-0001

**RESEARCH OPPORTUNITIES IN SPACE SCIENCE - 2002
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RESEARCH OPPORTUNITIES IN SPACE SCIENCE - 2002 (ROSS-2002)

SUMMARY OF SOLICITATION

1. INTRODUCTION AND GENERAL POLICIES

The stated mission of the Space Science Enterprise of the National Aeronautics and Space Administration (NASA) is to solve the mysteries of the universe, to explore the solar system, to discover planets around other stars, and to search for life beyond Earth. To carry out this mission, NASA's Office of Space Science (OSS) sponsors a broad range of research programs relevant to its four Science Themes, defined as:

- *Astronomical Search for Origins and Planetary Systems (ASO)* that addresses the origins of galaxies, stars, proto-planetary and extra-solar planetary systems, Earth-like planets, and the origin of life;
- *Solar System Exploration* (abbreviated as ESS) that seeks to understand all aspects of our Solar System, including the planets, satellites, small bodies, and solar system materials, and the search for possible habitats of life beyond Earth;
- *Structure and Evolution of the Universe (SEU)* that involves the study of cosmology, the large scale structure of the universe, the evolution of stars and galaxies, including the Milky Way and objects with extreme physical conditions, and an examination of the ultimate limits of gravity and energy in the Universe; and
- *The Sun-Earth Connection (SEC)* that concerns the Sun as a typical star and as the controlling agent of the space environment of the Solar System, especially the Earth.

From a humanistic point of view, these four themes seek to answer four fundamental questions:

“How did the Universe begin and evolve?”

“Where did we come from?”

“Where are we going?” and

“Are we alone?”

Further information about these themes, as well as access to the most recent Strategic Plans (as of late 2001) for both NASA and OSS, may be found through the OSS homepage on the World Wide Web at <http://spacescience.nasa.gov> .

OSS pursues these science themes using a wide variety of both space flight programs and investigations in basic science and technology. This current NASA Research Announcement (NRA) ROSS-2002 solicits proposals for Supporting Research and Technology (SR&T) investigations that seek to understand naturally occurring space phenomena and space science-related technologies. Proposals in response to this NRA should be submitted to the most relevant science Program Elements given in Appendix A (see also the Table of Contents that prefaces this Summary of Solicitation). Table 1 at

the end of this Summary lists these Program Elements in the order of their deadlines for the submission of proposals, while Table 2 lists them in the order in which they are organized in Appendix A. Tables 1 and 2 also cross reference these Program Elements to the four OSS Science Themes noted above. Appendix A contains detailed descriptions of each Program Element, and questions about each may be directed to their respective Discipline Scientist(s) identified in the “Programmatic Information” section that concludes each one.

The ROSS NRA’s issued in 2000 (NRA 00-OSS-01) and 2001 (NRA 01-OSS-01) organized the Program Elements into nine “clusters” based on their scientific objectives and/or research techniques. However, in mid-2001, the Office of Space Science was reorganized into three scientific Divisions,

- Astronomy and Physics Division,
- Solar System Exploration Division, and
- The Sun-Earth Connection Division.

Therefore, starting with this ROSS-2002 NRA, the Program Elements are now organized into four main Sections in Appendix A, of which the first three are managed respectively by these three new OSS science Divisions, while the fourth one contains Interdisciplinary Program Elements. Each of these four main sections of Appendix A is prefaced with an “Overview” subsection that provides a broad introduction to its program content and objectives that all interested applicants to this NRA are urged to read before preparing their proposals.

Recommendations for funding for the proposals submitted to this NRA will be based on the peer evaluation of each proposal’s intrinsic merit, its relevance to NASA’s objectives, and its cost. For the purposes of this NRA:

- (i) by intrinsic merit is meant the proposal’s science and technical merits, the capabilities of the proposing institution, the qualifications of the proposing personnel, and the overall standing of the proposal among similar proposals and/or evaluation against the state-of-the-art;
- (ii) by relevance to NASA’s objectives is meant the proposal’s relevance to the objectives of the OSS science Program Element in this NRA to which the proposal is submitted as well as to the achievement of the OSS and NASA goals as given respectively in their most recent Strategic Plans; and
- (iii) by cost is meant the reasonableness and realism of the proposal’s requested budget in addition to its size with respect to the available funds.

Finally, it should be noted that, regardless of the merits of the submitted proposals, the Government’s obligation to make awards is contingent upon the availability of appropriated funds through the Federal budget process from which payment can be made and the receipt of proposals in response to this NRA that NASA determines are acceptable for award.

Participation in this program is open to all categories of U.S. and non-U.S. organizations, including educational institutions, industry, nonprofit institutions, NASA Centers, and other Government agencies. Historically Black Colleges and Universities (HBCU’s), other minority educational institutions, and small businesses and organizations owned

and controlled by socially and economically disadvantaged individuals or women are particularly encouraged to apply. Participation by non-U.S. organizations in this program is encouraged subject to NASA's policy of no-exchange-of-funds (see further information in the *NASA Guidebook for Proposers* discussed below).

Finally, all prospective proposers are advised that safety is a top priority in all NASA's programs. Safety is the freedom from those conditions that can cause death, injury occupational illness, damage to or loss of equipment or property, or damage to the environment. NASA's safety priority is to protect: (1) the public, (2) astronauts and pilots, (3) the NASA workforce (including employees working under NASA instruments), and (4) high-value equipment and property. All proposals submitted in response to this solicitation are expected to comply with this policy.

2. INSTRUCTIONS FOR PREPARATION AND SUBMISSION OF PROPOSALS

Starting with last year's ROSS-2001 NRA, the policies and procedures for the preparation and submission of proposals, as well as those for NASA's review and selection of proposals for funding, are now presented in a separate document entitled *Guidebook for Proposers Responding to NASA Research Announcements* (abbreviated as *NASA Guidebook for Proposers*) that is accessible by opening the single Web site portal for the submission of proposals to any of the NASA program offices at the World Wide Web URL <http://research.hq.nasa.gov>, and linking through the menu item "Helpful References," or may be directly accessed at URL

<http://www.hq.nasa.gov/office/procurement/nraguidebook/> .

By reference, this *NASA Guidebook for Proposers, Edition: 2001 (May 4, 2001)* is hereby incorporated into this ROSS-2002 NRA, and proposers to this NRA are responsible for understanding and complying with its procedures before preparing and submitting their proposals. Proposals that do not conform to its standards may be declared noncompliant and returned without review. The required proposal *Budget Summary* form is now both available from and must be submitted through the same Web site as that for the *Cover Page/Proposal Summary* (see Summary Information below; note: this online submission of the *Budget Summary* is a new procedure that starts with this OSS solicitation). After the requested data are entered, both of these forms are printed for submission with the required hard copies of the proposal.

The other chapters and appendices of this *NASA Guidebook for Proposers* provide supplemental information about the entire NRA process, including NASA policies for the solicitation of proposals, guidelines for writing complete and effective proposals, the NASA policies and procedures for the review and selection of proposals, as well as for issuing and managing the awards to the institutions that submitted selected proposals, and Frequently Asked Questions (FAQ's) about a variety of the NASA proposal and award processes and procedures. Note that the NASA policy for proposals involving non-U.S. participants is given in Section (l) of Appendix B of this *NASA Guidebook*. Comments and suggestions of any nature about this *Guidebook* are encouraged and welcomed and may be directed at any time to Dr. David Bohlin, Code SS, Office of Space Science, NASA Headquarters, Washington, DC 20546-0001; telephone: 202-358-0880; E-mail: david.bohlin@hq.nasa.gov (if submitted by E-mail, use "Proposer's Guidebook" as the Subject of the message).

The World Wide Web site for submitting both a Notice of Intent (NOI) to propose (which is encouraged but not required) and a proposal's *Cover Page/Proposal Summary* and *Budget Summary* is given in Section 5, Summary Information, below (also Chapters 2 and 3 of the *Guidebook for Proposers* contain detailed information about these two items). Although a point of contact for assistance in accessing and/or using this Web site is given in the Summary Information below, interested applicants to this NRA are urged to access this site well in advance of the various due dates for materials to familiarize themselves with its structure.

3. OSS EDUCATION AND PUBLIC OUTREACH PROGRAM

The Office of Space Science is committed to fostering the broad involvement of the space science community in Education and Public Outreach (E/PO) with the goal of enhancing the Nation's formal education system and contributing to the broad public understanding of science, mathematics, and technology. Progress towards achieving this goal has become an important part of the broad justification for the public support of space science.

As a consequence of the plans and policies that have been established and implemented over the past several years, a significant national E/PO space science program is now underway as described by the OSS E/PO *Newsletters* and the *Annual Reports* that may be accessed by opening the "Education" link on the OSS homepage at <http://spacescience.nasa.gov>. This site also provides access to the two key documents that establish the basic policies and guidance for all OSS E/PO activities: A strategic plan entitled *Partners in Education: A Strategy for Integrating Education and Public Outreach Into NASA's Space Science Programs* (March 1995), and an implementation plan entitled *Implementing the Office of Space Science Education/Public Outreach Strategy* (October 1996). Both of these documents may also be obtained in hard copy from Dr. Jeffrey D. Rosendhal, Office of Space Science, Code S, NASA Headquarters, Washington DC 20546; E-mail: jeffrey.rosendhal@hq.nasa.gov.

In response to the many constructive comments received from members of the space science community on how to improve, simplify, and streamline OSS's efforts to involve scientists in E/PO activities, substantial changes in procedures for incorporating E/PO into research grants were made starting in 2001 that are continued into 2002. These changes are intended to decrease the overall workload on the space science community, increase the likelihood that more E/PO proposals of merit will be funded, and more effectively encourage successful science proposers to add an E/PO component to their "parent" research effort. In addition, OSS has worked to open up new avenues for E/PO participation for space scientists and to develop a variety of approaches that allows such contributions to be recognized and acknowledged (details may be accessed through the "Education" Web site indicated above).

A summary of the key elements of the current OSS E/PO program that apply to this NRA are as follows:

- E/PO proposals are solicited only from those proposers whose research proposals have been selected for a research award under this NRA;
- The cost cap on E/PO proposals by individual investigators is now \$15K/year;
- Selected Principal Investigators have two windows of opportunity to submit an E/PO proposal, either: (i) no later than 45 days after the date of their letter of selection for a new research award (with the anticipation of starting the E/PO activity within the first half of the first year of the parent research award); or (ii) no later than 75 days in advance of the yearly anniversary date of their award (with the anticipation of starting the E/PO activity in conjunction with the next year's funding supplement for the award);
- Anyone holding an existing multiple year research award funded through any previous OSS NRA may propose an E/PO supplement to be funded through their "parent" research award or to participate in E/PO in some other appropriate fashion (see the indicated Education Web site);
- The "Institutional Proposal" option has been reintroduced that allows several OSS-funded researchers located at the same institution to collectively carry out a more ambitious, expansive E/PO program (a cost cap of \$50K/year but no more than \$125K over the nominal three-year lifetimes of the parent awards); and
- Consistent with past E/PO policies and to ease the burden of NASA's administration of such small supplemental awards, the total period of performance for any E/PO award is restricted to not exceed that of its parent research award.

For further details and specific guidance and information on preparing and submitting a proposal for E/PO funding under this or any previous OSS NRA, reference the Web site at <http://spacescience.nasa.gov/education/scientists/guidelines/index.html>. Questions and/or comments and suggestions about the OSS E/PO program are sincerely welcomed and may be directed to either Dr. Philip Sakimoto (telephone: 202-358-0949; E-mail: phil.sakimoto@hq.nasa.gov) or Ms. Rosalyn Pertzborn (telephone: 202-358-1953; E-mail: rpertzbo@hq.nasa.gov).

4. ITEMS OF SPECIAL IMPORTANCE

(i) Because this ROSS-2002 NRA is released far in advance of most of the deadlines given in Tables 1 or 2, additional programmatic information for any Program Element may develop before its proposals are due. If so, such information will be added as Amendments to this NRA as posted at its Web site no later than 30 days before the proposal deadline. Although NASA OSS will also send an electronic notification of any such amendments to all subscribers of its electronic notification system (see item (iii) below), it is the responsibility of prospective proposers to check this NRA's Web site for updates concerning the Program Element(s) of interest.

(ii) OSS now requires the electronic submission of certain key elements of proposals through the World Wide Web (see below in Section 5, Summary Information). While every effort is made to ensure the reliability and accessibility of this Web site, and to maintain a Help Desk via E-mail, difficulty may arise at any point on the Internet including the user's own equipment. Therefore, prospective proposers are urged to familiarize themselves with this site and to submit the required proposal materials well in advance of the deadline(s) of the Program Element(s) of interest.

(iii) OSS maintains an electronic notification system to alert interested subscribers of the impending release of its research program announcements. Subscription to this service is accomplished through the menu item "To subscribe to the OSS electronic notification system" found on the menu of the OSS research page at http://research.hq.nasa.gov/code_s/code_s.cfm. Owing to the increasingly multidisciplinary nature of OSS programs, this electronic service will notify subscribers of all NASA OSS program announcements regardless of the type and science objectives (about 10 to 15 per year). Regardless of whether or not this service is subscribed to, all OSS research announcements may be accessed from the menu listing *Current (Open) Solicitations* at the Web site given above as soon as they are posted (typically by 8:30 a.m. Eastern Time on their date of release).

(iv) For more information about the types of research supported by the program elements in previous editions in this series of ROSS NRA's, abstracts for currently funded investigations are available through the menu listing *Past/Archive Solicitations & Selections* at http://research.hq.nasa.gov/code_s/code_s.cfm.

5. SUMMARY INFORMATION APPLICABLE TO THIS NRA

<ul style="list-style-type: none"> • Program Alpha-Numeric Identifier 	NRA 02-OSS-01
<ul style="list-style-type: none"> • Date of NRA Release 	January 28, 2002
<ul style="list-style-type: none"> • Access to text 	Link through the menu listings <i>Research Solicitations</i> → <i>Current (Open) Solicitations</i> starting from the OSS home page at http://spacescience.nasa.gov .
<ul style="list-style-type: none"> • Guidance for preparation and submission of proposals (including default page limits) 	“ <i>NASA Guidebook for Proposers Responding to a NASA Research Announcement (NRA)</i> ” at URL http://www.hq.nasa.gov/office/procurement/nraguidebook/
<ul style="list-style-type: none"> • <i>Notice of Intent (NOI) to Propose</i> (encouraged but not required): <ul style="list-style-type: none"> - Desired due date - Web site for electronic submission - Late submission (up to 15 days prior to Proposal Deadline) 	<ul style="list-style-type: none"> - See Tables 1 or 2 below for Program Element of interest - Open appropriate menu listing at http://research.hq.nasa.gov (available for submissions for ~30 days starting ~90 days prior to Proposal Deadline (Help Desk E-mail: r-help@nasaprs.com) - Submit information specified in Section 3.1 of <i>NASAS Guidebook for Proposers</i> by E-mail to deb.tripp@hq.nasa.gov
<ul style="list-style-type: none"> • <i>Cover Page/Proposal Summary and Budget Summary</i>: <ul style="list-style-type: none"> - Deadline - Web site for electronic submission 	<ul style="list-style-type: none"> - Same as for proposals (see Tables 1 or 2 for Program Element of interest); print completed items from Web site http://research.hq.nasa.gov - Same as above (open for submissions starting ~ 45 days prior to Proposal Deadline (Help Desk: E-mail: r-help@nasaprs.com)

<ul style="list-style-type: none"> • Proposal page limits 	<p>Default values given in Section 2.3 of <i>NASA Guidebook for Proposers</i> (unless otherwise specified in Program Element in Appendix A).</p>
<ul style="list-style-type: none"> • Submission of proposal (including printed <i>Cover Page/Proposal Summary and Budget Summary</i>): <ul style="list-style-type: none"> - Required Number - Deadline - Address for submission by U.S. Postal Service, commercial delivery, or private courier 	<ul style="list-style-type: none"> - Signed original proposal plus 15 copies (unless otherwise specified in Program Element in Appendix A). - 4:30 p.m. ET on date in Tables 1 or 2 for Program Element of application. <p><u>Name of Program Element</u> ROSS-2002 NRA Office of Space Science NASA Peer Review Services 500 E Street, SW, Suite 200 Washington, DC 20024 Telephone: 202-479-9030</p>
<ul style="list-style-type: none"> • Selecting Official 	<p>Cognizant Division Director for Program Element of application (unless otherwise noted), NASA Office of Space Science</p>
<ul style="list-style-type: none"> • Announcement of selections 	<p>Goal: 150 days after Proposal Deadline</p>
<ul style="list-style-type: none"> • Initiation of funding for new awards 	<p>Goal: 46 days after proposal selections <u>or</u> passage of NASA Fiscal Year 2003 budget, which ever occurs <u>last</u>.</p>
<ul style="list-style-type: none"> • Further information: <ul style="list-style-type: none"> - For a <u>specific</u> Program Element - For <u>general</u> NRA policies and procedures 	<ul style="list-style-type: none"> - See cognizant Discipline Scientist(s) identified at end of each Program Element in Appendix A. - Dr. J. David Bohlin Code SS Office of Space Science NASA Headquarters Washington, DC 20546-0001 E-mail: david.bohlin@hq.nasa.gov

Your interest and cooperation in responding to this ROSS-2002 NRA are welcome. Comments about the inclusive nature and/or structure of this NRA for the OSS supporting research and analysis programs are also sincerely solicited and may be

directed to either the Discipline Scientists identified for the Program Elements in Appendix A or to the point of contact for “general NRA policies and procedures” identified in the table of Summary Information above.

Dr. Colleen N. Hartman
Director
Solar System Exploration Division

Dr. Anne L. Kinney
Director
Astronomy and Physics Division

Dr. George L. Withbroe
Director
The Sun-Earth Connection Division

TABLE 1

**SCIENCE PROGRAM ELEMENTS SOLICITED IN THE ROSS-2002 NRA
(in order of the proposal due dates)**

NRA Appendix	Science Program Element (see Appendix A)	NOI Due Date [M/D/Y]	Proposal Due Date [M/D/Y]	Relevant OSS Science Themes [1]			
				ASO	SEU	ESS	SEC
A.2.14	Mars Fundamental Research	2/25/02	3/21/02			X	
A.4.2	In-Space Propulsion Technologies	3/04/02	4/03/02	X	X	X	X
A.1.6	High Energy Astrophysics [2]	2/22/02	4/05/02		X		
A.3.8	Living With a Star Geospace Instrument Development	3/01/02	4/12/02			X	X
A.3.6	Sun-Earth Connection Instrument Development	3/01/02	4/12/02			X	X
A.2.15	Mars Instrument Development	2/28/02	5/01/02			X	
A.2.3	Planetary Geology and Geophysics [3]	3/08/02	5/03/02			X	
A.1.5	Space Astrophysics Research and Analysis	3/13/02	5/10/02	X	X		
A.3.5	Sun-Earth Connection Guest Investigator	3/15/02	5/17/02				X
A.2.2	Cosmochemistry [3]	3/29/02	5/24/02	X		X	
A.2.9	Planetary Atmospheres [3]	4/05/02	6/07/02			X	
A.2.6	Sample Return Laboratory Instruments & Data Analysis	4/08/02	6/07/02	X		X	
A.2.4	Origins of Solar Systems	3/15/02	6/14/02	X		X	
A.2.8	Near Earth Object Observations	4/26/02	6/28/02	X		X	
A.2.7	Planetary Astronomy [3]	4/26/02	6/28/02	X		X	
A.1.2	Astrophysics Data Analysis	5/15/02	7/10/02	X	X		

A.1.3	Long-Term Space Astrophysics	5/15/02	7/10/02	X	X		
A.3.3	Geospace Sciences	5/24/02	7/26/02			X	X
A.2.11	Planetary Instrument Definition and Development	6/07/02	8/07/02			X	
A.2.10	Exobiology [3]	6/07/02	8/09/02	X		X	
A.2.5	Mars Data Analysis	6/14/02	8/16/02			X	
A.1.4	Astrophysics Theory	6/27/02	8/30/02	X	X		
A.3.7	Living With a Star Targeted Research & Technology	7/19/02	9/20/02				X
A.2.13	Astrobiology Science and Technology Instrument Development	9/06/02	11/06/02	X		X	
A.3.2	Solar and Heliospheric Physics	12/13/02	2/14/03				X
A.2.12	Planetary Major Equipment [3]	See ESS Program Element of interest. [3]		X		X	
A.3.4	Sun-Earth Connection Theory		Not solicited in this NRA				X

Notes:

- [1] ASO: Astronomical Search for Origins; SEU: Structure and Evolution of the Universe; ESS: Solar System Exploration; SEC: The Sun-Earth Connection.
[2] The *High Energy Astrophysics* Program Element now combines those separately identified in the ROSS-2001 NRA as *X-ray and Gamma-ray Astrophysics* and as *Cosmic Ray Astrophysics*.
[3] The proposals for *Planetary Major Equipment* Program Element A.2.12 may be submitted in conjunction with Program Elements A.2.2: *Cosmochemistry*; A.2.3: *Planetary Geology and Geophysics*; A.2.7: *Planetary Astronomy*; A.2.9: *Planetary Atmospheres*; and A.2.10 *Exobiology*.

TABLE 2

**SCIENCE PROGRAM ELEMENTS SOLICITED IN THE ROSS-2002 NRA
(in order of listing in Appendix A)**

NRA Appendix	Science Program Element (see Appendix A)	NOI Due Date [M/D/Y]	Proposal Due Date [M/D/Y]	Relevant OSS Science Themes [1]			
				ASO	SEU	ESS	SEC
A.1.2	Astrophysics Data Analysis	5/15/02	7/10/02	X	X		
A.1.3	Long-Term Space Astrophysics	5/15/02	7/10/02	X	X		
A.1.4	Astrophysics Theory	6/27/02	8/30/02	X	X		
A.1.5	Space Astrophysics Research and Analysis	3/13/02	5/10/02	X	X		
A.1.6	High Energy Astrophysics [2]	2/22/02	4/05/02		X		
A.2.2	Cosmochemistry [3]	3/29/02	5/24/02	X		X	
A.2.3	Planetary Geology and Geophysics [3]	3/08/02	5/03/02			X	
A.2.4	Origins of Solar Systems	3/15/02	6/14/02	X		X	
A.2.5	Mars Data Analysis	6/14/02	8/16/02			X	
A.2.6	Sample Return Laboratory Instruments & Data Analysis	4/08/02	6/07/02	X		X	
A.2.7	Planetary Astronomy [3]	4/26/02	6/28/02	X		X	
A.2.8	Near Earth Object Observations	4/26/02	6/28/02	X		X	
A.2.9	Planetary Atmospheres [3]	4/05/02	6/07/02			X	
A.2.10	Exobiology [3]	6/07/02	8/09/02	X		X	
A.2.11	Planetary Instrument Definition and Development	6/07/02	8/07/02			X	
A.2.12	Planetary Major Equipment [3]	See ESS Program Element of interest. [3]		X		X	

A.2.13	Astrobiology Science and Technology Instrument Development	9/06/02	11/06/02	X		X	
A.2.14	Mars Fundamental Research	2/25/02	3/21/02			X	
A.2.15	Mars Instrument Development	2/28/02	5/01/02			X	
A.3.2	Solar and Heliospheric Physics	12/13/02	2/14/03				X
A.3.3	Geospace Sciences	5/24/02	7/26/02			X	X
A.3.4	Sun-Earth Connection Theory	Not	solicited in	this	NRA.		X
A.3.5	Sun-Earth Connection Guest Investigator	3/15/02	5/17/02				X
A.3.6	Sun-Earth Connection Instrument Development	3/01/02	4/12/02			X	X
A.3.7	Living With a Star Targeted Research & Technology	7/19/02	9/20/02				X
A.3.8	Living With a Star Geospace Instrument Development	3/01/02	4/12/02			X	X
A.4.2	In-Space Propulsion Technologies	3/04/02	4/03/02	X	X	X	X

Notes:

[1] ASO: Astronomical Search for Origins; SEU: Structure and Evolution of the Universe; ESS: Solar System Exploration; SEC: The Sun-Earth Connection.

[2] The *High Energy Astrophysics* Program Element now combines those separately identified in the ROSS-2001 NRA as *X-ray and Gamma-ray Astrophysics* and as *Cosmic Ray Astrophysics*.

[3] The proposals for *Planetary Major Equipment* Program Element A.2.12 may be submitted in conjunction with Program Elements A.2.2: *Cosmochemistry*; A.2.3: *Planetary Geology and Geophysics*; A.2.7: *Planetary Astronomy*; A.2.9: *Planetary Atmospheres*; and A.2.10 *Exobiology*.

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