



**National Aeronautics
and Space Administration**

**September 14, 2000
NRA 00-OSS-06**

NASA Research Announcement

Gossamer Spacecraft Exploratory Research and Technology

**Notice of Intent Due:
Proposals Due:**

**September 28, 2000
NOVEMBER 1, 2000**

OMB Approval No. 2700-0087

Gossamer Spacecraft Exploratory Research and Technology

NASA Research Announcement
Soliciting Basic Research Proposals

NRA 00-OSS-06
Issued: September 14, 2000
Notice of Intent Due: September 28, 2000
Proposals Due: November 1, 2000

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

GOSSAMER SPACECRAFT EXPLORATORY RESEARCH AND TECHNOLOGY

Introduction

NASA's Office of Space Science (OSS) issues this NASA Research Announcement (NRA) for Gossamer Spacecraft Exploratory Research and Technology. The Gossamer Spacecraft Initiative will focus on developing revolutionary spacecraft architectures for very large, ultra-lightweight apertures and structures. This NRA solicits proposals for exploratory research to begin long-range development of gossamer spacecraft technology. The overarching goal of the Gossamer Spacecraft Initiative is to achieve breakthrough enhancements in mission capability and reductions in mission cost, primarily through revolutionary advances in structures, materials, optics, and adaptive and multifunctional systems. Gossamer spacecraft technology will enable bold new missions of discovery for Space Science and ultimately for all of NASA such as:

- Very large aperture telescopes for imaging extra-solar planets, studying the formation of large-scale structure in the early universe, and continuously monitoring Solar System bodies from distant vantage points;
- Large deployable and inflatable antennas for space-based radio astronomy, high-bandwidth communications from deep space, and remote sensing with radar and radiometers;
- Solar sails for low-cost propulsion, station-keeping in unstable orbits, and precursor interstellar exploration missions; and
- Large solar power collection and transmission systems for future exploration missions, and for the commercial development of space.

Appendix A contains a detailed description of technical areas for which proposals are solicited. Appendix B provides the standard NASA guidance for responding to NASA Research Announcements. Appendix C provides amendatory guidance to Appendix B for the specific proposal format and submission requirements for this NRA. Note that Appendix C incorporates many formats and/or procedures that are now standard for OSS NRA's. Therefore, interested proposers are advised to read Appendix C in its entirety before writing their proposals.

The entirety of this NRA may be found and downloaded in a variety of standard formats by opening "Research Opportunities" from the menu at the OSS homepage on the World Wide Web at URL: <http://space.science.nasa.gov/>. It is the offeror's responsibility to monitor the forementioned Internet site for the release of the NRA and amendments (as may be posted). Potential offerors will be responsible for downloading their own copy of the final NRA and amendments (if any).

Participation in this program is open to all categories of U.S. and non-U.S. organizations or teams of organizations, including educational institutions, industry, nonprofit institutions, Federally Funded Research and Development Centers (FFRDC), NASA Centers, and other Government agencies. Foreign proposers should be aware that their proposed participation would be on a no-exchange of funds basis in accordance with Section (l) of NASA Federal Acquisition Regulations Supplement (NFS) 1872.306 (Appendix B of this NRA). 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.

Special attention is directed to the instructions in Appendix C for electronic submissions to a World Wide Web site of both a Notice of Intent (NOI) to propose and a combined Cover Page/Proposal Summary. Since transmission difficulties may arise anywhere through the Internet, starting at the proposer's institution, at any of its intermediate nodes, and/or at NASA's receiving sites, proposers are encouraged to submit these items well in advance of their respective due dates to allow for resolution of any difficulties (note: an "edit" function is provided at the Web site to allow changes after the original submissions but before their respective due dates).

OSS policy now strongly encourages participation by the space science and technology communities in education and public outreach activities with the goal of contributing to the broad public understanding of science and technology. Therefore, proposers to this NRA are encouraged to propose an Education/Public Outreach (E/PO) activity as an addition to any proposal submitted in response to this NRA; see the last section in Appendix A for details. Please note that because of limited funding and the short duration of Phase 1 activities (see below), E/PO activities will only be solicited in conjunction with Phase 2.

NRA Budget

The following budget information is tentative, and is provided for planning purposes only. Any award will be subject to the availability of funds and appropriate evaluations.

All activities under this NRA will consist of two phases. Phase 1 activities will begin exploratory research on a broad range of innovative gossamer spacecraft concepts. The duration of Phase 1 activities is six months. The approximate total funding to be awarded in fiscal year 2001 is \$4M, for an anticipated 20-25 Phase 1 awards. Typical funding awards for Phase 1 proposals is expected to range from \$100K to \$200K.

In Phase 2, the most promising concepts resulting from Phase 1 will be selected for further development. The duration of Phase 2 activities may range up to two years.

\$4M is expected to be available for Phase 2 activities in each of fiscal years 2002 and 2003. Typical funding awards for Phase 2 proposals is expected to range from \$300K to \$500K per year.

Funds for awards under this NRA are subject to the overall Federal Government and NASA funding process. Funding of any task beyond the first year will be dependent upon progress and the availability of funds. The Government's obligation to make awards is contingent upon the availability of appropriated funds from which payment for award purposes can be made and the receipt of proposals that the Government determines are acceptable for award under this NRA.

Recommendations for funding will be based on the evaluation of each proposal's scientific and/or technical merits, its relevance to the objectives as described in this NRA, and its requested budget. A proposed E/PO activity of merit will be used to discriminate between proposals of otherwise nominally equal scientific, technological, and programmatic merits (see Section A.5 of Appendix A).

The following summary information applies to this NRA:

- NRA identifier: NRA 00-OSS-06
- Date of issue: September 14, 2000
- Notice of Intent (NOI) to propose:
 - Due date: September 28, 2000
 - Address for electronic submission: URL: <http://props.oss.hq.nasa.gov>
Contact dtripp@hq.nasa.gov for assistance.
- Address for electronic submission of proposal *Cover Page/Proposal Summary*:
 - URL: <http://props.oss.hq.nasa.gov>
 - Contact dtripp@hq.nasa.gov for assistance.
- Submission of Proposal:
 - Required number: 15 copies plus signed original.
 - Due date by close of business: November 1, 2000 (45 days after date of issue)

- Address for delivery by U.S. Postal Service, personal courier, or commercial service:

Gossamer Spacecraft NRA
NASA Peer Review Services
500 E Street SW, Suite 200
Washington DC 20024
Telephone: (202) 479-9030

- Selecting Official: Director
Flight Programs Division
- Announcement of selections: Goal - 150 days after proposal due date.
- Initiation of funding for new awards: Goal - 46 days after proposal selection.
- Programmatic Point of Contact:
Dr. Melvin D. Montemerlo
Gossamer Initiative Program Executive
Flight Programs Division
Code SD
Office of Space Science
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: (202) 358-4664
E-mail: mmonteme@mail.hq.nasa.gov

Notice of electronic notification service for NASA OSS research announcements: NASA OSS has implemented an electronic notification system for all of its research program announcements. Subscription to this service may be immediately made by selecting the menu item “Get E-mail Announcements” on the OSS homepage at URL <http://spacescience.nasa.gov/>, and then following the instructions within the subsection entitled “Space Science Research Announcements.” This electronic service will notify subscribers of all future NASA OSS program announcements regardless of the topic or type of announcement (about 20 per year).

Your interest and cooperation in responding to this NRA are appreciated.

Kenneth W. Ledbetter
Director
Flight Programs Division

APPENDICES

A: Program Description

B: Instructions for Responding to NASA Research Announcements

C: Specific Guidance for Proposal Preparation and submission

PROGRAM DESCRIPTION

This NRA solicits proposals for exploratory research to begin long-range development of Gossamer spacecraft technology. Gossamer spacecraft technology will enable very large ultra-lightweight systems for bold new missions of discovery for Space Science and ultimately for all of NASA, such as:

- Very large aperture telescopes for imaging extra-solar planets, studying the formation of large-scale structure in the early universe, and continuously monitoring Solar System bodies from distant vantage points;
- Large deployable and inflatable antennas for space-based radio astronomy, high-bandwidth communications from deep space, and remote sensing with radar and radiometers;
- Solar sails for low-cost propulsion, station-keeping in unstable orbits, and precursor interstellar exploration missions; and
- Large solar power collection and transmission systems for future exploration missions and for the commercial development of space.

The overarching goal of Gossamer spacecraft technology development is to achieve breakthroughs in mission capability and cost, primarily through revolutionary advances in structures, materials, optics, and adaptive and multifunctional systems. This first Gossamer NRA will emphasize the following high-priority areas for gossamer spacecraft technology development:

- Large Apertures
- Solar Sails
- Multifunctional and Adaptive Systems
- Gossamer Spacecraft Systems

A.1 LARGE APERTURES

NASA is studying future missions requiring very large space observatories. The long-range goal of the Astronomical Search for Origins and Planetary Systems (ASO) theme in the Space Science Enterprise is to detect and characterize planets in orbit around nearby stars. This grand challenge is a driver of Gossamer technology development for large aperture telescopes.

Independent of any specific instrument concept, the basic detection physics sets minimum requirements for the optical apertures. Set against the benchmark of the largest ground-based telescopes and the 8-meter Next Generation Space Telescope (NGST), terrestrial planet spectroscopic characterization requires a 10-fold increase in aperture area, and

low-resolution direct imaging requires an additional 25-fold increase in area. Such large collection area requirements most likely preclude the implementation of missions with only single telescopes. Rather, such missions are currently envisioned to utilize constellations of large aperture telescopes flying in formation and operating as interferometers.

The basic building block for these systems is likely to be diffraction limited optical collectors of 20-40 meter diameter each. One of the critical metrics for such systems is the areal density of the fully loaded primary mirror (defined as including the optical surface, reaction structure, actuators, and wiring). An areal density of 100 kg/m² is typical for conventional ground-based telescopes, and NGST is striving to achieve between 10 and 15 kg/m². For future ASO missions, areal densities of 1 kg/m² or less are required to enable affordable system architectures. Ultimately, to achieve higher resolution imagery and spectroscopy, even more aggressive architectures with collecting areas equivalent to much larger (100's to 1000's of meters) aperture diameters and much lower areal densities (< 0.1 kg/m²) will be required.

Large aperture technologies also have direct applicability to the needs of other NASA missions. For example, the Structure and Evolution of the Universe (SEU) theme needs large apertures for advanced X-ray telescopes, and for radio frequency, microwave, and submillimeter antennas. Space-based radio telescopes and planet observing antennas for soil moisture and ocean salinity measurements will need great improvements in antenna technology in the near term. These new antennas will be characterized by sizes exceeding 25 meters in diameter, a fraction of a kilogram per square meter areal density, and operating frequencies between 1-100 GHz. Other applications that could benefit from large aperture technology include high-resolution imagers and radar, deep-space communications, and large-scale solar power generation.

Given this background, proposals are requested for exploratory research to define advanced concepts for very large gossamer apertures (> 20 meters), to identify key technologies, and to begin development of these technologies in a program culminating in proof-of-concept hardware demonstrations (\geq 1 meter diameter). In particular, two types of proposals are solicited for Large Apertures: (A) Concept Studies, and (B) Proof-of-Concept Demonstrations, as follows.

A. Concept Studies

Proposed activities may include development and demonstration of concepts for telescopes, antennas, or other large apertures. Areas of specific interest are:

- Concepts to enable very large, ultra-lightweight (areal density $\leq 1 \text{ kg/m}^2$) optical systems for astronomical telescopes and planetary imagers that can observe in the submillimeter/Far Infra-Red, Infra-Red, visible, Ultra-Violet, and X-ray spectral regions;
- Concepts to enable large deployable and/or inflatable antennas for use in space-based radio astronomy, microwave radiometry, radar, and communications.

Desirable performance characteristics for these systems and for near term proof-of-concept technology and hardware development are:

- (1) High packaging efficiency for small launch volume;
- (2) Rapid, low-cost manufacturing;
- (3) Design traceable to space-durable materials;
- (4) Robust system response to re-pointing of aperture; and
- (5) High surface reflectivity after repeated deployment.

Phase 1 proposals for Concept Studies are limited to a duration of six months. All Phase 1 proposals will commence with feasibility studies. No hardware development should be proposed for Phase 1 activities. In Phase 1, the proposers are expected to identify key technologies and submit plans for their development in Phase 2. Phase 2 will include technology development outlined in Phase 1, and is expected to culminate in proof-of-concept hardware demonstrations (≥ 1 meter diameter).

B. Proof-of-Concept Demonstrations

Proposals in this area will begin immediately with development of proof-of-concept hardware. Although the visionary program goal is an areal density of $\leq 1 \text{ kg/m}^2$, proposals for proof-of-concept hardware development with an areal density $> 1 \text{ kg/m}^2$ will be considered if they offer a significant potential advantage in performance and rapid, low-cost manufacturing, and if the hardware represents an intermediate step traceable to designs meeting the $\leq 1 \text{ kg/m}^2$ goal. Proof-of-concept hardware development for diffraction-limited optical performance at visible and IR wavelengths should strive for an immediate areal density goal of $< 5 \text{ kg/m}^2$.

All Phase 1 proposals for Proof-of-Concept Demonstrations are limited to a duration of six months. Hardware development begins in Phase 1, and is completed in Phase 2.

A.2 SOLAR SAILS

Solar sails are being considered for several missions planned in the Sun-Earth Connection (SEC) theme, including a Solar Polar Imager, and a first generation Interstellar Probe to be launched within a decade to explore the outer reaches of the solar system. Several missions of the Solar System Exploration (SSE) theme would also be greatly enhanced by the use of solar sails, such as missions to comets and the outer planets. This technology could also enable other large membrane structures such as sunshields needed to stabilize and protect large gossamer apertures and other cryogenic telescopes, and sail occulters for blocking starlight in the detection of extra-solar planets

Two types of proposals are solicited for Solar Sails: (A) Concept Studies and Near-Term Technology Development, and (B) Long-Term Technology Development.

A. Concept Studies and Near-Term Technology Development

The main objective is to rapidly advance the readiness of key technologies so that a solar sail (exhibiting $<10 \text{ g/m}^2$) space flight experiment can be conducted within the next few years. In Phase 1, proposers should conduct either feasibility studies of advanced concepts or execute a short program to test or improve existing sail materials, structures, packaging, or deployment techniques. Phase 2 proposals may include the following options: key technology development for concepts that prove feasible in Phase 1, further comprehensive testing or improvement of the best materials or structures down selected after Phase 1, or proof-of-concept development. Proposals are sought in the following areas:

- Innovative designs for solar sails, with emphasis on packageability, areal density, structural stability, deployability, controllability, and scalability to large sails (> 100 m). Includes concepts for 3-axis stabilized sails, spin-stabilized sails, and heliogyros, and sails without support booms;
- Innovative concepts for using sails not only as a propulsion system, but also to perform other spacecraft functions such as communications, science gathering, and power generation;
- Advanced methods for sail control, including adaptive control algorithms, models of sail dynamics, sail warping, and variable reflectivity materials;
- Testing of candidate materials to assess their applicability for sail missions, including measurement of critical properties such as strength, modulus, areal density; and reflectivity, emissivity, electrical conductivity, thermal tolerance, toughness, and radiation sensitivity.

All Phase 1 proposals for Sail Concept Studies and Near-Term Sail Technology Development are limited to a duration of six months.

B. Long-Term Technology Development

Proposals should outline a well structured three year program to develop and demonstrate technology for advanced sail missions (exhibiting $<1 \text{ g/m}^2$). The development of fundamental concepts should begin in Phase 1 of the proposed program. Phase 2 should further develop the technology to the point where it can be integrated into a proof-of-concept solar sail system. Proposals are sought in the following areas:

- Innovative concepts for sail stowage and deployment, including low-volume packaging, launch restraints, deployment methods, and control of deployment dynamics;
- Advanced structural concepts for lightweight deployable and inflatable solar sail support structures with high buckling strength (50-100 meters long);
- Ultra-lightweight ($< 1 \text{ g/m}^2$), high-strength, reflective sail materials with inherent tear resistance. Materials should have operational lifetimes greater than 10 years and should be resistant to ultraviolet radiation, particle radiation, and extreme temperatures;
- Advanced sail materials concepts such as microporous membranes, microtruss fabrics, biomimetic materials, and materials that sublime when exposed to space; and
- Low-cost techniques for fabrication, coating, seaming, and handling of large-area membranes. The research would involve fabricating large membranes to validate proposed manufacturing and assembly processes and to verify scalability of mechanical, thermal, and optical properties.

All Phase 1 proposals for Long-Term Sail Technology Development are limited to a duration of six months.

A.3 MULTIFUNCTIONAL AND ADAPTIVE SYSTEMS

It is expected that both large apertures and solar sails will rely heavily on multifunctional and adaptive systems. To achieve breakthroughs in lowering the cost, launch volume, and mass of future missions it will be necessary to develop highly integrated multifunctional membranes with embedded thin-film electronics, sensors, actuators, and power sources. Adaptive systems are needed for measuring and correcting surface figure and wavefront errors for large aperture telescopes and antennas and for controlling structural geometry and dynamics. Proposals are sought for development of multifunctional and adaptive systems applicable to large, ultra-lightweight deployable or inflatable structures.

Technologies of specific interest are:

- Integration of membranes, electronics, sensors, actuators, MEMS devices, power sources, and their associated interconnects into a unified and adaptable structure. Includes advanced materials, processes, and modeling;
- Lightweight, distributed power systems, and active or passive thermal control systems integrated with membrane structures, including models for optimizing power storage and thermal management designs;
- Materials with controllable surface properties that, when combined with integral control electronics, could adapt to changing environmental conditions or mission needs (e.g., changing optical properties to steer a solar sail);
- Processes for thinning and bonding electronic substrates for attachment to membranes; and
- Concepts and components for active, adaptive wavefront control systems, including shape control of membrane mirrors, to within 1 wavelength in the IR and visible.

All Phase 1 proposals for Multifunctional and Adaptive Systems are limited to a duration of six months. Proposals should outline a well conceived technology development program. Technology development begins in Phase 1, and culminates in a proof-of-concept demonstration at the end of Phase 2.

A.4 GOSSAMER SPACECRAFT SYSTEMS

Proposals are sought for development of revolutionary Gossamer spacecraft system concepts and evaluation of their potential performance in support of Space Science, missions. These novel concepts should provide either an order of magnitude improvement over existing concepts, or enable missions that were previously considered impossible, while keeping cost and risk within reasonable limits. Spacecraft system concepts can use Gossamer elements such as deployable or inflatable structures, multifunctional membranes, tethers, or completely new Gossamer technologies. System concepts may involve astronauts for assembly, deployment, checkout, and servicing. An example concept is a gossamer spacecraft capable of modifying its shape or other functional characteristics so that it can adapt to different mission phases or environments.

All Phase 1 proposals for Gossamer Spacecraft Systems are limited to a duration of six months. In Phase 1, proposals should define the system concept, describe its potential benefits for enhancing mission capability and reducing cost, identify enabling technologies, and provide supporting analysis to substantiate system engineering tradeoffs. In Phase 2, proposers should conduct a well planned technology development in the key areas of their concepts.

A.5. EDUCATION/PUBLIC OUTREACH (E/PO) PROGRAM

A.5.1 Scope of Program

The Office of Space Science (OSS) has developed a comprehensive approach for making education at all levels (with a particular emphasis on K-14 education) and the enhancement of public understanding of space science integral parts of all of its research missions and programs. To this end, OSS invites and encourages all proposers who are selected for Phase 1 of this program to include an Education and Public Outreach (E/PO) component in their research proposals for Phase 2. The two key documents that establish the basic policies and guidance for all OSS E/PO activities are 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 (OSS) Education/Public Outreach Strategy* (October 1996). Both of these documents may be obtained by selecting *Education and Public Outreach* from the OSS homepage at <http://spacescience.nasa.gov>, or from Dr. Jeffrey Rosendhal, Office of Space Science, Code S, NASA Headquarters, Washington, DC 20546-0001.

The following policies and guidelines apply to the E/PO activities solicited through this NRA:

- The proposed E/PO activity is expected to have general intellectual linkage to the science and technology objectives of its “parent” proposal and/or the science expertise of its PI;
- An E/PO activity may be funded only as an add-on to an award for a “parent” research proposal; therefore, the period of performance of the E/PO activity is restricted to that of its parent award;
- Up to 5% per year of the total research budget for Phase 2 may be proposed for an E/PO program (Note: a Budget Summary must be submitted as part of an E/PO proposal as described further below);
- NASA requests (but does not require) that the submitting organization waive PI labor costs and its customary overhead charges on an E/PO budget, since in many cases such activities will directly aid a local educational or public science institution, and the budget available for this OSS E/PO program is extremely limited;

- The parent research proposal may identify an additional Co-Investigator who, along with the PI of the parent research proposal, will be responsible for completing the E/PO activities (e.g., an appropriately qualified colleague from the PI institution, or from an educational institution such as a public school district, science museum, planetarium, etc.);
- E/PO proposals will be evaluated (see criteria below) by appropriately qualified scientific, education, and outreach personnel, and the substance of these reviews will be conveyed to the proposers in a summary report; and
- The OSS Selecting Official will take into account proposed E/PO tasks and their review ratings when deciding on final selections and funding levels for Phase 2 and as an aid in discriminating between highly qualified research proposals having otherwise comparable merits.

A.5.2 Evaluation Criteria

OSS has developed a document, entitled *Explanatory Guide to the NASA Office of Space Science Education and Public Outreach Evaluation Criteria*, as a resource for proposers who want to submit an E/PO proposal in conjunction with their research proposal. This *Explanatory Guide* may be accessed through the OSS homepage Web site indicated above or directly at <http://spacescience.nasa.gov/education/guide.html> ; navigation through this *Explanatory Guide* at its Web site is facilitated by internal active links. This *Guide* is not an extension of the E/PO requirements or criteria but is meant to provide an easy-to-follow introduction to this program using a series of Frequently Asked Questions (FAQ), followed by a detailed discussion of the E/PO review criteria given below. All proposers who are considering the submission of an E/PO proposal but who are not familiar with the specific OSS standards for E/PO activities are urged to review this *Explanatory Guide*.

Based on the OSS E/PO strategy and implementation plans noted above, there are two classes of evaluation criteria against which proposed E/PO activities will be evaluated. Although creativity and innovation are certainly encouraged, note that neither of these sets of criteria concerns the originality of the proposed effort. Instead, NASA seeks assurance that the proposer is personally committed to the E/PO effort and that the PI of the parent proposal and/or appropriate research team members will be actively involved in carrying out a meaningful, effective, credible, and appropriate E/PO activity; that such an activity has been planned and will be executed; and that the proposed investment of resources will make a significant contribution towards meeting stated OSS plans and objectives (interested proposers to this E/PO program are urged to consult the *Explanatory Guide* referenced above).

General Criteria

The following general criteria will be applied to the evaluation of all proposals and reflect requirements necessary for further consideration by NASA OSS of an E/PO proposal:

- The quality, scope, and realism of the proposed E/PO program including the adequacy, appropriateness, and realism of the proposed budget;
- The capabilities and commitment of the proposer and the proposer's team to carry out the proposed E/PO program, including the direct involvement of one or more science team members in overseeing and carrying out the proposed E/PO program (Note: this criterion is intended to preclude proposals that serve only to "pass through" money to an external organization or individual who would carry out the proposed E/PO activity, since such a case is inconsistent with the intention of OSS that the research community be actively involved in education and public outreach);
- The establishment or continuation of effective partnerships with institutions and/or personnel in the fields of educational and/or public outreach as the basis for and an integral element of the proposed E/PO program; and
- The appropriateness of plans for evaluating the effectiveness and impact of the proposed education/outreach activity.

Specific Criteria

To ensure that the goals and objectives of the OSS E/PO strategy are realized in practice, E/PO proposals will also be evaluated using at least one of the following specific criteria, as appropriate, for the submitted proposal. Because of the modest financial scope of this program, not all E/PO proposals can (or even should) address all of these specific factors; a sound, well-posed, and focused effort that will clearly be effective in reaching its intended target audience is preferable to an unrealistically broad effort. These specific criteria are:

- For proposals dealing directly with or strongly affecting the formal education system (e.g., teacher workshops or student programs carried out at public institutions such as science museums and planetariums), the degree to which the proposed E/PO effort is aligned with and linked to nationally recognized and endorsed education reform efforts and/or reform efforts at the state or local levels;
- The degree to which the proposed E/PO effort contributes to the training, involvement, and broad understanding of science and technology by underserved and/or underutilized groups; and/or
- The potential for the proposed E/PO activity to expand its scope by having an impact beyond the direct beneficiaries (e.g., reaching relatively large audiences, being suitable for replication or broad dissemination, and/or drawing on resources beyond those directly requested in the proposal).

OSS expects that most E/PO proposals will be submitted by a single proposer as a supplement to a single science and technology proposal submitted in response to this NRA.

A.5.3 Submission of the Same E/PO Proposal with Multiple Research Proposals Submitted by the Same Proposer

OSS recognizes that a single proposer may submit more than one research proposal in response to this NRA, or to different OSS NRA's over the course of a given calendar year. In such a case, that one proposer may submit the same E/PO proposal with all his/her research proposals subject to the three conditions that: (i) OSS will review such an E/PO proposal only the first time it is submitted; (ii) this one evaluation will carry through to all other submissions of that same E/PO proposal for this NRA as well as all other OSS NRA's to be issued in this calendar year; and (iii) such an E/PO proposal will be funded only once (i.e., NASA will not fund the same activity more than once even though it may be enhanced by such an increase in support). The Web page to be used for the submission of an E/PO proposal (see further below) will request information regarding the first submission and any subsequent submissions of this proposal to this NRA. Note that in such a case, the E/PO proposal must be resubmitted in the identical form as it was the first time; OSS does not have the resources to separately evaluate E/PO proposals that have only minor changes between such multiple submissions. Of course, multiple but substantially different E/PO proposals submitted by the same proposer will receive individual evaluations.

A.5.4 Assistance for the Preparation of E/PO Proposals

To help interested proposers in developing an effective E/PO proposals, NASA OSS has established a nationwide infrastructure of space science education/outreach groups to directly aid space science investigators in identifying and developing high quality E/PO opportunities. This infrastructure provides the coordination, background, and linkages for fostering partnerships between the space science and E/PO communities, and the services needed to establish and maintain a vital national, coordinated, long-term OSS E/PO program. The two elements of this system of particular interest to researchers interested in submitting E/PO proposals are:

- Four OSS science theme-oriented "E/PO Forums" that aid OSS in organizing the comprehensive education/outreach aspects of OSS space science missions and research programs, and provide both the space science and education communities with ready access to relevant E/PO programs and products; and
- Five regional "E/PO Broker/Facilitators" that search out and establish high leverage opportunities, arrange alliances between educators and OSS-supported scientists, and help scientists turn results from space science missions and programs into educationally-appropriate activities suitable for regional and/or national dissemination.

Prospective proposers are strongly encouraged to make use of these groups to help identify suitable E/PO opportunities and arrange appropriate partnerships and alliances but should note that the responsibility for actually developing the E/PO program and writing the proposal is that of the proposer. Points of contact and addresses for all of these E/PO Forums and Broker/Facilitators are found by opening *Education and Public Outreach* from the menu of the OSS homepage at <http://spacescience.nasa.gov> .

A.5.5 Preparation and Submission of an E/PO Proposal

To aid interested proposers in composing and submitting a complete E/PO proposal for Phase 2 of this program, NASA OSS has established a comprehensive electronic form that is accessed through menu on the Web site <http://www.lpi.usra.edu/panel/>. Completion of all the fields of this electronic form with the requested information and text is necessary before a proposal may be submitted for evaluation (Note: only electronically submitted E/PO proposals will be evaluated). This site will be accessible starting 60 days in advance of the due date for Phase 2 proposals. By using a unique identification number that will be provided at the time of first access, all fields may be edited up to final submission. The requested information may be transferred from any standard word processing software, although only text may be used to complete these fields on this Web site; i.e., this site will not accept illustrations or drawings. As an aid in developing the required information for the final electronic submission, this E/PO format may also be printed at any time. This Web submission will also require a summary of the E/PO budget (both by year and total) using the same format shown for the research Budget Summary form shown in this NRA.

Once it is submitted, the completed E/PO proposal (including all Budget Summary sheets) can then be printed out from the Web site by the proposer to provide the appropriate hard copy for submission with the parent Phase 2 research proposal.

A.5.6 Reporting Activities for Approved E/PO Proposals

In order to assist OSS in obtaining a coherent picture of the entire portfolio of E/PO efforts supported across all OSS programs a brief report of selected E/PO activities are to be provided as part of the annual Progress Reports required for the parent research award (Note: it is expected that all such Progress Reports for the proposals selected through this NRA will be submitted electronically through a to-be-designated Web site). In addition, one of the OSS Education Forums (see above) will contact the PI's of selected E/PO components to obtain basic summary information concerning the nature of and intended audience for their selected E/PO effort.

A.5.7 Additional Information

General questions about this E/PO program may be directed to:

Dr. J. David Bohlin
Research Program Management Division
Code SR
Office of Space Science
National Aeronautics and Space Administration
Washington DC 20546-0001
Telephone: (202) 358-0880
E-mail: david.bohlin@hq.nasa.gov

Finally, attention is also called to the Initiative to Develop Education through Astronomy and Space Science (IDEAS) program administered by the Space Telescope Science Institute (STScI) on behalf of OSS. The IDEAS program is open to any space scientist based in the U.S. regardless of whether or not they hold a research grant from NASA OSS. This program, which selects proposals yearly, provides awards of up to \$40K to foster the development of innovative approaches to space science education and outreach by space scientists and their educator partners. The annual solicitation for the IDEAS program is typically released in July with proposals due in October. The annual request for proposals is posted at <http://ideas.stsci.edu/>. Inquiries may be addressed by E-mail to IDEAS@stsci.edu or by postal mail to: IDEAS Program, Office of Public Outreach, Space Telescope Science Institute, 3700 San Martin Drive, Baltimore MD 21218.

APPENDIX B

INSTRUCTIONS FOR RESPONDING TO NASA RESEARCH ANNOUNCEMENTS

NASA Federal Acquisition Regulations (FAR) Supplement (NFS)

Part 1852.235-72

(accessible through URL: <http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm>)

(a) **General.**

(1) Proposals received in response to a NASA Research Announcement (NRA) will be used only for evaluation purposes. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre-award synopsis published for individual proposals.

(2) A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

(3) NRA's contain programmatic information and certain requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRA's.

(4) A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded in response to an NRA. NASA will determine the appropriate instrument. Contracts resulting from NRA's are subject to the Federal Acquisition Regulation and the NASA FAR Supplement. Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NPG 5800.1).

(5) NASA does not have mandatory forms or formats for responses to NRA's; however, it is requested that proposals conform to the guidelines in these instructions. NASA may accept proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposers' most favorable terms.

(6) To be considered for award, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation.

(b) **NRA-Specific Items.** Several proposal submission items appear in the NRA itself: the unique NRA identifier; when to submit proposals; where to send proposals; number of copies required; and sources for more information. Items included in these instructions may be supplemented by the NRA.

(c) The following information is needed to permit consideration in an objective manner. NRA's will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

(1) Transmittal Letter or Prefatory Material.

- (i) The legal name and address of the organization and specific division or campus identification if part of a larger organization;
- (ii) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;
- (iii) Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;
- (iv) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;
- (v) Identification of other organizations that are currently evaluating a proposal for the same efforts;
- (vi) Identification of the NRA, by number and title, to which the proposal is responding;
- (vii) Dollar amount requested, desired starting date, and duration of project;
- (viii) Date of submission; and
- (ix) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

(2) Restriction on Use and Disclosure of Proposal Information. Information contained in proposals is used for evaluation purposes only. Offerors or quoters should, in order to maximize protection of trade secrets or other information that is confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting an appropriate identification in the notice. In any event, information contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

Notice

Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [*insert page numbers or other identification*] of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

(3) **Abstract.** Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective and the method of approach.

(4) **Project Description.**

- (i) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the plan of work, including the broad design of experiments to be undertaken and a description of experimental methods and procedures. The project description should address the evaluation factors in these instructions and any specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Subcontracting significant portions of a research project is discouraged.
- (ii) When it is expected that the effort will require more than one year, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

(5) **Management Approach.** For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and arrangements for ensuring a coordinated effort should be described.

(6) **Personnel.** The principal investigator is responsible for supervision of the work and participates in the conduct of the research regardless of whether or not compensated under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

(7) **Facilities and Equipment.**

- (i) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any Government-owned facilities, industrial plant equipment, or special tooling that are proposed for use. Include evidence of its availability and the cognizant Government points of contact.

- (ii) Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for research and non-research purposes should be explained.

(8) Proposed Costs (U.S. Proposals Only).

- (i) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; consultants; subcontracts; other miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all staffing data in terms of staff-months or fractions of full-time.
- (ii) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases.
- (iii) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 1831 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).
- (iv) Use of NASA funds--NASA funding may not be used for foreign research efforts at any level, whether as a collaborator or a subcontract. The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted. Additionally, in accordance with the National Space Transportation Policy, use of a non-U.S. manufactured launch vehicle is permitted only on a no-exchange-of-funds basis.

(9) Security. Proposals should not contain security classified material. If the research requires access to or may generate security classified information, the submitter will be required to comply with Government security regulations.

(10) Current Support. For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

(11) **Special Matters.**

- (i) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.
- (ii) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.

(d) **Renewal Proposals.**

(1) Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. A renewal proposal should not repeat all of the information that was in the original proposal. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered during the period for which support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

(2) NASA may renew an effort either through amendment of an existing contract or by a new award.

(e) **Length.** Unless otherwise specified in the NRA, effort should be made to keep proposals as brief as possible, concentrating on substantive material. Few proposals need exceed 15-20 pages. Necessary detailed information, such as reprints, should be included as attachments. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments.

(f) **Joint Proposals.**

- (1) Where multiple organizations are involved, the proposal may be submitted by only one of them. It should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.
- (2) Where a project of a cooperative nature with NASA is contemplated, describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. The proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.

(g) **Late Proposals.** Proposals or proposal modifications received after the latest date specified for receipt may be considered if a significant reduction in cost to the Government is probable or if there are significant technical advantages, as compared with proposals previously received.

(h) **Withdrawal.** Proposals may be withdrawn by the proposer at any time before award. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

(i) **Evaluation Factors.**

(1) Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

(2) Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.

(3) Evaluation of its intrinsic merit includes the consideration of the following factors of equal importance:

(i) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

(ii) Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

(iii) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives.

(iv) Overall standing among similar proposals and/or evaluation against the state-of-the-art.

(4) Evaluation of the cost of a proposed effort may include the realism and reasonableness of the proposed cost and available funds.

(j) **Evaluation Techniques.** Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house, others are evaluated by a combination of in-house and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. The final decisions are made by a NASA selecting official. A proposal which is scientifically and programmatically meritorious, but not selected for award during its initial review, may be included in subsequent reviews unless the proposer requests otherwise.

(k) Selection for Award.

(1) When a proposal is not selected for award, the proposer will be notified. NASA will explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.

(2) When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation. The contracting officer may request certain business data and may forward a model award instrument and other information pertinent to negotiation.

(l) Additional Guidelines Applicable to Foreign Proposals and Proposals Including Foreign Participation.

(1) NASA welcomes proposals from outside the U.S. However, foreign entities are generally not eligible for funding from NASA. Therefore, unless otherwise noted in the NRA, proposals from foreign entities should not include a cost plan unless the proposal involves collaboration with a U.S. institution, in which case a cost plan for only the participation of the U.S. entity must be included. Proposals from foreign entities and proposals from U.S. entities that include foreign participation must be endorsed by the respective government agency or funding/sponsoring institution in the country from which the foreign entity is proposing. Such endorsement should indicate that the proposal merits careful consideration by NASA, and if the proposal is selected, sufficient funds will be made available to undertake the activity as proposed.

(2) All foreign proposals must be typewritten in English and comply with all other submission requirements stated in the NRA. All foreign proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals must be received before the established closing date. Those received after the closing date will be treated in accordance with paragraph (g) of this provision. Sponsoring foreign government agencies or funding institutions may, in exceptional situations, forward a proposal without endorsement if endorsement is not possible before the announced closing date. In such cases, the NASA sponsoring office should be advised when a decision on endorsement can be expected.

(3) Successful and unsuccessful foreign entities will be contacted directly by the NASA sponsoring office. Copies of these letters will be sent to the foreign sponsor. Should a foreign proposal or a U.S. proposal with foreign participation be selected, NASA's Office of External Relations will arrange with the foreign sponsor for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency or funding institution will each bear the cost of discharging their respective responsibilities.

(4) Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

- (i) An exchange of letters between NASA and the foreign sponsor; or
- (ii) A formal Agency-to-Agency Memorandum of Understanding (MOU).

(m) **Cancellation of NRA.** NASA reserves the right to make no awards under this NRA and to cancel this NRA. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation.

(End of provision)

APPENDIX C

SPECIFIC GUIDANCE FOR PROPOSAL PREPARATION AND SUBMISSION

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C.1 Introduction

C.1.1 General Provisions and Policies

- *Relationship of Appendices B and C.* The material in Appendix C augments and supplements the material in Appendix B of this NRA. In case of conflict, the material in Appendix C takes precedence.
- *Nominal Period of Performance for Selected Proposals.* Unless otherwise specified in the Cover Letter or Appendix A, the period of performance for a proposal submitted in response to this NRA is restricted to three years or less. For such multiple year awards, yearly funding allotments are provided only after the submission of an acceptable yearly progress report. The period of performance for an Education/Public Outreach (E/PO) proposal is restricted to that of its “parent” research award.
- *Unrestricted Freedom to Propose to this NRA.* NASA OSS welcomes proposals in response to this NRA from all qualified proposers. 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. In accordance with Federal statutes and NASA policy, no eligible applicant shall be excluded from participation in, denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NASA on the grounds of race, color, creed, age, sex, national origin, or disability.
- *Opportunity to Propose Educational/Public Outreach Activities.* Educational/Public Outreach (E/PO) activities are now considered vital and integral parts of all NASA space science missions and research programs. Therefore, NASA OSS encourages proposers to this NRA to submit an E/PO proposal as a supplement to their "parent" research proposal in accordance with the guidelines given elsewhere. Additionally, any existing multiple year OSS research award having at least one full year remaining in its period of performance can serve as a “parent” proposal for an E/PO supplement; therefore, the Principal Investigators of such awards are encouraged to propose E/PO activities.
- *Anticipated Level of Competition for Selection.* Regardless of the budget that is indicated as available for selections for this NRA, prospective proposers are advised that competitions for NASA programs have traditionally been extremely competitive. In the last several years, because of the shortage of resources, typically as few as one out of four to six proposals have been selected for funding.

- *Public Access to Data.* As a matter of NASA policy, all data taken or products created in the performance of a NASA research award are considered to be public domain. In addition, NASA may judge that new data or products (including items produced in the pursuit of an Education/Public Outreach proposal) obtained through an investigation selected through this NRA may be of value to the science and/or education communities at large. If so, NASA reserves the right to direct that such items be deposited in an approved publicly accessible site and, if so, will negotiate appropriate funding to enable such activities (e.g., the reduction and calibration of the data into a format amenable for use by peer scientists).
- *Data and Computational Infrastructure.* Information on current space science data centers and services can be found on the World Wide Web at <http://ssds.nasa.gov>, whereas information on high performance computing resources can be found at <http://spacescience.nasa.gov/hecc/>. Any need for high performance computing resources for the proposed research should be explicitly described in the proposal, including the computing system, location, and an estimate of the amount of computing time needed.
- *Late proposals.* NASA's general policy on late proposals is given in Part (g) of Appendix B and states that such a proposal may be considered only if it is judged to be in the best interests of the Government. Owing to the historically large over-subscription of proposals for NASA's programs, a proposal submitted after the published deadline is unlikely to be considered of uniquely greater value to NASA than the proposals that are submitted on time. Finally, note that processing delays at the proposer's home institution or its method of shipping does not excuse the late submission of a proposal.

C.1.2 Types of Proposing Institutions

NASA OSS accepts proposals in response to its NRA's from all types of U.S. and non-U.S. institutions (proposals from non-U.S. institutions must adhere to the provision of Part (l) Appendix B). As an aid to NASA in deciding on the appropriate type of award or agreement in the event that the proposal is selected, one of the categories listed below must be indicated at the appropriate line on the proposal's *Cover Page* (see Section 5.4 of this Appendix):

- *Educational institution* -- A university or two- and four-year college (including a U.S. community college) accredited to confer degrees beyond that of the K-12 grade levels (all such institutions are considered by NASA as nonprofit).
- *Nonprofit, nonacademic organization* -- A private or Government supported research laboratory, university consortium, museum, observatory, or similar organization that supports advanced research but whose principal charter is not for training of students.

- *Commercial organization* -- An organization of any size that operates for profit (fee basis) and with appropriate capabilities and interests to conduct basic research in science.
- *NASA Center* -- All NASA Field Centers and the Jet Propulsion Laboratory.
- *Other Federal Agency* -- Any non-NASA, U.S. Federal Executive agency or Federally Funded Research and Development Center (FFRDC) sponsored by a Federal agency.
- *Unaffiliated U.S. resident* -- Any person residing in the U.S., whether a U.S. citizen or resident alien, who has the capabilities and access to facilities for carrying out the proposed project and who, if selected, agrees to fiscal arrangements that, in NASA's opinion, ensures responsible management of appropriated Federal funds.
- *Non-U.S. Organization* -- Institutions outside the U.S. that propose on the basis of a policy of no exchange of funds (consult Section (I) of Appendix B for specific details).

C.1.3 Proposal Personnel

Every organization submitting a proposal in response to this NRA must designate a single *Principal Investigator* (PI) who will be responsible for the quality and direction of the entire proposed investigation and for the use of all awarded funds. Note that NASA does not accept the designation of a "Co-Principal Investigator;" there must be only one PI who is solely responsible for an investigation.

NASA strongly encourages proposers to identify only the most critically important personnel to aid in the execution of their proposals. Should such personnel be required, *Co-Investigators* (Co-I's) may be identified who are critical for the successful completion of an investigation through the contribution of unique expertise and/or capabilities, and who serve under the direction of the PI, regardless of whether or not they receive compensation directly under the award. A Co-I must have a well-defined role in the investigation that is explicitly defined in the Management section of the proposal (see Section 5.3 below). In addition, for all proposals submitted in response to this NRA, evidence of the commitment of a Co-I to participate in the proposed investigation is required by way of a brief letter from him/her even if they are from the same institution as that of the PI (see Section 5.3 below).

There are two informal subcategories of Co-I's that a proposal may identify in its Management section (see Section 5.3 below), as appropriate:

A Co-I may be additionally designated as the *Science PI* for those cases where the proposing institution does not permit that individual to formally serve as the PI as defined above. In such a case, the Science PI will be understood to be in charge of the scientific direction of the proposed work, although the formally designated PI is still held responsible by NASA for the overall direction of the effort and the use of funds.

A senior, leading Co-I may be additionally designated as an *Institutional PI* if his/her institution is committed to make a major contribution to a proposal submitted by a PI from another institution, e.g., a substantial portion of an experimental investigation. At the recommendation of the responsible Discipline Scientist, NASA may elect to provide an award directly to that Co-I institution with the Institutional PI serving as the "PI" for what otherwise would be a subcontract from the proposing PI institution. However, in such a case, the proposal's designated PI is still held responsible by NASA for the overall scientific direction of the proposed effort.

Finally, proposals may also identify unfunded Collaborators who are less critical to the overall proposal than a Co-I but who are committed to provide a specific contribution to the proposed task. As for Co-I's noted above, proposals submitted in response to this NRA must include a brief letter of commitment from each Collaborator that describes their specific, intended contribution to the investigation.

C.1.4 Proposal Evaluation

Although OSS secures scientific and technical evaluations from appropriately qualified peers of the proposers, proposers are expected to provide sufficient detail to enable evaluation by persons who are knowledgeable of but not necessarily specialists in the proposed research. The evaluation criteria in part (i) of Appendix B, as amended below, applies to this NRA with the understanding that relevance to NASA's objectives shall mean relevance to the specific objectives and goals as described in this NRA for which the proposal is submitted.

C.1.5 Proposal Selection and Implementation

Following peer evaluation, the cognizant Program Executive will further review the scientifically and technologically top rated proposals against the programmatic objectives, program balance, and available financial resources. Based on these factors, including judgment of the comparison of the scope and importance of the proposed investigation to its cost, the Program Executive then will present a recommendation for selection to the

NASA Selecting Official (identified in this NRA's covering summary letter). A critical consideration in the selection of proposals for funding will be to maximize scientific return within the available budget. To achieve this objective, NASA will weigh the proposed costs of those proposals deemed meritorious against the available funding; final selection will reflect an appropriate balance. The Selecting Official will select for funding those proposals deemed worthy as judged against all of the evaluation criteria and for which financial resources are available. The Selecting Official will also decide on the selection of Education/Public Outreach (E/PO) proposals of merit that are associated with those research proposals being considered for selection. An E/PO proposal of merit will be used as an additional factor to discriminate between research proposals of otherwise equal merits.

Each proposer will be notified by postal or electronic mail of their selection or nonselection and offered a debriefing to explain that decision. Note that NASA reserves the right to offer selection of only a portion of a proposed investigation; in such a case the proposer will be given the opportunity to accept or decline the offer. Those recommended for selection will be informed of the recommended amount of their award and that their organization will be contacted by a NASA Procurement Office to arrange for an appropriate funding instrument (e.g., a grant, contract, or work order). In all cases, awards are made to the proposing institution, not directly to the proposal's PI. No financial commitment on the part of NASA or the Government may be inferred from any communication, even if in writing, from the NASA Discipline Scientist or Selecting Official. Only a NASA Procurement Office can make financial commitments, obligations, or awards on behalf of the Agency and authorize the expenditure of funds.

C.2 Notice of Intent to Propose

In order to plan for a timely and efficient peer review process, *Notices of Intent* (NOI's) to propose are requested by the date given in the summary cover letter of this NRA. The submission of a NOI is not a commitment to submit a proposal, nor is information contained therein considered binding on the submitter. NOI's are to be submitted electronically by entering the requested information through the World Wide Web site identified in the Cover Letter, which will request at least the following information:

- reference to this NRA by its alpha-numeric identifier (Note: this may be included on the Web site template);
- the Principal Investigator's name, physical location mailing address, phone number, and E-mail address;
- the name(s) and institution(s) of any Co-Investigator(s) identified by the NOI due date;
- a descriptive title of the intended investigation; and,
- a brief description of the investigation to be proposed.

Additional information (for example, a subcomponent of the NRA objectives) may be requested specific to the program description. A separate NOI must be submitted for each intended proposal. Note that this NOI also serves to provide the basic information for the proposal *Cover Page/Proposal Summary*; therefore, the Web site will provide a password to the user for future use in updating this information for the final *Cover Page/Proposal Summary* as the deadline for submission of the final proposal approaches (see further discussion in Section C.5.4 below).

C.3 “Renewal” (Successor) Proposals

Holders of existing research awards frequently propose in response to successive NRA’s in the same program area in order to extend an ongoing research activity to its next logical step. However, in order to ensure equitable treatment of all submitted proposals, NASA does not extend any special consideration to such proposals in terms of preferential handling, review, or priority for selection. Therefore, NASA does not recognize or use the term “renewal proposal” as discussed in Part (d) of Appendix B. Instead, all proposals in response to OSS NRA's are considered “new” regardless of their previous history of NASA funding. Nevertheless, such follow-on proposals are welcome and encouraged and should indicate relevant achievements made during the course of any previously existing award in its *Scientific/Technical/Management Section* (see below in Section C.5.4).

However, in order to allow their identification and assessment of previous achievements, proposers who seek to extend the thrust of an existing research activity for which NASA funding will expire in the current Fiscal Year should enter the existing NASA grant or contract number in the designated field on the proposal *Cover Page* (see Section 5.4 below for details). Such successor proposals must otherwise fully comply with all guidelines for preparation, content, and submission as outlined in this NRA, and they will be reviewed on an equal basis with all other submitted proposals.

C.4 Guidelines for International Participation

Guidelines for proposals involving non-U.S. participation either as the Principal Investigator or as a Co-Investigator must follow the guidelines given in Section (I) of Appendix B. Note especially the requirement for the submission of a letter of endorsement from the government agency or funding/sponsoring institution that is sponsoring the non U.S. participation.

C.5 Guidelines for Preparation of Proposals

C.5.1 Standard Default Formats

The standard, default formats for all proposals submitted in response to this NRA are as follows:

- Typewritten English text using an easily read font having no more than 15 characters per inch (i.e., typically 12-point font) on white, 8.5x11 inch paper (or A4 stock for non-U.S. proposals).
- Single or double column format with at least 1 inch (2.5 cm) margins all around.
- Double-sided printing preferred but not required.
- Bound only with metal staples to facilitate recycling (i.e., no cardboard or plastic covers or permanent binders), with the original copy bound in a manner that allows easy disassembly should NASA need to make additional copies.
- Use of fold out pages, colored illustrations, or photographs only if critical for the unique display of important proposal data.
- No material submitted on any type of electronic media, nor reference to World Wide Web sites for information needed to complete or to review the proposal.
- Use of only metric and standard astronomical and engineering units.
- Strict adherence to the fixed page limits given in Section C.5.3.

C.5.2 Additional Guidelines for Proposals

- Proposals to this solicitation should include technical and cost information for both Phase 1 and Phase 2 activities at initial submittal. The Phase 1 information will be considered a firm proposal, while the Phase 2 information, which will be considered preliminary and used to understand the overall scope of the proposed effort, will be a factor in the Phase 1 selection. Using the information generated in Phase 1, the Phase 2 proposals may be updated prior to Phase 2 final selection for this updated proposal (details will be provided at the time of selection for Phase 1). Note that there are separate page limits for the proposal text given in Section C.5.3 for the Phase 1 and Phase 2 parts of the proposal. NASA reserves the right to not fund Phase 2 proposals if the updated cost proposal exceeded the original not-to-exceed estimate used in the initial selections.

- Respondents having support from other NASA programs should include clear, concise statements of how their work proposed under this NRA may complement and/or extend their current NASA-funded work. One half extra page beyond the page limits given in Section C.5.3 may be included for this material.
- All U.S. investigators should include the cost of a one day program review in their budgets for Phase 1. The reviews will be held at the completion of Phase 1, and will take place in the vicinity of Hampton, Virginia, or Pasadena, California. Annual program reviews will be held during Phase 2 to track progress, and their cost should be included in the budgets for Phase 2.
- All proposals shall include a 1-page quad chart in Microsoft Powerpoint (or equivalent) format that summarizes the technical objectives and expected benefits of the proposed research, identifies significant milestones for Phase 1 and Phase 2, and illustrates the system concept or component technology to be developed with a graphic or sketch. A template for the quad chart is included in Section C.6 of Appendix C in this NRA. One extra page beyond the page limits given in Section C.5.3 may be included for this material.

C.5.3 Checklist For Proposal Preparation and Submission

Details for each item are given in the same order in Section C.5.4.

PRESUBMISSION ACTIVITIES

___ *Notice of Intent (NOI) to Propose* - The NOI is electronically submitted to the World Wide Web site and by the date given in the Cover Letter of this NRA (this Web site will be open for submissions starting approximately 30 days prior to the due date for the NOI).

___ *Cover Page/Proposal Summary* - The information required for the Cover Page/Proposal Summary is initially entered on the World Wide Web site given in the Cover Letter and according to the directions below. It is then printed out in hard copy by the proposer in order to secure original signatures as required for submission with the copies of the proposal itself by the deadlines in the Cover Letter (this Web site will be open for submissions approximately 30 days prior to the due date for the proposals themselves)..

CONSTITUENT PARTS OF A PROPOSAL (in order of final assembly)

	<u>PAGE LIMITS*</u>
___ <i>Cover Page/Proposal Summary</i>	Per printout from Web
___ <i>Table of Contents</i>	1
___ <i>Summary of Personnel, Commitments, and Costs</i>	1
___ <i>Scientific/Technical/Management Section - Phase 1</i>	≤8**
<i>- Phase 2</i>	≤3**
___ <i>Statement of how proposed work complements/extends proposer's currently funded work (if needed), (see Section C.5.2)</i>	1/2
___ <i>References</i>	None
___ <i>Quad Chart (see Section C.5.2)</i>	1
___ <i>Facilities And Equipment (as needed and appropriate)</i>	≤2
___ <i>Curriculum Vitae</i>	for the PI: ≤3
	For each Co-I: ≤1
___ <i>Current and Pending Support</i>	None
___ <i>Statement(s) of Commitments from Co-I's and/or Collaborators</i>	None
___ <i>Research Budget Summary and Details</i>	None
___ <i>Reprints/Preprints (optional; maximum of 2)</i>	N/A

* where each side of a single sheet containing text or illustration counts as a page.

** including illustrations, tables, and figures.

SUBMISSION ACTIVITIES

- ___ *Cover Page/Proposal Summary* - print out final and complete version from specified Web site in time to secure the Principal Investigator and Authorizing Institution signatures, and to produce the required number of hard copies to be submitted (originally signed *Cover Page/Proposal Summary* to preface original of proposal).

- ___ *Education/Public Outreach Proposal* (optional) - print out final and complete version from specified Web site in time to include as part of final hard copy of proposal.

- ___ Provide for delivery of the specified number of hard copies (see Cover Letter) of the proposal to the correct address by close of the normal business day on the specific Due Date (see the Cover Letter for submission date).

C.5.4 Details of Proposal Contents

All proposals in response to this OSS NRA should be assembled with the following parts (note that some are only as required or optional) in the order listed. Proposals that omit any of their required parts will be returned without review. For reference, each of the items below is cross-indexed to the corresponding part of Appendix B of this NRA. Note: Several parts of Appendix B are not cited but should also be considered for a complete understanding of all the policies and provisions for proposals solicited through this NRA.

- *Cover Page/Proposal Summary* [Appendix B.(c)(1) and (3)]

All proposals must be prefaced by an integrated *Cover Page/Proposal Summary* that contains important, required information (see below). This item is produced by first entering the requested information electronically through the World Wide Web site given in the Cover Letter and then by printing out this form. Note that a sample of this Web form may be printed out at any time for preliminary inspection, and that the only valid format for submission of this item is through the Web. The printed copy of the electronically submitted form is then used to obtain original signatures of the PI and an official from the proposing institution to submit with the original copy of the proposal.

Upon accessing the specified Web site and selecting this NRA through use of a menu, at a minimum the following information for the *Cover Page* will be requested:

- Alpha-numeric identifier of this NRA and full name of the NASA Research Announcement (Note: this item will be included on the electronic form).
- Name and full institutional physical location mailing address of the proposing Principal Investigator, telephone and facsimile numbers, and E-mail address (Note: an open block for signature and date will be provided on the printed hard copy).
- Full descriptive title of proposed investigation.
- Abbreviated title of proposed investigation (limited to 50 characters).
- NASA Grant or Contract Number of any current NASA award that the PI may hold that is a logical predecessor of the newly proposed work.
- Names, institutional affiliations, and E-mail addresses of any Co-Investigators (see definition of Personnel in Section C.1.3; also note that all listed Co-I's must also be functionally identified in the proposal – see Section C.5.4).
- Names, institutional affiliations, and E-mail addresses of any Collaborators (see definition of Personnel in Section C.1.3).
- The physical mailing address, telephone number, and E-mail address of the office of sponsored programs at the proposing institution.
- Institutional endorsement, including the name and title of the Authorizing Official, name of proposing institution (Note: an open block for signature and date will be provided on the printed hard copy).
- Designation of the type of institution per the definitions in Section 1.2 above.
- The budget for the proposed research task both by year and for the total proposed period of performance.

A block of space (≤ 2000 characters, including spaces, or about one-half page using the formats specified above) will be provided in the electronic *Cover Page/Proposal Summary* form for a self-contained *Proposal Summary* of the proposed research activity. (Note: this material may be transferred from any standard word processing software). The *Summary* must include the following information:

- A description of the key, central objectives of the proposed research in terms sufficient for a nonspecialist to grasp its essence and a statement of methods proposed to accomplish those proposed objectives;
- The perceived significance of the proposed work to NASA OSS interests.

Special conditions and instructions concerning the *Cover Page/Proposal Summary*:

1) Changes (such as whiteout or strikethrough) to the printed *Cover Page/Proposal Summary* are not permitted. Any needed changes to the information submitted electronically may only be made by editing the electronic submission by following the "edit" instructions on the Web page, after which the final *Cover Page/Proposal Summary* is then printed in order to secure the necessary signatures.

2) The authorizing institutional signature on the *Cover Page* certifies that the proposing institution has read and is in compliance with the three required certifications printed in full in Section C.6 of this Appendix; therefore, it is not necessary to separately submit these certifications with the proposal.

3) Electronic submission of a *Cover Page/Proposal Summary* does not satisfy the deadline for proposal submission. The required number of proposal copies (see Cover Letter), must be received at the indicated address by the proposal due date.

4) NASA OSS publishes the names of the proposal, the PI, and the proposing institution, and the *Proposal Summary* of every selected investigation in a public data base (e.g., see <http://spacescience.nasa.gov/codesr/results.html>). Therefore, the *Summary* should not include proprietary information that precludes its unrestricted release (see also Appendix B, (a)(2) and (c)(2)).

- *Table of Contents*

A one page *Table of Contents* should identify each of the key parts of the proposal, as well as the subsections of the proposal's central *Scientific/Technical/Management Section*. Each of the proposal's sections may be individually numbered.

- *Summary of Personnel, Commitments, and Costs*

The proposal must contain a one page summary list, in simple tabular form, that gives the names and intended work commitment for the PI and for every Co-I of the proposed investigation both in time (rounded to the nearest 0.01 of a Work Year of typically 1880 hours) and unburdened salary (rounded to the nearest \$1K) for each year of the proposed period of performance (Note: "unburdened" means without addition of overhead or fees). These entries of commitments should be shown separately for the research effort and for any proposed E/PO proposal. In addition, this list must contain the name(s) of any collaborator(s) associated with the proposal.

- *Scientific/Technical/Management Section* [Appendix B.(c)(4), (c)(5), and (c)(6)]

This *Section* is the main body of a proposal and should cover the following topics in the order given, all within the specified page limit:

- The objectives and expected significance of the proposed research, including a complete description of any instruments or hardware proposed to be built in order to carry out the research (Note: see also the *Facilities and Equipment* section below for the description of critical equipment needed for carrying out the proposed research);
- The perceived impact of the proposed work to the state of knowledge in the field and, if the proposal is a direct extension of an existing OSS award, how the proposed work is expected to build on and otherwise extend the previous accomplishments to date;
- The technical approach and methodology to be employed in conducting the proposed research, including any special facilities of the proposing institution(s) and/or capabilities of the proposer(s) for carrying out the work;
- The relevance of the proposed work to past, present, and/or future NASA OSS programs and interests and to the specific objectives given in this NRA;
- An outline of the general plan of work, including anticipated key milestones for accomplishments and the management structure for the personnel involved; and
- A statement of the expected contribution by the PI and each Co-I identified on the proposal, whether or not they derive support from the proposed budget (Note: Co-I's who have either insignificant or unjustified roles will be considered a weakness for purposes of the evaluation of the proposal).

The *Scientific/Technical/Management Section* may contain illustrations that amplify and demonstrate key points in the main text of the proposal (including milestone schedules, if appropriate). Any illustrations and figures must be of publication quality, of an easily viewed size, and have self-contained captions that do not contain critical information not provided elsewhere in the proposal.

- *References*

All citations given in the *Scientific/Technical/Management Section* must be included in a list of references, which should include the full title of the paper and/or book, as appropriate, and an easily understood abbreviation of the publication.

• *Facilities and Equipment*

[Appendix B.(c)(7)]

As appropriate, this section should describe any facilities (including any U.S. Government owned facilities) and/or major equipment critical for carrying out the proposed project that are already available or would need to be purchased in order to carry out the proposed investigation. In the latter case, these costs should be entered in the required proposal *Budget Summary* and described in accompanying budget details.

• *Curriculum Vitae*

[Appendix B.(c)(6)]

The PI must submit a *Curriculum Vitae* that includes his/her professional experiences, positions, and a bibliography of publications relevant to the proposal. The proposal must also include a one page *Vitae* for each key Co-I. A Co-I who serves as a Science or an Institutional PI (see section C.1.3 above), or as the lead Co-I for an E/PO proposal, may submit a *vitae* using the same page limit as for the PI. *Vitae* from Collaborators are not to be submitted.

• *Current and Pending Support*

[Appendix B.(c)(10)]

Information must be provided for all ongoing and pending projects and proposals that involve the proposing PI and any Co-I's who are either expected to perform a significant share of the proposed work (e.g., as a Science or as an Institutional PI (see section C.1.3 above)), or who are proposed to receive support through the proposal. Information is required for each of two categories of support awards that may exist at the time of the proposal submission deadline, namely,

- a) Current Support (for any of the period that overlaps with the proposal being submitted to this NRA); and
- b) Pending Support (including the proposal to this NRA).

For each of these categories, provide the following information for each such key individual on the proposal team as noted above:

- Title of award or project;
- Program name (if appropriate) and sponsoring agency or institution (including point of contact);
- Proposed period of performance and budget; and
- Commitment in fractions of a full time Work Year (WY = 1880 hr).

In addition, provide the name of any other institution, including point of contact with telephone number, to which the proposal submitted to this NRA, or any part thereof, has been or will be submitted for consideration of funding. For such pending research, the PI's must notify the relevant Discipline Scientist immediately of any successful proposals that are awarded anytime after the proposal submission date until the time of selections.

Budget Summary. If the proposal is selected, NASA will execute an inter- or intra-Agency funds transfer, as appropriate, to cover the cost of the Government Co-I. Conversely, if a Government PI institution teams with a private sector Co-I institution, that Government institution is expected to cover such Co-I costs through a subcontract that they execute (see item (iii) below); therefore, such private sector Co-I costs should be entered on line 2.a, “Subcontracts,” on the *Budget Summary*.

(iii) The proposing (PI) institution must subcontract the funding of all proposal Co-I's who reside at other institutions (except for a Government Co-I for a private sector PI as noted above); that is, NASA will not separately make awards to Co-I's at distributed institutions regardless of the cost impact to the PI's proposing institution for the management of such subcontracts.

(iv) In addition to the *Budget Summary* and in accordance with the *Instructions for Budget Summary* given in Section C.6 of this Appendix, the proposing institution must append at the end of the proposal sufficient details in narrative format to allow a full understanding of the budget. The proposing institution may also append the proposed budget in the format of their choice and without page limit.

(v) NASA is expected to be operating on the basis of full cost accounting as soon as possible, including all Civil Service salaries with overhead. In the interim period, proposals involving NASA and JPL employees as either a PI or as a Co-I should use the accounting method authorized at their institutions at the time proposals are due and for the entire proposed period of performance.

- *Reprints/Preprints*

A maximum of two reprints and/or preprints for peer-reviewed publication that are considered critical to understanding the background of the proposal may be appended to the proposal. However, even if such items are appended, NASA's peer reviewers are directed to base their judgments of the merits of the proposal only on its *Scientific/Technical/Management Section* and other related parts as described above in this section.

C.6 Forms and Certifications

The following pages contain:

(i) the *Budget Summary* format and *Instructions for Budget Summary* (Note: a reasonable facsimile of the *Budget Summary* may be generated by the proposer for submission or the electronic form may be downloaded from the Web site that contains this NRA); and

(ii) copies of the three *Certifications* currently required by U.S. Code (Note: these individual *Certifications* are included for reference only and should not be signed and returned; language is now included on the proposal *Cover Page* that confirms that these certification requirements are met once the printed copy of the *Cover Page* is signed by the Authorizing Institutional Representative and submitted with the proposal).

(iii) template for the 1-page quad chart in Microsoft Powerpoint that summarizes the technical objectives and expected benefits of the proposed research, identifies significant milestones for Phase 1 and Phase 2, and illustrates the system concept or component technology to be developed with a graphic or sketch. (see Appendix A.5, item 6)

BUDGET SUMMARY for RESEARCH PROPOSAL

For (check one):

___ **Total Period of Performance from (M/D/Y)** _____ **to** _____

___ **For Year** ___ **of** ___ **from (M/D/Y)** _____ **to** _____

	<u>NASA USE ONLY</u>		
	A	B	C
1. <u>Direct Labor</u> (salaries, wages, and fringe benefits)	_____	_____	_____
2. <u>Other Direct Costs:</u>			
a. Subcontracts	_____	_____	_____
b. Consultants	_____	_____	_____
c. Equipment	_____	_____	_____
d. Supplies	_____	_____	_____
e. Travel	_____	_____	_____
f. Other	_____	_____	_____
3. <u>Facilities and Administrative Costs</u>	_____	_____	_____
4. <u>Other Applicable Costs:</u>	_____	_____	_____
5. <u>SUBTOTAL--Estimated Costs</u>	_____	_____	_____
6. <u>Less Proposed Cost Sharing</u> (if any)	_____	_____	_____
7. <u>Carryover Funds</u> (if any)			
a. Anticipated amount : _____			
b. Amount used to reduce budget _____	_____	_____	_____
8. <u>Total Estimated Costs</u>	_____	_____	XXXXXXXX
9. APPROVED BUDGET	XXXXXXX	XXXXXXX	_____

INSTRUCTIONS FOR BUDGET SUMMARY

- Provide a complete Budget Summary (which may include an optional Education/Public Outreach effort) for the total as well as each individual year of the proposed period of performance.
 - Enter the proposed estimated costs in Column A (Columns B & C for NASA use only).
 - Provide, as attachments, detailed computations of all estimates in each cost category with narratives as required to fully explain each proposed cost as follows.
1. Direct Labor (salaries, wages, and fringe benefits): Attachments should list the number and titles of personnel, amounts of time to be devoted to the grant, and rates of pay.
 2. Other Direct Costs:
 - a. Subcontracts: Attachments should describe the work to be subcontracted, estimated amount, recipient (if known), and the reason for subcontracting.
 - b. Consultants: Identify consultants to be used, why they are necessary, the time they will spend on the project, and rates of pay (not to exceed the equivalent of the daily rate for Level IV of the Executive Schedule, exclusive of expenses and indirect costs).
 - c. Equipment: List separately. Explain the need for items costing more than \$5,000. Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Grant Officer. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the basic research proposed and why it cannot be purchased with indirect funds.
 - d. Supplies: Provide general categories of needed supplies, the method of acquisition, and the estimated cost.
 - e. Travel: Describe the purpose of the proposed travel in relation to the grant and provide the basis of estimate, including information on destination and number of travelers where known.
 - f. Other: Enter the total of direct costs not covered by 2a through 2e. Attach an itemized list explaining the need for each item and the basis for the estimate.
 3. Facilities and Administrative (F&A) Costs: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance. If unapproved rates are used, explain why, and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.
 4. Other Applicable Costs: Enter total explaining the need for each item.
 5. Subtotal-Estimated Costs: Enter the sum of items 1 through 4.
 6. Less Proposed Cost Sharing (if any): Enter any amount proposed. If cost sharing is based on specific cost items, identify each item and amount in an attachment.
 7. Carryover Funds (if any): Enter the dollar amount of any funds expected to be available for carryover from the prior budget period. Identify how the funds will be used if they are not used to reduce the budget. NASA officials will decide whether to use all or part of the anticipated carryover to reduce the budget (not applicable to 2nd-year and subsequent-year budgets submitted for award of a multiple year award).
 8. Total Estimated Costs: Enter the total after subtracting items 6 and 7b from item 5.

**Certification Regarding Debarment, Suspension, and
Other Responsibility Matters**

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 34 CFR Part 85, Section 85.510, Participant's responsibilities. The regulations were published as Part VII of the May 26, 1988 Federal Register (pages 19160-19211).

1. The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:
 2. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
 3. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
 4. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and
 5. Have not within three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.
- (2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Certification Regarding Lobbying

2. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
3. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
4. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000, and not more than \$100,000 for each such failure.

**Certification of Compliance with the NASA Regulations Pursuant to Nondiscrimination
in Federally Assisted Programs**

The (*Institution, corporation, firm, or other organization on whose behalf this assurance is signed, hereinafter called "Applicant "*) hereby agrees that it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352), Title IX of the Education Amendments of 1962 (20 U.S.C. 1680 et seq.), Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and the Age Discrimination Act of 1975 (42 U.S.C. 16101 et seq.), and all requirements imposed by or pursuant to the Regulation of the National Aeronautics and Space Administration (14 CFR Part 1250) (hereinafter called "NASA") issued pursuant to these laws, to the end that in accordance with these laws and regulations, no person in the United States shall, on the basis of race, color, national origin, sex, handicapped condition, or age be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives federal financial assistance from NASA; and hereby give assurance that it will immediately take any measure necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of federal financial assistance extended to the Applicant by NASA, this assurance shall obligate the Applicant, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which the federal financial assistance is extended to it by NASA.

This assurance is given in consideration of and for the purpose of obtaining any and all federal grants, loans, contracts, property, discounts, or other federal financial assistance extended after the date hereof to the Applicant by NASA, including installment payments after such date on account of applications for federal financial assistance which were approved before such date. The Applicant recognized and agrees that such federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign on behalf of the Applicant.

Template for the 1-page quad chart in Microsoft Powerpoint

Proposal Title

<p style="text-align: center;">Products</p> <p>Insert sketch or image to illustrate system concept or technology product to be developed. Annotate image as necessary to explain what is shown.</p>	<p style="text-align: center;">Participants</p> <ul style="list-style-type: none"> • Long-range performance objective or vision that the proposed task aims to achieve • Expected benefits of proposed technology to future NASA missions • Brief description of product at end of Phase 1 • Brief description of product at the end of Phase 2 																																								
<p style="text-align: center;">Objectives</p> <ul style="list-style-type: none"> • Principal Investigator, affiliation, email, phone number • Major Co-Investigators, affiliations 	<p style="text-align: center;">Schedule & Funding</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Milestones</th> <th style="text-align: center;">FY'00</th> <th style="text-align: center;">FY'01</th> <th style="text-align: center;">FY'02</th> </tr> </thead> <tbody> <tr> <td colspan="4"><u>Phase 1</u></td> </tr> <tr> <td>• milestone #1</td> <td></td> <td></td> <td></td> </tr> <tr> <td>• milestone #2</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="4"><u>Phase 2</u></td> </tr> <tr> <td>• milestone #1</td> <td style="text-align: center;">■</td> <td></td> <td></td> </tr> <tr> <td>• milestone #2</td> <td></td> <td style="text-align: center;">■</td> <td></td> </tr> <tr> <td>• milestone #3</td> <td></td> <td style="text-align: center;">■</td> <td style="text-align: center;">■</td> </tr> <tr> <td>Required Funding</td> <td style="text-align: center;">\$K</td> <td style="text-align: center;">\$K</td> <td style="text-align: center;">\$K</td> </tr> <tr> <td>Co-Funding (if applicable)</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Milestones	FY'00	FY'01	FY'02	<u>Phase 1</u>				• milestone #1				• milestone #2				<u>Phase 2</u>				• milestone #1	■			• milestone #2		■		• milestone #3		■	■	Required Funding	\$K	\$K	\$K	Co-Funding (if applicable)			
Milestones	FY'00	FY'01	FY'02																																						
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