D.8 STRATEGIC ASTROPHYSICS TECHNOLOGY

NOTICE: Amended on March 24, 2015. When setting the schedule for ROSES-2015, the proposal due date for this program element was inadvertently placed on Saturday. This amendment corrects that error, shifting the due date to the prior Friday. Proposals are now due by March 18, 2016. Notices of Intent to propose are still due by January 22, 2016.

1. Scope of Program

1.1 Overview

Over the next decade and beyond, NASA's Astrophysics Division expects to undertake space flight missions that will explore the nature of the universe at its largest scales, its earliest moments, and its most extreme conditions; missions that will study how galaxies and stars formed and evolved to shape the universe we see today; and missions that will search and characterize the planets and planetary systems orbiting other stars. To enable implementation of these missions, the NASA Science Mission Directorate's Astrophysics Division has established the Strategic Astrophysics Technology (SAT) program to support the maturation of key technologies to the point at which they are feasible for implementation in space flight missions.

The 2010 Decadal Survey of Astronomy and Astrophysics (hereafter, Astro2010), strongly endorsed the SAT program (http://www.nap.edu/catalog.php?record_id=12951). The SAT program is a key element of the strategy adopted by the Astrophysics Division in implementing the Astro2010 recommendations (see the Astrophysics Implementation Plan at http://science.nasa.gov/media/medialibrary/2012/12/20/Rev1-StrategicIImplementationPlan-20Dec2012.pdf).

The focus of the SAT program is described in terms of the Technology Readiness Level (TRL) of the technologies involved. NASA uses a nine-level classification system to rate the readiness of a particular technology for use in a space flight mission. The TRL definitions are articulated in detail in NPR 7123.1B Appendix E (http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7123_001B_&page_name=AppendixE). Briefly, TRL levels one to three are generally considered to be basic research on new technologies, while TRL levels seven to nine correspond to the development of flight hardware

The SAT program is designed to support the maturation of technologies whose feasibility has already been demonstrated (i.e., TRL 3), to the point where they can be incorporated into NASA flight missions (TRL 6-7). Table D.8.1 provides the definitions for the midrange TRLs supported by the SAT program.

Table D.8.1. Expanded Maturity Definitions for Midrange TRLs (SAT Program)				
TRL	Definition	Hardware Description	Software Description	Exit Criteria
3	- Analytical and experimental critical function and/or characteristic proof-of-concept	Analytical studies place the technology in an appropriate context and laboratory demonstrations, modeling and simulation validate analytical prediction.	Development of limited functionality to validate critical properties and predictions using nonintegrated software components.	Documented analytical/experimental results validating predictions of key parameters.
4	Component and/or breadboard validation in laboratory environment.	A low fidelity system/component breadboard is built and operated to demonstrate basic functionality and critical test environments, and associated performance predictions are defined relative to final operating environment.	Key, functionality critical software components are integrated and functionally validated to establish interoperability and begin architecture development. Relevant environments defined and performance in the environment predicted.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of relevant environment.
5	Component and/or breadboard validation in relevant environment.	A medium fidelity system/component brassboard is built and operated to demonstrate overall performance in a simulated operational environment with realistic support elements that demonstrate overall performance in critical areas. Performance predictions are made for subsequent development phases.	End-to-end software elements implemented and interfaced with existing systems/simulations conforming to target environment. End-to-end software system tested in relevant environment, meeting predicted performance. Operational environment performance predicted. Prototype implementations developed.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of scaling requirements.

TRL	Definition	Hardware Description	Software Description	Exit Criteria
6	System/subsystem model or prototype demonstration in a relevant environment.	A high fidelity system/component prototype that adequately addresses all critical scaling issues is built and operated in a relevant environment to demonstrate operations under critical environmental conditions.	Prototype implementations of the software demonstrated on full-scale, realistic problems. Partially integrated with existing hardware/software systems. Limited documentation available. Engineering feasibility fully demonstrated.	Documented test performance demonstrating agreement with analytical predictions.

The Astrophysics Division has three main science programs: Exoplanets Exploration (ExEP), Physics of the Cosmos (PCOS), and Cosmic Origin (COR), which cover, respectively, the search for planets outside the Solar System, the origin and evolution of the universe, and the birth of stars and galaxies. These areas of scientific interest are represented within the SAT program through its three elements:

- Technology Development for Exoplanet Missions (TDEM)
- Technology Development for Physics of the Cosmos (TPCOS)
- Technology Development for the Cosmic Origins (TCOR)

1.2 Requirements for SAT Proposals

This section describes the general requirements for SAT proposals common to TDEM, TPCOS, and TCOR. Proposers are also urged to read Sections 2, 3, and 4 for further details on the requirements specific to each science area.

Proposers shall:

- Identify the SAT element(s) most closely related to the proposed technology (e.g., TDEM, TPCOS, TCOR; see Section 3). Proposed technologies may be relevant to more than one of these three areas. Consequently, NASA reserves the right to reassign a proposal to any of the three Programs for the purposes of review and funding;
- Identify a strategic mission or mission concept to which the proposed technology is anchored (competed missions, such as Explorers, are not considered *strategic* missions);
- Describe the proposed path to achieving the goals of the proposed technology. In particular:
  (a) Provide proof that the technology being proposed is already at TRL=3;
  (b) Specify the expected end TRL at the conclusion of the proposed program. However, it is neither required nor expected that proposers will complete this entire

development process (or even advance a full step on the TRL scale) within the two or three year duration of proposals solicited in this call;

(c) Define at least one objectively verifiable milestone that represents a meaningful advancement of their chosen technology and provide a schedule for achieving that (those) milestone(s) over the course of their proposed project;

(d) Describe a work plan that fully articulates the technical parameters to be demonstrated for all technical milestones identified. This work plan should include the measurements to be made, analyses to be applied, success criteria, and documentation to be provided. The work plan and associated milestones will be critically evaluated as part of the peer-review process.

In addition, both the *NASA Guidebook for Proposers* (Section 2) and Section IV (b) ii of the *ROSES-2015 Summary of Solicitation* provide clear and specific requirements for the format of proposals submitted in response to this solicitation (e.g. page limits, acceptable font sizes, line spacing, margins, etc.). Proposals found to violate these guidelines will be penalized, even to the extent of being declined without review, or not being funded, independent of their intrinsic merit evaluation. Proposers are reminded that it is the PDF version of their proposal in NSPIRES that will be judged for compliance. Since, in rare cases, cross-platform translation of PDF documents can alter the formatting of a document, proposers are strongly urged to download copies of any documents they upload to the NSPIRES system to ensure that they still conform to all formatting requirements. NASA does not require a data management plan for proposals to this program element.

1.3 Annual Program Office Presentations

In addition to the annual progress report, successful proposers may also be asked to present orally their results to the Program Office and other relevant officers (See Sections 2, 3, and 4). NASA reserves the right to terminate a grant if it deems that achievement of the proposed goals according to the proposed schedule is unlikely to occur.

2. Technology Development for the Exoplanet Exploration Program

NASA's Exoplanet Exploration Program (ExEP) supports the development of those technologies that will allow us to search and characterize extrasolar planets and planetary systems. As compelling as these future ExEP missions are, implementing them presents many daunting technological challenges. The Technology Development for Exoplanet Missions (TDEM) element of the SAT Program is designed to support the maturation of key technologies that will overcome these challenges and pave the way to ever more ambitious exoplanet exploration missions.

2.1 TDEM Areas of Emphasis

The ultimate goal for exoplanet exploration envisioned by Astro2010 is a "*New Worlds Mission*" that would conduct imaging and spectroscopy of rocky planets in the habitable zones of stars in the Solar neighborhood. To meet the challenge of Astro2010, the TDEM element of the SAT program solicits investigations that will advance the technology readiness of technologies that

feed directly into key starlight suppression techniques (coronagraphy, external occulters) that will enable a future strategic *New Worlds Mission*. Detailed discussion of the current technology needs in the relevant areas can be found in the Exoplanet Exploration Program Technology Plan, which can be downloaded at http://exep.jpl.nasa.gov/reportsAndDocuments. Prospective SAT/TDEM proposers are strongly encouraged to review this document before preparing their proposal, as it reflects the programmatic considerations that will be taken into consideration in the review and selection of TDEM submissions.

Technology activities of particular interest to the Exoplanet Exploration Program and the TDEM Program are those that undertake milestones in the following areas:

1. *Starlight Suppression Demonstrations*
Demonstration of technologies that will enable a space observatory to reject scattered starlight to the degree that the light of an exoplanet can be separated from that of its parent star (10^7 contrast ratio at infrared wavelengths; 10^{10} contrast ratio at visible wavelengths). For coronagraph technologies, there is special interest in demonstrations with obscured, segmented apertures suitable for operation with 10m-class telescopes.

For starshade technologies, there is interest in (a) deployment activities, such as petal unfurling mechanisms and latches, (b) shielding (aka blanketing) concepts and demonstrations such as opacity testing and resistance to micro-meteoroids, (c) stray light investigation and analyses, including petal surfaces and edges, (d) as with coronagraphs, there is special interest in starshades suitable for operation with 10m-class telescopes.

2. *Wavefront Sensing and Control of Scattered Starlight*
In order to achieve the requisite degree of starlight rejection, the light paths within both coronagraphic systems must be controlled to picometer precision consistent with 10^{-11} contrast stability. Advances in control algorithms, sensing technology, and deformable mirror technology are, therefore, central to implementing such instruments on a space-based platform. Likewise, external occulter observatories require sensors and algorithms that enable the system to move from star to star and that enable the system to meet and maintain positional stability during science observations.

3. *System Performance Assessment*
Testing new subsystems, instruments, and observatory designs on the ground for performance verification may not be feasible, even if they are small enough to fit in existing vacuum chambers. Thus, future exoplanet missions will have to rely on high-fidelity, very high density models that capture the physics properly and seamlessly integrate thermal, mechanical, and optical models, to infer expected picometer-level on-orbit performance based on nanometer-level ground measurements.

Relevant technology development activities involving ground-based astronomical facilities are eligible for funding under the TDEM element, providing there is clear and explicit traceability to a future exoplanet mission. Unfortunately, due to budgetary constraints, proposals for suborbital programs are not solicited at this time.

Over the years, the ExEP has developed a number of advanced testing and modeling tools to support the development of exoplanet exploration technologies. These tools are available to the community and proposers are encouraged to take advantage of them, as appropriate. An informational workshop will be held in advance of the proposal deadline to provide information for proposers wishing to take advantage of one or more of the available ExEP test facilities and/or tools and to provide guidance for developing quantitative, practical technology milestones for their proposed task. Information about the scheduling of the workshop and instructions for participation will be posted at http://exep.jpl.nasa.gov/news. Prospective proposers should be aware, however, that high-priority technology development activities associated with the advancement of a potential coronagraph for an AFTA-based WFIRST mission (see description below) will nearly fully subscribe the time available on the ExEP's two High Contrast Imaging Testbeds (HCIT). Consequently, it is likely that little to no time will be available on either of those testbeds to support new TDEM investigations.

2.2 TDEM-specific Exclusions.

Proposals in the following areas are specifically not solicited under the TDEM element of SAT 2015:

- Investigations that advance technologies for future missions with goals other than the direct detection of extrasolar planets (e.g. astrometry, high-precision photometry, transit spectroscopy);
- Investigations that advance technologies for ancillary measurements that (although they may enhance the scientific capabilities of a future mission) do not directly enhance the ability of the system to isolate and analyze the light emitted or reflected from an exoplanet;
- Investigations that advance technologies leading to the development of infrared interferometry as the basis for a future strategic exoplanet direct detection mission;
- Proposals for the development of technologies for potential competed (e.g., Explorer) exoplanet direct detection missions;
- Investigations that address general technology maturation activities without specific application to the requirements of a future strategic exoplanet direct detection mission;
- Proposals for development and maintenance of testing facilities and/or tools that substantively reproduce the capabilities of existing ExEP infrastructure;
- Proposals for the advancement of technologies in the following specific areas: (1) detector technology; (2) mirror technology (with the exception of adaptive systems associated with wavefront sensing and control in coronagraphs); (3) telescope assembly technology; (4) spacecraft sunshields and thermal control; (5) propulsion systems; (6) vibration isolation systems; and (7) spacecraft pointing control (with the exception of telescope-starshade alignment control in external occulter systems).

Finally, the potential use of one of the 2.4-m space telescopes NASA obtained from another Federal agency (termed the Astrophysics Focused Telescope Assets, or AFTA) as the basis for implementing the Wide Field InfraRed Survey Telescope (WFIRST) envisioned in the Astro2010 Decadal Survey has unexpectedly created a new, near-term opportunity in exoplanet

exploration. Studies commissioned by the Astrophysics Division have established that an AFTA-based WFIRST mission (WFIRST-AFTA), augmented by the addition of a coronagraphic instrument, could be capable of conducting direct detection observations of planets as small as Neptune in the Solar neighborhood. In view of this promise, a coronagraph is now included as a component of the baseline WFIRST-AFTA mission concept, and advancement of relevant coronagraph technologies has been incorporated into the directed technology development program that NASA has established to bring WFIRST-AFTA to a suitable level of technology readiness on a timescale consistent with its expected implementation (i.e., after the launch of JWST). Consequently, coronagraph technologies that will be advanced under the WFIRST-AFTA technology development are not eligible for funding under the auspices of the SAT Program. Technologies that are not eligible include: (1) masks/apodizers for Shaped-pupil, hybrid Lyot, and Phase-Induced Amplitude Apodization Complex Mask (PIAA-CMC) coronagraphs; (2) Low-order wavefront sensing and control; (3) data post-processing; (4) system-level performance demonstration and modeling of obscured aperture systems.

2.3 The TDEM Technology Development Model.

The ExEP model for advancement of technologies is founded on the following three interrelated components:

1. Demonstration of milestone performance must be stable and repeatable, thereby demonstrating that the result is not spurious or transient;
2. Modeling of the milestone demonstration must be consistent with the demonstrated result, thereby establishing that the behavior is thoroughly understood; and
3. Error budget for the milestone must be consistent with the models.

Milestones proposed under the auspices of the TDEM element may involve one or all of these elements. In addition, milestones for all SAT/TDEM investigations that make use of ExEP high-contrast testbeds shall incorporate both predictive and posttest validated modeling. In the interests of consistency and comparability, investigators will be expected to make use of the ExEP's existing modeling capability.

For all technical milestones identified in a proposal, the PI will be expected to prepare a milestone white paper—a work plan that fully articulates the technical parameters to be demonstrated, the measurements to be made, analysis to be applied, success criteria, and documentation to be produced. That white paper will be reviewed by an independent technology assessment committee and may be iterated until an agreement between the technologists, the reviewers, and NASA is reached. When the PI believes that his/her team has achieved all of the requirements set forth in their milestone white paper, they will be required to write a milestone report that addresses all of the aspects identified in the original white paper. The milestone report will then be subject to independent review and interaction by the same groups involved in the initial white paper.

3. Technology Development for Physics of the Cosmos (TPCOS) Missions

The primary science objectives of the Physics of the Cosmos (PCOS) Program are to understand the origin and destiny of the Universe, the physics of phenomena near black holes and other compact objects, and the nature of gravity, addressing the question "How does the Universe work?" (see http://science.nasa.gov/about-us/smd-programs/physics-of-the-cosmos/). Missions that are directed at advancing the fields of cosmology, high-energy astrophysics, and fundamental physics are nominally within the scope of this program. Detailed discussion of the current PCOS technology needs in the relevant areas can be found in the most recent version of the PCOS Program Annual Technology Report, which is available from the PCOS Program web site at http://pcos.gsfc.nasa.gov/. Prospective SAT/TPCOS proposers are urged to review this document before preparing their proposals.

The following technological areas are identified as of particular interest for the TPCOS Program:

- *Technologies for X-ray Astrophysics,* including, but not limited to, high-resolution microcalorimeter arrays, lightweight replicated optics and precision structures, high-resolution gratings (both transmission and reflection).
- *Technologies for Gravitational Wave Astrophysics,* including, but not limited to: dimensionally stable, optical telescopes; frequency-stabilized metrology lasers; high-resolution phasemeters; low-noise microthrusters; ultra-quiet inertial references; and long-distance, laser metrology techniques.
- *Technologies for CMB Polarization Measurements,* including, but not limited to, high-throughput cold mm-wave telescopes and large low-background multiplexed arrays of detectors.

Due to the limited budget available, proposals requiring a dedicated suborbital flight (balloon or rocket) for technology tests or risk reduction are not solicited in this call, but may be included in future solicitations. However, proposals that require suborbital balloon or rocket flights may be considered if they piggyback with a payload of an already approved suborbital mission, or a payload on a Suborbital Reusable Launch Vehicle. Questions concerning piggyback payloads may be addressed to the individuals listed in the table below.

Piggyback Balloon Payload	Piggyback Sounding Rocket Payload
Debora Fairbrother Balloon Program Office Code 820 Wallops Flight Facility NASA Wallops Island, VA 23337 Telephone: (757) 824-1453 Email: Debora.A.Fairbrother@nasa.gov	Philip Eberspeaker Sounding Rocket Program Office Code 810 Wallops Flight Facility NASA Wallops Island, VA 23337 Telephone: (757) 824-2202 Email: Philip.J.Eberspeaker@nasa.gov

Piggyback Suborbital Reusable Launch Vehicles (sRLV)
LK Kubendran Flight Opportunities Space Technology Program NASA Headquarters Washington, DC 20546 Telephone: (202) 358-2528 Email: lk@nasa.gov

The proposal must address the question of how a potential future mission that primarily addresses PCOS science goals will be enabled or enhanced by the proposed suborbital work.

Annual reports for a selected TPCOS investigation must be submitted to the Program Scientist before funds for the following year of the grant are disbursed. The annual report shall contain detailed documentation of the progress towards the milestones identified in the proposal and a description of the plan forward and its expected outcomes.

In addition, PIs of selected investigations shall submit a short status update on a bimonthly basis and make an annual progress presentation to the PCOS Program Office. By the end of the full term of the investigation, the Program Office convenes a technology management board to evaluate the technology readiness level realized during the course of the project.

4. Technology Development for the Cosmic Origins Program (TCOR)

The Cosmic Origins Program (COR) seeks to investigate how planets, stars, galaxies, and cosmic structure come into being and when and how the elements of life in the Universe arose. In general, areas of astronomy and astrophysics not explicitly called out in the previous program definitions fall within the Cosmic Origins Program. Further information on the scope, activities, and the Program Annual Technology Report (PATR) of the Cosmic Origins theme can be found in the website at: http://cor.gsfc.nasa.gov. First and second priorities for areas of long-lead and mission enabling technology development that are of particular interest to the Cosmic Origins Program include:

1. *Next Generation Detectors*
Highly sensitive detectors and large arrays of detectors are fundamental to the capabilities of COR missions. In particular, high- Quantum Efficiency (QE), large-format, photon counting and ultra-low-noise detectors from the extreme ultraviolet to the far-infrared portion of the spectrum and their associated technologies (e.g., manufacturability, read-out electronics, packaging) will be critical to achieving the goals of future Cosmic Origins investigations. Of particular interest are detectors sensitive to wavelengths shortward of 2000 Å and photon counting detectors from the visible to near-IR wavelengths.

2. *Optical Coatings, Gratings and Filters*
Improved coatings for optics, for reflective purposes as mirrors, for antireflective (AR)

uses on optical elements such as gratings and detectors, and for wavelength-selective applications as filters, dichroics, or blockers, could yield more sensitive instruments and permit more instrument design freedom. The known UV reflective materials and protective coatings used on Al, such as MgF_2, LiF, CaF_2, LaF_3, etc., may have reached performance limitations, and we are seeking new and superior solutions that could be incorporated into flight hardware. For reflective coatings, most crucially in the Lyman ultraviolet (900-1300 Å), increasing system throughput is a very cost-effective way to achieve more science. Studies of improved deposition processes for known Lyman UV-reflective coatings (e.g., SiC) and investigations of new coating materials with promising Lyman UV performance, with reflectivities in excess of 50%, and reflectivities close to unity at longer UV wavelengths are areas where progress would be valuable. Because SAT proposals assume a TRL entry gate of at least 3, proposals that address the needs outlined here, but do not meet this TRL threshold, should be submitted as APRA proposals.

3. *Precision Large Optics*
Missions within COR rely heavily on their ability to collect sufficient light with appropriate angular resolution to address important relevant questions. Therefore, a premium is placed on the ability to develop scalable manufacturing techniques, including the testing and control optics of suitable and affordable mirror sizes. Keys to advancements in this arena are new techniques and technologies for reducing areal density of optics, production times, and cost; manufacturing ultra-precise, low-mass structures to reduce launch volume for large-aperture space telescopes and interferometers; operation at short wavelengths (900 – 2000 Å); and mechanisms and methods for improving thermal and dynamic stability, and wavefront sensing and control.

Proposals that are building on previously funded COR technology development must be justified with new, distinct, objectives for the new investigation. Such proposals should also include a clear description of prior advances, milestones, and TRL achieved. The proper justification and demonstration of the TRL level 3 or higher of the proposed technologies is an explicit requirement for compliance with this SAT call for proposals. The annual report for selected efforts should contain documentation of the progress towards the milestones identified in the proposal.

Due to the limited budget available, proposals requiring a dedicated suborbital flight (balloon or rocket) for technology tests or risk reduction are not solicited in this call, but may be included in future solicitations. However, proposals that require suborbital balloon or rocket flights may be considered if they piggyback with a payload of an already approved suborbital mission. Questions concerning piggyback payloads may be addressed to the individuals listed in the table above in Section 3.

The proposal must address the question of how a potential future mission that primarily addresses COR science goals will be enabled or enhanced by the proposed suborbital work.

An Annual Report for each selected investigation must be submitted, containing detailed documentation of the progress towards the milestones identified in the proposal, and a

description of the plan forward and its expected outcomes. This Report will be included in the Program Annual Technology Report.

In addition, PIs of selected investigations submit a short status update on a bimonthly basis, and make an annual progress presentation to the Program Office. By the end of the full term of the investigation, the Program Office convenes a technology management board to evaluate the technology readiness level realized during the course of the project.

5. Programmatic Information

5.1 General Information

The period of performance for proposals submitted in response to this solicitation may not exceed two or three years depending on the program element (see Section 6). The following table provides the approximate amount of funding available for new awards, distributed over Fiscal Years 2017 and 2018. It also gives the number of new investigations that may be selected for the three SAT categories pending the availability of funds and an adequate number of proposals of sufficient merit.

SAT Category	Approximate Funds for New Selections [$M]	Approximate Number of New Selections
TDEM	$2.0 per year	~2-5
TPCOS	$2.0 per year	~2-5
TCOR	$2.0 per year	~2-5

5.2 Student Participation

When appropriate, participation of graduate students is encouraged, especially if the project can be concluded within the nominal tenure of graduate training. In such cases, a brief summary of the educational and training goals of the student participants should be included in the proposal.

5.3. Request for reviewer names

Proposers are strongly encouraged to provide names and contact information of up to five nonconflicted experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is. This information should be included in the proposal summary in the Notice of Intent.

6. Summary of Key Information

Expected program budget for first year of new awards	See Section 5.1
Number of new awards pending adequate proposals of merit	See Section 5.1

Maximum duration of awards	3 years for TDEM and TCOR elements, 2 years for TPCOS; proposals with a term shorter than 2 years will be accepted, but are not encouraged.
Due date for Notice of Intent to propose (NOI)	**March 18, 2016** See Tables 2 and 3 in the *ROSES Summary of Solicitation*. [**Amended March 24, 2015]**
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	January 1 of the year following the proposal due date (except proposers from NASA Centers may plan for a start at the beginning of the fiscal year).
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-SAT
NASA point of contact concerning this program	The relevant Program Officers listed below with their areas of expertise, all share the same mailing address: Astrophysics Division Science Mission Directorate NASA Headquarters 300 E Street SW Washington, DC 20546-0001

Name	Program Element	Telephone	E-mail
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