B.3 HELIOPHYSICS TECHNOLOGY AND INSTRUMENT DEVELOPMENT FOR SCIENCE

NOTICE: Proposal submission to all calls in Heliophysics will be performed by a two-step process, in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an Authorized Organizational Representative (AOR). Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. The title, science goals, and investigators may not be changed between the Step-1 and Step-2 proposals. Step-1 proposals will be checked for compliance, but will not be peer reviewed. All Step-1 proposers will be permitted to submit a Step-2 proposal, unless the Step-1 proposal has been determined to be noncompliant with program requirements. See Section 2.2 for details.

1. Scope of Program

The Heliophysics Technology and Instrument Development for Science (H-TIDeS) program is a component of the Heliophysics Research Program and proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in Appendix B.1 of this ROSES NASA Research Announcement.

1.1 Overview

The H-TIDeS program combines technology elements previously separated within the old Solar, Heliosphere, and Geospace (Magnetosphere-Ionosphere-Thermosphere-Mesosphere (Mag-ITM)) Science Supporting Research and Technology programs.

Supporting Research studies are found under ROSES Program Element B.2 Heliophysics Supporting Research (H-SR). Guest Investigator studies are found under ROSES Program Element B.4 Heliophysics Guest Investigators.

H-TIDeS seeks to investigate key Heliophysics science questions through three separate subelements. These subelements are also established for the purpose of organizing the evaluation and peer review process.

- Low-Cost Access to Space (LCAS): science and/or technology investigations that can be carried out with instruments flown on suborbital sounding rockets, stratospheric balloons, CubeSats, suborbital reusable launch vehicles, or other platforms, collectively referred to as Low-Cost Access to Space (see Section 1.2 below)
- Instrument and Technology Development (ITD): state-of-the-art instrument technology development for instruments that may be proposed as candidate experiments for future space flight opportunities, called Instrument and Technology Development, which may be carried out in the laboratory and/or observatory (see Section 1.3 below)
- Laboratory Nuclear, Atomic, and Plasma Physics (LNAPP): laboratory research designated as enabling Laboratory Nuclear, Atomic, and Plasma Physics studies (see Section 1.4 below).

Advancement in Heliophysics science requires the development and application of new technologies that will yield the next generation of innovative instruments. Laboratory research

can be a relevant supplement to instrumentation and to the science of Heliophysics. The ability to achieve significant progress toward the scientific and technical challenges in Heliophysics in the coming years is greatly enhanced through the H-TIDeS program.

These investigations are carried out in support of NASA's Heliophysics Science strategic objective "to understand the Sun and its interactions with Earth and the solar system, including space weather" and three overarching science goals, from the *Science Mission Directorate Science Plan for 2014* (http://nasascience.nasa.gov/about-us/science-strategy).

Proposals to all H-TIDeS programs shall link the proposed work to the NASA Heliophysics science plan in a three-step process:

1) NASA Heliophysics Science Goal(s)
2) The science questions to be answered in achieving the science goals
3) The proposed investigation objective(s) required to address the science goals (either technological or observational or both)

The three Heliophysics Science Goals (described in the *2014 NASA Science Plan*) have a broad scope, while a proposed objective is a more narrowly focused part of a strategy to achieve the goal(s) (e.g., identify specific science questions to be addressed and/or demonstrate a new technology is capable of obtaining future measurements that may bring closure to the science questions or goals). Proposed investigations must achieve their proposed objectives (technological and/or observational); however, the investigation might only make progress toward their proposed science question(s) and toward the top science goal(s) without fully achieving them.

The ability to determine whether a proposed investigation is successful depends on a well-formulated articulation of the proposed science question(s) and investigation objectives. Each proposal shall clearly define its science question(s), shall demonstrate how the science questions are derived from the high-level science goals, and shall show how the science question(s) lead to investigation objectives that subsequently map into measurement, data, instrument, and mission (as appropriate) requirements.

1.2 Low-Cost Access to Space

The Low-Cost Access to Space (LCAS) component supports investigations addressing NASA Heliophysics Science Goals using investigator-developed instrumentation (with or without new technology development) that must be completed through suborbital or orbital flights. The LCAS and ITD programs are expected to continue to lead the way in the development of a large fraction of the instrument concepts for future solar, heliospheric, magnetospheric, and ionosphere-thermosphere-mesosphere (ITM) missions. LCAS-class investigations provide unique opportunities not only for executing intrinsically meritorious science investigations, but also for advancing the technology readiness levels of future space flight detectors and supporting technologies and for preparing future leaders of NASA space flight missions, such as junior researchers and graduate students.

LCAS Investigation Characteristics:

1. The investigation objectives address NASA Heliophysics Science Goals
2. The investigator develops instrumentation/sensor
3. Spaceflight is required to achieve investigation objectives
4. Data acquired is reduced, analyzed, and interpreted in terms of investigation objectives
5. The reduced (calibrated) data is archived in a NASA on-line facility and the interpretation is published in professional journals
6. The investigation is completed within a time interval less than or equal to four years.
7. The investigation cost is consistent with the available LCAS program funding (Section 4)
8. The Principal Investigator (PI) manages all the program resources (including schedule and cost) and no reserve is held by NASA

Suborbital launch vehicle services include those provided by the NASA Sounding Rocket Program Office (SRPO), the NASA Balloon Program Office (BPO), and commercial suborbital Technology Mission Directorate. The Science Mission Directorate also provides launch opportunities for CubeSats and International Space Station payloads. Detailed information, including suborbital and orbital specifications and points of contact, is found in the *ROSES Summary of Solicitation*, Section V (b), Suborbital-Class Investigations:

(i) NASA-provided Sounding Rocket Services
(ii) NASA-provided Balloon Services
(iii) Suborbital Reusable Launch Vehicles (sRLV)
(iv) Research Investigations utilizing the International Space Station
(v) Use of Short Duration Orbital Platforms (CubeSats and other Flights of Opportunity)

Note: "Short Duration" in (v) above refers to the Suborbital program plan mission assurance level defined by NPR 7120.8.

1.2.1 LCAS Step-2 Proposal Content

Proposals for the LCAS program must be for a complete investigation, based on clearly defined investigation objectives that address scientific questions appropriate for (this or future) Heliophysics missions linked back to Heliophysics Science goals. The investigation objectives must be achieved through a process, including payload construction, space or near-space flight, data analysis, data archiving, and publication of results. In addition to the requirements for all H-TIDeS proposals discussed above, LCAS proposals must also provide sufficient information on the flight performance characteristic and the mission requirements in order to demonstrate the feasibility of the investigation.

The Scientific/Technical/Management section of proposals is restricted to twenty pages, except for CubeSats and Flights of Opportunity, which are permitted twenty three pages (see below). The Scientific/Technical/Management section must include the following information:

- The investigation objectives and perceived impact of the proposed work to the state of knowledge in the field; references to existing work in the field should be limited to that which is needed to justify the value of the science proposed;
- A science traceability matrix;

- A general plan of work, the management structure for the proposal personnel, and a description of the expected contribution to the proposed effort by the PI and each person as identified in the proposal - whether or not they derive support from the proposed budget. Postdoctorals and students do not need to be named.
- A discussion of the plan for management, analysis, interpretation, and public dissemination of the data. Note: Level zero observational data from a LCAS flight must be deposited in a NASA-approved data center within 60 days of being obtained and calibrated observational data must be deposited in the same location before the end of the investigation.

Performance characteristics (which shall be considered as requirements on the flight system) shall include mass, power, volume, data rate(s), thermal, pointing (such as control, stability, jitter, drift, accuracy, etc.), spatial and spectral resolution, observable precision, retrieved parameter sensitivity and accuracy, and calibration requirements. This section shall demonstrate that the instrumentation can meet the measurement requirements, including factors such as retrieval results for each remote sensor, error analysis of the information in all sensors, vertical and horizontal resolution, signal-to-noise (S/N) calculations, and any other aspects of the instrumentation upon which the observations depend.

The mission requirements that the science goals and investigation objectives impose on the mission design elements, including mission design, instrument accommodation, platform design, required launch vehicle capability, ground systems, communications approach, and mission operations plan, shall be provided in tabular form and supported by narrative discussion. Table B2 provides an example of a tabular Mission Traceability Matrix, with examples of matrix elements. Specific information that describes how the science investigation imposes unique requirements on these mission design elements shall be included.

All LCAS investigations are conducted under the NASA Suborbital-Class program plan. Reference for management of these investigations is NPR 7120.8. Typically, management compliance of projects conducted under the NASA Sounding Rocket and Balloon Programs is ensured by their respective Program Offices. Proposals for LCAS investigations using other flight opportunities (International Space Station (ISS), CubeSat, Flight of Opportunity, etc.) must provide a management plan explicitly compliant with NPR 7120.8.

Proposals to the LCAS program must supply information that is needed in order to generate an estimate of the costs associated with the operational requirements for the proposed investigation. For sounding rockets, this information is the envisioned vehicle type and quantity, payload mass, trajectory requirements, launch site, telemetry requirements, attitude control or pointing requirements, and any plans for payload recovery and reuse. For CubeSats, this information is a table specifying the expected mass/size, power, and telemetry budgets, including reserves, the orbit characteristics (perigee, apogee, inclination), and access-to-space methodology. Three additional pages (up to 23 total) are permitted for CubeSat proposals, given the added necessity of describing the CubeSat spacecraft systems (e.g., attitude control, telemetry, power, space environment survivability, etc.). The three additional pages must be in a clearly labeled section that describes only the CubeSat spacecraft systems. Balloon projects needing unique engineering and/or technical support services and/or vehicles and/or the Wallops Arc-Second Pointing System (WASP) should contact the Balloon Program Office directly for an estimate of the

Government Furnished Equipment (GFE) cost of the desired support. It is advisable that PIs contact the SRPO or BPO before submitting proposals requesting large amounts of resources (e.g., high number of rocket flights) to determine if the proposed investigation is realistic.

Investigations based on ISS spaceflight must include a statement from the NASA Johnson Space Center ISS Research Integration Office/OZ indicating the feasibility of accommodating the investigation. Investigations using Flights of Opportunity spaceflight must include a statement from the organization providing the flight stating the proposed investigation is manifested on the relevant mission.

Budgets are expected to cover complete investigations, including payload development and construction, instrument calibration, launch, and data analysis. The number of investigations that can be supported is limited and heavily dependent on the funds available to this program. Note that NASA does not carry reserves to accommodate any cost overrun incurred by a particular investigation, including the loss of the payload owing to a rocket or balloon system failure. Therefore, failure to achieve the proposed goals within the proposed time and budget could require either descoping the initially proposed investigation, delaying it, canceling a particular launch date opportunity, or canceling the investigation altogether.

Science support elements, such as science radars, lidars, ionosondes, optical sites, and the associated logistics, can be supported, when appropriate. The funding for these support elements must be included in science proposal budgets.

Data returned from LCAS investigations shall be deposited in a publicly accessible NASA repository, such as the Solar Data Analysis Center (SDAC) or Space Physics Data Facility (SPDF). Quick look data shall be deposited as soon as possible after it is acquired and all reduced data shall be deposited before the end of the investigation.

Additional requirements for the proposal content are provided in Section 2.3.1.

1.2.2 Export Control Laws specific to the Sounding Rocket Program

Export licenses are required for all foreign nationals accessing sounding rocket-class hardware. LCAS program Principal Investigators (PIs) should contact the Sounding Rocket Program Office regarding PI responsibilities in this arena. Procuring the required State Department licenses can take some time, and PIs are urged to begin the process well before team members need access to the actual flight hardware. Questions concerning U.S. Export Control Laws and Regulations for sounding rocket-class missions may be addressed to Philip.J.Eberspeaker@nasa.gov of the Sounding Rocket Program Office.

1.2.3 LCAS Proposals from Multiple Institutions

The LCAS program no longer makes separate awards to the Principal Investigator (PI) and Co-Investigators (Co-Is) of the same investigation at different institutions, except in those cases where a Co-Investigator is affiliated with a U.S. Government Laboratory (see the *NASA Guidebook for Proposers*, Section 2.3.10(c)), in which case NASA separately funds that Co-

Investigator through a direct transfer of funds. In all other cases, the PI institution is expected to fund participating Co-I(s).

No separate Co-I cost proposals will be accepted.

1.3 Instrument and Technology Development (ITD)

The ITD program supports the development of instrument or detector concepts that show promise for use in scientific investigations on, or give rise to future Heliophysics missions, including the development of laboratory instrument prototypes, detectors, instrument components, etc., but not of major space flight hardware. Proposals for ITD must demonstrate relevance to the Heliophysics program, including clearly defined scientific goals appropriate for future Heliophysics missions. The goal of the program is to define and develop scientific instruments and/or components of such instruments to the point where complete instruments may be proposed in response to future Announcements of Opportunity without significant additional technology development.

Either new measurement concepts or methods to improve the performance of existing instruments or detectors may be proposed, provided they would be candidates for use in space. Among the characteristics typically desirable in space-quality detection systems are high sensitivity to relevant signals, low mass, low vulnerability to particle radiation effects, low power consumption, compactness, ability to operate in a vacuum (such that high-voltage arcing is minimized), vibration tolerance, ease and robustness of integration with instrumentation, and ease of remote operation, including reduced transient effects and ease of calibration.

1.3.1 ITD Step-2 Proposal Content

Proposals to the ITD must demonstrate relevance to the Heliophysics program, including clearly defined scientific goals appropriate for current and/or future Heliophysics missions and linkage to the proposal objectives, and that the proposed development is a necessary precursor to solving specific scientific problems. However, the proposers are not necessarily expected to apply the results of their efforts to the science problems within the time period of the proposed effort.

Additional requirements for the proposal content are provided in Section 2.3.1.

1.4 Laboratory Nuclear, Atomic, and Plasma Physics (LNAPP)

The LNAPP program supports studies that probe fundamental nuclear, atomic, and plasma physical processes and produce chemical and spectroscopic measurements that support spacecraft observations and atmospheric models. They provide benchmarks for integrating theory and modeling with observation in solar and space physics. Laboratory experiments allow the use of a controlled environment to perform reproducible measurements that shed light on key processes with the Heliophysics environment. These experiments are directed toward understanding basic processes. Additionally, there are also important experiments that are directly used to facilitate the interpretation of spacecraft observations, e.g., spectroscopic or cosmic ray measurements. As such, LNAPP encompasses measurements of fundamental atomic parameters, e.g., cross sections associated with various processes.

1.4.1 LNAPP Step-2 Proposal Content

Proposals for LNAPP must demonstrate relevance to the Heliophysics program, including clearly defined scientific goals appropriate for current and/or future Heliophysics missions and linkage to the proposal objectives. Proposals to LNAPP must demonstrate that the proposed work is a necessary precursor to solving specific scientific problems. The proposers are not necessarily expected to apply the results of their efforts to the science problem(s) within the time period of the proposed effort. Proposals for projects that aim to produce data products for wide use across the heliophysics community should explain how those products would be made available to the intended users in a stable fashion.

Additional requirements for the proposal content are provided in Section 2.3.1.

2. Submission and Evaluation Guidelines

2.1 General Considerations

Each Principal Investigator is allowed to submit one and only one Step-1 proposal to each subelement (LCAS, ITD, LNAPP) of this solicitation. In that proposal, the Principal Investigator is expected to invest a substantial portion of his/her time, 10-30%, to the investigation. Co-investigators must each have a specific and defined task in the project, and the task must be essential to completion of the project. Use of Collaborators is discouraged. Proposals may be declared noncompliant based on either the Step-1 or Step-2 proposal if they are outside the scope of the H-TIDeS program or if they fail to meet submission guidelines specified below (2.2 and 2.3).

2.2 Step-1 Proposals

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in *Section IV. (b) vii* of the ROSES-2016 *Summary of Solicitation*.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the *ROSES-2016 Summary of Solicitation*). Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. An Authorized Organizational Representative (AOR) from the PI’s institution must submit the Step-1 proposal. No budget is required (see below). Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Full (Step-2) proposals must have the same scientific goals and investigation objectives proposed in the Step-1 proposal. In addition, the Step-1 proposal title and investigators (Principal Investigator, Co-Investigators, Collaborators, Consultants, and Other Professionals) may not be changed between in the Step-1 and Step-2 proposals. The expected format and compliance evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later. Each Principal Investigator is allowed to submit one and only one Step-1 proposal for each subelement described in Section 1 above.

2.2.1 Step-1 Proposal Format and Content

The Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages. It should include the following information:

- A description of the science goals and investigation objectives to be addressed by the proposal.
- A brief description of the methodology (data, models, facilities, instrumentation, and, if relevant, flight systems) to be used to address the science goals and objectives.

The NSPIRES system for proposal submission requires that Step-1 proposals include a summary (i.e., abstract) describing the proposed work as outlined above. The proposal summary is entered directly into a text field in NSPIRES. No PDF attachment is required or permitted for Step-1 proposal submission. All information will be entered within the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages. Proposers will be notified by E-mail when they are able to submit their Step-2 proposals.

2.2.2 Step-1 Evaluation Criteria

Step-1 proposals will be declared noncompliant if the proposed work is outside the scope of the H-TIDeS program, as described in Section 1. PIs of noncompliant proposals will not be eligible to submit the associated Step-2 proposal and will receive a letter to this effect. All who submit a compliant Step-1 proposal will be invited to submit a corresponding Step-2 proposal.

2.2.3 Request for Reviewer Names

Proposers are strongly encouraged to provide names and contact information of five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is. The PI can confidentially provide this information through the NASA Science URL http://science.nasa.gov/researchers/suggested-reviewers when submitting a Step-1 proposal.

2.3 Step-2 Proposals

A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). An Authorized Organizational Representative (AOR) from the institution of the PI must submit the Step-2 proposal. A budget and other specified information is required. The Step-2 proposal title, Principal Investigator, and all Co-Investigators, Collaborators, Consultants, and Other Professionals must be the same as those in the Step-1 proposal. Step-2 proposals must contain the same scientific goals and investigation objectives proposed in the Step-1 proposal. Each Principal Investigator is allowed to submit only one proposal for each subelement.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. A Step-2 proposal cannot be submitted if the corresponding Step-1 proposal was deemed noncompliant.

Proposers are expected to respond to requests to conduct mail-in reviews for up to four proposals in this competition. Much of the science expertise lies in the PIs and Co-Is, since nearly the entire Heliophysics community proposes. In order to maintain a high-caliber review process, it is important to get these mail-in reviews to cover all proposals fairly.

2.3.1 Step-2 Proposal Content

Proposers should refer to the PDF entitled "How to submit a Step-2 proposal" that will appear under "Other Documents" on the NSPIRES page for this program after the Step-1 proposal due date. The process for preparation and submission of the Step-2 (full) proposals is that for any other ROSES proposal. Guidelines for content and formatting of Step-2 full proposals are specified in Table 1 of the *ROSES Summary of Solicitation*.

Proposals to the H-TIDeS program must contain the following elements.

The proposal shall describe the investigation to be performed, the types of measurements to be taken; the characteristics, precision, and accuracy required to attain the investigation objectives; and the projected instrument performance. This section shall describe the data to be returned in the course of the investigation. The quality (e.g., resolution, coverage, pointing accuracy, measurement precision, signal to noise ratio, background identification/removal, etc.) and quantity (bits, images, etc.) of data that must be returned shall be described. The relationship between the proposed data products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) and the investigation objectives, as well as the expected results, shall be described. How the science products and data obtained will be used to fulfill the scientific requirements shall be demonstrated and supported by quantitative analysis.

Traceability from science goals to measurement requirements to instrument requirements (functional and performance), and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Projected instrument performance shall be compared to instrument performance requirements. Table B1 of this appendix provides an example of a tabular Science Traceability Matrix, with examples of matrix elements. This matrix provides the reference points and tools needed to track overall mission requirements and provides systems engineers with fundamental requirements needed to design the mission.

The proposal shall describe the instrumentation and the rationale for its selection. It shall identify the instrument systems (i.e., individual instruments), instrument subsystems, and instrument components, including their characteristics and requirements, and indicate items that are proposed for development, as well as any existing instrumentation or design/flight heritage. It shall provide a clear understanding of how the concept will provide the required data.

A data management plan is required for all proposed investigations. All data obtained through H-TIDeS funded efforts shall be made public in a prompt manner. Special requirements for public release of observational data obtained through the LCAS subelement are noted in Section 1.2. In addition to the public release of data, proposals must describe the analysis, interpretation, and dissemination in professional meetings and publications of the results of the proposed investigation.

Additional requirements for the proposal content are provided in Sections 1.2, 1.3, and 1.4.

2.3.2 Step-2 Evaluation Criteria

Step-2 proposals that are not compliant with format requirements may be rejected without review. See Section IV (b) ii of the *ROSES Summary of Solicitation* and the *NASA Guidebook for Proposers* for details. Proposers must select the subelement that is appropriate for their proposal. Proposals that have changed the scientific scope from that of their Step-1 proposal may be declared noncompliant.

Compliant proposals will be evaluated according to the criteria specified in Section VI. (a) of the *ROSES Summary of Solicitation* and C.2 of the *NASA Guidebook for Proposers*. These criteria are intrinsic scientific and technical merit, relevance to NASA's objectives, and cost realism/reasonableness.

Cost realism/reasonableness includes assessing the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. Only Co-Investigators and Collaborators with specific roles in the investigation should be included and their roles must be clearly laid out. Proposals should not include Collaborators whose only role is advisory.

Proposals will be evaluated for scientific and technical merit based on the following:

1. The importance of the proposed investigation objectives and science question(s) in relationship to the Heliophysics Science goals, including
    a. the unique value of the investigation to make scientific progress in the context of current understanding in the field,
    b. the importance of carrying out the investigation now;
2. The feasibility of the proposed investigation objectives in answering the science questions and achieving the required technology demonstration and/or observations, including the appropriateness of
    a. data and/or models,
    b. facilities,
    c. instrumentation,
    d. flight systems

Based on these two factors, the evaluation will consider the overall potential science impact and probable success of the investigation.

Note: Proposals are not required to obtain full closure on the science question(s) during the investigation. However, if the investigation does not obtain closure on the science question(s), the proposal must demonstrate the viability of answering those science question(s) through subsequent flights and/or future orbital missions relying on the proposed technologies. Closure on the individual investigation objectives (technology development and/or observations) is required.

Additionally, though not required, the degree to which the proposed effort advances the readiness of junior researchers or graduate students to assume leadership roles on future NASA space flight missions will be considered.

3. Available Funds

A total of about $4.5M-5.0M program funds next fiscal year will allow the selection of about twelve new awards. ITD and LNAPP proposals of exceptional scientific merit will be considered for funding, within the constraints of the budget.

It is anticipated that approximately $3.5M in next fiscal year funds will be available to support three to eight new selections for LCAS.

It is anticipated that approximately $0.8M in next fiscal year funds will be available to support two to five new selections for ITD.

It is anticipated that approximately $0.4M in next fiscal year funds will be available to support one to three new selections for LNAPP.

4. Maximum Duration of Awards

The maximum duration of ITD and LNAPP awards is three years. Although most LCAS awards are also three years in duration, a four-year proposal may be accepted to develop a new, highly meritorious investigation through its first flight.

5. Summary of Key Information

Expected program budget for first year of new awards	~$4.5M-5.0M Total, $3.5M LCAS, $0.8M ITD, $0.4M LNAPP
Number of new awards pending adequate proposals of merit	~12 for LCAS, ITD, LNAPP combined
Maximum duration of awards	LCAS – 4 Years; ITD, LNAPP – 3 years.
Due date for Step-1 Proposal	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 (full) proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal. See also Chapter 2 of the *NASA Guidebook for Proposers*	ITD and LNAPP: 15 pages
	LCAS Sounding Rocket, Balloon, sRLV & ISS: 20 Pages
	LCAS CubeSat & Flight of Opportunity: 23 pages
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 proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH16ZDA001N-HTIDS
NASA point of contact concerning this program	Dan Moses Heliophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0558 E-mail: dan.moses@nasa.gov

TABLE B1
EXAMPLE SCIENCE TRACEABILITY MATRIX
(REQUIRED FOR ALL H-TIDeS PROPOSALS)

Science Goals	Science Objectives	Scientific Measurement Requirements		Investigation Functional Requirements		Projected Performance	Mission Functional Requirements (Top Level)
Goal 1	Objective 1	Absorption line	Column density of absorber	Alt. Range	XX km	ZZ km	Observing strategies: requires yaw and elevation maneuvers
Goal 2		Emission line	Density and temperature of emitter				Launch window: to meet nadir and limb overlap requirement. Window applies day to day
Etc.			Size of features	Vert. Resol.	XX km	ZZ km	Need AA seasons to trace evolution of phenomena
		Morphological feature		Horiz. Resol.	XX deg x XX lat x XX long	ZZ deg x ZZ lat x ZZ long	
			Rise time of eruptive phenomenon	Temp. Resol.	XX min	ZZ min.	Need AA months of observation to observe variability of phenomena
				Precision	XX K	ZZ K	
		Rate of change of observable phenomenon		Accuracy	XX K	ZZ K	
	Objective 2 to N			Repeat above categories			

TABLE B2
EXAMPLE MISSION TRACEABILITY MATRIX
(REQUIRED FOR LCAS PROPOSALS)

Mission Functional Requirements	Mission Design Requirements	Spacecraft/Payload Requirements	Ground System Requirements	Operations Requirements
From Table B1	Rocket type Launch date: Mission length Orbit altitude requirement and rationale Geographic coverage and how it drives orbit requirement Orbit local time and rationale for the requirement Type of orbit, e.g. Sun synchronous, precessing, Lagrangian point, other Other	Spinning, stabilized Mass Power Volume: Data Rate Temperature Range for spacecraft systems Pointing Control: Knowledge, Stability, Jitter, Drift , Other Detector radiation shielding requirements and rationale Other	Passes per day and duration Assumed antenna size Data volume per day Real time data transmission requirements Transmit frequency Power available for comm (Watts) Downlink data rate Number of data dumps per day Spacecraft data destination (e.g., mission operations center) Science data destination (e.g., science operations center) Other	General spacecraft maneuver requirements and frequency Special maneuvers requirements Rationale for maneuvers Ephemeris requirements Changes in viewing modes and directions per orbit, per day or over longer time periods. Rationale for these changes Other
Msn Functional Req or Instrument Accommodation (from Table B1)	Mission	Spacecraft	Ground System	Operations
Four different observing strategies: Solar, limb, nadir, zenith; requires yaw and elevation maneuvers		Agility requirements Slew rate = y deg/sec Settle = stability < .001 deg/sec after 30 secs		Target planning on 3 day centers Ephemeris accuracy of x with updates every 2 days
Instrument X precision of 5K		Thermal stability of 1 deg/hr S/C bus stability of .01 deg over 10 secs	Bit error rate < 1e-5 Time correlation to 2 msec over 1 week	Weekly time correlation