B.9 HELIOPHYSICS LOW COST ACCESS TO SPACE

NOTICE: Amended April 17. This amendment releases final text for this program element, which had been listed as "TBD". Neither a notice of intent nor a Step-1 proposal is requested. Proposals are due September 23, 2024.

A remote campaign emphasizing geospace sounding rocket investigations launched from near the Earth's magnetic equator is under consideration for CY 2028. Proposals for investigations to participate in this campaign are invited in ROSES-2024 and will be invited in ROSES-2025.

Proposers are strongly encouraged to use the standard Heliophysics template for Current and Pending Support for the PI and all Co-Is, regardless of time commitment and the template for the Open Science and Data Management Plan (OSDMP), see Section 2.2.2 and https://science.nasa.gov/researchers/templates-heliophysic-division-appendix-b-roses-proposals.

Proposers must provide a Payload Reference Document (PRD) along with the proposal to allow NASA to best match the research payload needs with multiple compatible flight platforms and identify the greatest suborbital research capabilities and launch flexibilities possible. See Section 2.2.3.

1. Scope of Program

The Heliophysics Low Cost Access to Space (H-LCAS) program seeks to investigate key heliophysics science questions and to advance the development of technologies and their application to enable new investigations of heliophysics science questions in the coming years. This is achieved through investigations flown on suborbital rockets, stratospheric balloons, or airborne platforms. Note that in addition to the traditional LCAS platforms provided through the NASA Sounding Rockets Operations Contract (NSROC), the Columbia Scientific Balloon Facility (CSBF) and the NASA Airborne Science Program (ASP), a new-generation of commercial sub-orbital platforms are now available for LCAS investigations through the NASA Space Technology Mission Directorate (STMD) commercial suborbital Flight Opportunities Program (FOP). More information regarding the current suborbital platforms available to H-LCAS proposers can be found in the NASA SMD Suborbital Research web page (https://science.nasa.gov/researchers/suborbital). For clarity regarding investigations involving commercial flight providers, no human-tended research payloads nor Entry-Descent-Landing (EDL) type vehicles will be considered in this solicitation.

It is anticipated that some of the technologies developed through the H-TIDeS (program element B.8) might be proposed to H-LCAS to mature by demonstration in a relevant environment, however, this is not a prerequisite for submitting a proposal to H-LCAS.

H-LCAS is a component of the Heliophysics Research Program and proposers interested in this program element are encouraged to read B.1 The Heliophysics Research Program Overview, for Heliophysics-specific requirements. Default

requirements for all ROSES elements are found in *the ROSES-2024 Summary of Solicitation* and the most basic information for all Agency solicitations in *the NASA Proposer's Guide*. The order of precedence is the following: Program Element B.9 (this document), followed by B.1 The Heliophysics Research Program Overview, followed by the ROSES *Summary of Solicitation*, and last the *Proposer's Guide*. Proposers should be familiar with all of these resources.

1.1 Solicited Investigations

The LCAS program supports investigations addressing NASA Heliophysics Science Goals using investigator-developed instrumentation that must be completed through suborbital flights. Proposals submitted to H-LCAS must have the following characteristics:

1. The investigation objectives must address NASA Heliophysics Science Goals and Objectives (see Heliophysics Overview, B.1);
2. The investigation must develop or enhance an instrument/sensor for flight;
3. Suborbital flight of the investigation-developed instrument/sensor is required to achieve investigation objectives;
4. Data acquired from flight 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, typically three years for all but complex investigations;
7. The investigation cost is consistent with the available program funding (Section 6 of this program element);
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 NASA Airborne Science Program, as well as services provided by the Space Technology Mission Directorate (STMD) commercial sub-orbital Flight Opportunities Program. Detailed information, including suborbital specifications and points of contact, is found in the *ROSES Summary of Solicitation*, Section VIII. Suborbital-Class Investigations:

I. NASA-provided Sounding Rocket Services; https://sites.wff.nasa.gov/code810/srpo.html;
II. NASA-provided Balloon Services; https://sites.wff.nasa.gov/code820/index.html;
III. NASA-provided Airborne Services. https://airbornescience.nasa.gov
IV. Commercial Suborbital Flight Opportunities https://www.nasa.gov/directorates/spacetech/flightopportunities/flightproviders
V. NASA SMD Suborbital Research web page https://science.nasa.gov/researchers/suborbital

Additionally, RideShare or Hosted Payload on alternative sub-orbital opportunities may be proposed on an *ad hoc* basis. The funding and management of these alternative services will be established on a case-by-case basis.

LCAS is expected to lead the way in the development of much of the instrument concepts for future solar, heliospheric, magnetospheric, and ionosphere-thermosphere-mesosphere (ITM) missions. LCAS-investigations provide unique opportunities not only for executing intrinsically meritorious science investigations, but also for advancing the technology readiness levels of future space flight sensors and supporting technologies and for preparing future leaders of NASA space flight missions, such as junior researchers and graduate students.

1.2 Traceability Matrix

Proposals to H-LCAS shall link the proposed work to the NASA Heliophysics Science Goals and Objectives (see B.1), documented in the proposal traceability matrix (Table B.9-1, below) and supported by the proposal text:

A) NASA Heliophysics Science Goal(s);
B) The investigation-specific science goals, formulated as questions, proposed to achieve significant progress toward the Heliophysics Science Goals and Objectives.
C) The proposed investigation objective(s) required to address the science goals (either technological or observational or both)

The Heliophysics Science Goals have a broad scope, while an objective is a more narrowly focused part of a strategy to address the investigation-specific science goal(s). While a successful proposal is expected to bring closure to the proposed investigation objectives, it is not necessary to provide closure to the science goals and it is unlikely to bring closure to the associated Heliophysics Science Goals and Objectives. For example, an investigation may 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 technological objectives (letter C in Table B.9-1, below).

Table B.9-1. Example Science Traceability Matrix

A. Science Goal(s)	B. Science Questions	C. Investigation Objective Requirements			Mission Top Level Requirements
		Measurement	Requirement	Projected Performance	
Goal # Goal # Etc.	Question # Question # Etc.	Examples: Temporal Resolution Etc.	XX Sec.	XXX Sec.	Examples: Observing strategies: requires yaw and elevation maneuvers. Launch window: to meet nadir and limb overlap requirements. Window applies day to day.
		Precision	YY%	YYY%	
		Accuracy	ZZ %	ZZZ%	

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 and instrument requirements. Instructions for proposal submission are provided in Section 2.

Note: investigations primarily targeting technology development and/or demonstration will benefit, in many cases, by the inclusion of two STM in a proposal: one STM describing the goals of the proposed flight and a separate STM describing the science questions to be addressed by a successful implementation of the technology in a subsequent mission.

1.3 Export Control

Export Control: Export licenses are required for all foreign persons accessing flight programs. H-LCAS Principal Investigators (PIs) should contact the program office with whom they are working regarding PI responsibilities in this arena. Procuring the required State Department licenses can take some time, so PIs are urged to begin the process well before team members need access to the actual flight hardware. Appendix A of the *NASA Proposer's Guide* includes links to information regarding U.S. export regulations, export-control guidelines applicable to proposals including foreign participation, and how to handle export-controlled material in proposals.

1.4 2028 Peruvian Launch Campaign

A launch campaign from Punta Lobos Rocket Range, Peru, is anticipated to be conducted in 2028. The focus of this campaign will be geospace phenomena associated with the geomagnetic equator. Collaborative observations from the Jicaarca Radio Observatory and the Huancayo Magnetic Observatory are a significant component of this campaign. The White Paper describing this campaign is available:

https://rscience.gsfc.nasa.gov/keydocs/PeruWhitePaperMarch31_2023.pdf

There is no "set aside" in the 2024 LCAS call specifically targeting proposals devoted to this campaign. All LCAS proposals will be competitively evaluated under the same selection criteria: scientific and technical merit, feasibility, and contribution to the advancement of the next generation of researchers.

The unique opportunity provided by remote campaigns typically enables very compelling science. The resource requirements of remote sounding rocket campaigns are such that a given campaign cannot be repeated on a cadence much shorter than a decade of more. The last geomagnetic equator campaign was conducted from Alcantra, Brazil in 1994.

The launch infrastructure available for this campaign limits the size of the launch vehicle to that of the Black Brant X or smaller. Increased investment in infrastructure might be considered if a larger vehicle is required for an extraordinarily compelling proposal. However, such an investment is not currently included in the Peru Campaign resource planning.

Campaign coordination and additional information will be provided by:

David Hysell, Cornell Univ. email: dlh37@cornell.edu
Esayas Shume, NASA HQ email: esayas.b.shume@nasa.gov

2. Proposal Submission Guidelines

2.1 General Guidelines

The guidelines for the technical content of the proposal are provided in Section 2.2.

A proposal must be submitted electronically by the due date given in Tables 2 and 3 of ROSES. An Authorized Organizational Representative (AOR) from the institution of the PI must submit the proposal. A budget and other specified information is required.

An individual may be Principal Investigator (PI) of one and only one proposal to this program element. The Principal Investigator is expected to invest a substantial portion of their time. Co-investigators must each have a specific and defined task in the project, and the task must be essential to completion of the project. Unfunded team members who are performing tasks that are essential to completion of the project are unfunded Co-Is, not collaborators. Unfunded Co-Is must show support for their effort, e.g., by the inclusion of a letter of support as is required for foreign Co-Is, see Table 1 of *ROSES-2024*. Use of multiple team members is discouraged, and team members are expected to have defined tasks in the project. Collaborators are expected to have defined tasks in the project with a separate source of funding identified for completion of the tasks.

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 flight system failure. Therefore, failure to achieve the proposed goals within the proposed time and budget could require either de-scoping 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.

Proposals may be declared non-compliant if they are outside the scope of the H-LCAS Program as defined in previous sections, or if they fail to meet submission guidelines specified below.

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 by sending an email the Point of Contact listed in Section 5 of this program element by the due date of the proposal.

Proposers are expected to respond to requests to conduct (external) mail-in reviews for up to three proposals in this competition. Much of the science expertise lies in the PIs and Co-Is. To maintain a high-caliber review process, it is important to obtain these additional mail-in reviews to obtain findings requiring specialized expertise to fully address all proposals fairly.

2.2 Proposal Content

Proposals must be for a complete investigation, based on clearly defined investigation objectives that address scientific questions appropriate for the Heliophysics missions linked back to Heliophysics Science Objectives (see B.1). 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, proposals must also provide sufficient information on the flight performance characteristic and the mission requirements in order to demonstrate the feasibility of the investigation.

2.2.1 *Science/Technical/Management Section*

The Science/Technical/Management (S/T/M) section of proposals submitted to this program element is limited to 20 pages. In addition to the requirements provided in the Checklist for Proposers, *Table 1 of ROSES-2024*, the S/T/M section must include the following information:

I) 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.

II) A traceability matrix from investigation-specific 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. This matrix provides the reference points and tools needed to track overall investigation requirements. A sample science traceability matrix is shown in Table B.9-1 of this program element. The science traceability matrix shall be included as a table within the S/T/M section. This matrix should summarize how the instrument performance requirements are a direct consequence of the proposed science questions and investigation objectives. The traceability matrix is a critical tool in both the evaluation of a proposed investigation as well as the management and implementation of a selected investigation.

III) If technology development and/or maturation is a component of the proposed investigation, then a technology summary section is required, as shown in Table B.9-2 of this program element (below). This section requires an assessment of the Technology Readiness Level (TRL) at the start of the proposed work, and the projected TRL at the conclusion of the proposed work. The TRL is a metric-based assessment of the maturation of technologies.

The NASA Technology Readiness Level definitions are provided at https://www.nasa.gov/pdf/458490main_TRL_Definitions.pdf. The primary technology area refers to the technology areas defined in the 2020 NASA Technology Taxonomy (https://www.nasa.gov/offices/oct/taxonomy/index.html).

Table B.9-2. An Assessment of Technology Benefits and Advancements

Primary Technology Area (TA)	Refer to NASA Space Technology Roadmaps. Provide TA number down to level 2 or 3.
Target Destination (The Sun, Earth, Moon, Mars, Others inside the Solar System, Outside the Solar System, Foundational Knowledge)	Select up to 3.
Start TRL*	
Estimated End TRL*	
Anticipated Benefits	

* Refer to https://www.nasa.gov/pdf/458490main_TRL_Definitions.pdf

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 in the mission requirements column of the traceability matrix, and supported by narrative discussion.

Reference for management of H-LCAS investigations is found in NPR 7120.8. Typically, management compliance of projects conducted under the NASA Sounding Rocket, Balloon, and Airborne Programs is ensured by their respective Program Offices.

IV) Student Participation and NASA Workforce Development

The participation of graduate students is strongly encouraged, especially if the project can be concluded within the nominal tenure of graduate training. In such cases, brief details of the educational goals and training of the participants should be included in the proposal. Specific factors that will be considered when evaluating a proposal's intrinsic merit include the degree to which it advances the readiness of participating personnel to assume new roles in achieving NASA's strategic

objectives. In addition to the specific case of graduate students, personnel development considerations also include post-graduate early career and mid-career personnel exploring new areas of work. Personnel development in the fields of spaceflight engineering and program management are also a consideration in this evaluation of workforce development.

2.2.2 *Open Science and Data Management Plan*

Proposals must provide an Open Science and Data Management Plan (OSDMP) that addresses how publications, "scientifically useful" data, and software will be made available, within the constraints of export control law and regulation, vendor proprietary information, and other regulations or constraints related to spaceflight vehicle performance data. See Section 1.6 of B.1 The Heliophysics Research Program Overview and the SMD Open-Source Science Guidance at http://science.nasa.gov/oss-guidance. However, even if the OSDMP convincingly argues that certain kinds of data should not be made available in general, the standard requirements regarding anything published still apply: all data behind figures and tables in peer reviewed publications must be made available at the time of publication, e.g., in supplementary material. Proposals must describe the management plan of any science data obtained in the investigation described. Proposals must discuss the release of data obtained in an investigation characterizing the performance of an instrument technology, although it is permissible to summarize this data. 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. The OSDMP is a separate 2-page section of the proposal, immediately following the references for the S/T/M Section and does not count against the S/T/M 20-page limit. Note that this text supersedes any conflicting text in B.1.

Note: Data returned from flight 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.

2.2.3 *Payload Reference Document*

A Payload Reference Document (PRD) will provide information that will allow NASA to best match the research payload needs with multiple compatible flight platforms and identify the greatest suborbital research capabilities and launch flexibilities possible. The PRD form will be available under “Other documents” on the NSPIRES page for H-LCAS, and will include questions like:

- Type of suborbital vehicle required (high-altitude balloon or rocket-powered vehicle)
- Approximate payload dimensions (width, height, length) [m]
- Approximate payload mass [kg] and power [W]
- Launch location(s)
- Flight date requirements
- Desired minimum altitude
- Desired duration for microgravity / observation

The PRD will not count against the page limit for the S/T/M section. The content of the PRD is not used to establish any portion of the scientific and technical merit of the proposed investigation. Please note that while proposers might express a provider preference, NASA has in the past - and will continue in the foreseeable future - to reserve the right to assign the flight provider.

a. Researchers requesting suborbital flight opportunities using NASA-provided platforms (either traditional sounding rockets or balloons, or NASA-procured commercial suborbital platforms) are not required to obtain quotes or cost-estimates for the requested suborbital/suborbital-class flight services, nor should the cost of the platform be included in the budget.
b. Proposers may negotiate their own launch services as part of their proposal (so-called Proposer-Provided commercial Suborbital Launch Vehicles – PPSLVs), in which case the PI is responsible for all aspects of that service contract including its full cost (see Sections VIII(b) and VIII(c)(iv) of *the ROSES-2024 Summary of Solicitation*). Note: The difference between PPSLV and the STMD FOP launch options it that the PI is responsible for the cost, negotiation and management of the launch services under the PPSLV while NASA takes responsibility for these aspects under STMD FOP. A proposer might consider the PPSLV approach in the case where an investigation is uniquely suited to a commercial launch service that is not currently listed as available via STMD FOP. However, before committing to this approach, the proposer may approach the FOP Point of Contact and inquire about the possibility of incorporating a new vendor option in the FOP since a core objective of this program is to support the development of new commercial launch opportunities.

2.2.4 Feasibility Letters

All investigations with unique requirements must obtain a letter of mission feasibility from the relevant program office point of contact (listed in Section VIII(c) of the *ROSES-2024 Summary of Solicitation*). Unique requirements include, but are not limited to, remote launch campaigns and constraints on the time/date of launch. The mission feasibility letter should be included in the proposal, after Current and Pending Support, per *Table 1 of ROSES-2024*. It does not count against the page limit for the S/T/M section.

2.2.5 *Budget*

To allow advance planning, all proposal Budgets must cover complete investigations, including payload development and construction, instrument calibration, launch activities, and data analysis. Proposals must supply information needed to generate an estimate of the costs associated with the operational requirements for the proposed investigation. For example, 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. 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 (BPO) directly for an estimate of the Government Furnished Equipment (GFE) cost of the desired support. It is advisable that PIs contact 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.

The budget narrative and details in the peer reviewed proposal should be redacted, i.e., not include salary, fringe, or overhead, see Section IV(b)iii of the *ROSES-2024 Summary of Solicitation* and the online budget FAQ. The NSPIRES cover page budget and separately uploaded total budget must be complete, not redacted.

3. Award Duration and Type

H-LCAS awards are expected to be three years, with a maximum of four years for investigations that require (and justify) the extra time. H-LCAS is not expected to award contracts as it would not be appropriate for the nature of the work solicited. Awards to non-governmental organizations are expected to be grants if only funds are provided. For flight investigations, grants are the funding instruments used when the proposer procures their own ride directly from an alternative (non-NASA) launch provider. Cooperative agreements are the funding instrument used when NASA provides or procures the ride. In the case of cooperative agreements, NASA's contribution to the investigation is primarily through providing or procurement of the ride, e.g., by covering outside of the PI-managed cost launch and launch vehicle integration costs for spaceflight launches.

ROSES proposals, including those to LCAS, do not result in separate awards to the Principal Investigator (PI) and Co-Investigators (Co-Is) of the same proposal at different institutions, except in those cases where a Co-Investigator is affiliated with a U.S. Government Laboratory or NASA Center, including JPL (see Section IV(d) of the *ROSES Summary of Solicitation*), 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 proposal will be accepted.

4. Evaluation Criteria

All proposals with be evaluated for Intrinsic Merit, Cost, and Relevance, as defined in Appendix D of the *2024 NASA Proposer's Guide* and consistent with Section V(a) of the *ROSES-2024 Summary of Solicitation* and B.1 the Heliophysics Research Overview. In addition, the evaluation of intrinsic merit will include the degree to which the proposed investigation advances the technology readiness level of a sensor or supporting technology, and the degree to which it advances the readiness of early-career researchers or graduate students to assume roles in advancing NASA's strategic objectives, see Section 2.2.1.

5. Summary of Key Information

Projected program budget for first year of new awards	$5M
Anticipated number of new awards pending adequate proposals of merit	5-7 Awards
Typical duration of award	3 years
Maximum duration of awards	4 years (with justification).
Neither a notice of intent nor a Step-1 proposal is requested	

Due date for proposals	See Tables 2 and 3 of this ROSES NRA
Planning date for start of LCAS Investigations	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of the proposal	20 pages, see Section 2.2.1. Does not include items in Sections 2.2.2 - 2.2.6.
Page limit for the Open Science and Data Management Plan.	2 pages, See Section 2.2.2
General information and overview of this solicitation	See the *ROSES-2024 Summary of Solicitation*.
General requirements for content of proposals	See B.1 The Heliophysics Research Program Overview, Section IV and Table 1 of ROSES-2024 and, finally, Section 2 of the *NASA Proposer's Guide*.
Detailed instructions for the submission of proposals	See NSPIRES Online Help, the *2024 NASA Proposer's Guide* and Section IV(b) of *the ROSES Summary of Solicitation*.
Submission medium	Electronic proposal submission is required; no hard copy is permitted.
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	https://www.grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH24ZDA001N-HLCAS
Point of contact concerning this program	Dan Moses Heliophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Email: dan.moses@nasa.gov