B.18 HELIOPHYSICS LIVING WITH A STAR TOOLS AND METHODS

NOTICE: Amended February 22, 2021. This amendment presents a new program element in ROSES-2021. Step-1 Proposals are due July 1, 2021 and Step-2 proposals are due August 31, 2021.

Each PI is limited to submit one and only one Step-2 proposal to this program element. Current and Pending Support must be included for all Co-Is, regardless of committed time to the project. The S/T/M section of Step-2 proposals is limited to ten (10) pages.

1. Scope of Program

This Heliophysics Living With a Star (LWS) Tools and Methods (LWSTM) Program solicits tools, techniques and/or methods that enable critically needed science advances in the area of heliophysics research covered by LWS objectives, see https://science.nasa.gov/heliophysics/programs/living-with-a-star. Proposed tools and/or methods must be "shovel-ready", that is, able to proceed expeditiously leading to completion in one and half years.

The specific context of this call is guided by the Science Mission Directorate's *Strategy for Data Management and Computing for Groundbreaking Science 2019-2024* with emphasis on improved ease and use and discoverability of data that enhance science applications and incorporates best practices and state of the art technologies utilizing deep learning, machine learning, and artificial intelligence and in applying these techniques, where meaningful, in a High-End Computing environment.

H-LWSTM is a component of the Heliophysics Research Program and proposers interested in this program element should read B.1, the Heliophysics Research Program Overview for Heliophysics-specific requirements. Defaults for all ROSES elements are found in the ROSES *Summary of Solicitation* and for all NASA solicitations in the *Guidebook for Proposers*. The order of precedence is the following: This document (B.18) followed by B.1, followed by the ROSES *Summary of Solicitation* and last the *Guidebook for Proposers*. Proposers should review all of these resources to ensure compliance with Program requirements.

1.1 Background

Data science, machine learning, cloud computing and the technologies and practices underlying them are an exciting era of scientific discovery with unprecedented volumes of science data available from observations from multiple spacecraft in all LWS science regimes, with prospects for even more observations with future missions. Furthering scientific understanding is predicated on integration or closure of the triad of theory to models to observations. Computer and information science and technology is a vital and often enabling capability in all elements of this triad.

The program element utilizes NASA data and other open-source datasets to surface new knowledge, accelerate new discoveries and support science workflows that are suited to applied artificial intelligence (AI) techniques to:

- Improve discovery and access for all heliophysics data to immediately benefit science data users and improve the overall user experience.

- Leverage current technology for the discovery, access, and effective use of NASA's data, as well as enable new technology and analysis techniques for scientific discovery in areas of heliophysics research covered by LWS objectives.

1.2 Solicited Investigations

H-LWSTM seeks innovative adaptations and applications of emerging AI techniques, concepts, methodologies, etc. to demonstrate their feasibility and potential to increase science return, as well as to inform missions in heliophysics research disciplines of promising techniques and capabilities.

The H-LWSTM program element is intended to allow heliophysics research to be an early, innovative, and less risk-averse adopter of AI tools and techniques, especially in areas with potential for high payoff, if successful.

Notional areas of interest for proposals to this heliophysics research program include, but are not limited to:

- Creation of homogeneous machine learning (ML)-ready datasets and related quality enhancement and standards.
- Historic restoration: To combine data from different instruments of different capabilities and turn them into a single, homogeneous, data set.
- Super-resolution: To combine data from imagers that have different resolutions to enhance the lower-resolution instrument
- High Signal to Noise Instruments: To use machine learning techniques to make expensive and advanced de-noising and image processing techniques inexpensive.
- High level data products: To use ML techniques to significantly speed up and simplify current high-level pipelines while avoiding the need to store the high-level data since the calculations can be done quickly and inexpensively.
- Optimal Algorithms for Compression and Decompression of data: Deep learning algorithms for the optimal compression of data that can be used to reduce the cost of storage and satellite downlink.
- Data/information synthesis and intelligent knowledge capture.
- Multidimensional data representation, visualization, and comparison.

1.3 Limitations in Scope

Proposals outside the scope of LWS Tools and Methods include the following:

- Proposals for the same or essentially the same work submitted concurrently to other program elements in Appendix B or F, as specified in Section 1 of B.1;
- Work for which the proposing organization (or investigators) are already funded by NASA. Proposals involving currently funded investigators must include a description in a separate subsection of the scientific/technical/management section that specifies how the new proposed effort is different and not duplicative with currently supported efforts;
- Proposals that are focused on science analysis or technology development.

Tool or model development that supports concurrent awards from other Heliophysics (Appendix B) program elements is acceptable as long as the specific development is not already covered by the concurrent award.

2. Submission and Evaluation Guidelines

2.1 General Considerations

Each Principal Investigator (PI) is allowed to submit one and only one proposal to this program element. Within the proposing team, the PI, Science PI, and Co-Investigators (Co-Is) must each have specific and defined tasks in the project, and the tasks must be essential to the completion of the project. Proposals may be declared noncompliant based on either the Step-1 or Step-2 proposal if they are outside the scope of the LWSTMprogram (see Section 1 above) or if they fail to meet submission guidelines specified below (Section 2.2-2.4).

2.2 Two-Step Submission Process

To provide adequate notice to potential reviewers, this program uses the "binding" two-step proposal submission process described in Section IV(b)vii of the ROSES *Summary of Solicitation*. See also Section 1.3 of B.1 the Heliophysics Research Program Overview. Those who are not familiar with the two-step process may refer to the "How to Submit a Step-1 Proposal" PDF under "Other documents" on the NSPIRES page for this program element.

In the two-step process a Step-1 proposal is required. Potential reviewers are solicited based on the Step-1 proposals. The proposal team members may not be changed between the Step-1 and Step-2 proposals, unless prior approval is obtained from the Program Officer of the element. The title and broad science goals of the proposal may not be changed such that they would significantly affect the scientific or technical expertise required to properly evaluate a proposal. Changes in a proposal that alter the title and/or broad science goals will result in a proposal being declared non-compliant.

2.3 Step-1 Proposals

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date given in Tables 2 and 3 of ROSES. The Step-1 proposal must be submitted by the organization's Authorized Organizational Representative (AOR). No budget or other elements are required. Only proposers who submit a Step-1 proposal are eligible to submit a full proposal.

Step-1 proposals will be checked for compliance, but they will not be evaluated. The expected format is described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later.

2.3.1 *Step-1 Proposal 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 this proposal is enabling and that are appropriate for Heliophysics LWSTM investigations.
- A brief description of the methodology to be used to address the science goals and objectives. This will include a description of the AI tools and techniques and the data set to be produced or improved.

No PDF attachment is required or permitted for Step-1 proposal submission. Proposers will be invited by NSPIRES when they are able to submit their Step-2 proposals.

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. This information can be supplied in response to NSPIRES cover page questions at the time of submission of the Step-1 proposal.

2.4 Step-2 Proposals

To be eligible, the 10-page (maximum) Step-2 proposal must be submitted electronically by the Step-2 due date (see Tables 2 and 3 of ROSES). The Step-2 proposal must be submitted via NSPIRES or Grants.gov by the organization's Authorized Organizational Representative (AOR). A budget and other specified information is required.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers who received a noncompliance letter are not eligible to submit a Step-2 proposal.

2.4.1 *Step-2 Proposal Content*

The process for preparation and submission of the Step-2 proposal is the same as that for any other ROSES proposal. Please refer to the "How to create and submit a Step-2 proposal" PDF under "Other documents" on the NSPIRES page for this program element. Guidelines for content and formatting Step-2 full proposals are specified in the ROSES-2021 *Summary of Solicitation*. Proposals must adhere to formatting requirements (e.g., margins, font sizes, line spacing).

The Scientific/Technical/Management section of Step-2 Proposals are restricted to ten (10) pages and must include the following sections with the preferred order:

- The science objective(s) that would be enabled with the completion of the tool or method and the perceived impact of the proposed work to the state of knowledge in the field of LWS, (see Section 1); references to existing work in the field should be limited to that needed to justify the value of the tool or method;
- The methodology to be employed in developing the tool or method; the proposal must demonstrate (1) that the methodology is both appropriate and feasible to make substantial progress on the tool or method and (2) that the validation of the tool and/or method is appropriate and makes use of relevant data;
- The relevance of the proposed work to heliophysics research covered by LWS objectives (see Section 1);
- 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. Postdoctoral fellows and students need not be named.
- The archive to which the tool or method will be submitted.

The Proposal Summary put into the NSPIRES cover page text box must include the following: the tool and/or method to be delivered; the archive to which it will be delivered (e.g., CCMC, data center, mission site, etc.); expected delivery date. Proposals that do

not include this information explicitly in the Proposal Summary will be deemed non-compliant and will not be reviewed.

Current and Pending Support must be provided for all Co-Is, regardless of committed time to the project.

2.4.2 *Step-2 Evaluation Criteria*

Compliant proposals will be evaluated according to the criteria defined in the *Guidebook for Proposers* and as specified in Section V(a) of the *ROSES Summary of Solicitation*. These criteria are Relevance, Merit, and Cost reasonableness. Clarifications and additions specific to this program element are listed below.

The evaluation of scientific and technical merit will include the following:

- Compelling nature and scientific priority of the proposed investigation's science goals and objectives that will be enabled by completion of the tool and/or method, including the importance of the problem within the broad field of Heliophysics and the importance of carrying out the development now.
- Appropriateness and feasibility of the methodology used to develop the tool and/or method, including the appropriateness of the validation and any relevant data.
- Preference will be given to projects that will be ready within 18 months or less.

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

Relevance to and priority within the LWSTM program will be assessed based on criteria discussed in Section 1. Each proposal must demonstrate that the investigation is relevant and of high priority.

The evaluation of cost reasonableness includes the amount of work to be accomplished versus the amount of time proposed. Only necessary Co-Investigators and Collaborators should be included, and their specific tasks and roles in the investigation must be clearly laid out.

3. Available Funds

It is expected that there will be approximately ~$2M available to support new Heliophysics LWS Tools and Methods investigations selected through this program element. Due to the expected 18-month duration, total funding for the duration is expected to fall in the range of ~$150-$190K per investigation.

4. Award Types

The H-LWSTM program will award funds through three vehicles: (1) grants, (2) interagency transfers, and (3) awards to NASA Centers. The H-LWSTM program will not award contracts.

5. Summary of Key Information

Expected Total Program Budget for entire duration of all awards	~$2M
Number of new awards pending adequate proposals of merit	~10-14

Maximum duration of awards	2 years
Due date for Step-1 proposal	See Tables 2 and 3 of this ROSES NRA
Due date for full Step-2 proposals	See Tables 2 and 3 of this ROSES NRA
Planning date for start of investigation	6 months after full proposal due date.
Page limit for the central Science-Technical-Management section of full proposal	10 pp; see also Table 1 of the *ROSES Summary of Solicitation* and Section 3.7 of the *Guidebook for Proposers*
Relevance	This program is relevant to the Heliophysics 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*.
General requirements for content of proposals	See Section 2.4 of this program element, Table 1 and Section IV of *the ROSES Summary of Solicitation*, and Section 3 of the *Guidebook for Proposers*.
Detailed instructions for the submission of proposals	See https://nspires.nasaprs.com/tutorials/ Sections 3.22-4.4 of the *NASA Guidebook for Proposers* 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 Step-1 and Step-2 proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and Step-2 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	NNH21ZDA001N-LWSTM
Point of contact concerning this program.	Lika Guhathakurta Heliophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1992 Email: madhulika.guhathakurta@nasa.gov