D.15 LISA PREPARATORY SCIENCE

NOTICE: Amended April 7, 2020. This Amendment adds this program element to ROSES-2020. Mandatory NOIs are due September 15, 2020, and proposals are due December 15, 2020.

This program requires a Notice of Intent (NOI). Proposals that are not preceded by the mandatory NOI may be returned without review. No feedback will be provided in response to the NOI. PIs must provide the names of their co-investigators and collaborators on the NOI for review planning purposes.

1. Scope of Program

1.1 Overview

NASA is partnering with the European Space Agency (ESA) on the ESA-led Laser Interferometer Space Antenna (LISA) gravitational wave observatory planned for launch in the early 2030s. LISA will detect gravitational waves in the milli-Hz band, opening a new window to study the Universe. LISA will measure gravitational radiation from a variety of astrophysical sources including the mergers of massive black holes, the capture of stellar-remnant black holes by galactic center black holes, close compact binaries in our own galaxy, and other potential sources. More information about the LISA mission can be found at https://lisa.nasa.gov.

NASA's specific contributions to LISA are the subject of ongoing discussions with ESA, but are expected to include elements of the instrument, elements of the spacecraft, and aspects of science data analysis and science interpretation, including potential Guest Investigator activities. While the development of hardware and ground-segment infrastructure is supported by NASA through the NASA LISA Study Office (NLSO) at NASA's Goddard Space Flight Center, this ROSES element concerns the support of U.S.-based investigators for developing tools and techniques for the analysis and interpretation of LISA data.

1.2 Program Objectives

The LISA Preparatory Science (LPS) program has been created to provide support for U.S. investigators to conduct activities that contribute to furthering the eventual science yield of LISA. It is not intended as a vehicle for funding specific U.S. contributions to the LISA instrument or science ground segment, or to develop concepts for other missions outside of LISA. Proposals to the LPS program may request support to:

- Perform high-fidelity simulations of the expected waveforms for LISA sources and assessing their impact on LISA's science return;
- Develop data analysis and statistical techniques useful for the extraction of scientific measurements from LISA data (e.g., parameter estimators, etc.);
- Refine and expand on LISA's capabilities to conduct specific astrophysical investigations and evaluate LISA’s potential contributions in the context of the broader astrophysical landscape;

- Conduct astrophysics investigations that demonstrably prepare for the analysis and interpretation of the LISA data.

Note that the NLSO is responsible for NASA's direct contributions to both the instrument and science ground segment. More information on the current activities of the NLSO can be found at https://lisa.nasa.gov/teamActivities.html. Proposers must ensure that the proposed investigations do not duplicate these activities. Proposals also must not duplicate previously funded LPS projects; for a list and brief description of prior LPS projects see https://lisa.nasa.gov/LPSprogram.html.

Proposals to the LPS program may not:

- Address topics that are predominantly theoretical in nature. Such proposals may be directed to the mission-specific programs or the Astrophysics Theory Program (ATP) described in Program Element D.4 of ROSES-2020;
- Consist primarily of data reduction or analysis of archival data other than that in direct support of LISA-centric investigations. Such proposals may be directed, as appropriate, to the mission-specific programs or the Astrophysics Data Analysis Program (ADAP) described in Program Element D.2 of ROSES-2020;
- Consist primarily of new astronomical observations. Such proposals may be directed to the mission-specific Guest Observer programs;
- Propose to develop technologies or experimental concepts for LISA;
- Request support for organizing and/or hosting scientific meetings. Such proposals may be directed to the Topical Workshops, Symposia, and Conferences (TWSC) program described in Program Element E.2 of ROSES-2020; or
- Request support for substantial computing facilities or resources.

1.3. Availability of High-End Computational Resources

Those investigators whose research requires high-performance computing should refer to the *ROSES Summary of Solicitation*, Section I(d), "NASA-provided High-End Computing Resources." This section describes the opportunity for the successful procedure that proposers must follow to apply for computing time on either of two NASA computing facilities at the Goddard Space Flight Center's Computational and Information Sciences and Technology Office or at the Ames Research Center's Advanced Supercomputing Division.

2. Programmatic Information

2.1 Eligibility

All U.S. Organizations are eligible to receive funding via this program element. Participants from non-U.S. institutions are eligible on a no-exchange-of-funds basis. Proposals from U.S. organizations with participants affiliated with non-U.S. institutions who have a significant role on a proposal must include a letter from their government agency or funding/sponsoring institution in their country indicating that they have the support to allocate the time promised to carry out the project.

One may not be funded twice for the same work. The LPS program is not intended to fund activities that should be supported by the NLSO. Those who will already be receiving NASA funding for LISA-related activities during the proposed period of performance (i.e., from the NASA LISA Study Office for the LISA Core Teams), may not participate on proposals submitted to this program element as funded or unfunded PIs or Co-Is, but may be collaborators. Questions regarding eligibility may be directed to the point of contact in Section 4.

2.2 Proposal Guidelines

Proposals must have a clear, single focus. All individuals participating in the proposed investigation should be included as Co-Investigators and Collaborators.

Investigators may submit more than one proposal if the research program of each proposal is significantly distinct and if the implied work does not over commit the personnel involved. The proposals must state clearly what the overlap is in the proposed work and why funding of both proposals is warranted and desirable.

Proposers of previously funded LPS projects must provide a status report on the funded activity and explain the relationship of the newly proposed project to the previously funded one. If the proposed project overlaps with a previous LPS proposal, the proposers must provide a justification of why additional funding and time is needed.

NASA does not anticipate awarding contracts in response to proposals submitted to this program element because it would not be appropriate for the nature of the work solicited.

Proposals must address items above. Any questions may be addressed to the point-of-contact dentified in Section 4 at least two weeks before the proposal due date. The anonymized questions and the answers will be collected by the Program Officer and posted on the NSPIRES page for this program element under "Other documents".

2.3 Additional Requirements

In addition to the default required proposal elements (as outlined in Table 1 of the *Summary of Solicitation*), including the new requirement regarding the data management plan (DMP) described in Section 1.1 of The Astrophysics Research Program Overview, Program Element D.1 of ROSES-2020, proposals for this program element must include the following in the Scientific/Technical/Management section:

- A brief description of how the goals of the proposed project relate and enhance the LISA science goals;
- A description of how the proposed project complements and augments other currently funded LISA science projects of the PI and CoIs, if any;
- A description of how the proposed project complements and/or augments activities of the NASA LISA Study Office and prior funded LPS investigations, if applicable (see https://lisa.nasa.gov/).

2.4 Mandatory Notice of Intent

To facilitate the early recruitment of a conflict-free review panel, a Notice of Intent (NOI) to propose is required for all submissions to this Program Element. Proposals that are

not preceded by an NOI will be returned without review. The proposers are strongly encouraged to finalize their team's composition before submitting the NOIs. The NOIs will be used to recruit non-conflicted reviewers, and any later changes to the Team composition would hinder this effort. The PI is strongly encouraged to list the names of all their Co-Investigators and Collaborators on the NOI. If additions to the Team composition are made after the submission of the NOI, the proposers must inform thomas.hams-1@nasa.gov as soon as possible, but no fewer than four weeks in advance of the proposal due date.

The period of performance of investigations for this research element is restricted to a maximum of three (3) years. Projects of three-year duration must be well justified, shorter duration projects are allowed.

2.5 Proposal Evaluation and Awards

The default evaluation process is described in Section VI(a) of the *ROSES Summary of Solicitation* and the three basic criteria, defined in Appendix D of the *NASA Guidebook for Proposers*, are Relevance, Merit, and Cost. For this program element the evaluation of Merit will include:

a. How well the investigation goals relate to or advance the LISA science requirements, as outlined in the LISA mission proposal (available at https://lisa.nasa.gov/documentsReference.html);
b. The merit of a plan for disseminating the results of the research project to the broader community;
c. If development of analysis tools is being proposed, the availability and usefulness of the tools developed under the award for the astronomy and astrophysical scientific community at large for engaging in LISA science, and the timeline for their release. Note that software, whether a stand-alone program, an enhancement to existing code, or a module that interfaces with existing codes, created as part of an LPS award, should be made publicly available when it is practical and feasible to do so, and when there is scientific utility in doing so.

In addition, as part of the evaluation of relevance, the peer review panel will assess:

d. The extent to which the proposed project overlaps or duplicates LISA efforts ongoing in the NASA LISA Study Office or prior funded LPS invstigations as described at https://lisa.nasa.gov/teamActivities.html;
e. The extent to which the proposed project overlaps or duplicates funded LPS projects, past or ongoing, as listed at https://lisa.nasa.gov/LPSprogram.html.

For items d) and e), please contact thomas.hams-1@nasa.gov when in doubt.

3. Reporting

For each year of the investigation period, the PI shall prepare a standard annual progress report (See SARA web page for more information), and submit it at least 60 days before the anniversary of the start date. The title and abstract of the funded LPS proposal, at a minimum, will be made available on https://lisa.nasa.gov.

NASA HQ may organize a special session for LISA Preparatory Science at a future meeting or science conference. If such a session is organized, the PIs or designated

team members of the selected proposals shall give an oral or poster presentation with the results of their LPS projects. Proposers should plan for at least one domestic trip in their proposed budgets to attend a future NASA HQ organized LISA Preparatory Science special session.

4. Summary of Key Information

Expected program budget for first year of new awards	~$1M
Number of new awards pending adequate proposals of merit	~4-6
Maximum duration of awards	3 years; shorter-term proposals are encouraged
Due date for mandatory Notice of Intent to propose (NOI)	See Tables 2 and 3 of this ROSES NRA
Due date for proposals	See Tables 2 and 3 of this ROSES NRA
Planning date for start of investigation	October 1, 2021
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Table 1 of ROSES and 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	Please see *Section I(g)* Order of Precedence and Table 1 of the ROSES *Summary of Solicitation* and the *NASA Guidebook for Proposers.*
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted.
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	NNH20ZDA001N-LPS
Point of contact concerning this program	Thomas Hams Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-5162 Email: thomas.hams-1@nasa.gov