



Technology Advancement and Applied Research Leveraging the ISS
National Lab

ISS National Lab Research Announcement (NLRA) 2022-5 CYCLE 2

Instructions to Offerors

Center for Advancement of Science in Space, Inc.

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Issuance Date: December 7, 2021

Cycle 1:

End Date of Step 1: Concept Summary submission period: February 14, 2022

Due Date for Step 2: Full Proposal submission: May 2, 2022

Cycle 2:

End Date of Step 1: Concept Summary submission period: August 8, 2022

Due Date for Step 2: Full Proposal submission: October 17, 2022

*Note: For any updates regarding submission deadlines, please visit www.issnationallab.org/nlra2022-5.
For general questions relating to this research announcement, please contact info@issnationallab.org.*

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I. SUMMARY

The International Space Station (ISS) is a one-of-a-kind laboratory that enables research and technology development not possible on Earth. As a public service enterprise, the ISS National Laboratory allows researchers to leverage this multiuser facility to improve quality of life on Earth, mature space-based business models, advance science literacy in the future workforce, and expand a sustainable and scalable market in low Earth orbit (LEO).

Through this orbiting national laboratory, research resources on the ISS are available to support non-NASA science, technology, and science, technology, engineering, and mathematics (STEM) education initiatives from U.S. government agencies, academic institutions, and the private sector. The Center for the Advancement of Science in Space, Inc. (CASIS) manages the ISS National Lab, under Cooperative Agreement with NASA, facilitating access to its permanent microgravity research environment, a powerful vantage point in LEO, and the extreme and varied conditions of space.

As a U.S. taxpayer-funded organization, CASIS only contracts with U.S. Persons, as defined by the Code of Federal Regulations at 22 CFR §120.15. Submitted proposals must be compliant with all U.S. Export Administration Regulations (EAR) and International Traffic in Arms Regulations (ITAR). This document will assist offerors in the development of quality proposals to leverage the ISS for applied research and technology development and demonstration.

II. DESCRIPTION OF RESEARCH

This ISS National Lab Research Announcement (NLRA) is soliciting proposals that seek to demonstrate applied research and development (R&D), translational medicine, technology readiness level (TRL) maturation, and technology demonstration in a broad range of existing or emerging technology areas. Research projects are desired for which space-based testing can uniquely enable technical solutions to known or new science and engineering challenges and for the creation of new products and business opportunities. The objective is to use the unique ISS environment to develop, test, or mature products and processes that have a demonstrated potential to produce near-term, positive economic impact.

The ISS National Lab enables long-term studies within the unique, persistent microgravity environment inside the ISS. When gravity is no longer a dominant physical force, myriad unique effects on physical and biological systems and phenomena are induced, enabling new capabilities of these systems that can be exploited to develop and demonstrate new technologies. Technology Development studies utilizing the extreme conditions of the LEO environment may be conducted using facilities externally attached or within the ISS. Refer to this document's section, "Additional ISS Facilities," for ISS facility descriptions and additional information. Offerors' proposals may seek to develop new ISS National Lab facilities for Technology Development applications.

To be competitive, all responsive proposals must demonstrate sound rationale for the use of ISS National Lab resources and must have a well-defined path to specific industrial applications. Technologies proposed for testing should generally be beyond basic concept validation and instead focus on seeking technological maturity through development and/or demonstration in the space environment. Desirable flight experiments will target raising the TRL from 4 or higher to 6 or higher (see Appendix A for a description of TRL). Ideally, it is desired that the results of flight experiments will rapidly enable a commercial offering of new technologies or products to end users.

Of particular interest are proposals within the areas of hardware development/proliferation and process improvement investigation using ISS remote sensing data for geospatial analytics production with commercial use as an intent, as well as operationalizing spaceflight R&D by utilizing ISS edge computing and Earth-based cloud computing. However, this NLRA is open to a broad range of additional proposal topics including but not limited to areas focusing on material synthesis or bonding and translational medicine.

Background

Microgravity

The ISS National Lab offers the opportunity to conduct long-duration experiments in persistent microgravity, where gravity-driven physical forces are nearly absent. Results of research inspired by microgravity-driven phenomena have been shown to provide new practical insights and tangible benefits to multiple, cross-cutting life science, physical science, and engineering fields and areas of industrial application.

LEO Extreme Conditions

The ISS National Lab supports a variety of facilities and hardware to exploit the extreme LEO environment for development and testing of new materials, devices, and subsystems. Such testing provides a mechanism for rapid failure and analysis, thereby accelerating the qualification and commercial readiness of these new devices and products.

Innovative concepts may also be proposed to specifically demonstrate the effective use of external LEO vacuum, radiation, and/or thermal cycling in a space-based industrial process, or to demonstrate and qualify new technologies involving robotic operation and assembly. For more information on the effects of these conditions of the space environment, see NASA's [A Researcher's Guide to Space Environmental Effects](#).

Vantage Point

The ISS offers a vantage point in LEO with unique opportunities for technology development and demonstration in remote sensing. The ISS orbits at an average altitude of 400 km (250 miles), offering a wide range of Earth viewing geometries and spatial resolutions for sensors mounted on the externally attached platforms. Sensors may also be mounted inside the ISS with access to observation windows offering Earth-facing or other orientations. The orbital inclination of 51.6 degrees covers approximately 90% of Earth's populated area every 90 minutes and allows revisits of the same targets every three to five days. The ISS offers variable illumination conditions for Earth viewing and similar solar illumination conditions approximately every 63 days.

For more information about the benefits of R&D in space, see www.issnationallab.org/research-on-the-iss/areas-of-research.

ISS National Lab Implementation Partners, Facilities, and Capabilities

Offerors should be familiar with the capabilities of flight hardware for in-orbit studies that are relevant to their proposed objective. The ISS National Lab partners with a variety of Implementation Partners, organizations that provide research, engineering, and technical services—and, in some cases, operate

and maintain commercial payload facilities on the ISS, to support and facilitate flight projects. For details about these providers and their specific hardware/services, visit our [Implementation Partner database](#). Where applicable, the ISS National Lab encourages contact between offerors and Implementation Partners prior to concept or proposal submission in order to obtain information that may be useful for budget and schedule estimates. If requested, the ISS National Lab can facilitate contacts between Implementation Partners and offerors. Proposals to utilize facilities owned and operated by international partners will not be considered for this research announcement.

Relevant ISS Facilities

Multiple ISS facilities and services to support this technology development NLRA are available. Facilities and services may be provided by NASA or by ISS National Lab Implementation Partners. A listing and descriptions of current or soon-to-be available facilities on the ISS can be browsed on NASA's [Space Station Research Explorer](#) web tool. Detailed descriptions of facilities are also provided in NASA's [ISS Researcher's Guides Series](#). Additional information on physical science flight investigations sponsored by NASA is available in the NASA [Physical Sciences Informatics System](#). Information on commercial facilities and services for technology development applications in microgravity is available from organizations listed in the [Implementation Partner database](#).

Research and Technology Development Objectives or Priorities

ISS National Lab applied research and technology development is intended to validate technological breakthroughs and rapidly advance the development of new Earth or space-based products to bring value to our nation and drive a robust, sustainable, and scalable LEO economy. These objectives will be achieved by successfully executing flight experiments utilizing microgravity, the extreme conditions in LEO, or the vantage point of the ISS. Proposals must include a statement defining how the scientific aims will benefit from being executed in space and why the proposed investigation can only be performed in space. Responsive proposals must describe how successful space-based experiments will quickly advance the technology or product toward a viable market offering. The ISS National Lab strongly recommends obtaining and submitting letters of support from commercial partners and/or potential users of new technologies or products to demonstrate feasibility or commercial interest, when applicable.

Additionally, emphasis will be placed on proposals for testing and space-qualification of hardware prototypes and on advancing process improvements. Suggested concepts under these areas are described below:

- **Hardware prototype testing:** Innovations addressing hardware product development gaps and emerging technology proliferation in the following areas: computing, electronics, nanotechnologies, robotics, sensors, communications, space-based quantum communication, remote sensing, and satellite technology (assembly, inspection, refueling, operations, and in-orbit servicing). Proposals of interest in this area will typically feature ground-tested, ready-to-fly hardware prototypes that require space qualification to capture new market opportunities.
 - Sensors are either hosted on external platforms or mounted inside the ISS where targets on Earth or in space may be viewed through observation windows. Past and current remote sensing instruments include commercial off-the-shelf (COTS) high-resolution cameras and prototypes of a variety of sensor technologies including hyperspectral, multispectral, and light detection and ranging (LIDAR). Sensor data have been used to demonstrate several commercial and practical applications, such as the monitoring and mitigation of

environmental pollutants (methane and carbon dioxide) from chemical processing facilities; measurement of atmospheric carbon dioxide; monitoring of cloud and aerosol characteristics to aid understanding of climate and weather patterns; monitoring and optimization of agricultural practices; analysis of ocean and forest ecosystems; and assistance with disaster relief. Proposals for remote sensing should indicate novel features of new sensors to be tested and describe how the data acquired from new or existing sensors will be used to generate products of commercial value. For more information on the remote sensing features of the ISS, see NASA's [A Researcher's Guide to Earth Observations](#).

- **Process improvements:** Use of the ISS as a test bed for advancing development of facilities for high-throughput investigations; use of spaced-based data to facilitate modeling or operations of industrial systems; and demonstrating new methodologies for spaceflight research and development (e.g., combinations of ISS edge computing and Earth-based cloud computing), including the use of robotics/automation and artificial intelligence.
- **Advanced materials:** Current advanced materials research addresses the development of next-generation production methods, the synthesis and testing of novel materials, and the exploitation of mechanisms involved in material transformations for production of new materials with unique characteristics.
 - Potential topic areas of interest under this NLRA include but are not limited to material bonding (e.g., soldering, brazing, or welding); biomaterials; soft materials (e.g., emulsions, foams, or liquid crystals); metamaterials; granular materials; and hard, functional materials with unique microstructure (e.g., metal alloys, semiconductors, ceramics, glassy alloys, metallic foams, or composites).
- **Translational medicine:** Potential topics for consideration in translational medicine include validation of accelerated disease models, analyzing macromolecular structures for structure-based drug design, and demonstration of novel drug delivery and diagnostic devices.

III. SUBMISSION AND SELECTION PROCESS

This research announcement will follow a two-step proposal submission process. Before being invited to submit a full proposal, all interested investigators must first complete and submit for review a Step 1: Concept Summary. The purpose of Step 1 is an initial evaluation of the offeror's concept for operational feasibility, scientific or technological scope, compliance, and alignment with the research announcement scope.

Step 1: Concept Summary Submission

- Concept summaries must use the template provided on the research announcement webpage.
- Concept summaries may be submitted and will be received, evaluated, and potentially approved continuously during the research announcement open period.
- A CASIS internal review team with representatives from science, business, operations, and compliance will evaluate each concept summary. Approved concept summaries will be invited to submit a full proposal.
- Concepts approved based on Step 1 evaluation will proceed to Step 2 by invitation only.
- Concepts not invited to submit a full proposal will receive feedback.
- If your proposal is a resubmission from a previous research announcement, you must identify it as a resubmission in your Step 1 concept summary. Address the feedback provided in your prior submission(s) in your Step 2 proposal.

Step 2: Full Proposal Submission

- The process for developing full proposals is outlined below and set forth in greater detail within the Proposal Instructions published on the research announcement webpage.
- Full proposals will be evaluated in accordance with proposal evaluation documents provided as attachments.
- At the end of Step 2, the proposals recommended for selection will be presented for final determination to the CASIS Chief Executive Officer, who is the selecting official.

Further details and requirements on concept summary and full proposal submission, including instructions and templates, can be found in the Proposal Instructions document available on the research announcement webpage at www.issnationallab.org/nlra2022-5.

Award Information

CASIS may award a funded or unfunded agreement for a selected proposal. All awarded proposals will receive ISS National Lab sponsorship of ISS resource utilization, payload launch to the ISS, in-orbit ISS crew time, data return, and payload return, if required. Grant funding is not available for ground-based efforts.

Funds Availability: The obligation of CASIS to make an award is contingent upon the availability of funds from which payment can be made. The number of grants awarded and the amount of grant funding for each award will depend on the number of meritorious applications.

Funding for this Research Announcement: The total set aside funding for this research announcement is approximately \$1 million, with an expectation to make two to four awards. CASIS funding is to be allocated to support Implementation Partner mission integration and operations costs only. It is anticipated that CASIS will execute task orders and/or subcontracts directly with the Implementation Partner on behalf of the awarded principal investigator. No funding will be granted to cover the offeror's internal project costs. Requesting funding for cost elements not covered by this NLRA is grounds for disqualification. CASIS reserves the right to refuse award of grant if no meritorious offers are received.

Notice of Award: For selected proposals, a CASIS officer will contact the principal investigator named in the proposal. Offerors have the right to be informed of the major factor(s) that led to the acceptance or rejection of their proposal.

Period of Performance: It is anticipated that the period of performance will be no longer than three (3) years from date of award.

CASIS assumes no liability (including bid and proposal costs) for cancelling this NLRA or for any entity's failure to receive notice of cancellation.

IV. PROPOSAL PREPARATION AND CONTENT

The Step 1: Concept Summary instructions and the Step 2: Full Proposal submission guidelines can be found in the Proposal Instructions available on the ISS National Lab research announcement webpage.

Before finalizing proposals, offerors are strongly encouraged to consult with the ISS National Lab Payload Operations team (Ops@ISSNationalLab.org) for feedback regarding feasibility and compliance with flight requirements and capabilities. Please include reference to NLRA 2022-5 in the subject line

and note that questions and answers will be posted on the ISS National Lab website. Offerors are also encouraged to work with an Implementation Partner—organizations that work with the ISS National Lab to provide services related to payload development. There are two ways to do this:

- Visit www.issnationallab.org/implementation-partners to browse, select, and contact an Implementation Partner.
- Contact the ISS National Lab Payload Operations team for guidance.

Offeror Qualifications

Proposals must be submitted by a principal investigator or an authorized official of the proposing organization. Any individual business entity or institution capable of executing the proposed research may submit a proposal. However, CASIS will **ONLY** consider proposals from U.S. persons (business or individual), as defined by the Code of Federal Regulations (22 CFR §120.15).

V. PROPOSAL EVALUATION AND SELECTION

Proposals will be evaluated under the CASIS review and selection criteria for the ISS National Lab's technology development and demonstration line of business. The proposal evaluation factors are scientific and technical merit, business and economic merit, funding and resource commitment, implementation and commercialization feasibility, and operations and ISS utilization. These factors will be used to evaluate each proposal. Each factor is numerically weighted and scored. Project cost is not scored but is a factor in the final selection. All proposals submitted must include an expressed commercial purpose or intent. Proposals that are determined to better fit other CASIS research announcements will be redirected to those areas.

Please note that CASIS will not accept or consider proposals submitted by NASA or NASA civil servants.

The proposal review is guided by an overall assessment of expected project impact upon successful completion of proposed objectives. CASIS has overall responsibility for conducting and facilitating reviews, presenting information for final determination, and ensuring compliance with CASIS-defined processes. For further information on proposal evaluation and selection, including the relative importance of each evaluation factor, refer to the ISS National Lab Proposal Evaluator Instructions in the information package linked to the research announcement webpage.

VI. CONTRACTING

To be considered, proposals must be received from U.S. persons and U.S. entities, as defined in the Code of Federal Regulations ([CFR](#)), and must be compliant with ISS National Lab export control programs and policies.

Award recipients will be required to enter into a User Agreement or Grant Agreement with the Center for Advancement of Science in Space, Inc. (CASIS). As a nonprofit corporation doing business with the federal government via a Cooperative Agreement with NASA, CASIS is contractually bound, and bound by federal procurement law and regulations, to flow down to award recipients various contractual obligations that are in the CASIS Cooperative Agreement with NASA. The obligations are regulated in part by the Federal Acquisition Regulations (FAR), 48 C.F.R., as well as NASA-specific regulations. Mandatory clauses are non-negotiable and cannot be removed from CASIS User Agreements or Grant Agreements. If an award recipient does not desire to, or cannot, comply with mandatory flow down

clauses, the awardee should not accept the award opportunity. These terms and conditions from the NASA Cooperative Agreement will apply to all Grant Agreements (funded) and User Agreements (unfunded). The documents listing the mandatory flow down provisions contained in a User Agreement and Grant Agreement are provided as part of the Step 1 and Step 2 zipped documents made available to offerors via the CASIS web page for this research announcement. For further information on contracting, see the document, "Submission Instructions and Evaluation Overview for Proposals in Technology Development/Demonstration."