



Lunar Science Rideshare Mission (*Luna Ride*) Request for Information (RFI)

<u>Solicitation Number:</u>	MSSI22LMVA01
<u>Response Window Opens:</u>	November 4, 2022
<u>Response Window Closes:</u>	March 03, 2023

Summary

The MILO Space Science Institute (MILO) actively seeks collaborations with international partners based on their unique capabilities and mutual scientific goals to participate in a Lunar science rideshare mission, ***Luna Ride***. MILO will work with respondents who are interested in deploying payloads to the surface of the Moon on the Lockheed Martin Lunar Mobility Vehicle (LMV; Figure 1).¹ The *Luna Ride* mission will include transportation, communication, support for survivability, and deployment of payloads onto the lunar surface. We seek responses and indications of interest from nations or organizations with mature space flight heritage as well as from those with relatively new, and perhaps growing, space agencies and/or ecosystems. The MILO Project Office supports mission concept design and operations, identification of science objectives, and access to test facilities and subject matter experts with deep space mission experience to minimize risk. *Luna Ride* offers respondents the opportunity to advance lunar surface science, demonstrate science-focused engineering capability, and grow regional space capacity through access to hands-on instrument development, test, and operations.



Figure 1. The Lockheed Martin Lunar Mobility Vehicle (LMV) enables unprecedented exploration of the Moon with autonomous, telerobotic, and manual operation. Credit: Lockheed Martin.¹

The MILO Space Science Institute is a non-profit research collaborative led by Arizona State University (ASU), with support from Lockheed Martin. MILO was founded to enable more scientists, engineers, and students, including those with a range of experience levels, to design, develop, and participate in missions with high science return. MILO's primary objectives are to create access to space exploration, build up



The MILO Institute, Luna Ride Mission Request for Information

local space science ecosystems, and to develop the next generation of space science investigators. MILO offers value to its partners with opportunities for scientists, engineers, and new space industry to develop

1. <https://www.lockheedmartin.com/en-us/news/features/2021/lunar-terrain-vehicle.html>

mission concepts, build instruments, and participate in mission operations to advance space science and discovery.

MILO seeks to engage governmental agencies, universities, industry, and philanthropic and non-profit organizations around the world who will participate in exploration of the Moon via the *Luna Ride* mission. A full suite of mission services is being offered to the consortium of partners, including launch, surface landing, payload delivery or relocation, supply of power and other resources, and data/telemetry downlink and processing services. Data from *Luna Ride* payloads will be sent to the Lunar Mission Operations Center at ASU, with real-time forwarding to respondent's designated locations.

Background

Over the past three years, MILO has engaged with 140 international universities, 35 space agencies, along with numerous investors and new space companies to better understand the challenges in growing the space supply chain and space science and technology workforce. We have heard multiple stories about obstacles that colleagues consistently encounter. These include lack of opportunities to participate in space science missions, limited access to affordable hands-on training from experienced organizations, limited understanding of mission process training, and the inability to achieve the technology maturation needed to achieve flight readiness.

To prepare and advance the global emerging space economy, MILO has developed a series of capacity building programs² to prepare clients for participation in space missions. The programs leverage the space heritage at ASU, which has been at the forefront of space innovation since the dawn of the space age.³ ASU has designed and built a wide array of instruments enabling scientific research throughout the solar system⁴, including instruments for Europa Clipper, Lucy, Artemis 1, Lunar Reconnaissance Orbiter, Mars rover Perseverance, Mars Odyssey, OSIRIS-REx, and the Korean Pathfinder Lunar Orbiter, among others. Core research facilities contain the latest equipment and tools, including capabilities for instrument testing and calibration, rapid prototyping, mission design and mission control. Resources can be made available to participants of the Luna Ride mission.

Participants in *Luna Ride* will develop science instruments that fly on missions through a ride share business model. The contemporary approach to space offers access to unparalleled capabilities on the LMV with unprecedented cost savings for individual participants. Savings are realized through cost sharing from multiple payloads, mission infrastructure as a service, and economies of scale realized through LMV's Aerospace and Automotive heritage. The dramatic reduction in the cost of lunar exploration opens access to the moon for many new participants, including university space programs, small businesses, and other non-traditional organizations.

Intended Audience and Participation Levels

This RFI solicits responses from any organizations or institutions interested in participating in lunar surface science or science-focused engineering development investigations carried by LMV. MILO is seeking to build a consortium of members interested in lunar surface instrumentation and experience and offers multiple levels of participation to accommodate a wide variety of available budgets. For example, respondents could express interest in:



1. Building and flying your own instrument investigation in the 2 to 20 kg range
2. Purchasing low-cost science instruments from ASU that are derived from previous high-heritage lunar and planetary deep space missions

2. <https://miloinstitute.org/workforce-development/>

3. <https://miloinstitute.org/timeline/>

4. <https://space.asu.edu/exploration>

3. Participating in the analysis and scientific interpretation of data obtained by other MILO member instrument investigations carried by the autonomous vehicle

MILO will also consider other kinds of participation, as defined by respondents to this RFI and tailored to their specific circumstances and in-country requirements. As an example, payloads can also support experiments and demonstrations of engineering systems and technologies that could potentially directly enable or enhance new science in the future.

Requested Response Topics

Thirteen small regions within 6° of latitude from the Moon's south pole have been selected as the location for the Artemis III human landing site and the subsequent Artemis Base Camp.⁵ While details are still TBD, it is likely that an autonomous vehicle will be deployed to these regions in advance of Artemis III to perform scientific discovery missions. The thirteen candidate landing regions for Artemis III will permit:

- Access to persistently illuminated areas of the Moon
- Potential access to surface-accessible volatile deposits (like water ice) that can be extracted for large-scale resource utilization

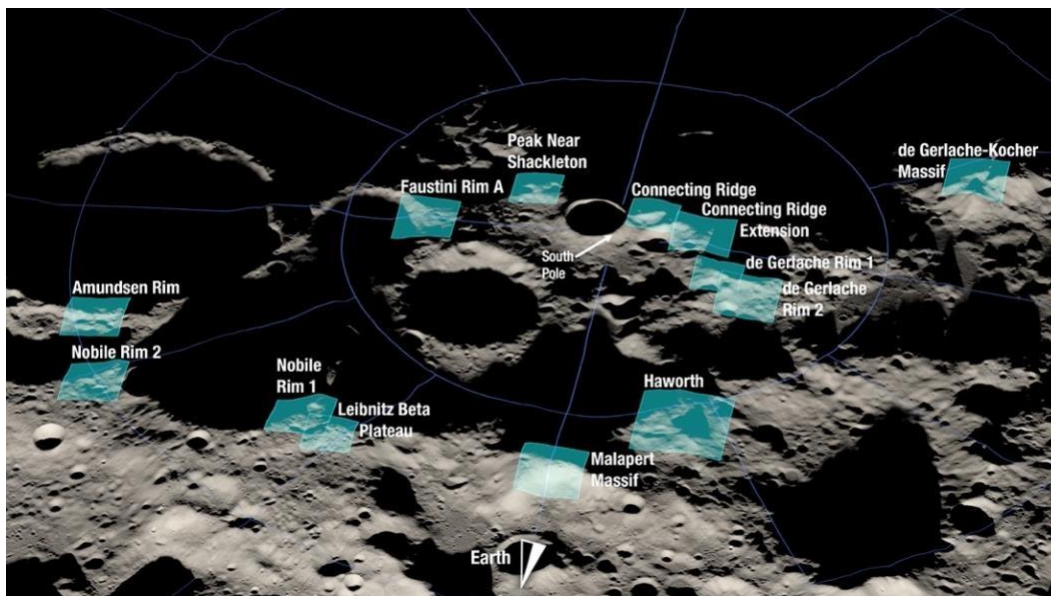


Figure 2. Location of the thirteen candidate landing regions for Artemis III. Each landing region is approximately 15 square kilometers. A landing site is a location within these regions with an approximate 100-meter radius. Credit: NASA.⁵

MILO requests descriptions of an instrument and/or mission concept that can be deployed on or from the LMV and that will significantly advance internationally-recognized lunar science goals (as defined in, for example, consensus reports like the U.S. National Academy of Sciences recent Decadal Survey of



The MILO Institute, Luna Ride Mission Request for Information

Planetary Sciences report⁶, or the 2007 Scientific Context for the Exploration of the Moon report⁷, or other similar documents) and/or NASA's Artemis Science Plan.⁸ The Artemis Science Plan defines a number of overarching science objectives for the entire Artemis program, spanning all Artemis missions up to and including activities at the Artemis Base Camp.

5. <https://www.nasa.gov/press-release/nasa-identifies-candidate-regions-for-landing-next-americans-on-moon>

6. <https://nap.nationalacademies.org/read/26522/chapter/1>

7. https://www.nap.edu/catalog.php?record_id=11954

8. <https://www.nasa.gov/sites/default/files/atoms/files/artemis-iii-science-definition-report-12042020c.pdf>

The Artemis Science Plan objectives are:

- | | |
|---|---|
| 1. Understanding planetary processes | 5. Observing the universe from a unique location |
| 2. Understanding volatile cycles | 6. Conducting experimental science in the lunar environment |
| the impact history of the Earth-Moon system | 7. Investigating and mitigating exploration risks to humans |
| 4. Revealing the record of the ancient Sun | |

The LMV will be rated for full, Level 5 autonomous operations, and will provide standardized mech/data/power interfaces and high data rates. A robotic arm is capable of interfacing with payloads & surface. The rover will allow payloads to survive the lunar night. The concepts sought in this RFI will take advantage of the unmatched capability and extended operational lifetime offered by LMV.

MILO will integrate a variety of science instruments, with masses expected to range from approximately 2 to 20 kg, into a container. The container will provide power, data networking, and a stable mechanical structure for individual instruments. Integrated payloads with mass greater than 20 kg are potentially acceptable, pending additional detailed discussions. The concept of operations (CONOPS) for the payloads should support operations over two lunar days and one lunar night.

Following the initial responses solicited here, MILO will conduct one-on-one meetings with respondents to discuss more details of each potential instrument and/or mission investigation. These meetings will allow for exchange of technical and resource information and will provide an opportunity for respondents to provide feedback on preliminary requirements and acquisition approach. If desired, MILO will keep the identities and other details of the respondents and their potential investigations/missions anonymous and proprietary. To the full extent that it is protected pursuant to U.S. laws and regulations, information identified by respondents as "Proprietary or Confidential," "Competition Sensitive," and/or "Sensitive but Unclassified" will be kept confidential.

This RFI is being used to obtain information for planning purposes only. Responses to this notice are not considered offers and are non-binding. This information is being made available for market research, information, and planning purposes and to allow the broader community the opportunity to verify reasonableness and feasibility of the *Luna Ride* mission. This RFI is subject to review or cancellation at any time and is not to be construed as a commitment by MILO to enter a contract. MILO will not pay for the information submitted in response to this request.

It is emphasized that the MILO is not a funding organization and does not sponsor missions. This RFI is NOT a Request for Proposals, nor is it an Invitation for Bid. Participation in the *Luna Ride* mission would require the cost of services be covered by the respondents. However, we note that these costs would be significantly reduced compared to dedicated launch and deployment of individual respondent instrument or mission payloads due to the cost sharing nature of MILOs consortium and rideshare model. *This*



Request for Information (RFI) does not constitute a commitment, implied or otherwise, that the MILO Space Science Institute will act in this matter.

Requested Information

On a strictly voluntary basis, respondents may submit confidential or proprietary information. Respondents SHOULD NOT submit export-controlled information, including information subject to the restrictions outlined in the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). Note that it is the respondent's responsibility to determine whether any submitted information is subject to the provisions of ITAR or EAR. Information about U.S. export regulations is available at <http://www.pmddtc.state.gov/> and at <http://www.bis.doc.gov/>.

Responses should contain the following information:

1. Name and contact information of primary point of contact for the submitter and all Co-Investigators/Collaborators on the RFI response (institutional affiliations, E-mail addresses).
2. A clear and succinct description (1 page or less) of the science objectives that will be addressed.
3. A clear and succinct description (1 page or less) of the Concept of Operations (CONOPS) to achieve the science objectives.
4. A specific indication and description (1 page or less) of the level of participation desired:
 - 4.1. Development of your own scientific instrument/mission investigation
 - 4.2. Purchase of a high-heritage scientific instrument from ASU
 - 4.3. Participation in the mission's science data return
5. If you wish to develop your own scientific instrument or mission investigation, please also answer the following questions using no more than 3 pages of text and/or figures as appropriate:
 - 5.1. What are the physical dimensions of the envisioned scientific instrumentation or integrated payload, including mass and volume?
 - 5.2. What are the operational requirements of the envisioned scientific instrumentation or integrated payload, including data transmission rate, power requirements, deployment or mobility requirements, and any other relevant requirements.
 - 5.3. Can you describe and justify the approximate technology readiness level(s) (TRL) of the scientific instrumentation or integrated payload?
 - 5.4. Do you anticipate needing assistance with mission concept design, access to subject matter experts with deep space mission experience, access to test/calibration facilities, and/or support for mission operations?
6. Please provide information and relevant details (1 page or less) about the anticipated sponsor organization/institution that will support the cost of services for the proposed *Luna Ride* instrument and/or mission investigation. Please include the anticipated impact on the responder's national space-related goals, the local space ecosystem, university/educational programs, and/or industry/workforce programs.

Response Instructions

The response window opens November 4, 2022.

All responses must be received by 11:59 p.m. U.S. Pacific Standard Time on March 03, 2023. The RFI response must be a PDF-formatted document under 10MB that is uploaded to the RFI submittal page. All responses must adhere to the following formatting requirements:

Length: 8 pages or less



**The MILO Institute, Luna Ride Mission
Request for Information**

Page size: 8.5" x 11.0" paper size

Paragraph: Single-spaced, single-column text with no more than 5.5 lines per vertical inch

Margins: One-inch margins on all four sides with no content in the margins.

Font: Font size 12 point, not to exceed 15 characters per horizontal inch, with spaces.

Inserts: Figures, tables, references, and any other inserts must be included within the 8page limit.