



LSIC

Newsletter

The Lunar Surface Innovation Consortium is administered by the Johns Hopkins Applied Physics Laboratory, and operates in collaboration with the NASA Space Technology Mission Directorate under the Lunar Surface Innovation Initiative. Its purpose is to harness the creativity, energy, and resources of the nation to help NASA keep the United States at the forefront of lunar exploration. To find out more, sign up to participate, or access past additions of this newsletter, please visit lsic.jhuapl.edu.

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Director's Update

Hello LSIC Community! This month, I wanted to talk a little bit about the Executive Committee. Over the past two years, our Executive Committee has helped provide feedback on LSIC goals, operations, and more. The initial committee was recruited to provide a cross-section of voices from the space and technology communities, who could help us to develop our operational model, grow the consortium, establish goals, and evaluate our progress towards those goals. We are extremely grateful for the time that they have donated to help us thus far.

Seats on the Executive Committee are balanced to ensure that we have representation from different types of commercial, academic, and non-profit organizations. As our current members' terms conclude over the next year or two, we will be opening up opportunities for those who would be interested in serving to apply. The Executive Committee is tasked with meeting quarterly, with three meetings held virtually and one hybrid (in-person encouraged) meeting being a roughly full-day meeting in the Spring, to vote on candidates for organizational membership, provide feedback on focus group and consortium progress and goals, and help develop annual objectives and evaluation metrics. If you think you might be interested in being considered for a seat on the Executive Committee, please stay tuned, as we will be releasing information about how to apply and what type of institutional seats will be available in the near future.



Rachel Klima

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Focus Areas

Monthly Telecon Schedule

Dust Mitigation (DM)

Third Thursdays at 12PM Eastern

Extreme Access (EA)

Second Thursdays at 3PM Eastern

In Situ Resource Utilization (ISRU)

Third Wednesdays at 3PM Eastern

Excavation & Construction (E&C)

Fourth Wednesdays at 2PM Eastern

Extreme Environments (EE)

Second Tuesdays at 3PM Eastern

Surface Power (SP)

Fourth Thursdays at 11AM Eastern

LSIC General Updates

As a reminder, If you don't have access to LSIC's Confluence wiki, please email Andrea Harman at ams573@alumni.psu.edu to get signed up.

Fall Meeting: First Call for Abstracts

Meeting Information

The Lunar Surface Innovation Consortium (LSIC) fall meeting will be held on Nov 2nd-3rd, 2022, at the University of Texas at El Paso and online. The event will feature interrelationships between the six focus areas identified by the Consortium, with a specific focus on how they relate to excavation and construction.

LSIC's overall goal is to foster communication and collaboration among academia, industry, non-profits, and government. The fall meeting will feature individual invited talks, group and panel discussions, as well as poster sessions, breakout groups, and networking opportunities. Information about the event, including registration and abstract portal, will be posted to the event page here: <https://lsic.jhuapl.edu/Events/Agenda/index.php?id=350>

Call for Abstracts

We invite abstracts describing technical capabilities within the six LSIC focus areas, as well as those that identify lunar surface technology needs and assess the readiness of relative systems and components. Other topics of interest include defining the parameters and constraints of the architecture required to support a sustained presence on the lunar surface, as well as economic and policy considerations.

The six LSIC technical focus areas are:

- Dust Mitigation
- Excavation & Construction
- Extreme Access
- Extreme Environments
- In Situ Resource Utilization
- Surface Power

The abstract submission portal will open no later than mid August, and all abstracts are due by 11:59PM EDT on September 13th. Abstracts should be submitted in pdf format, and are limited to 1 page, including any figures and tables, at no smaller than 10-point font (and 1-inch margins). Please use the abstract template that will be provided on the meeting webpage. Contributed abstracts will be presented as posters, with a subset of those selected by the technical organizing committee also highlighted in lightning talks.

Public Dissemination Disclaimer

Please note that your abstract submission will be viewed as permission to publish uploaded presentation materials (e.g. abstracts, slides, recorded presentations) to the general public on the LSIC website.

Focus Group Updates

Dust Mitigation

In July, the Dust Mitigation Focus Group hosted a meeting on the topic of “Dust Sensing and Filtration.” Our two highlighted speakers were:

- Daniel Cantin, INO (Institut National d’Optique) – “iSIPS an innovative dust characterization and monitoring tool: preliminary proof of concept and looking for Lunar applications”
- Dr. Ben Sumlin, NASA Glenn Research Center – “Dust Detection Challenges in Complex Environments”

There was great conversation, including links to relevant papers which have now been posted to the [Dust Mitigation Resources page on Confluence](#). Thank you to our speakers and community members for joining, asking questions, and sharing helpful materials – feel free to keep the conversation going on Confluence!

Our next focus group meeting will be held on Thursday, August 18th at 12:00 pm Eastern Time. The topic for the meeting will focus on “Testing in Dusty Environments.” The meeting will include featured technology presentations along with a discussion session.

Excavation & Construction

In July, the Excavation & Construction Focus Group hosted a joint meeting with the Extreme Environments Focus Group. The meeting highlighted four speakers on the topic of Regolith for Radiation Shielding. Our four exciting talks were:

- Dan Britt, University of Central Florida – “The Lunar Regolith and Shielding”
- Tony Slaba, NASA Langley – “Radiation Shielding for Lunar Missions: Regolith Considerations”
- John Watts, CSPAR-University of Alabama Huntsville – “Radiation Analysis of Candidate Structures for Moon-to-Mars Planetary Autonomous Technology (MMPACT)”
- Melanie Grande, NASA Langley – “Protecting Crew and Surface Systems with a Long-Duration Lunar Safe Haven”

At this meeting we also unveiled NASA’s new initiative of data buys from commercial providers. NASA is interested to learn more about the interest in the LSIC community about this program and your feedback is valuable. Please visit the following Confluence page for a presentation and providing feedback: <https://lsic-wiki.jhuapl.edu/x/HgAiAw>

At next month’s meeting, August 24th @ 2pm EST, the E&C Focus Group will be launching its subgroups:

- Autonomy & Site Planning
- Additive Manufacturing & Raw Materials
- Site Prep, Horizontal & Vertical Construction
- Outfitting & Maintenance

Please join us as we shape deeper discussions in topics of interest to our community. We look forward to seeing everyone there!

Extreme Access

Happy summer! We are busy preparing for the upcoming “Designing for the Extremes” workshop, which is joint with EE on August 5. We hope you can join us! It should be an interesting afternoon discussing design and environment challenges to perform ISRU in deep PSRs at the lunar poles. This last month, our monthly telecon featured two guest speakers: Jean-Pierre de la Croix (JPL) who provided an update on the Cooperative Autonomous Distributed Robotic Explorers (CADRE) project, and Brad Buckles (NASA) who spoke about RASSOR and ROS. The recordings will be up on the wiki and website if you missed it. Next month, Lindsay Papsidero (Lockheed Martin) will present about the Parsec lunar communications system at both the regular Extreme Access telecon and then have a more detailed discussion and questions at the Position, Navigation, and Timing subgroup. The other subgroups are also active with guest speakers and monthly meetings. We do send out reminders for all of those, but also please look at the wiki for connection information. We’re already getting ready for the fall where we will have another workshop, this time joint with Excavation and Construction, about autonomous technology needs for EC&O. Get excited!

Extreme Environments

Extreme Environments joined forces with Excavation and Construction for the July monthly meeting with another great “Cross Talk” that focused on using regolith as a radiation shield. The recording and presenters’ slide packages can be found on confluence at <https://lsic-wiki.jhuapl.edu/x/aoABAw>. Another exciting collaboration is coming up on Friday, August 5 where Extreme Environments and Extreme Access will hold a joint workshop titled “Designing for the Extremes” which will take a deeper look into the Robotics Lunar Surface Operations 2 (RLSO2) study and environment effects related to designing hardware to access these extreme locations. We look forward to seeing you there! There will be no monthly meeting in August since the workshop is so close to our regular time/date. We will return in September with another great speaker. Please don’t forget, we will be looking for a new space weather and plasma subgroup lead soon. If you are interested, please let the team know! As always, if community members have ideas for what they would like to see or discuss, please reach out to any member of EE leadership.

ISRU

The ISRU focus group held its July monthly meeting on 20th, with presentations focused on the intersection between the regolith and ISRU. Melissa Roth, Off-Planet Technologies, presented insights into the nature of the lunar soil at a granular level and the challenges of developing appropriate simulants, including icy simulants relevant for ISRU studies. Lucas de Melo, Johns Hopkins University, discussed the general nature of soils and how the lunar ‘soil’ or regolith. LSIC ISRU Focus Group solicited feedback on the possibility of NASA pursuing lunar surface “data buy”. The LSIC ISRU Focus group also supported the Lunar Surface Science Workshop-17 on Lunar Prospecting.

Surface Power

In July the Surface Power Focus Group held a workshop on Low Temperature Power and Energy Storage for the Lunar Surface. Featuring essential input from the Extreme Environments group, the workshop aimed to discuss near-term solutions for advancing key objectives – surviving the lunar night, and operating through the lunar night or within permanently shadowed regions. With plenary

talks, a panel discussion, a dozen lightning talks, and breakout sessions covering mission scenarios, the workshop contained and produced a plethora of critical information, all of which will be available shortly on the LSIC event page. We will work to distill this workshop's output by the August monthly telecon, which will also feature time dedicated to networking, something called out as a need by a recent poll of the focus group.

Working Group – Modular Open Systems Approach (MOSA)

The MOSA WG hosted its third monthly telecon on July 13th 2022 at 11:00 AM ET, where Dr. Brian Weeden (Executive Director of CONFERS & Director of Program Planning for the Secure World Foundation) gave a presentation on the Overview of the Consortium for Execution of Rendezvous and Servicing Operations (CONFERS). Following the presentation, we had a great Q&A discussion where Dr. Weeden shared many of the lessons learned from starting the consortium to working with the community on standards development.

The working group continues to build MOSA resources on Confluence (<https://lsic-wiki.jhuapl.edu/x/4YAxAg>) with the help of the LSIC community, including a standards library and other suggested materials of interest. Please continue to post new content and feedback. If you are interested in joining the MOSA WG or need a Confluence account, please email Andrea Harmon at ams573@alumni.psu.edu.

Working Group – Simulants

The APL-LSII Lunar Simulants team has been busy preparing for the newest round of simulants assessment. In July, we acquired eight lunar regolith simulants that will be part of our next round of tests and began preparing them for geotechnical testing. We also worked with our colleagues John Gruener (NASA JSC) and Lucas de Melo (JHU) to design our test strategy and visited the JHU soils laboratory where tests will be conducted. While there, we worked with Dr. de Melo to calibrate the instrumentation to be used for these tests and trained on how to conduct the experiments. Testing of lunar regolith simulants is planned for late July and early August. Once we have that data collected, we will begin writing up the results and analysis in the 2022 assessment in August. Also in August, we will also be preparing a manuscript and presentation on lunar regolith simulants for the 73rd International Astronautical Congress (IAC) that will be held in Paris in September.

Feature Article

APL Technology and Gap Assessment for NASA STMD's Lunar Surface Innovation Initiative

In the spring, APL in its trusted agent systems engineering role, conducted technology and gap assessments for each of the six capability areas. This involved reviewing the NASA architecture for a sustained human lunar presence, as it relates to each capability area, and then analyzing how well the planned technology investments could enable the desired architecture. APL was provided information on a wide range of NASA programs to include in the assessments. Additionally, each capability area conducted one or more technical interchange meetings to gather additional details. Part of the assessment was to look for how technologies developed by industry or academia could be integrated into the NASA architecture.

A number of themes and key findings emerged as each capability area developed their individual reports.

Some of the general cross cutting themes included:

- Technology investments could be combined together into a maximum impact “flagship mission”
- Developing (and publicly releasing) an integrated architecture roadmap
- Defining traceable requirements so that industry can assess how to contribute
- Identifying near-term executable Design Reference Missions to bound the requirements for needed technology development
- Pursuing CLPS deliveries to test systems of technologies that require demonstration in the lunar environment
- Acquisition of new data sets that help inform and refine technology, both orbital and surface, should be a high priority
 - Data for an ice-prospecting campaign would have additional agency-wide value
 - Consider innovative approaches such as data buys

Each focus area provided a summary of their findings and recommendations from their gap assessment.

The **Excavation and Construction (E&C)** key findings included bringing in industry ASAP for construction equipment and autonomous construction technologies. Creative collaborative opportunities should be actively pursued. Recommendations include leveraging industry expertise through creative funding opportunities to develop several classes of E&C equipment. There is a need to develop incentives to increase commercial interest in the area of E&C. Several technology areas require more investment including technologies for site preparation and autonomous assembly of structures (Class II construction). Additionally, lunar surface demonstration missions are critical, as lunar construction has never been attempted before (assembly of tall towers, launch and landing pads, shelters etc). STMD should fund more system-level lunar surface technical demonstrations that incorporate multiple functionalities (such as ISRU, excavation, delivery, power, etc.) and interaction of systems with lunar environment. Industry and academia should participate in or even lead these surface missions.

The **In-Situ Resource Utilization (ISRU)** key findings and recommendations included that NASA should continue to pursue both water-ice extraction and Oxygen extraction from regolith ISRU technology paths. It is important to execute a prospecting campaign for water-ice reserves in order to define the requirements for, and mature, several of the ice-related technologies. A surface demonstration of Oxygen extraction from regolith was deemed a high priority. Another priority is the development of metal extraction technologies.

The **Surface Power (SP)** key findings included the importance of site location for detailed knowledge of the surface illumination conditions, which in turn permits the derivation of darkness power requirements. The length of shadowed periods that need to be survived is a key driver for both Industry assumptions and determining relevant scales for power capability areas. Illumination is possibly the most valuable lunar resource, and before illumination, everything is speculation. It is important that the rationale for requirements is clearly communicated to the community. For example, why did Fission Surface Power requirement go from 10 kW to 40 kW? There is a need to plan for testing bottlenecks (rad-hard electronics, large-scale fuel cells, integrated systems, etc.), and coordination with OGAs (need for an interagency roadmap for nuclear, shared interests such as rad-hard modeling, low-temperature batteries). Emplacement of power components on the lunar surface is the toe-hold for sustaining surface operations.

The **Dust Mitigation (DM)** key findings included that it is difficult to determine if technologies will be ready when needed because there are no “need dates” for the technologies, i.e. there are no links between the technologies to specific flight programs. Similar to the Surface Power finding, better requirements flow down and traceability is needed. These combined factors make it difficult to set priorities.

The **Extreme Environments (EE)** key findings included that NASA should encourage technology investments aimed at addressing multiple aspects of the lunar environment, ideally all relevant environmental types. NASA should define environmental testing standards for the environments of interest to SMD and ESDMD. A systems approach to technology development is required to ensure engineering requirements established for individual technologies are appropriate for future applications. There is insufficient emphasis on technology infusion planning as a part of technology development, NASA should require proposed technologies to include ties between investments, roadmaps, capabilities, and goals.

The **Extreme Access (EA)** key findings included that a large number of EA-relevant large-scale technology drivers were identified to illustrate high-level capability needs for access, but further information is needed to determine whether achieving all of these technologies will be sufficient to achieve the objectives. There is a need to establish (integrated) technology development timelines and priorities to shape the envisioned futures. Focusing on open-source or modular systems helps facilitate development and reduce redundancy. The investments in SpaceROS (Robot Operating System), for example, represent a useful investment and development strategy.

These technology and gap assessments will be updated annually as technologies mature and new gaps are identified. NASA is already using the findings in the planning for and prioritization of technology development projects. Future reports will also include more details on non-NASA efforts from academia and industry.

Member Spotlight

Lunar-VISE

Kerri Donaldson Hanna (Principal Investigator (PI)) & Adrienne Dove (Deputy PI)

The Lunar Vulkan Imaging and Spectroscopy Explorer (Lunar-VISE) was recently selected as one of two NASA Payloads and Research Investigations on the Surface of the Moon (PRISM) projects, and will be hitching a ride to the Moon's Gruithuisen Domes with a provider through the Commercial Lunar Payload Services (CLPS) program. There will be instruments both on the lander and on the rover, with a VNIR Imaging Camera (LV-VIC) and Compact Infrared Imaging System (LV-CIRiS) from Ball Aerospace located on the rover to provide vital details about the domes themselves, and Context and Descent Cameras also from Ball on the lander to study dust interactions on the surface during landing and to characterize the landing site and plan how the rover will traverse the area. Arizona State University (ASU) will be contributing a Gamma Ray and Neutron Spectrometer (LV-GRNS) for the rover, marking the first time an instrument like this has been used on the surface of the Moon.

The mission will be led from the University of Central Florida by Assistant Professor Kerri Donaldson Hanna, mission PI, and Associate Professor Adrienne Dove, Deputy PI. Donaldson Hanna's main area of expertise is trying to understand the composition of the Moon and other airless bodies using spectroscopy, particularly in the thermal infrared. "I've been investigating the Moon using remote sensing for nearly 12 years," explained Donaldson Hanna, "And when Ball Aerospace asked about collaborating on upcoming missions, I jumped at the chance to build the instruments I want, and being able to work on the surface of the Moon is super exciting." Dove added, "Kerri started these conversations because of her successful past work, pulled together a suite of high-heritage instruments to address outstanding lunar science questions, and did an excellent job forming the mission team."

Dove herself is interested in the dust on planetary surfaces, and the interactions between regolith, dust, and plasma, as well as studying interactions between spacecraft surfaces and plasma. She is involved in projects looking at the distributed dust environment, how dust is disturbed, and what it tells us about geotechnical and layering properties. Dove is hoping to capture images and information about the lander plume, as well as how dust is distributed after landing and when the rover is driving around. "I'm also involved with the Heimdall Camera System being sent on an earlier CLPS mission," shared Dove, "which will be looking at plume interactions with the surface - we're hoping to be able to look at both data sets and to start to understand how the surface behaves in different areas of the Moon."

The seeds of Lunar-VISE were really planted when Donaldson Hanna first started working at UCF and met Dove. Their interests coincided, and they felt they could use their different research techniques to do complimentary science to get at the geotechnical properties they were both interested in. They both have previous experience working with Ball and proposed a mission for the first PRISM payload that they unfortunately did not get - but when the new landing site, the Gruithuisen Domes, was announced, they knew thermal infrared remote sensing was going to be key for that area. They rethought their payloads, redesigned their proposal, and resubmitted - and are now working towards their 2026 launch. "An exciting part of this is using the different instruments on the surface to

compare against what we have from orbital observations, and doing ground truthing to match our orbital science,” Dove said. Wavelengths used by the instruments have been specifically chosen to match what is already being used by orbital assets to facilitate this comparison.

This mission has a lot of moving parts – instruments from Ball and ASU, leadership and expertise from UCF, and their mission operations will be centered at the University of Colorado, Boulder (UCB). At UCF Donaldson Hanna and Dove will have a postdoc and graduate student working on the project with them, as well as undergraduates every year during the investigation to both provide lab support and to run social media for the mission. Several Co-Is will also have grad students and postdocs working on the project as well. “I’ve been very impressed with the students I have working in my lab, and the students that reach out to do research with us,” shared Donaldson Hanna, “typically they’re super motivated, smart, and capable. It’s great to have such a wonderful resource of students to draw from here at UCF.” Both Dove and Donaldson Hanna teach undergraduate level courses, which has been a great way to introduce their research and recruit students to work with them. Dove also has students working on hardware, and shares that electrical engineers are often the hardest students to find.

And the impact this mission will have on students even goes beyond the college level – Lunar-VISE will feature a teacher-in-residence program to involve K-12 teachers and students as well. The idea is to help teachers develop curriculum materials and bring it to their classrooms, while encouraging them to share with other educators as well. Teachers will be involved in science meetings and even lab research, will be provided with a stipend, and will bring their research straight from the lab into their classrooms. One of the mission’s Co-I’s was a high school teacher himself and has given valuable perspective on this aspect of the project as it continues to develop.

Lunar-VISE is an exciting opportunity for LSIC to keep building community resources by providing a platform where researchers like Donaldson Hanna and Dove can share their research. Both Donaldson Hanna and Dove are interested in keeping connected with the community because they see their mission as collecting data for everyone, and they want to make sure that it is accessible. Like most missions, its information will be made available through the Planetary Data System (PDS), but having information also available through a platform like LSIC’s Confluence could help improve access for members of the community who don’t have experience using PDS like companies and nonprofits.

When looking to their mission’s future, Donaldson Hanna and Dove are most excited about getting to make observations in a completely pristine region of the lunar surface. But there are plenty of hurdles to overcome before they get there. Even though the instruments they are flying are heritage (which means the same or similar instruments have been proven in previous missions), there are short timeframes to get them ready for this specific mission. They also need to work with NASA to define payload requirements as NASA works to find lander and rover providers through CLPS – something neither the PI nor her deputy have done before. “It’ll be an interesting and exciting challenge to face,” shared Dove.

But the promise of getting to this untouched, unexplored region keeps them going. Both Donaldson Hanna and Dove know that as women in their early-to-mid career, this is an enormous opportunity to make their mark on the current understanding of this area of lunar science. And the importance of confirming orbital observations through their on-the-ground sensing equipment can’t be overstated. Lunar-VISE promises to be a groundbreaking mission for many fields of study and will open new pathways of exploration to a whole new area of the lunar surface.

NASA and Community News

NASA Administrator Statement on Agency Authorization Bill

NASA News \ \ 28 July 2022

<https://www.nasa.gov/press-release/nasa-administrator-statement-on-agency-authorization-bill>

Korea's 1st lunar orbiter mission to be delayed amid SpaceX rocket maintenance issue

Korea Times \ \ 28 July 2022

https://www.koreatimes.co.kr/www/tech/2022/07/133_333508.html

NASA Prepares for Space Launch System Rocket Services Contract

NASA News \ \ 26 July 2022

<https://www.nasa.gov/press-release/nasa-prepares-for-space-launch-system-rocket-services-contract>

NASA is closer than ever to generating nuclear power on the moon

Freethink \ \ 26 July 2022 \ \ Kristin Houser

<https://www.freethink.com/space/nuclear-power-on-the-moon>

NASA's VIPER Prototype Motors Through Moon-like Obstacle Course

NASA Ames News \ \ 26 July 2022

<https://www.nasa.gov/feature/ames/nasas-viper-prototype-motors-through-moon-like-obstacle-course>

A New Private Moon Race Kicks Off Soon

Scientific American \ \ 23 July 2022 \ \ Rebecca Boyle

<https://www.scientificamerican.com/article/a-new-private-moon-race-kicks-off-soon/>

Teams Press Ahead Toward Artemis I Launch in Late August

NASA Artemis News \ \ 22 July 2022 \ \ Antonia Jaramillo Botero

<https://blogs.nasa.gov/artemis/2022/07/22/teams-press-ahead-toward-artemis-i-launch-in-late-august/>

NASA Selects Draper to Fly Research to Far Side of Moon

NASA News \ \ 21 July 2022

<https://www.nasa.gov/press-release/nasa-selects-draper-to-fly-research-to-far-side-of-moon>

NASA Announces Artemis Concept Awards for Nuclear Power on Moon

NASA Artemis News \ \ 21 July 2022

<https://www.nasa.gov/press-release/nasa-announces-artemis-concept-awards-for-nuclear-power-on-moon>

Goodyear developing airless metal tires for GM's moon buggy

CNN Business \ \ 20 July 2022 \ \ Peter Valdes-Dapena

<https://www.cnn.com/2022/07/20/business/goodyear-lunar-rover-tire/index.html?linkId=100000137483985>

Astrobotic's CubeRover delivered to NASA and lunar surface system updates

Satnews \ 18 July 2022

<https://news.satnews.com/2022/07/18/astrobotics-cuberover-delivered-to-nasa-and-lunar-surface-system-updates/>

NASA Replans CLPS Delivery of VIPER to 2024 to Reduce Risk

NASA Commercial Space News \ 18 July 2022

<https://www.nasa.gov/feature/nasa-replans-clps-delivery-of-viper-to-2024-to-reduce-risk>

Firefly gears up for second Alpha launch

SpaceNews \ 17 July 2022 \ *Jeff Foust*

<https://spacenews.com/firefly-gears-up-for-second-alpha-launch/>

GM's Ultium EV batteries could power NASA's lunar rover

Automotive News \ 16 July 2022 \ *Hannah Lutz*

<https://www.autonews.com/mobility-report/gms-ultium-ev-batteries-could-power-nasas-lunar-rover>

China's moon sample-return mission finds water evidence twice over

Space.com \ 16 June 2022 \ *Andrew Jones*

<https://www.space.com/china-moon-lander-water-detection>

Registration Now Open for NASA 2022 International Space Apps Challenge

NASA News \ 15 July 2022

<https://www.nasa.gov/press-release/registration-now-open-for-nasa-2022-international-space-apps-challenge>

Lunar Outpost eyes up first-mover advantage for moon markets

TechCrunch \ 13 July 2022 \ *Aria Alamalhodaie*

<https://techcrunch.com/2022/07/13/lunar-outpost-eyes-up-first-mover-advantage-for-moon-markets/>

MIT design for Mars propellant production trucks wins NASA competition

MIT News \ 11 July 2022 \ *Sara Cody*

<https://news.mit.edu/2022/design-mars-propellant-production-trucks-wins-nasa-competition-0711>

Rocket Lab Is Headed to the Moon. The Stock Is Rising.

Barron's \ 05 July 2022 \ *Al Root*

<https://www.barrons.com/articles/rocket-lab-stock-moon-photon-nasa-51657030599>

Funding Opportunities

Tech Development

- Planetary Society STEP Grants 2022
<https://planetary.s3.amazonaws.com/assets/pdfs/STEP-Grants-RFP-2022.pdf>
Preliminary Proposals Due: 17 August 2022
- NASA SBIR Ignite 2022 Program Solicitation
<https://sbir.nasa.gov/solicit-detail/80089>
Proposals Due: 01 September 2022
- Break the Ice Lunar Challenge - Phase 2
<https://breaktheicechallenge.com/>
Registration Closes: 30 September 2022
- Space Technology Research Institutes (STRI) Solicitation
<https://nspires.nasaprs.com/external/solicitations/summary!init.do?solId=%7b000FAF75-9F37-814C-AC23-A21022A96037%7d&path=open>
Preliminary Proposals Due: 03 August 2022 - Invited Full Proposals Due 03 November 2022
- NASA Innovation Corps Pilot
<https://nspires.nasaprs.com/external/solicitations/summary.do?solId=%7b1B42E782-61BB-9834-F20F-44CBEF13C0A6%7d&path=&method=init>
Proposals may be submitted at any time through March 29, 2023, but applications will be reviewed in intervals on the following dates: July 22, 2022; Sept. 16, 2022; Nov. 17, 2022; and Jan 20, 2023

For more funding opportunities, please visit LSIc's website here: <http://lsic.jhuapl.edu/Resources/Funding-Opportunities.php>