



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

As in-person activities are beginning to resume in the United States, we have been spending a lot of time thinking about how to move forward in a way that serves our large participant base but allows in-person networking. The LSIC kickoff on February 28th, 2020 was right before the country really started to realize that operations would have to change. When we conceived of the LSIC meeting cycle, the idea was to have two in-person meetings with a heavy focus on networking, combined with virtual workshops and meetings for each of the focus areas.

With the pandemic, we moved the semi-annual, LSIC-wide meetings to virtual as well, enabling a large number of people to participate. We don't want to lose that, but we do want to provide the in-person networking that we had originally envisioned. To that end, our Fall Meeting will be at least partially in-person, and will be held on November 3-4th, 2021. Our host for the meeting is Bowie State University, located in Bowie, Maryland. COVID-19 trends in Maryland have been very good, with very low infection rates, but we will continue to monitor this and modify the number of participants who can attend accordingly.

Bowie State can support a hybrid meeting, and we will be working over the next few months to develop virtual content for those who either cannot or would prefer not to travel. If you are interested in attending this meeting (either in-person or virtually), we would be grateful to have you fill out this short survey here: <https://forms.gle/DpdnJM5LPiXwcste7> to assist us in planning the logistics for the meeting. Also, I encourage everyone who would like to present technical work to begin working on your abstracts early, as we will not be able to provide the same level of deadline flexibility that we have for fully virtual meetings.

Rest assured that LSIC will continue to operate in the virtual realm for focus group activities, and will still include virtual networking opportunities to increase accessibility to as much of the community as possible.



Rachel Klima

Director, Lunar Surface Innovation Consortium
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Focus Areas

Monthly Telecon Schedule

Dust Mitigation

Third Thursdays at 12PM Eastern

Extreme Access

Second Thursdays at 3PM Eastern

In Situ Resource Utilization

Third Wednesdays at 3PM Eastern

Excavation & Construction

Last Fridays at 3PM Eastern

Extreme Environments

Second Tuesdays at 3PM Eastern

Surface Power

Fourth Thursdays at 11AM Eastern

LSIC General Updates

INTRODUCING LSIC'S CIRCUIT INTERNS

What is CIRCUIT?

CIRCUIT is a Cohort-based Integrated Research Community for Undergraduate Innovation and Trailblazing that was created in 2017. The program consists of multiple cohorts of undergraduate fellows involved in cutting edge research projects. Fellows split time between training and research throughout the program. They learn core topics such as Data Science, Machine Learning, Artificial Intelligence, and Applied Mathematics.

Why was CIRCUIT created?

CIRCUIT was created to give undergraduate students a chance to create meaningful change within the world through solving problems that today's leading minds can't solve. CIRCUIT students bring a variety of unique abilities and skill sets to the table and they are tasked with applying this knowledge to the projects given to them. Projects include topics in space science, cybersecurity, artificial intelligence, and precision medicine.

What are the goals for the Lunar Surface Innovation Initiative (LSII) Cohort?

We will examine the feasibility of creating a sustainable lunar base in the near future. Our efforts will be focused in the following areas: Extreme Environments, Dust Mitigation, Excavation & Construction, Surface Power, Extreme Access, and In Situ Resource Utilization. Each cohort member has been assigned a Focus Group Mentor and will utilize their guidance to advance their respective path during the fellowship.

What do we hope to gain from CIRCUIT?

We are using this opportunity to gain experience in conducting research and working in a professional environment. By the end of the program, we hope to gain technical and professional skills, as well as soft skills and connections. Many of us are also using the CIRCUIT program as a way to pinpoint exactly what interests us and what we might want to do in our future career.

LSII CIRCUIT Cohort (2021-2022)

Jessica Harryman, Sebastian Cabrejos, Malcolm Gilmore, Shivanie Ally, & Julian Hodge



KSC-20210622-PH-FMX01_0222

Teams with NASA's Exploration Ground Systems and contractor Jacobs prepare to integrate the launch vehicle stage adapter (LVSA) for NASA's Space Launch System (SLS) rocket with the massive SLS core stage on the mobile launcher in the agency's Vehicle Assembly Building (VAB) at NASA's Kennedy Space Center in Florida on June 22, 2021.

POWER BEAMING WORKSHOP (Abstracts Due 09 July, Event 22-23 July)

Delivering power across the lunar surface is an exceptional challenge. The combined absence of infrastructure, the need for operations in permanently shadowed regions, and unique aspects of the lunar environment create and provide a potential niche for lunar power beaming solutions. In this LSIC workshop, we will explore the potential role of wireless power transfer, or power beaming, to deliver power on and across the lunar surface. Day one of the workshop will engage a broad audience with content covering context and demand as well as an overview of power beaming, with time for small group break-out discussions, while day two will delve deeper into technical talks and discussions. Abstracts are being accepted through 09 July, so please remember to submit yours soon. Submission details and registration is available on the event website here: <http://lsic.jhuapl.edu/News-and-Events/Agenda/index.php?id=142>

LSIC FALL MEETING, SAVE THE DATE (03-04 November)

The 2021 LSIC Fall Meeting will be hosted by Bowie State University (<https://www.bowiestate.edu/>) and will include in-person sessions. We will also provide as much online content and interaction as possible, to improve accessibility for those who cannot or prefer not to travel. To aid in planning for tools and space, we would appreciate anyone who is considering attending filling out the anonymous survey here so that we can get an idea of how many people would like to attend in-person versus virtually. Survey link: <https://forms.gle/HPsYuQLMr3sRq5m96>

Feature Article

LSIC Focus Groups Celebrate Their First Year

LSIC's focus groups have officially been up and running for a year, and we wanted to hear from the leads about their impressions of what's been accomplished, and what they're looking forward to that's coming up. If you'd like to review any of the past meetings that have been held so far, you can view the videos and presentations on LSIC's public website here: <http://lsic.jhuapl.edu/>, and official participants can view more in-depth discussion on Confluence here: <https://lsic-wiki.jhuapl.edu/>.

What do you feel are the most important accomplishments your focus group has made over this past year? What do you feel are LSIC's best overall accomplishments?

Dust Mitigation (Jorge Núñez): Wow, what a year! Hard to believe that it has now been a year since we started the Dust Mitigation Focus Group with the kickoff meeting last June. A lot has happened during that time with too many items to note in a small paragraph. Despite a global pandemic that impacted everyone's lives, it amazes me how people interested in Dust Mitigation from academia, government, industry, and non-profit have come together every month to build a community interested in addressing the challenges and hazards posed by lunar dust. Over the past year, we have learned about NASA's Integrated Dust Mitigation Strategy, new lunar simulants, and the latest innovative dust tolerant/mitigation technologies. A significant accomplishment that stands out, is the LSIC Dust Mitigation Workshop that was held early this year on February 4, 2021. Over 340 attendees from over 200 institutions, including lunar architecture systems developers, dust mitigation technology developers, and scientists representing Academia (20%), Government (28%), Industry (43%), and Nonprofit (9%), participated in the day-long workshop to discuss the most outstanding challenges and knowledge gaps in dust mitigation, identify latest technology solutions that are already available or in development, and highlight technology areas that are in need of future investment. The results from the workshop were shared with NASA STMD and are helping influence future funding solicitations. For those that would like to review, please see <http://lsic.jhuapl.edu/News-and-Events/Agenda/index.php?id=118> for the recorded proceedings.

Excavation & Construction (Athonu Chatterjee): The E&C focus group has grown enormously over the past year. Starting with around 100 members last June, it has over 500 members now with participation from all sectors: industry, academia, and government. One of our main goals when we started was to create a vibrant community, an alliance of E&C enthusiasts. To this end, we have succeeded beyond our expectations. Our monthly meetings are routinely attended by 70+ members with technical presentations given by experts from diverse backgrounds. Ideas disseminated in these meetings have established the important role of E&C in lunar base development. We have also successfully stepped into our role as a conduit between NASA and industry, which is critical for the success of LSII.

LSIC as a whole has done an incredible job! Its biggest achievement has been creating a dynamic alliance of lunar enthusiasts, a platform where diverse views of people can be expressed. It has done so very successfully, by creating an infrastructure comprising of a website, confluence wiki pages for all focus groups, and hugely popular and informative bi-annual meetings.

Extreme Access (Angela Stickle): In Extreme Access, I think we've provided a good resource for the community to learn more about extreme access challenges and the technology we will need to explore the lunar (sub)surface. It's been interesting seeing all our Technology Spotlight speakers and the discussion that they've generated at the telecons. I am also proud of the Lunar Mapping

for Precision Landing Workshop that we hosted in March. We had a great turnout and I think the discussions were really good. We received a lot of feedback that it was useful to the community, and I am excited to continue the discussions started there going forward. My goal is always to provide useful resources for the community and a pathway to have conversations with, or provide feedback to, NASA, so I was really pleased to hear it was useful.

I think LSIC fits nicely within the larger and pre-existing lunar community and provides an important space for talking about technology and technology development in detail. It's been great seeing the variety of people participating in telecons and events and that a large portion of them had never worked with STMD previously. It's really gratifying to have been working with a great LSIC leadership team for only a year and to have a vibrant consortium up and running. One of our biggest accomplishments, I think, is getting the focus groups started and then hosting the discussions and workshops to really dig into needs and specialized topics. The fact that we have had several hundred people attend all of them shows the interest and need for these spaces.

Extreme Environments (Benjamin Greenhagen): In our first year, the Extreme Environments focus group set up five subgroups based on major lunar environmental factors (e.g., Space Weather and Plasma Environment). We then used this assembled expertise to describe lunar surface environments specific to locations or types of locations (e.g., lunar pits and lave tubes) and summarize technology challenges for these distinct surface environments. At the same time, each of the subgroups has been working on a community resource that is relevant to their area of expertise. I couldn't be more proud of the work that has been done by Extreme Environments and our subgroups during year 1!

ISRU (Karl Hibbitts): The mission of the ISRU Focus Group, for which myself, Kirby Runyon and Michael Nord, all work together to facilitate is to enable the community of private industry, academia, non-profits, and government to develop the technologies needed in order for the U.S. to develop a sustained lunar surface presence. While striving to achieve this goal, we are also striving for collaboration across six separate groups to achieve the same overarching goal of LSIC. By working closely with NASA and industry, we are facilitating information flow and community interactions. This role varies from compiling and disseminating information on requirements or needs, such as estimates for how much ISRU products will be needed and how much can be effectively distilled on the Moon; to helping technology developers better understand the needs and challenges of operating on the Moon; to enabling small or new businesses to interact with more established entities to have insight into the community. LSIC overall has also done very well at accomplishing these goals through the combination of individual FG meetings, larger workshops, and the LSIC-wide meetings.

Power (Wes Fuhrman): The Surface Power Focus Group came together early to help set the focus of the first LSIC biannual meeting, and since then there have been many highlights. For me, seeing Space Tech funding in action in the community is definitely a highlight. Our efforts (power and the LSIC at large) have contributed to the direction of funding as well as increasing new participation. Seeing the funding come to fruition is awesome, and for surface power we've had many notable solicitations – Watts on the Moon, LuSTR, the VSAT awards, and more. Those who have not won awards have nonetheless elevated the competition and pushed us forward. When we all work together, we get there faster.

What are you most looking forward to seeing from your focus group community in the coming year?

Dust Mitigation (Jorge Núñez): Of course, the LSIC Dust Mitigation Workshop and focus group

meetings during our first year is just the beginning, and we plan to delve deeper into these key technology areas in the second year during our monthly focus group meetings. We are also standing up Dust Mitigation subgroups focused on key technology areas that are led by members of the focus group. These subgroups not only serve as a valuable resource for NASA and the community with their expertise, but also further refine gaps and needs in each key technology area in Dust Mitigation. In addition, we have created a Who's Who in Dust Mitigation page and plan to create other networking opportunities to foster more collaborations. I am very excited to see what comes out of Year 2.

Excavation & Construction (Athonu Chatterjee): In the coming year we look forward to more active participation from focus group members in shaping a roadmap for future E&C activities and planning E&C related CLPS missions. Members can help by participating in focused E&C workshops, by volunteering to present their work in our monthly meetings, and by being active on Confluence. NASA is fully committed to a public-private partnership model for LSII and the community will play a critical role in this regard through LSIC.

Extreme Access (Angela Stickle): I am really excited to see how the subgroups go. I hope it will provide a place to have more in depth conversations and allow people to network and work together on challenges and solutions. We cover a wide range of topics in extreme access, and so I'm looking forward to being able to dig in a bit more. These can also be a tool to build some more community networks and consensus, and I'm also really looking forward to seeing what comes out of the discussions for gaps and recommendation for technology development going forward.

Extreme Environments (Benjamin Greenhagen): Next year I'm really looking forward to seeing the focus group and subgroups do deep dives into some of the specific environments with extending working meetings or workshops. We're also looking forward to hosting meetings and networking opportunities with other subgroups as was done in May for the Vertical Solar Array Technology meeting.

ISRU (Karl Hibbitts): We look forward to continuing to work with focus group members to understand their needs and enable their development of ISRU technology, with a focus on developing systems to be deployed on the Moon. Thus, we are organizing to tackle the challenges facing both industry and government that need to be resolved to enable this.

Power (Wes Fuhrman): In short, more of them. We've done very well building off of each other in the smaller discussions we've had—breakouts, off-cycle tag-ups, etc.—and I'm looking forward to getting to know more of the group in this way. I'm also very much looking forward to building our systems-level understanding through engaging within our focus group as well as across focus groups.

Member Spotlight

USNC-Tech

Ultra Safe Nuclear Corporation (USNC) was founded in 2011, born in part out of researchers' reactions to the Fukushima Daiichi nuclear disaster that same year. When founder Francesco Venneri and his colleagues learned what happened, they realized that the research they were doing could prevent similar accidents by infusing a new degree of safety into nuclear power – by focusing on fuel safety, in addition to the reactor. USNC is now working to establish HALEU (High-Assay Low-Enriched Uranium) fuel processing capabilities for its subsidiary USNC-Tech's space nuclear power and propulsion systems by the mid-2020s. A specific goal is to develop Pylon, a modular, scalable (1-40 kWe+), HALEU-fueled fission power system for demonstration on the lunar surface and market deployment by 2027.

Since 2011, the company has grown by leaps and bounds. As it celebrates its first decade of existence this year, it boasts over 130 employees across its three divisions: Commercial Power (commercial-grade, zero-carbon, zero-risk energy systems for power and heat utilization – on or off-grid), Core (high-temperature materials and fuels designed and manufactured at scale), and Advanced Technologies (advanced systems and technology targeting space applications). Three new major facilities are currently being established nationwide. In Seattle, WA USNC is establishing hardware capabilities for non-nuclear testing and prototyping of USNC's space power reactor, Pylon. A ceramics manufacturing facility is being set up in Salt Lake City, UT, which will be focused on developing advanced ceramics for reactor applications. Finally, a pilot fuel facility will be based in Oak Ridge, TN, which will be a radiological facility focused entirely on fuel development and manufacturing. Overall, for USNC this has meant moving from design, analysis, and modeling towards becoming a vertically integrated company with prototyping pilot-scale manufacturing, and eventually full production within its own facilities. Over the past year and a half, USNC-Tech (the Advanced Technologies division) alone has grown from seven employees to almost forty.

"USNC-Tech is the advanced technologies and concepts group," explained Brandon Seifert, Business Development Lead. "This team is focused on the development and deployment of nuclear power and propulsion technologies for space exploration and development. But we do terrestrial work as well, helping USNC with Earth-based fuel and reactor technologies." USNC-Tech is working to become the first private power provider on the surface of another celestial body – the first lunar utility. Their aim is to provide stability to those working on the lunar surface in terms of sources of heat and electricity, providing a microgrid users can plug their architecture and technology into. "We want to stay ahead of their needs," says Seifert, "maybe in the short run the demand is for tens or hundreds of kilowatts, but that'll jump to the hundreds of kilowatts and into the megawatts range if they're successful. We need to be ready with our technologies and systems ahead of that demand." They have found that making their technologies safe for space also means that the company drastically increases safety for Earth-based applications as well, even beyond what is typically required by current industry standards.

In addition to Pylon, as part of USNC and USNC-Tech's efforts to create a proprietary nuclear thermal propulsion (NTP) system for near-term commercial applications, the company is now supporting two of three contracts that were awarded for the DARPA DRACO (Demonstration Rocket for Agile Cislunar Operations) NTP program. Chargeable Atomic Batteries (CAB) are also being developed. The aim is to create a suite of commercially manufacturable and globally deployable

radioisotope thermal generator solutions. These would provide milliwatts to kilowatts of electrical and thermal power for both space and terrestrial applications.

Looking at today's space sector, USNC-Tech sees companies continuing along a growth path for their technologies which will require the kind of power levels that can be produced by nuclear systems. Over the past decade commercial space ventures have been securing funding and starting to move into an area previously held only by the government, whether it be NASA or the Department of Defense. And those organizations will need power, both electrical and thermal. The demand pull is no longer coming from the government alone – the private sector is starting to wield its own influence.

But the space sector's development is not without its challenges. "The first bit is getting there," Seifert stated. "We haven't finished developing the technologies to get to the lunar surface yet." An obvious challenge on USNC-Tech's radar is maintaining stability in both funding and political intent so that companies working on infrastructure capabilities can finish their work, allowing ideas and technologies (and the necessary funding) to line up and continue building. There needs to be a fundamental scaling of space operations beyond small prototype and proof of concept missions to reliable pieces of infrastructure. "It feels like these milestones are always five to ten years away, and it's not because the engineers don't know what they're doing," says Seifert, "it's because the problems we're trying to solve aren't purely technical. That's why I like LSIC – you bring everyone together and keep them talking, building momentum, and shortening the timeline to space."

USNC-Tech has specific goals for its interactions with LSIC and learning about what people need as well as when they will need it is first and foremost. Equally important is determining what isn't needed so they can maximize their usefulness and focus on what matters. And finally, trying to identify and address what companies need to get to the Moon and start using power. Whether that's specific technology or architecture needs, looking for partners or suppliers, they're invested in helping the community grow and being useful every step of the way.



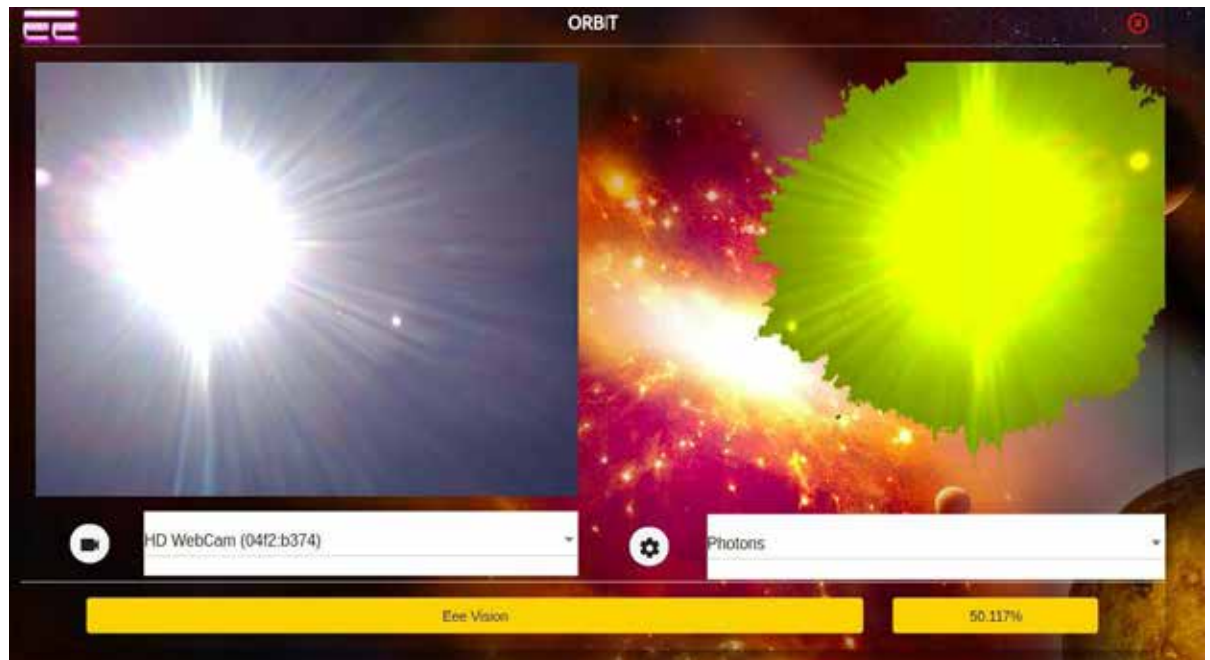
Artistic rendering of Pylon, as integrated into a notional lander system.

Community Bulletin Board

Orbit's Latest Milestone Accomplishment

Submitted by Dave Traore, Orbit Space Research and Technology

This is the preliminary result of the CLuS'N spacecraft[1] optical system, Eee's Real-time Electromagnetic Radiation Sensor (RERS). The experiment was carried using a standard HD Webcam pointing at the Earth's host star. The percentage of photons gets calculated and mirrored as a function of time relevant to the angle of view. A major milestone accomplishment.



Astrobotic's Planetary Mobility as a Service for the NASA PRISM-2 Solicitation – Wednesday July 14th (12:00 PM – 1:00 PM EST)

Submitted by Jennifer Lopez, Astrobotic

Astrobotic will be hosting an exciting webinar on Wednesday, July 14th for LSIC community members to learn more about how Astrobotic can support your science suites for NASA's PRISM-2 solicitation. The webinar will last approximately one hour and will be the perfect opportunity to hear from Astrobotic leadership. Registration is free but open slots are in high demand! Use the "Registration" link below to register for your complimentary invitation. Join us on Wednesday, July 14th at 12:00 PM EST!

Registration: <https://www.eventbrite.com/e/get-your-science-suites-supported-for-nasas-prism-2-registration-161919195673>

NASA News

NASA Administrator Announces New Members of Leadership Team

Jun 24, 2021 (RELEASE 21-085): NASA Administrator Bill Nelson announced four new additions to the agency's senior staff Thursday. Shahra Anderson Lambert will serve as senior advisor for engagement and Bale Dalton will serve as the deputy chief of staff. Nelson also announced Bryan Gulley as media relations specialist and Justin Weiss as deputy press secretary. Click here to read more: <https://www.nasa.gov/press-release/nasa-administrator-announces-new-members-of-leadership-team>

Pam Melroy Sworn in as NASA Deputy Administrator

Jun 21, 2021 (RELEASE 21-083): NASA Deputy Administrator Pam Melroy took office Monday after she was given the oath of office by NASA Administrator Bill Nelson during a ceremony at the Mary W. Jackson NASA Headquarters building in Washington. "It is a joy to be back in the NASA family, the smartest and most dedicated workforce of any place that I've ever worked. I always knew this was the most exciting place to work from the time I was a child, inspired by the first landing on the Moon," Melroy said. "I'm very honored to be teamed with Administrator Nelson and our Associate Administrator Bob Cabana and rest of the NASA team. We do have a lot of work to do, but it's our intention not to just lead today's NASA, but also lead us forward into the future and support the generations of fantastic things that NASA will continue to do." Click here to read more: <https://www.nasa.gov/press-release/pam-melroy-sworn-in-as-nasa-deputy-administrator>

NASA Launches Mission Equity, Seeks Public Input to Broaden Access

Jun 15, 2021 (RELEASE 21-080): NASA is launching Mission Equity, a comprehensive effort to assess expansion and modification of agency programs, procurements, grants, and policies, and examine what potential barriers and challenges exist for communities that are historically underrepresented and underserved. Click here to read more: <https://www.nasa.gov/press-release/nasa-launches-mission-equity-seeks-public-input-to-broaden-access>

NASA Selects New Science Investigations for Future Moon Deliveries

Jun 10, 2021 (RELEASE 21-078): As NASA continues plans for multiple commercial deliveries to the Moon's surface per year, the agency has selected three new scientific investigation payload suites to advance understanding of Earth's nearest neighbor. Two of the payload suites will land on the far side of the Moon, a first for NASA. All three investigations will receive rides to the lunar surface as part of NASA's Commercial Lunar Payload Services, or CLPS, initiative, part of the agency's Artemis approach. The payloads mark the agency's first selections from its Payloads and Research Investigations on the Surface of the Moon (PRISM) call for proposals. Click here to read more: <https://www.nasa.gov/press-release/nasa-selects-new-science-investigations-for-future-moon-deliveries>

Funding Opportunities

Tech Development

- NLRA 2021-5: In-Space Production Applications: Advanced Manufacturing and Materials
<https://www.issnationallab.org/research-on-the-iss/solicitations/nlra2021-5/>

Step 2 Proposals Due: July 12, 2021

- NASA Innovative Advanced Concepts (NIAC) 2022 PHASE I Call for Proposals
<https://www.nasa.gov/content/apply-to-niac>

Phase 1: July 21 2021 Phase 2: October 2021 Phase 3: December 2021

- NASA TechLeap
<https://www.nasa.gov/centers/armstrong/features/techleap-prize.html>

Registration deadline: July 28, 2021 Submission deadline: August 11, 2021

- Deep Space Food Challenge
https://www.nasa.gov/directorates/spacetech/centennial_challenges/spacefood/index.html

Submission Deadline: July 30, 2021

Student Tech Development

- NASA Fellowship Activity 2021
<https://nspires.nasaprs.com/external/solicitations/summary!init.do?sollId=%7b24E3CA0D-F71B-03FF-AD0E-AB283B3B1050%7d&path=open>

Due: July 19th, 2021

- NASA Fellowship Activity 2021: Minority Serving Institution Fellowships 2021
<https://nspires.nasaprs.com/external/solicitations/summary!init.do?sollId=%7b24E3CA0D-F71B-03FF-AD0E-AB283B3B1050%7d&path=open>

Due: July 19th, 2021

- NASA TechRise Student Challenge
<https://www.nasa.gov/press-release/new-nasa-student-challenge-offers-hands-on-tech-development>

Educator Workshops: July 28 and August 11, 2021 Student Registration Opens: August 18, 2021

Submission Deadline: November 3, 2021

Request For Information (RFIs)

- Advancing Racial Equity and Support for Underserved Communities in NASA Programs, Contracts and Grants Process
<https://www.federalregister.gov/documents/2021/06/15/2021-12668/request-for-information-on-advancing-racial-equity-and-support-for-underserved-communities-in-nasa>

Response Due Date: July 12, 2021

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