



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 provide a few quick updates about what we're working on behind the scenes. First off, planning is underway for our Fall Meeting, which will be held on Nov. 2-3rd at the University of Texas at El Paso. We are really looking forward to having folks join us in El Paso to learn about the exciting work going on at the University! We are also considering an optional field trip to White Sands on the Friday following the meeting. A call for abstracts and registration information will be distributed to the listserv soon.

We are also moving forward with plans for our LSIC mentoring portal and program. Mentoring resources are being developed both for students as well as for those who are looking for other types of mentoring, including peer-to-peer networking for topics such as applying for funding, learning about operating in the space sector, etc. We will be rolling out the mentoring program itself as a pilot program at first, so if this is something you're interested in participating in (and willing to commit to providing feedback on), please stay tuned.

I hope everyone has a wonderful summer, and gets to take a little time off to relax!



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

Fourth Wednesdays at 2PM Eastern

Extreme Environments

Second Tuesdays at 3PM Eastern

Surface Power

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.

Intern Introductions

LSIC is pleased to welcome three interns to our summer ATLAS program. We're delighted to have them on board and look forward to seeing what they accomplish over the course of the summer.

Ayana DeSears

I'm Ayana DeSears, a sophomore Physics and Aerospace Engineering Major at Spelman College (an HBCU in Atlanta, Georgia). I'm excited to be an ATLAS intern at APL this summer where I can apply my knowledge and skills to support LSIC's operations.

During my first year at Spelman College, I became a member of the Spelman Sisters of STEM, the Society of Women Engineers, and the Atlanta University Center's CodeHouse where I learned how to expand networks, analyze data, and code programs in Python. I was also enrolled in the Cherry Creek Innovation Campus where I developed CAD models to additively manufacture products, and also learned about data organization and project management. Finally, I helped build an autonomous machine/robot using basic wiring schematic and worked with 6 DOF robotic arms using remote programming. Having prior experience with product design and robotics, I plan to expand my knowledge in tech development and information systems as well as STEM related fields during my time here at APL.

My career goals entail making an impact in the space exploration side of aerospace, whether that be conducting research or hands on development, and developing a product that improves aircraft safety, speed, and/or functionality. Choosing APL will help me reach these goals and more, which is why I am ready to broaden my experience and knowledge in every way I can!



Carissma McGee

Carissma McGee is currently a rising senior at Howard University majoring in applied physics and minoring in computer science, mathematics, and political science on the astronomy and astrophysics concentration. She is dedicated to obtaining a Ph.D. in astrophysics, and Howard inspires her to her full potential. Prior to being accepted into the Karsh STEM Scholars Program, she served as the first Black female senior intern at Mount Cuba Astronomical Observatory, Delaware's only nonprofit space research center. During her undergraduate tenure, she focused on expanding her background in physics through research on a variety of astrophysical topics, such as gravitational-wave motion, supernova formation, photon jet streams near blazars, and high-energy particles released by celestial bodies. After consistently meeting with her state representative, Congresswoman Lisa Blunt Rochester, to discuss renewable energy policy in her hometown and working alongside the US House Committee on Space, Science, and Technology, Carissma is dedicated to increasing advancements in STEM through policy and advocacy efforts. She is excited to be a part of the Lunar

Surface Innovation Consortium to encourage a focus on immersive cislunar policy including member organizations.

Researching at a Mount Cuba Astronomical Observatory, the Cerro Tololo Inter-American Observatory in Chile, NASA Goddard Space Flight Center, NASA Jet Propulsion Laboratory, and the illustrious Howard University have helped Carissma discover her path. Science is undergoing a data explosion, and astronomy is leading the way. Within her most notable “Whole Earth Telescope” project, she focused on binary pulsating star evolution at key phases in their lifetime in collaboration with over seven hundred astronomers around the world. Carissma can depict how she saw herself represented by the astronomers on the mission, hungry to learn with curiosity and a creative imagination. With the Jet Propulsion Laboratory, she worked on the SPHEREx Mission set to launch in 2024 with the purpose of creating a map of the entire sky in 96 different color bands. In addition to her work with the LSIC Mission, Carissma is a Dorrit Hoffleit Fellow at Yale University and an NSBP/SAO EHT at the Harvard-Smithsonian Center for Astrophysics this summer, where she conducts research on dark matter perturbation and black holes with the Event Horizon Telescope. Her community of mentors, graduate students, and post-docs has guided her to learn more about supermassive black holes, dark matter clusters at their centers, and the operational benefits of cislunar advancements. She remains fascinated by the innovations of this department in those areas. With her experience at Johns Hopkins Applied Physics Laboratory, she plans to further develop her skill sets in intersecting the space industry and government.

Comparable to the emergence of stars in the heavens, Carissma stands in between two worlds: that of which is seen and unseen. She ultimately plans to be a part of an expanding cadre of women of color in STEM who bring fresh perspectives and advanced theories to life while taking on the toughest and most exciting socio-technological issues of this modern era. Similar to the mission of the Johns Hopkins Applied Physics Laboratory, who seeks to uncover the truths about the distant and ancient universe by analyzing the properties of star formation and high energy astrophysics, Carissma understands that her research is a tool of service that brings the world closer together. In essence, she thrives off of discovery in every realm.

Akalyn “Kay” Grant

I am Akalyn Grant, a junior architectural engineering student at North Carolina A&T State University. I am originally from Snellville, GA and have lived in Georgia my whole life. Since 2020, I’ve taken basic engineering courses, as well as design courses, including Architectural Design and History. Although my expertise is not in Lunar Science and Exploration, I am really excited to be working at Johns Hopkins University Applied Physics Lab with LSIC in order to broaden my knowledge and garner experience in such an ever growing field! This is my first internship, so I’m thrilled to see what I can learn and to interact with all the people I meet.



In terms of research interest, I enjoy gaining knowledge on BIM (Building Information Modeling) and General Modeling! I have experience with systems like AutoCAD and Revit, and I would love to learn more about the features and tools those systems have to offer. I am also interested in seeing how BIM and architecture can be translated into an area such as Lunar Exploration and missions such as establishing a permanent presence on the moon, seeing that there are not many organizations

currently researching this topic. However, the current knowledge and ideas that we as a community do have are all very interesting and I hope to study them in more detail.

Once I complete my undergraduate degree, I would like to go back to school and obtain a master's degree in architecture. Upon completing my master's, I would like to work for a firm or an organization like APL. This would allow me to gain more experience in working in collaborative groups on a professional level, giving professional presentations, and engineering in a daily setting. Then, I would love to open a firm of my own and transition into entrepreneurship.

Workshop: Low Temperature Power and Energy Storage for the Lunar Surface (28 July)

Abstracts are being solicited for lightning talks during the event. Please use the downloadable template on this page to submit an abstract (no longer than 400 words) if you are interested in participating. Submissions are due by 08 July, and decisions about acceptance will be released by 13 July.

The Moon provides an expansive landscape of thermal extremes with requirements far beyond most terrestrial technologies. In particular, the permanently shadowed regions near the lunar poles, rich in science and containing potentially commercially relevant volatiles, reach ultra-cold temperatures ranging down to tens of degrees Kelvin.

While technologies such as nuclear fission and regenerative fuel cells offer large-scale solutions for power during periods of darkness on the Moon, lower-power options such as batteries that will survive or operate within the ultra-cold or over large temperature regimes, as well as strategies that ensure survival through hibernation during periods of eclipse, are immediate needs critical for operations on the lunar surface and beyond.

Meeting these needs will unlock dramatic potential, including enabling longer-term CLPS missions and resource evaluation within permanently shadowed regions that will inform avenues for commercialization of the Moon.

In this workshop, we will discuss near-term solutions for power during the lunar night at the sub-kW regime, with particular interest in the following topics:

- Hibernation
- Thermal management/design
- Low-T battery chemistry
- Radioisotope thermal support/power
- Fuel cells/chemical heat/power

The agenda will include

- Context on needs and lunar thermal environments
- Panel discussion of near-term system solutions
- Lightning talks that survey recent developments
- Focused session on low temperature batteries
- Breakout scenario description
- Break-out discussions targeting specific scenarios

Registration for this event is open! This, abstract submission, and additional information will be available on the event page here: <https://lsic.jhuapl.edu/Events/Agenda/index.php?id=214>

Focus Group Updates

Dust Mitigation

The Dust Mitigation (DM) Focus Group held its monthly focus group meeting on June 23rd. The June focus group meeting centered on the topic of “Dust Tolerant Mechanisms” and featured multiple technology presentations. These included technology presentations by Apollo LRV veteran Ron Creel on “Lunar Dust Protection on Apollo Rover Mechanisms”, Dr. Hunter Williams from Honeybee Robotics on “Lunar Dust Tolerant Electrical and Data Connector for Small to Large Payloads,” and Dr. Justin Scheidler and Dr. Erica Montbach from NASA Glenn Research Center on “Motors for Dusty and Extremely Cold Environments.” In addition, Kristin Jaburek (APL and MOSA Working Group Facilitator) talked about the upcoming LSIC MOSA Working Group meeting on July 13th, and APL’s Reeve Heinis and Bryan Camacho conducted a “virtually in-person” feedback session with participants on how LSIC, the Dust Mitigation Focus Group, and NASA can best meet the community’s needs. You can view the recording, slides, and notes from June’s FG meeting and previous meetings at our LSIC Dust Mitigation Focus Group page on the LSIC website: <https://lsic.jhuapl.edu/Focus-Areas/index.php?fg=Dust-Mitigation>.

Our next focus group meeting will be held on Thursday, July 21st at 12:00 pm Eastern Time. The topic for the meeting will focus on “Dust Sensing and Filtration.” The meeting will include featured technology presentations along with a discussion session.

Excavation & Construction

In the month of June, the E&C focus group hosted John Connolly of NASA Johnson Space Center (JSC) as a guest speaker. John has been studying planetary surface systems and lunar landers for much of his 35-year NASA career. Among his many assignments, he has served as NASA HQ Chief Exploration Scientist, Lunar Surface System lead, and Altair lunar lander Deputy Project Manager.

He presented a talk titled “Lunar Geotechnical Engineering Guide” – summarizing lunar soil properties measured by US and Russian landed missions, including particle size distribution, particle shape, bulk density, shear strength, cohesion and bearing strength, as well as observations of mechanical excavation forces and rocket exhaust viscous erosion forces needed to liberate particles from the soil matrix. This presentation also discussed why more understanding of lunar soil geotechnical properties is essential for better understanding of excavation, lander plume-surface interaction, and lunar construction. Further, APL’s Reeve Heinis led a brief strategizing session regarding how LSIC and NASA can best meet the community’s needs.

In July we will hold a joint monthly meeting (a cross talk) with the Extreme Environment focus group discussing various aspects of use of regolith for radiation shielding. This will be held on July 18, 2 – 3:30 PM Eastern. There will be talks on regolith properties, radiation modeling tools and Lunar Safe Haven work related to protection from radiation. There will also be a panel discussion.

Extreme Access

Happy summer, lunar technology enthusiasts! June was a bit of a quiet month. The telecon this past month included some general surveys and requests for feedback about how the focus group is operating as well as discussion of the currently open NASA LIVE RFI. Thank you to everyone who participated! In July, we will have an opportunity to delve a bit deeper into how the EA focus group

is working, your feedback, and ideas for the future. Please join us for that discussion! Following that, we will have two Technology Spotlights. We will hear from Jean-Pierre de la Croix (JPL) about the Cooperative Autonomous Distributed Robotic Explorers (CADRE) project, and Brad Buckles (NASA) about RASSOR and ROS. We are also working to finalize dates for the rescheduled “Designing for Extremes” workshop, so keep your eyes open for that.

Extreme Environments

In June, Extreme Environments welcomed Tom McCarthy, from Motiv Space Systems, Inc. who covered the extreme environment technologies his company has been developing in the motion control arena. Our new thermal subgroup lead kicked off his new series in late May. Other than our radiation subgroup, we will take this month off as a “summer vacation”. The EE and EA workshop titled “Designing for the Extremes” was postponed, but we are closing in on a new date in the first week of August. For our July meeting, we have another “Cross Talk” lined up with Excavation and Construction focused on using regolith as radiation shielding. This supersized (1.5 hour) meeting has a panel of experts that cover regolith properties related for radiation shielding, radiation modeling, testing efforts, and current studies. We look forward to seeing you there! Additionally, we will be looking for a new space weather and plasma subgroup lead soon. We would like to thank Justin Likar for his hard work. 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

In the June ISRU focus group, Tibor Pacher (Puli Space Systems) and John Vrubleviskis, (Thales Alenia) spoke to the group. Tibor Pacher spoke on “Lightweight, Low Cost COTS-based Water Ice Prospecting with Puli Lunar Water Snoopers and Small Rover.” Essentially, their rovers would be equipped with neutron spectrometer to prospect for hydrogen—and thus water—in lunar PSRs. John Vrubleviskis spoke about the Metalysis FFC process for extracting oxygen and metal from silicate lunar rocks. Reeve Heinis from APL conducted an informal survey of LSIC ISRU participants; broadly, the results show that LSICers want to see more cross-focus group discussion; more discussion on funding opportunities; and more opportunities to fly payloads. Users reported that through LSIC, they had networked or otherwise connected with 1-6 potential collaborators. We have listened and are looking at steering conversation more toward funding opportunities across focus groups as we move forward with the July and August meetings. We also highlighted the upcoming July 28 workshop, “Low-Temperature, Sub-kW Power and Energy Storage for the Lunar Surface,” <https://lsic.jhuapl.edu/Events/Agenda/index.php?id=214>.

Surface Power

In June, the Surface Power Focus Group hosted Martin Narendorf Jr., from CenterPoint Energy. Martin provided perspective from a terrestrial utility provider on the standards governance needed for the lunar surface. In July, the surface power focus group will hold a virtual workshop on Low Temperature, sub-kW power and energy storage, focused on near-term solutions for the lunar surface. More information can be found on the event page. Registration is required, but is fast, free, and open to anyone. Abstracts for lightning talks are due July 8th! Click here to view the event page: <https://lsic.jhuapl.edu/Events/Agenda/index.php?id=214>.

Working Group – MOSA

The MOSA WG hosted its second monthly telecon on June 8th 2022 at 12:00 (noon) PM ET, where Dr. Katherine Morse (Principal Professional Staff at JHU/APL, IEEE Fellow), presented standards development processes. The next working group meeting is planned for July 13 at 11 AM ET, where Dr. Brian Weeden (the Executive Director of CONFERS and Director of Program Planning for the Secure World Foundation) will give a presentation on the “Overview of the Consortium for Execution of Rendezvous and Servicing Operations (CONFERS)”, highlighting some of the standards the consortium has developed.

The group has also been working to build MOSA resources on Confluence (<https://lsic-wiki.jhuapl.edu/x/4YAxAq>) with the help of the LSIC community, including a standards library and other suggested materials of interest.

If you are interested in joining the MOSA WG please email Andrea Harmon at ams573@alumni.psu.edu to get the latest updates and information on upcoming LSIC MOSA events.

Feature Article

Planetary Science Decadal Survey: Relevance and Importance for LSIC

Once a decade, NASA requests a Survey from the National Academies of Sciences, Engineering, and Medicine that identifies a strategy for the next ten years of planetary science funding, research priorities, and missions. The Decadal Survey process itself is a grassroots effort, with input solicited from the broad planetary science community through professional society conference outreach, mission-design team collaboration, and white paper submission. The most recently released [Decadal Survey](#) seeks to maximize planetary science, astrobiology, and planetary defense advancement during 2023 – 2032. Here, we summarize the Decadal Survey chapters and priorities most relevant to LSIC’s mission.

The Lunar Discovery and Exploration Program (LDEP), funded within NASA’s Planetary Science Division (PSD), supports industry partnerships including the Commercial Lunar Payload Services (CLPS) program. **The Decadal Survey provides two clear recommendations for LDEP in the next decade (Chapter 22):**

1. *“The Planetary Science Division should execute a strategic program to accomplish planetary science objectives for the Moon, with an organizational structure that aligns responsibility, authority, and accountability.”*
2. *“Endurance-A should be implemented as a strategic medium-class mission as the highest priority of the [LDEP].”*

Endurance-A, the recommended highest-priority mission for LDEP in the next decade is a lunar rover that would traverse over 1000 km across the South Pole–Aiken basin and collect ~100 kg of samples and deliver them to a location where astronauts can retrieve the samples and return them to Earth. The Decadal Survey highlights this mission as an opportunity for synergy between traditional PSD robotic missions and the human exploration program. Brett Denevi, who served on the steering group of the Decadal Survey and as the Vice Chair of the Panel on the Moon and Mercury notes that “technology like automation will enable Endurance-A to travel much greater distances than any previous rover, and provide a truly revolutionary cache of samples that will help us understand how and why large impacts shaped the early history of our Solar System.”

The Decadal Survey also examined how human exploration can benefit planetary science, and a notable theme of the text (Chapter 19) is to ensure that human exploration and science are tied together in the next decade of lunar surface activities: “High-priority lunar science objectives... should be a key requirement of the Artemis human exploration program.”

The Decadal Survey also emphasizes that human exploration of space benefits technology development. Establishing a sustained presence on the Moon and enabling sustainable lunar surface operations are key foci of LSIC. NASA’s Artemis plans include long-term human surface presence through a Base Camp that will include power systems and ISRU capabilities – surface sustainability components that LSIC members are currently working on. “Seeing science, technology, and exploration come together in the melting pot that is Artemis is really exciting! ISRU on the Moon will enable science, which will enable exploration, which will enable science...and so on in a virtuous cycle,” says Kirby Runyon, one of the LSIC ISRU Facilitators. The Decadal also states that sending robotic missions to characterize exploration environments and maximize science return of human

activity is particularly valuable. In fact, **the Decadal Survey makes a clear recommendation specific to complementary human and robotic activity:**

“PSD should develop a strategic lunar program that includes human exploration as an additional option to robotic missions to achieve decadal-level science goals at the Moon.”

The Decadal Survey also emphasizes that enabling planetary science missions requires substantial technology investments in early stages (Chapter 21). It acknowledges progress made in tech development over the last decade and identifies improvement areas that can further enable lunar science missions to be carried out over 2023 – 2032. One element of progress includes the establishment of the Space Technology Mission Directorate (STMD) itself. **Regarding potential technology advancement improvements, the following funding recommendations are included:**

“NASA PSD should strive to consistently fund technology advancement at an average of 6 to 8 percent of the PSD budget.”

Furthermore, *“STMD should ensure that its level of investment in SMD [Science Mission Directorate] mission technologies is balanced at approximately 30 percent of its overall budget with the PSD portion at no less than 10 percent.”*

Also discussed are a series of general technology areas that should be advanced in the upcoming decade, including, but not limited to: autonomy, challenging environments, communication systems, radioisotope power systems, and subsurface access (Table 21.1). The Decadal also discusses ‘game-changing’ technology trends that could impact future SMD missions, for example, advanced materials and manufacturing, small fission reactors for power and propulsion, and automotive electronics. **This includes a recommendation for the next decade specific to emerging and new technologies that could transform lunar surface science and activity:**

“NASA should maintain cognizance of emerging new technologies and encourage the science and engineering communities to explore new ways that these technologies can enable greater science while reducing development and operations costs.”

Ben Greenhagen, LSIC Extreme Environments Lead, remarks that “there are significant hurdles in adapting existing technologies and developing new technologies to survive and operate in extreme lunar surface environments. The Decadal Survey describes a framework aimed at maximizing contributions from stakeholders and outcomes to both science and exploration.”

For the first time, the Decadal Survey also included a focus on how the state of the profession (SoP) – including issues of diversity, equity, inclusivity, and accessibility (DEIA) – is central to the success of the planetary science enterprise. The report encourages the engagement of students from underrepresented communities at secondary and college levels, and to create and sustain a diverse planetary science community. The SoP recommendations include education about the costs of bias and improvement of institutional practices, broadening opportunities to advance the SoP, and creating an inclusive and inviting community free of hostility and harassment. The report also recommends that NASA, NSF, affiliated institutions, and professional societies work to mitigate bias at all levels, and should include engagement with the community to develop creative initiatives to uncover and mitigate bias.

Given the planned lunar surface activities of NASA, along with its commercial and international partners, the next decade is set to be an exciting one. The technology and human exploration recommendations of this Decadal Survey are a valuable guide that will aid in the decisions and implementation of lunar surface technology development over the 2023 – 2032 timeframe.

Member Spotlight

Exolith Lab

Park Easter (Chief Geotechnical Engineer) & Alexander Madison (ISRU Engineer)

Parks Easter was a sophomore at the University of Central Florida (UCF) when he heard about the Exolith Lab from a talk given at the library during Space Week. He was on the verge of switching majors from environmental to geotechnical engineering, and finding out about the Lab inspired him to not only email Anna Metke, the Lab's Director of Operations, but to also take the plunge and officially change majors. He joined the team in 2020 and has been working on helping the organization grow and expand ever since. He just graduated this past May with his degree and is now working full time for the Exolith Lab as their Chief Geotechnical Engineer.

Alexander Madison also started with the Exolith Lab as an undergrad in 2021, though he began work originally with the Florida Space Institute, which works closely with the Lab. Originally providing project management support, he eventually moved into his current role as a Research Engineer. He also graduated this past May with a degree in aerospace engineering and is an incoming graduate student at UCF in mechanical engineering and planetary science.

The Exolith Lab began in a partnership between UCF and Deep Space Industries (DSI) under a NASA SBIR to make multiple tons of asteroid simulants for upcoming missions. DSI decided to get out of the simulant business and Exolith continued as part of the Center for Lunar and Asteroid Surface Science (CLASS) and the Florida Space Institute (FSI) developing lunar and Martian simulants, and that's when the Exolith Lab was born. The organization continues to be located in Orlando, FL near the UCF campus and can operate at-cost through funding from the Florida Space Institute and CLASS, the Center for Lunar and Asteroid Surface Science at UCF, and NASA SSERVI.



Parks Easter, Jared Long-Fox, and Catherine Millwater examining simulated LMS-1 agglutinates

When the Exolith Lab first grew out of Deep Space Industries, it was a small operation that started making simulant out of a lab on campus by the kilogram, doing work by hand. As the organization grew, an off-campus space was rented in 2020, the organization website was launched, the team grew, and larger equipment was brought in to crush minerals and mix larger batches to make more kilograms per day. Eventually they moved from that first off-campus space and expanded into a much larger warehouse facility in 2021, ramping up their production capability from up to 50 kilograms per day to up to an order for 10 tons in a month. "That was a cool time because it was the first giant order that I was a part of," said Madison. "We knew we could do it, but it was still a difficult time – figuring out international shipping, how to make equipment not fail when using it all day every day." And today, Exolith Lab can ship over 100kg per day. Two years ago, the



Outreach Coordinator Ana-Paula Dovali moving a pallet of lava rock

weekly order average was 5 kilograms. Today, it's regularly between 50 and 100 kilograms per week. Even as their organization has grown, however, demand for more and more simulant keeps pushing the boundaries of what's possible.

The Lab's objective is to supply the space industry and academia with high quality regolith simulants at reasonable prices. Rather than charging a flat hundreds of dollars per kilogram and having everything perfectly characterized, they offer a sliding scale of quality, from low to high fidelity well characterized simulants, with most falling in the middle. Mineralogy drives every aspect of their regolith simulant development, including its geotechnical properties. This is one of the core ideas underpinning their product. The Exolith Lab staff also advise and provide support to customers, in addition to being supporting many different NASA projects. Providing regolith consultations to create custom product is also part of their everyday operations. The organization works with both local and international groups for educational outreach. One of the major initiatives they're involved in is the "Plant the Moon" challenge (<https://plantthemoon.com/>), which has K-12 schools grow plants in regolith and record the results. Exolith Lab also offers educational kits that provide regolith and educational materials for purchase at affordable rates.



Lead Biologist Steven Elsaid working on his Lunar plant growth experiment

The Exolith Lab is also an active ISRU research center, with multiple projects always going on. For example, one of the postdocs, Hannah Sargeant, is working on molten regolith electrolysis. They also have plant growth research underway with their different simulants and mineral mixes to see how they affect plant growth. While their primary operation is selling simulant, they also operate in the academic and research sphere, making scientific studies of regolith properties, putting out papers and participating in conferences as well. The Exolith Lab also allows external researchers to contract to use their regolith bins for research into areas such as dust mitigation, mobility, regolith operations and they hope to see a rover tested in their lab someday. To that end they're currently working on a 10m x 10m x 1m "open source" regolith bin with gravitational offloading capabilities that will be available to use to the commercial sector. It's currently planned for opening in the fall.



Simulant tech crushing lava rock with hammer mill

The team powering the Exolith Lab is unique – while it's headed up by leaders in the field such as Dr. Daniel Britt, Dr. Julie Brisset, Dr. Zoe Landsman, and Jared Long-Fox (along with the previously mentioned Metke), more than 90% of their workforce is made up of undergraduates and high school students. A variety of degrees in planetary science, geology, aerospace, and geotechnical engineering are all represented, among others. And the Lab has become a proving ground for the next generation of engineers and scientists – students graduating from Exolith Lab have been employed by companies like Honeybee Robotics or gone straight into NASA. While

many professional missions and organizations keep science and engineering teams separate, at the Exolith Lab the groups are comingled, with scientists providing characterizations directly to the engineers who act to build to those specifications, feeding back to each other throughout the process. This allows them to work at a speed that sets them apart in the industry, able to get up to

20 kilograms out next-day, and capable of delivering tons of simulant within a few weeks.

The Exolith Lab has been participating in LSIC because of their passion to return to the Moon, which they see reflected in LSIC and its other members. They see value in an organization that has gathered disparate groups for structured talks and collaboration when there's so much to keep track of in the broader lunar development ecosystem. "We fit into the community and the supply chain, and we're partnering with a lot of people within LSIC. We're all really on the bleeding edge, at the front of lunar surface innovation, and anything new that's coming out is going to hit LSIC first," explained Easter. And there's a lot to look forward to – with upcoming CLPS missions and Artemis landings, Exolith Lab is really seeing technology beginning to move towards the development of a sustained presence on the Moon. And their business model has been structured to be as sustainable as possible to continue testing and developing technology for just that purpose.

For more information about the Exolith Lab, please visit: <https://exolithsimulants.com/>



Operations Manager Konrad Kroll posing in front of LHS-1 Simulant order

NASA and Community News

CAPSTONE Launches to Test New Orbit for NASA's Artemis Moon Missions

NASA News \ \ 28 June 2022

<https://www.nasa.gov/press-release/capstone-launches-to-test-new-orbit-for-nasa-s-artemis-moon-missions>

NASA Introduces 2022 Class of Flight Directors

NASA News \ \ 22 June 2022

<https://www.nasa.gov/press-release/nasa-introduces-2022-class-of-flight-directors>

NASA Announces Artemis Concept Awards for Nuclear Power on Moon

NASA News \ \ 21 June 2022

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

ESA and NASA to Cooperate on Earth Science and Lunar Mission

SpaceNews \ \ 15 June 2022 \ \ Jeff Foust

<https://spacenews.com/esa-and-nasa-to-cooperate-on-earth-science-and-lunar-mission/>

Underrepresented candidates bring new ideas to NASA in "HackWeek"

12WBOY \ \ 14 June 2022 \ \ Jeena Cadigan

<https://www.wboy.com/news/local/monongalia-and-preston/underrepresented-candidates-bring-new-ideas-to-nasa-in-hackweek/>

China's Moon Sample-return Mission Finds Water Evidence Twice Over

Space.com \ \ 14 June 2022 \ \ Andrew Jones

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

GM and Lockheed Are Expanding Their Moon Buggy Into a Whole Lunar Lineup

CNN \ \ 11 June 2022 \ \ Peter Valdes-Dapena

<https://amp.cnn.com/cnn/2022/06/10/business/gm-lockheed-moon-buggy-scn/index.html>

This Lunar Robot Prototype Looks Like a Centaur Meant for the Moon

CNN \ \ 08 June 2022 \ \ Jackie Wattles

<https://edition.cnn.com/2022/06/08/tech/lunar-robot-demonstration-jaxa-gitai-scn/>

France joins Artemis Accords

SpaceNews \ \ 08 June 2022 \ \ Jeff Foust

<https://spacenews.com/france-joins-artemis-accords/>

The Canadian Space Agency Provides \$1.75M for 7 Moon Infrastructure Ideas

spaceQ \ \ 07 June 2022 \ \ Marc Boucher

<https://spaceq.ca/the-canadian-space-agency-provides-1-75m-for-7-moon-infrastructure-ideas/>

Tucson's Paragon Space to help develop new NASA spacesuits

Tucson.com \ 03 June 2022 \ David Wichner

https://tucson.com/news/local/subscriber/tucson-paragon-space-to-help-develop-new-nasa-spacesuits/article_2c7731e6-e359-11ec-8608-b3f15abccf2e.html

NASA Selects New Instruments for Priority Artemis Science on Moon

NASA News \ 02 June 2022

<https://www.nasa.gov/press-release/nasa-selects-new-instruments-for-priority-artemis-science-on-moon>

NASA Funds Projects that Aim to Inspire Artemis Generation

NASA News \ 02 June 2022

<https://www.nasa.gov/press-release/nasa-funds-projects-that-aim-to-inspire-artemis-generation>

NASA Administrator to Launch Artemis Learning Lunchbox Initiative

NASA News \ 01 June 2022

<https://www.nasa.gov/press-release/nasa-administrator-to-launch-artemis-learning-lunchbox-initiative>

Funding Opportunities

Tech Development

- Announcement for Partnership Proposals (AFPP) to Advance Tipping Point Technologies
<https://nspires.nasaprs.com/external/solicitations/summary.do?solId=%7b9987D88F-0A12-5203-FC25-423773FAF134%7d&path=&method=init>
 Final proposals due: July 28, 2022
- Space Technology Announcement of Collaboration Opportunity (ACO)
<https://nspires.nasaprs.com/external/solicitations/summary.do?solId=%7bA9C79925-6F41-69E8-4BE0-5325903D777C%7d&path=&method=init>
 Final proposals due: July 28, 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>