



Lunar Surface Innovation

C O N S O R T I U M

LSIC Dust Mitigation Focus Group

Monthly Meeting

July 20, 2023



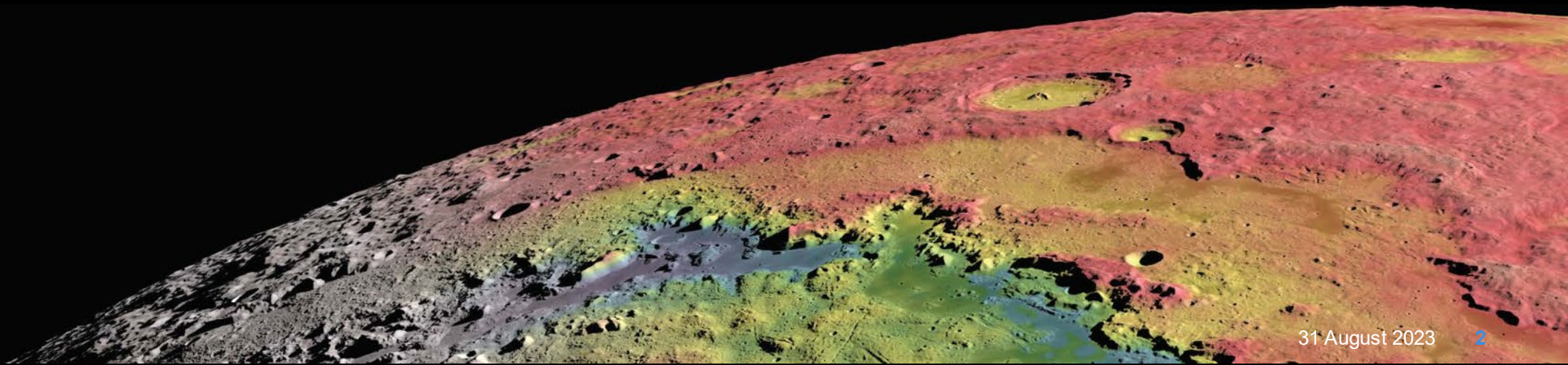
JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

Jorge Núñez, Sarah Hasnain, Lindsey Tolis, Richard Miller,
Stephen Izon, Timothy Cole

Facilitator_DustMitigation@jhuapl.edu

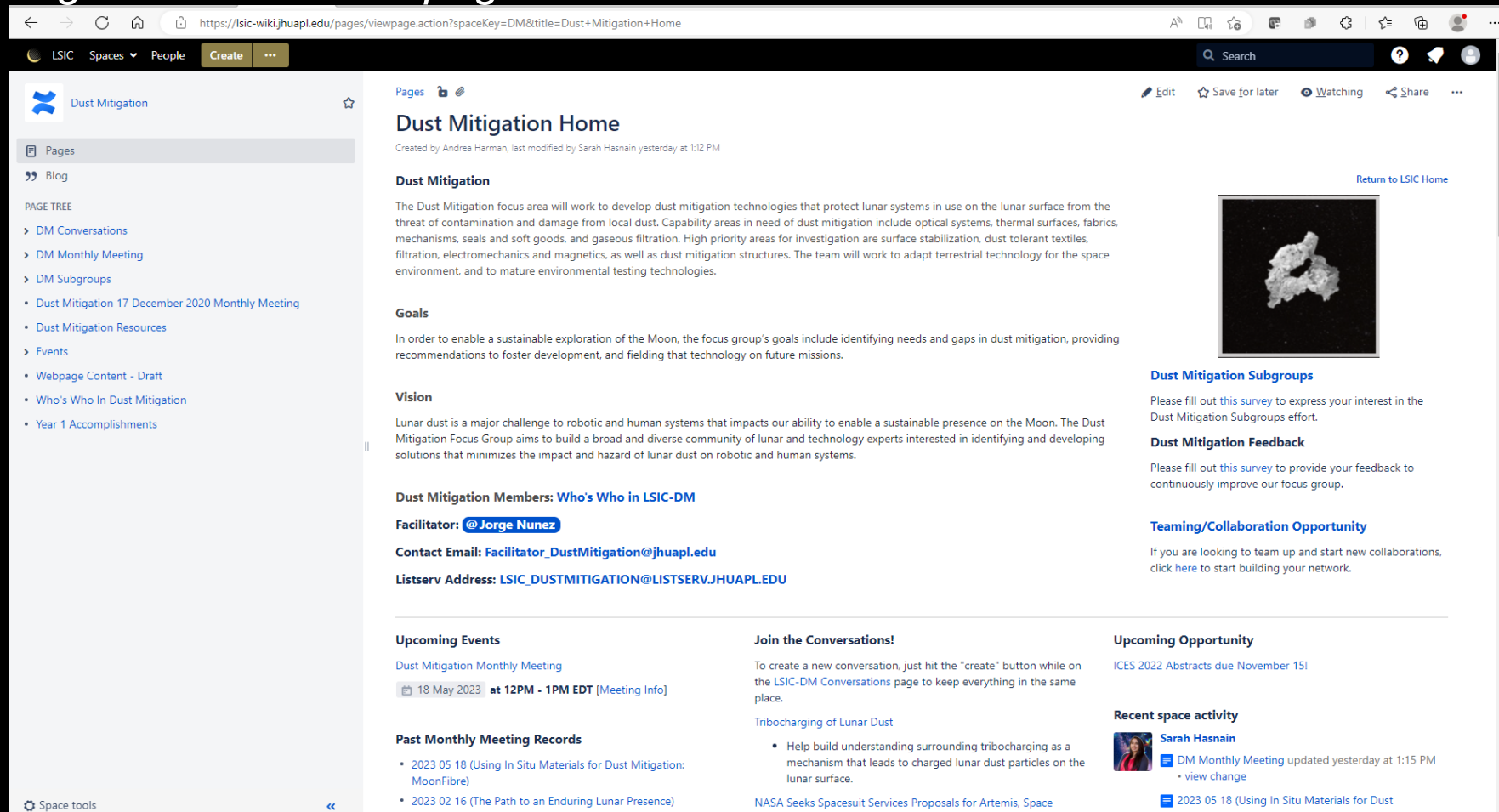
Agenda

- Welcome, LSIC and Focus Group Updates
- Upcoming Opportunities and Meetings
- Featured Technology Presentation:
 - **“Developing a Large-Scale Lunar Regolith Test Bin with Gravity Offload Capabilities”**
 - Lucas Weber, Chief Engineer at the Exolith Lab
- Discussion on Lunar Simulants



LSIC Dust Mitigation Wiki Page

- To request access, please contact lsic-wiki-admins@listserv.jhuapl.edu
- *Dust Mitigation Discussion page and wiki*

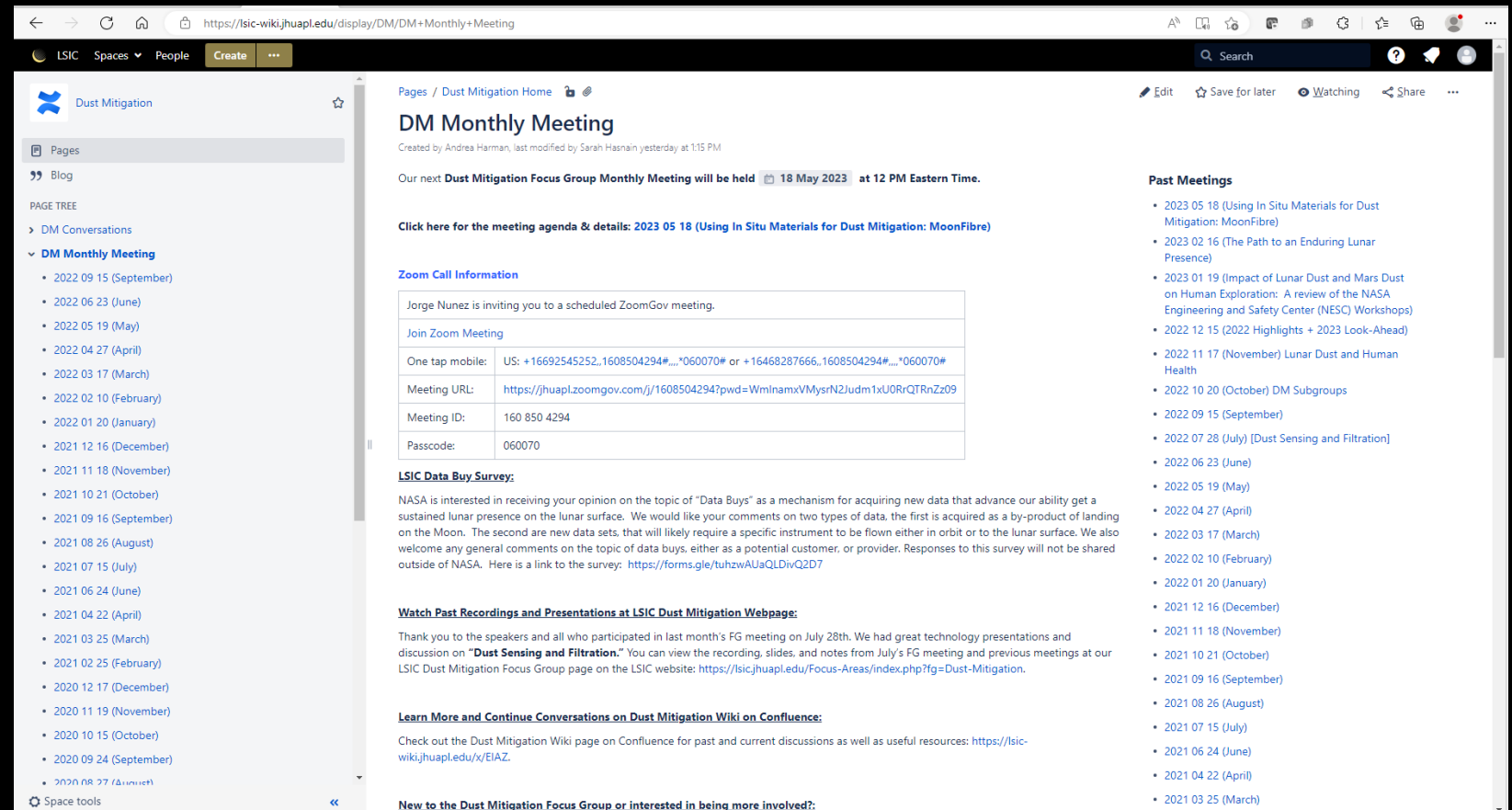


The screenshot shows the 'Dust Mitigation Home' page on the LSIC wiki. The page is titled 'Dust Mitigation Home' and was created by Andrea Harman, last modified by Sarah Hasnain yesterday at 1:12 PM. The main content area includes sections for 'Dust Mitigation' (describing the focus area and goals), 'Goals' (listing objectives like sustainable exploration), 'Vision' (discussing the challenge of lunar dust), and 'Dust Mitigation Members: Who's Who in LSIC-DM'. It also lists the 'Facilitator: @Jorge Nunez', 'Contact Email: Facilitator_DustMitigation@jhuapl.edu', and 'Listserv Address: LSIC_DUSTMITIGATION@LISTSERV.JHUAPL.EDU'. On the right side, there are links for 'Dust Mitigation Subgroups', 'Dust Mitigation Feedback', and 'Teaming/Collaboration Opportunity'. The bottom of the page features 'Upcoming Events' (Dust Mitigation Monthly Meeting on 18 May 2023), 'Join the Conversations!', 'Upcoming Opportunity' (ICES 2022 Abstracts due November 15!), and 'Recent space activity' (DM Monthly Meeting updated yesterday at 1:15 PM).

Join the Discussion on our Wiki Page

- To request access, please contact lsic-wiki-admins@listserv.jhuapl.edu
- *Dust Mitigation Discussion page and wiki*

- 1. Sign-in to add a comment
- 2. Add comment at bottom of page
- 3. You can comment before, during, or after today's meeting



The screenshot shows a web browser displaying the 'Dust Mitigation' wiki page. The page title is 'DM Monthly Meeting'. It includes a navigation sidebar on the left with a 'PAGE TREE' showing 'DM Monthly Meeting' as a sub-page under 'DM Conversations'. The main content area features an announcement for the next meeting on May 18, 2023, at 12 PM Eastern Time. Below this is a 'Zoom Call Information' table with details for a Zoom meeting, including a mobile number, meeting URL, ID, and passcode. Further down, there are sections for 'LSIC Data Buy Survey', 'Watch Past Recordings and Presentations at LSIC Dust Mitigation Webpage', and 'Learn More and Continue Conversations on Dust Mitigation Wiki on Confluence'. A right-hand sidebar lists 'Past Meetings' with dates from March 2023 back to March 2021. The browser's address bar shows the URL: https://lsic-wiki.jhuapl.edu/display/DM/DM+Monthly+Meeting.

Updates and Communications

- Monthly LSIC newsletter – New edition came out early July 2023
 - POC: Josh Cahill
 - <https://lsic.jhuapl.edu/Resources/LSIC-Resources.php>
- Mailing list
 - The listserv goes to all participants. Use with caution. But feel free to use!
 - Please make sure to add LSIC_DUSTMITIGATION@LISTSERV.JHUAPL.EDU to safe senders list.
 - If we need smaller, focused lists we can set those up
- Updates to the webpage - <https://lsic.jhuapl.edu/Our-Work/Focus-Areas/index.php?fg=Dust-Mitigation>
 - Notes, slides, recordings from telecons posted here
- Keep up on the Wiki!
 - Confluence is free to you and available to all registered LSIC members
 - **To request access, please contact lsic-wiki-admins@listserv.jhuapl.edu**
- Lightning Talks at monthly focus group meetings
 - Anyone can volunteer to give a featured talk (~15 mins)
 - Email me if you want to sign up: Facilitator_DustMitigation@jhuapl.edu

Follow the Code of Conduct for all Focus Group communications

<https://lsic.jhuapl.edu/Resources/LSIC-Resources.php>

Space Technology Funding Opportunities

Current Tech Development Opportunities

- [NSF SBIR and STTR »](#)
 - NSF recommends treating the submission window like a deadline, but you can submit anytime within a year of receiving an official invitation from NSF. (NSF uses submission windows to help gather and review proposals, but sometimes proposals are reviewed as they are received.)
Windows: March 2, 2023 - July 5, 2023 July 6, 2023 - November 1, 2023
- [NASA Innovation Corps Pilot »](#)
 - Proposals may be submitted at any time through July 22, 2022, but applications will be reviewed in intervals on the following dates: Sept. 16, 2022; Nov. 17, 2022; and Jan 20, 2023
- [Technology Advancement Utilizing Suborbital and Orbital Flight Opportunities “TechFlights” »](#)
 - Mandatory Preliminary Proposals Due - 6/7/2023 Full Proposals Due - 10/4/2023
- [Human Lander Challenge](#)
 - Notice of Intent (NOI) Due October 22, 2023; Full Proposals Due March 4, 2024
- [NASA's 2024 BIG Idea Challenge »](#)
 - Notice of Intent Deadline – September 20, 2023; Q&A Session for Interested Teams – October 12, 2023; Proposal Deadline – January 23, 2024; 2024 BIG Idea Forum – November 5-7, 2024

Future Solicitation and Opportunities

- [NASA Innovative Advanced Concepts \(NIAC\) 2024 Phase I Call for Proposals »](#)
 - The NIAC program supports visionary research ideas through multiple progressive phases of study. Phase I studies are nine-month efforts to explore the overall viability and advance the technology readiness level (TRL). Eligible recipients of Phase I awards can propose for a follow-on Phase II study.

Human Lander Challenge

- Through the 2024 HuLC competition, NASA's Human Landing System (HLS) Program provides college students the opportunity to explore innovations and potential solutions to lunar Plume-Surface Interaction (PSI) risks and challenges.
- NASA's HLS Program is responsible for the transportation in deep space to carry humans to and from the surface of the Moon for NASA's Artemis lunar exploration program. Crews will board the HLS in lunar orbit and descend to the surface where they will collect samples, perform science experiments, and observe the lunar environment before returning to orbit in the HLS.
- Teams are invited to submit proposals for **innovative, systems-level solutions to understand, mitigate, and manage the impacts of lunar PSI that can be implemented within 3-5 years**. The potential solutions teams can propose to could include, but are not limited to, the following categories:
 - Trade Studies on Landing Trajectories that Minimize PSI
 - Reduction / Mitigation of Erosion (Cratering) and Ejecta during Descent, Landing, and Ascent
 - Development of PSI Flight Instrumentation / Measurement Methods and Concepts
 - Tracking Dust During Descent, Landing, and Ascent
 - Instrumentation Performance Through the Dust Cloud During Landing
 - HLS Asset Safety (ejecta damage, excessive lander heating, etc.)
 - PSI Modeling and Validation
- **Notice of Intent (NOI) Due October 22, 2023; Full Proposal Due March 4, 2024**
- https://hulc.nianet.org/challenge_details/

LSIC Activities

Recent and Upcoming LSIC Meetings and Workshops (<https://lsic.jhuapl.edu/Events/>)

- Lunar Proving Ground Definition Workshop (July 12-13, 2023)
- Surface Power Reliability Workshop (July 26-27, 2023)
- Autonomy Workshop (August 21-22, 2023)
- LSIC Fall Meeting (October 10-12, 2023)
 - Community College of Allegheny County, Pittsburgh, PA
- LSIC Dust Mitigation Workshop (November 7-8, 2023)
 - Follow-up to DM Workshop from 2021
 - Held virtually; Information to be sent later

Other Recent and Upcoming Dust Mitigation Related Workshop and Meetings

- Annual Meeting of the Lunar Exploration Analysis Group Meeting (September 20-22, 2023)
 - Laurel, MD
 - <https://www.lpi.usra.edu/leag/>
- 2023 ASCEND Meeting (October 23-25, 2023)
 - Las Vegas, NV
 - [2023 ASCEND](#)



Lunar Surface Innovation

C O N S O R T I U M

LUNAR PROVING GROUNDS DEFINITION WORKSHOP

Preliminary Insights

July 12-13, 2023



JOHNS HOPKINS

APPLIED PHYSICS LABORATORY

LSIC | Lunar Proving Grounds Definition Workshop, July 12-13th, 2023

The Lunar Surface Innovation Consortium (LSIC) hosted a Lunar Proving Grounds (LPG) Definition Workshop that brought together stakeholders across NASA/Academia/Commercial and more to discuss possible manifestations of an LPG as well as the technical and programmatic needs to achieve system-of-systems testing in pursuit of an enduring Lunar presence.

300+ individuals (100 in-person) attended the meeting over the course of two days in the first LSIC hybrid workshop. Detailed results from the workshop will be presented at ASCEND 2023.

Meeting Content Included panels with extended Q&A, small-group discussions on targeted topics, and preliminary discussions of major insights. The hybrid format was widely-praised and was the top-voted format for future meetings.

Takeaways and Community Feedback:

- An LPG should focus on integration, validation, lifecycle testing, and humans-in-the-loop. An LPG is critical for technology needed to enable sustained presence and operational validation.
- An LPG should include interoperable infrastructure representative of the operational space.
- Deconflicted and coordinated facilities can serve many of the component-level testing in advance of the need for an LPG, while reducing administrative burden and building efficiencies.
- Digital engineering tools can meet a sub-set of LPG elements, but there is need to detail the appropriate technologies and environments.
- An LPG should have a pathway for international access to facilities, which should be considered during planning.

LSIC | Surface Power Reliability Workshop



- Date: July 26-27
- Time: 11:00AM – 3:30 PM ET
- Location: Virtual via Zoom
- Abstracts Due: 30 June

• **REGISTRATION AND ABSTRACT SUBMISSION ARE OPEN**

- How do we approach reliability from the system/grid level and how should this affect the early-TRL development at the component level?



John Scott (NASA)
Principal Technologist
Power & Energy



Clay Smith (APL)
ISS Probabilistic Risk
Assessment Creator



David McGlone (NAVSEA)
Director
Submarine Safety Program



Steve Miller (NSF)
Antarctic Facilities
Program Manager



Jim Soeder (NASA, re)
Senior Power Technologist (08-21)
Power Development Chief (87-08)



Roger Boyer (NASA)
Artemis Probabilistic
Risk Assessment Lead



Blanca Lara (NASA)
JSC EHP Lunar Power
Lead



Bill Anderson (NAVFAC)
Director of Utilities and
Energy Management

Autonomy Workshop (EA and E&C)

August 21-22, 2023

Full-days, Virtual

Registration
open soon!
Check back on
the LSIC
webpage.

Objective: The goal of this workshop is to gather the Lunar community to exchange ideas on autonomy, as well as identify technology gaps and use cases for establishing a sustainable presence on the Moon and Mars.

Day 1:

- Morning - Autonomous Systems, Situational and Self Awareness, Reasoning and Acting
- Afternoon - Collaborative Systems

Day 2:

- Morning - Applications in Autonomy on Lunar Surface - Current Champions (e.g. Autonomous Construction & Assembly)
- Afternoon - Challenges in Autonomy (Test & Evaluation, Cybersecurity, Dynamic Reasoning Models, Environmental Considerations)

Get Involved with Dust Mitigation

- Sign-up to Receive LSIC and Dust Mitigation FG Updates:
 - Fill out the LSIC Survey and indicate interest in Dust Mitigation to receive news and event invitations:
 - <https://lsic.jhuapl.edu/News/Sign-Up.php>
- Help us improve the Dust Mitigation Focus Group!
 - Feedback survey:
https://docs.google.com/forms/d/e/1FAIpQLSdjuTIK_TLMnCM4_aSMLAzLS762qtzbgmcOd2fgizlCsab6KQ/viewform
- Join one of the Dust Mitigation Subgroups!
 - Dust Mitigation Subgroup Membership/Leaders survey:
<https://forms.gle/AGpyJcNZBd6ihdaq7>
 - Still looking for subgroup leads!
- Interested in Teaming/Collaborating with Others?
 - Add yourself to our Who's Who page: <https://lsic-wiki.jhuapl.edu/display/DM/Who%27s+Who+In+Dust+Mitigation>
- Looking for info on lunar dust or dust mitigation resources?
 - Checkout our resources page on the Dust Mitigation Wiki page on Confluence: <https://lsic-wiki.jhuapl.edu/x/94Rf>

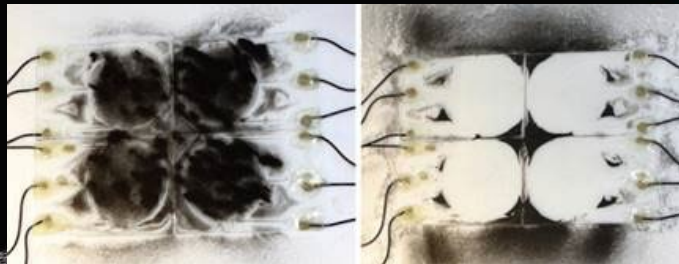
Dust Mitigation FG Subgroups

- **Standards & Interoperability [Subgroup Lead: Dan Hawk]**
 - Standards and interoperability across testing and operational use cases
- **Isolation Technologies [Subgroup Lead: Ron Creel]**
 - Technologies that keep dust out
- **Materials & Coatings**
 - Optical Systems – Viewports, camera lenses, solar panels, space suit visors, mass spectrometers, other sensitive optical instruments
 - Thermal Surfaces – Thermal radiators, thermal painted surfaces, thermal connections
 - Fabrics – Space suit fabrics, soft wall habitats, mechanism covers
 - Seals and Soft Goods – Space suit interfaces, hatches, connectors, hoses
- **Mechanisms & Connectors**
 - Mechanisms – Linear actuators, bearings, rotary joints, hinges, quick disconnects, valves, linkages
 - Dust-tolerant connectors
- **Modeling & Monitoring**
 - Gaseous Filtration – Atmosphere revitalization, ISRU processes
 - Dust monitoring – Cabin and external dust monitoring
 - Dust plume modeling

Interested in leading a
Dust Mitigation Subgroup?

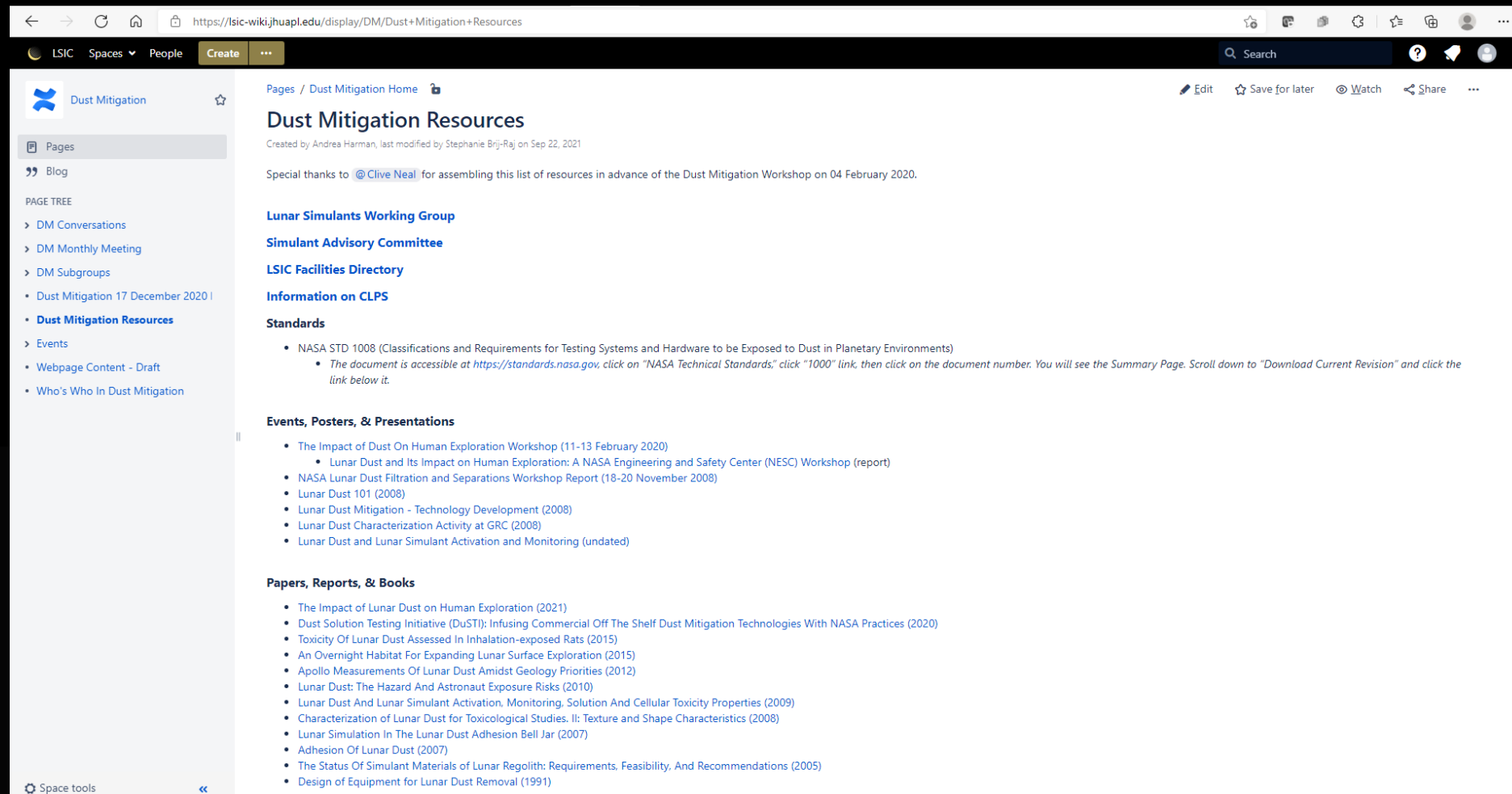
Fill out our survey!

<https://forms.gle/AGpyJcNZBd6ihdaq7>



Dust Mitigation Resources

- Looking for info on lunar dust or dust mitigation resources? Checkout our resources page on the Dust Mitigation Wiki page on Confluence: <https://lsic-wiki.jhuapl.edu/x/94Rf>



The screenshot shows a web browser displaying the 'Dust Mitigation Resources' page on the LSIC Wiki Confluence site. The page title is 'Dust Mitigation Resources' and it was created by Andrea Harman, last modified by Stephanie Brij-Raj on Sep 22, 2021. The page content includes a special thanks to @Clive Neal for assembling the list of resources in advance of the Dust Mitigation Workshop on 04 February 2020. The page is organized into several sections: 'Lunar Simulants Working Group', 'Simulant Advisory Committee', 'LSIC Facilities Directory', 'Information on CLPS', 'Standards', 'Events, Posters, & Presentations', and 'Papers, Reports, & Books'. The 'Standards' section lists NASA STD 1008 (Classifications and Requirements for Testing Systems and Hardware to be Exposed to Dust in Planetary Environments) with a note that the document is accessible at <https://standards.nasa.gov>. The 'Events, Posters, & Presentations' section lists several workshops and reports, including 'The Impact of Dust On Human Exploration Workshop (11-13 February 2020)', 'NASA Lunar Dust Filtration and Separations Workshop Report (18-20 November 2008)', and 'Lunar Dust 101 (2008)'. The 'Papers, Reports, & Books' section lists various scientific publications, including 'The Impact of Lunar Dust on Human Exploration (2021)', 'Dust Solution Testing Initiative (DuSTI): Infusing Commercial Off The Shelf Dust Mitigation Technologies With NASA Practices (2020)', and 'Toxicity Of Lunar Dust Assessed In Inhalation-exposed Rats (2015)'. The page also features a sidebar with navigation options like 'Pages', 'Blog', and 'PAGE TREE', and a search bar at the top right.

Looking for Funding?

The Funding Opportunities tool can help match your needs to NASA funding resources.



[Read More](#)



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Funding Opportunities

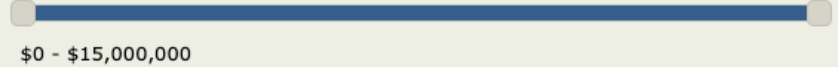
Interested in developing technology with NASA?

Tell us about the types of opportunities you are looking for. Please note, this page is for informational purposes only, and solicitation dates are subject to change. This information does not constitute a solicitation. To respond to a funding opportunity listed, please access and respond according to the provided solicitation link. NASA does not collect or store any of the information provided by users of this page.

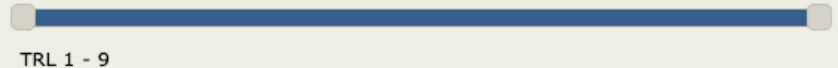
Your roles or organization:

- General Public / Innovator
- Small Business
- Large Business
- Non-Profit or Research Institution
- International
- NASA
- Undergraduate Student
- Graduate Student
- High School Student
- Other Academic Researcher
- Minority-Serving Institution

Funding Needed



Technology Maturity ⓘ



These opportunities might be a good fit for you:

[Clear all filters](#)

19 results found

Funding Opportunity	Average Project Funding	Average Duration (Months)	Frequency	Next Opportunity	Mission Directorate	Topic-Specific or Open
BIG Idea Challenge	\$180,000	9	Annual	2024/01	STMD	Topic
Centennial Challenges	\$500,000	36	Ongoing	Ongoing	STMD	Topic

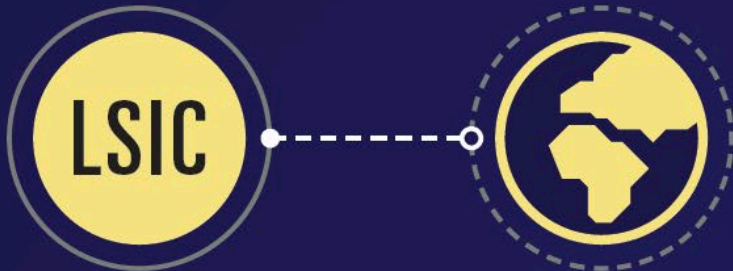


THE PATH TO AN ENDURING LUNAR PRESENCE

In the early 2030s, lunar infrastructure could support a science outpost and exploration proving grounds that can also bootstrap commercial activities.

The LSIC community is publishing a white paper to share their perspectives on key enabling actions that will help our nation and the world move together toward our shared use of the lunar surface.

LSIC Community
Draft White Paper



JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

LSIC White Paper and M2M Feedback

LSIC Whitepaper

The Path to an Enduring Lunar Presence

Perspectives on key enabling actions that will help our nation and the world move together toward our shared use of the lunar surface.

Access White Paper:

<https://lsic.jhuapl.edu/Resources/files/The%20Path%20to%20an%20Enduring%20Lunar%20Presence.pdf>

Send feedback to: LSIC-Feedback@jhuapl.edu

NASA Moon to Mars Whitepapers

Architecture Concept Review

Systems Analysis of Architecture Drivers

Why NRHO: The Artemis Orbit

Why Artemis will Focus on the Lunar South Polar Region

Gateway: The Cislunar Springboard for International and Sustainable Human Deep Space Exploration

Mars-Forward Capabilities to be Tested at the Moon

Mars Transportation

Access White Papers:

<https://www.nasa.gov/MoonToMarsArchitecture>

Today's Technology Presentation

“Developing a Large-Scale Lunar Regolith Test Bin with Gravity Offload Capabilities”



Lucas Weber

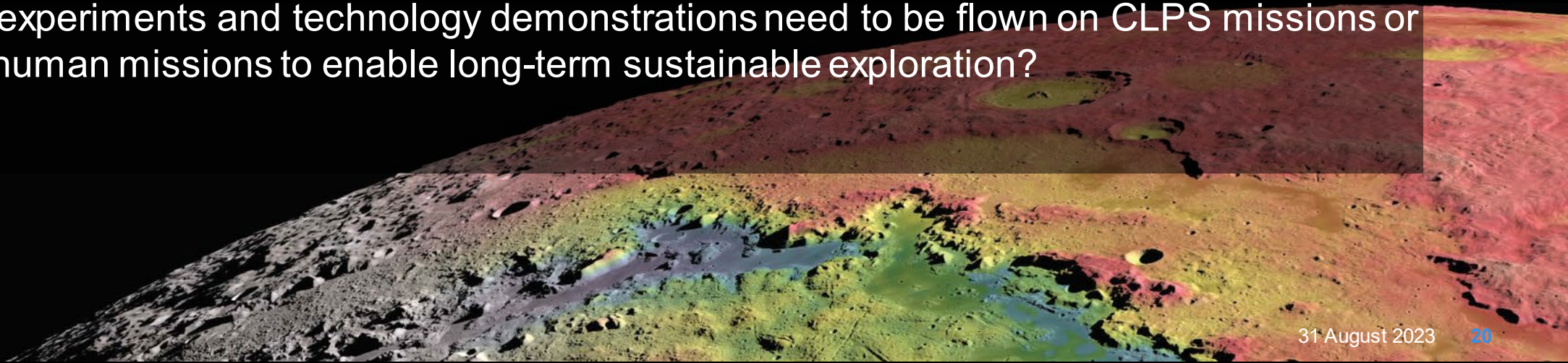
Chief Engineer

The Exolith Lab

Lucas.Weber@ucf.edu

Discussion on Lunar Simulants

- What gaps exist in our understanding of lunar dust and regolith?
- What data do we still need to help improve our understanding of lunar dust and regolith?
- What plans are in place to ensure we get the data we need to close those gaps?
- Do upcoming CLPS missions help get the data we need? If so, what kind of data is needed?
- Do Lunar Regolith simulants approximate lunar dust sufficiently for dust mitigation testing needs? If not, what properties are missing?
- What experiments and technology demonstrations need to be flown on CLPS missions or early human missions to enable long-term sustainable exploration?





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APPLIED PHYSICS LABORATORY

Lunar Surface Technology Demonstration Strategy

Power, ISRU, Autonomy, Robotics, Excavation, Construction

Early lunar surface demonstrations will increase technology readiness for key infrastructure capabilities with opportunities for collaboration with OGAs, industry, academia, and international partners

◆ IM-2 Demo (on CLPS IDIQ)

- Polar Resources Ice Mining Experiment (PRIME-1)
- Nokia 4G LTE Communications
- Intuitive Machines Deployable Hopper (TP)



Oxygen Extraction Ground Demo

◆ CT-1 Space Tech CLPS Demo

◆ CT-2 Space Tech CLPS Demo

CT Candidate Technologies (in formulation):

- ISRU Subscale Demo
- Power (e.g. Vertical Solar Array, Power Beaming, Fuel Cells)
- Dust Mitigation
- Autonomy & Robotics (e.g. Mobility, Navigation, etc.)
- Excavation
- Construction

◆ Fission Surface Power Demo

◆ ISRU Pilot Plant

Volatiles Investigating Polar Exploration Rover (VIPER)
(Science Mission Directorate)

◆ Space Tech Lunar Surface Demo

2023



2033

Near-term Lunar Technology Demos

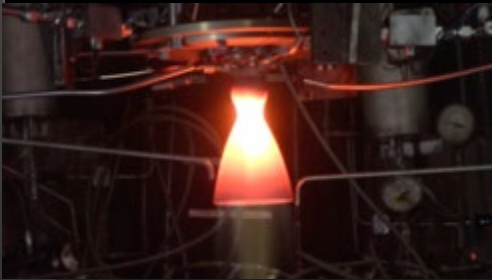
Early lunar surface demonstrations, via the Commercial Lunar Payload Services (CLPS) Program, are opportunities to mature the capabilities required for NASA and industry

Astrobotic Peregrine-1 Mission

Launch date under assessment



Astrobotic Terrain Relative Navigation (ATRN) - Tipping Point with Astrobotic

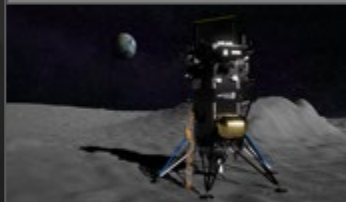


Thruster for Advancement of Low Temperature Operations in Space (TALOS)

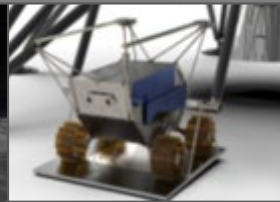
Intuitive Machines (IM)-2 Mission

Planned for Q4 CY23

Launch date under assessment



Polar Resources Ice-Mining Experiment (PRIME-1)



LTE Proximity Comms (Tipping Point w/Nokia)



Deployable Lunar Hopper (Tipping Point w/ IM)

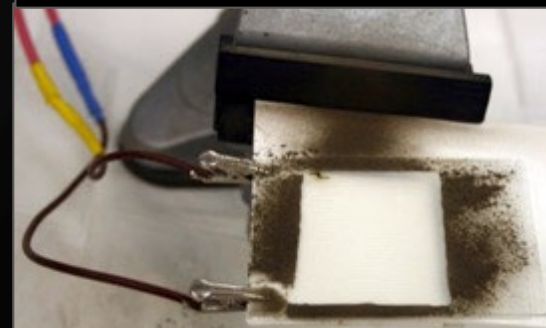
CLPS 19D Mission (Firefly)

Planned for Mid-CY24

Launch date under assessment



Stereo Camera for Lunar Plume Surface Studies (SCALPSS)



Electrodynamic Dust Shield (EDS)

CLPS CP11 Mission (IM)

Early/Mid 2024



Cooperative Autonomous Distributed Robotic Explorers (CADRE)