



Lunar Surface Innovation

C O N S O R T I U M

LSIC Dust Mitigation Focus Group

Monthly Meeting

January 20, 2022



JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

Dr. Jorge Núñez
Senior Scientist
Space Exploration Sector

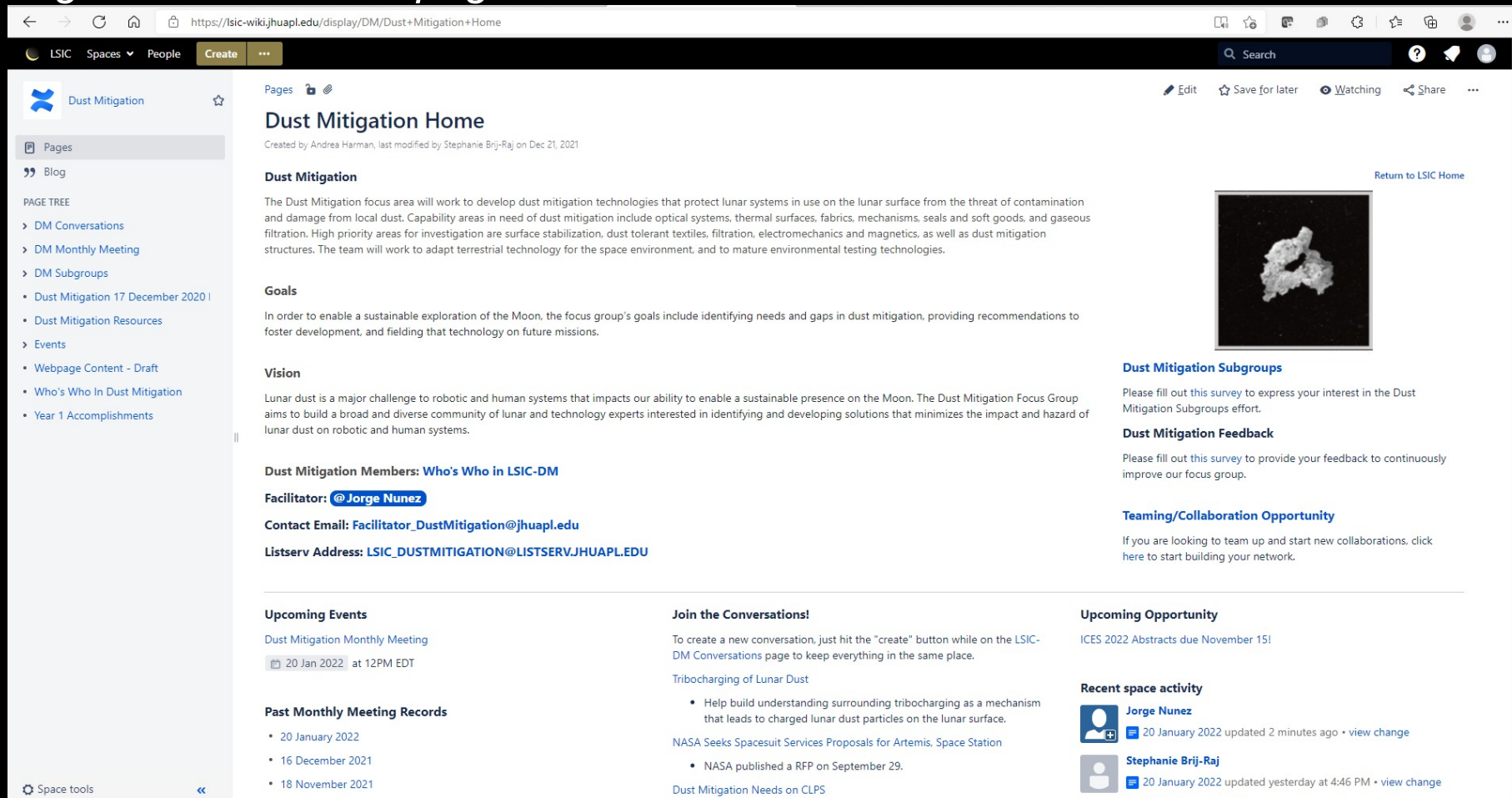
Facilitator DustMitigation@jhuapl.edu

Agenda

- Welcome, LSIC and Focus Group Updates
- Upcoming Opportunities and Meetings
- Quick DM Updates
 - Who's Who in Dust Mitigation
 - What is next for Dust Mitigation FG
 - Dust Mitigation Resources page
- Featured Presentations on “Passive Dust Removal”:
 - Jacquelyne Black, NASA Johnson Space Center
 - “DuSTI Outbrief: Dust Mitigation Characterization of Coatings and Pliable Cleaners”
 - Dr. Stephen Furst, Founder and CEO of Smart Material Solutions, Inc.
 - “Passive Nano- and Micro-Textured Dust-Mitigation Surfaces in Space”
- Discussion on needs/gaps/opportunities of Passive Dust Removal

LSIC Dust Mitigation Confluence Site

- Please contact Andrea Harman (ams573@alumni.psu.edu) to get set up with an account!
- *Dust Mitigation Discussion page and wiki*



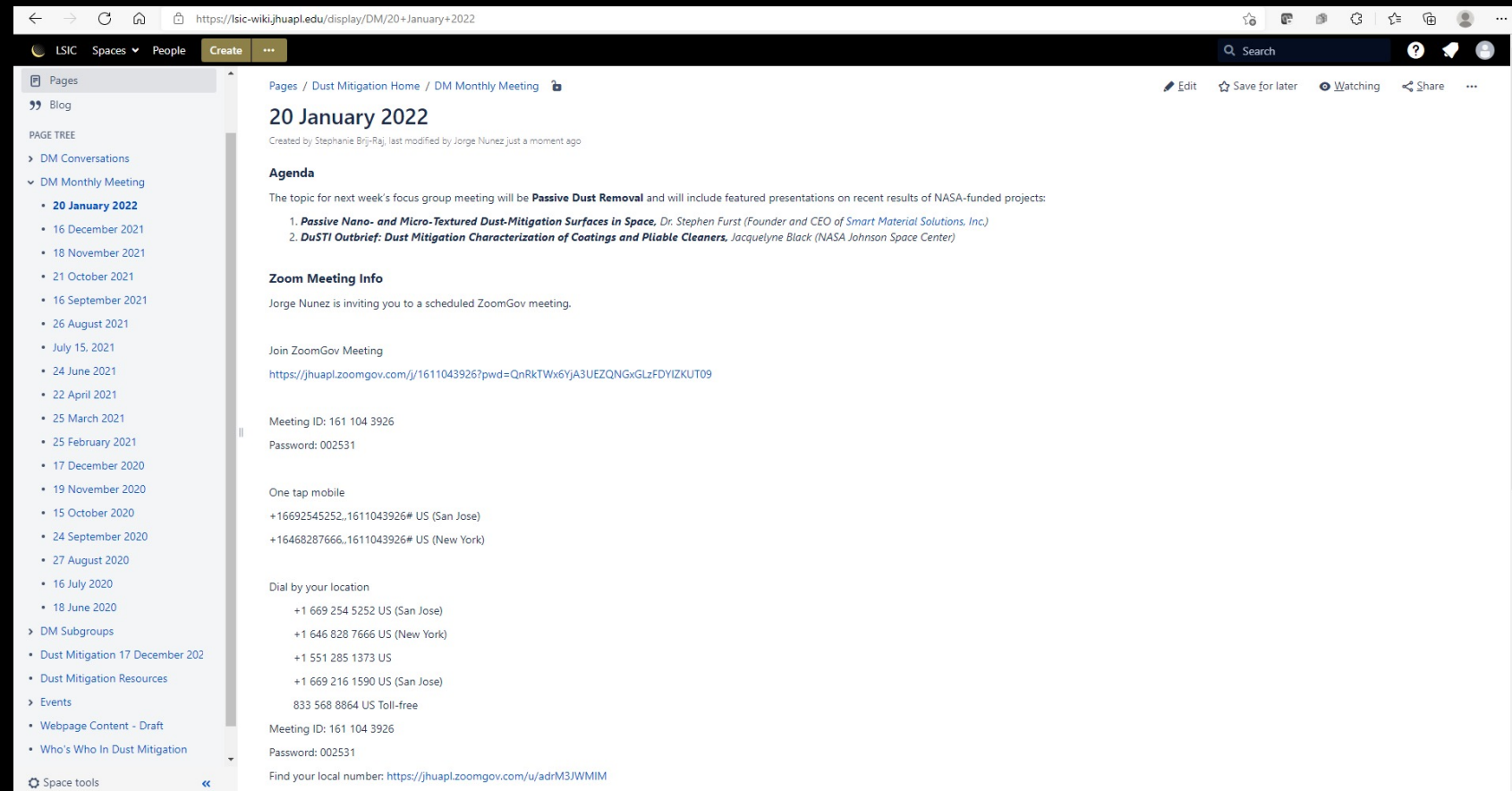
The screenshot shows the Confluence page for the Dust Mitigation Home. The page is titled "Dust Mitigation Home" and was created by Andrea Harman, last modified by Stephanie Brij-Raj on Dec 21, 2021. The page content includes:

- Dust Mitigation:** The Dust Mitigation focus area will work to develop dust mitigation technologies that protect lunar systems in use on the lunar surface from the threat of contamination and damage from local dust. Capability areas in need of dust mitigation include optical systems, thermal surfaces, fabrics, mechanisms, seals and soft goods, and gaseous filtration. High priority areas for investigation are surface stabilization, dust tolerant textiles, filtration, electromechanics and magnetics, as well as dust mitigation structures. The team will work to adapt terrestrial technology for the space environment, and to mature environmental testing technologies.
- Goals:** In order to enable a sustainable exploration of the Moon, the focus group's goals include identifying needs and gaps in dust mitigation, providing recommendations to foster development, and fielding that technology on future missions.
- Vision:** Lunar dust is a major challenge to robotic and human systems that impacts our ability to enable a sustainable presence on the Moon. The Dust Mitigation Focus Group aims to build a broad and diverse community of lunar and technology experts interested in identifying and developing solutions that minimizes the impact and hazard of lunar dust on robotic and human systems.
- Dust Mitigation Members: Who's Who in LSIC-DM**
- Facilitator:** @Jorge Nunez
- Contact Email:** Facilitator_DustMitigation@jhuapl.edu
- Listserv Address:** LSIC_DUSTMITIGATION@LISTSERV.JHUAPL.EDU
- Upcoming Events:** Dust Mitigation Monthly Meeting on 20 Jan 2022 at 12PM EDT.
- Past Monthly Meeting Records:**
 - 20 January 2022
 - 16 December 2021
 - 18 November 2021
- Join the Conversations!**
 - Help build understanding surrounding tribocharging as a mechanism that leads to charged lunar dust particles on the lunar surface.
 - NASA published a RFP on September 29.
- Upcoming Opportunity:** ICES 2022 Abstracts due November 15!
- Recent space activity:**
 - Jorge Nunez: 20 January 2022 updated 2 minutes ago • view change
 - Stephanie Brij-Raj: 20 January 2022 updated yesterday at 4:46 PM • view change

Join the Discussion on Confluence Site

- Please contact Andrea Harman (ams573@alumni.psu.edu) to get set up with an account!
- *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 Confluence page for a meeting on 20 January 2022. The page is titled "20 January 2022" and was created by Stephanie Bri-Raj. The agenda includes two items: "Passive Nano- and Micro-Textured Dust-Mitigation Surfaces in Space" by Dr. Stephen Furst, and "DuSTI Outbrief: Dust Mitigation Characterization of Coatings and Pliable Cleaners" by Jacquelyne Black. The page also provides Zoom meeting information, including a meeting ID of 161 104 3926 and a password of 002531. There are also mobile and dial-in numbers listed.

Updates and Communications

- Monthly LSIC newsletter – New edition came out early January 2022
 - <http://lsic.jhuapl.edu/Resources/>
- 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 - <http://lsic.jhuapl.edu/Focus-Areas/Dust-Mitigation.php>
 - Notes, slides, recordings from telecons posted here
- Wiki is ready!
 - Confluence is free to you and available to all registered LSIC members
 - To request an account, please email Andrea Harman: ams573@alumni.psu.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

http://lsic.jhuapl.edu/Resources/files/Code%20of%20Conduct_05222020.pdf

LSIC Activities

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

- LSIC Dust Mitigation Focus Group Meeting (01/20) – Today!
 - Topic: Passive Dust Mitigation
- LSIC Dust Mitigation Focus Group Meeting (02/17)
 - Topic: Active Dust Mitigation
 - May get moved to 02/24 to deconflict with LSSW Virtual Session 14
- LSIC Regolith to Rebar: ISRU - E&C Metal Workshop (02/23)
 - Registration required
 - <https://lsic.jhuapl.edu/Events/Agenda/index.php?id=177>

Other Recent and Upcoming Dust Mitigation Related Workshop and Meetings

- SBIR/STTR: Dissecting the Solicitations Webinar (Today 12-2 pm ET)
 - <https://sbir.nasa.gov/dissectingthesolicitations2022>
- LSSW Virtual Session 13: Inclusive Lunar Exploration (01/26-01/27)
 - <https://www.hou.usra.edu/meetings/lunarsurface2020/>
- LSSW Virtual Session 14: Heliophysics Applications Enabling and Enabled by Human Exploration of the Lunar Surface (02/17)
 - “What are the electrodynamic conditions on the lunar surface and their relationship to exploration hazards such as dust and electrostatic discharge?”
 - <https://www.hou.usra.edu/meetings/lunarsurface2020/>

LEAG: Specific Action Team Regarding Analog Objectives for Artemis

Special LEAG Update (<http://lsic.jhuapl.edu/News-and-Events/>)

- NASA's Science Mission Directorate Planetary Science Division recently requested that the Lunar Exploration Analysis Group (LEAG) form a Specific Action Team regarding Analog Objectives for Artemis (AOA-SAT).
- The task of the AOA SAT is to catalog and prioritize the objectives for science and science operations in preparation for Artemis human missions that can be achieved through analog activities.
- The draft report was completed on January 15 and is now available at the links below. This report is open for community comment for one week, and the final report is due on Tuesday, February 1.
- Please take some time to review this draft report and its Terms of Reference and submit comments no later than Tuesday, January 25, 11:59 pm PST.
- Find Report available at LEAG Webpage: <https://www.lpi.usra.edu/leag/documents/AOA-SAT-Draft-Report-15-Jan-2022.pdf>

NASA SBIR & STTR Solicitations 2022

- Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR)
- *Open to U.S. small businesses*
 - *May collaborate with universities and industry partners*
- Phase I: Up to \$150 K for 6 Mo (up from \$125K)
- Phase II: Up to \$750 K for 24 Mo
- Focus Area 24: “Dust Mitigation and Extreme Lunar Environment Mitigation Technologies”
- Phase I Solicitation Closes **March 9, 2022**
- Phase II Solicitations Due by last day of Phase I contract
- Phase I Selections expected May 25, 2022
- <https://sbir.nasa.gov/solicit-detail/79614>



The poster features the NASA logo at the top right and the text "National Aeronautics and Space Administration" at the top left. The central image is a collage: the top left shows an astronaut on a lunar surface; the top right shows a city skyline; the bottom left shows an astronaut in a space suit; the bottom right shows a group of four people in NASA attire with their hands clasped. The text "NASA SBIR PROGRAM SOLICITATION 2022" is prominently displayed in the lower half, with the tagline "Join our diverse community of pioneers who are researching and developing technologies to change the world" below it. At the bottom, it says "NASA SBIR/STTR PROGRAM | sbir.nasa.gov".

NASA SBIR & STTR Solicitations 2022

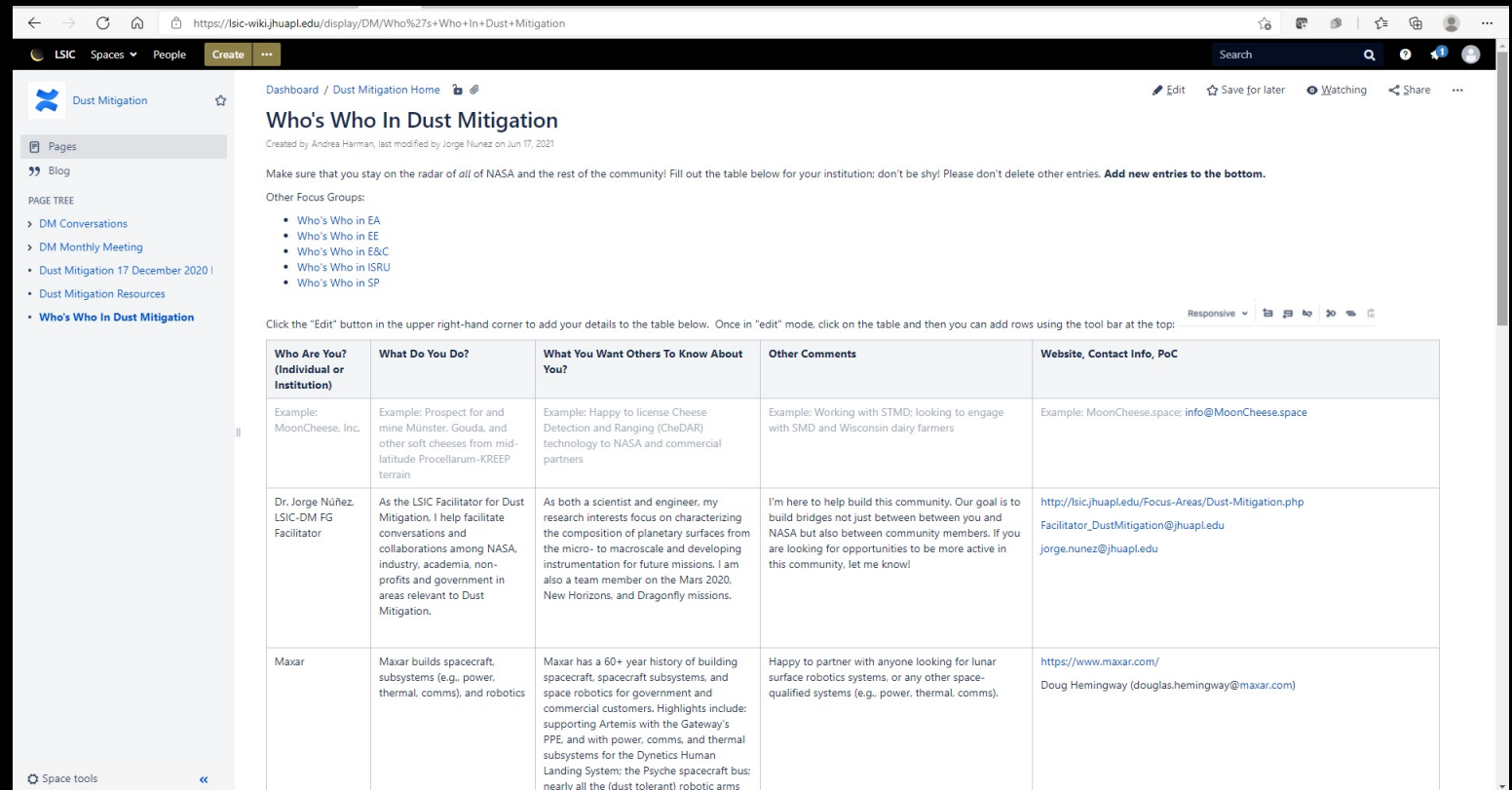
- **Focus Area 24: Dust Mitigation and Extreme Lunar Environment Mitigation Technologies**
 - 4 Sub-topic areas (1 new sub-topic added)
- **1. Active and Passive Dust Mitigation Surfaces (Z13.01)**
 - Lead Center: KSC
 - Participating Center(s): JSC, LaRC
- **2. Mechanisms for Extreme Environments (Z13.02)**
 - Lead Center: KSC
 - Participating Center(s): GRC, JSC, LaRC
- **3. Technologies for Spacesuits in Extreme Surface Environments (Z13.03)**
 - Lead Center: JSC
- **4. Lunar Dust Filtration and Monitoring (Z13.04)**
 - Lead Center: GRC
 - Participating Center(s): JSC, KSC
- <https://sbir.nasa.gov/solicit-detail/79614>



The poster features the NASA logo at the top right and the text 'National Aeronautics and Space Administration' at the top left. The central image is a collage: the top left shows an astronaut on a space station with Earth in the background; the bottom right shows a group of four people in NASA flight suits with their hands clasped; and the bottom right corner shows a view of Earth from space. The text 'NASA SBIR PROGRAM SOLICITATION 2022' is prominently displayed in blue, with '2022' in a larger font. Below this, it says 'Join our diverse community of pioneers who are researching and developing technologies to change the world'. At the bottom, it reads 'NASA SBIR/STTR PROGRAM | sbir.nasa.gov'.

Who's Who in Dust Mitigation

- We have setup a Who's Who in Dust Mitigation page on Confluence
 - Great opportunity stay on the radar of *all* of NASA and the rest of the community
 - Please contact Andrea Harman (ams573@alumni.psu.edu) to get set up with an account!
1. Sign-in to add your and your organization's information
 2. Click the "Edit" button in the upper right-hand corner to add your details to the table
 3. You can add your information before, during, or after today's meeting



Dashboard / Dust Mitigation Home

Who's Who In Dust Mitigation

Created by Andrea Harman, last modified by Jorge Nunez on Jun 17, 2021

Make sure that you stay on the radar of *all* of NASA and the rest of the community! Fill out the table below for your institution: don't be shy! Please don't delete other entries. **Add new entries to the bottom.**

Other Focus Groups:

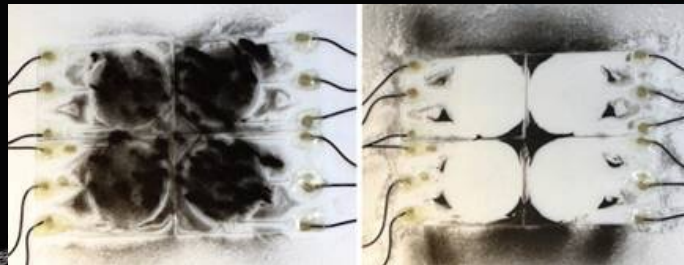
- Who's Who in EA
- Who's Who in EE
- Who's Who in E&C
- Who's Who in ISRU
- Who's Who in SP

Click the "Edit" button in the upper right-hand corner to add your details to the table below. Once in "edit" mode, click on the table and then you can add rows using the tool bar at the top:

Who Are You? (Individual or Institution)	What Do You Do?	What You Want Others To Know About You?	Other Comments	Website, Contact Info, PoC
Example: MoonCheese, Inc.	Example: Prospect for and mine Münster, Gouda, and other soft cheeses from mid-latitude Procellarum-KREEP terrain	Example: Happy to license Cheese Detection and Ranging (CheDAR) technology to NASA and commercial partners	Example: Working with STMD; looking to engage with SMD and Wisconsin dairy farmers	Example: MoonCheese.space; info@MoonCheese.space
Dr. Jorge Núñez, LSIC-DM FG Facilitator	As the LSIC Facilitator for Dust Mitigation, I help facilitate conversations and collaborations among NASA, industry, academia, non-profits and government in areas relevant to Dust Mitigation.	As both a scientist and engineer, my research interests focus on characterizing the composition of planetary surfaces from the micro- to macroscale and developing instrumentation for future missions. I am also a team member on the Mars 2020, New Horizons, and Dragonfly missions.	I'm here to help build this community. Our goal is to build bridges not just between between you and NASA but also between community members. If you are looking for opportunities to be more active in this community, let me know!	http://lsic.jhuapl.edu/Focus-Areas/Dust-Mitigation.php Facilitator_DustMitigation@jhuapl.edu jorge.nunez@jhuapl.edu
Maxar	Maxar builds spacecraft, subsystems (e.g., power, thermal, comms), and robotics	Maxar has a 60+ year history of building spacecraft, spacecraft subsystems, and space robotics for government and commercial customers. Highlights include: supporting Artemis with the Gateway's PPE, and with power, comms, and thermal subsystems for the Dynetics Human Landing System; the Psyche spacecraft bus; nearly all the (dust tolerant) robotic arms	Happy to partner with anyone looking for lunar surface robotics systems, or any other space-qualified systems (e.g., power, thermal, comms).	https://www.maxar.com/ Doug Hemingway (douglas.hemingway@maxar.com)

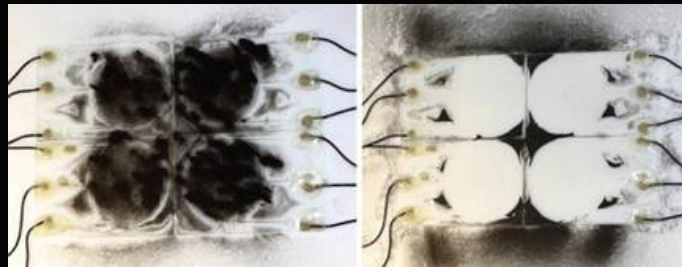
Dust Mitigation FG Subgroups

- **Materials and Surface 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
- **Seals, Soft Goods, and Fabrics:**
 - *Fabrics* – Space suit fabrics, soft wall habitats, mechanism covers
 - *Seals and Soft Goods* – Space suit interfaces, hatches, connectors, hoses
- **Mechanisms:**
 - *Mechanisms* – Linear actuators, bearings, rotary joints, hinges, quick disconnects, valves, linkages
- **Monitoring and Filtration:**
 - *Gaseous Filtration* – Atmosphere revitalization, ISRU processes
 - *Dust monitoring* – Cabin and external dust monitoring
- **Modeling:** – *Dust plume modeling*
- **Lunar Surface Modification** – Lunar landing pads, dust free zones and workspaces
- **Isolation Technologies** – Technologies that keep dust out



Dust Mitigation FG Subgroups

- Please fill out the short survey below if interested or would like to sign-up:
- <https://docs.google.com/forms/d/e/1FAIpQLScB6iT2fgPqj2zIaP0s-rwWQDQ04TPfgVyiC5zn0AQPAT5CZA/viewform>
- Anyone is welcome to join! Thank you to those who have already filled out the survey.

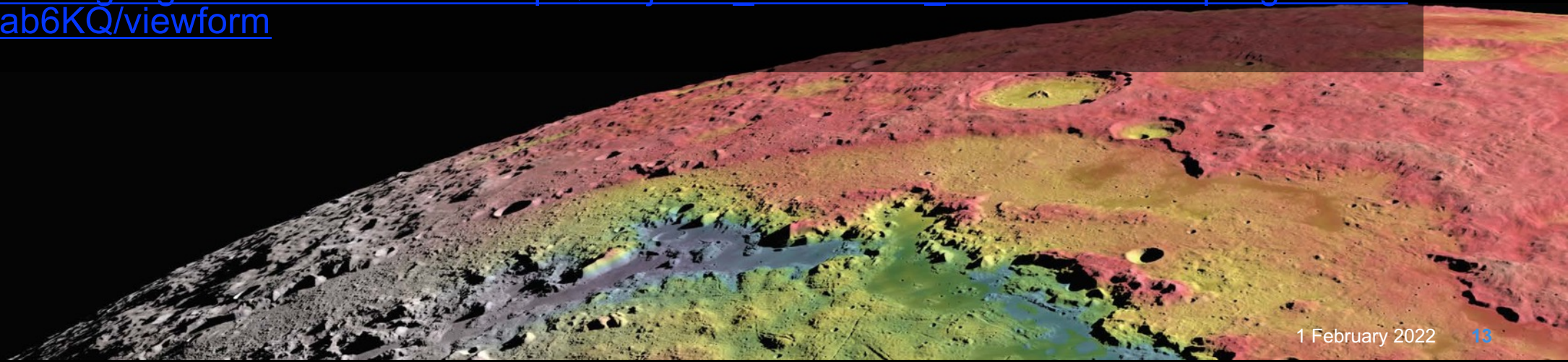


What is next for Dust Mitigation FG?

Help us improve the Dust Mitigation Focus Group!

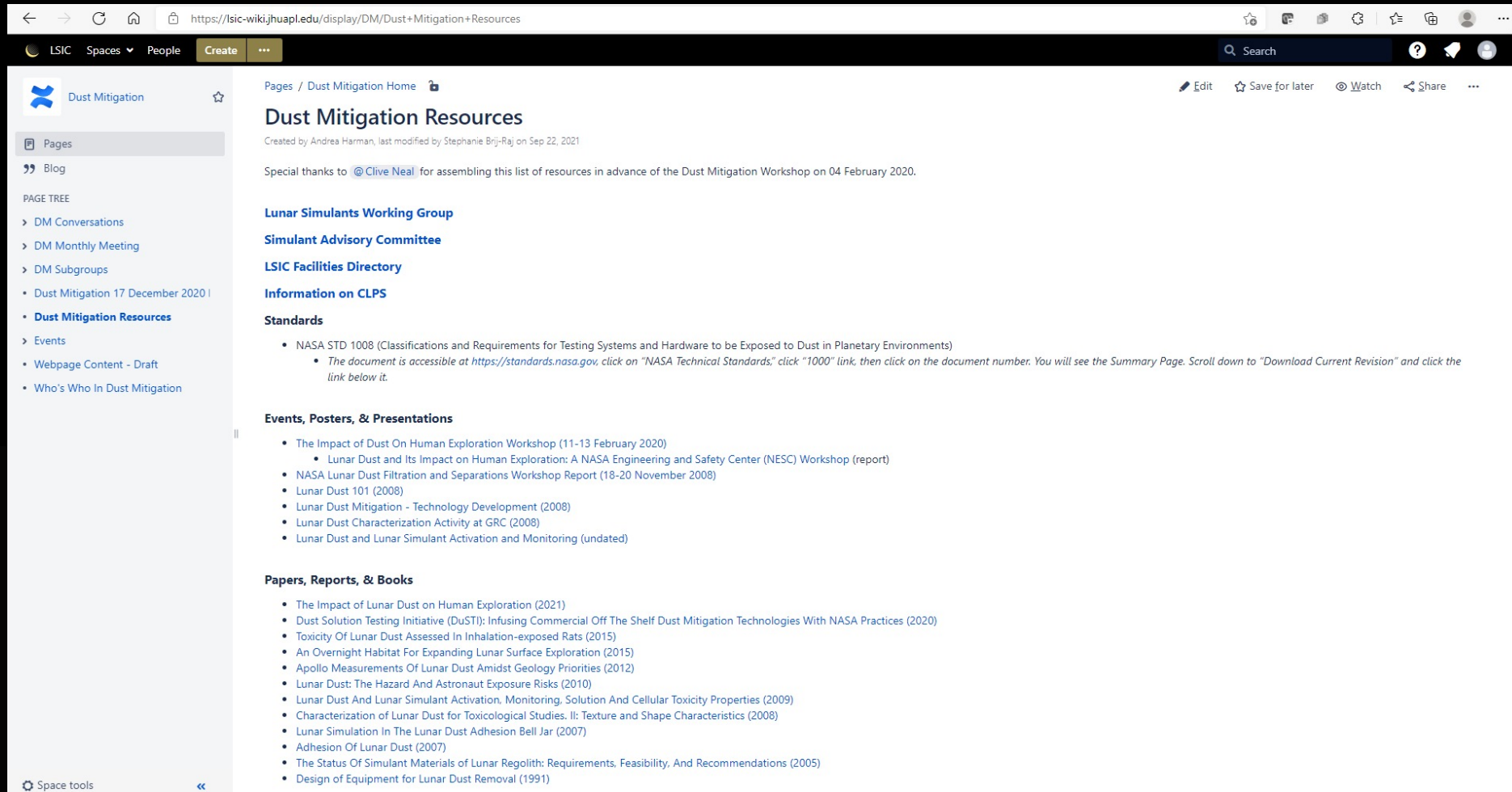
- What benefits have you gained from being part of the LSIC Dust Mitigation Focus group?
- Is there anything else you enjoy about monthly meetings? Anything you'd like to see us change?
- Is there anything you liked about this past year that you'd like to see continue?
- Is there anything about this past year that you'd change going forward?
- Are there other activities you would like to see us organize?

- Please fill out the feedback survey:
- https://docs.google.com/forms/d/e/1FAIpQLSdjuTIK_TLMnCM4_aSMLAzLS762qtzbgmcOd2fgizlCsab6KQ/viewform



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 Confluence Wiki. 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:

- Special thanks to @Clive Neal for assembling this list of resources in advance of the Dust Mitigation Workshop on 04 February 2020.
- Lunar Simulants Working Group**
- Simulant Advisory Committee**
- LSIC Facilities Directory**
- Information on CLPS**
- Standards**
 - NASA STD 1008 (Classifications and Requirements for Testing Systems and Hardware to be Exposed to Dust in Planetary Environments)
 - The document is accessible at <https://standards.nasa.gov>. click on "NASA Technical Standards," click "1000" link, then click on the document number. You will see the Summary Page. Scroll down to "Download Current Revision" and click the link below it.
- Events, Posters, & Presentations**
 - The Impact of Dust On Human Exploration Workshop (11-13 February 2020)
 - Lunar Dust and Its Impact on Human Exploration: A NASA Engineering and Safety Center (NESC) Workshop (report)
 - NASA Lunar Dust Filtration and Separations Workshop Report (18-20 November 2008)
 - Lunar Dust 101 (2008)
 - Lunar Dust Mitigation - Technology Development (2008)
 - Lunar Dust Characterization Activity at GRC (2008)
 - Lunar Dust and Lunar Simulant Activation and Monitoring (undated)
- Papers, Reports, & Books**
 - 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)
 - Toxicity Of Lunar Dust Assessed In Inhalation-exposed Rats (2015)
 - An Overnight Habitat For Expanding Lunar Surface Exploration (2015)
 - Apollo Measurements Of Lunar Dust Amidst Geology Priorities (2012)
 - Lunar Dust: The Hazard And Astronaut Exposure Risks (2010)
 - Lunar Dust And Lunar Simulant Activation, Monitoring, Solution And Cellular Toxicity Properties (2009)
 - Characterization of Lunar Dust for Toxicological Studies. II: Texture and Shape Characteristics (2008)
 - Lunar Simulation In The Lunar Dust Adhesion Bell Jar (2007)
 - Adhesion Of Lunar Dust (2007)
 - The Status Of Simulant Materials of Lunar Regolith: Requirements, Feasibility, And Recommendations (2005)
 - Design of Equipment for Lunar Dust Removal (1991)

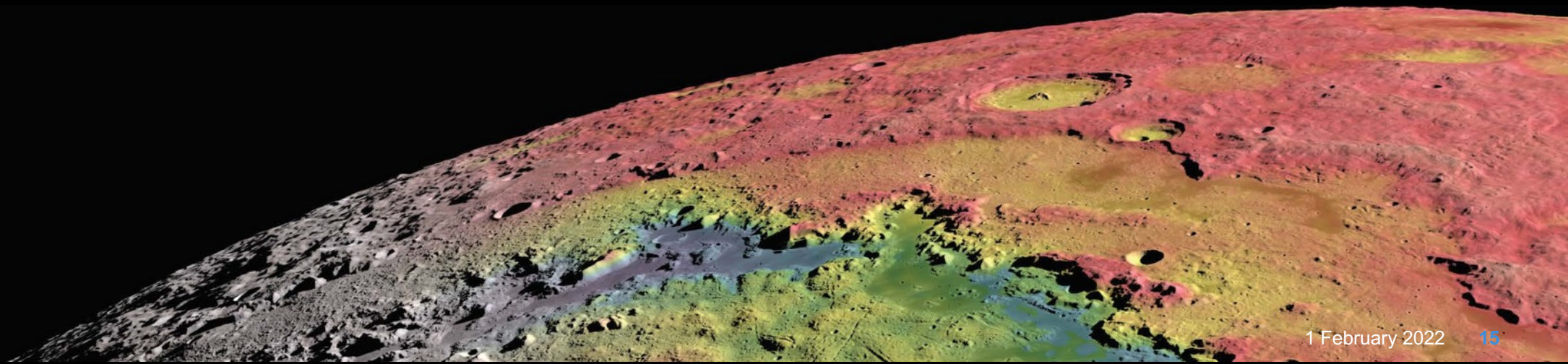
Today's Presentation – 1 of 2

“DuSTI Outbrief: Dust Mitigation Characterization of Coatings and Pliable Cleaners”

Jacquelyne Black

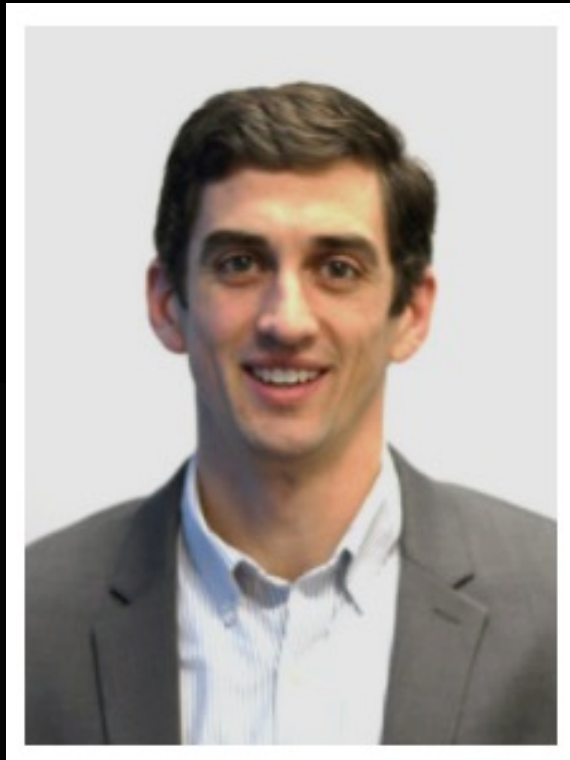
NASA Johnson Space Center

jacquelyne.l.black@nasa.gov



Today's Presentation – 2 of 2

“Passive Nano- and Micro-Textured Dust-Mitigation Surfaces in Space”



Dr. Stephen Furst

CEO

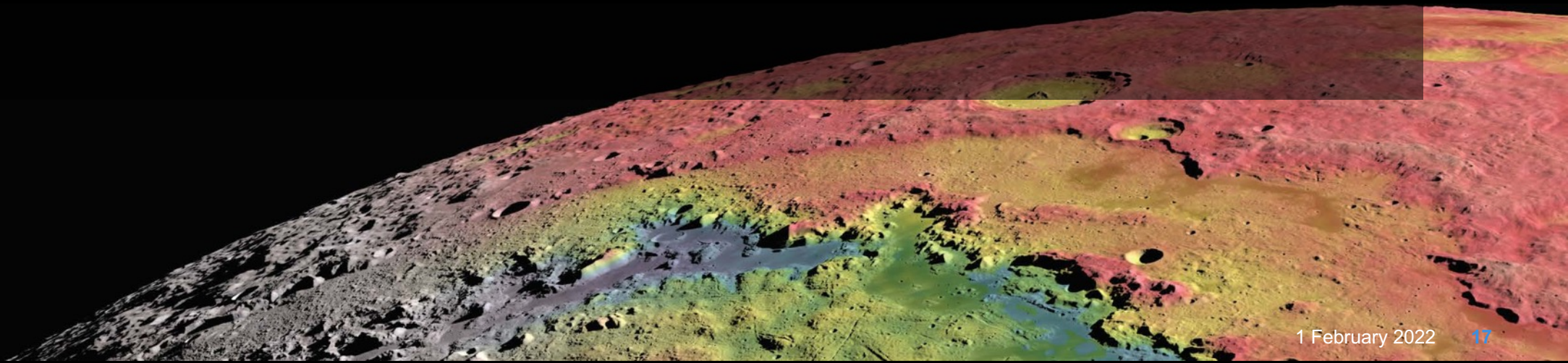
Smart Material Solutions, Inc.

furst@smartmaterialsolutions.com

<http://www.smartmaterialsolutions.com/>

Passive Dust Mitigation Discussion

- What gaps exist in our understanding of lunar dust and passive dust mitigation, and what data do we still need?
- 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?
- Are there priority technology areas in passive dust mitigation that are in need of investment?
- Are in-flight demonstrations needed?





JOHNS HOPKINS
APPLIED PHYSICS LABORATORY