JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

LSIC Surface Power Focus Group

March 25, 2021

Begins at 11:03

Lunar Surface Innovation
CONSORTIUM

Dr. Wesley T. Fuhrman
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Space Exploration Sector

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Confluence Discussion:
https://lsic-wiki.jhuapl.edu/display/SP/25+March+2021+SP+telecon

Overview

- LSIC community updates
  - LSIC Semi-annual meeting
    - 2-day, virtual. May 11-12
  - Updates on other FG activities
  - Funding opportunities
    - LuSTR Awards!
    - VSAT Awards!
    - Watts on the Moon deadline is ***today!***
- Presentation:
  - Microgrid for Lunar Power, Jeff Csank NASA GRC
- Upcoming activities and discussion
  - Power Beaming Workshop
  - Themed telecon: Vertical Solar – Power, Dust, Extreme Environments
  - Subgroups

Lunar Surface Innovation
CONSORTIUM

Lunar Surface Innovation Consortium Spring Meeting

Tuesday, May 11, 2021 -Wednesday, May 12, 2021

Venue: Virtual

The LSIC Spring Meeting will be held virtually on May 11-12. The meeting will include updates from NASA, networking opportunities, and contributed technical content from the community. We invite the community to submit abstracts describing technical capabilities within the six LSIC focus areas, as well as those that identify lunar surface technology needs and assess the readiness of relative systems and components. Other topics of interest include defining the parameters and constraints of the architecture required to support a sustained presence on the lunar surface, as well as economic and policy considerations. Abstracts should be limited to 1 page with no smaller than 10 point font, and use the template provided here. All abstracts are due by April 7th, 2021.

We are currently exploring options for a peripheral meeting on May 13th that would focus on funding related issues, including more information on proposal opportunities, tips for writing good proposals, and open networking time for members to discuss teaming. Please stay tuned for more information.

EVENT DETAILS

Date: Tuesday, May 11, 2021 - Wednesday, May 12, 2021
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Submit Abstracts

Related Documents:

- lsic-abstract-template.docx

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ISRU Updates

- General updates “Who’s Who in ISRU” – diverse contributions…keep this up.
  - Setting Year 1 goals. Penultimate version – and topic for discussion for second half of today. LSIC Semi-annual meeting. 2-day. Virtual. End of April, or early May.

- Abstracts for the 11th joint meeting of the Planetary & Terrestrial Mining Sciences Symposium (PTMSS) & the Space Resources Roundtable (SRR) are **due on April 12th.** https://www.ptmss.ca

- The AIAA ASCEND 2021 conference will take place Nov 15-17, 2021 in Las Vegas, NV (USA) in a hybrid format (in-person and online). The call for content is open and Space Resources is one of the central themes of the forum in high level strategic discussions and technical paper presentations. This year, the call for papers (to submit technical papers and presentations) and the call for sessions (to propose the creation of special sessions) are separate under the link above. The call is open until March 30, 2021.

ISRU Updates

Technology Showcase

Blue Origin. Dr. Erika Wagner. Payload Sales Director.

Operations.

Lunar –G: Partial Gravity Capability in the New Shepard Suborbital Vehicle

A presentation followed by discussion

Lunar Surface Innovation CONSORTIUM

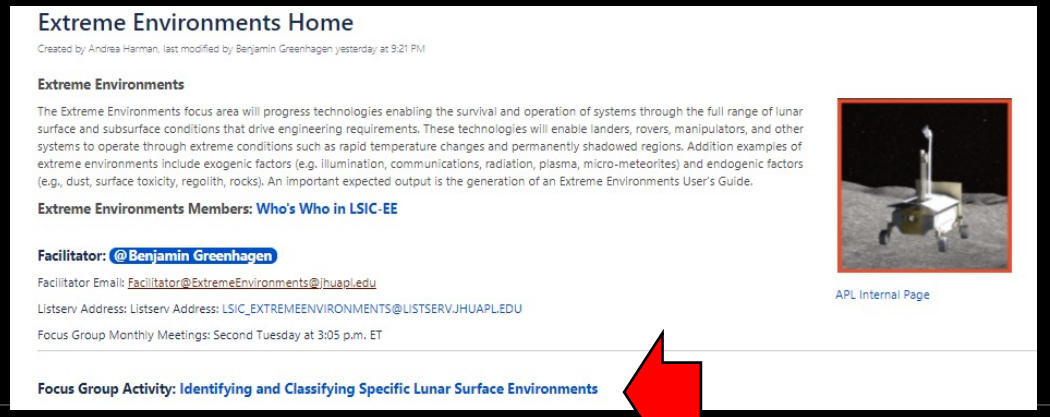
Extreme Environments – Mar 21

Current Activity: Identifying and Classifying Specific Lunar Surface Environments

- Purpose and Products
  - "Breaking Down the Lunar Environment Monolith"
  - How do different environments stress technologies in different ways
  - How do specific lunar environment differ from descriptions of the general lunar environment?
  - Product #1: Preliminary environmental assessments for each type, archived on Confluence
  - Product #2: "Final" list of environments ranked by subgroups according to difficulty

- Identified 3 Polar and 4 Non-Polar Environment Types (including 19 variants)
  - Activity is on Confluence: https://lsic-wiki.jhuapl.edu/display/EE/Identifying+and+Classifying+Specific+Lunar+Surface+Environments

- LSIC-EE Subgroups Meetings in Late March to Evaluate Environments
  - Radiation, Regolith & Surface Interface, Space Weather & Plasma, Thermal & Illumination, Vacuum & Exosphere
  - Schedules on Confluence



Extreme Environments – Mar 21

LSIC-EE "Supersized" Working Meeting on April 13th, 2:30-4:30 ET

- 2:30 - Introduction, Scope, and Products (5 min)
- 2:35 - Review of Environment Drivers (5 min lightning talks)
- 3:00 - Transition to Breakout Zooms (5 min)
- 3:05 - Breakout Sessions (55 min)
  - Polar Specific Environments
  - Non-Polar Specific Environments
- 4:00 - Transition to Plenary Zoom (5 min)
- 4:05 - Brief Recaps / Burning Questions (10 min)
- 4:15 - Next Steps and Discussion (15 min)

Follow-up Activities Kickoff After the LSIC Spring Meeting

- Prioritize Specific Lunar Environments (and down select to a few to focus on initially)
- Identify Capabilities and Gaps related to Observation (Knowledge) & Simulation (Prediction), Technology Capabilities, and Experimental Testing & Technology Maturation (including Facilities)

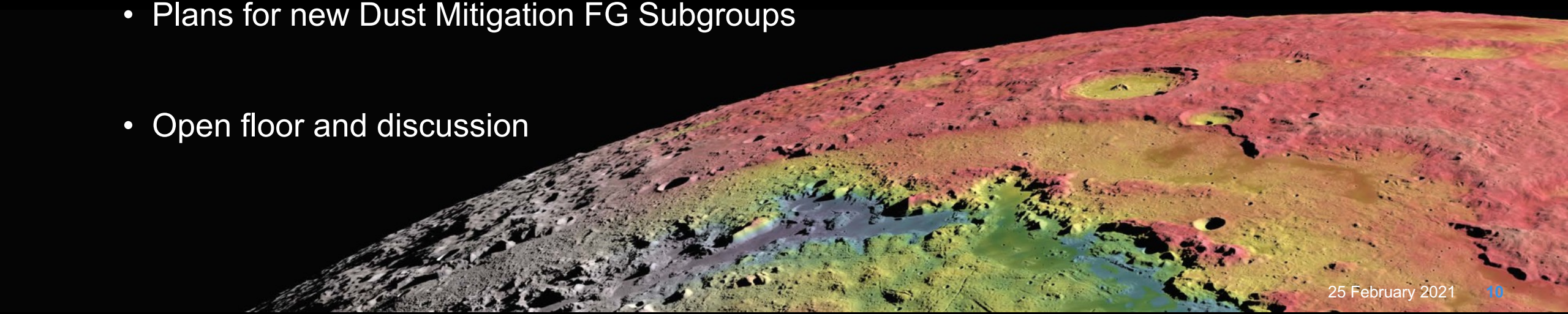
Extreme Access: Workshop on Lunar Mapping for Precision Landing

- March 2-4, 2021
  - 12-4 ET each day
  - http://lsic.jhuapl.edu/Events/Agenda/index.php?id=120

- Goal: Bring together lunar geologists, data scientists, navigation engineers
- Objective: Develop a mutual understanding of map requirements to achieve lunar TRN solutions and provide better insight into the map data and map building processes
- Purpose was to get input from the community to help NASA catalog existing tools, methods and approaches for building DEMS, accurate rendering of the surface, verification and validation (V&V) of TRN systems

DM Agenda

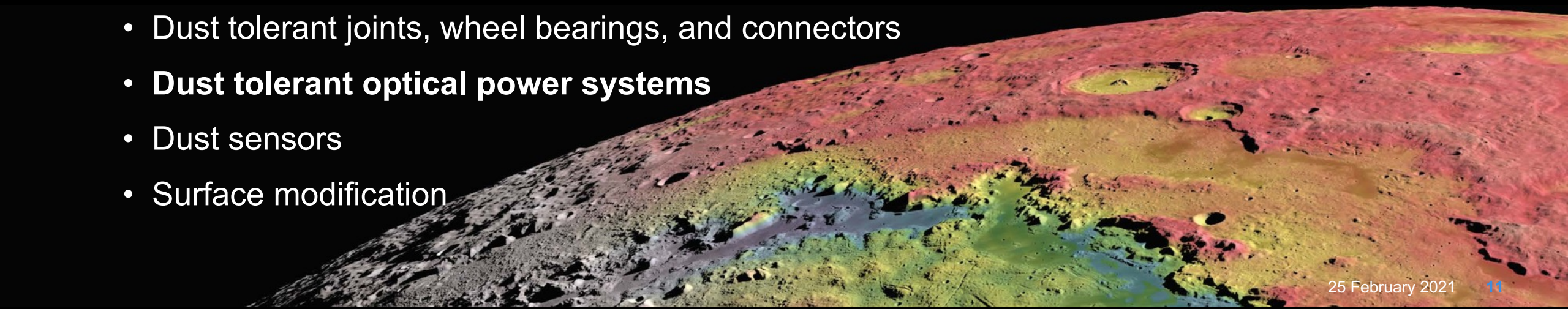
- **Featured Presentation by Hunter Williams, Honeybee Robotics**
  - **“Dust-Tolerant Electrical Connectors for Robotic and Human Exploration Missions”**
- Brief Follow up to Dust Mitigation Workshop
- Plans for the monthly focus group meetings, including monthly topics
- Plans for new Dust Mitigation FG Subgroups
- Open floor and discussion



Potential Topics For DM FG Meetings

- An outcome from the Dust Mitigation Workshop, we plan to highlight some of the topics below during our focus group meetings, featuring a technology presentation:

- Plume/Surface Interaction
- Passive/Active Dust Removal
- Space Suits/Fabrics
- Habitats and Vacuum/Filtration
- Dust tolerant Mechanisms
- Dust tolerant joints, wheel bearings, and connectors
- **Dust tolerant optical power systems**
- Dust sensors
- Surface modification



Dust-Tolerant Connectors and Mechanisms for Robotic and Human Exploration Missions

Speaker:
Hunter Williams
Honeybee Robotics
Business Development Engineer, Exploration Systems

Collaborators: J. Herman, S. Sadick, M. Maksymuk, P. Chu, and L. Carlson

HONEYBEE ROBOTICS
Spacecraft Mechanisms Corporation

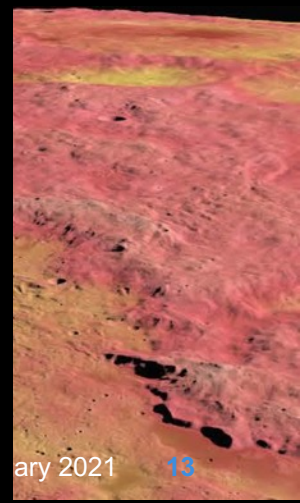
Electrical Breadboard Testing in JSC-1A

Electrical connector prototype was tested with lunar simulant at 1 Torr and at 10^-3 Torr

No degradation of membrane material in final configuration

High fidelity design tested to 500+ mate/de-mate cycles via automated test setup

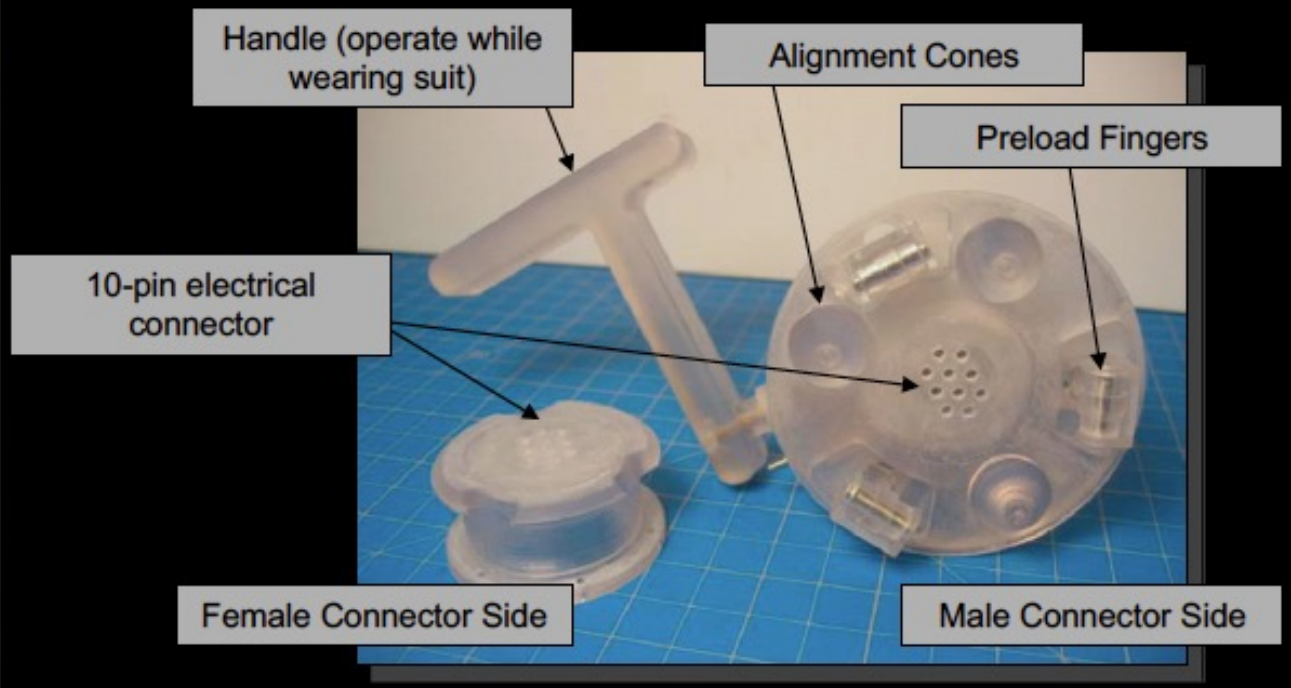
Current lab scale 10 electrical pins 300V, 50-100A 1kg for male and female side.



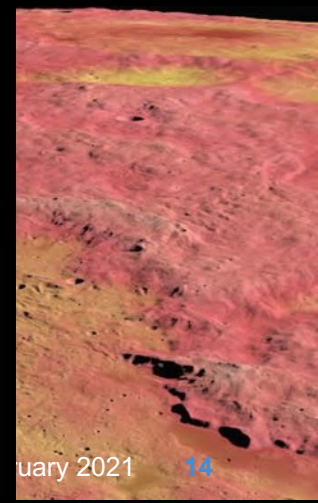
Manual PLSS Umbilical (Dust-Tolerant)

Manual operation by astronaut EVA or IVA

- 360 mate/de-mate cycles minimum (6 months lunar stay)
- 10 electrical pins (28V, 6A)
- -153˚C to +123˚C in vacuum
- Easy operation while wearing pressurized suit (< 45N exertion)
- 90° preloads and mechanical mate, 180° electrical mate
- All sub-components dust tolerant



SLA Model



LSIC | Current Funding Opportunities

Watts on the Moon

***Phase 1 Registration and Submission Deadline: 25 March 2021**, up to $5M*

Energy distribution, management, and/or storage that address NASA technology gaps and can progress toward flight readiness and future operation on the lunar surface.

https://www.herox.com/WattsOnTheMoon

Other opportunities:

https://www.nasa.gov/directorates/spacetech/solicitations

MUREP Space Technology Artemis Research (M-STAR) solicitation

Pre-Proposal Webinar: March 29, 2021

Nuclear Thermal Propulsion Reactor Preliminary Design (DoE)

Proposals due: April 30, 2021

CASIS (ISS payloads)

https://www.issnationallab.org/research-on-the-iss/solicitations/nlra2021-4/

LSIC | Recent Funding Awards: LuSTR Awards

ISRU

- The University of Texas in El Paso: advanced thermal mining (Ahsan Choudhuri)
- Washington University in St. Louis: rover-mounted drill to quantify the 3D distribution of water (Alian Wang)
- Michigan Technological University: heated percussive cone to characterize regolith strength (Paul van Susante)

Power

- The University of California in Santa Barbara, led by principal investigator Philip Lubin, will research **wireless power transfer** feasibility from a base station to multiple distant assets on the Moon. Small rovers, for example, could be equipped with low-power beacons capable of receiving around 100 Watts of power in regions where solar or tethered power transfer is impractical, such as in the Moon's deep and dark craters.

- Vanderbilt University in Nashville will look into using **silicon carbide power components** for lunar surface applications. At present, these power components are particularly susceptible to radiation and frequently fail or experience reduced performance in space. Principal investigator Arthur Witulski will lead the project.

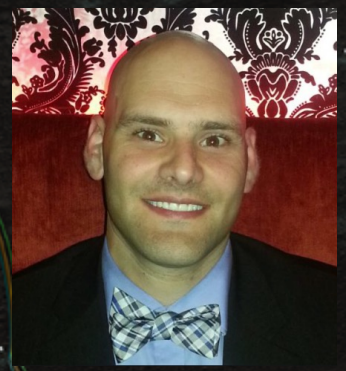
- The Ohio State University in Columbus will explore **flexible energy distribution** between multiple, different power grids – that may use solar, radioisotope, and battery sources – that could be deployed on the lunar surface to support the Artemis program. The project, led by Jin Wang, will focus on **control methodologies and perform both hardware and software demonstrations**.

LSIC | Recent Funding Awards: VSAT Awards

NASA selected the following **five** companies for base period contracts to complete their 10 kW vertical solar array designs and conduct analysis.

- Astrobotic Technology, Pittsburgh
- ATK Space Systems (Northrop Grumman), Goleta, California
- Honeybee Robotics, Brooklyn, New York
- Lockheed Martin, Littleton, Colorado
- Space Systems Loral (Maxar Technologies), Palo Alto, California

LSIC | Presentation from Jeff Csank (NASA Glenn)



Microgrid for Lunar Surface Power

Discussion captured on Confluence:
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LSIC | Open Discussion

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Upcoming activities and discussion
- Power Beaming Workshop
- Themed telecon: Vertical Solar – Power, Dust, Extreme Environments

LSIC | Open Discussion: Power Beaming

Discussion captured on Confluence:

Timeline: June/July

Potential notional schedule:

Day One: Overview and context/demand.

- Overview and capabilities
- Insight from power users with specific demands, such as ISRU or exploration operating within a PSR.
- Workshop the best use-cases for power beaming

Day Two: Deeper Technical Discussions

- Latest updates in Power Beaming - lightning talks and/or poster presentations
- Panel on challenges and critical steps to advance power beaming
- Small-group breakouts
  - If possible, centered on specific topics.
  - May require careful placement of participants, advanced planning of topics

LSIC | Open Discussion: Vertical Solar Array Telecon

Discussion captured on Confluence:

Themed telecon: Vertical Solar – Power, Dust, Extreme Environments:

- Dust: Mitigation on panels, dust tolerant connections, dust in deployment/re-deployment
- Extreme Environments: Illumination – incident on the panels and shadows induced by panels

What else would you like to see?


APL
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