



Lunar Surface Innovation

C O N S O R T I U M

Extreme Access Focus Group Telecon

November 10, 2021

We'll start around 3:03-3:05

Dr. Angela Stickle
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JHU Applied Physics Laboratory

Facilitator_ExtremeAccess@jhuapl.edu



JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

Today's Agenda

- LSIC Updates
- Upcoming Meetings/Opportunities
- Lunar Communications Standards feedback
- Fall Meeting feedback
- Technology Spotlight
- Open floor and Discussion



Pages / Extreme Access Home / EA Monthly Meeting

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10 November 2021

Created by Angela Stickle, last modified just a moment ago

Welcome to the November meeting of the LSIC Extreme Access Focus Group!

Add a comment below to sign in and discuss.

Please add yourself to the [Who's Who](#) if you haven't had a chance. Feel free to add any info about what you're hoping to get out of the LSIC network (collaborations, etc) in "other comments"

[Check out the new LSIC Facilities Database!!](#)

Discussion Topics

[LSIC general updates](#)

[Fall meeting feedback](#)

Technology Spotlights

[Sam Peterson, Swedish Space Corporation, Commercial Lunar Communication Services](#)

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<https://lsic-wiki.jhuapl.edu/x/LYiXAAQ>

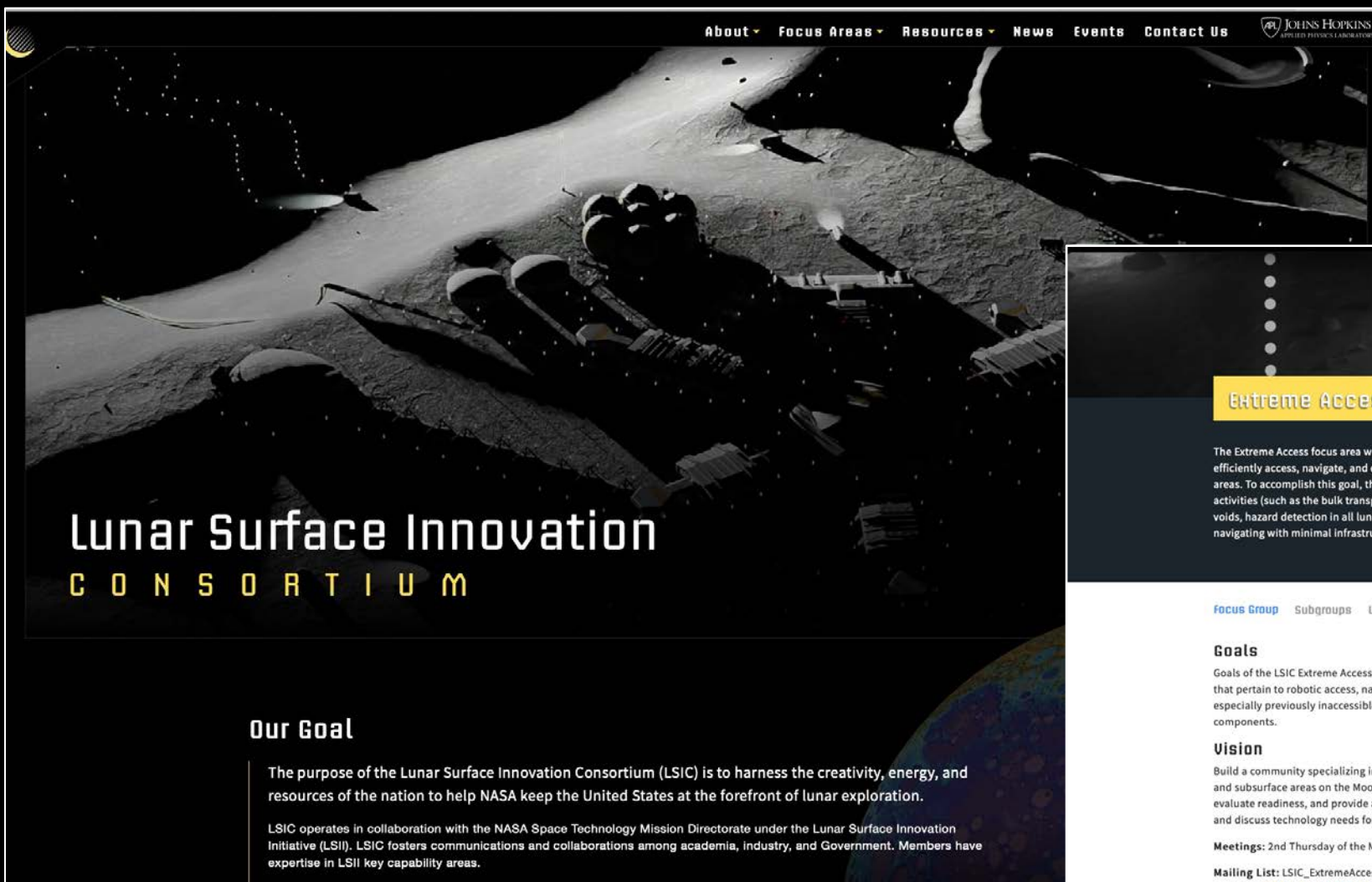
1. Add a comment to sign in
2. Select an agenda topic and comment your thoughts
3. Follow-up after the telecon to continue to discussion!

No labels

Content posted to LSIC must be approved for public release. Remember to safeguard your intellectual property when sharing information, as this forum is open to all the members of LSIC. Please keep LSIC's code of conduct (available on homepage) in mind when posting.

Confluence is an important resource to provide asynchronous discussion opportunities and a record of conversations

LSIC Updates

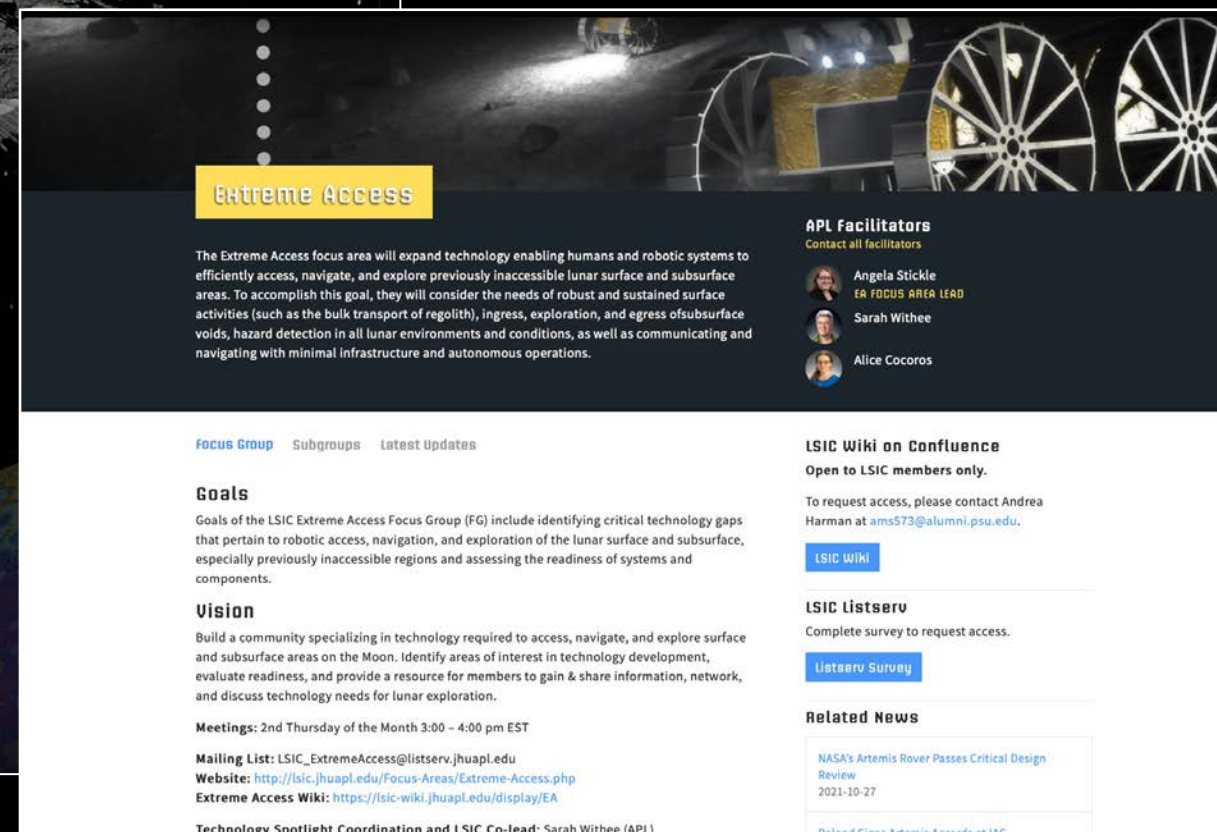


Our Goal

The purpose of the Lunar Surface Innovation Consortium (LSIC) is to harness the creativity, energy, and resources of the nation to help NASA keep the United States at the forefront of lunar exploration.

LSIC operates in collaboration with the NASA Space Technology Mission Directorate under the Lunar Surface Innovation Initiative (LSII). LSIC fosters communications and collaborations among academia, industry, and Government. Members have expertise in LSII key capability areas.

LSIC has a new webpage!



Extreme Access

The Extreme Access focus area will expand technology enabling humans and robotic systems to efficiently access, navigate, and explore previously inaccessible lunar surface and subsurface areas. To accomplish this goal, they will consider the needs of robust and sustained surface activities (such as the bulk transport of regolith), ingress, exploration, and egress of subsurface voids, hazard detection in all lunar environments and conditions, as well as communicating and navigating with minimal infrastructure and autonomous operations.

APL Facilitators

Contact all facilitators

-  Angela Stickle
EA FOCUS AREA LEAD
-  Sarah Withee
-  Alice Cocoros

[Focus Group](#) [Subgroups](#) [Latest Updates](#)

Goals

Goals of the LSIC Extreme Access Focus Group (FG) include identifying critical technology gaps that pertain to robotic access, navigation, and exploration of the lunar surface and subsurface, especially previously inaccessible regions and assessing the readiness of systems and components.

Vision

Build a community specializing in technology required to access, navigate, and explore surface and subsurface areas on the Moon. Identify areas of interest in technology development, evaluate readiness, and provide a resource for members to gain & share information, network, and discuss technology needs for lunar exploration.

Meetings: 2nd Thursday of the Month 3:00 – 4:00 pm EST

Mailing List: LSIC_ExtremeAccess@listserv.jhuapl.edu

Website: <http://lsic.jhuapl.edu/Focus-Areas/Extreme-Access.php>

Extreme Access Wiki: <https://lsic-wiki.jhuapl.edu/display/EA>

Technology Spotlight Coordination and LSIC Co-lead: Sarah Withee (APL)

LSIC Wiki on Confluence

Open to LSIC members only.

To request access, please contact Andrea Harman at ams573@alumni.psu.edu.

[LSIC Wiki](#)

LSIC Listserv

Complete survey to request access.

[Listserv Survey](#)

Related News

[NASA's Artemis Rover Passes Critical Design Review](#)
2021-10-27

[Richard Clark Artemis Endeavor at APL](#)

LSIC Updates

Funding Opportunities






- Over the Dusty Moon Challenge (Colorado School of Mines & Lockheed Martin)
 - <https://www.overthedustymoon.com/>
 - Webinar Nov 29, 2021 & Deadline for entries: Dec 20, 2021
- 2022 Breakthrough, Innovative and Game-Changing (BIG) Idea Challenge: Extreme Terrain Mobility Challenge
 - <http://bigidea.nianet.org/competition-basics/>
 - Proposal and Video deadline: January 18, 2022
- CCRPP Opens November 12
 - Matching funds up to \$2.5M for STTR/SBIR Phase 2
 - <https://sbir.nasa.gov/content/post-phase-ii-initiatives>
 - <https://sbir.nasa.gov/content/ccrpp-phase-2>
- Please visit LSIC website for full list
 - <http://lsic.jhuapl.edu/Resources/Funding-Opportunities.php>

STMD RFI Released

- “Industry-Developed Tipping Point Technologies and Climate and Clean Energy Technologies for Early Stage Investment” released Nov. 8
- STMD intends to broaden the topic base for the next Tipping Point Call, seeking input
- Request for Information is available via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <https://nspires.nasaprs.com>
- Responses to this RFI are due December 3, 2021
- Response format: 2-5 pages pdf

- Reminder, “Tipping Points” advance key space technologies to a point beyond which industry, without further government investment, could then develop and qualify them for market. (TRL ~/> 4)

Technologies should be aligned with STMD Strategic Framework

Lead	Thrusts	Outcomes	Primary Capabilities
 <p>Ensuring American global leadership in Space Technology</p> <ul style="list-style-type: none"> • Advance US space technology innovation and competitiveness in a global context • Encourage technology driven economic growth with an emphasis on the expanding space economy • Inspire and develop a diverse and powerful US aerospace technology community 	 <p>Go Rapid, Safe, and Efficient Space Transportation</p>	<ul style="list-style-type: none"> • Develop nuclear technologies enabling fast in-space transits. • Develop cryogenic storage, transport, and fluid management technologies for surface and in-space applications. • Develop advanced propulsion technologies that enable future science/exploration missions. 	<ul style="list-style-type: none"> • Nuclear Systems • Cryogenic Fluid Management • Advanced Propulsion
	 <p>Land Expanded Access to Diverse Surface Destinations</p>	<ul style="list-style-type: none"> • Enable Lunar/Mars global access with ~20t payloads to support human missions. • Enable science missions entering/transiting planetary atmospheres and landing on planetary bodies. • Develop technologies to land payloads within 50 meters accuracy and avoid landing hazards. 	<ul style="list-style-type: none"> • Entry, Descent, Landing, & Precision Landing
	 <p>Live Sustainable Living and Working Farther from Earth</p>	<ul style="list-style-type: none"> • Develop exploration technologies and enable a vibrant space economy with supporting utilities and commodities • Sustainable power sources and other surface utilities to enable continuous lunar and Mars surface operations. • Scalable ISRU production/utilization capabilities including sustainable commodities on the lunar & Mars surface. • Technologies that enable surviving the extreme lunar and Mars environments. • Autonomous excavation, construction & outfitting capabilities targeting landing pads/structures/habitable buildings utilizing in situ resources. • Enable long duration human exploration missions with Advanced Habitation System technologies. 	<ul style="list-style-type: none"> • Advanced Power • In-Situ Resource Utilization • Advanced Thermal • Advanced Materials, Structures, & Construction • Advanced Habitation Systems
	 <p>Explore Transformative Missions and Discoveries</p>	<ul style="list-style-type: none"> • Develop next generation high performance computing, communications, and navigation. • Develop advanced robotics and spacecraft autonomy technologies to enable and augment science/exploration missions. • Develop technologies supporting emerging space industries including: Satellite Servicing & Assembly, In Space/Surface Manufacturing, and Small Spacecraft technologies. • Develop vehicle platform technologies supporting new discoveries. • Develop transformative technologies that enable future NASA or commercial missions and discoveries 	<ul style="list-style-type: none"> • Advanced Avionics Systems • Advanced Communications & Navigation • Advanced Robotics • Autonomous Systems • Satellite Servicing & Assembly • Advanced Manufacturing • Small Spacecraft • Rendezvous, Proximity Operations & Capture

- **Industry-Developed Tipping Point Technologies and Climate and Clean Energy Technologies for Early Stage Investment**
- Request for Information is available via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <https://nspires.nasaprs.com>
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- Seeking input for the next “Tipping Point” solicitation
 - Goal: to advance key space technologies to a point beyond which industry, without further government investment, could then develop and qualify them for market. (TRL ~/> 4)
 - technologies should have the potential for significant market applicability and have applicability to both the commercial and government sectors once the development/demonstration project completes
- Section A of the solicitation outlines feedback requested



Upcoming Meetings

- Focus Group Telecons (2nd Thursday each month, 3-4 pm EST)
 - November 10, 2021
 - December 9, 2021
- Lunar Surface Science Workshop
 - Landing Sites and Capabilities for Future CLPS Deliveries (November 18)
 - Free, but **registration is required**
 - <https://www.hou.usra.edu/meetings/lunarsurface2020/>
- AIAA ASCEND (November 8-10, 15-17)
 - Registration now open for in-person and online programming
 - <https://www.ascend.events/2021-ascend/program/>



Lunar Surface Innovation

C O N S O R T I U M

LSIC Feedback on LunaNet Interoperability Standards

November 10, 2021

Sarah Withee
PNT Subgroup Lead
JHU Applied Physics Laboratory

Sarah.withee@jhuapl.edu



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APPLIED PHYSICS LABORATORY

Process Overview

- EA group discussion
 - Joint meeting of comms and PNT subgroups
 - Meeting to discuss possible use cases
 - Email discussion around frequency issues
 - Individual conversations with interested members of EA subgroup about timing and comms
 - Discussions on Confluence
- Reached out to ISRU and Excavation and Construction focus groups
 - Received email responses from E & C members
- Consulted with experts in spectrum management and timing
- Attended National Science Foundation webinar on impacts to current Earth-based and future Lunar surface-based radio astronomy as lunar communications networks are tested and deployed
- Drafted feedback and submitted to NASA on Monday November 8

Feedback categories

- Frequency and spectrum management
 - Requested review of existing recommendations for lunar spectrum use (SFCEG 32-2R2, IOAG, ICSIS, CCSDS) and more guidance about what frequencies should be used
 - Requested all frequency decisions keep in mind impacts on radio astronomy
 - S-band messaging concerns
 - S-band spectrum overuse/difficulty in getting licenses
 - Possible implications for future commercial radio development
- PNT and the need for standards beyond signal structure
 - Clocks
 - Reference frame/coordinate system
 - Navigation system receiver hardware
- Using comm signals for navigation
 - Need more study/information about how comm signal parameters affect navigation accuracy
- Economic implications of moving from a government-run model to commercially-driven model
 - Need revenue stream to pay for tech developments in industry
 - Incentive to keep costs down
 - Need customers to pay for services that is not a feature of the current GPS model

Further discussion/next steps

- Need for comms and nav standards beyond signal structure of current LunaNet interoperability draft
 - At fall LSIC meeting, members reiterated the need for standards for comms and nav
 - Could NASA help enable a system where lunar comms would be like cell service on Earth, where the end user does not have to worry about spectrum licensing?
- Request from Excavation and Construction community member to have a study done around comm needs for teleoperation of robots (or if one already exists, find it and make people aware of the info)
 - How many telerobots could be supported for how long over RF vs laser comm channels
 - Advantages and limitations of laser vs RF
- EA interest in a similar study on what kind of autonomy/machine learning to determine what level of machine learning/AI can be supported on current flight hardware and what further developments are needed to support autonomy
 - Moon Ranger CLPS mission
 - Existing studies



LSIC Fall Meeting 2021 Initial Feedback

Technology Spotlight

Sam Peterson (Swedish Space Corporation)

Commercial Lunar Communication Services



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- Confluence is our record of discussions and a good repository
 - Confluence is free to you and available to all registered LSIC members
 - We will be using Confluence to document discussions and provide resources to LSIC members. All focus groups have a separate page so it's a good collaboration space.
 - To request an account, please email Andrea Harman: ams573@alumni.psu.edu
- Technology Spotlights/Lightning Talks at monthly telecons
 - Anyone can volunteer to give a lightning talk (10-20 mins)
 - Email Angela or Sarah, or comment on Confluence, to sign up!
- Updates to the webpage - <http://lsic.jhuapl.edu/Focus-Areas/Extreme-Access.php>
 - Notes, slides, recordings from telecons posted here

Follow the Code of Conduct for all Focus Group communications

Contact information

LSIC Director: Rachel Klima, SES-LSIC-Director@jhuapl.edu
<http://lsic.jhuapl.edu>

Focus Group Area	Listserv address	Facilitator
In-Situ Resource Utilization	LSIC_ISRU@listserv.jhuapl.edu	Karl Hibbitts
Surface Power	LSIC_Power@listserv.jhuapl.edu	Wes Fuhrman
Extreme Environments	LSIC_ExtremeEnvironment@listserv.jhuapl.edu	Ben Greenhagen
Extreme Access	LSIC_ExtremeAccess@listserv.jhuapl.edu	Angela Stickle
Excavation and Construction	LSIC_ExcavationConstruction@listserv.jhuapl.edu	Athonu Chatterjee
Dust Mitigation	LSIC_DustMitigation@listserv.jhuapl.edu	Jorge Núñez

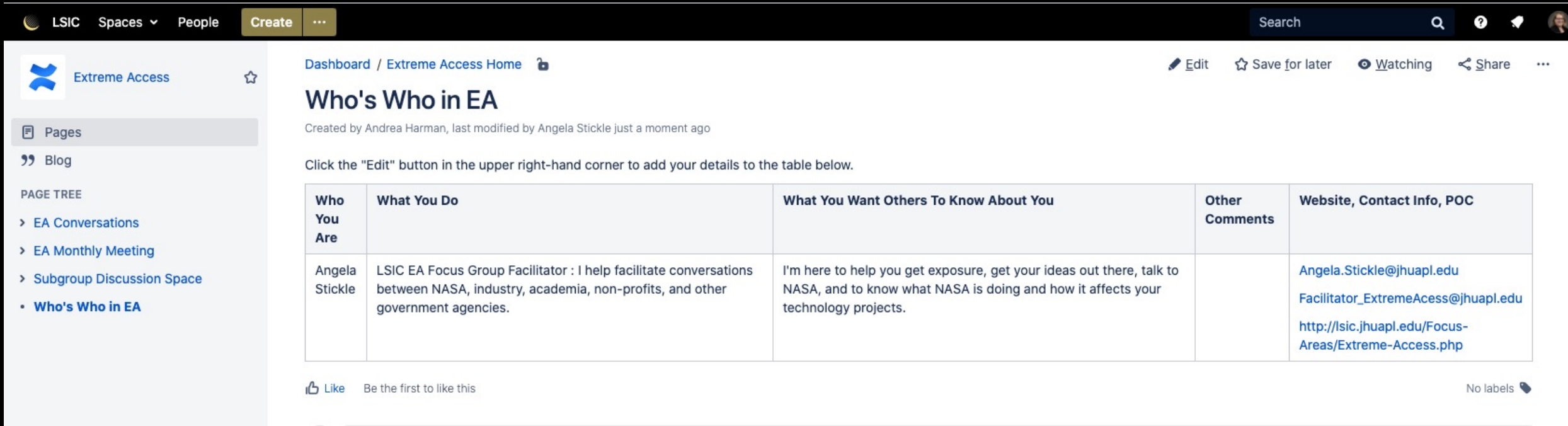


LSIC Meeting Cadence

- **Bi-Annual Meetings (Spring and Fall)**
 - May 11-12 Spring Meeting (accepting Abstracts now)
- **Monthly Focus Group Meetings**
 - 2nd Tuesday of the Month 3:00-4:00 pm – Extreme Environment
 - 2nd Thursday of the Month 3:00-4:00 pm – Extreme Access
 - 3rd Wednesday of the Month 3:00-4:00 pm – ISRU
 - 3rd Thursday of the Month 12:00-1:00 pm – Dust Mitigation
 - 4th Thursday of the Month 11:00 am-12:00 pm – Surface Power
 - 4th Wednesday of the Month 2:00-3:00 – Excavation and Construction
- **Thematic Workshops (as identified by FGs and NASA POCs)**
 - Workshops In development Funding, CLPS Provider

Get to know the community

<https://lsic-wiki.jhuapl.edu/x/0IVf>



LSIC Spaces People Create ... Search

Extreme Access

Dashboard / Extreme Access Home

Who's Who in EA

Created by Andrea Harman, last modified by Angela Stickle just a moment ago

Click the "Edit" button in the upper right-hand corner to add your details to the table below.

Who You Are	What You Do	What You Want Others To Know About You	Other Comments	Website, Contact Info, POC
Angela Stickle	LSIC EA Focus Group Facilitator : I help facilitate conversations between NASA, industry, academia, non-profits, and other government agencies.	I'm here to help you get exposure, get your ideas out there, talk to NASA, and to know what NASA is doing and how it affects your technology projects.		Angela.Stickle@jhuapl.edu Facilitator_ExtremeAccess@jhuapl.edu http://lsic.jhuapl.edu/Focus-Areas/Extreme-Access.php

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Who's Who in ISRU: <https://lsic-wiki.jhuapl.edu/display/ISRU/Who%27s+Who+in+ISRU>

Who's Who in Surface Power: <https://lsic-wiki.jhuapl.edu/display/SP/Who%27s+Who+in+LSIC-Surface+Power>

Who's Who in E&C: <https://lsic-wiki.jhuapl.edu/pages/viewpage.action?pageId=6260179>

Who's Who in EE: <https://lsic-wiki.jhuapl.edu/display/EE/Who%27s+Who+in+LSIC-EE>

STMD Opportunities for Academia and Industry

STMD anticipates awarding ~\$600M to academia and industry supporting 2020 solicitations & awards

STMD Tipping Point Multiple Awards: *Jan – Mar 2020*

\$250M

Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Phases I, II, II-E, Civilian Commercialization Readiness Pilot Program (CCRPP), Sequential: *Phase I Solicitation Jan – Apr 2020*

\$212M

Announcement of Collaborative Opportunity (ACO): *Jan – Mar 2020*

\$10M

Flight Opportunities Tech Flights: *Feb – May 2020*

\$10M

Early Career Faculty (ECF): *Feb – Apr 2020*

\$6M

Early Stage Innovations (ESI): *Apr – Jun 2020*

\$9M

NASA Innovative Advanced Concepts (NIAC) Phases I, II, III: *Phase I Solicitation Jun – Jul 2020*

\$4M

Space Technology Research Institutes (STRI): *Jun – Aug 2020*

\$30M

NASA Space Technology Graduate Research Opportunities (NSTGRO): *Sep – Nov 2020*

\$19M

SmallSat Technology Partnerships (STP): *Sep – Nov 2021*

\$3M

Centennial Challenges: *Varied release dates*

\$8M

NextSTEP Broad Agency Announcements (BAAs): *Varied release dates*

Varies

Lunar Surface Technology Research (LuSTR) Opportunities: *Coming soon!!!*

\$30M

Note: Funding awards are approximate and subject to change

Open Solicitations as of June 5, 2020

Solicitations were/will be open in the timeframe specified in italics