# Space Power Workshop

*Commoditization of Space:*
*Maintaining Resiliency in the Age of Faster and Cheaper*

## TUESDAY MORNING, APRIL 29, 2025

### 7:00 a.m. Registration and Continental Breakfast

### 8:00 a.m. Welcome Address

*Dr. Debra Emmons, Vice President and Chief Technology Officer, The Aerospace Corporation*

**Keynote Organizer**

*Justin Stocker, The Aerospace Corporation, justin.stocker@aero.org*

**Keynote Address**

**SSC Commercial Space Office Overview**

*Lt Col Aaron T. Stevenson, USAFR. Deputy Director, Commercial Space Office, Space Systems Command*

### 8:40 a.m. Invited Plenary Speakers

**Organizer**

*Jann Grovogui, The Aerospace Corporation, jann.grovogui@aero.org*

**Applications and challenges of metal halide perovskites and ultra-thin silicon photovoltaics for space**

*Seth Hubbard, Professor of Physics, Director of SSTI-ASTROMAT, Rochester Institute of Technology*

**Building Beyond Silos: Collaboration and Innovation for the Next Generation of Space Missions**

*Joseph P. Kozak, Chief Technologist, Space Formulation Mission Area, Johns Hopkins University—Applied Physics Laboratory*

### 10:00 a.m. Break

### 10:15 a.m. Mission and Program Experience

**Organizers**

*Valerie Ang, The Aerospace Corporation, valerie.j.ang@aero.org*
*Brandon Klefman, NASA Glenn Research Center, brandon.klefman@nasa.gov*
*Christopher Le, The Aerospace Corporation, christopher.le@aero.org*

**Maintaining Reliability in a Harsh Environment—The Design and Delivery of the CADRE Lunar Rovers and Basestation**

*Molly Shelton, Jet Propulsion Laboratory, molly.o.shelton@jpl.nasa.gov*

**Mission and development heritage—Faster and cheaper**

*Eric Trehet, Airbus Defence and Space, eric.trehet@airbus.com*

**Revisiting Solar Array String Failures on the International Space Station**

*Steven Korn, NASA Glenn Research Center, steven.korn@nasa.gov*

**Reliability and resiliency of high voltage transmission and distribution infrastructure**

*Craig Lamascus, The Aerospace Corporation, craig.r.lamascus@aero.org*

**GHPS: Generic High Power System for Gateway Test Results**

*Roberto Gutierrez, Airbus Crisa, roberto.gutierrez@airbus.com*

### 12:00 p.m. Lunch (on your own)

Note: all times are Pacific Daylight Time (UTC-7)

## TUESDAY AFTERNOON, APRIL 29, 2025

### 1:15 p.m. Energy Storage I—Space Battery Level Topics

*Organizers*

*Kevin MacDougall, The Aerospace Corporation, kevin.macdougall@aero.org*
*Alec Jackson, Air Force Research Laboratory, alec.jackson.1@spaceforce.mil*
*Michael Angell, The Aerospace Corporation, michael.r.angell@aero.org*

***Airbus Space Battery Heritage—Powering the future***
*Kévin Allenbach, Airbus Defence and Space, kevin.allenbach@airbus.com*

***Reducing development and manufacturing time using scalable designs***
*Richard Coffin, EaglePicher Technologies, richard.coffin@eaglepicher.com*

***Thermal Runaway Single Cell Material Testing and Puncture Location Investigation***
*Delaney Mann, EnerSys Advanced Systems ABSL, delaney.mann@eas.enersys.com*

***GS Yuasa MA 12x Modular Battery Platform Qualification Test Results***
*Thomas Pusateri, GS Yuasa Lithium Power, Inc., tom.pusateri@gsyuasa-lp.com*

***High Temperature Batteries for Planetary Missions***
*John-Paul Jones, Jet Propulsion Laboratory, john-paul.jones@jpl.nasa.gov*

### 3:00 p.m. Break

### 3:15 p.m. Energy Generation I—Space Solar Cell Technologies

*Organizers*

*Kyle Virgil, The Aerospace Corporation, kyle.virgil@aero.org*
*Alex Grede, Naval Research Laboratory, agrede@ieee.org*

***AZUR SPACE Product Portfolio for Versatile Space Applications***
*Torsten Torunski, AZUR SPACE Solar Power GmbH, torsten.torunski@azurspace.com*

***Resilient supply of Ge substrates for U.S. space market***
*Kristof Dessein, Umicore, kristof.dessein@eu.umicore.com*

***Quad-Junction Solar Cell Production, Solar Array Products, and Capacity Expansion at SolAero by Rocket Lab***
*Zachary Bittner, SolAero by Rocket Lab, zachary.bittner@rocketlabusa.com*

***Development of CIGS solar cells on glass substrates for space applications***
*Hiroshi Tomita, Idemitsu Kosan Co., Ltd., hiroshi.tomita.3920@idemitsu.com*

***Spectrolab's Pathway Forward: Modular Solutions for Bespoke Space Power Needs***
*Chris Fetzer, Spectrolab, christopher.m.fetzer@boeing.com*

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## TUESDAY EVENING, APRIL 29, 2025

**5:00 p.m.** **Poster Session and Networking Social Organizers**

Jann Grovogui, The Aerospace Corporation, jann.grovogui@aero.org
Sunny Yu, The Aerospace Corporation, sunny.yu@aero.org
Kyle Virgil, The Aerospace Corporation, kyle.virgil@aero.org

***Photovoltaic fiber as a building block for flexible space solar power***
Michael Jin, Johns Hopkins University Applied Physics Laboratory, michael.jin@jhuapl.edu

***Identifying Suitable Front Contacts for Cd(Se, Te) Solar Cells on Space-Qualified Cover Glass***
Aesha Patel, The University of Toledo, aesha.patel@rockets.utoledo.edu

***Radiative Durability of Coverglass-less CIGS Solar Cell***
Takato Ishiuchi, Idemitsu Kosan Co., Ltd., takato.ishiuchi.4710@idemitsu.com

***Cheap, Safe, and High Energy Density Lithium-Sulfur Batteries for Space Applications***
Taylor Xu, Navitas Systems LLC, txu@navitassys.com

***Proton Radiation Hardness of Antimony Chalcogenide Solar Cells***
Alisha Adhikari, The University of Toledo, alisha.adhikari@rockets.utoledo.edu

***Qualification Test Results for Space Grade Power RH GaN HEMT***
Wibawa Chou, IR HiRel, an Infineon Technologies Company, wibawa.chou@infineon.com

***Defect Densities of Proton-Irradiated Industry-Grade CdSeTe/CdTe PV Cells***
Scott Lambright, The University of Toledo, scott.lambright@rockets.utoledo.edu

***Photovoltaic Cells for Laser Power Receivers***
Geoffrey Landis, NASA Glenn Research Center, geoffrey.landis@nasa.gov

***Mitigating Morphology Resulting from Controlled Spalling to Maximize Space Solar Cell Substrate Materials Utilization***
Corinne Packard, University of Southern California, cpackard@usc.edu

***Subjunction Spatial Analysis of Irradiated Multijunction Solar Cells through Electroluminescence Imaging***
Kyle Virgil, The Aerospace Corporation, kyle.virgil@aero.org

***Radiation testing of Si PERC and diffused-junction GaAs solar cells***
Michael Kelzenberg, California Institute of Technology, mdk@caltech.edu

***MELCO's solar array panel/wing development***
Hirokazu Aoki, Mitsubishi Electric Corporation, aoki.hirokazu@bk.mitsubishielectric.co.jp

***Open-Source Code for Simulating Proton Transmission Through Thin Radiation Shields***
Phillip Jahelka, California Institute of Technology, pjahelka@caltech.edu

***3M encapsulant films for satellite solar cell arrays***
Sean Sweetnam, 3M, ssweetnam@mmm.com

***Space-Grade Battery Development for Next-Generation Platforms***
William Hadala, American Lithium Energy Corporation, william.hadala@americanlithiumenergy.com

***Technoeconomic analysis and cost-reduction strategies for space-grade solar cells***
Jacob Cordell, National Renewable Energy Laboratory, jacob.cordell@nrel.gov

***GauchoSat: The AMU Enabled Solar Cell Testbed Cubesat***
Brady Gin, Angstrom Designs, brady.gin@angstromdesigns.com

***20 Commercialization of Space; New xMOR DC-DC Family Supporting Deep Space and LEO***
Ronen Cohen, Crane Aerospace and Electronics, Ronen.Cohen@craneae.com

**7:30 p.m.** **Adjourn**

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## WEDNESDAY MORNING, APRIL 30, 2025

**7:00 a.m.** **Registration and Continental Breakfast**

**8:00 a.m.** **Advanced Concepts**

*Organizers*
Vien Vu, The Aerospace Corporation, vien.x.vu@aero.org
Michael Kelzenberg, California Institute of Technology, mdk@caltech.edu

***Progress in Small, Modular Radioisotope Thermoelectric Power Systems***
E. Joseph Nemanick, The Aerospace Corporation, ejoseph.nemanick@aero.org

***Alternative Radioisotope Power for Small Missions***
Vladimir Jovovic, Jet Propulsion Laboratory, vladimir.jovovic@jpl.nasa.gov

***Laser Power Beaming for Applications on the Moon***
Geoffrey Landis, NASA Glenn Research Center, geoffrey.landis@nasa.gov

***Developing Transition Metal Oxide-Based Carrier-Selective Contacts for Non-Epitaxial InP Solar Cells***
Anish Chaluvadi, University of Cambridge, vsac2@cam.ac.uk

***Space Wireless On-demand Optical Power (SWOOP) Performance Modeling***
Grant Erickson, Lockheed Martin Space, grant.e.erickson@lmco.com

***MOSSA-Ultra High-Efficiency Solar Arrays for Small Satellites***
Kiel Davis, Opterus Research & Development, kdavis@opterusrd.com

***Mitigating Arc Inception via Transformational Array Instrumentation***
Jeremiah Sims, NASA Glenn Research Center, jeremiah.d.sims@nasa.gov

**10:00 a.m.** **Break**

**10:15 a.m.** **Power Systems Architecture**

*Organizers*
Kelsey Dougherty, The Aerospace Corporation, kelsey.s.dougherty@aero.org
Markell Hardee, The Aerospace Corporation, markell.hardee@aero.org
Joshua Stewart, The Aerospace Corporation, joshua.stewart@aero.org

***Power System Subdesign of Small Satellites in Julia***
Ranjan Anantharaman, JuliaHub, Inc., ranjan.anantharaman@juliahub.com
David Dinh, JuliaHub, Inc., david.dinh@juliahub.com

***Need for Efficient and Reliable Power: GaNFET design solution for resiliency in the age of faster and cheaper***
Jason Stange, Packet Digital, jason.stange@packetdigital.com

***MSR Subsystem: Flexible GaN based power architecture for Deep Space missions***
Roberto Gutiérrez, Airbus Crisa, roberto.gutierrez@airbus.com

***Aging & Lifetime Testing of GaN Power Electronics for Power Conversion Systems***
Lee Gill, Sandia National Laboratories, lgill@sandia.gov

**12:00 p.m.** **Complimentary Luncheon**

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## WEDNESDAY AFTERNOON, APRIL 30, 2025

**1:15 p.m.** **Energy Generation II—Modules and Arrays Design**

***Organizers***

*Yao Lao, The Aerospace Corporation, yao.y.lao@aero.org*
*Christopher Kerestes, Air Force Research Laboratory, christopher.kerestes@spaceforce.mil*

***Ultra-light alternatives to space coverglass for solar arrays***

*Pilar Espinet Gonzalez, The Aerospace Corporation, pilar.espinetgonzalez@aero.org*

***Flexible and lightweight solar power modules for LEO satellites and next-generation arrays***

*Chris Youtsey, MicroLink Devices, Inc., cyoutsey@mldevices.com*

***Silicon Solar Power Modules for Roll Out Deployment***

*Stanislau Herasimenka, Solestial, Inc., sh@solestial.com*

***Development of a Synchronized Deployment Solar Array Wing for SmallSats***

*Ismael Sanchez, DHV Technology, i.sanchez@dhvtechnology.com*

***ROSA's Transformative Technology for GEO and Resilient Spacecraft Applications***

*Matt LaPointe, Redwire Space, matt.lapointe@redwirespace.com*

**3:00 p.m.** **Break**

**3:15 p.m.** **Workshops (Concurrent Sessions)**

## WORKSHOP TOPICS

***Energy Storage***

*Moderators: Kevin MacDougall and Christopher Choi, The Aerospace Corporation*

*Join us for an engaging and insightful discussion as we explore the future of energy storage for space missions. In this session, we will investigate innovative approaches to energy storage for harsh environments, such as the lunar surface or Mars. We will consider whether the challenges posed by these environments should be addressed primarily at the cell chemistry level, the battery control electronics level, or a combination of both, and whether innovations in commercially available options can enable novel solutions to these challenges. Additionally, we will examine how Artificial Intelligence (AI) and Machine Learning (ML) can be leveraged for battery modeling and mission assurance. By integrating AI/ML, we can model performance, predict failures, and improve overall system resilience, ensuring mission success even under extreme conditions. Join us as we discuss the intersection of advanced materials, engineering solutions, and cutting-edge AI/ML technologies to revolutionize energy storage for the next generation of space exploration.*

***Energy Generation***

*Moderator: Yao Lao, The Aerospace Corporation*

*Welcome to the Energy Generation session of the Space Power Workshop! In this 90-minute workshop, we will delve into the publicly available analysis tools and software that are essential for evaluating solar cell and array technologies for space missions. Our goal is to provide a comprehensive overview of these tools, ensuring that both new and experienced participants can effectively utilize them for their projects. We encourage you to bring any questions you have about the current technologies and methodologies, as your inquiries will drive our discussions and enhance our collective understanding.*

*We believe that the best way to advance our knowledge and capabilities in space energy generation is through collaboration and shared expertise. This session is designed not just as a lecture, but as an interactive platform where your insights and experiences are invaluable. Whether you have worked on solar energy projects in space or are looking to learn more about the latest advancements, your contributions will help shape the future of our efforts. Let's leverage this opportunity to address challenges, explore innovative solutions, and foster a community of forward-thinking professionals.*

*Join us with your questions, curiosity, and expertise to make this workshop a dynamic and enriching experience for all.*

***PMAD***

*Moderator: Peter J. Carian, The Aerospace Corporation*

***Power Generation, Storage, and Distribution: Arcing Concerns***

*Recent Mission failures due to electrical arcing have raised requests for guidelines on how to better protect against the initiation of arcing and prevent propagation of damage. This is especially true where redundancy boundaries may be breached.*

*We will discuss basic causes of arcing, damage potentials, and Voltage levels where secondary propagation poses real dangers for launch vehicles, spacecraft, and Lunar operations.*

*We will also summarize significant Events and Trends in the PMAD world over the past year.*

**5:00 p.m.** **Adjourn**

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## THURSDAY MORNING, MAY 1, 2025

**7:00 a.m.** **Registration and Continental Breakfast**

**8:00 a.m.** **PMAD—Power System Design and Analytical Techniques**

*Organizers*

John Morales, The Aerospace Corporation, john.f.morales@aero.org
Horacio Saldivar, The Aerospace Corporation, horacio.saldivar@aero.org
James Becker, The Aerospace Corporation, james.becker1@aero.org

***Airbus Crisa Next Space Designs: MEGA and MV Product Lines***
Roberto Gutiérrez, Airbus Crisa, roberto.gutierrez@airbus.com

***Optimizing SWaP-C Through Multi-Phase Clock Distribution***
Kiran Bernard, Renesas Electronics America, kiran.bernard.jy@gr.renesas.com

***Lunar Tethered Power System: Advancing Power Distribution Through Diverse Partnerships***
Brandon Burns, Jet Propulsion Laboratory, brandon.burns@jpl.nasa.gov

***RREAD Observer: Perceptive test as you fly capability***
David Caldwell, The Aerospace Corporation, david.j.caldwell@aero.org

**10:00 a.m.** **Break**

**10:15 a.m.** **Energy Storage III—Advanced Energy Storage Topics**

*Organizers*

Albert Zimmerman, The Aerospace Corporation, albert.h.zimmerman@aero.org
Martin Dann, Rochester Institute of Technology, madvpr@rit.edu

***Liquified Gas Electrolyte, LiGas®, as the Next Generation Electrolyte for Lithium Ion Batteries***
Ryo Tamaki, South 8 Technologies, rtamaki@south8.com

***Lithium Sulfur Batteries for Aerospace and Defense at JHU/APL***
Nicholas Pavlopoulos, Johns Hopkins University Applied Physics Laboratory, nicholas.pavlopoulos@jhuapl.edu

***Lyten Lithium-Sulfur Cells for Space and DoD Applications***
Ratnakumar Bugga, Lyten, kumar.bugga@lyten.com

***Data-Driven and Physics-Informed Li-ion Battery Performance Modeling***
Christopher Choi, The Aerospace Corporation, christopher.s.choi@aero.org

***Model for Voltage Hysteresis in Li-Ion Cells***
Albert Zimmerman, The Aerospace Corporation, albert.h.zimmerman@aero.org

**12:00 p.m.** **Lunch (on your own)**

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## THURSDAY AFTERNOON, MAY 1, 2025

### 1:15 p.m. Energy Generation III—Reliability and Characterization

**Organizers**

Pilar Espinet Gonzalez, The Aerospace Corporation, pilar.espinetgonzalez@aero.org
Jeremiah Sims, NASA Glenn Research Center, jeremiah.d.sims@nasa.gov

**Solar Cell Displacement Damage Testing Using Co-60 Gamma Rays**

Scott Messenger, Northrop Grumman Corporation, scott.messenger@ngc.com

**Impact of Radiation Environment and Solar Array Uncertainty on Achieving Mission Power Requirements**

Don Walker, The Aerospace Corporation, don.walker@aero.org

**Experimental Validation of Electro-Thermal Models for Solar Arrays**

Pilar Espinet Gonzalez, The Aerospace Corporation, pilar.espinetgonzalez@aero.org

**Proton Radiation Resilience of Industry-Grade CdSeTe/CdTe PV Cells for Space Applications**

Randy Ellingson, The University of Toledo, randy.ellingson@utoledo.edu

**The Importance and Limitations of Light I-V and Dark IV Testing for Space Solar Arrays**

Bao Hoang, Maxar Technologies, Bao.Hoang@maxar.com

### 3:00 p.m. Break

### 3:15 p.m. Energy Storage II—Cell Level Developments for Energy Storage

**Organizers**

Christopher Choi, The Aerospace Corporation, christopher.s.choi@aero.org
Lloyd Zilch, Naval Surface Warfare Center, Crane Division, lloyd.w.zilch.civ@us.navy.mil
Alexandria Kilzer, Naval Surface Warfare Center, Crane Division, alexandria.r.kilzer.civ@us.navy.mil

**VL10ES Cell and Battery Qualification Update**

Chengsong Ma, Saft, chengsong.ma@saft.com

**Effects of Low Temperature Freeze Cycles on COTS Li-ion Cells**

Justin Rauchwarg, EnerSys Advanced Systems ABSL, justin.rauchwarg@eas.enersys.com

**Advanced 18650 Battery Cells for Extreme Space Environments**

William Hadala, American Lithium Energy Corporation, william.hadala@americanlithiumenergy.com

**CAMX Power High Sensitivity Cell Screening Technology**

Christopher McCoy, CAMX Power, LLC, mccoy.chris@camx-power.com

**Cell Performance Mapping**

Steve Weiss, Xilectric, Inc., steve.weiss@xilectric.com

### 5:00 p.m. Adjourn

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