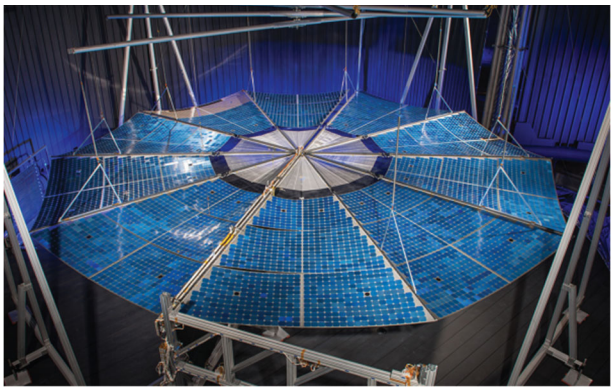
Help NASA Deploy Solar Arrays on the South Pole of the Moon



MegaFlex Solar Array developed by the NASA Glenn Research Center

Name of Technology: Lunar Surface Solar Array Structures

Participating NASA Centers: Langley Research Center (lead) and Glenn Research Center

Technological Area: TA12 - Materials, Structures, Mechanical Systems and Manufacturing

Vision for the Technology: The moon has harsh conditions including excessively cold 14-day nights in some locations. However, the South Pole of the moon receives sunlight 100% of the time in summer and 70% of the time in Winter. Hence, NASA seeks to land at the South Pole by 2024 and deploy solar arrays that can be used to power landers, rovers, and other equipment.

Challenges: The arrays must be lightweight and yet cover a large surface area. They must also be able to retract and be moved and redeployed as needed. The moon is a harsh environment so the array and its components must be able to withstand dust, radiation, and extreme temperatures. Lastly, in order to maximize the capture of sunlight, the arrays need to be 10 meters above the lunar terrain.

Overview of Student Project: NASA seeks innovative ideas from students that emphasize structural and mechanical innovations, not photovoltaics, electrical, or energy storage Innovations.

Ultimately, NASA Seeks to Develop Arrays that Meet the Following Specs

- Deployed area: 35 m2 (10 kW) initially; up to 140 m2 (40 kW) eventually per unit.
- Single-axis sun tracking about the vertical axis.
- Adjustable leveling to within 10 deg of vertical.
- Retractable for relocating, repurposing, or refurbishing.
- Number of deploy/retract cycles in service: >5; stretch goal >10.
- Optional 10 m height extension boom to reduce shadowing from local terrain.
- Lunar dust, radiation, and temperature resistant mechanical and electrical components.
- Specific mass: >150 W/kg at 35 m2; >100 W/kg at 140 m2.
- Specific packing volume: >60 kW/m3 at 35 m2; >40 kW/m3 at 140 m2.
- Lifetime: >15 years.

Innovative Areas Student Projects Can Address (It is recommended to focus on one area):

- Novel packaging, deployment, retraction, and modularity concepts.
- Lightweight, compact components including booms, ribs, substrates, and mechanisms.
- Novel actuators for telescoping solar arrays with tubular segments of ~4 m length and ~0.2 m diameter such as gear/rack, piezoelectric, ratcheting, or rubber-wheel drive devices.
- Mechanisms with exceptionally high resistance to lunar dust.
- Load-limiting devices to avoid damage during deployment, retraction, and solar tracking.
- Optimized use of advanced lightweight materials (but not materials development).
- Modular and adaptable solar array concepts for multiple lunar surface use cases.
- Completely new concepts; e.g., thinned “rigid panel” or 3D printed solar arrays, non-rotating telescoping “chimney” arrays, or lightweight reflectors to redirect sunlight onto solar arrays or into dark craters.

Research Funded by NASA on this Topic:

Proposal Number - 19-1- **H5.01-4161**
Simple Reliable Retractable Lunar Lander Solar Array

Proposal Number - 19-1- **H5.01-4072**
Sunflower Array

Proposal Number - 19-1- **H5.01-2900**
Software for the Rapid Comparative Design of Solar Arrays

Proposal Number - 19-1- **H5.01-2946**
Monolithic Truss Segment

Proposal Number - 19-1- **H5.01-4299**
Deployable and Retractable Solar Array for Lunar Surface/Lander Mobility Operations

References:

"Merits of a Lunar Pole Base Location," in Lunar Bases and Space Activities of the 21st Century

"Characterization of Lunar Polar Illumination from a Power System Perspective,"

"Illumination Conditions of the Lunar Polar Regions Using LOLA Topography,"

"Compact Telescoping Array: Advancement from Concept to Reality,"