NASA SBIR 2021 Phase I Solicitation

S3.01 Power Generation and Conversion

Lead Center: GRC

Participating Center(s): JPL

Scope Title:

Photovoltaic Energy Conversion

Scope Description:

This subtopic is seeking photovoltaic cell and blanket technologies that lead to significant improvements in overall solar array performance for missions in areasÂ of scientific interestÂ including high-intensity, high-temperature (HIHT);Â low-intensity, low-temperature (LILT);Â and high-radiation environments. Additionally sought are solar power systems that can provide high power in compactly stowed volumesÂ for small spacecraft.Â

These improvements may be achieved by optimizing the cell technology to operate in HIHT/LILT, increasingÂ end of life (EOL)Â performance,Â increasing photovoltaic cell efficiency above 35% at 1 AU, and decreasingÂ solar cell module/blanket stowed volume. Missions at distances of greater than 1 AU may include an inner planetary flyby, as such technologies that optimize solar cell string length to account for the changes in power generation are also of interest.Â

Photovoltaic energy conversion: advances in, but not limited to, the following: (1) Photovoltaic cell and blanket technologies capable of LILTÂ operation applicable to outer planetary (low solar intensity) missions;Â (2)Â Photovoltaic cell and blanket technologies capable of HIHTÂ operation applicable to innerÂ planetary missions; (3)Â Photovoltaic cellÂ and blanket technologies that enhance and extend performance in lunar applications including orbital, surface, and transfer;Â andÂ (4) Solar cell and blanket technologiesÂ to supportÂ missions in high-radiation, LILT environments nearÂ Jupiter and its moons.Â

Expected TRL or TRL Range at completion of the Project: 3 to 5
Primary Technology Taxonomy:
Level 1: TX 03 Aerospace Power and Energy Storage
Level 2: TX 03.1 Power Generation and Energy Conservation
Desired Deliverables of Phase I and Phase II:

- Research
- Analysis
- Prototype
- Hardware

Desired Deliverables Description:

Phase I deliverables include detailed reports with proof of concept and key metrics of components tested and verified.

Phase II deliverables include detailed reports with relevant test data along with proof-of-concept hardware and components developed.

State of the Art and Critical Gaps:

State-of-the-art (SOA) photovoltaic array technology consists of high-efficiency, multijunction cell technology on thick honeycomb panels and, as of late, lightweight blanket system deployable systems. There are very limited demonstrated technology for HIHTÂ and LILTÂ missions. A current solution for high-radiation intensity involves adding thick cover glass to the cells, which increases the overall system mass.Â

Significant improvements in overall performance are needed to address the current gaps between SOA and many mission requirements for photovoltaic cell efficiency >30%, array mass specific power >200 W/kg, decreased stowed volume,Â long-term operation in radiation environments, high-power arrays, and a wide range of environmental operating conditions.

Relevance / Science Traceability:

These technologies are relevant to any space science, Earth science, planetary surface, or other science mission that requires affordable high-efficiency photovoltaic power production for orbiters, flyby craft, landers, and rovers.

Specific requirements can be found in the References, but include many future Science Mission Directorate (SMD) missions. Specific requirements for orbiters and flybys to Outer planets include: LILT capability (>38% at 10 AU and <140 Â°C), radiation tolerance (6Ã—10 ^{15} 1 MeV e/cm^{2}), high power (>50 kW at 1 AU), low mass (3Ã— lower than the standard operating procedure (SOP)), low volume (3Ã— lower than SOP), long life (>15 years), and high reliability.

These technologies are relevant and align withÂ any Space Technology Mission Directorate (STMD) or Human Exploration and Operations Mission Directorate (HEOMD) mission that requires affordable high-efficiency photovoltaic power production.

NASA outlines New Lunar Science, Human Exploration Missions:Â https://www.nasa.gov/feature/nasa-outlines-new-lunar-science-human-exploration-missions

NASA Science Missions:Â https://science.nasa.gov/missions-page?field_division_tid=All&field_phase_tid=3951

References:

- Solar Power Technologies for Future Planetary Science Missions: https://solarsystem.nasa.gov/resources/548/solar-power-technologies-for-future-planetary-science-missions/
- NASA outlines New Lunar Science, Human Exploration Missions: https://www.nasa.gov/feature/nasa-outlines-new-lunar-science-human-exploration-missions
- NASA Science Missions: https://science.nasa.gov/missions-page