

High-Efficiency Lightweight Solar Array for Deep Space Missions

Andreea Boca¹ (PI), Jonathan Grandidier¹, Joel Schwartz¹, Clay McPheeters², Mike McEachen³

¹Jet Propulsion Laboratory, California Institute of Technology;

²SolAero Technologies Corp.; ³Northrop Grumman Innovation Systems

Program: Strategic Initiative

PROJECT OBJECTIVES

Overall (3-year):

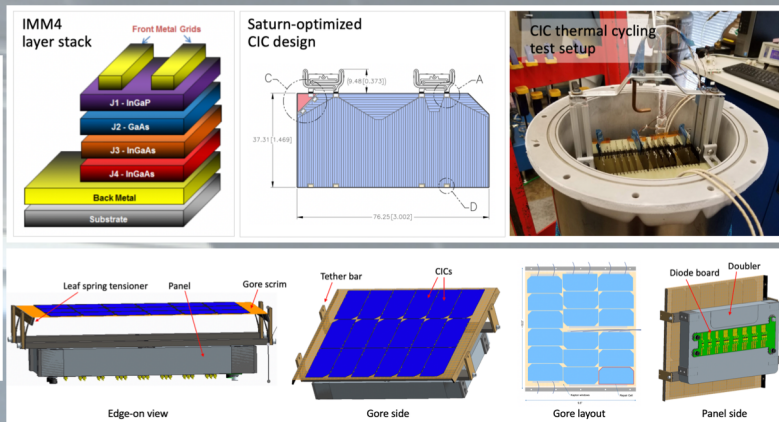
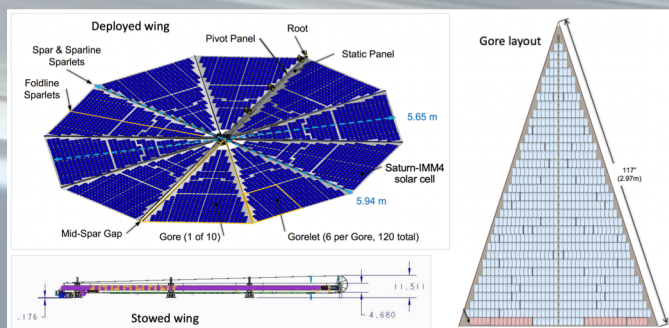
- Develop a solar array with ~3W/kg end-of-mission specific power at Saturn, and demonstrate its performance in the relevant environment (TRL5)

Specific for FY19:

- Develop requirements and generate conceptual design of 9.5AU small-spacecraft solar array
- Perform analyses on full-scale solar array, verify that the design meets performance targets
- Document detailed design and test requirements for reduced-scale prototype S/A Pilot coupon
- Demonstrate scalability of solar cell fabrication process and Saturn performance via large build

FY19 RESULTS

- Developed and documented an inclusive, realistic set of requirements for small-spacecraft Saturn solar arrays
- Completed full-scale solar array conceptual design; the optimized iteration is capable of 2.93W/kg at Saturn EOM
- Performed full-scale solar array analyses for all design iterations; verified that all requirements are being met
- Demonstrated through test that the IMM4 CICs survive eclipse temperatures without measurable degradation
- Completed Pilot prototype-coupon detailed design and documented its test requirements
- Fabricated and screened a large-quantity CIC build, and completed design and fabrication of LILT test fixture for it
- Completed beginning-of-life performance testing on large build, with data analysis still in progress



SIGNIFICANCE OF RESULTS

- Successfully completed the majority of objectives for FY19; well underway towards reaching TRL-5 by end of FY21

BENEFITS TO NASA AND JPL

- The advanced Saturn solar array offers a 5x mass reduction compared to state-of-art solar arrays; also, a 2x mass and an 8x cost savings relative to radioisotope thermoelectric generators (MMRTG)
- This technology is enabling for small Saturn spacecraft (SIMPLEx), and strongly enhancing for larger spacecraft as well (Discovery, New Frontiers, or Flagship)

PUBLICATIONS

- A. Boca, C. MacFarland and R. Kowalczyk, "Solar Power for Deep-Space Applications: State of Art and Development", AIAA Propulsion-Energy Forum, 19-22 August 2019, Indianapolis IN, doi: 10.2514/6.2019-4236.