



NASA SBIR 2019 Phase I Solicitation

S2.02 Precision Deployable Optical Structures and Metrology

Lead Center: JPL

Technology Area: TA8 Science Instruments, Observatories & Sensor Systems

Assembled Deployable Optical Metering Structures and Instruments

Planned future NASA Missions in astrophysics, such as the Wide-Field Infrared Survey Telescope (WFIRST) and the New Worlds Technology Development Program (coronagraph, external occulter, and interferometer technologies) will push the state of the art in current optomechanical technologies. Mission concepts for New Worlds science would require 10 - 30 m class, cost-effective telescope observatories that are diffraction limited at wavelengths from the visible to the far IR, and operate at temperatures from 4 - 300 K. In addition, ground based telescopes, such as the Cerro Chajnantor Atacama Telescope (CCAT), require similar technology development.

The desired areal density is 1 - 10 kg/m² with a packaging efficiency of 3- 10 deployed/stowed diameter. Static and dynamic wavefront error tolerances to thermal and dynamic perturbations may be achieved through passive means (e.g., via a high stiffness system, passive thermal control, jitter isolation, or damping) or through active opto-mechanical control. Large deployable multi-layer structures in support of sunshades for passive thermal control and 20m to 50m class planet finding external occulters are also relevant technologies. Potential architecture implementations must package into an existing launch volume, deploy, and be self-aligning to the micron level. The target space environment is expected to be the Earth-Sun L₂.

This subtopic solicits proposals to develop enabling, cost effective component and subsystem technology for assembling large aperture telescopes with low cost. Research areas of interest include:

- Precision deployable modules for assembly of optical telescopes (e.g., innovative active or passive deployable primary or secondary support structures).
- Hybrid Deployable/Assembled Architectures, packaging and deployment designs for large sunshields and external occulters.
- Innovative concepts for assembling fully integrated modules without multiple external connections for power, heat transfer, or communications, such as:
 - Mechanical connections providing micro-dynamic stability suitable for robotic assembly.
 - Data and power concepts between assemble modules which minimize complexity and mass.
 - Thermal heat transfer concepts between assembled modules which minimize complexity and mass.
- Innovative testing and verification methodologies.

NASA APD's 30-year roadmap calls out several technical needs:

- Under Optics deployment and co-phasing "an 8-16 m telescope will require a segmented approach and advanced options for optics deployment such as robotic assembly."

-
- Under New Technology Mirrors, On-orbit Fabrication and Assembly Technologies "The key to bigger and better space telescopes may rely, instead, on assembly and testing telescopes on-orbit."
 - In 6.5 Technology Summary Optics deployment and assembly is listed for the FIR Surveyor, Large UV Optical Infrared Surveyor, and the X-ray surveyor in the Formative Era, as well as the Cosmic Dawn Mapper and ExoEarth Mapper in the Visionary Era.

The goal for this effort is to mature technologies that can be used to fabricate 16 m class or greater, lightweight, ambient, or cryogenic flight qualified observatory systems. Proposals to fabricate demonstration components and subsystems with direct scalability to flight systems through validated models will be given preference. The target launch volume and expected disturbances, along with the estimate of system performance, should be included in the discussion. Proposals with system solutions for large sunshields and external occulter will also be accepted. A successful proposal shows a path toward a Phase II delivery of demonstration hardware scalable to 5 meter diameter for ground test characterization.

Proposals should show an understanding of one or more relevant science needs, as well as present a feasible plan to fully develop the relevant subsystem technologies and to transition into future NASA program(s).

The expected technology readiness level (TRL) or TRL range at completion of the project is from 3-5.

A successful Phase II would include a demonstration of assembly and disassembly of a stable, stiff structural connection which transfers significant heat as well as data/power. Such a component would be supported by analysis of an observatory optomechanical architecture suitable for future observatories.

References:

Assembled Deployable Optical Metering Structures and Instruments

- https://exoplanets.nasa.gov/exep/technology/in-space-assembly/iSAT_study/ (contains many links to useful recent studies that are ongoing)