



NASA SBIR 2011 Phase I Solicitation

S2.01 Precision Spacecraft Formations for Telescope Systems

Lead Center: JPL

Participating Center(s): GSFC

This subtopic seeks hardware and software technologies necessary to establish, maintain, and operate precision spacecraft formations to a level that enables cost effective large aperture and separated spacecraft optical telescopes and interferometers (e.g., <http://planetquest.jpl.nasa.gov/TPF/>, <http://instrument.jpl.nasa.gov/steller/>). Also sought are technologies (analysis, algorithms, and test beds) to enable detailed analysis, synthesis, modeling, and visualization of such distributed systems.

Formation flight can synthesize large effective telescope apertures through, multiple, collaborative, smaller telescopes in a precision formation. Large effective apertures can also be achieved by tiling curved segments to form an aperture larger than can be achieved in a single launch, for deep-space high resolution imaging of faint astrophysical sources. These formations require the capability for autonomous precision alignment and synchronized maneuvers, reconfigurations, and collision avoidance. The spacecraft also require onboard capability for optimal path planning and time optimal maneuver design and execution.

Innovations are solicited for:

- Sensor systems for inertial alignment of multiple vehicles with separations of tens of meters to thousands of kilometers to accuracy of 1 - 50 milli-arcseconds.
- Development of nanometer to sub-nanometer metrology for measuring inter-spacecraft range and/or bearing for space telescopes and interferometers.
- Control approaches to maintain line-of-sight between two vehicles in inertial space near Sun-Earth L2 to milli-arcsecond levels accuracy.
- Development of combined cm-to-nanometer-level precision formation flying control of numerous spacecraft and their optics to enable large baseline, sparse aperture UV/optical and X-ray telescopes and interferometers for ultra-high angular resolution imagery. Proposals addressing staged-control experiments, which combine coarse formation control with fine-level wavefront sensing based control are encouraged.

Innovations are also solicited for distributed spacecraft systems in the following areas:

- Distributed, multi-timing, high fidelity simulations.
- Formation modeling techniques.
- Precision guidance and control architectures and design methodologies.
- Centralized and decentralized formation estimation.
- Distributed sensor fusion.
- RF and optical precision metrology systems.
- Formation sensors.
- Precision microthrusters/actuators.
- Autonomous reconfigurable formation techniques.
- Optimal, synchronized, maneuver design methodologies.
- Collision avoidance mechanisms.
- Formation management and station keeping.
- Swarm modeling, simulation and control.

Proposals should show an understanding of one or more relevant science needs, and present a feasible plan to fully develop a technology and infuse it into a NASA program.