NASA SBIR 2006 Phase I Solicitation

S3.04 Optical Devices for Starlight Detection and Wavefront Analysis

Lead Center: MSFC

Participating Center(s): GSFC, JPL

This subtopic addresses the unique problems associated with collecting and pre-detection processing of star light for advanced optical telescopes and telescope arrays. This topic includes innovative optical subsystems, devices and components that directly collect and process optical signals and images for all regions of the electromagnetic spectrum from X-ray to UV to Visible to Far-IR/Sub-MM. Pre-detection technologies of interest include capabilities to preprocess or analyze an optical wave front or signal to extract time-dependent, spectral, polarization and spatial information from scenes or signals prior to detection. These devices can be placed anywhere within an optical system, between the entrance aperture and the focal plane. A specific technology area of interest is high reflectance UV coatings and uniform polarization coatings for all wavelengths. Collection technologies of interest include capabilities which enable large-baseline segmented-aperture telescopes and sparse aperture telescopes and interferometers that will be needed to obtain high angular resolution observations to support future science goals. This subtopic addresses problems associated with formation flying including development of high-precision, high-stability laser and phase sensors, as well as of techniques to enable the monitoring of the separations of the individual spacecraft and overall orientation of the constellation. Specifically of interest is component-level technology needed to enable the characterization and combination of wavefronts from multiple apertures. Innovative technology to fabricate and test large aperture optical substrates continues to be an interest of this subtopic. Additionally, this interest is specifically extended to include technology to fabricate and test large aperture very lightweight x-ray mirrors. The primary objective of this subtopic is to reduce the mass and volume of advanced telescopes and observatories - either the primary mirror or the relay and science instrument optics. The proposed effort must address the technical need of a recognized future NASA space science mission, science measurement objective or science sensor for a Discovery, Explorer, Beyond Einstein, Origins, GOESS, New Millennium, Landmark-Discovery, or Vision mission.

Proposals in the following areas are specifically solicited:

- Design and construction of UV, optical, infrared or far-infrared beam combiners suitable for wavelength-resolved fringe measurements from a large number of independent apertures with flat response over a broad wavelength range;

- Development of a metrology system suitable for monitoring path lengths in the meter to kilometer range with incremental resolutions of picometers and milliseconds, and sub-micron absolute distance resolution;


• Development and test of low cost laser metrology gauges and optical pathlength control devices for alignment and control in multi-stage, multi-vehicle formations;

• Single frequency, long lifetime (>10 years), visible, IR stable semiconductor lasers in the power range 1 to 10 watt for metrology of optical systems, wavefront sensing and control and interferometry;

• High throughput, radiation hard, large area, X-ray imaging devices such as Fresnel Zone plates and masks;

• Wavelength division demultiplexers, integrated optics waveguide, fiber optic and light pipe devices for spectral analysis of scene information from UV to IR;

• Innovative mirror substrate material/fabrication/test technologies and mounting/support technologies for large aperture lightweight low-cost x-ray, ambient and cryogenic applications in space telescopes;

• Optical coatings: broad-band polarization preserving and polarizing for UV to Far-IR/Sub-MM; high-reflectivity EUV; large area, high acceptance angle narrow-band optical filters; broad-band wide-acceptance angle UV anti-reflection on PMMA substrates; environmentally stable protected silver.

• Components or devices for spectroscopy and imaging applications using hyperspectral, polarometric, Stokes photo-polarimeters, etc. technology for visible to infrared.