NASA SBIR 2007 Phase I Solicitation

O1.08 Long Range Optical Telecommunications

Lead Center: JPL

Participating Center(s): GRC, GSFC

This subtopic seeks innovative technologies for long range Optical Telecommunications supporting the needs of space missions. Proposals are sought in the following areas:

- Systems and technologies relating to acquisition, tracking and sub-microradian pointing of the optical communications beam under typical deep-space ranges (to 40 AU) and spacecraft micro-vibration environments.

- Uncooled photon counting imagers with >1024 x 1024 formats, ultra low dark count rates and 400 - 2000 nm sensitivity.

- Ultra-low (0.7).

- Nutating fiber pointing mechanisms with high precision (3 kHz).

- Compact, lightweight, low power, broad bandwidth (0 - 3 kHz) disturbance rejection and/or isolation platforms.

- Space-qualifiable, > 20% wall plug efficiency, lightweight, 20-500 psec pulse-width (10 to > 100 MHz PRF), tunable (± 0.1 nm) pulsed 1064-nm or 1550-nm laser transmitter fiber MOPA sources with >1 kW of peak power per pulse (over the entire pulse-repetition rate), with Stimulated Brillouin Scattering (SBS) suppression and > 10 W of average power, near transform limited spectral width, and

- > 2-m diameter, 90% transmission.

- > 2-m diameter f/1.1 primary mirror and Cassegrain focus of ~f/6 optical communication receiver telescopes. Maximum RMS surface figure error of 1-wave at 1000 nm wavelength. Telescope is positioned with a 2-axis gimbal capable of 0.25 mrad pointing. Combined telescope and gimbal shall be manufacturable in quantity (tens) for

- Daytime atmospheric compensation techniques capable of removing all significant atmospheric turbulence distortions (tilt and higher-order components) on an uplink laser beam; and/or for a 2-m diameter downlink receiver telescope. Also of interest are technologies to compensate for the static and dynamic (gravity sag and thermal) aberrations of 2-m diameter telescopes with a surface figure of 10's of waves.
• Ground-based, relatively low-cost diode-pumped laser technology capable of reaching 100 kW average power levels in a TEM$_{00}$ mode, for uplink to spacecraft.

• Photon counting Si, InGaAs, and HgCdTe detectors and arrays for the 1000 to 1600 nm wavelength range with single photon detection efficiencies > 60% and output jitters less than 20 psec, active areas > 20 microns/pixel, and 1 dB saturation rates of at least 100 megaphotons (detected) per pixel and dark count rates of 2.

• Radiation hard (100 Mrad level) photon counting detectors and arrays for the 1000 to 1600 nm wavelength range with single photon detection efficiencies > 40% and 1 dB saturation rates of at least 30 megaphotons/pixel and operational temperatures above 220 K and dark count rates of

• Single-photon-sensitive, high-bandwidth (1 GHz), linear mode, high gain (> 1000), low-noise

Research should be conducted to convincingly prove technical feasibility during Phase 1, with clear pathways to demonstrating and delivering functional hardware, meeting all objectives and specifications, in Phase 2.