NASA SBIR 2007 Phase I Solicitation

S1.01 Lidar System Components

Lead Center: LaRC

Participating Center(s): GSFC

Accurate measurements of atmospheric parameters with high spatial resolution from ground, airborne, and space-based platforms require advances in the state-of-the-art lidar technology with emphasis on compactness, efficiency, reliability, lifetime, and high performance. Innovative lidar component technologies that directly address the measurements of the atmosphere and surface topography of the Earth, Mars, the Moon, and other planetary bodies will be considered under this subtopic. Innovative technologies that can expand current measurement capabilities to spaceborne or Unmanned Aerial Vehicle (UAV) platforms are particularly desirable. Development of components that can be used in planned missions such as Laser Interferometer Space Antenna (LISA) or Earth and planetary composition is highly encouraged. Research should be conducted to demonstrate technical feasibility during Phase 1 and show a path toward a Phase 2 prototype demonstration. For the PY07 SBIR, we are soliciting only the specific component technologies described below.

- Flight qualified, radiation hardened fiber optic components for high power fiber amplifier packages at 1064 nm. Pulse energies in the hundreds of microJoules, and even milliJoule-level, are needed.

- Fiber optic components specifically for use with Yb-doped photonic crystal fibers (PCF), to permit removal of any bulk optics or air gaps in fiber amplifier systems that use a PCF amplifier stage. The following specific components are needed: standard multimode or singlemode fiber to PCF connections, pump couplers for 915 nm or 980 nm, high power isolators at 1064 nm, 1064 nm filters, fiber combiners, and fiber splitters.

- Development of polarization maintaining Er and/or Yb doped optical fibers that are optimized for suppression of stimulated Brillouin scattering (SBS). Resulting fiber must be capable of single frequency (Gravitational wave detection in space uses laser interferometric techniques to measure picometer distance changes over megameter baselines. The application requires a space-qualifiable high reliability frequency-stabilized CW laser source with 1 W output power and a 5 year mission lifetime. A Master Oscillator Power Amplifier (MOPA) configuration is desirable because the source must be phase-modulated.

- Efficient and compact single frequency solid state or fiber lasers operating at 1.5 and 2.0 micron wavelength regimes suitable for coherent lidar applications. These lasers must meet the following general requirements: pulse energy 0.2 mJ to 100 mJ, repetition rate 10 Hz to 1 kHz, and pulse duration of approximately 200 nsec.
• Single frequency semiconductor or fiber laser generating 10s of mW of CW power in 1.5 or 2.0 micron wavelength regions with less than 100 kHz linewidth. Frequency modulation with about 5 GHz bandwidth and wavelength tuning over several nanometers are desirable.

• Interferometer technology to separately derive aerosol and molecular backscatter via High Spectral Resolution Lidar (HSRL) technique at 532 and 355 nm. Resolving power of the order of 1 GHz over an acceptance angle up to several milliradians is required. High quantum efficiency detectors, such as electron multiplying CCDs, suitable for spaceborne HSRL instruments are also needed. Detectors should be capable of rapid sampling rates greater than 1.5 MHz at 532 and 355 nm operating wavelengths.