NASA SBIR 2018 Phase I Solicitation

S1.01 Lidar Remote Sensing Technologies

Lead Center: LaRC

Participating Center(s): GSFC, JPL

Technology Area: TA8 Science Instruments, Observatories & Sensor Systems

NASA recognizes the potential of lidar technology in meeting many of its science objectives by providing new capabilities or offering enhancements over current measurements of atmospheric and topographic parameters from ground, airborne, and space-based platforms. To meet NASAs requirements for remote sensing from space, advances are needed in state-of-the-art lidar technology with an emphasis on compactness, efficiency, reliability, lifetime, and high performance. Innovative lidar subsystem and component technologies that directly address the measurement of atmospheric constituents and surface topography of the Earth, Mars, the Moon, and other planetary bodies will be considered under this subtopic. Compact, high-efficiency lidar instruments for deployment on unconventional platforms, such as balloon, small sat, and CubeSat are also considered and encouraged.

Proposals must show relevance to the development of lidar instruments that can be used for NASA science-focused measurements or to support current technology programs. Meeting science needs leads to four primary instrument types:

- *Backscatter* - Measures beam reflection from aerosols to retrieve the opacity of a gas.
- *Ranging* - Measures the return beams time-of-flight to retrieve distance.
- *Doppler* - Measures wavelength changes in the return beam to retrieve relative velocity.
- *Differential absorption* - Measures attenuation of two different return beams (one centered on a spectral line of interest) to retrieve concentration of a trace gas.

Phase I research should demonstrate technical feasibility and show a path toward a Phase II prototype unit. Phase II prototypes should be capable of laboratory demonstration and preferably suitable for operation in the field from a ground-based station, an aircraft platform, or any science platform amply defended by the proposer. For the 2018 SBIR Program, NASA is soliciting the component and subsystem technologies described below:

- Compact and rugged single-frequency continuous-wave and pulsed lasers operating between 290-nm and 2050-nm wavelengths suitable for lidar.Â Specific wavelengths are of interest to match absorption lines or atmospheric transmission: 290 to 320-nm (ozone absorption),Â 450 to 490-nm (ocean sensing),Â 532-nm, 817-nm (water line), 750 to 950-nm (aerosol sensing), 935-nm (water line), 1064-nm, 1570-nm (CO_2 line), 1650-nm (methane line), and 2050-nm (Doppler wind). Architectures involving new developments in diode laser, quantum cascade laser, and fiber laser technology are especially encouraged.Â Additionally, novel solid-state laser materials are sought for reaching infrared wavelengths of 2500-nm to 10,000-nm.Â For pulsed lasers two different regimes of repetition rate and pulse energies are desired: from 1-kHz to 10-kHz with pulse energy greater than 1-mJ and from 20-Hz to 100-Hz with pulse energy greater than 100-mJ.

- Optical amplifiers for increasing the energy of pulsed lasers in the wavelength range ofÂ 300-nm to 2050-nm. Also, amplifier and modulator combinations for converting continuous-wave lasers to a pulsed format are encouraged.Â Amplifier designs must preserve the wavelength stability and spectral purity of the input laser.
- Ultra-low noise photoreceiver modules, operating at 1600-nm or 2050-nm wavelength, consisting of the detection device, complete Dewar/cooling systems, and associated amplifiers.Â General requirements are: large single-element active detection diameter (>100 micron), high quantum efficiency (>85%), noise equivalent power of the order of 10^{-14} W/sqrt(Hz), and bandwidth greater than 10-MHz.
- Novel approaches and components for lidar receivers such as: new approaches for high-efficiency measurement ofÂ high spectral resolution lidar (HSRL)Â aerosol properties at 1064, 532 and/or 355 nm; compact and lightweight Cassegrain telescopes compatible with existing differential absorption lidar (DIAL) and HSRL lidar systems; frequency agile solar blocking filters at 817-nm and/or 935-nm, and scanners for large apertures of telescope of at least 10-cm diameter and scalable to 50-cm diameter.