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 NASA’s requirements, advances are needed in state-of-the-art lidar technology with emphasis on compactness, efficiency, reliability, lifetime, and high performance. Innovative lidar subsystem and component technologies systems 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.

Proposals relevant to the development of lidar instruments that can be used in planned missions or current technology programs are highly encouraged. Examples of planned missions and technology programs are: Laser Interferometer Space Antenna (LISA), Doppler Wind Lidar (3D-WINDS), Ozone Lidar, Lidar for Surface Topography (LIST), Mars atmospheric sensing, Mars and earth re-entry atmospheric entry and descent, Active Sensing of CO₂ Emissions over Nights, Days, and Seasons (ASCENDS), and Aerosols-Clouds-Ecosystems (ACE). In addition, innovative technologies relevant to the NASA sub-orbital programs, such as Unmanned Aircraft Systems (UAS) and Venture-class focusing on the studies of the Earth climate, carbon cycle, weather, and atmospheric composition, are being sought.

The proposals should target components and subsystems development for eventual space utilization. Phase I research should demonstrate the 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 or an aircraft platform. For the PY12 SBIR Program, we are soliciting the component and subsystem technologies described below.

Solid state, single frequency, pulsed, laser transmitter operating in the 1.0 µm - 1.7 µm range with wall-plug efficiency of greater than 25% suitable for CO₂ measurement, interferometry, and free-space laser communication applications. The laser transmitter must be capable of generating frequency transform-limited pulses with a quality beam M² of less than 1.5. We are interested in two different regimes of repetition rate and output energy: in one case, repetition rate from 5 kHz to 20 kHz with pulse energy from 1 - 4 mJ, and in the second case, repetition rate 20 Hz to 2 kHz with pulse energy from 30 - 300 mJ. In addition, development of non-traditional optical amplifier architectures that yield optical efficiency of >70% are of interest. Attention to the compact and rugged designs for possible aircraft flight tests is highly desirable.
Single-frequency solid-state crystal, planar waveguide or fiber amplifiers/lasers operating at 1.5 and 2.0 micron wavelength regimes suitable for direct detection differential absorption lidar (DIAL) and coherent lidar applications. These lasers must meet one of the two general requirements:

- Pulse energy 0.5 mJ to 2 mJ, repetition rate 2 kHz to 10 kHz, and pulse duration of 10 nsec for direct detection lidars.
- 5 mJ to 50 mJ, 20 Hz to 2 kHz, 200 nsec for coherent detection lidars.

2-micron single frequency laser system generating at least 30 mW of power with a precision frequency locking mechanism suitable for measurements of atmospheric CO$_2$. The laser must be locked to a CO$_2$ absorption line peak via a fiber gas cell with accuracy better than 200 kHz. The frequency locked laser shall be modulated to generate two preset offset frequencies from the center frequency alternatively, one at 3-4 GHz, and the other at 15-20GHz range. The frequency stability at these off-center frequencies shall be better than 500 KHz.

Pulsed, single frequency, solid state laser operating in the 450-500 nm range serving as a transmitter for an oceanography lidar. The laser must be able to produce bandwidth-limited pulses with 10 nsec or shorter duration. The proposed design must be scalable to at least 10 W of average power, preferably generating 100 mJ at 100-200 Hz, but will consider lower pulse energies with higher repetition rates. Pulse energies can be less than the above stated goals by a factor of 10 for the Phase II delivered unit.