NASA SBIR/STTR Technologies

S1.01-9084: 355nm Photon-Recycled Fringe Imager for HSRL

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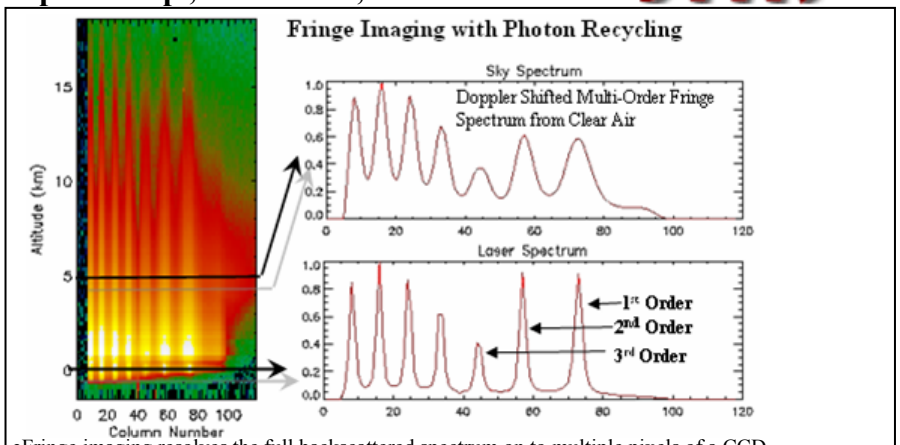
Identification and Significance of Innovation

The proposed work is to develop a high efficiency aircraft qualified Fabry-Perot based interferometer for the High Spectral Resolution LIDAR (HSRL). The HSRL instrument, being developed through the NASA Instrument Incubator Program (IIP), has a requirement for a 355nm interferometric receiver to spectrally resolve atmospheric backscatter. Through this Phase I effort Michigan Aerospace Corporation (MAC) will perform instrument simulations to optimize a photon-recycled fringe imaging receiver to meet the HSRL measurement requirements. Photon recycled, fringe imaging technology incorporates the use of high efficiency Charge Couple Devices (CCDs) to enable range gated measurements with high spectral resolution of the atmospheric backscatter from molecules and aerosols. The optimized 355nm receiver will be capable of spectrally separating the aerosol and molecular backscatter components in order to deduce the aerosol to total scattering ratio and aerosol extinction. End-to-end simulations will enable a thorough characterization of the measurement biases introduced from instrument instabilities and enable driving requirements to be formed for a phase II build. Also during Phase I, solid model receiver concepts and trade studies will be formed to enable a smooth transition in Phase II so that the HSRL receiver can be ready for flight in 2008.

Expected TRL Range at the end of Phase I Contract: 3-4



- Fringe imaging resolves the full backscattered spectrum on to multiple pixels of a CCD
- Fringe imaging method records laser spectrum for each laser pulse (located at 0 km), which facilitates the de-convolution of the backscatter spectrum into its molecular and aerosol components.
- Photon-Recycling increases throughput up to 5x; rightmost figure, 3rd- 7th order from recycling.
- In left figure altitude is along y-axis where x-axis contains spectral information across columns of CCD

Technical Objectives & Work Plan

The technical objectives for the phase I effort are as follows:

Objective 1: Requirements definition for the 355 nm fringe imaging interferometer for the HSRL.

Objective 2: End-to-end instrument model development for sensitivity analysis and system design trade studies

Objective 3: HSRL receiver hardware trade studies

Objective 4: Development of instrument concept designs for a Phase II demonstration

NASA Applications

This technology would benefit NASA by enabling the global measurement of atmospheric aerosol concentrations. Additionally, the proposed receiver technology can be used in small ground-based systems for aerosol and cloud observations. The ability of the proposed receiver to independently measure levels extinction and backscatter makes this technology a potential enhancement or replacement to the existing Miro-Pulse LIDAR Network.

Non-NASA Applications

The fringe imaging technology development proposed has potential civilian, military and homeland security applications which include pollution concentration detection and monitoring and could be developed as an early warning system for localized presence of aerosol pathogens.

Contact

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NON-PROPRIETARY DATA