All-Solid State Iron Resonance Lidar for Measurement of Temperature and Winds in the Upper Mesosphere and Lower Thermosphere

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The Arctic atmosphere and the subauroral region are a natural laboratory for understanding plasma-neutral and dynamical coupling in the atmosphere and geospace. During geomagnetically active periods the auroral electrojet and auroral precipitation are overhead at the High-Frequency Active Auroral Research Program (HAARP) facility in Gakona, Alaska (62°N, 145°W). This facilitates active experiments of the plasma using the Ionospheric Research Instrument (IRI) at HAARP. The scope of these active investigations will be significantly enhanced by the addition of high-resolution neutral temperature and wind measurements. Iron resonance lidar systems are uniquely suited for these measurements as naturally occurring iron layers extend from the upper mesosphere to the middle thermosphere (~70-150 km). A novel lidar system has been demonstrated at the German Aerospace Center using Nd:YAG lasers. The Nd:YAG laser operating at a minor line at 1116 nm and is tripled to the iron resonance line at 372 nm. This prototype resonance lidar system was fully solid-state with diode pumping, and did not require liquid dyes or flashlamps. We are developing a new lidar system based on that prototype system that can operate robustly at the remote location of HAARP. The laser system will employ a diode-pumped Nd:YAG laser with second and third harmonic generation. The laser will be injection seeded with a tunable diode laser allowing the laser to make frequency scans of the iron line. The laser pulse spectra will be recorded on a shot-to-shot basis using a etalon imaging system and a Rubidium -based spectral reference. The lidar system is intended to operate at 372 nm, with a pulse repetition rate of 100 pps, and a pulse energy of ~ 30 mJ. Coupled with a 1-m diameter telescope We present the system specifications and the expected performance of the system.