

The all-solid-state narrowband lidar developed by optical parametric oscillator/amplifier (OPO/OPA) technology for simultaneous detection of the Ca and Ca⁺ layers

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An all-solid-state narrowband lidar system for simultaneous detection of Ca and Ca⁺ layers has been established in Yanqing Station (40.41°N, 116.01°E). The uniqueness of this lidar lies in the transmitter based on the optical parametric oscillation and optical parametric amplification techniques.

The injection seeded optical parametric oscillator (OPO) and the optical parametric amplifier (OPA) are pumped by the second harmonic of a commercial injection-seeded Nd:YAG laser. It can generate the wavelength is 786 nm or 846 nm laser. Then through the frequency multiplier, the output of 393 nm or 423 nm. The detection laser pulse energies up to 30 mJ at these two wavelengths with a bandwidth smaller than 200 MHz, while the pulse energy of another laser system at 423nm research to 120 mJ. Results indicate that improve the detection capability of the system can produce higher quality signal and accurate measurements.

The detection results of the OPO lidar system are compared with those of the dye laser system at the same station, and the detection signal-to-noise ratio is much better than that of the dye laser lidar system. The improved height and temporal resolution allows us to see a more detailed structure of the time-varying height of the high-altitude calcium phenomenon.

The observations also showed a high-altitude Ca⁺ layer up to 300km. Potential applications and further improvements in this lidar technique are also discussed.