An Innovative Raster-Mirror Optical Detection System for CCD Camera Bistatic Lidar

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An innovative ground-based bistatic lidar to measure aerosol scattering in the atmospheric boundary layer was developed and tested for a proof of concept. This innovative optical system offers several magnitudes higher étendue and spatial resolution than existing systems thus allowing the use of lower-power, eye-safe lasers. The proposed design is based on dividing the wide 100º vertical field of view into several sectors, using 1-D rastering of mirrors and parallel imaging of the laser scattered light from each sector onto one change-coupled device (CCD) while employing a single narrow angle of view objective (Figure 1). The system is applicable to the simultaneous measurements of several laser beams to obtain spectral, spatial, and temporal information about the atmosphere. Using an off-axis parabolic mirror objective eliminates chromatic aberrations making the system employable in a broad spectral range from IR to UV. The advantages of the proposed technology are: the ability to control the dynamic range of the registered signal, the superior height resolution of 18 mm/pixel at the ground level, and 175m/pixel at 20 km altitude, low cost, and simplicity. The bistatic CLidar will consist of the prototype system with automatic system feedback and self-calibration. The system will be developed to accommodate daytime operational conditions.

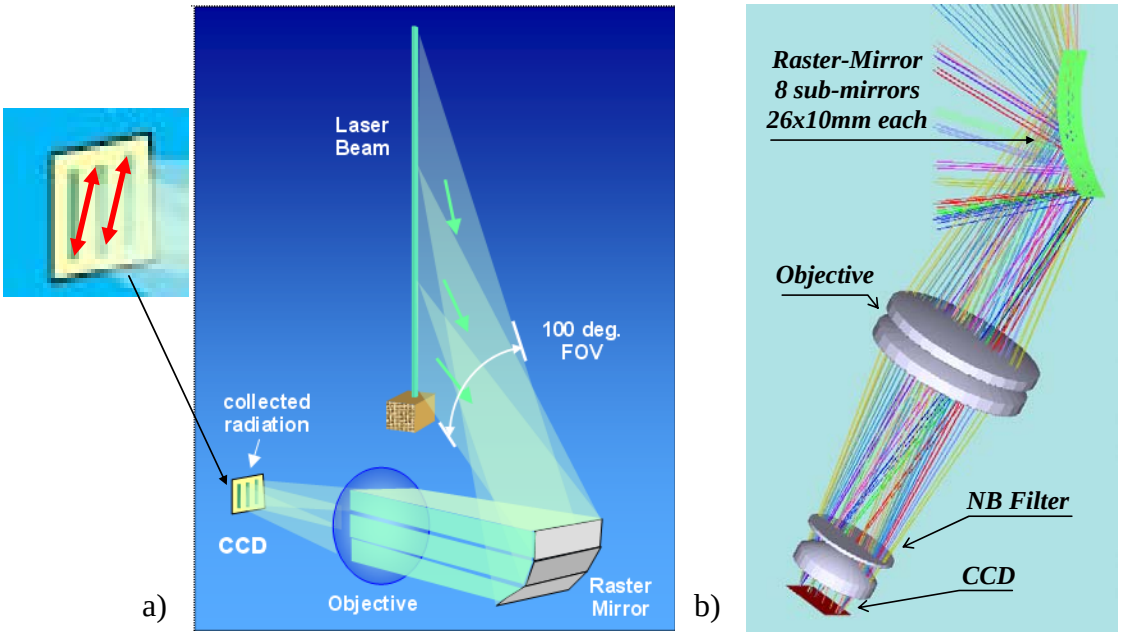

Figure 1. (a) The proposed design is based on dividing the vertical field of view into N sectors and rastering the 1-D flat mirrors (on the left). Overlap of adjacent segments allows a continuous altitude profile to be measured. (b) Zemax 3-D model of CLidar (on the right).