

Characterization of Aerosol Optical Properties Using Polar Nephelometry

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A simple, low-cost polar nephelometer is proposed for construction and testing for ground-based measurements of boundary layer aerosol scattering. The purpose is to (1) measure the angular distribution of light scattered by ambient aerosols and (2) from that distribution, calculate integral properties needed for studies of the climate forcing by particles: the backscatter/extinction ratio and the asymmetry parameter. Refined versions of the instrument will be used in conjunction with the high-resolution boundary layer measurements of the CMDL CCD camera Lidar (CLidar) to better characterize the vertical distribution of aerosols above the instrument.

The schematic diagram of the polar nephelometer is shown in the Figure 1. The instrument will employ a 1 W Nd:YAG laser source, the output of which traverses the perimeter of a rectangular sample chamber guided by two mirrors, one at each corner of the wall opposite the entrance aperture of the laser beam. A panoramic mirror positioned in the center of the sample chamber reflects light vertically that has been scattered by molecules and aerosols in the path of the beam. The reflected light then passes through a polarization filter and imaging lens to be focused onto a CCD camera positioned above the panoramic mirror looking down. The 532 nm and 1064 nm operational wavelengths of the Nd:YAG laser can be used to calculate the Ångström exponent. The nephelometer will measure aerosol phase functions with parallel and perpendicular laser polarizations, as well as the depolarization ratio of scattered light. A built-in heater matches the temperature of the chamber walls to that of the incoming air sample to minimize condensation on the walls because of humid aerosols. Relative humidity control will be incorporated into the instrument to characterize the functional dependence of scattering. A particle filter will be introduced on the sample inlet for clean air measurements of molecular scattering.

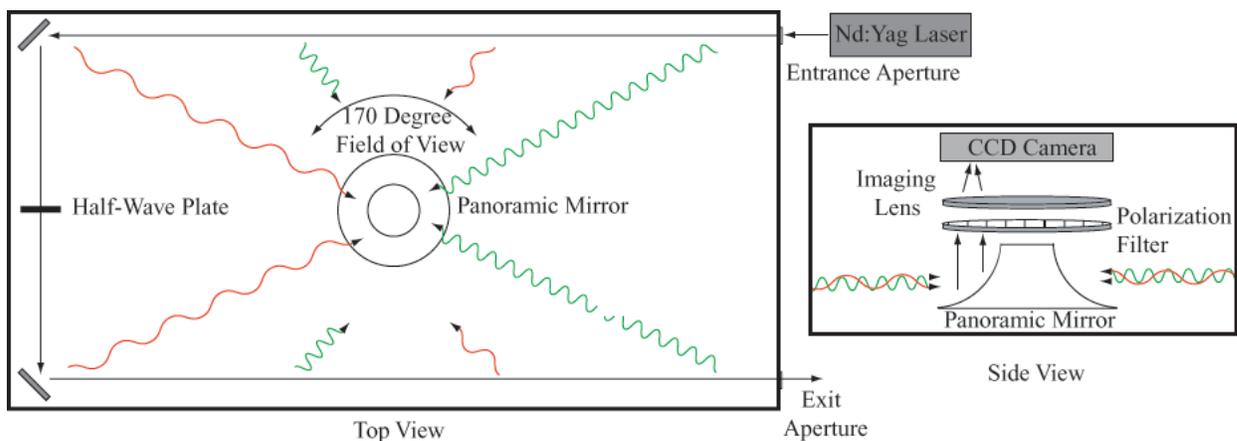


Figure 1. Polar nephelometer diagram (top and side view).