High Spectral Resolution Lidar Based On Optical Coherence Technology

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Abstract: As one of the most complicated and important atmospheric constituents, aerosol particles interact with solar radiation through absorption and scattering. The precision in observing the aerosol optical properties needs to be improved urgly. The atmospheric wind field directly affects the transport process of aerosol. Hence the synchronous observation of atmospheric aerosol and wind field is particularly crutial. In this paper, a high spectral resolution lidar based on the principle of optical coherence is developed to measure the atmospheric wind field and aerosol optical properties simultaneously. The detection of atmospheric wind profile was completed by using the principle of pulse coherent Doppler. A frequency discriminator is deployed to separate the aerosol and the Rayleigh Brillouin backscattering spectrum and to complete the high-spectral measurement of aerosol optical properties. A high-speed processor, a broadband signal detecting and processing module, and a algorithm processor constitute the frequency discriminator (FD) of Coherent High Spectral Resolution Lidar (CHSRL). Window function and filtering algorithm are used in the FD to reduce the signal crosstalk of the Mie channel and the Rayleigh Brillouin channel. The crosstalk suppression of the FD can reach more than 36 dB. Different noise sources in the FD are analyzed and corrected. The influence of different noise sources on Rayleigh Brillouin spectrum signal is analyzed. Aiming at evaluating the effects of different noise on Rayleigh Brillouin spectral line type, a spectral line type correction algorithm is proposed and the verification experiments are carried out with the intermediate frequencies of 40 MHz and 120 MHz. The results agree well with that modelled with the Tenti S6. The field observation for comparison was conducted near Ocean University of China (120.51°N, 36.15°E) with the co-located instruments include CHSRL, Raman lidar and coherent Doppler wind lidar. It is porved that the CHSRL is of great potiential in observing wind and aerosol optical properties.