

激光雷达专辑

基于光纤F-P滤波器的全光纤水汽拉曼激光雷达系统的设计与分析

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摘要:

提出并设计了一套基于光纤F-P滤波器的可见波长域全光纤水汽拉曼激光雷达系统, 实现对大气水汽和气溶胶的精细探测。讨论了光纤F-P腔内损耗和腔镜反射率对F-P透射谱的细度、峰值透过率以及带宽的影响, 得到腔内损耗在小于3%的情况下, 光纤F-P滤波器具有较高的峰值透过率(>0.5)和较窄的谱线带宽(<0.9nm)。通过结合光纤带通滤波器和二级级联光纤F-P滤波器的参数设计, 在三个独立的光通道中分别实现水汽拉曼信号(660nm)、氮气拉曼信号(606nm)和米瑞利信号(532nm)的窄带宽、高透过率严格滤波, 并获得对杂散光的高抑制率。通过系统仿真, 对各散射信号强度分布、水汽廓线和探测信噪比进行了数值仿真计算, 验证了系统方案的可行性。

关键词: 遥感 水汽 拉曼激光雷达 光纤F-P滤波器

Analysis of an all-fiber Raman lidar system for water vapor by fiber Fabry-Perot filters

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Abstract:

An all-fiber Raman water vapor lidar system is proposed and designed based on fiber Fabry-Perot (F-P) filters in the visible wavelength domain, to achieve the fine-detection of the atmospheric water vapor and aerosols properties. The influences of cavity loss and the reflectance on the fitness, the transmission peak and the bandwidth of fiber F-P filters are analyzed that the fiber F-P filter features a higher transmission peak and narrower bandwidth under the condition of the F-P cavity loss less than 3%. The combination of fiber band-pass filters and the two-cascade fiber F-P filters is used as fiber spectroscopic system and the corresponding parameters are designed to achieve narrow-band high-peak transmission of the Raman signals of water vapor (660nm) and nitrogen (606nm) and Mie-Rayleigh signals (532nm), respectively, and obtain high rejection-rate of stray lights. The numerical simulations of the intensity distribution of returned signals, the water vapor vertical profile and the detection signal to noise ratio (SNR) are obtained respectively, to verify the feasibility of the system.

Keywords: remote sensing water vapor Raman lidar fiber F-P filter

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