

Design and development of an all-solid-state lidar system for water vapor profiling

DENG Qian ⁽¹⁾, LIU Dong ^(*1,2), WU Decheng ⁽¹⁾, WANG Yingjian ⁽¹⁾

⁽¹⁾ *Key Lab of Atmospheric Optics, Anhui Institute of Optics and Fine Mechanics, Hefei Institutes of Physical Science, Chinese Academy of Sciences, Hefei 230031, China, E-mail: dengq@aiofm.ac.cn*

⁽²⁾ *University of Science and Technology of China, Hefei 230026, China, E-mail: dliu@aiofm.cas.cn*

Water vapor is the most important greenhouse gas in the Earth's atmosphere, and plays a very important role in the global water cycle, weather system, atmospheric chemistry and other processes. The content of water vapor in atmosphere is very little and the volume ratio of the moisture to air is about 0.1% ~ 3%, but water vapor is the most active molecule in atmosphere. The water vapor Raman lidar is an important tool for measuring the vertical distribution of water vapor. The traditional lidar has a complicated structure and a large volume and power consumption. A high-precision water vapor real-time detection lidar system based on an solid-state laser with output laser wavelength of 532.1nm is proposed and designed. The solid-state water vapor lidar system has lower cost and longer life and also better stability and environmental adaptability. Firstly, based on the characteristics of laser power and backscattered signals, an integrated dual optical axis system structure with separate transmission and reception is designed. Then, the laser beam expanding collimation transmitting system and telescope receiving system are designed and simulated by Zemax software. The simulation results are consistent with the design well, which proves the feasibility of the design system. Finally, the mechanical structure of the transmitting system and the receiving system is developed, which avoids light interference between the transmitting and receiving systems, reduces the complexity of the optical system, and enables horizontal and vertical detection.