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Atmospheric laser spectroscopy for remote sensing of chemical distribution in the environment

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Abstract: Spectroscopy is an established methodology for identification of chemicals.This method uses absorption or scattering characteristics of species. Atmospheric laser spectroscopy utilizes the method of remote sensing to identify chemicals in the surrounding air. This spectroscopy technique locates chemical in the atmosphere, as well as provides temporal information of distribution/location of chemical. Raman scattering exploited through this spectroscopy technique, results into Raman Lidar. This works as optical radar that uses spectroscopy technique for measurement of chemicals in the atmosphere and quantifies the spatial distribution of individual atmospheric molecular trace constituents. This paper presents Laser radiation technique used for chemical sensing based on Raman scattering that uses wavelength-dependent interaction between electromagnetic radiation and matter. The report incorporates the calculation of backscattering cross-section of atmospheric gas molecules for different excitation wavelengths such as 308,355,514, and 532 nm. This paper also presents the result and comparison of the Raman cross sections of various molecules present in the atmosphere such as N_2,O_2, CO, CO_2, SO_2, CH_4, NO, H_2O, N_2O and NH_3relative to that of N_2. In above mentioned gases water vapour is one of the most important components as well as one of the most difficult to quantify due to its high variability on short time and space scales.Therefore, a high interest in obtaining water vapor profiles is manifested in the meteorological and remote sensing scientific world all around the globe. We will conclude with different analysis of profile measurements of atmospheric water vapour using the Raman Spectroscopic Lidar.

Keywords: Spectroscopy, Raman Lidar, chemical sensing, backscattering cross-section, Raman scattering cross-sections, Laser radiation technique.

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