Laboratory Investigations of C_2H_4 by Infrared Heterodyne Spectroscopy

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Heterodyne Spectroscopy can make a significant contribution to remote studies of planetary atmospheres and other gaseous astronomical objects. Infrared heterodyne investigations of planetary atmospheres permits the determination of their composition, distribution of pressure and temperature with altitude, and investigation of local physics and chemistry[1]. But this method is especially important for investigations of atmosphere dynamics. It has a high spectral resolution ($\lambda/\Delta\lambda \approx 10^7$), which makes it possible to remotely determine the direction and speed of winds with an accuracy 2 m/s [2]. However, in order to retrieve atmospheric parameters from atmospheric line measurements, it is important to know the molecular parameters of the lines being measured. Ethylene is an important hydrocarbon present in atmospheres of Jupiter, Saturn, and Titan (*e.g.*, 3). It is a product of methane chemistry in the stratospheres of these planets and has a complicated spectrum in middle IR region. This makes it a very interesting and usable probe of physical-dynamical properties of these atmospheres. In this report we present initial results of laboratory investigations of absorption lines of ethylene (C_2H_4) in the ν_7 band near 10.5 μm. The measurements were made using a laboratory infrared heterodyne spectrometer with the ethylene gas at temperatures 293–297K and pressures 0.05–0.5 Torr.

Positions of more then 150 lines were measured relative to lines in the P and R branches of the $^{12}C^{16}O_2$ laser. Absolute frequencies of the stronger lines were determined to $\pm 5 \times 10^{-5}$ cm^{-1}. Their intensities were determined to $\approx 10\%$. Comparison of our results with other experimental and theoretical results (J. Hillman *et al.*, this meeting) will be discussed. A number of unknown absorption lines were discovered. The possible source of these lines will be discussed, including foreign gas admixture (although 99.99% ethylene was used), isotopic $^{13}C^{12}CH_4$ or weak $^{12}C_2H_4$ lines

References:

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