CONTINUUM MEASUREMENTS IN GASES OF NONPOLAR MOLECULES AND THEIR MIXTURES IN THE MILLIMETER WAVE RANGE

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This work presents CO_2-CO_2, CO_2-Ar, CH_4-CH_4, CH_4-CO_2, CH_4-N_2, CO_2-N_2, and N_2-Ar continuum measurements at pressures up to 2 atmospheres at room temperature in a frequency range of 155-255 GHz with expected extension down to about 80 GHz and up to 350 GHz. It continues the cycle of our recent studies of atmospheric nonpolar molecules spectra, which began with N_2 [1] and CO_2 [2] continuum measurements using a resonator spectrometer [3]. The obtained data are valuable for studying the atmospheres of Solar system planets, exoplanets and their satellites, where the continuum absorption can make a considerable contribution to the total absorption and planetary radiation balance.

In considered frequency range, the absorption of all the studied gases is determined by bimolecular absorption under chosen conditions. The only exception is methane with a rotationally induced resonance spectrum of CH_4 monomer that contributes up to 40% to the total observed absorption. The expected bimolecular pressure dependences are experimentally verified and confirmed for all mixtures under consideration. Quadratic frequency dependence of the continuum is observed, except for CO_2-Ar, CH_4-CO_2 and CO_2-N_2 mixtures. This deviation from the quadratic law, which is stipulated in our spectral range by the so-called radiation term, may indicate a significant contribution of dimers to the continuum.

The obtained spectra are expected to be used for validating results of ongoing bimolecular absorption calculations using a semiclassical trajectory-based method [4, 5] which looks promising for detailed understanding of the continuum absorption nature on a much broader scale in terms of frequency, temperature and type of colliding molecules.

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