Continuum absorption of CO_2 in the millimeter wavelength range

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Carbon dioxide absorption spectrum in the millimeter wavelength range is determined only by continuum absorption, since CO_2 molecule does not have a permanent dipole moment, and therefore, a purely rotational spectrum. This makes the experimental study of the CO_2 absorption of this range promising for the understanding of the nature of the continuum on a much broader scale. Experimental data on the CO_2 continuum in this range are scarce and are based on the measurements at single frequency points having a large uncertainty in amplitude [1,2].

The spectra of pure CO_2 and its mixture with Ar were recorded using a resonator spectrometer [3] in the frequency region of 105–240 GHz for several pressures ranging from 375 to 1490 Torr and temperatures within the range of 268–317 K.

The obtained data are supported [4] by calculations of the collision-induced absorption using a semi classical trajectory-based method. Underestimation of the observed CO_2-CO_2 and CO_2-Ar continuum by about 20% and 10% respectively is probably related to the use of the rigid monomer approximation in the calculations. The observed frequency and temperature dependences are reproduced by the results of calculations and confirm the significant contribution of dimers to the continuum absorption.

The parametrization of the frequency and temperature dependences of CO_2-CO_2 and CO_2-Ar continuum spectral function will allow to construct a physically based continuum model necessary to describe the radiative properties of the atmospheres of the Solar system planets (Mars, Venus, Earth's paleoclimate) and many exoplanets whose atmospheres composed mainly of CO_2, where continuum absorption has a significant effect.

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References

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