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Collisional Induced Absorption (CIA) bands measured in the IR spectral range

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Abstract.

In this work we present two experimental setup able to characterize the optical properties of gases, in particular CO_2 and H_2, at typically planetary conditions. The apparatus consists of a Fourier Transform InfraRed (FT-IT) interferometer able to work in a wide spectral range, from 350 to 25000 cm^{-1} (0.4 to 29 μm) with a relatively high spectral resolution, from 10 to 0.07 cm^{-1}. Two dedicated gas cells have been integrated with the FT-IR. The first, called High Pressure High Temperature (HP-HT), can support pressures up to 300 bar, temperatures up to 300^{o}C and is characterized by an optical path of 2 cm. The second one, a Multi Pass (MP) absorption gas cell, is designed to have a variable optical path, from 2.5 to 30 m, can be heated up to 200^o and operate at pressures up to 10 bar. In this paper, measurements of Collision-Induced Absorption (CIA) bands in carbon dioxide and hydrogen recorded in the InfraRed spectral range will be presented. In principle, linear symmetric molecules such as CO_2 and H_2 possess no dipole moment, but, even when the pressure is only a few bar, we have observed the Collisional Induced Absorption (CIA) bands. This absorption results from a short-time collisional interaction between molecules. The band integrated intensity shows a quadratic dependence versus density opposed to the absorption by isolated molecules, which follows Beer's law (Frommhold 1993). This behaviour suggests an absorption by pairs rather than by individual molecules. The bands integrated intensities show a linear dependence vs square density according to (Baranov and Vigasin 1999) and (Vigasin 1996). For what concerns the H_2 CIA bands, a preliminary comparison between simulated data obtained with the model described in (Borysow et al. 1985)and measured, shows a good agreement. These processes are very relevant in the dense atmospheres of planets, such as those of Venus and Jupiter and also in extrasolar planets. A detailed knowledge of these contributions is very important to include this effect in the radiative transfer calculations.

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