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Characterization of the CO_2 optical properties at typically planetary condition: measures and model

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In this work we describe an experimental setup able to characterize the optical
properties of gases at typically planetary conditions, in particular CO_2, the main constituent of the venusian atmosphere, at high pressure and high temperature.
We prefixed two scientific objectives: to measure CO_2 absorption coefficients in order to expand the available spectroscopic databases to better match the broadening and line mixing effect; to update the commonly used tools of radiative transfer calculation in order to improve the accuracy of remote sensing data analysis. Our experimental setup consist 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. A special customized gas cell, designed to support pressure up to 350 bar and temperature up to 300 [U+25E6] C has been integrated inside the interferometer. To recreate the same conditions found in the deep atmosphere of Venus, we varied the pressure and temperature according to a vertical profile measured by the Venera probes. The CO_2 absorption coefficients recorded with a resolution of 2 cm-1 and obtained varying the P and T from1 to 50 bar and 294 to 600K, give us chemical and physical information from an altitude of 50 Km down to 16 km. The measurements have been compared with synthetic spectra obtained using at tools, named Line Mixing Model (LMM), which take into account the line mixing effect. The comparison between measured and simulated leads us to conclude that The LMM reproduces the data with an integral deviation better than 6% on the full range presently explored of the venusian deep atmosphere. Contrary to the widely used Lorentz shape, the LMM leads to have a good agreement with the experimental data in the central and near wing regions of the vibrational bands. Models that do not take into account the line mixing and far wings effects have shown to be inadequate to reproduce satisfactory the carbon dioxide absorption in the deep Venusian atmosphere below the clouds.