

Titre du projet :

Continua d'absorption de CO₂ dans le proche infrarouge en support à l'analyse des spectres de Vénus.

Volet : Recherche

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Bilan du projet

The very weak absorption continuum of CO₂ has been studied by Cavity Ring Down Spectroscopy using three DFB lasers diodes which give access to three 20 cm⁻¹ wide spectral intervals near the centre of the 1.74 μm window (5693 - 5795 cm⁻¹). For each spectral interval, a set of room temperature spectra is recorded at pressures between 0 and 10 bar thanks to a high pressure CRDS spectrometer (Fig. 1).

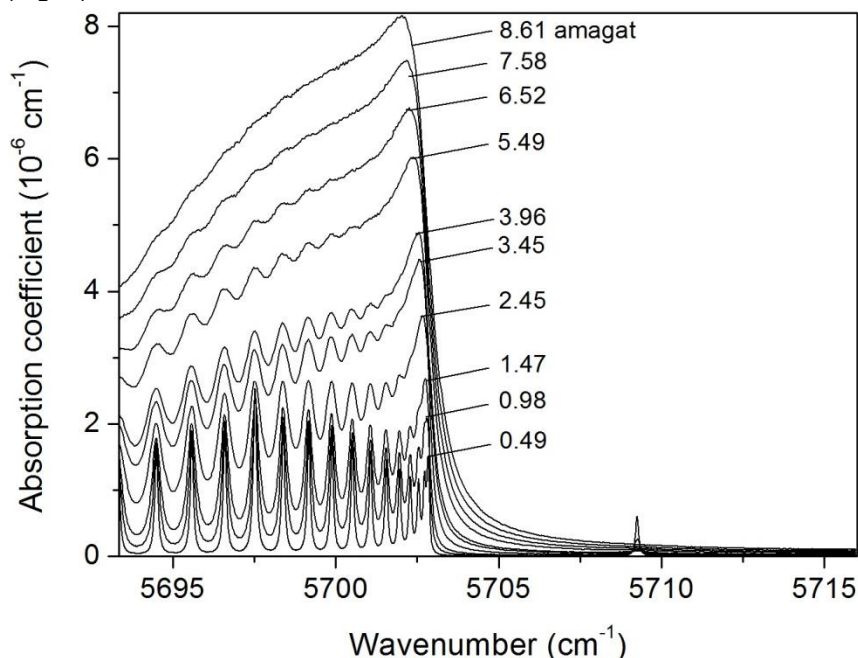


Figure 1. Overview of the series of pure CO₂ spectra recorded at different densities in the region of R branch of the 00031-10002 band.

The absorption continuum was retrieved after subtraction of the contributions due to Rayleigh scattering and to local lines of CO₂ and water (present as an impurity in the sample) from the measured extinction (Fig. 2). Due to some deficiencies of the CO₂ HITRAN2012 line list, a composite line list had to be built on the basis of the Ames calculated line list with line positions adjusted

according to the Carbon Dioxide Spectroscopic Databank and self-broadening and pressure shift coefficients calculated with the Complex Robert Bonamy method. The local line contribution of the CO₂ monomer is calculated using this list and a Voigt profile truncated at ± 25 cm⁻¹ of the line centre. Line mixing effects were taken into account through the use of the impact and Energy Corrected Sudden approximations.

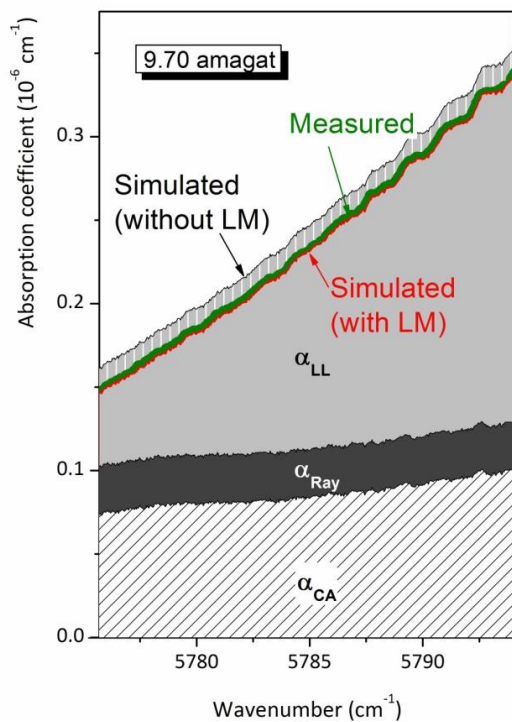


Figure 2. The different contributions to the CO₂ extinction near 5785 cm⁻¹ recorded with a density of 9.70 amagat. The simulated spectrum with LM (red line) matches very well the measured extinction (green circles). Note the negative contribution of the LM.

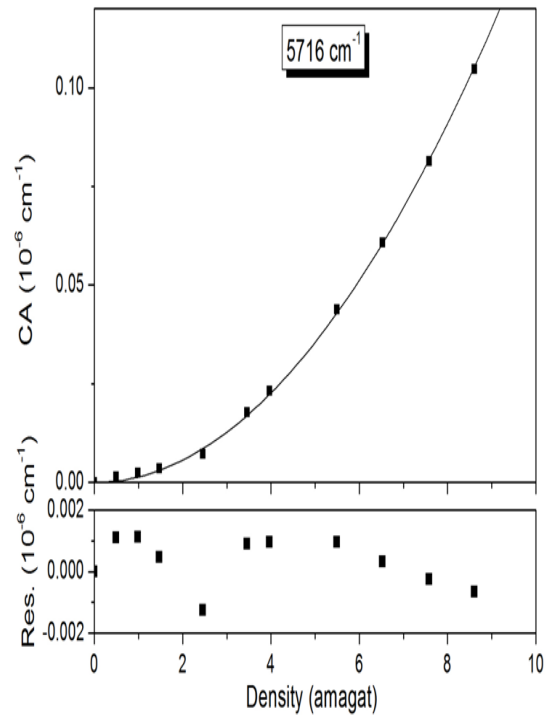


Figure 3. Density dependence of the continuum absorption at 5716 and 5730 cm⁻¹ (upper panels) and corresponding residuals (lower panel) after subtraction of the fitted quadratic polynomial. At 5716 cm⁻¹, the fit uses a purely quadratic function while a linear term (blue line) is included in the fit at 5730 cm⁻¹

The density dependence of the retrieved continuum absorption was found to be purely quadratic in the low frequency interval below 5710 cm⁻¹ (**Fig. 3**) but a small significant linear contribution was required to reproduce the observations above this value. This linear increase is tentatively attributed to the foreign-continuum of water vapor present in CO₂ with a relative concentration of some tens ppm.

The retrieved binary coefficient is observed to vary smoothly with the wavenumber with a minimum value of 6×10^{-10} cm⁻¹amagat⁻². By gathering the present data with the results reported in *Kassi et al J Quant Spectrosc Radiat Transf 2015;167:97*, a recommended set of binary coefficients is provided for the 5700—5950 cm⁻¹ region.

Illustrations - avec légende et crédit (à envoyer également séparément)

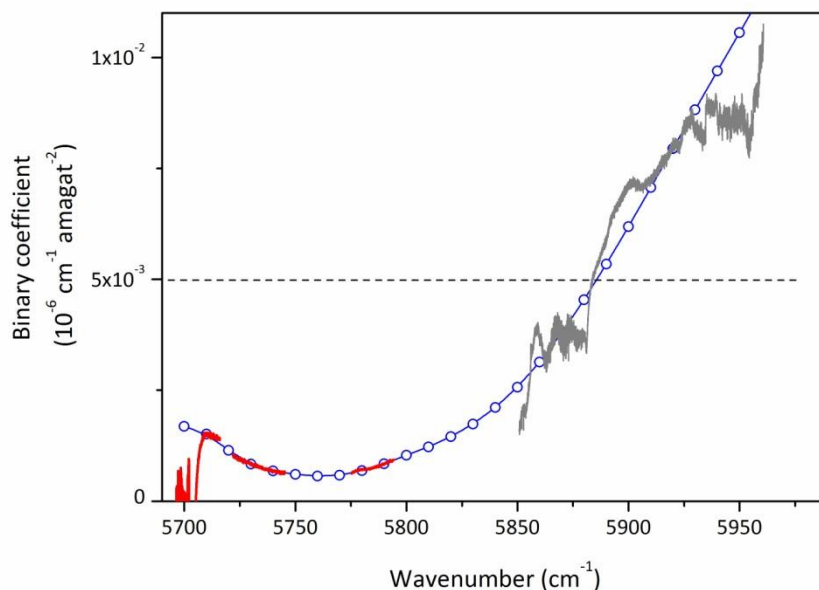


Figure 4. Overview of the binary coefficient retrieved at room temperature from CRDS spectra recorded in this work (red line) and reported in [in Kassi et al J Quant Spectrosc Radiat Transf 2015;167:97 (grey line)]. The blue open circles represent the approximate function recommended for the CO₂ binary coefficient in the region. The dashed line corresponds to the constant value used to obtain the best fit of the Venus spectra for the 1.74 μm -window.

Production scientifique (articles scientifiques, actes de congrès...)

D. Mondelain, A. Campargue, P. Čermák, R.R. Gamache, S. Kassi, S.A. Tashkun, H. Tran
The CO₂ absorption continuum by high pressure CRDS in the 1.74 μm window
 J. Quant. Spectrosc. Radiat. Transfer submitted 24 Janvier

Bilan financier succinct (avec suivant les cas : co-financements éventuels, équipements achetés, missions, recrutements divers, fonctionnements divers...)

Nous avons demandé 13425 € pour l'achat de 5 diodes lasers DFB à 1735, 1740, 1745, 1750 1755 nm.

La somme de 6000 € qui nous a été attribuée a contribué à l'achat de 3 diodes à 1728, 1744 et 1755 nm (d'un montant global de 9879 €) qui sont celles utilisées dans les résultats ci-dessus.