Line intensity measurements and electric dipole moment fit of the ν_2/ν_4 dyad of CH_4 through high resolution and high temperature infrared emission spectra

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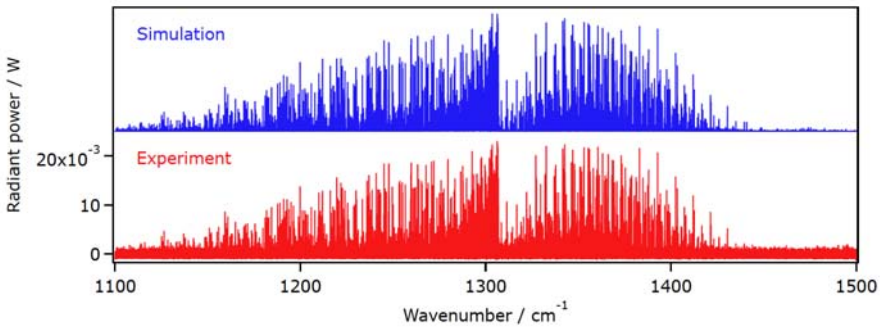
Much interest is currently being devoted to the study of specific astronomical objects, such as brown dwarfs and giant exoplanets. Despite the difficulty to fully exploit the numerous spectroscopic data recorded, the presence of hot methane in the atmosphere of these bodies is well known. However, obtaining reference spectroscopic information for molecules at the high temperatures characterizing these astronomical objects is difficult [1,2]. We used an original experimental setup to record hot methane spectra at thermodynamic equilibrium and analysed them to bring new experimental information to improve the theoretical modelling of methane spectroscopy. Five emission spectra of CH_4 have thus been recorded between 702 K and 1401 K in the dyad spectral region located around 1300 cm^{-1}. The experimental setup was based on the High Enthalpy Source prototype [3] developed at the "Institut de Physique de Rennes", in which methane was forced to migrate from the outside to the hollow centre of a cylindrical, resistively-heated porous graphite rod. The emission of the resulting hot methane was recorded with the Bruker IFS125 HR Fourier transform spectrometer available at the SOLEIL Synchrotron facility. Using computer programs developed in Brussels, the graphite black body emission baseline was removed from the experimental spectra and the latter were least-squares fitted to a specifically-developed radiative transfer model to measure line intensities in the ν_2/ν_4 dyad. This new experimental information was then used to obtain refined parameters of the dyad electric dipole moment of CH_4 within the XTDS software developed in Dijon.



Overview of the ν_2/ν_4 dyad experimental and simulated emission spectra at 1173 K.

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[2] S. Depraz, M.Y. Perrin, A. Soufiani, *JQSRT* **2012**, 113, 1 & 14;
[3] J. Thiévin, R. Georges, S. Carles, A. Benidar, B. Rowe, J.-P. Champion, *JQSRT* **2008**, *109*, 2027.