Simulation of hot methane spectra

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Methane is known to play a crucial role for the structure and spectrum of the coolest stars – T-type dwarfs and carbon-type dwarfs – as well as in hot-Jupiter exoplanets, brown dwarfs, and the proto-solar nebula.

Laboratory data represent well the room temperature monochromatic absorption coefficient of methane, while even the most extensive laboratory data only account for less than 1% of the complete methane absorption coefficient at 3000 K.

We present here the first line-by-line computation of the absorption coefficient of methane aimed at describing the high temperature opacities of the gas-phase. Our preliminary data include 5 million lines with an accuracy in the line position of 1 cm^{-1} for all vibrations and rotational values up to J=65, and with an accuracy of approximately 10% in the intensity. The preliminary data have a fair degree of completeness for temperatures up to 2500 K, but cover for the moment only the limited spectral region from 800 to 4000 cm^{-1}.