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Temperature dependence of the absorption spectrum of methane by high sensitivity laser spectroscopy between 1.27 and 1.71 micron at 80 K and 300 K. Importance of the CH3D contribution in the 1.58 micron transparency window.

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The high resolution absorption spectrum of methane has been recorded between 1.27 and 1.71 μmby high sensitivity laser absorption spectroscopy at room temperature and at 80 K. By combining the CW-Cavity Ring Down Spectroscopy technique with a specifically designed cryogenic cell, a noise equivalent absorption of α_{min} $\sim 3\times10^{-10}$ cm^{-1} was achieved allowing for a the first detailed characterization of the 1.58 μm transparency window at 80 K. A list of transitions with intensity as weak as 1×10^{-29}cm/molecule was constructed from the recordings at 296 and 80 K. The low energy values of the transitions observed both at 80 K and at room temperature were derived from the variation of their line intensities. The quality of the obtained empirical low energy values is demonstrated by the marked propensity of the empirical low J values of CH_4 to be close to integers. The line lists associated to the low energy values allow accounting for the temperature dependence of methane absorption between these two temperatures. A comparison with a spectrum of CH_3D recorded separately by Fourier Transform Spectroscopy shows that the CH_3D isotopologue in natural abundance contributes significantly to the absorbance in the1.58 μm transparency window.