EMPIRICAL LOWER STATE ENERGIES OF $^{13}CH_4$ AT 1.66 μm USING 296 K AND 81 K SPECTRA

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The high resolution absorption spectra of $^{13}CH_4$ were recorded at 81 K by differential absorption spectroscopy using a cryogenic cell and a series of Distributed Feed Back (DFB) diode lasers at room temperature by Fourier transform spectroscopy (a Bruker IFS-125HR at JPL). Empirical line lists were constructed containing, respectively, 1629 $^{13}CH_4$ transitions detected at 81 K (5852 - 6124 cm^{-1}) and 3481 features measured at room temperature (5850 - 6150 cm^{-1}); the minimum observed intensities were, respectively, 3×10^{-26} and 4×10^{-25} cm/molecule at 81 K and 296 K. From the variation of the cold and room temperaure line intensities, empirical lower state energies were derived for 1196 $^{13}CH_4$ transitions. Over 400 additional weak features, detected at 81 K, could not be matched to lines observed at room temperature. The observed intensities represent 99.2% and 84.6% of the total absorbance at 81 K and 296 K, respectively. The quality of the resulting empirical low energy values is demonstrated by the excellent agreement with the already-assigned transitions and the clear propensity of the empirical low J values to be close to integers.[a]

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