GLOBAL FREQUENCY AND INFRARED INTENSITY ANALYSIS OF $^{12}$CH$_4$ LINES IN THE 900–4800 CM$^{-1}$ REGION

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A new global analysis of methane lines in the 900–4800 cm$^{-1}$ region has been performed thanks to new experimental data for both line positions and intensities. This implies three of the $^{12}$CH$_4$ polyads, namely the dyad (940–1850 cm$^{-1}$, 2 vibrational levels, 2 sublevels), the pentad (2150–3350 cm$^{-1}$, 5 vibrational levels, 9 sublevels) and the octad (3550–4800 cm$^{-1}$, 8 vibrational levels, 24 sublevels) and some of the associated hot bands. New FTIR spectra of the pentad and octad regions have been recorded with a very high resolution (better than 0.001 cm$^{-1}$ instrumental bandwidth, unapodized) at 78 K using the Bruker IFS 125 HR Zürich prototype spectrometer$^a$. New intensity measurements were performed in the whole region at the Kitt Peak National Observatory. We also used previously recorded high-resolution Raman spectra$^b$. The effective Hamiltonian was expanded up to order 6 for the ground state, 6 for the dyad, 5 for the pentad and 5 for the octad. We obtain global root mean square deviations $d_{RMS}$ for line positions $= 1.4 \times 10^{-4}$ cm$^{-1}$ for the dyad, $6.0 \times 10^{-4}$ cm$^{-1}$ for the pentad and $3.3 \times 10^{-3}$ cm$^{-1}$ for the octad. This analysis represents a large improvement over the previous one$^c$ with $d_{RMS} = 0.041$ cm$^{-1}$ for the octad system.