Investigation in the Overtone Icosad of $^{13}CH_4$ Using Jet-CRD Spectroscopy

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Methane is a most important molecular species in many areas, including applications in atmospheric chemistry, combustion science and planetary and space science. While the main isotopomer $^{12}CH_4$ has been subject to substantial spectroscopic efforts including recent analysis up to the octad [1] (up to 4700 cm^{-1}) and partial analysis up to the tetradecad ranges [2] (up to 6250 cm^{-1}), much less is known about the spectra of the second most important isotopomer $^{13}CH_4$ with about 1% natural abundance (see [3]).

We have investigated the $\nu_2+2\nu_3$ combination band of methane $^{13}CH_4$ centered at 7493.15918 cm^{-1} within the icosad of the overtone absorption. The jet-CRD setup combining supersonic jet expansions and cavity ring-down spectroscopy which was already used for the reinvestigation of the same spectral region for the main isotope of methane $^{12}CH_4$ [4] has been used to record spectra of the Q and R branches at room temperature as well as at very low temperatures (down to 4 K). Based on our previous temperature-dependent investigations, we provide a careful analysis and an assignment for lines involving angular momentum quantum numbers up to $J=4$. The analysis of relative intensities in spectra taken at various rotational and effective translational temperatures indicates conservation of nuclear spin symmetry upon supersonic jet expansion, similar to the results for the main isotopomer [4].

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