THE FIRST TORSIONALLY EXCITED STATE OF METHYLAMINE: ROTATIONAL SPECTRUM AND INTERSTELLAR DETECTION

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Methylamine (CH_3NH_2) exhibits two large amplitude motions, methyl torsion and amine wagging, that complicate the spectral analysis especially in excited vibration states. To deal with the problem of fitting spectra in excited torsional states in the molecules like methylamine a new so-called 'hybrid' Hamiltonian model was developed not far ago.[1] Our current work aims to study experimentally and theoretically the terahertz rotational spectrum of methylamine to provide a reliable basis for the ISM detection of rotational transitions in v_t = 1 state. In its v_t = 0 state methylamine was first detected in the interstellar medium (ISM) toward Sgr B2 almost 50 years ago.[2] The terahertz spectrum of methylamine was measured from 150 to 1520 GHz with the Lille fast scan spectrometer. Using a new hybrid Hamiltonian model, we were able to fit accurately the rotational spectrum of the v_t= 1 state of methylamine including the analysis of the nuclear quadrupole hyperfine structure. The results of this spectroscopic analysis allowed us to search for rotational transitions of methylamine in its first torsionally excited state toward the high-mass star forming region Sgr B2(N) that was the target of the imaging spectral line survey ReMoCA performed with the Atacama Large Millimeter/submillimeter Array (ALMA). We report the first interstellar detection of methylamine in its v_t = 1 state on the basis of this interferometric data set. Also, further steps in fitting the rotational transitions in the second torsional state of methylamine v_t= 2 will be shown.

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[1] Kleiner, I. and Hougen, J. T. 2015, J. Phys. Chem. A, 119, 10664
[2] Kaifu, et al. 1974, ApJ, 191, L135; Fourikis et al. 1974, ApJ, 191, L139