SUBMILLIMETER-WAVE SPECTROSCOPY OF $^{13}C_1$-METHYL FORMATE IN THE GROUND STATE

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Detection of $^{13}C_1$-methyl formate ($H^{13}COOCH_3$) in interstellar hot cores is highly expected from the large abundance of the normal isotopologue and the detection of the ^{13}C isotopic species of fundamental molecules such as methanol. Because of a lack of laboratory data for $H^{13}COOCH_3$, its submillimeter-wave spectrum was recently investigated in selected portions of the wide frequency region between 7-610 GHz[a]. In this study, the rotational-torsional spectrum of $H^{13}COOCH_3$ has been exhaustively observed throughout the 100-380 GHz region with our FASSST apparatus. More than 4000 lines were assigned to a and b-type transitions with rotational quantum numbers J and K_a through 57 and 14, respectively, in both A and E sub-states of the ground torsional state. In addition, forbidden c- and x-type transitions were found in the E sub-state. The previous submillimeter-wave data of Willaert et al. and our new data were analyzed together with the ERHAM program, which was developed for molecules with one or two internal rotors and successfully applied to the internal rotation analysis of methyl cabamate[b]. In addition, the spectrum of normal methyl formate has been remeasured with the FASSST apparatus. The previous data of normal methyl formate[c] were reanalyzed together with present data using the ERHAM program. Although most of the transitions were fitted within 200 kHz, the least-squares fitting revealed large and systematic deviations in Q-branch transitions with $J > 25$ at low K_a which were newly assigned in both species; such deviations had not been measured in previous studies. Perturbations in the spectrum of methyl formate will be discussed along with other new results.

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[b] P. Groner, M. Winnewisser, I. R. Medvedev, F. C. De Lucia, E. Herbst and K. V. L. N. Sastry, ApJSS 169, xxx (2007)
[c] L. C. Oesterling, D. W. Ferguson, E. Herbst, F. C. De Lucia, Journal of Molecular Spectroscopy 172, 469-484 (1995)