LABORATORY AND POSSIBLE INTERSTELLAR DETECTION OF TRANS-METHYL FORMATE

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The rotational spectrum of the trans conformational isomer of methyl formate has been assigned using pulsed jet spectroscopy. A total of 28 transitions, 19 from the A-symmetry torsional state and 9 from the E-symmetry torsional state, have been detected in the laboratory. This spectrum was expected to have strong internal rotor effects due to a low three-fold barrier to methyl group internal rotation, calculated to be around 20 cm$^{-1}$. The population of this conformer, which lies approximately 2000 cm$^{-1}$ higher in energy than the previously assigned cis conformer, was enhanced through the use of an electric discharge. Transitions were found by a combination of chirped-pulse Fourier transform microwave spectroscopy, a high-sensitivity Fourier transform microwave spectrometer, and microwave-microwave double resonance spectroscopy to confirm quantum state connections. A total of five transitions (three from the A-symmetry torsional state and two from the E) have been identified in absorption in Green Bank Telescope survey scans towards Sgr-B2(N), showing an abundance relative to the cis conformer that is much higher than the relative energies would predict. This detection, if confirmed, could offer insight into the production mechanism of methyl formate in the interstellar medium.
