EXTENDING PURE ROTATIONAL MEASUREMENTS OF THE CH_3O RADICAL TOWARD THE TERAHERTZ DOMAIN

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Current astronomical observations, for instance with ALMA and NOEMA, extend well into the submillimeter-wave frequency domain. For many molecules, including some that have already been detected in the interstellar medium, laboratory data remain limited to the microwave and millimeter-wave regions. This is particularly striking for numerous reactive species difficult to produce in the laboratory. Considering that frequency extrapolation in absence of laboratory data is particularly unreliable, this lack of measurements surely prevents a thorough analysis of the observational data at high frequencies. The CH_3O radical is one such species: it is a known interstellar molecule [1] for which laboratory measurements do not extend beyond 370 GHz [2].

In this work, we have investigated the pure rotational spectrum of CH_3O toward the terahertz domain. The radical was produced by H-abstraction from methanol using atomic fluorine, itself produced using a microwave discharge in F_2 diluted in He, a method that we successfully used recently to investigate the rotation-tunneling spectrum of the CH_2OH radical [3]. Compared to that previous work, several enhancements have been made to our (sub)millimeter-wave spectrometer that now allows for double-pass into the absorption cell and magnetic-field modulation. The strength of the double-modulation (source frequency and magnetic field) scheme is that only transitions of open-shell species are visible over a completely flat baseline, a feature that has proven invaluable in the case of CH_3O to disentangle an otherwise dense spectrum with numerous strong transitions arising from the precursor or other reaction products (such as H_2CO). Overall, about 500 lines of CH_3O have been recorded up to 900 GHz, with accuracies ranging from 10 to 200 kHz. These transitions have been fit, together with available pure rotation literature data, to a rigid-rotor Hamiltonian using the SPFIT/SPCAT software.

[1] J. Cernicharo *et al.*, *Astrophys. J.* **759** L43 (2012) [2] Y. Endo *et al.*, *J. Chem. Phys.* **81**, 122 (1984); T. Momose *et al.*, *J. Chem. Phys.* **88** 5338 (1988) & **90** 8 (1990); J. C. Laas, S. L. Widicus Weaver, *Astrophys. J.* **835** 46 (2017) [3] O. Chitarra *et al.*, *Astron. Astrophys.* **644** A123 (2020)