SUB-MILLIMETER WAVE SPECTROSCOPY OF THE CH_2CHO RADICAL

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The vinoxy radical (CH_2CHO) is a known product of the reaction involving $O(^3P)$ and unsaturated hydrocarbons as C_2H_4[1]. Its detection in the interstellar medium would help to understand the chemical networks involving large radicals.

The CH_2CHO radical has previously been studied at high resolution by several authors. Its pure rotational spectrum was first investigated by Endo and Nakajima[2] using millimeter-wave spectroscopy and later by Endo, Saito, and Hirota[3] using Fourier-transform microwave spectroscopy and double resonance spectroscopy. Utkin et al.[4] studied its rovibrational spectra allowing for ground state combination differences.

In this work, we have measured the pure rotational spectrum of the vinoxy radical at millimeter- and sub-millimeter wavelengths (110–860 GHz). CH_2CHO was produced by H abstraction from acetaldehyde (CH_3CHO) using atomic fluorine in a double pass absorption cell at room temperature[5]. A Zeeman-modulated spectrometer has been used to record the pure rotational transitions of the radical, in which a magnetic field is modulated in magnitude. As the recorded spectra are free from signals arising from closed-shell species, the setup allows spectral acquisition over wide spectral windows. We probed transitions involving relatively high values of the rotational quantum numbers N'' and K_a'' (up to 41 and 18 respectively). Their combination with available high-resolution literature data (pure rotation[1,2] and ground state combination difference from ro-vibration studies[3]) led to an improvement of the modeling of the CH_2CHO rotational structure. This laboratory study provides complete spectroscopic information to search for CH_2CHO in various interstellar environments, from cold (e.g. typically 10 K for dense molecular clouds) to warm (e.g., $\sim$ 200 K for hot corinos) objects.

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