THE BENDING OF C_3: EXPERIMENTALLY PROBING THE l-TYPE DOUBLING AND RESONANCE

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C_3, a pure carbon chain molecule that has been identified in different astronomical environments, is considered a good probe of kinetic temperatures through observation of transitions involving its low-lying bending mode (ν_2) in its ground electronic state. With the aim to investigate this bending mode with multiple quanta of excitation, we have undertaken high resolution optical and mid-infrared investigations on the species produced in discharge experiments.

We report here the most complete analysis of the $\tilde{\mathrm{X}}$ and $\tilde{\mathrm{A}}$ states of C_3 (literature and present study) using a single PGOPHER file. New experimental measurements result in 36 rovibronic $\tilde{\mathrm{A}}\ {}^1\Pi_u - \tilde{\mathrm{X}}\ {}^1\Sigma_g^+$ bands (originating from $\tilde{\mathrm{X}}(0v_20)$, $v_2 = 0-5$, levels) recorded by laser induced fluorescence spectroscopy at the University of Science and Technology of China and the rovibrational ν_3 band (revealing hot bands involving up to 5 quanta of excitation in v_2) recorded by Fourier-transform infrared spectroscopy using a globar source on the AILES beamline of the SOLEIL synchrotron facility.

The combined fit allows for the accurate determination of the rotational parameters and absolute energy levels of C_3, in particular for states involving the bending mode. The spectroscopic information derived from this work enables new interstellar searches for C_3, not only in the infrared and optical regions investigated here but also notably in the ν_2 band region (around 63 cm^{-1}) where vibrational satellites can now be accurately predicted. This makes C_3 a universal diagnostic tool to study very different astronomical environments, from dark and dense to translucent clouds.