THE BENDING OF C₃: EXPERIMENTALLY PROBING THE υ-TYPE DOUBLING AND RESONANCE

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C₃, 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 (υ₂) 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 $\tilde{X}$ and $\tilde{A}$ states of C₃ (literature and present study) using a single PGOPHER file. New experimental measurements result in 36 rovibronic $\tilde{A}^1Π_u - \tilde{X}^1Σ_g^+$ bands (originating from $\tilde{X}(0v₂0)$, $v₂ = 0 − 5$, levels) recorded by laser induced fluorescence spectroscopy at the University of Science and Technology of China and the rovibrational $ν₃$ band (revealing hot bands involving up to 5 quanta of excitation in $ν₂$) 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 C₃, in particular for states involving the bending mode. The spectroscopic information derived from this work enables new interstellar searches for C₃, not only in the infrared and optical regions investigated here but also notably in the $ν₂$ band region (around 63 cm⁻¹) where vibrational satellites can now be accurately predicted. This makes C₃ a universal diagnostic tool to study very different astronomical environments, from dark and dense to translucent clouds.