AN ANALYSIS OF THE TORSION-ROTATION-VIBRATION ROTATIONAL SPECTRUM OF THE LOWEST IN-PLANE BEND AND FIRST EXCITED TORSIONAL STATE OF THE C_{3V} INTERNAL ROTOR C_2H_5CN

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C_2H_5CN (Propionitrile or ethyl cyanide) is a well known interstellar species abundantly observed in hot cores during the onset of star formation. The onset of star formation generally results in elevated temperature, which thermally populates may low lying vibrational states such as the 206 cm^{-1} in-plane bend and the 212 cm^{-1} first excited torsional state in C_2H_5CN. Unfortunately, these two states are strongly coupled through a complex series of torsion-vibration-rotation interactions, which dominate the spectrum. In order to understand the details of these interactions and develop models capable of predicting unmeasured transitions for astronomical observations in C_2H_5CN and similar molecules, several thousand rotational transitions in the lowest excited in-plane bend and first excited torsional state have been recorded, assigned and analyzed. The analysis reveals very strong a- and b-type Coriolis interactions and a number of other smaller interactions and has a number of important implications for other C_{3V} torsion-rotation-vibration systems. The relative importance and the physical origins of the coupling among the rotational, vibrational and torsional motions will be presented along with a full spectroscopic analysis and supporting astronomical observations.