OBSERVATION OF A DIPOLE-BOUND STATE IN THRESHOLD PHOTODETACHMENT SPECTROSCOPY OF THE INTERSTELLAR ANION C_3N^-

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The existence of negative molecular ions in space has been known for over a decade. Despite the determinations of anion abundances within various regions of the interstellar medium, questions remain as to how these weakly bound systems are formed within such harsh environments. The proposed formation mechanism, radiative electron attachment (REA), in which the negative ion is formed through a collision between the neutral parent molecule and a free electron with the emission of a photon is considered too slow to explain observed abundances. REA rates may be augmented however by the electron first transitioning through a dipole-bound state (DBS) close to the threshold for attachment. The C_3N molecule possesses a permanent dipole of magnitude supercritical for the formation of DBS. In this talk, we present the results of threshold photodetachment spectroscopy of C_3N^-. Observed excitation in the detachment cross section below threshold at room temperature is attributed to activation of the two lowest energy bending modes in the trapped ion. This excitation disappears at cryogenic temperatures leading to a very sharp threshold. High resolution scans of the threshold region resolve two features which we assign to the P and R rotational branches of a two-photon detachment process via a DBS with $^1\Sigma^+$ symmetry. Our group recently presented results from threshold photodetachment spectroscopy of CN^- in which the energy dependence of the cross section was explained in terms of a model function [Simpson et al, J. Chem. Phys. **153**, 184309 (2020)]. By adapting this model to C_3N^- and including the resonant interaction, we are able to determine both the rotational origin of the DBS and an improved value for the electron affinity of the C_3N molecule thereby confirming the bound nature of the observed state.