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Ion Momentum Imaging of Dissociative Electron Attachment to Small Molecules[1]

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In recent years, low energy dissociative electron attachment (DEA) interactions have been of interest to varying biological and technological applications. To study the dynamics resulting from DEA, we used an ion-momentum imaging apparatus based on the Cold Target Recoil Ion Momentum Spectroscopy (COLTRIMS) technique in which a molecular beam is crossed by a pulsed electron beam. The beam interaction takes place in a 4π pulsed electrostatic spectrometer that collects the anion fragments resulting from DEA. The molecular beam is formed by a supersonic expansion which results in a well-localized and cold target. Using this apparatus we have investigated the DEA dynamics for several small molecules: CO_2 at the 4 eV shape resonance and the 8 eV Feshbach resonance; N_2O at the 2.3 eV shape resonance; HCCH at the 3 eV shape resonance; and CF_4 near the 7 eV resonance. An overview of these experimental ion-momentum results will be compared to ab initio electronic structure and fixed-nuclei scattering calculations to gauge the resulting dynamics driven by DEA. In many cases, conical intersections play a pivotal role in driving the dynamics. Some of these systems exhibit non-axial recoil conditions indicative of a bending dynamics in the transitory negative ion state while others exhibit a direct axial recoil dissociation without any bending.

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