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Double valence ionization of propadiene

Abstract: Due to their structure, cumulenes of configurations as $H_2C_nH_2$ ($n \geq 2$) are of high importance in a broad field of chemical processes like combustion, chemistry of the atmosphere and interstellar media and also in more technical applications like nanomechanics and nanoelectronics.

We studied the breakup of propadiene ($H_2C_3H_2$) after double ionization induced by 40 eV and 53 eV synchrotron radiation. A COLTRIMS reaction-microscope was used to measure the momenta of both the recoil ions and the two ejected electrons in coincidence. We were able to observe several breakup channels ($H^+/C_3H_3^+$; $H_2^+/C_3H_2^+$; H_3^+/C_3H^+ and $CH_2^+/C_2H_2^+$), different excited electronic states of the dication and angular distributions of the reaction products. Depending on the photon energy, different double ionization processes take place. At higher energies, a sequential channel opens which we assume to be delayed autoionization like previously observed in smaller molecules.