Probing molecular-ion beams with intense few-cycle laser pulses – two-color controlled dissociation

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We have studied laser-induced fragmentation of molecular-ion beams using coincidence 3D momentum imaging, with direct separation of all the reaction products measured simultaneously. These measurements provide detailed kinetic energy release and angular distributions of the different fragmentation processes. We mainly focus on the fundamental H_2^+ and H_3^+ molecules (in 5-50 fs laser pulses having 10^{12}-10^{16} W/cm^2 peak intensity) as models for more complex systems, and at times we do explore more complex molecules such as O_2^+ and CO^{2+}.

In this talk, we will discuss electron localization on specific nuclei during strong-field dissociation of molecular-ion beams which is controlled by the relative phase between the 790 and 395 nm components of an ultrashort laser pulse.

In addition, clear experimental and theoretical evidence for the intriguing zero-photon dissociation (ZPD) process of H_2^+ will be presented. The key role of the laser-pulse bandwidth and chirp on ZPD control will be discussed. Moreover, we will explore control over the final dissociation product of HD^+, either $H^+ + D$ or $H + D^+$ – usually referred to as *channel asymmetry*.

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