

Strong-Field Double Ionization of H₂/D₂: Wavelength Dependent Study

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We studied double-ionization of H₂ and D₂ by intense femtosecond laser pulses of different wavelengths (500, 600, 800, 1300, 2000 nm) and peak intensities. The kinetic energy release (KER) spectra measured in the Coulomb explosion of the molecules were used to identify the various mechanisms responsible for the dissociation and ionization of H₂/D₂ in the laser fields. In addition to fragments from well known bond softening and enhanced ionization channels, high energy protons/deuterons of KER around 11 eV were for the first time observed when using short wavelengths (500 and 600 nm) at high-peak intensities. This channel exhibited wavelength dependence, with KER decreasing for longer wavelengths. This observation implies that a multiphoton-ionization process is actively operating at short internuclear distances and must be accounted for to correctly understand the strong-field ionization of H₂/D₂ by short laser pulses.

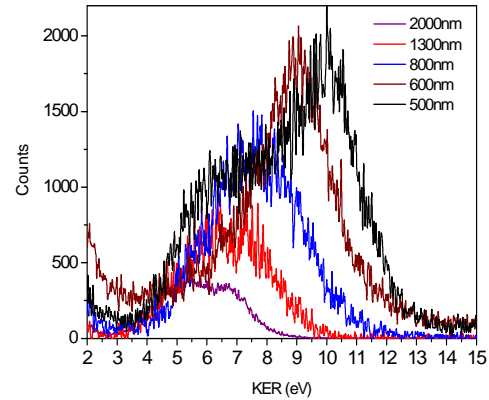


Figure 1. Kinetic energy release spectra for D⁺ fragments (total energy for two fragments) resulting from double ionization of D₂ molecules by linearly polarized laser pulses of various wavelengths. Pulse duration is 70 fs for 800 nm and 100 fs for other wavelengths. Peak intensities are about 4×10^{14} W/cm².