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Exploration and Control of Molecular Dissociation in Strong Asymmetric Laser Fields[1]

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Intense lasers can be effective tools for manipulating and probing coherent dynamics within atoms and molecules. Asymmetric laser fields, in which there is a pronounced, controllable difference in the peak amplitude in one direction over another, are particularly interesting in this regard. Such fields can be produced through carrier-envelope-phase stabilization of few-cycle laser pulses or by coherently combining even and odd harmonics of a laser pulse (e.g. with frequencies ω and 2ω). We have used such fields to explore asymmetric dissociation of multiply-charged homo- and hetero-nuclear diatomic and triatomic molecules. Robust high-contrast control over the emission direction of specific ion fragments is observed for target species with a variety of different molecular structures, suggesting a common dynamical mechanism. The phase, intensity, and pulse-duration dependence of the directional emission could provide new insight into the combined nuclear and electronic evolution, from the initial ionization step through expansion and subsequent ionization.

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