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Attosecond control of electron dynamics

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The availability of laser pulses with a duration down to about a hundred attoseconds opened up the possibility to study the motion of electrons on the timescales where this motion occurs in nature. Control of chemical reactions or photo-biology has been achieved by using laser fields as photonic reagents, which interact with a medium in a manner that is determined by their duration, intensity, frequency, chirp, and polarization. The introduction of phase-stabilized laser pulses now adds new functionality to photonic reagents to control electronic motion. An experiment will be presented on the dissociation of D_2^+ into $D^+ + D$ by intense few-cycle laser pulses with controlled field evolution, where a pronounced dependence of the direction of the D^+ ejection (and hence of the localization of the electron in the system) on the waveform driving the reaction was observed. Quantum-classical computations reveal that light-field control of molecular electron dynamics is responsible for the observed phenomenon. The possibility to steer electron localization in a molecule and control its dissociation, comprises a completely new way of coherent control that takes place on a sub-femtosecond time scale.