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Attosecond electron dynamics in molecules and liquids

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The ultrafast motion of electrons and holes following light-matter interaction is fundamental to a broad range of chemical and biophysical processes. In this lecture, I will discuss some of our recent experiments that measure the atomic-scale motion of charge with attosecond temporal resolution (1 as = 10^{-18}s). The first experiment is carried out on isolated, spatially oriented molecules in the gas phase. Using high-harmonic spectroscopy, we resolve the migration of an electron hole across the molecule with a resolution of ∼100 as and simultaneously demonstrate extensive control over charge migration [1]. In the second class of experiments, we use an attosecond pulse train synchronized with a near-infrared laser pulse to temporally resolve the process of photoemission from molecules in the gas phase [2] and from a liquid-water microjet, resolving electron transport through liquid water on the attosecond time scale.

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