Resolving and manipulating attosecond processes via strong-field light-matter interactions

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The interaction of intense light with atoms or molecules can lead to the generation of extreme ultraviolet (XUV) pulses and energetic electron pulses of attosecond (10-18) duration. The advent of attosecond technology opens up new fields of time-resolved studies in which transient electronic dynamics can be studied with a temporal resolution that was previously unattainable. I will review the main challenges and goals in the field of attosecond science. As an example, I will focus on recent experiments where the dynamics of tunnel ionization, one of the most fundamental strong-field phenomena, were studied. Specifically, we were able to measure the times when different electron trajectories exit from under the tunneling barrier created by a laser field and the atomic binding potential. In the following stage, subtle delays in ionization times from two orbitals in a molecular system were resolved. These experiments provide an additional, important step towards achieving the ability to resolve multielectron phenomena – a long-term goal of attosecond studies.