Abstract for an Invited Paper
for the DAMOP06 Meeting of
The American Physical Society

Applications of Attosecond Lasers to Atoms and Molecules in Strong Laser Fields

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In the past two decades femtosecond time-resolved experiments have allowed the observation of molecular rotations and vibrations, and of photo-induced chemical processes. However, these experiments often tell only half the story: they show the motion of atoms moving under the influence of potential energy curves that result from a time-average over the motion of all electrons in the system. The natural time-unit for this electronic motion itself is the atomic unit of time (1 a.u. = 0.024 fsec = 24 attoseconds). *Real-time* observation of this motion therefore requires recently developed attosecond laser techniques. When considering motions of electrons we may distinguish between motion that results from driving the electrons with a strong laser field and motion that results from photo-absorption in a weak laser field. In strong laser fields the electron motion can be quite intuitive. Eventually, studies of photo-absorption in weak laser fields are important, since all photo-absorption processes in nature (i.e. outside a laser laboratory) occur in this regime. At the meeting I will discuss experiments aimed at observing the motion of electrons on attosecond timescales in strong laser fields. An interesting example is the dissociative ionization of the hydrogen molecule (into a proton and a neutral atom), where we have recently observed that the dissociation process can be controlled by the carrier envelope phase of a few-cycle laser pulse.