The frontiers of attosecond physics

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The genesis of light pulses with attosecond (10^{-18} seconds) durations signifies a new frontier in time-resolved physics. The scientific importance is obvious: the time-scale necessary for probing the motion of an electron(s) in the ground state is attoseconds (atomic unit of time = 24 *as*). The availability of attosecond pulses would allow, for the first time, the study of the time-dependent dynamics of correlated electron systems by freezing the electronic motion, in essence exploring the structure with ultra-fast snapshots, then following the subsequent evolution using pump-probe techniques.

This talk will examine the fundamental principles of attosecond formation by Fourier synthesis of a high harmonic comb and phase measurements using two-color techniques. Quantum control of the spectral phase, critical to attosecond formation, has its origin in the fundamental response of an atom to an intense electromagnetic field. We will interpret the laser-atom interaction using a semi-classical trajectory model. Finally, the comparison of recent measurements with the predictions of strong-field scaling will be used to show that high energy photons with inherently shorter bursts can be created using long wavelength fundamental fields.