MAR13-2012-020158

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Attosecond Streaking Chronoscopy of Surfaces

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With the advent of sub-femtosecond ultrashort XUV pulses and of phase-stabilized IR pulses with sub-cycle time resolution, novel pathways have been opened up for studying time-resolved electronic quantum dynamics on the attosecond scale. These experiments pose challenges for theory: How do short pulses interact with matter? Which novel information can be extracted from time-resolved spectroscopies that cannot be gained from precision experiments in the spectral domain? In this talk we discuss attosecond chronoscopy by streaking photoelectron emission from solid surfaces. Experimental photoemission data reveal a time delay between conduction electrons and core electrons on the $\sim$50 attosecond scale. We show that the temporal information accessible for such a many-electron system in the condensed phase includes both the coherent wavepacket dynamics characterized by the Eisenbud-Wigner-Smith (EWS) time delay as well as decohering processes in transport and relaxation. Extensions to nanostructures will be discussed.