LCLS-PULSE Seminar

Nonlinear Ultrafast Time-resolved Photoemission: Exploring the Dynamical Structure of Matter with Electrons and Light

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4:00pm SSRL (Bldg 137) 3rd floor conference Room

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Experiments on nonlinear multiphoton photoemission from solid surfaces followed soon after the development of lasers and initial experiments in nonlinear optics. Although there has been substantial progress in the development of ultrafast laser sources and methods for photoelectron energy and momentum analysis, current experiments are hardly exploiting the potential of time-resolved nonlinear photoemission for studying the dynamical structure of matter. The development of broadly tunable high-power free-electron femtosecond laser sources could potentially revolutionize our ability to study dynamical phenomena in solid state materials provided that we evolve our understanding of light-mater interactions on the time scales of electronic dephasing in solids.

In this talk I will present two topics at the forefront of time-resolved photoemission. First, I will describe resonant multiphoton photoemission from Cu(001) surface involving doubly resonant transition from the d-band initial states, through sp-band and image potential intermediate states, into the free-electron continuum of final states. The advantage of resonant photoemission process is that it allows band mapping of solids without momentum and energy uncertainty that affects conventional photoemission spectroscopy. Furthermore. I will show how the coherent coupling of spin-orbit split states allows spin polarization and coherent control of spin in diamagnetic copper. The second topic concerns the surface femtochemistry of photodesorption of Cs from Ag(111) surface. I will argue that time-resolved photoemission measurements not only probe the nuclear wave packet motion during the photodesorption process, but also the evolution of the electronic wave function as Cs atoms escape from the influence of the surface.

Finally. I will put forth a proposal for a national facility for time-resolved photoemission science that will greatly enhance our ability to probe the dynamical structure of matter.