Colloquium Announcement

"Faculty Candidate"

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Photoinduced phase transition in vanadium dioxide

Novel behavior in condensed matter systems, including superconductivity, insulator-to-metal transitions and colossal magnetoresistance, among many others, often results from the interplay between several different competing processes. These result from the often subtle interaction between the spin, lattice, and electronic degrees of freedom in a material. In this talk, I will highlight one such condensed matter system, vanadium dioxide, which undergoes a phase transition from a monoclinic insulator to a rutile metal at 340 K. Although research on this transition has been ongoing for over 40 years, the mechanism responsible for the electronic and structural phase transition is currently unclear.

Recent work performed by some of our collaborators (Cavalleri, *et al*. PRL 87, 237401) has demonstrated the first ultrafast measurements of the photoinduced *structural* phase transition using the newly developed technique of ultrafast x-ray diffraction. In our experiment, we study the corresponding electronic transition using ultrafast terahertz spectroscopy. We initiate the photoinduced phase transition using an ultrafast (<100 fs) optical pulse and monitor the dynamics of the collapse of the bandgap by measuring the time dependence of the terahertz frequency conductivity. As the sample is heated towards the phase transition in the insulating phase, we find a *dramatic* reduction of the number of photons needed to drive the system toward its high temperature metallic state. This threshold drop is much larger than would be expected from sample heating alone. While the origin of this softening is not currently clear, I will discuss the possible mechanisms that could result in this phenomenon and suggest experimental strategies for further investigation. These data also highlight the very novel physics that can be unlocked by exploiting *impulsively* driven "phase transitions", which can access otherwise hidden electronic and structural phases.

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Campbell Hall 274

Refreshments served at 12:00 p.m. in CH 361

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