"Time-Resolved Optical Studies of Collective Modes in Complex Materials"

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1:30 pm
Thursday May 8, 2008
Ingersoll 3439

Abstract

Understanding the complex phase behavior and transitions of strongly correlated systems has become one of the most important unsolved problems in condensed matter physics. So far the equilibrium properties and the phase diagrams have been studied in great detail, however very few publications were devoted to the dynamical aspects of their physical behavior. Therefore the dynamics of phase transitions remains largely unknown although the detailed understanding of microscopic processes is undoubtedly a crucial aspect in the evaluation of the technical merit of correlated systems. We use time-resolved optical techniques to study low energy dynamics of collective modes, spin coherence, and electron-lattice coupling in charge-density wave conductors, colossal magnetoresistive (CMR) manganites, and ferromagnetic semiconductors. We show that time-resolved pump-probe optical spectroscopy is an extremely powerful probe of the rich dynamics of complex materials, as it is capable of revealing key details concerning many of the low-energy excitations important in correlated systems, including lattice-, electronic-, spin-, and orbital-excitations. The concepts and principles forming the results will be presented in the talk.