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Abstract

Femtosecond dynamics of symmetry changes in solids

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Competing interactions in materials often result in superlattice structures that overlay the normal translational symmetry of a crystal structure. The formation and destruction of these superlattice structures are largely responsible for the complex phase diagrams often observed in strongly correlated electron systems. Understanding the dynamics of the different components of the superlattice has the potential to reveal a considerable amount about the underlying physics in these materials. In this talk I will describe several different approaches to studying light-induced phase transitions by using x-ray diffraction as a direct probe of superlattice structures. In one example, x-ray diffraction is used to directly probe the structural component of orbital- and charge-order melting in a manganite. A second example focuses on the charge density wave (CDW) in TiSe2, a material where the mechanism of CDW formation is controversial. Time-resolved x-ray diffraction shows that the superlattice structure in this material is destroyed at electronic energy densities far below the threshold for driving the phase transition thermally, lending support for the "excitonic insulator" model for the CDW. A third example is a light-induced phase transition to a multiferroic phase in CuO, where resonant soft x-ray diffraction observes directly changes in the magnetic superstructure associated with the phase transition.