# A direct view of order dynamics with femtosecond x-ray diffraction

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X-ray diffraction has long been recognized as an important tool for quantitative measurements of the long-range structural order in crystalline materials. Recently, new x-ray sources have enabled a new generation of x-ray diffraction experiments with sufficient time resolution to resolve dynamics in these structures. With an aim toward developing a means to use light to control the atomic-scale structure in correlated electron materials, here I will discuss some examples of how intense light pulses can induce large-scale structural changes that can be directly measured using x-rays. Specifically, I discuss examples where near-infrared pulses induce structural phase transitions in mixed-valence manganites and $K_{0.3}MoO_3$. X-ray diffraction measurements show how the atomic structural order dynamically shifts from a lower-symmetry configuration to a position of higher symmetry. I also discuss recent measurements on the multiferroic compound $TbMnO_3$ performed at LCLS, where an intense pulse of THz-frequency radiation resonantly drives a coherent electromagnon. In this case x-ray diffraction is able to measure quantitatively the spin response of this system.