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Controlling Quantum Condensed Matter With Light

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In this talk I will discuss some of our recent work aimed at controlling the properties of quantum condensed matter with light, for instance in High-Tc cuprates or in Mott Insulators. The focus is on the use of high-field THz radiation rather than near-visible excitations, thus using photon energies that do not destroy the broken symmetry state of the solid, for example by breaking Cooper pairs. Rather we study the non-linear electrodynamics of the solid, for example by manipulating low-lying lattice vibrations coherently or by driving the phase excitations in superconducting condensates. A straightforward conceptual analogy can be found with experiments that that study driven dynamics of strongly correlated atomic gases in optical lattices. Due to the short lengthscales and the fast timescales involved in condensed matter, femtosecond x-ray scattering and spectroscopy experiments with the LCLS Free Electron Laser are necessary to interrogate the microscopic non-equilibrium paths explored by the stimulated solid.