Zhiyuan Sun

Title: Order parameter steering by light

Abstract: An emerging subject in nonequilibrium physics is “order parameter steering” where experimentally controllable perturbations (such as light pulses) may drive the order parameters of symmetry broken phases to evolve. I will theoretically demonstrate this phenomenon in two categories: mean field steering and fluctuation steering. In the first category, we show that in excitonic insulators with s-wave electron-hole pairing, an applied light pulse can induce a p-wave component to the order parameter, and further drive it to rotate in the s+ip plane. In one dimension, each cycle of rotation pumps exactly two electrons across the sample while higher dimensional systems are similar, realizing a Thouless charge pump as a collective manybody effect. We further show that in electron-hole bilayer realizations of excitonic insulators, high order Josephson effects lead to degenerate ground states which can be steered between by electric field pulses. In the fluctuation steering category, we study the dynamics of a competing order system which is rapidly heated up by a pump and then cools down. In the cooling process, exponentially growing thermal fluctuations lead the system into the phase associated with the faster-relaxing order parameter, which is not necessarily the ground state. This theory offers a natural explanation for the widespread experimental observation that metastable states may be induced by laser induced collapse of a dominant order.