Theory of Laser-Controlled Competing Superconducting and Charge Orders

We investigate the nonequilibrium dynamics of competing coexisting superconducting (SC) and charge-density wave (CDW) orders in an attractive Hubbard model. A time-periodic laser field A(t) lifts the SC-CDW degeneracy, since the CDW couples linearly to the field (A), whereas SC couples in second order (A^2) due to gauge invariance. This leads to a striking resonance: When the photon energy is red-detuned compared to the equilibrium single-particle energy gap, CDW is enhanced and SC is suppressed, while this behavior is reversed for blue detuning. Both orders oscillate with an emergent slow frequency, which is controlled by the small amplitude of a third induced order, namely η pairing, given by the commutator of the two primary orders. The \textit{induced} η pairing is shown to control the enhancement and suppression of the dominant orders. Finally, we demonstrate that light-induced superconductivity is possible starting from a predominantly CDW initial state.