Februar 7th, 2022 10:00 AM
QED & Materials seminar
Christian Eckhardt

Title
“Cavity engineering of Hubbard U via phonon polaritons"

Abstract
Pump-probe experiments have suggested the possibility to control electronic correlations by driving infrared-active phonons with resonant midinfrared laser pulses. In this work we study two possible microscopic nonlinear electron-phonon interactions behind these observations, namely coupling of the squared lattice displacement either to the electronic density or to the double occupancy. We investigate whether photon-phonon coupling to quantized light in an optical cavity enables similar control over electronic correlations. We first show that inside a dark cavity electronic interactions increase, ruling out the possibility that Tc in superconductors can be enhanced via effectively decreased electron-electron repulsion through nonlinear electron-phonon coupling in a cavity. We further find that upon driving the cavity, electronic interactions decrease. Two different regimes emerge: (i) a strong coupling regime where the phonons show a delayed response at a time proportional to the inverse coupling strength, and (ii) an ultra-strong coupling regime where the response is immediate when driving the phonon polaritons resonantly. We further identify a distinctive feature in the electronic spectral function when electrons couple to phonon polaritons involving an infrared-active phonon mode, namely the splitting of the shake-off band into three bands. This could potentially be observed by angle-resolved photoemission spectroscopy.

and the related preprint https://arxiv.org/abs/2201.04128