Wednesday, February 6th, 2019 – 10:00 p.m.
CFEL Seminar room IV (Bldg. 99)

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Nonequilibrium dynamics in strongly correlated systems: spin-charge coupling in a photo-doped Mott insulator and possible induced superconductivity

Nonequilibrium pump-probe time-domain spectroscopy opens new perspectives in studying the dynamical properties of the strongly correlated electron systems. In particular, the interplay between different degrees of freedom in strongly correlated materials can be studied by their temporal evolution [1] and also the optical switching to some novel phases is possible [2].

Firstly, using a nonequilibrium implementation of the extended dynamical mean field theory (EDMFT) we simulate the relaxation of a photo-excited doped Mott insulator [3]. We consider the t-J model and focus on the interplay between the charge- and spin-dynamics in different excitation and doping regimes. In particular, we observe a correlated oscillatory evolution of the kinetic energy and spin-spin correlation function after a photoexcitation, which is a direct consequence of strong spin-charge coupling. Moreover, we propose a pump-probe setup, which allows to directly observe these oscillations in the optical conductivity originating from string states (see Fig. (a)).

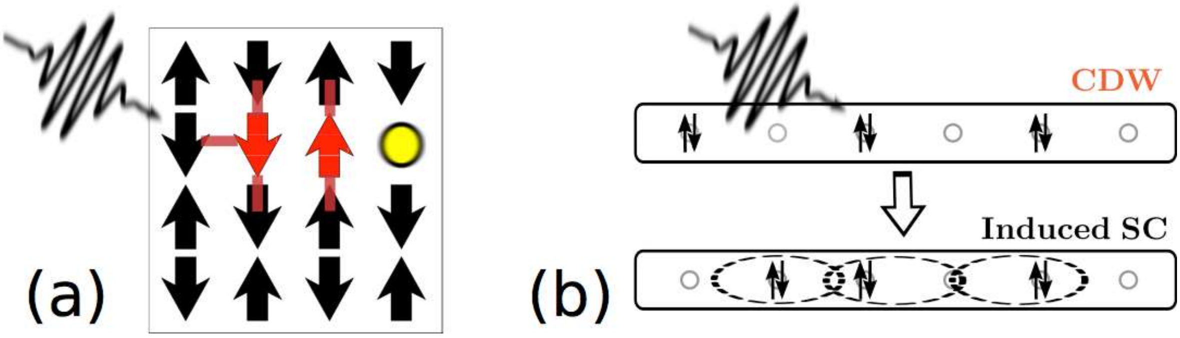
Secondly, within the framework of the time-dependent Lanczos algorithm we demonstrate [4] that the possible light-induced superconducting coherence can emerge as a result of the modulated effective correlations (see Fig. (b)). Here, we investigate two different nonequilibrium scenarios: (i) an interaction quench and (ii) action of a light pulse. In both cases we could identify a possible transient Meissner effect, which is a fingerprint of the induced superconductivity. In addition, we find that the stability of the possible induced superconducting state depends crucially on the nature of the excitation quench: namely, a pure interaction quench induces a long-lived superconducting state, whereas a phase quench leads to a short-lived transient superconductor.

[1] S. Dal Conte et al. Science, 335, 1600 (2012)

[2] S. Kaiser et al. PRB, 89, 184516 (2014); D. Fausti et al. Science 331, 189 (2011); M. Mitrano et al. Nature, 530, 461 (2016)

[3] N. Bittner et al. PRB, 97, 235125 (2018)

[4] N. Bittner et al. arxiv:1706.09366



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