## Max-Planck-Institut für Struktur und Dynamik der Materie



Max Planck Institute for the Structure and Dynamics of Matter

## November 4<sup>th</sup> 2014 – 15:30 CFEL Seminar room IV, 01.111 (Bldg. 99)

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## Nonequilibrium superconductors: Thermalisation crossover and Higgs mode

There are growing fascinations with nonequilibrium[1] as a promising avenue for exploring novel phenomena. This talk will focus on two topics on nonequilibrium superconductors. One is a standard electron-phonon system (Holstein model), which is shown[2] to also accommodate a supersolid phase accompanied by a quantum critical point. We have looked into nonequilibrium dynamics in interaction quenches with DMFT, and have revealed the existence of a ``thermalisation crossover" from phonon- to electron-dominated relaxation, where a phonon damping faster than electron relaxation is taken over by an electron relaxation faster than phonon damping as the electron-phonon coupling is increased[3]. In the latter regime, despite long-lived phonon oscillations, the electron momentum distribution exhibits a temporary thermalisation. The origin of the crossover is traced back to different behaviours of the electron and phonon self-energies against the electron-phonon interaction.

Our second topic concerns superconductors illuminated by laser. A strong THz light is experimentally shown[4] to induce oscillations of the superconducting order parameter with twice the frequency of the laser. Interestingly, a large third-harmonic generation is detected, which is theoretically captured[5] as a collective precession of Anderson's pseudospins resonating with the Higgs (amplitude) mode of the superconductor.

[1] H. Aoki, N. Tsuji, M. Eckstein, M. Kollar, T. Oka and P. Werner, Rev. Mod. Phys. 86, 779 (2014).

[2] Y. Murakami, P. Werner, N. Tsuji and H. Aoki, arXiv:1402.6456.

[3] Y. Murakami, P. Werner, N. Tsuji and H. Aoki, arXiv:1407.8288.

[4] R. Matsunaga, N. Tsuji, H. Fujita, A. Sugioka, K. Makise, Y. Uzawa, H. Terai, Z. Wang, H. Aoki and R. Shimano, Science 345, 1145 (2014).

[5] N. Tsuji and H. Aoki, arXiv:1404.2711.



Host: Martin Eckstein

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