Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

Wednesday, February 8th 2017 - 11:00
CFEL Seminar room IV (Bldg. 99)

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Strongly correlated Floquet systems: Cluster Perturbation Theory approach

Under the influence of periodic fields quantum systems may reach regimes inaccessible under equilibrium conditions and new phases may be engineered by a tunable control [1]. The coexistence of periodic driving forces and electron-electron correlation is particularly interesting for two main reasons: on one side the external driving effectively modulates the inter-site hopping enhancing the effects of the e-e repulsion and the tendency to an insulating behaviour. On the other hand, irradiation itself is responsible for a photo-doping consisting in an electronic energy dressing that may turn a Mott insulator into a metal. Due to these competing effects, novel phenomena are expected when strongly correlated quantum systems are exposed to time-dependent fields.

In this seminar, I will present a scheme that allows to treat photo-induced phenomena in the presence of many body interactions, where both the nonlinear effects of the external field and the electron-electron correlation are treated simultaneously and in a non-perturbative way. The Floquet approach is used to include the effects of the external time-periodic field and the Cluster Perturbation Theory to describe interacting electrons in a lattice. They are merged in a Floquet-Green function method that allows to calculate photon-dressed quasiparticle excitations. In particular, I will discuss the combined effects of on-site e-e interaction and of a time-periodic field on an infinite 1D Hubbard lattice: an unconventional Mott insulator-to-metal transition occurs for given intensities and frequencies of the applied field [2], while in the extended finite chain edge states appear in correspondence of the "bulk" gap regions for certain values of the field intensity [3].

[1] Gomez-Leon, Andres, et al., "Floquet-Bloch theory and Topology in Periodically Driven Lattices". Physical Review Letters, 110, 200403-1 200403-5, (2013)

[2] Puviani, M. and Manghi, F., "Periodically Driven Interacting Electrons in one dimension: Many-body Floquet Approach", Physical Review B 94, 161111

[3] Puviani, M. and Manghi, F., "Theory of photon-driven correlated electrons in one dimension", accepted (Journal of Physics: Conference Series)

Host: Angel Rubio

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