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Nonequilibrium Mott-Hubbard Systems Driven by a Strong, Time-periodic, External Field

Optical pump-probe experiments, employing short laser pulses, make it possible to investigate and separate the different time scales present in strongly interacting electron systems. Moreover, Mott-Hubbard insulating materials, e.g., have the potential of being used in ultrafast electro-optic switches due to the short relaxation times characteristic for strongly correlated systems. These perspectives require to develop the nonequilibrium theory for strongly correlated lattice electron systems in the presence of a time-periodic, external laser field.
Here we consider, in particular, the Hubbard model at half filling, driven by a stationary laser field. The electromagnetic vector potential couples to the charge current density, i.e., it induces a field-dependent, odd-parity hopping amplitude and, thus, enables photodoping into the upper Hubbard band. We generalize the dynamical mean-field theory (DMFT) to nonequilibrium with periodic-in-time external fields, using a Floquet mode representation and the Keldysh formalism. We study, in particular, the photoinduced nonequilibrium insulator-metal transition of the Hubbard model. To that end, we calculate the nonequilibrium electron distribution function, the spectral properties in the insulating and in the metallic state and the DC conductivity in the presence of the driving laser field for laser frequencies tuned from below to above the Mott-Hubbard gap.

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