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Non-equilibrium Mott-Hubbard Systems in Strong External Laser Fields

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We consider the Hubbard model at half filling, driven out of equilibrium by a strong external laser field, represented by a a classical single-mode, time-periodic electromagnetic field. We show that in an appropriate U(1) gauge the low-frequency, long-wavelength limit may be taken in a controlled way, such that no spurious infared singularities (orthogonality catastrophe) occur, in contrast to the familiar Peierls substitution. We generalize the Dynamical Mean Field Theory (DMFT) for the Hubbard model to non-equilibrium in a time-periodic field, using the Floquet mode expansion and the Keldysh technique. Spectral densities, electronic distribution functions, relaxation rates and the DC conductivity out of equilibrium are calculated for both, the metallic and the insulating phase. In the metallic pseudogap phase, enhanced quantum coherence is predicted due to a polariton-like coupling of the electronic excitations to the discrete electromagnetic mode. This leads to a resonant revival of the Kondo-like manybody resonance at the Fermi level. In the Mott insulating phase, the external field drives a non-equilibrium insulator-metal transition as a function of the laser frequency as well as a collapse of the Mott-Hubbard gap for sufficiently high laser intensities, in qualitative agreement with experiments.

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