PAUL SCHERRER INSTITUT

CONDENSED MATTER THEORY SEMINAR

Realization of density-dependent Peierls phases for ultracold fermions in optical lattices

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Tuesday, Feb 19, 2019, 11:00-12:00

WHGA/121 (PSI-West)

Abstract:

Periodic driving can be used to coherently control the properties of quantum many-body systems and to engineer novel effective Floquet-Hamiltonians, which feature for example topological band structures or extended Hubbard models with density-dependent tunneling. We use a strongly interacting Fermi gas in a periodically driven optical lattice to study and implement a driven Hubbard model. By comparing the many-body dynamics to analog static implementations and nonequilibrium DMFT calculations, we can show for which timescales the effective Hamiltonian description is valid and how heating through the drive can be strongly suppressed by minimizing the dispersion of higher bands. Furthermore, we experimentally realize density-dependent Peierls phases with a two-frequency, near-resonant driving scheme, which simulate the effect of quantized dynamical gauge fields on a lattice. We directly measure on a Hubbard dimer, the complex phase and amplitude of the tunneling matrix element and observe the winding structure around an interaction-induced Dirac point appearing in an abstract driving parameter space.

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