Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Relaxation dynamics of a Fermi gas in an optical superlattice

AMENEH SHEIKHAN SOUDANI, CORINNA KOLLATH, HISKP, University of Bonn Nussallee 14-16, D-53115 Bonn, Germany, JOHANNA E. BOHN, Cavendish Laboratory, University of Cambridge, JJ Thomson Avenue, Cambridge CB30HE, United Kingdom, DANIEL PERTOT, EUGENIO COCCHI, LUCK A. MILLER, MARCO KOSCHORRECK, MICHAEL KOEHL, Physikalisches Institut, University of Bonn, Wegelerstraße 8, 53115 Bonn, Germany — The question of how a closed quantum system out of equilibrium evolves and relaxes, is still not well understood. A specific setting of coherent quantum dynamics can be provided by quenches when one starts from the ground state of an initial Hamiltonian and suddenly changes the Hamiltonian's parameters. After this change the system is highly excited with respect to the new Hamiltonian and evolves in time. Ultracold quantum gases in optical lattice are good candidates to study such non-equilibrium situations. Here we present an experimental and theoretical investigation of the time evolution of a Fermi gas following fast and slow quenches of a one-dimensional double-well superlattice potential. We probe both the local tunneling in the double wells and the global dynamics towards a steady state. The local observables in the steady state resemble those of a thermal equilibrium state, whereas the global properties indicate a strong non-equilibrium situation. The experimental results are compared to the numerical studies based on the exact diagonalization of the Hamiltonian in the continuum considering the loading procedure of the three-dimentional Fermionic cloud into the one-dimensional optical superlattice and the measurement sequences.

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Date submitted: 28 Jan 2015 Electronic form version 1.4