Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Fermionic quantum gases with tunable interactions in optical lattices ULRICH SCHNEIDER, LUCIA HACKERMÜLLER, Universität Mainz, Germany, THORSTEN BEST, SEBASTIAN WILL, SIMON BRAUN, MARIA MORENO CARDONER, BELEN PAREDES, Universität Mainz, IMMANUEL BLOCH, Universität Mainz, Max Planck Institut für Quantenoptik, Garching, Germany — Fermionic atoms in optical lattices can serve as a model system for condensed matter physics, as they present an implementation of the Hubbard hamiltonian with high experimental control of the relevant parameters. In our system we sympathetically cool ^{87}Rb and ^{40}K in an optically plugged quadrupole trap and an optical dipole trap. After evaporation, a balanced spin mixture of 40K atoms is loaded into a blue detuned optical lattice where the interactions can be changed via a Feshbach resonance. We present experimental and theoretical studies of the behaviour of fermionic atoms for both attractive and repulsive interactions. For repulsive interactions we show a transition from compressible, metallic states to Mott-insulating and finally band insulating states. On the attractive side we investigate an anomalous expansion when the interaction is strongly attractive and study the dynamics of atoms and repulsively and attractively bound pairs.

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Date submitted: 22 Jan 2009 Electronic form version 1.4