SFB/TRR 21 - Seminar
22. April 2008, Ulm

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Ultra-cold Bose-Fermi mixtures in 1D optical lattices

I will discuss mixtures of bosons and spin-polarized fermions in one dimensional optical lattices in the limits of heavy and light fermions. The first case can be mapped to a purely bosonic system with a fermion induced disorder with binary distribution or a superlattice. Boundaries between Mott-insulating and compressible phases are determined analytically within an extended strong-coupling perturbation expansion as well as numerically using the density matrix renormalization group (DMRG). New partially compressible phases will be identified which show exponentially decaying first-order correlations and thus have glass-type character. In the opposite limit of ultra-light fermions, adiabatic elimination of the fast fermions leads to an effective bosonic Hamiltonian with oscillatory long-range interactions.
The latter leads to new phases such as compressible density waves (CDW). An analytic theory is presented and compared to DMRG calculations which quantitatively predicts the oscillation amplitude and particle-hole gap. Numerical DMRG calculations suggest that density oscillations and quasi long-range off-diagonal order do not coexist.

22. April 2008, 16 Uhr

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