Q 49 Stark korrelierte atomare Systeme

Zeit: Dienstag 17:00–18:00 Raum: HU Kinosaal

Q 49.1 Di 17:00 HU Kinosaal

Pairing and transport properties in 1D Bose-Fermi and Fermi-Fermi Mixtures — •Felix Schmitt, Markus Hild, and Robert Roth — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt

We investigate the phase diagram of atomic boson-fermion and fermion-fermion mixtures in an one dimensional optical lattice at zero temperature within the Bose-Fermi and Fermi-Fermi-Hubbard model. In order to allow for the description of strongly correlated states and quantum phase transitions we solve the large scale eigenvalue problem exactly using a Lanczos algorithm. Observables, e.g., one-body and two-body density matrices in coordinate as well as in momentum space are analysed with the aim to identify signatures of different quantum phases and to establish an heuristic understanding of pairing. Furthermore, transport properties are characterised via the rigidity of the system under phase twists (Drude weight) providing a distinction between conducting or superfluid and insulating phases. Together, these quantities reveal a detailed picture of pairing properties and the structure of the phase diagram for this new class of strongly correlated quantum systems.

Q 49.2 Di 17:15 HU Kinosaal

Exact time evolution of ultracold atomic gases in modulated optical lattices — •Markus Hild, Felix Schmitt, and Robert Roth — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

We study the time evolution of interacting Bose gases and Fermi/Fermi-mixtures in an one-dimensional optical lattice in the framework of the time-dependent Bose- and Fermi-Hubbard-model. We compute the exact time evolution of the system to simulate its dynamic behaviour under temporal and spatial perturbations. As in the experiment by Stöferle et. al. [Phys. Rev. Lett. 92, 130403 (2004)] we can, e.g., modulate the depth of the lattice potential. We discuss the evolution of observables like mean occupation number, number variance and energy transfer over a wide range of interaction strengths to examine the behaviour of such systems especially in the regime of the quantum phase transitions. Our results for Bose gases are in good qualitative agreement with the recent experimental data. The calculations on Fermi/Fermi-mixtures provide valuable information for future experiments.

Q 49.3 Di 17:30 HU Kinosaal

The Dynamic Structure Factor of the 1D Bose Gas near the Tonks-Girardeau Limit — •Joachim Brand[1] and Alexander Cherny[1,2] — [1]Max Planck Institut fuer Physik komplexer Systeme, Dresden — [2]Bogoliubov Laboratory of Theoretical Physics,Joint Institute for Nuclear Research, Dubna, Russia

While the 1D Bose gas appears to exhibit superfluid response under certain conditions, it fails the Landau criterion according to the elementary excitation spectrum calculated by Lieb. The apparent riddle is solved by calculating the dynamic structure factor of the Lieb-Liniger 1D Bose gas. A pseudopotential Hamiltonian in the fermionic representation is used to derive a Hartree-Fock operator, which turns out to be well-behaved and local. The Random-Phase approximation for the dynamic structure factor based on this derivation is calculated analytically and is expected to be valid at least up to first order in $1/\gamma$, where γ is the dimensionless interaction strength of the model. The dynamic structure factor in this approximation clearly indicates a crossover behavior from the non-superfluid Tonks to the superfluid weakly-interacting regime, which should be observable by Bragg scattering in current experiments.

Q 49.4 Di 17:45 HU Kinosaal

Charge and spin dynamics of interacting Fermions in a one dimensional harmonic trap — •Wolfgang Häusler[1], Lars Kecke[2], and Hermann Grabert[2] — [1]Institut für Theoretische Physik, Universität Erlangen, Staudtstr. 7, D-91058 Erlangen, Germany — [2]Physikalisches Institut, Universität Freiburg, Hermann-Herder-Str. 3, D-79104 Freiburg, Germany

We study an atomic Fermi gas interacting through repulsive contact forces in a one dimensional harmonic trap. Bethe-Ansatz solutions lead to an inhomogeneous Tomonaga-Luttinger model for the low energy excitations. The equations of motion for charge and spin density waves are analyzed both near the trap center and near the trap edges. While the center shows conventional spin-charge separation the edges cause a giant increase of the separation between these modes.