A 6 Ultrakalte Atomphysik II: Dynamik mit Bose-Einstein Kondensaten

Zeit: Dienstag 14:00–15:30 Raum: H6

Hauptvortrag

A 6.1 Di 14:00 H6

Interaction-Induced Localization of an Impurity in a Trapped Bose Condensate — •Doerte Blume — Department of Physics and Astronomy, Washington State University, Pullman, WA 99164-2814

The behaviors of weakly interacting Bose gases have been successfully modeled within a mean-field framework. To this end, one replaces the true atom-atom potential by a contact interaction, and solves the resulting many-body Schroedinger equation at the Hartree level. The resulting non-linear single-particle Schroedinger equation, also referred to as Gross-Pitaevskii equation, predicts many behaviors of inhomogeneous Bose gases accurately, including the onset of instability for Bose systems with negative two-body s-wave scattering length for a critical number of particles. Motivated by rapid experimental pogress, we study the ground state properties of a trapped Bose condensate with a neutral impurity. Our self-consistent mean-field treatment provides a first step towards a systematic understanding of impurities in a Bose condensate. We find that the degree of localization of the impurity at the trap center can be controlled by varying the strength of the attractive atom-impurity interactions. As the impurity becomes more strongly localized the peak condensate density, which can be monitored experimentally, grows markedly. For strong enough attraction, the impurity can make the condensate unstable by strongly deforming the atom density in the neighborhood of the impurity. This "collapse" can possibly be investigated in bosenova-type experiments. We also discuss a simple variational treatment which reproduces the key features of the self-consistent results. *This work is supported by the NSF.

A 6.2 Di 14:30 H6

BEC Magnetic Field Microscopy of Polycrystalline Gold Wires — •Simon Aigner[1], Leonardo Della Pietra[1], Ron Folman[2], and Jörg Schmiedmayer[1] — [1]Physikalisches Institut, Universität Heidelberg, Germany — [2]Ben Gurion University, Israel

A Bose Einstein Condensate on an atom chip can be used to measure magnetic field deviations of the trapping potential to unprecedented accuracy [1]. From the measured magnetic field map one can reconstruct angular deviations from straight current flow down to better then 10^{-4}rad. We use this magnetic field microscope to characterize the electric current flow in precisely prepared nano fabricated test wires of thin poly-crystalline gold. The wires have different combinations of grain size (50nm and 140nm), thickness (0.25μm and 2μm) and width (5μm to 200μm), while the edges show a roughness between 10nm-40nm. From our measurements we hope to get a better understanding for the material parameters that lead to deviations in the current direction and the resulting fragmentation potentials in atom chip experiments.The test chip has been fabricated by the group of Ron Folman at Ben Gurion University. We want to acknowledge support by the DFG SCHM1599/2-2, EU:HPRN-CT-2002-00304 (FASTNet) and German-Israel Project DIP-F 2.2.

[1] Wildermuth et al, Nature 435, 440 (26 May 2005)

A 6.3 Di 14:45 H6

Atomic current across an optical lattice — •Alexey Ponomarev[1,2], Javier Madronero[1,3], Andrey Kolovsky[1,2], and Andreas Buchleitner[1] — [1]Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Str. 38, D-01187 Dresden — [2]Kirensky Institute of Physics, Ru-660036 Krasnoyarsk — [3]Physik Department, Technische Universität München, James-Franck-Straße, D-85747 Garching

We devise a microscopic model for the emergence of a collision-induced, fermionic atomic current across a tilted optical lattice. Tuning the – experimentally controlable – parameters of the microscopic dynamics allows to switch from Ohmic to negative differential conductance. We show that relevant parameters can be calculated using the theory of (a)diabatic transitions between instanteneous eigenstates of a time-dependent Hamiltonian.

[1] A. V. Ponomarev, J. Madronero, A. R. Kolovsky, A. Buchleitner, cond-mat/0509602

A 6.4 Di 15:00 H6

Microscopic dynamics of Bose atoms in a parabolic lattice — •Andrey Kolovsky[1,2], Alexey Ponomarev[1,2], and Andreas Buchleitner[1] — [1]Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Str. 38, D-01187 Dresden — [2]Kirensky Institute of Physics, Ru-660036 Krasnoyarsk

We consider bosonic atoms in an anisotropic three dimensional optical lattice, created by standing laser waves with amplitudes $V_z \ll V_x, V_y \sim 30E_R$ (E_R being the recoil energy). The strong transverse confinement of the atoms reduces the problem to that for a small ($N < 100$) ensemble of bosonic atoms in a 1D parabolic lattice, where the atom-atom interaction plays a crucial role. We study the dynamical response of the system to a sudden perturbation (like switching off the magnetic field which compensates the gravitational force), in dependence of the atom number N, and of the amplitude V_z of the optical potential along the weak axis of the 3D lattice.

A 6.5 Di 15:15 H6

Thermally Induced Fluctuations of the Relative Phase between two Coupled Bose-Einstein Condensates — •Rudolf Gati, Börge Hemmerling, Timo Ottenstein, Jerome Esteve, and Markus K. Oberthaler — Kirchhoff-Institut für Physik, Universität Heidelberg, Im Neunheimer Feld 227, 69120 Heidelberg

The effects caused by a thermal background play an important role for the experimental investigation of quantum physics with Bose-Einstein condensates. This is due to the fact that real experiments are always performed at finite temperature, even if the thermal background is not directly observable. By introducing an energy scale which is on the order of the thermal energy the effects arising from arbitrarily low temperatures become accessible. Since a Josephson junction consisting of two weakly coupled Bose-Einstein condensates allows for the adjustment of the tunnelling coupling and thus the tuning of the characteristic energy scale it is an ideal probe for the investigation of thermal effects.

Here we report on the experimental investigation of fluctuations of the relative phase between two Bose-Einstein condensates arising from the coupling to a thermal environment and show quantitative agreement with a classical model. Due to this agreement we can apply the measurements of the phase fluctuations as a tool for measuring the temperature in a regime where standard methods fail. With this we are able to monitor the heating up of a Bose-Einstein condensate and deduce the heat capacity of the degenerate weakly interacting Bose gas. The observed heat capacity agrees well with the prediction confirming the third law of thermodynamics.