A 32: Ultra-cold atoms, ions and BEC VI (with Q)

Time: Thursday 11:00–12:30 Location: B 305

A 32.1 Thu 11:00 B 305

Experimental observation of universal scaling at a quantum phase transition — •Eike Nicklas, Moritz Höfer, Wolfgang Müssel, Helmut Strobel, Ion Stroescu, Jiri Tomkovic, Maxime Joos, Daniel Linnemann, David B Hume, and Markus K Oberthaler — Kirchhoff-Institut für Physik, Heidelberg, Germany

A prominent feature of phase transitions is a universal scaling in the divergence of characteristic length and time scales when approaching a critical point. Here we report on the experimental observation of such scaling close to a quantum phase transition in a one-dimensional binary condensate of Rubidium. The quantum phase transition is realized by a microwave dressing field transforming the system from immiscible to miscible, where the distance to the critical point can be well controlled via the amplitude of the dressing field. We investigate the dynamics of in-situ spin-spin correlations and observe scaling behaviour of the correlation length. Both the deduced critical coupling strength and the power law exponent are consistent with theoretical predictions.

A 32.2 Thu 11:15 B 305

Coupled l-wave confinement-induced resonances in cylindrically symmetric waveguides — •Panagiotis Giannakeas[1], Fotios Diakonos[2], and Peter Schmelcher[1] — [1]Zentrum für Optische Quantentechnologien, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — [2]Department of Physics, University of Athens, GR-15771 Athens, Greece

A semi-analytical approach to atomic waveguide scattering for harmonic confinement is developed taking into account all partial waves. As a consequence l-wave confinement-induced resonances are formed being coupled to each other due to the confinement. The corresponding resonance condition is obtained analytically using the K-matrix formalism. Atomic scattering is described by transition diagrams which depict all relevant processes the atoms undergo during the collision. Our analytical results are compared to corresponding numerical data and show very good agreement.

A 32.3 Thu 11:30 B 305

Evaporative cooling and thermalization in one-dimensional Bose gases — •Bernhard Rauer, Tim Langen, Michael Gring, Max Kuhnert, David Adu Smith, Remi Geiger, and Jörg Schmiedmayer — Vienna Center for Quantum Science and Technology, Atominstitut, Technische Universität (TU) Wien, Stadionallee 2, 1020 Vienna, Austria.

We experimentally study the process of evaporative cooling for a one-dimensional (1D) Bose gas in the quasi-condensate regime. While this process is well understood for 3D systems, evaporative cooling in 1D is strongly affected by the discrete level structure of the trap and the strongly inhibited thermalization. Consequently, the exact mechanism is still the subject of theoretical debate. The problem is closely related to our ongoing effort to understand relaxation and thermalization in a 1D quantum gases. The current status of this investigation will be presented.

A 32.4 Thu 11:45 B 305

Hermitian four-well potential as a realization of a $\mathcal{PT}$ symmetric system — •Manuel Kreibich, Jörg Main, and Günter Wunner — 1. Institut für Theoretische Physik, Universität Stuttgart, Pfaffenwaldring 57, 70550 Stuttgart, Germany

A $\mathcal{PT}$ symmetric Bose-Einstein condensate can be theoretically described using a complex optical potential, however, the experimental realization of such an optical potential describing the coherent in- and outcoupling of particles is a nontrivial task.

As an alternative, we propose an experiment for a quantum mechanical realization of a $\mathcal{PT}$ symmetric system. The $\mathcal{PT}$ symmetric currents of a two-well system are implemented by coupling two additional wells to the system, which act as particle reservoirs. In terms of a simple four-mode model we derive conditions under which the two middle wells of the Hermitian four-well system behave *exactly* as the two wells of the $\mathcal{PT}$ symmetric system. We apply these conditions to calculate stationary solutions and oscillatory dynamics. By means of frozen Gaussian wave packets we relate the Gross-Pitaevskii equation to the four-mode model and give parameters required for the external potential, which provides approximate conditions for a realistic experimental setup.

A 32.5 Thu 12:00 B 305

The impact of spatial correlation on the tunneling dynamics of few-boson mixtures — •Lushuai Cao, Ioannis Brouzos, Budhaditya Chatterjee, and Peter Schmelcher — Zentrum für Optische Quantentechnologien, Universität Hamburg, Germany

We investigate the tunneling properties of a two-species few-boson mixture in a one dimensional triple well and harmonic trap. The mixture is prepared in an initial state with a strong spatial correlation for one species and a complete localization for the other species. We observe a correlation induced tunneling process in the weak interspecies interaction regime. The onset of the interspecies interaction disturbs the spatial correlation of one species and induces tunneling among the correlated wells. The corresponding tunneling properties can be controlled by the spatial correlations with an underlying mechanism which is inherently different from the well known resonant tunneling process. We also observe the correlated tunneling of both species in the intermediate interspecies interaction regime and the tunneling via higher band states for strong interactions.

A 32.6 Thu 12:15 B 305

Thermally induced coherent collapse of dipolar Bose-Einstein condensates — •Andrej Junginger[1], Jörg Main[1], Günter Wunner[1], and Thomas Bartsch[2] — [1]1. Institut für Theoretische Physik, Universität Stuttgart, Germany — [2]Department of Mathematical Sciences, Loughborough University, UK

We investigate Bose-Einstein condensates (BECs) with additional anisotropic and long-range dipolar interaction at finite temperature. The ground state of such a system is metastable and one decay mechanism is the BEC's coherent collapse due to collective thermal excitations. With focus on the latter and as an alternative to solving the Hartree-Fock-Bogoliubov equations, we make use of a variational approach to calculate the corresponding decay rates at temperatures small compared to the critical temperature. Within this variational approach, the collectively excited states of the condensates which form the "activated complex" are accessible. Using a normal form expansion of the equations of motion and the energy functional, the variational parameters can be mapped to classical phase space which allows for the application of transition-state theory. We show that the collapse dynamics of the dipolar BEC breaks the symmetry of the external trap if it is confined cylindrically symmetrical and present thermal decay rates for different temperatures of the quantum gas obtained from a variational ansatz using coupled Gaussian orbitals.