Q 40: Quantengase (Bosonen I)

Zeit: Donnerstag 14:00–16:00 Raum: 1A

Q 40.1 Do 14:00 1A

Differences between mean-field dynamics and N-particle quantum dynamics as a signature of entanglement — Christoph Weiss[1,3] and •Niklas Teichmann[2,3] — [1]Laboratoire Kastler Brossel, École Normale Supérieure, Université Pierre et Marie-Curie-Paris 6, CNRS, Paris, France — [2]Institut Henri Poincaré, Centre Emile Borel, Paris, France — [3]Institut für Physik, Carl von Ossietzky Universität, Oldenburg, Germany

A Bose-Einstein condensate in a tilted double-well potential under the influence of time-periodic potential differences is investigated in the regime where the mean-field (Gross-Pitaevskii) dynamics become chaotic. For some parameters near stable regions, even averaging over several condensate oscillations does not remove the differences between mean-field and N-particle results. While introducing decoherence via piecewise deterministic processes reduces those differences, they are due to the emergence of mesoscopic entangled states in the chaotic regime.

Q 40.2 Do 14:15 1A

Anisotropic scattering of Bogoliubov quasi particles — •Christopher Gaul and Cord A. Müller — Universität Bayreuth

In order to study the interplay of disorder and interaction in atomic BECs, we investigate scattering of Bogoliubov quasi particles (BQP) by the spatial fluctuations of an external optical potential. We first calculate the amplitude for a single scattering event. In contrast to the case of noninteracting particles, the scattering amplitude of BQPs has a sign change and consequently a node at a certain angle. In the long-wavelength limit, we understand this as a fundamental sound-wave property, which becomes apparent in a hydrodynamic formulation. This scattering anisotropy has the curious consequence that in the 2D multiple-scattering regime the diffusive Boltzmann transport length becomes shorter than the scattering mean free path for particle-like excitations scattered by short-range correlated potentials.

Q 40.3 Do 14:30 1A

Commuting Heisenberg operators in the Wigner representation — •Bettina Berg[1], Lev Plimak[1], Murray K. Olsen[2], Michael Fleischhauer[3], and Wolfgang P. Schleich[1] — [1]Institute of Quantum Physics, Ulm University, Germany — [2]School of Physical Sciences, University of Queensland, Australia — [3]Fachbereich Physik, Technische Universität Kaiserslautern, Germany

We discuss commuting Heisenberg operators as a response problem in the phase space. In the Wigner representation one calculates averages of symmetrically ordered two-time operator pairs [1]. As the quantities that are experimentally measured are the time-normally ordered correlation functions, we need a way of commuting Heisenberg operators at different times. For an operator pair, solution to this problem is given by Kubo's linear response relation [2] expressing the commutator as a linear response function. This quantity can be found in the Wigner representation simply by adding sources to the "Langevin" equations in the phase space. By using the truncated Wigner representation [3], one can calculate the normally-ordered correlation functions approximately yet with relative ease. These techniques are demonstrated for the Bose-Hubbard model [4].

[1] L. I. Plimak, M. K. Olsen, M. Fleischhauer, M. J. Collett, Europhys. Lett. **56**, 372 (2001). [2] R. Kubo, *Lectures in Theoretical Physics, v. 1* (Wiley, New York, 1959). [3] M. J. Werner, P. D. Drummond, J. Comput. Phys. **132**, 312 (1997). [4] D. Jaksch, C. Bruder, J. I. Cirac, C. W. Gardiner, P. D. Zoller, Phys. Rev. Lett. **81**, 3108 (1998).

Q 40.4 Do 14:45 1A

Transverse instability of straight vortex lines in dipolar Bose-Einstein condensates — •Michael Klawunn[1], Rejish Nath[1], Paolo Pedri[2], and Luis Santos[1] — [1]Institut für Theoretische Physik , Leibniz Universität Hannover, Appelstr. 2, D-30167, Hannover, Germany — [2]Laboratoire de Physique Theorique et Modeles Statistiques, Universite Paris Sud, 91405 Orsay Cedex, France

The physics of vortex lines in dipolar condensates is studied. Due to the nonlocality of the dipolar interaction, the 3D character of the vortex plays a more important role in dipolar gases than in typical short-range interacting ones. In particular, the dipolar interaction significantly affects the stability of the transverse modes of the vortex line. Remarkably, in the presence of a periodic potential along the vortex line, the spectrum of transverse modes shows a roton minimum, which eventually destabilizes the straight vortex when the BEC as a whole is still stable, opening the possibility for new scenarios for vortex-line configurations in dipolar gases.

Q 40.5 Do 15:00 1A

The spectrum of a non-Hermitian two-mode Bose-Hubbard system — •Eva-Maria Graefe[1], Uwe Guenther[2], Astrid Niederle[1], and Hans Jürgen Korsch[1] — [1]TU Kaiserslautern, Germany — [2]Forschungszentrum Dresden Rossendorf, Germany

We study an N-particle, two-mode Bose-Hubbard system, modelling a Bose-Einstein condensate in a double-well potential. By introducing effective complex energies to the modes we describe a coupling to a continuum. The eigenvalues of the resulting non-Hermitian matrix model are in general complex where the imaginary parts describe the decay rate into the continuum. In dependence on the systems parameters, the eigenvalues show intricate patterns of avoided and real crossings, as well as characteristic bifurcations. In the present talk the effect of the interplay between the particle interaction and the non-Hermiticity on characteristic features of the spectrum is analysed and its peculiarities are clarified by perturbational methods.

Q 40.6 Do 15:15 1A

Phase fluctuations in one-dimensional quasi-condensates — •Stephanie Manz, Thomas Betz, Christian Koller, Robert Bücker, Wolfgang Rohringer, Aurélien Perrin, Thorsten Schumm, and Jörg Schmiedmayer — Atominstitut der Österreichischen Universitäten, Technische Universität Wien, Stadionallee 2, A-1020 Vienna, Austria

Due to the possibility to fabricate wire structures down to the micrometer scale, atomchips are ideally suited to examine ultracold one-dimensional systems. In contrast to the three-dimensional case, one-dimensional sytems do not exhibit long-range order. The respective phase fluctuations can either be seen in interference experiments with split one-dimensional Bose-Einstein condensates [1,2] or by directly observing density modulations in time-of-flight images [3].

We study the ballistic expansion of tightly confined atomic clouds and compare the results to theory.

[1] S. Hofferberth et al., Nature Phys. **2** 710 (2006).
[2] G.-B. Jo et al., arXiv:0706.4041v3
[3] D. Hellweg et al., Appl. Phys. B **73** 173 (2001).

Q 40.7 Do 15:30 1A

Bose-Einstein condensates and optical waveguides — •J. Nes, S. Hertsch, M. Krutzik, T. Lauber, O. Wille, and G. Birkl — Institut für Angewandte Physik, Technische Universität Darmstadt, Schlossgartenstr. 7, 64289 Darmstadt

Achieving Bose-Einstein condensation in optical potentials has been tried since the early days of laser cooling. The first BEC in a dipole trap was created with a CO2 laser. Since then, achieving BEC in optical potentials is routine. However, using a CO2 laser to trap and evaporate atoms is favourable for some, but might be inconvenient for other implementations. Therefore, several groups have been trying to create BECs by trapping atoms with lasers with lower wavelengths. So far, only few groups have reached condensation with a laser having a wavelength in the one micron range by simple means.

Our work aims at creating ultracold atom samples in the sub-microKelvin temperature range and especially BECs, in a crossed optical dipole trap made with a laser with a wavelength of 1030 nm. After reaching these temperatures, the atoms are transferred into an optical guiding or storing structure created by microfabricated optical elements, so that the coherence properties can be studied. One of our projects is to guide the atoms along a waveguide and past a corrugated optical potential surface, such as an optical lattice, in order to investigate the modification of the wavepacket dynamics as compared to an uncorrugated guiding structure.

Q 40.8 Do 15:45 1A

Quantum chaos limits DMRG efficiency — •Hannah Venzl[1], Florian Mintert[1], Andrew Daley[2], and Andreas Buchleitner[1]

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The spectrum of the Bose-Hubbard Hamiltonian exhibits quantum chaos for certain ranges of the system parameters. One possible way to probe the chaos transition in this system is by tuning the strength of an additional static force. Likewise, the efficiency of time-dependent Density Matrix Renormalization Group (t-DMRG) simulations of the system dynamics depends strongly on the applied static field. We probe the connections between this loss of efficiency and the underlying spectral structure.