Q 10: Quantum Gases: Bosons 2

Time: Monday 14:30–16:00 Location: HÜL 386

Q 10.1 Mon 14:30 HÜL 386

Non-Equilibrium Dynamics of 1d Bose Gases Studied via Quantum Noise Distributions — •Tim Langen, Michael Gring, Maximilian Kuhnert, David Alexander Smith, and Jörg Schmiedmayer — Atominstitut, Technische Universität Wien, 1020 Wien, Österreich

The non-equilibrium dynamics of many-body quantum systems is at the center of many fundamental questions such as decoherence, phase transitions and transport phenomena. Here we present a first test of the use of quantum noise distributions to study the dynamics of such systems. We employ a coherently split one-dimensional ultracold Bose gas, which provides a highly non-equilibrium state that is easily accessible and offers a striking example of the effects of interactions on correlated many-body systems. By mapping noise distributions at different length scales of the system, we demonstrate that the multimode character and enhanced role of fluctuations in one-dimensional systems play a dramatic role in the resultant non-equilibrium dynamics.

Q 10.2 Mon 14:45 HÜL 386

Quantum superpositions of Bose-Einstein condensates and periodic shaking — •Christoph Weiss — Institut für Physik, Universität Oldenburg, 26111 Oldenburg

Quantum superpositions of ultra-cold atoms are investigated for periodically shaken systems [1-3]. The focus of the talk will lie on how to distinguish quantum superpositions from statistical mixtures. All proposals would start with Bose-Einstein condensates.

[1] C. Weiss and N. Teichmann. Differences between mean-field dynamics and N-particle quantum dynamics as a signature of entanglement. Phys. Rev. Lett., 100:140408, 2008.

[2] B. Gertjerenken, S. Arlinghaus, N. Teichmann, and C. Weiss. Reproducible mesoscopic superpositions of Bose-Einstein condensates and mean-field chaos. Phys. Rev. A, 82:023620, 2010.

[3] K. Stiebler, B. Gertjerenken, N. Teichmann, and C. Weiss. Spatial two-particle quantum superpositions in periodically driven three-well potentials. Submitted to J. Phys. B, 2010.

Q 10.3 Mon 15:00 HÜL 386

Open Bose-Hubbard model: Beyond the mean-field approximation — •Georgios Kordas[1], Dirk Witthaut[2], and Sandro Wimberger[1] — [1]Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 19, D-69120 Heidelberg, Germany — [2]Max-Plank-Institute for Dynamics and Self-Organization, D-37073 Göttingen, Germany

We investigate the dissipative dynamics of bosonic quantum gases, beyond the mean-field approximation. To this end we use a Bose-Einstein condensate in an optical lattice subject to localized particle dissipation and phase noise. Our starting point is the full many-body dynamics, which is described by a master equation. We use this equation to derive the generalized mean-field and Bogoliubov backreaction approximations. The second method is taking into account higher-order correlation functions, so it gives a much better simulation of the many-body dynamics than the mean-field approach. As it will be shown the localized particle dissipation leads to surprising dynamics, since it can suppress the decay and restore the coherence of a Bose-Einstein condensate.

Q 10.4 Mon 15:15 HÜL 386

Solitons and solitons' filaments in an array of one-dimensional dipolar condensates. — •Kazimierz Łakomy[1], Rejish Nath[2], and Luis Santos[1] — [1]Institut für Theoretische Physik, Leibniz Universität Hannover, Appelstrasse 2, 30167 Hannover, Germany — [2]Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Strasse 38, 01187 Dresden, Germany

Dipolar ultracold gases offer broad spectrum of novel physical phenomena due to the long-range and anisotropic character of the dipole-dipole interactions. The effects of the interactions are particularly relevant to what concerns the nonlinear properties of dipolar Bose Einstein condensates. In this talk, we will focus on the physics of one-dimensional solitons. After presenting some new properties of the solitons in dipolar gases, we will discuss the possibility of achieving solitons' filaments in an array of dipolar condensates. Even in the case of the absence of a hopping between the sites of the array, the inter-site attractive dipole-dipole interactions are shown to introduce an inter-soliton attractive potential that leads to the formation of solitons' filaments. We analyze this possibility for realistic systems with condensates of chromium and polar molecules, and discuss possible ways to probe the filaments.

Q 10.5 Mon 15:30 HÜL 386

Dissipative defects in ultracold quantum gases — •Matthias Scholl, Arne Ewerbeck, Andreas Vogler, Peter Würtz, Vera Guarrera, Giovanni Barontini, and Herwig Ott — Fachbereich Physik, Universität Kaiserslautern

We study the evolution of a Bose-Einstein condensate subjected to a local dissipative defect. In our experiment, we locally remove atoms from the cloud by ionizing them with a focussed electron beam. By analyzing the time resolved ion signal, we explore the decay dynamics of the BEC. Theoretically, we model the decay by a numerical simulation of the Gross-Pitaevskii equation with an imaginary potential.

Q 10.6 Mon 15:45 HÜL 386

Turbulent dynamics of ultracold bosons — •Jan Schole[1,2], Maximilian Schmidt[1,2], Boris Nowak[1,2], Denes Sexty[1,2], and Thomas Gasenzer[1,2] — [1]Institut für Theoretische Physik, Ruprecht-Karls-Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt, Germany

Turbulent dynamics in an ultracold Bose gas, in one, two and three spatial dimensions, is analysed by means of statistical simulations using the classical field equation. A special focus is set on the time-evolution of characteristic quantities such as the energy and velocity distributions, vortical density and spectral function. The results give insight into the dynamics of an ultracold Bose gas in the quantum turbulent regime.