Q 27: Poster Quantengase

Zeit: Dienstag 16:30–19:00 Raum: Poster C2

Q 27.1 Di 16:30 Poster C2

Transport properties of Bogoliubov excitations in correlated disorder — •Christopher Gaul, Christian J. Harrer, and Cord A. Müller — Universität Bayreuth

We study 2D quantum transport in a many-body system by considering a Bose-Einstein condensate in a correlated disordered optical potential. The correlation length of the disorder potential together with the healing length are the two relevant length scales of the problem. The effective transport characteristics of Bogoliubov excitations are investigated by calculating suitable configuration averages. We obtain the disorder-broadened Bogoliubov dispersion relation, the scattering length, and the transport mean free path. In particular we examine the regime where the disorder correlation length is not the shortest of all length scales.

Q 27.2 Di 16:30 Poster C2

Bloch dynamics of a BEC: mean-field vs. microscopic descriptions — •Eva-Maria Graefe[1], Andrey R. Kolovsky[2], and Hans Jürgen Korsch[1] — [1]TU Kaiserslautern, Germany — [2]Kirensky Institute of Physics, Krasnoyarsk, Russia

Recently much attention is paid to the Bloch dynamics of a BEC loaded into an optical lattice, subject to a static, for example, gravitational field. We compare two theoretical approaches to this problem, the mean-field description, based on the discrete nonlinear Schrödinger equation (DNLSE), and the microscopic description, based on the Bose-Hubbard model. Within the mean-field approach the main phenomena related to the Bloch dynamics are the dynamical instability (also known as modulation instability) and self-thermalization due to the onset of classical chaos in the DNLSE. We argue that the quantum manifestations of these phenomena are the depletion of the Floquet-Bogoliubov states, defined as the "low-energy" eigenstates of the evolution operator over one Bloch period, and the decoherence of the BEC. The correspondence between mean-field and microscopic description is analysed in dependence on the number of particles as well as on the magnitude and direction (for 2D or 3D lattices) of the static field.

Q 27.3 Di 16:30 Poster C2

Atom Laser by all-optical means for Atom Interferometry — •Maic Zaiser, Temmo Wübbena, Stefan Jöllenbeck, Wolfgang Ertmer, and Ernst Maria Rasel — Leibniz Universität Hannover

We present the current status of our all-optical ATom LASer (ATLAS), an experiment aiming at Bose-Einstein-Condensation (BEC) in a dilute atomic gas of ^{87}Rb by all-optical means. The project is motivated by the possible improvements of the accuracy of matter-wave interferometers based on quantum degenerated atoms. Optical dipole traps allow a high repetition rate in an interferometer and are also able to trapp all m_F-substates, especially $m_F = 0$, which is in the first order insensitive to magnetic fields. We investigate the potential of such an atomic source for precision atom interferometers, such as the Cold Atom Sagnac Interferometer (CASI) [1] currently being set up in Hanover.

The atomic source consists of a three dimensional magneto-optical trap (3D-MOT) loaded by a 2D-MOT. We present the very compact vacuum chamber and a compact laser system for atom cooling employing modular integrated and fiber-based optics ensuring a high stability of the system. We will discuss the suitability of a high power Thulium fiber laser at 2 μm wavelength for trapping and evaporatively cooling atoms to quantum degeneracy. This work is part of the project FINAQS funded by the European Union. (www.finaqs.uni-hannover.de)

[1] Versatile compact atomic sources for high resolution dual atom interferometry; T. Müller, T. Wendrich, M. Gilowski, C. Jentsch, E.M. Rasel, W. Ertmer Phys. Rev. A, in press.

Q 27.4 Di 16:30 Poster C2

Bose-Einstein condensation and atom optical experiments — •Thomas Lauber[1], Susanne Hertsch[1], Markus Krutzik[1], Johanna Nes[1], Oliver Wille[1], Anna Sanpera[2], and Gerhard Birkl[1] — [1]Institut für Angewandte Physik; Technische Universität Darmstadt, Schlossgartenstr. 7, D-64289 Darmstadt — [2]Department of Physics, Theoretical Physics Group, Universitat Autónoma Barcelona, E-08193 Bellaterra

Optical trapping and guiding configurations have evolved as a powerful tool for the manipulation of ultracold atoms. In our experiment, rubidium atoms are loaded in a crossed optical dipole trap of 1030nm laser beams directly from a MOT. We create ultracold atom samples in the sub-microKelvin temperature range by evaporative cooling.

The advantage of a pure optical setup is its flexibility and independence of the magnetic properties of the trapped atoms. It is also possible to superimpose arbitrary magnetic fields on the trapping configuration. Our work aims at studying the coherence properties of ultracold thermal atoms and degenerate quantum gases in traps created by miniaturized optical lens structures. With these elements we can realize various trap geometries including a storage ring for atom interferometry experiments, and optical waveguides, in which the ultracold gas can be transferred.

Recent calculations promise an interesting velocity selective behaviour in one-dimensional periodic structures superimposed on a waveguide. We can implement these structures either with standing waves or microlens arrays.

Q 27.5 Di 16:30 Poster C2

Mesoscopic physics in quantum gases — •Bruno Zimmermann, Torben Müller, Henning Moritz, and Tilman Esslinger — Institute of Quantum Electronics, ETH Zürich, Hönggerberg, CH-8093 Zürich, Switzerland

We present an experimental setup which allows us to study an ultracold fermionic quantum gas in a potential that can be arbitrarily controlled down to the smallest relevant length scale, i.e. that of the atomic wavefunction. The basic idea is to prepare an ultracold gas of fermionic lithium in a region of high optical access by using standard laser cooling and trapping technics, followed by a transport and direct evaporation in an optical dipole trap. In the final position the gas will be sandwiched between two microscopes. The shape of the laser beams focused by these microscopes, i.e. the shape of the optical potential, will be controlled by spatial light modulators. The interaction strength of colliding atoms can be tuned by accessing a Feshbach resonance. This setup will allow us to study Josephson oscillations in the BEC-BCS crossover regime and to manipulate strongly correlated atomic samples on a local scale. First results on the cooling and trapping will be shown.

Q 27.6 Di 16:30 Poster C2

Far-From-Equilibrium Dynamics of an Ultracold Fermi Gas — •Matthias Kronenwett and Thomas Gasenzer — Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg

The dynamics of ultracold Fermi gases far from thermal equilibrium is studied. A functional-integral approach based on the Schwinger-Keldysh closed time path integral is employed to derive the two-particle irreducible (2PI) effective action. From this, the two-point correlation functions are determined self-consistently. The action is expanded in inverse powers of the number of field components $\mathcal{N}$, and the dynamic equations are derived in next-to-leading order of this expansion. This approach reaches far beyond mean-field theory and includes quantum statistical aspects of equilibration dynamics. It enables to describe, e. g., the dynamical evolution of trapped Fermi gases in optical lattices, as well as the BEC-BCS crossover dynamics.

Q 27.7 Di 16:30 Poster C2

Towards a degenerate mixture of ^{6}Li and ^{40}K — •Antje Ludewig, Tobias Tiecke, Sebastian Kraft, Steve Gensemer, and Jook Walraven — Van der Waals-Zeeman-Instituut, Universiteit van Amsterdam, The Netherlands

We have constructed an apparatus for the simultaneous cooling of the fermionic isotopes ^{6}Li and ^{40}K. Our goal is to get a degenerate mixture to search for novel pairing mechanisms involving fermions of different masses.

Instead of using a Zeeman slower as a source for cold lithium atoms we have developed a lithium 2D-MOT which is loaded directly from thermal vapor emitted by an hot oven at 400C. A second 2D-MOT, loaded from ^{40}K enriched vapor, serves as a potassium source.

Using these bright sources we load via differential pumping sections 10^9 atoms of both ^{6}Li and ^{40}K into a dual MOT in the main vacuum chamber. We then transfer both species into a magnetic trap and cool them by forced evaporation.

The current status of the experiment is summarized on the poster.

Q 27.8 Di 16:30 Poster C2

Interacting Rubidium and Caesium Atoms — •Shincy John, Michael Haas, Nicolas Spethmann, Lars Steffens, Claudia Weber, Artur Widera, and Dieter Meschede — Institut für Angewandte Physik, Universität Bonn, Wegelerstr. 8, 53115 Bonn

In our experimental set up we magnetically trap a mixture of Rubidium and a few Caesium atoms simultaneously. We selectively cool only Rubidium atoms by a microwave field tuned to the Rubidium ground state hyperfine transition. Caesium is sympathetically cooled via elastic collisions with Rubidium. We are able to cool down the mixture to temperatures below 1μK. Analysing the dynamics of sympathetic cooling we have estimated a lower limit for the Rubidium-Caesium s-wave scattering length to 150 a_0. Our next step is to load the mixture in an optical dipole trap. Using an external homogeneous magnetic field we intend to tune the inter-species interaction. We will present our latest results.

Q 27.9 Di 16:30 Poster C2

Lattice physics in ultracold Bose-Fermi mixture gases — •Philipp Ernst[1], Sören Götze[1], Karsten Pyka[1], Kai Bongs[2], and Klaus Sengstock[1] — [1]Institut für Laserphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg — [2]Midlands Centre for Ultracold Atoms, School of Physics and Astronomy, University of Birmingham, Edgbaston, Birmingham B15 2TT, United Kingdom

Ultracold gas experiments have the huge advantage of being pure and tunable systems. In our experiment we use a KRb mixture giving access to different statistics which can be loaded into a far red-detuned optical lattice at 1030nm. The system furthermore offers several options to manipulate the gases from excellent magnetic field control to access Feshbach resonances over microwave and rf tools for spectroscopic as well as state preparation purposes. We present recent developments in the preparation, manipulation and detection of quantum states in optical lattices.

Q 27.10 Di 16:30 Poster C2

Transport of a quantum degenerate heteronuclear Bose-Fermi mixture in a harmonic trap — Carsten Klempt, Thorsten Henninger, •Oliver Topic, Johannes Will, Stephan Falke, Wolfgang Ertmer, and Jan Arlt — Institut für Quantenoptik, Leibniz Universität Hannover, Welfengarten 1, D-30167 Hannover, Germany

We report on the simultaneous transport of mixed quantum degenerate gases of bosonic ^{87}Rb and fermionic ^{40}K in a harmonic potential. The samples are transported over a distance of up to 6 mm to the geometric center of the anti-Helmholtz coils of the QUIC trap.

This magnetic transport scheme is an important tool for the manipulation of quantum degenerate gases, since it enables transport experiments with large quantum degenerate samples in macroscopic trap configurations without disturbances added by close by surfaces. Since the mechanism may be cascaded to cover even larger distances, it is of particular relevance for interference experiments which can particularly profit from the signal-to-noise ratio available with large samples.

In addition, this novel method allows all experiments using QUIC traps to significantly improve the experimental conditions. We demonstrate two particular experiments which profit from the transport scheme. By transporting the atoms to the centre of the trap, the highly homogeneous magnetic field that can be created there is available to experiments which exploit Feshbach resonances to tune the atomic interaction. The mechanism may also be used to accelerate and launch atomic clouds for further experiments.

Q 27.11 Di 16:30 Poster C2

From BEC to fermionization in 1-D double-well traps — •Sascha Zöllner[1], Hans-Dieter Meyer[1], and Peter Schmelcher[1,2] — [1]Universitaet Heidelberg, Theoretische Chemie, Im Neuenheimer Feld 229, 69120 Heidelberg — [2]Universitaet Heidelberg, Physikalisches Institut, Philosophenweg 12, 69120 Heidelberg

We investigate the transition of a quasi-one-dimensional few-boson system from weak correlations to the fermionization limit of infinitely repulsive forces. Based on a numerically exact multi-configurational method (MCTDH), we show that the ground state reveals 'localization' of the particles, which can be interpreted as mimicking Pauli's exclusion principle. We provide a deeper understanding of that transition by relating it to the loss of coherence in the one-body density matrix and to the emerging long-range tail in the momentum distribution.

This crossover has striking effects on the tunnel dynamics of few atoms in a double well. Starting from Rabi oscillations in the noninteracting limit, correlated pair tunneling evolves as the interaction is slightly increased, reminiscent of self-trapping for BECs. Toward the fermionization limit, however, we observe modulated Rabi oscillations of a strongly correlated atom pair.

Q 27.12 Di 16:30 Poster C2

Transport of Bose-Einstein condensates through two-dimensional mesoscopic structures — •Timo Hartmann, Michael Hartung, Klaus Richter, and Peter Schlagheck — Institut für theoretische Physik, Universität Regensburg

The tremendous progress over the last decade in the experimental techniques for Bose-Einstein condensates permits the creation of almost arbitrarily shaped confinement geometries for interacting matter waves on the basis of atom chips or atom-optical billiards [1]. This opens new experimental possibilities for probing the transport properties of Bose-Einstein condensates through mesoscopic scattering geometries.

We numerically investigate the quasi-stationary propagation of a condensate through two dimensional cavities within the mean-field approximation of the condensate. This is accomplished using a generalisation of the approach used in Ref. [2] to two dimensions. Special attention is paid to the resonance structures in the transmission spectrum which are strongly modified through the non-linear term in the Gross-Pitaevskii equation.

[1] V. Milner et al. Phys. Rev. Lett. 86, 1519 (2001), N. Friedman et al. Phys. Rev. Lett. 86, 1518 (2001)
[2] T. Paul et al., Phys. Rev. Lett. 94 (2005)

Q 27.13 Di 16:30 Poster C2

How Dissipation Fermionizes a One-Dimensional Gas of Bosonic Molecules and Atom-Molecule Oscillations in a Mott Insulator — •Dominik Bauer, Matthias Lettner, Niels Syassen, Thomas Volz, Daniel Dietze, Stephan Dürr, and Gerhard Rempe — Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Str. 1, 85748 Garching, Germany

Here we report on our latest results about ultracold molecules in optical lattices.

First, we show how dissipation creates a Tonks gas of molecules. If a gas of bosons is confined to 1D, the interaction between particles can become so important that the strongly correlated regime is reached. This is called a Tonks-Girardeau gas. In the limit of infinite interaction strength, one cannot find two bosons at the same position. Previous studies of the Tonks Gas relied on elastic interactions.

Second, we observe large-amplitude Rabi oscillations between an atomic and a molecular state near a Feshbach resonance. The frequency and amplitude of the oscillations are well described by a two-level model. The observed density dependence of the oscillation frequency agrees well with the theoretical prediction. We confirm that the state produced after a half-cycle contains exactly one molecule at each lattice site. In addition, we show that for energies in a gap of the lattice band structure, the molecules cannot dissociate.

Q 27.14 Di 16:30 Poster C2

Bosonic and fermionic metastable neon atoms in optical and magnetic traps — •Jan Schütz, Eva-Maria Kriener, Wouter van Drunen, Norbert Herschbach, and Gerhard Birkl — Institut für Angewandte Physik, Technische Universität Darmstadt, Schlossgartenstr. 7, 64289 Darmstadt

We experimentally investigate the interactions of laser cooled metastable neon atoms in a magneto-optical trap (MOT), in magnetic traps, and optical dipole traps. For the bosonic isotopes ^{20}Ne and ^{22}Ne we determined the rate coefficients for inelastic collisions and the scattering lengths for atoms in the metastable $^3P_2$ state.

As the next step, we succeeded in optically trapping both bosonic isotopes in the metastable $^3P_0$ state and are currently determining the two-body loss coefficients.

Recent extensions of our laser configuration allow us to trap the fermionic isotope ^{21}Ne and mixtures of bosonic and fermionic isotopes. We report on the status of these experiments.

Q 27.15 Di 16:30 Poster C2

Ultracold Atomic Gases in 1D Optical Lattices: Qualitative

behaviour of the DMRG method in inhomogenous topologies — •Felix Schmitt, Markus Hild, Sven Binder, and Robert Roth — Institut fuer Kernphysik, Technische Universitaet Darmstadt

The Density Matrix Renormalisation Group (DMRG) has become the state of the art method to treat ultracold atomic gases in optical lattices. While the infinite-size algorithm is usually sufficient to describe cold atoms in homogenous lattices with high precision even with moderate numbers of many-particle states, it becomes unreliable once inhomogenities occur. In most cases this can be cured by the finite-size DMRG algorithm. We focus on the problem of the Bose-Glass transition in order to study the behaviour of DMRG when unequal degrees of freedom are appended. This may shed light on the behaviour of DMRG applied to other quantum mechanical many-body problems, e.g. for nuclei or nuclear matter.

Q 27.16 Di 16:30 Poster C2

Exact theoretical description of two ultracold atoms in a 3D optical lattice — •Sergej Grishkevich and Alejandro Saenz — AG Moderne Optik, Institut für Physik, Humboldt-Universität zu Berlin, Hausvogteiplatz 5-7,10117 Berlin, Germany

The physics of ultracold atoms has attracted a lot of interest since the experimental realization of Bose-Einstein condensation in dilute alkali atom gases. Besides the exciting physics at ultracold energies by itself, a further important progress was the positioning of the ultracold gas in an optical lattice formed with the aid of standing light waves. Atoms in lattice are important systems to study solid state physics since the optical lattice resembles in a certain sense the periodicity of a crystal potential. These systems are furthermore supposed to be of great interest for quantum information purposes.

A theoretical approach was developed that allows for a full numerical description of a pair of ultracold atoms trapped in a three-dimensional optical lattice. This approach includes the possible coupling between center-of-mass and relative motion coordinates in a configuration-interaction type of calculations. The atoms are allowed to interact by their full interaction potential that is, presently, only limited to be central. With the aid of the newly developed method deviations from the harmonic approximation are discussed. The developed method is also used to model experimental data [1].

[1] C. Ospelkaus, S. Ospelkaus, L. Humbert, P. Ernst, K. Sengstock, and K. Bongs, Phys.Rev.Lett. **97**, 120402 (2006).

Q 27.17 Di 16:30 Poster C2

All-optical BEC for an optical lattice experiment with single site addressability — •Jacob Sherson, Oliver Loesdau, Manuel Endres, Jan Petersen, Christof Weitenberg, Immanuel Bloch, and Stefan Kuhr — Institut für Physik,Universität Mainz, Staudingerweg 7, 55128Mainz

In optical lattice experiments, ultracold atoms have to be loaded from a Bose-Einstein condensate (BEC), in order to populate the lowest energy band of the lattice. We report on the generation of a BEC in a crossed optical dipole trap. Laser cooled atoms are transferred from a double MOT system directly into the dipole trap. The dipole trap is formed by a 50 W Yb:YAG fiber laser (1070 nm). The shape of the trap can be dynamically changed by moving the foci of the laser beams. This increases the collision rate and allows for rapid evaporative cooling to the BEC transition within typically 5 s.

The BEC will then be transported by a single beam dipole trap to the experimental region. There, the atoms are transferred into an optical lattice which is placed in front of an ultrahigh resolution optical imaging system. The imaging system is designed to operate at a wavelength of 420.3 nm, corresponding to the $5S_{1/2} \rightarrow 6P_{3/2}$ transition of ^{87}Rb. It has a numerical aperture of NA = 0.75 yielding a diffraction-limited resolution of about 300 nm, which will allow for the detection of individual sites of the optical lattice.

Q 27.18 Di 16:30 Poster C2

Preparing and Detecting Quantum States with Ultracold Atoms in an Optical Superlattice — •Stefan Trotzky[1], Ute Schnorrberger[1], Patrick Cheinet[1], Michael Feld[1,2], Jeff Thompson[1], Simon Fölling[1,3], and Immanuel Bloch[1] — [1]Johannes Gutenberg Universität Mainz — [2]Technische Universität Kaiserslautern — [3]Harvard University, USA

Ultracold atoms in optical lattices have shown to be versatile systems to mimick condensed matter physics. The concept of superlattices for ultracold atoms has recently been realized in experiments and extends the toolbox for the manipulation of the system on the many-body scale. Furthermore, it allows to control effective interactions and dynamics emerging in Hubbard-type models. In our experiments, we combine monochromatic optical lattices on two perpendicular axes with a superlattice on the third axis which is formed by the superposition of two standing light fields with periodicity d and $2d$ to yield an array of double well potentials. We demonstrate how this bichromatic superlattice can be used to realize effective spin Hamiltonians with controllable spin-spin interactions as well as how to measure the atomnumber distribution within the array by means of interaction blockade. Moreover, we are able to create entangled spin-triplet pairs in the double wells and detect these via the coherent transformation into spin-singlet pairs and back.

Q 27.19 Di 16:30 Poster C2

Optical lattice with a staggered magnetic field — •G. Wirth[1], A. Hemmerich[1], L.-K. Lim[2], and C. Morais Smith[2] — [1]Universitaet Hamburg, Institut fuer Laser-Physik, Luruper Chaussee 149, 22761 Hamburg, Germany — [2]Institute for Theoretical Physics, Utrecht University, 3508 TD Utrecht, The Netherlands

We show how an effective staggered magnetic field can be implemented in a two-dimensional bosonic square optical lattice via stimulated Raman scattering and discuss the phase diagram of this quantum system. Apart from the homogeneous superfluid and the Mott insulator, known to exist in the conventional Bose-Hubbard model, a novel kind of superfluid phase arises characterized by finite momentum and a staggered vortex lattice. Its characteristic momentum spectrum permits straight forward experimental detection of this phase.

Q 27.20 Di 16:30 Poster C2

Interaction-induced dephasing of Bloch oscillations - experiments and simulations — •Manfred Mark, Matthias Gustavsson, Elmar Haller, Johann Danzl, and Hanns-Christoph Nägerl — Institut für Experimentalphysik und Forschungszentrum für Quantenphysik, Universität Innsbruck, 6020 Innsbruck, Austria

A BEC in an optical lattice undergoes Bloch oscillations when subject to an external force. However, interactions lead to dephasing, limiting the number of oscillations one can observe.

We quantitatively characterize this dephasing by tuning the interaction strength using a Feshbach resonance. For non-zero interaction strength, structure on a scale much smaller than the Bloch momentum can be observed in the momentum distribution of a dephased condensate.

For vanishing interaction strength, we are able to follow more than 20000 oscillations over 12 s. Also a measurement of the Ramsauer-Townsend minimum with a precision of 10^{-5} was performed. In this regime breakdown and revival phenomena in the presence of an additional harmonic potential can be observed.

The performed measurements are compared to numerical simulations of discrete and non-discrete 1D Gross-Pitaevskii equations.

Q 27.21 Di 16:30 Poster C2

Interaction-controlled transport of an ultracold Fermi gas — •Robert Jördens[1], Niels Strohmaier[1], Yosuke Takasu[2], Kenneth Günter[3], Michael Köhl[4], Henning Moritz[1], and Tilman Esslinger[1] — [1]Institute for Quantum Electronics, ETH Zurich, 8093 Zurich, Switzerland — [2]Department for Electronic Science and Engineering, Kyoto University, Kyoto 615-8510, Japan — [3]Laboratoire Kastler Brossel, 75005 Paris, France — [4]Cavendish Laboratory, University of Cambridge, Cambridge CB3 0HE, United Kingdom

We explore the transport properties of an interacting Fermi gas in a three-dimensional optical lattice. In analogy to the characterization of transport behavior in condensed matter systems through conductivity measurements, we study the atom cloud's center of mass motion after a sudden displacement of the trap minimum.

Different interaction strengths and lattice fillings are shown to have a characteristic influence on the dynamics. With increasingly strong attractive interactions the weakly damped oscillation, observed for the non-interacting case, turns into a slow drift: local pairs with a reduced tunneling rate are formed for strong inter-atomic attraction. This interpretation is supported by a measurement of the number of doubly occupied lattices sites. Application of this technique in other interaction regimes, lattice depths and fillings in the Fermi-Hubbard model may provide a tool for the identification of quantum phases such as the fermionic Mott-insulator. Experimental results on repulsively interacting Fermi gases will be presented.

Q 27.22 Di 16:30 Poster C2

Dynamics of localization phenomena for hard-core bosons in optical lattices — •Birger Horstmann, Ignacio Cirac, and Tommaso Roscilde — Max-Planck-Institut für Quantenoptik, Garching, Deutschland

We investigate the behavior of ultracold bosons in optical lattices with a disorder potential generated via a secondary species frozen in random configurations. The statistics of disorder is associated with the physical state in which the secondary species is prepared. The resulting random potential, albeit displaying algebraic correlations, is found to lead to localization of all single-particle states. We then investigate the real-time dynamics of localization for a hardcore gas of mobile bosons which are brought into sudden interaction with the random potential. Regardless of their initial state and for any disorder strength, the mobile particles are found to reach a steady state characterized by exponentially decaying off-diagonal correlations and by the absence of quasicondensation; when the mobile particles are initially confined in a tight trap and then released in the disorder potential, their expansion is stopped and the steady state is exponentially localized in real space, clearly revealing Anderson localization.

Q 27.23 Di 16:30 Poster C2

Degenerate ground states in a 0-π-junction of an atomic gas — •Matthias Mutschler, Oliver Crasser, Reinhold Walser, and Wolfgang P. Schleich — Institut für Quantenphysik, Universität Ulm, D-89081 Ulm

0-π-Josephson-junctions are an important tool and research subject in superconductivity [1]. In the present contribution we examine an analogous model realised with a two-componend bosonic atomic gas which is trapped in a quasi one-dimensional double well potential. Within a simple four-mode approximation we obtain an system analogous to a 0-π-junction. We present an analysis of the ground states and tunneling effects between the degenerated ground state manifold.

[1] W. Buckel and R. Kleiner, Superconductivity: Fundamentals and applications, Wiley-VCH, Berlin (2004)
[2] E. Goldobin et al., Phys. Rev. B 72, 054527 (2005)
[3] V.M. Kaurov and A.B. Kuklov, Phys. Rev. A 73, 013627 (2006)
[4] E. Goldobin et al., New J. Phys., in preparation

Q 27.24 Di 16:30 Poster C2

Barrier transmission for the one–dimensional nonlinear Schrödinger equation: resonances and transmission profiles — •Kevin Rapedius and Hans Jürgen Korsch — Technische Universität Kaiserslautern, FB Physik, D-67653 Kaiserslautern, Germany

The stationary nonlinear Schrödinger equation (or Gross-Pitaevskii equation) for one-dimensional potential scattering is studied. The nonlinear transmission function shows a distorted profile, which differs from the Lorentzian one found in the linear case. This nonlinear profile function is analyzed and related to Siegert type complex resonances. It is shown, that the characteristic nonlinear profile function can be conveniently described in terms of skeleton functions depending on a few instructive parameters. These skeleton functions also determine the decay behavior of the underlying resonance state. Furthermore we extend the Siegert method for calculating resonances, which provides a convenient recipe for calculating nonlinear resonances. Applications to a double Gaussian barrier and a square well potential illustrate our analysis.

Q 27.25 Di 16:30 Poster C2

Kicked Bose-Hubbard systems and kicked tops – destruction and stimulation of tunneling — •Martin P. Strzys, Eva-Maria Graefe, and Hans Jürgen Korsch — TU Kaiserslautern, Germany

In a two-mode approximation, Bose-Einstein condensates (BEC) in a double-well potential can be described by a many particle Hamiltonian of Bose-Hubbard type. We focus on such a BEC whose interatomic interaction strength is modulated periodically by δ-kicks which represents a realization of a kicked top. In the (classical) mean-field approximation it provides a rich mixed phase space dynamics with regular and chaotic regions. By increasing the kick-strength a bifurcation leads to the appearance of self-trapping states localized on regular islands. This self-trapping is also found for the many particle system, however in general suppressed by coherent many particle tunneling oscillations. By varying the kick-strength and the coupling between the two wells the quasi-energy levels undergo both avoided and even actual crossings. Therefore stimulation or complete destruction of tunneling can be observed for this many particle system. Thus real self-trapping is possible for the full quantum system and the system can be tuned from enforced tunneling to this regime. This yields the possibility of a systematic and accurate population transfer between the two potential wells.

Q 27.26 Di 16:30 Poster C2

Dynamics of a low-dimension ultracold Bose gas — •Cédric Bodet and Thomas Gasenzer — Institüt für Theoretishe Physik, Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg

The dynamical evolution of a Bose-Einstein condensate trapped in a one-dimensional lattice potential is investigated theoretically in the framework of the Bose-Hubbard model. The emphasis is set on the far-from-equilibrium evolution in a case where the gas is strongly interacting. This is realized by an appropriate choice of the parameters in the Hamiltonian, and by starting with an initial state, where one lattice well contains a Bose-Einstein condensate while all other wells are empty. Oscillations of the condensate as well as non-condensate fractions of the gas between the different sites of the lattice are found to be damped as a consequence of the collisional interactions between the atoms. We approach this problem by numerically solving the Schrödinger equation for this model. We study in detail the particle number fluctuations on-site and between sites in order to investigate the conditions for producing squeezed states in experimentally realistic configurations.

Q 27.27 Di 16:30 Poster C2

Bose-Einstein condensates coupled to solid state systems — •Stephan Camerer[1,2], David Hunger[1,2], Daniel König[2], J.P. Kotthaus[2], T.W. Hänsch[1,2], Jakob Reichel[3], and Philipp Treutlein[1,2] — [1]Max-Planck-Institut für Quantenoptik, Garching — [2]Fakultät für Physik, Ludwig-Maximilians-Universität München — [3]LKB, Ecole Normale Superieure, Paris

The experimental fusion of quantum optics and solid-state physics is an emerging and auspicious field of fundamental research. Due to their capability to control atom clouds near surfaces, atomchip experiments seem to be particularly well suited to provide an experimental interface between a quantum optics and a condensed matter system.

Our experiment aims at studying the interaction between small atom clouds, particularly Bose-Einstein condensates (BECs), and nanomechanical resonators. We consider two different coupling schemes: the coupling of a nanoresonator to the magnetic spin of the atoms [P. Treutlein et al., Phys. Rev. Lett. 99, 140403 (2007)] and the coupling of a resonator to the motion of the atoms. In both cases, the BEC serves as a quantum probe for the mechanical motion of the resonator.

The current status of the experiment is reported.

Q 27.28 Di 16:30 Poster C2

Functional renormalisation group approach to far-from-equilibrium quantum field dynamics — •Stefan Kessler, Jan M. Pawlowski, and Thomas Gasenzer — Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg

We present a derivation of dynamic equations for quantum fields far from equilibrium by use of functional renormalisation group techniques. The obtained equations are non-perturbative and lead substantially beyond mean-field and quantum Boltzmann type approximations. The approach is based on a regularised version of the generating functional for correlation functions, where times greater than a chosen cutoff time are suppressed. As a central result a time evolution equation for the non-equilibrium effective action is derived. The time evolution of Green functions is computed within a vertex expansion. In a truncation of the flow equations the dynamic equations as known from the 1/N-expansion of the 2PI effective interaction are recovered.