the Feshbach resonance.

Poster Q 53.10 Thu 17:00 P OG2

Spin and Charge Correlation Measurements in the 2D Hubbard Model — Jan Drewes[1], Luke Miller[1,2], Eugenio Cocchi[1,2], Chun Fai Chan[1], Nicola Wurz[1], •Marcell Gall[1], Daniel Pertot[1], Ferdinand Brennecke[1], and Michael Köhl[1] — [1]Physikalisches Institut, University of Bonn, Wegelerstrasse 8, 53115 Bonn, Germany — [2]Cavendish Laboratory, University of Cambridge, JJ Thomson Avenue, Cambridge CB3 0HE, United Kingdom

We experimentally study the emergence of correlations in an ultracold, fermionic 2D lattice system, representing a realisation of the Hubbard model. Our ability to precisely tune the system parameters over a large range and the possibility to simultaneously detect the density distribution of both spin components in-situ enables us to examine the emergence of density and spin correlations as a function of doping interaction strength and temperature. In addition we gain from the measurement of the equation of state insight into the full thermodynamics of the 2D Hubbard model. To improve our preparation and detection capabilities, we use a spin spiral technique which allows us to detect the spin structure factor at arbitrary wave vectors. Further we employ a spatial light modulator to reshape the underlying trapping potential of the optical lattice to realize the homogeneous Hubbard model and reach lower temperatures by redistributing entropy between different spatial regions.

Poster Q 53.11 Thu 17:00 P OG2

BEC of ^{41}K in a Fermi Sea of ^{6}Li — Rianne S. Lous[1,2], Isabella Fritsche[1,2], •Fabian Lehmann[1,2], Michael Jag[1,2], Emil Kirilov[1,2], Bo Huang[1], and Rudolf Grimm[1,2] — [1]IQOQI, Austrian Academy of Science, Innsbruck, Austria — [2]Inst. for Experimental Physics, University of Innsbruck, Innsbruck, Austria

We report on the production of a double-degenerate Fermi-Bose mixture of ^{6}Li and ^{41}K. In our experimental sequence the potassium atoms are sympathetically cooled by the lithium atoms, which are evaporatively cooled in an optical dipole trap. We obtain 10^4 ^{41}K atoms with a BEC fraction close to 1 and a $T/T_F \approx 0.05$ with 10^5 ^{6}Li atoms in each spin state. To measure the temperature of our fermionic sample we use the ^{41}K BEC as a tool for thermometry. As the system is in thermal equilibrium we evaluate the condensed fraction of our ^{41}K atoms and extract the temperature of the atoms. To investigate the properties of the ^{6}Li-^{41}K mixture near the inter-species Feshbach resonance at 335.8 G we use another scheme of evaporation around 300 G which enables us to achieve similar temperatures. We explore both the repulsive side and attractive side of the Feshbach resonance and observe phase separation for strong repulsive interactions and collapse for attractive interactions. This work is supported by the Austrian Science Fund FWF within the SFB FoQuS.

Poster Q 53.12 Thu 17:00 P OG2

Probing Many-body physics with an ultra-narrow clock transition in an Ytterbium quantum gas — •Bodhaditya Santra[1], Benjamin Abeln[1], Bastian Hundt[1], André Kochanke[1], Thomas Ponath[1], Anna Skottke[1], Klaus Sengstock[1,2], and Christoph Becker[1,2] — [1]Zentrum für Optische Quantentechnologien, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — [2]Institut für Laserphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany

During the last decade ultracold fermionic alkaline earth quantum gas attracted a lot of attention due to their unique properties such as long-lived meta-stable state, an ultra-narrow optical clock transition, SU(N) symmetric interactions as well as the existence of an interorbital Feshbach resonance. In particular fermionic Yb quantum gas allow for quantum simulation of lattice systems with orbital degrees of freedom, like the Kugel-Khomskii model or the Kondo lattice model (KLM).

We will present recent progress of the Hamburg Yb experiment towards realizing the KLM and correlated KLM, including measurements on spin polarized as well as on interacting Fermi gases with an improved clock laser setup.

This work is supported by the DFG within the SFB 925 and the Marie Curie Initial Training Network QTea.

Poster Q 53.13 Thu 17:00 P OG2

Local control of transport in an atomic quantum wire: from one scanning gate to a finite size lattice — •Samuel Häusler[1], Martin Lebrat[1], Dominik Husmann[1], Laura Corman[1], Sebastian Krinner[1], Shuta Nakajima[2], Jean-Philippe Brantut[1], and Tilman Esslinger[1] — [1]Institute for Quantum Electronics, ETH Zürich, 8093 Zürich, Switzerland — [2]Department of Physics, Graduate School of Science, Kyoto University, Kyoto 606-8502, Japan

Building on the holographic shaping of optical potentials and a high-resolution microscope, we demonstrate the local control of fermionic lithium atoms flowing through a one-dimensional structure. We first image the transport through a quantum wire, in a way similar to the scanning gate technique applied to solid state devices. By scanning the position of a sharp, repulsive optical gate over the wire and measuring the subsequent variations of conductance, we spatially map the transport at a resolution close to the transverse wavefunction inside the wire. The control of the gate at the scale of the Fermi wavelength makes it sensitive to quantum tunnelling. Furthermore, our knowledge of the optical potential allows a direct comparison of the experimental maps with a numerical and an analytical model for non-interacting particles.

The flexibility offered by our setup makes it relatively simple to imprint more complex structures. By projecting several consecutive scatterers, a lattice of variable length can be built inside the quantum wire. This opens the path to study metal-insulator physics with strong attractive interactions.

Poster Q 53.14 Thu 17:00 P OG2

Interacting Anyons in a One-Dimensional Optical Lattice — •Martin Bonkhoff, Kevin Jägering, Sebastian Eggert, and Axel Pelster — State Research Center OPTIMAS and Fachbereich Physik, Technische Universität Kaiserslautern, 67663 Kaiserslautern, Germany

We analyze in detail the properties of the one-dimensional Anyon-Hubbard model, which can be mapped to a corresponding Bose-Hubbard model with a density-dependent Peierls phase via a generalized Jordan-Wigner transformation [1]. At first we extend the modified version of the classical Gutzwiller-mean-field ansatz of Ref. [2] in order to obtain the pair-correlation function for both the bosonic and the anyonic system. A comparison of the resulting quasi-momentum distributions with high-precision DMRG calculations reveals in general a parity breaking, which is due to anyonic statistics. Afterwards, we determine how the boundary of the superfluid-Mott quantum phase transition changes with the statistical parameter. We find in accordance with Ref. [1] that the statistical interaction has the tendency to destroy superfluid coherence.

[1] T. Keilmann, S. Lanzmich, L. McCulloch, and M. Roncaglia, Nat. Commun. **2**, 361 (2011)

[2] G. Tang, S. Eggert, and A. Pelster, New J. Phys. **17**, 123016 (2015)

Poster Q 53.15 Thu 17:00 P OG2

Creating topological interfaces and detecting chiral edge modes in a two-dimensional optical lattice — •Frederik Görg[1], Nathan Goldman[2], Gregor Jotzu[1], Michael Messer[1], Kilian Sandholzer[1], Rémi Desbuquois[1], and Tilman Esslinger[1] — [1]Institute for Quantum Electronics, ETH Zurich, Zurich, Switzerland — [2]CENOLI, Université Libre de Bruxelles, Brussels, Belgium

The appearance of topological properties in lattice systems caused by a non-trivial topological band structure in the bulk is closely related to the existence of chiral edge modes via the bulk-edge correspondence. These edge states appear at the interface of two spatial regions with a distinct topology, which for example naturally arise at the boundaries of a sample surrounded by vacuum. In cold atom systems, these edge modes are difficult to detect, since the underlying harmonic trapping potential does not feature sharp boundaries. Therefore, we propose a different method to design topological interfaces within the bulk of the system. We illustrate this scheme by an optical lattice realization of the Haldane model, where a spatially varying lattice beam leads to the appearance of distinct topological phases in separated regions of space. The versatility of the method allows to tune the position, the localization length and the chirality of the edge modes. We numerically study the propagation of wave packets in such a system and demonstrate the feasibility to experimentally detect chiral edge states. Finally, we show that the edge modes, unlike the bulk states, are topologically protected against the effects of disorder, which makes a random potential a powerful tool to detect edge states in cold atom setups.

Poster Q 53.16 Thu 17:00 P OG2

Transport dynamics in optical lattices with flux — •Ana Hudomal[1], Ivana Vasić[1], Walter Hofstetter[2], and Antun Balaž[1] — [1]Scientific Computing Laboratory, Center for the Study of Complex Systems, Institute of Physics Belgrade, University of Belgrade, Serbia — [2]Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität, Frankfurt am Main, Germany

Recent cold atom experiments have realized artificial gauge fields in periodically modulated optical lattices [1,2]. We study the dynamics of atomic clouds in these systems by performing numerical simulations using the full time-dependent Hamiltonian and comparing these results to the semiclassical approximation. Under constant external force, atoms in optical lattices with flux exhibit an anomalous velocity in the transverse direction. We investigate in detail how this transverse drift is related to the Berry curvature and Chern number, taking into account realistic experimental conditions.

[1] G. Jotzu et al., Nature **515**, 237 (2014).
[2] M. Aidelsburger et al., Nature Phys. **11**, 162 (2015).

Poster Q 53.17 Thu 17:00 P OG2

Towards the investigation of collective scattering in nanofiber-trapped atomic ensembles — •Adarsh S. Prasad, Jakob Hinney, Samuel Rind, Philipp Schneeweiss, Jürgen Volz, Christoph Clausen, and Arno Rauschenbeutel — TU Wien - Atominstitut, Stadionallee 2, 1020 Wien, Austria

We realize an efficient optical interface between guided light and laser-cooled atoms which are arranged in two linear arrays in a two-color evanescent-field dipole trap created around an optical nanofiber [1]. In this configuration, the probability of a nanofiber-guided photon being absorbed and then re-emitted into free space by a trapped atom is as high as 10%. For a periodic array of atoms, interference of the fields scattered by different atoms result in a collective emission into a cone with a well-defined angle with respect to the fiber axis. We plan to study this collective emission and its dependence on various experimental parameters. The next step will be to adjust the periodicity of the atomic array to fulfill the Bragg condition such that fiber-guided light is strongly back-reflected [2]. Here, the interaction between the atomic array and the fiber-guided light depends strongly on the polarization of the light field. In particular, light that is polarized in (orthogonal to) the plane of atoms will be weakly (strongly) reflected. We want to implement such highly reflecting atomic arrays, which could then be used to implement cavity quantum electrodynamics experiments in which the resonator itself is made of quantum emitters.

[1] E. Vetsch et al., Phys. Rev. Lett. 104, 203603 (2010).
[2] Fam Le Kien et. al., Phys. Rev. A 90, 063816 (2014).

Poster Q 53.18 Thu 17:00 P OG2

Setup of a new micro-structured linear Paul trap with integrated solenoids and reduced axial micromotion — •H. Siebeneich, D. Kaufmann, T. Gloger, P. Kaufmann, M. Johanning, and ch. Wunderlich — Department Physik, Universität Siegen, 57068 Siegen, Germany

We present the status of a new 3d segmented ion trap setup with integrated solenoids, in which an improved design allows for a substantial reduction of axial micromotion and for an increased magnetic gradients. Our trap consists of three layers of gold plated alumina, where the segmented outer layers provide the trapping potentials [1], and the middle layer contains solenoids that are used to create a magnetic field gradient [2]. The gradient gives rise to coupling between the ions' internal and motional states. The trap is mounted on a ceramic chip carrier that, at the same time, acts as an ultra-high vacuum interface, featuring about 100 thick-film printed current and voltage feedthroughs. The thick film interface has been improved by replacing previously used Ag-Pd layers by Au layers which reduced their resistivity by a factor of eight. The previously high resistivity used to be a a bottleneck for achieving high solenoid currents and thus a magnetic gradient. The shape of the solenoids was redesigned, leading to an expected reduction of axial micromotion by four orders of magnitudes.

[1] S.A. Schulz et al.: Sideband cooling and coherent dynamics in a microchip multi-segmented ion trap, New Journal of Physics, Volume 10, April 2008 [2] D. Kaufmann et al.: Thick-film technology for ultra high vacuum interfaces of micro-structured traps, Appl Phys B (2012) 107:935-943

Poster Q 53.19 Thu 17:00 P OG2

Design and construction of a Perpetual Atom Laser Machine — •Chun-Chia Chen, Shayne Bennetts, Benjamin Pasquiou, and Florian Schreck — Institute of Physics, University of Amsterdam, Amsterdam, The Netherlands

We have developed a machine aimed at producing a perpetual atom laser, a long standing goal within atomic physics. Continuous production of Bose-Einstein condensate (BEC) or an atom laser requires two incompatible cooling processes, laser cooling a gas sample, then cooling evaporatively until degeneracy is reached. In order to produce a perpetual output these stages take place simultaneously in different parts of our machine. To protect the condensate from scattered photon heating we use a combination of physical separation, baffles and a "transparency" beam. Our machine has now demonstrated a perpetual MOT of 2×10^9 ^{88}Sr atoms with temperatures as low as 20μK on a 7.4-kHz wide laser cooling transition with a continuous loading rate of 7×10^8 atoms/s. Using a different set of parameters and location we have also demonstrated a perpetual MOT of 2×10^8 ^{88}Sr at 2μK with a loading rate of 9×10^7 atoms/s which we have successfully loaded into a dipole trap. By switching to the 0.5% abundance ^{84}Sr isotope we are able to evaporate to BECs of 3×10^5 ^{84}Sr atoms. Critically, for the second location we have validated the effectiveness of our architecture in protecting a BEC from scattered broad-linewidth laser cooling light, which is used in the first cooling stages. We will describe our design and the performance demonstrated so far.

Poster Q 53.20 Thu 17:00 P OG2

Optical trapping of neutral mercury — •Holger John and Thomas Walther — Technische Universität Darmstadt, Institut für Angewandte Physik, Schlossgartenstraße 7, 64289 Darmstadt

Laser-cooled mercury constitutes an interesting starting point for various experiments, in particular in light of the existence of bosonic and fermionic isotopes. On the one hand the fermionic isotopes could be used to develop a new time standard based on an optical lattice clock employing the $^1S_0$ - $^3P_0$ transition. Another interesting venue is the formation of ultra cold Hg-dimers employing photo-association and achieving vibrational cooling by employing a special scheme.

The laser system is based on an interference-filter stabilized external cavity diode laser with excellent spectral properties combined with a home built non-cryogenic fiber amplifier for the 1015nm fundamental wavelength with a slope-efficiency of more than 35 % delivering up to 4W of pump limited output power. The fundamental wavelength is frequency doubled twice to reach the cooling transition at 253.7 nm. The challenging requirements meeting the natural linewidth of 1.27 MHz are mastered by use of a ULE reference resonator.

After integrating a 2D-MOT as an atom source to the vacuum system the first measurements of ultra-cold atoms with the new laser system will be reported.

Poster Q 53.21 Thu 17:00 P OG2

Diffusion of Single Atoms in Bath — •Daniel Adam, Farina Kindermann, Tobias Lausch, Daniel Mayer, Felix Schmidt, Steve Haupt, Michael Hohmann, Nicolas Spethmann, and Artur Widera — TU Kaiserslautern, Department of Physics, Kaiserslautern, Germany

Diffusion is an essential phenomenon occurring in various systems such as biological cells, traffic models or stock markets. While most systems are well described by standard Brownian motion, anomalous diffusion can lead to markedly different dynamical properties.

Experimentally, we study the diffusion of individual atoms illuminated by near-resonant light and trapped in a periodic potential. All relevant parameters such as damping coefficient and potential hight can be controlled in order to realize different diffusive regimes.

We explore the amount of information contained in the Kramers rate, i. e. the rate at which a diffusing atom can escape from a potential well. Furthermore we exploit the excellent control over the optical trapping potential and study the diffusion of the atom in a time-varying periodic trap, complemented by numerical simulations of the dynamics.

Poster Q 53.22 Thu 17:00 P OG2

Kinetic Monte Carlo simulation of percolation in driven-dissipative Rydberg gases — •Stephan Helmrich, Philipp Fabritius, Graham Lochead, and Shannon Whitlock — Physikalisches Institut, Universität Heidelberg, Im Neuenheimer Feld 226, 69120 Heidelberg

Directed percolation is perhaps the most prominent example of a unique class of phenomena which exhibit genuine non-equilibrium phase transitions and non-trivial critical behaviour. We explore whether highly tunable gases of ultracold atoms excited to long-range interacting Rydberg states can serve as a clean experimental realisation of percolation phenomena in two and three dimensions. The mechanism investigated is the cooperative excitation of Rydberg atoms triggered when the excitation laser is resonant for atoms within a characteristic distance of another Rydberg atom (facilitated excitation). To simulate the dynamics of this system we use a kinetic Monte Carlo algorithm which is able to reproduce many of the experimental features of laser excited Rydberg gases. We investigate the scaling behavior for the fraction of Rydberg excitations (active sites) and their spa-