A 31: Ultra-Cold Atoms, Ions and BEC IV (with Q)

Zeit: Donnerstag 16:30–18:00 Raum: VMP 6 HS-C

Fachvortrag A 31.1 Do 16:30 VMP 6 HS-C

Novel phases of spinor fermions in 1D optical lattices — •Karen Rodriguez, Arturo Argüelles, and Luis Santos — Leibniz Universität Hannover, Hannover, Deutschland

The Hubbard Hamiltonian model shows two different phases namely Mott insulator and superfluid. When internal degrees of freedom like spin is added to the system, new phases can appear. By means of numerical simulations using Matrix Product State algorithms combined with an effective Hamiltonian which allows up to one particle per site, we found that the ground state of the system inside the Mott region shows the presence of spin-Peierls ordering. Furthermore, we showed that adding a magnetic field, the quadratic Zeeman effect allows us to drive the spin ordering into a Neel state.

Fachvortrag A 31.2 Do 17:00 VMP 6 HS-C

Ultracold chaos – strongly coupled bosons — •Sandro Wimberger — Institut für Theoretische Physik, Universität Heidelberg — Heidelberger Graduiertenschule für Fundamentale Physik

Modern atom-optics experiments allow one an unprecedented control of atomic degrees of freedom and, as a consequence, the clean realization of toy models used to explain transport phenomena in condensed matter physics. We present recent results on extended Bose-Hubbard systems. For reasonable lattice sizes, this model gives access to the full quantum spectrum, which allows us a complete characterization of "horizontal" (spatially) and "vertical" (energetic) quantum transport. Various dynamical regimes can be prepared, using atom-atom interactions, disorder, and external forces as control parameters. We show that the interband transport of atoms – confined to a periodic lattice and subject to an additional tilting force – is strongly dependent on the dynamics of the ground-state band. Analogies between Stark localisation and Anderson localisation are discussed, as well as predictions for experiments to observe signatures of complex interband dynamics with ultracold atoms.

A 31.3 Do 17:30 VMP 6 HS-C

Few-body physics in a three-component Fermi gas — •Timo Ottenstein[1], Thomas Lompe[1], Andre Wenz[1], Gerhard Zürn[1], and Selim Jochim[1,2] — [1]Max-Planck Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg — [2]Ruprecht-Karls-Universität Heidelberg

Here we report on our experiments studying a three-component Fermi gas in thermal equilibrium consisting of atoms in the three lowest magnetic substates of ^{6}Li. Our first experiments analyzed the collisional stability of the gas in dependence of the two-body interaction strength, which can be tuned by means of Feshbach resonances [1]. Three body-collisions lead to strong variation of the stablility as a function of the applied magnetic field, including a strongly enhanced trap loss at 127 G. It turns out that the behaviour of three-body loss over the adressed magnetic field range can be explained by the presence of a trimer state consisting of one atom in each of the three states, which crosses the continuum twice at different magnetic field values [2]. The physics of this trimer state is comparable to Efimov's scenario in bosonic systems.

Furthermore, the interaction properties of this three-component Fermi gas resemble SU(3) symmetry, making it a promising candidate to study phenomena related to QCD and baryon formation. By addition of an optical lattice, the SU(3) Hubbard model can be studied, in which new and interesting quantum phases are predicted.

[1] T.B. Ottenstein et al., Phys. Rev. Lett. 101, 203202 (2008)
[2] E. Braaten et al., arXiv 0811.3578 (2008)

A 31.4 Do 17:45 VMP 6 HS-C

Towards Single Impurities in a Bose-Einstein Condensate — •Stefan Palzer, Christoph Zipkes, Carlo Sias, and Michael Köhl — Cavendish Laboratory, University of Cambridge, JJ Thomson Avenue, Cambridge CB3 0HE, United Kingdom

We are currently working on an experimental setup to combine a single trapped Ytterbium ion with a Bose-Einstein Condensate (BEC) of Rubidium (Rb) atoms. Once the ion trap is implemented inside the BEC chamber this experiment will open the path to investigate ultracold atom-ion collisions and to study single impurities in superfluid systems. Moreover, this experiment could provide a new approach to cool trapped ions sympathetically thus prolonging the coherence time for quantum operations. To produce the Bose-Einstein Condensate (BEC) we trap and cool about 10^9 Rb atoms in a magneto-optical trap (MOT). The atomic cloud then is magnetically transported into the ultrahigh-vacuum (10^{-11} mbar) interaction chamber. We cool the atoms well below the BEC transition temperature by evaporative cooling and create a BEC of about 10^6 atoms. A single trapped Ytterbium ion will be used as impurity. A linear Paul trap is loaded with one (or more) Yb ion(s) using resonance enhanced isotope-selective photoionisation. Both systems are currently characterized independently.