Q 59: Ultracold atoms and BEC - VI (with A)

Time: Friday 14:30–16:00 Location: N 1

Invited Talk Q 59.1 Fri 14:30 N 1

Sympathetic cooling of OH- by means of a heavy buffer gas — •Henry Lopez[1], Bastian Höltkemeier[1], Jonas Tauch[1], Tobias Heldt[1], Eric Endres[2], Roland Wester[2], and Matthias Weidemüller[1] — [1]INF 226, 69120 Heidelberg — [2]Technikerstraße 25/3, 6020, Innsbruck

Sympathetic cooling is a versatile tool that is used when other standard cooling methods like laser cooling are not applicable. In the last few years there has been a big debate about its limitations under certain circumstances: is it possible to cool down trapped ions in a system where the coolant is heavier than the cooled particle? By using a spatially confined buffer gas * e.g. a magneto optical trap - for atoms and a high-order radio frequency trap for ions, we have theoretically shown that sympathetic cooling of ions in such hybrid systems becomes feasible. In order to proof this experimentally we are developing a novel hybrid atom-ion trap. As buffer gas we use an ultracold cloud of Rb atoms confined in a dark spontaneous-force optical trap loaded from a 2D-MOT. The ions, in particular OH-, are stored in an 8-pole rf trap made of thin wires, guaranteeing optical access into the trapping region. For probing the temperature of the ions we apply electron-photodetachment tomography of the negative ions. In this talk I report on the latest experimental results, the status of our experiment, its limitations and possible applications.

Q 59.2 Fri 15:00 N 1

In-situ charge control of a silica optical nanofiber in an ion trap — •Benjamin Ames[1], Johannes Ghetta[1], Jan Petersen[2], Philip Holtz[1], Kirill Lakhmanskiy[1], Michael Brownnutt[3], Florian Ong[1], Arno Rauschenbeutel[2], Yves Colombe[1], and Rainer Blatt[1,4] — [1]Institut für Experimentalphysik, University of Innsbruck, Innsbruck, Austria — [2]TU Wien, Wien, Austria — [3]University of Hong Kong, Pokfulam, Hong Kong — [4]Institut für Quantenoptik und Quanteninformation, Innsbruck, Austria

A trapped ion confined within the evanescent field of an optical nanofiber could be a novel ion-photon interface for networking quantum information between registers. However, achieving the sub-micron ion-fiber distance required to observe coupling to the evanescent field remains problematic due to charges on the nanofiber surface. We report on in-situ techniques developed to mitigate the charge of the nanofiber. Using photoemission and anomalous field emission we are able to charge the fiber positively, while both positive and negative states can be obtained by means of electron flooding at different energies. These results can be applied to a variety of AMO experiments where charge control of dielectrics is desired.

Q 59.3 Fri 15:15 N 1

Commensurate-incommensurate transition with ions — •Andreas Alexander Buchheit[1], Haggai Landa[2], Cecilia Cormick[3], Thomas Fogarty[4], Vladimir Stojanovic[5], Eugene Demler[5], and Giovanna Morigi[1] — [1]Universität des Saarlandes, D-66123 Saarbrücken, Germany — [2]LPTMS, CNRS, Univ. Paris-Sud, Université Paris-Saclay, 91405 Orsay, France — [3]IFEG, CONICET and Universidad Nacional de Cordoba — [4]Okinawa Institute of Science and Technology, Japan, — [5]Department of Physics, Harvard University, Cambridge, MA 02138, USA

We show that the commensurate-incommensurate transition can be simulated with a trapped linear chain of ions which are additionally confined by an optical lattice. The ratio between the ion interparticle distance in the absence of the lattice and the lattice wavelength can be adjusted by modifying the ion trapping potential, and we focus on the regime when these two lengths are nearly commensurate. We show that in this system one can observe the onset of the incommensurate phase through the creation of solitons at the chain edges followed by the formation of a soliton chain, and we further identify the range of ion temperatures and chain sizes which allows these dynamics to be realised. We finally discuss the observables which signal the inception of this phase and the regime of experimental parameters for which these dynamics can be observed.

Q 59.4 Fri 15:30 N 1

Excitation and Transport of Discrete Solitons in Coulomb Crystals — •Jonathan Brox[1], Philip Kiefer[1], Miriam Bujak[1], Haggai Landa[2], and Tobias Schaetz[1] — [1]Atom-, Molekül- und optische Physik, Physikalisches Institut, Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg — [2]LPTMS, Université Paris Sud, Orsay, France

We study structural defects (kinks), which are formed in 2D Coulomb crystal [1].

Ion crystals with such structural defects feature localized modes in the vibrational spectrum[2]. We show that resonant excitation of kinks leads to a directed transport conditional on the conformation of the topological protected defect inside the ion crystal [3].

[1] M. Mielenz et al., Phys. Rev. Lett. **110**, 133004 (2013)
[2] H. Landa et al., New J. Phys. **15**, 093003 (2013)
[3] J. Brox et al., publication in preparation

Q 59.5 Fri 15:45 N 1

Strong Backscatterer at the Edge of a Two-dimensional Topological Insulator — •Junhui Zheng[1,2] and Miguel A. Cazalilla[2] — [1]Institut für Theoretische Physik, Goethe-Universität, 60438 Frankfurt/Main, Germany — [2]Department of Physics, National Tsing Hua University, Hsinchu 30013, Taiwan

We study the problem of a backscattering impurity coupled to the edge states of a two-dimensional topological insulator. In the regime where the backscattering potential is larger than the band gap and accounting for electron-electron interactions, it is shown that the system can be described as a resonant level coupled to the one-dimensional (1D) channel of interacting edge electrons. We discuss the relationship of this system to the model of a (structureless) impurity in a 1D interacting electron liquid. Different from the latter model, in the resonant regime transmission is suppressed also for weak to moderately attractive interactions.