

## Q 64 Quantengase IV

Zeit: Mittwoch 11:00–12:45

Raum: HU Kinosaal

Q 64.1 Mi 11:00 HU Kinosaal

**Micromanipulation of ultra-cold atoms close to conducting surfaces** — ●STEPHAN WILDERMUTH<sup>1</sup>, PETER KRÜGER<sup>1</sup>, SEBASTIAN HOFFERBERTH<sup>1</sup>, ELMAR HALLER<sup>1</sup>, DANIEL GALLEGO GARCIA<sup>1</sup>, SÖNKE GROTH<sup>1,2</sup>, MAURITZ ANDERSON<sup>1</sup>, ISRAEL BAR-JOSEPH<sup>2</sup>, and JÖRG SCHMIEDMAYER<sup>1</sup> — <sup>1</sup>Physikalisches Institut, Universität Heidelberg, Philosophenweg 12, 69120 Heidelberg — <sup>2</sup>Weizmann Institut, Rehovot, Israel

Atom chips allow to manipulate ultra-cold thermal clouds or Bose-Einstein condensates (BEC) microns above a conducting surface by means of magnetic and electro-static fields. The current and charge carrying structures creating these potentials are fabricated by standard microfabrication technology.

In our setup disorder potentials which arise from imperfections in the chip surface have been observed to be two orders of magnitude smaller than in experiments done in other groups. With quasi-1D BECs as a sensitive probe we have been able to study fluctuations of the trapping potentials below  $\Delta B/B \sim 10^{-5}$  at atom to surface distances in the micron range. This reduction is due to lithographically fabricating the atom chip structures into high quality evaporated gold layers.

We have carried out a variety of experiments to further investigate these surface disorder potentials: several different wires have been probed, magnetic and electro-static disorder potentials have been compared, and 2D potential maps above broad chip wires have been measured.

Q 64.2 Mi 11:15 HU Kinosaal

**Rotating BEC in Anharmonic Traps** — ●SEBASTIAN KLING<sup>1</sup> and AXEL PELSTER<sup>2</sup> — <sup>1</sup>Institut für Theoretische Physik, Freie Universität Berlin, Berlin, Germany — <sup>2</sup>Fachbereich Physik, Universität Duisburg-Essen, Essen, Germany

We study a Bose gas within a rotating anharmonic trap in the corotating frame. For fast rotation, interesting physics takes place, since the centrifugal force overcompensates the harmonic confinement and, due to anharmonic terms, the trapping potential becomes mexican-hat shaped. We calculate the eigenfrequencies of the condensate at zero temperature for low-energy excitations and the velocity profile after switching off the trap. In addition, we discuss thermodynamic properties of the rotating Bose gas.

Q 64.3 Mi 11:30 HU Kinosaal

**Making ground state molecules with optical Feshbach resonances** — ●CHRISTIANE KOCH<sup>1,2</sup>, RONNIE KOSLOFF<sup>2</sup>, and FRANÇOISE MASNOU-SEEUWS<sup>1</sup> — <sup>1</sup>Laboratoire Aimé Cotton (CNRS), Campus d'Orsay, Bât. 505, 91405 Orsay Cedex, France — <sup>2</sup>Department of Physical Chemistry and The Fritz Haber Research Center, The Hebrew University, Jerusalem 91904, Israel

Molecular Bose-Einstein condensates (BEC) have recently been created by adiabatically sweeping over magnetic Feshbach resonances. Unfortunately, Feshbach resonances are not always available at magnetic field strengths which can easily be handled in experiment. We therefore investigate the possibility to create molecules using the optical analogue of the Feshbach resonance in which a laser couples the open and closed channels. We discuss how intensity and detuning of the laser need to be chosen to avoid loss due to spontaneous emission and to create molecules directly in the *ground* state. Our simulations for <sup>87</sup>Rb show that this scheme to create ultracold molecules works for sufficiently tight traps.

Q 64.4 Mi 11:45 HU Kinosaal

**Interferenz in magnetischen Mikrofallen** — ●JÓZSEF FORTÁGH, ANDREAS GÜNTHER, SEBASTIAN KRAFT, PHILIPP WICKE und CLAUS ZIMMERMANN — Physikalisches Institut der Universität Tübingen, Auf der Morgenstelle 14, D-72076 Tübingen

Mikrostrukturierte Potentiale für Bose-Einstein-Kondensate bringen uns einen Schritt näher an die Realisierung von integrierter Atomoptik auf einem Chip. Vorstellbar sind Materiewellen-Interferometer für die ultrasensitive Messung von Kräften oder auch Quantenbits für die Quanteninformationsverarbeitung. Aktuelle Mikrofallen-Experimente konzentrieren sich auf die Kontrolle des Bose-Einstein-Kondensats mithilfe von einfachen atomoptischen Elementen. In unserem Experiment wird dem magnetischen Wellenleiterpotential eines Atom-Chips ein magnetisches Gitterpotential der Periode von vier Mikrometer überlagert. Beobach-

tet wird die Bragg-Reflexion des Kondensats am Gitter. Ausgehend von Bloch-Oszillationen und Landau-Zener-Tunneln wurde ein interferometrischer Kraftsensor realisiert.

Q 64.5 Mi 12:00 HU Kinosaal

**Resonance scattering from a trapped bosonic gas** — ●REINHOLD WALSER, GERRIT NANDI, MICHAEL GRUPP, and ENDRE KAJARI — Abteilung für Quantenphysik, Universität Ulm

Discrete bound states imbedded in the scattering continuum are a fascinating aspect of quantum mechanics. Feshbach resonances in nuclear physics or Fano-profiles in atomic physics are beautiful realizations of this phenomenon. In particular, Feshbach resonances in binary atomic collision physics have gained tremendous importance recently for degenerate atomic gases, as it becomes possible to actively control the mutual interaction between particles.

In the present contribution, we will examine the analogous physical effect, however not on the atomic scale, but on a mesoscopic scale of a condensed, two-component bosonic gas in a quasi one-dimensional trap. In particular, we will discuss the scattering of a weak perturbation from a ground-state condensate.

Q 64.6 Mi 12:15 HU Kinosaal

**Kohärenz und Thermodynamik von F=1 <sup>87</sup>Rb Spinor-Kondensaten** — ●JOCHEN KRONJÄGER, CHRISTOPH BECKER, THOMAS GARL, KAI BONGS und KLAUS SENSTOCK — Institut für Laserphysik, Luruper Chaussee 149, Gebäude 69, 22761 Hamburg

Ausgehend von der Kenntnis der Grundzustände und der prinzipiellen Dynamik in F=2 und F=1 Spinor-Bose-Einstein Kondensaten [1,2] untersuchen wir Spinor-Kondensate im Übergangsbereich zwischen kohärenter und thermisch getriebener Dynamik. Üblicherweise werden Spinor-BEC vereinfacht als kohärente Überlagerung der verschiedenen Zeeman-Untersubzustände beschrieben. Unsere Messungen deuten jedoch darauf hin, dass Spinkohärenz auf der Zeitskala der Dynamik in F=1 Spinorkondensaten nicht gegeben ist. Darüber hinaus wird ein deutlicher Einfluss der Temperatur auf die Spindynamik und den Grundzustand erwartet.

[1] H. Schmaljohann, M. Erhard, J. Kronjäger, M. Kottke, S. van Staa, K. Cacciapuoti, J. J. Arlt, K. Bong and K. Sengstock, Dynamics of F=2 Spinor Bose-Einstein condensates, Phys. Rev. Lett. 92, 040402 (2004)

[2] M. Erhard, H. Schmaljohann, J. Kronjäger, K. Bongs and K. Sengstock, Bose-Einstein condensation at constant temperature, Phys. Rev. A 70, 031602(R) (2004)

Q 64.7 Mi 12:30 HU Kinosaal

**Observation of Single Atoms in Quantum Degenerate Gases** — ●STEPHAN RITTER, ANTON ÖTTL, MICHAEL KÖHL, and TILMAN ESSLINGER — Institut für Quantenelektronik, ETH Zürich, ETH Hönggerberg HPF D25, CH-8093 Zürich, Schweiz

We have observed single atoms from a quantum degenerate source. The detection process, based on a cavity QED method, is state-selective and non-destructive, which is a prerequisite for quantum gate operations.

We produce ultra-cold thermal and Bose-Einstein condensed ensembles of up to 2 million <sup>87</sup>Rb atoms in our novel experimental apparatus. Via radio frequency induced transitions between hyperfine states we are able to coherently output couple a continuous beam of atoms, which is directed through the non-destructive single-atom detector placed 40mm below the atomic cloud. The detector consists of a ultra-high finesse optical cavity with a finesse F=300.000 and a length of 180μm bringing us into the strong coupling regime. A single atom inside the cavity mode volume alters the resonance of the cavity significantly, thereby changing the transmission of a weak near-resonant probe beam. By recording the transmission of the probe light with a single photon counter we are able to detect single atom transits. The arrival times of individual atoms yield the statistics of the atomic source.

The next step of our experiment is to investigate and manipulate two-particle correlations. These are expected to differ fundamentally for degenerate and coherent thermal atomic beams.