Q 60: Fallen und Kühlung (gemeinsam mit A)

Zeit: Donnerstag 14:00–16:00 Raum: 5D

Q 60.1 Do 14:00 5D

Time-Averaged Adiabatic Potentials: Novel traps and waveguides for ultracold quantum gases — •Wolf von Klitzing and Igor Lesanovsky — Institute of Electronic Structure and Laser, Foundation for Research and Technology -Hellas, P.O.Box1527, GR-71110 Heraklion, Greece

We demonstrate a novel class of trapping potentials, time-averaged adiabatic potentials (TAAP) which allows the generation of a large variety of traps and waveguides for ultracold atoms. Multiple traps can be coupled through controllable tunneling barriers or merged altogether. We present analytical expressions for pancake-, cigar-, and ring- shaped traps. The ring-geometry is of particular interest for guided matter-wave interferometry as it provides a perfectly smooth waveguide of controllable diameter, and thus a tunable sensitivity of the interferometer.

[1] I. Lesanovsky and W. von Klitzing, preprint: cond-mat/0612213 (2006)

Q 60.2 Do 14:15 5D

Ultra-cold strontium atoms for optical frequency metrology — •Joseph Sundar Raaj Vellore Winfred, Thomas Legero, Fritz Riehle, and Uwe Sterr — Physikalisch-Technische Bundesanstalt, Braunschweig, Germany

Precise measurement of time is of paramount importance in technological and scientific endeavors. Recent advancement in optical frequency metrology promises to measure time with a fractional accuracy of 10^{-17}. Strontium is an attractive candidate for such an optical clock because of its narrow line transition with a linewidth of about 1 mHz and the existence of a magic wavelength for the clock transition in the NIR region. Here we report preliminary results of cooling and trapping of strontium atoms. The strontium atoms are cooled down to ultra-cold temperature regime($2\,\mu$K) in a two-stage cooling process. An overview of our experimental set up, characterization of a 1-D optical dipole trap with respect to different trap parameters and its relevance to frequency measurement will be presented.

Q 60.3 Do 14:30 5D

Auf dem Weg zu wenigen fermionischen Atomen in einer Mikrofalle — •Friedhelm Serwane[1], Timo Ottenstein[1] und Selim Jochim[1,2] — [1]Max-Planck-Institut für Kernphysik, Heidelberg — [2]Fakultät für Physik und Astronomie, Universität Heidelberg

Wir berichten über die Planungen für ein Experiment zur Präparation eines Systems bestehend aus einer deterministischen Anzahl von fermionischen ^{6}Li-Atomen im Grundzustand einer optischen Mikrofalle. Mittels einer Feshbachresonanz kann die Wechselwirkung zwischen Teilchen in unterschiedlichen Spinzuständen frei eingestellt werden. Auf diese Weise kann die Physik weniger wechselwirkender Fermionen untersucht werden, die auch die Eigenschaften von Kernen und Atomen entscheidend bestimmt. Besonders interessant erscheint dabei auch die Möglichkeit, exotische Konfigurationen nach Belieben zu präparieren, wie sie zum Beispiel als Halokerne in der Kernphysik studiert werden. Ausgangspunkt für diese Experimente wird ein molekulares Bose-Einstein-Kondensat von $^6Li_2$-Molekülen sein, mit dem eine ausreichend niedrige Temperatur erreicht werden kann, bevor dann die meisten Teilchen durch kontrolliertes Absenken des Fallenpotentials entfernt werden.

Q 60.4 Do 14:45 5D

Noise reduction in a cold atomic trapped sample — •Jerome Esteve, Andreas Weller, Jens Appmeier, Christian Gross, Rudolf Gati, and Markus Oberthaler — Kirchhoff Institut für Physik, Im Neuenheimer Feld 227, 69120 Heidelberg

In typical cold atom experiments, the fluctuations of the total atom number in the trap are dominated by technical fluctuations and are usually bigger than shot-noise. Reducing these fluctuations as much as possible is of great interest for numerous experiments. In particular, it is a prerequisite to the generation of entangled states in Bose-Einstein condensates since many entanglement schemes rely on the knowledge of the absolute atom number. In this presentation, we will show experimental results where the total atom number fluctuations in an optical dipole trap are strongly reduced down to approximately the shot-noise level by introducing three body losses in the sample. We will discuss the minimal noise that can be achieved by this method and show that sub-shot-noise fluctuations should indeed be observable.

Q 60.5 Do 15:00 5D

Laser Cooling of Barium — •Subhadeep De, Umakanth Dammalapati, Klaus Jungmann, and Lorenz Willmann — 1KVI, University of Groningen, 9747 AA Groningen, The Netherlands

Heavy alkaline earth elements like radium offer unique possibilities to test fundamental symmetries in nature. This has triggered the interest in laser cooling and trapping of such isotopes. We have developed strategies for laser cooling with barium, which exhibits a very similar level scheme. These isotopes suffer from large losses from the strong 1S0-1P1 cooling transition to metastable D-states. The branching ratio to the 1D2, 3D2, 3D1-states is 330:1 for barium and similar for radium. We have performed the first laser spectroscopy of the 1D2, 3D2, 3D1 to 1P1 repumping transitions in barium. With the repumpers (1108nm, 1130nm, 1500nm) we were able to demonstate the first laser cooling of barium, where we reduced the loss to the metastable state to less than 1 in 10000. This allow to slow an atom by more than 100m/s. In addition, we are investigating other schemes for repumping in barium. We plan to apply these results to laser cooling of radium.

Q 60.6 Do 15:15 5D

Atomfalle im Internet — •Anika Vogel, Greta Johannsen, Kai Bongs und Klaus Sengstock — Institut für Laserphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

Die Physik kalter atomarer Gase findet weltweit größtes Interesse in Grundlagenforschung und Anwendung und wurde 1997 mit dem Nobelpreis gewürdigt. Um dieses Gebiet für Studenten (und potentiell Schüler) aller Welt zugänglich und aktiv erfahrbar zu machen, erstellen wir derzeit ein reales Experiment zur magnetooptischen Speicherung von Rubidium-87-Atomen, das wir in einem Internetportal mit interaktiv steuerbaren experimentellen Parametern zugänglich machen wollen. Lernmodule sollen ein Verständnis der Laserkühlung mit detaillierten Texten zu den theoretischen Grundlagen sowie mit Animationen und Simulationen zum Thema ermöglichen. In diesem Vortrag wird der experimentelle Aufbau und der aktuelle Stand der Arbeiten vorgstellt. Das Projekt wird vom Multimediakontor Hamburg gefördert.

Q 60.7 Do 15:30 5D

Electric trapping of Rb atoms — •Thomas Rieger, Pepijn Pinkse, and Gerhard Rempe — Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Str. 1, 85748 Garching

Here we report on all-electric trapping of Rb atoms. Electric trapping of neutral atoms in time-varying electric fields was already proposed in the early nineties [1]. Recently, Katori and co-workers demonstrated first electric trapping in a micro trap [2]. We have shown two-dimensional trapping (guiding) of neutral molecules in time-varying electric fields [3] with a similar technique. The perspective of sympathetic cooling of molecules with atoms led us to set up an experiment for trapping neutral atoms in time-varying electric fields. In contrast to the one in Ref. [2], our electric trap is of millimeter size, allowing good optical access.

Based on simulations predicting a trap depth of $30\,\mu$K, a magneto-optical trap has been setup. The laser-cooled atoms are magnetically trapped and transferred to the electric trap by mechanically moving the trap coils. After turning on the alternating electric fields, the atoms are electrically trapped for a few hundred milliseconds. The experimental results will be discussed in detail.

[1] F. Shimizu and M. Morinaga, Jpn. J. Appl. Phys., **31**, L1721 (1992)
[2] H. Katori et al., AIP Conf. Proc. **770**, 112 (2005)
[3] T. Junglen et al., Phys. Rev. Lett., **92**, 223001 (2004)

Q 60.8 Do 15:45 5D

Optical Storage Ring for Cold Atoms — •Andre Lengwenus[1], Jens Kruse[1], Michael Volk[1], Wolfgang Ertmer[2], Matthias Gruber[3], Jürgen Jahns[3], and Gerhard Birkl[1] — [1]Institut für Angewandte Physik, Technische Universität Darmstadt, 64289 Darmstadt, Germany — [2]Institut für Quantenoptik, Universität Hannover, 30167 Hannover, Germany — [3]Lehrgebiet Optische Nachrichtentechnik, FernUniversität Hagen, 58084 Hagen, Germany

Most applications for atom interferometers, e.g. sensors for rotation or acceleration, benefit from long interaction times and large enclosed areas. Both can be achieved, using guided interferometer structures for cold atoms. We experimentally demonstrate a new interferometer-type guiding structure for laser cooled neutral atoms based on a ring-shaped dipole potential. The dipole potential is created by focusing a far red-detuned laser beam by a specially designed micro-fabricated optical structure.

We can load atoms into this miniaturized storage ring and can observe how atoms move along the ring-shaped potential minimum. Illuminating only part of the ring lens with a moveable asymmetrical gaussian laser beam gives us the possibility to create a double well potential with variable barrier height. This enables us to move the atoms around the ring as well as dividing and recombining the atom cloud as required for a guided-atom interferometer.