

Q 6 Poster Ultrakalte Moleküle

Zeit: Freitag 11:00–12:30

Raum: Poster HU

Q 6.1 Fr 11:00 Poster HU

FeLiKx - A Fermionic ${}^6\text{Li}$ - ${}^{40}\text{K}$ Experiment — •ERIC WILLE^{1,2}, FLORIAN SCHRECK¹, and RUDOLF GRIMM^{1,2} — ¹Institut für Quantenoptik und Quanteninformation, Österreichische Akademie der Wissenschaften, Innsbruck, Österreich — ²Institut für Experimentalphysik, Universität Innsbruck, Österreich

${}^6\text{Li}$ and ${}^{40}\text{K}$ are the only naturally occurring fermionic alkali metals. Therefore, these isotopes offer a unique possibility to study the physics of ultracold fermi-fermi mixtures using established techniques from neutral atom trapping and cooling.

Recently ${}^6\text{Li}_2$ and ${}^{40}\text{K}_2$ molecules were formed and cooled below quantum degeneracy. This opened new perspectives to study many-body quantum effects like the BEC-BCS transition in the vicinity of Feshbach resonances. The formation of ultracold heteronuclear dimers of ${}^6\text{Li}{}^{40}\text{K}$ would allow to study new effects due to the polarity of these molecules.

We present an experimental setup to produce ultracold ${}^6\text{Li}$ - ${}^{40}\text{K}$ mixtures below quantum degeneracy which is currently build at the new Institute of Quantum Optics and Quantum Information (IQOQI) in Innsbruck. The setup considers the peculiarities of trapping and cooling ${}^6\text{Li}$ and ${}^{40}\text{K}$. Additionally, a possible way to form heteronuclear molecules using two-species Feshbach resonances is discussed.

Q 6.2 Fr 11:00 Poster HU

Tuning a Feshbach resonance through a shape resonance in the dissociation of ultracold molecules — •NIELS SYASSEN¹, THOMAS VOLZ¹, STEPHAN DÜRR¹, GERHARD REMPE¹, ERIC VAN KEMPEN², and SERVAAS KOKKELMANS² — ¹Max-Planck-Institut für Quantenoptik, P.O. Box 1327, 85741 Garching, Germany — ²Eindhoven University of Technology, P.O. Box 513, 5600MB Eindhoven, The Netherlands

We study the dissociation of ultracold molecules made from an atomic ${}^{87}\text{Rb}$ Bose-Einstein condensate using a Feshbach resonance. For the resonance investigated here, the atoms form a bound state with angular momentum quantum number $l = 2$, a d-wave molecule. When these molecules are dissociated by jumping the magnetic field across the Feshbach resonance, the s and d partial waves of unbound atoms are populated leading to a spatial interference pattern. The d-wave decay-channel exhibits a shape resonance caused by a quasi-bound state behind the centrifugal barrier. This shape resonance is studied by magnetically tuning the Feshbach resonance through it [1]. The relative phase between the partial waves, the branching ratio, and the total decay rate show a clear signature of the shape resonance. For the first time, we capture the physics of the shape resonance in a dissociation experiment instead of a scattering experiment. A theory which connects scattering and decay is developed and agrees well with the experiment.

[1] T. Volz et al., cond-mat/0410083

Q 6.3 Fr 11:00 Poster HU

Wechselwirkung ultrakalter Calciumatome — CHRISTOPH GRAIN¹, TATIANA NAZAROVA¹, CHRISTIAN LISDAT², EBERHARD TIEMANN², FRITZ RIEHLE¹ und UWE STERR¹ — ¹Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig — ²Institut für Quantenoptik, Universität Hannover, Welfengarten 1, 30167 Hannover

Erdalkaliatome eignen sich durch ihre einfache Niveaustuktur ohne Hyperfeinstruktur und mit nichtentartetem Grundzustand hervorragend zur Untersuchung der Wechselwirkung kalter Atome und deren Vergleich mit theoretischen Beschreibungen. So konnten wir z.B. aus der Photoassoziation an der ${}^1S_0 - {}^1P_1$ Asymptoten die Streulänge des Calcium-Grundzustandes auf $50a_0 - 300a_0$ eingrenzen. Wir verwenden Ensemble ultrakalter Calcium-Atome mit ca. 10^7 Atomen bei einer Temperatur von ca. $10 \mu\text{K}$, die in einer MOT auf dem Interkombinationsübergang ${}^1S_0 - {}^3P_1$, $\lambda = 657 \text{ nm}$ gekühlt und gespeichert sind. In einer anschließenden Stufe sollen die Atome in einer optischen Dipolfalle im Fokus eines CO_2 Lasers gespeichert werden, um daran Photoassoziationsmessungen durchzuführen. Aufgrund der fehlenden Grundzustandsaufspaltung gibt es bei der Photoassoziation von ${}^{40}\text{Ca}$ keine dominanten zustandsändernden Stöße und der Fallenverlust wird daher zum größten Teil durch den Energiegewinn bewirkt (*radiative escape*). Wir stellen ein Modell vor, das den beobachteten Fallenverlust in Abhängigkeit der Falltiefe quantitativ beschreibt. Implikationen für Experimente in Dipolfallen werden diskutiert, und erste Ergebnisse zur Photoassoziation von ultrakalten Atompaaren in optischen Fallen werden vorgestellt.

Q 6.4 Fr 11:00 Poster HU

Sympathetic Cooling of Molecular Ions embedded in Ba^+ ion crystals: Exploration of the Coolable Mass Range — •ALEXANDER OSTENDORF, BERNHARD ROTH, CHAOBO ZHANG, and STEPHAN SCHILLER — Heinrich-Heine-Universität Duesseldorf

Ultracold molecular ions embedded inside Coulomb crystals are very promising for a variety of studies in molecular physics, quantum optics and fundamental physics.

We have developed a versatile experimental setup suitable for sympathetic cooling of molecular ions covering the wide mass range from 20 up to 20.000 amu. As coolant we use lasercooled ${}^{138}\text{Ba}^+$ ions in a linear rf-trap. So far we have produced lasercooled Barium ion crystals of different sizes and shapes by varying trapping parameters and the amount of Barium. We also succeeded in embedding Ar^+ and CO_2^+ in the ion crystals corresponding to a mass ratio of $m_{\text{Ba}}/m_{\text{SympCooled}}=3.45$ which to our knowledge is the largest value achieved so far.

We will also report on the extension of the apparatus to cool heavy multiply charged molecules generated by electrospray ionization and transferred to the experimentation chamber.