Q 51: Poster Ultrakalte Moleküle

Zeit: Donnerstag 16:30–19:00 Raum: Poster C2

Q 51.1 Do 16:30 Poster C2

Towards an ultracold gas of polar molecules — •Karin Mörtlbauer, Christian Glück, Jörg Lange, Johannes Deiglmayr, Anna Grochola, Roland Wester, and Matthias Weidemüller — Albert-Ludwigs Universität, Physikalisches Institut, Hermann-Herder-Str. 3, 79104 Freiburg i.Brsg., Germany

We recently demonstrated the formation of ultracold LiCs molecules by the trapping light of a double species magneto optical trap [1] and also achieved the active photoassociation of dipolar LiCs molecules in the same setup. In order to create a stable and large ensemble of ultracold LiCs molecules, we will form the molecules in an optical dipole trap [2] and transfer them into the absolute ro-vibrational ground state relying on a Raman-type relaxation scheme and radiative decay. Estimates for the transfer efficiency are derived and the current status of the experimental setup is described.

[1] S. D. Kraft *et al.*, J. Phys. B **39**, S993 (2006)
[2] M. Mudrich *et al.*, PRL **88**, 253001 (2002)

Q 51.2 Do 16:30 Poster C2

Photoassociation of ultracold atoms by shaped ultrashort pulses — •Simone Götz[1], Wenzel Salzmann[1], Terry Mullins[1], Magnus Albert[1], Judith Eng[1], Roland Wester[1], Matthias Weidemüller[1], Andrea Merli[2], Fransizka Sauer[2], Fabian Weise[2], Steffan Weber[2], Mateusz Plewicki[2], Ludger Wöste[2], and Albrecht Lindinger[2] — [1]Physikalisches Institut, Universität Freiburg, Herrmann-Herder-Str.3, 79104 Freiburg — [2]Institut für Physik, Freie Universität Berlin, Arnimallee 14, D-14195 Berlin

We present experiments on the photoassociation (PA) of ultracold atoms using shaped femtosecond laser pulses. In a pump-probe scheme, molecules are produced in am excited state from an ultracold gas of ^{85}Rb atoms, are ionized and mass selectively detected. Pump-pulses are shaped to suppress atomic losses from the trap [1] and address only bound molecular states. The molecular ion signal shows rich coherent interactions between the molecules and the electric field. Quantum dynamical simulations accompany the data, providing detailed insight into the process. Wavepacket motion is a requirement for proposed PA into ground states [2] and was not observed due to rapid wavepacket dispersion. We circumvent this by the use of picosecond pulses with a more suitable bandwidth that is closely matched to the free-bound Franck-Condon factors. A new pulse-shaper design allows high-resolution shaping of such pulses and thus application of coherent control techniques to the PA process in the perturbative domain.

[1] W. Salzmann et al., PRA 73, 023414 (2006)
[2] C. Koch et al., PRA 73, 043409 (2006)

Q 51.3 Do 16:30 Poster C2

Formation of Ultracold Ground State Molecules with a Single Short Laser Pulse — •Ruzin AĜanoĜlu and Christiane P. Koch — Freie Universität zu Berlin, Institut für Theoretische Physik, Arnimallee 14, 14195 Berlin

Bringing ultracold systems and coherent control schemes together is a promising subject of current research. One method to combine ultracold and ultrafast is photoassociation where two colliding atoms are transferred to an electronically excited state coherently with a short laser pulse. Already after a single pulse, formation of ultracold molecules in their electronic ground state is also observed. This is due to the change of the initial scattering wavefunction which leads to molecules in very weakly bound levels of the electronic ground state.

Here we study the creation of ground state molecules with a single short laser pulse. Since the molecule formation is desired only in the electronic ground state, an excited state is chosen with a repulsive potential and the short laser pulse is blue detuned for excitation.The laser parameters can be chosen such that atoms far from each other are blown away while atoms very close to each other are kept and form molecules.

The initial thermal probability density of atoms is expected to be very small at short internuclear distances. However, it can be manipulated by changing the scattering properties of the atoms. In this work an optically induced Feshbach resonance is employed to modify the initial atomic distribution prior to photoassociation by a single short pulse.

Q 51.4 Do 16:30 Poster C2

The Efimov Molecule with short and finite range potentials — •Bettina Berg[1], Lev Plimak[1], Misha Ivanov[2] und Wolfgang P. Schleich[1] — [1]Institute of Quantum Physics, Ulm University, Germany — [2]NRC, Ottawa, Canada

The Efimov effect [1,2] has always been regarded somewhat of a mystery. As there is an evergrowing interest in this problem, a simple explanation of this effect utilizing only elementary quantum mechanics appears more than desirable. We investigate the so-called Efimov molecule formed by two heavy and one light particle in the Born-Oppenheimer limit, by applying an Ansatz from "Quantum Chemistry 101" and assuming that the light particle interacts with the heavy ones via a short-range potential. The resulting molecular term exhibits the typical $1/R^2$ behaviour of a Efimov potential [3]. An extention of our method to potentials of arbitrary radius is also discussed.

[1] V. N. Efimov, *Weakly Bound States of Three Resonantly-Interactiong Particles*, Sov. J. Nucl. Phys. 12, 589-595 (1971).
[2] T. Kraemer *et al.*, *Evidence for Efimov quantum states in an ultracold gas of caesium atoms*, Nature 440, 315-318 (16 March 2006), cond-mat/0512394.
[3] L. Plimak, B. Berg, M. Ivanov, W. Schleich, *Quantum Chemistry of the Efimov Molecule*, submitted.

Q 51.5 Do 16:30 Poster C2

Few-body physics with ultracold Cs atoms and molecules — •Steven Knoop[1], Martin Berninger[1], Francesca Ferlaino[1], Harald Schöbel[1], Michael Mark[1], Hanns-Christoph Nägerl[1], and Rudolf Grimm[1,2] — [1]Institut für Experimentalphysik, Universität Innsbruck, Austria — [2]Institut für Quantenoptik und Quanteninformation, Innsbruck, Austria

Ultracold atomic gases are versatile systems to study few-body physics because of full control over the external and internal degrees of freedom and the magnetic tunability of the scattering properties using Feshbach resonances. Here we experimentally study three- and four-body physics by investigating ultracold (30-250 nK) atom-dimer and dimer-dimer collisions with Cs Feshbach molecules in various molecular states and Cs atoms in different hyperfine states. Resonant enhancement of the atom-dimer relaxation rate is observed in a system of three identical bosons and interpreted as being induced by a trimer state, possibly an Efimov state. A strong magnetic field dependence of the relaxation rate is also observed when the atoms are transferred to a different hyperfine sublevel [1]. For dimer-dimer collisions we have observed an unexpected temperature dependence and a suppression of the collisional loss rate [2].

[1] S. Knoop et al., in preparation [2] F. Ferlaino et al., in preparation

Q 51.6 Do 16:30 Poster C2

Ultracold Cesium Feshbach Molecules — •Martin Berninger[1], Steven Knoop[1], Francesca Ferlaino[1], Harald Schöbel[1], Michael Mark[1], Hanns-Christoph Nägerl[1], and Rudolf Grimm[1,2] — [1]Institut für Experimentalphysik, Universität Innsbruck, Austria — [2]Institut für Quantenoptik und Quanteninformation, Innsbruck, Austria

We present our recent work on ultracold Cesium Feshbach molecules in an optical dipole trap. We have implemented a new crossed-beam laser trap, which traps atoms and molecules simultaneously. By scanning one laser beam the ellipticity can be dynamically tuned for an optimal trap configuration. We routinely prepare ultracold mixed atomic and molecular or pure molecular samples at temperatures down to 30 nK [1]. We selectively populate Feshbach molecules in various s-, d-, g- and even l-wave states [2]. We have experimentally demonstrated that the l-wave dimers can be stable against spontaneous decay on the timescale of one second well above the dissociation threshold [3]. We have recently implemented the technique of resonantly modulated magnetic field spectroscopy [4]. Transitions between the atomic continuum and dimer states, and vice versa, as well as dimer-dimer transitions can be driven. Our main motivation is to apply this technique to search for trimer and tetramer states, whose presence has been indicated by resonances in collisional loss measurements.

[1] F. Ferlaino et al., in preparation; [2] M. Mark et al., Phys. Rev. A 76, 042514 (2007); [3] S. Knoop et al., arXiv:0710.4052; [4] T. M. Hanna et al., Phys. Rev. A 75, 013606 (2007)