MO 11: Ultrakalte Moleküle (gemeinsam mit Q)

Zeit: Dienstag 16:30–18:00 Raum: 3G

MO 11.1 Di 16:30 3G

Photoassociation of ultracold molecules by shaped femtosecond laser pulses — •Wenzel Salzmann[1], Terry Mullins[1], Simone Götz[1], Roland Wester[1], Magnus Albert[1], Judith Eng[1], Matthias Weidemüller[1], Fabian Weise[2], Andrea Merli[2], Stefan Weber[2], Franziska Sauer[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

We present first experiments on the formation on photoassociation of ultracold molecules with shaped femtosecond laser pulses. In a pump-probe sequence of laser pulses, molecules are produced in their excited state from an ultracold gas of rubidium atoms and subsequently ionized. Molecular ions are mass selectively detected with single ion efficiency. Pulse shaping techniques are used to restrict the pump pulse spectral intensity to address only bound molecular potentials of the first electronically excited state and to suppress atomic losses from the trap due to ionization [1]. The pump-probe detected molecular ion signal shows rich oscillatory dynamics, caused by coherent interactions of molecular electronic dipole with the electric field of the pump pulse [2]. Analysis of the data is accompanied by quantum dynamical simulations which give detailed insight into the pulsed photoassociation process. We further find indications for the formation of molecules in their electronic ground state by spontaneous decay.

[1] W. Salzmann *et al.*, PRA 73, 023414 (2006)
[2] A. Monmayrant *et al.*, PRL 96, 103002 (2006)

MO 11.2 Di 16:45 3G

Engineering an all-optical route to ultracold molecules in their vibronic ground state — •Christiane P. Koch[1] and Robert Moszynski[2] — [1]Freie Universität Berlin, Institut für Theoretische Physik, Arnimallee 14, 14195 Berlin, Germany — [2]Dept. of Chemistry, University of Warsaw, Pasteura 1, 02-093 Warsaw, Poland

We propose an improved photoassociation scheme to produce ultracold molecules in their vibronic ground state. Formation of molecules is achieved by short laser pulses in a Raman-like pump-dump process where an additional (near-)infrared laser field couples the excited state to an auxiliary state. The efficiency of population transfer is determined by the shape of the excited state potential; it is dauntingly low for typical potentials. In our proposal, the coupling due to the additional field effectively changes the shape of the excited state potential, allowing for efficient population transfer to v=0. Such a field-induced coupling can significantly enhance any short pulse Raman-like process.

MO 11.3 Di 17:00 3G

Photoassociation of ultracold LiCs — •Christian Glück, Jörg Lange, Johannes Deiglmayr, Stephan Kraft, Karin Mörtlbauer, 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]. After spontaneous decay into the electronic ground state and one-color two-photon ionization, the molecular ions are detected by a high-resolution time-of-flight mass spectrometer [2].

Here we present the active photoassociation of ultracold LiCs molecules, leading to a significantly increased production rate. Photoassociation resonances in the $B^1\Pi$ potential correlated to the $2S_{1/2}$-$6P_{3/2}$ asymptote are identified and the ro-vibrational state distribution of the produced ground state molecules is discussed. The perspectives for the production of LiCs molecules in the absolute ground state are evaluated and future experiments with an ultracold gas of polar LiCs molecules are outlined.

[1] S. D. Kraft *et al.*, J. Phys. B **39**, S993
[2] S. D. Kraft *et al.*, to appear in Applied Physics B

MO 11.4 Di 17:15 3G

Towards a BEC of Ground State Molecules — •Johann Georg Danzl, Mattias Gustavsson, Elmar Haller, Manfred Mark, and Hanns-Christoph Nägerl — Institut für Experimentalphysik und Forschungszentrum für Quantenphysik, Universität Innsbruck, Innsbruck, Austria

We report on recent progress on optical spectroscopy of ultracold Cs_2 Feshbach molecules. Our ultimate goal is the production of ultracold molecules in the rovibrational ground state of the singlet molecular potential [1] and the production of a BEC of ground state molecules. Coherent state transfer with an efficiency approaching unity should be possible by means of stimulated Raman adiabatic passage (STIRAP) [2]. We plan to apply two consecutive two-photon STIRAP steps where the first step will transfer the molecules from the initial Feshbach state to an intermediate vibrational level near ν=70 of the singlet potential. As part of the first step, we have found several strong bound-bound transitions in the wavelength region 1120 nm to 1130 nm, far off resonance from the atomic D1 and D2 lines.

[1] D. Jaksch, V. Venturi, J. I. Cirac, C. J. Williams, and P. Zoller, Creation of a Molecular Condensate by Dynamically Melting a Mott Insulator, Phys.Rev. Lett. 89, 040402 (2002).
[2] K. Winkler, F. Lang, G. Thalhammer, P. v.d. Straten, R. Grimm, J. Hecker Denschlag, Coherent optical transfer of Feshbach molecules to a lower vibrational state, Phys. Rev. Lett. 98, 043201 (2007)

MO 11.5 Di 17:30 3G

Few-body physics with ultracold Cs atoms and molecules — •Steven Knoop[1], Francesca Ferlaino[1], Martin Berninger[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 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 and interpreted as being induced by a trimer state [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

MO 11.6 Di 17:45 3G

Photoassociation spectroscopy in a mixture of ultracold Rb and Yb atoms — Nils Nemitz, •Florian Baumer, Frank Münchow, and Axel Görlitz — Institut für Experimentalphysik, HHU Düsseldorf, Germany

Currently, many groups are pursuing the production of ultracold heteronuclear molecules in the electronic ground state. Among the most fascinating features that such a system would offer are the study of strongly dipolar quantum gases and potentially fundamental precision measurements for suitably chosen molecules.

The goal of our experiment is the formation of molecules through photoassociation of ultracold paramagnetic Rb atoms and diamagnetic Yb atoms. The first step towards this goal is the investigation of one-photon spectroscopy from the atomic ground state of the two atomic species to an electronically excited state of the heteronuclear RbYb molecule.

Here, we report on recent results of photoassociation spectroscopy close to the Rb D1-transition at 795 nm in a combined magneto-optical trap. By detecting the Yb trap loss as a function of the frequency of the photoassociation laser, we are able to observe spectral lines corresponding to several vibrational states and resolve the rotational substructure of the excited RbYb molecule.

The next steps will be photoassociation spectroscopy of conservatively trapped RbYb mixtures and the extension to two-photon photoassociation in order to produce ultracold ground state molecules.