

MO 10: Kalte Moleküle 1

Zeit: Dienstag 10:30–12:30

Raum: VMP 6 HS-G

Hauptvortrag MO 10.1 Di 10:30 VMP 6 HS-G
Ultracold Triplet Molecules in the Rovibrational Ground State — ●FLORIAN LANG¹, KLAUS WINKLER¹, CHRISOPH STRAUSS¹, RUDOLF GRIMM^{1,2}, and JOHANNES HECKER DENSCHLAG¹ — ¹Institut für Experimentalphysik und Zentrum für Quantenphysik, Universität Innsbruck — ²Institut für Quantenoptik und Quanteninformation der Österreichischen Akademie der Wissenschaften

The successful production of quantum degenerate gases of weakly bound molecules has triggered a quest for quantum gases of tightly bound molecules. These can be used to investigate ultracold collisions and chemistry of molecules, to produce molecular Bose-Einstein condensates (BEC), and to develop molecular quantum optics.

We report [1] the production of an ultracold gas of tightly bound Rb₂ triplet molecules in the rovibrational ground state, close to quantum degeneracy. This is achieved by optically transferring weakly bound Rb₂ molecules to the absolute lowest level of the ground triplet potential with a transfer efficiency of about 90%. The transfer takes place in a 3D optical lattice which traps a sizeable fraction of the tightly bound molecules with a lifetime exceeding 200 ms.

[1] F. Lang *et al.*, *Phys. Rev. Lett.* **101**, 133005 (2008)

MO 10.2 Di 11:00 VMP 6 HS-G
Photoassociation spectroscopy of the B¹Π -state of LiCs — ●MARC REPP^{1,2}, JOHANNES DEIGLMAYR², ANNA GROCHOLA², OLIVIER DULIEU³, PHILIPPE PELLEGRINI⁴, ROBIN COTÉ⁴, ROLAND WESTER², and MATTHIAS WEIDEMÜLLER^{1,2} — ¹Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg — ²Physikalisches Institut, Albert-Ludwigs-Universität Freiburg — ³Laboratoire Aimé Cotton, CNRS, University Paris-Sud XI, Orsay, France — ⁴Department of Physics, University of Connecticut, Storrs, USA

We recently achieved the formation of ultracold LiCs-molecules in the rovibrational ground state $X^1\Sigma^+, v''=0, J''=0$ [1] via photoassociation (PA) through the B¹Π potential in double-species magneto-optical trap. In this talk we will present a detailed analysis of the photoassociation step, including the strength of the PA resonances. We observed an enhancement of the PA rates for deeply bound states which might be explained by an increased amplitude of the scattering wave function at the inner turning point of the lowest triplet state $a^3\Sigma^+$. This perturbation is possibly introduced into the singlet projection of the wave function by a Feshbach resonance close to zero magnetic field [2].

[1] J. Deiglmayr *et al.*, *Phys. Rev. Lett.* **101**, 133004 (2008)

[2] J. Deiglmayr *et al.*, submitted to *New Journal of Physics*

MO 10.3 Di 11:15 VMP 6 HS-G
Predissociation lifetimes of LiCs states — ●ANNA GROCHOLA¹, JOHANNES DEIGLMAYR^{1,2}, OLIVIER DULIEU², ROLAND WESTER¹, and MATTHIAS WEIDEMÜLLER³ — ¹Physikalisches Institut, Albert-Ludwigs-Universität Freiburg — ²Laboratoire Aimé Cotton, CNRS, University Paris-Sud XI, Orsay, France — ³Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg

Since many years there is a big interest in production of ultracold diatomic polar molecules, showing a great need for the knowledge about properties of alkali metal dimers. One of the important processes, which may influence the formation and further investigation of molecules, is predissociation of excited energy levels. One example is the LiCs molecule [1], interesting due to its strong dipole moment.

Predissociation effects in the LiCs molecule are investigated using the Fourier Grid Hamiltonian (FGH) method [2] with an optical potential [3]. We concentrate on five LiCs states dissociating to the two lowest lying asymptotes, namely A¹Σ⁺, a³Σ⁺, c³Σ⁺, b³Π and B¹Π. A possible predissociation of the b³Π levels is found, showing a feature characteristic for all alkali metal dimers containing a lithium atom. The calculated widths are compared with experimental results.

[1] J. Deiglmayr, A. Grochola, M. Repp, K. Mörtlbauer, C. Glück, J. Lange, O. Dulieu, R. Wester and M. Weidemüller, *Phys. Rev. Lett.* **101**, 133004 (2008)

[2] O. Dulieu and P.S. Julienne, *J. Chem. Phys.* **103**, 60 (1995)

[3] V. Kokouline, O. Dulieu, R. Kosloff and F. Masnou-Seeuws, *Phys. Rev. A* **62**, 032716 (2000)

MO 10.4 Di 11:30 VMP 6 HS-G
Absolute photodetachment cross section measurements of the

O⁻ and OH⁻ anion — ●PETR HLAVENKA¹, RICO OTTO¹, SEBASTIAN TRIPPEL¹, MARTIN STEI¹, MATTHIAS WEIDEMÜLLER², and ROLAND WESTER¹ — ¹Physikalisches Institut, Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg — ²Physikalisches Institut, Universität Heidelberg, Albert-Überle-Str. 3-5, 69120 Heidelberg

Almost all measurements of absolute photodetachment cross sections of anions can be traced back to two studies on O⁻, which act as a calibration standard. Here we present absolute total photodetachment cross sections of O⁻ and OH⁻ anions stored in a multipole radiofrequency trap [1]. The O⁻ cross sections 5.9(1) and 6.3(1)·10⁻¹⁸ cm² measured at 662 nm and 532 nm, respectively, agree with preceding experiments. A significant deviation is found compared to ab initio calculations. For OH⁻ the total cross sections measured at 662 nm and 632 nm, were found to be constant in the temperature range 8-300 K. Using a novel laser depletion tomography method we increase the accuracy of this calibration standard [2].

[1] S. Trippel *et al.*, *Phys. Rev. Lett.* **97**, 193003 (2006)

[2] P. Hlavenka *et al.*, submitted

MO 10.5 Di 11:45 VMP 6 HS-G
A Stark decelerator on a chip — ●SAMUEL A. MEEK, HORST CONRAD, and GERARD MEIJER — Fritz-Haber-Institut der MPG, Faradayweg 4-6, 14195 Berlin

A microstructured array of 1254 electrodes on a substrate has been configured to generate an array of local minima of electric field strength with a periodicity of 120 μm about 25 μm above the substrate. By applying sinusoidally varying potentials to the electrodes, these minima can be made to move smoothly along the array. Polar molecules in low-field seeking quantum states can be trapped in these traveling potential wells. Previously, we experimentally demonstrated this by transporting metastable CO molecules at constant velocities above the substrate [1]. More recently, we have experimentally demonstrated how this microstructured array can be used to decelerate polar molecules directly from a molecular beam. For this, the sinusoidally varying potentials need to be switched on when the molecules arrive above the chip, their frequency needs to be chirped down in time, and they need to be switched off before the molecules leave the chip again. Deceleration of metastable CO molecules from an initial velocity of 360 m/s to a final velocity as low as 240 m/s is demonstrated in the 15-35 mK deep potential wells above the 5 cm long array of electrodes. This corresponds to a deceleration of almost 10⁵ g, and about 85 cm⁻¹ of kinetic energy is removed from the metastable CO molecules in this process.

[1] S A Meek, H L Bethlem, H Conrad, and G Meijer. Trapping molecules on a chip in traveling potential wells. *PRL* 100:153003 (2008)

MO 10.6 Di 12:00 VMP 6 HS-G
Spatially separating individual conformers of neutral molecules — ●FRANK FILSINGER¹, JOCHEN KÜPPER¹, GERARD MEIJER¹, JONAS L. HANSEN², JENS H. NIELSEN², LOTTE HOLMEGAARD², IFTACH NEVO², JOCHEN MAURER², and HENRIK STAPELFELDT² — ¹Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin, Germany — ²Århus University, Århus, Denmark

Large (bio)molecules exhibit multiple conformers (structural isomers), even under the cold conditions present in a supersonic jet. For various applications, i.e., scattering experiments or time resolved studies, it would be highly desirable to prepare molecular packets of individual conformers.

It is well known that polar molecules can be manipulated using strong electric fields. Recently, we have demonstrated that electrostatic deflection of a molecular beam can be used for quantum-state selection of large molecules [1]. Here we demonstrate how this quantum state selectivity can be exploited to spatially separate the individual conformers of large molecules based on their distinct mass-to-dipole (m/μ) ratios. In a proof-of-principle experiment, we have spatially isolated both, cis and trans, conformers of 3-aminophenol. We will compare this approach to conformer selection using alternating gradient (dynamic) focusing in an m/μ-selector [2].

[1] L. Holmegaard *et al.*, *Phys. Rev. Lett.*, in press, preprint available at arXiv:physics.chem-ph 0810:2307 (2008)

[2] F. Filsinger *et al.*, *Phys. Rev. Lett.* **100**, (2008),133003

MO 10.7 Di 12:15 VMP 6 HS-G

Gas Phase Vibrational Spectroscopy of Suberate Dianions

— •TORSTEN WENDE¹, DANIEL J. GOEBBERT², RISSHU BERGMANN¹, GERARD MEIJER¹, and KNUT R. ASMIS¹ — ¹Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany — ²Department of Chemistry, University of Arizona, Tucson, Arizona 85721-0041

A generally applicable method for forming ion-messenger atom complexes is presented. Mass-selected ions from an electrospray source are trapped and collisionally cooled to sufficiently low temperatures in a buffer gas filled ion trap, such that the formation of the entropically un-

favorable complexes occurs via three body collisions. The technique is exploited to measure the first gas phase vibrational spectra of suberate dianions via infrared vibrational predissociation (IRVPD) of the corresponding ion-Kr atom complexes. The IRVPD spectra show that at 63 K the all-trans isomer is the most abundant species, but that dynamically interconverting conformers also contribute to the absorption cross section in the C-H stretching region. Addition of a water molecule leads to a very broad band in the O-H stretching region, which is attributed to strong anharmonic coupling between the O-H stretch modes and intermolecular rocking motion with the H₂O binding to the carboxylate group in a bidentate fashion.