MO 24: Kalte Moleküle

Zeit: Donnerstag 16:30–19:00 Raum: Poster C1

MO 24.1 Do 16:30 Poster C1

Anion molecule reaction dynamics — •Rico Otto, Jochen Mikosch, Sebastian Trippel, Christoph Eichhorn, Petr Hlavenka, Matthias Weidemüller, and Roland Wester — Physikalisches Institut, Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg

Anion-molecule reaction processes are known for their rich reaction dynamics, caused by a complex potential energy surface. We have carried out the first kinematically complete study of the S_N2 reaction of $Cl^- + CH_3I$ using crossed molecular beam imaging [1]. Different reaction mechanisms are observed as a function of collision energy. Currently, we study molecular dissociation dynamics in strong laser fields. In addition our experimental approach for the study of reactive scattering with laser aligned molecules will be discussed.

Slow collisions of anions at fixed temperature are also investigated in a 22pole radio frequency trap. We could identify evaporation of stored ions as the ultimate loss channel in this trapping device [2]. Proton transfer from H_2 to NH_2^- showed unexpected low temperature characteristics in the reaction rate coefficient. Ab initio calculations were carried out in order to explain this behaviour. The absolute cross section of OH^- photodetachment was measured using a tomography scan [3]. Two-dimensional tomography scans at different temperatures reveal further details of the ion density distribution.

[1] J. Mikosch *et al.*, Science (in press)
[2] J. Mikosch *et al.*, Phys. Rev. Lett. **98**, 223001 (2007)
[3] S. Trippel *et al.*, Phys. Rev. Lett. **97**, 193003 (2006)

MO 24.2 Do 16:30 Poster C1

A planar multipol ion trap for spectrocopy of water clusters — •Christian Greve[1], Michael Kröner[2], Markus Debatin[1], Jochen Mikosch[1], Sebastian Trippel[1], Markus Reetz-Lamour[1], Peter Woias[2], Roland Wester[1], and Matthias Weidemüller[1] — [1]Physikalisches Institut, Universität Freiburg — [2]Institut für Mikrosystemtechnik, Universität Freiburg

Microhydrated ions provide the opportunity to study solvent effects such as reaction rates and ionisation potentials as a function of the solvation number and are subject to numerous theoretical and experimental investigations. We plan to perform spectroscopy in a planar chip trap providing an almost rectangular multipol trapping potential [1]. For good optical access the trap consists of two opposing glass chips each with an electrode structure which can be made transparent using indium tin oxide. For the creation of water cluster ions we have designed a source composed of an electron gun, a pulsed valve and an electrostatic lens in a small differentially pumped vacuum chamber. Detection after storage is accomplished by a Wiley-McLaren type spectrometer setup. For future experiments with water cluster ions we will implement a quadrupole filter for mass selective loading, which will eventually be integrated onto the same chip with the trap. In addition, we will combine the trap with a magneto optical trap for experiments on interactions of trapped ions with ultracold atoms.

[1] M. Debatin et al., in prep.
[2] J. Mikosch et al., Phys. Rev. Lett. 98, 223001 (2007)

MO 24.3 Do 16:30 Poster C1

Stark deceleration of SO_2 — •Oleg Bucicov[1], Eberhard Tiemann[1], and Christian Lisdat[2] — [1]Institut für Quantenoptik, Leibniz Universität Hannover — [2]Physikalisch-Technische Bundesanstalt, Braunschweig

We present a Stark decelerator for low-field-seeking states with 326 stages, with which we succeeded in decelerating SO_2 molecules to the velocity of about 50 m/s [1]. With this decelerator it should be possible to bring the relatively heavy SO_2 molecules to a standstill and to trap them electrostatically.

This offers the possibility of studying the predissociation of the trapped cold SO_2 at the threshold resulting in the production of cold SO molecules and O atoms. We will measure the velocity distribution of the photofragments. The previous research showed that the dissociation process can be manipulated by an external electric field that shifts the dissociation asymptotes relative to the predissociating levels [2]. In this way the reaction channels can be opened or closed at will or the tuning of the velocity of fragments can be attained, these opportunities being very attractive for the field of cold molecules and cold chemistry.

[1] O. Bucicov et al., submitted to EPJD.
[2] S. Jung et al., J. Phys. B 39, S1085, 2006.

MO 24.4 Do 16:30 Poster C1

Production of a continuous guided beam of slow and internally cold molecules from a cryosource — •Christian Sommer, Laurens van Buuren, Sebastian Pohle, Michael Motsch, Joseph Bayerl, Pepijn Pinkse, and Gerhard Rempe — Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Str. 1, 85748 Garching

Dense samples of cold polar molecules offer new perspectives in physics [1]. Studies of cold collisions and chemical reactions as well as high precision measurements will benefit from these samples. Further cooling to the ultracold regime will lead to conditions where the long range and anisotropic dipole-dipole interaction becomes dominant and new phenomena could be observed.

We have developed a new source delivering a continuous beam of slow and internally cold polar molecules. In the source room-temperature ND_3 molecules are injected into a cryogenic helium buffer gas where they are cooled in all degrees of freedom [2]. A fraction of the cold molecules is extracted by an electric quadrupole [3] and transported to a high-vacuum region outside the cryogenic source where it can, for example, be loaded into an electrostatic trap [4]. We will discuss the principle of operation, details of the set up, and present data of its performance.

[1] J. Doyle *et al.*, Eur. Phys. J. D **31**, 149 (2004)
[2] J.D. Weinstein *et al.*, Nature (London) **395**, 148 (1998)
[3] T. Junglen *et al.*, Eur. Phys. J. D **31**, 365 (2004)
[4] T. Rieger *et al.*, Phys. Rev. Lett. **95**, 173002 (2005)

MO 24.5 Do 16:30 Poster C1

Aufbau einer Stark-Effekt geführten Quelle für langsame Moleküle — •Adam Piechaczek, Michael Stolle und Hans-peter Helm — Molekül- und Optische Physik, Physikalisches Institut, Stefan-Meier-Str. 19, 79104 Freiburg

Mit dem Ziel langsame Moleküle in einer optischen Dipolfalle zu fangen und dort sympathetisch mit kalten Alkali-Atomen zu kühlen, haben wir nach dem Vorbild [1] eine Apparatur zur Selektion und Führung langsamer Moleküle aufgebaut. Dabei werden mittels eines zweimal um 90 Grad gebogenen Vierpols in drei differentiellen Pumpstufen neutrale, polare Moleküle anhand des Stark-Effekts geführt, bzw. schnelle Moleküle ausgefiltert. Um zuletzt auch die innere Energie der Moleküle zu erniedrigen, wird dem langsamen Molekülstrahl am Ende des Vierpols räumlich eine Dipolfalle, gefüllt mit kalten Rb-Atomen, überlagert. Dort sollen sehr tiefe Temperaturen und damit hochauflösende Molekül-Spektroskopie sowie Untersuchung langsamer interner Prozesse gefangener Moleküle möglich werden. Momentan wird im ersten Schritt versucht, fluoreszierende Moleküle durch den Vierpol zu leiten, um über LIF zeitlich aufgelöst ihren inneren Zustand und ihre Bewegung zu verfolgen. In diesem Zusammenhang wollen wir auch koaxiale Laser-Spektroskopie am Stark-geführten Molekülstrahl durchführen um die Anfangsbedingungen der zur Kühlung vorliegenden Moleküle zu ermitteln.

[1] T. Rieger et al., Eur. Phys. J. D 31, 365 (2004), T. Junglen et al. PRL 92 223001, (2004)

MO 24.6 Do 16:30 Poster C1

Imino Tautomers of Gas Phase Guanine from Mid-Infrared Laser Spectroscopy — Kai Seefeld, Robert Brause, •Thomas Häber, and Karl Kleinermanns — Institut für Physikalische Chemie, Heinrich-Heine Universität Düsseldorf, 40225 Düsseldorf, Germany

We reinvestigated the assignment of the three major guanine conformers detected via resonance enhanced two-photon ionization (R2PI) in supersonic expansions and present IR/UV double resonance spectra in the spectral region between 1500 and 1800 cm^{-1}. Comparison with B3LYP/TZVPP and RI-MP2/cc-pVQZ calculations shows that both conformers B and C are 7H-keto tautomers with an imine group in 2-position. They differ only in the local conformation of the imine group, but are otherwise identical. Conformer A is an amino-enol form with the OH group in trans position.

MO 24.7 Do 16:30 Poster C1

Conveyor belt for single molecular ions starts moving — •Steffen Kahra, Günther Leschhorn, and Tobias Schaetz — Max-Planck-Institut für Quantenoptik, Garching

Recent and ongoing endeavours for growingly precise measurements of time dependent structural properties of molecules have raised interest in better adapted target preparation methods. This can be understood as it might be crucial to extend existing methods to the few femtosecond or attosecond time scale. The experimental scheme we present aims for a fully controllable emitter of molecular ions. By exploiting the collected advantages of a linear Paul trap, sympathetic cooling schemes, light pressure separation of different ion species, field free alignment and a tunable reloading mechanism we might be able to position external cold and aligned molecular ions to a precision of about one micrometer at a repetition rate of up to 10 kHz inside a linear Paul trap. These targets seem to be suited for ultrafast electron diffraction and/or cold chemistry experiments. We will discuss the ability to incorporate those methods and can possibly comment on first results. The project is part of the excellence initiative MAP, financial support by MPG and IMPRS-APS is acknowledged.

MO 24.8 Do 16:30 Poster C1

Core hole loaclization von N_2 — •Markus Schöffler[1], Jasmin Titze[1], Nikos Petridis[1], Till Jahnke[1], Kyra Cole[1], Lothar Schmidt[1], Achim Czasch[1], Dominique Akoury[1], Joshua Williams[5], Nikolai Cherepkov[3], Sergey Semenov[3], Bill McCurdy[2], Tom Rescigno[2], Lew Cocke[4], Timur Osipov[2], Sun Lee[2], Mike Prior[2], Ali Belkacem[2], Allen Landers[5], Horst Schmidt-Böcking[1], Thorsten Weber[2] und Reinhard Dörner[1] — [1]Institut für Kernphysik, Frankfurt, Deutschland — [2]Lawrence Berkeley National Laboratory, Berkeley, USA — [3]State University of Aerospace Instrumentation, St. Petersburg, Russland — [4]Department of Physics, Kansas State University, USA — [5]Department of Physics, Auburn University, USA

Seit Jahrzehnten diskutieren Physiker und Chemiker ob eine durch Photoabsorption erzeugte Innerschalenvakanz ein lokalisiertes Loch oder einen delokalisierten Quantenzustand hinterlässt. Wir haben dieses Problem anhand der Absorption von 419 eV zirkular polarisierten Photonen in N_2-Moleküls untersucht. Mit einem speziell auf diese Frage abgestimmten Impulsspektrometer (COLTRIMS) konnten erstmals Photoelektron (10 eV), Augerelektron (400 eV) und die beiden Stickstoff-Rückstoßionen (5 eV) in Koinzidenz detektiert werden. Zusammen mit theoretischen Rechnungen kann zum ersten Mal überhaupt gezeigt werden, dass wie Symmetriebrechung bzw. deren -erhaltung zusammenhängen; letztendlich ist dies eine Ergebnis aus dem Zerfall eines verschränkten Bell-Zustandes.