Q 19: Kalte Moleküle III [gemeinsam mit MO]

Zeit: Dienstag 14:00–16:00 Raum: 3G

Q 19.1 Di 14:00 3G

Cumulenic carbon chains: giant absorbers — •Dmitry Strelnikov and Wolfgang Krätschmer — Max-Planck-Institut für Kernphysik, 69117 Heidelberg.

Cumulenic carbon chains have extremely strong IR and UV-Vis absorptions, a feature which facilitates their detection even in minute quantities. We present our results obtained by IR and UV-Vis spectroscopy on bare carbon chains and their oxides trapped in cryogenic matrices. IR spectra of a novel hybrid molecule consisting of a C3 carbon chain attached to a C60 fullerene will also be presented and discussed.

Q 19.2 Di 14:15 3G

Internal-state thermometry by depletion spectroscopy in a cold guided beam of formaldehyde — •Michael Motsch, Markus Schenk, Laurens D. van Buuren, Martin Zeppenfeld, Pepijn W.H. Pinkse, and Gerhard Rempe — Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Str. 1, 85748 Garching, Germany

Velocity filtering by means of an electrostatic quadrupole guide is an efficient technique to produce slow beams of polar molecules from a thermal reservoir. For formaldehyde, fluxes of $10^{10}\,s^{-1}$ with velocities down to $\sim$10 m/s have been demonstrated [1]. However, so far the internal-state distribution of the velocity filtered molecules was not accessible in the experiment.

We present measurements of the internal-state distribution of electrostatically guided formaldehyde [2]. Upon excitation with continuously tunable ultraviolet laser light, molecules can be excited to a dissociating state, leading to a decrease in the molecular flux. The population of individual guided states is measured by addressing transitions originating from them. The measured populations of selected states show good agreement with theoretical calculations for different temperatures of the molecule reservoir. The purity of the guided beam as deduced from the entropy of the guided sample using a reservoir temperature of 150 K corresponds to that of a thermal ensemble with a temperature of about 30 K.

[1] S.A. Rangwala et al., Phys. Rev. A **67**, 043406 (2003)
[2] M. Motsch et al., arXiv:chem-phys 0710.3316v1 (2007), accepted for publication in Phys. Rev. A

Q 19.3 Di 14:30 3G

Cooling and Slowing in High Pressure Jet Expansions — •Wolfgang Christen and Klaus Rademann — Institut für Chemie, Humboldt-Universität zu Berlin, Brook-Taylor-Strasse 2, 12489 Berlin

The expression for the mean flow velocity in supersonic beams of ideal gases is extended to include real gas properties. This procedure yields an explicit dependence of the flow velocity on pressure, as observed in recent experiments of free jet expansions [1,2]. Applied to stagnation conditions slightly above the critical point, the model suggests that seeded high pressure jets might be suitable for slowing down virtually any molecule with high efficiency. Moreover, we discuss the consequence of a pressure-dependent flow velocity v_0 for the speed ratio $S = v_0/\Delta v_{\parallel}$ with respect to collisional cooling and suggest to use the velocity spread $\Delta v_{\parallel}$ as a more non-ambiguous measure of translational temperature in high pressure jet expansions.

[1] L. W. Bruch, W. Schöllkopf, J. P. Toennies, *J. Chem. Phys.* **117**, 1544 (2002).
[2] W. Christen, T. Krause, K. Rademann, *Rev. Sci. Instrum.* **78**, 073106 (2007).

Q 19.4 Di 14:45 3G

Überschallexpansion von überkritischen Fluiden - Ethen und Propan — •Oliver Korup, Klaus Rademann und Wolfgang Christen — Institut für Chemie, Humboldt-Universität zu Berlin, Brook-Taylor-Strasse 2, 12489 Berlin

Mit hochaufgelösten Flugzeitmessungen gepulster Überschallmolekularstrahlen wird die Geschwindigkeitsverteilung von reinem Ethen und Propan als Funktion des Stagnationsdrucks und der Stagnationstemperatur bestimmt. Beide Spezies werden hierzu unter präzise definierten Stagnationsbedingungen [1] ins Vakuum expandiert. Der untersuchte Druck- und Temperaturbereich umfasst den gasförmigen, flüssigen und überkritischen Aggregatzustand. Die Messungen werden durch Untersuchungen zur Clustergrößenverteilung, unter Verwendung der Gegenfeldmethode [2], ergänzt. Ausgangspunkt zu den hier präsentierten Ergebnissen sind vorangegangene Untersuchungen [3] zur überraschend effizienten Kühlung bei der Überschallexpansion von CO und CO_2, die in dieser Arbeit eine Erweiterung auf größere Moleküle finden.

[1] W. Christen, T. Krause, K. Rademann, *Rev. Sci. Instr.* **78**, 073106 (2007).
[2] J. Bauchert, O.-F. Hagena, *Z. Naturforschg.* **20a**, 1135-1142 (1965).
[3] W. Christen, K. Rademann, U. Even, *J. Chem. Phys.* **125**, 174307 (2006).

Q 19.5 Di 15:00 3G

Competing chemical dynamics in $F^- + CH_3Cl$ — •Rico Otto, Jochen Mikosch, Sebastian Trippel, Christoph Eichhorn, Matthias Weidemüller, and Roland Wester — Physikalisches Institut, Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg

Chemical reactions often show a variety of competing reaction mechanisms depending on the energy available. We have studied this for anion molecule nucleophilic substitution (S_N2) reactions [1], which are described by a complex potential energy surface with a submerged barrier and by weak coupling of the relevant rotational-vibrational quantum states.

Here we present results for the anion molecule reaction $F^- + CH_3I$ which we studied in a crossed beam imaging experiment at low energies between 0.3 - 12.5 eV. We have observed three distinct reaction channels which we identified by time of flight analysis of the formed product ions. By mapping the transfer from translational energy into internal vibrational modes we could identify different reaction mechanisms for each of these channels.

[1] J. Mikosch, S. Trippel, C. Eichhorn, R. Otto, U. Lourderaj, J. X. Zhang, W. L. Hase, M. Weidemüller, R. Wester, Science (in press)

Q 19.6 Di 15:15 3G

Nonequilibrium magnesium complexes formed in helium nanodroplets — •Andreas Przystawik, Sebastian Göde, Josef Tiggesbäumker, and Karl-Heinz Meiwes-Broer — Institut für Physik, Universität Rostock, Universitätsplatz 3, 18051 Rostock

Doping helium droplets with alkaline earth atoms is an interesting tool to investigate the interaction with the superfluid helium. Magnesium is a corner case regarding the degree of solvation in helium [1,2] which may enable the detection of quantized vortices in helium droplets.

In this contribution we add another facet to the discussion. The absorption of helium droplets doped with magnesium atoms is measured with resonant two-photon ionization at different combinations of droplet size and the number of doped Mg atoms. This enables the unambiguous identification of the absorption of an isolated atom inside the droplet centered around 279 nm. When increasing the Mg content of the droplet we find evidence for the formation of metastable, weakly bound Mg complexes. After excitation of such a complex it collapses to a Mg cluster on a timescale of 20 ps.

[1] J. Reho *et al.*, J. Chem. Phys. **112**, 8409 (2000)
[2] Y. Ren and V.V. Kresin, Phys. Rev. A **76**, 043204 (2007)

Q 19.7 Di 15:30 3G

High Resolution Spectroscopy of Acetylene-Furan in Ultracold Helium — •Anja Metzelthin, Özgür Birer, and Martina Havenith — Physikalische Chemie II, Ruhr Universität Bochum, Universitätsstr. 150, D-44780 Bochum

The acetylene-furan system is an interesting benchmark system for the evaluation of hydrogen bonds. Since acetylene is the smallest molecule containing two hydrogens and a π-system it is interesting to study the influence of a C-H "lone-pair"hydrogen-bond and a CH-π or even a π-π interaction.

The global and local minimum structures have been predicted in a recent study [1]. For the experiment the molecules have been embedded in superfluid helium nanodroplets. The radiation source was a single-resonant OPO with an output power of up to 2.7 W and a resolution of up to 4×10^{-5} cm^{-1}. Helium clusters, which have a temperature of 0.37 K are doped with acetylene (pick-up pressure 1.3×10^{-5} mbar) and furan (pick-up pressure 0.9×10^{-5} mbar) and are then excited with the OPO-radiation. A mass-spectrometer is used to detect the depletion of the cluster beam. With this setup measurements were carried

out in the region of the asymmetric stretch vibration of the acetylene. Between 3256 cm^{-1} and 3280 cm^{-1} five acetylene-furan cluster peaks could be detected. Two of these could be assigned to the acetylen-furan dimer. We will present a detailed analysis of the data.

[1] E. Sánchez-García, A. Mardyukov, A. Tekin, R. Crespo-Otero, L.A. Montero, W. Sander, G. Jansen, submitted

Q 19.8 Di 15:45 3G

Molecular Spectroscopy in Superfluid Helium Nanodroplets Created in a Pulsed Even-Lavie Nozzle — •Dominik Pentlehner and Alkwin Slenczka — Universität Regensburg, Institut für Physikalische und Theoretische Chemie, 93053 Regensburg, Germany

Pulsed molecular beam sources provide enhanced particle density while the average flux of gas is reduced. Therefore, molecular spectroscopy with pulsed lasers provides a better signal to noise ratio in a pulsed molecular beam than obtained in a continuous beam. One of the most reliable pulsed molecular beam sources developed by U. Even and N. Lavie [1] was tested at low temperatures to produce a pulsed beam of superfluid helium droplets. By the observation of Rayleigh scattering and laser induced fluorescence the pulsed droplet source was characterized. The reliability of the Even-Lavie nozzle as helium droplet source appears to be excellent for repetition rates below 30 Hz. The fluorescence excitation spectra of organic molecules doped into the droplets generated in the pulsed nozzle expansion will be presented.

[1] U. Even, J. Jortner, D. Noy, and N. Lavie, C. Cossart-Magos, J. Chem. Phys. 112 (2000), 8068.