MO 21: Cold Molecules & Helium Droplets 2

Time: Friday 11:00–13:00 Location: f142

Invited Talk MO 21.1 Fri 11:00 f142

Rotational state thermometry of hydroxyl anions at the Cryogenic Storage Ring (CSR) — •Christian Meyer[1], Arno Becker[1], Klaus Blaum[1], Christian Breitenfeldt[1,2], Sebastian George[1], Jürgen Göck[1], Manfred Grieser[1], Florian Grussie[1], Philipp Herwig[1], Jonas Karthein[1], Claude Krantz[1], Holger Kreckel[1], Sunil Kumar[1], Jorrit Lion[1], Svenja Lohmann[1], Preeti M. Mishra[1], Oldřich Novotný[1], Aodh P. O'Connor[1], Roland Repnow[1], Kaija Spruck[1,3], Stefan Schippers[3], Dirk Schwalm[1,4], Lutz Schweikhard[2], Stephen Vogel[1], Robert von Hahn[1], and Andreas Wolf[1] — [1]Max-Planck-Institut für Kernphysik, 69117 Heidelberg, Germany — [2]Institut für Physik, Ernst-Moritz-Arndt Universität Greifswald, 17487 Greifswald, Germany — [3]Institut für Atom- und Molekülphysik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany — [4]Weizmann Institute of Science, Rehovot 76100, Israel

The population of rotational states in a beam of OH^- ions stored in the CSR [1] was monitored for up to 1200 s using near-threshold photodetachment spectroscopy, similar to previous ion trap studies [2]. In the 35 m circumference electrostatic storage ring operated at around 10 K vacuum chamber temperature, storage times of the order of 1 hour for 60 keV ion beams were recently demonstrated. By photodetachment spectroscopy the evolution of level populations in J=2, 1 and 0 could be derived. Equilibrium populations over 95% in J=0 were reached.

[1] R. von Hahn et *al.*, Nucl. Instr. Meth. B 269, 2871 (2011)
[2] R. Otto et *al.*, Phys. Chem. Chem. Phys. 15, 612 (2013)

MO 21.2 Fri 11:30 f142

The Cryofuge: Deceleration of buffer-gas-cooled polar molecules — •Thomas Gantner, Xing Wu, Sotir Chervenkov, Martin Zeppenfeld, and Gerhard Rempe — Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Str. 1, 85748 Garching, Germany

We present a general technique to produce an intense, continous, guided beam of rotationally and motionally cold molecules. The molecules are first cooled in a cryogenic buffer gas cell [1] and then extracted and guided by an electrostatic quadrupole guide [2] to the centrifuge decelerator [3]. There, they are slowed down by employing the centrifugal force in a rotating quadrupole guide. Finally, they are detected by a quadrupole mass spectrometer. We demonstrate the deceleration of various molecules (CH_3F and CF_3CCH), achieving fluxes of about 10^{10} molecules/s with internal-state purity above 90% at velocities below 20 m/s by varying the settings of the buffer gas cell as well as the centrifuge rotation frequency.

[1] L.D. van Buuren et al., Phys. Rev. Lett. 102, 033001 (2009)
[2] S.A. Rangwala et al., Phys. Rev. A 67, 043406 (2003)
[3] S. Chervenkov et al., Phys. Rev. Lett. 112, 013001 (2014)

MO 21.3 Fri 11:45 f142

Toward multi-MW continuous-wave intracavity power lasers for the alignment of molecules — •Bastian Deppe[1,2,3,4], Günter Huber[1,2,3], Christian Kränkel[1,3], and Jochen Küpper[2,3,4] — [1]Institut für Laser-Physik, Universität Hamburg — [2]Department of Physics, University of Hamburg — [3]Centre for Ultrafast Imaging, University of Hamburg — [4]Center for Free-Electron Laser Science, DESY, Hamburg

We are setting up a CW thin disk laser with high finesse to align molecules for pump-probe experiments at X-ray light sources with arbitrary repetition rates. A resonator internal focus of $\omega_0 = 25\ \mu$m will provide intensities in excess of 10 GW/cm^2, sufficient for the continuous adiabatic alignment of molecules. Recently we demonstrated more than 130 kW of intracavity power at only 60 W of pump power with a pump spot diameter of 1.2 mm using Yb:YAG as the gain medium [1]. This result gives rise to a further scaling of the intracavity power by nearly two orders of magnitude into the multi-MW-range by pumping with the same intensity onto a pump spot diameter in the cm-scale utilized in state-of-the-art commercial thin disk lasers. In our presentation we will discuss the progress of our research in this respect and discuss different resonator configurations, different ytterbium-doped gain materials, the effects of additional required intracavity optics and polarization elements, as well as the challenges connected to in-vacuum operation of the laser.

[1] Deppe, Huber, Kränkel, Küpper, Opt. Exp. 23, 28491 (2015)

MO 21.4 Fri 12:00 f142

Light induced collapse of magnesium foam in helium droplets investigated by photoelectron spectroscopy — •Lev Kazak, Josef Tiggesbäumker, and Karl-Heinz Meiwes-Broer — Institute of Physics, University of Rostock, Albert-Einstein-Str. 24,18059 Rostock, Germany

Recent investigation shows, that magnesium atoms embedded in helium droplets are exist in metastable network of single atoms surrounded by the layer of helium atoms, called foam. The resonant two-photon ionization (R2PI) of Mg atom doped helium droplet reveals a narrow peak blue-shifted relative to atomic transition at λ=279 nm. For droplet containing more than one Mg atom, additional peak at λ= 282 nm appears. This feature is presented irrespective to the cluster size (up to Mg20). It suggests that before the absorption of the photon, single magnesium atoms are dissolved within the droplets, with interatomic Mg-Mg distance about 10 Å. Here we are using photoelectron spectroscopy to reveal the electronic structure of Mg complexes. The magnesium aggregate are probed by R2PI in vicinity of 31P10-31So transition in the wavelength region 276-284 nm. Complex photoelectron spectra arise when more than one magnesium atom is present in the dropletd. Additionally, peaks, which corresponds to highly exited atoms appears, indicating a possible relaxation of the metastable structure. The photoelectron spectra at different doping conditions will be disscused.

MO 21.5 Fri 12:15 f142

Imaging desorption dynamics of rubidium atoms attached to helium nanodroplets — •Johannes von Vangerow[1], Antonio Leal[2], Manuel Barranco[2,3], Nadine Halberstadt[3], François Coppens[3], Martí Pi[2], Frank Stienkemeier[1], and Marcel Mudrich[1] — [1]Physikalisches Institut, Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg, Germany — [2]Departament ECM, Facultat de Física, and IN^{2}UB, Universitat de Barcelona. Diagonal 645, 08028 Barcelona, Spain — [3]Laboratoire des Collisions, Agrégats, Réactivité, IRSAMC,UMR 5589, CNRS et Université Paul Sabatier-Toulouse 3, 118 route de Narbonne, F-31062 Toulouse Cedex 09, France

This contribution will focus on photo-induced dynamics of rubidium (Rb) atoms attached to the surface of quantumfluid helium nanodroplets. A femtosecond (fs) pump-probe sequence is initiated by resonant excitation to droplet perturbed states correlating to the Rb 6p and 5p atomic orbitals. Subsequently, a fs probe pulse ionises the Rb atom and velocity map ion and electron images are recorded. Depending on excitation wavelength and pump-probe delay, dynamics involving either desorption or submersion as well as formation of $Rb^+He_n = 1, 2$ complexes are observed. The experimental results will be discussed and compared to simulations based on time dependent density functional theory.

Invited Talk MO 21.6 Fri 12:30 f142

Infrared Spectroscopy of mass/charge selected biomolecules in liquid helium droplets — •Gert von Helden — Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin

Mass-to-charge selected ions are accumulated in an ion trap and picked up by a traversing beam of helium droplets. The doped droplets are probed by light from the Fritz-Haber-Institut Free-Electron-Laser (FHI-FEL) and IR spectra of the embedded species are recorded. Results for several types of biological molecules ranging from peptides to proteins and carbohydrates will be presented.