

## MO 30: Poster: Spectroscopy in He droplets

Zeit: Dienstag 16:30–18:30

Raum: Poster A

MO 30.1 Di 16:30 Poster A

**Characterisation of the Even-Lavie nozzle as a source for a pulsed helium nanodroplet beam** — ●CHRISTOPH STRAUSS, OLIVER BÜNERMANN, MARCEL MUDRICH, and FRANK STIENKEMEIER — Universität Freiburg, Physikalisches Institut, D-79104 Freiburg, Germany

We present first measurements with the Even-Lavie valve to characterise the flux and the peak intensity of a pulsed He droplet beam. Both mass-spectrometric measurements of the undoped beam as well as surface ionization detection of alkali-doped helium droplets were performed. The nozzle is designed for high repetition rates up to 1000Hz at temperatures down to 10K. Due to the short opening time (20 $\mu$ s) high peak intensities can be generated at moderate pumping speeds in the source chamber. Because of a low electric power consumption (< 3W) and an efficient cooling of the copper housing of the Even-Lavie valve, the low cooling power of a standard closed cycle refrigerator establishes cryogenic conditions. Eventually, the pulsed source will be used in combination with kHz laser ablation and kHz femtosecond lasers.

MO 30.2 Di 16:30 Poster A

**Doping of helium nanodroplets by high repetition rate laser ablation** — ●BENJAMIN FORKL, SEVERIN MÜLLER, MARCEL MUDRICH, and FRANK STIENKEMEIER — Physikalisches Institut, Universität Freiburg, Germany

In recent years helium nanodroplets have been established as an almost ideal matrix for spectroscopical studies of atoms and molecules. By evaporation of helium atoms they can dissipate energy introduced by the species under study, thus cooling molecules and complexes down to millikelvin temperatures, well below the energy needed to excite the samples vibrational degrees of freedom. By sequential doping with different atoms the droplets can be used as nanoreactors to synthesize novel complexes, thereby extending the possibilities for spectroscopic studies. In the most straightforward fashion the droplets are doped by pick-up of dopant particles from the gas phase. Since thermal evaporation is hard to achieve for high refractory metals, ions or fragile biological molecules, a pulsed laser ablation source has been constructed. An ablation laser is focused on the dopant material, thus generating a plasma in the droplet formation region providing gas phase densities of atoms, molecules or ions to be picked-up by the droplet beam. First measurements are presented of the new ablation source employing a kHz repetition rate laser.

MO 30.3 Di 16:30 Poster A

**Modelling the shift and broadening of absorption lines of alkali metal atoms attached to helium nanodroplets** — ●SEVERIN MÜLLER<sup>1</sup>, OLIVER BÜNERMANN<sup>1</sup>, FRANK STIENKEMEIER<sup>1</sup>, and MANUEL BARRANCO<sup>2</sup> — <sup>1</sup>Universität Freiburg, Physikalisches Institut, D-79104 Freiburg, Germany — <sup>2</sup>Departament E.C.M., Facultat de Física, Universitat de Barcelona, E-08028, Spain

In the context of helium nanodroplets alkali metal atoms are of special interest. Whereas most picked up atoms submerge in the liquid helium droplets, alkali metals reside in a dimple on the surface. The absorption spectra of the first electronic state of all stable alkali atoms are experimentally available. Though theory already addressed these systems, the shifts and broadenings of the spectra are still not fully understood. We applied a simple model treating the system droplet-alkali atom as a diatomic molecule to calculate the helium-induced shift and broadening of excitation lines. The helium density distribution of the

alkali-helium droplet system used in these calculations are taken from data derived from density functional theory by M. Barranco et al [1]. In this way we are able to attribute the splitting of absorption lines and a shoulder of the absorption on the red side of the main line to the excitation to different vibrational modes of the alkali-helium molecular system. Furthermore, the droplet size dependence and the influence of the helium isotope on the absorption spectra of light alkali atoms can be reproduced.

[1] F. Stienkemeier, O. Bünermann, R. Mayol, F. Ancilotto, M. Barranco and M. Pi, Phys. Rev. B 70, 214509 (2004)

MO 30.4 Di 16:30 Poster A

**Spectroscopy of PTCDA Complexes in Helium Nanodroplets** — ●MATTHIEU DVORAK and OLIVER BÜNERMANN — Physikalisches Institut, Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg

PTCDA (3,4,9,10 perylen-tetracarboxylic dianhydride) is a planar organic semi-conducting molecule. It became a model system for organic semiconductors because of the well-ordered films formed on surfaces. Attaching this molecule to helium nanodroplets is one of the best methods to collect very precise spectroscopic information. Due to the very low temperature (0.4 K) and the superfluid properties, helium nanodroplets provide a very cold and weak interacting matrix, ideal for spectroscopic measurements. The ability to form complexes of a desired composition via successive doping opens the way to probe oligomers and size effects. The previous studies obtained in our group concerning PTCDA [1] are extended into the blue and UV spectral region. Spectra of the monomer transition as well as the excitonic transition for PTCDA stacks were collected. Comparison with theory and film spectra quantify the red shift for monomer and excitonic transition of PTCDA films.

[1] M. Wever and F. Stienkemeier, PRB 67, 125201 (2003)

MO 30.5 Di 16:30 Poster A

**Spektroskopie von Erdalkaliatomen in <sup>3</sup>He- und <sup>4</sup>He-Nanotröpfchen** — ●ADRIAN ZIMMER, OLIVER BÜNERMANN und FRANK STIENKEMEIER — Physikalisches Institut, Universität Freiburg, Hermann-Herder-Str.3,79104 Freiburg

Heliumnanotröpfchen stellen eine sehr kalte, schwach wechselwirkende Matrix für spektroskopische Messungen zur Verfügung. Die meisten der zu untersuchenden Einlagerungen sind dabei im Inneren der Tröpfchen gebunden. Nur Alkali- und Erdalkaliatome bilden Ausnahmen mit äußerst geringen Wechselwirkungen und Bindungen auch an die Oberfläche von Heliumnanotröpfchen. Alle stabilen Erdalkaliatome bis auf Beryllium wurden in Heliumnanotröpfchen spektroskopisch charakterisiert. Die Eindringtiefe der Erdalkaliatome in Heliumnanotröpfchen wurde mit Hilfe von Absorptionsspektren im Vergleich mit Spektren in flüssigem Helium untersucht. Dabei sind im Falle von <sup>4</sup>He alle Erdalkaliatome bis auf Magnesium in einer tiefen Mulde an der Oberfläche gebunden. Eine interessante Frage ist, wie die Erdalkaliatome an <sup>3</sup>He-Tröpfchen gebunden sind. Wir haben dazu den  $5s5p^1P_1^o \leftarrow 5s2^1S_0$  Übergang des Strontium sowie den  $4s4p^1P_1^o \leftarrow 4s2^1S_0$  von Kalzium auf <sup>3</sup>He-Nanotröpfchen mittels Absorptionsspektroskopie untersucht. Vergleich der Ergebnisse mit entsprechenden Spektren an <sup>4</sup>He-Tröpfchen und Spektren in flüssigen Helium deuten auf eine Bindung der Atome im Inneren der <sup>3</sup>He-Tröpfchen hin. Der Befund wird durch aktuelle theoretische Rechnungen [1] bestätigt.

[1] A. Hernando, R. Mayol, M. Pi, M. Barranco, F. Ancilotto, O. Bünermann and F. Stienkemeier, in Vorbereitung