MO 7: Experimental Techniques

Time: Monday 14:00–16:00 Location: S HS 002 Biologie

MO 7.1 Mon 14:00 S HS 002 Biologie

Enabling efficient coincident measurements of electrons and photons in the wavelength regime of 120 nm to 300 nm by a drastically increased solid angle for the photon detection — •Christian Ozga[1], Philipp Schmidt[1], Andreas Nehls[1], Gregor Hartmann[1], Xaver Holzapfel[1], Clemens Richter[2,3], Johannes Viehmann[1], Philip Wenzel[1], Uwe Hergenhahn[2,4], Arno Ehresmann[1], André Knie[1], and Andreas Hans[1] — [1]Institute of Physics and Center for Interdisciplinary Nanostructure Science and Technology (CINSaT) University of Kassel Heinrich-Plett-Straße 40, 34132, Kassel, Germany — [2]Leibniz Institute of Surface Modification Permoserstr. 15, 04318 Leipzig, Germany — [3]Department pf Physics, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany — [4]Max Planck Institute for Plasma Physics Wendelsteinstr. 1, 17491 Greifswald, Germany

The coincident measurement of particles is a powerful tool for revealing and discriminating different de-excitation pathways. However, only few experiments detect photons due to the comparable small solid angle for their detection and therefore a low coincidence detection efficiency. We conceived a method for efficient coincident measurements of electrons and photons by a drastically increased solid angle for the photon detection. This set-up combined with a magnetic bottle time of flight spectrometer results in electron photon coincidence count rates appropriate for experiments at synchrotron radiation facilities, where beamtime is limited. Here we present measurements on atomic noble gases as prototypical samples to show the capabilities of the method.

MO 7.2 Mon 14:15 S HS 002 Biologie

Modeling the response of piezoelectric sensors used for detecting pulsed supersonic beams — •Paul Saftien[1], Karsten Lange[2], and Wolfgang Christen[1] — [1]Humboldt-Universität zu Berlin, Institut für Chemie, Brook-Taylor-Str. 2, 12489 Berlin, http://clusterlab.de — [2]SLT Sensor- und Lasertechnik GmbH, Freiheitstr. 124-126, 15745 Wildau

In our studies [1] a piezoelectric polyvinylidene fluoride (PVDF) foil is used for the detection of pulsed supersonic beams [2]. Benefits of this method are a fast detector response, a ruggedized setup and the fact that no ionization is required. Experimental results performed in a wide range of source conditions (source pressures between 3 bar and 20 bar, source temperatures between -40 °C and 70 °C) show that the detector response is proportional to the momentum flux of scattered particles. A simultaneous measurement and evaluation of the background pressure in the vacuum chamber allows a calibration of the detector to the amount of atoms per pulse. The evaluation of the signal can be performed either numerically or analytically with a model function considering the electrical and mechanical properties of the piezoelectric detector.

[1] P. Saftien, K. Lange, W. Christen, to be submitted.
[2] *Z. Phys. Chem.* **228(4-5)**, 369 (2014), *J. Chem. Phys.* **139(15)**, 154202 (2013), *J. Chem. Phys.* **139(2)**, 024202 (2013).

MO 7.3 Mon 14:30 S HS 002 Biologie

Poly-Anion Production of Gas-Phase Clusters — •Steffi Bandelow[1], Franklin Martinez[2], Stephan König[1], Gerrit Marx[1], and Lutz Schweikhard[1] — [1]Institute for Physics, University of Greifswald, 17487 Greifswald, Germany — [2]Institute for Physics, University of Rostock, 18059 Rostock, Germany

While there is a long tradition in investigating cluster properties as function of the cluster size, varying the charge state opens another dimension. But especially for negative charge states, the production process often changes the cluster itself, e.g. when stabilising ligands [1-2] or deprotonation [3] are used.

In an alternative approach, size selected aluminium gas-phase clusters are stored in a Penning trap simultaneously with electrons [4-5]. After an interaction time of 1s, the clusters are analysed with respect to the maximum number of excess electrons that have been attached. For the production of higher charge states, bigger clusters are required. Using clusters with up to 1950 atoms, gas-phase systems with up to 10 surplus electrons are produced and a quadratic dependence of the appearance size on the charge state is observed. This behaviour can be explained by considering the lifetimes of the meta-stable poly-anions.

[1] M. K. Scheller et al., J. Chem. Phys. 100, 8943 (1994).
[2] X.-B. Wang et al., J. Chem. Phys. 113, 10837 (2000).
[3] S. Banerjee et al., Int J Anal Chem 2012, 282574 (2012).
[4] F. Martinez et al., Int. J. Mass Spectrom. 266, 365 (2014).
[5] F. Martinez et al., J. Phys. Chem. C 119, 10949 (2015).

MO 7.4 Mon 14:45 S HS 002 Biologie

Autofragmentation of rovibrationally excited anionic metal dimers on hours time scale — •Jürgen Göck[1], Arno Becker[1], Klaus Blaum[1], Christian Breitenfeldt[1,2], Sebastian George[1,2], Manfred Grieser[1], Florian Grussie[1], Robert von Hahn[1], Philipp Herwig[1], Jonas Karthein[1], Claude Krantz[1], Holger Kreckel[1], Sunil Kumar[1], Jorrit Lion[1], Svenja Lohmann[1], Christian Meyer[1], Preeti M. Mishra[1], Oldřich Novotný[1], Aodh P. O'Connor[1], Roland Repnow[1], Kaija Spruck[1,3], Stefan Schippers[3], Lutz Schweikhard[2], Stephen Vogel[1], and Andreas Wolf[1] — [1]Max-Planck-Institut für Kernphysik (MPIK), Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Institut für Physik, Ernst Moritz Arndt Universität Greifswald, 17487 Greifswald, Germany — [3]I. Physikalisches Institut, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany

The tunneling dissociation of ro-vibrationally excited Ag_2^- and Co_2^- was studied for up to 1000 s in the Cryogenic Storage Ring (CSR) [1] at the MPIK. The cryogenic environment below 6 K leads to a residual gas pressure of less than 10^{-14} mbar (room-temperature equivalent)-ideal conditions for background-free gas-phase spectroscopy. The anions were produced in a metal-ion sputter source, accelerated up to 60 keV and stored in the CSR. The neutral and charged fragments of the reaction $X_2^{*-} \rightarrow X + X^-$ were recorded by micro-channel-plate based detectors [2].The data include coincidence signals from autodissociation of the anions as function of the storage time. The observed non-exponential nature of the decay will be discussed.

[1] R. von Hahn et al., Rev. Sci. Instrum. 87, 063115 (2016)
[2] K. Spruck et al., Rev. Sci. Instrum. 86, 023303 (2015)

MO 7.5 Mon 15:00 S HS 002 Biologie

Distinction of ortho-, meta- and para-benzene derivatives by means of chirped femtosecond laser ionization — •Viola Schäfer and Karl-Michael Weitzel — Philipps-Universität Marburg, Fachbereich Chemie, Germany

The distinction of structural isomers, in particular ortho-, meta-, para-isomers of benzene derivatives poses a considerable challenge in situations, where chromatographic separation is not the method of choice. Distinction by means of electron impact mass spectrometry is in general not possible. Here, the combination of femtosecond laser ionization with time-of-flight mass spectrometry (fs-LIMS) constitutes an alternative, multi-dimensional technique with high analytical power. The variation of laser pulse parameters, e.g. the spectral phase, allows the distinction of structural isomers.[1] In the current work we present a systematic chirped fs-LIMS investigation of ortho-, meta- and para-isomers of fluorotoluene and fluorobenzyl bromide. The mass spectra for the isomers of the respective compound look similar for transform limited laser pulses. By variation of linear and quadratic chirp we are able to enhance small differences between the isomers for specific fragmentation channels. We demonstrate, that we are able to distinguish the structural isomers of both compounds. In this context we will address the mechanism for the formation of common intermediates and the dynamics involved. The influence of the substituents and their positions at the benzene ring, as well as the relevance of specific fragments, e.g. tropylium and benzylium ions, will be discussed.

[1] N. Reusch, V. Krein, N. Wollscheid, K.-M. Weitzel, Z.f.Phys.Chem., 232, 689, (2018)

MO 7.6 Mon 15:15 S HS 002 Biologie

Setting up an experiment for electron-impact induced fluorescence spectroscopy of liquids — •Dana Bloss, Andreas Hans, Philipp Schmidt, Christian Ozga, Arno Ehresmann, and André Knie — Institut für Physik und CINSaT, Universität Kassel, Heinrich-Plett-Straße 40, 34132 Kassel

The investigation of liquids is a wide and interdisciplinary research field due to the fact that liquid water and aqueous solutions are the natural environment for many chemical and biological systems. How-

ever, the investigation of liquids with established experimental methods of atomic and molecular physics are challenging because of the typically required high vacuum conditions. With the development of the liquid microjet technique the investigation of volatile liquids in vacuum became possible. We already combined the liquid microjet with photon-impact induced fluorescence spectroscopy and observed a so far unknown broad emission between 170 - 340 nm which could be assigned to the liquid phase of the waterjet. For a better understanding of this emission feature we present an experiment for electron-impact induced fluorescence spectroscopy on liquid microjets. With this setup secondary processes can be investigated by direct excitation of the liquid with electrons of kinetic energies ranging from 400 eV to 3 keV.

MO 7.7 Mon 15:30 S HS 002 Biologie

Phase-space imaging of nanoparticle beams — •Lena Worbs[1,2], Jannik Lübke[1,3], Nils Roth[1,2], Amit K. Samanta[1], Daniel A. Horke[1,4], and Jochen Küpper[1,2,3,4] — [1]Center for Free-Electron Laser Science (CFEL), Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]Department of Physics, Universität Hamburg, Germany — [3]Department of Chemistry, Universität Hamburg, Germany — [4]The Hamburg Center for Ultrafast Imaging (CUI), Universität Hamburg, Germany

The generation and control of beams of internally cold biomolecules and nanoparticles is necessary for the production of reproducible samples, e.g., for single particle imaging experiments at x-ray free-electron lasers. The generation of those beams requires novel sample delivery methods and full characterization tools for nanometer sized particles in vacuum. Here, we present characterization methods that reconstruct the full 6D phase-space density of the beam for the optimization of nanoparticle beam sources.

MO 7.8 Mon 15:45 S HS 002 Biologie

Progress towards a molecular Zeeman slower — •Paul Kaebert, Mariia Stepanova, Maurice Petzold, Mirco Siercke, and Silke Ospelkaus — Institut für Quantenoptik, Leibniz Universität Hannover

The generation of large ultracold molecular ensembles is currently a challenge for researchers, due to the inefficient slowing methods available to them. In this talk I will summarize our efforts towards using our recently demonstrated Type-II Zeeman slowing technique to slow Calcium monofluoride (CaF) molecules. I will discuss the scheme and its implementation, as well as our approach for generating the laser light needed in the slowing process. Finally, I will discuss potential improvements to the design of our initial buffer gas beam source by comparing computational fluid dynamics simulations with flux and velocity profiles measured in the experiment.