MS 9: Ion Trap and FT-ICR-MS, Molecules, Clusters and Reactions

Time: Friday 10:30–12:15 Location: GÖR 229

Invited Talk MS 9.1 Fri 10:30 GÖR 229

Power-law decays of excited aluminum cluster anions and their blackbody radiation dependence — •Michael Froese, Felix Berg, Klaus Blaum, Michael Lange, Felix Laux, Sebastian Menk, Robert von Hahn, and Andreas Wolf — Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, 69117 Heidelberg

The decay of highly excited aluminum cluster anions has been investigated in the Cryogenic Trap for Fast ion beams (CTF). This electrostatic ion beam trap (EIBT) can be cooled with liquid helium and has demonstrated residual gas densities of 2000 particles/cm^3. A power-law is found to accurately reproduce the time dependence of the observed decay rates at early times, although the exponents significantly differ from the typically observed $1/t$ decay in other small metal clusters and bio-molecules. Quenching of the power-law decay was also observed at later times. A strong dependence of both the power-law exponent and the quenching time on the ambient temperature was observed when decays in the trap at room-temperature and cryogenic temperatures were compared. The effect of blackbody radiation on the $1/t$-type decay will be discussed based on these new observations.

MS 9.2 Fri 11:00 GÖR 229

Thermionic emission of highly excited cluster anions in a cryogenic electrostatic ion beam trap — •Sebastian Menk, Felix Berg, Klaus Blaum, Florian Fellenberger, Michael Froese, Michael Lange, Felix Laux, Robert von Hahn, and Andreas Wolf — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

In the Cryogenic Trap for Fast ion beams (CTF), ions are trapped between two electrostatic mirror electrodes allowing the storage of up to 20 keV ion beams in a cold environment (4 K - 300 K) for long times (minutes). After achieving the development goals of the Cryogenic Storage Ring (CSR), namely improving the cryogenic design and verifying an extremely low residual gas density of 2000 cm^{-3}, the CTF was moved to a new laboratory to make space for the CSR and for continued operation in molecular and cluster physics experiments.

Here, a new ion injection beam line has been taken into operation which includes a 90 ° dipole magnet for mass separation and an electrostatic quadrupole triplet for improved ion injection into the trap. In addition, a new 4 K helium supply line was installed, connecting the CTF again to the refrigeration system. A new MCP detection system equipped with a delay line anode has been placed inside the cryogenic vacuum chamber, providing enhanced solid angle detection and position sensitivity of the neutralized fragments.

We will report on room temperature thermionic emission measurements of Al_x^- (x=3-7) and SF_n^- (n=1-7) and include cold data down to 4 K from upcoming studies.

MS 9.3 Fri 11:15 GÖR 229

Broad-band detection for KATRIN and Ramsey excitation with FT-ICR MS — •Marta Ubieto Díaz[1], Klaus Blaum[1], R. Burcu Cakirli[1,2], Michael Heck[1], Martin Kretzschmar[3], Strahinja Lukic[4], Daniel Rodríguez[5], Lutz Schweikhard[6], and Stefan Stahl[7] — [1]Max-Planck-Institute for Nuclear Physics, Heidelberg, Germany — [2]Department of Physics, University of Istanbul, Istanbul, Turkey — [3]ohannes Gutenberg-Universität, Mainz, Germany — [4]Karlsruher Institut für Technologie, Karlsruhe, Germany — [5]Departamento de Física Atómica Molecular y Nuclear, Universidad de Granada,Granada, Spain — [6]Ernst-Moritz-Arndt-Universität-Greifswald, Greifswald, Germany — [7]Stahl Electronics. Kellerweg 23, 67528 Mettenheim, Germany

Penning traps are widely used as storage devices for charged particles. Based on these ion traps Fourier Transform Ion Cyclotron Resonance mass spectrometry (FT-ICR MS) has become a standard method for for both analytical and precision measurements. A broad-band FT-ICR detection system for monitoring the ion concentration at the KATRIN beamline has been developed and characterized at the Max-Planck-Institute for Nuclear Physics in Heidelberg. In addition, the on-line tests have been extended to fundamental studies on the ion motion, in particular by applying Ramsey excitation. In this contribution recent results of both studies, the off-line KATRIN tests and the Ramsey method, will be presented.

MS 9.4 Fri 11:30 GÖR 229

C-H bond activation at the surface of isolated homo- and heteronuclear transition metal clusters — Matthias Tombers, Christine Merkert, •Lars Barzen, and Gereon Niedner-Schatteburg — Fachbereich Chemie & Forschungszentrum OPTIMAS, Kaiserslautern

We chose to investigate the C-H bond activation of small organic molecules by size selected transition metal clusters and under single collision conditions. Cluster ions of either charge states originate from a standard pulsed laser vaporization source, and they are made to react within the ion trap of a Fourier Transform Ion Cyclotron Resonance (FT-ICR) mass spectrometer.

In general, most of the investigated Cobalt, Platinum, Rhodium and Tantalum clusters are found to be highly reactive towards the chosen substrates (methane, ethane, benzene derivatives and alcohols) with several dependencies of the reaction rate on the sizes of the clusters and on their charges.

Among the cationic Co_n^+ clusters we find intact adsorption of benzene for all clusters sizes with only Co_{13}^+ being able to activate the benzene molecule. Anionic Co_n^- clusters show intact adsorption and activation for n larger than n=6 where for n=9 to 16 the activation is the dominant process.

Current experiments on the activation of alkanes by mixed metal clusters are underway. This project is part of the new Transregional Collaborative Research Center SFB / TRR 88 "3MET".

MS 9.5 Fri 11:45 GÖR 229

On-line detection of illicit substances in liquid phase with proton-transfer-reaction mass spectrometry (PTR-MS) — •Simone Jürschik[1,3], Philipp Sulzer[2], Bishu Argawal[1], Fredrik Petersson[1,3], Stefan Haidacher[2], Alfons Jordan[2], Ralf Schottkowsky[2], Eugen Hartungen[2], Gernot Hanel[2], Hans Seehauser[2], Lukas Märk[2], and Tilmann D. Märk[1,2] — [1]Institut für Ionenphysik und Angewandte Physik, Universität Innsbruck, Technikerstr. 25, 6020 Innsbruck, Austria — [2]IONICON Analytik GmbH, Eduard-Bodem-Gasse 3, 6020 Innsbruck, Austria — [3]on leave from IONICON (Marie Curie-IAPP project no 218065)

The direct aqueous injection (DAI) technique was recently utilized for the detection of illicit substances in liquid phase. DAI turns out to be an ideal solution for direct analysis of liquid samples, since we can make good use of the outstanding advantages, such as real-time analysis, no sample preparation, low detection limits and short response time. Differences in TNT concentration in the water could be seen dependent on time and original size of the pieces and we could demonstrate a linear correlation between the concentration in liquid and the PTR-MS signal [1]. Furthermore, we were also able to demonstrate that this method is capable of detecting minute traces of "rape drugs", i.e. γ-butyrolactone and 1,4-butanediol, in liquids. This new method achieving sensitivities in the around 100 pptw range appears therefore well suited for the fight against drug crime and terrorism and for the evaluation of contamination of ammunition dumping sites.

[1] S. Jürschik et al.; ABC (2010) in press.

MS 9.6 Fri 12:00 GÖR 229

Rapid screening of pesticides from fruit surfaces by means of laser desorption ion mobility spectrometry — •Sven Rötering[1], Helko Borsdorf[2], and Christian Weickhardt[1] — [1]Leipzig University of Applied Sciences, Leipzig, Germany — [2]Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany

Multi residue analysis of pesticides in fruits and vegetables is complicated because a large number of substances belonging to multiple groups of chemicals with different features are used. Standard analysis of pesticide residues is carried out by gas chromatography or HPLC coupled to mass spectrometry. These methods require time consuming pre-treatments. Consequently, at the time the analysis results are available, fruits or vegetables are either eaten or no longer suitable for consumption.

A promising approach for a rapid and inexpensive screening technique is a combination of laser desorption and ion mobility spectrometry.

Pesticides are desorbed from the fruit skin by interaction with a

laser pulse. By means of a gas flow the desorbed molecules are transferred into an ion mobility spectrometer where they are identified and quantified. The results are available within seconds and the technique is applicable to many different pesticides representing insecticides and fungicides.

The report illustrates the set-up of the coupling and shows first results obtained for 26 pesticides detected on different fruit skins.