MS 3: Neue massenspektrometrische Methoden und Entwicklungen

Time: Tuesday 14:00–16:00 Location: F 428

Invited Talk MS 3.1 Tu 14:00 F 428

TOF-Bρ mass measurements of neutron rich nuclei at the NSCL — •Sebastian George[1,2], Alfredo Estrade[1,2,3], Milan Matoš[4], Mathew A. Amthor[5], Daniel Bazin[1], Ana D. Becerril[1,2,3], Thom J. Elliot[1,2,3], Alexandra Gade[1], Daniel Galaviz[1,2], Giuseppe Lorusso[1,2,3], Jorge Pereira[1,2], Mauricio Portillo[1], Andrew Rogers[1,2,3], Hendrik Schatz[1,2,3], Dan Shapira[6], Edward Smith[7], Andreas Stolz[1], and Mark S. Wallace[8] — [1]National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, MI, USA — [2]Joint Institute for Nuclear Astrophysics (JINA) — [3]Department of Physics and Astronomy, Michigan State University, East Lansing, MI, USA — [4]Louisiana State University, Baton Rouge, LA, USA — [5]Grand Accelerateur National d'Ions Lourds, Bd Henri Becquerel, BP 55027, F-14076 Caen Cedex 5, France — [6]Oak Ridge National Laboratory, Oak Ridge, TN, USA — [7]The Ohio State University, Columbus, OH, USA — [8]Los Alamos National Laboratory, Los Alamos, NM, USA

Nuclear masses of exotic nuclei far from stability are important key parameters for the understanding of the nuclear structure and several questions in nuclear astrophysics. Particularly the description of astrophysical processes, such as nucleosynthesis during the r-process or the evolution of matter in the crust of accreting neutron stars, is limited by the use of theoretical mass models. The experimental access to the mass of atoms is based on different techniques. Beside the measurements of nuclear decays and nuclear reaction studies, Penning trap facilities and time-of-flight (TOF) experiments allow the determination of masses. The latter two are somewhat complementary methods in respect of precision and accessibility of exotic nuclei. The time-of-flight-Bρ (TOF-Bρ) method has shown the potential to access nuclides very far from stability at several radioactive beam facilities. Here the setup of the TOF-Bρ experiment at the National Superconducting Cyclotron Laboratory (NSCL) at the Michigan State University is presented. The results of the first experiment in the region of neutron-rich isotopes as well as upcoming measurements will be discussed.

MS 3.2 Tu 14:30 F 428

Thermal ionization mass spectrometry (TIMS) of actinides: Pushing the limits of accuracy and detection — •Stefan Bürger[1], Sergei Boulyga[1], Alan Cunningham[1], Dilani Klose[1], Andreas Koepf[1], Jane Poths[1], and Stephan Richter[2] — [1]Safeguards Analytical Laboratory, International Atomic Energy Agency, Vienna, Austria — [2]Institute for Reference Materials and Measurements, JRC-EU, Retieseweg 111, 2440 Geel, Belgium

New method developments in multi-collector thermal ionization mass spectrometry (MC-TIMS) for actinide isotope ratio analysis to improve accuracy and limits of detection will be presented. With respect to limits of detection, results on improving work function using various carbon additives will be reviewed and presented as well as developments in cavity ion source (as compared to standard flat ribbon filament ion source) for femto- and attogram levels of uranium, plutonium, and americium. With respect to accuracy, results on isotope ratio measurements of isotopes of uranium (relative accuracy of 0.3 % to 0.01 %) will be presented with an example being U-234-Th-230 age-dating (NBL CRM 112-A). In this context, the importance of traceability (to the S.I. units) and the use of (certified) reference materials will be emphasized. The focus of this presentation will be on applications to nuclear safeguards / forensics.

MS 3.3 Tu 14:45 F 428

Isotope dilution mass spectrometry at the limit: a novel concept

— •Axel Pramann, Olaf Rienitz, and Detlef Schiel — Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig

The experimental measurement of the molar mass M of silicon crystals has been performed for the first time applying a modification of the powerful isotope dilution mass spectrometry (IDMS) technique. This method has been successfully applied in combination with a multicollector-ICP-mass spectrometer (MC-ICP-MS).[1] The background of this work is linked to an international project for the redetermination of the Avogadro constant with an associated relative measurement uncertainty in the range of 10^{-8}.[2] M is measured by isotope ratio measurements. Isotope ratios near unity can be measured after separating the element under investigation (silicon) into a virtual element consisting of all isotopes of the element (^{29}Si and ^{30}Si) except the isotope of highest abundance (^{28}Si). Then, IDMS is applied on this virtual element resulting in the isotopic pattern and thus molar mass of the complete element (all isotopes). The novel IDMS-method is explained and first results of silicon crystal material are presented and discussed on a metrological level with the aid of a comprehensive uncertainty budget.

[1]O. Rienitz, A. Pramann, D. Schiel, Int. J. Mass Spectrom., **289**, 47 (2010).
[2]P. Becker, Metrologia **40**, 366 (2003).

MS 3.4 Tu 15:00 F 428

Explosives and chemical warfare agents - detection and analysis with PTR-MS — •Philipp Sulzer[1], Fredrik Petersson[2], Simone Jürschik[1], Stefan Jaksch[1], Alfons Jordan[1], Gernot Hanel[1], Eugen Hartungen[1], Hans Seehauser[1], Lukas Märk[1], Stefan Haidacher[1], Ralf Schottkowsky[1], and Tilmann Märk[1,2] — [1]IONICON Analytik GmbH, Technikerstr. 21a, 6020 Innsbruck, Austria — [2]Institut für Ionenphysik und Angewandte Physik, Leopold-Franzens Universität Innsbruck, 6020 Innsbruck, Austria

We utilized a recently developed high sensitivity PTR-MS instrument equipped with a high resolution time-of-flight mass analyzer for detailed investigations on explosives and chemical warfare agents (CWAs). We show that with this so called PTR-TOF 8000 it is possible to identify solid explosives (RDX, TNT, HMX, PETN and Semtex A) by analyzing the headspace above small quantities of samples at room temperature and from trace quantities not visible to the naked eye placed on surfaces. As the mentioned solid explosives possess very low vapor pressures, the main challenge for detecting them in the gas phase is to provide an instrument with a sufficient sensitivity. CWAs on the other side have very high vapor pressures but are difficult to identify unambiguously as their nominal molecular masses are usually comparably small and therefore hard to distinguish from harmless everyday-compounds (e.g. mustard gas: 159 g/mol). In the present work we demonstrate that we can detect a broad range of dangerous substances, ranging from the CWA mustard gas to the explosive HMX.

MS 3.5 Tu 15:15 F 428

On-line Charakterisierung von Aerosolpartikeln mit einem neuen, kompakten, mobilen Flugzeitmassenspektrometer LAMPAS 3 — •Klaus-Peter Hinz, Elmar Gelhausen und Bernhard Spengler — Institut für Anorganische und Analytische Chemie, Universität Giessen

Die bipolare on-line Lasermassenspektrometrie ermöglicht die Bestimmung von Größe und chemischer Zusammensetzung einzelner Mikro- und Nanopartikel uns umgebender Aerosole. Die Partikel werden dazu ohne weitere Beeinflussung direkt in die Ionenquelle des Flugzeitmassenspektrometers eingelassen. Nach Detektion des Streulichts an zwei kontinuierlichen Laserstrahlen erfolgt die Verdampfung und Ionisation der Partikel mittels zeitlich abgestimmter Laserdesorption durch einen UV-Laserpuls. Die chemische Charakterisierung der Einzelpartikel erfolgt anhand der simultan detektierten positiv und negativ geladenen Ionen. Die umfassende Weiterentwicklung der vorhandenen Methodik (LAMPAS 2 [1]) ermöglichte die Realisierung eines verbesserten, kompakten Gerätes für die schnelle und aussagekräftige vor-Ort-Aerosolanalytik. Das System und seine Leistungsfähigkeit werden anhand erster Messungen vorgestellt.

[1] A. Trimborn, K.-P. Hinz, B. Spengler. Aerosol Sci. Technol. 33 (2000) 191-201.

MS 3.6 Tu 15:30 F 428

Simulations of a stopping cell for the LEB of the Super-FRS at FAIR — •Daniel Schäfer[1], Wolfgang R. Plass[1,2], Peter Dendooven[3], Hans Geissel[1,2], Sivaji Purushothaman[3], Maneesha Ranjan[3], and Christoph Scheidenberger[1,2] — [1]II.Physikalisches Institut, Justus-Liebig-Universität, Gießen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]KVI, University of Groningen, Netherlands

The low energy branch of the Super-FRS at the Facility for Antipro-

tons and Ions Research will be equipped with a cryogenic cell for stopping and extracting exotic nuclei produced by projectile fragmentation or fission, thus making them available for further experiments. This stopping cell has been developed and constructed at KVI, University of Groningen, Netherlands. Several computer models have been developed utilizing the ion trajectory simulation program. The design and basic features of the cell have been determined using these simulations, and optimal operating parameters have been found. Furthermore, simulations confirmed (semi-)analytical descriptions of ion collecting devices. Comparisons with first experimental results will be presented as well.

MS 3.7 Tu 15:45 F 428

Implementation of a MR-ToF isobar separator at the online mass spectrometer ISOLTRAP — •Robert Wolf[1], Klaus Blaum[2], Christopher Borgmann[2], Martin Breitenfeldt[1], Daniel Fink[2], Alexander Herlert[3], Magdalena Kowalska[3], Susanne Kreim[2], Dave Lunney[4], Gerrit Marx[1], Sarah Naimi[4], Marco Rosenbusch[1], and Lutz Schweikhard[1] — [1]University Greifswald — [2]Mpi for Nuclear Physics, Heidelberg — [3]Cern, Geneva, Switzerland — [4]Csnsm, Orsay, France

A multi-reflection time-of-flight mass separator (MR-ToF-MS) was installed at the ISOLTRAP/CERN mass spectrometer for isobaric purification of rare isotope ensembles as a preparation for precision mass determinations. The MR-ToF-MS consists of two ion optical mirrors between which ions are oscillating and are separated by their mass-over-charge ratio m/q. Flight paths of several hundreds of meters are folded to an apparatus length of less than one meter. Previous tests resulted in a mass resolving power of up to $m/\Delta m \approx 10^5$ and the separation was demonstrated for the isobaric ions CO^+ and N_2^+. In combination with a Bradbury-Nielsen beamgate, the MR-ToF-MS will support the existing purification methods of the setup to gain access to nuclides produced with high isobaric contamination yields at the ISOLDE facility. The modified ISOLTRAP setup and its performance will be presented.