Mass Spectrometry Division
Fachverband Massenspektrometrie (MS)

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Overview of Invited Talks and Sessions

(lecture room V57.06; Poster.IV)

Invited Talks

MS 1.1	Mon	10:30–11:00	V57.06	**Analysis of engineered and laser generated aerosols by Laser Ablation Inductively Coupled Plasma Mass Spectrometry** — •Detlef Guenther, Joachim Koch, Luca Flamigni, Sabrina Gschwind
MS 2.1	Mon	14:00–14:30	V57.06	**Recent atomic mass measurement results from JYFLTRAP** — •Tommi Eronen, Dmitry Gorelov, Jani Hakala, Ari Jokinen, Anu Kankainen, Veli Kolhinen, Juho Rissanen, Juha Äystö
MS 3.1	Mon	16:30–17:00	V57.06	**The resonance ionization laser ion source RILIS - leading all-rounder of on-line ion sources** — •Sebastian Rothe, Valentin Fedosseev, Daniel Fink, Ralf Rossel, Maxim Seliverstov, Klaus Wendt
MS 4.1	Tue	10:30–11:00	V57.06	**Present and future mass measurements at the FRS-ESR Facility at GSI** — •Ronja Knöbel
MS 5.1	Tue	14:00–14:30	V57.06	**Präzisionsmassenmessungen an ISOLTRAP für Kernstrukur- und Astrophysik** — •Susanne Kreim
MS 7.1	Thu	10:30–11:00	V57.06	**Optimizing small AMS systems beyond C-14** — •Christof Vockenhuber
MS 8.1	Thu	14:00–14:30	V57.06	**Structure and dynamics of finite Fermi systems: simple metal clusters and fullerenes** — •Bernd v. Issendorff
MS 8.2	Thu	14:30–15:00	V57.06	**Light induced reactions (LIR) in a cold 22-pole ion trap** — Oskar Asvany, Sandra Brünken, •Stephan Schlemmer

Invited talks of the joint symposium SYAD

See SYAD for the full program of the Symposium.

SYAD 1.1	Mon	14:00–14:30	V47.01	**A Quantum Information approach to Statistical Mechanics** — •Gemma De las Cuevas
SYAD 1.2	Mon	14:30–15:00	V47.01	**Bose-Einstein condensation of photons** — •Jan Klärs
SYAD 1.3	Mon	15:00–15:30	V47.01	**Broadband Optical Quantum Memory at Room Temperature** — •Klaus Reim
SYAD 1.4	Mon	15:30–16:00	V47.01	**First Spin-Flips Ever Observed with a Single Trapped Proton** — •Stefan Ulmer, Cricia Rodegheri, Klaus Blaum, Holger Kracke, Andreas Mooser, Wolfgang Quint, Jochen Walz

Invited talks of the joint symposium SYIB

See SYIB for the full program of the Symposium.

SYIB 1.1	Tue	10:30–11:00	V55.22	**Nuclear physics with stored highly-charged radioactive ions** — •Yuri Litvinov
SYIB 1.2	Tue	11:00–11:30	V55.22	**High Precision Laser Spectroscopy at the Storage Ring ESR** — •Wilfried Nörtershäuser
SYIB 1.3	Tue	11:30–12:00	V55.22	**Storage-ring measurements of hyperfine-induced one-photon transitions in highly charged ions** — •Stefan Schippers

SYIB 1.4	Tue	12:00–12:30	V55.22	**Low-Temperature Molecular Recombination from fast Electron and Ion Beams** — •Oldrich Novotny
SYIB 2.1	Tue	14:00–14:30	V55.22	**Ion induced fragmentation of large (bio)molecules** — •Thomas Schlathölter
SYIB 2.2	Tue	14:30–15:00	V55.22	**Using femtosecond lasers for determining the structure and dynamics of complex molecules** — •Jason Greenwood
SYIB 2.3	Tue	15:00–15:30	V55.22	**Fast beam momentum spectroscopy on XUV excited molecular ions** — •Henrik Pedersen
SYIB 2.4	Tue	15:30–16:00	V55.22	**Electron Emission from Hot Stored Molecular and Cluster Anions** — •Michael Lange, Klaus Blaum, Christian Breitenfeldt, Michael Froese, Sebastian Menk, Andreas Wolf, Swarup Das, Manas Mukherjee

Sessions

MS 1.1–1.7	Mon	10:30–12:30	V57.06	**Resonance Ionization MS, ICPMS and others I**
MS 2.1–2.7	Mon	14:00–16:00	V57.06	**Precision Mass Spectrometry and Fundamental Applications I**
MS 3.1–3.4	Mon	16:30–17:45	V57.06	**Resonance Ionization MS, ICPMS and others II**
MS 4.1–4.4	Tue	10:30–11:45	V57.06	**Ion Storage Rings**
MS 5.1–5.7	Tue	14:00–16:00	V57.06	**Precision Mass Spectrometry and Fundamental Applications II**
MS 6.1–6.17	Tue	16:30–19:00	Poster.IV	**Poster**
MS 7.1–7.7	Thu	10:30–12:30	V57.06	**Accelerator Mass Spectrometry and Applications I**
MS 8.1–8.7	Thu	14:00–16:15	V57.06	**Ion Trap and FT-ICR-MS, Molecules, Clusters and Reactions**
MS 9.1–9.8	Fri	10:30–12:30	V57.06	**Accelerator Mass Spectrometry and Applications II**

Mitgliederversammlung Fachverband Massenspektrometrie

Dienstag 11:45–12:15 V57.06

- Begrüßung
- Bericht des MS-Vorsitzenden
- Wahl des neuen MS-Vorsitzenden
- Vorschläge für Symposien
- Verschiedenes

MS 1: Resonance Ionization MS, ICPMS and others I

Time: Monday 10:30–12:30 Location: V57.06

Invited Talk MS 1.1 Mon 10:30 V57.06

Analysis of engineered and laser generated aerosols by Laser Ablation Inductively Coupled Plasma Mass Spectrometry — •Detlef Guenther, Joachim Koch, Luca Flamigni, and Sabrina Gschwind — ETH Zurich, Wolfang Pauli Strasse 10, CH-8093 Zurich

The most recent trend in LA-ICP-MS is focused on quantitative, high spatial resolution elemental mapping, which is required to reconstruct the trace element distribution in tissues, in stalagmites or in alloys and steel samples and many others. Therefore, low dispersion and sample-geometry independent ablation cells have been developed, which allow monitoring minimum changes in trace element concentrations. Some most recent ablation cell geometries will be discussed and their features on selected applications will be shown. A recently introduced atmospheric sampling system, allowing the analysis of samples without an airtight ablation cell will be explained and some promising applications will be discussed in detail [1]. Furthermore, the analysis of individual nanoparticles becomes more an more important. A well defined sample introduction system for quantitaitve analysis of nanoparticles will be introduced and preliminary figures of merit for some selected elements will be discussed.

[1]*Kovacs, R., Nishiguchi, K., Utani, K., Günther, D., Development of Direct Atmospheric Sampling for Laser Ablation - Inductively Coupled Plasma - Mass Spectrometry. J. Anal. At. Spectrom., 2010, 24, 142-147

MS 1.2 Mon 11:00 V57.06

Untersuchungen von Uran und Plutonium mittels nano-ESI TOF Massenspektrometrie — •Michael Steppert, Clemens Walther, Sebastian Büchner und Markus Fuss — Karlsruher Institut für Technologie (KIT), Institut für Nukleare Entsorgung, Hermann-von-Helmholtz-Platz 1, D-76344 Eggenstein-Leopoldshafen

Uran und Plutonium, selbst in kleinsten Mengen, erregen in der öffentlichen Wahrnehmung besondere Besorgnis. Daher kommt diesen Elementen schon seit langem eine Schlüsselrolle bei Speziationsuntersuchungen zu, insbesondere auch im Kontext der tiefen geologischen Lagerung nuklearen Abfalls über mehrere 100.000 Jahre. Eine besondere Herausforderung hierbei ist die quantitative Speziation Radionuklide in Lösung. Sowohl sechswertiges Uran als auch Plutonium bilden aufgrund von Hydrolyse im nahe-neutralen pH-Bereich kleine Polymere. Als Methode zum direkten Nachweis aller in Lösung vorkommender Hydrolysespezies wurde die nano-ESI TOF MS eingesetzt. Lösungen von U(VI) und Pu(VI) wurden in HNO_3 zwischen pH 3-6 untersucht, um die Unterschiede in den gebildeten Hydrolyseprodukte dieser beiden Actiniden herauszuarbeiten. Im Uranyl-System konnten erstmalig neben den monomeren und trimeren Hydrolysespezies die dimere Spezies $[(UO_2)_2(OH)_2]^{2+}$ mittels ESI MS nachgewiesen werden. Auch in den Pu(VI)-Lösungen gelang der erste quantitative massenspektrometrische Nachweis aller in Lösung vorhandener Hydrolysespezies: Pu(VI) bildet im Gegensatz zum U(VI) maximal dimere Hydrolysespezies. Eine Bildung von Trimeren kann ausgeschlossen werden.

MS 1.3 Mon 11:15 V57.06

Progress of the ILIAS project for selective isobar suppression by Laser photodetachment — •Oliver Forstner[1], Pontus Andersson[1], Robin Golser[1], Martin Martschini[1], Alfred Priller[1], Peter Steier[1], Dag Hanstorp[2], and Anton Lindahl[2] — [1]VERA Laboratory, Faculty of Physics, University of Vienna, Austria — [2]Department of Physics, University of Gothenburg, Sweden

At the VERA Laboratory of the University of Vienna a test facility for studying selective isobar suppression of negative ions by Laser photodetachment is currently under construction. The ILIAS (Ion Laser InterAction Setup) test setup consists of a negative ion spectrometer providing mass separated beams of negatively charged atomic or molecular ions with energies up to 30 keV. The negative ions are produced in a Middleton type cesium sputter ion source. The mass selected ions are stopped in a gas-filled radio frequency quadrupole cooler where they overlap with a strong continuous wave Laser beam. By careful selection of the photon energy only unwanted isobars are neutralized while the isobar of interest remain as ions. With this scheme a selective suppression of isobars can be achieved.

After a description of the setup and a status report of the commissioning of the negative ion spectrometer, the progress of the construction of the RFQ cooler will be presented. As a future outlook the first photodetachment experiments with the RFQ cooler and a possible scheme for application of this new method to a 3 MV AMS facility will be described.

MS 1.4 Mon 11:30 V57.06

Kombination einer Miniatur- Radiofrequenz-Quadrupolstruktur mit der resonanten Laserionisation zum Aufbau einer massenselektiven Ionenquelle — •Fabian Schneider[1], Klaus Eberhardt[2], Wilfried Nörtershäuser[2], Sven Richter[1], Szilard Nagy[2] und Klaus Wendt[1] — [1]Institut für Physik, Johannes-Gutenberg-Universität Mainz — [2]Institut für Kernchemie, Johannes-Gutenberg-Universität Mainz

Die Verwendung von resonanter Laserstrahlung zur Ionisation erlaubt eine elementspezifische Ionisation und wird in vielen off-line und on-line Ionenquellen sehr erfolgreich eingesetzt. Die Nutzung von heißen Kavitäten als Atomisationsofen bewirkt aber immer eine Kontamination des Ionenstrahls durch unerwünschte Oberflächenionisation primär von Alkalielementen. Der Einsatz einer Radiofrequenz-Quadrupolstruktur mit einer geringen Baugröße erlaubt eine Massenfilterung direkt am Ort der Quelle und damit eine effektive Aussonderung der Kontaminationen zur Reduktion der Belastung des nachfolgenden Massenseparators durch hohe Raumladungsdichten, die zur Beeinträchtigung der für das Experiment relevanten Ionenströme führen könnten. Eine weitere Anwendung der massenselektiven Quelle bietet sich auch bei Nutzung nicht-resonanter Laserdesorption/-ionisation, z.B. zur Erzeugung eines Massenreferenzkamms aus Kohlenstoff-Clustern für Penningfallen-Massenmessungen an. Es werden Simulationen sowie erste Testmessungen vorgestellt.

MS 1.5 Mon 11:45 V57.06

The Laser Ion Source and Trap (LIST) at CERN: Improving the Selectivity of the Resonance Ionization Laser Ion Source — •Daniel Fink[1,2,3], Klaus Blaum[2,3], Richard Catherall[1], Bernard Crepieux[1], Valentin Fedosseev[1], Bruce Marsh[1], Sven Richter[4], Ralf Rossel[1,4], Sebastian Rothe[1,4], Thierry Stora[1], Pekka Suominen[1], and Klaus Wendt[4] — [1]CERN — [2]Universität Heidelberg — [3]Max-Plack-Institut für Kernphysik, Heidelberg — [4]Universität Mainz

The on-line isotope mass separator ISOLDE at CERN is a facility dedicated to the production of a large variety of radioactive ion beams. Various experiments, coupled on-line, cover front-line research in, e.g., atomic, nuclear, and solid-state physics. A high ionization efficiency combined with ultimate isotope selectivity is of utmost importance for all on-line experiments on exotic, short-lived radionuclides with the lowest production rates. The ionization technique that most closely meets this requirement is the element selective Resonance Ionization Laser Ion Source (RILIS). Unfortunately, even when the RILIS is used, many rare isotope beams produced at ISOLDE remain contaminated with surface ionized isobars. In order to suppress the surface ions, a radio-frequency quadrupole device known as the Laser Ion Source and Trap (LIST) has been developed at the University of Mainz and at CERN. The LIST was tested at ISOLDE for the first time online at a radioactive beam facility in spring 2011. Characteristics such as transmission, selectivity, and ionization efficiency were determined. The results of the on-line run and the latest studies will be presented.

MS 1.6 Mon 12:00 V57.06

Weiterentwicklungsmöglichkeiten der On-line Laserionenquelle LIST — •Sven Richter[1], Klaus Blaum[2], Daniel Fink[3], Sebastian Rothe[3], Fabian Schneider[1] und Klaus Wendt[1] — [1]Institut für Physik, Universität Mainz — [2]Max-Plank-Institut für Kernphysik, Heidelberg — [3]CERN, Genf, Schweiz

Als Weiterentwicklung der On-line Laserionenquelle RILIS bei ISOLDE am CERN wurde am Institut für Physik der Universität Mainz die LIST (Laser Ion Source and Trap) speziell zur hochselektiven Ionisation exotischer Radionuklide entwickelt. Die bisher bei der ISOLDE/RILIS verwendete heiße Kavität wird in der LIST als Quelle eines kollimierten Atomstrahls eingesetzt, der axial in die LIST-Quadrupolstruktur einläuft und dort durch Laserstrahlung mehrstufig resonant ionisiert wird. Dabei gleichzeitig generierte Oberflächenionen, die den Großteil des Untergrunds darstellen, werden durch eine Re-

pellerelektrode unterdrückt. Die LIST-Quadrupolstruktur bietet eine Reihe von Weiterentwicklungsmöglichkeiten für die Optimierung eines möglichst untergrundfreien, selektiven und effizienten Ionisationsprozesses an. Dazu gehört die Optimierung des Überlapps zwischen Atom- und Laserstrahlen, die Ausnutzung der Zeitstruktur der gepulst erzeugten Laserionen wie auch ein möglicher massenselektiver Betrieb der LIST. Für diese Entwicklungsschritte sind Adaptionen der Ionenoptik sowie Geometrieänderungen der Kavität und der LIST Elektroden notwendig. Der aktuelle Entwicklungsstand dieser Aktivitäten, Simulationsrechnungen sowie entsprechende Testmessungen am Mainzer Off-line Massenseparator RISIKO werden vorgestellt.

MS 1.7 Mon 12:15 V57.06

Vorteile einer Nachweisapparatur für Referenzmessungen in der RIS — •Tobias Kron[1], Volker Sonnenschein[1,2], Sebastian Raeder[1,3] und Klaus Wendt[1] — [1]Institut für Physik, Universität Mainz, 55128 Mainz, Germany — [2]University of Jyväskylä, Finland — [3]TRIUMF, 4004 Wesbrook Mall, Vancouver, BC V6T 2A3, Canda

Die Resonanzionisationsspektroskopie bedient sich der elementselektiven Ionisation durch stufenweise Anregung mit resonant abgestimmter Laserstrahlung. Die Methode wird erfolgreich in der Produktion von Ionenstrahlen seltenster radioaktiver Nuklide an on-line Isotopentrennern wie z.B. ISOLDE bei CERN als Laserionenquelle, wie auch in der modernen lasermassenspektrometrischen Ultraspurenbestimmung radiotoxischer Kontaminationen genutzt. Die Ionisationseffizienz des mehrstufigen Ionisationsschemas hängt dabei maßgeblich von den Parametern Intensität, Wellenlänge und örtlicher sowie zeitlicher Überlagerung der Laserpulse der verwendeten abstimmbaren Laser ab. Zur beständigen Kontrolle dieser Parameter während langwieriger Messphasen an einem seltenen Zielisotop bietet sich der Einsatz einer kompakten Referenzapparatur an, in welcher ein Bruchteil der Laserstrahlung zur resonanten Ionisation eines stabilen Referenzisotopes genutzt wird. Ohne langwierige Abstimmung des Massenspektrometers kann somit permanent der optimale Betriebszustand des Lasersystems verifiziert und gleichzeitig eine zeitnahe Kalibration für Präzisionsmessungen an bekannten Daten erfolgen. Die Bedeutung der Parameter des Lasersystems und die Konstruktion einer kompakten Nachweisapparatur für ISOLDE/CERN werden vorgestellt.

MS 2: Precision Mass Spectrometry and Fundamental Applications I

Time: Monday 14:00–16:00 Location: V57.06

Invited Talk MS 2.1 Mon 14:00 V57.06

Recent atomic mass measurement results from JYFLTRAP — •Tommi Eronen[1,2], Dmitry Gorelov[1], Jani Hakala[1], Ari Jokinen[1], Anu Kankainen[1], Veli Kolhinen[1], Juho Rissanen[1], and Juha Äystö[1] — [1]University of Jyväskylä, Finland — [2]Max-Planck-Institut für Kernphysik, Heidelberg, Germany

JYFLTRAP [1] is a double Penning trap setup located at the accelerator laboratory of the University of Jyväskylä. It has been built for measuring atomic masses of short-lived isotopes produced using the IGISOL method [2], which is fast and enables the extraction of any element, including refractory ones. Until the summer of 2010, before the setup was shut down for upgrade, masses of about 300 short-lived nuclei ranging from ^{10}C to ^{203}Bi were measured, many of them for the first time.

In this contribution, an overview of JYFLTRAP mass measurement is given with emphasis on the most recent work. These include tests of the conserved vector current hypothesis (CVC) [3], nuclear structure studies on the neutron rich side of the nuclide chart [4], and decay energy measurements of double β decay emitters and double electron capture candidates for neutrino studies [5].

[1] A. Jokinen *et al.*, Hyperfine Interact. **173**, 143 (2006)
[2] J. Äystö, Nucl. Phys. A **693**, 477 (2001)
[3] T. Eronen *et al.*, Phys. Rev. C **83**, 055501 (2011)
[4] J. Hakala *et al.*, Eur. Phys. J. A **47**, 1 (2011)
[5] S. Rahaman *et al.*, Phys. Lett. B **703**, 412 (2011)

MS 2.2 Mon 14:30 V57.06

Double-beta transition Q-value and direct mass measurements with TRIGA-TRAP — •Christian Smorra[1,2,3], Thomas Beyer[1,2], Klaus Blaum[1], Michael Block[4], Christoph E. Düllmann[2,4,5], Martin Eibach[2,3], Sergey Eliseev[1], Sebastian Klein[2], Szilard Nagy[1,4], Wilfried Nörtershäuser[2,4], and Dennis Renisch[1,2] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg — [2]Institut für Kernchemie, Johannes Gutenberg-Universität, Fritz-Strassmann-Weg 2, D-55128 Mainz — [3]Fakultät für Physik und Astronomie, Ruprecht-Karls-Universität, Philosophenweg 12, D-69120 Heidelberg — [4]GSI Helmholtzzentrum für Schwerionenforschung, Planckstraße 1, D-64291 Darmstadt — [5]Helmholtz-Institut Mainz, Johannes Gutenberg-Universität, D-55099 Mainz

Neutrinoless double-beta transitions are difficult to observe due to their long half-lives. In case of neutrinoless double-electron capture, a resonant enhancement of the decay rate by several orders of magnitude occurs if the energy levels of initial and final state are degenerate in energy. In order to search for nuclides undergoing a resonantly-enhanced double-electron capture the Q-values of the transitions in ^{106}Cd, ^{108}Cd, and ^{184}Os were determined by the double-Penning trap mass spectrometer TRIGA-TRAP with a precision better than 1 keV. The double-beta decay Q-value of ^{110}Pd was investigated as well. The recent results will be presented.

MS 2.3 Mon 14:45 V57.06

A New Method for Ion Separation in Penning Traps — Georges Audi[1], Dietrich Beck[2], Klaus Blaum[3], Christine Böhm[3], Christopher Borgmann[3], Martin Breitenfeldt[4], R. Burcu Cakirli[3], Thomas Elias Cocolios[5], Sergey Eliseev[3], Sebastian George[6], Frank Herfurth[2], Alexander Herlert[7], Jürgen Kluge[2], Magdalena Kowalska[5], Susanne Kreim[3,5], David Lunney[1], Enrique Minaya Ramirez[2], Sarah Naimi[8], Dennis Neidherr[2], •Marco Rosenbusch[9], Stefan Schwarz[6], Lutz Schweikhard[9], Juliane Stanja[10], Meng Wang[1], Frank Wienholtz[9], Robert N. Wolf[9], and Kai Zuber[10] — [1]CSNSMIN2P3-CNRS, Université de Paris Sud, Orsay, France — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [4]Instituut voor Kernen Strahlingsfysica, Leuven, Belgium — [5]CERN, Geneva, Switzerland — [6]NSCL, Michigan State University, East Lansing, USA — [7]FAIR GmbH, Darmstadt, Germany — [8]RIKEN Research Facility, Japan — [9]Ernst-Moritz-Arndt-Universität, Greifswald, Germany — [10]Technische Universität, Dresden, Germany

The beams delivered by radioactive ion-beam (RIB) facilities mostly consist of a mixture of the ions of interest and other isobaric and isomeric species. However, experiments performed with such beams usually depend crucially on the purity of the ion ensemble. Ion purification by mass-selective buffer-gas cooling [1] in Penning traps has been employed successfully with resolving powers of up to 10^5. However, new techniques are are needed to further increase the resolving power or, equivalently, to reduce the duration of the separation process. In addition, buffer gases cannot be utilized in experiments which require a high vacuum, e.g. experiments with highly-charged ions. A new method for isobaric purification will be presented based on the superposition of a dipolar excitation of the magnetron motion of all trapped ions and a quadrupolar excitation at the cyclotron frequency of the ions of interest. Preliminary results of off-line measurements at the ISOLTRAP mass spectrometer at the RIB facility ISOLDE/CERN have shown a resolving power of $4 \cdot 10^5$ as for an excitation duration of 400ms.

[1] G. Savard et al., Phys. Lett. A 158, 247-252(1991).

MS 2.4 Mon 15:00 V57.06

Online Commissioning of a Multiple-Reflection Time-of-Flight Mass Spectrometer (MR-TOF-MS) at the FRS Ion Catcher — •Jens Ebert[1], Timo Dickel[1,2], Wolfgang R. Plass[1,2], Samuel Ayet[2], Peter Dendooven[3], Alfredo Estrade[2], Fabio Farinon[2], Hans Geissel[1,2], Emma Haettner[1,2], Christian Jesch[1], Nasser Kalantar-Nayestanaki[3], Ronja Knoebel[1,2], Jan Kurcewicz[2], Johannes Lang[1], Iain Moore[4], Chiara Nociforo[2], Stephane Pietri[2], Andrej Prochazka[2], Sivaji Purushothaman[2], Manisha Ranjan[3], Moritz P. Reiter[1], Sami Rinta-Antila[4], Christoph Scheidenberger[1,2], Maya Takechi[2], John Winfield[2], Helmut Weick[2], and Mikhail I. Yavor[5] — [1]JLU Giessen — [2]GSI, Darmstadt — [3]KVI, University

of Groningen, Netherlands — [4]University of Jyväskylä, Finland — [5]Russian Academy of Sci., St. Petersburg

A MR-TOF-MS covers a wide field of applications, from ultra high-resolution and broad band mass measurements to isobar separation. To enhance the performance of our MR-TOF-MS several important improvements have been implemented. Such as a new detector system, that opens further application areas like decay-spectroscopy of isobarically clean beams. Online commissioning of the MR-TOF-MS has been performed using radioactive nuclei at the FRS Ion Catcher. The ions were stopped in a novel cryogenic stopping cell and the MR-TOF-MS was used for performance investigation of the stopping cell. Results of the improvements and the online measurements will be presented as well as future perspectives.

MS 2.5 Mon 15:15 V57.06

On-line commissioning of the cryogenic stopping cell for the Super-FRS — •Sivaji Purushothaman[1], Peter Dendooven[2], Timo Dickel[1,3], Jens Ebert[3], Alfredo Estrade[1], Fabio Farinon[1], Hans Geissel[1,3], Emma Haettner[1,3], Christian Jesch[3], Nasser Kalantar-Nayestanaki[2], Ronja Knoebel[1,3], Jan Kurcewicz[1], Johannes Lang[1], Iain Moore[4], Chiara Nociforo[1], Stephane Pietri[1], Wolfgang Plass[1,3], Andrey Prochazka[1], Manisha Ranjan[2], Moritz Pascal Reiter[1], Sami Rinta-Antila[4], Christoph Scheidenberger[1,3], Maya Takechi[1], John Winfield[1], and Helmut Weick[1] — [1]GSI, Darmstadt, Germany — [2]KVI, University of Groningen, Netherlands — [3]JLU, Giesen, Germany — [4]University of Jyväskylä, Finland

A cryogenic stopping cell developed for the low-energy branch of the Super-FRS at FAIR has been successfully commissioned in combination with a multiple-reflection time-of-flight mass spectrometer at the FRS at GSI. The stopping cell has a stopping length of 1 m and is operated at 100 mbar helium at 100 K. The helium density used in this test is several times higher than the gas densities achieved in comparable room temperature stopping cells. In-flight separated and range-focussed ^{223}Th fragments from the FRS have been slowed down, thermalized and extracted. Results of this test and the plans for future experiments will be discussed

MS 2.6 Mon 15:30 V57.06

Investigation of work functions for precision experiments to investigate the standard electroweak model — •Marcus Beck, Christian Schmidt, Werner Heil, and Alexander Wunderle — Institut für Physik, Johannes Gutenberg-Universität Mainz

The standard model of the electroweak interaction is tested with ever increasing precision by non-accelerator experiments, e.g. using beta decay. The precision of these experiments has reached a point where the variation of the work function of the materials used, e.g. for electrodes, starts to limit the sensitivity. We investigate these variations of the work function using a scanning Kelvin probe. In this talk we will discuss the issue of the variation of the work function in the context of the KATRIN experiment, which will measure the absolute mass of the electron-antineutrino. The question of the variation of the work function is especially important for the rear wall and the main retardation electrode of KATRIN. Together these two define the retardation potential, which has to be known with an absolute precision of 50 mV. First measurements of surfaces covered with a thin gold layer will be presented.

MS 2.7 Mon 15:45 V57.06

WITCH - Erste Ergebnisse mit ^{35}Ar-Ionen — •Martin Breitenfeldt[1], Tomica Porobic[1], Michael Tandecki[1], Simon van Gorp[1], Anna Bakenecker[2], Marcus Beck[2], Peter Friedag[2], Christian Weinheimer[2], Dalibor Zakoucky[3], Ferenc Glück[4], Valentin Kozlov[4] und Nathal Severijns[1] — [1]Institut voor Kern een Stralenfysika, Katholieke Universiteit Leuven — [2]Institut für Kernphysik, WestfälischeWilhelms-Universität Münster — [3]Nuclear Physics Institute of ASCR, Rez near Prague — [4]Karlsruher Institut für Technologie

Mit dem WITCH-Experiment wird die Rückstoßenergieverteilung von Tochterkernen nach dem Betazerfall von Ionen in einer Penningfalle untersucht. Diese wird durch die Variation eines Potentials im Retardierungsspektrometer gemessen. Aus dieser Verteilung läßt sich dann die Beta-Neutrino-Winkelkorrelation a extrahieren. Das Ziel des WITCH-Experiments ist es, a mit einer Genauigkeit von $\Delta a < 0{,}5\%$ zu bestimmen, was Rückschlüsse auf eine skalare Komponente in der schwachen Wechselwirkung erlaubt. Im letzten Jahr gelang es zum ersten Mal ein Rückstoßspektrum des ^{35}Ar mit genügend Statistik aufzunehmen, um a zu extrahieren. Die geschieht mittels weitreichenden Bahnverfolgungs- und Penningfallensimulationen, deren Ergebnisse mit den Messungen verglichen werden. In dieser Kombination von Simulation und Experiment werden auch die systematischen Unsicherheiten des WITCH-Experiments bestimmt.

MS 3: Resonance Ionization MS, ICPMS and others II

Time: Monday 16:30–17:45 Location: V57.06

Invited Talk MS 3.1 Mon 16:30 V57.06

The resonance ionization laser ion source RILIS - leading all-rounder of on-line ion sources — •Sebastian Rothe[1,2], Valentin Fedosseev[1], Daniel Fink[1], Ralf Rossel[1,2,3], Maxim Seliverstov[1], and Klaus Wendt[2] — [1]CERN, Geneva, Switzerland — [2]Institut für Physik, Uni Mainz, Germany — [3]Hochschule Rhein-Main, Wiesbaden, Germany

The resonance ionization laser ion source (RILIS) of the on-line isotope separator facility ISOLDE at CERN, is based on the method of stepwise resonant laser excitation and ionization of atoms. The element selectivity of the RILIS complements the mass selection process of the ISOLDE separator magnets to provide high purity ion beams of many isotopes. The RILIS, which now includes two complementary and independent tunable laser systems (dye and titanium:sapphire lasers), has been significantly improved since its first demonstration of selective ionization of Yb isotopes in 1992. Today, on account of the high degree of selectivity for the 27 elements now offered, the annual operation of RILIS exceeds 2500 h, making it the most versatile and commonly used ion source at ISOLDE. The use of a narrow band dye laser enables precision in-source laser spectroscopy of isotope shifts and hyperfine structures of isotopes far from stability as well as the production of isomer pure beams as has been demonstrated for Ag, Cu, Pb, Bi, Po, and Tl . A recent upgrade of the RILIS comprises the incorporation of a complementary all solid state laser system as well as the Laser Ion Source Trap (LIST), which greatly enhances selectivity by suppressing any surface ionized isobars.

MS 3.2 Mon 17:00 V57.06

Performance of a high repetition rate pulsed laser system for in-jet laser ionization and spectroscopy studies in the Leuven laser ion source, LISOL — •Volker Sonnenschein[1], Rafael Ferrer[2], Mark Huyse[2], Tobias Kron[3], Yuri Kudryavtsev[2], Nathalie Lecesne[4], Iain Moore[1], Johannes Rossnagel[3], Sebastian Raeder[5], Herve Savajols[4], Paul Van den Bergh[2], Piet Van Duppen[2], and Klaus Wendt[3] — [1]University of Jyväskylä, Finland — [2]Instituut voor Kern- en Stralingsfysika, Katholieke Universiteit Leuven — [3]Institut für Physik, Universität Mainz — [4]GANIL, Caen, France — [5]TRIUMF, Vancouver, Canada

The laser ionization efficiency of the Leuven gas cell-based laser ion source at the LISOL facility was investigated under on- and off-line conditions using two distinctly different laser systems - a medium repetition rate dye laser system (200 Hz) as well a high repetition rate Ti:sapphire laser system (10 kHz). A systematic study of the ion signal dependence on repetition rate and laser pulse energy was performed in off-line tests on stable cobalt and copper isotopes. Off-line studies also included high resolution in-jet laser spectroscopy measurements of the hyperfine structure of ^{63}Cu and the investigation of laser ion pulse time profiles.
A final on-line run with the short-lived radioisotope ^{59}Cu showed a very comparable yield from the two laser systems for in-cell ionization, however, a considerable advantage of using the high-repetition rate system for in-jet laser ionization within the sextupole extraction structure could be demonstrated.

MS 3.3 Mon 17:15 V57.06

High Resolution Mass Identification with Calorimetric Low

Temperature Detectors — •Artur Echler[1,2], Alexander Bleile[1,2], Peter Egelhof[1,2], Stoyanka Ilieva[1], Saskia Kraft-Bermuth[3], Jan Patrick Meier[1], and Manfred Mutterer[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]Johannes Gutenberg Universität, Mainz, Germany — [3]Justus-Liebig-Universität, Gießen, Germany

Calorimetric low temperature detectors (CLTD's) for heavy-ion detection provide, as compared to conventional ionisation detectors, due to their detection principle, substantial advantages in detector performance, such as energy resolution and linearity, etc. The absence of any pulse height defect makes them an ideal tool for detection of low energetic heavy ions. CLTD's have been frequently demonstrated to achieve an excellent relative energy resolution of $\Delta E/E$ = 1-2×10^{-3} in a wide range of ions and energies. The combination of CLTD's as high resolution energy detectors with time-of-flight (ToF) detectors provides a detector system for high resolution mass identification of low energetic heavy ions. Possible applications are, among others, the mass identification of superheavy elements, of heavy fission products, or of reaction products in experiments with radioactive beams. Recent experiments with an array of 8 CLTD-pixels with a total active area of 12×6 mm^2 combined with a ToF-detector have shown a mass resolution of Δm (FWHM) = 1.3 amu for ^{238}U-ions in an energy range of 65 - 150 MeV. These and other results from experiments with various ions and energies will be presented and discussed.

MS 3.4 Mon 17:30 V57.06

First Performance Results of a Mobile High-Resolution MR-TOF Mass Spectrometer for in-situ Analytical Mass Spectrometry — •Johannes Lang[1], Timo Dickel[1,2], Wolfgang Plass[1,2], Jens Ebert[1], Hans Geisssel[1,2], Emma Haettner[1,2], Mikhail Yavor[3], and Christoph Scheidenberger[1,2] — [1]II. Physikalisches Institut, JLU Giessen — [2]GSI, Darmstadt — [3]RAS St. Petersburg

A mobile multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS) has been designed, built and commissioned. While other mobile mass spectrometers are restricted to low or medium mass resolving power, this MR-TOF-MS allows for the first time for a mass resolving power exceeding 100.000 and a sub ppm accuracy in a transportable format. It can thus resolve isobars and enables to accurately determine the composition and structure of biomolecules. An atmospheric pressure interface provides compatibility to various atmospheric ion sources. The mass spectrometer part comprises an RFQ mass filter, ion cooler, ion trap, time-of-flight analyzer and detector. Supply electronics, DAQ and control system are mounted together with the spectrometer into a single frame with a total volume of only 0.8m^3. First results with the MR-TOF-MS will be presented, and an overview of envisaged life science applications will be given, such as real-time tissue recognition in electrosurgery, identification of mycotoxins and analysis of soil samples for environmental studies.

MS 4: Ion Storage Rings

Time: Tuesday 10:30–11:45 Location: V57.06

Invited Talk MS 4.1 Tue 10:30 V57.06

Present and future mass measurements at the FRS-ESR Facility at GSI — •Ronja Knöbel — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt, Germany

Schottky and Isochronous Mass Spectrometry were developed at the FRS-ESR facility at GSI and are essential methods for precise and accurate mass measurements. New developments of experimental tools and refinements in the analysis were achieved for both methods which led to the discovery of new isotopes and new isomers along with new mass and half-life measurements. Recent results from both methods will be presented and comparisons to theoretical predictions will be given. These results improve the understanding of nuclear structure and of the astrophysical nucleosynthesis-pathways.

MS 4.2 Tue 11:00 V57.06

Isochronous mass spectrometry with longer observation of ions and improved timing performances of a time-of-flight detector at ESR — •Natalia Kuzminchuk[1,2], Marcel Diwisch[1], Samuel Ayet[2], Timo Dickel[1,2], Hans Geissel[1,2], Ronja Knöbel[1,2], Wolfgang Plass[1,2], Christoph Scheidenberger[1,2], Baohua Sun[1,2], and Helmut Weick[2] — [1]Justus-Liebig-Universität Gießen — [2]GSI, Darmstadt

Using Isochronous Mass Spectrometry at the FRS-ESR the mass of the exotic nuclei can be deduced from precise revolution time measurements by a time-of-flight detector. In the detector, the ion impinge on a thin carbon foil and the emitted secondary electrons are deflected by 180° with an applied electric and magnetic fields to two MCP detectors. Due to the high revolution frequencies of the ions in the ESR (∼2 MHz), a high rate acceptance is required as well as good timing characteristics. The rate capability improvements developed in offline work using MCPs with smaller pore size and employing thinner carbon foils were studied online with ^{238}U fragments for the first time at the FRS-ESR facility. As a result, up to 10 times more revolutions of the stored ions in the ring were observed. To improve the timing accuracy the TOF detector was modified for higher kinetic transport energies of the secondary electrons from the foil to the MCPs. Offline measurements with a radioactive alpha source showed that the time accuracy of the detector was improved by up to 50 %.

MS 4.3 Tue 11:15 V57.06

Investigation of heavy neutron-rich nuclides with time-resolved Schottky mass spectrometry — •D. Shubina[1,2], M.W. Reed[3], I.J. Cullen[3], P.M. Walker[3], Yu.A. Litvinov[1,4], K. Blaum[1], F. Bosch[4], C. Brandau[4], R.B. Cakirli[1,5], J.J. Carroll[6,7], R.F. Casten[8], D.M. Cullen[9], A.Y. Deo[3], B. Detwiler[6], C. Dimopoulou[4], F. Farinon[4], H. Geissel[4,10], E. Haettner[10], M. Heil[4], R.S. Kempley[3], R. Knöbel[4], C. Kozhuharov[4], J. Kurcewicz[4], N. Kuzminchuk[4], S.A. Litvinov[4], Z. Liu[11], R. Mao[12], C. Nociforo[4], F. Nolden[4], Z. Patyk[4], W.R. Plass[10], A. Prochazka[4], M.S. Sanjari[4], C. Scheidenberger[4,10], M. Steck[4], Th. Stöhlker[2,4], B. Sun[4], T.P.D. Swan[3], G. Trees[6], H. Weick[4], N. Winckler[1], M. Winkler[4], P.J. Woods[11], and T. Yamaguchi[13] — [1]MPIK, Heidelberg — [2]Heidelberg Uni. — [3]Surrey Uni. — [4]GSI, Darmstadt — [5]Istanbul Uni. — [6]YSU, Youngstown — [7]US Army RL — [8]Yale Uni. — [9]Manchester Uni. — [10]Gießen Uni. — [11]Edinburgh Uni. — [12]IMP, Lanzhou — [13]Saitama Uni.

Neutron-rich heavy nuclides, which were produced by fragmentation of a ^{197}Au primary beam and separated in the FRS, were investigated with Schottky Mass Spectrometry (SMS) using the GSI ESR. Masses for nine nuclides were measured for the first time: ^{181,183}Lu, ^{185,186}Hf, ^{187,188}Ta, ^{191}W and ^{192,193}Re. Also, the accuracy of the mass values for three other nuclides (^{189,190}W and ^{195}Os) was significantly improved. The new data was used for nuclear structure investigations by studying the behavior of two neutron separation energies, S_{2n}, and comparing them with the energies of the first excited 2^+ states.

MS 4.4 Tue 11:30 V57.06

Direct mass measurements of short-lived proton-rich nuclides at CSRe — •X.L. Yan[1,2], X.L. Tu[1,2], M. Wang[1], Yu.A. Litvinov[1,3,4], Y.H. Zhang[1], H.S. Xu[1], Z.Y. Sun[1], G. Audi[5], K. Blaum[3], C.M. Du[1,2], W.X. Huang[1], Z.G. Hu[1], P. Geng[1,2], S.L. Jin[1,2], L.X. Liu[1,2], Y. Liu[1], B. Mei[1], R.S. Mao[1], X.W. Ma[1], H. Suzuki[6], P. Shuai[7], Y. Sun[1,8], S.W. Tang[1,2], J.S Wang[1], S.T Wang[1,2], G.Q. Xiao[1], X. Xu[1,2], J.W Xia[1], J.C. Yang[1], R.P. Ye[1,2], T. Yamaguchi[9], Y.J. Yuan[1], Y. Yamaguchi[10], Y.D. Zang[1,2], H.W. Zhao[1], T.C. Zhao[1], X.Y. Zhang[1], X.H Zhou[1], and W.L Zhan[1] — [1]IMPCAS, China — [2]GUCAS, China — [3]MPIK, Germany — [4]GSI, Germany — [5]CSNSM-IN2P3-CNRS, Université de Paris Sud, France — [6]Uni. of Tsukuba, Japan — [7]USTC, China — [8]SJTU, China — [9]Saitama Uni., Japan — [10]RIKEN, Japan

Masses of $A = 2Z - 1$ proton-rich nuclides were measured with the experimental cooler storage ring CSRe in Lanzhou by employing the isochronous mass spectrometry (IMS) method. The short-lived proton-rich nuclides were produced via ^{78}Kr projectile fragmentation, separated in the radioactive beam line RIBLL2 and then stored in CSRe. A typical mass resolving power of $R = m/\Delta m \approx 1.7 \cdot 10^5$ was achieved. After the improvement of the stability of CSRe dipole magnet power supplies, a new measurement with ^{58}Ni projectile fragments was carried out. The data analysis methods for both experiments will be presented.

MS 5: Precision Mass Spectrometry and Fundamental Applications II

Time: Tuesday 14:00–16:00 Location: V57.06

Invited Talk MS 5.1 Tue 14:00 V57.06

Präzisionsmassenmessungen an ISOLTRAP für Kernstrukur- und Astrophysik — •Susanne Kreim — Max-Planck Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

Penningfallen-Massenmessungen liefern u.a. für neutronenreiche Kerne schwerer als Blei hochpräzise Massenwerte, die uns Aufschluss über die Kernstruktur und Nukleosyntheseprozesse in dieser Region geben. Von besonderem Interesse ist hier der schnelle Neutroneneinfangprozess (r-Prozess). Änderungen in der Bindungsenergie, welche aus der Bestimmung der Masse extrahiert werden kann, geben Information über die im Kern wirkenden Kräfte. Mit dieser Motivation wurden Hochpräzisionsmassenmessungen an langen Isotopenketten von Rn, Fr und Ra mit ISOLTRAP durchgeführt, die im Vortrag mit theoretischen Vorhersagen verglichen werden.

Außerdem kann die in diesem Massenbereich stattfindende Kernspaltung zur Erklärung für ein Wiederaufleben des r-Prozess gereichen. Mit den sechs neuen, jüngst gemessenen Massen von Ra und Fr Isotopen können Betazerfallsenergien berechnet und deren Auswirkung auf den r-Prozess-Pfad untersucht werden. Es wird außerdem erwartet, dass die kürzlich am ISOLTRAP-Experiment bestimmte Masse und Halbwertszeit von Zn-82 eine große Auswirkung auf den r-Prozess um den Abschluss der Neutronenschale N=50 haben wird.

MS 5.2 Tue 14:30 V57.06

Direct mass measurements above Z = 100 — •E. Minaya Ramirez[1], D. Ackermann[2], K. Blaum[3,4], M. Block[2], C. Droese[5], Ch.E. Düllmann[1,2,6], M. Dworschak[2], M. Eibach[6], S. Eliseev[3], E. Haettner[2,7], F. Herfurth[2], F.P. Hessberger[2], S. Hofmann[2], J. Ketelaer[3], J. Ketter[3], G. Marx[5], M. Mazzocco[8], D. Nesterenko[9], Yu. Novikov[9], W.R. Plass[2,7], S. Rahaman[10], D. Rodríguez[11], C. Scheidenberger[2,7], L. Schweikhard[5], P.G. Thirolf[12], G.K. Vorobjev[2,9], and C. Weber[12] — [1]Helmholtz-Institut Mainz — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [3]Max-Planck-Institut für Kernphysik, Heidelberg — [4]Ruprecht-Karls-Universität Heidelberg — [5]Ernst-Moritz-Arndt-Universität, Greifswald — [6]Johannes Gutenberg-Universität Mainz — [7]Justus-Liebig-Universität Gießen — [8]Dipartimento di Fisica and INFN Sezione di Padova — [9]PNPI RAS Gatchina, St. Petersburg — [10]LANL, Los Alamos — [11]Universidad de Granada — [12]Ludwig-Maximilians-Universität München

High-precision mass measurements of radionuclides are a direct way to obtain the nuclear binding energy, a crucial parameter to investigate the nuclear shell structure. Furthermore, the combination of α-decay spectroscopy and directly measured masses above fermium ($Z > 100$) allows determining the masses of higher-Z nuclides to support the search for the island of stability of superheavy elements. Besides, mass measurements of the heaviest actinides allow studying the deformed shell gap $N = 152$ connected to the spherical shell gap in much heavier nuclei by the same single-particle orbitals. Recently, the masses of the nuclides ^{255}No and ^{255,256}Lr have been measured with high accuracy using the Penning trap mass spectrometer SHIPTRAP at GSI Darmstadt. In addition, the accuracy of the ^{252}No and ^{254}No masses (previously measured at SHIPTRAP) was further improved. The radionuclides were produced in fusion-evaporation reactions and separated from the primary beam by the velocity filter SHIP. Until now the masses of the lawrencium isotopes were only estimated from systematic trends and the extension to ^{256}Lr represents a new stage in mass measurements of elements with very low cross sections performed with a Penning trap. Work supported in part by BMBF (06ML9148).

MS 5.3 Tue 14:45 V57.06

Status of THe-Trap — •Jochen Ketter[1], Tommi Eronen[1], Martin Höcker[1], Sebastian Streubel[1], Robert S. Van Dyck Jr.[2], and Klaus Blaum[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg — [2]Department of Physics, University of Washington, Seattle, WA 98195-1560, USA

Originally developed at the University of Washington and relocated to the Max-Planck-Institut für Kernphysik in 2008, the Penning-trap spectrometer THe-Trap [1] is specially tailored for a ^{3}H/^{3}He mass-ratio measurement, from which the Q-value of the beta-decay of ^{3}H to ^{3}He can be derived. Improving the current best value [2] by at least an order of magnitude will provide an important independent test parameter for the determination of the electron-antineutrino's mass by the Karlsruhe Tritium Neutrino Experiment (KATRIN) [3]. However, Penning-trap mass spectrometry has to be pushed to its limits in a dedicated experiment for a sufficiently accurate mass-ratio measurement with a relative uncertainty of 10^{-11}. Unlike the closed-envelope, single-trap predecessor, the new spectrometer features an external ion source, owing to the radioactive nature of tritium, and two traps in order to speed up the measurement cycle. While the double-trap technique holds great promise, it also calls for more intricate procedures, such as ion transfer. Details about the recent progress of the experiment will be given.

[1] C. Diehl *et al.*, Hyperfine Interactions (2011) 199:291–300
[2] Sz. Nagy *et al.*, Europhys. Lett., **74** (3), pp. 404–410 (2006)
[3] E. W. Otten *et al.*, Int. J. Mass Spectrom. 251 (2006) 173–178

MS 5.4 Tue 15:00 V57.06

Extraction of neutron-rich fission products from a nuclear reactor: status of the online-coupling at TRIGA-SPEC — •T Beyer[1,2], K Blaum[1,2], M Block[4], K Eberhardt[3], M Eibach[2,3], Ch Düllmann[3,4], F Herfurth[4], D Lunney[5], Sz Nagy[1,4], W Nörtershäuser[3,4], D Renisch[1,3], and Ch Smorra[1,2] — [1]Max-Planck-Institut für Kernphysik, 69117 Heidelberg — [2]Physikalisches Institut, Universität Heidelberg, 69120 Heidelberg — [3]Institut für Kernchemie, Universität Mainz, 55128 Mainz — [4]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt — [5]CSNSM, Université de Paris Sud, 91495 Orsay, France

Precise experimental data of the ground-state properties of short-lived nuclei are required to test the predictive power of nuclear mass models and to support astrophysical nucleosynthesis calculations. Besides the measurement of these properties with high precision, the creation and preparation of the nuclides of interest is one of the biggest challenges in this field of physics. The TRIGA reactor in Mainz provides high neutron fluxes for the production of exotic nuclei by neutron-induced fission of suitable actinoide targets. The extraction and preparation of these nuclei for both a double-Penning-trap mass spectrometer and a collinear-laser-spectroscopy setup is achieved by using an aerosol-loaded gas-jet system, a high-temperature surface ion source, a separator magnet, and an RF quadrupole cooler/buncher. The status of the online-coupling as well as intermediate test results will be presented.

MS 5.5 Tue 15:15 V57.06

The multi-Penning trap experiment PENTATRAP — •Christine Böhm[1,2,3], José R. Crespo López-Urrutia[1], Andreas Dörr[1,2], Sergey Eliseev[1], Mikhail Goncharov[1,2], Jochen Ketter[1,2], Yuri N. Novikov[3,4], Julia Repp[1,2], Christian Roux[1,2], Sven Sturm[1,5], Stefan Ulmer[6], and Klaus Blaum[1,2] — [1]Max-Planck-Institut für Kernphysik, 69117 Heidelberg — [2]Fakultät für Physik und Astronomie, Ruprecht-Karls-Universität, Heidelberg — [3]ExtreMe Matter Institute EMMI, Helmholtz Gemeinschaft, 64291 Darmstadt — [4]Petersburg Nuclear Physics Institute, 188300 Gatchina, Russia — [5]Johannes Gutenberg-Universität Mainz, Institut für Physik, 55099 Mainz — [6]Atomic Physics Laboratory, RIKEN Advanced Science Institute, Hirosawa, Wako, Saitama 351-0198, Japan

The PENTATRAP experiment is under construction at the Max-Planck-Institut für Kernphysik Heidelberg. It aims for high-precision mass ratio measurements of long-lived and stable, highly charged nuclides with masses up to uranium with an accuracy of $\delta m/m \approx 10^{-12}$. Primary goals are for example tests of quantum electrodynamics and neutrino oriented mass measurements. In order to reach the desired accuracy the PENTATRAP experiment contains a stack of five cylindrical cryogenic Penning traps and a dedicated detection system. The current status of the experimental setup will be presented.

MS 5.6 Tue 15:30 V57.06

Ion production at the mass spectrometer PENTATRAP — •Julia Repp[1,2], Christine Böhm[1,2,3], José Crespo López-Urrutia[1], Andreas Dörr[1,2], Sergey Eliseev[1], Mikhail Goncharov[1,2], Christian Roux[1,2], and Klaus Blaum[1,2] — [1]Max-Planck-Institut für Kernphysik, 69117 Heidelberg — [2]Fakultät für Physik und Astronomie, Ruprecht-Karls-Universität, 69120 Heidelberg — [3]ExtreMe Matter Institute EMMI, Helmholtz Gemeinschaft, 64291 Darmstadt

A main feature of the high-precision mass spectrometer PENTATRAP is an access to highly charged long-lived and stable ions. Well proven sources for highly charged ions are electron beam ion traps (EBITs). PENTATRAP has access to two EBITs for ion production: a small commercial room temperature Dresden-EBIT3 with an additional Wien filter and the Heidelberg-EBIT. The Dresden-EBIT3 is limited to the production of helium- and neon-like ions for medium- and high-Z elements, respectively. Therefore, this ion source will be used for the commissioning of PENTATRAP and for the investigation of its performance. Moreover, it can be used to produce ions for measurements in the field of neutrino physics. For physics applications, which require extremely high charge states of long-lived and stable nuclides, e.g., bare or hydrogen-like lead or uranium, PENTATRAP will obtain ions from the Heidelberg-EBIT. The talk will focus on the Dresden-EBIT3 and first measurements will be presented.

MS 5.7 Tue 15:45 V57.06

Detection electronics at the Penning-trap mass spectrometer PENTATRAP — •Andreas Dörr[1,2], Christine Böhm[1,2,3], Sergey Eliseev[2], Mikhail Goncharov[2], Julia Repp[1,2], Christian Roux[1,2], Sven Sturm[2,4], Stefan Ulmer[5], and Klaus Blaum[1,2] — [1]Fakultät für Physik und Astronomie, Ruprecht-Karls-Universität, 69120 Heidelberg, Germany — [2]Max-Planck-Institut für Kernphysik, 69117 Heidelberg, Germany — [3]ExtreMe Matter Institute EMMI, Helmholtz Gemeinschaft, 64291 Darmstadt, Germany — [4]Institut für Physik, Johannes Gutenberg-Universität, 55099 Mainz, Germany — [5]Atomic Physics Laboratory, RIKEN Advanced Science Institute, Hirosawa, Wako, Saitama 351-0198, Japan

The five Penning-trap mass spectrometer PENTATRAP is currently being built at the Max-Planck-Institut für Kernphysik in Heidelberg. Measurements of masses of single stable and long lived highly charged ions with a relative uncertainty on the order of 10^{-11} are aimed for. The experiment is based on the non-destructive detection of image currents the ion induces in the trap electrodes. Essential part of each detection circuit is a cryogenic high-Q inductance, configured either as a copper wire coil or as a superconducting toroid, in both cases mounted in a copper housing. The following amplification stages consist of cryogenic GaAs FET amplifiers, which provide high input impedances and have low input-related noise densities. With these cryogenic detection systems, the tiny image currents (∼fA) induced by a single ion become detectable. The current status of the detection electronics as well as future perspectives will be presented in the talk.

MS 6: Poster

Time: Tuesday 16:30–19:00 Location: Poster.IV

MS 6.1 Tue 16:30 Poster.IV

A year-by-year record of 236U/238-U in coral as a step towards establishing 236-U from nuclear weapons testing fallout as oceanic tracer — •Stephan Winkler[1], Peter Steier[1], and Jessica Carilli[2] — [1]University of Vienna, Faculty of Physics, Vienna, Austria — [2]Australian Nuclear Science and Technology Organisation, Lucas Heights, Australia

Since uranium is known to behave conservatively in ocean waters, 236-U has great potential in application as oceanic tracer. 236-U (t1/2=23.4Ma) was introduced into the oceans by atmospheric nuclear weapon testing with amount estimates ranging from 700kg to 1500kg. Thus a resulting initial average 236-U/238-U ratio of at least 5e-9 is expected for an oceanic mixed layer depth of 100m. This ratio is already higher than the natural pre-nuclear background, which is expected to be at 10e-14 levels.

Even the elevated ratios of global stratospheric fall-out are beyond the capabilities of ICPMS and TIMS methods. However, the exceptional sensitivity and ultra-low background for 236-U of the Vienna Environmental Research Accelerator's Accelerator Mass Spectrometry system allows us to measure down to 10-13 detection limits.

We present a year-by-year record of 236-U/238-U for a Caribbean coral core covering years 1944 to 2006, thus allowing to us put constraints on the oceanic input of 236-U by atmospheric testing. Moreover modelling of the results also demonstrates the capabilities of 236-U as oceanic tracer.

MS 6.2 Tue 16:30 Poster.IV

Magnetic Field stabilization in THe-Trap — •Sebastian Streubel[1], Tommi Eronen[1], Martin Höcker[1], Jochen Ketter[1], Robert S. Van Dyck Jr.[2], and Klaus Blaum[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Department of Physics, University of Washington, Seattle, WA 98195-1560, USA

THe-Trap is a Penning trap mass spectrometer dedicated to measure the ^{3}H to ^{3}He mass ratio aiming to a relative mass uncertainty better than 10^{-11}. The most vital prerequisite for this measurement is a stable magnetic field: The relative temporal fluctuations during a measurement cycle of typically 1 hour, should be better than 10^{-11}. The 5.26 T field is provided by a superconducting magnet. Unfortunately, the materials within the cryostat have a temperature-dependent susceptibility which necessitates a temperature stabilization. The stabilization is achieved by controlling the liquid helium level above the traps, and by keeping the pressure of the liquid helium constant. An important part of the system is the pressure reference, which is stable at a 0.04 Pa level.

In addition to the stabilization of the field fluctuations within the cryostat itself, a system to cancel external fluctuations is set up consisting of a passive coil with a shielding factor of up to 180 build into the cryostat. Furthermore, a Helmholtz coil pair is placed around the cryostat. The compensation signal is provided by a custom-built fluxgate magnetometer.

Technical details about the stabilization systems will be given.

MS 6.3 Tue 16:30 Poster.IV

Mass measurements of ^{82,83}Kr — •Martin Höcker[1,2], Klaus Blaum[1], and Edmund G. Myers[2] — [1]Max-Planck-Institut für Kernphysik, Heidelberg — [2]Department of Physics, Florida State University, Tallahassee, 32306-4350, USA

In 2005, The Florida State University Precision Penning Trap group made mass measurements of ^{84,86}Kr and ^{129,132}Xe, which revealed a three sigma deviation to the previously adopted value of the mass of ^{84}Kr [1,2]. Because noble gases can serve as readily available reference masses for a wide range of mass spectrometers, the group concurred to measure two more krypton isotopes, ^{82,83}Kr, to cross-check whether similiar deviations are present in these isotopes as well, and to provide state-of-the-art reference mass values for all major krypton isotopes.

The measurements were carried out in the FSU/MIT-trap, which currently provides the most accurate mass ratios for stable, low-charged atomic and molecular ions. The measurement technique uses two single ions in the trap simultaneously, with the ions alternately being parked on a large cyclotron orbit and measured in the center of the trap with the pulse-and-phase technique.

The new measurements are presented and an overview of the statistical and systematic limitations is given.

This work was supported by the U.S. National Science Foundation.

[1] W. Shi *et al.*, Physical Review A **72** 022510 (2005)
[2] M. Redshaw *et al.*, Physical Review A **74** 012506 (2009)

MS 6.4 Tue 16:30 Poster.IV

MR-ToF Isobar Separation for Mass and Life-Time Measurements of Neutron-Rich Zinc at ISOLTRAP — Georges Audi[1], Dietrich Beck[2], Klaus Blaum[3], Christine Böhm[3], Christopher Borgmann[3], Martin Breitenfeldt[4], R. Burcu Cakirli[3], Thomas Elias Cocolios[5], Sergey Eliseev[3], Sebastian George[6], Frank Herfurth[2], Alexander Herlert[7], Jürgen Kluge[2], Magdalena Kowalska[5], Susanne Kreim[3,5], David Lunney[1], Enrique Minaya Ramirez[2], Sarah Naimi[8], Dennis Neidherr[2], •Marco Rosenbusch[9], Stefan Schwarz[6], Lutz Schweikhard[9], Juliane Stanja[10], Meng Wang[1], Frank Wienholtz[9], Robert N. Wolf[9], and Kai Zuber[10] — [1]CSNSMIN2P3-CNRS, Université de Paris Sud, Orsay, France — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [4]Instituut voor Kernen Strahlingsfysica, Leuven, Belgium — [5]CERN, Geneva, Switzerland — [6]NSCL, Michigan State University, East Lansing, USA — [7]FAIR GmbH, Darmstadt, Germany — [8]RIKEN Research Facility, Japan — [9]Ernst-Moritz-

Arndt-Universität, Greifswald, Germany — [10]Technische Universität, Dresden, Germany

High-precision Penning-trap mass measurements of short-lived nuclei are performed with ISOLTRAP at the on-line isotope separator ISOLDE/CERN. An important prerequisite to achieve relative uncertainties of $\delta m/m = 10^{-8}$ is the availability of purely isobaric ion ensembles. To enhance the purity of radioactive ion beams, a multi-reflection time-of-flight mass separator developed at the University of Greifswald [1,2] has recently been implemented at the ISOLTRAP setup. A mass resolving power of $R = 2 \cdot 10^5$ and a contaminant reduction of four orders of magnitude by use of a Bradbury-Nielsen ion gate have been achieved. The performance of the combined setup (including an RFQ ion buncher, the MR-ToF MS and the two Penning traps) in both offline tests as well as in first applications with radioactive ion beams will be presented. Furthermore, the physics case and recent results of mass measurements of neutron-rich Zinc will be shown.

[1] R. N. Wolf et al., Hyperfine Interact. 199, 115 (2011)
[2] R. N. Wolf et al., Int. J. Mass Spectrom., accepted

MS 6.5 Tue 16:30 Poster.IV

Multianionen-Erzeugung in der Penningfalle in Abhängigkeit von der Fallenspannung — •Franklin Martinez, Steffi Bandelow, Christian Breitenfeldt, Gerrit Marx, Lutz Schweikhard und Frank Wienholtz — Institut für Physik, Ernst-Moritz-Arndt Universität, 17487 Greifswald, Deutschland

Die simultane Speicherung von Clusteranionen und Elektronen in einer Penning-Ionenfalle eignet sich zur Erzeugung höherer negativer Ladungszustände der Cluster. Dabei muss zum einen die Fallenspannung so groß gewählt werden, dass gespeicherte Elektronen ausreichend Energie haben, um das Coulomb-Potential der bereits anionischen Cluster zu überwinden. Zum anderen darf die Fallenspannung zur Speicherung der Cluster aber einen kritischen Wert nicht übersteigen, welcher sich invers zum Masse/Ladungs-Verhältnis der zu speichernden Ionen verhält. Da die Ausgangscluster jeweils einfach geladen sind, und zur Erzeugung höherer Ladungszustände insbesondere größere Cluster benötigt werden, widersprechen sich beide Kriterien für die Fallenspannung. Durch schrittweises Aufladen der Cluster und Erhöhen der Fallenspannung kann dieser Widerspruch jedoch umgangen werden. Die experimentelle Umsetzung wird am Beispiel der Erzeugung fünffach negativ geladener Aluminiumcluster im 5-T-Feld vorgestellt. Der Zusammenhang zwischen der Höhe des Coulomb-Potentials und der zur Elektronenanlagerung benötigten Fallenspannung werden diskutiert, ebenso wie die erweiterten Möglichkeiten im kürzlich installierten 12-T-Magneten.

MS 6.6 Tue 16:30 Poster.IV

Eine mobile Fallenapparatur für Cluster-Laser-Experimente an massenselektierten Clustern — •Madlen Müller[1], Robert Irsig[2], Gerrit Marx[1], Karl-Heinz Meiwes-Broer[2] und Lutz Schweikard[1] — [1]Institut für Physik, Ernst-Moritz-Arndt Universität, 17487 Greifswald — [2]Institut für Physik, Universität Rostock, 18501 Rostock

Im Rahmen des SFB652 [1] wurde ein Ionenfallensystem zur Untersuchung von massenselektierten Clustern unter Einwirkung eines Laserfeldes aufgebaut und getestet. In einer ersten linearen Paulfalle wird ein Ionenensemble von einer Clusterquelle eingefangen, gekühlt und massenselektiert. Die so präparierten Ionen können entweder direkt einer Wechselwirkung mit Laserlicht ausgesetzt werden oder in eine zweite lineare Paulfalle transferiert werden. Nachgewiesen werden die in der Falle verbliebenen Reaktionsprodukte über eine Flugzeitanalyse. Eine variable Speicherzeit erlaubt kurze, aber auch definierbar ausgedehnte Wechselwirkungszeiten mit Laserlicht und nachfolgende Reaktionszeiten. In ersten Experimenten konnten C_{60}^+- und C_{70}^+-Fullerene akkumuliert, gespeichert, gekühlt und selektiert werden. Die mit Photoanregung in der Falle erzeugten und weiter gespeicherten Reaktionsprodukte wurden mittels Flugzeitmassenspektrometrie analysiert. Im nächsten Schritt soll das Fallensystem mit einer Magnetron-Ionenquelle verbunden werden, um die Untersuchungen an Metall-Clustern fortzusetzen.

[1] http://web.physik.uni-rostock.de/sfb/

MS 6.7 Tue 16:30 Poster.IV

Spin and orbital moments of isolated clusters - synchrotron radiation elucidates nanomagnetism — Sergey Peredkov[1], Matthias Neeb[2], Wolfgang Eberhardt[1], Jennifer Meyer[3], Matthias Tombers[3], and •Gereon Niedner-Schatteburg[3] — [1]TU Berlin, Institut für Optik und Atomare Physik, Hardenbergstr. 36, 10623 Berlin, Germany — [2]Helmholtz-Zentrum Berlin für Materialien & Energie, BESSY II, Albert-Einstein-Str. 15, 12489 Berlin, Germany — [3]TU Kaiserslautern, Fachbereich Chemie und Foschungszentrum OPTIMAS, 67663 Kaiserslautern, Germany

The determination of spin and orbital magnetic moments from the free atom to the bulk phase is an intriguing challenge for nanoscience, since most magnetic recording materials are based on nanostructures. We present temperature-dependent X-ray magnetic circular dichroism (XMCD) measurements of free Co-clusters (N=8-22) from which the intrinsic spin and orbital magnetic moments have been deduced [1]. An exceptionally strong enhancement of the orbital moment is verified for free magnetic clusters which is 4-6 times larger than the bulk value. Our temperature-dependent measurements reveal that the spin orientation along the external magnetic field is nearly saturated at ca. 20 K and 7 T while the orbital orientation is clearly not. The comparison of the magnetic moments as deduced from XMCD and previous Stern-Gerlach measurements might help to reconcile divergent results of the total magnetic moments of small Co-clusters published earlier. We present an outlook towards other transition metal clusters.

References: [1] S.Peredkov et al., PRL 107, 233401 (2011)

MS 6.8 Tue 16:30 Poster.IV

Normal and inverse H/D-isotope effects in the reactions of size selected transition metal cluster ions with aromatic hydrocarbon molecule — •Christine Merkert, Matthias Tombers, Lars Barzen, Anke Stamm, Maximilian Gaffga, and Gereon Niedner-Schatteburg — TU Kaiserslautern, Fachbereich Chemie und Foschungszentrum OPTIMAS, 67663 Kaiserslautern, Germany

Isolated transition metal cluster ions have been subject of reactivity studies ever since appropriate ion sources became available. We have utilized high resolution mass spectrometry in conjunction with ion trapping for the investigation of aromatic hydrocarbon reactivity of Iron, Cobalt and Nickel cluster cations and anions in the cluster size range from 3 to 30 atoms per cluster under single collision conditions. The measurements serve to determine relative rate constants for various reaction channels observed. Reaction rates of normal and perdeuterated reactants reveal remarkable isotope effects, that are in part normal and in part inverse. Mechanistic interpretations are to discuss.

MS 6.9 Tue 16:30 Poster.IV

A Detector for 3D Molecular Fragmentation Imaging at the Cryogenic Storage Ring — •Arno Becker[1], Klaus Blaum[1], Claude Krantz[1], Oldřich Novotný[2], Andrey Shornikov[1], Kaija Spruck[3], and Andreas Wolf[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg — [2]Columbia Astrophysics Laboratory, 550 West 120th Street, New York, NY 10027, USA — [3]Institut für Atom- und Molekülphysik, Leihgesterner Weg 217, 35392 Giessen

The electrostatic Cryogenic Storage Ring (CSR), currently under construction at the Max-Planck-Institute for Nuclear Physics in Heidelberg, will enable long time storage of slow molecular ions with energies up to 300 keV and low blackbody radiation corresponding to the ∼10 K temperature of the storage ring enclosure. Under these conditions, polyatomic ions up to high masses can be prepared in or near the rovibrational ground state. Their fragmentation can be studied by fast-beam coincidence fragment momentum imaging. A detection system for 3D imaging of neutral fragments from Dissociative Recombination reactions is being developed. The requirements of the CSR regarding the huge temperature range from operation at ∼10 K to bakeout at ∼520 K as well as an extremly high vacuum of 10^{-13} mbar place high demands on the detector design. The use of an MCP-based detector with a multi-hit-capable position- and time-resolving delay-line anode is investigated. Simulations of the achievable multi-hit resolution performance for typical fragmentation events to be studied at the CSR and the cryogenic implementation will be presented.

MS 6.10 Tue 16:30 Poster.IV

A Converter-Plate Ion-Counting Detector for the Cryogenic Storage Ring — •Kaija Spruck[1], Arno Becker[2], Klaus Blaum[2], Claude Krantz[2], Alfred Müller[1], Oldřich Novotný[3], Stefan Schippers[1], Andrey Shornikov[2], and Andreas Wolf[2] — [1]Institut für Atom- und Molekülphysik, Leihgesterner Weg 217, 35392 Giessen — [2]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg — [3]Columbia Astrophysics Laboratory, 550 West 120th Street, New York, NY 10027, USA

The electrostatic Cryogenic Storage Ring (CSR), currently under construction at the Max-Planck-Institute for Nuclear Physics in Heidelberg, will allow for experiments with atomic, molecular and cluster ions of 300 keV or lower energy in extremely high vacuum (XHV) conditions. XHV will be achieved by cryopumping at 2 K in a chamber kept at about 10 K. Collisions of the stored ions with photons, electrons, or neutral heavy particles will lead to reaction products with masses and/or charge states that differ from those of the primary particles. For the detection of the reaction products a high-efficiency single-particle detector based on a converter plate and electron detection by a microchannel plate detector has been designed and is currently being tested. It has a sensitive area of $\sim$20$\times$50 mm^2 and will be mounted on a translation stage with a travel range of up to $\sim$40 cm inside the cryogenic XHV. The layout is compatible with the cryogenic operating conditions and a high-temperature bakeout of up to $\sim$250°C.

MS 6.11 Tue 16:30 Poster.IV

Das CSR-Reaktionsmikroskop — •Johannes Goullon, Shaofeng Zhang, Klaus Blaum, Manfred Grieser, Robert von Hahn, Andreas Wolf, Alexander Dorn, Daniel Fischer, Robert Moshammer, Claus Dieter Schröter und Joachim Ullrich — Max-Planck-Institut für Kernphysik, Heidelberg

Am Max-Planck-Institut für Kernphysik in Heidelberg wird derzeit ein kryogener elektrostatischer Speicherring (CSR) aufgebaut. Unter Flüssig-Helium-Kühlung werden Temperaturen weniger Kelvin bei extremen Vakuumbedingungen ($< 10^{-13}$ mbar) erreicht. Dies erlaubt die Durchführung von Experimenten mit niederenergetischen, hochgeladenen Ionen, zustandsselektierten Clustern oder ultra-kalten, wohlpräparierten Molekülionen (20 - 300 keV / Ladungszustand) mit langen Speicherzeiten und denkbar geringen Störungen durch die Umgebung, d.h. durch Restgas oder Wärmestrahlung. Wir berichten über den Aufbau eines kryogenen Reaktionsmikroskops (REMI) mit einem Gasjet-Target und dessen Implementierung in den CSR.

MS 6.12 Tue 16:30 Poster.IV

Status of the Cryogenic Storage Ring (CSR) — •Sebastian Menk[1], Arno Becker[1], Felix Berg[1], Klaus Blaum[1], Florian Fellenberger[1], Michael Froese[1], Johannes Goullon[1], Manfred Grieser[1], Claude Krantz[1], Michael Lange[1], Felix Laux[1], Roland Repnow[1], Andrey Schornikov[1], Kaija Spruck[2], Robert von Hahn[1], and Andreas Wolf[1] — [1]Max-Planck-Institut für Kernphysik (MPIK), 69117 Heidelberg — [2]Institut für Atom- und Molekülphysik Justus-Liebig-Universität, 35392 Giessen

A novel cryogenic storage ring is currently under construction at the MPIK. By electrostatic ion optical elements, the 35 m circumference Cryogenic Storage Ring will be able to store ions at energies of up to 300 keV per charge unit without any mass limitations. The CSR consists of a cryogenic ($\sim$5 K) beam pipe surrounded by two radiation shields (40 and 80 K) in a large outer, thermal insulation vacuum. Extreme vacuum (density $\sim 10^3$ cm^{-3}) will be achieved by 2 K cryopumping as demonstrated in a prototype ion beam trap. The ion optics was completely assembled within the precision cryogenic mounting and shielding structure of the first corner. There, cooldown tests to $\sim$40 K were performed which confirmed the required sub-millimeter accuracy of the specially designed electrode positioning under large temperature changes. The high-voltage connections to the cryogenic electrodes were installed and breakdown tests will be reported. Based on the test results the beam pipe, electrode mounting and shielding structures are under final construction for mounting during 2012.

MS 6.13 Tue 16:30 Poster.IV

Status of the Low-Energy Electron Cooler for the Cryogenic Storage Ring — •Claude Krantz[1], Arno Becker[1], Klaus Blaum[1], Oldřich Novotný[2], Stefan Schippers[3], Andrey Shornikov[1], Kaija Spruck[3], and Andreas Wolf[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg — [2]Columbia Astrophysics Laboratory, 550 West 120th Street, New York, NY 10027, USA — [3]Institut für Atom- und Molekülphysik, Leihgesterner Weg 217, 35392 Giessen

The Cryogenic Storage Ring (CSR) under construction at the Max-Planck Institute for Nuclear Physics in Heidelberg is a next-generation electrostatic storage ring for atomic, molecular, and cluster ions. The CSR beam pipe will be cooled to $\sim$10 K, thereby reducing the residual gas density and the black body radiation background to very low values. This will allow precision experiments on IR-active or very massive ionic species that are not possible in room-temperature setups. The CSR features an electron-ion merged beams section that can be used both for electron cooling of the stored ions and for low-energetic electron-ion collision experiments. The design of the cooler must comply with the requirements of the CSR with regard to its very large range of operating and bakeout temperatures and the target vacuum of 10^{-13} mbar. The cooler will use a combination of superconducting and cold copper coils for magnetic guiding of the electron beam. The latter will be produced by a cold photocathode source already in operation. The cooler entered its construction phase in 2011 and is expected to become operational for the commissioning phase of the CSR.

MS 6.14 Tue 16:30 Poster.IV

High resolution in-jet resonance ionization laser spectroscopy using an injection-locked Ti:sapphire laser @ RIKEN — •Volker Sonnenschein[1], Hideki Tomita[2], Iain Moore[1], Mikael Reponen[1], Tetsuo Sonoda[3], Michiharu Wada[3], and Klaus Wendt[4] — [1]Institute of Physics, University of Jyväskylä, Finland — [2]Department of Quantum Engineering, University of Nagoya, Japan — [3]RIKEN, Tokyo, Japan — [4]University of Mainz, Germany

The combination of resonant laser ionization with a radiofrequency based ion guide extraction structure from a gas cell or hot cavity has proven to provide high purity ion beams at radioactive ion beam facilities. So far this technique has been predominantly applied in combination with a hot cavity atomizer, i.e. as the Laser Ion Source Trap (LIST) at ISOLDE. The adaptation of this technique at facilities using a buffer gas-filled stopping chamber like JYFL, LISOL, or BigRIPS to stop and extract nuclear reaction products should provide further benefits. The velocity spread of the atoms exiting the target chamber in a supersonic jet is greatly reduced allowing for in-jet high resolution studies of hyperfine structures as well as isotope shifts of the produced isotopes. An injection locked pulsed Ti:sapphire laser is an ideal system for studies in this environment as it provides both a narrow bandwidth of less than 20 MHz as well as high photon flux enabling efficient single pass frequency conversion to access the corresponding atomic ground state transition wavelengths for the first step of the resonant ionization process. A description of modifications made to the existing laser geometry will be given together with first spectroscopic results.

MS 6.15 Tue 16:30 Poster.IV

Hochpräzise Messungen der Kohlenstoff-Konzentration in Silicium mittels SSMS — •Bernhard Wiedemann[1], Michael Deveaux[1], Michael Petri[1], Hans Christian Alt[2], Maria Porrini[3], Maria Giovanna Pretto[3] und Roberto Scala[3] — [1]Institut für Kernphysik, Goethe-Universität, Max-von-Laue-Str. 1, D-60438 Frankfurt am Main — [2]University of Applied Sciences, D-80335 München — [3]MEMC Electronic Materials, I-39012 Merano

Die Kohlenstoff-Konzentration in hochreinem kristallinem Silicium wird mittels hochauflösender FTIR-Absorptionsspektroskopie bei tiefen Temperaturen (77K) gemessen. Multikristallines Silicium zeigt gegenüber monokristallinem Silicium eine stark veränderte Phononenstruktur, so dass für kleine Kohlenstoff-Konzentrationen die FTIR-Absorptionsspektroskopie nicht unmittelbar anwendbar ist. Dies wird erst durch eine Wärmebehandlung bei 1360°C ermöglicht, die zu einer Annäherung der Phononenstruktur von multikristallinem an die von einkristallinem Silicium führt. Hochpräzise Messungen mittels SSMS-Methode ergeben an mono- und an multikristallinen Silicium-Proben höhere Kohlenstoff-Konzentrationen als die FTIR-Absorptionsmethode, die materialabhängig zwischen 20ppb(atomar) und 80ppb(atomar) liegen. In ultrahochreinem multikristallinem Material sind oberhalb von 10ppb(atomar) unter gleichen Bedingungen keine Kohlenstoff-Konzentrationen mittels SSMS nachweisbar. Es werden experimentelle Vorgehensweisen beschrieben, die zu einer richtigen Bestimmung der Kohlenstoff-Konzentration im Bereich oberhalb einer Nachweisgrenze von 5ppb(atomar) notwendig sind.

MS 6.16 Tue 16:30 Poster.IV

Ion Beam Camera for Mass Spektrometers — •Ann-Kathrin Rink[1], Jens Ebert[1], Timo Dickel[1,2], Hans Geissel[1,2], Martin Petrick[1], Wolfgang Plass[1,2], and Christoph Scheidenberger[1,2] — [1]Justus-Liebig-Universität, Giessen — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

For the design and performance optimisation of a mass spectrometer the spatial distribution of the ion beam plays an important role. In particular, for a multiple-reflection time-of-flight mass spectrometer it is important to know how the spatial distribution of ions evolves with increasing number of turns. The ion beam camera has been developed, which allows to determine the ion distribution.

For detecting the ions two micro-channel-plates (MCP) in chevron configuration are used to generate conversion electrons and amplify the signal. The electrons are post-accelerated onto a phosphor screen. The fluorescence light is recorded by a CCD camera mounted in vacuum. The advantage of such a detector system is the fast method of position distribution determination, the simplicity of the required setup and electronics and the single ion sensitivity. Furthermore the MCP detectors can be tested for their spatial homogeneity.

The instrument was designed, constructed and successfully tested. The setup and results will be shown and discussed.

MS 6.17 Tue 16:30 Poster.IV

A monitoring and control system for the ISOLDE resonance laser ion source RILIS — •Ralf Rossel[1,2,3], Valentin Fedosseev[1], Bruce Marsh[1], Sebastian Rothe[1,2], and Klaus Wendt[2] — [1]Engineering Department, CERN, Geneva, Switzerland — [2]Institut für Physik, Johannes Gutenberg-Universität, Mainz, Germany — [3]Fachbereich Design Informatik Medien, Hochschule Rhein-Main, Wiesbaden, Germany

The RILIS laser ion source is one of the central components of the ISOLDE on-line isotope production facility. A record of about 2500 hours of on-line operation for the year 2011 shows the major importance and high demand for RILIS which provides radioactive ion beams of various elements with the highest efficiency and unmatched isobaric purity. The RILIS is currently operated 24/7 with the operators continuously present to control and possibly correct the crucial laser parameters, i.e. wavelength, output powers and beam positions of all individual lasers in use. Moreover, the operator acts as contact person for the ISOLDE user to inform about its current status. Deploying a widely automated, network-based monitoring and control software will not only enable manpower to devote their time to system improvement rather than supervision but also greatly improve health issues and work safety as stay in areas with increased levels of radiation exposition will be significantly reduced. The on-going software and hardware development covers the four key aspects: Machine protection, monitoring of beam parameters, automated correction and a RILIS status display for the users. The concept and the status of implementation are presented.

MS 7: Accelerator Mass Spectrometry and Applications I

Time: Thursday 10:30–12:30 Location: V57.06

Invited Talk MS 7.1 Thu 10:30 V57.06

Optimizing small AMS systems beyond C-14 — •Christof Vockenhuber — ETH Zurich, Zurich, Switzerland

Measurements of long-lived radionuclides are becoming more and more important in many fields of sciences. Accelerator Mass Spectrometry (AMS) is the most sensitive method for these investigations. In this respect, radiocarbon is one the most often used long-lived radionuclide. Its importance has grown as smaller, more compact and cheaper measurement devices have become available.

Other long-lived radionuclides such as ^{10}Be, ^{26}Al, ^{41}Ca, ^{129}I, ^{236}U and Pu isotopes are often still measured at larger facilities. However, developments in recent years have shown that these nuclides can be measured at small AMS facilities (with terminal voltages below 1 MV) at a level comparable to larger facilities. In some cases, the performance is even better allowing for higher sample throughput, higher precision and higher efficiencies.

In this presentation I will give an overview of recent developments of small AMS facilities with the focus on the activities at the Laboratory of Ion Beam Physics at ETH Zurich.

MS 7.2 Thu 11:00 V57.06

^{93}Zr measurements with Accelerator Mass Spectrometry using a passive absorber — •Karin Hain[1], Thomas Faestermann[1], Leticia Fimiani[1], Gunther Korschinek[1], Peter Ludwig[1], and Georg Rugel[1,2] — [1]Fakultät für Physik, Technische Universität München, D-85748, Garching, Germany — [2]Forschungszentrum Dresden-Rossendorf, D-01314, Dresden, Germany

First test measurements for the detection of the long-living fission product ^{93}Zr ($T_{1/2}$=1.5·10^{6}a) were performed at the Maier Leibnitz Laboratorium in Munich. For the suppression of the isobaric background due to ^{93}Nb, a passive absorber with a subsequent Time of Flight path and a multi-anode ionization chamber was used. From blank measurements a region of interest (ROI) for ^{93}Zr events could be calculated by linear interpolation between ^{92}Zr and ^{94}Zr events. The separation of this ROI from the background events at different experimental settings was compared. In this way Silicon Nitride foils with a total thickness of approximately 2.4 mg/cm^2 were determined as optimal passive absorber. An upper detection limit of ^{93}Zr/Zr=6·10^{-9} was obtained. In this talk, the method of isobar separation with the help of a passive absorber will be presented and the results of the measurements using a ZrO_2 blank sample will be discussed.

MS 7.3 Thu 11:15 V57.06

^{10}Be und ^{26}Al Messungen mit Niederenergie-AMS — •Johannes Lachner[1], Marcus Christl[1], Arnold Müller[1], Hans-Arno Synal[1], Mirjam Schaller[2] und Colin Maden[3] — [1]Labor für Ionenstrahlphysik, ETH Zürich — [2]Geodynamik, Universität Tübingen — [3]Institut für Geochemie und Petrologie, ETH Zürich

An der Niederenergie-AMS Anlage Tandy wurden Tests und Messungen der Radionuklide ^{10}Be und ^{26}Al durchgeführt.

Eine Vergleichsstudie einer trägerfreien Bestimmung des ^{10}Be/^{9}Be Verhältnisses mit Niederenergie-AMS und einer konventionellen Messung, in der das Verhältnis durch die Kombination aus AMS für ^{10}Be und ICP-MS für ^{9}Be ermittelt wurde, zeigte eine gute Übereinstimmung der beiden Methoden an natürlichen Proben. In einem ersten größeren Projekt wurde die neue trägerfreie Methode zur Untersuchung von marinen Sedimenten im Zeitbereich der magnetischen Feldumkehr vor 800.000 Jahren (Brunhes-Matuyama) angewandt.

Durch die Verwendung von He als Strippergas konnten auch für Al hohe Transmissionen für die Ladungszustände 1+,2+ und 3+ erreicht werden. Das macht auch eine Messung dieses Radionuklids attraktiv für die Niederenergie-AMS.

MS 7.4 Thu 11:30 V57.06

Herkunftsbestimmung von Innenraumschadstoffen mittels Beschleunigermassenspektrometrie — •Matthias Schindler[1], Wolfgang Kretschmer[1], Andreas Scharf[1], Alexander Stuhl[1], Karin Kritzler[1] und Ewald Hannappel[2] — [1]Physikallisches Institut (KORA), Uni Erlangen, Erwin-Rommel-Str. 1, 91058 Erlangen — [2]Institut für Biochemie, Emil-Fischer Zentrum, Fahrstraße 17, 91054 Erlangen

Mit Hilfe der ^{14}C-Methode ist es möglich, rezente und fossile Proben anhand ihres ^{14}C-Gehalts zu unterscheiden. Diese Methode eignet sich auch, um Umweltschadstoffe auf ihren Ursprung zu untersuchen. Umweltschadstoffe können sich durch ihre allergene und kancerogene Wirkung zeigen. Um die Quellen der Schadstoffe abzuschaffen, ist es nötig, ihren Ursprung zu bestimmen.

In dieser Arbeit wurde das Augenmerk auf Aldehyde und Ketone gelegt. Da diese gasförmigen Stoffe zum Messen in die flüssige oder feste Phase gebracht werden müssen, ist eine Derivatisierung nötig. Da bei Derivatisierungen in der Regel Fremdkohlenstoffe ohne ^{14}C eingebracht werden, ändert sich das Isotopenverhältnis $^{12}C/^{14}C$, was zu einem erhöhten Messfehler führt.

In dieser Arbeit wurden deshalb verschiedene Derivatisierungen getestet. Dabei wurden sowohl klassische wie auch moderne solventfreie Reaktionen als auch verschiedene Chromatographieverfahren (HPLC, GC und DC) getestet.

Es werden die Ergebnisse der verschiedenen Versuchsreihen, sowie erste Realdaten (biogen und anthropogen) vorgestellt.

MS 7.5 Thu 11:45 V57.06

Ergebnisse erster Messungen von CologneAMS für kosmogene Nuklide — •Stefan Heinze[1], Alfred Dewald[1], Martin Melles[2], Jan Jolie[1], Andreas Zilges[1], Michael Staubwasser[2], Ulrich Ratke[3,4], Jürgen Richter[5] und Friedhelm von Blankenburg[6] — [1]Institut für Kernphysik, Universität zu Köln — [2]Institut für Geologie und Mineralogie, Universität zu Köln — [3]Geographisches Institut, Universität zu Köln — [4]Universität Duisburg-Essen — [5]Institut für Ur- und Frühgeschichte, Universität zu Köln — [6]Deutsches GeoForschungsZentrum (GFZ), Potsdam

CologneAMS ist ein neues Zentrum für Beschleuniger-Massenspektro-

metrie (AMS) an der Universität zu Köln. Es wurde durch die DFG gefördert um die experimentelle Situation insbesondere für deutsche Wissenschaftler, welche AMS für ihre Arbeit einsetzen, zu verbessern. Die neue AMS-Anlage wurde von High-Voltage-Engeneering Europa (HVEE) gebaut und im bestehenden Beschleunigergebäude des Instituts für Kernphysik installiert. Spezielle Labore für die Probenaufbereitung wurden am Institut für Geologie und Mineralogie errichtet. In Zukunft wird es einen umfassenden Service für die Probenaufbereitung für externe Nutzer geben. Die AMS-Anlage ist für die Spektrometrie von Nukliden aller Massenbereiche wie z.B. 10Be, 14C, 26Al, 36Cl, 129I als auch schwere Ionen bis hin zu 239U and 244Pu designed. In diesem Report wird der Status von CologneAMS sowie die Ergebnisse der Performance-Tests als auch der ersten Messungen präsentiert.

MS 7.6 Thu 12:00 V57.06

Development of an ion source for volatile elements at DREAMS — •Stefan Pavetich, Shavkat Akhmadaliev, Silke Merchel, and Georg Rugel — Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Institute of Ion Beam Physics and Materials Research, Dresden, Germany

After successful measurements of ^{10}Be, ^{26}Al and ^{41}Ca [1] at DREAMS (DResden Accelerator Mass Spectrometry), extensive test measurements of ^{36}Cl started. Besides the challenge of separating the stable isobar ^{36}S, which at DREAMS is accomplished by post-stripping and a split-anode-ionization-chamber, the problem of ion source memory must be solved [2]. To characterize this effect we use ^{35}Cl/^{37}Cl samples of natural composition and ^{35}Cl-enriched samples with a ^{35}Cl/^{37}Cl-ratio > 100. Similar measurements at the French AMS facility ASTER [3] showed differences of 2-4% in the ^{35}Cl/^{37}Cl ratios of the highly enriched samples after 24 h of sputtering samples with natural isotopic ratios [3]. To minimize the long-term-memory effect, two modified designs of the original source (HVEE) were constructed at DREAMS. A more open geometry was used to improve the vacuum level, and parts of the target loading system were modified to allow the exchange of the individual cathode aperture with each target.

[1] G. Rugel, these proceedings.
[2] K.M. Wilcken et al. NIM B, 268 (2010) 748-751
[3] M. Arnold et al. The French accelerator mass spectrometry facility ASTER after 4 years: Status and recent developments on ^{36}Cl and ^{129}I, article submitted NIM B

MS 7.7 Thu 12:15 V57.06

Technical requirements for 14C analysis of airborne particulate matter — •Sönke Szidat[1], Yanlin Zhang[1,2], Peter Zotter[2], André Prévôt[2], and Lukas Wacker[3] — [1]Universität Bern, Departement für Chemie und Biochemie & Oeschger-Zentrum für Klima- und Klimafolgenforschung, Bern, Schweiz — [2]Paul Scherrer Institut (PSI), Villigen, Schweiz — [3]ETH Zürich, Labor für Ionenstrahlphysik, Zürich, Schweiz

Carbonaceous aerosols are a major fraction of airborne particulate matter. They contribute to climate and health effects of the total aerosol burden of the atmosphere by counteracting the current trend of global warming and inducing respiratory and cardiovascular diseases, respectively. In spite of this general importance, only little is known about composition and sources of carbonaceous aerosols. Analysis of the long-lived radioactive isotope 14C is a unique source apportionment tool, as it unambiguously separates fossil from non-fossil sources. However, 14C analysis of carbonaceous aerosols involves two major drawbacks. First, sample masses amount typically <0.05 mgC and sometimes even <0.01 mgC. Second, various fractions of the carbonaceous aerosol may originate from distinctly different sources, which makes subsampling of individual portions for 14C measurement necessary. This work presents strategies of optimized sample preparation and 14C analysis based on a MICADAS accelerator mass spectrometer with a gas ion source.

MS 8: Ion Trap and FT-ICR-MS, Molecules, Clusters and Reactions

Time: Thursday 14:00–16:15 Location: V57.06

Invited Talk MS 8.1 Thu 14:00 V57.06

Structure and dynamics of finite Fermi systems: simple metal clusters and fullerenes — •Bernd v. Issendorff — Physikalisches Institut, Universität Freiburg, 79104 Freiburg

Of all metallic systems sodium clusters are the ones which are closest to the ideal case of a finite free electron gas. Their electronic density of states is strongly discretized and shows a clear similarity with the electron shell structure of a spherical free electron system, although with some perturbation caused by the usually nonspherical outer shape and the internal atomic structure of the clusters. Recently we have shown by angular resolved photoelectron spectroscopy that in spherical sodium clusters these perturbed electron states still exhibit well defined angular momentum eigenstate character. Here similar results on strongly spheroidally deformed clusters will be presented, which show that even in such cases the angular momentum eigenstate character is preserved. In fact the deformation just lifts the degeneracy of the m_l-substates of a given l-state and causes a mixing between certain states which follows a strict selection rule. Fullerenes with their delocalized valence electron system are well suited for the study of electron dynamics due to their high stability. Time-resolved photoelectron spectroscopy has been applied to gas phase C_{60} anions of controlled temperature. The results show a strong temperature dependence of the relaxation time of the final (and slowest) process in the chain of relaxation processes of the excited excess electron, the $t_{1g} \rightarrow t_{1u}$ transition, which can be seen as a textbook example of the vibrational excitation dependence of a radiationless transition.

Invited Talk MS 8.2 Thu 14:30 V57.06

Light induced reactions (LIR) in a cold 22-pole ion trap — Oskar Asvany, Sandra Brünken, and •Stephan Schlemmer — I. Physikalisches Institut, Universität zu Köln

Ion molecule reactions play an important role in astrophysics and other plasma environments like planetary atmospheres. They are studied in a variable temperature 22-pole ion trap where the temperature dependence of the rate coefficient and thus related activation energies are determined. Reactions with competing product channels are of particular interest because the outcome often strongly depends on the internal states of the reaction partners. In the experiments described vibrational and/or rotational levels of the stored ions are excited by IR or FIR photons. The increase or decrease of the number of product ions monitored by mass spectrometry as a function of the excitation wavelength results in a very sensitive method of action spectroscopy of the parent ions. Examples include protonated hydrogen, H_3^+, the most abundant molecular ion in space, the very floppy CH_5^+ molecule or a radical like CH_2D^+. Experiments at low temperatures lead to simplified spectra and to significant changes in reactivity based on the population of particular states, an effect with significant consequences on the molecular composition of the interstellar medium.

MS 8.3 Thu 15:00 V57.06

Electrostatic ion beam traps: self-bunching, intrabeam scattering, and RF-bunching — •Michael Froese[1], Manfred Grieser[1], Oded Heber[2], Michael Lange[1], Felix Laux[1], Sebastian Menk[1], Roland Repnow[1], Yoni Toker[2], Robert von Hahn[1], Andreas Wolf[1], and Klaus Blaum[1] — [1]Max Planck Institute for Nuclear Physics, 69117 Heidelberg — [2]Weizmann Institute of Science, Rehovot 76100, Israel

The Cryogenic Trap for Fast ion beams (CTF) has been used to investigate the properties of ion bunches in electrostatic ion beam traps (EIBTs). The main ion loss mechanism in these traps (collisional detachment) has been made negligible via our high vacuum levels. For the self-bunching trapping mode achievable with EIBTs, the longitudinal ion bunch density distribution has been measured by photo-detaching aluminum dimer anions, which also revealed the presence of a DC ion beam component co-existing with the oscillating bunch. Stable coherent bunch observation in self-bunching mode was extended from 100 ms in room-temperature EIBTs to times as long as 12 s using N_2^+ and Al_2^- with kinetic energies of 6-7.1 keV. The decay of the bunch signal amplitude was observed to be intensity dependent. A model employing intrabeam scattering as well as the expansion of the bunch with time is found to well reproduce the data. This model was also found to reproduce the decay of the bunch signal when RF bunching was applied in agreement with the newly developed EIBT bunch dynamics. These

bunches were observed for 600 s placing correspondingly small upper limits on all other EIBT losses.

MS 8.4 Thu 15:15 V57.06

Electron auto-detachment of excited SF_6^- — •Sebastian Menk[1], Klaus Blaum[1], Swarup Das[2], Michael Froese[1], Michael Lange[1], Manas Mukherjee[2], Robert von Hahn[1], Dirk Schwalm[1,3], Robert von Hahn[1], and Andreas Wolf[1] — [1]MPI für Kernphysik, 69117 Heidelberg — [2]Raman Center for AMO Science, IACS, Kolkata 700 032 — [3]Weizmann Institute of Science, Rehovot, 76100, Israel

Electron auto-detachment of excited SF_6^- has been investigated using the Heidelberg cryogenic electrostatic ion beam trap (CTF), where ions can be confined as a beam at keV energies and a time-dependent decay signal is gained by detecting neutralized fragments which escape from the trapping region. The cryogenic conditions provide extremely high vacuum and accordingly low background rates. Hence, they offer the possibility to observe this decay, in principle, over minutes. For the initial auto-detachment stemming from the SF_6^- excitation in the ion source, we followed its rate until it naturally vanished at ∼100 ms after ion injection. This enabled us to observe for the first time its fall-off from the previously seen power-law behavior. By detailed modeling of the vibrational auto-detachment, this fall-off is found to reflect the detachment threshold and the rotational excitation, with the power-law separately representing the vibrational excitation in the ion source. Corresponding excitation temperatures could be inferred. Over the longer storage time scale uniquely accessible at the CTF, studies of the same process following laser excitation are in preparation.

MS 8.5 Thu 15:30 V57.06

Buffer-gas cooling in a linear radiofrequency quadrupole trap at the CTF — •Christian Breitenfeldt[1], Klaus Blaum[2], Mike Froese[2], Michael Lange[2], Gerrit Marx[1], Sebastian Menk[2], Birgit Schabinger[1], and Lutz Schweikhard[1] — [1]Institut für Physik, Ernst-Moritz-Arndt Univ., 17489 Greifswald, Germany — [2]Max-Plank-Institut für Kernphysik (MPIK), 69117 Heidelberg, Germany

The Cryogenic Trap for Fast ion beams (CTF) is an Electrostatic Ion Beam Trap (EIBT) setup investigating the decay of anions with complex multi-body internal structure at cryogenic temperatures, located at the MPIK in Heidelberg. Recent measurements showed a strong influence of the rotational and vibrational temperatures in the decay of SF_6^-. For more detailed studies using, e.g. laser excitation from well defined initial states, the injection of pre-cooled molecular ions and clusters into the CTF will be of great advantage. Hence, we plan to install a linear RadioFrequency Quadrupole (RFQ) trap to store the hot ions from the source and cool them via buffer gas before their injection into the EIBT. Internal pre-cooling of ions in this buffer-gas RFQ trap can be much faster than in the EIBT. In addition, the implementation of a linear RFQ trap will allow a more effective use of the ions produced by the source. As we typically employ microsecond long pulses, which are stored for several seconds, all other ions are currently lost. By the use of the linear RFQ trap, however, it will be possible to accumulate ions throughout most of the injection cycle, vastly improving the sensitivity and the number of different species accessible.

MS 8.6 Thu 15:45 V57.06

One- and two-pulse quadrupolar excitation schemes of the ion motion in a Penning trap investigated with FT-ICR detection — •Michael Heck[1], Klaus Blaum[1], R.Burcu Cakirli[1,2], Hendrik Golzke[1,3], Martin Kretzschmar[4], Gerrit Marx[5], Lutz Schweikhard[6], Stefan Stahl[7], and Marta Ubieto-Diaz[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Department of Physics, University of Istanbul, Istanbul, Turkey — [3]Karlsruher Institut für Technologie, Karlsruhe, Germany — [4]Institut für Physik, Johannes Gutenberg-Universität, 55099 Mainz, Germany — [5]Institute of Physics, Ernst-Moritz-Arndt-University Greifswald, 17487 Greifswald, Germany — [6]Universidad de Granada, 18071, Granada, Spain — [7]Stahl-Electronics, Kellerweg 23, 67582 Mettenheim, Germany

Penning traps are widely used as storage devices for charged particles in the fields of analytical and precision mass spectrometry. The coupling of the radial motional modes is achieved by using azimuthal quadrupolar radio frequency (rf) fields. In this work we studied the interconversion of radial modes by applying one- and two-pulse (Ramsey) quadrupolar rf-fields. Dipolar-detection of the Fourier transform ion cyclotron resonance (FT-ICR) signal at the modified cyclotron frequency has been studied as a function of the interaction parameters such as excitation frequency, amplitude and duration and is compared with the theoretical results.

MS 8.7 Thu 16:00 V57.06

Broad-band detection and mass comparison between lithium ions by FT-ICR MS — •Hendrik Golzke[1,2], Klaus Blaum[1], R. Burcu Cakirli[1,3], Michael Heck[1], Daniel Rodriguez[4], Lutz Schweikhard[5], Stefan Stahl[6], and Marta Ubieto-Diaz[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]Institut für Experimentelle Kernphysik, Karlsruher Institut für Technologie, Karlsruhe, Germany — [3]Department of Physics, University of Istanbul, Istanbul, Turkey — [4]Departamento de Física Atómica Molecular y Nuclear, Universidad de Granada, Granada, Spain — [5]Institute of Physics, Ernst-Moritz-Arndt-University Greifswald, Greifswald, Germany — [6]Stahl Electronics, Kellerweg 23, 67528 Mettenheim, Germany

Penning traps are widely used as storage devices for charged particles. With such a trap a mass-spectrometry system for the KArlsruhe TRItium Neutrino (KATRIN) experiment has been developed and characterized at the Max-Planck-Institute for Nuclear Physics in Heidelberg. A broad-band non-destructive Fourier Transform Ion Cyclotron Resonance (FT-ICR) method which is able to record simultaneously the eigenfrequencies of different stored particles over a wide range is used. In this talk the dipolar and quadrupolar detection technique and a recent mass comparison between $^6Li^+$ and $^7Li^+$ will be presented.

MS 9: Accelerator Mass Spectrometry and Applications II

Time: Friday 10:30–12:30 Location: V57.06

MS 9.1 Fri 10:30 V57.06

Helium Strippergas bei Radiocarbon AMS — •Martin Seiler, Sascha Maxeiner und Hans-Arno Synal — ETH Zürich, 8093 Zürich, Schweiz

Bei der Entwicklung von kleineren AMS-Systemen ist die Reduktion der Beschleunigerspannung ein entscheidender Faktor. Bei der Verwendung von Helium konnten bereits hohe Ladungsausbeuten im 1+ Zustand für Kohlenstoffionen bei Energien unterhalb von 200 keV gemessen werden. Diese Messungen wurden auf weitere Ladungszustände ausgeweitet und systematisch untersucht. Die Messungen an einer modifizierten Version des MICADAS erlaubten auch sehr geringe Flächendichten im Strippergas. Bei diesen Messungen liessen sich die Umladungsprozesse genauer analysieren und durch Wirkungsquerschnitte quantifizieren. Neben den Umladungsdaten werden auch die Ergebnisse durchgeführter ^{14}C-Messungen präsentiert und ein Ausblick auf weitere Entwicklungen gegeben.

MS 9.2 Fri 10:45 V57.06

Cosmogenic nuclides in meteorites — •Silke Merchel[1], Shavkat Akhmadaliev[1], Georg Rugel[1], Julia A. Cartwright[2], Ulrich Ott[2], Thomas Faestermann[3], Leticia Fimiani[3], Gunther Korschinek[3], and Peter Ludwig[3] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]MPI für Chemie, Mainz, Germany — [3]TU München, Garching, Germany

After successful installation of the **Dre**sden **A**ccelerator **M**ass **S**pectrometry (*DREAMS*) facility [1], determinations of the lighter radionuclides ^{10}Be, ^{26}Al, and ^{41}Ca are now easily attainable in Germany. Accompanied by data for the heavier radionuclides (i.e. ^{53}Mn and ^{60}Fe) that can be measured at the 14 MV tandem at Munich and stable nuclides such as $^{21,22}Ne$ and ^{38}Ar from noble gas mass spectrometry at MPI Mainz, complete and unique exposure histories of extraterrestrial material can be reconstructed.

For example, recent analyses of the 100^{th} Martian meteorite *Ksar Ghilane 002* [2] and four samples from the nickel-rich ataxite *Gebel Kamil* [3] show interesting features revealing amazing stories.

Ackn.: A. Bischoff and L. Folco are thanked for providing meteorite material and data for bulk chemical data.

Ref.: [1] G. Rugel et al., this meeting. [2] J. Llorca et al., submitted to *Meteorit. Planet. Sci.*. [3] L. Folco et al., *Science* 329 (2010) 804.

MS 9.3 Fri 11:00 V57.06

^{53}Mn and ^{60}Fe measurements in lunar samples by means of accelerator mass spectrometry (AMS) — •Leticia Fimiani[1], Thomas Faestermann[1], José Manuel Gómez Guzmán[1], Karin Hain[1], Gregory Herzog[2], Klaus Knie[3], Gunther Korschinek[1], Bret Ligon[2], Peter Ludwig[1], Jisun Park[2], and Georg Rugel[1,4] — [1]Fakultät für Physik, Technische Universität München, D-85748, Garching, Germany — [2]Department of Chemistry & Chemical Biology, Rutgers University, Piscataway, NJ 08854, United States — [3]GSI, Planckstrasse 1, D-64291, Darmstadt, Germany — [4]Forschungszentrum Dresden-Rossendorf, D-01314, Dresden, Germany

Cook et al, 40th LPSC 1129 (2009) reported a concentration of 14^{+9}_{-6} dpm ^{60}Fe/[kg Ni] ($T_{1/2}$=2.62·10^{6}a) in a surface sample of the Apollo 12 12025/8 drive tube. This value is higher than the one expected due to galactic or solar cosmic ray production and may suggest the deposition of supernova debris on the lunar surface about 2 Ma ago. In order to try to reproduce this result, new measurements were made in material from the same core and position. To widen the search for supernova debris, we also analyzed four near-surface samples of lunar drive tube 15008; and one each from the skim, scoop and under-boulder samples 69921/41/61 via AMS in the Maier Leibnitz Laboratorium in Garching, Germany. The measuring technique and the preliminary results will be discussed.

MS 9.4 Fri 11:15 V57.06

Bestimmung des Iod-129/Iod-127-Verhältnisses in Umweltproben mittels AMS — •Abdelouahed Daraoui[1], Mareike Schwinger[1], Monika Gorny[1], Beate Riebe[1], Christof Vockenhuber[2] und Hans-Arno Synal[2] — [1]Institut für Radioökologie und Strahlenschutz, Leibniz Universität Hannover, Deutschland — [2]Ion Beam Physics, ETH Zürich, Schweiz

Das langlebige Radionuklid I-129 (HWZ = 15,7 Ma) aus natürlichen und anthropogenen Quellen wird mit dem Niederschlag aus der Atmosphäre eingetragen, mit dem Oberflächenwasser transportiert, infiltriert das Grundwasser, wird in Böden akkumuliert und macht seinen Weg durch die Biosphäre. Dabei sind die ökologischen Wege des Iod, und speziell die Radioökologie des I-129 immer noch nur unvollständig bekannt. In einem vom BMU geförderten Forschungsvorhaben wird eine aktuelle Bestandaufnahme von I-129 in Deutschland vorgenommen. Ein wesentliches Ziel dieses Forschungsprojektes ist es, eine bundesweite Bilanzierung der vorhandenen Iod-Inventare in der Pedosphäre (Bodenproben) zu machen und eine Erfassung der atmosphärischen Einträge (Luft, Niederschläge) sowie des Austrags (Oberflächenwasser) von I-129 vorzunehmen. Der Gehalt an I-129 wird mittels AMS bestimmt. Mit der Anwendung von Helium-Gas als Stripper im Vergleich zum Argon-Gas, wird die Transmission bei der I-129-Messung erhöht (> 40 %). Für die Messung wird dabei der Ladungszustand 2+ verwendet. Hier wird über den aktuellen Stand des Forschungsvorhabens im Hinblick auf erste Ergebnisse für I-129 und I-129/I-127 Isotopenverhältnisse berichtet.

MS 9.5 Fri 11:30 V57.06

Investigations of the sputtering process in Middleton type ion sources — •Martin Martschini[1], Pontus Andersson[1], Oliver Forstner[1], Robin Golser[1], Dag Hanstorp[2], Anton O. Lindahl[2], and Johan Rohlén[2] — [1]University of Vienna, Faculty of Physics - Isotope Research, VERA Laboratory, Vienna, Austria — [2]University of Gothenburg, Gothenburg, Sweden

Since 1977, sputter ion sources of the Middleton type have been the main tool used to create stable, intense negative ion beams for injection into AMS machines. Nevertheless, the theory behind negative ion formation is not fully agreed upon. As part of the work in trying to unravel the mechanisms of hard sputtering in a cesium rich environment, we have resolved the spectrum of blue light emitted from the cathode region during high current output. A fiber coupled spectrometer was used to detect light in the wavelength region 200 to 1100 nm. The spectrum showed that the emitted light consists almost entirely of persistent lines from neutral cesium and no persistent lines from other species or charge states such as Cs^+ were observed.

In another experiment, the surprising effect of continuous wave laser light directed onto the cathode surface was studied. The laser light induced a significant change in oxygen, sulfur and chlorine negative ion production from a AgCl target. Independent from laser wavelength, ∼100 mW of laser light changed the elemental composition of the ion beam by up to one order of magnitude. This technique was successfully applied during a regular AMS measurement of ^{36}Cl at VERA. However, the physics behind the effect requires further investigations.

MS 9.6 Fri 11:45 V57.06

Aktinidenmessungen am ETH Kleinbeschleuniger TANDY — •Marcus Christl, Johannes Lachner, Christof Vockenhuber und Hans-Arno Synal — Labor für Ionenstrahlphysik, ETH Zürich

Dieser Beitrag soll einen umfassenden Überblick über die Aktinidenmessungen am Kleinbeschleuniger TANDY der ETH-Zürich geben. Es werden der Messaufbau, die Messparameter (z.B.: Sensitivität, Detektionseffizienz) sowie aktuelle Anwendungsbeispiele für Aktinidenmessungen präsentiert. Durch die Verwendung von Helium anstelle von Argon als stripper Gas konnte eine etwa dreimal höhere Transmission von Aktiniden (z.B. Uran: 12 - 15% mit Ar vgl. 35 - 42% mit He) durch den Beschleuniger erreicht werden. Die Anwendungsbeispiele umfassen eine Evaluierungsstudie zur Isotopenanalyse von Femtogramm bis Attogramm Mengen Pu in menschlichem Urin, sowie erste flächendeckende Messungen von anthropogenen U-236 in der Nordsee.

MS 9.7 Fri 12:00 V57.06

Status von AMS–Messungen an DREAMS — •Georg Rugel, Shavkat Akhmadaliev, Silke Merchel und Stefan Pavetich — Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstr. 400, 01328 Dresden

Am Helmholtz–Zentrum Dresden–Rossendorf wurde im Jahr 2010 die **Dre**sdner **A**ccelerator **M**ass **S**pectrometry (DREAMS) Anlage mit einem 6 MV Beschleuniger installiert. Für die Routinemessungen mit ^{10}Be und ^{26}Al wurden Vergleichsmessungen mit anderen Laboren vorgenommen. Ausserdem wurden die verwendeten *in–house–Standards* an sogenannte Primärstandards ankalibriert. Von Testmessungen an volatilen Elementen wie Chlor (^{36}Cl) berichtet S. Pavetich [1]. AMS–Messungen von ^{41}Ca/Ca–Verhältnissen wurden an Proben aus dem Rückbau nuklearer Anlagen und an Meteoritenproben (siehe [2]) vorgenommen. In Kooperation mit externen Partnern wurden bisher zahlreiche terrestrische Proben auf ^{10}Be und ^{26}Al untersucht.

Danksagung: Wir danken dem **V**erein für **K**ernverfahrens**t**echnik und **A**nalytik Rossendorf e. V. für die Bereitstellung von Probenmaterial.

Ref.: [1] S. Pavetich et al., diese Tagung.
[2] S. Merchel et al., diese Tagung.

MS 9.8 Fri 12:15 V57.06

A new TOF-BPM system for CologneAMS — •Claus Müller-Gatermann[1], Gheorghe Pascovici[1], Lukas Fink[1], Claus Feuerstein[1], Alfred Dewald[1], Stefan Heinze[1], Markus Schiffer[1], Michael Pfeiffer[2], Jan Jolie[2], Karl-Oskar Zell[2], and Friedhelm von Blanckenburg[3] — [1]CologneAMS, Universität zu Köln — [2]IKP, Universität zu Köln — [3]GFZ, Portsdam

At the center for accelerator mass spectrometry at the University of Cologne (CologneAMS) a complex beam detector consisting of a high resolution Beam Profile Monitor (BPM) and a Time of Flight (TOF) spectrometer with tracking capabilities was developed especially for the needs of the Cologne AMS facility. The complex beam detector assembly is designed to match the beam specifications of the 6MV Tandetron AMS setup and is fully compatible with its DAQ system. The TOF-BPM system was designed in a reconfigurable structure, namely: either a faster TOF subsystem with a smaller active area or a more complex TOF-BPM detector with beam tracking capabilities and with a larger active area of ∼16 sq.cm. The system was put in operation in Nov. 2011 and it was successfully tested with various ion beams of Be, C, Cl etc. The system aims for background suppression in case of the spectrometry of heavy ions, e.g. U, Cm, Am etc. Using additional thin degraders mounted in the first detector head, the system could also be used for tagging isobars, i.e. isobar separations. We will report on details of the design and on first experimental results obtained with accelerated beams (timing resolution, spatial resolution and tracking capabilities in conjunction with some auxiliary detectors)