

MS 6: Posters

Time: Tuesday 17:00–17:00

Location: C/Foyer

MS 6.1 Tue 17:00 C/Foyer

Bestimmung der stereochemischen Absolutkonfiguration mittels Koinzidenzspektroskopie — ●MARTIN PITZER¹, MAXIM KUNITSKI¹, GREGOR KASTIRKE¹, REINHARD DÖRNER¹, JÜRGEN STÖHNER², ROBERT BERGER³ und MARKUS SCHÖFFLER¹ — ¹Institut für Kernphysik, Goethe-Universität Frankfurt am Main — ²Fachbereich Chemie, Philipps-Universität Marburg — ³Zürcher Hochschule für Angewandte Wissenschaften

Zahlreiche pharmazeutische Wirkstoffe besitzen eine definierte Händigkeit, d.h. nur eines der beiden möglichen molekularen Spiegelbilder (Enantiomere) besitzt den erwünschten therapeutischen Nutzen. Aus diesem Grund besteht ein großes Interesse, den Enantiomerenüberschuss in einer Probe zu bestimmen. Bisherigen Methoden gelingt dies jedoch meist nur über den Umweg chemischer Reaktionen oder makroskopischer Effekte. Kürzlich wurde am Beispiel des Halogenmethans CHBrClF gezeigt, dass sich Koinzidenzspektroskopie dazu eignet, die absolute Händigkeit einzelner Moleküle zu bestimmen [1]. Dabei wurden die Moleküle vielfach ionisiert und die dreidimensionalen Impulsvektoren der Fragmente mittels COLTRIMS (Cold Target Recoil Ion Momentum Spectroscopy) [2] gemessen. Dieser Beitrag zeigt, dass die Effizienz der Methode deutlich gesteigert werden kann, wenn geeignete molekulare Aufbrüche zur Bestimmung der Händigkeit gefunden werden. Dies eröffnet neue Möglichkeiten für Grundlagenforschung und diagnostische Anwendung.

[1] M. Pitzer et al., *Science* Vol. 341, 1096-1100 (2013)[2] J. Ullrich et al., *Rep. Prog. Phys.* Vol. 66, 1463-1545 (2003)

MS 6.2 Tue 17:00 C/Foyer

Room-temperature ultrasensitive mass spectrometer via dynamical decoupling — ●NAN ZHAO¹ and ZHANG-QI YIN² — ¹Beijing Computational Science Research Center — ²The Center for Quantum Information, Institute for Interdisciplinary Information Sciences, Tsinghua University

We propose an ultrasensitive mass spectrometer based on a coupled quantum-bit-oscillator system. Under dynamical decoupling control of the quantum bit (qubit), the qubit coherence exhibits a comb structure in the time domain. The time-comb structure enables high-precision measurements of oscillator frequency, which can be used as an ultrasensitive mass spectrometer. We show that, in the ideal case, the sensitivity of the proposed mass spectrometer has better performance at higher temperature and scales with the temperature T as $\eta \sim T^{1/2}$. While taking into account qubit and oscillator decay, the optimal sensitivity reaches a universal value independent of environmental temperature T . The measurement sensitivity also shows an improved dependence on the control-pulse number N as $\eta \sim N^{3/2}$, in comparison with the $N^{1/2}$ scaling in previous magnetometry studies. With the present technology on solid-state spin qubit and high-quality optomechanical system, our proposal is feasible to realize an ultrasensitive room-temperature mass spectrometer.

MS 6.3 Tue 17:00 C/Foyer

MAC, Software for data acquisition and hardware control of time-of-flight mass-spectrometers — ●JULIAN BERGMANN¹, ALEXANDER PIKHTELEV², SAMUEL AYET SAN ANDRES³, TIMO DICKEL^{1,3}, JENS EBERT^{1,4}, HANS GEISSEL^{1,3}, CHRISTINE HORNUNG¹, JOHANNES LANG¹, WAYNE LIPPERT¹, CHRISTIAN LOTZE¹, WOLFGANG PLASS^{1,3}, ANN-KATHRIN RINK¹, and CHRISTOPH SCHEIDENBERGER^{1,3} — ¹JLU Gießen, Deutschland — ²Institute of Energy Problems of Chemical Physics, Russian Academy of Sciences, Moscow, Russia — ³GSI Darmstadt, Deutschland — ⁴TU Darmstadt, Deutschland

MAC, short for Mass Analyzer control, is a software written in C++ for reading and controlling ADCs and TDCs as well as implemented analyzing methods in connection to multiple-reflection time of flight mass spectrometers (MR-TOF-MS).

As it supports multiple hardware (currently 3 TDCs and 2 ADCs), it is very versatile and can be adapted to specific applications.

It supports long-term measurement, online peak detection and data auto-saving, online multi-turn calibration (as used in our MR-TOF-MS), synchronous multi-channel readout and integrated hardware control (e.g. timing and voltage control) for automation procedures. MAC is able to import and export into different common file formats used by external software, which allows easy and flexible postprocessing of

the data.

In the near future there will be automatic optimization of the MR-TOF-MS and online draft correction available.

MS 6.4 Tue 17:00 C/Foyer

An experimental setup for spectroscopic and reactivity studies of metal clusters with adsorbates in the gas phase — ●MARTIN TSCHURL¹, KATHRIN LANGE¹, DANIEL NEUWIRTH¹, JAN ECKHARD¹, BRADLEY VISSER², and UELI HEIZ¹ — ¹Lehrstuhl für Physikalische Chemie & Catalysis Research Center, Chemistry Department, Technische Universität München, Lichtenbergstraße 4, 85748 Garching bei München, Germany — ²Paul-Scherrer Institute, 5232 Villigen PSI, Switzerland

The elucidation of the properties of small metal clusters is inspired by their potential applicability in chemistry as powerful heterogeneous catalysts. Studies in the gas phase enable very well-defined experimental conditions, which allow for the easy modelling of the systems. The combination of reactivity studies and spectroscopy is particularly powerful for obtaining a complete picture of the system. While the latter enables the elucidation of the cluster geometries and their electronic state, the first allows for a determination of all reaction pathways as well as kinetic and thermodynamic properties of the reaction. In this work we present our apparatus, which enable the investigation of bare metal clusters and their adsorbate complexes by laser spectroscopic methods. In a second part of the apparatus these species are stored in a ring-electrode ion trap for the study of reaction kinetics under isothermal conditions. The abilities of our setup is demonstrated by the reactivity of small Ta-cluster cations.

MS 6.5 Tue 17:00 C/Foyer

Discharge ion source for systematic studies of a cryogenic stopping cell — ●FLORIAN GREINER¹, TIMO DICKEL^{1,2}, HANS GEISSEL^{1,2}, IVAN MISKUN³, WOLFGANG PLASS^{1,2}, MORITZ PASCAL REITER¹, ANN-KATHRIN RINK¹, and CHRISTOPH SCHEIDENBERGER^{1,2} — ¹JLU Giessen, Germany — ²GSI, Darmstadt, Germany — ³Tomsk Polytechnic University, Russia

At the FRS Ion Catcher facility ions are produced, selected and range-bunched in the FRS. In a gas-filled cryogenic stopping cell (CSC) the ions will be thermalized and extracted via a RF carped into an RF quadrupole and guided to further detectors.

An electrical discharge source was installed inside the CSC. The advantages of this source are a high current and a broad spectrum of ion masses (~ 4 u to 250 u). Due to the high current it is possible to investigate space charge effects and the wide range of masses are necessary to proof the mass-dependent operation of the RF carpet.

Systematic studies for different mass-over-charge ratios can be done by filtering the mass of interest with the RFQ mass filter. In this case one mass region or one mass line was cut with the extraction RFQ in a mass-selective mode. Even in the high-pressure region of the RFQ, good mass filter performance was achieved. It was shown that the RF carpet can transport ions with masses down to 60 u and that doubly-charged ions can be extracted.

Systematic studies of the mass and intensity dependence of the RF carpet will be presented.

MS 6.6 Tue 17:00 C/Foyer

Aufrüstung der Ionenoptik des RISIKO-Massenseparators zur präzisen Ionenstrahlimplantation — ●SVEN JUNCK, REINHARD HEINKE, TOM KIECK, PASCAL NAUBEREIT, FABIAN SCHNEIDER und KLAUS WENDT — Institut für Physik, Johannes Gutenberg-Universität Mainz

Das ECHO-Projekt exploriert ein neuartiges Verfahren zur Bestimmung der oberen Grenze der Masse des Elektronenneutrinus. Hierzu ist die kalorimetrische Charakterisierung des Elektroneneinfangs von Holmium-163 in einem metallischen, magnetischen Kalorimeter vorgesehen. Die isotonenreine und möglichst isobarenfreie Implantation der Ho-163-Atome soll am RISIKO-Massenseparator der Arbeitsgruppe LARISSA der JGU Mainz über Resonanzionisation und direkte Ionenstrahlimplantation durchgeführt werden. Über autoradiographische Untersuchungen lässt sich bestimmen, dass mit den aktuellen Strahlparametern des RISIKO-Massenseparators die geometrische Implantationseffizienz in den kleinflächigen Detektor nur sehr gering ist. Auf-

grund der stark eingeschränkten Verfügbarkeit des Ho-163 ist dies nicht tragbar und soll mittels einer speziellen Ionenoptikanordnung verbessert werden. Eine kurzbrennweitige Einzellinsenanordnung dient der Fokussierung des Ionenstrahls, ein Ablenker der Korrektur und gezielter Steuerung der Ionenstrahlablege. Dadurch ist eine Steigerung der geometrischen Effizienz von etwa 1% bis auf 50% zu erwarten.

MS 6.7 Tue 17:00 C/Foyer

Absolute mass measurement of oxygen-16 at THE-Trap — ●TOM SEGAL¹, TOMMI ERONEN^{1,2}, MARTIN HÖCKER¹, JOCHEN KETTER¹, MARC SCHUH¹, SEBASTIAN STREUBEL¹, ROBERT S. VAN DYCK JR.³, and KLAUS BLAUM¹ — ¹Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg — ²Department of Physics, University of Jyväskylä, P.O. Box 35, FI-40014 University of Jyväskylä, Finland — ³Department of Physics, University of Washington, Seattle, WA 98195-1560

THE-Trap is a Penning-trap mass spectrometer that aims to measure the atomic mass ratio of tritium to helium-3 with a relative uncertainty of $1 \cdot 10^{-11}$. To test the experiment's accuracy and precision, we measured the mass ratio of carbon-12 to oxygen-16, which is one of the most precisely determined mass ratios [1].

In 2014 we reported a measurement of this mass ratio with a relative uncertainty of $6.3 \cdot 10^{-11}$ [2], which was limited by systematic effects. Since then we upgraded the experiment, including the ion source, the vacuum system, and the amplifier for the detection of the induced image current. Due to the improved ion storage times we were able to characterize the amplitude dependent systematic shifts [3] and reach a significantly lower uncertainty that approaches the uncertainty of the literature value.

[1] R. S. Van Dyck Jr. *et al.*, *Int. J. Mass Spectrom.* (2006) 251:231–242

[2] S. Streubel *et al.*, *Appl. Phys. B* (2014) 114: 137–145

[3] J. Ketter *et al.*, *Int. J. Mass Spectrom.* (2014) 358: 1–16

MS 6.8 Tue 17:00 C/Foyer

Laser-Resonanzionisation und Spurennachweis von Dysprosium und Erbium für das ECHO-Projekt — ●DOMINIK STUDER, PATRICK DYRAUF, MICHAEL FRANZMANN, TINA GOTTWALD, TOM KIECK, TOBIAS KRON, FABIAN SCHNEIDER und KLAUS WENDT — Institut für Physik, Johannes Gutenberg-Universität Mainz

Zur Untersuchung optischer Spektren von Dysprosium und Erbium wie auch zum elementselektiven Nachweis in ausgewählten Proben wird in der LARISSA Arbeitsgruppe die Methode der Laserresonanzionisation eingesetzt. Die mehrstufige Anregung optischer Übergänge erfolgt durch die in der Arbeitsgruppe entwickelten hoch-repetierenden Titan:Saphir-Laser und bedient sich zusätzlich einer nachfolgenden Massenseparation im Quadrupol-Massenspektrometer MABU (Mainzer Atomic Beam Unit). Die Kenntnis der Spektren der Holmium-Nachbarelemente Dysprosium und Erbium ist insbesondere im Rahmen des ECHO-Projekts wünschenswert, bei dem die Masse des Elektron-Neutrinos durch Untersuchung des Elektroneneinfangprozesses am Radioisotop Ho-163 bestimmt werden soll. Da bei der dort verwendeten Holmiumprobe bereits geringfügige Verunreinigungen durch die Nachbarelemente Dysprosium und Erbium die Messung signifikant beeinträchtigen können, ist die Bereitstellung hocheffizienter elementselektiver Selektions- und Nachweisverfahren mittels Resonanzionisation zur Reinheitsprüfung der Ausgangsproben unabdingbar. Hierzu werden spektroskopische Untersuchungen und Effizienzmessungen vorgestellt.

MS 6.9 Tue 17:00 C/Foyer

An ion trap for in-trap nuclear decay-spectroscopy experiments* — ●CHRISTINE WEBER and PETER G. THIROLF — Fakultät für Physik, LMU - München, 85748 Garching

A novel type of ion-trap setup, dedicated for decay-spectroscopy experiments on stored ions, is presently being built at the MLLTRAP Penning trap system in Garching [1]. Being free from any background or scattering effects, a trapped ion resembles the ideal source, and hence will facilitate a direct, in-situ observation of its decay products. For this purpose, a customized 'detector trap' made from Si-strip detectors will provide the ion storage potential and allow for the detection of alpha particles, whereas emitted electrons can be very efficiently guided by the magnetic field of the trap's solenoid to an auxiliary detector.

Possible experiments are in-trap alpha-decay experiments of heavy actinides and conversion-electron spectroscopy. Moreover, a coincident detection of an alpha decay with electron detection allows for a reconstruction of the original positions of electron clouds initiated by

shake-off as well as from subsequent conversion decay. Via this decay length, the half-lives of states, *e.g.*, 2^+ , populated by alpha decay can be derived in a unique type of recoil-distance method. In this presentation, the design and characterization results of the detector systems are presented and possible physics experiments are highlighted.

[1] C. Weber *et al.*, *Int. J. of Mass Spectrometry* 349-350, 270 (2013).

* Supported by BMBF (06ML9148, 05P12WMFNE), DFG (HA 1101/14-1).

MS 6.10 Tue 17:00 C/Foyer

A setup for studying correlation effects in poly-anionic metal clusters by photoelectron spectroscopy — ●MADLEN MÜLLER¹, FRANKLIN MARTINEZ², GERRIT MARX¹, PATRICE OELSSNER², JOSEF TIGGESBÄUMKER², ROBERT WOLF³, KARL-HEINZ MEIWESE-BROER², and LUTZ SCHWEIKHARD¹ — ¹Ernst-Moritz-Arndt-Universität, Greifswald, Deutschland — ²Universität Rostock, Rostock, Deutschland — ³Max-Planck-Institut für Kernphysik, Heidelberg, Deutschland

Photoelectron spectroscopy (PES) experiments open insight into the electronic structure of atomic clusters. In the case of multiply negatively charged clusters, electron affinities and Coulomb barriers of these species can be probed by varying the wavelength of the photo-detachment laser. In addition, poly-anionic metal clusters serve as model systems for electron-correlation phenomena. A setup is presented, which combines a Paul trap, used for cluster-size selection and poly-anion production by electron attachment, with a magnetic-bottle time-of-flight electron spectrometer. As a first test PES on mono-anionic fullerenes with ultraviolet nanosecond laser pulses has been performed. In the future, the measurements will be extended to poly-anionic metal clusters in order to explore their electronic properties. As the appearance size of an anionic cluster increases with higher charge state, the resulting need of an increased mass resolving power will be satisfied by the implementation of a multi-reflection time-of-flight mass-separator/spectrometer. The project is funded by the Collaborative Research Center (SFB) 652.

MS 6.11 Tue 17:00 C/Foyer

A large-area 4k-pixel detector for position and energy resolving detection of neutral molecular fragments — ●D. SCHULZ¹, L. GAMER¹, A. FLEISCHMANN¹, L. GASTALDO¹, S. KEMPF¹, C. KRANTZ², O. NOVOTNY³, A. WOLF², and C. ENSS¹ — ¹KIP Heidelberg University. — ²MPI-K Heidelberg. — ³Columbia Astrophysics Laboratory, New York, USA.

To investigate reactions like dissociative recombination in a laboratory environment, the Max Planck Institute for Nuclear Physics in Heidelberg is commissioning the Cryogenic Storage Ring to prepare molecular ions in their rotational and vibrational ground state. The full kinematics of these processes can be resolved by a position and energy sensitive detection of the produced neutral molecular fragments.

We present the design of a new large-area multi-pixel detector using metallic magnetic calorimeters for position and energy sensitive detection of massive particles with kinetic energies of up to a few hundred keV. The detector encompasses an array of 4096 quadratic absorbers, each with a side length of 700 μm , amounting to a total detection area of about 20 cm^2 . Groups of four absorbers are thermally connected to one paramagnetic sensor, using different thermal links for pixel discrimination. A temperature change in the paramagnetic sensor leads to a change of magnetization in the sensor. Thanks to a novel readout scheme, all 4096 sensors can be read out using at total of 32 SQUIDS only.

MS 6.12 Tue 17:00 C/Foyer

Electron Capture Decay Studies of $142\text{Pm}60+$ Ions at GSI — ●FATMA CAGLA OZTURK^{1,2}, YURI A. LITVINOV¹, FRITZ BOSCH¹, and YESIM OKTEM² for the Two-Body Weak-Decay-Collaboration — ¹GSI, Darmstadt, Germany — ²Istanbul University, Istanbul, Turkey
GSI accelerator facility leads the scientific innovations on highly charged, heavy ions and search for the structure of atomic nucleus and the universe. Experimental Storage Ring (ESR) gives a great opportunity to study the periodic time modulations, claimed recently in the two-body orbital electron capture (EC) decay of $142\text{Pm}60+$ ion, with period near to 6 seconds by using a 245 MHz resonator cavity with a high sensitivity and time resolution.

This study presents the results obtained from the latest experiment on EC decays of $142\text{Pm}60+$ ions which are produced in FRS (FRagment Separator).

MS 6.13 Tue 17:00 C/Foyer

Measurement of the $^{144}\text{Sm}(\alpha,\gamma)^{148}\text{Gd}$ reaction cross section using Accelerator Mass Spectrometry — ●P. SCHOLZ, A. DEWALD, S. HEINZE, C. MÜLLER-GATERMANN, L. NETTERDON, and A. ZILGES — Institute for Nuclear Physics, University of Cologne

The extinct p process nuclide ^{146}Sm serves as an astrophysical and geochemical chronometer through measurements of isotopic anomalies of its α -decay daughter ^{142}Nd . Hence, it serves as a clock for determining the chronology of solar-system formation and planetary differentiation. For this, the half-life of ^{146}Sm as well as the initial ratio of ($^{144}\text{Sm}/^{146}\text{Sm}$) has to be known very precisely. The initial isotopic ratio after p -process nucleosynthesis is still very unclear. Determining cross sections of reactions producing ^{144}Sm or ^{146}Sm would put predictions leading to p -process abundances on a more reliable basis. Although the very challenging $^{144}\text{Sm}(\alpha,\gamma)^{148}\text{Gd}$ reaction was measured before [1], the results are heavily debated for methodical reasons. In a new approach, enriched ^{144}Sm -targets activated by high-intense α -particle beam will be analyzed for their content of ^{148}Gd via Accelerator Mass Spectrometry at CologneAMS. General ideas for isobaric suppression and normalization procedures as well as the different experimental setups will be presented.

Supported by the ULDETIS project within the UoC Excellence Initiative institutional strategy.

[1] E. Somorjai *et al.* *Astron. Astrophys.* **333**, 1112-1116, 1998.

MS 6.14 Tue 17:00 C/Foyer

Heavy ions at the DREAMS facility — ●STEFAN PAVETICH¹, KEITH FIFIELD², MICHAELA FRÖHLICH², MICHAEL HOTCHKIS³,

SILKE MERCHEL¹, GEORG RUGEL¹, ANTON WALLNER², and RENÉ ZIEGENRÜCKER¹ — ¹Helmholtz-Zentrum Dresden-Rossendorf, Germany — ²Australian National University, Australia — ³Australian Nuclear Science and Technology Organisation, Australia

The Dresden Accelerator Mass Spectrometry (DREAMS) facility is designed for the measurement of ^{10}Be , ^{26}Al , ^{36}Cl , ^{41}Ca and ^{129}I [1]. The actual goal is to extend the measurement capabilities to actinides. For this purpose, a time-of-flight system was designed and is currently under construction. The system is based on a 1.5 m long flight path and thin carbon foils with Micro Channel Plates as start and stop detectors. For an optimal tuning of the system with low currents, special beam diagnostic elements are planned. In order to characterize the existing system, first measurements of actinide samples have been performed in collaboration with the ANU and ANSTO, using an ionization chamber as detector. Measurements of Pu-isotopes in the 3+ and the 5+ charge state have been conducted.

[1] S. Akhmadaliev *et al.*, *NIMB* 294 (2013) 5.

MS 6.15 Tue 17:00 C/Foyer

Physical and chemical testing of graphite targets — ●MATTHIAS SCHINDLER, WOLFGANG KRETSCHMER, ALEXANDER STUHL, ALEXANDER TSCHÉKALINSKIJ und ANDREAS SCHARF — Uni Erlangen-Nürnberg, Physikalisches Inst. Abt. IV, 91058 Erlangen

One way to reduce the background in radiocarbon AMS is to reduce the content of hydrocarbons in the target material. Therefore we did physical tests like thermogravimetric analysis and molecular spectroscopy to determine the composition of graphite targets. Based on this results the reduction parameters were adjusted and cross checked.