MS 9: Mass Spectrometry Posters

Time: Wednesday 16:30–18:30 Location: Empore Lichthof

MS 9.1 Wed 16:30 Empore Lichthof

LIONTRAP - A High-Precision Mass Spectrometer — Sascha Rau[1], Sangeetha Sasidharan[1], Fabian Heisse[1], •Florian Köhler-Langes[1], Wolfgang Quint[2], Sven Sturm[1], and Klaus Blaum[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]GSI-Helmholtzzentrum für Schwerionenforschung Darmstadt, Germany

The precise knowledge of the atomic masses of various light nuclei, e.g. of the proton, deuteron, helion and triton, is of great importance for several tests of fundamental physics. For example, the mass of the proton is an important input parameter for hydrogen spectroscopy. Furthermore, an essential consistency check of the KATRIN experiment will require an ultra-precise measurement of the mass difference of triton and helion on a so far unrivalled level of precision of 30 meV/c^2. However, five sigma discrepancies between high-precision measurements of these light nuclear masses question their current literature values. They give strong motivation for a new and independent experiment, the LIONTRAP (Light ION TRAP) apparatus [1], aiming for relative uncertainties of a few parts per trillion. Several setup highlights like the doubly compensated Penning trap, an in-situ B_2 shim coil, various precisely tuned detection systems and an online-tunable trap tilt are presented on the poster. Furthermore, the proton mass campaign ($\delta m_p/m_p = 3 \cdot 10^{-11}$) [2], the current measurement campaign on deuteron and future plans on the helion and triton masses are explained. [1] F. Heiße et al., Phys. Rev. A 100, 022518 (2019) [2] F. Heiße et al., Phys. Rev. Lett. 119, 033001 (2017)

MS 9.2 Wed 16:30 Empore Lichthof

Latest results of the high-precision Penning-trap mass spectrometer Pentatrap — •M. Door[1], J. R. Crespo López-Urrutia[1], P. Filianin[1], W. Huang[1], C. M. König[1], K. Kromer[1], Y. Novikov[2], A. Rischka[1], R. X. Schüssler[1], Ch. Schweiger[1], S. Sturm[1], S. Ulmer[3], S. Eliseev[1], and K. Blaum[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]Peterburg Nuclear Physics Institute, Gatchina, Russia — [3]RIKEN, Fundamental Symmetries Laboratory, Saitama, Japan

The Penning-trap mass spectrometer Pentatrap [1] located at the Max-Planck-Institut für Kernphysik in Heidelberg recently proved its capabilities performing first mass-ratio measurements with a relative uncertainty in the 10^{-11} regime using highly charged ions of stable xenon isotopes [2]. Pentatrap will continue with mass measurements of dedicated nuclides which will allow, among others, to contribute to tests of special relativity, bound-state QED and neutrino-physics research. Achieving this level of precision requires using a cryogenic detection system with single ion sensitivity and phase sensitive image-current detection methods in combination with highly charged ions provided by external ion sources. A unique feature of Pentatrap is the suppression of systematic uncertainties by performing simultaneous measurements in two adjacent traps, which, according to our latest tests, are subject to equal fluctuations of the magnetic field.
[1] Repp, J. et al., Appl. Phys. B 107, 983 (2012)
[2] Rischka, A. et al., Phys. Rev. Lett., submitted (2020).

MS 9.3 Wed 16:30 Empore Lichthof

High-current caesium sputter ion source with planar ionizer for accelerator mass spectrometry — •Dimitar Yordanov[1], Hans Hofsäss[1], Georg Rugel[2], Shavkat Akhmadaliev[2], Johannes von Borany[2], Stefan Facsko[2], and Jenny Feige[3] — [1]University of Göttingen, Göttingen, Germany — [2]Institute of Ion Beam Physics and Material Research, Helmholz-Zentrum Dresden Rossendorf, Germany — [3]Technical University of Berlin, Berlin, Germany

A new caesium sputter negative ion source with planar ionizer for Accelerator Mass Spectrometry (AMS) is being built, regarding quantifying the ratios of long-lived cosmogenic radionuclides in micrometeorites. The focus of the ion source is on an optimal ion-optics design, together with a realization of new concepts for the construction and function of the ionizer, with the possibility of the precise in-situ adjustment of the ion-optical components, and optimization of the caesium ion beam and ion transport. In addition, the source is designed for operation with higher cathode voltage (up to 20 kV), which aims to increase the sputter rate of the sample, and in turn to increase the extracted negative current. Higher ion currents and better ion yields mean shorter measuring times, higher precision due to higher counting statistics and/or higher throughput of samples in an AMS runs.

The authors would like to thank the Federal Ministry of Education and Research of Germany for its financial support (project 05K2016), and the HZDR's Ion Beam Center for its essential contribution to the realization of this project.

MS 9.4 Wed 16:30 Empore Lichthof

Gas filled magnet for isobar separation for use with a 5.0 MV Tandetron AMS system — •Matthias Klein, Dirk Mous, Nicolae Podaru, and Guillermo Dominguez — High Voltage Engineering Europa B.V., Amersfoort, The Netherlands

AMS Measurements of 26Al are presently done using Al- extraction from the ion source at the 5.0 MV Tandetron AMS system at CEREGE, France. Extraction of AlO- increases the usable source output by about an order of magnitude, allowing a higher measurement throughput. However, isobaric 26Mg from MgO- injection forms an interference that must be reduced for avoiding overload of the final detector. For this purpose, a gas-filled magnet (GFM) will be connected to the existing high-energy spectrometer. It separates Al and Mg ions based on their different characteristics regarding average charge state and energy loss. The mass-energy product of the GFM is sufficiently high for supporting measurements of 36Cl and reduction of 36S as well. The magnet is followed directly by a multi-anode gas ionization chamber with a large entrance window, allowing as much as possible of the Al beam which has increased in size due to angular straggling by passage through the gas. In this contribution we will present the design and the specification details of this GFM detection system.

MS 9.5 Wed 16:30 Empore Lichthof

Design of an isotope separator for target production — •Dominik Studer[1], Rugard Dressler[2], Ulli Köster[3], Dorothea Schumann[2], and Klaus Wendt[1] — [1]JGU Mainz — [2]PSI Villigen — [3]ILL Grenoble

With the rising demand for isotopically pure targets for the study of specific nuclear reactions, the construction of a high-throughput isotope separator is foreseen within the SANDA project. Specifically the handling and purification of radioisotopes is mandatory and will be enabled by installation of the whole setup within a radiologically supervised working area in close contact to a hot lab. In the current project phase the design of the apparatus and establishment of a suitable commissioning site, located at PSI, is planned. The design will be derived from experiences with the RISIKO isotope separator at Mainz University, which has been successfully used for radioisotope purification and implantation, e.g. within the ECHo project. It features a hot-cavity laser ion source. The laser system is based upon tunable pulsed Ti:sapphire lasers with high repetition-rate. Ion extraction from the source region with about 30 to 50 kV, electrostatic beam focussing and separation with a conventional double focussing sector field magnet seem most suitable for the task. After passing the separation slit, the ion beam can be re-focused to well below mm size for implantation into detectors, collectors or targets with sub mm control and resolution. In this contribution we present the principles, capabilities and limitations of the RISIKO separator with regard to improvements which can be implemented in the new SANDA isotope separator.

MS 9.6 Wed 16:30 Empore Lichthof

Studies of lanthanide desorption for laser spectroscopic investigations of the heaviest actinides — •Sebastian Raeder[1,2], Michael Block[1,2,3], Premaditya Chhetri[1,2], Katherine Diaz[1], Francesca Giacoppo[1,2], Mustapha Laatiaoui[1,3], and Tobias Murböck[1,4] — [1]HI Mainz — [2]GSI, Darmstadt — [3]JGU Mainz — [4]TRIUMF, Vancouver

Laser spectroscopic investigations on the heaviest elements allow for a deeper understanding of fundamental atomic and nuclear properties. Due to relativistic effects on the atomic electron shell, the configuration of the atomic ground state , for instance, may differ for an element with respect to its lighter homologue, like in element 103, lawrencium. Only precise determination of the first ionization potential or a hyperfine structure measurement will help to unambiguously characterize the atomic ground state.

The sensitive RAdiation Detected Resonance Ionization Spectroscopy (RADRIS) technique allowed studying the element nobelium (No, Z=102), the only element with Z>100 for which atomic spectroscopy was performed to date. Crucially, the RADRIS technique relies on a fast and complete desorption of collected atoms from a catcher filament. Therefore an off-line mass spectrometry setup was developed to study the desorption behaviour of lutetium, the isolectronic homologue of Lr, from different filament materials as well as the competing process of surface ionization. In this contribution, first results of theses desorption studies will be presented along with the prospects of laser-spectroscopic investigations on lawrencium.

MS 9.7 Wed 16:30 Empore Lichthof

Mapping of elements in various environmental matrices with LA-ICP-QQQ-MS — •Dorian Zok, Anica Weller, and Georg Steinhauser — Leibniz University Hannover - Institute of Radioecology and Radiation Protection

We coupled our triple quadrupole ICP-mass spectrometer with a nanosecond laser ablation unit for the mapping of various elements. This coupling has the offers spatial resolution of the concentrations over the entire sample area. In this study, natural inorganic stomatolites as well as organic sample matrices such as carrot plants and shitake mushrooms were investigated. Stromatolites as biogenic rocks can be used as monitor for marine changes in a long time history. We analysed the deposition of nearly 20 main and rare earth elements in the thin layer structure of this rocks. We observed a correlation between some collectively deposited elements within the different layers. Mass ratios were semi-quantified by the NIST 610 glass standard and in the range of ppm for the rare earth elements. The carrot plants and shitake mushrooms were selected due to their importance in the human diet. Carrots were spiked with high activities of long-lived Tc-99, and mushrooms with Cs-137 and Ag-108m. Both matrices have effectively incooperated the anthropogenic radionuclides into their compartments due to the signals inside of the cross section. We successfully coupled both laser ablation and MS units and measured various kinds of matrices. In the future, we want to extend this to the build-in reaction cell of the mass spectrometer to improve the system for more difficult-to-measure elements/radionuclides.