MS 1: Präzisionsmassenspektrometrie, Ionenfallen, FT-IZR-MS, Moleküle, Cluster I

Zeit: Montag 10:45–12:45 Raum: VMP 8 R05

Hauptvortrag MS 1.1 Mo 10:45 VMP 8 R05

First direct mass measurements of nobelium isotopes — •Michael Block — GSI Helmholtzzentrum für Schwerionenforschung

The region of superheavy elements with their very high proton and neutron number is of particular interest to study the nuclear strucutre evolution at the extremes. The stability of these elements despite their large Coulomb repulsion is due to shell effects. The next spherical shell closures have been predicted by different theoretical models at proton numbers $Z = 114 - 126$ and neutron number $N = 184$. In recent years many new elements have been synthesized but the shell closure has not been reached. Thus, accurate experimental data such as masses of nuclei with $Z > 100$ are important to benchmark the theoretical models. The Penning trap mass spectrometer SHIPTRAP at GSI is presently the only device of its kind that can access trans-fermium elements for which no direct mass measurements have been performed so far. Recently, a major breakthrough has been achieved with the direct mass measurements of the nobelium isotopes $^{252-254}$No ($Z = 102$). Their production rates of less than one ion per second in the case of ^{252}No make these studies very challenging. The investigated isotopes are connected by α decay chains up to Ds (Z=110) and can be used for an accurate mass determination of these heavier nuclides that are not accesible for a direct mass measurement yet. Moreover, direct mass measurments can be used to pin down endpoints of decay chains that are not connected to the known territory and can contribute to the identification of superheavy elements.

Hauptvortrag MS 1.2 Mo 11:15 VMP 8 R05

Recent activities and results at the Penning-trap mass spectrometer ISOLTRAP — •M. Kowalska[1], G. Audi[2], D. Beck[3], Klaus Blaum[4], M. Breitenfeldt[5], Ch. Böhm[6], Ch. Borgmann[4], S. George[4], Frank Herfurth[3], A. Herlert[1], A. Kellerbauer[4], D. Lunney[2], E. Minaya-Ramirez[2], S. Naimi[2], D. Neidherr[6], M. Rosenbusch[5], S. Schwarz[7], Lutz Schweikhard[5], and U. Warring[4] — [1]CERN, Geneva, Switzerland — [2]Université de Paris Sud, Orsay, France — [3]GSI Darmstadt, Germany — [4]MPI für Kernphysik Heidelberg, Germany — [5]Ernst-Moritz-Arndt-Universität Greifswald, Germany — [6]Johannes Gutenberg-Universität Mainz, Germany — [7]NSCL MSU, East Lansing, USA

The Penning-trap mass spectrometer ISOLTRAP located at ISOLDE/CERN, with its high performance and ability to address nuclides with production yields of a few 100 ions/s and half-lives below 100 ms, is a powerful tool to investigate the nuclear binding energies. To its recent scientific highlights belong the masses of the proton halo candidate ^{17}Ne, ^{132,134}Sn relevant for the r process in nucleosynthesis and magicity of $N = 82$, and $^{223-229}$Rn revealing a unique behaviour of the double-mass differences proportional to the interaction of the last proton and neutron. 2008 gave also the first discovery of a nuclide in a Penning trap, namely ^{229}Rn. Technical activities included the C-cluster ion source, new excitation schemes in the purifying trap - to increase mass selectivity, studies of systematic effects - to lower the present residual systematic uncertainty, and tests of tape-station system for decay-spectroscopy studies on isobarically-purified samples.

MS 1.3 Mo 11:45 VMP 8 R05

Untersuchung alternativer Anregungsmethoden in der Präparationspenningfalle von ISOLTRAP — •M. Rosenbusch[1], Klaus Blaum[2], Ch. Böhm[3], Ch. Borgmann[2], M. Breitenfeldt[1], A. Herlert[4], M. Kowalska[4], S. Naimi[5], D. Neidherr[3] und Lutz Schweikhard[1] — [1]Ernst-Moritz-Arndt-Universität, Greifswald, Deutschland — [2]MPI für Kernphysik, Heidelberg, Deutschland — [3]Johannes Gutenberg-Universität, Mainz, Deutschland — [4]CERN, Genf, Schweiz — [5]Université Paris-Sud, Orsay, Frankreich

In vielen Bereichen der Physik werden Penningfallen zum Speichern und Präparieren von Ionen genutzt. Insbesondere ist das massenselektive Kühlen von Ionen mit hohem Auflösungsvermögen ($R = \frac{m}{\Delta m} = 10^5$) bei ISOLTRAP [1] eine wirksame Technik, um Ionen von isobaren Kontaminationen zu separieren. Dazu wird in der puffergasgefüllten Präparationsfalle eine azimutale Quadrupolanregung auf der Zyklotronfrequenz $\nu_c = q/m \cdot B$ der zu zentrierenden Ionen eingestrahlt, um die Magnetronbewegung der Ionen in die schnellere Zyklotronbewegung umzuwandeln und diese im Puffergas zu kühlen [2]. In diesem Beitrag werden Untersuchungen zu alternativen Anregungsformen vorgestellt, mit dem Ziel der Verkürzung der Kühlzeit und der Erhöhung des Auflösungsvermögens.

[1] M. Mukherjee *et al.*, Eur. Phys. J. A 35, 1-29(2008)
[2] G. Savard *et al.*, Phys. Lett. A 158, 247-252(1991)

MS 1.4 Mo 12:00 VMP 8 R05

Systematic studies at ISOLTRAP using the invariance theorem — •Christine Boehm[1], Klaus Blaum[2], Ch. Borgmann[2], M. Breitenfeldt[3], A. Herlert[4], M. Kowalska[4], D. Lunney[5], S. Naimi[5], Dennis Neidherr[1], M. Rosenbusch[3], and Lutz Schweikhard[3] — [1]Johannes Gutenberg University, Mainz, Germany — [2]MPI for Nuclear Physics, Heidelberg, Germany — [3]Ernst-Moritz-Arndt University, Greifswald, Germany — [4]CERN, Geneva, Switzerland — [5]University Paris-Sud 11, Orsay, France

ISOLTRAP is a Penning-trap mass spectrometer at the ISOLDE facility (CERN) where high-precision mass measurements on exotic nuclides are performed by determining their cyclotron frequency relative to that of a reference ion. For the obtained frequency ratios the present relative systematic uncertainty limit is $\delta m/m = 8 \cdot 10^{-9}$ based on systematic studies using carbon cluster ions [1]. To further investigate the origin of the systematic uncertainty, and hopefully to decrease the magnitude, the invariance theorem by Brown and Gabrielse [2] was used. All three motional ion eigenfrequencies, as well as the conversion frequency were measured and compared. The difference $\Delta\omega_c$ between the conversion frequency and the cyclotron frequency calculated from the invariance theorem was found to be mass independent and about 240 mHz. The knowledge of $\Delta\omega_c$ in turn allows to estimate trap imperfections. The results of this study will be presented. [1] A. Kellerbauer *et al.*, Eur. J. Phys. D 22, 53 (2003) [2] L. S. Brown, G. Gabrielse, Phys. Rev. A 25, 2423 (1982)

MS 1.5 Mo 12:15 VMP 8 R05

TRIGA-TRAP: A Penning trap mass spectrometer at the research reactor TRIGA Mainz — •Christian Smorra[1,2], Klaus Blaum[1,3], Michael Block[4], Klaus Eberhardt[2], Martin Eibach[5], Frank Herfurth[4], Jens Ketelaer[5], Jochen Ketter[5], Konstantin Knuth[5], Szilard Nagy[3], and Julia Repp[5] — [1]Physikalisches Institut, Universität Heidelberg, D-69120 Heidelberg — [2]Institut für Kernchemie, Universität Mainz, D-55128 Mainz — [3]Max-Planck-Institut für Kernphysik, D-69117 Heidelberg — [4]GSI Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt — [5]Institut für Physik, Universität Mainz, D-55128 Mainz

Nuclear masses represent the binding energies and, therefore, the sum of all interactions in the nucleus. They provide an important input parameter to nuclear structure models. Presently, a tremendous interest in masses of very exotic neutron-rich nuclides exists to support theoretical models for the nucleosynthesis via the rapid neutron capture process. The research reactor TRIGA Mainz provides access to a large variety of neutron-rich nuclides produced by thermal-neutron induced fission of an actinide target. The double-Penning trap mass spectrometer TRIGA-TRAP will perform high-precision mass measurements in this region of the nuclear chart as well as on actinides from uranium to californium [1]. It also serves as a test facility for the development of new techniques that will be implemented in future facilities like MATS at FAIR (GSI, Darmstadt). The layout of TRIGA-TRAP as well as recent mass measurements will be presented.

[1] J. Ketelaer et al., Nucl. Instr. Meth. A 594 (2008) 162.

MS 1.6 Mo 12:30 VMP 8 R05

Penning trap mass measurements and laser spectroscopy on neutron-rich fission products extracted from the research reactor TRIGA-Mainz — •Martin Eibach[1], Klaus Blaum[2], Klaus Eberhardt[5], Frank Herfurth[4], Jens Ketelaer[1], Jochen Ketter[1], Konstantin Knuth[1], Szilard Nagy[2], Wilfried Nörtershäuser[5], and Christian Smorra[3,5] — [1]Institut für Physik, Universität Mainz, D-55128 Mainz — [2]Max-Planck-Institut für Kernphysik, D-69117 Heidelberg — [3]Physikalisches Institut, Universität Heidelberg, D-69120 Heidelberg — [4]GSI Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt — [5]Institut für Kernchemie, Universität Mainz, D-55128 Mainz

TRIGA-SPEC is a setup for Penning trap mass spectrometry and collinear laser spectroscopy on short-lived neutron-rich nuclides located at the research reactor TRIGA-Mainz. It is dedicated to the determination of nuclear ground-state properties like masses and charge-radii[1]. The nuclides are produced by neutron-induced fission of an actinide target located in a target chamber near the reactor core. It is required to extract the nuclides fast and with high efficiency from the target chamber in order to make precision experiments on short-living species with half-lives in the order of 1s. To this end, they are flushed out with a helium gas jet containing carbon aerosols and transported through a skimmer region to an ECR ion source. The characterisation of the carbon aerosol generator and the verification of transported fission products will be presented.

[1] J. Ketelaer et al., Nucl. Instr. Meth. A 594 (2008) 162