MS 2: Precision Mass Spectrometry 1/ RIMS

Time: Monday 14:00–15:30 Location: DO24 1.205

Invited Talk MS 2.1 Mon 14:00 DO24 1.205

A Phase-Imaging Ion-Cyclotron-Resonance Technique for Mass Measurements of short-lived Nuclides — •Sergey Eliseev[1], Klaus Blaum[1], Michael Block[2], Stanislav Chenmarev[3], Andreas Doerr[1], Christian Droese[4], Tommi Eronen[1], Pavel Filjanin[3], Mikhail Goncharov[1], Martin Hoecker[1], Jochen Ketter[1], Enrique Minaya Ramirez[1], Dmitriy Nesterenko[3], Yuri Novikov[3], Lutz Schweikhard[4], and Vanessa Simon[1] — [1]Max-Planck Institute for Nuclear Physics, Germany — [2]GSI Helmholtzzentrum fuer Schwerionenforschung GmbH, Germany — [3]Petersburg Nuclear Physics Institute, Russia — [4]Institute for Physics, Ernst-Moritz-Arndt-University,Germany

A novel approach to mass measurements on the sub-ppb level even for short-lived nuclides with half-lives well below one second is presented. It is based on the projection of the radial ion motion in a Penning trap onto a position sensitive detector. Compared to the presently employed time-of-flight ion-cyclotron-resonance technique, the novel approach is 25-times faster and provides a 40-fold gain in resolving power. With the new technique low-lying isomeric states with excitation energy on the 10-keV level can be separated from the ground state. Moreover, the new technique possesses a substantially higher sensitivity since just two ions are sufficient to determine the ion cyclotron frequency. A measurement of the mass difference of singly charged ions of 132Xe and 131Xe with an uncertainty of 25 eV has demonstrated the great potential of the new approach.

MS 2.2 Mon 14:30 DO24 1.205

Progress with the PENTATRAP mass spectrometer — Hendrik Bekker[1], •Christine Böhm[1,2], José Crespo López-Urrutia[1], Andreas Dörr[1], Sergey Eliseev[1], Mikhail Goncharov[1], Yuri Novikov[3], Julia Repp[1], Alexander Rischka[1], Christian Roux[1], Sven Sturm[1], and Klaus Blaum[1] — [1]Max-Planck-Institut für Kernphysik, 69117 Heidelberg, Germany — [2]ExtreMe Matter Institute EMMI, Helmholtz Gemeinschaft, 64291 Darmstadt, Germany — [3]PNPI, Gatchina, 188300 St. Petersburg, Russia

The five-trap mass spectrometer PENTATRAP has been constructed and is currently being characterized at the Max-Planck-Institut für Kernphysik, Heidelberg. It aims for high-precision mass ratio measurements with a relative mass uncertainty of a few 10^{-12}. Long-lived and stable, highly charged nuclides with masses up to uranium will be addressed to perform e.g. stringent tests of quantum electrodynamics and neutrino oriented mass measurements. The main part of the experiment is a stack of five cylindrical cryogenic Penning traps. An ultra-stable voltage source is required to supply the Penning trap electrodes with appropriate and stable potentials. Therefore, an elaborated source was developed and built at MPIK. Recently, first ions have been successfully trapped. Details about the progress of the installation, especially the status of the voltage source and first ion signals will be presented in the talk.

MS 2.3 Mon 14:45 DO24 1.205

High-precision mass measurements of transuranium nuclides at TRIGA-TRAP — •M. Eibach[1,2,3], T. Beyer[2,3], K. Blaum[3], M. Block[4], Ch. E. Düllmann[1,4,5], K. Eberhardt[1,5], J. Grund[1], Sz. Nagy[3,4], W. Nörtershäuser[1,4,6], D. Renisch[1], F. Schneider[1], and C. Smorra[3,7] — [1]Johannes Gutenberg-Universität, Mainz — [2]Ruprecht-Karls-Universität, Heidelberg — [3]Max-Planck-Institut für Kernphysik, Heidelberg — [4]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [5]Helmholtz-Institut Mainz, Mainz — [6]Technische Universität Darmstadt, Darmstadt — [7]RIKEN Advanced Science Institute, Wako, Japan

Reflecting the sum of all interactions inside a nucleus, its mass is an important characterizing property. Precisely known nuclear masses are used to benchmark and improve nuclear mass models and to probe the nuclear structure. Penning-trap mass spectrometers such as TRIGA-TRAP are well-suited to provide such data with highest precision. At TRIGA-TRAP, the nuclides of interest are either produced by thermal neutron-induced fission of, e.g., ^{235}U at the research reactor TRIGA Mainz or ionized off-line by a non-resonant laser ablation ion source. The latter was recently upgraded with a miniature radio-frequency quadrupole device resulting in an efficiency gain of more than an order of magnitude enabling for the first time direct mass measurements of long-lived transuranium nuclides. In this contribution the mass measurement results on ^{241,243}Am, ^{244}Pu, and ^{249}Cf will be presented. Their impact on nuclear structure studies as well as their implementation into the Atomic-Mass Evaluation will be discussed.

MS 2.4 Mon 15:00 DO24 1.205

Die hochselektive Ionenquelle LIST und darüber hinaus — •Sven Richter[1], Klaus Blaum[2], Daniel Fink[3], Sebastian Rothe[3], Bruce Marsh[3], Valentin Fedosseev[3] und Klaus Wendt[1] — [1]Institut für Physik, Universität Mainz — [2]MPI für Kernphysik, Heidelberg — [3]CERN, Genève

Für Grundlagenforschung und wichtige Präzisionsmessungen an exotischen Nukliden, wie sie nur an modernen On-line Isotopengeneratoren wie ISOLDE am CERN durchgeführt werden können, sind hochselektive Ionenquellen eine der entscheidenden Voraussetzungen. Da ein Isotopenseparator prinzipiell keine isobaren Kontaminationen eliminieren kann, wurde als Verfeinerung der nur weitgehend elementselektiven Laserresonanzionisation die Laserionenquelle Ion Source & Trap (LIST) entwickelt und erfolgreich in den on-line Betrieb aufgenommen. Sie gewährleistet vollständige Isobarenunterdrückung, wodurch Messungen an Poloniumisotopen möglich wurden, die bisher durch isobares Francium verhindert wurden.

Spezielle Effekte, die während des on-line Betriebs aufgetreten sind, wie eine eingeschränkte Isobarenunterdrückung für einige wenige Isotope, sowie andererseits der unerwartete Nachweis von extrem kurzlebigen Nukliden, wurden beobachtet. Der Vortrag schildert hier die Ursachenforschung und macht Ansätze das System besser kontrollierbar zu machen. Der aktuelle Stand daraus abgeleiteter weiterer Entwicklungen zur Selektivitäts- und Effizienzsteigerung der Laserionisation wird vorgestellt.

MS 2.5 Mon 15:15 DO24 1.205

Difference-frequency generation with pulsed Titanium:sapphire lasers and sodium spectroscopy — •Julia Marín Sáez, Pascal Naubereit, Amin Hakimi, Tobias Kron, Fabian Schneider, and Klaus Wendt — Institut für Physik, Universität Mainz

Tunable laser emission with wavelengths in the green to yellow spectral range of 550 to 600 nm is easily achieved with conventional dye lasers, while it is a challenge for state-of-the-art solid-state Titanium:sapphire lasers emitting in the range of 680 to 1000 nm. In the workgroup Larissa at Mainz University narrow bandwidth, high-repetition rate pulsed Ti:sapphire lasers are developed and used for atomic spectroscopy, ultra trace analysis and application at on-line radioisotope production plants like ISOLDE/CERN. For enhancing the universality of these laser systems the expansion to this wavelength range is aimed for. Therefor frequency mixing of the radiation from a Ti:sapphire laser, operating in the fundamental infrared range, and from a frequency doubled Ti:sapphire in the blue range was carried out by means of difference-frequency generation in a non-linear crystal, obtaining the green-yellow-orange visible spectral range. To demonstrate its performance two- and three-step resonant ionization was tested on atomic sodium. The excitation schemes have the well-known 589 nm sodium doublet as first transition. Step-wise resonance ionization up to excitation of Rydberg states with even and/or odd parity are studied and presented.