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.