MS 2: Präzisionsmassenspektrometrie, Ionenfallen, FT-IZR-MS, Moleküle, Cluster II

Zeit: Montag 14:00–16:00 Raum: VMP 8 R05

Hauptvortrag MS 2.1 Mo 14:00 VMP 8 R05

PENTATRAP: A precision Penning trap mass spectrometer for highly-charged ions — •Sergey Eliseev[1], Jose Crespo López-Urrutia[1], Christoph Diehl[1], Sebastian George[1,2], Jens Ketelaer[3], Szilard Nagy[3], Yuri Novikov[4], David Pinegar[1], Wolfgang Quint[5], Julia Repp[1,2], Christian Roux[1,2], Andreas Rosa[2], Stefan Ulmer[3,5], and Klaus Blaum[1] — [1]Max-Planck-Institut für Kernphysik, D-69117 Heidelberg — [2]Ruprecht Karls Universität Heidelberg, D-69120 Heidelberg — [3]Johannes Gutenberg-Universität, Institut für Physik, D-55128 Mainz — [4]St. Petersburg Nucl. Phys. Inst., 188300 Gatchina, Russia — [5]Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt

A novel cryogenic Penning trap setup called PENTATRAP is under construction at the Max-Planck-Institut für Kernphysik, Heidelberg. It aims for high-precision mass measurements on highly-charged stable and long-lived single ions related to tests of fundamental symmetries and constants. In order to reach the needed accuracy of 10^{-11} for medium-heavy nuclides a monitoring of the magnetic field in real time in combination with the dip detection technique performed on highly-charged ions will be implemented. The apparatus is planned to be coupled to the EBIT at MPI-K and later to the HITRAP facility at GSI. The design studies of the project will be presented.

MS 2.2 Mo 14:30 VMP 8 R05

Penning trap setup and detection principle at the PENTATRAP project. — •Julia Repp, Sergey Eliseev, Sebastian George, Andreas Rosa, Christian Roux, and Klaus Blaum — Max-Planck-Institut für Kernphysik, D-69117 Heidelberg

PENTATRAP constructed at the Max-Planck-Institute of nuclear physics in Heidelberg is a unique Penning trap experiment, since a stack of five cylindrical Penning traps will be used for high-precision mass measurements. The ions of interest will be highly charged ions delivered either from an EBIT in Heidelberg or from the HITRAP facility at GSI. In the on-line apparatus the Penning traps will be located in an ultra high vacuum inside a copper chamber. This chamber will be situated in liquid helium inside a superconducting cryogenic magnet. The trap setup itself consists of two monitor traps for a continuous B-field investigation, two preparation traps enabling a fast ion exchange and a precision trap where the actual mass measurement is carried out via a non-destructive image current detection technique. To perform the individual measurements, some trap electrodes will be connected to tank circuits which consist of a high-Q inductor followed by a low-noise amplifier with high input impedance.

In this talk, the importance of the five Penning taps to gain highest precision will be discussed. Moreover, further design developments of the electronics as well as the trap and trap chamber manufactoring progress will be presented.

MS 2.3 Mo 14:45 VMP 8 R05

Preparation of a tritium Q-value measurement in a double Penning trap — •Christoph Diehl[1,2], David Pinegar[1], Robert Van Dyck Jr.[3], Christoph Orth[1,2], and Klaus Blaum[1,2] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Physikalisches Institut, Ruprecht-Karls-Universität, 69120 Heidelberg, Germany — [3]Department of Physics, University of Washington, Seattle, WA 98195-1560, USA

A precise determination of the Q-value of tritium (^{3}H) is of relevance for the determination of the electron anti-neutrino mass as aspired by the Karlsruhe Tritium Neutrino Experiment (KATRIN). In our double Penning trap mass spectrometer we aim to measure the mass ratio of ^{3}H and its β-decay product ^{3}He to an accuracy of 10^{-11}, which would determine the Q-value to an accuracy of 30 meV. The spectrometer we utilize is an enhanced version of the University of Washington Penning trap mass spectrometer (UW-PTMS)[1] and was recently transfered from Seattle to Heidelberg, where it is set up at the moment as the MPIK/UW-PTMS. We will present the necessary preparation work at the Max-Planck-Institut für Kernphysik. This includes major reconstructions of the building as well as studies and control of environmental parameters in the laboratory, like temperature and magnetic field.

[1] D. B. Pinegar, S. L. Zafonte, R. S. Van Dyck Jr., Hyperf. Int. 174, 47 (2007)

MS 2.4 Mo 15:00 VMP 8 R05

Broad-band FT-ICR detection at the Penning trap mass spectrometer TRIGA-TRAP — •Konstantin Knuth[1], Klaus Blaum[2,3], Michael Block[4], Klaus Eberhardt[5], Martin Eibach[1], Frank Herfurth[4], Jens Ketelaer[1], Jochen Ketter[1], Szilard Nagy[2], Julia Repp[1,2], Christian Smorra[3,5], Sven Sturm[1], and Stefan Ulmer[1,3] — [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, D-64291 Darmstadt — [5]Institut für Kernchemie, Universität Mainz, D-55128 Mainz

The double Penning trap mass spectrometer TRIGA-TRAP will perform high-precision mass measurements on exotic neutron-rich nuclides, which are produced via neutron-induced fission of actinide targets at the research reactor TRIGA Mainz. In order to determine which ion species are present in the ion bunch delivered to the Penning trap system, a non-destructive ion detection technique will be implemented in the cylindrical purification trap. This so called broad-band Fourier transform ion cyclotron resonance (FT-ICR) detection technique is based on the detection of image currents, induced by the ions in the trap electrodes. To this end, a new cryogenic low-noise broad-band amplifier is being designed and tested. With this system the identification of contaminations will be possible without the need to eject ions from the trap as usually done at other facilities. The setup as well as its present status will be presented.

MS 2.5 Mo 15:15 VMP 8 R05

Status der MATS Facility — •Gerrit Marx[1], Lutz Schweikhard[1], Klaus Blaum[2], Michael Block[3], Christopher Geppert[4], Frank Herfurth[3], A. Herlert[5], Wilfried Noerteshaeuser[4], W. Plass[6], Lutz Schweikhard[1], Peter Thirolf[7] und die MATS collaboration[3] — [1]Institut für Physik, Ernst-Moritz-Arndt-Universität, 17487 Greifswald — [2]MPI für Kernphysik, 69117 Heidelberg — [3]GSI, 64291 Darmstadt — [4]Johannes-Guthenberg-Universität, 55099 Mainz — [5]CERN, CH-1211 Geneva 23 — [6]Justus-Liebig-Universität, 35390 Giessen — [7]Ludwig-Maximilians-Universität, 80539 München

Die Masse, bzw. die Kernbindungsenergie, ist eindeutig und charakteristisch für jeden einzelnen Kern und ist das Resultat der starken und der elektromagnetischen Kraft im Kern. Präzise Massenmessungen und der damit mögliche präzise Vergleich mit kerntheoretischen Modellen erlaubt die Verfeinerung dieser Modelle. Die Untersuchung lokaler Eigenschaften wie Deformationen oder die Bindungsenergie der letzten Nukleonen fordern Massenmessungen mit einer relativen Genauigkeit von bis zu 10^{-8}. Die entscheidenden Tests sind nur an besonders exotischen Kernen möglich, wie sie am geplanten Super FRS zur Verfügung stehen werden. Die MATS Facility (Precision Measurement of very short-lived nuclei using an Advanced Trapping System for highly charged Ions) an FAIR besteht aus der Kombination eines RFQ Buncher, einer EBIT, eines MR-ToF und verschiedenen Pennigfallen. In diesem Beitrag wird der Status des Experiments vorgestellt.

MS 2.6 Mo 15:30 VMP 8 R05

Status des WITCH Experimentes — •Marcus Beck[1], Peter Friedag[1], Jonas Mader[1], Christian Weinheimer[1], Nausikaa Geeraert[2], Nathal Severijns[2], Michael Tandecki[2], Emil Traykov[2], Simon van Gorp[2], Frederik Wauters[2], Alexander Herlert[3] und die ISOLDE Kollaboration[3] — [1]Institut für Kernphysik, WWU Münster, Wilhelm-Klemm Str. 9, 48149 Münster, Deutschland — [2]Instituut voor Kern- en Stralingsfysica, K.U.Leuven, Celestijnenlaan 200D, B-3001 Leuven, Belgien — [3]CERN, CH-1211 Geneve 23, Schweiz

Das WITCH Experiment misst das Rückstoßspektrum der Tochterionen nach Kern-Betazerfall unter Verwendung von Penningfallen als Quelle und eines Retardierungsspektrometers zur Energieanalyse. Aus dem Rückstoßspektrum soll die Beta-Neutrino Winkelkorrelation mit hoher Genauigkeit (¡0,5%) bestimmt werden. Ziel ist dabei die Suche nach exotische Wechselwirkungen jenseits des Standardmodelles.

In 2008 und 2009 wurden zahlreiche Verbesserungen am experimentelle Aufbau vorgenommen sowie Simulationen zu Transmission und systematischen Effekten durchgeführt. In diesem Vortrag werden wir den Stand des Experimentes, der Simulationen und der Auswertung bestehender Meßdaten vorstellen, sowie einen Überblick der Planung für 2009 und 2010 geben. Diese soll zu einer präzisen Messung des Rückstoßspektrums und der Bestimmung wesentlicher systematischer Effekte führen.

Dieses Projekt wird durch das BMBF unter dem Kennzeichen 06MS270 gefördert.

MS 2.7 Mo 15:45 VMP 8 R05

Recent results from the Penning trap mass spectrometer JYFLTRAP — •Christine Weber, Viki-Veikko Elomaa, Tommi Eronen, Jani Hakala, Ari Jokinen, Anu Kankainen, Saidur Rahaman, Juho Rissanen, and Juha Äystö — Department of Physics, P.O. Box 35 (YFL), FI-40014 University of Jyväskylä, Finland

Accurate mass determination employing Penning ion traps has gained increasing importance after the installation of several new on-line facilities at accelerator labs. These setups combine unique production possibilities for rare isotopes with elaborate ion-capture and manipulation techniques. Since the final commissioning of the JYFLTRAP setup at the IGISOL facility in Jyväskylä, the masses of more than 200 short-lived nuclides have been measured. Their knowledge applies to studies on nuclear structure, the modeling of nucleosynthesis processes, tests of the conserved vector current (CVC) hypothesis and the unitarity of the CKM matrix, and furthermore, can help to assist in ongoing searches of neutrinoless double-beta decays. This presentation will focus on recent highlights studied at JYFLTRAP.