MS 2: New Methods, Technical Development I

Time: Monday 16:45–18:15 Location: HS 2 Chemie

Invited Talk MS 2.1 Mon 16:45 HS 2 Chemie

Non destructive mass and lifetime measurement of unstable nuclear states in heavy ion storage rings — •Shahab Sanjari — GSI Darmstadt

Storage rings provide a unique experimental environment for non-destructive measurements of the mass and lifetimes of unstable nuclei and/or their isomeric states. With their high resolution, cavity-based Schottky detectors provide the speed and sensitivity required for such measurements. In order to increase the measurement accuracy, the velocity spread of the particles must be addressed. In the past, the electron cooler was used for this purpose. However, since the cooling time is on the order of seconds, efforts have been made to perform measurements of shorter-lived states by tuning the lattice of the storage ring to the isochronous ion-optical mode. During the last beam times, the isochronous mode was successfully used in combination with sensitive and fast non-destructive Schottky detectors (S+IMS method), thus combining the measurement of short lifetimes with high frequency resolution. In order to further improve the accuracy of mass measurements using non-destructive Schottky cavities, the effect of velocity outside the isochronous window needs to be addressed. For this purpose, a novel position sensitive detector structure was simulated, designed and constructed at GSI for use in the R3 storage ring at RIKEN. In this work we describe the successful application of the new combined Schottky and isochronous mass (and lifetime) spectroscopy (S+IMS) method. The experimental setup, used detectors and methods are described and future perspectives are discussed.

MS 2.2 Mon 17:15 HS 2 Chemie

Setup for Technical Development of Resonance Ionization Spectroscopy in Buffer Gases — •Tim van de Vendel[1,2], Michael Block[2,3,4], Julia Even[1], and Sebastian Raeder[2,4] — [1]University of Groningen, The Netherlands — [2]GSI Helmholtzzentrum für Schwerionenforschung, Germany — [3]Johannes Gutenberg University, Mainz, Germany — [4]Helmholtz-Institut Mainz, Germany

A new offline development setup is being established in the laser spectroscopy group of the Superheavy Physics-department at GSI. While the existing RADRIS [1] and JetRIS [2] setups provide efficient, high-precision online measurements, they offer limited flexibility for off-line development studies.

This new setup solves this problem by constructing a novel three-cell design, where atoms are ionized in a pressurized cell and guided into a second cell. Here, a compact RFQ design directs the ions to a detector cell. The setup allows pressures in the first two cells to be easily varied, and the construction simplifies exchange of components.

This setup can be used for a variety of studies including pressure broadening effects in different gases, the extraction efficiency of various electrode designs, and other preparatory studies for online experiments.

An overview of the current status of the setup and future applications are discussed.

[1] F. Lautenschläger et al., NIMB, 383, (2016) 115-122

[2] R. Ferrer et al., Nat Commun, 8, 14520 (2017)

MS 2.3 Mon 17:30 HS 2 Chemie

Recent beam line and vacuum line upgrades at the FRS Ion Catcher — •Leonard Welde[1] and Jiajun Yu[2,3] for the FRS Ion Catcher-Collaboration — [1]Justus-Liebig-Universität Gießen, Gießen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou, China

At the FRS Ion Catcher, located at GSI, experiments with exotic nuclei are conducted. Exotic nuclei produced and separated at the Fragment Separator (FRS) are stopped in a gas-filled cryogenic stopping cell (CSC), transported via a radio frequency quadrupole (RFQ) beam line, which contains mass filters, to a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS).

Experiments targeting exotic nuclei with detection rates down to less than one ion per hour demand an as high as achievable transport efficiency from the CSC to the MR-TOF-MS, to be able to get sufficient statistics in a reasonable time frame. Simulations of the RFQ beam line were done, indicating possibilities to improve the transport efficiency by changing the positioning and/or the geometry of different apertures inside the beam line. In addition an upgrade of the pre-vacuum lines was done to be able to achieve higher areal densities in the CSC for future experiments. The results of these recent technical upgrades will be reported in this contribution.

MS 2.4 Mon 17:45 HS 2 Chemie

Simulations of ion transport at the high-density RF Carpet for the Cryogenic Stopping Cell of the Super-FRS — •Nils Steinbrenner[1], Daler Amanbayev[1,2], Timo Dickel[1,2], and Wolfgang R. Plass[1,2] — [1]II. Physikalisches Institut, Justus-Liebig Universität, Gießen, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Deutschland

In the context of the Super-FRS at FAIR, the Cryogenic Stopping Cell (CSC) is responsible for decelerating and stopping exotic ion beams produced at relativistic energies. The CSC's design is constrained by the need to achieve exceptionally high areal gas densities, up to 40 mg/cm^2, which presents significant challenges in ion extraction. The RF carpet, a critical component in this process, experiences decreased efficiency in ion capture and transport at high gas densities. To optimize the RF carpet's performance, detailed ion trajectory simulations were conducted. This contribution presents recent investigations into various RF-carpet geometries and explores the influence of the gap-to-electrode ratio on ion transport efficiency, with the ultimate goal of enhancing the RF carpets functionality for future CSC configurations.

MS 2.5 Mon 18:00 HS 2 Chemie

Comparing a Conventional and an Improved Faraday Cup in an Element-Specific Analysis for Ion Beam Current Measurements — •Sarah Oehler[1], Sebastian Berndt[1], Vadim Gadelshin[1], Raphael Hasse[1], Christoph E. Düllmann[1,2,3], Tom Kieck[2,3], Nina Kneip[1], and Klaus Wendt[1] — [1]Johannes Gutenberg-Universität, Mainz — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [3]Helmholtz-Institut, Mainz

Faraday cups are crucial tools for ion beam current measurements in mass spectrometry, at accelerators or storage rings. Comparative measurements at the RISIKO mass separator facility in Mainz using γ-spectroscopy indicated a systematic underestimation of the ion beam current, leading to the implementation of a new Faraday cup design. This new design provides an optimized geometry and an adapted material composition for significantly improved suppression of any charged secondary particles. Within the experiment, primary ions of various elements along the Periodic Table were measured on both a conventional and the improved Faraday cup. The results show that for non-alkali and non-alkaline earth metals, the improved Faraday cup reduces loss of sputtered particles by an average of 24.8% compared to the conventional design at 200 V repeller voltage. Further, for alkali and alkaline earth metals the corrections were observed to reach above 50% with respect to the conventional design.