Q 15: Precision Mass Spectrometry (joint session MS/Q)

Time: Monday 17:00–19:00 Location: N 6

Invited Talk Q 15.1 Mon 17:00 N 6

Pushing the Boundaries at FRIB: High-Precision Mass Measurements Near The Driplines — •Franziska Maria Maier, Scott Campbell, Hannah Erington, Christian Ireland, and Ryan Ringle — FRIB, USA

With new radioactive-ion-beam facilities such as FRIB becoming operational, the properties of nuclei in close proximity to the driplines are coming within reach of high-precision measurements. Within the last two years, at a fraction of FRIB's ultimate beam intensity, we used the LEBIT facility to successfully perform Penning-trap mass measurements of ^{22}Al [1], ^{101,103}Sn [2,3] and ^{23}Si [4]. These masses provide insights into the smoothness of the mass surface, help assess isospin symmetry breaking and offer valuable anchor points for nuclear models - especially for predicting properties near the driplines, where experimental data remain scarce. As FRIB ramps up its beam intensity, the production of many more nuclei will enable new and exceptional research opportunities. However, the short half-lives of many of these nuclei pose challenges for Penning-trap mass spectrometry. To overcome these, we are developing MR-ToF devices at FRIB, that will also expand FRIB's mass separation capabilities [5,6].

[1] S. Campbell et al., PRL 132, 152501 (2024)
[2] C.M. Ireland, F.M. Maier et al., PRC 111, 014314 (2025)
[3] C.M. Ireland et al., arxiv.org/abs/2510.11815
[4] F.M. Maier et al., PRC 112, 014329 (2025)
[5] F.M. Maier, C.M. Ireland et al., arxiv.org/abs/2509.16428
[6] C.M. Ireland, F.M. Maier et al., arxiv.org/abs/2510.11741

Q 15.2 Mon 17:30 N 6

A Laser-Ablation Ion Source for the ISOLTRAP Experiment — •Paul Florian Giesel for the ISOLTRAP-Collaboration — Universität Greifswald, Institut für Physik, Greifswald, Germany

ISOLTRAP is a precision mass spectrometer at ISOLDE/CERN dedicated to measure the masses of short-lived radionuclides far from stability. It utilizes both multi-reflection time-of-flight (MR-ToF) [1] and Penning-trap mass spectrometry [2-4]. Conversion of the resulting mass values into nuclear binding energies provides insights into the underlying nuclear forces and structures.

All measurements at ISOLTRAP rely on suitable reference ions. This contribution will present the laser-ablation ion source (LAIS), developed to supply a versatile set of reference species produced from various target materials, including e.g. carbon-cluster ions or aluminum and bismuth ions. This enables flexible calibration across a broad mass range. Beyond delivering reference ions, this source facilitates characterization studies of the ISOLTRAP setup, which can be performed in combination with an alkali ion source. An example is the investigation of space-charge effects in the MR-ToF analyzer with $^{13}C^{12}C_{10}^{+}$ and $^{133}Cs^{+}$ ions as well as the formation of hydrides and oxides in the ISOLTRAP RFQ cooler-buncher.

[1] Wolf R. N. et al., Int. J. Mass Spectrom. 349-350:123-133 (2013)
[2] M. König, et al., Int. J. Mass Spectrom. 142, 95 (1995)
[3] S. George, et al., Int. J. Mass Spectrom. 264, 110 (2007)
[4] S. Eliseev, et al., Phys. Rev. Lett. 110, 082501 (2013)

Q 15.3 Mon 17:45 N 6

High-precision Q-value measurements for neutrino physics using the JYFLTRAP Penning trap — •Jouni Ruotsalainen[1], Elina Kauppinen[1], Maxime Mougeot[1], Tommi Eronen[1], Anu Kankainen[1], Jouni Suhonen[1,2], Vikas Kumar[1], Marek Stryjczyk[1], Marlom Ramalho[1], Zhuang Ge[1], and Jenni Kotila[2,3] — [1]University of Jyvaskyla, Department of Physics, Accelerator Laboratory, P.O. Box 35(YFL) FI-40014 University of Jyvaskyla, Jyväskylä, Finland — [2]International Centre for Advanced Training and Research in Physics (CIFRA), P.O. Box MG12, 077125 Bucharest-Măgurele, Romania — [3]Finnish Institute for Educational Research, University of Jyväskylä, P.O. Box 35, Jyväskylä FI-40014, Finland

In this contribution, I will present the results and conclusions of the precise Q-value measurements of the ^{110}Ag^{m} beta decay, and ^{104}Ru and ^{122}Sn double-beta decays, and the utilized JYFLTRAP double Penning trap system at the University of Jyväskylä, Finland. These nuclides are possible candidates for future experiments studying the mass of the neutrino and whether the neutrino is its own antiparticle. In collaboration with the nuclear theory group at the University of Jyväskylä, the half-lives of the decays were calculated to determine the feasibility of observing these decays. While the ^{110}Ag^{m} was determined to be a suitable candidate for neutrino mass measurements, the half-lives of ^{104}Ru and ^{122}Sn neutrinoless double-beta decay were estimated to be too long for the decays to be observed with current experimental sensitivity.

Q 15.4 Mon 18:00 N 6

High-Precision Mass Measurements of Actinides at TRIGA-Trap for Nuclear Structure Studies — •Tanvir Sayed[1], Klaus Blaum[1], Michael Block[2,3,4], Burcu Cakirli[1], Stanislav Chenmarev[1], Christoph Düllmann[2,3,4], Szilard Nagy[1], and Dennis Renisch[2,3] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, DE — [2]Helmholtz-Institut Mainz, DE — [3]Department Chemie - Standort TRIGA, Mainz, DE — [4]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, DE

Actinides encompass an important region of the chart of nuclides with great relevance in nuclear and astrophysics research. The TRIGA-Trap experiment – set-up in the TRIGA research reactor hall at the University of Mainz – involves high-precision mass measurements of heavy radioactive nuclides, in particular actinides, with a double Penning-Trap mass spectrometer [1,2]. Recent measurements include nuclides in the Pu isotopic chain namely ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu. The precise masses can be used to compute mass filters, such as S_{2n} (two-neutron separation energies), to explore nuclear structure in heavy, deformed nuclei as well as test predictions from present nuclear shell models. This presentation will provide an overview of the current status of the experiment, discuss recent results along with their application in nuclear structure evaluation, and outline future prospects.

References: [1] J. Ketelaer et al. Nucl. Instrum. Meth. A 594, 162-177 (2008). [2] S. Chenmarev, S. Nagy, J.J.W. van de Laar et al. Eur. Phys. J. A 59(2), 29 (2023).

Q 15.5 Mon 18:15 N 6

Mass measurements of neutron-deficient nuclides close to the N = Z line with the FRS Ion Catcher — •Nived Keeppalli[1] and Gabirella K.Koncz[1,2] for the Super-FRS Experiment-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Germany — [2]School of Physics and Astronomy, University of Edinburgh, United Kingdom

Mass measurements near the N = Z line were performed with the multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS) at the FRS Ion Catcher at GSI Darmstadt. The MR-TOF-MS enables high precision mass measurements of exotic species having few ms half-life and low production cross sections (∼nb), with high mass resolving power (10^6) and accuracy ($\delta m/m \approx 10^{-8}$).

In this contribution, results from the measurement campaigns carried out near the N = Z line will be presented, including the first direct mass measurement of ^{93}Pd, the one-proton-decay daughter of the (21+) isomer in ^{94}Ag, reducing the mass uncertainty by an order of magnitude. The results indicate that the excitation energies of the parent states responsible for the one-proton (1p) and two-proton (2p) decays in ^{94}Ag differ by 10 standard deviations, pointing towards an incompatibility in the previously reported decay scheme of the 1p and 2p branches. Moreover, the possibility of the existence of two structurally different, high-spin states in ^{94}Ag, feeding the 1p and 2p decay branches was studied, performing state-of-the-art shell-model and mean-field calculations.

Q 15.6 Mon 18:30 N 6

Recent mass measurements and the first application of mass-selective re-trapping at ISOLTRAP — •Daniel Lange for the ISOLTRAP-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

The Isoltrap mass spectrometer [1], located at ISOLDE/CERN, performs high-precision mass measurements of short-lived, exotic nuclides far from stability. These measurements provide direct access to nuclear binding energies, which reflect the underlying nuclear interactions and enable studies in nuclear structure and nuclear astrophysics, among others. Precision mass measurements at the Isoltrap mass spectrometer are performed using various ion traps, including a tan-

dem Penning-trap system and a multi-reflection time-of-flight mass spectrometer (MR-ToF MS). The latter is particularly well-suited for both efficient mass separation and fast, precise mass measurements.
In this contribution, recent mass measurements of neutron-deficient cadmium isotopes in the direct vicinity of the doubly-magic self-conjugate ^{100}Sn nucleus will be presented. Furthermore, the advancements in ion purification with the first application of the mass-selective re-trapping technique [2], enabled by a newly implemented mini-RFQ following the MR-ToF MS, will be shown. Based on the mass measurement of neutron-rich argon using this technique, the feasibility of low-yield experiments in the presence of extremely abundant isobaric contamination and its limitations will be demonstrated.
[1] Lunney, D. *et al.*, J. Phys. G: Nucl. Part. Phys. 44, 064008 (2017)
[2] Dickel, T. *et al.*, J. Am. Soc. Mass Spectrom. 28, 1079-1090 (2017)

Q 15.7 Mon 18:45 N 6

Schottky + Isochronous Mass Spectrometry: Methodology and Results (on behalf of the Experimental Storage Ring Collaboration) — •David Freire Fernandez — University of Cologne, Cologne, Germany

We present a detailed account of Schottky+Isochronous Mass Spectrometry (S+IMS), a novel experimental technique for high-precision nuclear measurements in heavy-ion storage rings. This hybrid method combines the isochronous mode of the GSI-ESR with non-destructive, time-resolved resonant Schottky detectors. We describe the experimental setup, ring tuning procedures, and data analysis workflow. The technique achieves a mass resolving power enabling the separation of isomers with excitation energies down to 100 keV.

To demonstrate the method's capabilities, we present high-precision mass measurements from recent experimental campaigns. These results determine nuclide masses with uncertainties in the keV range, confirming most literature values while revealing significant deviations and improved precision for specific cases, such as 72As and 69As. This work details the methodological foundation for the recent observation of the two-photon decay of 72Ge (Phys. Rev. Lett. 133, 022502) and establishes S+IMS as a powerful tool for exploring short-lived isomers across the nuclear landscape.