MS 2: Precision Mass Measurements II

Time: Monday 14:00–15:30 Location: H3

Invited Talk MS 2.1 Mon 14:00 H3

Experiments with multiple-reflection time-of-flight mass spectrometers (MR-TOF-MS) at TRIUMF and GSI/FAIR — •Christine Hornung[1], the FRS Ion Catcher Collaboration[1,2], and the TITAN Collaboration[3] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany — [3]TRIUMF, Vancouver, Canada

MR-TOF-MS have been developed for the TITAN experiment at TRIUMF and for the FRS/Super-FRS at GSI/FAIR at the JLU Giessen. The systems incorporate several novel and unique concepts. The design enables world class performance, including a mass resolving power up to 1,000,000, mass accuracies down to $1.8 \cdot 10^{-8}$ and a background suppression of greater than 7 orders of magnitude.

Experiments contributing to different fields from nuclear astrophysics and structure were performed at the FRS Ion Catcher experiment at the in-flight fragment separator FRS at GSI and the TITAN experiment at the ISOL facility ISAC at TRIUMF, Canada.

In addition, the use of these MR-TOF-MS goes even beyond precision mass measurements, e.g., they can be employed to identify and analyze ions independent of their decay properties unambiguously. This enables novel and universal approaches to measure reaction cross sections, fission yields, half-lives, and branching ratios. Recent highlights and perspectives from both experiments at GSI and TRIUMF will be presented focusing on different regions of the chart of nuclei.

MS 2.2 Mon 14:30 H3

Latest improvements on TITAN*s Multiple-Reflection Time-Of-Flight Mass-Spectrometer — •Ali Mollaebrahimi[1,2], Timo Dickel[1,3], Andrew Jacobs[2,4], Ania Kwiatkowski[2,5], Tobias Murböck[2], Moritz Pascal Reiter[6], and Coulter Walls[2] — [1]University of Gießen, Gießen, Germany — [2]TRIUMF, Vancouver, Canada — [3]GSI, Darmstadt, Germany — [4]University of British Columbia, Vancouver, Canada — [5]University of Victoria, Victoria, Canada — [6]University of Edinburgh, Edinburgh, United Kingdome

TRIUMF*s Ion Trap for Atomic and Nuclear science (TITAN) is specialized in high-precision mass measurement and isobaric separation of exotic nuclei by using different electromagnetic and electrostatic traps: A precision Penning trap for the highest-precision mass measurements, EBIT (Electron Beam Ion Trap) for charge breeding and gamma spectroscopy measurements of radioactive nuclei and MR-TOF-MS (Multiple-Reflection Time-Of-Flight Mass Spectrometer) for high-precision mass measurement as well as for monitoring and identification of ISAC beam. MR-TOF-MS can be also used as an isobar separator for beam purification with a high separation power and send the isobarically-purified beam toward the penning trap or other downstream experiments. MR-TOF MS is one of the crucial setups enables the studies of short-lived and exotic nuclei far away from the valley of stability. Mass measurements of these isotopes are demanded for studies of nuclear structure and nuclear astrophysics processes. In this work, the performance, the capabilities and the latest technical improvements of MR-TOF-MS is going to be presented.

MS 2.3 Mon 14:45 H3

High-Precision Mass Spectrometry of Superheavy Elements — •Oliver Kaleja[1,2], Brankica Andelic[2,3,4], Luisa Arcila Gonzalez[4], Joacquín Berrocal[5], Lennart Blaauw[4], Klaus Blaum[6], Michael Block[2,3,7], Pierre Chauveau[2,3], Stanislav Chenmarev[3,6], Premaditya Chhetri[2,3], Christoph E. Düllmann[2,3,7], Martin Eibach[1], Julia Even[4], Pavel Filianin[6], Francesca Giacoppo[2,3], Manuel J. Gutiérrez Torres[5], Fritz P. Hessberger[2,3], Nasser Kalantar-Nayestanaki[4], Jacques J. W. van de Laar[3,7], Mustapha Laatiaoui[3,7], Steffen Lohse[3,7], Enrique Minaya Ramirez[8], Andrew Mistry[2], Elodie Morin[8], Yury Nechiporenko[9,10], Dennis Neidherr[2], Steven Nothhelfer[3,7], Yuri Novikov[9,10], Sebastian Raeder[2,3], Elisabeth Rickert[3,7], Daniel Rodríguez[5], Lutz Schweikhard[1], Peter G. Thirolf[11], Jessica Warbinek[2,7], and Alexander Yakushev[2,3] — [1]Univ. Greifswald — [2]GSI Darmstadt — [3]HIM Mainz — [4]Univ. of Groningen — [5]Univ. of Granada — [6]MPIK Heidelberg — [7]JGU Mainz — [8]IJCLab Orsay — [9]PNPI Gatchina — [10]St. Petersburg Univ. — [11]LMU Munich

One of the keys in understanding the existence of superheavy elements with proton numbers $Z \geq 104$ is the study of phenomena like nuclear shell effects far from stability. For these studies, one has to measure atomic masses at the borders of the nuclear chart very accurately. In 2021, the performance of the mass spectrometer SHIPTRAP at the GSI in Darmstadt was significantly improved. As a result, the atomic masses of several heavy At, Bi, Cf, Fr, Rn, Th, Po and Pb isotopes and the superheavy nuclides ^{257}Rf ($Z = 104$) and ^{258}Db ($Z = 105$) were measured directly. For many of these nuclides also long-lived isomeric states were observed allowing us to determine their excitation energy. In this contribution, an overview of the experimental improvements and results will be given.

MS 2.4 Mon 15:00 H3

Investigation of ground and metastable nuclear states in the heaviest nuclei at SHIPTRAP — •Francesca Giacoppo[1,2], Brankica Anđelić[1,2,3], Luisa Arcila Gonzalez[3], Joaquín Berrocal Sánchez[4], Lennart Blaauw[3], Klaus Blaum[5], Michael Block[1,2,6], Pierre Chauveau[1,2], Stanislav Chenmarev[2,5], Premaditya Chhetri[1,2], Christoph E. Düllmann[1,2,6], Martin Eibach[1], Julia Even[3], Pavel Filianin[5], Manuel Jesús Gutiérrez Torres[1,2,4], Fritz P. Hessberger[1,2], Nasser Kalantar-Nayestanaki[3], Oliver Kaleja[1,7], Jacques W. van de Laar[2,6], Mustapha Laatiaoui[2,6], Steffen Lohse[2,6], Enrique Minaya Ramirez[8], Andrew Mistry[1], Elodie Morin[8], Yury Nechiporenko[9,10], Dennis Neidherr[1], Steven Nothhelfer[2,6], Yuri Novikov[9,10], Sebastian Raeder[1,2], Elisabeth Rickert[2,6], Daniel Rodríguez[4], Lutz Schweikhard[7], Peter Thirolf[11], Jessica Warbinek[1,2,6], and Alexander Yakushev[1,2] — [1]GSI Darmstadt, Germany — [2]HIM Mainz, Germany — [3]University of Groningen, the Nederlands — [4]University of Granada, Spain — [5]MPIK Heildeberg, Germany — [6]JGU University Mainz, Germany — [7]Universiy of Greifswald, Germany — [8]IJCLab Orsay, France — [9]PNPI Gatchina, Russia — [10]Saint Petersburg State University, Russia — [11]LMU University Munich, Germany

In a very recent experimental campaign performed with the Penning trap spectrometer SHIPTRAP at GSI the superheavy isotopes ^{257}Rf and ^{258}Db were investigated despite their low production rates. The masses of the ground state and isomeric states as well as for several nuclides with $Z = 82 - 98$ were directly measured with high accuracy.

Valuable information on the nuclear shell structure, its strength and evolution in the region of the heaviest elements can be directly derived from our experimental findings.The latter, therefore, complement results achieved in decay spetroscopy studies. Furthermore, such accurate masses in the vicinity of the superheavy element region serve as anchor points to determine the masses of heavier nuclei which are crucial for nuclear models attempting to pinpoint the position of the predicted island of stability.

In this contribution an overview of the results will be given.

MS 2.5 Mon 15:15 H3

Status report on the TRIGA-TRAP experiment — •Jacques J. W. van de Laar[1,2], Klaus Blaum[3], Michael Block[1,2,4], Stanislav Chenmarev[3,5], Christoph E. Düllmann[1,2,4], Steffen Lohse[1,2], and Szilard Nagy[3] — [1]Department Chemie - Standort TRIGA, Johannes Gutenberg-Universität Mainz, DE — [2]Helmholtz-Institut Mainz, DE — [3]Max-Planck-Institut für Kernphysik, Heidelberg, DE — [4]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, DE — [5]Petersburg Nuclear Physics Insitute, Gatchina, RU

Experimental data of ground-state properties of exotic nuclei are important for nuclear structure studies and can test the reliability of nuclear mass models. The TRIGA-TRAP experiment is a double Penning-trap mass spectrometer used to perform high-precision measurements on long-lived transuranium isotopes and fission produced neutron-rich radionuclides at the research reactor TRIGA Mainz. Recently, a new cylindrical measurement trap was installed and characterized. After recommissioning, a mass measurement campaign started with several long-lived actinide isotopes. The data evaluation is still ongoing. The current status and first results will be presented.