MS 8: Isobar Suppression Techniques

Time: Friday 11:00–12:45 Location: N 6

Invited Talk MS 8.1 Fri 11:00 N 6

Nuclear reaction studies at the GSI storage rings - An astrophysics program — •Jan Glorius — GSI Helmholtzzentrum, Darmstadt, Germany

Over the past decade, a rich experimental nuclear-astrophysics program has been established at the GSI storage rings ESR & CRYRING. Centered around low-energy reaction studies, a variety of detection schemes and setups have been successfully implemented and put to use in multiple beamtimes. The common goal of all those inverse-kinematics studies is to extend our understanding of nucleosynthesis by focussing on stored radioactive beams. A diverse spectrum of nuclear reactions has recently been studied, including proton-induced reactions in a direct approach as well as neutron-induced reactions using an indirect technique. This contribution will outline the challenges and specialties of in-ring reaction studies, summarize the recent experimental campaigns and sketch an outlook regarding future measurements.

MS 8.2 Fri 11:30 N 6

Progress on the ILIAMS-assisted measurements of ^{91,94}Nb and ^{93}Mo at VERA — •Carlos Vivo-Vilches[1], Esad Hrnjic[1], Kyra Altindag[1], Silke Merchel[1], Martin Martschini[1], Lee W. Packer[2], Johannes H. Sterba[3], Matic Dokl[4], Jixin Qiao[4], Erik Strub[5], and Karin Hain[1] — [1]University of Vienna, Faculty of Physics, Vienna, Austria — [2]UKAEA, Culham Campus, Abingdon, United Kingdom — [3]Center for Labelling and Isotope Production, TRIGA Center Atominstitut, TU Wien, Vienna, Austria — [4]Department of Environmental and Resource Engineering, Technical University of Denmark, Roskilde, Denmark — [5]Division of Nuclear Chemistry, University of Cologne, Cologne, Germany

At the Vienna Environmental Research Accelerator (VERA) we are developing the AMS of ^{91}Nb, ^{94}Nb and ^{93}Mo to measure their concentrations in Mo-containing alloys irradiated with neutrons from deuterium-tritium fusion. These measurements require the use of the unique Ion-Laser InterAction Mass Spectrometry (ILIAMS) setup to suppress their respective stable isobars: ^{91}Zr, ^{94}Zr and ^{94}Mo, and ^{93}Nb. For ^{91,94}Nb, to achieve isobar suppression, we need to select NbO_3^-, which is less prolific than other niobium oxide anions. Therefore, we studied the enhancement of its ionization yield by mixing the Nb_2O_5 powder with Ag and AgO. Estimated ^{91}Nb/^{93}Nb and ^{94}Nb/^{93}Nb blank ratios are 10^{-14} and 10^{-10}, respectively. Using samples with roughly known amounts of ^{93}Mo, the ^{93}Mo/^{nat}Mo blank level for VERA has been determined to be lower than 10^{-12}. Precise reference materials for ^{93}Mo AMS will be produced from proton-irradiated Nb foils.

MS 8.3 Fri 11:45 N 6

First ion cooler assisted measurements at a 1 MV AMS facility — •Johannes Lachner[1], Robin Golser[2], Dominik Koll[1], Georg Rugel[1], Alexander Wieser[1,2], Stella Winkler[1], and Anton Wallner[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Universität Wien, Fakultät für Physik

The 1 MV AMS system HAMSTER (Helmholtz Accelerator Mass Spectrometer Tracing Environmental Radionuclides) contains an injector with an ion cooler, the so-called Ion Linear Trap for Isobar Suppression (ILTIS). This beam line is designed for the purpose of isobar suppression in collisions with buffer gas and by laser photodetachment and will expand the capabilities for radionuclide measurements beyond the classical nuclides measured at low-energy AMS facilities.

The presentation will cover results from first experiments with the cooled ion beam transmitted through the whole AMS system. A particular focus is set on the preparations for transmitting Cl beams in lower charge states and exploring the challenges of ^{36}Cl measurements at final beam energies below 1 MeV.

MS 8.4 Fri 12:00 N 6

Design and optimization of a ΔE-E$_{res}$ gas ionization chamber for Be-10 isobar suppression at low energies. — •Samuel Marty, Arnold Müller, Christof Vockenhuber, Andreo Crnjac, René Gruber, Daniel Hösli, and Marcus Christl — Laboratory of Ion Beam Physics, ETH Zurich, Otto-Stern-Weg 5, Zurich, Switzerland

Contrary to C-14 and its isobar N-14, the radioisotope Be-10 has a large isobaric background due to B-10 being able to form negative ions. There are various ways to suppress this unwanted signal: degrader foils, extracting BeF instead of BeO, and finally a detection method which exploits the difference in energy loss. One such method is the ΔE-E$_{res}$ gas ionization chamber, which has been used at ETH since the 2000s. However, most of the deployed detectors operate in ionization mode, where the primary electrons are measured directly. By increasing the field strength, the detector can be brought into proportional mode, where avalanche formation greatly enhances the signal-to-noise ratio. Particularly at low energies, significant improvements to the detector resolution can be achieved for light elements. Moreover, the detector does not necessitate cooled preamplifiers anymore. To confirm this claim, the energy resolution for both modes was measured using a variety of particles. Additionally, the multiplication factor as a function of the field contains information on the first Townsend coefficient of hexane, a key parameter for gas multiplication. Finally, the stability of gas ionization detectors operating in the proportional regime was studied.

MS 8.5 Fri 12:15 N 6

Collisional detachment of AlO^- and MgO^- in the ALIS RFQ ion cooler at CologneAMS — •Derin Schmidt[1], Markus Schiffer[1,2], Timm-Florian Pabst[1], Natasha Goaba Kalanke[3], Stefan Heinze[1], and Dennis Muecher[1] — [1]University of Cologne, Institute of Nuclear Physics, Germany — [2]University of Cologne, Department of Prehistoric Archaeology, Laboratory of Isotope Archaeology, Germany — [3]Department of Physics and Astronomy, Botswana International University of Science and Technology, Botswana

Laser isobar suppression is currently revolutionizing AMS; however, the underlying atomic- and molecular-level mechanisms responsible for its exceptional photodetachment efficiency are not yet fully understood.

In the Anion Laser Isobar Separator (ALIS) at CologneAMS, a radio frequency quadrupole (RFQ) ion cooler filled with He buffer gas is used in combination with a high-power laser to suppress the $^{26}MgO^-$ molecular isobar in $^{26}AlO^-$ beams.

Systematic measurements of collisional detachment in this cooler are presented. For a stable $^{27}AlO^-$ beam, the transmission was measured as a function of He pressure.

The count rate in the gas ionization detector for standard materials was analyzed for different ion cooler He buffer gas pressures and normalized to the slow sequentially injected stable ^{27}Al beam, to determine the ratio of collisional-detachment cross sections $\sigma_{col}(^{26}MgO)/\sigma_{col}(^{27}AlO)$.

MS 8.6 Fri 12:30 N 6

A compact AMS laser photo-detachment system for isobar suppression — •Lauren Bezzina, Christof Vockenhuber, Marcus Christl, Philip Gautschi, Lukas Wacker, Urs Ramsperger, Arnold Müller, and Thorben Wulff — Labor für Ionenstrahlphysik (LIP), Otto-Stern-Weg 5, 8093 Zürich, Switzerland

Compact accelerator mass spectrometry (AMS) systems have advanced significantly in recent years, yet effective isobar suppression for nuclides such as 36Cl at the 200 kV scale remains a major challenge. To address this, we are implementing a laser photo-detachment scheme that selectively neutralises interfering anions while preserving the radionuclide of interest. This approach requires decelerating the ion beam to sub-eV energies to maximise laser-ion interaction, typically achieved using a radiofrequency quadrupole (RFQ) cooler operated with a light buffer gas. The suppression stage will be integrated into a recommissioned 200 kV MICADAS-type accelerator. The upgraded system, named MI-Q, will be the first compact AMS instrument to incorporate a laser-based isobar suppression stage.

We present the design and optimisation of the MI-Q low-energy section, comprising the deceleration optics and RFQ cooler. A multi-electrode deceleration lens is being developed to provide tunable potential gradients, enabling precise control of sub-eV beam transport into the gas cell. The RFQ incorporates guide electrodes that generate the axial DC drag field needed to transport ions through the cooler while maintaining transverse confinement. Fabrication of the key components is underway, with thorough commissioning planned.