MS 6: Isobar Suppression Techniques

Time: Thursday 11:00–12:30 Location: HS 2 Chemie

Invited Talk MS 6.1 Thu 11:00 HS 2 Chemie

Isobar analysis in the actinide range and the characterization of an isotopic Np spike — •Andreas Wiederin[1,2,3], Martin Martschini[1], Aya Sakaguchi[4], Peter Steier[1], and Karin Hain[1] — [1]University of Vienna, Faculty of Physics, Isotope Physics Austria — [2]University of Vienna, Vienna Doctoral School in Physics, Austria — [3]Austrian Academy of Sciences, Austria — [4]University of Tsukuba, Institute of Pure and Applied Sciences, Japan

^{237}Np is the second most abundant anthropogenic actinide in the environment and has great potential as an environmental tracer. An isotopic Np spike would solve the problem of normalization for mass spectrometric ^{237}Np measurements in a robust and reliable manner. Such a material has been produced via the ^{232}Th(^{7}Li,3n)^{236g}Np reaction at the Nishina AVF cyclotron (<10^{10}at ^{236g}Np). The co-production of the isobars ^{236}U, ^{236}Pu presented a challenge for the spike characterization since no AMS facility could distinguish isobars in this high mass range. An approach that combines AMS (Accelerator Mass Spectrometry), AFIA (Anion Formation Isobar Analysis) and the first non-chemical isobar separation in the actinide range in AMS using ILIAMS (Ion Laser InterAction Mass Spectrometry) has been developed to characterize a Np spike candidate. This pilot spike has been applied to a selection of environmental samples to analyze ^{237}Np. This work was funded by the Austrian Science Fund (FWF): [I-4803-N], a Dimitrov Fellowship of the Austrian Academy of Sciences, and supported by the Vienna Doctoral School in Physics, the Japanese Society for the Promotion of Sciences, and the ERAN network.

MS 6.2 Thu 11:30 HS 2 Chemie

Investigations on ILIAMS isobar suppression for non-routine AMS isotopes — •Martin Martschini[1], Denis Ibrahimovic[1], David Krebs[1], Oscar Marchhart[1], Silke Merchel[1], Thorben Niemeyer[2], Raphael Haase[2], Klaus Wendt[2], and Karin Hain[1] — [1]University of Vienna, Faculty of Physics - Isotope Physics, Austria — [2]Johannes Gutenberg-University, Mainz, Germany

The Ion-Laser InterAction Mass Spectrometry (ILIAMS) setup at Vienna offers unique opportunities for atomic isobar suppression in AMS via element-selective laser photodetachment. Over the past years, several studies on the ILIAMS performance for rather exotic AMS isotopes like ^{32}Si, ^{44}Ti, ^{59}Ni, ^{60}Fe, and ^{107}Pd ($t_{1/2} = 60 - 7\times10^{6}$ yr) were carried out, fueled by interest in these isotopes from nuclear astrophysics and environmental sciences. First, screening campaigns of oxide and fluoride molecular anions to identify systems suited for suppression of S, Ca, Co, Ni and Ag, respectively, were conducted using our fixed-frequency lasers of typically 10 − 20 W output power. Subsequently, negative ion yields of several of these anions in a Cs-sputter ion source were investigated. Additionally, measurement campaigns with tunable Ti:Sa and OPO lasers have recently been started to pin down unknown detachment energies of further promising systems. This work was partly supported by ChETEC-INFRA (EU H2020 #101008324).

MS 6.3 Thu 11:45 HS 2 Chemie

New light in Cologne: low-energy isobar suppression for trace isotopes — •Markus Schiffer[1], Oscar Marchhart[1,2,3], Derin Schmidt[1], Ferhat Altun[1], Stefan Heinze[1], Natasha Kalanke[1], Martin Martschini[2], Timm-Florian Pabst[1], Peter Steier[2], Gereon Weingarten[1], Erik Strub[4], Robin Golser[2], Tibor Dunai[5], and Dennis Mücher[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]University of Vienna, Faculty of Physics, Isotope Physics, Austria — [3]University of Vienna, Vienna Doctoral School in Physics, Vienna, Austria — [4]University of Cologne, Institute for Nuclear Chemistry, Germany — [5]University of Cologne, Institute for Geology and Mineralogy, Germany

CologneAMS has successfully implemented a new low-energy isobar suppression unit, the Anion Laser Isobar Separator (ALIS), to improve and expand the detection of trace amounts of isotopes for scientists that apply the AMS technique for their geologic, environmental, archaeological, nuclear chemical, and nuclear astrophysical research. The new infrastructure ALIS consists of four major sections: anion beam formation and mass selection, anion cooling and isobar suppression, ion-beam transport to the 6 MV AMS system and finally an 18 W 532 nm continuous wave laser. We will report on the detailed design and the status of ALIS. First beams are transmitted through ALIS and we will show initial physics cases, with a focus on geological and environmental aspects, that are feasible with the achieved transmissions and characteristics of the setup.

MS 6.4 Thu 12:00 HS 2 Chemie

Installation and characterization of the new ion cooler beamline at the 1 MV AMS facility in Dresden — •Johannes Lachner[1], Alexander Wieser[1,2], Robin Golser[2], Stefan Findeisen[1], Thilo Hauser[3], Timo Kirschke[1], Markus Meyer[1], Allan O'Connor[3], Carlos Vivo-Vilches[1,2], Nicole Wagner[1], Gerald Wedel[1], Stella Winkler[1], and Anton Wallner[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Universität Wien, Fakultät für Physik — [3]National Electrostatics Corp.

The AMS system HAMSTER (Helmholtz Accelerator Mass Spectrometer Tracing Environmental Radionuclides) will be installed at HZDR in 2025. This 1 MV facility includes an additional injection line for the purpose of isobar suppression with an ion cooler, the so-called Ion Linear Trap for Isobar Suppression (ILTIS). The beamline was installed in 2024 and its operation with the new ion cooler has started. The design of the ion cooler follows the system used for Ion-Laser InterAction Mass Spectrometry (ILIAMS) at the University of Vienna. An important update is the segmentation of the electrodes inside the cooler. This modular design allows the ion cooler to be operated as a single system or split into multiple radiofrequency quadrupole (RFQ) sections, which gives us more control of the ion energy. Within the RF circuit, the additional inductivity can be continuously adjusted. This simplifies the trap's adaptation for different frequencies.

Our presentation will cover a description of the new injection line and results from first experiments with the cooled ion beam and the characterization of the Paul trap using ion beams of Cl^- and Cu^-.

MS 6.5 Thu 12:15 HS 2 Chemie

Photodetachment measurements of negatively charged molecules and element separation at VERA — •T. Niemeyer[1], S. Berndt[1], Ch. E. Düllmann[1,2,3], O. Forstner[4,5], K. Hain[6], R. Hasse[1], K. Hens[7], M. Martschini[6], S. Merchel[6], M. Stemmler[8], and K. Wendt[1] — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]GSI Darmstadt — [4]Friedrich-Schiller-Universität Jena — [5]Helmholtz-Institut Jena — [6]Universität Wien — [7]Hübner GmbH & Co. KG, Division HÜBNER Photonics, Kassel — [8]Institut für Radioökologie und Strahlenschutz (IRS), Leibniz Universität Hannover

Detection limits of 16 orders of magnitude in isotope ratios and isobaric suppression make Acccelerator Mass Spectrometry (AMS) the method of choice for ultra-sensitive trace analysis in various fields such as radiometric dating, nuclear astrophysics and geology. However, isobaric interferences still challenge ultrarare isotope measurements, e.g., of Mn-53 which is used for long-term geological and extraterrestrial dating or Fe-60 as an indication of supernovae remains found on Earth.

To suppress interfering isobar anions such as CrO on mass 53, tunable light sources, based on Ti:Sa and OPO technology, were used for the first time at the ILIAMS cooler at the low-energy side of the VERA AMS facility at the University of Vienna. Here we report on measurement of laser photodetachment curves for various oxide anions such as FeO, NiO, MnO, CrO and TiO, delivering useful molecular physics data as well as predictions on the expected isobaric suppression of e.g. MnO against CrO for AMS applications.