MS 1: Accelerator Mass Spectrometry I

Time: Tuesday 11:00–13:00 Location: F128

Invited Talk MS 1.1 Tue 11:00 F128

Lasers against barium – Detection of ^{135}Cs in the environment by AMS — •Alexander Wieser[1], Johannes Lachner[1,2], Silke Merchel[1], Martin Martschini[1], Anaëlle Magre[3], Judith Kobler Waldis[4], Oscar Marchhart[1], and Robin Golser[1] — [1]University of Vienna, Isotope Physics, Vienna, Austria — [2]HZDR, Accelerator Mass Spectrometry and Isotope Research, Dresden, Germany — [3]Institut de Radioprotection et de Sûreté Nucléaire, Fontenay-aux-Roses, France — [4]Universität Basel, Departement Umweltwissenschaften, Basel, Schweiz

^{137}Cs ($T_{1/2} \approx 30$ yrs) is a high-yield product of nuclear fission and easily detectable via its gamma decay but ^{137}Cs alone without further information is not assignable to an anthropogenic source. The measurement of ^{135}Cs ($T_{1/2} \approx 2$ Myrs) can help identifying the origin of radiocesium. While it is impossible to measure ^{135}Cs radiometrically in the presence of ^{137}Cs, mass spectrometric methods need to suppress stable isobars ^{135,137}Ba and molecules of similar mass. The Ion-Laser Interaction Mass Spectrometry (ILIAMS) setup at the Vienna Environmental Research Accelerator (VERA) does exactly that. Overlapping a 10 W laser beam with the ion beam in a radiofrequency quadrupole, the interfering isobars ^{135,137}Ba are suppressed by seven orders of magnitude, realizing detection limits of $7 \cdot 10^6$ atoms, i.e. ≈ 5 mBq of ^{137}Cs per sample. We will present the progress of our ILIAMS measurements at VERA, with our struggles to reduce cross contamination in the ion source and a focus on Cs measurements of environmental sediment samples prepared from 100 g of soil.

MS 1.2 Tue 11:30 F128

Thickness measurement of thin foils using a Time of Flight spectrometer — •Elisa Chopan, Gereon Hackenberg, Markus Schiffer, Stefan Heinze, Martina Gwozdz, Timm-Florian Pabst, Carlo Baddeliyanage, Tom Sittig, Alfred Dewald, and Dennis Mücher — Institut für Kernphysik, Universität zu Köln, Zülpicher Str. 77, 50937 Köln, Deutschland

In many nuclear physics experiments, a target foil is shot at, whereby the precise thickness is often unknown. A Time of Flight setup at the AMS setup of the Cologne FN tandem accelerator (10 MV) was established, with which the thickness of thin target foils can be determined. The setup can use ions of different charges and energies to measure the ToF between a start and stop detector. The foil of interest is placed in front of the start and stop detector and hence induces an energy loss of the ions. Using known stopping powers then allows to determine the thickness of the foil. In this contribution, we present the setup consisting of multichannel plate (MCP) detectors and show the achieved accuracy for different combinations of foils and ions. We have found good agreement of our results with measurements using standard techniques.

MS 1.3 Tue 11:45 F128

Status of the advanced radiofrequency quadrupole for AMS - first results from the test bench setup of VERA — •Oscar Marchhart[1,2], Markus Schiffer[3], Alfred Priller[1], Susan Herb[3], Peter Steier[1], Gereon Hackenberg[3], Martin Martschini[1], Dennis Mücher[3], Alfred Dewald[3], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics, Isotope Physics, Vienna, Austria — [2]University of Vienna, Vienna Doctoral School in Physics, Vienna, Austria — [3]University of Cologne, Institute for Nuclear Physics, Cologne, Germany

Accelerator Mass Spectrometry (AMS) is the most sensitive method for the detection of trace amounts of long-lived radionuclides. The Ion-Laser InterAction Mass Spectrometry (ILIAMS) setup at the Environmental Research Accelerator (VERA) has demonstrated great isobar suppression capabilities using laser photodetachment in a gas-filled radiofrequency quadrupole (RFQ). With the ILIAMS technique, new AMS isotopes for research on environmental radioactivity (^{90}Sr, ^{135}Cs) and astrophysics (^{182}Hf) become accessible.
An advanced RFQ ion cooler based on ILIAMS has been developed and built. Its performance is currently being studied at the test bench setup of VERA. The new design consists of elliptically shaped injection and extraction electrodes and a new guiding field structure that uses hybrid-electrodes. These changes intend to solve the technical challenges of decelerating and trapping ion beams with high emittance which typically arise when using fluoride anions like SrF_3^- and result in significant transmission losses up to 90%.

MS 1.4 Tue 12:00 F128

Towards ^{41}Ca AMS measurements at low energies with laser-based isobar suppression — •Carlos Vivo-Vilches[1], Martin Martschini[2], Silke Merchel[2], Johannes Lachner[1], and Anton Wallner[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Accelerator Mass Spectrometry and Isotope Research, Germany — [2]University of Vienna, Faculty of Physics, Isotope Physics, Austria

In 2023, a new 1 MV AMS facility including laser-based isobar suppression capabilities, HAMSTER, will be installed at HZDR. Because of the successful use of this suppression technique to ^{41}Ca AMS measurements at VERA (Vienna, Austria), preliminary tests were performed there at a terminal voltage of 1.2 MV.

The transmission through the He gas stripper for charge states 1+, 2+ and 3+ at different stripping energies was studied. A transmission of 38% for the 2+ state at 1.2 MV was measured. While molecular ions survive the interaction with the buffer gas and the 355 nm laser, these can be totally discriminated by the gas ionization chamber, even for the 2+ state (2.9 MeV). Hence, a higher stripper pressure to suppress these molecular ions is not required.

After collision- and photo-induced KF_3^- dissociation, the final ^{41}K/^{40}Ca interference was $(2.0 \pm 1.0) \times 10^{-13}$. Looking for suppression based on electron photodetachment, the stability of CaF^- and KF^- ions interacting with laser light of different wavelengths might be worth to be studied in the future.

MS 1.5 Tue 12:15 F128

Improving the ^{10}Be detection efficiency with DREAMS — •Johannes Lachner, Carlos Vivo Vilches, Dominik Koll, Georg Rugel, Konstanze Stübner, and Anton Wallner — Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Accelerator Mass Spectrometry & Isotope Research

^{10}Be measurements presently take up the largest fraction of the DREAMS (DREsden AMS) beamtimes at the 6 MV accelerator of HZDR. We investigated the advantages of increasing the accelerator terminal voltage in order to improve the ^{10}Be counting efficiency. Stripping of the BeO^- ions extracted from the ion source to Be^{2+} is done using Ar stripper gas at a gas density below the level required for an equilibrium charge state distribution. The positive ions are directed towards a 1 μm thin silicon nitride foil that helps to suppress the ^{10}B interference by differential energy loss and separation in the following electrostatic analyser. After passage through the absorber foil the mean charge state of Be ions is increased and the 4+ charge state is selected and transported to the detector. Because of the higher ion energy, the yield for this charge state gets higher and the efficiency of ^{10}Be measurements is improved with higher terminal voltage.

At 5.8 MV terminal voltage ca. 32.5% of the ^{10}Be extracted from the ion source are transported to the detector compared to 23% at the previous setting of 4.5 MV. We furthermore present data of samples with known B concentration and give values for the ^{10}B suppression related to the different effects of separation, via the energy loss and via the gas ionization chamber.

MS 1.6 Tue 12:30 F128

The Anion Laser Isobar Separator - ALIS — •Markus Schiffer[1], Oscar Marchhart[2,3], Gereon Hackenberg[1], Peter Steier[2], Alfred Priller[2], Susan Herb[1], Timm-Florian Pabst[1], Elisa Chopan[1], Carlo Baddeliyanage[1], Martin Martschini[2], Robin Golser[2], Alfred Dewald[1], and Dennis Mücher[1] — [1]University of Cologne, Institute of Nuclear Physics, Cologne, Germany — [2]University of Vienna, Faculty of Physics, Isotope Physics, Vienna, Austria — [3]University of Vienna, Vienna Doctoral School in Physics, Vienna, Austria

Low energy isobar suppression has taken on increasing importance and has demonstrated a new access to environmental (^{90}Sr, ^{135}Cs), and cosmogenic isotopes (^{26}Al, ^{41}Ca). For this purpose, a new injector for the Cologne 6 MV AMS-System was developed. This "Anion Laser Isobar Separator" (ALIS) uses an advanced gas-filled radio frequency quadrupole (RFQ) ion cooler to suppress isobars by use of laser photodetachment in combination with gas reactions.

ALIS will use a 134 sample MC-SNICS ion source and a double focusing magnet for the ion cooler injection. The system is designed to separate the ion beam by slits before it is focused into the deceleration section of the RFQ. The ion cooler extraction section is designed to couple the ion beam to the ion optics of the AMS-System, or alternatively to a diagnose setup for stand-alone operation. For the element selective isobar suppression by laser photodetachment a 532 nm continuous wave laser with 18 W will be used.

MS 1.7 Tue 12:45 F128

Implementation of an EA-IRMS-GIS system to CologneAMS — •Martina Gwozdz, Stefan Heinze, Markus Schiffer, Alexander Stolz, Carlo Baddeliyanage, Elisa Chopan, Gereon Hackenberg, Devin Hymers, Timm-Florian Pabst, Tom Sittig, Alfred Dewald, and Dennis Mücher — Universität zu Köln, Germany

As part of the CRC1211 project "Earth - Evolution at the dry limit"

^{14}C dating analysis is asked for soil samples from the Atacama desert, resulting in ultra-small samples with a carbon content of 2-20μg. The ultra-small-scale AMS ^{14}C analysis will be used for the determination of ages of organic compounds isolated from the desert soils.

For this reason a new elemental analyser (EA) and an isotope ratio mass spectrometer (IRMS) have been coupled to the 6MV AMS system of CologneAMS. The EA oxidises solid samples and measures the nitrogen and carbon content. For the measurement of δ^{13}C and δ^{15}N the sample is transported to the IRMS.

The EA-IRMS has been set up with a direct connection to the existing gas injection system (GIS) and has been implemented into the software which is controlling the measurements. In this way it is possible to measure quasi-simultaneously the ^{14}C concentration with the 6MV AMS system and the δ^{13}C value with the IRMS.

We will investigate whether this new set-up will enable improved fractionation correction which are used in the ^{14}C data evaluation. This will increase the measurement accuracy and therefore will contribute to solve dating problems in different archives of the desert.