

## MS 7: Accelerator Mass Spectrometry I

Time: Thursday 10:45–12:30

Location: H3

## Invited Talk

MS 7.1 Thu 10:45 H3  
**The new compact, multi isotope AMS system (MILEA) at ETH Zurich - performance and applications** — ●MARCUS CHRISTL<sup>1</sup>, SASCHA MAXEINER<sup>2</sup>, ARNOLD MÜLLER<sup>2</sup>, PHILIP GAUTSCHI<sup>1</sup>, CHRISTOF VOCKENHUBER<sup>1</sup>, and HANS-ARNO SYNAL<sup>1</sup> — <sup>1</sup>ETH Zürich, Switzerland — <sup>2</sup>Ionplus AG, Dietikon, Switzerland

The prototype version of a new, compact, multi-isotope, low energy accelerator mass spectrometry system (MILEA) was built in collaboration with Ionplus AG and set into operation at ETH Zurich in late 2018. The system is based on a 300 kV power supply and was optimized for small footprint (3.5 x 7 m<sup>2</sup>) and to reach optimal performance for <sup>10</sup>Be, <sup>14</sup>C, <sup>26</sup>Al, <sup>129</sup>I, and actinide measurements at low energies. During the past years the system was thoroughly tested and it is now increasingly being used for routine AMS operations.

In the first part of the presentation, the layout of the system, its properties and setup for the different nuclides will be presented and the performance of the system will be discussed for the different nuclides. In the second part of the presentation some recent results of our actinide and heavy ion program will be presented including a <sup>236</sup>U/<sup>238</sup>U record from sea shells in the Northeast Atlantic Ocean and <sup>233</sup>U/<sup>236</sup>U data from the Arctic Ocean.

MS 7.2 Thu 11:15 H3  
**Integration of the EA-IRMS system to the CologneAMS facility** — ●MARTINA ANNA GWOZDZ, GEREON HACKENBERG, STEFAN HEINZE, SUSAN HERB, TIMM-FLORIAN PABST, MARKUS SCHIFFER, ALEXANDER STOLZ, and ALFRED DEWALD — Institute for Nuclear Physics, University of Cologne, Germany

Recently a new elemental analyser (EA) and an isotope ratio mass spectrometer (IRMS) for stable isotopes have been installed at the 6MV AMS device of CologneAMS. In addition to the <sup>14</sup>C content of a sample this will provide precise values of stable isotopic ratios like  $\delta^{13}\text{C}$  or  $\delta^{15}\text{N}$ .

A direct connection to the existing gas interface as well as the implementation of the new devices into the control software of the existing AMS system were realized. In this way it is possible to measure quasi-simultaneously the <sup>14</sup>C concentration with the 6MV AMS system and the  $\delta^{13}\text{C}$  value with the IRMS device.

We will also investigate whether this new set-up will enable improved fractionation correction which are used in the <sup>14</sup>C data evaluation as proposed by Ravi Prasad et al. [1].

[1] G.V. Ravi Prasad et al., 2019,  $\delta^{13}\text{C}$  correction to AMS data: Values derived from AMS vs IRMS values., Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, v. 455, p.244-249

MS 7.3 Thu 11:30 H3  
**Investigation of the beam trajectory and beam profile development in the 135° gas-filled magnet at the AMS device for medium mass isotopes at the Cologne University** — ●SUSAN HERB, GEREON HACKENBERG, MARKUS SCHIFFER, STEFAN HEINZE, and ALFRED DEWALD — Institute of Nuclear Physics, University of Cologne, Germany

First <sup>53</sup>Mn and <sup>60</sup>Fe test measurements revealed that improvements of the AMS set-up at the FN tandem accelerator should be made to enable the measurement of lower level isotopic ratios of 10<sup>-13</sup> and 10<sup>-16</sup>, respectively. Therefore, we aim to improve the isobar separation of the high energy mass spectrometer and its transmission. The beam profile along the ion paths through the 135° gas-filled magnet was measured in the dispersive direction (x-axis) with homemade silicon pin diode detector arrays. It was measured at 4 locations along the flight path in x direction and two-dimensional (x/y) at the exit of the magnet. We also investigated the effect of using nitrogen or helium gas. The measured data was used to test our in-house developed Monte-Carlo simulation code, which simulates the ion transport in a gas-filled magnet. The first version of the code was designed for nitrogen gas and was now adapted for helium. The comparison of the calculated and the measured beam trajectories revealed that the gas density effect influencing the ion charge has to be considered [1]. The contribution will report on details of the conducted measurements and compare it with the calculations. Ongoing developments of the simulation code will be discussed. [1] Betz, 1972, Reviews of Modern Physics, 44.

MS 7.4 Thu 11:45 H3  
**Measurements of volatile radioactive isotopes in reactor graphite** — ●TIMM-FLORIAN PABST<sup>1</sup>, GEREON HACKENBERG<sup>1</sup>, STEFAN HEINZE<sup>1</sup>, SUSAN HERB<sup>1</sup>, YANNIK JACOBI<sup>1</sup>, MARKUS SCHIFFER<sup>1</sup>, ALEXANDER STOLZ<sup>1</sup>, ERIK STRUB<sup>2</sup>, and ALFRED DEWALD<sup>1</sup> — <sup>1</sup>Institute for Nuclear Physics, University of Cologne, Germany — <sup>2</sup>Department of Chemistry, University of Cologne, Germany

Activated graphite, e.g. from graphite moderated reactors, contains several radioactive nuclides like <sup>14</sup>C, <sup>36</sup>Cl, or <sup>3</sup>H. For the final disposal of such material a quantitative characterization is demanded.

We are aiming for a system which enables automated measurements using the AMS technique with gaseous samples, for <sup>14</sup>C, <sup>36</sup>Cl, and <sup>3</sup>H. The planned system should provide a high sample throughput as well as the possibility of sample dilution in cases of high activity. Therefore a new gas-interface was built which uses two syringes for the transport of the sample gas into the ion source and a separate reservoir for blank gas which can be used for the dilution.

For the measurement of the tritium concentration, we expanded our ion source test bench. A 100 kV accelerator stage with a carbon stripper foil in the centre was installed along with an additional 90° analysing magnet and a silicon detector. This will allow efficient and accurate characterisation of the activity in reactor graphite material, which is foreseen be stored in repositories like e.g. the mine Konrad where activity limits have to be considered. In this contribution we will present the layout of our systems as well as its present status.

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MS 7.5 Thu 12:00 H3  
**Developments towards the detection of <sup>135</sup>Cs and <sup>137</sup>Cs by AMS** — ●ALEXANDER WIESER<sup>1</sup>, JOHANNES LACHNER<sup>1,2</sup>, DORIAN ZOK<sup>3</sup>, MARTIN MARTSCHINI<sup>1</sup>, PETER STEIER<sup>1</sup>, ALFRED PRILLER<sup>1</sup>, and ROBIN GOLSER<sup>1</sup> — <sup>1</sup>University of Vienna, Faculty of Physics - Isotope Physics, Vienna, Austria — <sup>2</sup>Helmholtz-Zentrum Dresden-Rossendorf, Accelerator Mass Spectrometry and Isotope Research, Dresden, Germany — <sup>3</sup>Leibniz Universität Hannover, Institute of Radioecology and Radiation Protection, Hannover, Germany

The isotopic ratio <sup>135</sup>Cs/<sup>137</sup>Cs can be used to assign sources of anthropogenic cesium input, or as a geochemical tracer, or for modifying anthropogenic radionuclide dispersion models. Due to the long half-life of  $\approx 2.3$  Ma, <sup>135</sup>Cs is hard to detect via radiometric methods, while mass spectrometry has to deal with isobaric interferences, i.e. <sup>135</sup>Ba and <sup>137</sup>Ba for Cs detection. The new method of Ion Laser InterAction Mass Spectrometry (ILIAMS) at the Vienna Environmental Research Accelerator (VERA) overcomes this problem by exploiting differences in the electron affinities of CsF<sub>2</sub><sup>-</sup> and BaF<sub>2</sub><sup>-</sup>. A <sup>133</sup>CsF<sub>2</sub><sup>-</sup> current on the order of 50 nA from a mixed Cs<sub>2</sub>SO<sub>4</sub> and PbF<sub>2</sub> - matrix is extracted from the ion source. At VERA two sputtering processes are currently investigated: Rubidium sputtering and negative ion production without external sputter agent. First results show reproducible detection of <sup>135</sup>Cs and <sup>137</sup>Cs in an in-house reference material, while reaching blank levels of <sup>135,137</sup>Cs/<sup>133</sup>Cs = 6·10<sup>-12</sup>. We aim to reduce this value by at least two orders of magnitude for measuring environmental samples.

MS 7.6 Thu 12:15 H3  
**First studies on <sup>99</sup>Tc detection using Ion Laser InterAction Mass Spectrometry (ILIAMS)** — ●JOHANNA PITERS<sup>1,2</sup>, FADIME GÜLCE<sup>1</sup>, KARIN HAIN<sup>1</sup>, MARTIN MARTSCHINI<sup>1</sup>, and ROBIN GOLSER<sup>1</sup> — <sup>1</sup>University of Vienna, Faculty of Physics — <sup>2</sup>Vienna Doctoral School in Physics

Minute environmental concentrations of the anthropogenic radionuclide <sup>99</sup>Tc (t<sub>1/2</sub>=2.1·10<sup>5</sup> a) can serve as a tracer for transport processes e.g. in oceanography. However, detection of environmental <sup>99</sup>Tc presently requires Accelerator Mass Spectrometry (AMS) at the largest facilities available in order to adequately suppress the strong interference from the isobar <sup>99</sup>Ru.

As part of an FWF-funded project, we aim at making <sup>99</sup>Tc accessible for measurement at the 3-MV facility VERA (Vienna Environmental Research Accelerator) with the novel isobar suppression technique of ILIAMS (Ion Laser InterAction Mass Spectrometry). For this development, laser photodetachment, chemical sample preparation, sample matrix material and ion source output all require optimization. As

there is no stable Tc isotope, a normalization to an isotopic Tc spike material, e.g.  $^{97}\text{Tc}$ , or a stable reference isotope of another element needs to be established as well.

This contribution presents the ongoing development and preliminary results, which yield a laser-suppression of Ru by up to 5 orders of magnitude and a  $^{99}\text{Tc}$ -detection limit of less than  $10^6$  atoms.