MS 6: Accelerator Mass Spectrometry and Applications I

Time: Wednesday 14:30–16:30 Location: RW 2

Invited Talk MS 6.1 Wed 14:30 RW 2

Laser Isobar suppression for cooled $^{26}AlO^-$ and $^{36}Cl^-$ ions — •Johannes Lachner, Andreas Kalb, Christoph Marek, Martin Martschini, Alfred Priller, Peter Steier, and Robin Golser — Faculty of Physics, University of Vienna, Austria

The newly developed Ion-Laser InterAction System (ILIAS) was connected to the Vienna Environmental Research Accelerator (VERA). ILIAS allows to slow down negatively charged ions to thermal velocities in a linear radiofrequency quadrupole (RFQ) filled with He gas. I will present our experiments on isobar suppression via collisions in the RFQ and via element selective photodetachment.

In the photodetachment experiments we used a 532 nm laser (18 W), which is coupled into the beamline and our RFQ via a viewport in a 90° magnet, the first filter after the negative ion source. The VERA mass spectrometer then allows identifying trace amounts of nuclides and molecules in the beam transmitted through the ion cooler. We studied the effects of collisions of the beam with He buffer gas and of laser photodetachment on the AMS-relevant ions $^{36}Cl^-$ and $^{26}AlO^-$: Suppression factors of the isobars ($^{26}MgO^-$ and $^{36}S^-$) of 10^3 and 10^7, respectively, are realized. Sufficient suppression of the isobars in the ion cooler will allow for the choice of lower charge states after the accelerator and improve the yields of detection. We therefore tested different charge states for the nuclides of interest and report on the separation of the isobars and of m/q interferences at beam energies between 10 and 25 MeV using a multi-anode gas-ionization chamber. The new isobar suppression method will widen the capabilities of smaller and middle-sized AMS facilities and open the future for novel AMS isotopes.

MS 6.2 Wed 15:00 RW 2

^{10}Be results from Trondheim 1 MV AMS — •Martin Seiler[1], Johanna Anjar[1], Einar Vaernes[1], Marie-Josée Nadeau[1], and Grazia Scognamiglio[2] — [1]National Laboratory for Age Determination, NTNU, Trondheim — [2]Centro Nacional de Aceleradores, Universidad de Sevilla, Sevilla

The 1 MV AMS system in Trondheim is regularly used for radiocarbon dating and provides stable measurement conditions for reliable results. The initial acceptance tests was conducted for ^{10}Be, ^{26}Al and ^{14}C. However, for many years only ^{14}C was measured. Recently the first tests with ^{10}Be were done. The 2^+2^+ measurement setup with a 150 nm thick degrader foil yielded a good efficiency as well as a low background level and was therefore chosen for further measurements. In order to determine the achievable performance under measurement conditions, several samples have been run in an ordinary measurement. This includes primary standards, which were used for normalization of the other samples. The precision for a single sample was 0.5 % at a nominal ratio of ^{10}Be/Be $2.709{\cdot}10^{-11}$. Secondary standards with ^{10}Be/Be ratios between $5{\cdot}10^{-13}$ and $9{\cdot}10^{-12}$ were used to prove the accuracy of the measurement. As we aim to measure samples for cosmogenic exposure dating, the background level for rock samples was determined with process blanks of a Be extraction process from quartz were used. The average normalized blank level for these samples was $3{\cdot}10^{-15}$. A detailed analysis of the performance as well as an outlook to real sample applications will be given.

MS 6.3 Wed 15:15 RW 2

A dedicated AMS setup for medium mass isotopes at the Cologne FN-Tandem Accelerator — •Markus Schiffer, Richard Altenkirch, Gereon Hackenberg, Claus Müller-Gatermann, Claus Feuerstein, Susan Herb, Alexander Stolz, Marcel Marock, Gregor Zitzer, Stefan Heinze, Mario Cappellazzo, and Alfred Dewald — Institute for Nuclear Physics, University of Cologne, Germany

The new AMS system at the Cologne 10 MV FN accelerator has been finalized in its first stage. The system has been designed for the measurement of medium mass isotopes, especially for ^{53}Mn and ^{60}Fe.

In a first test period we have measured the suppression and separation capability of the system with ^{54}Cr and ^{54}Fe as well as ^{58}Fe and ^{58}Ni. The achieved suppression is mainly dominated by the energy loss and the energy loss straggling at stacked SiN degrader foils. Further we investigated the performance of the single components, the dispersion of the electrostatic analyzer as well as the resolution of the time of flight system and of the gas ionization detector. It will be shown, that energies of 100 MeV are sufficient for a suppression of ^{60}Ni from ^{60}Fe down to a ratio of 10^{-15} nearly without software gates and for the suppression of ^{53}Cr from ^{53}Mn down to a ratio of 10^{-8} with a 50% software gate. The final component of our AMS setup, a 135°-magnet, designed for gas-filled operation will be installed in spring 2017 and will increase the overall efficiency.

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MS 6.4 Wed 15:30 RW 2

Modification of the 120° Bending Magnet at the CologneAMS as Gas-Filled-Magnet — •Richard Altenkirch, Claus Feuerstein, Markus Schiffer, Stefan Heinze, Claus Müller-Gatermann, and Alfred Dewald — Institute for Nuclear Physics, University of Cologne, Germany

Routine measurements of the last years at the 6 MV AMS system showed a good isobar suppression for all Isotopes, measured with the Degrader-Foil-Method, especially ^{36}Cl and ^{9}Be. However, the efficiency is reduced due to the charge state distribution by this technique.

For measurements with atomic ^{26}Al the efficiency is limited by the low beam output of the ion source. In the case of AlO the output is larger by the factor of 10. In this case the suppression of ^{26}Mg will become necessary.

In order to minimize efficiency losses for ^{9}Be, ^{26}Al and ^{36}Cl measurements the 120° magnet at the 6 MV AMS system was modified to enable a Gas-Filled-Operation, under the special condition to keep the equipment for the degrader-foil technique untouched.

Besides constructional steps, first results for ^{26}Al and ^{36}Cl beams will be presented. This includes beam broadening and isobar separation as a function of the gas pressure. The measured data will be compared to Monte Carlo simulations.

A new designed multi-wire chamber in combination with an ionisation chamber will be presented.

MS 6.5 Wed 15:45 RW 2

New data for cosmogenic ^{53}Mn and ^{60}Fe in iron meteorites — •Thomas Smith[1], Ingo Leya[1], Silke Merchel[2], Georg Rugel[2], Stefan Pavetich[3], Michaela Fröhlich[3], Anton Wallner[3], Keith Fifield[3], Stephen Tims[3], Gunther Korschinek[4], and Thomas Faestermann[4] — [1]University of Bern, Switzerland — [2]HZDR, Dresden, Germany — [3]ANU, Canberra, Australia — [4]TUM, Munich, Germany

Cosmogenic nuclides in meteorites can provide information on cosmic ray exposure (CRE) histories. In space, meteoroids are irradiated by galactic cosmic ray particles, inducing the production of cosmogenic nuclides (^{10}Be, ^{26}Al, ^{36}Cl, ^{41}Ca, ^{53}Mn, ^{60}Fe). Meteorites are routinely measured for ^{10}Be, ^{26}Al, and ^{36}Cl. However the database for ^{53}Mn and ^{60}Fe is scarce due to the low availability of high-MV accelerators and the debate over the half-lives of ^{53}Mn and ^{60}Fe. We report new ^{53}Mn and ^{60}Fe data for iron meteorites measured at Canberra (^{53}Mn, ^{60}Fe) and Munich (^{60}Fe). Among these radionuclides, ^{53}Mn has the longest half-life, thus is least influenced by terrestrial ages. The advantage of ^{53}Mn and ^{60}Fe isotopes is that only two (Fe, Ni) and one (Fe) target element(s), respectively, dominate production, overcoming the problem of inhomogeneous S and P distribution. Our new ^{60}Fe data almost doubles that present in the literature. We measured ^{53}Mn in seven subsamples of the iron meteorite Twannberg. The new ^{53}Mn and ^{60}Fe data, with ^{10}Be, ^{26}Al, ^{36}Cl, ^{41}Ca and the noble gases, will better constrain the CRE histories of meteorites and will also serve as benchmarks to validate and improve Monte-Carlo model calculations.

MS 6.6 Wed 16:00 RW 2

Analysis of ^{233}U/^{236}U in environmental samples — •Karin Hain[1], Peter Steier[1], Rosmarie Eigl[2], Robin Golser[1], Xiaolin Hou[3], Johannes Lachner[1], Jixin Qiao[3], Francesca Quinto[4], and Aya Sakaguchi[2] — [1]University of Vienna, Faculty of Physics, Austria — [2]Hiroshima University, Japan — [3]Technical University of Denmark, Denmark — [4]Karlsruhe Institute of Technology, Germany

For the tracing of environmental waters, long-lived radionuclides of soluble elements like U, which mainly behave conservatively in water,

are demanded. Even though ^{236}U ($T_{1/2}$=2.342·10^7 a) in many cases is a suitable tracer for this application, the results on the concentration of ^{236}U can be difficult to interpret, e.g. for several contamination sources. The Accelerator Mass Spectrometry set-up at the Vienna Environmental Research Accelerator (VERA) has recently increased its detection efficiency for actinides such that it is now capable to detect also ^{233}U ($T_{1/2}$=1.592·10^5 a) in environmental samples. The detected average ^{233}U/^{236}U ratio in the environment is at a level of around 1%. First, preliminary results of ^{233}U/^{236}U in different types of sample material, e.g. corals, sediments, peat bog and sea water will be presented in this talk. These results indicate a predominant production of ^{233}U in a specific type of thermonuclear explosions which allows for source identification.

MS 6.7 Wed 16:15 RW 2

Quasi simultaneous measurements of ^{236}U/^{238}U ratios on the compact ETH Zurich Tandy AMS system — •Marcus Christl, Christof Vockenhuber, Sascha Maxeiner, Núria Casacuberta, Jürg Thut, and Hans-Arno Synal — Laboratory of Ion Beam Physics, ETH Zurich, Switzerland

Measurements of actinides with the compact 0.5 MV AMS system Tandy at ETH Zurich have become routine over the past years. With more than 200 samples analyzed per year (2012-2016), ^{236}U currently represents the most important actinide nuclide measured at ETHZ. Very recently new, small Faraday Cups (FC) with an opening of 8x12 mm^2 have been developed and installed at the HE side of the Tandy AMS system. With the new FCs it is now possible to perform quasi simultaneous measurements of ^{236}U/^{238}U ratios using the standard fast pulsing system. In this presentation the design of the FCs, the concept of the new AMS setup for ^{236}U/^{238}U and ^{236}U/^{233}U measurements, as well as the performance of the new FCs is presented. In addition to the technical part, new data from the ongoing oceanographic mapping program of ^{236}U (and ^{129}I) as well as the status of an intercalibration effort for ^{236}U will be presented.