MS 6: Accelerator Mass Spectrometry II

Time: Thursday 14:30–16:30 Location: F128

MS 6.1 Thu 14:30 F128

Status and development of Sr-90 measurements at CologneAMS — •Gereon Hackenberg[1], Markus Schiffer[1], Susan Herb[1], Dominik Elchine[2], Stefan Heinze[1], Carlo Baddeliyanage[1], Elisa Chopan[1], Devin Hymers[1], Martina Gwozdz[1], Tom Sittig[1], Erik Strub[2], Alfred Dewald[1], and Dennis Mücher[1] — [1]Institute for Nuclear Physics, University of Cologne — [2]Division of Nuclear Chemistry, University of Cologne

^{90}Sr is produced by nuclear fission and is a prominent nuclide in nuclear waste and fallout. Since the decay of ^{90}Sr produces no γ rays, but only low energy β rays, the detection mainly depends on the β decay of the daughter nucleus ^{90}Y. This demands a complex chemical treatment, because a probe has to be free of other beta emitters.

Using accelerator mass spectrometry ^{90}Sr can be measured directly. Here main efforts are a high sputter efficiency and the suppression of the stable isobar ^{90}Zr.

Measurements have been performed at the 10MV tandem accelerator in Cologne using standards produced at the department of nuclear chemistry. At 9MV a full separation of ^{90}Sr and ^{90}Zr was achieved. This contribution will present charge state distributions behind the stripper, transmission measurements, dE/dx-measurements with our multi anode gas ionization detector and sensitivity limits of the current setup for multiple energies.

This technique will be applied to characterize soil samples from the AVR Jülich.

MS 6.2 Thu 14:45 F128

Slow ions for heavy nuclei: The quest to find interstellar ^{182}Hf on Earth — •Michael Kern[1,2], Martin Martschini[1], Silke Merchel[1], Peter Steier[1], Anton Wallner[3], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics, Isotope Physics, Austria — [2]Vienna Doctoral School in Physics, University of Vienna, Austria — [3]Helmholtz-Zentrum Dresden-Rossendorf, Germany

A decade-long search to pin down nucleosynthesis events in our stellar neighborhood could be propelled by measuring the abundance patterns of live ^{182}Hf ($T_{1/2} = 8.9\,\mathrm{Myr}$) together with ^{60}Fe and ^{244}Pu, which were incorporated in terrestrial archives.

At the Vienna Environmental Research Accelerator (VERA), we developed an ion-laser interaction mass spectrometry (ILIAMS) setup to suppress challenging medium-mass isobars. It uses a radio-frequency quadrupole ion-guide filled with a reactive buffer-gas (He and O_2), where an intense laser beam overlaps with the ion beam. Less-strongly bound unwanted isobar species ($^{182}WF_5^-$) are removed, while wanted species ($^{182}HfF_5^-$) remain unaffected.

Ion optical simulations on injection and transport through the ILIAMS setup resulted in a new ion-guide design. It will allow acceptance of large emittance ion beams and will feature a UV-laser to destroy and/or neutralize WF_5^-. Additional challenges for ^{182}Hf detection are (a) the chemical preparation of HfF_4 AMS targets from large amounts of deep-sea MnFe crusts and (b) fabrication of reliable low-level ($^{182}Hf/Hf \simeq 10^{-13}$) reference materials.

MS 6.3 Thu 15:00 F128

Measurement of Interstellar Radionuclides as Fingerprints of Recent r-Process Events — •Sebastian Zwickel[1,2], Sebastian Fichter[1], Dominik Koll[1], Johannes Lachner[1], Georg Rugel[1], Konstanze Stuebner[1], Carlos Vivo Vilches[1], Stephan Winkler[1], and Anton Wallner[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Technical University Dresden, Dresden, Germany

Interstellar radionuclides deposited in our solar system can give information about recent nucleosynthesis events in the solar neighbourhood. The detection of ^{60}Fe with Accelerator Mass Spectrometry (AMS) in various geological and lunar samples yields evidence for two nearby supernovae (SNe) in the last 10 My. Measuring pure r-process ^{244}Pu in the same samples can relate SN nucleosynthesis with r-process signatures; either as a concomitant production or deposition. Its first detection in a deep sea manganese crust demonstrates the recent deposition of interstellar r-process nuclides in terrestrial archives, but is suffering from poor time resolution due to the rarity of ^{244}Pu.

This talk discusses the motivation and chemical sample preparation towards the search for ^{244}Pu as well as other radionuclides in lunar soil. The absence of geological activity allows for a longer search into the past than is possible with terrestrial material.

MS 6.4 Thu 15:15 F128

Improved ^{60}Fe measurements at CologneAMS — Susan Herb, Gereon Hackenberg, Markus Schiffer, Timm Pabst, Elisa Chopan, Alfred Dewald, and •Dennis Mücher — Institut für Kernphysik, Universität zu Köln

Since the first indication of Supernovae (SN) deposited signals in terrestrial reservoirs, the key isotope ^{60}Fe became an appealing isotope for astrophysical applications. Furthermore, ^{60}Fe produced in iron meteorites by galactic cosmic rays via spallation on ^{62}Ni and ^{64}Ni gives pivotal insight into the structure and history of our solar system. AMS is by far the most sensitive method to detect ^{60}Fe, with currently only a single laboratory offering ^{60}Fe AMS measurements, worldwide. This is partly due to the high beam energies required to suppress and separate the highly abundant isobar ^{60}Ni. In this work we present recent improvements of the 10MV AMS system at the University of Cologne which have significantly improved the efficiency and stability of the ^{60}Fe measurements using a gas-filled magnet. The fully digital setup now allows to tune the system and conduct the ^{60}Fe measurements fully automatically, further improving the overall efficiency of the AMS measurements. The currently achieved background level of $^{60}Fe/Fe$ of about $5 \cdot 10^{-15}$ allows for a routine measurement of iron meterotites. Future ideas to further improve the detection limit and efficiency of the setup will be discussed.

MS 6.5 Thu 15:30 F128

Cosmogenic ^{10}Be Dating of a Ferromanganese Crust Into the Early Miocene — •Dominik Koll[1,2], Anton Wallner[1], Johannes Lachner[1], Sebastian Fichter[1], Georg Rugel[1], Konstanze Stuebner[1], Carlos Vivo-Vilches[1], Stephan Winkler[1], Rene Ziegenruecker[1], and Sebastian Zwickel[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]The Australian National University, Canberra, Australia

Deep-sea ferromanganese crusts are slow-growing geological archives on seamounts without sediment coverage and are found in all major oceans. Their growth by precipitation with growth-rates of 1-10 mm/Myr records the oceanic inventory of radionuclides over several million years. The dating of ferromanganese crusts is typically achieved by following the decrease of cosmogenic ^{10}Be concentration in a depth-profile as a result of its radioactive decay.

In preparation for the search for the interstellar radionuclides ^{60}Fe and ^{244}Pu, the ferromanganese crust VA13/2-237KD was analyzed by optical and X-ray scans, stable element analysis and accelerator mass spectrometry for cosmogenic ^{10}Be until the end of the early Miocene. In this contribution, the characterization of the crust is presented with results from the cosmogenic ^{10}Be dating at the DREAMS facility of HZDR including an unexpected anomaly during the late Miocene.

MS 6.6 Thu 15:45 F128

Lowering the background levels of ^{14}C AMS measurements at CologneAMS — •Tom Sittig, Martina Gwozdz, Stefan Heinze, Markus Schiffer, Elisa Chopan, Gereon Hackenberg, Timm Pabst, and Dennis Mücher — Institute for Nuclear Physics, University of Cologne, Germany

AMS CO_2 gas measurements are useful as they allow for ultra small sample sizes to be analysed. A low background is important to achieve reliable and reproducible $^{14}C/^{12}C$ ratios. Because previously these background levels were higher than expected at CologneAMS when performing blank measurements, a source of contamination was investigated. As the result a new preparation routine has been implemented at the 6MV AMS system of CologneAMS.

By including the target holders alongside the CO_2-targets during heating for an extended period of time, followed by cooling both to room temperature under an argon atmosphere, we were able to decrease the background level by 60%. The new blank ratios are consistent with the machine blank level at $3.7 \cdot 10^{-15} \pm 18\%$. The stability of background levels is also improved and consistent with statistical expectations.

This increased stability allows us to investigate the sources of memory effects observed in cases where samples with low ^{14}C contents were

preceded by samples with high ^{14}C content, optimising our setup even further in the future.

MS 6.7 Thu 16:00 F128

Exploring analysis of ^{99}Tc at environmental levels — •Stephanie Adler[1], Karin Hain[1], Fadime Gülce[1], Martin Martschini[1], Stefan Pavetich[2], Stephen G. Tims[2], L. Keith Fifield[2], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics - Isotope Physics, Vienna, Austria — [2]Australian National University, Canberra, Australia

Determination of absolute concentrations of the anthropogenic radionuclide ^{99}Tc ($t_{1/2}$=2.1×10^5 yr) in environmental samples by AMS requires suppression of the stable isobaric background of ^{99}Ru and a reliable normalization method. At the Vienna Environmental Research Accaelerator (VERA) it was shown that RuF_5^- can be suppressed by a factor of up to 10^5 using a laser, making extraction of $^{99}TcF_5^-$ a viable option for Ion Laser InterAction MS (ILIAMS). However, none of the methods for the extraction of TcF_5^- provided a reproducibility better than 50%. Without ILIAMS, the separation of ^{99}Ru from ^{99}Tc is currently only possible at the AMS facility at the Australian National University (ANU), using a 14 MV tandem accelerator. There, ^{99}Ru and ^{99}Tc are separated in an 8-anode ionization chamber owing to minute differences in their energy loss characteristics, observable only at high ion energies. Experiments at the meanwhile shut-down Munich AMS-facility using TcO^- and normalization to the ^{93}Nb-current extracted from the sputter matrix showed a precision of 30%. Using this approach at the ANU, a ^{99}Tc dilution series of 10^{10}-10^7 at/sample was measured in preparation for the measurement of environmental samples, achieving R^2=0.993 and a blank level of ∼2×10^6 at/sample.

MS 6.8 Thu 16:15 F128

Sample preparation for accelerator mass spectrometry (AMS) – Approach to identify potential ^{10}Be contamination sources — •Silke Merchel[1,2], Johannes Lachner[1,2], Oscar Marchhart[1], Georg Rugel[2], and Alexander Wieser[1] — [1]University of Vienna, Faculty of Physics, Isotope Physics, Austria — [2]Helmholtz-Zentrum Dresden-Rossendorf, Germany

In the last decades, AMS has largely improved in the direction of lower detection limits, especially for applications of ^{10}Be/^{9}Be in Earth and environmental sciences. However, potential sources of ^{10}Be contamination while chemical sample preparation are often known but rarely identified in detail and quantified, which would be the first step to reduce these unwanted contributions. Thus, we have aimed at investigating ^{10}Be in (a) deionised/subboiled water, (b) commercial ^{27}Al carrier solutions, (c) ^{9}Be minerals and (d) cation exchange materials differently precleaned before first use. For better quantification, we have e.g., varied ^{27}Al amounts and used ^{27}Al carriers from different companies. Though, it was partially hard to distinguish in-between "single" ^{10}Be sources and between other sources like laboratory "dust" and cross-contamination (in lab and ion source) at the <4x10^{-15} level. To conclude, our general recommendation is to minimize the amounts of water, ion exchange materials and ^{27}Al carrier. For ultra-low-level ^{10}Be/^{26}Al dating, subboiled water and customised Al carriers from minerals might be advantageous. The good news, cross-contamination in an AMS chemistry lab in use for >12 years – for samples orders of magnitude different in ^{10}Be/^{9}Be – is negligible.