MS 8: Accelerator Mass Spectrometry and Applications I

Time: Wednesday 14:30–16:00 Location: f128

Invited Talk MS 8.1 Wed 14:30 f128

The new compact, multi isotope AMS system (MILEA) at ETH Zurich - performance and applications — •Marcus Christl[1], Sascha Maxeiner[2], Arnold Milenko Müller[2], Philip Gautschi[1], Christof Vockenhuber[1], Maxi Castrillejo[1], Nuria Casacuberta[1], and Hans-Arno Synal[1] — [1]Laboratory of Ion Beam Physics, ETH Zurich, Switzerland — [2]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 2018. The system is based on a 300 kV power supply and was optimized for small footprint (3.5 x 7 m^2) and to reach optimal performance for ^{10}Be, ^{14}C, ^{26}Al, ^{129}I, and actinide measurements at low energies. During the past year the system was thoroughly tested and is now starting to be used for routine AMS operations. In the first part of the presentation, the layout of the system, its ion optical properties and the setup for the different nuclides will be presented. The performance of the system with respect to ion currents, over-all transmission and background will be discussed for the different nuclides. In the second part of the talk most recent results of our actinide and heavy ion program will be presented. The results include some new data measured on MILEA which shows superior performance compared to our 500 kV Tandy system. In the application part new data from the distribution of ^{236}U and ^{129}I in the ocean as well as a ^{236}U/^{238}U record from sea shells from the Northeast Atlantic Ocean will be presented.

MS 8.2 Wed 15:00 f128

Increased ionization efficiency for the detection of ^{236}U and ^{233}U by AMS — •Michael Kern, Karin Hain, Maki Honda, Peter Steier, Andreas Wiederin, and Robin Golser — University of Vienna, Faculty of Physics - Isotope Physics, Austria

The ^{233}U/^{236}U ratio is a promising method for contamination source assessment. The detection of ^{233}U is most critical due to its abundance ranging below 10^{-12}, where the Vienna Environmental Research Accelerator (VERA) is to date the only instrument delivering sufficient detection efficiency for routine measurements of environmental samples. The ionization efficiency is the main limiting factor ($\approx 10^{-4}$). Introduction of a new preparation method for samples containing $\approx 5\,\mu$g U extracted as UF_5^- within PbF_2 + Fe_2O_3 matrix instead of UO^- sputtered from Fe_2O_3 yields a strong improvement in detection efficiency by up to a factor 10. Thus substantially shortened measurement duration could be obtained, while maintaining the same statistical uncertainty. We also succeeded in further cutting down hydrides of highly abundant adjacent masses (^{232}ThH^{3+}, ^{235}UH^{3+}) at lower He stripper gas pressure, which results in a further improvement of efficiency. This presentation will give detailed insights on the new sample preparation as well as ion current characteristics and method verification.

MS 8.3 Wed 15:15 f128

The difficulty to measure the neutron capture cross section of ^{235}U at thermal energies — Anton Wallner[1,2], Peter Schillebeeckx[3], Stefaan Pomme[4], Jan Wagemans[4], Jan Heyse[3], Roberto Capote[5], Michaela Froehlich[2], Peter Steier[6], Zsolt Revay[7], Christian Stieghorst[7], Ulli Koester[8], Thorsten Soldner[8], and •Tobias Jenke[8] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany — [2]The Australian National University, Canberra, Australia — [3]JRC-Geel, Retieseweg 111 B-2440 Geel, Belgium — [4]SCK CEN, Mol, Belgium — [5]Nuclear Data Section, IAEA, Vienna — [6]VERA laboratory, Univ. of Vienna, Austria — [7]FRM II, TU Munich, Germany — [8]Institut Laue-Langevin, Grenoble, France

The recommended *highly precise* cross-section value for ^{235}U neutron-capture at thermal energies is largely based on the difference from total and competing cross-sections of ^{235}U. Despite its importance and high value (100 barn), direct measurements of (n,γ) are rare (only two exist for thermal energies) and exhibit large uncertainties. The reason is the difficulty to measure the characteristic radiation of the reaction product ^{236}U within a dominant fission background (^{236}U has a long half-life of 23.4 Myr).

For this reasons, we started a project with a new method utilizing different neutron fields to evaluate its energy dependence in the low energy region. We use a combination of neutron activation and subsequent accelerator-mass-spectrometry (AMS) for direct atom counting of the reaction product ^{236}U.

MS 8.4 Wed 15:30 f128

Application of AMS to the research on nuclear waste disposal safety — •Francesca Quinto[1], Ingo Blechschmidt[2], Thomas Faestermann[3], Karin Hain[4], Dominik Koll[3], Gunther Korschinek[3], Stephanie Kraft[1], Johanna Pitters[4], Markus Plaschke[1], Georg Rugel[5], Thorsten Schäfer[6], Peter Steier[4], and Horst Geckeis[1] — [1]Karlsruhe Institute of Technology, Germany — [2]National Cooperative for the Disposal of Radioactive Waste, Switzerland — [3]Technical University of Munich, Germany — [4]University of Vienna, Austria — [5]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [6]Friedrich-Schiller-University, Jena, Germany

At the Grimsel Test Site (Switzerland), several in situ tracer tests aim at studying the possible radionuclide release from the bentonite engineered barrier system and the processes which may lead to their subsequent migration though the granodiorite host rock. We investigate the diffusion of Tc-99 and actinides (AN) through the bentonite and the remobilization over a time period of several years of the AN tracers employed in previous in situ tests. AMS is the ultra-trace analysis method of choice for studying the behaviour of Tc-99 and AN with concentration at and below fg/g levels in such dedicated long-term in situ tests, providing results that contribute to the safety evaluation of future nuclear waste repositories.

MS 8.5 Wed 15:45 f128

Ultra-trace Detection of ^{99}Tc in Environmental Samples by Accelerator Mass Spectrometry — •Johanna Pitters[1,2], Thomas Faestermann[3], Fadime Gülce[1], Karin Hain[1], Dominik Koll[3,4], Gunther Korschinek[3], Martin Martschini[1], Francesca Quinto[5], Georg Rugel[6], and Robin Golser[1] — [1]University of Vienna, Isotope Physics, Austria — [2]Vienna Doctoral School in Physics, Austria — [3]Technical University of Munich, Germany — [4]The Australian National University, Australia — [5]Karlsruhe Institute of Technology, Germany — [6]Helmholtz-Zentrum Dresden-Rossendorf, Germany

In our project we are developing methods for the detection of the anthropogenic radionuclide 99-Technetium by Accelerator Mass Spectrometry (AMS). For environmental samples, a highly effective chemical sample preparation method was developed, that removes a large fraction of the interfering elements Ruthenium and Molybdenum and embeds the Tc in a Niobium matrix. The samples were measured at the AMS setup of the Maier-Leibnitz-Laboratory in Munich by extraction of ^{99}TcO$^-$ from the ion source, stripping to ^{99}Tc^{12+} and normalizing to the ^{93}Nb^{11+} current. A particle energy of 150 MeV in combination with the detection via a Time-of-Flight path and the Gas-filled Analyzing Magnet System (GAMS) allows for a sensitivity of $5{\cdot}10^6$ atoms per sample. The method is discussed together with results from environmental samples. In particular, ^{99}Tc concentrations along a water column from the Pacific Ocean, as well as in porewater from an Austrian peat-bog are presented.