MS 5: Poster

Time: Tuesday 17:30–19:00 Location: Foyer Physik

MS 5.1 Tue 17:30 Foyer Physik

An experimental setup to study collisions of molecular ions using the 4k-pixel microcalorimeter detector MOCCA and follow-up integration into the Cryogenic Storage Ring CSR — •Selina Gaisser[1], Christian Enss[2], Andreas Fleischmann[2], Lisa Gamer[1], Oded Heber[3], Daniel Hengstler[2], Christopher Jakob[3], Daniel Kreuzberger[2], Ansgar Lowack[2], Abdullah Özkara[2], Micheal Rappaport[3], Andreas Reifenberger[2], Dennis Schulz[2], Abhishek Shahi[3], Yoni Toker[4], Andreas Wolf[1], and Oldřich Novotný[1] — [1]MPIK Heidelberg — [2]KIP Heidelberg University — [3]Weizmann Institute of Science, Rehovot, Israel — [4]Bar-Ilan University, Ramat Gan, Israel

One key process for the formation of over 300 molecular species detected in the InterStellar Medium (ISM) is Dissociative Recombination (DR). For a better understanding of this reaction, experimental studies under conditions similar to those in the ISM are necessary. A facility capable of such conditions and measurements is the electrostatic Cryogenic Storage Ring (CSR) at the Max Planck Institute for Nuclear Physics in Heidelberg. To obtain precise data, a detector which collects neutral DR products with high energy, time and position resolution is essential. Therefore, the 4k-pixel MOleCule Camera Array (MOCCA) based on Metallic Magnetic Calorimeters was designed and fabricated at the Kirchhoff Institute for Physics in Heidelberg. MOCCA will first be implemented in a CSR-independent standalone setup, where collisions between ions and a gas jet will be studied. The current status of the project will be presented.

MS 5.2 Tue 17:30 Foyer Physik

Recent technical developments and measurements at ISOLTRAP — •Paul Florian Giesel for the ISOLTRAP-Collaboration — Universität Greifswald, Institut für Physik, Greifswald, Deutschland

The ISOLTRAP setup at ISOLDE/CERN is a high-precision mass spectrometer designed to measure the masses of short-lived, exotic radionuclides far from the valley of stability. Utilizing both multi-reflection time-of-flight (MR-ToF) and Penning-trap mass spectrometry, ISOLTRAP performs precise absolute and relative mass measurements. Converting these measured masses into nuclear binding energies (via the mass-energy equivalence) provides critical insights into the underlying nuclear forces and structures.

This contribution will present the current status of ISOLTRAP and highlight recent technical developments, such as the implementation of a second linear Paul trap to rebunch mass-selected ion beams and the addition of a temperature-stabilization system for the MR-ToF mass spectrometer. Recent beamtime results will also be shown, focusing on the neutron-deficient ^{97,98}Cd ground states in the vicinity of the doubly-magic ^{100}Sn and the ^{97m}Cd isomeric state, as well as the first mass measurements of the neutron-rich ^{209,210,212}Hg.

MS 5.3 Tue 17:30 Foyer Physik

Investigation of a New Control Loop for the Stability of the Cologne 10 MV AMS System — •Marcus Sickmöller, Markus Schiffer, Gereon Weingarten, and Dennis Mücher — Institute for Nuclear Physics, University of Cologne

This work focuses on improving the voltage stability of the 10 MV tandem accelerator at the University of Cologne for improved Accelerator Mass Spectrometry (AMS) measurements. AMS requires pulsed ion beams with highly stable beam energies for precise isotopic ratio measurements, such as Fe-60 and Mn-53. Until now, the slit control mode, which offers superior long-term voltage stability (50-100 V/MV compared to 500-1000 V/MV in the Generating Voltmeter (GV) mode), could not be utilized due to the pulsed nature of AMS beams.

In this research project, modifications to the accelerator enabled the slit control mode to be applied for the first time with pulsed beams. A comparative analysis showed that the slit control mode significantly reduces beam instability caused by voltage fluctuations, enhancing measurement precision. However, challenges were observed during extended non-active pulse times, indicating areas for further optimization.

This work provides a starting point for improving terminal voltage stability in pulsed beam operation, making it comparable to that of non-pulsed beams.

MS 5.4 Tue 17:30 Foyer Physik

Ion-optical and optical measurements of the Anion Laser Isobar Separator - ALIS — •Derin Schmidt[1], Stefan Heinze[1], Oscar Marchhart[1,2,3], Dennis Mücher[1], and Markus Schiffer[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]University of Vienna, Faculty of Physics, Isotope Physics, Austria — [3]University of Vienna, Vienna Doctoral School in Physics, Vienna, Austria

As the detection of trace amounts of certain nuclides via Accelerator Mass Spectrometry (AMS) is highly dependent on the suppression of isobars, the Anion Laser Isobar Separator (ALIS) was installed at the University of Cologne for element-selective photo-detachment and buffer-gas reactions. The ion-optical system of the ion source and the injector magnet was characterized by beam profile measurements, and the results were compared to simulations. The ion source efficiency was measured for ^{12}C, ^{27}AlO, ^{88}SrF$_3$, and ^{35}Cl. An 18W continuous-wave 532 nm laser was installed, and transmission tests were conducted with the optical system to prepare for its future application in element-selective photo-detachment.

MS 5.5 Tue 17:30 Foyer Physik

Advancing AMS-based techniques for ultra-trace detection of ^{99}Tc — •Stephanie Adler[1,2], Martin Martschini[1], Dennis Mücher[3], Erik Strub[3], Thomas C. Meisel[4], and Karin Hain[1] — [1]University of Vienna, Faculty of Physics, Austria — [2]University of Vienna, Vienna Doctoral School in Physics, Austria — [3]University of Cologne, Institute for Nuclear Physics, Germany — [4]Montanuniversität Leoben, Austria

Determination of absolute concentrations of the anthropogenic radionuclide ^{99}Tc ($t_{1/2}$=2.1×10^5 yr) in environmental samples by accelerator mass spectrometry (AMS) requires the suppression of the stable isobaric background of ^{99}Ru and a reliable normalisation method. Classical AMS of ^{99}Tc at the Vienna Environmental Research Accelerator (VERA) yielded a reproducibility of 15% for normalisation to ^{93}Nb^{4+}. We achieved a detection limit of 2×10^9 atoms ^{99}Tc when correcting for the ^{99}Ru background by monitoring ^{101}Ru. With the addition of the Ion-Laser InterAction Mass Spectrometry (ILIAMS) setup, a better ^{99}RuF$_5^-$ suppression of up to 10^5 can be achieved. Previously, this method showed poor reproducibility, but we have finally improved the reproducibility from 50% to 15% by optimisation of ion source parameters. At the Montanuniversität Leoben, isobar suppression was tested using a thermal ionisation source. By extracting ^{99}TcO$_4^-$ ions, a ^{99}Ru suppression factor of 10^6 was achieved. The feasibility of normalisation with a ^{97}Tc spike is investigated. To produce the spike, a Nb foil was irradiated with a ^{7}Li^{3+} beam at the Institute for Nuclear Physics in Cologne yielding $> 5\times10^{12}$ atoms of ^{97}Tc.

MS 5.6 Tue 17:30 Foyer Physik

AMS-detection of ^{182}Hf: Characterization of new low-level reference materials and cross-contamination experiments — •Laurenz Widermann[1], Martin Martschini[1], Silke Merchel[1], Sebastian Fichter[2], Dominik Koll[2,3], Johannes Lachner[2], Johannes H. Sterba[4], Anton Wallner[2], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics, Austria — [2]HZDR, Dresden, Germany — [3]TUD Dresden University of Technology, Dresden, Germany — [4]TRIGA Center Atominstitut, TU Wien, Vienna, Austria

To detect the potentially supernova-produced radionuclide ^{182}Hf ($t_{1/2} = 8.9\cdot10^6$ yr) as low as $2.2\cdot10^4$ atoms per ferromanganese crust sample with Accelerator Mass Spectrometry (AMS), the stable isobar ^{182}W needs to be suppressed by six orders of magnitude.

Ion-Laser InterAction Mass Spectrometry (ILIAMS) in Vienna allows suppression of ^{182}WF$_5^-$ by a factor of 10^5. New low-level reference materials prepared from a known activity of ^{182}Hf, with ^{182}Hf/^{180}Hf ratios between 10^{-13}–10^{-11}, were characterized and cross-checked against ViennaHf-10 and ViennaHf-11. These previously used materials have too high ^{182}Hf/^{180}Hf ratios ($> 10^{-10}$) to allow measurements at the 10^{-14} level expected from crust samples.

New isobar spikes for correcting A = 182 counts for residual ^{182}W were investigated at the AMS-facilities in Vienna and Dresden. Sputtering targets spiked with varying amounts of tungsten revealed both short-term cross-contamination and long-term memory effects.

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MS 5.7 Tue 17:30 Foyer Physik

Multi-Actinide Analysis on Air Filters Collected in Different Environmental Settings — •Mihails Pavlenko, Helinä Poutamo, Nathalie Schuster-Bourgin, and Karin Hain — University of Vienna, Faculty of Physics, Austria

The earth's surface was labelled with human-produced long-lived actinides deposited as nuclear weapons fallout in the 1950s and 1960s, and, more locally restricted, by emission from the nuclear industry and major nuclear accidents. Until today, they take part in redistribution processes and are re-mobilized in the form of aerosols. The signals of the anthropogenic actinides ^{233,236}U, ^{237}Np,^{239,240,241}Pu, and ^{241}Am have been studied in air filters using Accelerator Mass Spectrometry (AMS) at the Vienna Environmental Research Accelerator (VERA). Samples provided by Deutscher Wetterdienst had been collected at various locations in Germany which suggest a different aerosol composition.

In this context, a chemical procedure preparing U, Pu and Np together in the same AMS target is being developed. First results e.g. on the chemical recovery, were compared to our routine preparation protocol of separating U from Pu and Np, respectively. The parallel analysis of Pu and U is within reach thanks to the efficient suppression of neighbouring masses in the actinide region at VERA.

MS 5.8 Tue 17:30 Foyer Physik

AMS for long-lived cosmogenic radionuclides in stony meteorites - Now without chemical preparation — •Silke Merchel, Oscar Marchhart, Martin Martschini, Alexander Wieser, and Robin Golser — University of Vienna, Faculty of Physics, Austria

Long-lived radionuclides in meteorites are a result of the interaction with cosmic rays. These cosmogenic nuclides (CNs) record the history of extraterrestrial matter. Reconstruction parameters of interest are: 1. pre-atmospheric size and shielding depth of the body in space (meteoroid); 2. irradiation time in space; 3. identification of complex exposure, i.e., repeated collisions or inherited CNs from pre-exposure at the surface of the meteoroid's parent body (asteroid, Moon, Mars); 4. residence time on Earth (terrestrial age). Accelerator mass spectrometry (AMS) is the preferred method for the detection of CNs such as ^{10}Be, ^{14}C, ^{26}Al, ^{36}Cl, and ^{41}Ca ($t_{1/2}$ = 6 ka – 1.4 Ma). However, tedious radiochemical separation to deplete matrices and isobars has been essential for AMS preventing rapid analysis until recently. Now, the unique Ion-Laser InterAction Mass Spectrometry (ILIAMS) system at the Vienna Environmental Research Accelerator provides isobar suppression of up to 14 orders of magnitude. Thus, ILIAMS-assisted AMS, allows the direct detection of ^{26}Al/^{27}Al ($\sim 10^{-10}$) and ^{41}Ca/^{40}Ca ($\sim 10^{-11}$) in stony meteorites containing intrinsic ∼1% Al and Ca. Isobars of the naturally-abundant elements (∼15% Mg, ∼0.1% K) do not interfere, making radiochemical separation redundant. Recent examples are the German and Austrian meteorite falls of Elmshorn, Ribbeck (Bischoff et al., *MAPS* 2024a/b) and Kindberg.

MS 5.9 Tue 17:30 Foyer Physik

Recurring Routine Measurements at DREAMS - Status and Challenges — •Georg Rugel, Toralf Döring, Sebastian Fichter, Klemens Kirsch, Dominik Koll, Johannes Lachner, Annabel Rolofs, Konstanze Stübner, Alexander Wieser, Stella Winkler, Janis Wolf, René Ziegenrücker, Sebastian Zwickel, and Anton Wallner — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

DREAMS, the DREsden AMS-facility in operation since 2011 is based on a 6 MV tandetron (manufactured by High Voltage Engineering Europa) and shared with other research groups at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR). DREAMS has been used primarily for the measurement of the cosmogenic isotopes ^{10}Be and ^{26}Al. Over the years, we have improved the AMS facility in various aspects for increased performance, particularly for these two isotopes. In this poster we will give details on the performance of our routine measurements over the past 13 years of operation with a focus on the impact of methodological developments since 2021. We will present our recent investigations and improvements on the performance of ^{10}Be and ^{26}Al measurements, highlight remaining key challenges, and point to potential future optimisations. Finally, we will show a comparison of our in-house standards material for ^{26}Al with the standards provided by Nishiizumi (KNSTD) demonstrating the compatibility of our analytical results with exposure-age calculators such as CRONUS-Earth.