Mass Spectrometry Division
Fachverband Massenspektrometrie (MS)

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Overview of Invited Talks and Sessions

(Lecture hall HS 3042; Poster Foyer Aula)

Invited Talks

MS 1.1	Mon	11:00–11:30	HS 3042	**High precision determination of nuclear mass ratios of stable even Yb isotopes to probe for fifth force mediators** — •Menno Door, Lucia Ensmann, Pavel Filianin, Zoltán Harman, Jost Herkenhoff, Christoph H. Keitel, Kathrin Kromer, Daniel Lange, Chunhai Lyu, Jan Nägele, Alexander Rischka, Christoph Schweiger, Sergey Eliseev, Klaus Blaum
MS 2.1	Mon	17:00–17:30	HS 3042	**Measurement of the bound-state beta decay of $^{205}Tl^{81+}$ ions at heavy-ion storage ring** — •Ruijiu Chen, Jan Glorius, Guy Leckenby, Yury A Litvinov, Maria Lugaro, Riccardo Mancino, Mohammad Shahab Sanjari, Ragandeep Singh Sidhu, Balazs Szanyi
MS 3.1	Tue	11:00–11:30	HS 3042	**Recent Developments at CologneAMS** — •Dennis Mücher
MS 5.1	Wed	11:00–11:30	HS 3042	**Laser spectroscopy studies of heavy actinides** — •Dominik Studer
MS 6.1	Wed	17:00–17:30	HS 3042	**Can we tame neutrons with a storage ring?** — •Iris Dillmann
MS 7.1	Thu	11:00–11:30	HS 3042	**High-precision mass measurements for nuclear structure and nuclear astrophysics** — •Anu Kankainen
MS 9.1	Fri	11:00–11:30	HS 3042	**Influx of interstellar ^{60}Fe and ^{244}Pu onto Earth within the last 10 million years recorded in a ferromanganese crust** — •Dominik Koll, Anton Wallner, Michael Hotchkis, Sebastian Fichter, L. Keith Fifield, Michaela Froehlich, Michi Hartnett, Johannes Lachner, Stefan Pavetich, Georg Rugel, Zuzana Slavkovska, Steve Tims

Invited Talks of the joint Symposium SAMOP Dissertation Prize 2024 (SYAD)

See SYAD for the full program of the symposium.

SYAD 1.1	Mon	14:30–15:00	Paulussaal	**Quantum steering of a Szilárd engine** — •Konstantin Beyer
SYAD 1.2	Mon	15:00–15:30	Paulussaal	**Does a disordered Heisenberg quantum spin system thermalize?** — •Titus Franz
SYAD 1.3	Mon	15:30–16:00	Paulussaal	**Quantum optical few-mode models for lossy resonators** — •Dominik Lentrodt
SYAD 1.4	Mon	16:00–16:30	Paulussaal	**Non-Hermitian topology and directional amplification** — •Clara Wanjura

Invited Talks of the joint Symposium Coulomb Explosion Imaging (SYCE)

See SYCE for the full program of the symposium.

SYCE 1.1	Tue	11:00–11:30	Paulussaal	**Dissociation of halogenated organic molecules induced by soft X-rays – pathways and early stages** — •Edwin Kukk
SYCE 1.2	Tue	11:30–12:00	Paulussaal	**X-ray induced Coulomb explosion imaging with channel-selectivity** — •Rebecca Boll
SYCE 1.3	Tue	12:00–12:30	Paulussaal	**Time-resolved Coulomb Explosion Imaging using X-ray Free-Electron Lasers** — •Till Jahnke

SYCE 1.4	Tue	12:30–13:00	Paulussaal	**Dynamics and control of microsolvated biomolecules studied by Coulomb explosion imaging** — •Sebastian Trippel, Jochen Küpper

Prize Talks of the joint Awards Symposium (SYAS)

See SYAS for the full program of the symposium.

SYAS 1.1	Tue	15:00–15:30	Paulussaal	**Quantum Simulations with Atoms, Molecules and Photons** — •Immanuel Bloch
SYAS 1.2	Tue	15:30–16:00	Paulussaal	**Spectroscopy of molecules with large amplitude motions: a journey from molecular structure to astrophysics.** — •Isabelle Kleiner
SYAS 1.3	Tue	16:00–16:30	Paulussaal	**Quantum x-ray nuclear optics: progress and prospects** — •Olga Kocharovskaya
SYAS 1.4	Tue	16:30–17:00	Paulussaal	**3D printed complex microoptics: fundamentals and first benchmark applications** — •Harald Giessen

Invited Talks of the joint Symposium Size Selected Metal Cluster Spectroscopies (SYMC)

See SYMC for the full program of the symposium.

SYMC 1.1	Thu	11:00–11:30	Paulussaal	**Infrared spectroscopic studies of molecular activation at metal clusters** — •Stuart Mackenzie
SYMC 1.2	Thu	11:30–12:00	Paulussaal	**Dynamic metal-metal cooperation in chemical reactions** — •Jana Roithová
SYMC 1.3	Thu	12:00–12:30	Paulussaal	**A closer look at the electronic structure of simple metal clusters** — •Bernd von Issendorff
SYMC 1.4	Thu	12:30–13:00	Paulussaal	**IR action spectroscopy of metal clusters, complexes and diatomics with free electron lasers** — •André Fielicke

Sessions

MS 1.1–1.7	Mon	11:00–13:00	HS 3042	**Precision Mass Spectrometry**
MS 2.1–2.8	Mon	17:00–19:15	HS 3042	**New Methods, Applications, Storage Rings**
MS 3.1–3.7	Tue	11:00–13:00	HS 3042	**Accelerator Mass Spectrometry I**
MS 4.1–4.14	Tue	17:00–19:00	Aula Foyer	**Poster**
MS 5.1–5.7	Wed	11:00–13:00	HS 3042	**Heavy and Superheavy Nuclei**
MS 6.1–6.7	Wed	17:00–19:00	HS 3042	**New Methods, AMS II, Applications, Actinides**
MS 7.1–7.7	Thu	11:00–13:00	HS 3042	**Accelerator Mass Spectrometry III**
MS 8	Thu	13:00–14:00	HS 3042	**Members' Assembly**
MS 9.1–9.7	Fri	11:00–13:00	HS 3042	**Accelerator Mass Spectrometry IV**

Members' Assembly of the Mass Spectrometry Division

Thursday 13:00–14:00 HS 3042

- Report
- Poster Prize Award
- Miscellaneous

MS 1: Precision Mass Spectrometry

Time: Monday 11:00–13:00 Location: HS 3042

Invited Talk MS 1.1 Mon 11:00 HS 3042

High precision determination of nuclear mass ratios of stable even Yb isotopes to probe for fifth force mediators — •Menno Door[1], Lucia Ensmann[1,2], Pavel Filianin[1], Zoltán Harman[1], Jost Herkenhoff[1], Christoph H. Keitel[1], Kathrin Kromer[1], Daniel Lange[1], Chunhai Lyu[1], Jan Nägele[1], Alexander Rischka[1], Christoph Schweiger[1], Sergey Eliseev[1], and Klaus Blaum[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]Universität Heidelberg, Fakultät für Physik und Astronomie, Heidelberg, Germany

Measurements with the Penning-trap mass spectrometer Pentatrap at the Max-Planck-Institut für Kernphysik in Heidelberg allow to determine mass-ratios of long-lived nuclides with a relative uncertainty of a few parts per trillion (ppt) using highly charged ions. These mass-ratio determinations of selected nuclides allow, among others, to contribute to stringent tests of bound-state quantum electrodynamics, neutrinophysics research, and physics beyond the Standard Model in general. The results that will be presented aim at the search for a new spinless boson, coupling electrons and neutrons, causing additional isotope shifts in the spectral lines of ytterbium. The required precision of a few ppt for the determination of even isotope mass-ratios was reached using a tunable cryogenic image-current detection system with single ion sensitivity, phase-sensitive measurement techniques, and remarkably stable trapping fields. The talk will present the experimental methods and results, and give an outlook in the context of King plot analysis and the interpretation for limits on proposed fifth force mediators.

MS 1.2 Mon 11:30 HS 3042

The Mass of ^{3}He - the Last Missing Piece in the Light Ion Mass Puzzle — •Olesia Bezrodnova[1], Sangeetha Sasidharan[1,2], Wolfgang Quint[2], Sven Sturm[1], and Klaus Blaum[1] — [1]Max Planck Institute for Nuclear Physics, Heidelberg, Germany — [2]GSI Helmholtzzentrum, Darmstadt, Germany

The masses of light nuclei form a network of parameters used in fundamental physics. $m(\mathbf{T}) - m(^3\mathbf{He})$, for example, must be known with the highest precision to check for systematic uncertainties in experiments such as KATRIN [1] or Project 8 [2], which study **T** β-decay to set a limit on the $\bar{\nu}_e$ mass. A Penning-trap measurement involving the bound electron g-factor can improve the precision of m_e if the mass of the reference nucleus, ^{4}**He**, is known with sufficient precision.

Penning trap mass measurements of the lightest nuclei have revealed considerable inconsistencies between the values reported by different experiments. To restore confidence in the literature values, the mass spectrometer LIONTRAP has measured the masses of the proton [3], the deuteron, the $\mathbf{HD}^+$ molecular ion [4], and most recently, ^{4}**He** [5]. This contribution presents the preliminary results of the ongoing ^{3}**He** mass measurement campaign, aimed at resolving the discrepancy of literature values known as the "Light Ion Mass Puzzle".

[1] M. Aker *et al.*, Nat. Phys. **18**, 160-166 (2022)
[2] Project 8 Collaboration, Phys. Rev. Lett. **131**, 102502 (2023)
[3] F. Heiße *et al.*, Phys. Rev. A **100**, 022518 (2019)
[4] S. Rau *et al.*, Nature **585**, 43-47 (2020)
[5] S. Sasidharan *et al.*, Phys. Rev. Lett. **131**, 093201 (2023)

MS 1.3 Mon 11:45 HS 3042

High-precision mass measurements with the PENTATRAP experiment — •Lucia Enzmann, Jan Nägele, Kathrin Kromer, Menno Door, Pavel Filianin, Christoph Schweiger, Sergey Eliseev, and Klaus Blaum — Max Planck Institute for Nuclear Physics, Heidelberg, Germany

The PENTATRAP experiment at the Max Planck Institute for Nuclear Physics in Heidelberg is one of the most precise Penning-trap mass spectrometers in the world capable of determining mass ratios of stable and long-lived highly charged ions with relative uncertainties in the low 10*12 regime. The data acquired by this state-of-the-art apparatus contributes to different fields of fundamental physics, e.g., fifth force search, neutrino physics, and highly charged ion clocks. In this contribution we will present latest results of PENTATRAP and its future perspectives. Some examples of our recent measurements are ^{163}Ho, the isotopic chain of Yb, ^{208}Pb, and ^{238}U.

MS 1.4 Mon 12:00 HS 3042

Re-measuring the nuclear masses of transuranium isotopes in the vicinity of the N=152 deformed neutron shell-closure — •Stanislav Chenmarev[1], Szilard Nagy[1], Klaus Blaum[1], Michael Block[2,3,4], Christoph E. Düllmann[2,3,4], and Dennis Renisch[3] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]Helmholtz-Institut Mainz, Germany — [3]Department Chemie - Standort TRIGA, Johannes Gutenberg-Universität, Mainz, Germany — [4]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

We have re-visited the region of actinides in the vicinity of the N=152 deformed neutron shell-closure, and repeated high-precision mass measurements using the newly implemented Phase Imaging Ion Cyclotron Resonance (PI-ICR) technique [1].

With our greatly improved apparatus we have measured the masses of ^{244}Pu, ^{241}Am, ^{243}Am, ^{248}Cm, ^{249}Cf, taking ^{208}Pb and ^{238}U as mass references. The masses of these reference ions were recently determined with ultra-high-precision at Pentatrap [2].

Our results are in good agreement with the latest Atomic Mass Evaluation. The recent mass measurements as well as their comparison to the AME2020 values will be presented and discussed.

[1] Chenmarev, S., *et al.* Eur. Phys. J. A **59.2** (2023): 29.
[2] Kromer, K., *et al.* Eur. Phys. J. A **58.10** (2022): 202.

MS 1.5 Mon 12:15 HS 3042

High-precision mass measurements of heavy and superheavy elements with SHIPTRAP — •Francesca Giacoppo for the SHIPTRAP-Collaboration — GSI Darmstadt, Germany — HIM Mainz, Germany

Probing the limit of existance at the uppermost corner of the nuclear chart requires a deep understanding of the nuclear properties of very heavy nuclides and their evolution in the superheavy region. Superheavy nuclei owe their existence to nuclear shell effects, which enhance their stability. The latter is also expressed in terms of increased binding energies, which can be experimentally investigated through direct mass measurements performed with Penning traps, providing information on the nuclear shell structure. If sufficient mass resolving power is achieved, the excitation energies of low-lying, long-lived metastable nuclear states, very common in the heaviest nuclei, can be obtained from the directly measured masses.

The SHIPTRAP experiment was developed to study heavy and superheavy nuclei produced via fusion-evaporation reactions at rates well below one particle per hour through Penning trap mass spectrometry. Thanks to the implementation of a cryogenic buffer-gas stopping cell and the development of the Phase-Imaging Ion-Cyclotron-Resonance technique, more exotic nuclei can be studied with even better precision and higher resolving power. In this contribution, a summary of the latest results, obtained as part of the FAIR phase-0 campaigns, will be presented.

MS 1.6 Mon 12:30 HS 3042

Recent mass measurements at ISOLTRAP — •Daniel Lange for the ISOLTRAP-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

High-precision mass measurements of radioactive ions are used to determine nuclear binding energies, which reflect all forces acting in the nucleus and are used to study among others nuclear structure, nuclear astrophysics, and weak interaction.

For this, the ISOLTRAP mass spectrometer at ISOLDE/CERN [1] uses various ion traps, including a tandem Penning-trap system and a multi-reflection time-of-flight mass spectrometer (MR-ToF MS), where the latter is suitable of both mass separation and fast, precise mass measurements.

In this contribution, the first direct mass measurements of neutron-deficient ^{97}Cd and the excitation energy of the ^{97m}Cd high-lying isomer along with a precise measurement of ^{98}Cd in the immediate vicinity of self-conjugate doubly magic $N = Z = 50$ ^{100}Sn will be presented together with measurements of neutron-rich ^{209,210}Hg.

Additionally, the current setup of the ISOLTRAP experiment is introduced together with the future re-bunching system using a new Mini-RFQ behind the MR-ToF MS to enable measurements of extremely contaminated beams.

[1] Lunney D. *et al.*, J. Phys. G: Nucl. Part. Phys. 44 (2017) 064008

MS 1.7 Mon 12:45 HS 3042

Analyzing a 30-year-old thorium foil with MR-ToF mass spectrometry — •Paul Fischer[1], Jonas Stricker[2,3], Dennis Renisch[2,3], Christoph Düllmann[2,3,4], and Lutz Schweikhard[1] — [1]Inst. f. Physik, Universität Greifswald, Germany — [2]Department Chemie, Johannes Gutenberg-Universität Mainz, Germany — [3]Helmholtz-Institut Mainz, Germany — [4]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

A foil of ^{232}Th produced roughly thirty years ago is investigated by high-vacuum laser-ablation and multi-reflection time-of-flight (MR-ToF) mass analysis. Cat- and anions are identified by precision mass measurements: By storing ions of interest between two opposing electrostatic mirrors, their flight time is increased, leading to mass resolving powers on the order of 100,000 and a corresponding rise in mass-measurement accuracy.

A number of thorium-monomer- and thorium-dimer-based molecules including carbon, nitrogen, oxygen, or fluorine atoms are found. Additionally, a small uranium contamination is observed, leading to compound molecules incorporating both Th and U. Selected species are excited with a 532-nm laser pulse to probe their photodissociation behavior and determine relative fragment abundances.

MS 2: New Methods, Applications, Storage Rings

Time: Monday 17:00–19:15 Location: HS 3042

Invited Talk MS 2.1 Mon 17:00 HS 3042

Measurement of the bound-state beta decay of $^{205}Tl^{81+}$ ions at heavy-ion storage ring — •Ruijiu Chen[1], Jan Glorius[1], Guy Leckenby[2], Yury A Litvinov[1], Maria Lugaro[4], Riccardo Mancino[1], Mohammad Shahab Sanjari[1], Ragandeep Singh Sidhu[1], and Balazs Szanyi[3] for the E121 collaboration-Collaboration — [1]GSI, Germany — [2]TRIUMF, Canada — [3]University of Szeged, Hungary — [4]Konkoly Observatory, Hungary

Heavy-Ion storage rings offer unparalleled capabilities for the measurement of the radioactive decay of highly charged ions. In this talk, we report on the recent results from the first direct measurement of the bound-state beta decay of bare $^{205}Tl^{81+}$ ions. The experiment was performed in March-April 2020 by employing the unique accelerator facility at GSI. The measurement is associated with two major physics motivations. One is linked with the LOREX project (acronym of LO-Randite EXperiment) wherein the measurement is needed to determine the matrix element for the pp neutrino capture by the ground state of ^{205}Tl to the 2.3 keV excited state in ^{205}Pb. This capture reaction has by far the lowest threshold ($E_{\nu_e} > 53$ keV) and is only experiment capable of extending the neutrino flux to lower energies. The second physics case is associated with the ^{205}Pb/^{205}Tl pair as a s-process cosmochronometer. In stellar plasmas, ^{205}Tl can exist in ionized form and β_b decay to the first excited state of ^{205}Pb can counter-balance the reduction of ^{205}Pb ions due to electron capture process. The measurement is crucial for predicting the ^{205}Pb expected in meteorites in the early solar system.

MS 2.2 Mon 17:30 HS 3042

Developments for the ion supply of the Heidelberg Cryogenic Storage Ring — •Felix Nuesslein[1], Klaus Blaum[1], Manfred Grieser[1], Florian Grussie[1], Thomas Kolling[2], Holger Kreckel[1], Preeti M Mishra[1], Gereon Niedner-Schatteburg[2], Oldřich Novotný[1], Viviane C Schmidt[1], and Andreas Wolf[1] — [1]Max-Planck-Institut für Kernphysik, 69117 Heidelberg, Germany — [2]Technische Universität Kaiserslautern, 67663 Kaiserslautern, Germany

The Cryogenic Storage Ring [1] provides optimal conditions for exploring interactions of charged atoms and molecules with photons, electrons, or neutrals in a radiatively cold environment. Its fully electrostatic design enables mass-independent storage of ions with kinetic energies up to 300 keV per elementary charge. The 300 kV ion source platform, one of two dedicated setups for these ions, branches into magnetic and electrostatic sections. The magnetic branch yields mass-selected continuous beams of atomic and small molecular ions with nA to μA currents, while the electrostatic branch focuses on more complex systems like clusters or biomolecules. Its ion optics can transport pulsed and continuous ion beams from up to four stationary sources, and its diagnostic elements are sensitive to μA ion currents down to single particles. In its initial development stage, the electrostatic branch will host a pulsed Laser VAPorization (LVAP) ion source for cluster ion production. We present commissioning results and the first mass spectra from the recently commissioned LVAP ion source.

[1] R. von Hahn et al., Rev. Sci. Instrum. 87 (2016) 063115.

MS 2.3 Mon 17:45 HS 3042

First experiments with the CSR-ReMi, the Reaction Microscope inside the cryogenic ion storage-ring CSR — •Felix Herrmann, Weiyu Zhang, David V. Chicharro, Florian Trost, Klaus Blaum, Manfred Grieser, Florian Grussie, Holger Kreckel, Oldřich Novotný, Andreas Wolf, Alexander Dorn, Robert Moshammer, Claus Dieter Schröter, and Thomas Pfeifer — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Deutschland

The CSR-ReMi is a newly installed in-ring reaction microscope for experiments with slow and cold molecular or cluster ions in the cryogenic storage ring CSR [1]. A reaction microscope (ReMi) is a combined electron and ion spectrometer [2, 3]. It offers multi-hit capability and provides high detection efficiency, acceptance and resolution. With the coincident detection of all collision fragments kinematically complete data-sets on the reaction dynamics can be collected. The integration of the CSR-ReMi into the CSR was finalized in July 2023 and first commissioning experiments under cryogenic conditions were performed recently. Emphasis was given to electron-transfer and electron-loss reactions in collisions of various types of stored ions with neutral atoms or molecules that were injected by a supersonic gas jet. Selected results of these first experiments will be presented.

References:
[1] R. von Hahn et al., Rev. Sci. Instrum. 87, 063115 (2016)
[2] J. Ullrich et al., Rep. Prog. Phys. 66, 1463-1545 (2003)
[3] H. Schmidt-Böcking et al., Ann. d. Phys. 533, 2100134 (2021)

MS 2.4 Mon 18:00 HS 3042

Noble Gas mass spectrometry of nuclear fuel particles from Chernobyl — •Laura Leifermann[1], Greg Balco[2], Autumn Roberts[2], Paul Hanemann[1], Tobias Weissenborn[1], Manuel Raiwa[2], Darcy van Eerten[1], Michael Savina[2], Brett Isselhardt[2], and Clemens Walther[1] — [1]IRS, Hannover, Deutschland — [2]LLNL, Livermore, USA

Noble gas mass spectrometry is generally used for determination of the elemental and isotopic composition of He, Ne, Ar, Kr and Xe in terrestrial and extraterrestrial samples. Here rock samples are heated to temperatures above 1500°C to extract the noble gases. In this work we analyzed the fission gases of individual micrometer-sized spent nuclear fuel particles from the Chernobyl exclusion zone. The particles were heated up to 1200°C and the released Xe and Kr was measured by noble gas mass spectrometry. The obtained isotope ratios give insight into important nuclear forensic information like neutron flux and sample age. In addition to noble gas mass spectrometry the particles were analyzed by resonant ion mass spectrometry for the particle's actinide isotopic composition. Furthermore, gamma spectrometry and energy-dispersive X-ray spectroscopy (EDS) measurements were carried out to maximize the knowledge on these 30-year-old nuclear fuel particles form the environment.

Part of this work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. Release number: LLNL-ABS-857826

MS 2.5 Mon 18:15 HS 3042

Photofission of dianionic tin-34 clusters — Alexander Jankowski, Paul Fischer, Moritz Grunwald-Delitz, and •Lutz Schweikhard — Inst. of Physics, Univ. of Greifswald, 17487 Greifswald

Small tin clusters (of number of atoms n below 50) are formed by building blocks of Sn_7, Sn_{10} [1-3] and, in the case of anionic clusters, Sn_{15} [3]. This leads to corresponding fragmentation patterns [4,5] as

confirmed and further investigated [6,7] at ClusterTrap [8]. In particular, dianionic tin clusters fission into two monoanionic fragments [7], as previously found for the case of lead clusters [9]. Now, selected ensembles of Sn_{34}^{2-} clusters were irradiated by nanosecond laser pulses of variable photon energies, causing photodissociation (besides electron detachment). After a variable delay time, the remaining stored cluster ensemble is analyzed by time-of-flight mass spectrometry. The time-resolved measurements allow for the reconstruction of the decay pathways, confirming the competition of fission processes.

[1] C. Majumder et.al., *Phys. Rev. B* **64**, 233405 (2001)
[2] H. Li et al., *J. Phys. Chem. C* **116**, 231-236 (2011)
[3] A. Lechtken et al., *J. Chem. Phys.* **132**, 211102 (2010)
[4] E. Oger et al., *J. Chem. Phys.* **130**, 124305 (2009)
[5] A. Wiesel et al., *Phys. Chem. Chem. Phys.* **14**, 234-245 (2012)
[6] S. König et. al., *Eur. Phys. J. D* **72**, 153 (2018)
[7] M. Wolfram et.al., *Eur. Phys. J. D* **74**, 135 (2020)
[8] F. Martinez et al., *Int. J. Mass Spectrom.* **266**, 365-366 (2014)
[9] S. König et. al., *Phys. Rev. Lett.* **120**, 163001 (2018)

MS 2.6 Mon 18:30 HS 3042

Solvation of Cun+/- in He and H2 — •Olga Lushchikova[1], Johannes Reichegger[1], Fabio Zappa[1], Machael Gatchell[2], Massimiliano Bartolomei[3], Jose Campos-Martínez[3], Tomas González-Lezana[3], Fernando Pirani[3], and Paul Scheier[1] — [1]Institut für Ionenphysik und Angewandte Physik, Universität Innsbruck, Austria — [2]Department of Physics, Stockholm University, Sweden — [3]Instituto de Física Fundamental, IFF-CSIC, Spain

The exploration of copper's versatility in hydrogen (H2) and helium (He) interactions at a microscale holds promise for novel energy storage and chemical applications. This research addresses the intricate challenges of understanding these interactions. Through mass spectrometry, we investigate how small copper clusters (Cun+/-, n=1-10) solvate in He and H2. Grown within superfluid helium nanodroplets, these clusters are exposed to room temperature He or H2, yielding He/H2-solvated copper ions. The low temperature and high collision rate enable the solvation of positively/negatively charged clusters in over fifty H2/He units, analyzed via high-resolution mass spectrometry.

Key findings identify stable structures in Cun+/- clusters, utilizing helium as a probing species. In H2 settings, alongside the Cu core, an H-Cu core has been observed within cationic clusters, displaying a unique series of solvation with the initial layer composed of four H2 molecules. Anionic clusters, in contrast, exhibit very weak binding to both H2 and He. These complexes became observable only due to ultracold helium droplet conditions.

MS 2.7 Mon 18:45 HS 3042

Resonant ionization spectroscopy (RIS) of Tm-169 with a quadrupol mass separator (QMS) setup — •Jana Weyrich[1,3], Michael Block[1,2,3], Premaditya Chhetri[1,3], Tom Kieck[1,2], Danny Münzberg[1,2,3], Sebastian Raeder[1,2], and Dominik Studer[1,2] — [1]Helmholtz-Institut, Mainz, DE — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, DE — [3]Johannes Gutenberg-Universität, Mainz, DE

Experimental studies on heavy and superheavy elements are an important field of research to contribute to our understanding of the underlying nuclear structure which stabilizes these nuclei against fission. As the heaviest nuclides are radioactive and often short-lived, they are typically only available in small quantities. Resonant ionization spectroscopy (RIS) and subsequent mass selection proves to be a useful technique to determine atomic and nuclear properties by probing atomic spectra. Additionally, preceding analysis of stable isotopes or lighter homologues of the nuclide under investigation is indispensable to optimize and tailor the techniques for gaining insight into the structure of the target nuclide.

Therefore, an existing setup was further developed for the investigation of elements available off-line and in macroscopic quantities using RIS and a quadrupole mass separator (QMS). As a first result an ionization scheme of thulium was developed for future studies of neutron deficient isotopes of thulium at the GSI facility with the RADRIS technique. In this contribution the setup will be presented, together with laser spectroscopic results and the future prospects will be discussed.

MS 2.8 Mon 19:00 HS 3042

MetroPOEM - Metrology for the harmonisation of measurements of environmental pollutants in Europe — •Stephan Winkler for the MetroPOEM-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The European Green Deal's commitment to achieving zero pollution necessitates the development of highly sensitive techniques for detecting minute amounts of pollutants. Fulfilling this need involves implementing strategies outlined by two European Metrology Networks (EMN): Pollution Monitoring (PolMo) and Radiation Protection. These networks support the Basic Safety Standards directive. Detecting radioactive isotopes and stable polluting elements in the environment requires analytical procedures that are not only fast, sensitive, and inexpensive but also validated using traceable multi-element reference materials for the optimal application of single collector ICP-MS. Unfortunately, multi-element certified reference materials are typically unavailable, and single-element certified reference materials are limited to a handful of elements. However, the urgent need for these reference materials persists, as they play a crucial role in calibrating mass spectrometric measurements and mitigating mass bias effects during the measurements in mass spectrometers. To tackle these challenges, the MetroPOEM project (21GRD09) has been initiated. Coordinated by the Physikalisch-Technische Bundesanstalt of Germany, MetroPOEM will be executed by a consortium of 23 partners spanning 13 European countries.

MS 3: Accelerator Mass Spectrometry I

Time: Tuesday 11:00–13:00 Location: HS 3042

Invited Talk MS 3.1 Tue 11:00 HS 3042

Recent Developments at CologneAMS — •Dennis Mücher — Institut für Kernphysik, Universität zu Köln

The Institute for Nuclear Physics at the University of Cologne hosts two AMS setups: the 10 MV FN Tandem coupled to a gas-filled magnet and the 6 MV Tandetron accelerator. CologneAMS is fully integrated into an interdisciplinary research infrastructure at the University of Cologne, enabling fruitful collaborations with the Departments for Geology, for Archeology and for Nuclear Chemistry, among others. In this talk I will give an overview about the status und future plans of the CologneAMS facilities related to various applications in geoscience, nuclear waste management, and others. The focus of my presentation will be our research on nucleosynthesis of heavy elements in the universe, creating a link between our local efforts to experiments at world-leading large-scale radioactive ion beam facilities.

MS 3.2 Tue 11:30 HS 3042

Preparations for a new 1 MV AMS facility in Dresden — •Johannes Lachner, Toralf Döring, Sebastian Fichter, Georg Rugel, Stephan Winkler, René Ziegenrücker, and Anton Wallner — Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research

A new AMS system called HAMSTER (Helmholtz Accelerator Mass Spectrometer Tracing Environmental Radionuclides) will be installed in Dresden-Rossendorf to expand the capabilities of radionuclide measurements at HZDR. It consists of a 1 MV pelletron tandem accelerator and has a conventional ion source for classic AMS operation and two additional injection lines: One injection line holds an ion cooler supporting isobar suppression (Ion Linear Trap for Isobar Suppression, called ILTIS), the other is a SIMS (Secondary Ion Mass Spectrometer) moved from its original location at the 6 MV DREAMS facility to continue performing Super-SIMS measurements at the new machine.

The facility will be placed in a new building that holds space for the experimental area and control room of the AMS as well as for two chemistry laboratories. Installation of the first injector beamline with the ILTIS is foreseen for early 2024 and we expect HAMSTER to be in operation by summer. In this contribution we will introduce the surrounding infrastructure and layout of the new facility.

MS 3.3 Tue 11:45 HS 3042

Upgrade of the silicon nitride absorber for ^{10}Be AMS at VERA — •Carlos Vivo-Vilches, Peter Steier, Martin Martschini, Silke Merchel, and Robin Golser — University of Vienna, Faculty of Physics, Austria

Suppression of ^{10}B in accelerator mass spectrometry of ^{10}Be at VERA is provided by a stack of silicon nitride foils placed in front of a gas ionization chamber. A nominal thickness of 6700 nm is just enough to stop ^{10}B ions, while letting ^{10}Be ions reach the detector. This avoids the ^{10}Be losses of the degrader foil technique used in the past, arising from angular scattering and the different charge states after the foil, increasing the detection efficiency. A disadvantage of the foil stack setup until now was the fixed thickness of the foils once the setup is inside the beamline. More generally, the background caused by products from the nuclear reaction of ^{10}B with the ^{1}H present in the foils, ^{1}H(^{10}B,α)^{7}Be, makes it challenging to reach similar ^{10}Be/^{9}Be blank ratios as with the degrader foil technique.

Recently, a rotatable silicon nitride foil with a thickness of 1200 nm was installed in front of the foil stack, allowing adjustments in the total thickness for optimization of the ^{10}B suppression and ^{10}Be transmission. Besides, it also improves discrimination of the ^{7}Be background. The size of each foil and their distances to the detector have also been studied in simulations and experimentally in order to decrease the angular acceptance of ^{7}Be ions without significantly losing ^{10}Be ions. In this talk we will present first results on the efficiency, reproducibility and the blank value achieved with this setup.

MS 3.4 Tue 12:00 HS 3042

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

During the last years the performance of DREAMS, the DREsden AMS-facility, at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR) was improved in various aspects. The system is based on a 6 MV tandetron manufactured by High Voltage Engineering Europa (HVEE) and shared with various other groups at HZDR. This report will give detail on the performance of our routine measurements and an overview of the range of research topics of user projects at DREAMS. Moreover, we will present recent improvements and investigations on the performance of ^{10}Be and ^{26}Al measurements and highlight key challenges remaining, and potential future developments.

MS 3.5 Tue 12:15 HS 3042

Current status of ALIS - The new low-energy isobar suppression setup at CologneAMS — •Markus Schiffer[1], Oscar Marchhart[1,2,3], Elisa Linnartz[1], Martin Martschini[2], Gereon Hackenberg[1], Peter Steier[2], Melisa Maslo[4], Timm-Florian Pabst[1], Erik Strub[4], Tibor Dunai[5], Robin Golser[2], and Dennis Mücher[1] — [1]University of Cologne, Institute of Nuclear Physics, Cologne, Germany — [2]University of Vienna, Faculty of Physics, Isotope Physics, Vienna, Austria — [3]University of Vienna, Vienna Doctoral School in Physics, Vienna, Austria — [4]University of Cologne, Division of Nuclear Chemistry, Cologne, Germany — [5]University of Cologne, Institute of Geology and Mineralogy, Cologne, Germany

The integration of a unique low-energy isobar suppression unit, the Anion Laser Isobar Separator (ALIS), marked a significant extension to the Cologne 6 MV AMS-System. After the successful test of the advanced gas-filled radio frequency quadrupole (RFQ) ion cooler at the Vienna test bench, we present insights from the first benchmark tests conducted at ALIS.

Our efforts focused on performance tests of the 134 sample MC-SNICS ion source and to verify its reliability, specifically for the extraction of SrF_3^-. The recent implementation of a beam attenuator has facilitated the injection of stable ion beams into the RFQ.

Additionally, we have integrated an 18 W 532 nm continuous wave laser for photodetachment of isobar anions, in compliance with German regulatory standards.

MS 3.6 Tue 12:30 HS 3042

Sample detection efficiency and detection limits for the determination of actinides at the ETH Zürich MILEA system — •Habacuc Pérez Tribouillier and Marcus Christl — Laboratory of Ion Beam Physics, ETH Zürich

This study investigates the impact of varied matrix compositions, specifically iron and niobium content, on the detection efficiency of actinides (Pu, Am, and U) using the MILEA system at ETH Zürich. Our findings highlight the significance of optimal matrix composition, a factor intricately linked to the desired analysis duration. Larger matrices are observed to be advantageous for extended measurement times, particularly beneficial for lower-concentration samples. Additionally, we present our detection limits for Pu, Am, and U isotopes, and apply them for the determination of these isotopes on small-volume samples from the area near the Fukushima Nuclear Power Plant and the North Sea.

MS 3.7 Tue 12:45 HS 3042

Applications for high throughput AMS gas measurements at the low energy limit — •Daniele De Maria[1], Urs Ramsperger[1], Marco Bolandini[2], Negar Haghipour[2], Lukas Wacker[1], and Marcus Christl[1] — [1]Laboratory of Ion Beam Physics, ETH Zurich, Switzerland — [2]Geological Institute, ETH Zurich, Switzerland

Over the last decade, the interest in radiocarbon AMS analysis of combusted samples has increased due to significant progresses made towards compact AMS systems and the development of hybrid ion sources, allowing the analysis of samples in gaseous form. To address the requirements of higher sample throughput and level of automation, a novel gas handling system, the Double Trap Interface (DTI), was developed. The original idea was to provide an instrument tailored to meet the specific requirements of biomedical companies performing metabolism and pharmacokinetic studies using ^{14}C-labeled pharmaceutical compounds as a tracer. The methodology has in general a huge potential for all high throughput applications, opening the field for nanoplastics studies and the analysis of different organic compounds in sediments. These applications are particularly suited for the miniaturized radiocarbon detection system LEA (Low Energy AMS), which has been installed at the Laboratory of Ion Beam Physics (ETH Zurich) in 2021. The instrument follows basic MICADAS design principles but operates at a terminal voltage of 50 kV only. An overview of LEA and the coupled peripherals for gas measurements as well as some preliminary results of the experiments performed over the last months are presented.

MS 4: Poster

Time: Tuesday 17:00–19:00 Location: Aula Foyer

MS 4.1 Tue 17:00 Aula Foyer

The CSR-ReMi – a wide-range spectrometer for collision studies in the CSR — •Claus Dieter Schröter, Felix Hermann, Weiyu Zhang, David V. Chicharro, Florian Trost, Klaus Blaum, Manfred Grieser, Florian Grussie, Holger Kreckel, Oldřich Novotný, Andreas Wolf, Alexander Dorn, Robert Moshammer, and Thomas Pfeifer — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Deutschland

Reaction microscopes (ReMi's) [1, 2] are combined electron and ion spectrometers for energy and angular resolved detection of fragments resulting from elementary collision processes. In order to use this powerful technique for collision studies with slow and cold molecular or cluster ions inside the cryogenic storage ring CSR [3], we have built a dedicated in-ring spectrometer, the CSR-ReMi. The CSR-ReMi is fully operational and first experiments have been performed just recently on electron transfer and collisional ionization reactions. Experiments on photo-detachment with atomic and molecular anions are envisaged for spring 2024. In the poster we will present an overview of the complex technical design of the machine and we will give insights into possible future scientific applications.

References:
[1] J. Ullrich et al., Rep. Prog. Phys. 66, 1463-1545 (2003)
[2] H. Schmidt-Böcking et al., Ann. d. Phys. 533, 2100134 (2021)
[3] R. von Hahn et al., Rev. Sci. Instrum. 87, 063115 (2016)

MS 4.2 Tue 17:00 Aula Foyer

Apparatus for deterministic ionization and loading of molecules — •René Nardi, Brandon Furey, Stefan Walser, Zhenlin Wu, Mariano Isaza Monsalve, Elyas Mattivi, and Philipp Schindler — Universität Innsbruck, Institut für Experimentalphysik, Innsbruck, Österreich

We study the complex rovibrational structure of trapped molecular ions and their potential applications in molecular quantum information processing. Our experiments are currently limited to investigating CaOH+, which are created from chemical reactions of trapped Ca+ and free H2O. In order to load other molecular species, we are building a test setup where a molecular gas is injected in a vacuum chamber, photoionized, and then guided into an ion trap. This test setup features a time-of-flight mass spectrometer to determine the ions created by photoionization of N2+ and acetylene. Mass filters and ion optics can then be added to steer and focus the molecule of interest through a differential pumping region towards a linear Paul trap in a UHV chamber. Molecular ions can be injected into the trapping region through an aperture in the end-cap electrode for axial confinement in our linear ion trap.

MS 4.3 Tue 17:00 Aula Foyer

Recent measurements and developments at Isoltrap — •Christoph Schweiger for the ISOLTRAP-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Isoltrap [1] is a multi ion-trap mass spectrometer located at ISOLDE/CERN dedicated to high-precision mass measurements of artificially produced, short-lived, exotic radionuclides far from stability. Experimentally, Isoltrap employs multi-reflection time-of-flight and Penning trap mass spectrometry for absolute and relative mass measurements. The measured masses can be connected to nuclear binding energies using Einsteins famous relation between mass and energy: $E = mc^2$. The nuclear binding energy reflects all underlying interactions in the nucleus and allows the study of nuclear structure and nuclear astrophysics, the weak interaction and further fundamental physics applications. The current status of the experimental setup and recent technical developments will be presented as well as the results of the most recent beamtime periods. This includes the neutron deficient ^{97,98}Cd ground states in 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}Hg. A measurement of the ^{79m}Zn isomer resolved the state ordering of the 1/2+ and 5/2+ states and solidifies previous evidence of shape coexistence [2].

[1] Lunney, D. *et al.*, *J. Phys. G: Nucl. Part. Phys.* **44**, 064008 (2017)
[2] Nies, L. *et al.*, arXiv:2310.16915v1 (2023)

MS 4.4 Tue 17:00 Aula Foyer

Simulating space charge effects in the ILIAMS ion cooler @ VERA — •Daniel Baumgartner, Martin Martschini, and Robin Golser — University of Vienna, Faculty of Physics, Austria

Ion Laser InterAction Mass Spectrometry (ILIAMS) at the Vienna Environmental Research Accelerator (VERA) is a novel approach to Accelerator Mass Spectrometry (AMS) enabling the measurement of nuclides otherwise inaccessible to low- and medium-energy AMS facilities and improving the detection limit for several other isotopes by orders of magnitude. Undesired isobaric components of an anion beam are neutralized through photodetachment via a collinearly overlapped laser of suitable energy inside a buffer-gas-filled, RF-Quadrupole ion cooler. The selected nuclear species of interest with higher detachment energy remain unaffected and propagate along a constant electric gradient. The system is optimized for long ion residence times of several milliseconds to ensure sufficient interaction time with the laser. However, measurements show that residence time decreases for increasing nA beam currents. At μA ion currents, even the transmission starts to decrease. To provide insights and potential explanations for these indeterminate effects, this poster highlights results of recent particle simulations with COMSOL Multiphysics® accounting for fully dynamic space charge. In addition to a strong influence on particle trajectories, charge effects can also cause an increase in a) phase space volume, b) average particle energy and c) velocity of propagation.

MS 4.5 Tue 17:00 Aula Foyer

Complementary Actinide Markers for the Anthropocene in Coral Cores — •Aline Zoufal[1], Kateřina Fenclová[2], Jens Zinke[3], Simon Turner[4], Andrew Cundy[5], and Karin Hain[1] — [1]University of Vienna, Faculty of Physics, Austria — [2]Czech Technical University in Prague, Czech Republic — [3]University of Leicester, England — [4]University College London, England — [5]University of Southampton, England

This study investigates the presence of anthropogenic actinides (^{236}U, ^{237}Np, ^{239,240}Pu) in the marine environment, originating from intense nuclear weapons testing in the 1960s, resulting in global fallout of radioactive isotopes. Corals, chosen for their ability to incorporate trace elements from surrounding seawater into their skeletons, serve as archives of past environmental conditions. Their growth bands offer a precise annual chronological record of actinide concentrations, potential proxies for ocean circulation changes in (sub)tropical oceans. Our project examines actinide concentrations in corals from Flinders Reef, Coral Sea, Australia in the context of discussions of the newly proposed Anthropocene epoch. This study presents the first profile of ^{237}Np in coral cores, positioning it as a promising oceanographic tracer. Preliminary results indicate a conservative behaviour in ocean water, similar to ^{236}U. The high sensitivity and selectivity of Accelerator Mass Spectrometry (AMS) allow for small sample sizes and eliminate the need for chemical separation of the elements. Consequently, a simplified sample preparation procedure can be applied which precipitates all actinides together with a carrier and a ^{242}Pu spike.

MS 4.6 Tue 17:00 Aula Foyer

Development and improvement of radiochemical separation schemes for actinide determination using AMS — •Janis Wolf, Dominik Koll, Sebastian Zwickel, and Sebastian Fichter — Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, Dresden, Germany

The determination of minute amounts of actinides in a huge variety of sample matrices is a challenging task. The current capabilities of state-of-the-art accelerator mass spectrometers enable detection limits close to a few hundred atoms per sample. However, proper sample preparation is inevitable to separate the element of interest from the overwhelming majority of the sample mass. Here, we present some of our current activities regarding the optimization of work-up procedures for different actinides (i.e. Pa, Np, Pu, Am, Cm) from environmental samples like water, soil, deep sea ferromanganese crusts and lunar regolith.

MS 4.7 Tue 17:00 Aula Foyer

Preparing the implantation of ^{55}Fe for radioactive activity standardisation at RISIKO using RIMS — •Daniel Mowitz[1], Sebastian Berndt[1], Holger Dorrer[1], Christoph E. Düllmann[1,2,3], Raphael Hasse[1], Sebastian Kempf[5], Tom Kieck[2,3], Nina Kneip[4], Michael Müller[5], Ole J. Nähle[6], Thorben Niemeyer[1], Dennis Renisch[1,3], and Klaus Wendt[1] — [1]Johannes Gutenberg-Universität, Mainz — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [3]Helmholtz-Institut, Mainz — [4]Leibniz Universität, Hannover — [5]Institut für Mikro- und Nanoelektronische Systeme, Karlsruhe — [6]Physikalisch-Technische Bundesanstalt, Braunschweig

In the frame of the EU PrimA-LTD project, injection of 5 Bq of the radioisotope ^{55}Fe into gold absorbers of metallic magnetic calorimeter (MMC) detectors with a size of 0.14 x 0.14 mm^2 is in progress at the RISIKO mass separator at JGU Mainz. Within PrimA-LTD, new activity standardisation techniques for radionuclide metrology are developed to increase the resolution of energy measurements on electron-capture decay considerably. Resonance ionisation mass spectrometry with a recently developed two-step ionisation scheme for iron is employed using the JGU Ti:Sa laser systems, to ensure outstanding element selectivity and efficiency. In order to attain maximum ion beam quality, i.e. yield and purity in respect to the ubiquitous stable iron isotopes ^{54,56,57,58}Fe, several components of the laser ion source unit were optimized. Mass spectra and further implantation tests show the feasibility of our approach and will be discussed at the conference.

MS 4.8 Tue 17:00 Aula Foyer

Photodissociation of mono-, di, and trianionic tin clusters — •Moritz Grunwald-Delitz, Paul Fischer, Alexander Jankowski, and Lutz Schweikhard — Inst. of Physics, Univ. of Greifswald, 17487 Greifswald

(Poly-)anionic tin clusters ($Sn_n z-$ of sizes $n < 70$ with charge states $z = 1, 2, 3$) were studied at the ClusterTrap setup [F. Martinez et al., IJMS **266** (2014) 365] with regard to their fragmentation patterns upon photoexcitation. While monoanionic tin clusters have shown a shift in their fragmentation behavior from break-off of neutral Sn_7 and Sn_{10} clusters (for $n < 45$) to sequential monomer evaporation (for $n > 45$)

[M. Wolfram et.al., EPJD **74** (2020) 135], the investigations have now been extended to larger clusters, also including charge state $z = 3$. To this end, the tin cluster ensemble, produced by laser ablation, is stored in a Penning trap. After isolation of a single mono-anionic cluster species, it is exposed to an electron bath for electron attachment, i.e. the population of higher charge states [S. König et. al., EPJD **72** (2018) 153]. The separated cluster species is then irradiated with a nanosecond-laser pulse, resulting in delayed photodissociation. Break-off of neutral Sn_3, Sn_5 and Sn_9 is observed for all three charge states. In addition, the trianionic cluster shows fission into Sn^{2-}_{n-10} + Sn^{-}_{10} in analogy to the decay of dianions, where Sn^{-}_{10} is also identified as a fission product.

MS 4.9 Tue 17:00 Aula Foyer

Progress Update on the ELISE Project at FSU Jena: Optimizing Negative Ion Supression for AMS through Laser Techniques — •Shiva Prasad Pulipati[1], Oliver Forstner[1], Klaus Wendt[2], and Thorben Niemeyer[2] — [1]Friedrich-Schiller-Universität Jena — [2]Gutenberg-Universität Mainz

The Extended Laser Isobar Separator (ELISE)@IBC project, is currently in the construction phase at FSU Jena. Our current work focuses on constructing a negative ion source test setup for ELISE and emphasizes the process of negative ion suppression through laser-assisted techniques. Our goal is to significantly improve the isotopic measurements concerning abundance sensitivity by highly selective AMS (accelerator mass spectrometer) techniques by further orders of magnitude without altering the state-of-the-art Cs sputter ion sources. This contribution provides a progress update on our ongoing investigations on the intricate relationship between laser radiation and negative ions at the low energy side of an AMS. Our primary objective is to leverage laser technology for the selective enhancement or suppression of specific negative ion species already during or immediately after production in the ion source, thereby enhancing the sensitivity of isotopic measurements considerably.Our efforts include the meticulous characterization of laser parameters influencing ion suppression and the testing of an ion cooler system designed to slow down negative ions to thermal energies, ensuring long-term overlap with a laser beam. Careful tuning of laser frequency and power for the photodetachment process will allow for optimum suppression of elemental and molecular contaminations.

MS 4.10 Tue 17:00 Aula Foyer

A new ion cooler for HAMSTER — •Alexander Wieser[1,2], Johannes Lachner[1], Stefan Findeisen[1], Martin Martschini[2], Toralf Döring[1], Toni Wallner[1], and Robin Golser[2] — [1]HZDR - Accelerator Mass Spectrometry and Isotope Research — [2]University of Vienna - Faculty of Physics, Isotope Physics

Using laser photodetachment for isobar separation in Accelerator Mass Spectrometry (AMS) was successfully established with the Ion-Laser Interaction Mass Spectrometry (ILIAMS) system at the Vienna Environmental Research Accelerator, enlarging the repertoire of long-lived radioisotopes measurable by AMS. The ion beam is overlapped with a laser beam of suitable photon energy, neutralizing interfering isobars, while leaving the isotope of interest unaffected. To maximize interaction time between laser beam and ion beam, the 30 keV ions are decelerated and cooled in a gas-filled radiofrequency quadrupole to near-thermal energies. A similar setup called ILTIS (Ion Linear Trap for Isobar Suppression) was designed at HZDR in cooperation with the University of Vienna and will be incorporated in the new 1 MV-accelerator facility HAMSTER. With a powerful 532 nm cw-laser, this ion cooler will enable HAMSTER to measure ^{36}Cl, ^{26}AlO, ^{90}Sr and ^{135,137}Cs at environmental abundances. This poster will give an overview on design and first ion beam tests of the new ion cooler.

MS 4.11 Tue 17:00 Aula Foyer

Characterization of ion transmission in an electrospray ionization-mass spectrometry interface equipped with an S-lens — •Yihui Yan, Kevin Li, and Jozef Lengyel — Chair of Physical Chemistry, TUM School of Natural Sciences, Technical University of Munich, Garching, Germany

We present the design and performance of an in-house-built electrospray ionization-mass spectrometry (ESI-MS) interface equipped with an S-lens ion guide. The ion source was designed specifically for our ion beam experiments to investigate the particle nucleation and chemical reactivity of the clusters and nanoparticles. This interface consists of standard ESI-MS components, including: ion transfer capillary, the S-lens, quadrupole, and hexapole ion guides. A custom design enables systematic optimization of all relevant factors influencing transfer through the interface. Each of these ion guides was characterized over a wide range of RF frequencies and amplitudes. To track the ion transmission properties, we monitored both ion current and ion signals recorded by TOF mass spectrometer. The maximum transmission efficiency of the ESI-MS interface ranged from 10% to 30%, depending on whether the analyte was a molecular ion or a fragile cluster. Herein, we will describe the factors influencing ion transmission and analyze the observed trends.

MS 4.12 Tue 17:00 Aula Foyer

MOCCA: a 4k-pixel molecule camera for the position and energy resolved detection of neutral molecule fragments — •Abdullah Özkara[1], Christian Enss[1], Andreas Fleischmann[1], Lisa Gamer[2], Loredana Gastaldo[1], Daniel Hengstler[1], Christopher Jakob[2], Daniel Kreuzberger[1], Ansgar Lowack[1], Oldřich Novotny[2], Andreas Reifenberger[1], Dennis Schulz[1], and Andreas Wolf[2] — [1]Heidelberg University — [2]Max Planck Institute for Nuclear Physics, Heidelberg

The MOCCA detector is a 4k-pixel high-resolution molecule camera based on metallic magnetic calorimeters and read out with SQUIDs that is able to detect neutral molecule fragments with keV kinetic energies. It will be deployed at the Cryogenic Storage Ring CSR at the Max Planck Institute for Nuclear Physics in Heidelberg, a storage ring built to prepare and store molecular ions in their rotational and vibrational ground states, enabling studies on electron-ion interactions. To reconstruct the reaction kinematics, MOCCA measures the energy and position of the molecule fragments incidenting on the detector, even with multiple particles hitting the detector simultaneously.
We present an improved read-out scheme which uses a logarithmic decay time spacing. This makes it possible to use only 32 SQUID channels for the read-out of 4094 pixels of the detector. In addition, we compare the simulations of this read-out scheme to previous measurements.

MS 4.13 Tue 17:00 Aula Foyer

Optimizing AMS parameters for actinide fluoride measurements — •Sophie Schoberleitner, Karin Hain, Martin Martschini, Andreas Wiederin, and Peter Steier — University of Vienna, Faculty of Physics, Austria

For anions with low ionization efficiencies by caesium sputtering, isotopic abundance ratios below 10^{-12} pose a significant challenge even for the sensitive method of Accelerator Mass Spectrometry (AMS), suppressing the total detection efficiency. Possibilities for improving actinide fluoride measurements at the Vienna Environmental Research Accelerator (VERA) regarding detection efficiency and reproducibility have been examined, and measurement procedures for detection efficiencies of ^{236}U, ^{237}Np, ^{242}Pu and ^{243}Am, extracted as various (oxy-)fluoride molecules, have been developed. Moreover, an in-depth investigation of the effect of various potential alternative sample holder materials (Ni, C, Fe) on the ionization efficiency of $^{238}UF_5^-$ has been carried out. The potential of the fluorine-rich NdF_3 sample matrix optimizing the formation of $^{237}Np/^{242}Pu$ (oxy-)fluoride molecules, as well as the influence of injection energy and the use of shorting rods on sections of the tandem accelerator on the ion beam transmission, have been explored. The comparison of hydride suppression for $^{238}UF_5^-$ and $^{238}UO^-$ molecular systems as a function of stripper gas pressure indicates that measurements using the fluoride system can run at lower pressure, and thus, increase the ion optical transmission.

MS 4.14 Tue 17:00 Aula Foyer

IRPD Study of $[Cu(OAc)H_2O]^{+1}$ and $[Cu_2(OAc)_3]^{+1}$ — •Shabnam Haque — Universität Leipzig, Wilhelm-Ostwald-Institut für Physikalische und Theoretische Chemie, Linnéstr. 2, 04103 Leipzig, Germany

Porous materials like MOFs and zeolites containing under-coordinated Cu centres play an important role in dihydrogen adsorption as well as the efficient isotope separation of H_2/D_2. In the present study, our focus lies on the spectroscopic characterization of Secondary Building Units (SBU) of MOFs and understand the H_2/D_2 adsorption and binding behaviour. The infrared photodissociation spectra of $[Cu(OAc)(H_2O)\text{ -}D_2]^{+1}$ and $[Cu_2(OAc)_3\text{ -}2D_2]^{+1}$ are measured at 14 K for both far-IR(1000-1900 cm^{-1}) and mid-IR regions (2400-4400 cm^{-1}). On comparison with harmonic calculations (B3LYP-TZVPP), $[Cu(OAc)(H_2O)\text{ -}D_2]^{+1}$ is found to have a trigonal structure whereas the cation with two Cu^{2+} centres assumes a paddle-wheel motif. The ν_{DD} stretch vibrations, appearing at 2802 cm^{-1} for $[Cu(OAc)(H_2O)$-

$D_2]^{+1}$ and at 2889 cm^{-1} for $[Cu_2(OAc)_3\text{-}2D_2]^{+1}$ indicate a stronger bonding. Furthermore, temperature dependent measurements performed in cryogenically cooled ring-electrode trap give an insight into the D_2 adduct yield. D_2 binding is found to be more efficient for $[Cu_2(OAc)_3]^{+1}$ compared to $[Cu(OAc)(H_2O)]^{+1}$, indicating a higher stability of the paddle-wheel complex.

MS 5: Heavy and Superheavy Nuclei

Time: Wednesday 11:00–13:00 Location: HS 3042

Invited Talk MS 5.1 Wed 11:00 HS 3042

Laser spectroscopy studies of heavy actinides — •Dominik Studer for the Fermium-Collaboration — Helmholtz-Institut Mainz — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

Precise measurements of nuclear ground-state properties, e.g., spins, electromagnetic moments, and charge radii provide data on the shell structure and serve as benchmarks for theory, which contribute to obtaining a comprehensive picture of nuclear phenomena in heavy nuclei. However, experiments with exotic artificial transuranics are challenging due to limited sample sizes or production yields, and scarcity of atomic structure information. Here we report on an extended laser spectroscopy campaign, targeting isotopes of Cf, Es and Fm. These nuclides were predominantly produced at ORNL's High Flux Isotope Reactor. Part of the sample from ORNL was subsequently also reirradiated at the high-flux reactor at ILL Grenoble, France, to produce ^{255}Es, serving as a ^{255}Fm generator, as well as ^{253,254}Cf. Laser spectroscopic studies were carried out at the RISIKO mass separator at the University of Mainz using resonance ionization spectroscopy. Broadband laser scans served to explore atomic spectra, and high-resolution spectroscopy - feasible with sample sizes on the femtogram level - allowed the extraction of isotope shifts and nuclear moments from hyperfine spectra. On-line laser spectroscopy of shortlived Fm isotopes, produced by nuclear fusion reactions at the GSI accelerator facility in Darmstadt, complement these studies and allowed the exploration of the N=152 neutron shell gap.

MS 5.2 Wed 11:30 HS 3042

Status of the JetRIS experiment for on-line laser spectroscopy of superheavy elements — •Sebastian Raeder for the JetRIS-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — Helmholtz-Institut Mainz

Laser spectroscopy of the heaviest elements is of high relevance for our understanding of fundamental atomic and nuclear structure. Atomic energy levels in heavy systems become strongly influenced by electron correlations as well as relativistic effects and are largely unknown for transfermium elements, while posing a major challenge to theory. From a nuclear physics point of view, superheavy elements lie on the frontier to the region of enhanced shell stabilization, with their unique structure manifesting in the evolution of various observables. Laser spectroscopy enables the determination of spins, electromagnetic moments and changes in mean square charge radii. Experiments on transfermium elements have to be performed on-line with quantities of few atoms per second or below. At GSI, fusion-evaporation products are separated from the primary beam by the SHIP velocity filter and stopped in a gas cell. In-gas cell spectroscopy has been used successfully to probe the spectra of No and Fm. However, the spectral resolution of this method is limited by Doppler- and pressure broadening, which often renders a detailed evaluation of hyperfine structures impossible. The JetRIS setup improves spectral resolution by performing spectroscopy in a low-pressure, low-temperature supersonic gas jet and enables experimental linewidths in the order of few hundred MHz. The current status of the JetRIS experiment will be presented.

MS 5.3 Wed 11:45 HS 3042

Status of Development of MR-ToF MS for JetRIS for laser spectroscopy of the heavy actinides at GSI/HIM — •Danny Münzberg[1,2,3], Michael Block[1,2,3], Alexandre Brizard[4], Arno Claessens[5], Rafael Ferrer[5], Paul Fischer[6], Christian Helmel[3], Mustapha Laatiaoui[3], Nathalie Lecesne[4], Sebastian Raeder[1,2], Hervé Savajols[4], Moritz Schlaich[7], Lutz Schweikhard[6], Matou Stemmler[3], Kenneth van Beek[1,7], Piet Van Duppen[5], Thomas Walther[7], Klaus Wendt[3], and Frank Wienholtz[7] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, DE — [2]Helmholtz-Institut, Mainz, DE — [3]Johannes Gutenberg-Universität, Mainz, DE — [4]GANIL, Caen, France — [5]KU, Leuven, Belgium — [6]Universität Greifswald, DE — [7]Technische Universität, Darmstadt, DE

The in gas-Jet Resonant Ionization Spectroscopy (JetRIS) apparatus is applied for laser spectroscopy of isotopes in the heavy actinide region to determine their atomic and nuclear properties, at GSI, Darmstadt, Germany. So far, JetRIS utilizes α-decay detection to maximize sensitivity while minimizing the background from unwanted ions. However, for long-lived nuclides ($t_{\frac{1}{2}} > 10$ h) decay-based detection will not be practical. Therefore a multi-reflection time-of-flight mass separator (MR-ToF MS) will be added to the JetRIS apparatus, allowing for a separation of ions by their mass-to-charge ratios with a high mass-resolving power and efficiency. This will open up the possibility of mass-selective ion detection with low background and will also enable the measurement of non α-decaying species, as well as long-lived and stable isotopes. The MR-ToF MS design is developed within the Darmstadt's MR-ToF (Da's MR-ToF) Collaboration and an overview on the setup and its integration into JetRIS will be given. The status of the comissioning, as well as experimental results and prospects for future measurements will be discussed.

MS 5.4 Wed 12:00 HS 3042

Characterization of the MR-ToF for JetRIS at GSI/HIM — •Christian Helmel[1,3], Michael Block[1,2,3], Alexandre Brizard[4], Arno Claessens[5], Rafael Ferrer[5], Paul Fischer[6], Mustapha Laatiaoui[3], Nathalie Lecesne[4], Danny Münzberg[1,2,3], Sebastian Raeder[2,3], Hervé Savajols[4], Moritz Schlaich[7], Lutz Schweikhard[6], Matou Stemmler[1], Kenneth van Beek[2,7], Piet Van Duppen[5], Thomas Walther[7], Klaus Wendt[1], and Frank Wienholtz[7] — [1]Johannes Gutenberg-Universität, Mainz, DE — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, DE — [3]Helmholtz-Institut, Mainz, DE — [4]GANIL, Caen, France — [5]KU, Leuven, Belgium — [6]Universität Greifswald, DE — [7]Technische Universität, Darmstadt, DE

At the GSI in Darmstadt and the Helmholtz Institute in Mainz laser spectroscopy is utilized to determine nuclear and atomic properties of heavy actinides with high precision. To extend the range of accessible nuclides practically independent of their half-lives and their decay mode the detection capability of the existing systems will be expanded by a Multi-Reflection Time-of-Flight Mass Separator (MR-ToF MS). This MR-ToF, built within the Da's MR-ToF Collaboration, enables mass-selective ion detection. Currently, the MR-ToF MS is in the characterization phase establishing the resolving power and the efficiency, for example, with off-line ion sources. An example of this would be the determination of the time focus on which the resolution and the circulation rate are to be optimized. Furthermore the influence of the beam path on the detector signal has to be tested. In addition, a cooler buncher is to be integrated to determine the influence of the energy distribution on the signal and make laser spectroscopy measurements with high repetition lasers possible. In the future, the MR-ToF MS will be added in the JetRIS setup for off-line and on-line MRToF assisted laser spectroscopy.

MS 5.5 Wed 12:15 HS 3042

Optimization and development of RFQ Cooler Bunchers for S3-LEB at GANIL and JetRIS at GSI — •Alexandre Brizard for the S3-LEB and JetRIS-Collaboration — GANIL, CEA/DRF-CNRS/IN2P3, Caen, France — GSI Helmholtzzentrum fur Schwerionenforschung GmbH, Darmstadt, Germany

At the focal plane of the S3 separator in GANIL, the S3-Low Energy Branch (S3-LEB) will perform in-gas-jet resonant laser ionization to access fundamental properties of exotic nuclei. This highly selective and efficient technique will produce pure beams for further measurements, among those mass measurements by a Multi-Reflection Time-Of-Flight Mass Spectrometer (MR-ToF-MS). JetRIS is working in complement to the Radiation Detected Resonance Ionization Spectroscopy (RADRIS) setup at GSI. The technique is similar to the one of the S3-LEB gas cell, with RIS performed in a hypersonic gas jet to

reduce the pressure and Doppler broadening. Presently, an alpha detector is used for efficient detection with low background. An MR-ToF-MS will be installed to study long-lived nuclides where alpha detection is impractical as well as beta-decaying nuclides. The MR-ToF-MS requires a beam bunching. A RFQ Cooler Buncher (RFQcb) has been designed and is commissioned with the S3-LEB setup. Ion-trajectory simulations will help optimizing the transmission and properties of bunches. The design of the JetRIS bunching unit is finalised and its commissioning will happen in 2024. Here, we present the ongoing work on the RFQcb simulations to improve the performances of S3-LEB in GANIL, and the design of the new RFQcb for JetRIS at GSI.

MS 5.6 Wed 12:30 HS 3042

Hyperfine structure of a Lawrencium homologue via Laser Resonance Chromatography — •Aayush Arya[1], Eunkang Kim[1], Michael Block[1,2,3], Biswajit Jana[1], Sebastian Raeder[2,3], Harry Ramanantoanina[1], Elisabeth Rickert[1], Elisa Romero Romero[1], and Mustapha Laatiaoui[1,2,3] — [1]Johannes Gutenberg-Universität Mainz, D-55128 Mainz — [2]Helmholtz-Institut-Mainz, D-55128 Mainz — [3]GSI Helmholtzzentrum für Schwerionenforschung, D-64291 Darmstadt

Atoms of different chemical elements possess absorption lines which serve as their unique fingerprints and provide direct insight into their internal structure. At present, elements up to atomic number 118 have been discovered, but due to their very short lifetimes and extremely low production rates even at the most intense beam facilities, the transfermium elements have thus far evaded direct spectroscopy. Recently, resonance ionization spectroscopy of nobelium was successfully achieved "one atom at a time". However, pushing beyond nobelium with existing methods is challenging, and may require development of new methods for accessing even a single element. To this end, a technique named Laser Resonance Chromatography was conceived and has been successfully commissioned. Here, we present measurements of hyperfine structure and isotope shifts of lutetium ions using this method.As lutetium is an electronic homologue of lawrencium, our method relying on the ion-mobility based separation of different excited states directly demonstrates its potential for the laser spectroscopy of Lr and opens a new window for studying the superheavy elements.

MS 5.7 Wed 12:45 HS 3042

Designing a compact buffer-gas cell for recoil-ion sources for the SHIPTRAP experiment — •Jaykumar Patel[1,2], Michael Block[1,3,4], Francesca Giacoppo[1,4], Manuel J. Gutiérrez[1,4,5], and Alexandre Obertelli[6,7] — [1]GSI, Darmstadt, Germany — [2]TUD, Darmstadt, Germany — [3]JGU, Mainz, Germany — [4]HIM, Mainz, Germany — [5]University of Greifswald, Germany — [6]IKP, TU Darmstadt, Germany — [7]RIKEN Nishina centre, Japan

Masses of transuranium nuclides, for example around the N=152 deformed shell gap are pivotal for understanding shell evolution and nuclear structure in that region. By combining α decay energies and direct mass measurements e.g. from SHIPTRAP and RIKEN-KEK, various masses in this region have already been determined. However, expecting extended regions of enhanced stability, the shell gap evolution in different isotopic chains is of interest. Mass measurements on long lived isotopes can be performed with high precision with Penning traps by using different ion sources. Currently used laser-ablation ion sources need large sample sizes, which is unsuitable for transuranium isotopes. This can be overcome by recoil ion sources where the recoil ions from α decays can be used for mass measurements. This work aims at building a compact buffer gas cell in which recoil ions are stopped at low energies for efficient transport to the Penning trap. The cell with a funnel-type electrode system will operate at room temperature with He gas at pressures around 50 mbar. This setup, enabling offline measurements of certain isotopes, can serve as a reference for mass measurements of superheavy element at SHIPTRAP, GSI Darmstadt.

MS 6: New Methods, AMS II, Applications, Actinides

Time: Wednesday 17:00–19:00 Location: HS 3042

Invited Talk MS 6.1 Wed 17:00 HS 3042

Can we tame neutrons with a storage ring? — •Iris Dillmann — TRIUMF Vancouver, Canada — University of Victoria, Canada

Neutrons play a crucial role in the synthesis of elements heavier than iron in stars and stellar explosions via the slow (s), intermediate (i), and rapid (r) neutron capture processes.

Due to the location of these processes on the chart of nuclei, the availability of experimental data greatly differs. While masses and beta-decay half-lives are well measured for the majority of the presently known ~3300 nuclei, neutron capture reactions have only measured at and close to stability in the past 50 years [1]. However, the direct measurement of neutron cross sections with shorter half-lives (half-live <1 year) requires the use of radioactive beams in inverse kinematics and the development of new methods.

For the measurement of neutron capture cross sections of shorter-lived nuclei so far only indirect methods have been used. I will describe a path towards a pioneering facility consisting of a heavy-ion storage ring connected to our ISAC radioactive beam facility at TRIUMF where some of these reactions could be measured directly, with a moderated neutron target [1].

[1] I. Dillmann, O. Kester, et al., Eur. Phys. J. A59 (2023) 105

MS 6.2 Wed 17:30 HS 3042

Assessment of anthropogenic actinide background levels on HZDR's research campus — •Sebastian Fichter[1], Karin Hain[2], Peter Steier[2], Michael Hotchkis[3], and Anton Wallner[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, Dresden, Germany — [2]University of Vienna, Faculty of Physics, Isotope Physics, Vienna, Austria — [3]Australian Nuclear Science and Technology Organisation, Lucas Heights, Australia

The new multi-purpose 1-MV AMS facility HAMSTER (*Helmholtz Accelerator Mass Spectrometer for Tracing Environmental Radionuclides*) in Dresden-Rossendorf will commence operation in 2024. The new machine is dedicated to the analysis of ultra-trace levels of actinides in environmental samples. Thus, the aim of this study is to assess the actinide background on HZDR's research campus to rule out any potential contamination caused by the former research reactor on-site. Hence, several soil samples close to the construction site of the new accelerator building and former radioisotope production facilities have been analyzed. The samples have been processed in the existing chemistry labs of HZDR's 6-MV DREAMS facility and the newly established HAMSTER labs showing comparable low background levels. The measured Pu concentrations and isotopic ratios are in agreement with global fallout signature. However, in some samples increased ^{236}U concentrations and relatively low ^{233}U/^{236}U atomic ratios have been detected pointing to an additional reactor source of ^{236}U. Additional sample analysis will be performed with HAMSTER in 2024.

MS 6.3 Wed 17:45 HS 3042

Where do we lose Protactinium in Environmental Sample Preparation for Accelerator Mass Spectrometry? — •Janis Wolf[1,2], Astrid Barkleit[2], Leonie Ebenberger[1,3], Sebastian Fichter[1], Robin Steudtner[2], and Anton Wallner[1] — [1]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf — [2]Institute of Resource Ecology, Helmholtz-Zentrum Dresden-Rossendorf — [3]University of Vienna, Austria

Protactinium-231 (Pa-231) is a long lived ($t_{1/2} = 3.28 \cdot 10^4$ a), naturally occurring radionuclide, produced in the natural decay series of uranium-235 (U-235). A measurement of Pa-231 at environmental concentrations would enable the investigation of the migration pattern of Pa-231 in the environment and thus improve the radiological risk assessment of the U-235 decay chain.

Pa-231 is not yet routinely measured by Accelerator Mass Spectrometry (AMS) but procedures for the chemical sample preparation for AMS measurements of Pa-231 are currently being developed. The biggest challenge in establishing a Pa-231 measurement procedure is the lack of knowledge on the chemical behavior of Pa. High losses of Pa in the sample preparation pose the biggest issue in the development of a reliable and reproducable chemical sample preparation procedure.

Using the short-lived isotope, Pa-233 ($t_{1/2}$ = 27 days), we tested the AMS sample preparation procedure for different environmental samples. By conducting gamma activity measurements of Pa-233 af-

ter every sample preparation step, a comprehensive overview of the biggest Pa sinks is established.

MS 6.4 Wed 18:00 HS 3042

Residence time measurements of Cl^- ions inside the ILIAMS cooler in equilibrium — •Felix Albrecht, Martin Martschini, Michael Kern, Peter Steier, and Robin Golser — University of Vienna, Faculty of Physics, Austria

The ILIAMS (Ion-Laser InterAction Mass Spectrometry) ion cooler, developed at VERA (Vienna Environmental Research Accelerator), plays a pivotal role in providing isobar separation for isotopes that are typically inaccessible to mid-energy accelerator mass spectrometry systems. By combining a gas-filled RFQ ion guide with high-powered lasers, ILIAMS suppresses unwanted isobaric anions via laser photodetachment. The suppression efficiency is limited by the ion residence time inside the cooler, which can be varied mainly through the buffer gas pressure and the guiding field strength.

For the first time, measurements of the ion residence time at equilibrium conditions were performed using a new, custom-built multi-beam switcher. Through sequential injection of the stable isotopes $^{35}Cl^-$ and $^{37}Cl^-$, followed by mass separation by a Wien filter, the buildup- and washout functions of both ion species were observed. The about 3-times higher-current $^{35}Cl^-$ beam pushed the previously injected, lower-current $^{37}Cl^-$ ions through the cooler, yielding a peak in the washout function. This allowed for a direct observation of space charge effects inside the ILIAMS cooler.

Similarly, by pulsed injection of $^{37}Cl^-$ into a $^{35}Cl^-$-filled cooler, residence time distributions of the former were directly measured.

MS 6.5 Wed 18:15 HS 3042

Development of an Ion Mobility Spectrometer towards studies of Lanthanides and Actinides — •Biswajit Jana[1,2], Aayush Arya[1,2], Eunkang Kim[1,2], Elisabeth Rickert[1,2,3], Elisa Romero Romero[1,2], Harry Ramanantoanina[1,2], Sebastian Raeder[2,3], Michael Block[1,2,3], and Mustapha Laatiaoui[1,2,3] — [1]Department Chemie, Johannes Gutenberg Universität, Fritz-Strassmann-Weg 2, 55128 Mainz, Germany — [2]Helmholtz-Institut Mainz, Staudingerweg 18, 55128 Mainz, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Planckstraße 1, 64291 Darmstadt, Germany.

Relativistic effects significantly alter the electronic configuration of the heaviest elements and strongly influence their chemical and physical properties. Ion mobility within a noble gas environment is sensitive to the ions' electronic configuration due to ion-neutral gas interactions, unveiling the impact of relativistic effects on their structure. An ion mobility spectrometer was developed to precisely measure the reduced ion mobility of heavy lanthanides and actinides by conducting parametric studies under varying electric fields, buffer-gas pressures, and temperatures. Ions from a specific element are generated through laser ablation. Following extraction, cooling, and bunching via an RF buncher, these ions traverse the drift tube and are separated by mass using a quadrupole mass spectrometer prior to detection. Here I report systematic ion mobility measurements of Lu+ ions drifting in helium gas for reduced electric fields, spanning from 1 to 30 Td.

MS 6.6 Wed 18:30 HS 3042

A compact single ion detector system for radioactive isotopes with α-decay energy discrimination — •Tom Kieck[1,2], Sebastian Raeder[1], and Michael Block[1,2,3] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Helmholtz-Institut Mainz — [3]Johannes Gutenberg-Universität, Mainz

The detection of single ions is usually done by secondary electron multiplication. When detecting isotopes originating as daughters from a radioactive decay and accelerator-produced radionuclides they need to be discriminated from unwanted stable and radioactive ions created in the beam-preparation processes. The detection of specific α-decay energies in a silicon detector provides a versatile solution. It can be a less complex and more compact alternative to mass spectrometric methods. The implementation and challenges of such a detector system in a cost-effective and "open" way will be presented together with application examples from off-line measurements and on-line laser spectroscopy of actinides.

MS 6.7 Wed 18:45 HS 3042

Production and characterisation of synthetic homogenous multi-element actinides samples via sol-gel as standards for mass spectrometry — •Aaron Lehnert, Paul Hanemann, Darcy van Eerten, Sandra Reinhard, Tim Schmalz, and Clemens Walther — Institute of Radioecology and Radiation Protection, Leibniz University Hannover, Herrenhäuser Straße 2, 30419 Hannover, Germany

MetroPOEM[1] is committed to developing SI-traceable mixed element reference materials for the calibration of mass spectrometric devices. In nuclear forensics, elemental selectivity and precise spatially resolved mass spectrometry is essential for ultra-trace analysis of environmental samples. Resonant laser secondary neutral mass spectrometry (rL-SNMS) combines both element selective isotope ratio measurements and spatial resolution on the micrometre scale. Multi-element reference materials are needed to investigate different ionisation efficiencies for the elements important for environmental analytics.

In this work we present a production method of mixed actinide samples such as U, Pu and Am via sol-gel. These samples consist exclusively of the respective metal and fulfil the conditions for homogeneity confirmed by EDX and SIMS. The spatially resolved element distribution was determined using rL-SNMS. ICP-MS is also used to determine the element composition.

[1]MetroPOEM is a collaboration of 22 partners from 13 countries throughout Europe funded by EURAMET under grant number 21GRD09 https://www.npl.co.uk/euramet/metropoem

MS 7: Accelerator Mass Spectrometry III

Time: Thursday 11:00–13:00 Location: HS 3042

Invited Talk MS 7.1 Thu 11:00 HS 3042

High-precision mass measurements for nuclear structure and nuclear astrophysics — •Anu Kankainen — University of Jyväskylä, Department of Physics, Accelerator laboratory, P.O. Box 35(YFL), FI-40014 University of Jyväskylä, Finland

High-precision atomic mass measurements with a Penning trap provide a way to precisely determine nuclear binding energies even for short-lived radioactive nuclei. Nuclear binding energies serve as excellent testing points for nuclear models and understanding nuclear structure far from stability. Masses are also key inputs for nuclear astrophysics applications, such as for the rapid neutron capture process (r process) responsible for around half of the heavy-element abundances above iron. Penning-trap mass spectrometry can also be used to determine excitation energies of isomeric states.

We have measured more than 460 atomic masses, including over 70 isomeric states, with the JYFLTRAP double Penning trap mass spectrometer at the Ion Guide Isotope Separator On-Line (IGISOL) facility in the Accelerator Laboratory of the University of Jyväskylä, Finland. A large number of low-lying isomeric states have been recently measured with the phase-imaging ion cyclotron resonance technique. In many cases, the measurements have been supported by laser or post-trap decay spectroscopy to further identify the studied states. In my presentation, I will give an overview with selected highlights on our precision mass measurements for nuclear structure and astrophysics.

MS 7.2 Thu 11:30 HS 3042

AMS of I-129 at low energies - 10 years later — Christof Vockenhuber[1,2], •Núria Casacuberta Arola[1,2], and Marcus Christl[1] — [1]Laboratory of Ion Beam Physics, ETH Zurich, Zurich, Switzerland — [2]Department of Environmental Systems Science, ETH Zurich, Zurich, Switzerland

For the DPG 2014 conference in Berlin we had a contribution on AMS of I-129 at low-energy AMS systems. Focusing on the 500 kV Tandy at the Laboratory of Ion Beam Physics at ETH Zurich, we were discussing the advantages but also the challenges of measuring this long-lived radionuclide at low energies with a special focus on cross contamination and its correction.

Here we will provide a review of I-129 AMS at low energies, after the experience we gained in the last 10 years by measuring thousands of samples. Although most of the measurements were performed in the AMS Tandy system, since a few years the 300 kV multi-isotope

systems MILEA is also in our portfolio. MILEA helped in expanding the measurement capabilities with a new type of ion source and an improved ion-optical setup. We will compare measurements performed at both Tandy and MILEA and discuss the performance with the focus on background, cross contamination and detection limit. Finally, we will also show a few examples of the application of I-129 as an anthropogenic ocean tracer from the past 10 years.

MS 7.3 Thu 11:45 HS 3042

First ^{129}I Measurements at CologneAMS — •Christian Schlaier[1], Stefan Heinze[1], Martina Gwozdz[1], Gereon Hackenberg[1], Marco Michel[2], Markus Schiffer[1], Erik Strub[2], and Dennis Mücher[1] — [1]Institut für Kernphysik, University zu Köln — [2]Institut für Kernchemie, Universität zu Köln

In the Atacama Desert, one of the driest places in the world, plants had to adapt to survive with the low humidity mainly caused by fog. This fog contains an increased proportion of the unstable rare ^{129}I due to nuclear bomb tests in the South Pacific. The AMS Iodine analysis of this plants can be used to gain information about environmental conditions and might help the colabborating bio- and geoscientists of the CRC1211 to understand the evolution of life in the hyper arid environement.
For this reason first Iodine measurements have been performed at the 6 MV AMS system of CologeneAMS. Standard samples covering the entire capabilities of the accelerator system were measured. In this contribution we will present the current status and the results of the Iodine measurements in Cologne.

MS 7.4 Thu 12:00 HS 3042

Analysis of ^{90}Sr in environmental samples with utmost sensitivity by Accelerator Mass Spectrometry — •Martin Martschini[1], Silke Merchel[1], Stephan Winkler[2], Maki Honda[3], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics, Austria — [2]HZDR, Accelerator Mass Spectrometry and Isotope Research, Germany — [3]Japan Atomic Energy Agency, Japan

The world-wide unique Ion-Laser InterAction Mass Spectrometry (ILIAMS) technique at the Vienna Environmental Research Accelerator AMS-facility provides unprecedented sensitivity for the radiologically relevant anthropogenic radioisotope ^{90}Sr ($T_{1/2}$ = 28.9 a). Highly-efficient suppression of the isobaric interference ^{90}Zr via ion-gas-reactions and laser photodetachment of ZrF_3^- inside a radiofrequency-quadrupole ion cooler enables a blank value of $^{90}Sr/Sr < 5\times10^{-16}$ at an overall Sr-detection efficiency of 4×10^{-4}. This corresponds to a detection limit of <0.016 mBq, i.e., 2×10^4 atoms or 3 ag of ^{90}Sr in a sample of mg of stable Sr, which is at least a factor 100 better than with any other technique including conventional AMS.

Recently, we have successfully applied this technique to determine the $^{90}Sr/Sr$ ratio in <1 g of contemporary coral aragonite and samples of 300-500 ml of South Atlantic seawater. Furthermore, the ^{90}Sr content in environmental archives like deer antlers, snail shells and ivory has been analyzed with sample sizes as low as 2 mg of ashed material. Measurement results on IAEA reference materials (bone and soil) are in good agreement with their expected values and demonstrate the robustness of the technique.

MS 7.5 Thu 12:15 HS 3042

Developments towards ion cooler assisted ^{90}Sr measurements at CologneAMS — •Oscar Marchhart[1,2,3], Markus Schiffer[3], Elisa Linnartz[3], Martin Martschini[1], Melisa Maslo[4], Gereon Hackenberg[3], Timm-Florian Pabst[3], Peter Steier[1], Erik Strub[4], Tibor Dunai[5], Dennis Mücher[3], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics - Isotope Physics, Vienna, Austria — [2]University of Vienna, Faculty of Physics & Vienna Doctoral School in Physics, Vienna, Austria — [3]University of Cologne, Institute for Nuclear Physics, Cologne, Germany — [4]University of Cologne, Division of Nuclear Chemistry, Cologne, Germany — [5]University of Cologne, Institute of Geology and Mineralogy, Cologne, Germany

The fission product ^{90}Sr ($T_{1/2}$ = 28.90 a) is a radiotoxic trace nuclide produced with high yield in the nuclear fuel cycle and weapons tests. State-of-the-art radiometric measurements are time-consuming and cumbersome, hence, accelerator mass spectrometry (AMS) has the potential to be a fast and highly sensitive alternative, especially for large quantities.
In a collaboration between the University of Vienna and University of Cologne, a new advanced ion cooler for ion beams with high emittance, e.g. SrF_3^-, was designed and built. Performance tests, including residence time measurements, have been conducted at a dedicated test bench in Vienna. Simultaneously, a simple and fast chemical preparation for Sr in soil samples for large amounts of samples is worked on. The performance tests and sample preparation will be presented.

MS 7.6 Thu 12:30 HS 3042

^{53}Mn burial dating at Cologne-AMS — •Gereon Hackenberg[1], Markus Schiffer[1], Steven Binnie[2], Alfred Dewald[1], Tibor Dunai[2], Stefan Heinze[1], Timm-Florian Pabst[1], and Dennis Mücher[1] — [1]Insitute for Nuclear Physics, University of Cologne — [2]Instiute for Geology and Mineralogy, University of Cologne

The CRC1211 Earth - Evolution at the Dry Limit investigates the formation and evolution of life and landscapes in severely water-limited environments, which constitute significant portions of the Earth. Age determination of sporadically deposited sediments in hyper-arid and arid regions poses challenges due to the absence of age-indicating fossils. In this presentation we discuss a novel approach using Accelerator Mass Spectrometry (AMS) to measure the cosmogenic $^{53}Mn/^3$He concentration in iron-titanium oxides (hematite, magnetite, titanomagnetite, ilmenite). Notably, ^{53}Mn, with a half-life of T=3.74*Ma, offers extended exposure times compared to 26Al/10Be burial dating.

The utilization of AMS for 53Mn demands a Tandem accelerator with a high terminal voltage, exemplified by the 10MV FN-Tandem accelerator at the University of Cologne, coupled to a gas-filled magnet. Systematic optimization, including the development of a new Bragg detector and enhanced stability of the accelerator voltage via active slit control, has resulted in stable conditions for ^{53}Mn burial dating, achieving a low blank level of $^{53}Mn/^{55}Mn < 10^{-13}$. Our presentation includes dating results from Namibian iron oxide surface samples and a discussion of their implications for advancing our understanding of the geological dynamics within the Namibian desert.

MS 7.7 Thu 12:45 HS 3042

Utilizing δ^{13}C from IRMS to improve the precision of AMS measurments — •Martina Gwozdz[1], Andrea Jaeschke[2], Stefan Heinze[1], Janet Rethemeyer[2], Dennis Mücher[1], and Markus Schiffer[1] — [1]University of Cologne, Institute for Nuclear Physics, Cologne, Germany — [2]University of Cologne, Institute for Geology and Mineralogy, Cologne, Germany

Within the CRC1211 project-Evolution at the Dry Limit, there is a need for precise dating analysis on soil samples from the Atacama Desert, which are characterized by low carbon contents. We employ an elemental analyser, an isotope ratio mass spectrometer and an existing gas interface in conjunction with the 6 MV AMS system of CologneAMS. This setup facilitates a fully automated, online analysis of $^{14}C/^{12}C$, while also delivering accurate δ^{13}C values. To address the compatibility of δ^{13}C values derived from AMS and IRMS measurements for fractionation correction, we simultneously determined δ^{13}C values from various standard materials using both AMS and IRMS. Our findings reveal that the mean δ^{13}C values from AMS and IRMS align within their respective error ranges. Consequently, we advocate for the utilization of the more precise δ^{13}C values from IRMS for an effective and refined AMS fractionation correction. Notably, our investigation did not unveil any correlation between the observed scattering of δ^{13}C AMS values and fluctuations in the $^{14}C/^{12}C$ AMS ratios. This insight sheds light on the origin of small fluctuations beyond statistical expectations in radiocarbon AMS dating applications.

MS 8: Members' Assembly

Time: Thursday 13:00–14:00 Location: HS 3042

All members of the Mass Spectrometry Division are invited to participate.

MS 9: Accelerator Mass Spectrometry IV

Time: Friday 11:00–13:00 Location: HS 3042

Invited Talk MS 9.1 Fri 11:00 HS 3042

Influx of interstellar ^{60}Fe and ^{244}Pu onto Earth within the last 10 million years recorded in a ferromanganese crust — •Dominik Koll[1,2,3], Anton Wallner[2,3], Michael Hotchkis[4], Sebastian Fichter[2], L. Keith Fifield[1], Michaela Froehlich[1], Michi Hartnett[1], Johannes Lachner[2], Stefan Pavetich[1], Georg Rugel[2], Zuzana Slavkovska[1], and Steve Tims[1] — [1]The Australian National University, Canberra, Australia — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [3]TU Dresden, Dresden, Germany — [4]Australian Nuclear Science and Technology Organisation, Sydney, Australia

Within the last 25 years, copious evidence was presented for supernova-produced ^{60}Fe influxes onto Earth using accelerator mass spectrometry (AMS); pointing to a near-Earth supernova activity within the last few million years. The rare interstellar r-process radionuclide ^{244}Pu, however, was only recently discovered. The combination of both, supernova-produced ^{60}Fe and r-process ^{244}Pu, allows to shed light onto the nucleosynthesis site of heavy elements in the universe.

A well-characterized and ^{10}Be-dated ferromanganese crust from the Pacific Ocean was used to search for ^{60}Fe and ^{244}Pu abundances with unprecedented time-resolution and sensitivity. The acquired ^{60}Fe profile shows two pronounced peaks of ^{60}Fe influxes with updated timing. A r-process ^{244}Pu influx was discovered with a time-resolution of 1 Myr within the last 10 Myr due to the extraordinarily high total efficiency of Pu AMS of 1% achieved in this project.

MS 9.2 Fri 11:30 HS 3042

Environmental ^{99}Tc concentrations determined by AMS — •Karin Hain[1], Stephanie Adler[1], L. Keith Fifield[2], Fadime Gülce[1], Martin Martschini[1], Stefan Pavetich[2], Stephen G. Tims[2], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics, Austria — [2]Australian National University, Research School of Physics, Australia

In the last 4.5 years we have intensively studied possibilities of analyzing environmental concentrations of the anthropogenic radionuclide ^{99}Tc ($t_{1/2}$ =2.1·10^5 yr) with AMS. The applied techniques for isobar suppression comprised the gas-filled analyzing system (GAMS) at the TU Munich and an 8-anode ionization chamber at the Australian National University (ANU, Canberra), both using a tandem accelerator with a terminal voltage of up to 14 MV. Experiments using the 3 MV tandem at VERA investigated the application of Ion-Laser InterAction Mass Spectrometry (ILIAMS). While all three methods achieved a ^{99}Ru suppression that enabled detection of Tc from global fallout, i.e. a blank level below 5·10^6 at/sample, none of them could make use of the ^{97}Tc spike added for normalization to obtain absolute concentrations owing to its omnipresent isobar ^{97}Mo. At ANU, we have followed the example of TU Munich and used the ^{93}Nb^{12+} current for normalization, achieving a precision of 15% when extracting TcO$^-$ and NbO$^-$ from the ion source. This allowed the determination of the ^{99}Tc concentration in selected samples from different environmental reservoirs, including 1 g peat bog samples and 10 L water samples from the Pacific Ocean and European rivers.

MS 9.3 Fri 11:45 HS 3042

Isobar suppression and normalization methods for ultra-trace analysis of Tc-99 — •Stephanie Adler[1], Karin Hain[1], Martin Martschini[1], Stefan Pavetich[2], Steve G. Tims[2], L. Keith Fifield[2], Dominik Koll[2], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics, Austria — [2]Australian National University, Research School of Physics, 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 Accelerator (VERA), isobar suppression is addressed with Ion-Laser InterAction MS (ILIAMS). It was shown that RuF_5^- can be suppressed by a factor of up to 10^5 using a 532 nm-laser, making extraction of $^{99}TcF_5^-$ a viable option for ILIAMS. For normalization to NbF_5^- extracted from the same sample, the reproducibility of the method was significantly improved from 50% to 15% by optimization of ion source parameters. 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 ion energies of up to 190 MeV. There, TcO$^-$ extraction and normalization to the ^{93}Nb-current showed a reproducibility of 15%. ^{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 highest ion energies. This method yielded a Ru suppression factor of 8000, and recent investigations showed a potential improvement by using an additional SiN degrader foil stack.

MS 9.4 Fri 12:00 HS 3042

Towards the Redetermination of the Half-life of ^{32}Si - AMS Measurement — •Matthias Schlomberg, Christof Vockenhuber, and Hans-Arno Synal — Laboratory of Ion Beam Physics, ETH Zurich

^{32}Si is a cosmogenic, long-lived radionuclide with potentially interesting applications for dating the recent past. However, its half-life of about 150 years is still not known with sufficient precision despite several independent measurements over the past four decades. The SINCHRON collaboration with partners from PSI, CHUV, PTB and ETH aims at a comprehensive redetermination of the half-life of ^{32}Si.

The Laboratory of Ion Beam Physics (LIP) at ETH Zurich will perform the AMS measurements using the 6 MV-Tandem facility for the determination of the number of ^{32}Si atoms in the samples used for the activity measurement. This task is especially challenging since an absolute measurement must be performed without having any standard material available.

Therefore, we developed a dedicated method using a passive gas absorber in front of a gas ionization detector for separation of ^{32}Si from its isobar ^{32}S at 30 MeV and 40 MeV which is compared to the standard method of using a gas-filled magnet. In this talk, the measurement setup and first results are presented and discussed. Furthermore, an outlook is given for a possible improvement and application to natural samples.

MS 9.5 Fri 12:15 HS 3042

Towards the half-life of ^{135}Cs — •Alexander Wieser[1,2], Johannes Lachner[2], Serge Nagorny[3], Martin Martschini[1], Anton Wallner[2], and Robin Golser[1] — [1]University of Vienna - Faculty of Physics, Isotope Physics — [2]HZDR - Accelerator Mass Spectrometry and Isotope Research — [3]Queen's University Kingston - Engineering Physics and Astronomy

^{135}Cs is a long-lived radionuclide which is produced both naturally via spontaneous fission of ^{238}U and anthropogenically in neutron induced fission. The half-life of ^{135}Cs is of special interest for geological repositories for high-level nuclear waste. The dose from the repository is dominated by ^{135}Cs on a million year timescale, however the half-life is not very well known. Published values range from 0.7 Myr to 3.0 Myr. For determining the half-life we need both, an activity measurement and a mass-spectrometric determination of the number of ^{135}Cs atoms in a sample, however, both measurements are challenging. ^{135}Cs is a pure beta-emitter and has a low end-point energy of only 268 keV, making low-level beta-measurements difficult, mainly due to interferences from other short-lived cesium isotopes. For the mass spectrometric determination, Cs measurements suffer from isobaric interference from the highly abundant ^{135}Ba. We present in this talk first results of accelerator mass spectrometry measurements of ^{135}Cs in a Cs_2ZrCl_6-crystal which was previously analyzed at Laboratori Nazionali del Gran Sasso, where a ^{135}Cs activity in the 100 mBq/kg-range was determined [Belli et al. 2023, EPJ A].

MS 9.6 Fri 12:30 HS 3042

Characterizing Lunar Soil with Cosmogenic Radionuclides for the Search for Interstellar Radionuclides — •Sebastian Zwickel[1,2], Sebastian Fichter[1], Dominik Koll[1,2,3], Johannes Lachner[1], Marc Norman[3], Stefan Pavetich[3], Georg Rugel[1], Konstanze Stuebner[1], Steve Tims[3], Josua Vahle[1,2], Stephan Winkler[1], and Anton Wallner[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Technische Universität Dresden, Dresden, Germany — [3]Australian National University, Canberra, Australia

Despite being responsible for the nucleosynthesis of half of all heavier nuclides in the galaxy, the site of the r-process is still an open question in nuclear astrophysics. The detection of the pure r-process nuclide

^{244}Pu, live, in deep-sea ferromanganese crusts already demonstrated ongoing r-process events. A complementary archive for ^{244}Pu is lunar soil - lacking in time resolution, but offering a proposed exposure time to interstellar dust deposition ranging from a few up to hundreds of million years. In this project we aim for the detection of interstellar ^{244}Pu and ^{60}Fe in lunar soil. Important will be the proper characterization of lunar soil for exposure history and composition. Among various additional analytical methods, we measure cosmogenic ^{10}Be, ^{26}Al, ^{41}Ca and ^{53}Mn.

This talk presents first results of the cosmogenic radionuclides ^{10}Be, ^{26}Al and ^{53}Mn measured in a set of lunar samples and discusses their use in characterizing the exposure history of the samples.

MS 9.7 Fri 12:45 HS 3042

Chasing Stardust: Unveiling Radionuclide Signatures in Antarctic Ice — •Annabel Rolofs[1], Dominik Koll[1,2], Florian Adolphi[3], Maria Hörhold[3], Johannes Lachner[1], Stefan Pavetich[2], Georg Rugel[1], Steve Tims[2], Sebastian Zwickel[1], and Anton Wallner[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden, Germany — [2]Australian National University (ANU), Canberra, Australia — [3]Alfred-Wegener-Institut, Bremerhaven, Germany

Radionuclides provide clues about the solar system's history and can elucidate the role of supernovae in its evolution. The production of ^{60}Fe in massive stars and its ejection in supernovae make this isotope an invaluable indicator to reconstruct cosmic history. Earlier studies showed an ^{60}Fe activity about 2 - 3 Myr ago, as well as an older influx 7 - 8 Myr ago, both attributed to interstellar dust containing traces of supernova-produced ^{60}Fe.

In this project, we analyse continuous-flow analysis (CFA) water from an Antarctic EDML ice core for its radionuclide concentrations to bridge a pivotal time gap in prior ^{60}Fe measurements. Antarctic ice offers a unique geological archive because the isolated location reduces terrestrial contamination to a minimum. The sample material spans a time period from 50,000 to 80,000 years ago. We will present results on the radionuclides ^{10}Be, ^{26}Al and ^{41}Ca that were measured at the DREAMS facility (HZDR), as well as ^{53}Mn and ^{60}Fe which were measured at HIAF (ANU).