MS 1: Accelerator Mass Spectrometry and Applications

Time: Monday 10:30–12:30 Location: GÖR 229

Invited Talk MS 1.1 Mon 10:30 GÖR 229

CologneAMS, ein neues Zentrum für Beschleuniger-Massenspektrometrie in Deutschland — •Alfred Dewald[1], Tibor Dunai[2], Stefan Heinze[1], Jan Jolie[1], Martin Melles[2], Jürgen Richter[3], Ulrich Radtke[4], Janette Rethemeyer[2], Michael Staubwasser[2], Andreas Zilges[1] und Friedhelm von Blanckenburg[5] — [1]Kernphysik, Universität Köln — [2]Geologie und Mineralogie, Universität Köln — [3]Ur- und Frühgeschichte, Universität Köln — [4]Geographie, Universität Köln — [5]GFZ, Potsdam

CologneAMS ist ein neues Zentrum für Beschleuniger - Massenspektrometrie (AMS) an der Universität zu Köln, das von der Deutschen Forschungsgemeinschaft gefördert wurde, um die Messmöglichkeiten auf dem Gebiet der Beschleuniger-Massenspektrometrie in Deutschland zu verbessern. Die AMS-Anlage ist im Beschleunigerbereich der Kernphysik installiert. Probenlabore werden im Institut für Geologie und Mineralogie aufgebaut. In Zukunft soll ein vollständiger Probenservice für auswertige Kunden angeboten werden. Die AMS-Anlage selbst ist dazu ausgelegt, alle gängigen kosmogenen Nuklide 10Be,14C,26Al,36Cl, 41Ca,129I zu spektrometrieren sowie für den sensitiven Nachweis von schweren Ionen bis zu 239U und 244Pu. Das Herzstück der AMS-Anlage ist ein 6 MV TANDETRON Beschleuniger, der mit Folien und Gasstripper ausgerüstet ist. In diesem Beitrag wird über den momentanen Status des neuen AMS Zentrums mit seinen Einrichtungen sowie über die Ergebnisse der ersten Testmessungen berichtet. Darüber hinaus werden erste Projekte der lokalen Gruppen vorgestellt.

MS 1.2 Mon 11:00 GÖR 229

A new BPM-TOF system for CologneAMS — •Gheorghe Pascovici[1], Alfred Dewald[1], Stefan Heinze[1], Markus Schiffer[1], Mark Feuerstein[1], Michael Pfeiffer[2], Jan Jolie[2], Karl Oskar Zell[2], and Friedhelm von Blanckenburg[3] — [1]CologneAMS, Universität zu Köln — [2]IKP, Universität zu Köln — [3]GFZ, Potsdam

At the center for accelerator mass spectrometry (CologneAMS) a complex beam detector consisting of a high resolution Beam Profile Monitor (BPM) and a Time of Flight (TOF) spectrometer with tracking capabilities was designed especially for the needs of the Cologne AMS facility. The complex beam detector assembly is designed to match the beam specifications of the 6MV Tandetron AMS setup and its DAQ system, which is presently in the commissioning phase at the IKP of the University of Cologne. The BPM-TOF system will have a reconfigurable structure, namely: either a very fast TOF subsystem with a small active area or a more complex BPM -TOF detector with beam tracking capabilities and with a large active area. The systems aims for background suppression in case of the spectrometry of heavy ions, e.g. U, Cm, Pu, Am etc. and could also be used as an additional filter e.g., for the isobar 36S in case of the spectrometry of 36Cl.

MS 1.3 Mon 11:15 GÖR 229

Revival of the Utrecht AMS-components at the Cologne FN tandem accelerator — •Markus Schiffer[1], Alfred Dewald[1], Astrid Holler[1], Stefan Heinze[1], Claus Feuerstein[1], and Klaas van der Borg[2] — [1]CologneAMS, Universität zu Köln — [2]Universität Utrecht

After the complete dismantling of the AMS-facility at the institute of physics and astronomy of the Utrecht university in 2009, most of the AMS-components have been taken over by the institute of nuclear physics of the Cologne university (IKP). It is planned to setup a complete AMS-System at the Cologne FN tandem accelerator using the components from Utrecht. This setup can be used for developments and tests of future AMS-devices and techniques. In addition, higher energies available at the FN accelerator will improve the AMS performance especially for heavier isotopes, eg. 41Ca and 53Mn. The design of the injector is completed and the installation work has started. In parallel, the NEC multi-cathode ion-source will be installed first at an existing port of the FN tandem injector for test purposes.

MS 1.4 Mon 11:30 GÖR 229

Accelerator-SIMS for isotopic analysis of trace elements — •Dominik Güttler, Christof Vockenhuber, Max Döbeli, and Hans-Arno Synal — Laboratory of Ion Beam Physics, ETH Zurich, HPK G31, Schafmattstrasse 20, 8093 Zurich, Switzerland

Secondary ion mass spectrometry (SIMS) is one of the most extensively used methods to detect impurities and their isotopic signatures in materials. However, especially for heavier trace elements, the sensitivity of SIMS is severely limited by molecular and charge state interferences. This problem can be overcome using accelerator mass spectrometry (AMS).

Here negative ions are analyzed by an electromagnetic mass spectrometer and then injected into a 6 MV EN-Tandem accelerator. At the terminal the ions are stripped to high charge states, which guarantees the destruction of all molecular ions. At the high energy side of the accelerator, 40 MeV ions are selected by an electrostatic deflector and analyzed by a magnetic spectrometer. Final detection of the ions is done with a position-sensitive gas ionization chamber that also measures dE/dx and the residual energy for isobar separation. A fast beam bouncing system and a wide detector entrance window allow for quasi simultaneously detection of multiple isotopes.

Within the EuroGENESIS program we are planning to use Accelerator-SIMS to measure isotopic compositions of rare earth elements in pre-solar grains. The isotopic signatures in these grains carry the fingerprint of nucleosynthesis and provide valuable astrophysical information.

MS 1.5 Mon 11:45 GÖR 229

AMS measurement of the reaction ^{35}Cl(n,γ)^{36}Cl — •Stefan Pavetich[1], Tamás Belgya[2], Max Bichler[3], Iris Dillmann[4], Oliver Forstner[1], Robin Golser[1], Franz Käppeler[4], Zoltan Kis[2], Martin Martschini[1], Alfred Priller[1], Peter Steier[1], Georg Steinhauser[3], Laszlo Szentmiklosi[2], and Anton Wallner[1] — [1]VERA Laboratory, Faculty of Physics, Univ. of. Vienna, Austria — [2]Department of Nuclear Research, Institute of Isotopes, Hungarian Academy of Science, Budapest — [3]Atominstitut, TU Wien, Austria — [4]Karlsruhe Institute of Technology, Germany

^{36}Cl is a long-lived radionuclide ($t_{1/2}$ = 301000 a), which is dominantly produced via the reaction ^{35}Cl(n,γ)^{36}Cl. In the present work we focused on: First, the production of an independent ^{36}Cl/^{35}Cl reference material for AMS and second, the determination of the Maxwellian averaged cross section (MACS) of ^{35}Cl(n,γ)^{36}Cl at 25 keV neutron energy, i.e. the energy range which is important for astrophysical network calculations. Approaching the first goal, NaCl pellets were irradiated with thermal neutrons in Vienna and Budapest. The neutron fluence, used for the calculation of the ^{36}Cl/^{35}Cl ratio of the irradiated samples, was determined via gold fluence monitores. For the determination of the neutron capture cross section of ^{35}Cl at stellar energies, AMS measurements were performed on two samples, which were irradiated with neutrons of a Maxwell-Boltzmann energy distribution of 25 keV. Combining the AMS- and the neutron-fluence data, the MACS for ^{35}Cl at 25 keV was calculated. The neutron irradiations, the measuring procedure of ^{36}Cl at VERA and our new results will be presented.

MS 1.6 Mon 12:00 GÖR 229

Massenspektrometrischer Nachweis von Radiokarbon bei Strahlenergien von 45 keV — •Martin Seiler, Tim Schulze-König und Hans-Arno Synal — Ion Beam Physics, ETH Zürich, 8093 Zürich, Switzerland

Für biomedizinische Anwendungen von ^{14}C ist ein Nachweisverfahren mit kompakten Massenspektrometern wünschenswert. Messungen mit Kohlenstoffionen bei niedrigen Energien zeigten, dass unterhalb von 100 keV eine hohe Transmission erreicht werden kann indem Helium als Strippergas verwendet wird. Ergänzt wurden diese Messungen durch die Bestimmung von Wirkungsquerschnitten für die Molekülzerstörung von ^{13}CH und ^{12}CH$_2$. Diese zeigten im gemessenen Energiebereich keine Energieabhängigkeit. Darauf basierend wurde ein ^{14}C-Massenspektrometer entwickelt, welches bei einer Ionenenergie von 45 keV operiert. Der Aufbau des Beschleunigers und erste Messergebnisse werden vorgestellt.

MS 1.7 Mon 12:15 GÖR 229

First experiments at the new 6 MV-Tandetron at HZDR — •Shavkat Akhmadaliev, René Heller, Daniel Hanf, and Silke Merchel — Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Institute of Ion Beam Physics and Materials Research, Dresden, Germany

The 6 MV tandem type accelerator replaces the old 5 MV machine in

the beginning of 2011. Besides ion beam analysis (IBA) and material modification via high-energy ion implantation, the system is equipped for accelerator mass spectrometry (AMS). The first interest is in the radioisotopes ^{10}Be, ^{26}Al, ^{36}Cl, ^{41}Ca, and ^{129}I [1].

An energy calibration of the machine and a test of ion beam energy stability have been carried out as a first experiment using the ^{1}H(^{15}N,$\alpha\gamma$)^{12}C nuclear reaction with a sharp resonance at an energy of 6385 keV. The total energy resolution for the system is about 12 keV.

First tests of the Dresden AMS system [2] have been performed and demonstrated background levels of $2{\cdot}10^{-16}$ for ^{10}Be/^{9}Be, $7{\cdot}10^{-16}$ for ^{26}Al/^{27}Al and $8{\cdot}10^{-15}$ for ^{41}Ca/^{40}Ca, respectively. The background of $2{\cdot}10^{-13}$ for ^{129}I/^{127}I originates from intrinsic ^{129}I (MERCK KI), whereas the reasons for high ^{36}Cl/^{35}Cl background of $3{\cdot}10^{-15}$ are under discussion.

References: [1] Sh. Akhmadaliev et al., MS6.2, DPG Frühjahrstagung der Sektion AMOP, Hannover 2010. [2] www.dresden-ams.de