MS 4: Beschleunigermassenspektrometrie und Anwendungen I

Time: Wednesday 10:30–13:00 Location: F 428

Invited Talk MS 4.1 We 10:30 F 428

Retrospektive Dosimetrie der I-131 Exposition nach dem Reaktorunfall von Tschernobyl mittels AMS-Messung von I-129 in Böden — •Rolf Michel[1], Abdelouahed Daraoui[1], Jens Korntheuer[1], Monika Gorny[1], Dieter Jakob[1], Rüdiger Sachse[1], Vasily Alfimov[2] und Hans-Arno Synal[2] — [1]Zentrum für Strahlenschutz und Radioökologie, Leibniz Universität Hannover, Deutschland — [2]Ion Beam Physics, Paul Scherrer Institut und ETH Zürich, Schweiz

Nach dem Reaktorunfall von Tschernobyl stiegen in der Ukraine, Weißrussland und Russland die Fälle von Schilddrüsenkrebs bei Jugendlichen aufgrund der I-131 Strahlenexpositionen dramatisch an. Aufgrund von zu wenigen direkten Messungen der Schilddrüsenaktivitäten ist die Dosimetrie der I-131 Expositionen nicht befriedigend. Mit Hilfe des langlebigen I-129 kann in hoch- und mittelkontaminierten Gebieten der Fallout von I-131 nach dem Unfall bestimmt und damit die Strahlenexposition modelliert werden. In dieser Arbeit wurden 62 Siedlungen der nördlichen Ukraine, für die auch Direktmes-sungen der Schilddrüsenaktivitäten vorliegen, untersucht. Pro Siedlung wurden je 5 Bodenproben bis zu einer Tiefe von 40 cm bzgl. Cs-137 und I-129 analysiert. Da mehr als 90 % der I-129-Konzentration noch immer in den obersten 40 cm lokalisiert ist, können die I-129-Inventare in den Profilen als Näherungen für die gesamten anthropogenen I-129-Iventare betrachtet werden. Aus den I-129 Inventaren wurden über aggregierte Dosisfaktoren die I-131 Schilddrüsendosen berechnet. Die Ergebnisse werden mit direkten Messungen der Schilddrüsenaktivität verglichen.

MS 4.2 We 11:00 F 428

The potential of Accelerator Secondary Ion Mass Spectrometry for astrophysical applications — •Christof Vockenhuber[1], Max Döbeli[1], and Anton Wallner[2] — [1]ETH Zurich, Zurich, Switzerland — [2]University of Vienna, Vienna, Austria

The understanding of the nuclear processes which formed the elements is based on the elemental abundances and their isotopic pattern. Astronomical observation allows to determine the elemental abundances; information of the isotopic pattern is obtained by mass spectrometry of meteoritic material. In particular, specific pre-solar grains, which preserved the isotopic composition of the early stage of our solar system, show strong deviations from the terrestrial isotopic pattern which can be attributed to different nucleosynthesis processes.

Since about 20 years pre-solar material has been analyzed using stable mass spectrometers, like SIMS, TIMS or ICPMS. However, especially elements in the rare earth region are difficult to measure due to the low concentrations and molecular interferences. The combination of a SIMS ion source with an AMS system allows for interference-free measurements. The potential and the challenges of this combination with prospects for future measurements will be discussed.

MS 4.3 We 11:15 F 428

New approaches investigating production rates of in-situ produced terrestrial cosmogenic nuclides — •Silke Merchel[1,2], Régis Braucher[1], Lucilla Benedetti[1], and Didier Bourlès[1] — [1]CEREGE, CNRS-IRD-Université Aix-Marseille, F-13545 Aix-en-Provence, France — [2]FZD, D-01314 Dresden, Germany

In-situ produced cosmogenic nuclides have proved to be valuable tools for environmental and Earth sciences. However, accurate application of this method is only possible, if terrestrial production rates in a certain environment over a certain time period and their depth-dependence within the exposed material are exactly known. Unfortunately, the existing data and models differ up to several tens of percent. Thus, one of the European project *CRONUS-EU* goals is the high quality calibration of the ^{36}Cl production rate by spallation at independently dated surfaces. As part of fulfilling this task we have investigated calcite-rich samples from four medieval landslide areas in the Alps: *Mont Granier*, *Le Claps*, *Dobratsch*, and *Veliki Vrh* (330-1620 m, 1248-1442 AD). For investigating the depth-dependence of the different nuclear reactions, especially, the muon- and thermal neutron-induced contributions, we have analysed mixtures of carbonates and siliceous conglomerate samples - for ^{10}Be, ^{26}Al, and ^{36}Cl - exposed at different shielding depths and taken from a core drilled in 2005 at *La Ciotat*, France (from surface to 11 m shielding). AMS of ^{36}Cl was performed at LLNL and ETH, ^{10}Be and ^{26}Al at ASTER.

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MS 4.4 We 11:30 F 428

The measured and modeled ^{36}Cl concentration in 100-m long limestone core from Vue des Alpes, Switzerland — •Vasily Alfimov[1], Susan Ivy-Ochs[1], Peter W. Kubik[1], Jürg Beer[2], and Hans-Arno Synal[1] — [1]Laboratory of Ion Beam Physics, ETH Zurich, Switzerland — [2]EAWAG, Duebendorf, Switzerland

A 100-m long limestone core was sampled in Vue des Alpes (1256.86m, 47°4'46.8"N, 6°52'14.70E), Switzerland, and analysed for ^{36}Cl with Accelerator Mass Spectrometry at the Laboratory of Ion Beam Physics, ETH Zürich. The measurements were compared with the theoretical calculation of ^{36}Cl content in the core. The long-lived radionuclide ^{36}Cl ($T_{1/2}$=301kyr) is produced in limestone by cosmic rays. There are several pathways of ^{36}Cl production in the limestone, and they have different attenuation lengths. At the surface the dominant production pathway is the spallation of Ca by fast neutrons. Under one meter of rock, the slow muon capture on ^{40}Ca starts to take over the lead, while after 10 m depth the fast-muon-induced processes in Ca starts to play a significant role. Three mentioned processes plus U-Th content of the rock also produce thermal neutrons, and these neutrons activate stable ^{35}Cl into ^{36}Cl. These are also important pathways, because concentration of stable chlorine in the sampled core is non-negligible (65 ppm on average). All pathways were combined in a model of ^{36}Cl production and applied to the calculation of ^{36}Cl content of the core. The talk will contain the comparison of the measured and calculated ^{36}Cl profiles, and our conclusions on the parameters included into the model.

MS 4.5 We 11:45 F 428

Production of a ^{55}Fe-AMS standard and Neutron Capture on ^{54}Fe — •Kathrin Buczak[1], Tamás Belgya[2], Max Bichler[3], Oliver Forstner[1], Robin Golser[1], Walter Kutschera[1], Claudia Lederer[1], Alfred Priller[1], Peter Steier[1], and Anton Wallner[1] — [1]VERA Laboratory, Faculty of Physics - Isotope Research, Univ. of Vienna, Austria — [2]Institute of Isotopes HAS, Dept. of Nuclear Research, Hungary — [3]Atominstitut, TU Wien, Austria

The interest in neutron capture on ^{54}Fe is linked to: studies of nucleo-synthesis in stellar environments, radioactive waste generation in fusion reactors and the half-life value of the long-lived ^{59}Ni. For the measurement of the thermal neutron capture cross section $\sigma(^{54}\mathrm{Fe}(n,\gamma)^{55}\mathrm{Fe})$, irradiations have been performed at the TRIGA reactor in Vienna, and with cold neutrons at the Budapest Research Reactor. The radionuclide ^{55}Fe ($t_{1/2}$ = 2.7 yr) produced in these activations, was measured at VERA (Vienna Environmental Research Accelerator) via accelerator mass spectrometry (AMS). Such isotoperatio measurements, however, require an accurate ^{55}Fe-AMS standard as reference material: (1) At VERA, iron samples, highly enriched in ^{54}Fe, were bombarded with 5.5 MeV protons to produce ^{55}Co ($t_{1/2}$ = 17.53 h), which decays to ^{55}Fe. The total number of daughter-nuclides ^{55}Fe was determined from the measured ^{55}Co-activity. (2) Another, independent standard was produced by a dilution series of a certified ^{55}Fe-standard-solution. The cross section value is expected to be accurate at a level of ± 3% and is directly coupled to a previous ^{59}Ni half-life value. The measurement procedure and the latest results will be presented.

MS 4.6 We 12:00 F 428

^{53}Mn - a long-lived activation product in a nuclear fusion environment — •Claudia Lederer[1], Iris Dillmann[2], Thomas Faestermann[2], Axel Klix[3], Gunther Korschinek[2], Johannes Lachner[2], Mikhail Poutivtsev[2], Georg Rugel[2], Klaus Seidel[3], Herbert Vonach[1], and Anton Wallner[1] — [1]VERA-Labor, Fakultät für Physik, Universität Wien, Österreich — [2]Physik Department, Technische Universität München, Deutschland — [3]Inst. f. Kern- und Teilchenphysik, TU und FZ Dresden, Deutschland

Since nuclear fusion devices as a potential energy source seem feasible, there is a strong need for accurate cross-section data to estimate production of long-lived radioisotopes. ^{53}Mn ($T_{1/2}$=3.7 Myr) is considered to contribute significantly for long-term waste disposal. It is mainly produced via interaction of 14-MeV (fusion) neutrons with Fe-

and Ni-containing structure materials (predominantly via reactions on ^{54}Fe). Fe samples, enriched in ^{54}Fe, were irradiated with quasi-monoenergetic neutrons of energies from 13.4 to 14.9 MeV at the 14 MeV neutron generator of the TU Dresden. The number of produced ^{53}Mn nuclei was quantified via AMS, utilizing the 14-MV tandem at the MLL of TU and LMU Munich. Previous measurements indicate nearly constant cross-section values of about 200 mb around 14 MeV, whereas evaluations show an increasing excitation function between 400 and 600 mb. Our results, which are the first ones based on AMS, suggest even higher cross-sections. These new experimental data will allow to forecast ^{53}Mn activation for an ITER-like device with a significant reduction of present uncertainties.

MS 4.7 We 12:15 F 428

Improved measurements of gaseous ^{14}C samples at Micadas — •Simon Fahrni[1,2,3], Lukas Wacker[4], Matthias Ruff[1,2,4], Sönke Szidat[1,3], and Hans-Arno Synal[4] — [1]Department of Chemistry and Biochemistry, University of Bern, Bern, Switzerland — [2]Laboratory for Radiochemistry and Environmental Chemistry, Paul Scherrer Institute, Villigen, Switzerland — [3]Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland — [4]Ion Beam Physics, ETH Hönggerberg, Zurich, Switzerland

Samples of 1 to 40 μg carbon are measured as CO_2 in the gas ion source of the small AMS facility MICADAS at ETH Zurich. This measurement technique offers a simple and fast way of ^{14}C measurements without the need of sample graphitization. Low negative ion currents, however, are a drawback of gaseous measurements as they result in a reduced precision. To overcome this problem, we optimized several parameters of the new ion source at MICADAS. The performance now achieved allows to measure samples faster, more efficiently and with a higher precision. Therefore, the gas ion source at MICADAS even becomes feasible for dating in the 5 per mil range. A report on the state of our gas ion source is presented.

MS 4.8 We 12:30 F 428

^{14}C AMS measurement and sample preparation methods of μg-sized carbon samples — •Jakob Liebl[1], Simon Fahrni[2], Robin Golser[1], Walter Kutschera[1], Klaus Mair[1], Alfred Priller[1], Peter Steier[1], Iris Vonderhaid[1], Lukas Wacker[3], and Eva Maria Wild[1] — [1]Vienna Environmental Research Accelerator (VERA), Faculty of Physics - Isotope Research, University of Vienna, Austria — [2]Department of Chemistry and Biochemistry, University of Bern, Switzerland — [3]Ion Beam Physics, Physics Department, ETH Zurich, Switzerland

^{14}C AMS measurement and sample preparation methods for μg-sized samples have been developed at VERA. Overall measurement uncertainties do not primarily originate from the uncertainty of the AMS measurement itself, but are strongly affected by carbon contamination introduced during sample preparation. In contrast to contamination levels at graphitization, contamination introduced at earlier steps of sample preparation is sparsely investigated. At VERA, procedures with no detectable ($<$0.2 μg C) carbon contamination during graphitization, and contamination below 0.4 μg C during sample combustion and pretreatment were developed. Sample preparation procedures and graphitization protocols currently applied for small samples are presented. We will also discuss results of comparative AMS measurements of CO_2 samples (10 μg C), either graphitized and measured at VERA or introduced as CO_2 into a gas ion source installed at a MICADAS facility of the ETH Zurich. With both methods, we have reached a precision level of about 1% for ^{14}C measurements of 10 μg C samples.

MS 4.9 We 12:45 F 428

Direct Radiocarbon Analysis of CO_2 samples — •Tim Schulze-König, Lukas Wacker, and Hans-Arno Synal — Ion Beam Physics, ETH Zurich, 8093 Zurich

Sample preparation of radiocarbon samples for analysis with Accelerator Mass Spectrometry is a time consuming process. A kit has been developed, which circumvents this process and allows direct analysis after sample taking. The kit uses a CO_2 trap and requires a small gas interface, which is connected to the gas ion source of the mass spectrometer. Initially developed for breath air analysis, it might be useful for analysis of exhaust air of industry plants, as well. An example of use will be given and potential applications will be discussed.