HK 69: Anwendungen kernphysikalischer Methoden

Time: Friday 14:00–15:45 Location: C-2

Group Report HK 69.1 Fri 14:00 C-2

The ERINDA project for research related to the transmutation of radiactive waste — •Eckart Grosse[1,2] and Arnd R. Junghans[1] for the ERINDA-Collaboration — [1]Helmholtz Zentrum Dresden Rossendorf — [2]IKTP Technische Universität Dresden

The strongest argument against a long-lasting commitment to nuclear power as energy supply is the difficult permanent disposal of the long lived radioactive waste produced in nuclear reactors. Significant efforts are thus being made worldwide directed towards the minimisation, management, and disposal of highly radioactive nuclear waste. The EU-FP7 ERINDA project aims for a coordination of European efforts to exploit up-to-date neutron beam technology for novel research on advanced concepts for nuclear fission reactors and the transmutation of radioactive waste.

Research to the aim of finding techniques optimized for a strong reduction of nuclear waste can already now be performed at nuclear facilities existing within ERINDA and the main objective is to provide adequate transnational access to these infrastructures. Support of the experimental work is expected from the funding of scientific workshops and visits as well as from PhD thesis work. As an example a correlated study of selected isotopes by photon absorption and radiative capture has yielded interesting insight into the ambiguities of statistical model calculations which may be used to predict transmutation rates.

HK 69.2 Fri 14:30 C-2

Fission γ-ray data measurements - a challenging endeavour — •Stephan Oberstedt[1], Robert Billnert[1,2], and Andreas Oberstedt[2,3] — [1]EC Joint Research Centre IRMM, Retieseweg 111, B-2440 Geel — [2]Chalmers Tekniska Högskola, S-41296 Göteborg — [3]Örebro Universitet, S-70182 Örebro

The OECD has published in its high priority data request list a demand for new data on prompt fission γ-ray emission for the standard actinide isotopes ^{235}U and ^{239}Pu in view of their importance for the development of future nuclear fission applications and a responsible handling of nuclear waste with respect to heat production and toxicity. Prompt fission γ-rays can be used to study the configurations of fission fragments very close to the scission point and to better understand how the total excitation energy available in the fissioning system gets transferred to intrinsic excitation in the fragments. They should preferably be known as a function of fission-fragment mass and excitation energy. Existing experimental data, however, were obtained in the 1970s for the above mentioned isotopes. In order to arrive at new and precise correlated γ-ray emission data the problem of efficient neutron/γ-ray separation has to be solved. This is usually achieved by means of time-of-flight and the pulse-shape discrimination technique and requires excellent timing resolution of the measurement system. Additionally, high detection efficiency is required. The talk will discuss present activities on fission γ-ray measurements with a particular emphasis on state-of-the art fission-fragment and γ-ray detectors.

HK 69.3 Fri 14:45 C-2

Spurenelementnachweis von Lithium in organischem Gewebe mit Neutronen — •Josef Lichtinger[1], Reiner Krücken[1], Roman Gernhäuser[1], Dominik Seiler[1], Sonja Winkler[1], Matthias Graw[2], Elisabeth Mützel[2], Jutta Schöpfer[2], Susanne Ring[2], Petra Kudejova[3], Lea Canella[3] und Karl Zeitelhack[3] — [1]TU-München, Physik-Dept. E12, D-85748 Garching — [2]LMU-München, Institut für Rechtsmedizin, D-80336 München — [3]FRM II, D-85747 Garching

Die Anzahl der an affektiven Störungen erkrankten Menschen stieg in den letzten Jahren immer mehr an. Diese Erkrankung ist auch die häufigste Ursache für Arbeitsunfähigkeit. Die biologische Ursache der affektiven Störungen ist jedoch noch weitgehend unbekannt. Lithium wird bei der Behandlung von affektiven Störungen als Antidepressiva-unterstützendes Medikament eingesetzt. Außerdem findet es bei der Prophylaxe von neurodegenerativen Erkrankungen Anwendung. Die genaue Wirkungsweise des Lithiums, kritische Konzentrationen und lokale Anreicherungen im Gehirn sind jedoch bisher noch ungeklärt. Aus diesem Grund wurde eine Messmethode entwickelt, um kleinste Lithiumspuren post mortem im menschlichen Gehirn ortsaufgelöst, mit der Hilfe von Neutronen aus der Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II), nachzuweisen. Wir stellen das grundsätzliche Konzept der Messmethode und die Targetpräparation vor und zeigen die Rekonstruktion der, in den Gewebeproben enthaltenen, Lithiumkonzentration anhand erster Messergebnisse.

HK 69.4 Fri 15:00 C-2

Verification of Monte Carlo Transport Codes: FLUKA, MARS and SHIELD-A — •Vera Chetvertkova[1,2], Edil Mustafin[2], Ulrich Ratzinger[1], Ivan Strasik[2], Ludmila Latysheva[3], and Nikolai Sobolevskiy[3] — [1]IAP, J. W. Goethe-University Frankfurt am Main, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung Darmstadt, Germany — [3]Institute for Nuclear Research RAS, Moscow, Russia

Monte Carlo transport codes like FLUKA, MARS and SHIELD are widely used for the estimation of radiation hazards in accelerator facilities. Accurate simulations are especially important with increasing energies and intensities of the machines. As the physical models implied in the codes are being constantly further developed, the verification is needed to make sure that the simulations give reasonable results. We report on the verification of electronic stopping modules and the verification of nuclide production modules of the codes. The verification of electronic stopping modules is based on the results of irradiation of stainless steel, copper and aluminum by 500 MeV/u and 950 MeV/u uranium ions. The stopping ranges achieved experimentally are compared with the simulated ones. The verification of isotope production modules is done via comparing the experimental depth profiles of residual activity (aluminum targets were irradiated by 500 MeV/u and 950 MeV/u uranium ions) with the results of simulations. Correspondences and discrepancies between the experiment and the simulations are discussed.

HK 69.5 Fri 15:15 C-2

γ-Spektroskopie im HERA-Tunnel — •Jan Hosrt Karl Timm für die COBRA-Kollaboration — Institut für Experimentalphysik, Universität Hamburg

Das COBRA-Experiment sucht nach den neutrinolosen Doppel-Beta Zerfall in Cd und Te Isotopen, vornehmlich in ^{116}Cd. Die erwarteten Halbwertszeiten dieser Zerfälle sind mit 10^{25} Jahren sehr hoch. Für die damit verbundenen niedrigen Zählraten ist die Reduzierung der Untergundrate von entscheidender Bedeutung. Charakterisierung von Materialien in Bezug auf ihre intrinsische Radioaktivität und Lagerung dieser Materialien unter einer Überdeckung von mindestens 15 m w.e. zur Abschirmung der nukleonischen Komponente der kosmischen Strahlung sind unbedingt notwendig.
Der Vortrag befasst sich mit γ-Spektroskopie im HERA-Tunnel. Der HERA-Tunnel in Hamburg bietet eine Überdeckung von etwa 40 m w.e. . Ein elektrisch gekühlter HPGe-Detektor wurde mit Blei und Myonveto abgeschirmt um die Untergrundrate möglichst gering zu halten. Die Resultate der Messungen unter verschiedenen Bedingungen werden vorgestellt.

HK 69.6 Fri 15:30 C-2

Monitoring of laser-accelerated particle beams for hadron therapy via Compton tracking — •C. Lang[1], D. Habs[1,4], P.G. Thirolf[1], A. Zoglauer[3], G. Kanbach[2], R. Diehl[2], J. Schreiber[4], and T. Tajima[1,4] — [1]LMU, München — [2]MPE, München — [3]SSL, Berkeley — [4]MPQ, Garching

Presently large efforts have been achieved towards the development of hadron cancer therapy based on laser-accelerated ion (p, C) beams, particularly aiming at the treatment of small tumors (few mm size).

Thus precise monitoring of the ion track is mandatory. Conventional PET technology suffers from limited signal strength and precision of locating the source position. We envisage to use Compton tracking, i.e. determining energy and momentum of Compton photons and electrons, emitted along the ion track in the irradiated soft tissue. Confining the Compton cone by tracking the scattered electron will allow to significantly improve on the position resolution.

Monte Carlo simulations have been performed to characterize the achievable position resolution and efficiency of a Compton camera. We estimate a resolution of 2 mm (1 mm; 5 mm) FWHM at 2 MeV (5 MeV; 0.5 MeV). An efficiency of $1.4 * 10^{-3}$ ($4.6 * 10^{-6}$) at 0.5 MeV (2 MeV) is envisaged. Optimized for an energy range between 0.5 MeV and 5 MeV, we plan for a system of 5 layers of double-sided Si strip

detectors (for Compton electron tracking) and an additional $LaBr_3$:Ce calorimeter, read out by a segmented photomultiplier tube.

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