HK 77: Nuclear Physics Applications

Time: Thursday 16:30–18:00 Location: H-ZO 100

Invited Group Report HK 77.1 Th 16:30 H-ZO 100

Modern ion-beam techniques for material science and for preserving cultural heritage — •Milko Jaksic — Rudjer Bošković Institute, Zagreb, Croatia

Accelerated ion beams of the low MeV energy range have been used for decades in many different applications. These are in particular techniques for materials analysis, as well as techniques for materials modification. Modern developments of ion beam techniques increased their impact to other fields of research which can be noticed today in two quite different fields, in material science and in preservation of cultural heritage objects.

Development of single ion techniques for materials modification expanded significantly in recent years. Unique property of fast heavy ions that can transfer a significant amount of energy to nanosized volumes became the basis of techniques for nanotechnology. Our recent results showed that even heavy ions with energies below 0.5 MeV/u can be successfully used for nanostructuring using single ion tracks. Furthermore, single ions have been shown to be a valuable tool for probing electronic transport properties (IBIC).

Among numerous examples of IBA (ion beam analysis) and cultural heritage research, the story of Apoxiomenos, an ancient bronze sculpture of athlete, being recovered after 2 millenniums from the bottom of the Adriatic Sea, could not be told without the nuclear physics. Here, AMS provided results to determine the age of sculpture, while microanalysis of alloy composition and studies of the isotope ratios suggested its provenance.

HK 77.2 Th 17:00 H-ZO 100

Die Dortmund Low Background Facility — •Holger Gastrich, Claus Gössling, Jennifer Jentzsch, Daniel Muenstermann, Till Neddermann und Oliver Schulz — Experimentelle Physik IV, TU Dortmund

An der Technischen Universität Dortmund wird eine oberirdische Messanlage im Low-Background-Bereich aufgebaut, um für den Aufbau und Erfolg von Low-Background-Experimenten (z.B. COBRA am LNGS-Untergrundlabor in Italien) eine notwendige Materialauswahl bezüglich geringer Radioaktivität treffen zu können.
Die Dortmund Low Background Facility (DLB) besteht aus einem Germaniumdetektor in Ultra-Low-Background-Ausführung, der durch eine mehrschichtige Abschirmung vor der Umgebungs- und kosmischen Strahlung geschützt wird. Dafür sind u.a. 2,7t Blei, ein Neutronenmoderator, 43t Eisen und 325t Barytbeton verbaut worden, woraus eine Überdeckung von mehr als 10 Meter Wasseräquivalent resultiert. Zusätzlich wurde ein aktives Myonenveto installiert.
Es werden das Konstruktionsschema der Messanlage, Messergebnisse bezüglich der Reduktion des Myonenflusses und der Umgebungsstrahlung sowie der momentane Stand des Aufbaus vorgestellt.

HK 77.3 Th 17:15 H-ZO 100

Hochspannungskalibration durch kollineare Laserspektroskopie an ISOLDE/CERN — •A. Krieger[1], M. Bissell[3], K. Blaum[4], G.W. Drake[5], Ch. Geppert[1,2], R. Sanchez[2], D. Tiedemann[1], M. Kowalska[6], J. Krämer[1], R. Neugart[1], F. Schmidt-Kaler[7], Z.C. Yan[8], Y. Yordanov[6], M. Zakova[1], C. Zimmermann[9] und W. Nörtershäuser[1,2] — [1]Institut für Kernchemie, Universität Mainz,Germany — [2]Gesellschaft für Schwerionenforschung, 64291 Darmstadt Germany — [3]Instituut voor Kern- en Stralingsfysica, KU Leuven, Belgium — [4]Max-Planck Institut für Kernphysik, 69117 Heidelberg, Germany — [5]Department of Physics, University of Windsor, Windsor, Canada, N9B 3P4 — [6]CERN, CH-1211 Geneva 23, Switzerland — [7]Institut für Quanteninformationsverarbeitung, Universität Ulm,Germany — [8]Department of Physics, University of New Brunswick, Fredericton, NB, Canada — [9]Institut für Physik, Universität Tübingen, Germany

Den Einsatz der kollinearen Laserspektroskopie zur Hochspannungsmessung schlug Poulsen im Jahre 1982 vor. Diese Technik wurde in Kombination mit einem präzisen Frequenzkamm-stabilisierten Lasersystem an dem on-line Isotopenseparator ISOLDE eingesetzt. Die Messungen der Beschleunigungsspannung von Be^+-Ionen deckten dabei eine Fehlkalibration der an ISOLDE installierten Hochspannungsteiler ASTEC 1 und ASTEC 2 auf. Kollineare und anti-kollineare Laserspektroskopie ermöglichten die Bestimmung der Beschleunigungsspannung der Ionen mit einer relativen Genauigkeit besser als $2 \cdot 10^{-5}$. Dadurch konnte eine relative Abweichung von 10^{-4} festgestellt werden.

HK 77.4 Th 17:30 H-ZO 100

Production of light and intermediate mass residual nuclides by proton induced reactions at medium energies — •Mihaela Tutuc[1], Rolf Michel[1], Sylvie Leray[2], and Jean-Christophe David[2] — [1]Zentrum für Strahlenschutz und Radioökologie, Leibniz Universität Hannover, Herrenhäuserstr. 2, 30419, Hannover, Germany — [2]CEA/Saclay, DAPNIA/SPhN, 91191 Gif-sur-Yvette, Cedex, France

A systematic survey was done for the production of intermediate mass fragments by proton induced reactions. Our study covers all previous available and new data for the production of residual nuclides with masses between 3 and 30, over an energy range extending from thresholds up to 2.6 GeV with targets spreading over the entire chart of nuclides.

Cross sections for the production of residual nuclides are a key issue for medium energy applications. Due to the large range of relevant target elements and the amount of product nuclides it will not be possible to measure all the cross sections needed. One will have to rely widely on models and codes to calculate the required data. In this context, the capabilities of some available codes, Talys and INCL4+ABLA, to predict cross sections for the production of residual nuclides in thin target experiments are tested and a comparison between experiment and theory is made.

This work was performed as a contribution to the NUDATRA work package 5.4 for the EUROTRANS Programme.

HK 77.5 Th 17:45 H-ZO 100

Measurement of neutron-induced fission cross sections of Pb-nat and Bi-209 up to 1 GeV — •Diego Tarrío[1], Ignacio Durán[1], Carlos Paradela[1], and Laurent Tassan-Got[2] for the CERN-nTOF Phase1-Collaboration — [1]Universidade de Santiago de Compostela (Spain) — [2]Centre National de la Recherche Scientifique/IN2P3-IPN, Orsay (France)

Lead and bismuth are widely proposed as candidate materials for the spallation source to be used in ADS fast reactors. On the other hand, Bi-209 fission cross section has been proposed as a new standard for neutron-induced fission in the subactinides region. Despite their importance for such applications, available data on fission about these elements are very scarce mainly due to its small cross section, of the order of tens of mb, while for the actinides is of the order of few barns. So, new and more precise measurements have been required by the international organizations (IAEA, OECD-NEA...)

The n_TOF facility at CERN provides a unique very-intensive and high energy resolution neutron beam, from 1 eV to 1 GeV. Fission Fragments in temporal coincidence were measured using a dedicated reaction chamber, developed at IPNO, based on PPAC detectors. Pb-nat and Bi-209 fission cross-sections have been measured using samples of U-235 and U-238 as references.

In this work, we present the n_TOF results about the cross sections of Pb-nat and Bi-209 from fission threshold up to 1 GeV.