HK 54: Nuclear Physics Applications

Time: Wednesday 14:00–16:00 Location: H-ZO 100

Invited Group Report HK 54.1 We 14:00 H-ZO 100

Beta decay measurements of importance for reactor heat calculations — •Alejandro Algora — IFIC (CSIC-Univ. Valencia), Valencia, Spain

Beta decay studies provide in many cases our primary information on the structure of unstable nuclei. These studies are in general complementary to in-beam studies and present different difficulties to the experimenter. In the case of beta decay one common experimental problem is the so-called "Pandemonium effect" [1] when decays with large Q values are studied. The solution to this problem is the application of the total abpsortion spectroscopy (TAS) technique.

In this contribution the results of recent beta-decay studies using the TAS technique will be presented. The main goal of these measurements was the study of nuclei that had been identified as important contributors to the decay heat in reactors [2]. The results of the analysis and their impact in reactor decay heat summation calculations will be presented.

[1] J. C. Hardy, L. C. Carraz, B. Jonson, P. G. Hansen, Phys. Letts 71B (1977) 307 [2] T. Yoshida, T. Tachibana, F. Storrer, K. Oyamatsu and J. Katakura, J. Nucl. Sci. Technol. 36 (1999) 135

Group Report HK 54.2 We 14:30 H-ZO 100

research on measurement of 126Sn by accelerator mass spectrometry — •hong tao shen, ming he, and shan jiang — Chian institute of Atomic Energy

126Sn is a long-lived beta emitting radionuclide with a half-life of (2.30*0.14)*105 years. Artificially produced 126Sn has entered our environment through nuclear weapons testing and releases from reprocessing plants and may locally lead to strongly enhanced 126Sn concentrations. So the long lived 126Sn may have implications on the nuclear pollution in our environment. Further more, in supernova explosions 126Sn is predominantly produced by rapid neutron capture (r process). The live 126Sn observed in primitive meteorites can imply that some live nuclear material was present at an early stage of the solar system formation. But the primary difficulty in the determination of the 126Sn concentration is the interference of the stable isobar 126Te. AMS is one of the most important methods to detect minute amounts of 126Sn .This work was carried out using the HI-13 tandem accelerator at CIAE National lab. SnF3- ions from the negative ion source were injected into the accelerator whose terminal voltage is 8.7 MV. Sn10+ ions were selected by an analyzing magnet and finally counted selectively using a ΔE-E gas ionization detector. A preliminary result of 126Sn/Sn=1.2*10-8 has been obtained for a 126SnO2 sample produced from spent U fuel. Further improvement is needed for the AMS measurement of 126Sn.

HK 54.3 We 15:00 H-ZO 100

First Measurements of Inelastic Neutron Scattering at nELBE — •Roland Beyer[1], Evert Birgersson[1], Eckart Grosse[1,2], Roland Hannaske[1], Arnd R. Junghans[1], Andrija Matic[1], Ralf Nolte[3], Klaus-Dieter Schilling[1], Ronald Schwengner[1], and Andreas Wagner[1] — [1]FZ Dresden-Rossendorf, PF 510119, 01314 Dresden,Germany — [2]TU Dresden, 01062 Dresden, Germany — [3]PTB Braunschweig,Bundesallee 100, 38116 Braunschweig, Germany

At the nELBE facility [1] at Forschungszentrum Dresden-Rossendorf fast neutrons with kinetic energies of 0.1 to 10 MeV will be used to deliver nuclear data on neutron induced reactions necessary for the development of future nuclear transmutation facilities and new types of nuclear reactors. Electrons from the superconducting electron linac ELBE are shot onto a liquid lead target where they produce Bremsstrahlung which in turn liberates neutrons via (γ,n) reactions. The short pico-second pulse structure of the electron beam enables neutron time-of-flight experiments with very short flight paths of 4-7 meters obtaining energy resolutions of about 1 %.

First experiments on inelastic neutron scattering on ^{56}Fe where performed using a double time-of-flight setup based on proton recoil detectors [2] and an array of 42 BaF_2 crystals to detect the emitted photons and neutrons in coincidence. First results will be presented.

[1] E.Altstadt, C.Beckert, et al. Ann.Nucl.Energy 34 (2007) 39. [2] R.Beyer, E.Grosse, et al., NIM A 575 (2007) 449-455.

HK 54.4 We 15:15 H-ZO 100

Pulse shape comparison procedure to characterise position sensitive HPGe detectors — •Namita Goel, Cesar Domingo Pardo, Tobias Engert, Juergen Gerl, Ivan Kojouharov, and Henning Schaffner — GSI Helmholtzzentrum fur Schwerionenforschung mbH, 64291,Darmstadt,Germany

A new tool to experimentally characterize 3D position sensitive HPGe detector based on pulse shape comparison procedure is proposed and implemented. It is a novel technique for measuring the HPGe detector pulse shapes as a function of the γ-ray interaction position inside the detector volume. The system also utilizes the principles of positron emission tomography to speed up the scanning time. An application of the Na-22 source emitting pairs of 511 keV gammas in back to back directions allows creating a "collimator-free"scanner, where pulse shapes for many lines across the detector or even the whole detector can be registered simultaneously. A position sensitive γ-ray scintillator detector (PSD) oriented towards the source is used for registration of 511 keV gammas in coincidence with the HPGe detector. This PSD is based on a crossed-wire anode position sensitive photomultiplier tube (PSPMT).The main difference with respect to similar existing devices is the individual multianode readout (IMAR) approach. The method allows to exploit better the intrinsic characteristics of the PSPMT, thus yielding better position linearity, improved spatial resolution of about 1 mm(FWHM) . This position sensitive γ-ray scintillator detector fulfills the requirements for its implementation in our scanning system.

HK 54.5 We 15:30 H-ZO 100

The Nucifer experiment : Reactor antineutrino detection for reactor monitoring — •Frédéric Yermia[1] and Alexis Nuttin[2] for the Nucifer-Collaboration — [1]SUBATECH (CNRS/IN2P3 - University of Nantes - Ecole des Mines de Nantes), Nantes, France — [2]LPSC (CNRS-IN2P3/UJF/INPG), Grenoble, France

During the last decades, tremendous progresses have been achieved on the fundamental knowledge and detection of neutrinos which give new opportunities of applied neutrino physics. Among them, antineutrinos could be exploited for two nuclear reactor monitoring applications: the thermal power measurement and the control of the isotopic composition of the reactor fuel. This application arouses the International Atomic Energy Agency (IAEA) interest as a potential new safeguard tool.

The Nucifer detector, under development in France, will be dedicated to applied neutrino physics. The design of the detector takes advantage of the technical improvements performed for fundamental neutrino experiments such as Double Chooz. Nucifer will be tested within the next two years at the OSIRIS (Saclay-France) and the ILL (Grenoble-France) research reactors. After an brief overview on the worldwide effort in the field of reactor monitoring with antineutrinos, the Nucifer experiment will be presented, as well as Monte-Carlo PWR and CANDU reactor simulations and the method to compute the antineutrino energy spectrum using nuclear databases. The expected response of the Nucifer detector to diversion scenarios in PWR and CANDU reactors will be shown.

HK 54.6 We 15:45 H-ZO 100

Approach for uncertainties in nuclear data evaluations based on modelling — •Helmut Leeb — Atominstitut der Österr. Universitäten, TU Wien, Wien, Austria

The design of new nuclear facilities, medical applications and dosimetry require the knowledge of all relevant nuclear cross sections and spectra. With regard to current developments in fusion and fission technologies an extension of nuclear data libraries up to 150 MeV and inclusion of covariance matrices for cross section uncertainties are requested. Because of the scarcity of experimental data beyond 20 MeV this extension is not trivial and the corresponding evaluations rely strongly on modelling. For such theory-based evaluations no well established procedures are available to estimate reliably the uncertainties. In this contribution we revisit currently studied methods and present a recently formulated evaluation procedure which is built upon fundamental Bayesian statistics. The feasibility and reliability of the method is successfully demonstrated for several isotopes. The work supported by the European Commission under the Contract of Asso-

ciation between EURATOM and the Austrian Academy of Sciences, was carried out within the framework of the European Fusion Development Agreement (EFDA). The views and opinions expressed herein do not reflect necessarily those of the European Commision.