

Executive Summary

Topics addressed during the NEMEA-6 workshop involved nuclear data needs and impact, nuclear data validation and benchmarks, the ANDES-accurate nuclear data for nuclear energy sustainability-project, detectors and facilities, and measurements of nuclear data.

The workshop was opened by Prof. Paweł Olko, the scientific director of the IFJ-PAN. Prof. Urszula Woznicka presented an overview of the research trends of the institute with emphasis on the Division of Applied Physics and Interdisciplinary Research, while Prof. Adam Maj surveyed of the engagements in nuclear structure research and Prof. Krzysztof Drozdowicz described the EURATOM fusion related studies. This was complemented, towards the end of the workshop, by an interesting presentation on thermoluminescent dosimeter (TLD) development “from nGy to MGy” for environmental doses of complex radiation at high-energy accelerators and thermonuclear fusion facilities by Dr. Barbara Obryk. The development of TLDs and their fields of application are a strong-point for the institute. Franco Michel-Sendis presented the nuclear and in particular the nuclear data projects of the OECD-NEA and Arjan Plompen gave a survey of the nuclear measurement programme and the collaborations of the Joint Research Centre’s Institute for Reference Materials and Measurements illustrated with examples of recent work.

In the session on data needs and impact Robert Jacqmin highlighted the use of sensitivity studies to determine target uncertainties for nuclear data. An analysis of the European fast reactor, an evolutionary sodium-cooled fast reactor and an innovative sodium-cooled fast reactor showed large differences for the uncertainties estimated for the peak power and reactivity swing. Alexej Stankovskiy looking at data needs for MYRRHA/XT-ADS through sensitivity studies with different models and data sets concluded on a list of nuclides and reactions requiring reduced uncertainty for the criticality uncertainty to reach the target of 300 pcm. He further found target uncertainties vary between 3d and RZ models and depend on the a priori assumed correlations among the uncertainties of the data. Grigorijus Duškesas considered the data needs associated with studies qualifying the residual activity of spent reactor graphite. For carbon-14 and fluence estimates a better knowledge is required for capture on carbon-12 and carbon-13 for the (n,a) reaction carbon-13 and for the (n,p) reaction on nitrogen-14. Mattias Lantz presented his efforts to establish a database for total reaction cross-sections. This is of certain interest to develop nuclear models and nuclear data standards for energies above 20 MeV.

In the session on nuclear data validation and benchmarks Jerzy Janczyszyn compared various model estimates with data for radionuclides produced in a spallation target irradiated with 660 MeV protons in Dubna. Anatoly Blokhin tested the neutron and gamma data for iron and lead in ENDF/B-VII and JENDL-3.3 on the basis of leakage spectra from spherical spheres with a Cf-252 and 14 MeV neutron source. Pavel Blokhin showed discrepancies in decay heat estimates for ^{235}U and ^{239}Pu between JEFF-3.1.1 and ENDF/B-VII.0 for long cooling times. Alberto Milocco presented the methodology for quality assessment of the fusion shielding benchmarks in the SINBAD 2010 database.

In connection with the ANDES project, Maëlle Kerveno presented the setup, measurement methodology and results of (n,xng)-measurements for thorium and uranium-235, while Jean-Claude Thiry investigated the limits of uncertainty of the technique resulting from the normalization by ^{235}U fission and the detection efficiency for gamma-rays. Heikki Penttilä showed how the IGISOL facility was used for decay data and fission yields measurement. The facility is currently being upgraded and is expected to be up and running with improved characteristics in 2011. Mattias Lantz showed a design study for a neutron target allowing fission yields and decay data measurements by neutron induced fission at the new IGISOL facility. Francesca Belloni presented the fission data obtained at the CERN n_TOF (neutron time-of-flight) facility for ^{233}U , ^{241}Am and ^{243}Am .

The larger sessions on detectors and facilities and on measurements of nuclear data were split over two days. Present experimental capabilities and future plans of the accelerator laboratory at Magurele were highlighted by Nicolae Marginean. The state of development of the SARAF accelerator at the Israeli institute SOREQ was shown by Yosef Eisen. Recent experiments to characterize the foreseen semi-Maxwellian Li(p,n) neutron source were presented and discussed. Natalia Janeva showed the first commissioning results of the IREN pulsed neutron source in Dubna and discussed the potential for new measurements at the facility. Mitja Majerle described the status of modelling of the d+C and d+Li neutron source reactions with the McDeLi code of the Karlsruhe Institute of Technology in the interest of the design of the Neutrons For Science facility at SPIRAL2 in GANIL, Caen. Alexej Stankovskiy presented the ALEPH Monte Carlo burnup code developed at SCK-CEN in Belgium. Zdenek Huna described an automatic dosimeter for kerma measurements.

Grzegorz Tracz presented Monte Carlo calculations on angular distributions of neutrons in selected points around the Wendelstein 7-X stellarator under construction in the IPP Greifswald. Ryszard Miklaszewski discussed the application of a plasma-focus pulsed neutron source for detection of explosives and other illicit materials.

In the session on measurements of nuclear data Ferenc Tarkanyi presented a systematic study of deuteron induced activation cross-sections for materials used in accelerator applications. Andras Fenyesi described the characterization of neutron leakage spectra for Bi at 8 and 18 MeV using an NE213 pulse height response spectrometer. Antonín Krása described the status and outlook for new measurements of (n,t) cross-sections at the Institute for Reference Materials and Measurements. Fusion related measurements were presented by Milan Honusek, Eva Simeckova and Jitka Vrzalová. High energy neutron induced Nb activation cross-sections were obtained at the Nuclear Physics Institute in Řež. At the same facility deuteron induced activation cross-sections were obtained for aluminium, iron and copper. Neutron-induced activation cross-sections for bismuth and gold were obtained from 20 to 100 MeV combining results from Řež and the Svedberg Laboratory in Uppsala. These three efforts provide nuclear data of interest to the foreseen IFMIF international fusion materials irradiation facility. The fission process was studied by Ruxandra Borcea using the VERDI spectrometer to obtain high resolution fission fragment yields for thermal neutron induced fission at the Budapest Neutron Centre. In addition, Shakir Zeinalov showed how the use of fast digitizers allows an improved study of prompt fission neutron yields and angular distribution. Vitaly Khryachkov gave an overview of results for (n,a) reactions on boron, nitrogen, oxygen, neon and argon obtained at IPPE Obninsk with a gridded ionization chamber and fast digitizer based data-acquisition. Finally Stanislaw Kistryn presented a summary of experimental studies and model analyses for the deuteron-proton breakup reaction.

The local organization was very well taken care of by Professor Urszula Woznicka and her team. The workshop venue, Polonia House, was on the main market square (Rynek Główny) of the old town (Stare Miasto) of Krakow and the workshop dinner took place in the Jan Haluszka chamber of the Wieliczka salt mine, 135 m underground. Both the old town and the salt mine are on the UNESCO world cultural heritage list.

On the last afternoon of the workshop a laboratory visit to IFJ-PAN introduced the participants to the experimental facilities of the Division of Applied Physics and Interdisciplinary Research. The visit included an introduction to the new proton cancer therapy facility using the AIC-144 cyclotron, the proton microprobe for studying small dose effects at the cellular level, and the radionuclide laboratory.

Arjan Plompen
Urszula Woznicka
Emmeric Dupont
January 2011