Seminar

Institute for Plasma Research

Title: Cross section Measurement of Tin and Rhenium Isotopes with Covariance Analysis and Simulation of Neutron Response Function for NE213 Scintillation Detector

Speaker: Dr. Zara Aftab
Institute for Plasma Research, Gandhinagar

Date: 17th April 2026 (Friday)

Time: 10:30 A.M.

Venue: Seminar Hall, IPR

Join the talk online: URL: https://bharatvc.nic.in/viewer/5992138016

(Conference ID: 5992138016; Password: 232142)

Abstract

Accurate knowledge of neutron-induced reaction cross sections is crucial for nuclear technology applications, including reactor design, radiation shielding, and nuclear data evaluation [1]. Despite the availability of evaluated data files and theoretical predictions, significant discrepancies still exist between different sources. Therefore, the experimental determination of cross sections under controlled conditions remains indispensable. These data are fundamental to reactor physics calculations, such as neutron transport, radioisotope production, and safety assessments. In this study, neutron-induced reaction cross sections for selected isotopes of fusion-relevant materials (Tin and Rhenium [2-5]) were measured for 15.04 MeV and 15.02 MeV neutrons, respectively. Specifically, the cross sections for ^{117}Sn(n,p)^{117g}In, ^{118}Sn(n,α)^{115g}Cd, ^{120}Sn(n,α)^{117g}Cd, ^{185}Re(n,2n)^{186g}Re, ^{187}Re(n,2n)^{186g}Re, ^{187}Re(n,p)^{187}W, ^{187}Re(n,α)^{187}Ta reactions were determined using the neutron activation technique followed by γ-ray spectroscopy. To ensure the reliability of the results, all required correction factors and parameter uncertainties were considered, and a detailed uncertainty analysis was performed using the covariance method. The experimental data were utilized to optimize theoretical model parameters using the TALYS-2.0 and TASMAN-2.0 codes. Furthermore, a sensitivity analysis was conducted to identify the key theoretical model parameters influencing the cross sections.

Another task focuses on the simulation of neutron response function of NE213 detector. The neutron response function relates the measured spectrum of the detector to the incident neutron energy spectrum. In this work, neutron response function of an NE213 scintillation detector was simulated using MCNP which is required for the unfolding of the neutron spectra.

References:

[1] R.A. Forrest, "Data Requirements for Neutron Activation Part I: Cross-Sections," Fusion Eng. Des., 81,2143(2006); http://dx.doi.org/10.1016/j.fusengdes.2006.01.001

[2] D.J.M. King, A.J. Knowles, D. Bowden, M.R. Wenman, S. Capp, M. Gorley, J. Shimwell, L. Packer, M.R. Gilbert, A. Harte," High temperature zirconium alloys for fusion energy" Journal of Nucl. Mat. 153431 (2022)

[3] M. Nakamoto, T. Baba, Y. Kasai, K. Sakamoto, H. Shimane, T. Shimizu, K. Saito, M. Nakahira, N. Koizumi, M. Inoue, "Completion of the first ITER toroidal field coil in Japan" Nucl. Fusion 61 116044 (2021)

[4] S. Nogami, A. Hasegawa, M. Fukuda, S. Watanabe, J. Reiser, and M. Rieth, Tungsten modified by potassium doping and rhenium addition for fusion reactor applications, Fusion Eng. Des. **152**, 111445 (2020).

[5] S. Nogami, D. Terentyev, A. Zinovev, C. Yin, M. Rieth, G. Pintsuk, and A. Hasegawa, Neutron irradiation tolerance of potassium-doped and rhenium-alloyed tungsten, J. Nucl. Mater. 553, 153009 (2021)