

Seminar

Institute for Plasma Research

Title: Study of uncertainty quantification and parameter estimation through nuclear reactions
Speaker: Dr. Mahesh Choudhary
Banaras Hindu University, Varanasi
Date: 10th January 2025 (Friday)
Time: 10.30 AM
Venue: Committee 1, IPR

Abstract

Nuclear reaction data, including cross sections and covariance, are vital for advancements in nuclear technologies and applications like reactor design, nuclear waste management, and astrophysics. This work presents a detailed study of neutron- and alpha-induced nuclear reactions, focusing on experimental measurements, uncertainty quantification, and theoretical model validation. Experiments were conducted at two premier facilities in India: FOTIA at BARC, Mumbai, and the K-130 cyclotron at VECC, Kolkata. A significant part of the thesis is dedicated to utilizing the Unscented Transform Kalman Filter (UTKF) technique for optimizing level density parameters and their correlations in theoretical nuclear models. This approach was applied to the $^{93}\text{Nb}(\alpha,2n)^{95}\text{Tc}$ and $^{93}\text{Nb}(\alpha,n)^{96}\text{Tc}$ reactions using the TALYS nuclear code. The findings are particularly relevant for niobium, a material critical to the design of superconducting radio-frequency (SRF) cavities in particle accelerators.

This work bridges experimental and theoretical efforts, presenting a detailed covariance analysis, precise cross-section measurements, and parameter optimization for nuclear models. The outcomes provide valuable insights into nuclear reaction mechanisms, enhancing the accuracy of theoretical predictions and facilitating their practical applications in nuclear technology and beyond.
