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P4.066 Evaluation of the spectrum unfolding methodology for the neutron activation system of a fusion device

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A Neutron Activation System (NAS) is a highly useful and reliable tool for neutron flux and spectrum measurements in fusion devices such as ITER or ENS. The underlying process involves neutron irradiation of chosen material probes followed by their gamma spectroscopy. The gamma spectra and the further data analyses produce quantitative information on the neutron field characteristics in the irradiation position. In state-of-the-art machines like JET, and for future reactors like ITER, NAS is a principal diagnostic component. For the European test blanket modules (TBM) in ITER, integrated NAS with pneumatic sample transport systems are proposed. The careful analysis of the activation foil measurements is crucial for the successful operation of this system, which forms the subject matter of this paper.
In this work, a fast and efficient methodology is being developed for processing of activation foil data from fusion devices. Starting with the gamma spectra of irradiated probes of selected materials, the method ultimately leads to unfolded spectra of the incident neutrons and uncertainty estimates. The method is tested using data from dedicated experiments at JET, and the Nuclear Physics Institute (NPI) Rez. These measurements utilize few, between 3 and 6 reaction channels for the unfolding. Two spectral adjustment code-packages are adapted for this purpose, and are compared: MAXED and STAYSL. The former is based on the maximum entropy method, whereas the latter follows a least squares algorithm. Monte-Carlo simulations are used to get the guess input spectra required by each code. For the response functions, evaluated data libraries like IRDFF-v.1.05, EAF-2010, ENDF-B/VII.1, and TENDL-2017 are taken as source of dosimetry cross-section data. They are also compared for selection of the most suitable data for unfolding. Finally, a closer investigation is made of the handling of uncertainties in the two codes, and the error propagation in the unfolding procedure.
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