

Analysis of the FNS Duct experiment with the Monte Carlo code TRIPOLI-4®

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The FNS Duct experiment is a neutron streaming experiment performed in the JAERI Fusion Neutronics Source facility. It aims at studying the transport of neutrons in a complex labyrinth. A deuterium beam hits a titanium hydride target (enriched in tritium) and produces 14 MeV neutrons. A stainless steel block with a dogleg inside is located in front of the neutron source and suitable detectors measure activation rates and neutron flux spectra in the dogleg or behind the steel block. These dogleg configurations are typical of ITER diagnostic configurations. The diagnostics monitor the plasma and the facing components. They let the suitable signals travel through the shielding of the reactor in order to be processed far away in a dedicated area where electronic devices are protected against the neutron and gamma fluxes. The dogleg is a typical configuration that protects the back-end of the facility and in the same time allow the transmission of the signals.

The purpose of the study is to analyze the FNS Duct experiment with the Monte Carlo code TRIPOLI-4®. This latest is a Monte Carlo code dedicated to the transport of neutrons, photons, electrons and positrons. It is widely used in the field of radiation protection simulation thanks to the variance reduction techniques that it implements. It is well suited to this kind of analyses.

The analysis focuses first on the model of the experiment (geometrical model, source model) and tests different variance reduction techniques. The Adaptative Multilevel Splitting technique is applied to the experiment simulation. Then, TRIPOLI-4® results are compared with the experiment with both FENDL-2.1 and FENDL-3.1d nuclear data libraries. The results are quite consistent with the experimental results when a dedicated normalization is applied, consisting in making experimental and calculation results consistent for a detector at the entrance of the labyrinth.

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