UPGRADE OF THE NEUTRON AND GAMMA D-LI SOURCE TERM FOR IFMIF NEUTRONICS CALCULATIONS

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The International Fusion Materials Irradiation Facility (IFMIF) is an accelerator-driven deuteron-lithium neutron source projected to produce neutrons at sufficient energy, intensity and irradiation volume and to test samples of candidate materials up to a full lifetime of anticipated use in fusion energy reactors [1].

To enable neutronics calculations for IFMIF, the Monte Carlo code McDeLiciuos [2] has been developed in 2002 as a further development of the McDeLi code [3]. The latter made use of simplified analytical formulae to represent the neutron generation from stripping and compound interactions of deuterons with lithium nuclei and employed the MCNP4 code [4] to transport neutrons and secondary photons. To improve the neutron source representation, the McDeLicious code has implemented the capability to sample neutrons by making use of complete evaluated d-Li cross sections data files that were prepared at that time [5]. This approach was intensively validated against available experimental data and was used as standard for the IFMIF neutronics calculations to predict expected nuclear responses during the project evaluation and design phases.

Since then, the McDeLicious code has been further extended covering the following topics: upgrading to the improved latest evaluation of d-Li cross sections [6] and validation against new experimental data; generation of tritium, beryllium-7 and γ-rays from the deuteron induced reactions in lithium and study their impact on the safety and nuclear responses [7,8]; extending the capabilities to read and validate other d-Li cross section data files such as those from TENDL-2010; upgrading to the latest standards of MCNP5, contemporary compilers and multiprocessing capabilities.

The present work provides an overview of the physical phenomena modelled in the McDeLicious code, illustrates the achieved quality of the simulation and presents the latest version to be released for IFMIF neutronics calculations.

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