ANALYSIS OF THE KANT EXPERIMENT ON BERYLLIUM USING TRIPOLI-4 MONTE CARLO CODE

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ITER is the only opportunity for testing breeding blankets in a real D-T fusion environment and three ITER equatorial ports are reserved for TBM (test blanket module) testing. To increase the performance of tritium production from Li-based materials in ITER TBM, neutron multipliers beryllium and lead are importantly used in the diverse designs of TBM.

Beryllium is the key material in fission and fusion nuclear technology for multiplying neutrons in the core of fission research reactors and in the blankets of D-T fusion reactors. However, beryllium nuclear data are differently presented in modern nuclear data evaluations. In addition, recent investigations with the TRIPOLI-4 Monte Carlo simulation of the tritium breeding ratio (TBR) demonstrated that beryllium reaction data are the main source of the calculation uncertainties between ENDF/B-VII.0 and JEFF3.1 libraries [1].

3D continuous energy Monte-Carlo neutron transport calculations are essential for ITER fusion neutronics. TRIPOLI-4 is the fourth generation of the TRIPOLI®+ family of Monte Carlo codes developed since the 60's by CEA [2]. The automatic variance reduction feature, the mixed libraries option, and the user friendly parallel calculation capability of TRIPOLI-4 code are interesting for the D-T fusion neutron transport calculations.

Karlsruhe Neutron Transmission (KANT) Experiment on beryllium was performed from 1990 to 1994. It has been used to validate neutron transport codes and nuclear data libraries. An elaborated benchmark based on KANT experiment is recently available from NEA/SINBAD database [3]. The neutron multiplication in bulk beryllium assemblies was considered with central D-T neutron sources. Neutron leakage spectra from 5, 10, and 17 cm thick spherical beryllium shells were measured from 15 MeV to 1 meV.

The neutronics study of ITER TBM is a new application field for TRIPOLI-4 code. TBM mock-up benchmarks have been taken into account to validate the code and its associated nuclear data libraries for tritium production calculations [4]. But current calculation studies with beryllium on fission criticality, neutron leakage spectra, and TBR benchmarks show a trend of underestimation of neutron multiplications with JEFF3.1 library.

To clarify the calculation uncertainties from JEFF3.1 library on beryllium, in this study TRIPOLI-4 calculations of KANT experiment have been performed by using ENDF/B-VII.0 and new JEFF3.1.1 libraries. Leakage neutron spectra and five-group partial leakage multiplications (15. – 3.2 – 0.5 – 0.1 – 1E-5 – 1E-9 MeV) will be reported and discussed. In general, improved C/E ratios on neutron leakage multiplications have been obtained.

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