8P67

ITERの簡易モデルを用いたMCNPコードによるITERの仮想真空容器内中性子計測

Synthetic In-vessel Neutron Diagnostics for ITER by using the MCNP Code with Simplified ITER Model

著者名　西谷健夫[1)]、石川正男[2)]、CHEON MunSeong[3)]、HONG SeongHee[3)]、RODIONOV Roman[4)]、DI SARRA Silvia[5)]、KRASILNIKOV Vitaly[5)]

著者名　NISHITANI Takeo[1)] , ISHIKAWA Masao[2)], CHEON MunSeong[3)], HONG SeongHee[3)], RODIONOV Roman[4)], DI SARRA Silvia[5)], KRASILNIKOV Vitaly[5)]

所属略称　(1)名大、(2)QST、(3)KFE、(4)RFDA、(5)ITER機構

所属略称　(1)Nagoya Univ., (2)QST, (3)KFE, (4)RFDA, (5)ITER Org.

It is important to predict the diagnostics output prior to the real plasma experiment. We have established a synthetic in-vessel neutron diagnostics for ITER by using the MCNP code with a simplified ITER model. By using the synthetic in-vessel neutron diagnostics, we can evaluate the response of those neutron diagnostics against the change of the plasma parameters.

The precise MCNP model of an ITER 40 degrees sector, the so-called C-model [1], is provided by the ITER Organization, however, it is very heavy and takes a long time to simulate the response of in-vessel neutron diagnostics. We have performed simplified 20 degrees and 360 degrees ITER models as the synthetic in-vessel neutron diagnostics [2], which include neutron flux monitors (NFM) in an equatorial port, micro fission chambers (MFC), diverter neutron flux monitors (DNFM), and a neutron activation system (NAS).

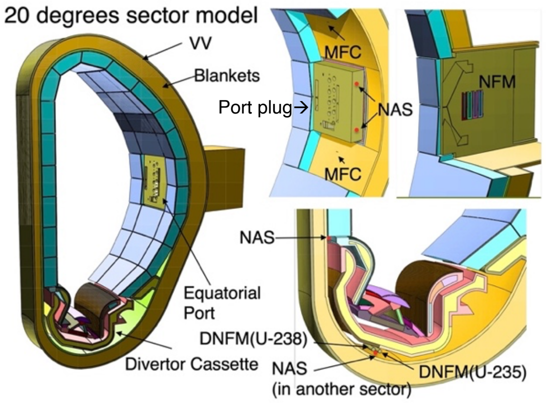

Fig. 1 Schematic views of the ITER 20 degrees sector model for the in-vessel neutron diagnostics.

Figure 1 shows the schematic views of the 20 degrees sector model, which includes Toroidal Field Coils (not shown in Fig.1). In this model, all in-vessel neutron diagnostics are assumed to be installed in the same sector. The equatorial port (EQ) plug with NFM is imported from the EQ#1 detailed structure of the C- model. Shielding blankets are modeled with armor plates and homogenized shielding blocks. The model of the divertor cassette has a continuous structure in the toroidal direction.

A benchmark calculation has been performed for neutron spectra at MFCs and DNFMs to confirm the validity of the simple model. It is found that neutron spectra at MFCs by the simple model agree well with those by C-model. However, neutron spectra at DNFMs by the simple model are a little bit under estimation compared with those by C-model.

The absolute calibration of the detection efficiency for the total neutron yield in the whole plasma is one of the most important issues in neutron diagnostics. In ITER, compact D-T neutron generators will be used as a neutron source for the neutron calibration, where the neutron source will move in the vacuum vessel. Here, the simulation for the neutron calibration using a compact D-T neutron generator is investigated by MCNP calculations with the simplified model.

Table 1 list the detection efficiencies of NFM, DNFM and MFC for the ITER standard plasma, an idealistic 14 MeV line source, and the compact D-T neutron generator moving on the plasma axis where the generator is facing to the radial direction. Detection efficiencies of NFM and DNFM for the neutron generator are 30% and 10% overestimate against those for the standard plasma, respectively. On the other hand, the detection efficiency of MFC is 6% under estimate against that for the standard plasma.

Table 1. Detection efficiencies of NFM, DNFM and MFC.

	Detection efficiency (counts/souce)		
Diagnostics	Standard plamsa	14MeV line source	Neut Generator
NFM	1.04E-08	1.19E-08	1.34E-08
DNFM(U-235)	2.83E-11	2.92E-11	3.08E-11
MFC(lower)	2.73E-11	2.44E-11	2.57E-11

[1] D. Leichtle *et al*., Fusion Eng. Des., **136**, 742-746 (2018).
[2] L. Bertalot *et al*., J. Isntrum., **7**, C04012 (2012).