§2. Study on Technical Problems on Measurements of Total Neutron Yields during D-D Plasma Experiments with LHD

Uritani, A., Yamamoto, S., Watanabe, K. (Grad. Sch. Eng., Nagoya Univ.),
Yamanishi, H., Isobe, M.

It is important to measure total neutron yields during D-D plasma experiments from the standpoint of not only scientific features but managements of experiments and radiation safety. There have been not so many experimental experiences of measurement of total neutron yields or calibration for the neutron yield measurements with very complicated fusion devices such as the LHD. It is the pressing issue to study the technical problems on the measurement and the calibration.

In the second year of this project, we studied neutron transport in the LHD. It is common to use some Monte Carlo simulation codes, such as MCNP, to calculate neutron transport phenomena. It is, however, difficult to make the input geometrical file for the LHD with the very complicated structures, especially the twisted herical coils. No attempts had been done to simulate the neutron transport. In this study, we modeled the herical coils with finely segmented hexahedrons.

We have calculated the neutron flux intensities and energy spectra outside the LHD when neutrons are generated in the plasma region by using MCNP-4C2. When the neutrons are generated at the entire region of the plasma, the neutron flux intensity outside the LHD shows a periodicity with a spatial angular frequency of 36 degrees due to existence of the herical coils. Figure 1 shows the neutron flux intensity on the central axis of the LHD torus as a function of a ^{252}Cf neutron source position and height from the equatorial plane. We can clearly see the neutron shielding effects by the herial coils at 0, 36 and 72 degrees. Figure 2 shows the neutron energy spectra for a DD and the ^{252}Cf (positioned at 0 and 18 degrees) neutron sources on the central axis of the LHD and on the equatorial plane. There are no prominent differences among these spectra al lower than 0.4 MeV. In the high energy region, however, there are some differences. It is pointed out that there are so many low energy neutrons below 0.1 eV due to scattering from the floor materials.

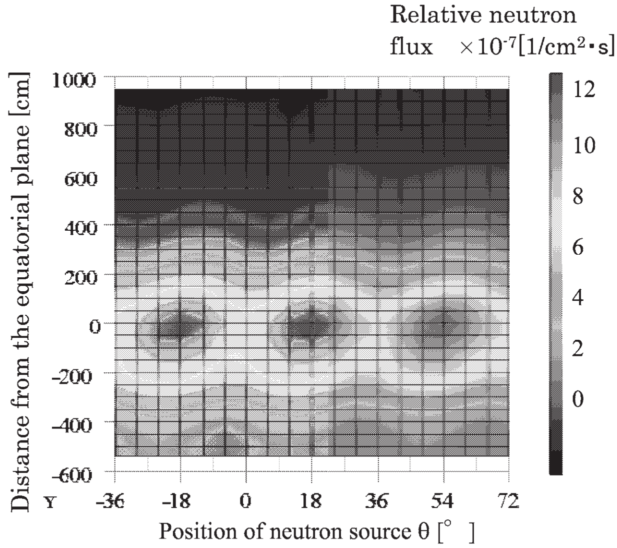

Fig. 1 Neutron flux on the center axis (^{252}Cf).

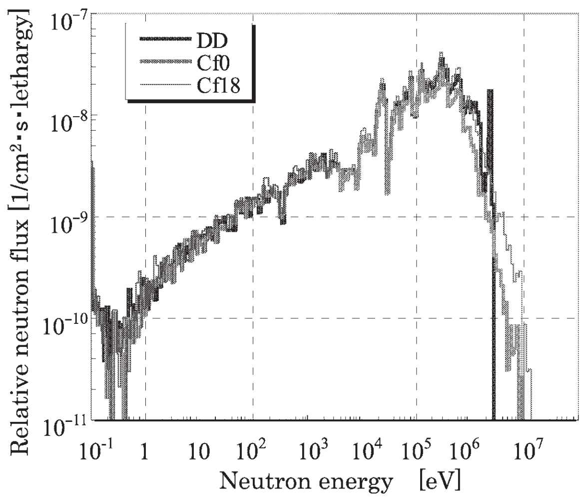

Fig. 2 Neutron energy spectra.