§1. Study on Measurement of Total Neutron Yield during Deuterium Experiments and its Calibration

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We have modeled the LHD device as a simple one to calculate the neutron transport in and out of the device using MCNP-4C2 code for these two years. We can now calculate the fluence rate and the energy spectrum of the neutrons near the LHD device.

For measurement of the total neutron emission yield of the LHD during deuterium burning plasma experiments, the calibration of neutron monitoring devices using a ^{252}Cf neutron source is necessary. Because the neutron spectra of D-D fusion reactions and that of the ^{252}Cf neutron source are somewhat different each other, it is necessary to know how the different spectra affect the calibration. In this study, we have evaluated the influence brought by the spectrum difference. Also investigated are the uncertainty associated with the calibration, and the influence of the initial position of the ^{252}Cf neutron source and the calibration interval angles. We adopted a fission chambers as neutron monitoring devices that have been used for the JT-60 burning plasma experiments.

The ratio α of the sensitivity of the fission chamber for D-D neutrons to that of the ^{252}Cf neutron source was evaluated. The ratio α was 1.04, although it slightly depended on the setting position of the fission chamber. We then evaluated the uncertainty associated with the ratio α for the case that the calibration was done for one week (7 days times 9 hours) using the ^{252}Cf neutron source with a neutron emission rate of 10^9 n/s. The uncertainty associated with the ratio α was smaller than 1.4 %, although it also depended on the setting position of the fission chamber and some other calibration conditions.

We evaluated the influences of the initial position of the ^{252}Cf neutron source and the calibration interval angle on calibration factors, when the calibration was done by setting the ^{252}Cf neutron at discrete position. Figure 1 shows the influence of the initial position of the ^{252}Cf neutron source on the calibration factors. In this figure the true value is the calibration factor when the source is set with one degree interval. The Z values depicted in the figure are the height of the setting position of the fission chambers from the equatorial plane of the LHD. We can see heavy influence of the initial position of the ^{252}Cf neutron source when the calibration interval is 36 degrees.

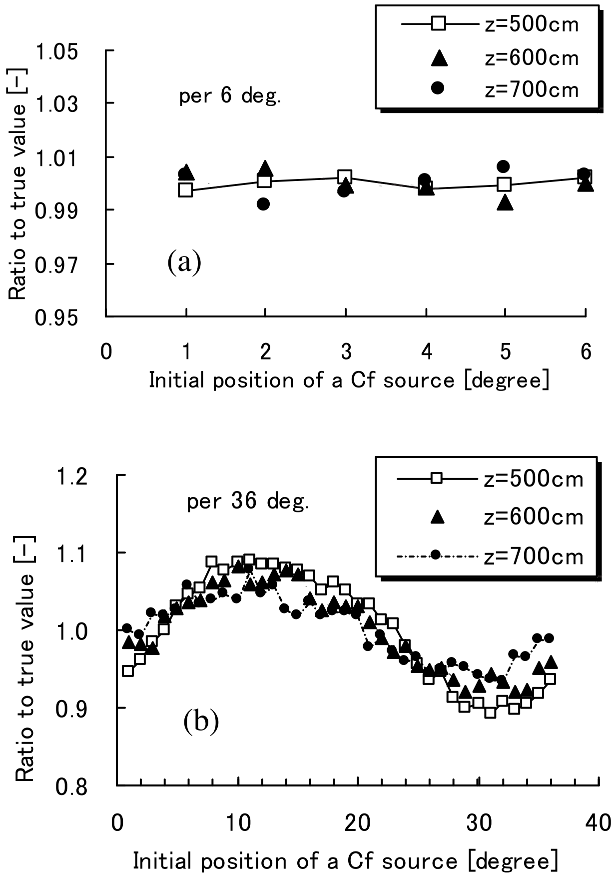

Fig. 1 Influence of initial position of the ^{252}Cf source and calibration interval on calibration factors: (a) calibration interval 6 degrees (b) 36 degrees.

Publication:
N. Nishio, S. Yamamoto, K. Watanabe, A. Uritani, M. Isobe, and H. Yamanishi, “A Study on the Neutron Monitoring System of LHD Based on Monte Carlo Simulations,” Review of Scientific Instruments, **81** (2010) 10D-306-1-10D-306-3.