§34. Study on Benchmark Experiment for Backward-Angle Scattering Reaction Cross Section at 14 MeV

Murata, I., Ohnishi, S., Manabe, M., Obata, T.,
Nakamura, R. (Osaka Univ.),
Sato, S., Sukegawa, A. (Japan Atomic, Energy Agency),
Motota, H., Hesham, N. (MHI Nuclear Engineering Company),
Sagara, A., Muroga, T., Tanaka, T.

There are a lot of integral experiments carried out so far using DT neutrons. In the experiments, elastic scatterings, especially forward scattering events are dominant because the forward scattering reaction cross section is larger than that of backward angle scattering. However, in deeper places contribution of the backward angle scattering can increase.[1,2] In order to validate large angle scattering cross sections, we have started investigating how integral experiments should be performed with a DT neutron source. The aim of this work is to design a new integral benchmark experiment with activation foils, in which the contribution of forward scattering neutrons to activation would be reduced as low as possible in order to emphasize that of backward scattering neutrons.

For this purpose, we have proposed a shadow-bar experiment.[3] The basic geometry is shown in **Fig. 1**. By using this arrangement, neutrons enter the detector foil after a few times scatterings at the target plate which are more-or-less backward scattering.

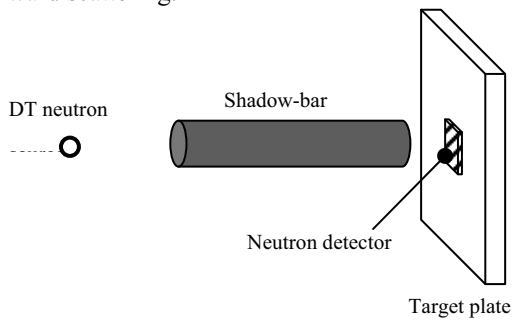

Fig. 1 Conceptual arrangement of experiment.

We examined several configurations for the experiments as shown in Figs. 2 and 3. To clarify which angle of scattering is frequent and to estimate the detection efficiency in these configurations, neutron transportation calculations were performed and tracks of neutrons were analyzed. In the simulation, Monte Carlo transport calculation code, MCNP5 was used and all the neutron tracks and events were recorded by PTRAC option. Also, the reaction rate of ^{93}Nb(n,2n)^{92m}Nb reaction was estimated.

As the results, in C configurations in Fig. 2, the large angle scatterings occurred more frequently and the reaction rates became larger than in E configurations in Fig. 3, if the target angles are the same. In the configuration where the target plate was set with a slant against a shadow-bar, the scattering angles of the tallied neutrons become shifted to the forward direction.

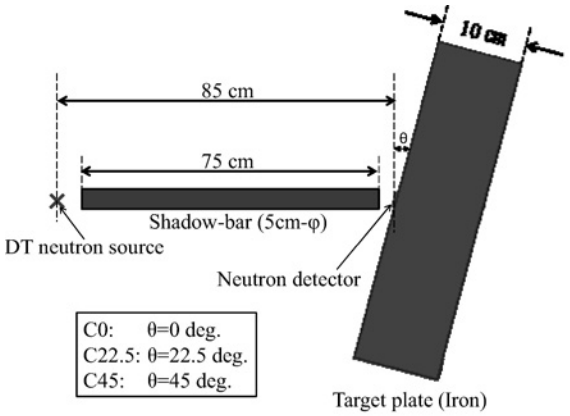

Fig. 2 Centered configuration.

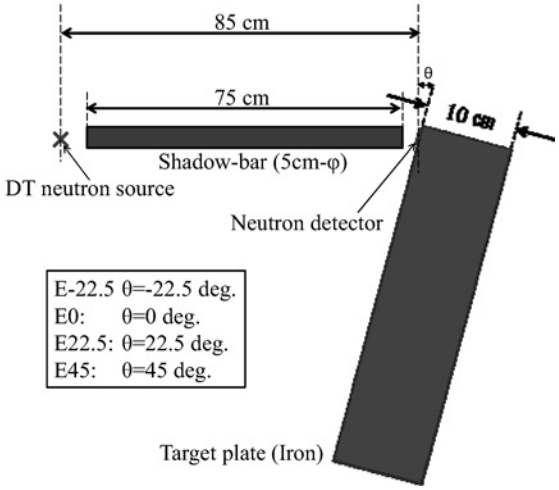

Fig. 3 Off-centered configuration.

The contribution of large angle scatterings varies according to configurations of the shadow bar and the target plate. It is emphasized best in the case of E-22.5 in Fig. 3, though the reaction rate is very small. It is thus implied that different configuration can validate different angle part of scattering cross sections. The validation of large angle scattering cross section would be performed by comparing C/Es obtained from these experiments.

1) S. Ohnishi, K. Kondo, S. Sato, K. Ochiai, K. Takakura, I. Murata, C. Konno, "Implementation of A DT Neutron Beam at the 1st Target Room of JAEA/FNS for New Integral Benchmark Experiments," *J. Korean Phys. Soc.,* **59[2]** (2011) 1949-1952.
2) S. Ohnishi, K. Kondo, T. Azuma, S. Sato, K. Ochiai, K. Takakura, I. Murata, C. Konno, "New integral experiments for large angle scattering cross section data benchmarking with DT neutron beam at JAEA/FNS," *Fusion Engineering and Design*, **87** (2012) 695-699.
3) S. Ohnishi, I. Murata, "Design of A New Integral Benchmark Experiment for Large Angle Scattering Using Shadow Bar and DT Neutron Source, " to be appeared in Progress in Nucl. Sci. and Technol. (2013).