References

[1] Suyalatu Zhang, et al., Atomic Energy Science and Technology, Suppl. 48(2014)45.

[2] Suyalatu Zhang, Zhiqiang Chen, Rui Han, et al., Nuclear Physics Review, 31(2014)235.

[3] W. Lin, et al., Phys, Rev, C, 89(2014)021601(R).

[4] W. Lin, X. Liu, M. R. D. Rodrigues, et al., Phys, Rev, C, 90(2014)044603.

[5] X. Liu, W. Lin, R. Wada, et al., Phys, Rev, C, 90(2014)014604.

[6] X. Liu, W. Lin, R. Wada, et al., Phys, Rev, C, 90(2014)014605.

2- 33 Measurement of Leakage Neutron Spectra for Tungsten with D-T Neutrons and Validation of Evaluated Nuclear Data

Zhang Suyalatu, Chen Zhiqiang, Han Rui, Liu Xingquan, Lin Weiping,
Ren Peipei, Tian Guoyu, Luo Fei, Liu Jianli and Shi Fudong

China has started to develop the Chinese Initiative Accelerator Driven Systems (C-ADS) project which is now underway vigorously. This project mainly aims at high radioactive nuclear waste transmutation, fuel breeding and clean energy production. In the design of C-ADS, $\sim$ 1 GeV high intensity proton beam bombards on heavy metal spallation target inside the subcritical reactor, and provides external neutron source for the subcritical reactor. The combination of evaluated nuclear data with a Monte Carlo transportation code like MCNP is widely utilized for designing such kind of nuclear engineering facilities. However, the transportation codes and evaluated nuclear data used need to be validated through integral experiments[1−5].

Tungsten is proposed to be one of the most promising candidate spallation targets and other structural materials of the CIADS project, as well as an important material in fusion devices. There some integral experiments and evaluations for Tungsten[6−10] have been reported for benchmarking evaluated nuclear data related to the design of fusion devices.

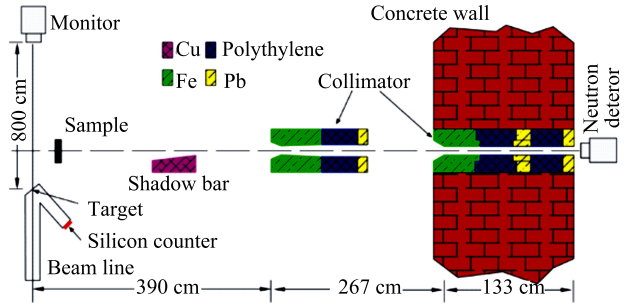

Fig. 1 (color online) A schematic view of the experimental arrangement.

Integral neutronics experiments have been investigated at Institute of Modern Physics, Chinese Academy of Sciences (IMP, CAS) in order to validate evaluated nuclear data related to the design of C-ADS. In present report, the accuracy of evaluated nuclear data for Tungsten has been examined by comparing measured leakage neutron spectra with calculated ones. Leakage neutron spectra from the irradiation of D-T neutrons on Tungsten slab sample were experimentally measured at 60° and 120° by using a time-of-flight method. A schematic view of the experimental arrangement is shown in Fig. 1. Theoretical calculations are carried out by Monte Carlo neutron transport code MCNP-4C with evaluated nuclear data of the ADS-2.0, ENDF/B-VII.0, ENDF/B-VII.1, JENDL-4.0 and CENDL-3.1 libraries. The measured leakage neutron spectra for the Tungsten sample at 60° and 120° are shown in Fig. 2 comparing with the calculated ones.

From the comparisons, it is found that the calculations with ADS-2.0 and ENDF/B-VII.1 give good agreements with the experiments in the whole energy regions at 60° while a large discrepancy is observed at 120° in the elastic scattering peak, caused by a slight difference in the oscillation pattern of the elastic angular distribution at angles larger than 20°. However, the calculated spectra using data from ENDF/B-VII.0, JENDL-4.0 and CENDL-3.1 libraries showed larger discrepancies with the measured ones, especially around 8.5 $\sim$ 13.5 MeV.

The present work shows that the experimental apparatus and the data analysis procedures work well and provide valuable data for benchmarking the evaluated nuclear data for Tungsten. The further integral benchmark experiments and differential cross section experiments will be investigated for materials related to design of the C-ADS in the future in the same frame of this work.