2- 34 Neutron Time-of-Flight Spectrometer Based on HIRFL for Studies of Spallation Reactions Related to ADS Project

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The combination of nuclear models with a Monte Carlo transportation code like MCNP, GEANT4 and FLUKA, nucleon meson transport codes (NMTC) are widely utilized for designing of Accelerator Driven Systems (ADS). However, the nuclear models embedded into transportation codes need to be validated by experimental measurements. A Neutron Time-of-Flight (NTOF) spectrometer, which is based on Heavy Ion Research Facility in Lanzhou (HIRFL), is designed for further investigations of reaction mechanisms and neutron productions of proton induced spallation reactions related to the ADS project. The NTOF spectrometer is capable of measuring neutrons in a wide energy and angular ranges. It consists of a beam pick-up detector and 10 individual neutron detection modules. The schematic view of the NTOF spectrometer is shown in Fig. 1.

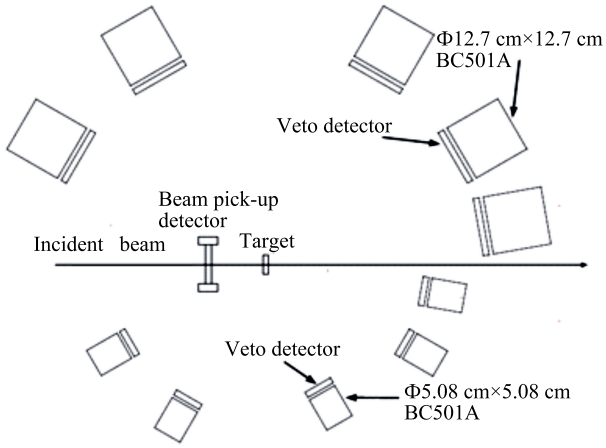

Fig. 1 A schematic view of the NTOF spectrometer.

A test experiment for the whole system of the NTOF spectrometer was performed by measuring energy spectrum, production yield and angular distribution of neutrons, γ rays and charged particles from a Tungsten target with ^{16}O beam at a bombarding energy of 400 MeV/u. In Fig. 2, a typical TOF spectrum excluding the charged particle events is given. The prompt gamma peak of the TOF spectrum was used as a time reference of the spectrum. The energy calibration of organic liquid scintillator detectors was accurately determined by comparing the experimental light output of standard gamma sources with GEANT4 simulated one [1]. In Fig. 3, the comparisons of experimental neutron production yield at detection angles from 10° to 60° using larger BC501A detectors with GEANT4 results are shown. The neutron production yield is converted from TOF spectra with normalizing by unit solid angle and incident ion numbers. The experimental neutron spectrum shape are well reproduced by the simulations. The experimental data have been normalized to the simulated one at 10° The experimental results show that the whole system of the NTOF spectrometer works well, and the data analysis procedure is established.

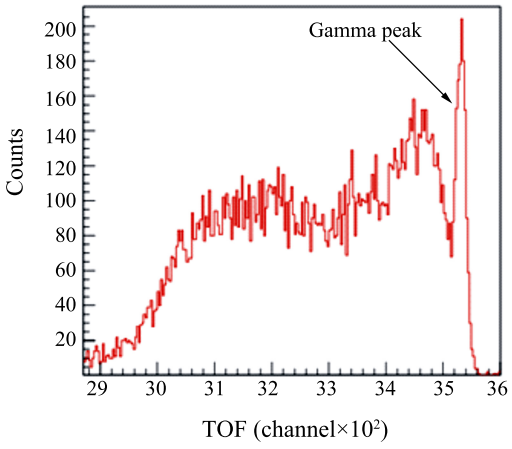

Fig. 2 (color online) TOF spectrum for neutrons and γ rays.

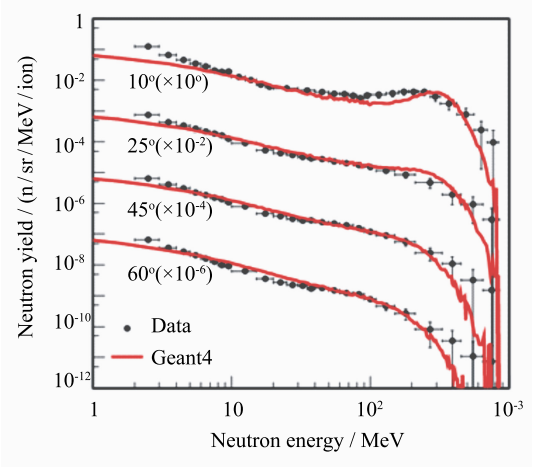

Fig. 3 (color online) Comparisons of experimental neutron production yield with GEANT4 results for 400 MeV/u ^{16}O bombarded on Tungsten at detection angles of 10° to 60°.

Reference

[1] S. Zhang, Z. Chen, R. Han, et al., Chinese Physics C, 12(2013)126003