Experiment 443

Neutron-Production Differential Cross Sections in the (p, xn) Reaction at Forward Angle

(Kyushu-JAERI-KEK)

In recent years, studies on spallation reaction have been made for various applications, such as spallation neutron sources and accelerator-driven subcritical reactors for nuclear waste transmutation and energy production. For the lack of experimental data, Calculation codes based on the intranuclear-cascade-evaporation model such as NMTC and HETC are often used in the design of facilities. However, calculation codes are not capable of describing the particle production in the most-forward directions satisfactorily. Then it is important to measure the cross section and obtain information for improvement of calculation codes.

The neutron-production differential cross sections at forward angle were measured for a spallation reaction induced by 0.8 and 1.5 GeV protons on Fe and Pb targets in E443 experiment. The experiment was carried out at the $\pi 2$ beam line of the KEK-PS. The experimental arrangement is shown in Fig. 1. Time-of-flight method was adopted because it has the higher detection efficiency and simpler data analysis than the recoil proton method. Neutrons were measured by time-of-flight technique with two different flight path lengths, i.e. 3.5 and 5.0 m at 0.8 and 1.5 GeV, respectively. NE213 liquid organic scintillators 12.7 cm in diameter and 12.7 cm in thick were set at 0° and 5° as neutron detectors. It is important to improve the energy resolution because of shorter flight path. For the improvement, the scintillator at 0° was connected with three Hamamatsu H2431 photomultipliers 5.1 cm in diameter. The photomultiplier has a faster rise time. The scintillator at 5° was connected with a Hamamatsu R1250 12.7 cm in diameter for better neutron-gamma pulse shape discrimination. The incident beam was bent at the downstream of the target by an electric magnet in order to prevent irradiation of the 0° detector.

In order to obtain the detection efficiency for high energy neutron, the SCINFUL code were modified, because the upper limit of application of the SCINFUL is 80 MeV. The QMD calculation was adopted to obtain the reaction cross sections above 150 MeV. The modified SCINFUL was called SCINFUL-QMD code. The detection efficiency of NE213 was obtained by the code. The data analysis is under in progress. Figure 2 shows neutron TOF spectra for 0.8 GeV proton incidence on Fe and Pb targets.

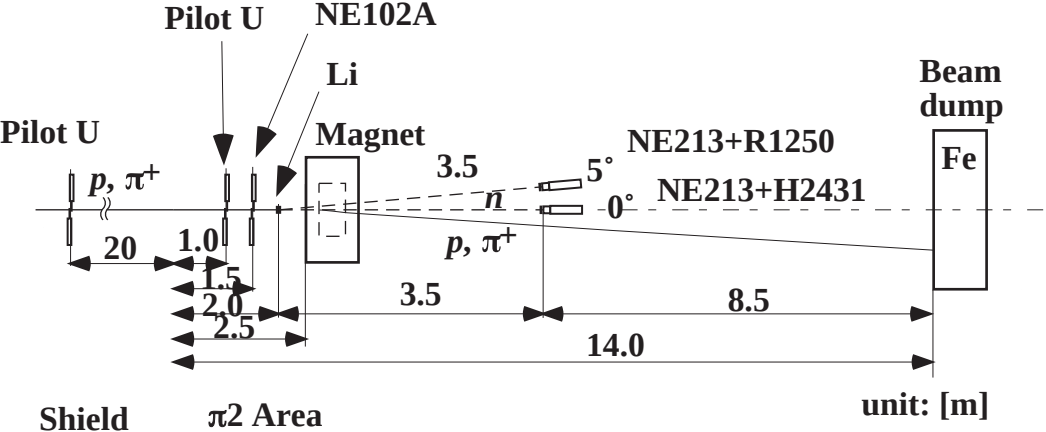

Fig. 1 Experimental setup for E443

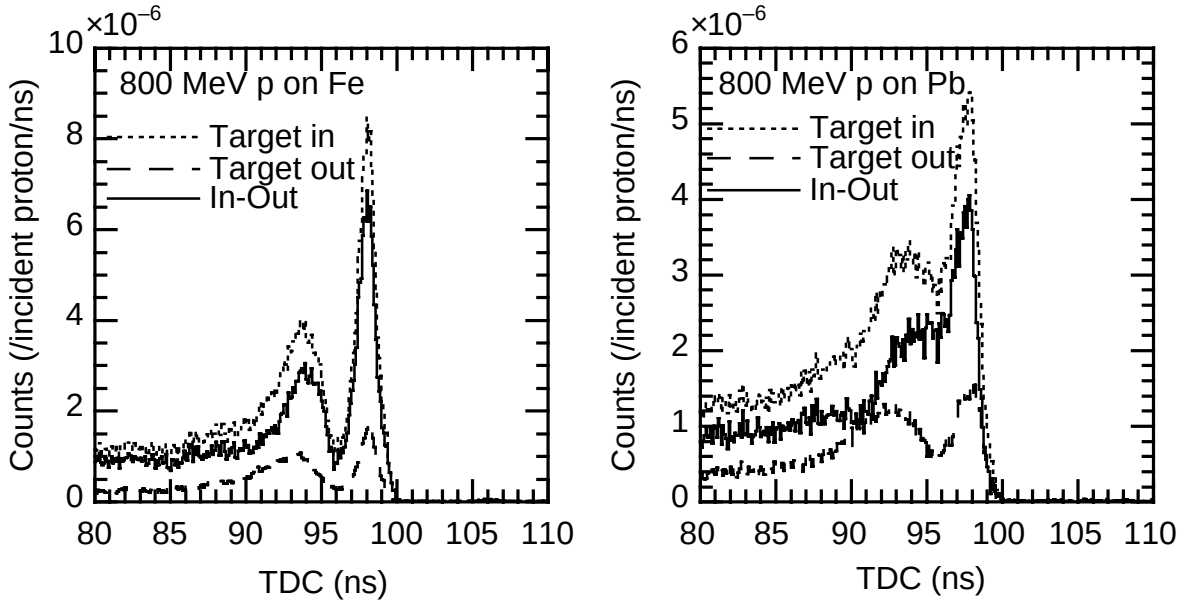

Fig.2 Neutron TOF spectrum for 0.8 GeV proton incidence on Fe and Pb targets at 0˚.