Experiment T527

Test of Phoswich Recoil Proton Detector

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The neutron incident neutron production (*n*, *xn*) double differential cross section (DDX) data is needed for utilization of spallation neutrons generated by the accelerator driven system. Our group has measured the (*n*, *xn*) DDX at Los Alamos Neutron Science Center (LANSCE). It is difficult to measure the emitted neutron energy by the time-of-flight (TOF) method using the organic scintillator like the NE213 because the incident neutron at LANSCE has the continuous energies up to 800 MeV. The recoil proton method is adopted for emitted neutron detection instead of the TOF method. To discriminate the full energy deposition event, the phoswich type NaI (Tl) scintillator surrounded by plastic scintillator were made. If a recoil proton stops inside a NaI (Tl) region, the light output is generated from the NaI (Tl) region only. On the other hand, the scintillation has two components when a recoil proton penetrate the phoswhich detector. Fig. 1 shows the phoswich detector and trajectory of particles inside the detector for 300 MeV proton incidence. In this study, we obtained the characteristics of the detector for mono energetic proton up to 500 MeV.

The experiment was performed at the $\pi 2$ beam line of the KEK-PS. The experimental setup is shown in Fig. 2. The incident proton energies were 100, 200, 300, 400 and 500 MeV. The charged particle from the beamline included the other momentum component in these lower energy region. The electromagnet and some plastic scintillators were used to select the beam momentum. For discrimination of protons and pions in the incident beam, the TOF method was adopted. The plastic scintillators were arranged to check the proton beam position and distinguish the proton penetrating event.

For example, Figure 3 stands for the pulse shape discrimination between NaI (Tl) and plastic scintillator and ADC spectrum of the phoswich type detector for 500 MeV proton incidence.

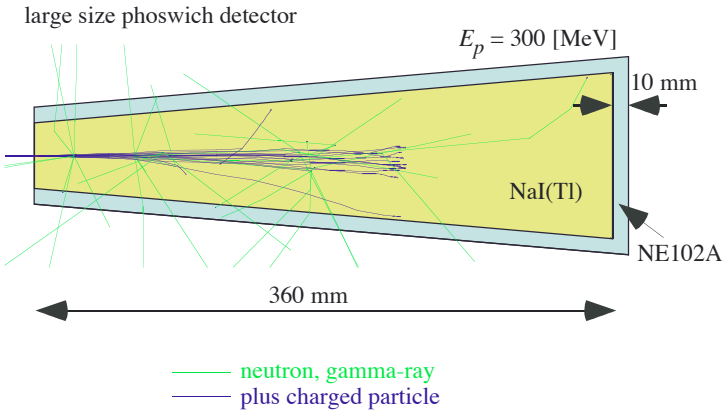

Fig. 1 Schematic of the phoswich type recoil proton detector

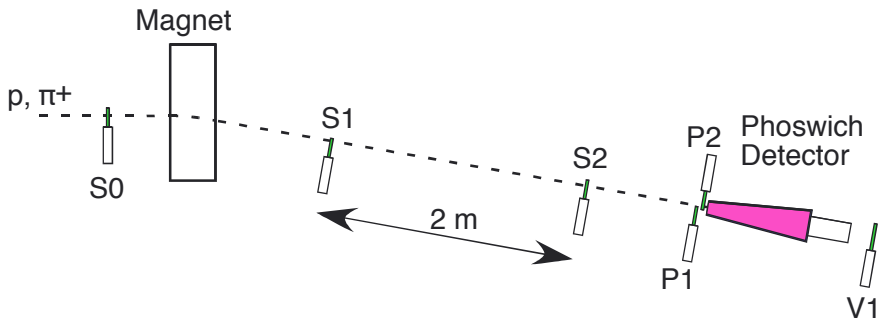

Fig. 2 Detector arrangement at π2 beam line

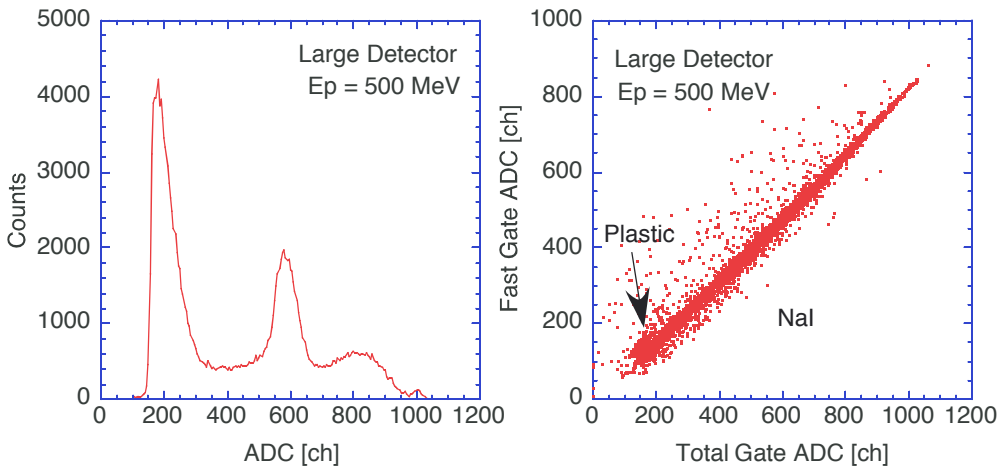

Fig. 3 ADC spectrum and pulse shape discrimination of the phoswich detector