Coherent Pion Production Measurement from the reaction ^{12}C(p,nπ^+)^{12}C

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The physics goal of this experiment is to investigate the short range component of the nuclear interaction by Coherent Pion Production (CPP) with reaction ^{12}C(p,nπ^+)^{12}C(Ground State). We measured pion production with ^{12}C(p,n) reaction at E169 experiment performed in September and December in 2004. A scintillation counter with Wave Length Shifter (WLS) fiber was developed for the detection of the pion. Because the scintillators should be installed in the limited space between magnet pole gap, we need to set Photo Multiplier Tubes(PMT) far from the magnet, and the emitted photons are transported to PMTs with WLS fibers molded in the scintillator, which is shown in Fig.1. TOF of neutron was observed by NPOL2[1] as shown Fig.2. Energy loss and TOF of pion counters are shown in Fig.3 and Fig.4. In this experiment, expected background is protons from the ^{12}C(p,p')X reaction at the target, and time difference between pion and proton is a few ns. Then, in the present setup, the pion and proton event is not separated clearly due to present timing resolution.

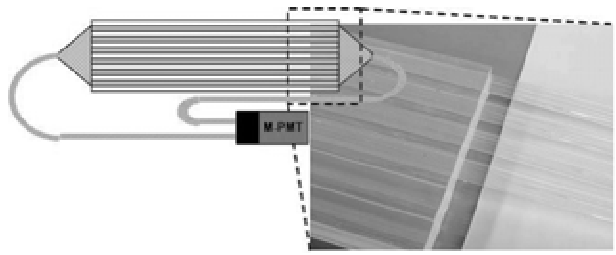

Figure 1: Scintillator and PMT connected with fiber.

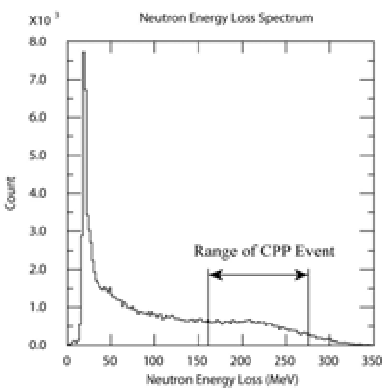

Figure 2: Energy loss spectrum for neutron.

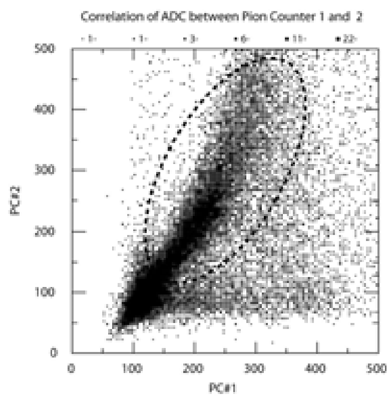

Figure 3: Correlation of energy loss in the scintillators. The area enclosed with dotted line include pion event.

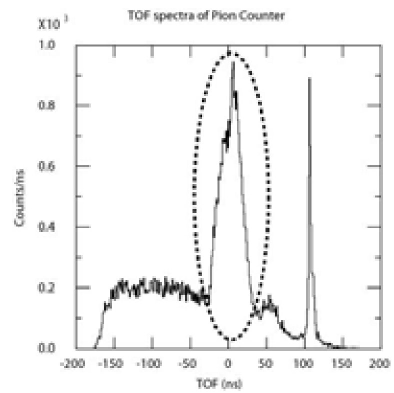

Figure 4: TOF spectrum.The area enclosed with dotted line include pion event.

Because pion event from the CPP is very rare, certain improvements for the detection system are necessary in order to reduce the background event. One thing is that the flight pass length should be made longer from 1m to 2m to get enough TOF resolution. The other is that additional shield should be placed around the beam line and scattering chamber, because the main background, which is protons from the ^{12}C(p,p') reaction, penetrate the beam pipe and comes to detectors directly. We started the Monte Carlo study to check the background source and to optimize the shield location. Moreover, to get clear identification of pion event, momentum information acquired by tracking detector is needed. In experiment E169, we also developed the new Gas Electron Multiplier (GEM)[2] detector for the charged pion measurement. The prototype of the detector is fabricated, and basic detector specification is measured. By using the tracking information in the magnet, resolution of β will be improved, and backgrounds which didn't come from original source point will be rejected.

References

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[2] F. Sauli, Nucl. Instr. and Meth. **A386** (1997) 531.