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A Basic Study for the Development of Collimator for J-PARC K_L experiment.

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One of the key issue for the J-PARC K_L experiment is how to reduce the beam-halo neutrons in the neutral beamline. While most of the neutrons produced at the K_L production target will be stopped by the thick collimator material, some neutrons penetrates it and forms the beam-halo. Because beam-halo neutrons could produce a fake signal in the photon detector, they would become a source of accidental background events. We also might loose the large portion of the signal events due to the tight cut for reducing such backgrounds. The aim of this test experiment is to obtain the basic profiles of the neutrons produced at the collimator materials.

Because the test beamline cannot provide neutron beam, we used the protons and pions at $\pi 2$ beamline of KEK 12-GeV PS for this study. This is still a good estimation because, according to the Monte Carlo simulation, the yields and momentum spectra of the secondary particles generated in the material by protons and pions are similar to those generated by neutrons.

The 1 GeV/c beam was focused on a 1.2 interaction-length thick lead block target. Incident protons and pions were identified by the TOF counters. Electrons in the beam were vetoed using gas Cerenkov counters. Neutrons generated at the target were detected by the NE213 liquid scintillator located downstream of the target. This detector consists of a 5 inch ϕ, 5 inch long cylindrical vessel, equipped with a 5 inch PMT. Photons are discriminated from neutrons by using the time-of-flight between the target and the neutron detector. Two plastic scintillators are located in front of the neutron detector to identify the charged particles generated at the target.

Yields and momentum spectra of the neutrons were measured by changing the position of the neutron detector. We then compared them with the Monte Carlo simulation results. Fig.1 shows the preliminary results for the angular dependency of the neutron yields for incident π^+ and protons. Monte Carlo results show less yields for either cases. Further study will be necessary to examine this results more precisely. The results in this test will be used for the collimator design of the J-PARC K_L experiment.

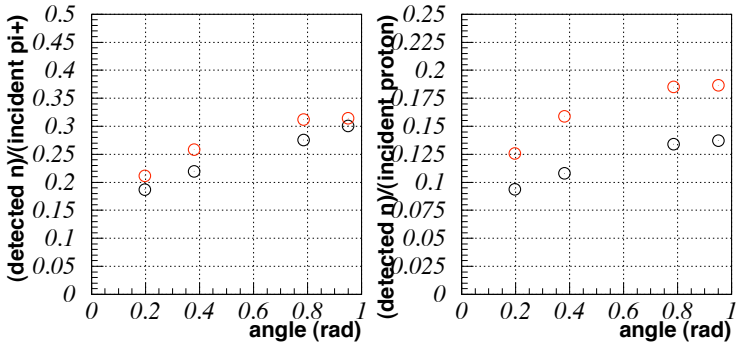

Figure 1: The angular distributions of neutrons for incident π^+ (left) and protons (right). Black circles show the simulation data and red circles show the MC data.