KEK-PS T489: Test of Position Sensing Cherenkov Detector (POSCH)

Kenta Itahashi[a] and Tetsu Yoneyama[b] for T489 collaboration.
[a]Muon Science Laboratory, RIKEN
[b]Department of Fundamental Physics, Tokyo Institute of Technology

We have been developing an innovative detector which has a capability of both particle identification and position measurement at the same time. The detector will be used as a focal plane tracking device in a coming experiment to search for η and ω mesic nuclei using the ^{12}C$(d, ^3$He) reaction in GSI, and it is required to measure the ^{3}He track with better resolution than 1 cm under very high background proton rate of about 100 MHz at maximum.

POSCH detector consists of a radiator bar and 16 PMT's looking into the bar through light guides. The incident particles emit Cherenkov photons inside the bar, and the photons are distributed to several PMT's. The center of mass of the PMT's analog outputs gives the incident position. The detector is designed to be blind to the particles with higher velocity than $\sim 0.90c$ (Fig. 1). The Cherenkov photons from such particles are totally reflected at the inner surface of the radiator and absorbed at the black painting. We have chosen UV transparent lucite as the radiator considering its refractive index and transparency to the UV photons.

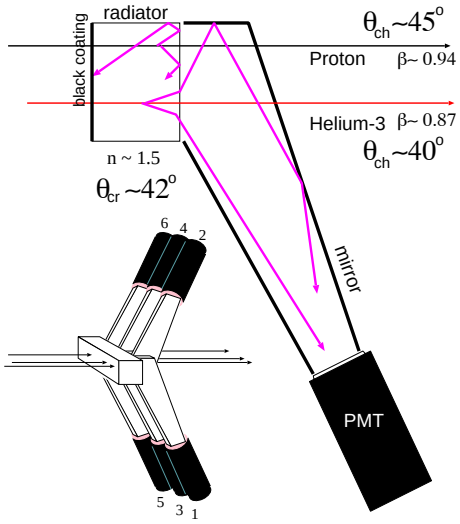

Figure 1: Concept of the detector. Cherenkov photons from particles with higher velocity are totally reflected at the inner surface of the detector.

The test was performed with the proton beam at the $\pi 2$ beamline using three different momenta: 2.52 GeV/c, 1.68 GeV/c, and 1.86 GeV/c for about one week.

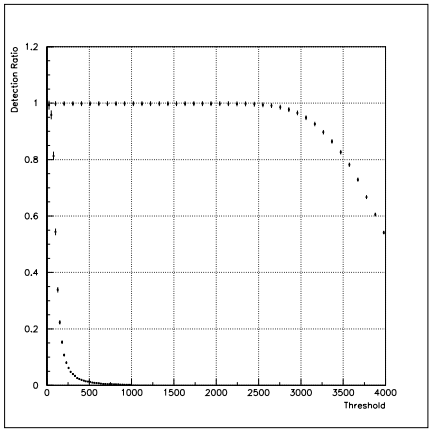

Figure 2: ^{3}He detection efficiency and proton rejection capability.

i) Particle identification capability.
We have exposed the POSCH detector to the proton beam with the momentum of 2.52 GeV/c ($\beta = 0.94$). Properly setting the threshold, we could achieve the proton rejection capability better than 10^{-3} within the incident beam angle smaller than 60 mrad and the ^{3}He detection efficiency better than 99 %.

ii) Position detection resolution.
We installed a drift chamber just before the POSCH detector to determine the incident particle tracks. We have not yet finished the analysis but the preliminary result showed sufficient resolution for the main experiment.

Basically the POSCH detector showed satisfying performance but the background rejection efficiency is not enough. We will install two sets of POSCH detector to overcome this problem.