Hall C Reference

Design of the HKS water Cherenkov counter

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May 10, 2005

Abstract

This document describes the purpose of the HKS water Cherenkov detector and its design parameters. General information on mechanical installation and electronics setup are also given.

1 Purpose

Role of the HKS water Cherenkov counter is to suppress protons in a kaon(P_c = 1.2 GeV/c ± 12.5 %) trigger on the online level. In the case of 100 mg/cm^2 ^{12}C target, stuggered two layors of this counter were designed to separate 0.34 kHz of kaons from 280 kHz of protons, and ∼100 Hz protons are expected to remain in the trigger. Additional precise particle identification should be done by offline analysis using beta information derived from TOF counter.

2 Design

One layer of the water Cherenkov counter is consisted of 12 segments. For each segment, $35^H \times 15^W \times 7.5^T$ cm^3 effective volume of the Cherenkov radiator *i.e.*, water(index: 1.33) is directly contained in a white acrylic diffusion box(3 mm thick., Mitsubishi Acrylite # 402) and 2 × 2" photomultipuliers(HAMAMATSU H7195−MOD) are attached on the two long sides through 3 mm thick colorless acrylic window(Mitsubishi # 000). Maximum diffuse reflectance of the diffusion box is 94.8 % on 458.5 nm incident ray and typical transmittance of the window plate is $\sim$ 90 % on the PMT quantum effective wave length region. 50 mg/l Amino G-salt(2-amino-6, 8-naphthalene-disulfonic acid) was dissolved in $\sim$18 MΩ·cm distiled water as a wave length shifter. This chemical and its handling is well controlled by Safety Lab(Chemical assistance team) chemical expert.

3 Installation

This counter is installed in front of the last HKS scintillation counter(HTOF2X) due to its large radiation length.

4 Electronics setup

The analog signals from the 2 $\times$ 12 segments $\times$ 2 layers, totally 48 PMT's were first led to the patch panel behind the HKS hut. The signals were splitted after upstairs patch panel into TDC line and ADC line. Since analog signal height is large enough by usage of the wave length shifter, and also the length of the signal delay cable is long enough, any signal attenuator is not required. 1/2 of the signal pulse height from each PMT was recorded as ADC signal. The remaining 1/2 were first discriminated and splitted into 2 lines again. The threshold of each discriminator was set to survive kaon as much as possible. 1/2 were recorded as TDC and scaler information, the rest were sent to grouping logic for PID.
The HVs of the PMTs were gain matched so that the one photo-electron peaks were aligned at about the same ADC channels after pedestal subtraction in the ADC spectra.