HKS Lucite Cherenkov Detector

Chunhua Chen and Liguang Tang

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Abstract:

This document describes the purpose of the HKS Lucite Cherenkov detector and its design parameters. General information on geometrical installation in HKS and high voltage setting are also given. In addition, information about bucking coil is included in this document.

1. Purpose

There are two purposes of this Lucite detector: (1) a particle identification detector (PID) and (2) an extra TOF counter. As a PID counter, it is used to increase rejection of protons in addition to the Water Cherenkov counters. It can be used both online and offline. In order to further improve the TOF resolution of HKS, the Lucite is used as the forth TOF timing plane in addition to the existing three scintillation counter planes (1X, 1Y, and 2X). Therefore, reasonably good timing resolution is required.

2. Design

There is one layer of the Lucite Cherenkov counter which consists of 13 segments, eight of them were previously made for SOS PID and five are new. All photomultiplier tubes are directly attached to the ends of the Lucite bar by UV curing glue. Seven of the old Lucite segments have an active area of about $43\times14cm^2$ and one about $43\times13.6cm^2$. The new ones have active area of about $40\times13.6cm^2$. All the segments have the same thickness, 2.4cm.

The old (8) segments are longer thus amounted on the lower momentum side to increase coverage with the narrow one mounted as the first segment. The new (5) ones are shorter and mounted to cover the high momentum region.

3. Installation

The Lucite Cherenkov (LC) counters are installed in one plane as the last detector just behind the water Cherenkov (WC) in the HKS detector system. They are mounted on a single frame which is attached to the common detector carriage for all TOF and Cherenkov counters.

4. Bucking Coil

It is anticipated that there exists a uniform fringe magnetic field of about 5 gauss leaked from the HKS dipole magnet in the area of the HKS detectors. This field flux is in the axial direction of the LC PMTs and causes a signal reduction about 20%. This effect reduces the effectiveness of LC as PID or losses efficiency as well as decreases the timing resolution. In order to cancel the influence of this external magnetic field, a bucking coil with 12 AWG hook-up wire winded 12 turns is mounted at the tip area of each LC PMT. The ratio of $N*I/B$ is about 4.7turns*AMP/Gauss, where N is the number of the turns of the coil, I is the current in the wire, and the B is external magnetic field, respectively. The field strength can be measured when the HKS spectrometer is energized then the needed bucking coil current can be calculated. All the bucking coils are connected in series and a single power supply is used. Total power is less than 1.5 W when external field is about 5 gauss. The coil wire has extra reserved length. In case of adjustment is needed to individual coil, number of turns for each PMT can be adjusted.

5. High Voltage Setting

The HV's of the LC PMT are gain matched during bench test so that one photon-electron peaks were aligned such that the same number of ADC channels per photo-electrons is reached. The following table lists the HV setting for each PMT. The sequence of the labeled number started from the low momentum end. T and B mean PMTs at top and bottom, respectively.

PMT#	High Voltage(V)	PMT#	High Voltage(V)
LC1T	2891	LC1B	2883
LC2T	2938	LC2B	2781
LC3T	2818	LC3B	2876
LC4T	2902	LC4B	2825
LC5T	2694	LC5B	2725
LC6T	2775	LC6B	2773
LC7T	2879	LC7B	2773
LC8T	2839	LC8B	2741
LC9T	2338	LC9B	2300
LC10T	2300	LC10B	2300
LC11T	2347	LC11B	2381
LC12T	2292	LC12B	2218
LC13T	2290	LC13B	2295