Development of Aerogel Cherenkov Counters for the PHENIX experiment

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As a detector upgrade plan of the PHENIX experiment at RHIC-BNL, installation of aerogel threshold Cherenkov counters has been proposed to enhance the particle identification capability. Because of the low refractive index of aerogel (n=1.01), efficient light collection system is necessary to obtain enough resolving power. We carried out the beam tests (T514, May 2002; T531, Dec 2002) at T1 beamline for 20 shifts each. In the beam tests, we have tested prototype counters with various configurations, and finalized the counter design.

Aerogel tiles in the counter box are contained to the half of the depth. An empty space of air is designed an integrating box which works following the principle similar to those of integration sphere used in optical measurement. Scattered light is detected by two 3-inch PMT's attached on the both sides of integration sphere (see Figure 1).

The prototype has achieved 99.5% pion detection efficiency and 0.5% proton fake rate at 2 GeV/c, and provides enough photoelectron yield per PMT to separate different particles. From the beam tests, two following issues are found to be advantage; (1) Integration sphere is effective to obtain positional uniformity of Cherenkov light yield from aerogel (see Figure 2), and (2) Propagation time of Cherenkov light from emission point to photocathode is correlated with particle track location. This correlation can be used in the actual experiment for help of matching tracks, rejecting the soft background from in-flight decays. Based on the successful results, mass production of the counters will take place. The final system will be installed by Fall 2003 (Run 4).

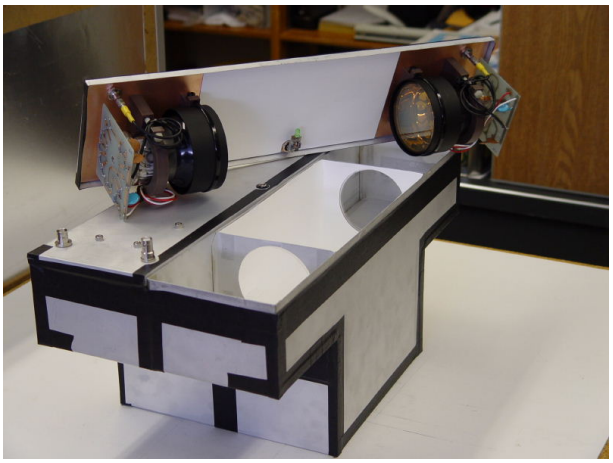

Figure 1: (Left) Pre mass-production box (installed in Run 3 of PHENIX). Lid with two PMT's, calibration LED is also shown.

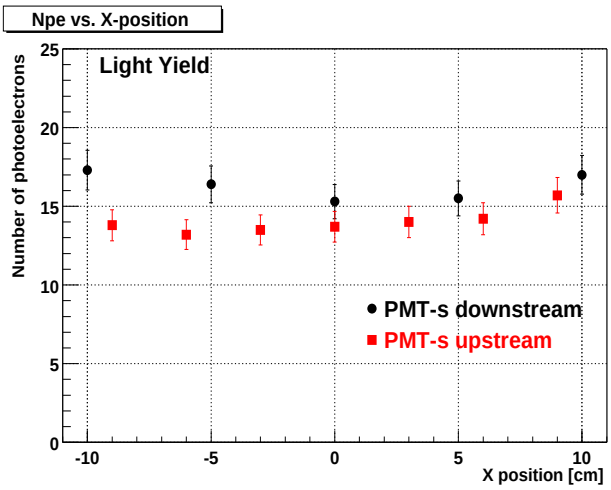

Figure 2: (Right) Total light yield as a function of hit position. Configuration with PMT's upstream and downstream are compared with respect to particle direction.