Tests of a proximity focusing RICH with aerogel as radiator

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Abstract

A study was carried out to measure the performance of a proximity focusing RICH with aerogel as radiator and multianode PMTs as the detector of Cherenkov photons. To increase the active area, a light collection system using a single lens per PMT tube was employed. The yield and resolution were measured by using cosmic rays.

Summary

The use of aerogels as Čerenkov radiators has been limited up to recently mainly by its low transparency for light and the fact that aerogels are hygroscopic. New methods of synthesis and improved manufacturing procedures have made available aerogels with better transparency and some are even hydrophobic [1–3]. This allows the use of aerogel Cherenkov radiation in developing detection methods for identifying and separating different species of particles. The BELLE experiment uses aerogel as a radiator in the threshold Cherenkov counter, while Cherenkov rings are observed in the HERMES experiment [4,5]. The idea of using aerogels in proximity focusing RICH detectors was already discussed several years ago [6]. The advantage of such a detector is its compactness, which is especially important for experiments at colliders. By making use of our experience with multi-anode photomultipliers as single photon detectors [7] and optical systems for light collection [8], we constructed an apparatus, shown in Fig. 1.

Since the expected number of photons is low, a light collection system was necessary to increase the fraction of the active area. The particular feature is in this case the need for large angular acceptance of such a light collection device. In Fig. 2 the angular dependence of light collection efficiency is shown for the employed lenses.

The parameters of the system are the following: 36 mm PMT pitch, 48 mm focal length of a closely packed pair of plan-convex lenses (HERA-B uses one such lens [8]), and a demagnification factor of two. Two sorts of aerogel will be employed: one with refractive index 1.05, the other with $n = 1.03$ [9].

The detector module of the apparatus is shown in Fig. 3. Results of various measurements with this test set-up will be presented.

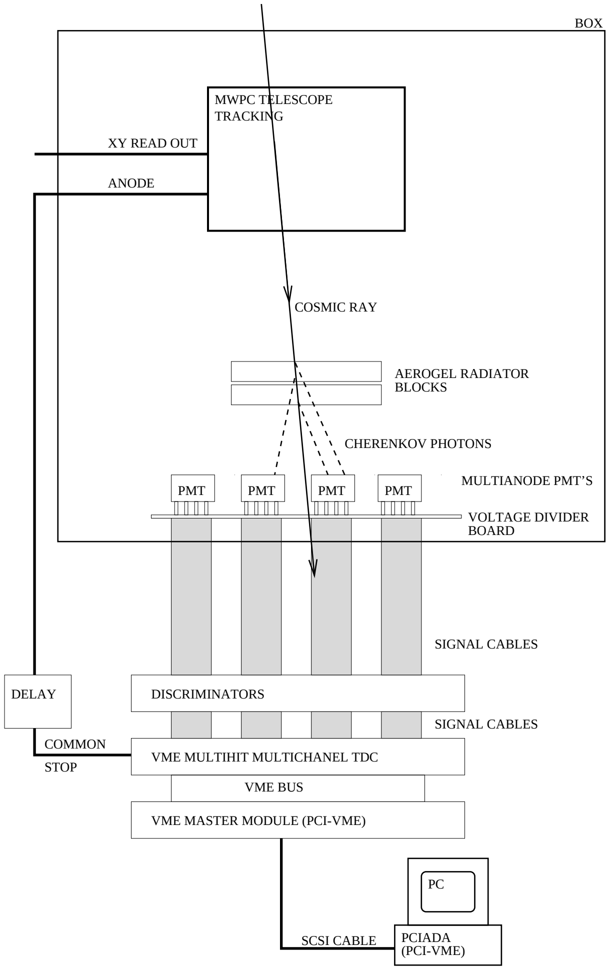

Fig. 1. Experimental setup

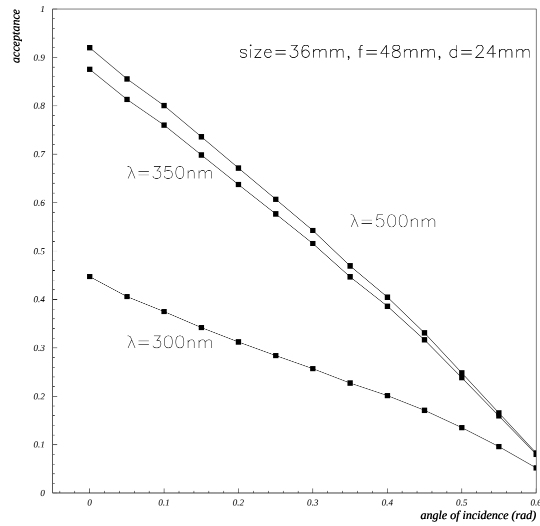

Fig. 2. *Acceptance of a thin lens light collection system by using a back-to-back coupled pair of HERA-B lenses, as determined by ray tracing using measured transparency data.*

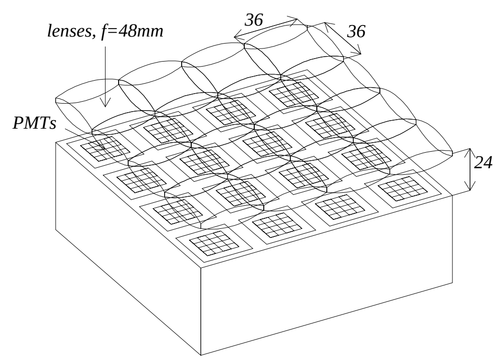

Fig. 3. *A 4x4 PMT module with a single lens light collection system.*

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