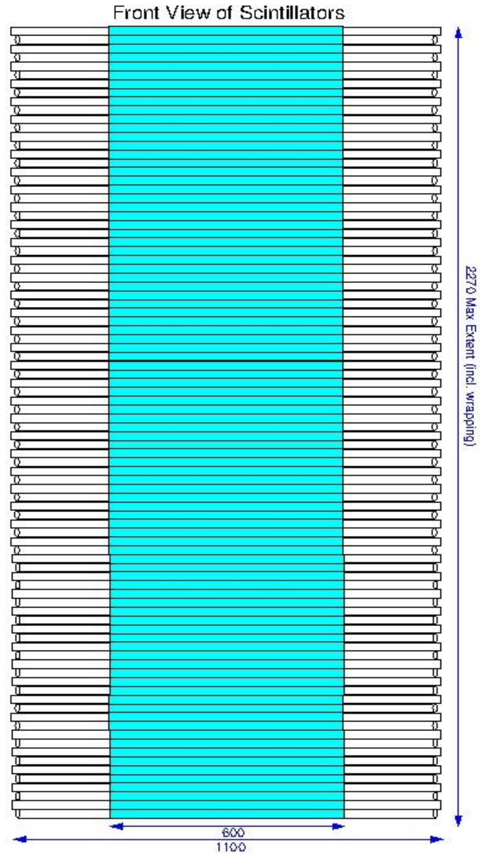
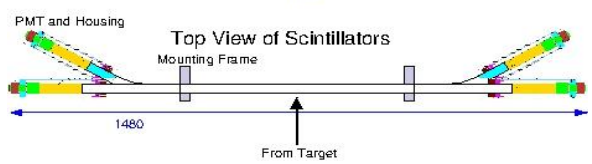
BigBite Timing Hodoscope



Overview

The BigBite timing hodoscope (BB-hodo) is an array of plastic scintillator bars arranged in a vertical stack sandwiched between the pre-shower and shower lead glass arrays. Each bar is read out by two 29 mm PMT and position independent timing is given by the mean time from the two PMT. Time difference gives the horizontal hit position. BB-hodo covers the full range of coordinates of the lead glass arrays. Its role is to provide a precise timing reference, operating with high efficiency for minimum-ionizing particles over the full range of particle momenta analyzed by BigBite. It should be capable of high rate operation and not impose any significant limitation on the luminosity which can be handled by BigBite.

Function



The primary function of BB-hodo is to provide high precision trigger timing information, which will be most important for two arm (e,e'N) measurements. The e' hit time in BB-hodo may be used as a reference for nucleon time of flight measurements in the SBS arm. BB-hodo will also provide pulse height information which may be of residual use in differentiating minimum-ionizing particles from low energy background and hit position information which may be of use in resolving tracking ambiguities in the GEM systems operating at high rate.

Performance Requirements

- The mean time resolution with fast PMT is ~ 100 ps. This has been measured with cosmic rays. With the ET 9125 PMT the mean-time resolution is ~300 ps. The mean time is position independent.

- The horizontal position resolution from PMT time difference is ~ 5cm (using a fast PMT). The time difference is linear with hit position.

- A clear Landau distribution is obtained for minimum-ionizing particles with the peak well separated from PMT noise. The position dependence of individual PMT pulse heights does not exceed a factor two and the mean pulse height varies by around 11% maximum along the length of the bar.
- Individual scintillator bars are capable of MHz operation

Calibration

Initial gain calibration may be made using a ^{90}Sr beta source or cosmic-ray muons. A more precise calibration of pulse height and time can be performed with scattered electrons by correlation with particle tracks provided by the GEM system and hits in the lead glass arrays. This would be performed at relatively low electron beam intensity.

Physical Characteristics

Number of Scintillator Bars	90
Dimensions of each bar	600 x 25 x 25 mm
Scintillator material	EJ 200 Plastic (Eljen Technology)
Number of PMT	180
PMT (if fast devices not available initially)	ET 9125 29 mm (from BaBar DIRC)
PMT for high time resolution	ET 9142 29 mm
PMT base	Custom high linearity, high rate design. PCB fits inside original BaBar container

Electronics

Cable from PMT anode to front end electronics	~2 m RG 174 coaxial, 50-ohm impedance, MCX coaxial connectors
Front-end electronics	16-channel NINO amplifier/discriminator card, free standing, mounted close to PMT. Provides 16 amplifier outputs, 16 LVDS discriminator outputs and 2 OR-8 outputs. LVDS is time over threshold +

	10ns and is compatible with Hall-A LVDS-to-ECL converters
Cable from NINO LVDS output	17-pair twist-and-flat, 110-ohm impedance
Low voltage supply	+5V, 1.25A per NINO card. Total current 15 A
External threshold-set voltage	+1.25 - +2.0 V variable. Total current ~ 250 mA
High voltage supply	-1500V maximum, current per channel 0.3 mA.
QDC	The amplifier output will drive a standard QDC. Alternatively pulse height information may be obtained from time over threshold, in which case the QDC can be omitted
TDC	A multi-hit TDC with resolution not poorer than 100 ps per channel is required. Tests have used the CAEN V1190A configured to fire on both leading and trailing edges of the LVDS from the NINO card, for time over threshold measurement.