Scintillator paddles as trigger detectors for RPCs

P. Patale[1], R. Kujur[1], L. M. Pant[1,*], A. K. Mohanty[1], P. Shukla[1], D. Dutta[1], S. Kailas[1], R. K. Choudhury[1], B. Satyanarayana[2], R. R. Shinde[2] , N. K. Mondal[2]

[1]*Nuclear Physics Division, Bhabha Atomic Research Centre, Mumbai - 400085, INDIA*
[2] *Department of High Energy Physics, TIFR, Mumbai – 400 085, India*
** email : lmpant@barc.gov.in*

The work reported in this contribution is part of the ongoing efforts to build bakelite RPCs to look into their long term stability and efficiency for the INO project at NPD-BARC. For trigerring the RPCs, with cosmics, three large area plastic scintillators (19cm x 40 cm x 1 cm) have been assembled. The scintillator sheets are from Bicron : BC-408, having a refractive index of 1.58, rise time ~ 1 ns, decay time ~ 2 ns and wavelength of maximum emission at 425 nm. The rectangular scintillators are coupled to the PMTs (Electron tubes) via a trapezoidal light guide made from perspex. The trapezoidal light guides tapers from 19 cm towards the scintillator end to 51 mm towards the PMT end matching with the PMT diameter. A cookie was used to match the rectangular face of the light guide to the circular face of the PMT. The dynode chain was designed for a positive polarity high voltage of 1800 Volts. The scintilllators, perspex light guide and the cookie for coupling to the PMTs were cut and polished to the required size. The light guide was coupled to the scintillator with optical cement and covered with Tydler and Tyvak papers and finally with black tape and tested for light leakage.

The tests were carried out at TIFR. Fig. 1 shows the schematic of scintillator paddle along with the test setup. The test paddle (Fig. 1(b) – no. 3) was sandwitched between four similar scintillator paddles, two each on the top and two each on the bottom of the test paddle. The total height from paddle no. 1 to paddle no. 5 was 100 cm. The thresholds were set at 30 mV and after adjusting for the cable delays count rates were measured as four fold and five fold coincidences as a function of increasing voltage to the PMT. The signals from paddle nos. 1,2, 4 & 5 were fed into a coincidence unit to produce a four fold coincidence. The signals from the test paddle were further ANDed, with the four fold coincidence to produce the five fold coincidence. The singles rate was of the order of 100 MHz in the test paddle and the rise time of the pulses of the order of 1ns. Fig. 2 shows the assembled scintillator and the ratio of four fold to five fold coincidences is plotted in Fig. 3. As is seen from the figure the efficiency remains saturated at 100% above 1.65 kV. It drops to 80% at 1.6 kV and drastically falls down to 5% at 1.4 kV, thereafter. The plateau curve basically defines the optimum region (in present case : 1.65 kV to 1.85 kV) for the scintillator paddles to operate in order to measure the counting efficiencies. The higher end of the voltage to the PMT is of course limited by the maximum voltage that a particular PMT is designed for. Work is in progress to get the plateau region for the other assembled scintillators too which would then be used to measure the efficiency of the bakelite RPCs which are presently being fabricated.

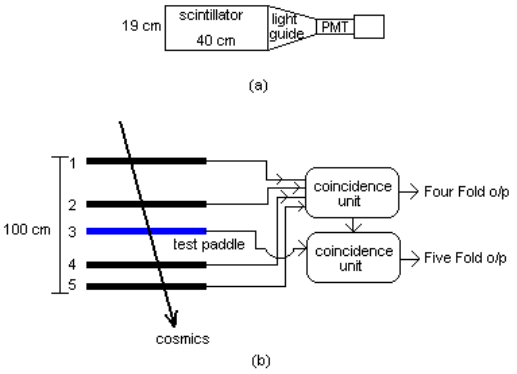

Fig. 1 (a) Schematic of the scintillator paddle and (b) the test setup

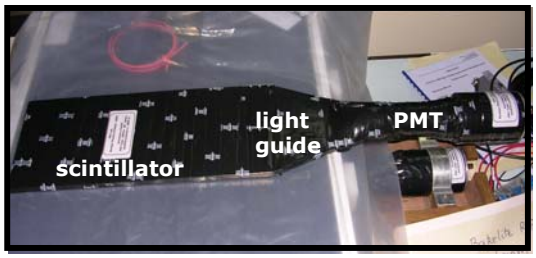

Fig. 2 Scintillator paddle

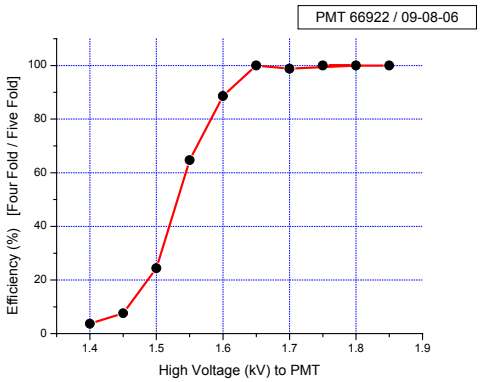

Fig. 3 Paddle efficiency vs. high voltage