

Characterization of Scintillator Detector

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Introduction

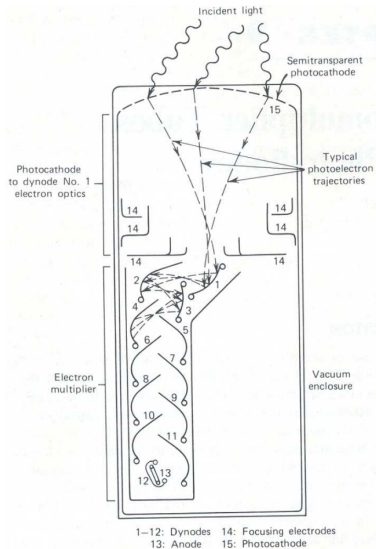
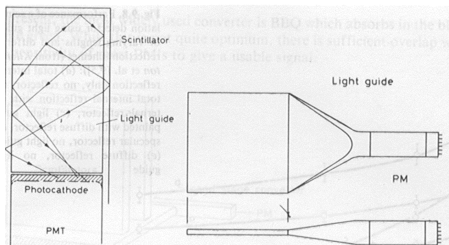


- The scintillator detectors are used in high energy physics experiments for good timing resolution.
- We are using organic scintillator to detect cosmic muons.
- Cosmic muons are produced during the interaction of primary cosmic rays with nuclei of the atmosphere.
- The muon passing through detector deposits energy and scintillator material produces photons.
- The emitted photons are collected by a photomultiplier tube and an amplified electronic signal is produced.

Scintillator Detector

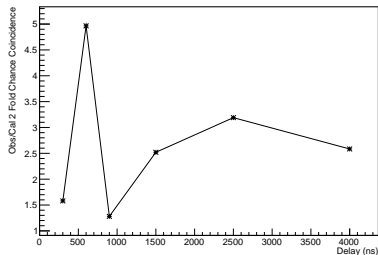
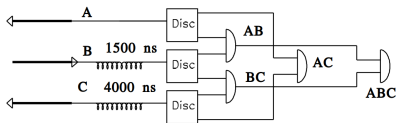
Components:

- Plastic Scintillator
- Waveguide or Wavelength Shifting Fiber
- Photo Multiplier Tube (PMT)



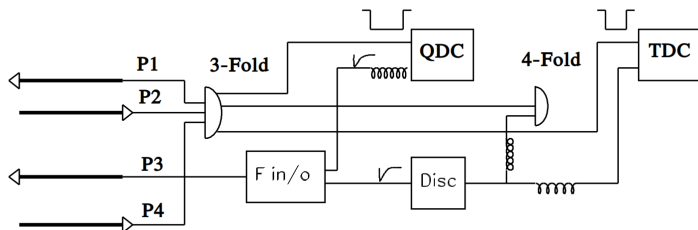
Chance Coincidence

$$\text{Chance Coincidence Rate} = N \times (n_1 \cdot n_2 \cdot n_3 \dots n_N) \times \tau^{N-1}$$



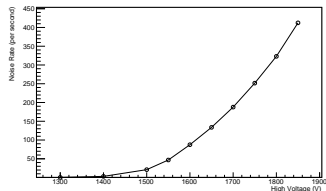
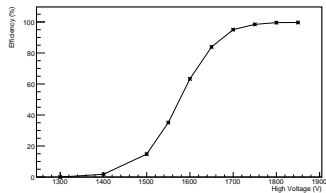
Observed rate of 3-fold chance coincidence = 0

Characterization of Scintillator



$$\text{Efficiency} = \frac{\text{4-Fold Count}}{\text{3-Fold Count}}$$

Efficiency of Scintillator Paddle



QDC and TDC Spectrum

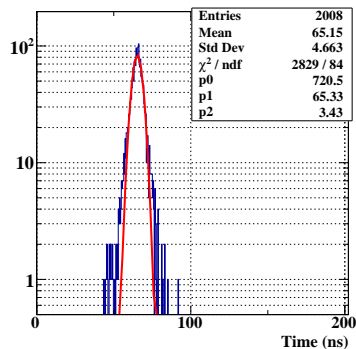
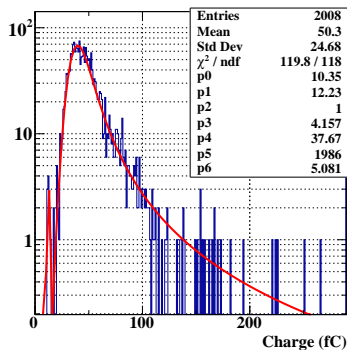
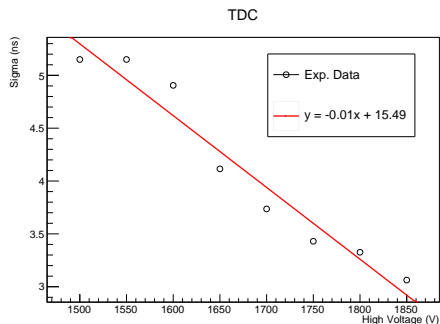
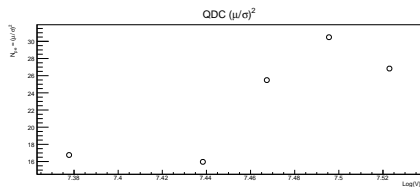
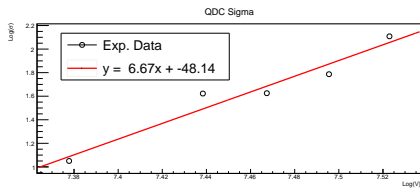
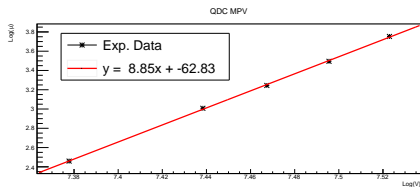


Figure: QDC (Left) and TDC (Right) Spectrum.



Summary

- The scintillator paddle has been characterized.
- The operating voltage should be around 1750 V.
- The time resolution is around 3 ns at operating voltage of 1750 V.

References:

- Scintillator Experiment Manual, EHEP, SERB School 2019.
- Techniques for Nuclear and Particle Physics Experiments by Dr. William R. Leo
- Radiation Detection and Measurement by Prof. Glenn F. Knoll

Thank You!!!

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