The Mu3e scintillating fibre detector R&D


Goal
Detect m.i.p. with high efficiency, minimum amount of material for a sub ns time resolution with just few photoelectrons/fiber

Requirements
- \(< 900 \mu m\) total thickness
- \(< 0.3\% X_0\)
- time resolution \(\Delta t < 1\) ns
- rate up to 250 KHz/fiber
- very tight space for cables, electronics and cooling

Parts
- cylindrical at \(-6 cm\) (radius);
- length of 28-30 cm;
- 3 layers of multi-clad 250 \(\mu m\) fibers
- fibers grouped onto SiPM array
- MuTRiG readout

Physical processes by GEANT4:
- From the first particle interaction in the medium to the photosensor
- PDE, gain/variation
- Cross-talk
- Saturation effect/timing recovery
- Dark Counts
- Pre-amp gain
- Signal digitisation up to 5 GS/s
- Waveform analysis

From detailed MC to Data

3 layer time resolution \(\sigma(550) ps\)
3 layer offline array charge collection (thr > 1.5 Nphe)

Addressed requirements with one of the first prototypes

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