Energy and time resolution for a LYSO matrix prototype of the Mu2e experiment

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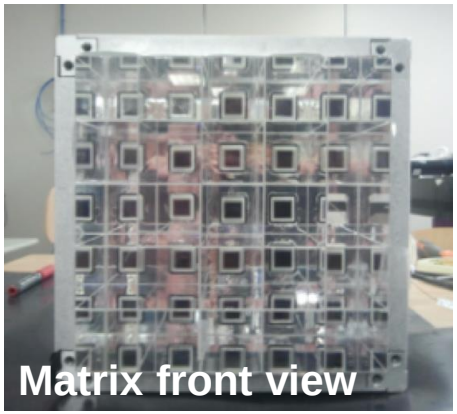
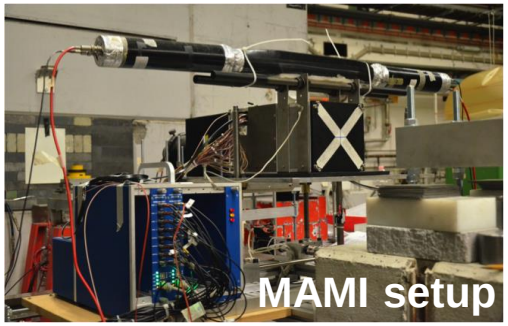
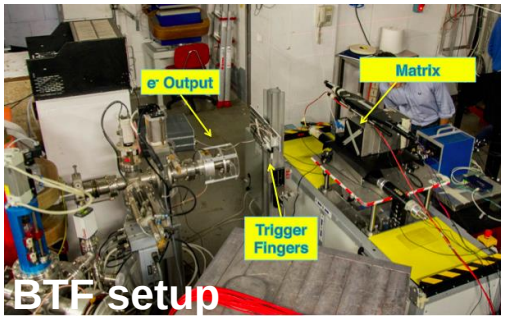
- 5 × 5 matrix prototype with (30 × 30 × 130) mm^3 LYSO crystals from SICCAS
- Each crystal wrapped with a 60 μm thick layer of super reflective ESR-3M
- Crystal readout: (10 × 10) mm^2 S8664 Hamamatsu APD
- APDs optically connected to crystals with Saint-Gobain BC-630 grease
- Custom made FEE providing both amplification and regulation of bias voltage



Matrix transverse and longitudinal dimensions: 2.8 R_M, 11.2 X_0





Matrix tested with:

- **tagged photons with energy 20-380 MeV, with few permil precision (MAMI, Mainz)**
- **e^+, e^- in the energy range: 100-500 MeV (BTF, Frascati)**

Trigger provided by two orthogonal (0.6 × 1 × 5) cm^3 fingers read out by (3 × 3) mm^2 SiPM

- Data acquired with CAEN waveform digitizer V1720, 250 Msps, 12 bit resolution, 0-2 V dynamic range
- APDs illuminated by green laser (λ = 530 nm) through 250 μm Ø fused silica optical fibers. Laser pulsed syncronized with an external trigger with a frequency of ~ 1 Hz.
- Equalization of matrix channels at 10% level with minimum ionizing particles
- Calibration of cell response with beam (450 MeV @ BTF, 92.5 MeV @ MAMI) firing on each cell center

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- Total energy spectra compared with GEANT4 MC simulation, with 2 mm beam spread included. Additional 2.6% Gaussian smearing needed in MC to describe data
- Time resolution measured @ BTF using both central crystal and the whole matrix. Trigger jitter subtracted. Minimum ionizing particles used to exploit the low energy region