Extruded scintillators R&D

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(Cuore + SuperB)

Requirements (SuperB/Cuore synergies)

- SuperB
- 11000 strips 3.7m x 5cm → ~2000m^2
- 2D position measurement (σ~10cm?)
- Low cost
- Mechanical constraints for non-z-coordinate bars

- Cuore
- 9x1.5m^2 panels (octagonal shield)
- 3 layers 5x5 m

Total: 130-280 m^2

- Very high efficiency
- Mechanical constraints (moving shield). Avoid long light guides
- Positioning? Optional

Rome commitments

- Light yield with different optical fibers
- Light yield with different extrusion geometries/grooves disposition
- Light yield with different glues
- **Readout tests (including optical/mechanical coupling studies)**
  - **PM(study behaviour in B field)**
    - **Low voltage option**
    - **multichannel**
  - **APD → Discarded**
  - **SiPM/MPCC(geiger;griglia da 1600/mm2;σ(t)=220ps→8cm); costo 800$/canale**
- **Alternative geometries**
  - **Improved efficiency/reduced noise**
  - **Improved resolutions**
  - **Efficiency uniformity**

R&D status

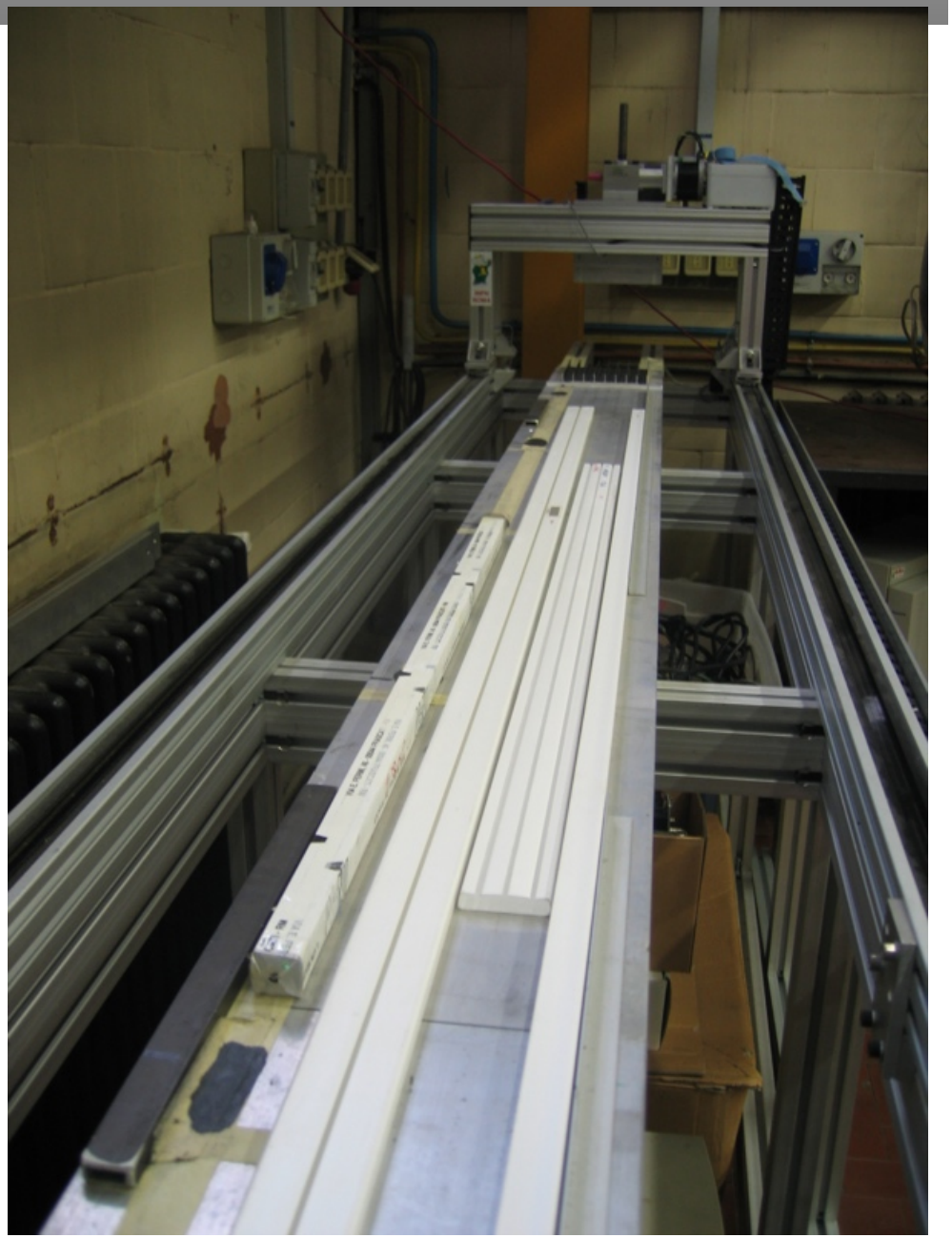
- **Already in Rome:**

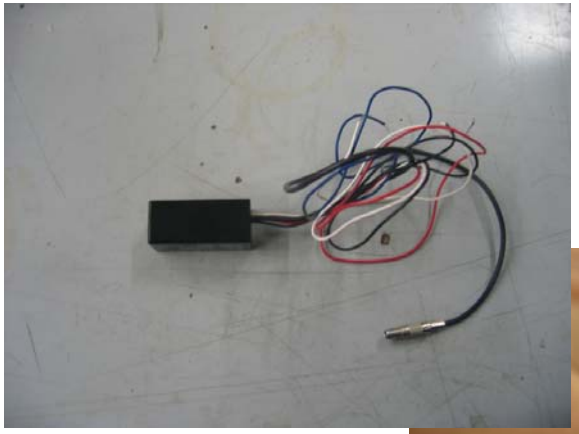
- **Scintillators:**
  - **1 Minos (ITASCA 2m)**
  - **1 Rectangle with internal fiber**
  - **1 JLAB (1m with three fibers)**
  - **Saint Gobain BCF-92 fibers from Ferrara (Ø 1mm)**
  - **Will be testing also the Opera ones [same geometry as minos, but made in Ucraina, 7.5€/kg]**

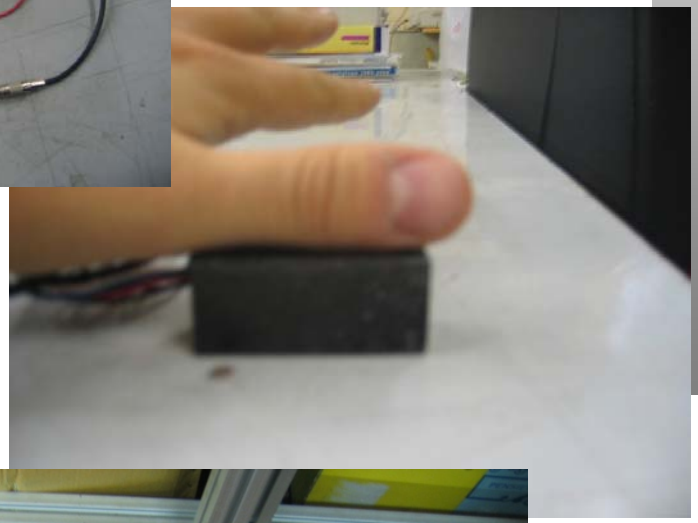
- **Detectors:**
  - **2 Low voltage compact PMT 300€/channel (?)**
  - **2 MPPC from Hamamatsu 50€/channel+stabilizer**
  - **Multichannel (x64) PMT 30€/channel**
  - **Waiting for SiPM**

- **Test stand: motorized biaxal table for scan**

- **Two test sources set up:**
  - **1974 Cs source with a 10 muCi activity (ν~800Hz)**
  - **Two 1.5cm scintillators (area of the smallest 10x5 cm^2)➔ cosmic rate ~1.5Hz**





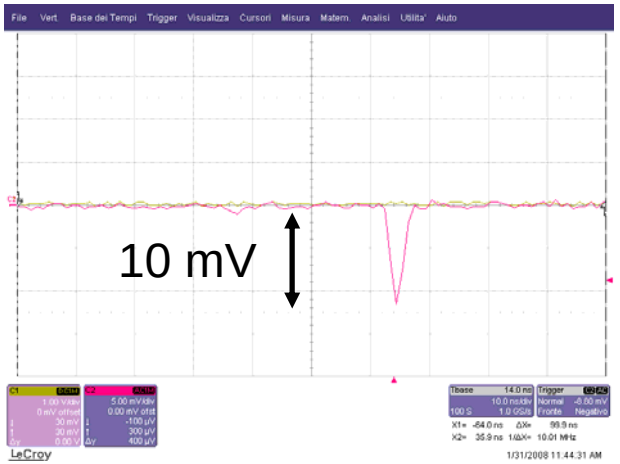


Low voltage compact PMT

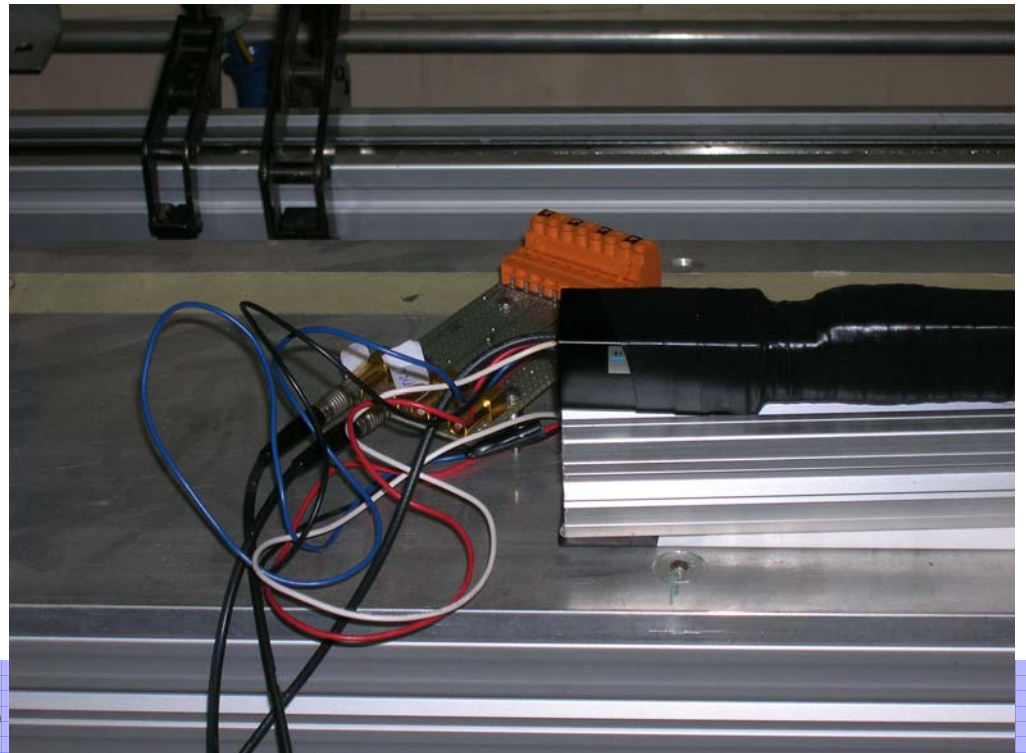
Pros	Cons
Compact (integrated into detector→ Cuore)	**Extremely delicate tuning of input voltages** **Interplay between control voltage and bias**
Bfield resistent? To be tested	
“HV”=11-15 V	

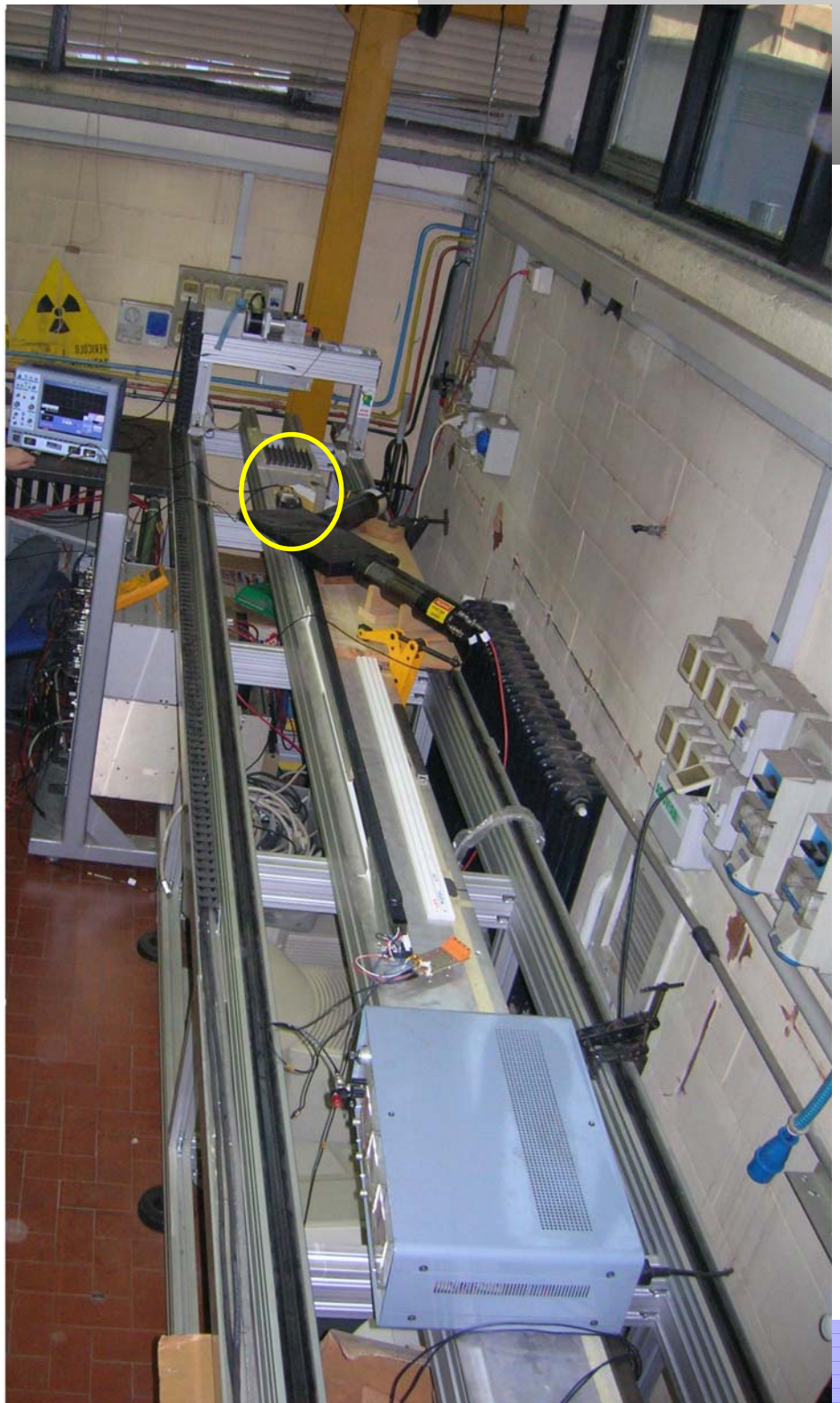
Characterization

- **Done with cosmics on scintillator (1cm thick plastic scintillator, 5x5 cm)**
  - **HV=14V, Vctrl~0.95V ➔ G~10^6**
  - **Signal ~15mV**
  - **Noise ~ 0.2 Hz with 8.8mV threshold**



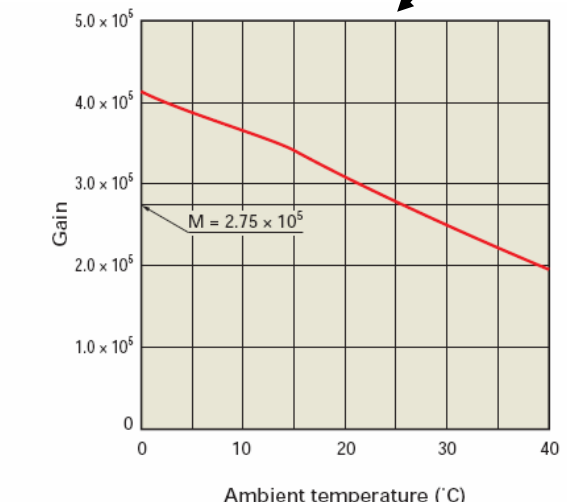
- **Test on extruded scintillator (2x2 cm with hole in the middle) with :**
  - **Optical coupling done, ready to look for the signal** ⟶





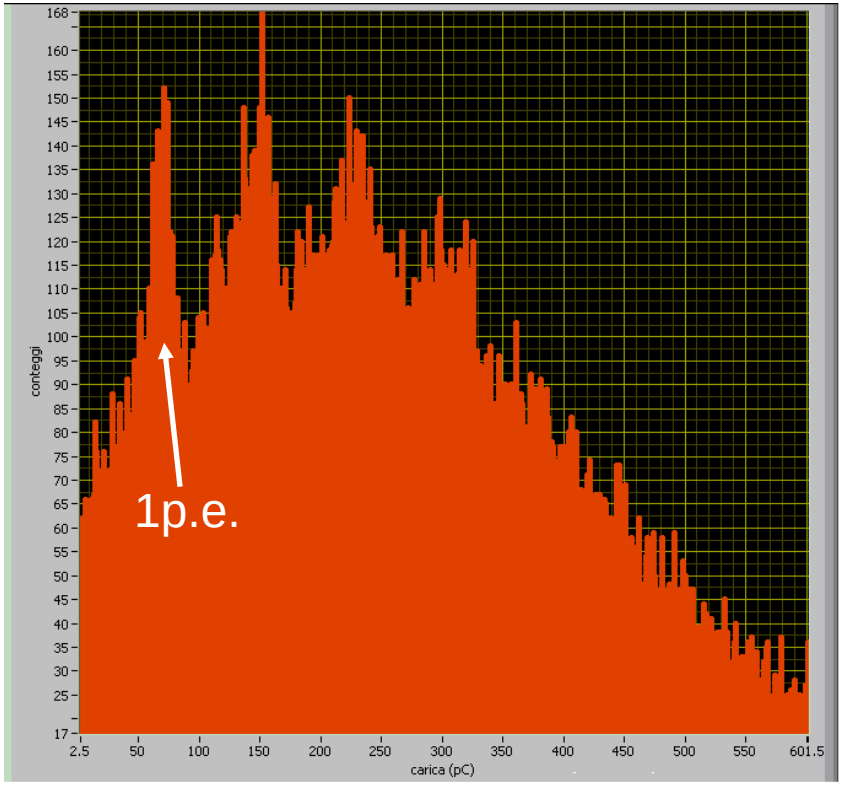
MPPC

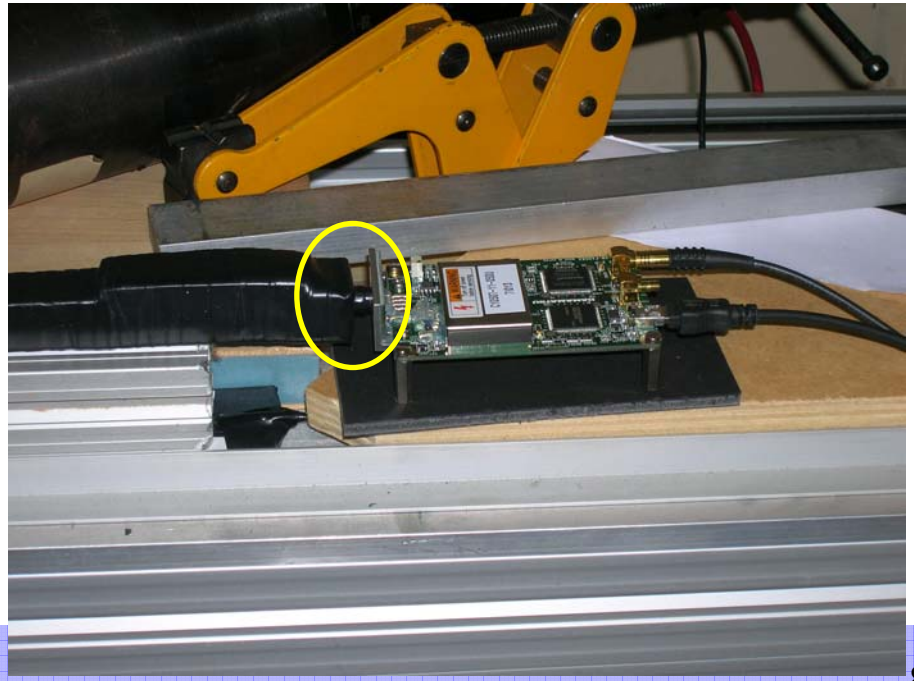
Pros	Cons
High sensitivity	**Requires voltage stabilization:** *** How accurate do we need the gain to be, can we tolerate 10% instabilities?**
Bfield resistent	**Delicate photocathode**
Compact	



Characterization

- **Standalone signal has reasonable size (100 mV/p.e.)**
  - **but extremely high rate (40KHz @0.5 p.e., 4KHz@2p.e.)**
  - **And extremely low eff (done with diode half way the fiber)[0 suppressed plot]** →
- **Coupling with extruded scintillators done, but no significant signal yet**





Plans

- **Understand MPPC efficiency and noise**
- **Understand extruded scintillator with compact PM**
- **Characterize multiple PM**
- **Longitudinal coordinate measurement with TDCs**
- **Optimization of mechanical couplings (both Cuore and SuperB)**
- **Behaviour in B field (2T magnet available)**
- **Choice among extrusions and investigation of variations**

BACKUP

Sources and electronics

- **Two test sources set up:**
  - **1974 Cs source with a 10 muCi activity (ν~800Hz)**
  - **Two 1.5cm scintillators (area of the smallest 10x5 cm^2)➔ cosmic rate ~1.5Hz**
- **DAQ system:**
  - **Comparators and coincidences for the cosmic trigger**
  - **Amplifier for the compact PM output**
  - **Scaler**
  - **ADC [specs?]**
  - **TDC [specs?]**
  - **PC interface**