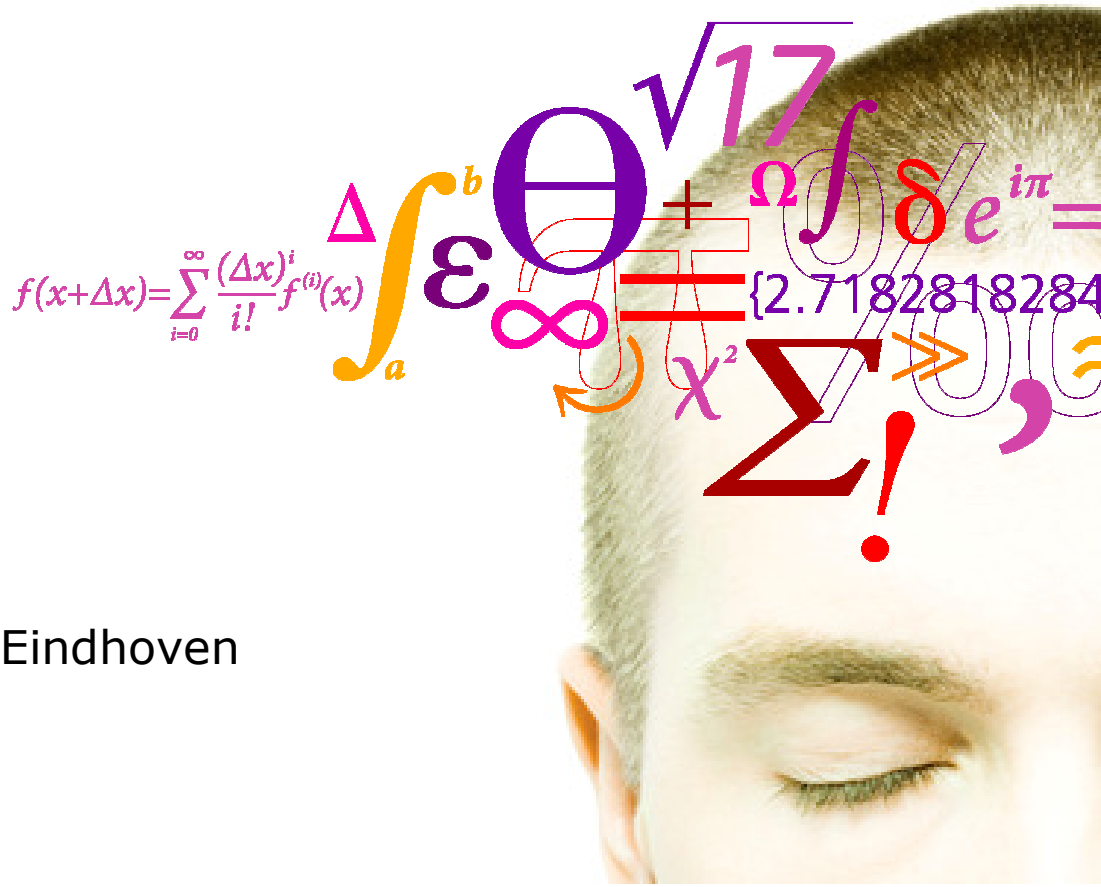
ASIM-CZT detector measurements of hard radiation from TU Eindhoven discharges -Preliminary results and plans



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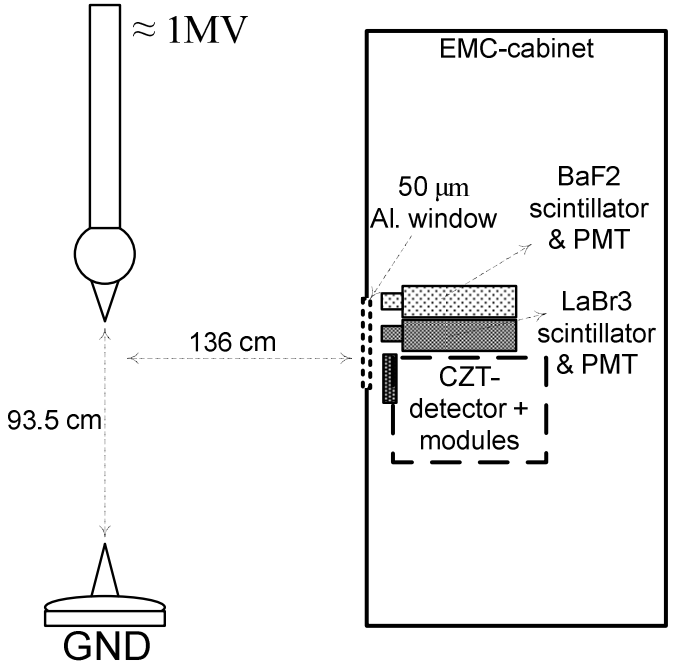
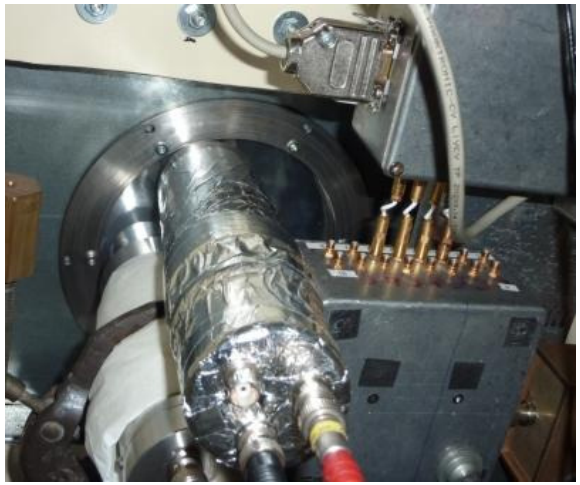
Outline

Detection of hard radiation from discharges:

- Eindhoven TU, June 2009 :
  - Experiment with a single CZT pixel detector (16 pixels, 1 cm^2 !)
  - Compact readout electronics (EMC problem was solved by TU-Eindhoven)
  - EMC cabinet (detector setup close to the discharge)
  - Pulse shape (using fast digital Oscilloscopes)
  - Both polarity discharges
- Detector setup:
  - CZT pixel detector (semiconductor)
  - $LaBr_3$ detector (scintillator)
  - BaF_2 detector (scintilator)
- Measurements
  - 500 discharges (both negative and positive polarity), last 100 discharges are positive polarity
  - Detected 7 CZT events (triggered two or all detectors)

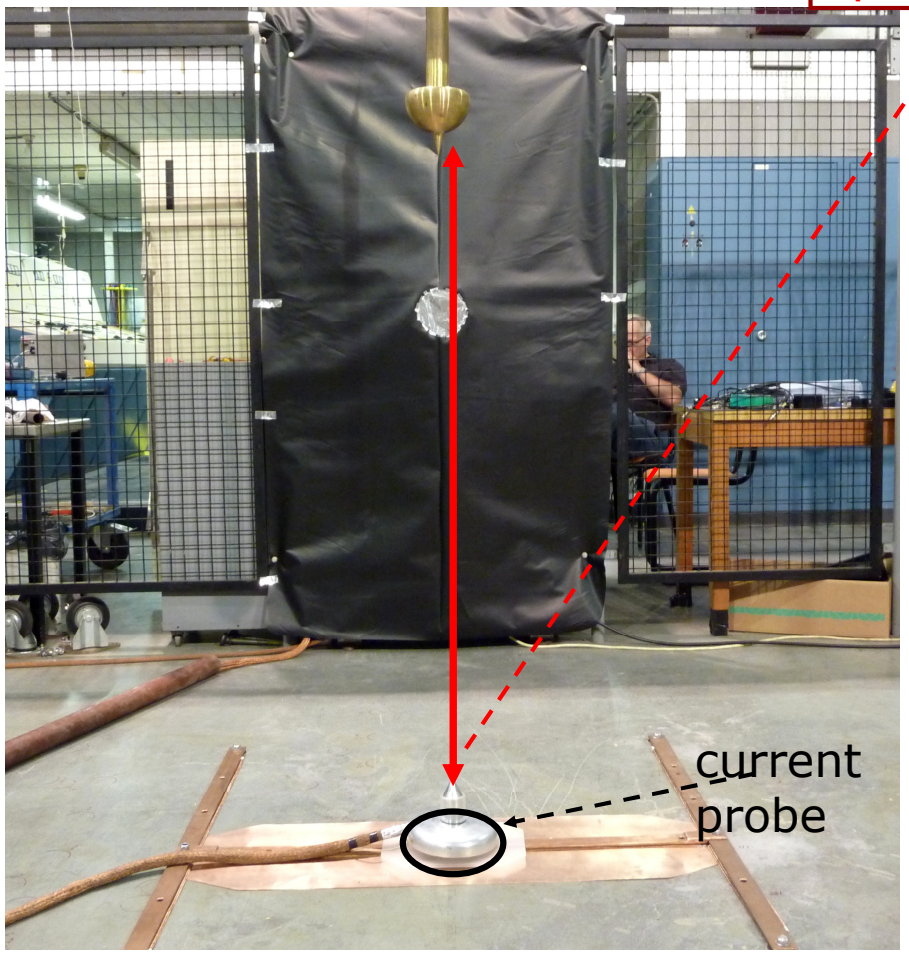
Setup



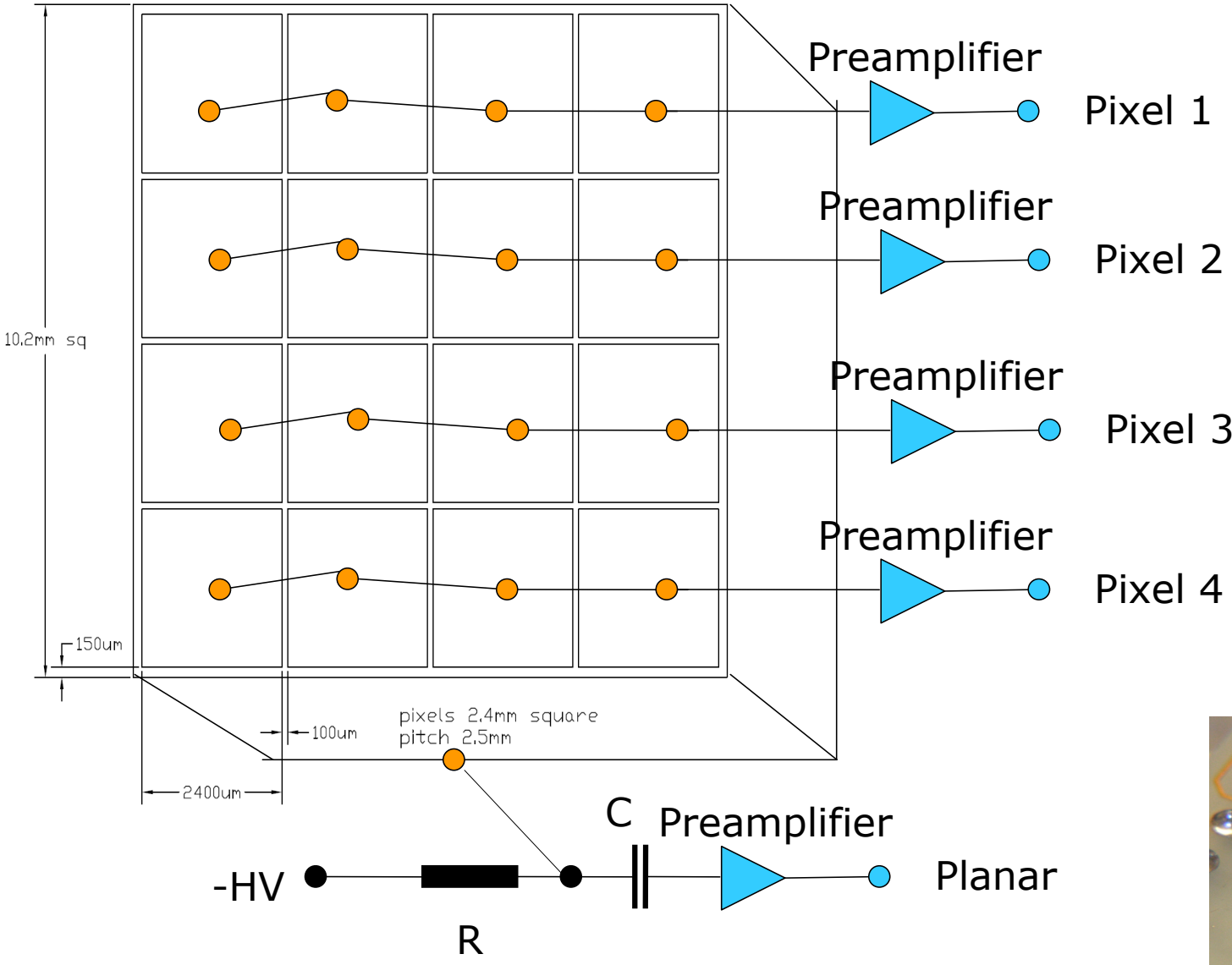


Point-plate symmetry

93.5 cm spark

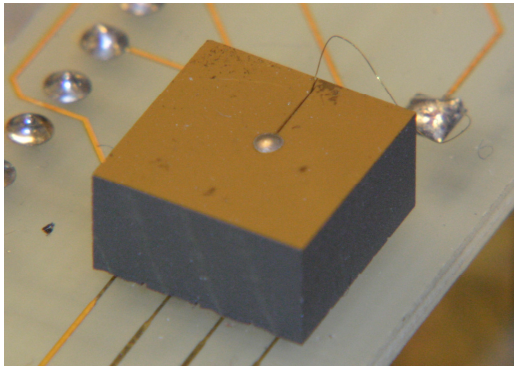


16 pixel CZT Detector

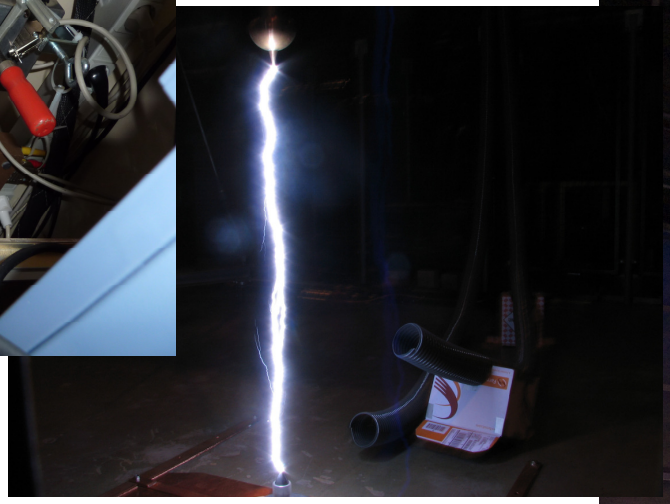


CZT Crystal:

10 mm x 10 mm x 5 mm



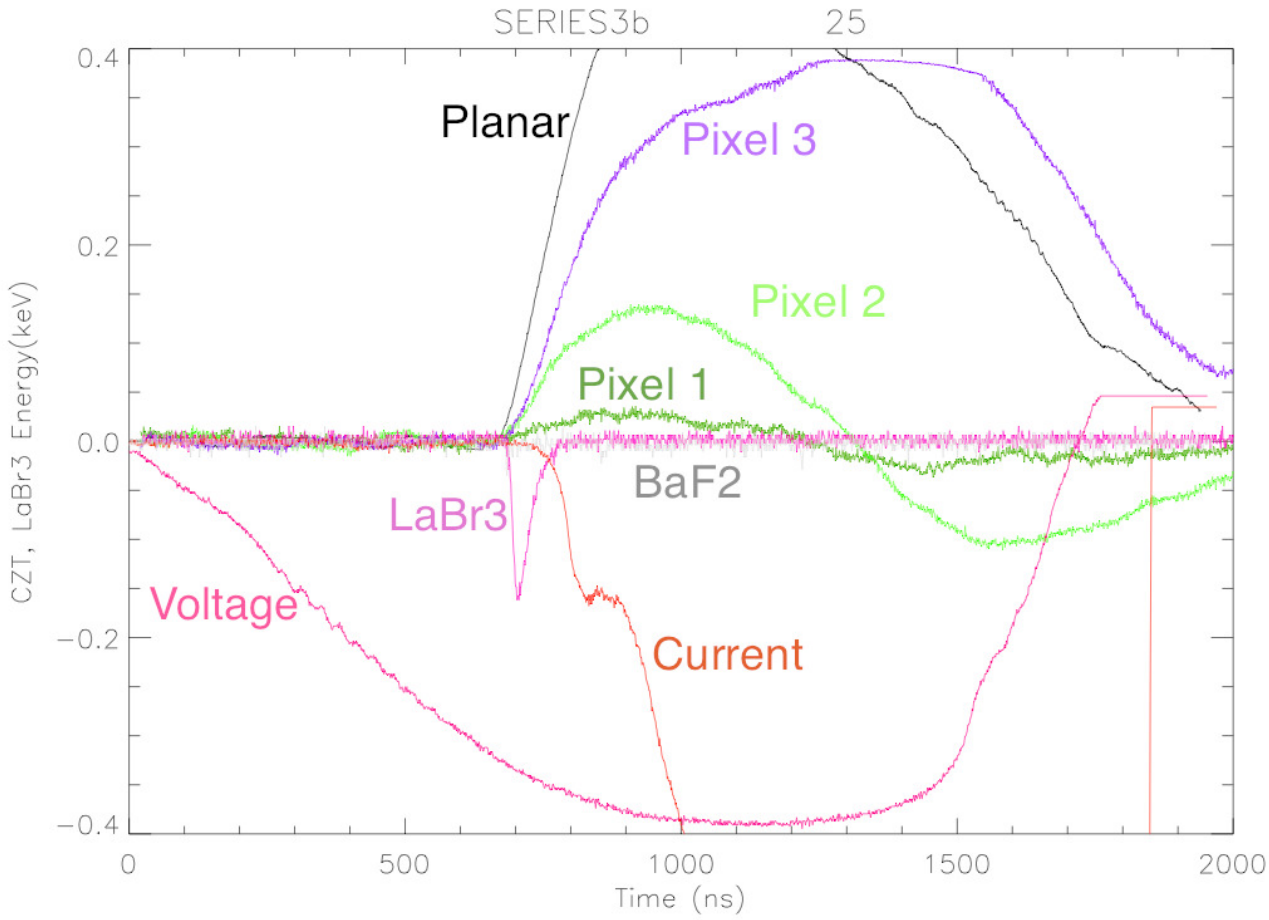
Setup



Measurements

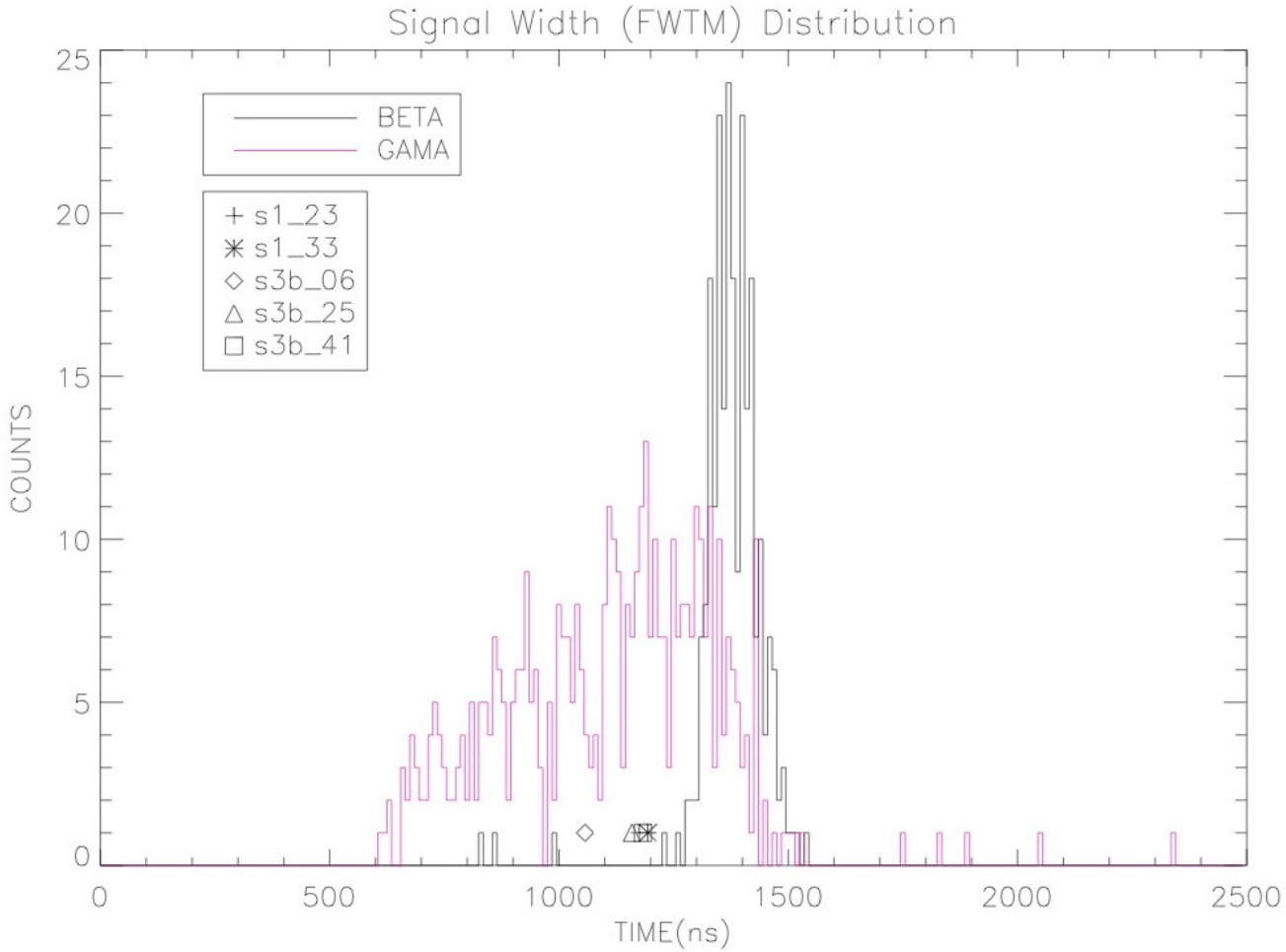
Event nr.	Discharge polarity	Pulseheight (mV)	Ph error (mV)	Energy (keV)	Energy error (keV)	Width (FWTM) (ns)	Width error (ns)
Series_1a ID_23	negative	20	3	60	9	1175	150
Series_1a ID_33	negative	145	3	435	9	1190	100
Series_3b ID_06	negative	147	5	441	15	1050	100
Series_3b ID_25	negative	160	3	480	9	1159	100
Series_3b ID_40	negative	200	20	600	60	1174	100
Series_5 ID_37	positive	30	4	90	12	1225	150

Total nr of discharges : 500



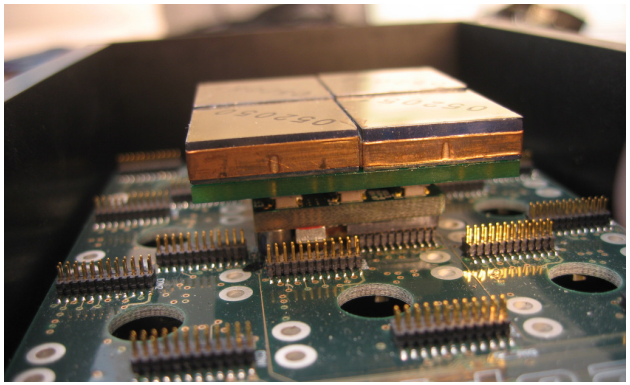
Result

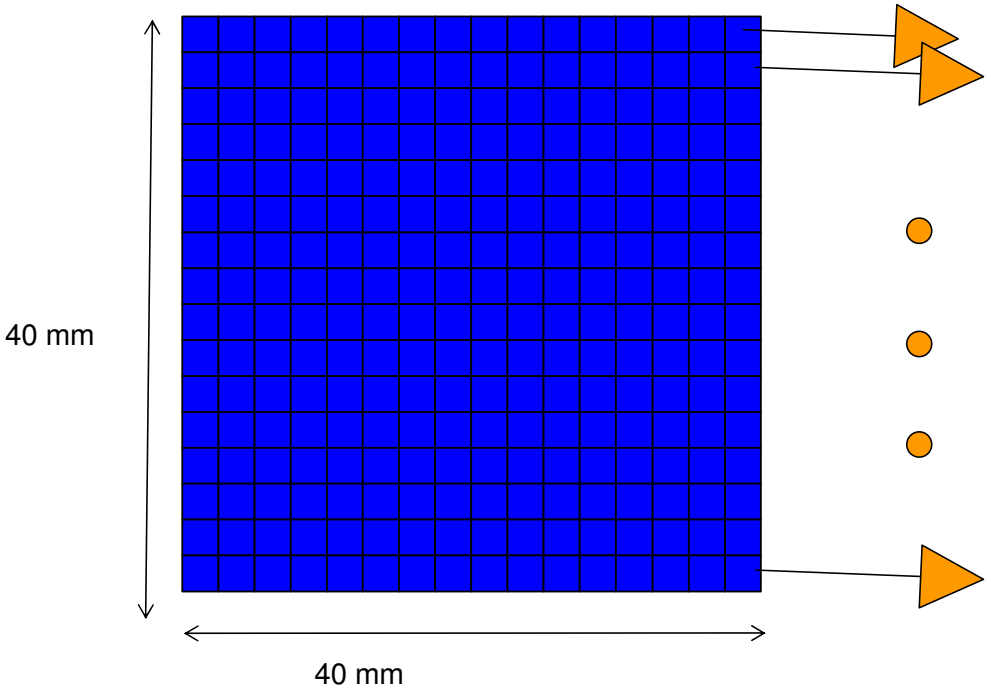
- 5 event data (neg polarity)
- Sr90 Calibration (electrons) data
- Cs137 Calibration (Gamma-ray) data



Future Plan

- Extention of the CZT detector sensitiv area from 1 cm^2 → 4 x 20 mm x 20 mm x 5 mm
- Configure 256 pixels (Pixel pitch:2.5 mm) → 16 strips
- Readout each strip → fast electronics+digitizer
- Possible to make 1D imaging device using slit





Conclusion

- Setup :
  - EMC protected setup
  - Difficult to locate the setup close to the discharge (~1 m)
  - CZT detector (1 cm^2 , 0.5 cm thick)
  - BaF2 detector (conical shape 4.0 cm x 2.5 cm)
  - LaBr3 detector (3.8 cm thick 3.8 cm Ø)

- Measurements:
  - 500 discharges (negative and positive polarity)
  - Only 7 CZT detector trigger event recorded
  - Average energy recorded (CZT) was around 400 keV which is close to the yield of maximum electron energy transfer in 1 MV electric field
  - The width of the CZT signals indicate that they were generated by electrons. The statistics is however too poor and the measurements aught to be repeated with better statistics.