TG 2: Status report on Phase II prototype detector „Siegfried“

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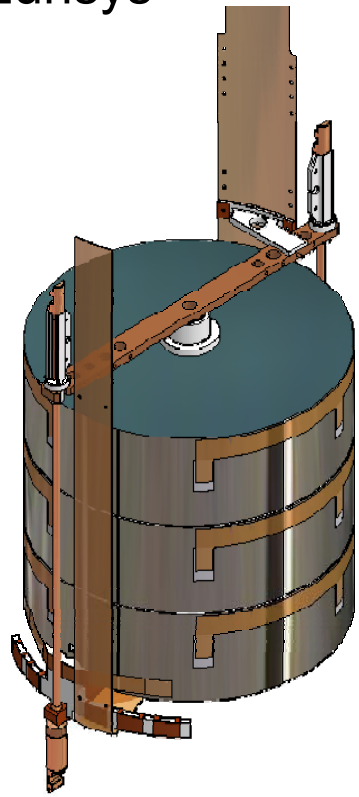
Siegfried

- Phase II prototype n-type detector produced at Canberra-Eurisys
- Since March 2006: detector at MPI Munich
- Dimensions:
  - Height: 69.8 mm
  - Outer Radius: 75.0 mm
  - Inner Radius: 5.0 mm
  - Mass: 1.63 kg
- Segmentation scheme:
  - 6-fold in azimuthal angle φ
  - 3-fold in height z

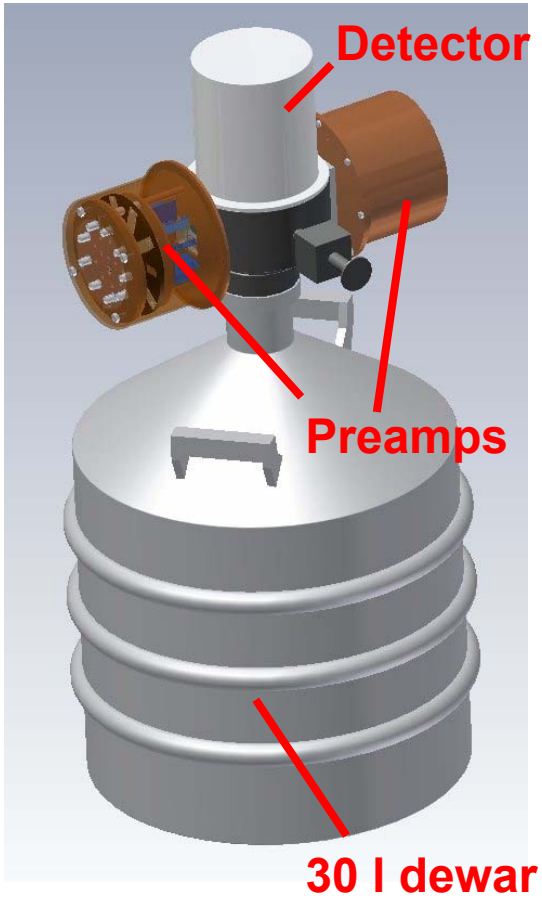


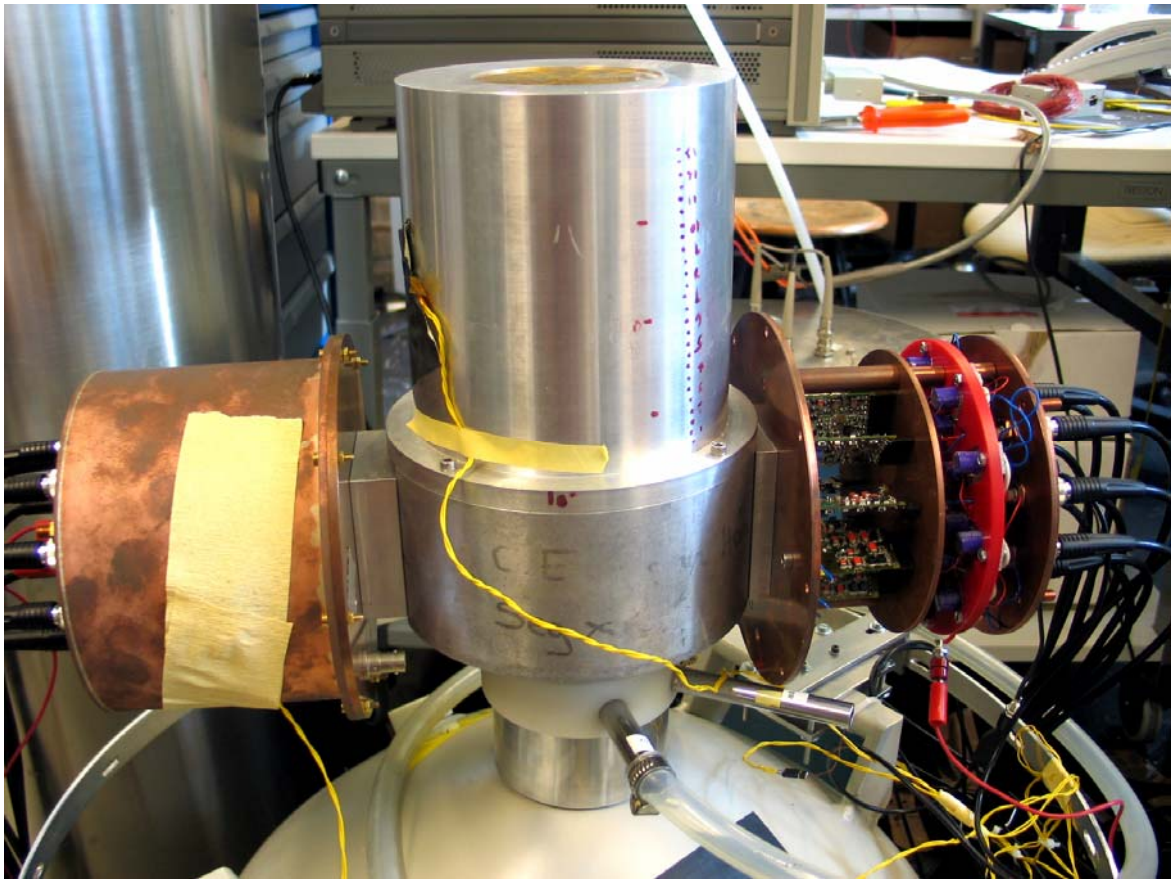
Contacting

- Contacting scheme: Kapton printed-circuit-board

Test stand

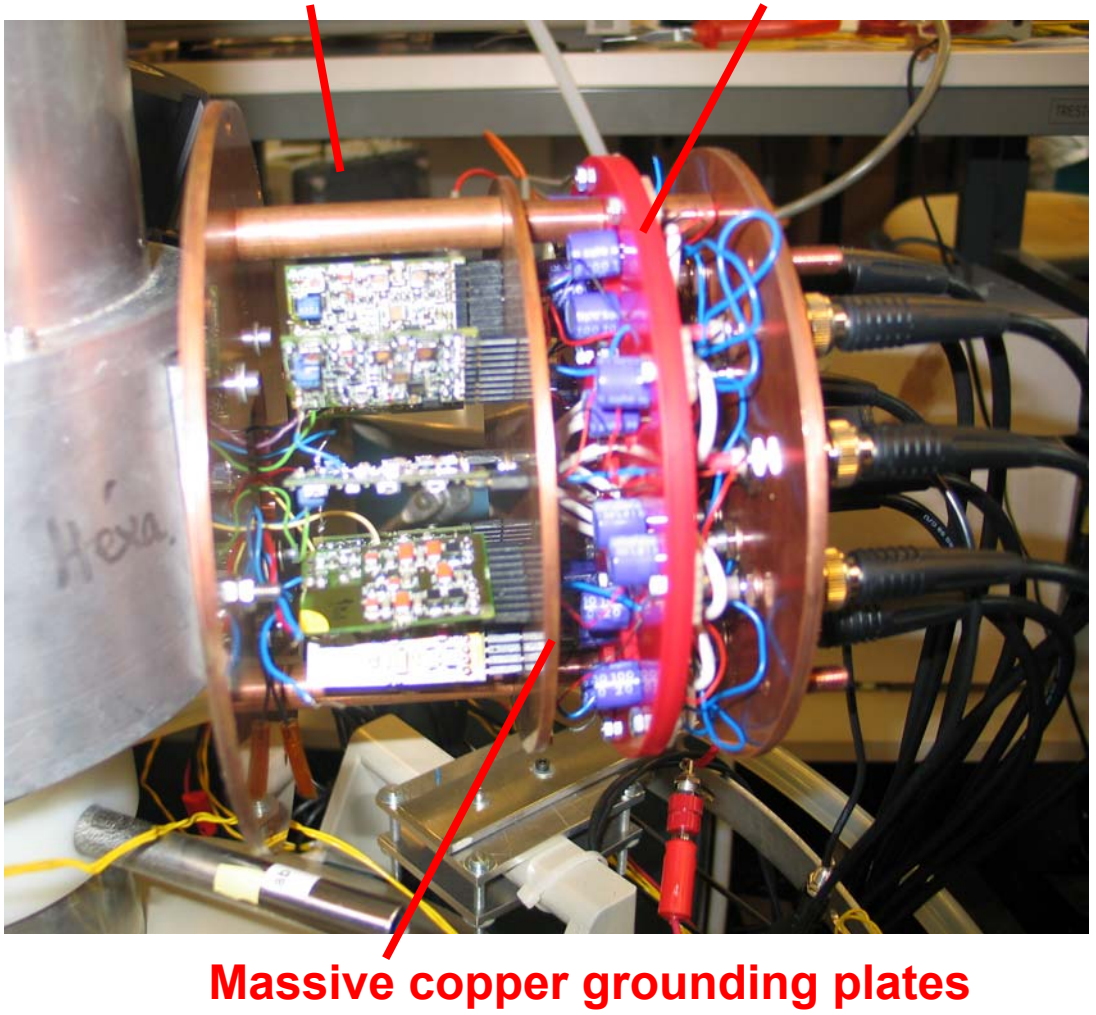
- Conventional vacuum test cryostat



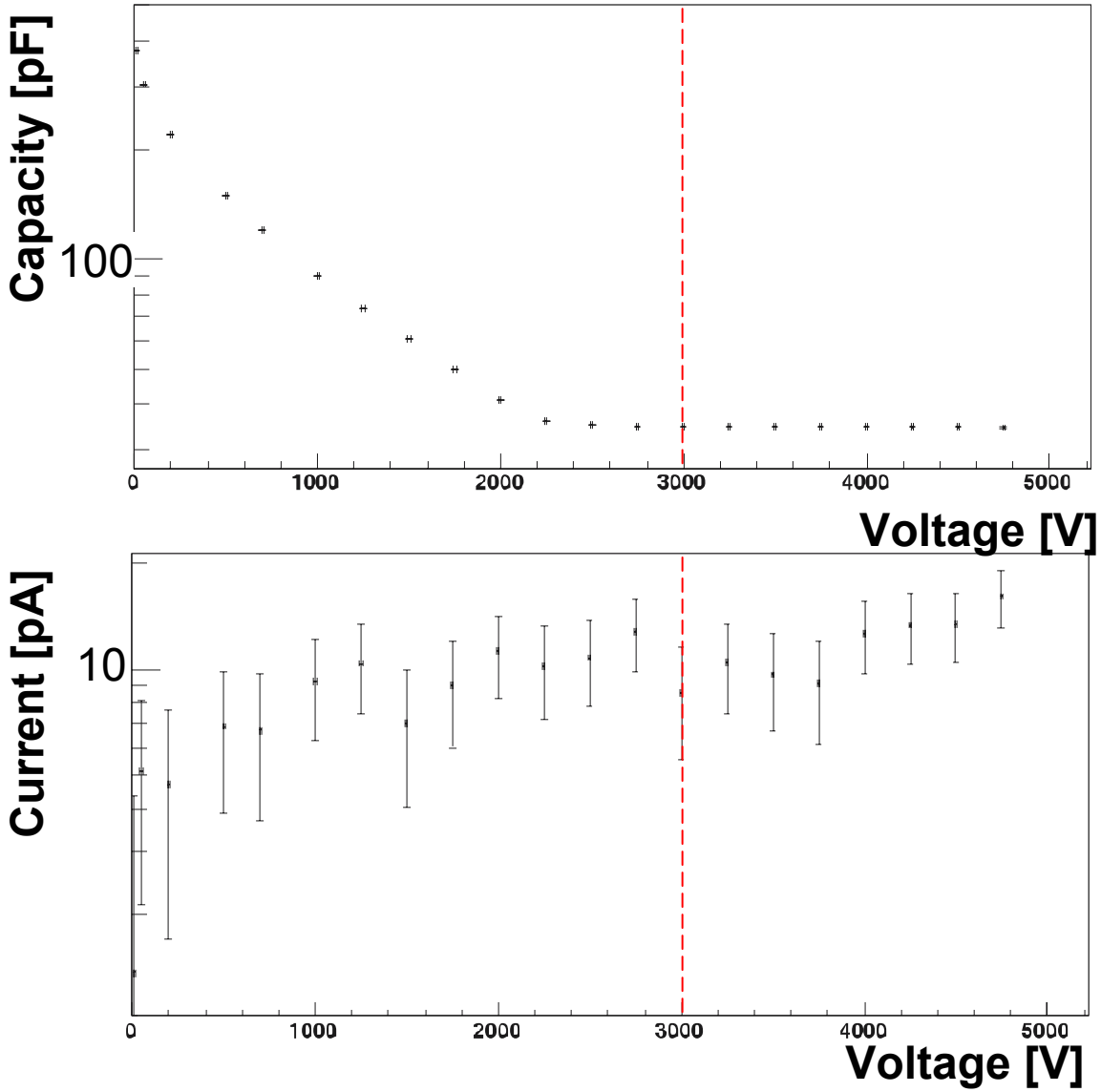


Electronics

- Cold FET for core, AC-coupled
- 18 warm FETs for segments, DC-doupled
- Cologne (PSC 823) charge sensitive pre-amplifiers grouped into two „ears“ (9 / 9+1)
- ***Thorough grounding needed***



Capacity / Current

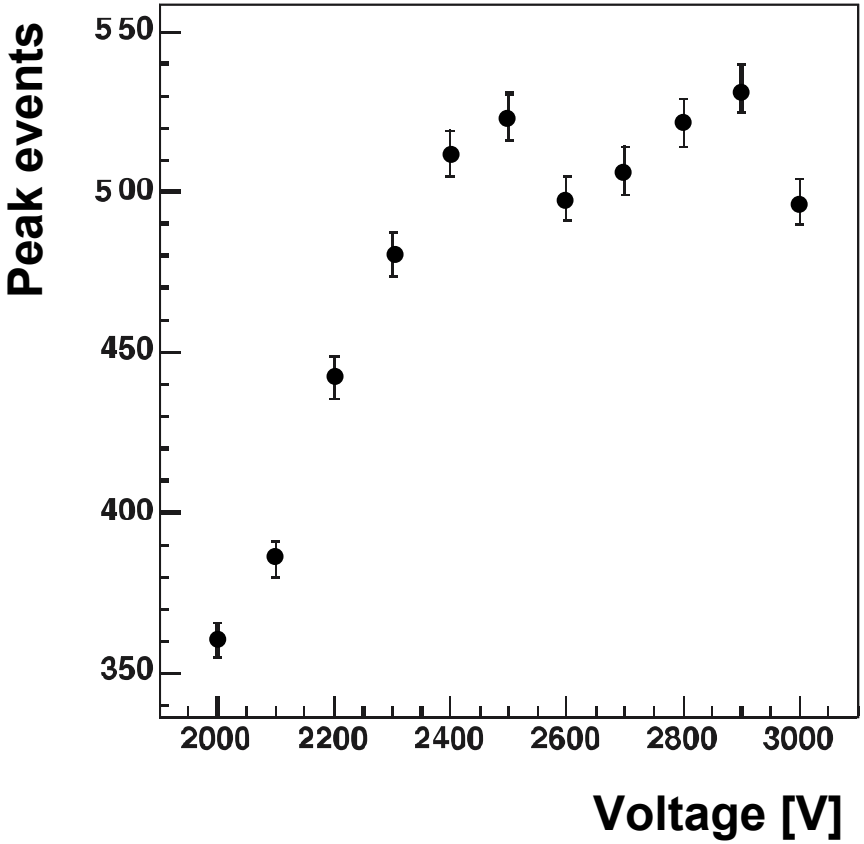


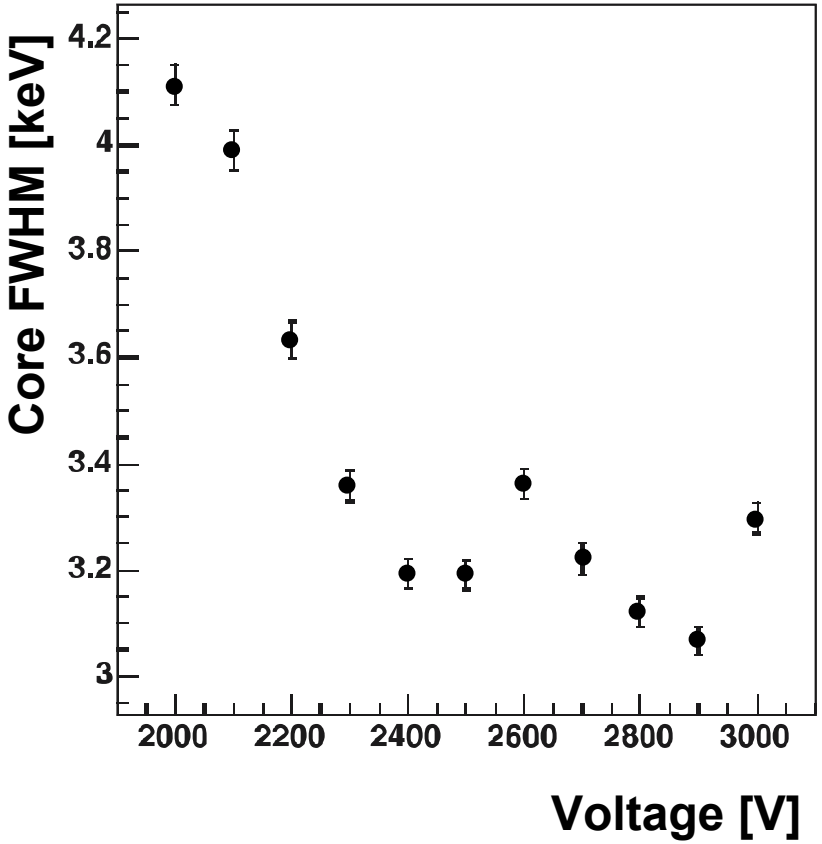
Operation voltage 3000 V

Total capacity ~ 35 pF

Current ~ 10 pA

Resolutions (@ 1.3 MeV)



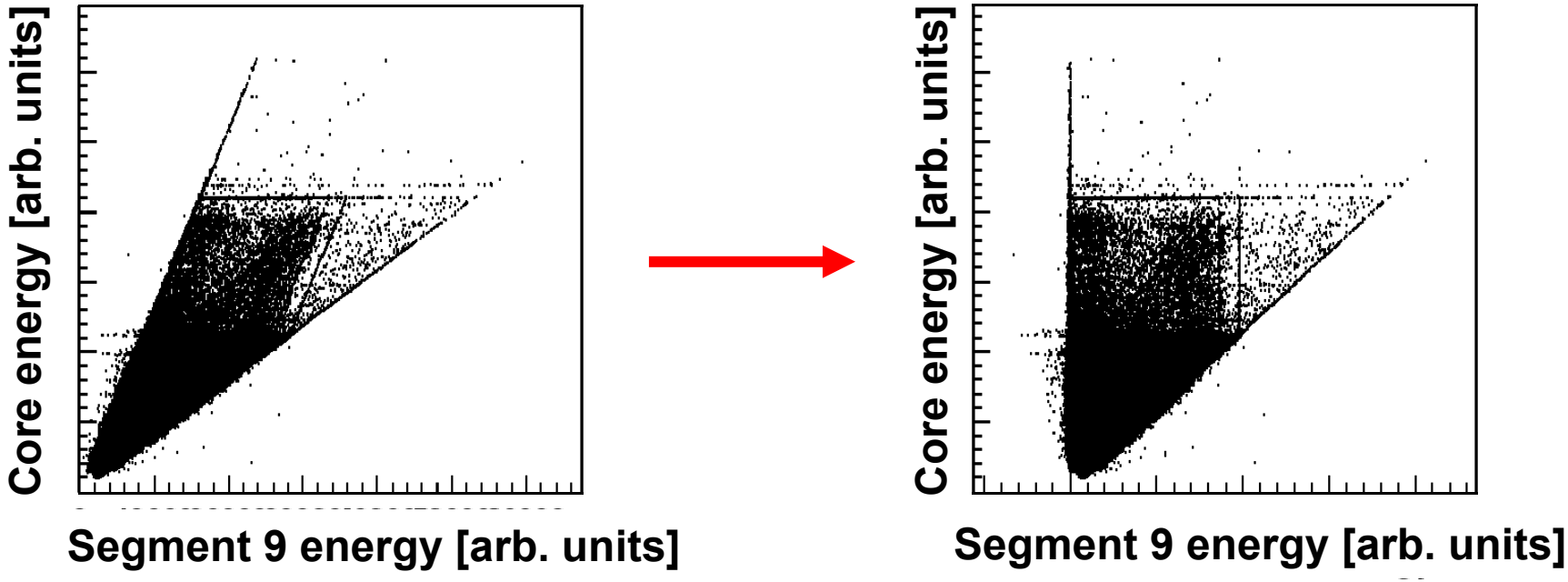


- Core (alone) ~ 2.3 keV (ear) ~ 3-4 keV

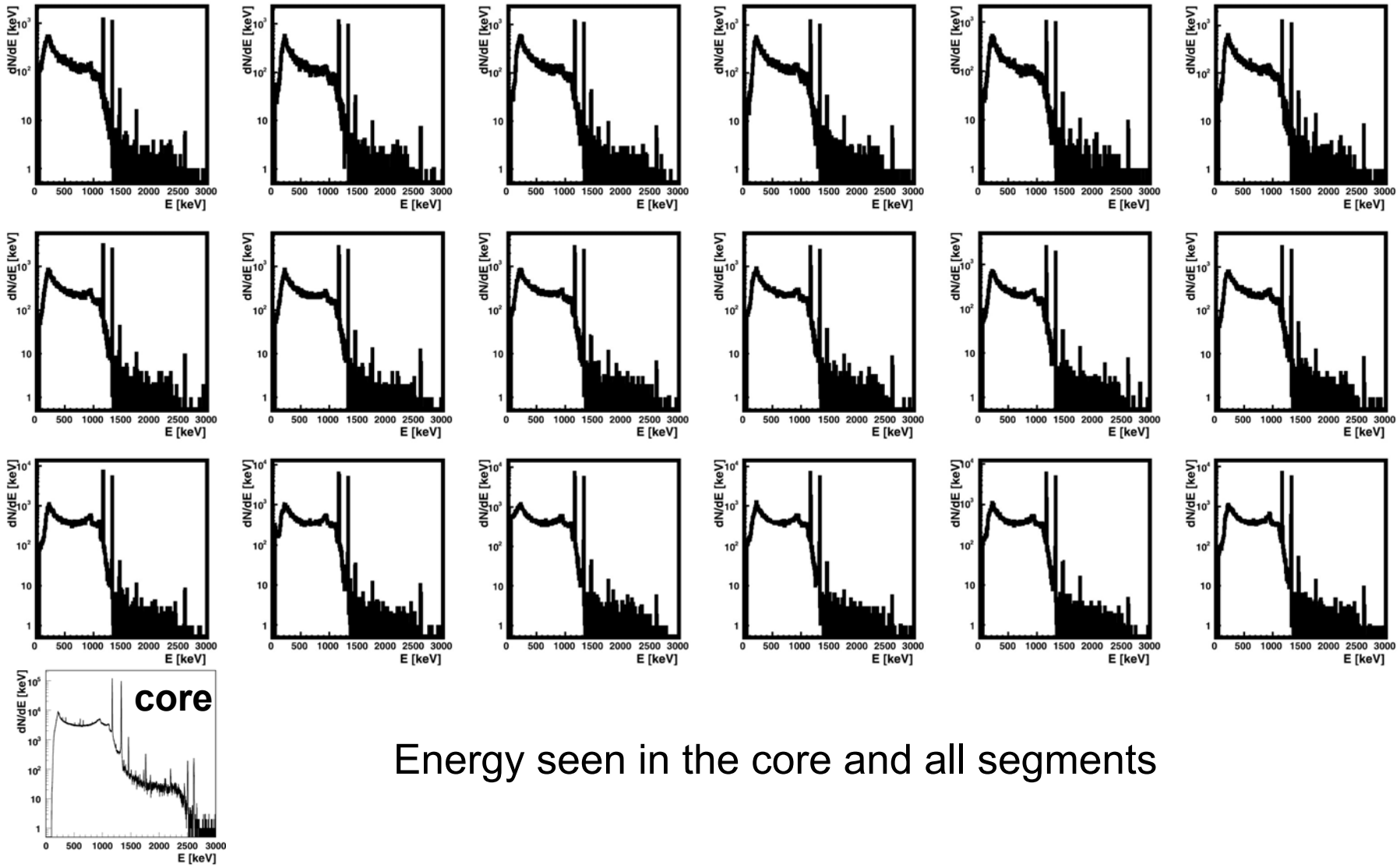
- Segments (ear) ~ 2.5 – 4 keV

Cross-talk correction

- Core FET cold
- Amplified signal is passed by the un-amplified signal → cross-talk
- Easy to correct for one detector, but nightmare for an array
- ***Learn to not use FET close to detector***

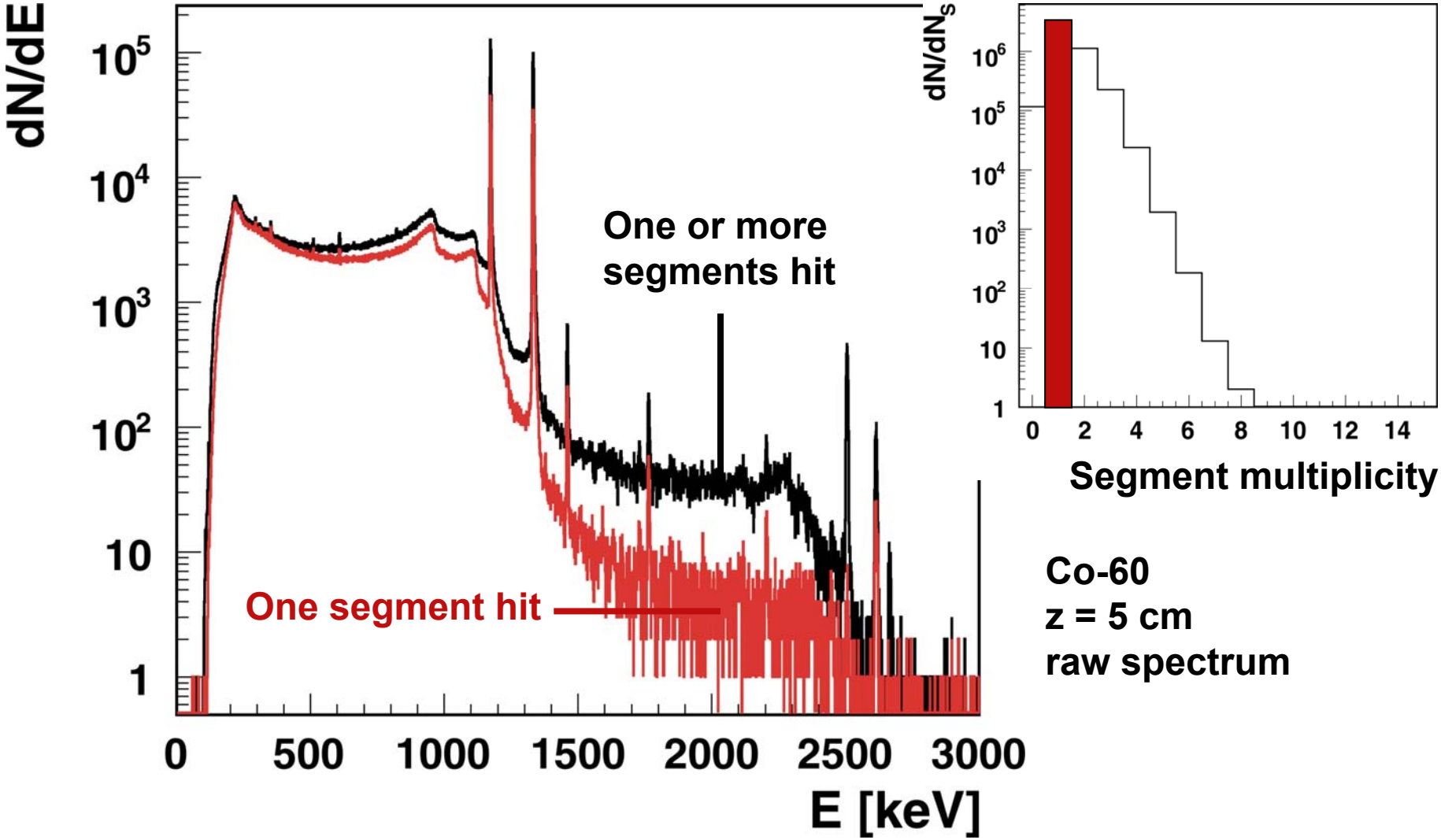


Co-60 spectra

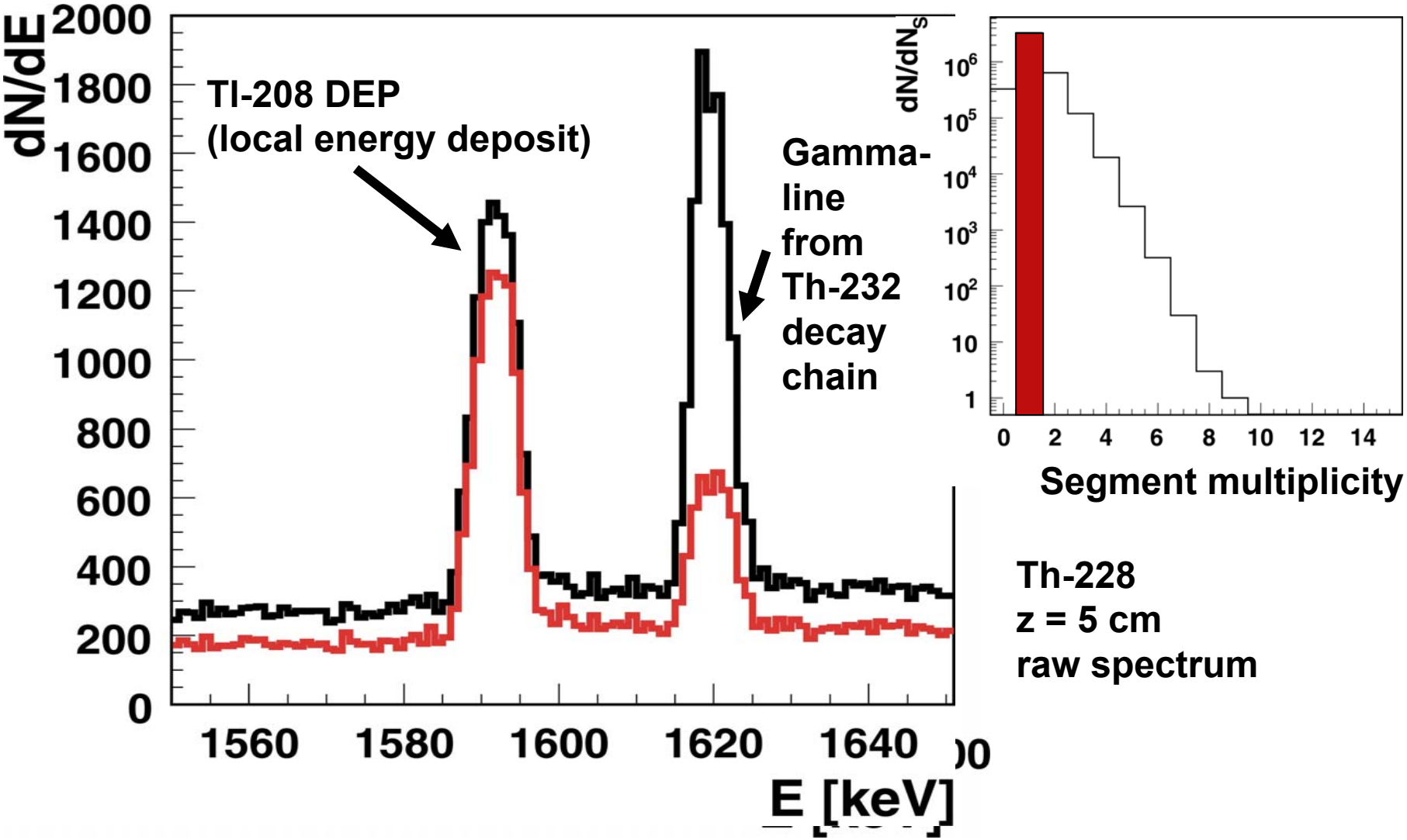


Energy seen in the core and all segments

Photon identification measurements I



Photon identification measurements II

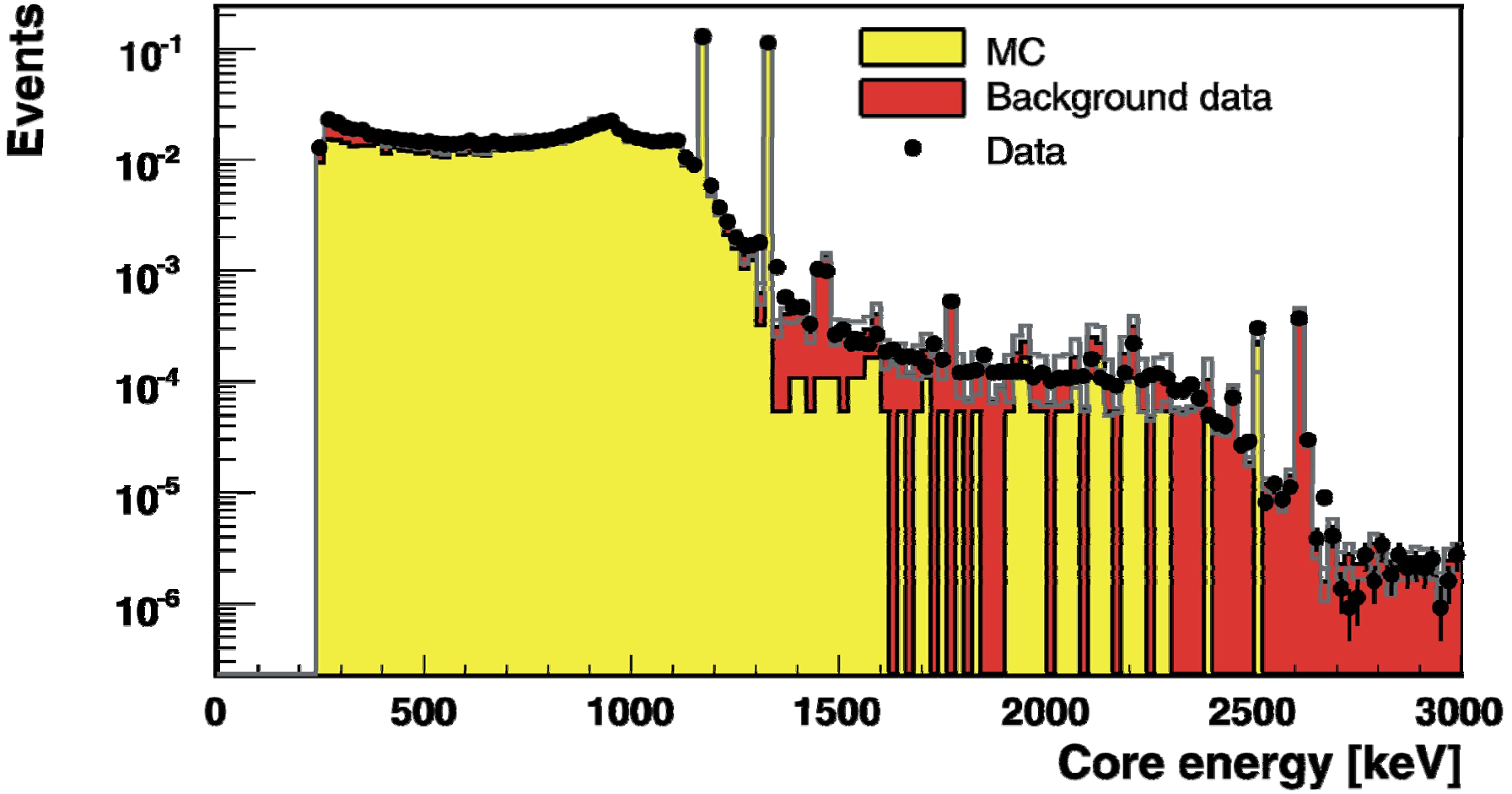


Th-228
z = 5 cm
raw spectrum

Data to Monte Carlo comparison I

Co-60
z = 10 cm

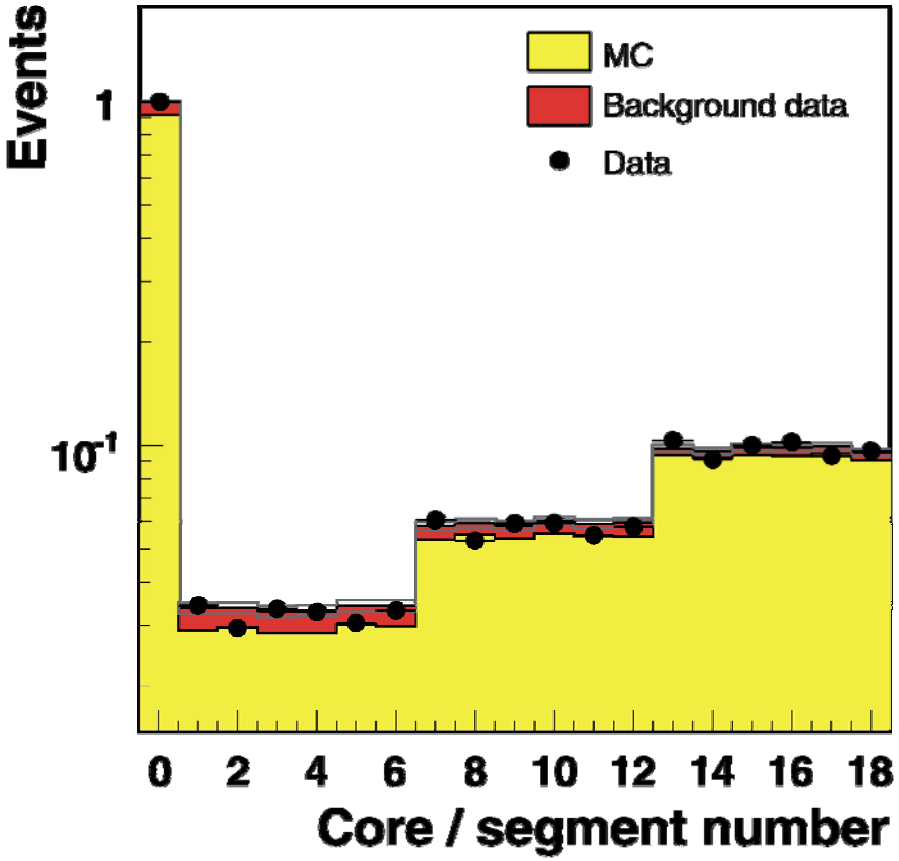
E_{thr} = 250 keV

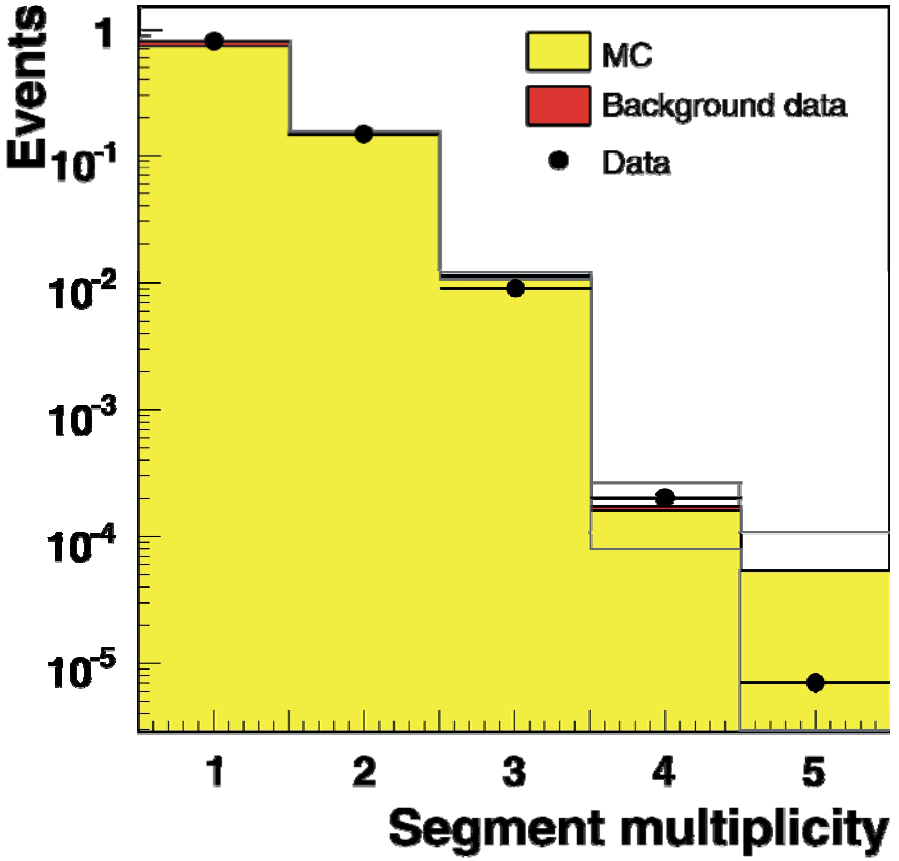


Data to Monte Carlo comparison II

Co-60
z = 10 cm

E_{thr} = 250 keV

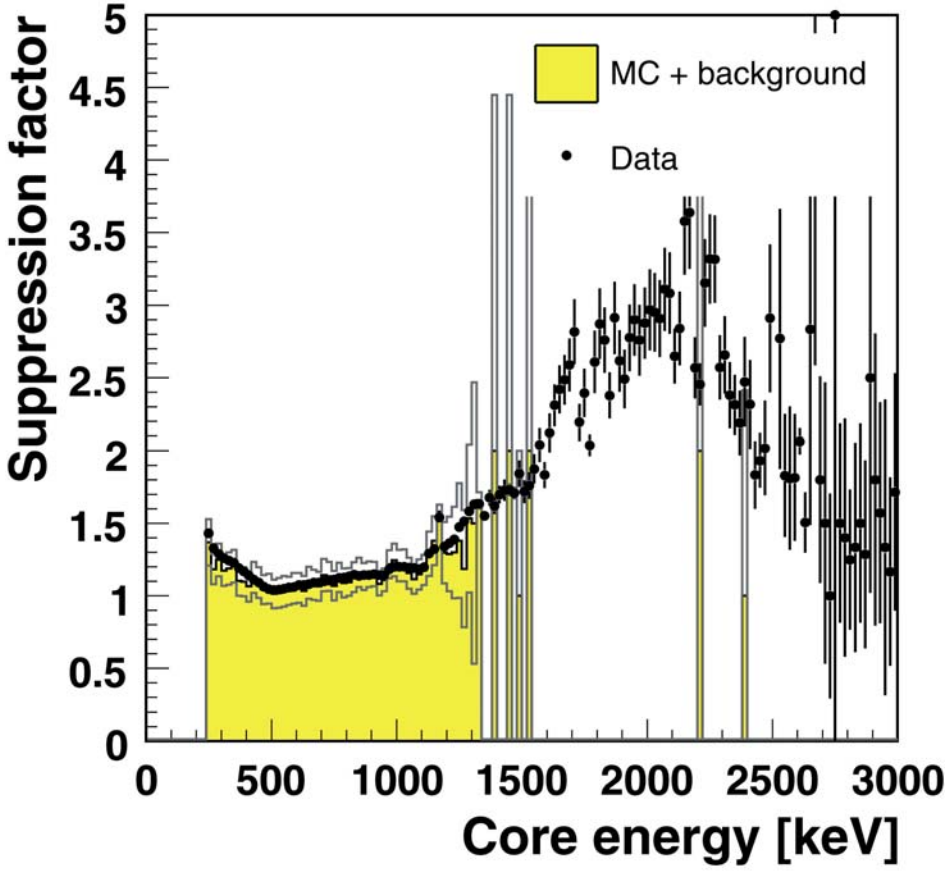




Data to Monte Carlo comparison III

Co-60
z = 10 cm

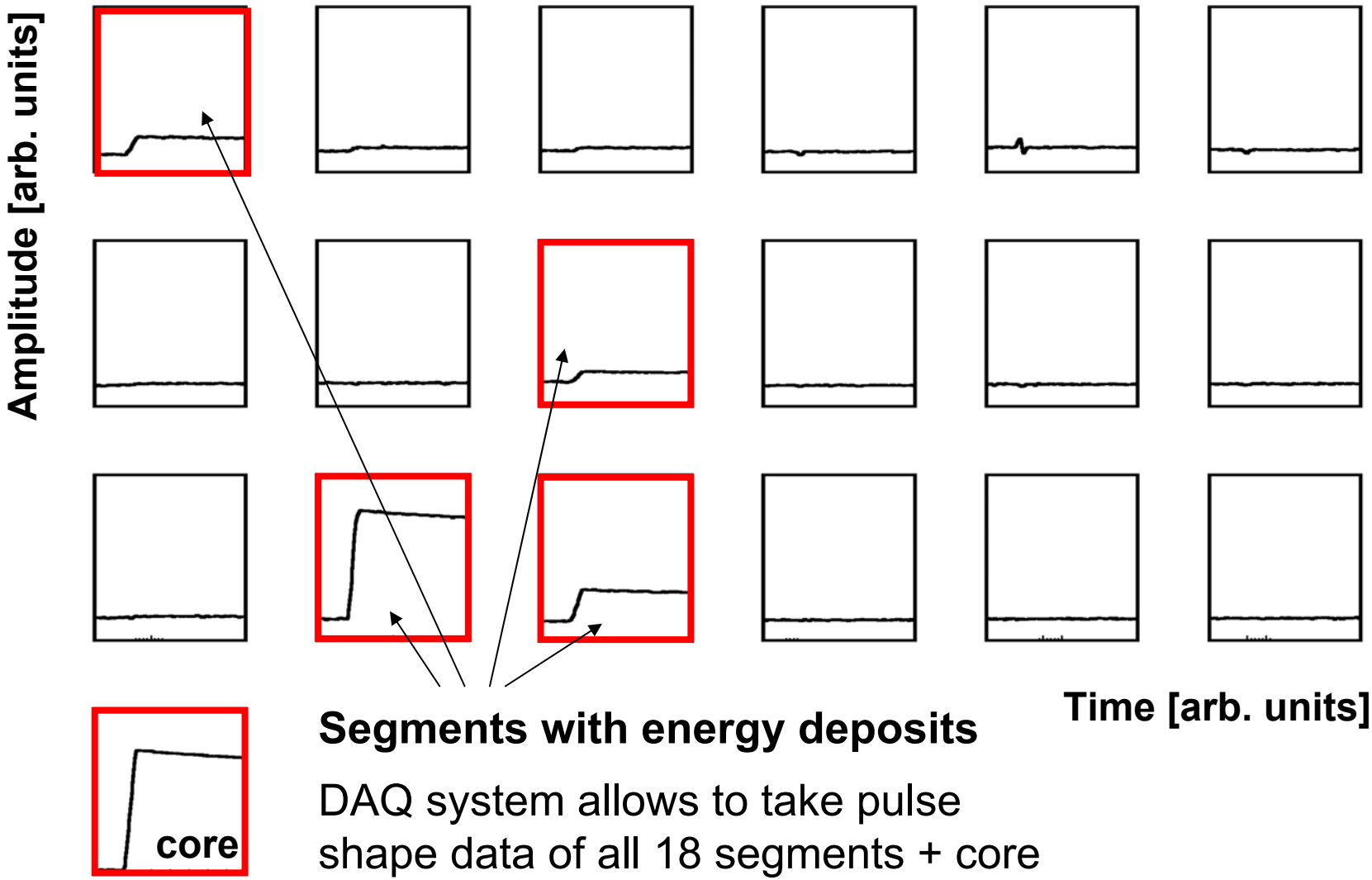
E_{thr} = 250 keV



- Data and Monte Carlo agrees well:
  - Energy spectra
  - Multiplicities
  - Suppression factors

→ ***Can trust our Monte Carlo calculations for background estimates***

Pulse shapes



Segments with energy deposits

DAQ system allows to take pulse shape data of all 18 segments + core

Pulse shape analysis I

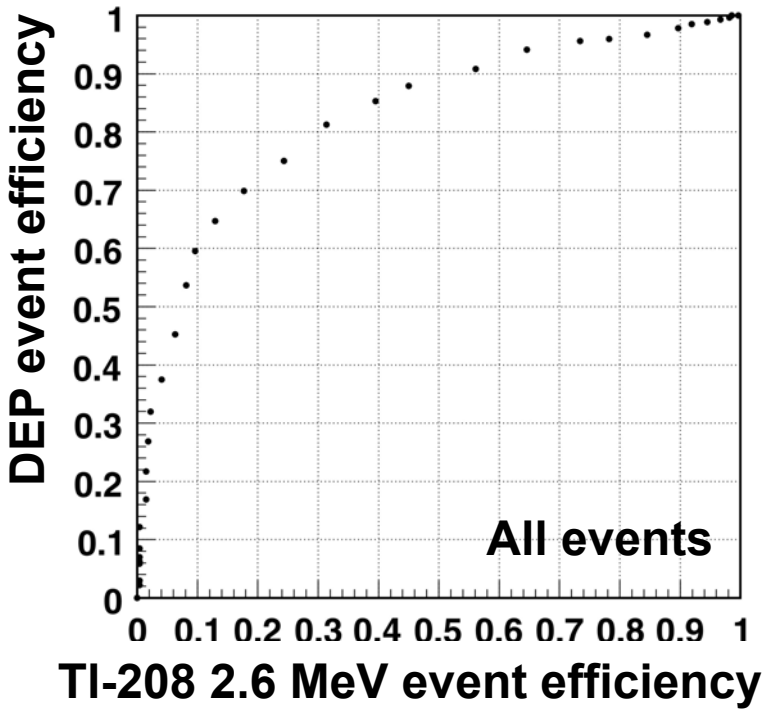
- Feasibility study for analysis of pulse shapes
- Data with core and one segment only (Tl-208 2.6 MeV vs. DEP)
- Follow three different approaches:
  - Likelihood discriminant based on event probabilities
  - X^2 analysis comparing pulse shapes to reference pulses
  - Neural network analysis using pulse shapes
- Use core and segment pulse shapes
- Work in progress, no optimization yet
- Note is upcoming

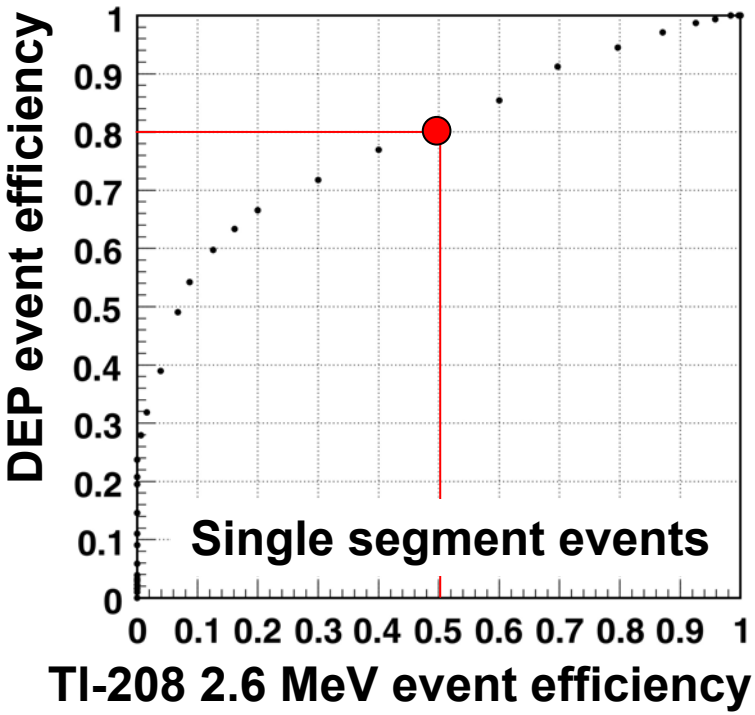
Pulse shape analysis II

- Preliminary results for neural network analysis

DEP: f(SSE) = 80% / 95%
Tl-208: f(MSE) = 96% / 89%

Photon suppression: 50%
Electron-like efficiency: 80%





→ ***Pulse shape analysis works***

Conclusions

- ***Phase II prototype detector Siegfried works well***
- Contacting scheme works
- Learned not to use cold FETs (cross-talk)
- Grounding scheme important
- Photon identification using anti-coincidences works
- Data to Monte Carlo comparison shows good agreement

  (which means that Monte Carlo can be trusted)
- Pulse shape analysis feasible

Outlook

- Detector will be send back to Canberra to be mounted in copper holder
- Submerge detector in liquid nitrogen afterwards → new test stand

- Continue photon identification measurements (note)
- Continue pulse shape analysis (note)

- Note on detector characterization on the way (GSTR-06-008)