蘭州大學
LANZHOU UNIVERSITY

Time properties of MPGD signals

—— MPGD studies in Lanzhou university

Yi Zhang

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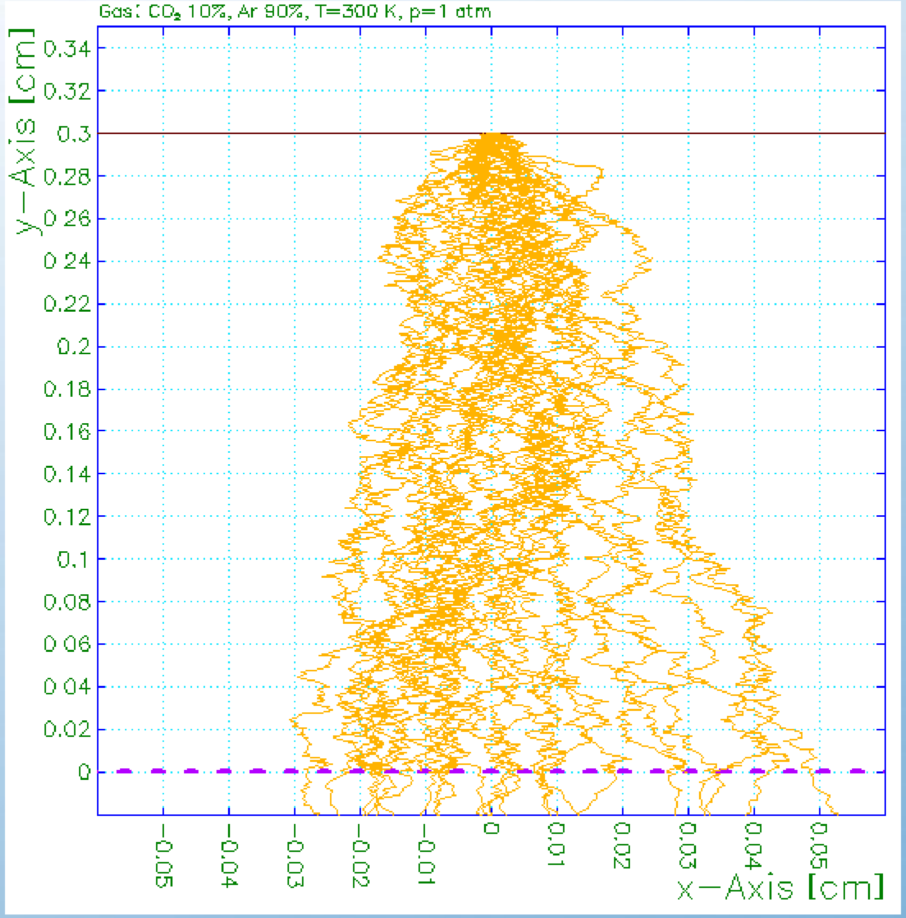
- Time properties of MPGD signals
- MPGD studies in Lanzhou university
- future plan

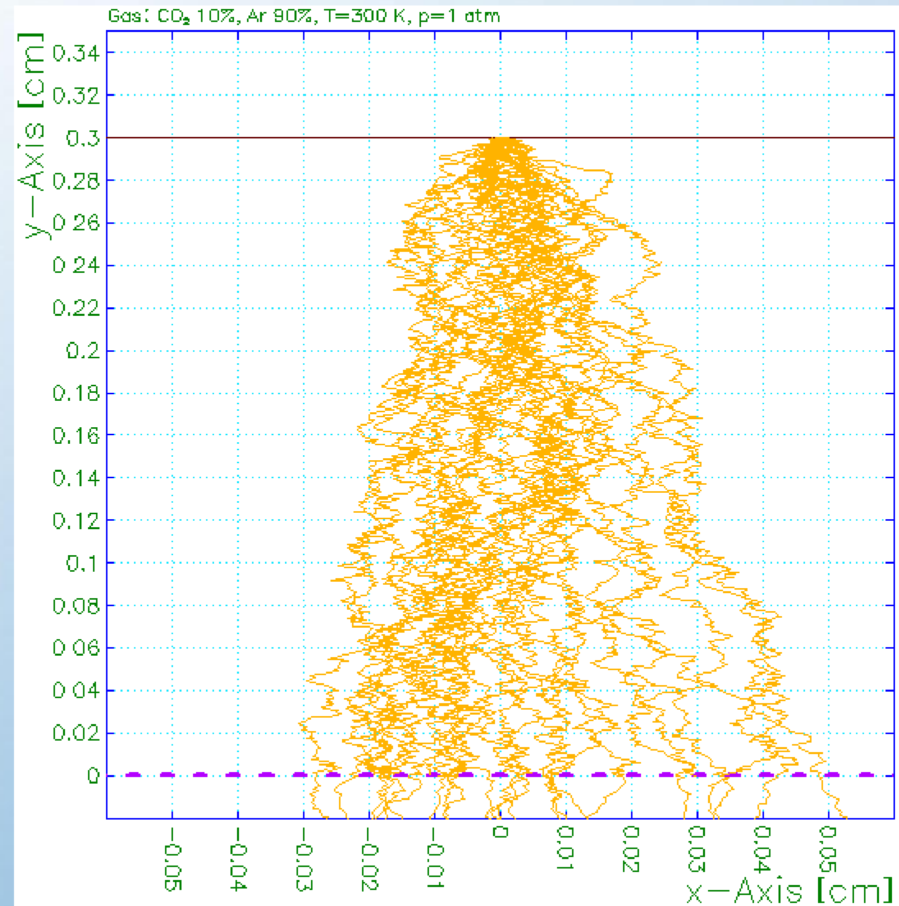
Time properties of MPGD signals

- Fast raising time
  - No inductive signals in drifting



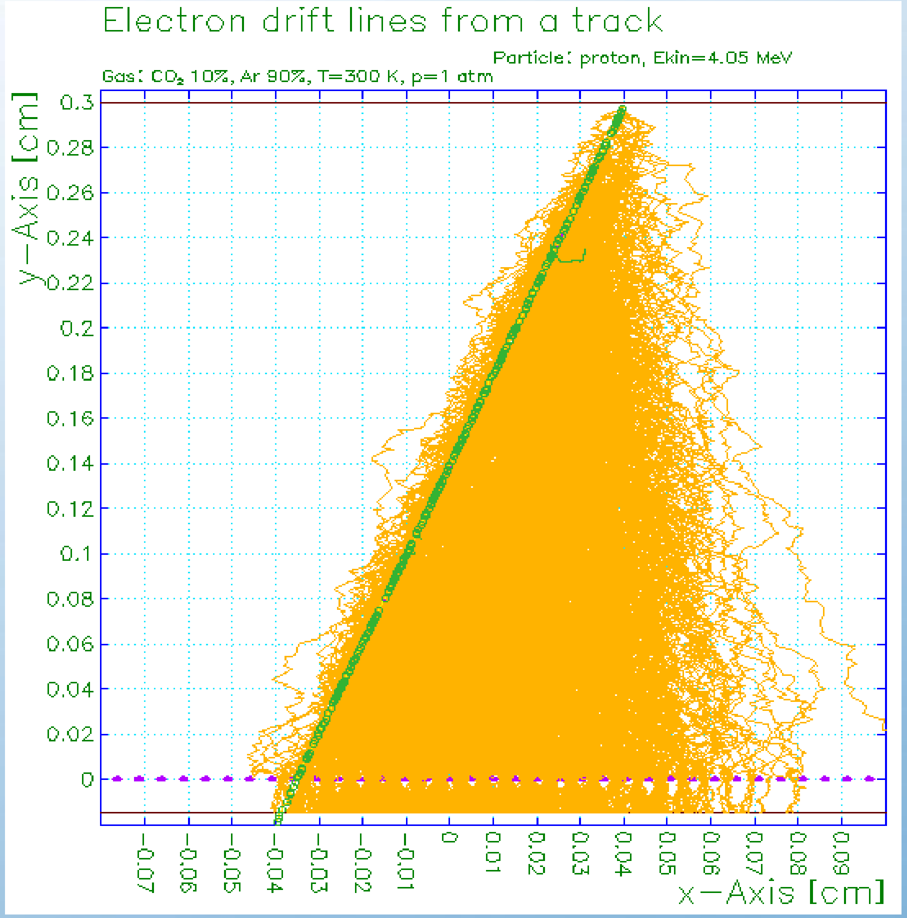
Time properties of MPGD signals

- Fast raising time
- Signal duration depends on the way of energy deposition



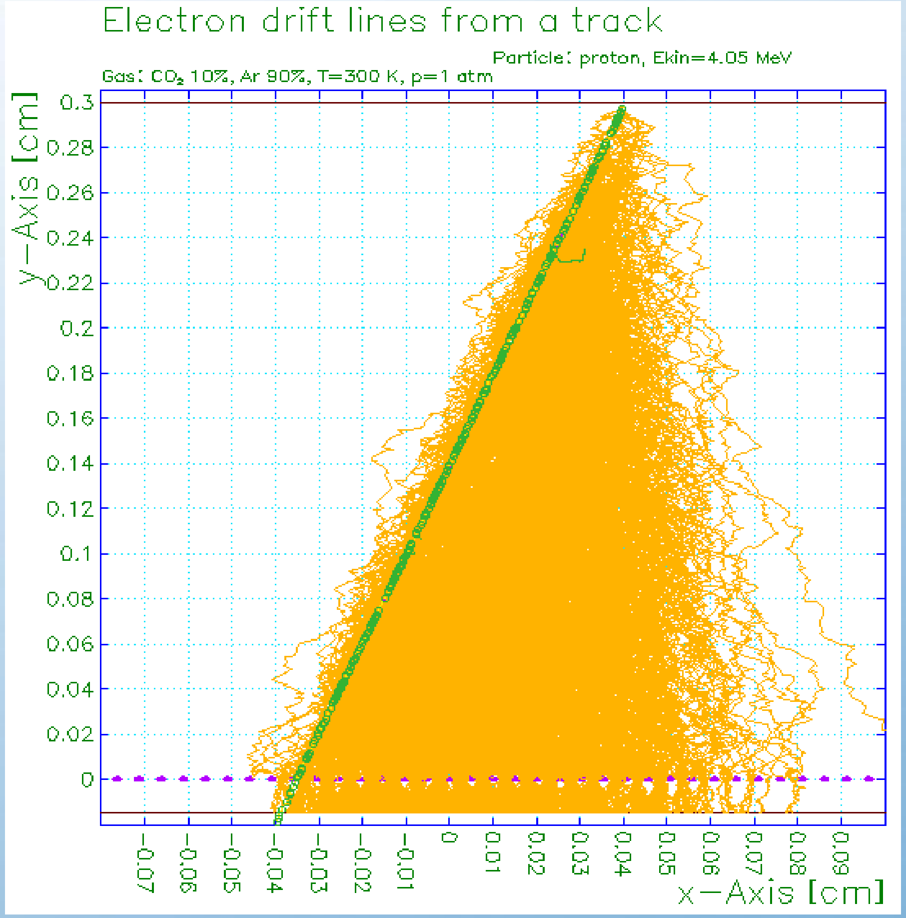
Time properties of MPGD signals

- Fast raising time
- Signal duration depends on the way of energy deposition
  - Particle identification by time cut

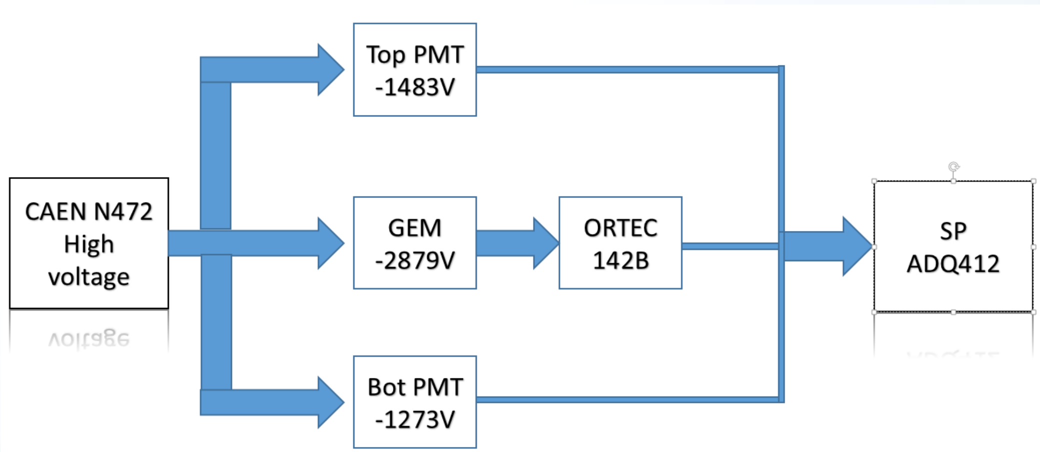


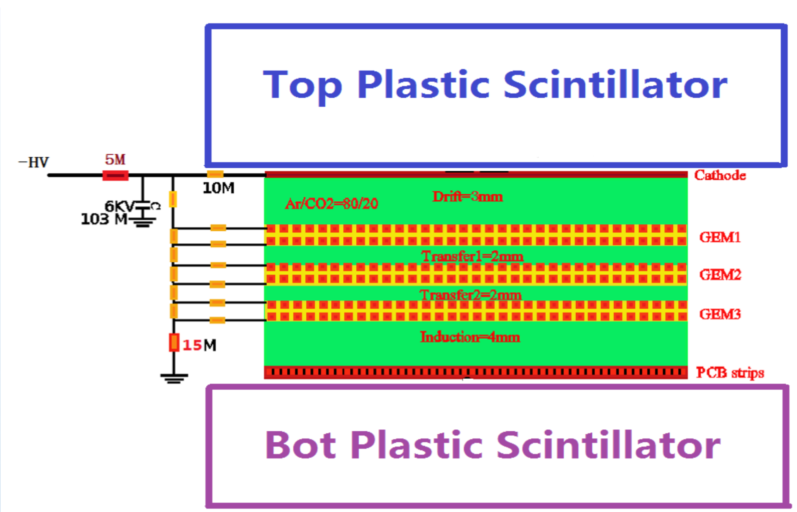
Time properties of MPGD signals

- Fast raising time
- Signal duration depends on the way of energy deposition
  - Particle identification by time cut
- The maximum duration is independent of incidental energy
  - Correct the initial position



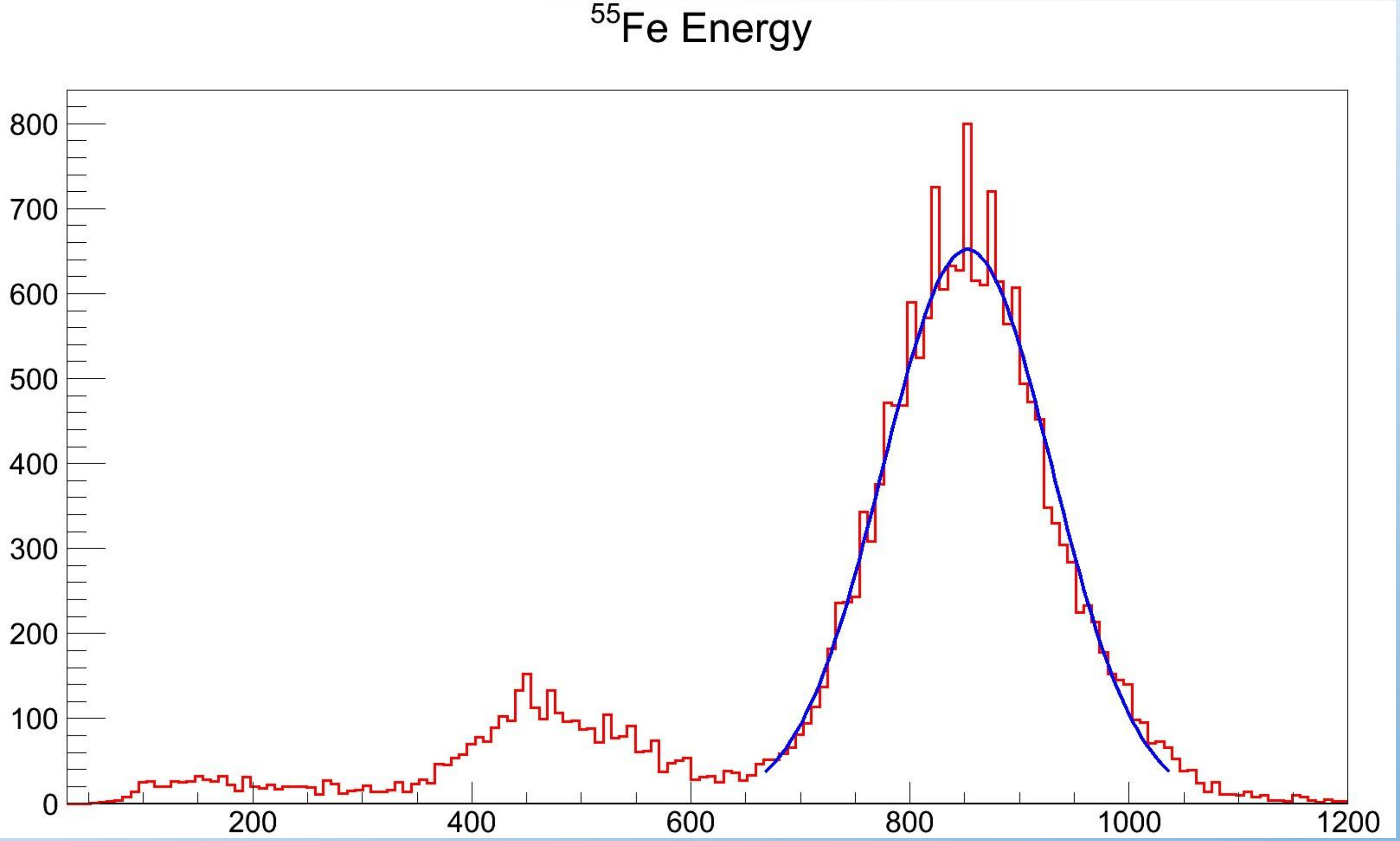
To demonstrate the conclusions, a test was done



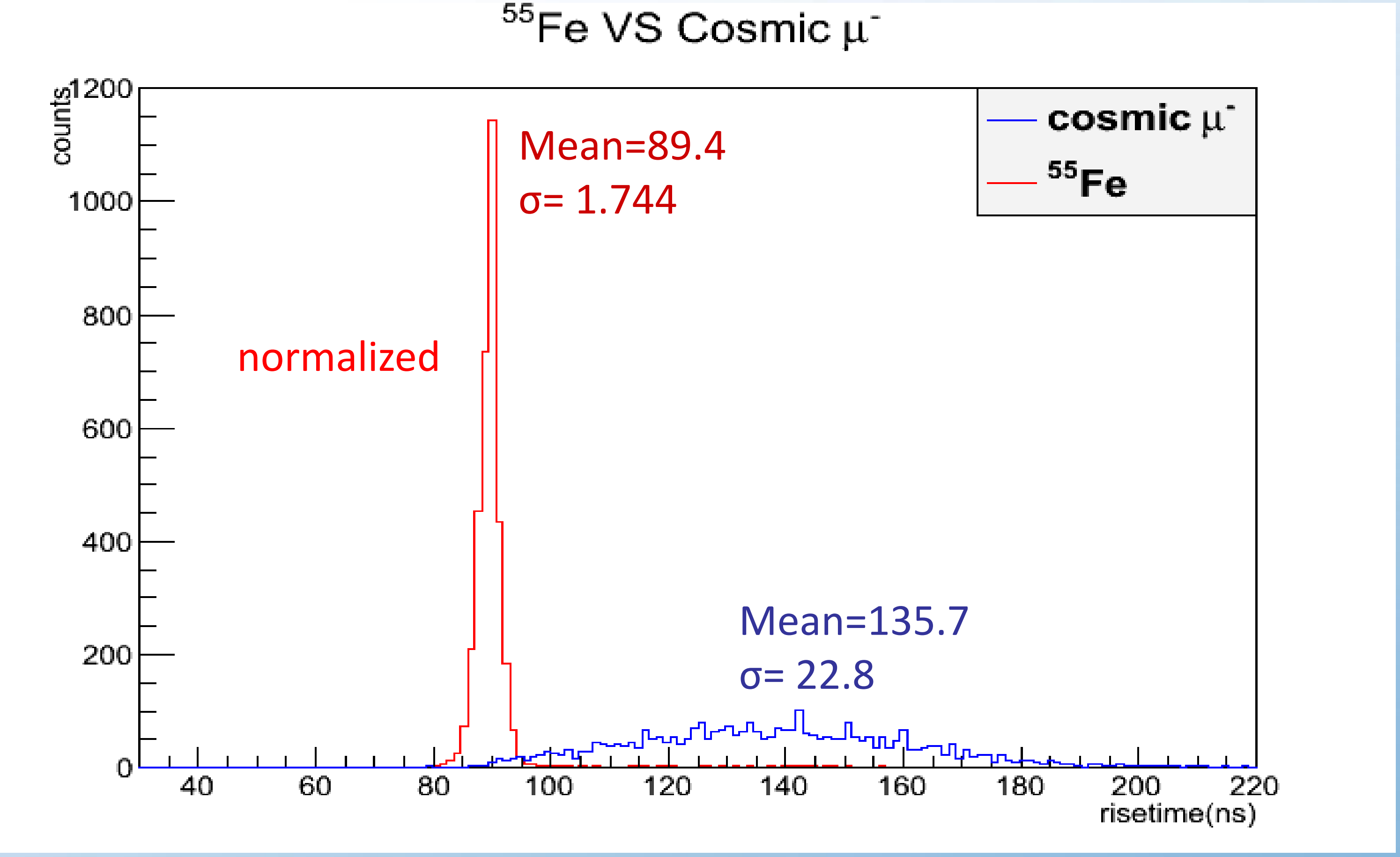


@ IMP

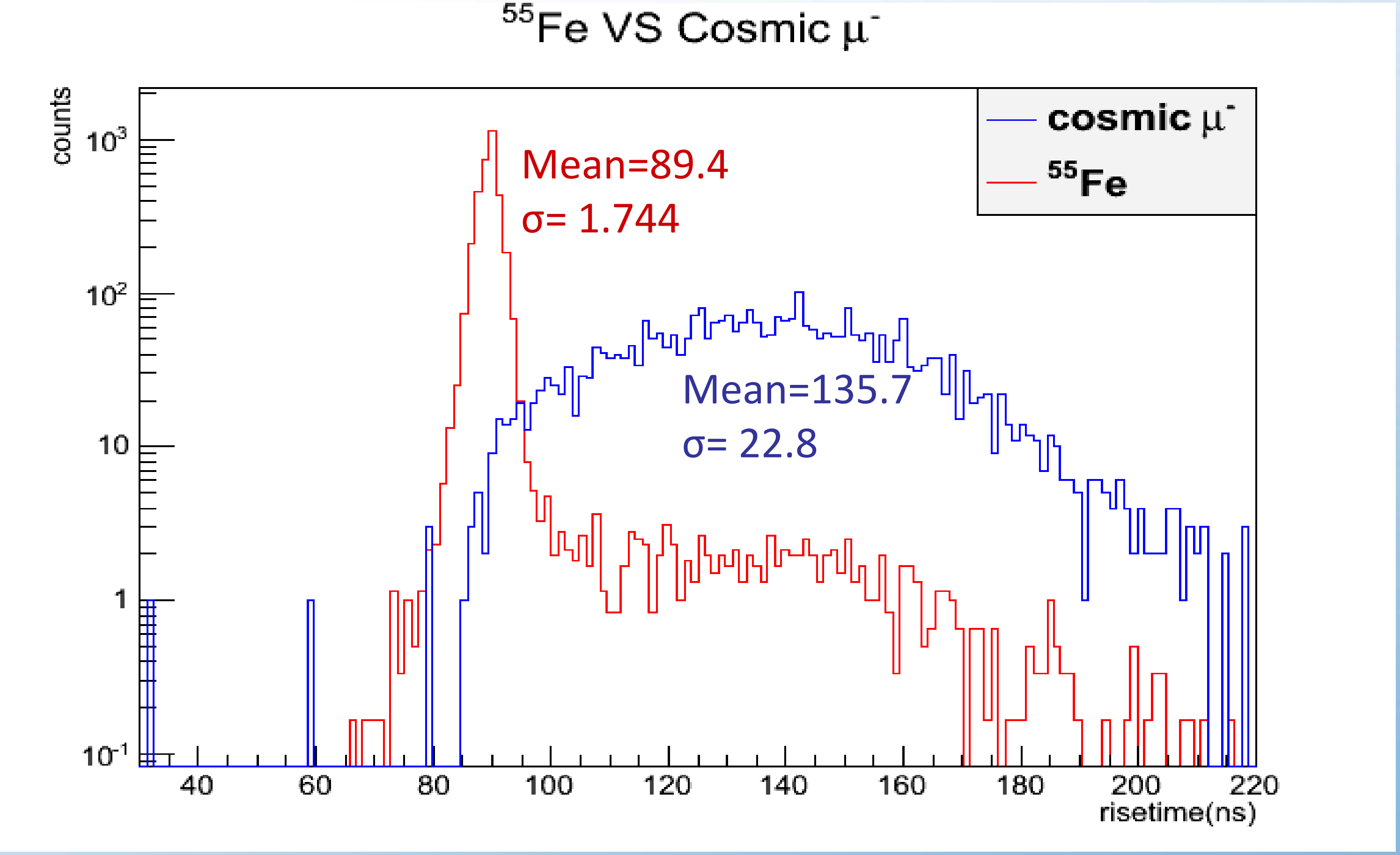
^{55}Fe spectrum, just to check the measured signal



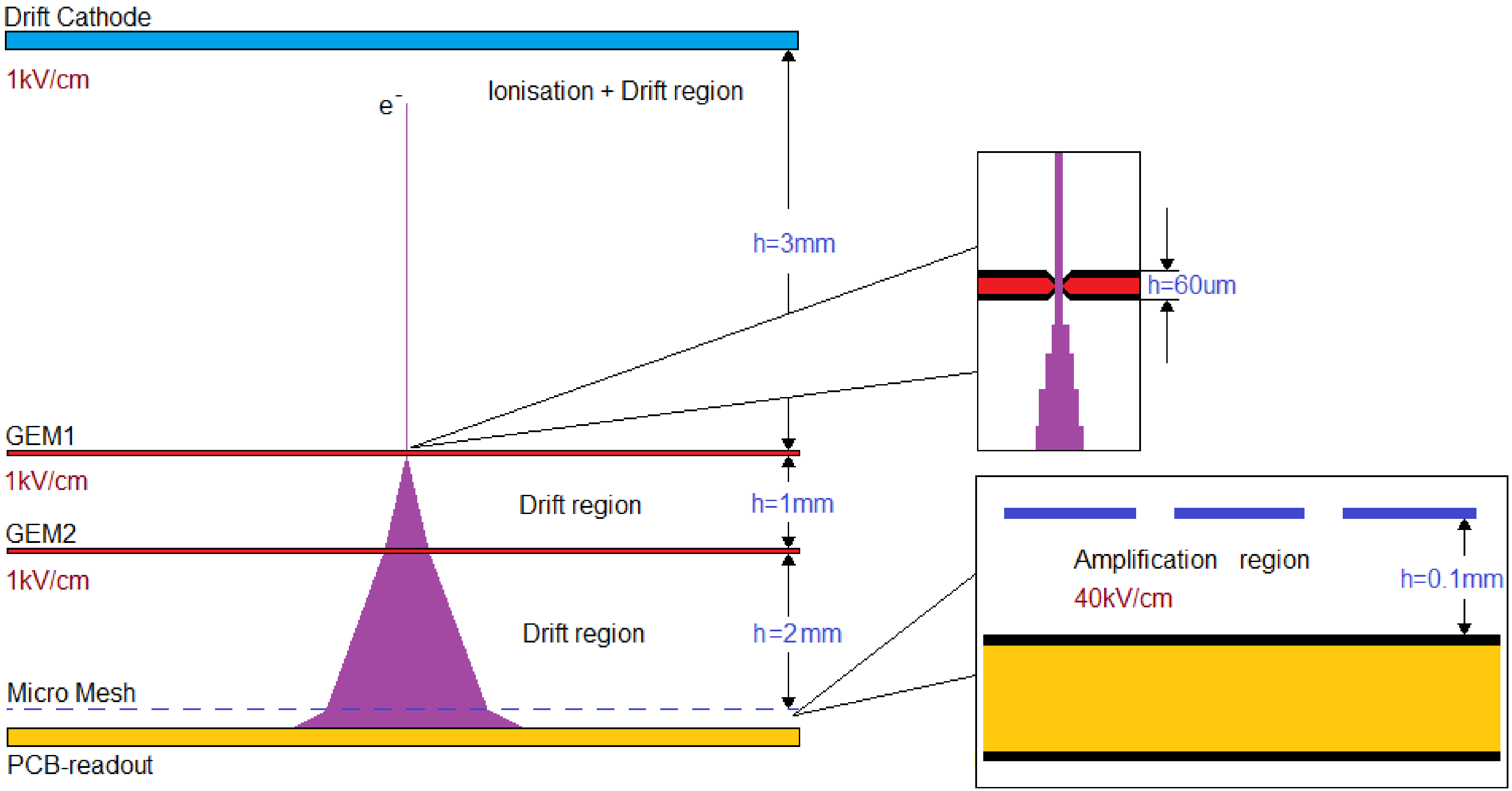
Got the expected result



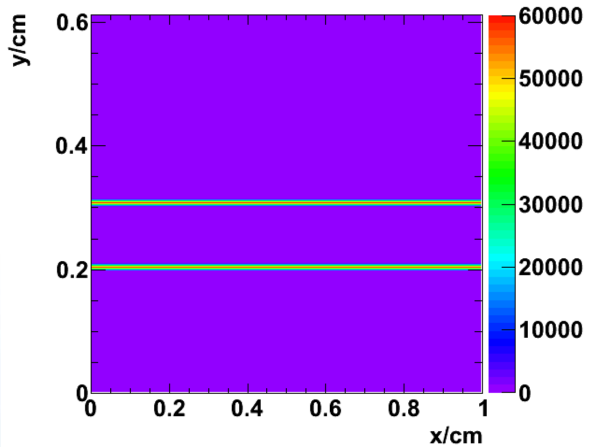
Got the expected result, but also issues

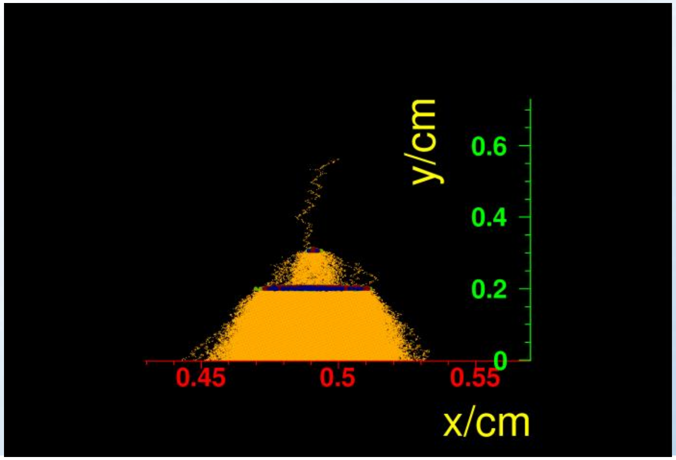


New version of the detector

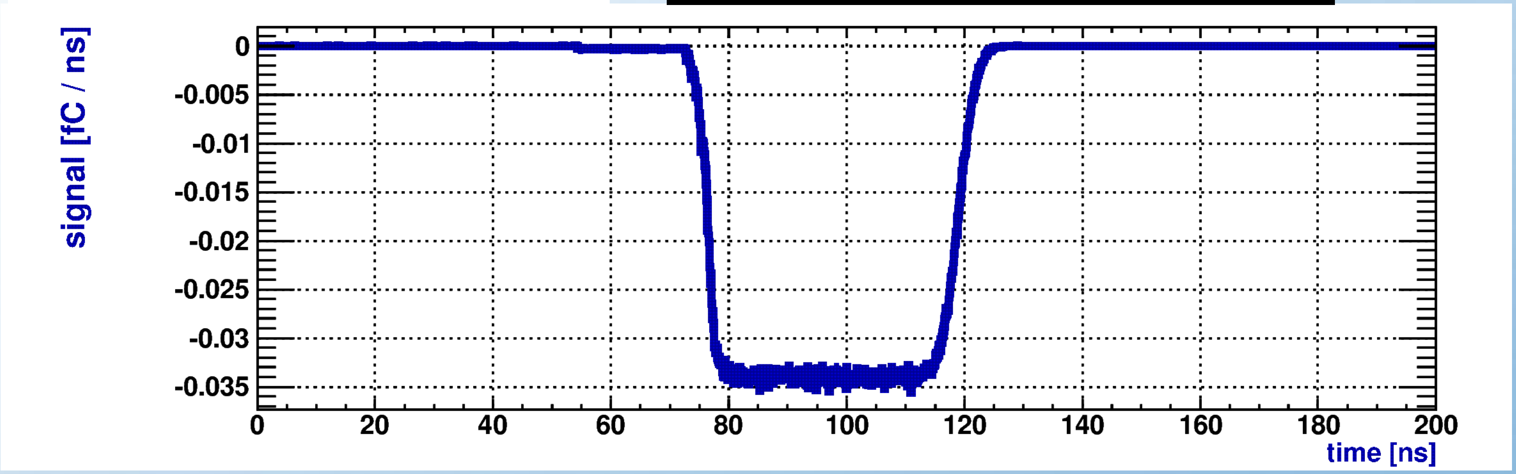


Garfield++ simulation of the double GEM (as a reference)

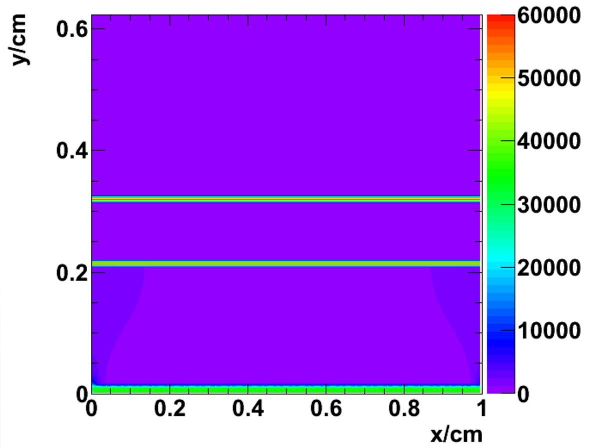


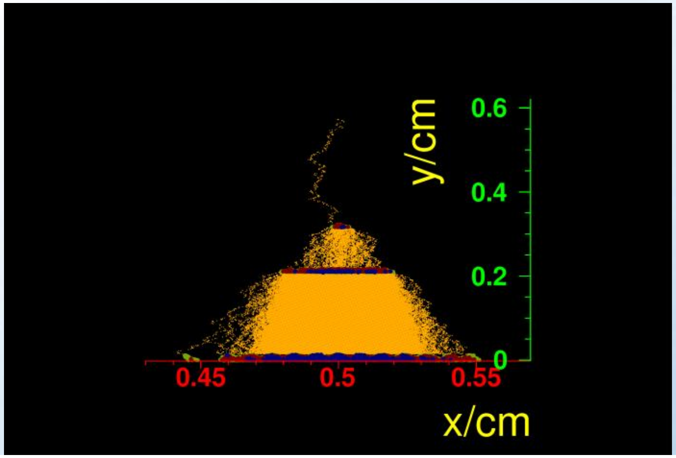


E_{drift}=1kV/cm
E_{Gem}=58.33kV/cm
gain=9032

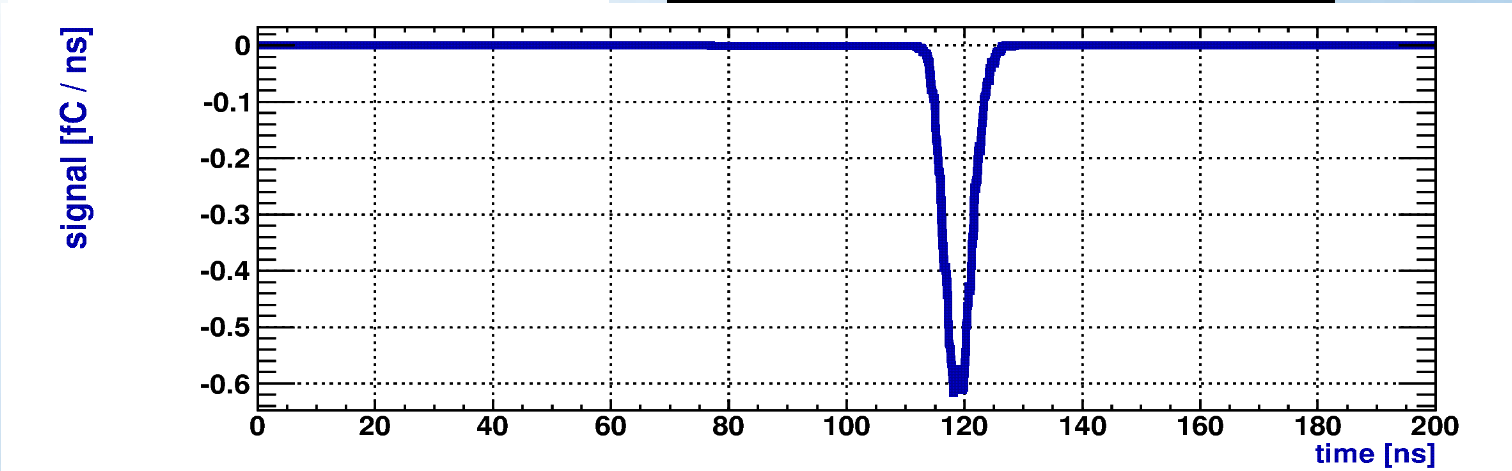


Garfield++ simulation of the double GEM + Mesh

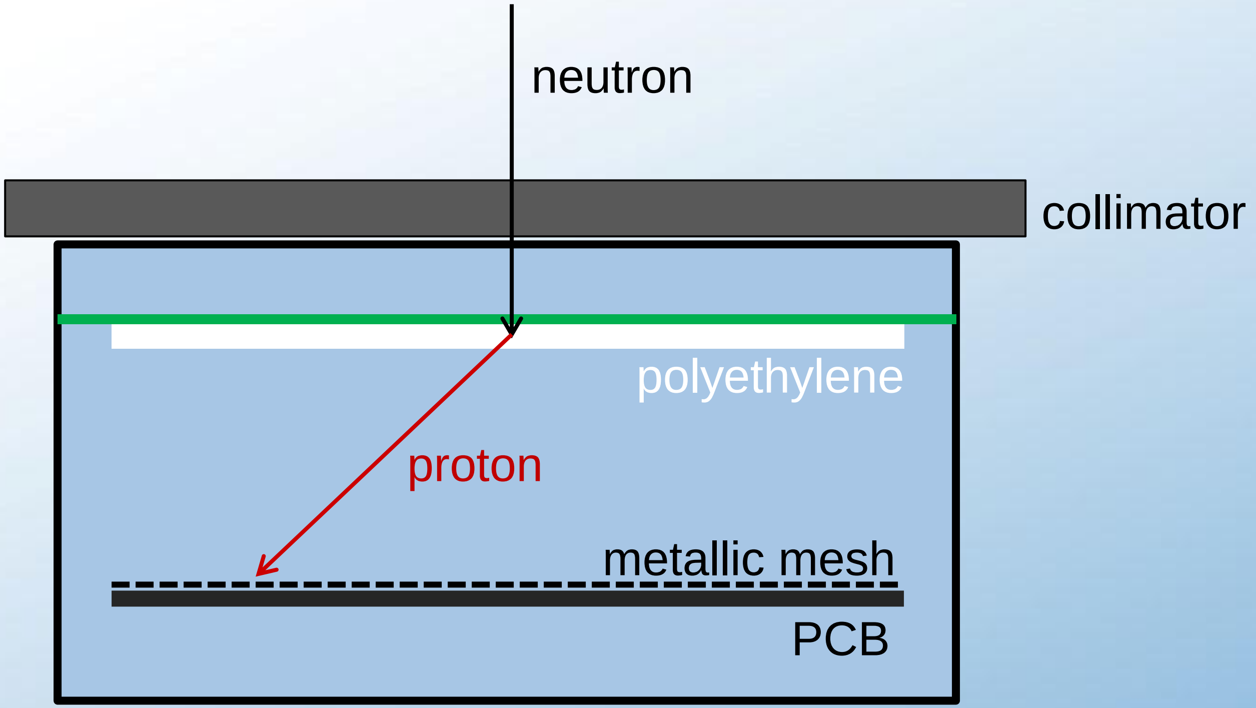




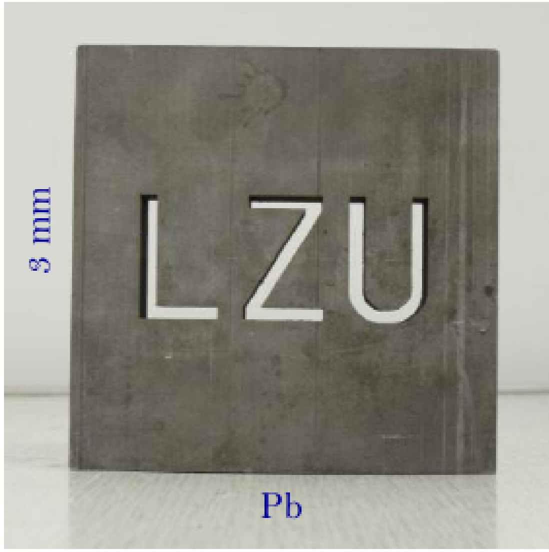
E_{drift}=1kV/cm
E_{Gem}=58.33kV/cm
E_{amp}=40kV/cm
gain=68930



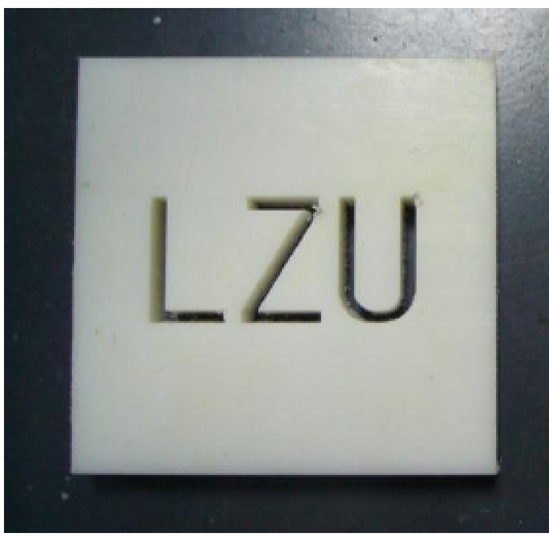
Schematic view of fast neutron imaging



厚度: 17 mm

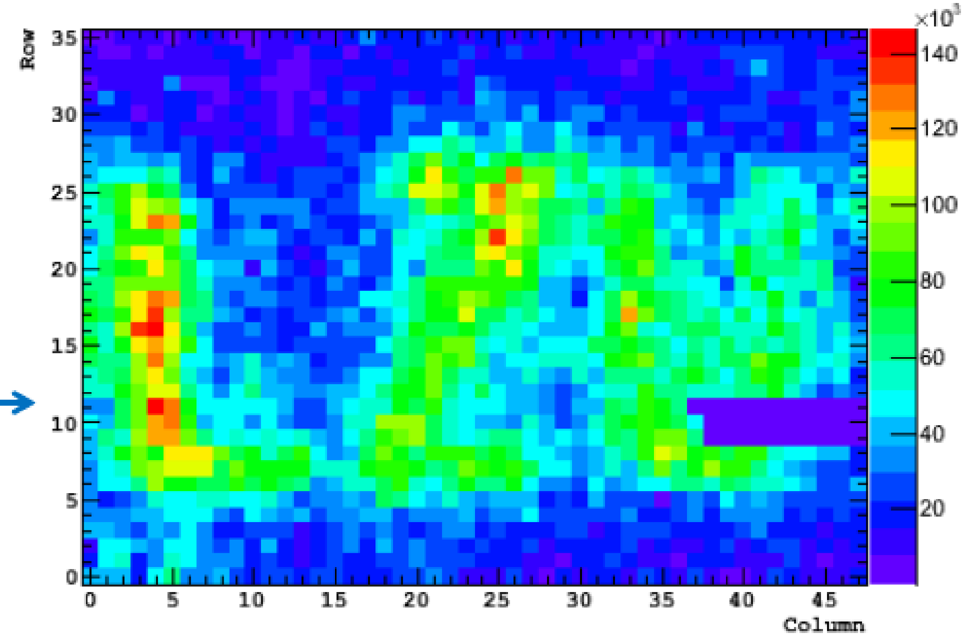


+



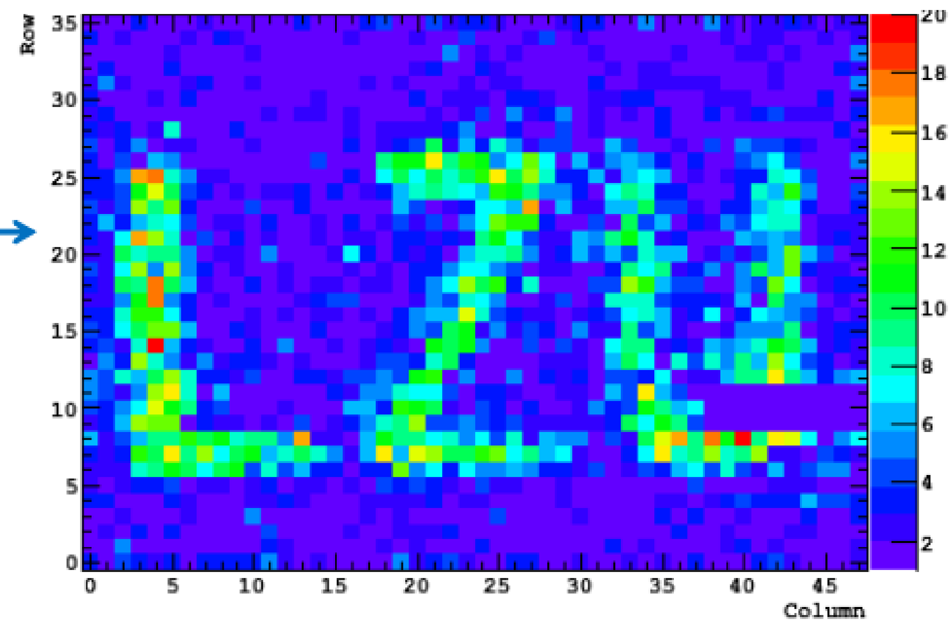
聚乙烯

Charge signal integration



Imaging

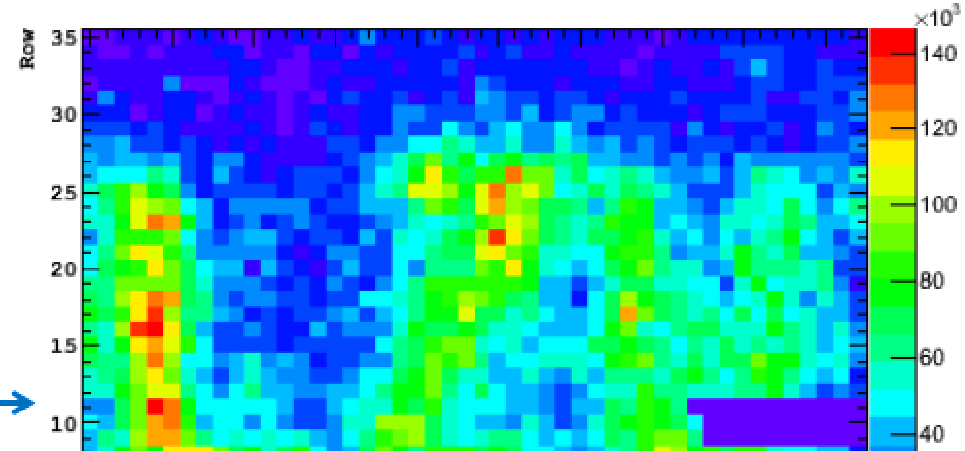
Cut in time and charge



厚度: 17 mm

3 mm

Charge signal integration



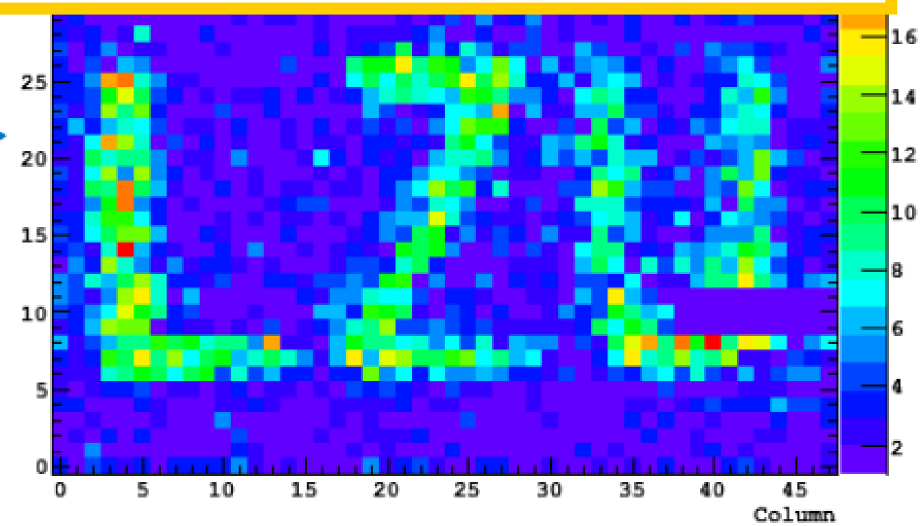
Challenge of DAQ for offline analysis (18×10 cm)

8(bit)×50MHz×1700(channel) = 79.162 GB/s

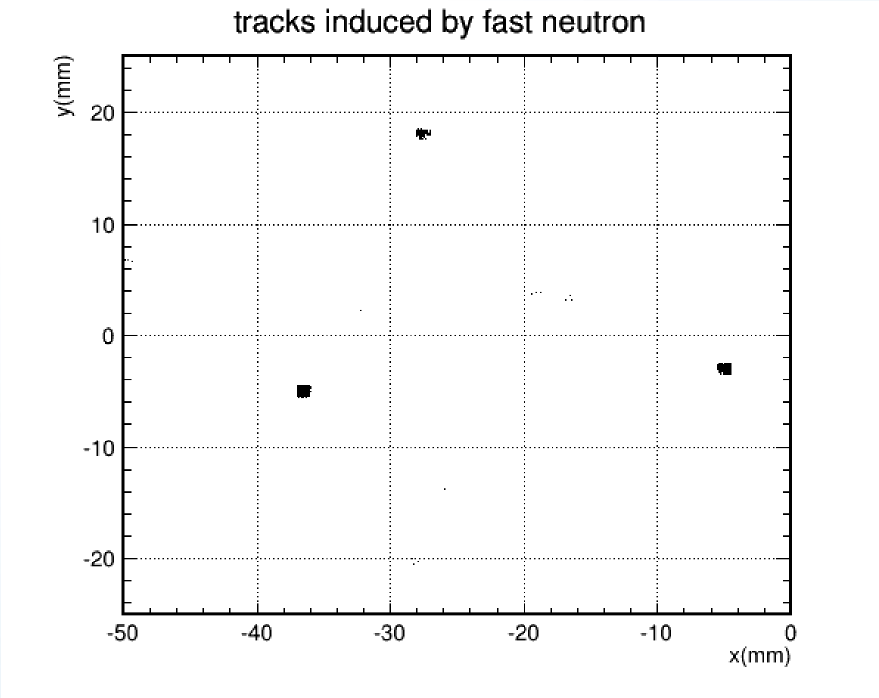
聚乙烯

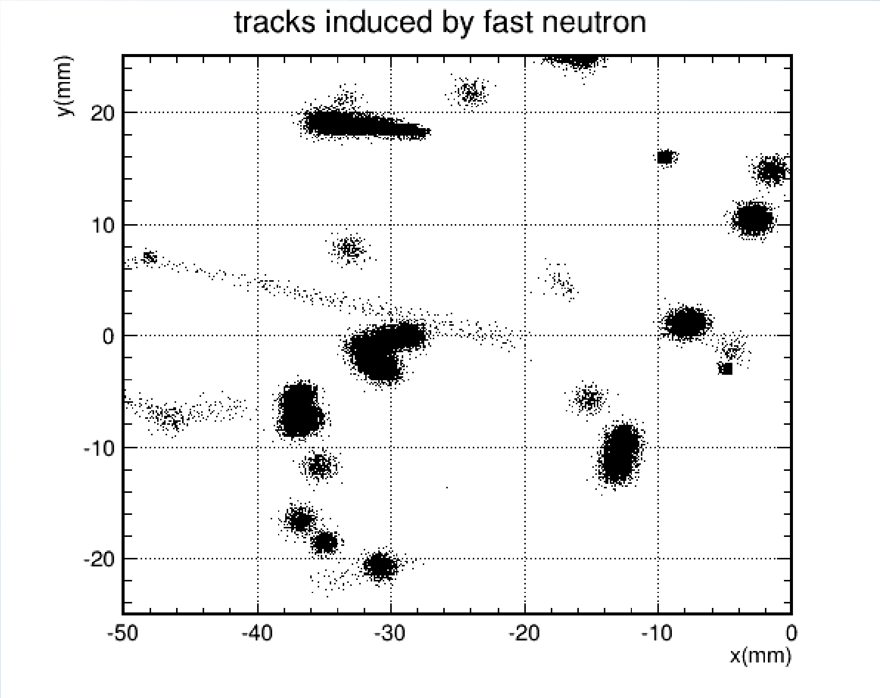
Imaging

Cut in time and charge



Signals collected on the PCB plane

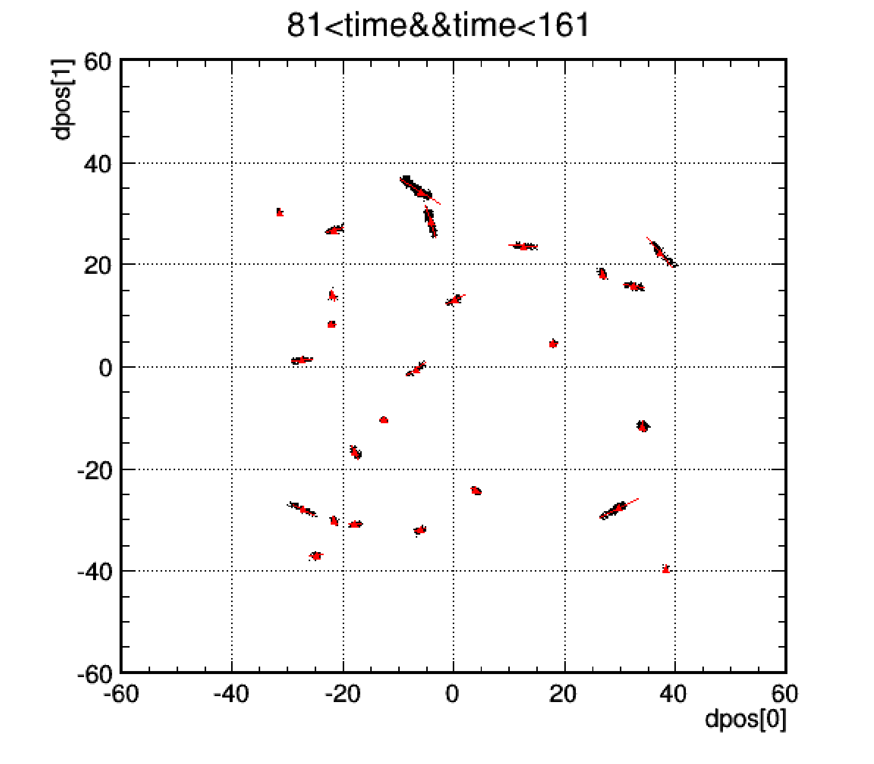


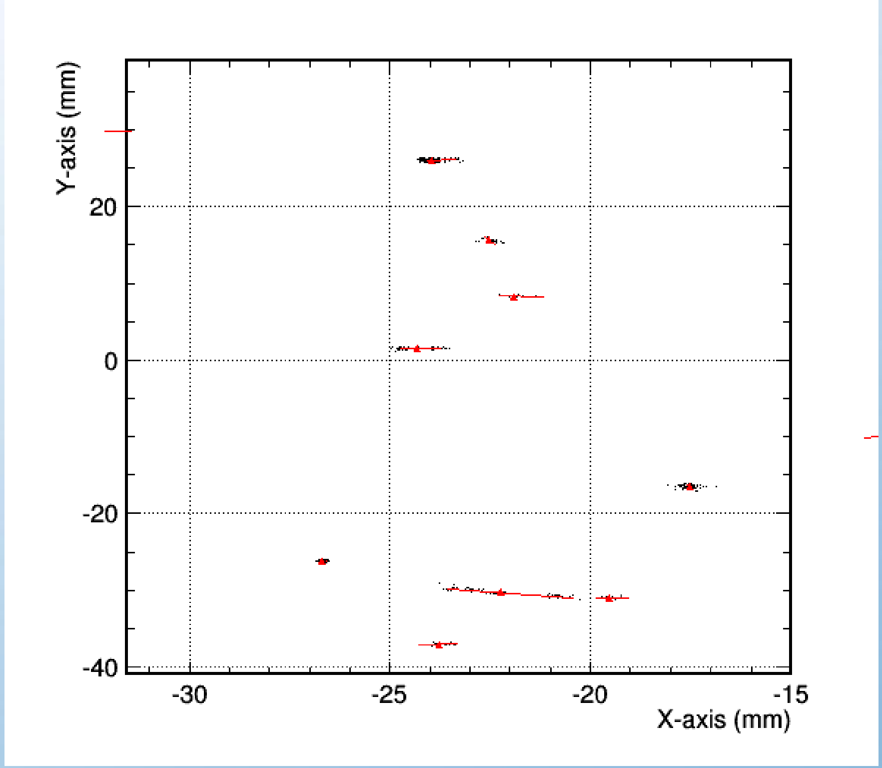


Steps of online track reconstruction

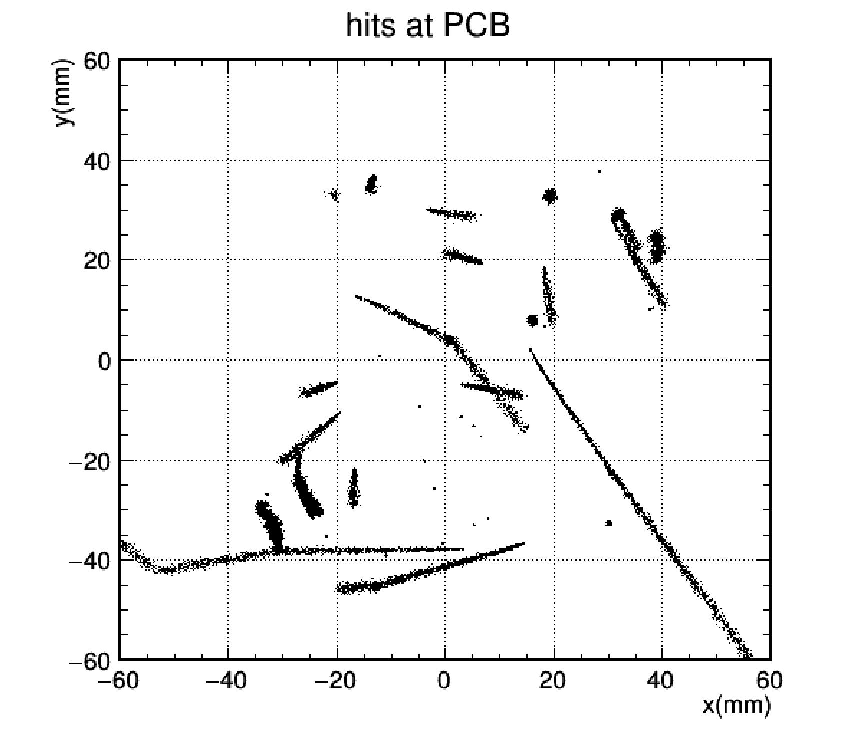
- Divide signals according time —— time slide
  - Segmentation in readout plane —— cut on signal amplitude
  - Combine adjacent segment —— identify clusters of hits
- Process multi time slides
  - Combine adjacent time slides —— distinguish if signal continues
  - Integrate multi time slides —— identify the start and end of a signal

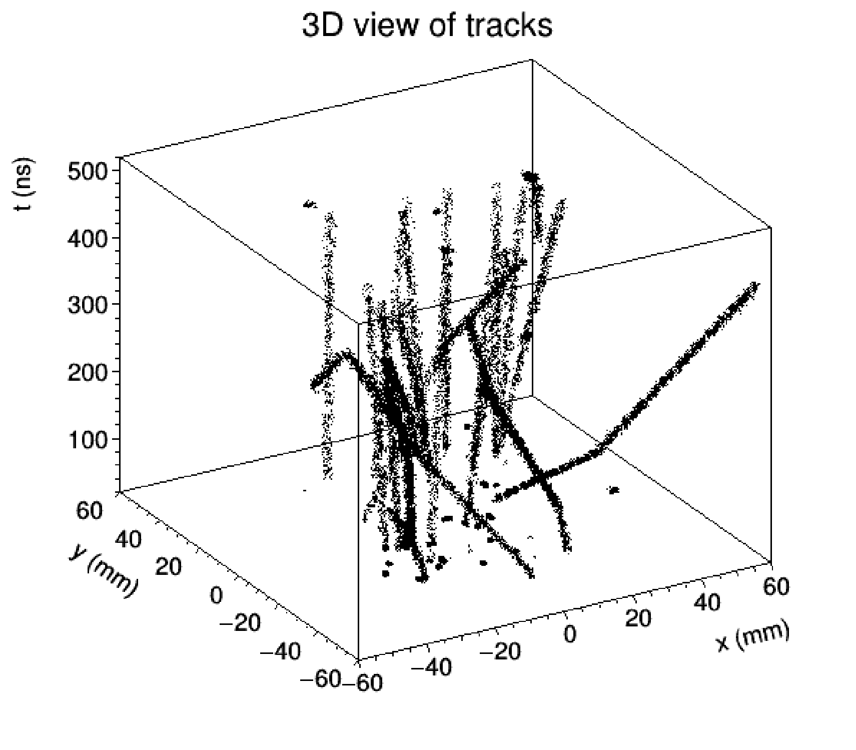
Forming hit clusters in one time slide



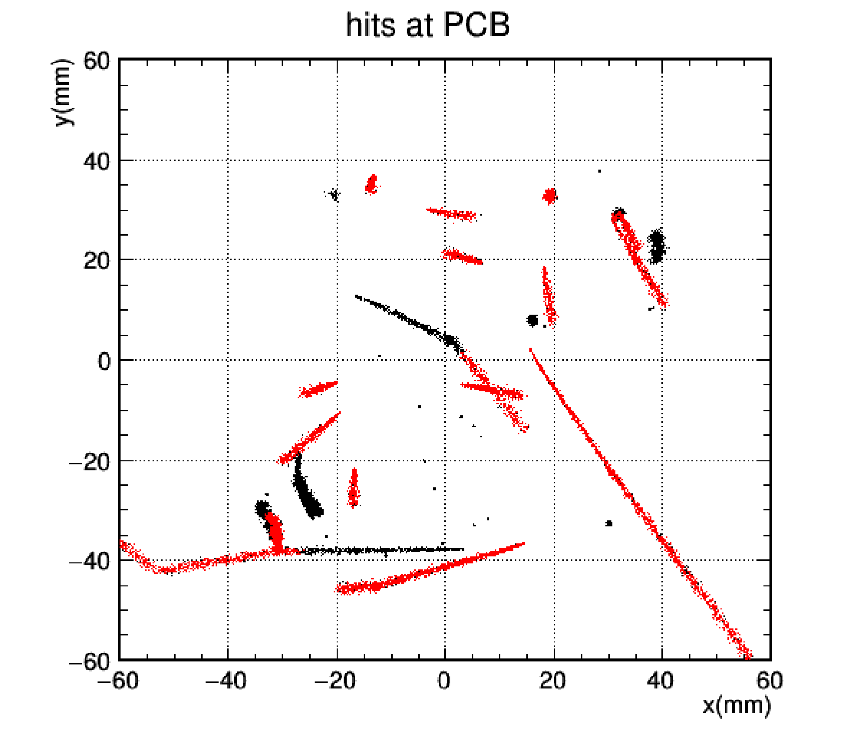


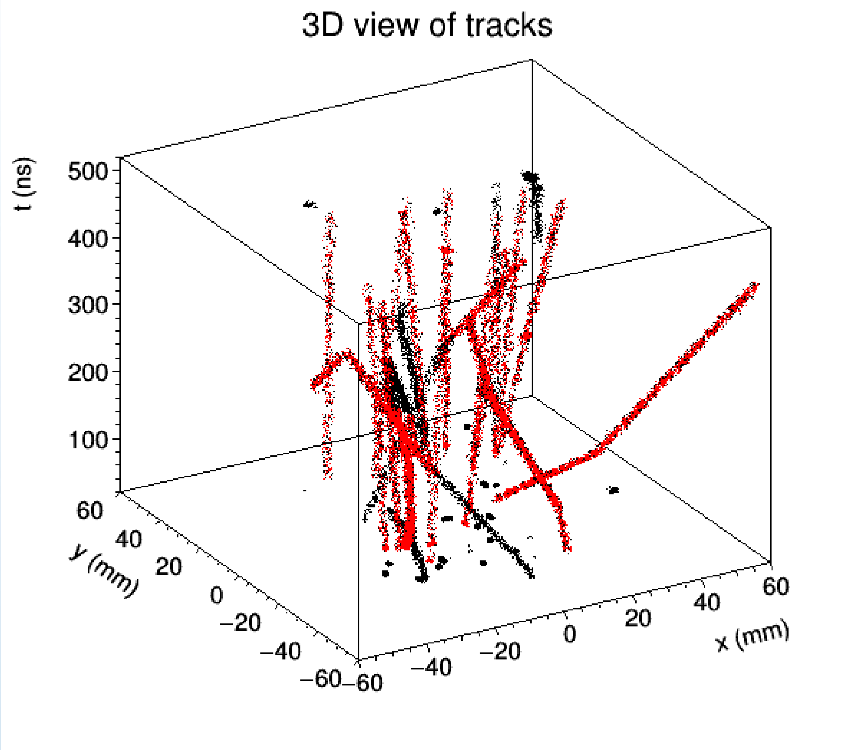
Combine few time slides, get the complete tracks



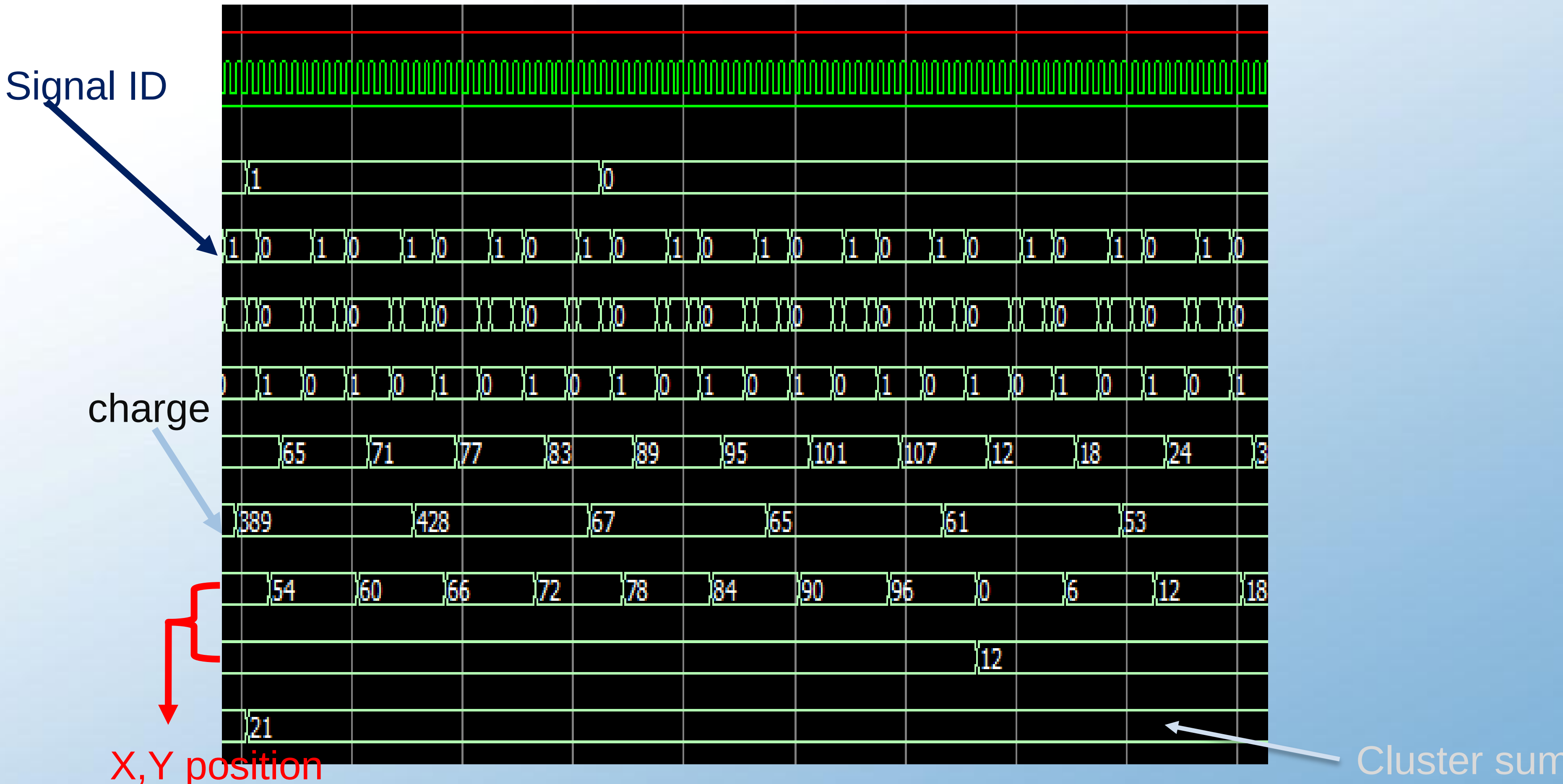


Identify the tracks

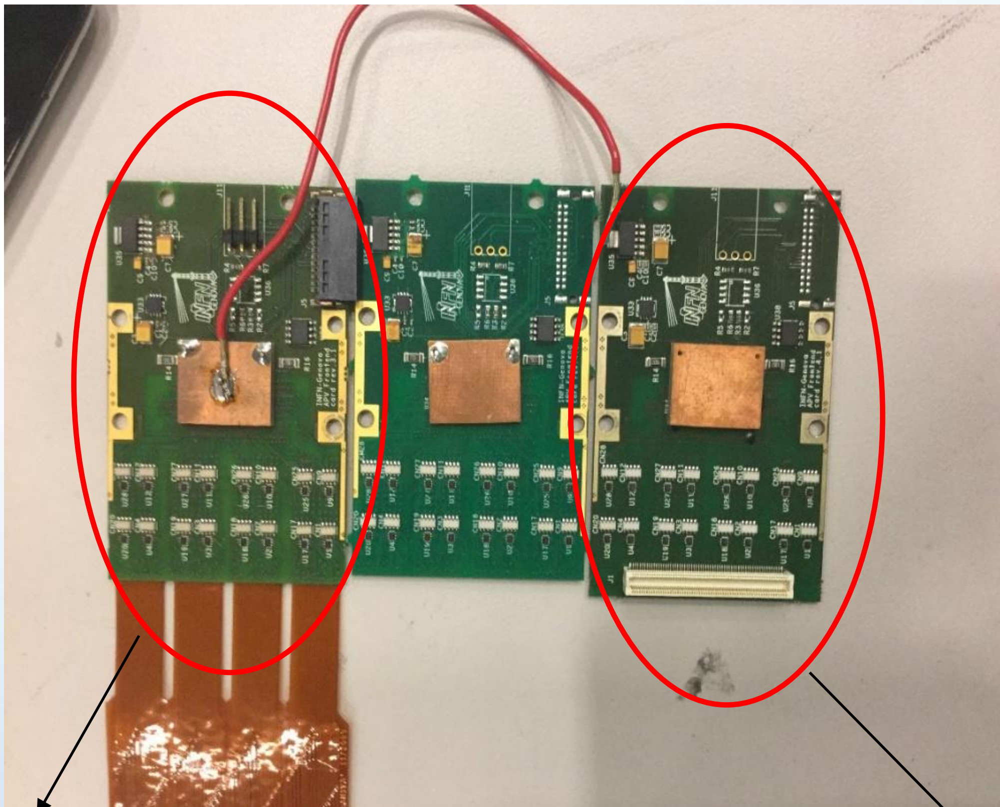




Simulation with Quartus II (FPGA development)



Participate the update of APV25 readout panel



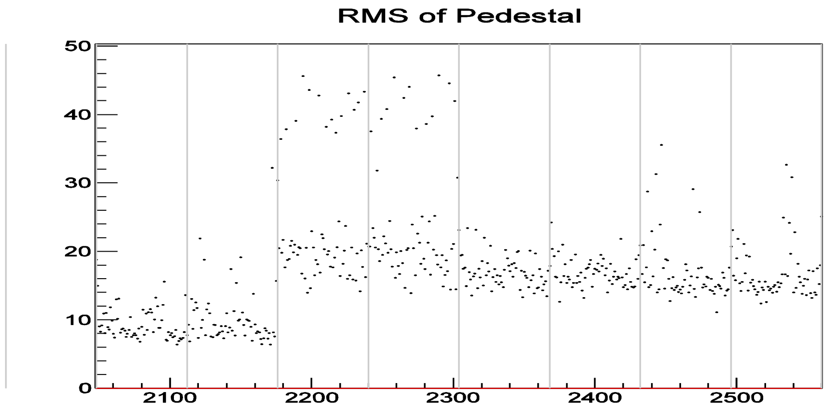
old

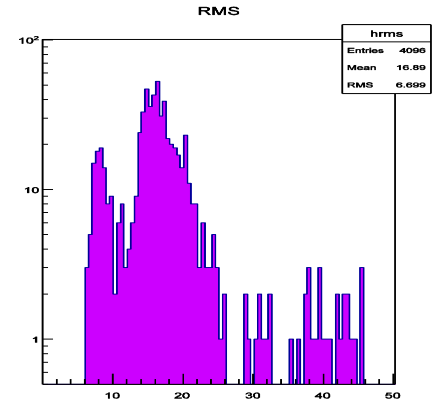
new

@ JLab

Improved signal/noise ratio

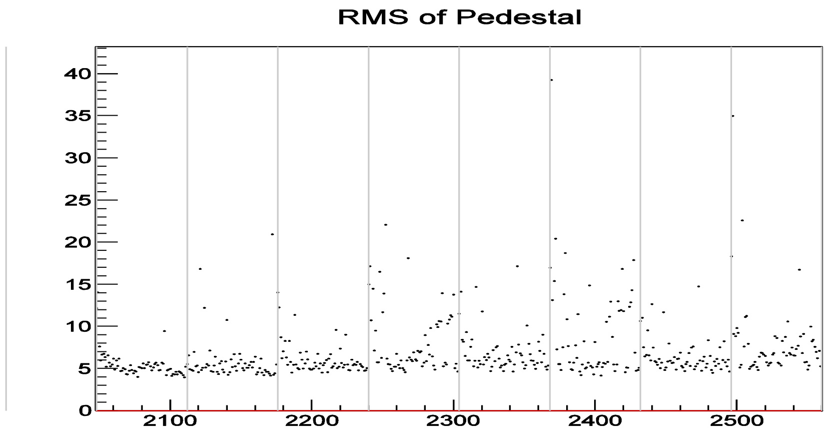
@ JLab

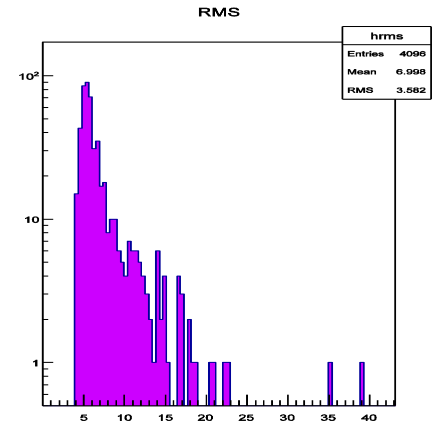




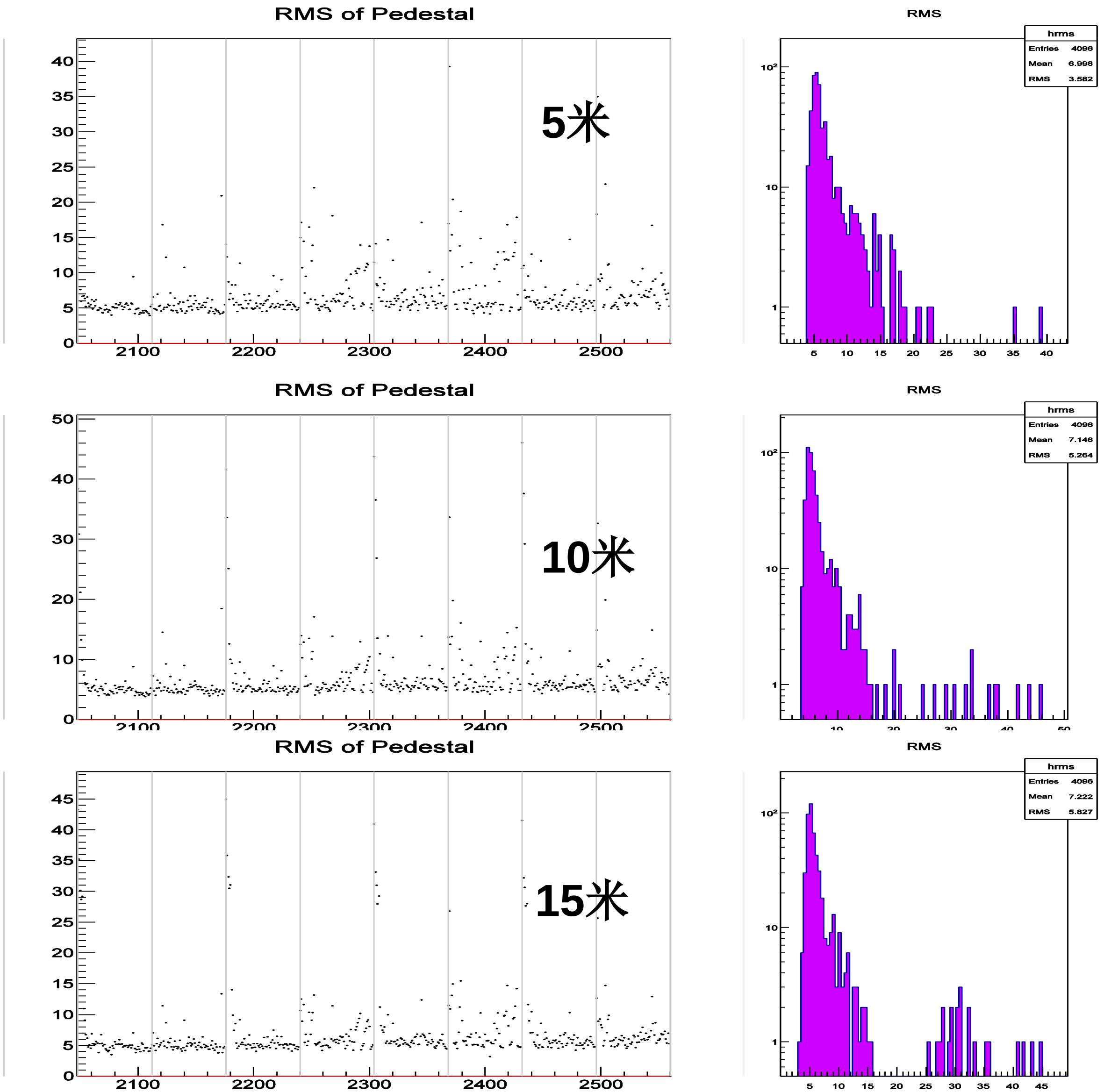
Old panel, RMS of noise ~16.89

Reduced ~60% noise





New panel, RMS of noise ~6.99

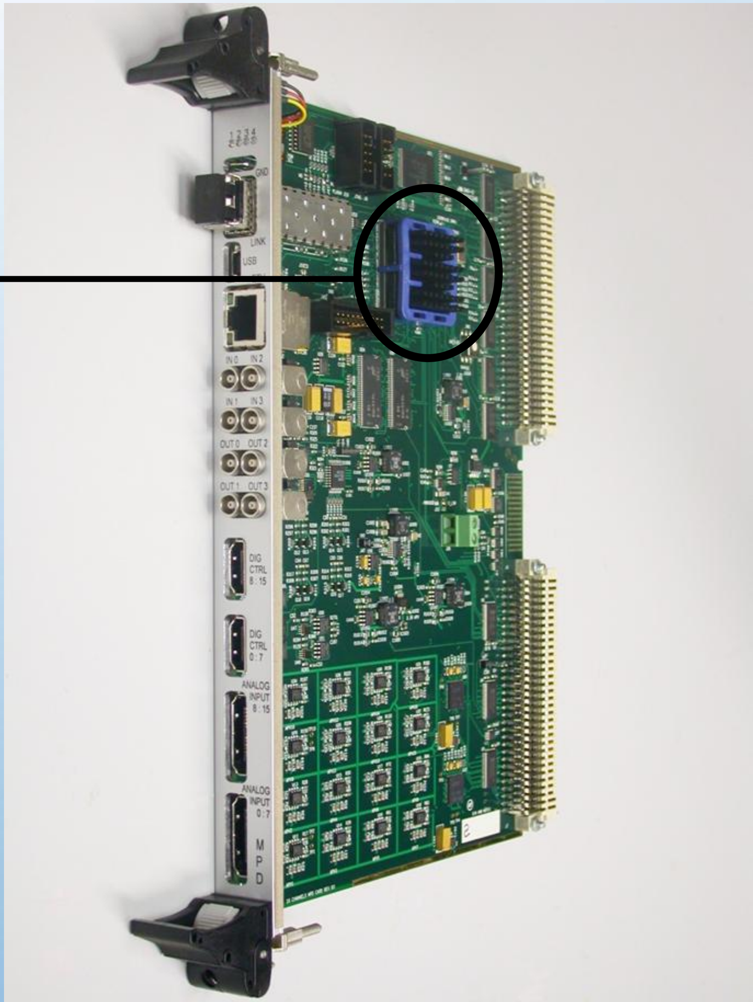


Observed an increase of noise with longer cable

Help from INFN

```
The fitting results without filters (actual version) are:
; Logic utilization                   ; 56 %
;     Combinational ALUTs             ; 21,247 / 48,080 ( 44 % )
;     Dedicated logic registers       ; 13,382 / 48,080 ( 28 % )
; Total registers                     ; 13661
; Total pins                          ; 312 / 395 ( 79 % )
; Total block memory bits             ; 1,808,252 / 2,528,640 ( 72 % )
; DSP block 9-bit elements            ; 0 / 256 ( 0 % )
; Total GXB Receiver Channels         ; 1 / 8 ( 13 % )
; Total GXB Transmitter Channels      ; 1 / 8 ( 13 % )
; Total PLLs                          ; 3 / 4 ( 75 % )
; Total DLLs                          ; 1 / 2 ( 50 % )

And with the filter we get:
; Logic utilization                   ; 58 %
;     Combinational ALUTs             ; 21,844 / 48,080 ( 45 % )
;     Dedicated logic registers       ; 13,584 / 48,080 ( 28 % )
; Total registers                     ; 13863
; Total pins                          ; 312 / 395 ( 79 % )
; Total block memory bits             ; 1,808,252 / 2,528,640 ( 72 % )
; DSP block 9-bit elements            ; 256 / 256 ( 100 % )
; Total GXB Receiver Channels         ; 1 / 8 ( 13 % )
; Total GXB Transmitter Channels      ; 1 / 8 ( 13 % )
; Total PLLs                          ; 3 / 4 ( 75 % )
; Total DLLs                          ; 1 / 2 ( 50 % )
```



The 5th CMPGD workshop @ LZU   Jul 23-24, 2015

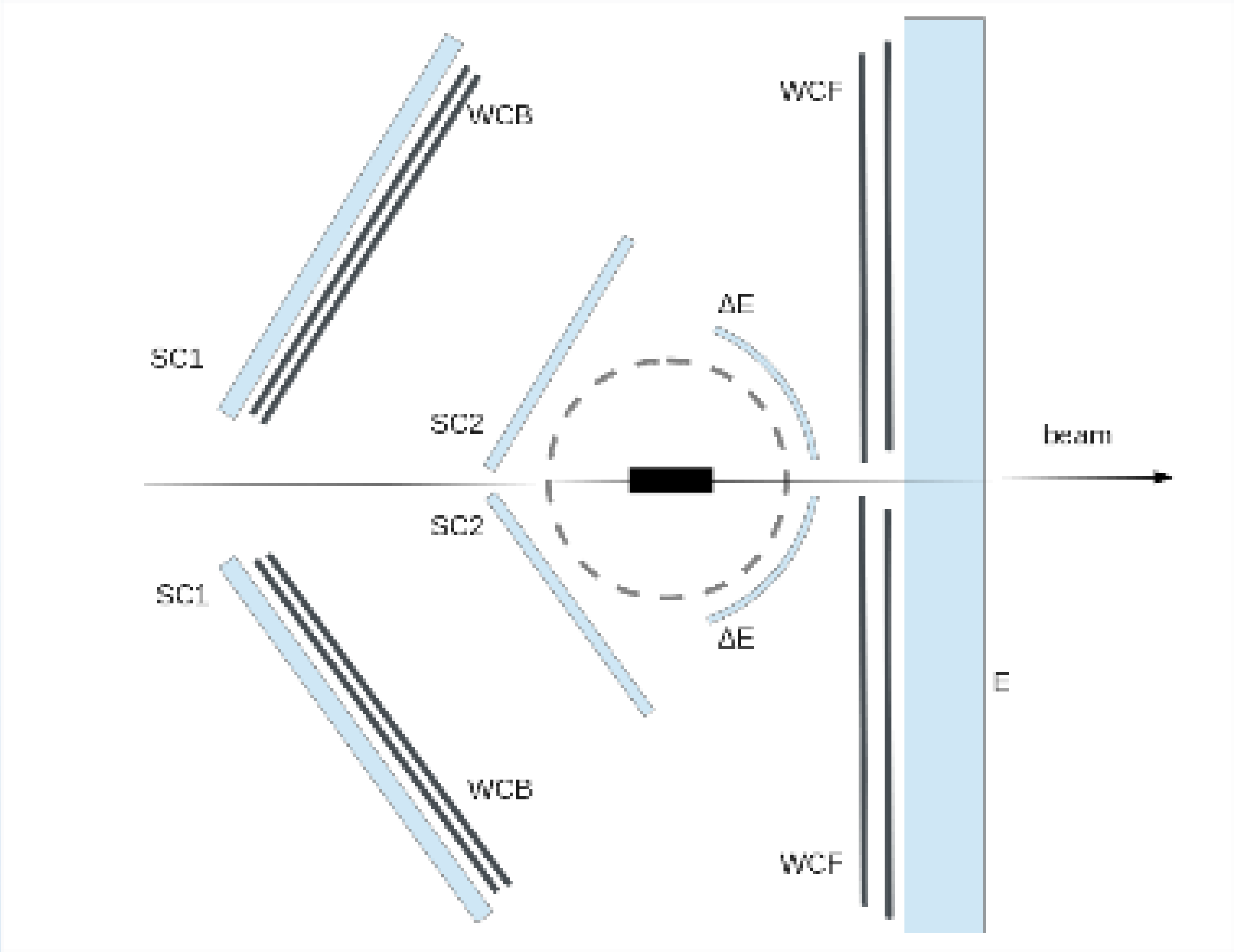
Future plan

- Detector —— build a hybrid MPGD
  - Gain, rising time, spark
- DAQ
  - Simulation + test on develop board
  - Design of the peripheral circuit
- Way of signal readout
  - Position encoding

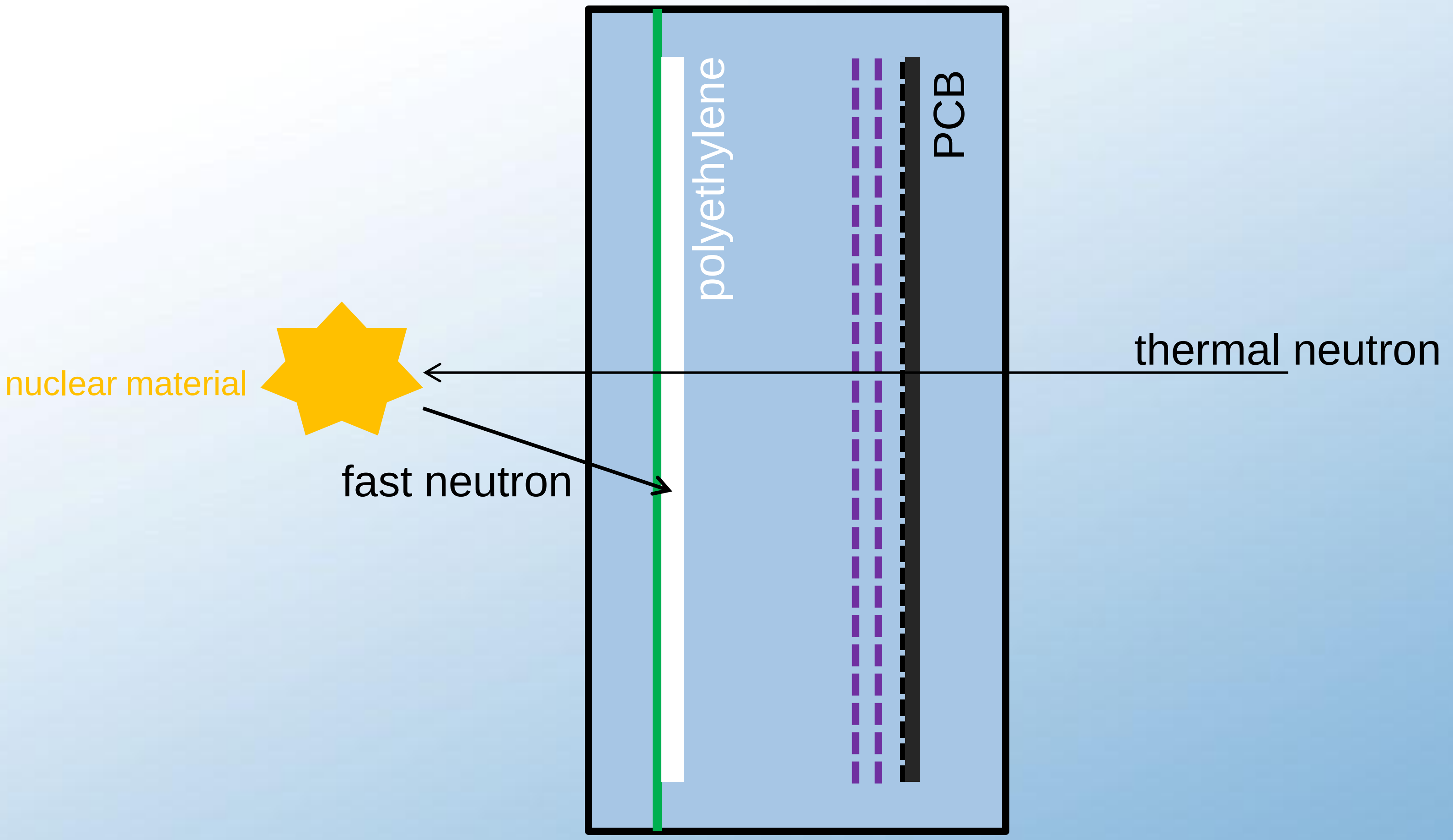
Thanks for your attention

BACKUP

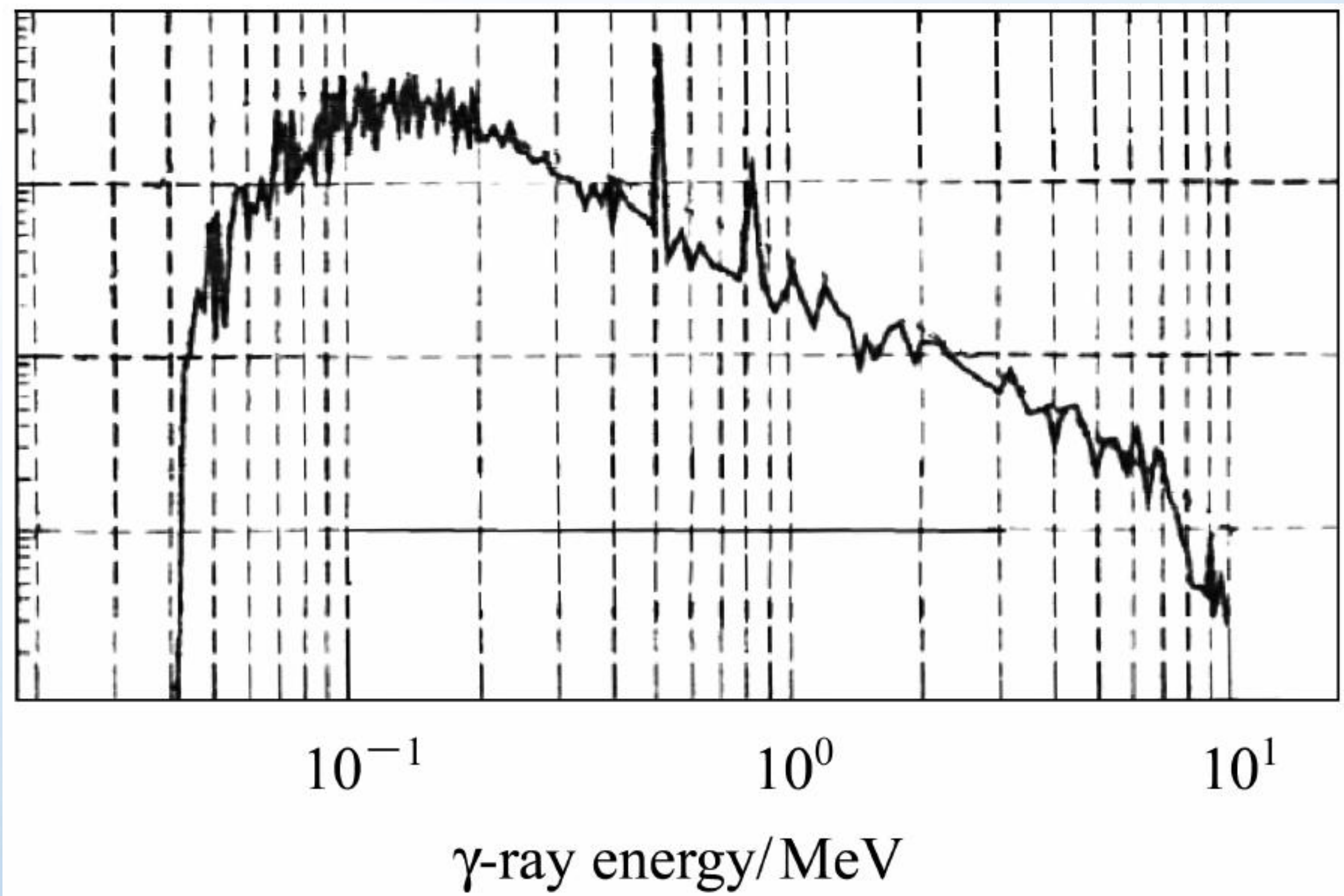
Future application I



Future application II



the γ spectrum



Key parameters in simulation

- material
  - PCB： FR-4(Si、C、H、Br、O) 1.5mm
  - Working gas： Ar(75%)+CO2(25%) drift 2cm
  - mesh: steel 100um thick 40% geometric transmission
  - polythene： 300um thick
- Energy of hot neutron 30keV～70keV
- Energy of fast neutron 0.8～3.3MeV