Total Measurement Calorimetry

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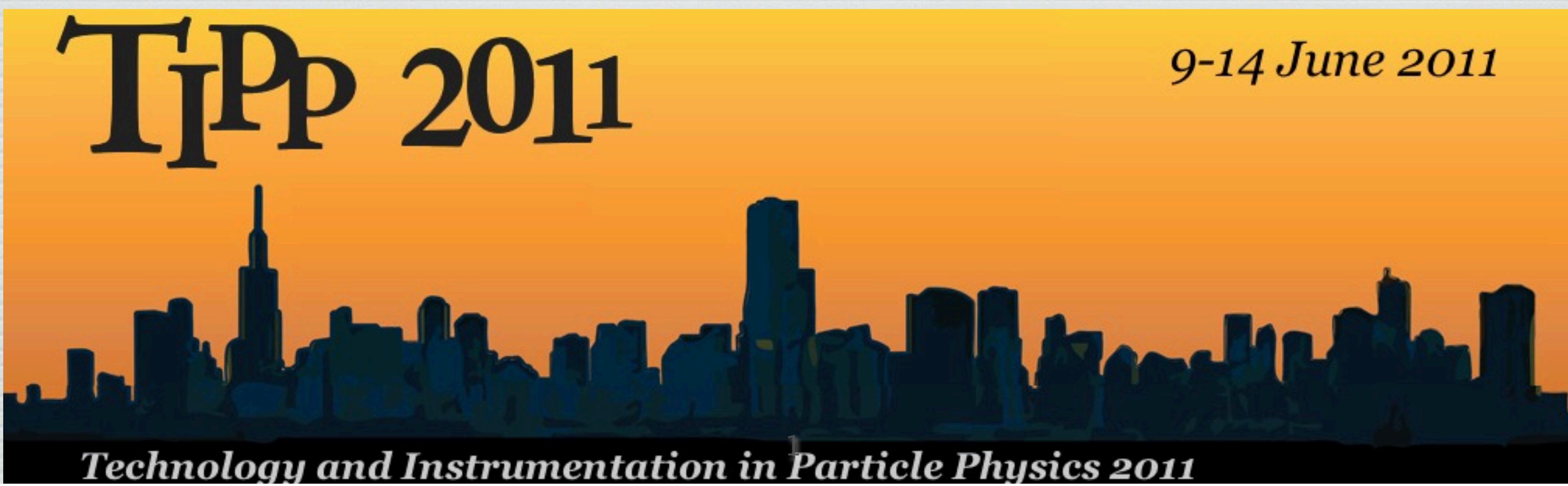
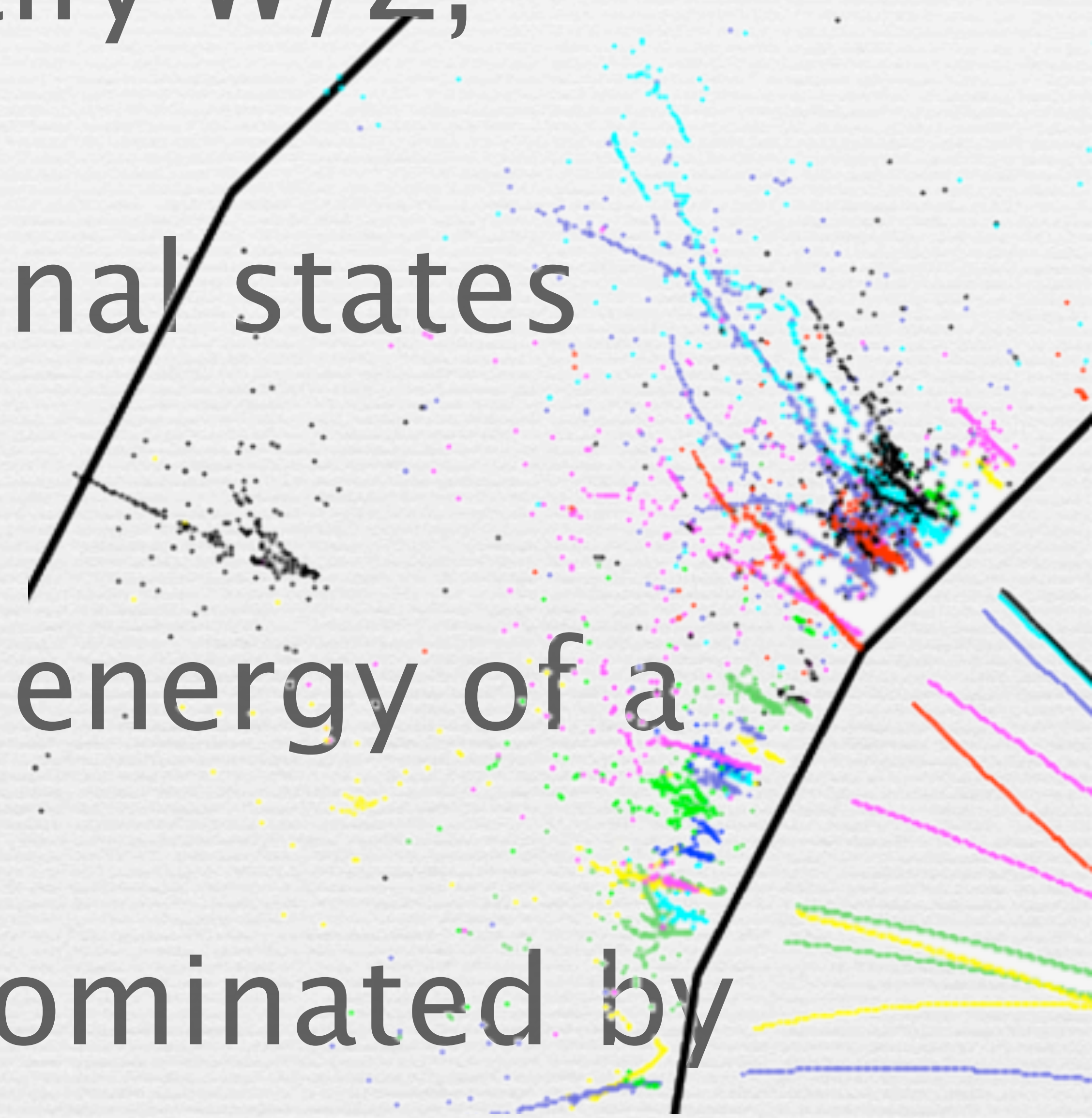


HE collisions

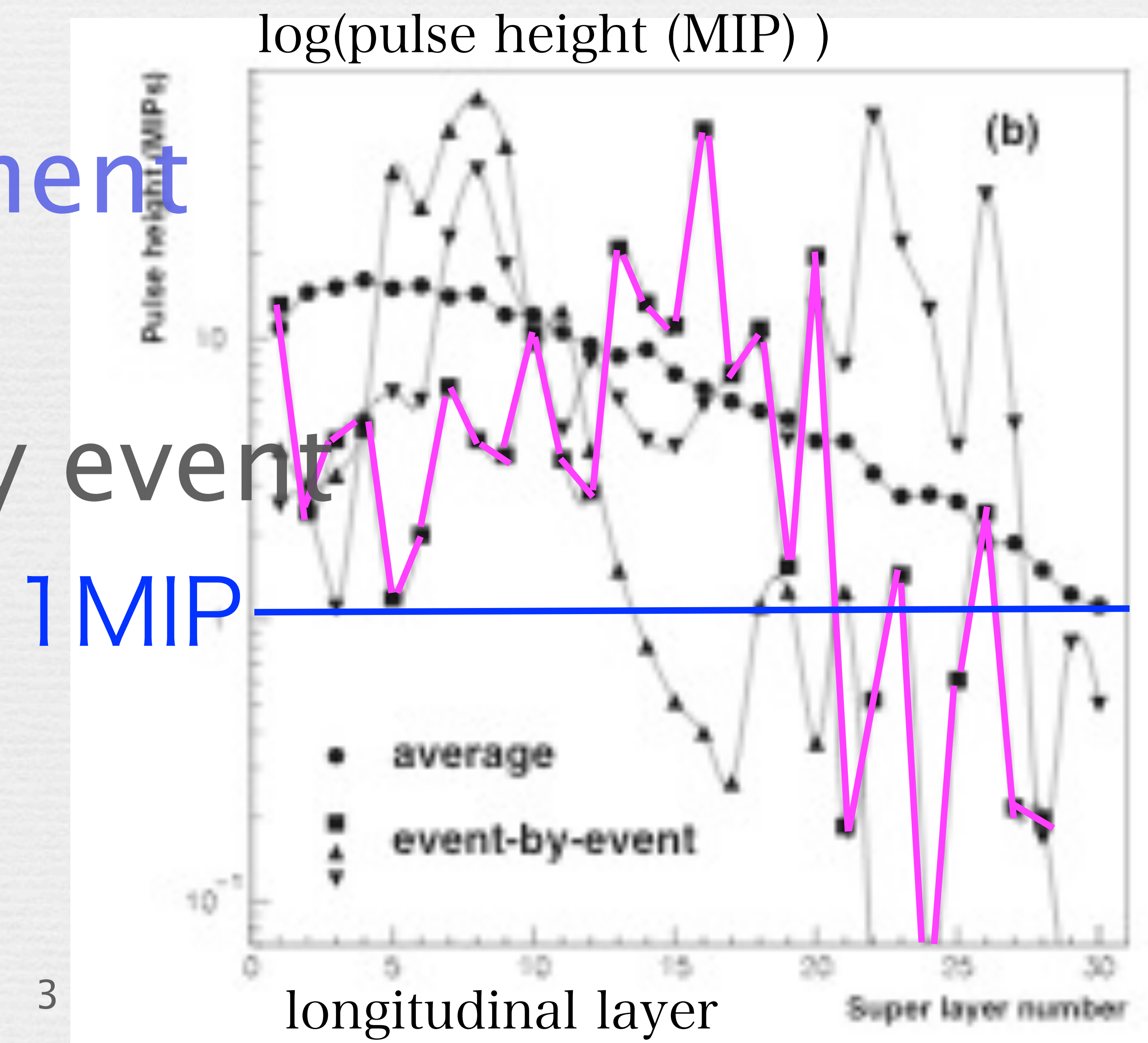
- physics output ~ identify W/Z, top/b, H...
- emerge as multi-JET final states
- tracker : separate JETs

  precise Pt measurement
- calorimeter : measure energy of a JET
  - energy resolution dominated by HCAL performance
  - how to improve HCAL



HE Hadron interaction

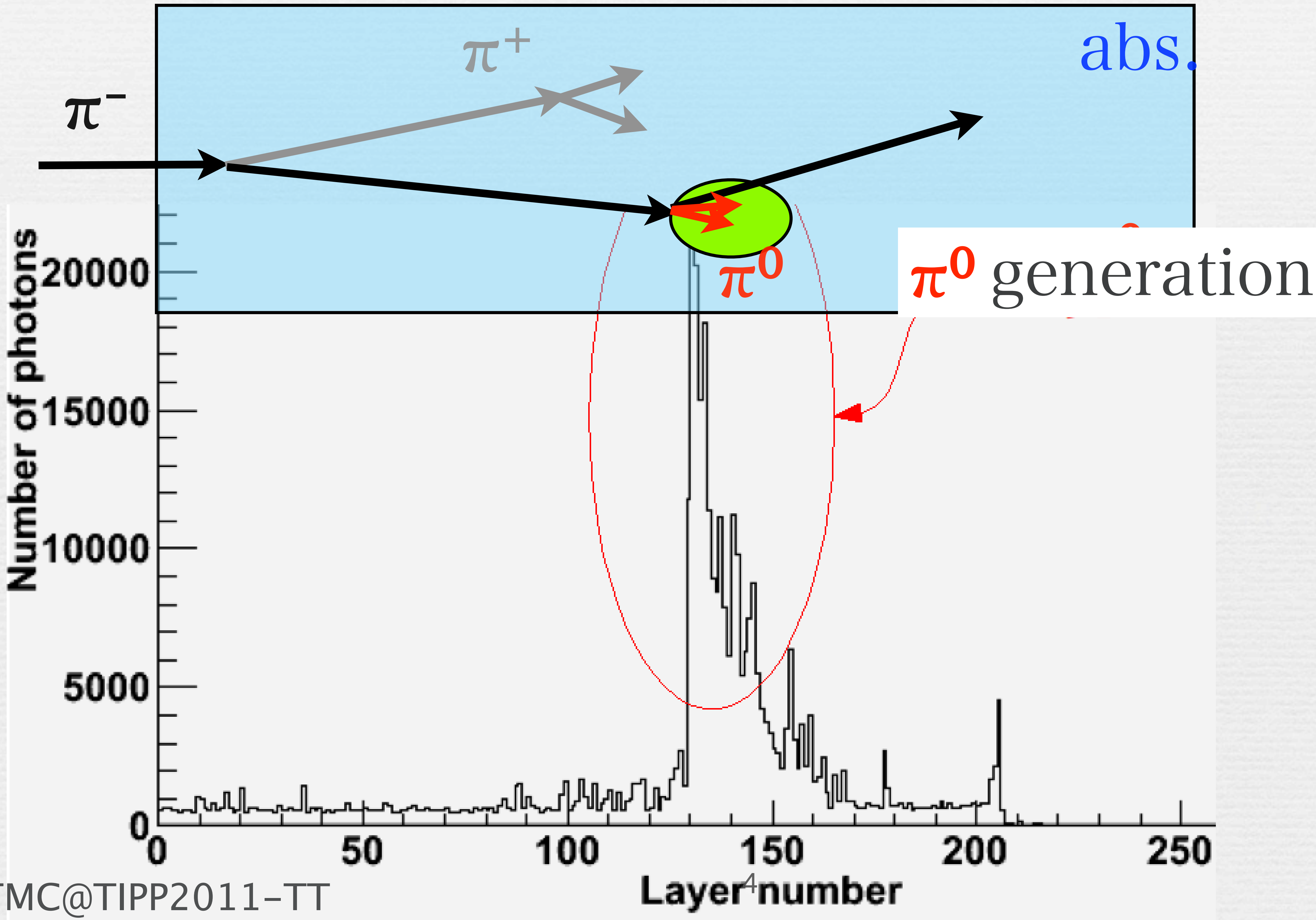
- HCAL : hadronic interactions as cascade
- hadronic fragments consist of mostly π^{+-} & π^0
- energy measurement
  $E\pi^0 >> E\pi^{+-}$
- fluctuate event by event
- due to prod. π^0



3 events of 4GeV pions in
30 superlayers
(Lead 8mm/scint.2mm)x4

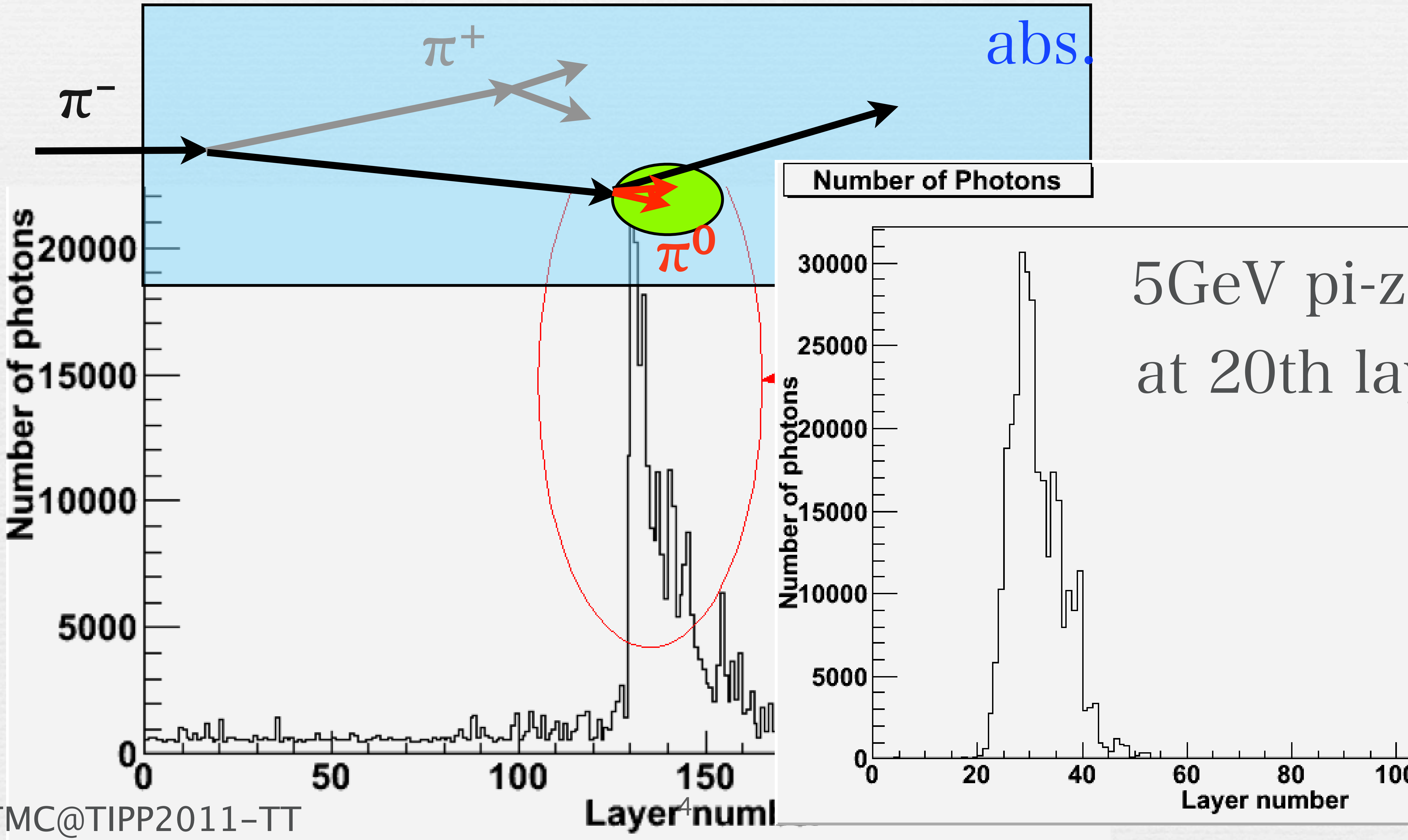
a hadron event

in fine longitudinal segmentation



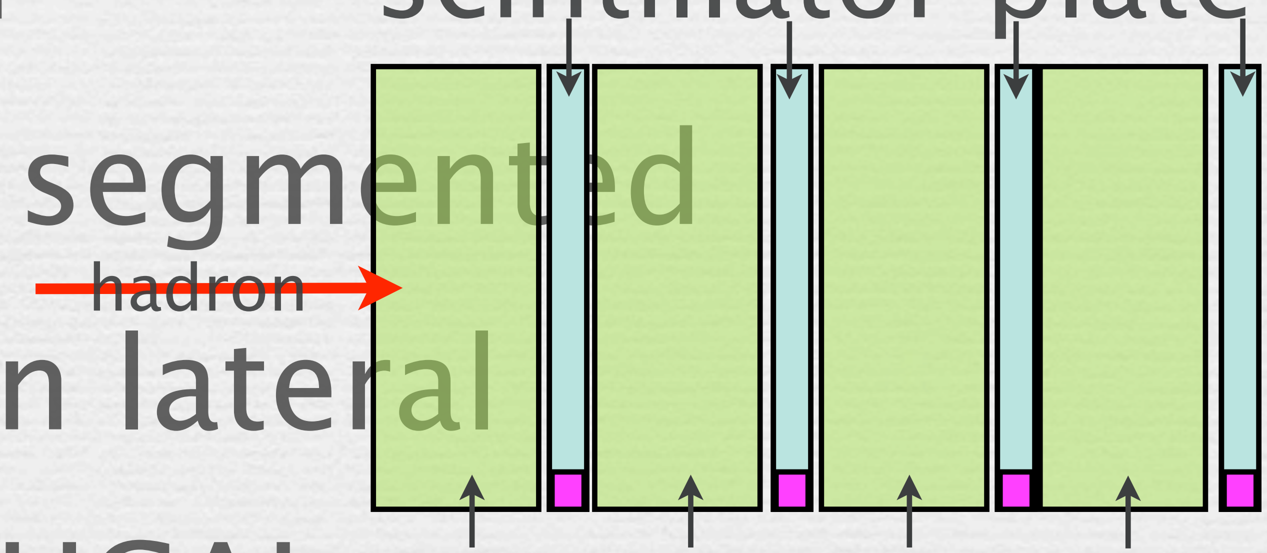
a hadron event

in fine longitudinal segmentation



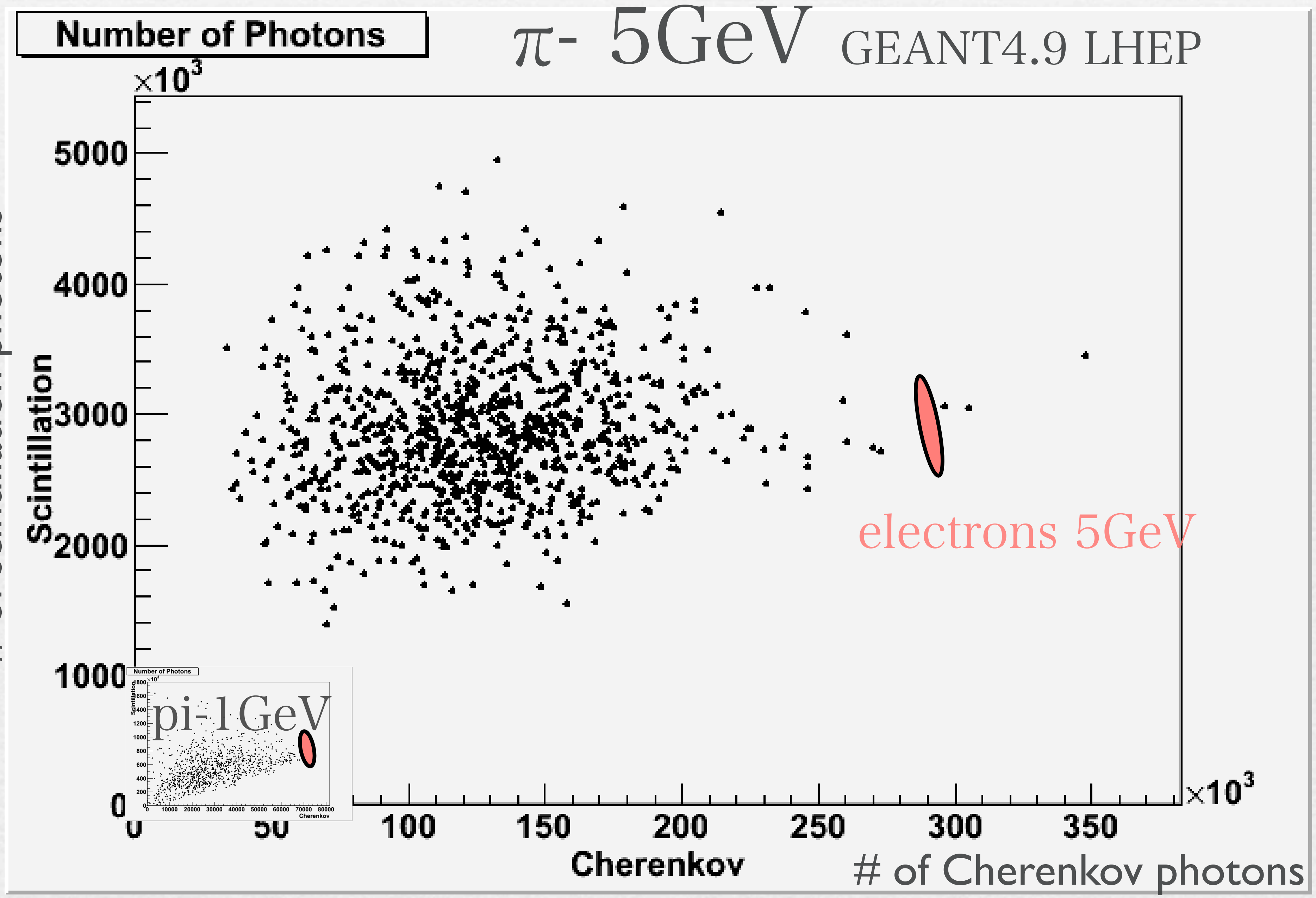
Total Measurement

- Heavy & transparent absorber for π^0 detection
- precise EM energy measurement :
- identify EM shower
- longitudinally fine segmented
- corse segmented in lateral
- combined ECAL & HCAL
- ~ homogeneous detector



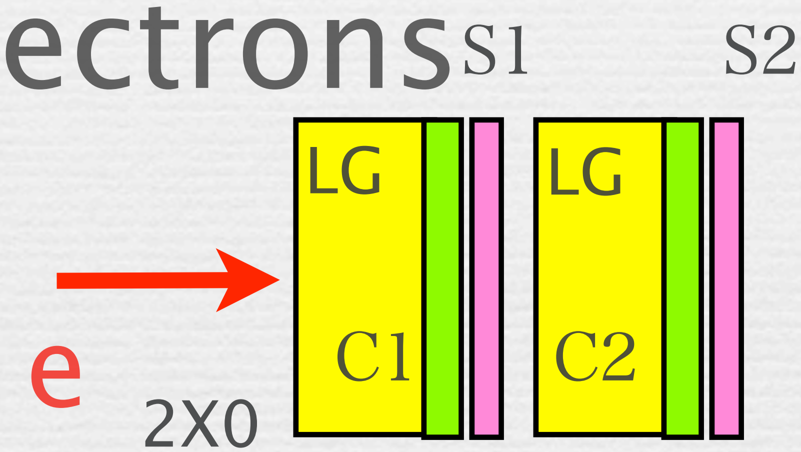
Response of TMC

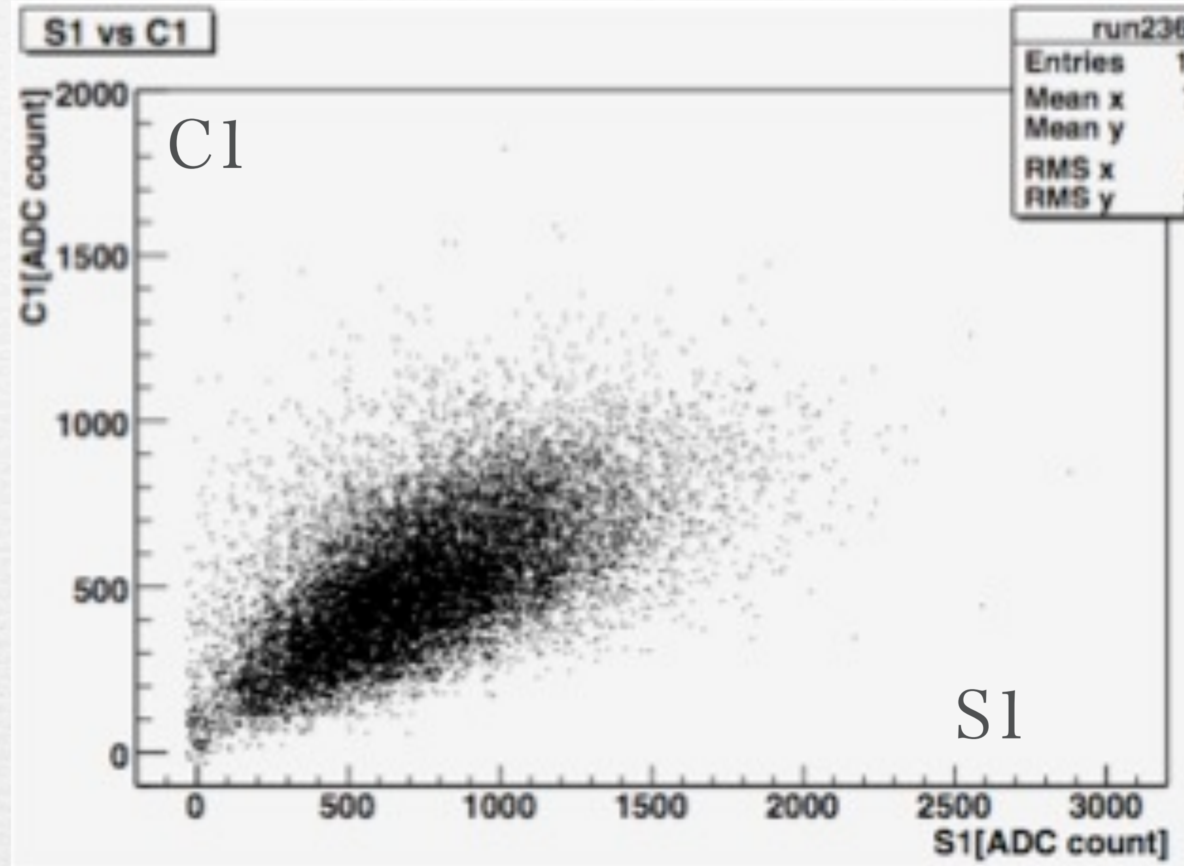
- simulation with hadrons & electrons

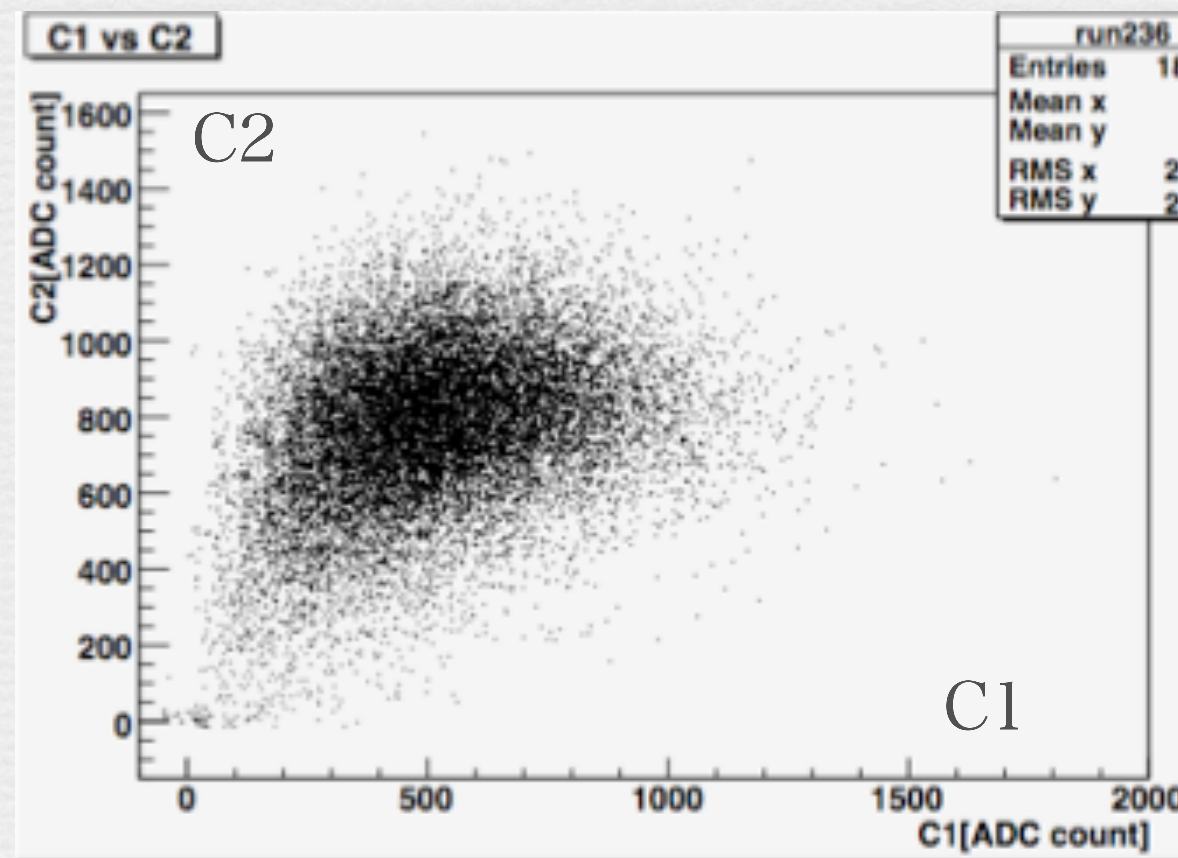


EM shower measurement

- 2 Lead Glasses and 2 scintillators
- tested by 3GeV electrons

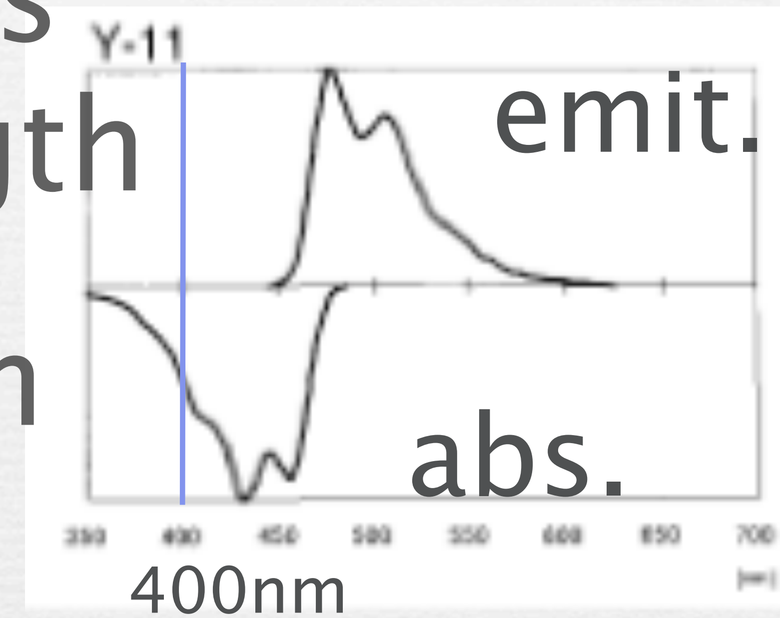




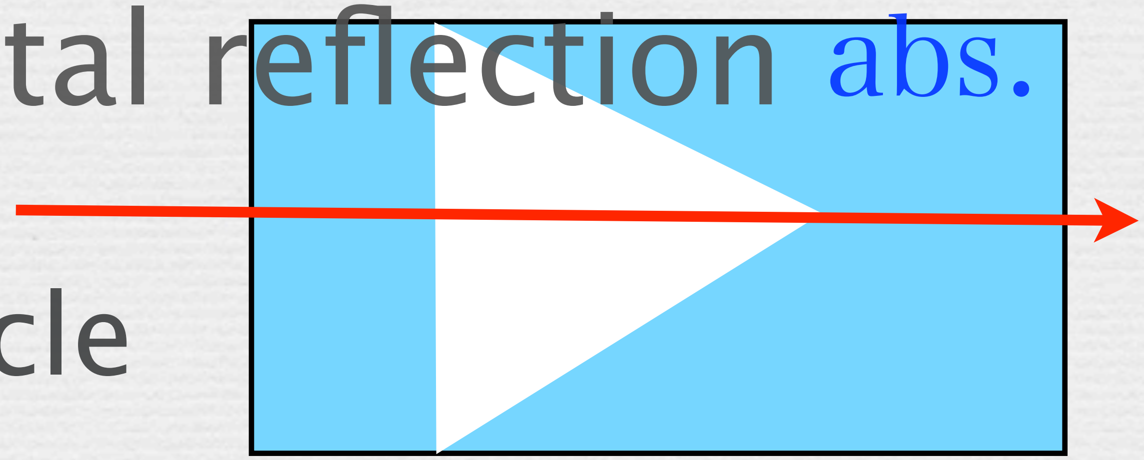


MIP detection in absorber

- number of Cherenkov light is small with shorter wave length
- need to collect photons from as much as surfaces area
- transparent absorber : high density & large diffraction index > total reflection



WLS Y11

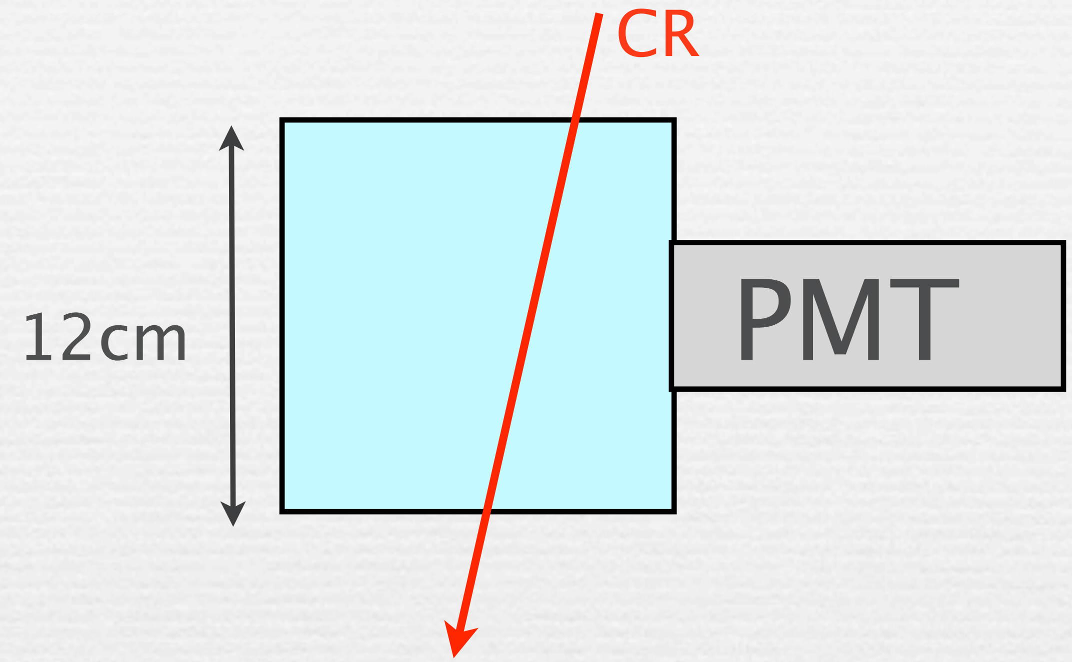


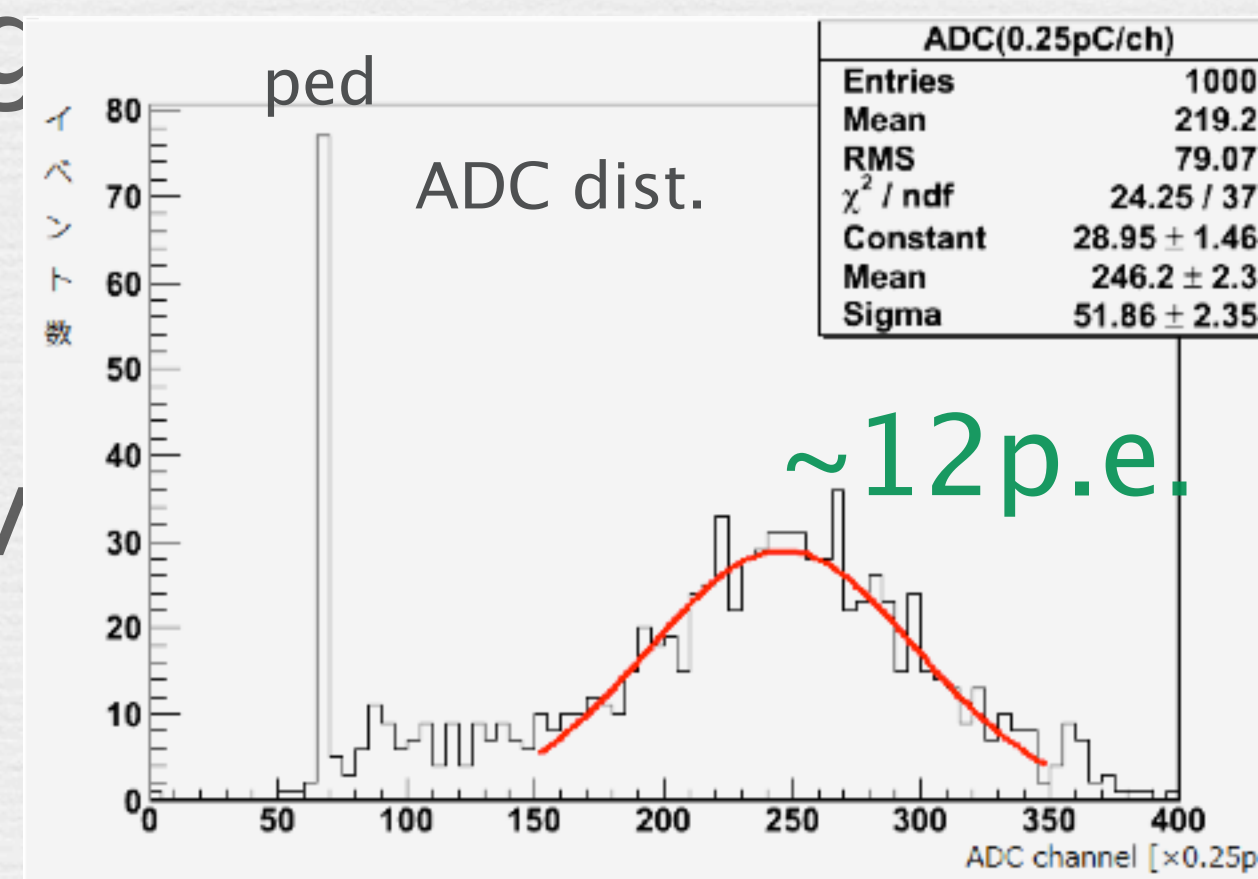
particle

Cherenkov lights

Lead Glass SF6

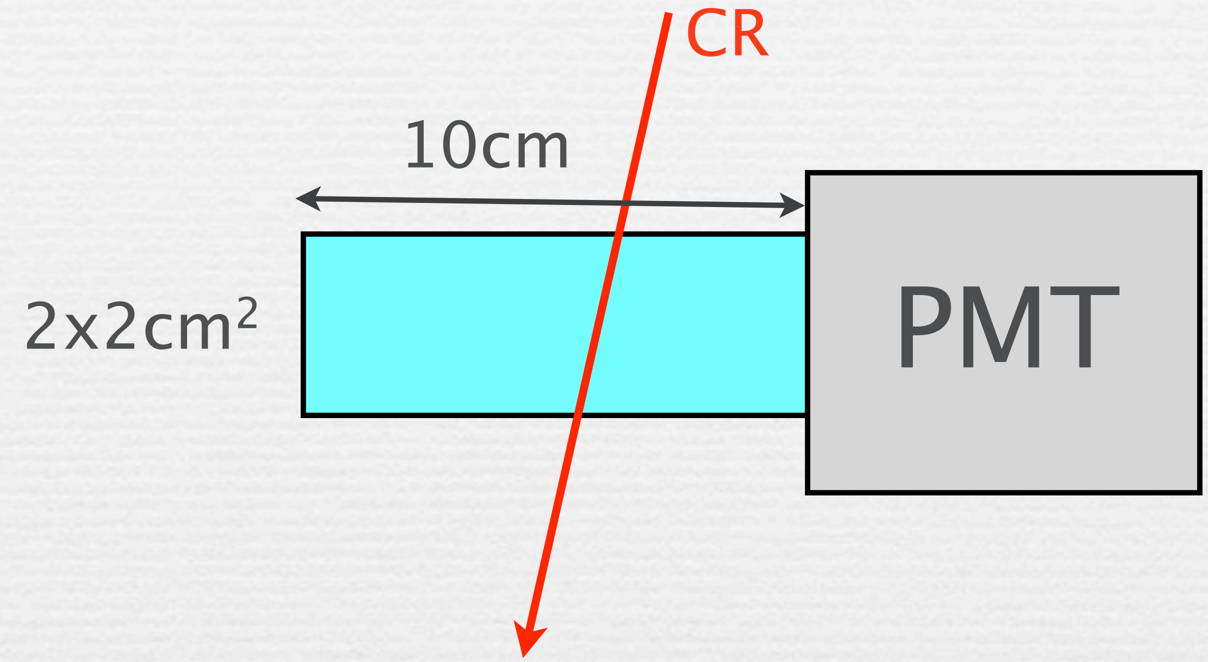
- n~1.81 , ρ~5.2 g/cm^3 , X_0~1.7cm
- 71% of weight PbO
- 12cm for CR passing
- PMT 2’ direct
- sufficient Cherenkov photons

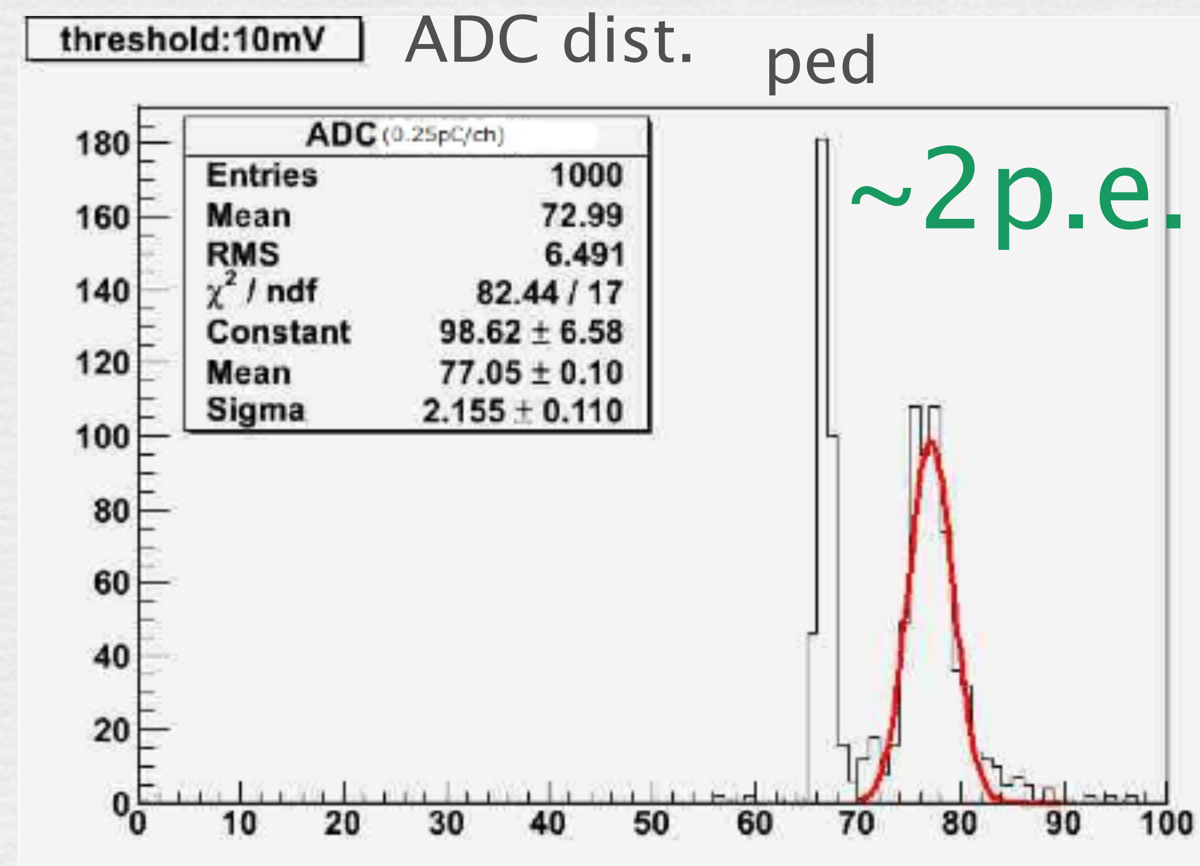




PbF_2 – I

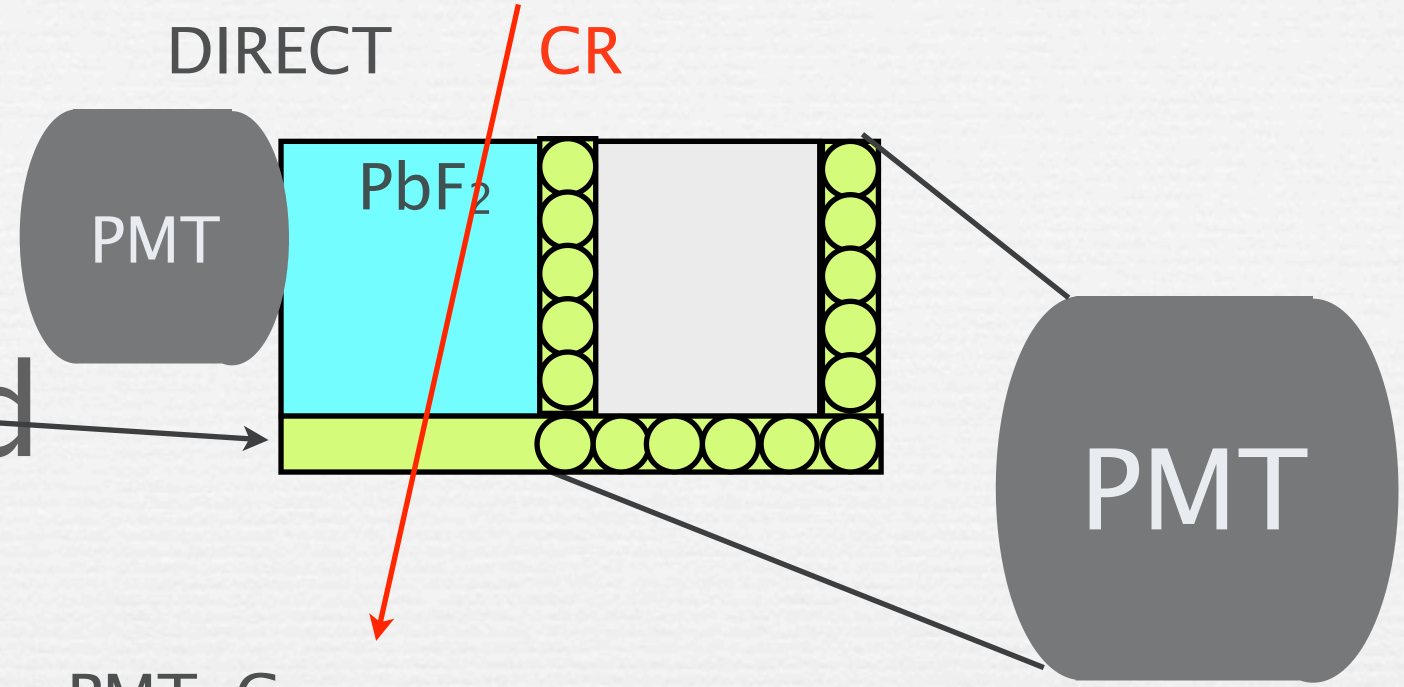
- $n \sim 1.82$, $\rho \sim 7.8$ g/cm^3, $X_0 \sim 0.9$cm
- 2cm for CR passing
- PMT 2' direct
- barely number of Cherenkov photons

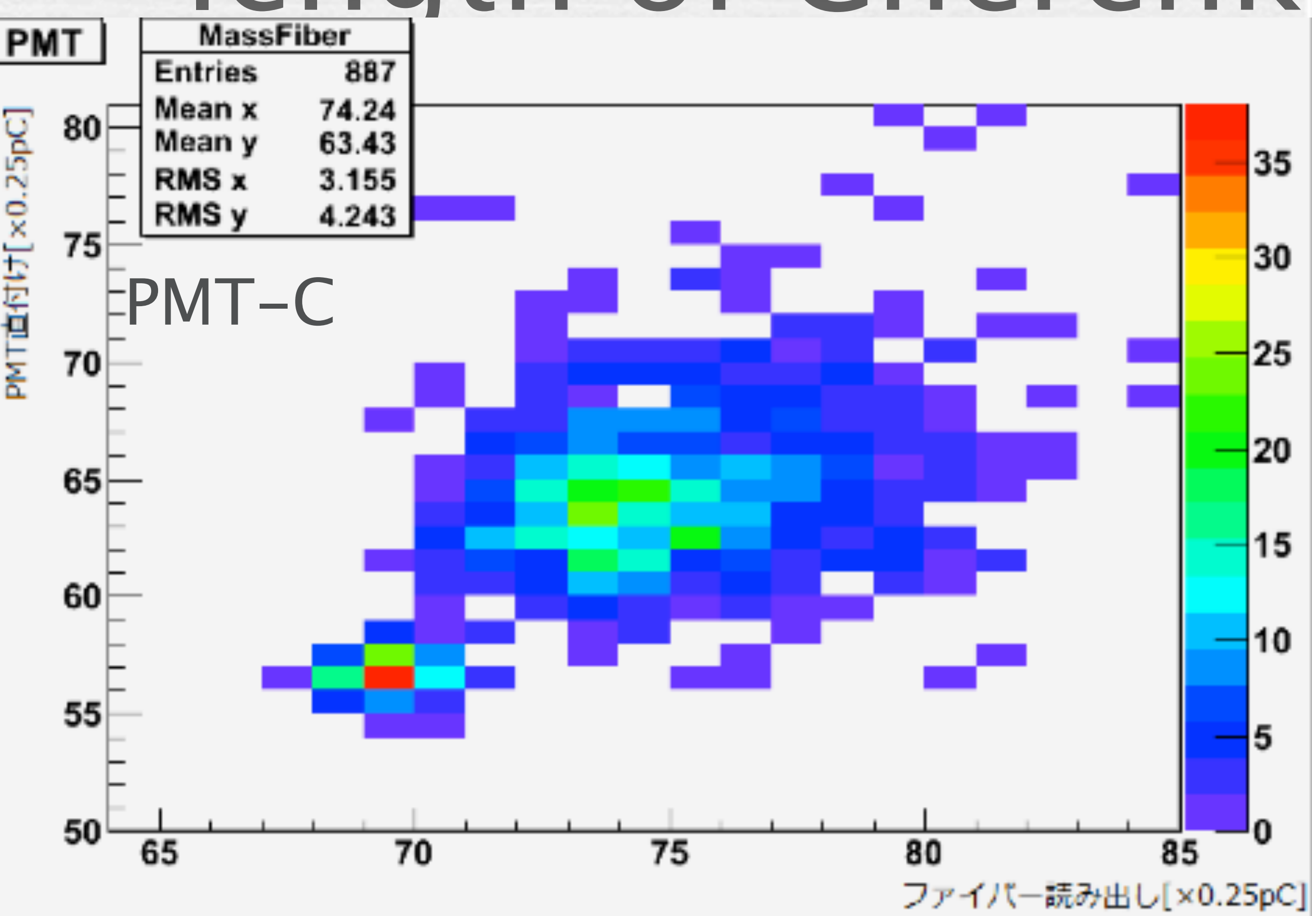


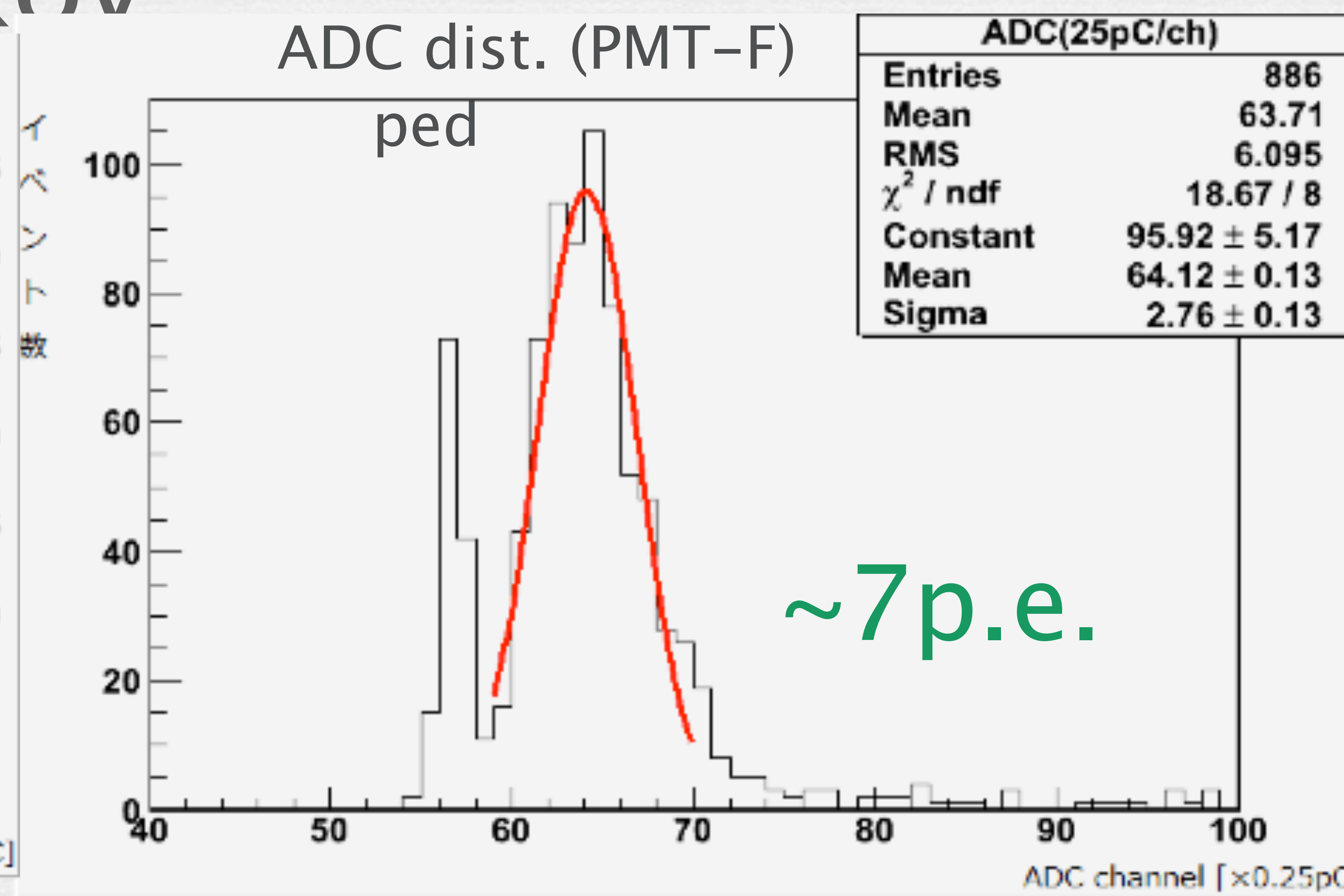


PbF_2 –II

- Wave Length Shifting Fibre read out
- utilize short wave length of Cherenkov

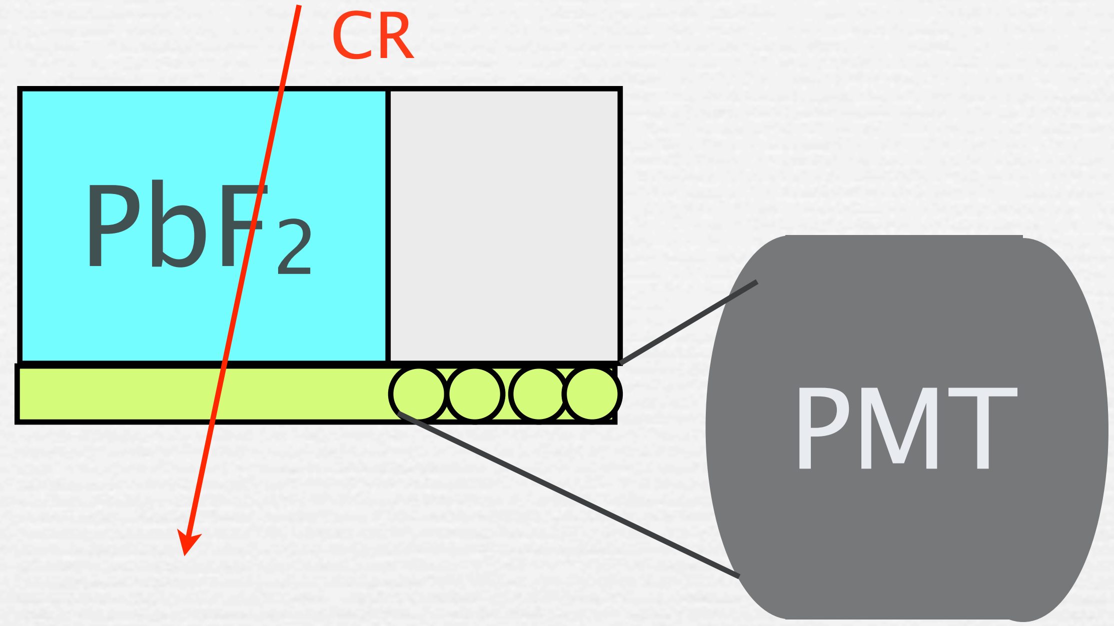


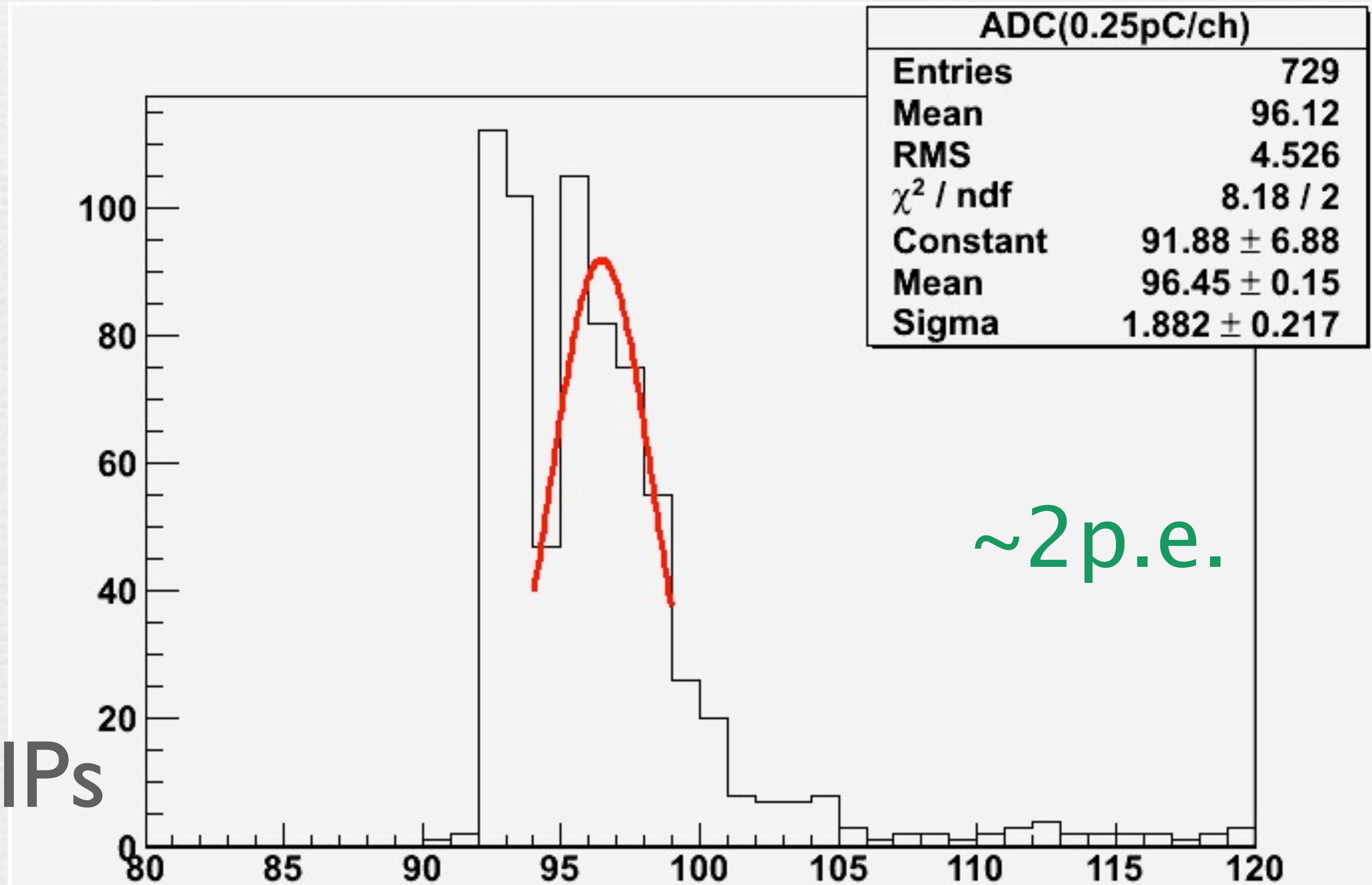




PbF_2 –III

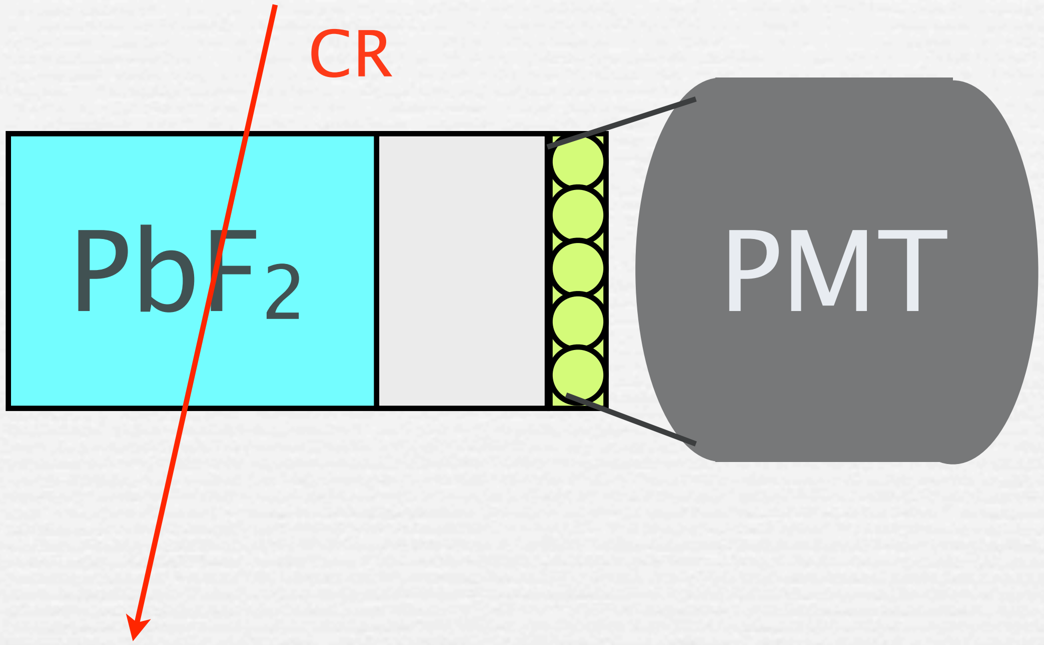
- read out by 20 wave length shifting fibers at bottom
- by a PMT
- ~ 2.p.e Cherenkov photons
- can detect MIPs

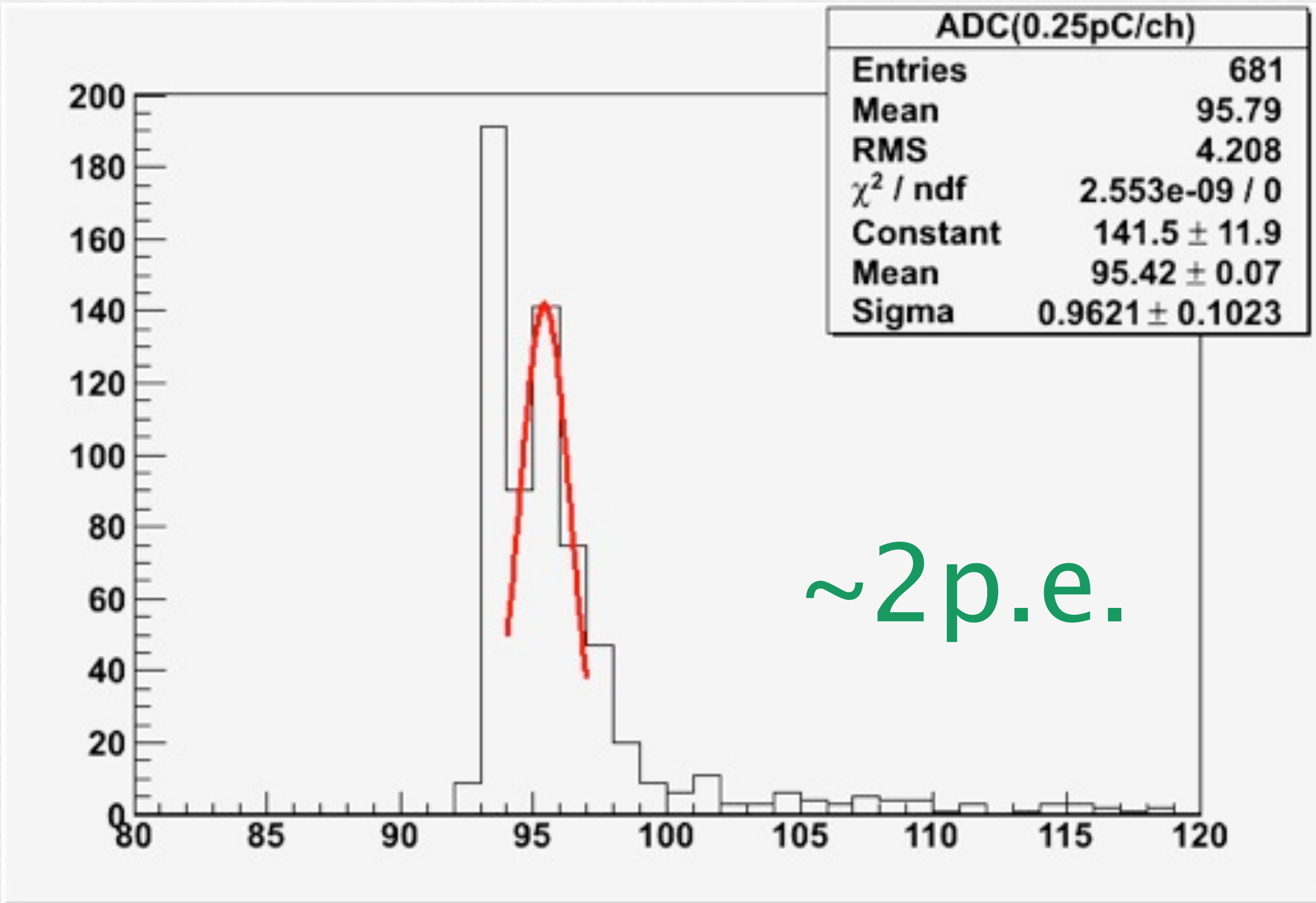




PbF_2 –IV

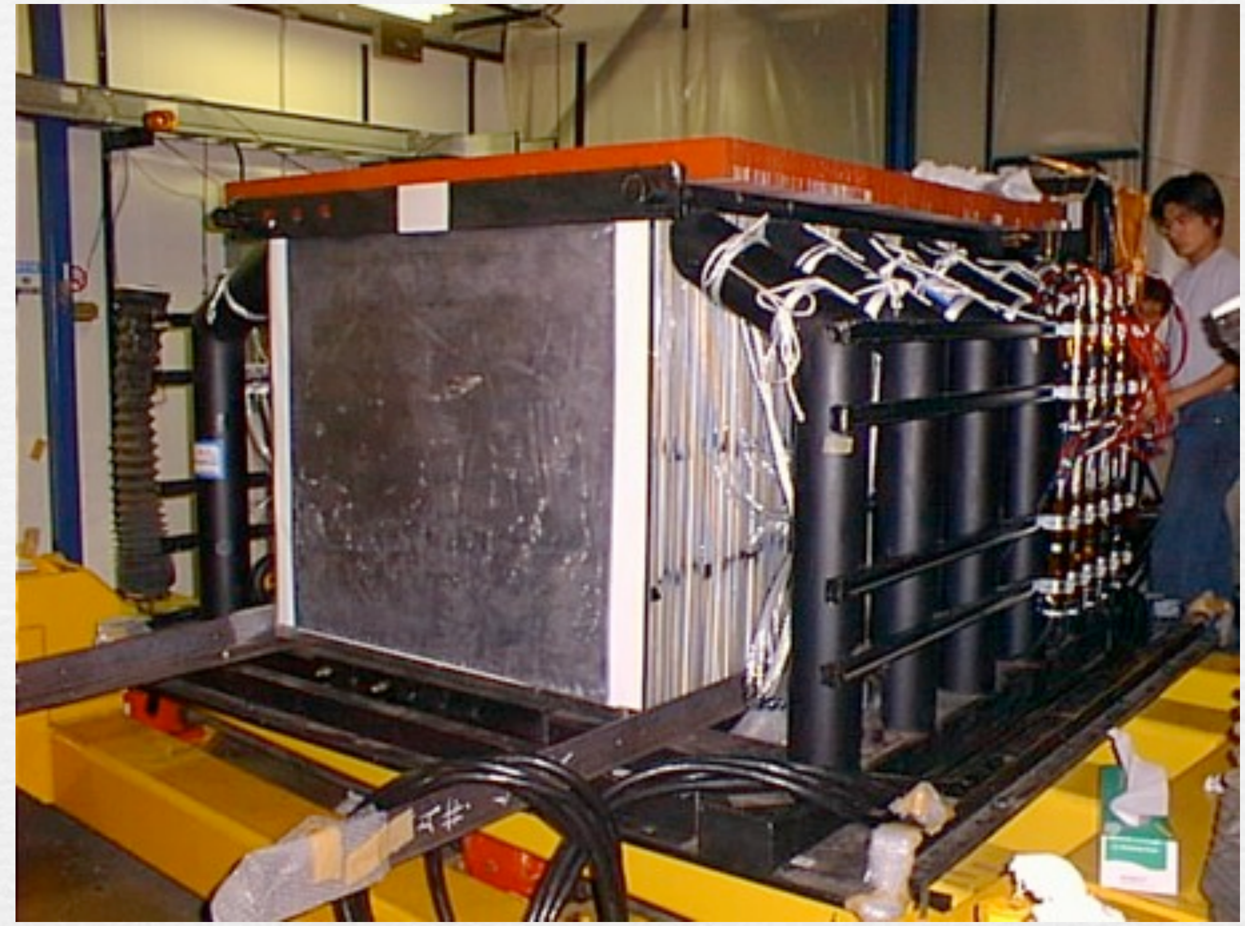
- one side surface is covered by 20 wave length shifting fibers
- by a PMT
- ~ 2.p.e Cherenkov photons
- ~ bottom read out
- can detect MIPs

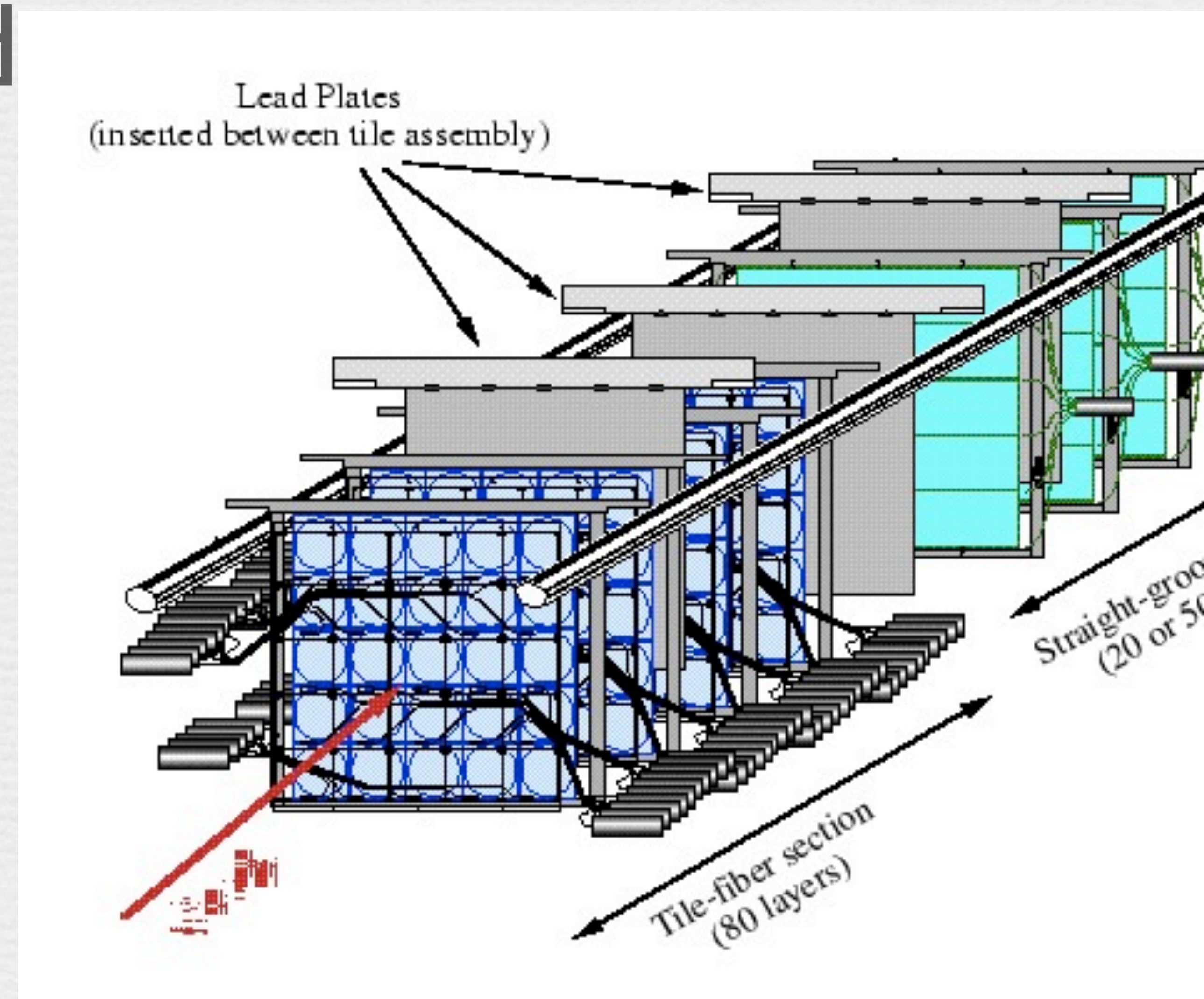




future plan

- $1m^3$ detector
- with LG/PbF2 blocks
- scintillators : MPPC read out enables us to read every layers
- fine longitudinal segmentation is the key issue



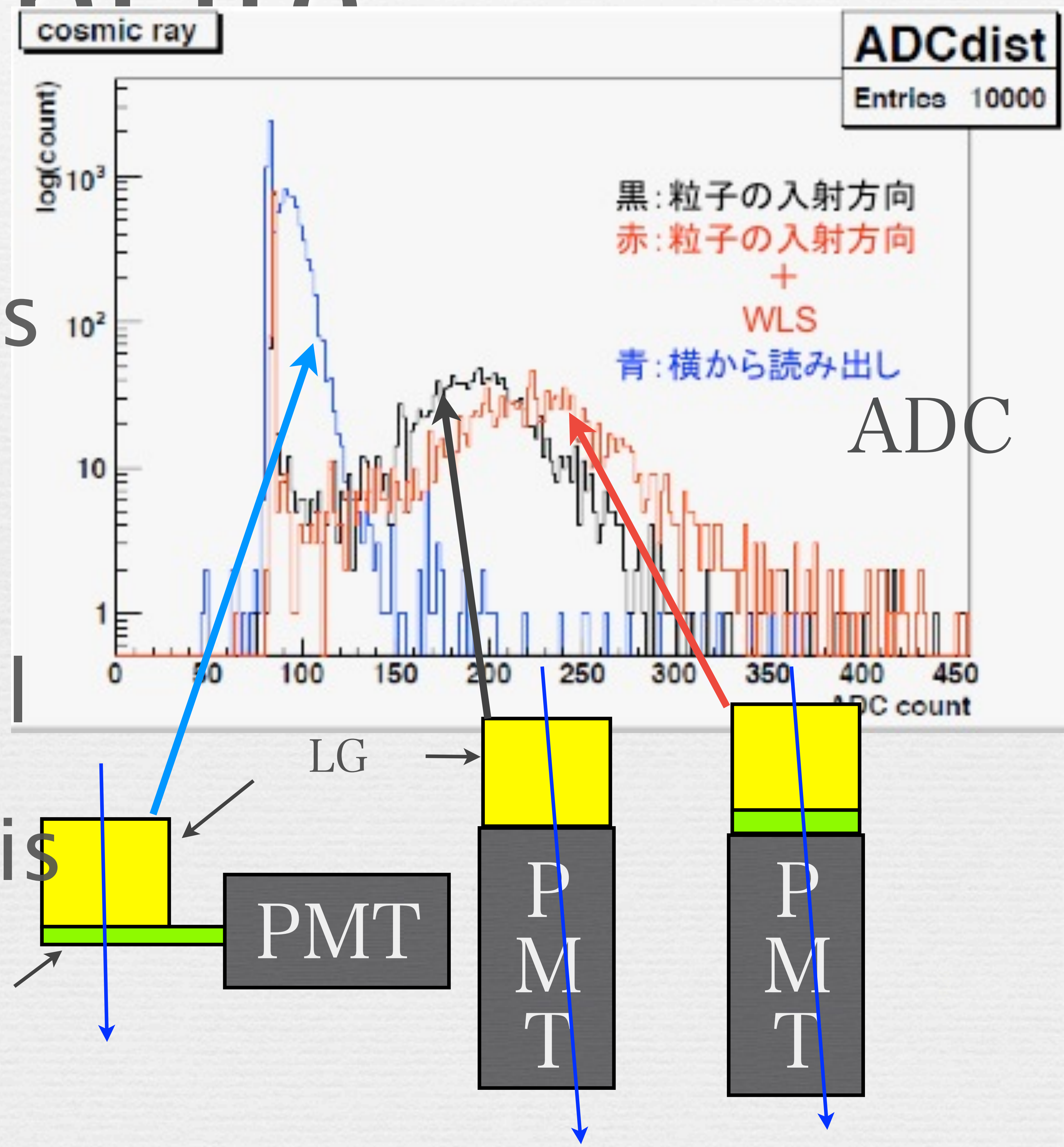


summary & outlook

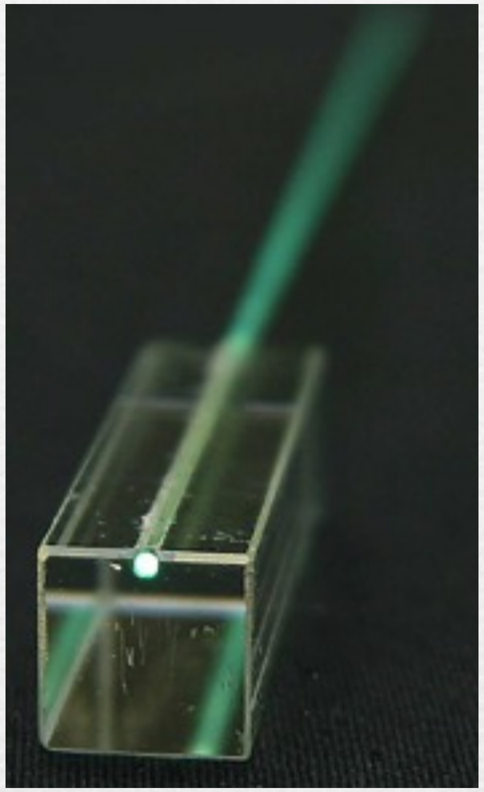
- neutral pion detection in hadronic shower is relevant for good JET energy resolution
- EM shower detection in the longitudinal segmentation actively
- Total Measurement Cal. TMC utilize Cherenkov light from the absorber material
- how to collect the Cherenkov light
- development using the PPDs

WaveLength Shifting plate

- Lead Glass 4cm
- cosmic Ray muons cosmic
- conversion ar WLSP works well
- light collection is



PbF2 test by Zhao



- a straight groove on a surface of PbF2
- 2.4 p.e. detected
- we did measured ~ 0.1 p.e.