AHCAL TB data analysis

Ryunosuke Masuda
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AHCAL beamdata analysis

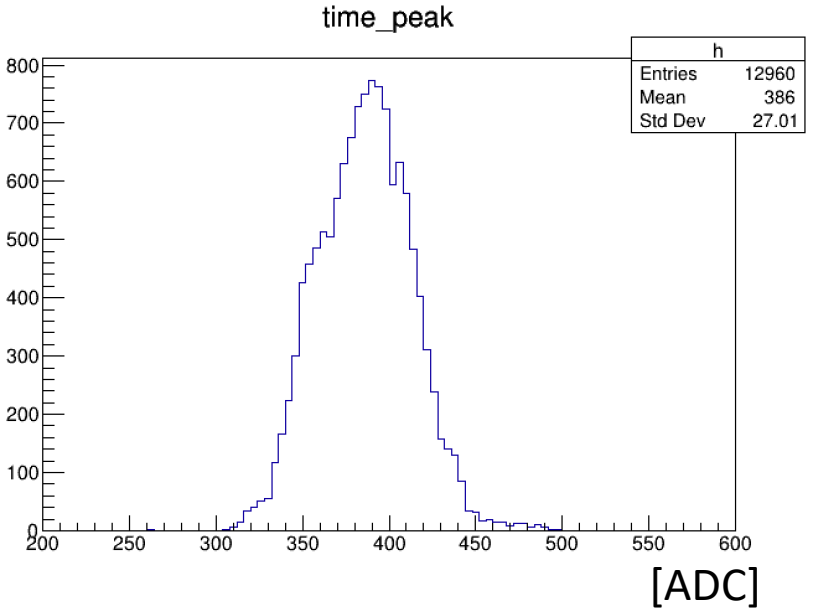
- Pedestal analysis
- HG/LG calibration
- MIP calculation

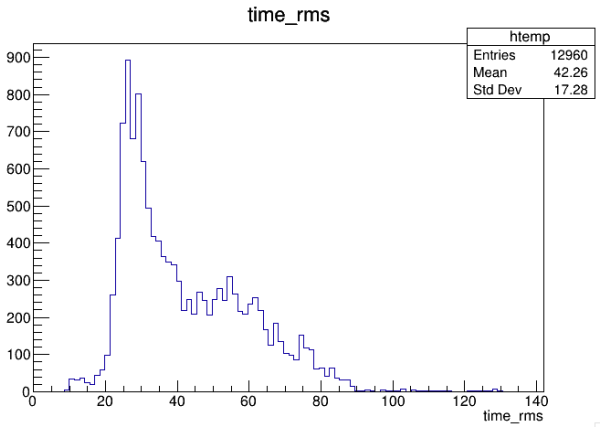
} Data crosscheck

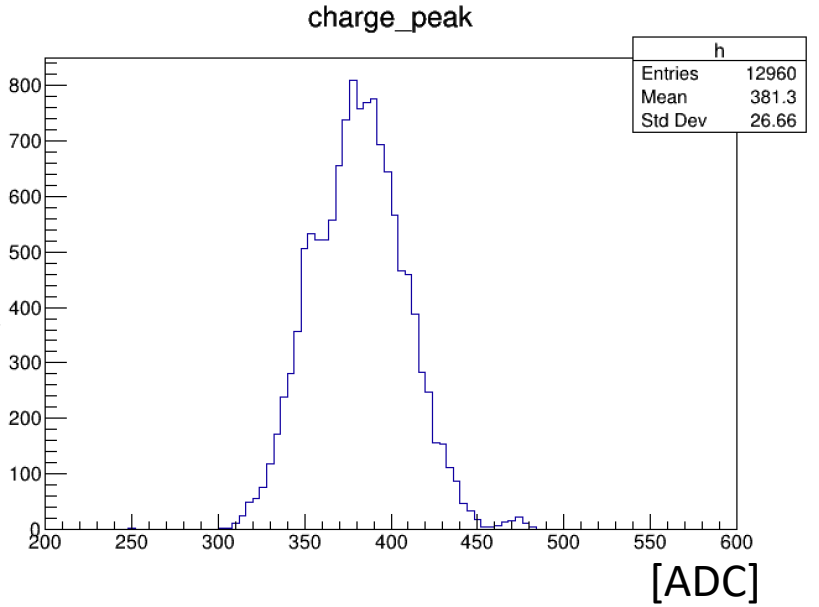
- Efficiency of Cherenkov counter
- Simple shower analysis

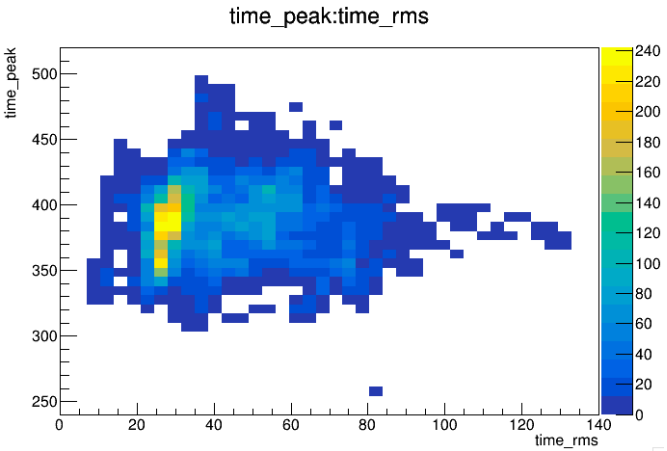
AHCAL beamdata analysis

- Pedestal analysis : pedestal value for each channel
- All muon run files are used (merge into a file)
- HG/LG pedestal distribution for all channel
  - ➡ Pedestal value : 300 - 500 [ADC], looks stable
  - ➡ RMS : Distribute widely
    - ➡ Considerable number of channel have wide or non-gaussian like ADC distribution
    - ➡ Need to check







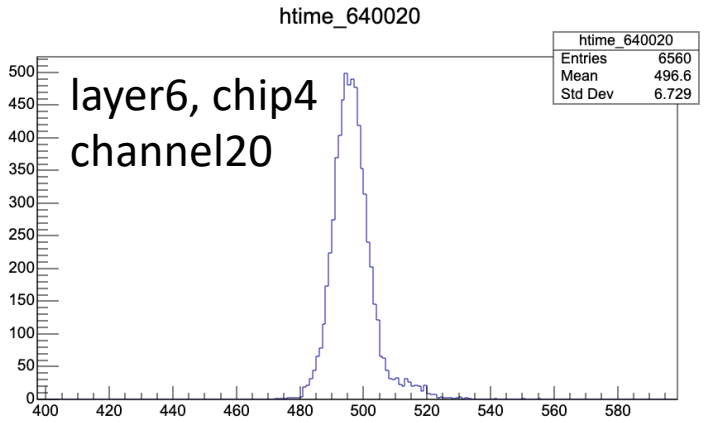


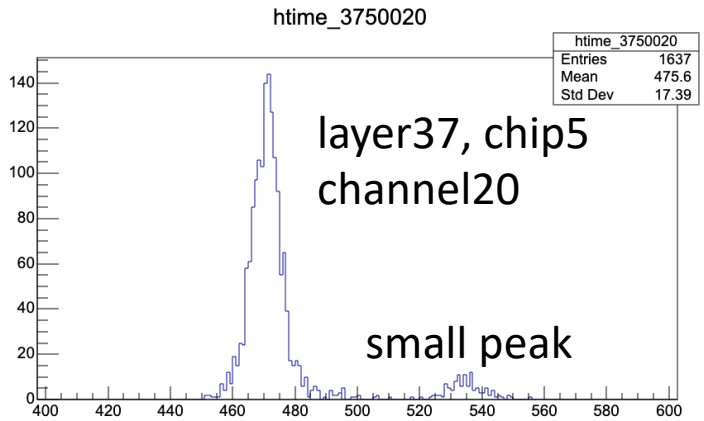
◀ No correlation between peak value and rms

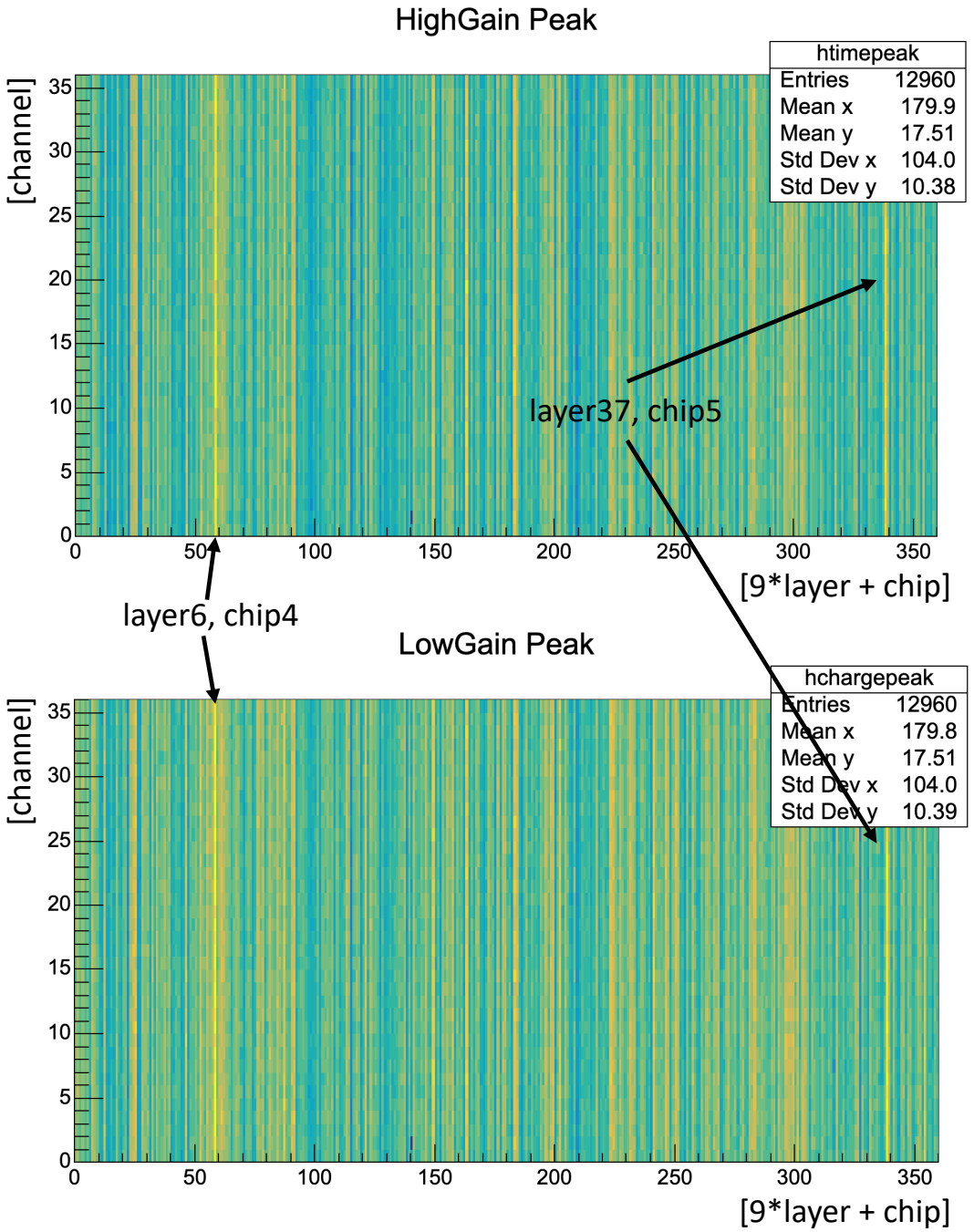
AHCAL beamdata analysis

- Pedestal analysis : pedestal value for each channel

some chips have especially high pedestal value

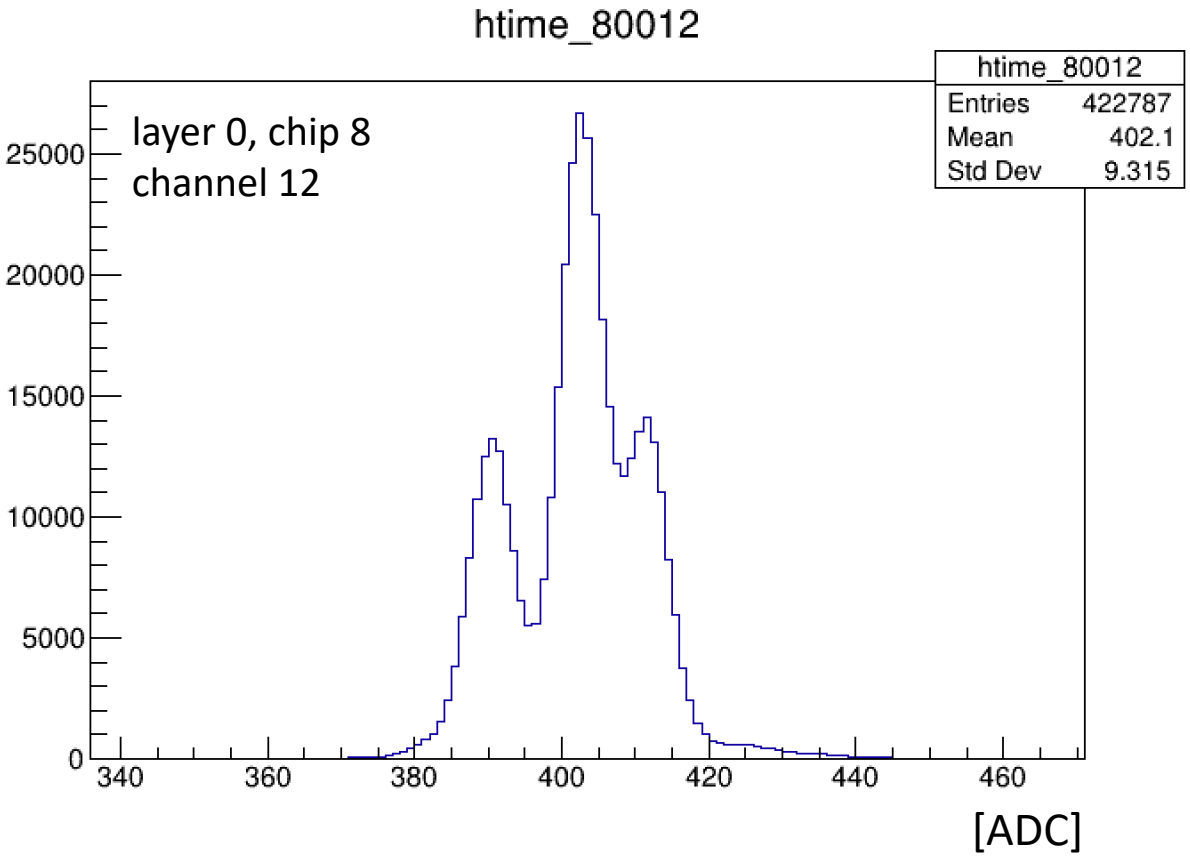






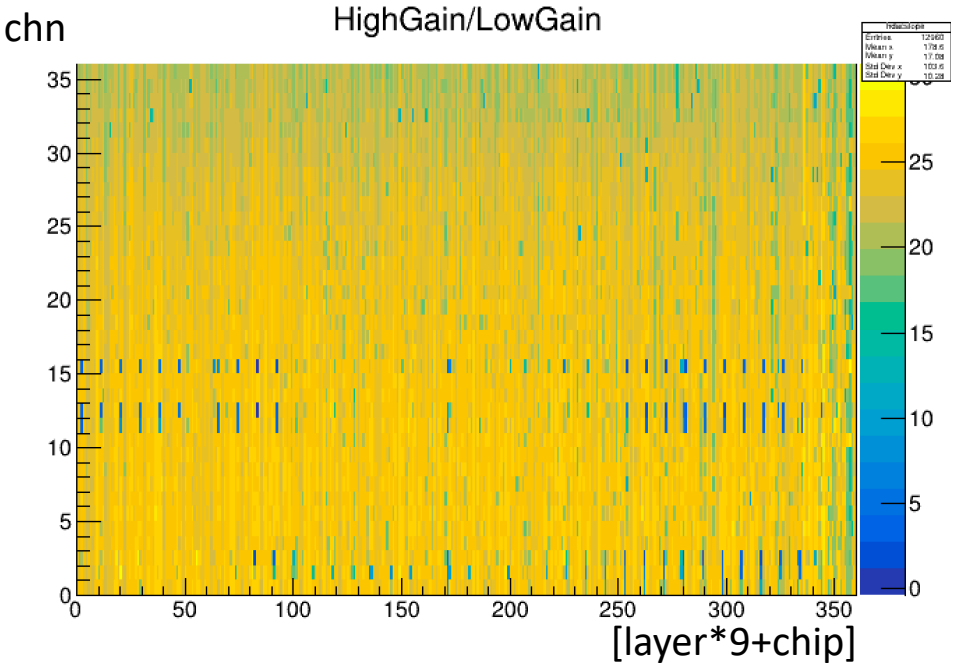
AHCAL beamdata analysis

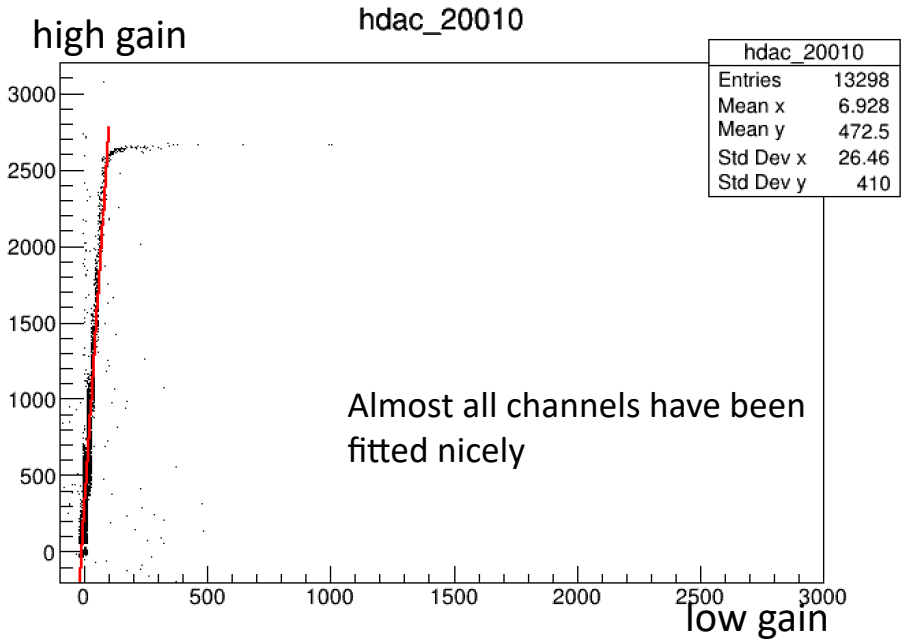
- Pedestal analysis : multipeak problem
  - ➡ Pedestal fitting quality is not assured due to multipeak structure at some channels
  - ➡ This strange structure can be seen in all of muon run event
    - ➡ Electronics or DAQ problem?
  - ➡ Possible to resolve by offline analysis? Under investigation



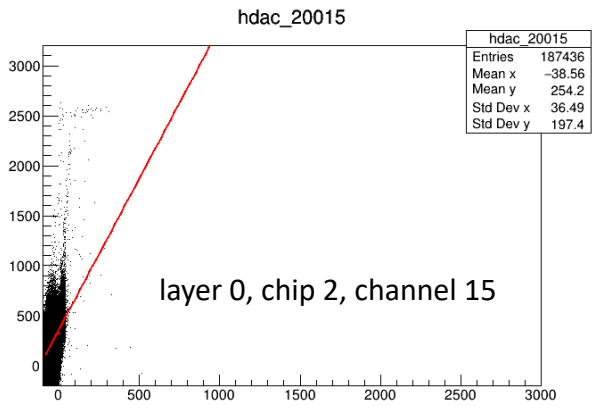
AHCAL beamdata analysis

- HG/LG ratio
  - ➡ Using all muon event
  - ➡ Some fitting parameters tuned to get more high-goodness slope values



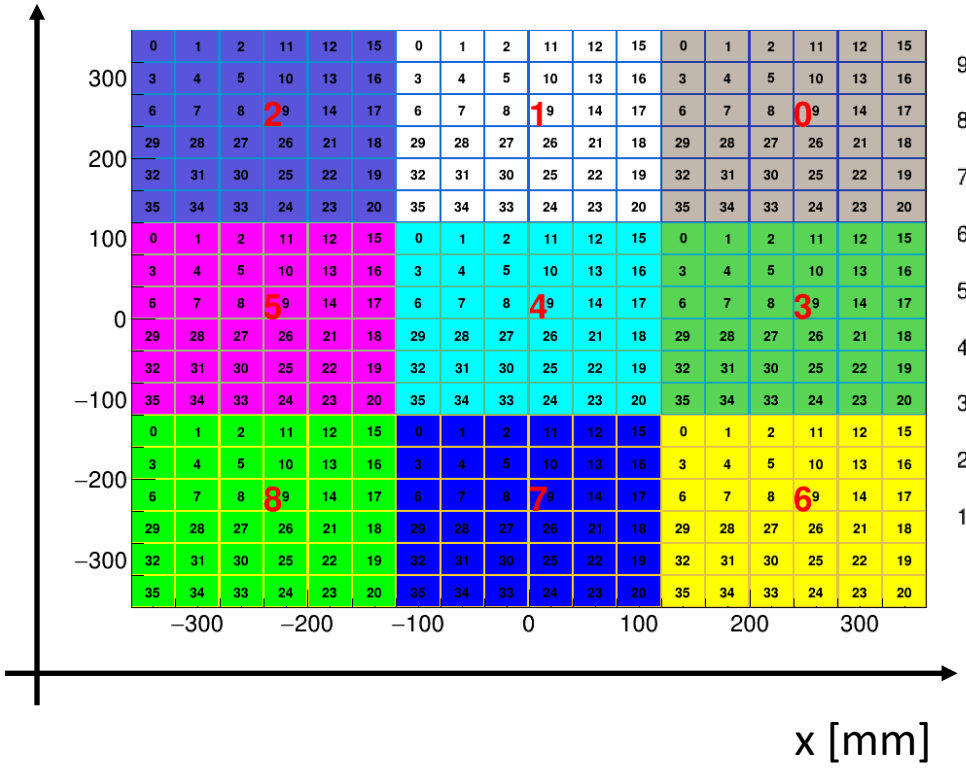


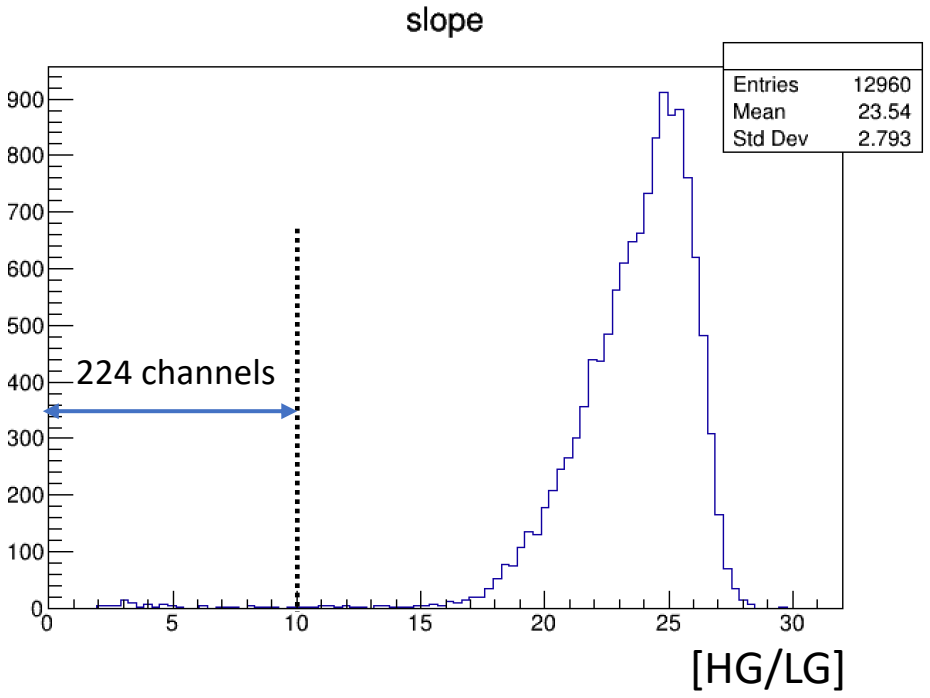
- Fitting is failed for some channels
  - ➡ Slope values for 224 channels (= ~1.7 % of all channel) are smaller than 10
  - ➡ Strange HG vs. LG distribution occurs a lot in specific chip, channels (channel 1,2 of chip 1 and 11,12,15 of chip 2)
    - ➡ DAQ problem?



AHCAL beamdata analysis

- DAC calibration (HG/LG fitting)
  Distribution of slope values for all channel

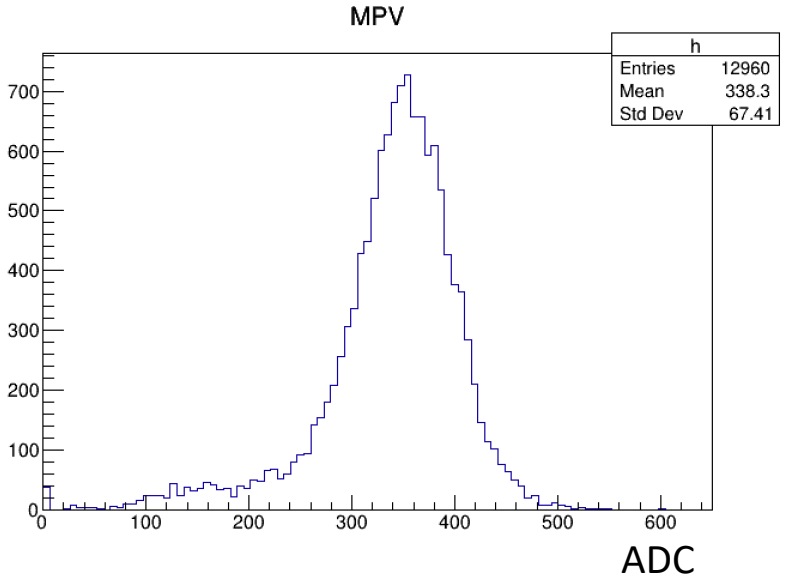




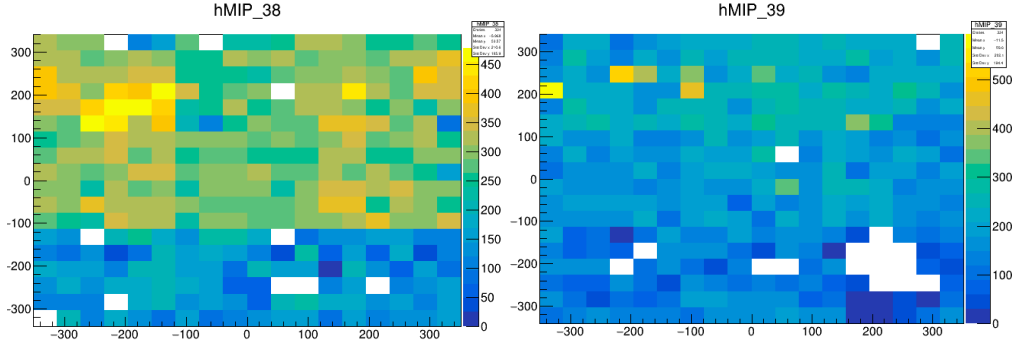
AHCAL beamdata analysis

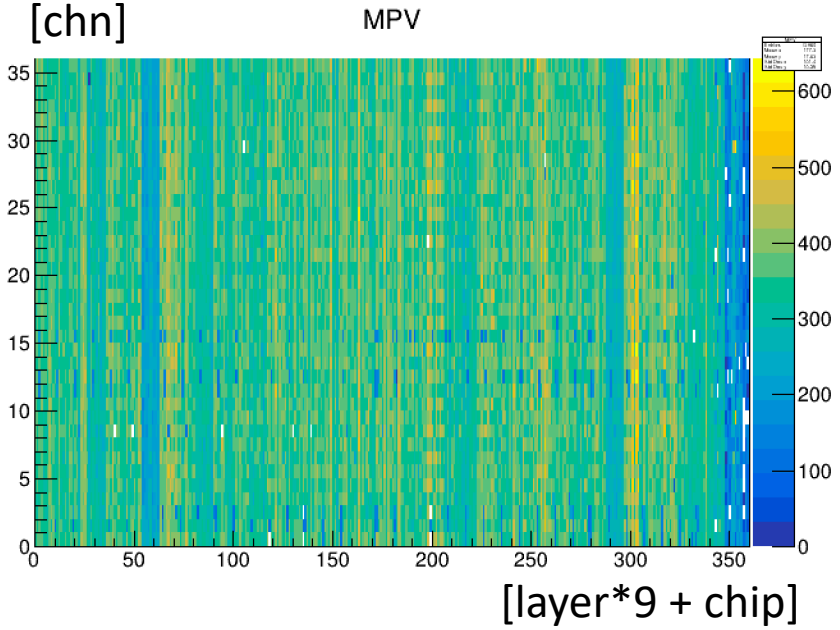
- MIP analysis : All channel scan

  ➡ Using a merged muon data file (all run files)
  ➡ 40 channels (~0.3 % of all channel) are dead
  ➡ A lot of channels of last two layers have abnormal MIP value as reported by Chinese group
  ➡ Same tendency as slope analysis



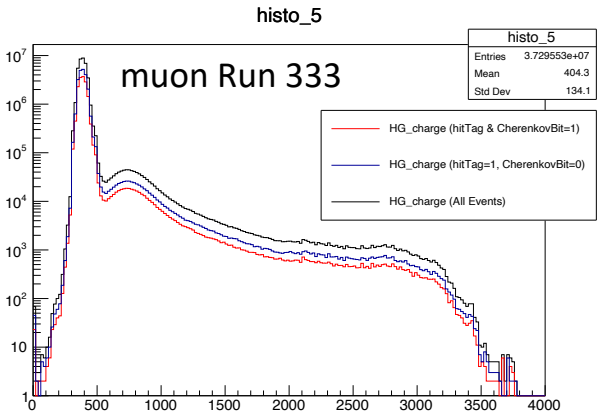
MIP value map layer 38 & 39



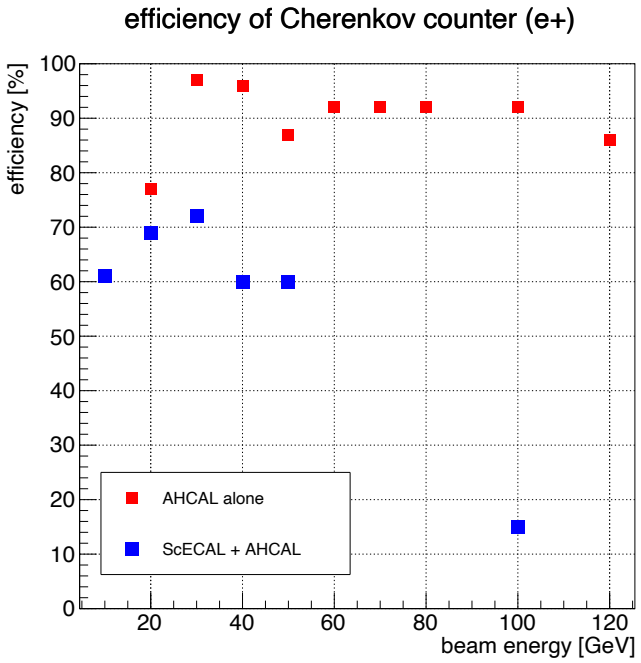


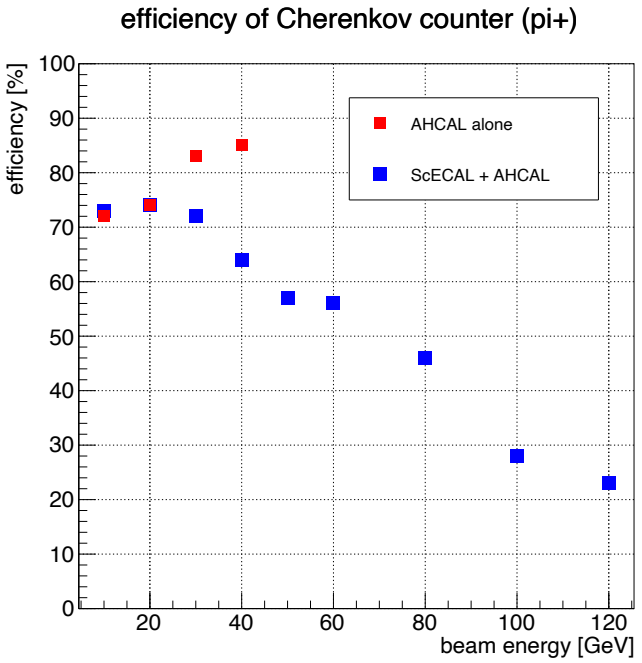
AHCAL beamdata analysis

- Cherenkov counter efficiency
  Defined as ratio (event whose Cherenkov bit is true)/(all event)
  ➡ Data scan has been finished
  mu+ : ~ 41 [%]
  e+ : 15 ~ 97 [%]
  pi+ : 22 ~ 85 [%]



➡ The data of some measurement pattern
don't have Cherenkov information
➡ For combined run, the efficiency tends to decrease as beam energy increases





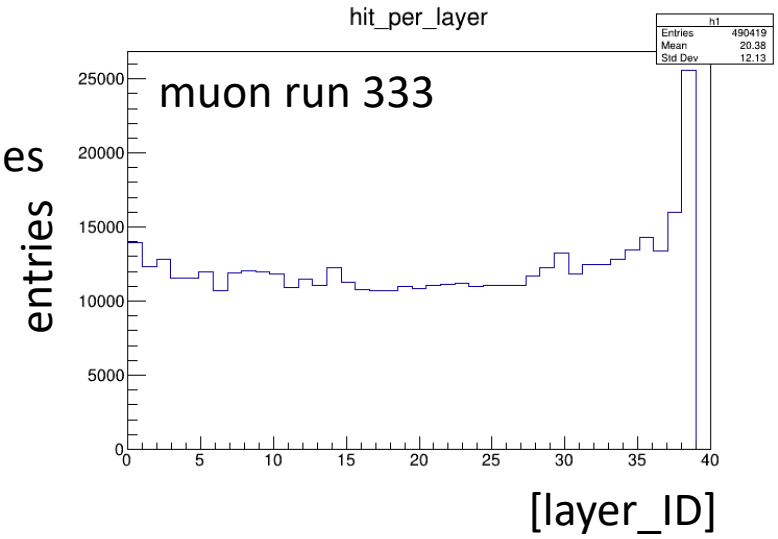
AHCAL beamdata analysis

- Calibrated data analysis
  - ➡ simple PID : To see detector response to each particles

- muon

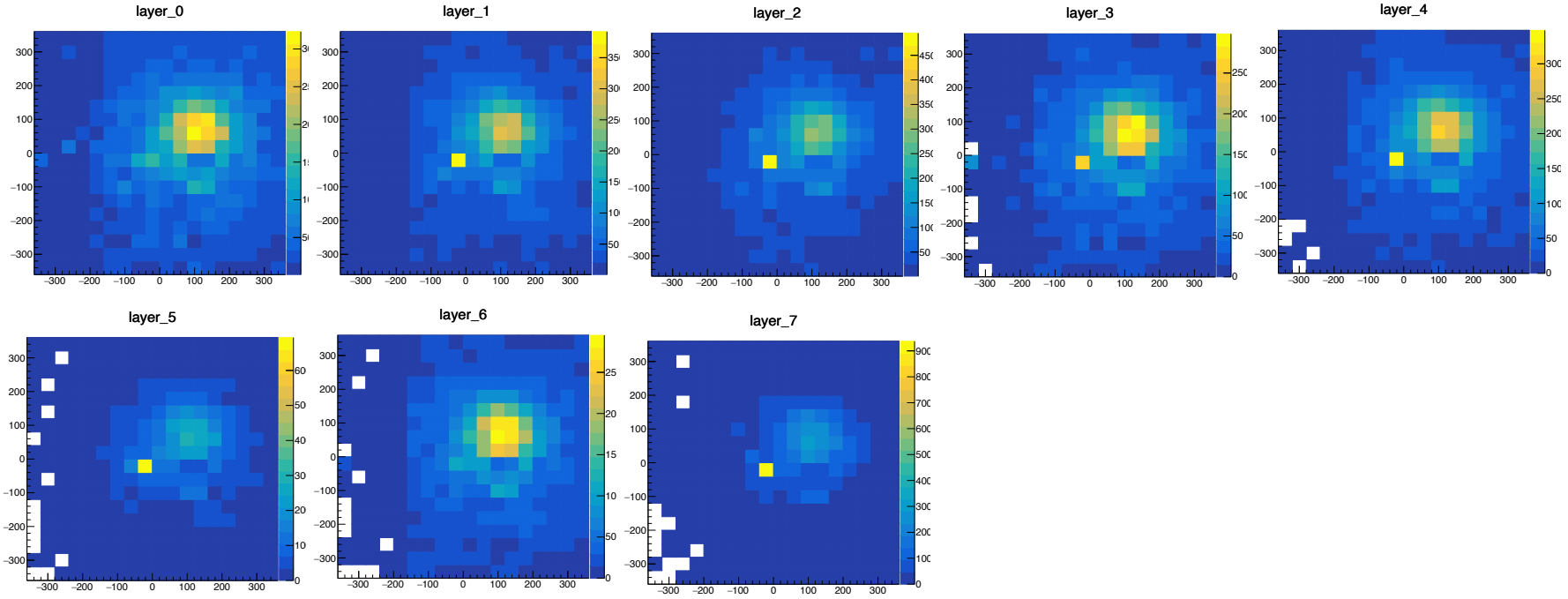
Hit # per layer

- ➡ Chose HitTag = 1, Cherenkov bit true events
- ➡ Last layer detects extremely large number of hit -> noise?



Hit # map for each layer

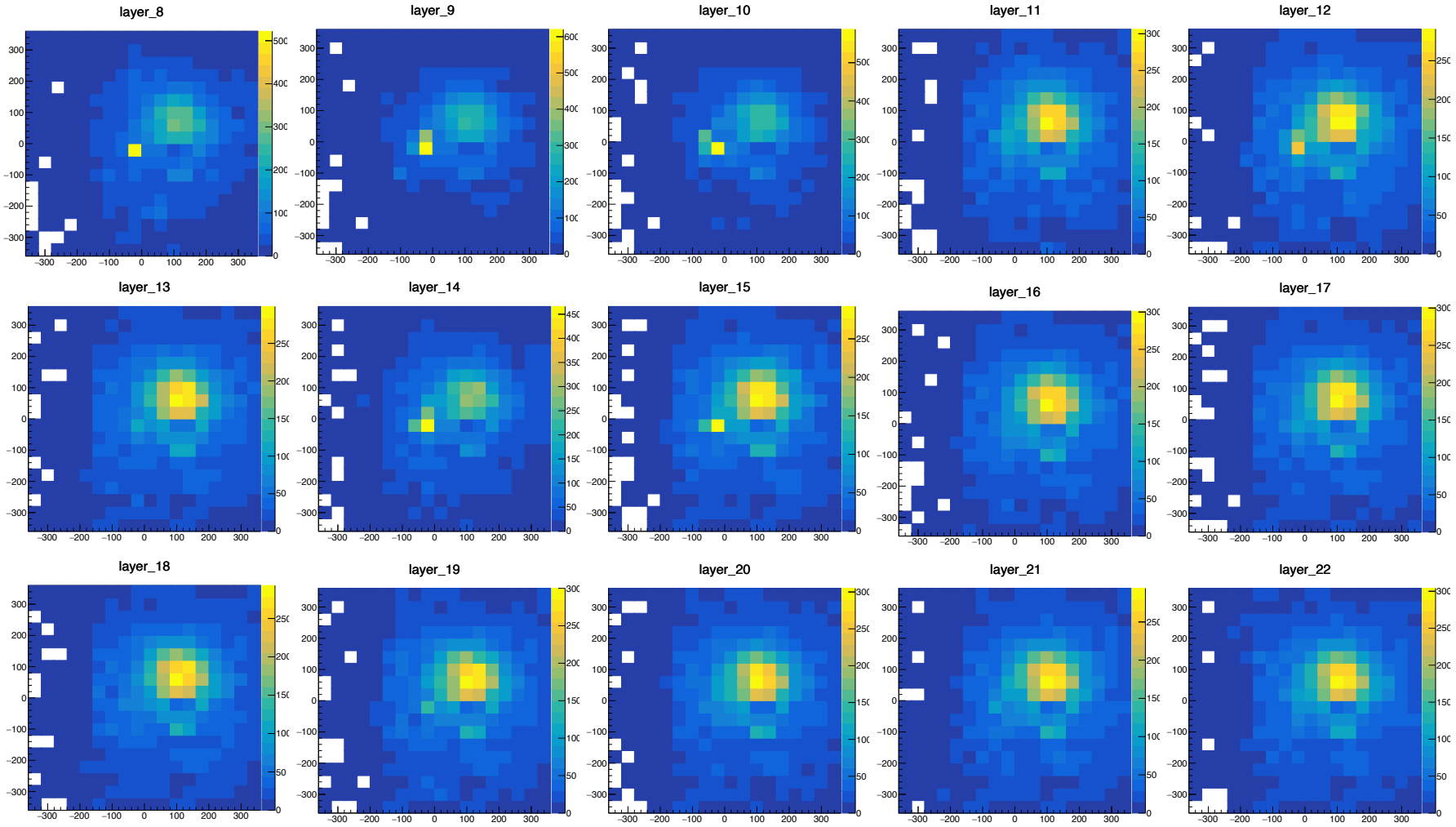
- ➡ Chip 4, cannel 27 (almost the middle of layer) in several layers



AHCAL beamdata analysis

Hit # map for each layer

➡ Chip 4, cannel 27 (almost the middle of layer) in several layers

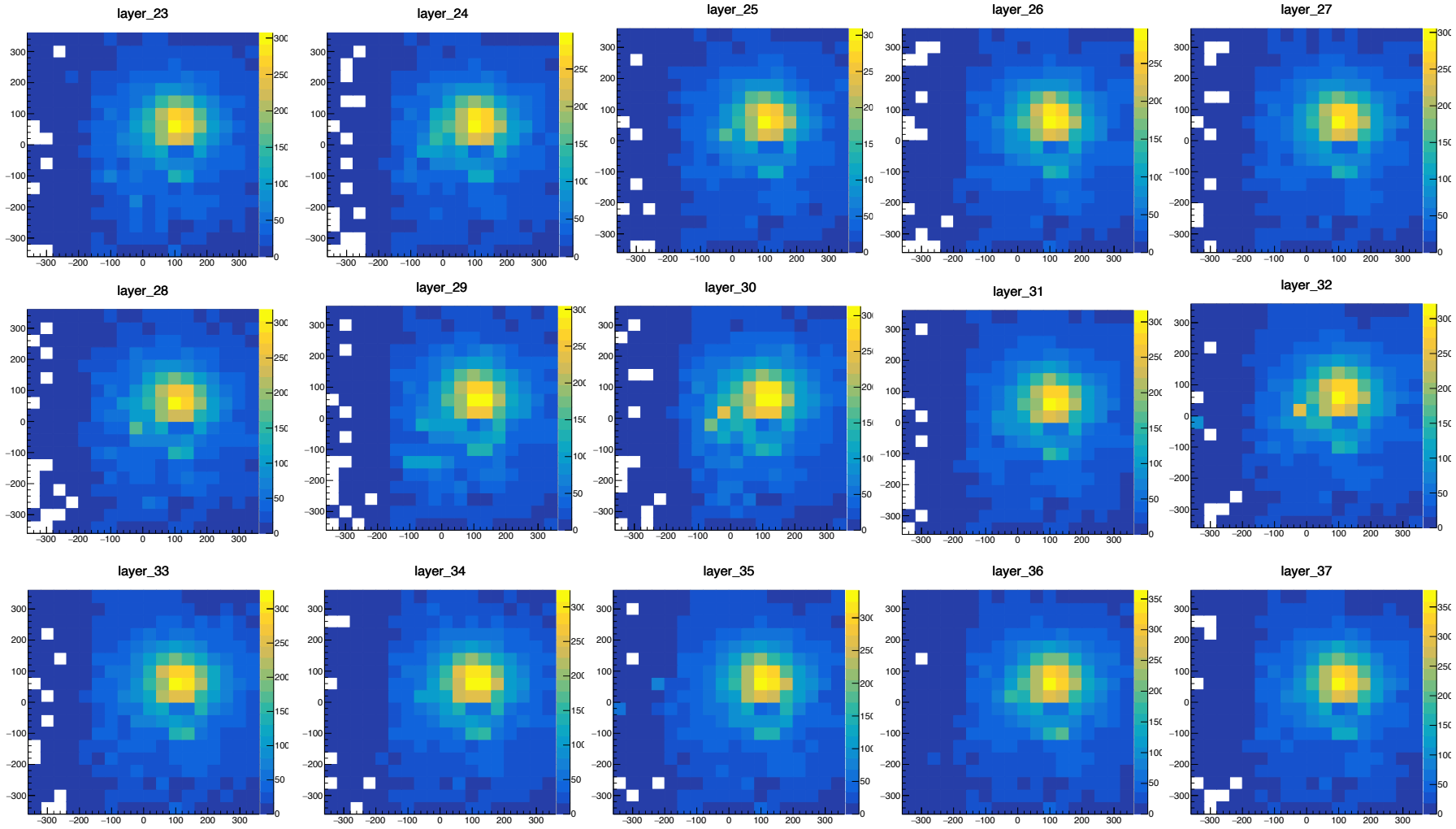


AHCAL beamdata analysis

- muon

Hit # per layer

➡ Chip 4, cannel 27 (almost the middle of layer) in several layers

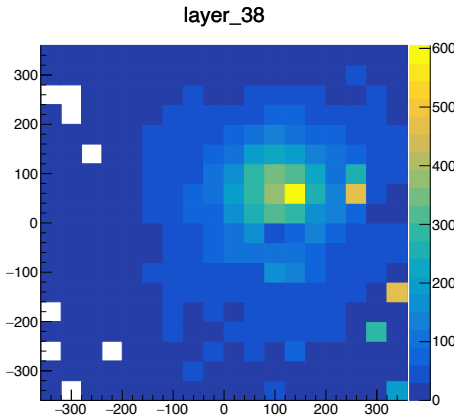


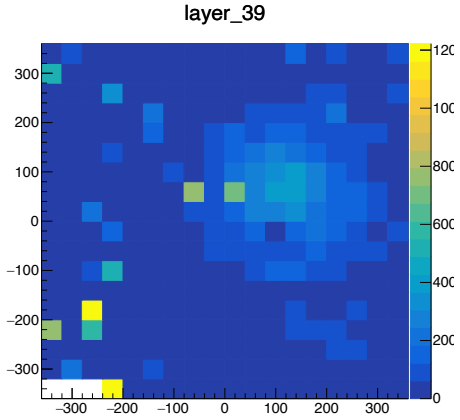
AHCAL beamdata analysis

・muon (Run 333)

Hit # per layer

➡ Some noisy channels in layer 38 & 39





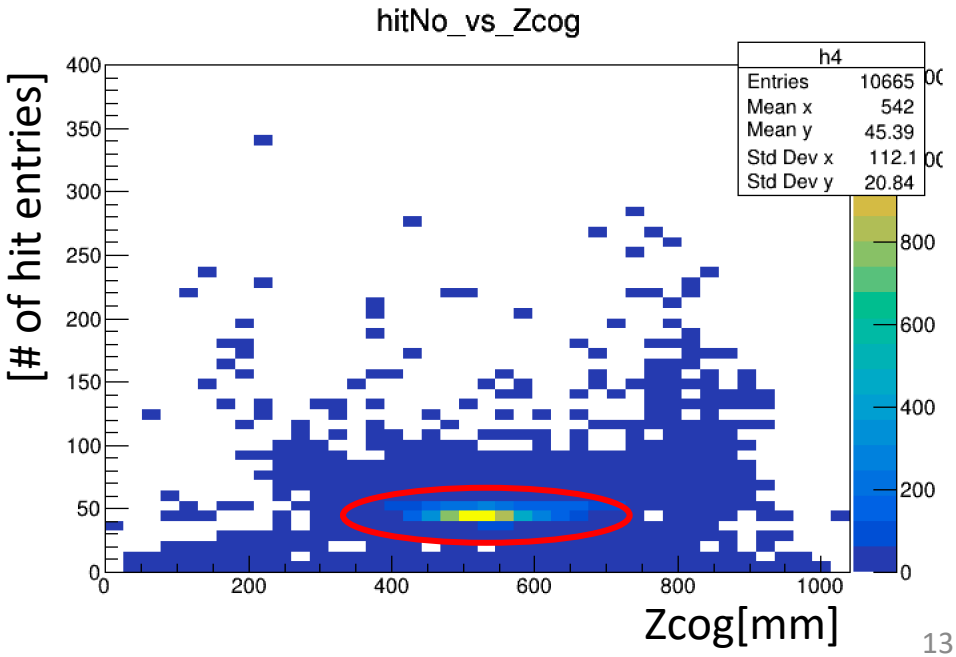
Hit # vs. Center of Gravity Z

$$* z_{CoG} = \frac{\sum_{i=1}^{N_{hits}} z_i \cdot E_i}{E_{sum}}$$

➡ Muon track can be seen

➡ There are also other elements (noise or other particles?)

➡ Validation of Cherenkov bit selection



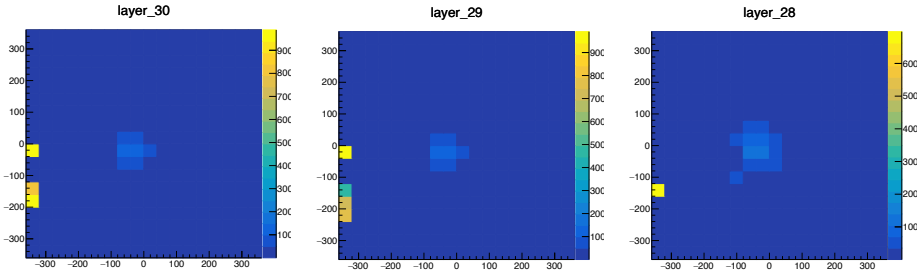
AHCAL beamdata analysis

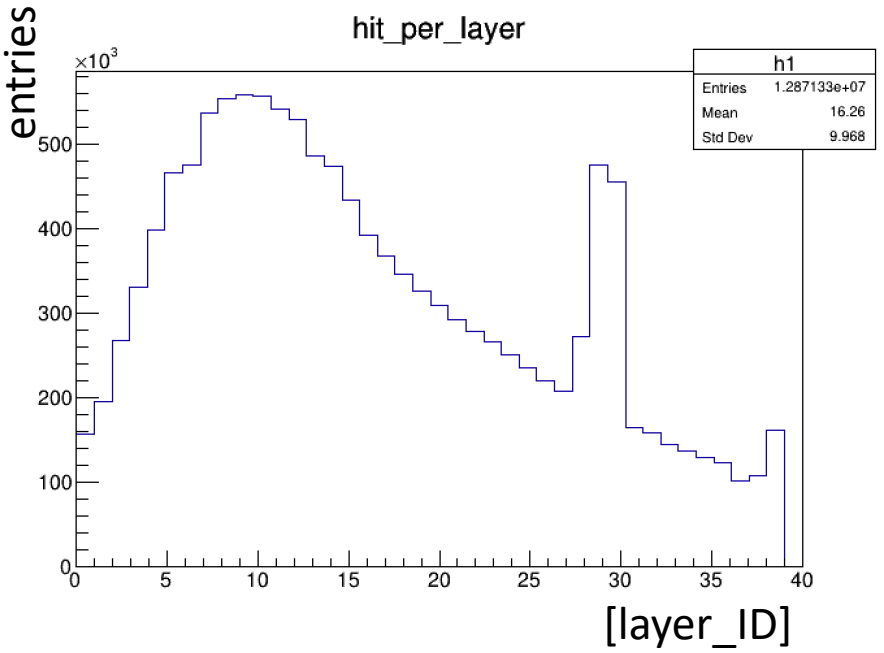
- 20 GeV e+ (AHCAL alone run 127)

Hit # per layer

➡ layer 28 - 30 have a few very noisy channels

➡ Light leakage?



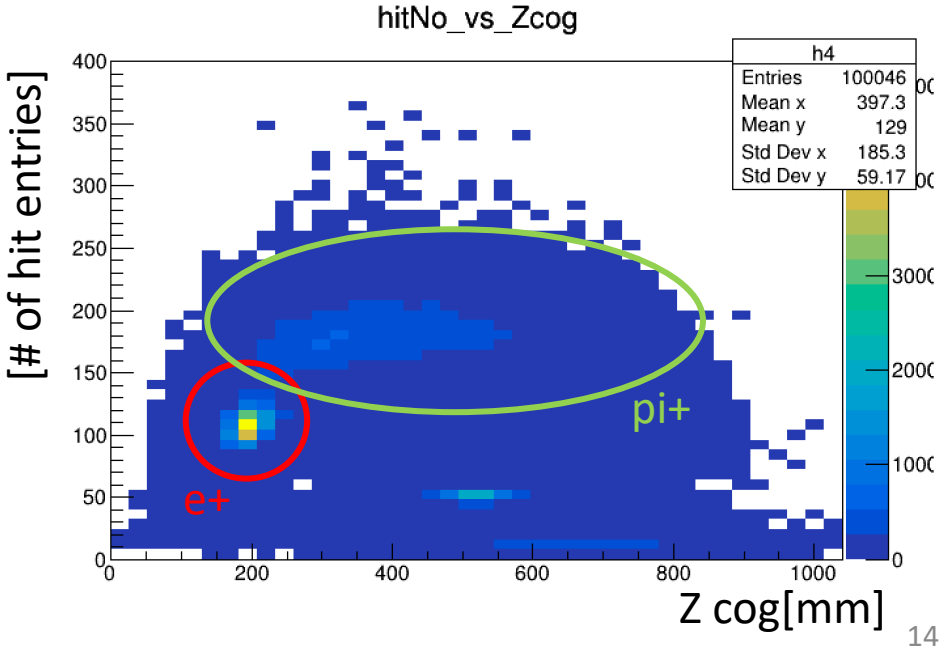


Hit # vs. Center of Gravity Z

$$* z_{CoG} = \frac{\sum_{i=1}^{N_{hits}} z_i \cdot E_i}{E_{sum}}$$

➡ pion-like (shower) events also exists

➡ Can't separate by using Cherenkov bit?



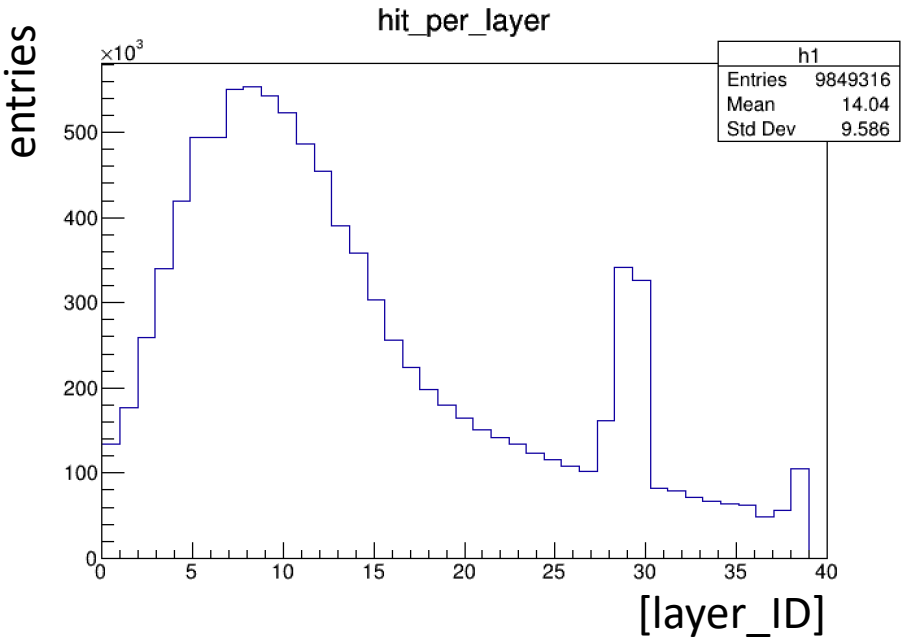
AHCAL beamdata analysis

・20GeV pi+ (AHCAL alone run 155)

Hit # per layer

➡ layer 28 - 30 have a few very noisy channels

➡ positron-like events dominate,
can't see shower-like behavior

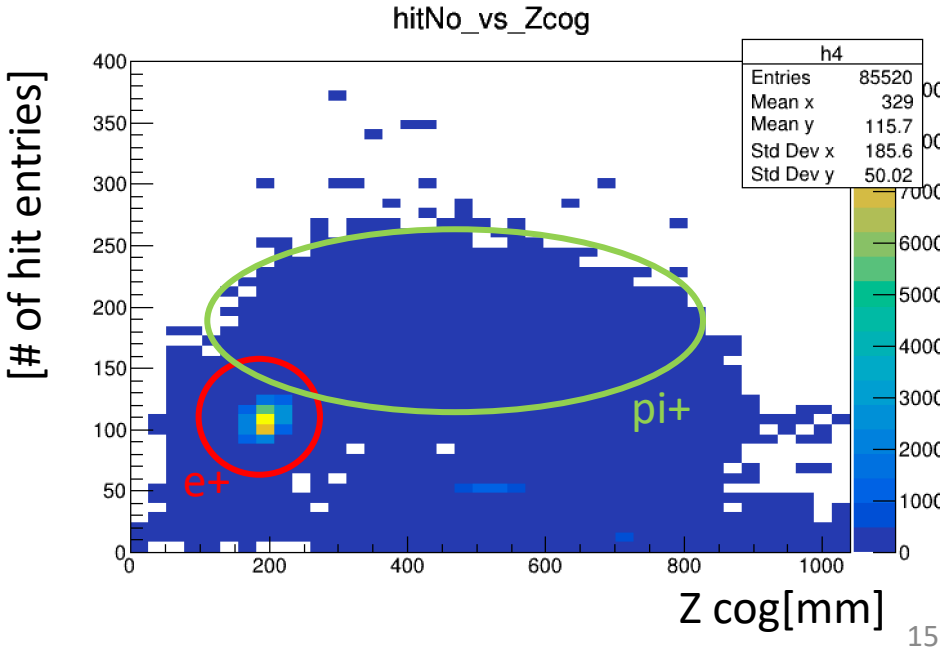


Hit # vs. Center of Gravity Z

$$* z_{CoG} = \frac{\sum_{i=1}^{N_{hits}} z_i \cdot E_i}{E_{sum}}$$

➡ Almost same as e+ run analysis

➡ Need other method for separation?



Summary & prospect

- AHCAL data crosscheck
  - ➡ Pedestal, HG/LG, MIP analysis
    - ➡ Pedestal : There are many channels which have multipeak structure
    - ➡ HG/LG : Specific channels of chip 1,2 have strange HG vs. LG distribution
    - ➡ MIP : Cannot calculate MIP value for 40 (~0.3 %) channels
      Dead channels can be seen more often in layer 38, 39

  under investigation

  - ➡ Efficiency of Cherenkov counter
    (# of event which Cherenkov bit == true)/(# of all event) has been checked
  - ➡ For combined run, the efficiency tends to decrease as beam energy increases
    - ➡ Why?

- Simple PID analysis
  - ➡ Hit number per layer, center of gravity z
  - ➡ Mixture of pion-like and positron-like event can be seen in many runfiles

- Ongoing
  - ➡ Temperature calibration for MIP calculation
  - ➡ Shower radius

• Shower radius (**r**)

$$R_{shower} = \frac{\sum_{i=1}^{N_{hits}} \sqrt{\left(x_{CoGi} - x_i\right)^2 + \left(y_{CoGi} - y_i\right)^2}}{N_{hits}}$$