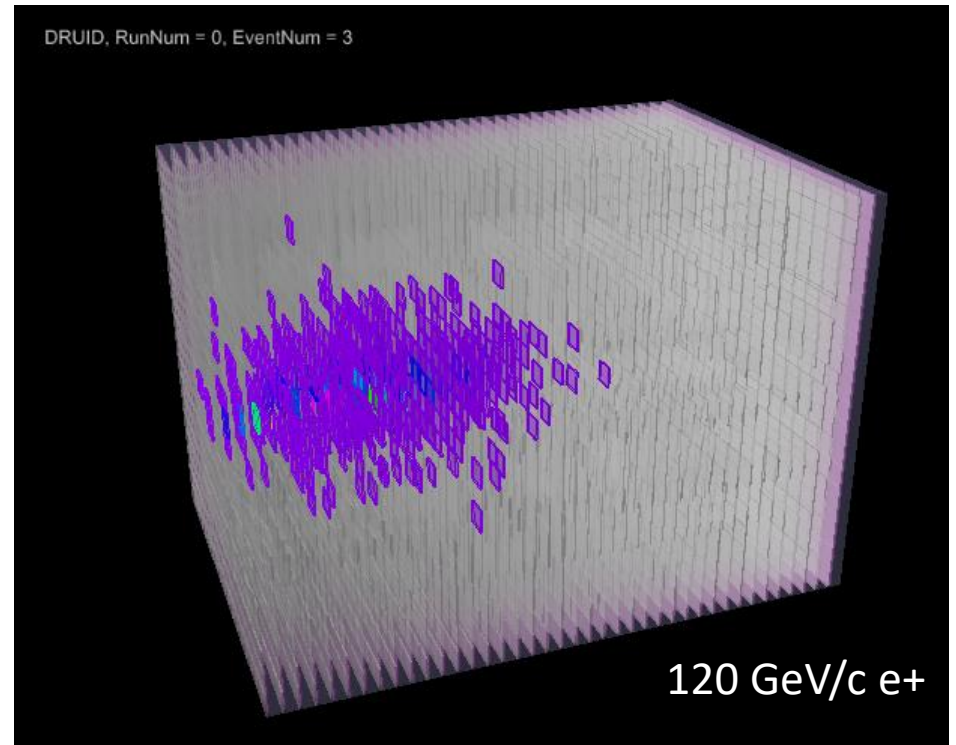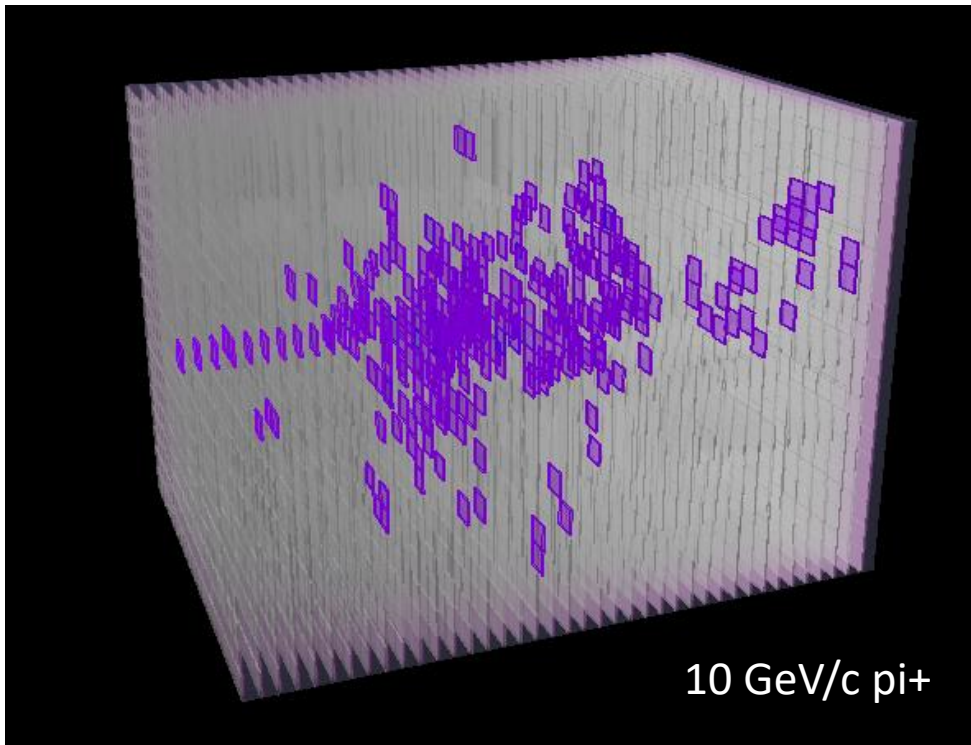# General Updates on Testbeam Simulation

Baohua Qi

February 23, 2023

Taskforce Meeting on CERN Testbeam Data
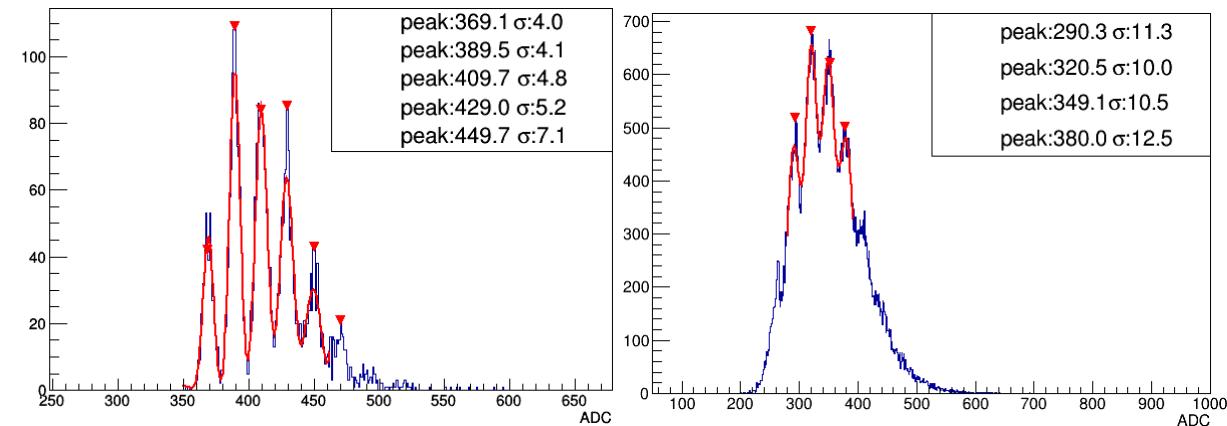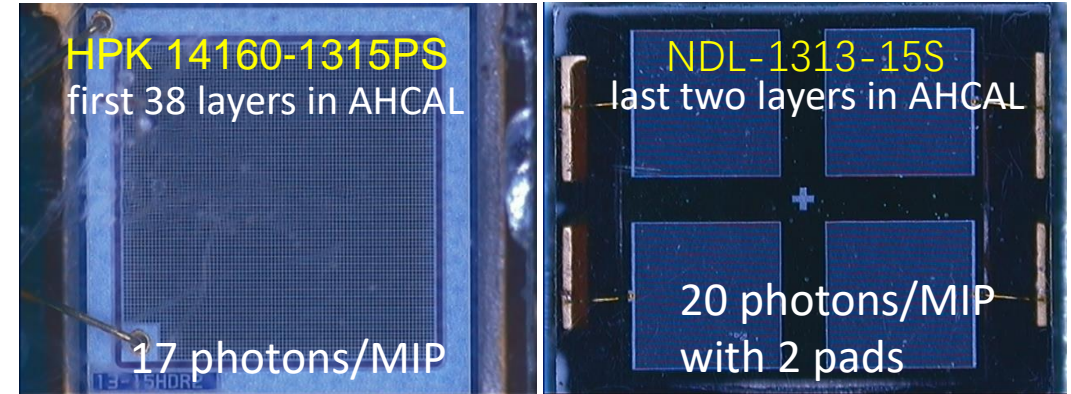
Geant4 simulation for beam test

- Simulation setup: AHCAL alone, Birks effect considered in simulations
- Beam: mu+, e+, pi+

10 GeV/c pi+

DRUID, RunNum = 0, EventNum = 3

120 GeV/c e+

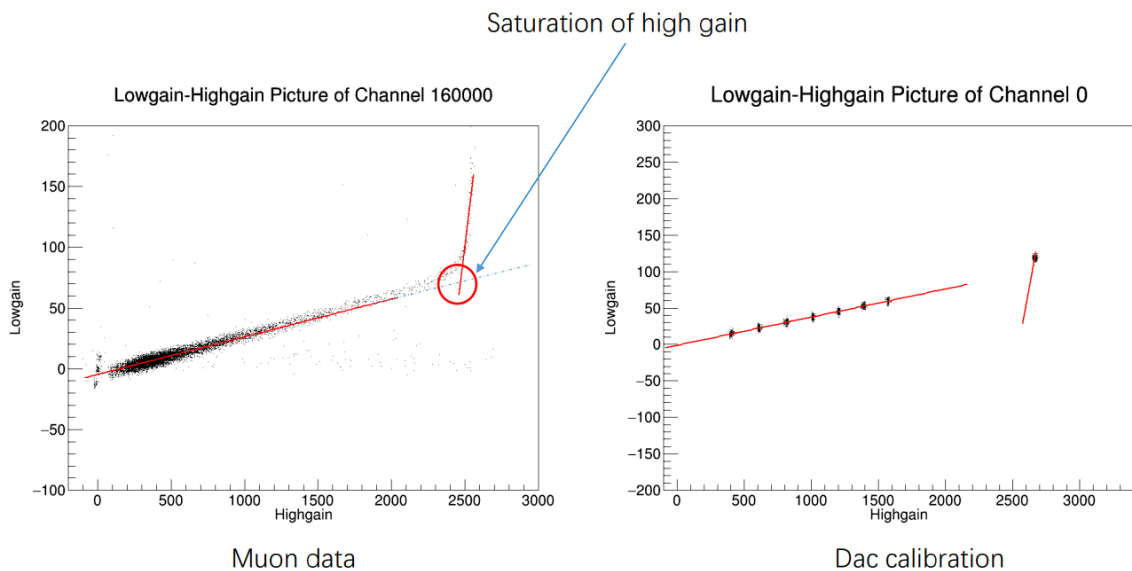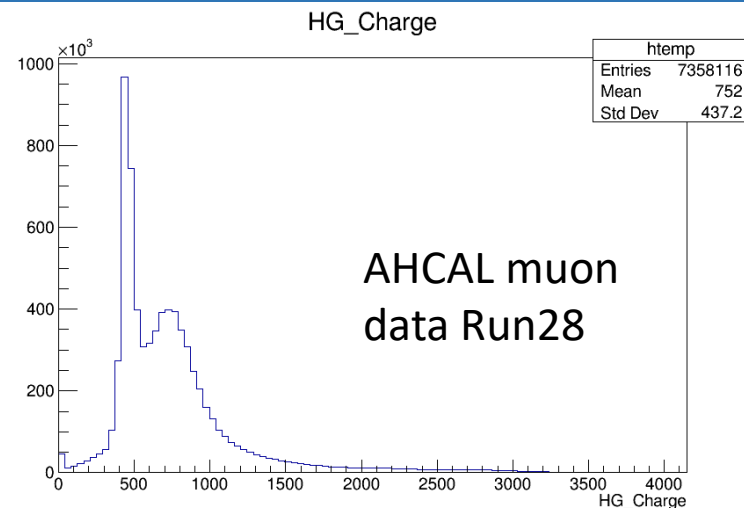# Testbeam: data simulation and digitization method

- Simulation: AHCAL alone
  - Birks effect considered in simulations
- Digitization:
  - Photon statistics: Poisson distribution concerning #detected photons (light output)

  - SiPM signal: $response = \#pixel \times e^{-\frac{photon}{\#pixel}}$
  - SiPM gain uncertainty
  - ADC error: assume 0.02%
  - ADC saturation: based on MIP data
  - Energy cut: 0.3 MIP

HPK 14160-1315PS
first 38 layers in AHCAL
17 photons/MIP

NDL-1313-15S
last two layers in AHCAL
20 photons/MIP
with 2 pads

peak:369.1 σ:4.0
peak:389.5 σ:4.1
peak:409.7 σ:4.8
peak:429.0 σ:5.2
peak:449.7 σ:7.1

peak:290.3 σ:11.3
peak:320.5 σ:10.0
peak:349.1 σ:10.5
peak:380.0 σ:12.5

https://indico.cern.ch/event/847884/contributions/4831207/

- Simulation of ADC response
  - Baseline: ~400 tics
  - High gain: ~300 tics/MIP
  - Low gain: ~8 tics/MIP
  - ADC limit: saturated at ~2700 tics

AHCAL muon data Run28

Saturation of high gain

Lowgain-Highgain Picture of Channel 160000

Lowgain-Highgain Picture of Channel 0

Muon data

Dac calibration

https://indico.ihep.ac.cn/event/18956/contributions/128809/attachments/66894/79174/AHCAL_Data_Calibration.pdf


If use a single HG/LG switch
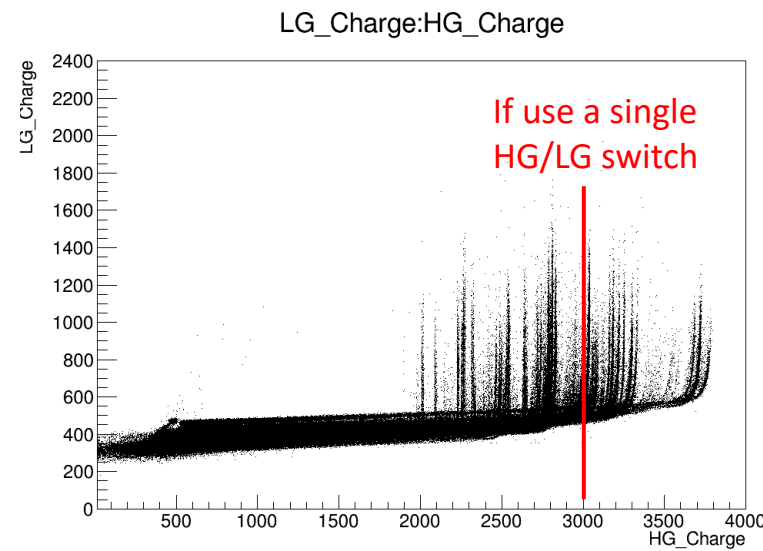
10 GeV pi+ data: need to adjust HG/LG threshold for different channels

Is there a correlation between the MIP peak and HG/LG threshold?

10 GeV pi+ events

- Preliminary analysis: AHCAL alone, redline: digitization, violet line: data
- High gain/Low gain switch in data: 3000 tics
- Since high gain ADC will be saturated at ~2700 tics in simulation, the low gain information is unused
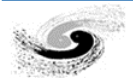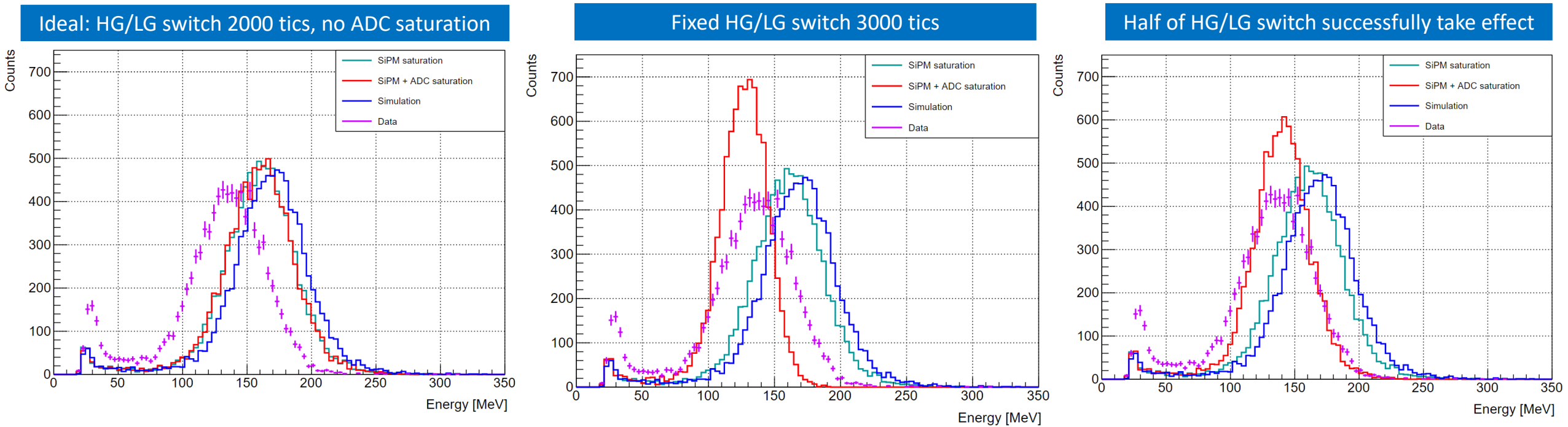
120 GeV e+ events

- Preliminary analysis: AHCAL alone
- The data seems contain a large fraction of hadrons