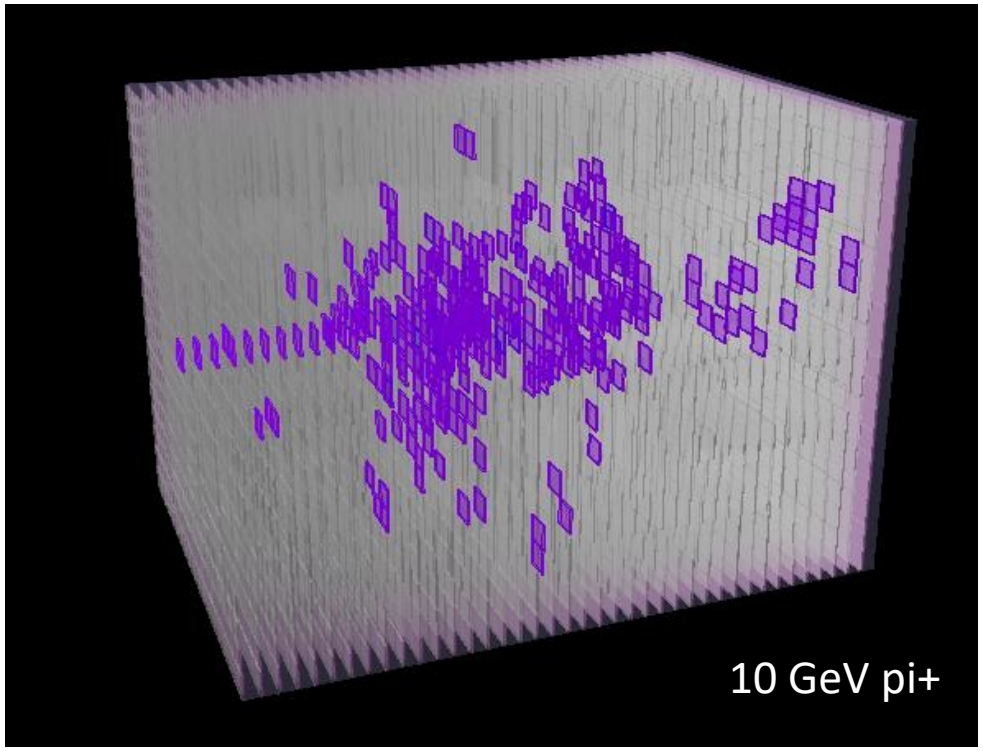
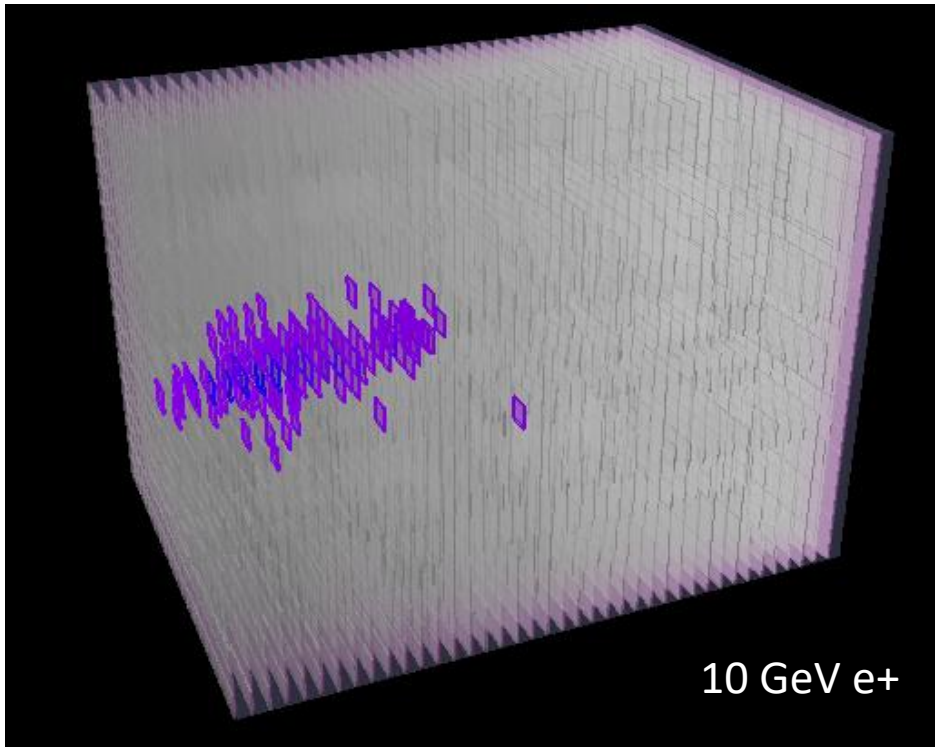
# Geant4 simulation for beam test

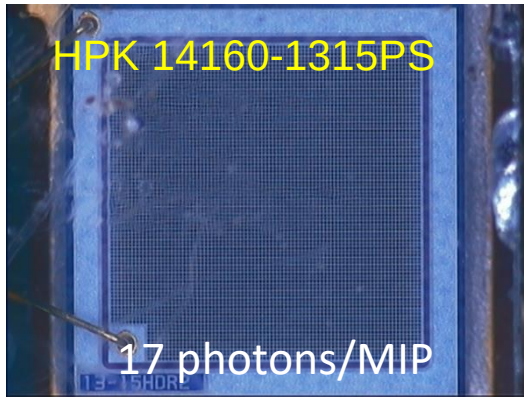
- Simulation setup: AHCAL alone
- Beam: mu+, e+, pi+

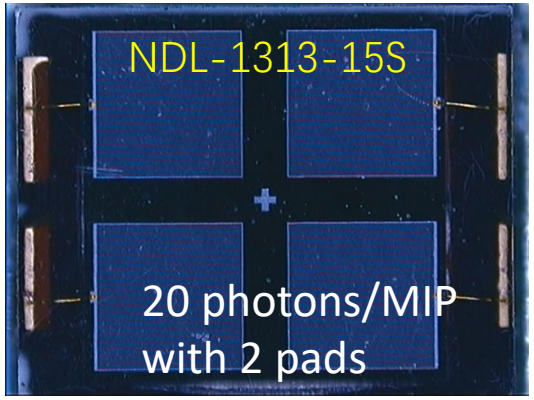


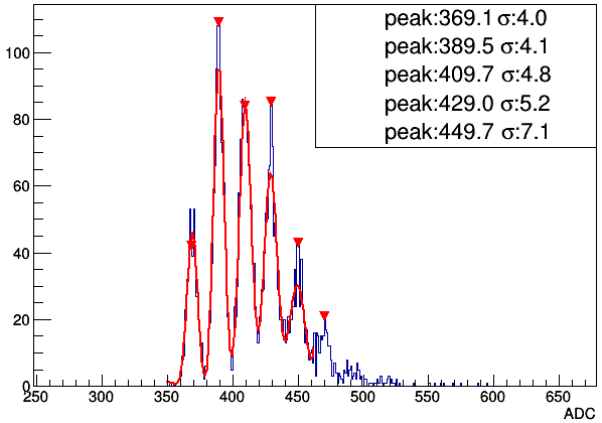



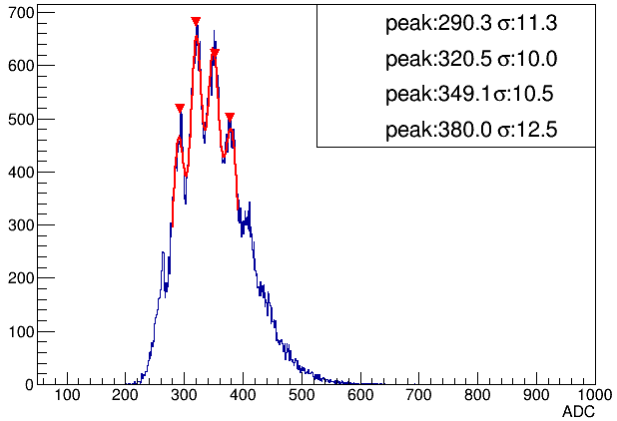
# Digitization method

- Digitization:
  - Photon statistics: Poisson distribution concerning #detected photons (light output)
  - SiPM saturation: $response = \#pixel \times e^{-\frac{photon}{\#pixel}}$
  - SiPM gain uncertainty: increases with #photon
  - ADC error: assume 0.02%, very low
  - Energy cut: 0.5 MIP
- SiPM
  - S14160-1315PS for first 38 layers in AHCAL
  - EQR15 22-1313D-S for last two layers



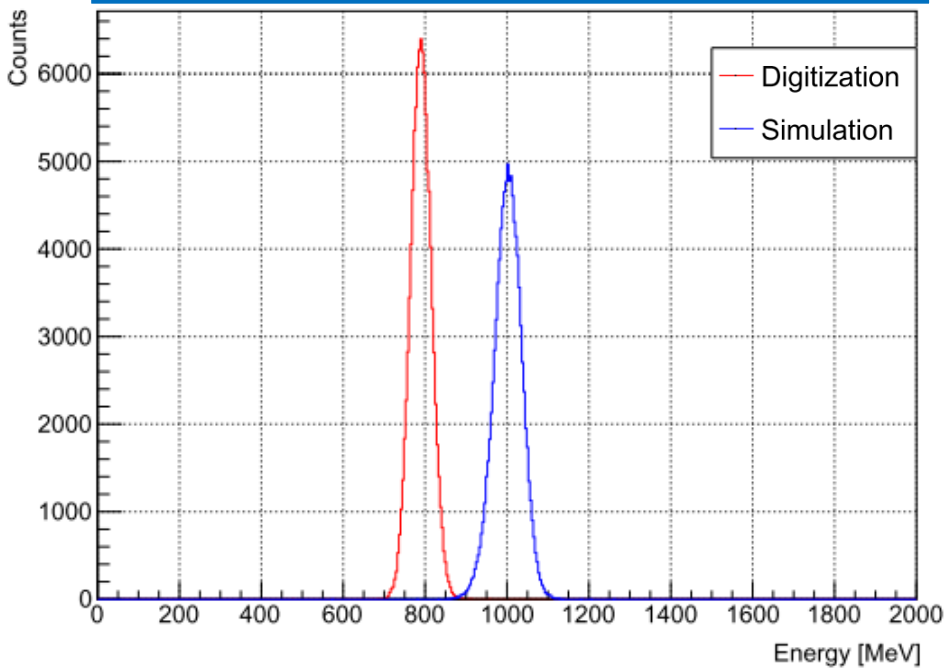




https://indico.cern.ch/event/847884/contributions/4831207/

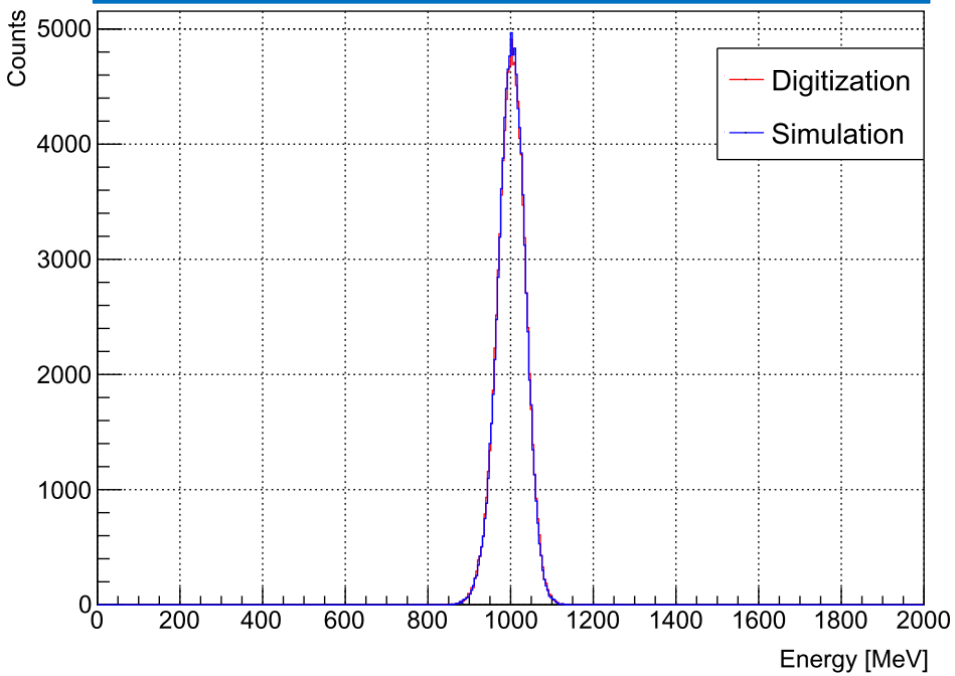
# Positron events

- Preliminary analysis: AHCAL alone, redline: digitization, blue line: simulation
- Birks effect considered in simulations

Full digitization for 50 GeV e+



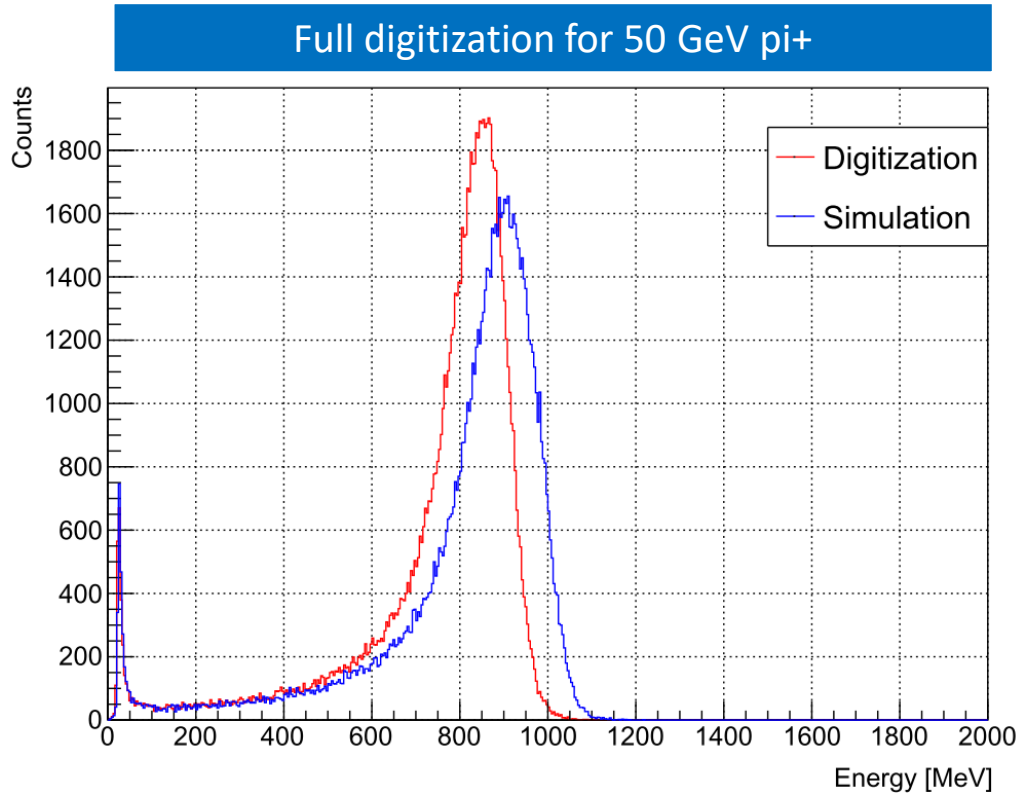

Consider only photon statistics




- Photon statistics effect is not significant in current AHCAL simulation setup
- Better resolution after digitization

# Pion+ events

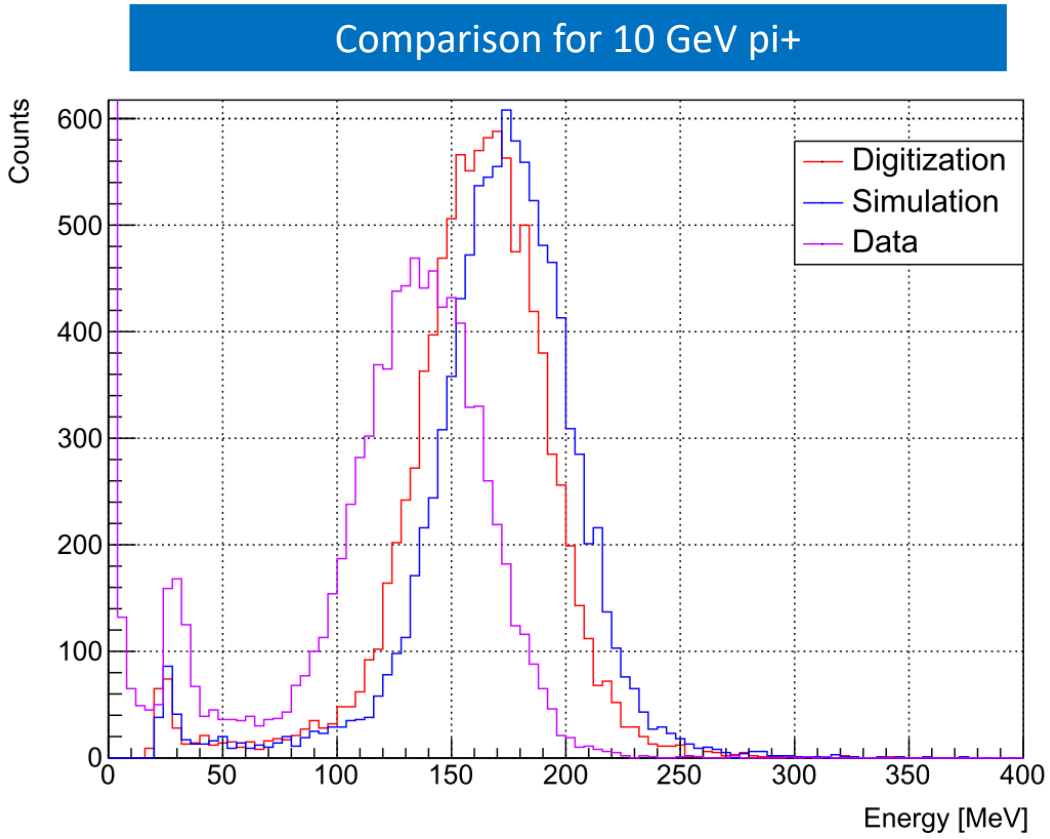
- Preliminary analysis: AHCAL alone, redline: digitization, blue line: simulation
- Birks effect considered in simulations




- Similar MIP peak: digitization barely affects the muon (MIP-like) events
- SiPM saturation and energy cut lead to a shift in the detected energy

# Pion+ events compare with data

- Preliminary analysis: AHCAL alone, redline: digitization, blue line: simulation, violet line: data
- Birks effect considered in simulations




- AHCAL Run156, 10000 events
- MIP-like response in simulation is lower than data
- Pion peak in simulation has higher energy than data: more serious saturation effect? Energy loss?