PDHD X-Arapuca efficiency studies

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ProtoDUNE PDS Sim/Reco Meeting

11 November, 2024

Outline

- **Main Goal**
  - Estimate the Supercell detection efficiency

$$\frac{\#PEs\ (Data)}{\#LPs\ (Sim)}$$

This presentation

- **Particle sample**
  - Kaons and Electrons -> 1 GeV (5% of dispersion and Background)
  - Electrons -> 7 GeV (5% of dispersion and Background)
  - Do not considering cosmic (slow simulation)

Simulated Data

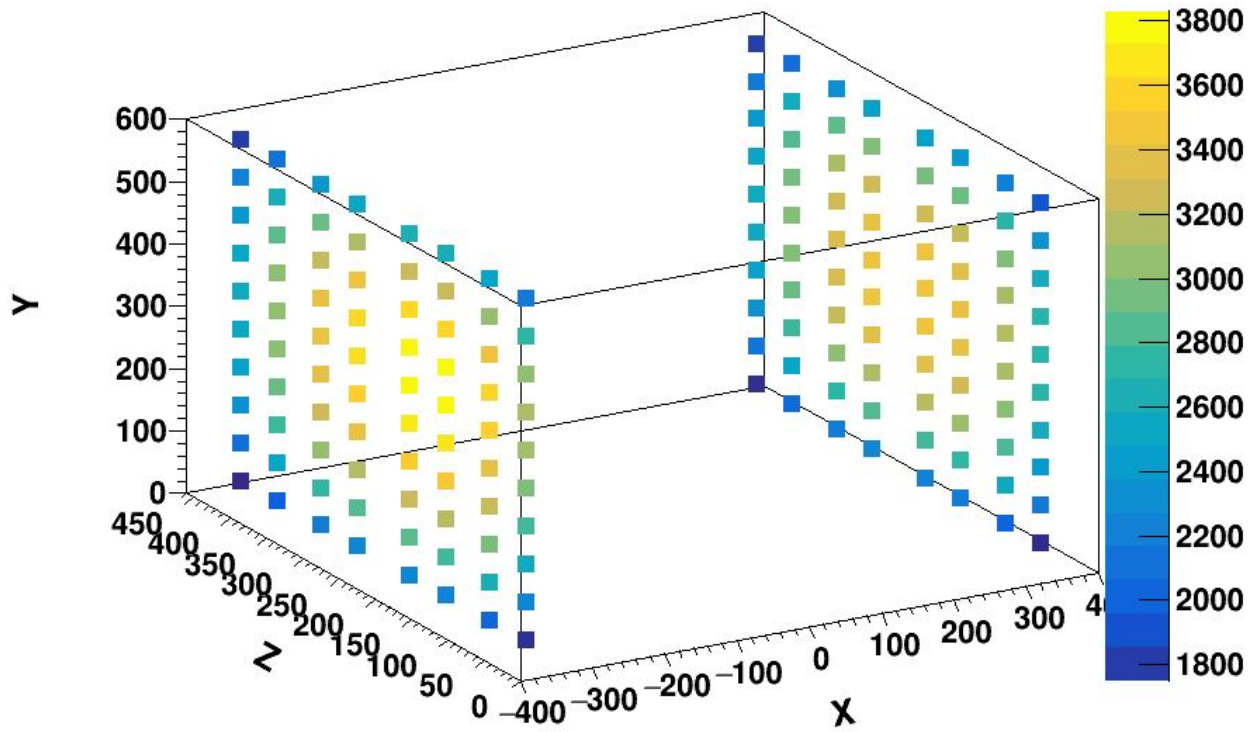
- **Background**
  - **Decay-0 model**
    - LAr only (Ar39, Ar42, Kr85, K42fromAr42)
    - From -3ms to 3ms

- **Beam Particles**
  - Single particle gen (1000 events each sample)
  - Using configs from ProtoDUNE-SP (*protoDUNE_gensingle.fcl*, not the ones in prodsinglep_protodunehd.fcl)

- **G4 Stage**
  - Using semi-analytical (hybrid) model
  - LArQL model

Results

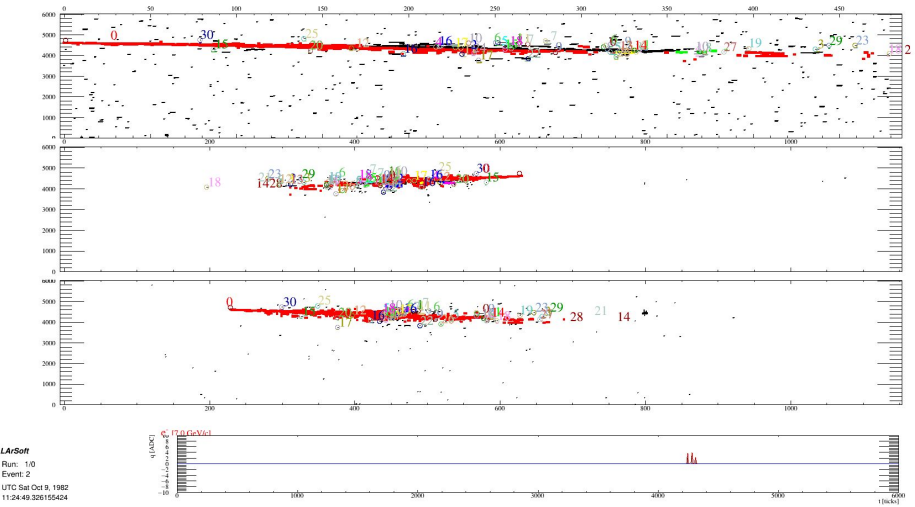
- **Background only (full sim window)**



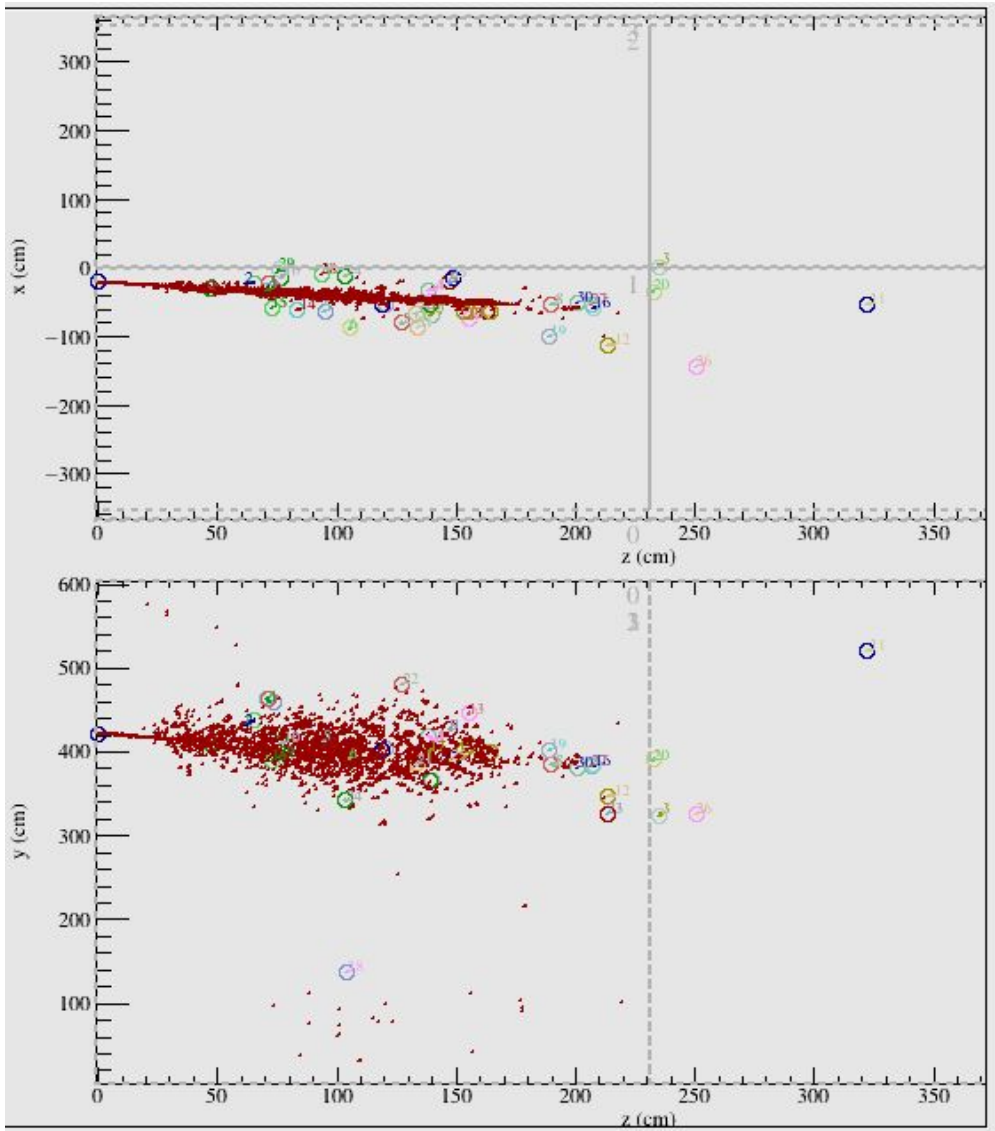
Results

- **Beam only (Event display)**

Electron Track (7 GeV)

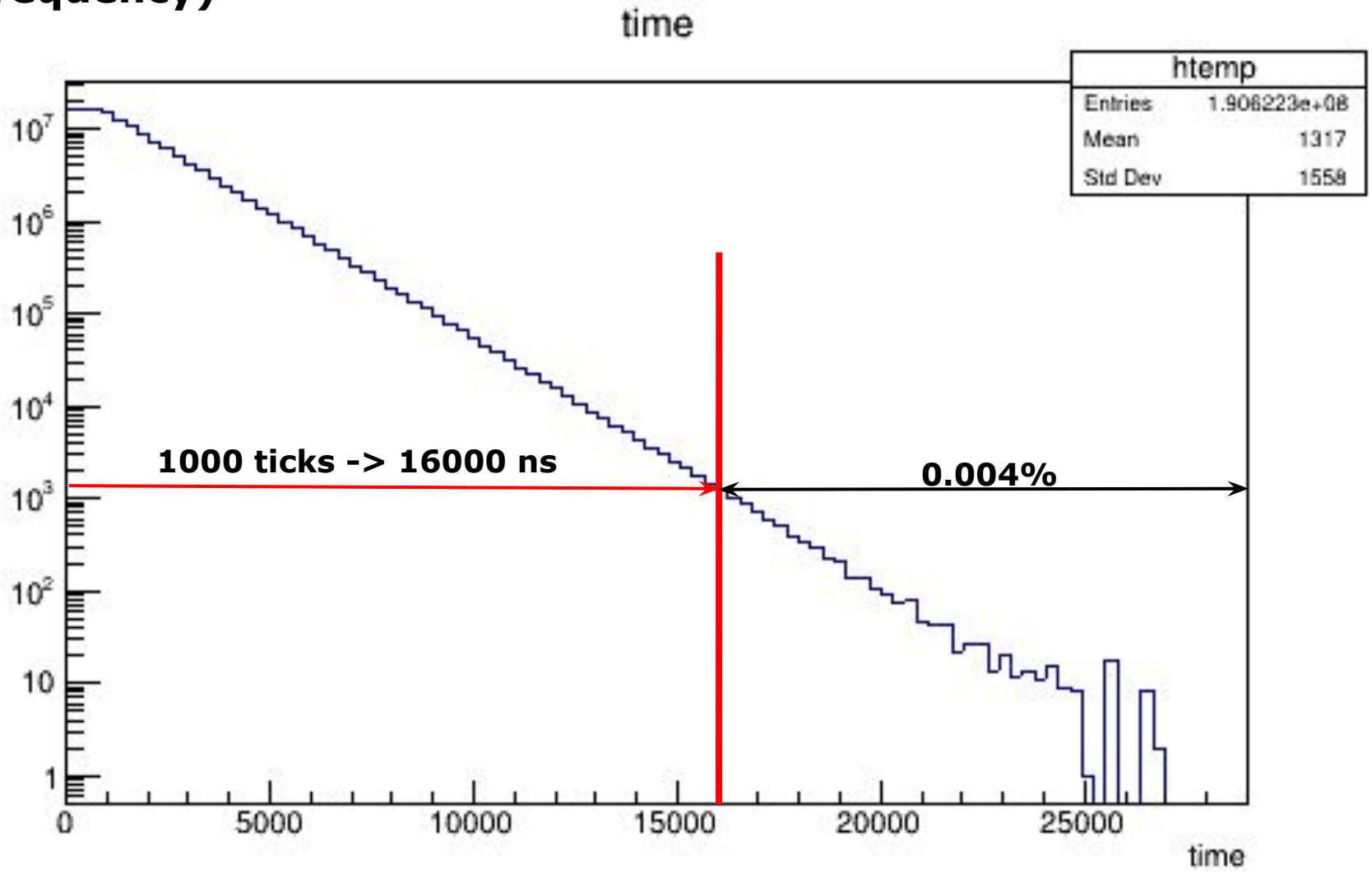


Beam origin from ProtoDUNE-SP



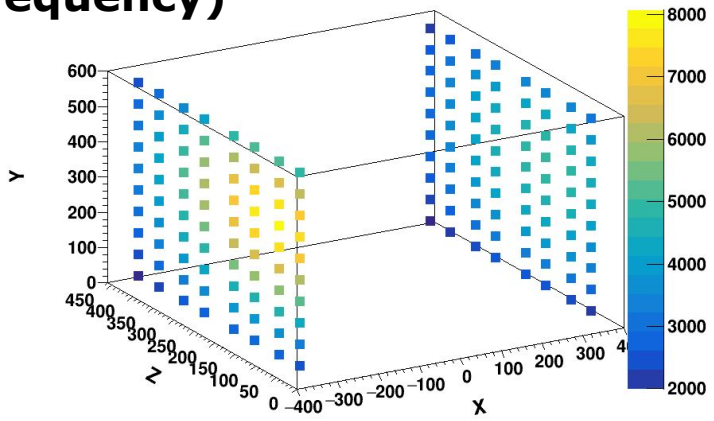
Results

- **Beam only (Time, 1 readout window = 1000 ticks , 62.5 MHz frequency)**

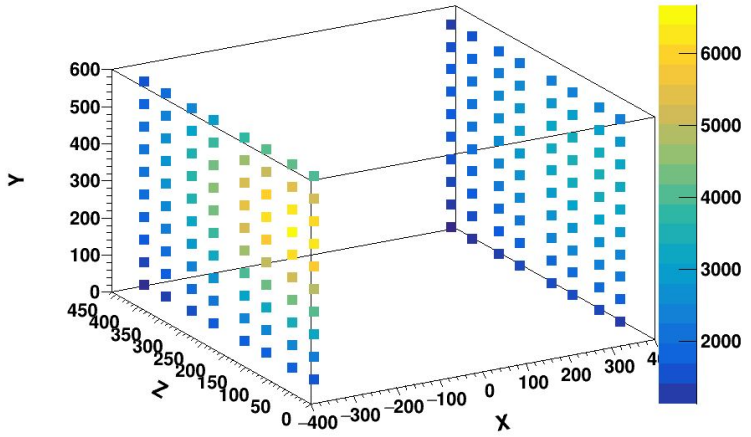


Results

- **Beam + Background (1 readout window = 1000 ticks , 62.5 MHz frequency)**

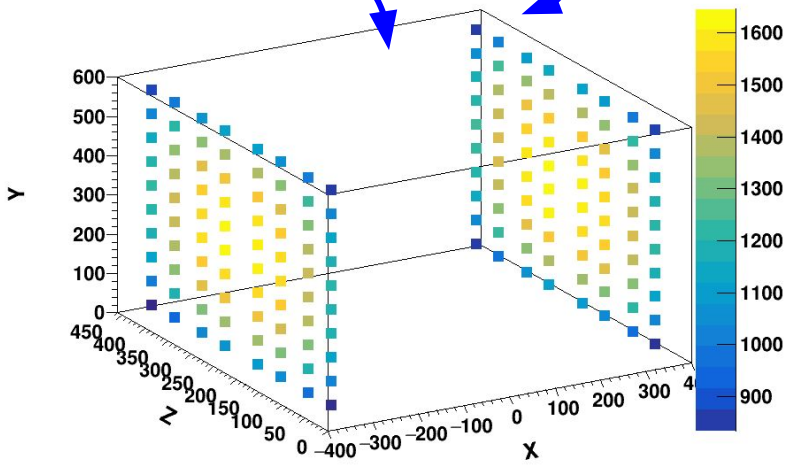


Electron 1 GeV with 5% of dispersion and background



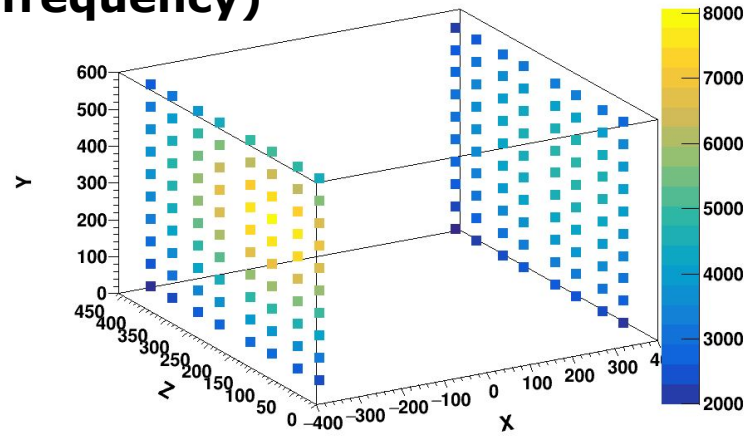
Electron 1 GeV with 5% of dispersion, background and time

Difference

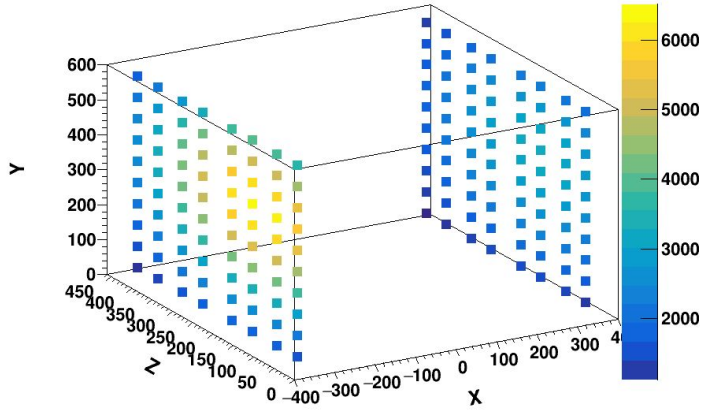


Results

- **Beam + Background (1 readout window = 1000 ticks , 62.5 MHz frequency)**

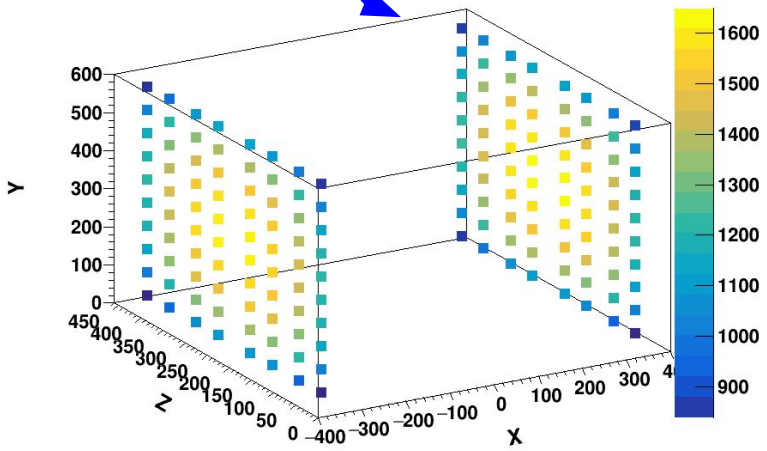


Kaon 1 GeV with 5% of dispersion and background

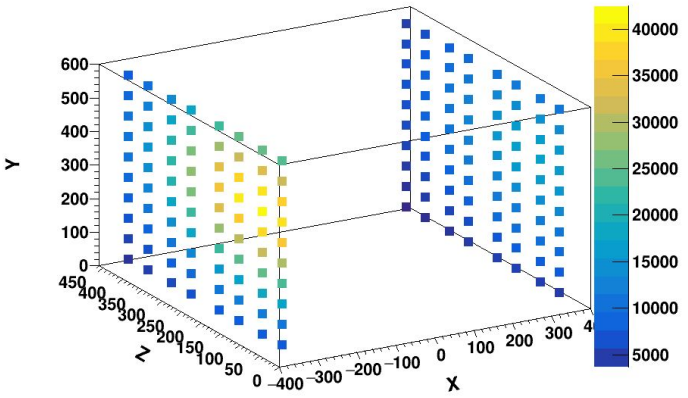


Kaon 1 GeV with 5% of dispersion, background and time

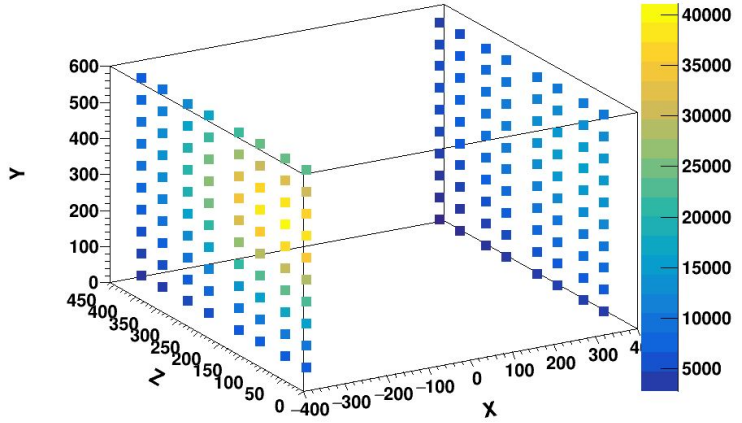
Difference



Results

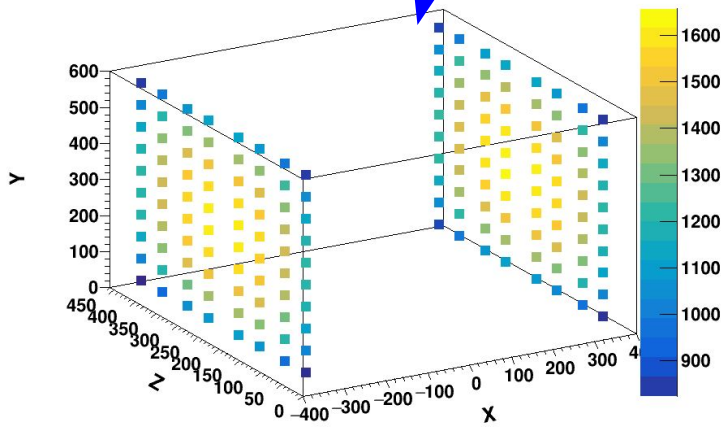


Electron 7 GeV with 5% of dispersion and background



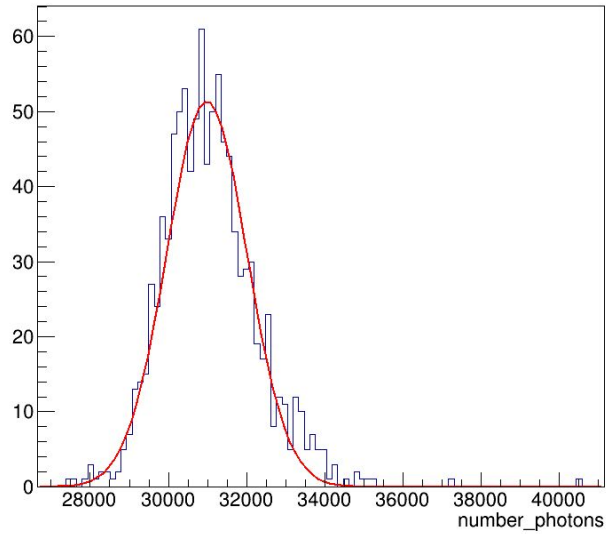
Electron 7 GeV with 5% of dispersion, background and time

Difference

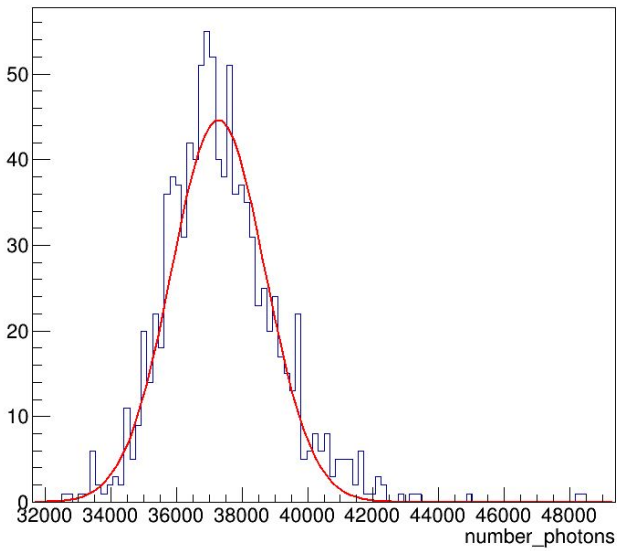


Results (Electron7GevBg)

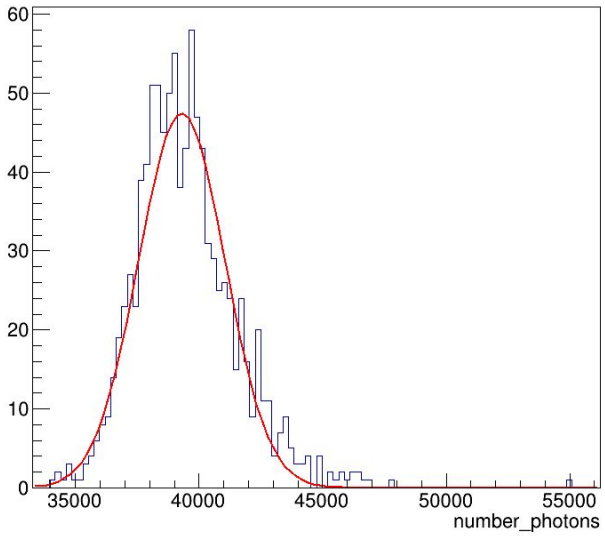
Channel 131



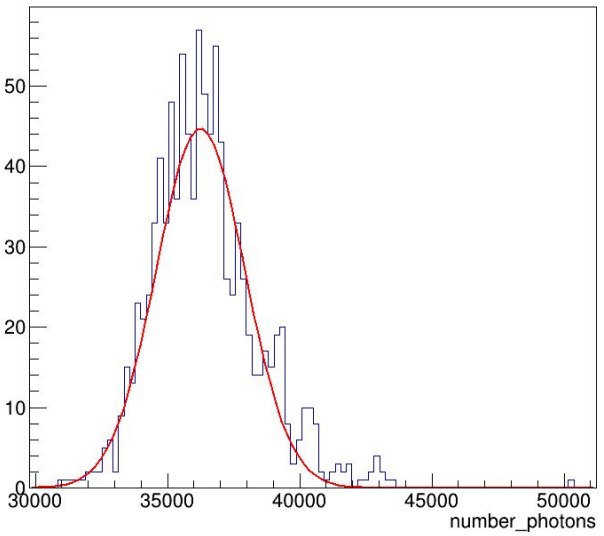
Channel 132



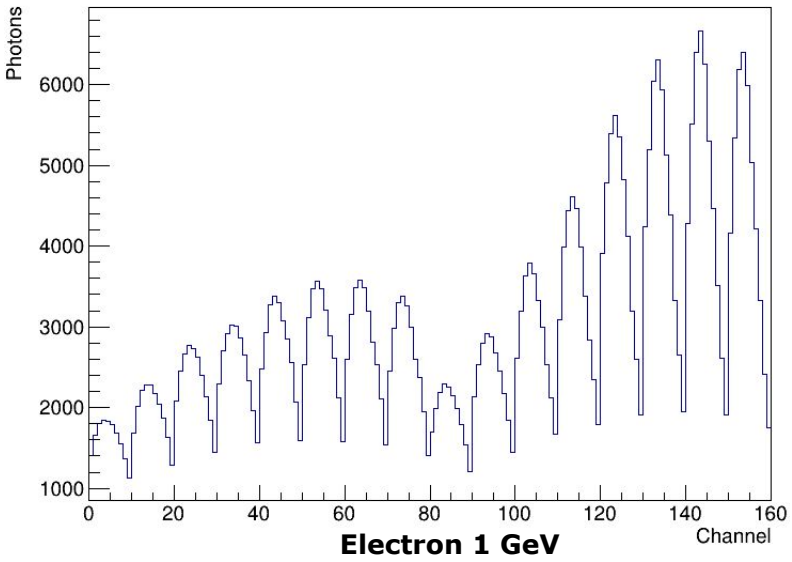
Channel 133

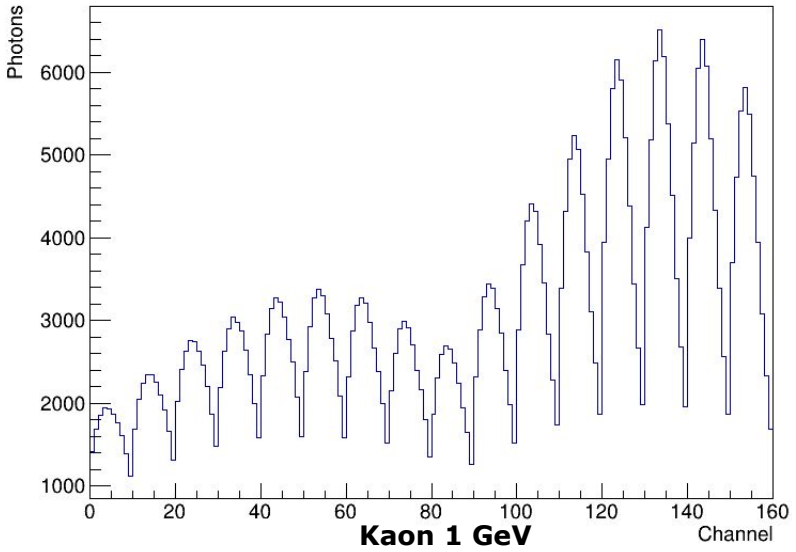


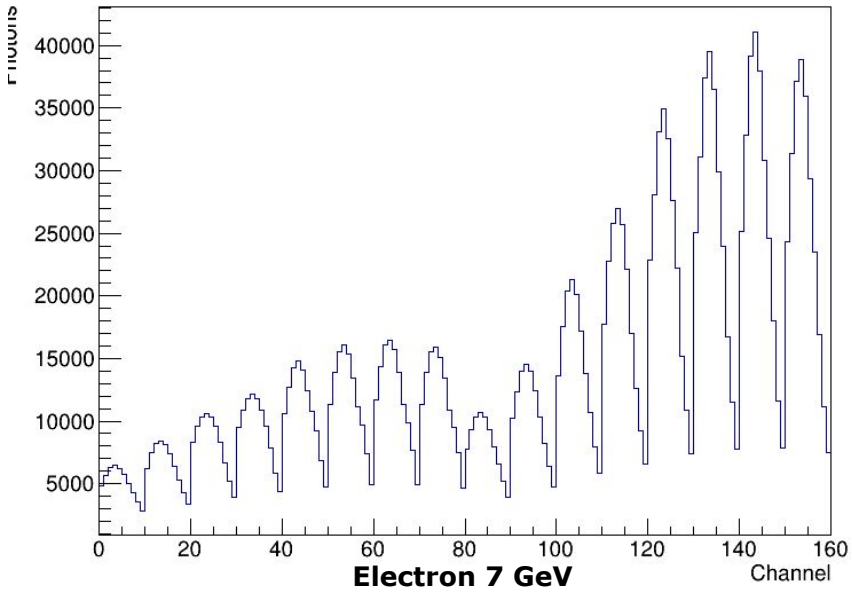
Channel 134



Results


Photons
6000
5000
4000
3000
2000
1000
0
20
40
60
80
100
120
140
160
Channel
Electron 1 GeV


Photons
6000
5000
4000
3000
2000
1000
0
20
40
60
80
100
120
140
160
Channel
Kaon 1 GeV


40000
35000
30000
25000
20000
15000
10000
5000
0
20
40
60
80
100
120
140
160
Channel
Electron 7 GeV

Conclusions

- **Update beam origin in simulation**
  - (-48.68 cm, 400.61 cm, 0cm)

- **Evaluate cosmic contamination for beam events**
  - Better to use clear cosmic free sample (using CRT data)
  - For other half, evaluate PD efficiency base on CRT data

- **Evaluate data (measured #PEs)**

Next steps

$$\frac{\#PEs\ (Data)}{\#LPs\ (Sim)}$$

Thank you for your attention!