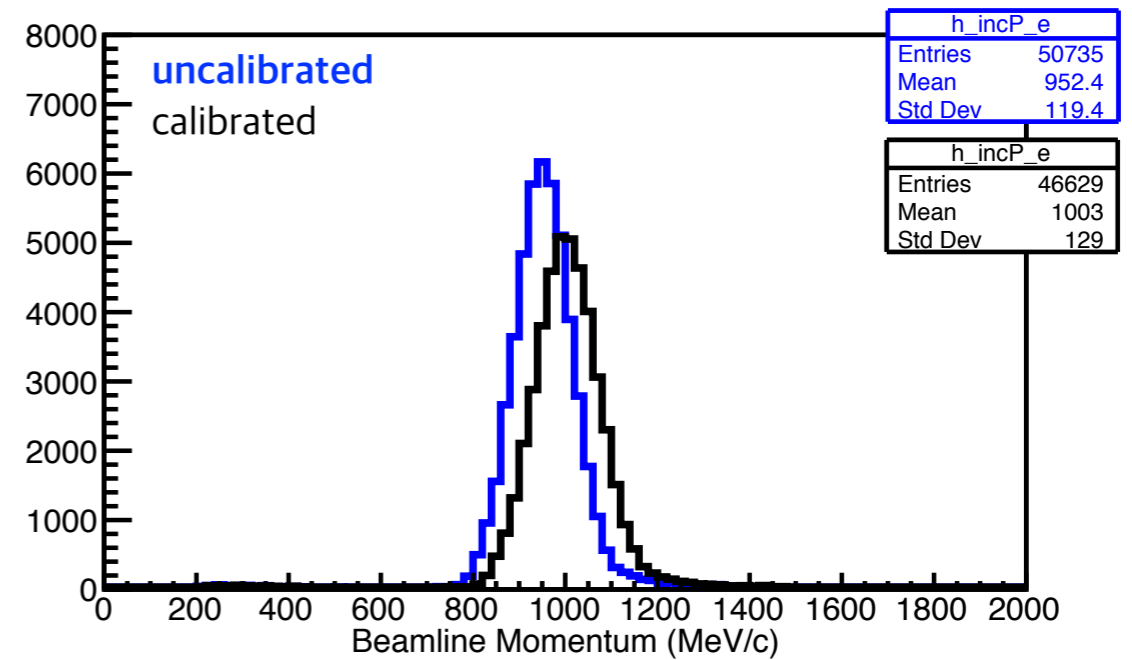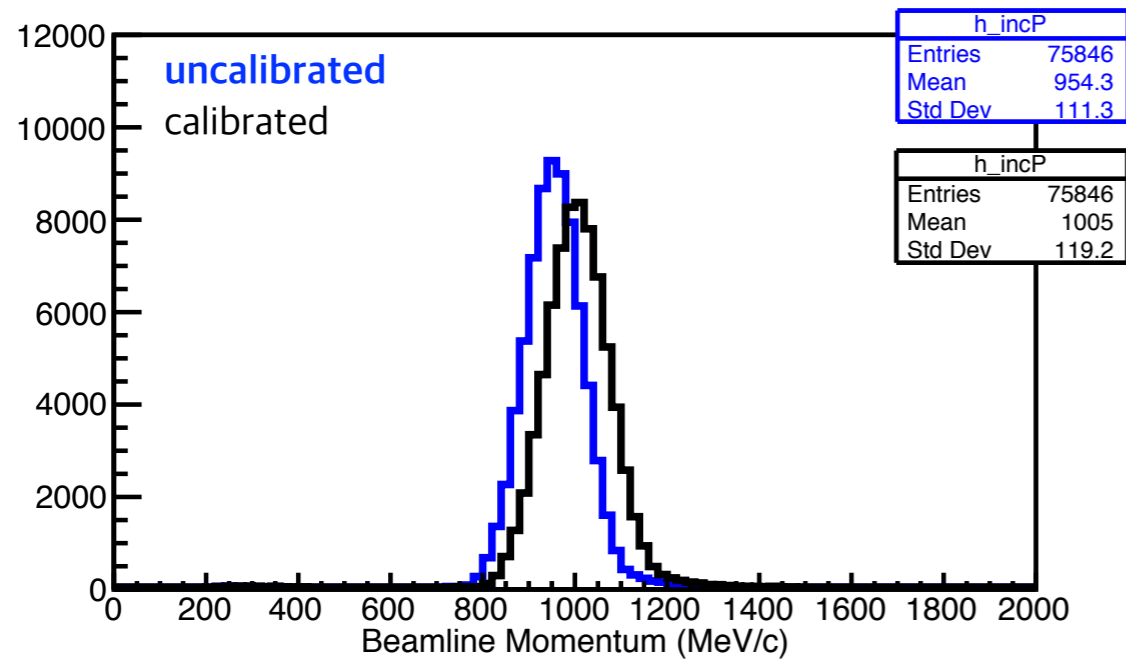# ProtoDUNE
Electron analysis

Aaron Higuera
University of Houston

Outline

1. Re-processing of run 5809 (beamevent producer)

2. High statistics samples data-MC comparison
   ```
   mcc11_pd_sp_sce_1.0GeV_histats
   mcc11_pd_sp_3ms_1.0GeV_histats
   ```

3. Electron Analysis Deliverables
   dE/dx
   longitudinal profile

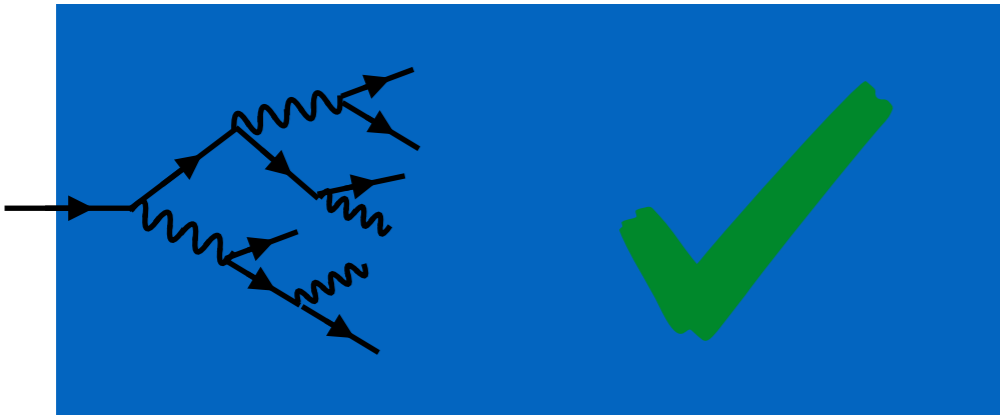# run 5809

Re-run **beamevent** produce w/ v_08_12_00

Beam triggers with beamline momentum
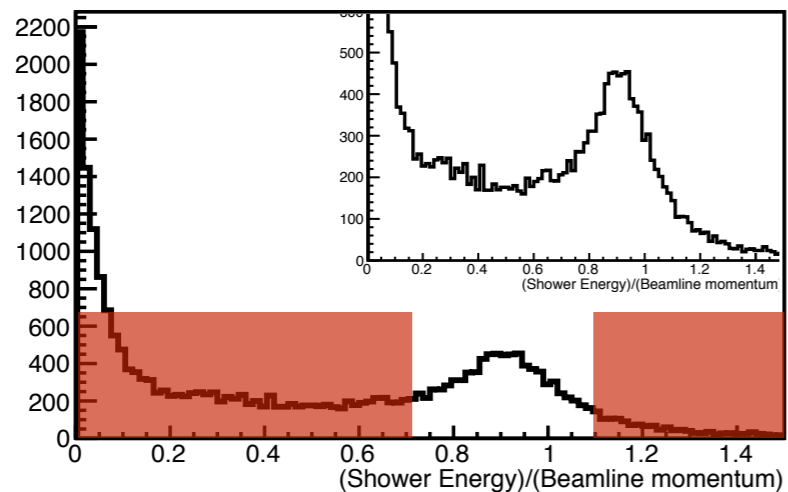
Beam triggers with beamline momentum
w/ Cherenkov[1] == 1
~8% less events, is this expected?
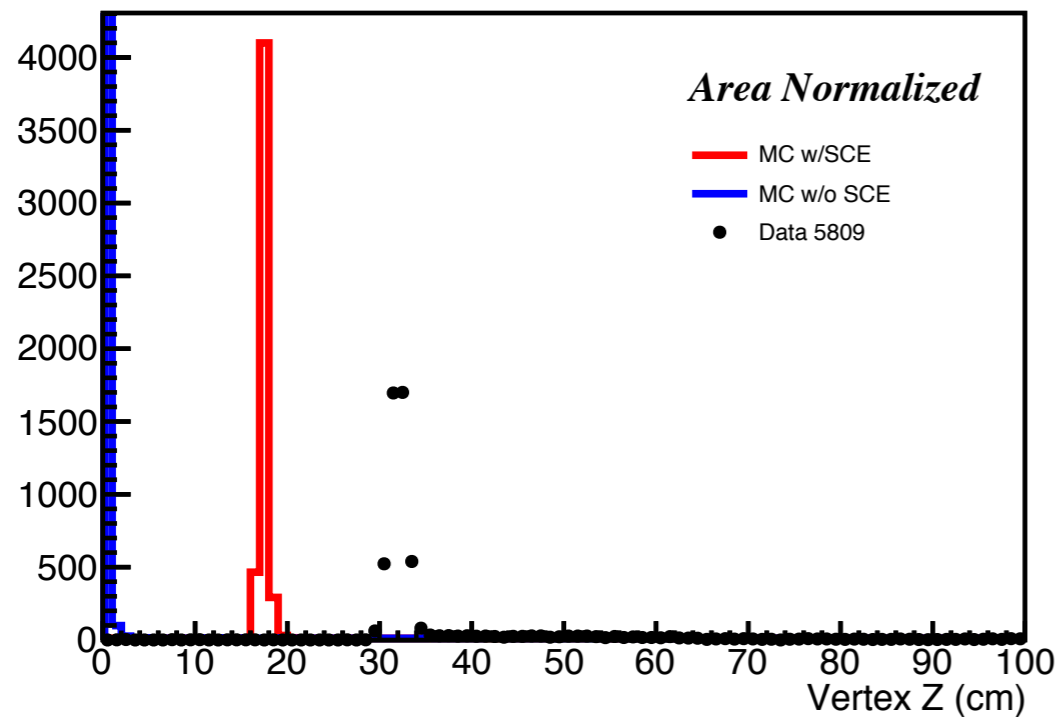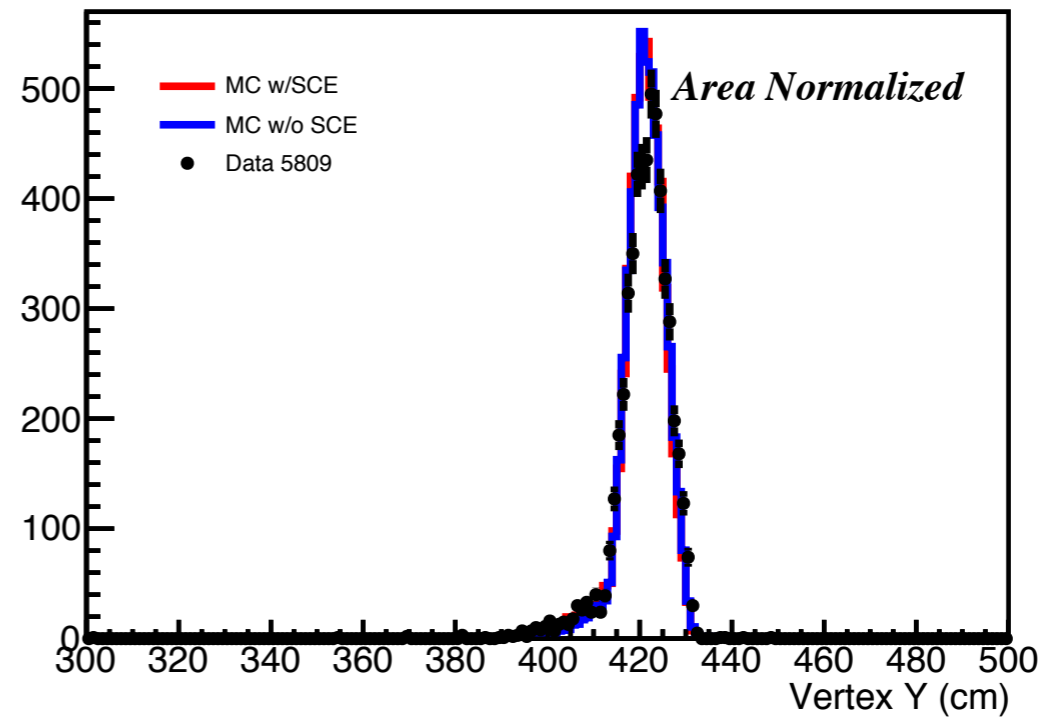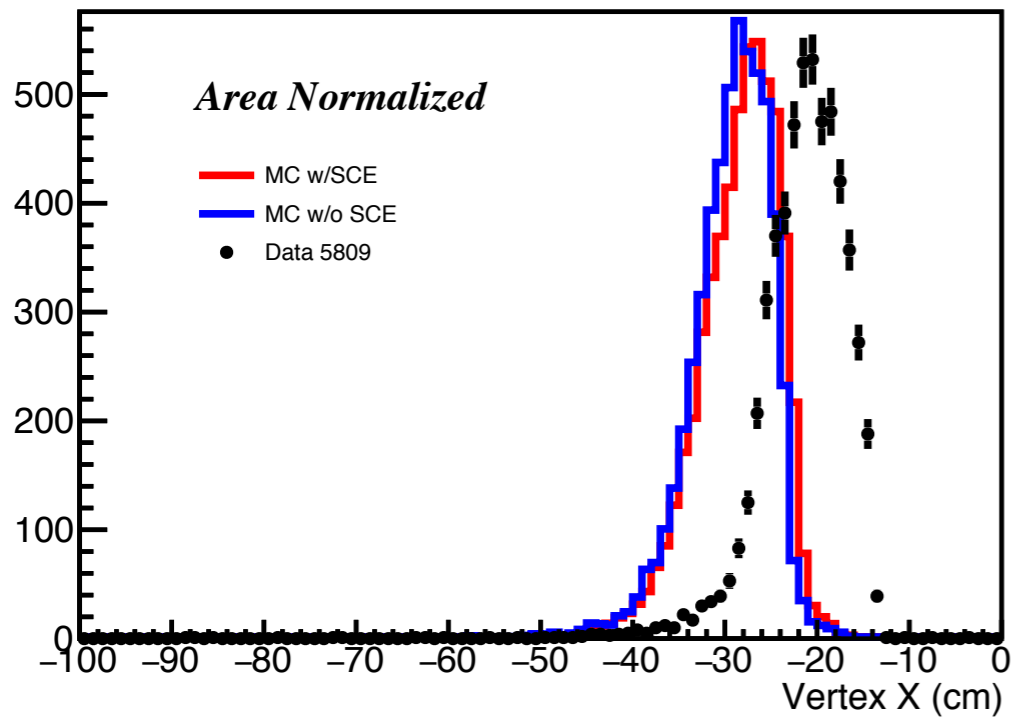Is this due to the calibration?

Electron Selection

- Select beam triggers with reconstructed momentum
- Select electron candidates (
- CherenkovStatus[1] == 1)
- Select events with a PFParticle as a shower
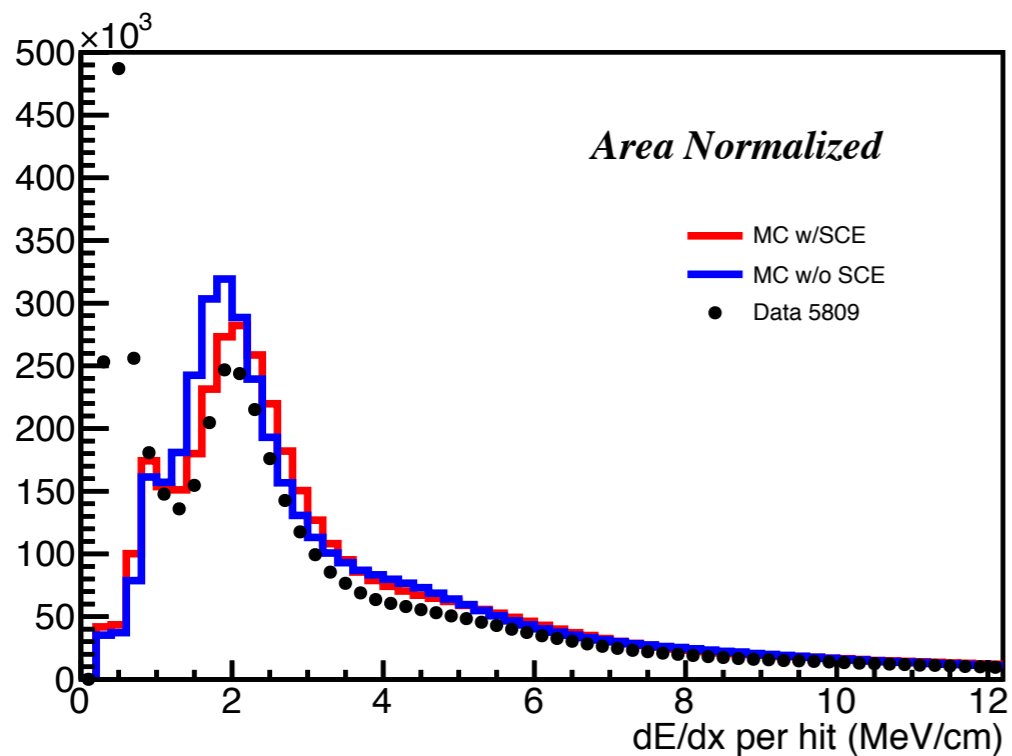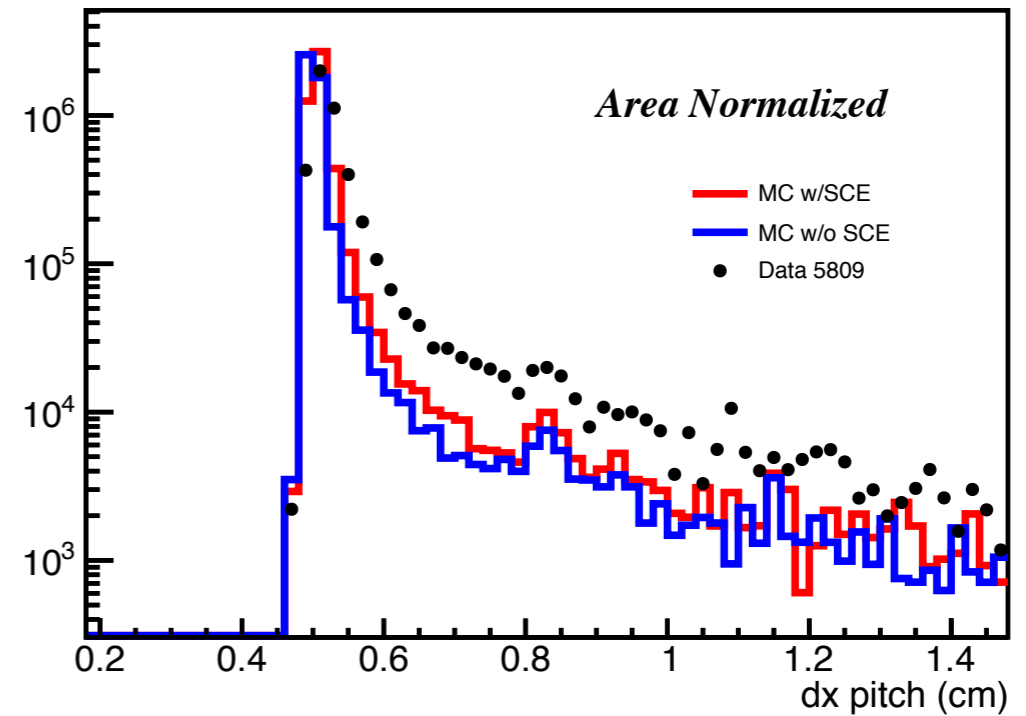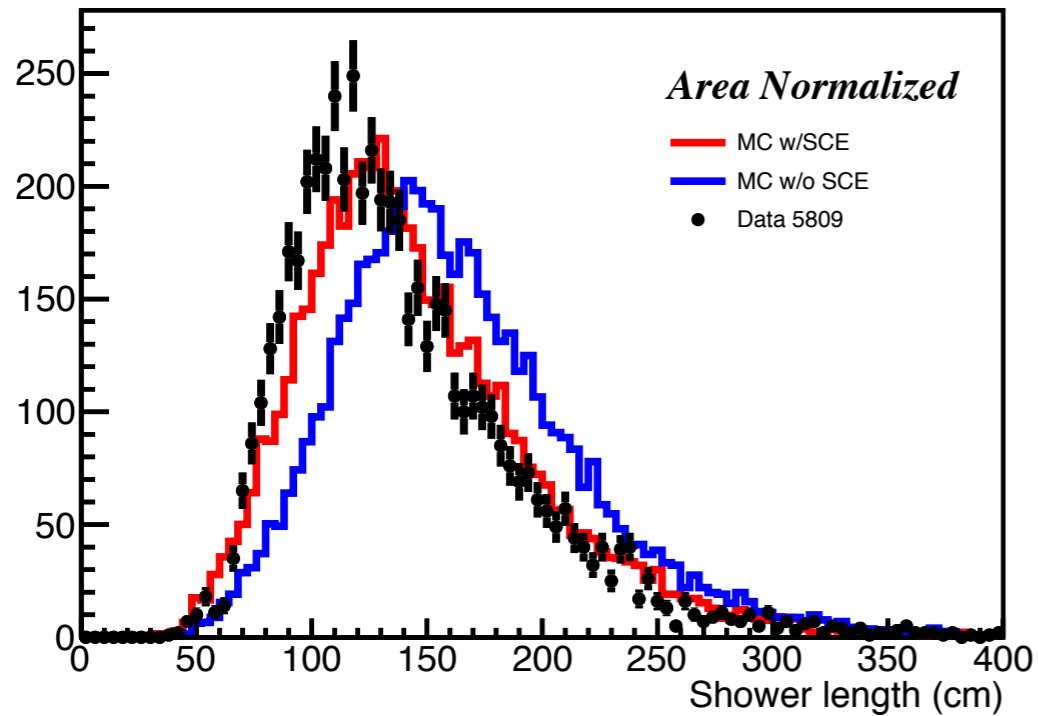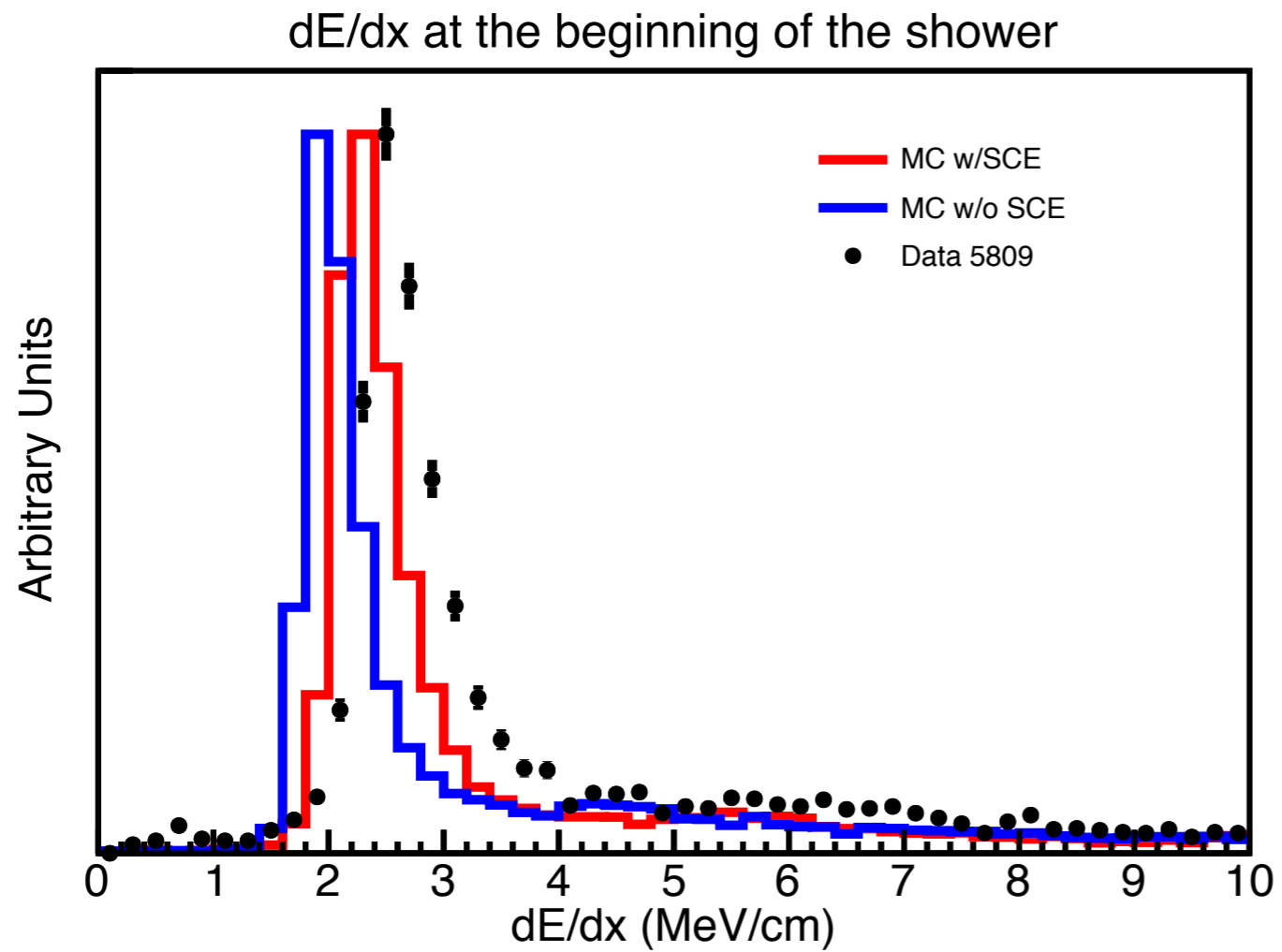- Select complete showers

Data/MC Comparisons

Vertex distributions are consistent with a higher SCE in data

Data/MC Comparisons

Shower length is consistent with a higher SCE in data

Data/MC Comparisons

dE/dx at the beginning of the shower

Legend:
- MC w/SCE
- MC w/o SCE
- Data 5809

Axis labels: Arbitrary Units (y-axis), dE/dx (MeV/cm) (x-axis)

Data/MC Comparisons
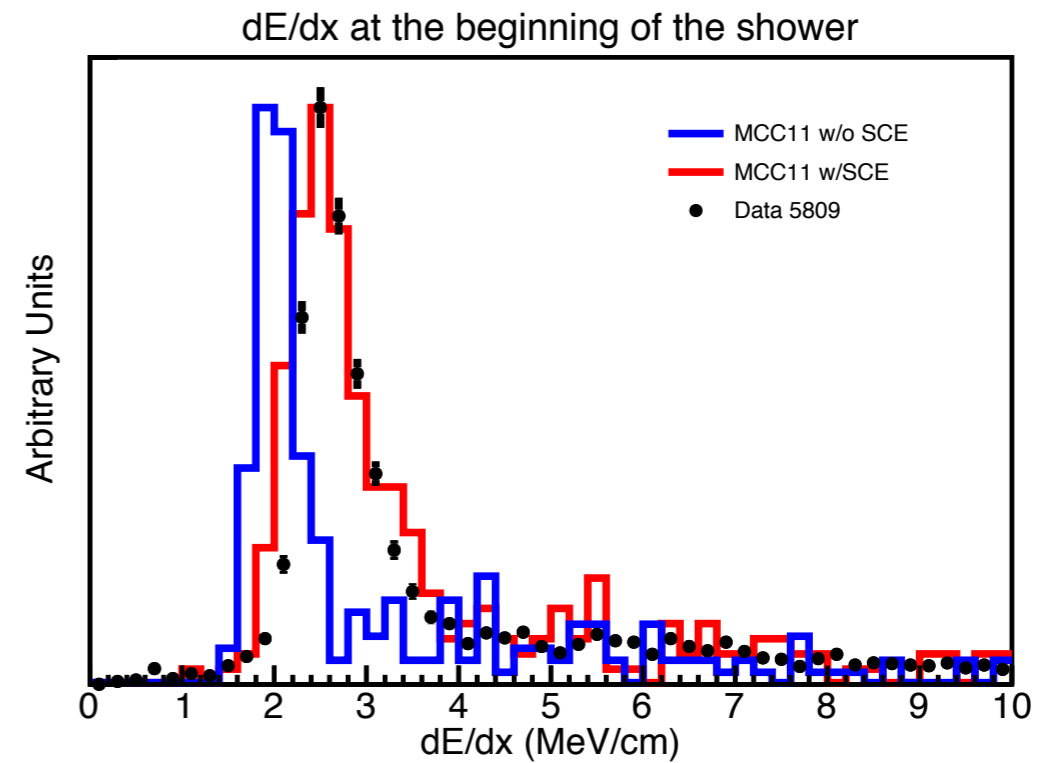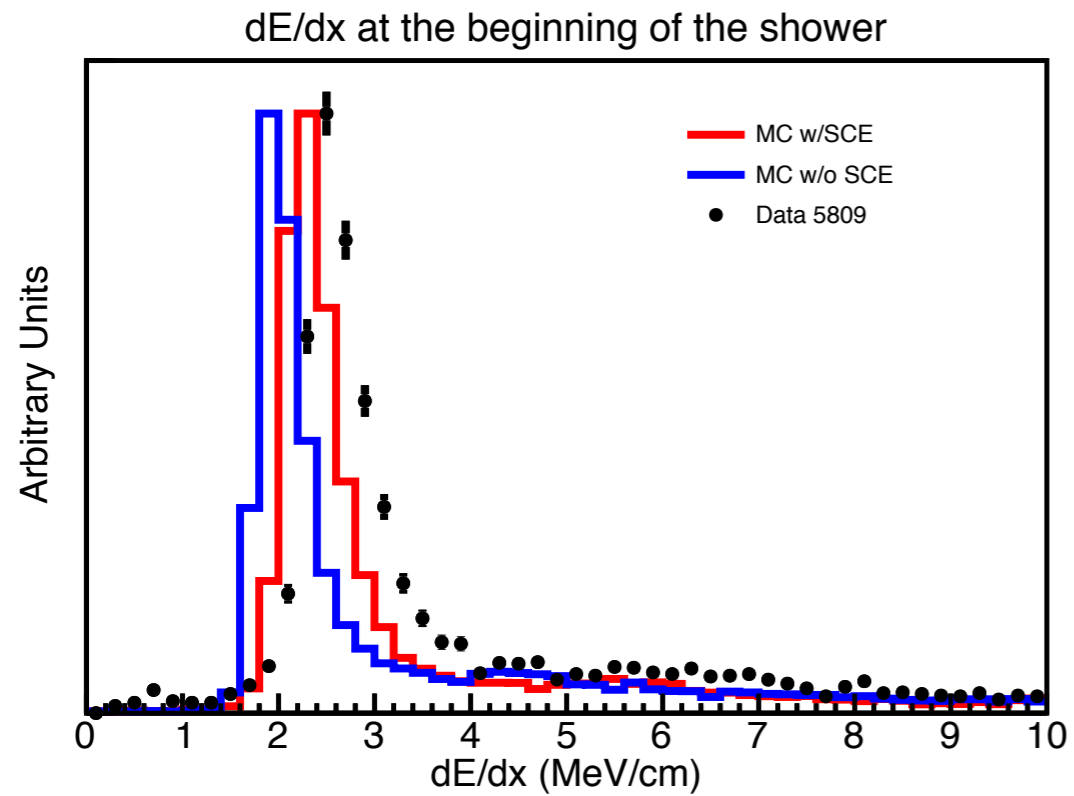
low statistics ~350 events
a bug? still under investigation

Electron Analysis Deliverables

1. dE/dx at the beginning of the shower

2. Longitudinal profile

$$\frac{dE}{dt} = E_0 b \frac{(bt)^{a-1} e^{-bt}}{\Gamma(a)}$$

The mean longitudinal profile of a electron shower can be described by the gamma distribution, where t= x/X_0 is the depth measured in radiation lengths, a describes the rise of the profile and b the tail of the profile, while E_0 is deposited energy
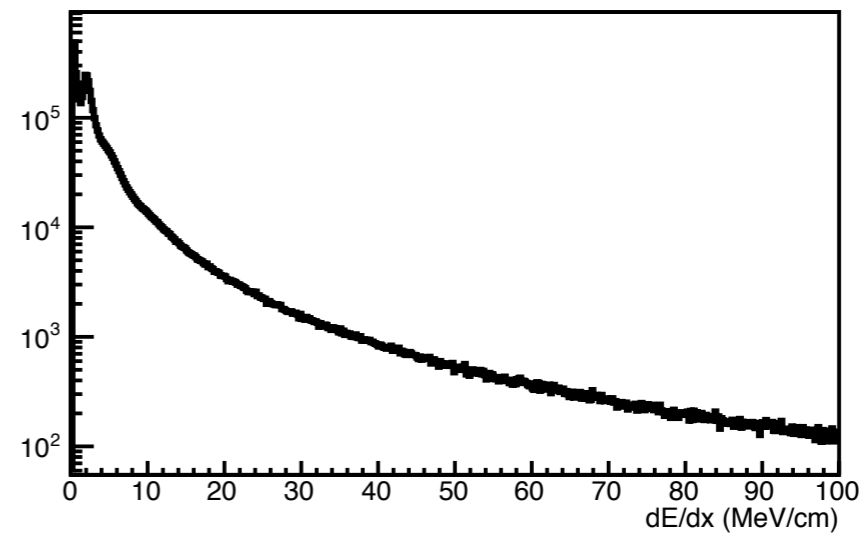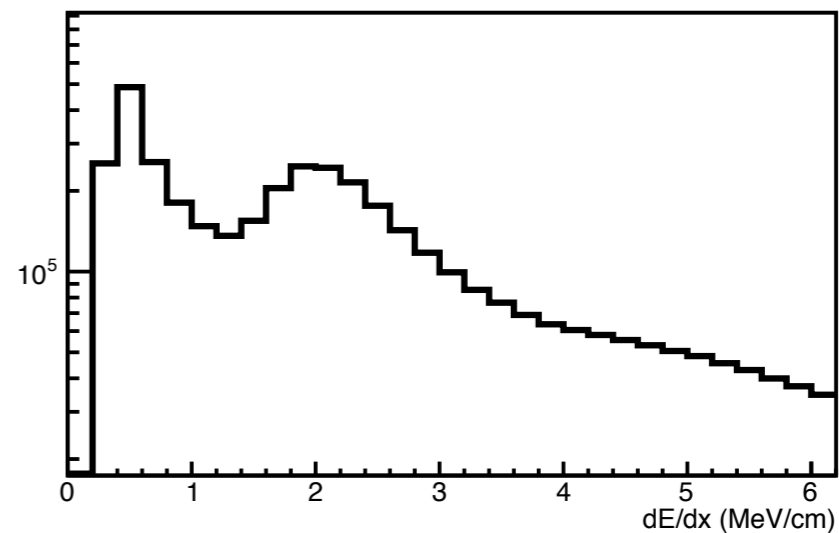
Ultimate goal is to show good agreement between data & MC

dE/dx per hit

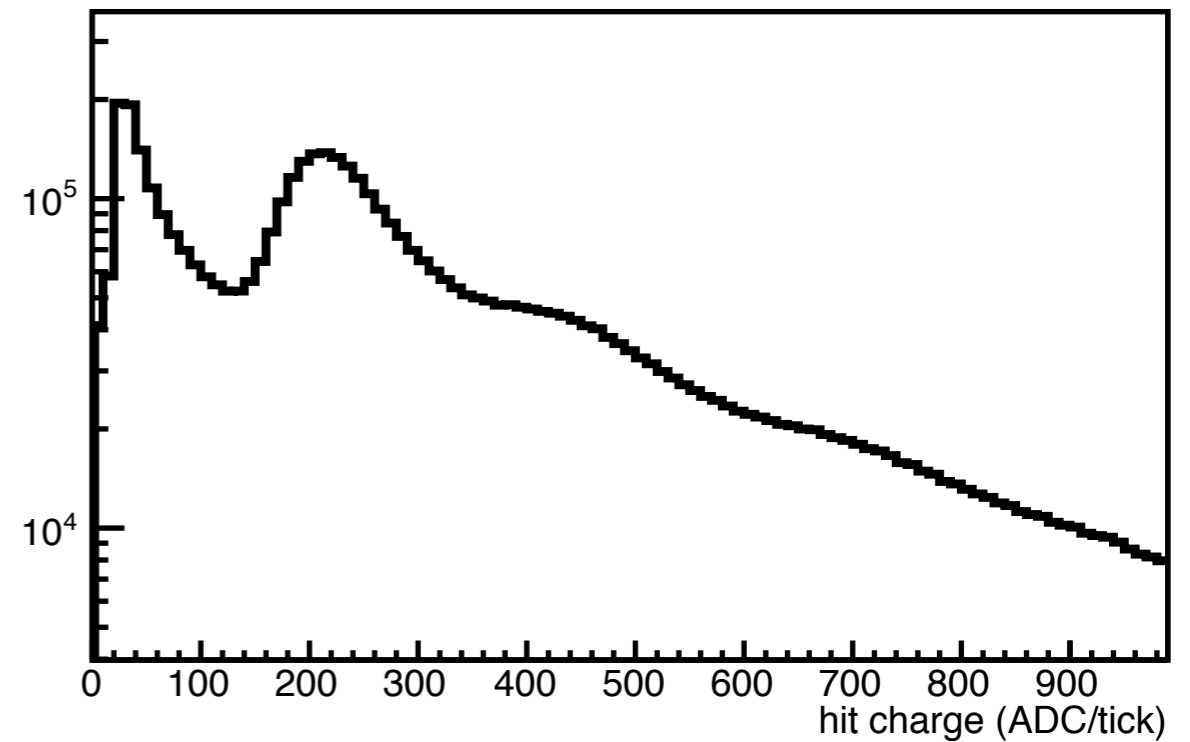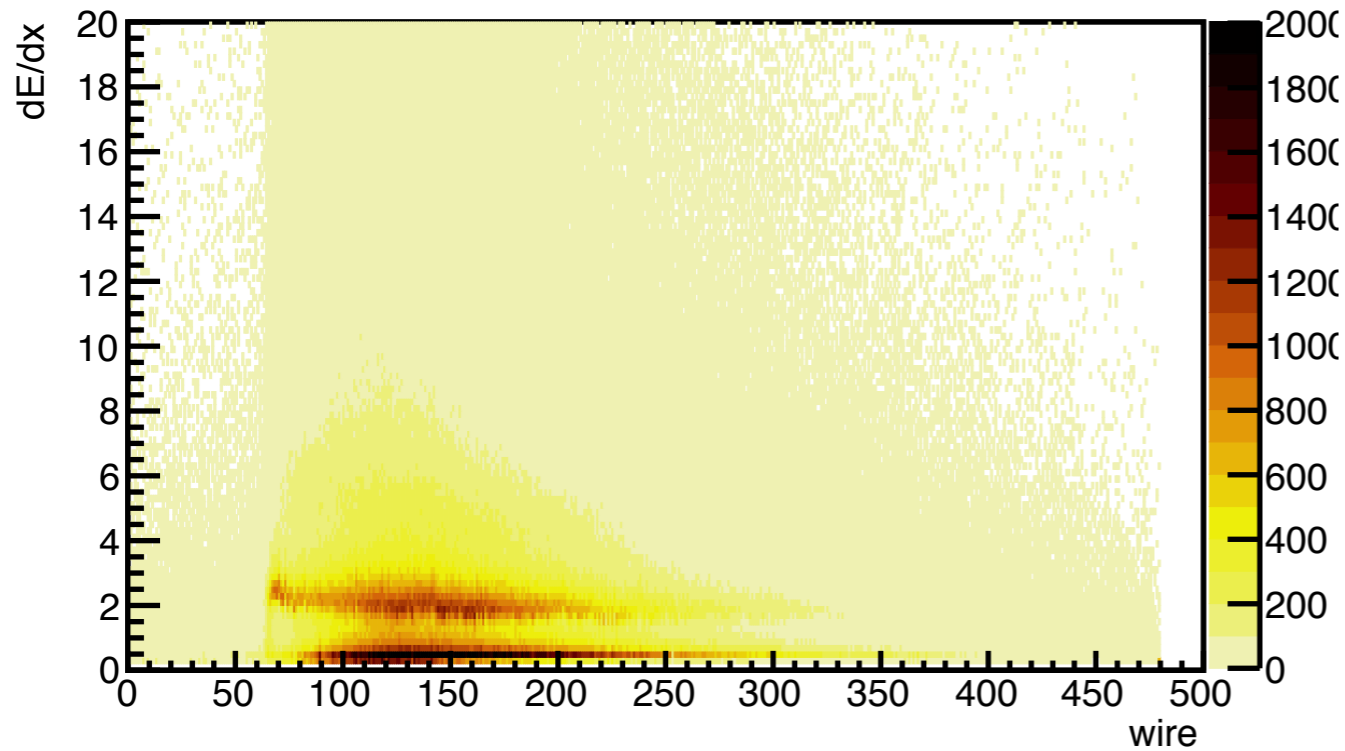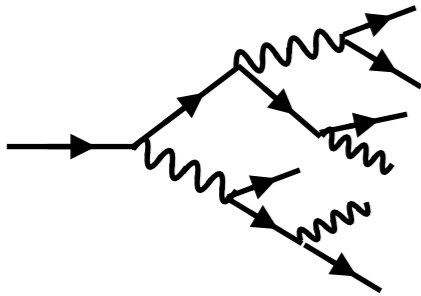run 5809, only collection plane
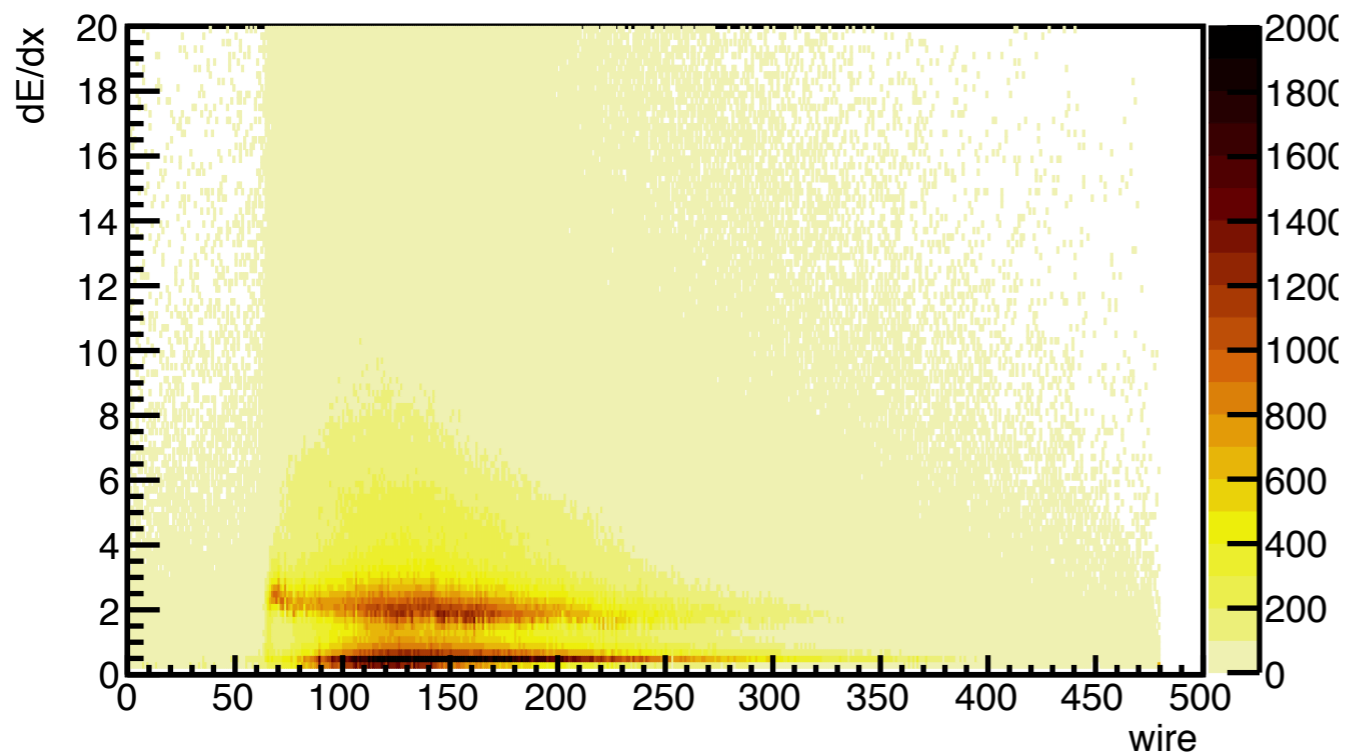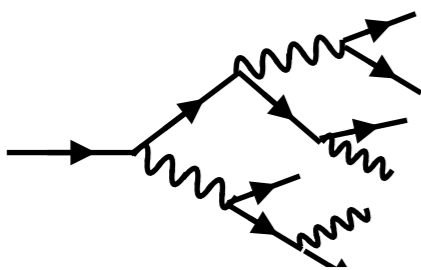
dE/dx per hit

Long tail with highly abnormal values of dE/dx
There is a <1 MIP dE/dx component, where is coming from?
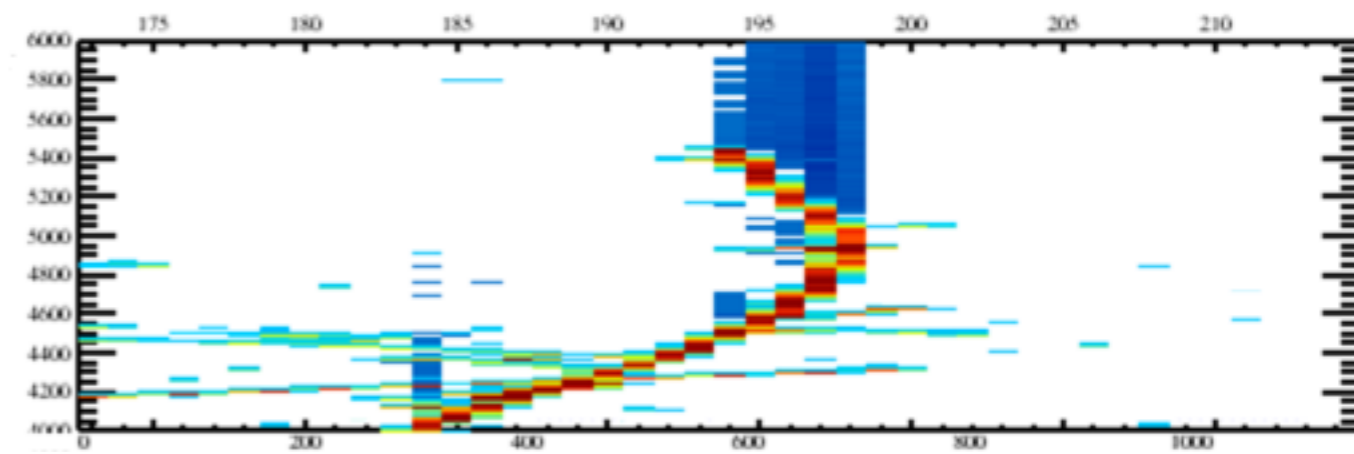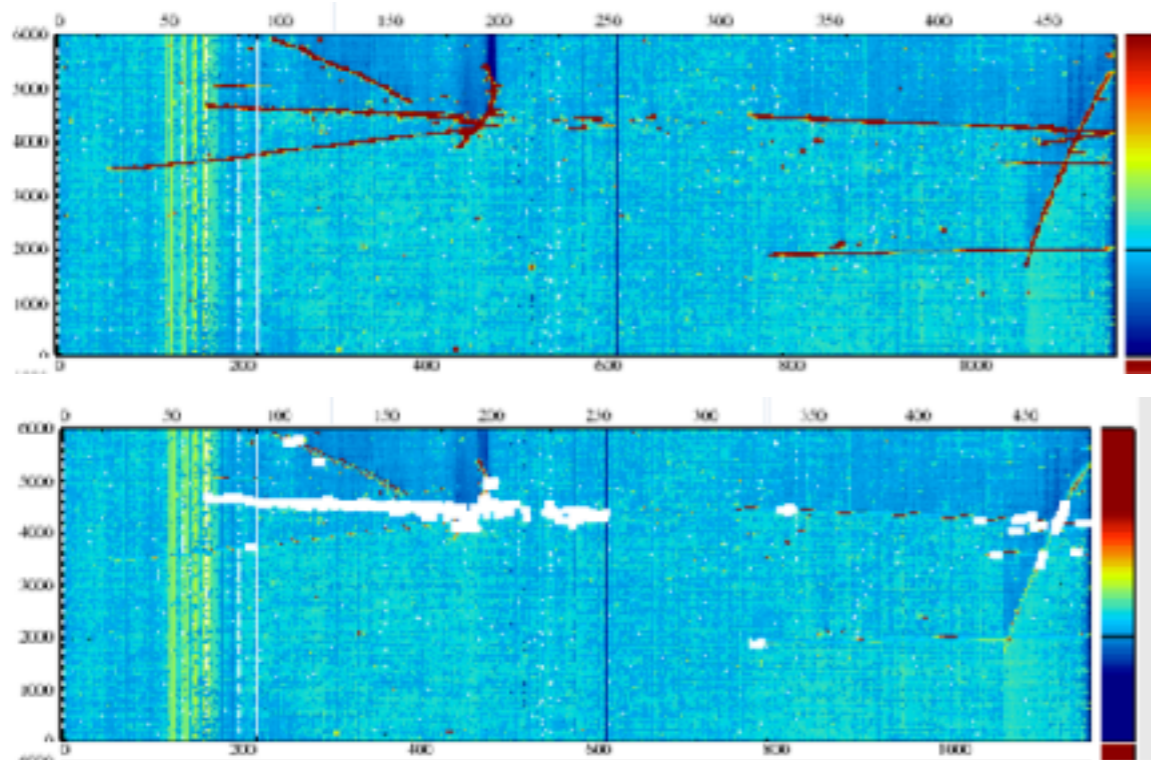
dE/dx per hit

run 5809, only collection plane

Long tail with highly abnormal values of dE/dx
There is a <1 MIP dE/dx component, where is coming from?
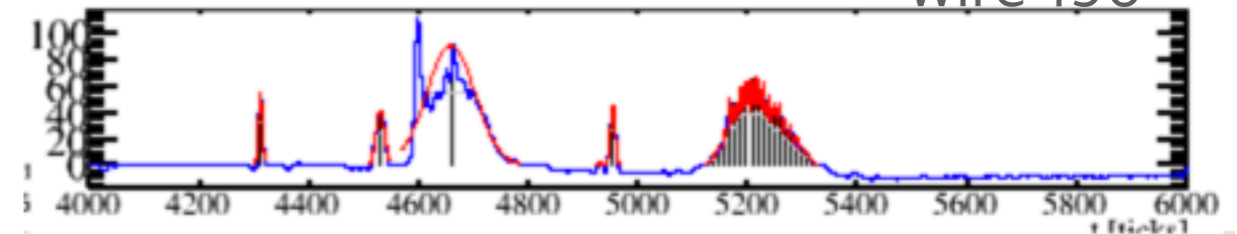
dE/dx per hit

run 5809

Long tail with highly abnormal values of dE/dx > 1e4 MeV/cm (hit integral = 8862.62)

wire 196
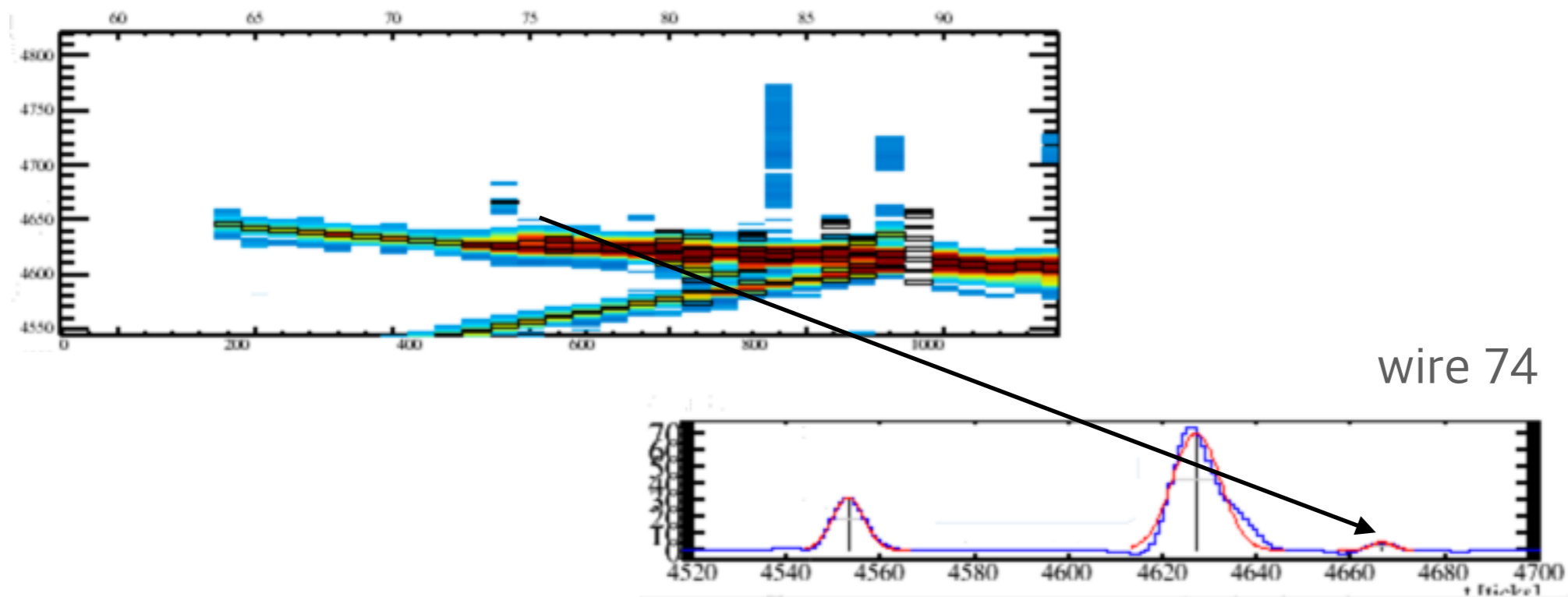
This would bias dE/dt distribution
We would remove highly abnormal hits from the shower profile

dE/dx per hit

run 5809

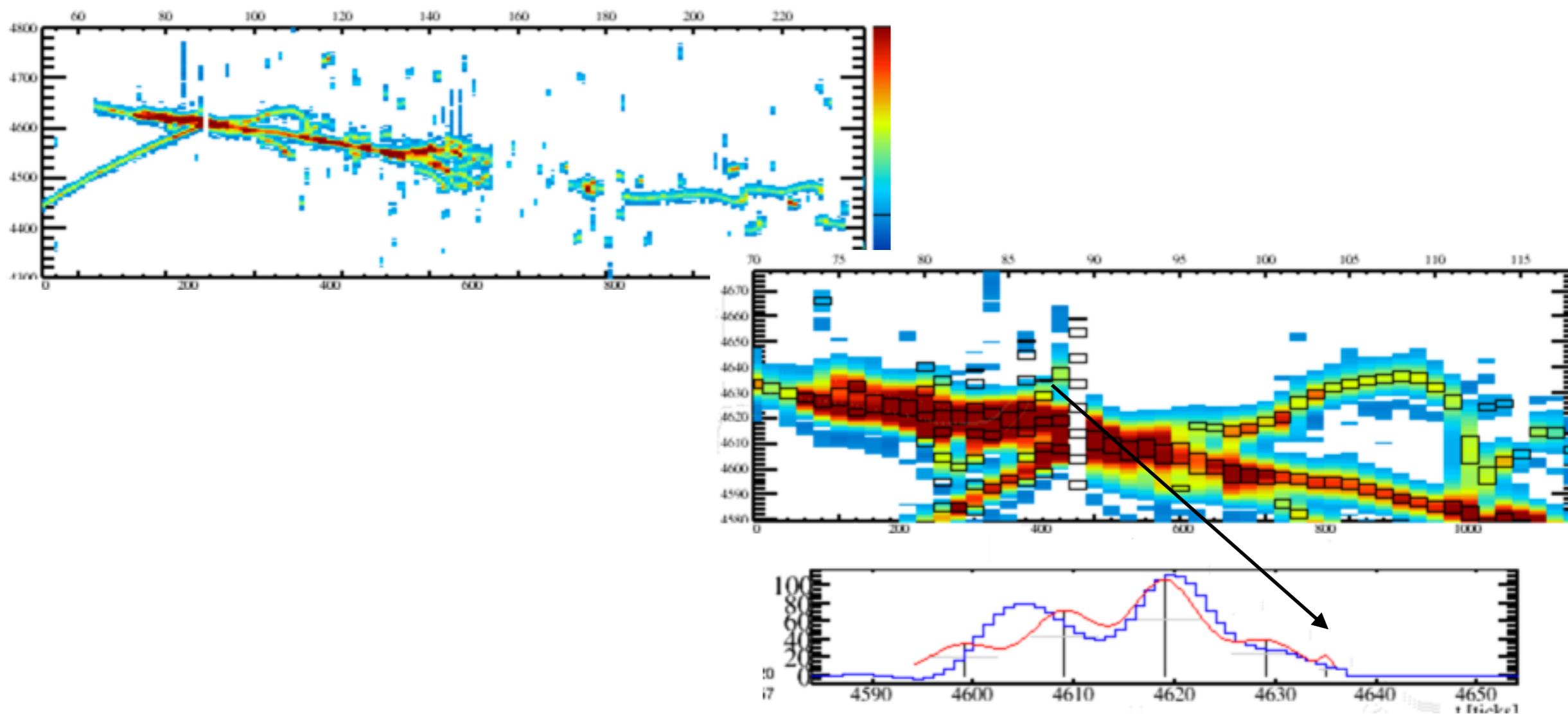There is a <1 MIP dE/dx component, where is coming from?   (0.43 MeV/cm)

wire 74

happened to be a very low energy hit
noise?

dE/dx per hit

run 5809

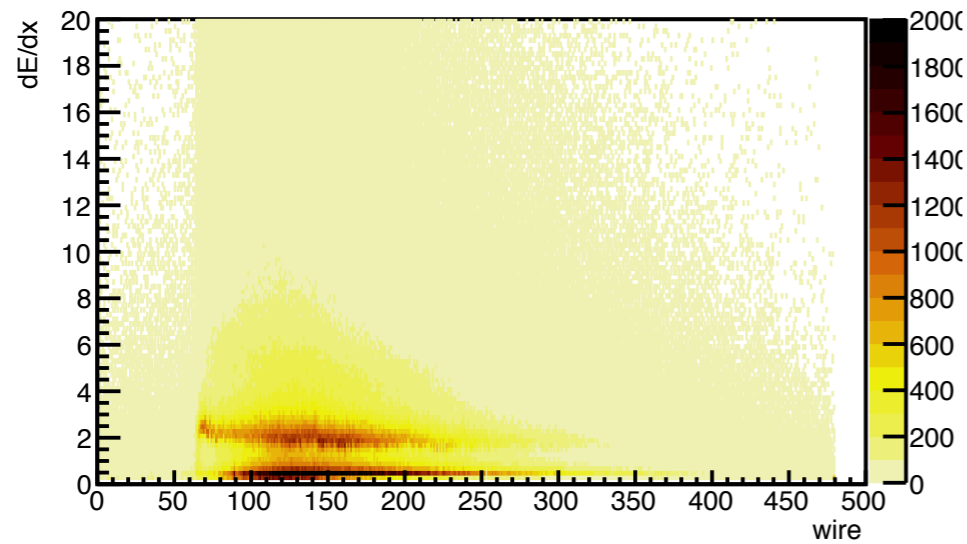There is a <1 MIP dE/dx component, where is coming from?   (0.43 MeV/cm)

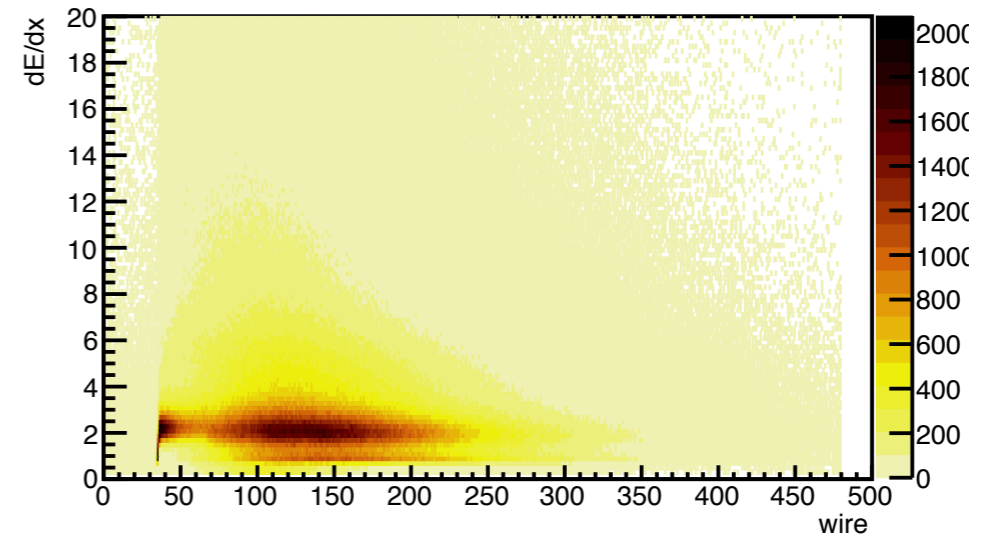happened to be a very low energy hit
noise?

wire 87

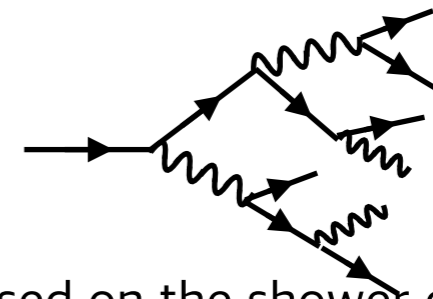# Longitudinal Profile

data

MC
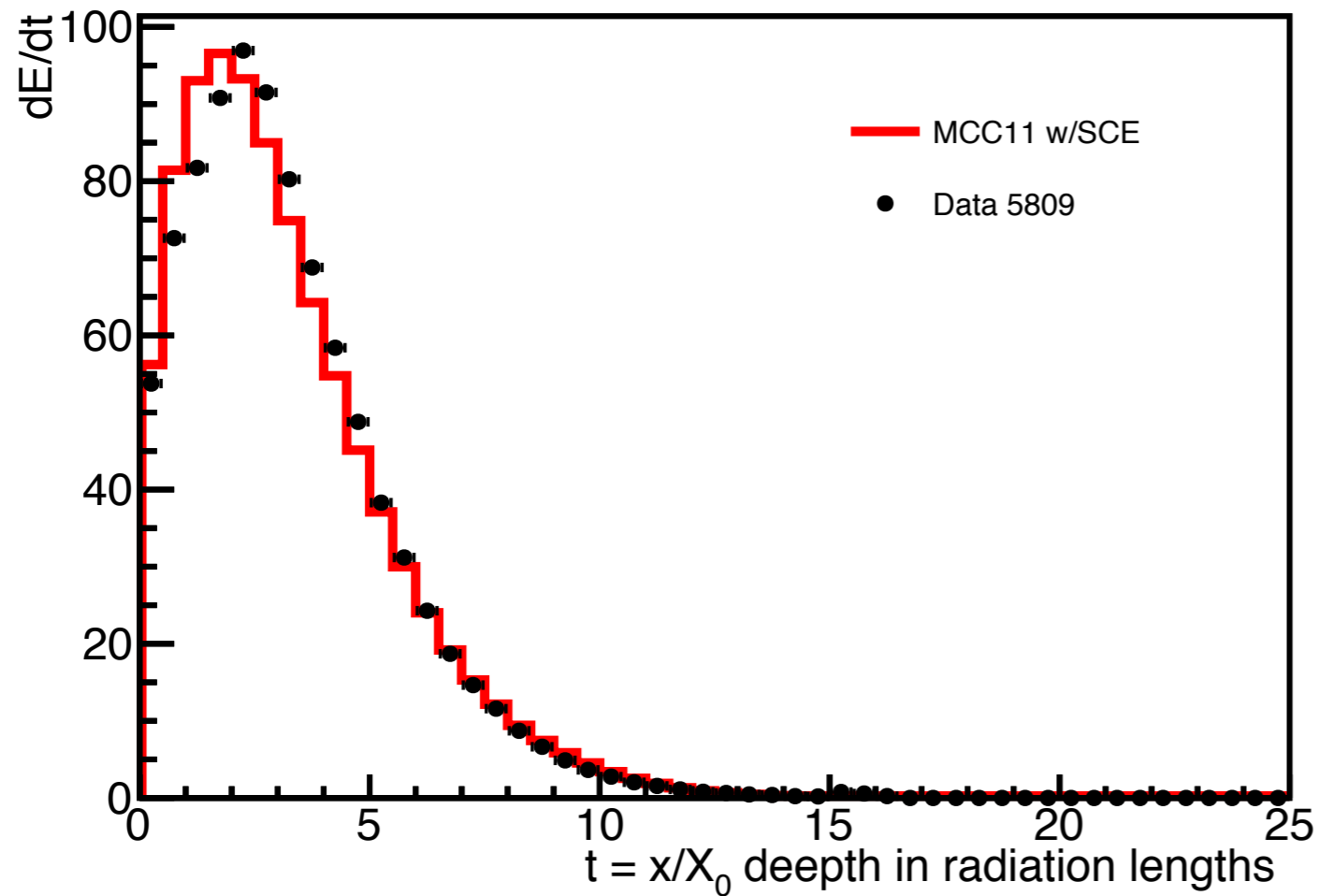

How we calculate t = x/X_0?

We can use dx to calculate dt

dx is corrected by the direction of the hit, the direction of the hit is based on the shower direction, this approach is fine the first hits (before showering) but not for hits in the shower cone

For the shower longitudinal profile use wire pitch as dx —> dt for all hits
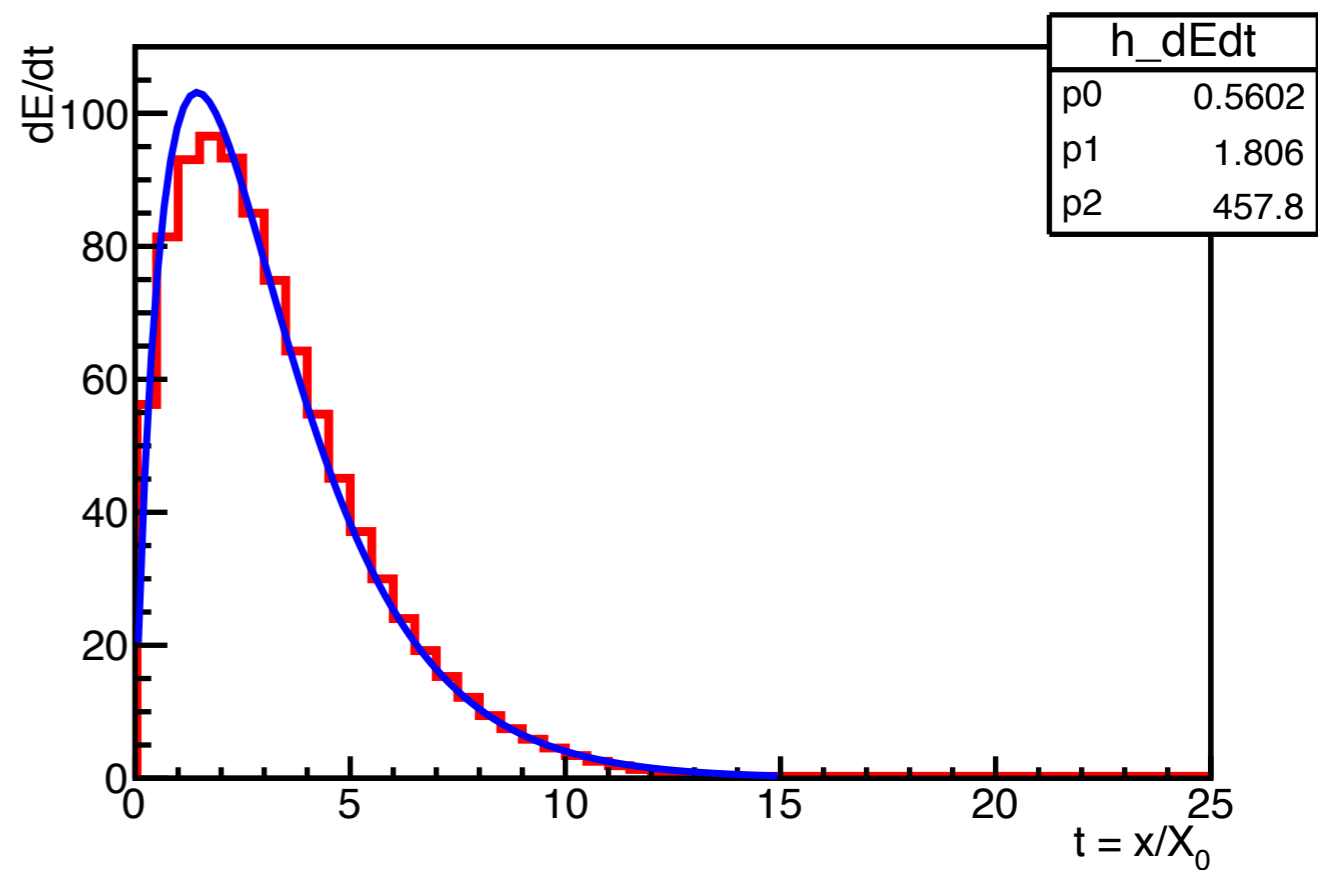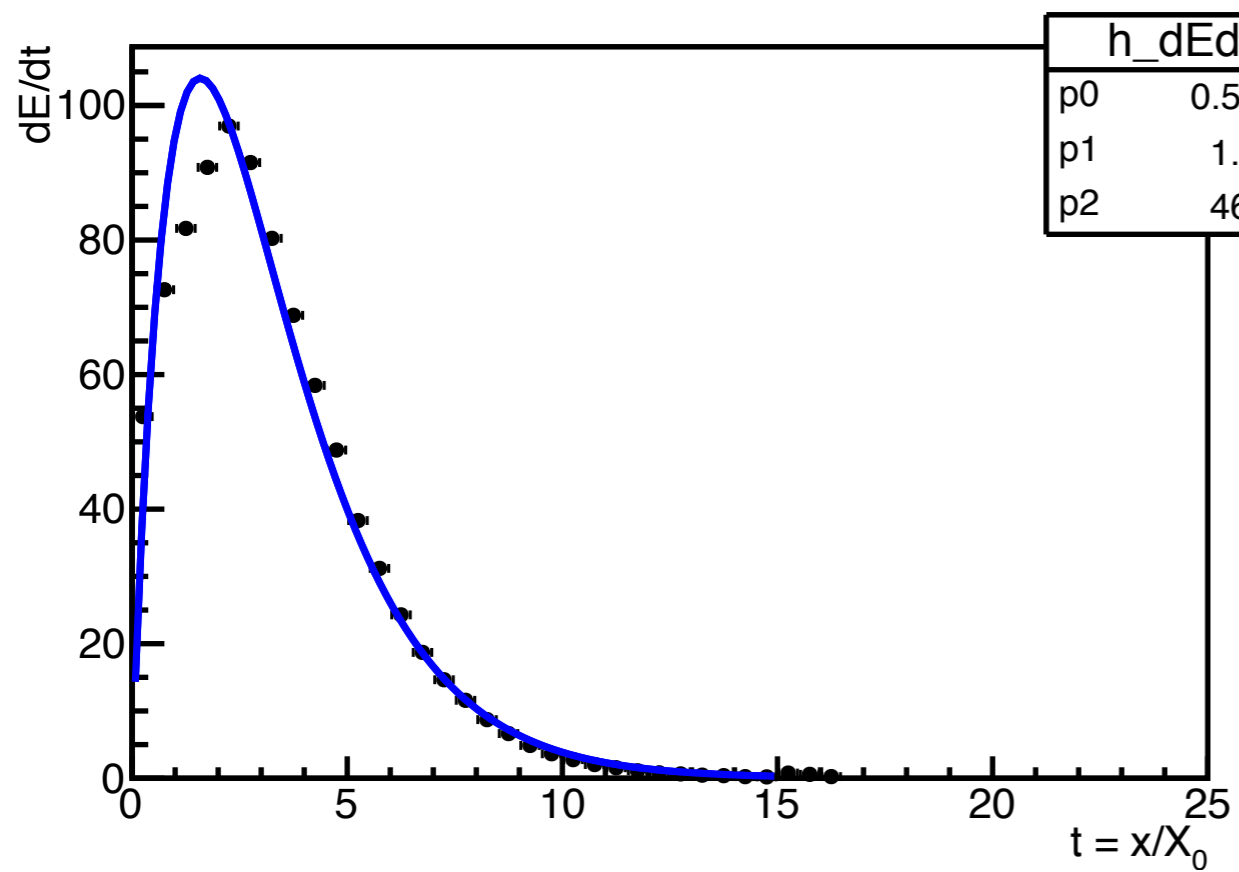
Longitudinal Profile

The mean longitudinal profile of a electron shower can be described by the gamma distribution, where t= x/X_0 is the depth measured in radiation lengths, a describes the rise of the profile and b the tail of the profile, while E_0 is deposited energy

$$\frac{dE}{dt} = E_0 b \frac{(bt)^{a-1} e^{-bt}}{\Gamma(a)}$$

Longitudinal Profile

$$\frac{dE}{dt} = E_0 b \frac{(bt)^{a-1} e^{-bt}}{\Gamma(a)}$$

Comments

We know SCE is out there

To have publishable physics results we need to do SCE corrections

Current infrastructure for SCE corrections works only for tracks need to coordinate with SCE team how to do it for showers (Pandora does not provide calorimetry information)

The End