Validating mcc12

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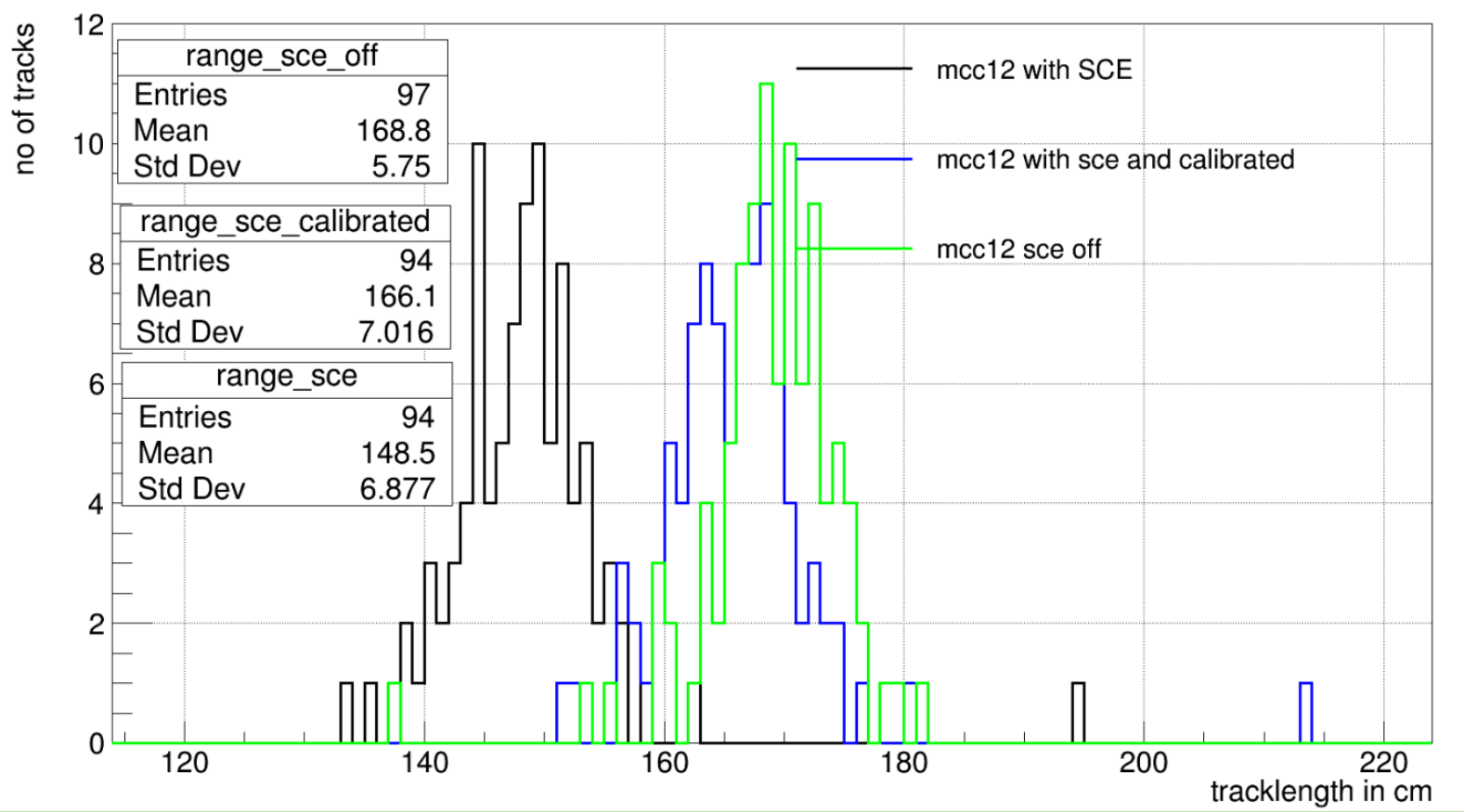
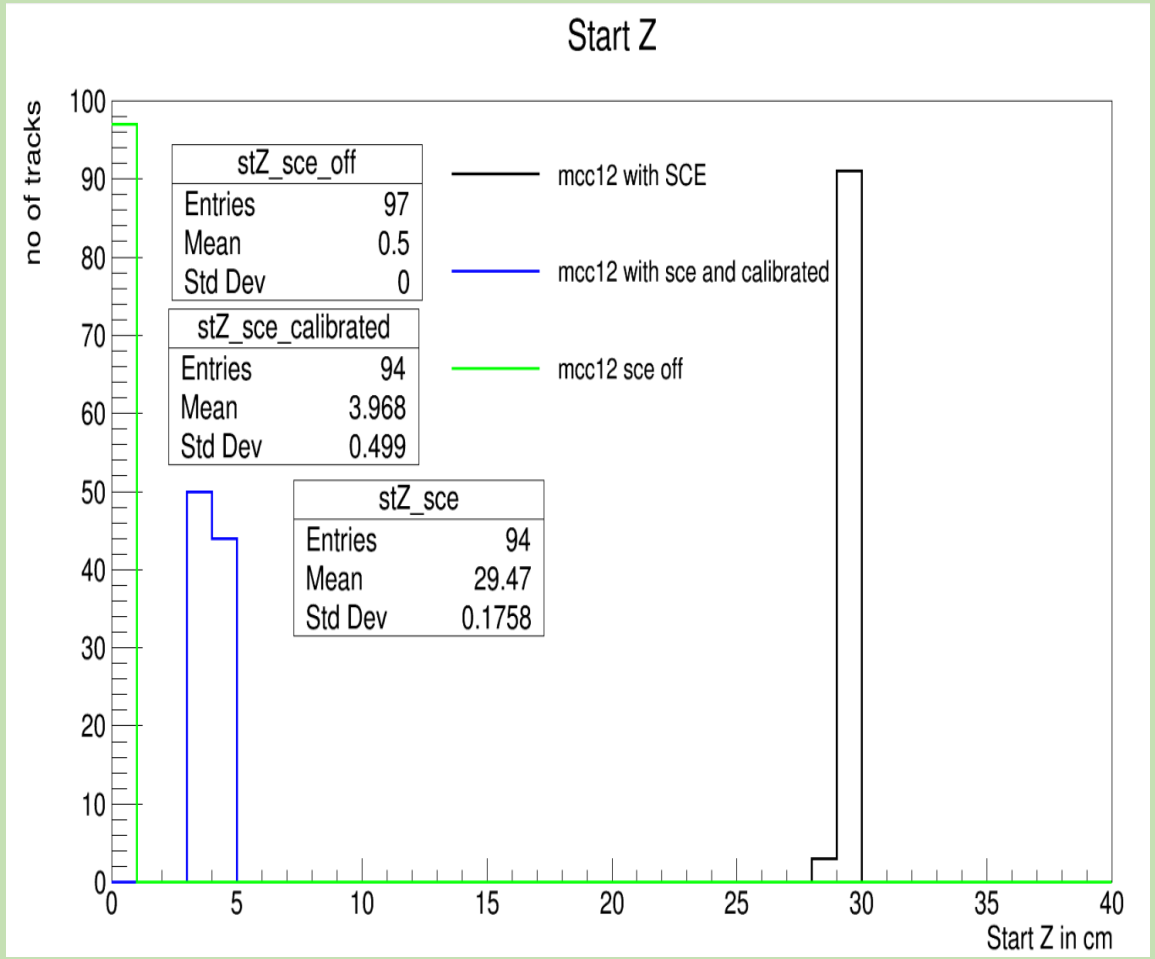
Looking at the track length for beam muons (mcc12):

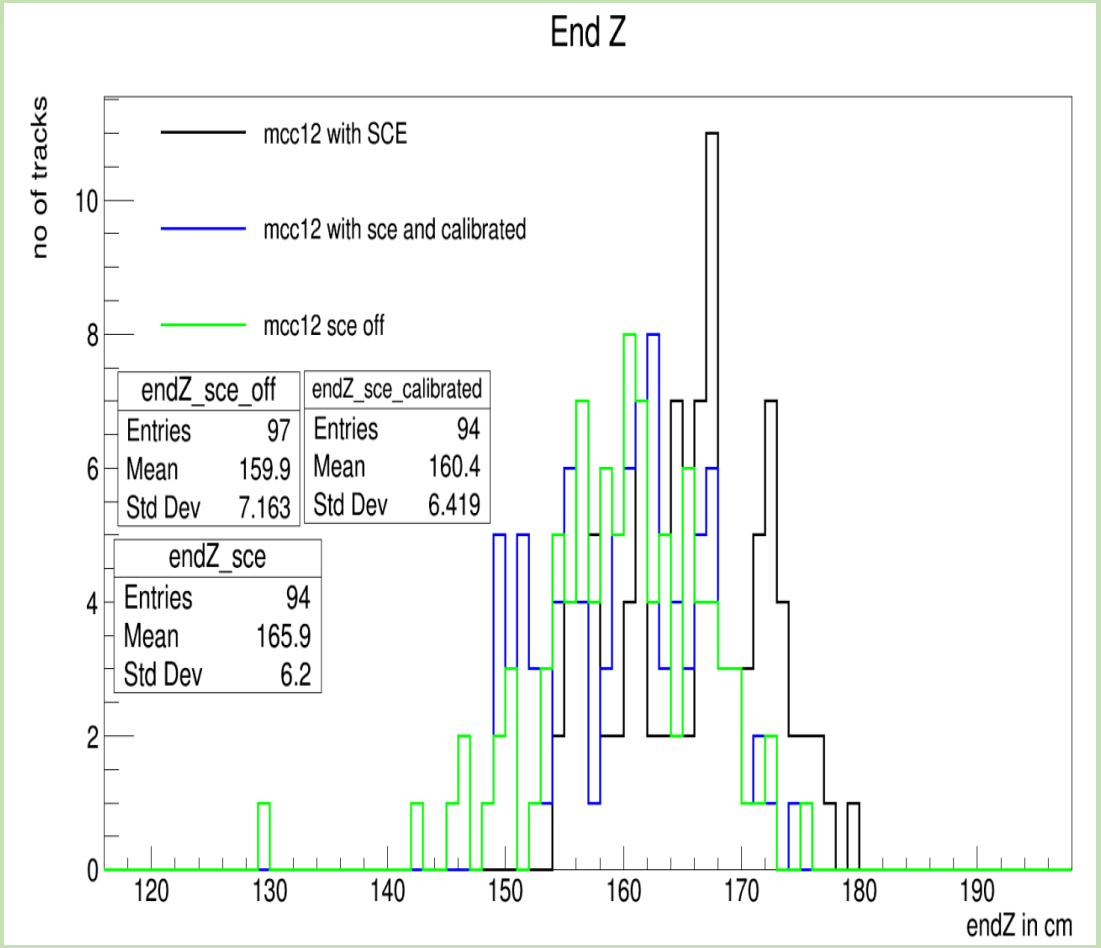
Generated 100, 0.5GeV momentum beam muons: Entries are less than 100 as I have removed broken tracks.



If we look at the mean value of tracklength after spatial calibration, it's pretty close to the SCE OFF sample.
After the spatial calibration ~3cm offset remains.

Start and EndZ position for the tracks in previous slide:

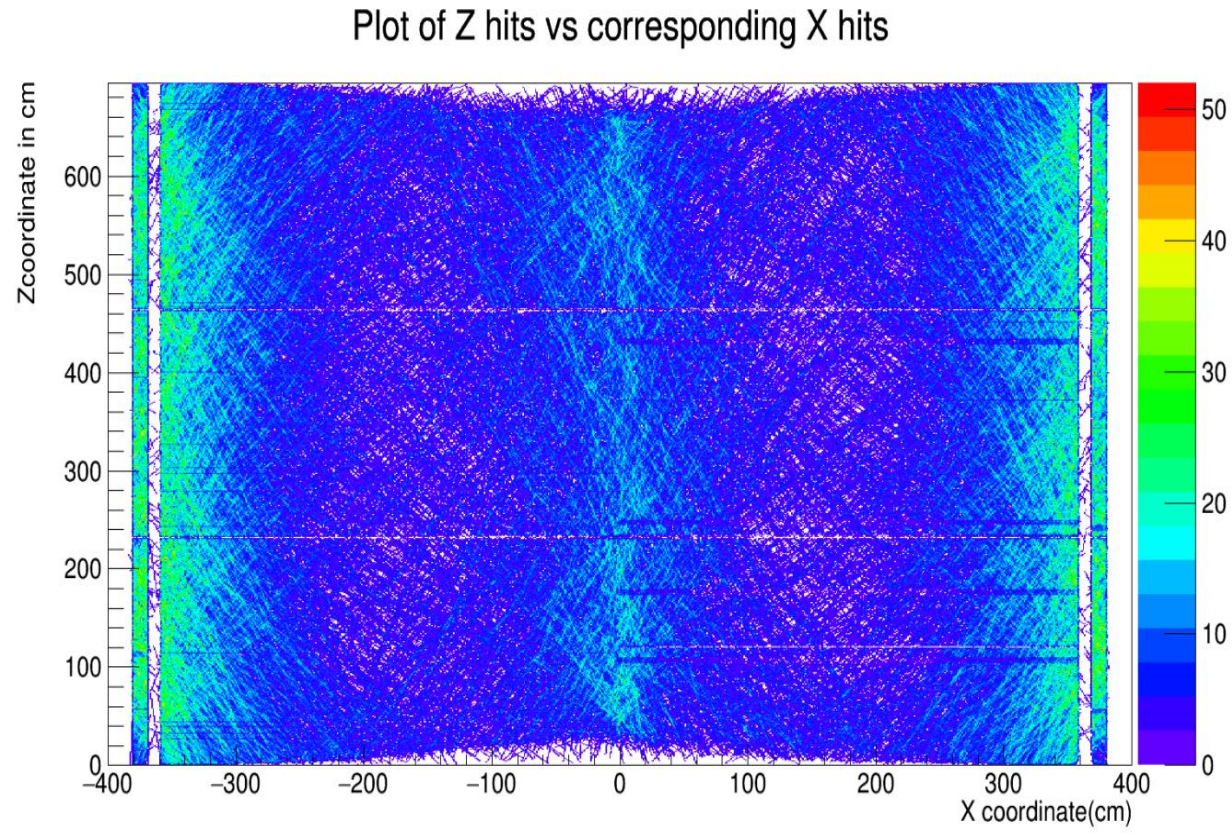




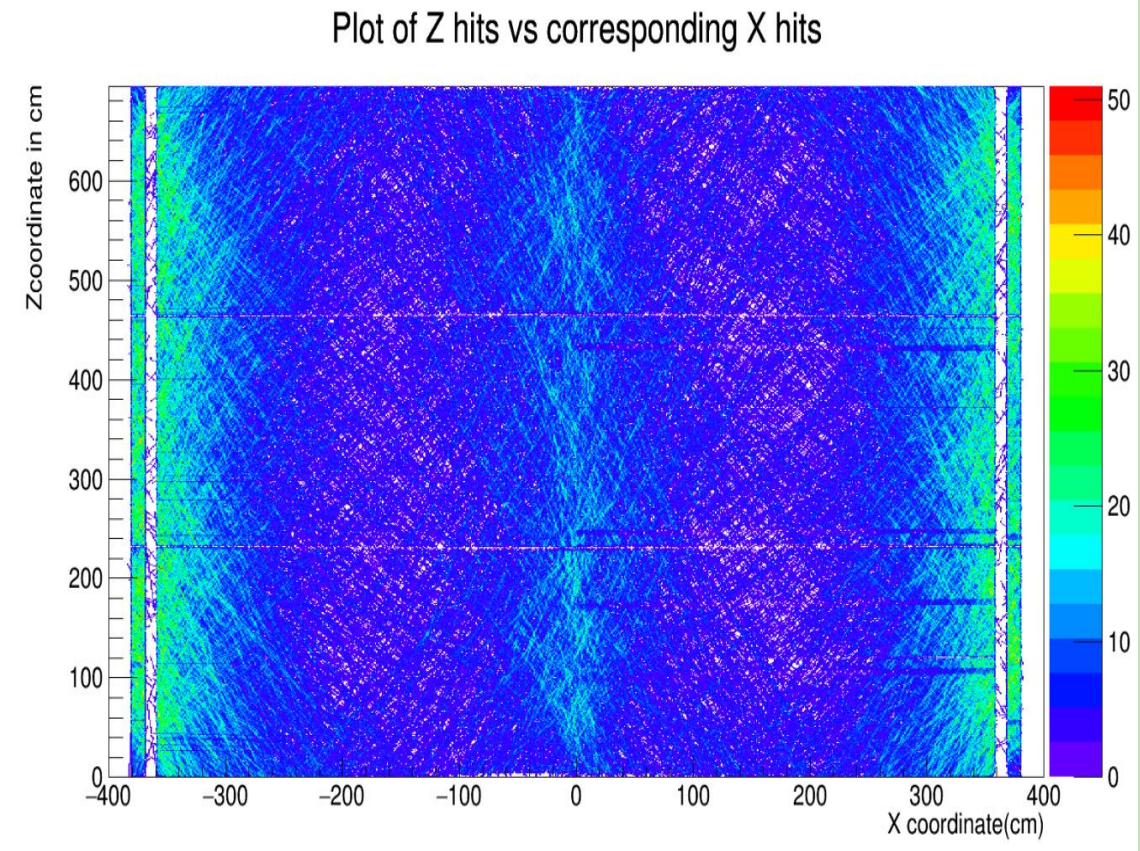
There is ~4cm offset between SCE OFF sample and SCE calibrated sample at the start.

Some more validation studies: mcc12, looking at the coverage map for cathode crossing cosmic tracks

Note: *Z axis shows the number of hits at a given Z, X position*



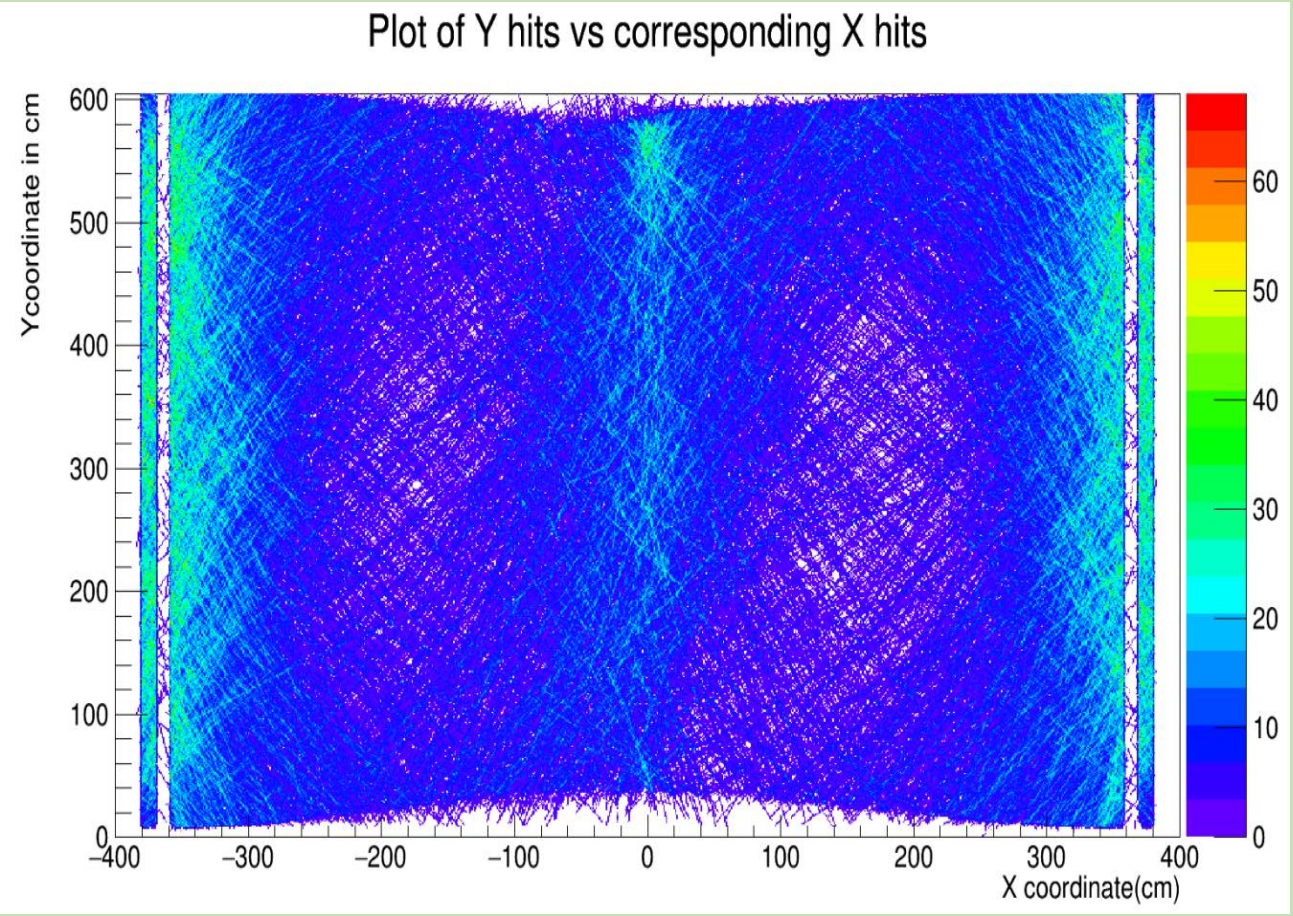
Left: hit X position vs hit Z position before spatial calibration



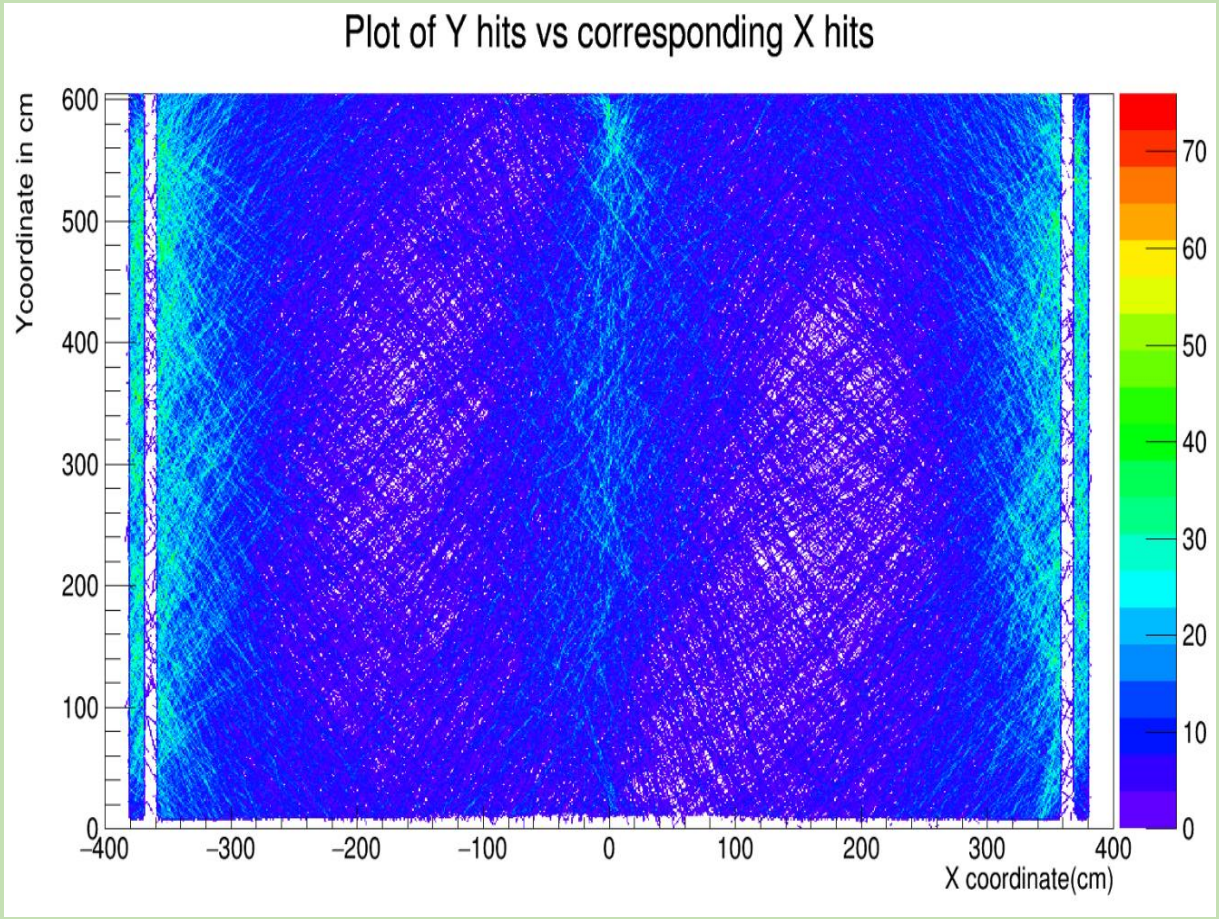
Left: hit X position vs hit Z position after spatial calibration

The spatial distortion in Z position causing a gap near the cathode appears to be removed on the right plot. cryostat side hits simulated. These tracks could be either cathode crossing or anode crossing or both, unlike mcc11 where it was required for the tracks to be cathode crossing to extract T0 values using track matching.

Mcc12: Y vs X:

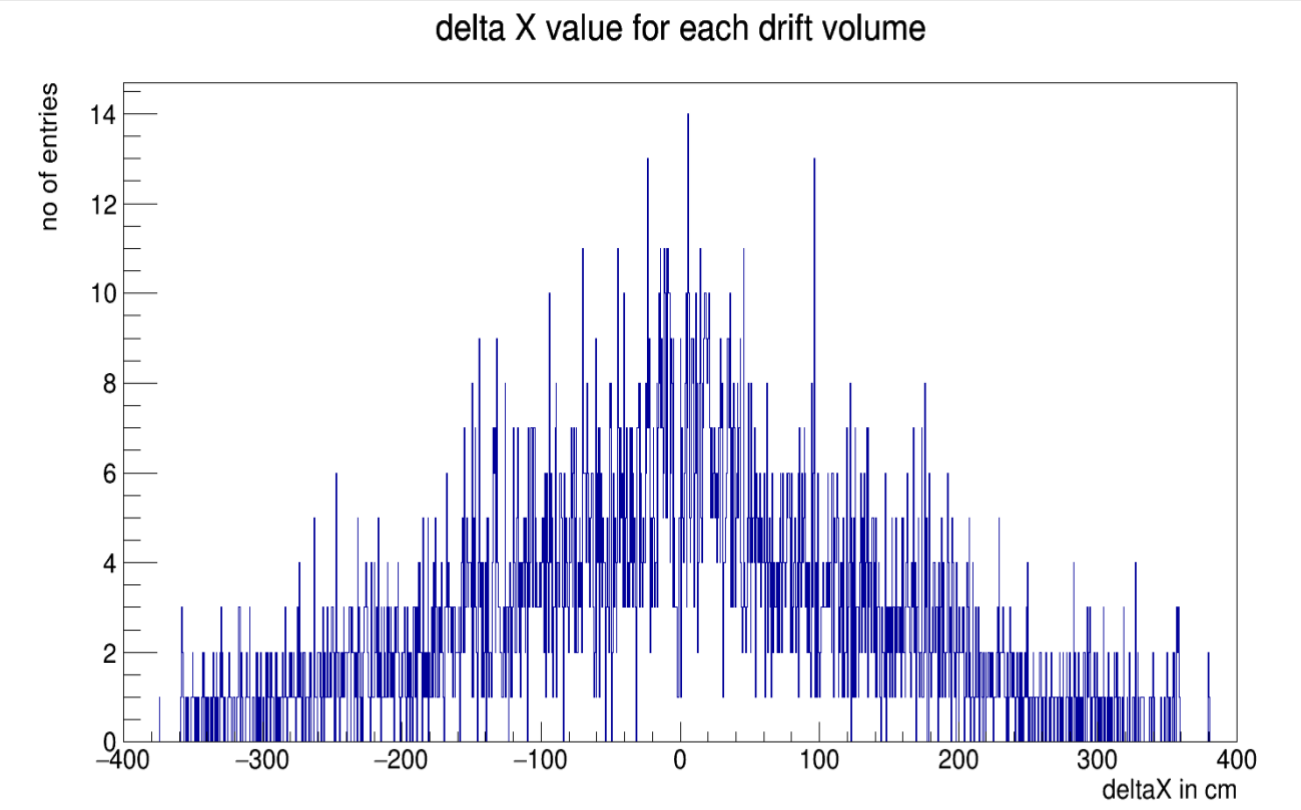


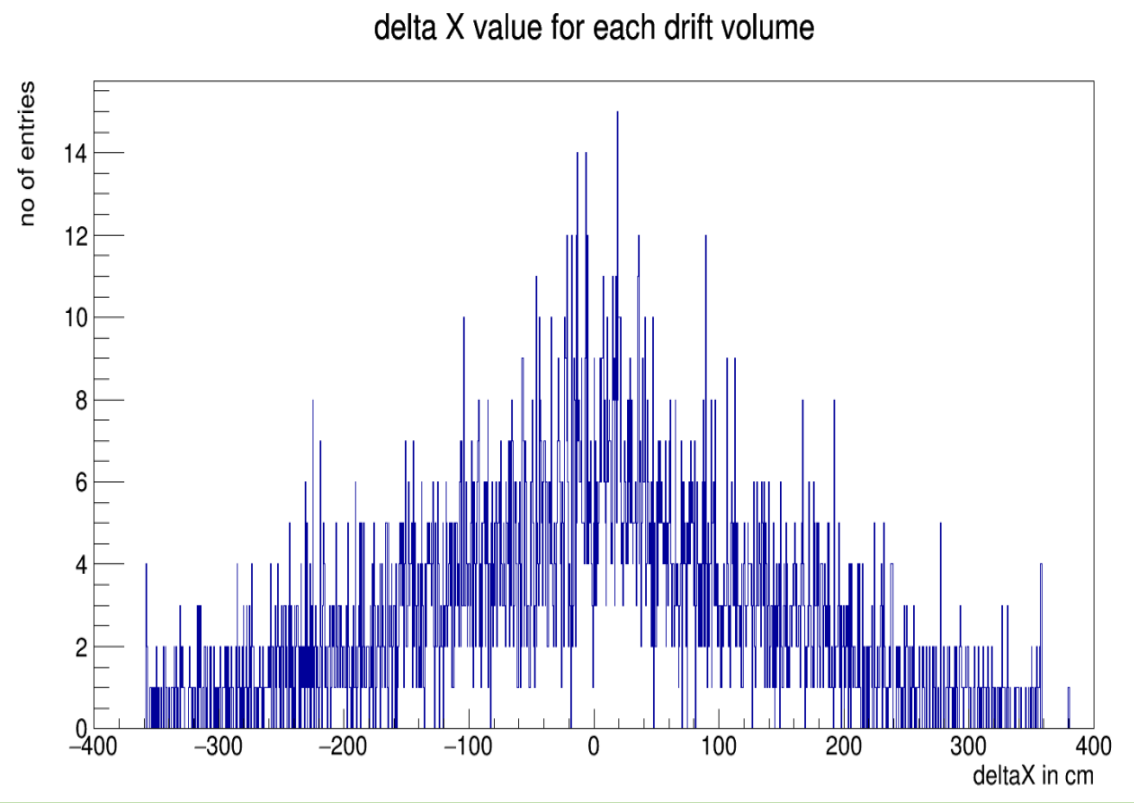
Before calibration



After calibration

mcc12: deltaX plot, deltaX is the X projection of a track in a drift volume(beam left or beam right)

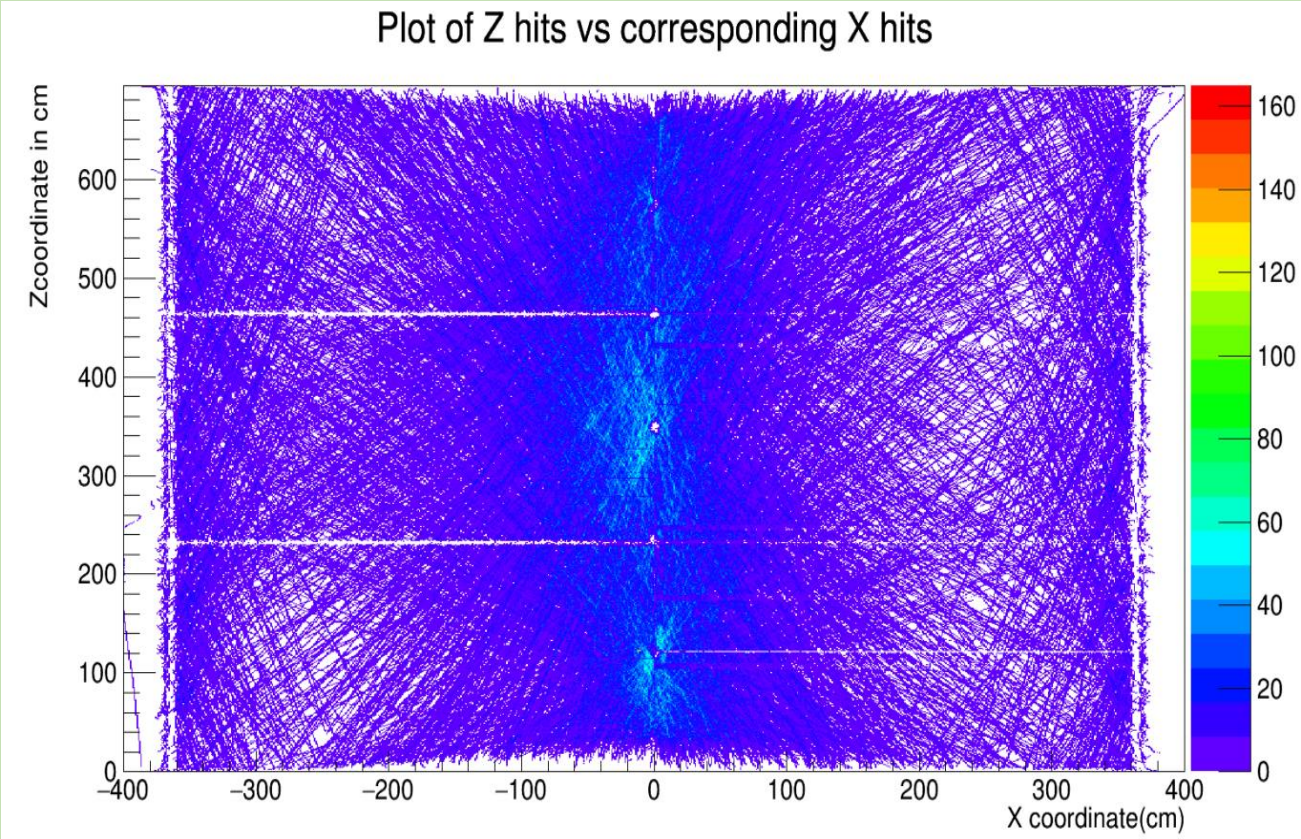




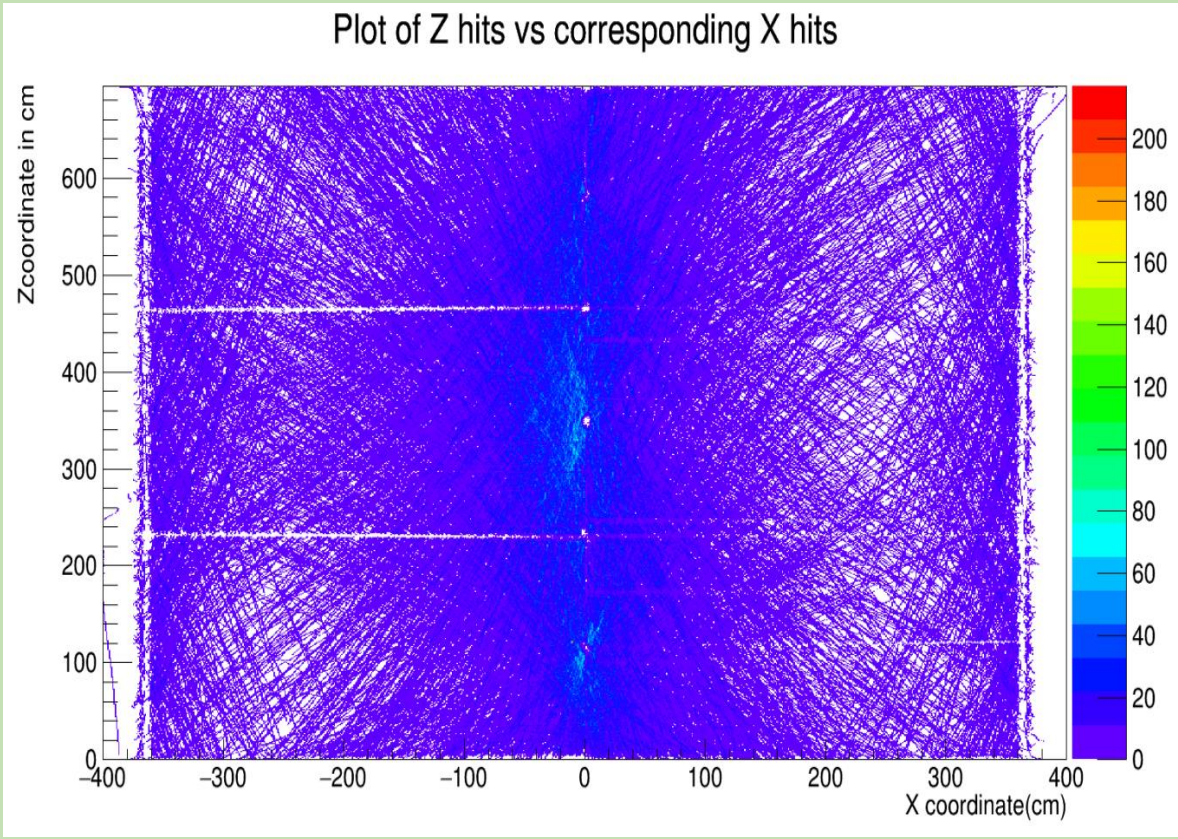
Statistics appear too low to derive much conclusion.

Here I am making a plot of the difference between maximum and minimum X value in a particular drift side.

Similar plots for data (run 5387): X vs Z



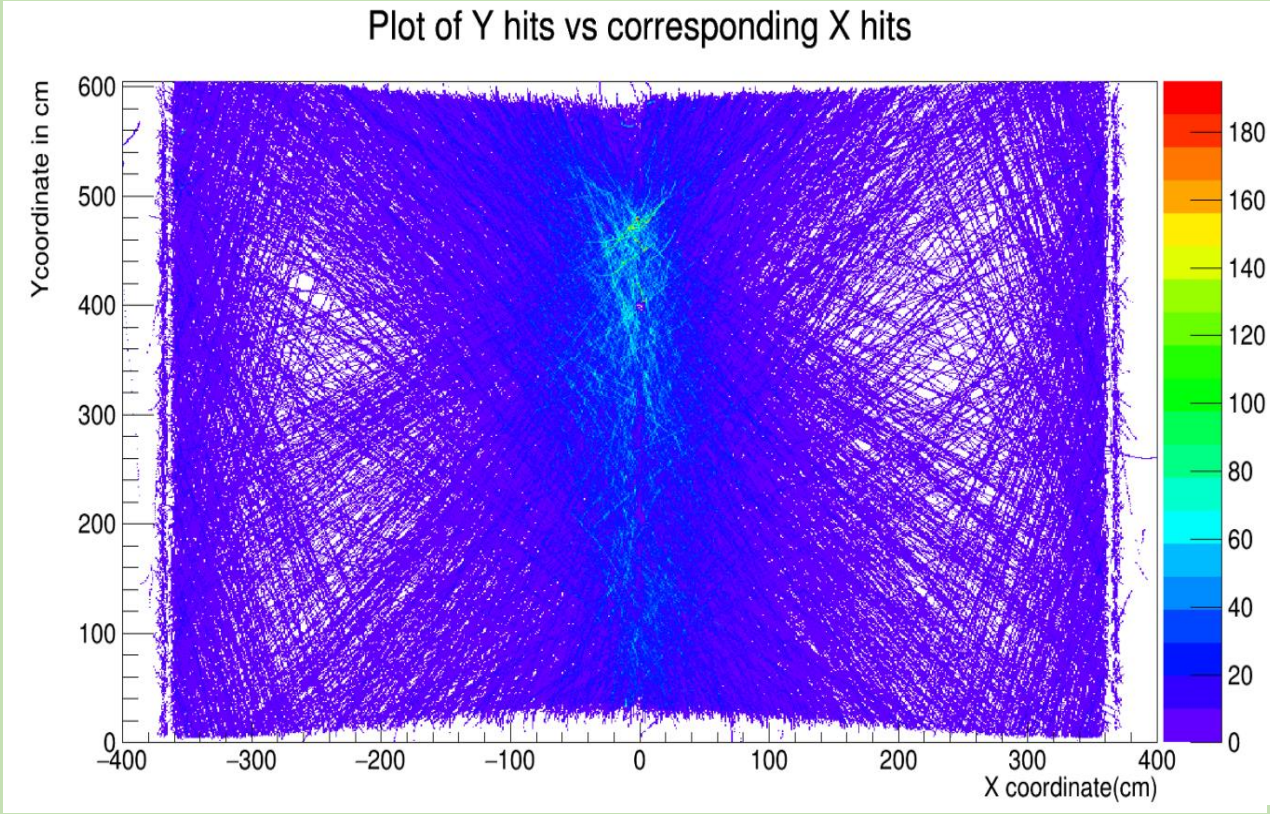
Before spatial calibration



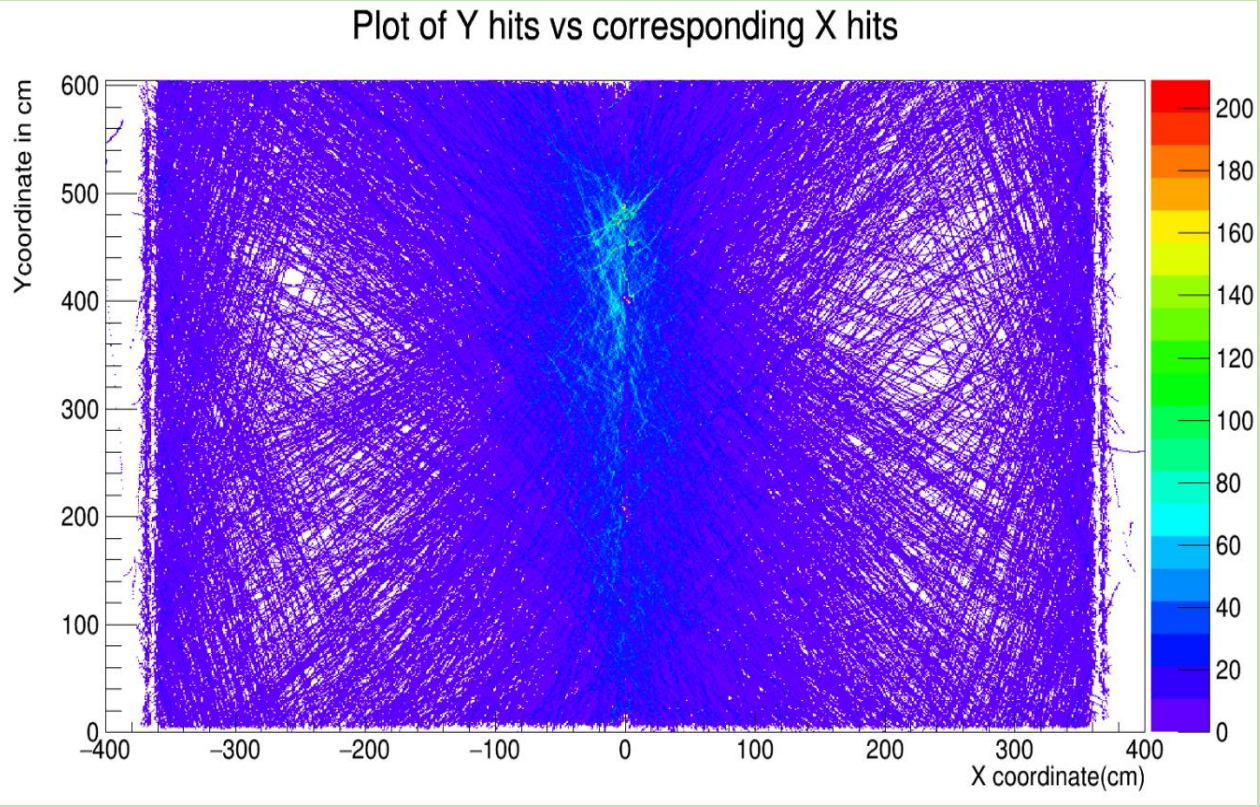
After spatial calibration

Distortion in Z near the code appears to be removed after the Spatial SCE correction.

Run 5387 X vs Y:

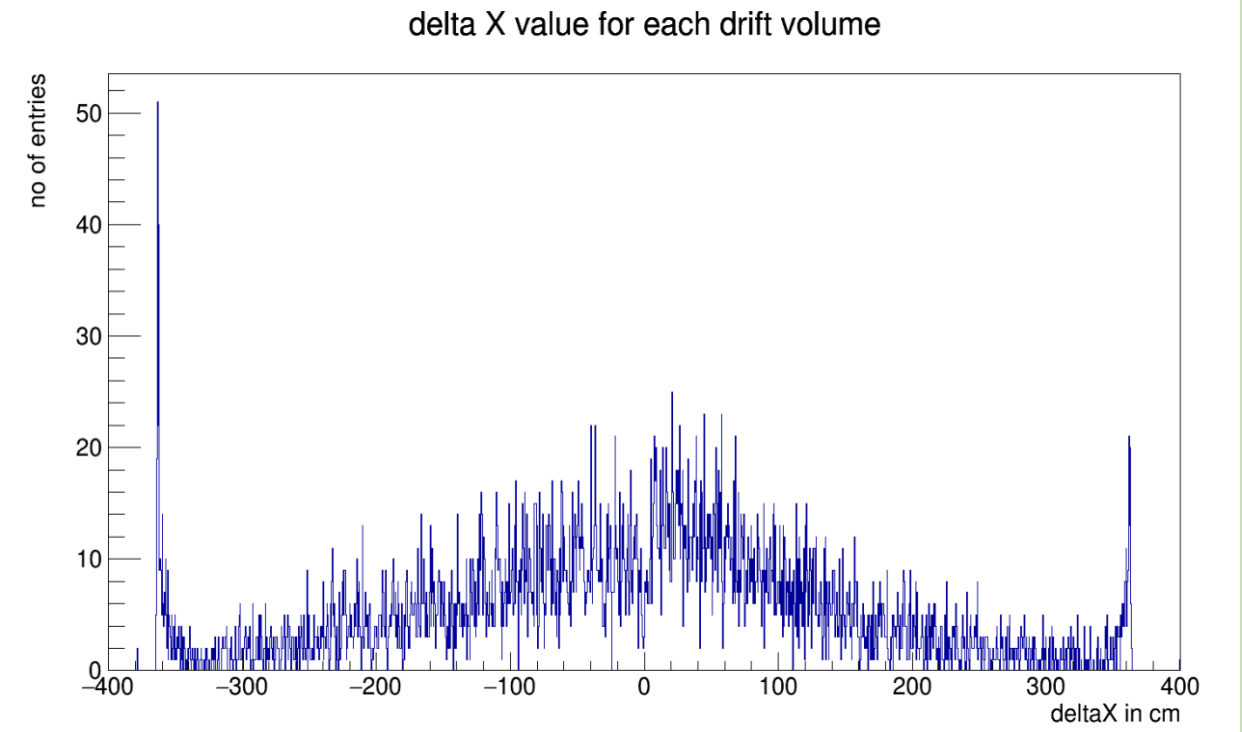


Before spatial calibration

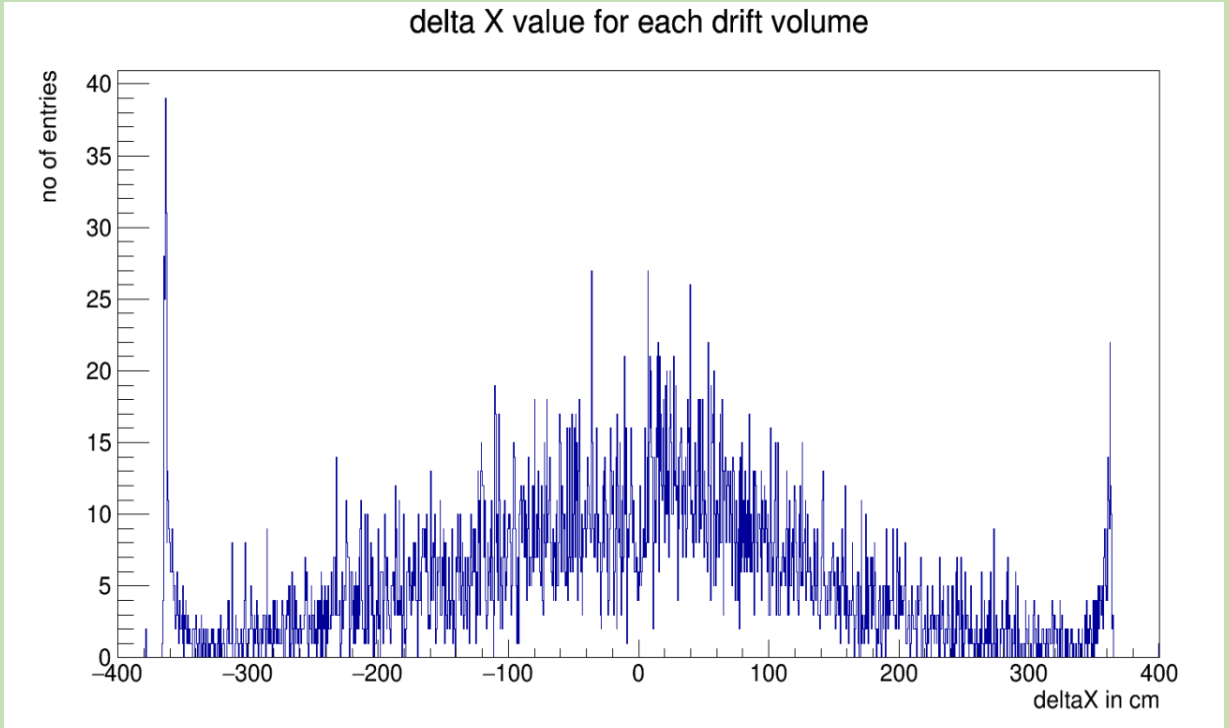


After spatial calibration

Run 5387, deltaX:



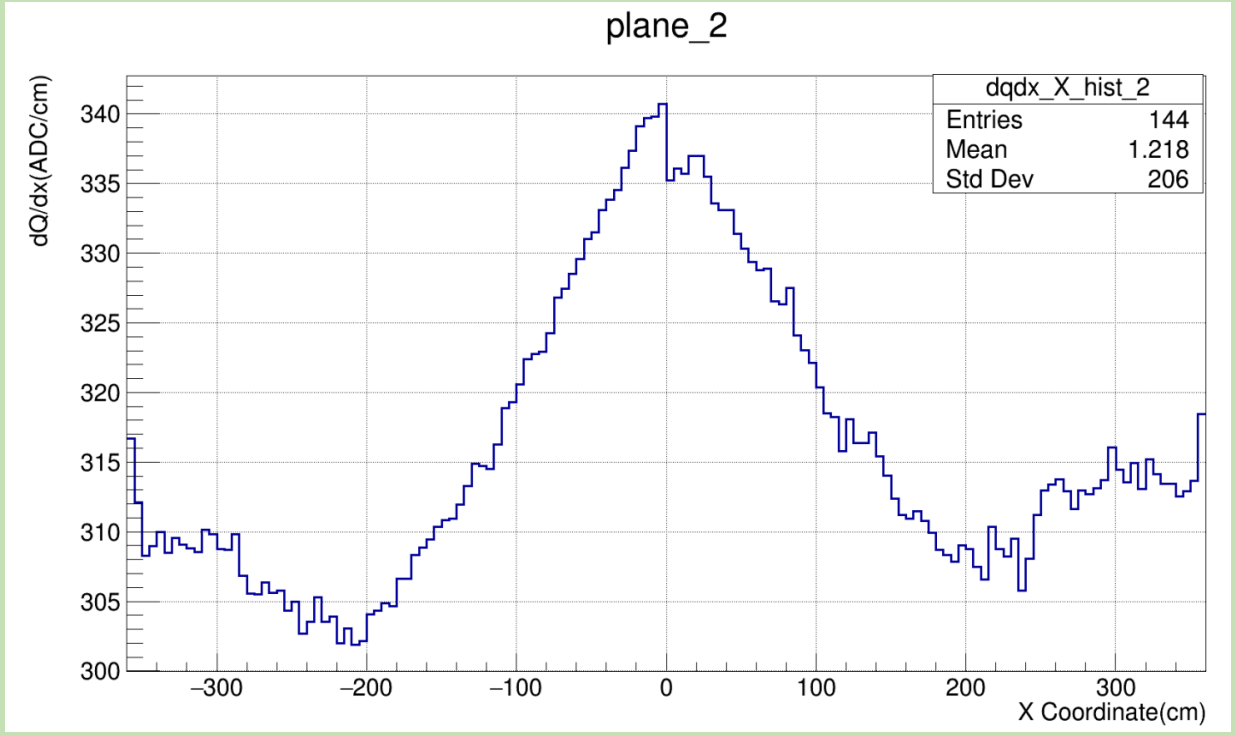
Before spatial calibration



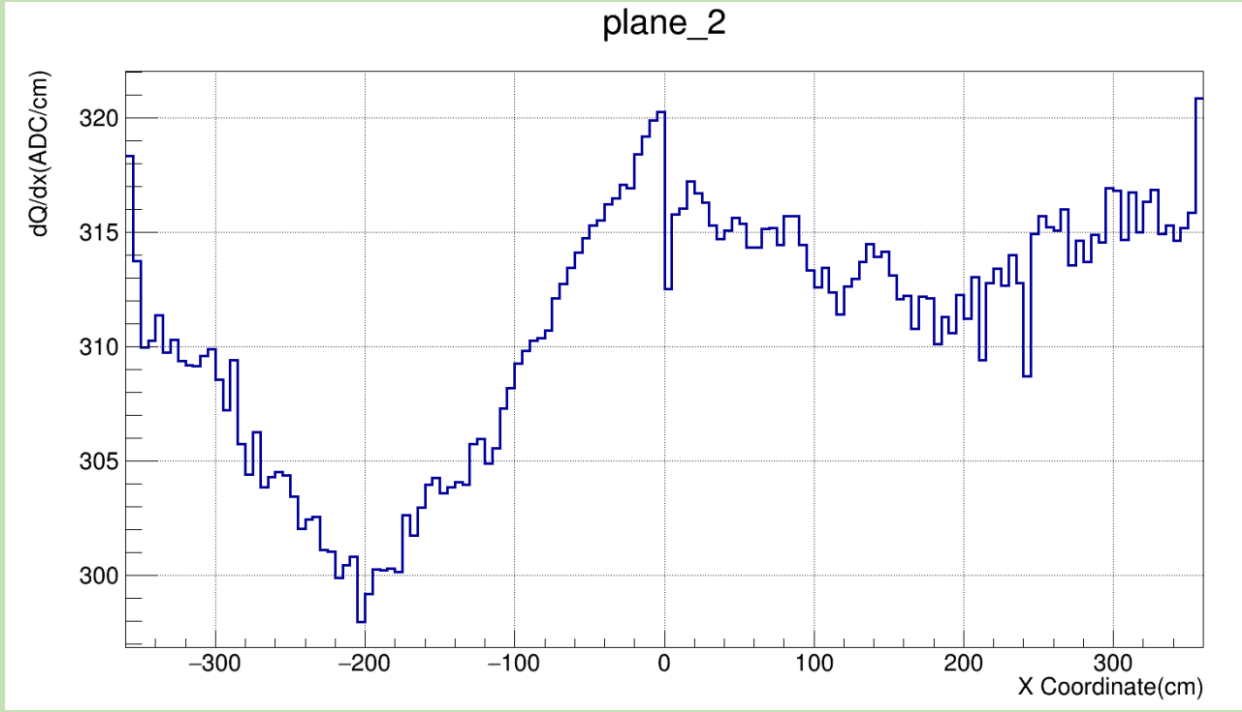
After spatial calibration

We still see many tracks appear past the APAs (X=+-360cm) even after the spatial calibration.

Run 5841 dQ/dx vs X plots for cathode crossing through going cosmic muons:



Before any calibration



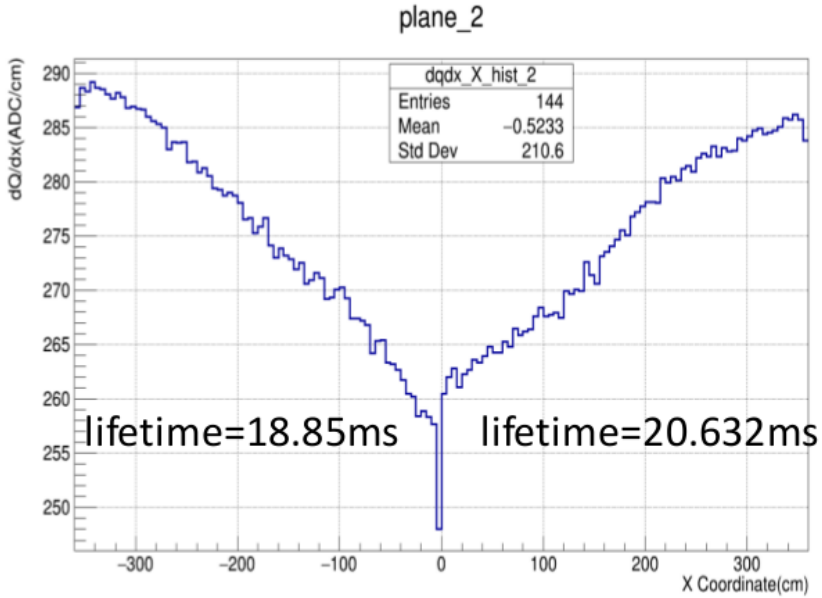
After SCE calibration

The shape on the right plot looks a little weird even after SCE correction. This could possibly a problem concerned with the implemetation of SCE service in LArSoft, efforts are underway to solve the issue.

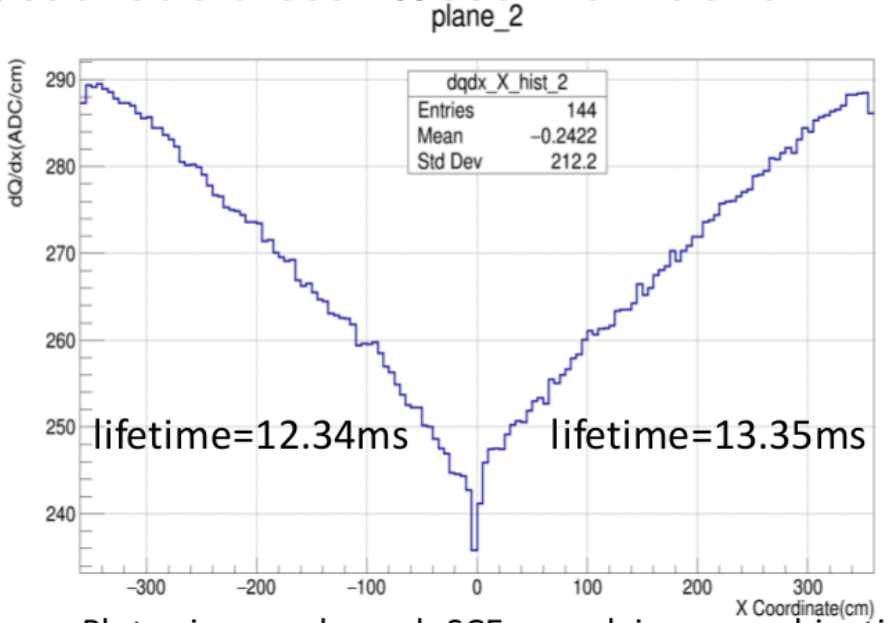
Below is the screenshot for Monte-Carlo plots shown last week which looked encouraging:

dQ/dx distribution plots:

dQ/dx vs X coordinate: mcc12 sample using cathode crossing cosmic muons



Plot using pandoracalo + YZ correction

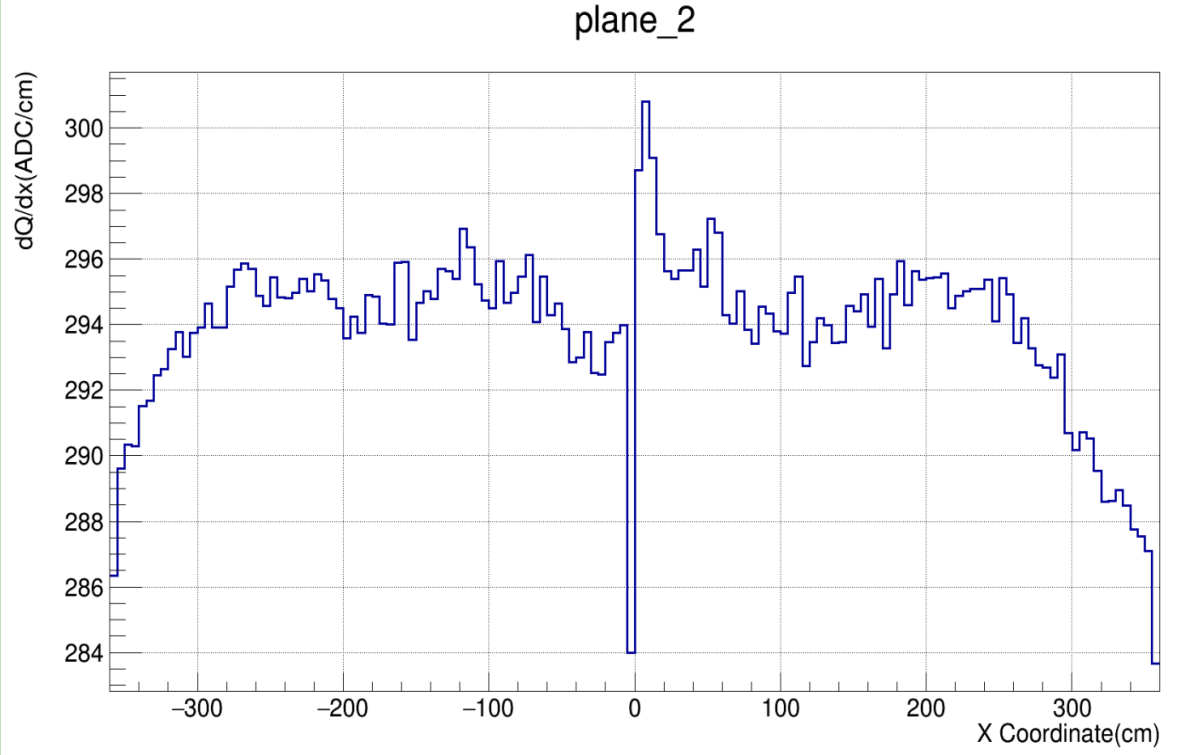


Plot using pandoracaloSCE + applying recombination correction using Efield values from SCE data driven maps + YZ correction

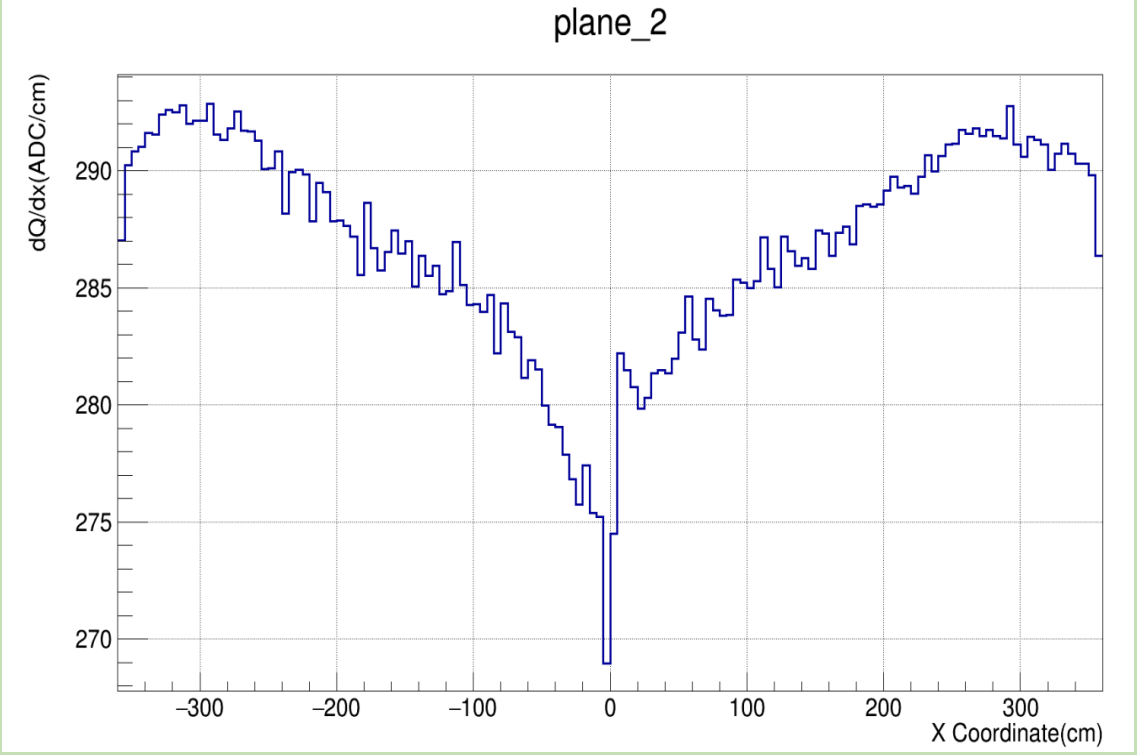
I calculated the electron lifetime for the two plots fitting an exponential function between x=20 to x=340cm (beam left) and x=-20 to x=-340cm (beam right).
Input lifetime is 12ms, so after doing SCE calibration we observe a lifetime very close to the input value.

Some MC study at high lifetime: Tingjun generated 50ms and 100ms lifetime samples which I looked at,

50 ms lifetime samples dQ/dx vs X:



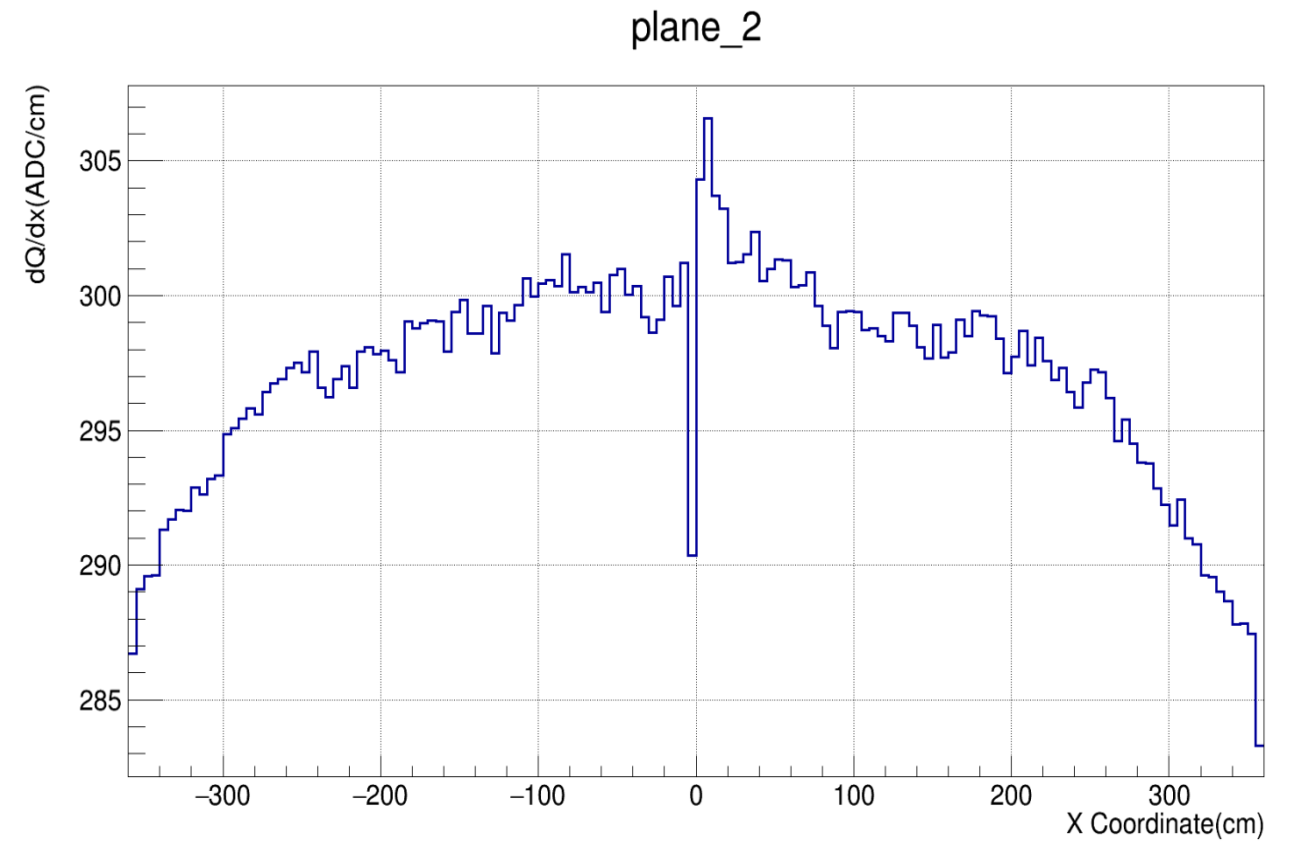
Before calibration



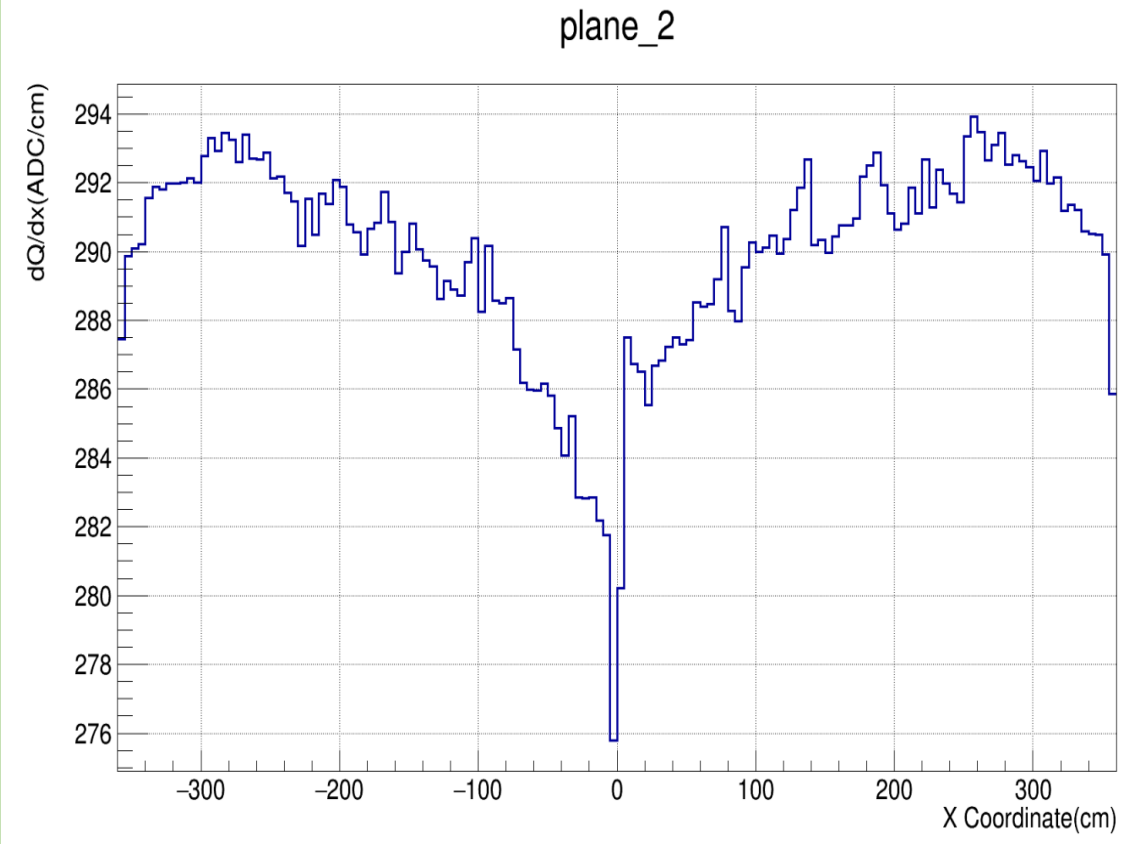
After SCE calibration

For reference: For drift time of 2.3 ms, lifetime of 50ms corresponds to Q(Cathode)=0.955*Q(Anode)

Looking at dQ/dx distribution at 100ms



Before calibration



After SCE calibration

For reference: For drift time of 2.3 ms, lifetime of 100ms corresponds to Q(Cathode)=0.977*Q(Anode)

Summary:

- Tracklength for beam particle shows improvements (closer to SCE OFF sample).
- Distortion along Y and Z appears to have been minimised.
- Cryostat side hits have been simulated in MC.
- Now we have both Anode crossing and cathode crossing T0 tagged tracks.
- One remaining issue is, the dQ/dx vs X distribution for data does not look as expected. Efforts are underway to address the issue.

THANKS