DEEP UNDERGROUND NEUTRINO EXPERIMENT

The University Of Sheffield.

Getting T0's for tracks from photon counter information

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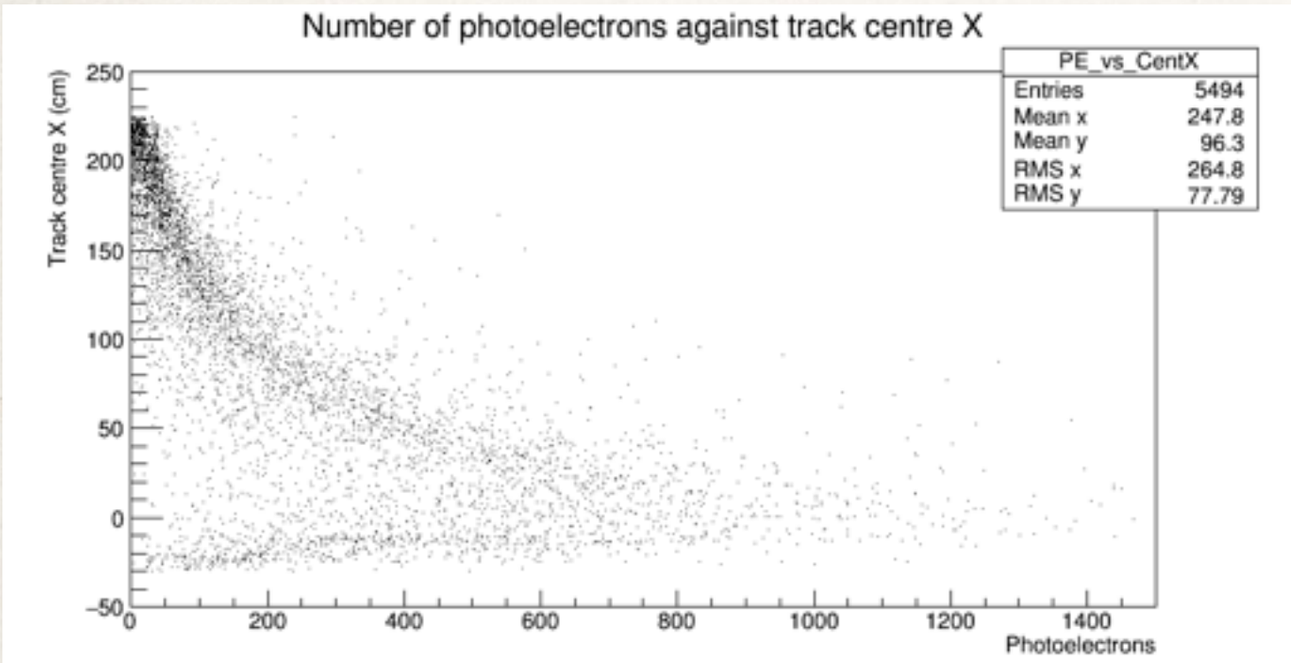
Why do we need a T0?

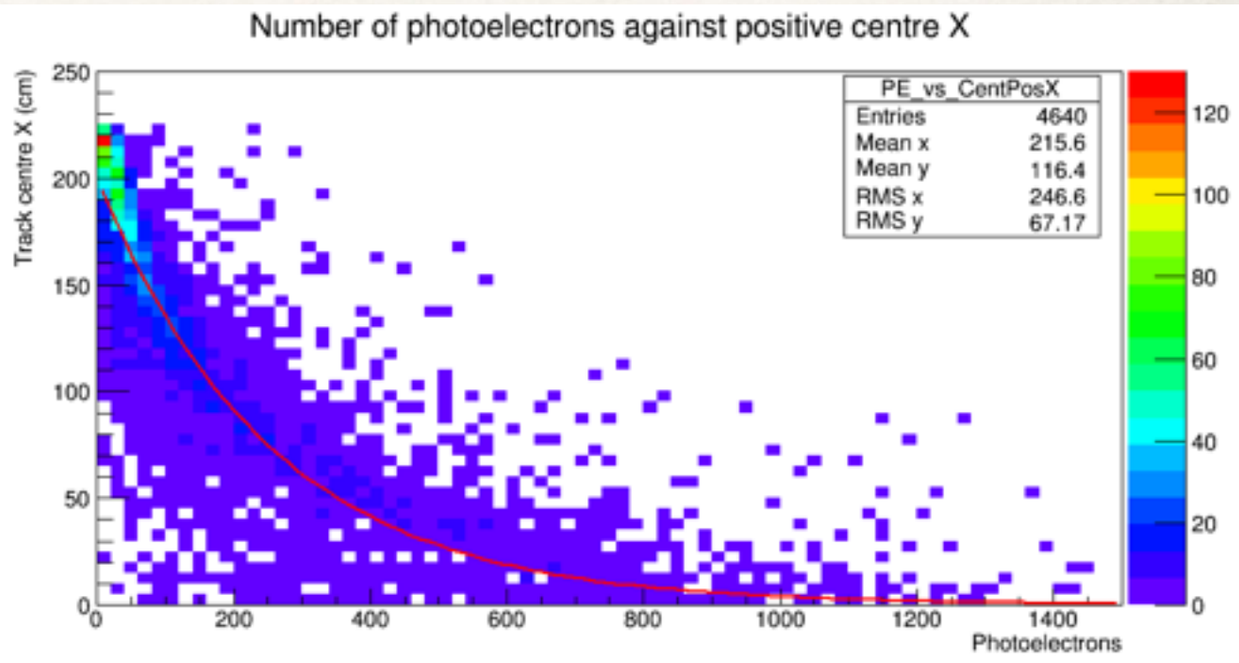
- During the run we will have no beam trigger and cosmic events have random timings.
- This means that the x position of the track is ambiguous, as a particle entering the detector near the APA can have hits at the same time as a particle entering near the CPA at an earlier time.
- The only way to distinguish between these scenarios is to know the time at which the particle crossed the detector
- Therefore need a T0!
  - Photon counters - 8 in between APA's.
  - Muon counters - Numerous around the outer walls of cryostat.

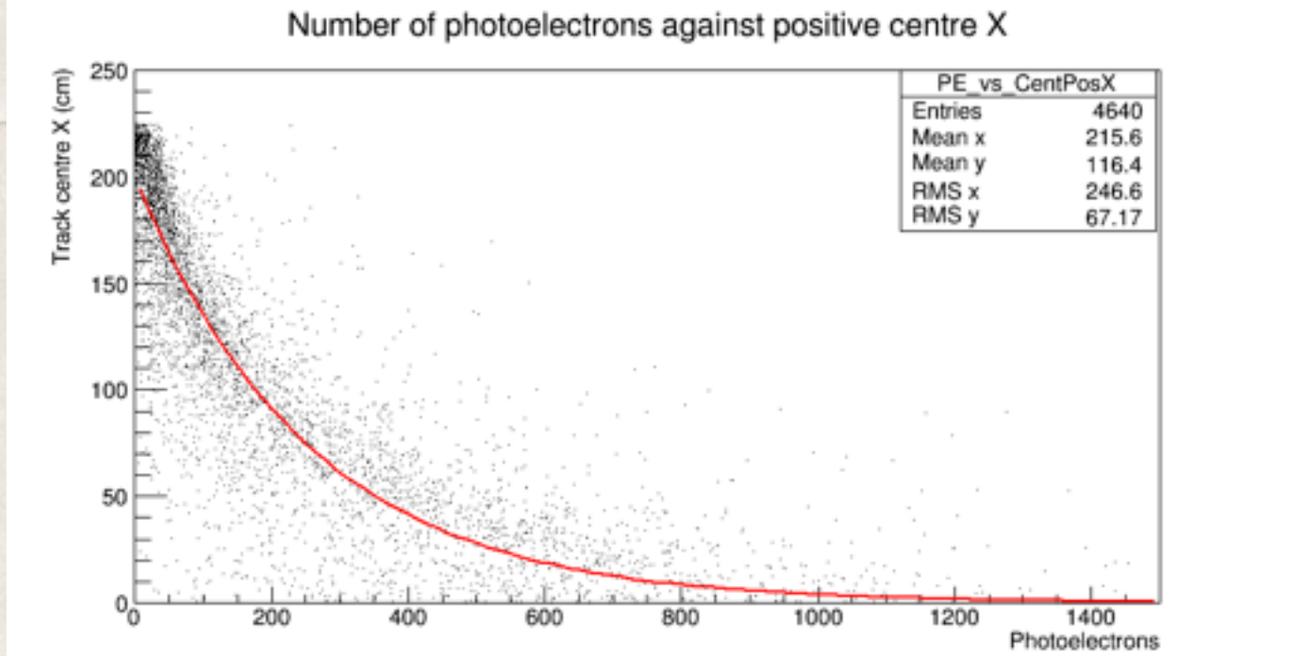
How to match tracks and flashes?

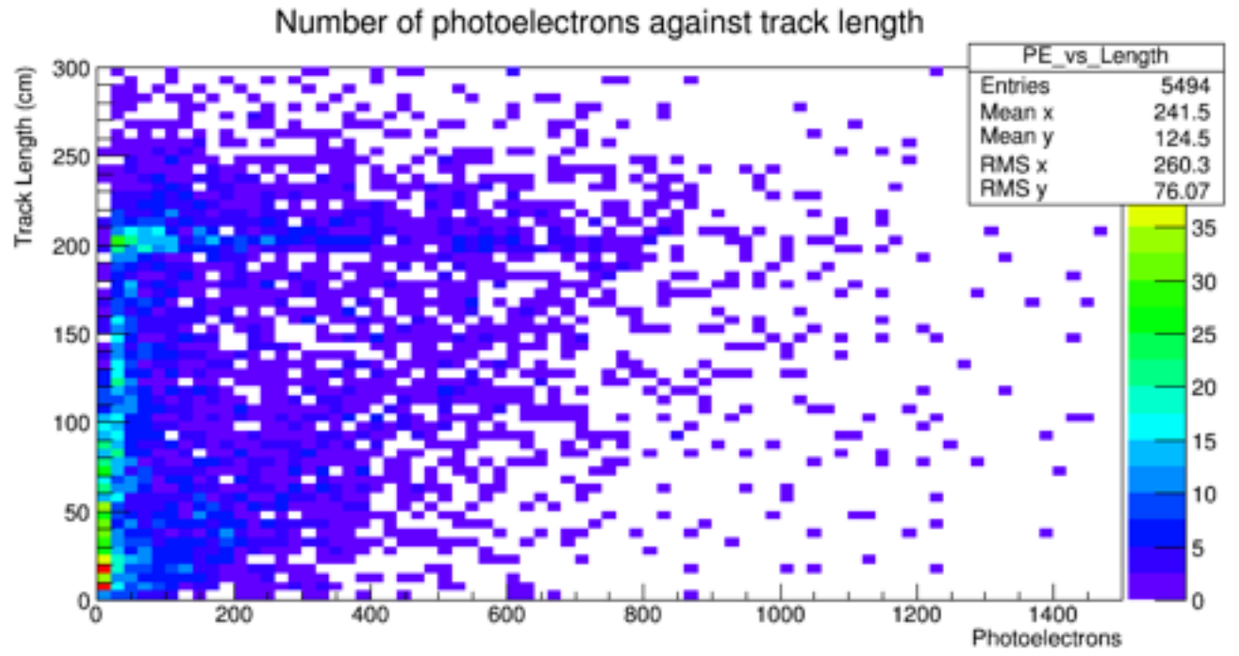
- After looking through MCC3 Anti-Muon sample I noticed a couple of patterns;
  - Number of photoelectrons is correlated to central X position of track.
  - As would expect time difference between the flash and track produced by a particle is related to the drift velocity.
  - Flashes are generally well reconstructed in YZ, so can work out a minimum distance between track and flash.
- Photon - track matching definitely appears do-able.

PE vs distance correlation



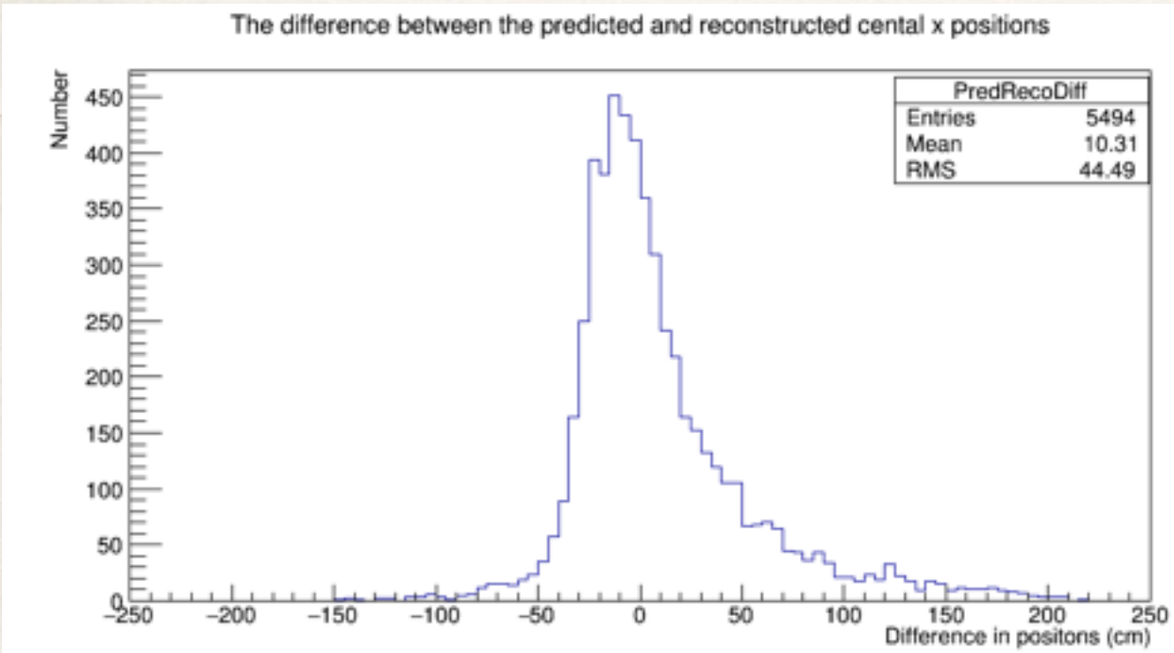


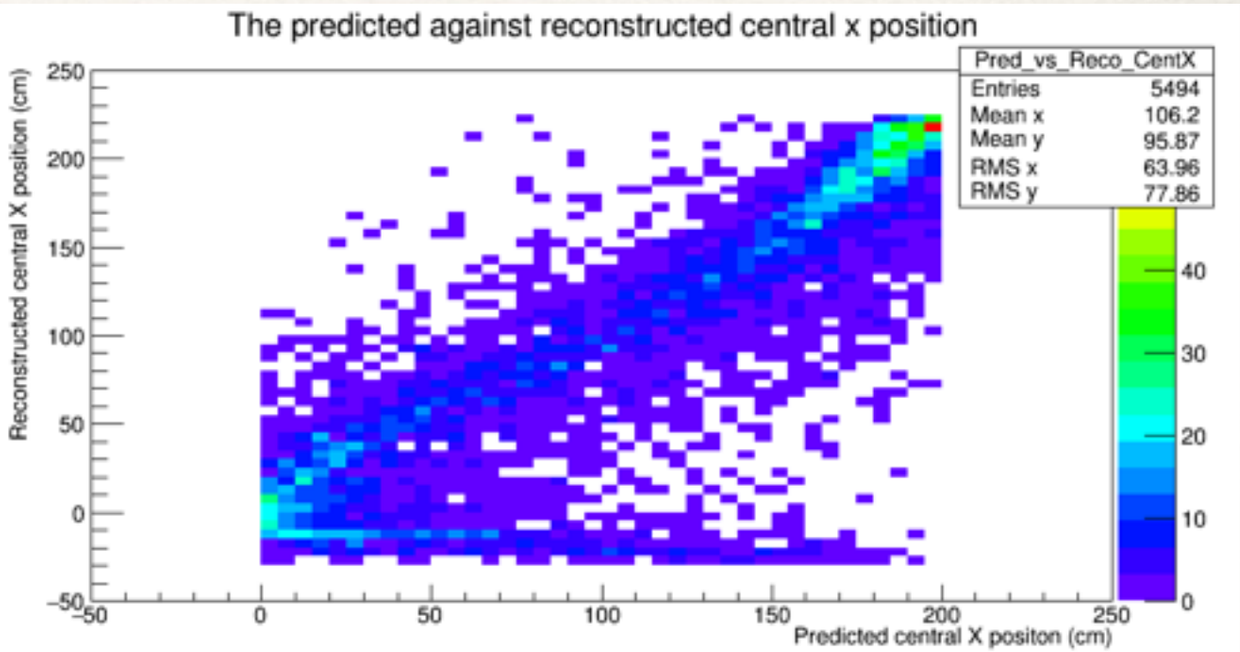




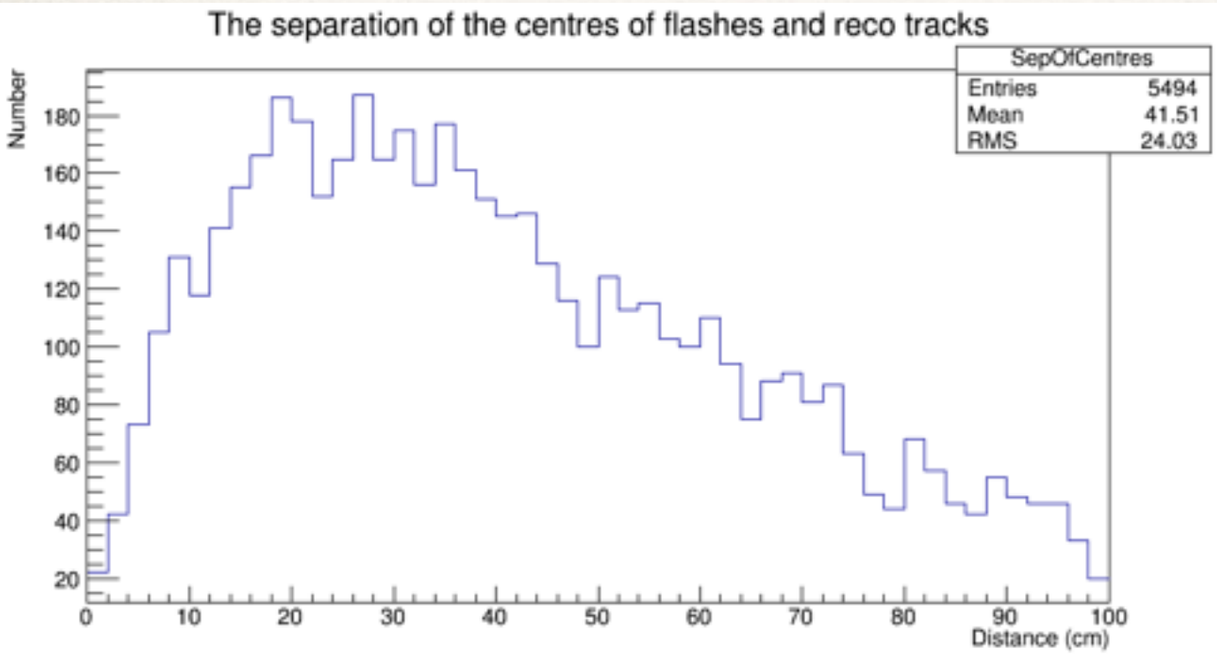
Predicting X position

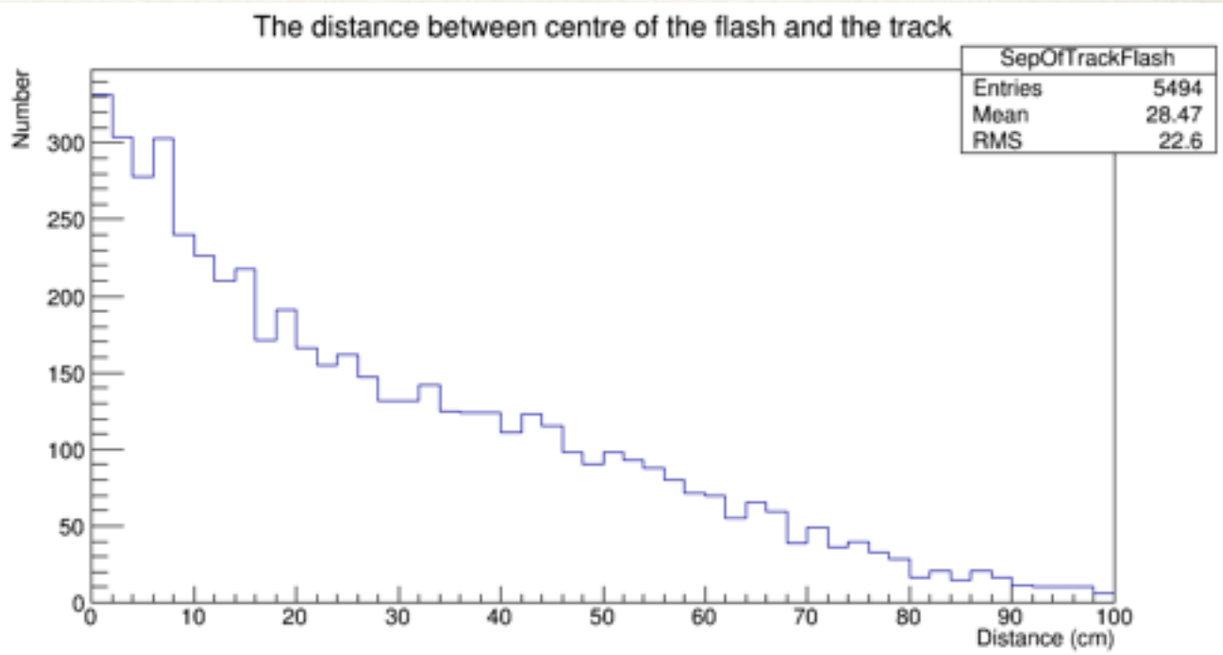
- As seen in previous slide, close relation between number of PE's and centre X position of track.

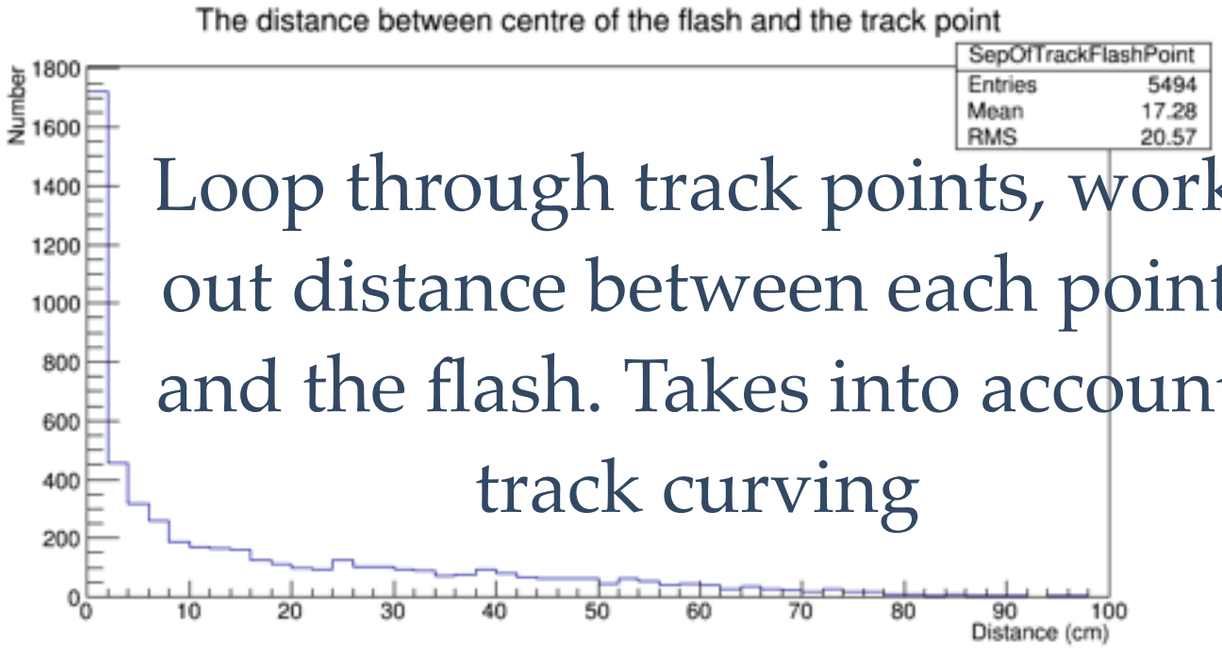




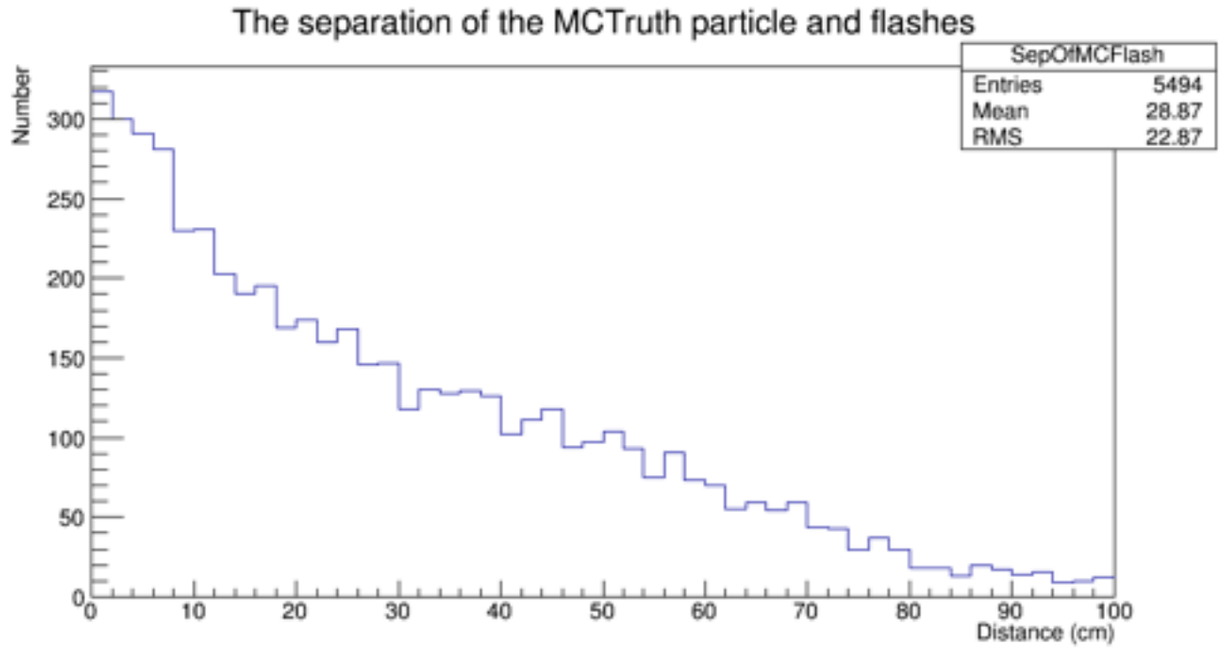
Distance between Flash and Track







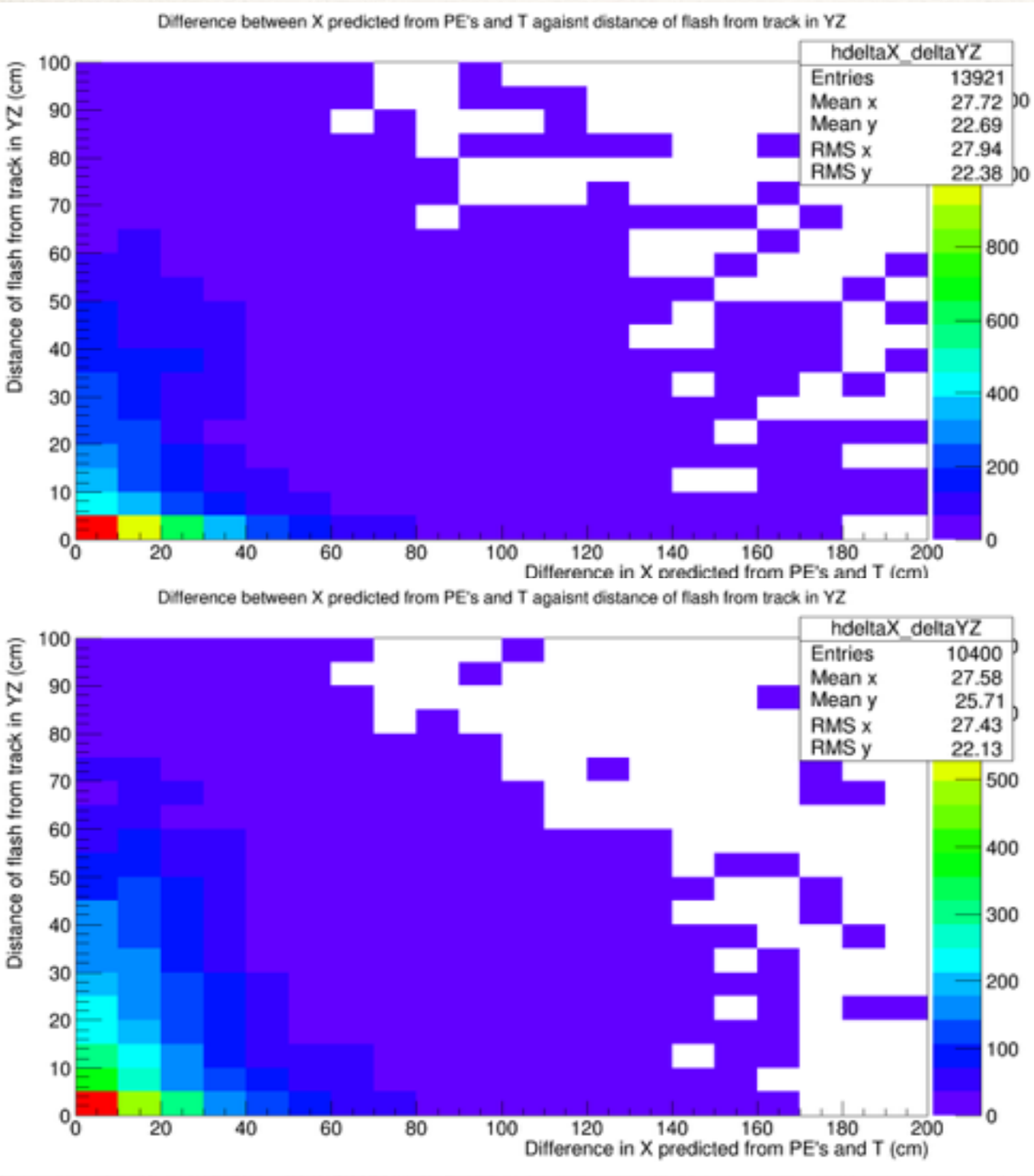
Loop through track points, work out distance between each point and the flash. Takes into account track curving

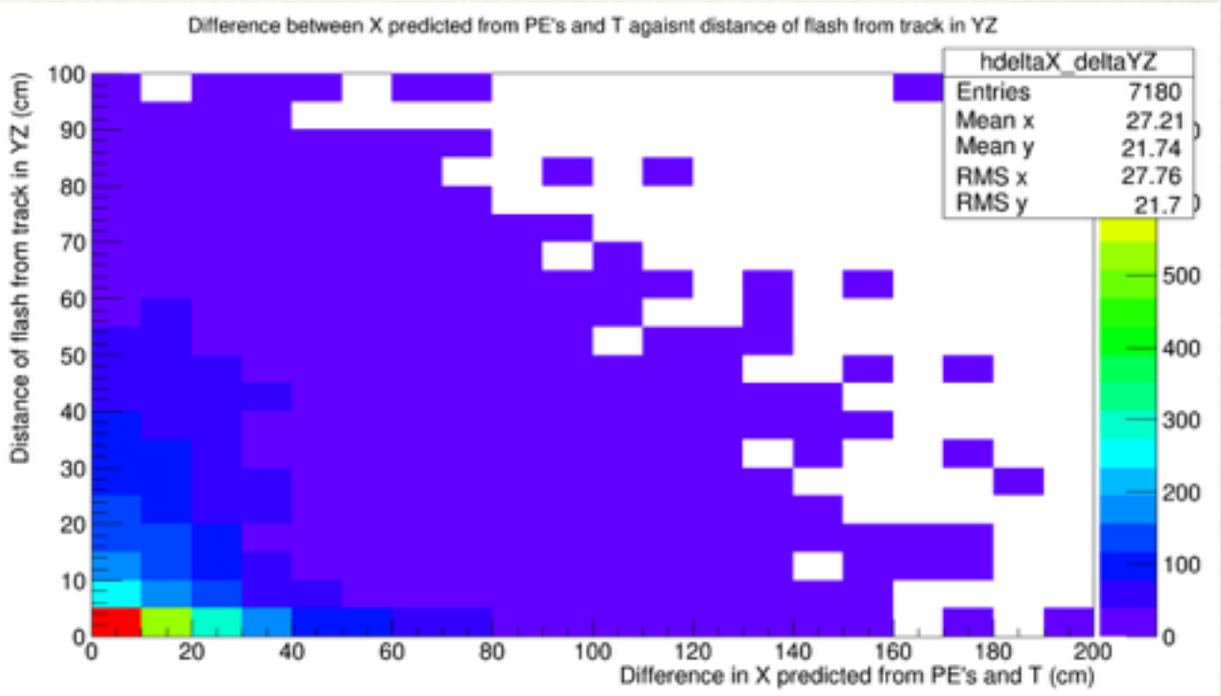


Actually Matching

- Previous plots made after all reco is done, using output of mergeana stage. Obviously want to match flashes during reconstruction so how to code this up?
  - Loop through all tracks
  - Loop through all photons and check that flash is within 1 drift window (before) track hits. I take central time of hits.
  - Work out the quantities shown above - PE X prediction, Timing X prediction, YZ separation.
  - Work out difference between X predictions, and plot this against YZ sep.
  - Work out which flash gives closest point to (0,0) on this plot, take this to be best matched flash. I call this distance 'FitParamter' - bad name just first thing which came to mind yesterday.

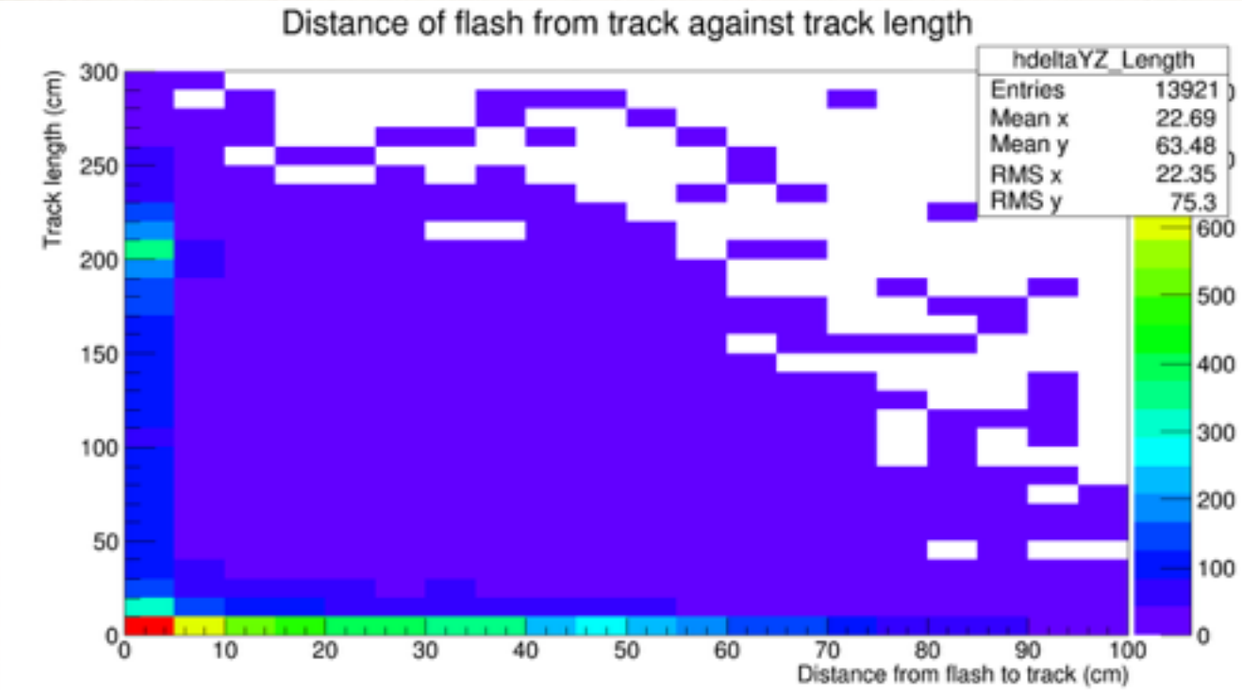
Difference in X predictions and seperation in YZ

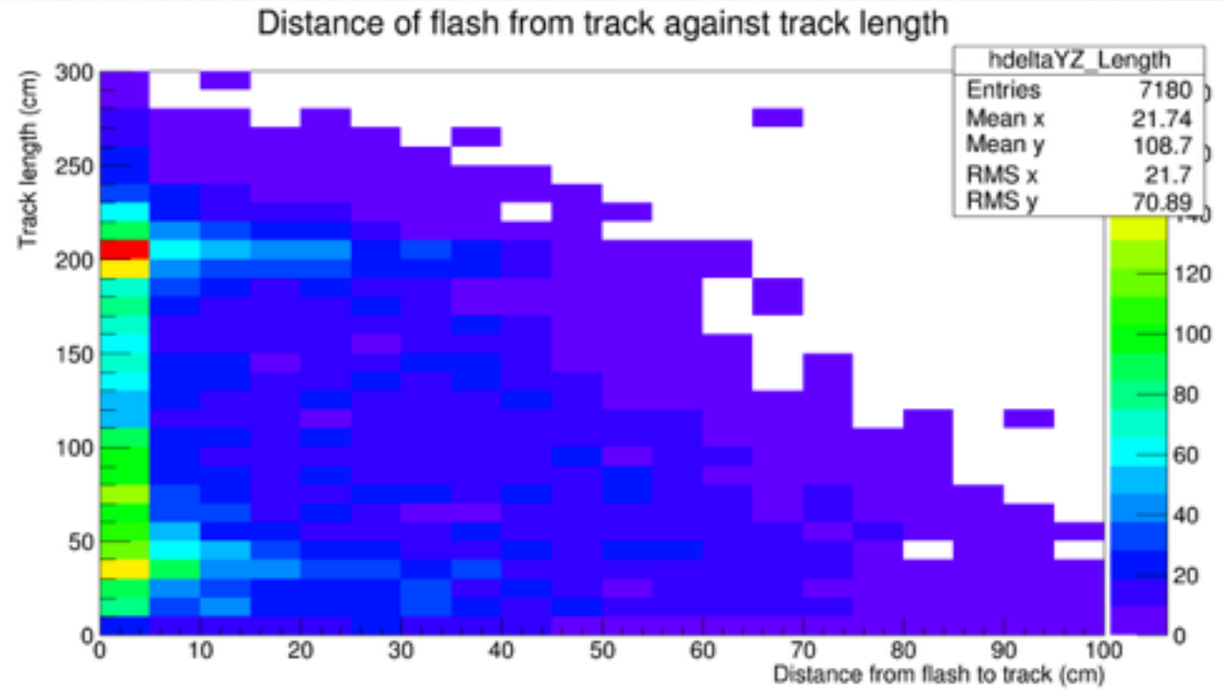


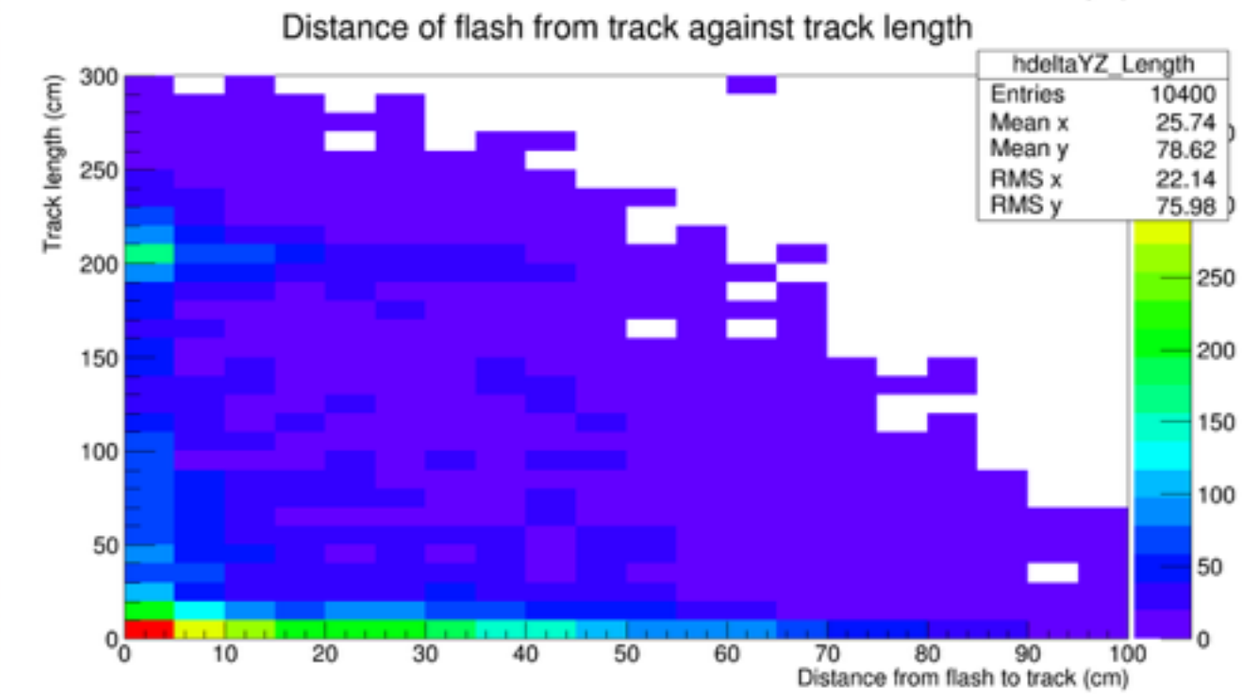


- CosTrk - Top Left
- Pandora - Top Right
- PMTrack - Bottom Left

Separation in YZ against reconstructed track length







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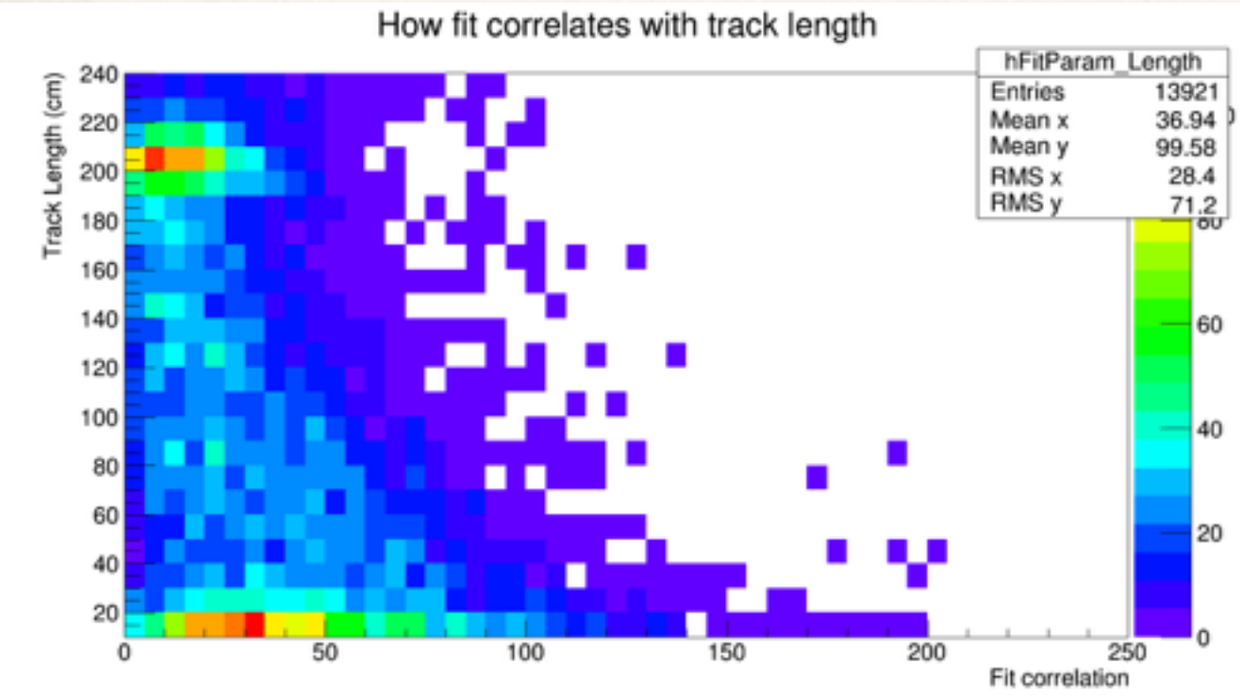
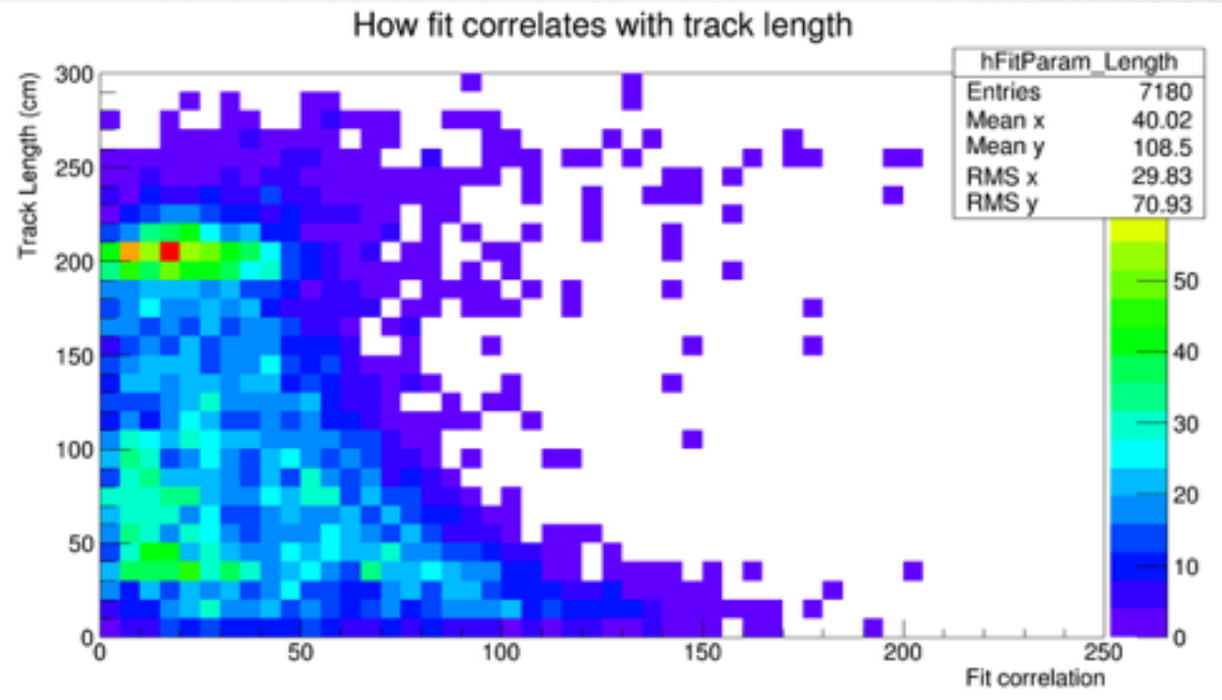
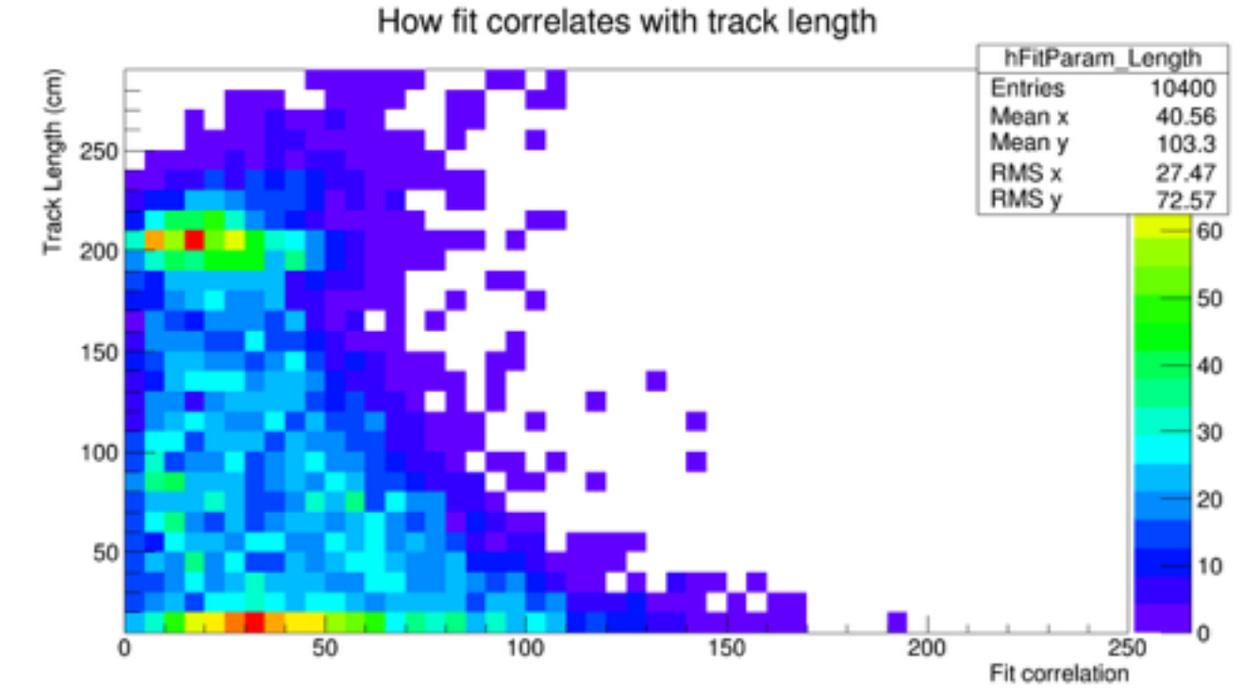
Difference in X predictions and seperation in YZ







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- PMTrack - Bottom Left

What next?

- The above plots are only for a 10K anti-mu sample, so the matching is really fairly straightforward
  - 1 ‘big’ track (mu+), so expect 1 flash.
    - Very little room for error.
- Over night have generated a CRY sample which I will try to match today.
- Will be looking at the plot of MCTruth T0 against counter matched T0.
- Should have this working at least preliminarily for MCC 4 next week.