Fermilab Physics | Lancaster University

35t/FD Sim, Reco and Analysis

Counter Alignment and Unique t_0 Update

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Brief Reminder

Two main aims.

- To initially check the counter positioning with respect to the TPC.
- Use the external counters to find a unique t_0 for each track.

Method Outline.

Step 1. Select only muons with 'straight' tracks.

Step 2. Associate counter hits to tracks by taking t_0's which force the entirety of the track to be inside the physical volume of the TPC.

Step 3. Extrapolate the straight muon tracks to the counter faces and look for discrepancies in position, using errors associated with extrapolation to reduce the number of possible t_0's for each track.

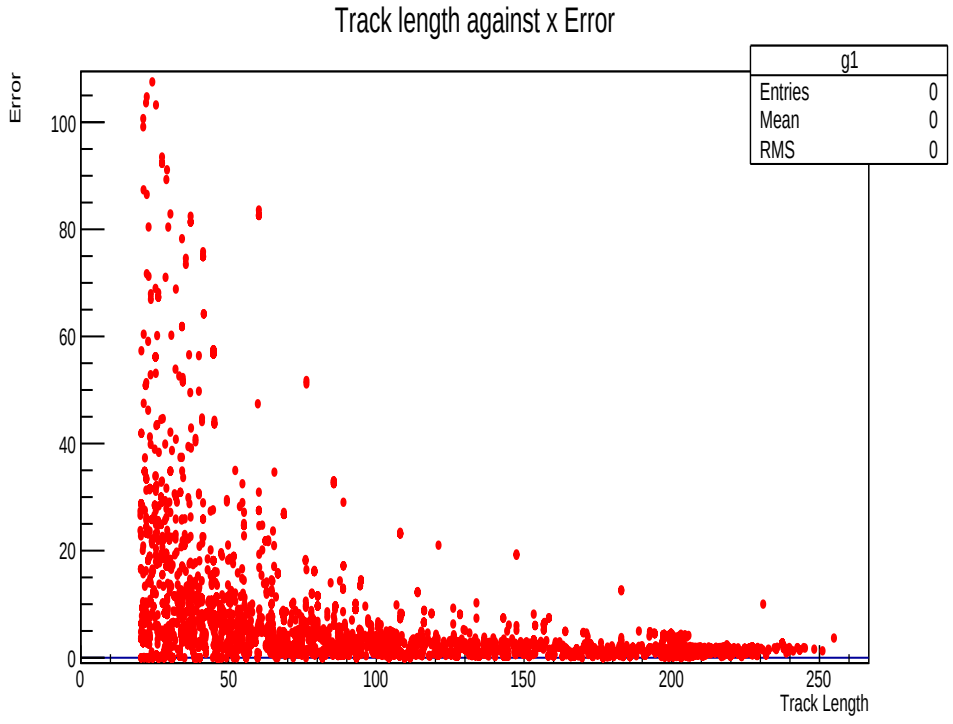
Method Outline, Step 1.

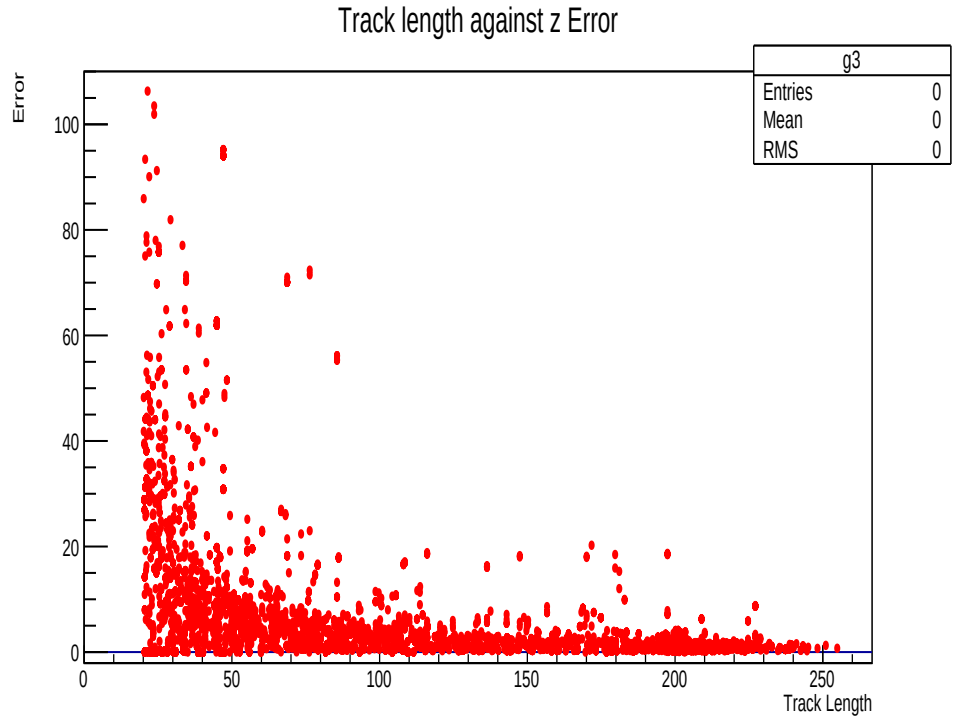
Selecting straight muons.

- All data from MCC4.
- Lower bound applied to number of track points and physical track length.
- For $\alpha, \beta, \gamma, \alpha', \beta', \gamma' \in \mathbb{R}$ and N spacepoints in the track.

$$\frac{x-\alpha}{\alpha'} = \frac{y-\beta}{\beta'} = \frac{z-\gamma}{\gamma'} \quad \Longrightarrow \quad \kappa^2(\alpha,\beta,\gamma,\alpha',\beta',\gamma') = \frac{1}{N\sigma^2}\sum_{\text{points}}^{N} d^2$$

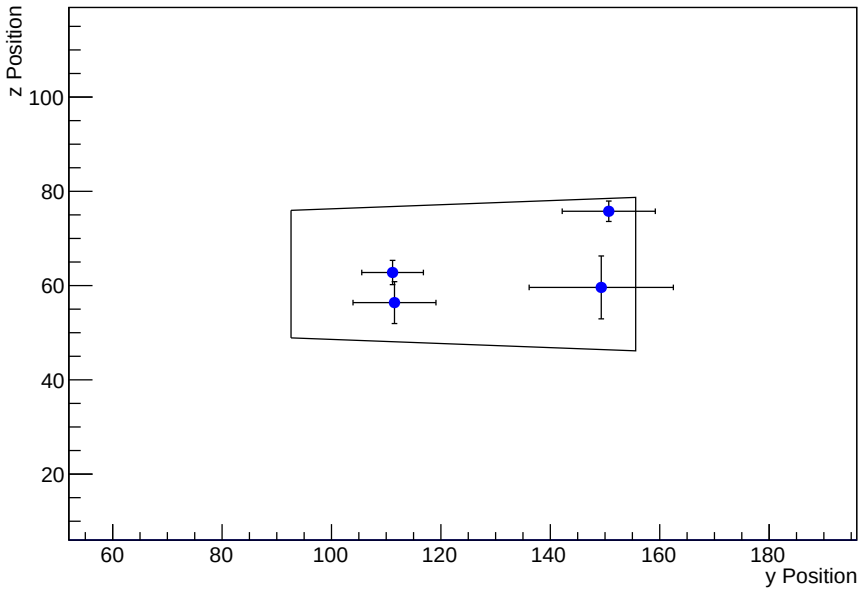
$$\sigma^2 = \sigma_{\text{x}}^2 + \sigma_{\text{yz}}^2 \quad , \quad \sigma_{\text{x}} = 0.4\text{cm} \quad , \quad \sigma_{\text{yz}} = 0.3\text{cm}$$



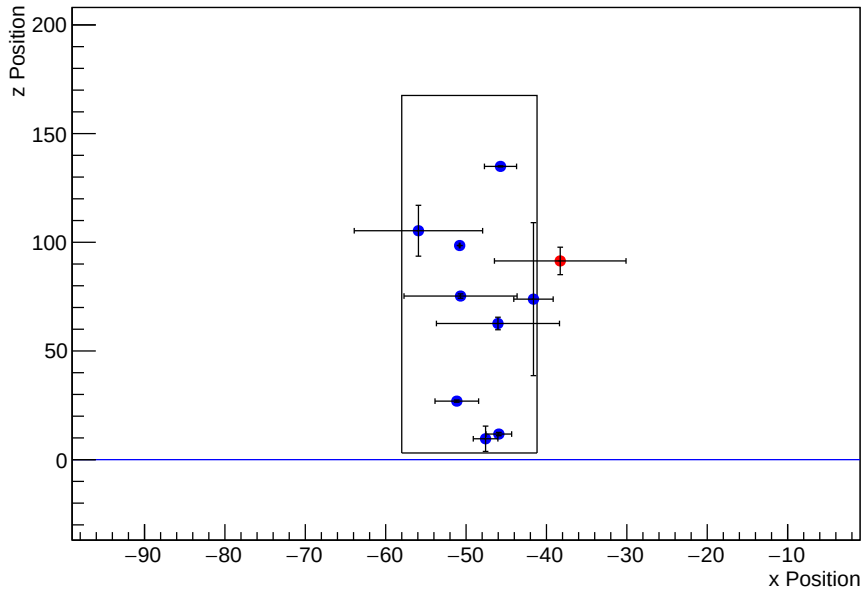


Counter Alignment.

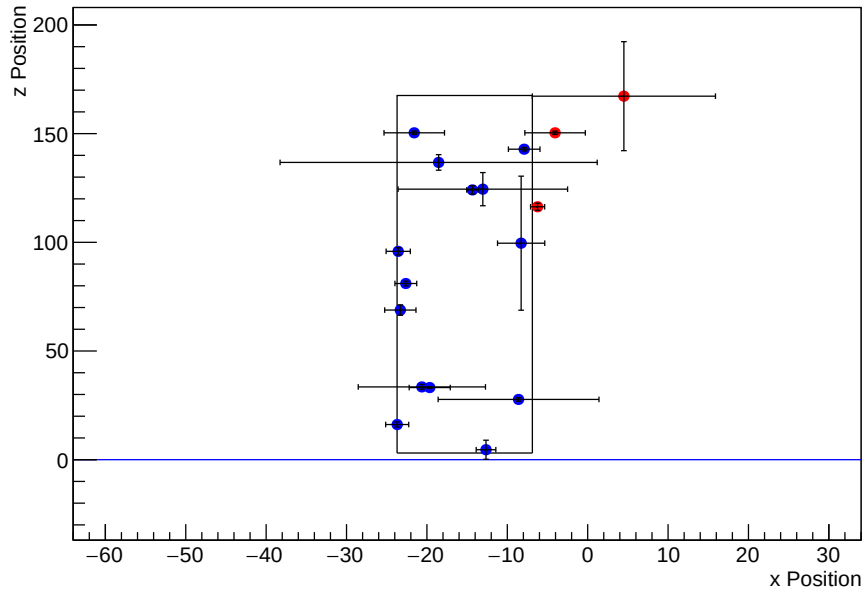
TSUCounter24



BSUCounter44



BSUCounter46

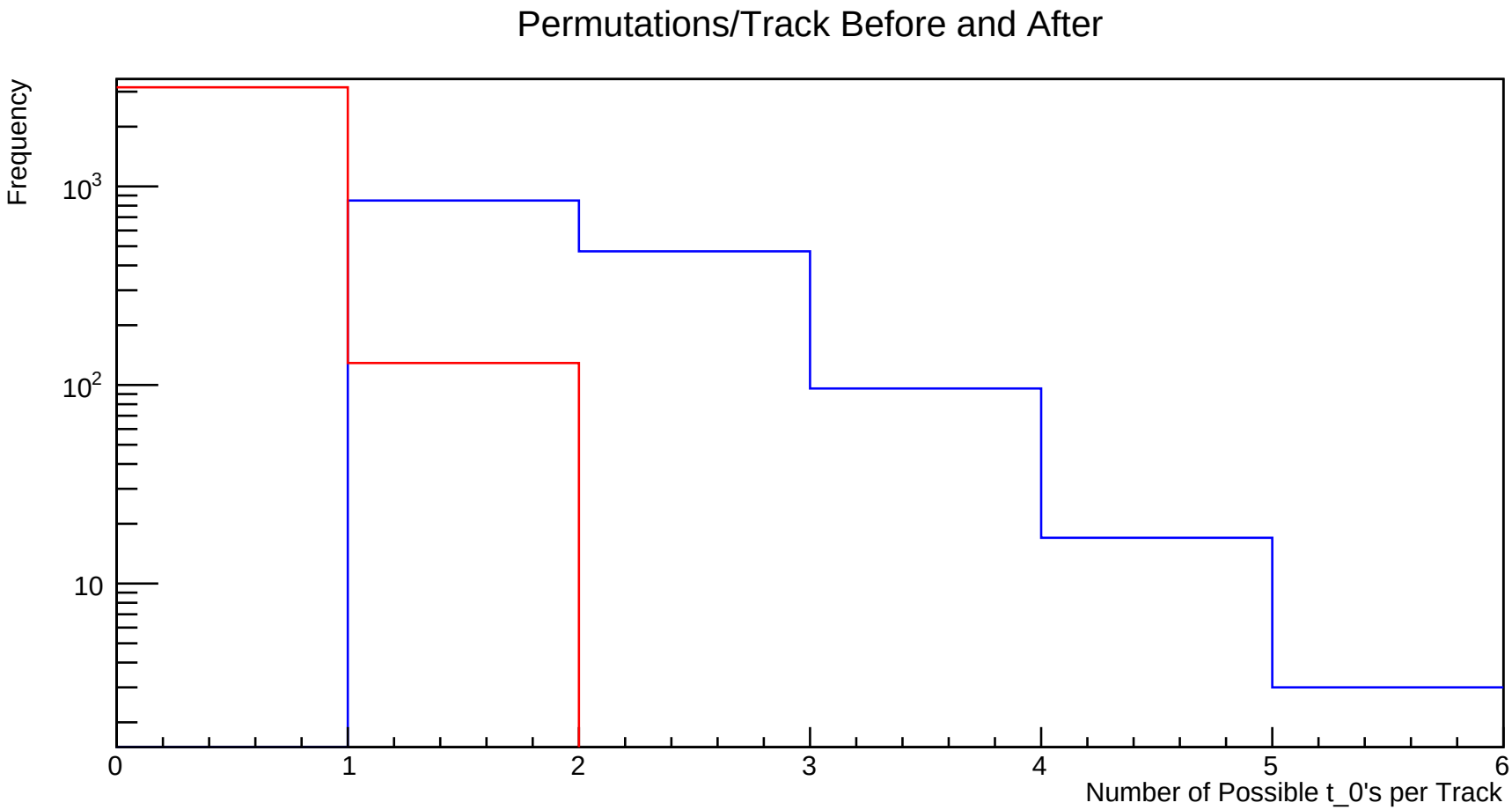


Blue points represent tracks which have a t_0 corresponding to the same counter as the track extrapolates to.

Red points represent tracks which have a t_0 corresponding to the counter shown in the plot, but extrapolate to a region nearby within error.

Using error bars to extract a unique t_0.

- Enforcing that the entirety of a track be within the physical volume of the TPC, is not a strong enough constraint to determine a unique t_0 for that track.
- Blue represents number of possible t_0's/track with only this restriction.



- Enforcing that for a given t_0 and associated counter trip, the track must extrapolate to that same tripped counter within the allowance of errors.
- Red represents number of possible t_0 after making this cut.

To Summarise.

- We are very close to concluding that the external counters are correctly alligned.
- Currently studying tracks leading to coincidences of 2 or more counters, this should produce even tidier plots.
- The method of using the error associated with extrapolation as a constraint, has been very sucessful in reducing the number of possible t_0's per track.