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35t/FD Sim, Reco and Analysis

Track t_0 from External Counters

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Work Overview

Two main aims.

- To initially check the counter positioning with respect to the TPC.
- To develop machinery capable of monitoring the efficiency of external counters as the prototype is tested.

Method Outline.

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

Step 2. Associate counter hits to tracks. (Associate photon detector hits to tracks).

Step 3. Extrapolate the straight muon tracks to the counter faces and look for discrepancies in position.

Method Outline, Step 1.

Selecting straight muons.

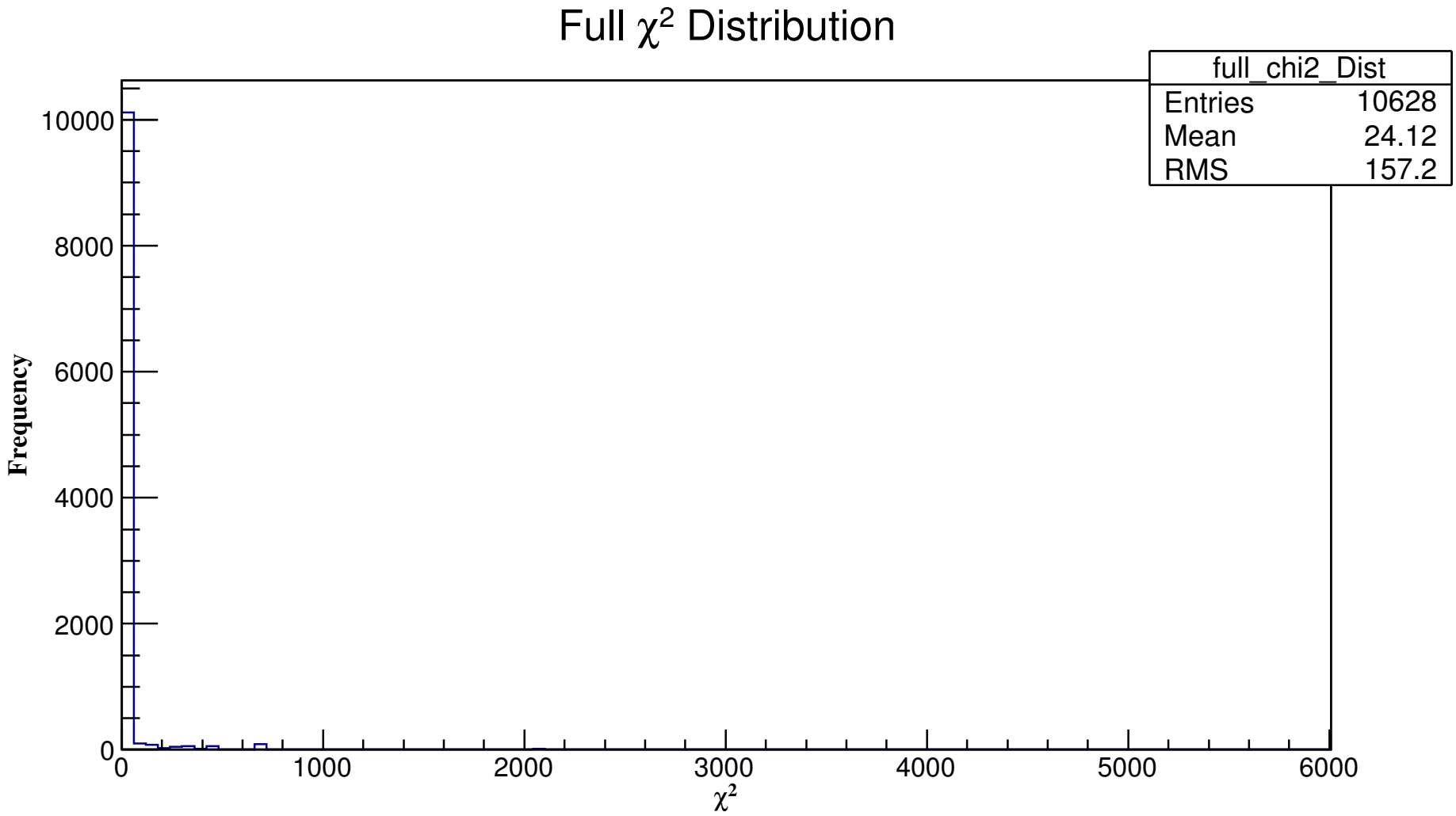
- All data from the tree made by Mark, has counter hits added to the MCC3 files. Made up of CRY milliblock events, 10 drift windows long and have random t_0's.
- For $\alpha, \beta, \gamma, \alpha', \beta', \gamma' \in \mathbb{R}$ and N spacepoints in the track.

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

- Use **TMiniut** to find the values of the six parameter such that χ^2 is a minimum.
- Use the properties of the left equation to plot the resulting line by varying parameter λ.

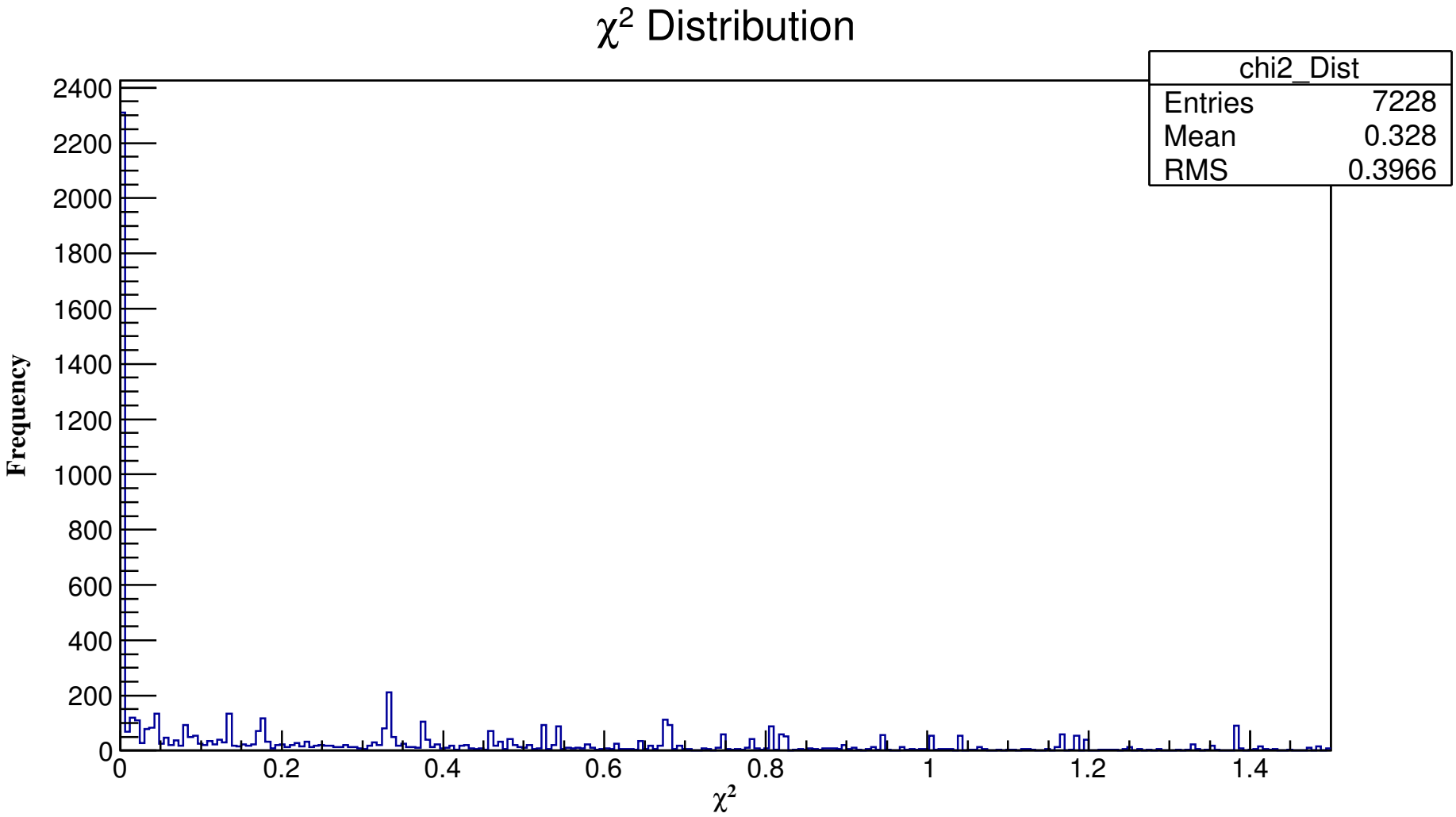
$$x = \alpha + \lambda\alpha' \quad , \quad y = \beta + \lambda\beta' \quad , \quad z = \gamma + \lambda\gamma'$$

χ^2 Discussion



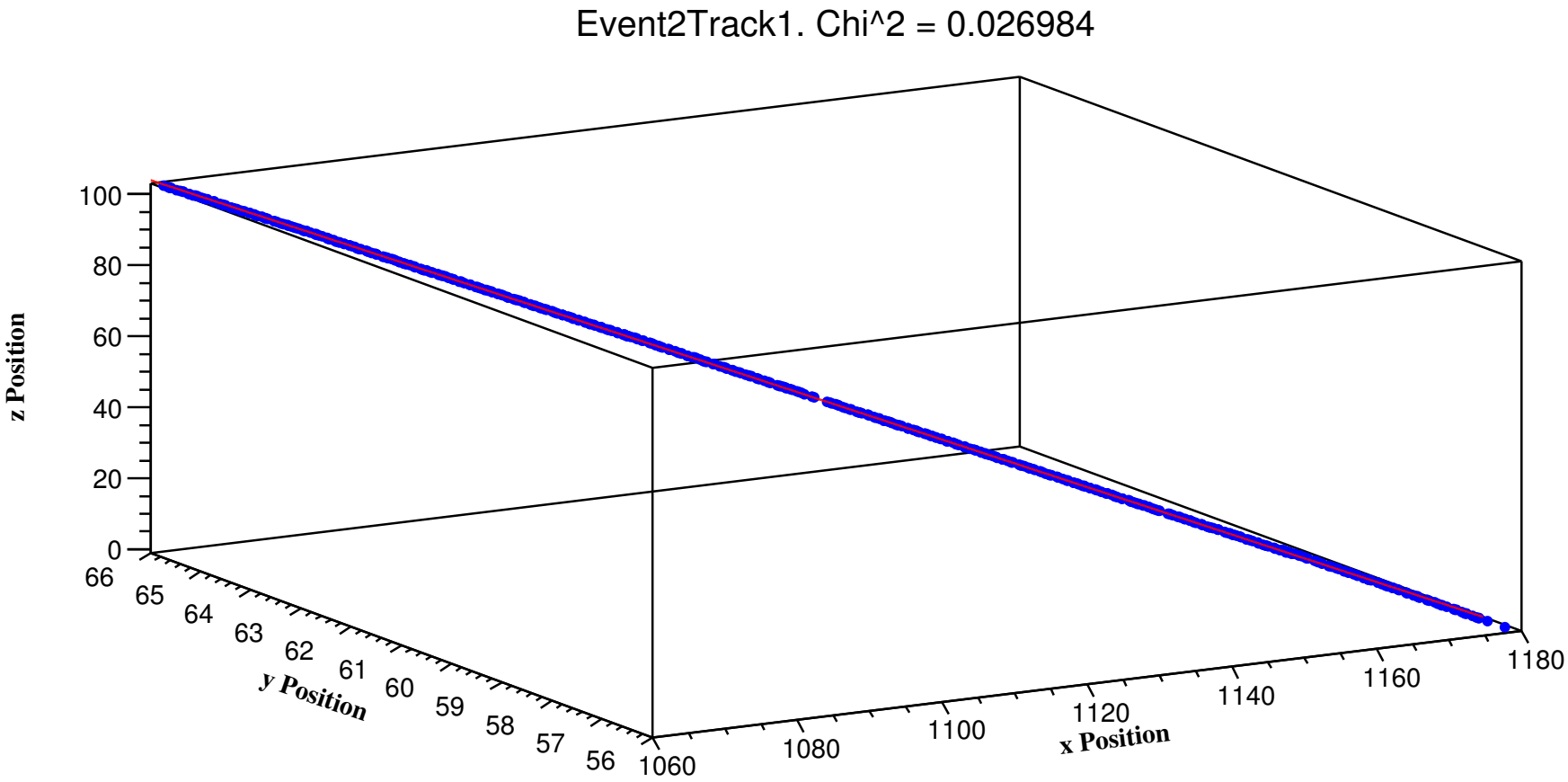
For now, all points have the same uncertainty.

χ^2 Discussion



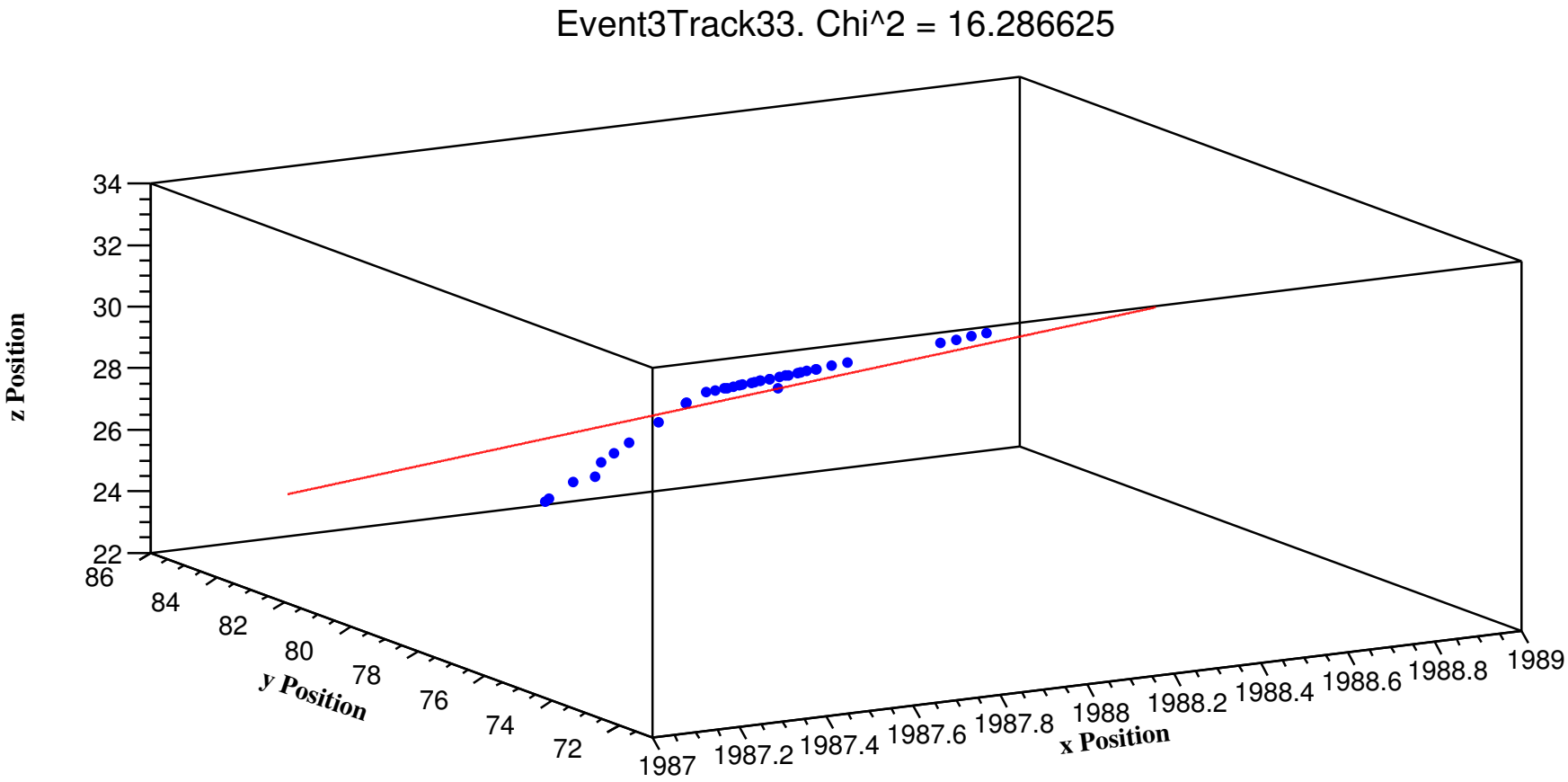
Define 'straight' to be a track with $\chi^2 \leq 1$.

χ^2 Discussion



Example of an accepted track.

χ^2 Discussion



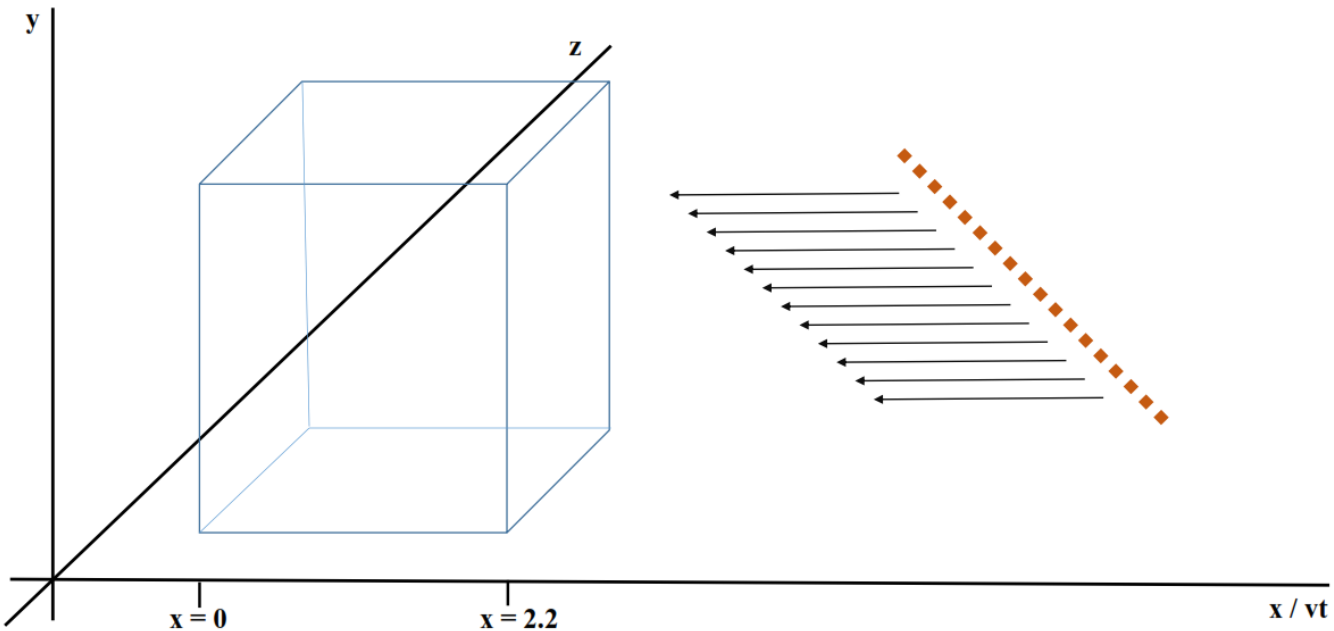
Example of a rejected track.

Method Outline, Step 2.

Associating tracks to counter hits.

- From the simulation file, the physical x coordinates of each track are entangled with a counter 'trip' time.

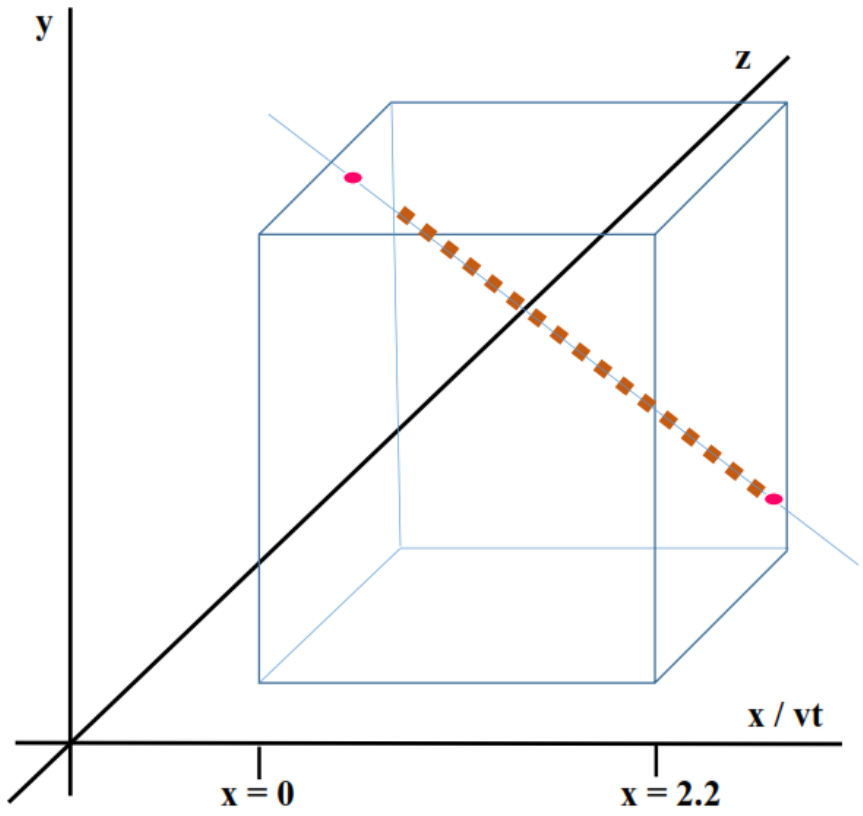
$$x_{physical} = x - v_{drift}t \quad , \quad y_{physical} = y \quad , \quad z_{physical} = z$$



- The simulation file also gives a corresponding counter number for this trip.

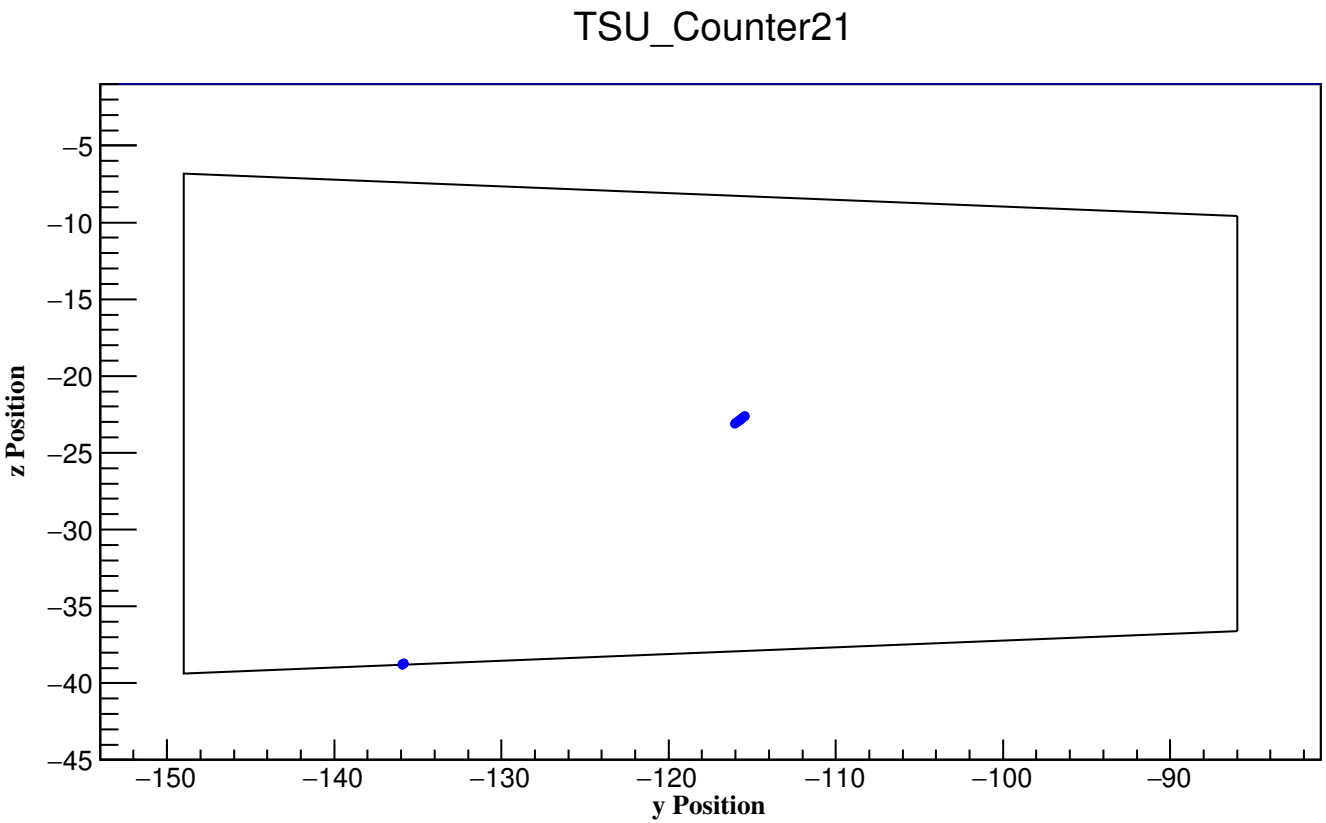
Translation of track.

- Within an event's 10 drift windows it is not possible to tell immediately which track corresponds to which counter trip.
- Loop over trip times for that event, associating with each track a value of t such that all of its spacepoints are physical.
- The extrapolated track could now hit a counter.



Positioning Check

- Does the extrapolated line intercept the same counter as was given by the simulation?



Not enough data to be conclusive about alignment.

Must be a 1 to 1 correspondence between triggers and tracks.

What's Next?

Monitoring counter efficiency.

- Require photon detector information, next Monte Carlo.

The plan:

- Use photon detectors to get t_0.
- Extrapolate as usual to the counter face and ask whether there is a hit.

$$Efficiency \propto \frac{No.\ Found\ Hits}{No.\ Expected\ Hits}$$