

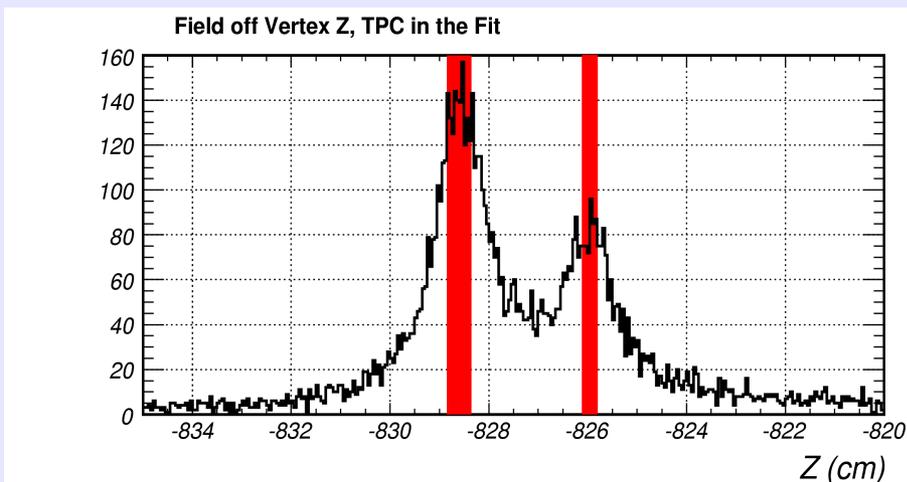
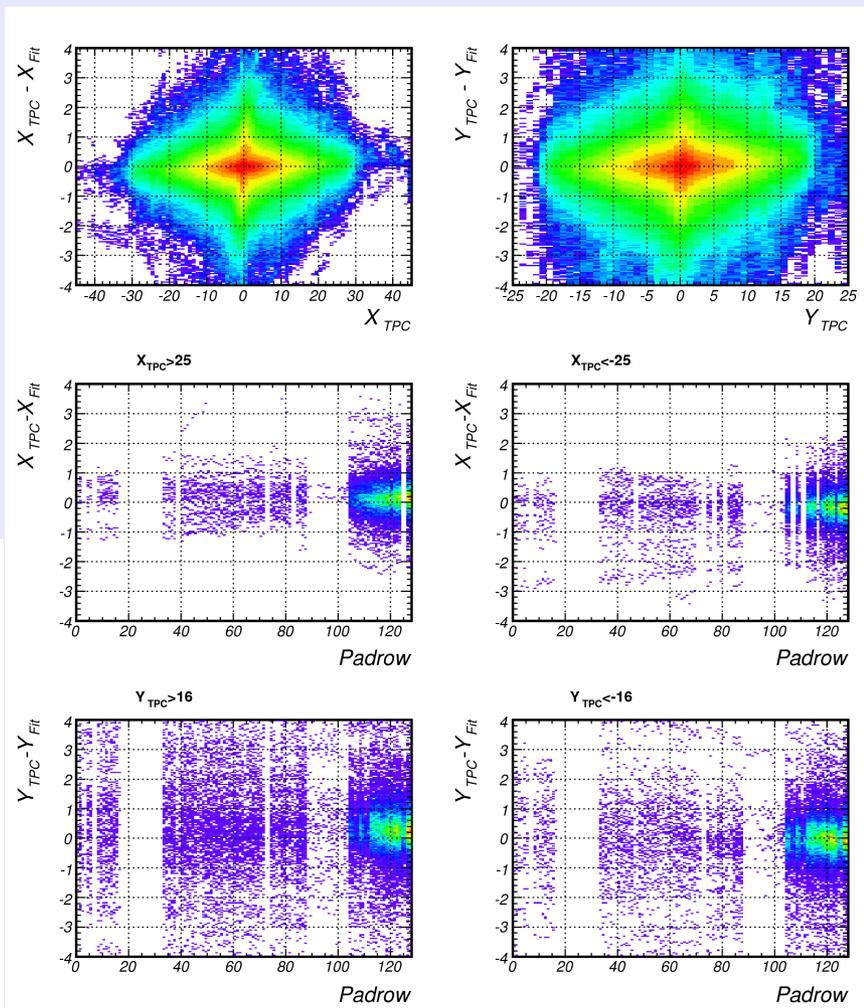
# TPC Distortions

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# Field off, Chamber-only Fit

- We have a small problem in X: about 2.5 mm over 25 cm
- Drift velocity is 0.6% off

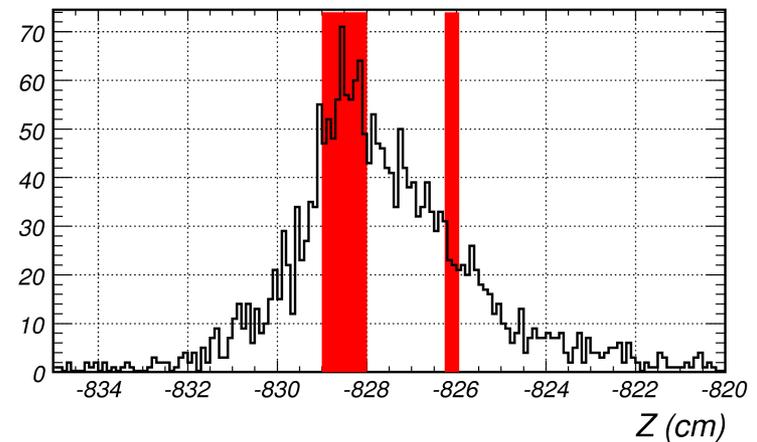




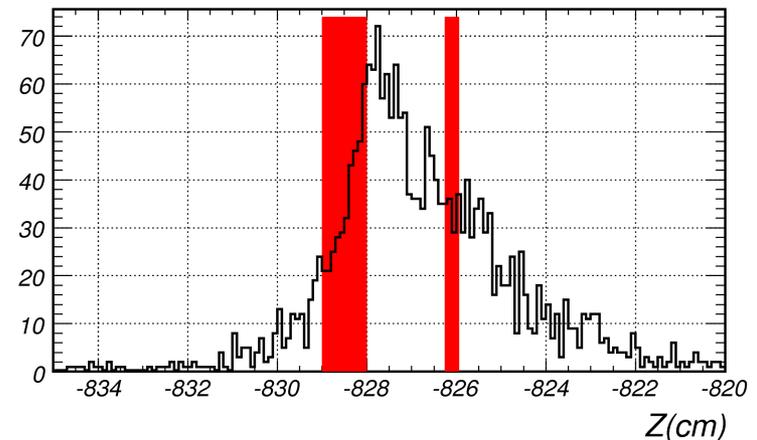
# First ResCor Attempt

- Vertex Z without ResCor is ok, but resolution is quite bad compared to field off runs
- ResCor was run with free target position, and the net result is that reconstructed target Z was pulled forward

Vertex Z run 15860, TPC in, no ResCor



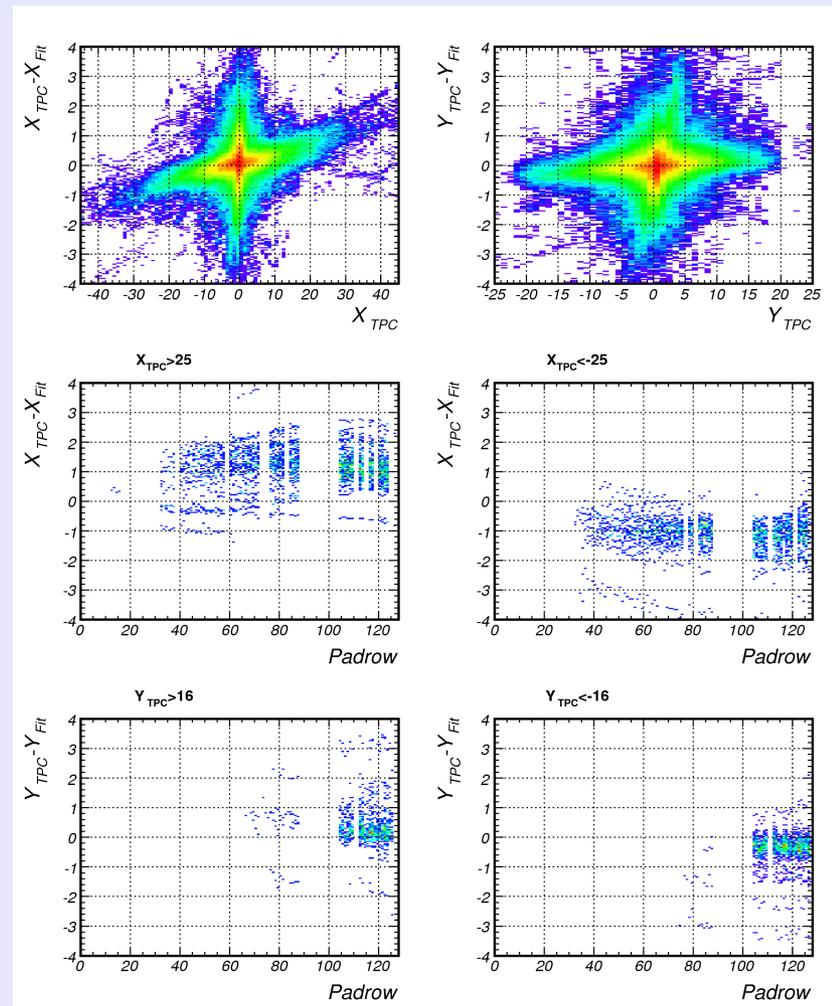
Vertex Z run 15860, TPC in, with ResCor





# Field on, Z fixed on Empty Target (run 15634)

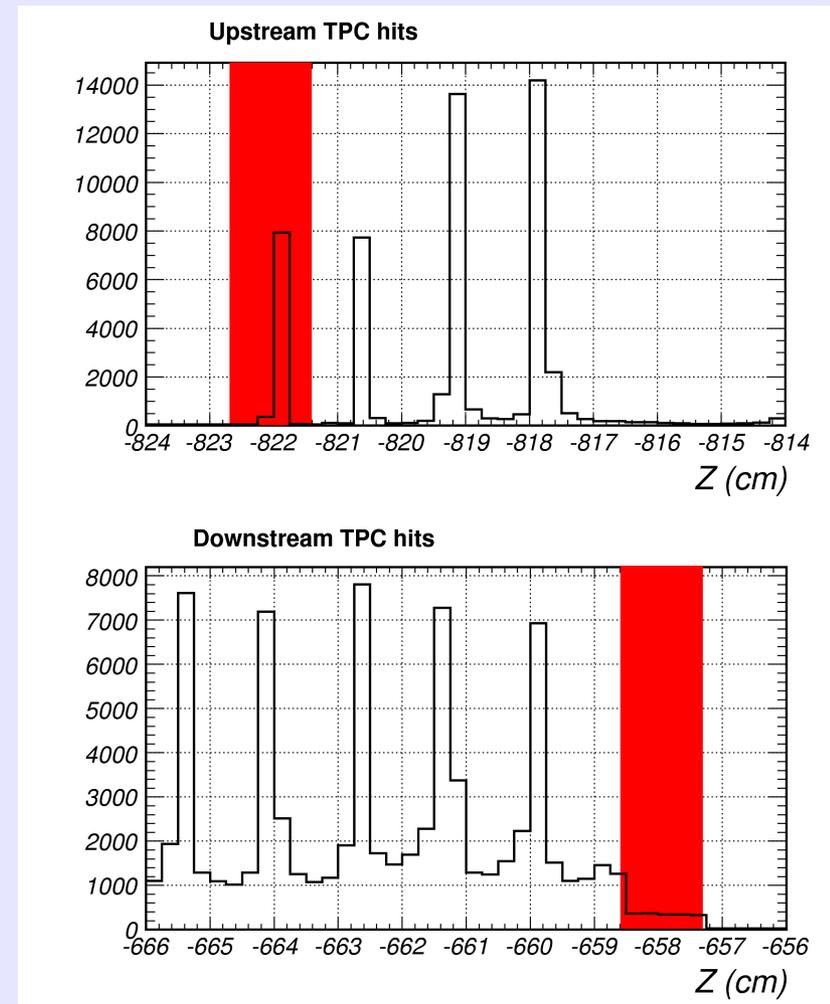
- New iteration of constrained fitting fixes vertex Z on target or scint
- Now the X problem is ~4 times worse than in field off
- Y is doing something funny as well





# Z of TPC hits

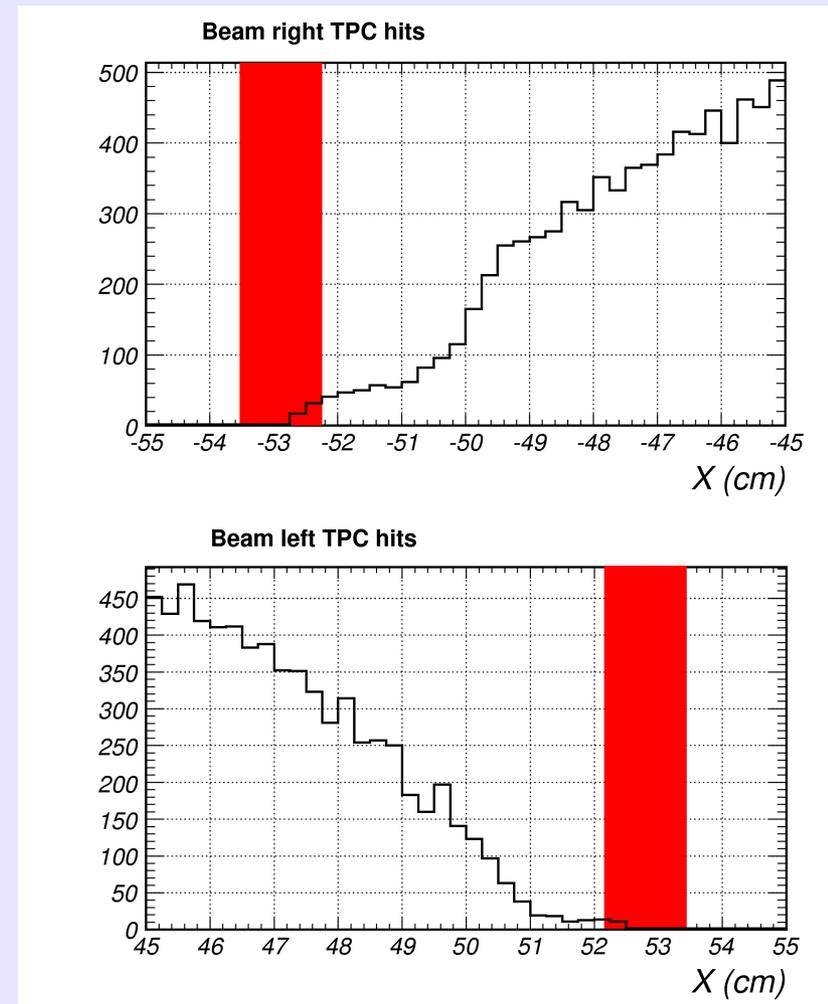
- Z locations are interesting in the sense that there are hits that seem to be coming out of the TPC field cage
- The red boxes are TPC field cage walls as defined by geometry

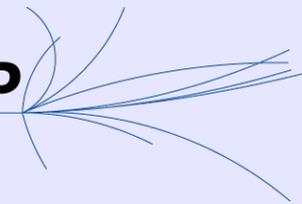




# X of TPC hits

- In X the situation is somewhat similar, except there are fewer tracks at extreme X and  $Y \sim 0$
- Inevitable conclusion is that drift corrections from Magboltz maps are too large along the transverse component of B





# Potential Phenomenological Correction

- Linear model predicts

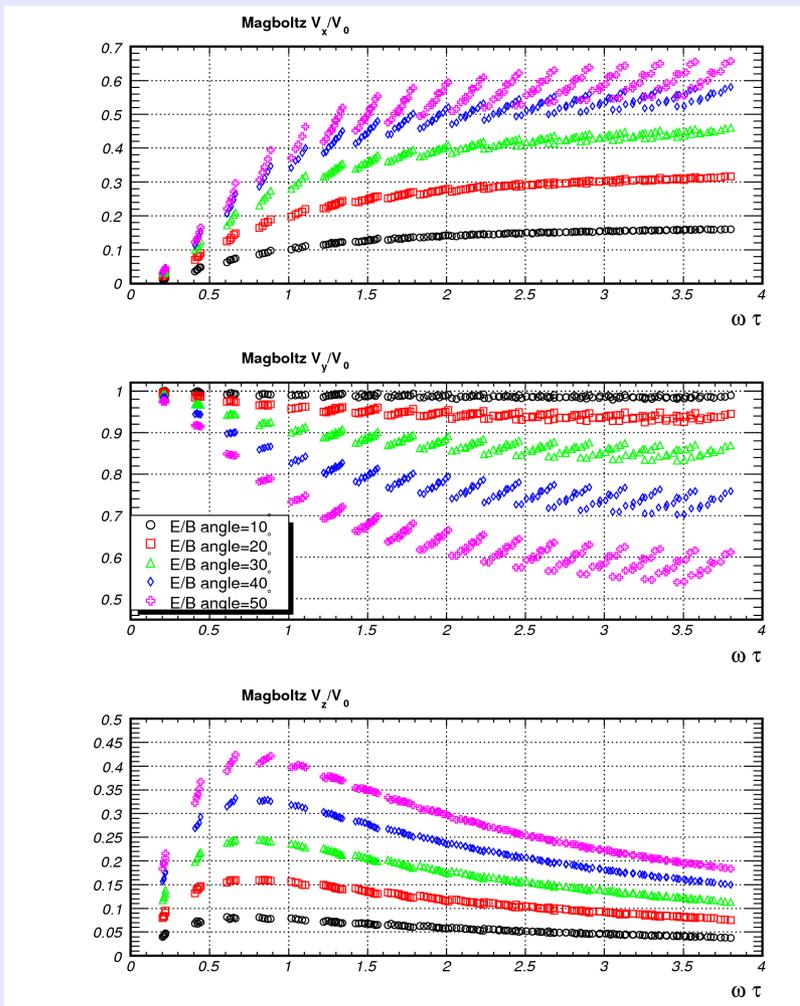
$$\frac{v_x}{v_0} = \frac{f^2 \cos \theta \sin \theta}{1 + f^2}, \quad \frac{v_y}{v_0} = \frac{1 + f^2 \cos^2 \theta}{1 + f^2}, \quad \frac{v_z}{v_0} = \frac{f \sin \theta}{1 + f^2}$$

where  $f = \omega \tau = v_0 B / E$ , and  $\theta$  is the angle between B and E fields

- We can add more terms to each component, determine the best fit for Magboltz data, and using that as the seed, feed our tracks into TMinuit to determine “corrections to drift model”



# How Good Can it Be?



- This set of 3 plots shows 11 Magboltz map components plotted vs  $\omega\tau$  for different angles between B and E fields
- We can see that Magboltz numbers from different maps are **not** a function of  $\omega\tau$  except at low angles



# Proposed Function

- The following construct satisfies requirements

- $V_x$  &  $V_z$  are odd functions of  $\theta$

- $V_y$  is an even function of  $\theta$ ,  $V_y=1$  when  $\theta=0$

$$\frac{v_x}{v_0} = \frac{p_0 f \sin \theta + p_1 f^2 \sin 2\theta + p_2 f^3 \sin 3\theta + p_3 f^4 \sin 4\theta}{1 + p_4 f^2 + p_5 f^4}$$

$$\frac{v_y}{v_0} = \frac{1 + p_6 f \cos \theta + p_7 f^2 \cos 2\theta + p_8 f^3 \cos 3\theta + p_9 f^4 \cos 4\theta}{1 + p_6 f + p_7 f^2 + p_8 f^3 + p_9 f^4}$$

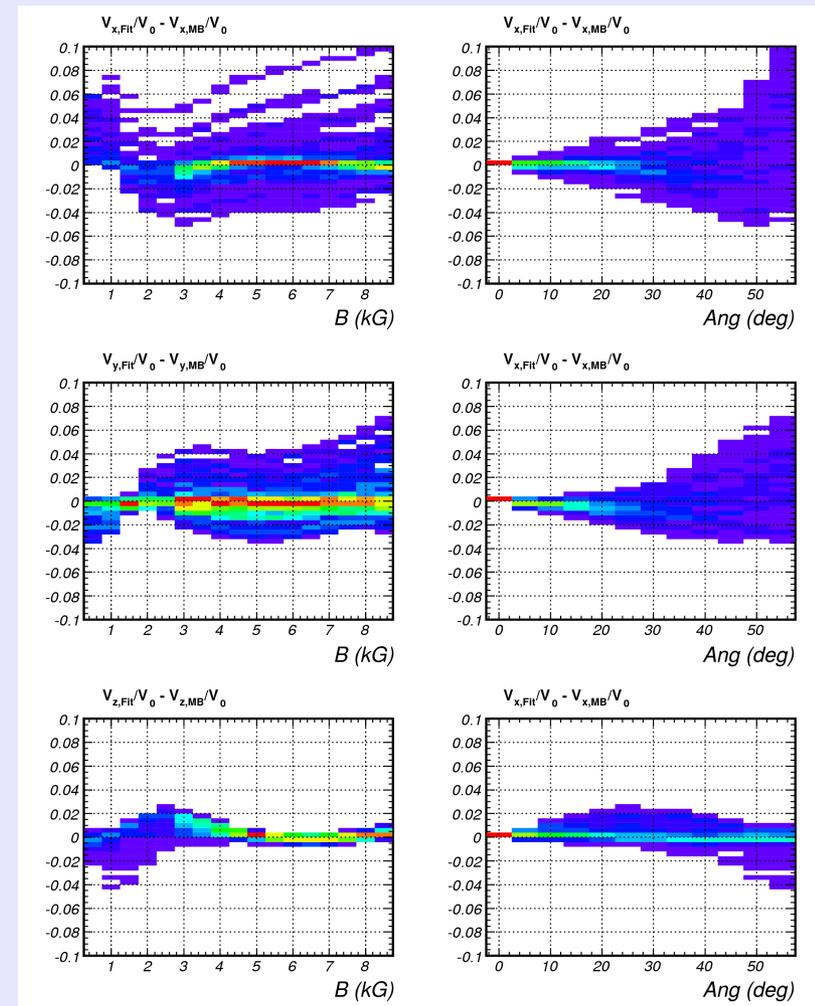
$$\frac{v_z}{v_0} = \frac{p_{10} \sin \theta + p_{11} f^2 \sin 2\theta + p_{12} f^3 \sin 3\theta}{1 + p_{13} f^2 + p_{14} f^4}$$



# Fitting to 11 Magboltz Maps

- The fit uses errors reported by Magboltz,  $\chi^2$  are:

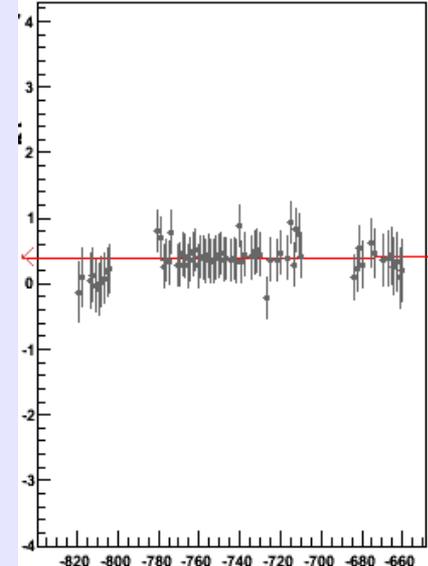
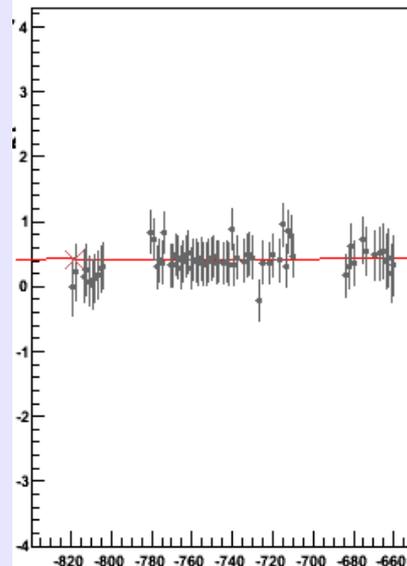
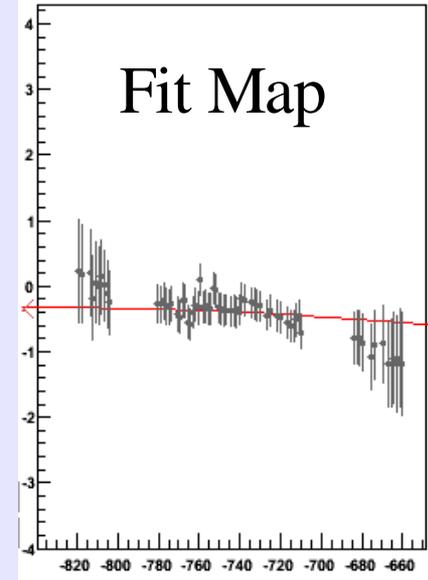
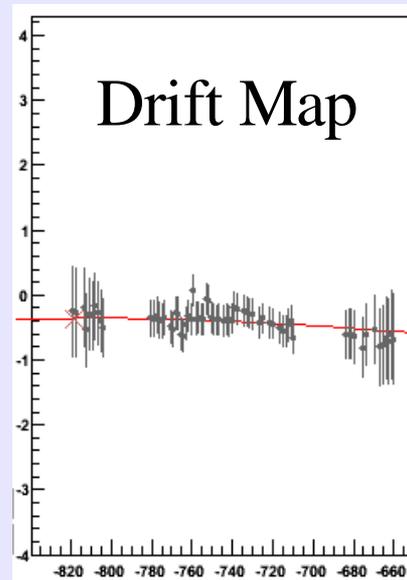
- $V_x$ : 2273 / (1884 – 6)
- $V_y$ : 5138 / (1884 – 4)
- $V_z$ : 1033 / (1884 – 5)





# Single Event

- Single event is enough to say that the fit to the maps doesn't work that well for our data
- As is equations already have a lot of parameters





# Using TMinuit

- I updated AlignTPCDrift module to pick up track from fit vertices, and minimize TPC residuals to the track by varying the 15 parameters
  - The track is not refit, so I'm using ConFit tracks fit using chamber info only
- Unfortunately, TMinuit can't handle that many parameters, so at this moment I can only say that this approach is not promising
  - When I fix higher order parameters, map fit gets worse



# Summary

- TPC problems are not fully solved
  - Still see systematic effect resembling a z-shift in field-off
  - Residuals with field-on amplify effect seen in field-off
    - Evidence is that DriftMap corrections are too large as some reconstructed hits “originate” from TPC walls
  - ResCor with floating target moves reconstructed target position downstream by ~1 cm
  - ResCor with fixed target calls for ~2 cm corrections on the wings