TPC Residual Corrections

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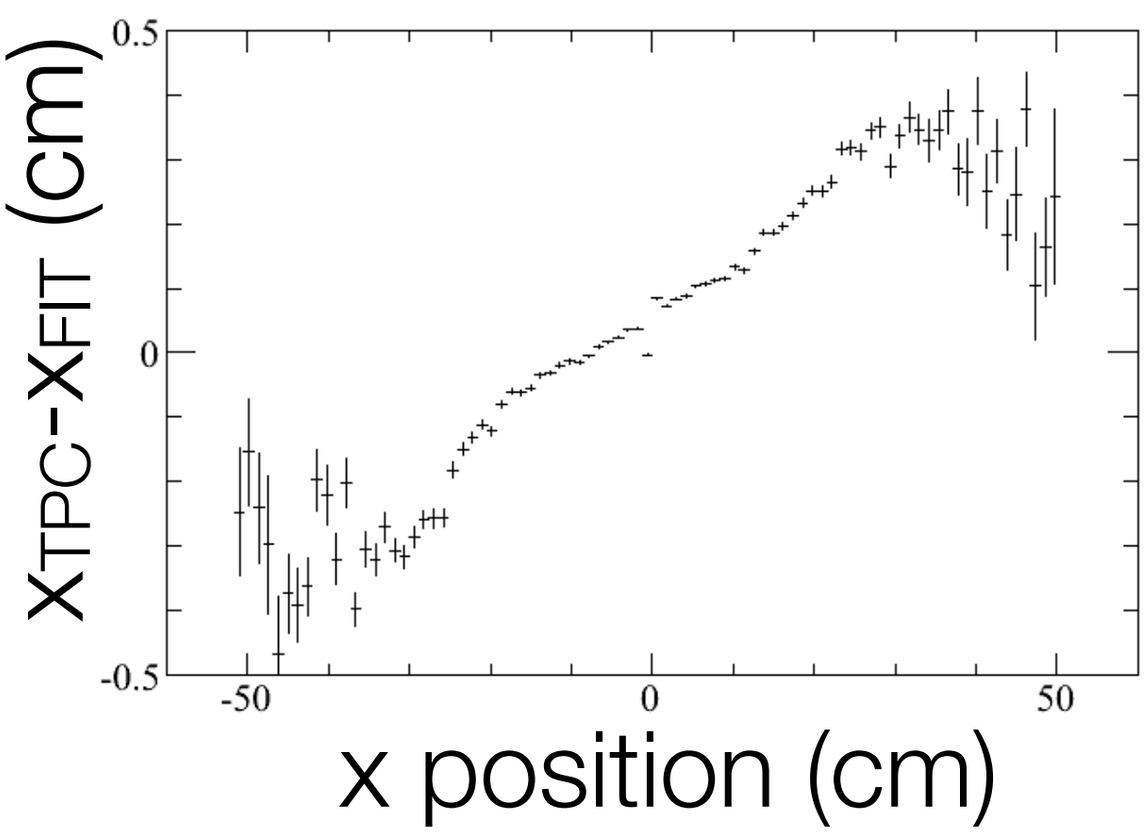
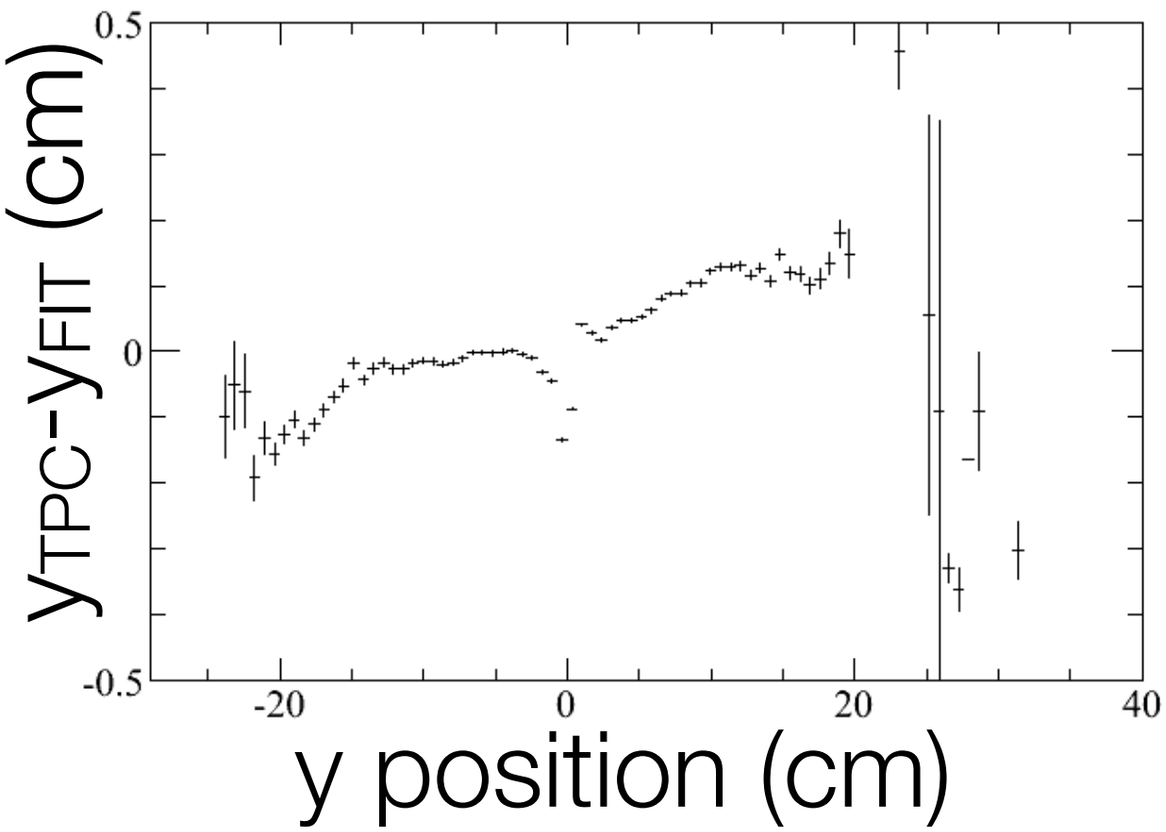
TPCResCor: Reminder of what it is

- Even after applying the MAGBOLTZ-parameterized distortion corrections we still see systematic trends in the TPC residuals at the several mm level:





- TPCResCor is a program to map these residuals out as a function of x,y and padrow in the TPC and adjust the hit positions to take the systematic biases out of the TPC hit positions

The method

- The maps are generated using empty target data. For these runs almost all the interactions seen take place on the scint counter. This counter is thin (3.2 mm) and allows a tight constraint to be placed on the z location of the vertex.
- Using this constrained vertex fit, I measure the x and y track fit residuals for each padrow in several in a 14*10 grid in the x-y plane. The bins have edges at x = {-50, -40, -30, -20, -15, -10, -5, 0, 5, 10, 15, 20, 30, 40, 50} cm and y = {-25, -15, -10, -5, 0, 5, 10 15, 25, 35, 55}. This is done separately for each padrow, yielding a final map which contains 128*14*10*2 = 36k numbers. The correction maps are updated according to a schedule which I will outline in later slides
- Once the map is generated, it can be read in during the TPC hit finding stage and the corrections to the hit locations are applied for reconstruction jobs. In this case the distance to move the hit location is based on an interpolation of the TPCResCor map given the uncorrected hit x and y position.

Building the maps

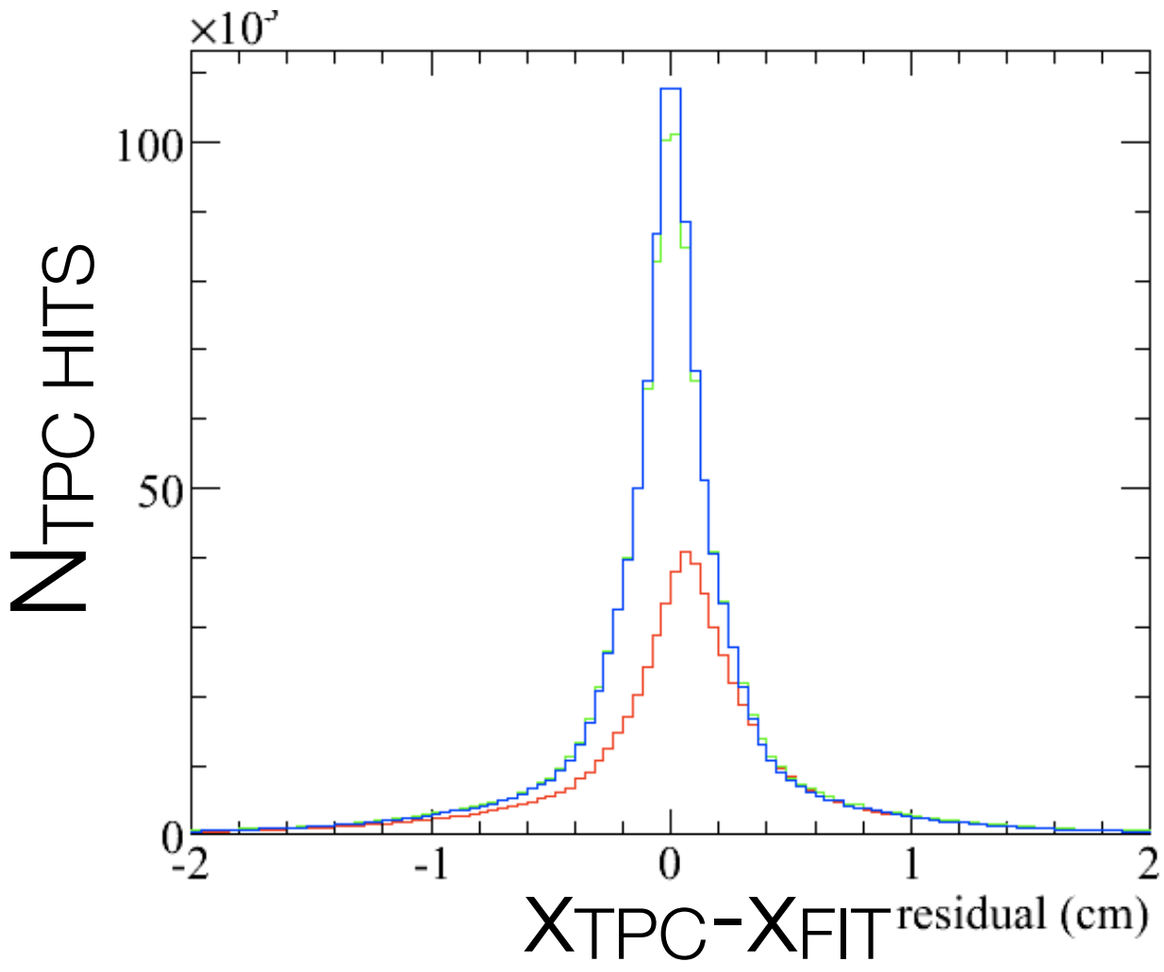
- The maps are built iteratively. In all iterations I require:
  - 4 tracks in a vertex
  - no more than 2 tracks not associated with the primary vertex
  - vertex r^2 <2 cm^2
- In iteration 1 the weights of all the TPC hits in a track are set to zero in the track fits and residuals are logged only for tracks containing hits in 10 wire chamber planes. Since the TPC information is not used in the track fit, the table is updated with the full magnitude of the residuals of the TPC hits associated with the track. Due to the requirement on the number of chamber hits, this stage is only effective in the central regions of the TPC
- In iteration 2 the requirement on the number of wire chamber hits is dropped to include more of the TPC volume. The weights of the TPC hits is increased from 0 to 1/10th of the nominal value. In this case, the map is updated using 1/2 of the measured residuals
- Iteration 3 is identical to 2 except that the TPC weights are increased to 0.3 of their nominal values and the residual correction map is updated using 1/3 of the measured residuals.
- In iteration 4 the TPC weights are increased to their nominal value and the residual correction map is updated using 1/3 of the measured residuals.
- Iteration 5 is a repeat of iteration 4 and is the final iteration
- During generation, the residual correction maps are stored in text files. Eventually they are loaded into the database.
- I plan to generate three sets of maps for run<13408, 13408<run<17256, and run>17256 which mark the running periods between magnet failures

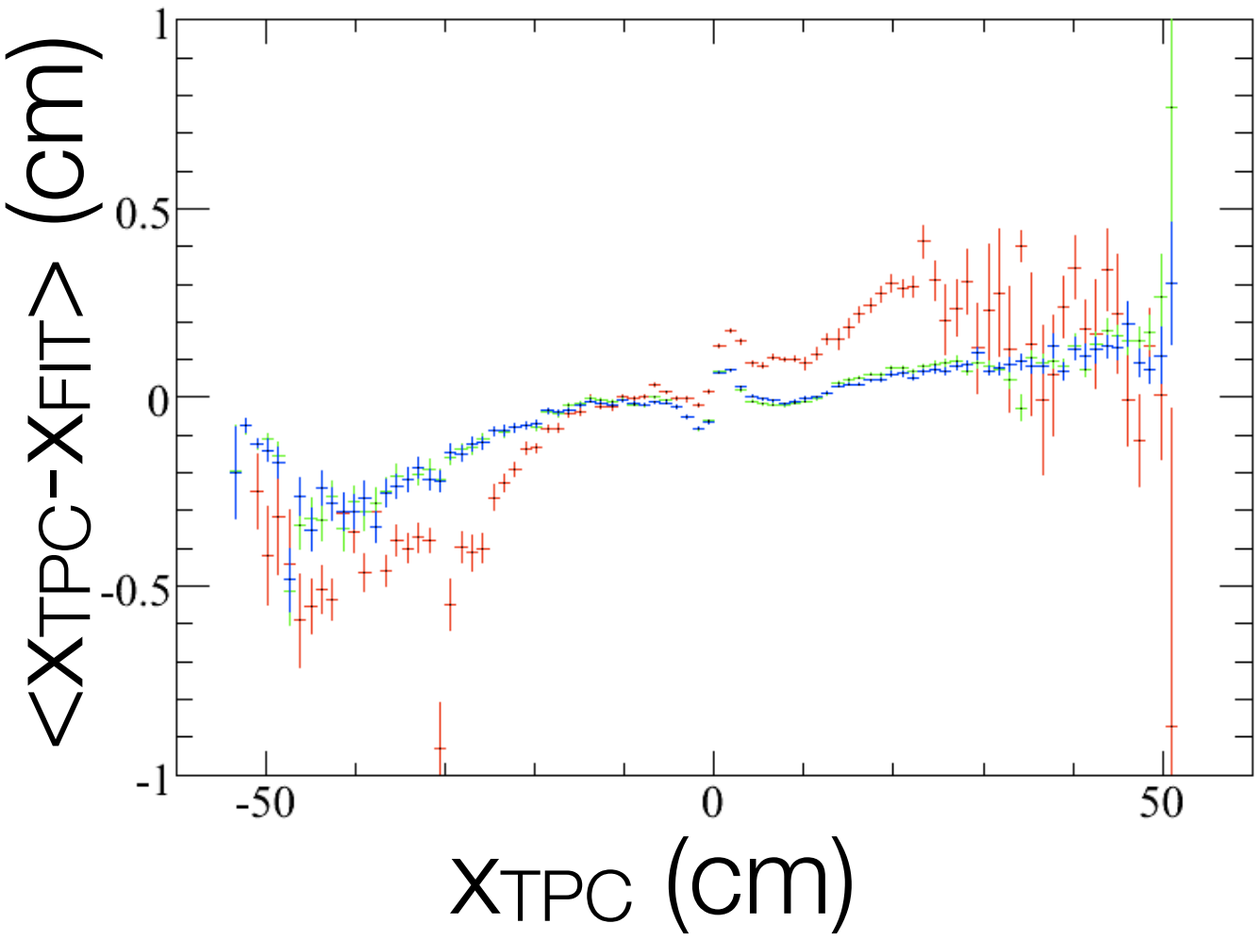
Ongoing work

- At the moment I am generating maps “by hand” using three sets of sub runs from runs 15335, 15356 and 15634 to generate the maps.

- As a check, I am rerunning two subruns from run 15860 through the pass4 reconstruction with the residual corrections on and off to compare the differences in the results

Making the maps *(first three iterations only so far...)*



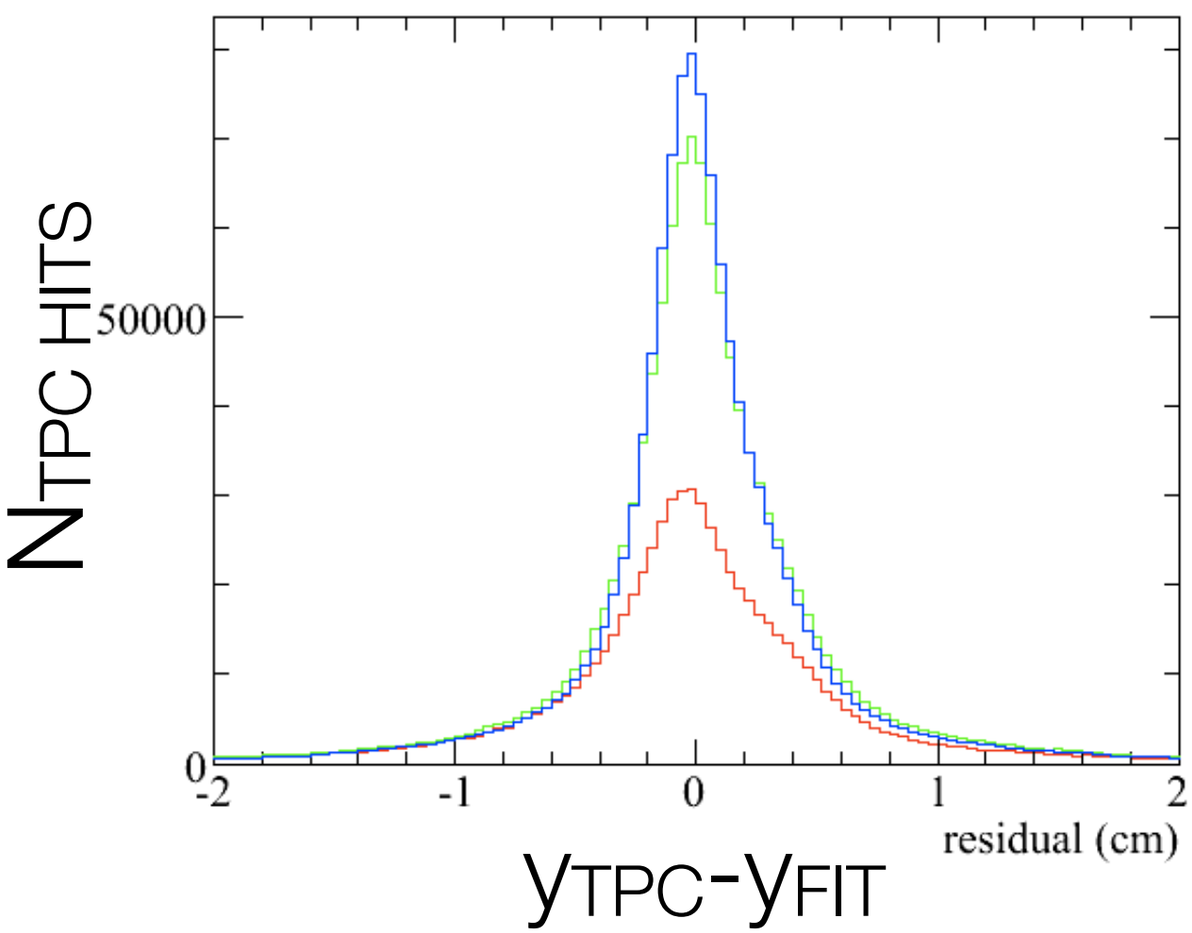


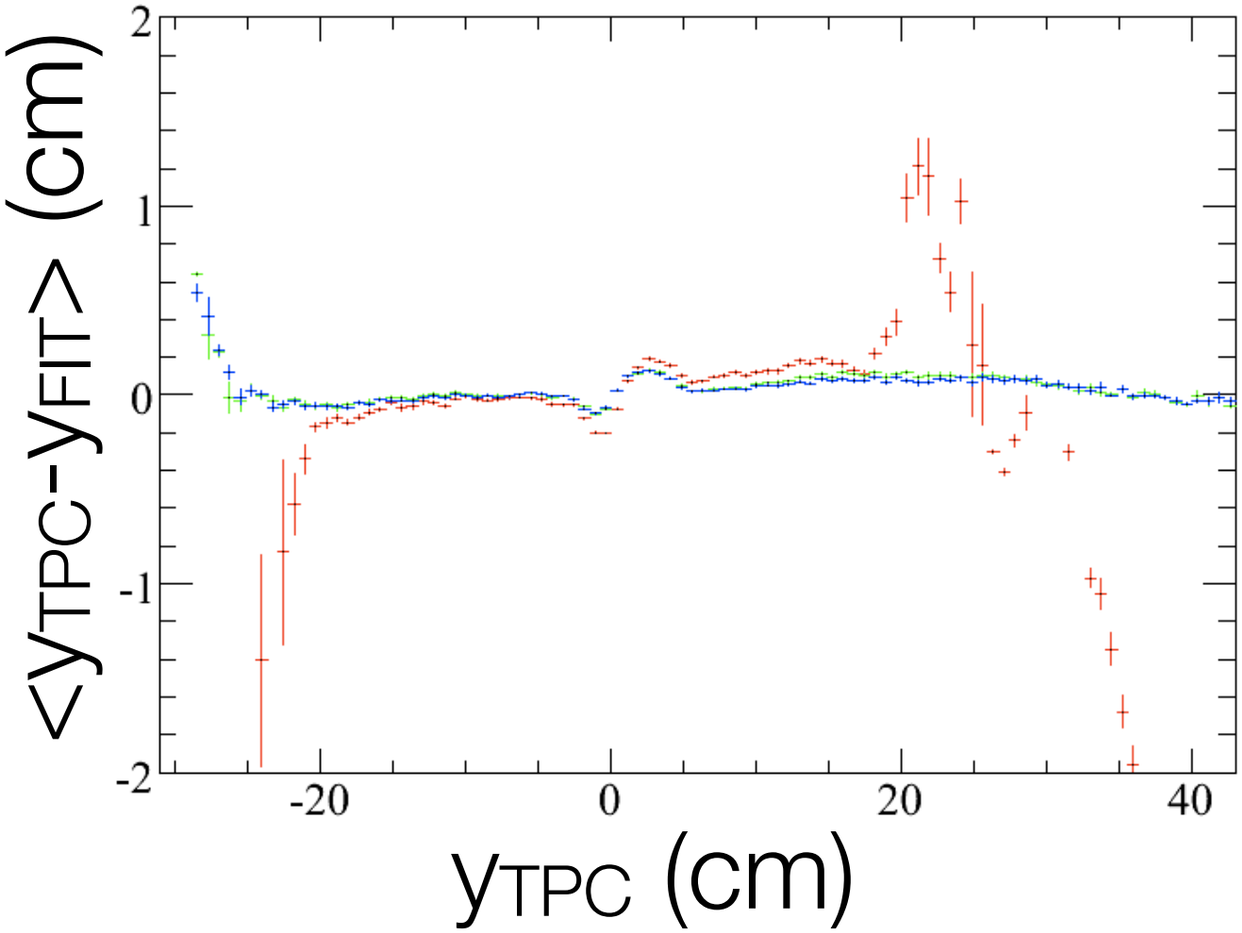
(1) initial residuals ave=+0.5 mm rms=5.4 mm

(2) after one iteration ave=-0.0 mm rms=4.5 mm

(3) after two iterations ave=-0.0 mm rms=4.3 mm

Making the maps *(first three iterations only so far...)*





(1) initial residuals ave=-0.15 mm rms=5.6 mm

(2) after one iteration ave=+0.21 mm rms=5.0 mm

(3) after two iterations ave=+0.17 mm rms=4.6 mm

Summary and plan

- ResCor looks like it may still have a roll to play to improve the tracking precision. Shaves roughly 1 mm out of 5 mm off the hit uncertainties.

- Unknown yet how this affects, say, vertex resolution. Will put jobs in queue today when maps are complete to test this on a target in data sample which was not used for generating the maps.

- Assuming everything checks out I should be ready to start processing on the farm Tuesday/Wednesday next week. Since ResCor only works with empty target data, running on the farm does not take long (previously took 2 days including my analysis time).