

ND280 SSG meeting  
04/04/2017

# TPC Momentum Resolution

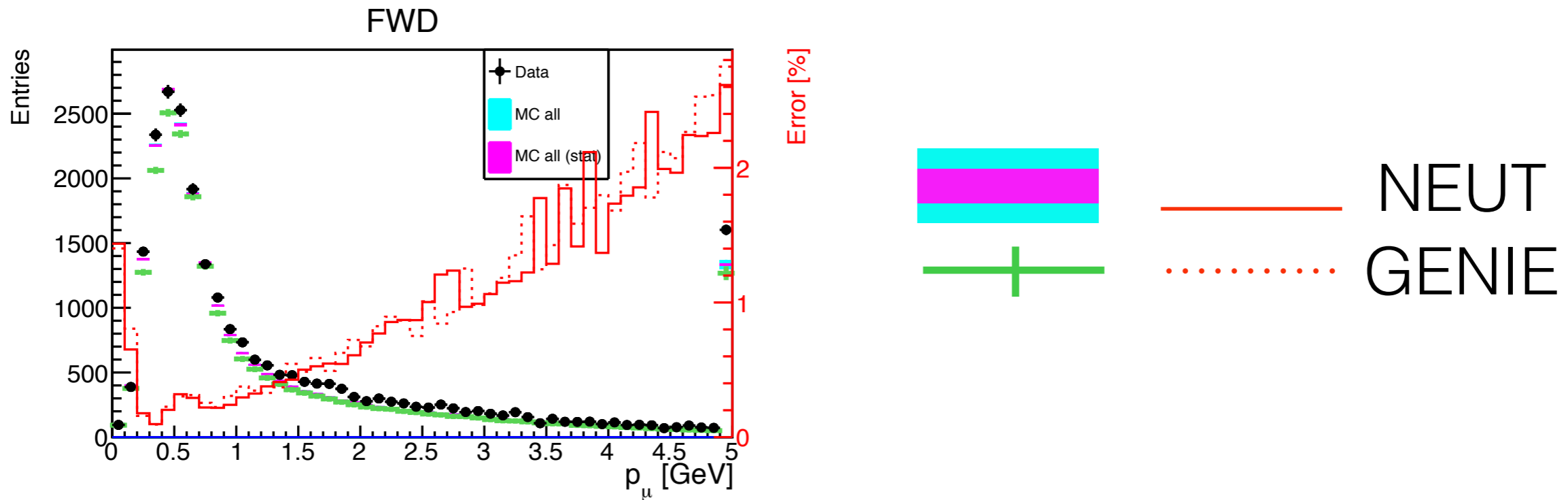
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Alfonso Garcia, Francesco Gizzarelli



# P6 TPC momentum resolution:

- TPC momentum resolution and bias is one of the main systematics in tracker analysis.



- Propagation -> Bias (correction) and smear (systematic) the reconstructed global and local TPC momentum for kTracksWithTPCInFGD1FV.

$x_{min}$ [mm]	$x_{max}$ [mm]	$C_{momres}$	$\sigma_{momres}$
-1000	-800	0.0	0.1
-800	-600	0.12	0.1
-600	-500	0.25	0.1
-500	-400	0.38	0.1
-400	-300	0.21	0.1
-300	0	0.00	0.1
0	150	0.05	0.1
150	400	0.16	0.1
400	700	0.28	0.1
700	1000	0.20	0.1

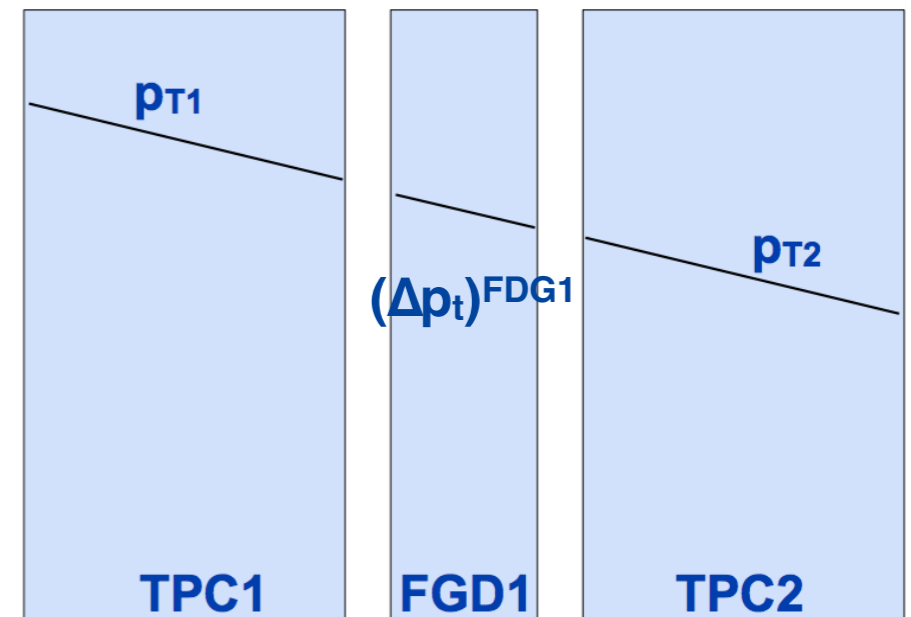
TN-245

# P6 TPC momentum resolution:

- Current uncertainties has been obtained comparing the TPC and global momentum resolutions of data and MC (TN-222).
- Tracks crossing at least two TPCs allows to compute the difference between the momentum reconstructed using the two TPC segments of the same global track.

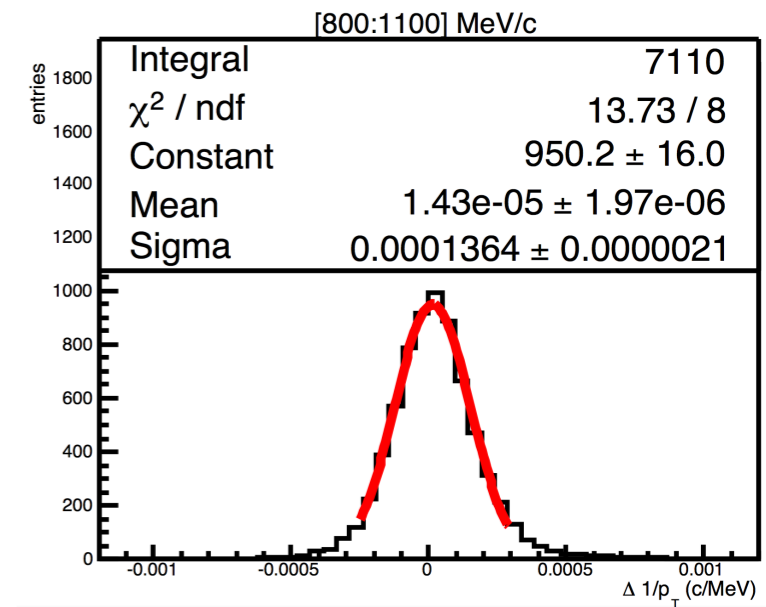
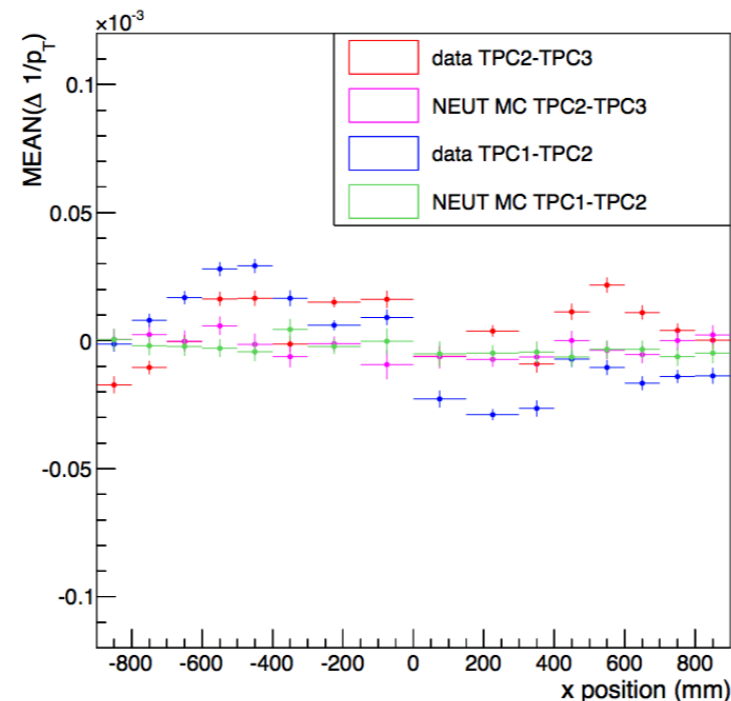
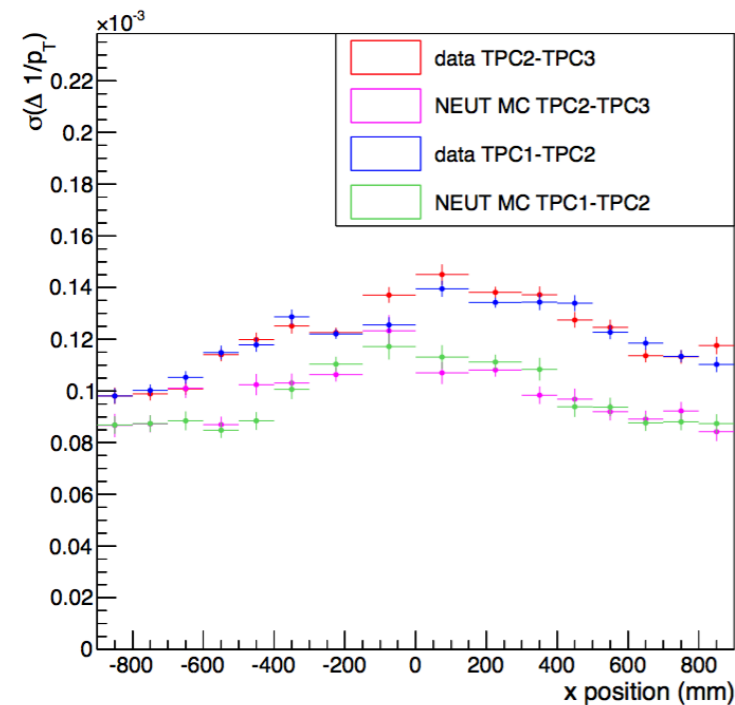
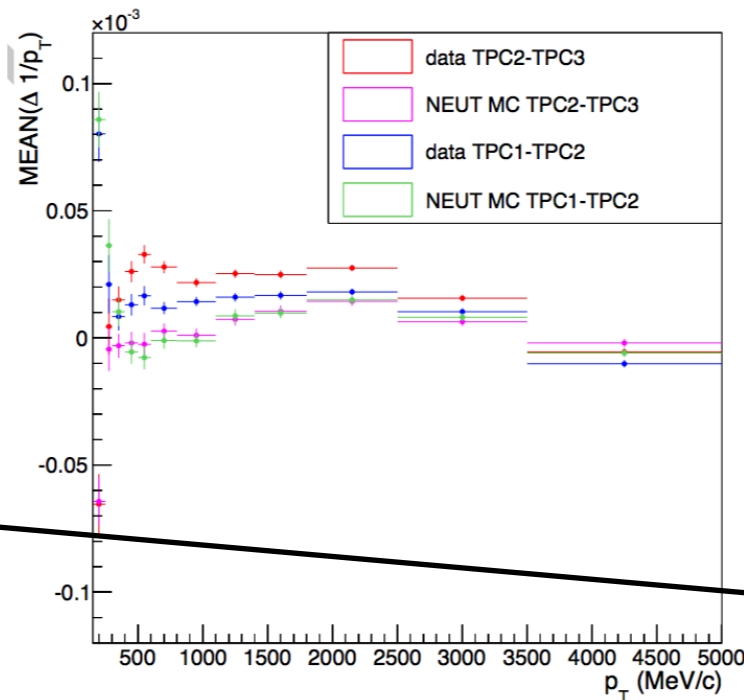
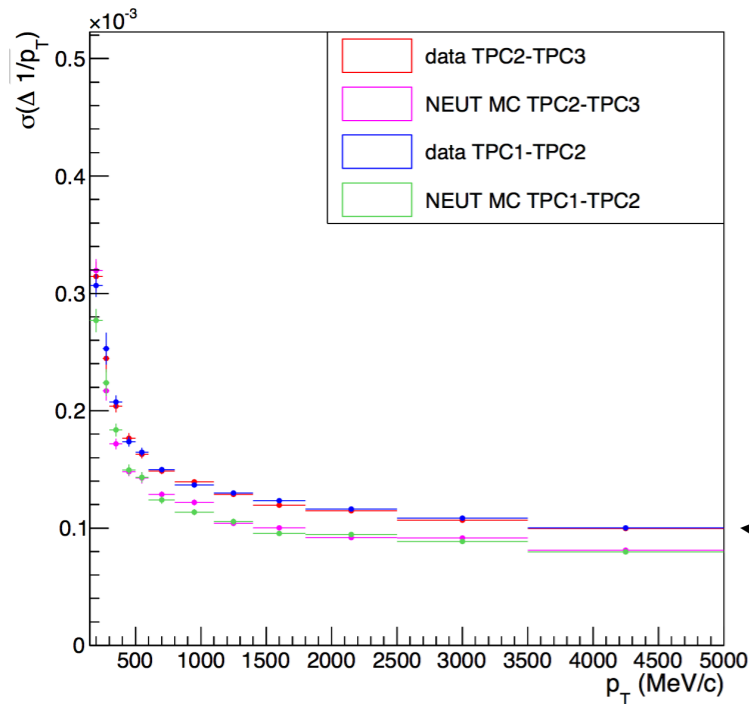
$$\Delta 1/p_t = \frac{1}{p_t^{(2)}} - \frac{1}{p_t^{(1)} - (\Delta p_t)^{FGD1}}$$

- Selection criteria:
  - highland2ControlSamples/multipleTPCsControlSamples
    - Event Quality cut.
    - Tracks with more than one TPC Segment but no more than one Segment per TPC.
    - At least two TPC Segments pass TPCTrackQualityCut.
  - highland2Systematics/momResolSystematics
    - Only 1 track with TPC segments.
    - TPC segments with #nodes>65.
    - FGD segment will length>320.
    - Charge = -1.
    - Passes Global Muon PID cut.



# P6 TPC momentum resolution:

- Compare the mean and width of  $\Delta(1/p_T)$  (gaussian-shape) in different kinematical regions for data and MC.

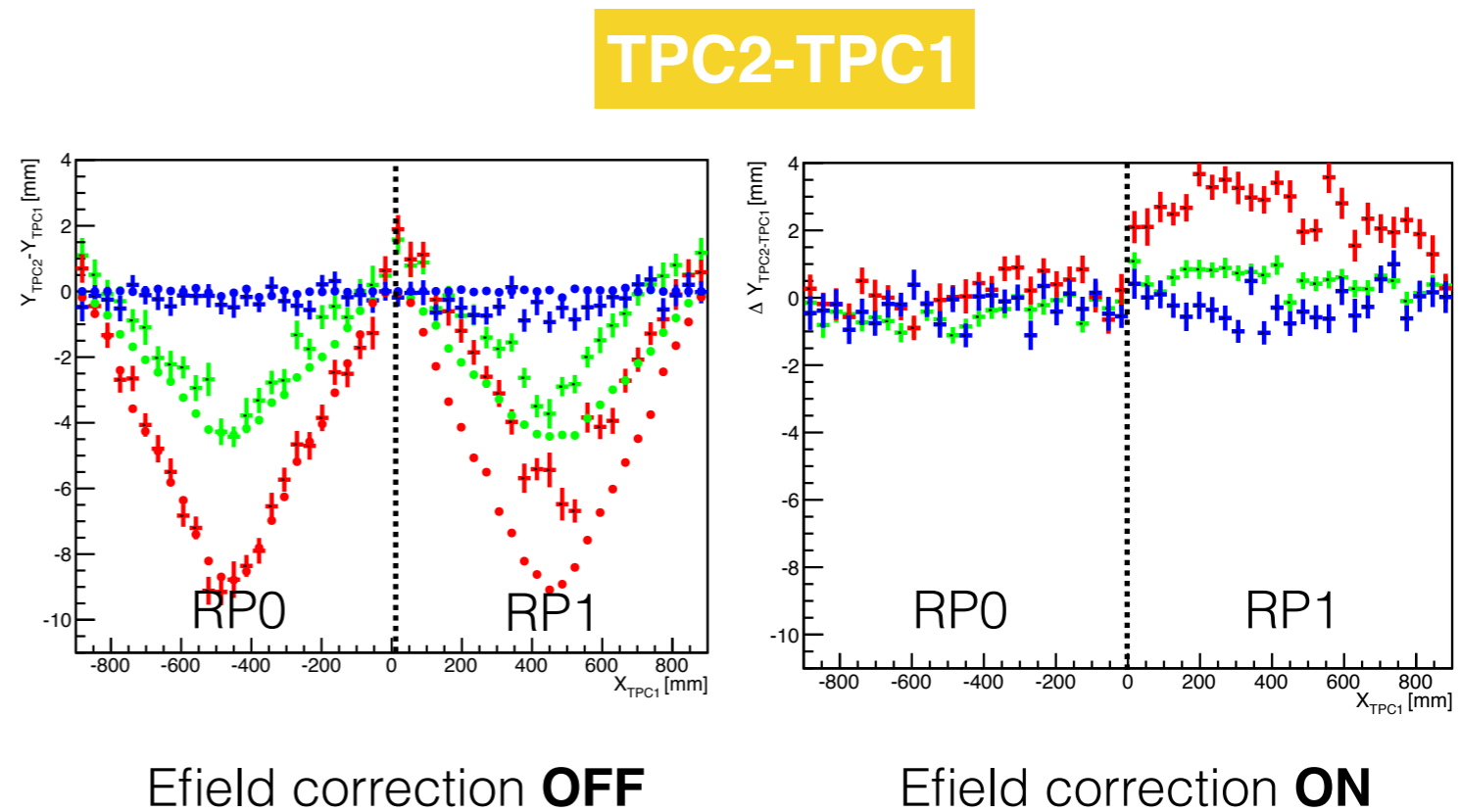
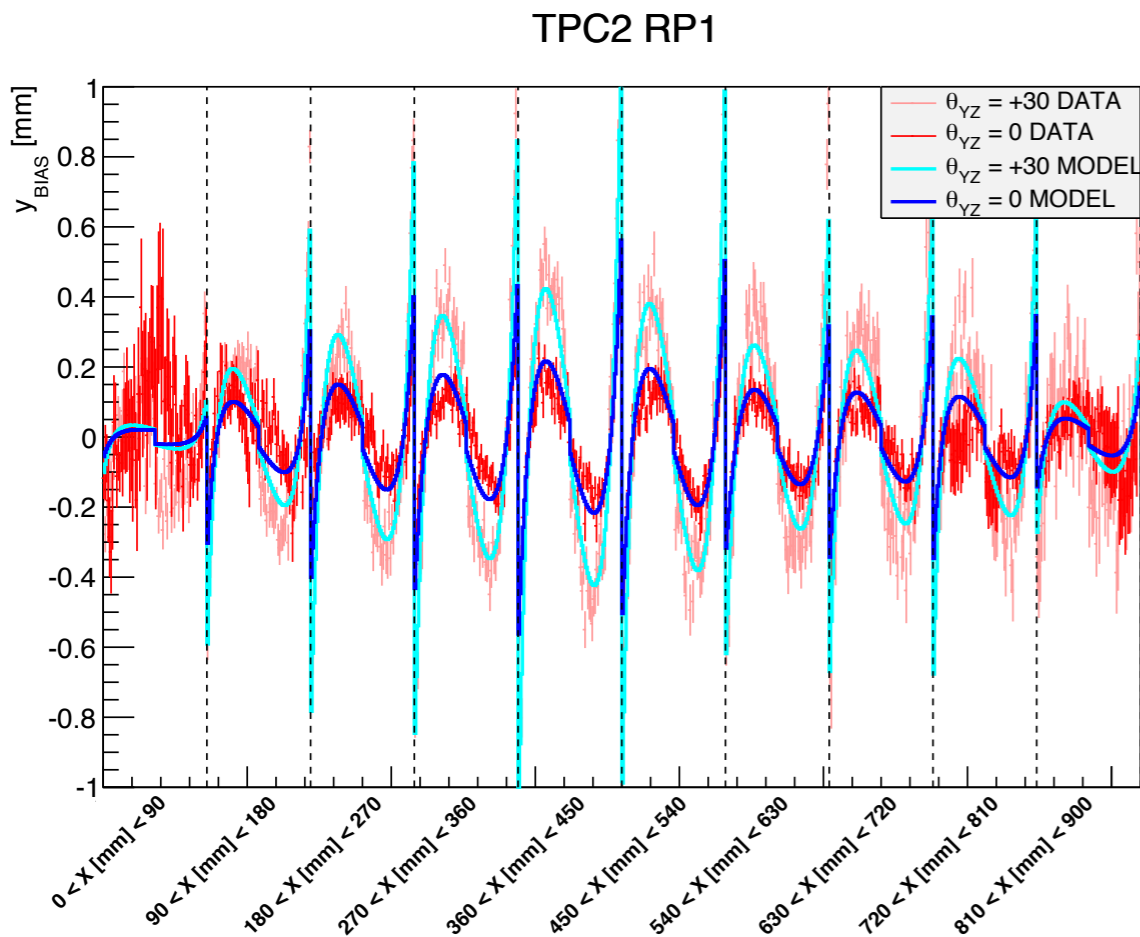
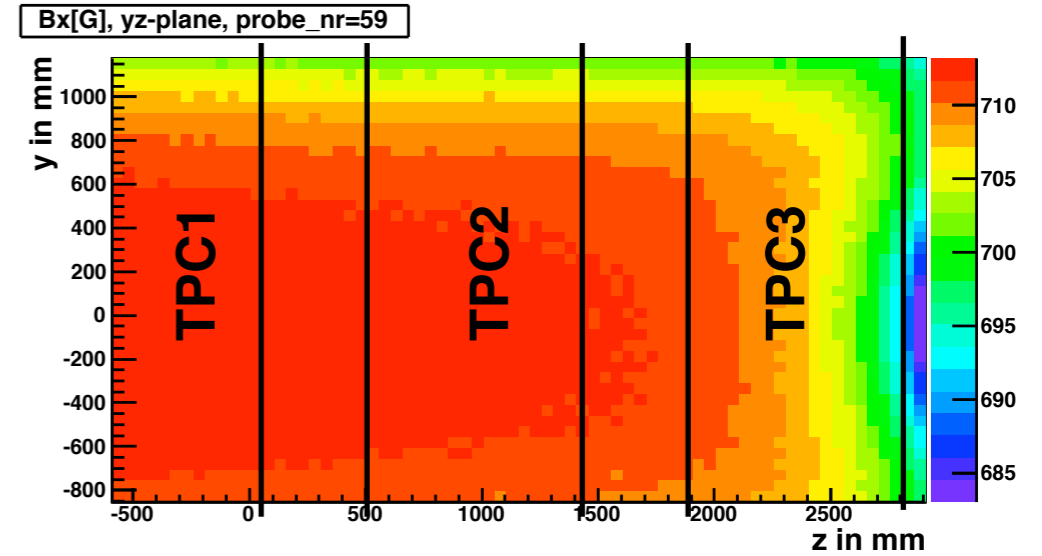


## Possible problems:

- Field distortions
- MM misalignment
- TPC misalignment

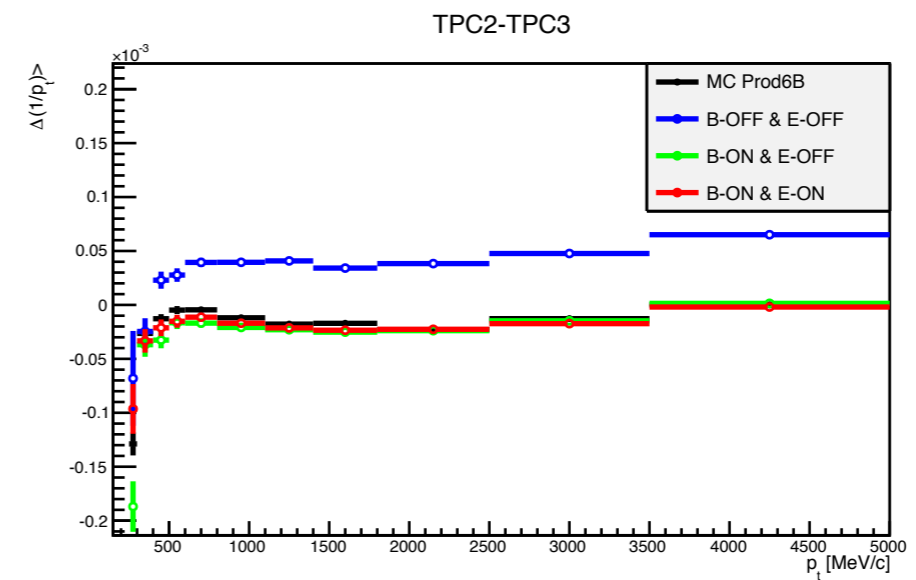
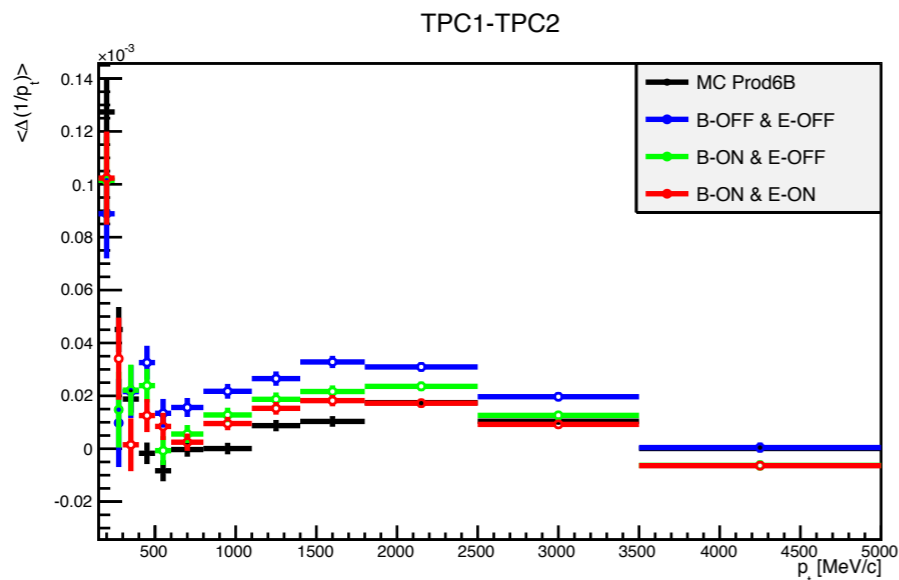
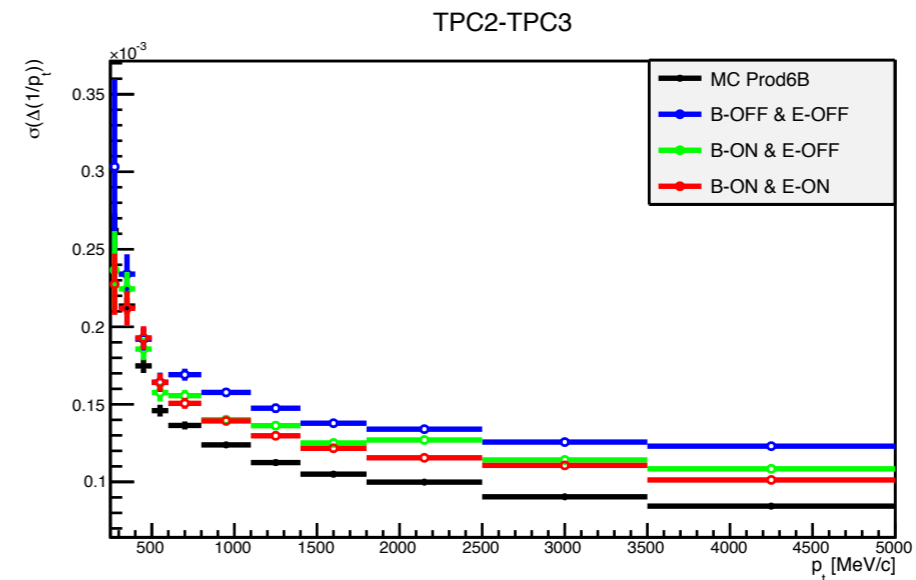
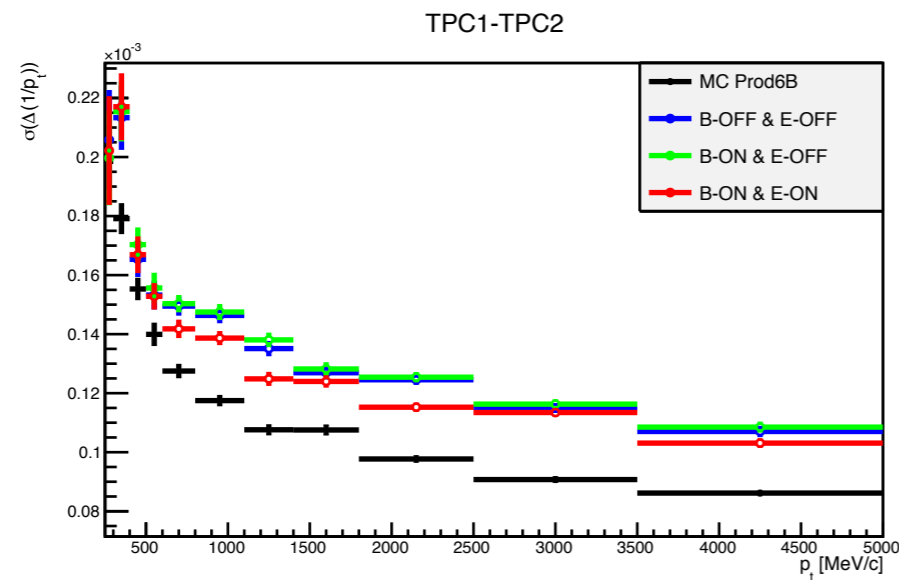
# Field distortions:

- Magnetic field distortions are corrected based on a B map measured inside the ND280 basket using a Hall probes.
- Electric field distortions are corrected based on the study of hit residuals for reconstructed TPC segments.



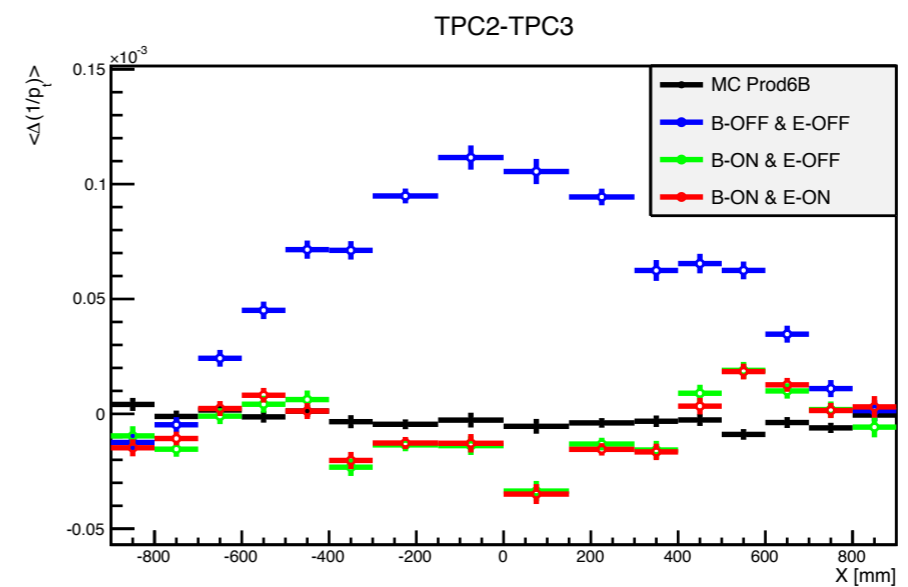
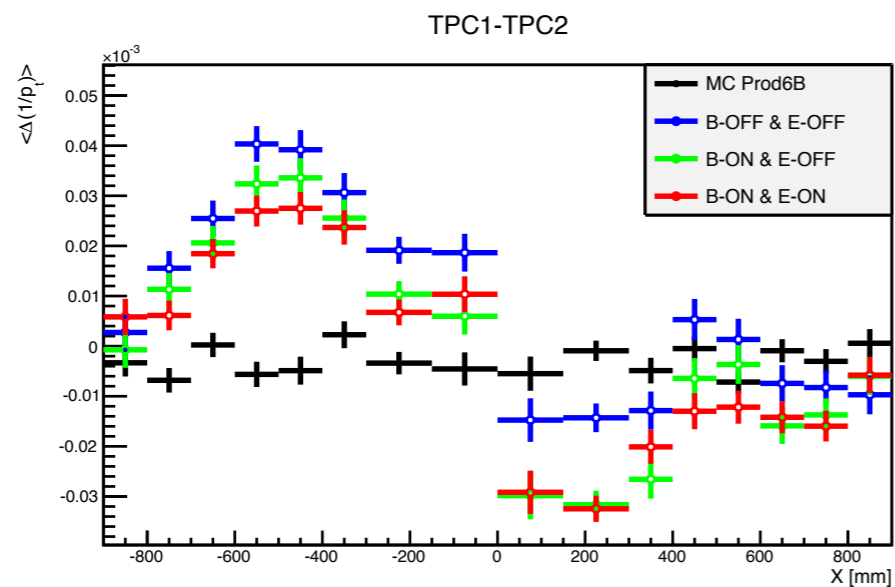
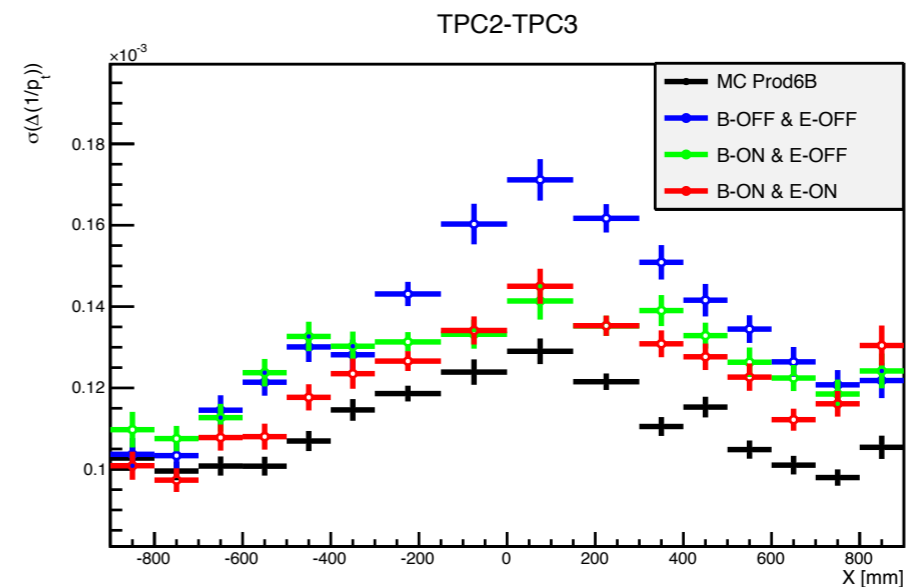
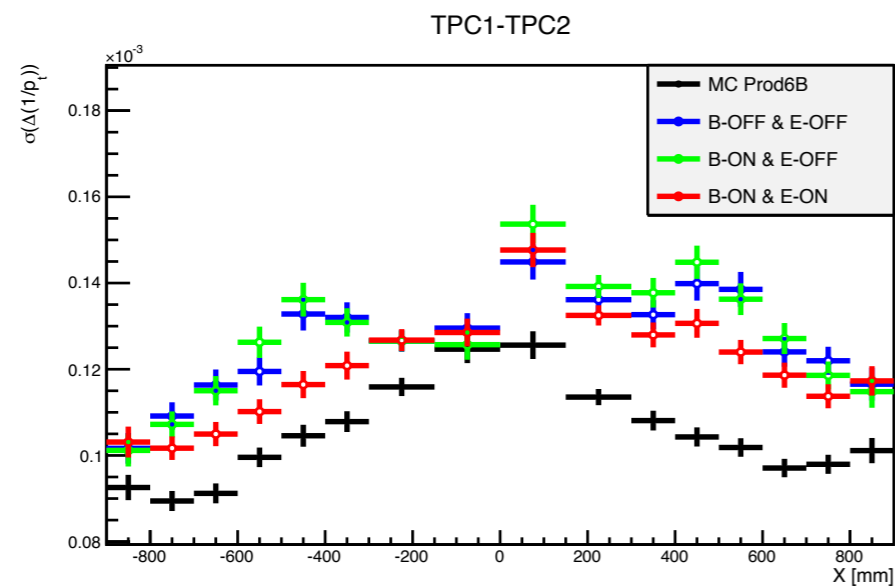
# Field distortions:

- Momentum resolution and bias are clearly affected by field distortions.
- Still discrepancies between data and MC -> MM misalignment???



# Field distortions:

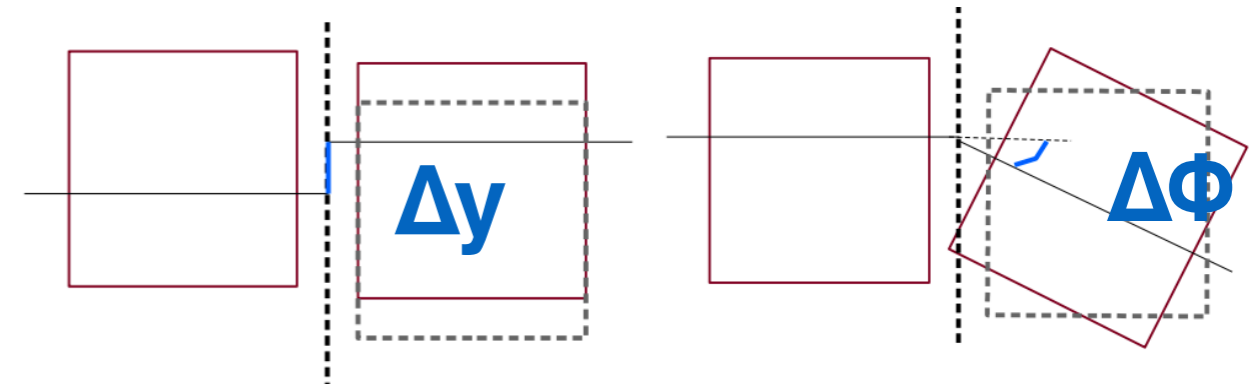
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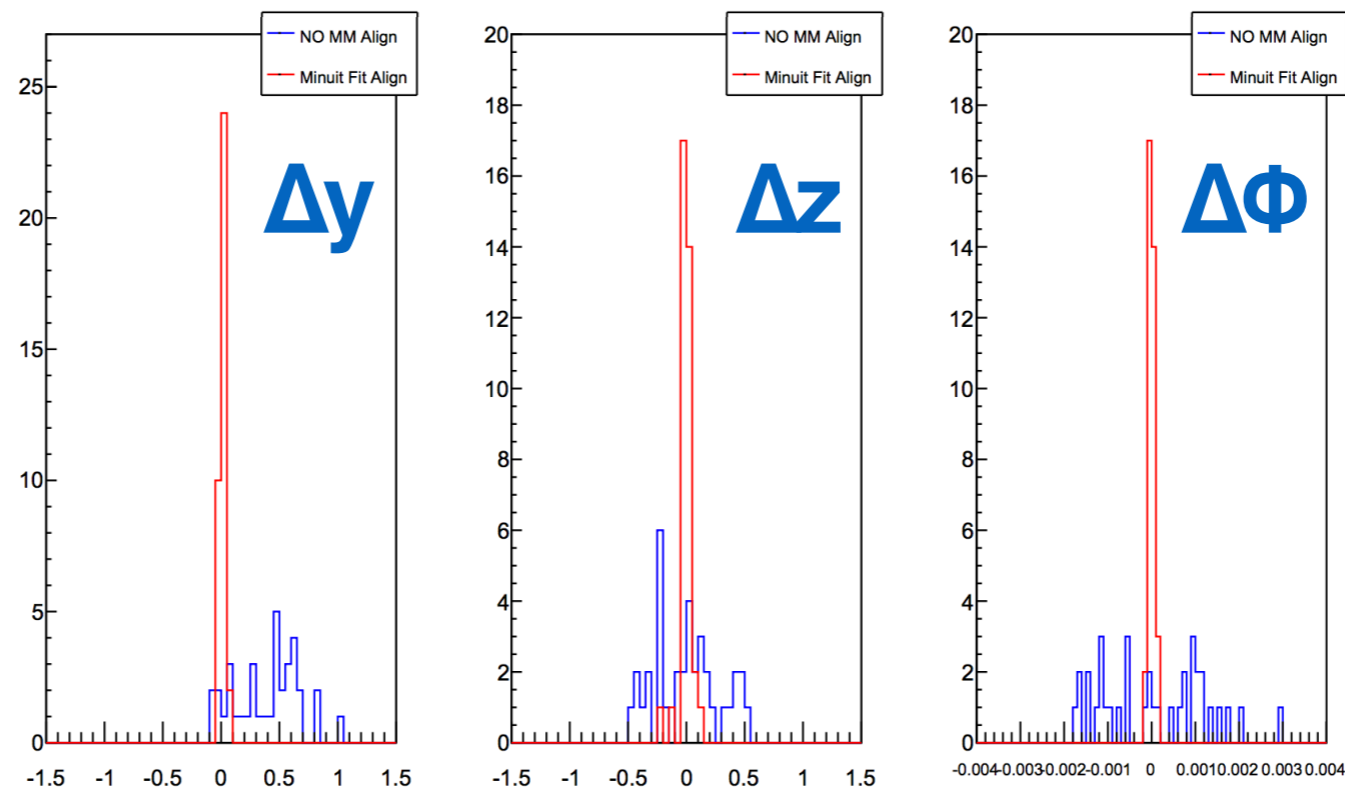
# MM misalignment:

- P6 uses the MM misalignment constant based on an optical Survey performed in
- New MM misalignment study has been performed by Francesco Gizzarelli (TN280):

- Cosmic muons crossing horizontally the TPCs with the magnet switch OFF.
- Compute the residuals ( $\Delta\Phi$ ,  $\Delta y$  and  $\Delta z$ ) between pairs of MM.



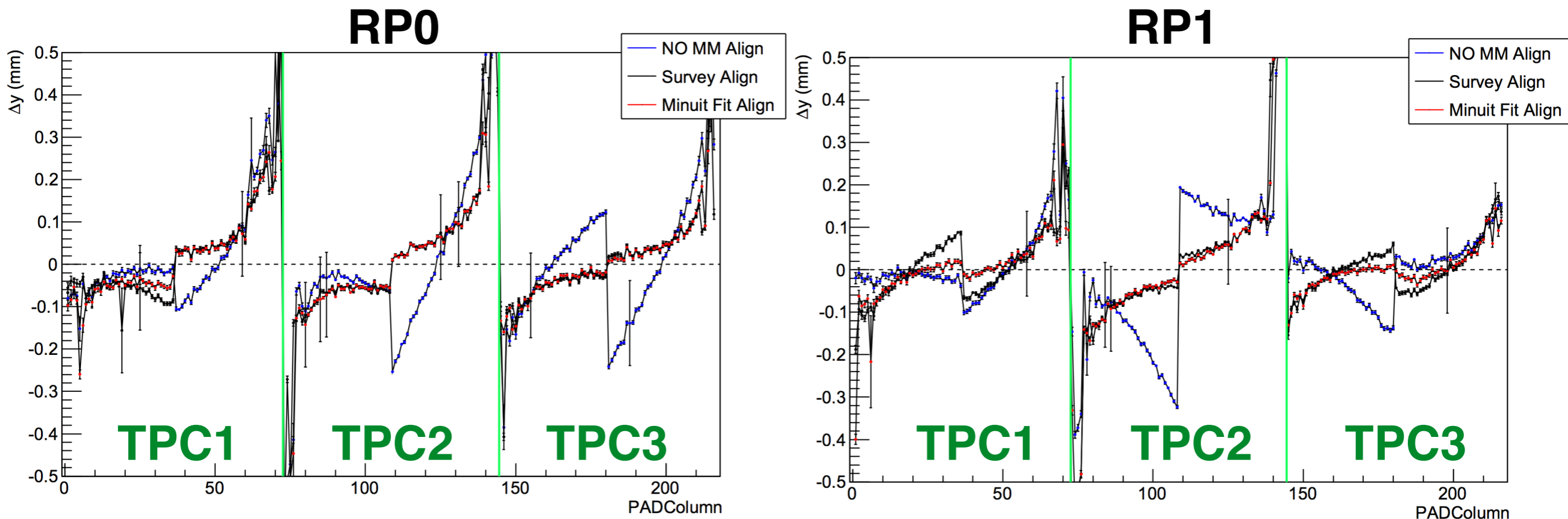
- Corrections extracted via minuit fit to the residuals.





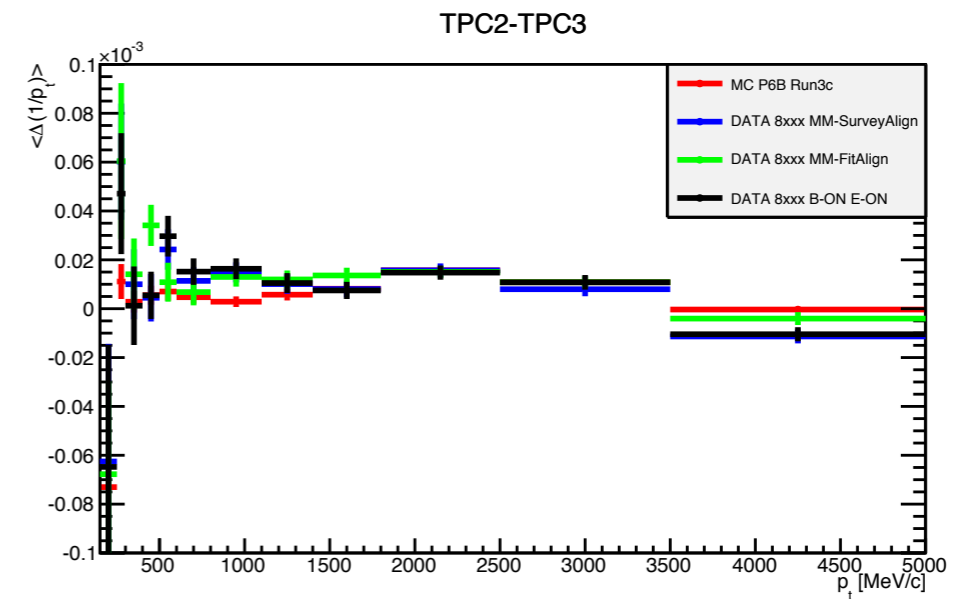
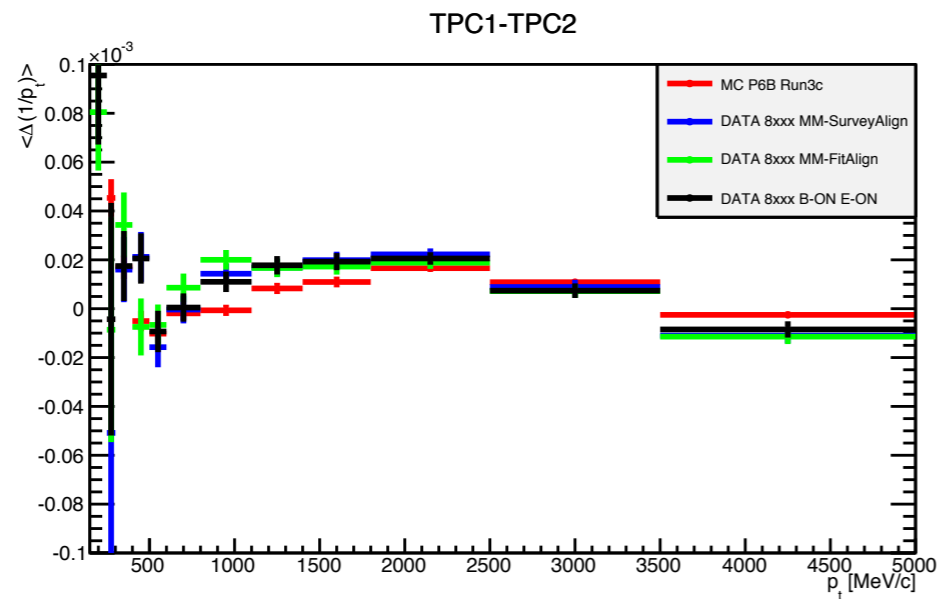
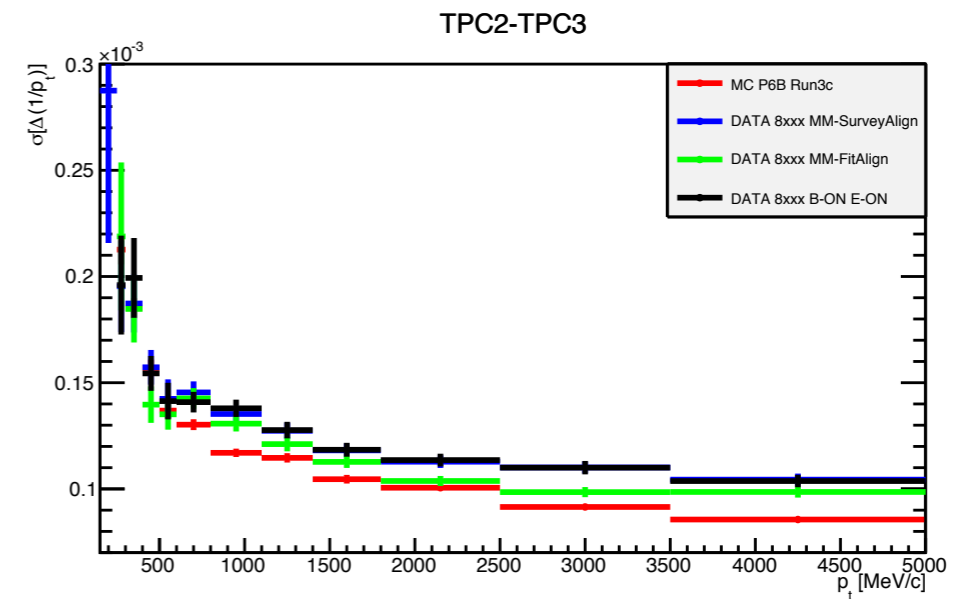
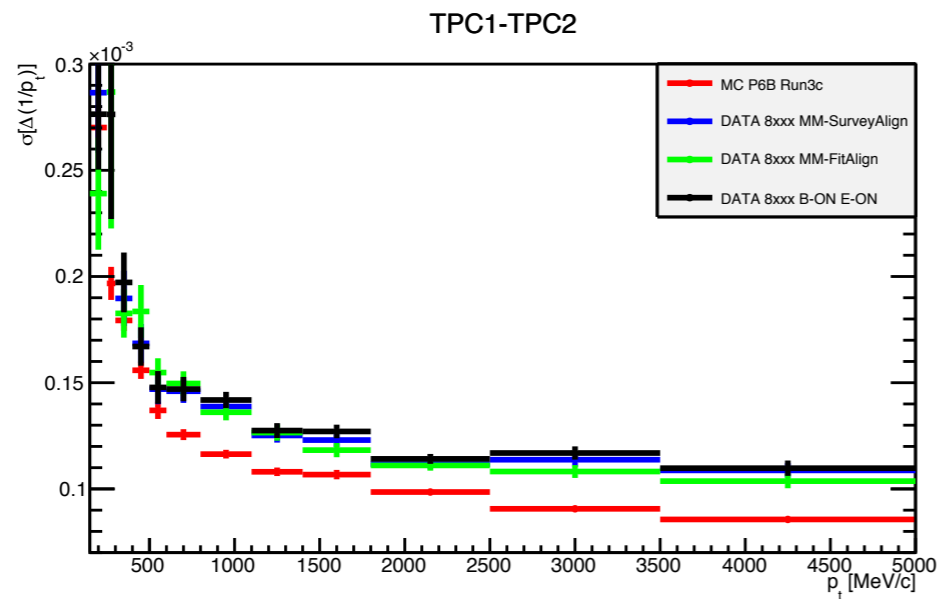
# MM misalignment:

- Hit residuals are less shifted between MM with new MM alignment.
- Current E field distortion measurement is affected by MM misalignment.
- New MM alignment could reduce such dependency.



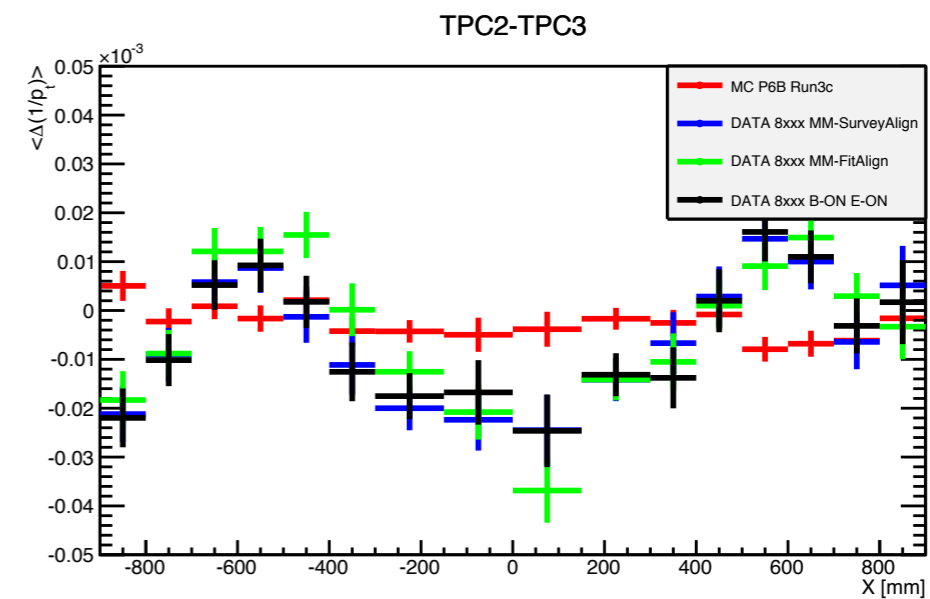
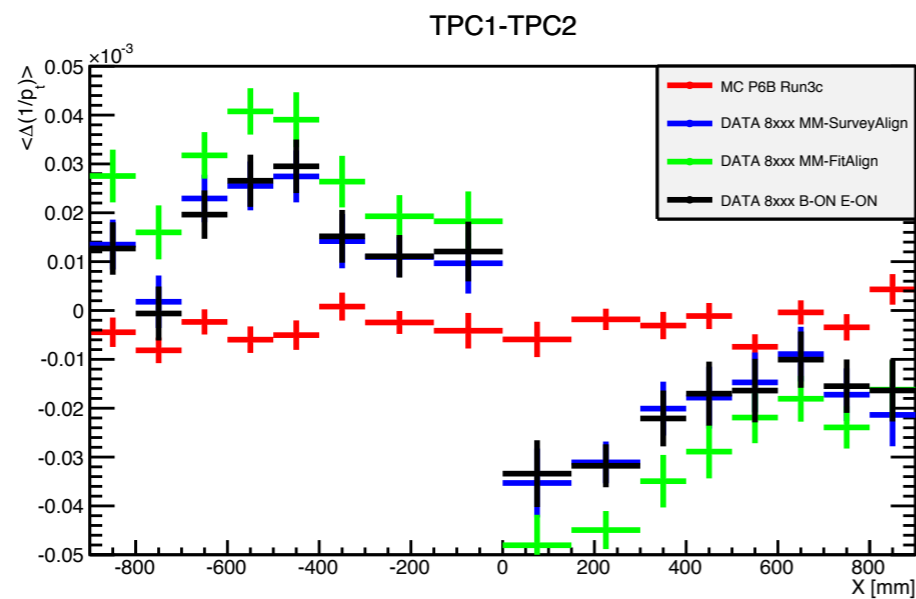
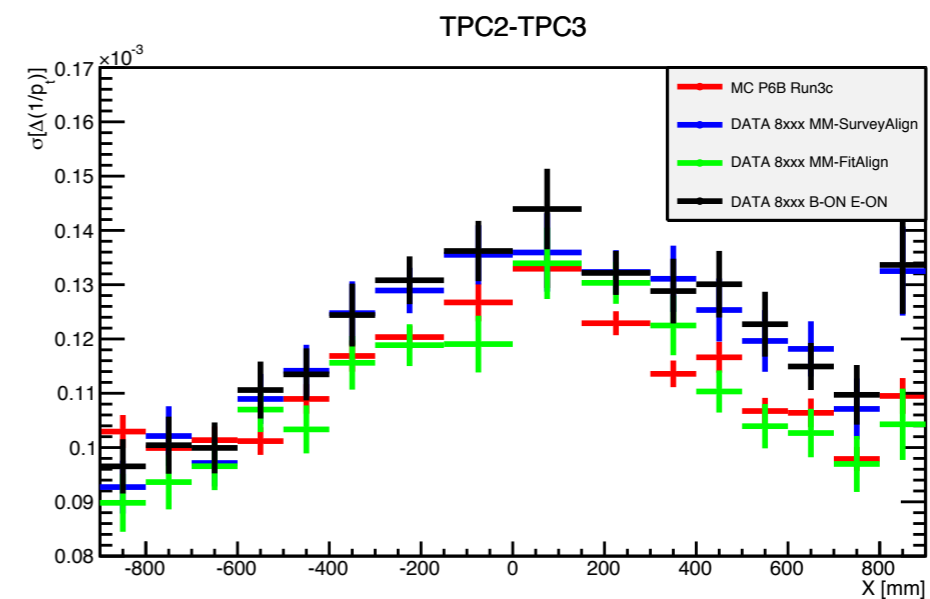
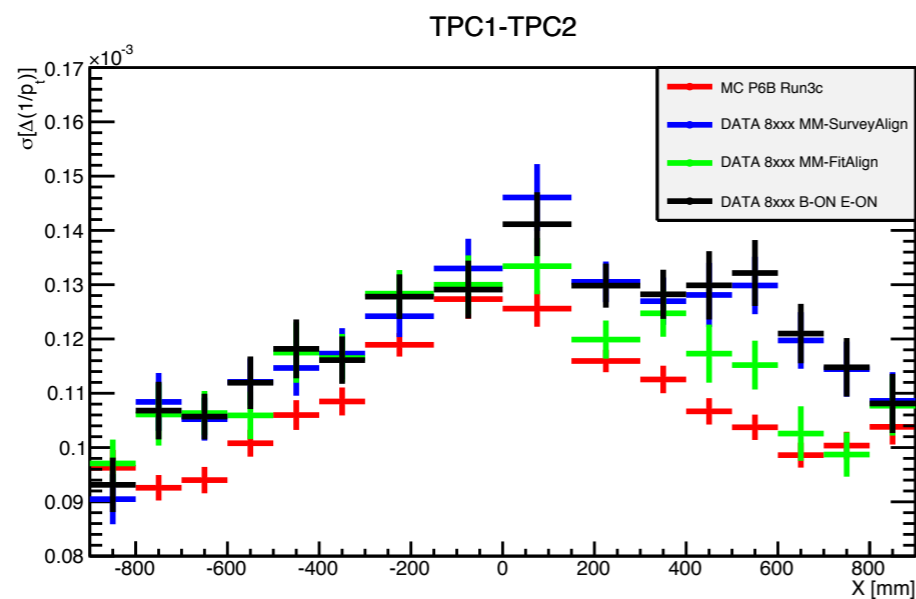
# MM misalignment:

- Momentum resolution and bias has been studied with the new MM misalignment constant.
- Data-MC discrepancy is further reduced.



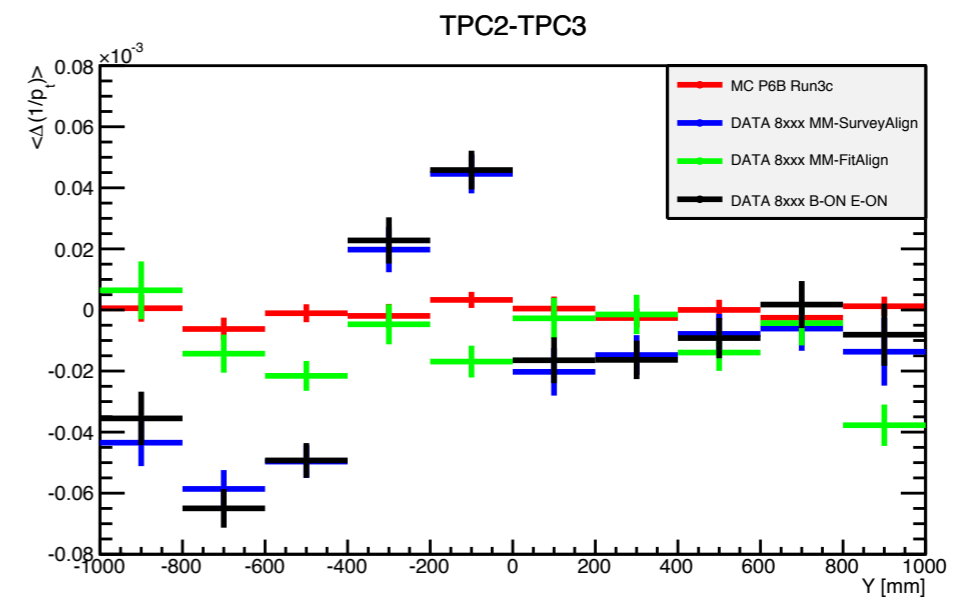
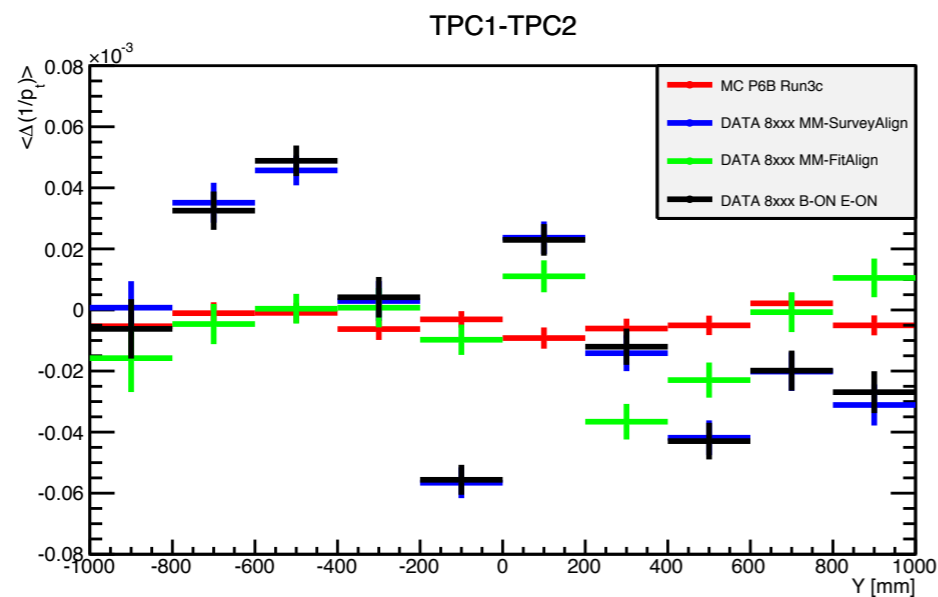
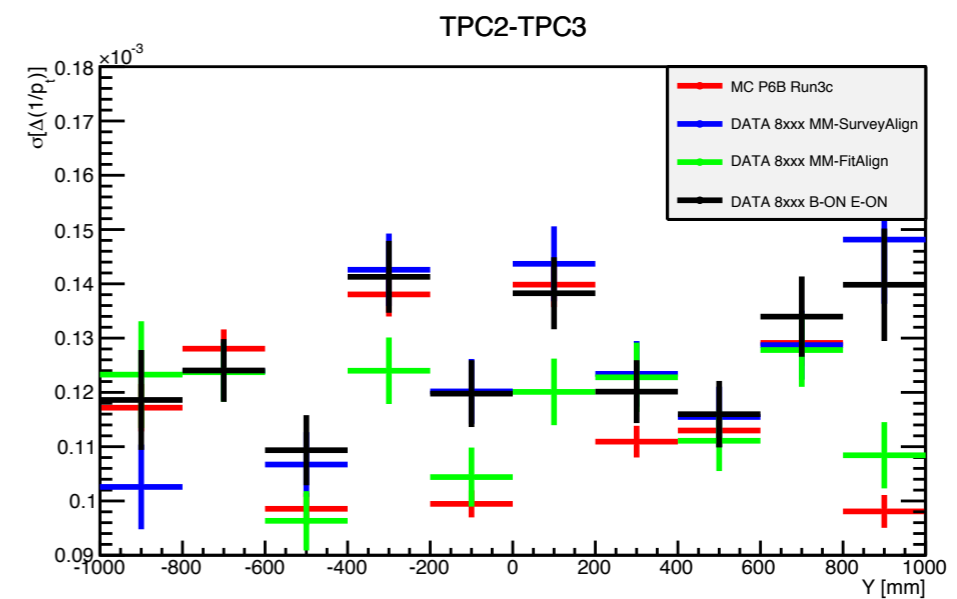
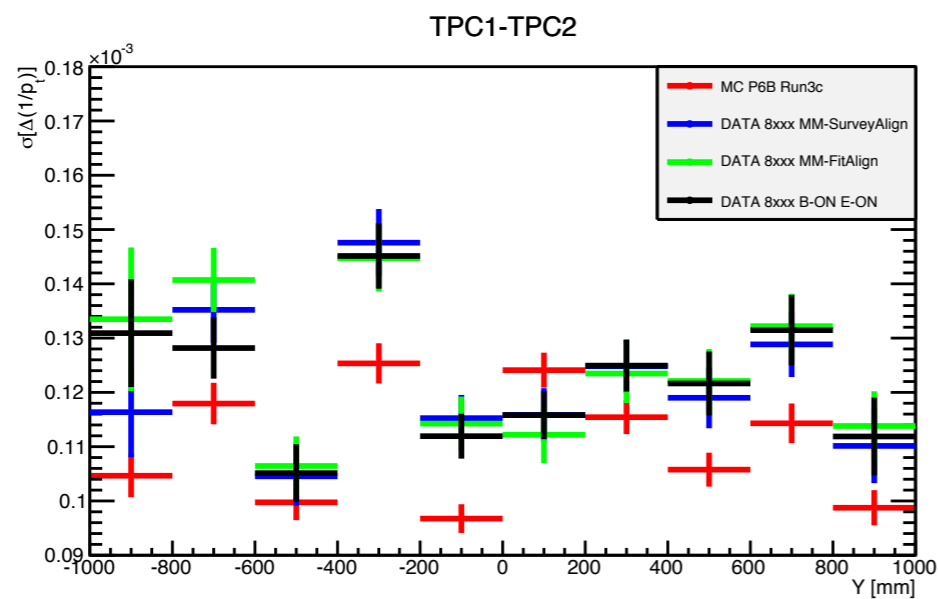
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# Conclusions:

- First look of the momentum resolution with new MM alignment constant.
- Results are promising but still some unknowns.
- Currently low statistics (8xxx) because the process is slow (it has to be run from raw midas files). Could it be improved?
- It would be interesting to redo the E field distortion studies with new MM alignment.