

CSC Alignment

- Closest hit approach
- All hits approach
- CSC case
- CSC hits cut
- New fit method
- New alignment results

Closest hit approach

Aligned position

Unaligned position

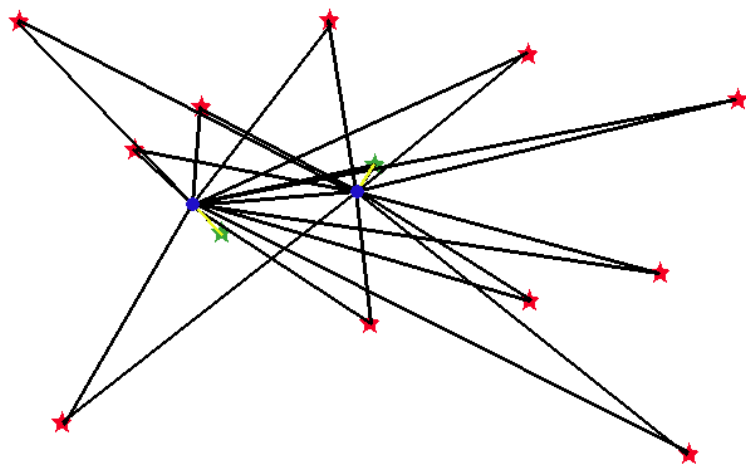


★ - wrong hit, ★ - right hit, ● - track extrapolation

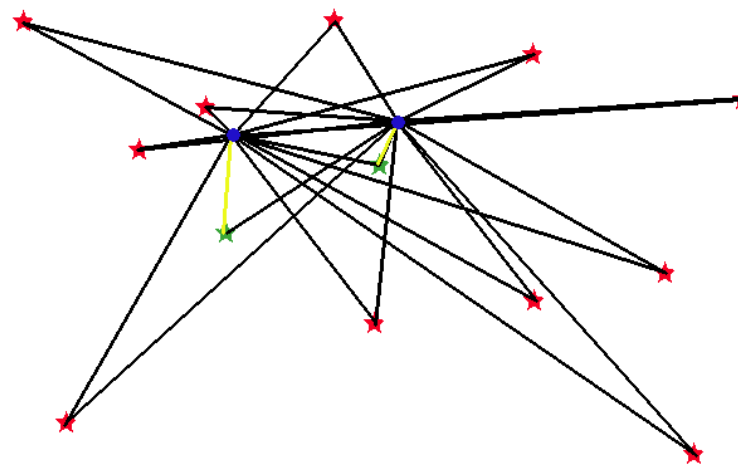
- We can **lose** right residuals
- If we far away of aligned position, all residuals can be **wrong**

All hits approach

Aligned position



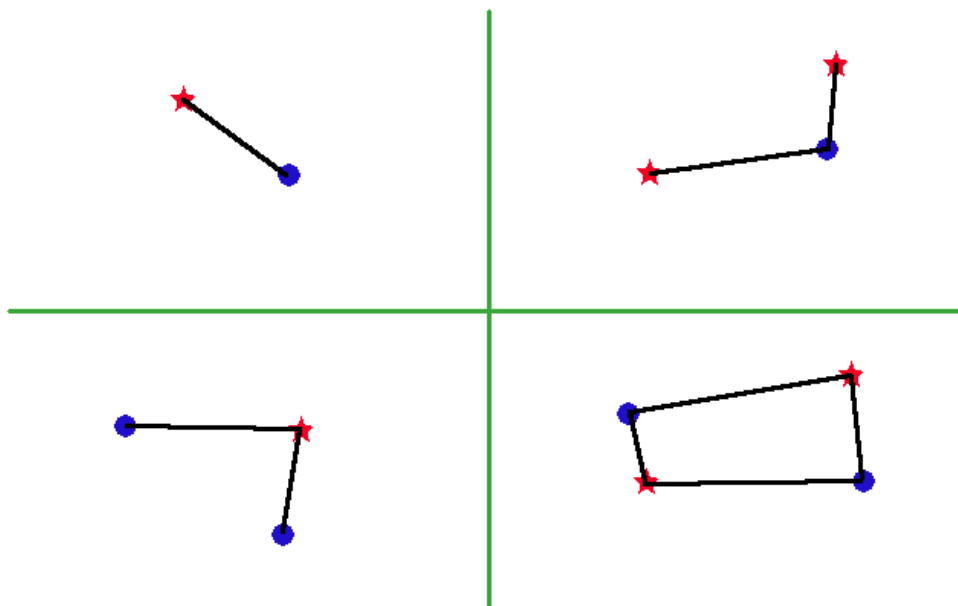
Unaligned position



★ - wrong hit, ★ - right hit, ● - track extrapolation

- We do not lose right residuals
- If the number of wrong hits is large, we will have a large combinatorial background
- Due to large background we need to use more sophisticated fitting algorithms

CSC case

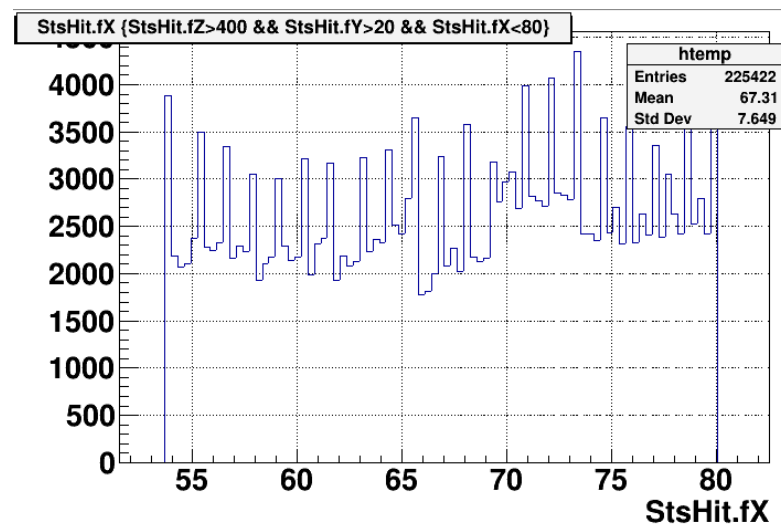
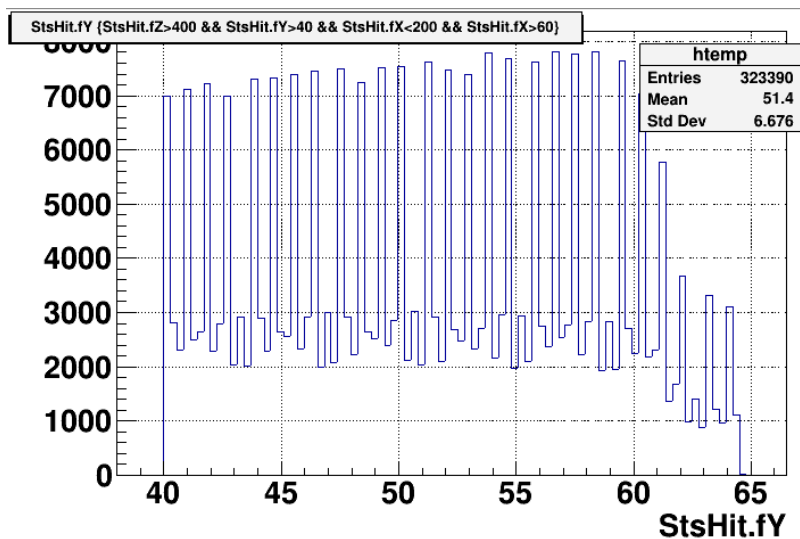
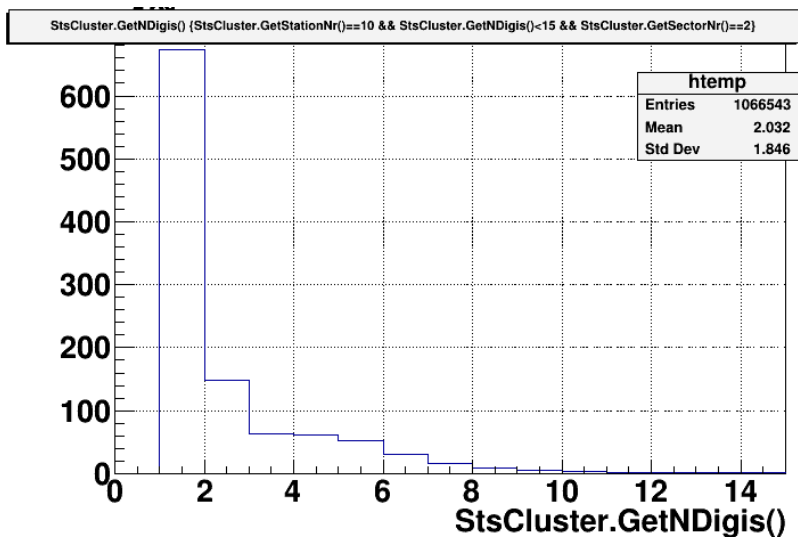


★ - hit, ● - track extrapolation

- Average number of combination without 1-digit clusters in hits < 3
- **Closest hit** and **all hits** approaches in this case seem to be equal

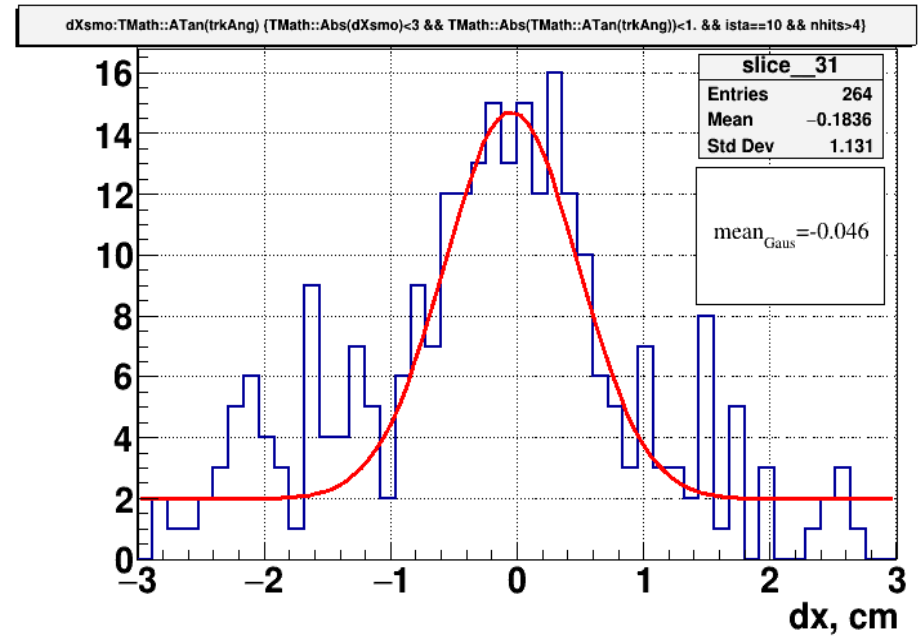
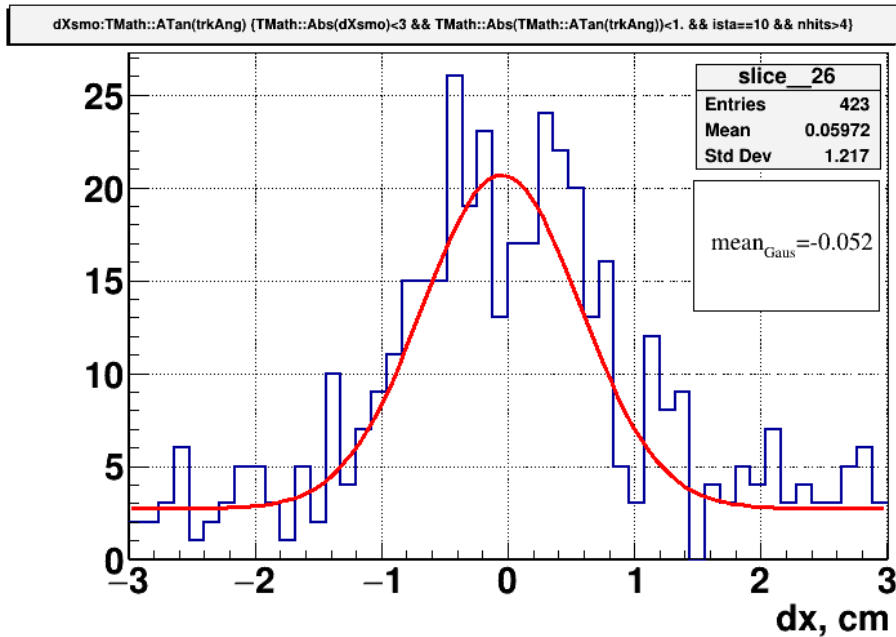
CSC Hits cut

- Average number of tracks-hits combination per event > 8



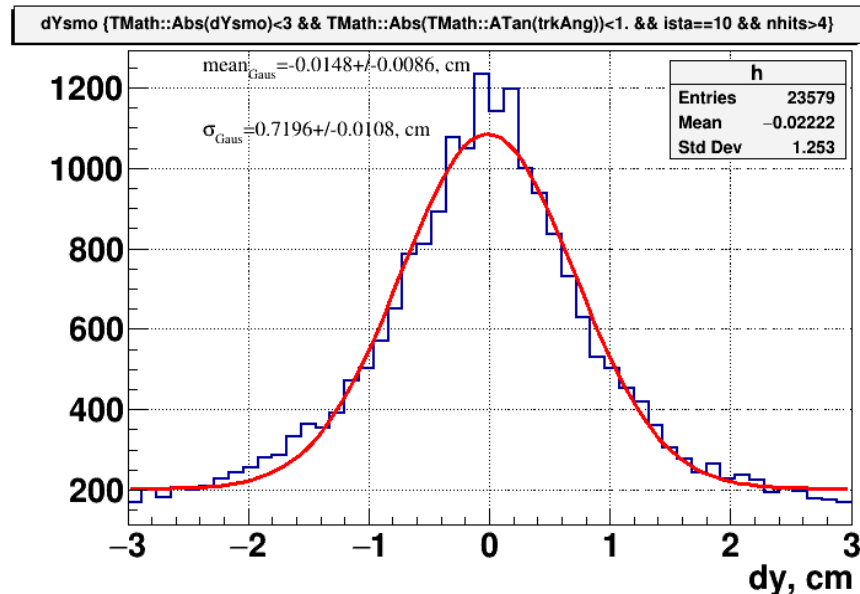
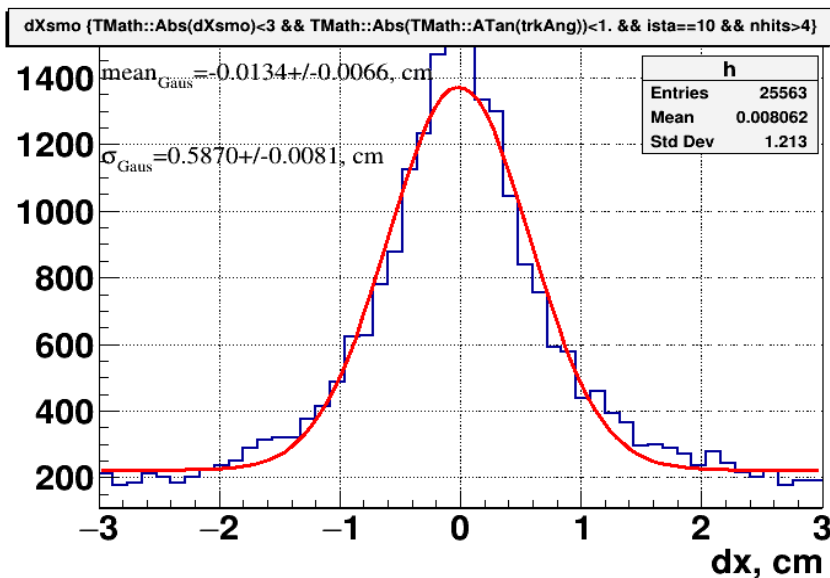
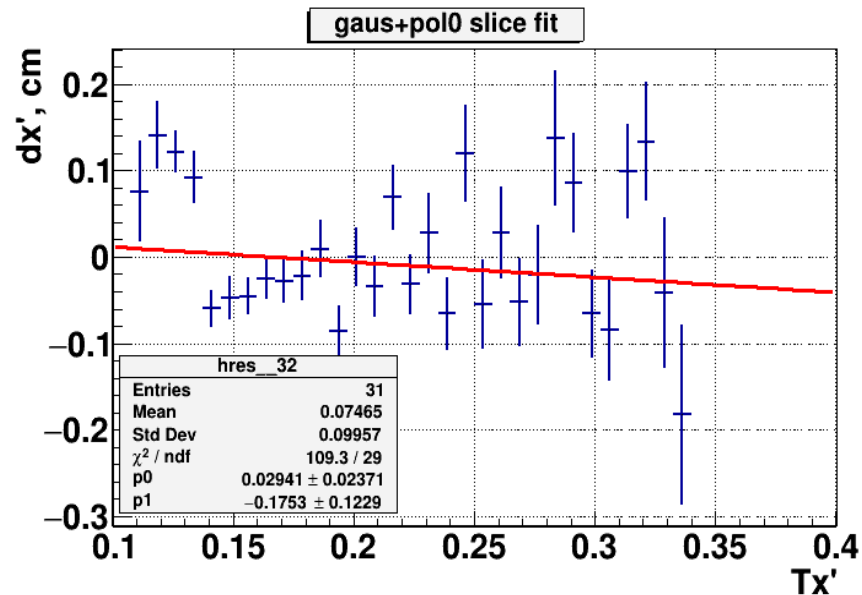
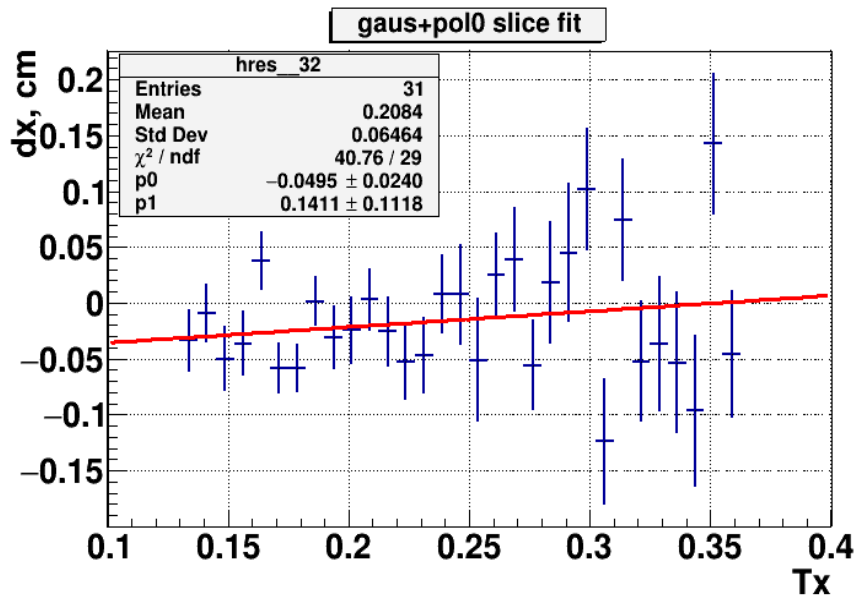
Remove hits with at least 1 cluster containing 1 digit

New fit method



- Mean_{Distrib} - Mean_{Gaus} variates more than ± 1 mm
- Use **gaus+pol0** to fit slices by T_x

New alignment results



New alignment results

- To get new aligned CSC position following shifts are implemented:
 - $Z_{\text{AllHits}} = Z_{\text{GEM}} - 0.88, \text{ cm}$ ($Z_{\text{ClosestHit}} + 0.13 \text{ cm}$)
 - $X_{\text{AllHits}} = X_{\text{GEM}} - 0.213, \text{ cm}$ ($X_{\text{ClosestHit}}$)
 - $Y_{\text{AllHits}} = Y_{\text{GEM}} + 0.085, \text{ cm}$ ($Y_{\text{ClosestHit}}$)
- Residual misalignment by X and Y $< 200 \mu\text{m}$
- For the CSC Closest Hit approach, the alignment is simpler and gives the same results



Backup

Data without field

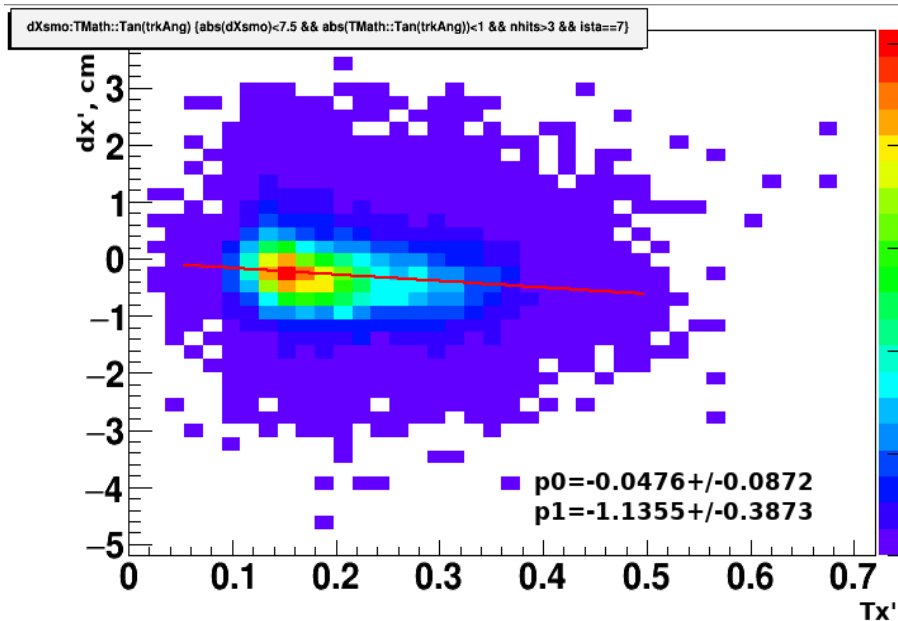
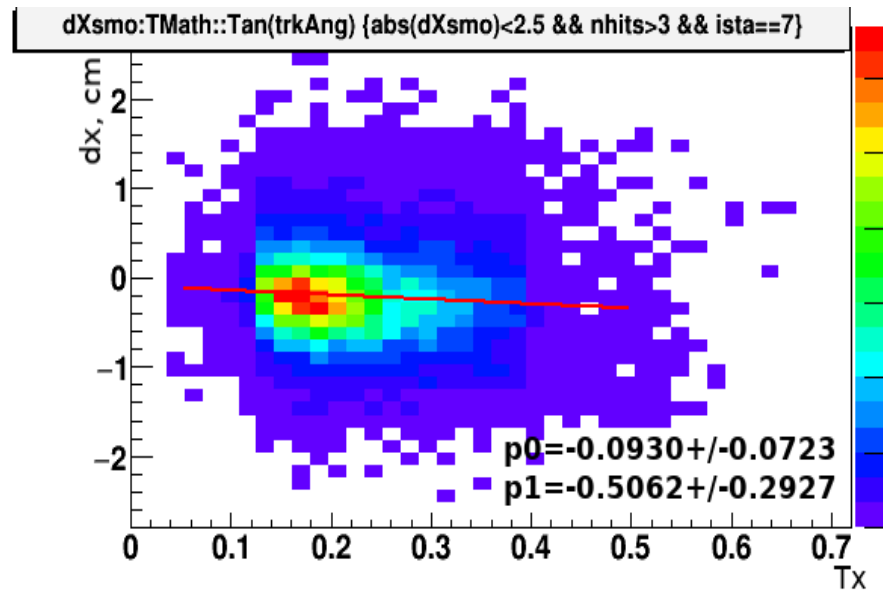
- Run 4648
- Argon beam
- Al target 3.3 mm wide

Previous result, GEM-CSC tracking

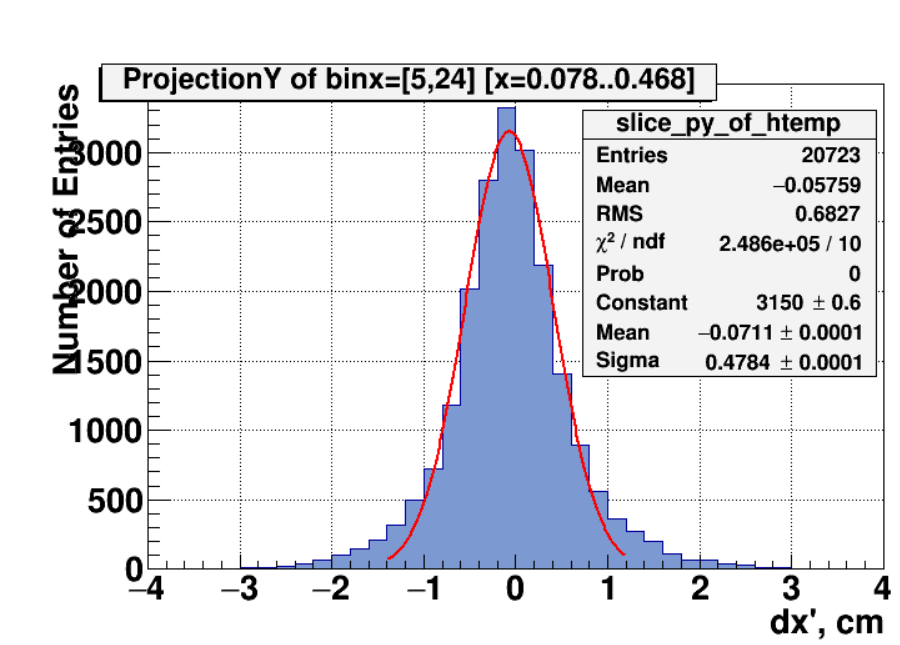
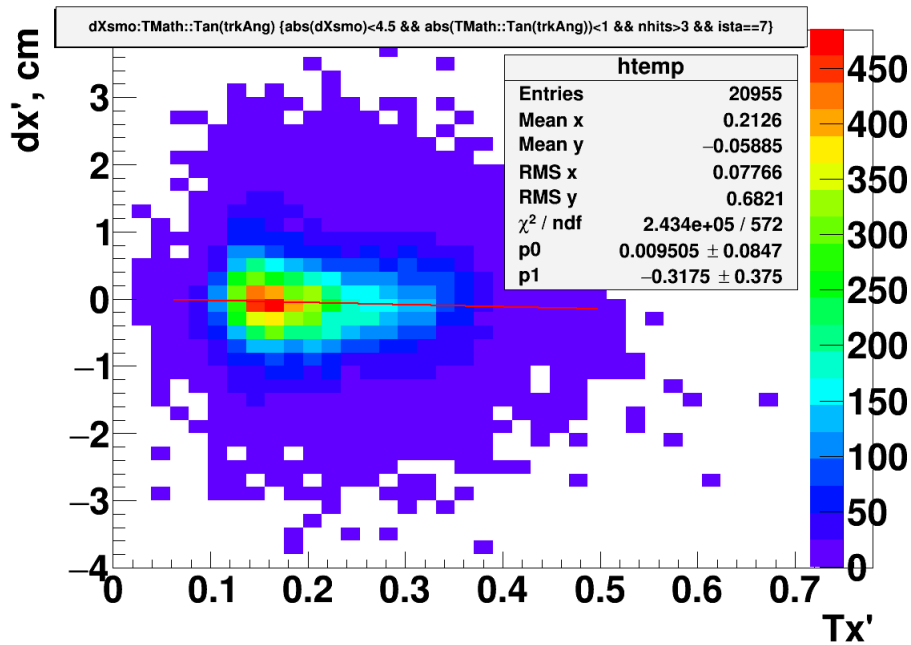
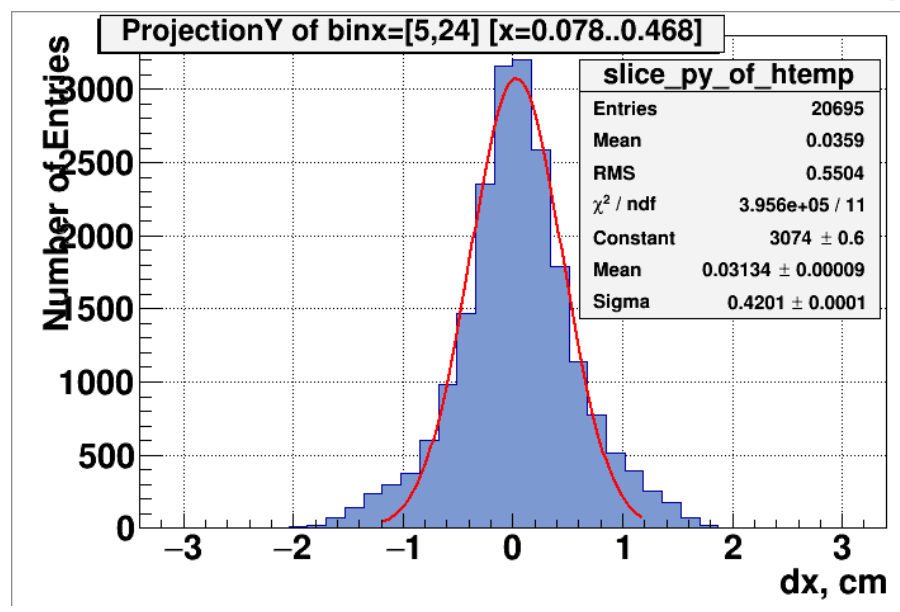
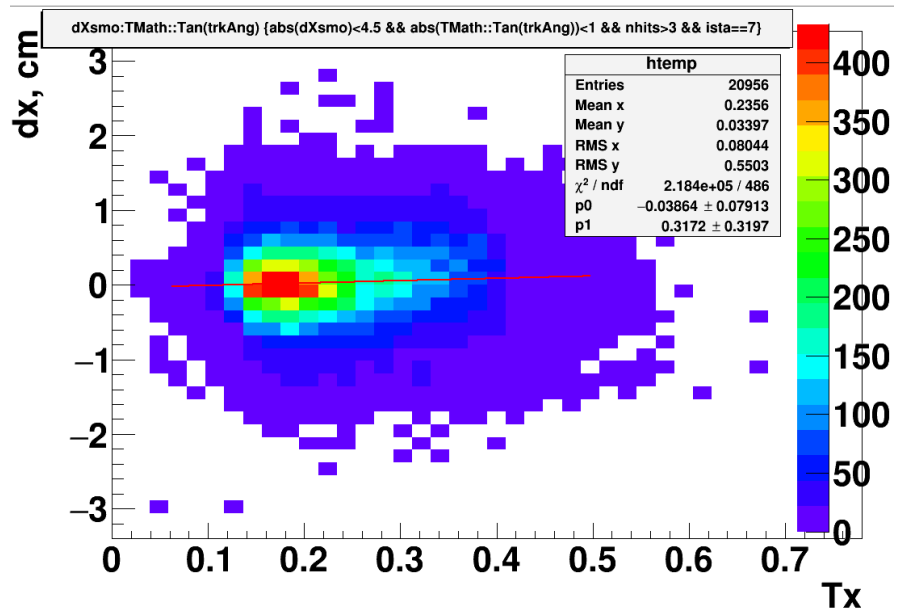
Residuals without field, X and X',

$Z_{\text{best}} + 1.5 \text{ cm}$

- Residuals for Z, shifted by 1.5 cm relative to the "optimal" Z
- Negative slope is visible for X and X'
- The slopes are different and correspond to the difference in position along Z $\Delta Z \approx 6.5 \text{ mm}$



Residuals without field, X и X' , Z_{best}

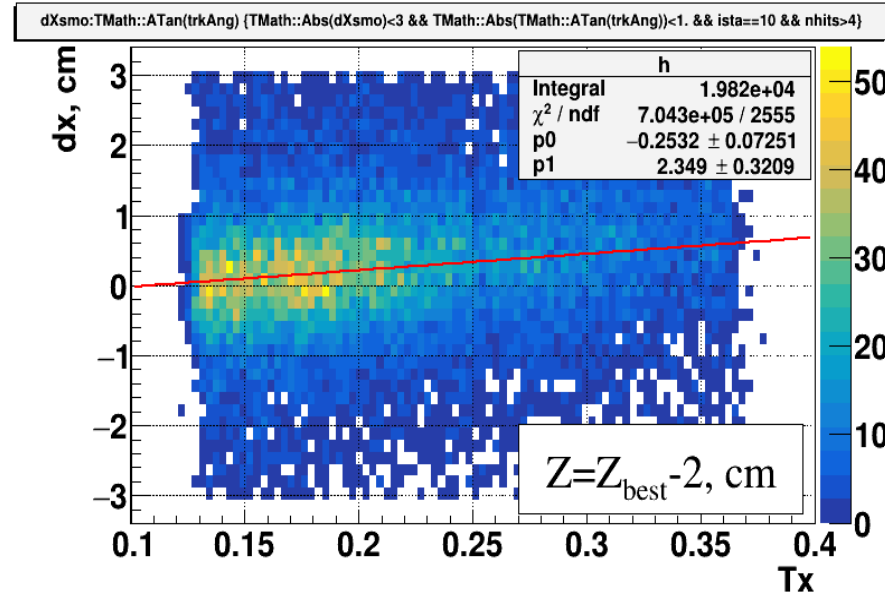


- Residuals were calculated by discarding the CSC hit and extrapolating the track from GEM
- Sigma of residuals about 4 mm
- Zef planes X and X' are separated by several millimeters in different directions relative to Z_{csc} (X' is closer to the target in Z)
- Z_{csc} , implemented in reconstruction, in the middle between X and X'

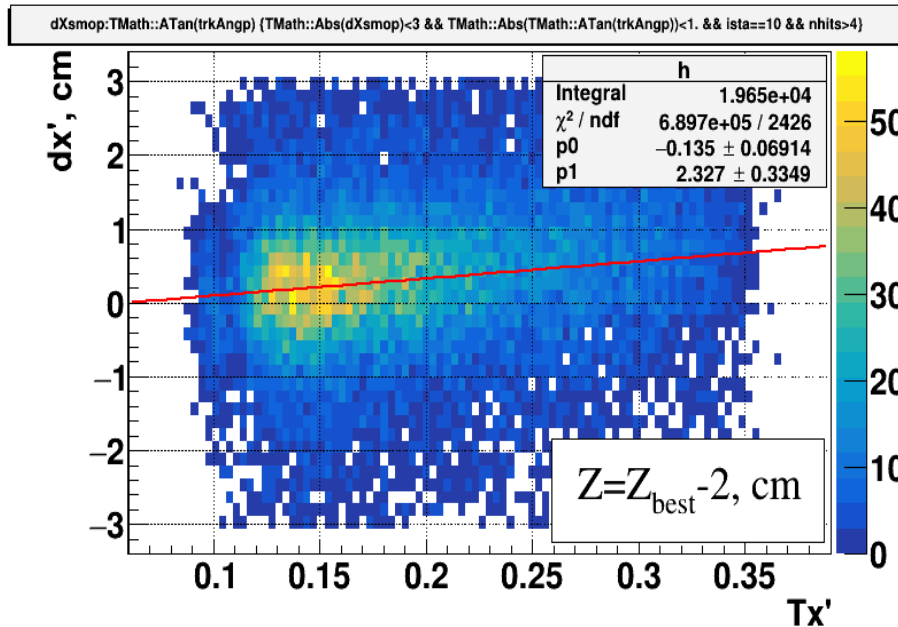
Si-GEM-CSC extended tracking

Residuals w/o field, X and X',

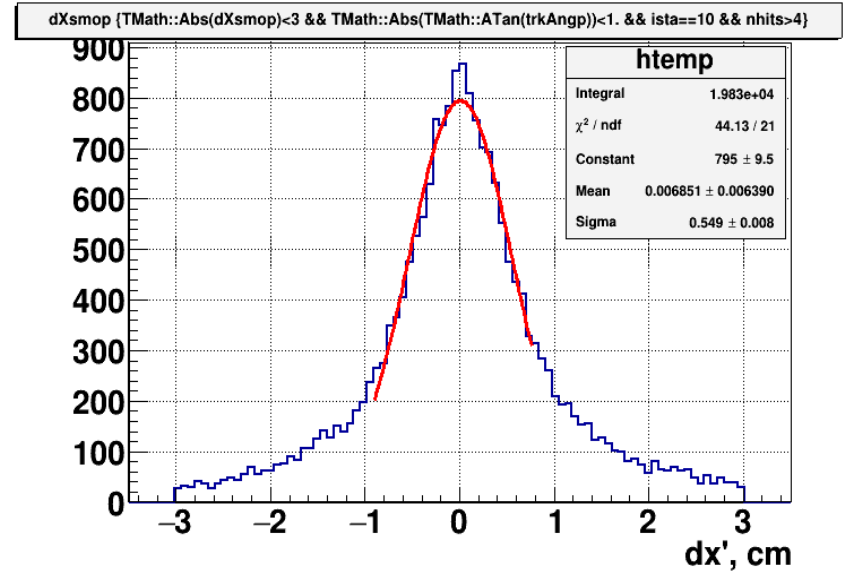
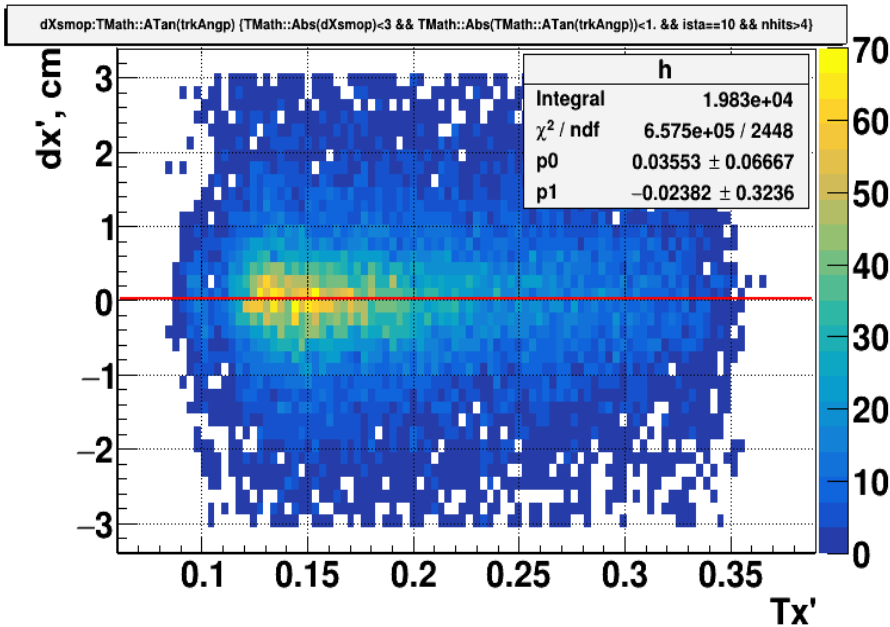
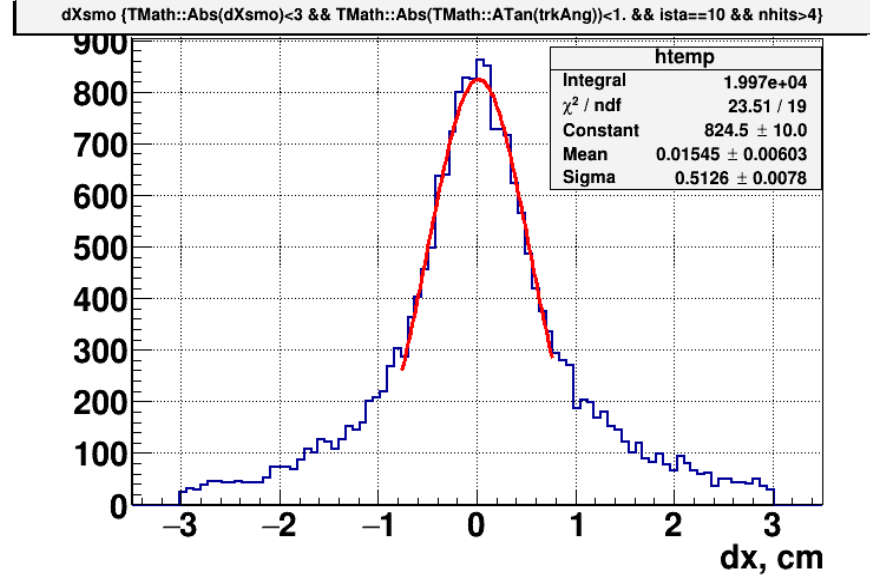
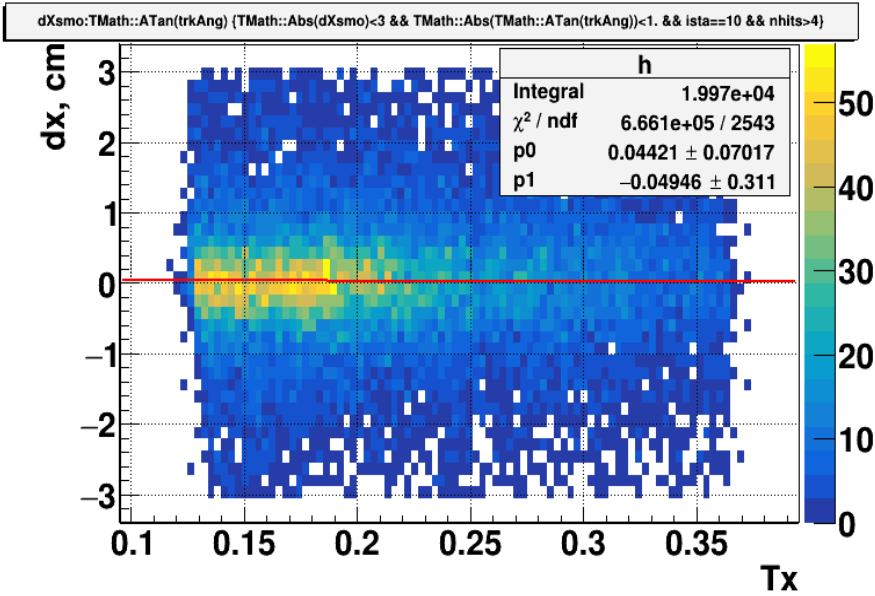
$Z_{best} - 2 \text{ cm}$



- Residuals for Z, shifted by 2 cm relative to the "optimal" Z
- Positive slope is visible for X and X'
- The slopes are close to each other



Residuals w/o field, X and X' , Z_{best}



Residuals without field, X и X' , Z_{best}

- To get new aligned CSC position following shifts are implemented:
 - $Z_{\text{new}} = Z_{\text{old}} - 1.01, \text{ cm}$
 - $X_{\text{new}} = X_{\text{old}} - 0.213, \text{ cm}$
 - $Y_{\text{new}} = Y_{\text{old}} + 0.085, \text{ cm}$
- Sigma of residuals about 5.3 mm (about 1 mm more than before)
- The slopes for the X and X' planes are close to each other
- The difference in slopes corresponds to a displacement along Z about $200 \mu\text{m}$

Displacement of X and X' planes

- X and X' plane displacement **issue not reproduced**
- The possible reasons are following:
 - New tracking
 - More accurate track selection (≥ 2 Si hits, ≥ 3 GEM hits)
 - Smaller binning
 - Using the same $X^{\wedge}X'$ angle in ResidOk as in the reconstruction (**influence $< 100 \mu\text{m}$**)

Residuals w/o field, X and X', Z_{best}

- Residuals vs tangent in XZ plane with “prof” option
- Errors are the errors of the mean
- The discrepancy with the alignment results using the “colz” option is about 1 mm

