

Status of the Λ^0 hyperon analysis in the carbon beam at the BM@N experiment

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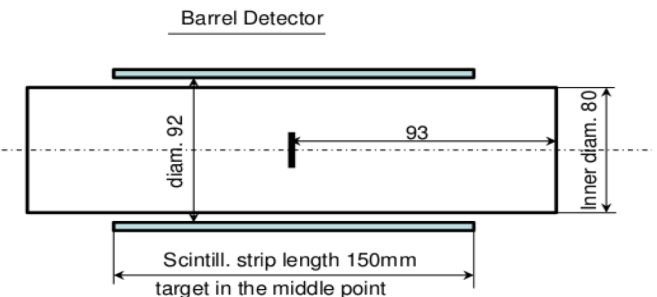
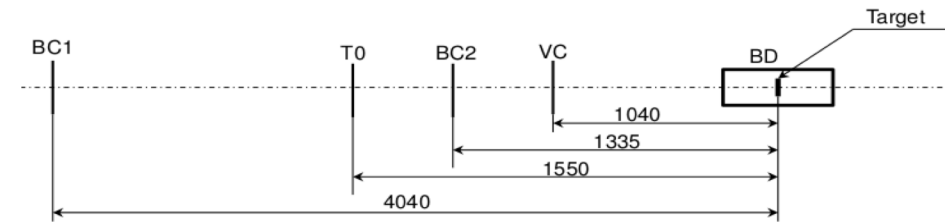
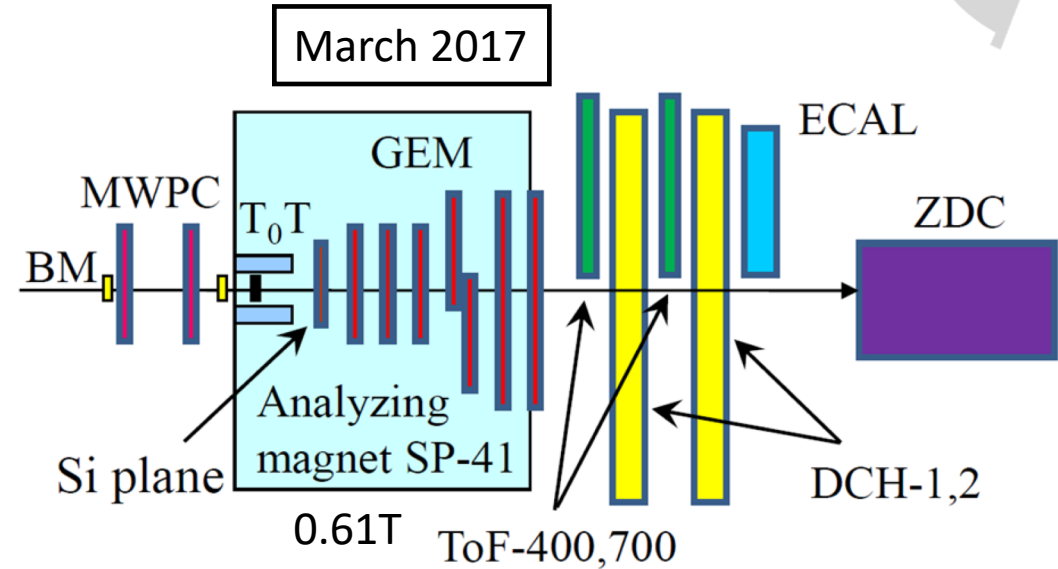


15.12.2021

BM@N configuration in Run6



- Central tracker
 - One plane of a forward Si detector
 - 6 GEM stations
 - 5 GEM detectors (66x41 cm²)
 - 2 GEM detectors (163x45 cm²)
- Triggers: BD, BC1, BC2, T0, VETO
- Beam E_{kin}=4.0 and 4.5 GeV
 - Intensity 10⁵ per spill
 - Spill duration 2-2.5 sec.
- Physics: measure inelastic reactions C+A→X
 - Targets: C, Al, Cu, Pb



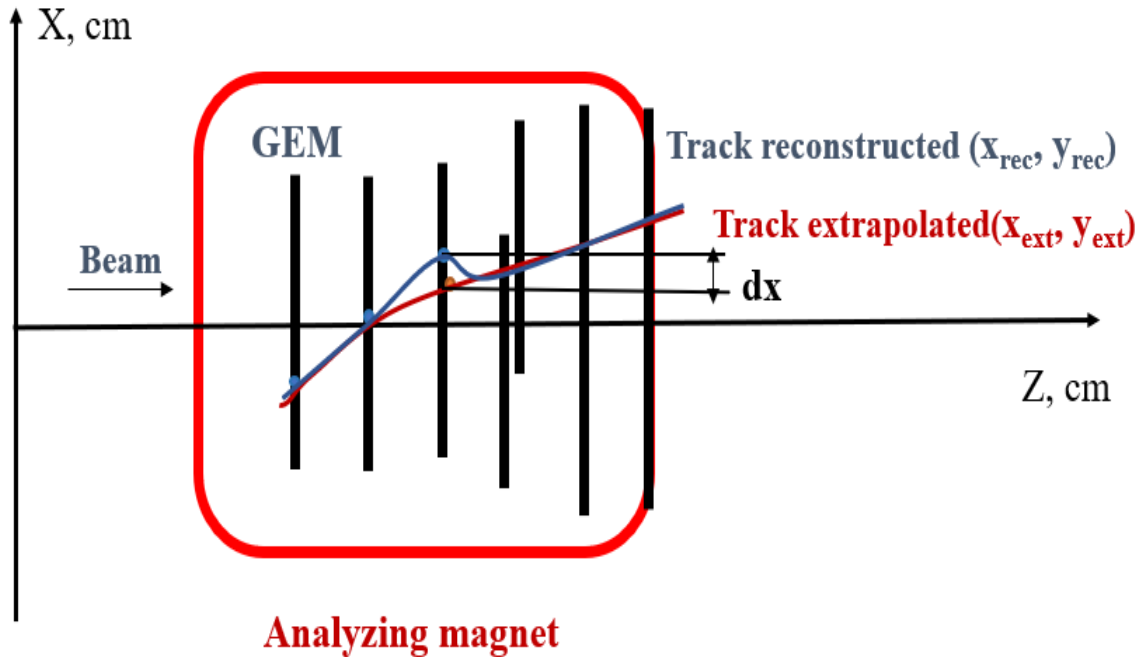
Analysis current status



- **Main goal of current analysis** – cross-check with previous analysis (was performed by Gleb Pokatashkin)
- **From previous analysis status:**
 - Check residuals for MC & Data ✓
 - Make corrections for residuals in Data & MC (see Ksenia & Anastasia talks) ✓
 - Momentum smearing procedure for MC simulation ✓
 - Check GEM efficiencies for MC & Data ✓
 - Apply efficiencies for MC simulation ⚠
- **Analysis:** compare distributions MC/Data for pt/momentum/etc. (in progress) ⚠
- **Measure cross-sections of the Λ^0 's hyperon**

In this talk

Dx Residual definition



Geometrical definition of dx -residual value:
 x_{rec} - reconstructed x hit track coordinate,
 x_{ext} - extrapolated x hit track coordinate

Residuals correction algorithm

1. Make $dx(x)$ dependence plots by the fitting procedure using function

$$F(dx)_{fit} = p_0 + p_1 dx + p_2 dx^2 + p_3 \exp\left(-\frac{1}{2} \left(\frac{dx - p_4}{p_5}\right)^2\right)$$

2. Fit the $dx(x)$ distributions using two functions for positive and negative values of x respectively;

$$F(x)_{fit} = p_0 + p_1 x + p_2 x^2 + p_3 x^3 + p_4 x^4 + p_5 x^5,$$

x - the coordinate of the track hit along the x -axis of the GEM station.

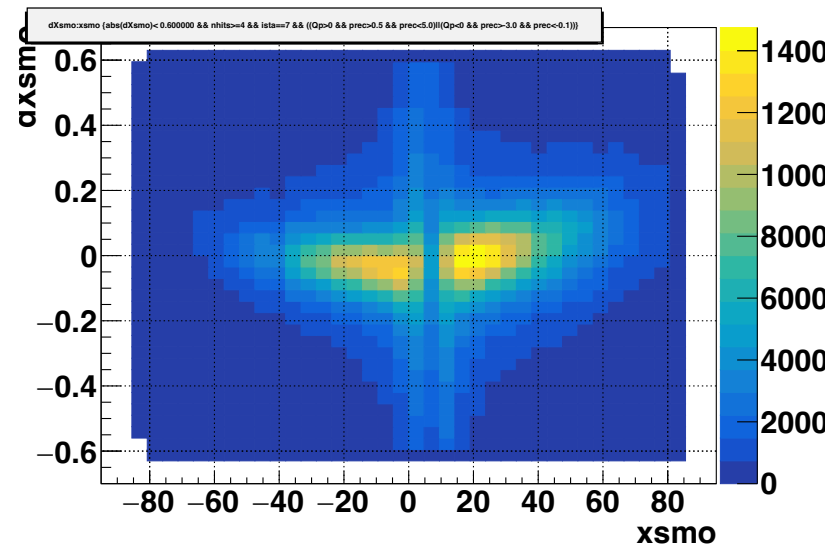
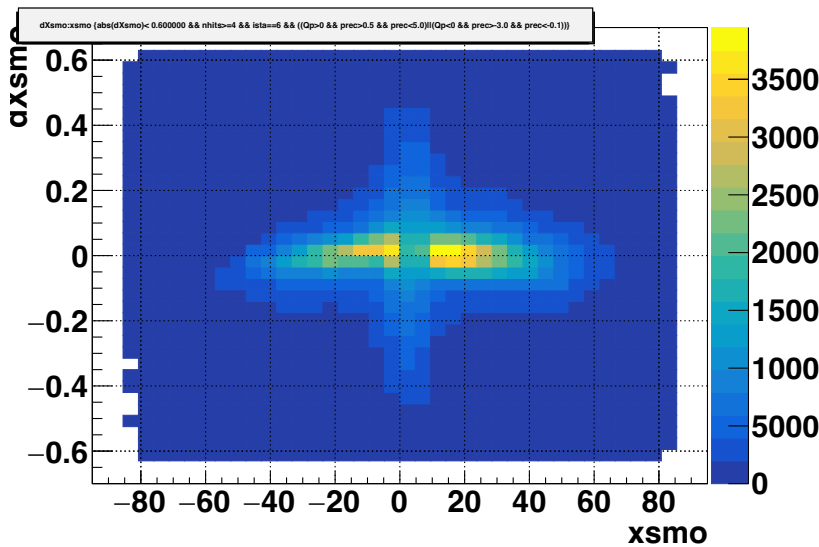
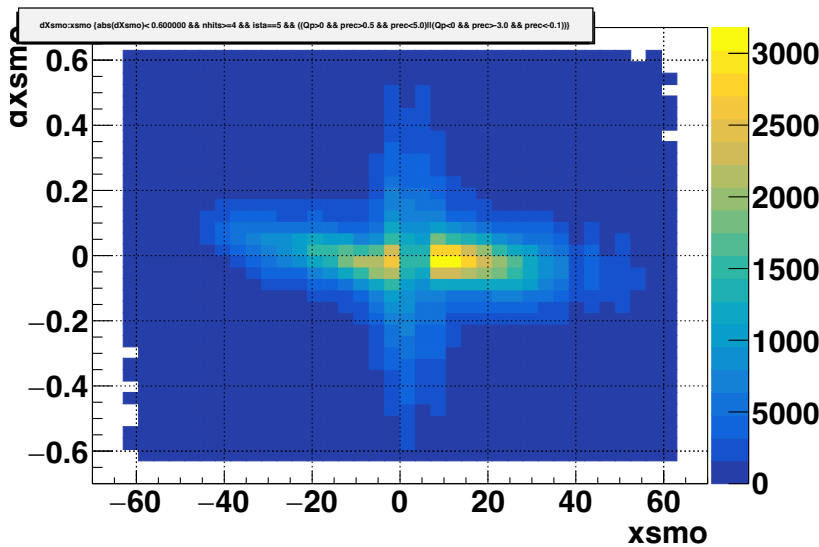
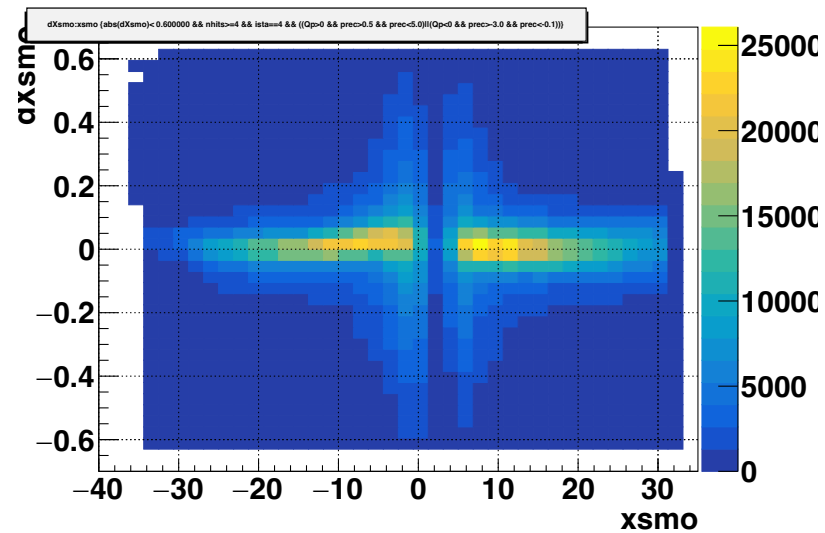
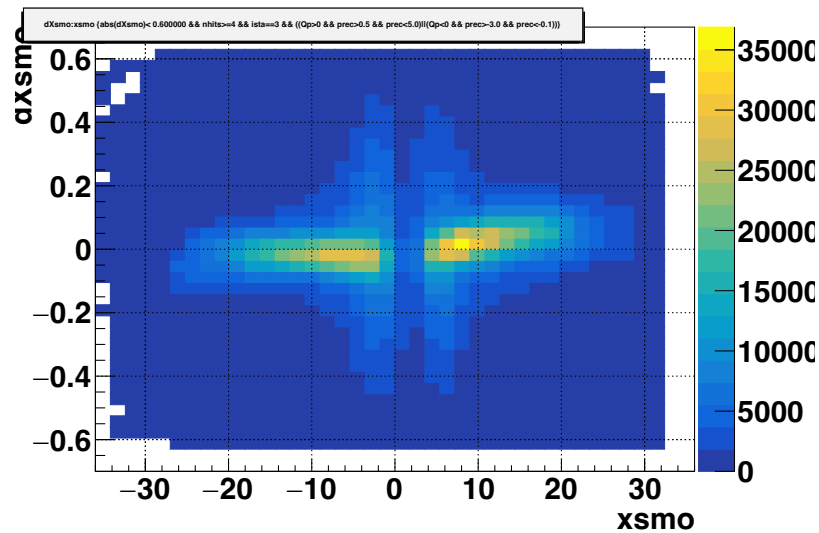
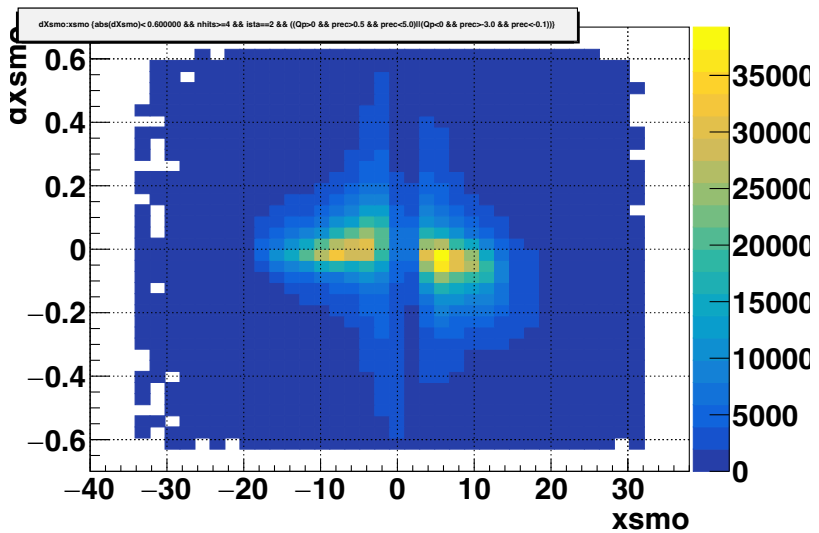
3. Make corrections of reconstructed x_{rec} values based on functions $F(x)_{fit}$ with extracted parameters from fit:

$$x_{rec} = x_{rec} - 0.5 \cdot F(x)_{fit}$$

4. Get new distributions of the $dx(x)$ value (as in step 1);
5. Check and compare results after corrections;
6. Repeat dx -residuals corrections procedure if necessary (steps 1-5).

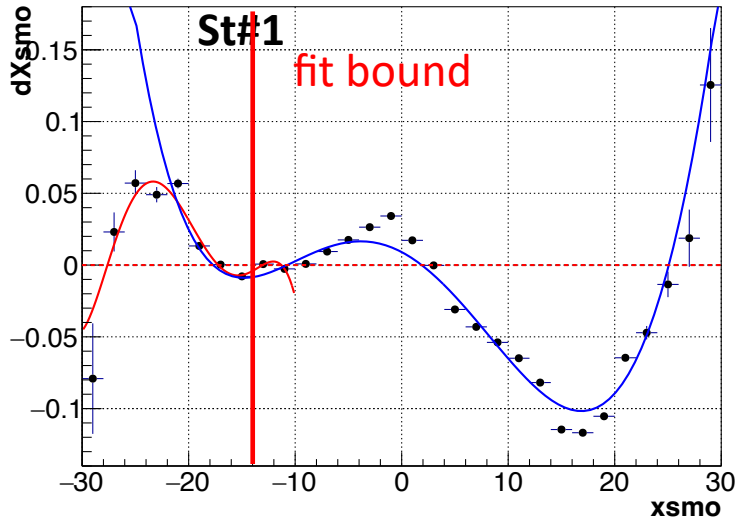
MC/DATA Dx vs. x corrections results in backup slides

Check residuals **Data** DX vs.X (4.0GeV CCu)

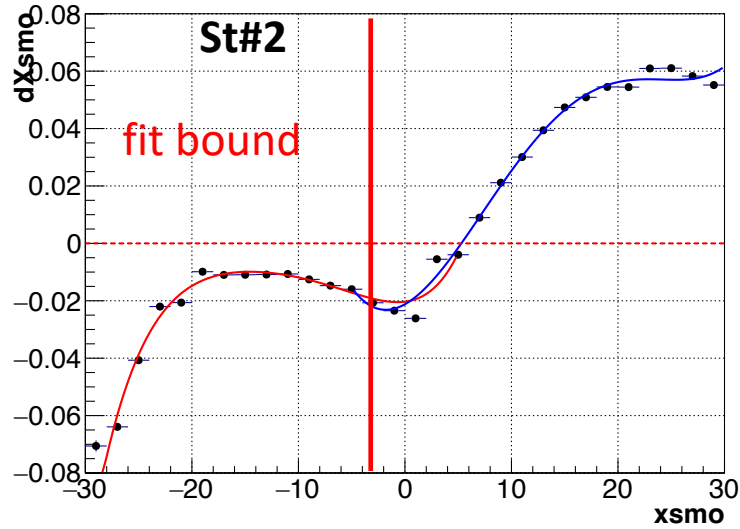


Dependencies Mean Dx vs x: example of pol5 fit (**Data** 4.0GeV C+Cu)

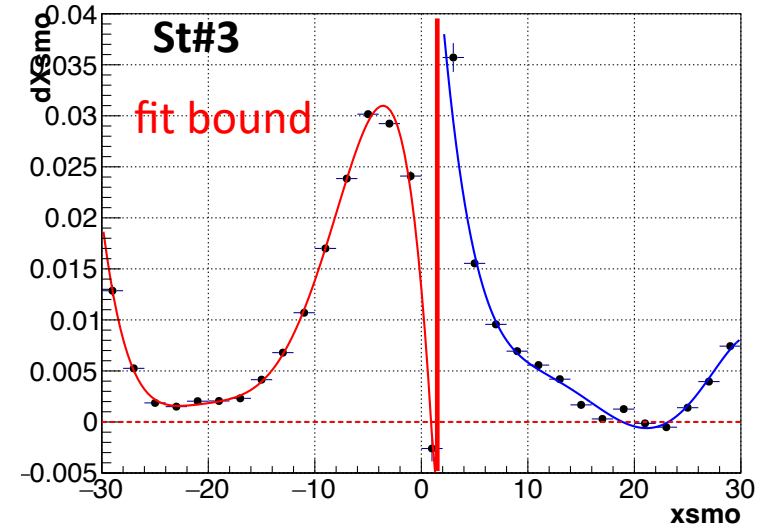
Mean of dXsmo versus xsmo (all tracks) ista=2



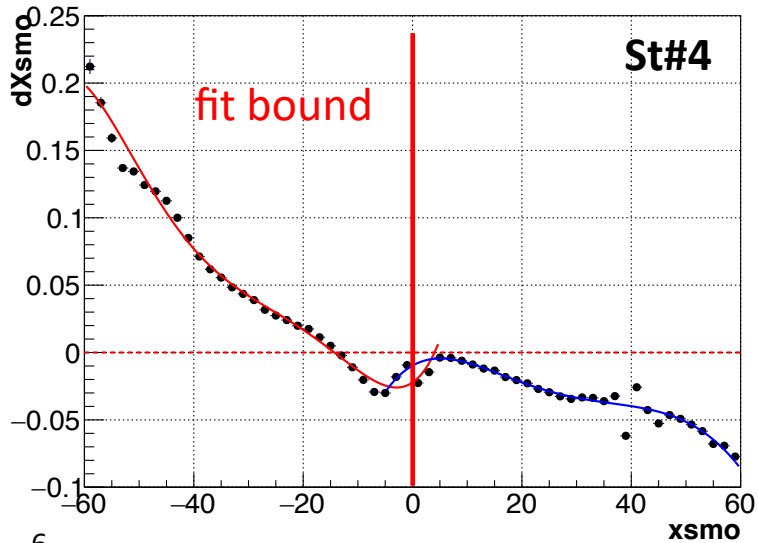
Mean of dXsmo versus xsmo (all tracks) ista=3



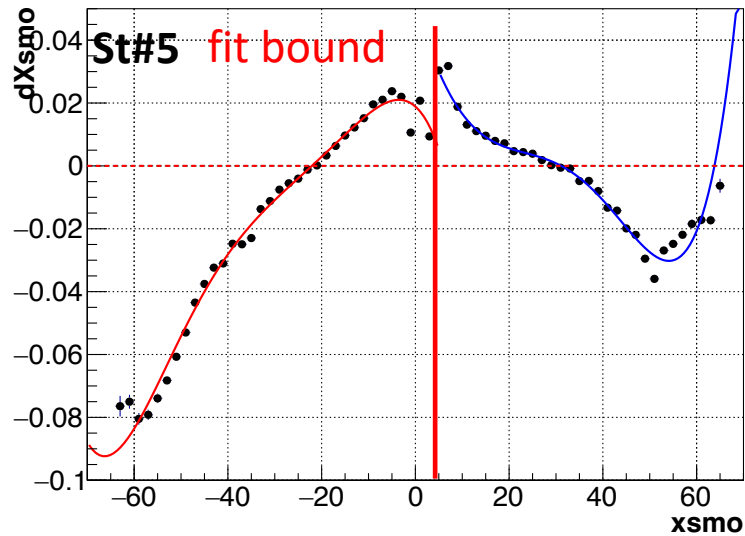
Mean of dXsmo versus xsmo (all tracks) ista=4



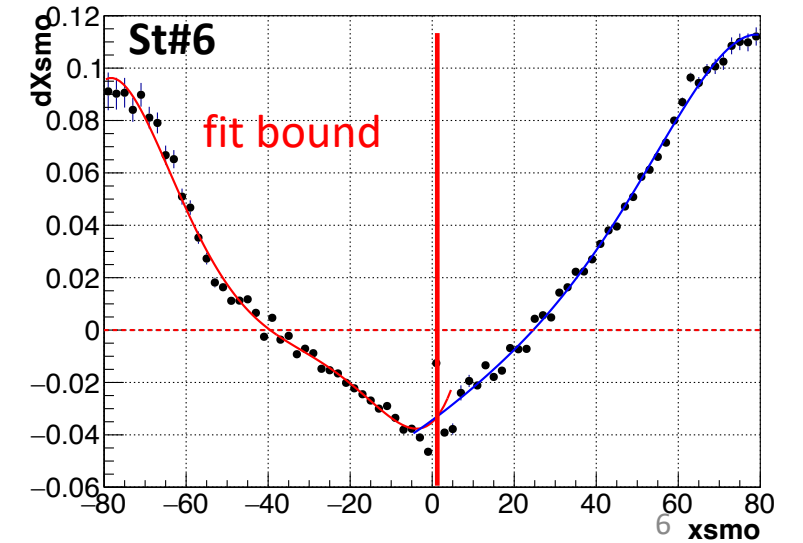
Mean of dXsmo versus xsmo (all tracks) ista=5



Mean of dXsmo versus xsmo (all tracks) ista=6



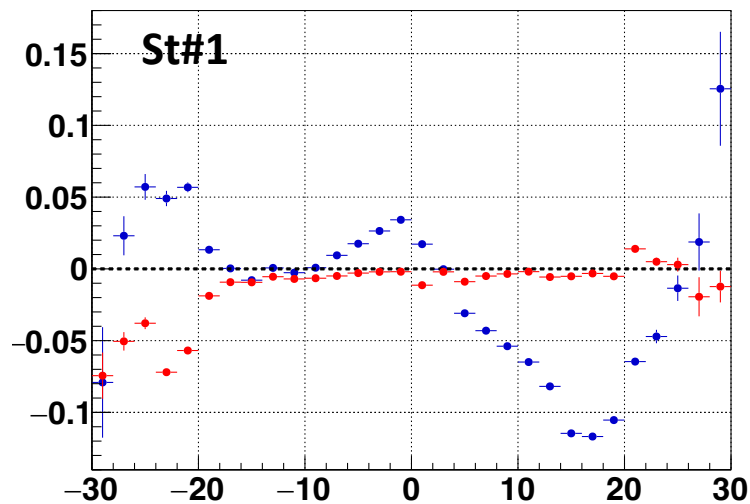
Mean of dXsmo versus xsmo (all tracks) ista=7



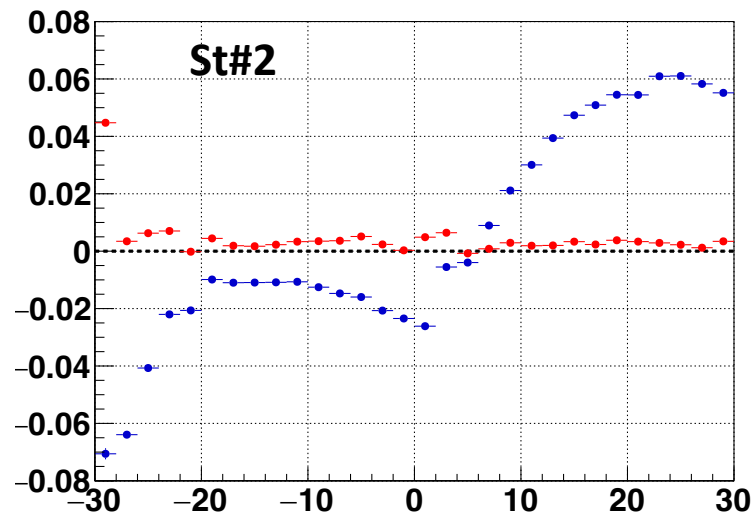
Blue: before corrections
Red: after corrections

Mean Dx vs x (DATA 4.0GeV C+Cu)

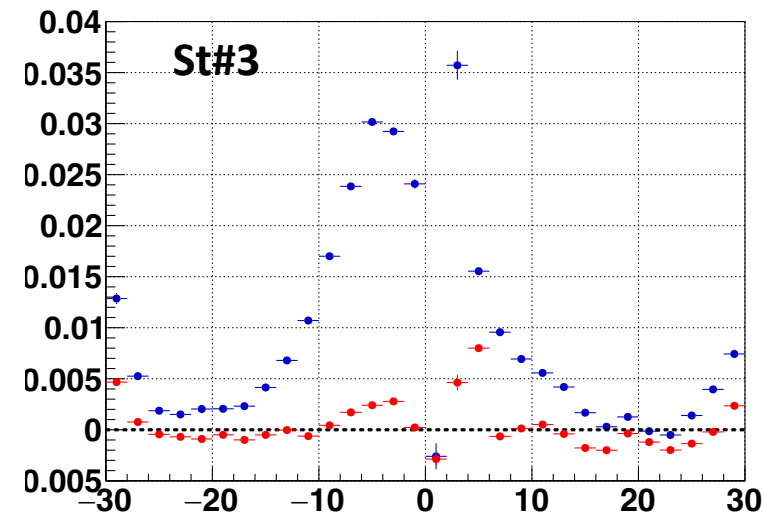
Mean dX vs. x ista==1 (DATA)



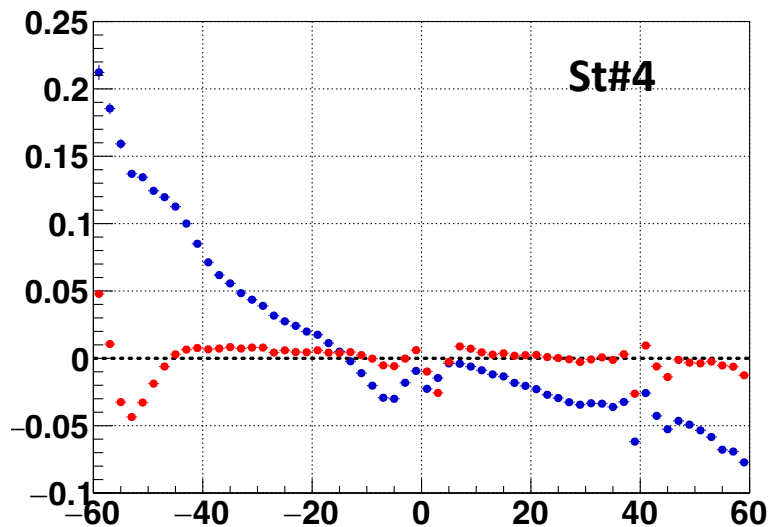
Mean dX vs. x ista==2 (DATA)



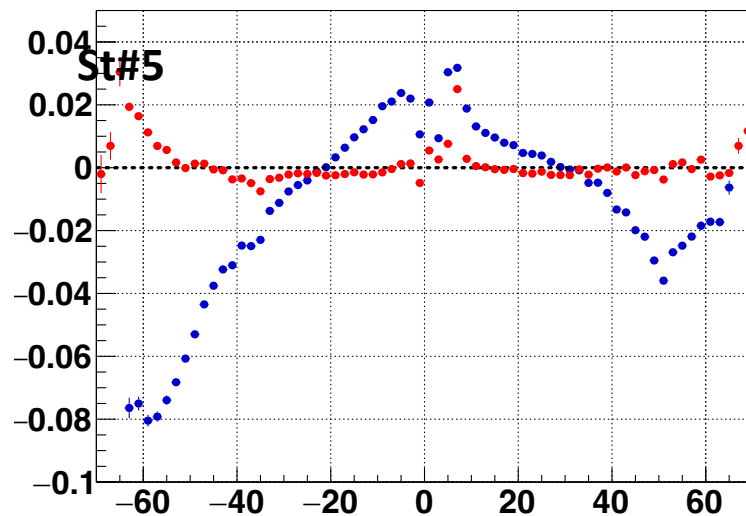
Mean dX vs. x ista==3 (DATA)



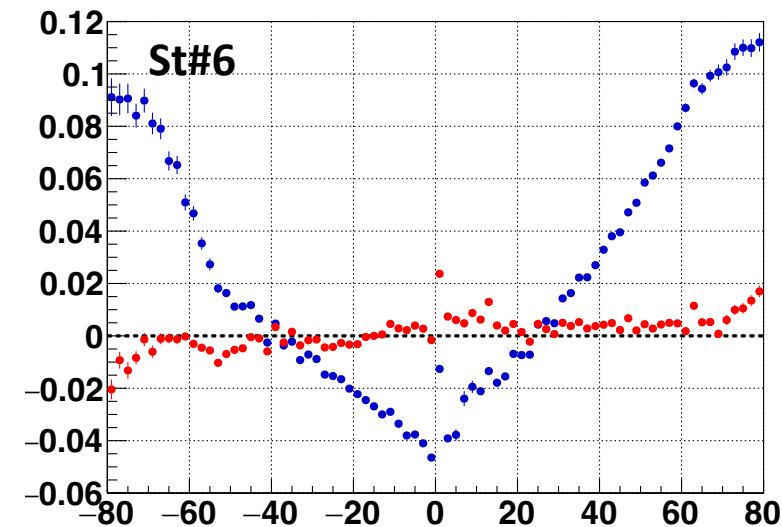
Mean dX vs. x ista==4 (DATA)



Mean dX vs. x ista==5 (DATA)



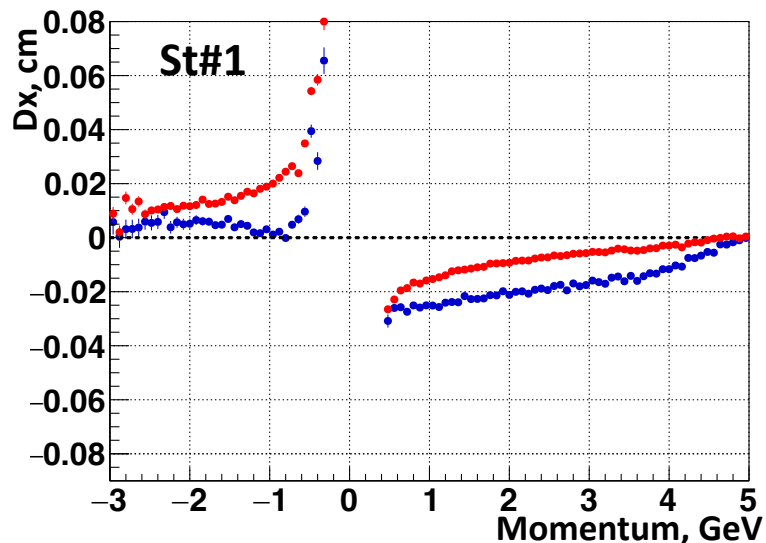
Mean dX vs. x ista==6 (DATA)



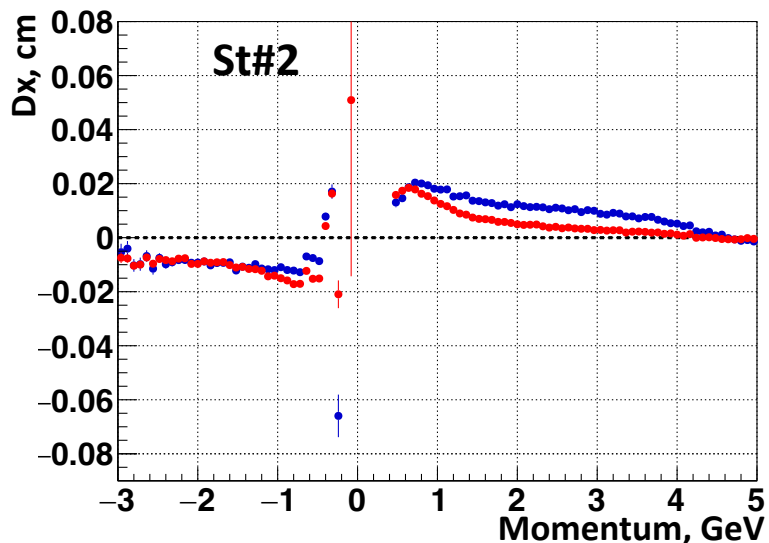
Blue: before corrections
Red: after corrections

Mean Dx vs Momentum (DATA 4.0GeV C+Cu)

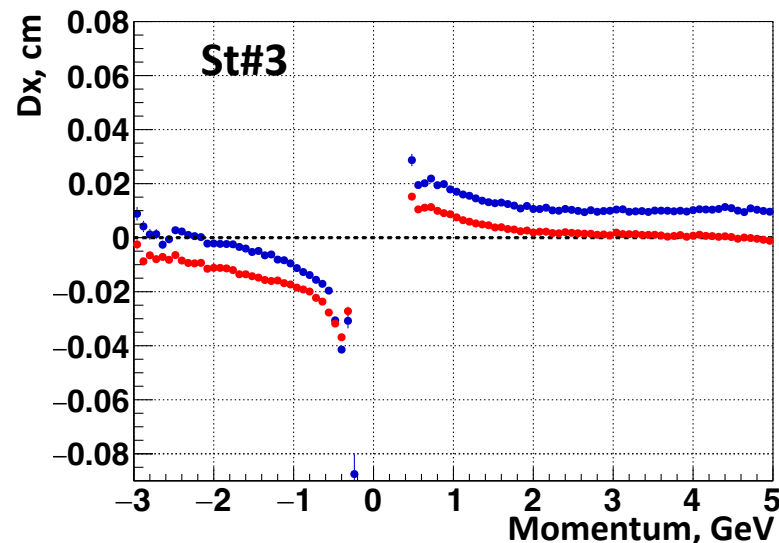
Mean Mom. vs. x ista==1 (DATA)



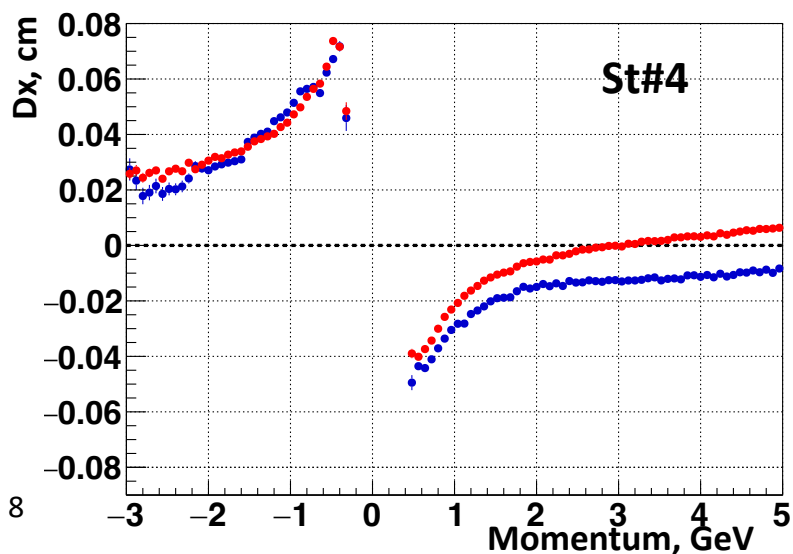
Mean Mom. vs. x ista==2 (DATA)



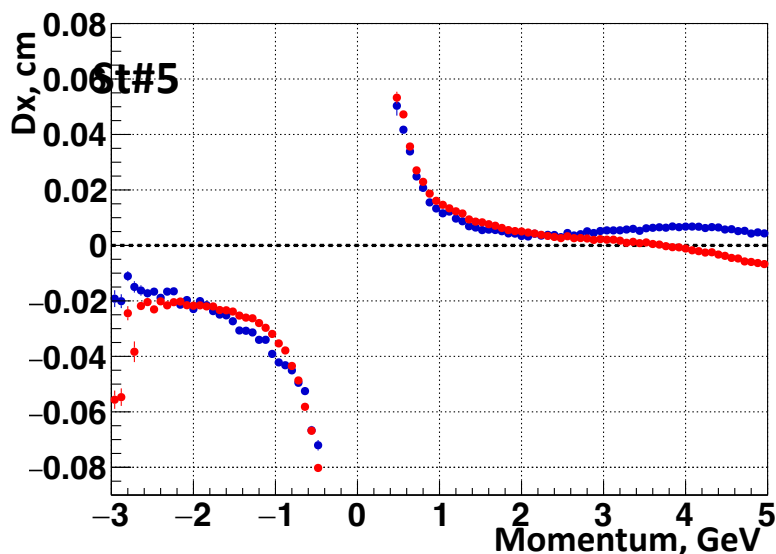
Mean Mom. vs. x ista==3 (DATA)



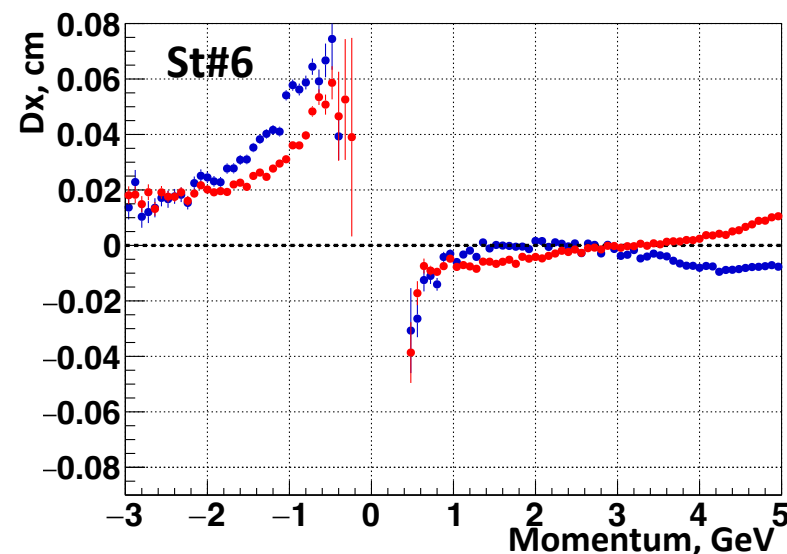
Mean Mom. vs. x ista==4 (DATA)



Mean Mom. vs. x ista==5 (DATA)



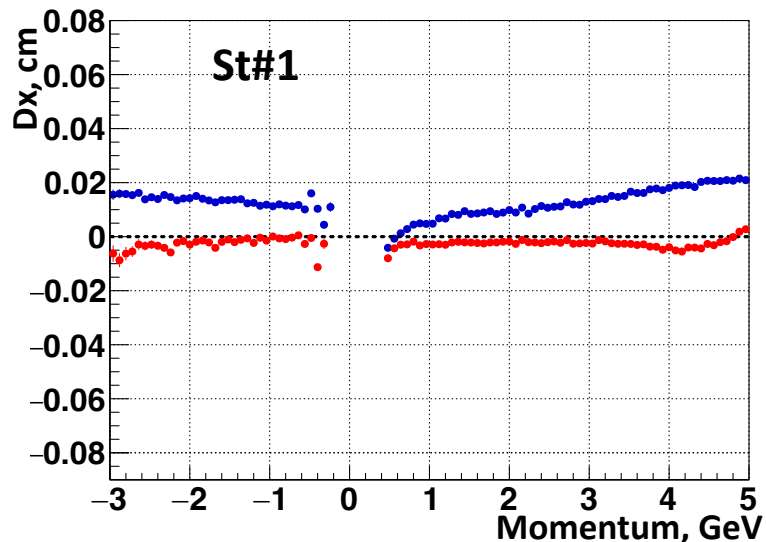
Mean Mom. vs. x ista==6 (DATA)



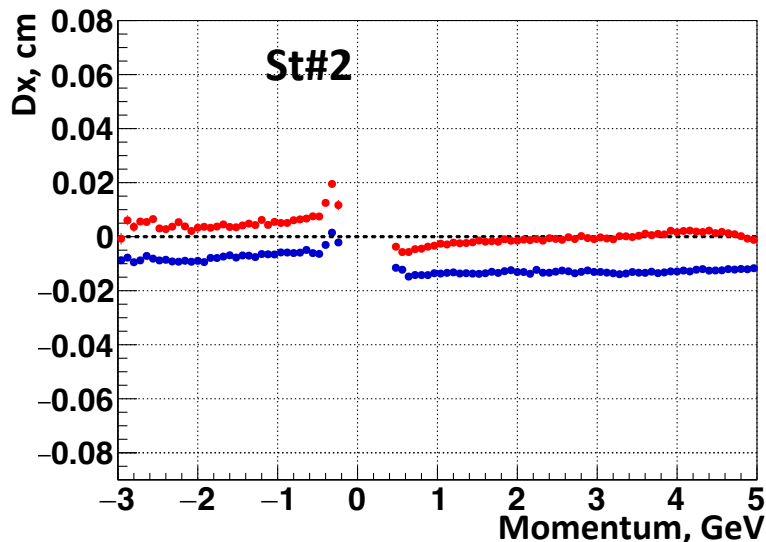
Blue: before corrections
Red: after corrections

Mean Dx vs Momentum (MC 4.0GeV C+Cu)

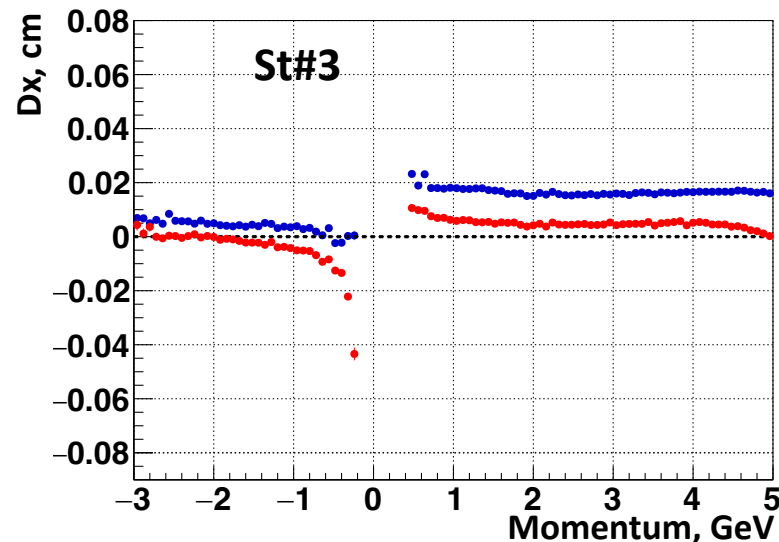
Mean Mom. vs. x ista==1 (MC)



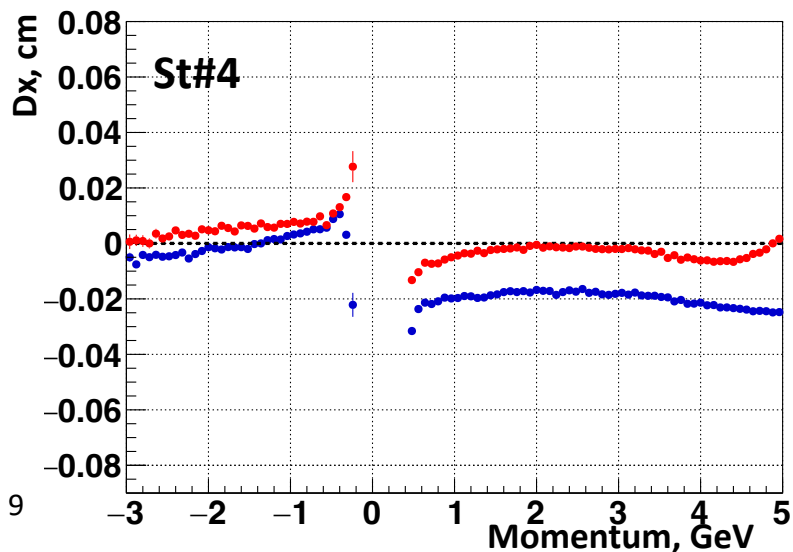
Mean Mom. vs. x ista==2 (MC)



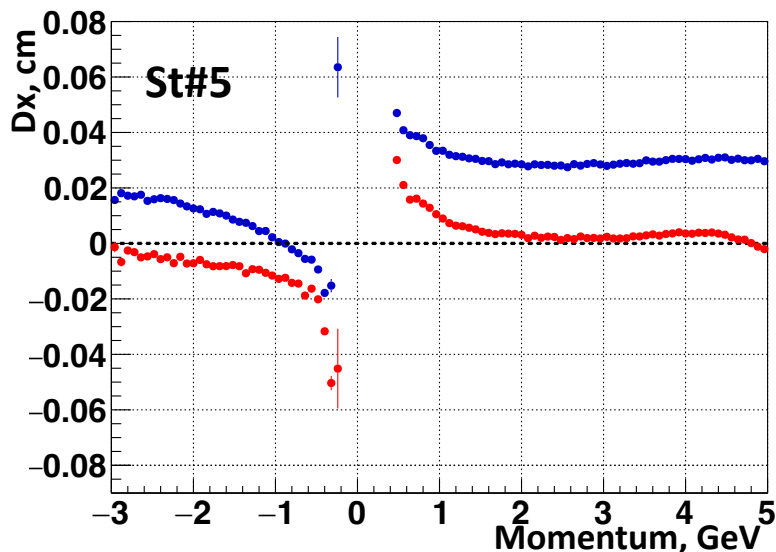
Mean Mom. vs. x ista==3 (MC)



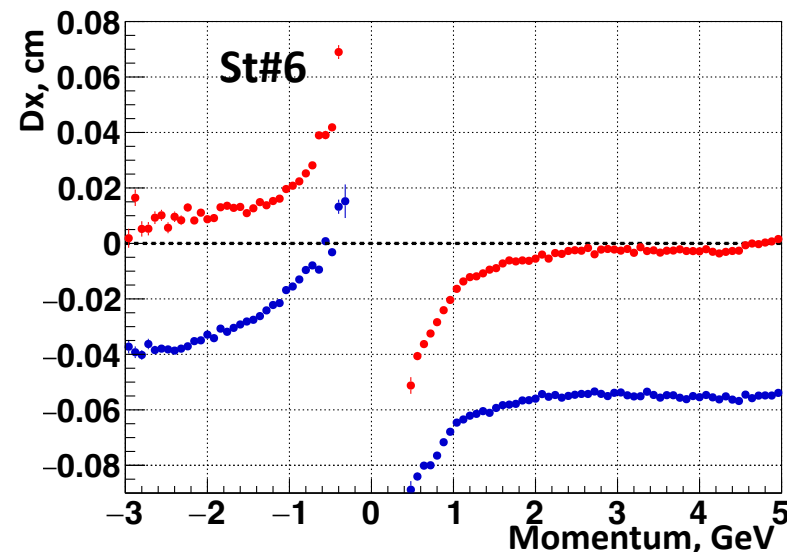
Mean Mom. vs. x ista==4 (MC)



Mean Mom. vs. x ista==5 (MC)



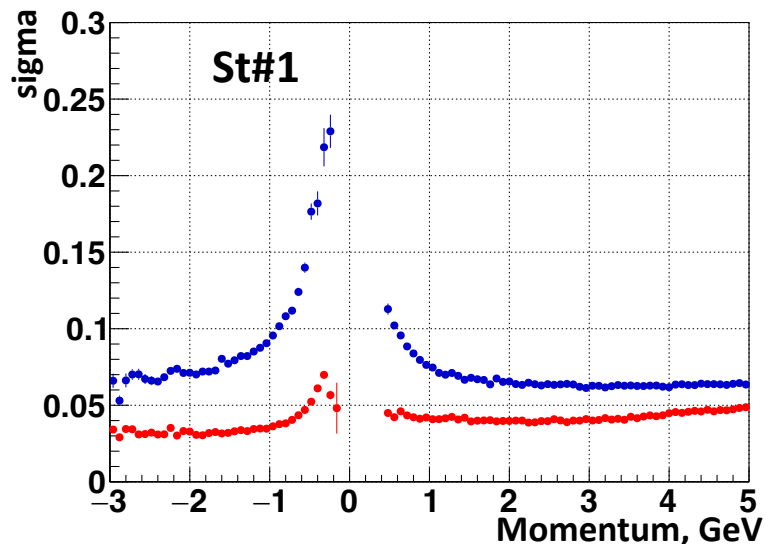
Mean Mom. vs. x ista==6 (MC)



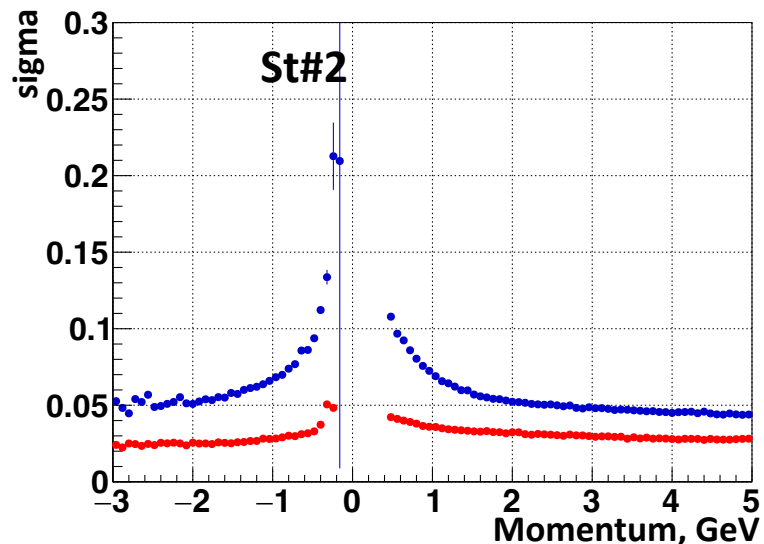
Blue: DATA
Red: MC

Sigma Dx vs Momentum (MC & Data 4.0GeV C+Cu)

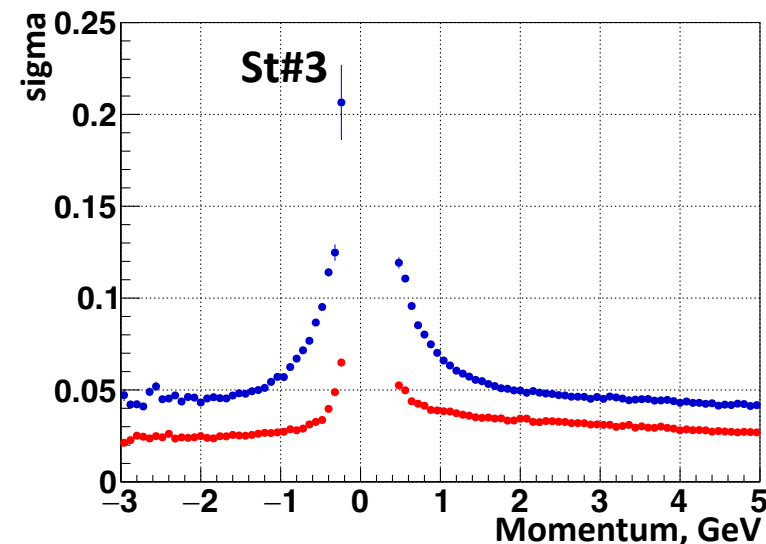
Sigma Mom& vs. x ista==1 (DATA & MC)



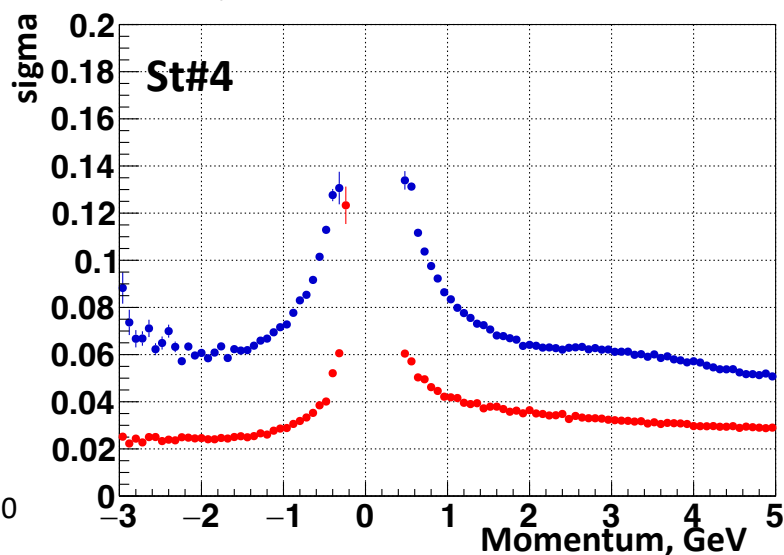
Sigma Mom& vs. x ista==2 (DATA & MC)



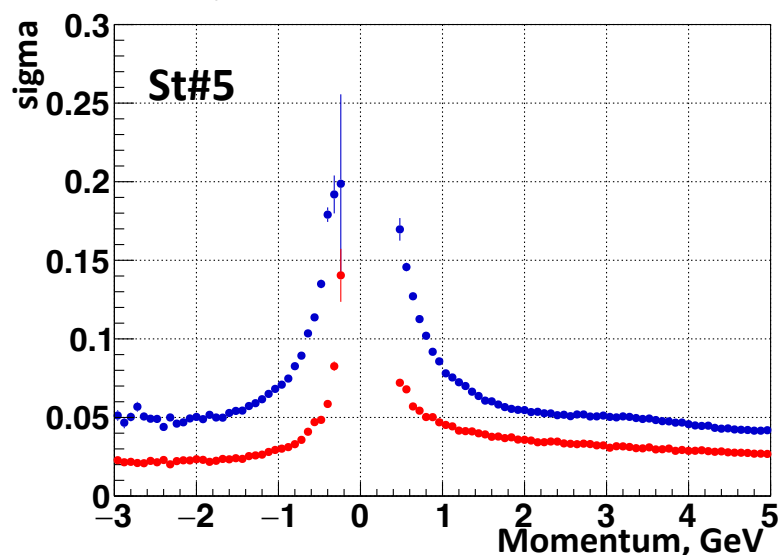
Sigma Mom& vs. x ista==3 (DATA & MC)



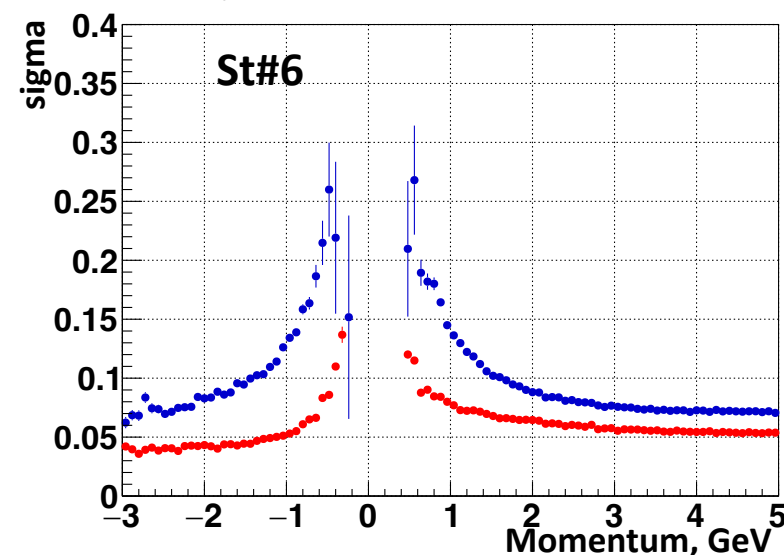
Sigma Mom& vs. x ista==4 (DATA & MC)



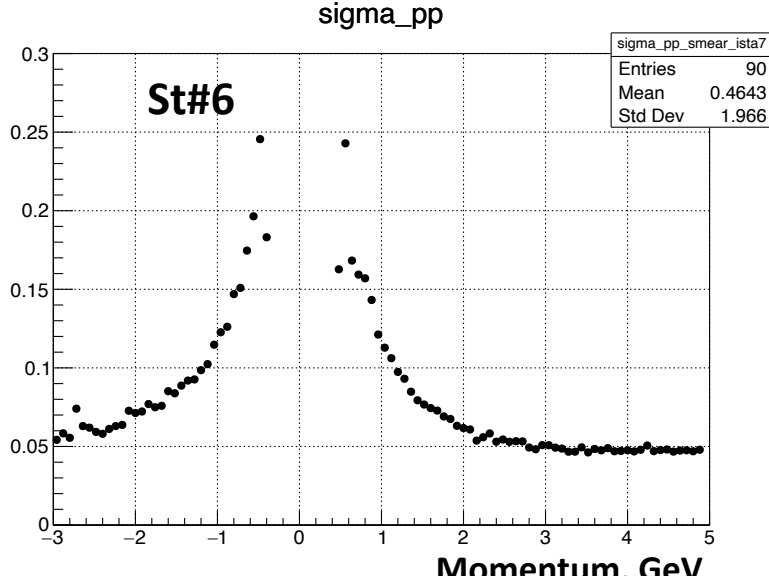
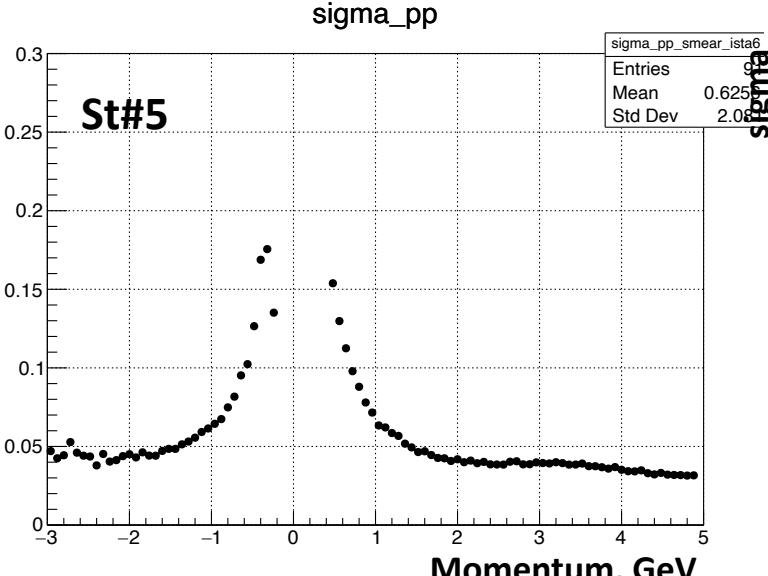
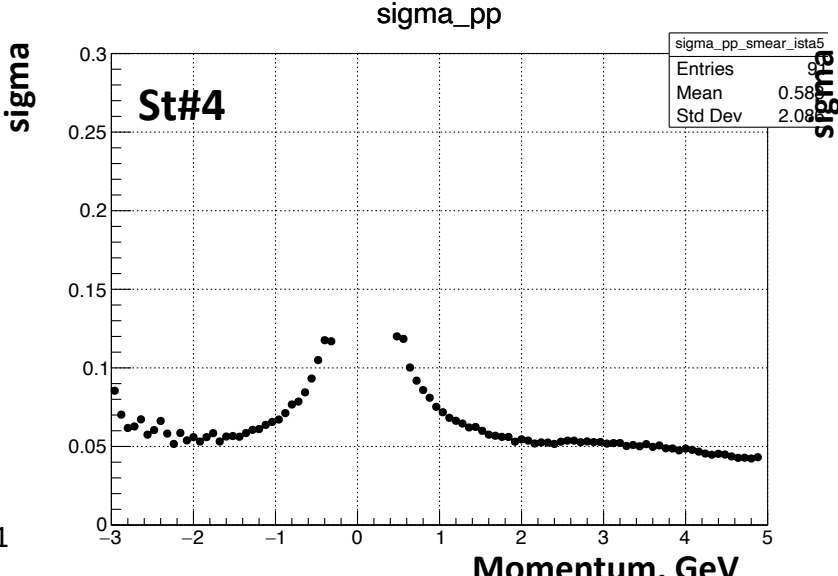
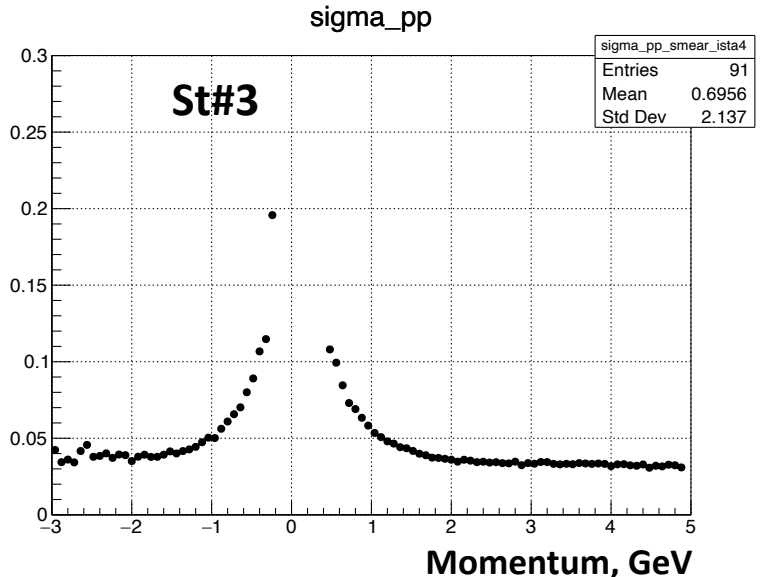
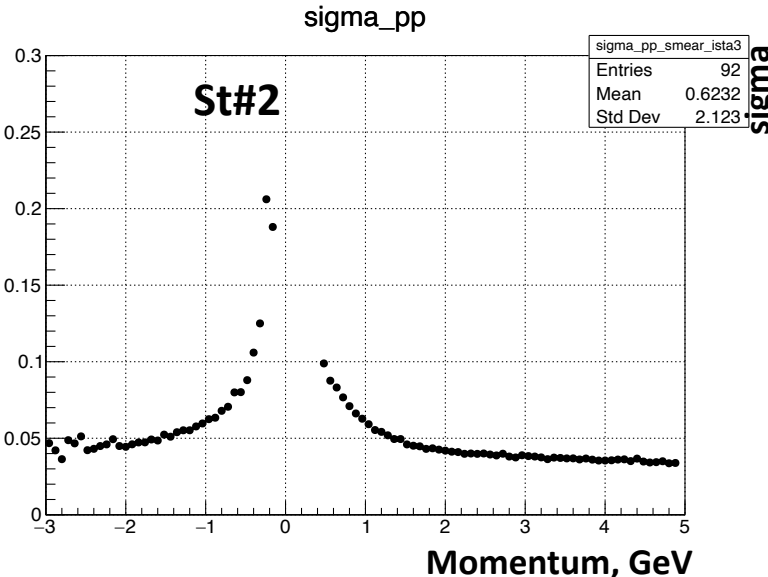
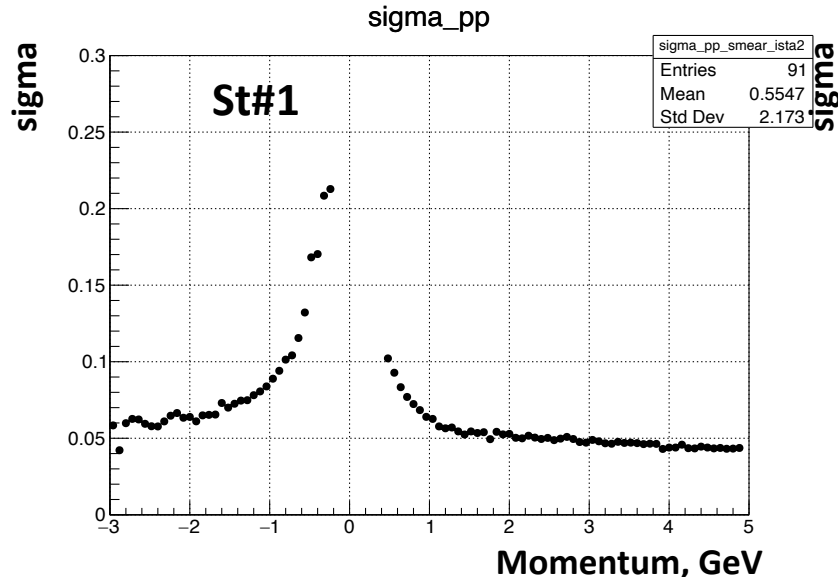
Sigma Mom& vs. x ista==5 (DATA & MC)



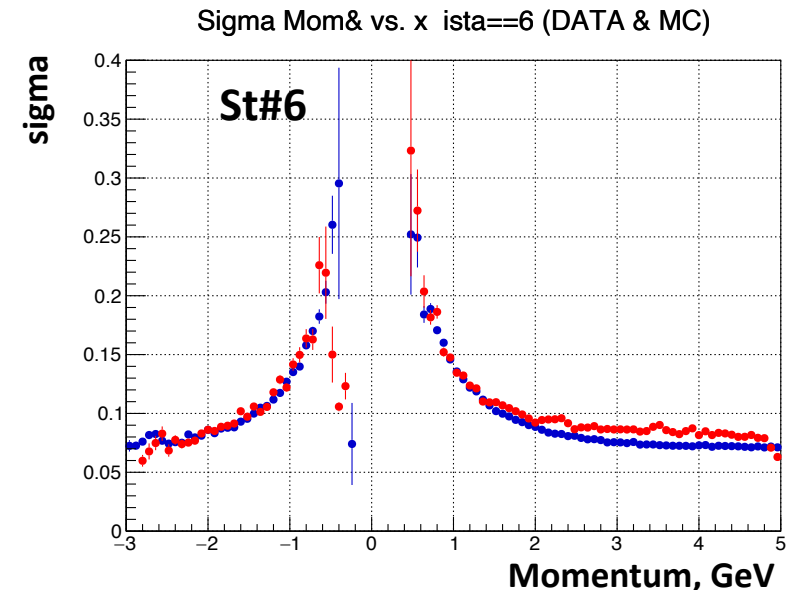
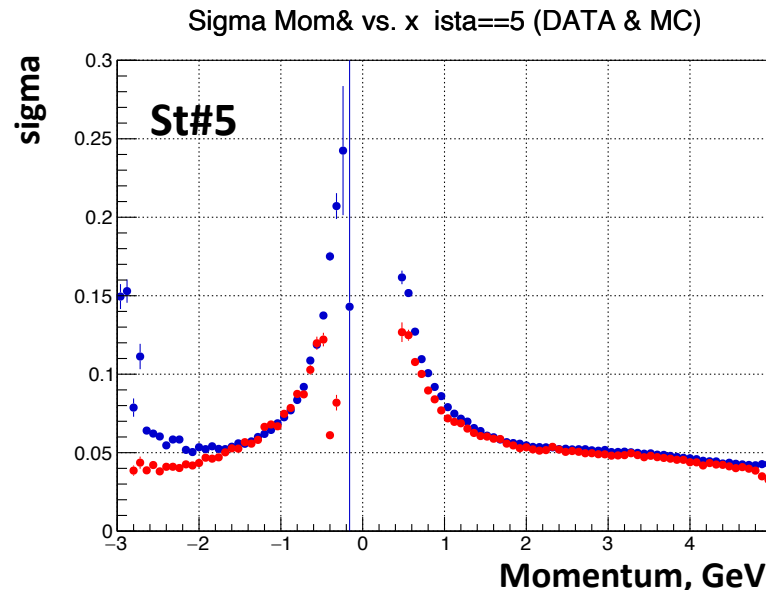
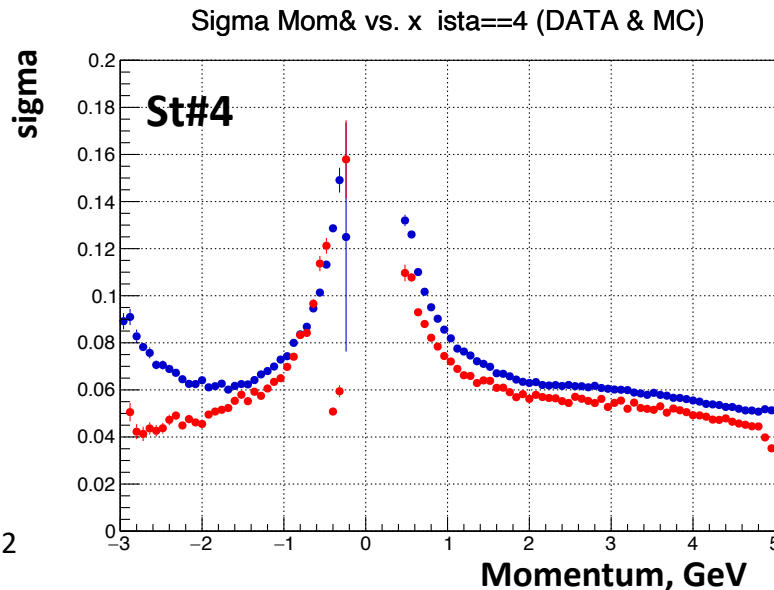
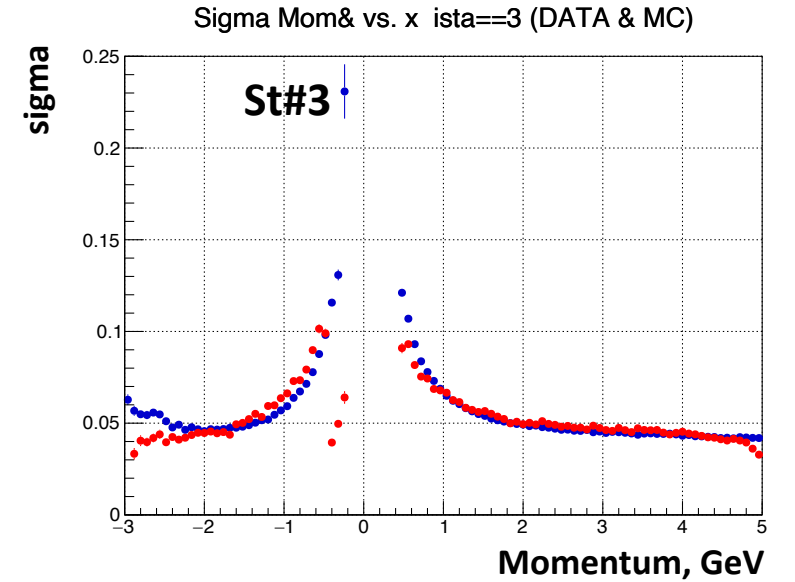
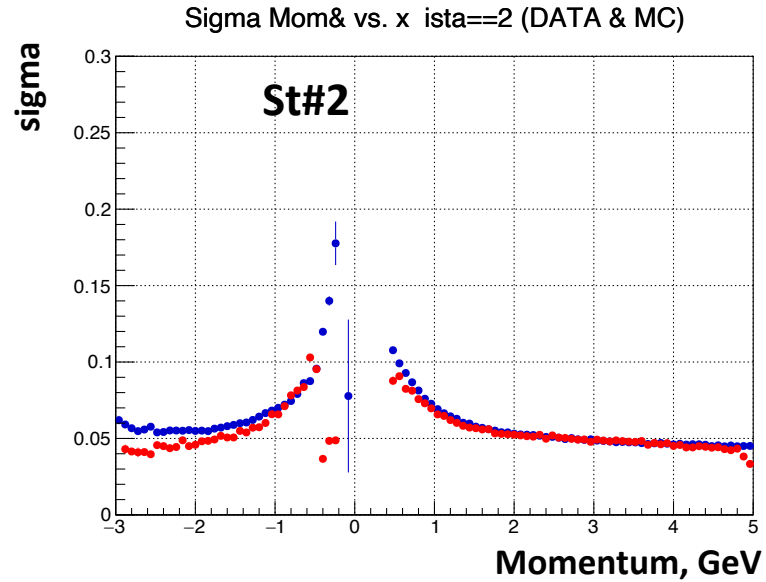
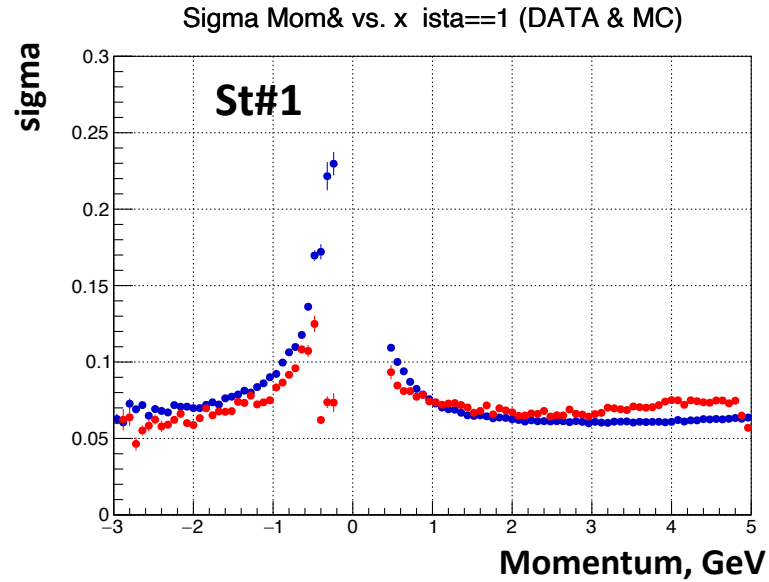
Sigma Mom& vs. x ista==6 (DATA & MC)



MC Smearing functions (Sigma Dx vs Momentum): $\sigma_{SMEAR} = \sqrt{\sigma_{DATA}^2 - \sigma_{MC}^2}$



Sigma Dx vs Momentum **after smearing** (MC & Data 4.0GeV C+Cu)

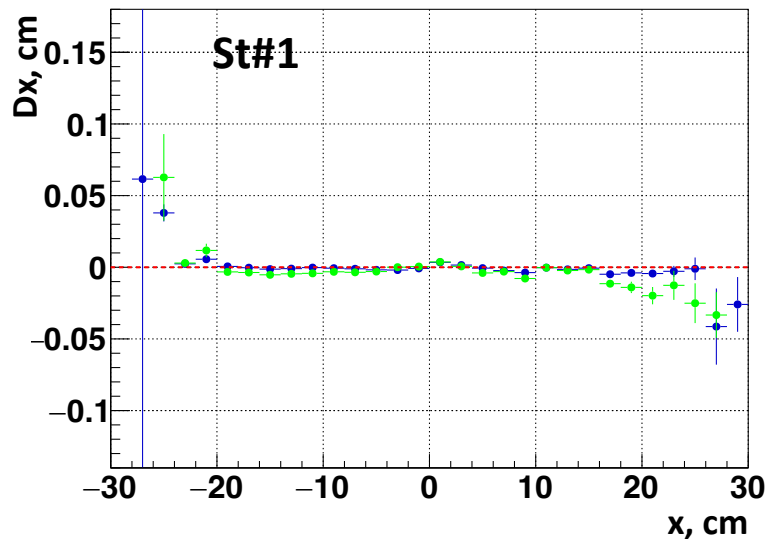


Mean Dx vs x **after**/**before** smearing (MC 4.0GeV C+Cu)

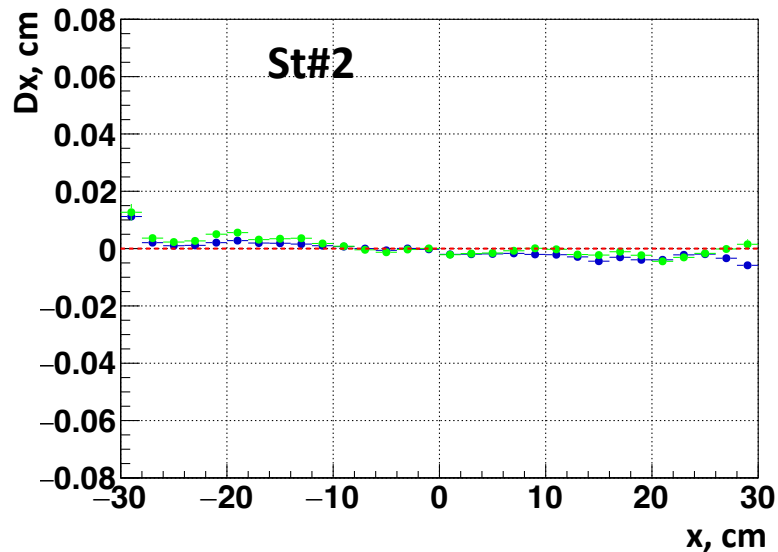
Blue: MC before smear

Red: MC after smear

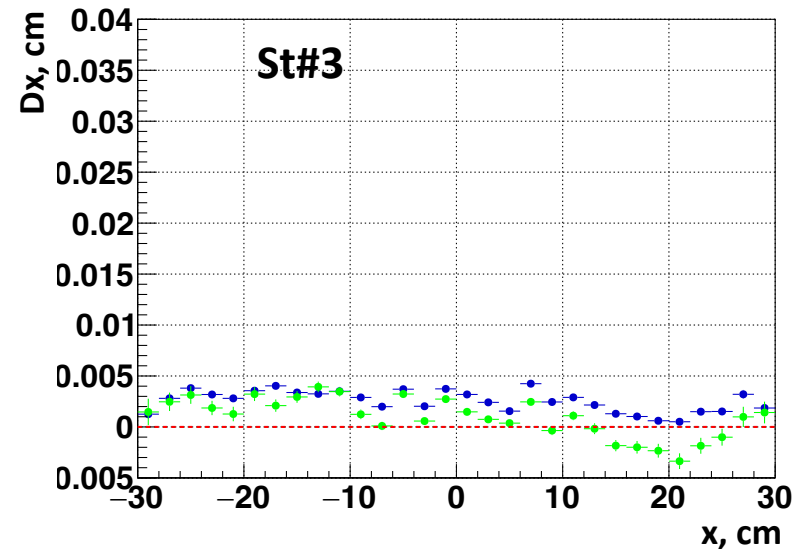
Mean dX vs. x ista==1 (MC & MC smear)



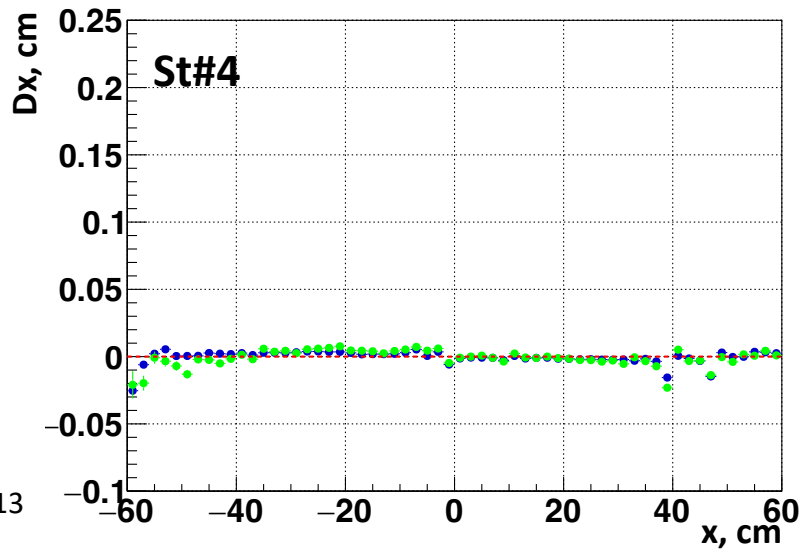
Mean dX vs. x ista==2 (MC & MC smear)



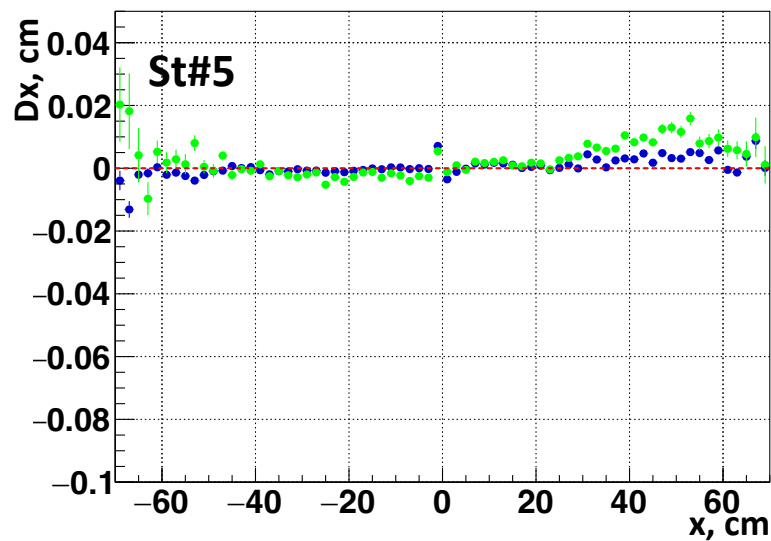
Mean dX vs. x ista==3 (MC & MC smear)



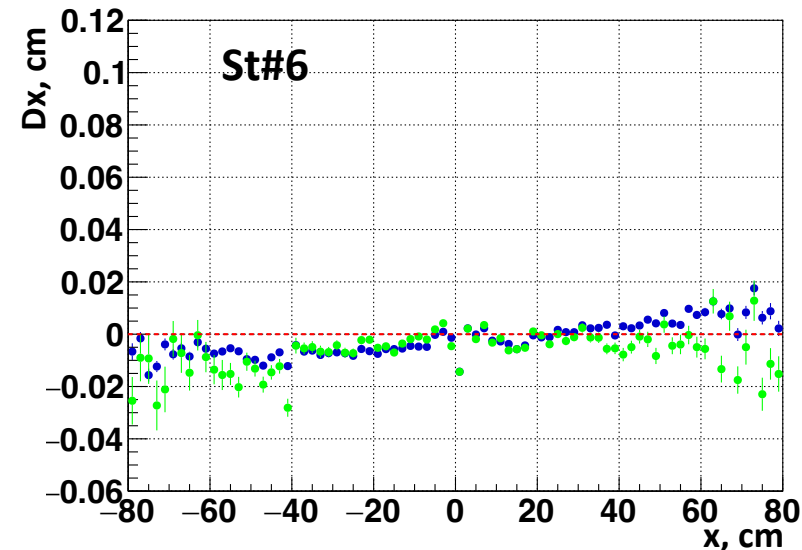
Mean dX vs. x ista==4 (MC & MC smear)



Mean dX vs. x ista==5 (MC & MC smear)



Mean dX vs. x ista==6 (MC & MC smear)

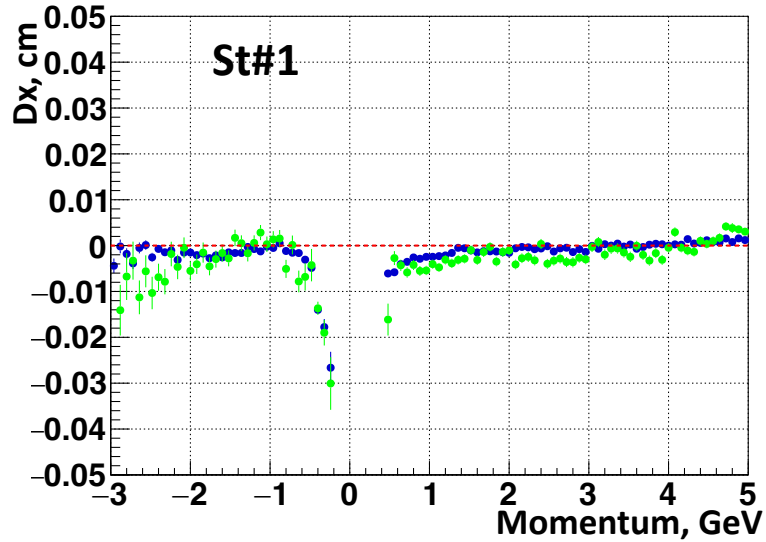


Mean Dx vs Mom after/before smearing (MC 4.0GeV C+Cu)

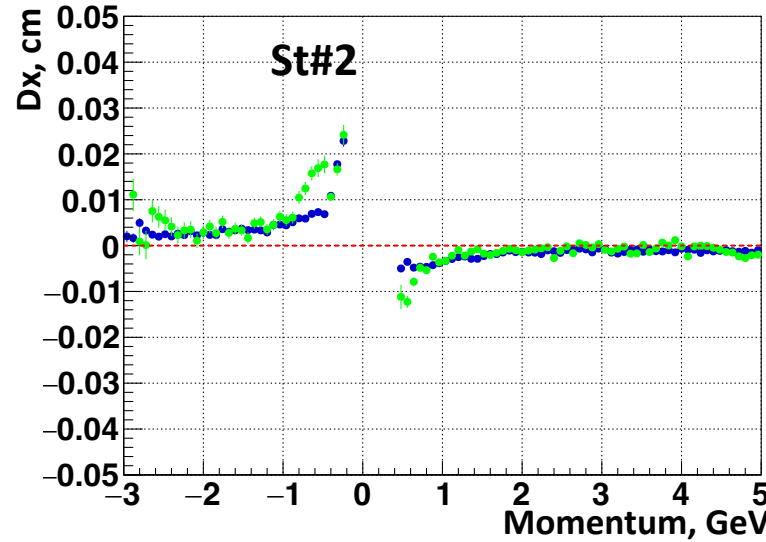
Blue: MC before smear

Red: MC after smear

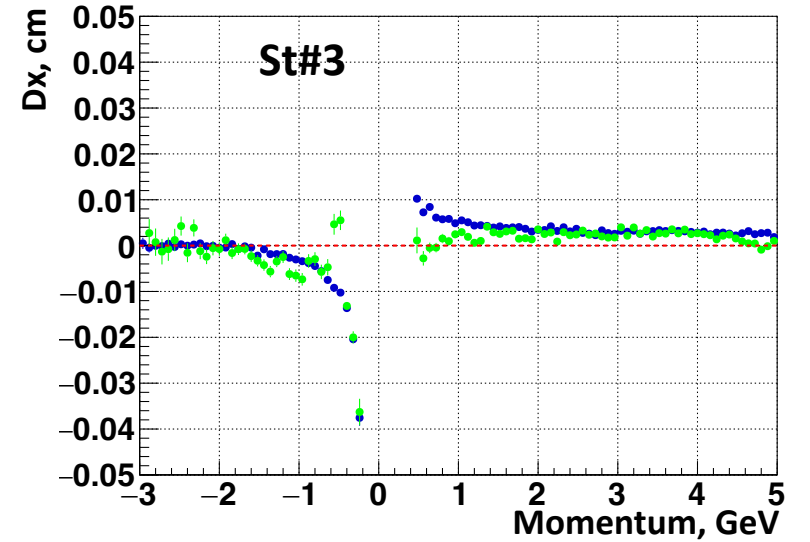
Mean Mom vs. x ista==1 (MC & MC smear)



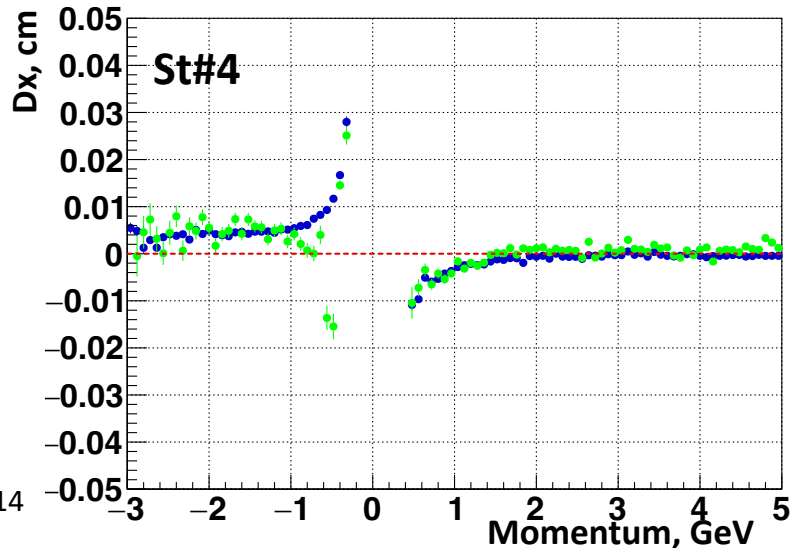
Mean Mom vs. x ista==2 (MC & MC smear)



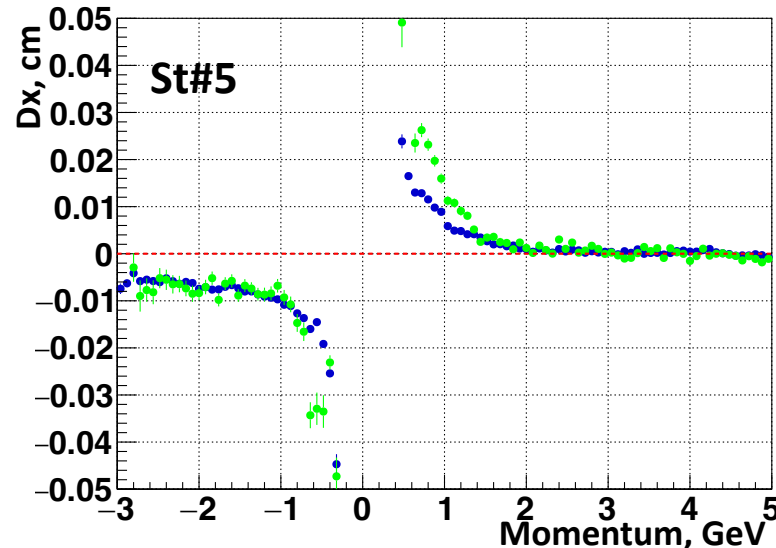
Mean Mom vs. x ista==3 (MC & MC smear)



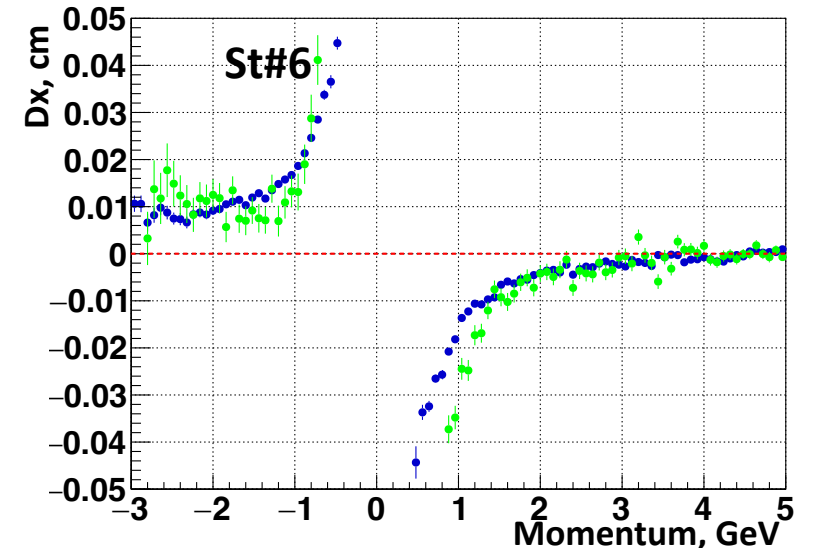
Mean Mom vs. x ista==4 (MC & MC smear)



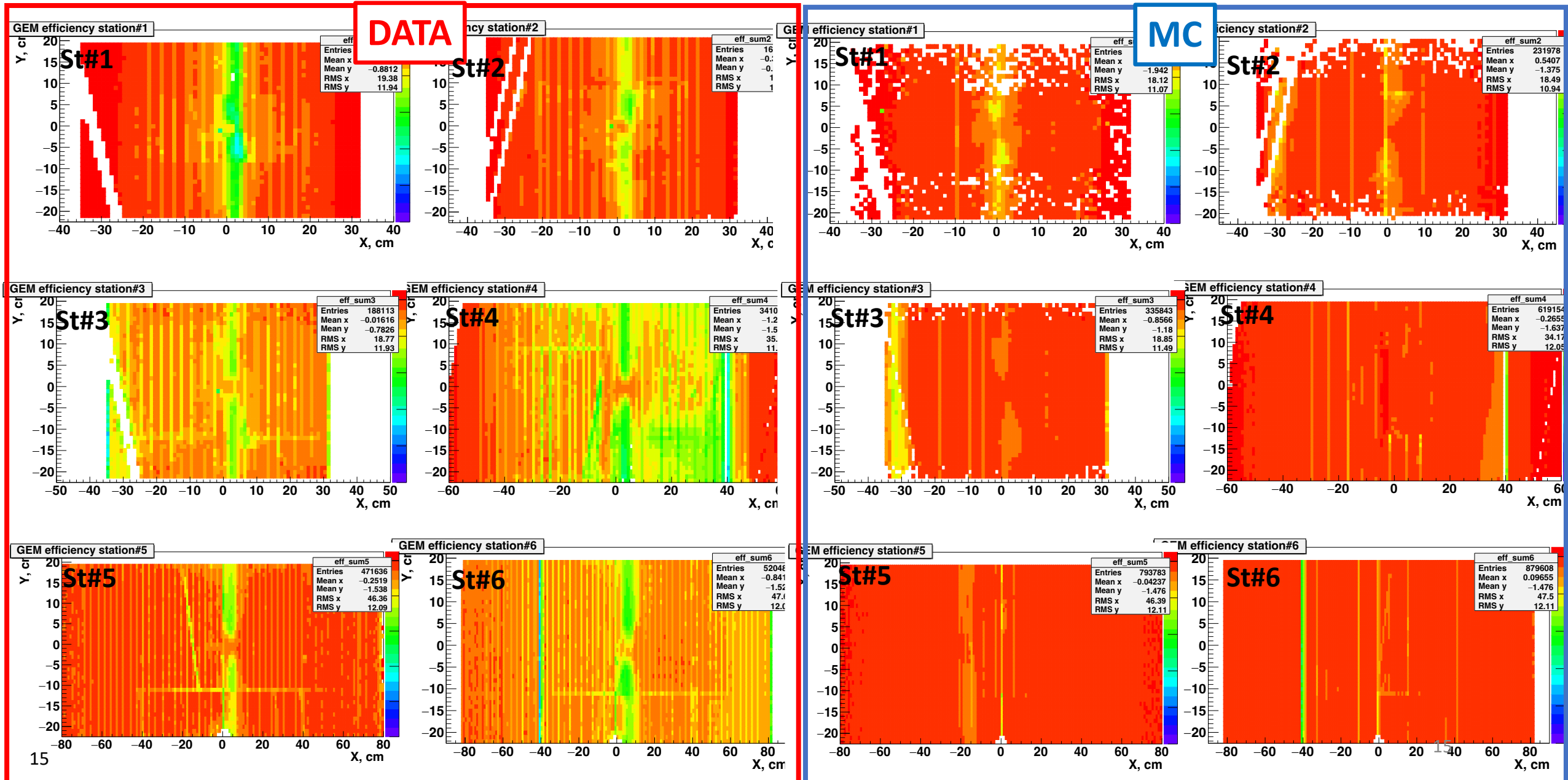
Mean Mom vs. x ista==5 (MC & MC smear)



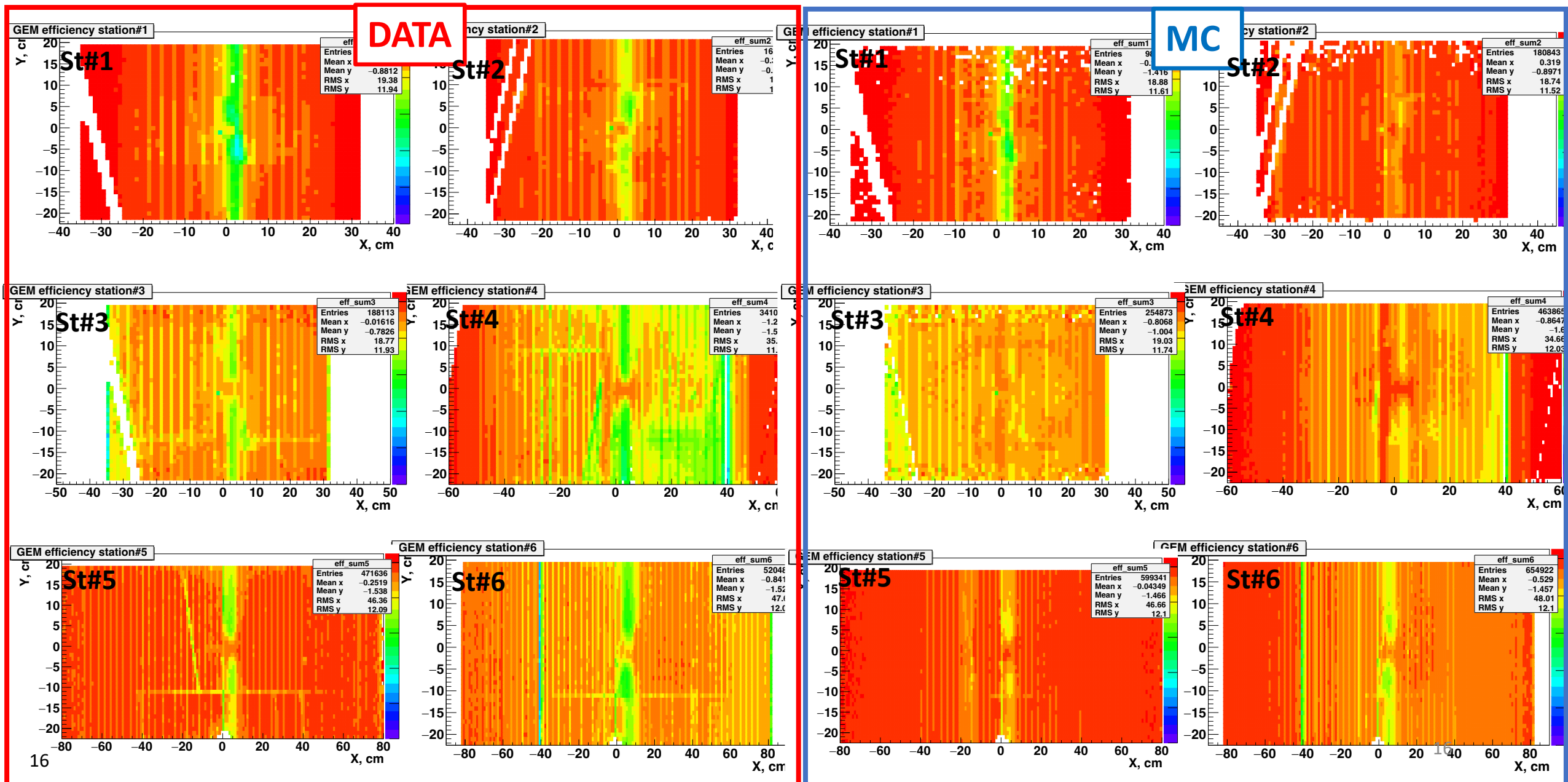
Mean Mom vs. x ista==6 (MC & MC smear)



GEM efficiencies comparison **Data**/**MC** (4.0GeV all)



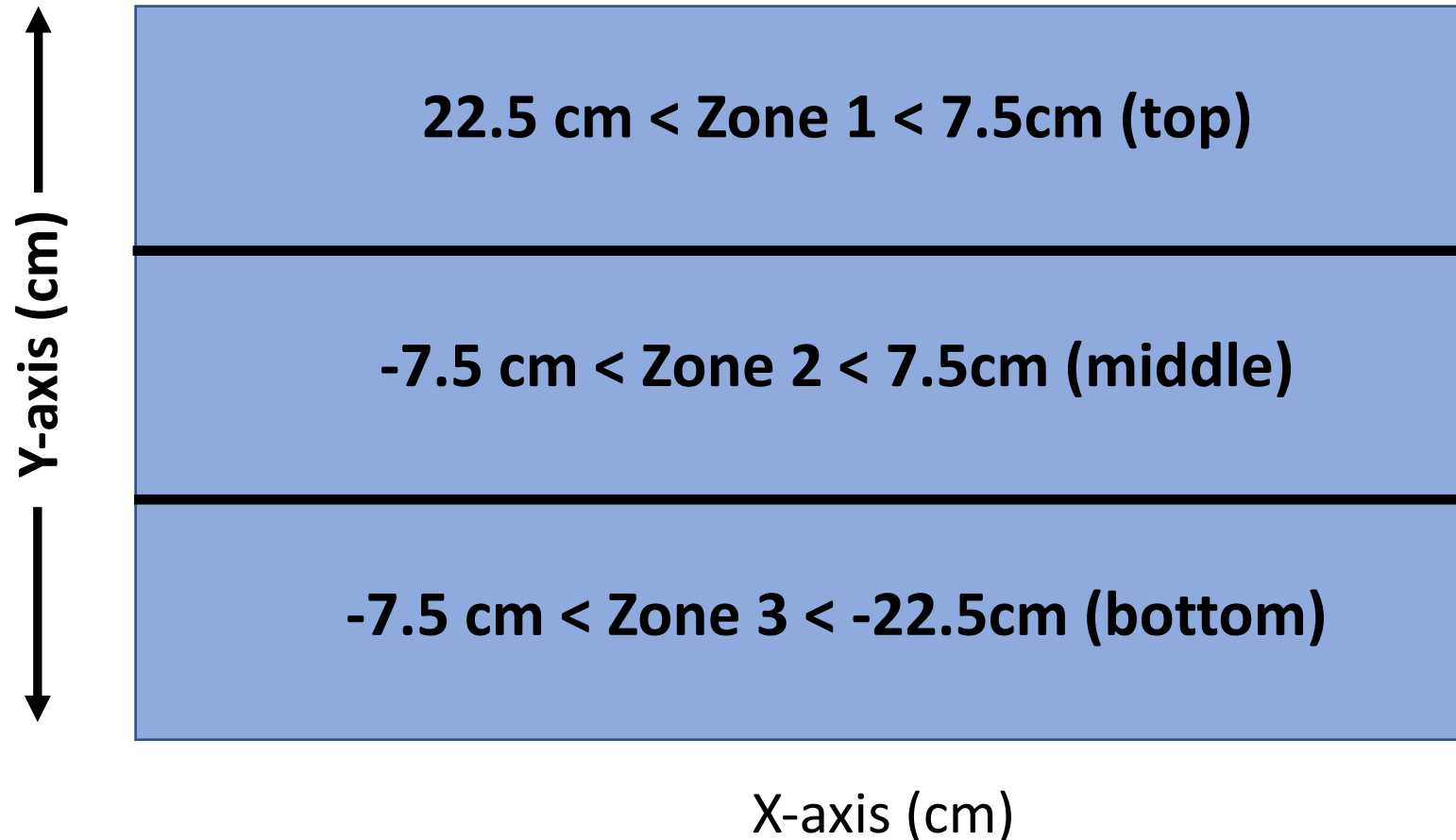
GEM efficiencies: Apply efficiencies to MC (4.0GeV all)



Apply GEM efficiencies to MC (check)



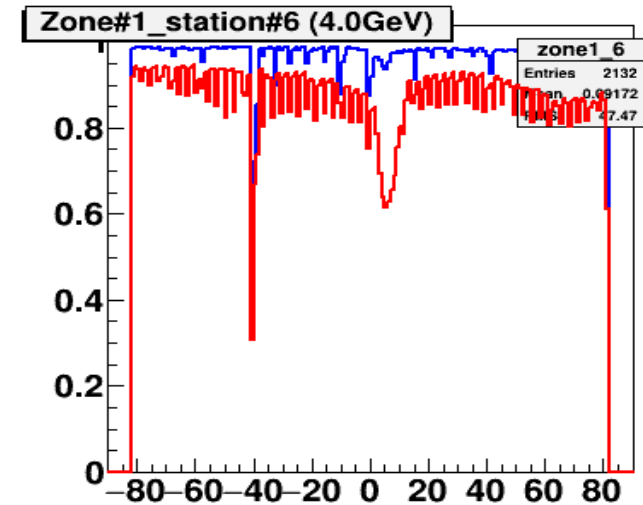
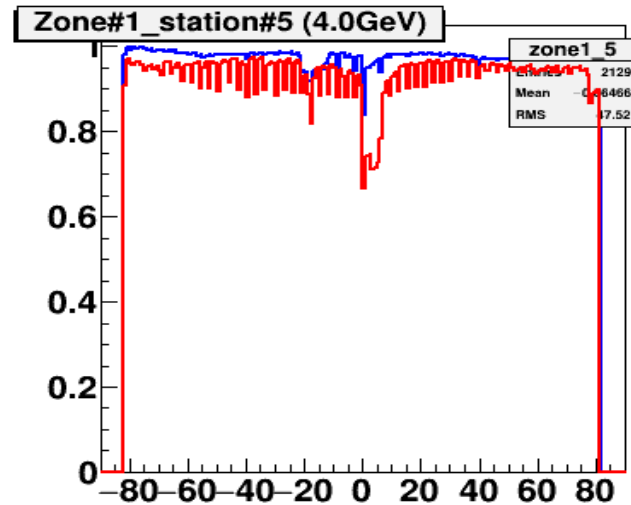
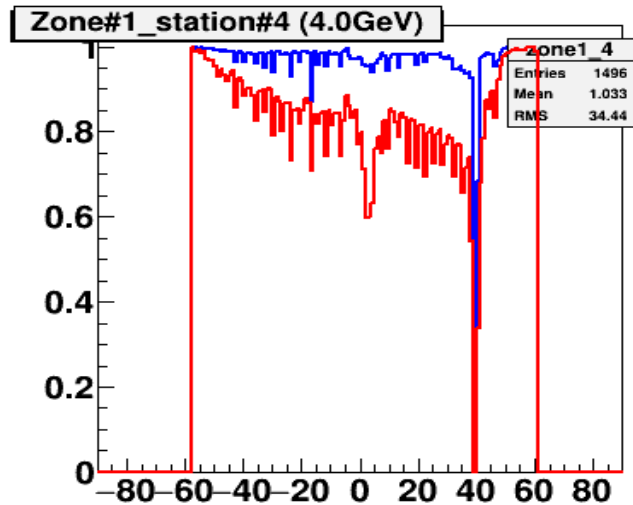
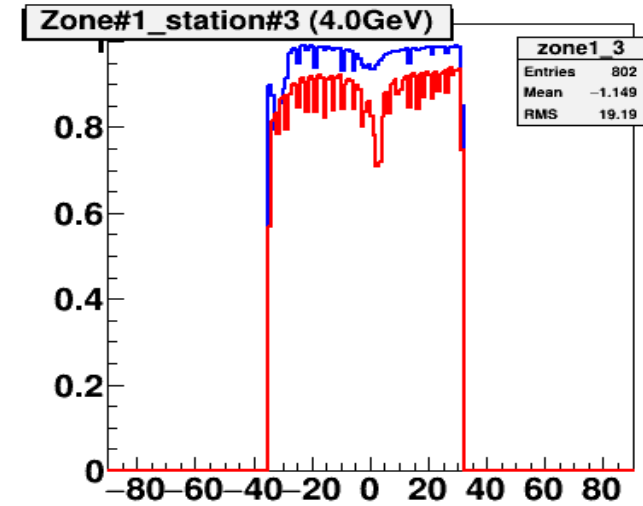
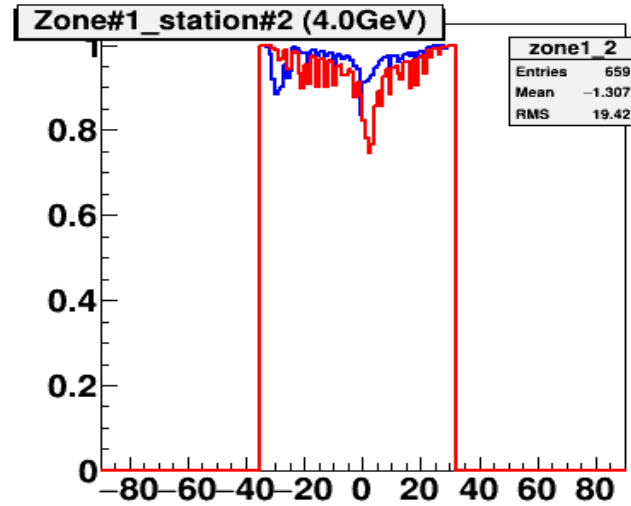
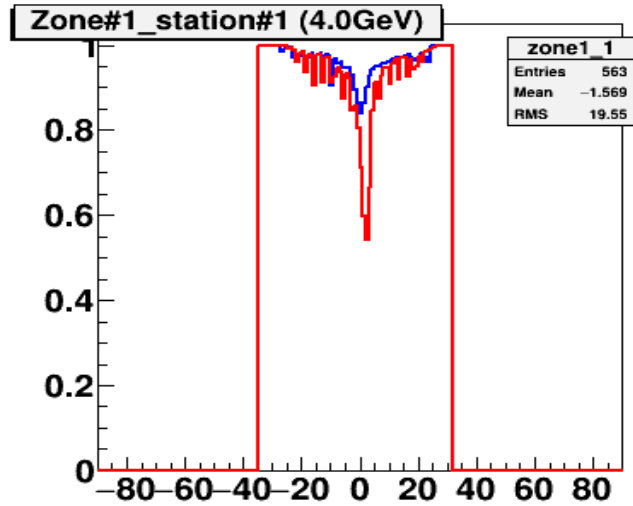
- Each GEM plane was divided into to 3 regions along Y-axis
 - Compare integral for efficiencies at each regions



GEM efficiencies (4.0GeV all, top)



Red: Data; Blue: MC; (22.5 cm < Zone 1 < 7.5cm (top))

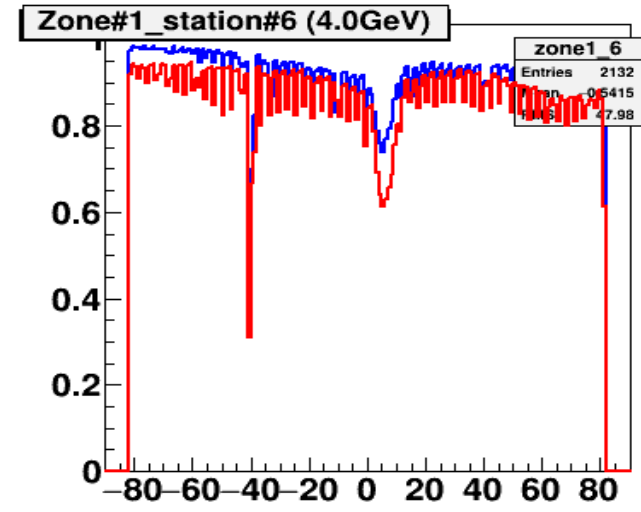
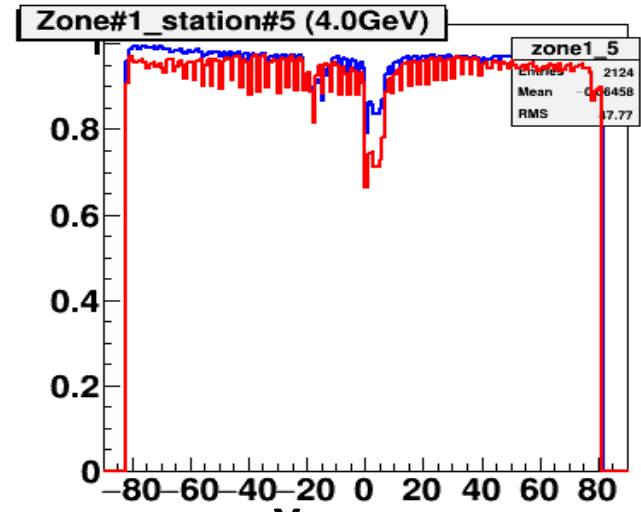
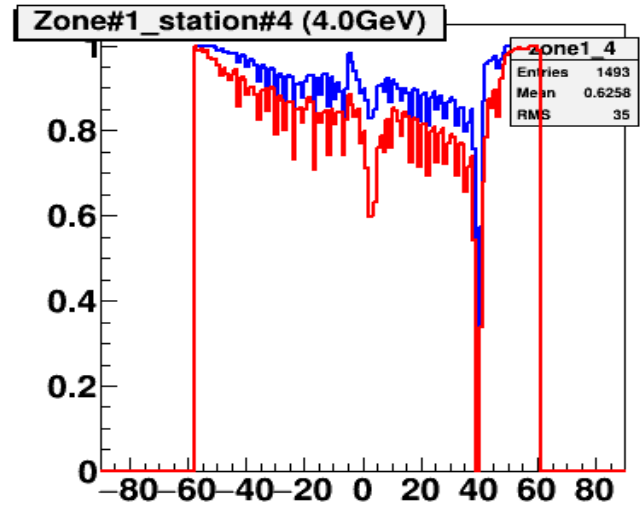
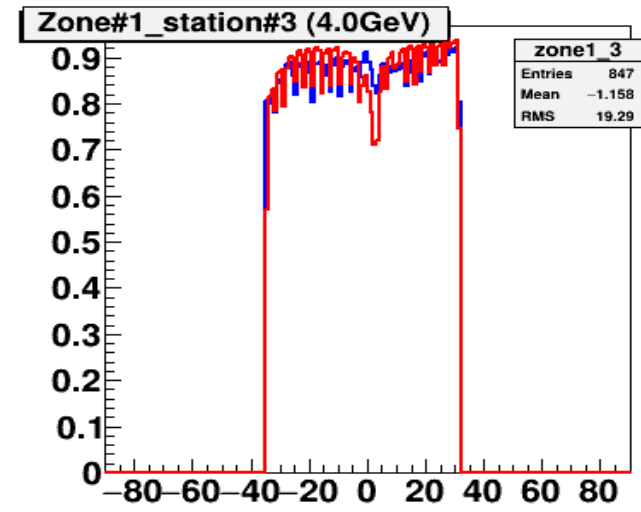
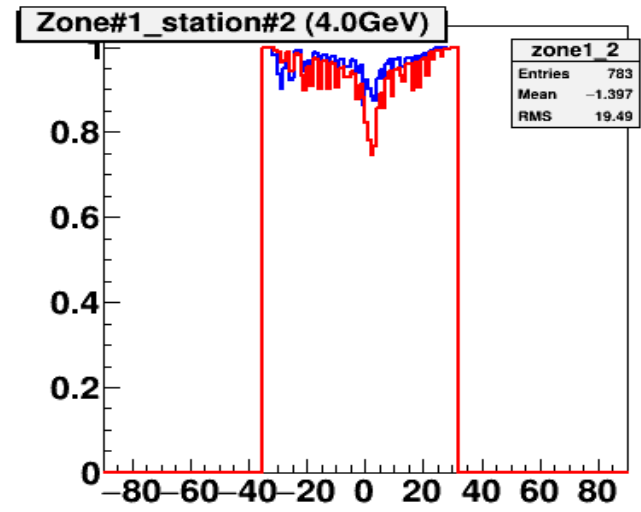
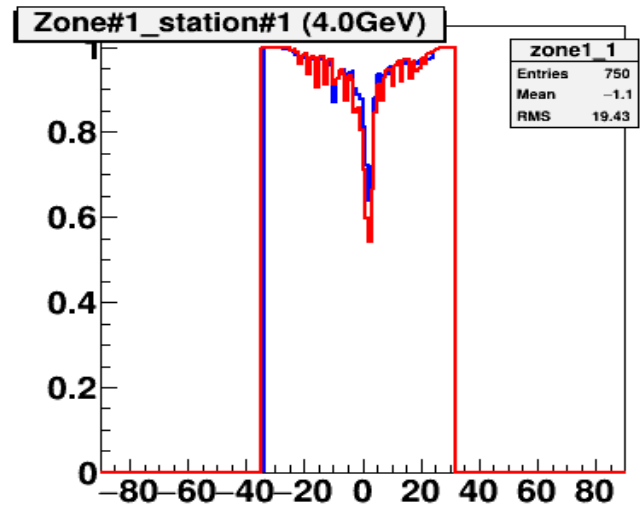


X, cm

GEM efficiencies: Apply efficiencies to MC (4.0GeV all, top)



Red: Data; Blue: MC; (22.5 cm < Zone 1 < 7.5cm (top))

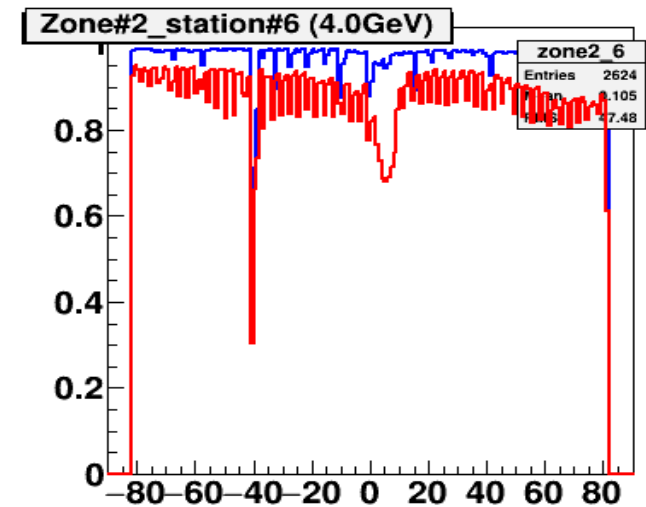
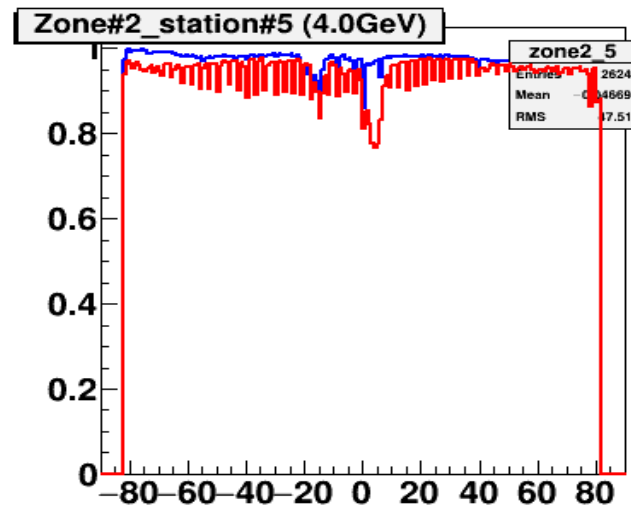
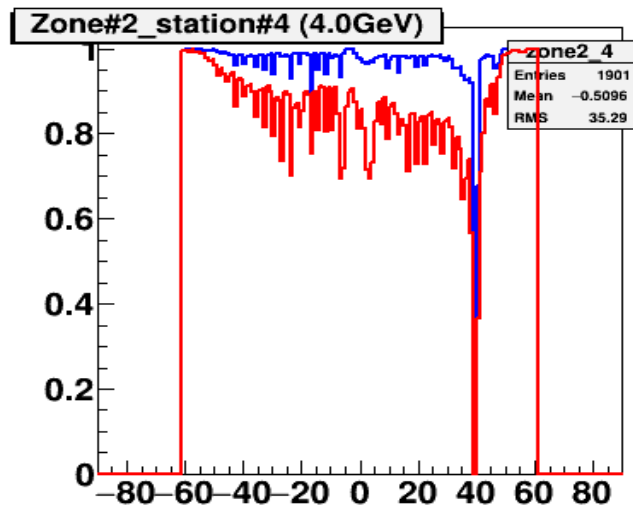
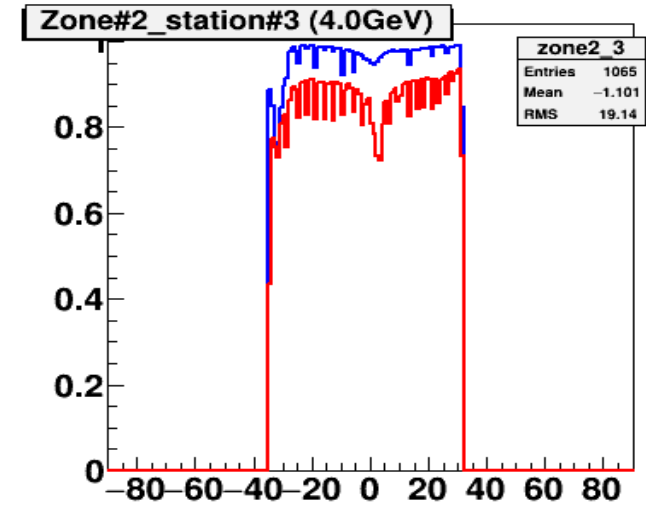
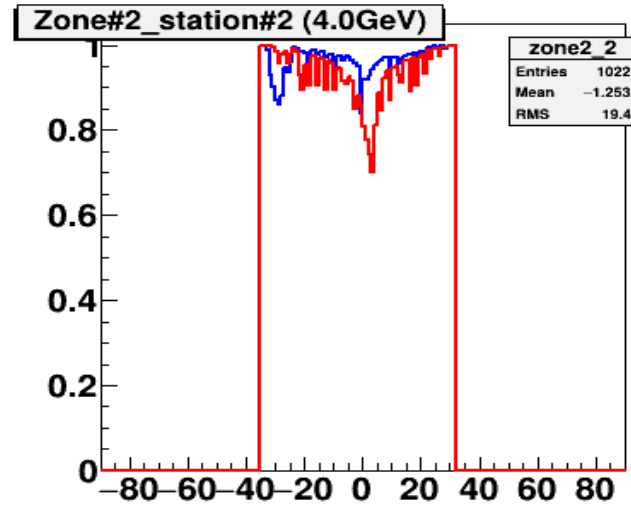
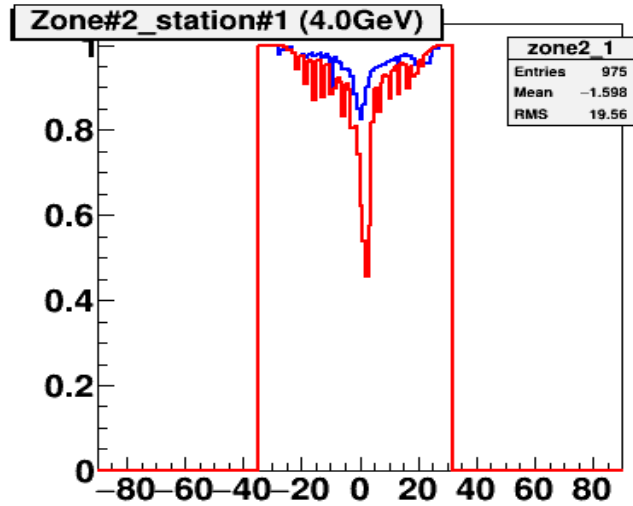


X, cm

GEM efficiencies (4.0GeV all, middle)



Red: Data; Blue: MC; (7.5 cm < Zone 2 < -7.5cm (middle))

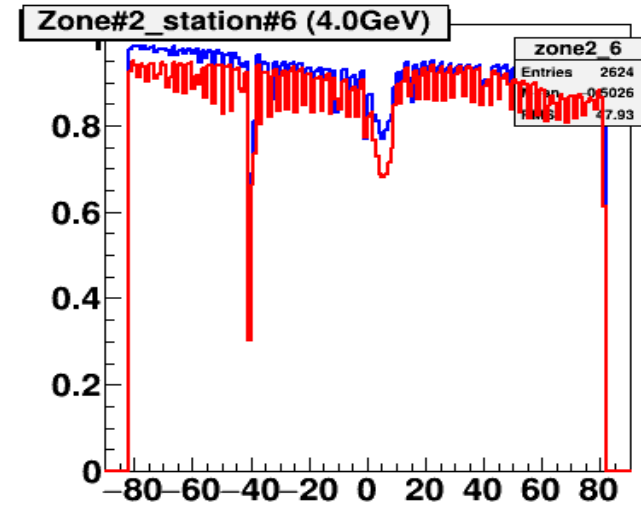
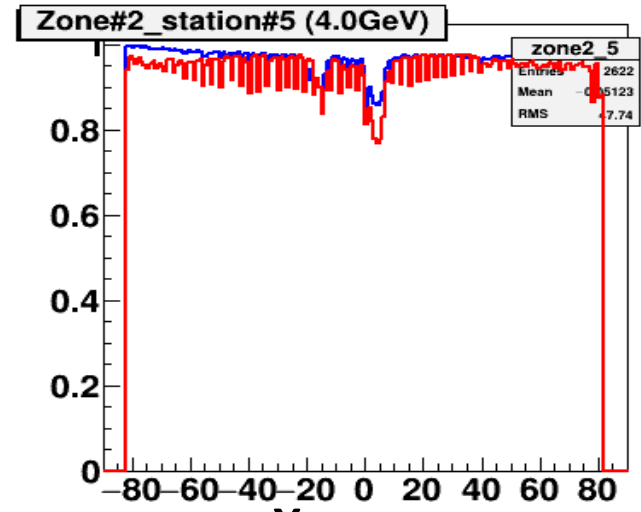
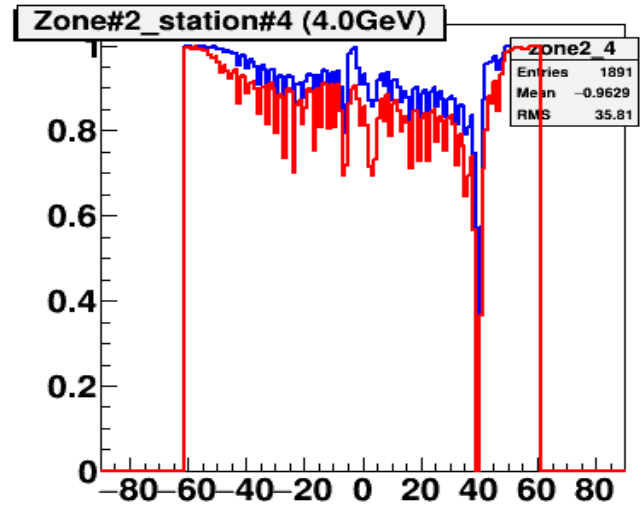
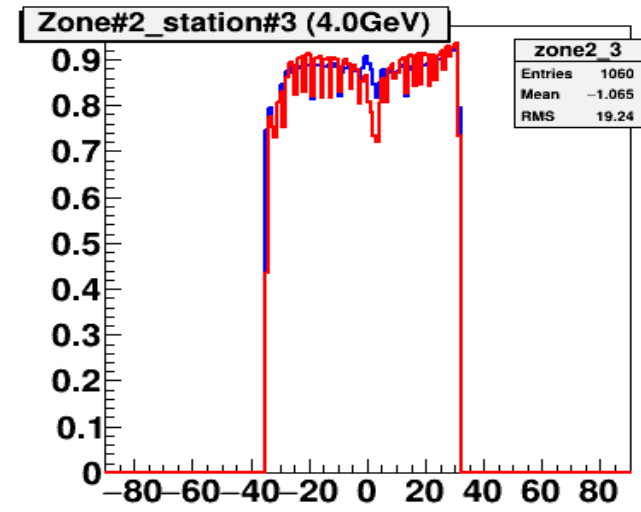
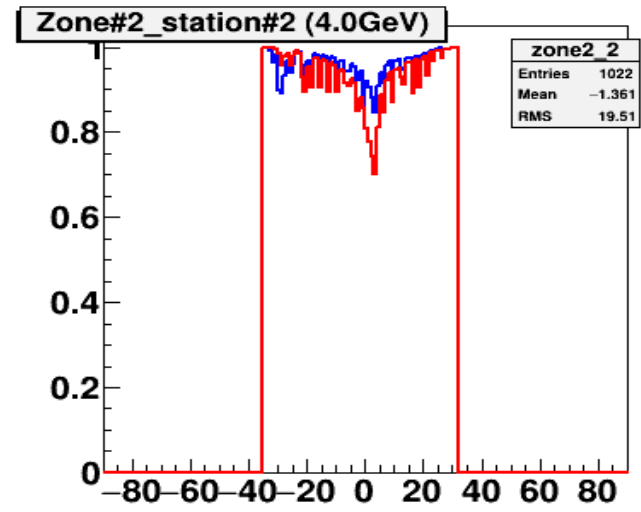
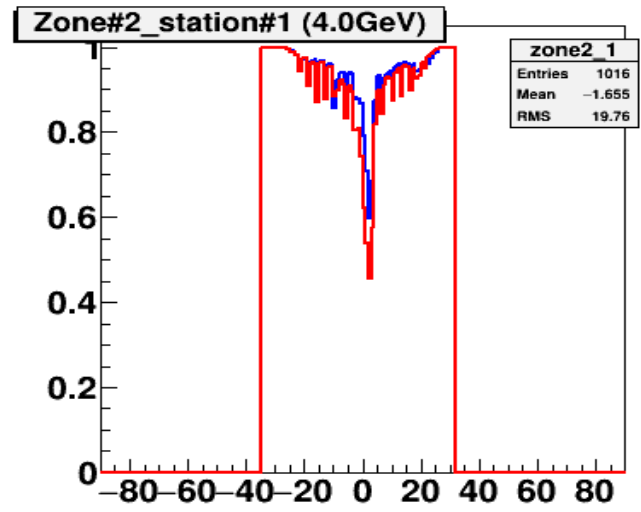


X, cm

GEM efficiencies: **Apply efficiencies to MC** (4.0GeV all, middle)



Red: Data; Blue: MC; (7.5 cm < Zone 2 < -7.5cm (middle))

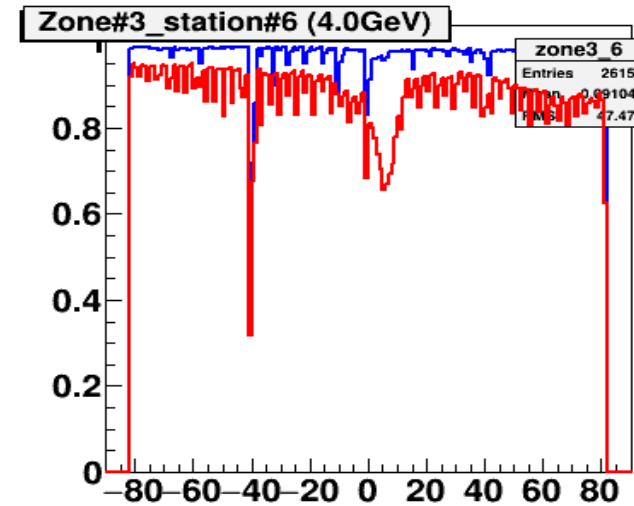
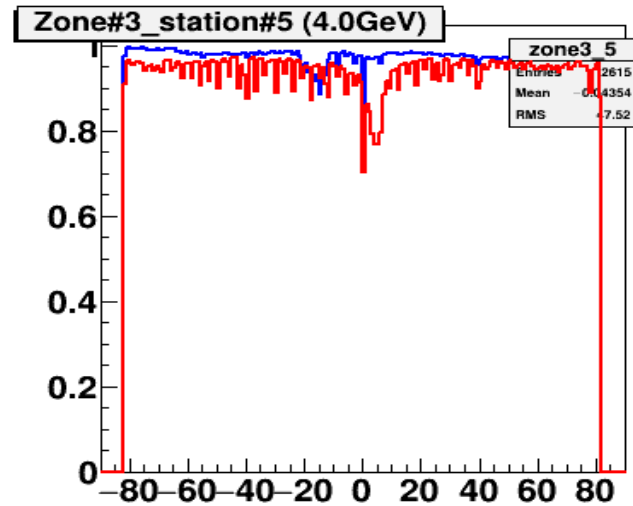
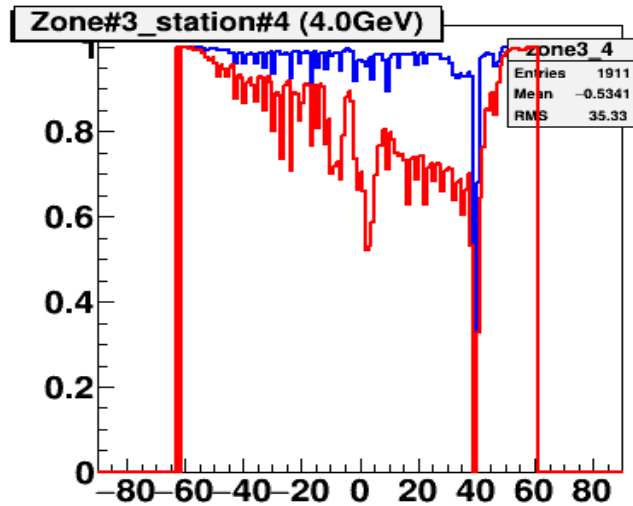
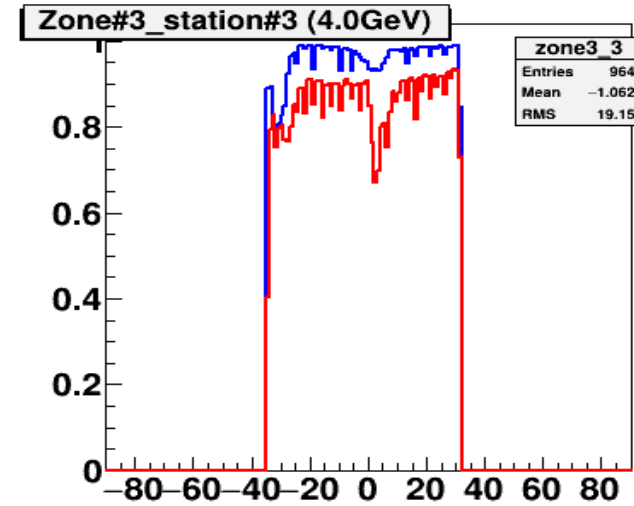
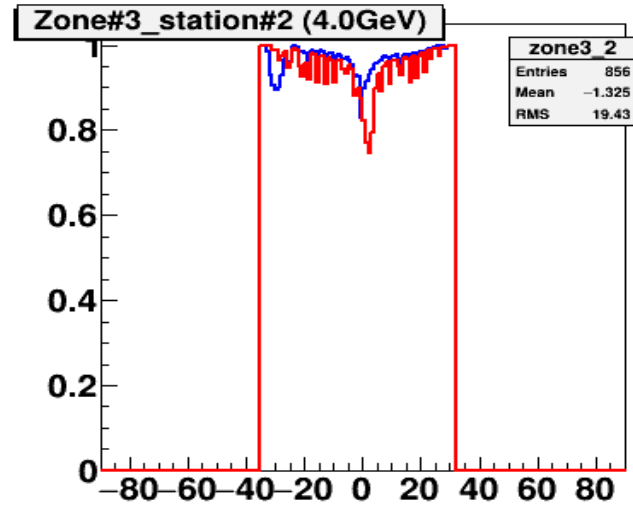
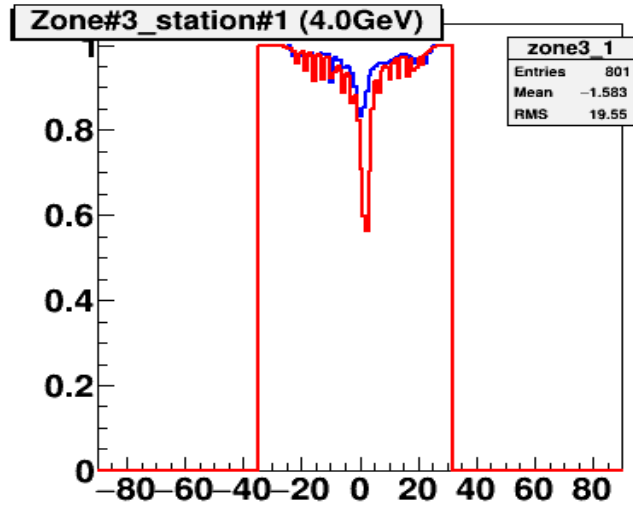


X, cm

GEM efficiencies (4.0GeV all, bottom)



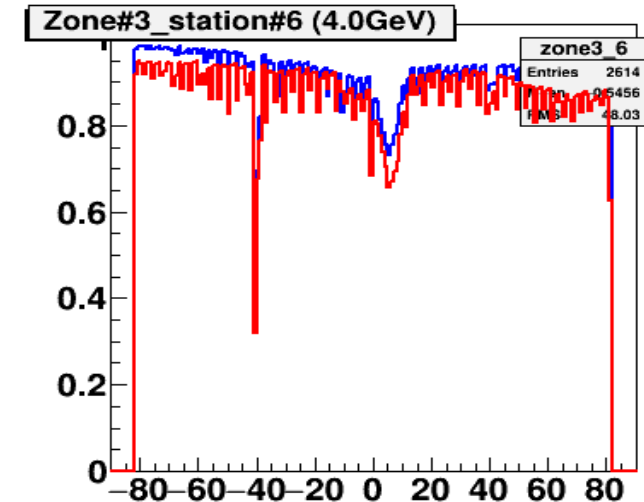
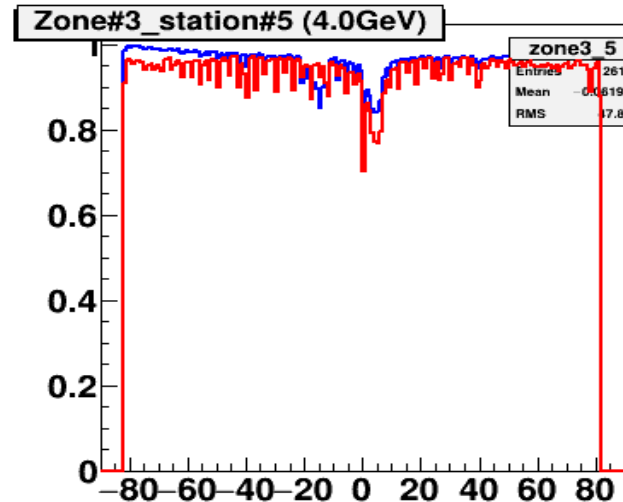
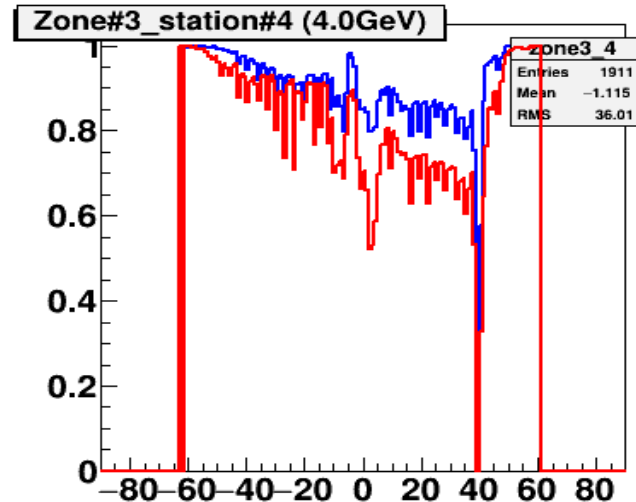
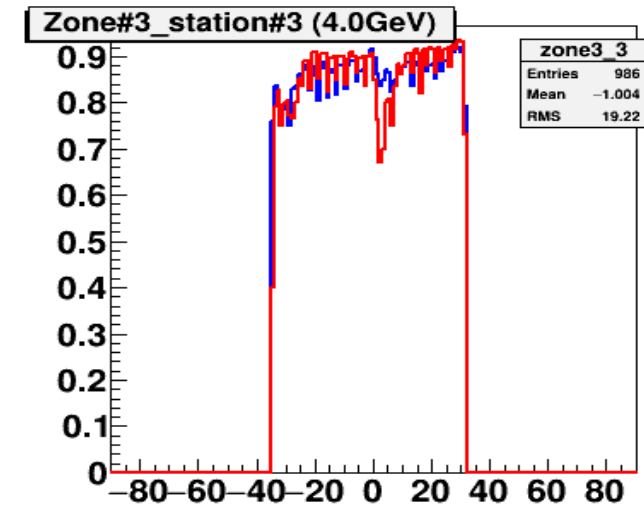
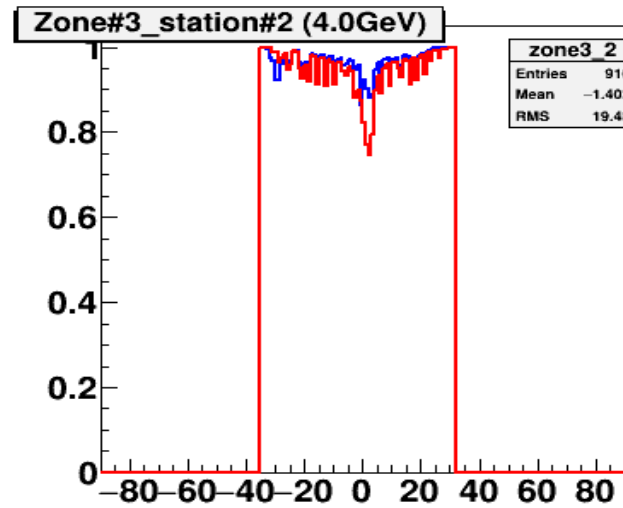
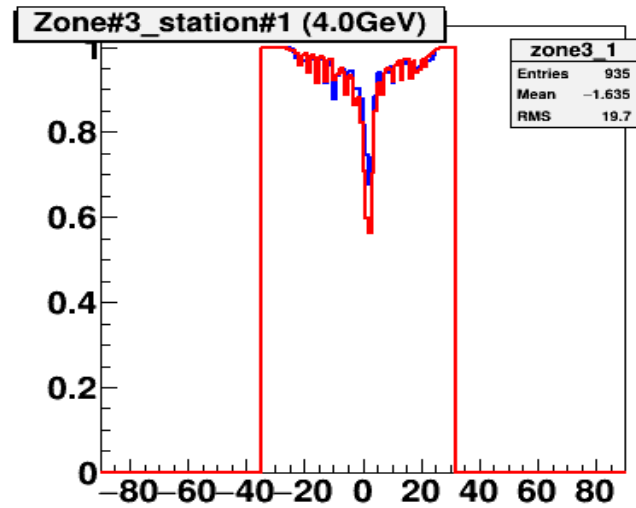
Red: Data; Blue: MC; (-7.5 cm < Zone 1 < -22.5cm (bottom))



X, cm

GEM efficiencies: **Apply efficiencies to MC** (4.0GeV all, bottom)

Red: Data; Blue: MC; (-7.5 cm < Zone 1 < -22.5cm (bottom))



X, cm

Next steps...



- Applying GEM efficiencies to MC simulation more precisely for better matching with Data according energies/targets/periods
- Comparing distributions MC/Data for pt/momentum/mass/etc...
- Measuring cross-sections of the Λ^0 's hyperon

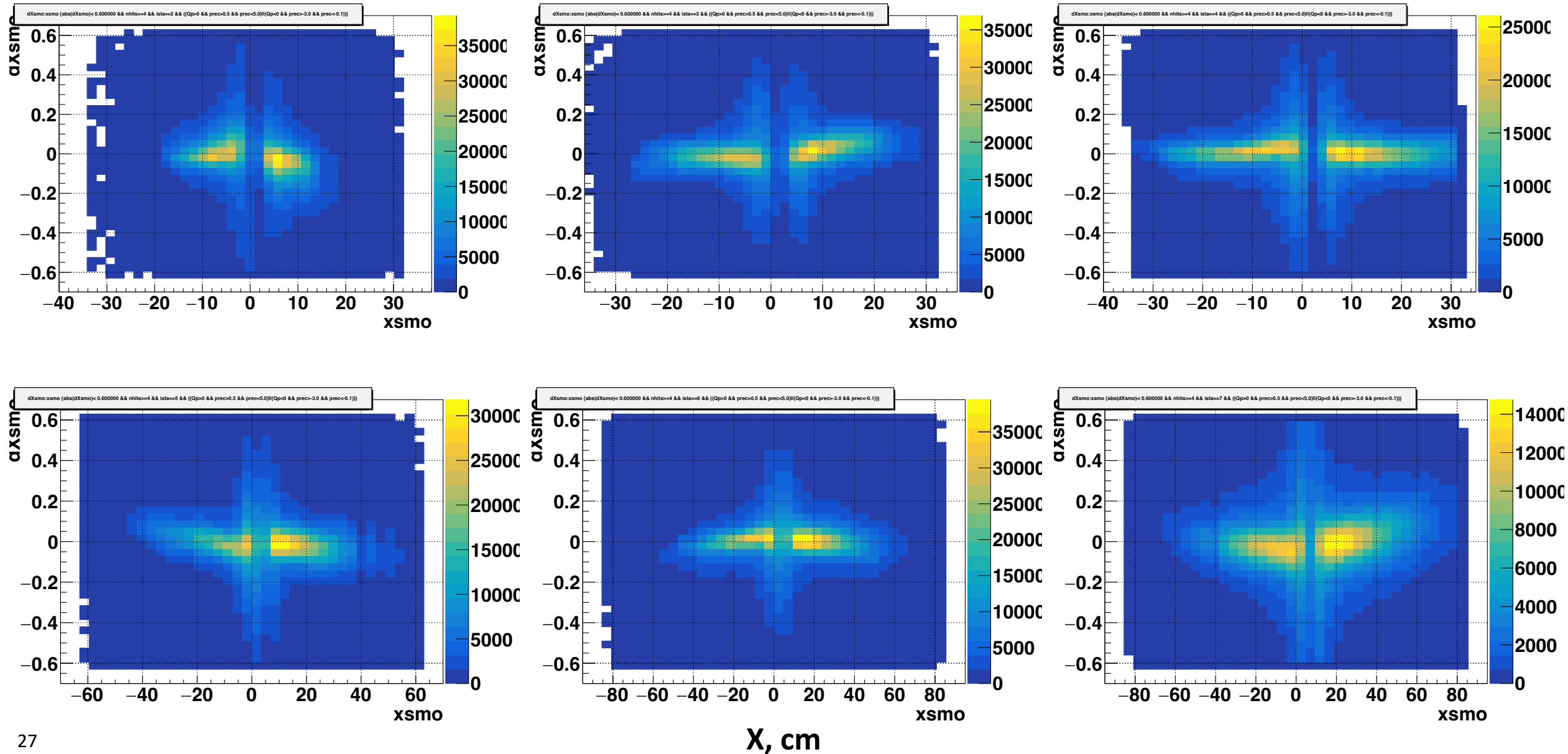
Thank you for your attention!



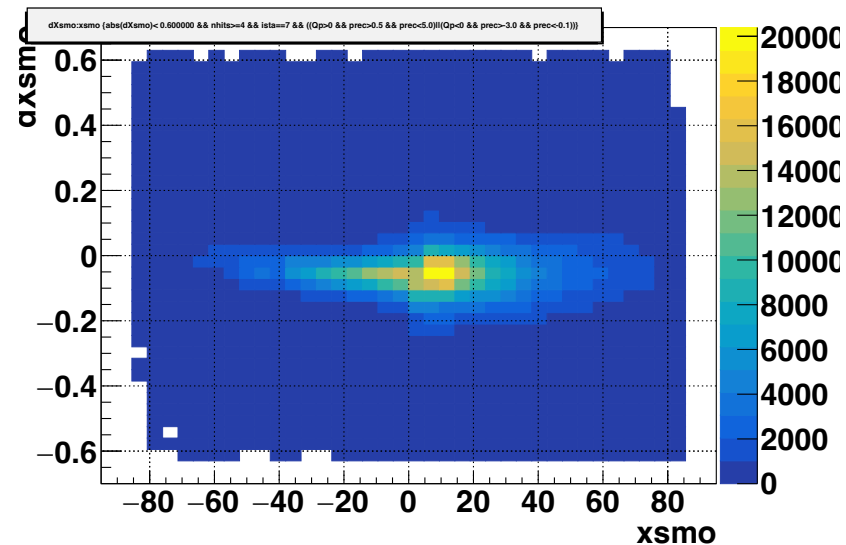
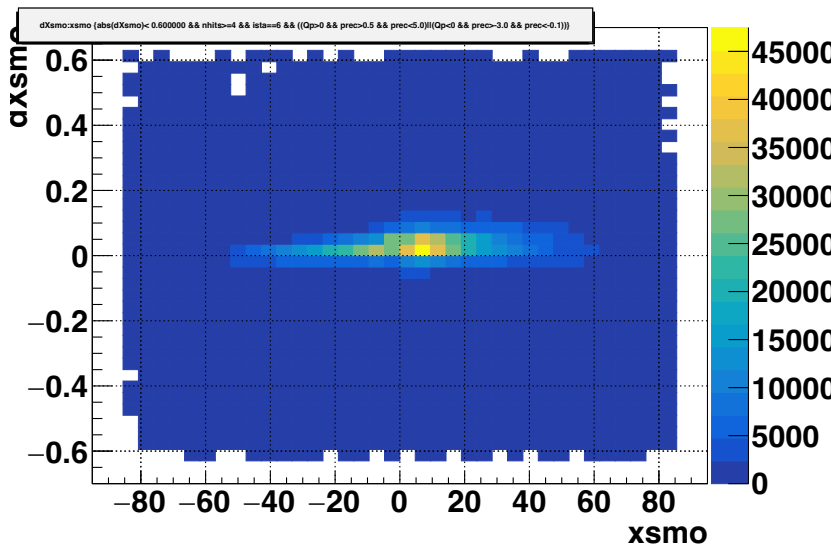
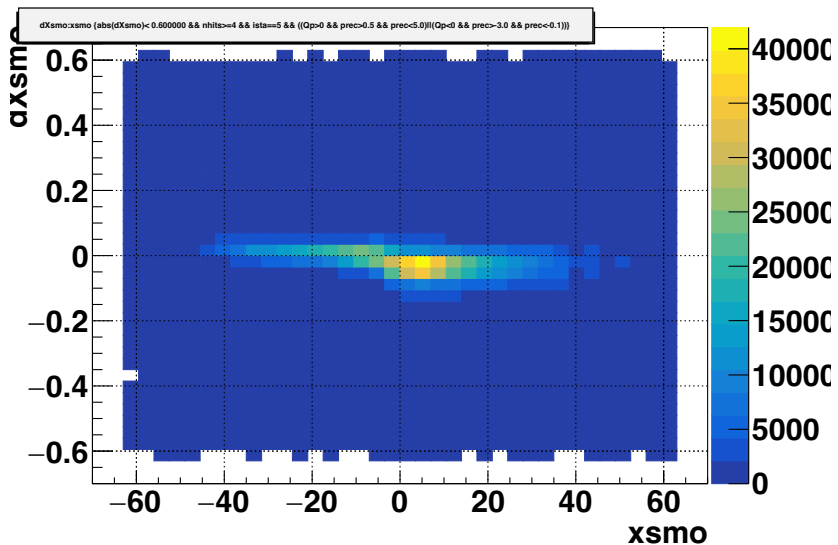
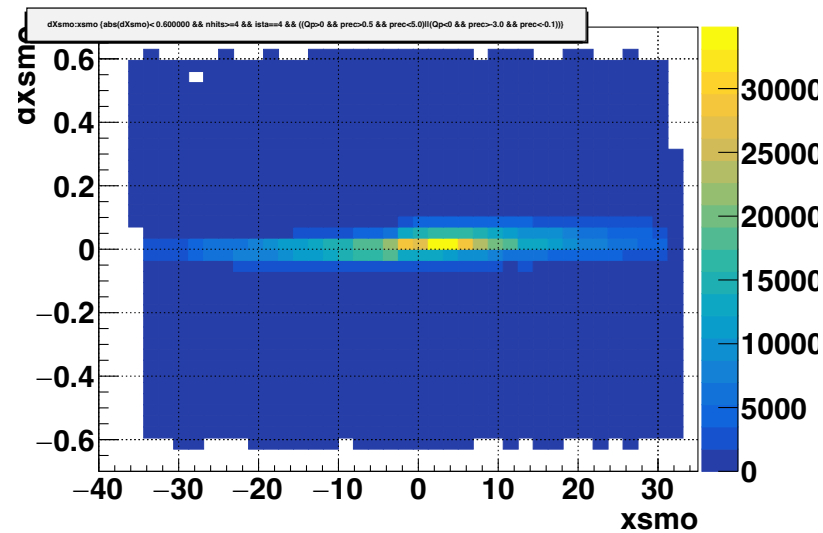
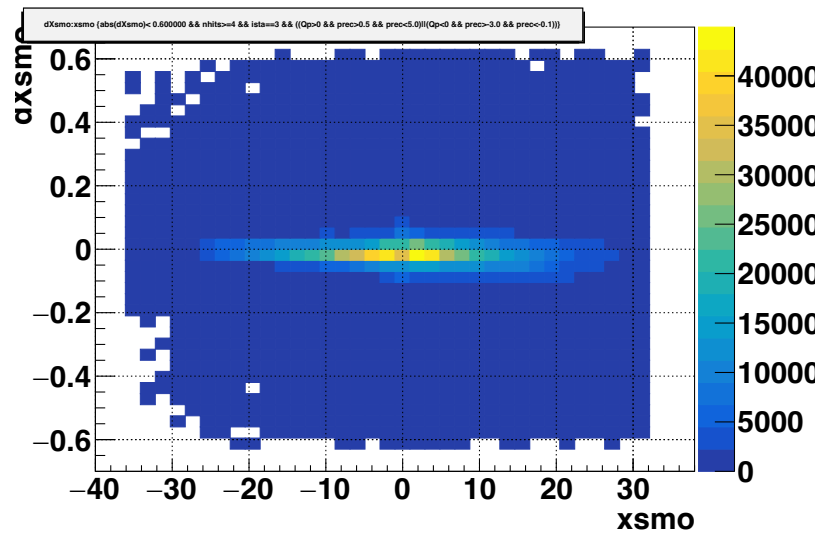
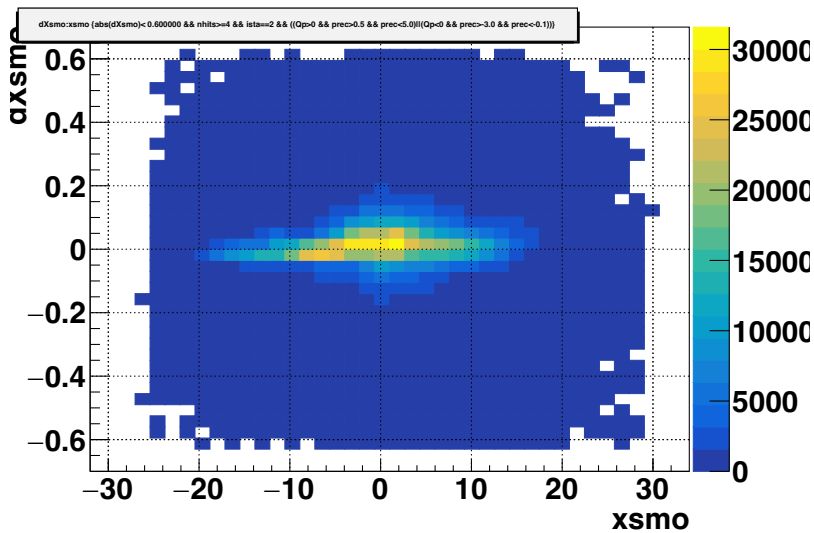
Back Up slides



Check residuals **Data** DX vs.X (4.0GeV CCu)



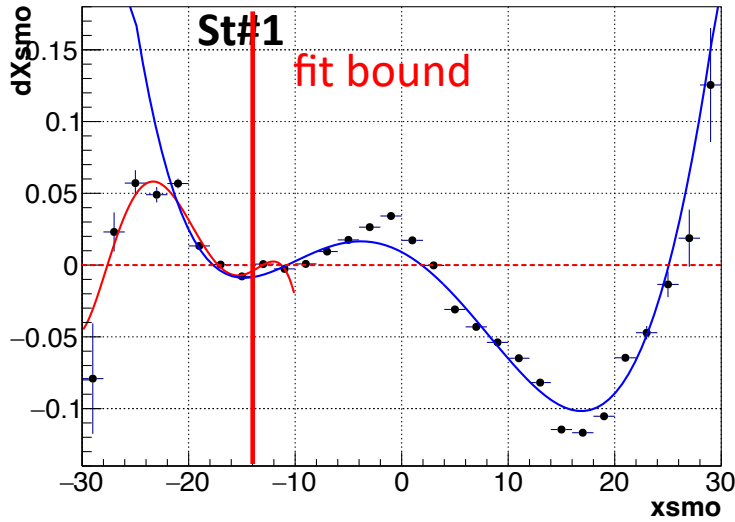
Check residuals MC DX vs.X (4.0GeV CCu)



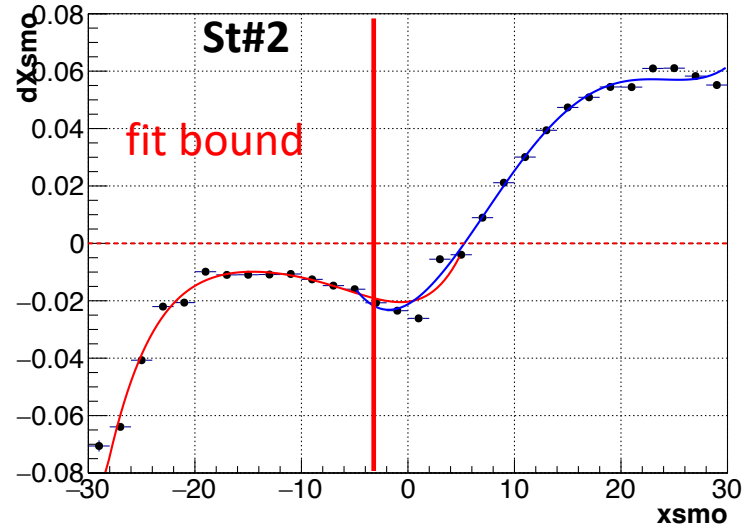
X, cm

Dependencies Mean Dx vs x: example of pol5 fit (**Data** 4.0GeV C+Cu)

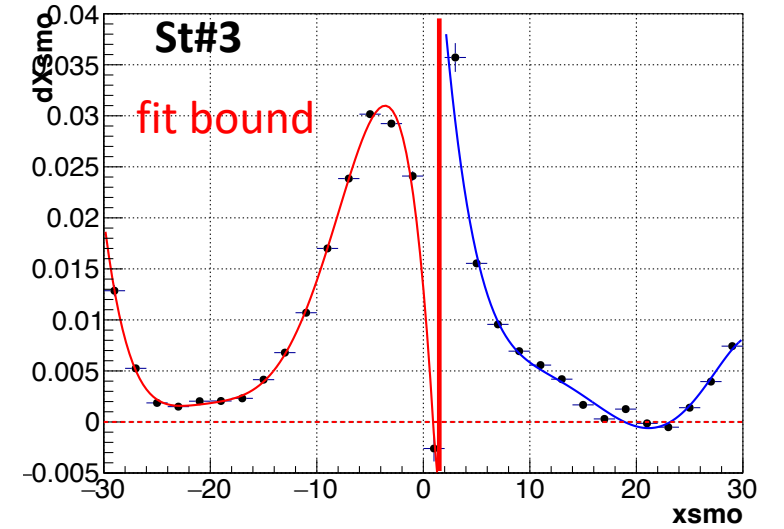
Mean of dXsmo versus xsmo (all tracks) ista=2



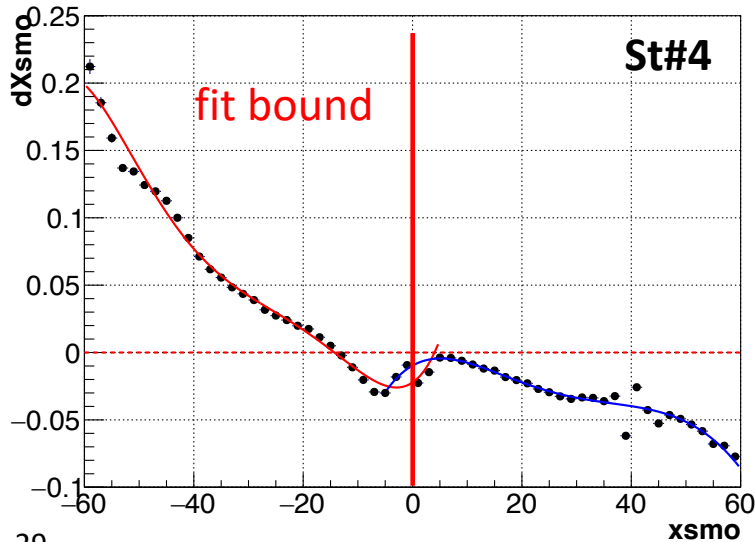
Mean of dXsmo versus xsmo (all tracks) ista=3



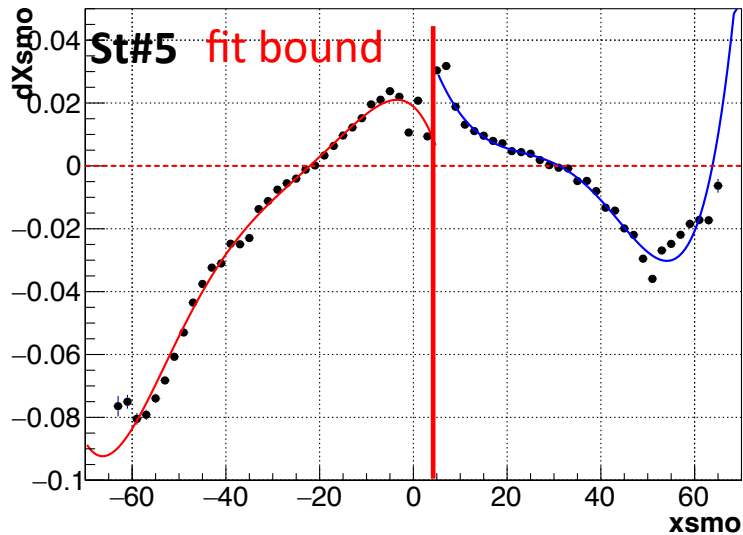
Mean of dXsmo versus xsmo (all tracks) ista=4



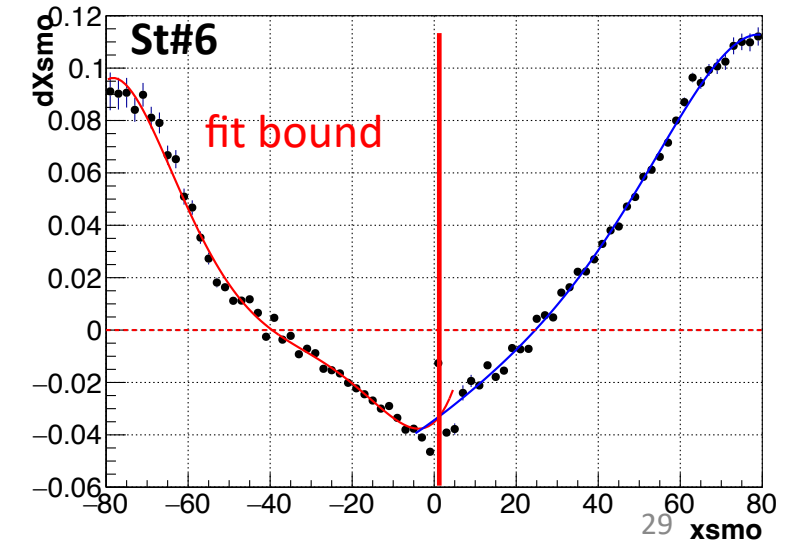
Mean of dXsmo versus xsmo (all tracks) ista=5



Mean of dXsmo versus xsmo (all tracks) ista=6

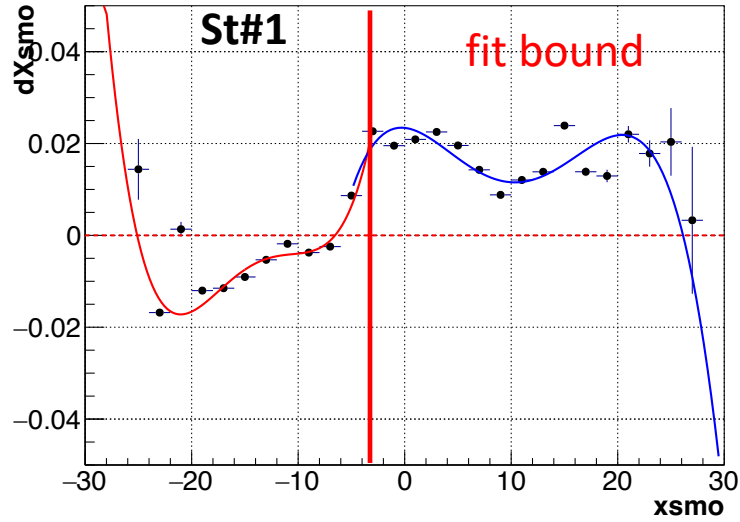


Mean of dXsmo versus xsmo (all tracks) ista=7

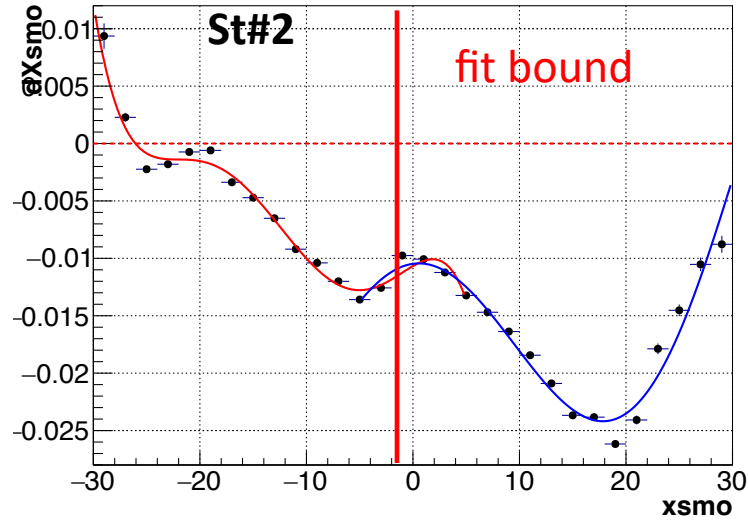


Dependencies Mean Dx vs x: example of pol5 fit (MC 4.0GeV C+Cu)

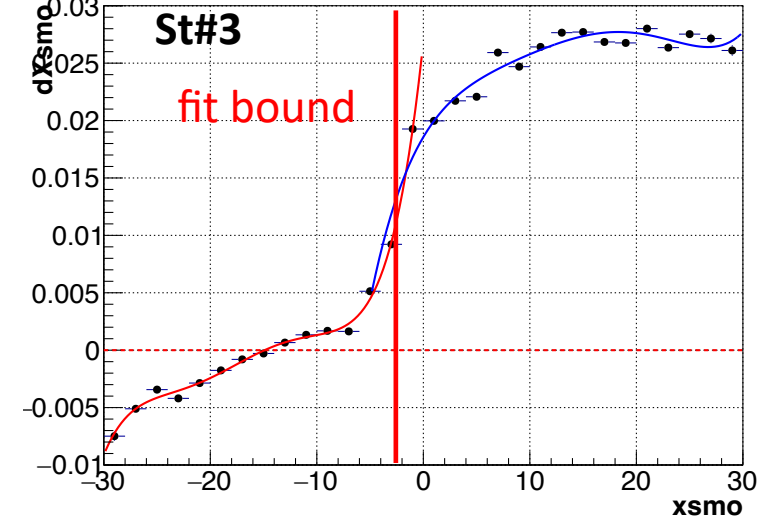
Mean of dXsmo versus xsmo (all tracks) ista=2



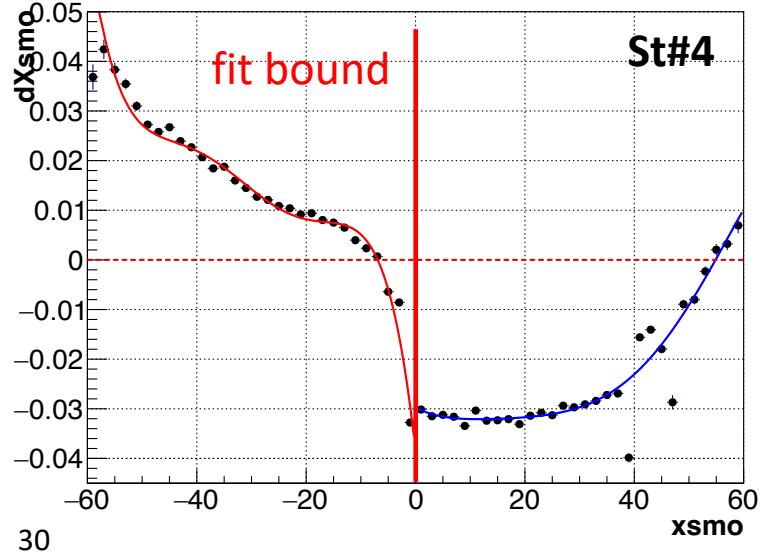
Mean of dXsmo versus xsmo (all tracks) ista=3



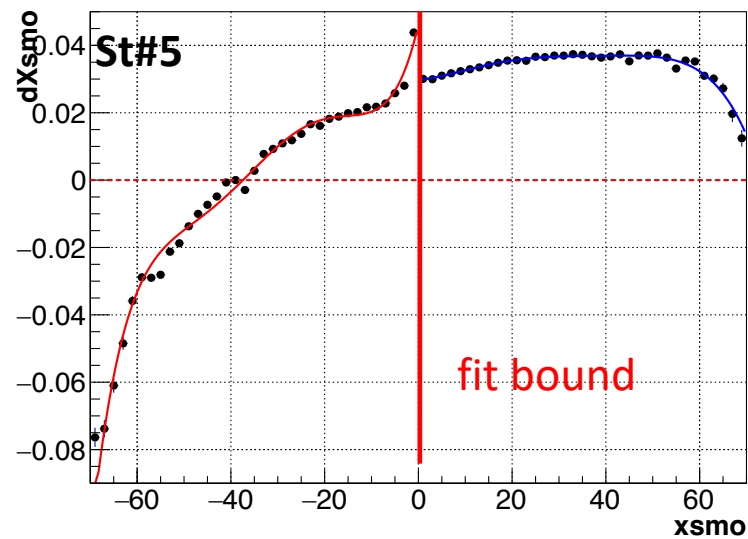
Mean of dXsmo versus xsmo (all tracks) ista=4



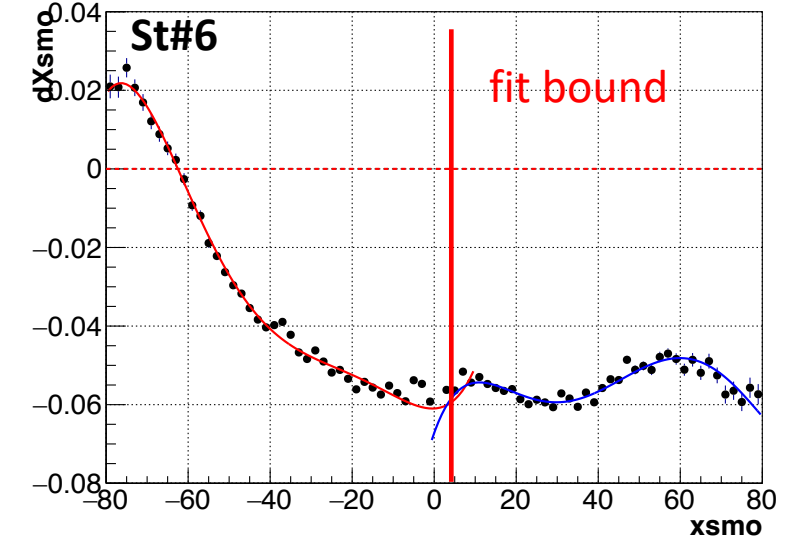
Mean of dXsmo versus xsmo (all tracks) ista=5



Mean of dXsmo versus xsmo (all tracks) ista=6



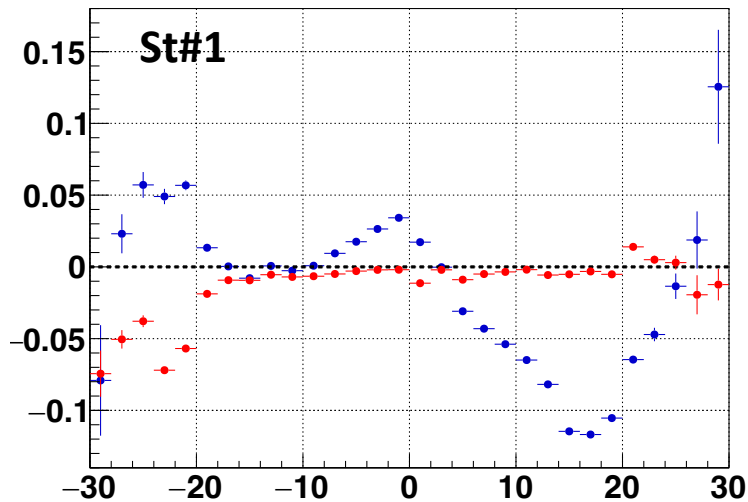
Mean of dXsmo versus xsmo (all tracks) ista=7



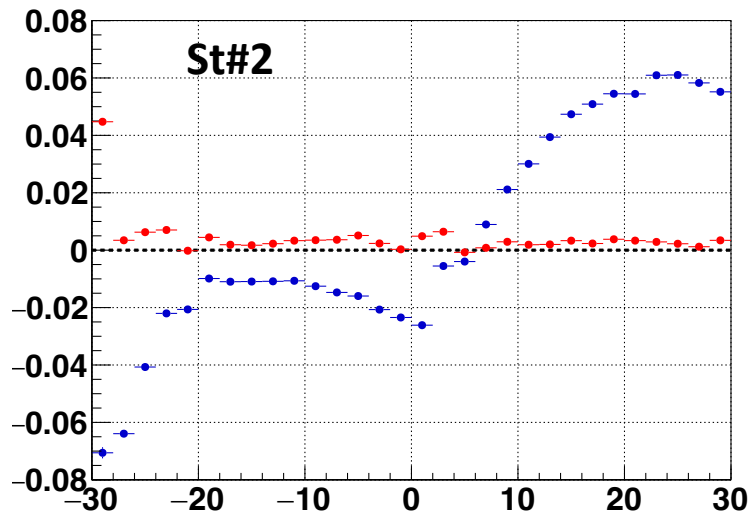
Blue: before corrections
Red: after corrections

Mean Dx vs x (DATA 4.0GeV C+Cu)

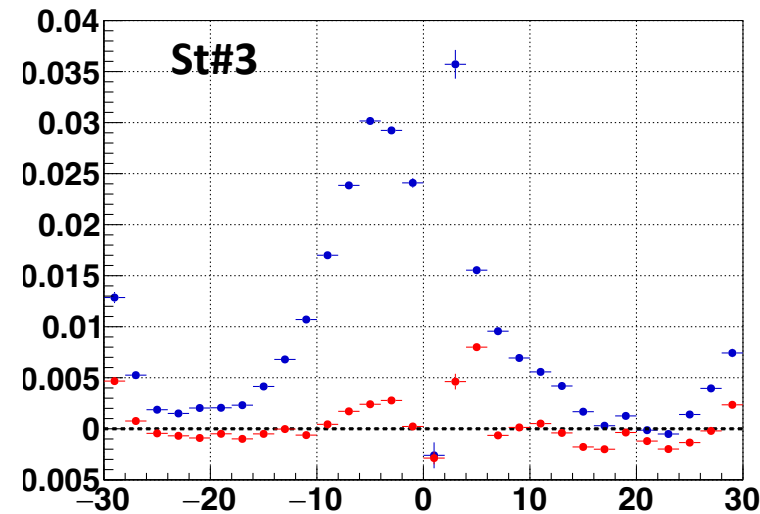
Mean dX vs. x ista==1 (DATA)



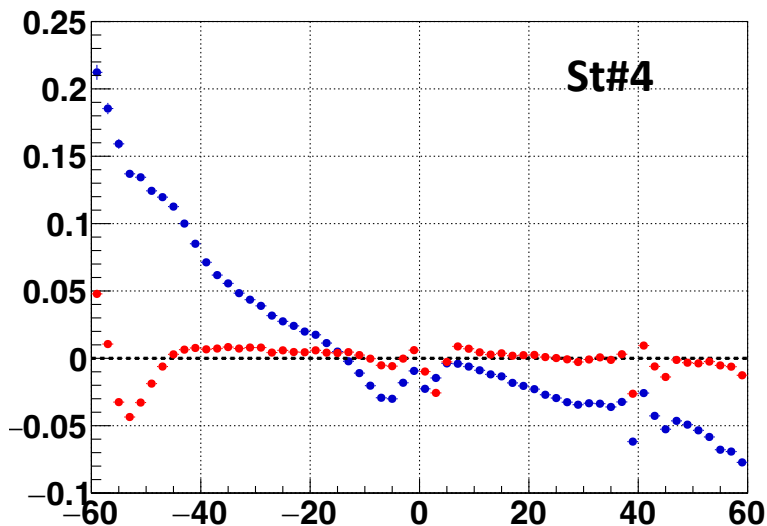
Mean dX vs. x ista==2 (DATA)



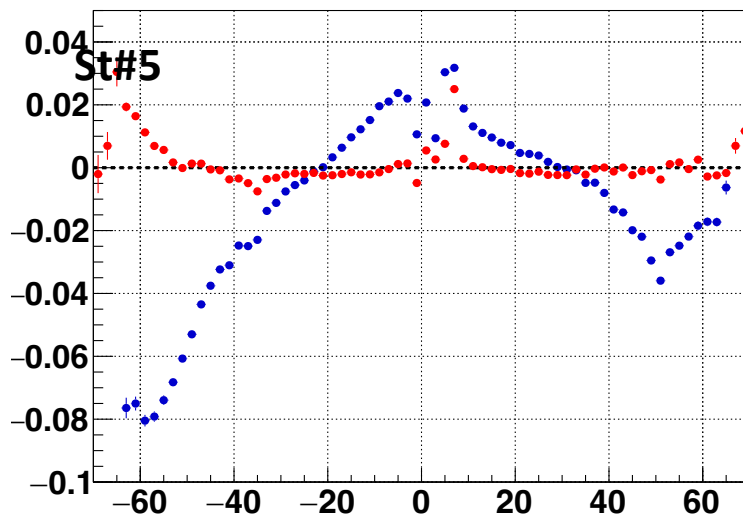
Mean dX vs. x ista==3 (DATA)



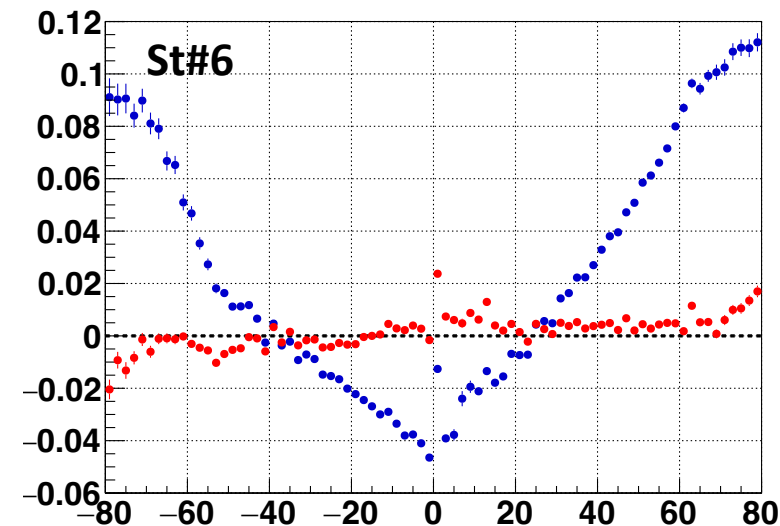
Mean dX vs. x ista==4 (DATA)



Mean dX vs. x ista==5 (DATA)



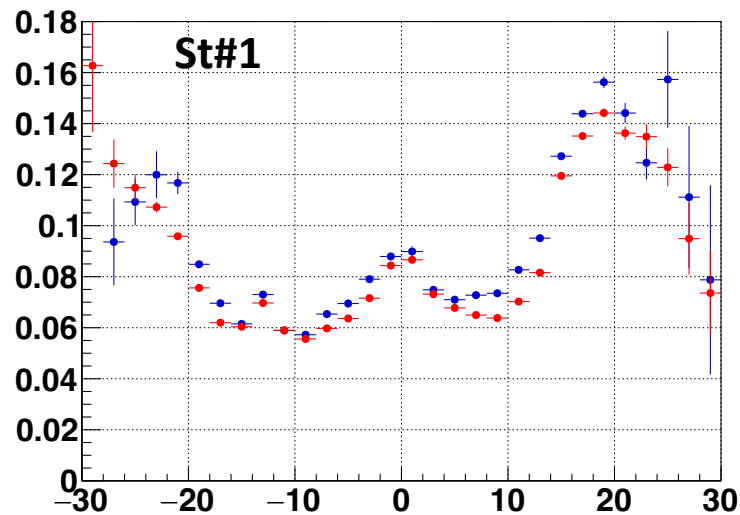
Mean dX vs. x ista==6 (DATA)



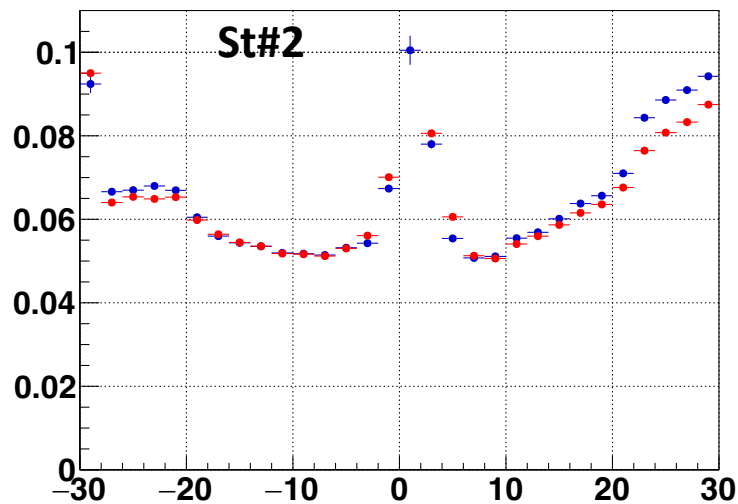
Blue: before corrections
Red: after corrections

Sigma Dx vs x (DATA 4.0GeV C+Cu)

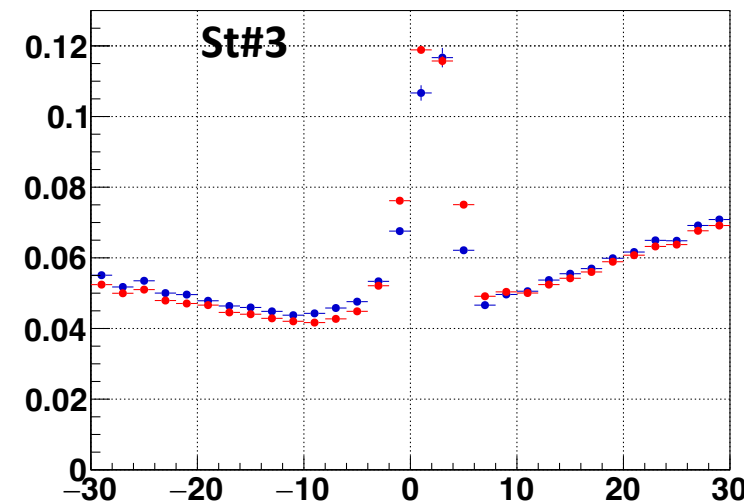
Sigma dX vs. x ista==1 (DATA)



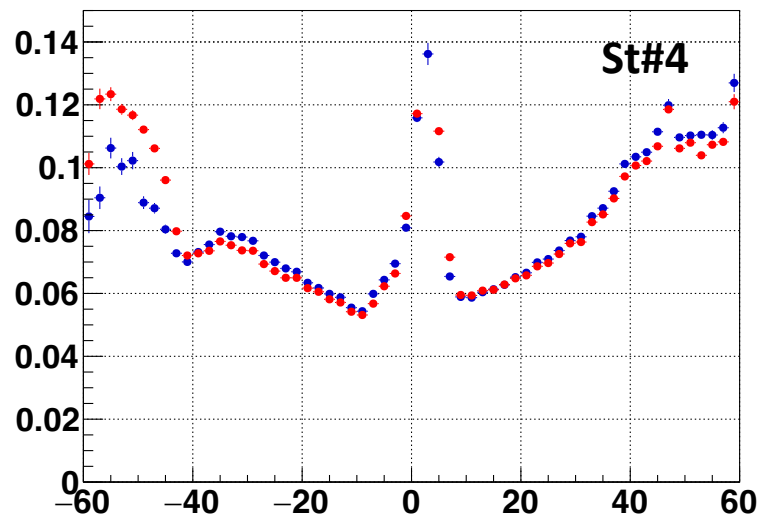
Sigma dX vs. x ista==2 (DATA)



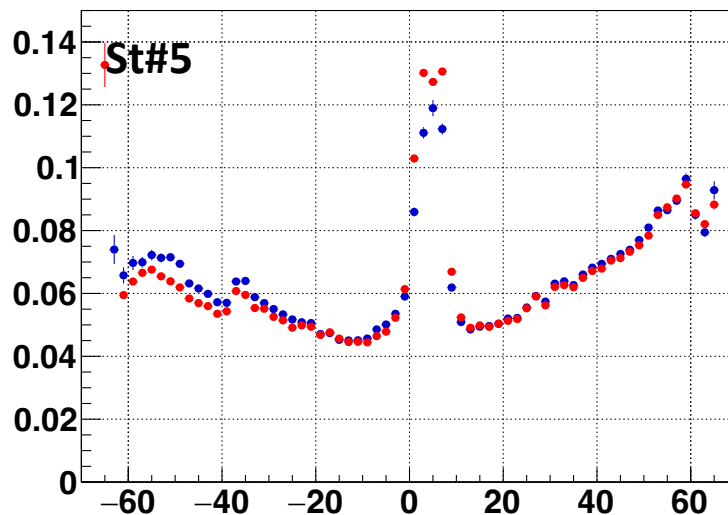
Sigma dX vs. x ista==3 (DATA)



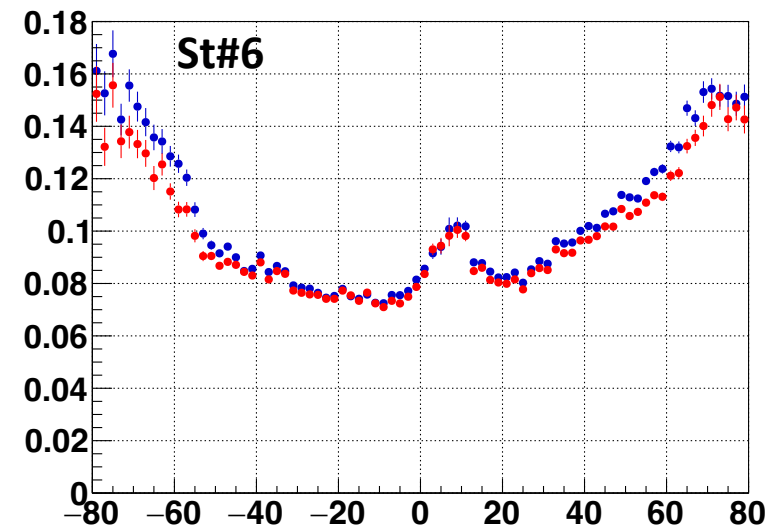
Sigma dX vs. x ista==4 (DATA)



Sigma dX vs. x ista==5 (DATA)



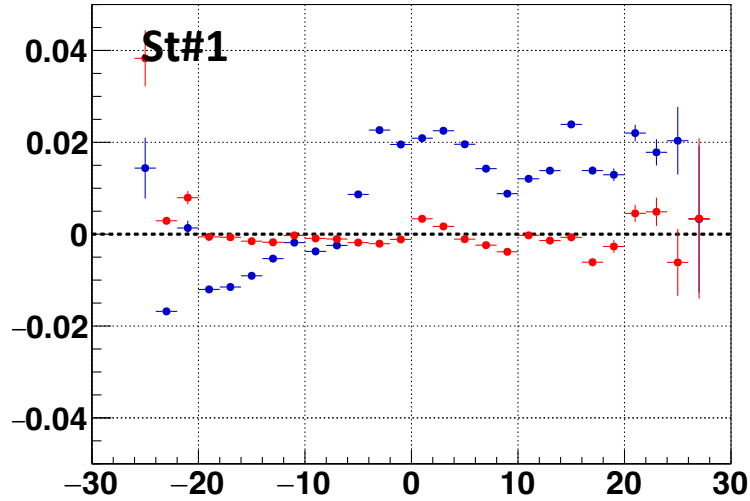
Sigma dX vs. x ista==6 (DATA)



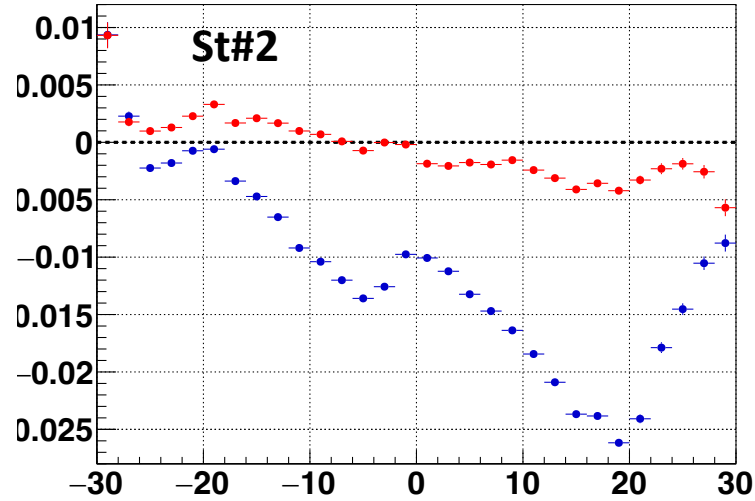
Blue: before corrections
Red: after corrections

Mean Dx vs x (MC 4.0GeV C+Cu)

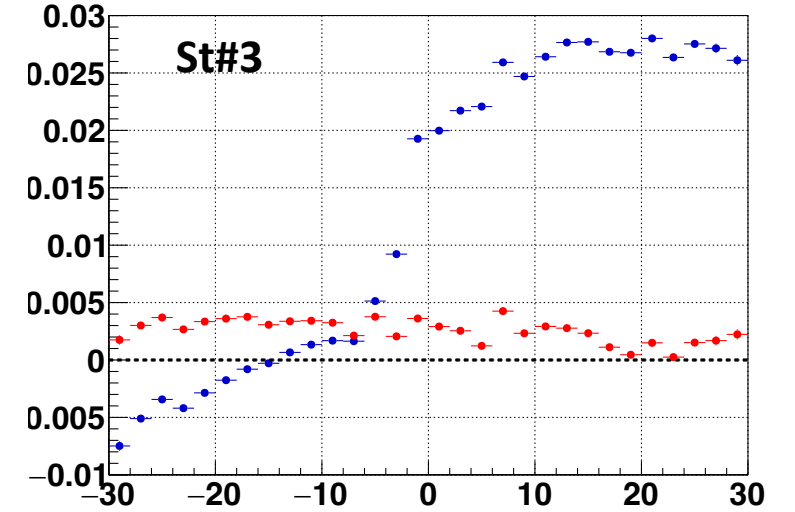
Mean dX vs. x ista==1 (MC)



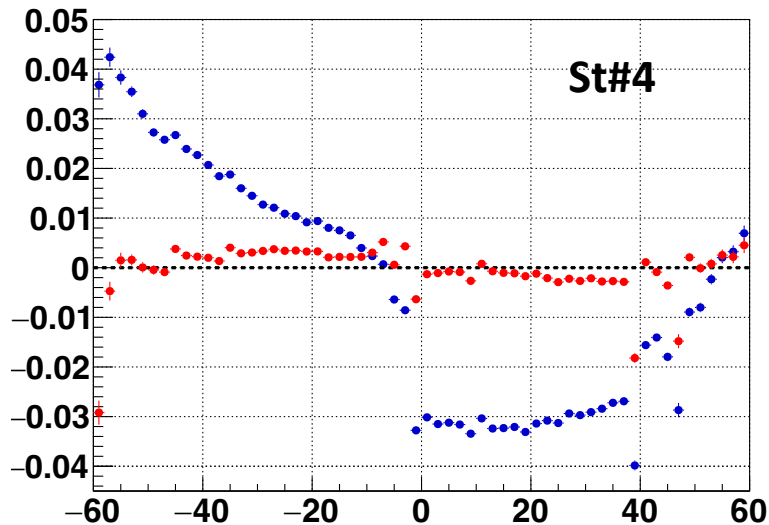
Mean dX vs. x ista==2 (MC)



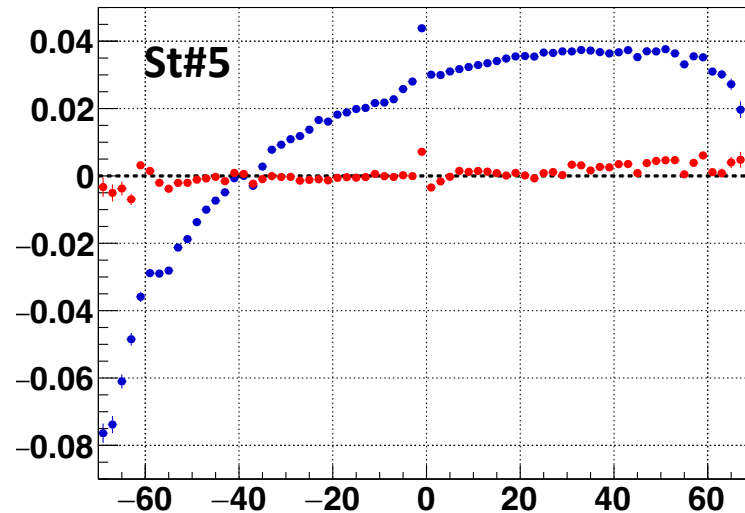
Mean dX vs. x ista==3 (MC)



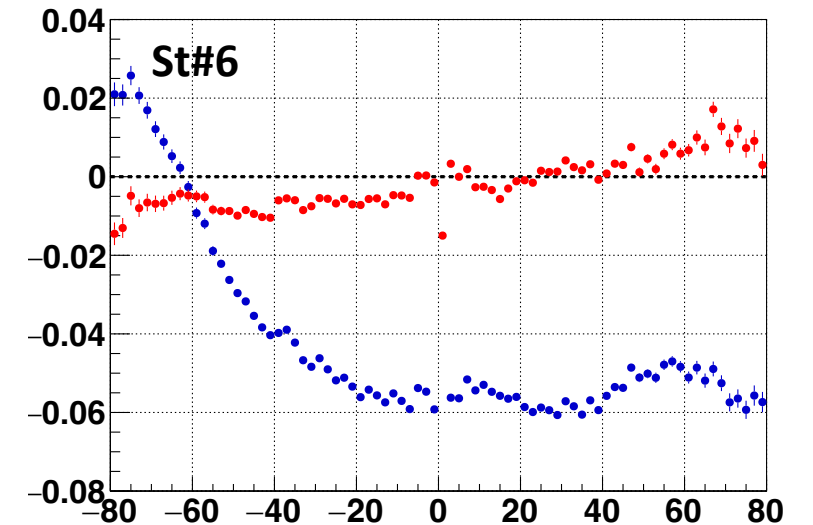
Mean dX vs. x ista==4 (MC)



Mean dX vs. x ista==5 (MC)



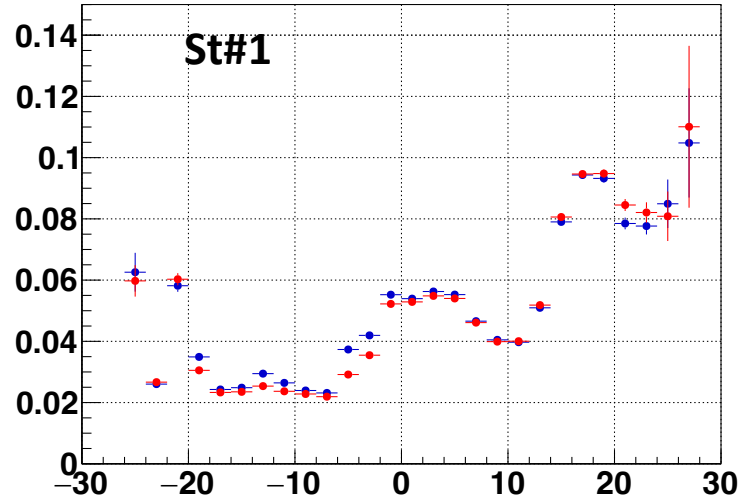
Mean dX vs. x ista==6 (MC)



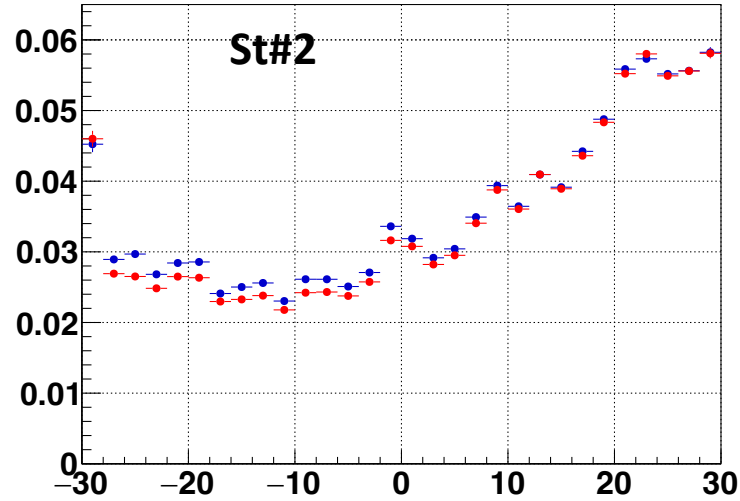
Blue: before corrections
Red: after corrections

Sigma Dx vs x (MC 4.0GeV C+Cu)

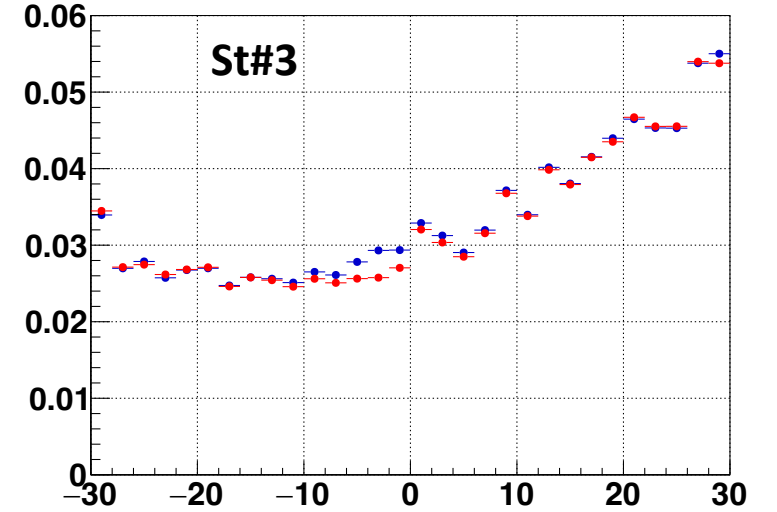
Sigma dX vs. x ista==1 (MC)



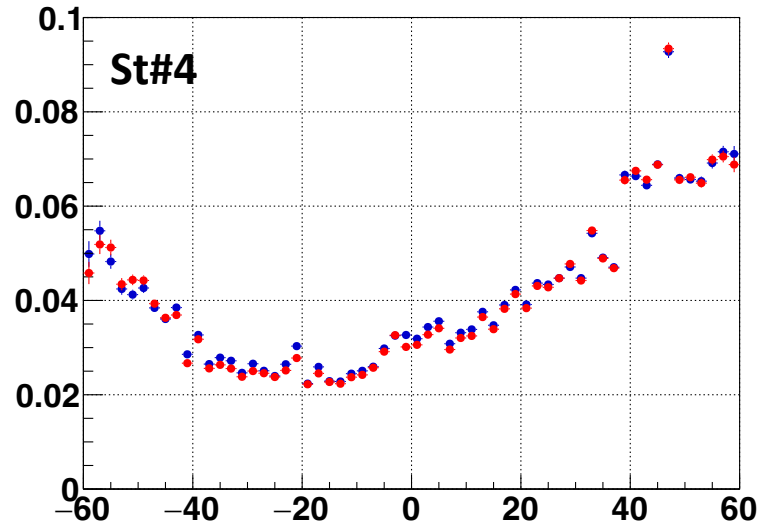
Sigma dX vs. x ista==2 (MC)



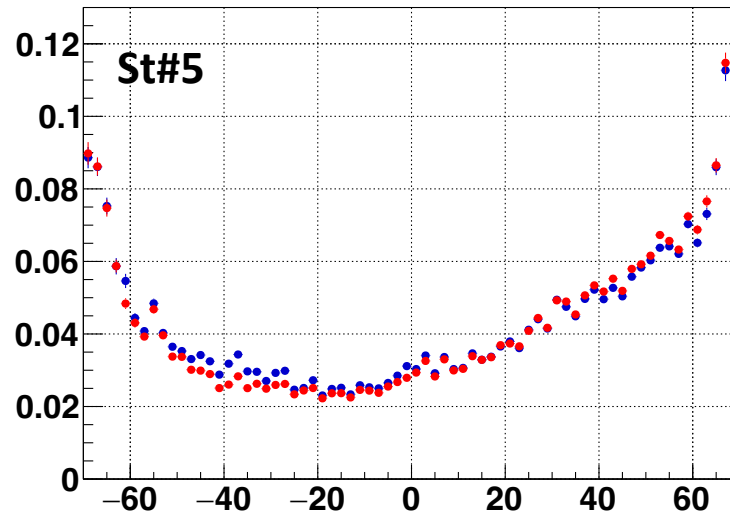
Sigma dX vs. x ista==3 (MC)



Sigma dX vs. x ista==4 (MC)



Sigma dX vs. x ista==5 (MC)



Sigma dX vs. x ista==6 (MC)

