

Status of the Λ^0 hyperon analysis in the carbon beam

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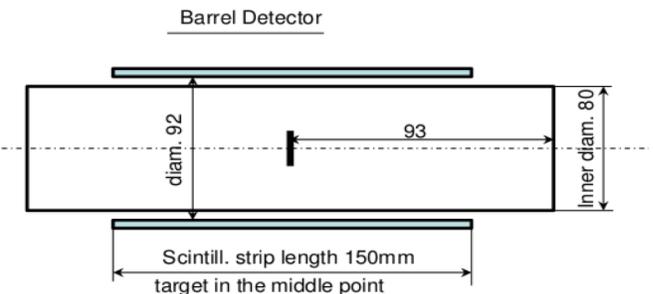
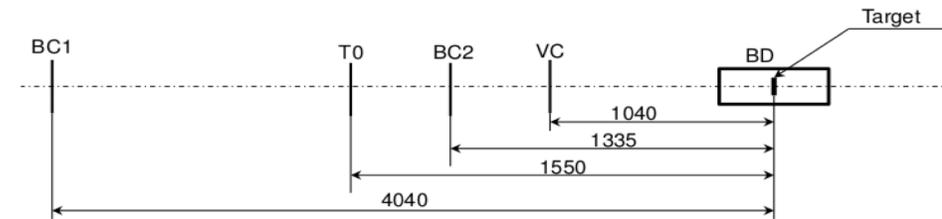
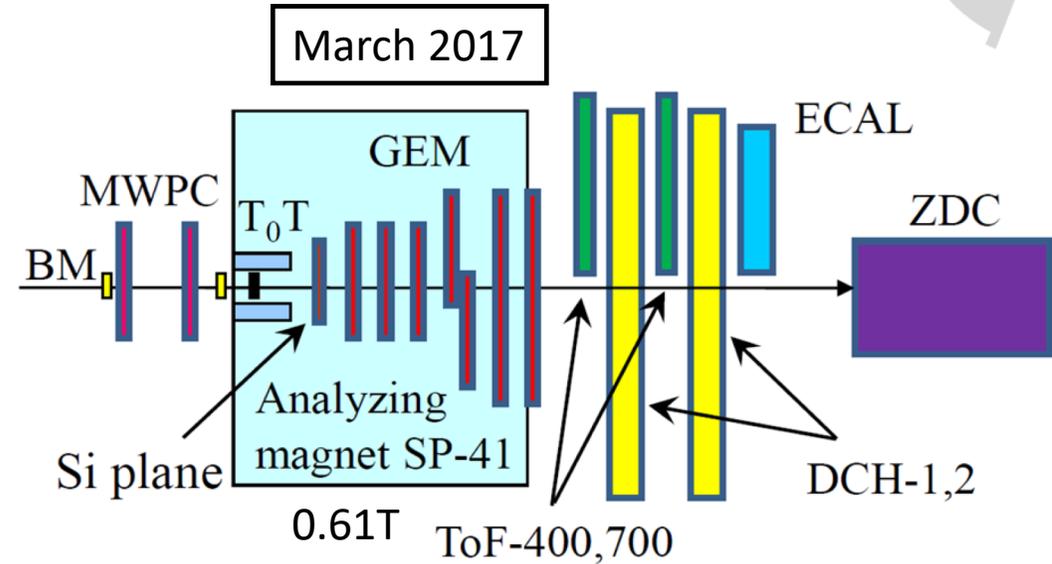


7th Collaboration Meeting of the BM@N Experiment at the NICA Facility
19-20 April 2021

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



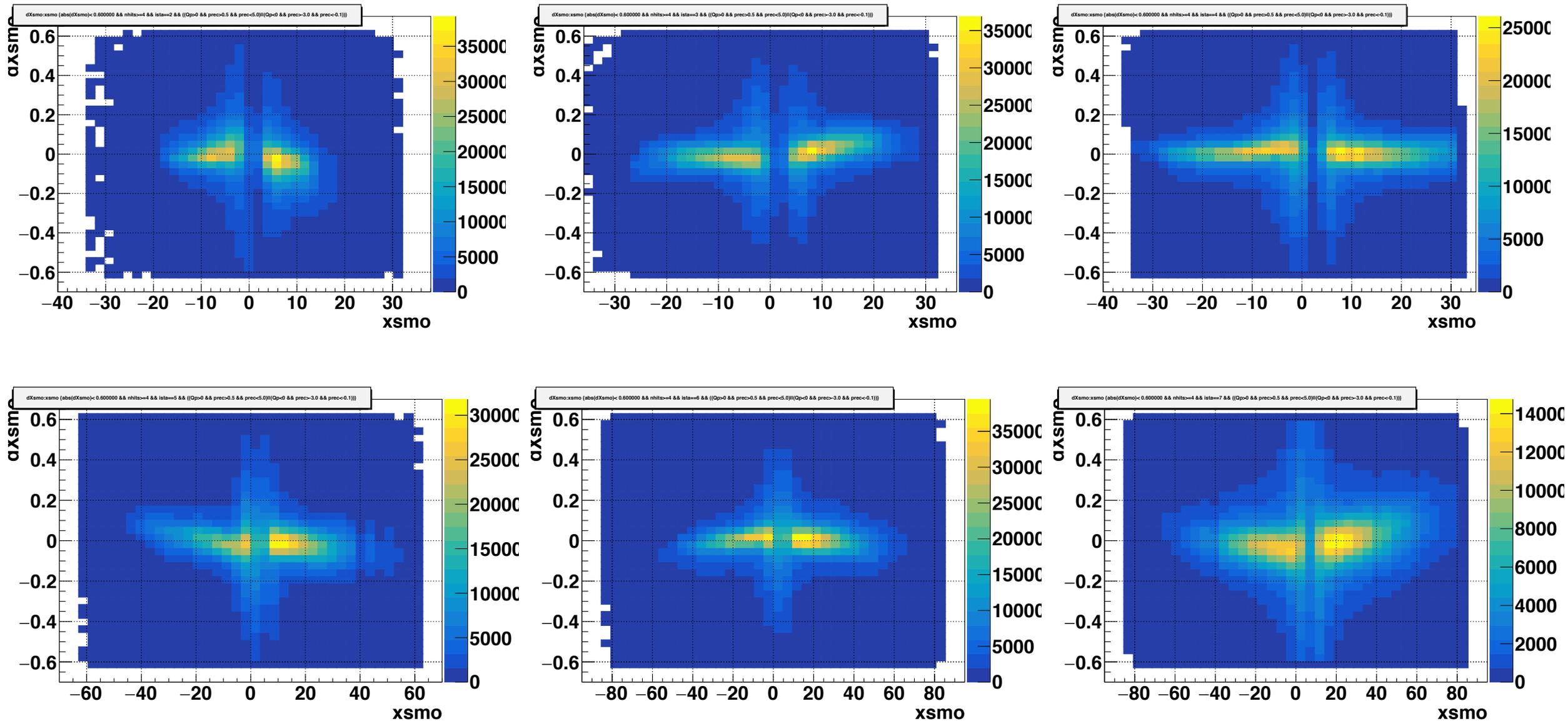
Analysis current status



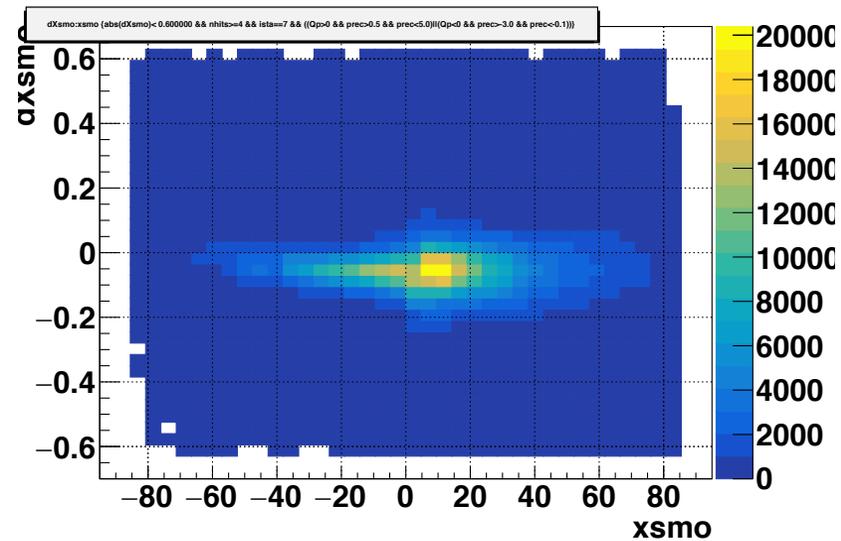
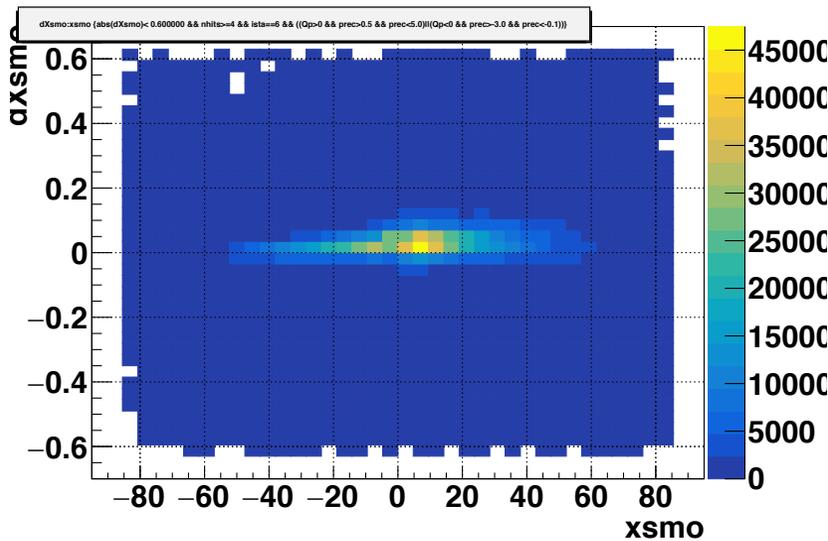
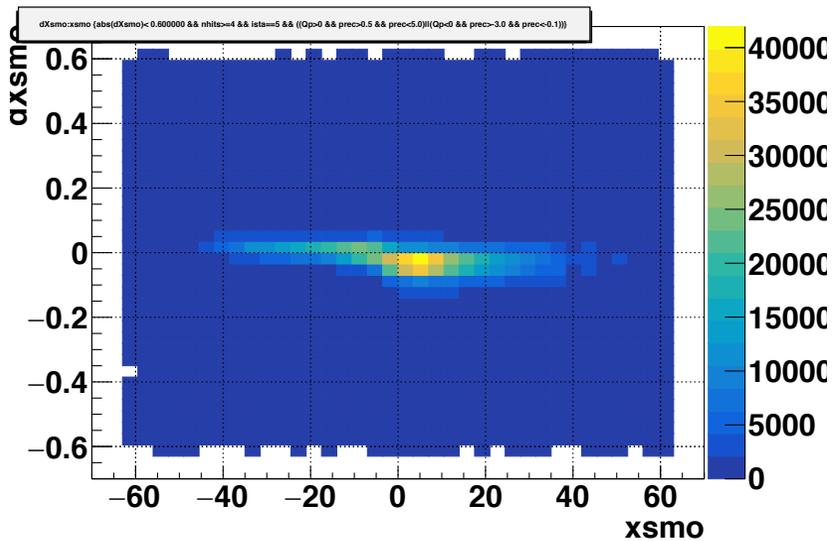
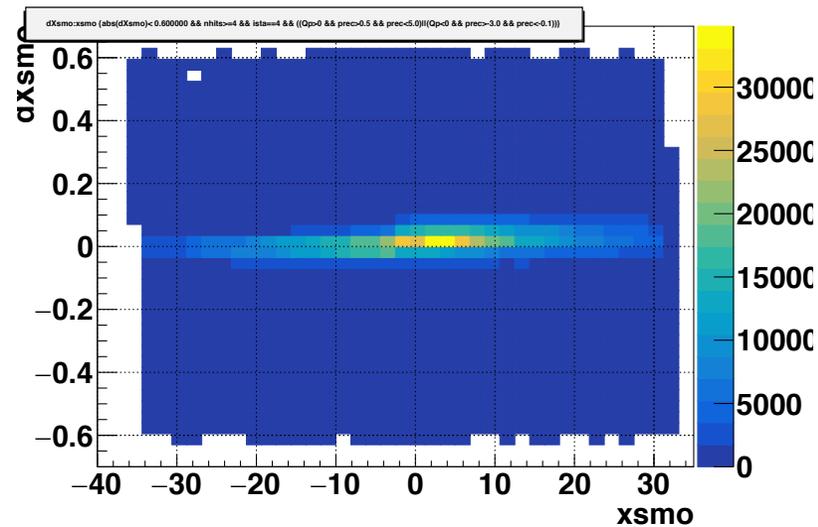
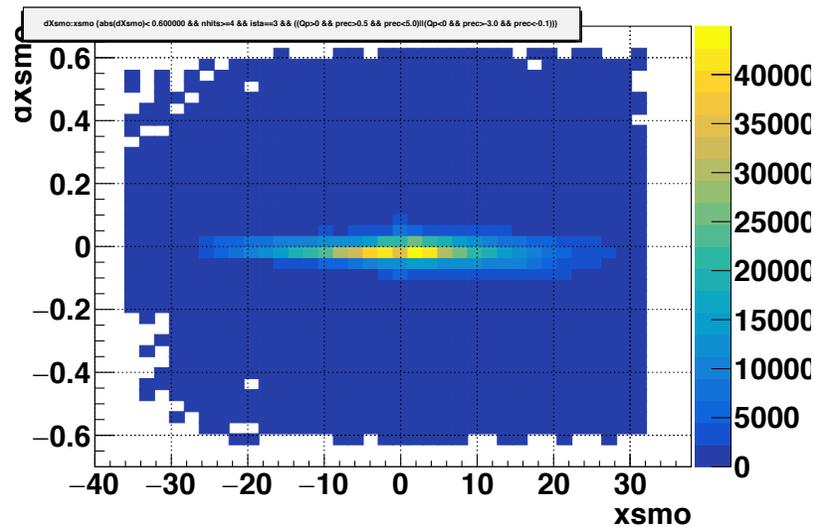
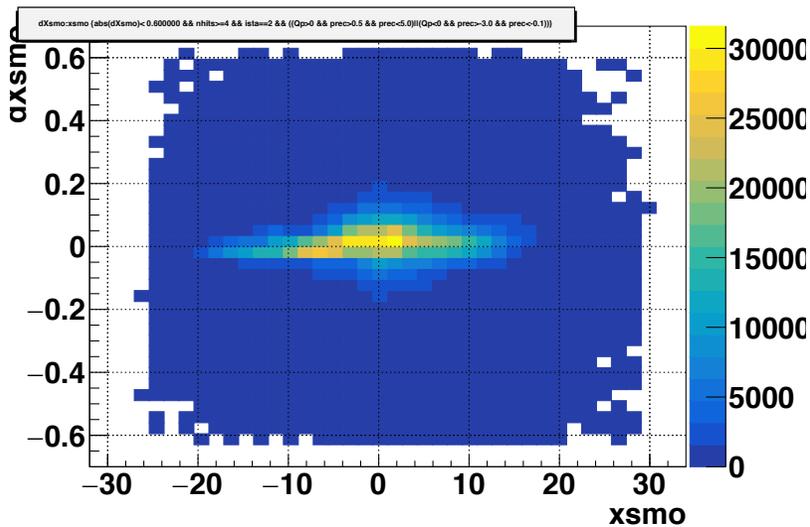
- **Main goal of current analysis** – cross-check with previous analysis (was performed by Gleb Pokatashkin)
- **From previous analysis status:**
 - Check residuals for MC & Data ✓
 - Make corrections for residuals in Data & MC ✓
 - Momentum smearing procedure for MC simulation ✓
 - Check GEM efficiencies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

May-June 2021

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



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



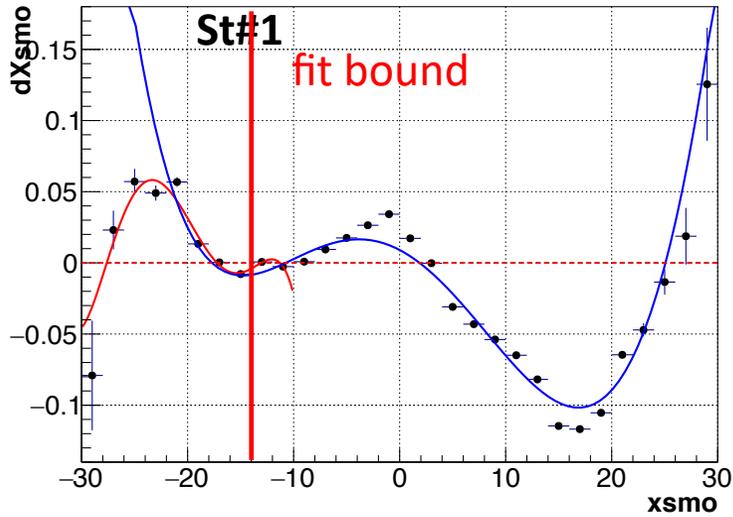
X, cm

Residuals corrections procedure flow for Data/MC

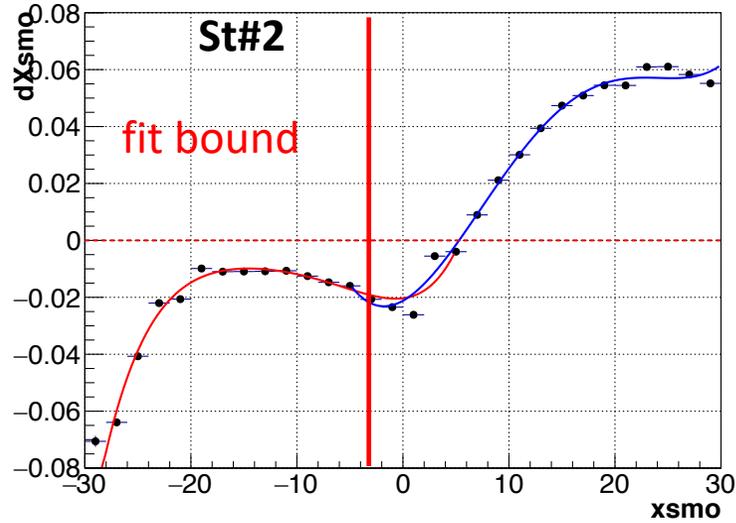
- 1) Get slices along x GEM coordinate: $DX(x)$
- 2) Fit each slice using Gaus + pol2 function
- 3) Get Mean & Sigma from the fit
- 4) Make plots: dependencies Mean $DX(x)$, Sigma $DX(x)$ for each GEM station
- 5) Fit Mean $DX(x)$ distributions using pol5 functions for negative & positive x
- 6) Apply corrections using pol5 fit functions
- 7) Check results after first correction
- 8) Make refit procedure (points 1-7)
- 9) Check and compare distributions for Data/MC: Mean $DX(x)$, Sigma $DX(x)$, Mean $DX(Mom)$, Sigma $DX(Mom)$

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

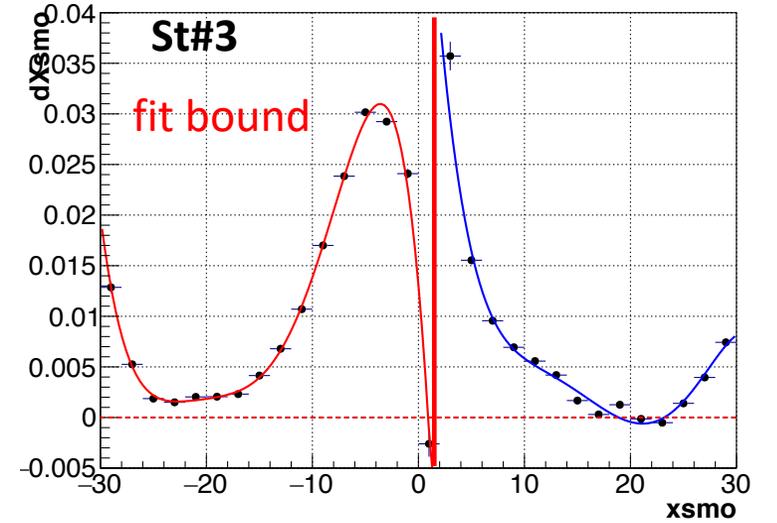
Mean of dXsmo versus xsmo (all tracks) ista=2



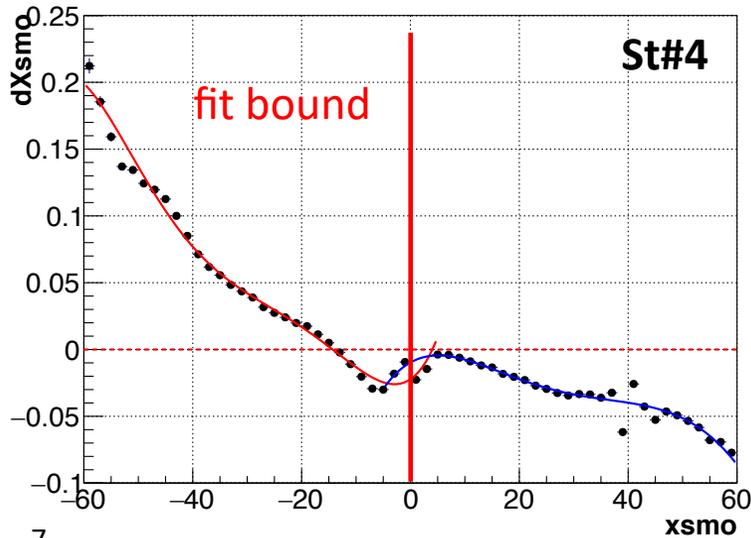
Mean of dXsmo versus xsmo (all tracks) ista=3



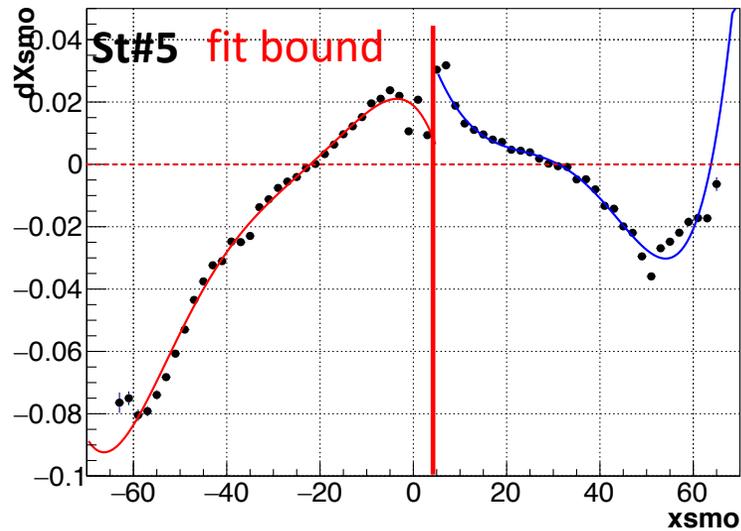
Mean of dXsmo versus xsmo (all tracks) ista=4



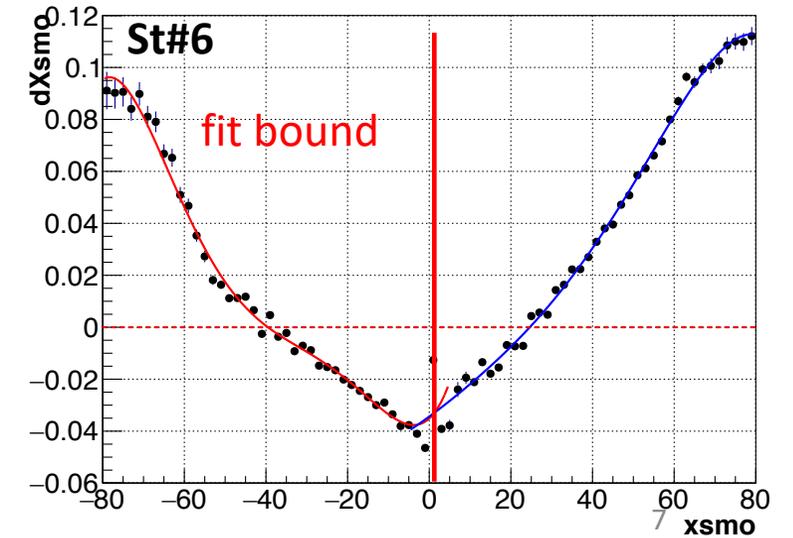
Mean of dXsmo versus xsmo (all tracks) ista=5



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

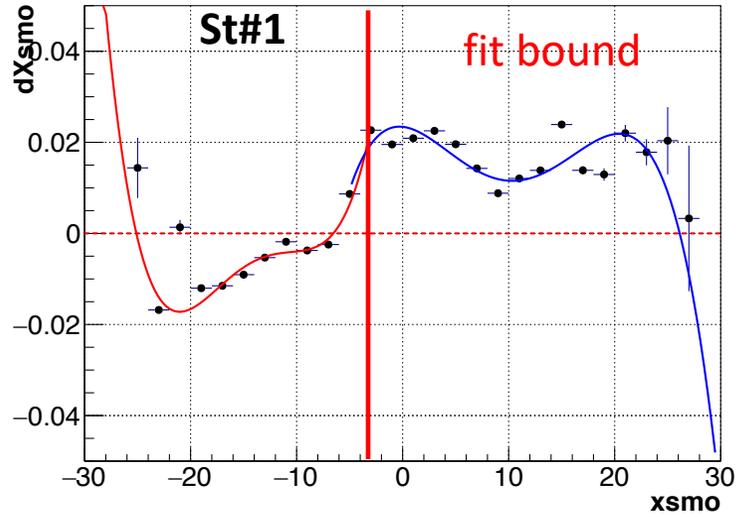


Mean of dXsmo versus xsmo (all tracks) ista=7

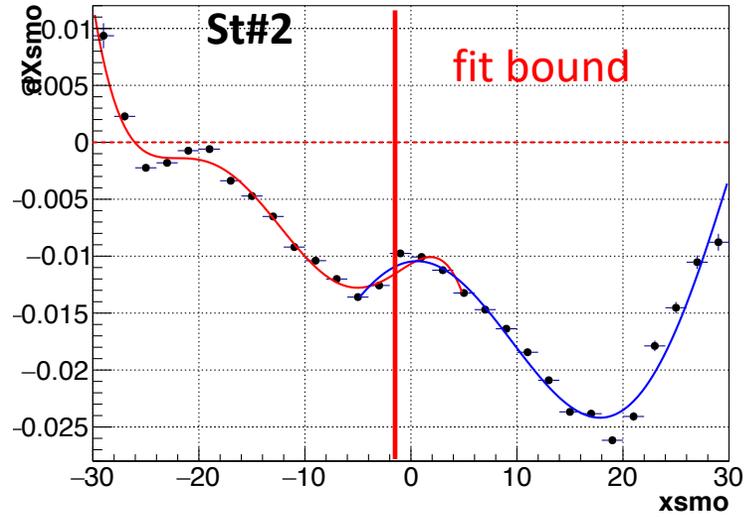


Dependencies Mean Dx vs x: example of pol5 fit (MC 4.0GeV C+Cu)

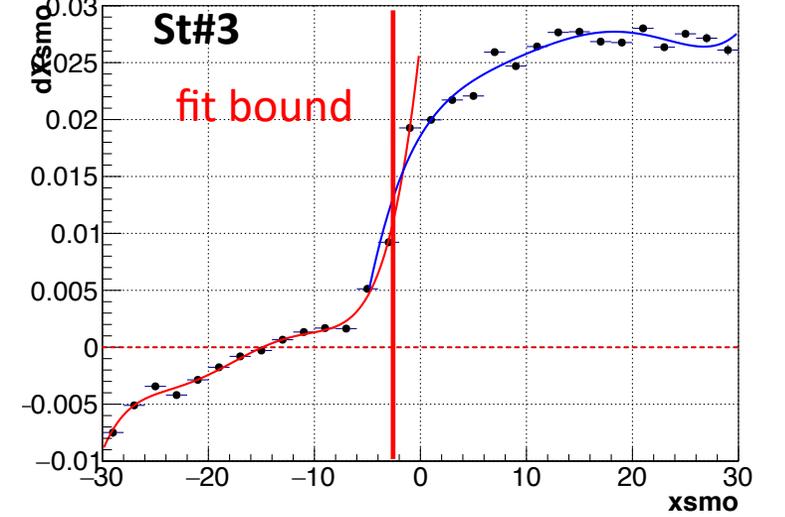
Mean of dXsmo versus xsmo (all tracks) ista=2



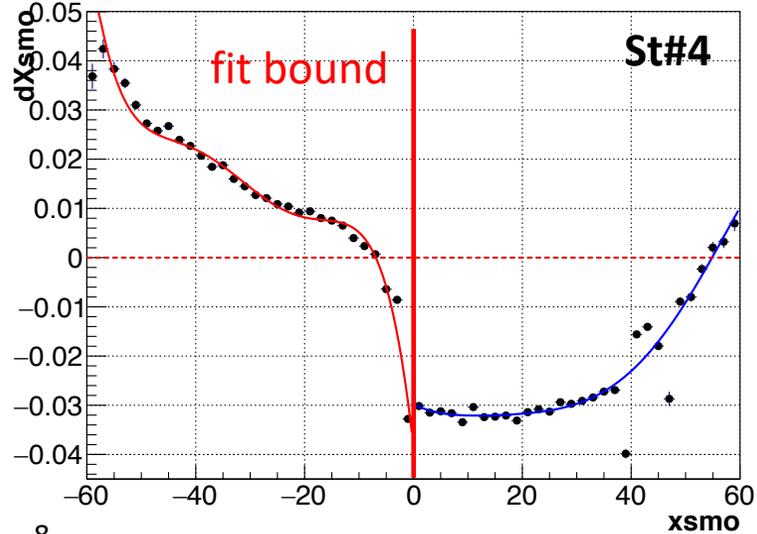
Mean of dXsmo versus xsmo (all tracks) ista=3



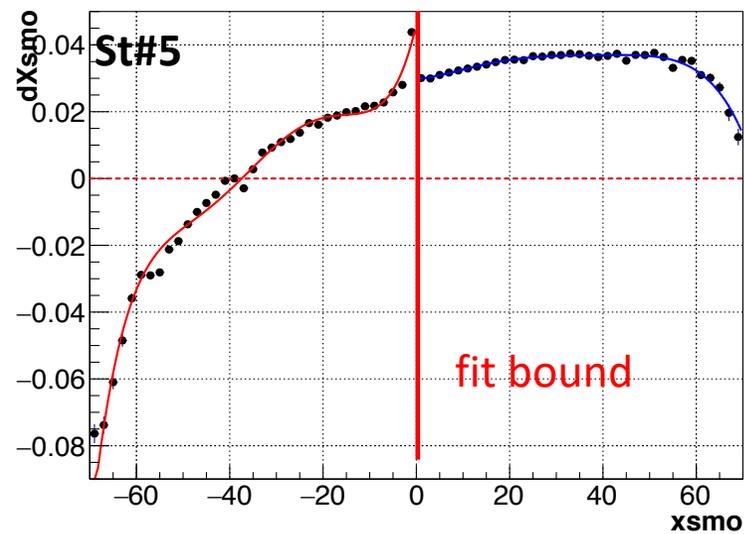
Mean of dXsmo versus xsmo (all tracks) ista=4



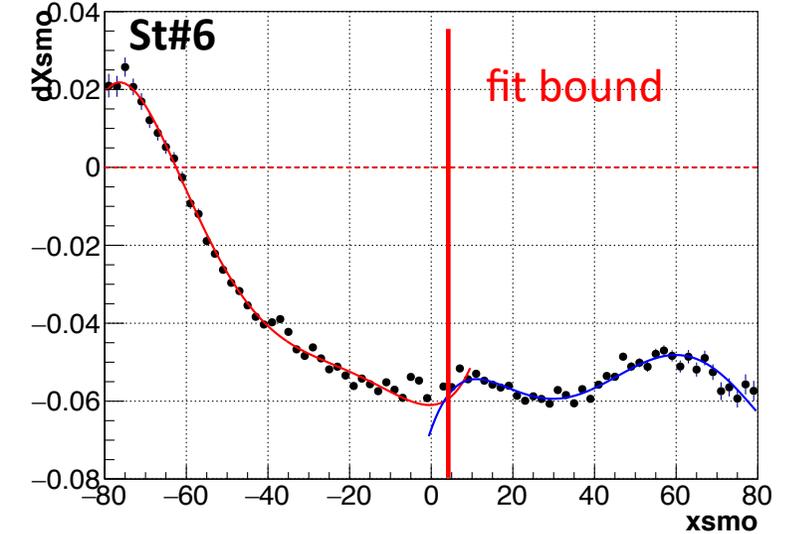
Mean of dXsmo versus xsmo (all tracks) ista=5



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



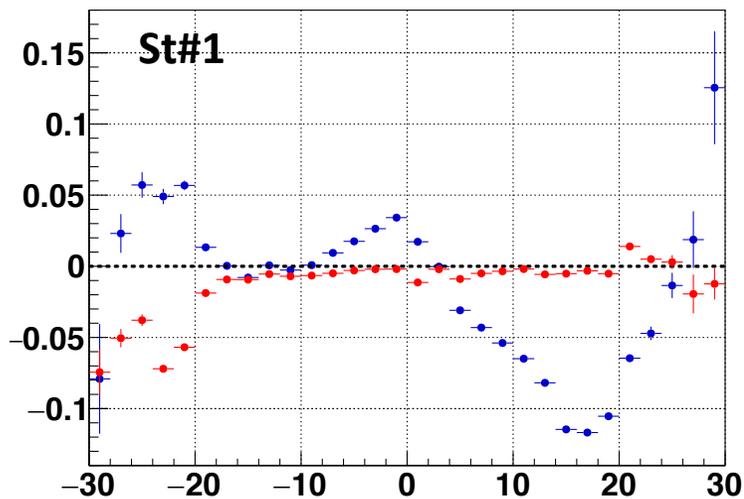
Mean of dXsmo versus xsmo (all tracks) ista=7



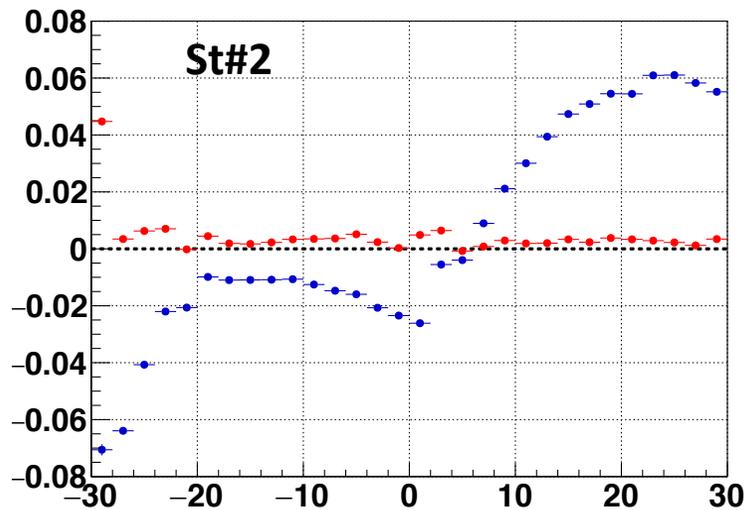
Blue: before corrections
Red: after corrections

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

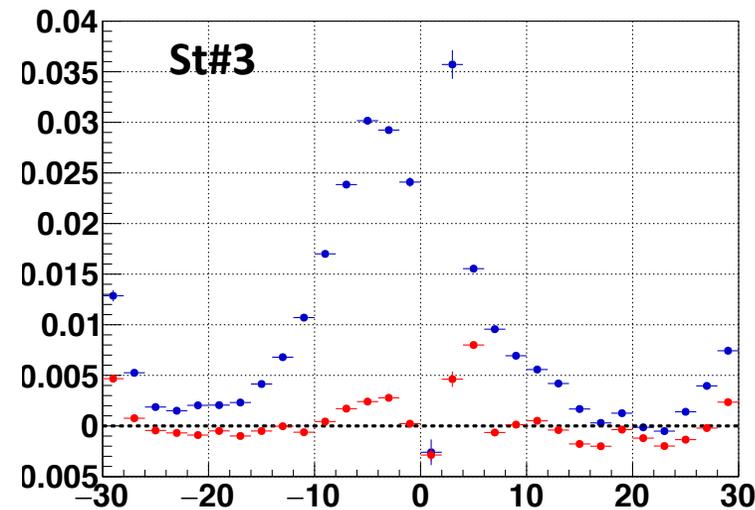
Mean dX vs. x ista==1 (DATA)



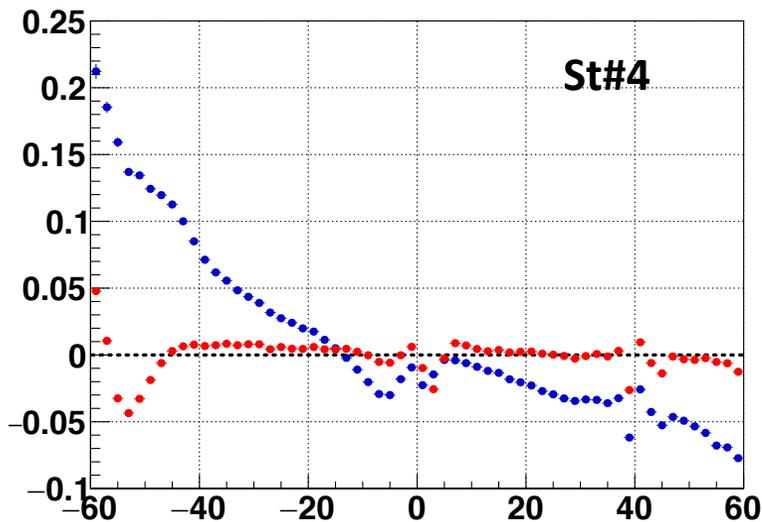
Mean dX vs. x ista==2 (DATA)



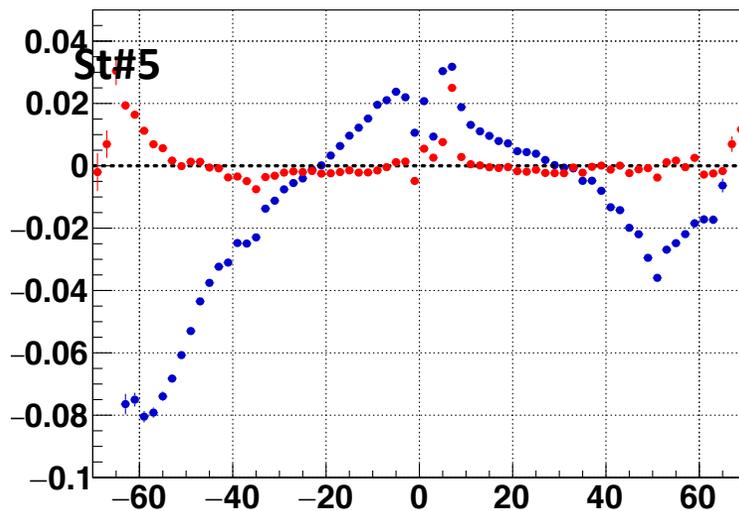
Mean dX vs. x ista==3 (DATA)



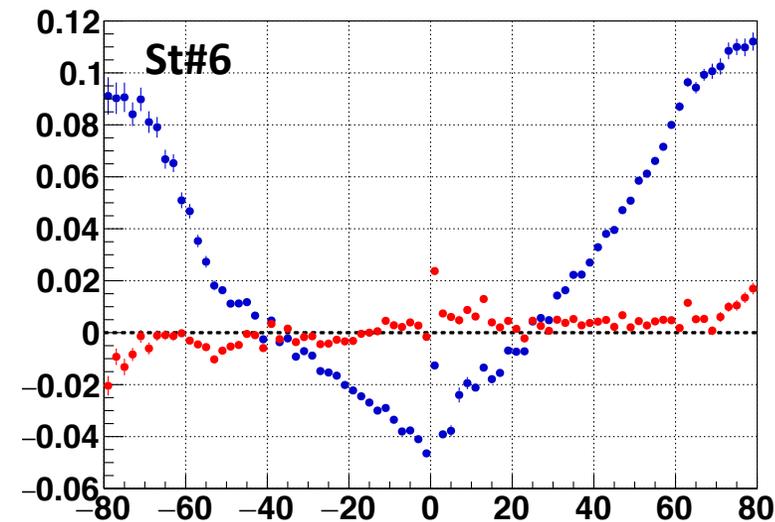
Mean dX vs. x ista==4 (DATA)



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



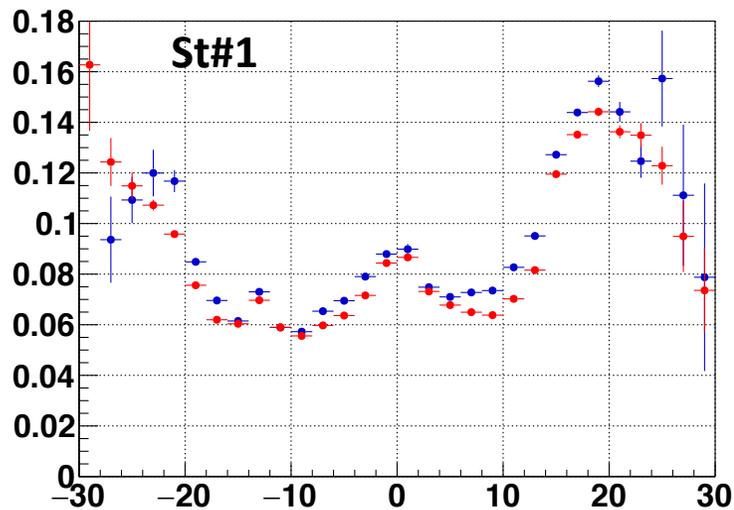
Mean dX vs. x ista==6 (DATA)



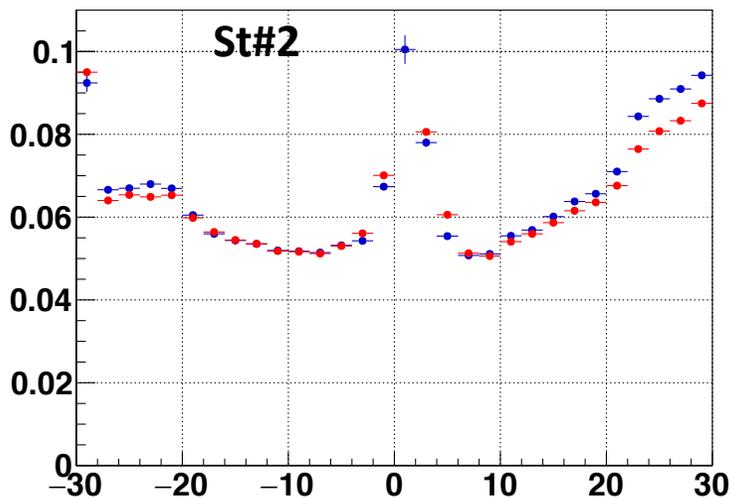
Blue: before corrections
Red: after corrections

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

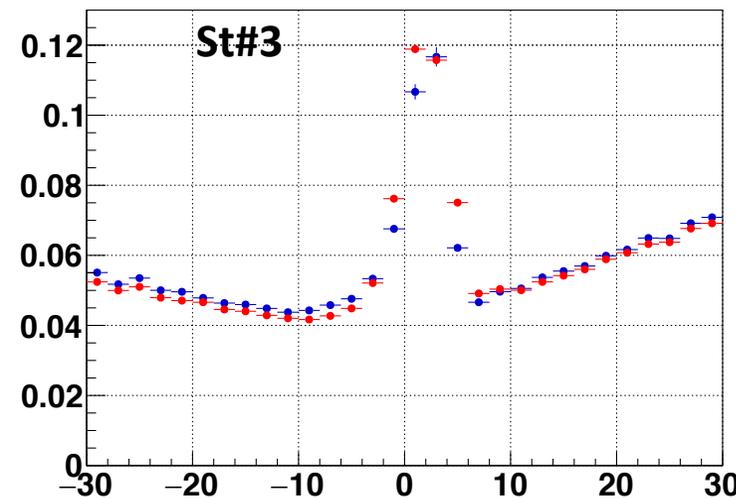
Sigma dX vs. x ista==1 (DATA)



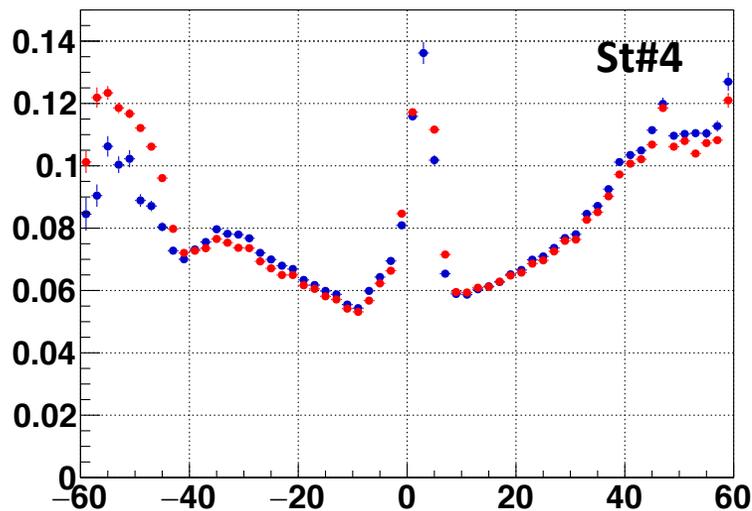
Sigma dX vs. x ista==2 (DATA)



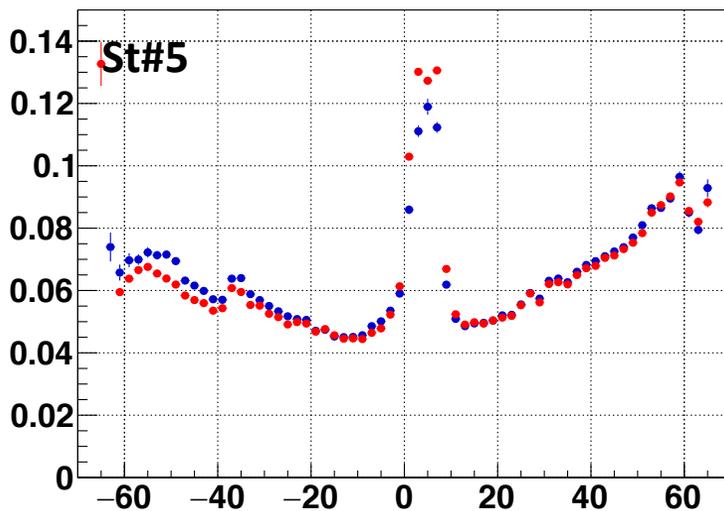
Sigma dX vs. x ista==3 (DATA)



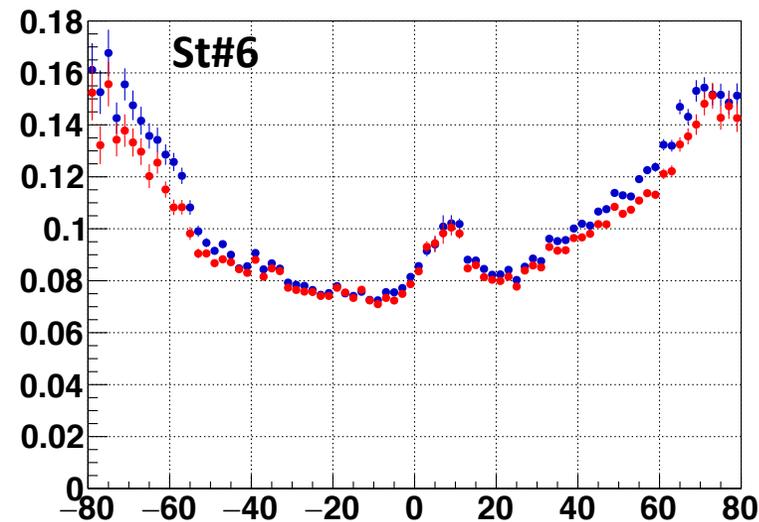
Sigma dX vs. x ista==4 (DATA)



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



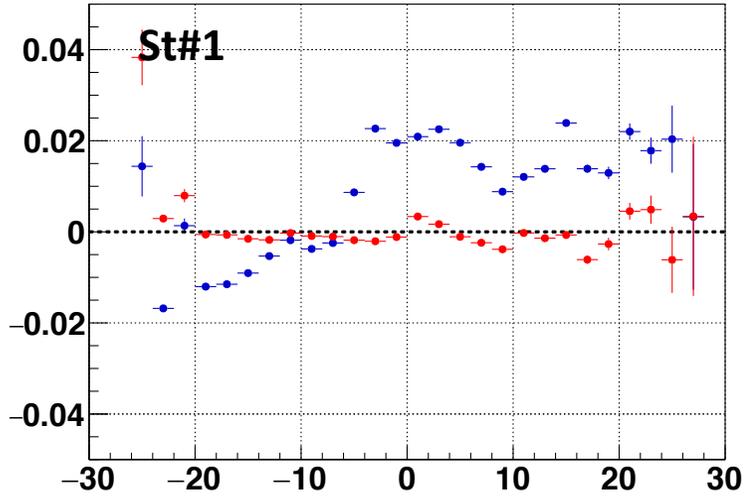
Sigma dX vs. x ista==6 (DATA)



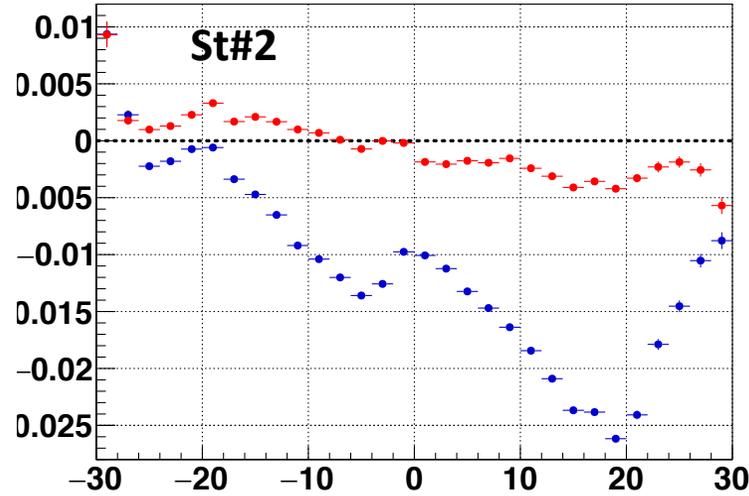
Blue: before corrections
Red: after corrections

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

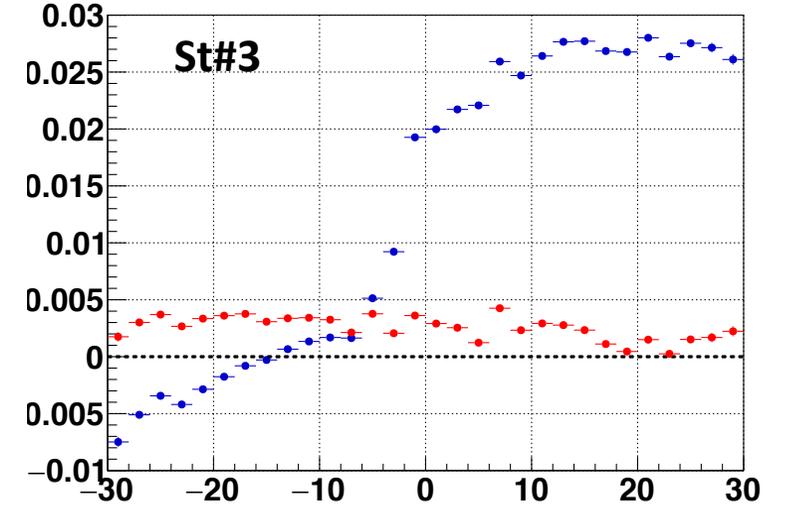
Mean dX vs. x ista==1 (MC)



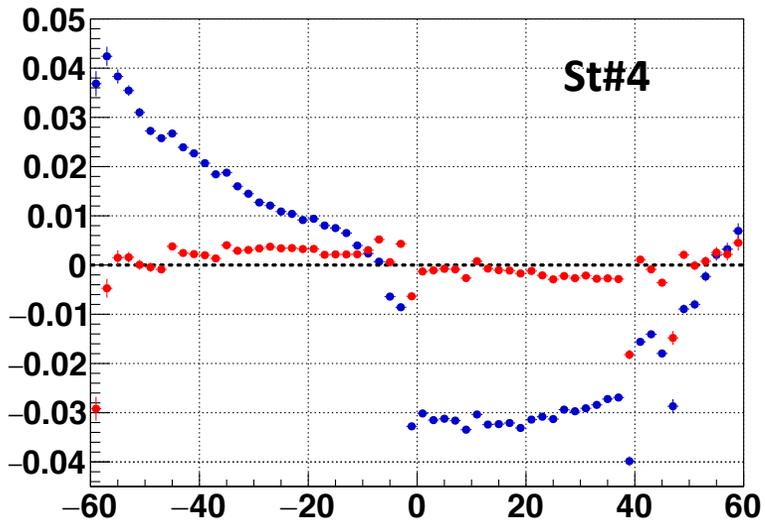
Mean dX vs. x ista==2 (MC)



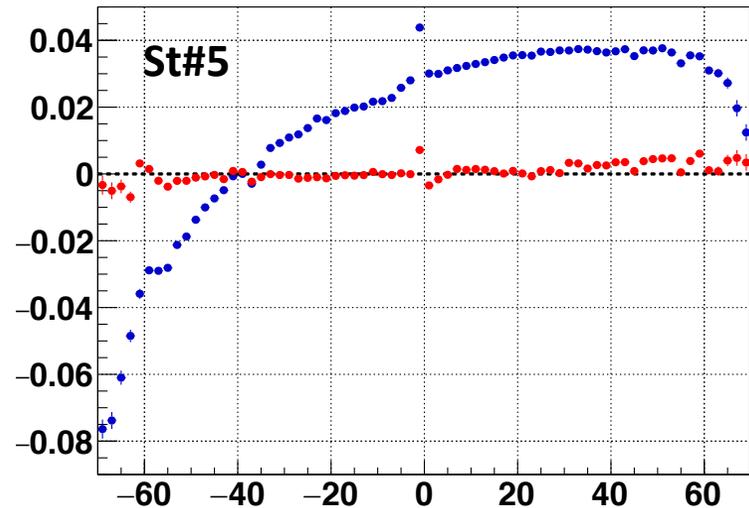
Mean dX vs. x ista==3 (MC)



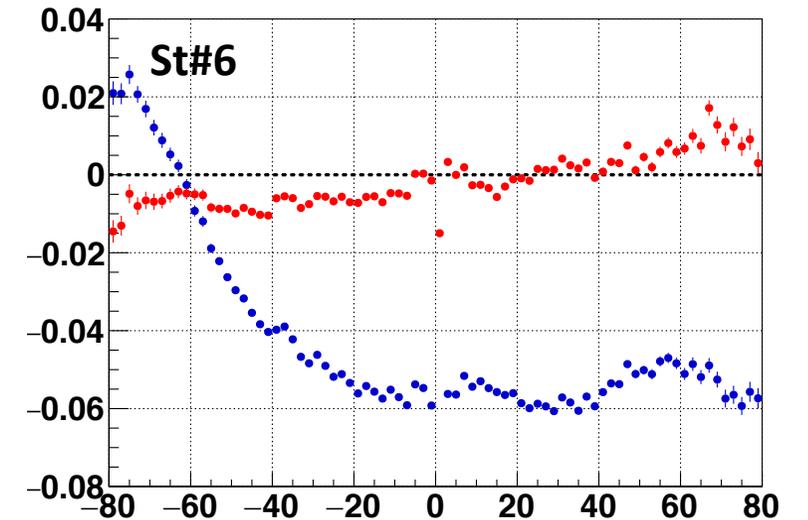
Mean dX vs. x ista==4 (MC)



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



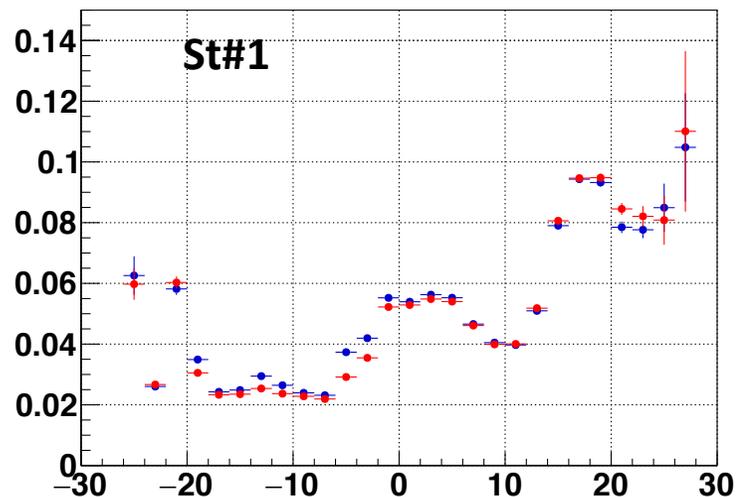
Mean dX vs. x ista==6 (MC)



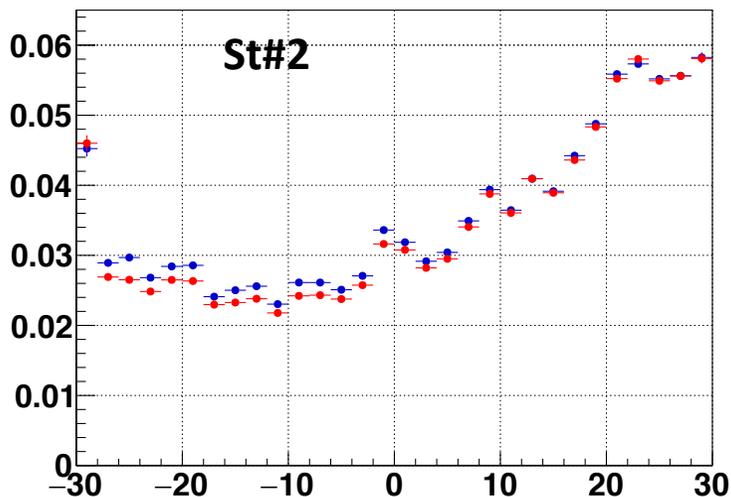
Blue: before corrections
Red: after corrections

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

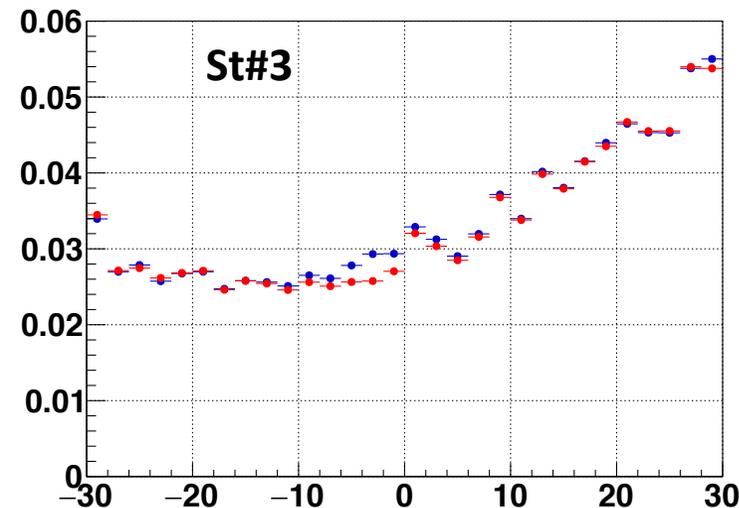
Sigma dX vs. x ista==1 (MC)



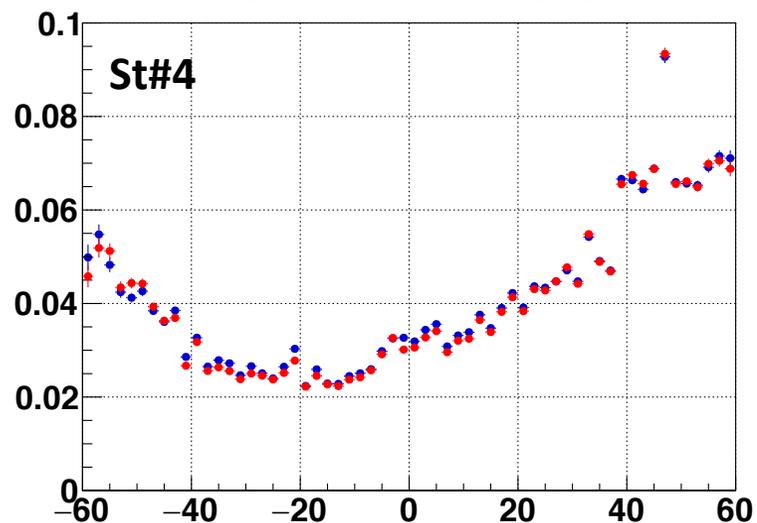
Sigma dX vs. x ista==2 (MC)



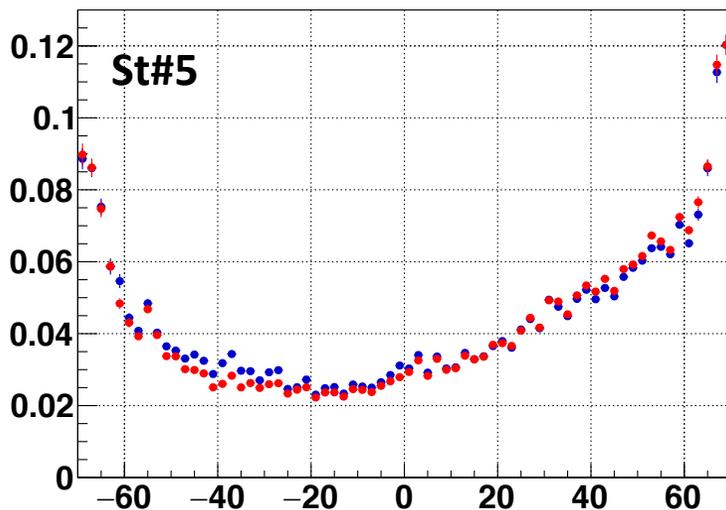
Sigma dX vs. x ista==3 (MC)



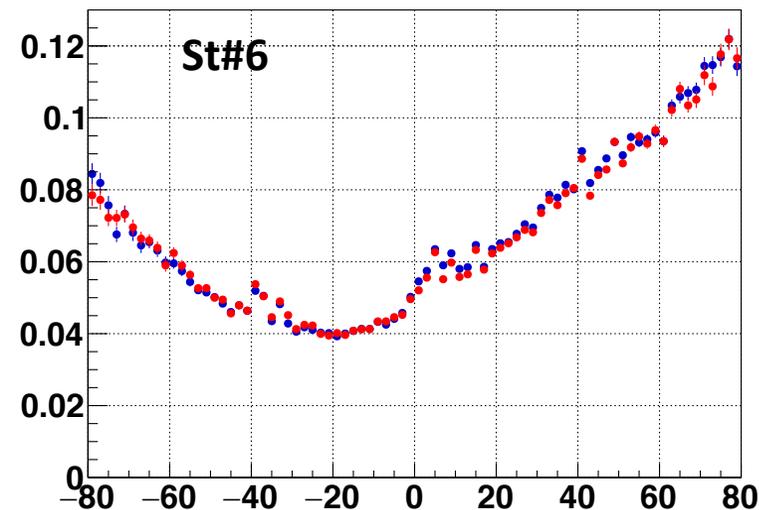
Sigma dX vs. x ista==4 (MC)



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



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



CC: Green

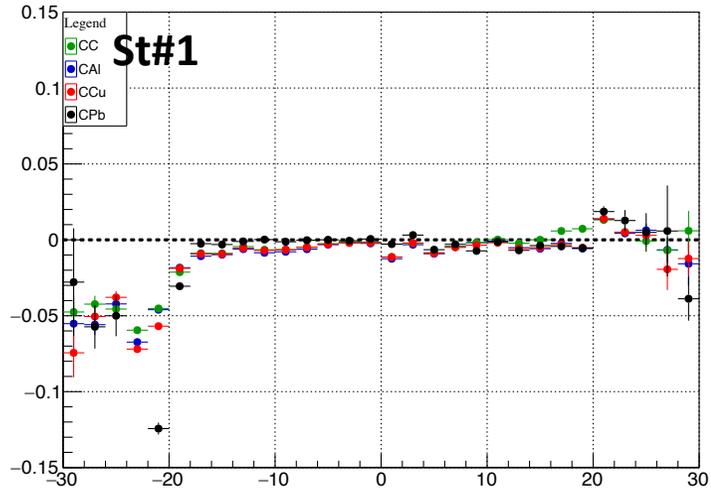
CAI: Blue

CCu: Red

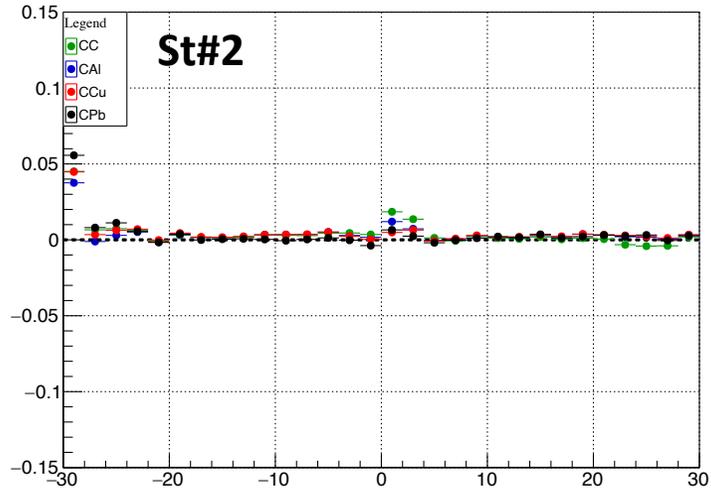
CPb: Black

Mean Dx vs x (DATA all targets)

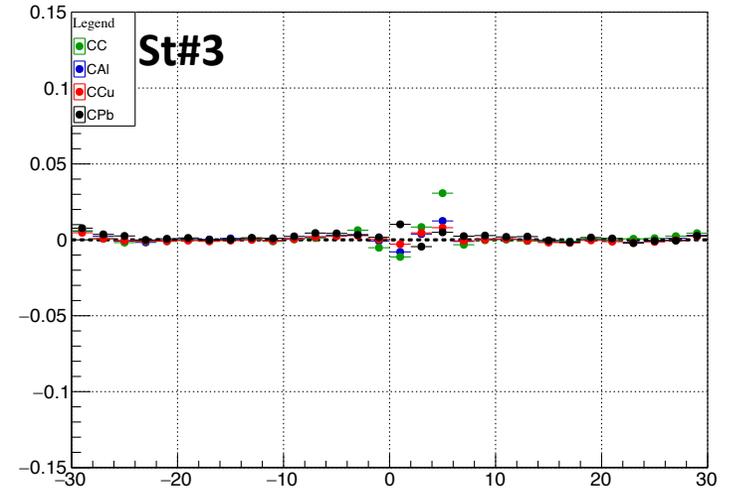
Mean dX vs. x ista==1 all



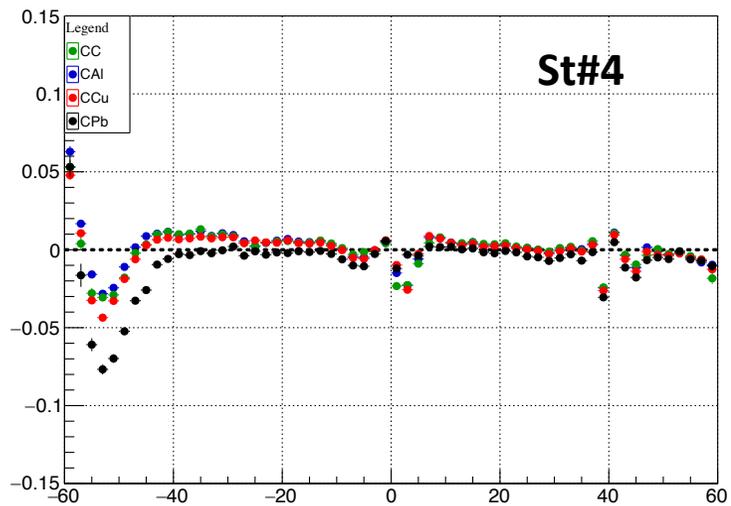
Mean dX vs. x ista==2 all



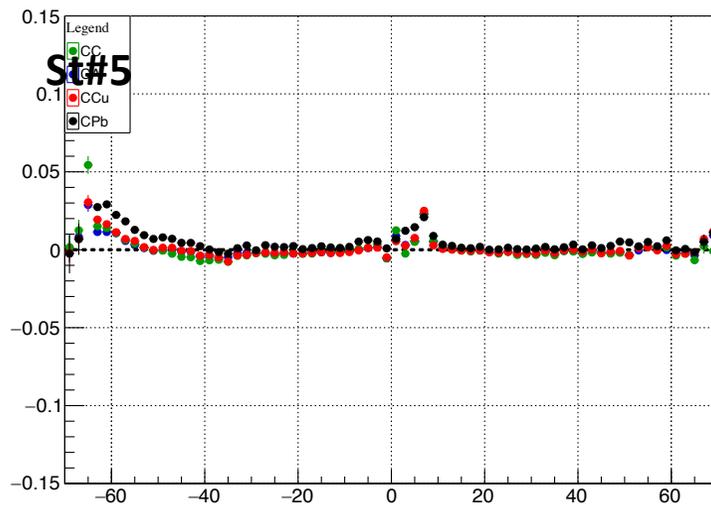
Mean dX vs. x ista==3 all



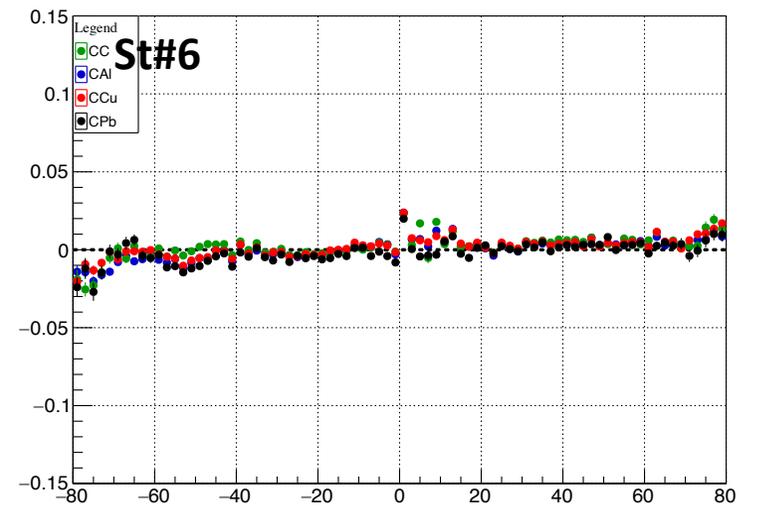
Mean dX vs. x ista==4 all



Mean dX vs. x ista==5 all



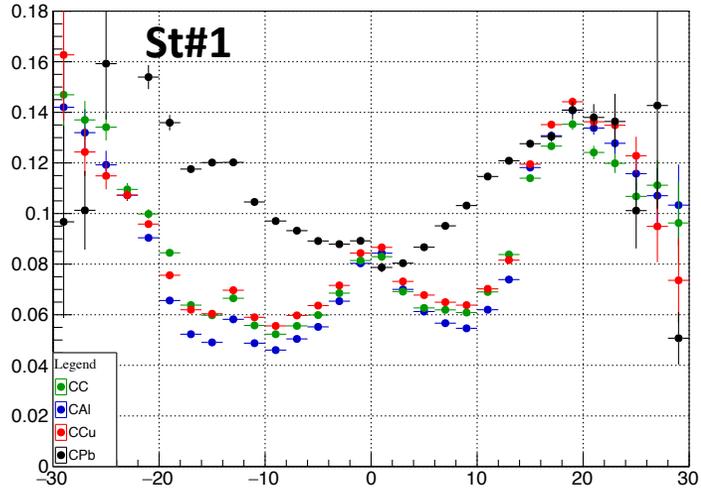
Mean dX vs. x ista==6 all



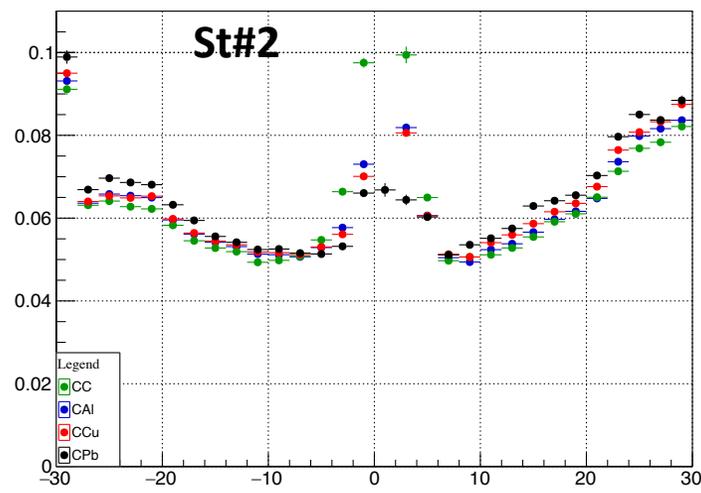
CC: Green
CAI: Blue
CCu: Red
CPb: Black

Sigma Dx vs x (DATA 4.0GeV all targets)

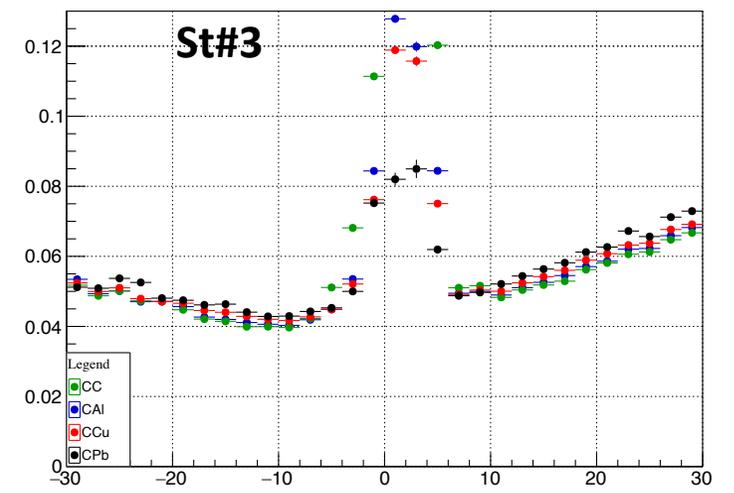
Sigma dX vs. x ista==1



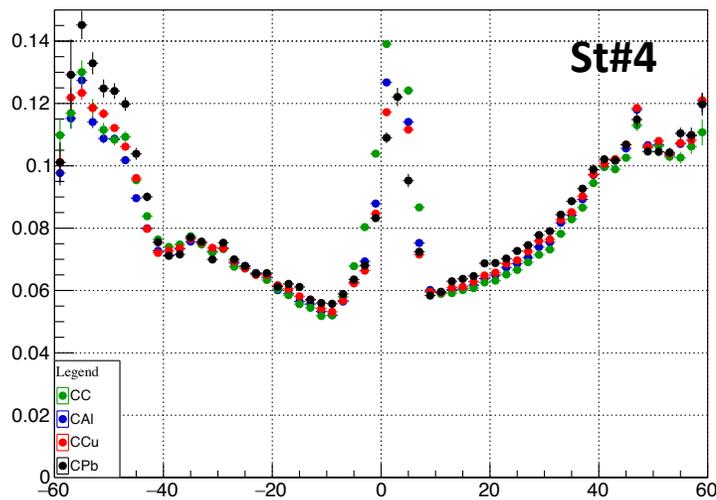
Sigma dX vs. x ista==2



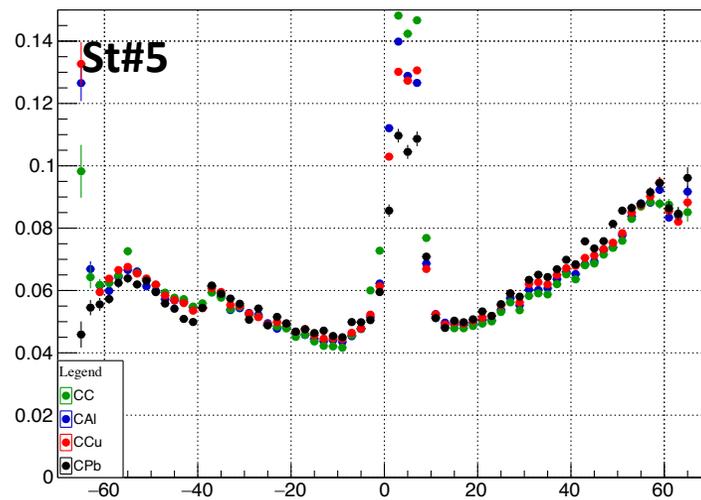
Sigma dX vs. x ista==3



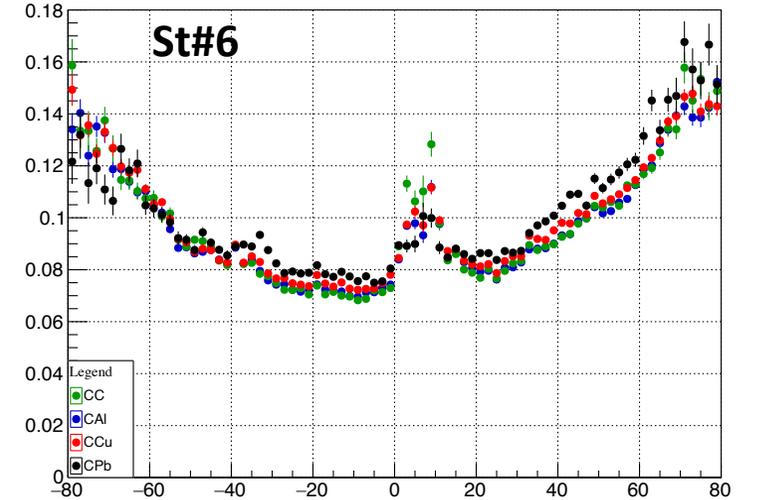
Sigma dX vs. x ista==4



Sigma dX vs. x ista==5



Sigma dX vs. x ista==6



CC: Green

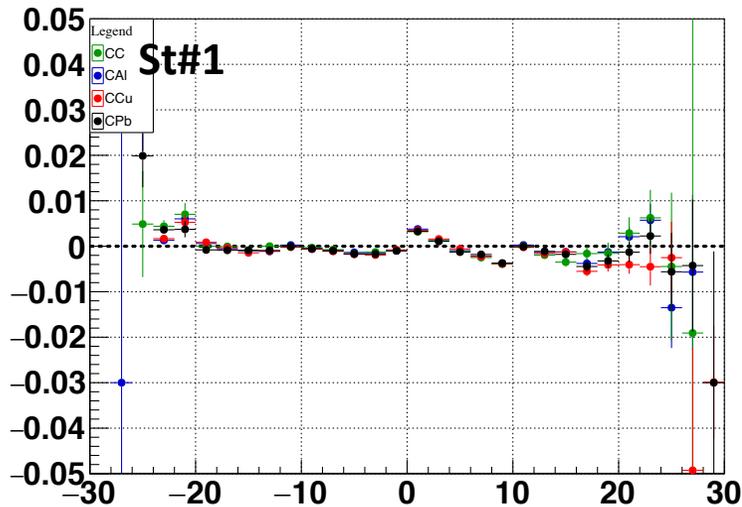
CAI: Blue

CCu: Red

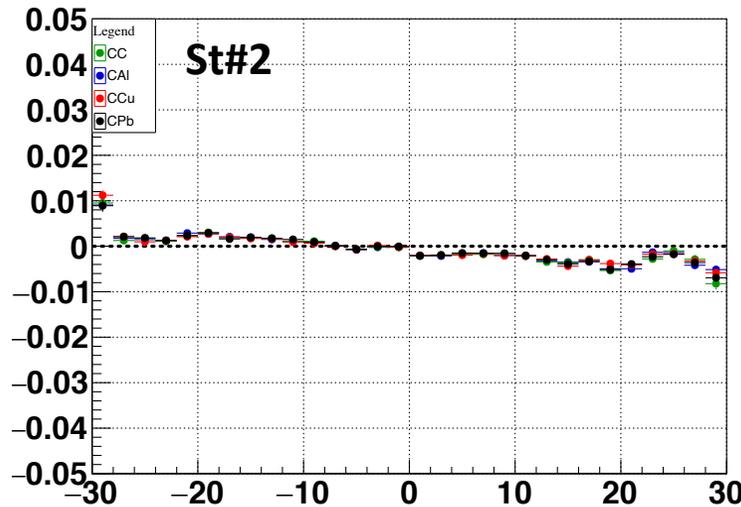
CPb: Black

Mean Dx vs x (MC 4.0GeV all targets)

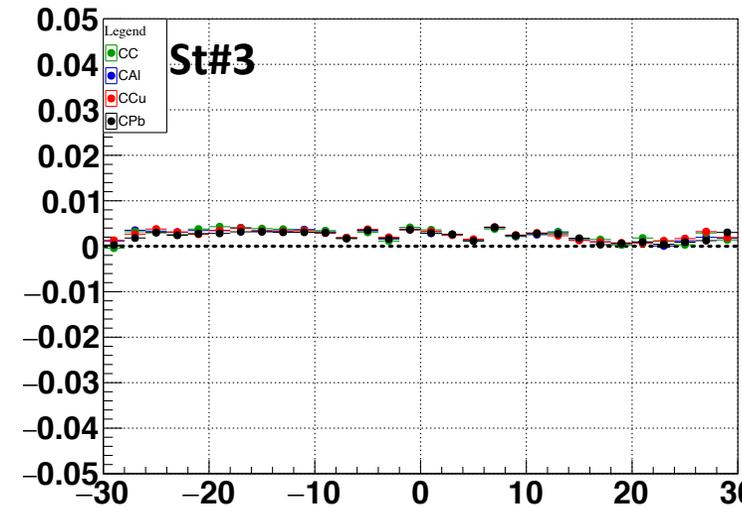
Mean dX vs. x ista==1 all



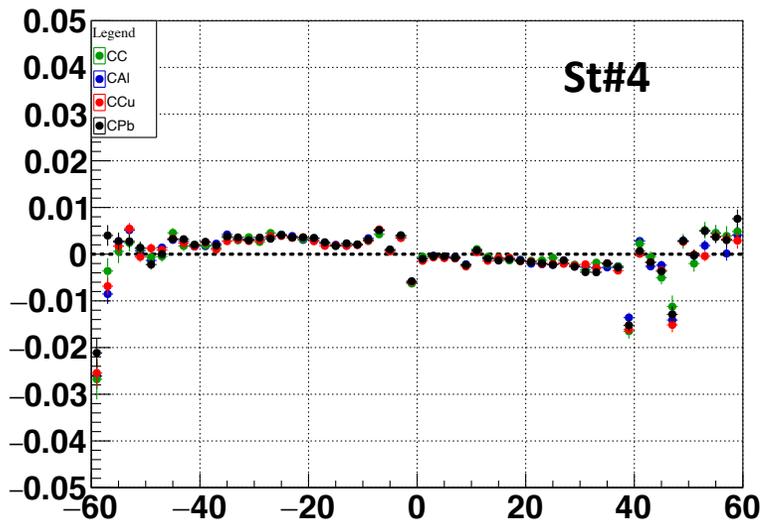
Mean dX vs. x ista==2 all



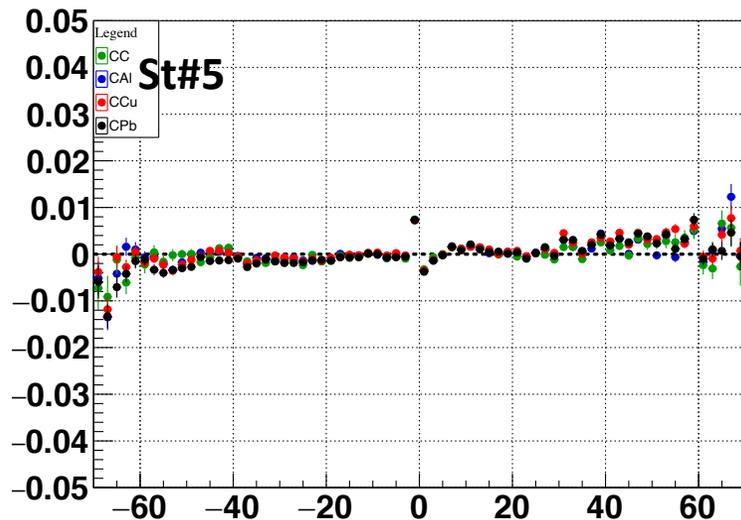
Mean dX vs. x ista==3 all



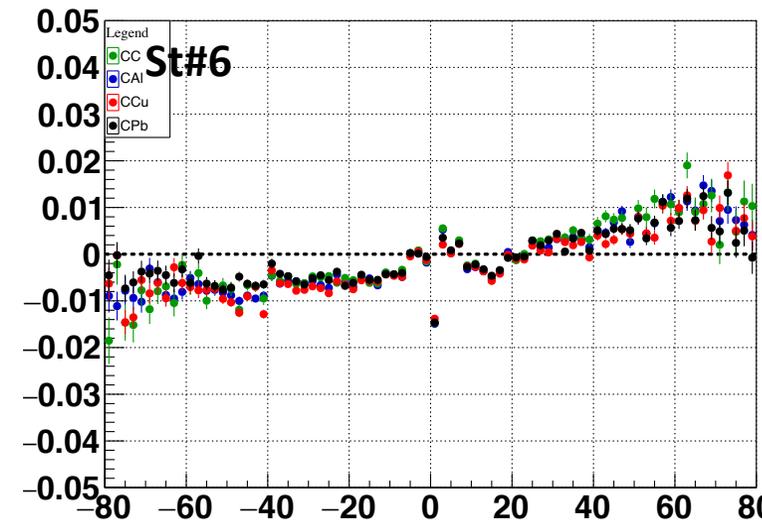
Mean dX vs. x ista==4 all



Mean dX vs. x ista==5 all



Mean dX vs. x ista==6 all



CC: Green

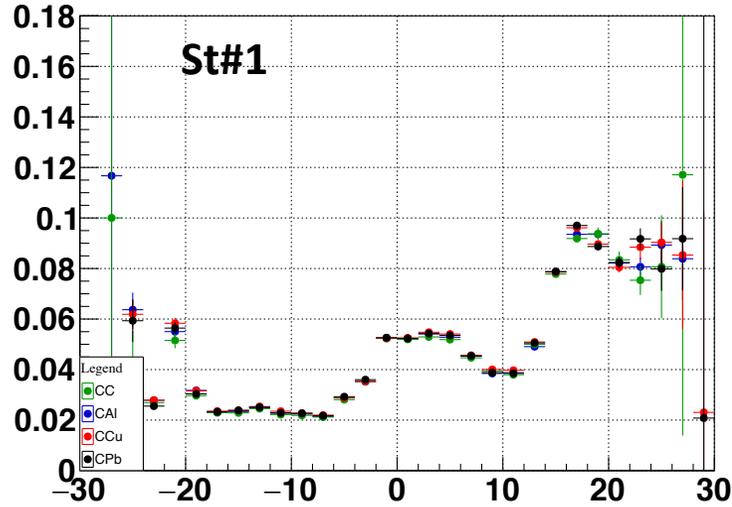
CAI: Blue

CCu: Red

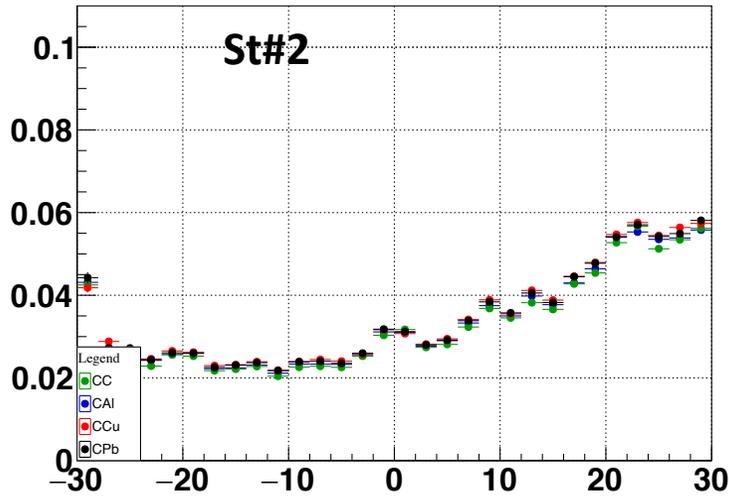
CPb: Black

Sigma Dx vs x (MC 4.0GeV all targets)

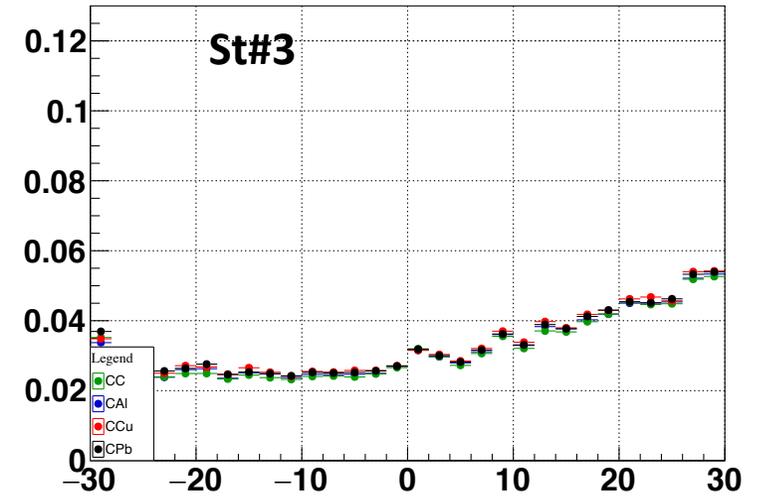
Sigma dX vs. x ista==1



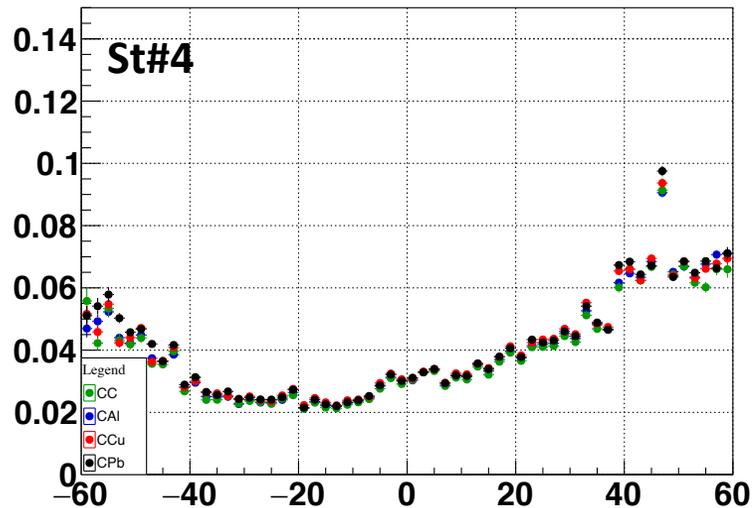
Sigma dX vs. x ista==2



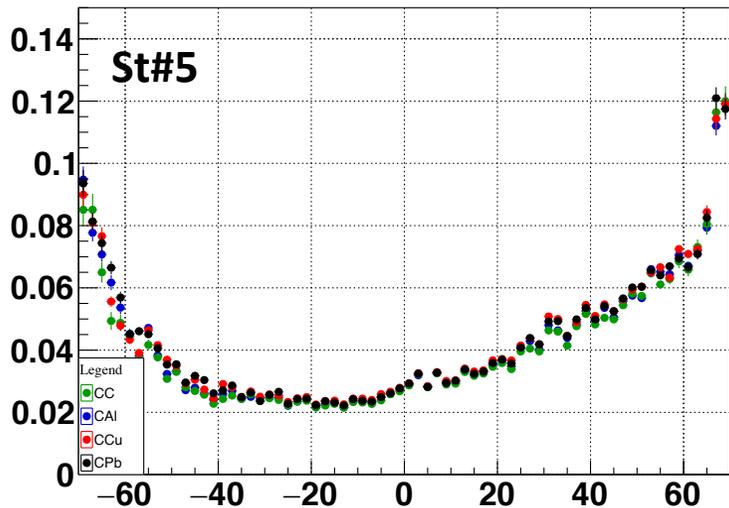
Sigma dX vs. x ista==3



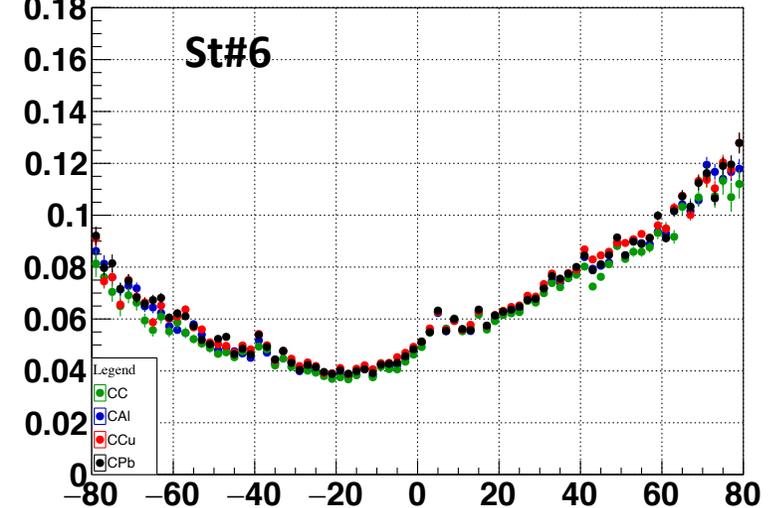
Sigma dX vs. x ista==4



Sigma dX vs. x ista==5



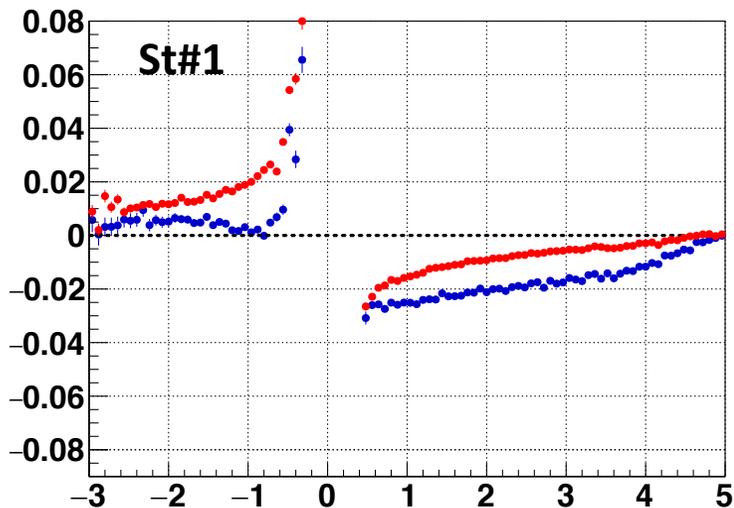
Sigma dX vs. x ista==6



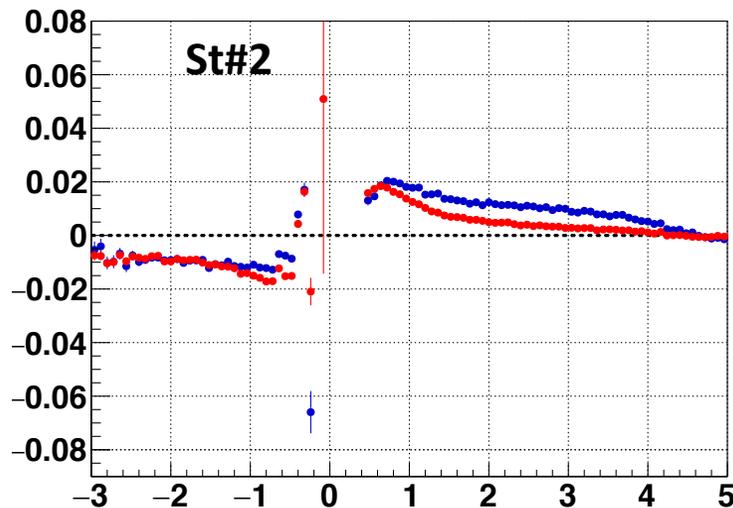
Blue: before corrections
Red: after corrections

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

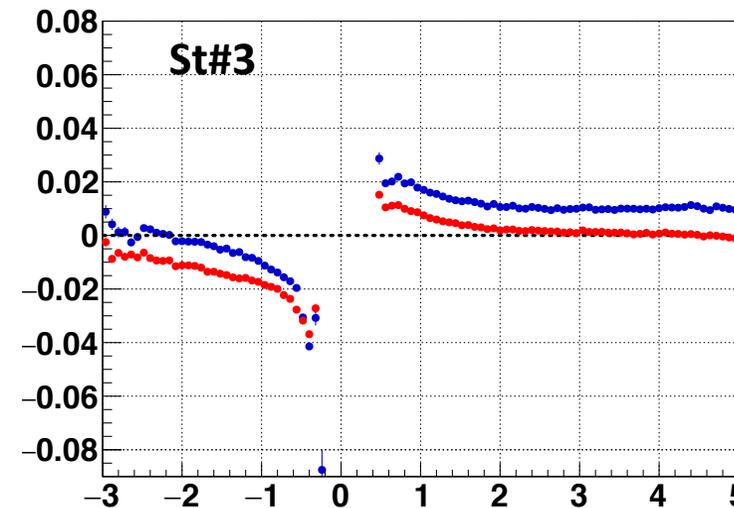
Mean Mom. vs. x ista==1 (DATA)



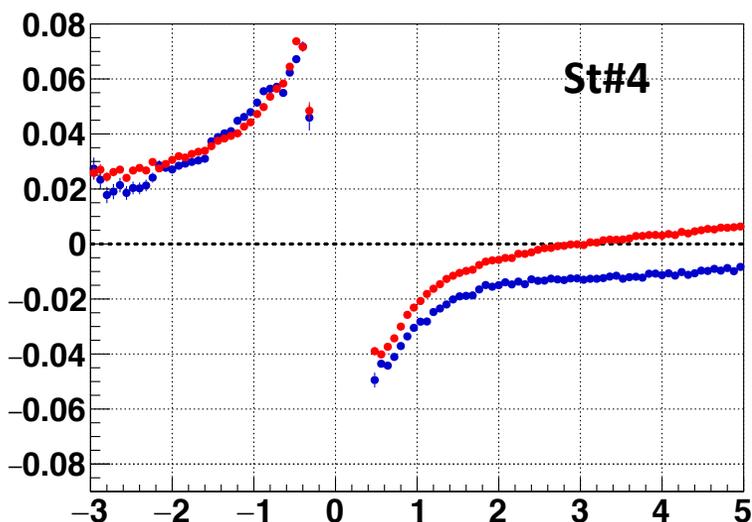
Mean Mom. vs. x ista==2 (DATA)



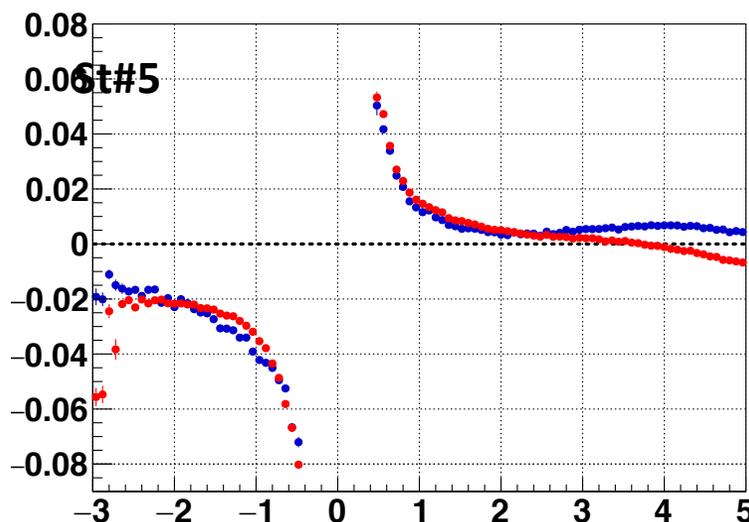
Mean Mom. vs. x ista==3 (DATA)



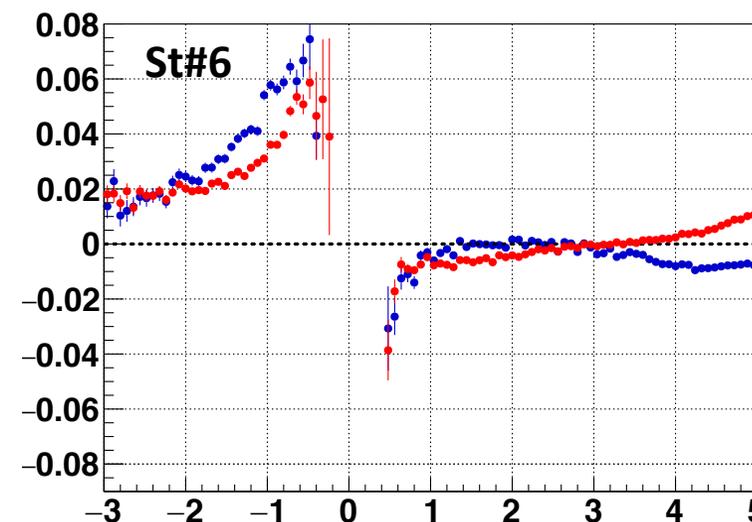
Mean Mom. vs. x ista==4 (DATA)



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



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



CC: Green

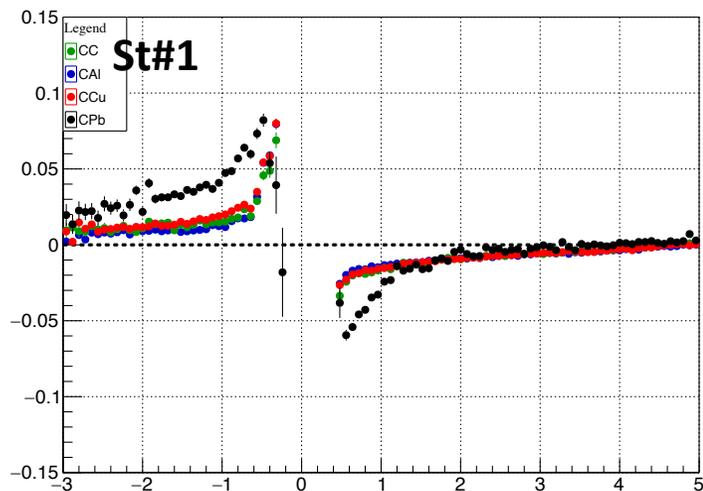
CAI: Blue

CCu: Red

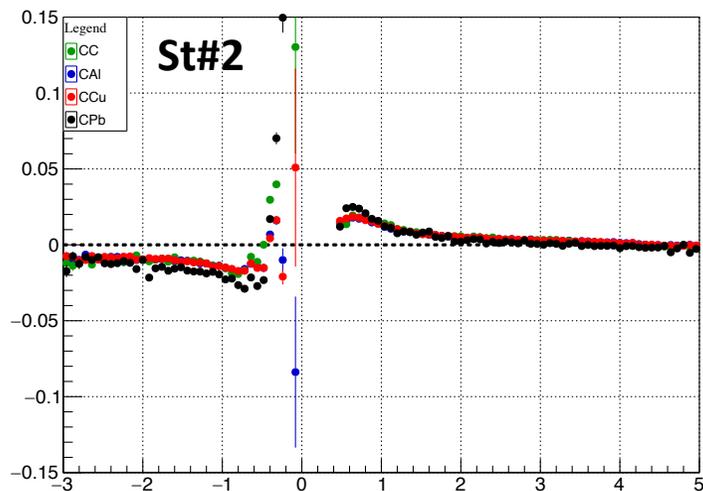
CPb: Black

Mean Dx vs Momentum (DATA 4.0GeV all targets)

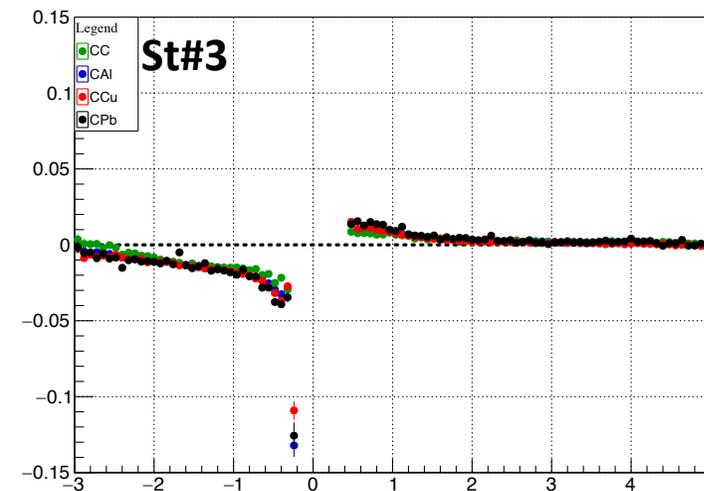
Mean Dx. vs. p ista==1



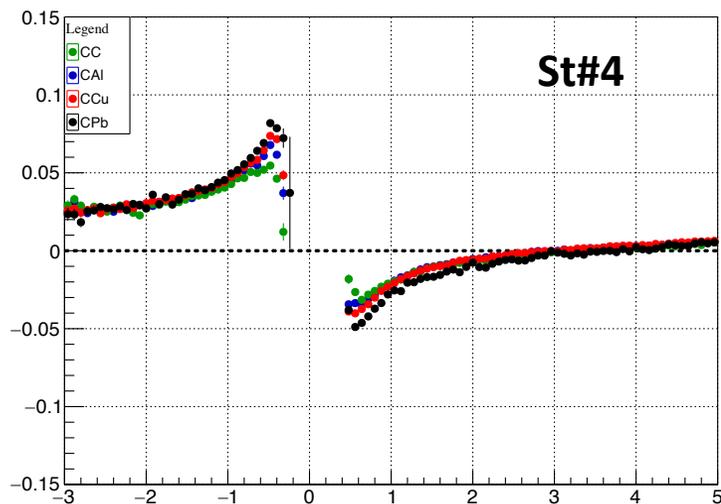
Mean Dx. vs. p ista==2



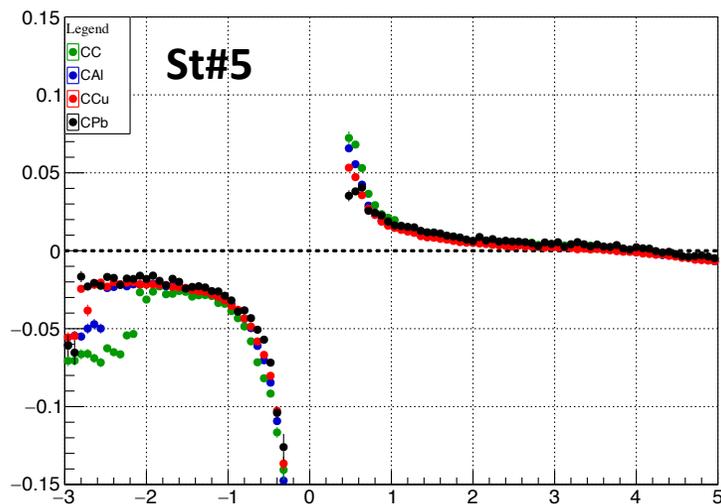
Mean Dx. vs. p ista==3



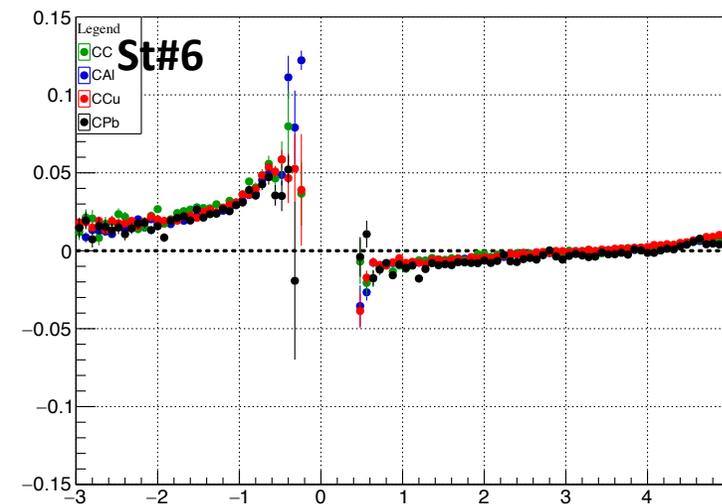
Mean Dx. vs. p ista==4



Mean Dx. vs. p ista==5



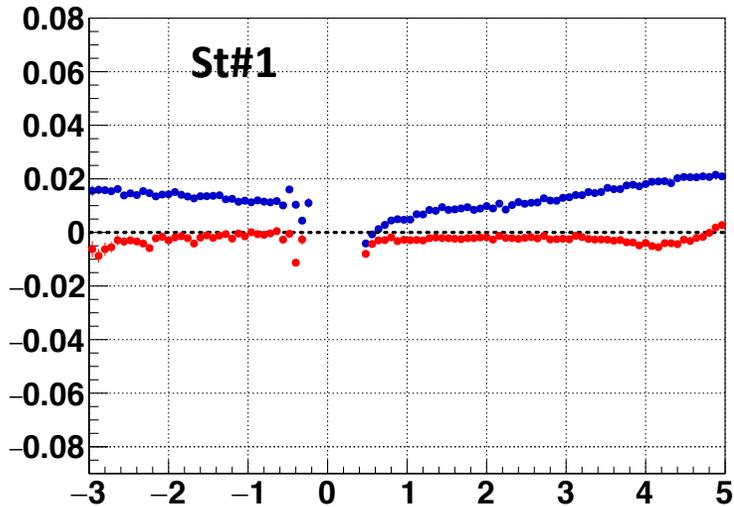
Mean Dx. vs. p ista==6



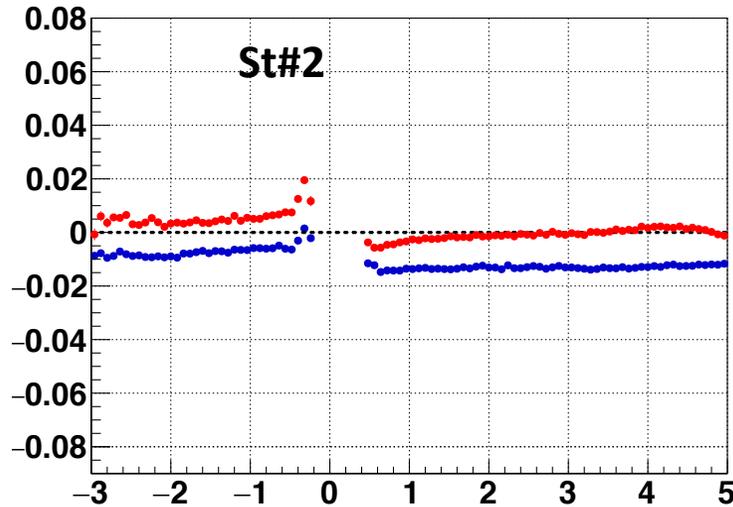
Blue: before corrections
Red: after corrections

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

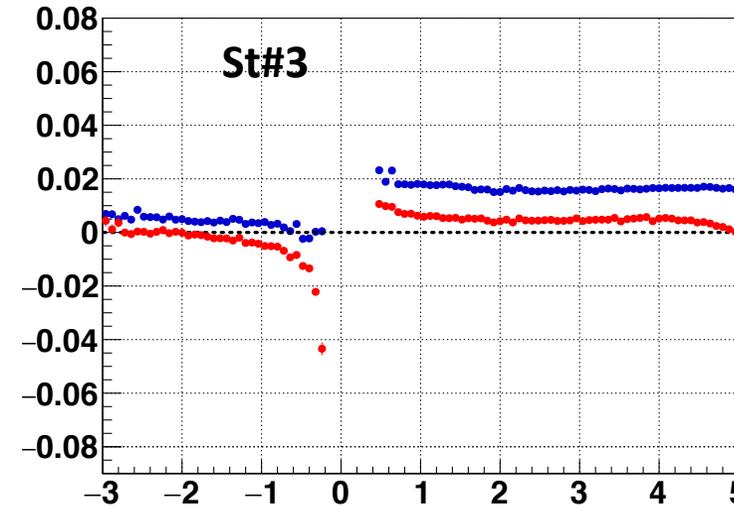
Mean Mom. vs. x ista==1 (MC)



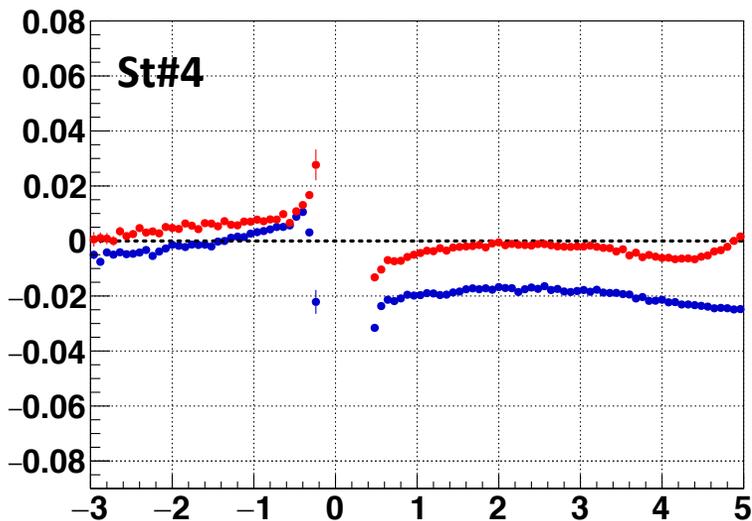
Mean Mom. vs. x ista==2 (MC)



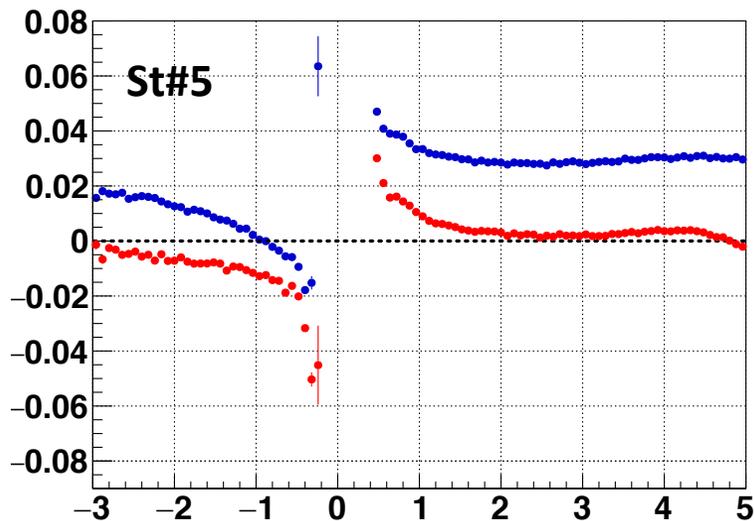
Mean Mom. vs. x ista==3 (MC)



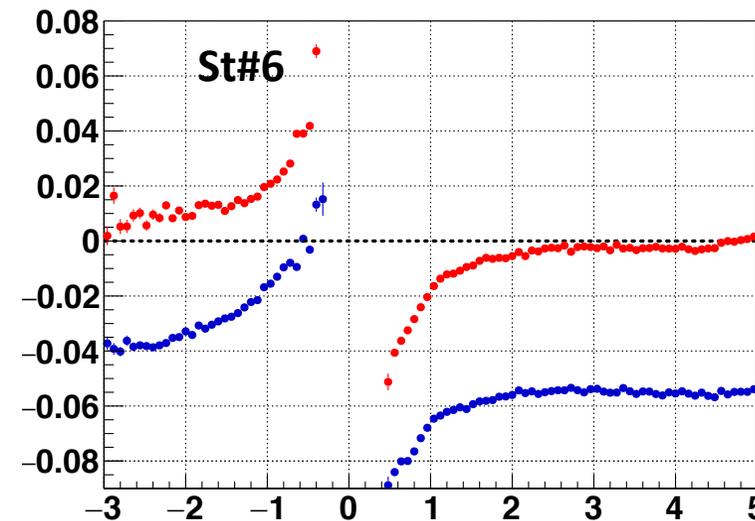
Mean Mom. vs. x ista==4 (MC)



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



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



CC: Green

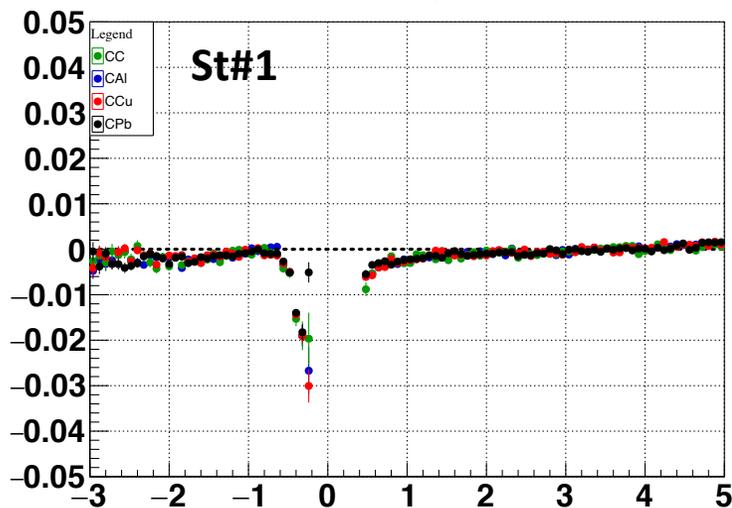
CAI: Blue

CCu: Red

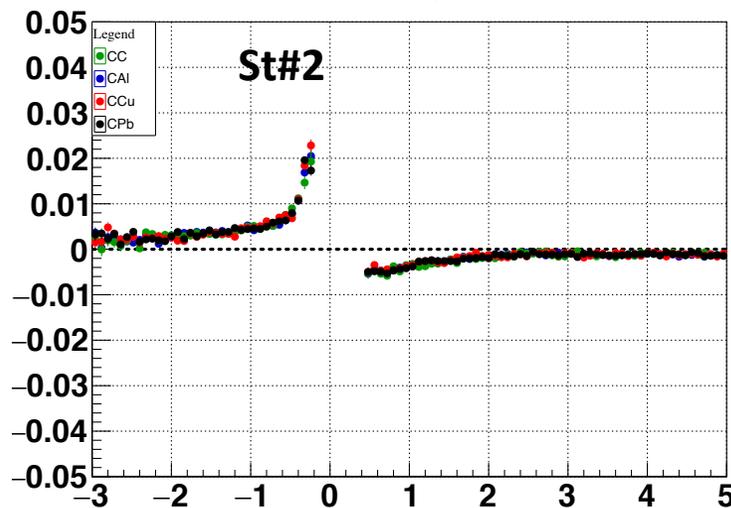
CPb: Black

Mean Dx vs Momentum (MC 4.0GeV all targets)

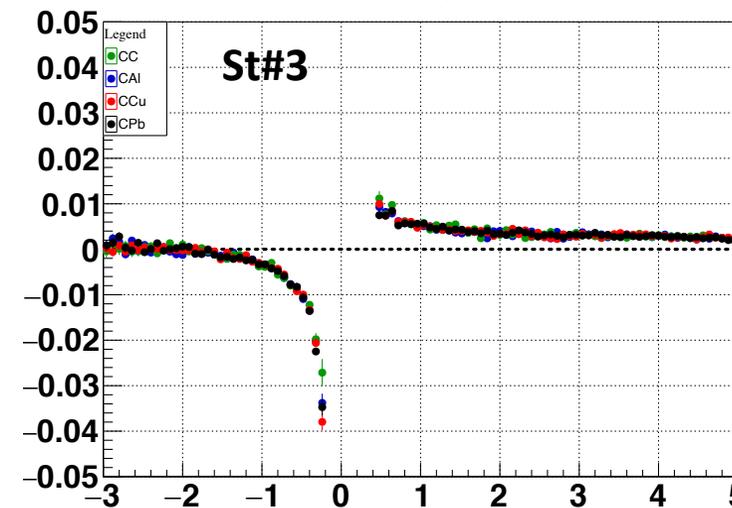
Mean Dx. vs. p ista==1



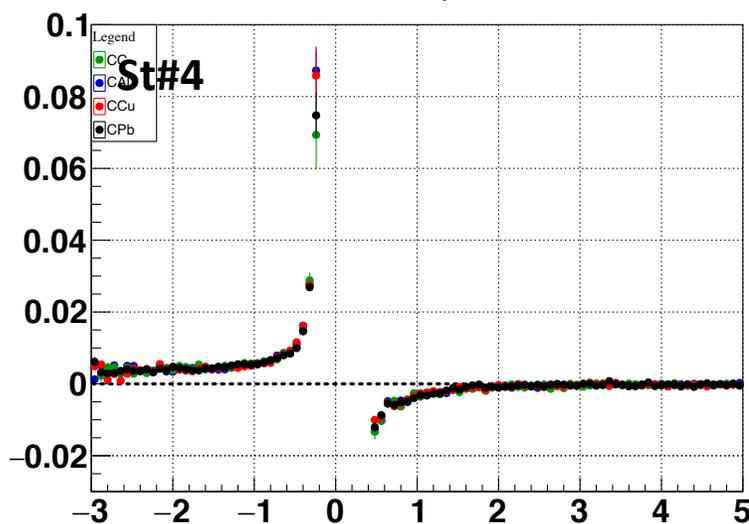
Mean Dx. vs. p ista==2



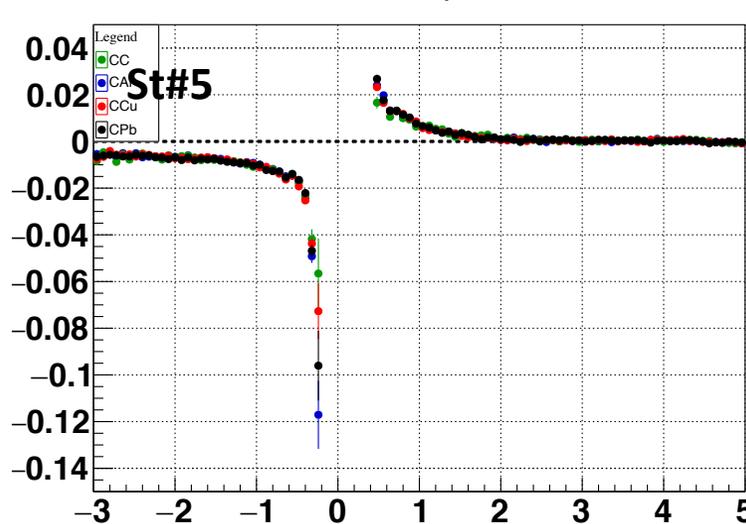
Mean Dx. vs. p ista==3



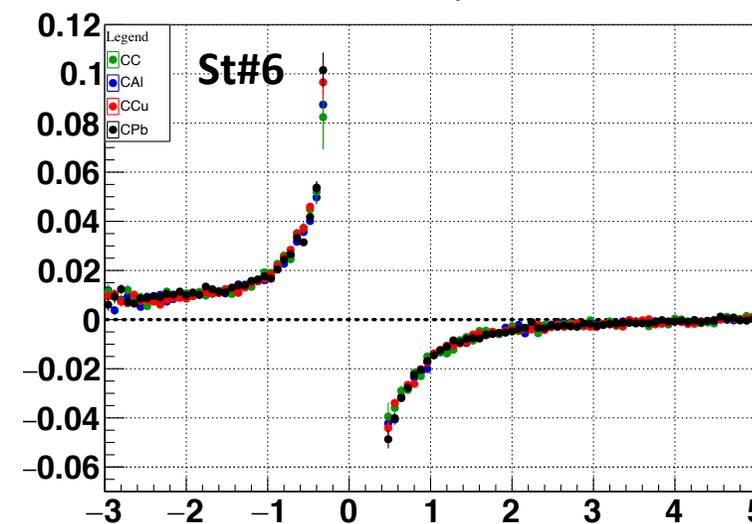
Mean Dx. vs. p ista==4



Mean Dx. vs. p ista==5



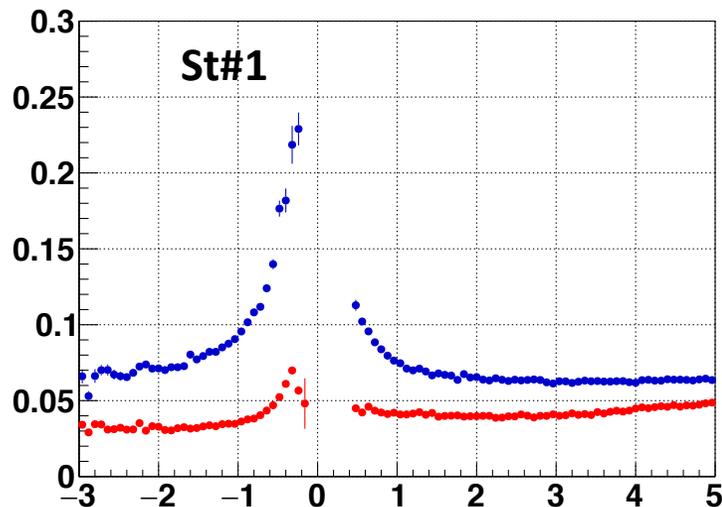
Mean Dx. vs. p ista==6



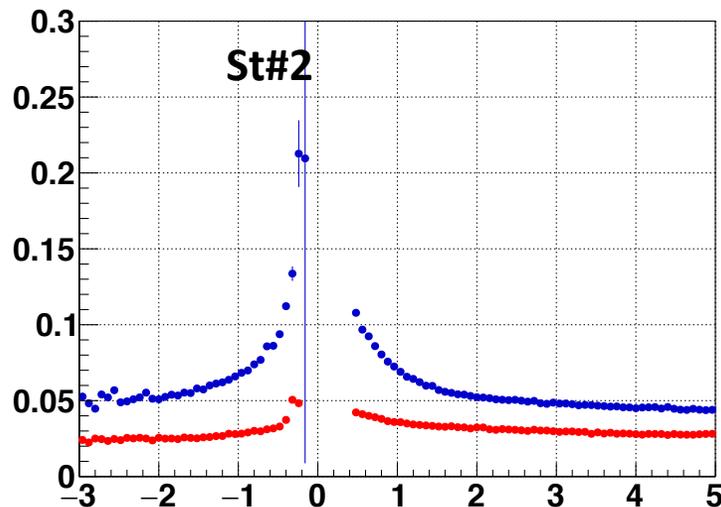
Blue: DATA
Red: MC

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

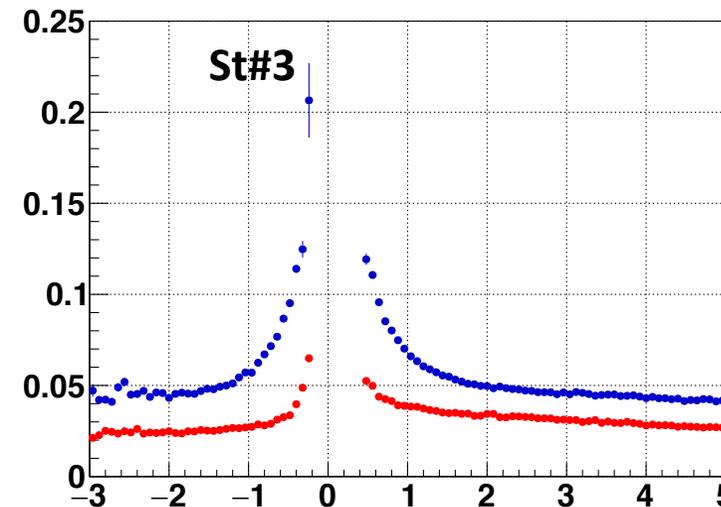
Sigma Mom& vs. x ista==1 (DATA & MC)



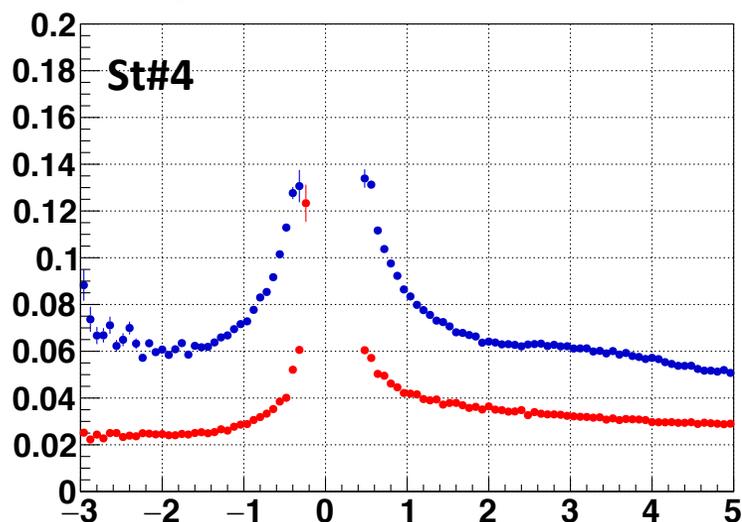
Sigma Mom& vs. x ista==2 (DATA & MC)



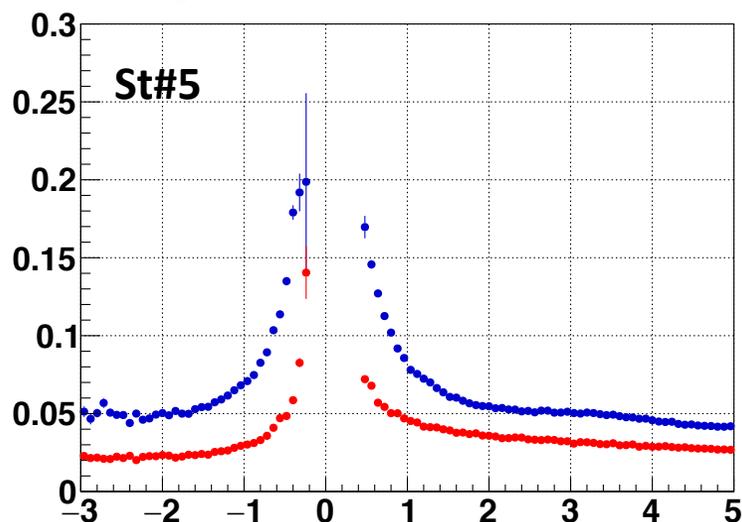
Sigma Mom& vs. x ista==3 (DATA & MC)



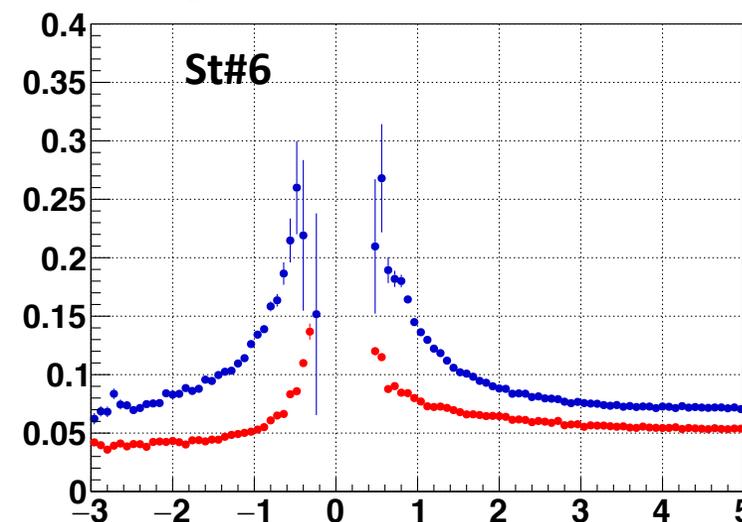
Sigma Mom& vs. x ista==4 (DATA & MC)



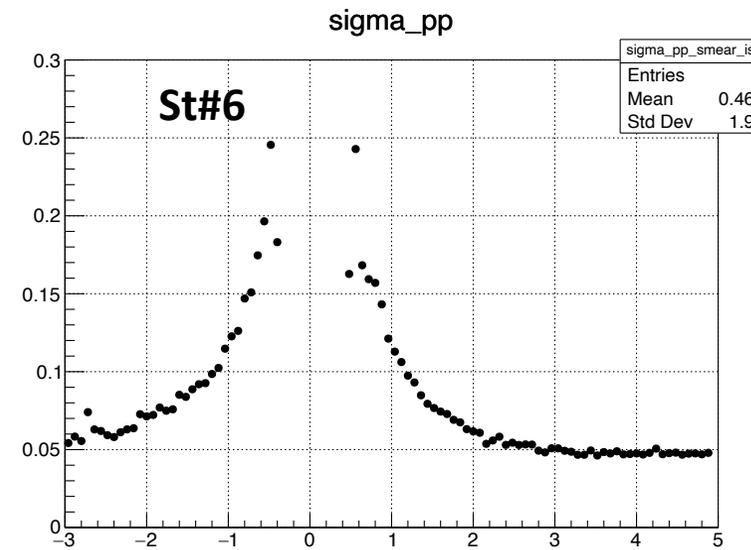
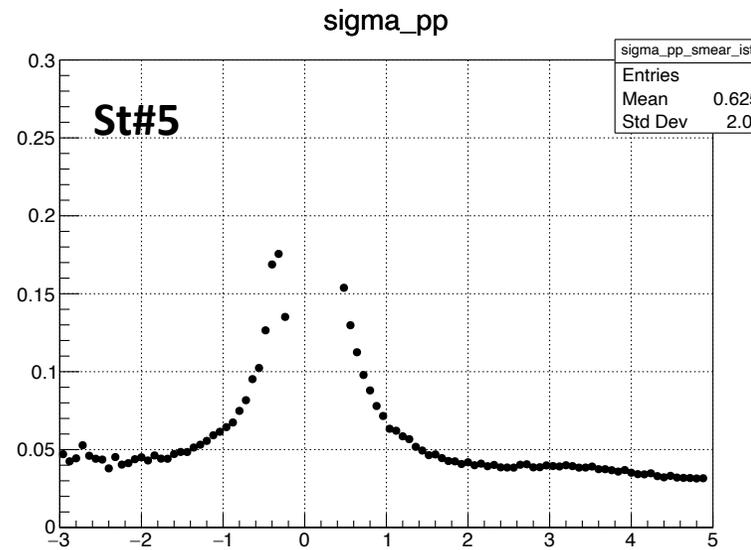
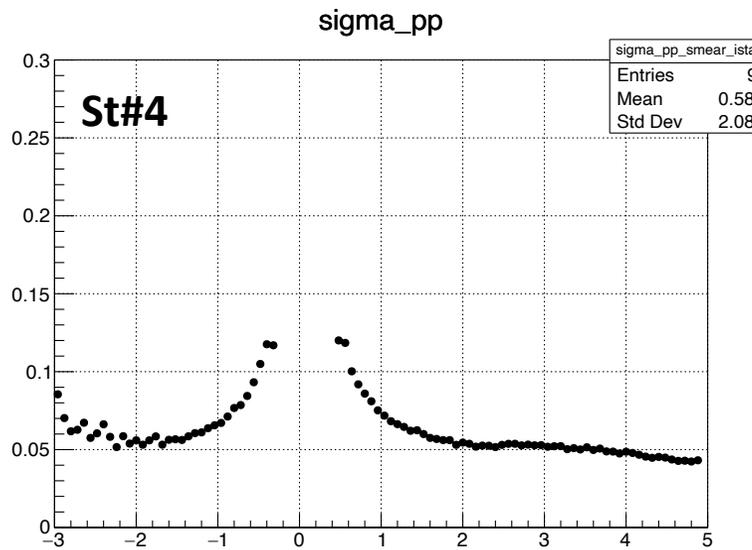
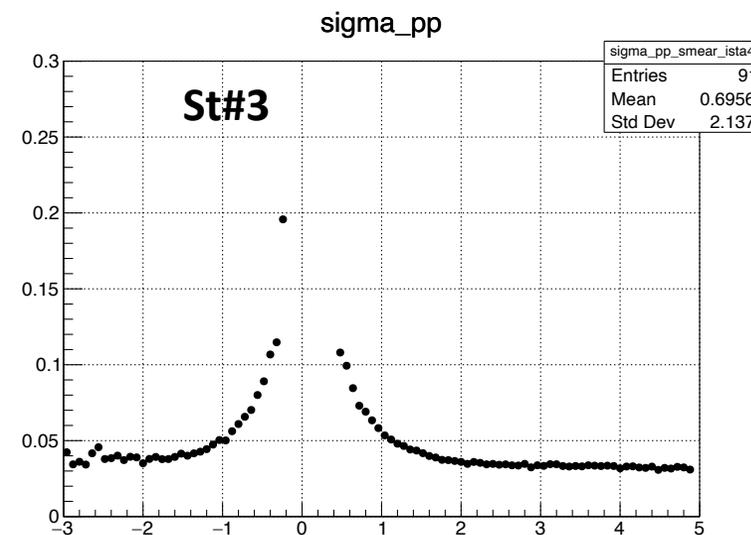
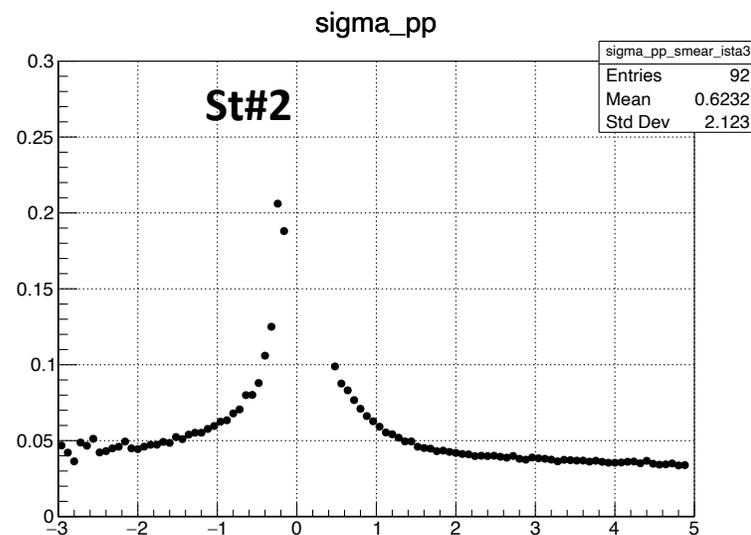
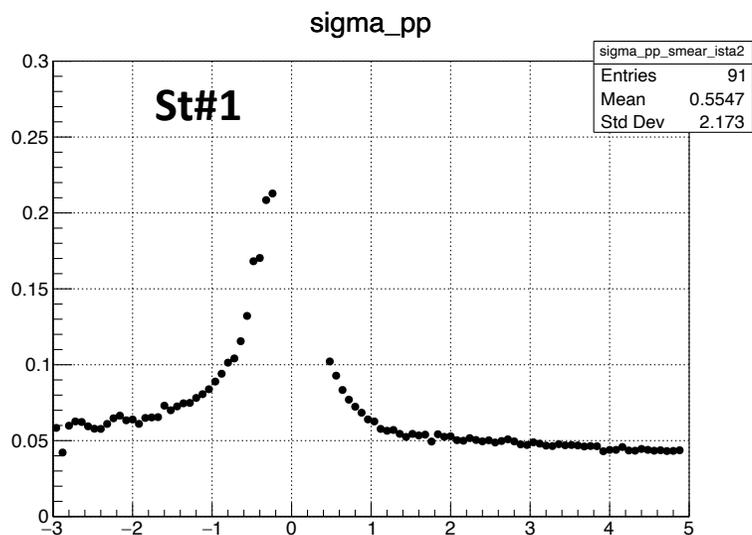
Sigma Mom& vs. x ista==5 (DATA & MC)



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

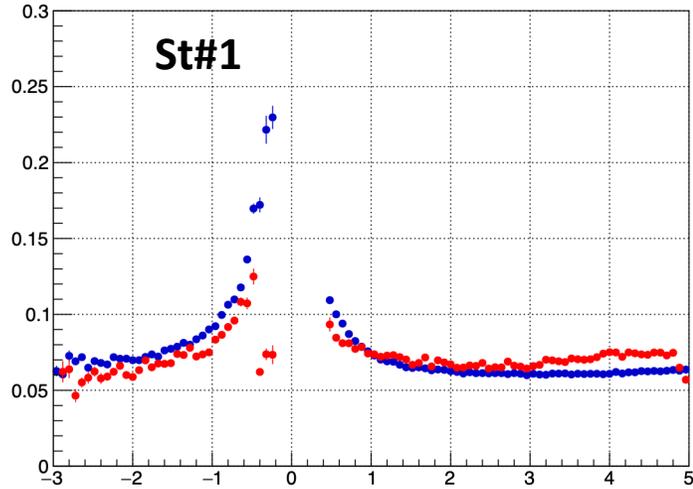


MC Smearing functions (Sigma Dx vs Momentum): $\sigma_{SMEAR} = \sqrt{\sigma_{DATA}^2 - \sigma_{MC}^2}$

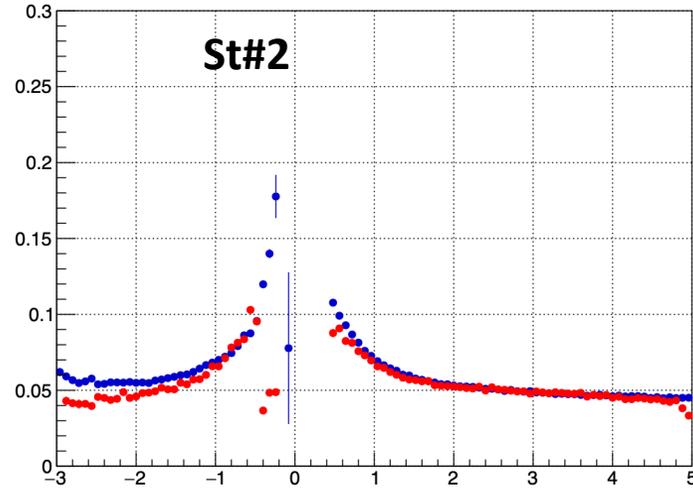


Sigma Dx vs Momentum **after smearing** (MC & Data 4.0GeV C+Cu)

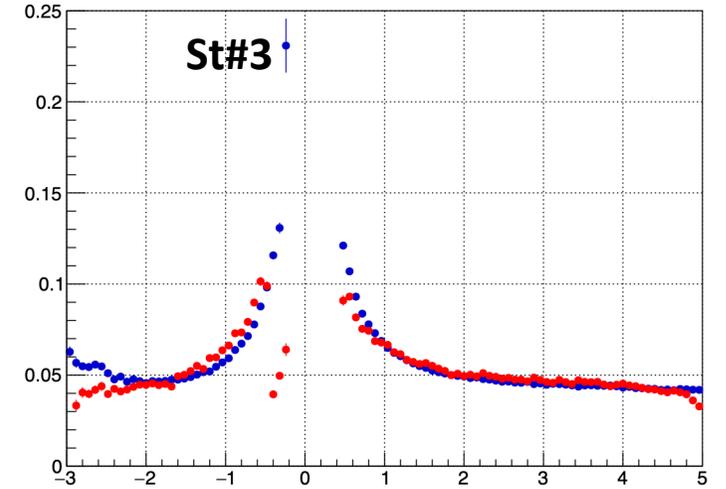
Sigma Mom& vs. x ista==1 (DATA & MC)



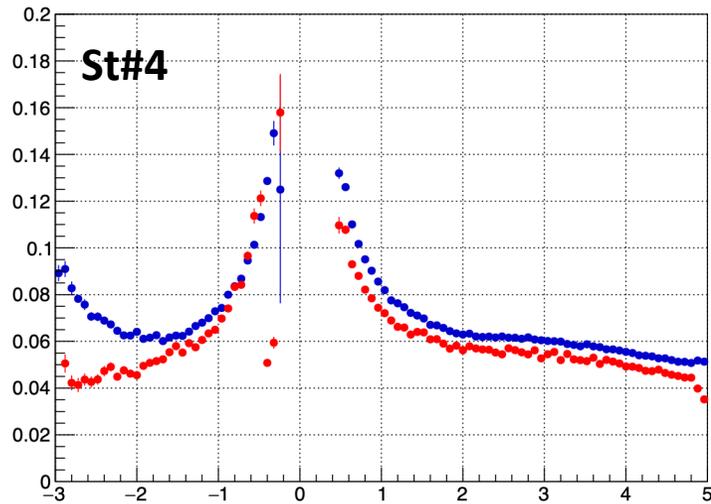
Sigma Mom& vs. x ista==2 (DATA & MC)



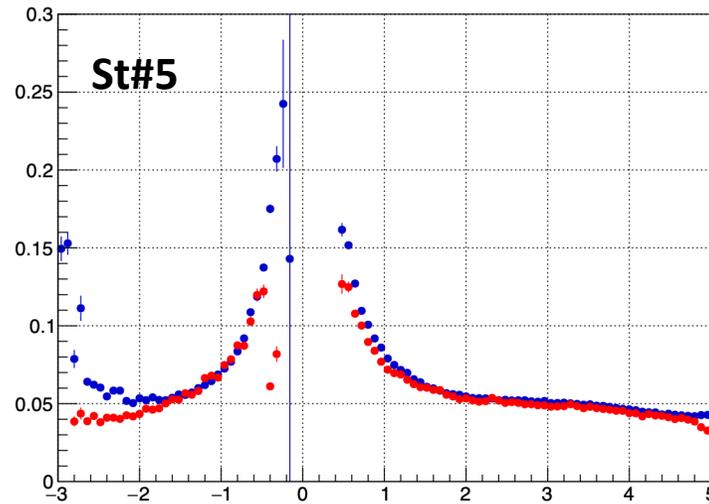
Sigma Mom& vs. x ista==3 (DATA & MC)



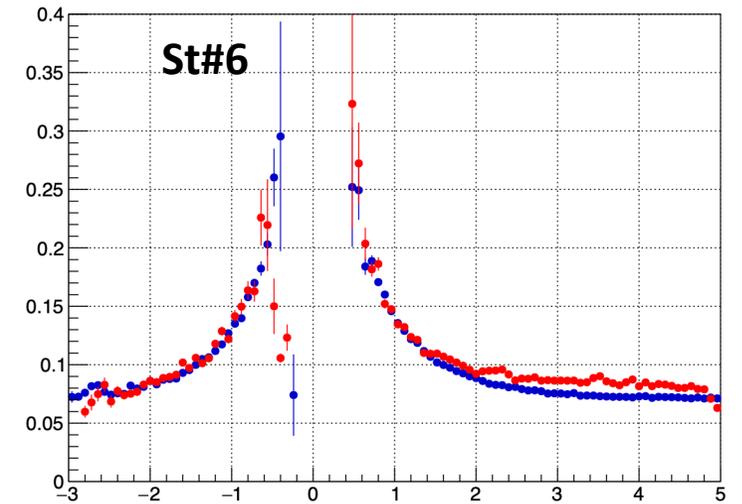
Sigma Mom& vs. x ista==4 (DATA & MC)



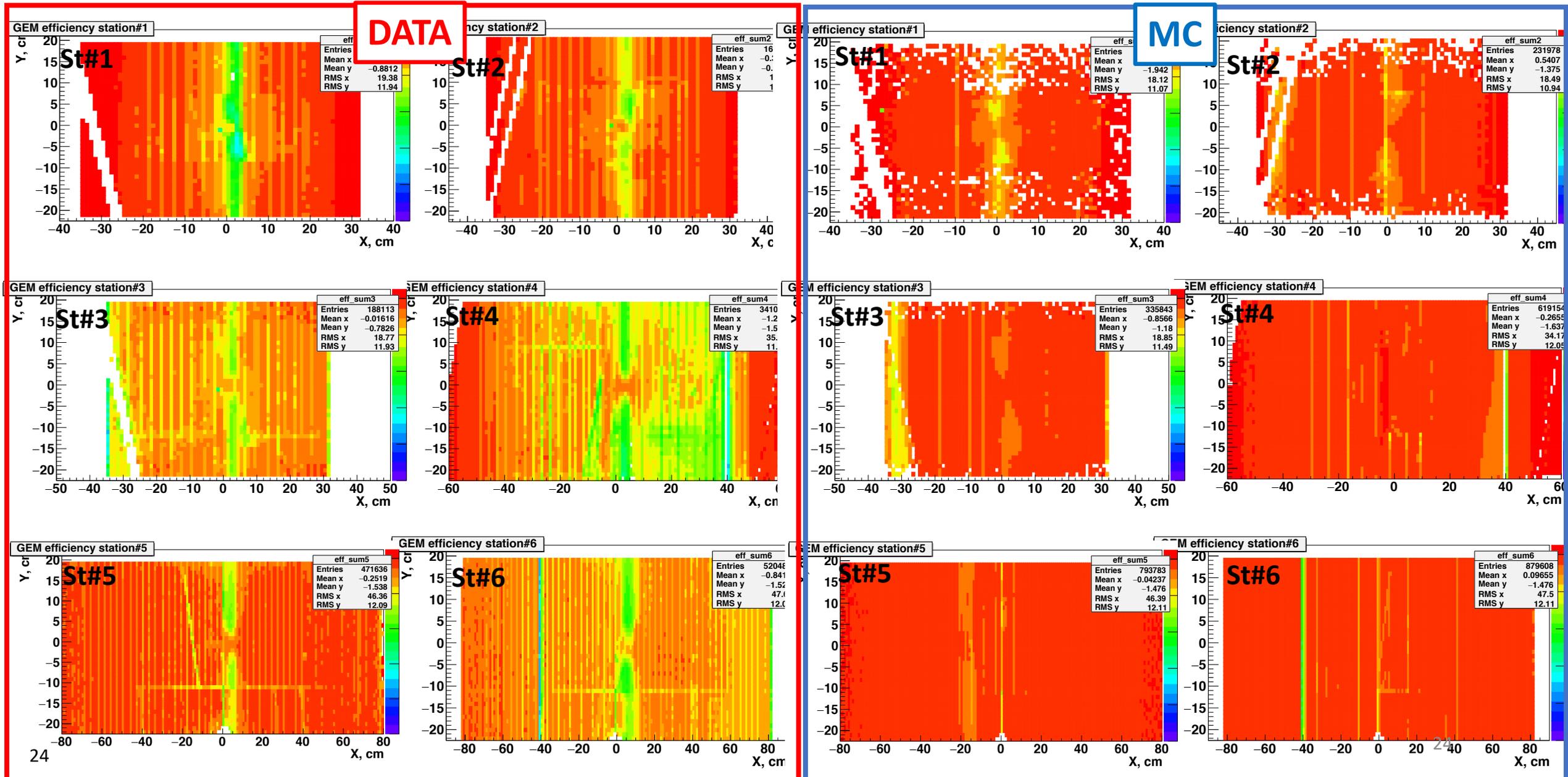
Sigma Mom& vs. x ista==5 (DATA & MC)



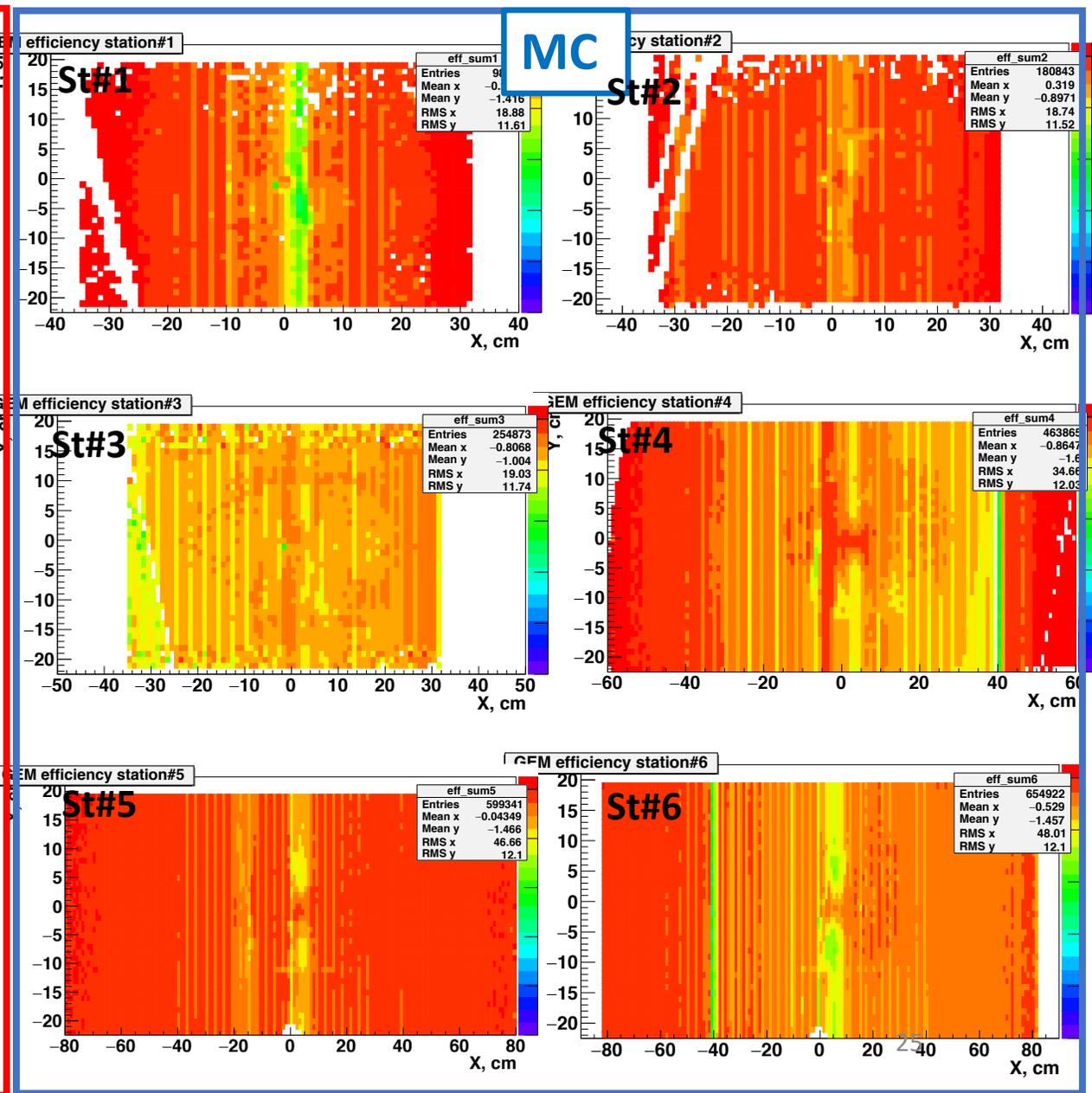
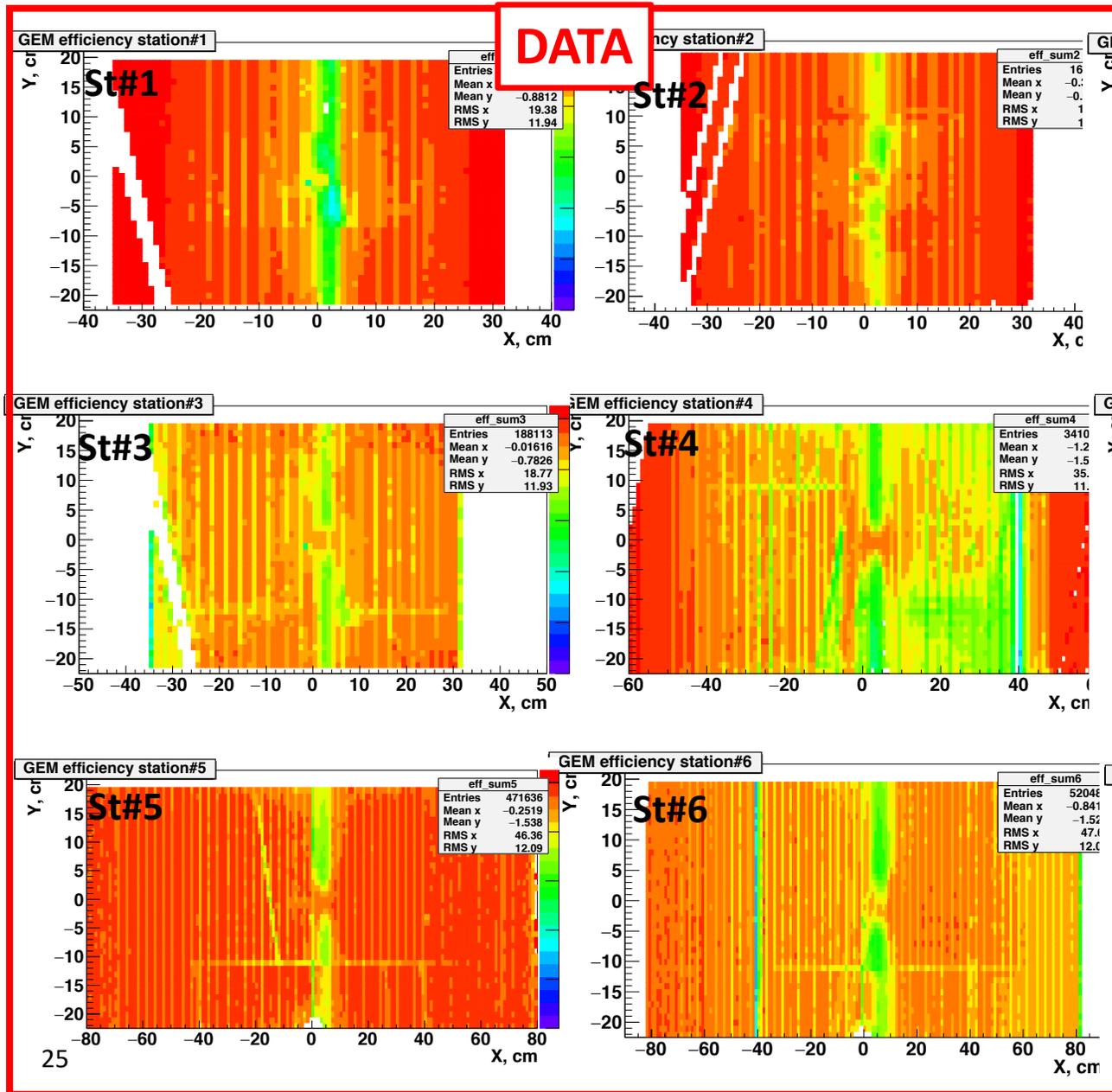
Sigma Mom& vs. x ista==6 (DATA & MC)



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



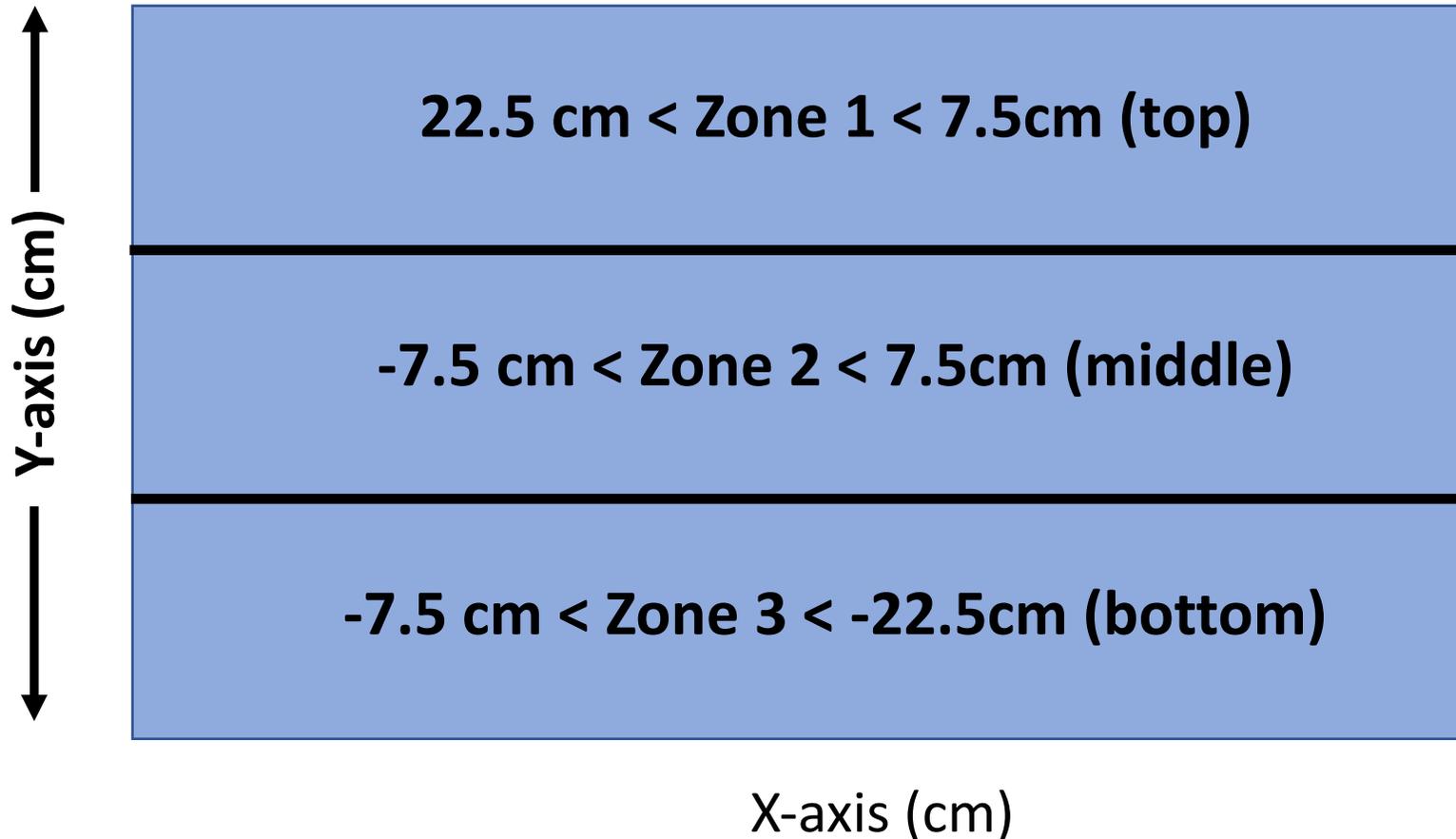
Preliminary GEM efficiencies: Apply efficiencies to MC (4.0GeV all)



Apply GEM efficiencies to MC (check)



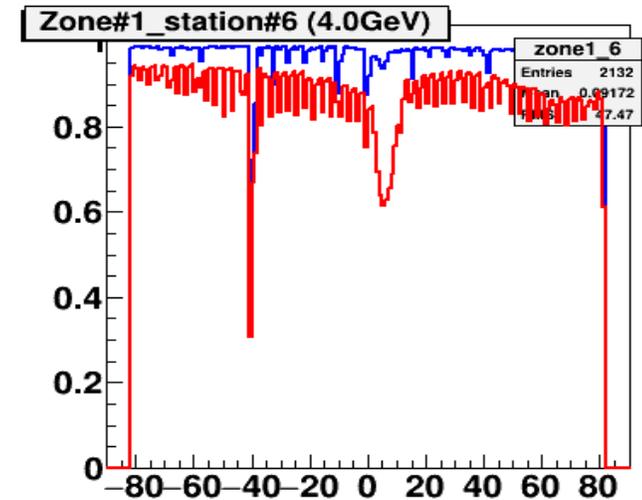
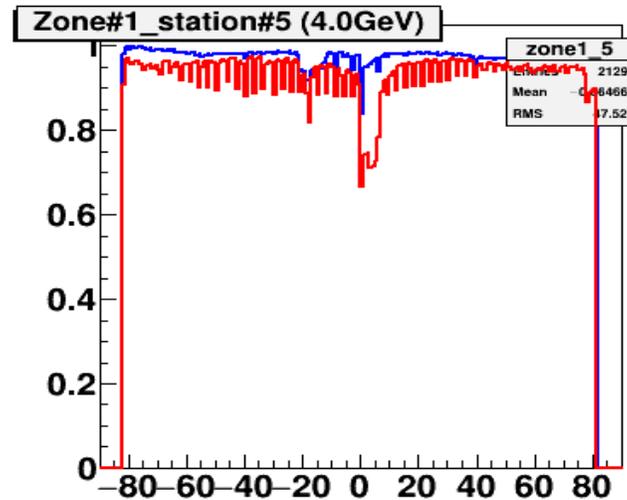
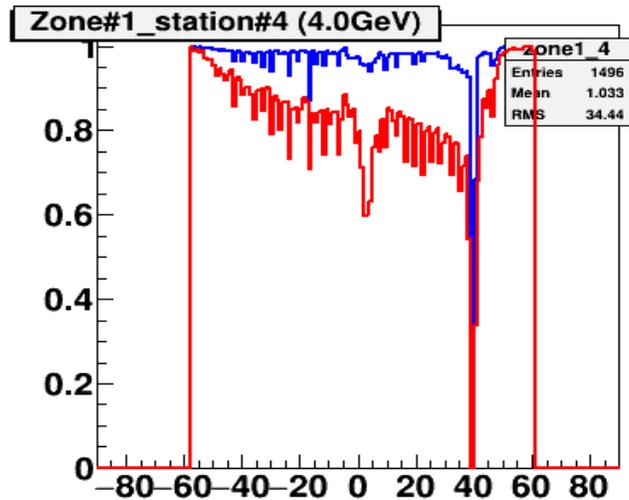
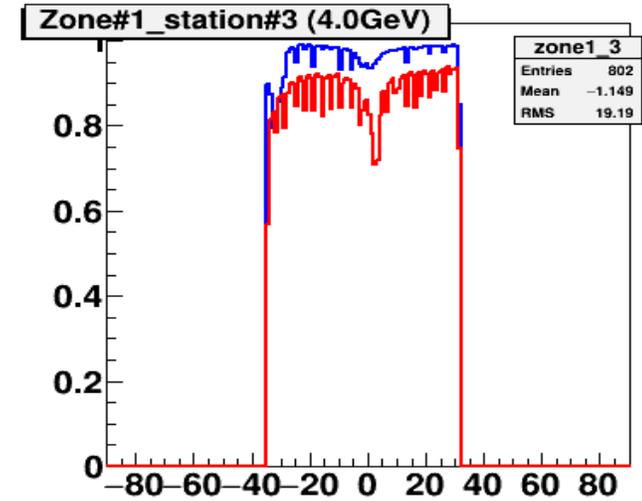
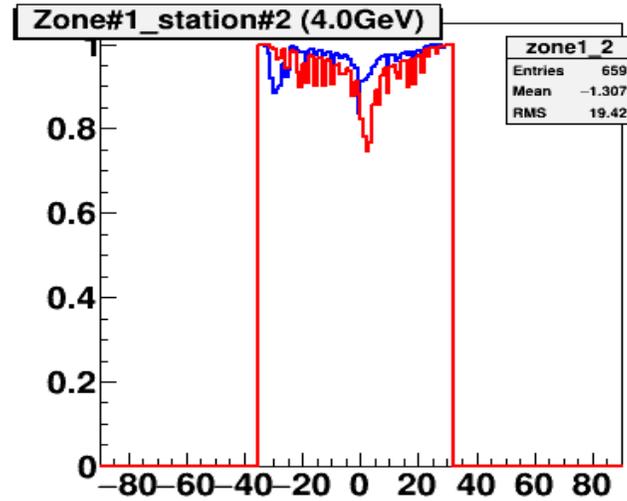
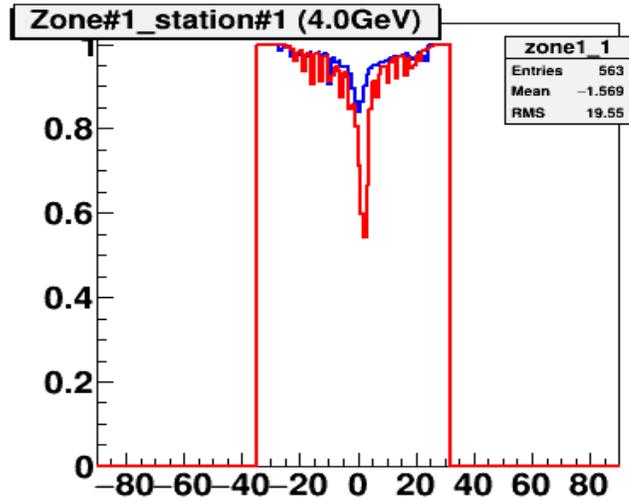
- Each GEM plane was divided into to 3 regions along Y-axis
 - Compare integral for efficiencies at each regions



GEM efficiencies (4.0GeV all, top)



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

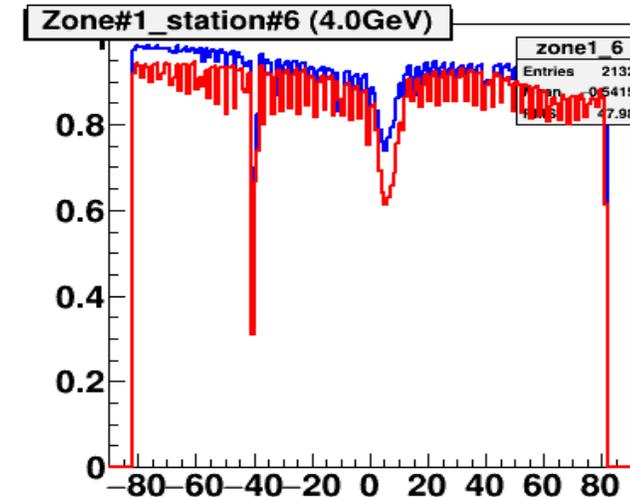
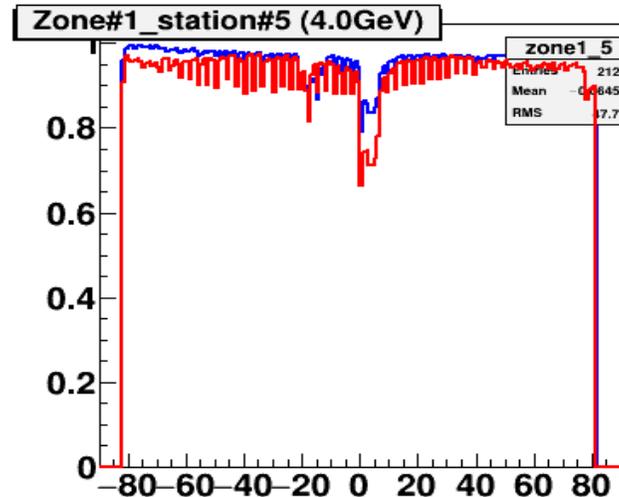
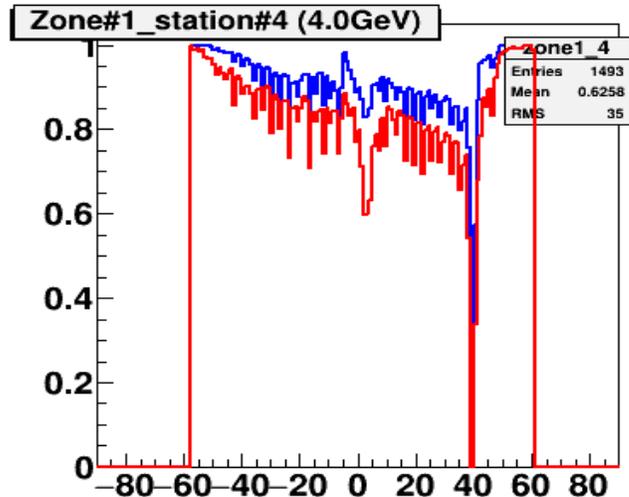
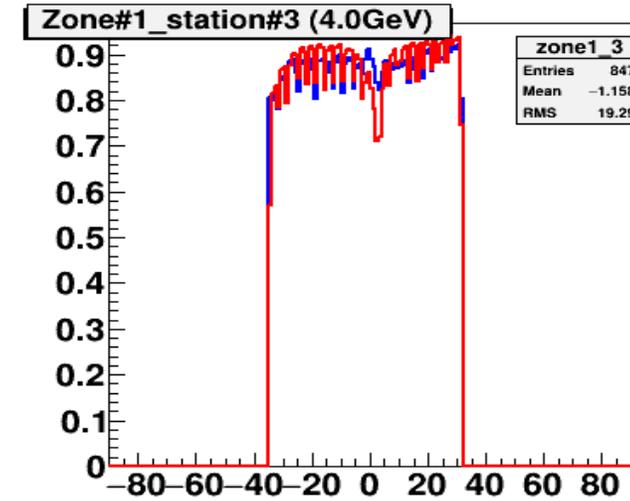
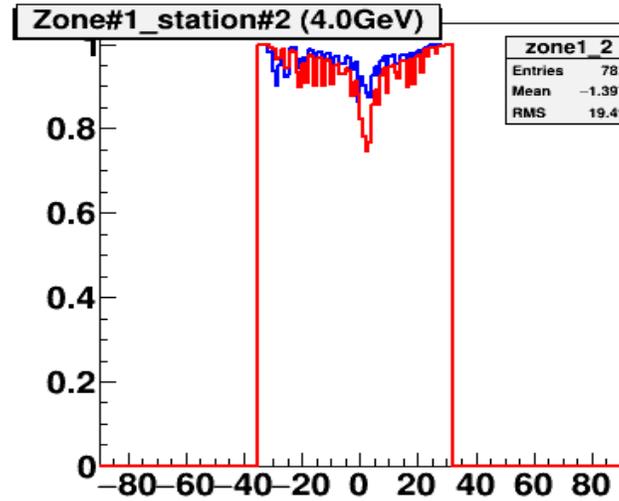
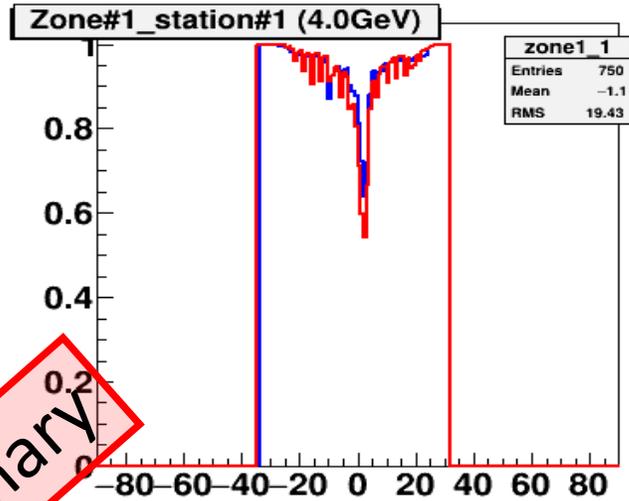


X, cm

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



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



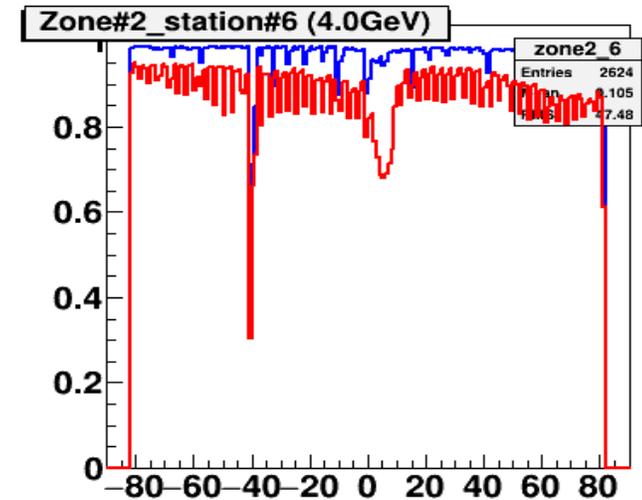
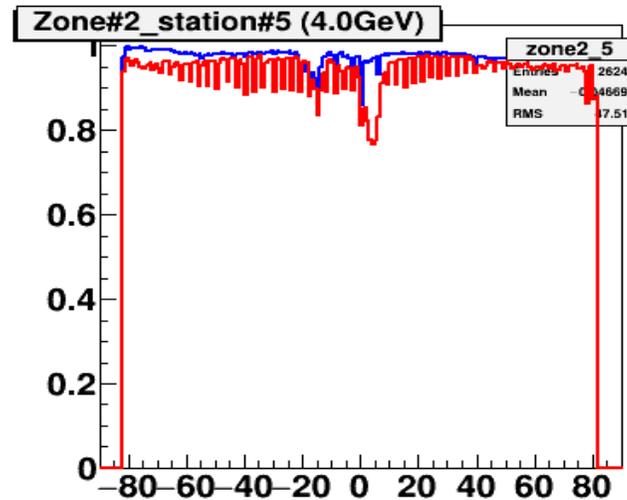
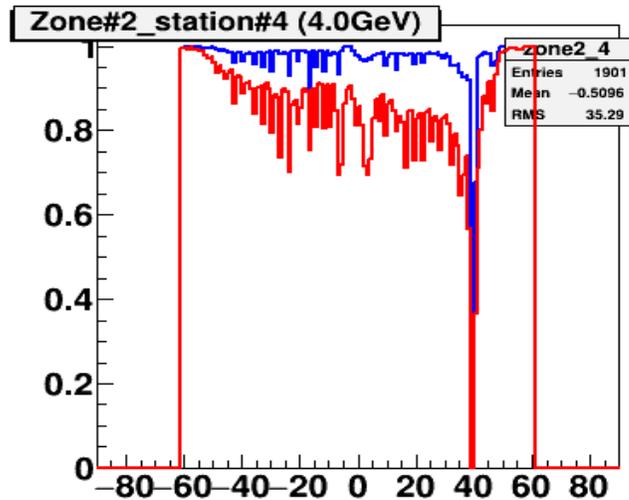
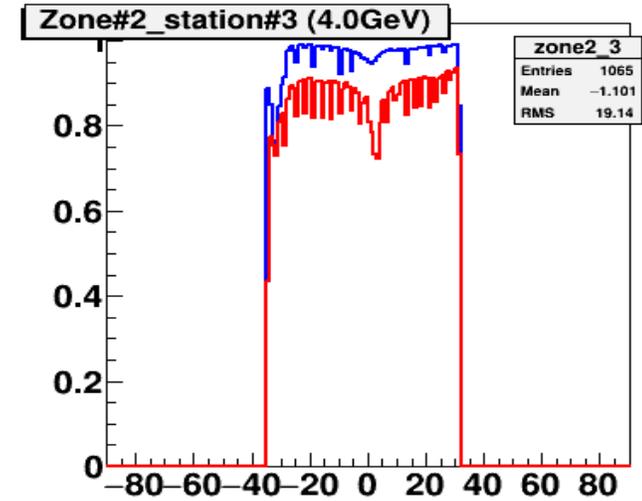
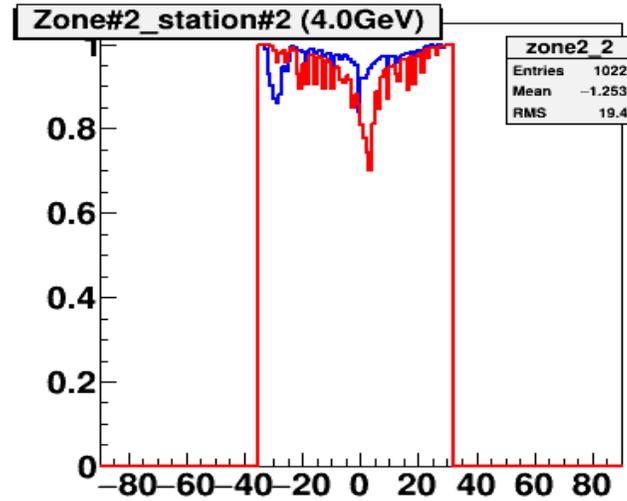
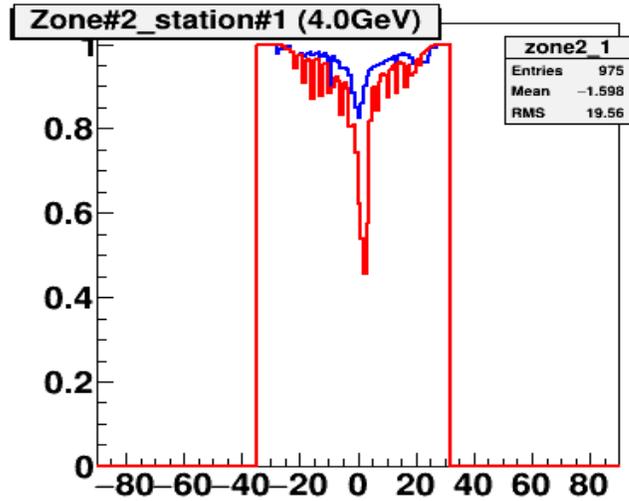
Preliminary

X, cm

GEM efficiencies (4.0GeV all, middle)



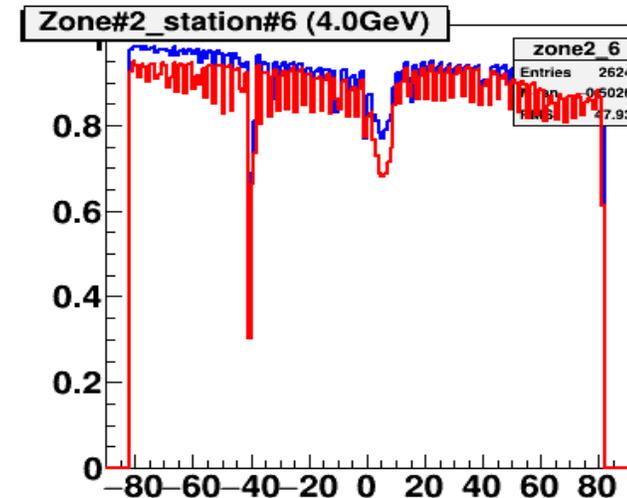
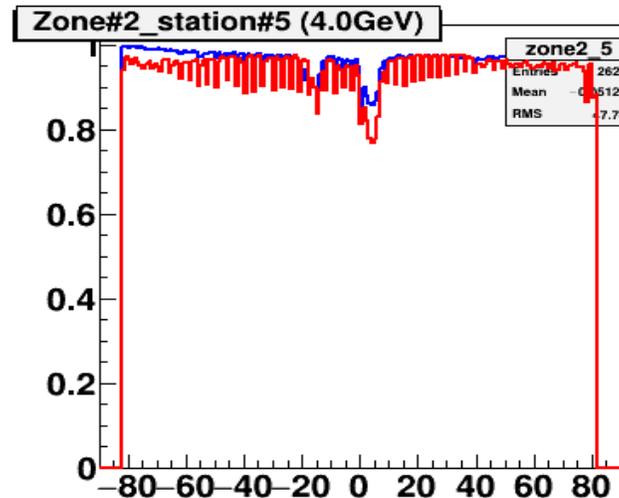
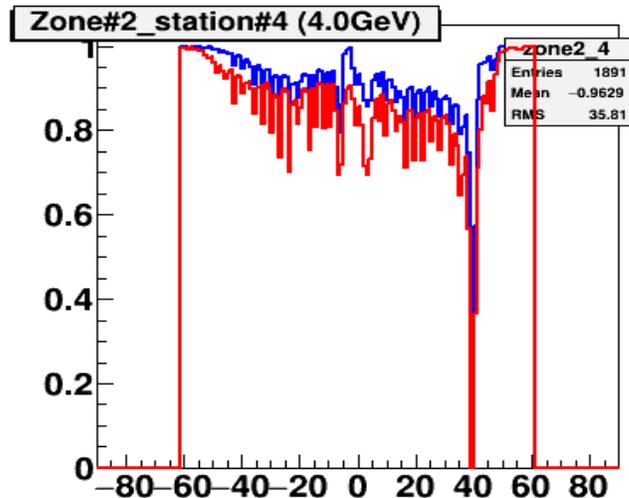
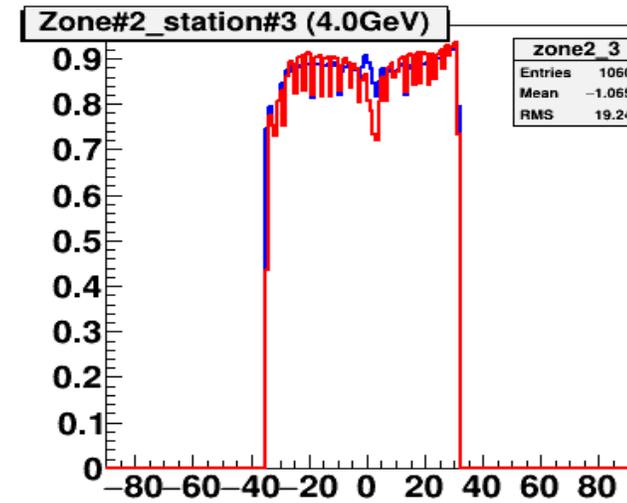
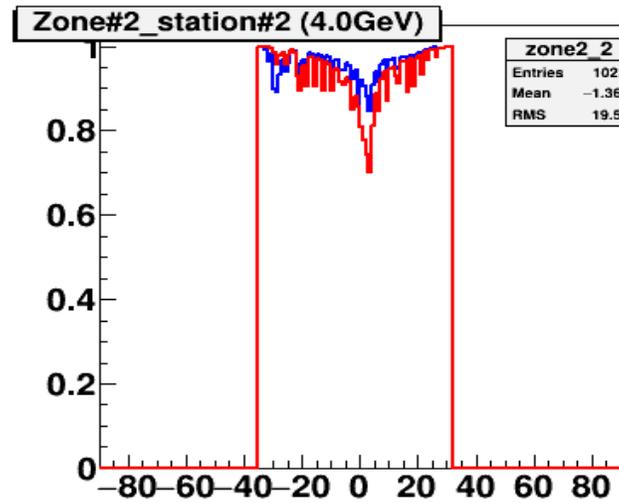
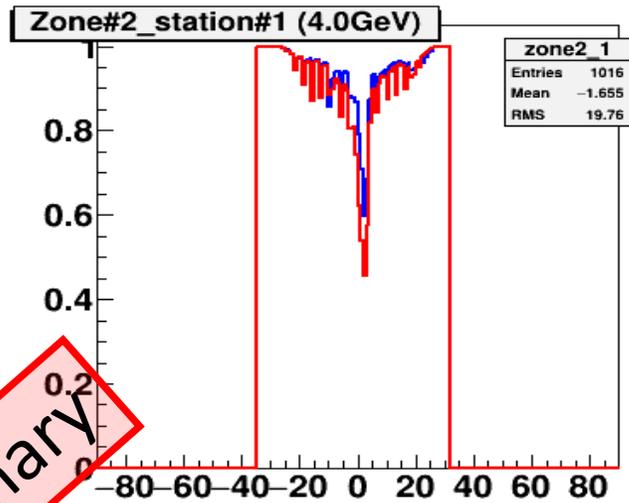
Red: Data; Blue: MC; (7.5 cm < Zone 2 < -7.5cm (middle))



X, cm

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

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



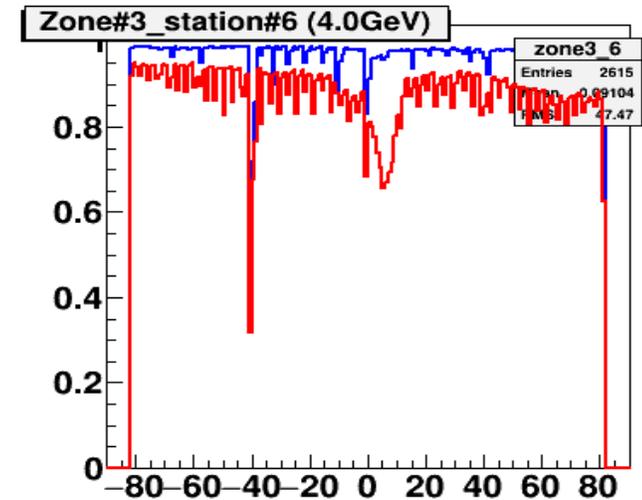
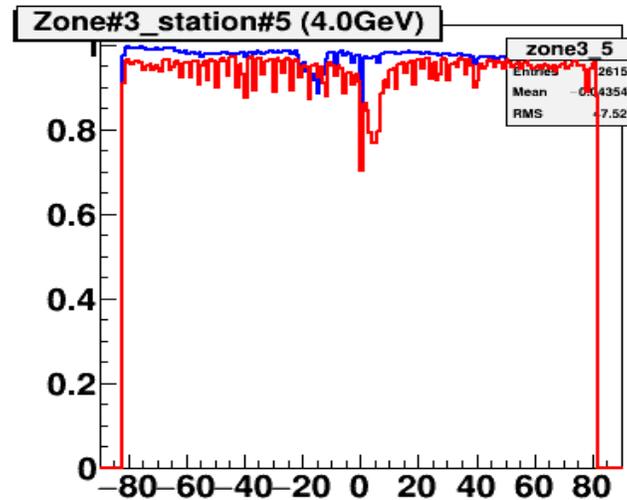
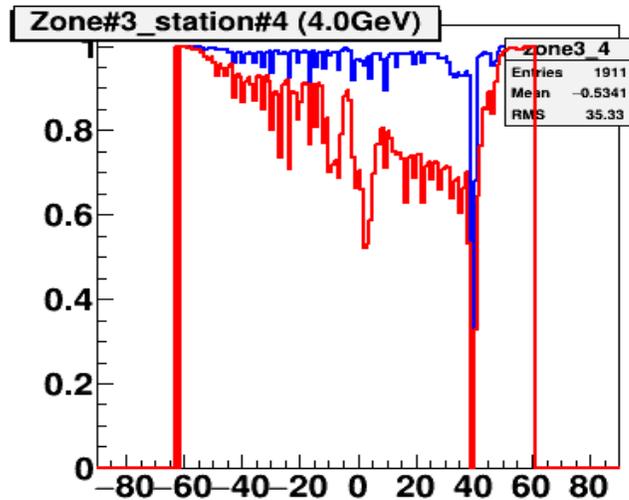
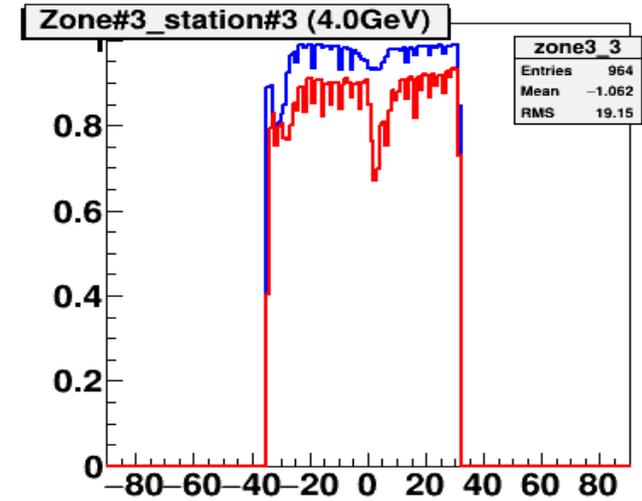
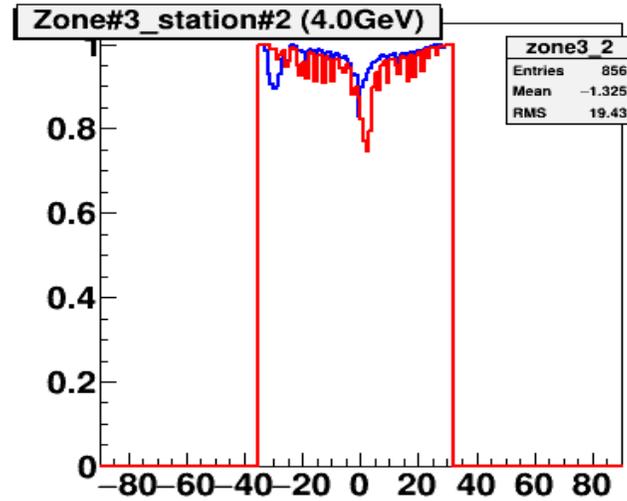
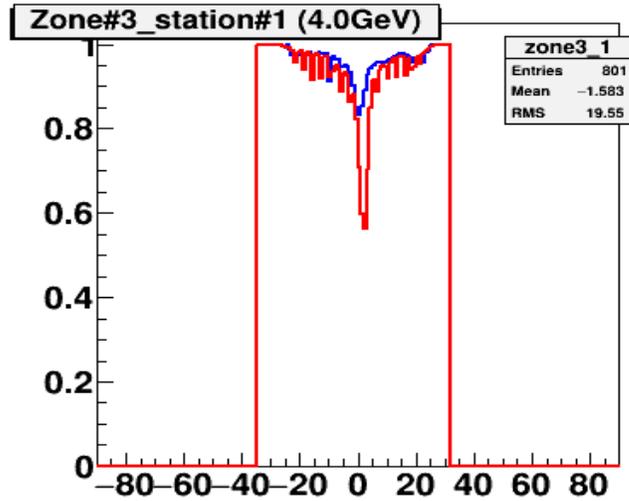
X, cm

Preliminary

GEM efficiencies (4.0GeV all, bottom)



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

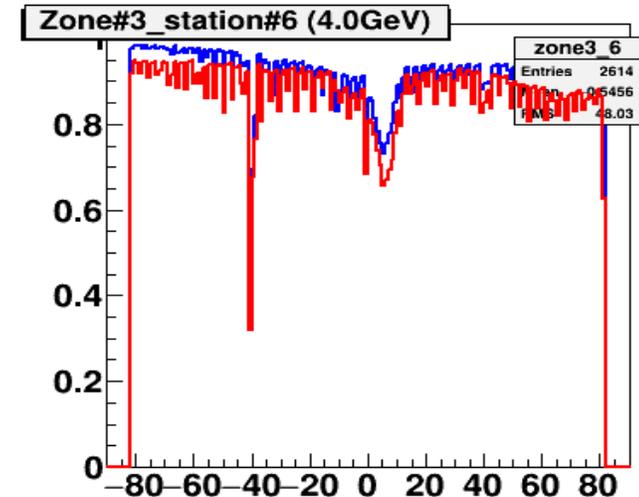
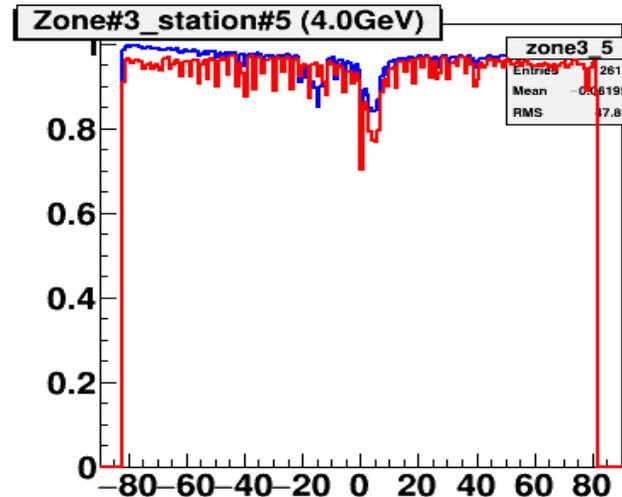
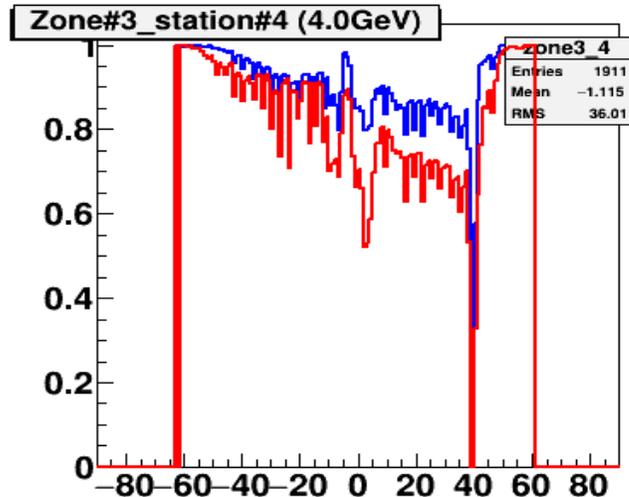
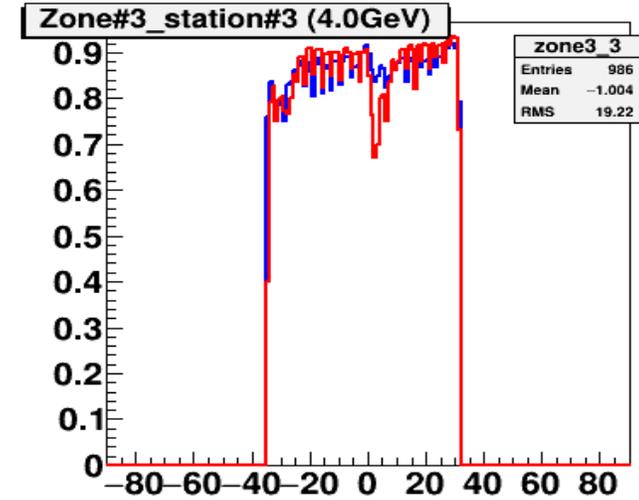
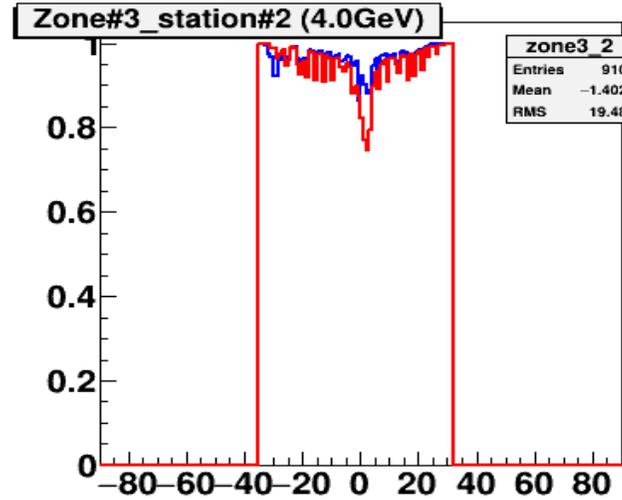
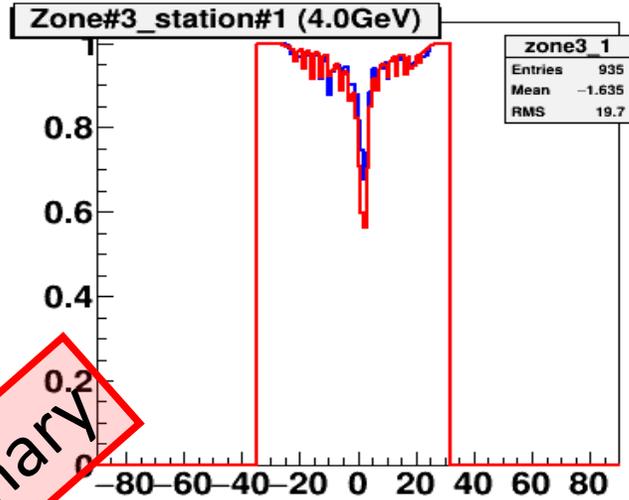


X, cm

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



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



Preliminary

X, cm

Next steps...



- Applying more accurate fit procedure for residuals corrections
- Applying corrections/smearing for Data/MC for 4.5GeV
- Applying GEM efficiencies to MC simulation according energies/targets/periods
- Comparing distributions MC/Data for pt/momentum/mass/etc...
- Measuring cross-sections of the Λ^0 's hyperon

Plan to finish Run6 analysis to the end of June 2021

Thank you for your attention!

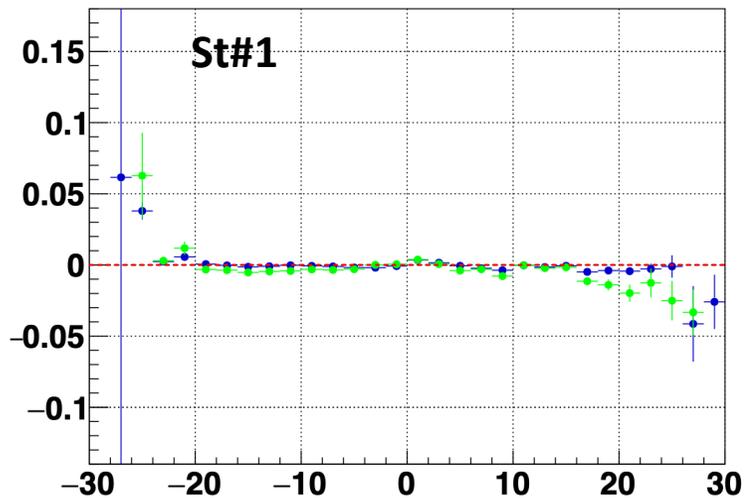


Mean Dx vs x after/before smearing (MC 4.0GeV C+Cu)

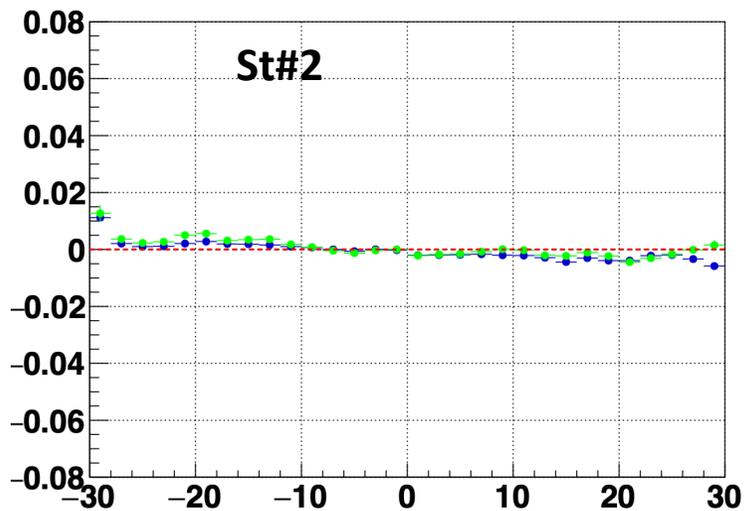
Blue: MC before smear

Red: MC after smear

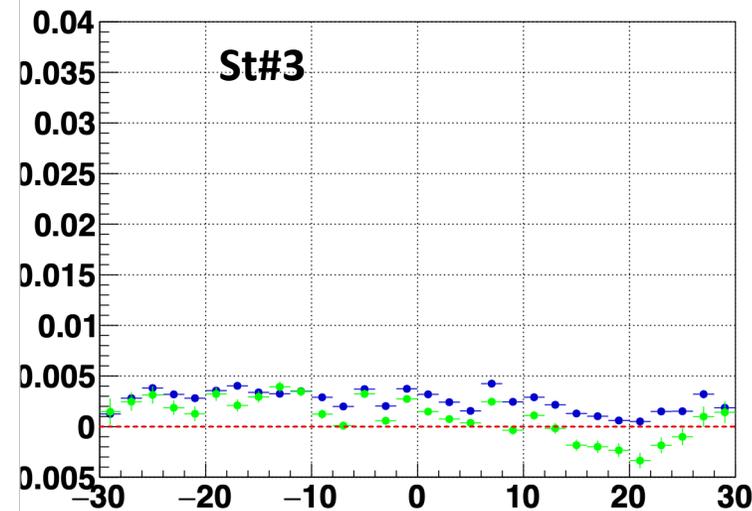
Mean dX vs. x ista==1 (MC & MC smear)



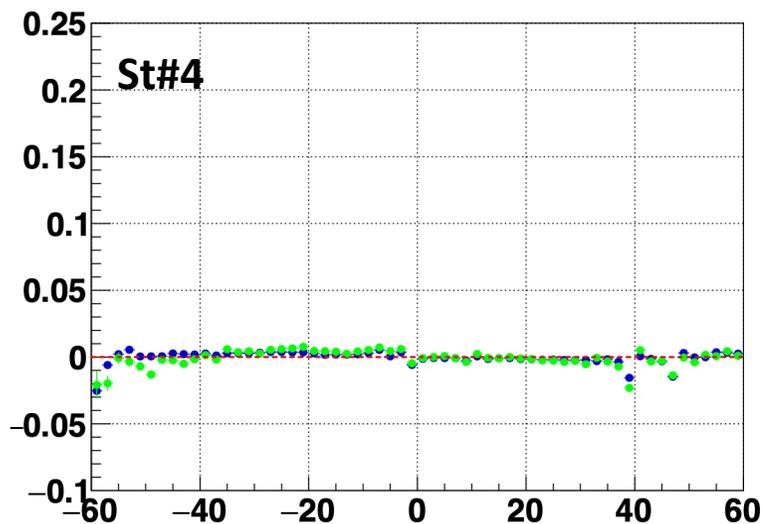
Mean dX vs. x ista==2 (MC & MC smear)



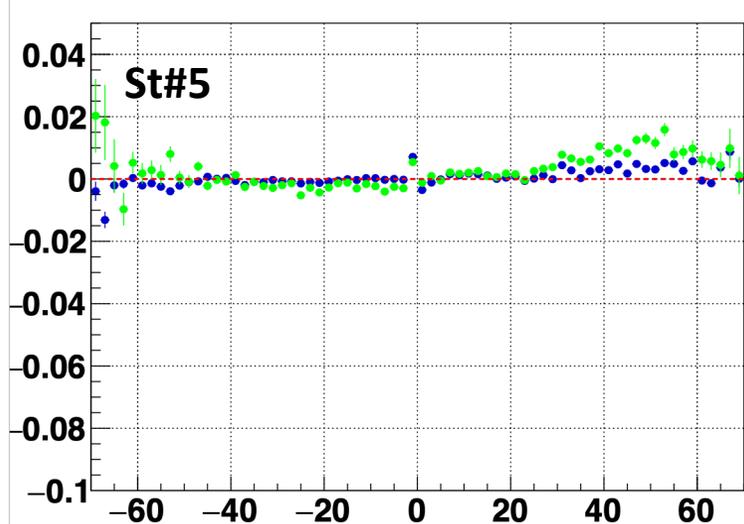
Mean dX vs. x ista==3 (MC & MC smear)



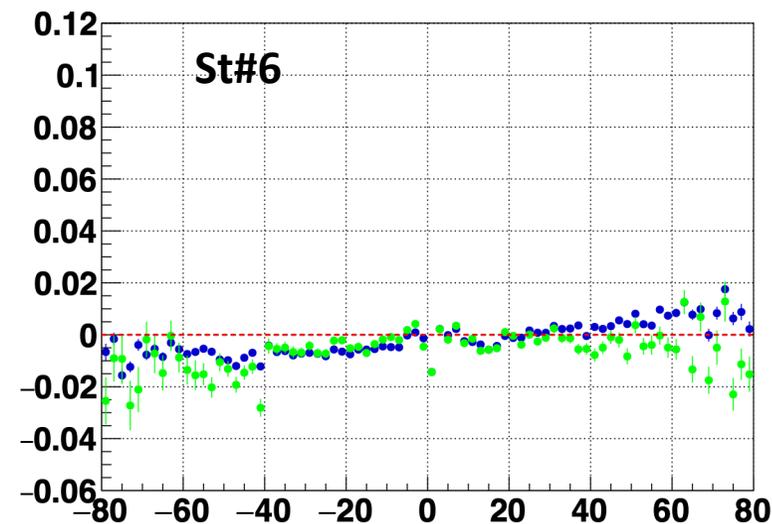
Mean dX vs. x ista==4 (MC & MC smear)



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



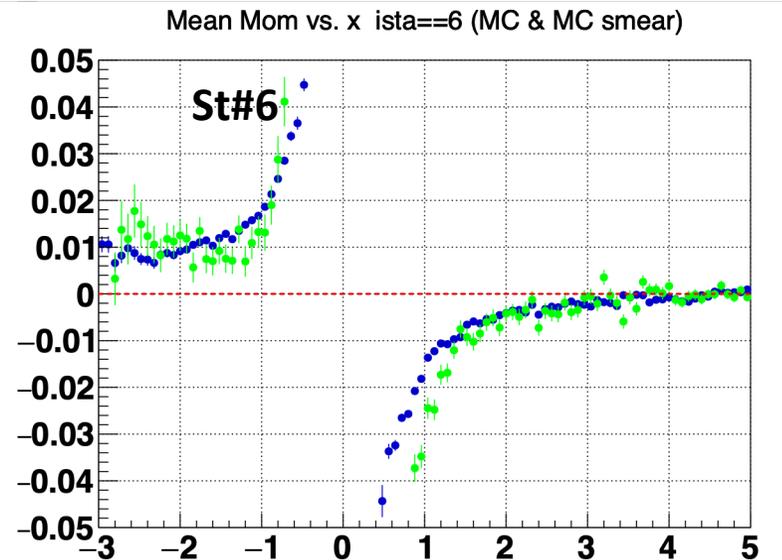
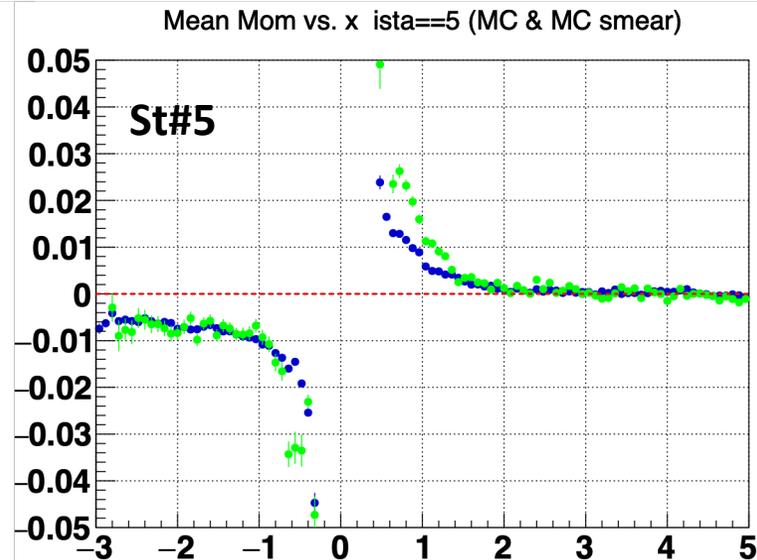
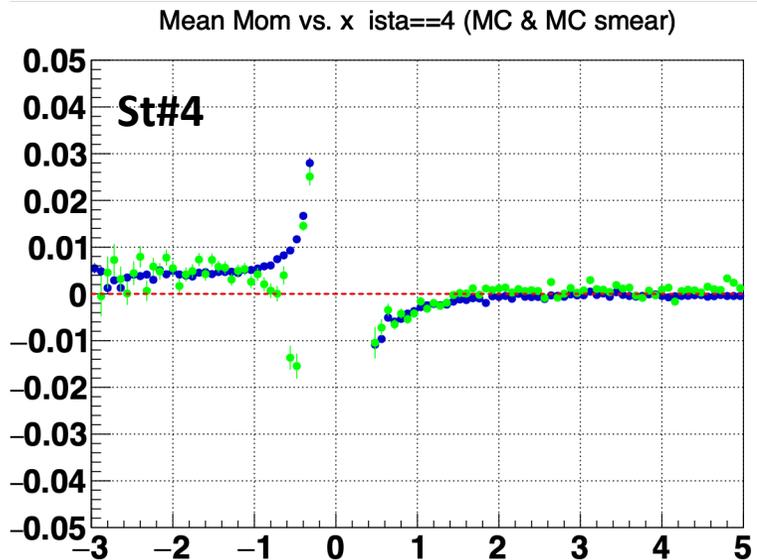
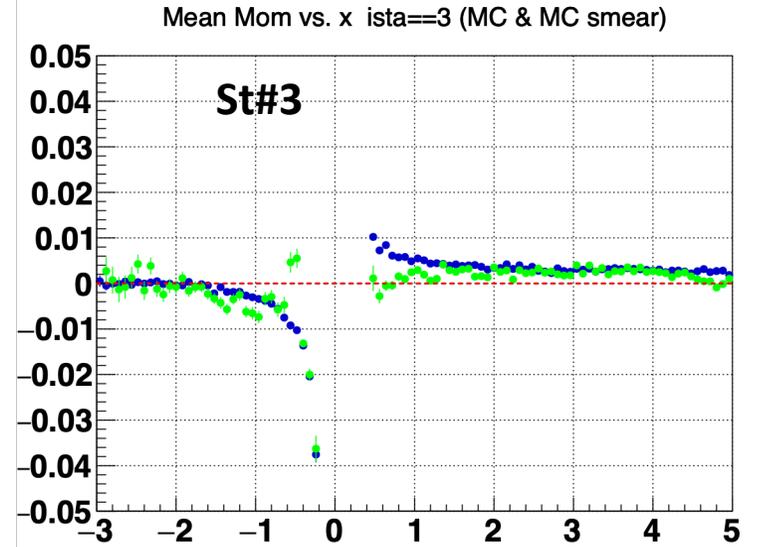
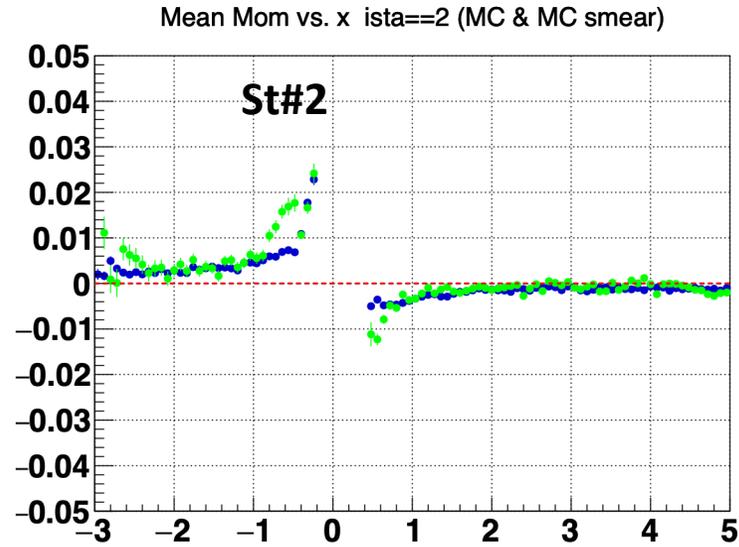
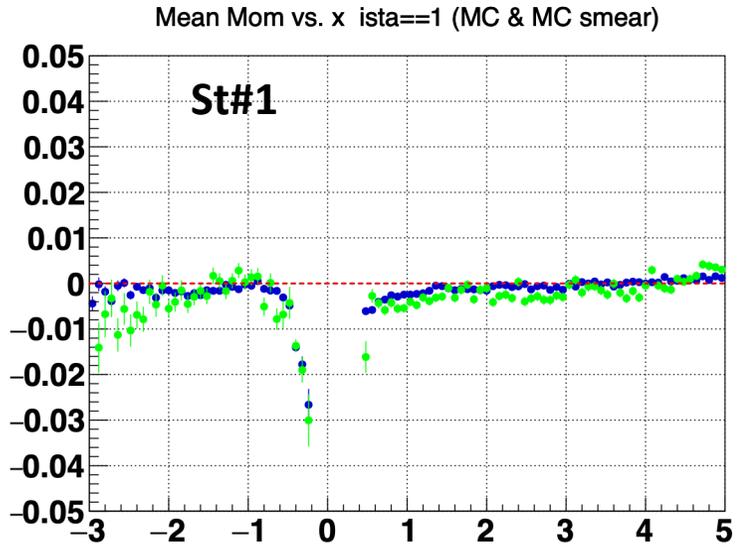
Mean dX vs. x ista==6 (MC & MC smear)



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

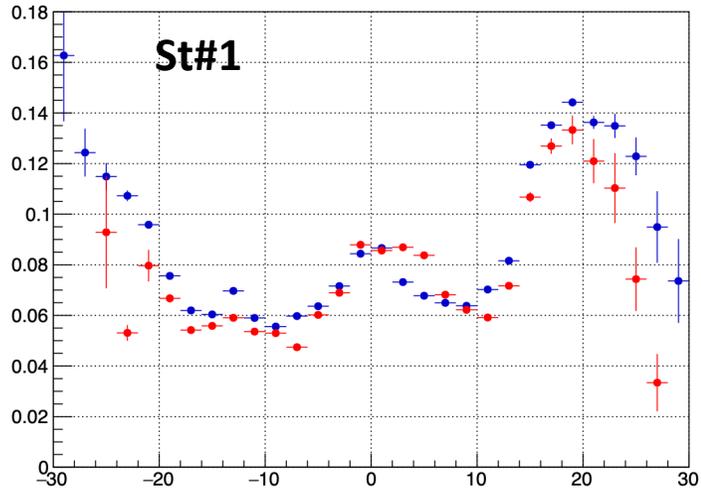
Blue: MC before smear

Red: MC after smear

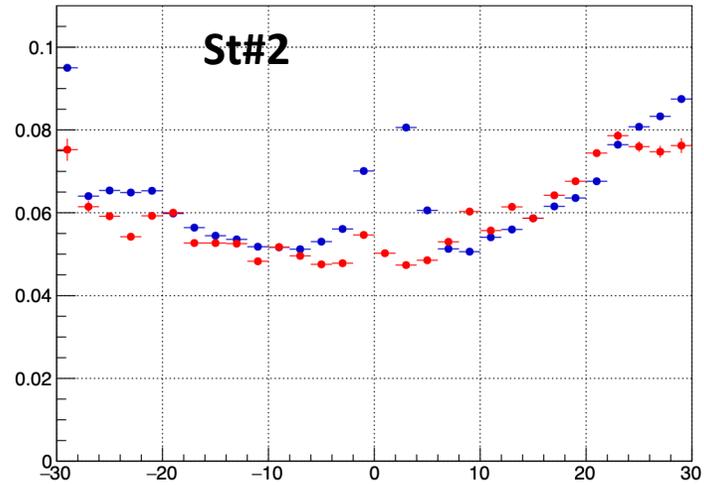


Sigma Dx vs x after smearing (MC & Data 4.0GeV C+Cu)

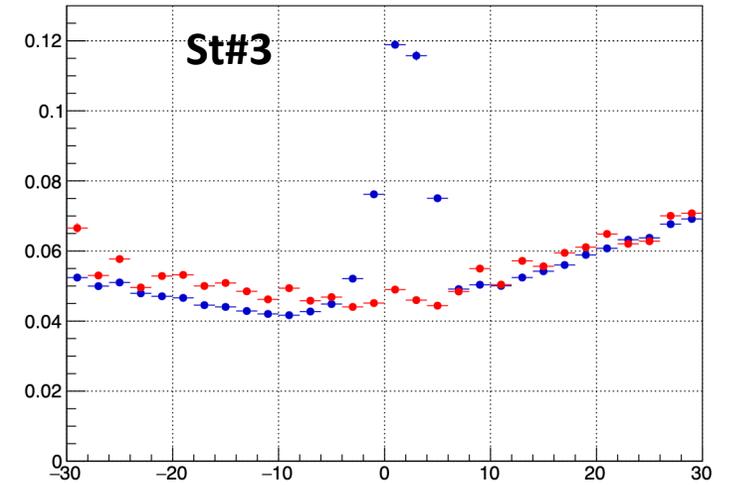
Sigma dX vs. x ista==1 (DATA & MC)



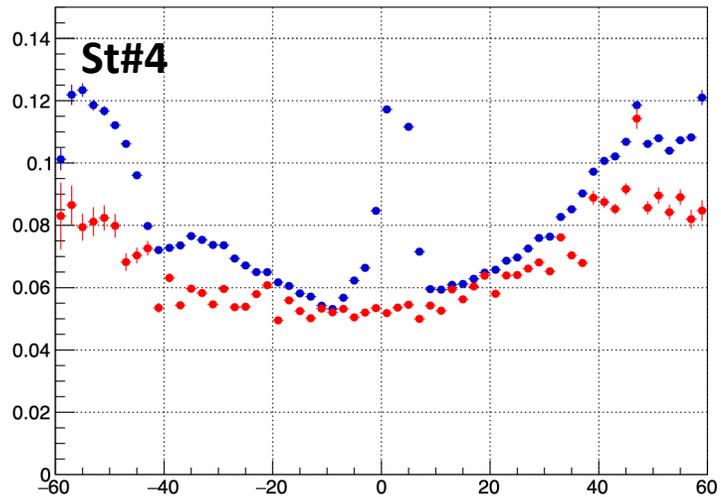
Sigma dX vs. x ista==2 (DATA & MC)



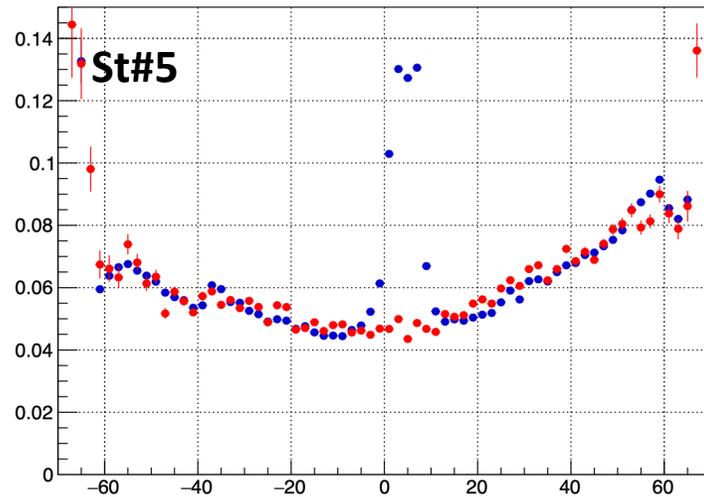
Sigma dX vs. x ista==3 (DATA & MC)



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



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



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

