

Production of Λ^0 hyperons in 4.0 and 4.5 AGeV carbon- nucleus interactions

(status report)

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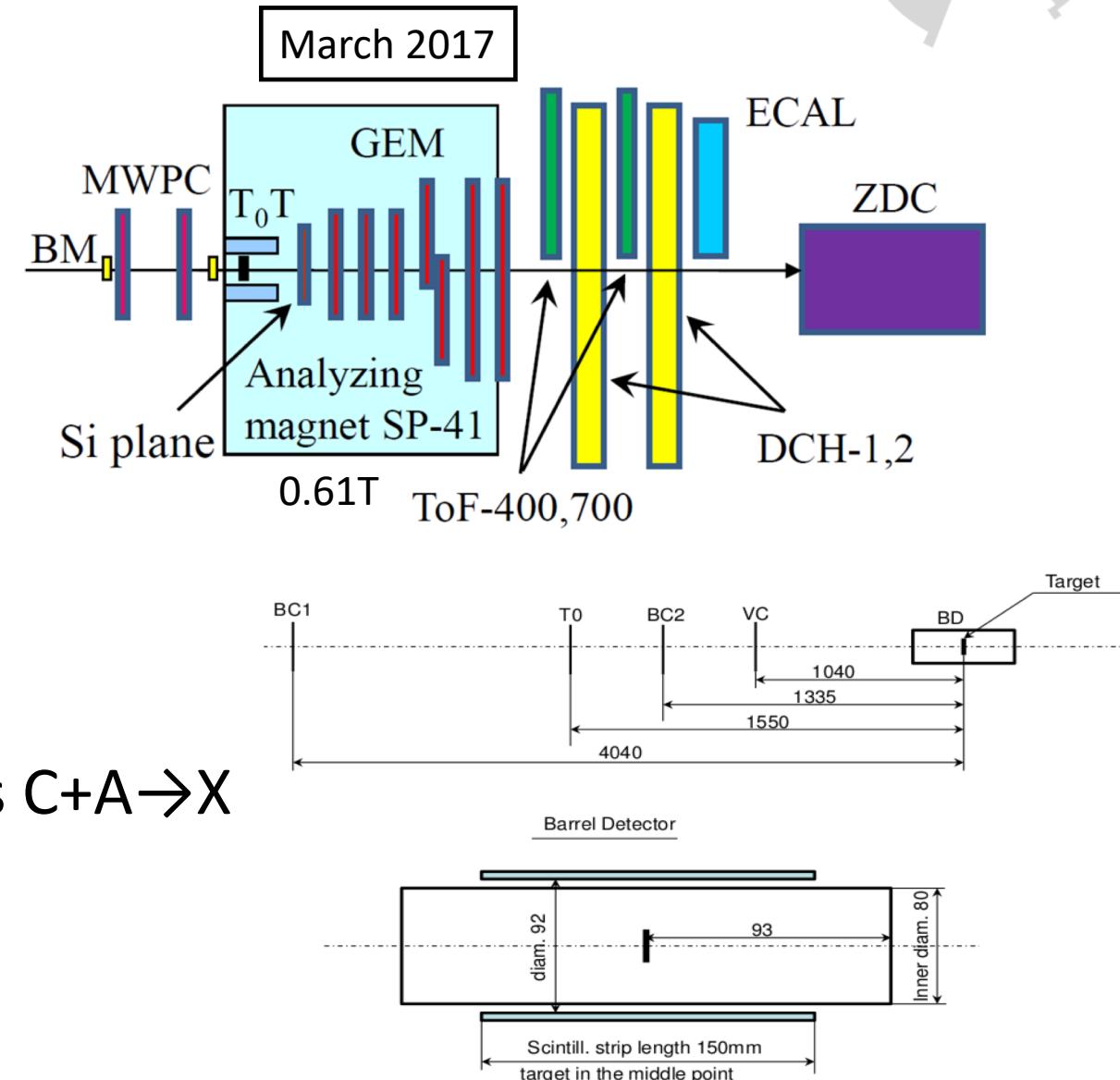


9th Collaboration Meeting of the BM@N Experiment at the NICA Facility
13-16 September 2022

BM@N configuration in Run6



- Central tracker
 - One plane of a forward Si detector
 - 6 GEM stations
 - 5 GEM detectors ($66 \times 41 \text{ cm}^2$)
 - 2 GEM detectors ($163 \times 45 \text{ cm}^2$)
- Triggers: BD, BC1, BC2, T0, VETO
- Beam $E_{\text{kin}}=4.0$ and 4.5 GeV
 - Intensity 10^5 per spill
 - Spill duration 2-2.5 sec.
- Physics: measure inelastic reactions $C+A \rightarrow X$
 - Targets: C, Al, Cu, Pb



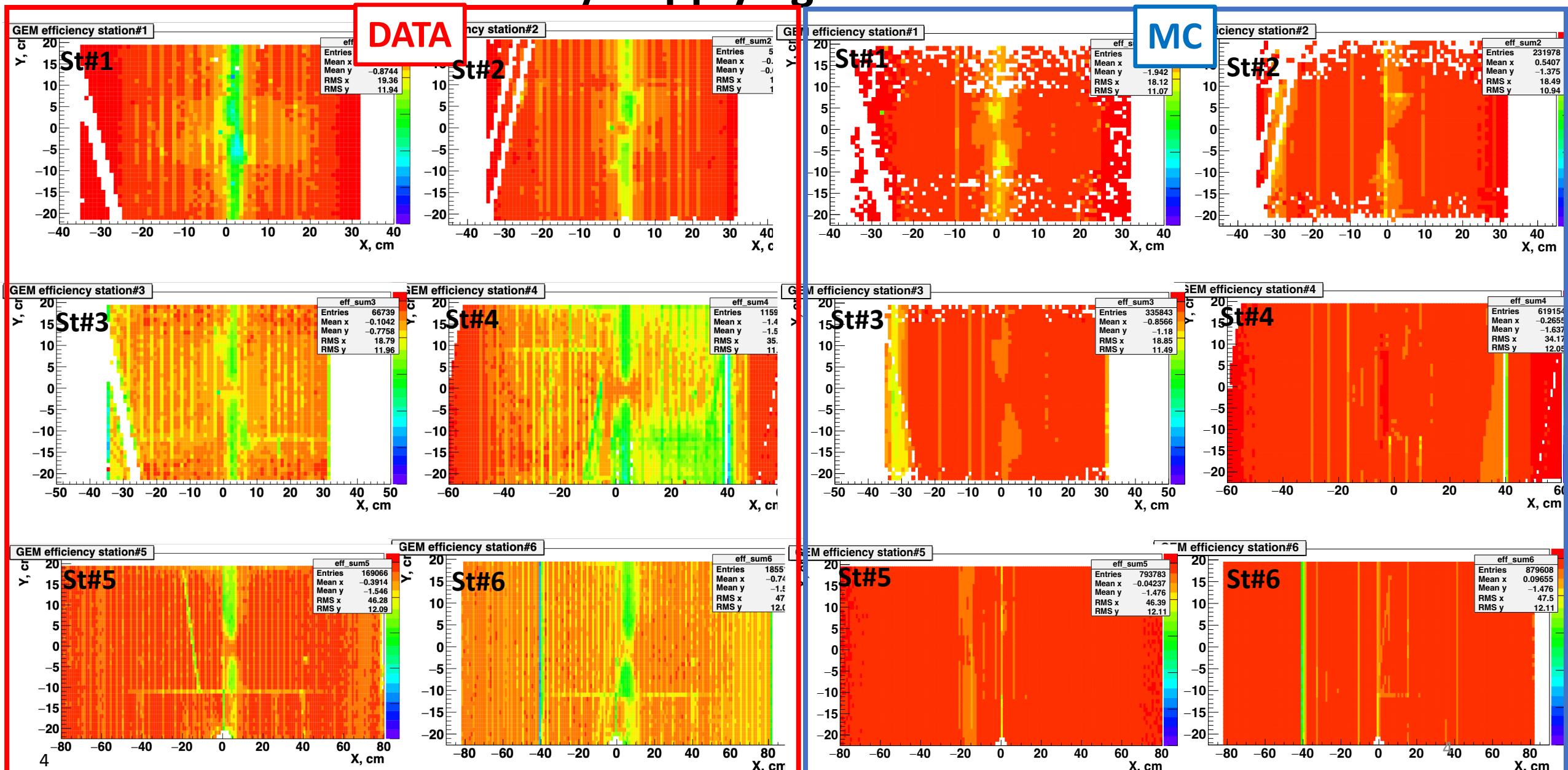
Analysis current status

- **Main goal of current analysis** – cross-check with previous analysis 2020 (was performed by Gleb Pokatashkin)
- **From previous analysis status:**
 - Check GEM efficiencies for MC & Data
 - Apply efficiencies for MC simulation
 - Check residuals for MC & Data
 - Make corrections for residuals in Data & MC
 - Momentum smearing procedure for MC simulation
 - Make corrections for sigma dx/dy in MC simulation
- **Analysis:** compare distributions MC/Data for pt/momentun/etc.
- **Measure cross-sections of the Λ^0 's hyperon (in progress now)**

All distributions will be for C+Cu 4.0 GeV sample

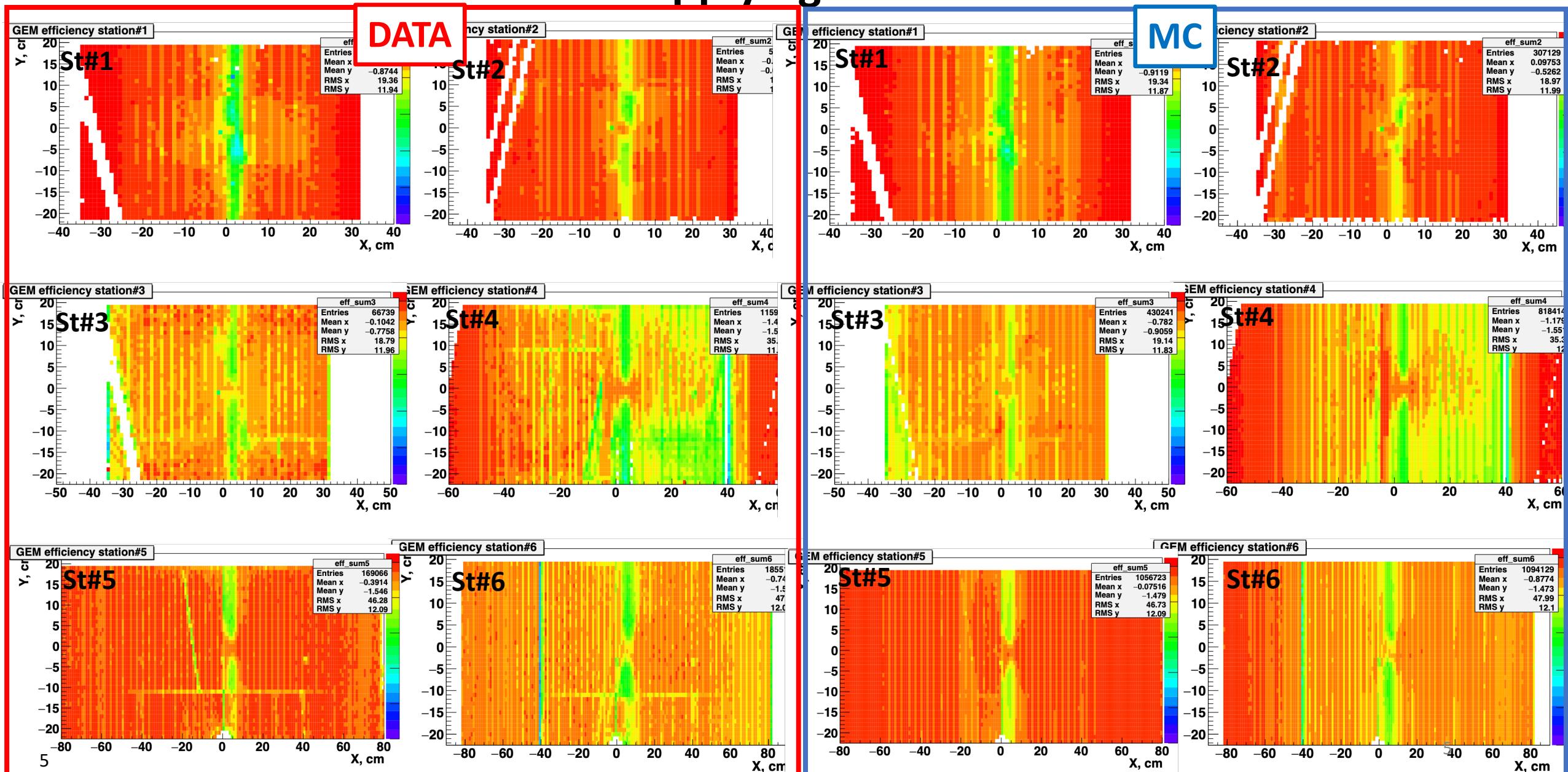
GEM efficiencies comparison Data/MC (4.0GeV C+Cu)

w/o applying effs to MC

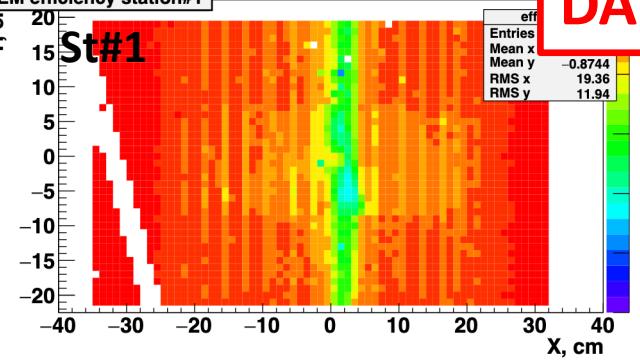


GEM efficiencies comparison Data/MC (4.0GeV C+Cu)

after applying effs to MC

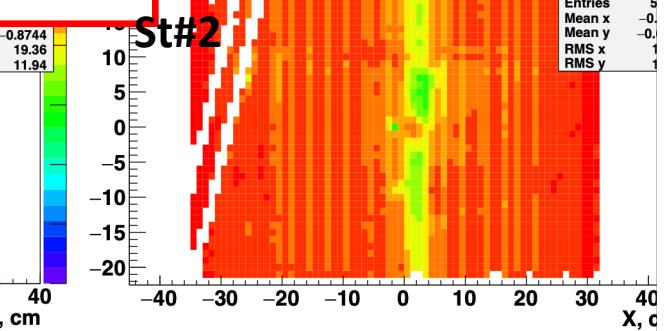


GEM efficiency station#1

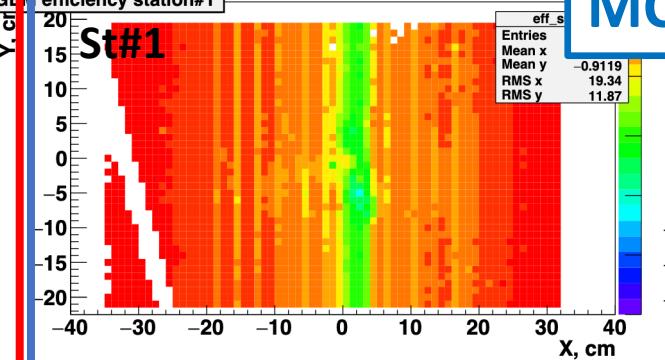


DATA

GEM efficiency station#2

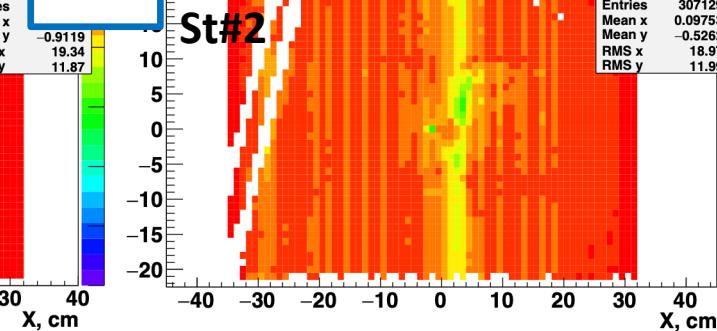


GEM efficiency station#1

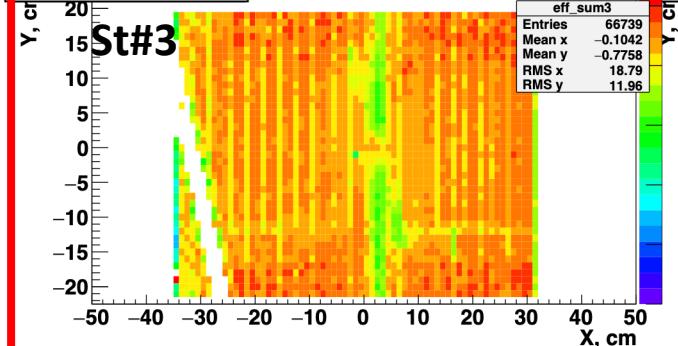


MC

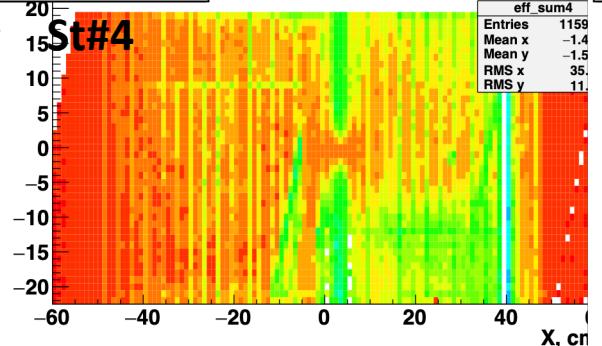
GEM efficiency station#2



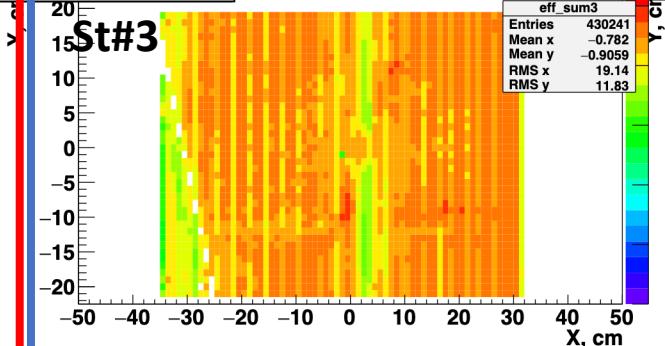
GEM efficiency station#3



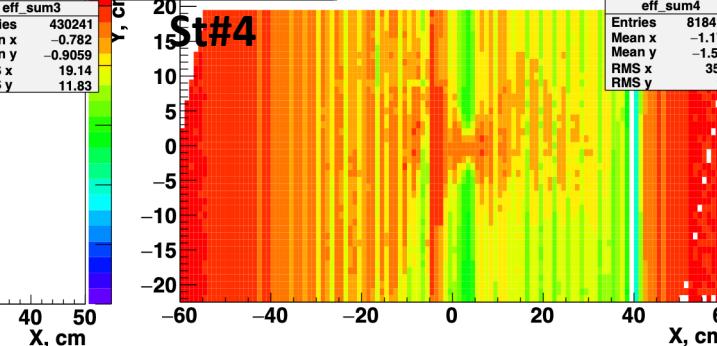
GEM efficiency station#4



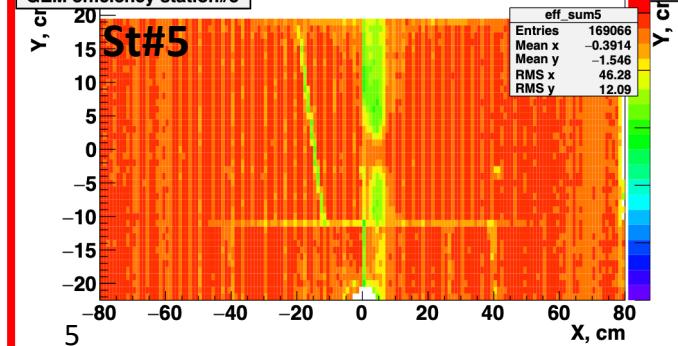
GEM efficiency station#3



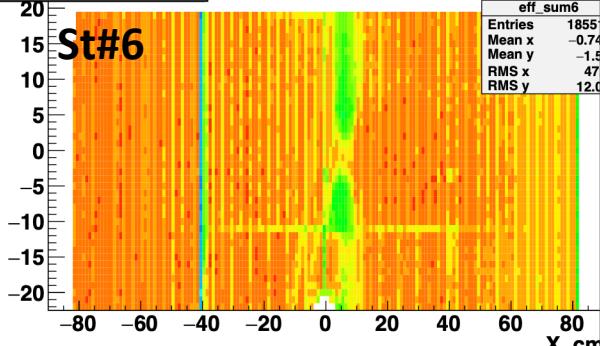
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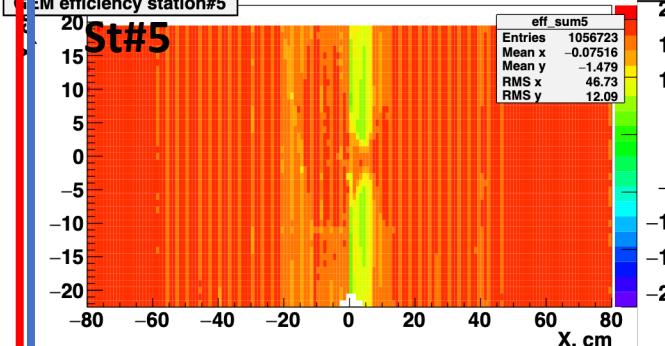
GEM efficiency station#5



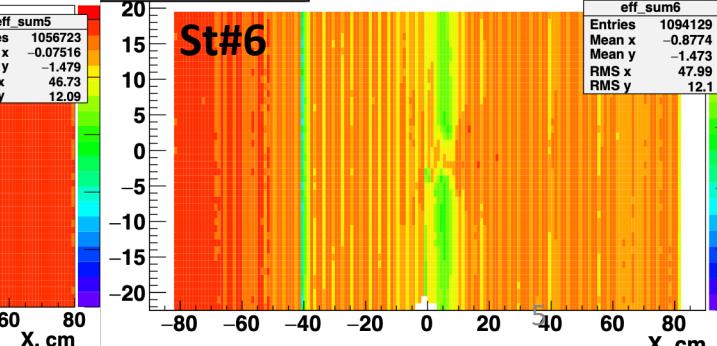
GEM efficiency station#6



GEM efficiency station#5

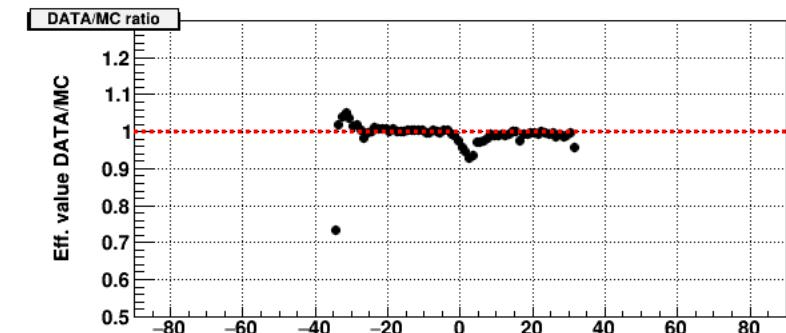
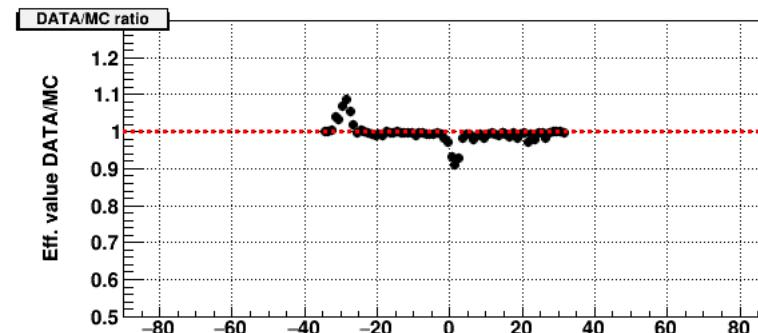
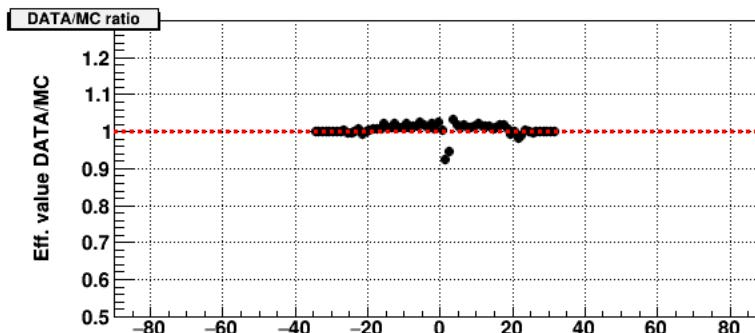
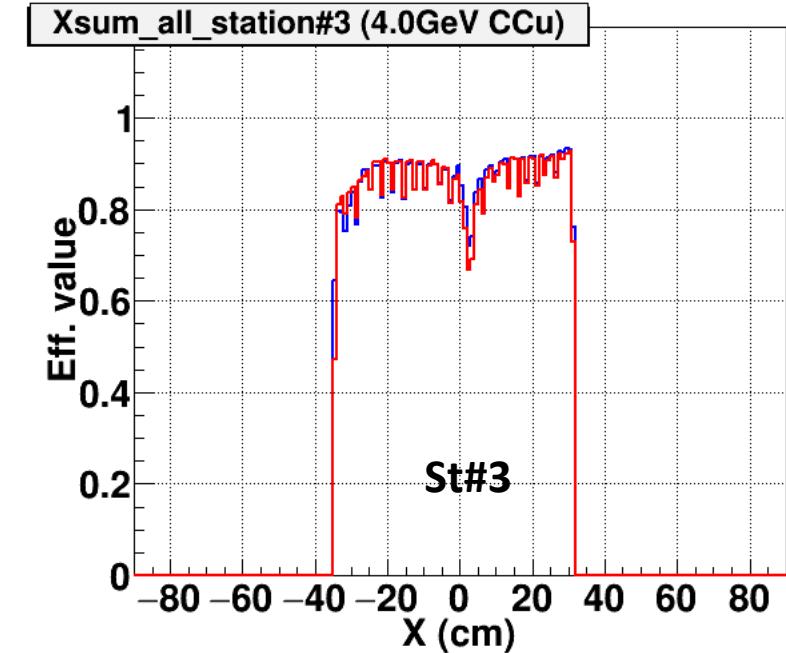
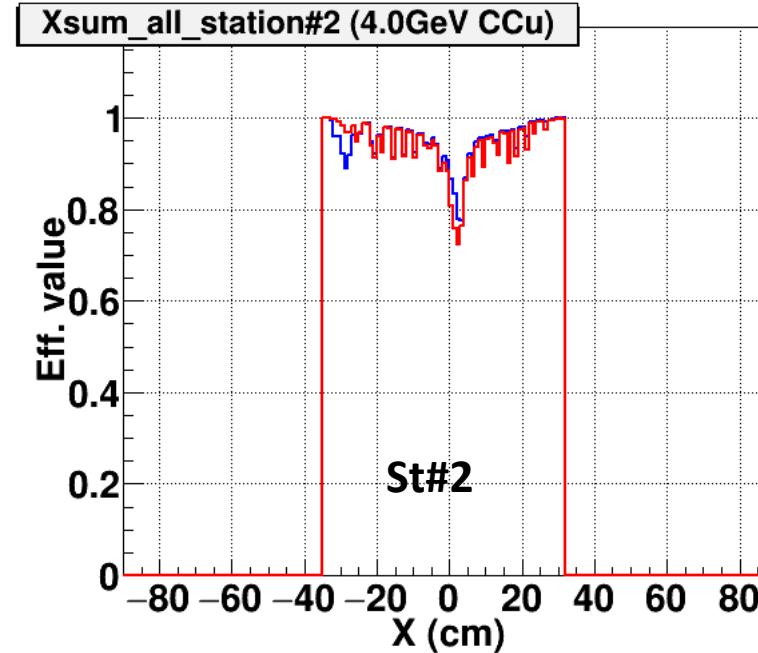
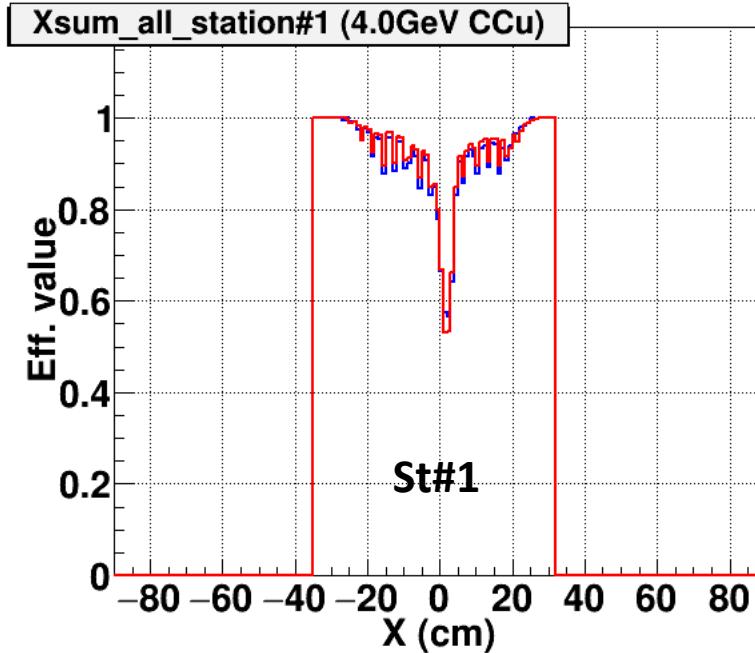


GEM efficiency station#6



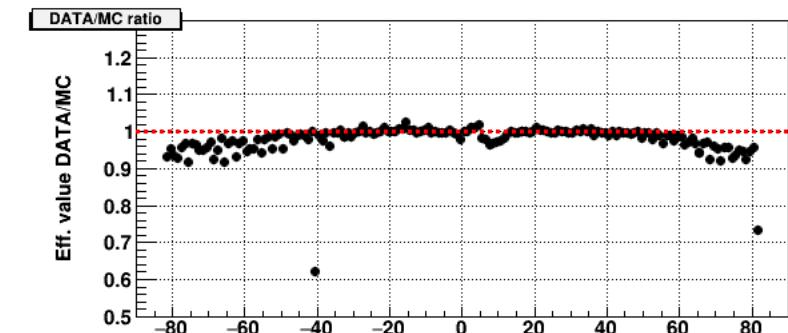
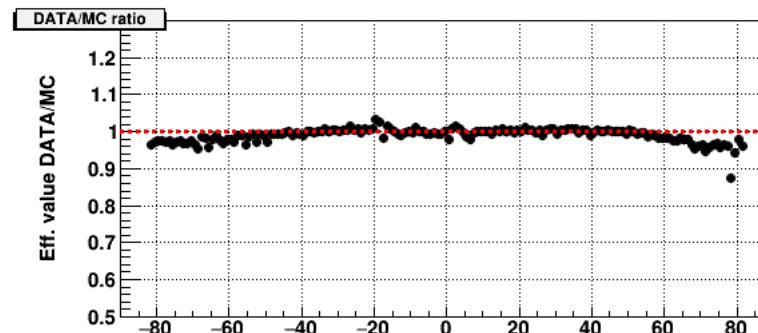
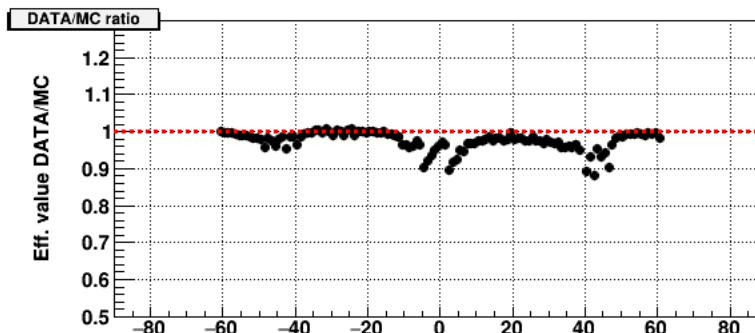
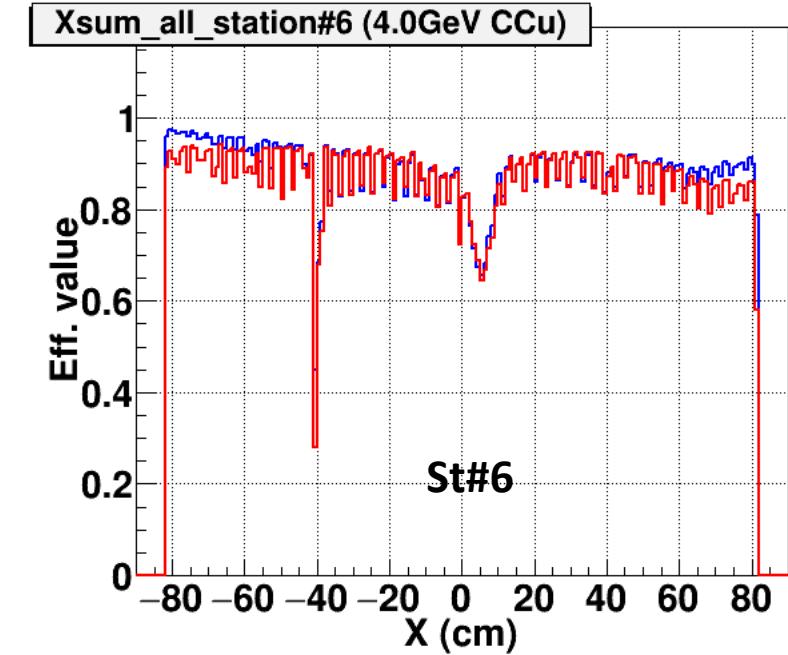
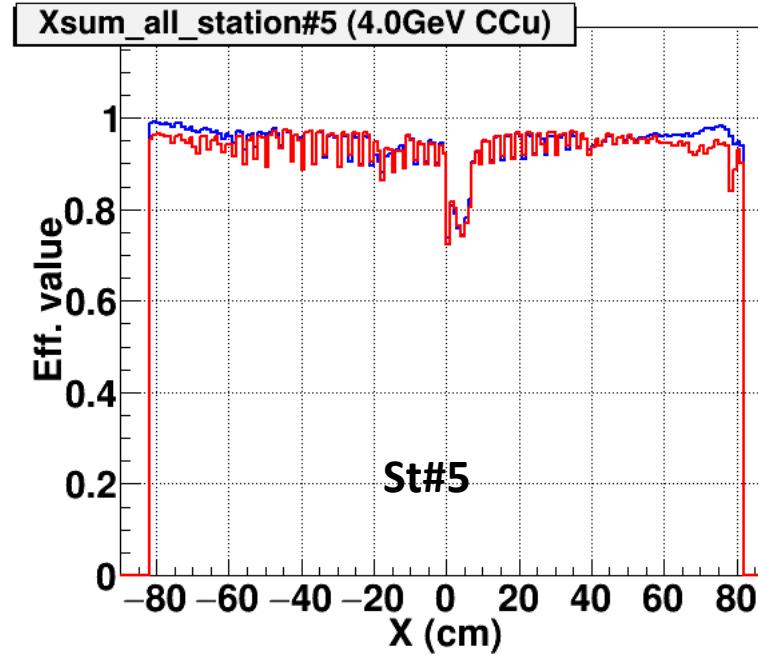
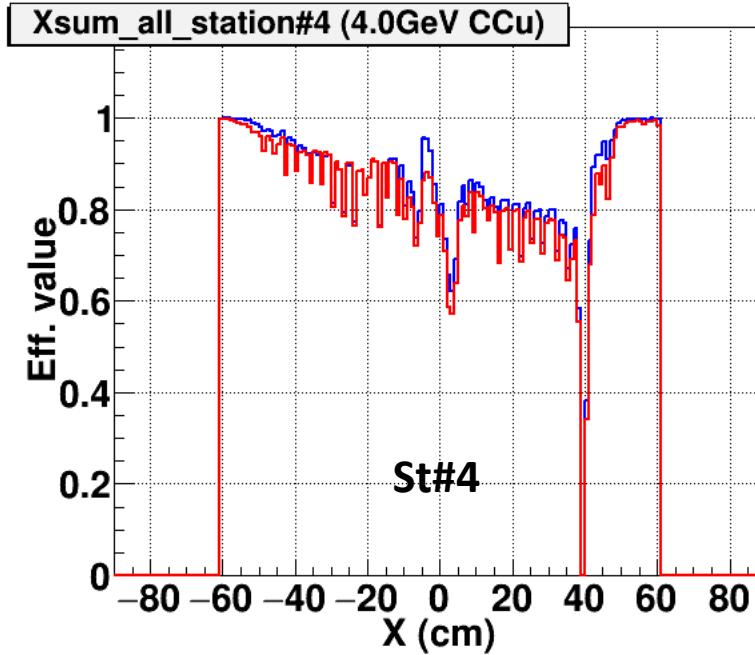
GEM efficiencies C+Cu 4.0GeV SumEff over X

Red: Data; Blue: MC;

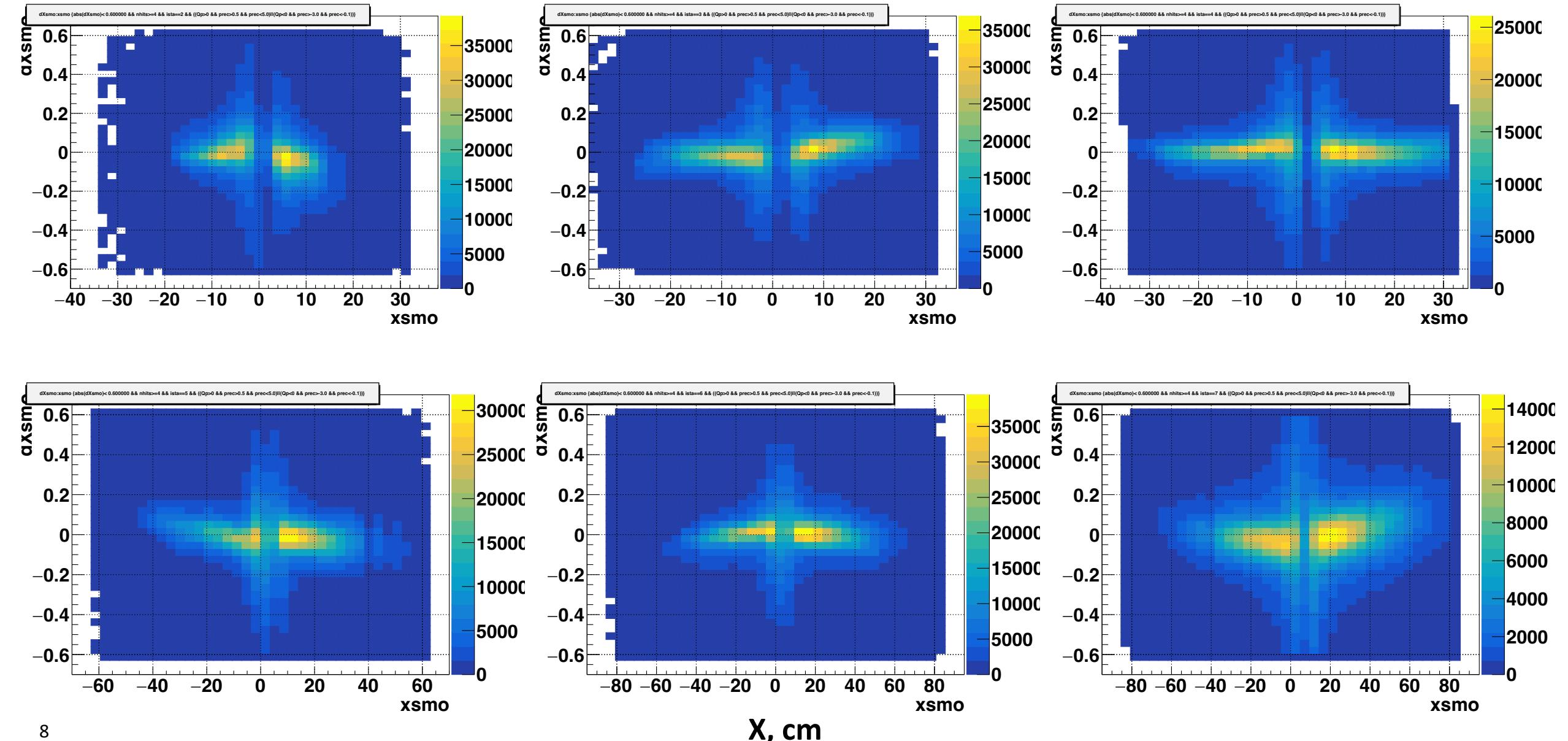


GEM efficiencies C+Cu 4.0GeV SumEff over X

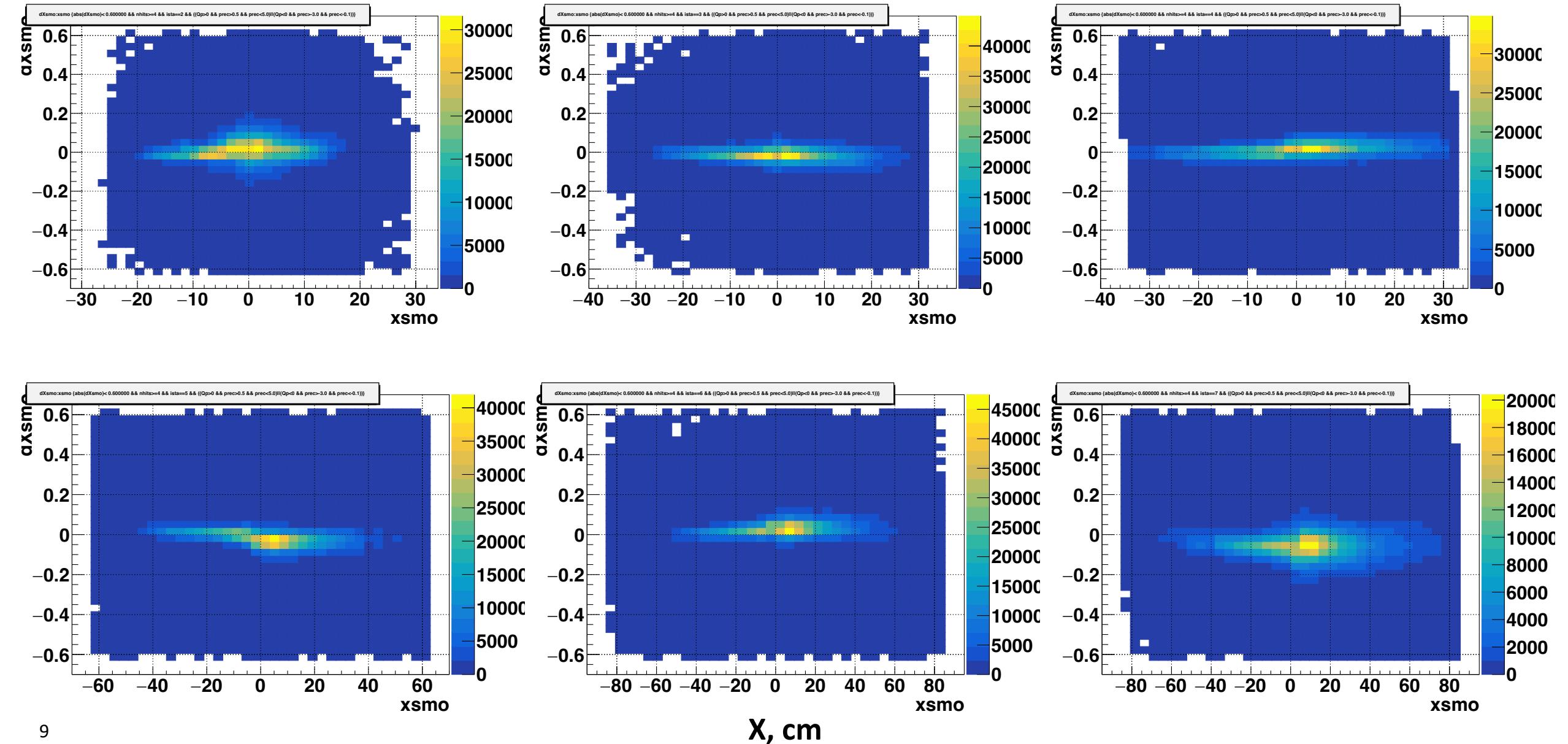
Red: Data; Blue: MC;



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



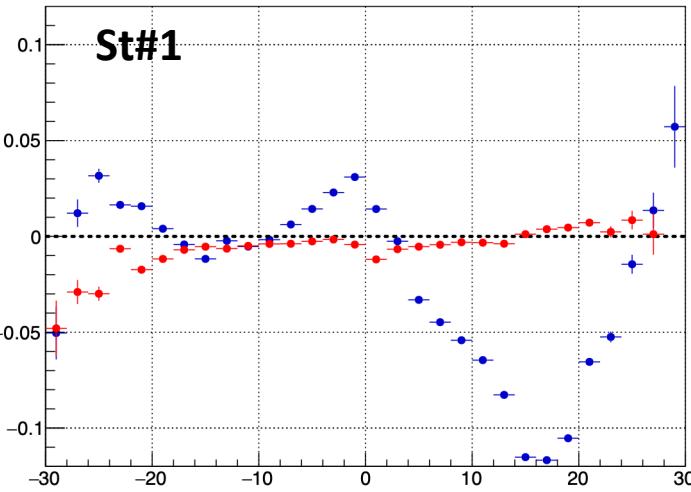
Check residuals MC DX vs.X (4.0GeV CCu)



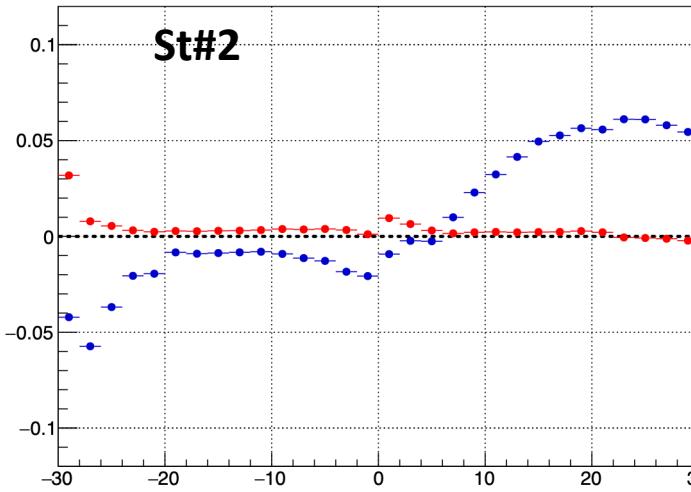
Blue: before corrections
Red: after corrections

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

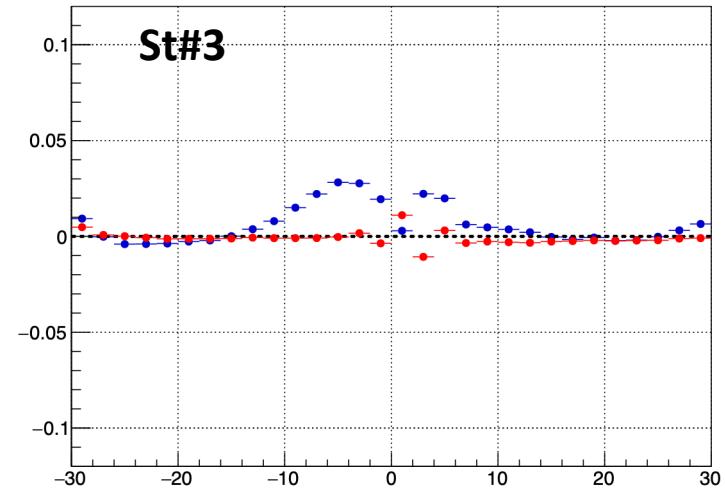
Mean dX vs. x ista==1 (DATA 4.0GeV C+Cu)



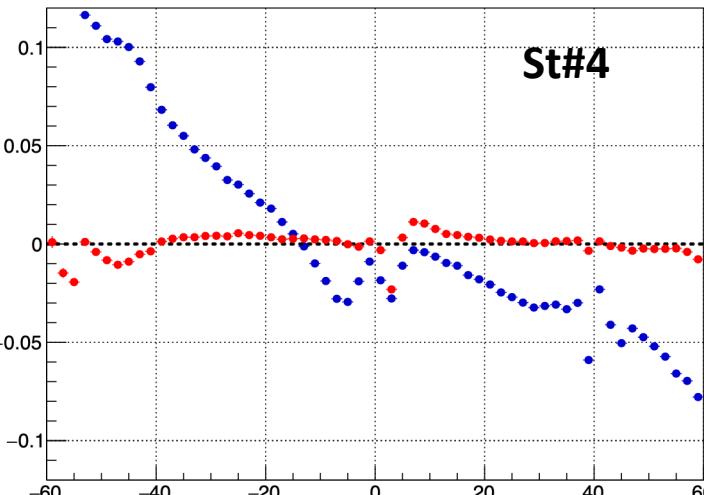
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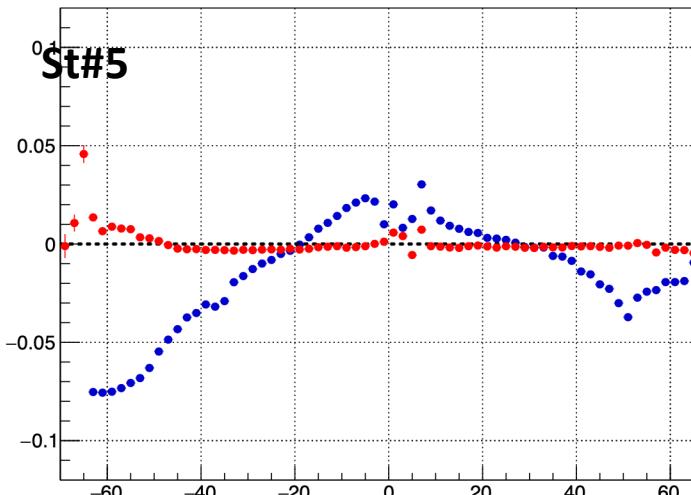
Mean dX vs. x ista==3 (DATA 4.0GeV C+Cu)



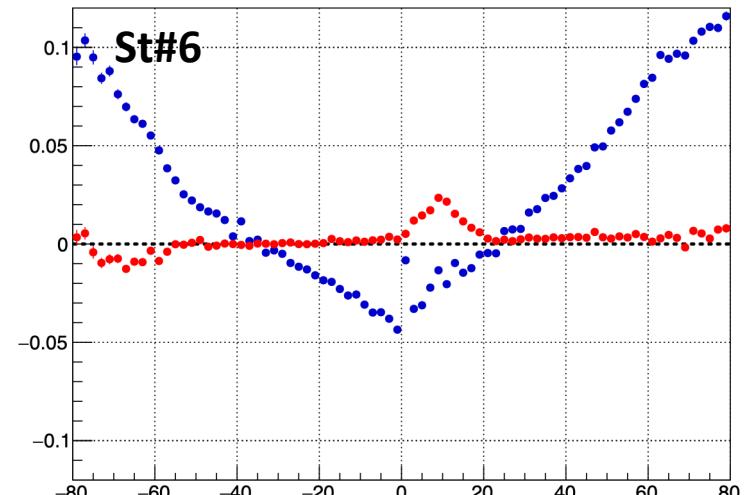
Mean dX vs. x ista==4 (DATA 4.0GeV C+Cu)



Mean dX vs. x ista==5 (DATA 4.0GeV C+Cu)



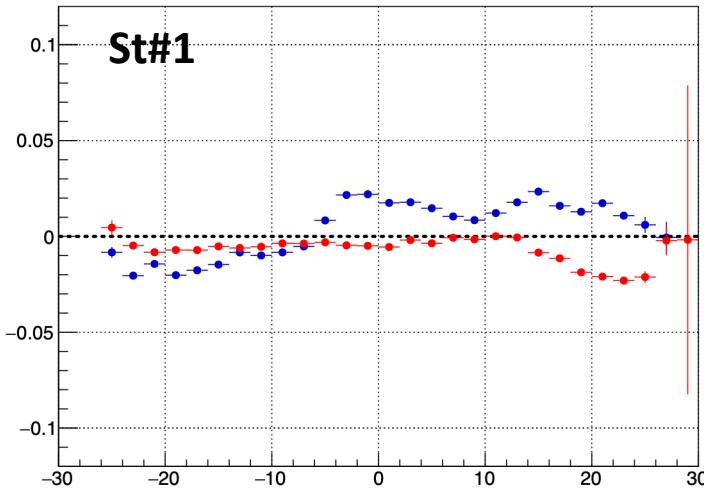
Mean dX vs. x ista==6 (DATA 4.0GeV C+Cu)



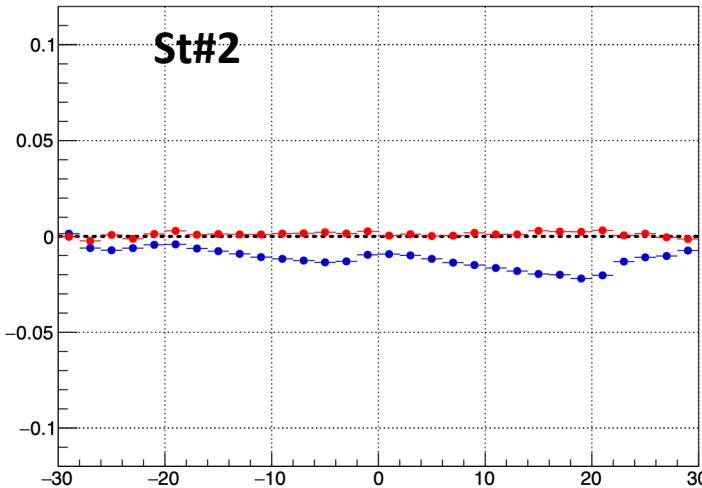
Blue: before corrections
Red: after corrections

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

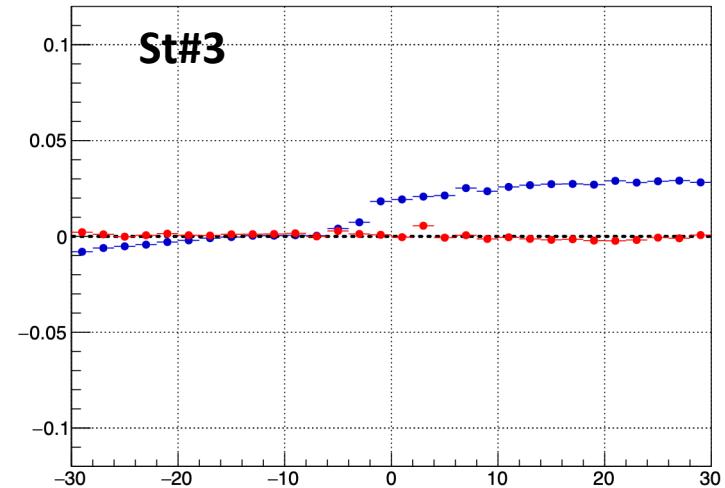
Mean dX vs. x ista==1 (MC 4.0GeV C+Cu)



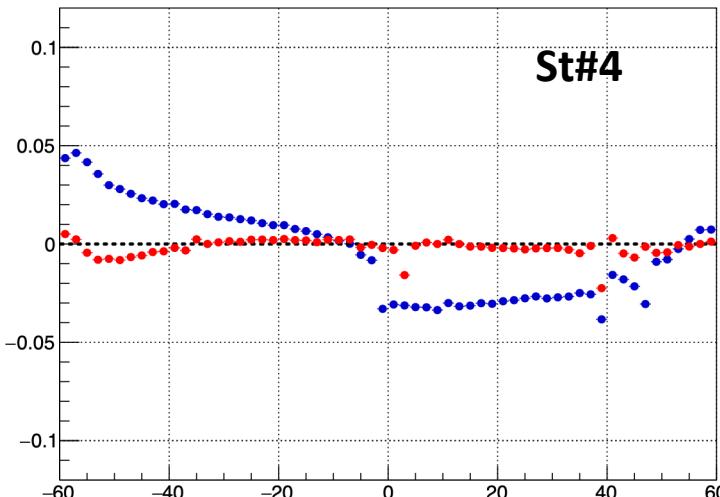
Mean dX vs. x ista==2 (MC 4.0GeV C+Cu)



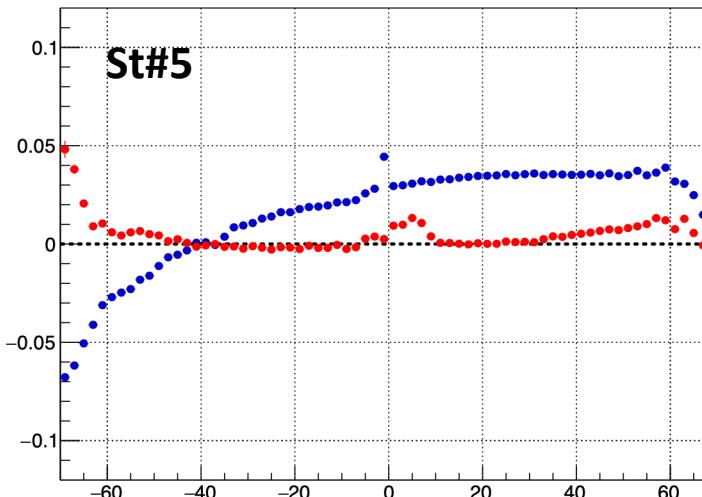
Mean dX vs. x ista==3 (MC 4.0GeV C+Cu)



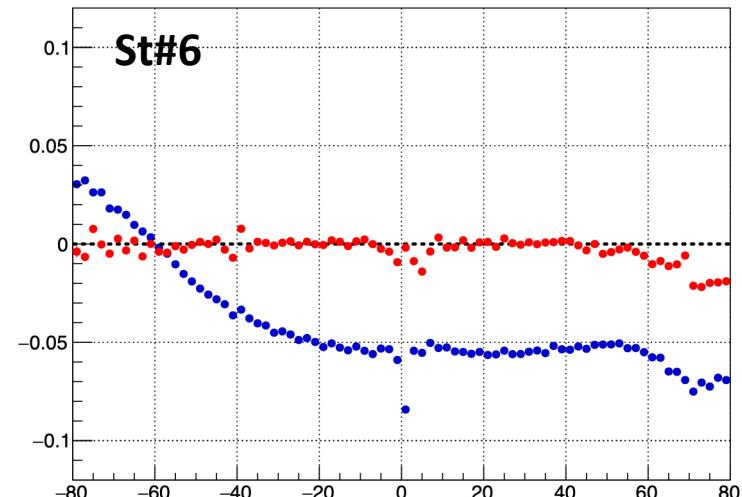
Mean dX vs. x ista==4 (MC 4.0GeV C+Cu)



Mean dX vs. x ista==5 (MC 4.0GeV C+Cu)

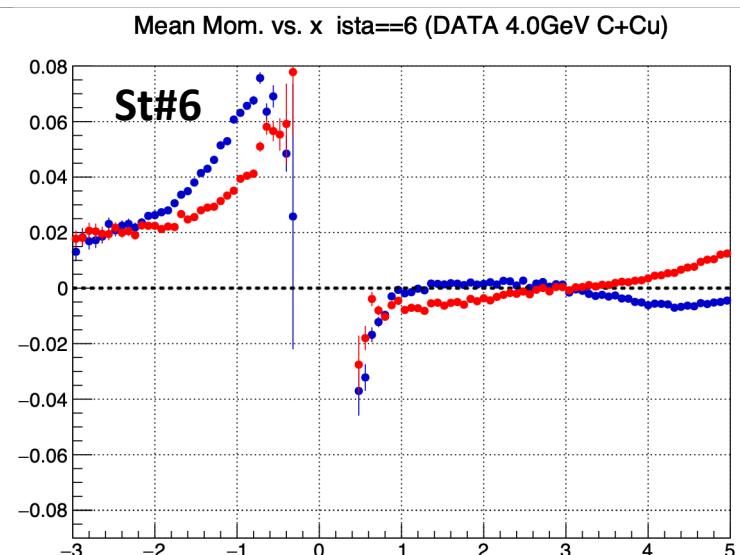
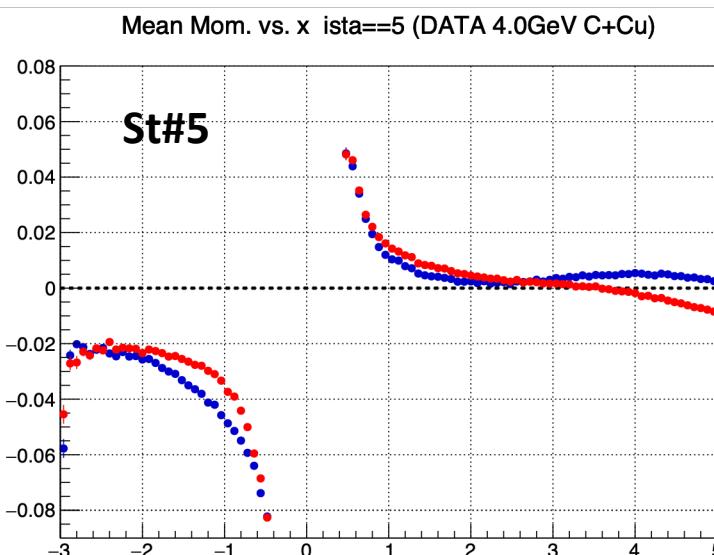
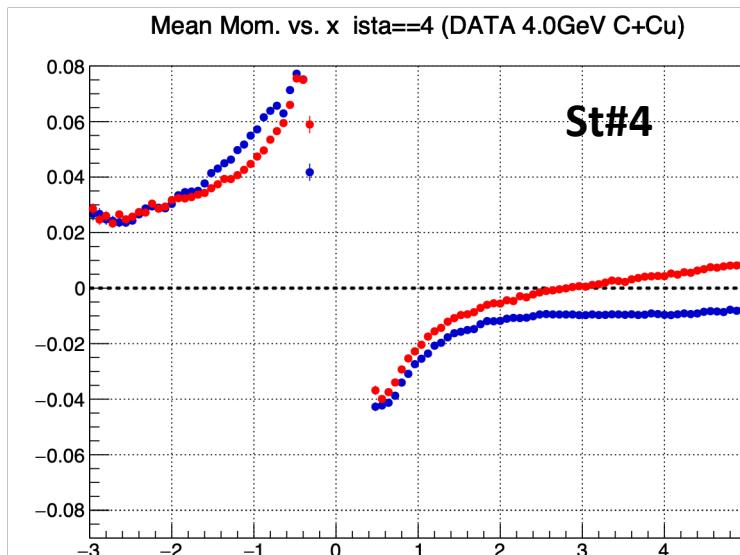
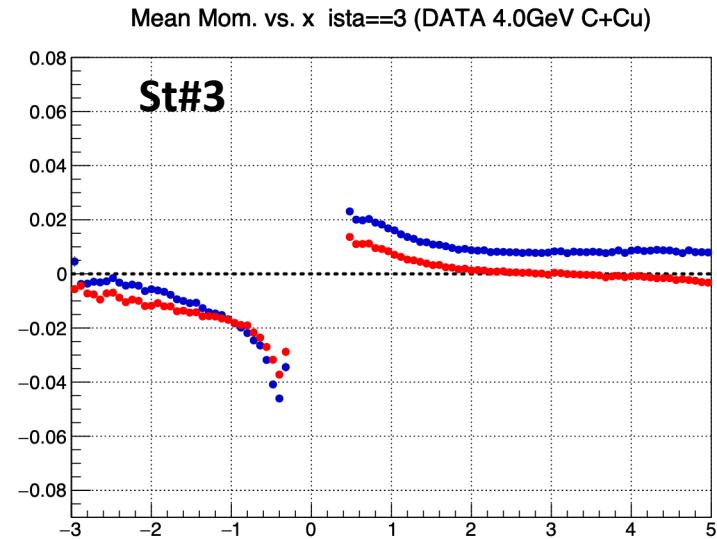
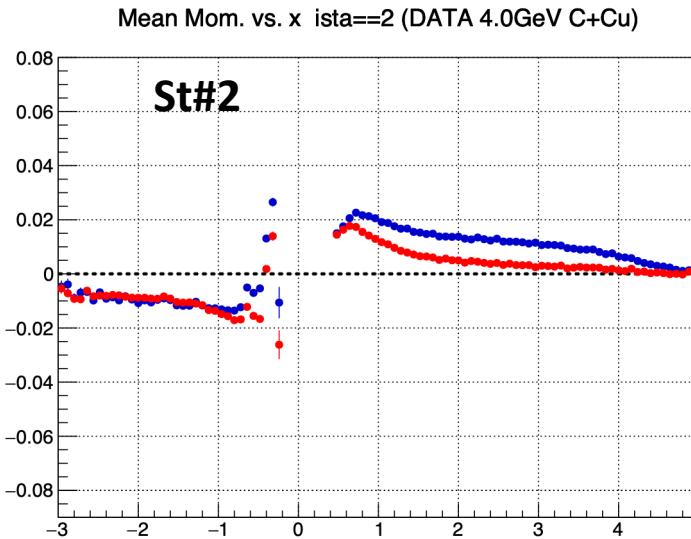
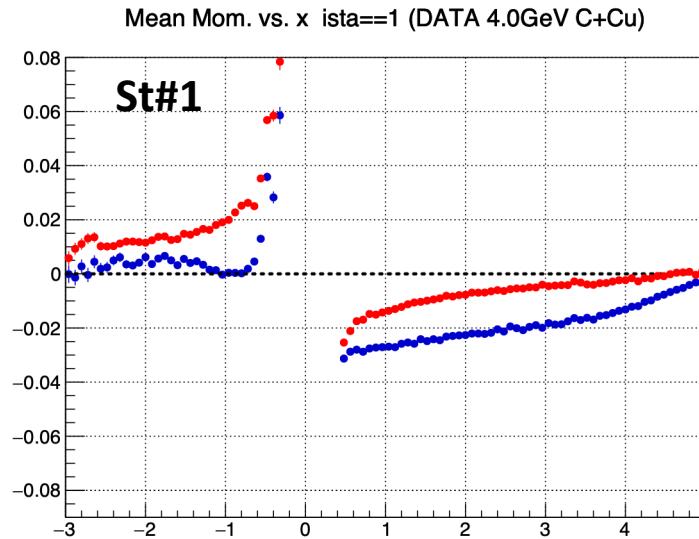


Mean dX vs. x ista==6 (MC 4.0GeV C+Cu)



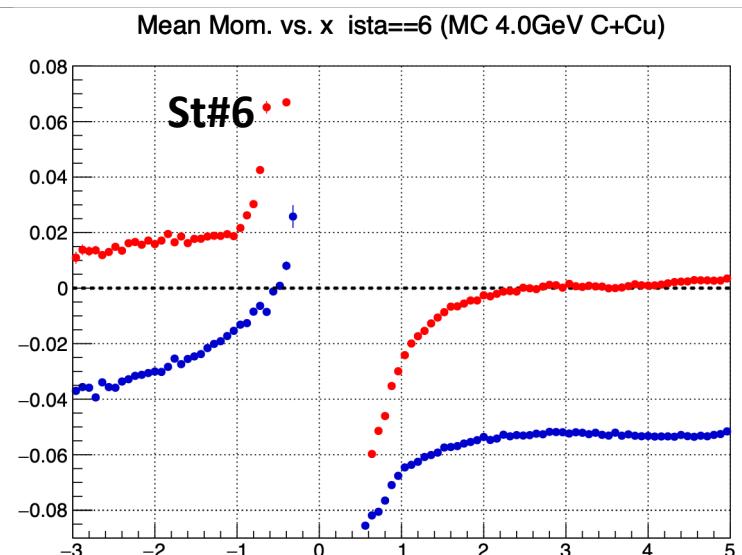
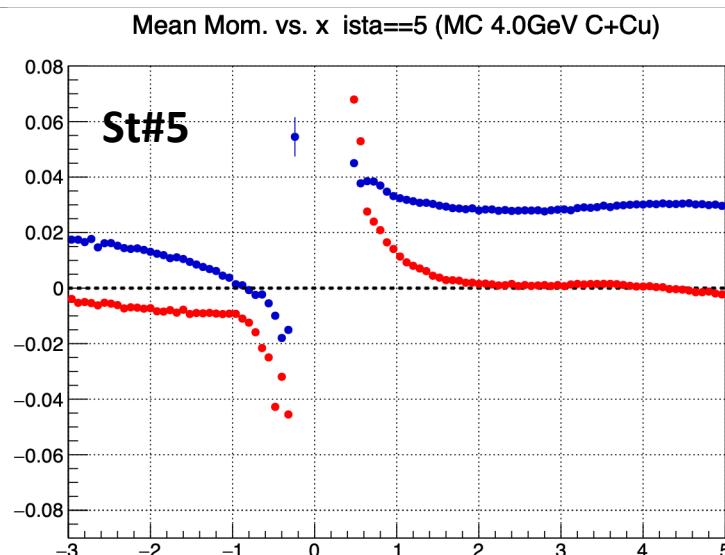
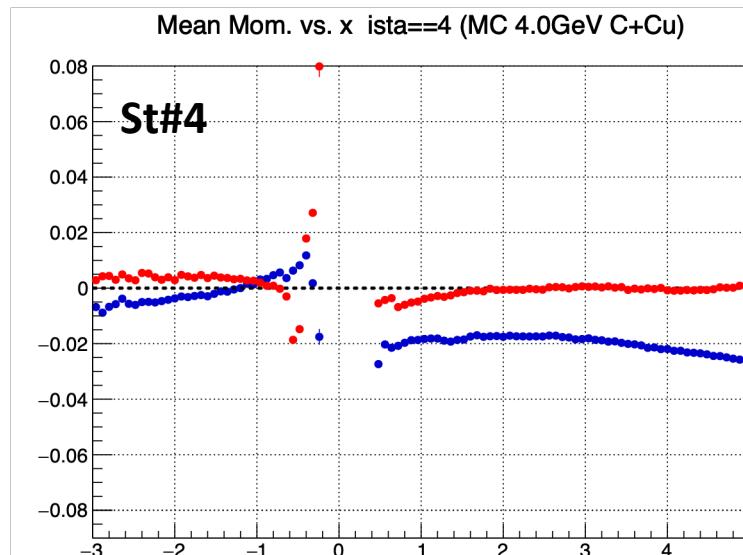
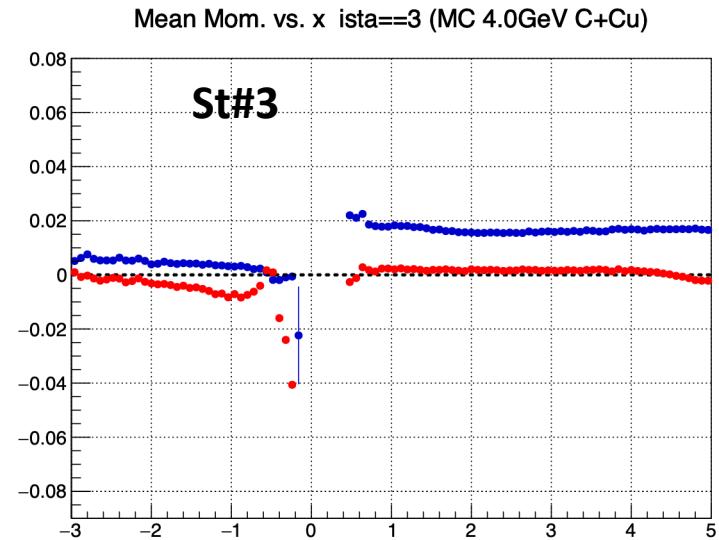
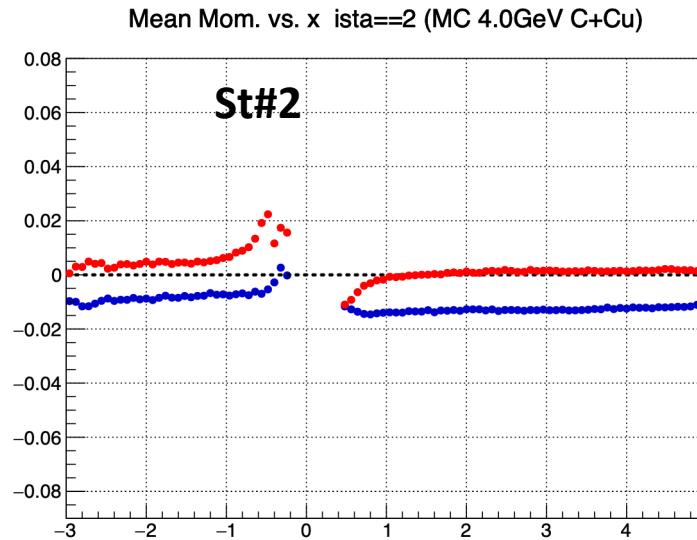
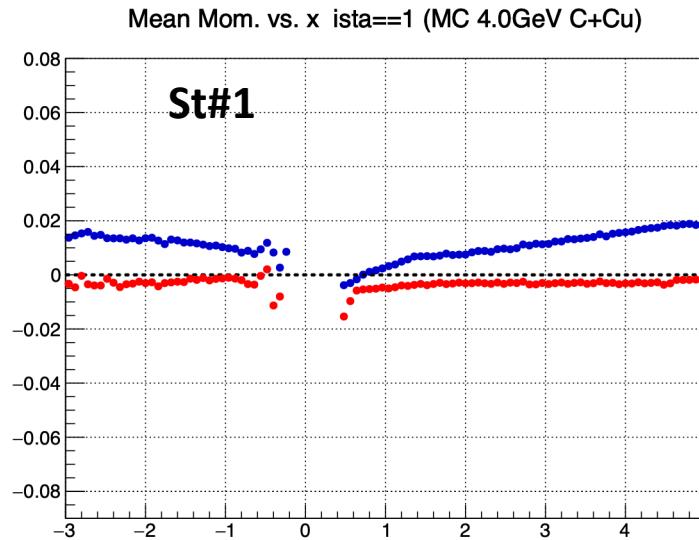
Blue: before corrections
Red: after corrections

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



Blue: before corrections
Red: after corrections

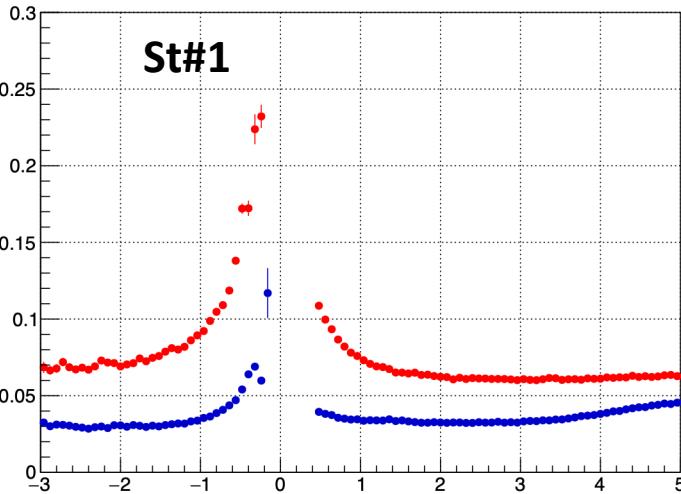
Mean Dx vs Momentum (MC 4.0GeV C+Cu)



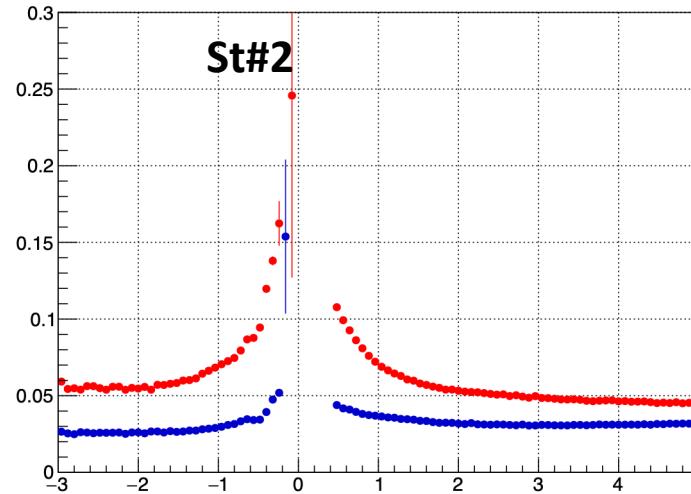
Blue: MC
Red: DATA

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

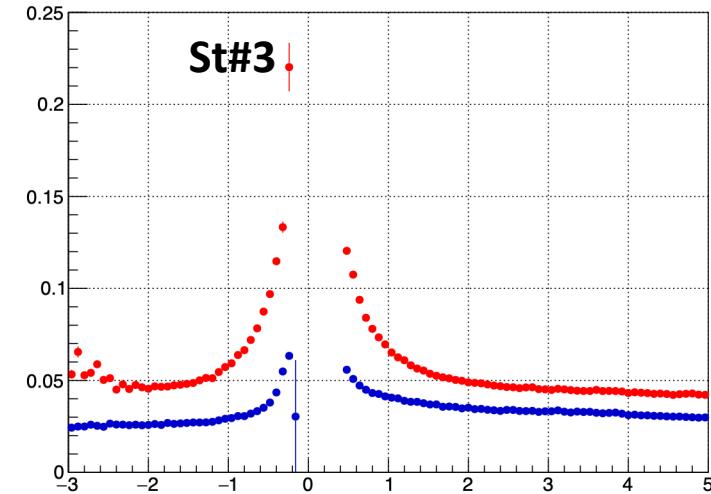
Sigma Mom& vs. x ista==1 (DATA & MC)



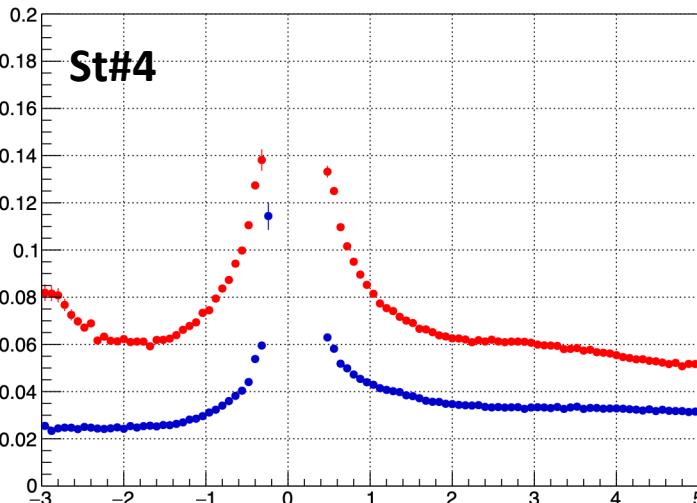
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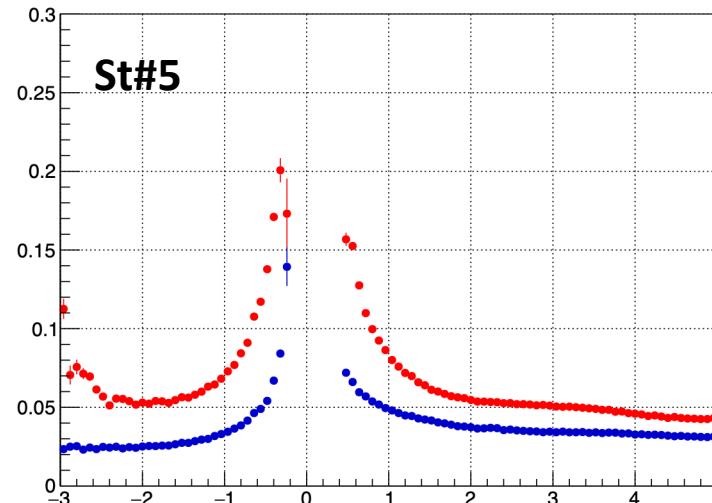
Sigma Mom& vs. x ista==3 (DATA & MC)



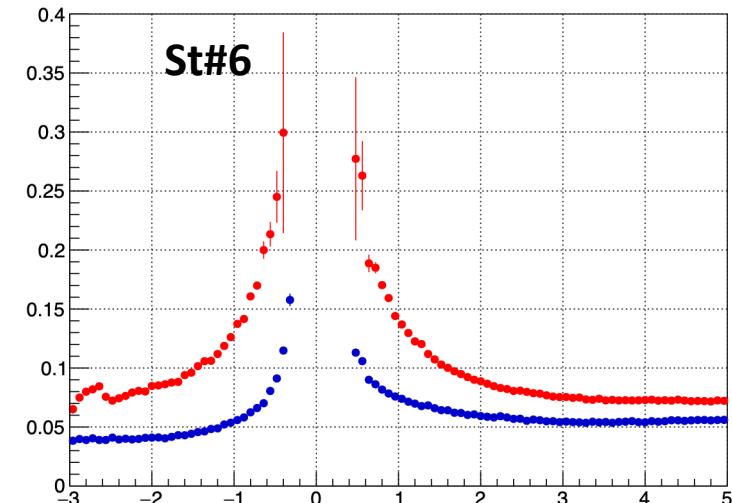
Sigma Mom& vs. x ista==4 (DATA & MC)



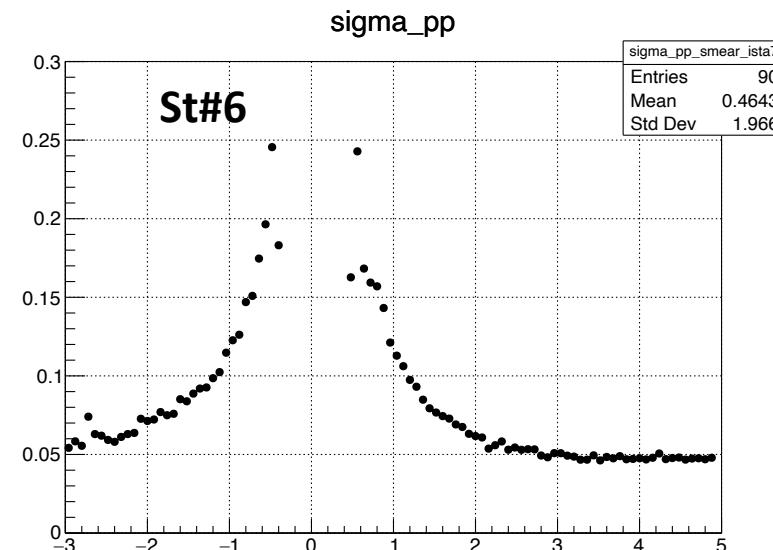
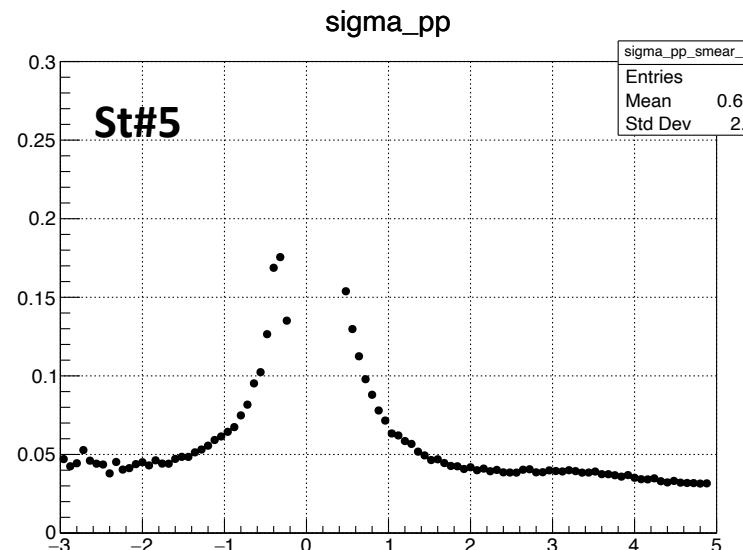
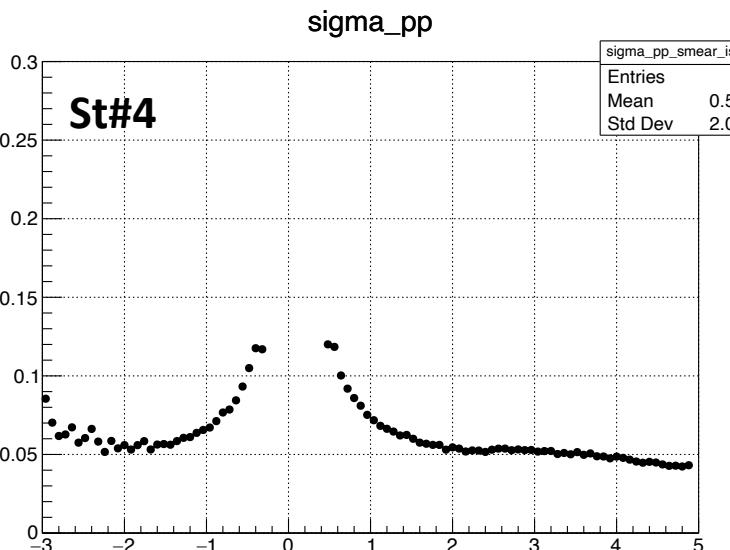
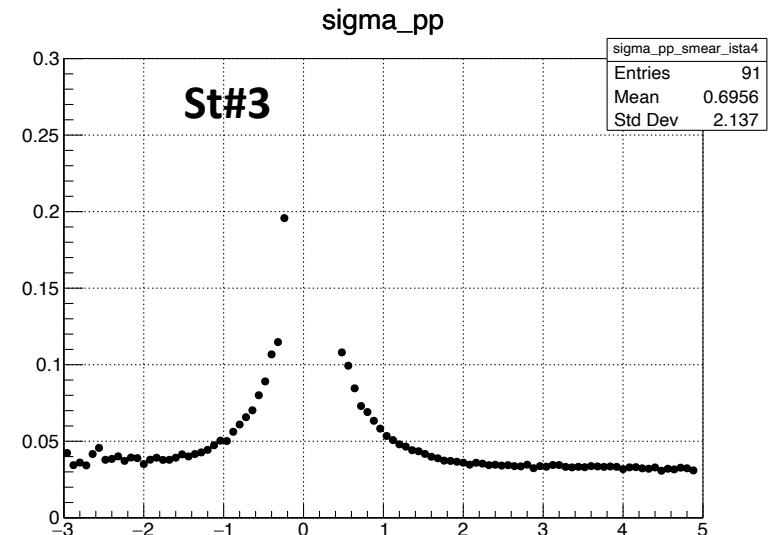
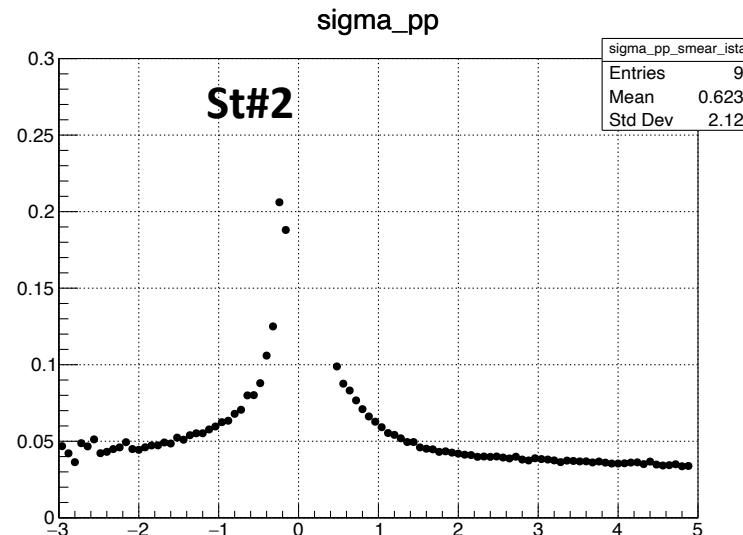
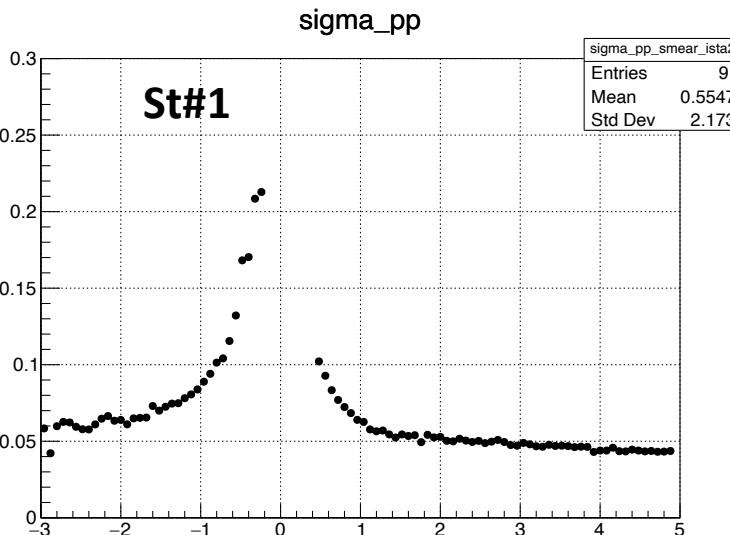
Sigma Mom& vs. x ista==5 (DATA & MC)



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

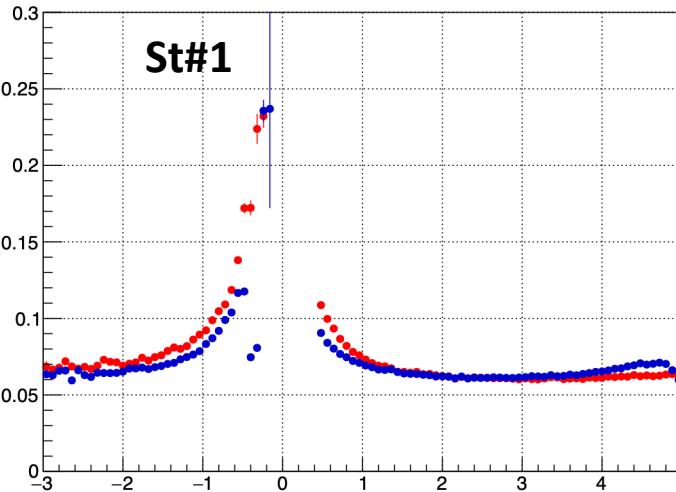


MC Smearing functions (Sigma Dx vs Momentum): $\sigma_{SMEAR} = \sqrt{\sigma_{DATA}^2 - \sigma_{MC}^2}$

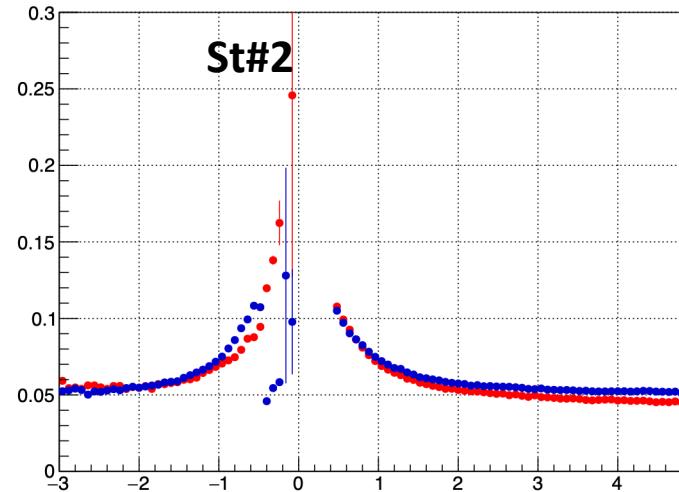


Sigma Dx vs Momentum after smearing (DATA & MC 4.0GeV C+Cu)

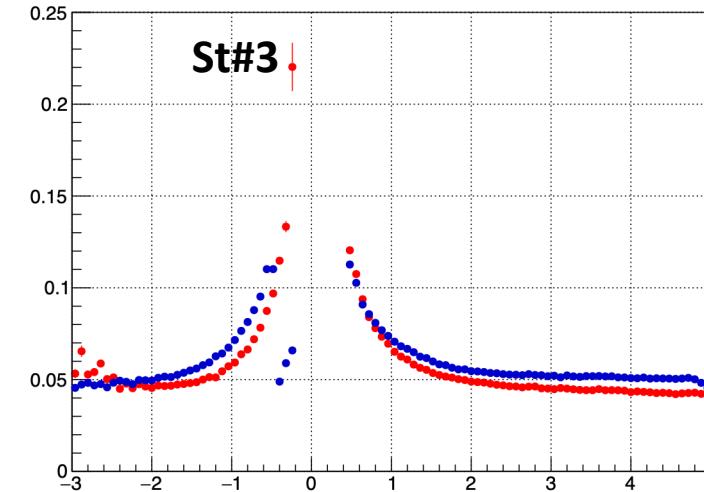
Sigma Mom& vs. x ista==1 (DATA & MC)



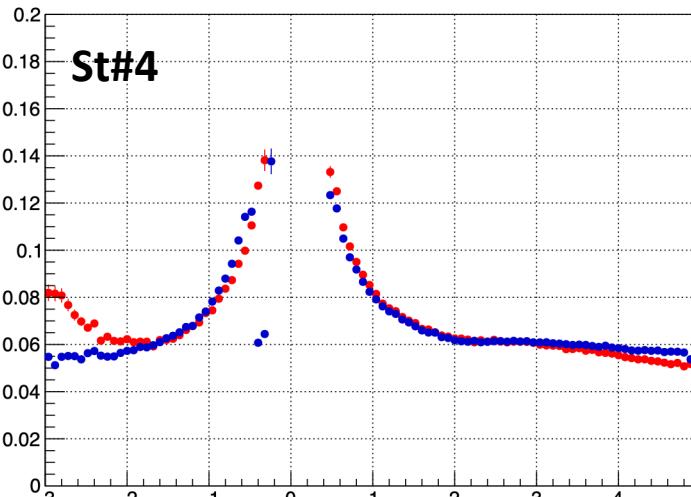
Sigma Mom& vs. x ista==2 (DATA & MC)



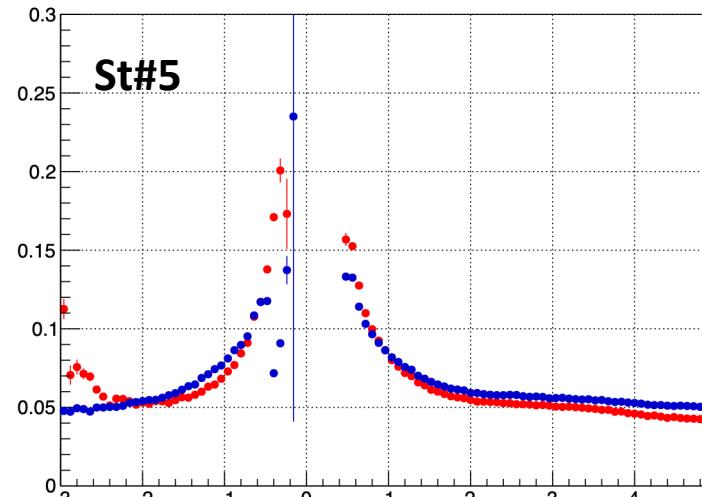
Sigma Mom& vs. x ista==3 (DATA & MC)



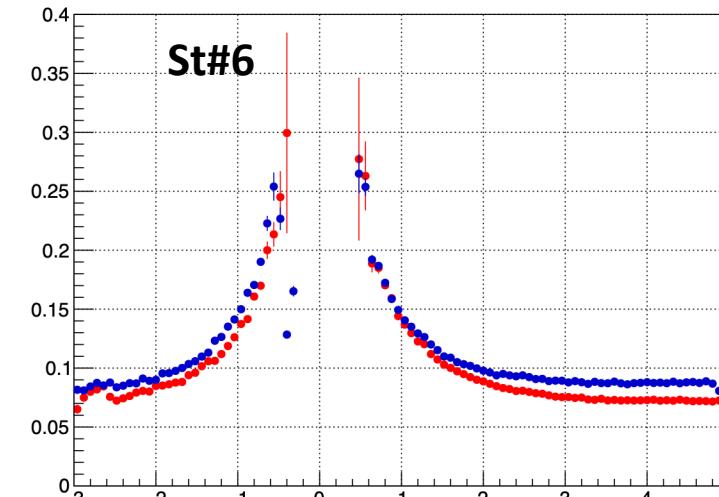
Sigma Mom& vs. x ista==4 (DATA & MC)



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



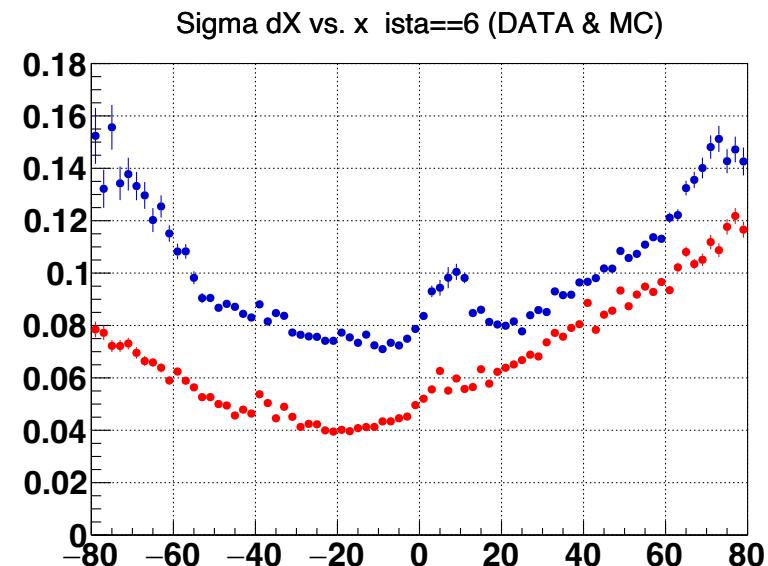
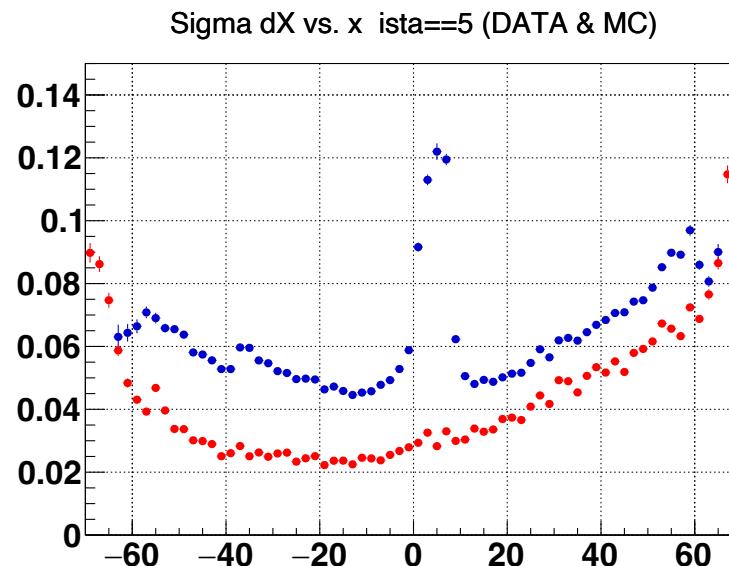
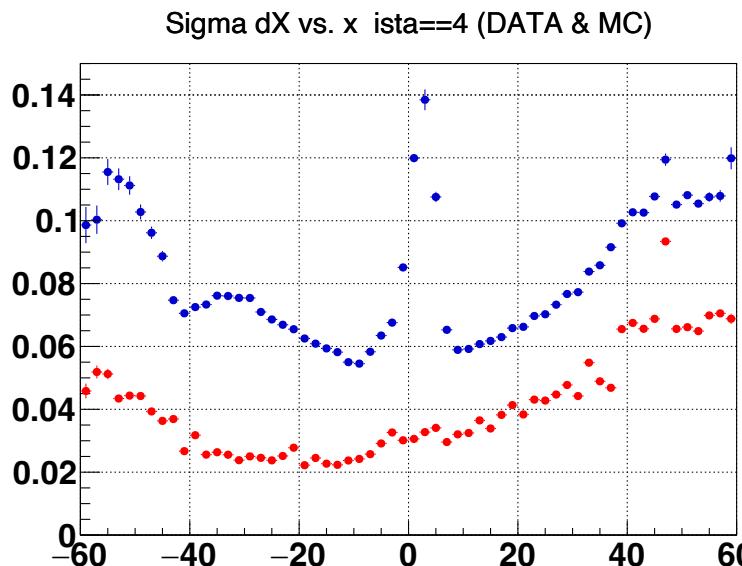
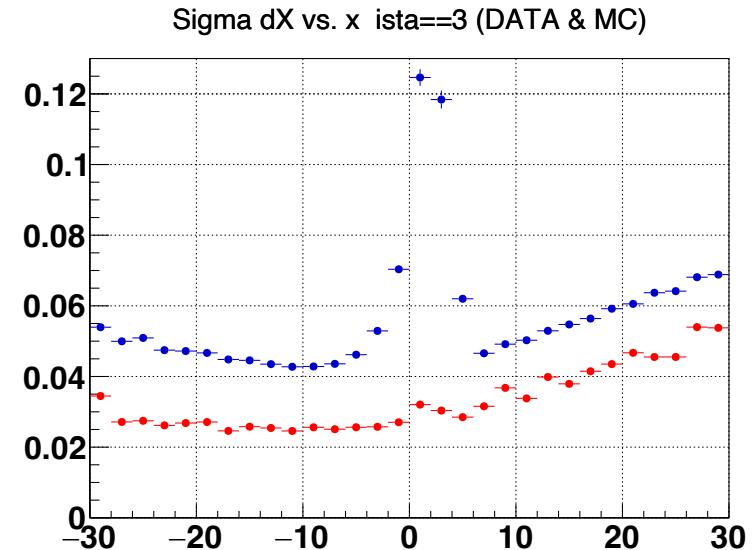
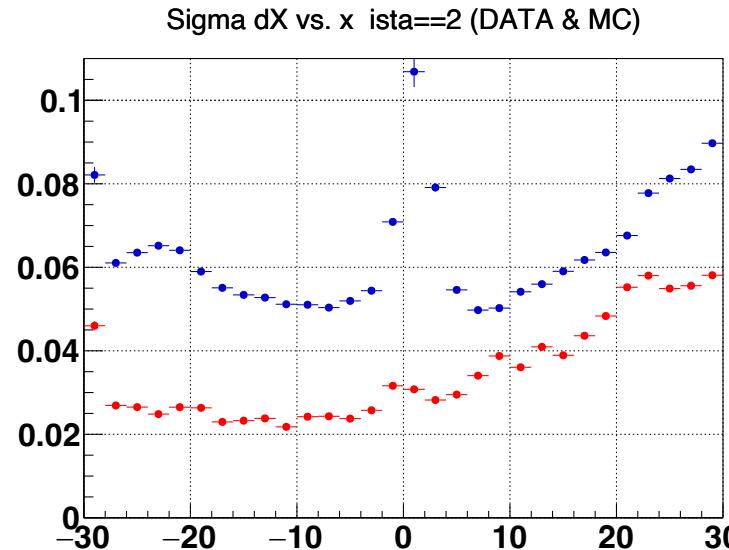
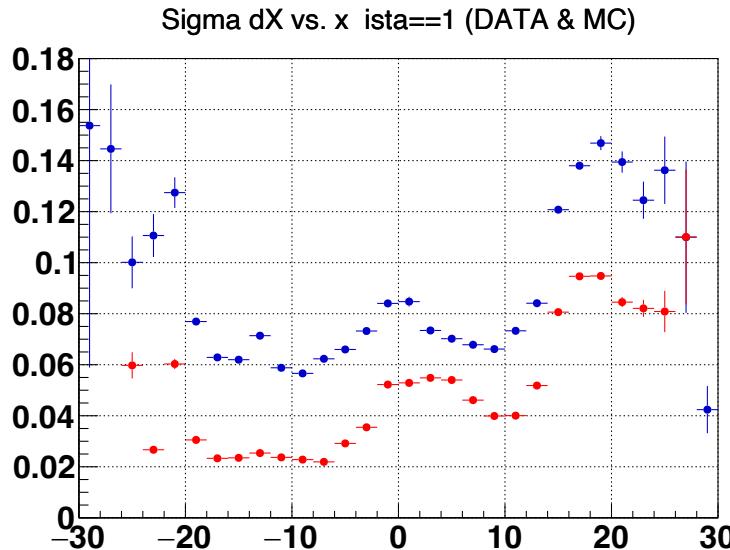
Sigma Mom& vs. x ista==6 (DATA & MC)



Blue: DATA

Red: MC

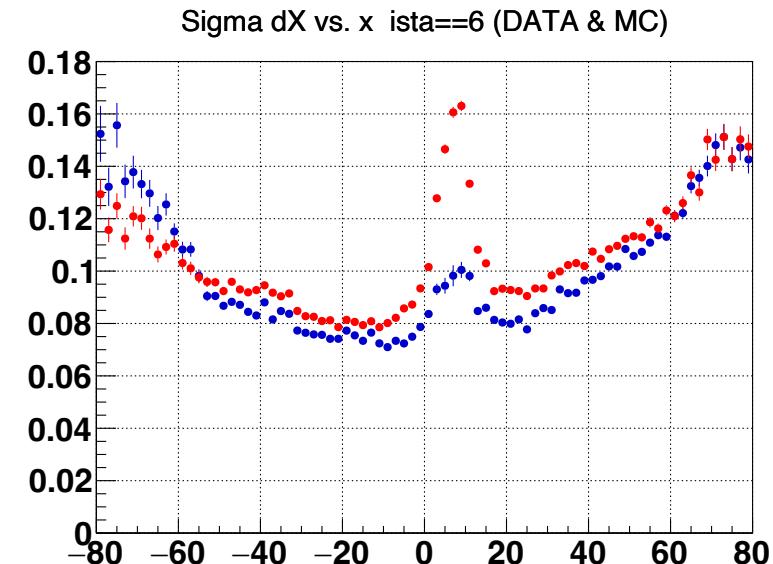
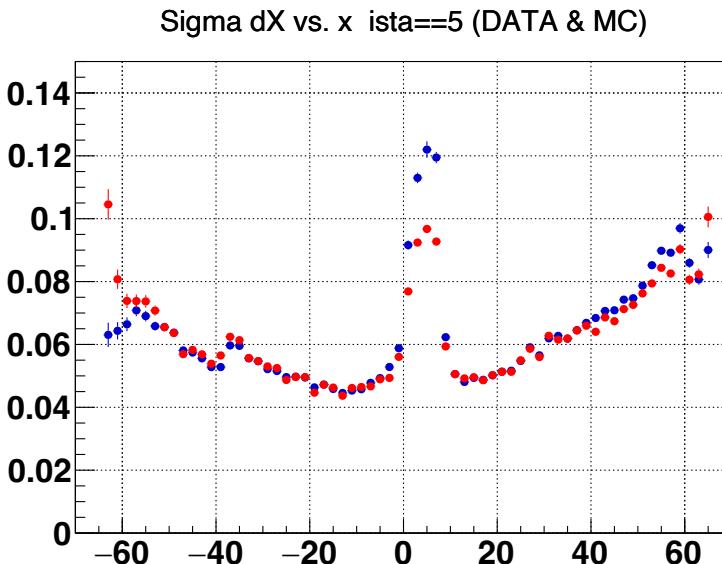
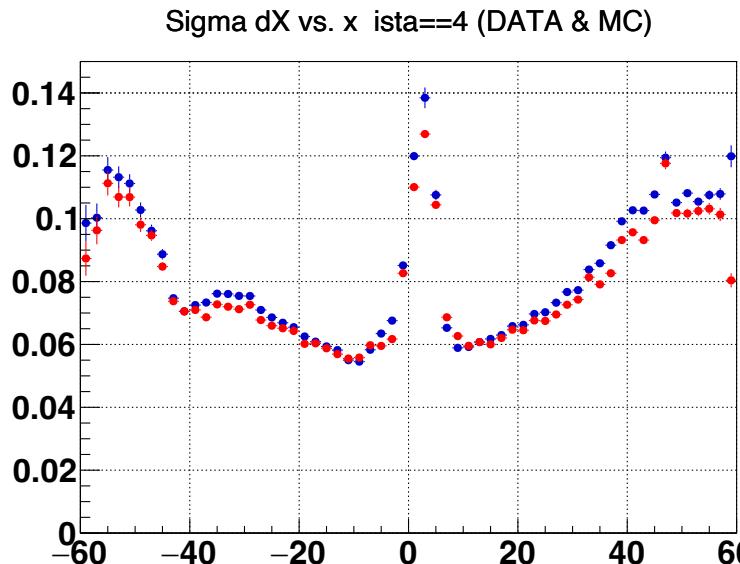
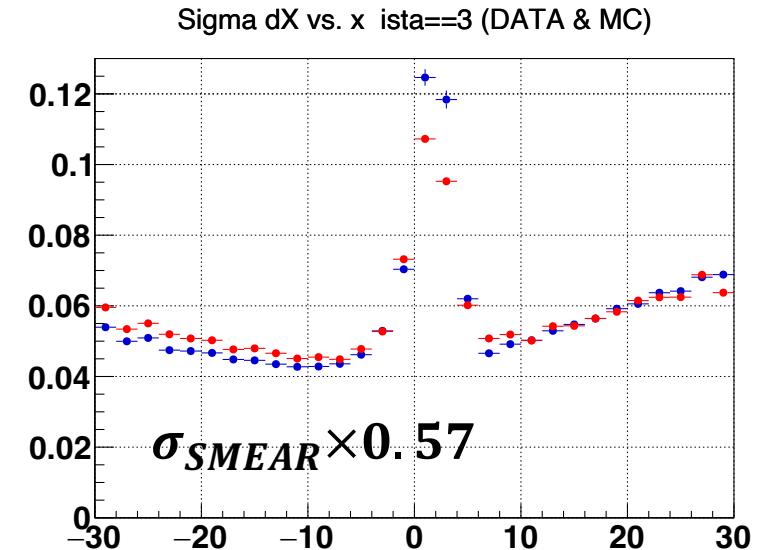
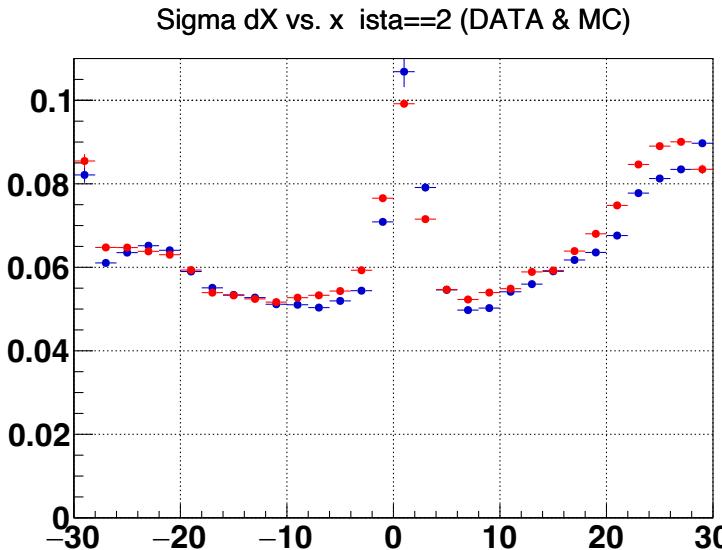
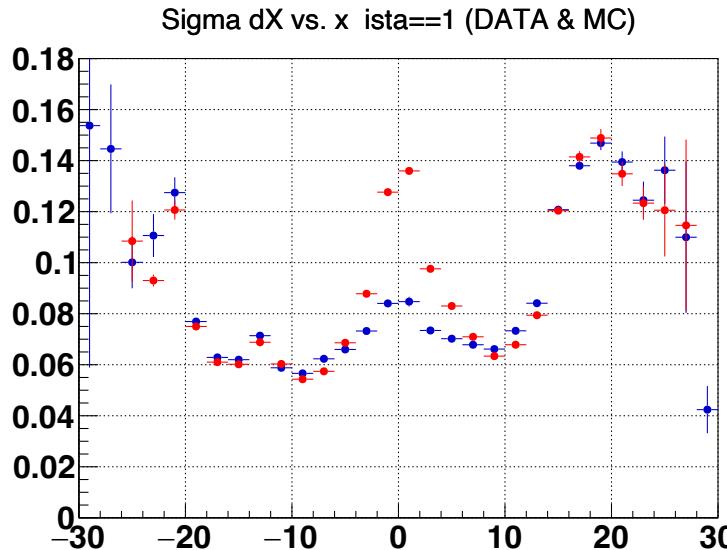
Sigma Dx vs X comparison (DATA & MC 4.0GeV C+Cu)



Blue: DATA

Red: MC

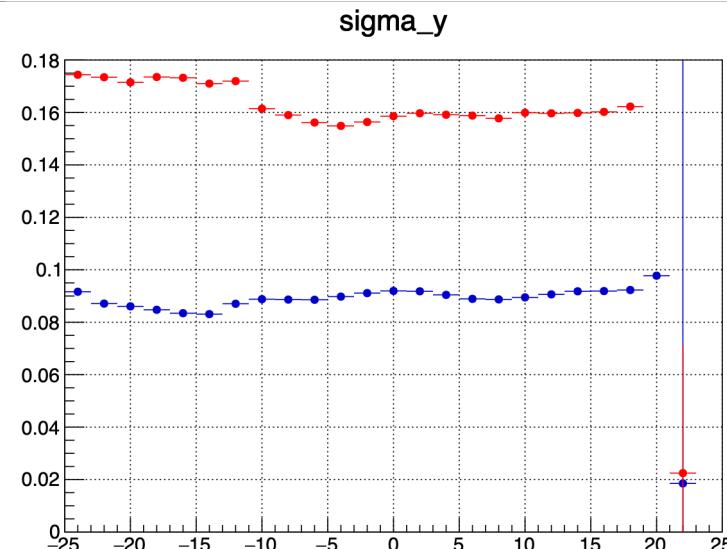
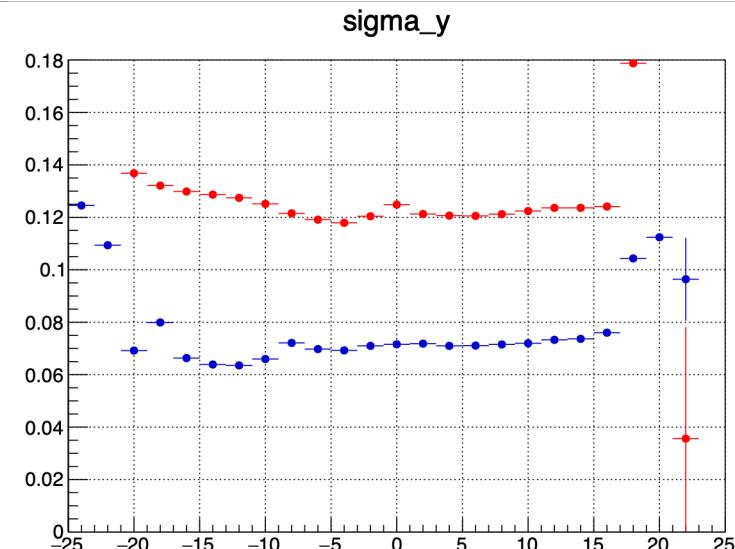
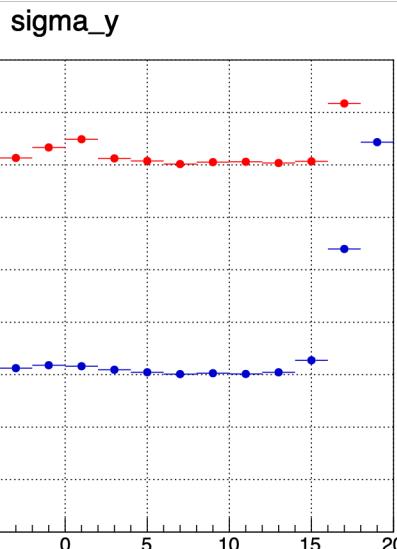
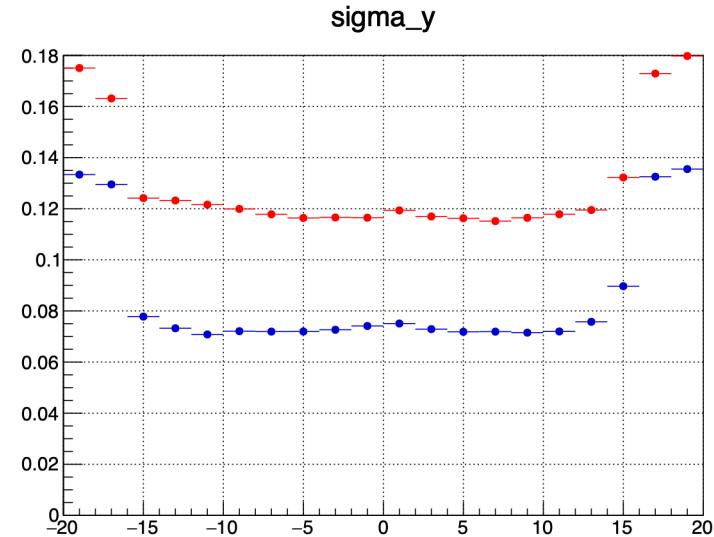
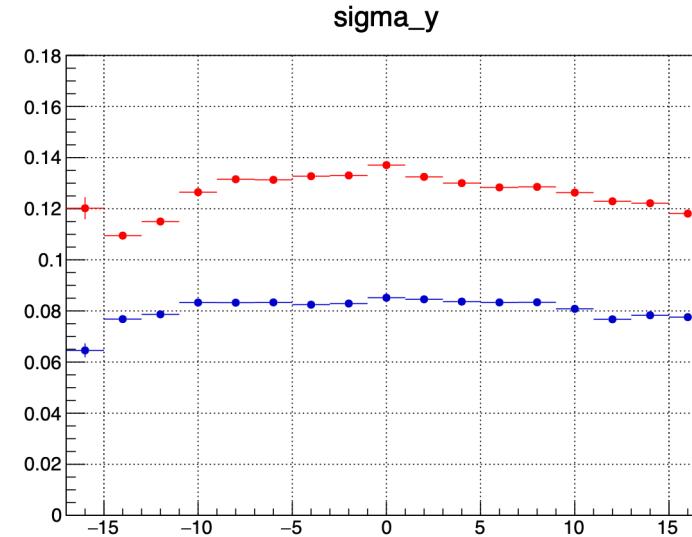
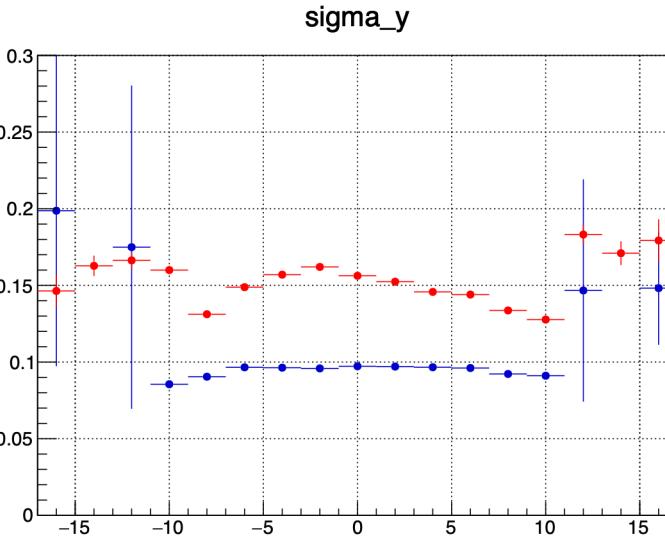
Sigma Dx vs X comparison after smearing (DATA & MC 4.0GeV C+Cu)



Red: DATA

Blue: MC

Sigma Dy vs Y comparison (DATA & MC 4.0GeV C+Cu)

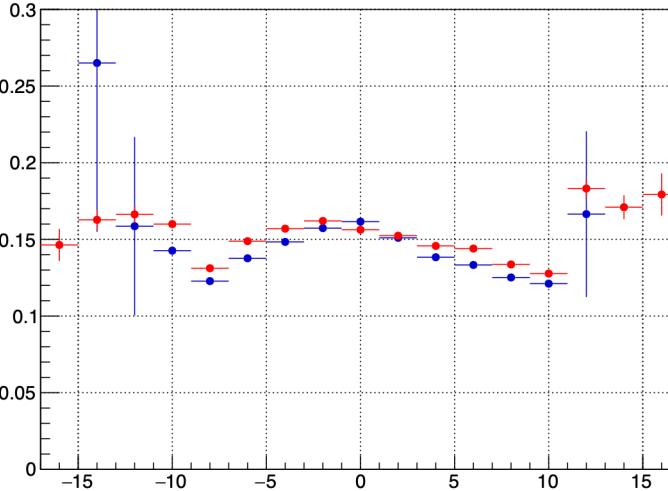


Red: DATA

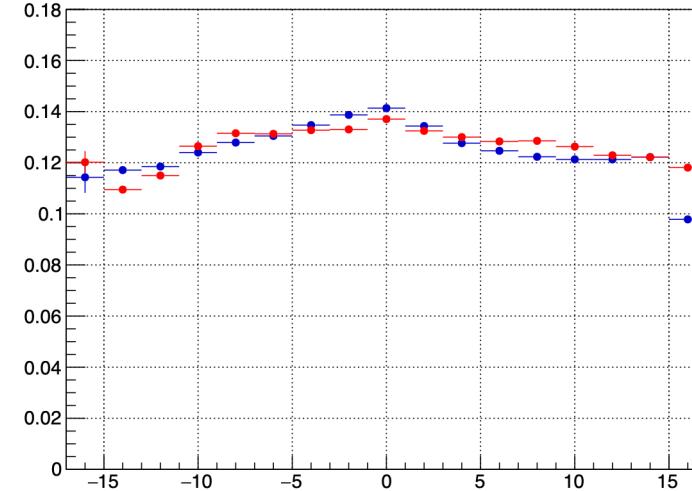
Blue: MC

Sigma Dy vs Y comparison after smearing (**DATA & MC 4.0GeV C+Cu**)

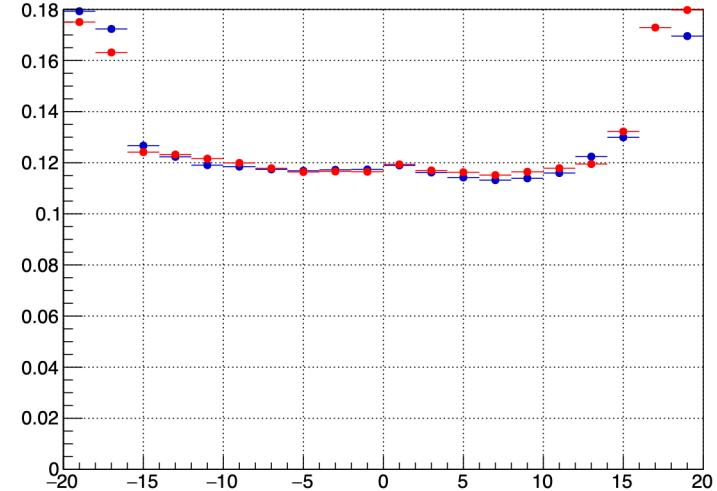
sigma_y



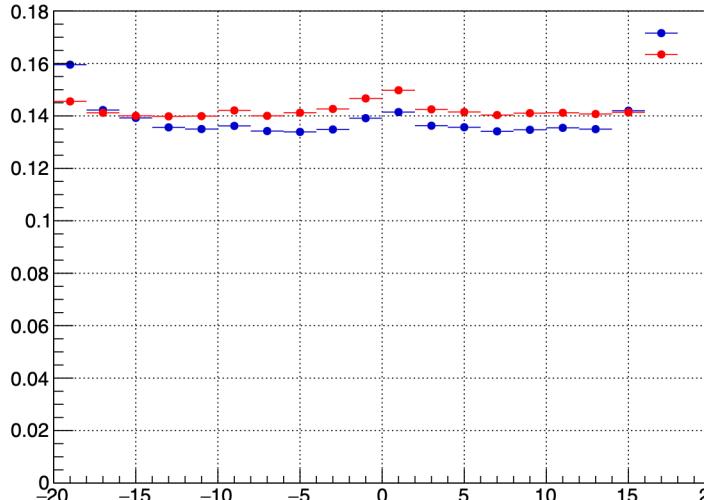
sigma_y



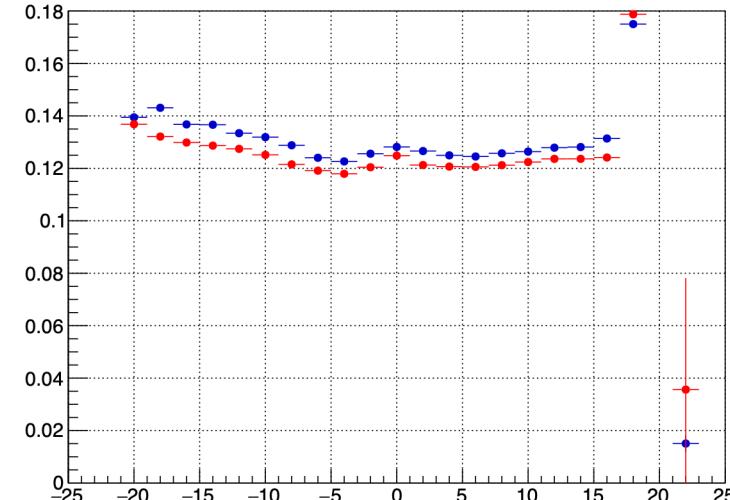
sigma_y



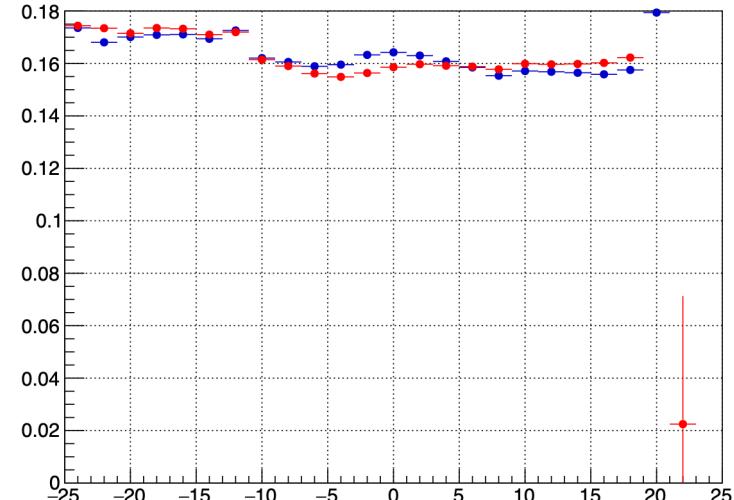
sigma_y



sigma_y



sigma_y

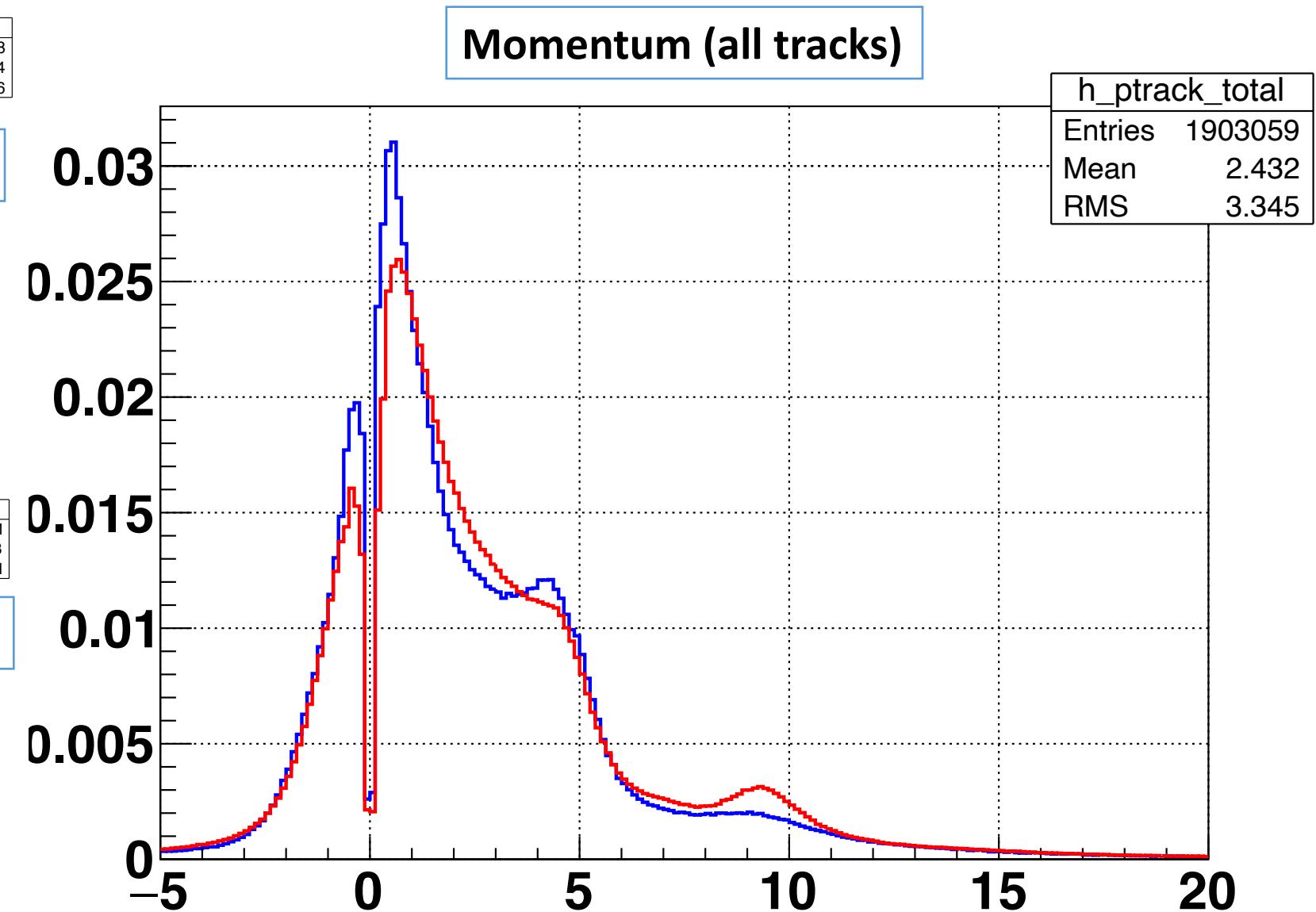
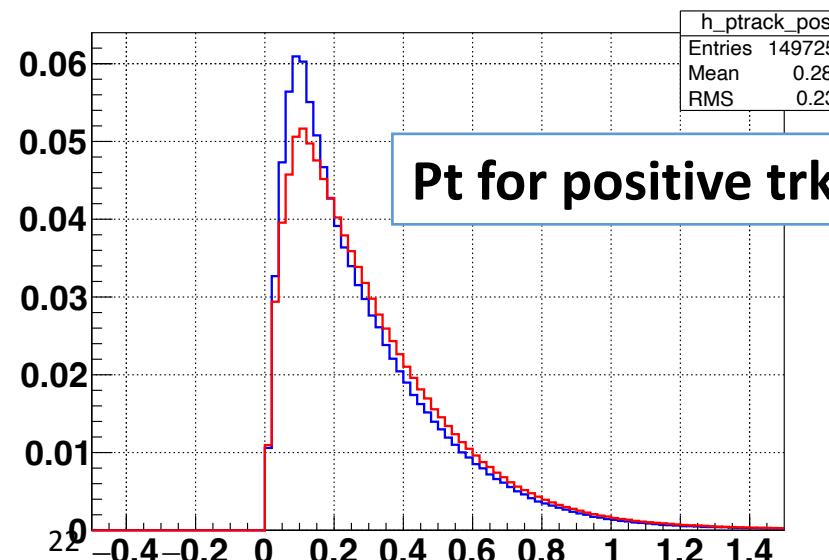
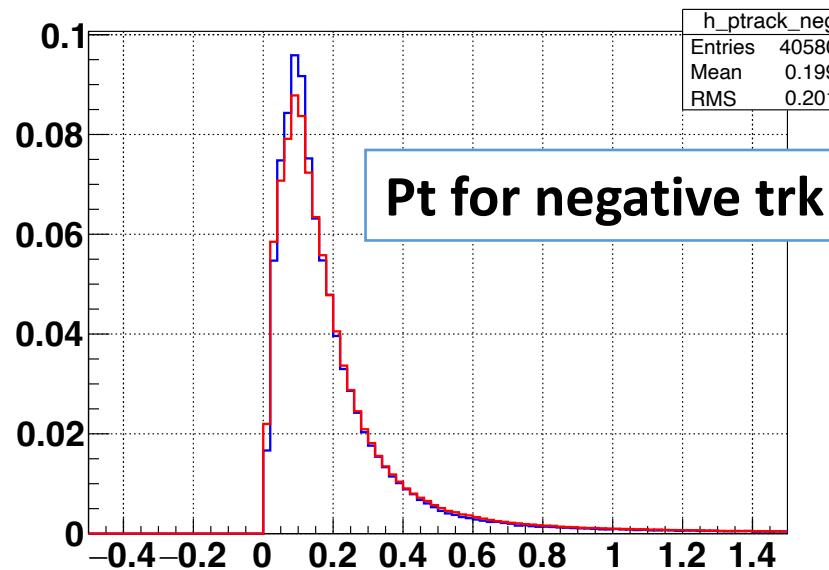


Events preselection cuts for control plots

- VETO==0
- BC2Hit==1, Mod==0
- BdHit>=2
- T0Hit==1, Mod==0
- Number tracks in event >= 2
- nHits on Track >=4
- Tracks from Primary Vertex >=2
- Nstrip < 440

C+Cu (4.0 GeV) Control plots (Pt & Momentum of all tracks)

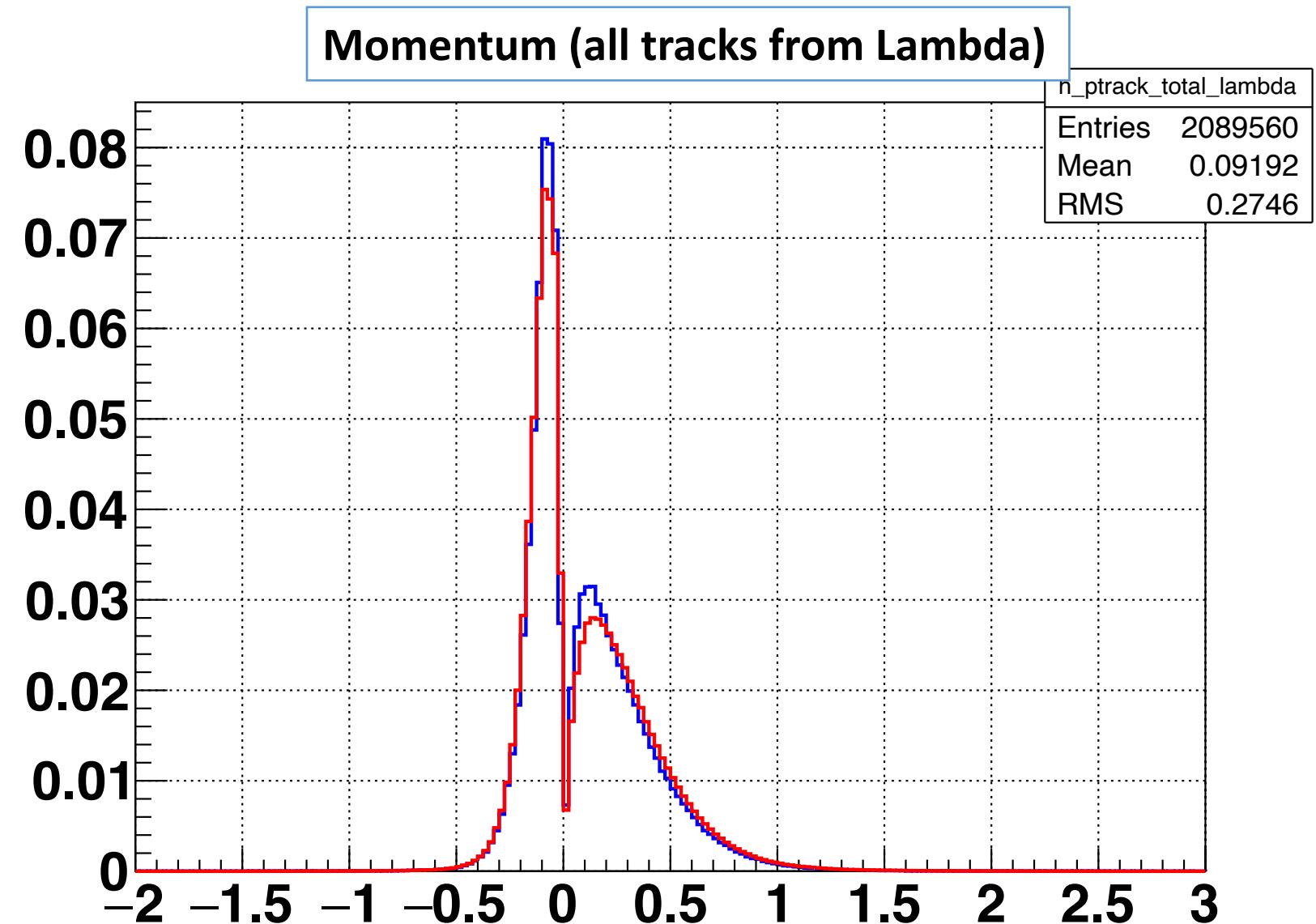
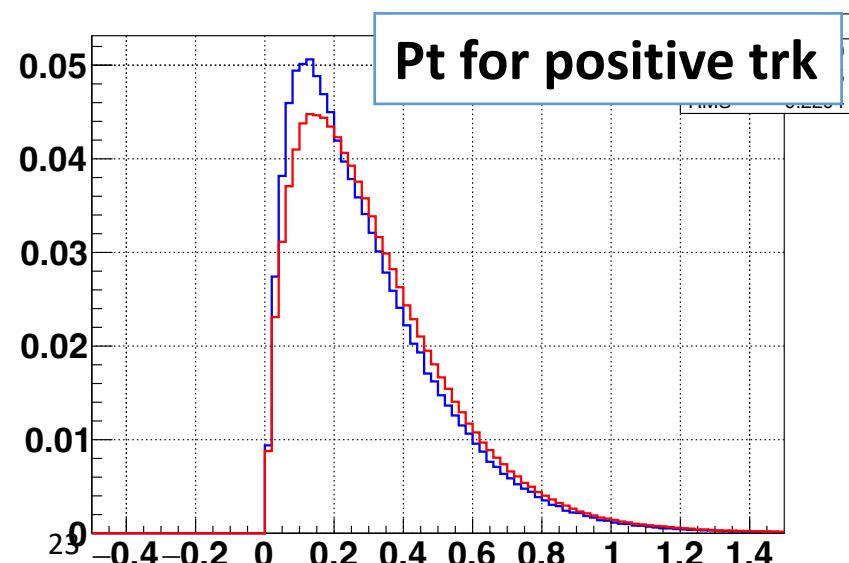
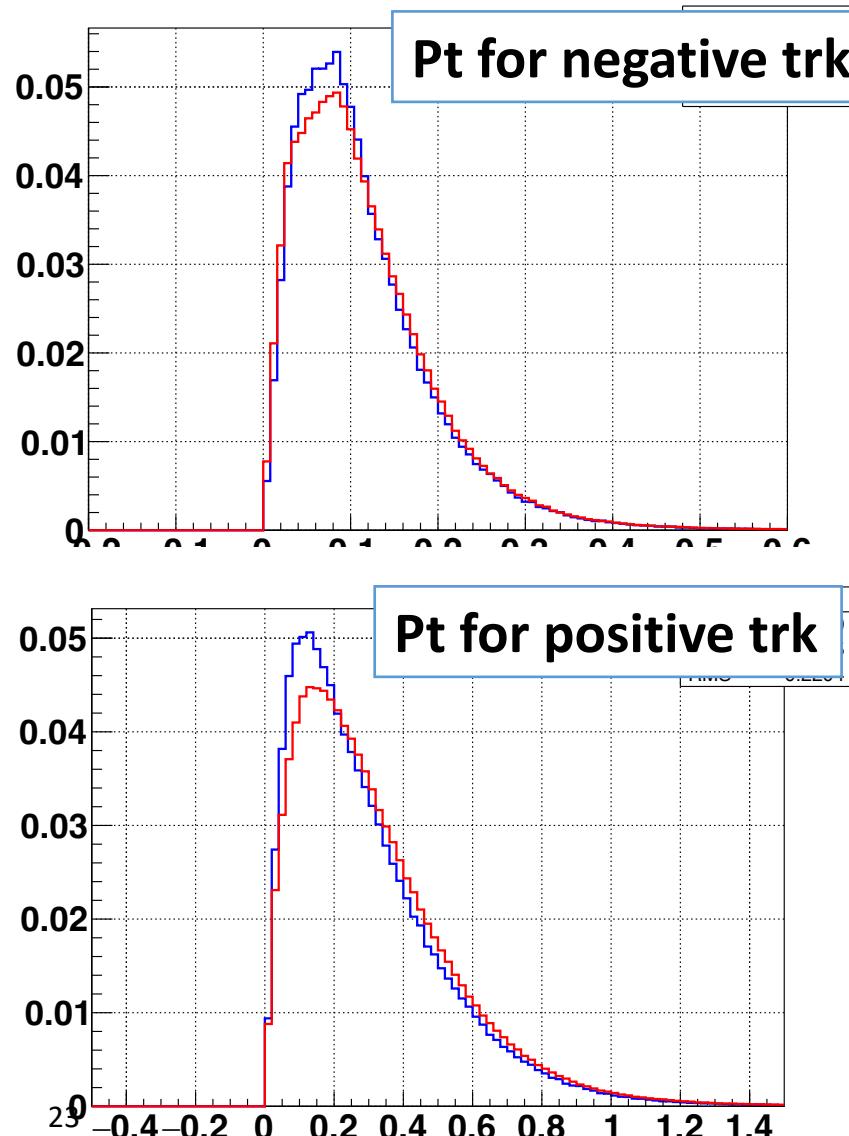
Red: Data; Blue: MC:



C+Cu (4.0 GeV)

Red: Data; Blue: MC;

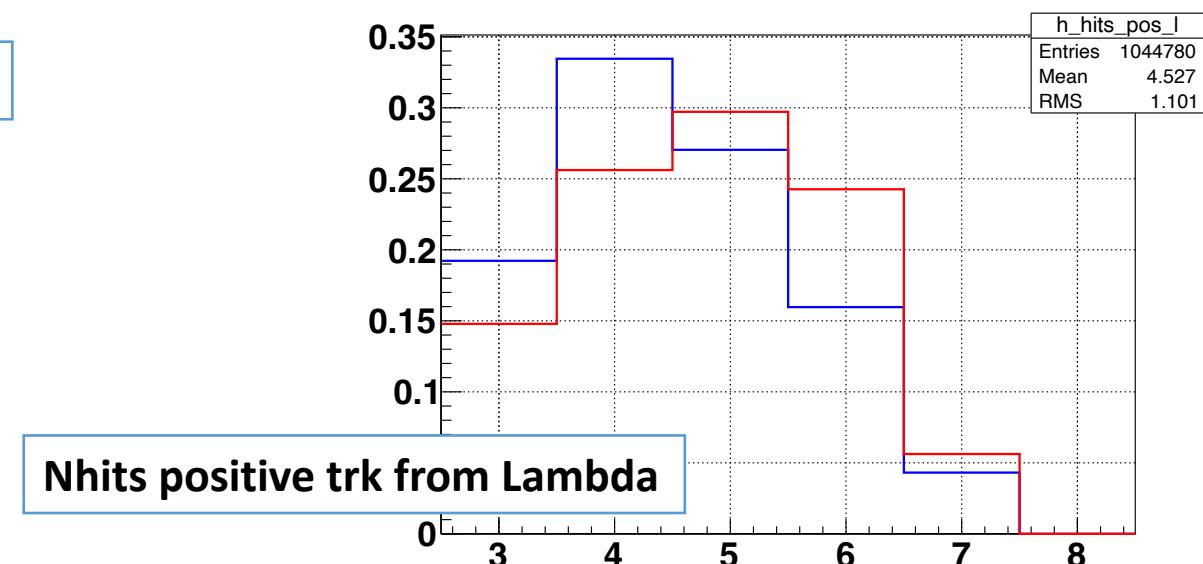
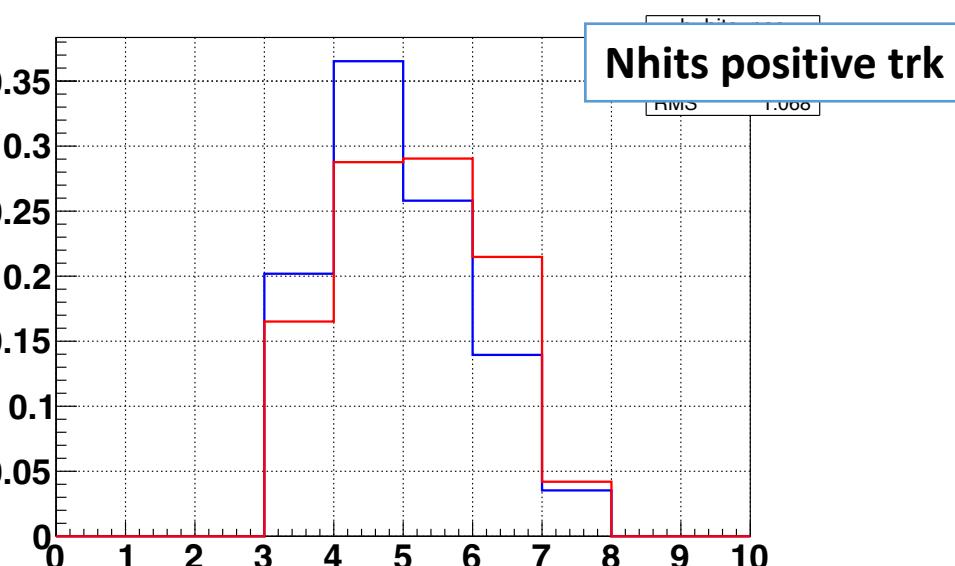
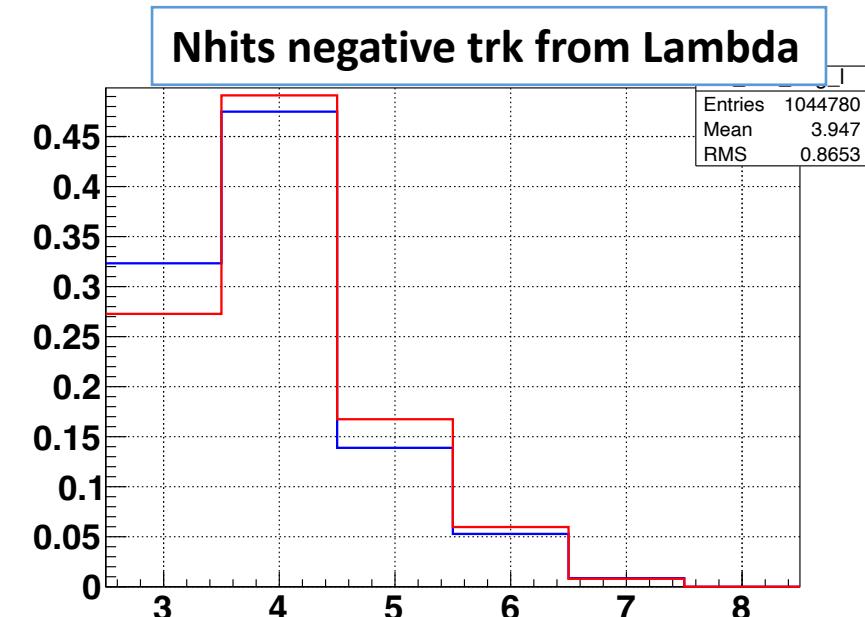
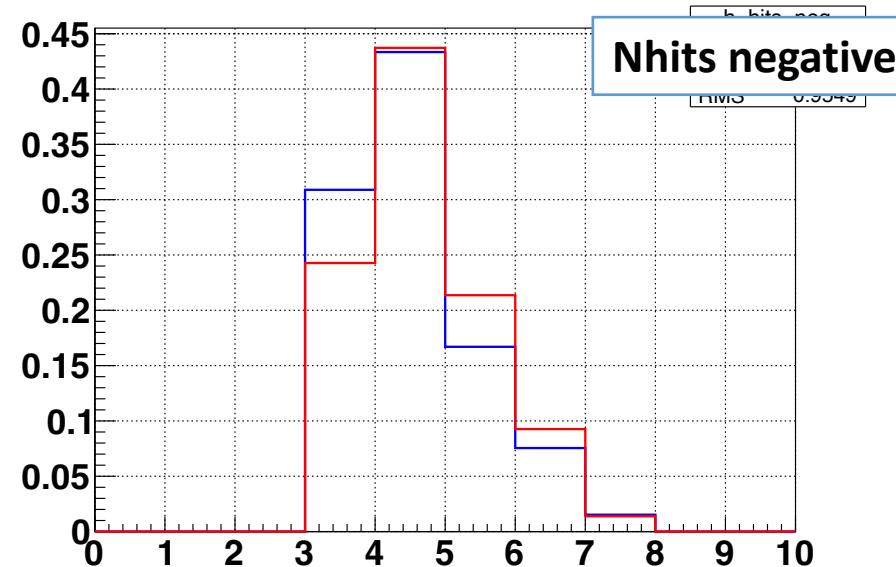
Control plots (Pt & Momentum of tracks from Lambda decay)



C+Cu (4.0 GeV)

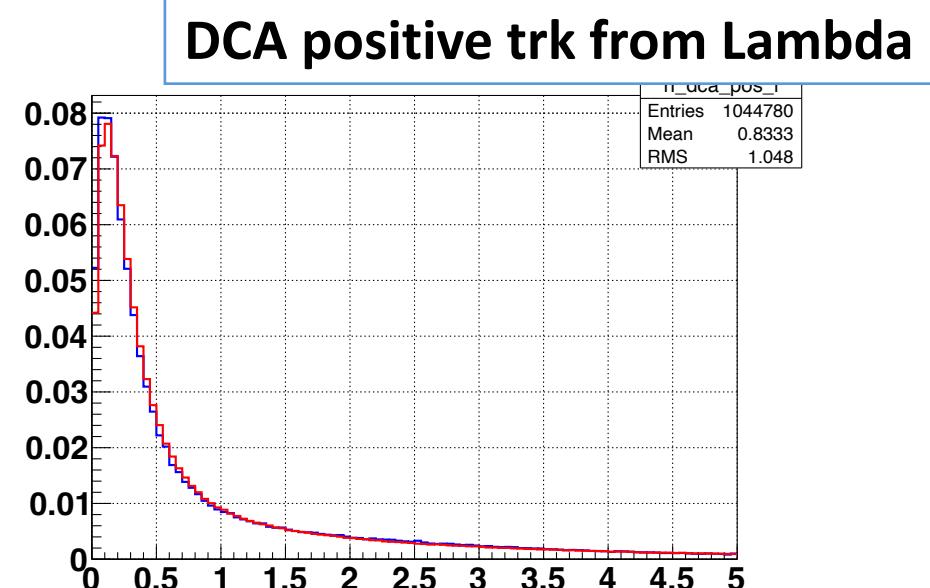
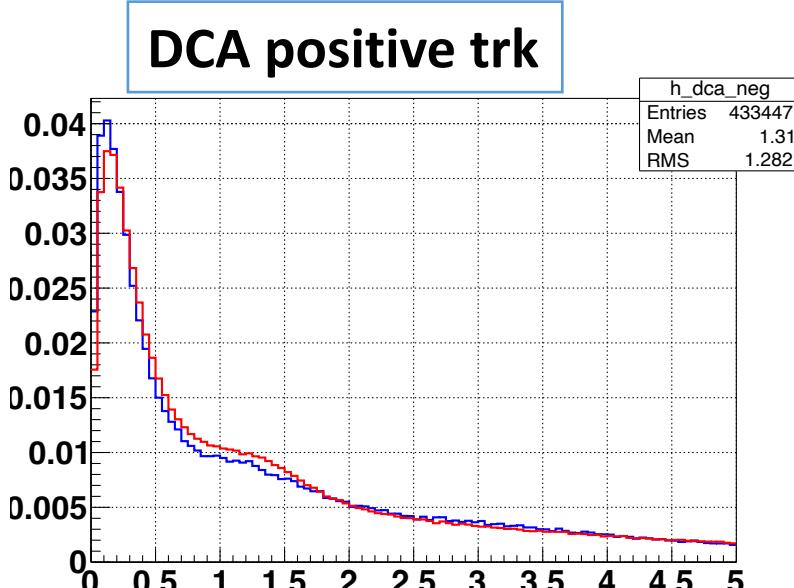
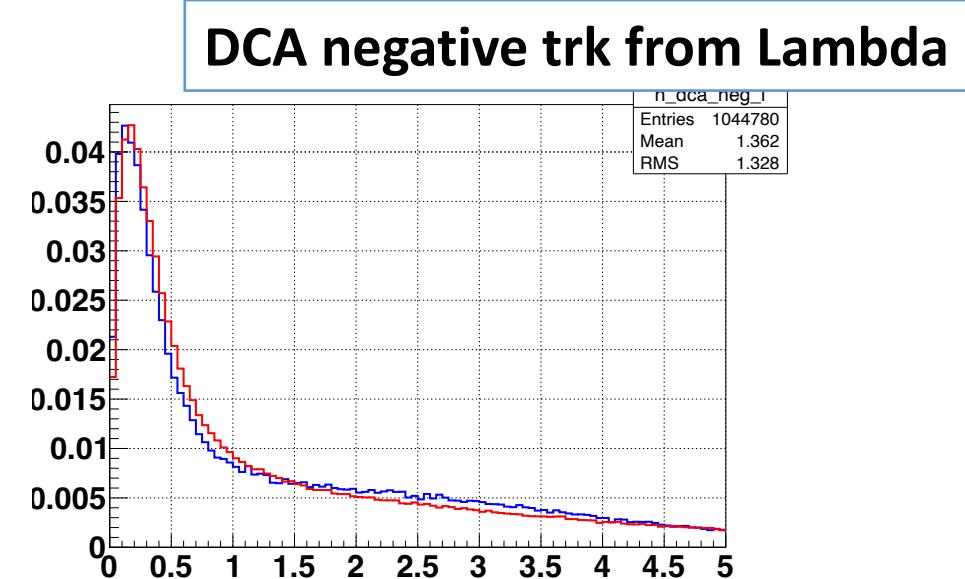
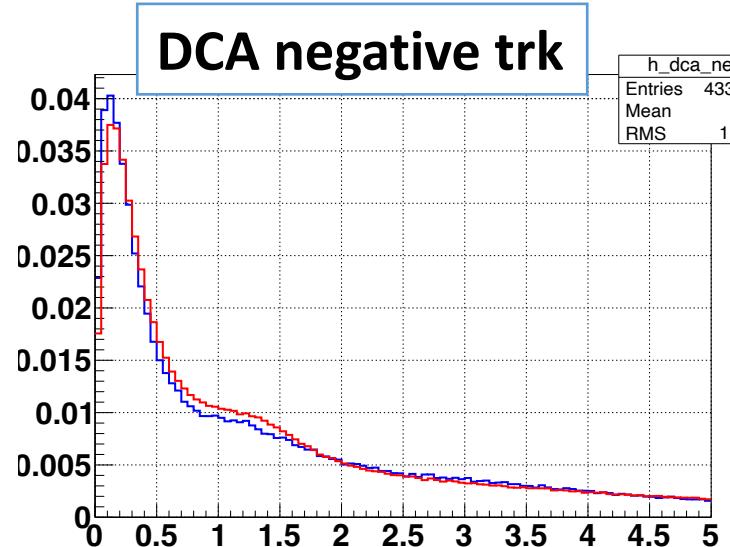
Red: Data; Blue: MC;

Control plots (Nhits for track)



C+Cu (4.0 GeV) Control plots (DCA tracks to PrimVtx)

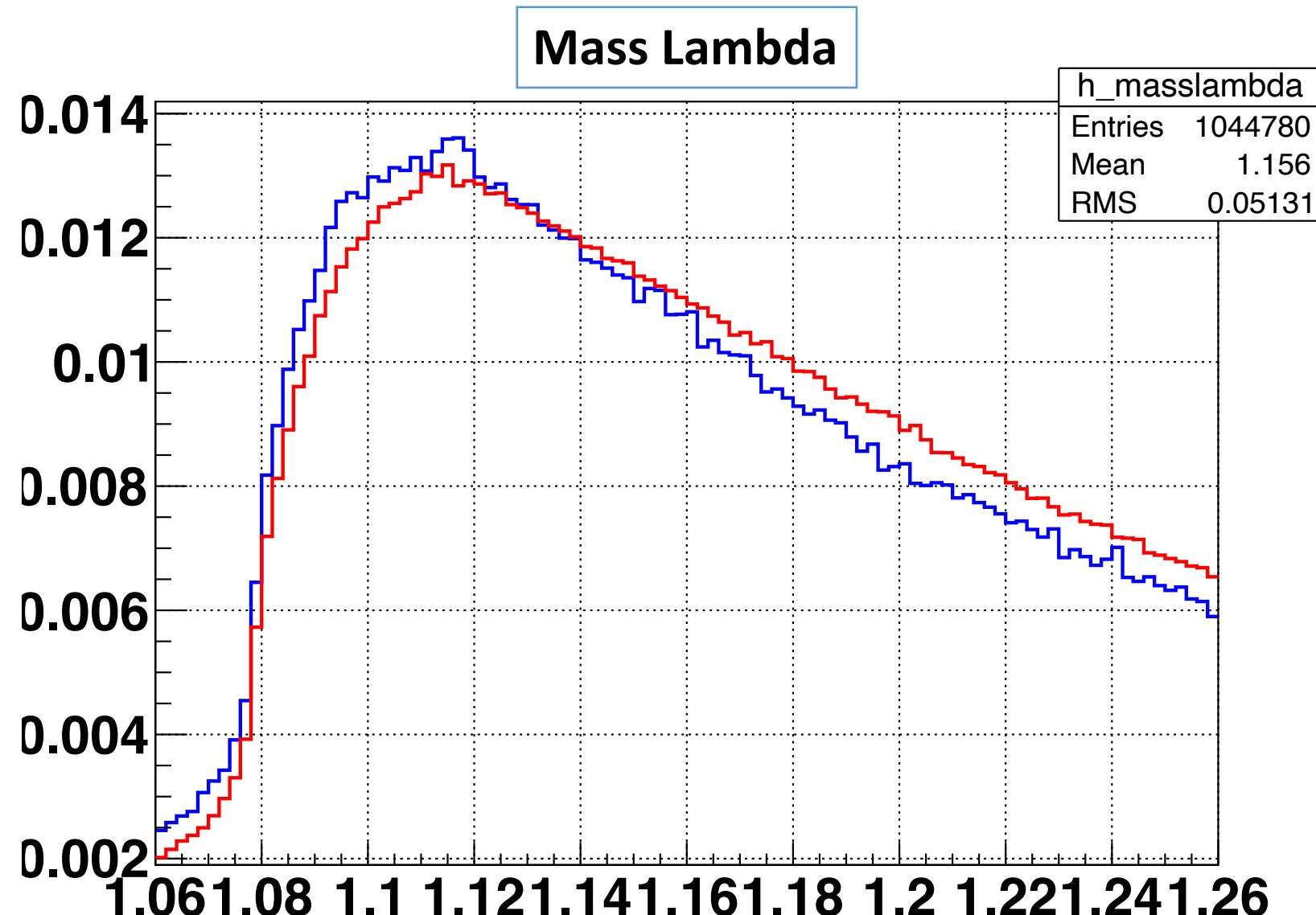
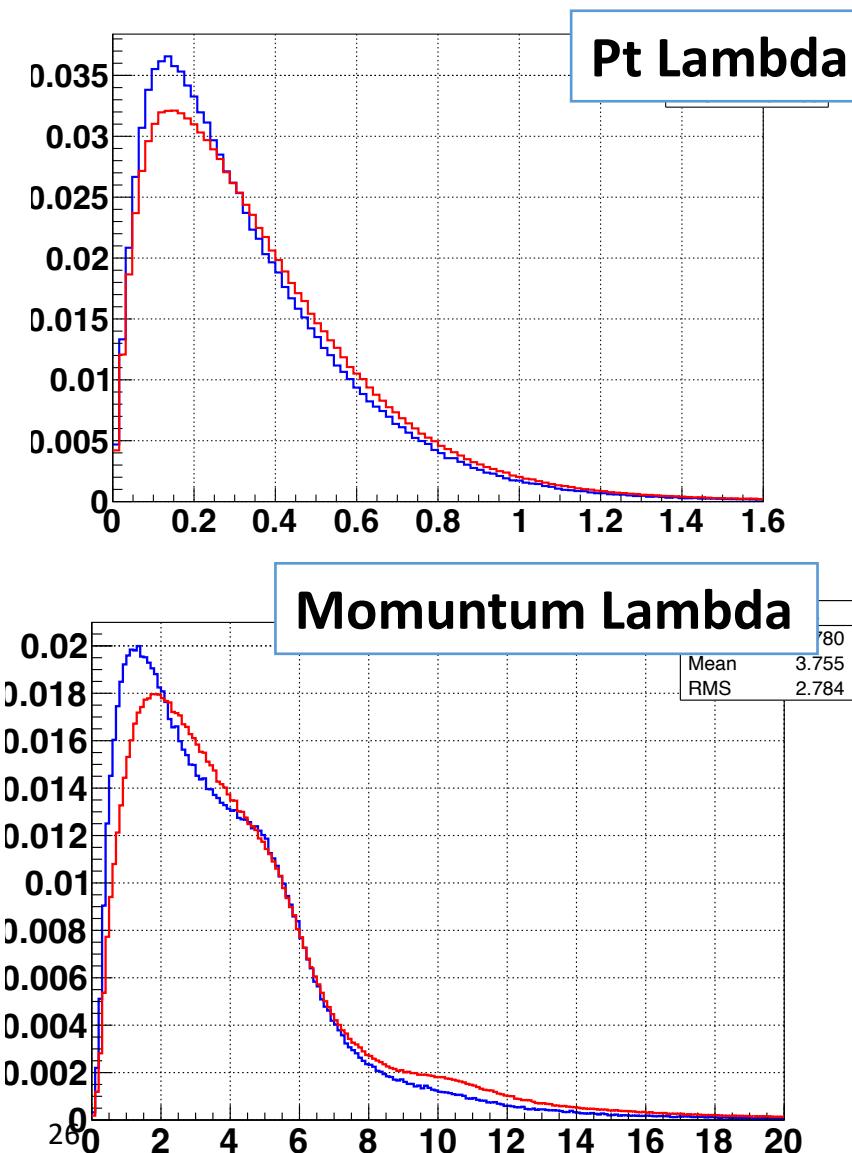
Red: Data; Blue: MC;



C+Cu (4.0 GeV)

Red: Data; Blue: MC;

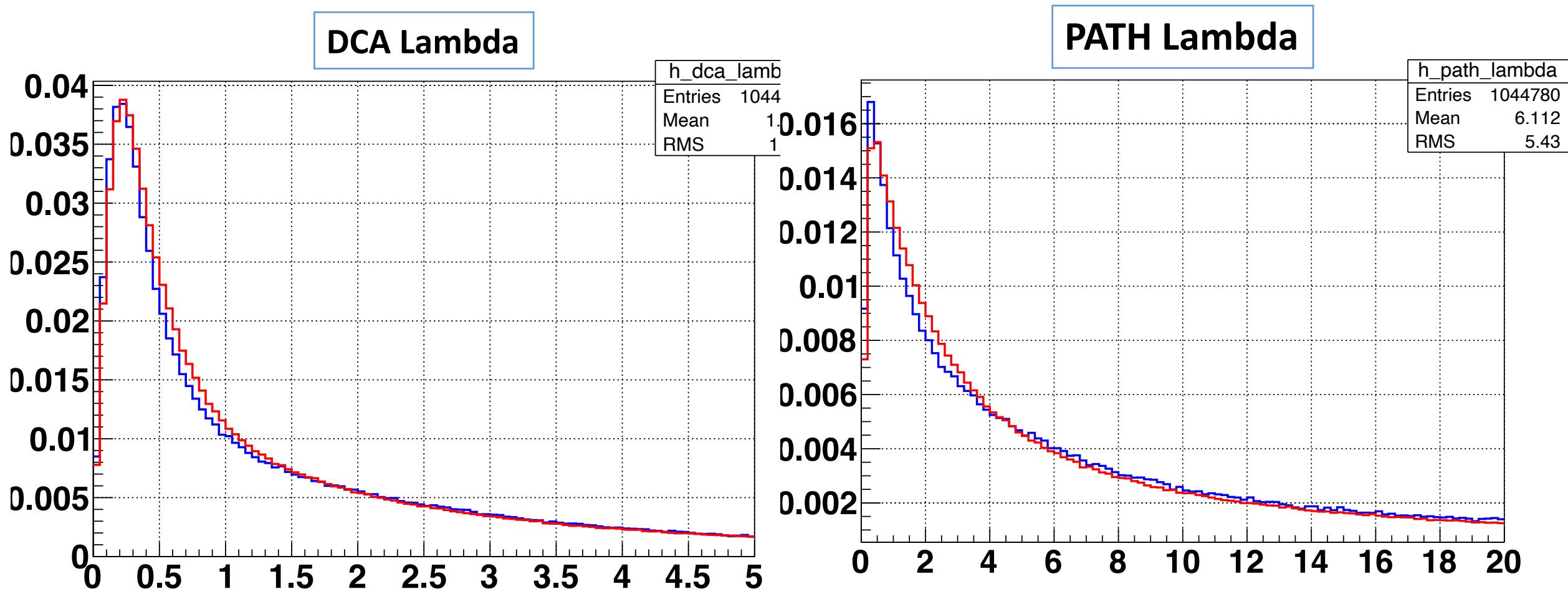
Control plots (Pt, Momentum & Mass of Lambda)



C+Cu (4.0 GeV)

Red: Data; Blue: MC;

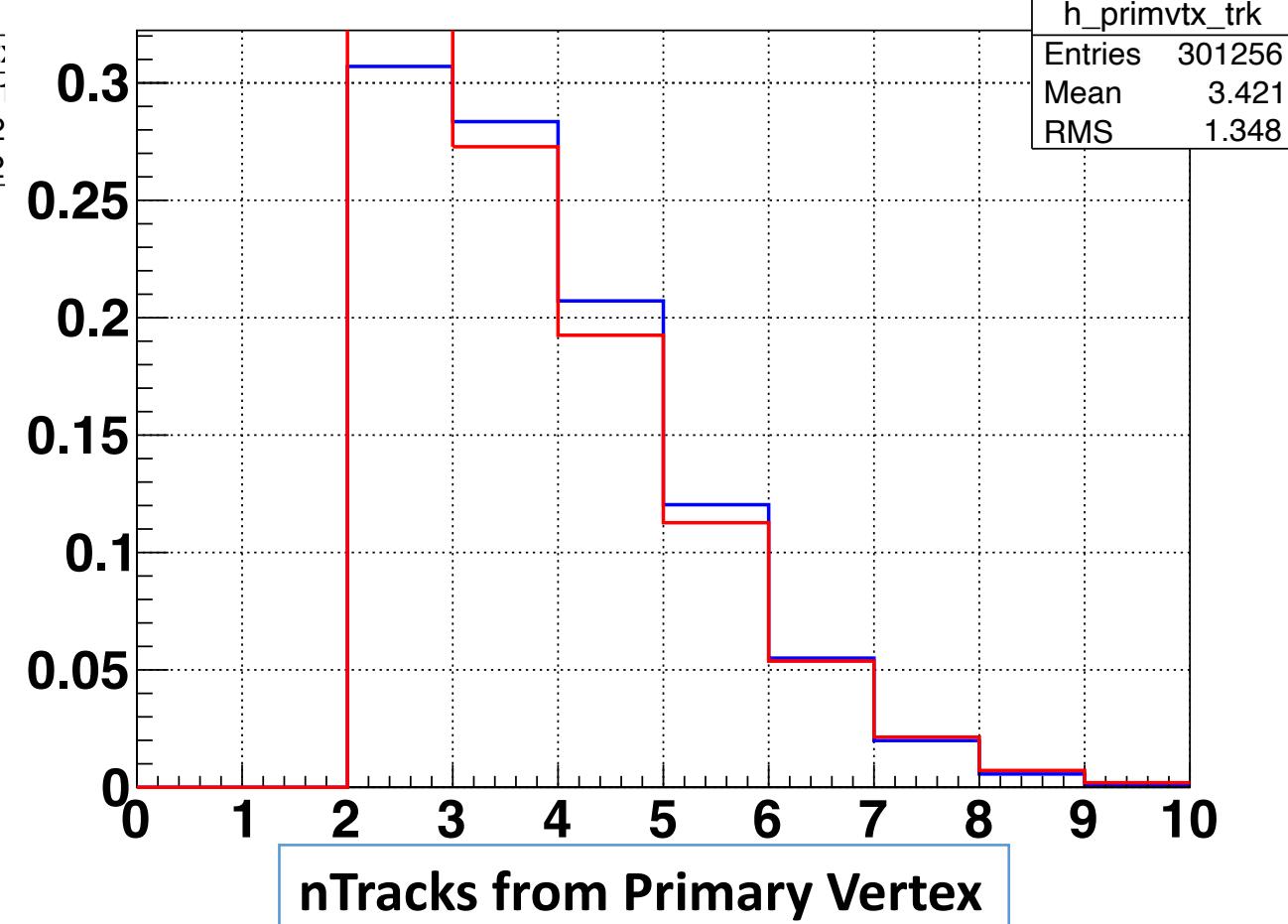
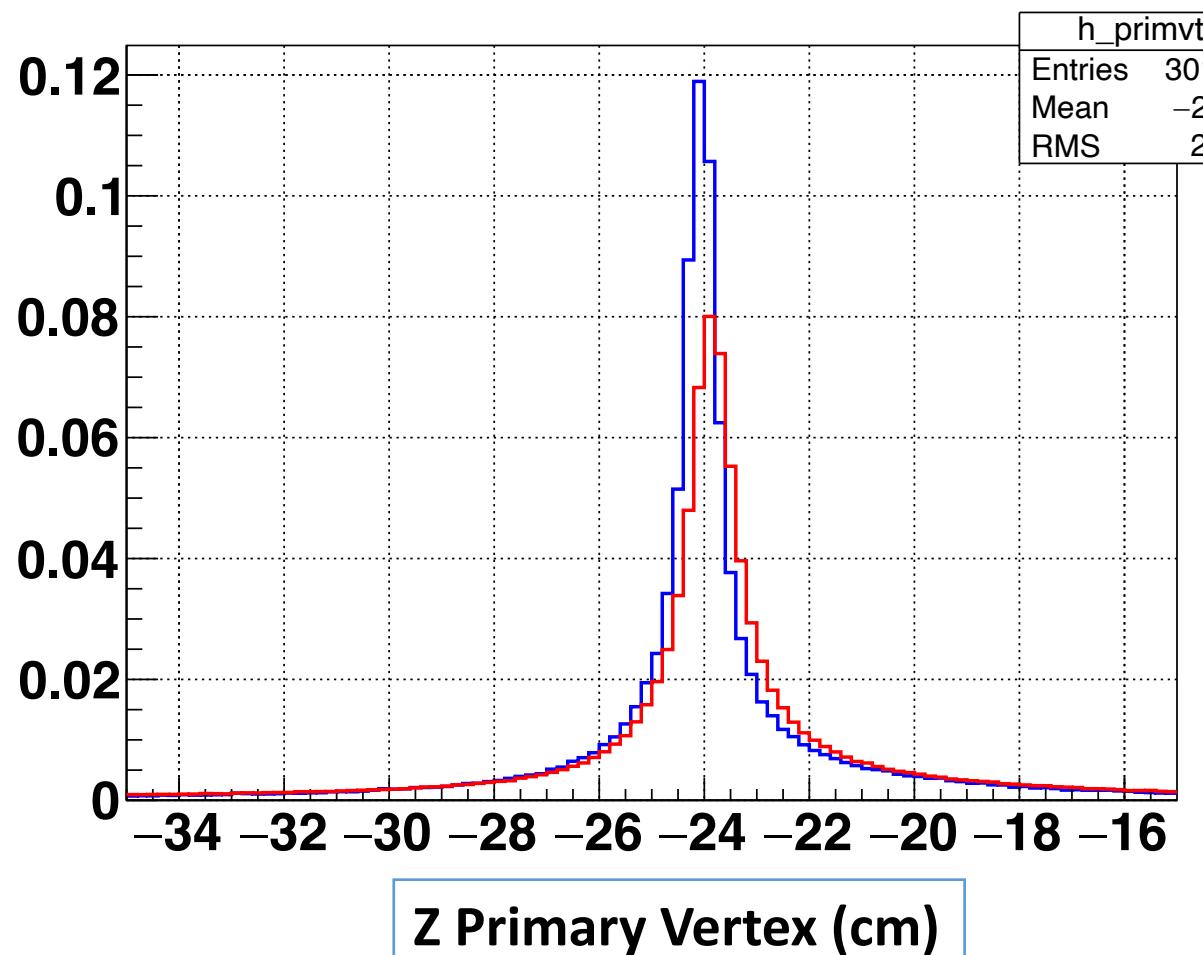
Control plots (DCA & PATH of Lambda)



C+Cu (4.0 GeV)

Control plots (Primary Vertex)

Red: Data; Blue: MC;

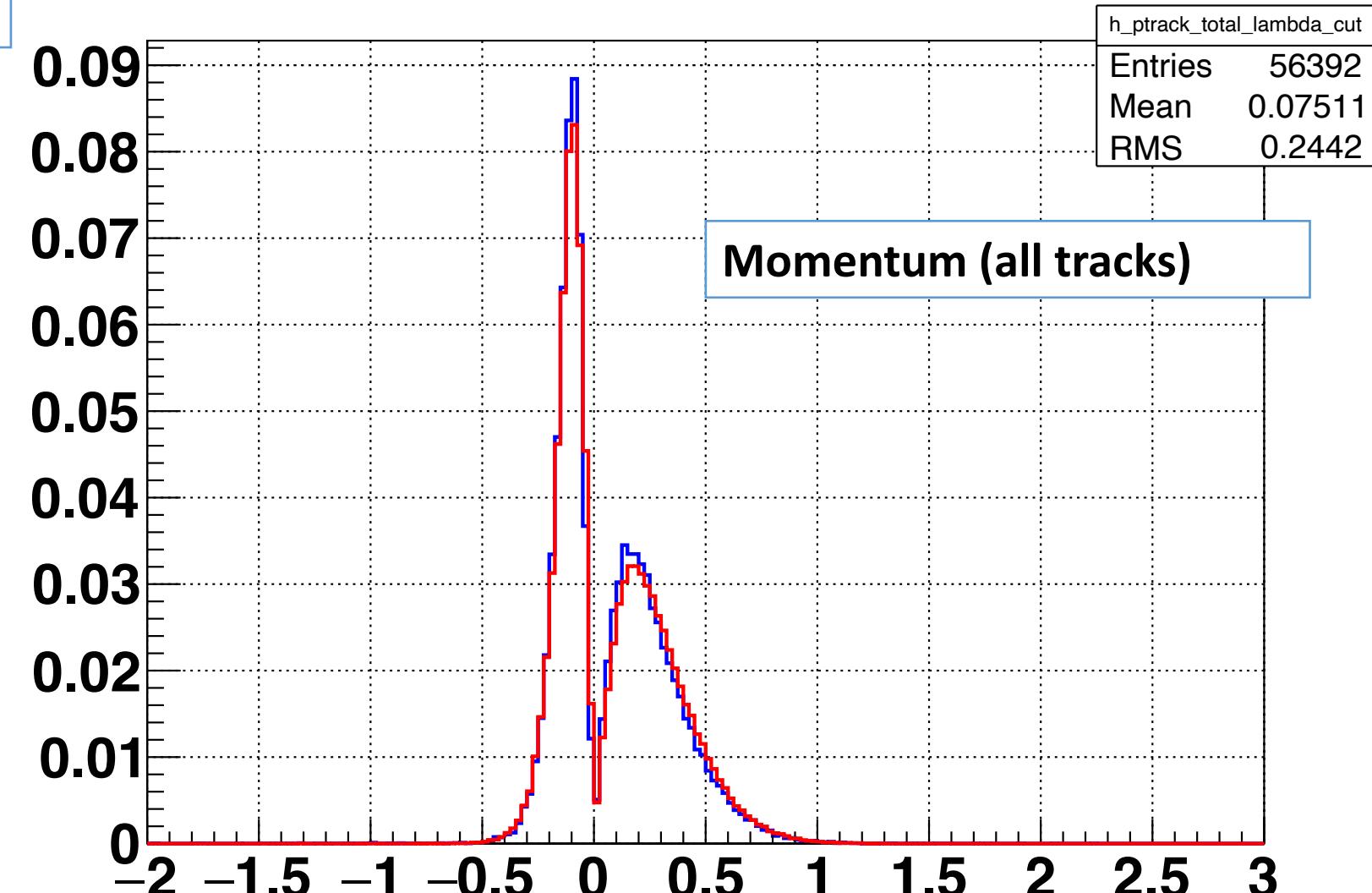
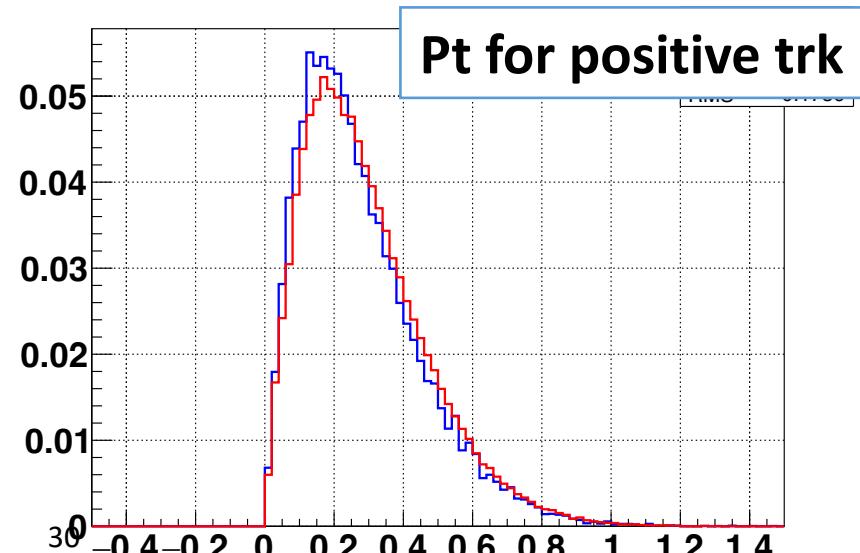
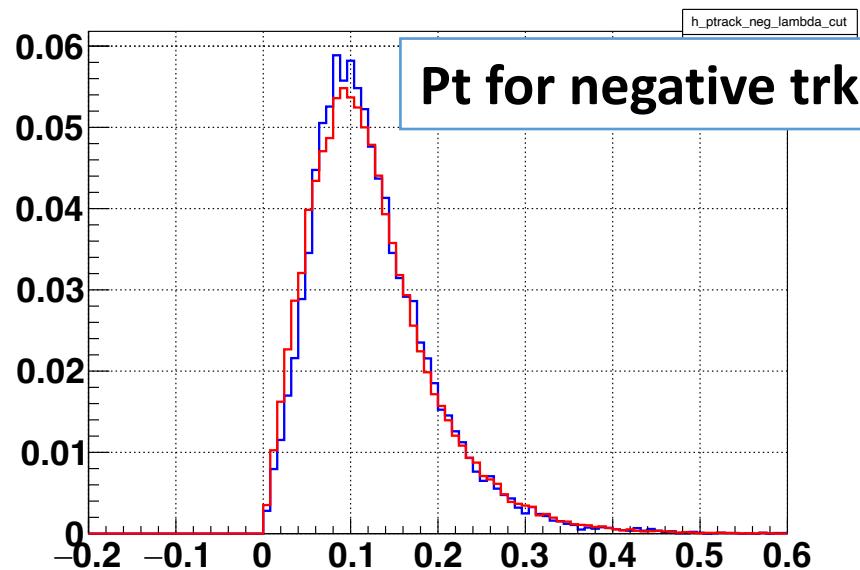


Apply additional cuts for Lambda

- Momentum proton track < 3.9
- Momentum pion track > 0.3
- Lambda path > 2.5
- Lambda DCA < 1.0

C+Cu (4.0 GeV) All cuts applied (Pt & Momentum of all tracks)

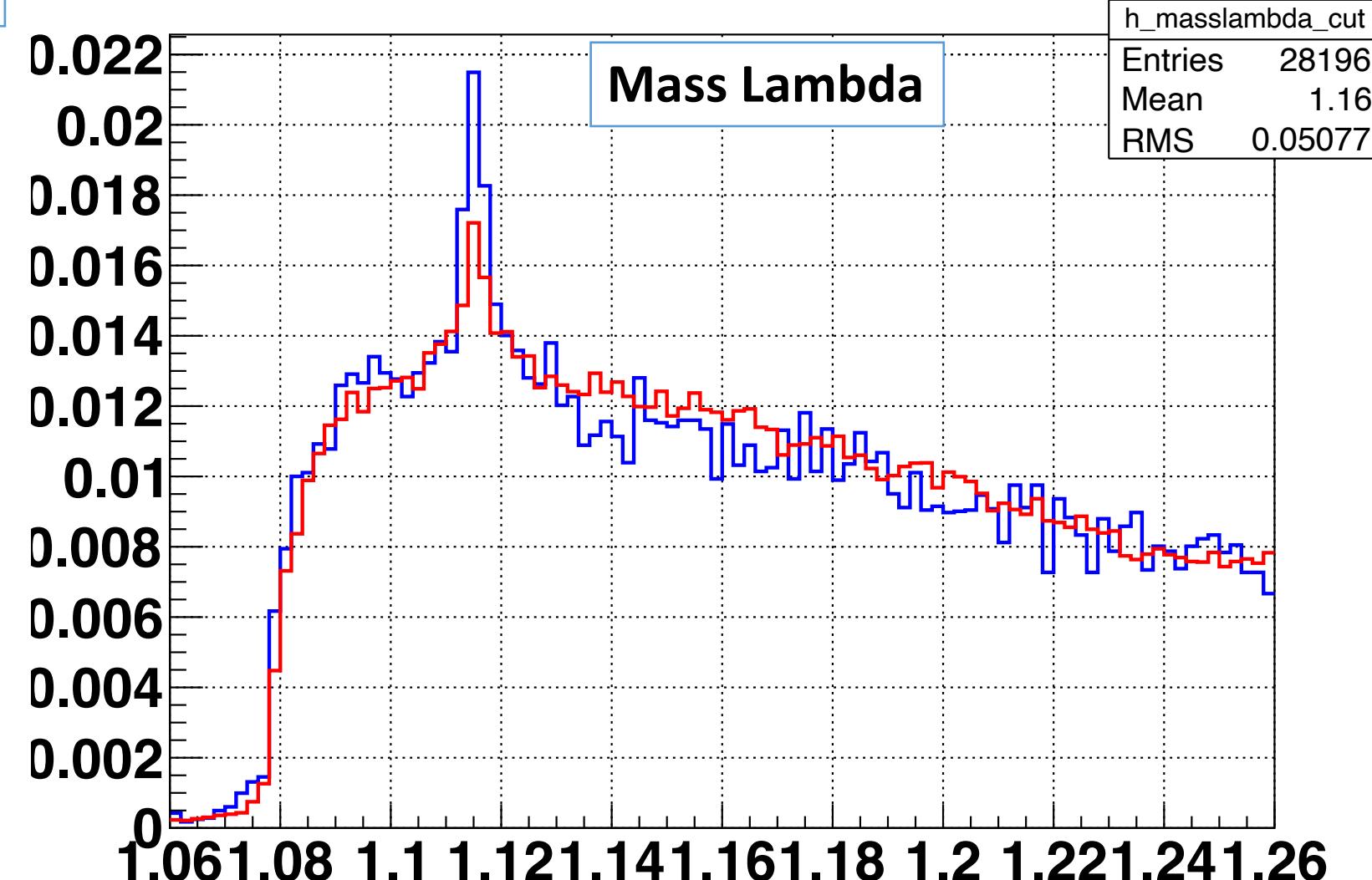
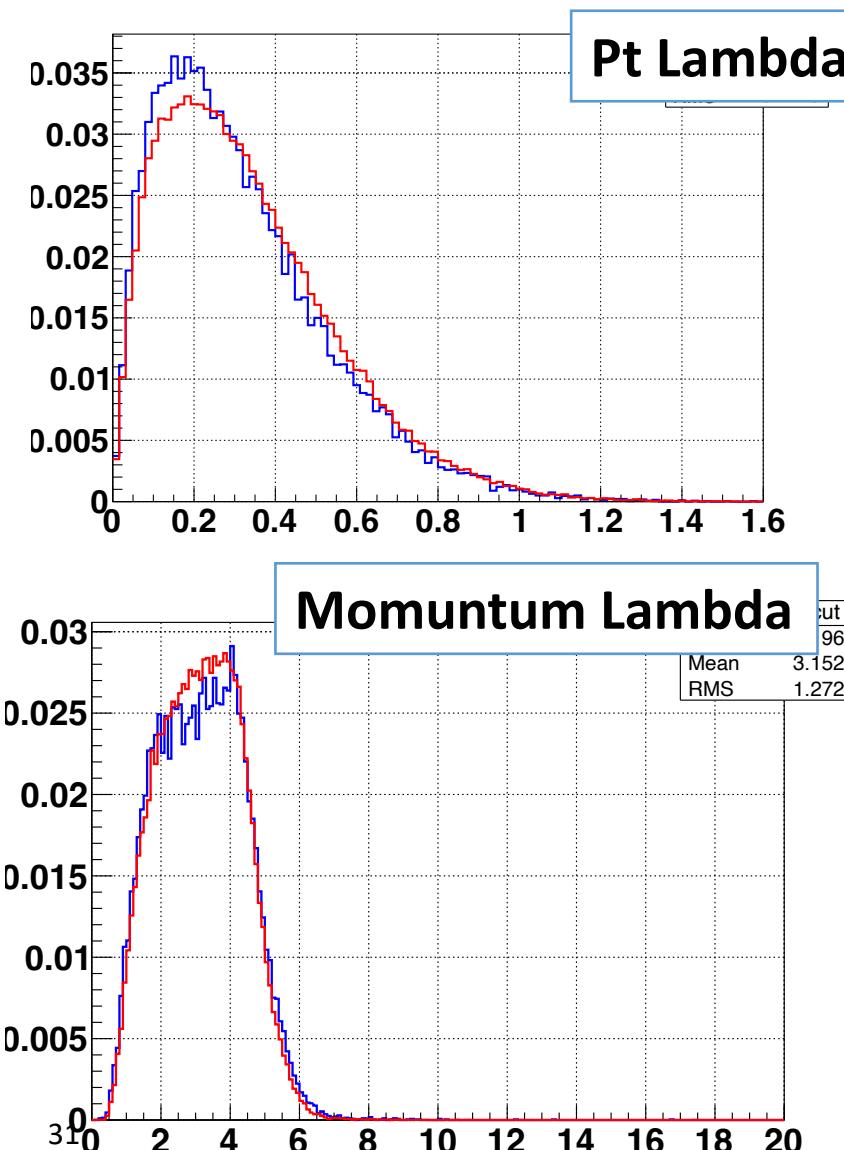
Red: Data; Blue: MC:



C+Cu (4.0 GeV)

Red: Data; Blue: MC;

All cuts applied (Pt, Momentum & Mass of Lambda)

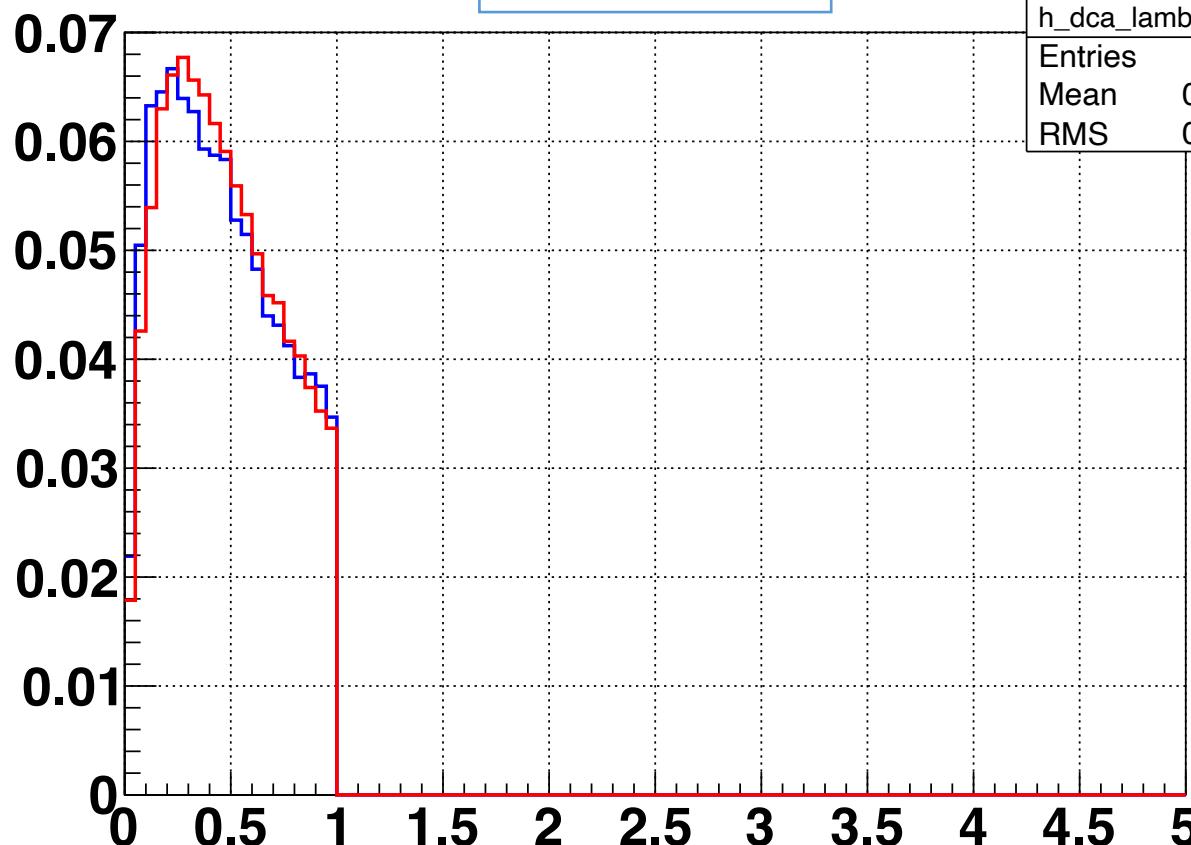


C+Cu (4.0 GeV)

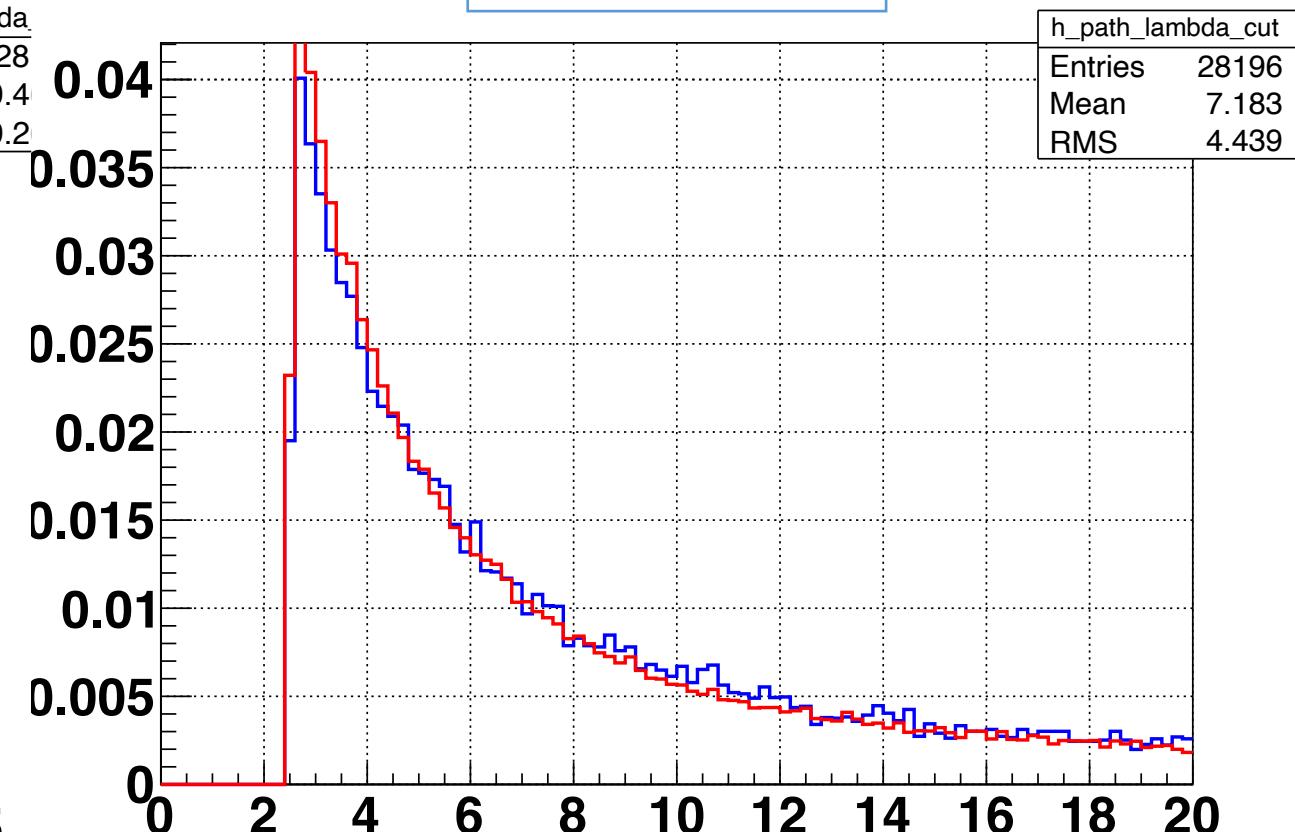
All cuts applied (DCA & PATH of Lambda)

Red: Data; Blue: MC;

DCA Lambda



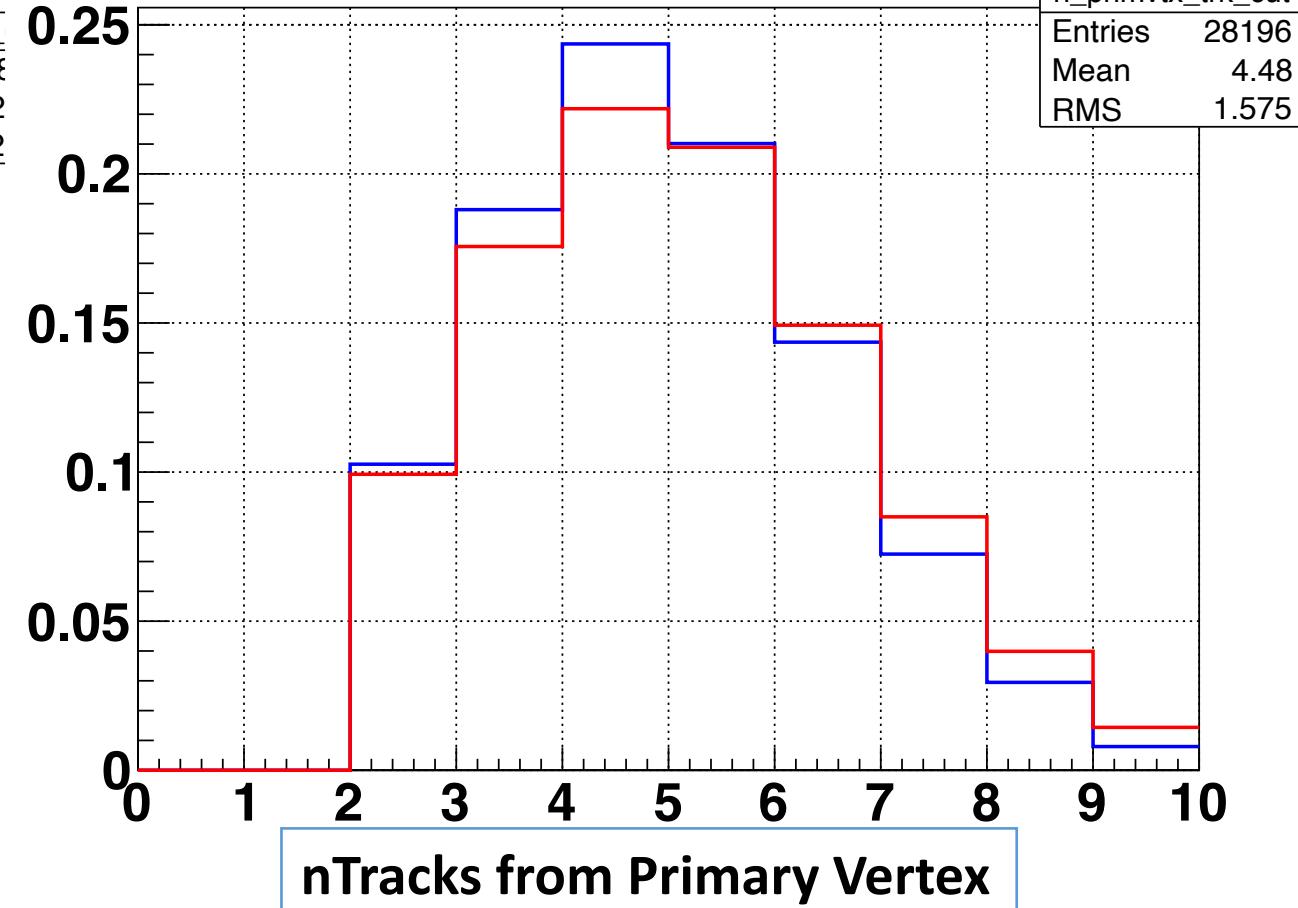
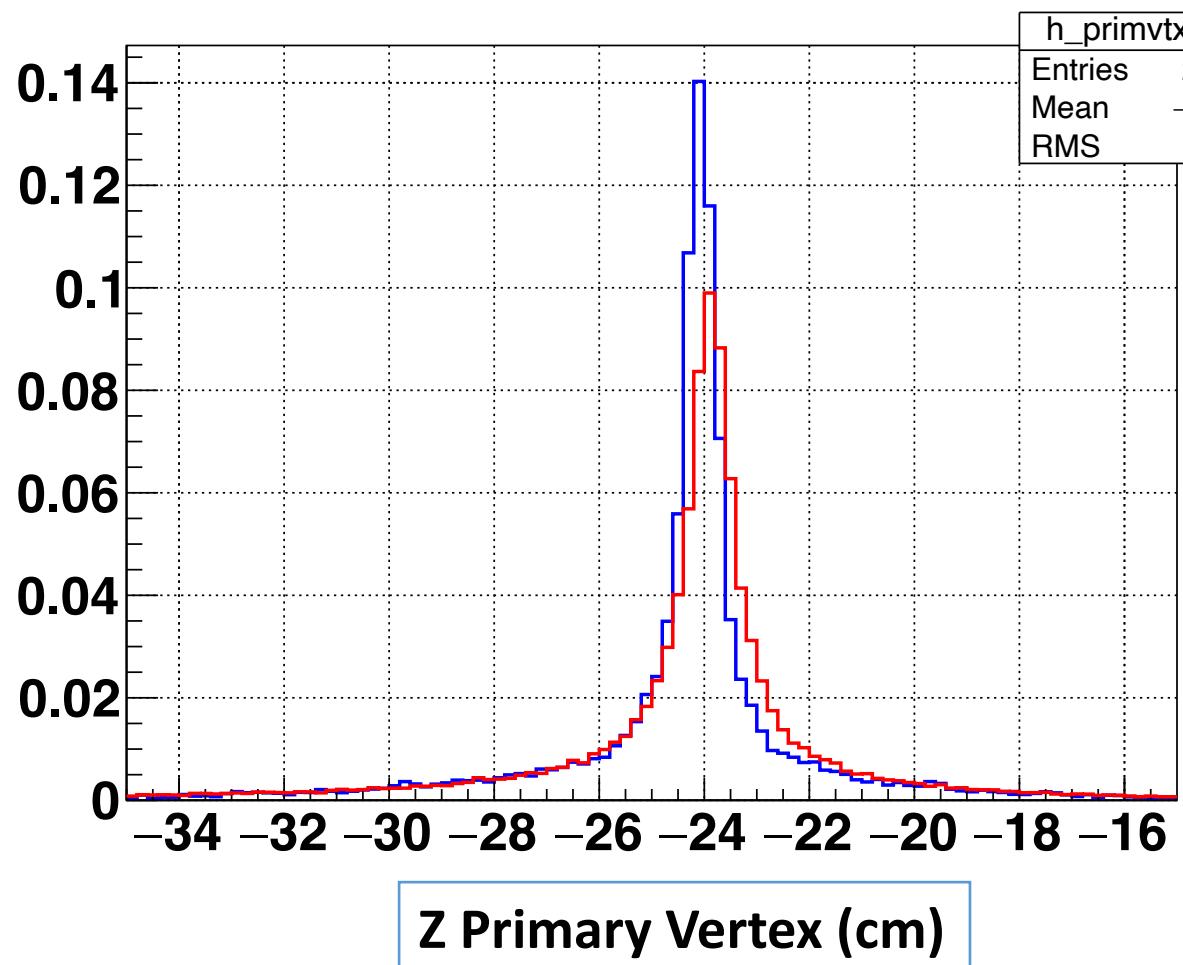
PATH Lambda



C+Cu (4.0 GeV)

Red: Data; Blue: MC;

All cuts applied (Primary Vertex)



Next & last steps...



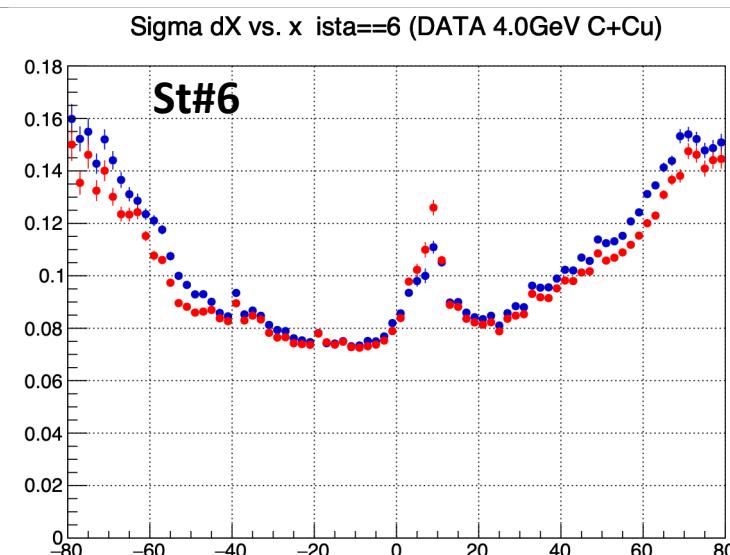
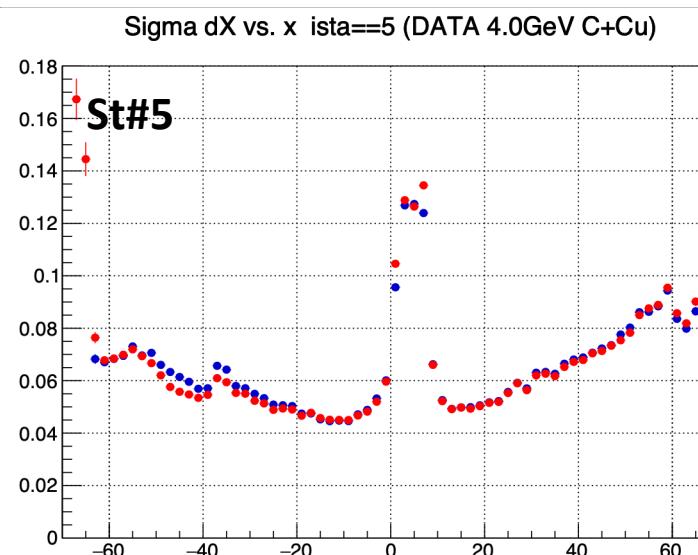
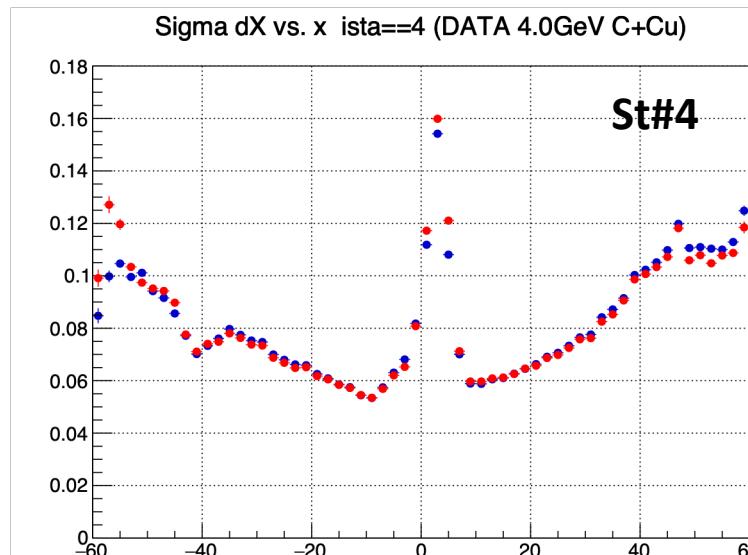
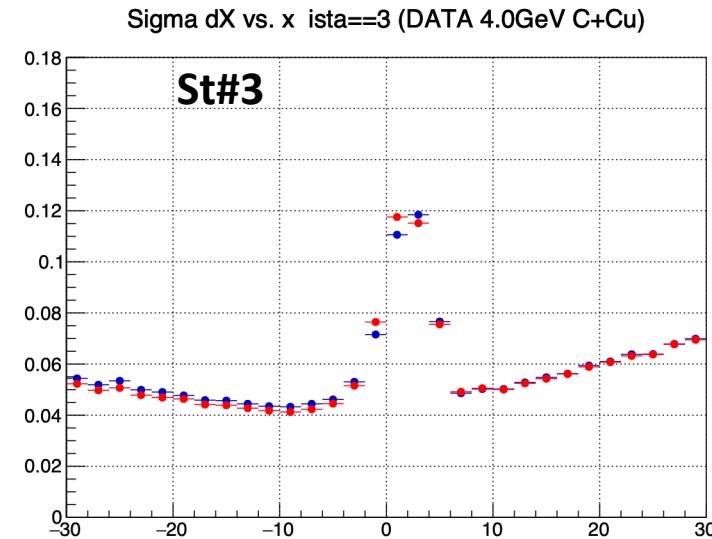
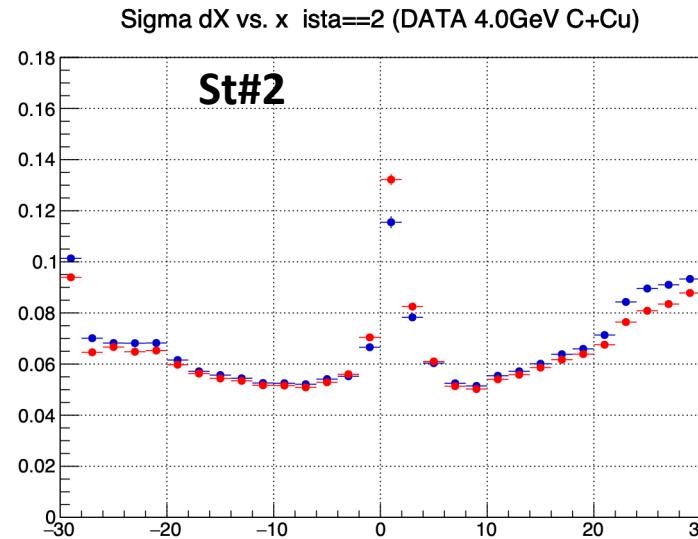
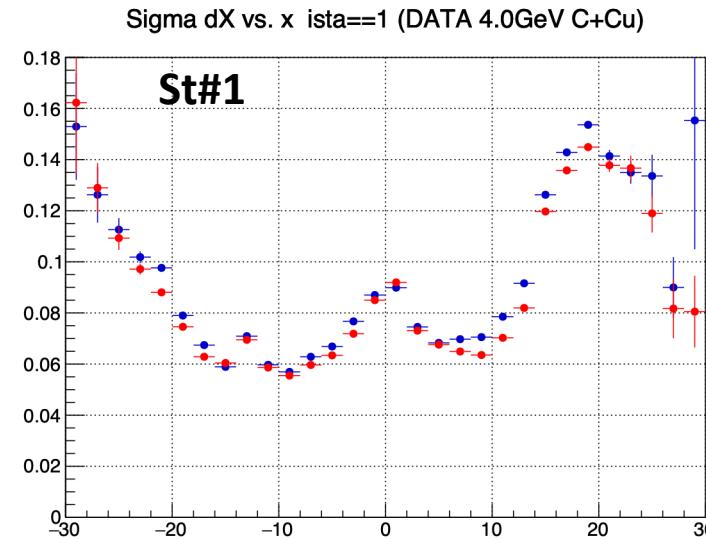
- We are ready to measuring cross-sections of the Λ^0 's hyperon
 - Make MC production with high statistics
 - PT & Y Lambda signal extraction
 - Calculate cross-sections of the Λ^0 's

Thank you for your attention!



Blue: before corrections
Red: after corrections

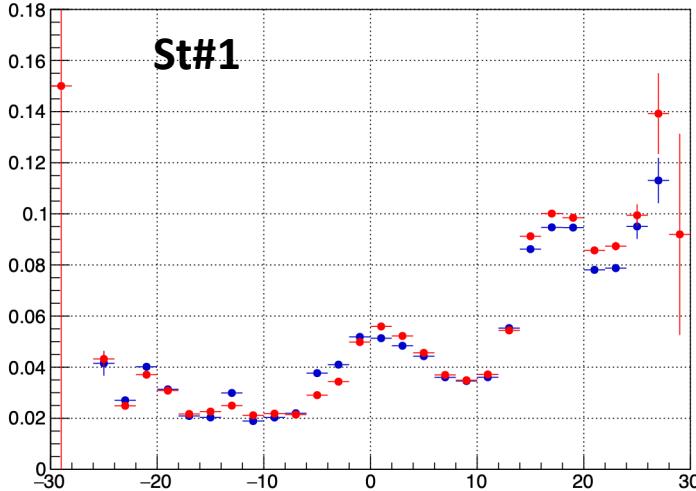
Sigma Dx vs x (**DATA** 4.0GeV C+Cu)



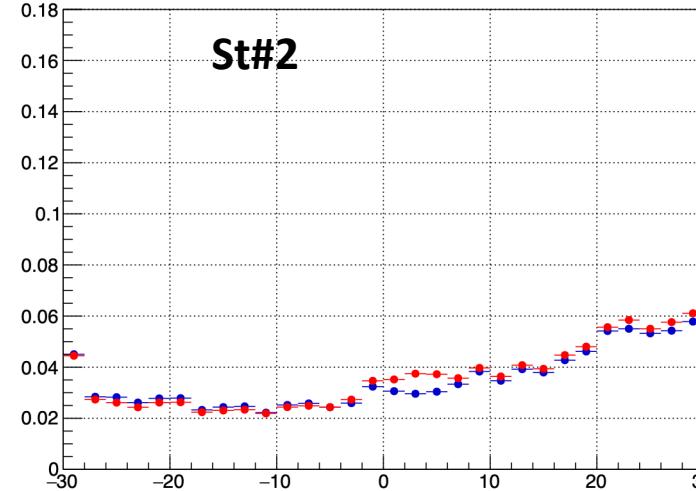
Blue: before corrections
Red: after corrections

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

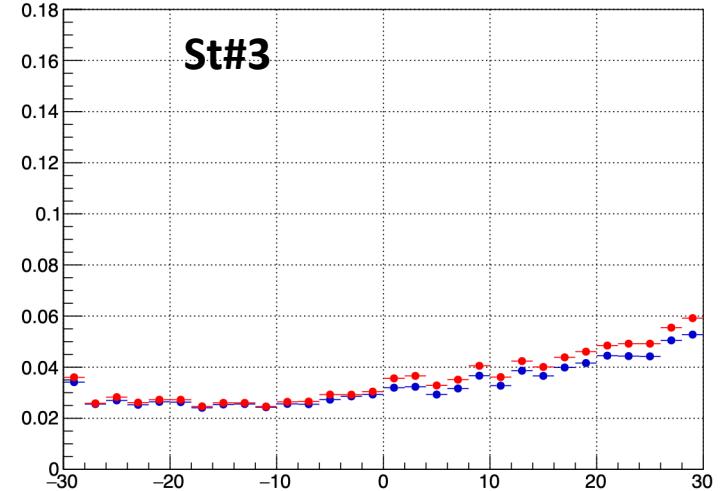
Sigma dX vs. x ista==1 (MC 4.0GeV C+Cu)



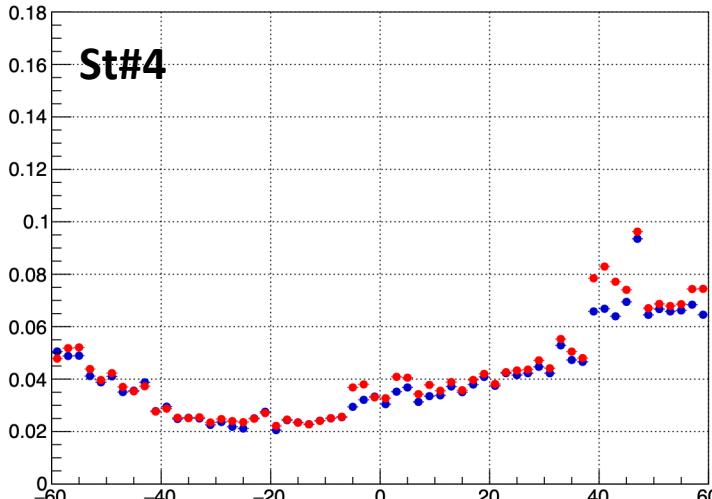
Sigma dX vs. x ista==2 (MC 4.0GeV C+Cu)



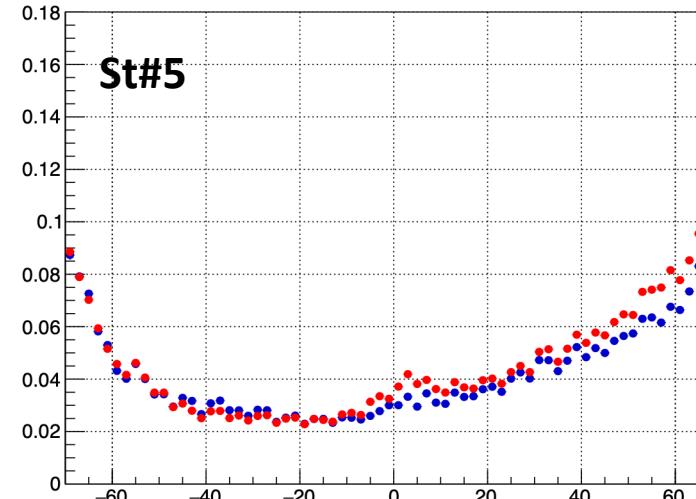
Sigma dX vs. x ista==3 (MC 4.0GeV C+Cu)



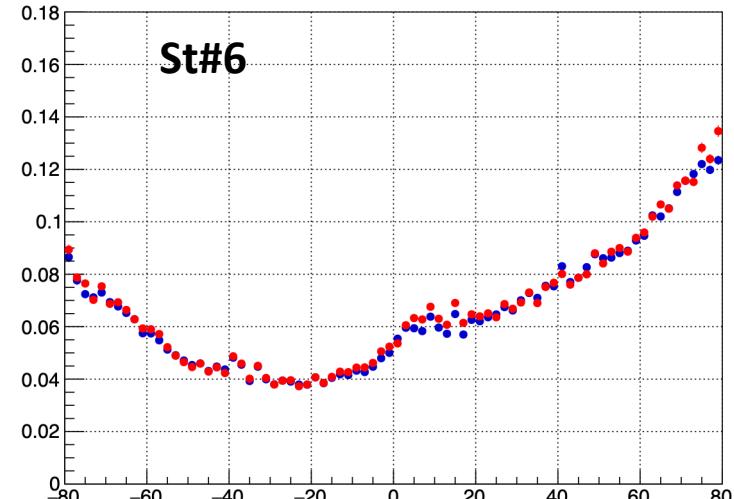
Sigma dX vs. x ista==4 (MC 4.0GeV C+Cu)



Sigma dX vs. x ista==5 (MC 4.0GeV C+Cu)



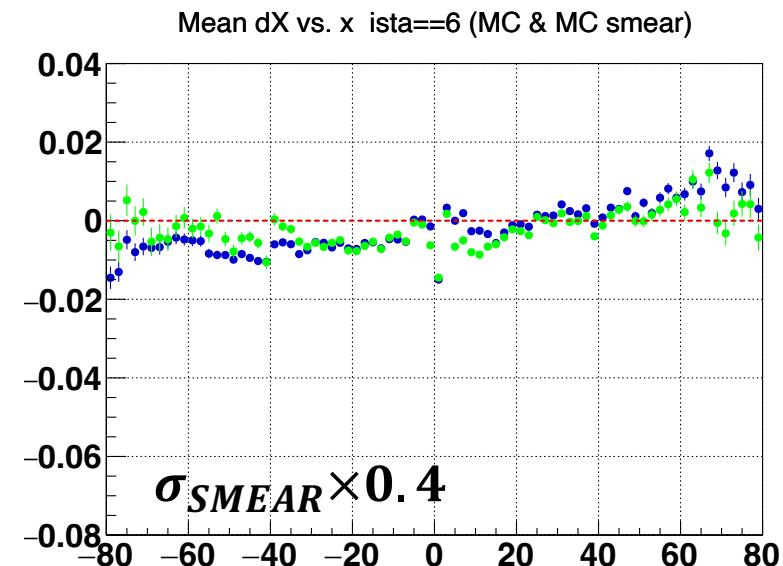
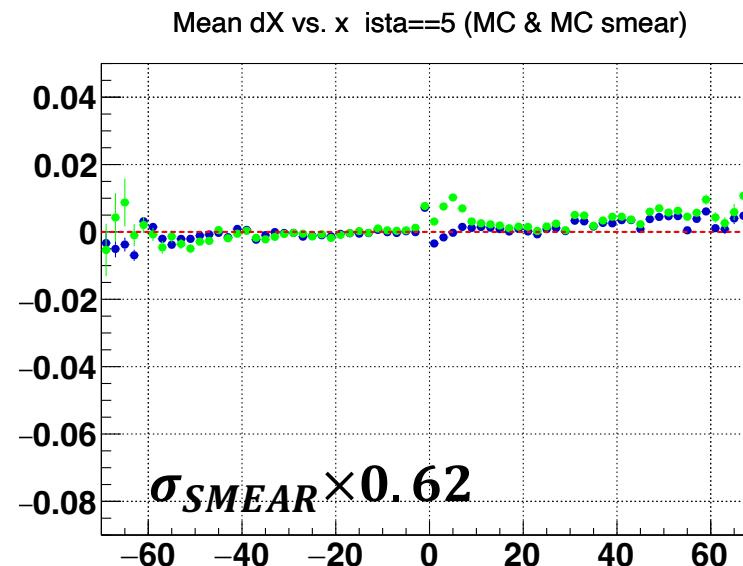
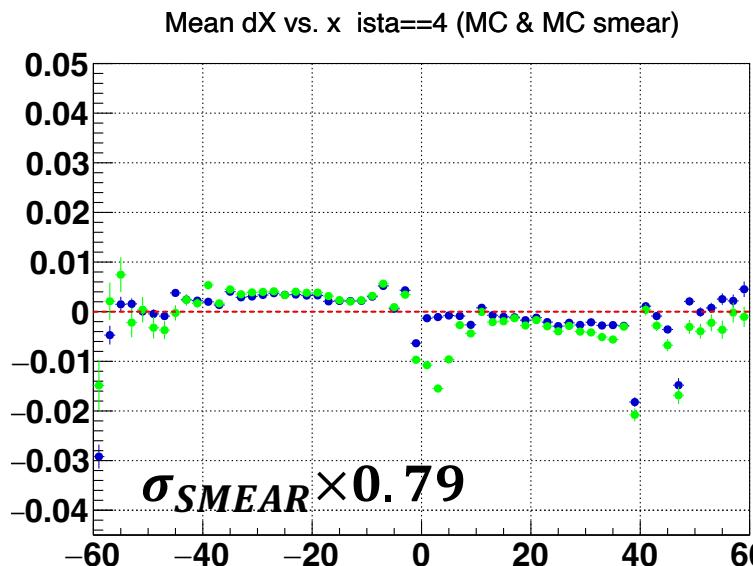
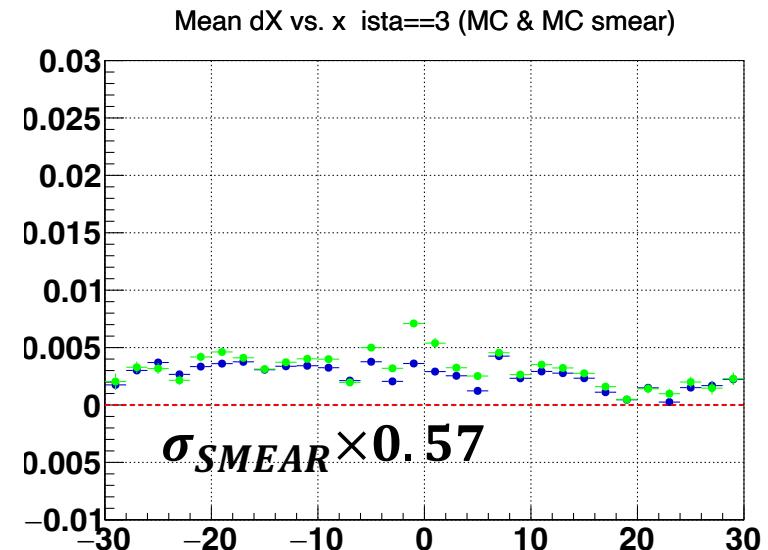
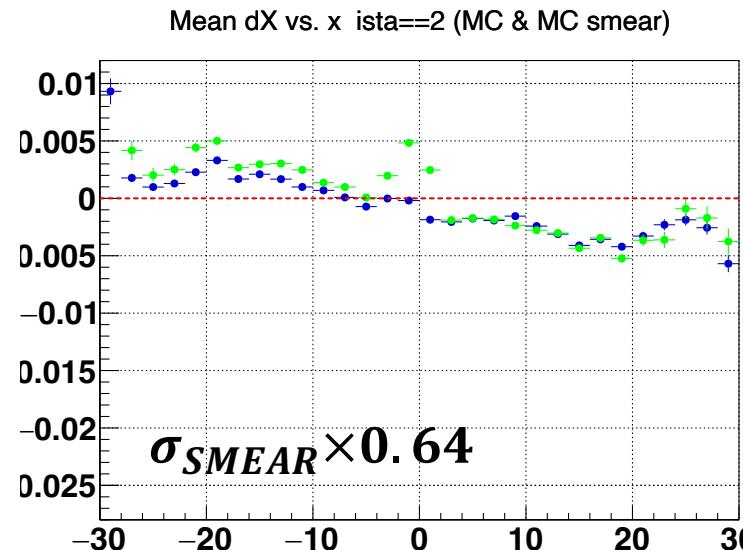
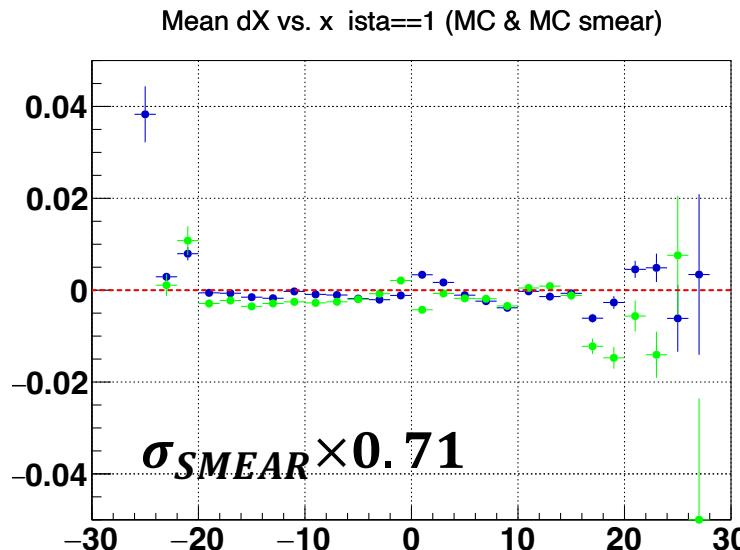
Sigma dX vs. x ista==6 (MC 4.0GeV C+Cu)



Mean Dx vs X comparison MC & MC after smearing

Blue: MC before smear

Red: MC after pp smear



Mean Dx vs Mom comparison MC & MC after smearing

Blue: MC before smear

Red: MC after pp smear

