

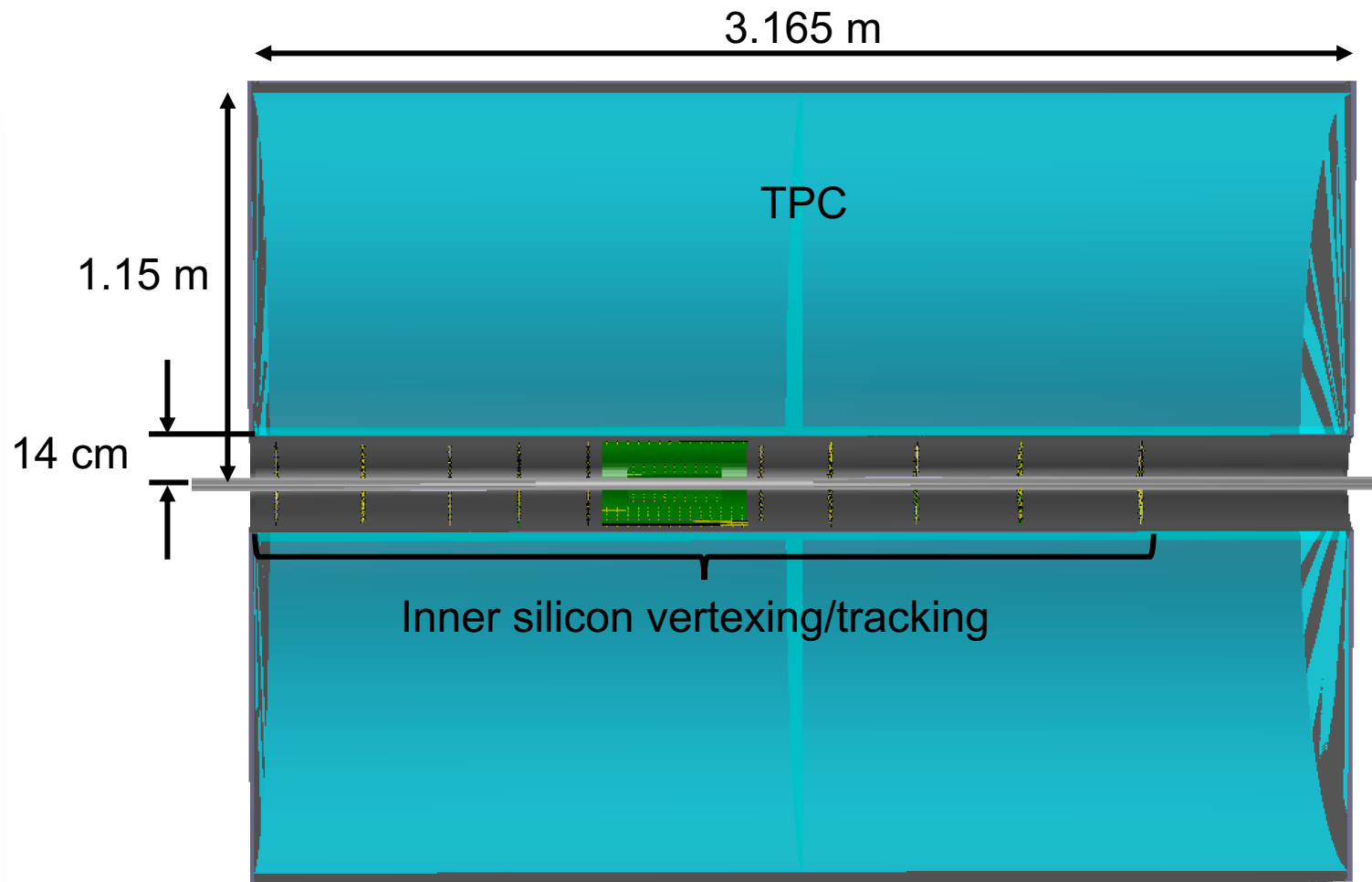
Detector 2 Tracking Simulation in ELCRoot

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10-28-2024

Tracking Detector Setup

*Tried to implement sPHENIX TPC materials (slide 7), but I can't find endcap electronics information



TPC

- Gas: $\text{ArCF}_4\text{iC}_4\text{H}_{10}$
- Field cage
 - carbon fiber
inner cage $t=2.62\text{mm}$
outer cage $t=9.28\text{mm}$
 - Kapton $t=150\mu\text{m}$
 - Aluminum $t=50\mu\text{m}$
- Central membrane: Kapton $t=100\mu\text{m}$
- Endcaps:
 - forward aluminum $t=13.4\text{mm}$ ($X/X_0=15\%$)
 - Backward aluminum $t=1.34\text{mm}$ (*does not affect tracking)

Magnetic field

Constant 2T, solenoid

Suppress secondary particles

TPC Digitization Parameters

These are the parameters inside the tpc-digi-250um.root.

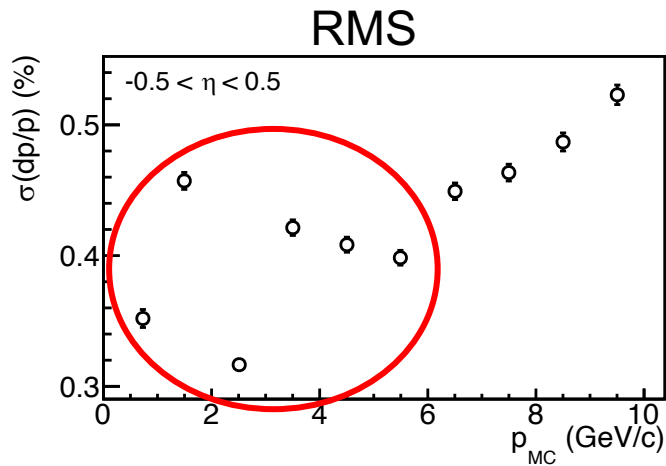
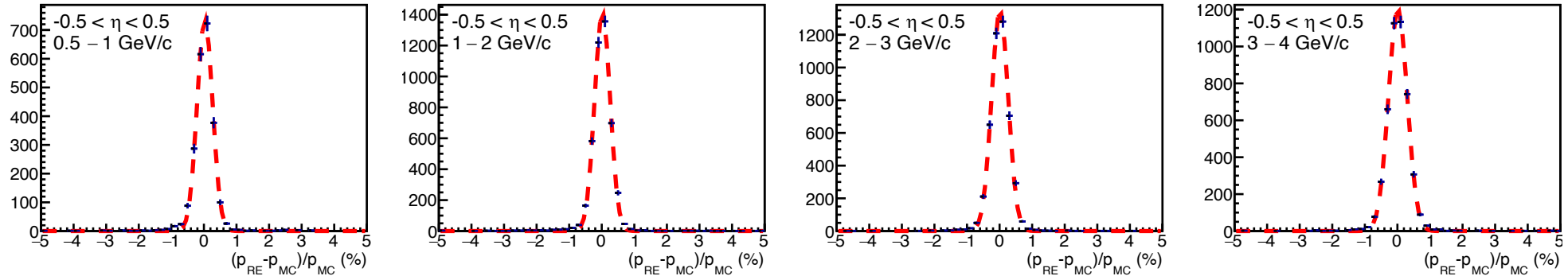
- transverse dispersion : 15.00 [um]/sqrt(D[cm])
- longitudinal dispersion : 1.00 [um]/sqrt(D[cm])
- transverse intrinsic resolution : 200.00 [um]
- longitudinal intrinsic resolution : 500.00 [um]
- radial intrinsic resolution : 0.00 [um]
- GEM vertical pad size : 0.50 [cm]

* No one remember how the 250um was determined at the moment

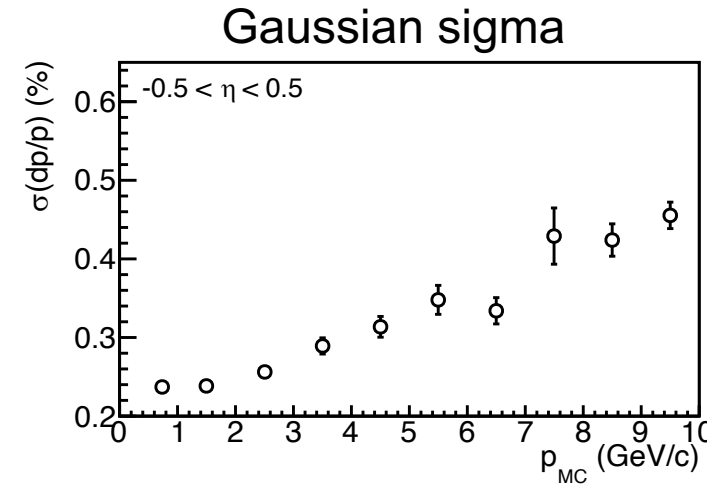
Alexander suggest focusing on the digitization parameters

→ Sent Joe a message before lunch today

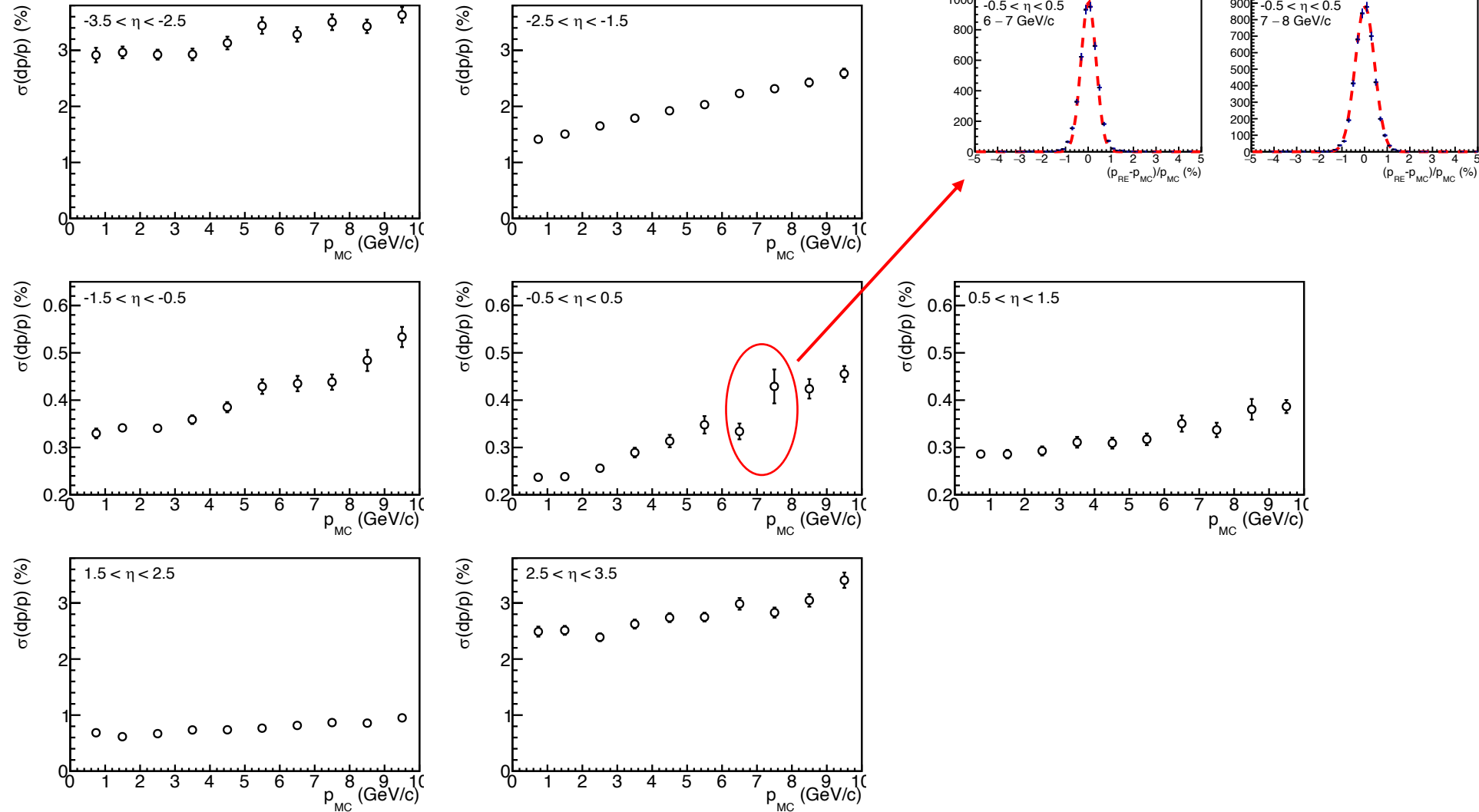
How to Extract Momentum Resolution



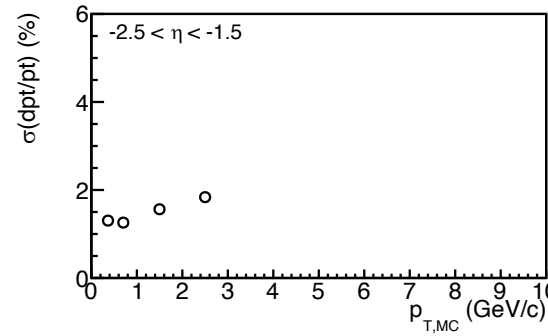
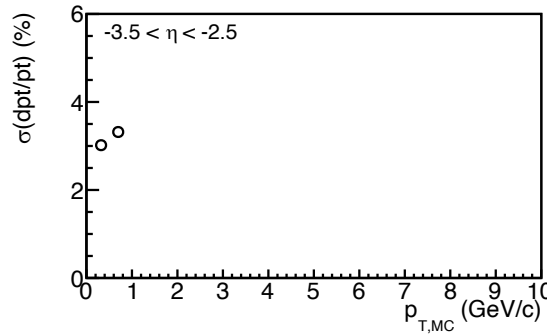
Not enough bins in dp/p ?



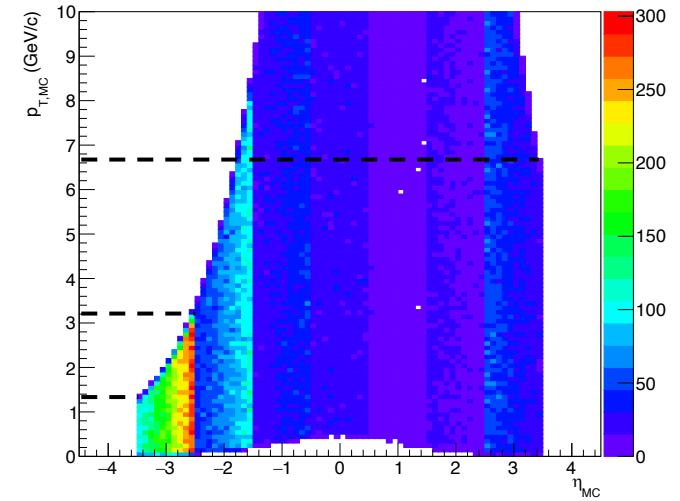
Momentum Resolution



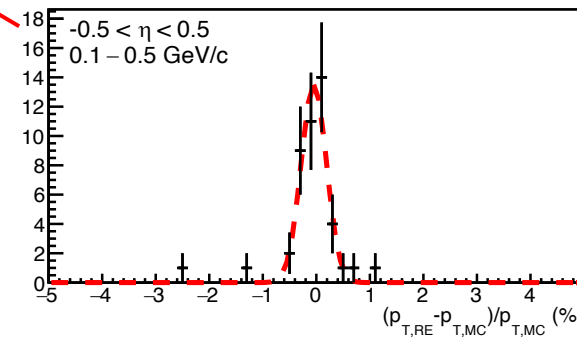
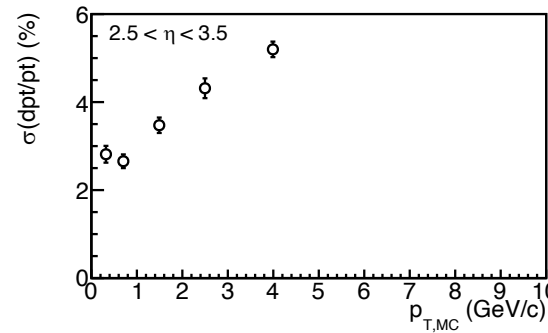
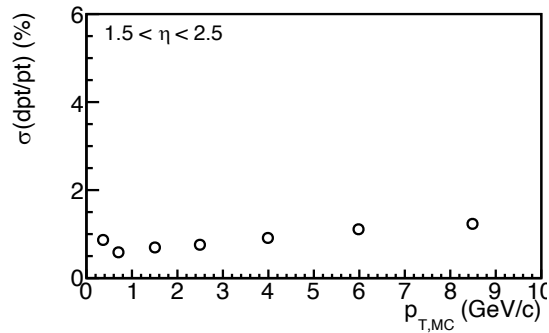
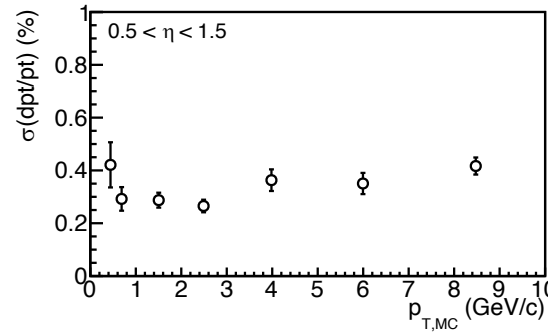
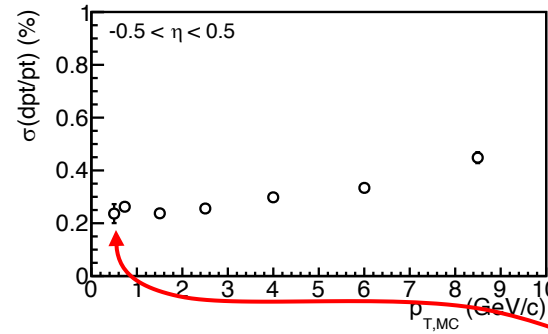
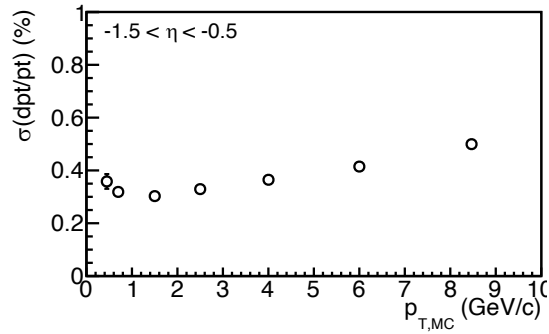
Transverse Momentum Resolution



Make more pt bins in backward pseudorapidity next time



Apply weight using eta distribution?



sPHENIX TPC

- Event rate 50kHz
- Ar:CF₄ 60:40
- Space charge ~1%
- Drift velocity of $\sim 80 \mu\text{ms}^{-1}$ at $E=400 \text{ Vcm}^{-1}$
- Inner/outer field cage
 - Carbon fiber $t=0.0254 \text{ cm} \times 2$
 - Kapton 0.2286 cm (insulating) + 0.0051 cm (circuit card)
 - Copper $0.0017 \text{ cm} \times 2$
 - Epoxy
- Digitization parameters (from Joe Osborn)
 - 1.transverse dispersion : $53 \mu\text{m}$
 - 2.longitudinal dispersion : $150 \mu\text{m}$
 - 3.transverse intrinsic resolution : $\sim 150 \mu\text{m}$
 - 4.longitudinal intrinsic resolution : $\sim 500 \mu\text{m}$
 - 5.radial intrinsic resolution : $5 - 10 \text{ mm}$
 - 6.GEM vertical pad size : ?

Summary

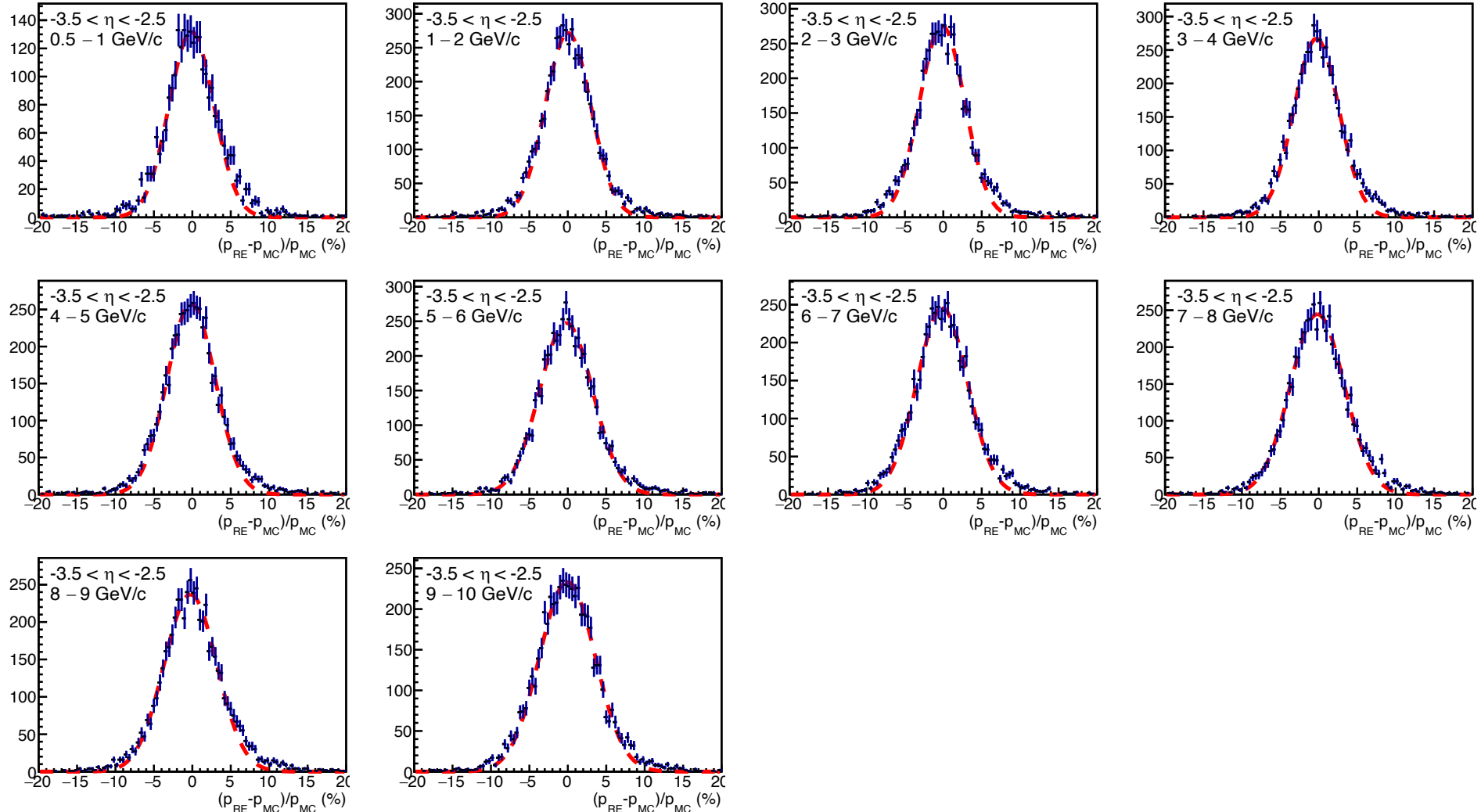
- Modification in detector setup
 - Thinner aluminum endcap of TPC in the backward direction
 - Constant 2T solenoid field for now
 - Still suppressing secondary particles
- Momentum resolutions
 - Looks reasonable and better than the ePIC trackers (*still suppressing secondary particles)

To-do List

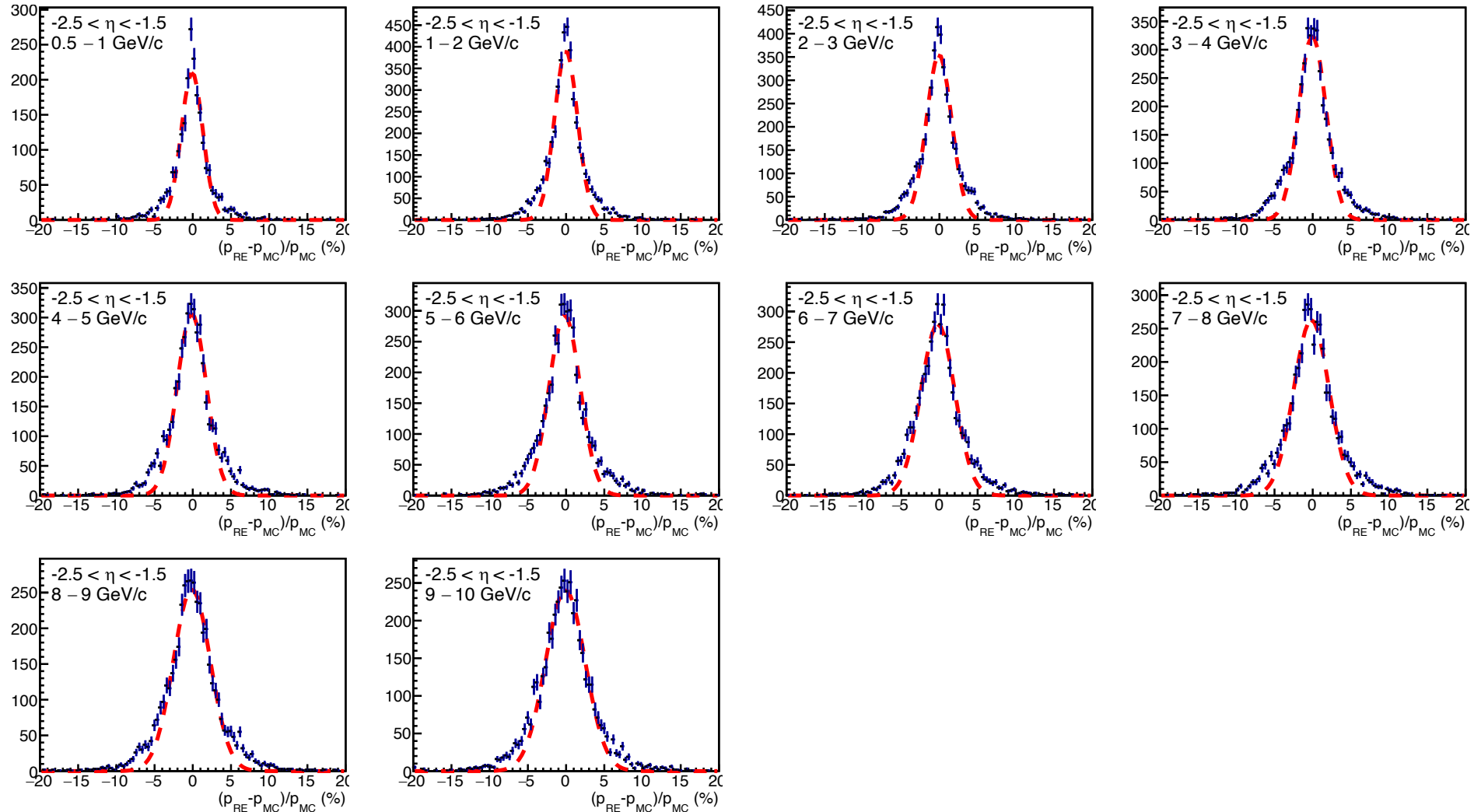
- Finalize p (p_T) binning in resolution figures
- Efficiency plots
- Include secondary particles in tracking
- Implement sPHENIX TPC materials and digitization parameters
- Tracking with background tracks
- Integrate PIDs and calorimeters

Backup

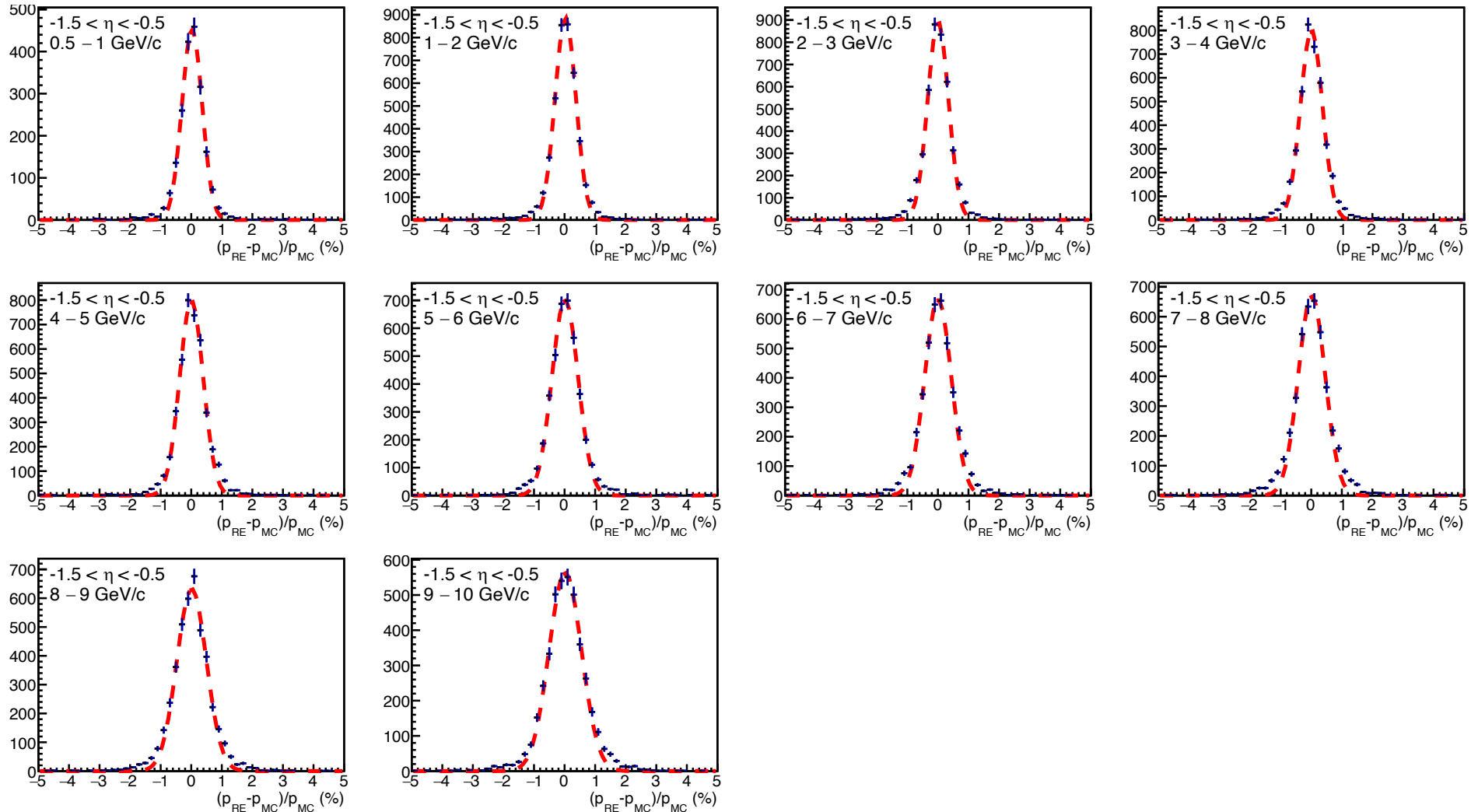
$dp/p \ (-3.5 < \eta < -2.5)$



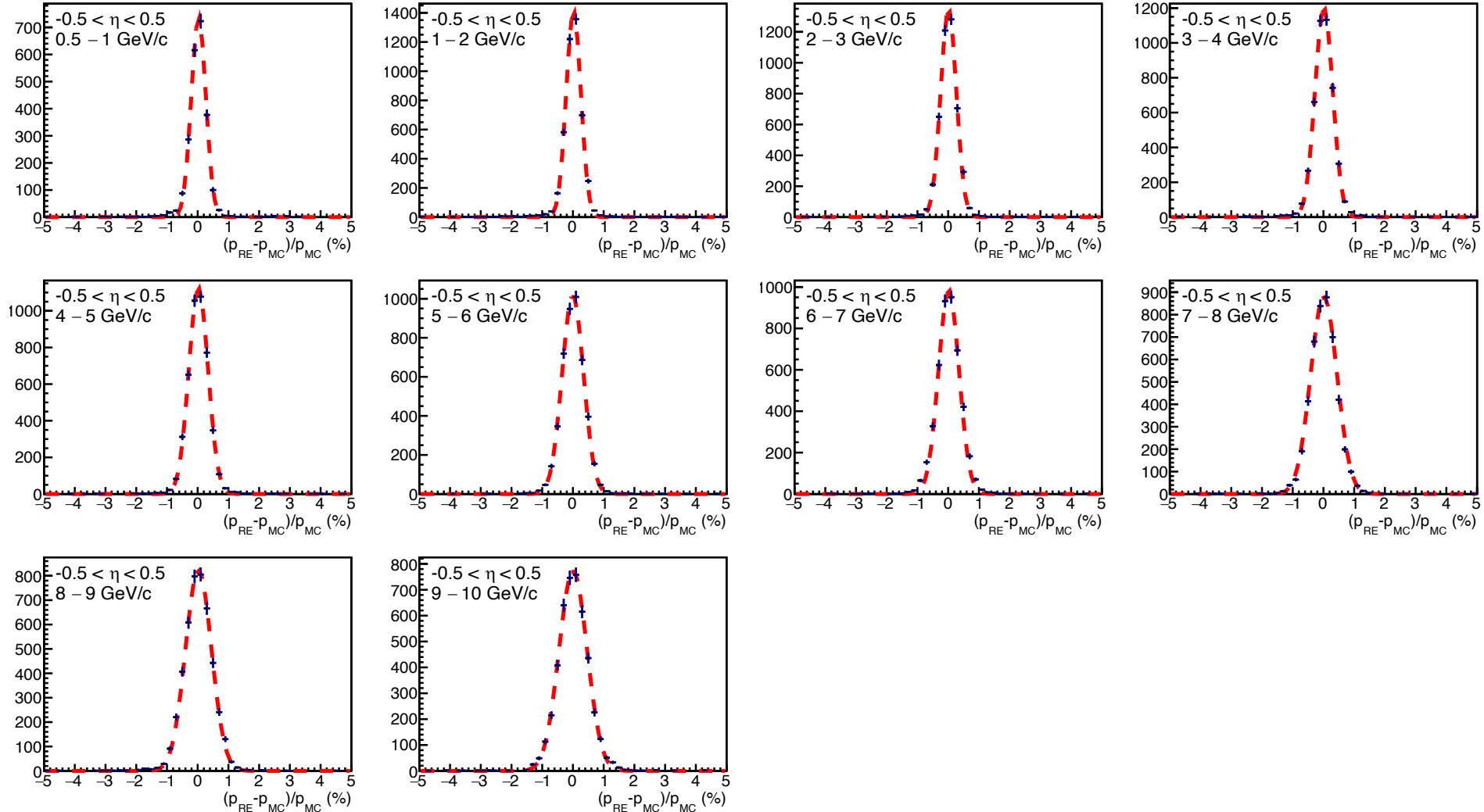
dp/p ($-2.5 < \eta < -1.5$)



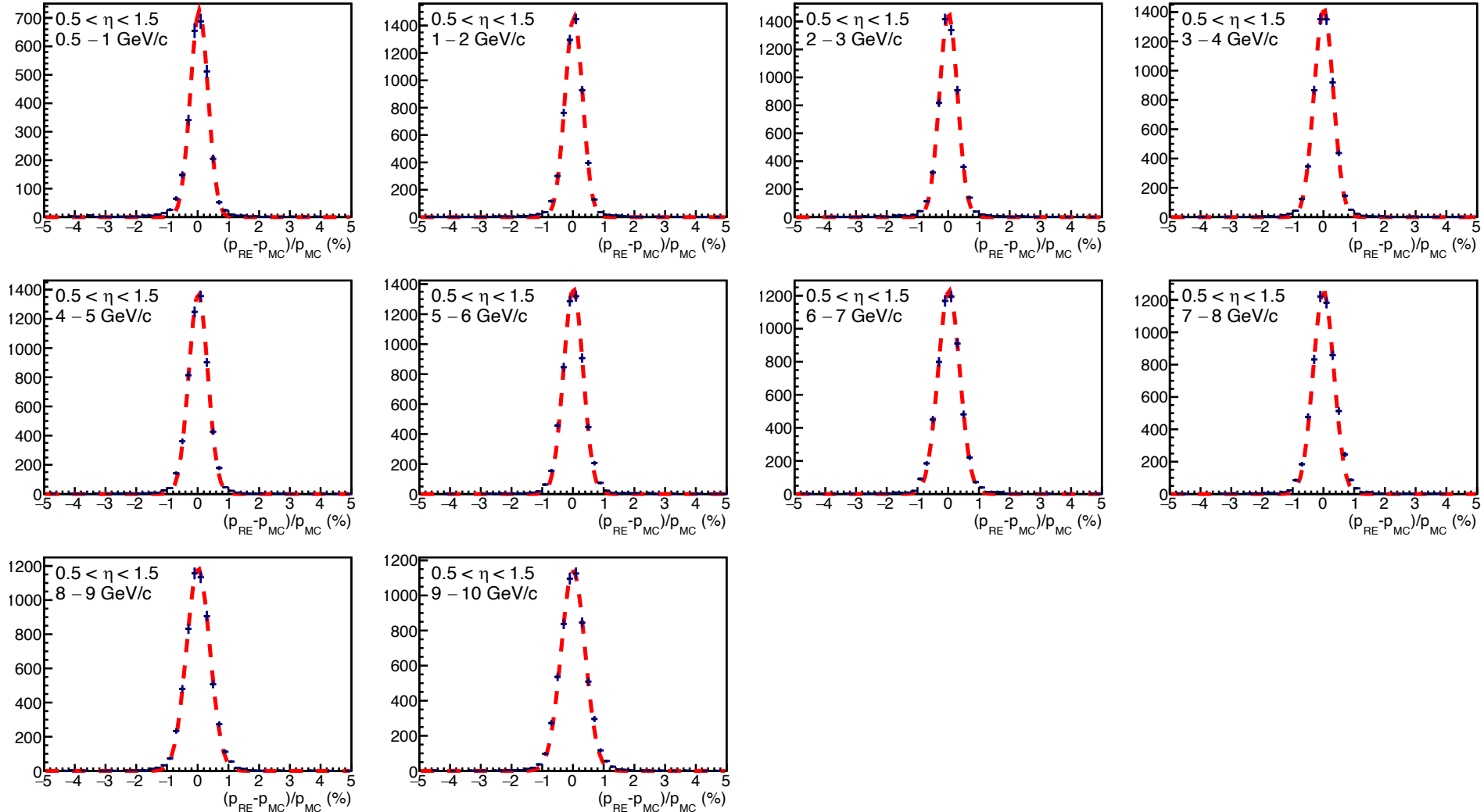
dp/p ($-1.5 < \eta < -0.5$)



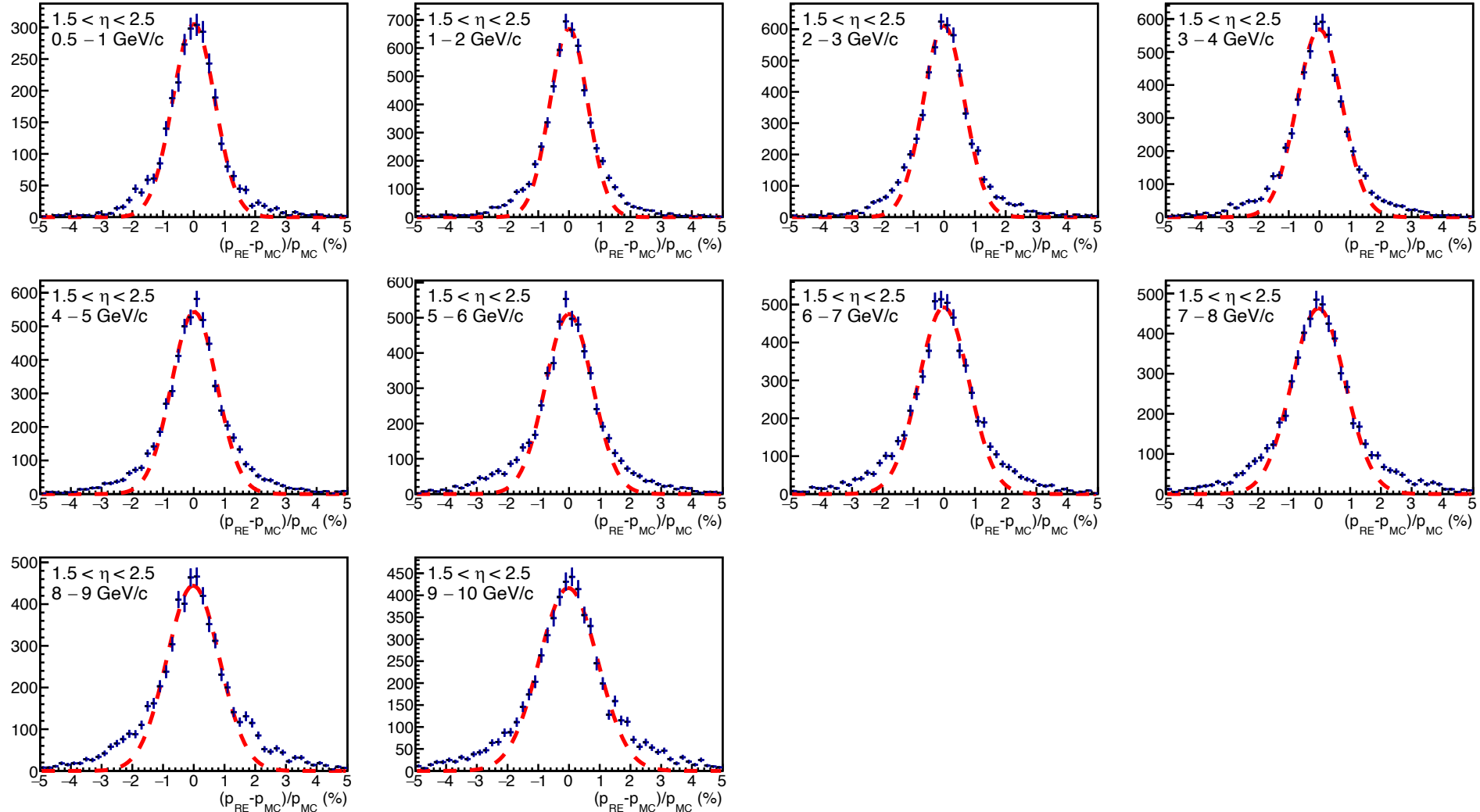
dp/p ($-0.5 < \eta < 0.5$)



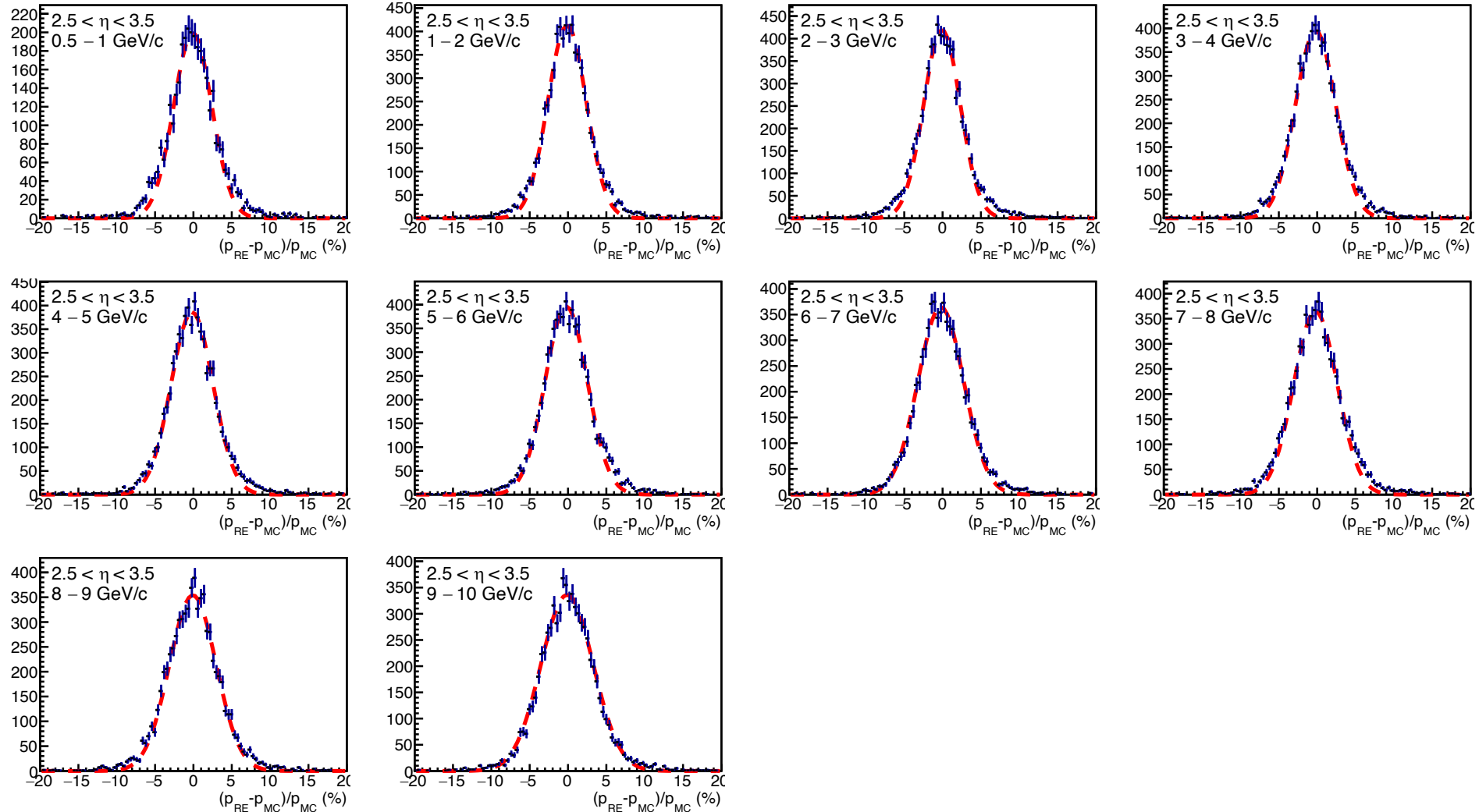
dp/p ($0.5 < \eta < 1.5$)



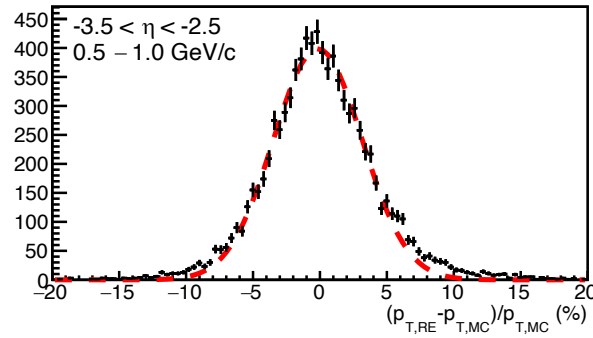
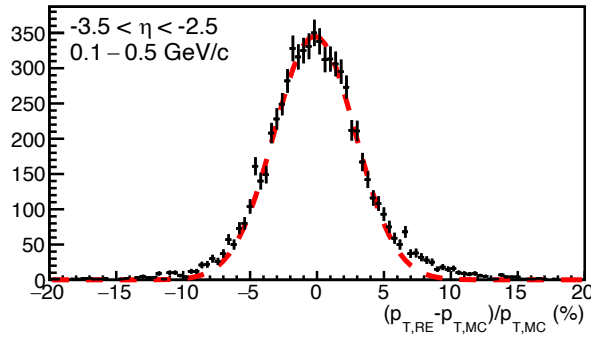
dp/p ($1.5 < \eta < 2.5$)



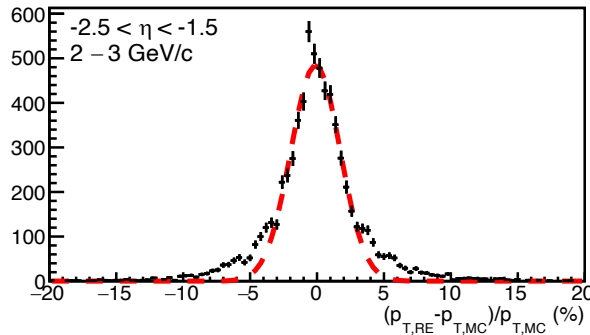
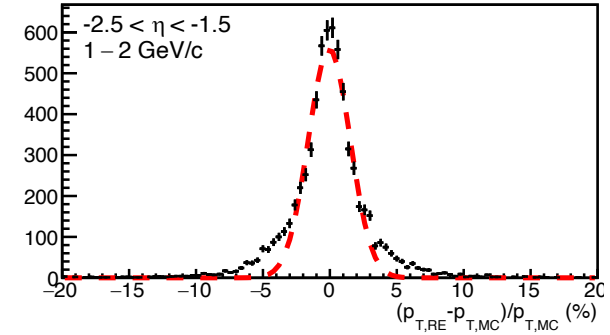
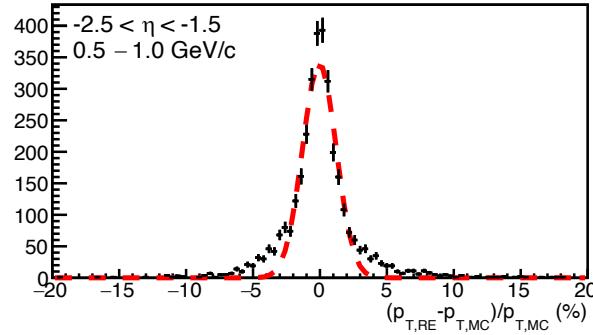
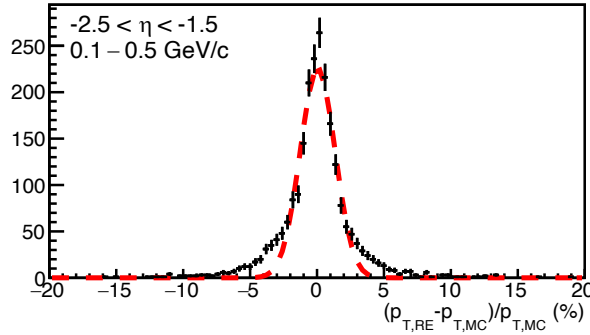
dp/p ($2.5 < \eta < 3.5$)



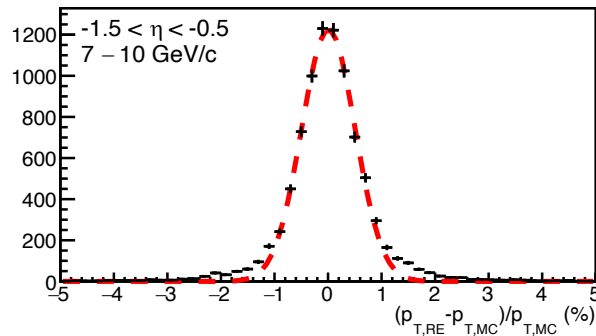
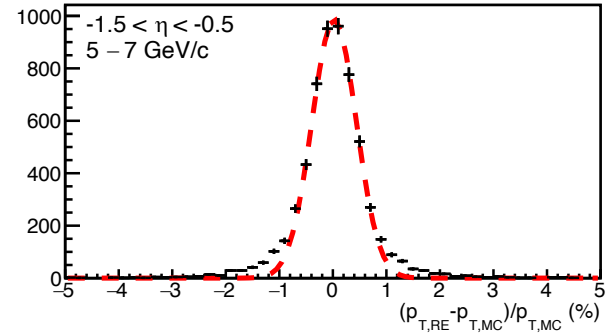
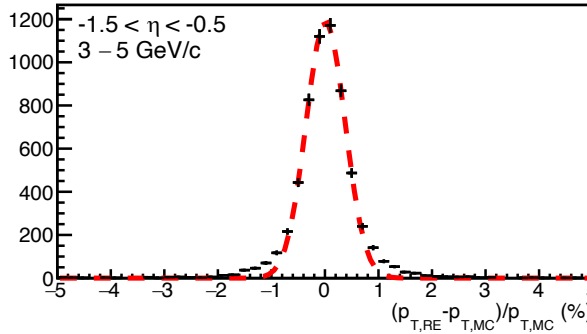
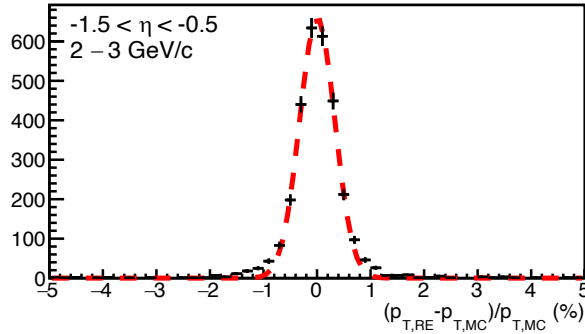
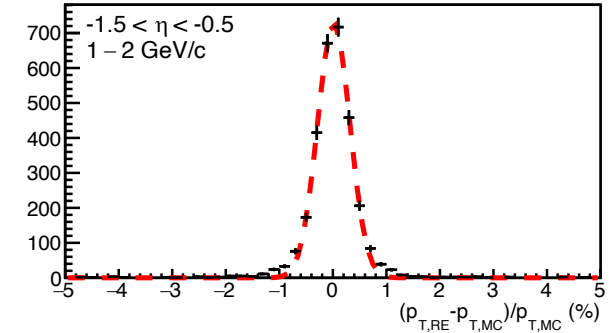
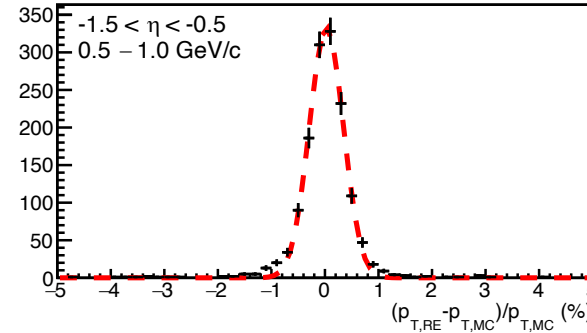
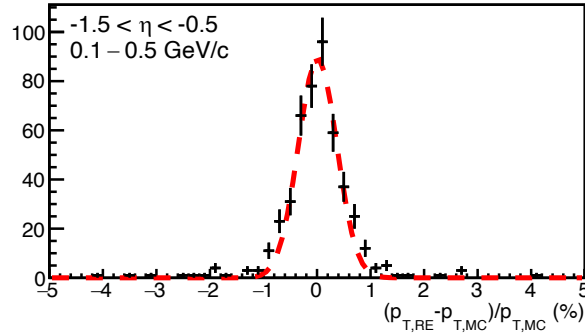
$dp_T/p_T \text{ } (-3.5 < \eta < -2.5)$



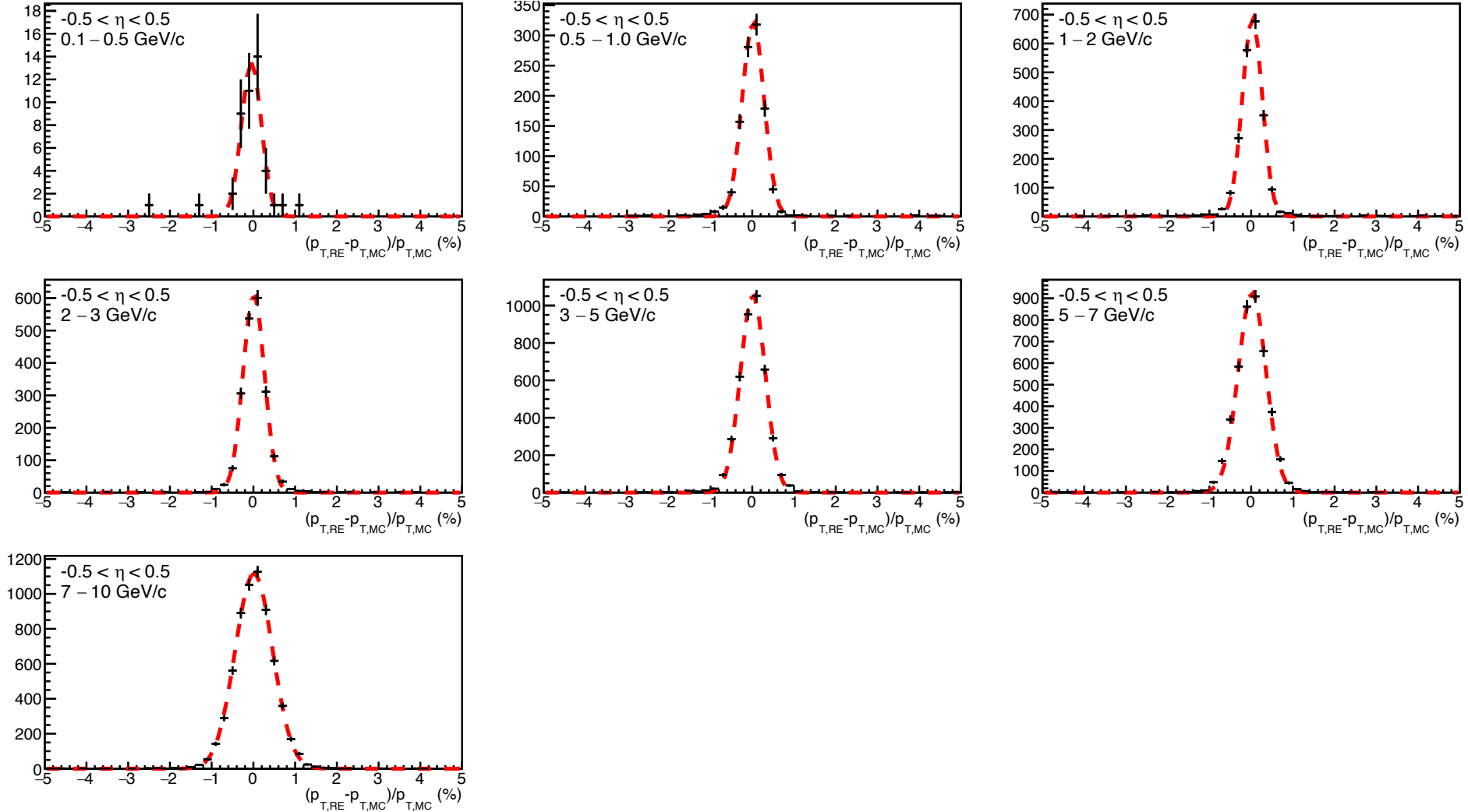
$dp_T/p_T \text{ } (-2.5 < \eta < -1.5)$



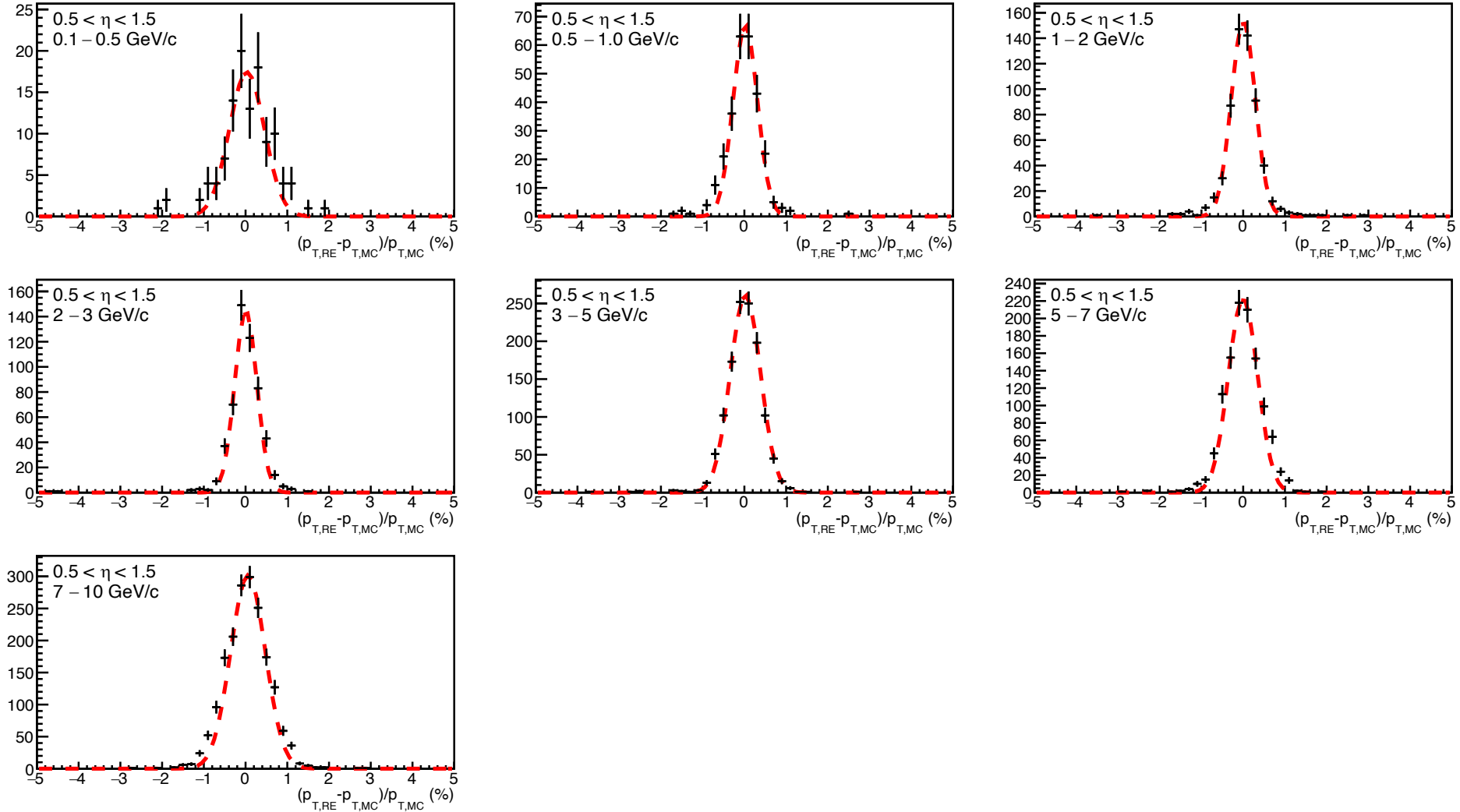
$dp_T/p_T \ (-1.5 < \eta < -0.5)$



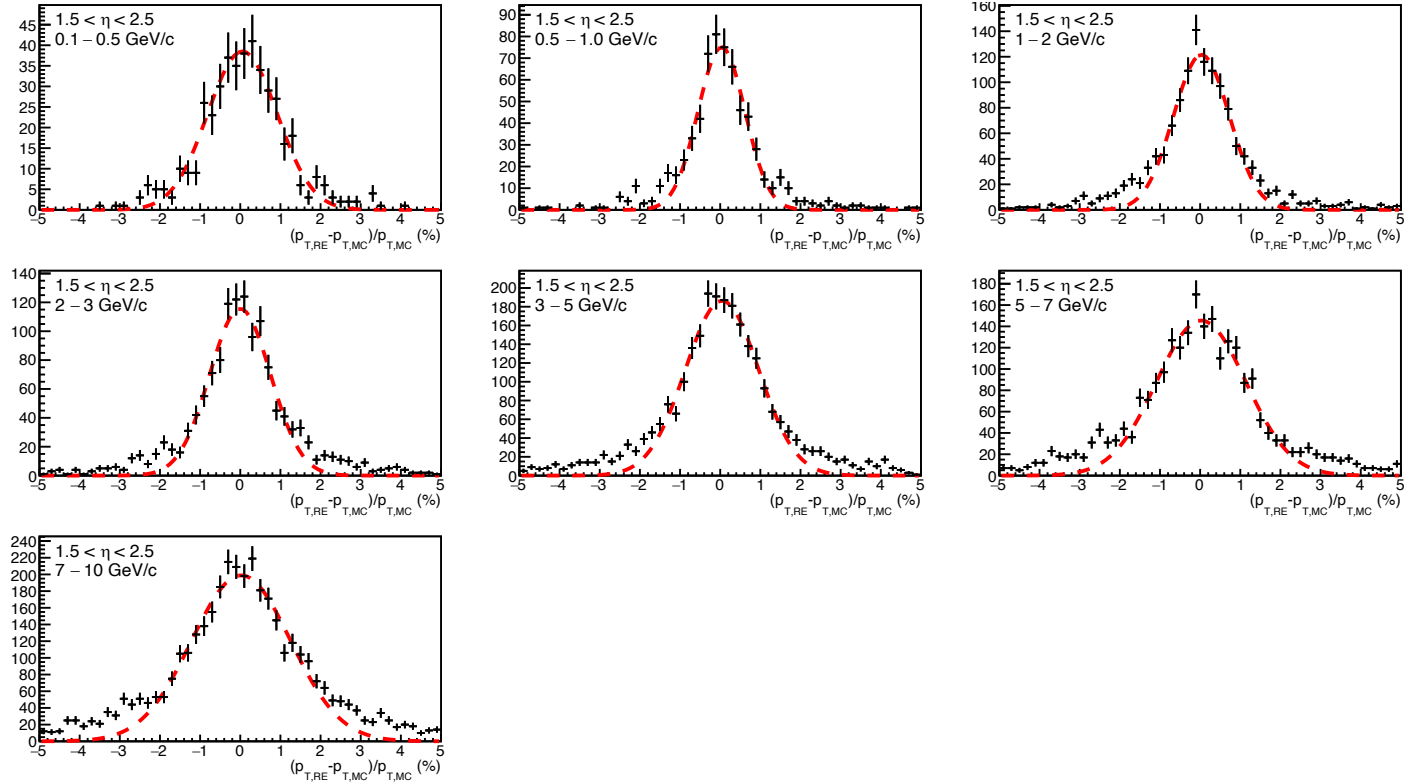
dp_T/p_T ($-0.5 < \eta < 0.5$)



dp_T/p_T ($0.5 < \eta < 1.5$)



dp_T/p_T ($1.5 < \eta < 2.5$)



dp_T/p_T ($2.5 < \eta < 3.5$)

