

Tracking Studies with New Geometry

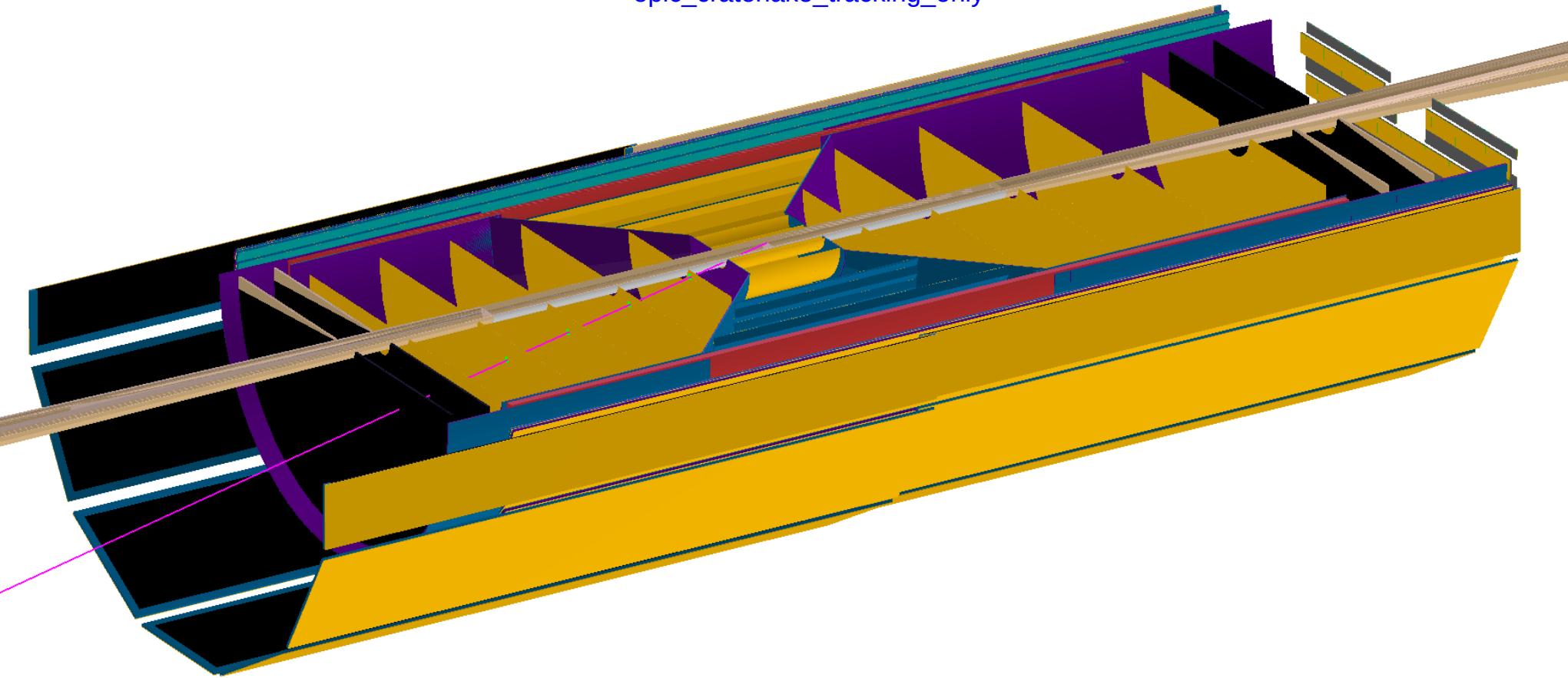
Shyam Kumar, Annalisa Mastroserio, Domenico Elia
INFN Bari, Italy

Geometry Name: epic_craterlake_tracking_only
epic tag: 23.07.1

Visualization of Geometry

Event-display

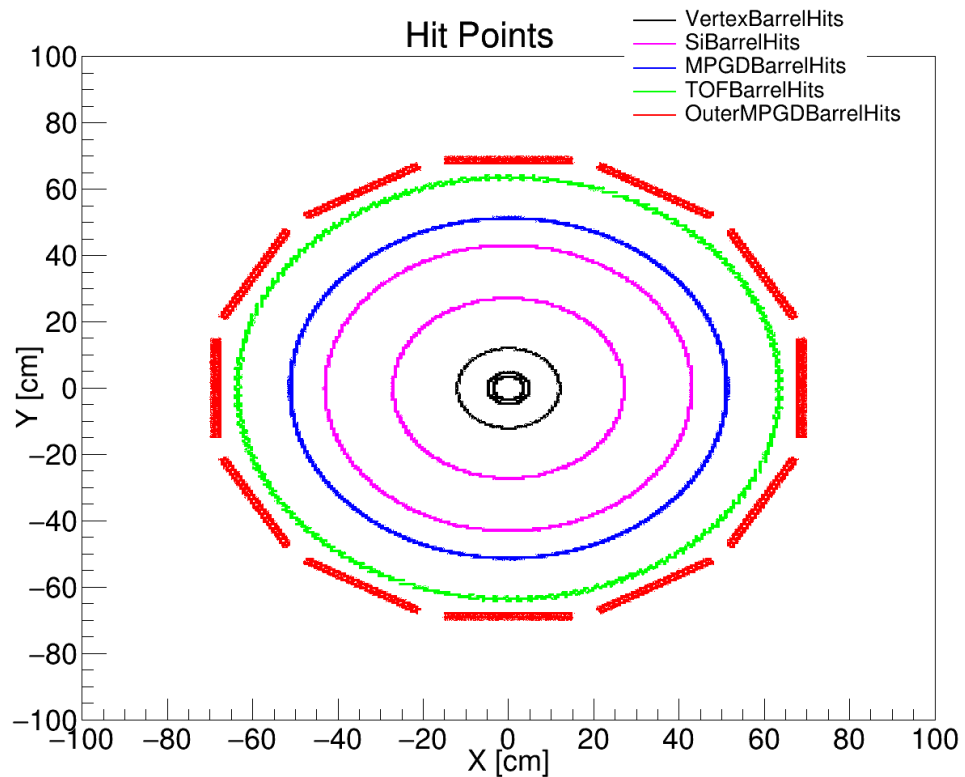
epic_craterlake_tracking_only



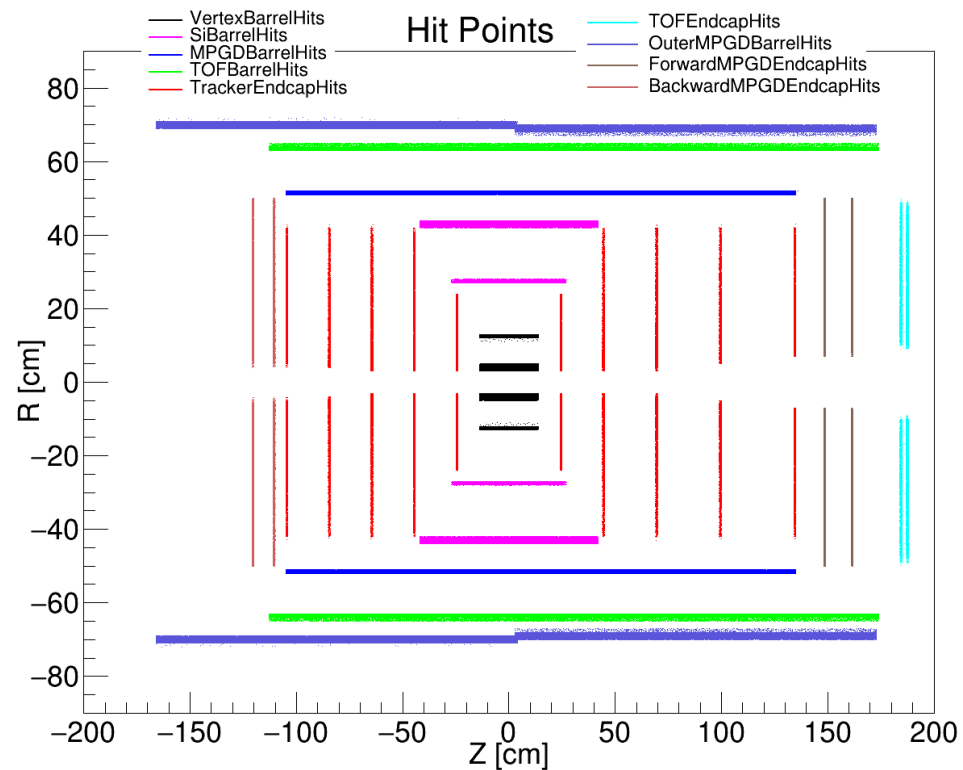
Simulation Details

Simulation of 3M π^+ in uniform momentum range [0.1, 30.] GeV/c and θ [3, 177] deg

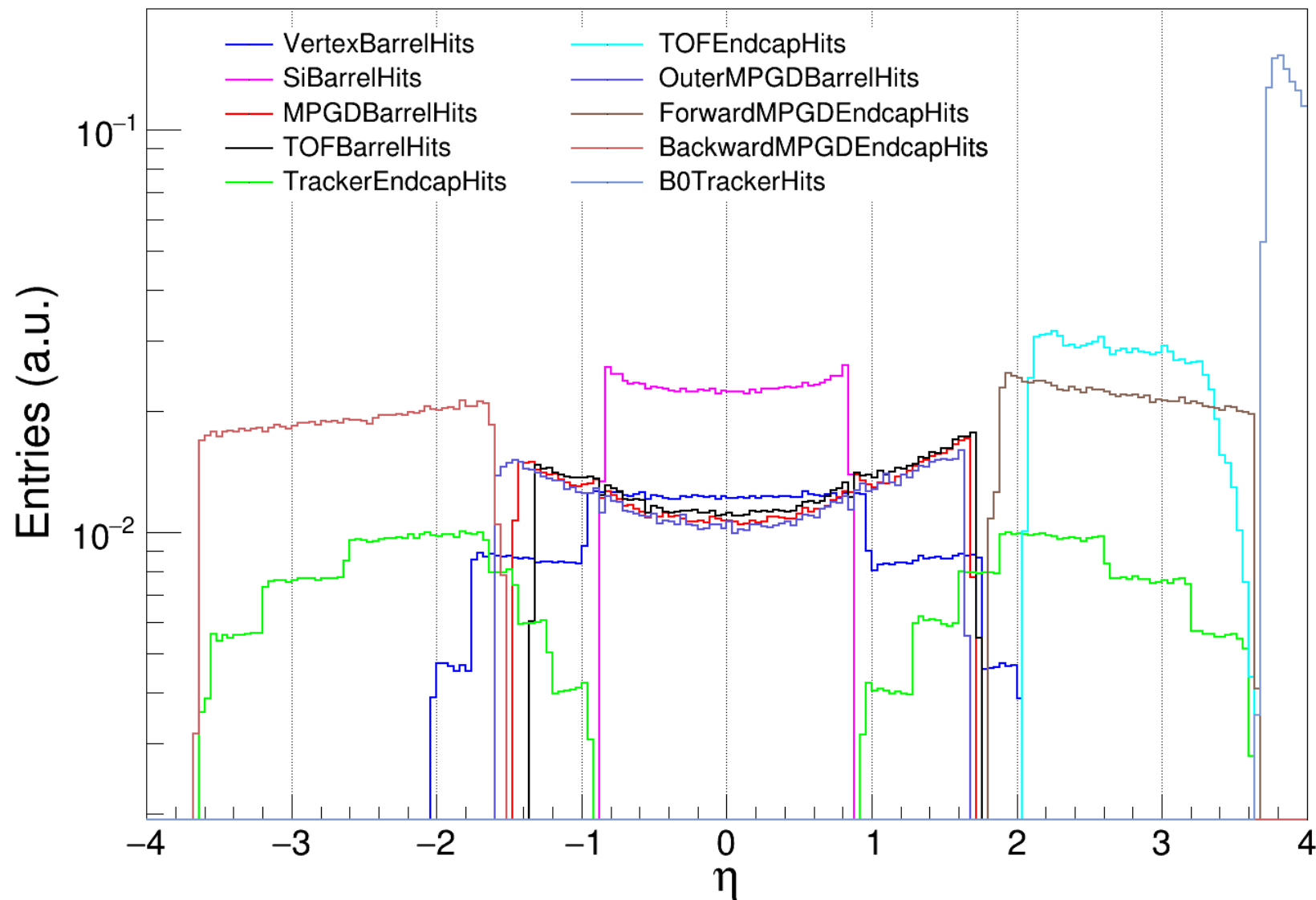
X-Y Points



R-Z Points

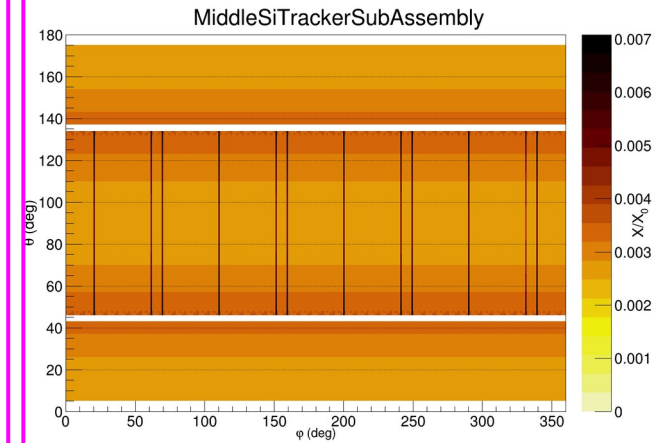
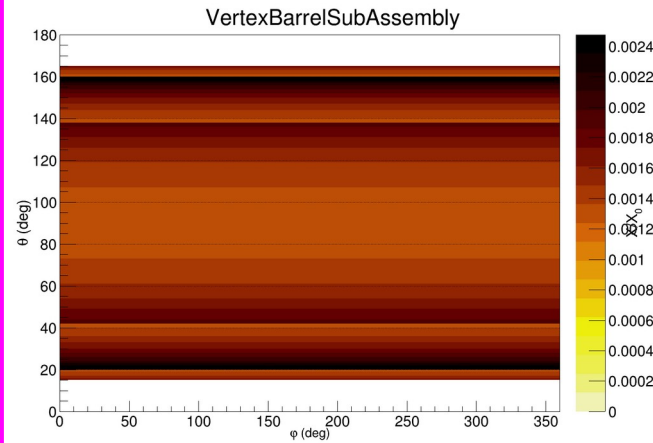
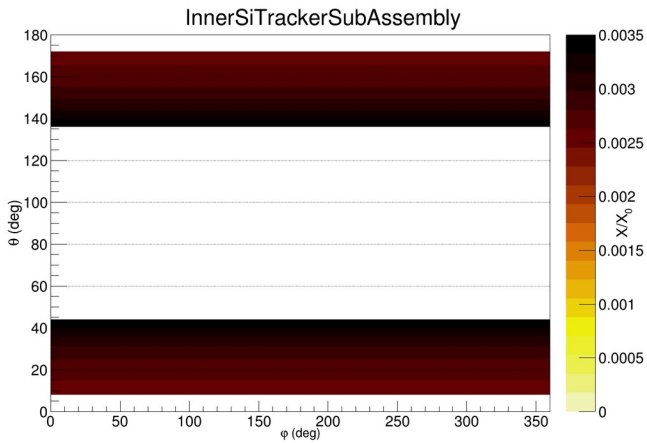
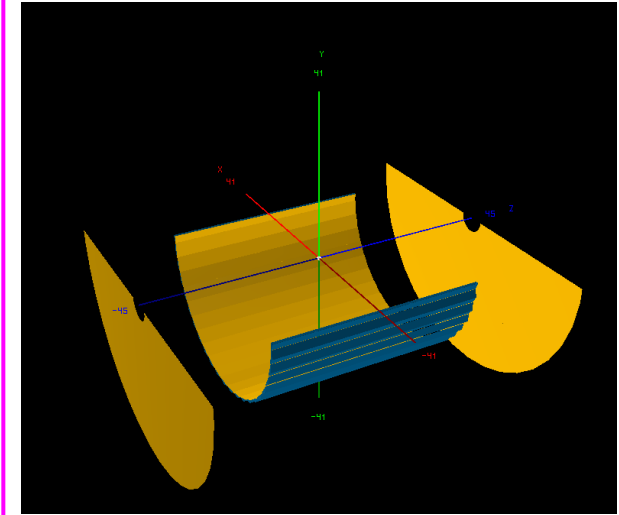
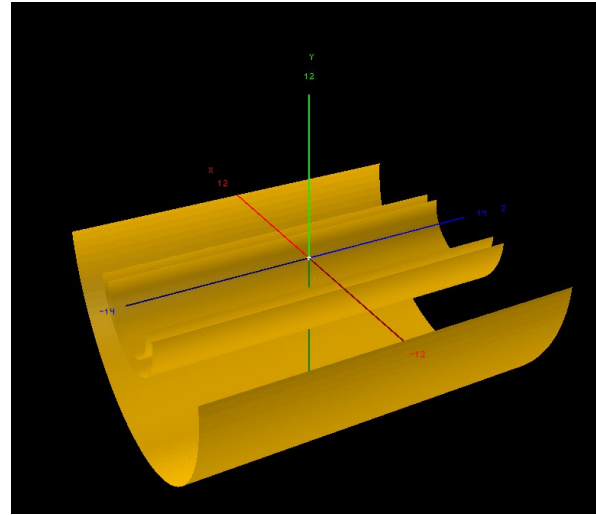
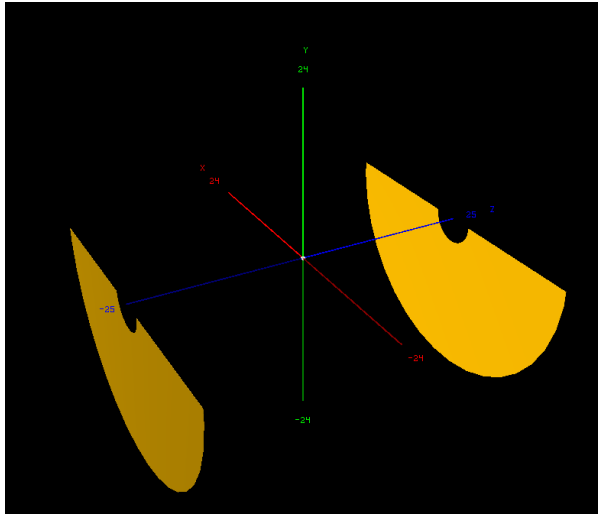


Eta Coverage (Acceptance)



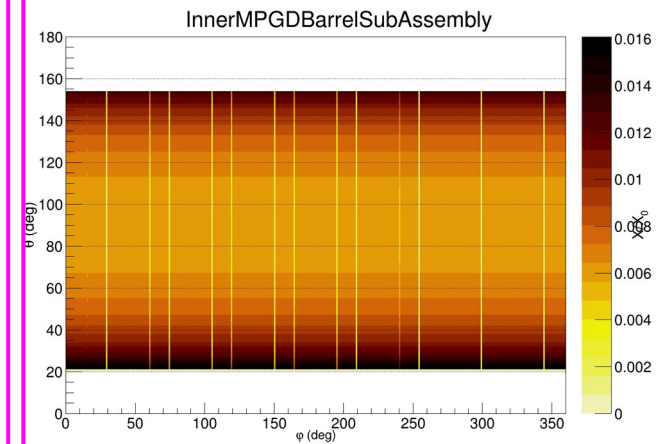
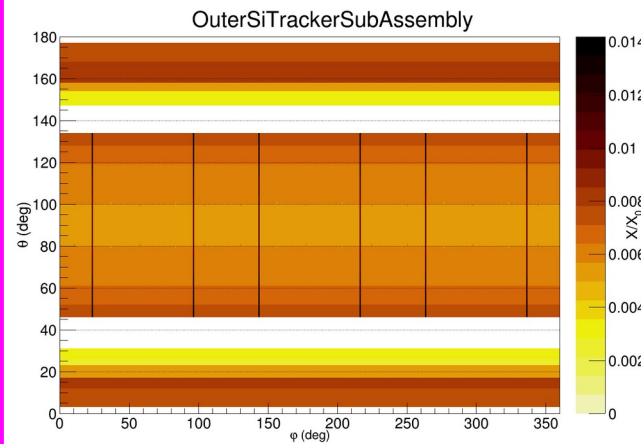
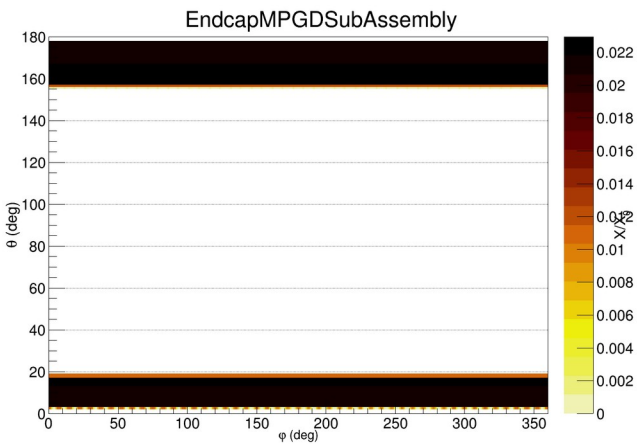
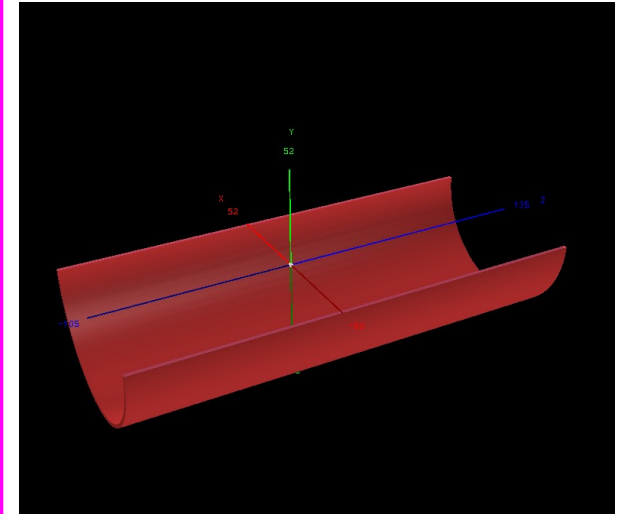
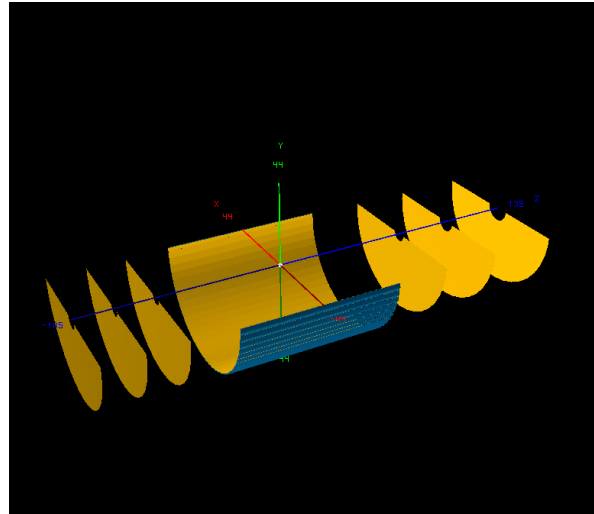
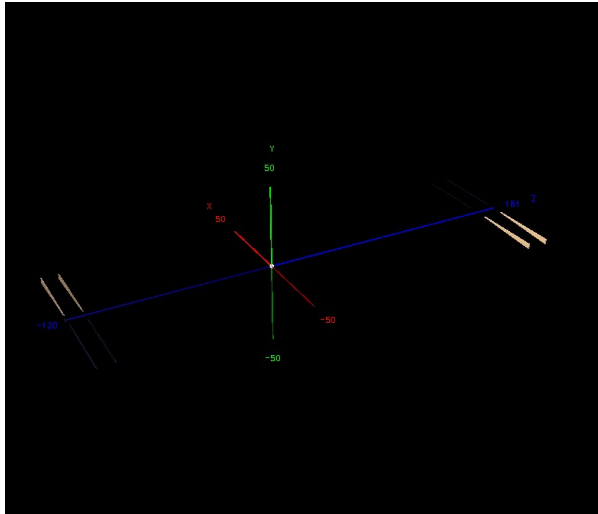
Material Map

Geometry and corresponding material map in the bottom row



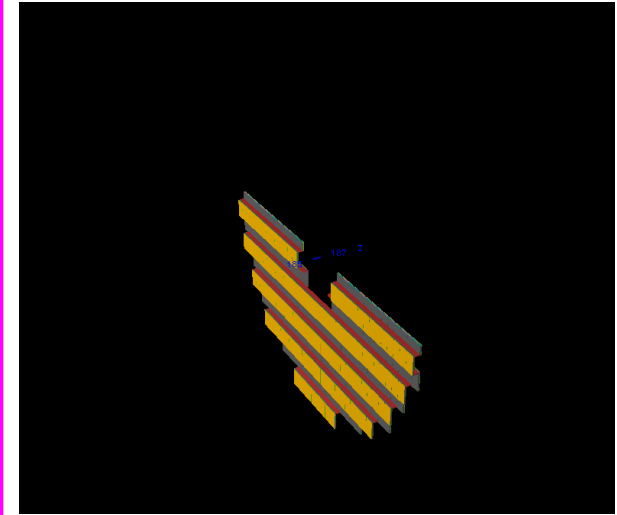
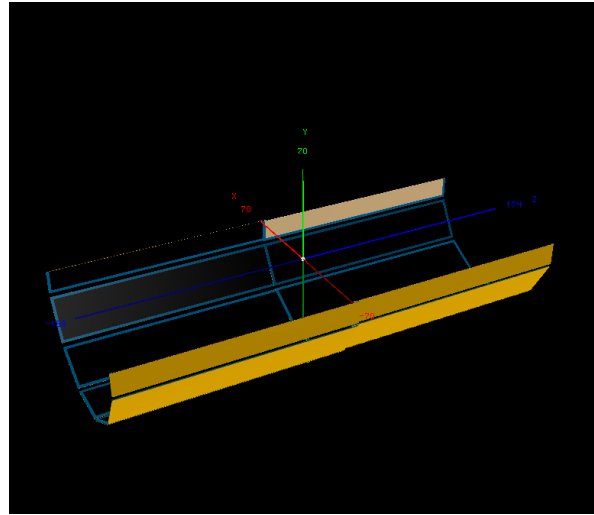
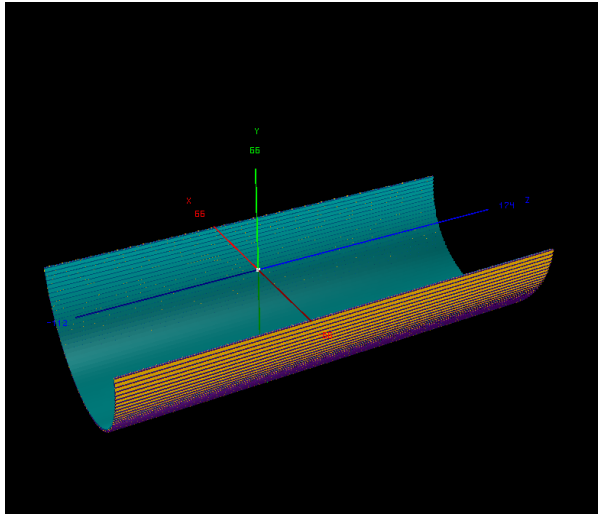
Material Map

Geometry and corresponding material map in the bottom row

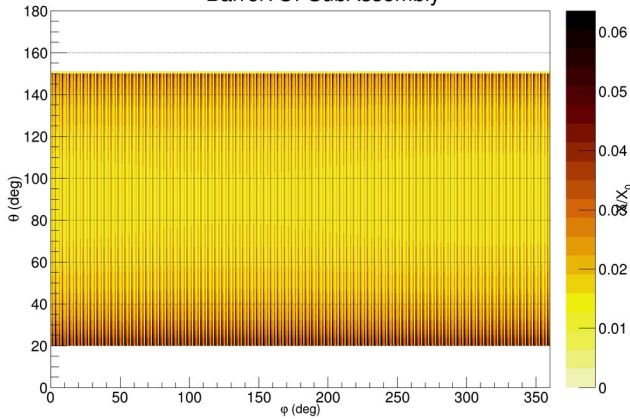


Material Map

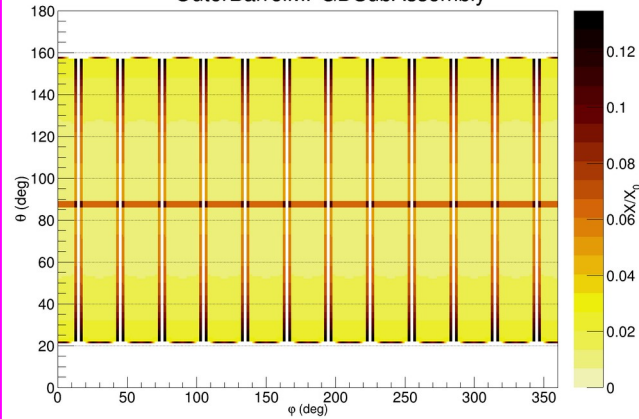
Geometry and corresponding material map in the bottom row



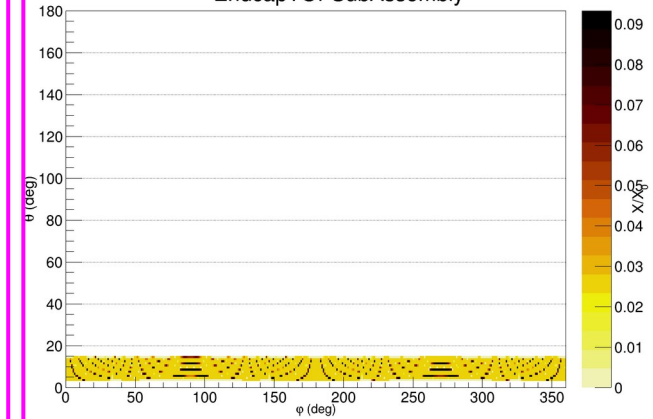
BarrelTOFSubAssembly



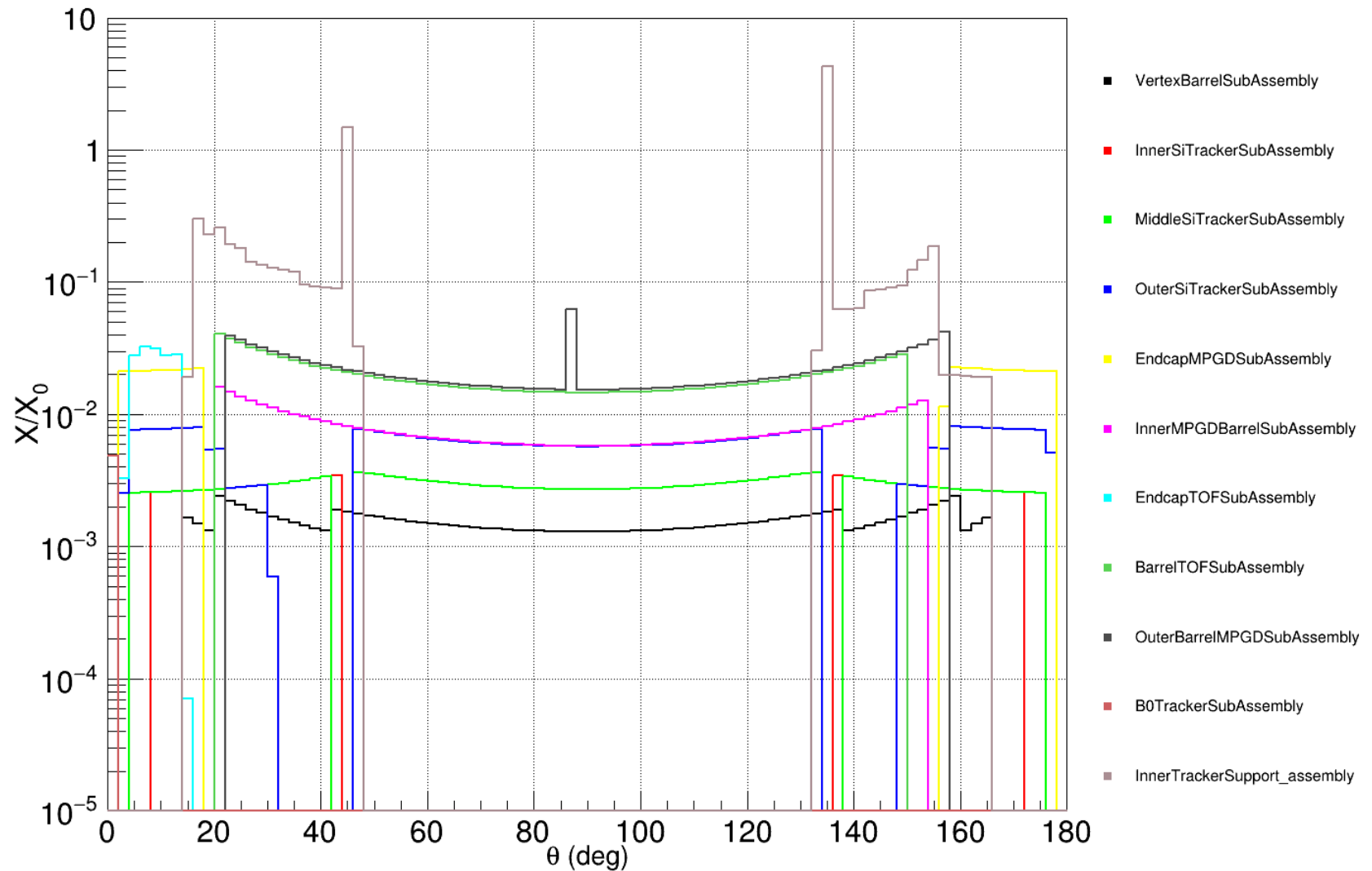
OuterBarrelIMPGDSubAssembly



EndcapTOFSubAssembly



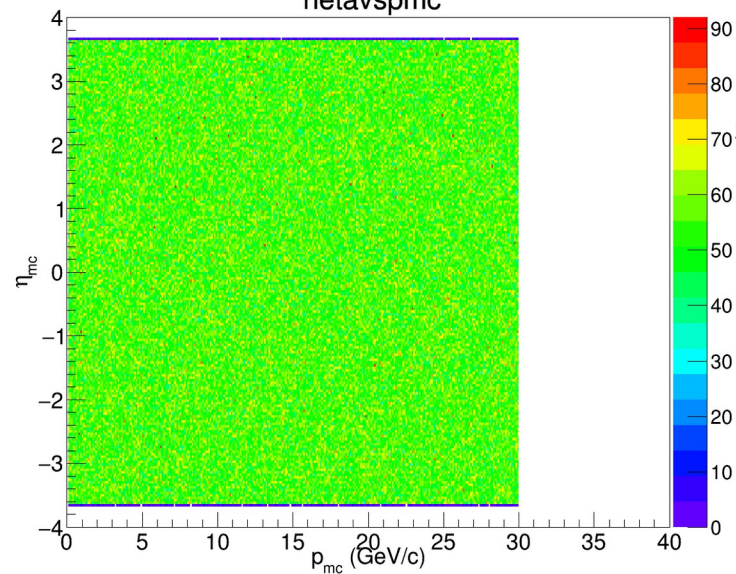
Material Map (Material Scan)



Eta vs Momentum

Generated level

hetavspmc

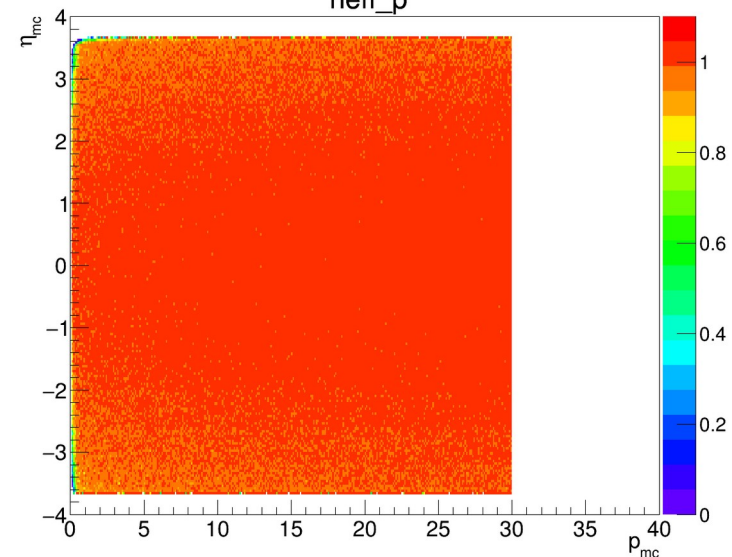
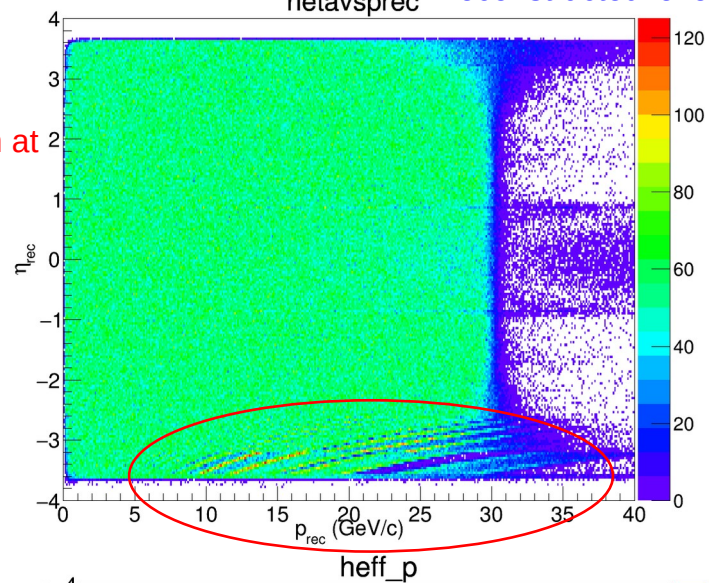


Structure in the backward direction at large η and momentum

Acceptance using truth seeding

Reconstructed level

hetavsprec



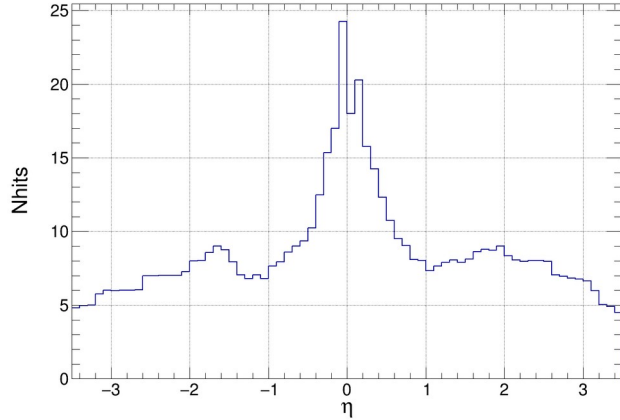
Nhits vs η (Generation Level)

Including calorimeters will improve
but simulation takes time

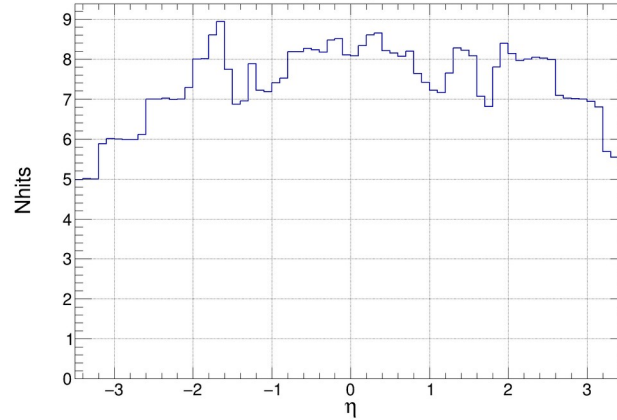
Without Calorimeters

With primary hits selected
using quality flag

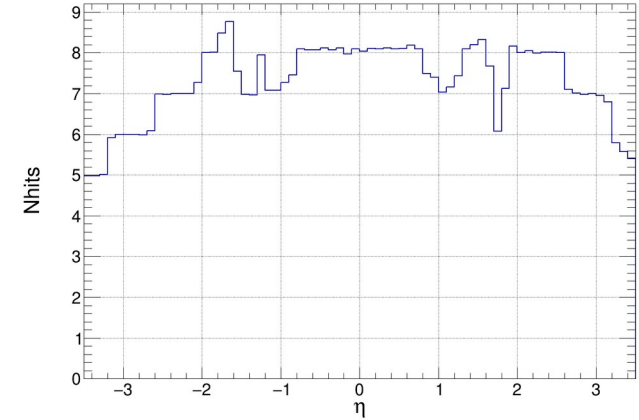
$0.2 < p \text{ (GeV/c)} < 0.4$



$0.4 < p \text{ (GeV/c)} < 0.6$

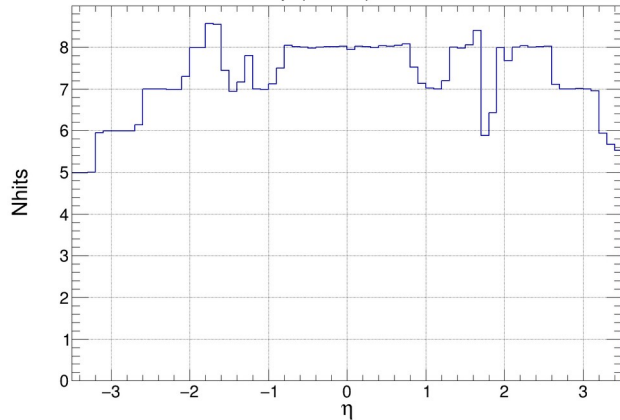


$0.6 < p \text{ (GeV/c)} < 0.8$

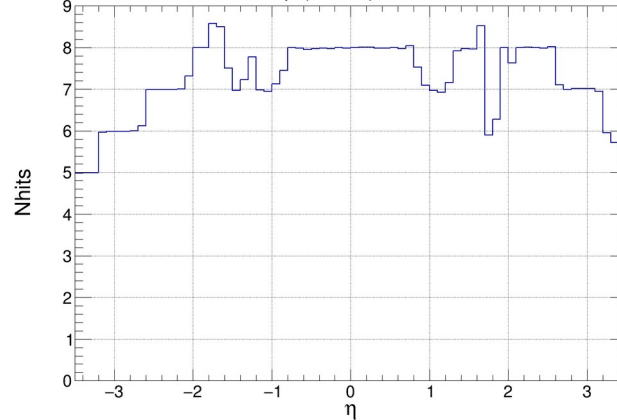


https://indico.bnl.gov/event/18214/contributions/74857/attachments/46665/79042/EPIC_Tracking_Meeting_Shyam23Mar2023.pdf

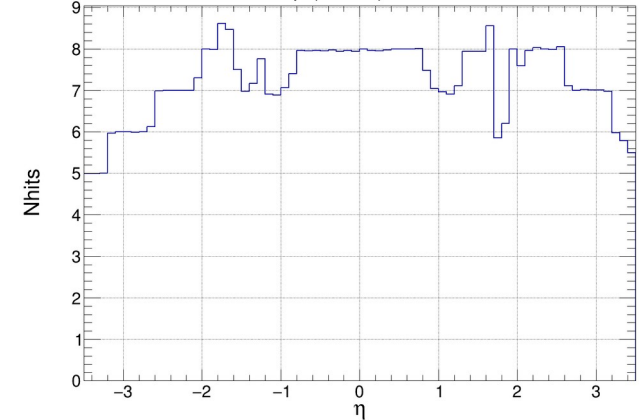
$1.0 < p \text{ (GeV/c)} < 2.0$



$2.0 < p \text{ (GeV/c)} < 3.0$



$6.0 < p \text{ (GeV/c)} < 7.0$

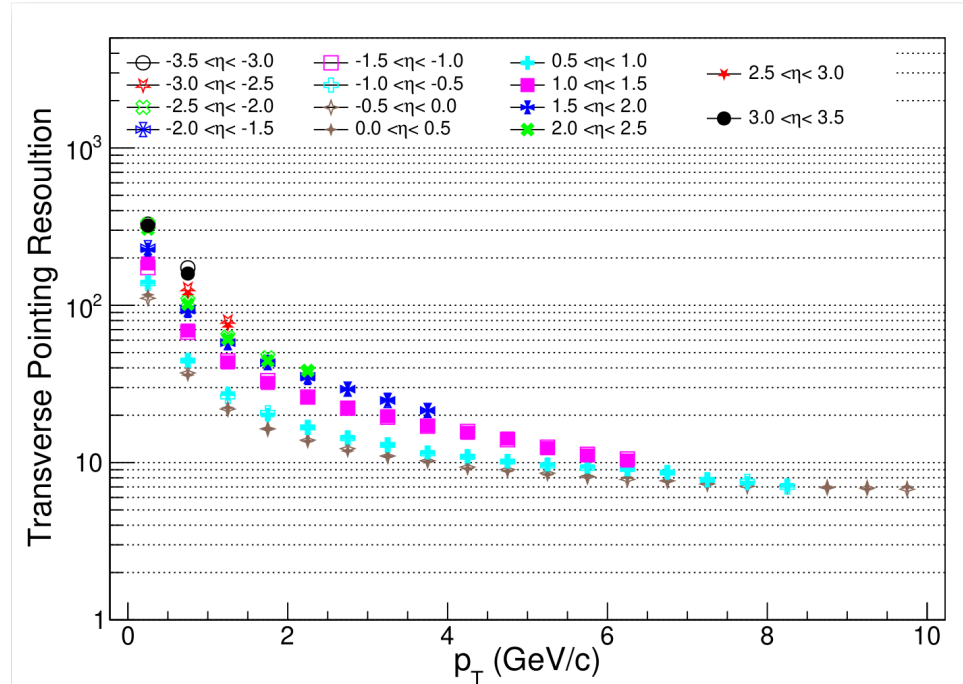
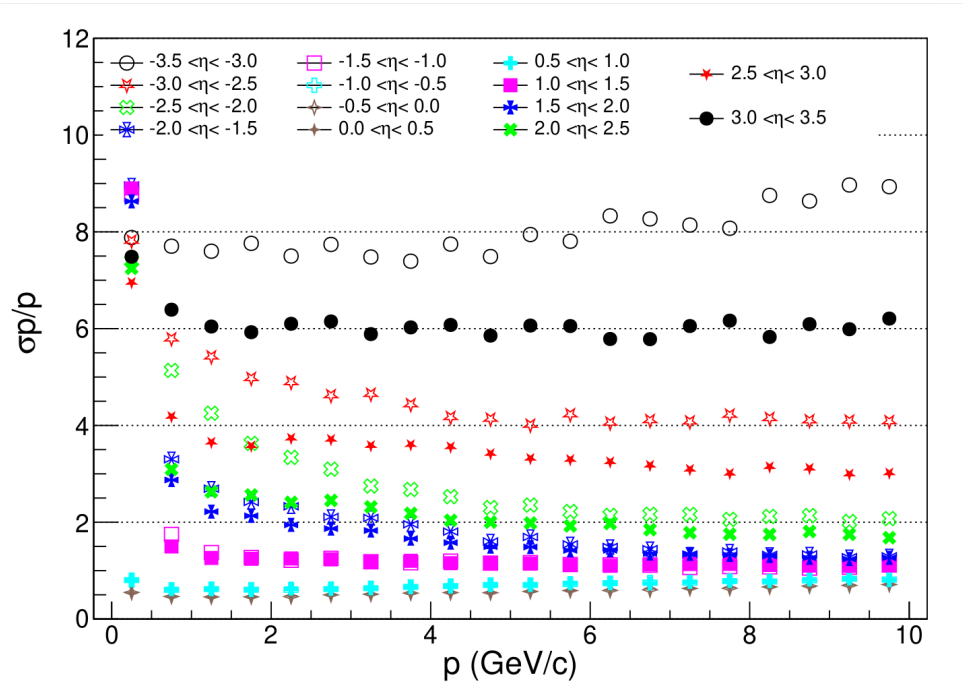


Tracking Performances

$$p_T = \frac{p}{\cosh(\eta)} = \frac{0.2}{\cosh(3.5)} = 0.012 \text{ GeV}/c$$

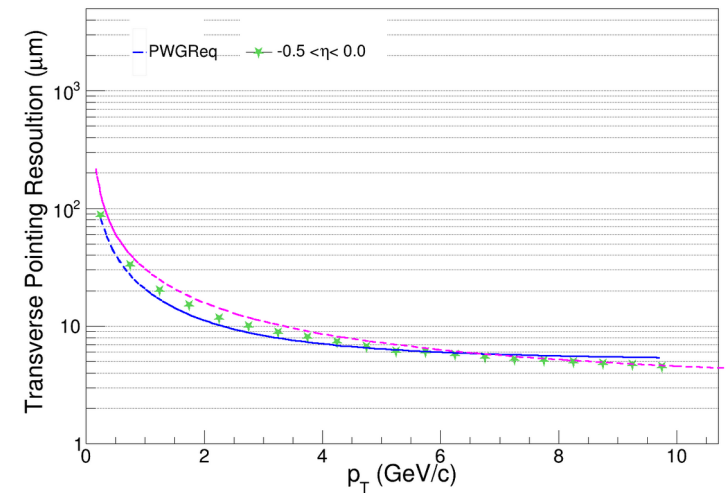
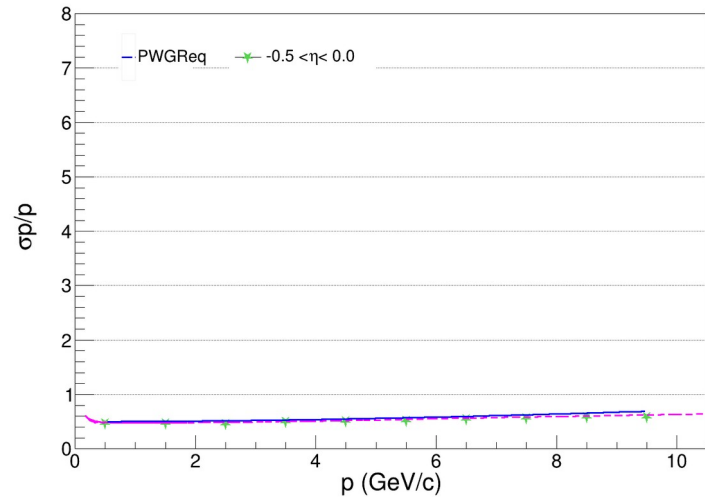
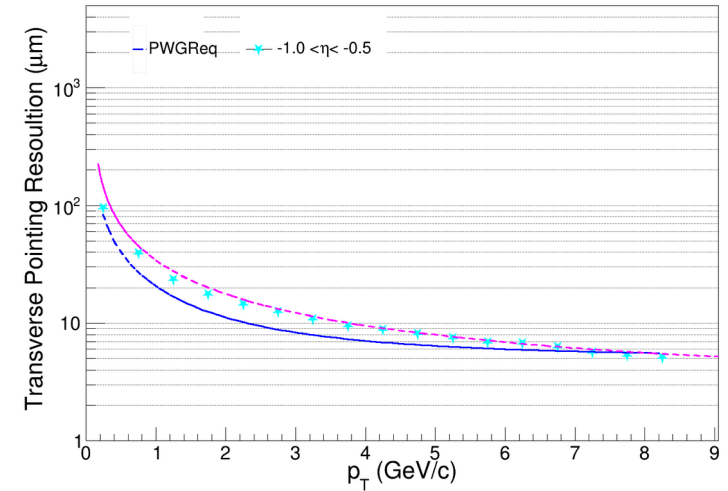
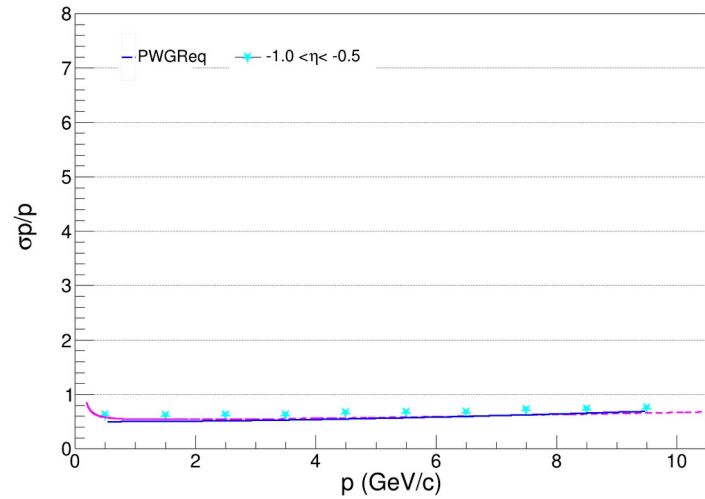
$$p = p_T \cosh(\eta)$$

$$R_{\min} = \frac{2.0 * 0.012}{0.3 * 1.7} = 0.047 = 4.7 \text{ cm}$$

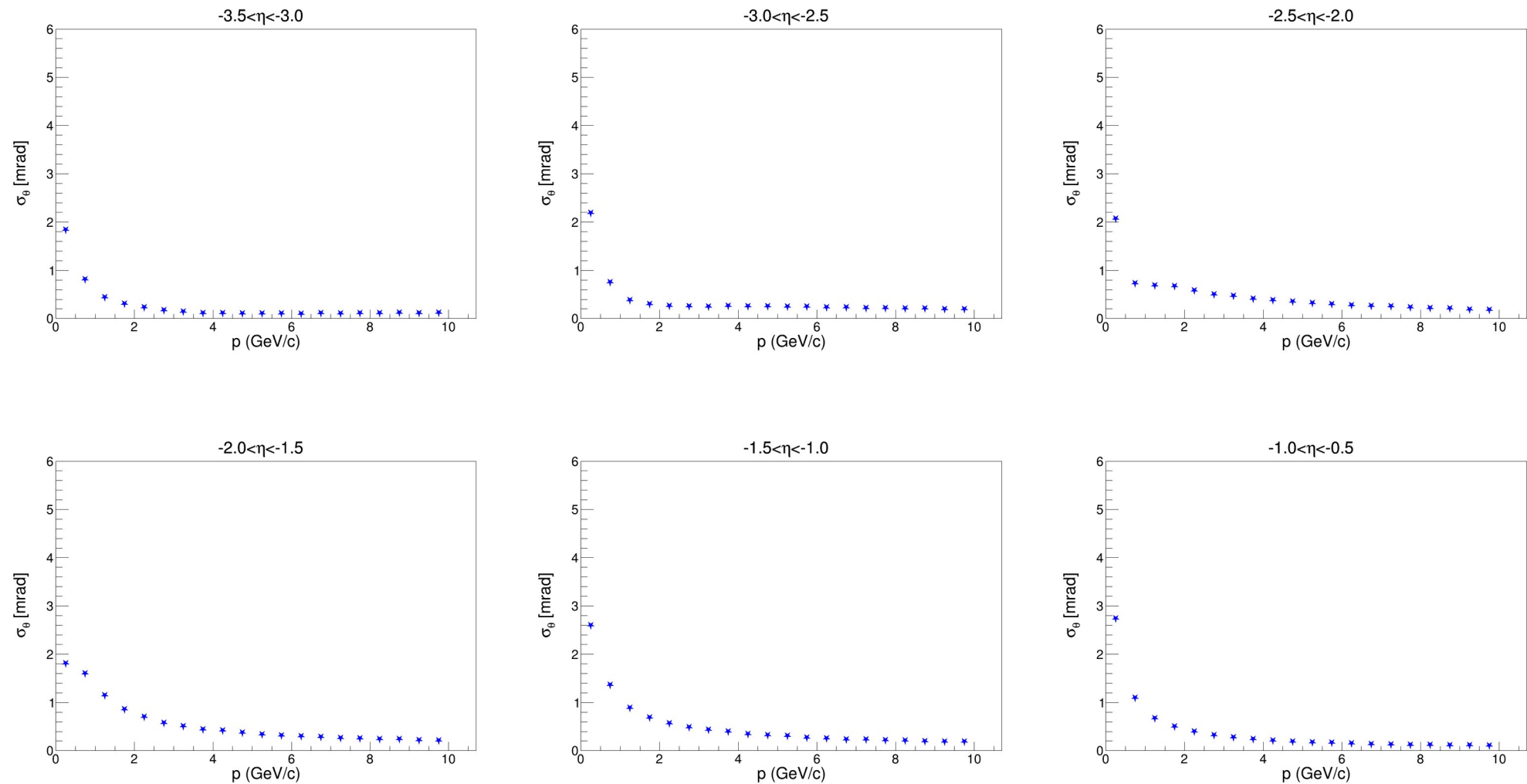


Tracking Performances

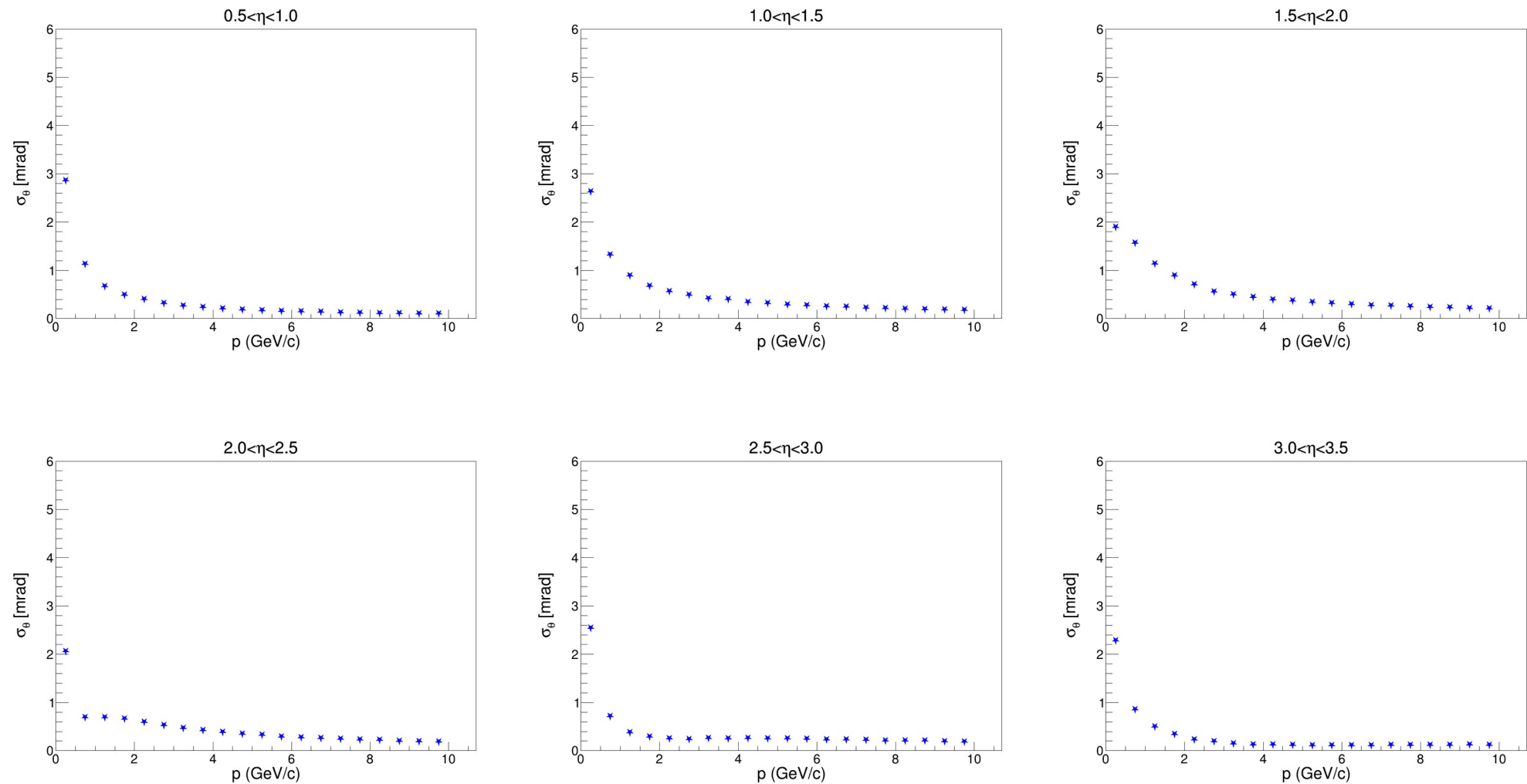
Magenta: Fast Simulations



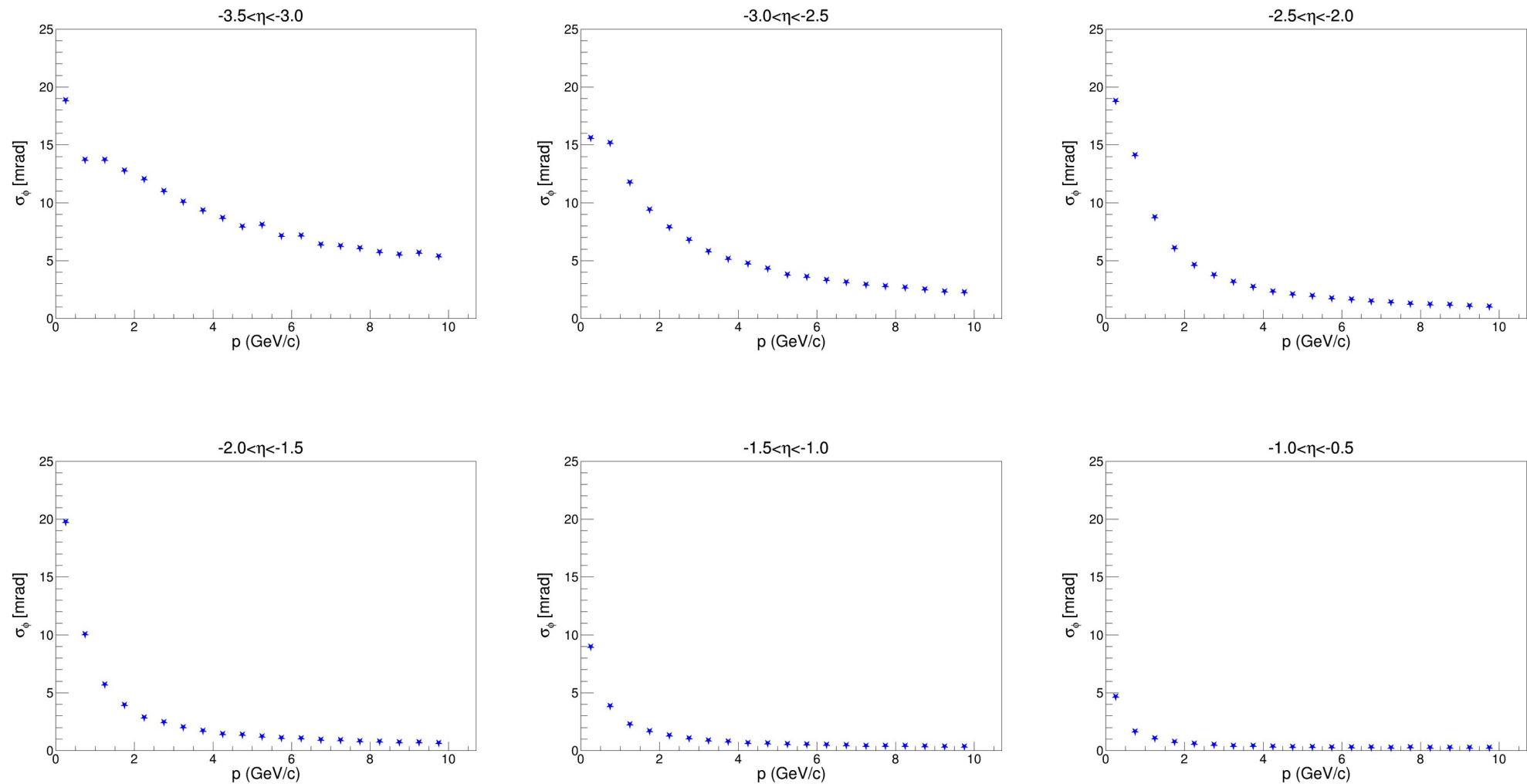
Theta Resolutions



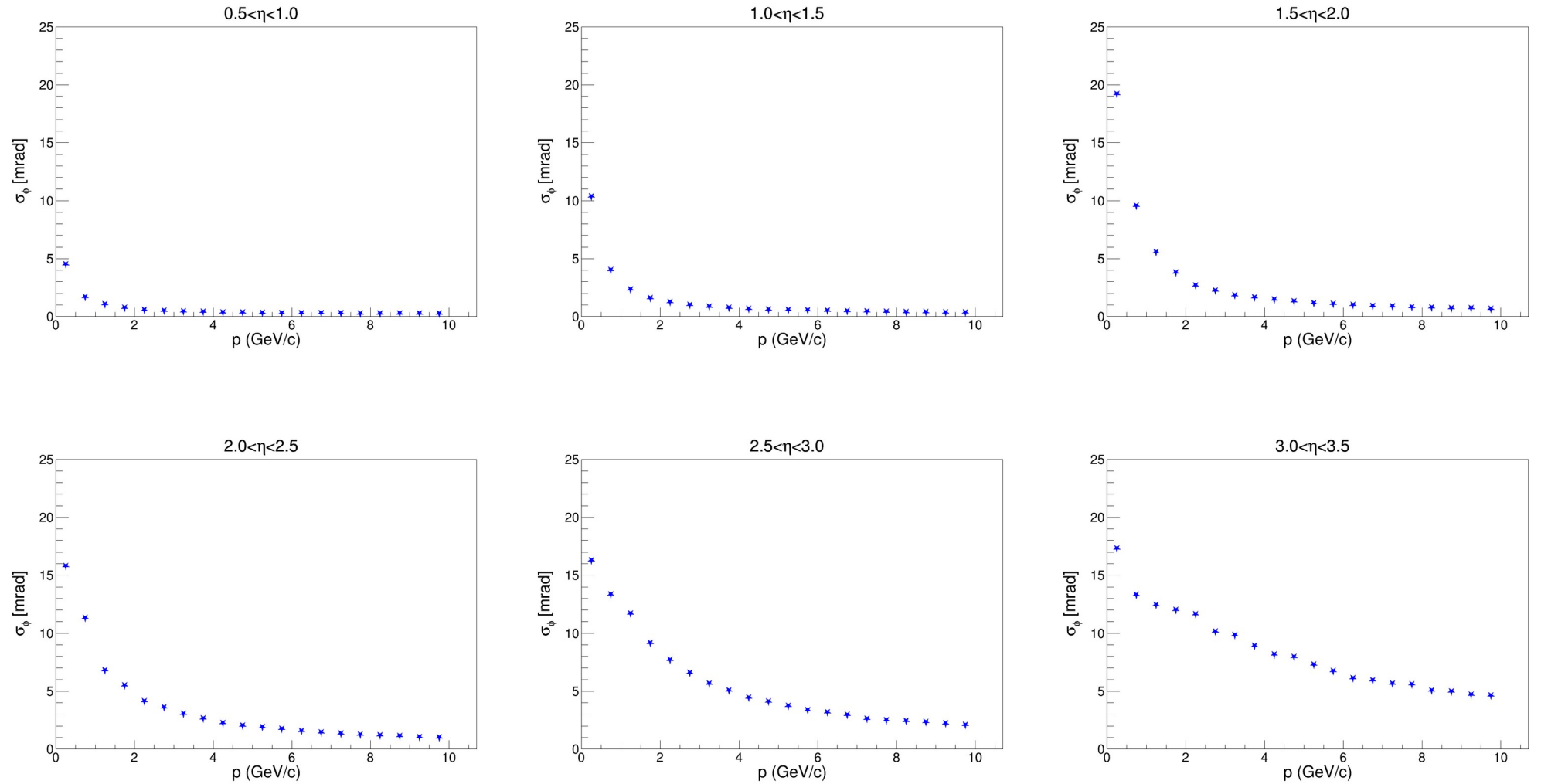
Theta Resolutions



Phi Resolutions



Phi Resolutions



Kalman Filter with Barrel Track Model

Detector EPIC: "Detector"						
Name	r [cm]	X0	phi	z	res [um]	layerEff
0. vertex	0.00	0.0000	-	-	-	-
1. bpipe	3.18	0.0036	-	-	-	-
2. VTX1	3.60	0.0005	6	6	0.95	
3. VTX2	4.80	0.0005	6	6	0.95	
4. VTX3	12.00	0.0005	6	6	0.95	
5. BARR1	27.00	0.0025	6	6	0.95	
6. BARR2	42.00	0.0055	6	6	0.95	
7. MM1	50.00	0.0050	150	150	0.95	
8. TOF	56.00	0.0100	30	3000	0.95	
9. MM2	67.00	0.0050	150	150	0.95	

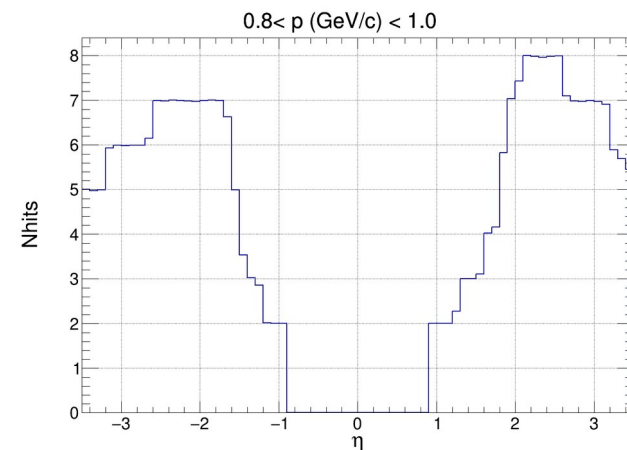
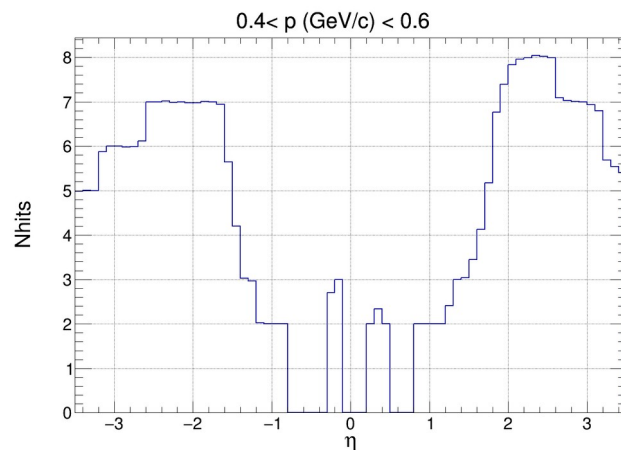
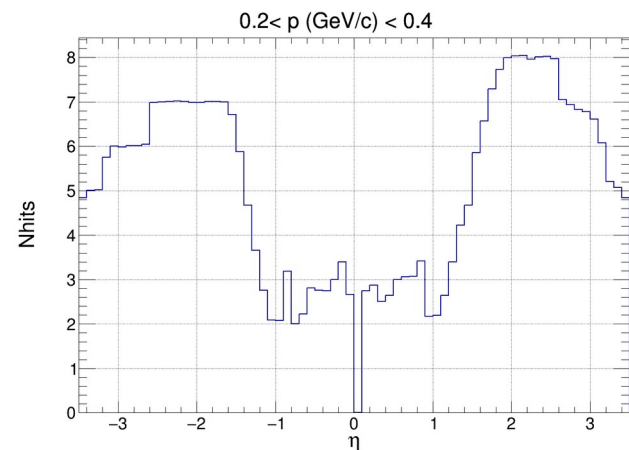
Summary

- First studies of hit points, material map, acceptance, number of hits, momentum, DCA_{xy} and theta/phi resolutions are presented
- Tracking performances are compared fast simulations in the barrel region.
- In the forward region, trying to estimate DCA_{xy} resolution using fast simulation code

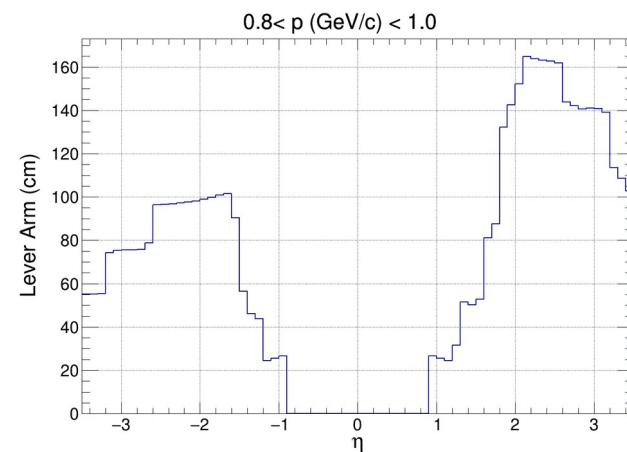
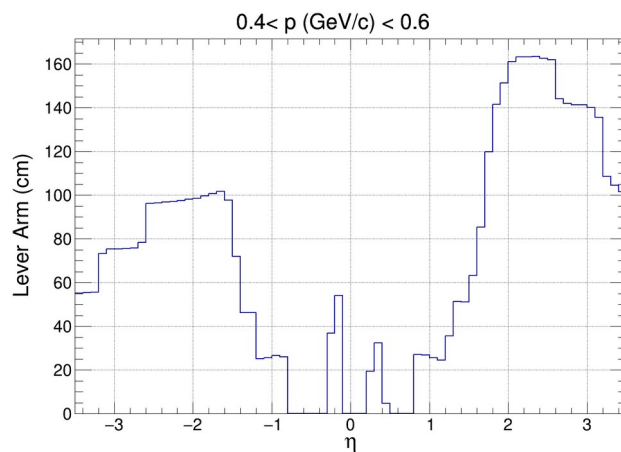
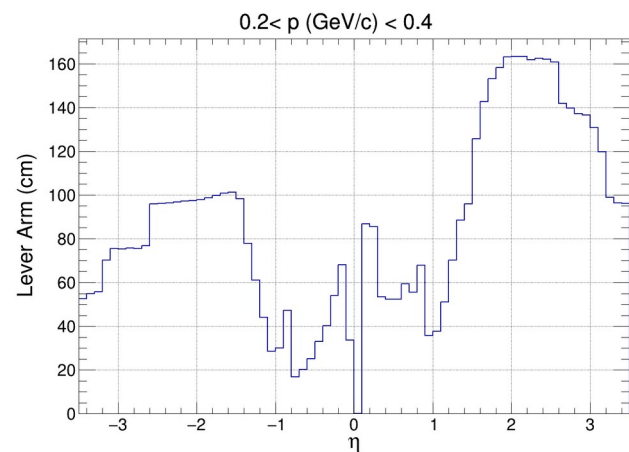
Thank You !!

Nhits vs η (EndCap Only)

Nhits [EndCap]



Lever Arm [distance between first and last hit]



Material Scan Numbers

For track theta = 90 deg (Barrel)

Volume Name:	VertexBarrelSubAssembly	Material Budget: 0.00130081
Volume Name:	MiddleSiTrackerSubAssembly	Material Budget: 0.0027159
Volume Name:	OuterSiTrackerSubAssembly	Material Budget: 0.00572107
Volume Name:	InnerMPGDBarrelSubAssembly	Material Budget: 0.00577311
Volume Name:	BarrelTOFSubAssembly	Material Budget: 0.0146295
Volume Name:	OuterBarrelMPGDSUBAssembly	Material Budget: 0.0153859
Volume Name:	InnerTrackerSupport_assembly	Material Budget: 0
Volume Name:	BeamPipe_assembly	Material Budget: 0.00364154

For track theta = 5 deg (Forward)

Volume Name:	EndcapMPGDSUBAssembly	Material Budget: 0.0212798
Volume Name:	EndcapTOFSubAssembly	Material Budget: 0.0279914