ePIC Crater Lake Tracking Performance

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Contents

- Comparison of Crater Lake Tracking
  - Materials
  - Performance
- Angular Resolutions at PID Surfaces:
  - pfRICH
  - DIRC
  - dRICH

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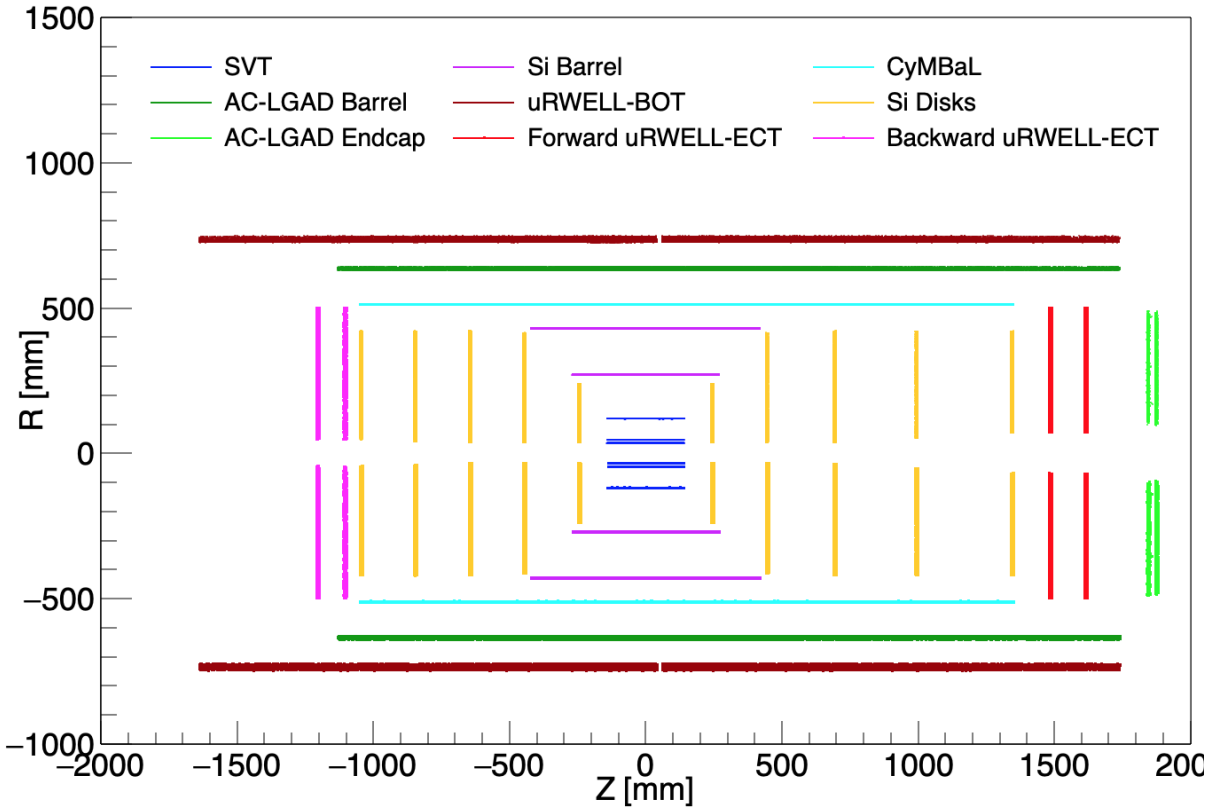
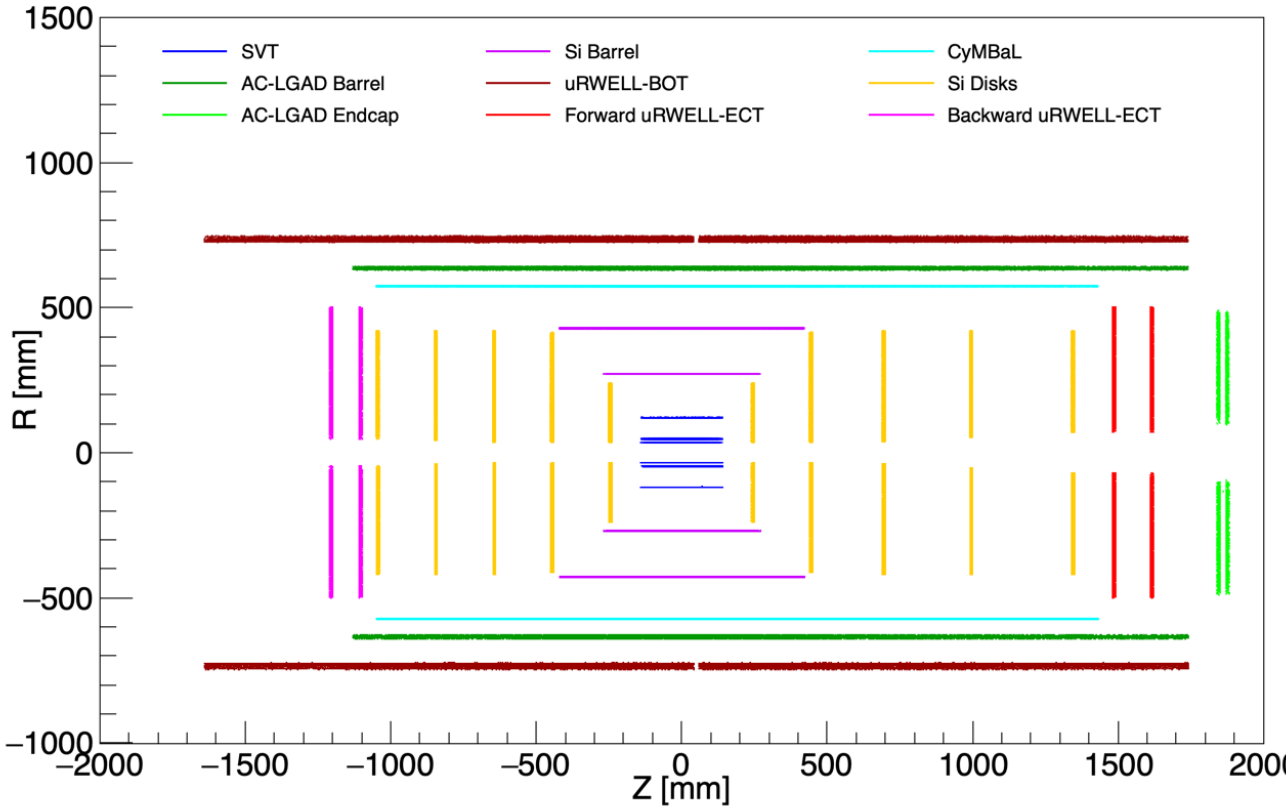
Detector Layout: R-Z

- CyMBaL detector moved to larger radial position (~50cm → ~55cm)

ePIC 24.02.1



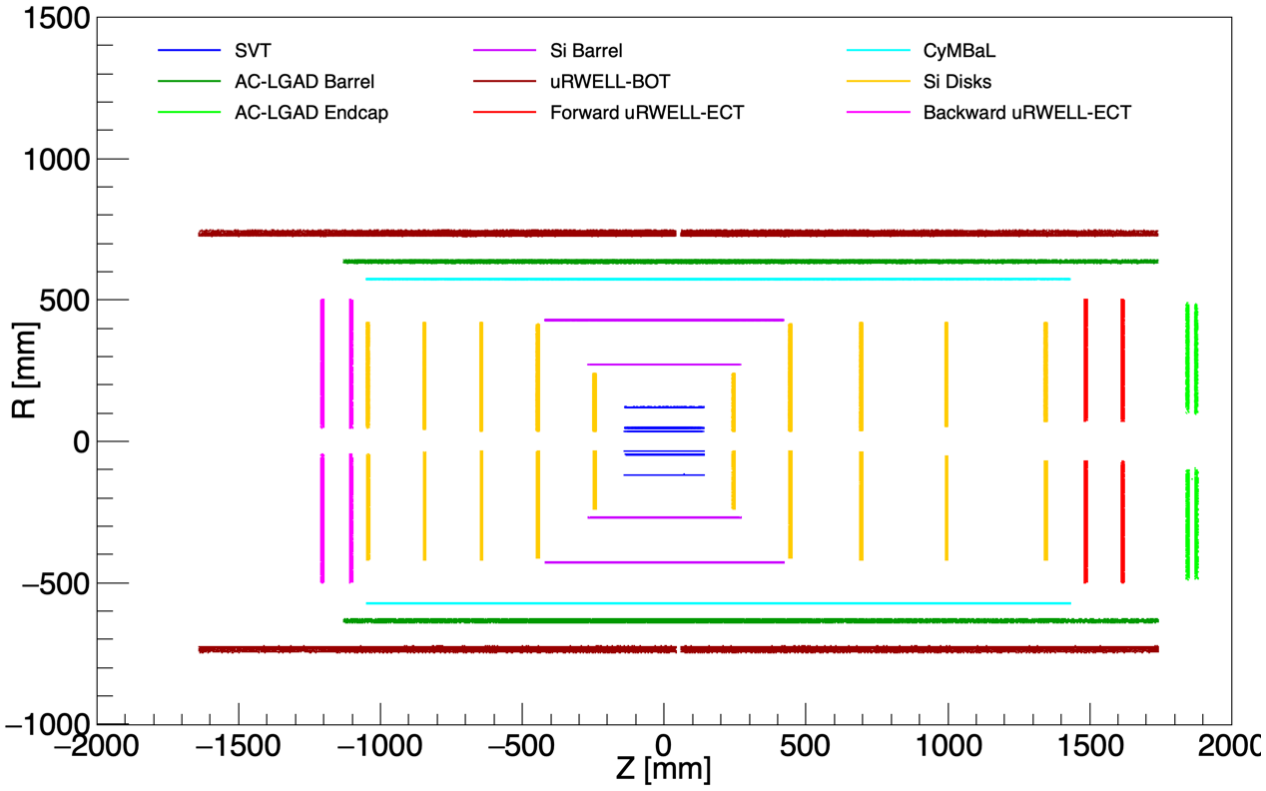
ePIC 24.04.0



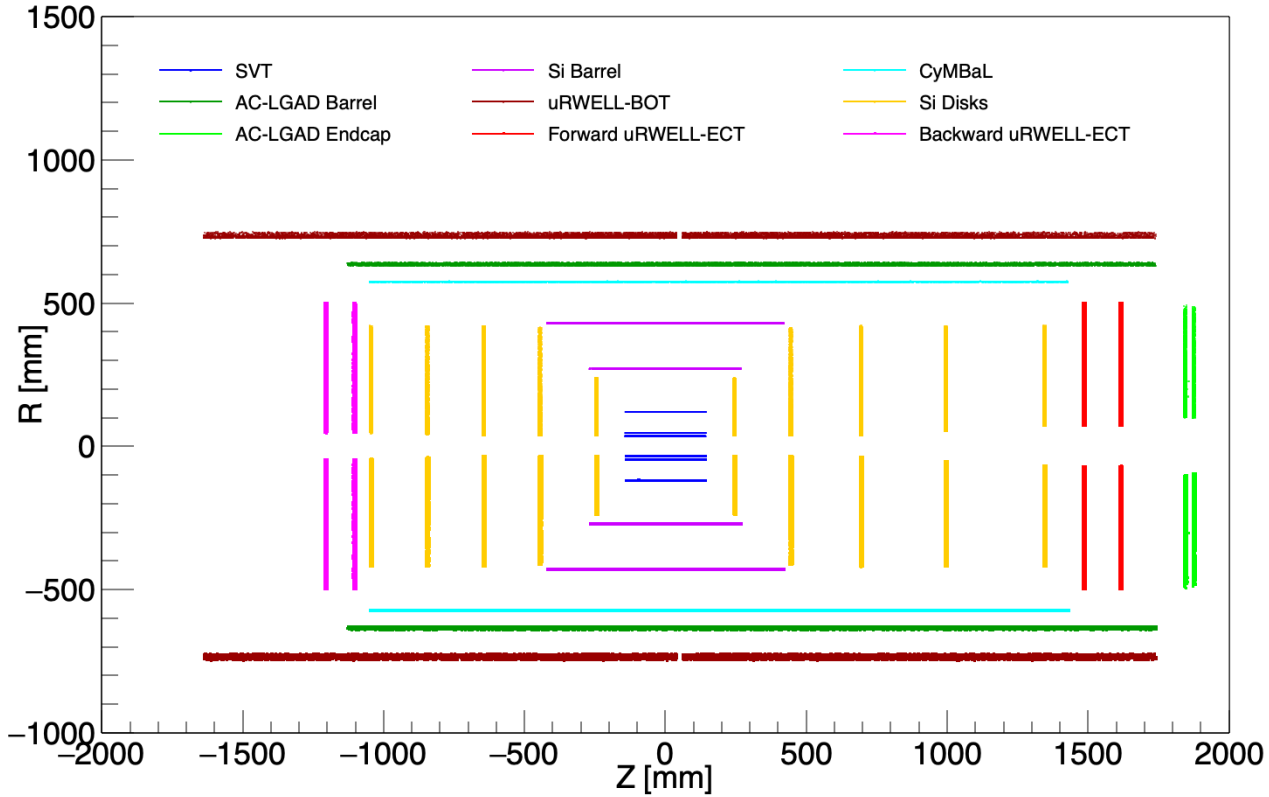
Detector Layout: R-Z

- No change in configurations

ePIC 24.04.0

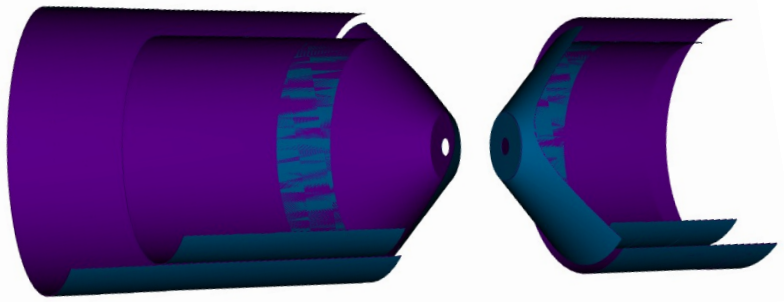


ePIC 24.05.0



Material Budget: Services and Supports

ePIC 24.02.1



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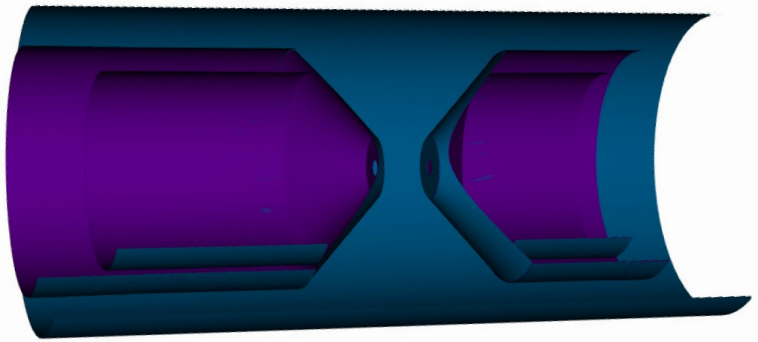

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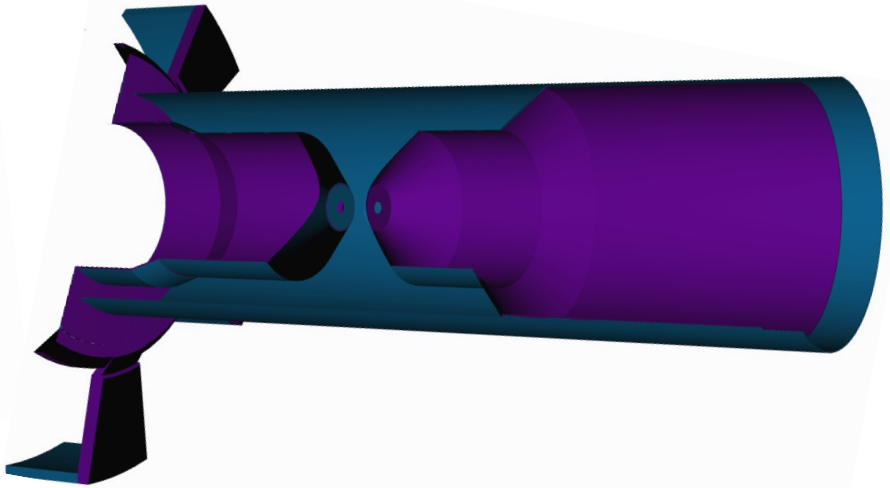
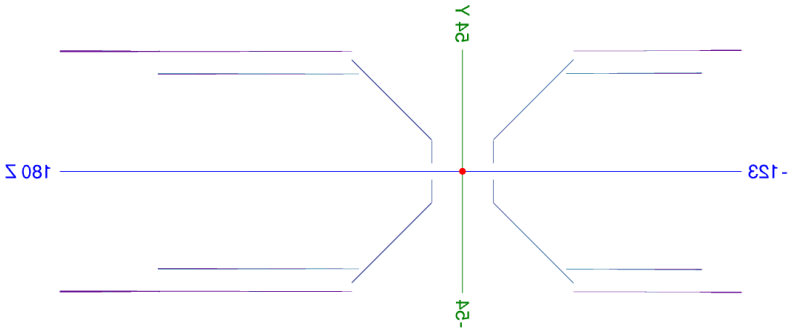
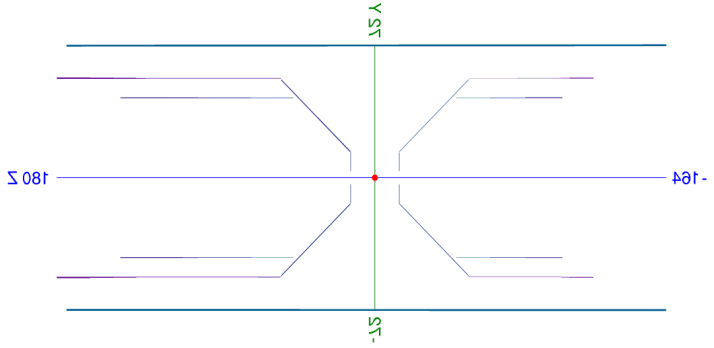
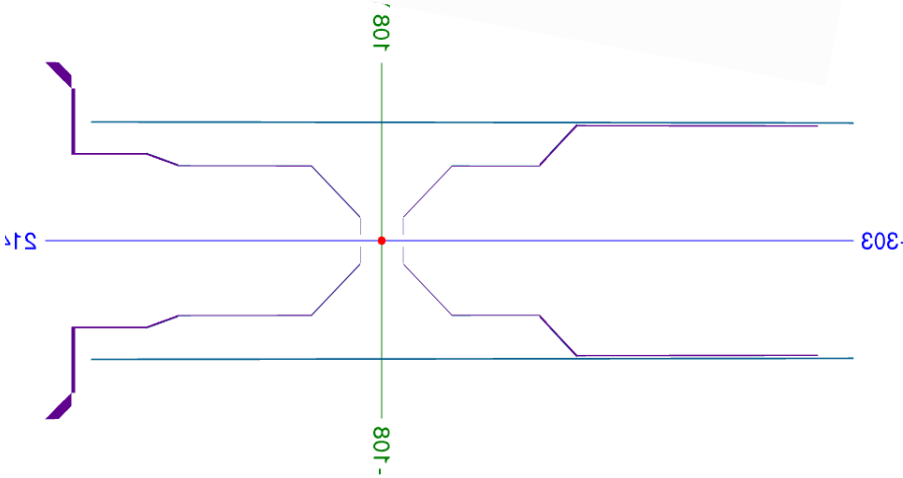


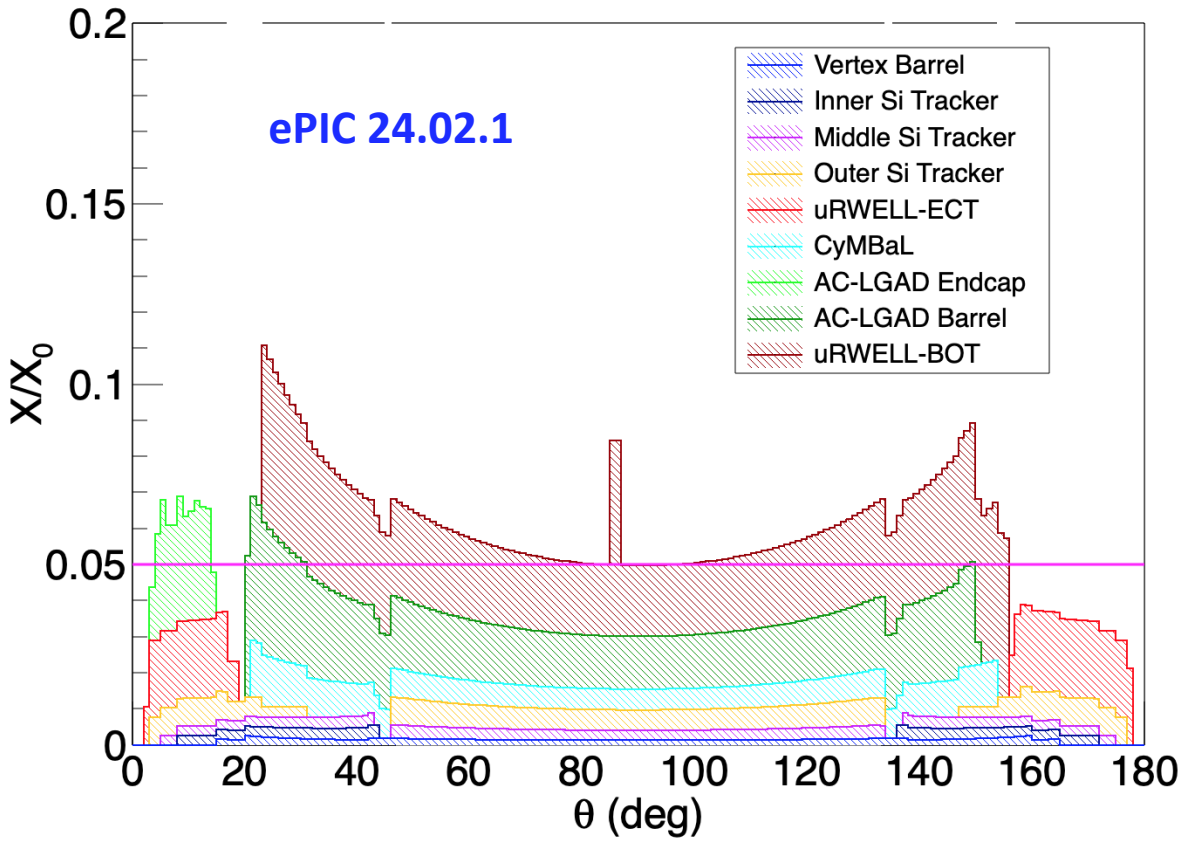


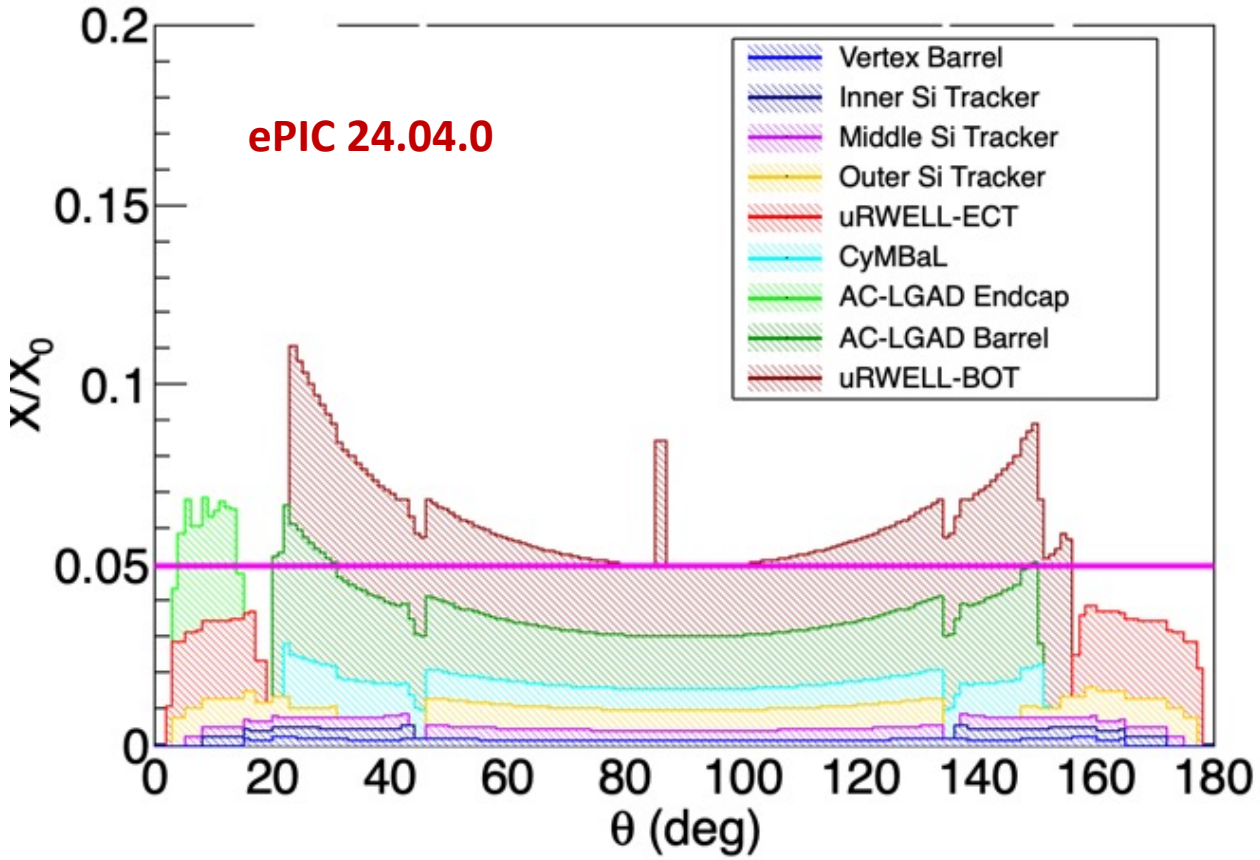




Material Budget: Detectors

- Detector materials are comparable





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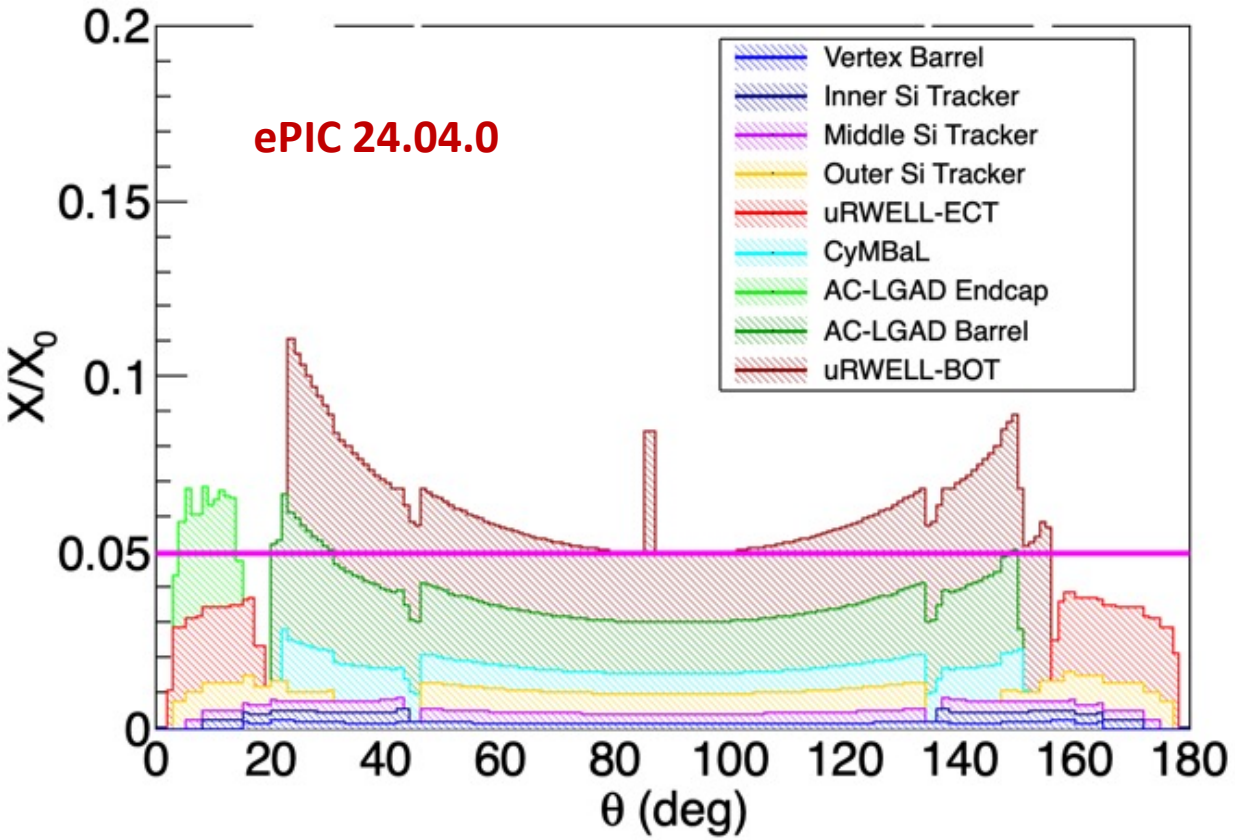
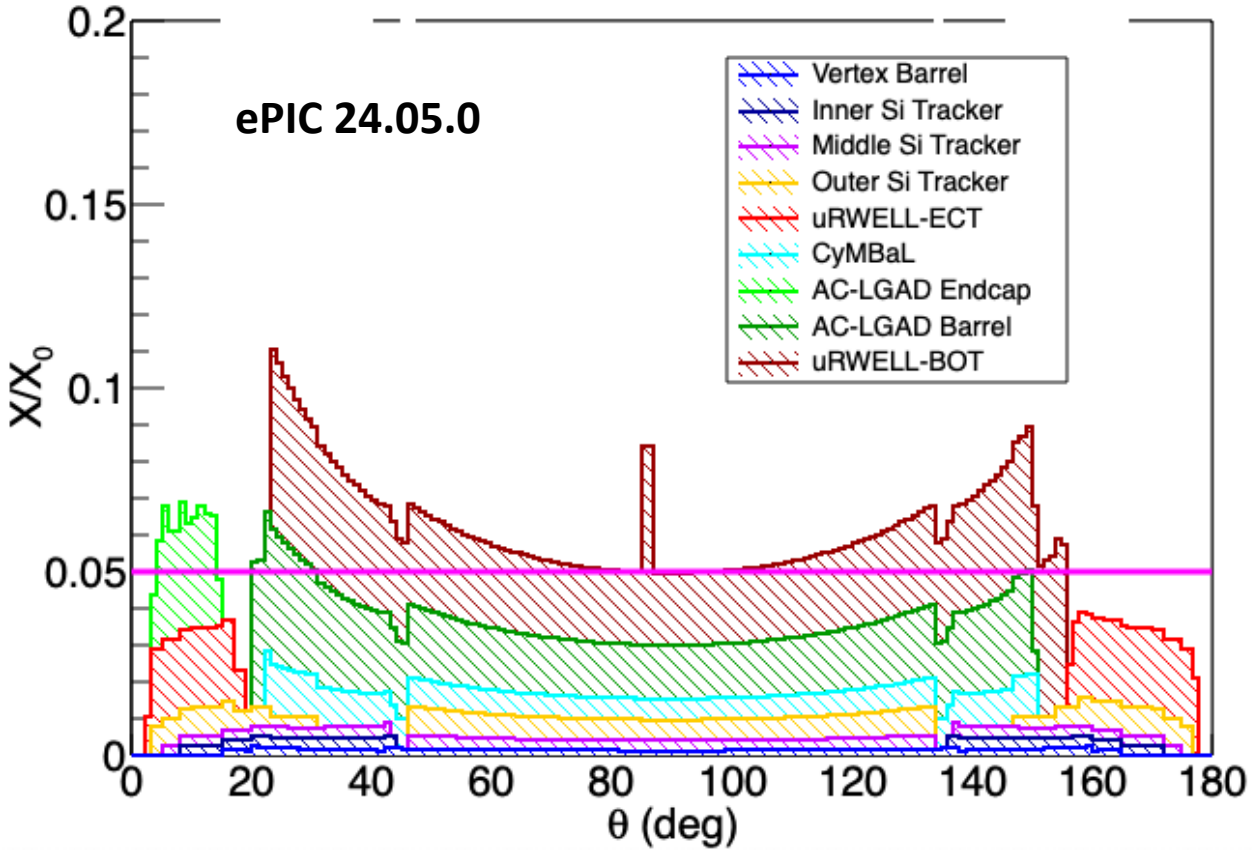
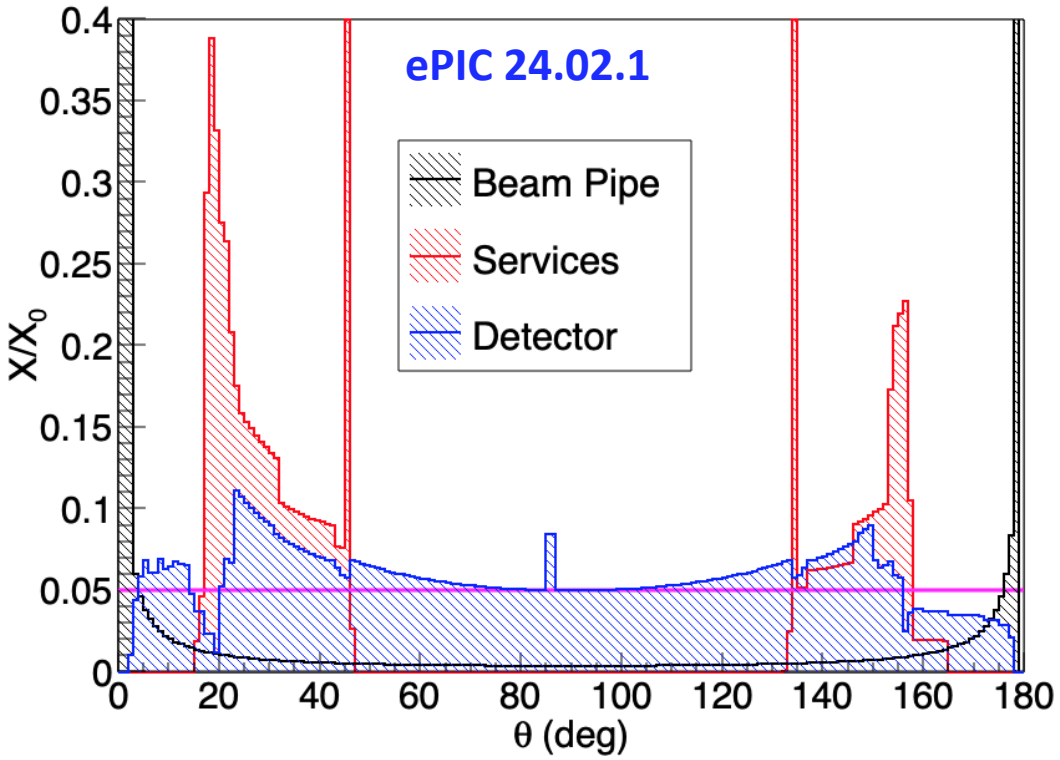
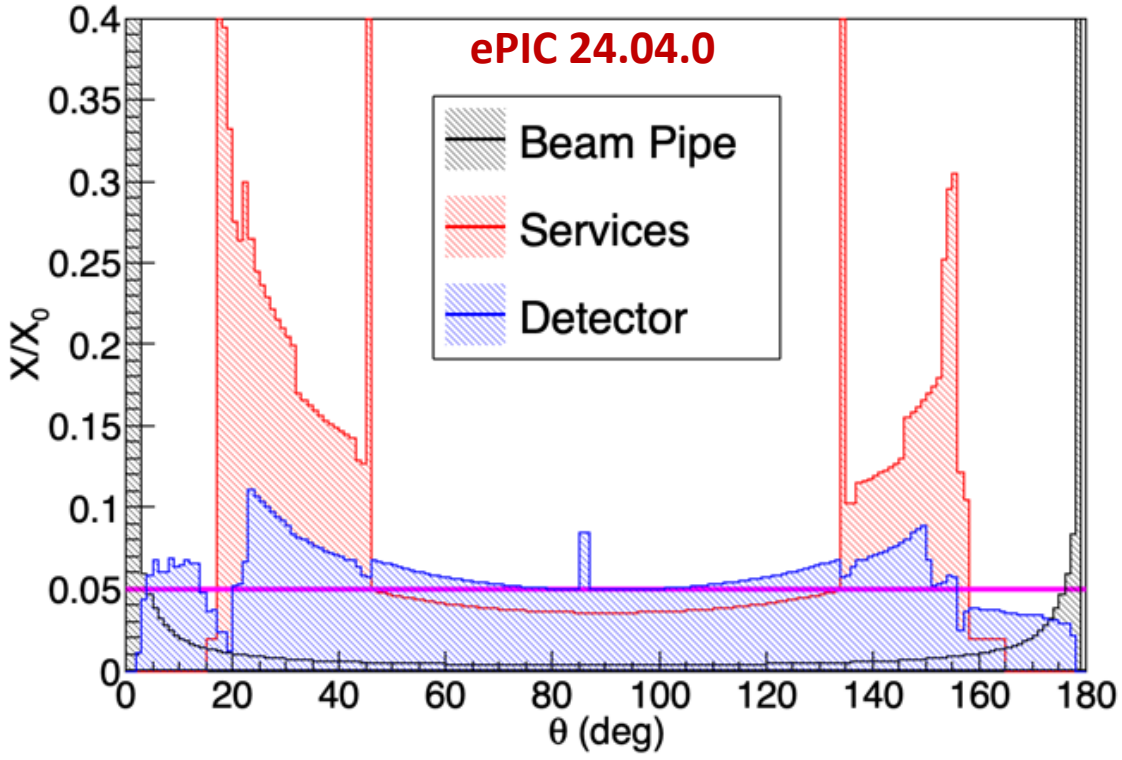




Material Budget: Detectors

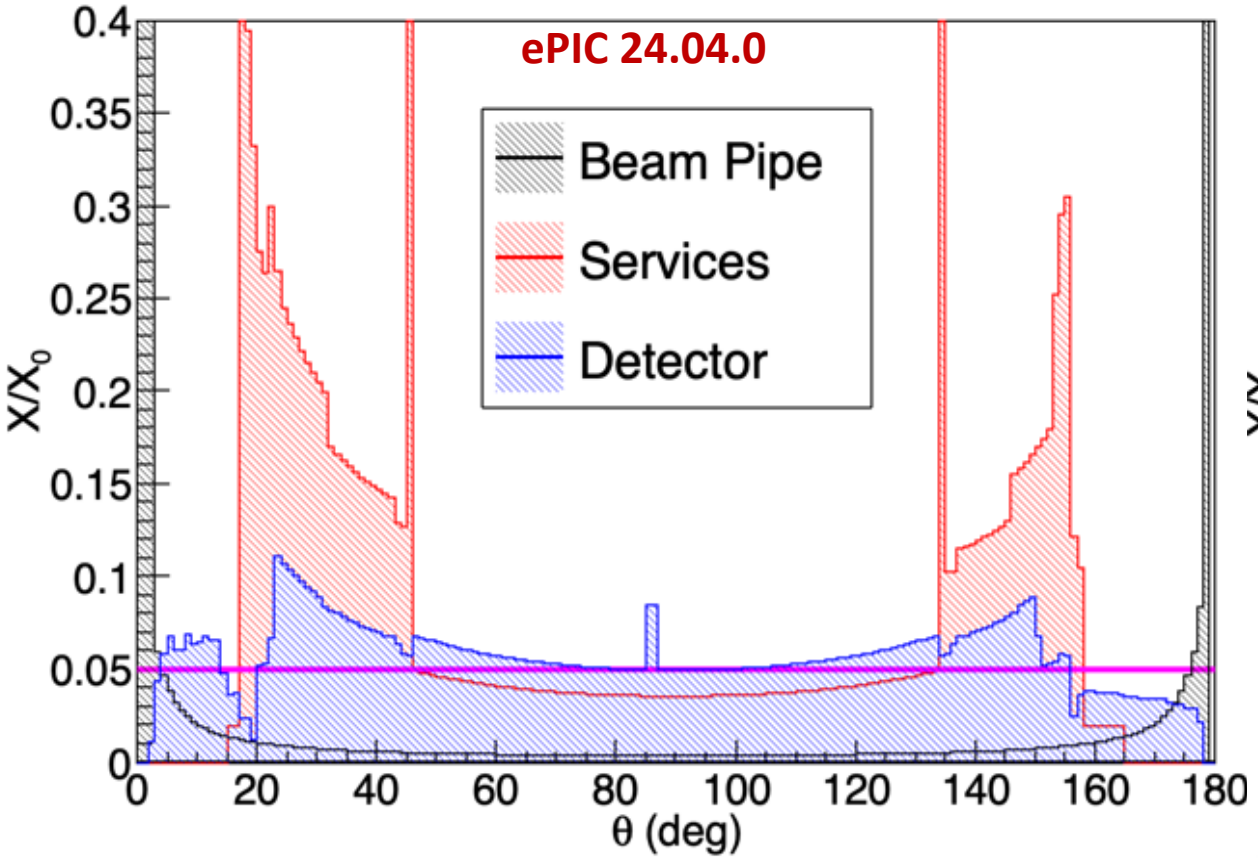
- Increase in service/support materials
  - Addition of support material in $55^o \leq \theta \leq 135^o$

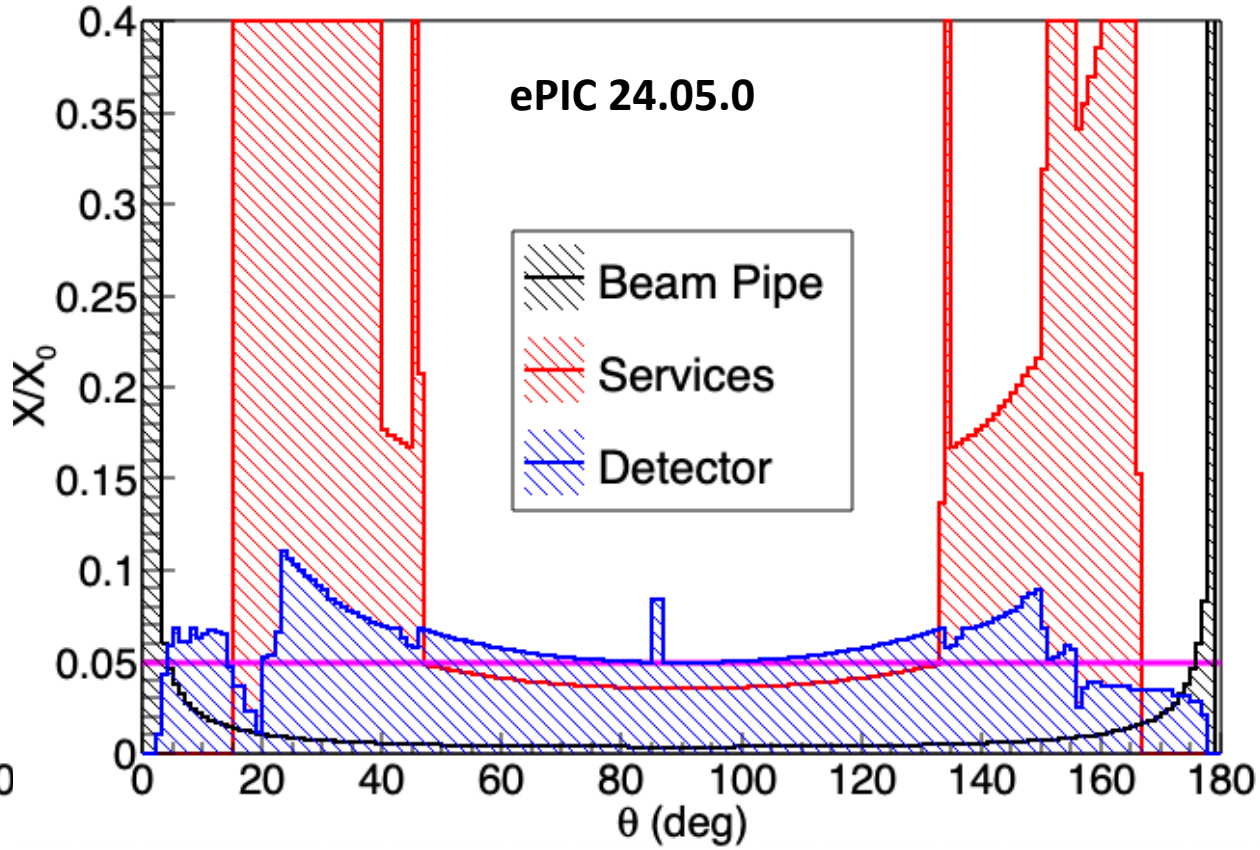




Material Budget: Detectors

- Increase in service/support materials





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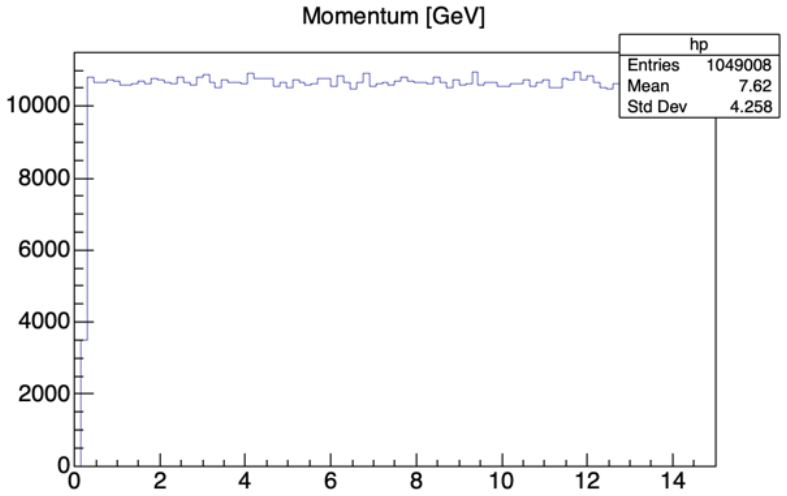
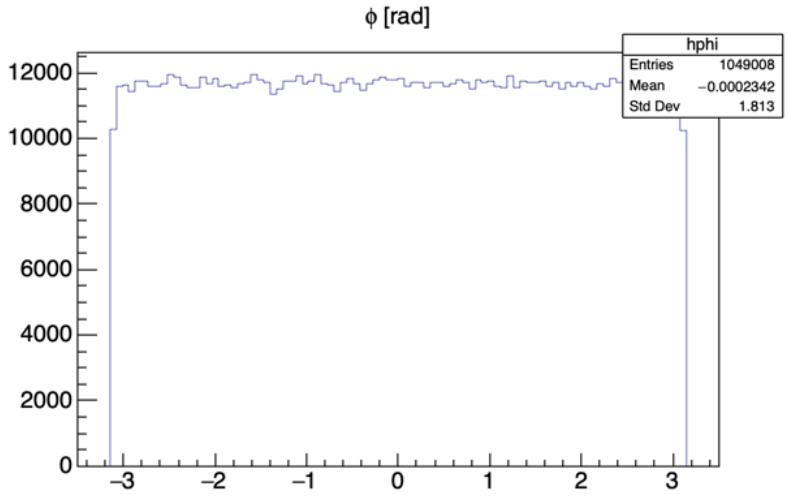
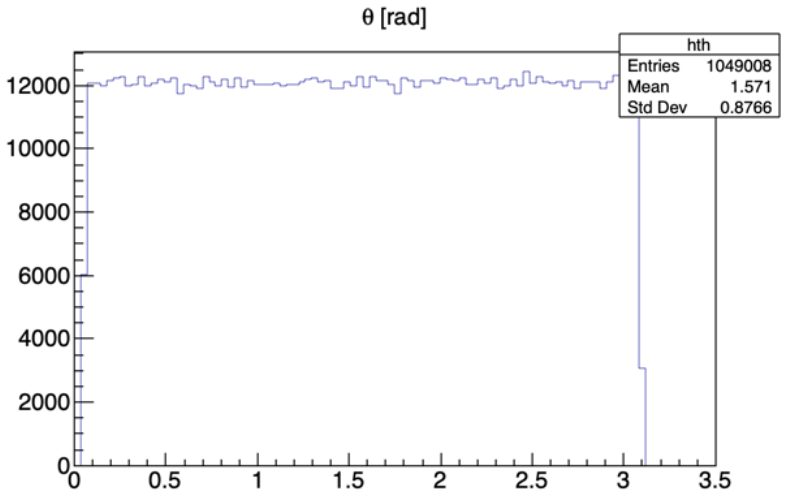
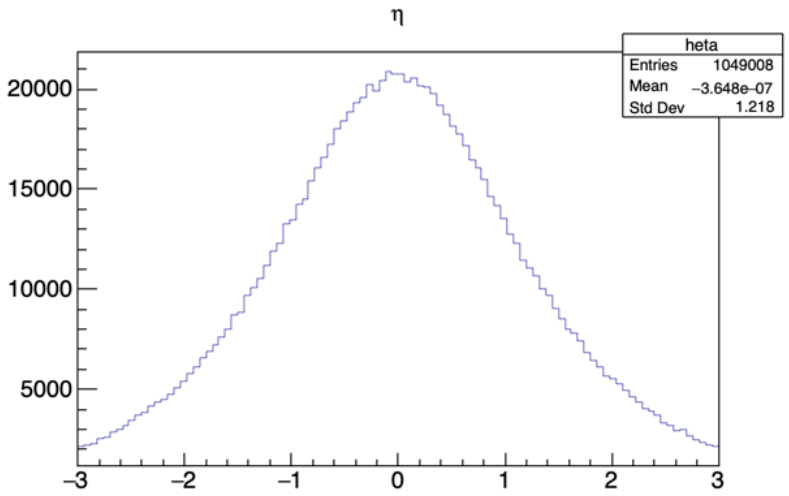
Simulation

- Single particle: π^-
- Uniform generation: $0.3\ GeV \leq p \leq 15\ GeV,\ 3^o \leq \theta \leq 177^o,\ 0^o \leq \phi \leq 360^o$









Particle Selection

- Selection Cuts:
  - *ReconstructedSeededChargedParticlesAssociations.recID==0 && MCParticles.generatorStatus==1*

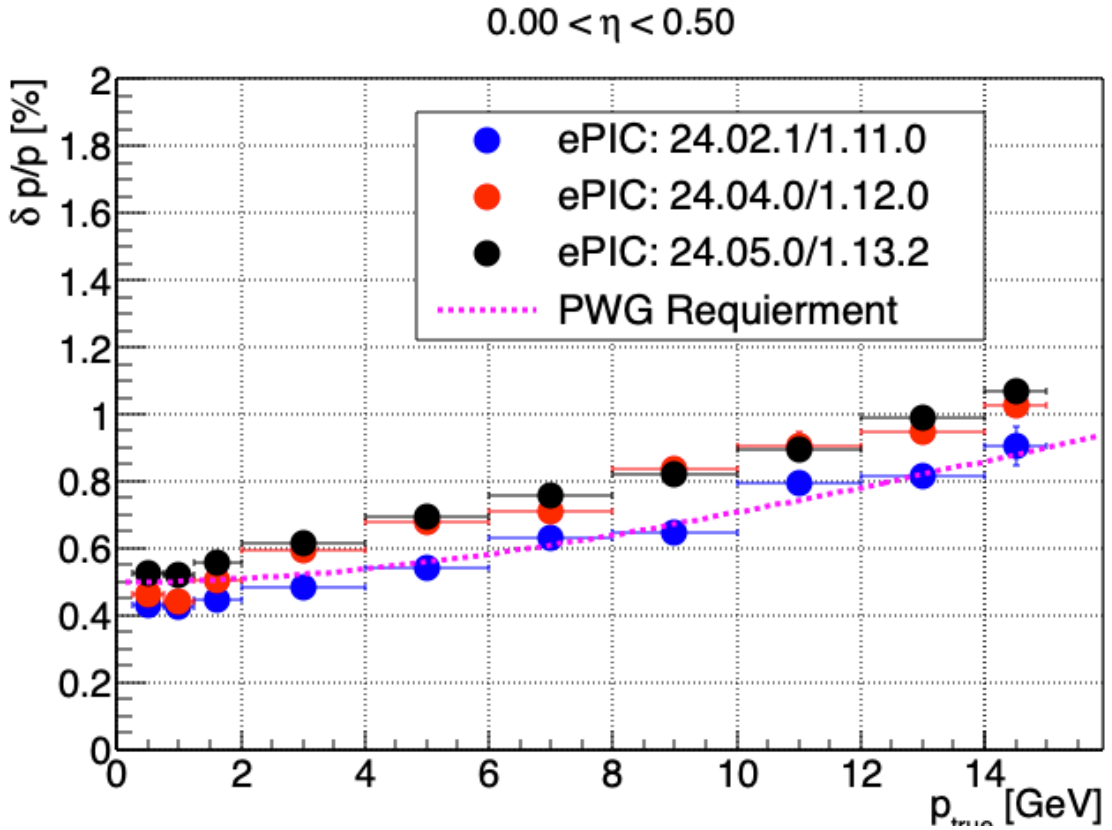
|ReconstructedSeededChargedParticles.momentum|

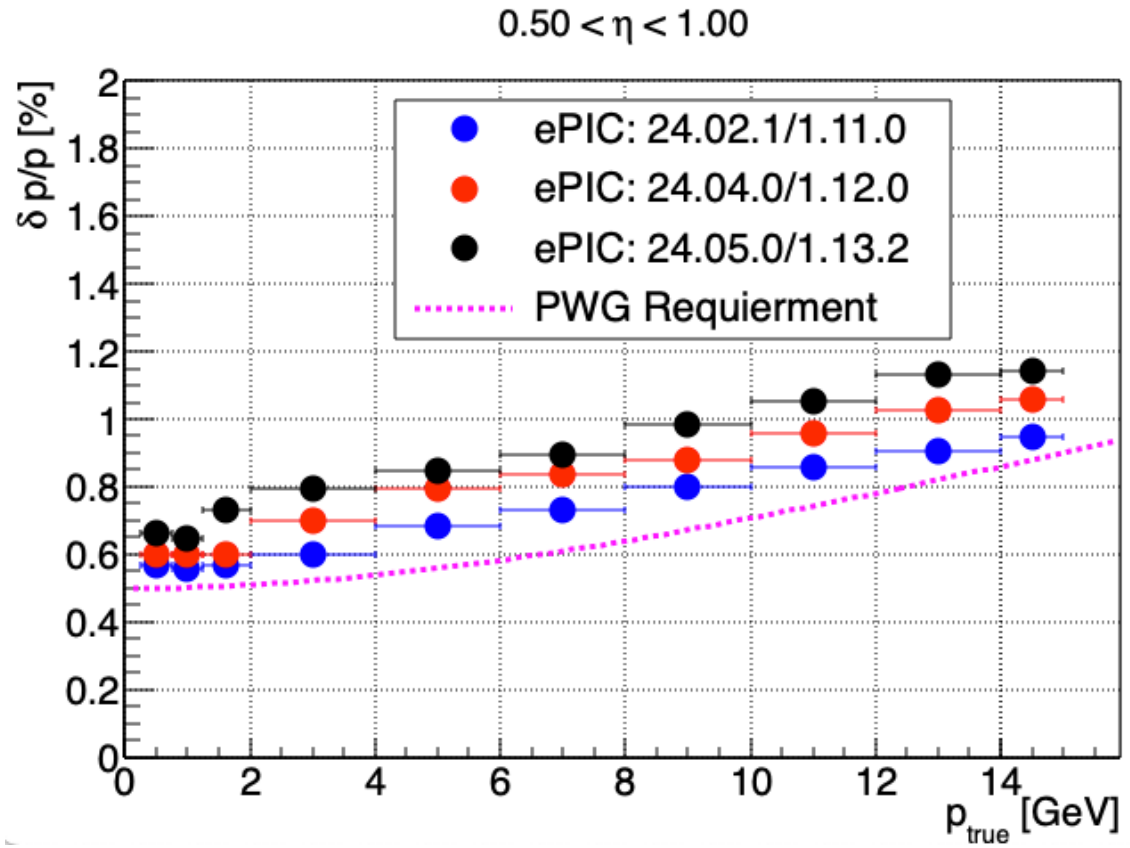
|ReconstructedChargedParticles.momentum|

Row	Instance	TMath::Sq	TMath::Sq	Reconstru	MCParticl	Reconstru
0	0	12.579718	12.579721	0	1	0
0	1	12.579710			0	
0	2	12.579964			0	
1	0	6.2294992	6.2294493	0	1	0
1	1	6.2295172				
2	0	13.941269	13.940542	0	1	0
2	1	13.941186				
2	2	13.939545				
3	0	3.3968344	3.3974978	0	1	0
3	1	3.3966162				
3	2	3.3964141				
4	0	5.0092931	5.0092349	0	1	0
4	1	5.0092674				
4	2	5.0091334				
5	0	8.0891855	8.0891234	0	1	0
5	1	8.0891989			0	
5	2	8.0894145				

Momentum Resolution: $|\eta| < 1.0$

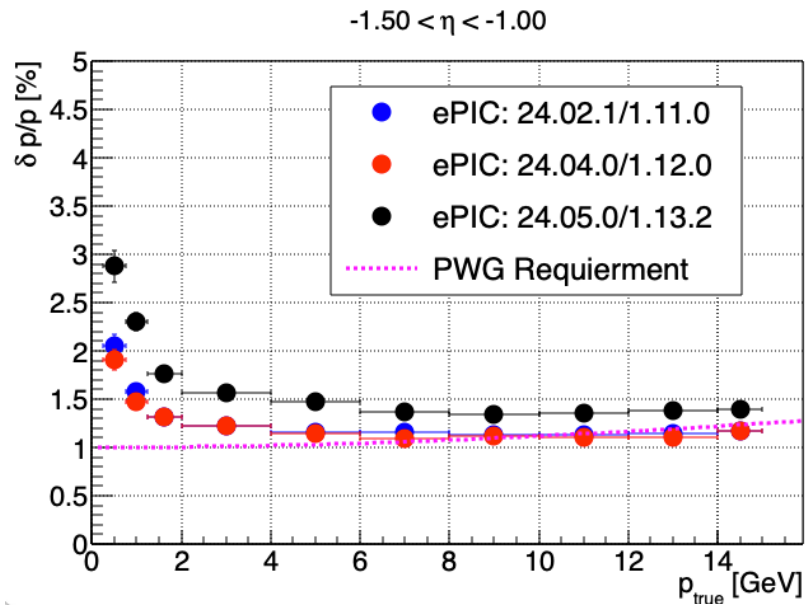
- Single particle: π^-
- Overall increase in momentum resolution

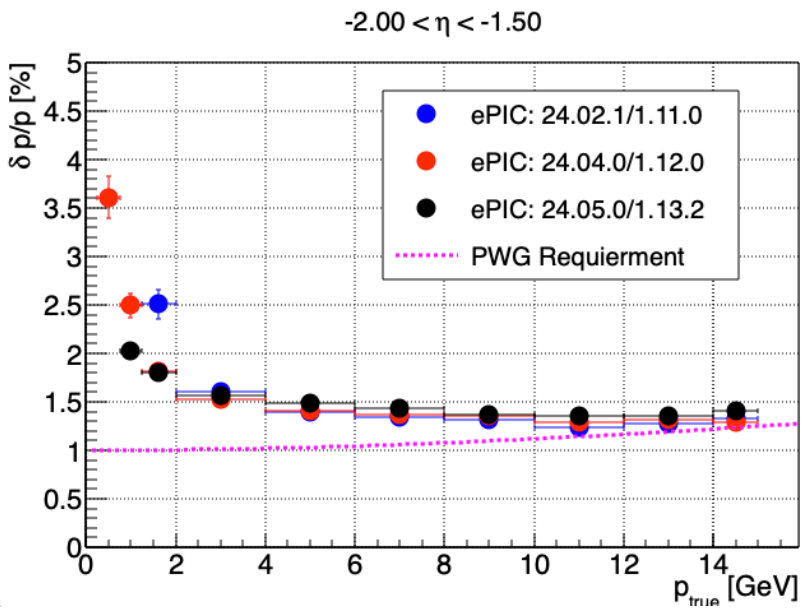


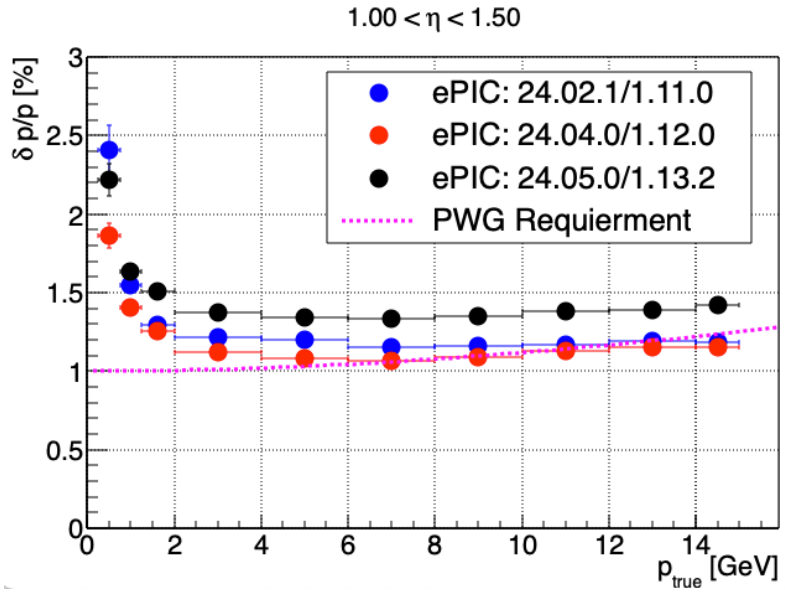


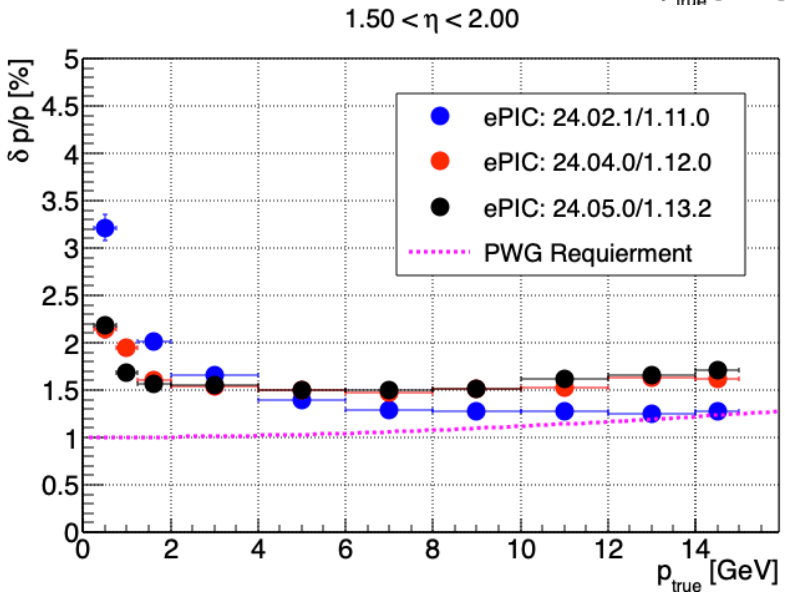
Momentum Resolution: $1.0 < |\eta| < 2.5$

- Single particle: π^-



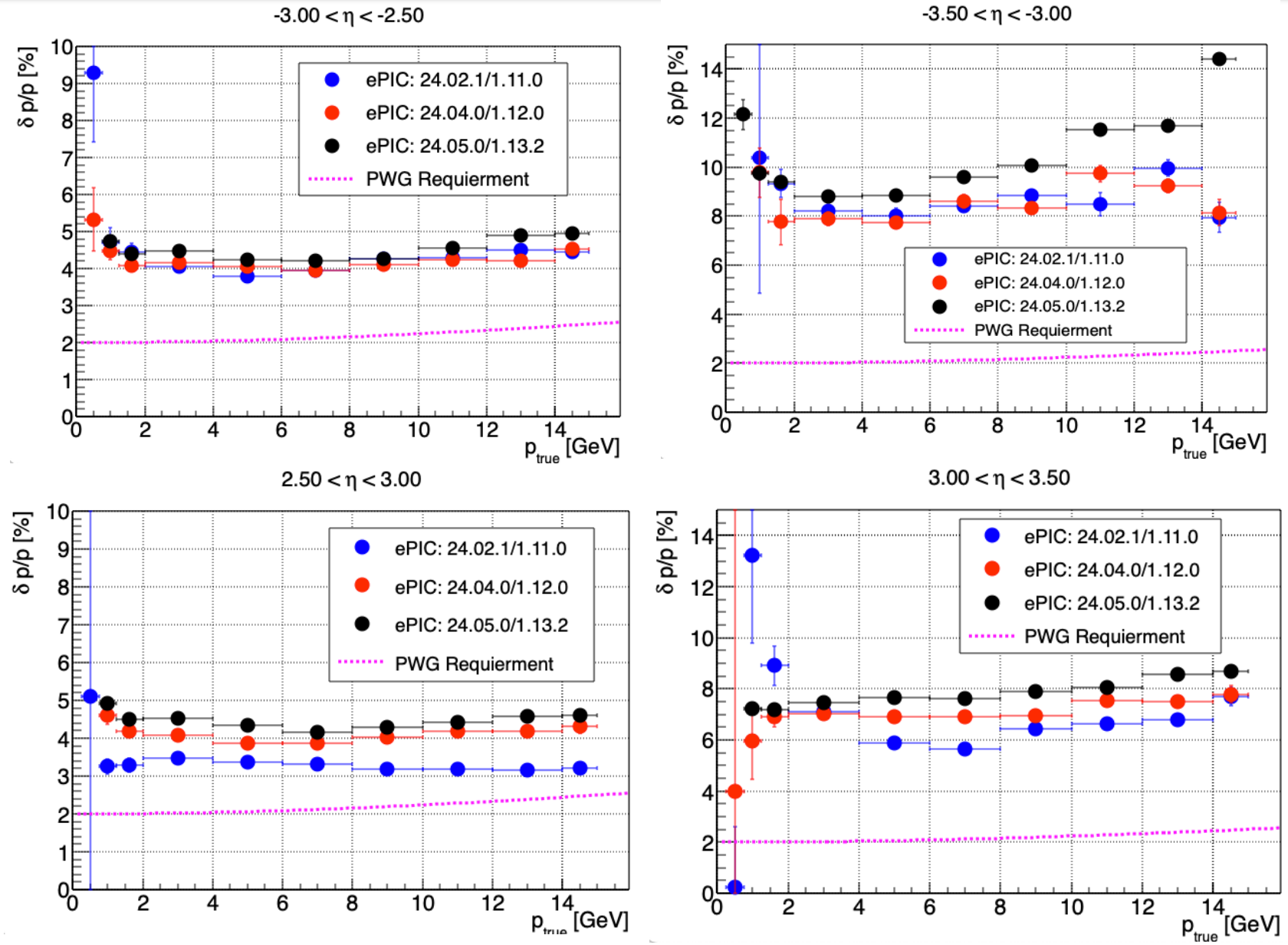






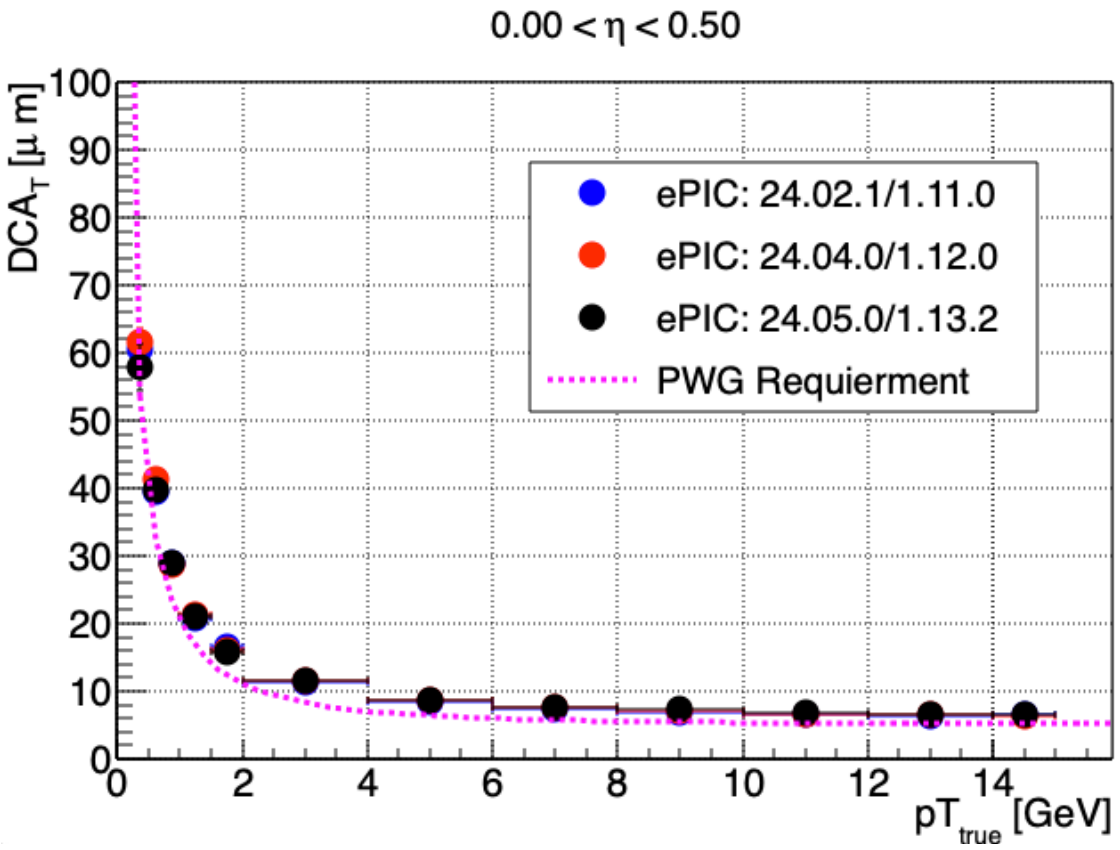
Momentum Resolution: $|\eta| > 2.5$

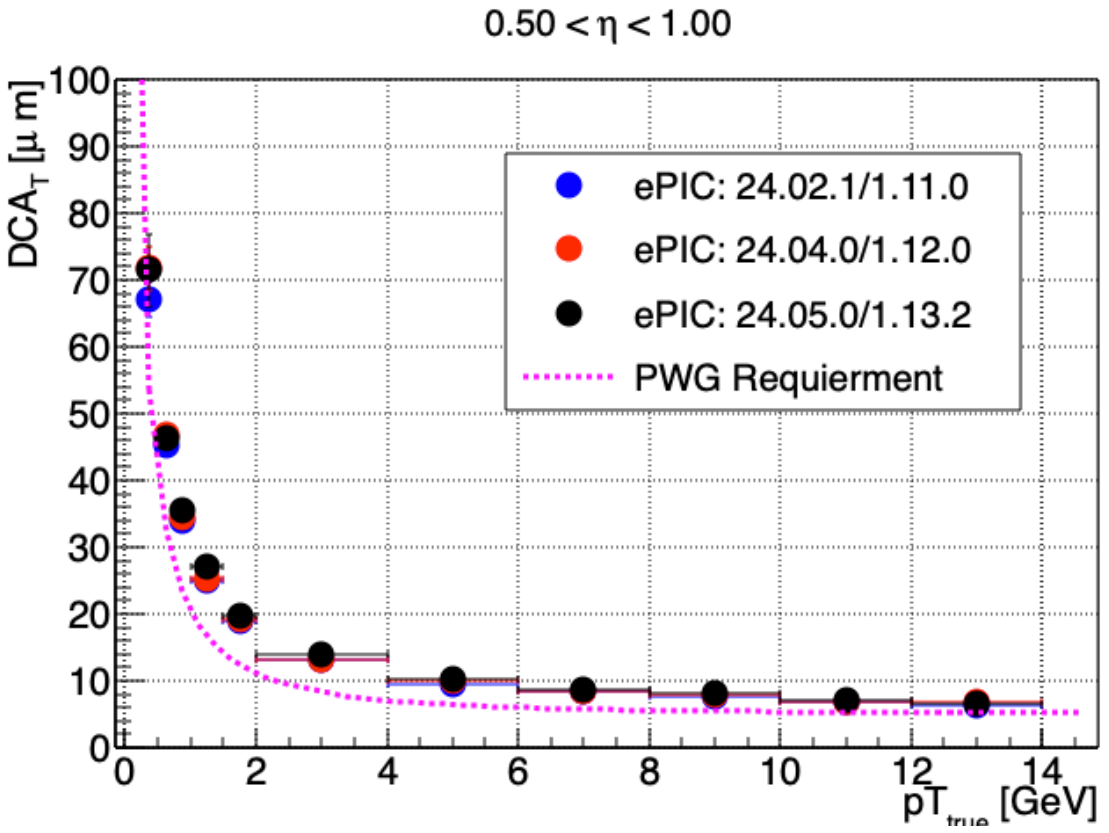
- Single particle: π^-



Transverse DCA Resolution: $|\eta| < 1.0$

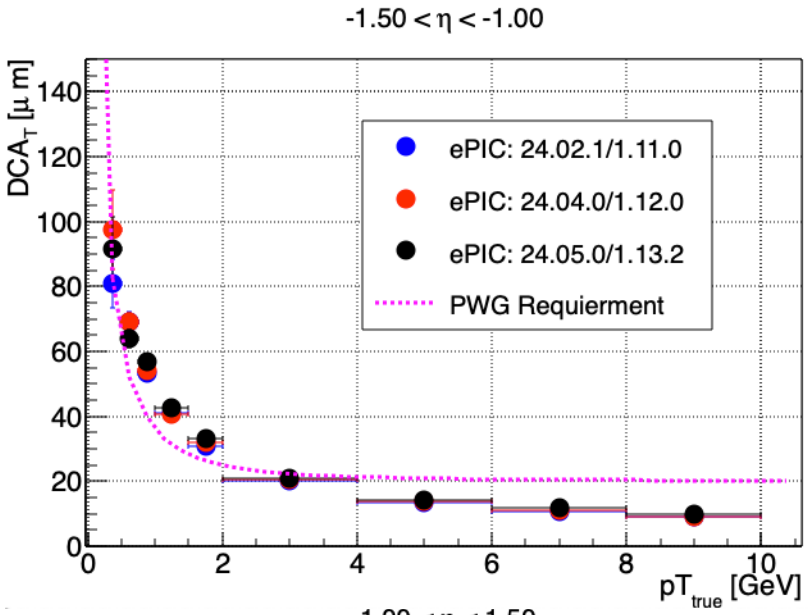
- Single particle: π^-
- DCA resolutions are comparable

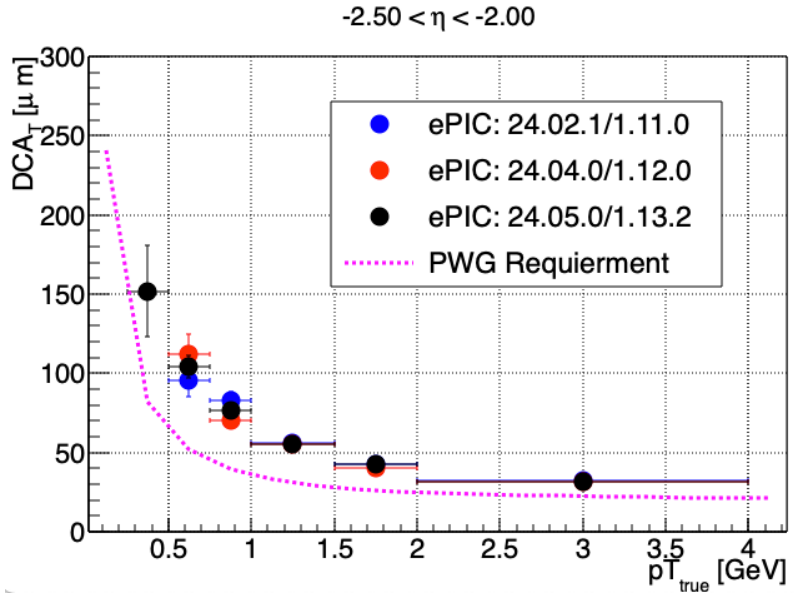


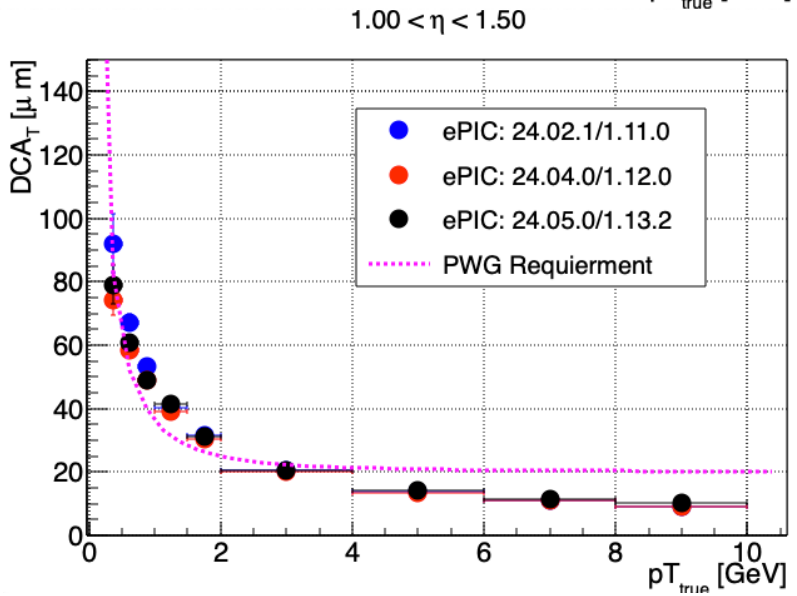


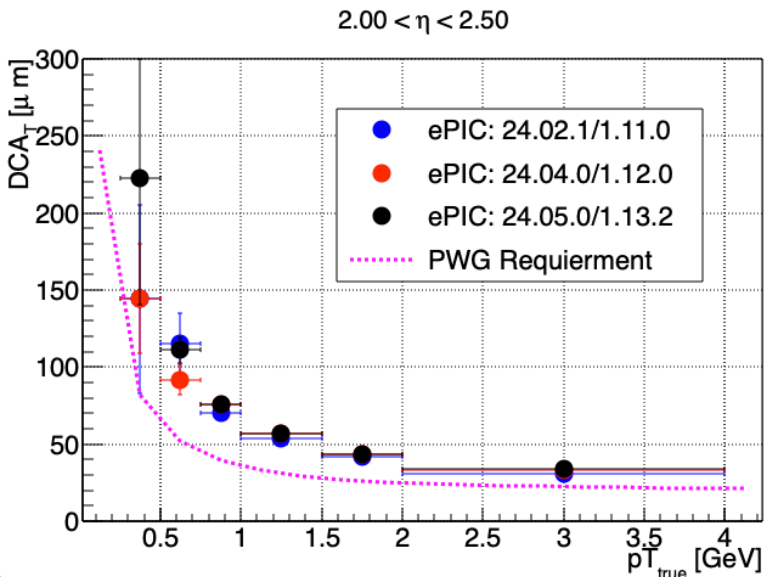
Transverse DCA Resolution: $|\eta| > 1.0$

- Single particle: π^-









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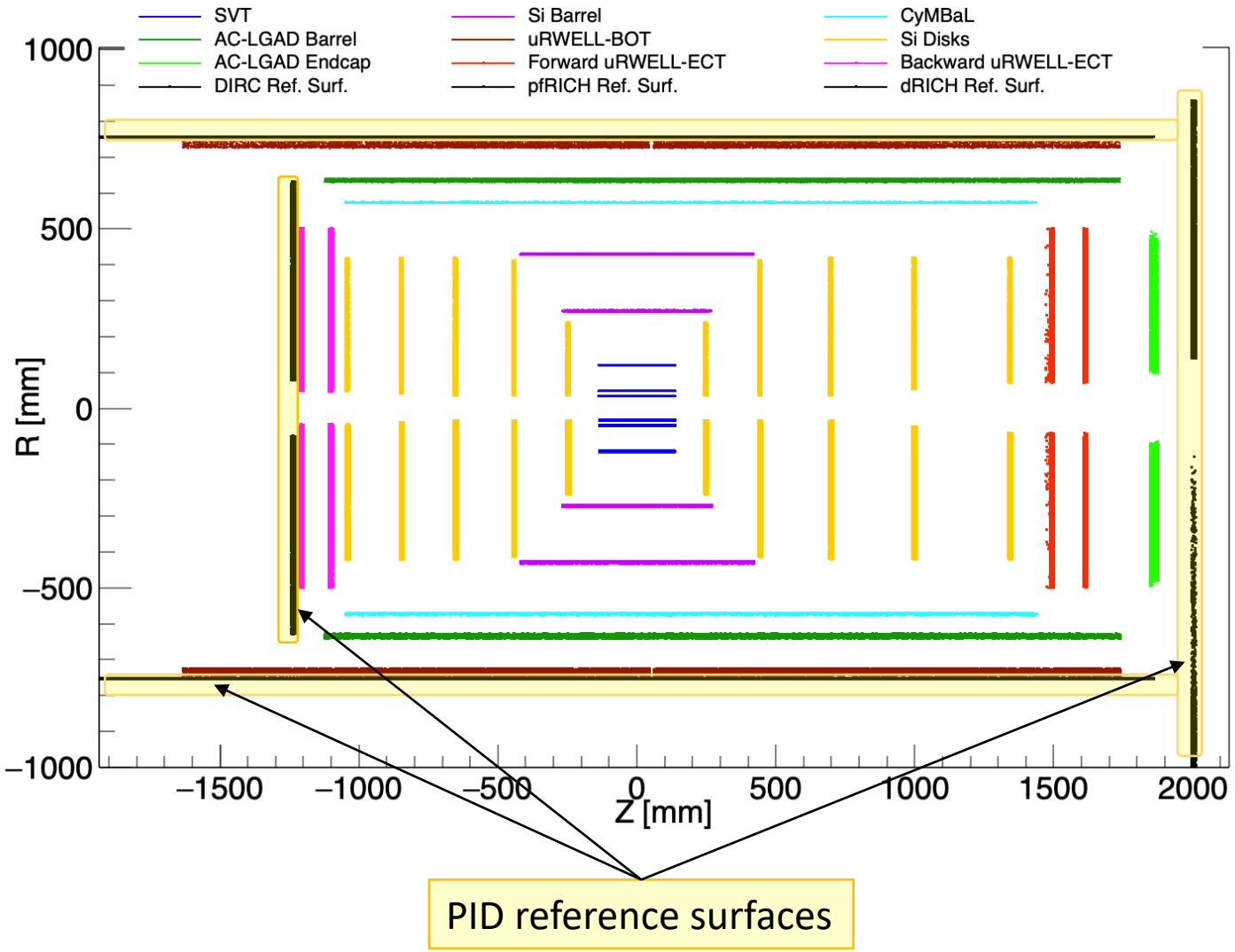
PID Reference Surfaces

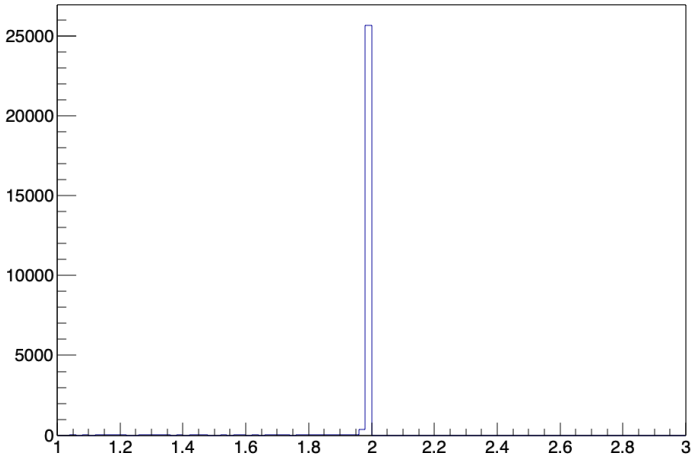
- DD4hep Reference Surface:
  - Used to register truth hit
  - Low mass X/X0 ~0.01%
  - Outside tracking volume
- Reference Surface Locations
  - pfRICH Z = -123.5 cm
  - DIRC R = 75.5 cm
  - dRICH Z = 200 cm
- Angular resolutions assessed via difference between track propagated to PID location and closest hit on dd4hep reference surface



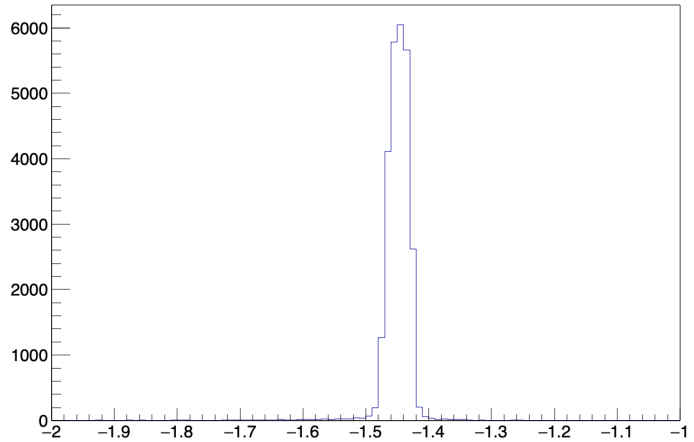
Simulation

- ePIC 24.04.0, EICrecon v1.12.0/v1.13.1
- Single particle: π^-
- $0^o \leq \phi \leq 360^o$
- 2^o θ-bins
- Discrete momentum values

pfRICH Example: $p = 2GeV, 152^o \leq \theta \leq 154^o$



$p\ [GeV]$



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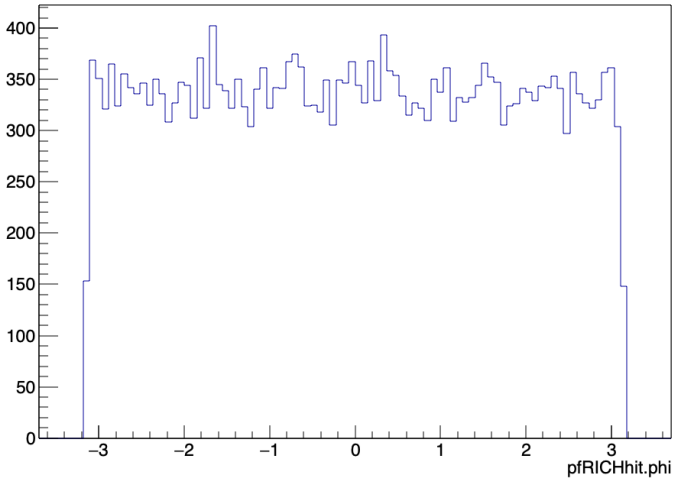
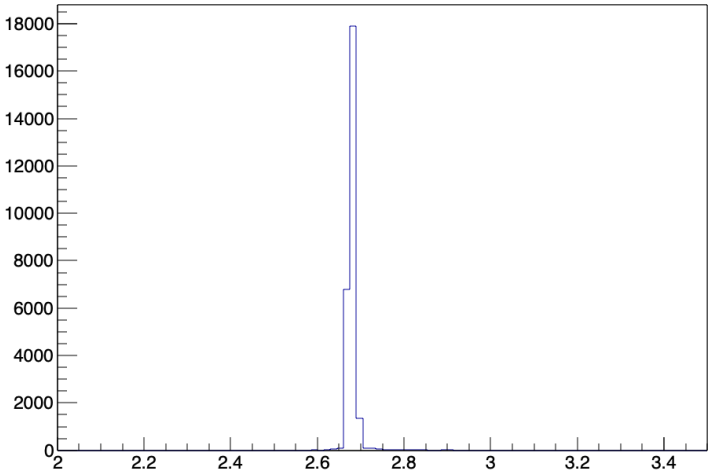


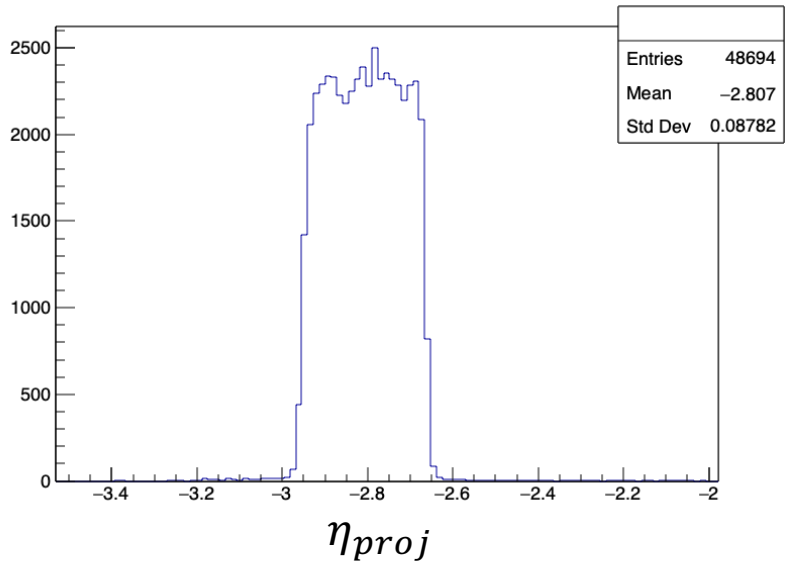
$\phi\ [rad]$

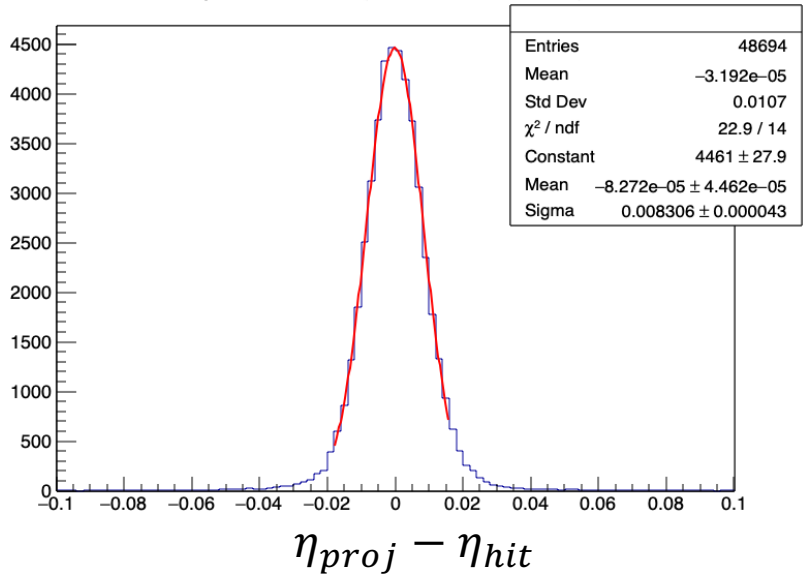


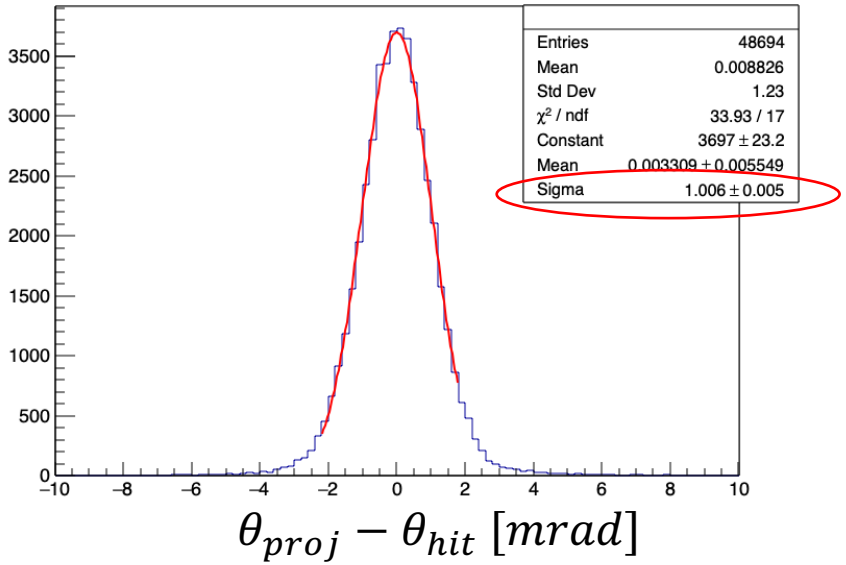
$\theta\ [rad]$

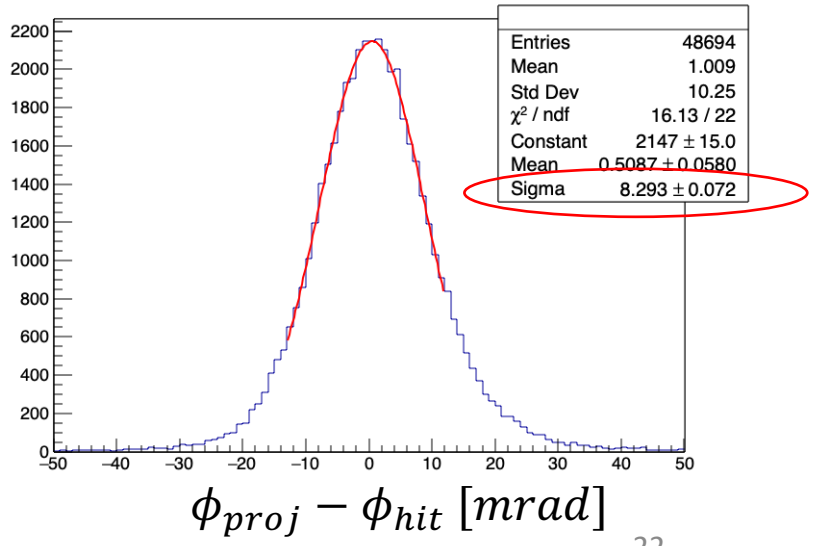
Extracting Angular Resolutions: pfRICH

- Representative pfRICH example
  - $p = 2\ GeV$
  - $172^o < \theta < 174^o$
  - $\Delta\eta \sim 0.01$
  - $\Delta\theta \sim 1.0$ mrad
  - $\Delta\phi \sim 8.3$ mrad









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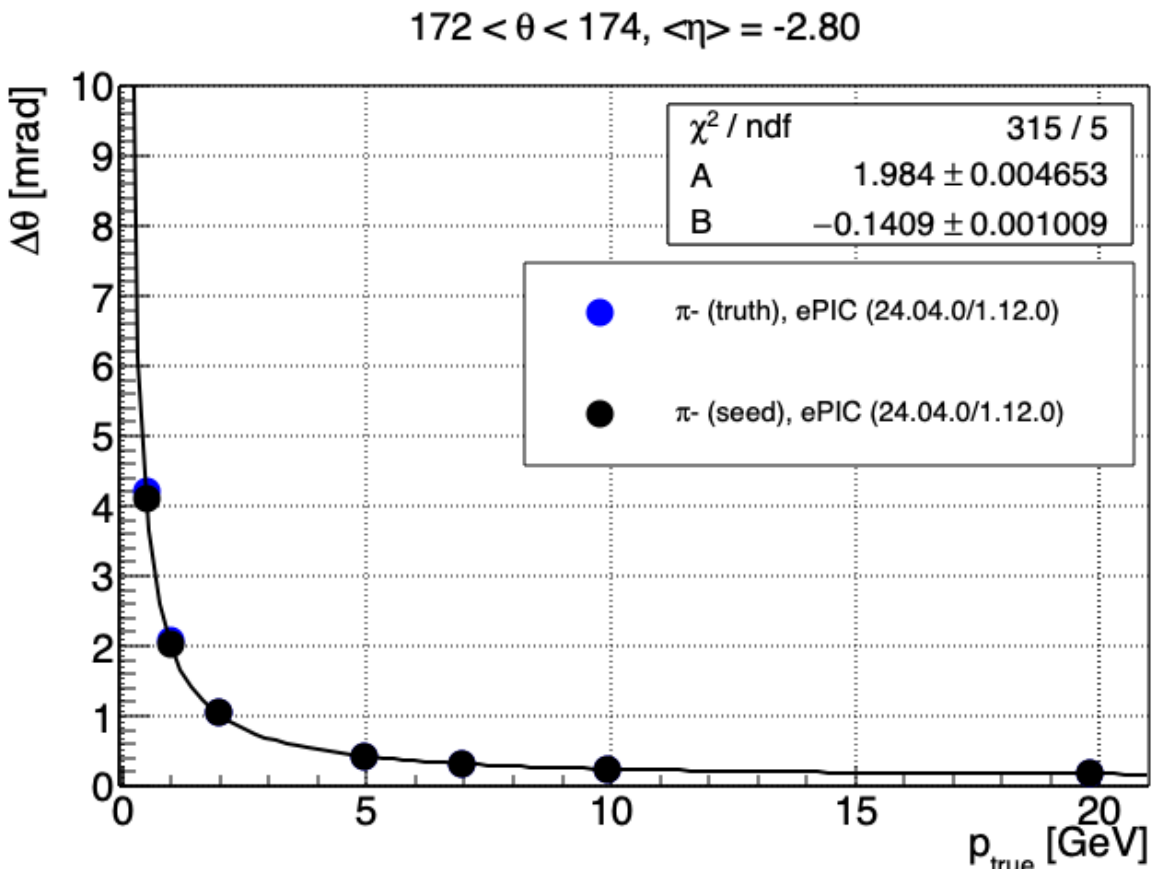
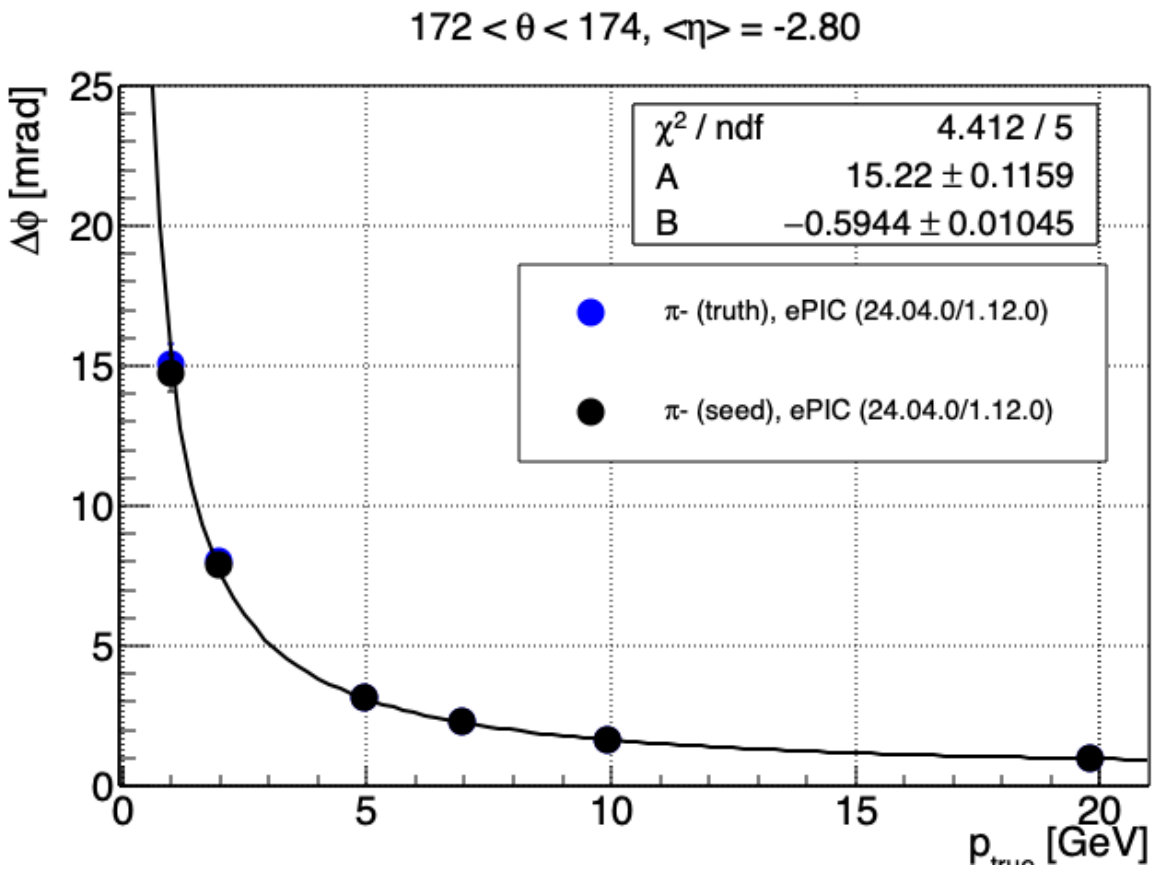
Angular Resolutions @ pfRICH

- Azimuthal resolution worst than polar angle resolution
- Good agreement between truth and realistic seeded results

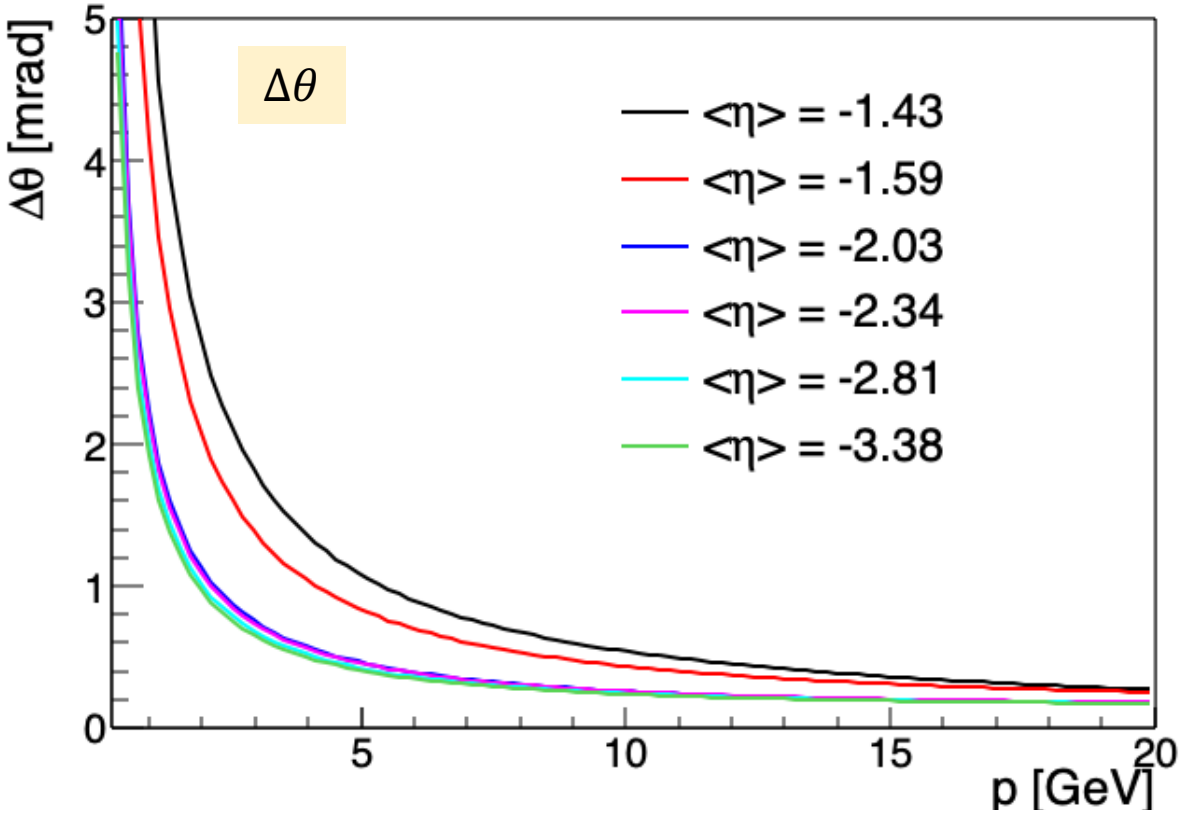
Fit Function: $\sqrt{\frac{A^2}{p[GeV]^2} + B^2}$



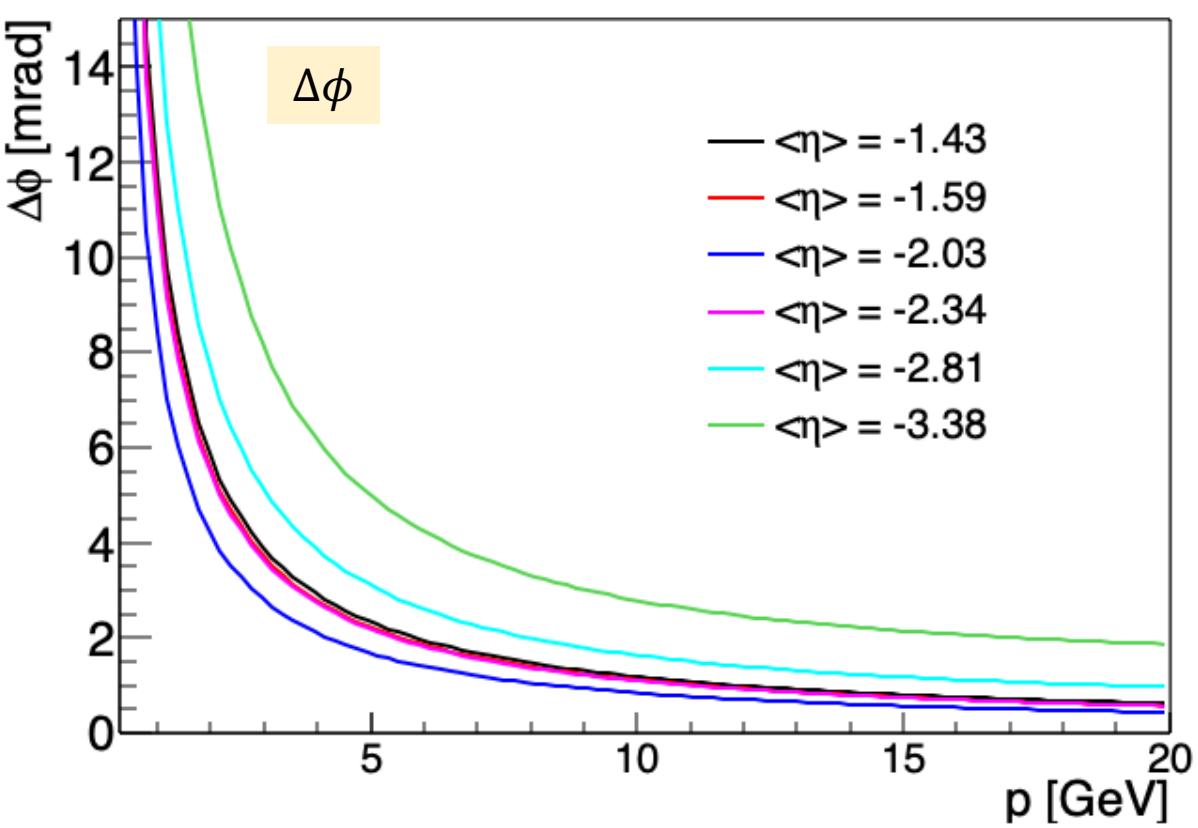


Angular Resolutions @ pfRICH

- Parameterization Results Summary
  - Used in pfRICH PID Look up tables



(extended vertical range)

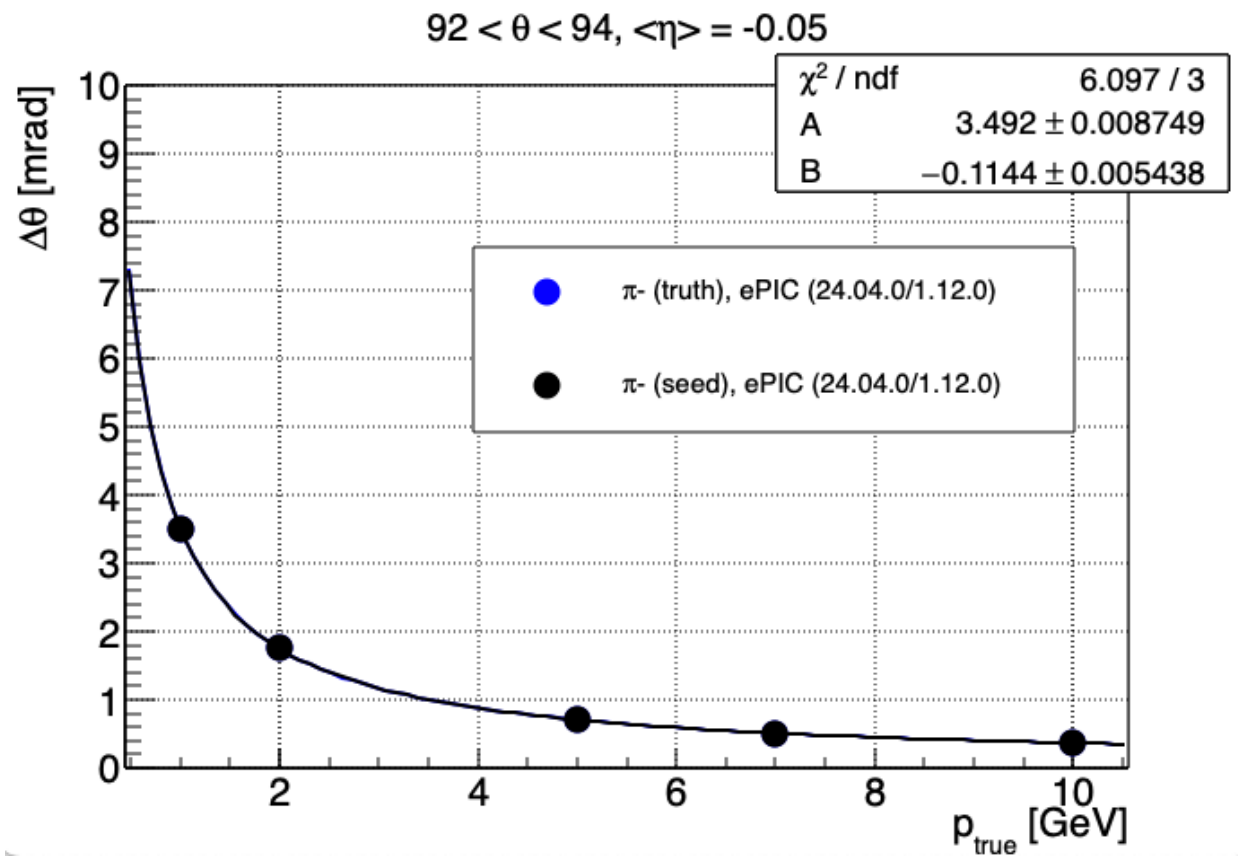


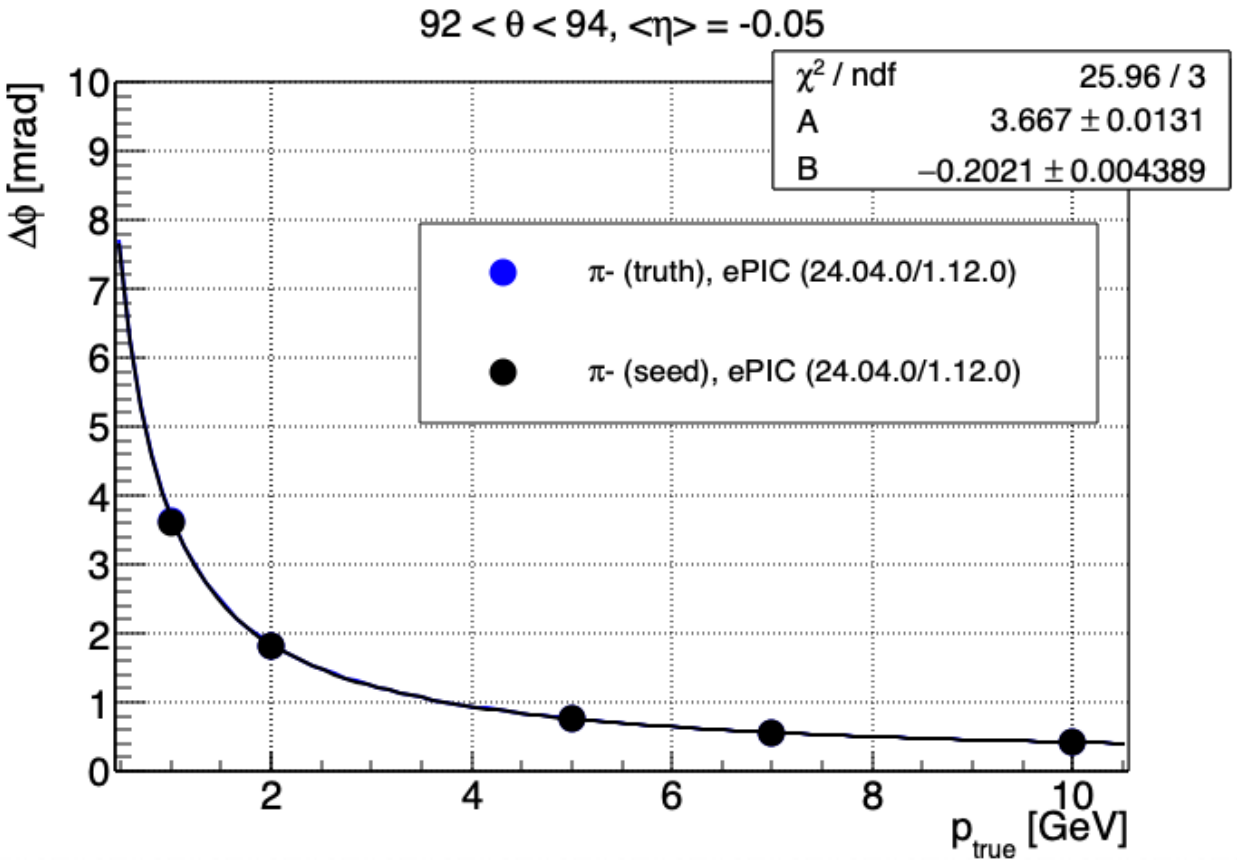
Contents

- Comparison of Crater Lake Tracking
  - Materials
  - Performance
- Angular Resolutions at PID Surfaces:
  - pfRICH
  - DIRC
  - dRICH

Angular Resolutions @ DIRC

Fit Function: $\sqrt{\frac{A^2}{p[GeV]^2} + B^2}$

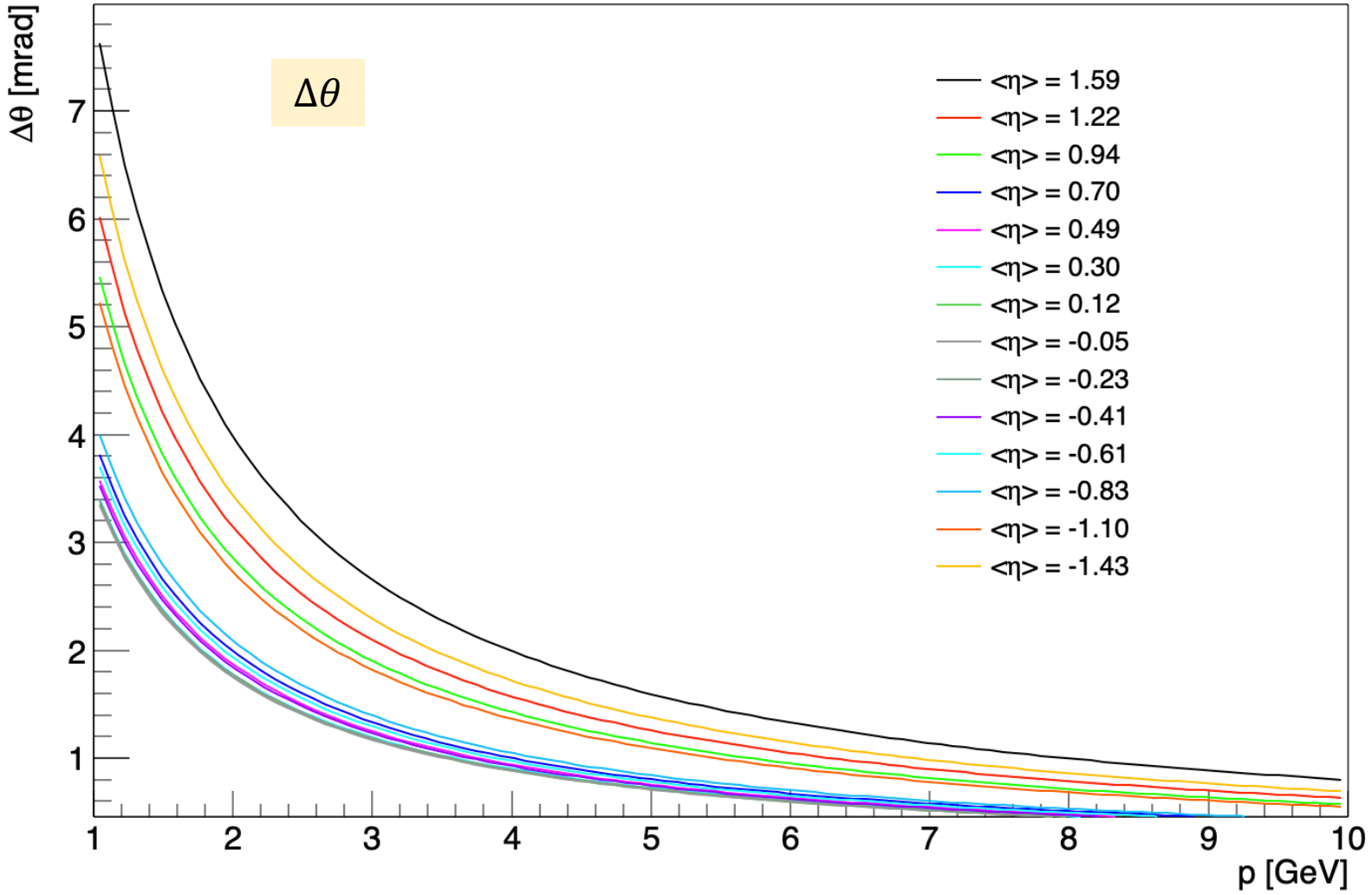




Angular Resolutions @ DIRC

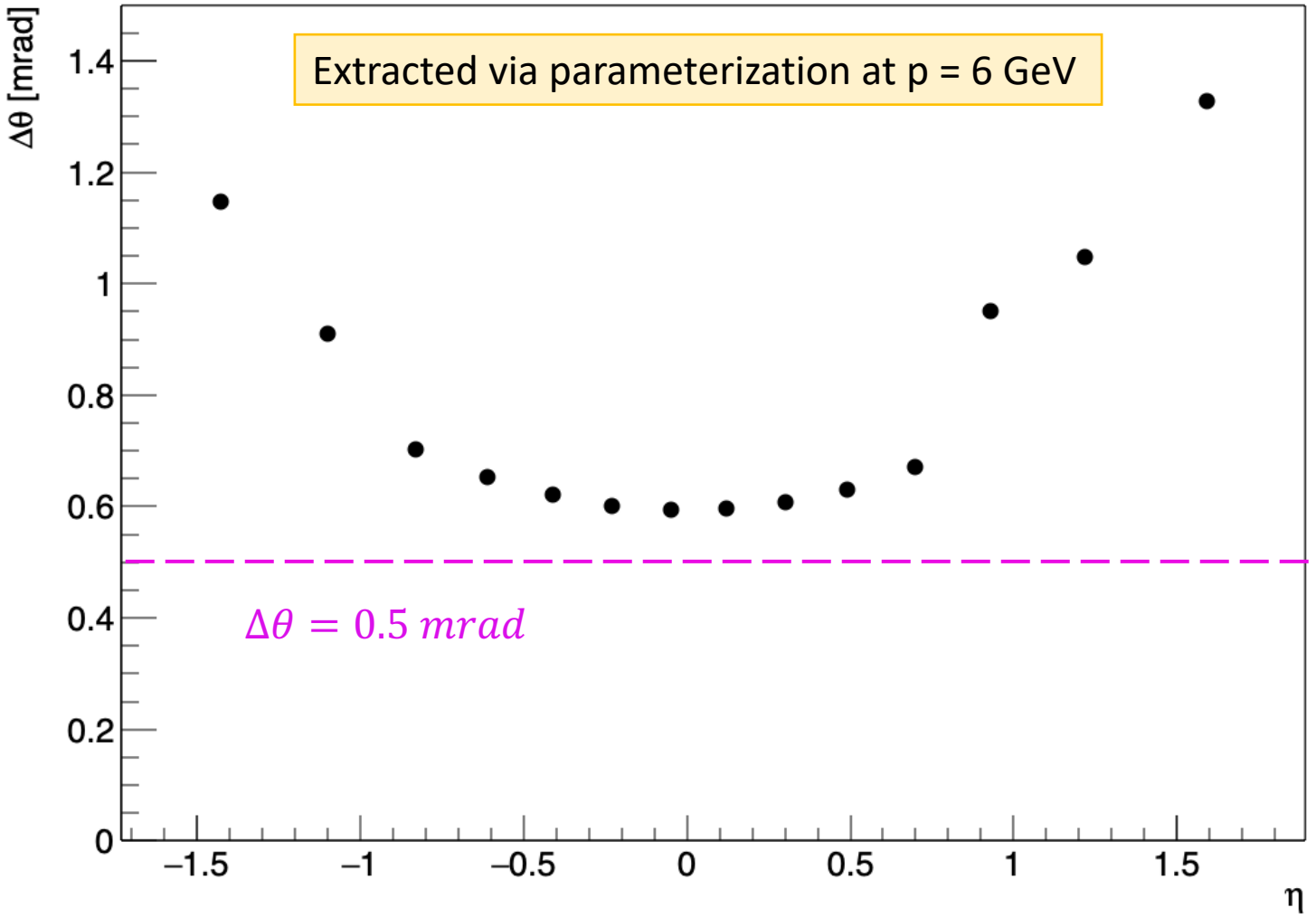
- Parameterization Results Summary
- Two general groupings
  - Outer grouping: $|\eta| > \sim 0.9$
  - Inner grouping: $|\eta| < \sim 0.9$
- DIRC PID look up tables assume

  $\Delta\theta = 0.5\ mrad$



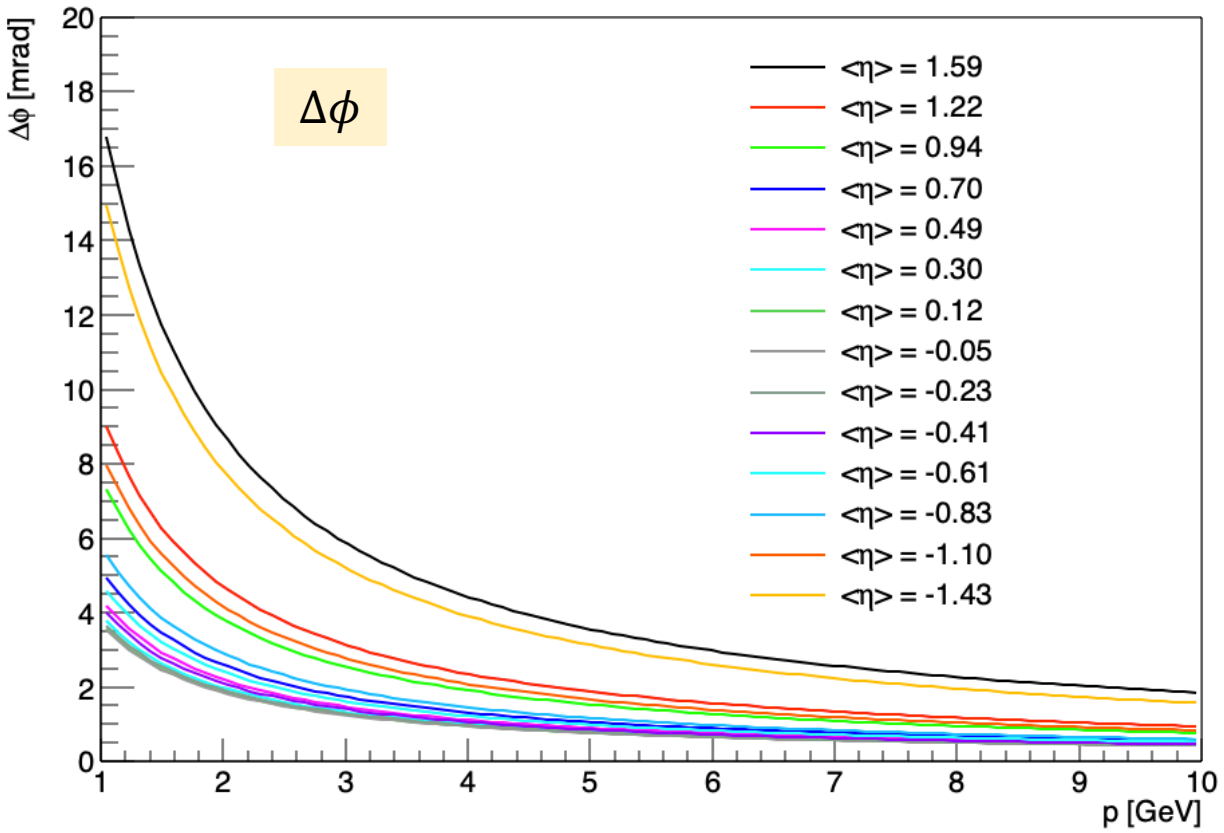
Angular Resolutions @ DIRC

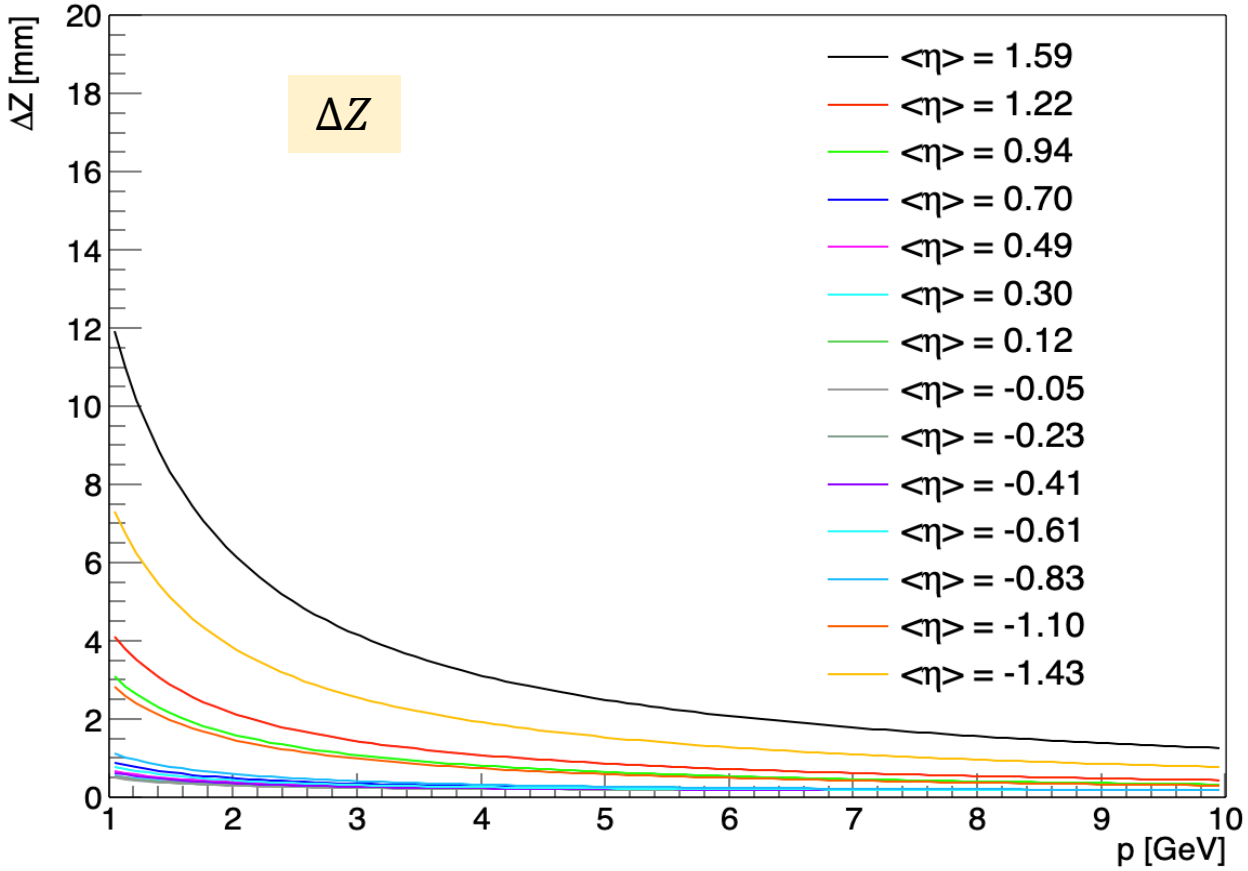
- ❑ Miss DIRC requirement of 0.5 mrad
- ❑ Best resolution ~0.6 mrad



Z Resolutions @ DIRC

- Parameterization Results Summary



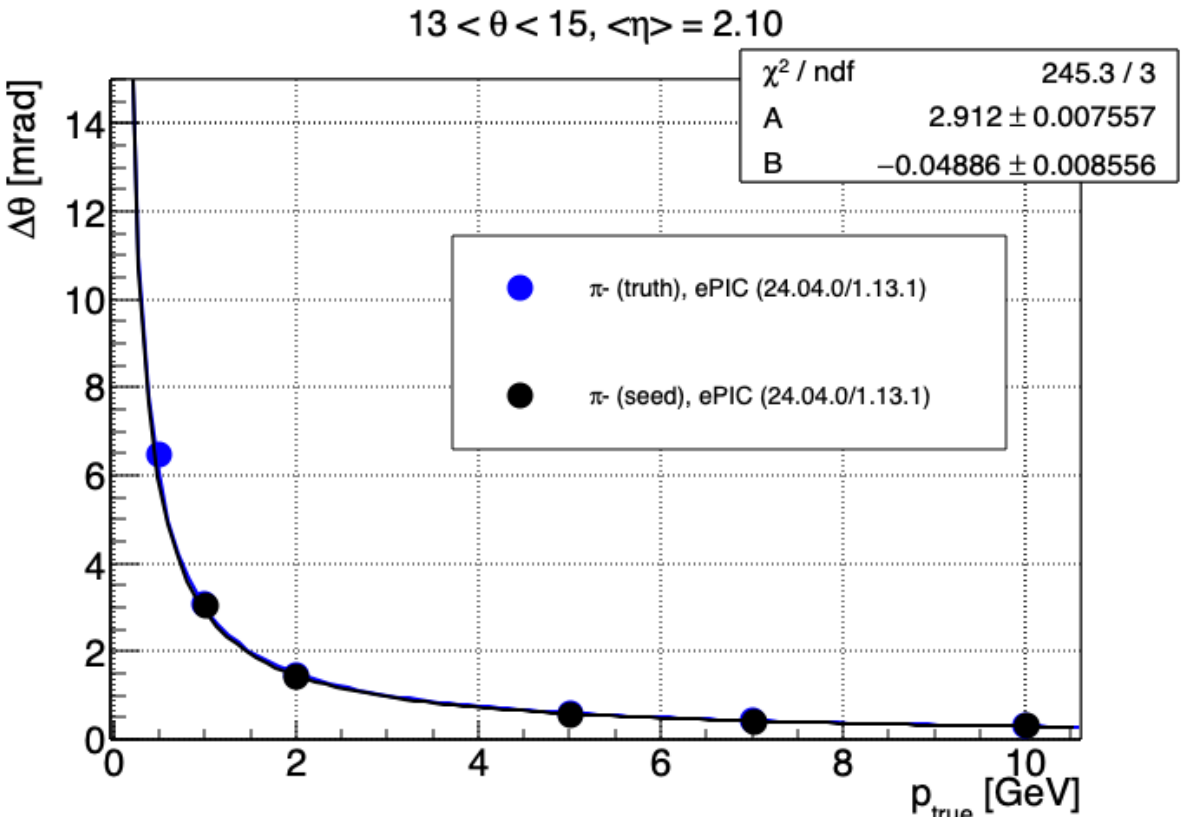


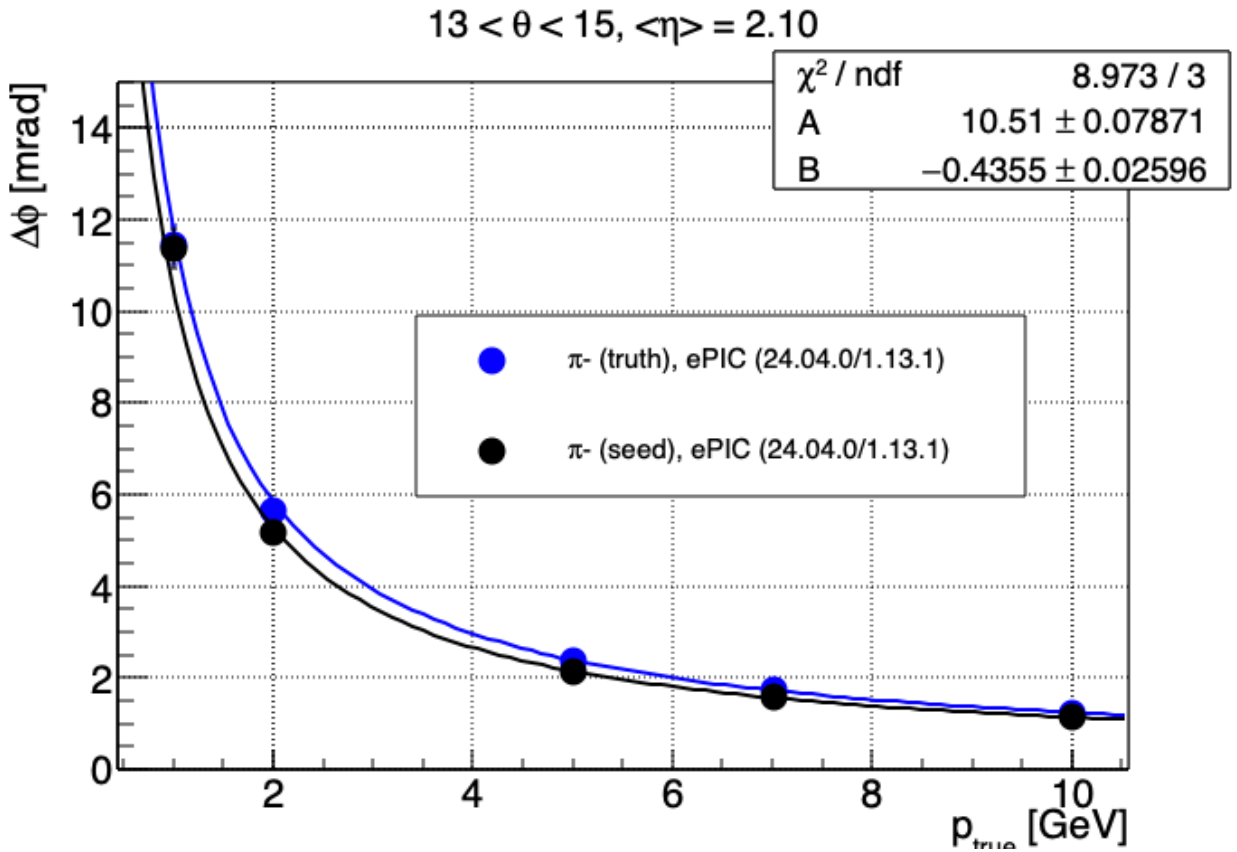
Contents

- Comparison of Crater Lake Tracking
  - Materials
  - Performance
- Angular Resolutions at PID Surfaces:
  - pfRICH
  - DIRC
  - dRICH

Angular Resolutions @ dRICH

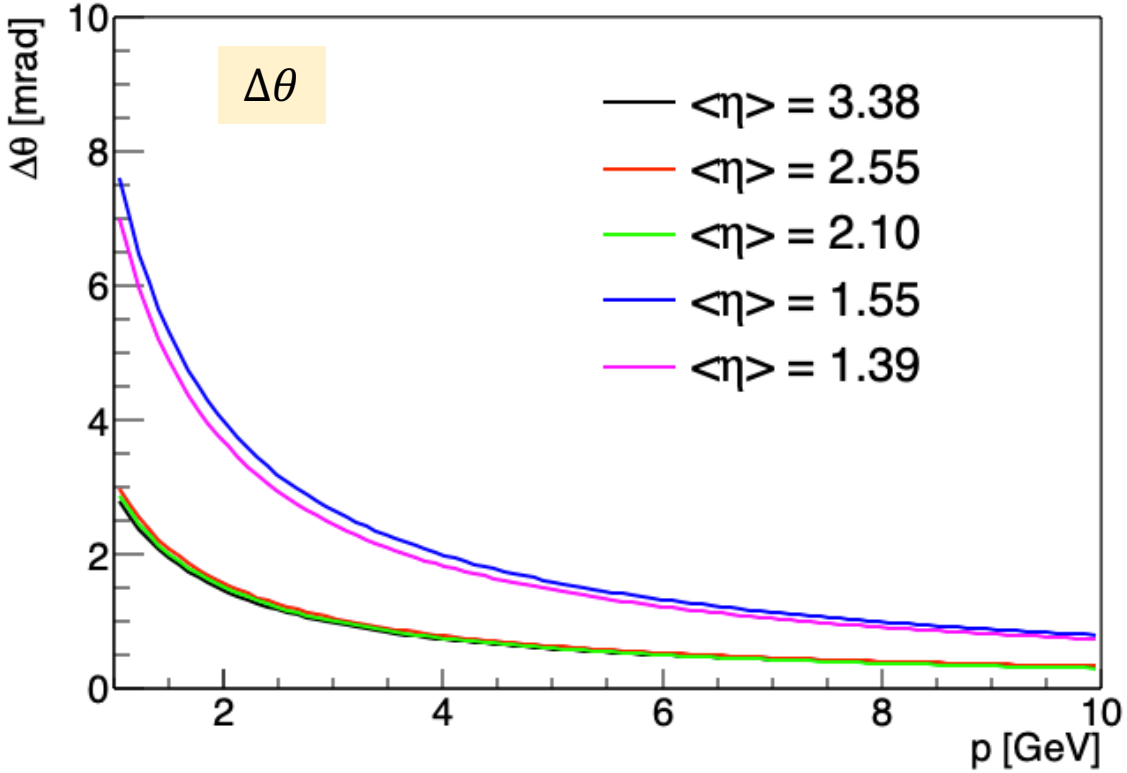
Fit Function: $\sqrt{\frac{A^2}{p[GeV]^2} + B^2}$

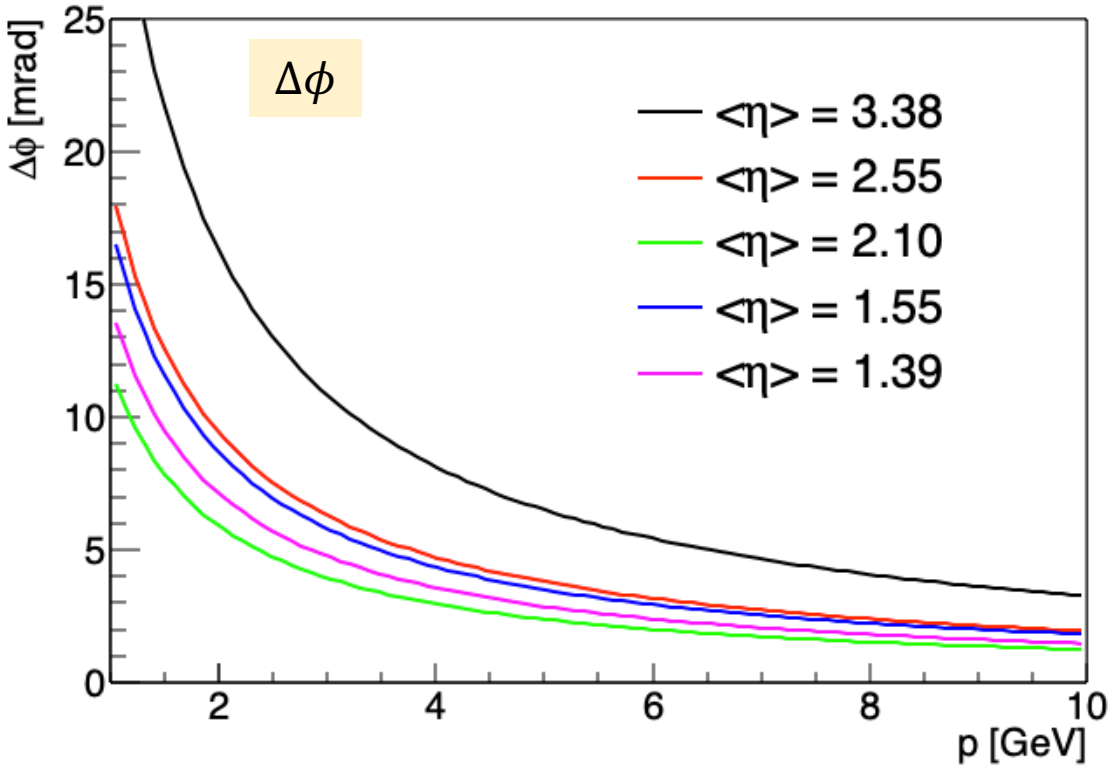




Angular Resolutions @ dRICH

- Parameterization Results Summary





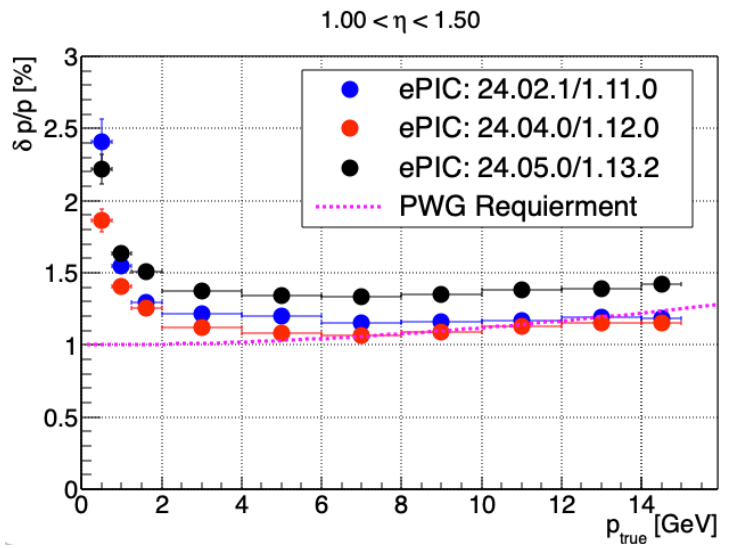
Summary

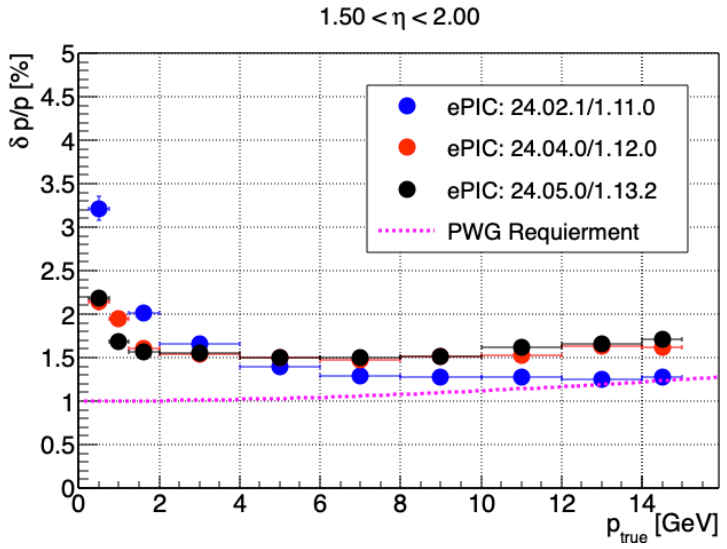
- ❑ Impact of additional materials evident in tracking performances
  - Worsening of performance with increasing material budgets
- ❑ Assessed angular resolutions at PID entrances for pfRICH, DIRC, and dRICH
  - Better estimates using information more local to PID detectors (e.g. avoid large extrapolation)?
  - Impact of BIC ?

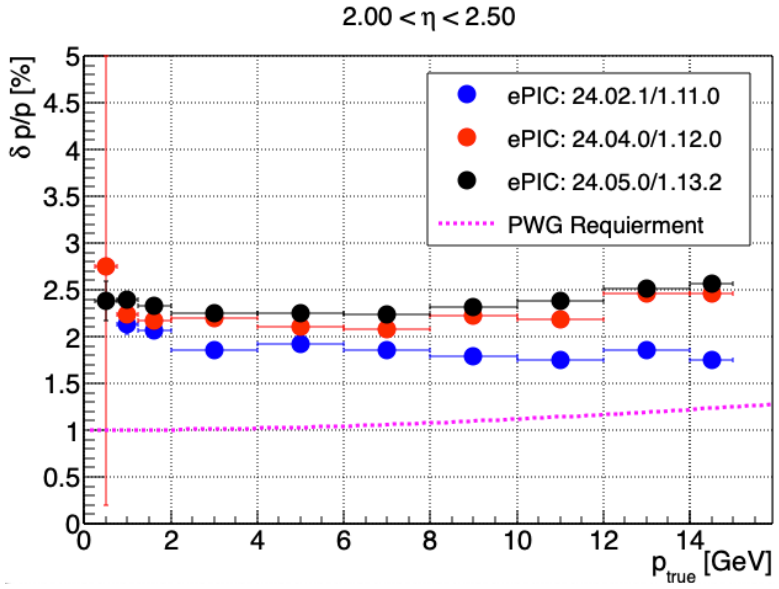
Backup

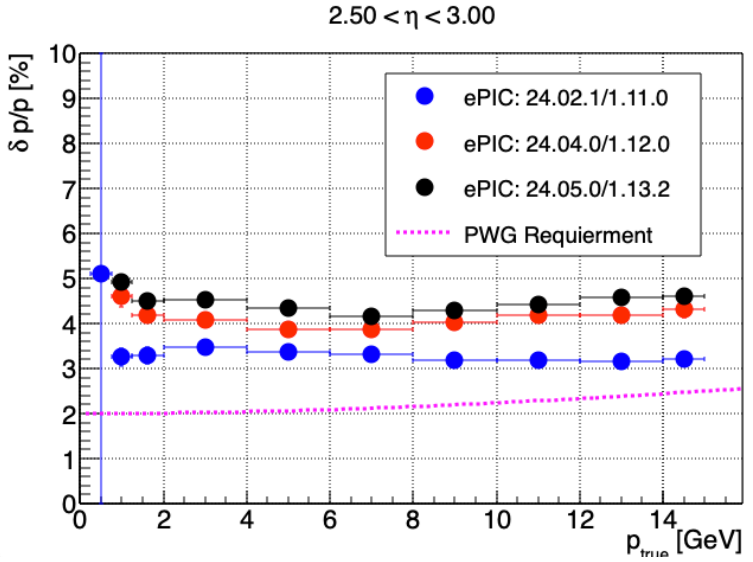
Momentum Resolution: Forward

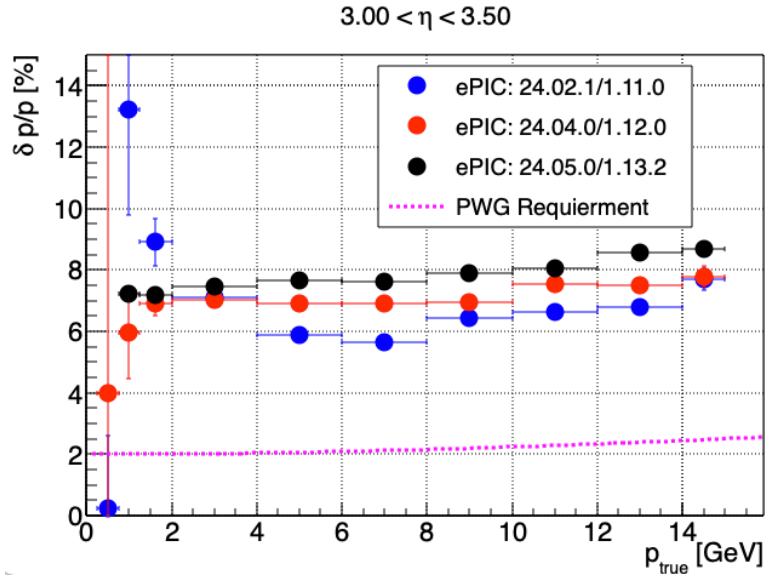
- Single particle: π^-





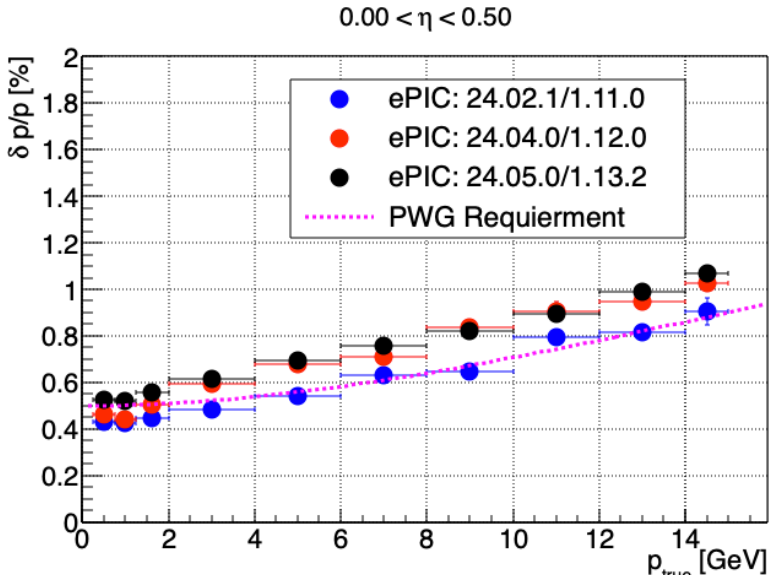


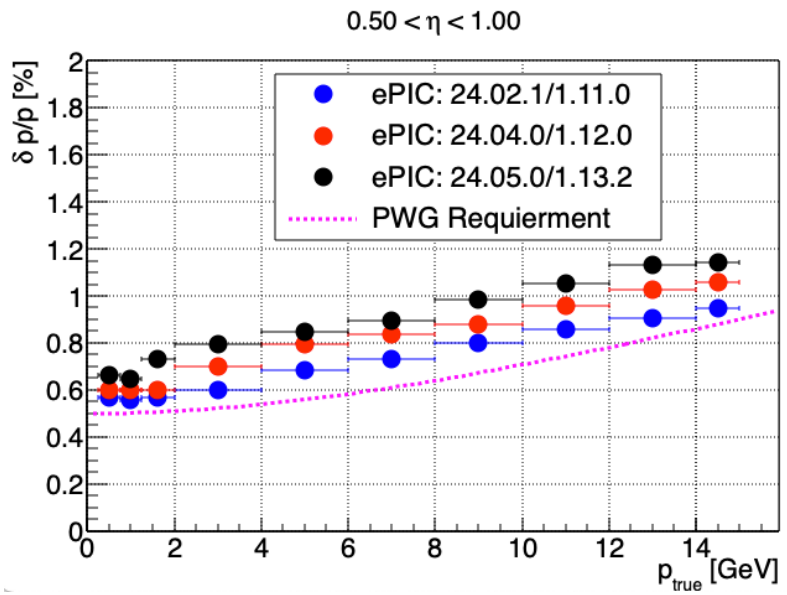


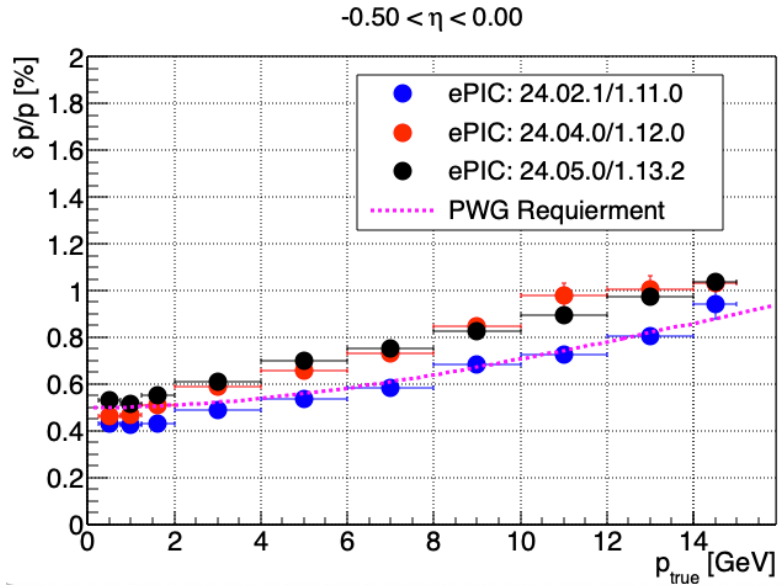


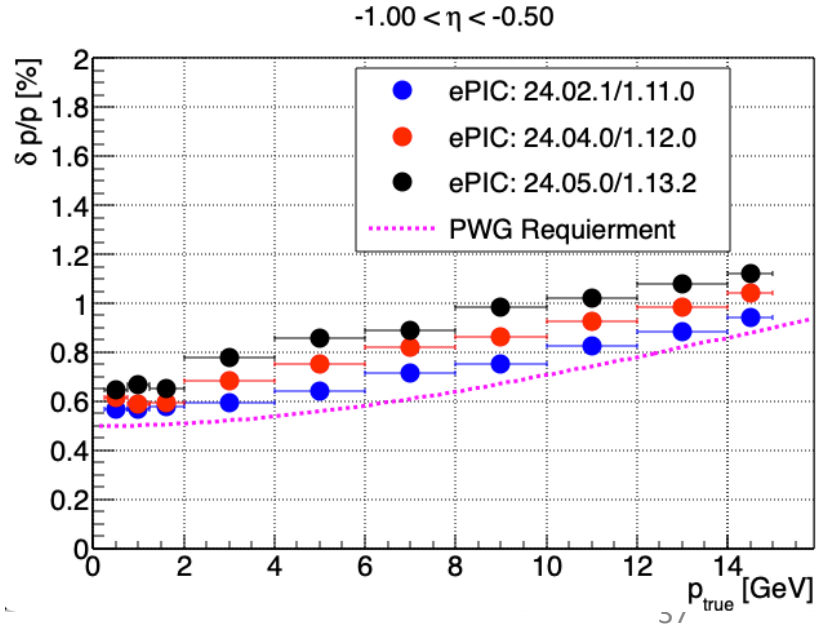
Momentum Resolution: Central

- Single particle: π^-



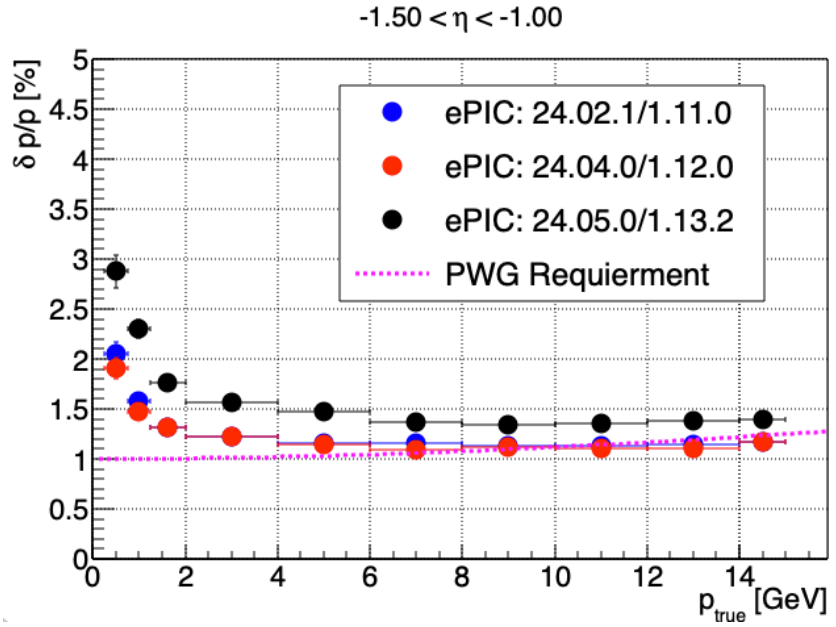


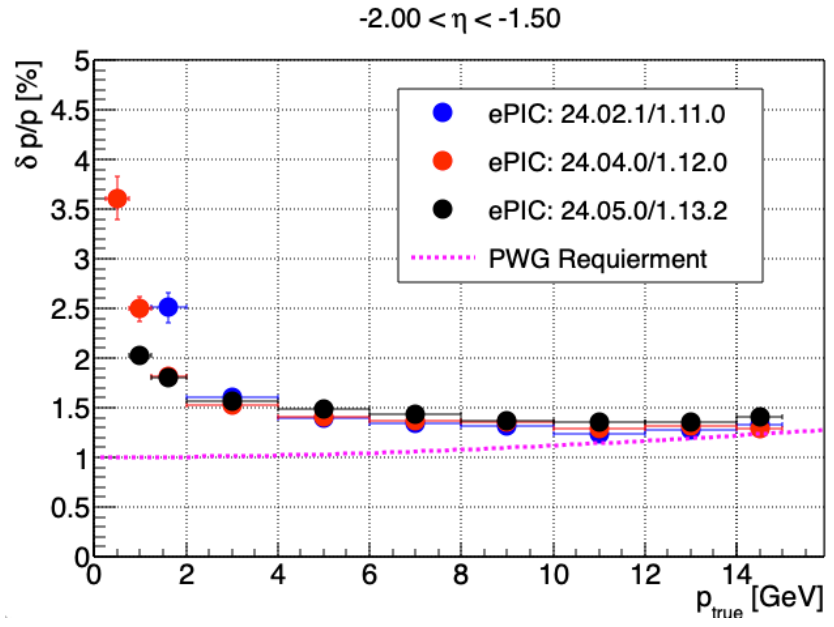


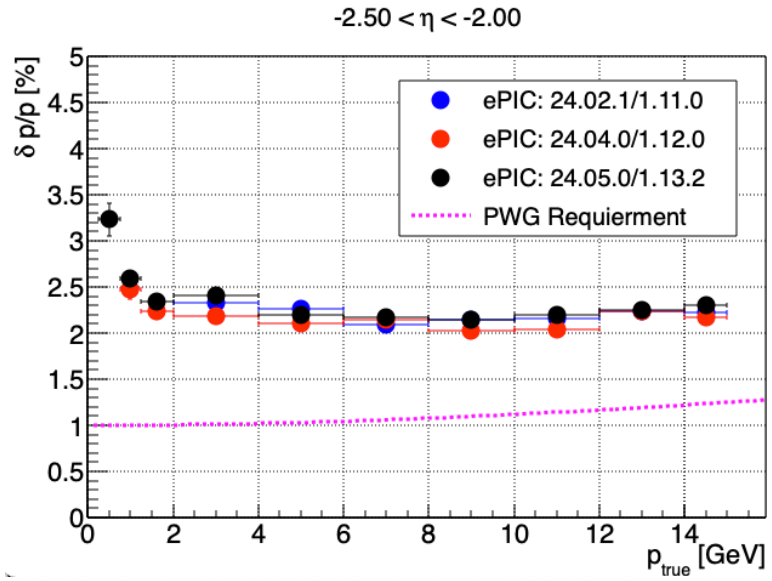


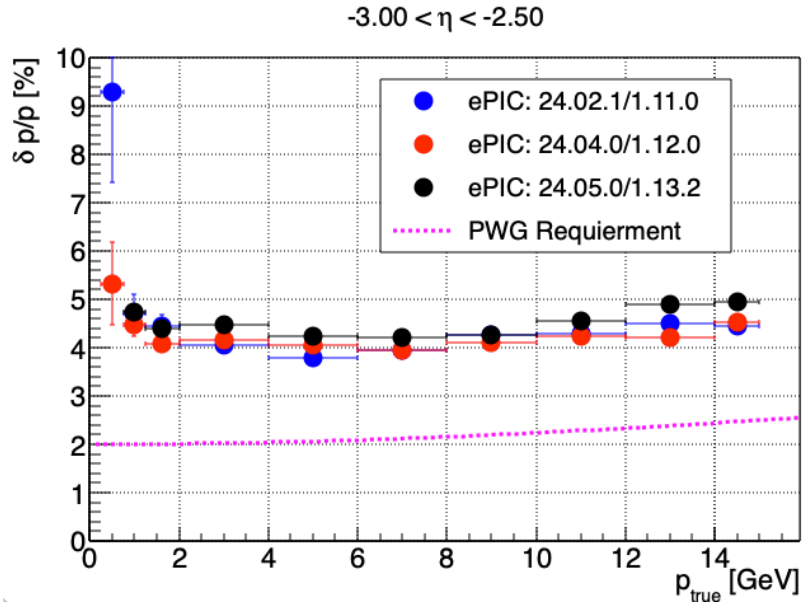
Momentum Resolution: Backward

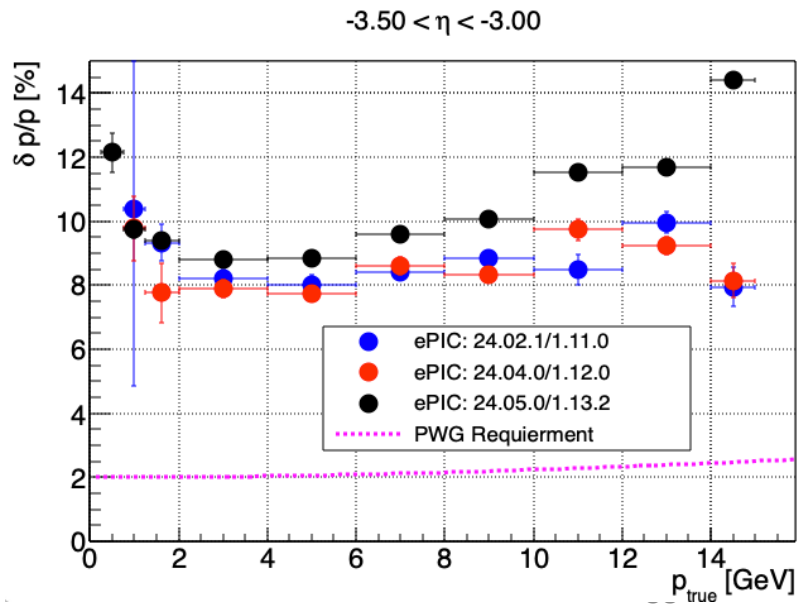
- Single particle: π^-





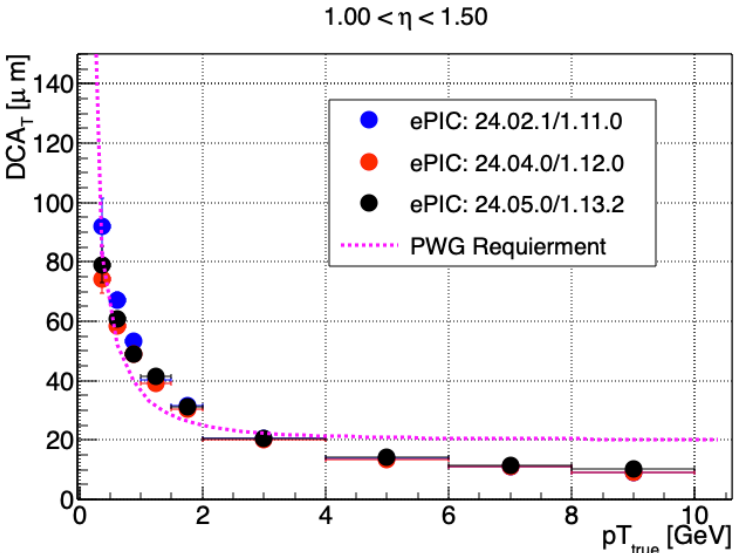


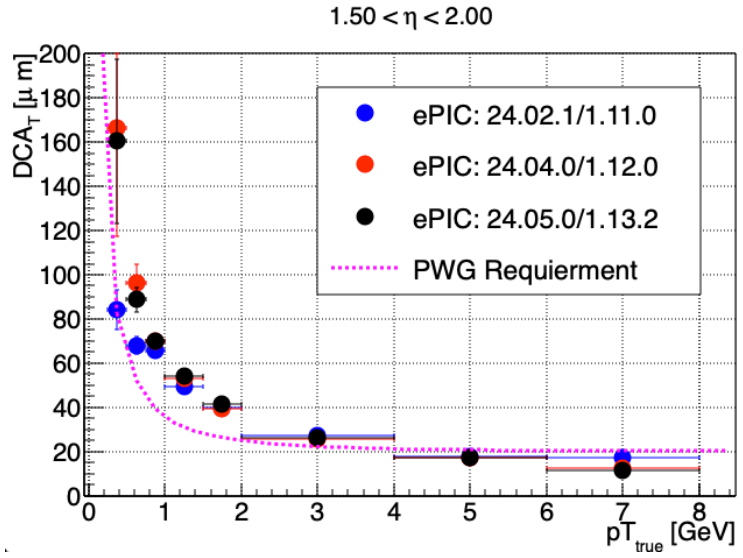


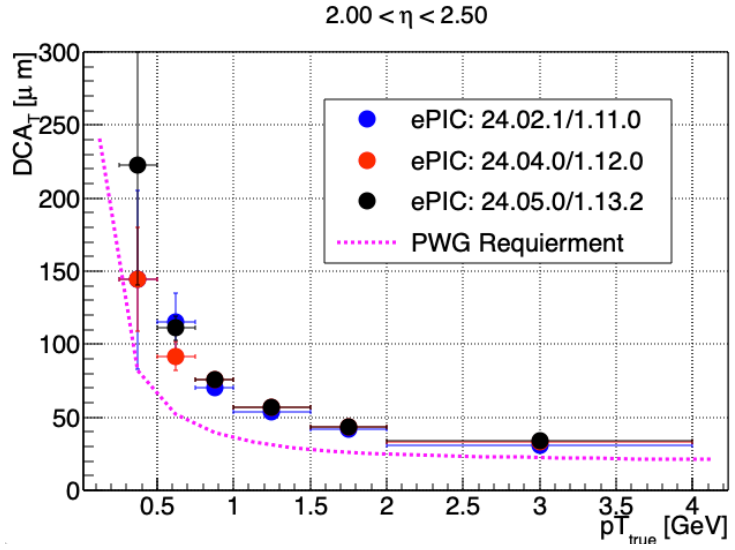


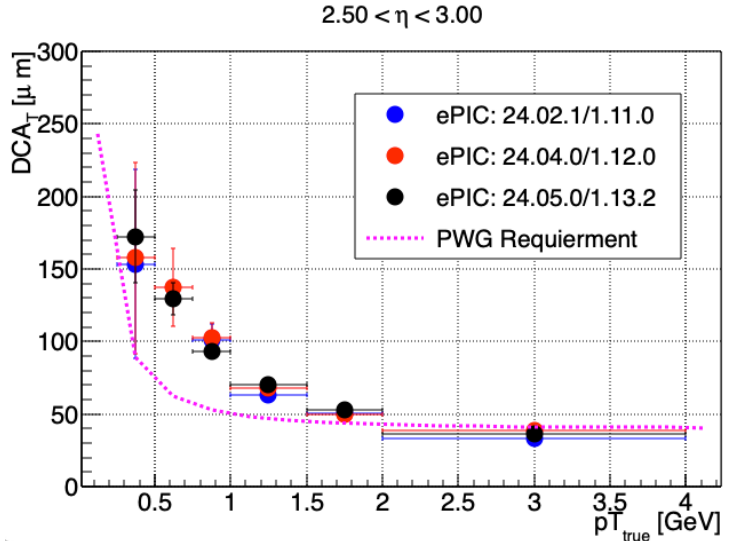
Transverse DCA Resolution: Forward

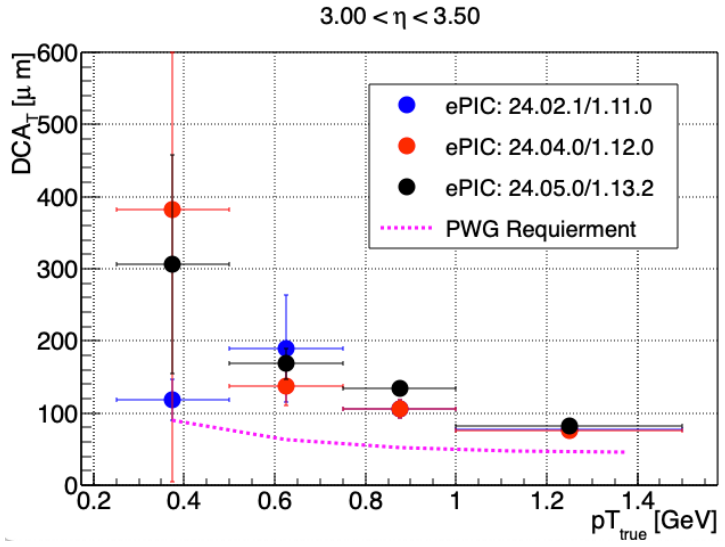
- Single particle: π^-





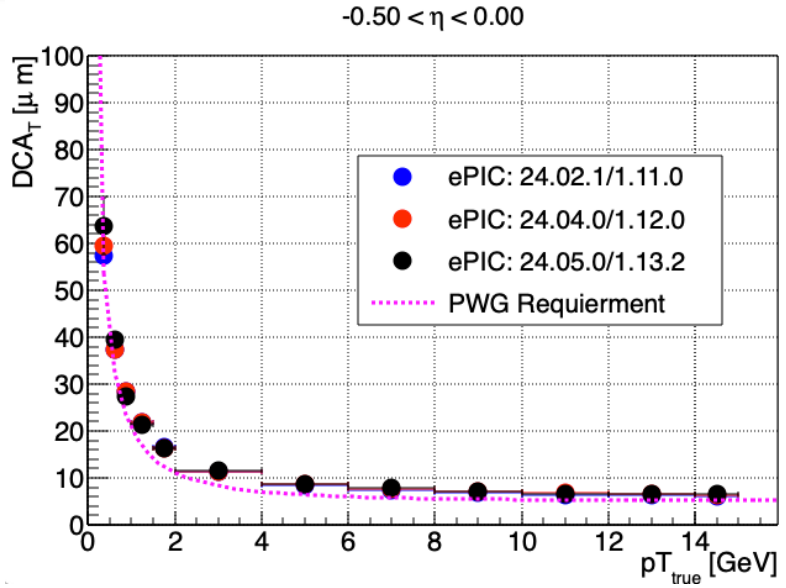


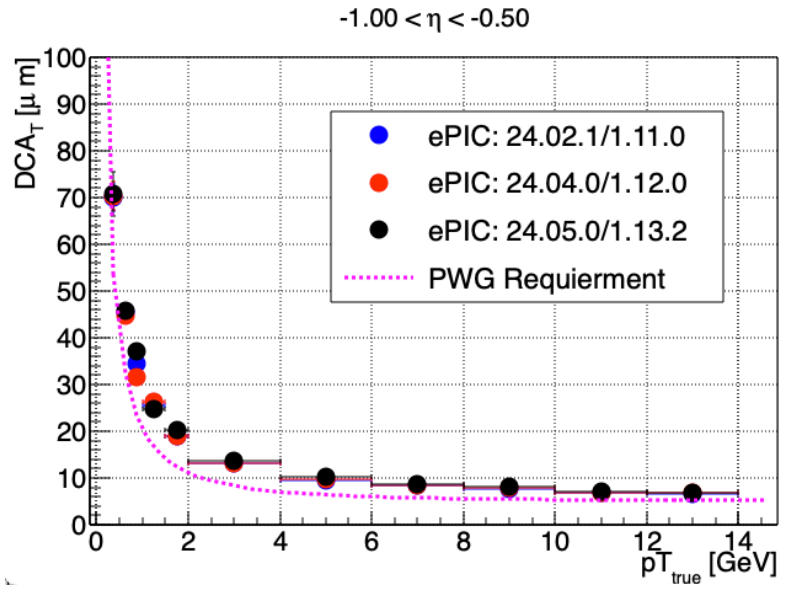


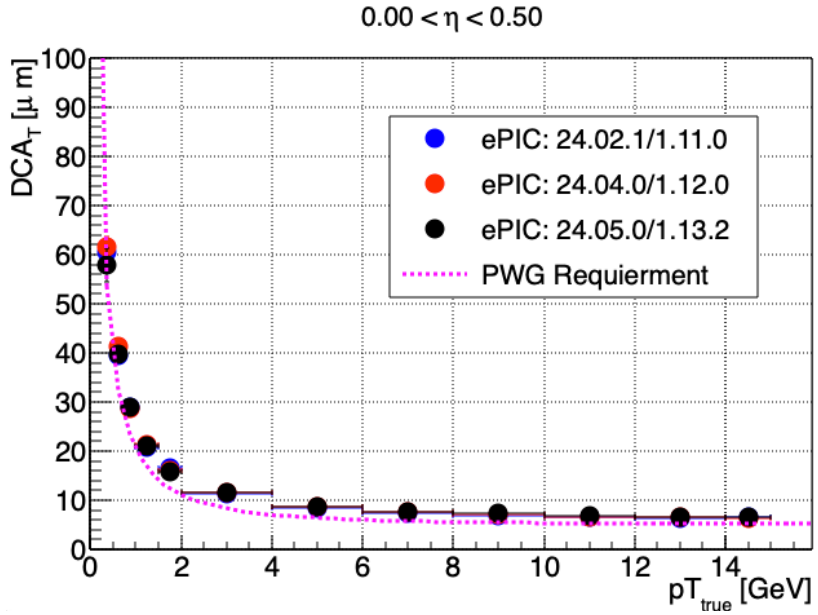


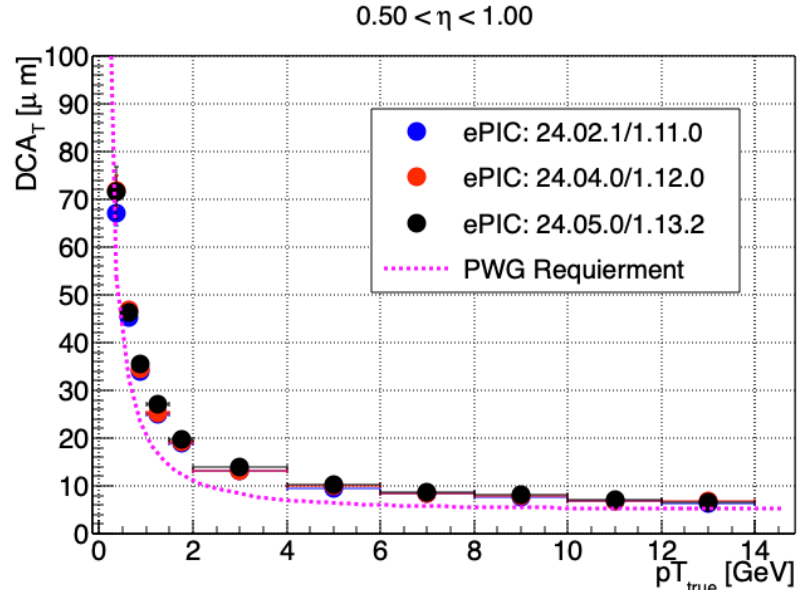
Transverse DCA Resolution: Central

- Single particle: π^-



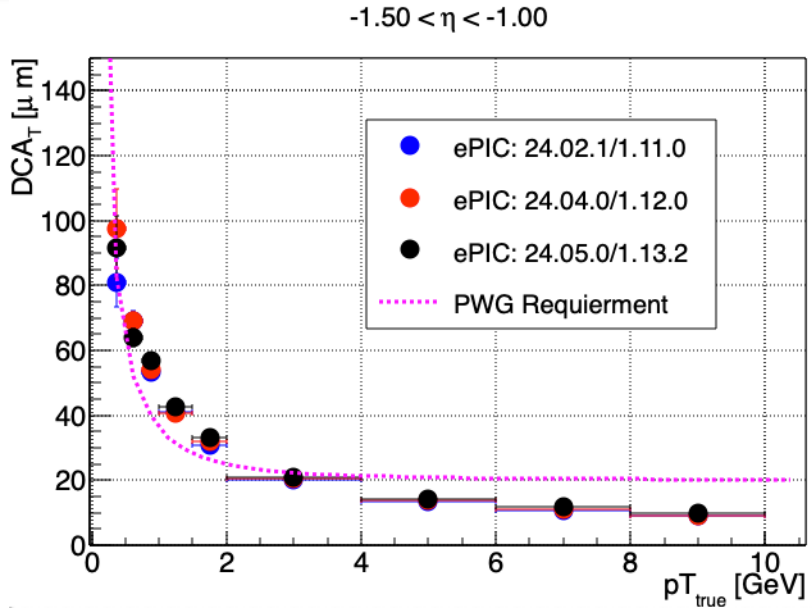


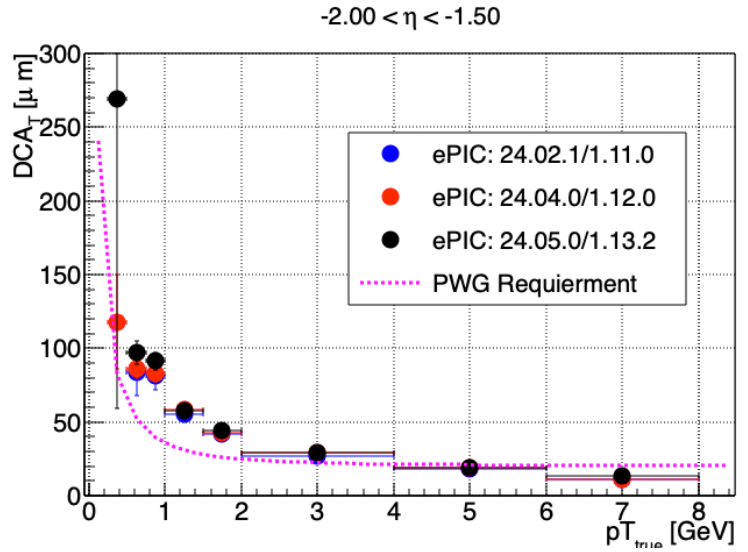


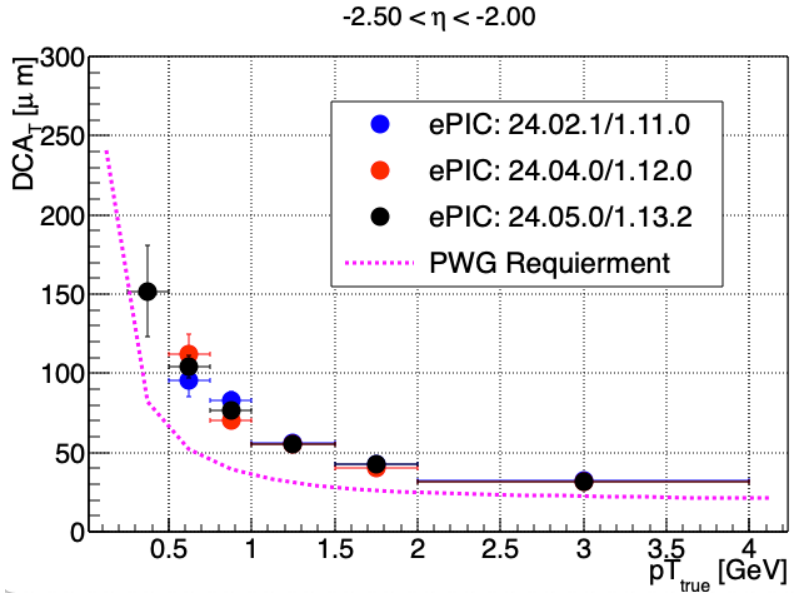


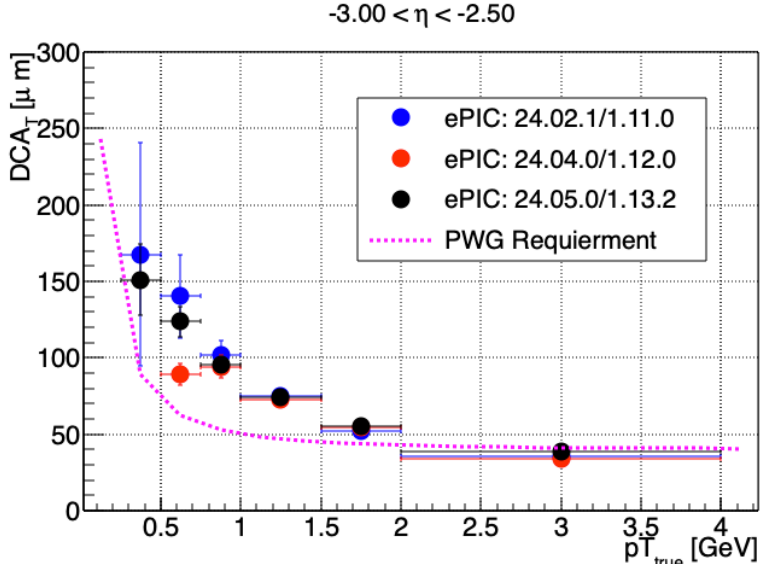
Transverse DCA Resolution: Backward

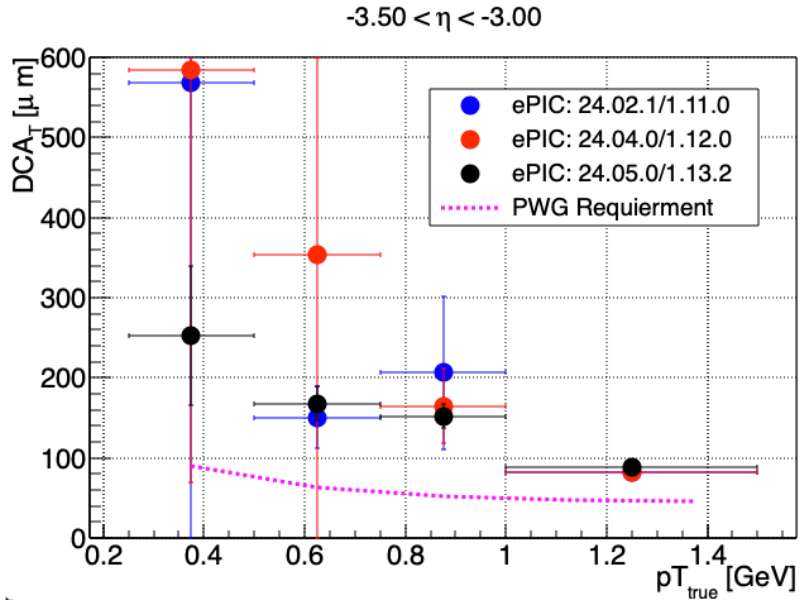
- Single particle: π^-





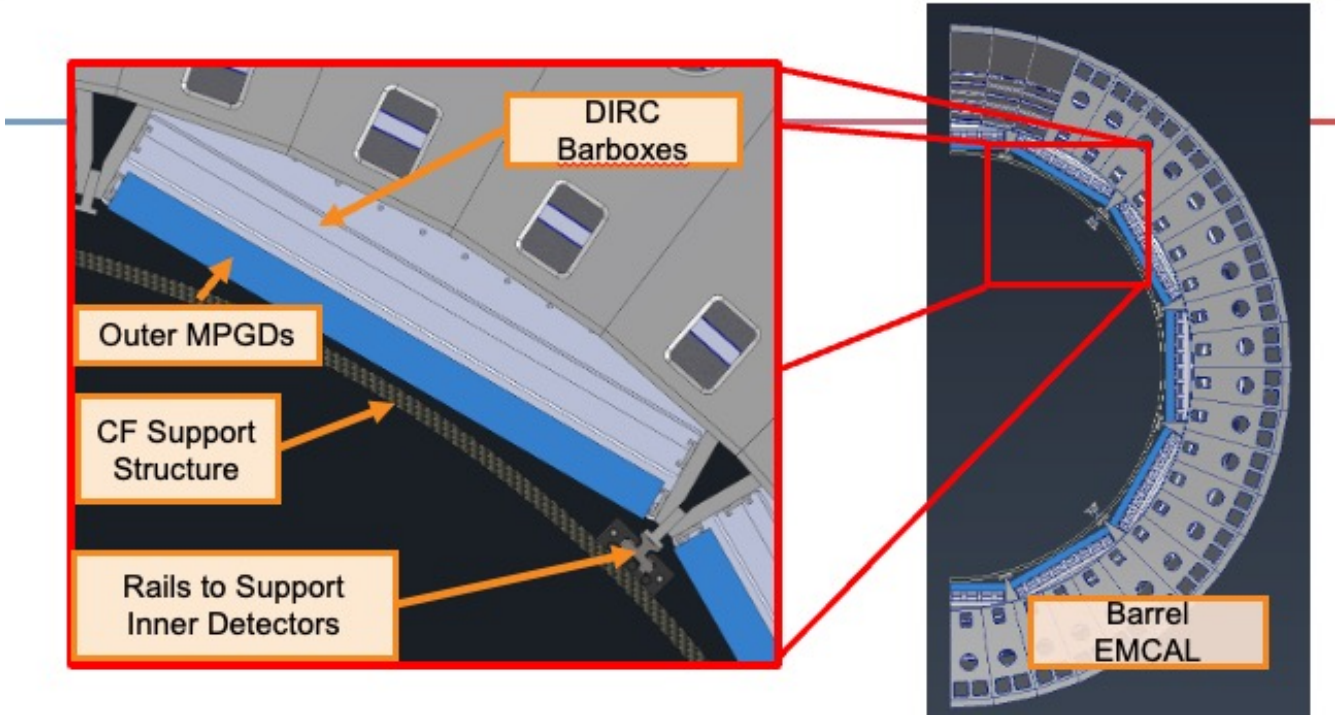


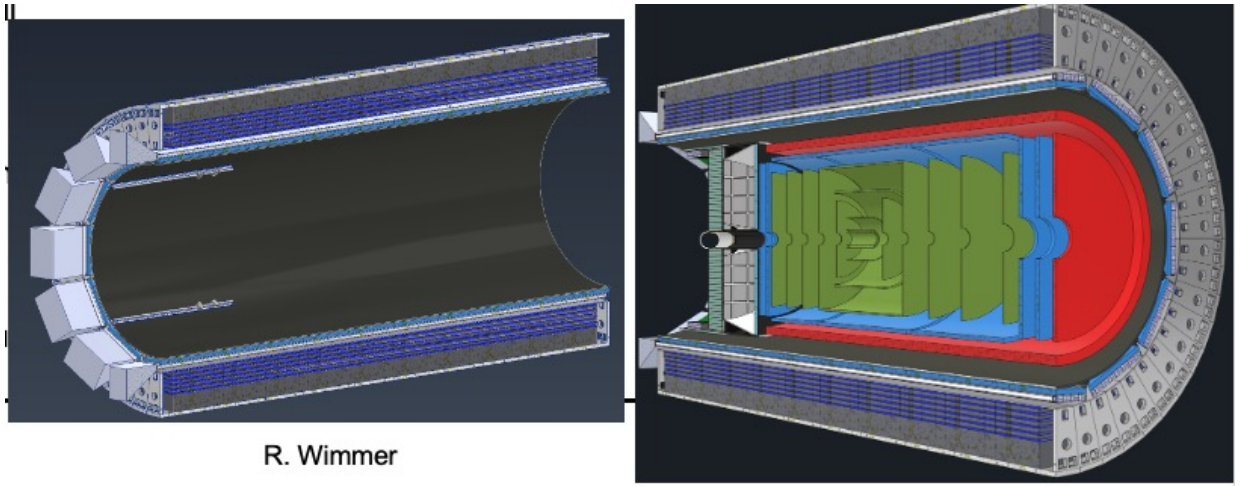




Simulation Details: Material

[TIC Meeting 3/10/24]





R. Wimmer