

Tracking with EPIC

Shyam Kumar, Annalisa Mastroserio
University and INFN Bari, Italy

Mini-TPC Details

1. Configuration with and without TPC

2. Magnetic field used is 1.4 tesla.

3. Inner cage and Outer cage material budget.

Ref: //

<https://pdg.lbl.gov/2005/AtomicNuclearProperties/substances/kapton.html>

// Case of P10 gas: (Total 1% as suggested)

Float_t radLInnerCage = 0.005; // 0.5%

Float_t radLOuterCage = 0.005; // 0.5%

Float_t radLPerRow = 0.1/
(13289.4); // P10 = 13289.4; Ne = 3.450E+04

// Case of Ne gas Kepton (1 mm) thickness

Float_t radLInnerCage = 0.1/28.57; // Kapton radiation length
= 28.57 cm

Float_t radLOuterCage = 0.1/28.57; // Kapton radiation length
= 28.57 cm

Float_t radLPerRow = 0.1/(3.450e+04); // P10 = 13289.4; Ne
= 3.450E+04

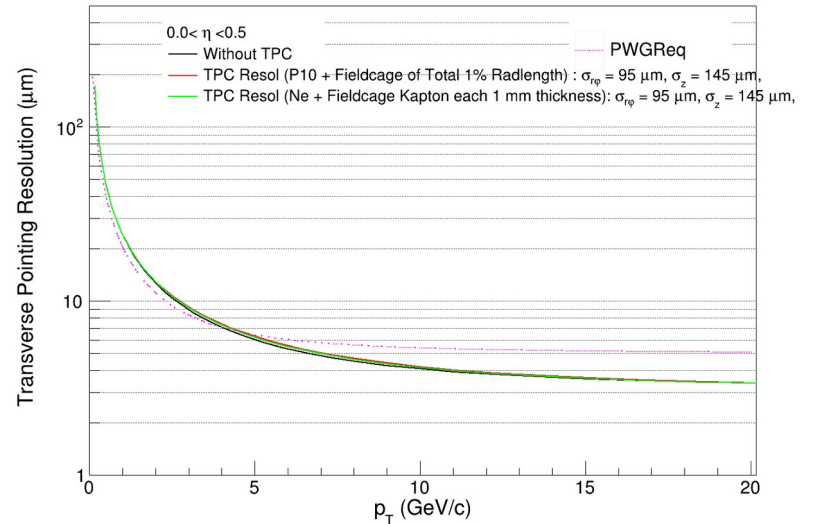
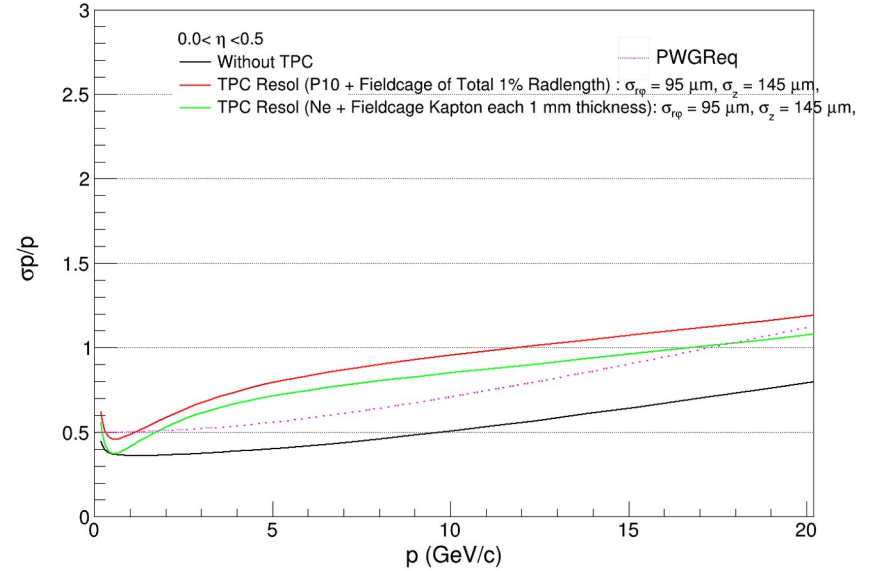
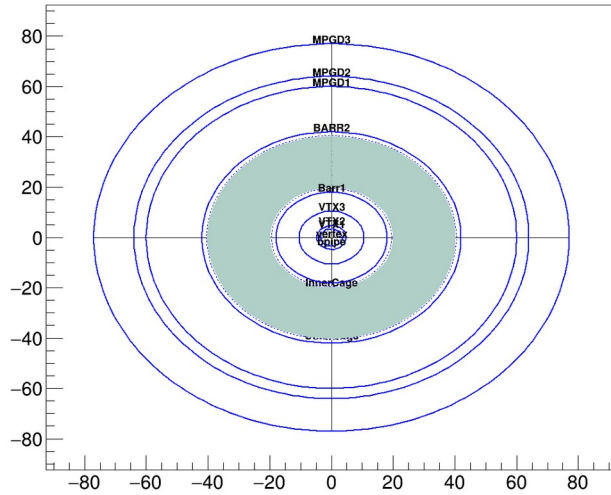
4. Other specifications:

Float_t tpcRadialPitch = 0.1 ; // cm

Float_t tpcRows = 200 ; // 200 points in TPC

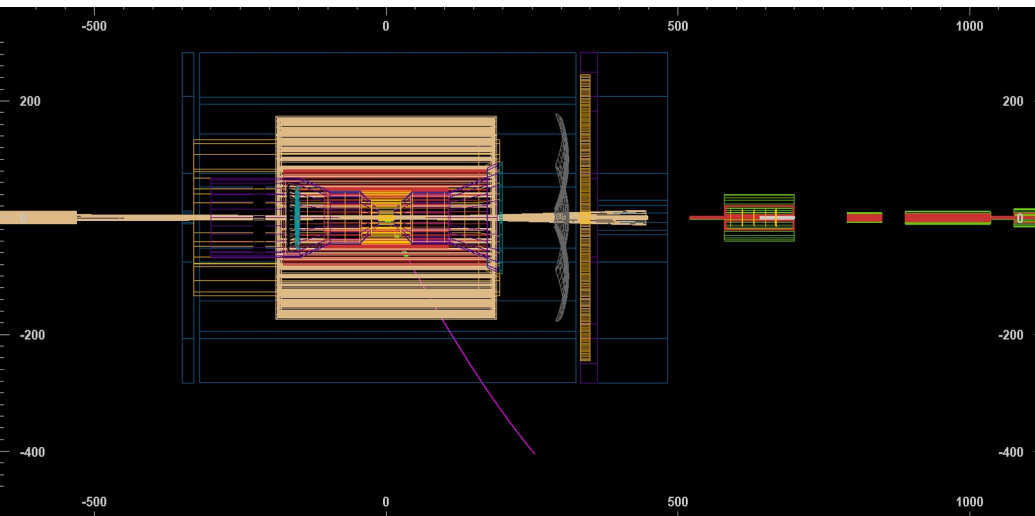
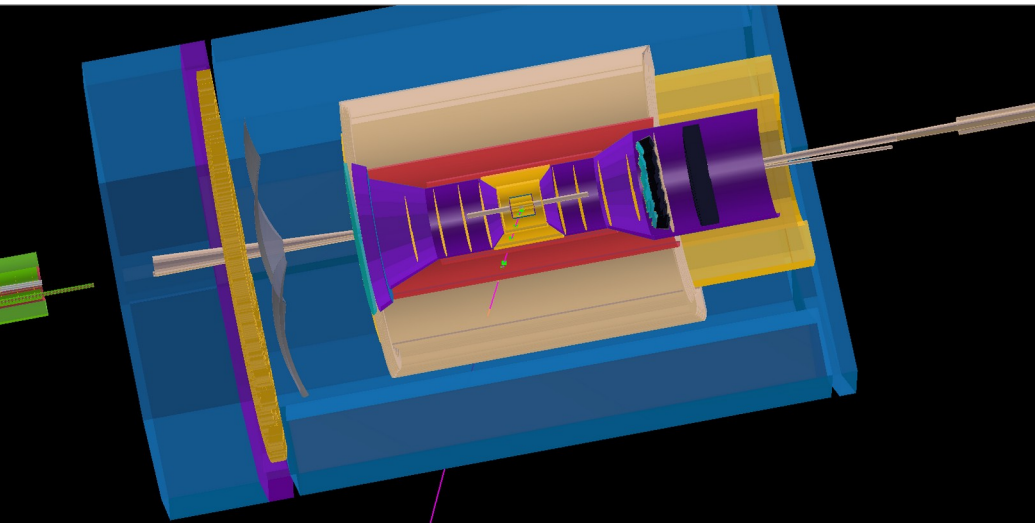
Float_t rowOneRadius = 20.1; // cm

TPC Performance



Name	r [cm]	X0	phi & z res [um]		layerEff
0. vertex	0.00	0.0000	-	-	-
1. bpipe	3.10	0.0022	-	-	-
2. VTX1	3.60	0.0005	3	3	1.00
3. VTX2	4.80	0.0005	3	3	1.00
4. VTX3	10.50	0.0005	3	3	1.00
5. Barr1	18.00	0.0005	3	3	1.00
6. InnerCage	19.50	0.0035	-	-	-
7. tpc_0	20.10	0.0000	95	145	1.00
207. OuterCage	40.50	0.0035	-	-	-
208. BARR2	42.00	0.0055	3	3	1.00
209. MPGD1	60.00	0.0026	55	55	1.00
210. MPGD2	64.00	0.0026	55	55	1.00
211. MPGD3	77.00	0.0026	55	55	1.00

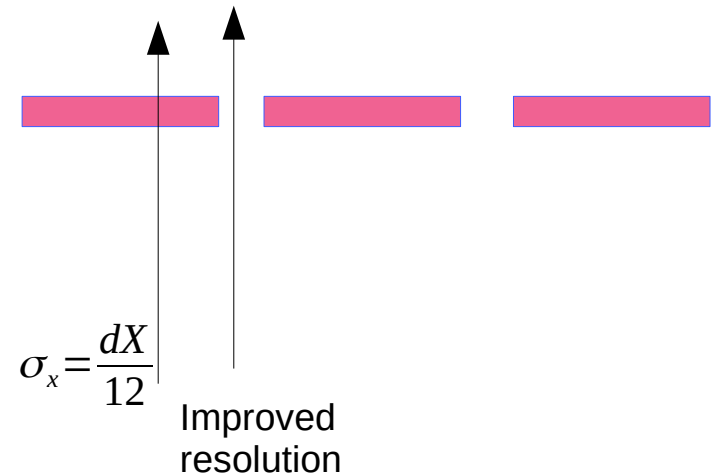
10 K pi+ simulation in DD4HEP

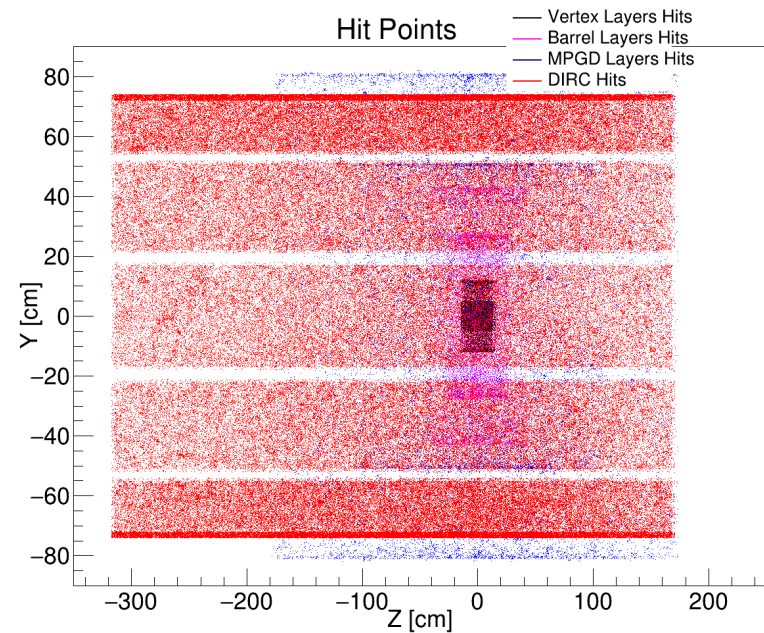
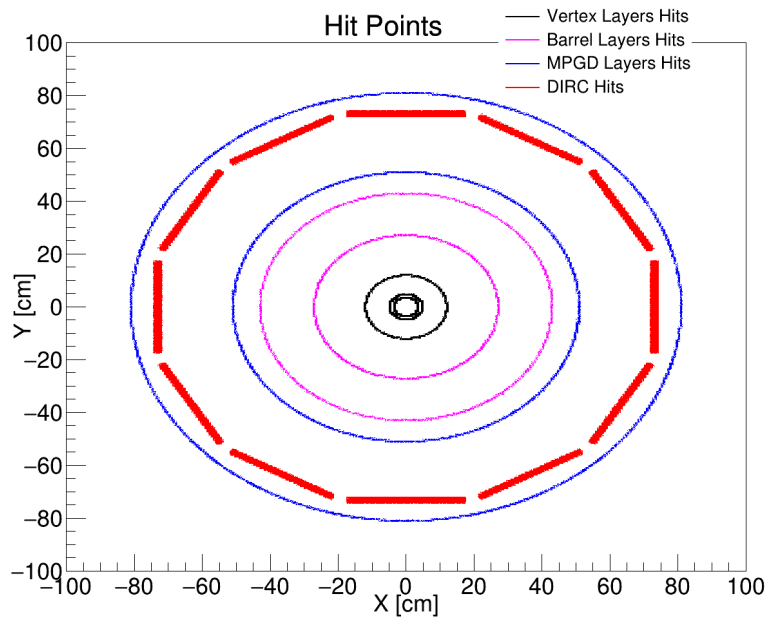


Event display

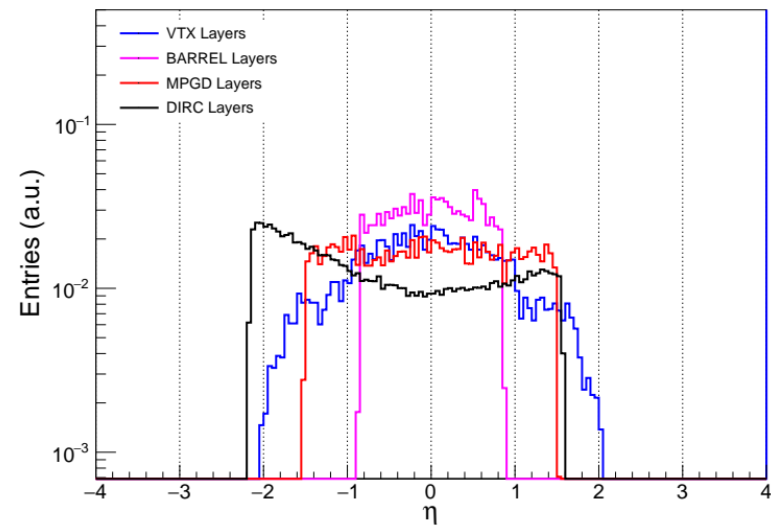
Fun4All: Fast simulation with true seeding

DD4HEP: Kind of Fast simulation with real seeding (smearing with resolution)





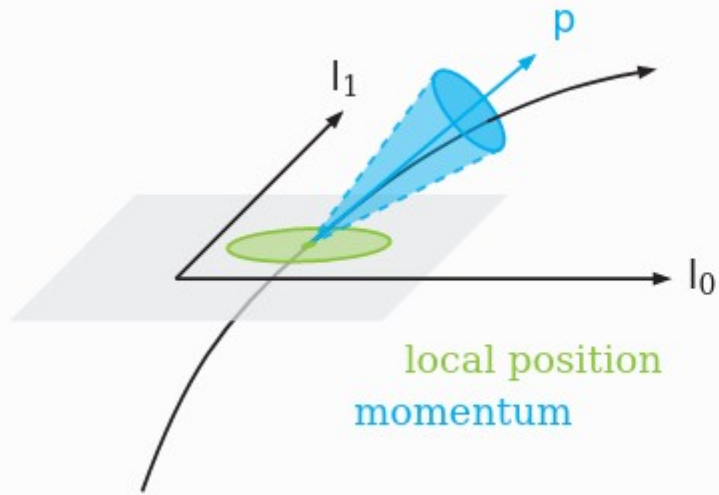
Hit Points and Eta distributions



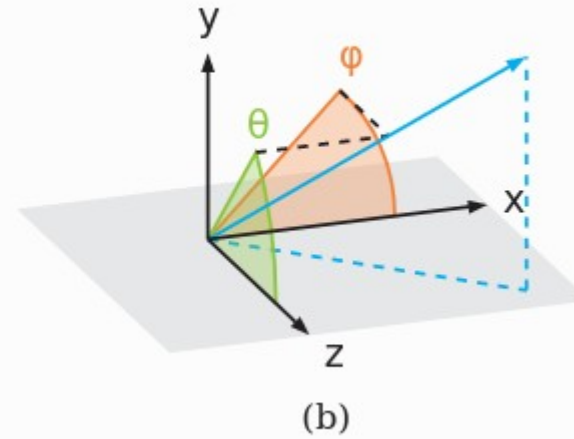
EPIC Configuration Barrel:

Name	Radius (cm)	X/X0	R-Phi resol (cm)	R-Z resol (cm)
BeamPipe	3.18	0.0022	-----	
Vtx1	3.6	0.0005	10.0e-4/sqrt(12)	10.0e-4/sqrt(12)
Vtx2	4.8	0.0005	10.0e-4/sqrt(12)	10.0e-4/sqrt(12)
VtxSupport	5.7	0.001	-----	
Vtx3	12.3	0.0005	10.0e-4/sqrt(12)	10.0e-4/sqrt(12)
BarrSupport	13.6	0.001	-----	
Barr1	30.0	0.0025	10.0e-4/sqrt(12)	10.0e-4/sqrt(12)
Barr2	40.0	0.0055	10.0e-4/sqrt(12)	10.0e-4/sqrt(12)
MM1	51.0	0.0026	55.0e-4	55.0e-4
ACLGAD	64.0	0.0558	30.0e-4	30.0e-4
DIRC	72.96	0.1274	-----	
MM2	77.0175	0.0026	55.0e-4	55.0e-4

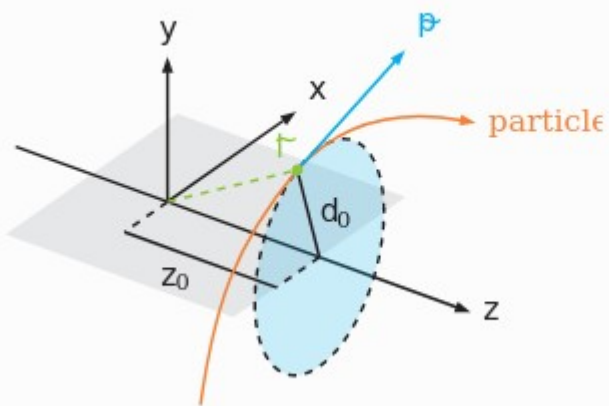
Tracking (ACTS)



(a)



(b)



Acts Common Tracking Software

Track finding and Track fitting

ACTS Seeding and Tracking

General equation of a circle

$$(x - x_0)^2 + (y - y_0)^2 = R^2$$

If circle passed through the vertex (0,0): $x_0^2 + y_0^2 = R^2$

$$x^2 + x_0^2 - 2xx_0 + y^2 + y_0^2 - 2yy_0 = R^2$$

using

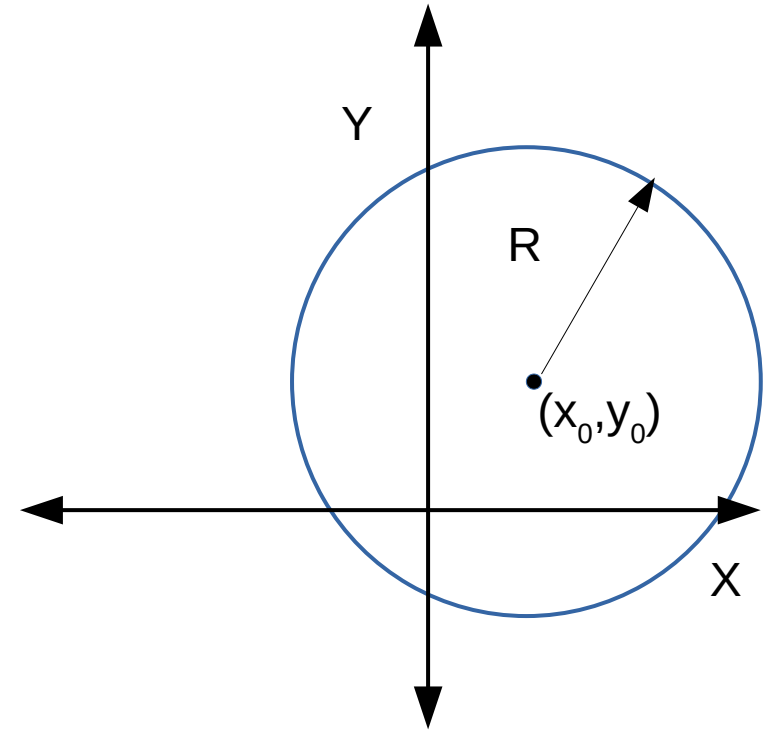
$$u = \frac{x}{x^2 + y^2} \quad v = \frac{y}{x^2 + y^2} \quad x_0^2 + y_0^2 = R^2$$

$$x^2 + y^2 - 2xx_0 - 2yy_0 = 0$$

$$1 - 2 \frac{xx_0}{x^2 + y^2} - 2 \frac{yy_0}{x^2 + y^2} = 0$$

$$2ux_0 + 2vy_0 = 1$$

Line in u-v space



Find three hits belong to straight line in u-v space use them as the seeding, later use combinatorial track finding and fitting

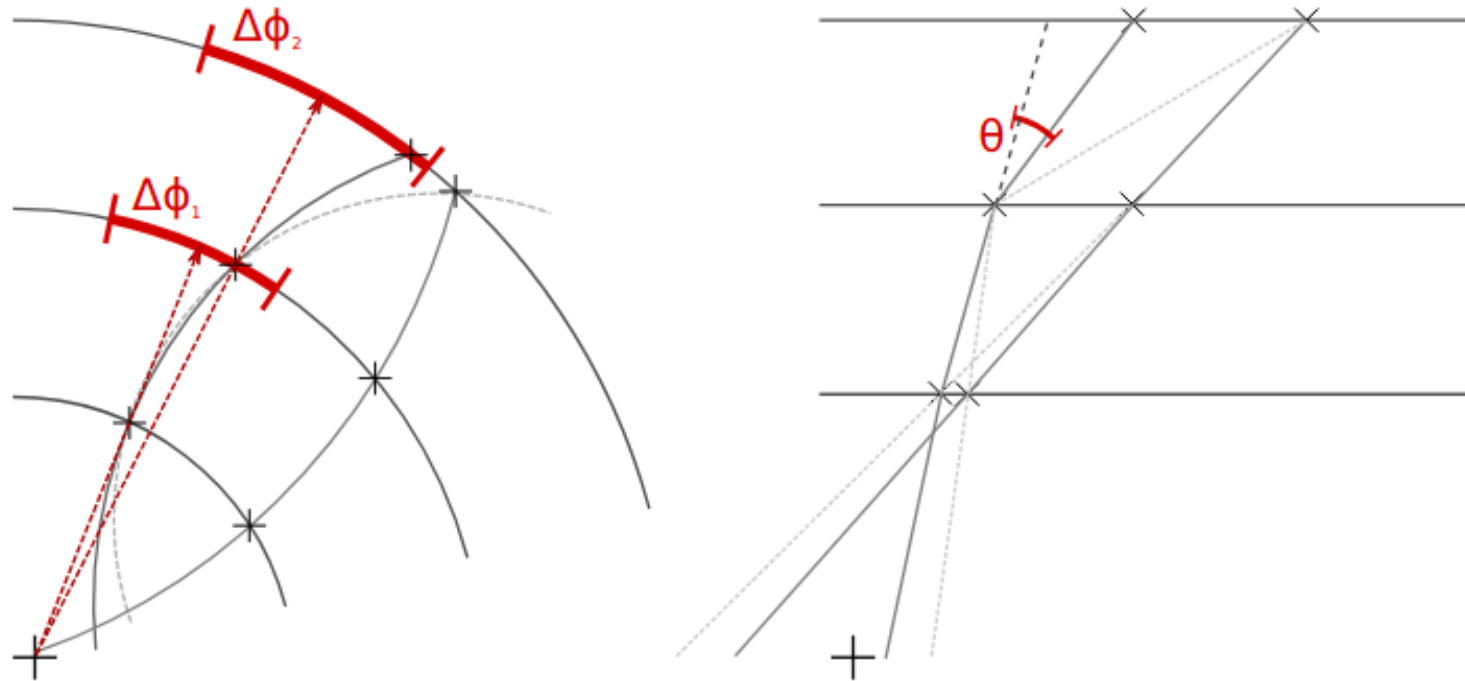


Figure 2. Illustration of the combinatorial seed finder for three-hit seeds in a barrel-like detector. Left: projection of the helix trajectory into the xy-plane transverse to the magnetic field direction. The two search windows $\Delta\phi_{\{1,2\}}$ on the second and third layer are defined with respect to the space point in the preceding layer. Right: hit combinations in the rz-plane along the magnetic field direction. The $\Delta\theta$ cut is defined as the difference in polar angle between the two hit doublets. Solid lines indicate true seeds, dashed lines indicate combinatorial background.

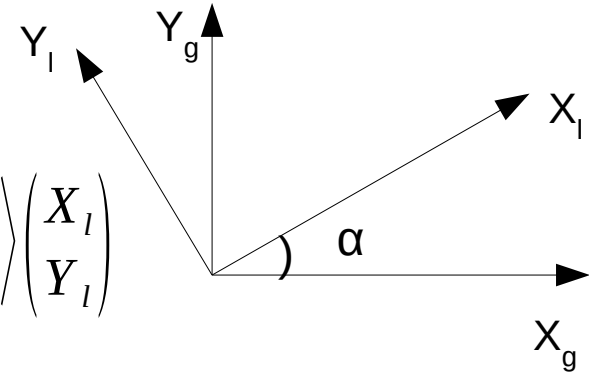
Track Parameters in ALICE

Track Parameters (Local): $(y, z, \sin \phi, \tan \lambda, q/p_T)$

On cylindrical surface:

$$x^2 + y^2 = R^2$$

$$\begin{pmatrix} X_g \\ Y_g \end{pmatrix} = \begin{pmatrix} \cos \alpha & -\sin \alpha \\ \sin \alpha & \cos \alpha \end{pmatrix} \begin{pmatrix} X_l \\ Y_l \end{pmatrix}$$



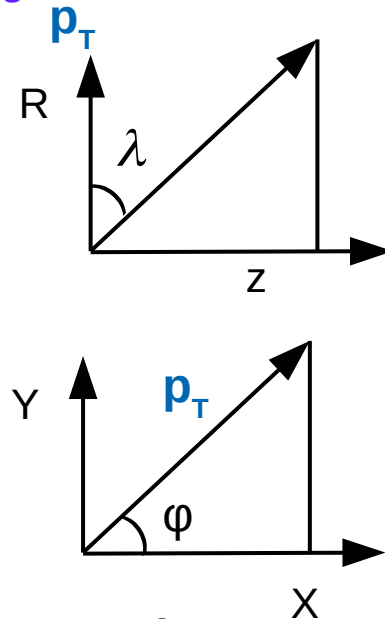
Local coordinates rotated by α
w.r.t. global coordinates

$$\frac{\sigma_{1/p_t}}{(1/p_t)} = \frac{1/p_t^2 * \sigma_{p_t}}{(1/p_t)} = \frac{\sigma_{p_t}}{p_t} \quad \sigma_{DCA_r\phi}^2 = \sigma_y^2 \quad \sigma_{DCA_z}^2 = \sigma_z^2$$

Parameter Covariance

Track Parameters

$$W = \begin{pmatrix} \sigma_y^2 & \sigma_{yz} & \sigma_{y \sin \phi} & \sigma_{y \tan \lambda} & \sigma_{y \cdot 1/p_T} \\ \sigma_{zy} & \sigma_z^2 & \sigma_{z \sin \phi} & \sigma_{z \tan \lambda} & \sigma_{z \cdot 1/p_T} \\ \sigma_{\sin \phi y} & \sigma_{\sin \phi z} & \sigma_{\sin \phi}^2 & \sigma_{\sin \phi \tan \lambda} & \sigma_{\sin \phi \cdot 1/p_T} \\ \sigma_{\tan \lambda y} & \sigma_{\tan \lambda z} & \sigma_{\tan \lambda \sin \phi} & \sigma_{\tan \lambda}^2 & \sigma_{\tan \lambda \cdot 1/p_T} \\ \sigma_{1/p_T \cdot y} & \sigma_{1/p_T \cdot z} & \sigma_{1/p_T \cdot \sin \phi} & \sigma_{1/p_T \cdot \tan \lambda} & \sigma_{1/p_T}^2 \end{pmatrix}$$

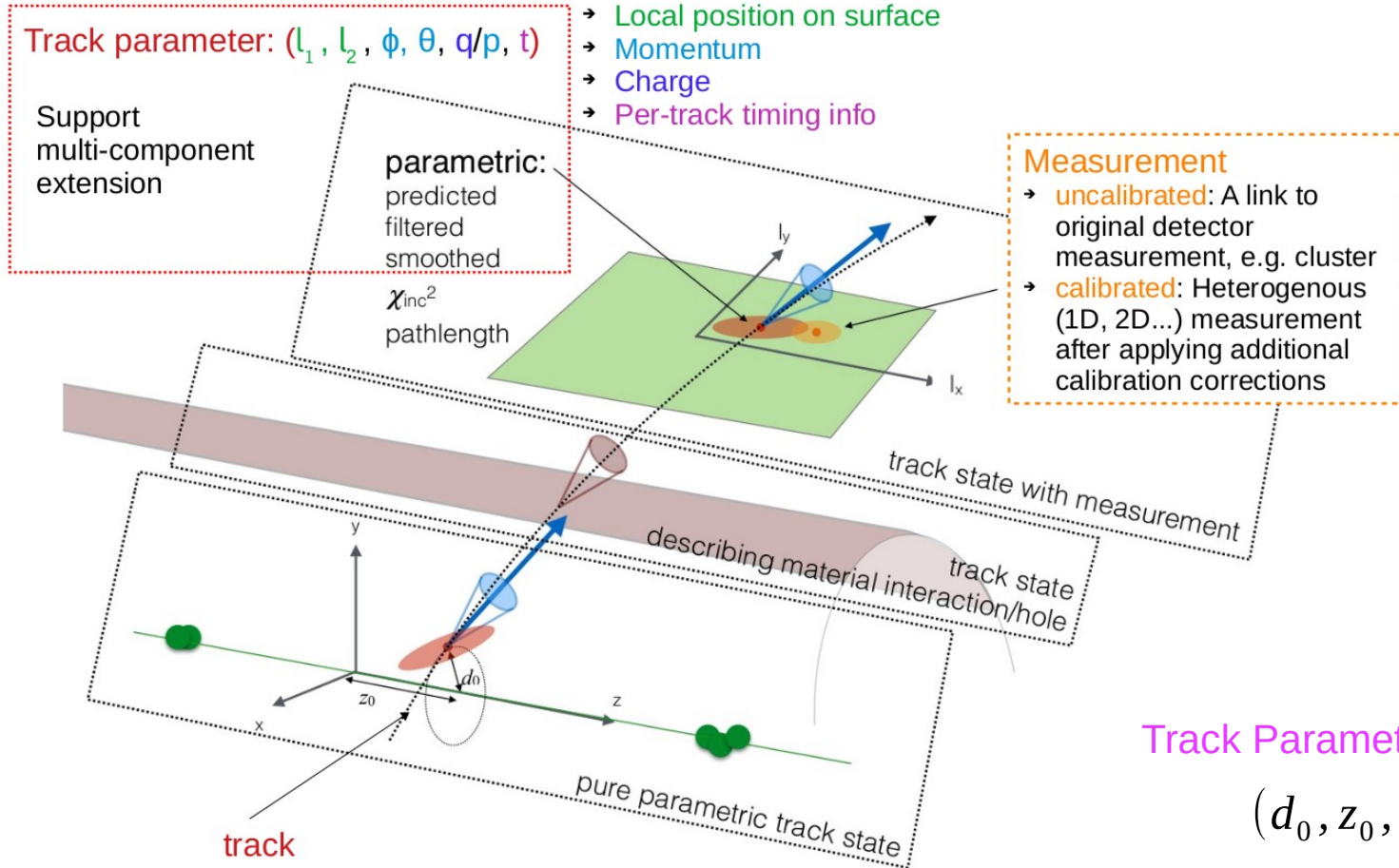


Parameter Covariance matrix = 5X5 matrix; $5(5+1)/2 = 15$ independent entries

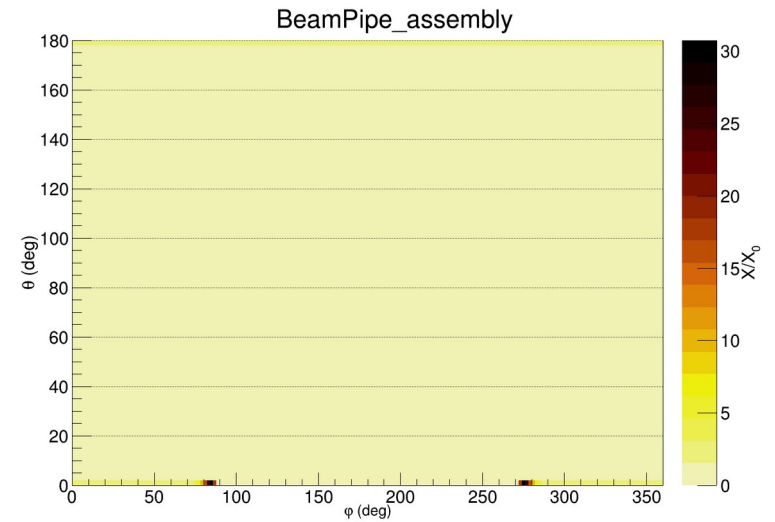
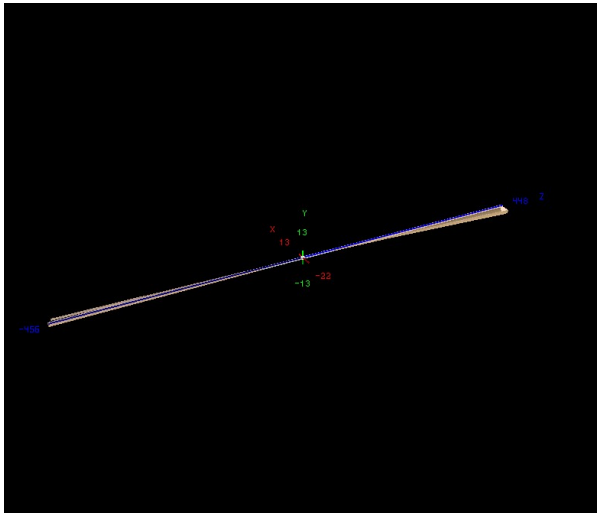
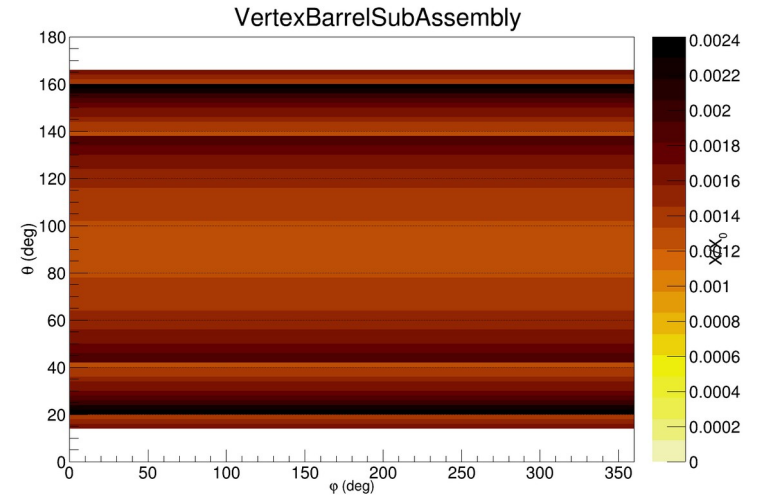
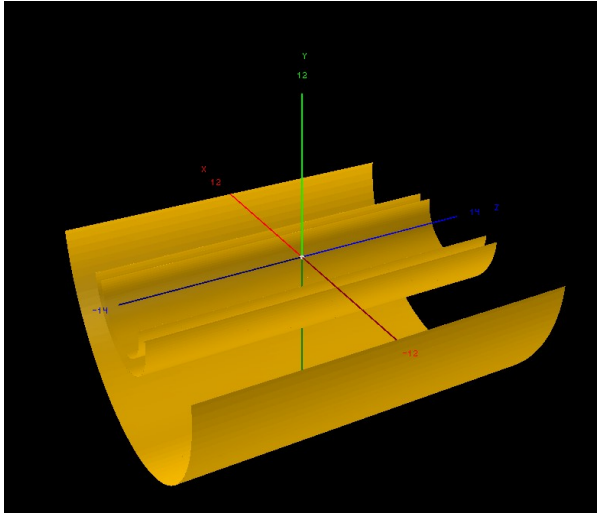
$$(\sigma_y^2, \sigma_{yz}, \sigma_{y \sin \phi}, \sigma_{y \tan \lambda}, \sigma_{y \cdot 1/p_T}, \sigma_z^2, \sigma_{z \sin \phi}, \sigma_{z \tan \lambda}, \sigma_{z \cdot 1/p_T}, \sigma_{\sin \phi}^2, \sigma_{\sin \phi \tan \lambda}, \sigma_{\sin \phi \cdot 1/p_T}, \sigma_{\tan \lambda}^2, \sigma_{\tan \lambda \cdot 1/p_T}, \sigma_{1/p_T}^2)$$

Event Data Model (EDM)

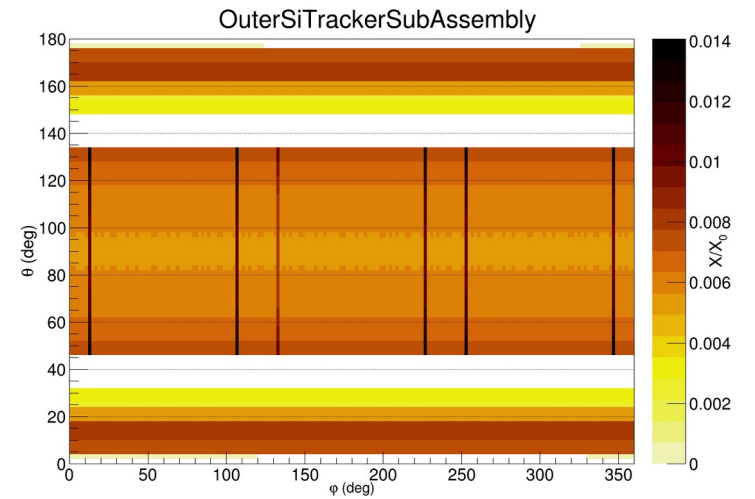
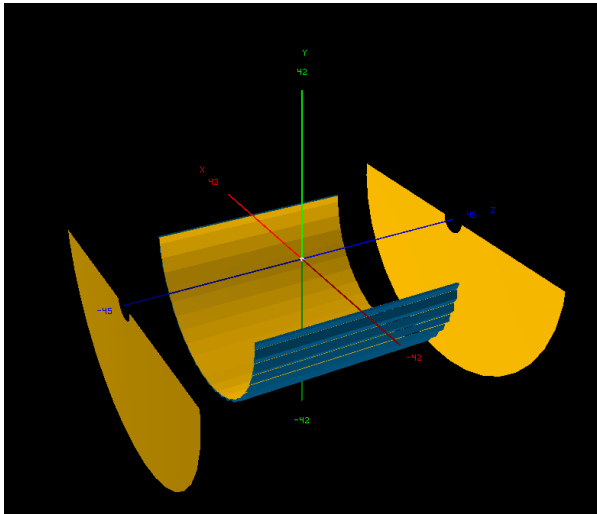
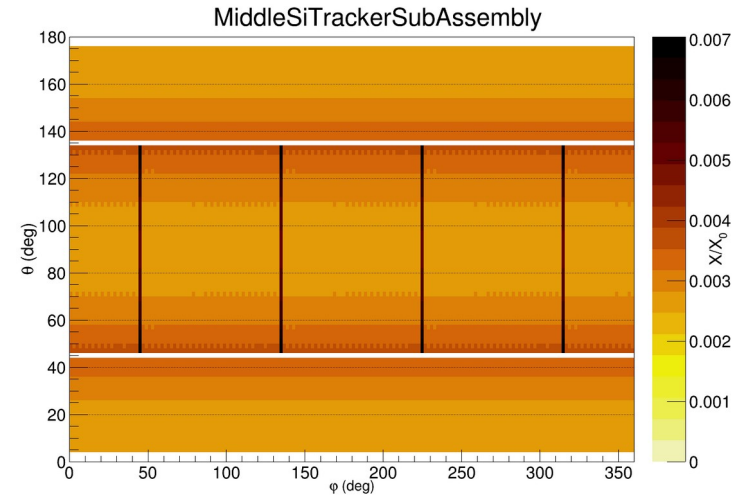
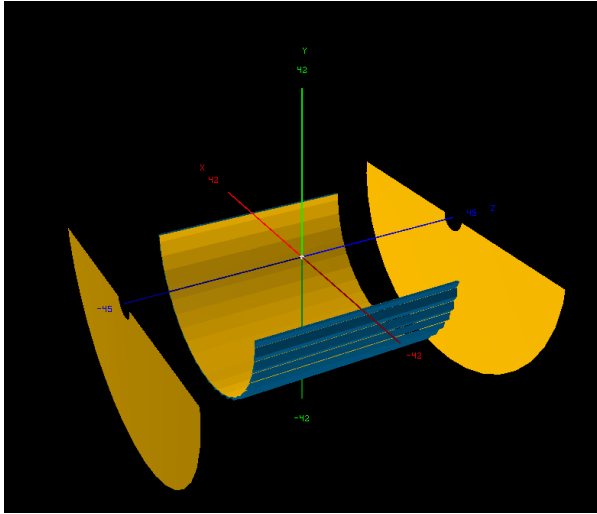
How to describe track parameter, measurement, track state and track...



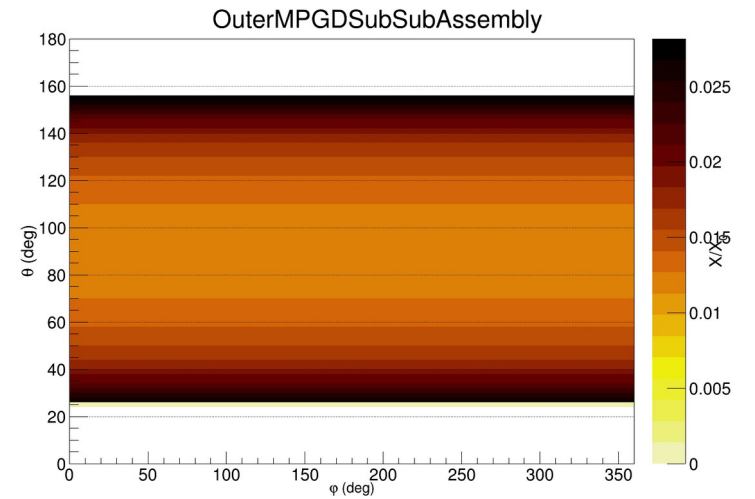
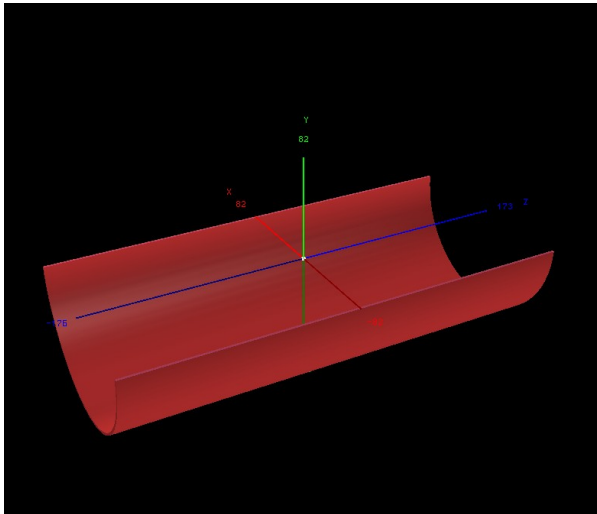
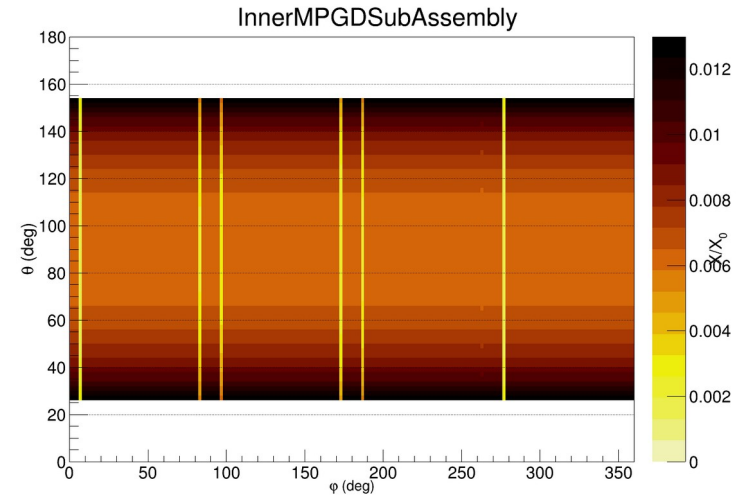
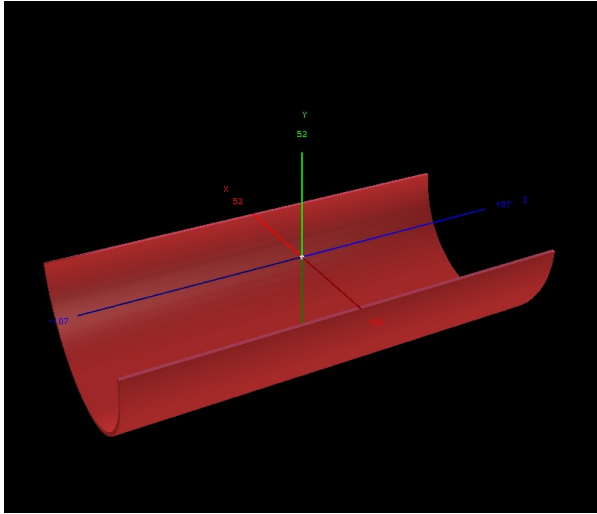
Material Budget (EPC_Tracking_Only DD4HEP)



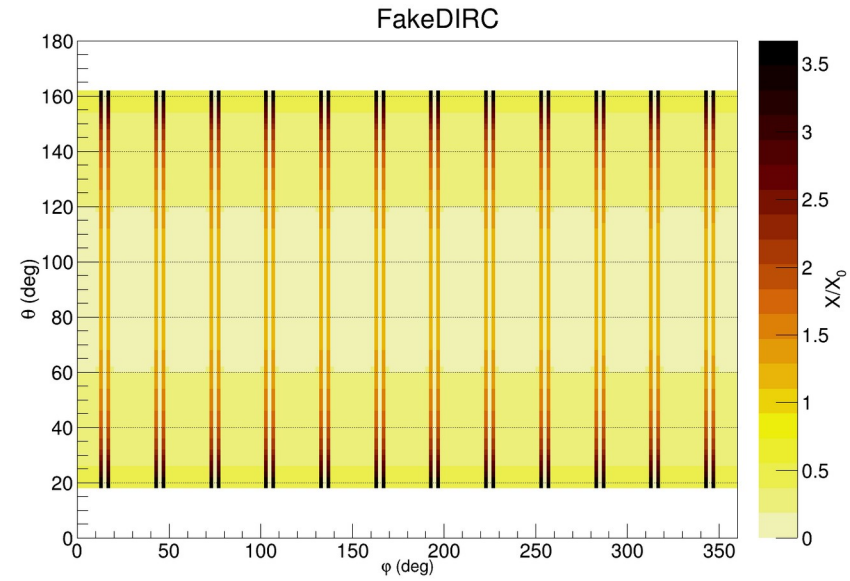
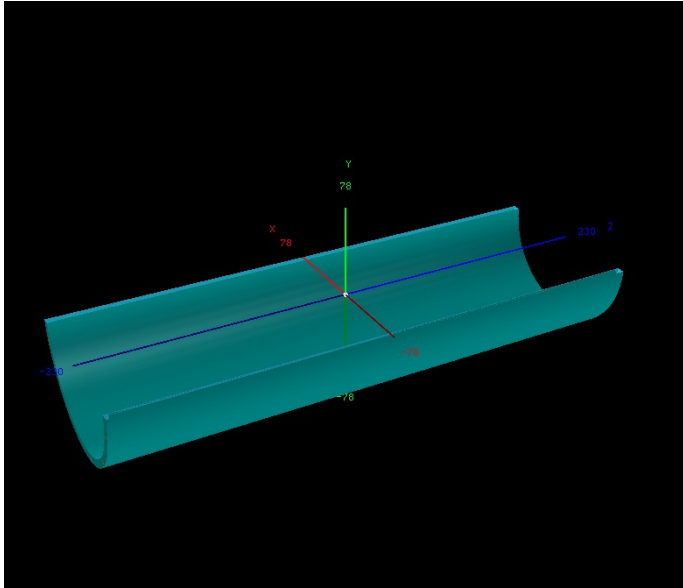
Material Budget



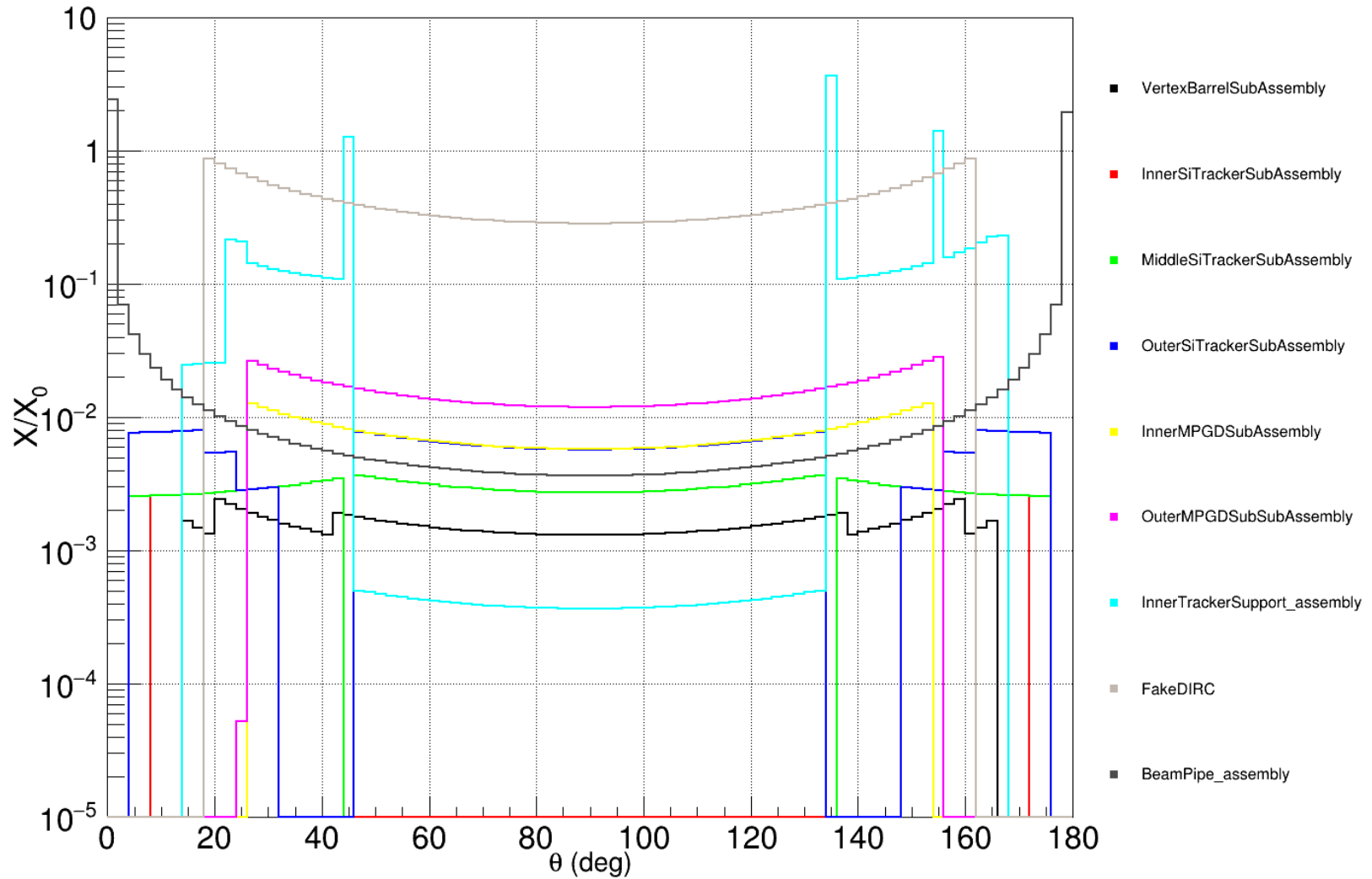
Material Budget



Material Budget

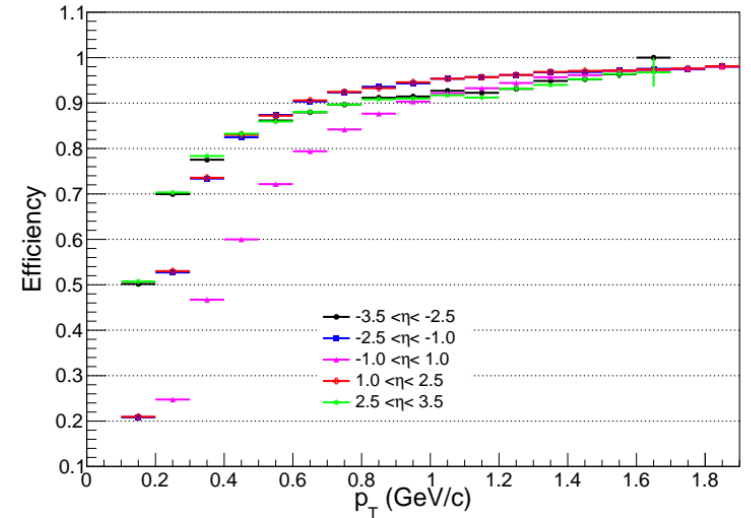
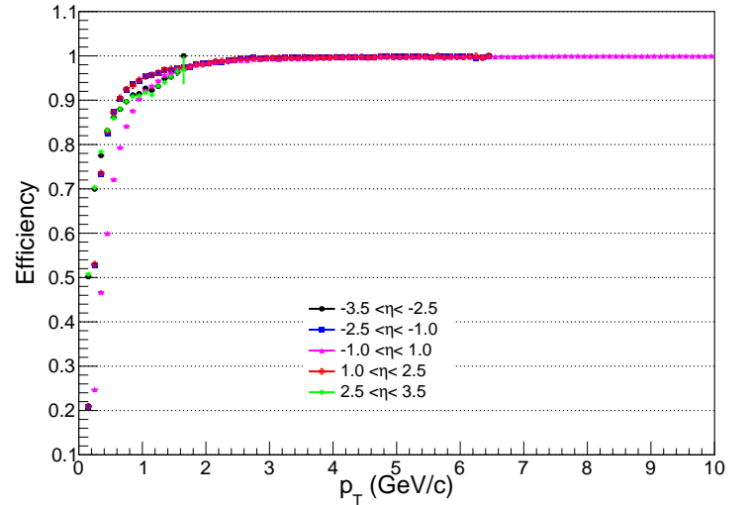
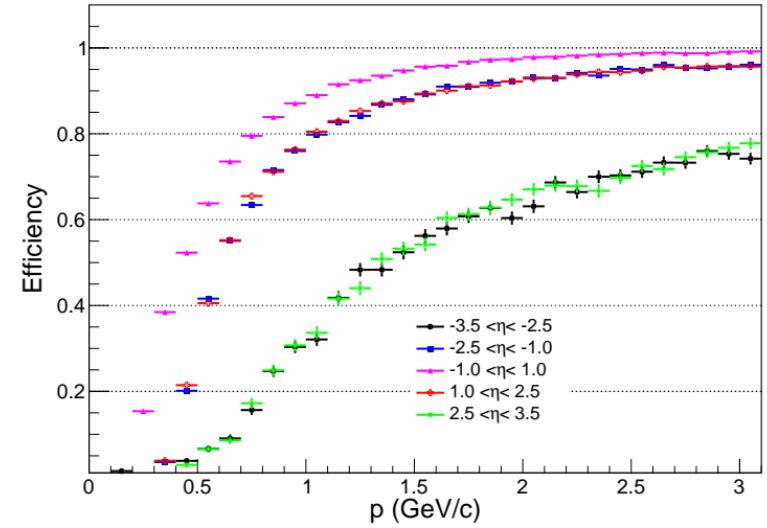
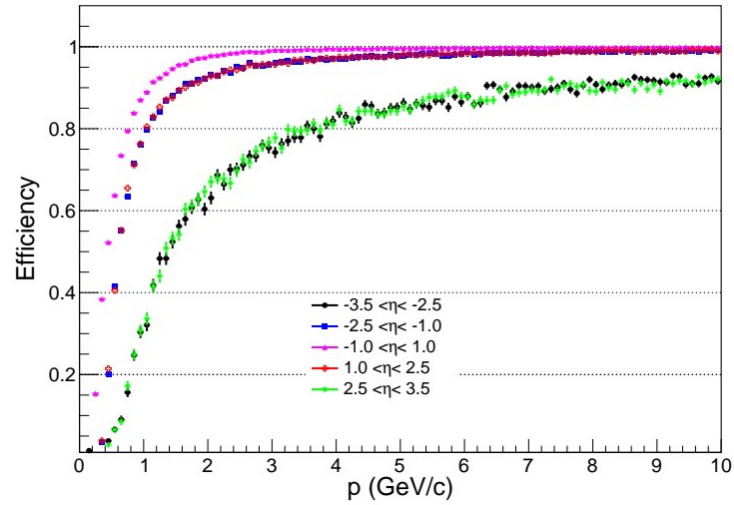


Material Budget

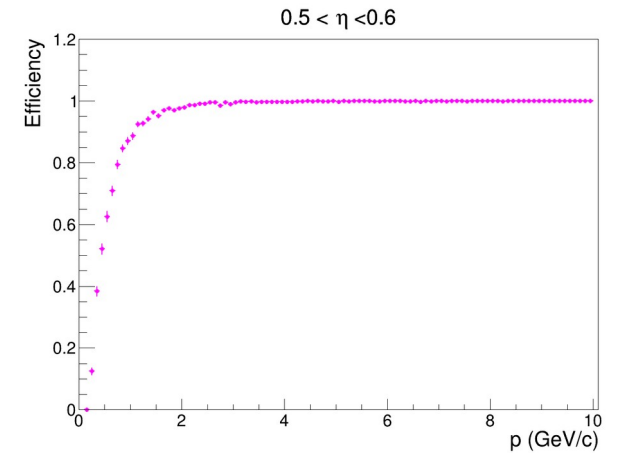
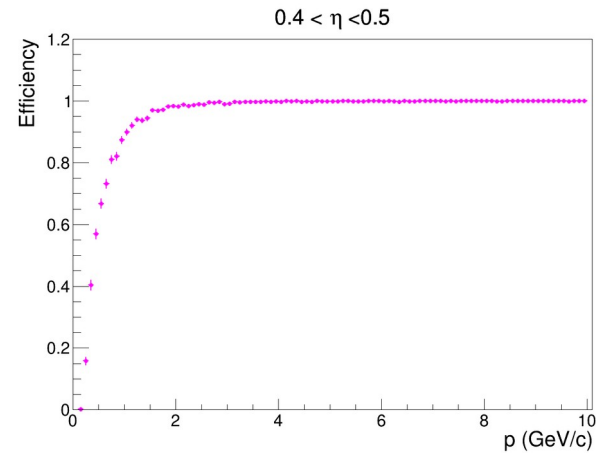
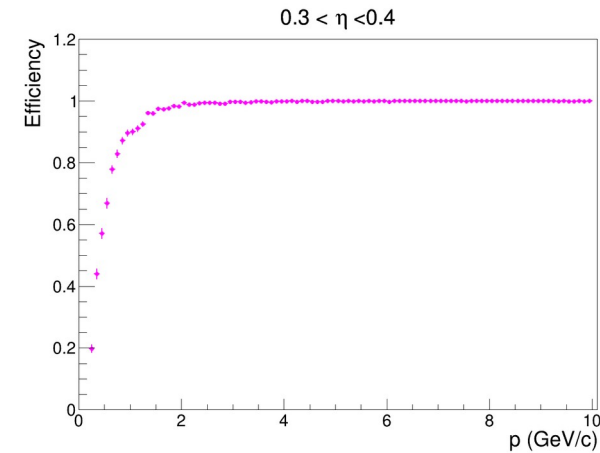
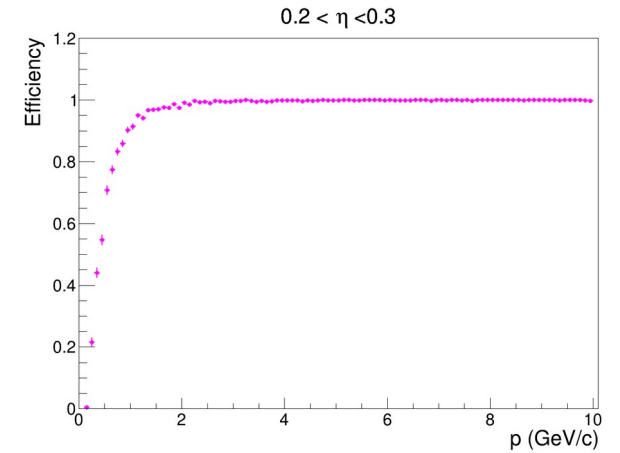
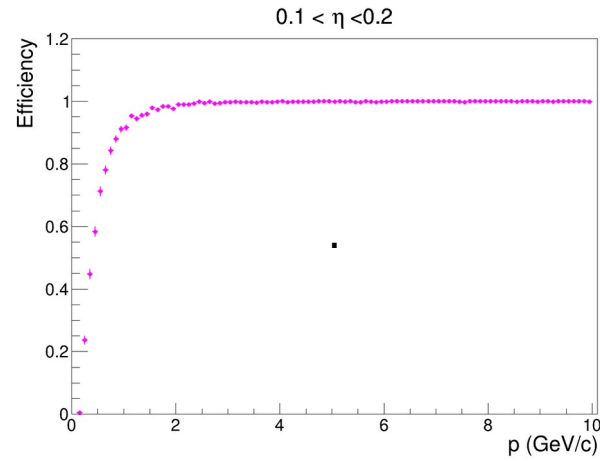
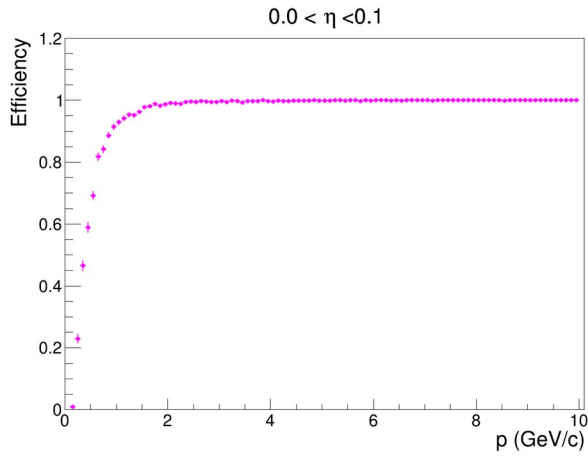


Efficiency

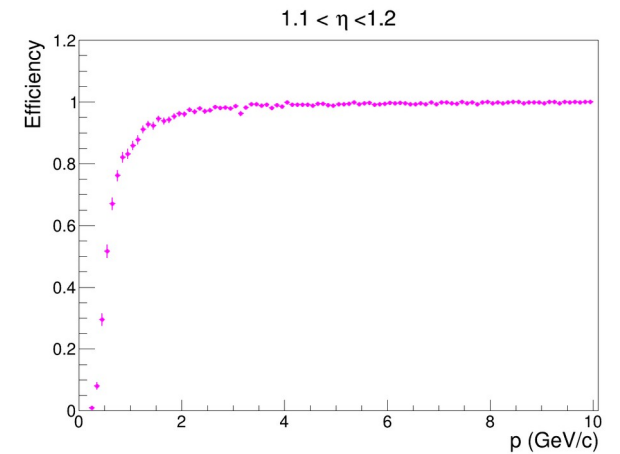
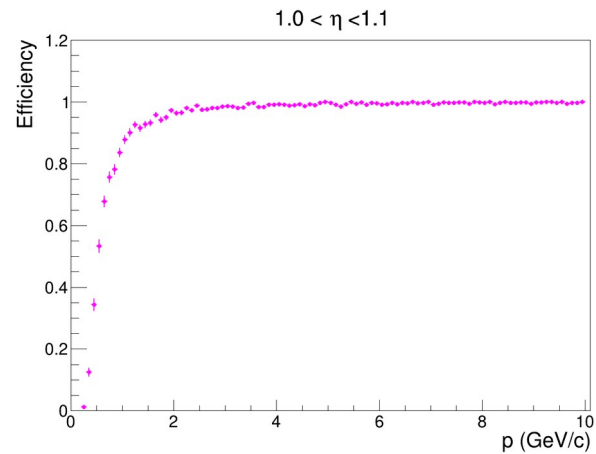
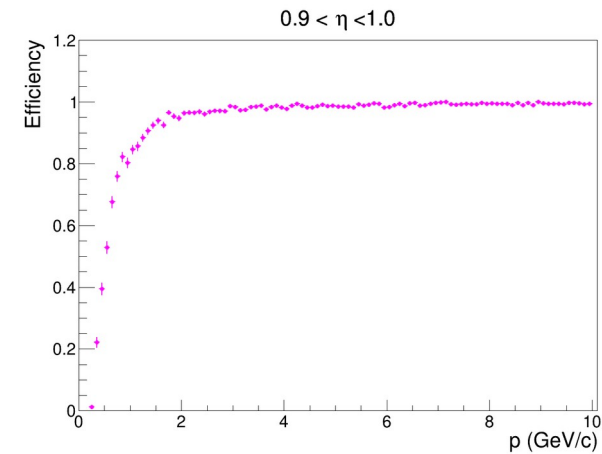
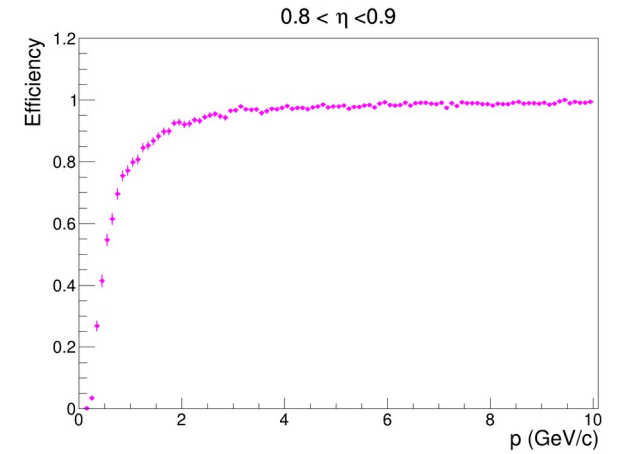
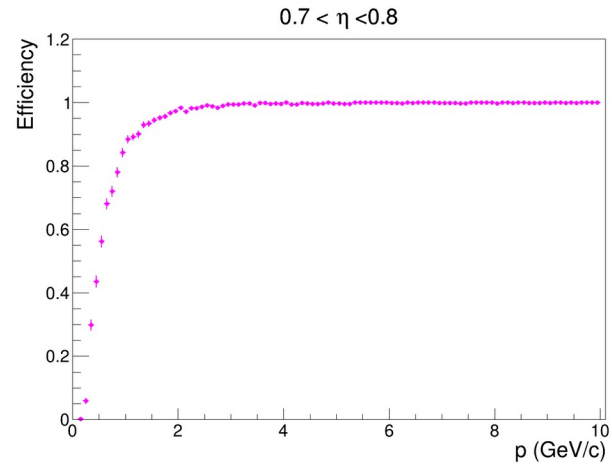
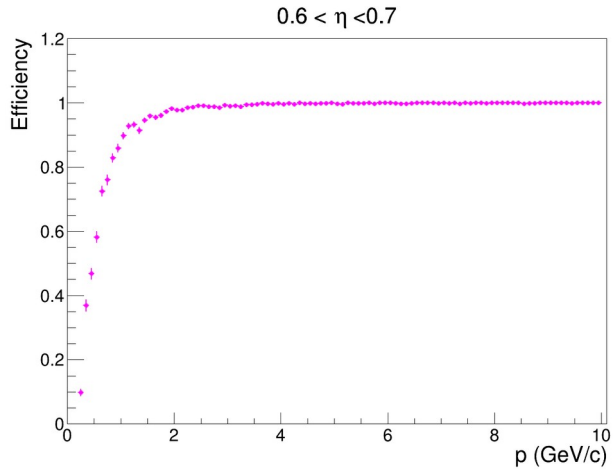
3 M Pi+ using particle gun



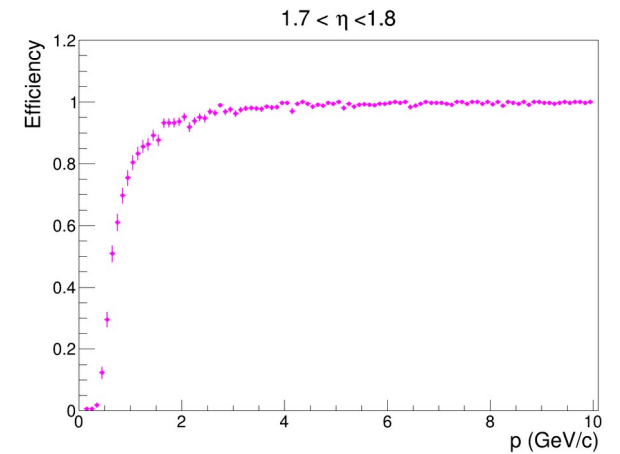
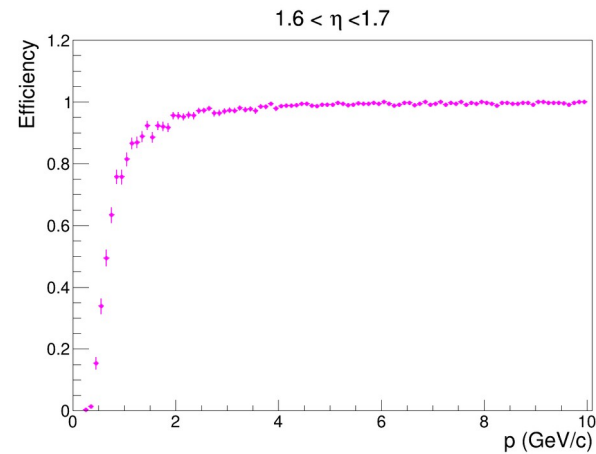
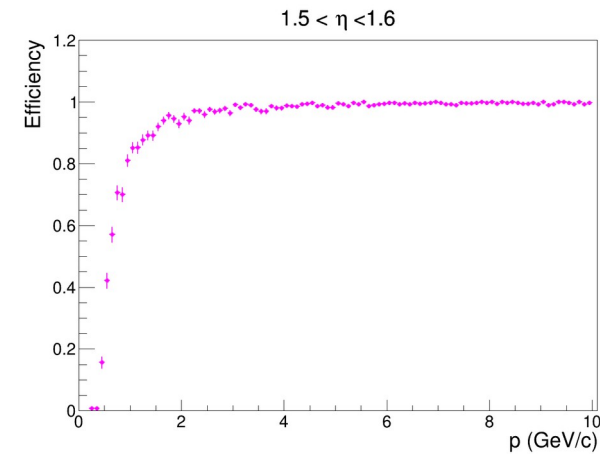
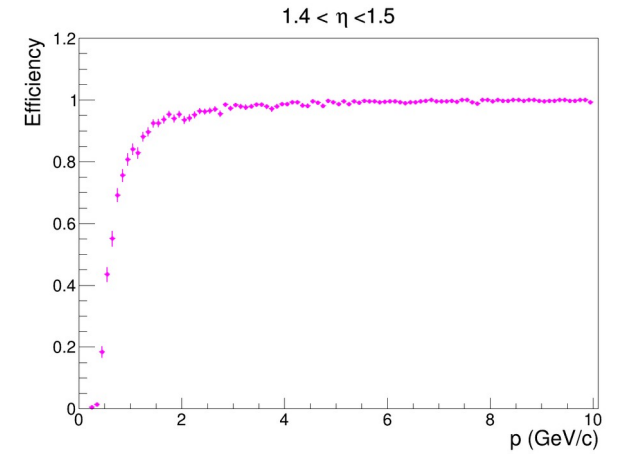
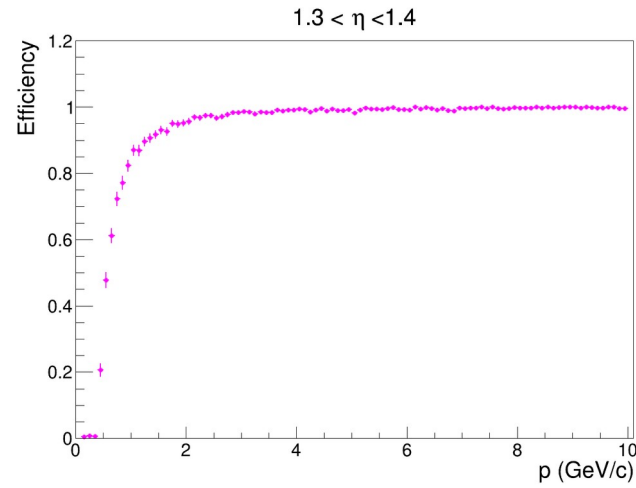
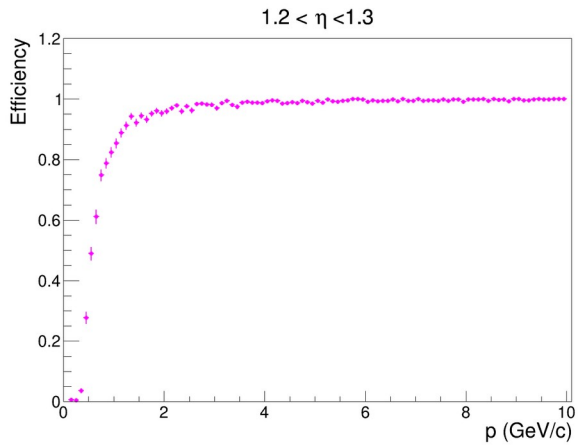
Efficiency Details



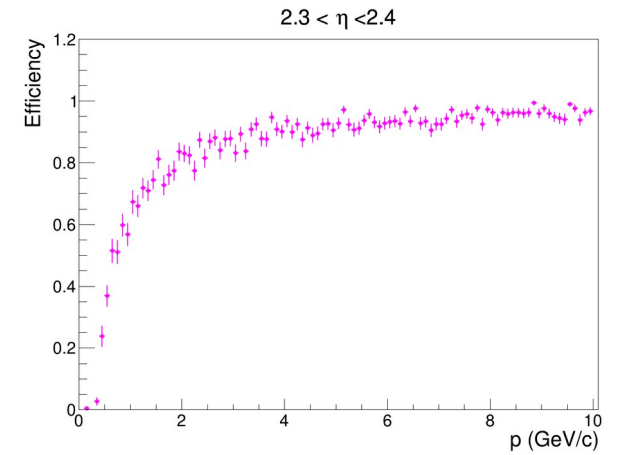
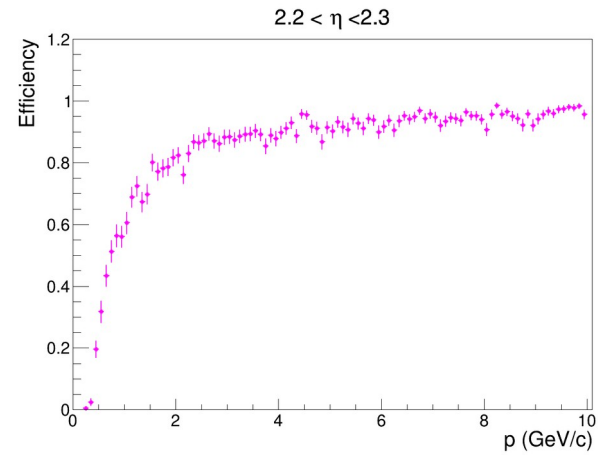
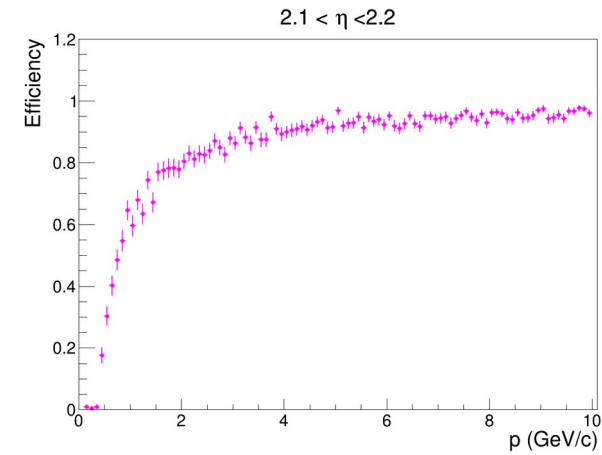
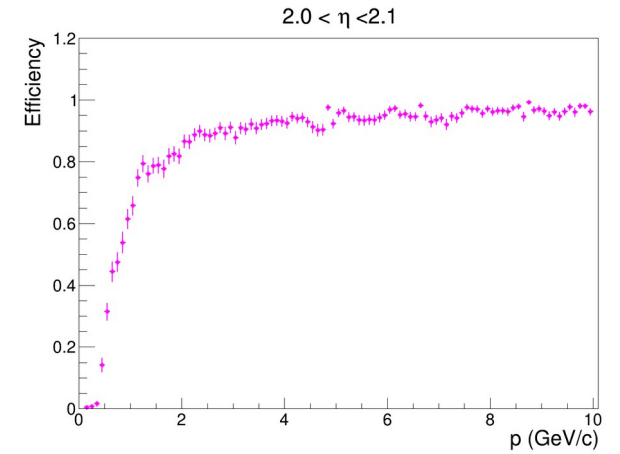
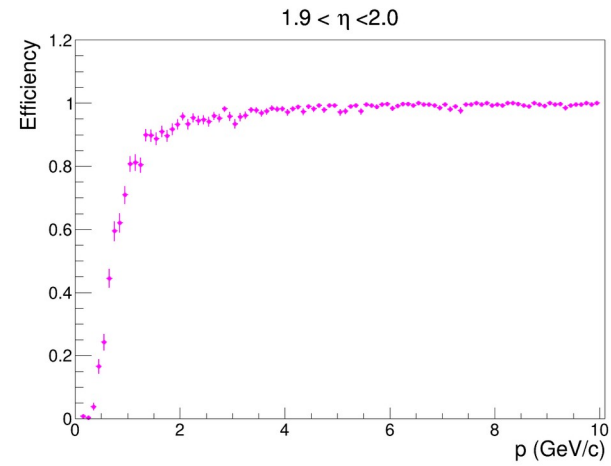
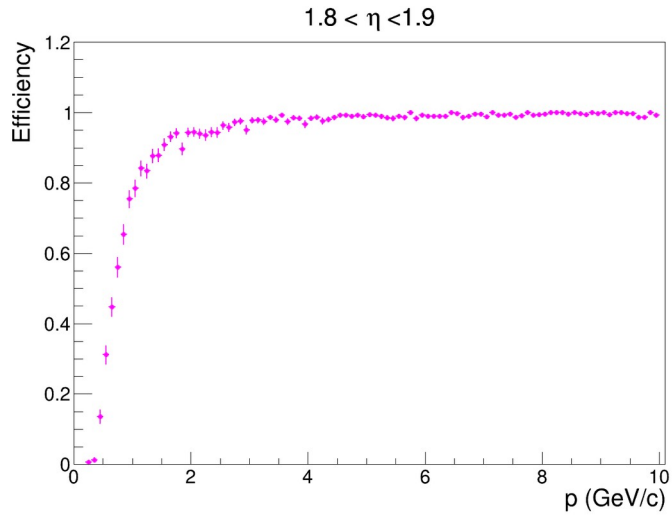
Efficiency Details



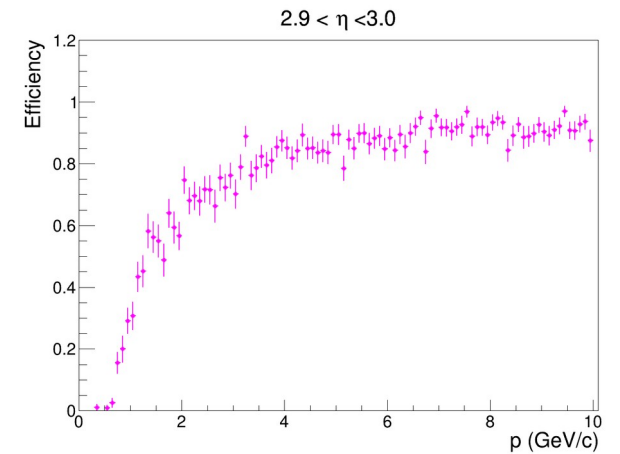
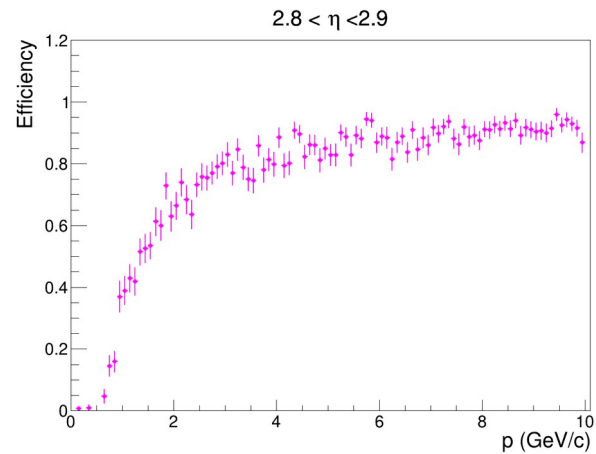
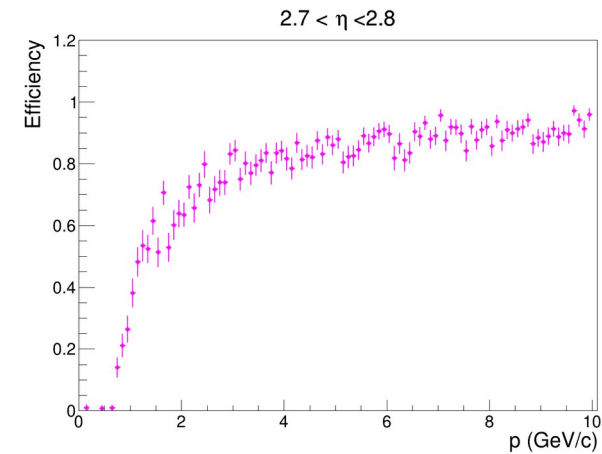
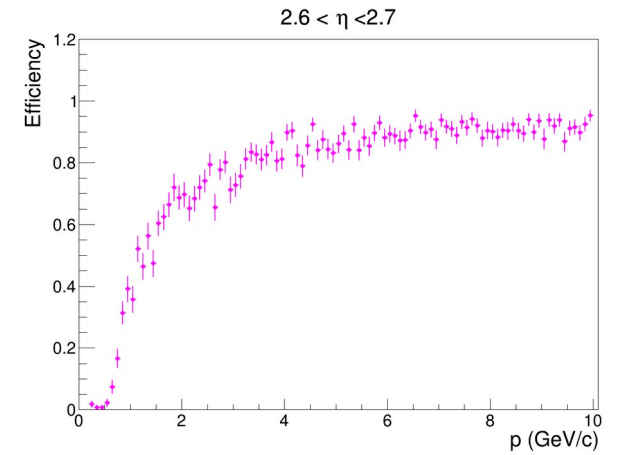
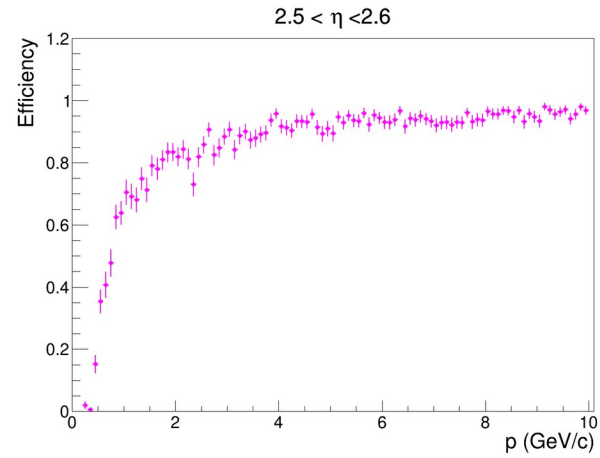
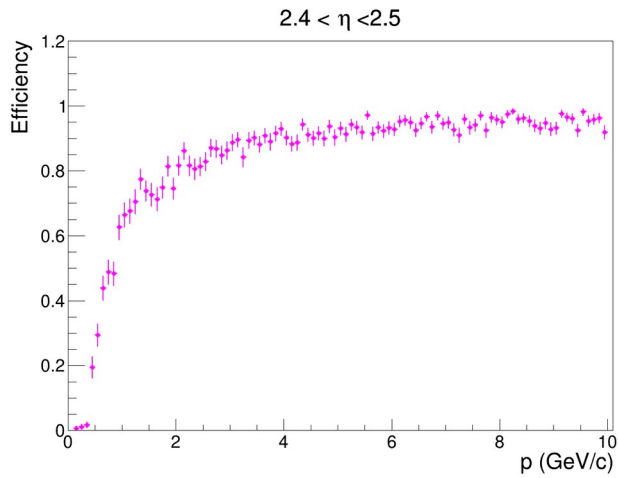
Efficiency Details



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Efficiency Details

