

Primary Vertexing with Machine Backgrounds

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Reconstruction of D^0 meson

Primary Vertex Reconstruction:

Reconstructed Tracks

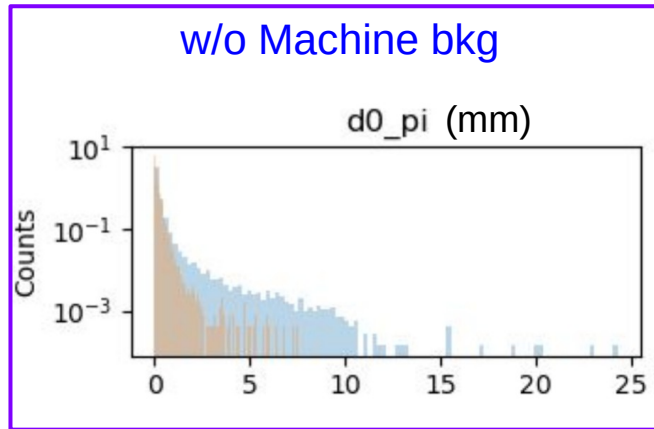
CentralTrackVertices

PrimaryVertices

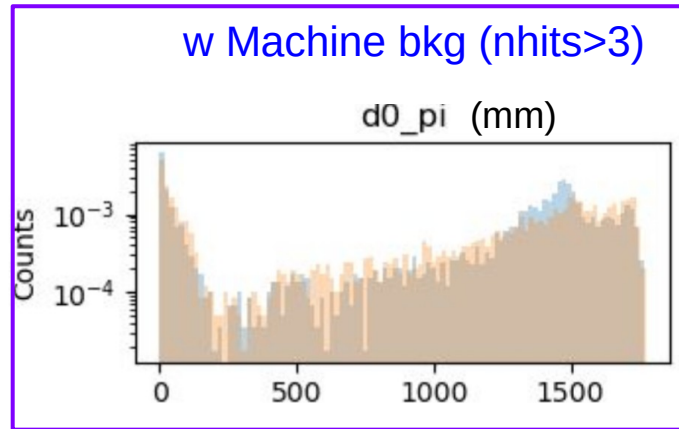
Seed Vertices indices (0,1,2,...)

Slides (connie)

10x100 ep, $Q^2 > 1$

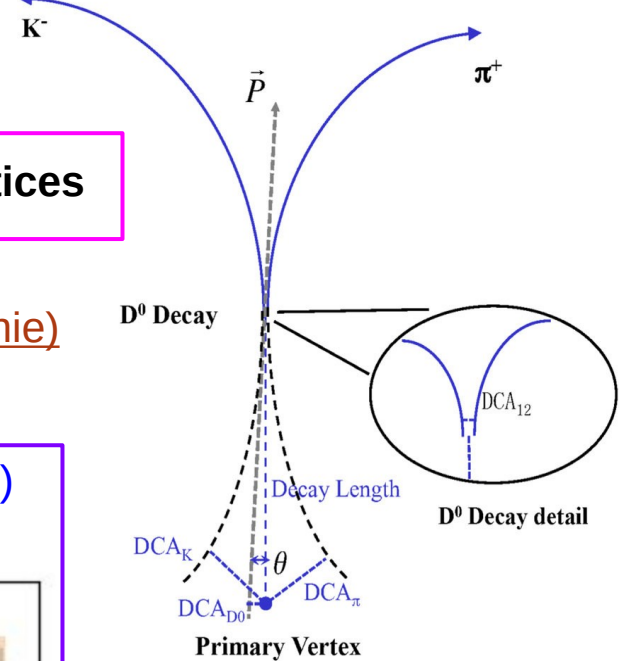


Signal (D^0 sample)



Bkg (DIS Sample)

Phys. Rev. C 102, 014905 (2020)

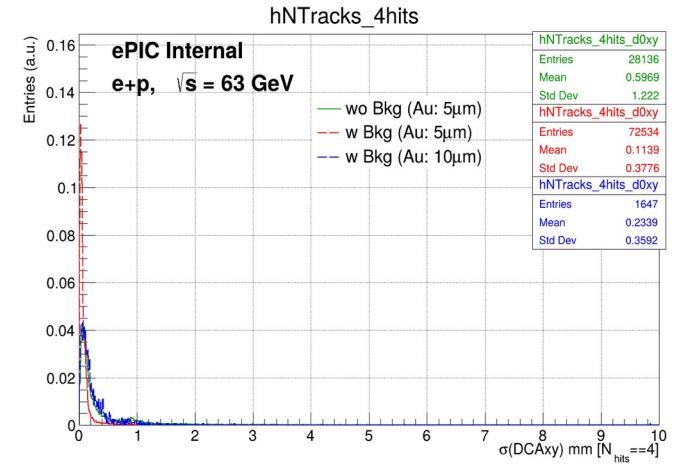
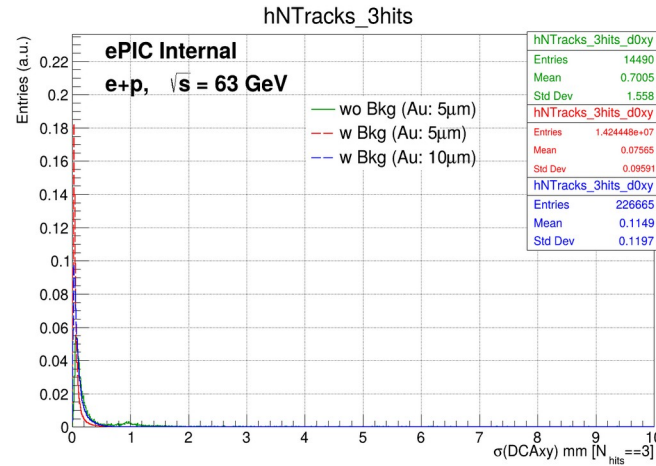
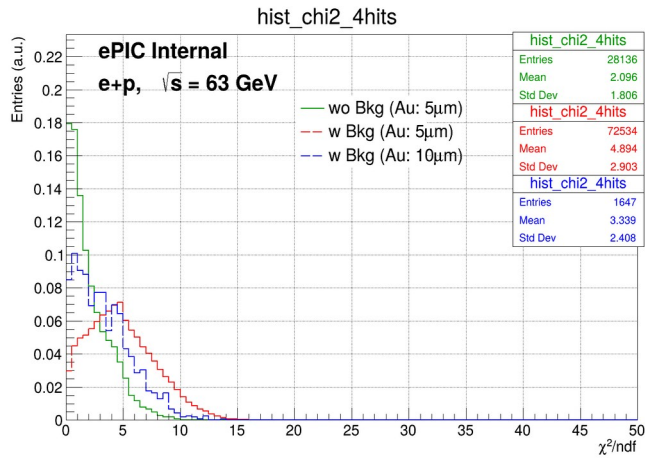
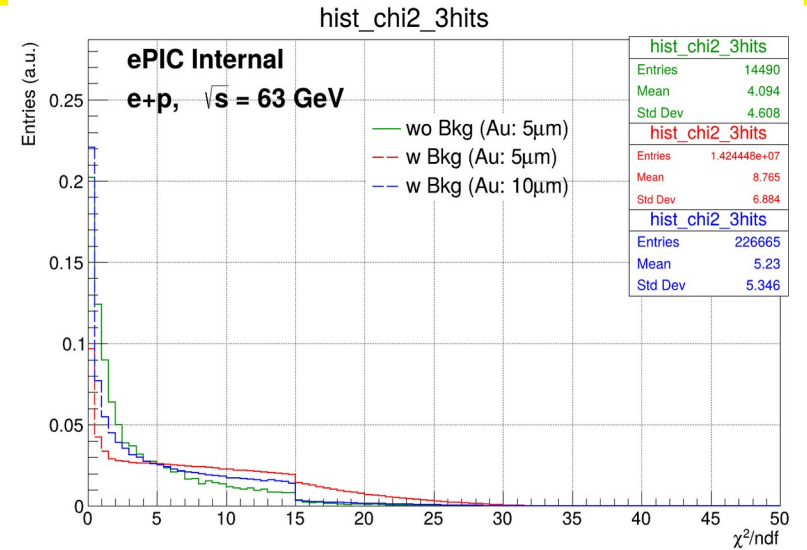
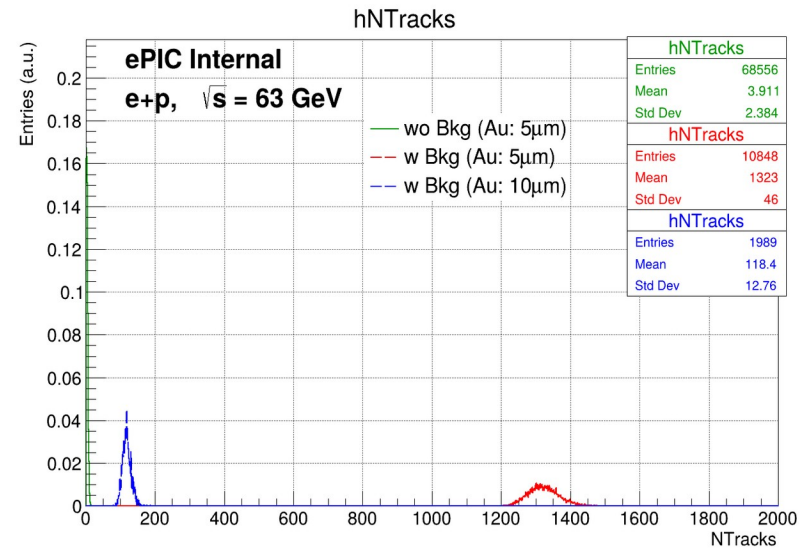


$d0_{\pi} = DCA_{\pi}$ (plot)

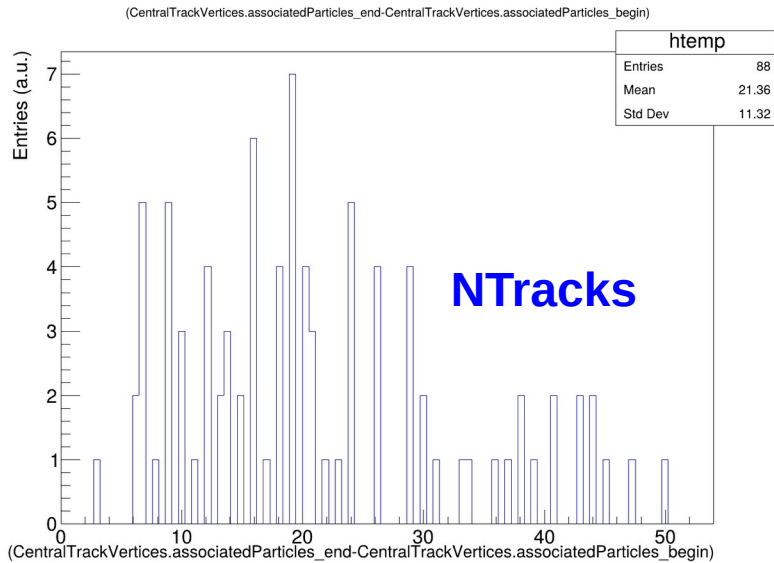
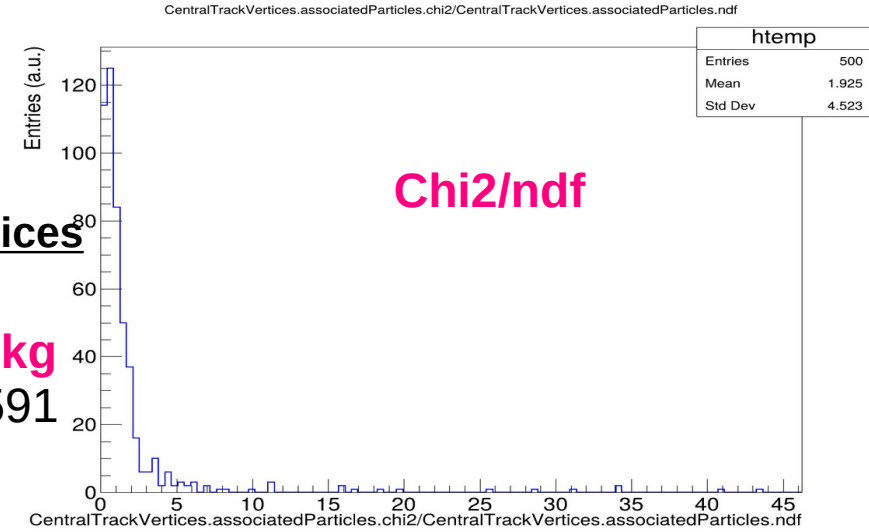
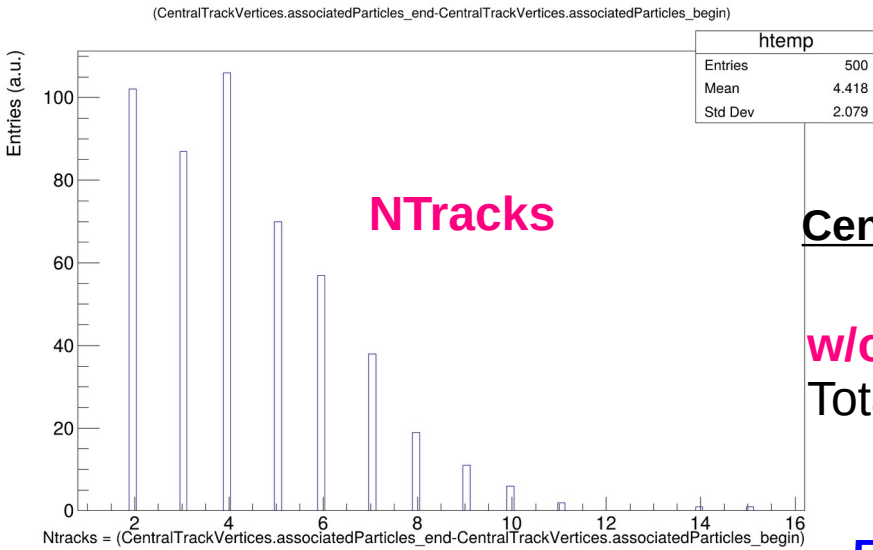
Broadening of $d0_{\pi}$ distribution points some issue in the primary vertex position (**DIS Sample**)

/volatile/eic/EPIC//RECO/26.03.0/epic_craterlake/Bkg_Exact1S_2us/GoldCt/10um/DIS (DISSample)

Reconstructed Tracks (CentralCKFTrackParameters)

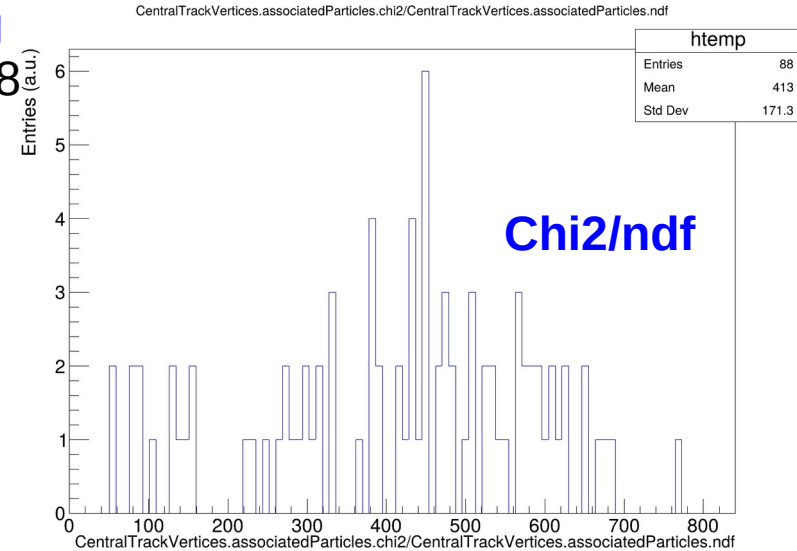


Primary Vertex w/o and w Machine Backgrounds (October 2025)

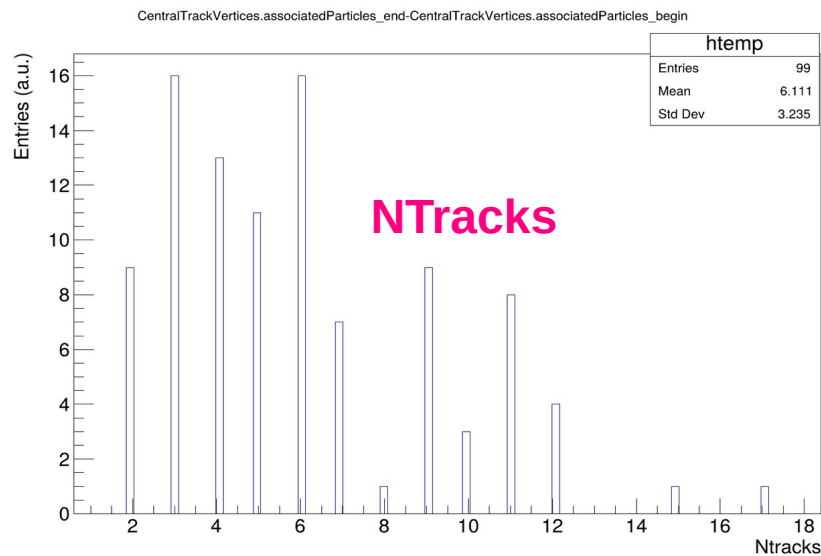


**5 μ m Au coating
w Machine Bkg**

Total events = 48

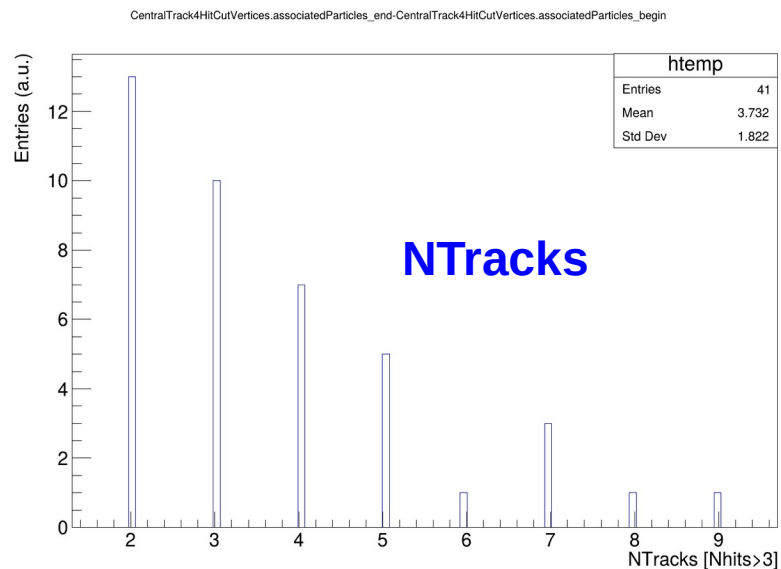
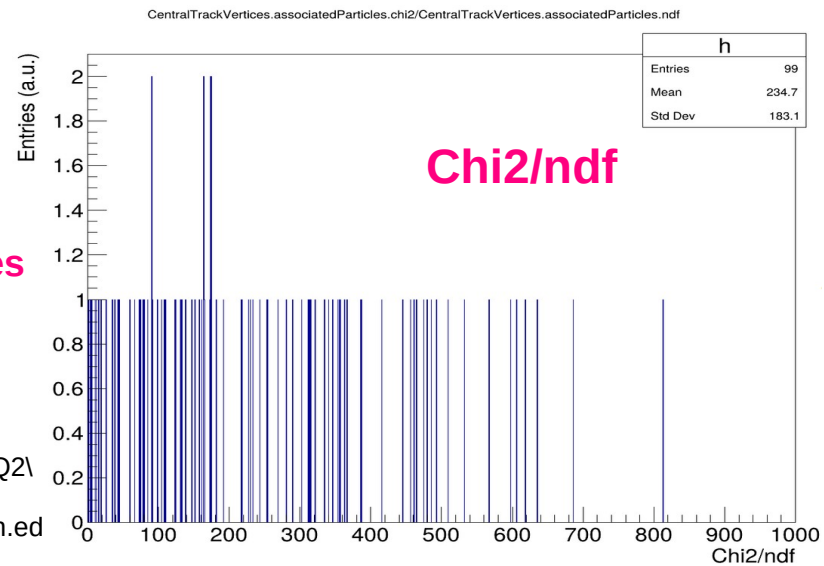


Primary Vertex w Machine Backgrounds (March 2026)

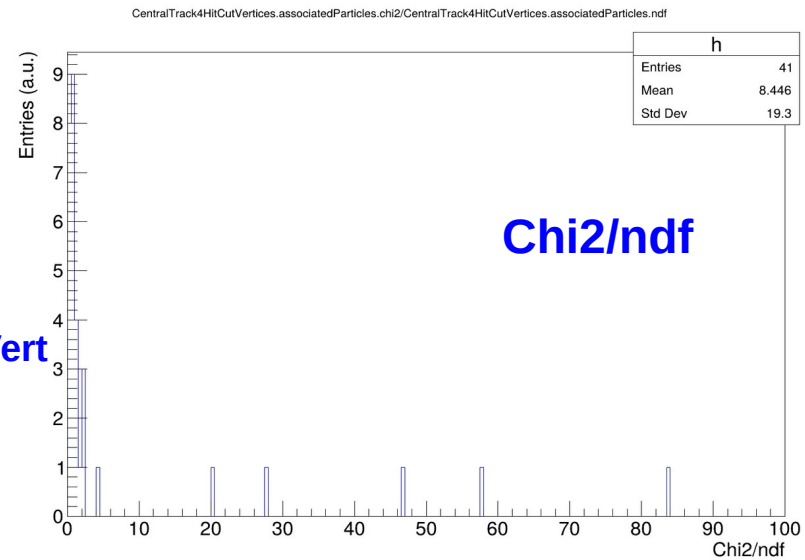


**10 μm Au coating
CentralTrackVertices
Total events = 39**

pythia8NCDIS_10x100_minQ2\
=1_beamEffects_xAngle\
0.025_hiDiv_1.0000.eicrecon.ed
m4eic.root

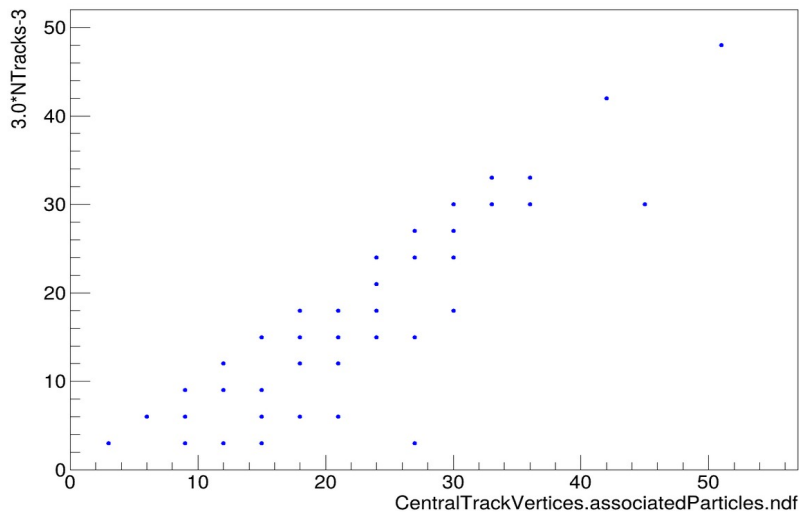


**Nhits>3
10 μm Au coating
CentralTrack4HitCutVert
ices
Total events = 39**



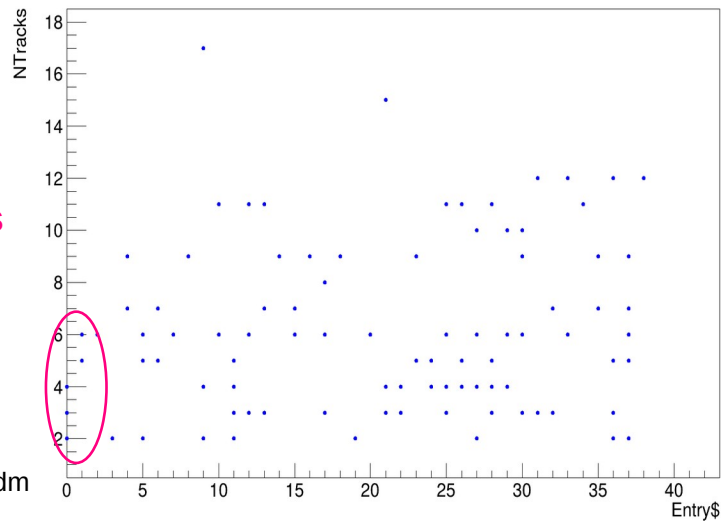
Primary Vertex w Machine Backgrounds (March 2026)

3.0*(CentralTrackVertices.associatedParticles_end-CentralTrackVertices.associatedParticles_begin)-3:CentralTrackVertices.associatedParticles.ndf

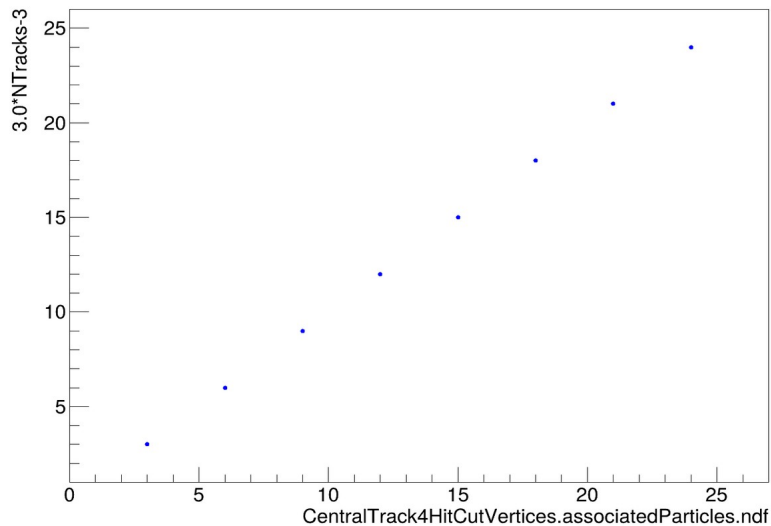


10 μm Au coating
CentralTrackVertices
Total events = 39

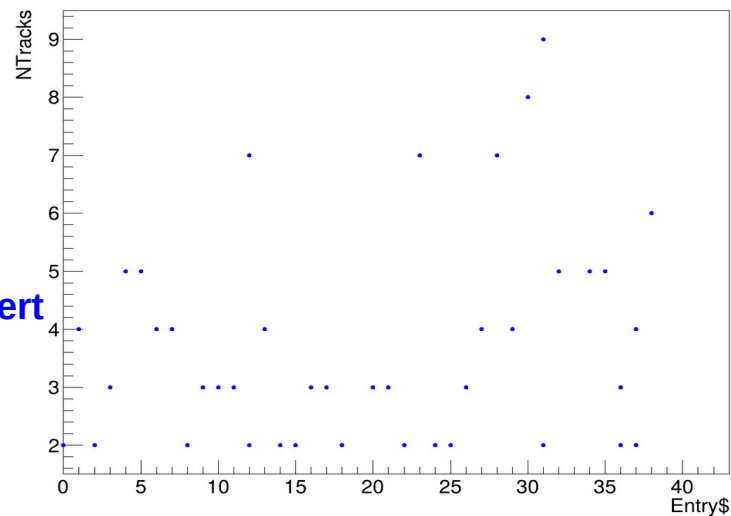
`pythia8NCDIS_10x100_minQ2\
=1_beamEffects_xAngle\
=0.025_hiDiv_1.0000.eicrecon.edm
4eic.root`



3.0*(CentralTrack4HitCutVertices.associatedParticles_end-CentralTrack4HitCutVertices.associatedParticles_begin)-3:CentralTrack4HitCutVertices.associatedParticles.ndf



Nhits>3
10 μm Au coating
**CentralTrack4HitCutVert
ices**
Total events = 39



Primary Vertices Contributors

```

*****
* Event * CTVld * NTracks * Chi2/ndf * PVld *
*****
* 0 * 0 * 4 * 44.825731 * 0 *
* 0 * 1 * 3 * 90.776652 * 1 *
* 0 * 2 * 2 * 77.564951 * 2 *
* 1 * 0 * 6 * 461.18099 * 0 *
* 1 * 1 * 6 * 227.18324 * 1 *
* 1 * 2 * 5 * 66.449620 * 2 *
* 2 * 0 * 6 * 164.00677 * 0 *
* 3 * 0 * 2 * 0.6729135 * 0 *
* 4 * 0 * 7 * 334.86699 * 1 *
* 4 * 1 * 9 * 252.62992 * *
* 5 * 0 * 2 * 1100.7133 * 2 *
* 5 * 1 * 5 * 72.928309 * 1 *
* 5 * 2 * 6 * 164.69259 * 0 *
* 6 * 0 * 7 * 415.92431 * 0 *
* 6 * 1 * 5 * 133.38862 * 1 *
* 7 * 0 * 6 * 91.522347 * 0 *
* 8 * 0 * 9 * 686.48974 * *
* 9 * 0 * 17 * 445.32601 * 1 *
* 9 * 1 * 4 * 345.55279 * 3 *
* 9 * 2 * 2 * 1.2486989 * 2 *
* 9 * 3 * 4 * 90.243611 * *
* 10 * 0 * 11 * 474.59833 * 1 *
* 10 * 1 * 6 * 567.28242 * *
* 11 * 0 * 2 * 108.01118 * 4 *
* 11 * 1 * 3 * 38.399136 * 2 *
* 11 * 2 * 4 * 635.13232 * 1 *
* 11 * 3 * 3 * 10.546546 * 3 *
* 11 * 4 * 5 * 42.583948 * 0 *
* 12 * 0 * 11 * 108.86196 * 0 *
* 12 * 1 * 3 * 25.849917 * 2 *
* 12 * 2 * 6 * 98.848673 * 1 *
* 13 * 0 * 7 * 385.74727 * 2 *
* 13 * 1 * 3 * 509.25791 * 0 *
* 13 * 2 * 11 * 243.47840 * 1 *
* 14 * 0 * 9 * 268.61698 * 0 *
* 15 * 0 * 6 * 163.52770 * 1 *
* 15 * 1 * 7 * 172.94673 * 0 *
    
```

CentralTrackVertices
PV with >=3hits tracks

CentralTrack4HitCutVertices
PV with >3hits tracks

```

*****
* Event * CTVld * NTracks * Chi2/ndf * PVld *
*****
* 0 * 0 * 2 * 1.0719711 * 0 *
* 1 * 0 * 4 * 2635.9275 * *
* 2 * 0 * 2 * 0.0866628 * 0 *
* 3 * 0 * 3 * 20.336893 * 0 *
* 4 * 0 * 5 * 0.2696957 * 0 *
* 5 * 0 * 5 * 0.2708678 * 0 *
* 6 * 0 * 4 * 0.5854042 * 0 *
* 7 * 0 * 4 * 12114.903 * *
* 8 * 0 * 2 * 0.3486811 * 0 *
* 9 * 0 * 3 * 460.04321 * 0 *
* 10 * 0 * 3 * 0.6729670 * 0 *
* 11 * 0 * 3 * 1.7874186 * 0 *
* 12 * 0 * 7 * 0.6600161 * 0 *
* 12 * 1 * 2 * 716362.58 * *
* 13 * 0 * 4 * 1959.6536 * *
* 14 * 0 * 2 * 2.2963560 * 0 *
* 15 * 0 * 2 * 83.748352 * 0 *
* 16 * 0 * 3 * 57.517700 * 0 *
* 17 * 0 * 3 * 1.0059920 * 0 *
* 18 * 0 * 2 * 0.0144712 * 0 *
* 19 * 0 * * * *
* 20 * 0 * 3 * 3464.5979 * *
* 21 * 0 * 3 * 0.5398761 * 0 *
* 22 * 0 * 2 * 27.915715 * 0 *
* 23 * 0 * 7 * 0.9096813 * 0 *
* 24 * 0 * 2 * 0.1016478 * 0 *
* 25 * 0 * 2 * 0.4814544 * 0 *
* 26 * 0 * 3 * 9385.5514 * *
* 27 * 0 * 4 * 17896.444 * *
* 28 * 0 * 7 * 2.0060723 * 0 *
* 29 * 0 * 4 * 4.2534730 * 0 *
* 30 * 0 * 8 * 1.2561947 * 0 *
* 31 * 0 * 9 * 2.1425058 * 0 *
* 31 * 1 * 2 * 46.846593 * 1 *
* 32 * 0 * 5 * 0.9432613 * 0 *
* 33 * 0 * * * *
* 34 * 0 * 5 * 0.8746768 * 0 *
* 35 * 0 * 5 * 0.6816328 * 0 *
* 36 * 0 * 2 * 0.2007146 * 1 *
* 36 * 1 * 3 * 1017.6177 * 0 *
    
```

Primary Vertices Contributors (Nhits>3)

CentralTrack4HitCutVertices

```

-----MC Vertex Information: Event No = 0-----
(-0.231462  0.00100639  38.5155)
-----Reco Vertex Information: Event No = 0-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
2           3       1.07197      (-0.104322 -0.00727957  38.1831)

-----MC Vertex Information: Event No = 1-----
(0.202966  -0.00577033  -58.893)
-----Reco Vertex Information: Event No = 1-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
4           9       2635.93      (4.89686   9.51209   85.3213)

-----MC Vertex Information: Event No = 2-----
(0.158751  0.00679257  37.3814)
-----Reco Vertex Information: Event No = 2-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
2           3       0.0866628    (0.285242  0.151963  38.3611)

-----MC Vertex Information: Event No = 3-----
(0.183743  0.003125    7.09439)
-----Reco Vertex Information: Event No = 3-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
3           6       20.3369      (0.461803  -0.221672  11.2171)

-----MC Vertex Information: Event No = 4-----
(-0.0738131 -0.00324729 -13.3178)
-----Reco Vertex Information: Event No = 4-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
5           12      0.269696     (-0.0298807 0.0170503 -13.3665)

-----MC Vertex Information: Event No = 5-----
(-0.275477  0.00666589  -15.8192)
-----Reco Vertex Information: Event No = 5-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
5           12      0.270868     (-0.289045  -0.0145419 -15.7855)

```

```

-----MC Vertex Information: Event No = 6-----
(0.0532232  0.00333409  45.716)
-----Reco Vertex Information: Event No = 6-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
4           9       0.585404      (0.0160037  0.0129135  45.7058)

-----MC Vertex Information: Event No = 7-----
(-0.237821  0.000122148  10.7846)
-----Reco Vertex Information: Event No = 7-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
4           9       12114.9      (2.16906   2.1681   -116.202)

-----MC Vertex Information: Event No = 8-----
(0.275048  0.00679094  -12.0624)
-----Reco Vertex Information: Event No = 8-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
2           3       0.348681      (0.264058  0.0199597 -12.8984)

-----MC Vertex Information: Event No = 9-----
(-0.287426  -0.00715041  -15.4685)
-----Reco Vertex Information: Event No = 9-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
3           6       460.043      (-6.48096  -4.86581  -93.2527)

-----MC Vertex Information: Event No = 10-----
(0.137061  -0.00632873  -61.8435)
-----Reco Vertex Information: Event No = 10-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
3           6       0.672967      (0.0912301  0.0255716 -60.9041)

-----MC Vertex Information: Event No = 11-----
(0.00958197 -0.0106679  18.6299)
-----Reco Vertex Information: Event No = 11-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
3           6       1.78742      (0.905683  0.697314  27.4747)

-----MC Vertex Information: Event No = 36-----
(-0.0610349  0.0115863  -20.6609)
-----Reco Vertex Information: Event No = 36-----
Ntracks      ndf      chi2ndf      Vx      Vy      Vz
2           3       0.200715      (-0.376867  -0.040876  -21.5385)
3           6       1017.62      (2.97613   -18.6836  -171.324)

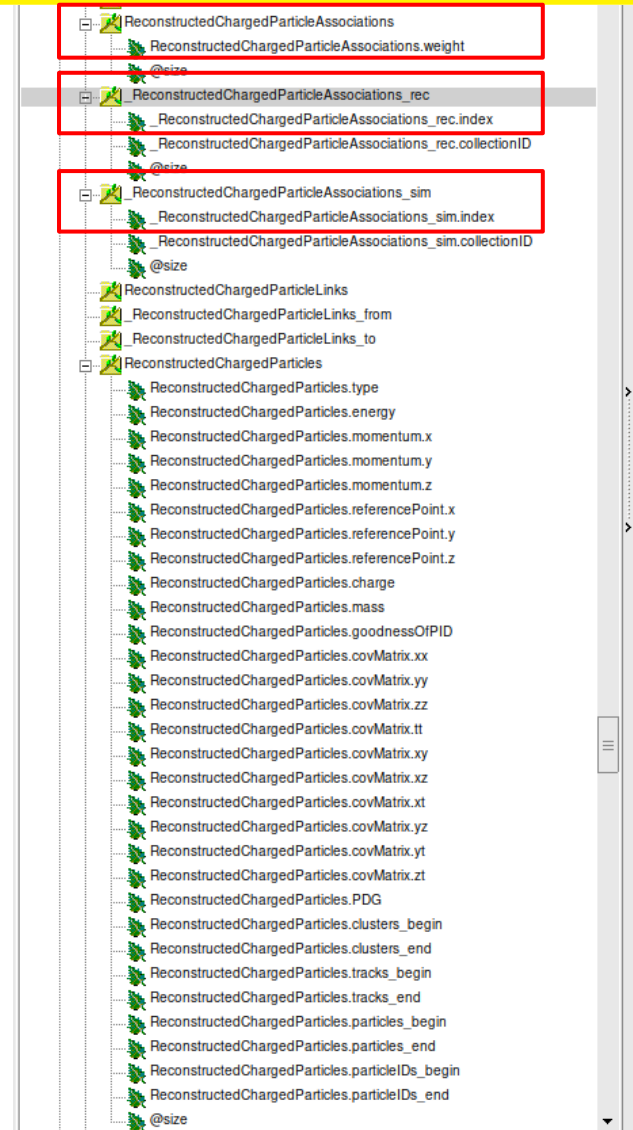
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Changes in Association Branches

October campaign

"ReconstructedChargedParticleAssociations.simID"
"ReconstructedChargedParticleAssociations.recID"
"ReconstructedChargedParticleAssociations.weight"

March campaign



Change the analysis code accordingly

Summary and Future Plan

- Primary vertex reconstruction with four hits show improvement in chi2 and the number of tracks
- Further tracks with 3 hits can be recovered at the analysis level applying significance of impact parameter ($dca_{xy}/\sigma(dca_{xy})$) cut
- Further to look at D^0 reconstruction performances by Connie with machine background.

Thank you for your attention!