Study on good primary vertex selection criteria

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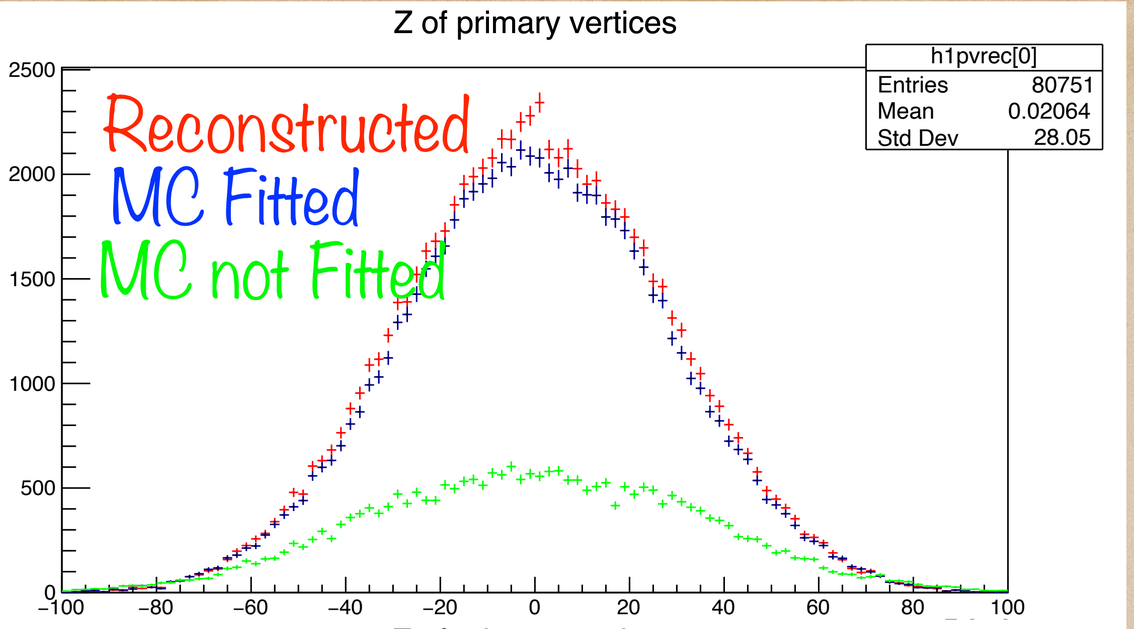
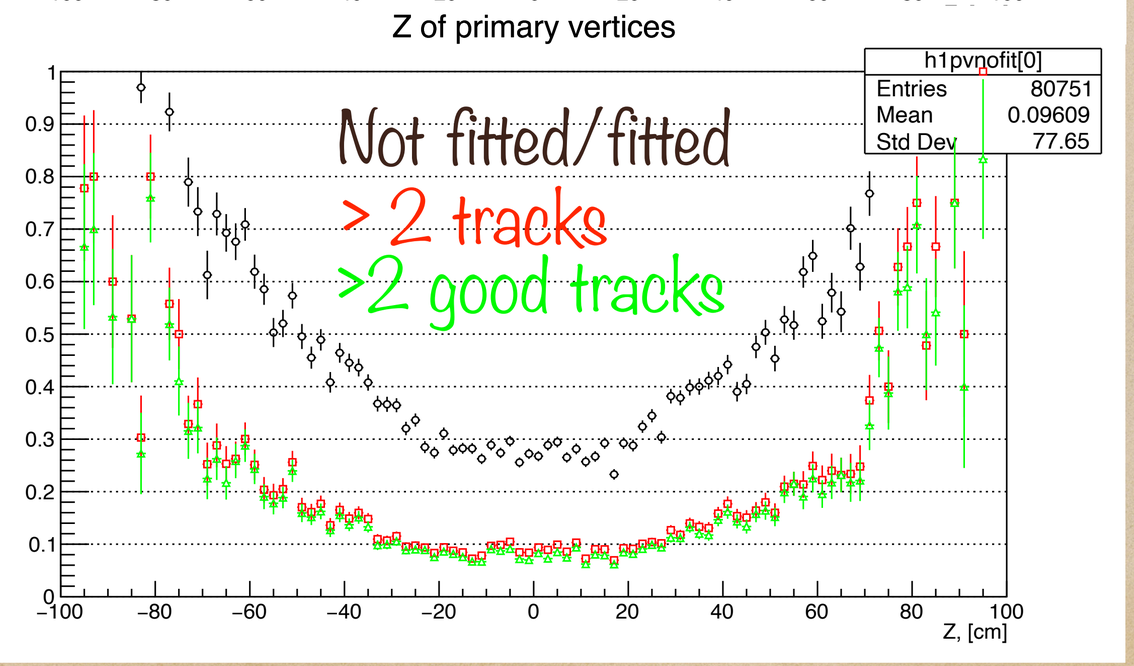
Generation and Reconstruction

- 100000 Soft QCD (w/o elastic) events with Pythia 8; pp at 27 GeV;
- SPDRoot v. 4.1.6; ITS: — MAPS 4 layers, no EndCap;
- Beam: gRandom->SetSeed(seed);

```
primGen->SetBeam(0., 0., 0.025, 0.025);//X0,Y0,Xwidth,Ywidth : 250 microns std. dev.
primGen->SmearGausVertexXY(kTRUE);
//Important : for uniform smearing or SmearVertexXY(kTRUE), give twice the width you want
//uniform smearing is done from -width/2 to width/2
//for Gaussian smearing or SmearGausVertexXY(kTRUE), give sigma or standard deviation you want

primGen->SetTarget(0., 30.);//Z0,Zwidth, 30 cm std. dev.
primGen->SmearGausVertexZ(kTRUE);
//Important : for uniform smearing or SmearVertexZ(kTRUE), give twice the width you want
//uniform smearing is done from -width/2 to width/2
//for Gaussian smearing or SmearGausVertexZ(kTRUE), give sigma or standard deviation you want
```





Reconstructed vertices:

SPDVertexRC()

- IsPrimary()
- GetFitPars()

MC Fitted vertices:

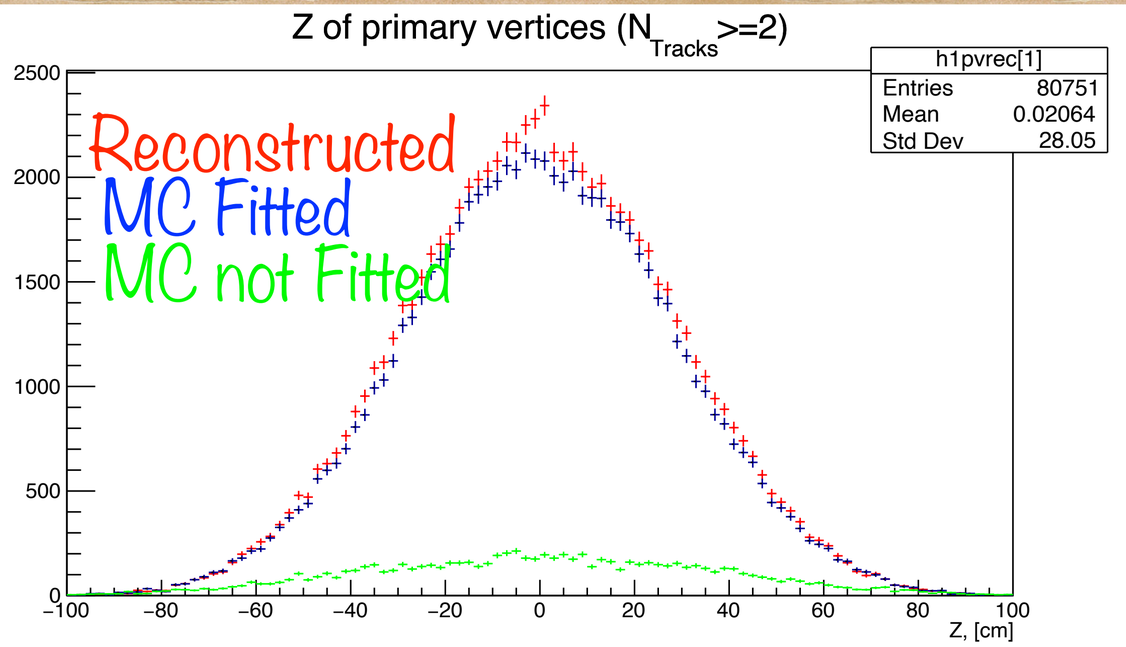
SPDVertexMC()

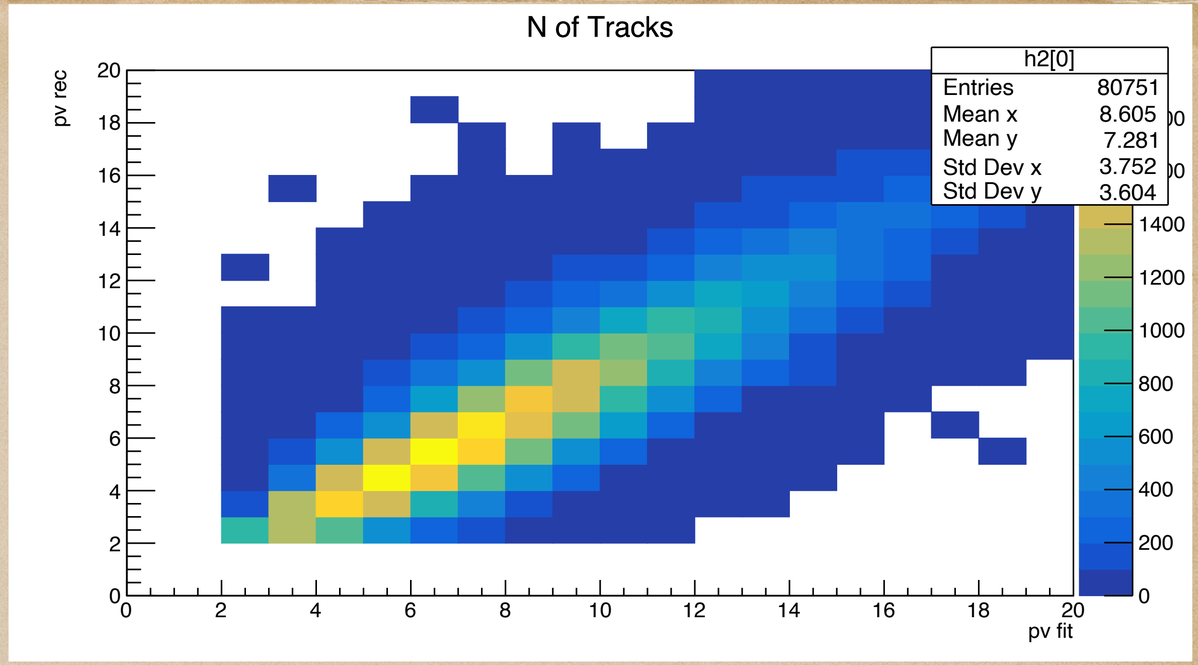
- IsPrimary()
- GetFitPars()

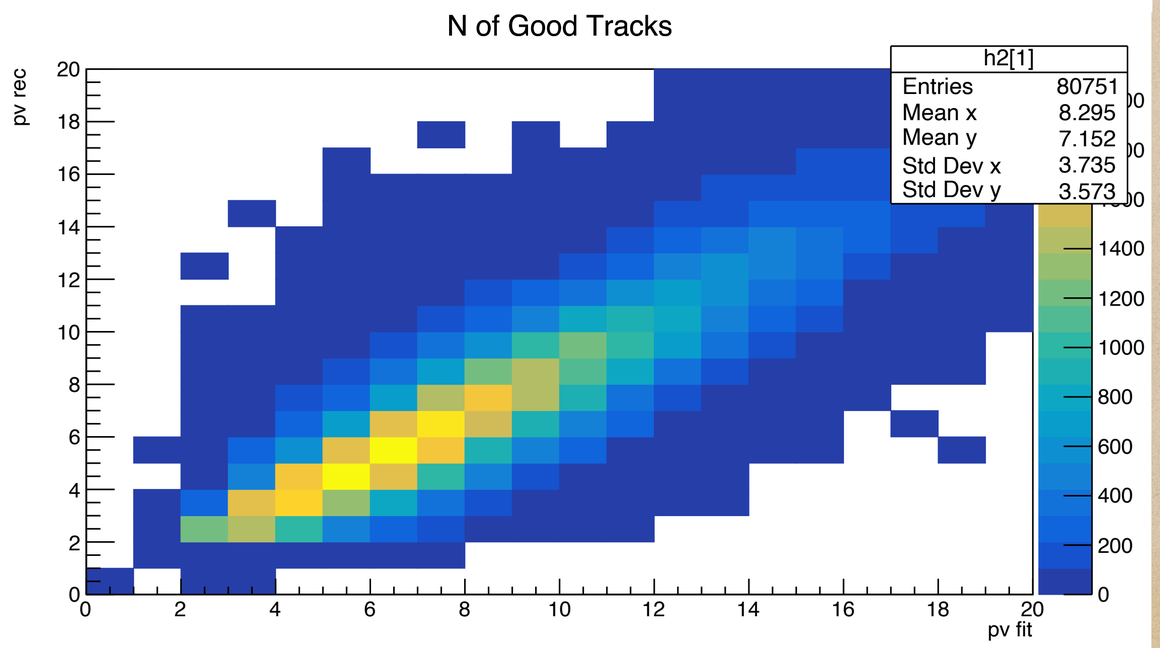
MC not Fitted vertices:

SPDVertexMC()

- IsPrimary()
- !GetFitPars()





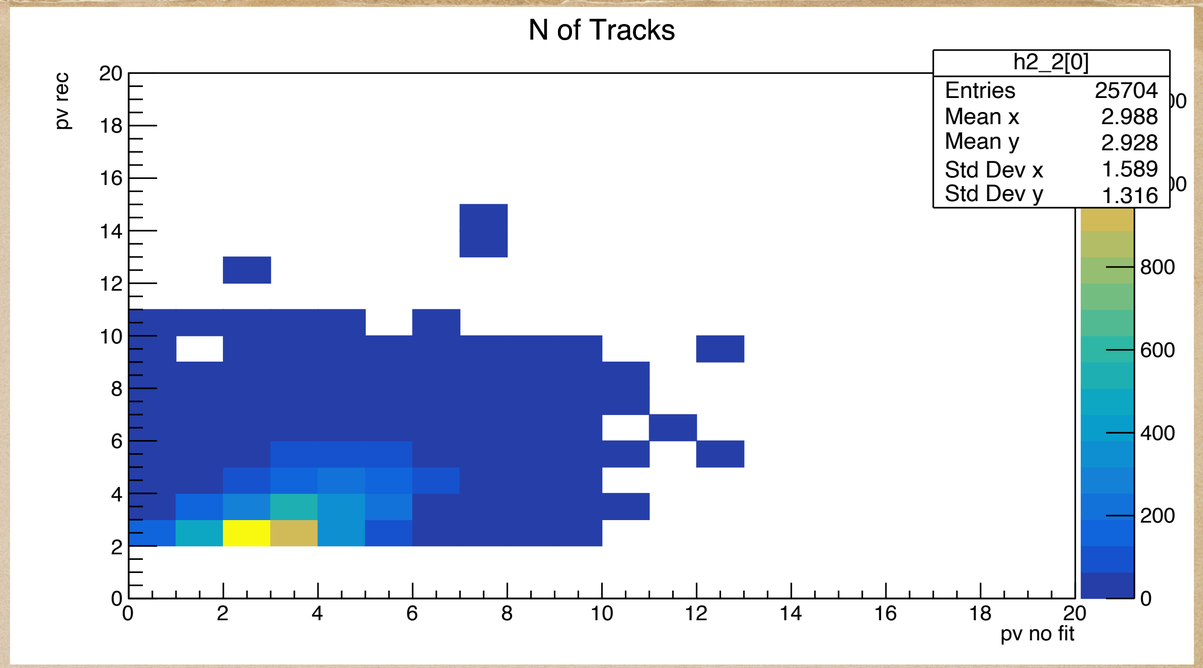


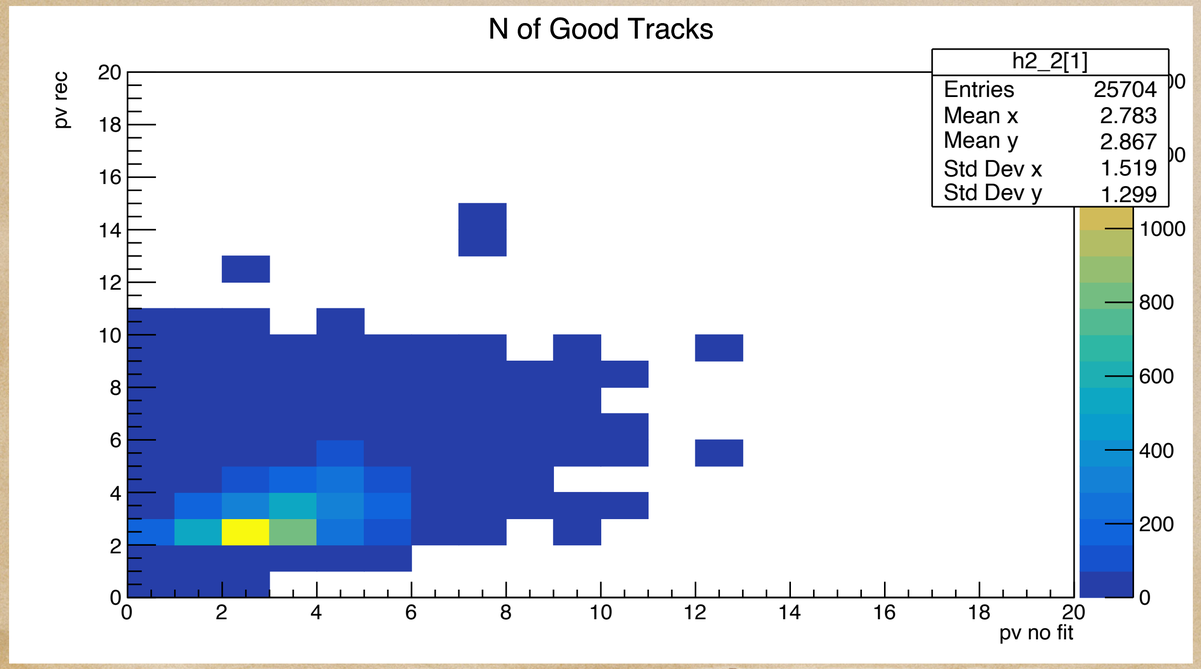
Fit: N of tracks > 2

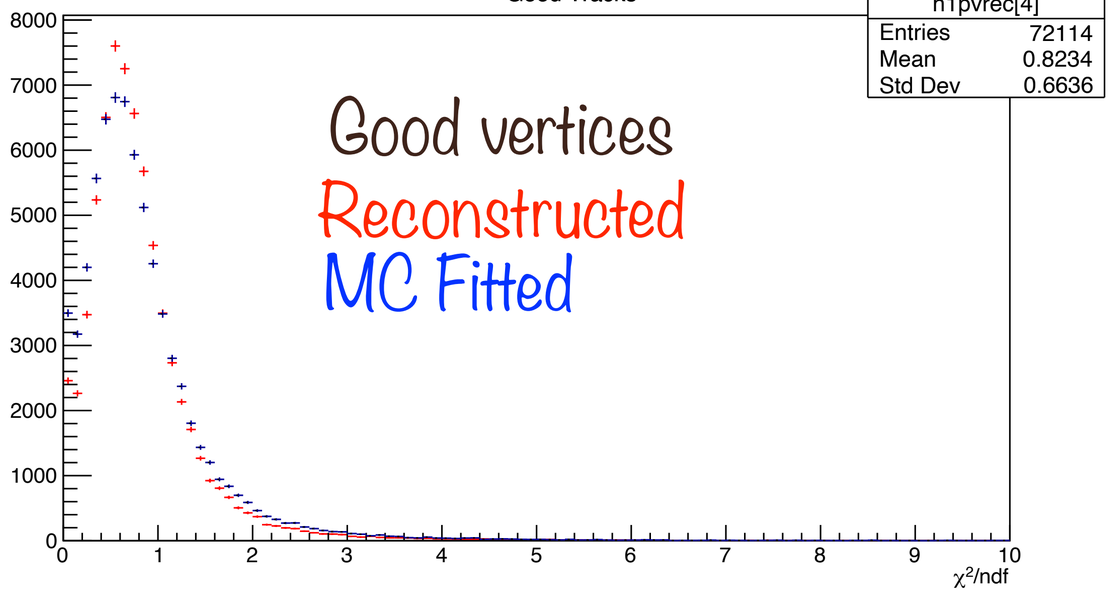
Good tracks:

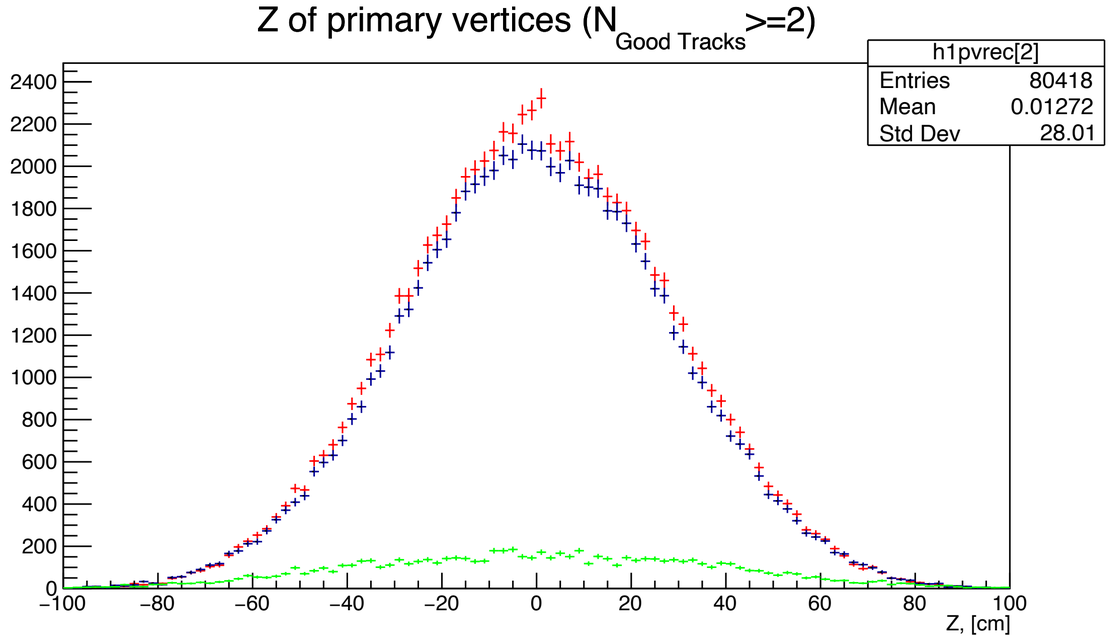
- At least 1 hit in ITS
- 8+ STRAW hits

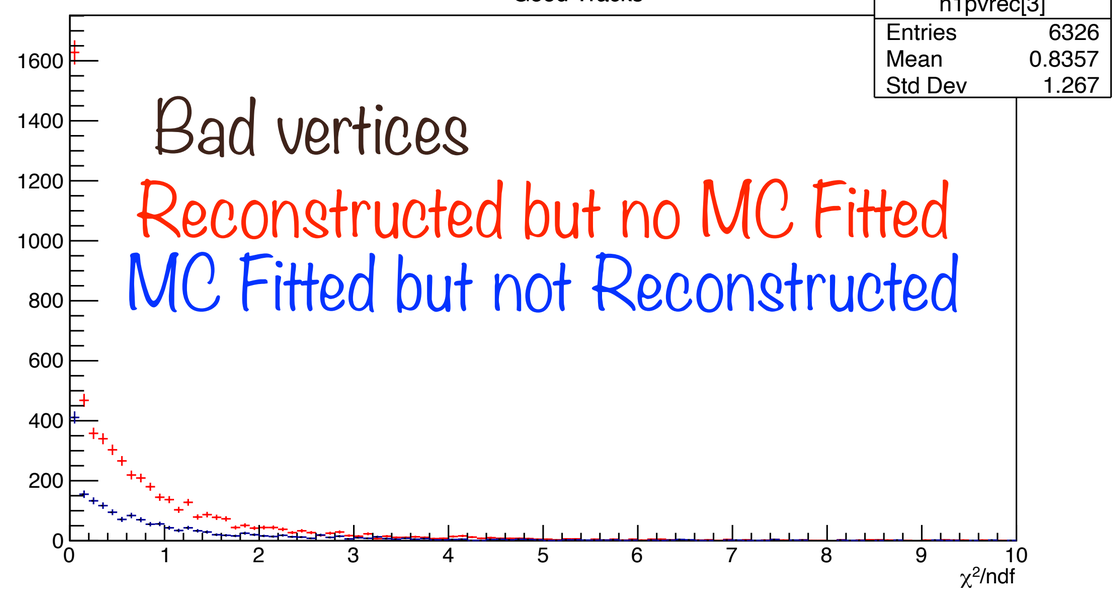
Not fitted MC primary vertices

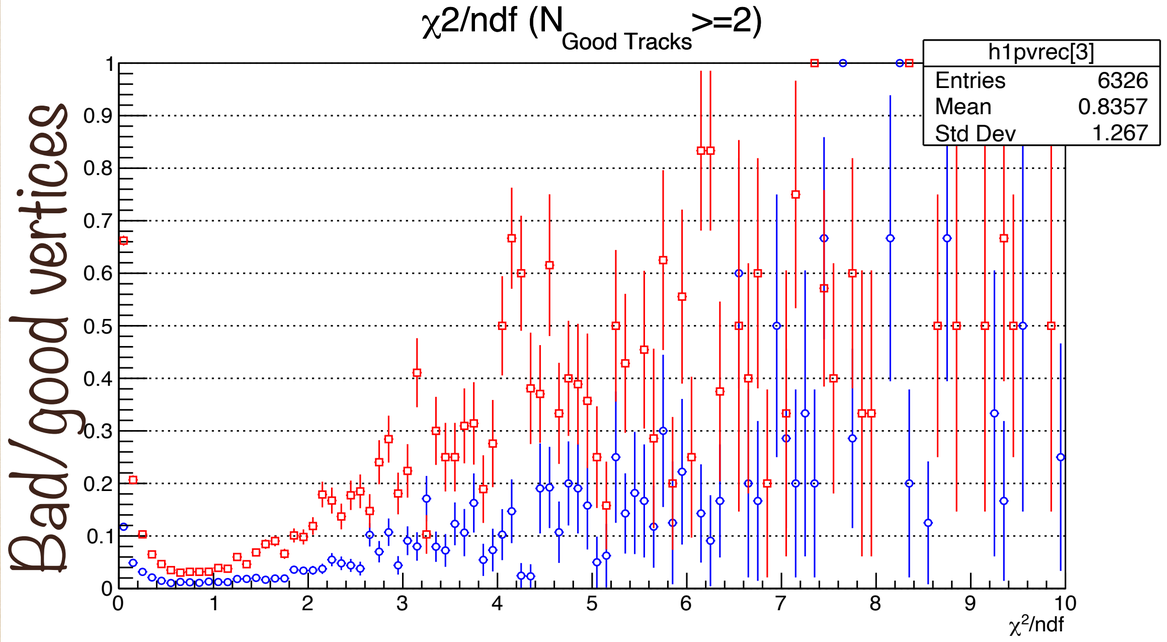


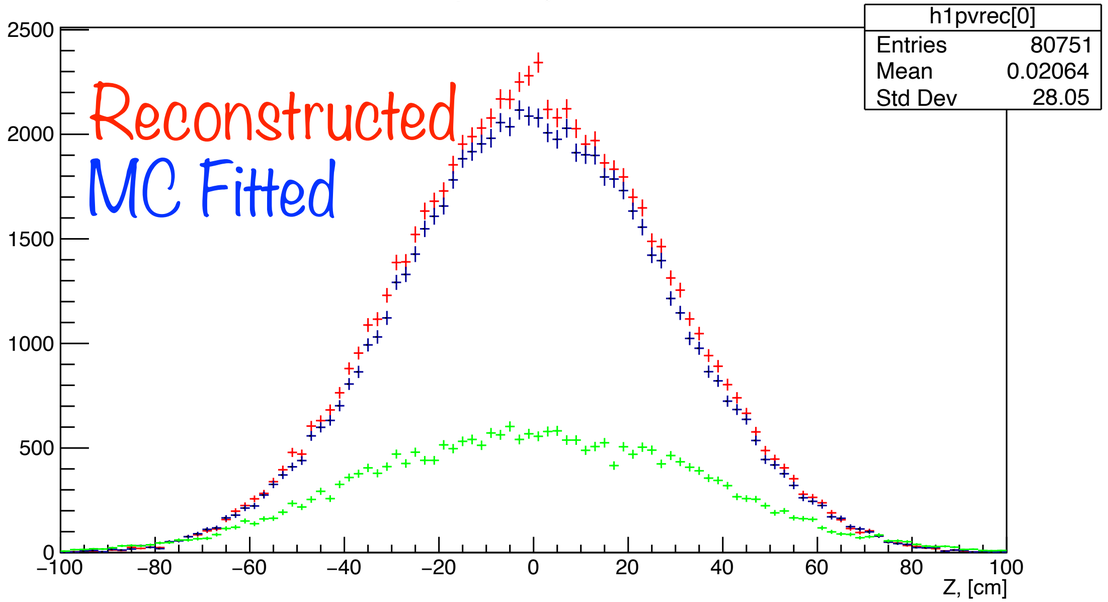


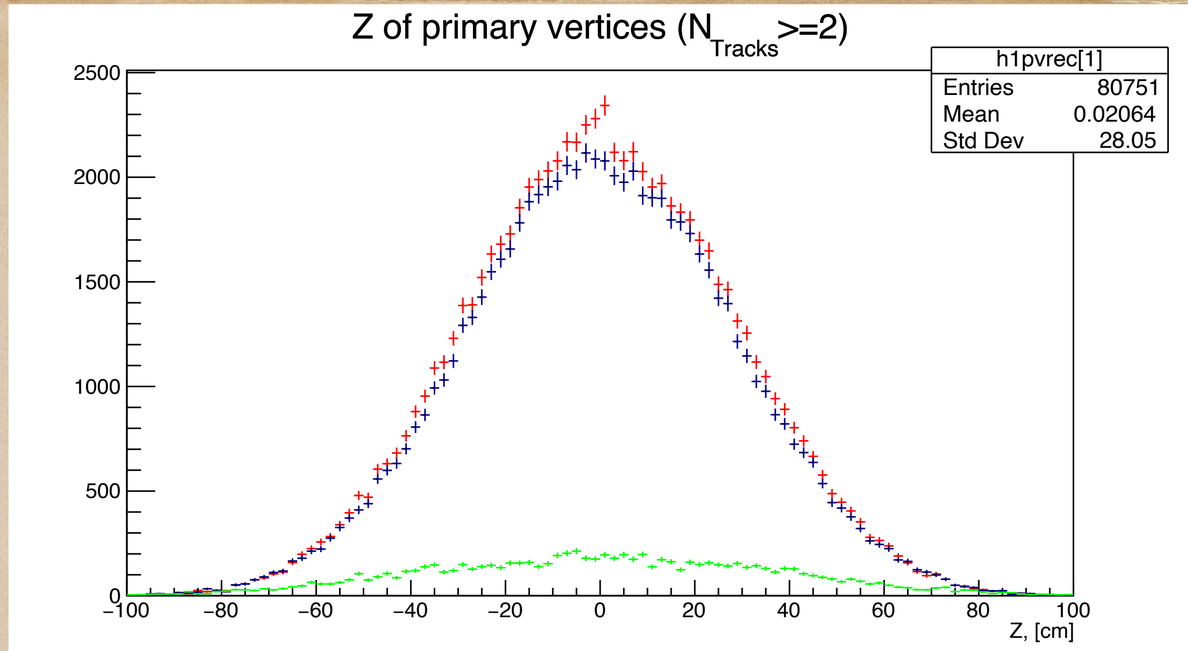

χ2/ndf (N Good Tracks >=2)
h1pvrec[4]
Entries 72114
Mean 0.8234
Std Dev 0.6636
Good vertices
Reconstructed
MC Fitted
χ²/ndf

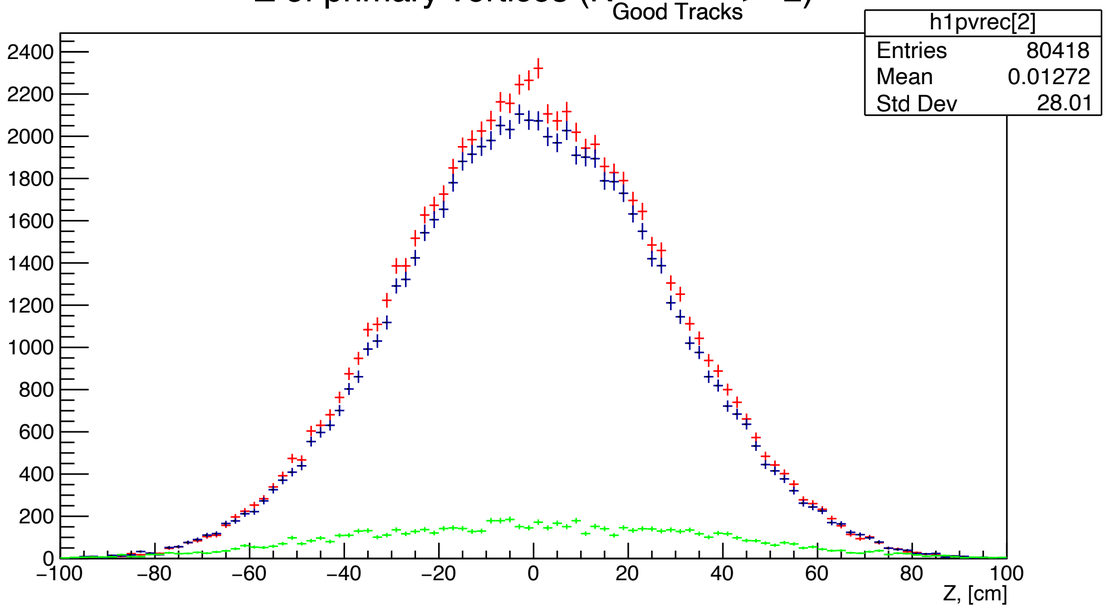

Z of primary vertices (N Good Tracks >=2)
h1pvrec[2]
Entries 80418
Mean 0.01272
Std Dev 28.01
Z, [cm]

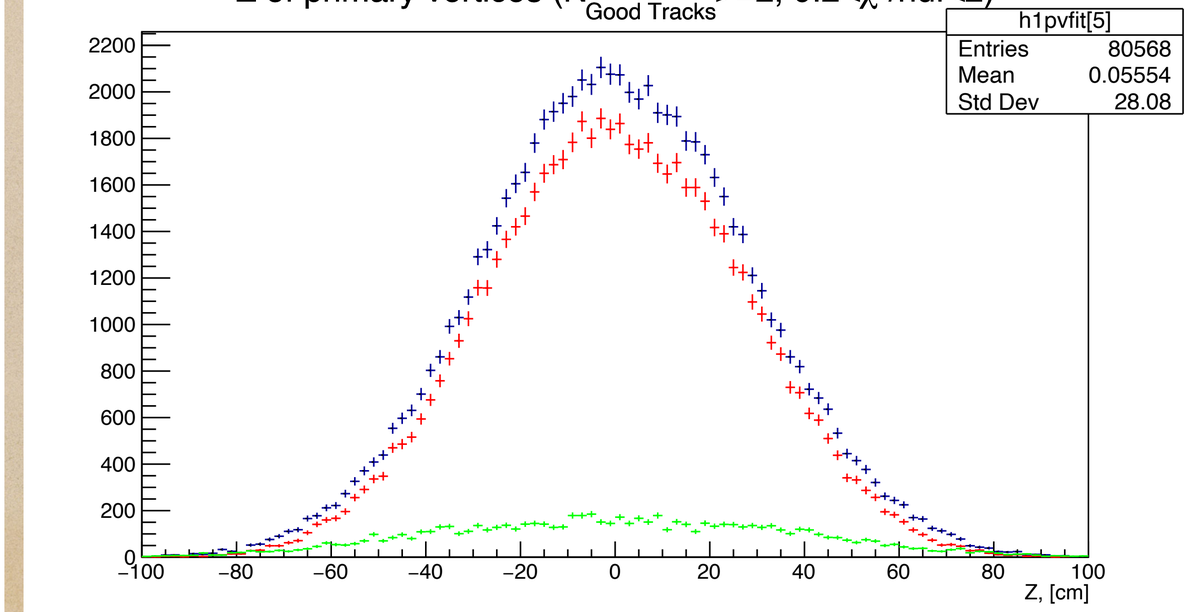

χ2/ndf (N Good Tracks >=2)
h1pvrec[3]
Entries 6326
Mean 0.8357
Std Dev 1.267
Bad vertices
Reconstructed but no MC Fitted
MC Fitted but not Reconstructed
χ²/ndf


χ2/ndf (N Good Tracks >=2)
h1pvrec[3]
Entries 6326
Mean 0.8357
Std Dev 1.267
Bad/good vertices
χ²/ndf

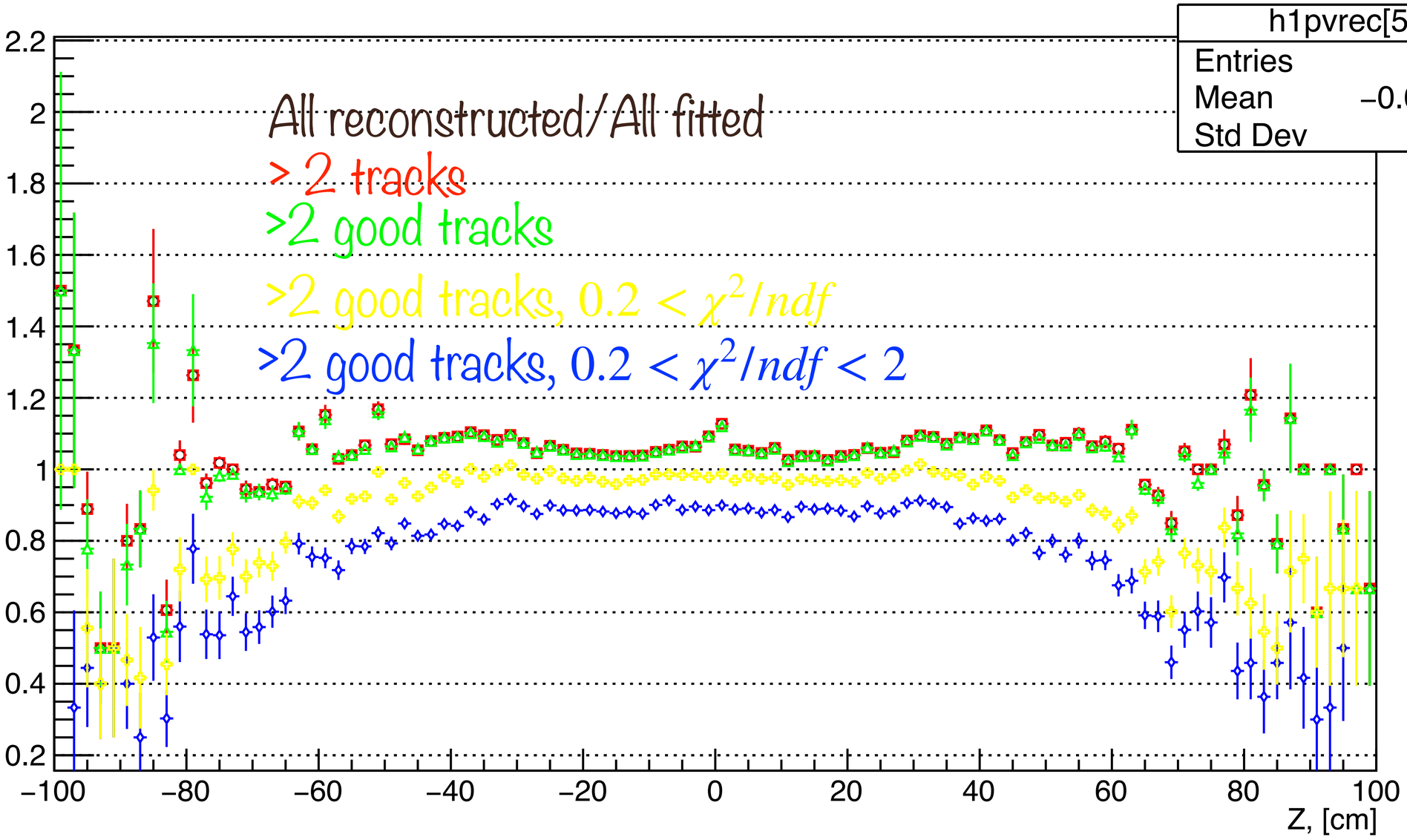

Z of primary vertices
h1pvrec[0]
Entries 80751
Mean 0.02064
Std Dev 28.05
Reconstructed
MC Fitted
Z, [cm]

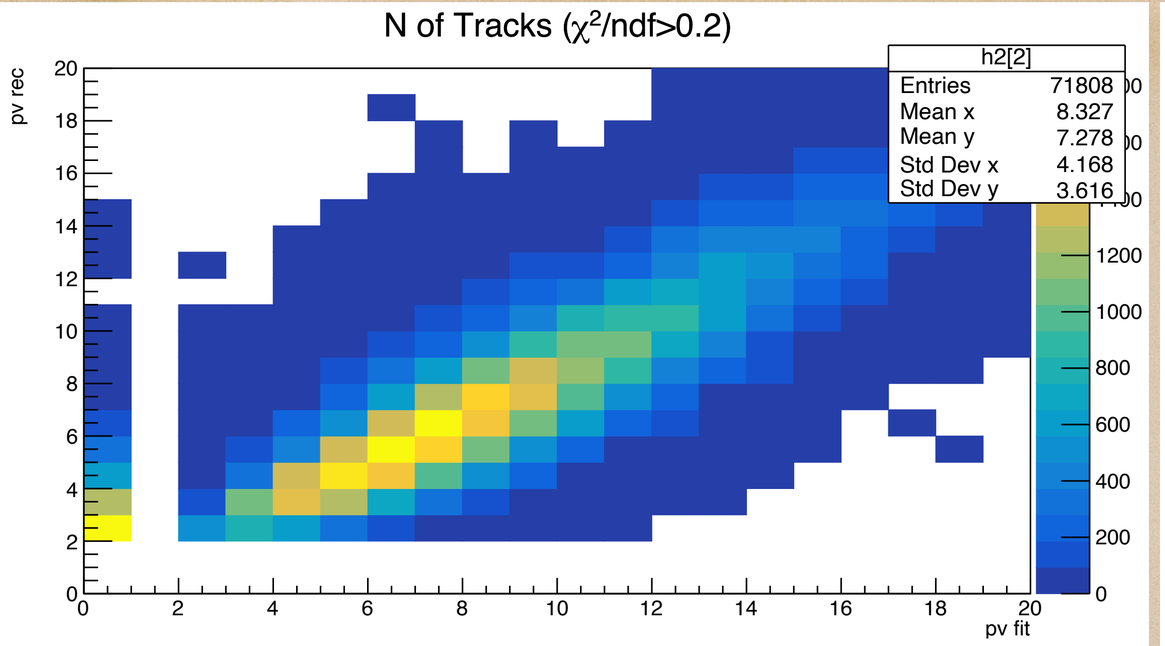

Z of primary vertices (N Tracks >=2)
h1pvrec[1]
Entries 80751
Mean 0.02064
Std Dev 28.05
Z, [cm]

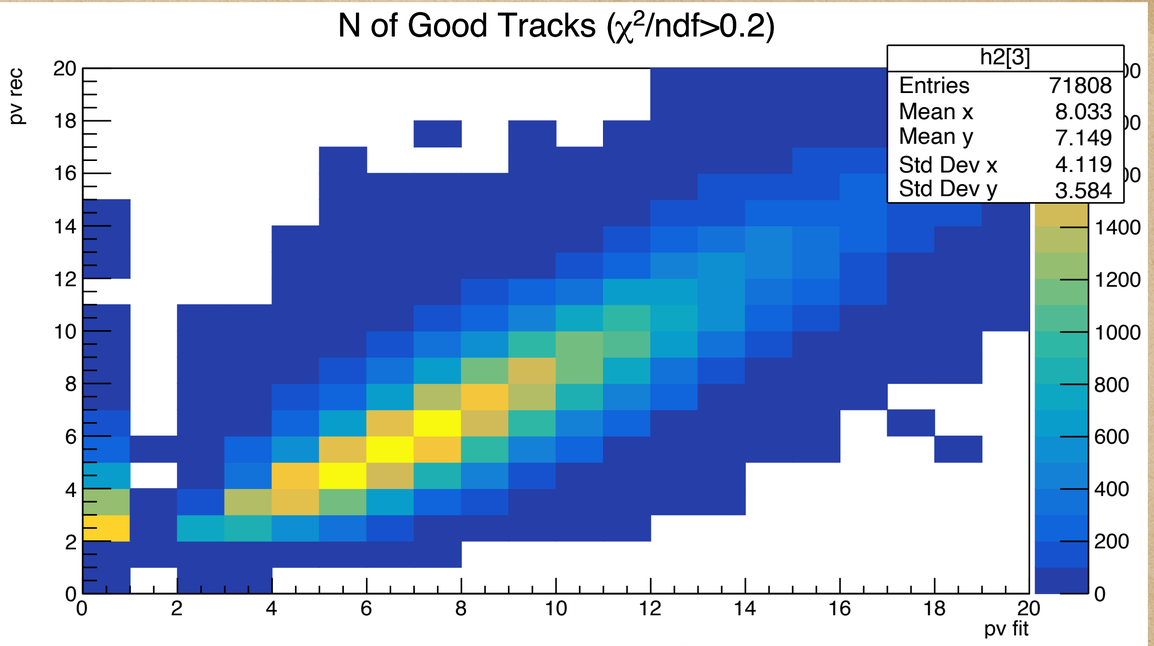

Z of primary vertices (N Good Tracks >=2)
h1pvrec[2]
Entries 80418
Mean 0.01272
Std Dev 28.01
Z, [cm]

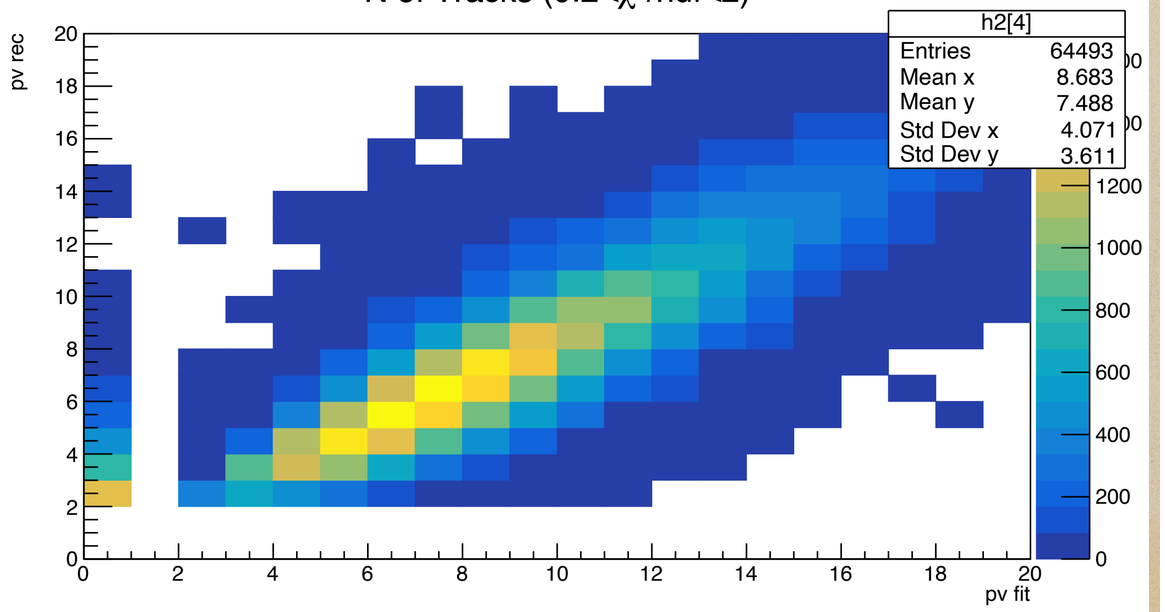

Z of primary vertices (N Good Tracks >=2, 0.2<χ²/ndf<2)
h1pvfit[5]
Entries 80568
Mean 0.05554
Std Dev 28.08
Z, [cm]

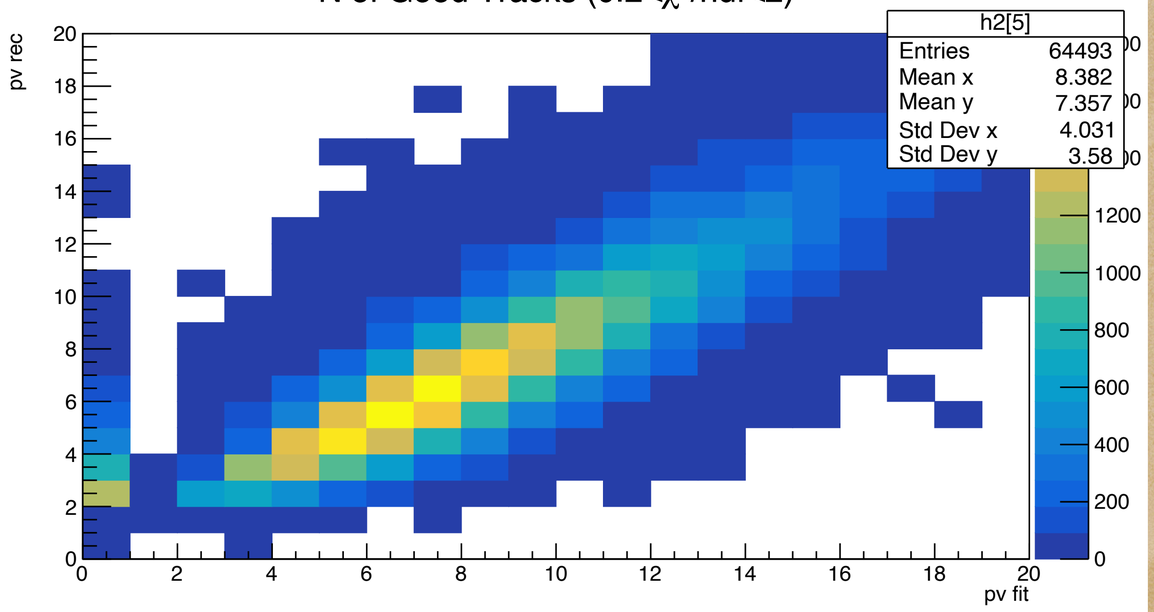
Z of primary vertices

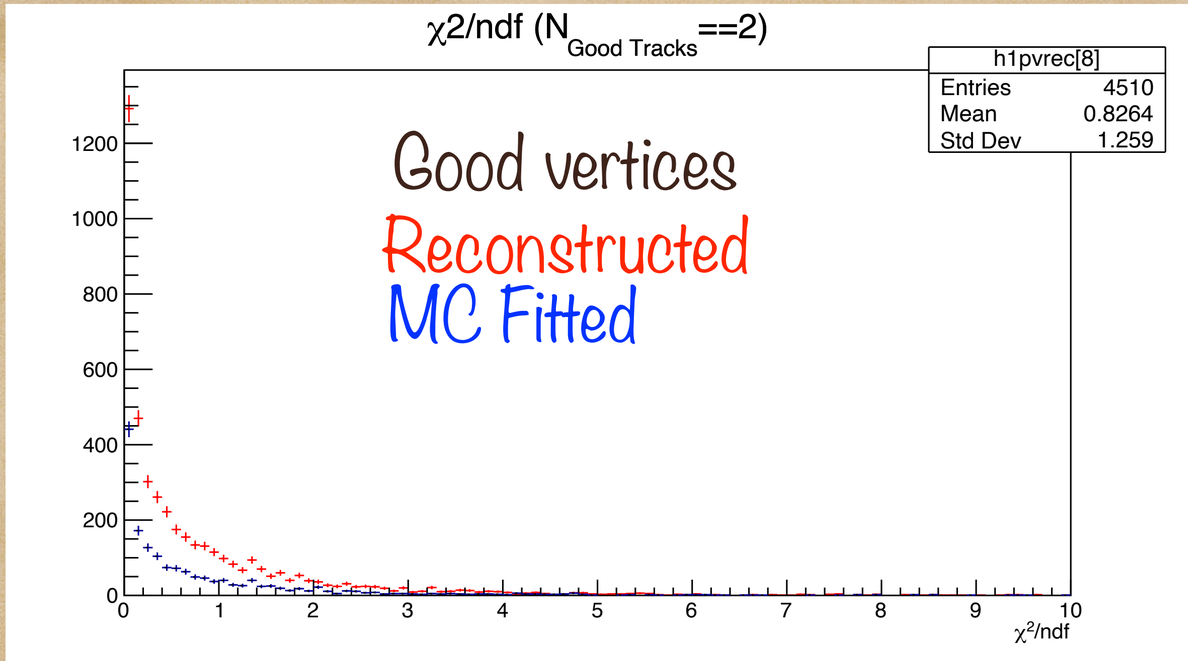


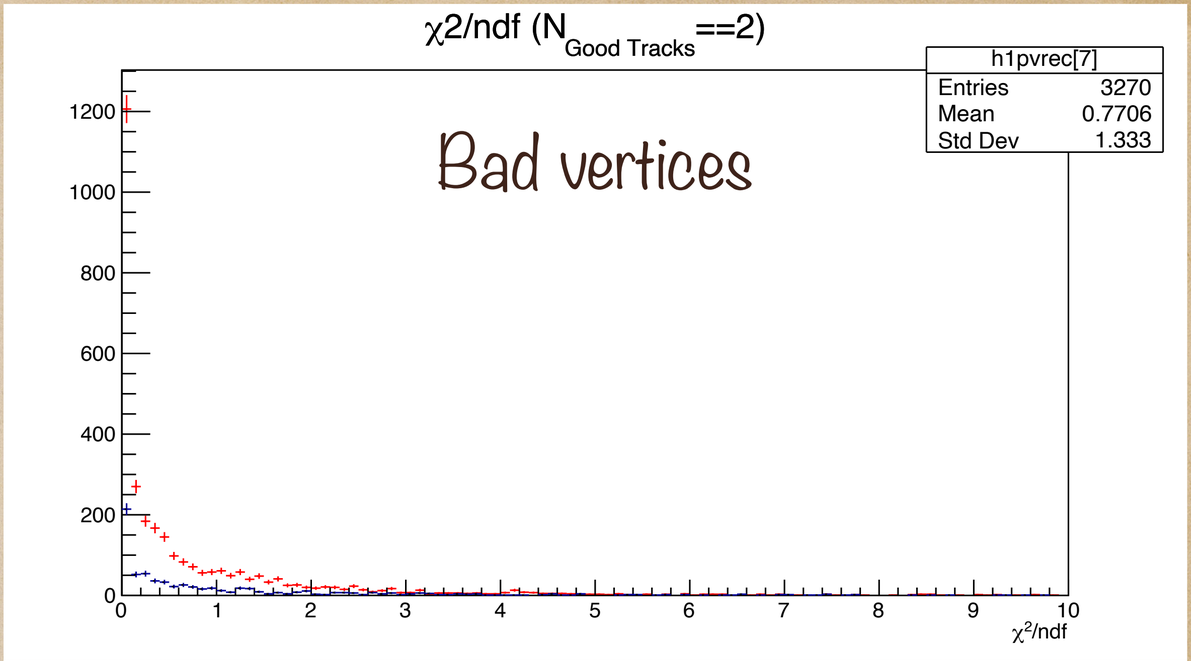

N of Tracks (χ^2/ndf>0.2)
h2[2]
Entries 71808
Mean x 8.327
Mean y 7.278
Std Dev x 4.168
Std Dev y 3.616
pv rec
pv fit

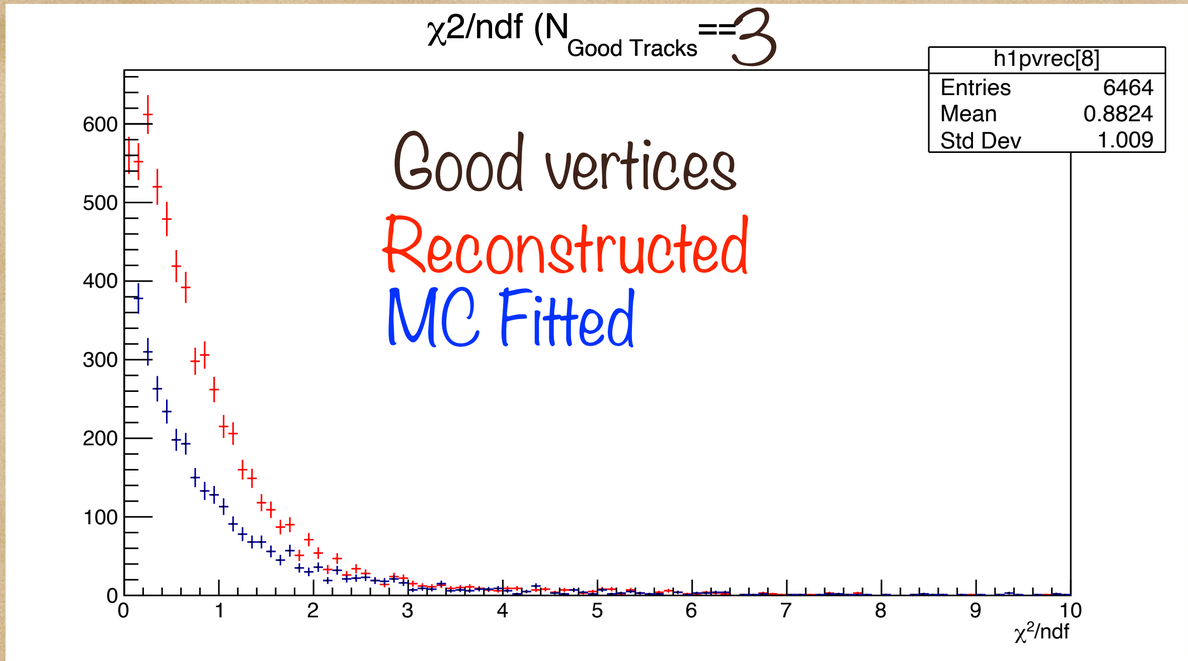

N of Good Tracks (χ^2/ndf>0.2)
h2[3]
Entries 71808
Mean x 8.033
Mean y 7.149
Std Dev x 4.119
Std Dev y 3.584
pv rec
pv fit

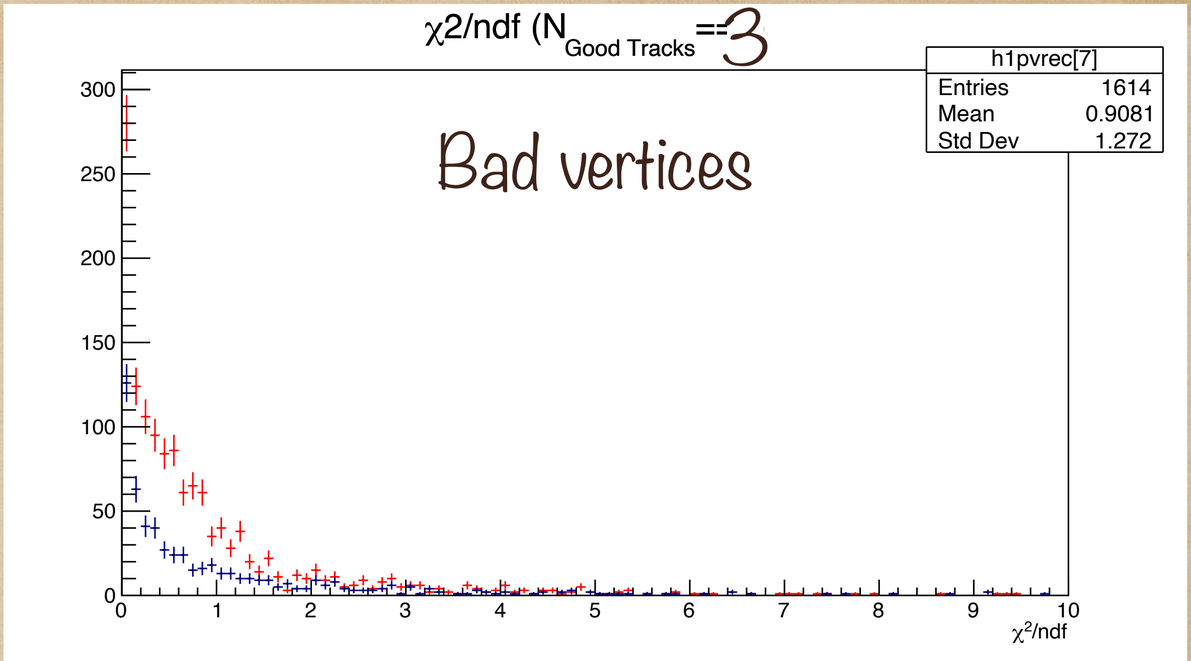

N of Tracks (0.2<χ^2/ndf<2)
h2[4]
Entries 64493
Mean x 8.683
Mean y 7.488
Std Dev x 4.071
Std Dev y 3.611
pv rec
pv fit

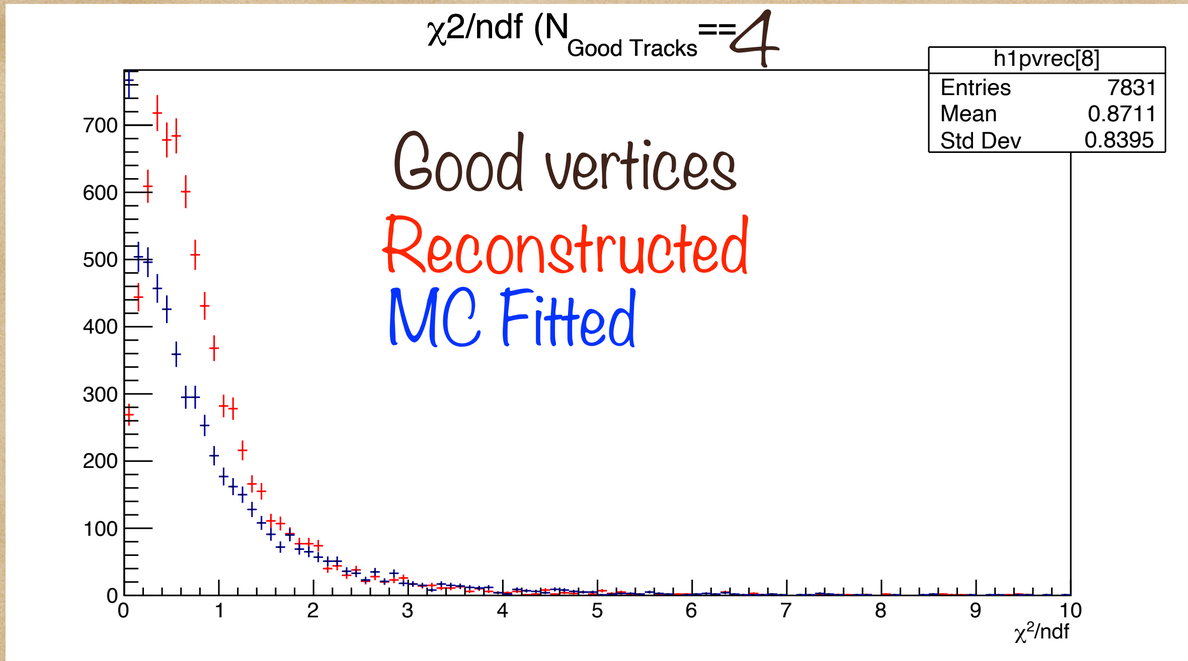

N of Good Tracks (0.2<χ^2/ndf<2)
h2[5]
Entries 64493
Mean x 8.382
Mean y 7.357
Std Dev x 4.031
Std Dev y 3.58
pv rec
pv fit

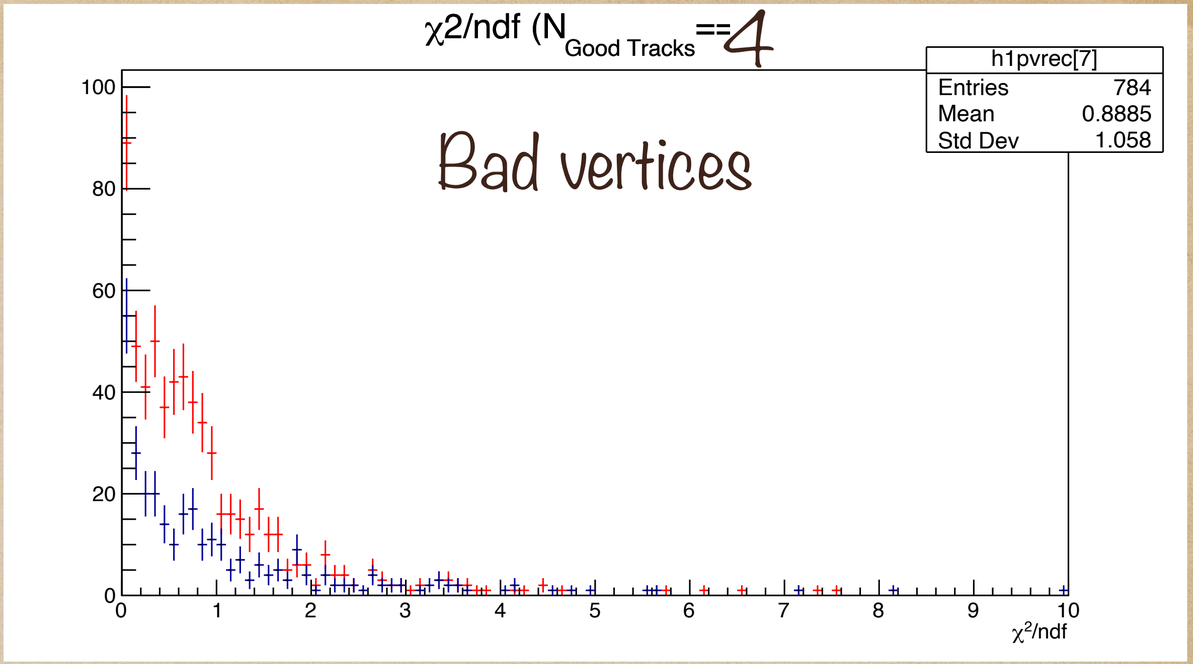

χ2/ndf (N Good Tracks ==2)
h1pvrec[8]
Entries 4510
Mean 0.8264
Std Dev 1.259
Good vertices
Reconstructed
MC Fitted
χ²/ndf


χ2/ndf (N Good Tracks ==2)
h1pvrec[7]
Entries 3270
Mean 0.7706
Std Dev 1.333
Bad vertices
χ²/ndf


χ2/ndf (N Good Tracks ==3
h1pvrec[8]
Entries 6464
Mean 0.8824
Std Dev 1.009
Good vertices
Reconstructed
MC Fitted
χ²/ndf


χ2/ndf (N Good Tracks ==3
h1pvrec[7]
Entries 1614
Mean 0.9081
Std Dev 1.272
Bad vertices
χ²/ndf


χ2/ndf (N Good Tracks ==4
h1pvrec[8]
Entries 7831
Mean 0.8711
Std Dev 0.8395
Good vertices
Reconstructed
MC Fitted
χ²/ndf


χ2/ndf (N Good Tracks ==4
h1pvrec[7]
Entries 784
Mean 0.8885
Std Dev 1.058
Bad vertices
χ²/ndf

Summary

- about 10% of MC PV with at least 2 good tracks are not fitted
- Good primary vertex selection criteria:
  - $-35\ cm < Z_{PV} < 35\ cm$
  - $\chi^2/ndf > 0.2$
  - Number of good outgoing tracks > 2 (3?, 4?)

Backup slides