Update of MC based b-JES Systematic

22, May, 2013 Naoyuki Kamo

Motivation

- Additional systematic uncertainties for heavy flavor jets are still in mc11
  - -> update with mc12
- Effect from the higher pileup rate
- ActiveArea based pileup correction
  - -> a new b-JES uncertainty in the uncertainty provider

Monte Carlo samples

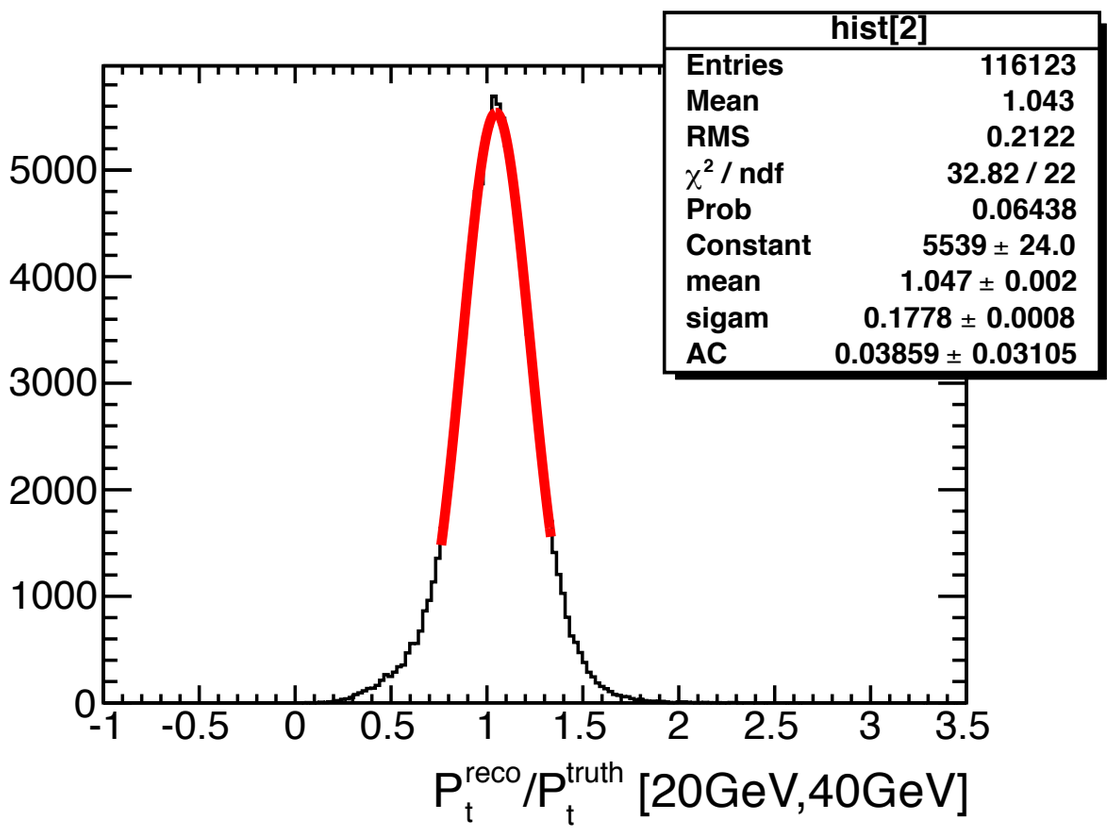
- **Pythia**
  - mc12_8TeV.
    14791*.Pythia8_AU2CT10_jetjet_JZ*W.merge.AOD.e1126_s1469_s1470_r3542_r3549/
- **Herwig**
  - mc12_8TeV.
    1591*.Herwigpp_EE3CTEQ6L1_jetjet_JZ*W.merge.NTUP_JETMET.e1373_s1499_s1504_r3658_r3549
- **Distorted geometry**
  - mc12_8TeV.
    14791*.Pythia8_AU2CT10_jetjet_JZ*W.merge.NTUP_JETMET.e1126_s1482_s1470_r3793_r3549_p1344
  - -> for systematics from additional dead material
- **Pythia FTFP_BERT**
  - mc12_8TeV.
    1479*.Pythia8_AU2CT10_jetjet_JZ*W.merge.NTUP_JETMET.e1126_s1625_s1622_r3658_r3549_p1344/
  - -> for validation of mc13

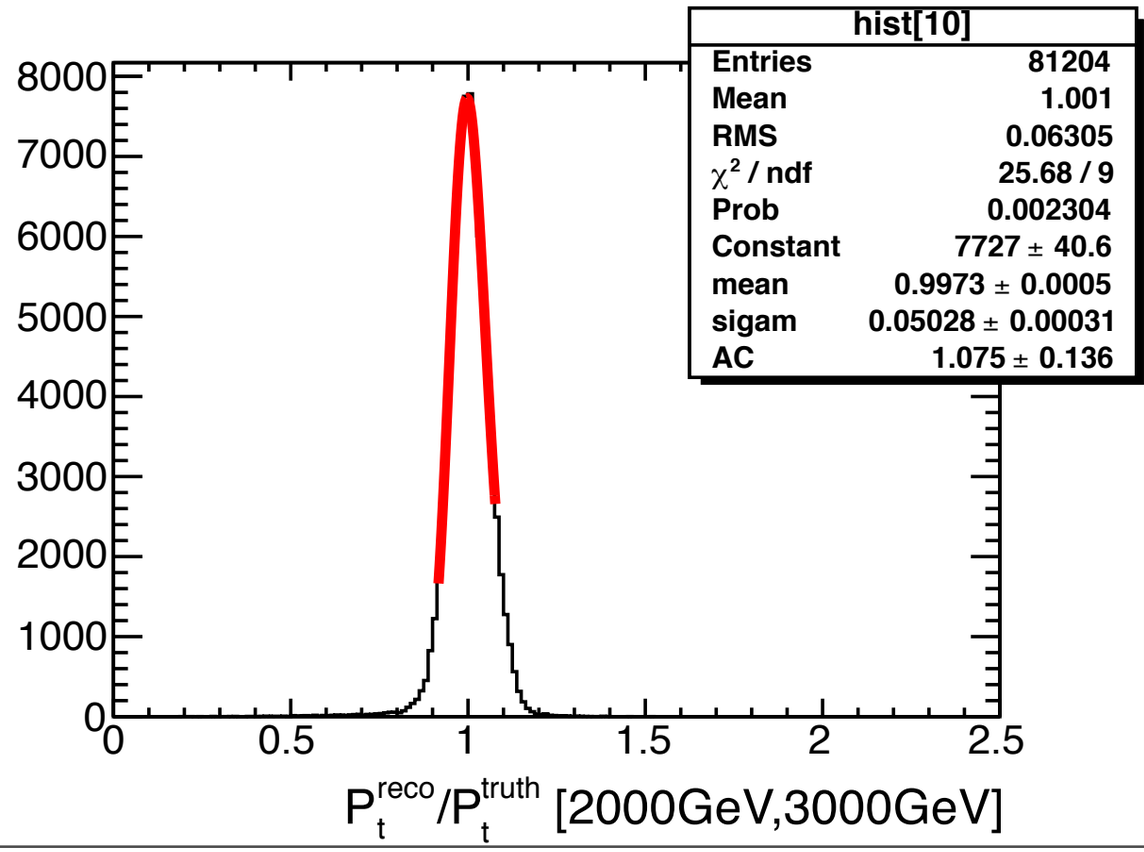
Jet selection and Pt response distribution

- **Jet selection**
  - $|\eta|<2.5$
  - require isolation from other Jets
    - -> $\Delta R < 2.5 \times$ AntiKt_R (= 1.0 or 1.5)
- **Pt_reco/Pt_truth distribution**
  - Pt_truth bins :{20,40,80,140,200,400,600,1000,2000,3000} GeV
  - select reco-Jet; ΔR from the truth-Jet is smallest
- **compare Jet PT response among the jet flavors**
  - inclusive Jet, light Jet,c-Jet,b-Jet
  - flavor tagging : require that c or b hadrons exist in range of AntiKt_R

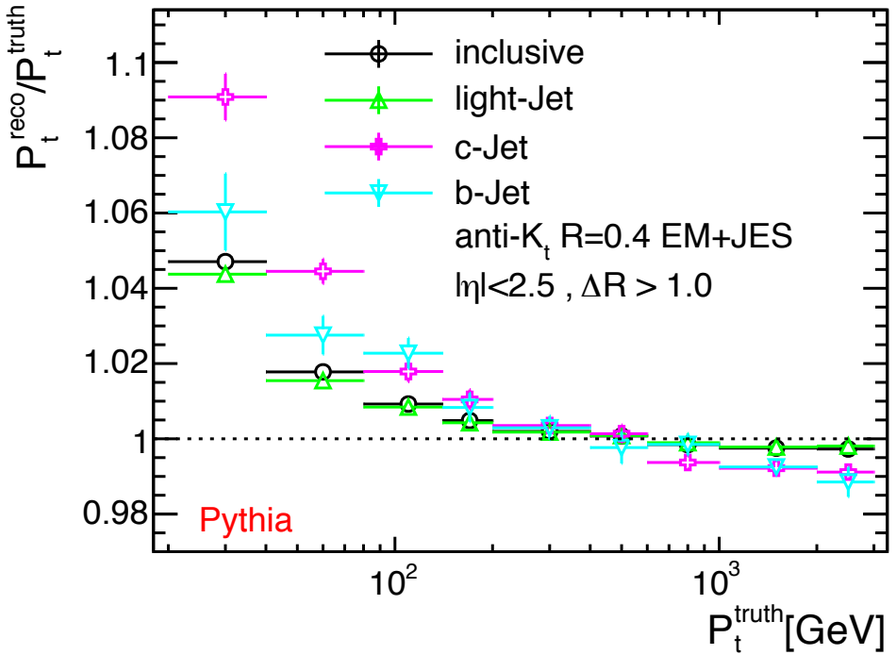
Fit to asymmetric gaussian

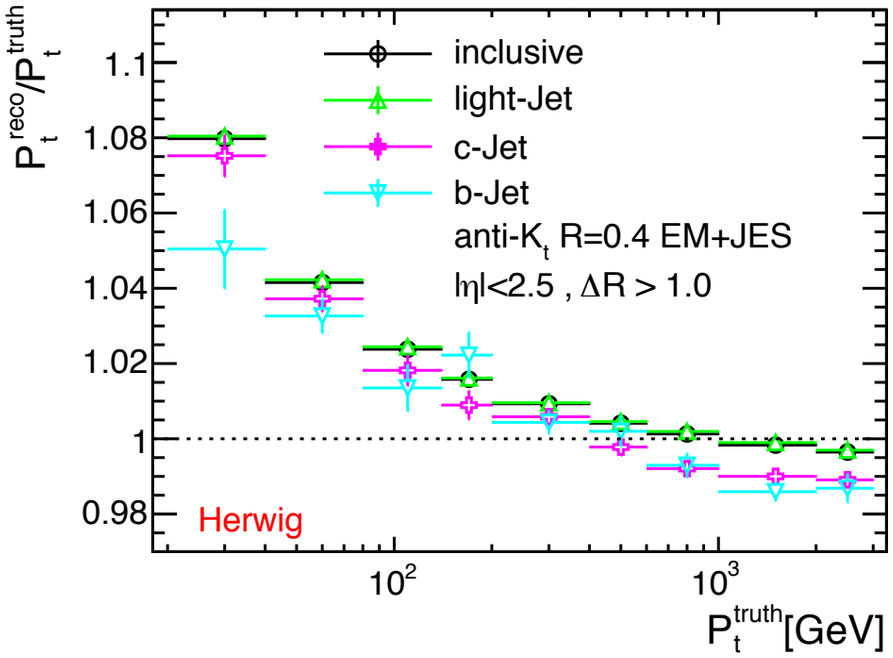
- due to Pt_reco threshold(>4GeV), the distribution , especially at low pt range, is distorted
- to derive correct mean of distribution, fit to asymmetric gaussian;
  - definition: Gauss(x,mean,σ(1+ c(x-mean))

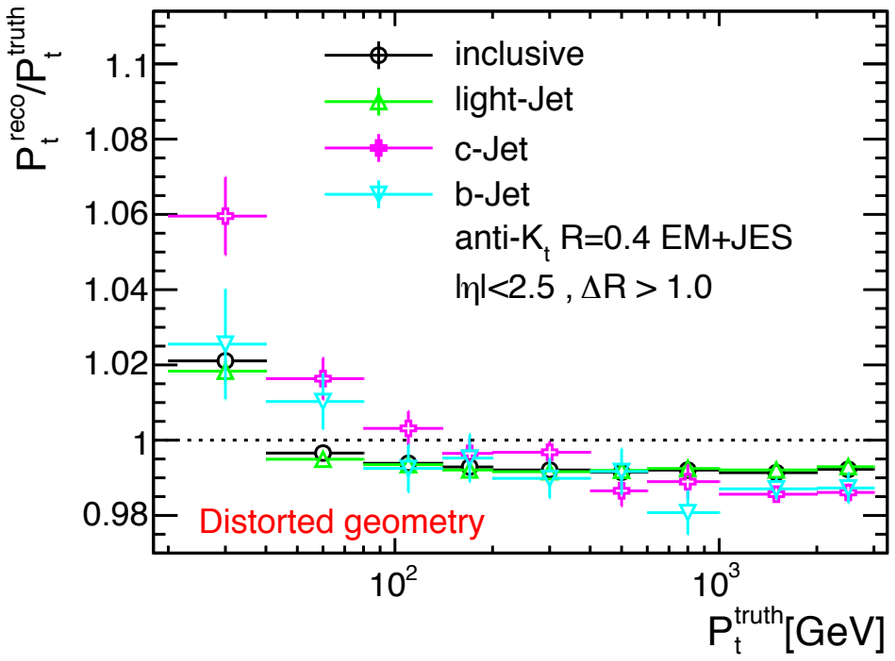


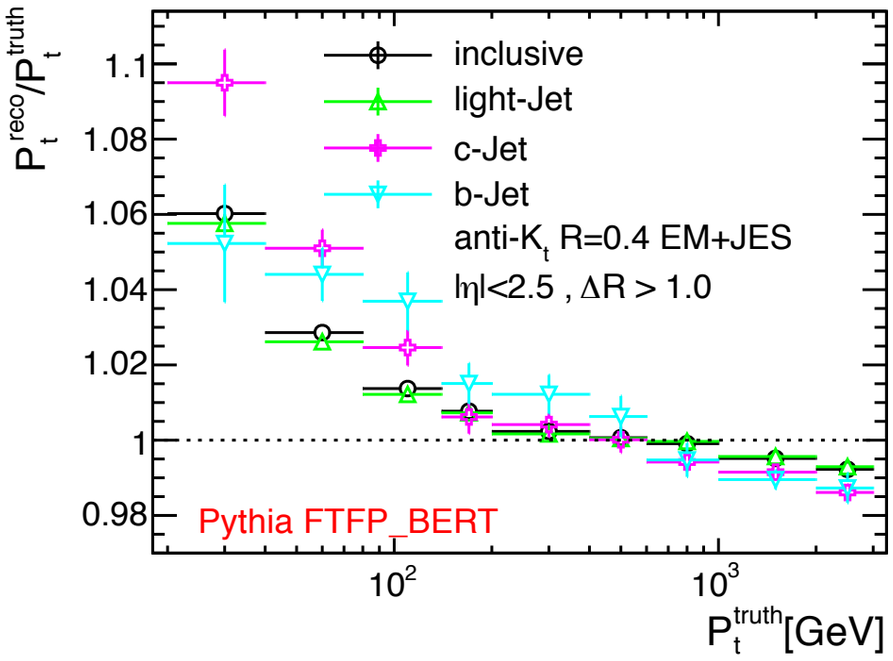


Flavor dependence of jet pT response



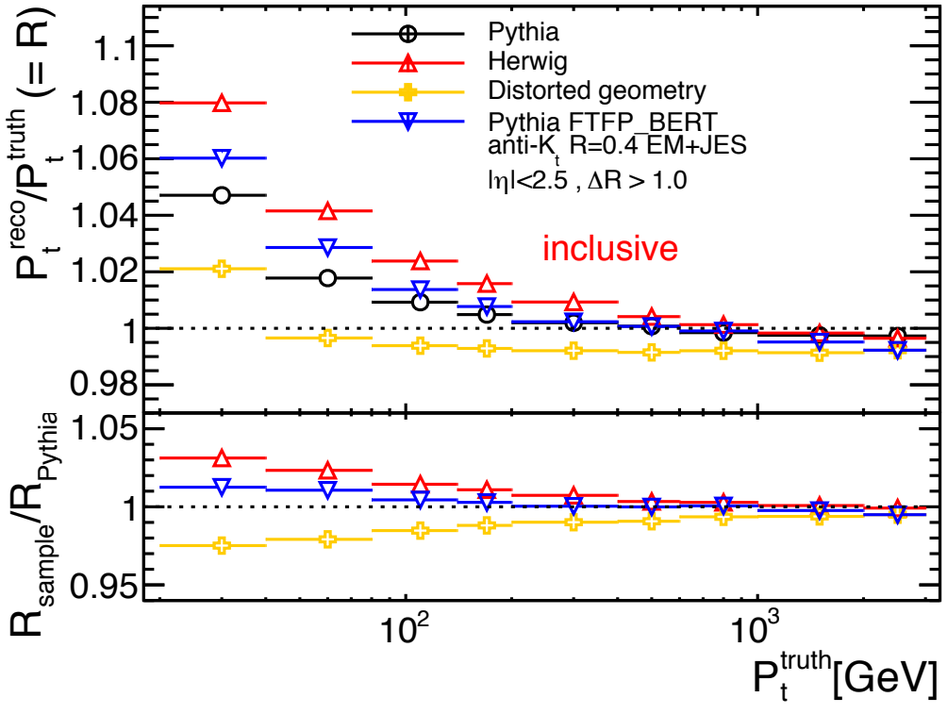


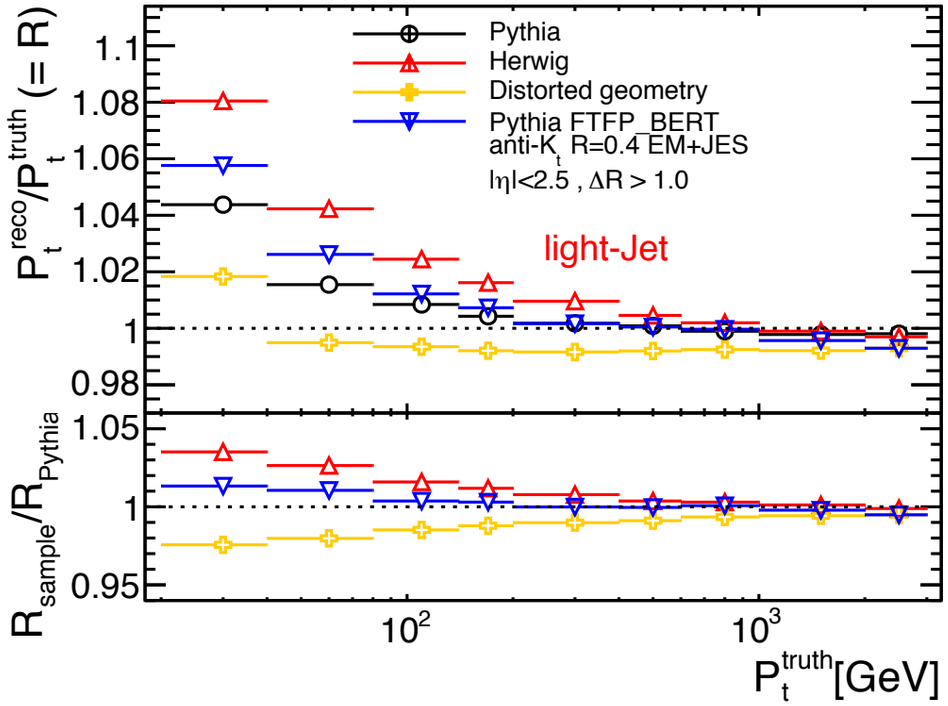


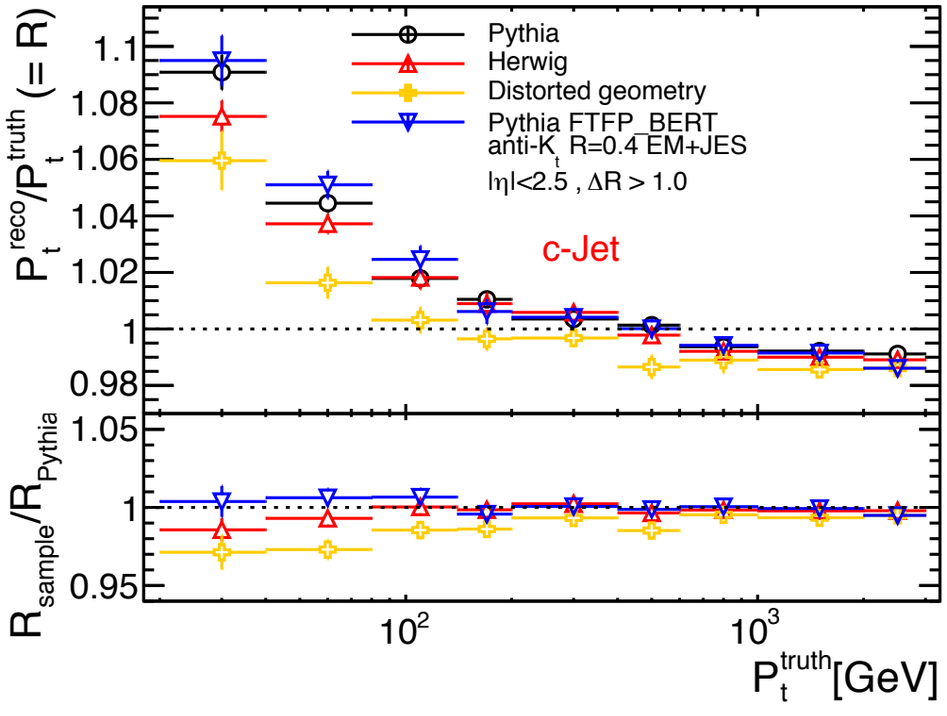


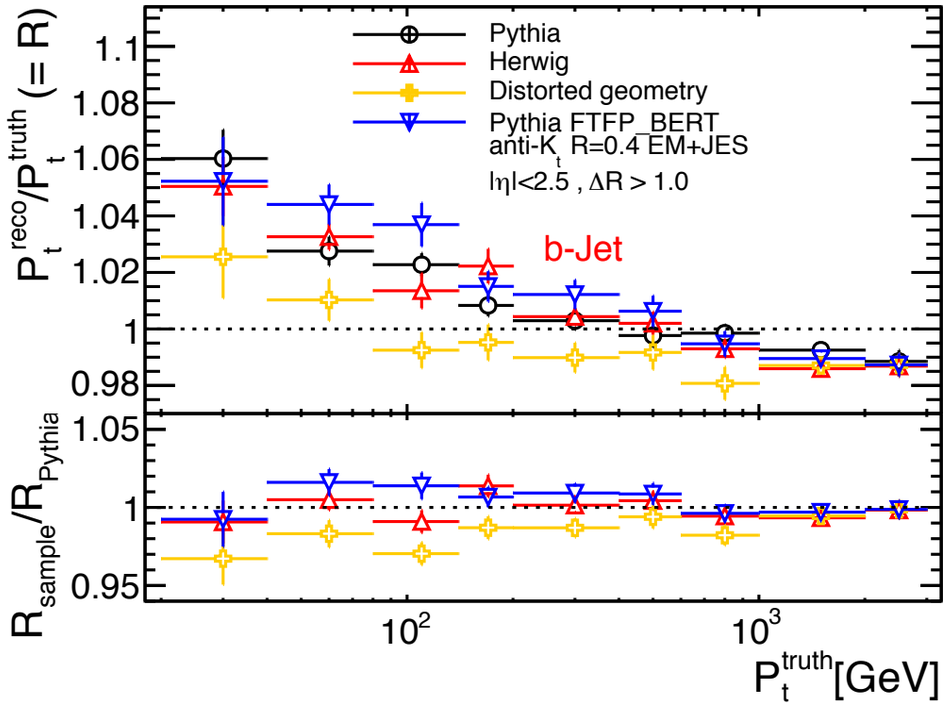
- Pythia : lower response of **c,b-Jet** at high pt, yet higher response at low pt
- Herwig : lower response of **c,b-Jet** at most bins
- Distorted Geometry : reasonably, the response of using is lower than other samples

Fraction dependence to Pythia



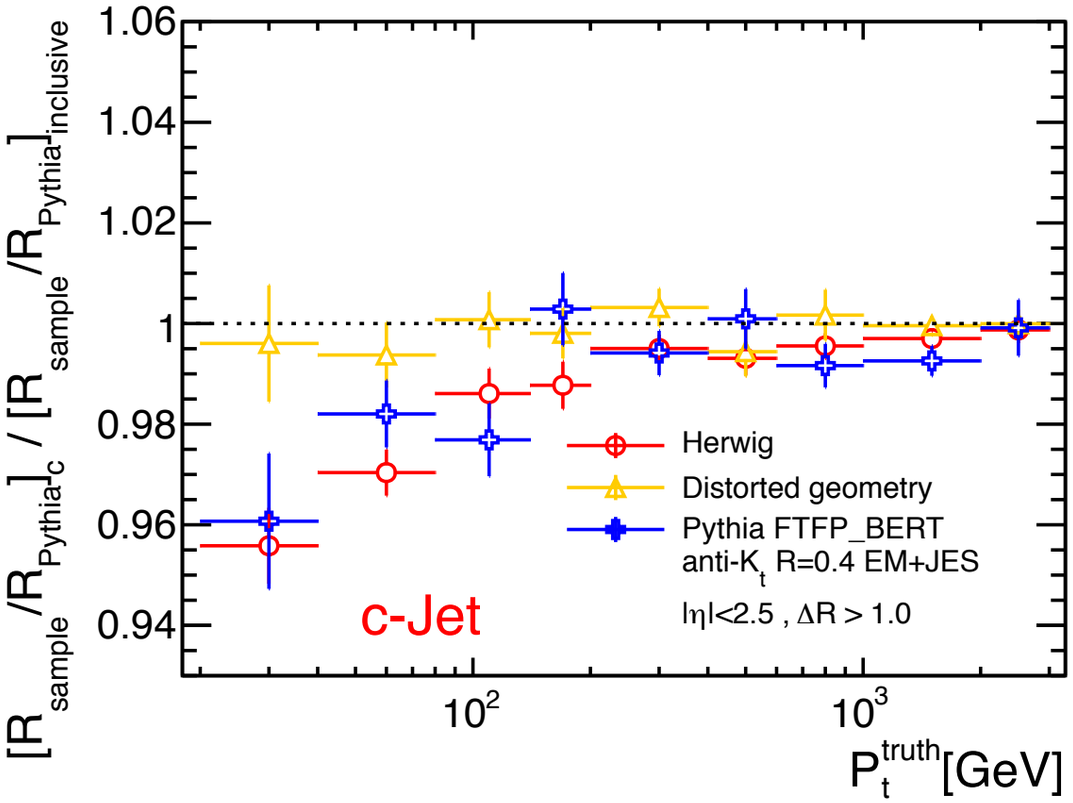


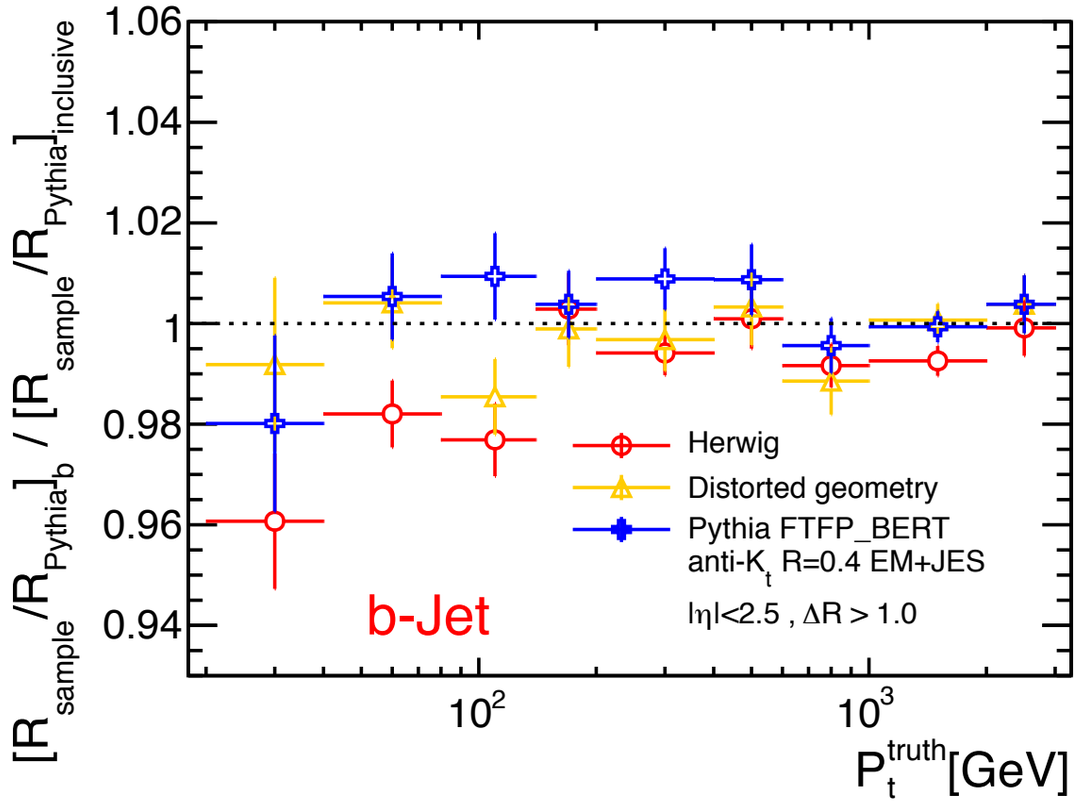




- higher response on **Herwig** than **Pythia**, yet to require c or b-jet, lower response
  - due to more N_track in c,b-Jet on **Herwig** than **Pythia**

Additional systematic of c-JES and b-JES

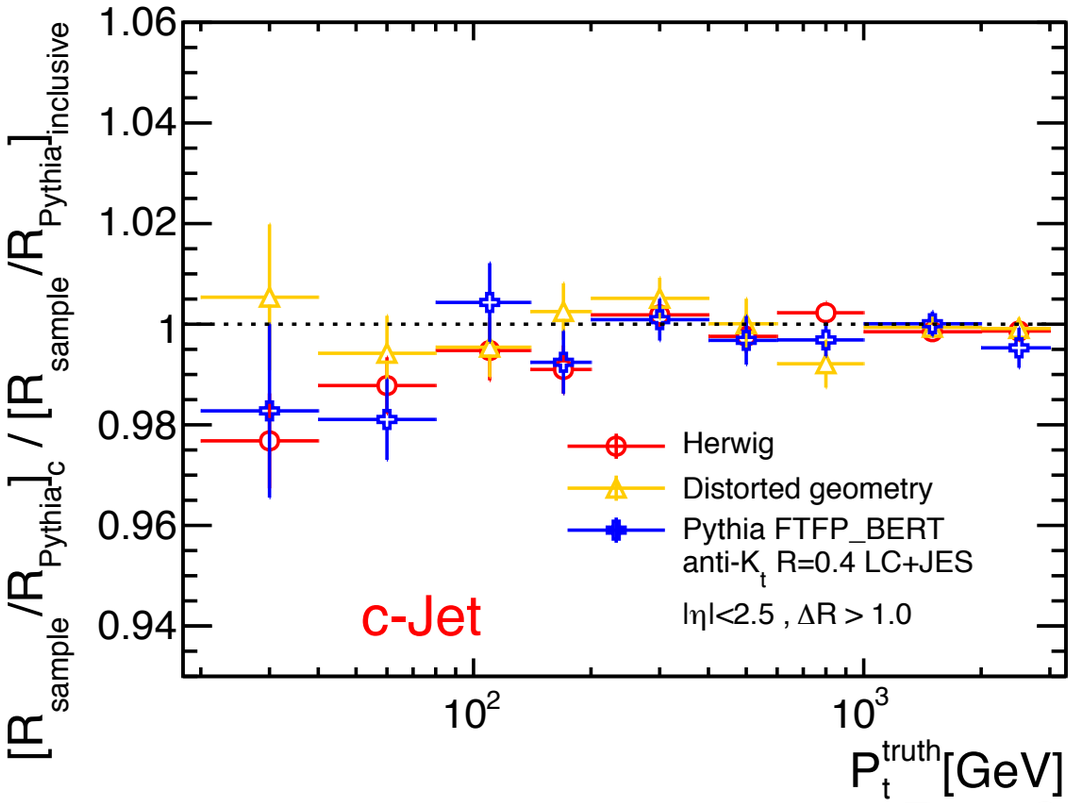


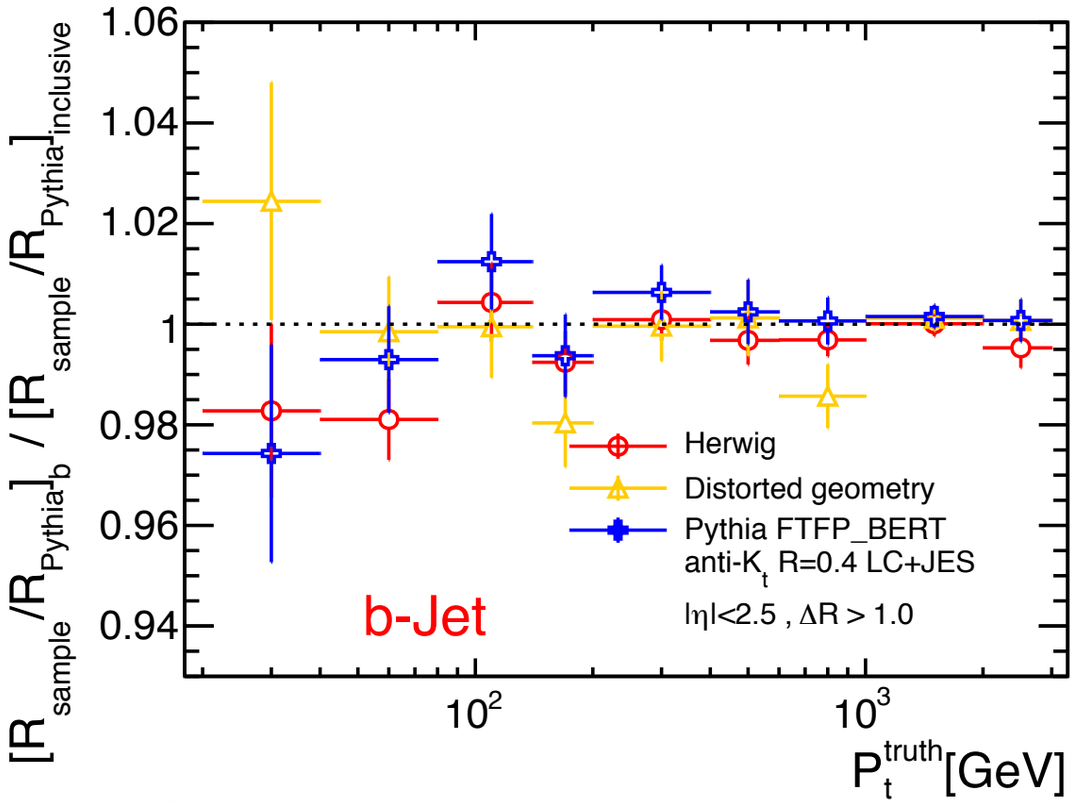


R=0.4 EM+JES

- Additional systematics uncertainties on c,b-jet energy scale
  - bigger systematic on **Herwig** at low pt
  - smaller systematic on **distorted** geometry

Additional systematic of c-JES and b-JES

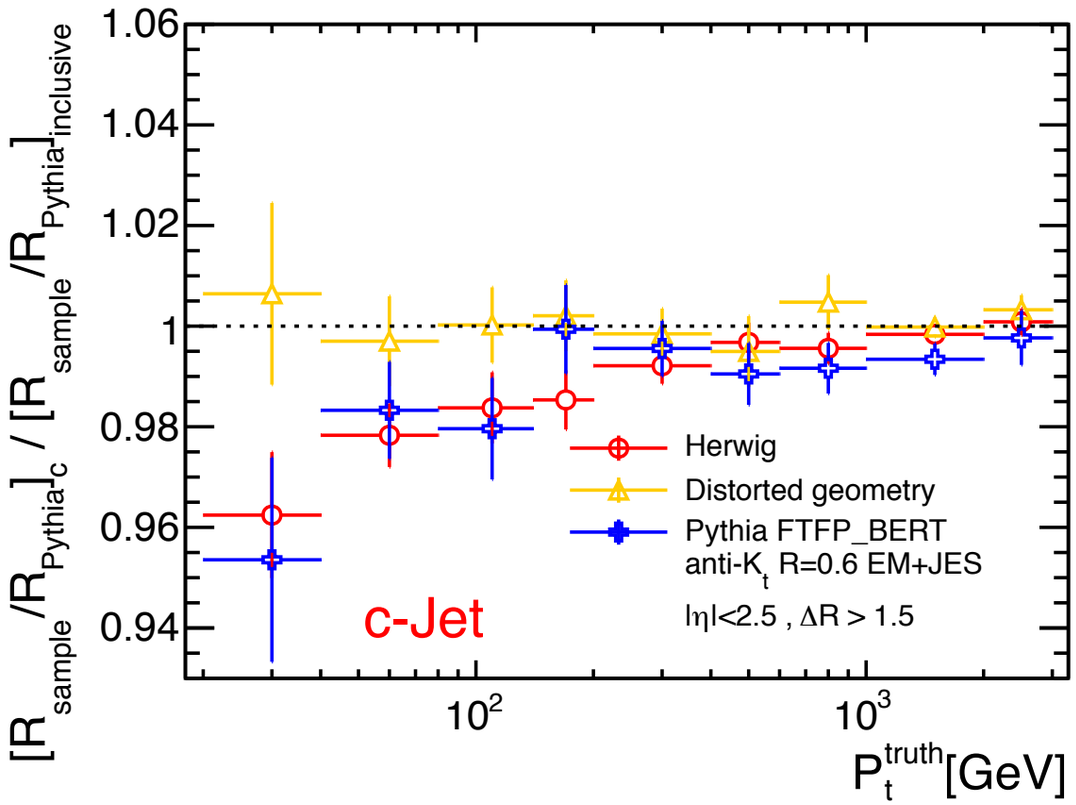


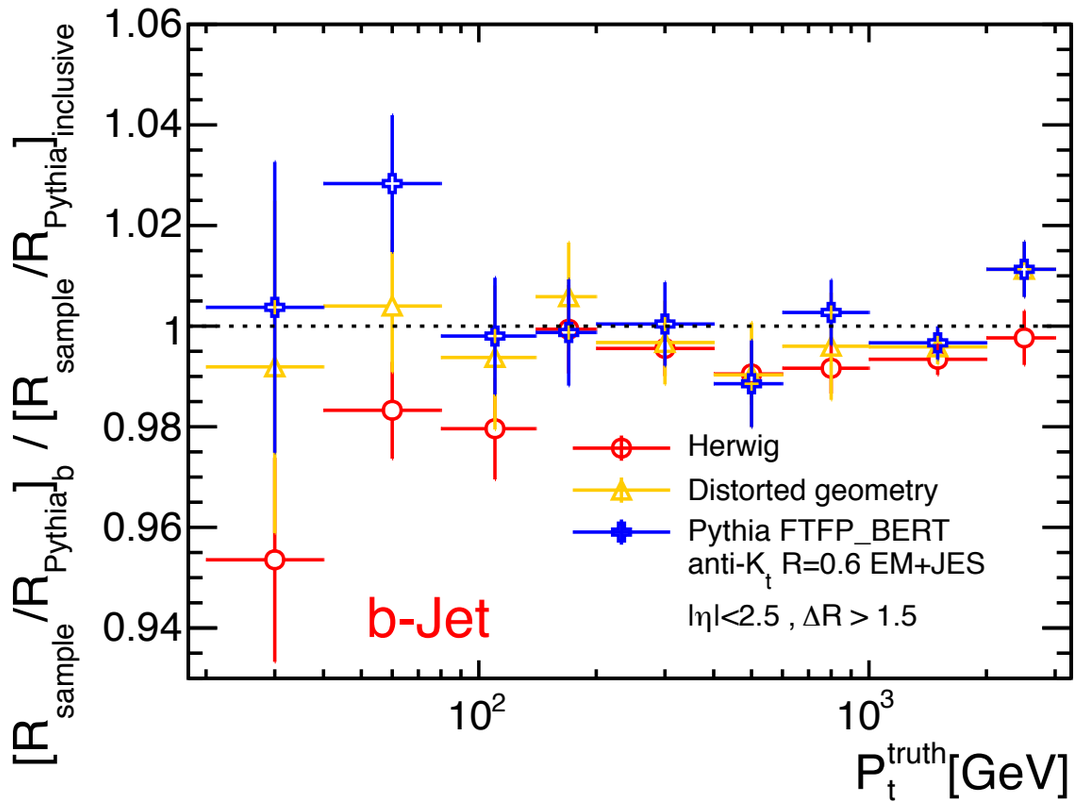


R=0.4 LC+JES

- smaller flavor dependence of systematic compared with EM+JES calibration

Additional systematic of c-JES and b-JES

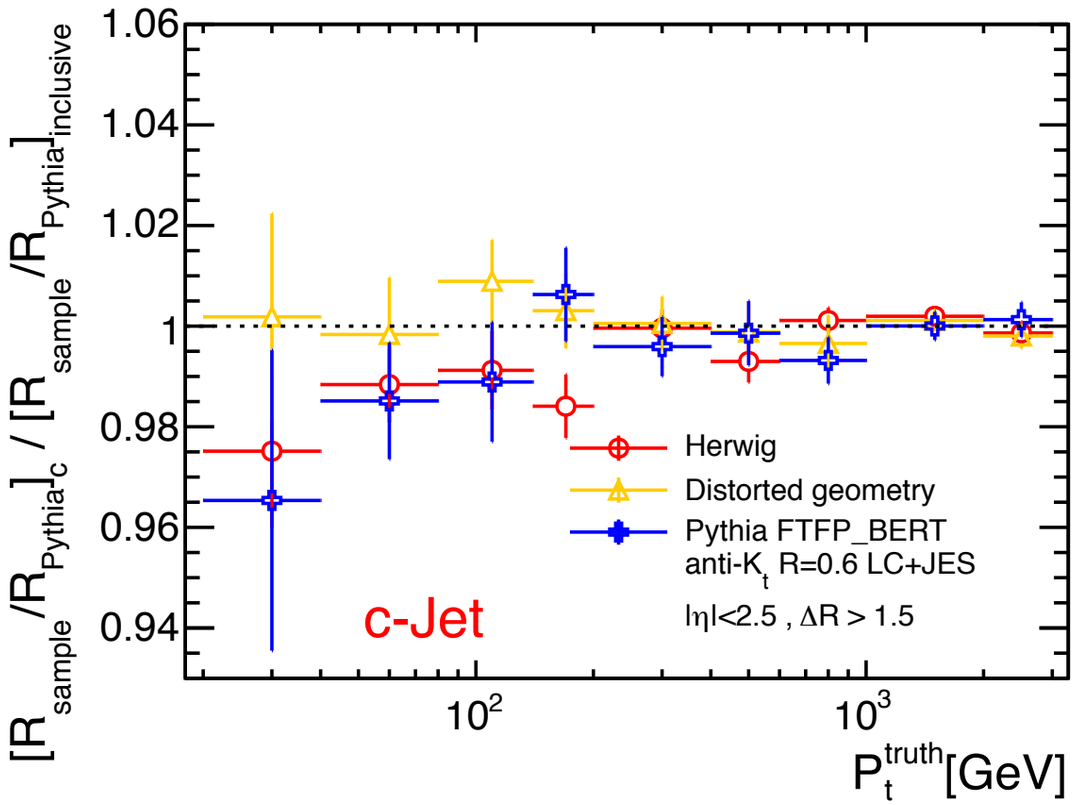


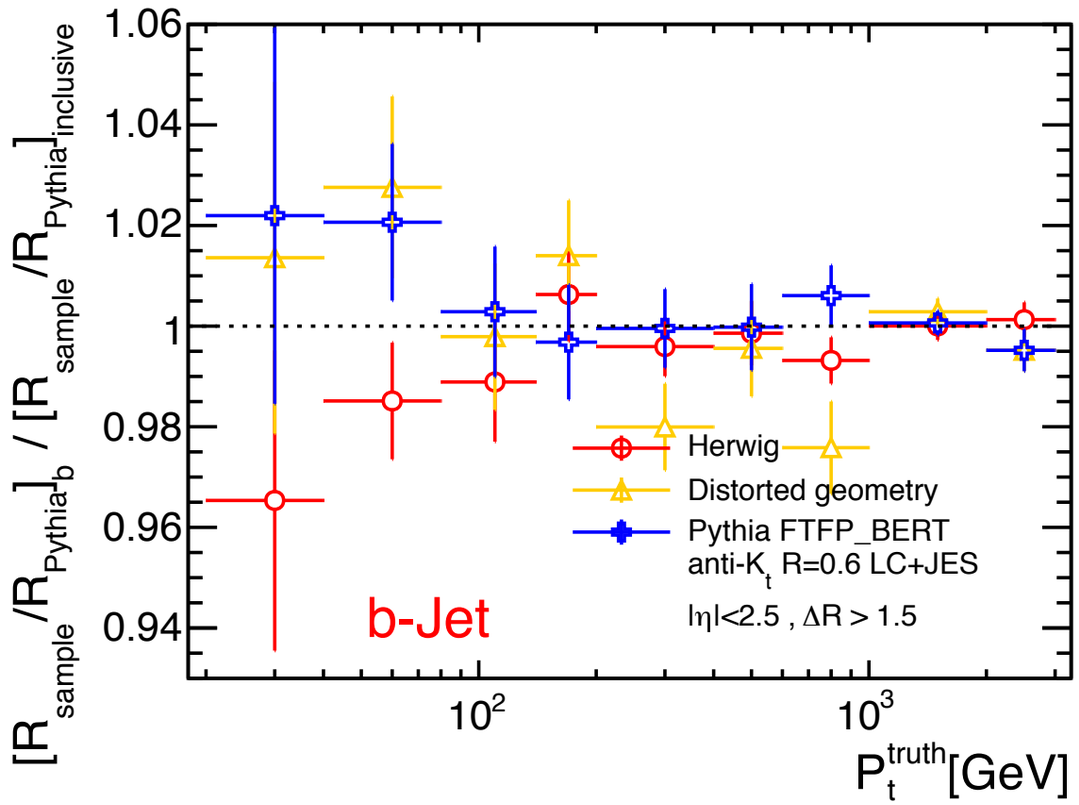


R=0.6 EM+JES

- much different behavior between c-Jet and b-Jet on FTFP_BERT

Additional systematic of c-JES and b-JES





R=0.6 LC+JES

- same as R=0.6 EM+JET, much different behavior between c-Jet and b-Jet on FTFP_BERT
- bigger systematic of b-Jet on **distorted** geometry compared with other calibration method

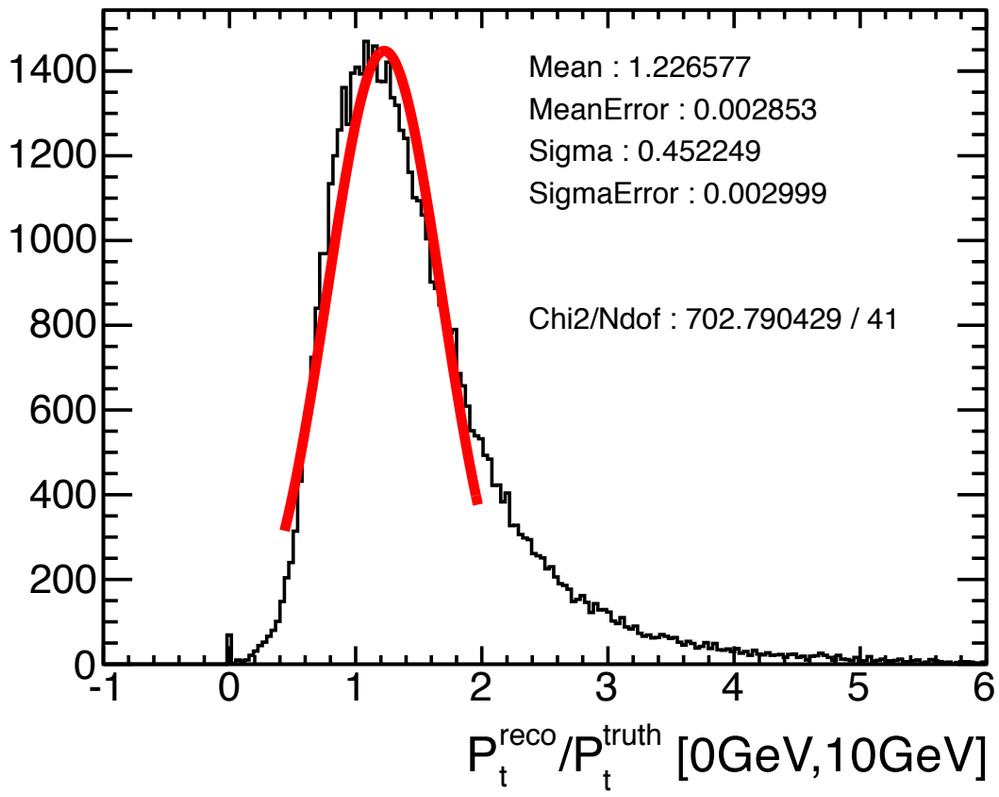
Summary

- Update of additional b-jet energy scale systematics uncertainty
  - mc12_8TeV : Pythia8, Herwig, Distorted geometry, (FTFP_BERT)
- The result;
  - Herwig: lower response -> larger additional systematics in low pT region,compared to mc11
  - smaller detector material effect on heavy flavor jet
- Other samples e.g. Professor-tune, Perugia, Sherpa : not available in mc12
  - need to produce them if additional systematics from fragmentation necessary

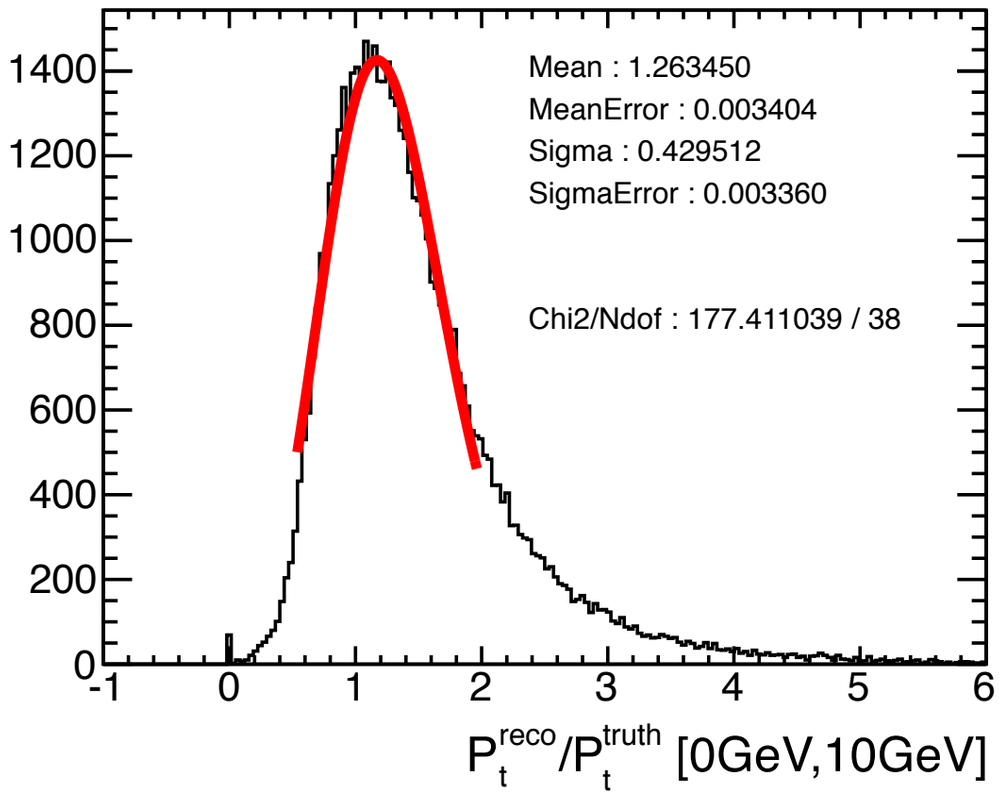
back up

comparative fit performance

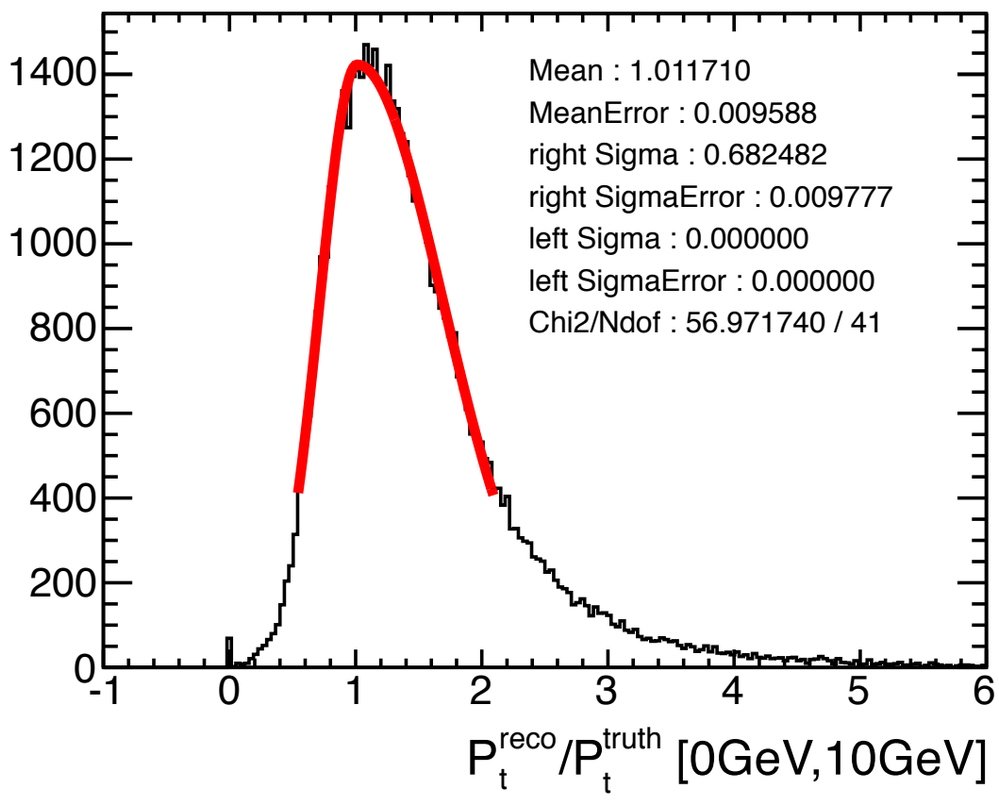
Gaussian



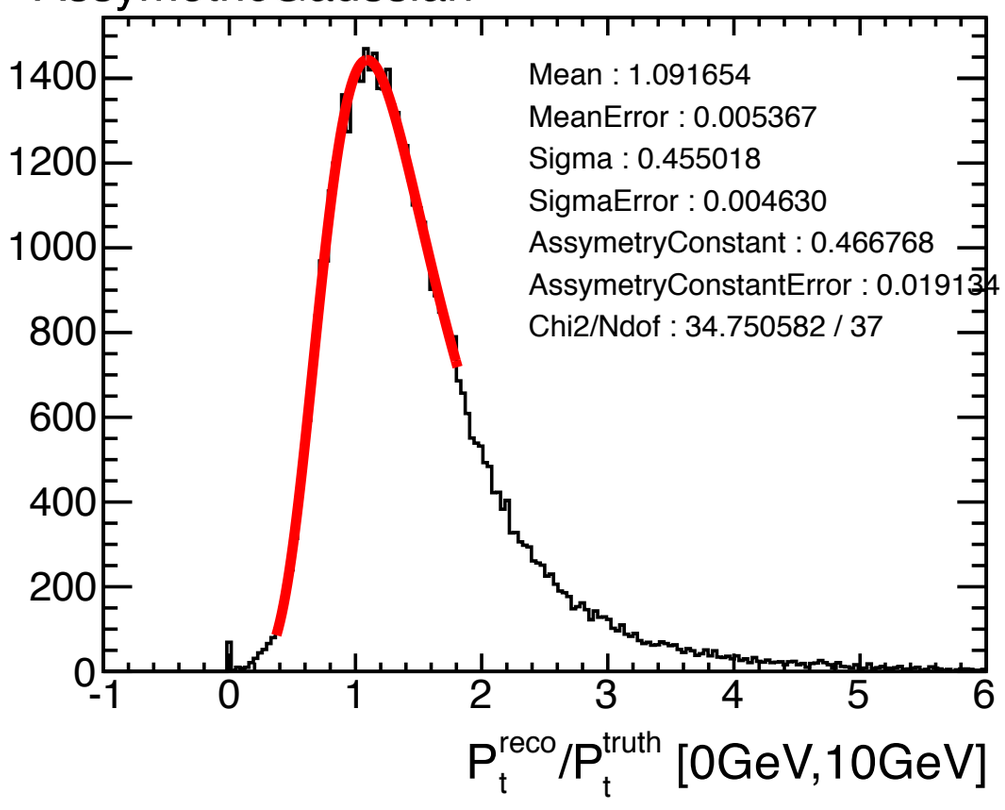
Poisson



BifurGaussian



AssymetricGaussian



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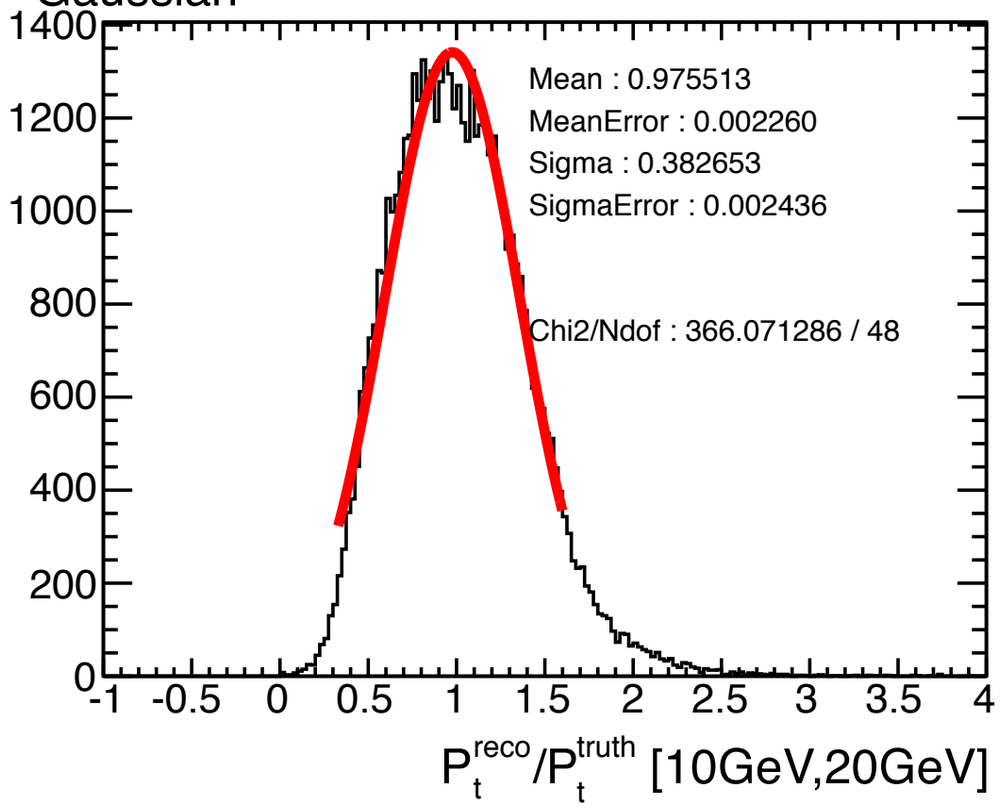

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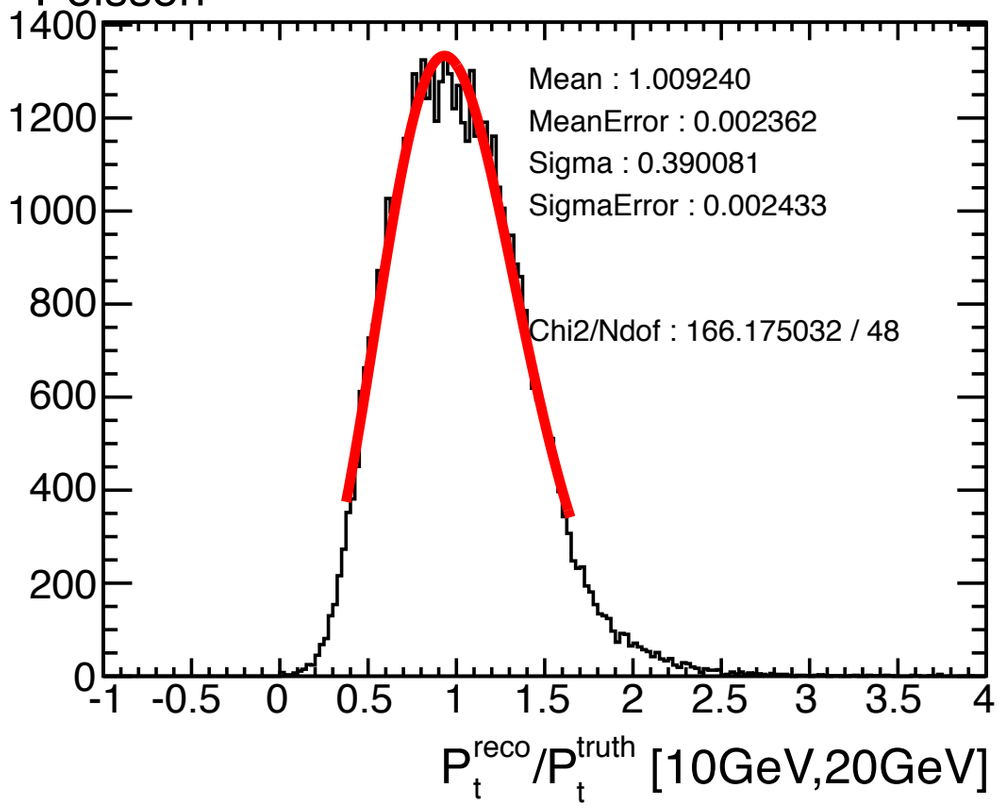

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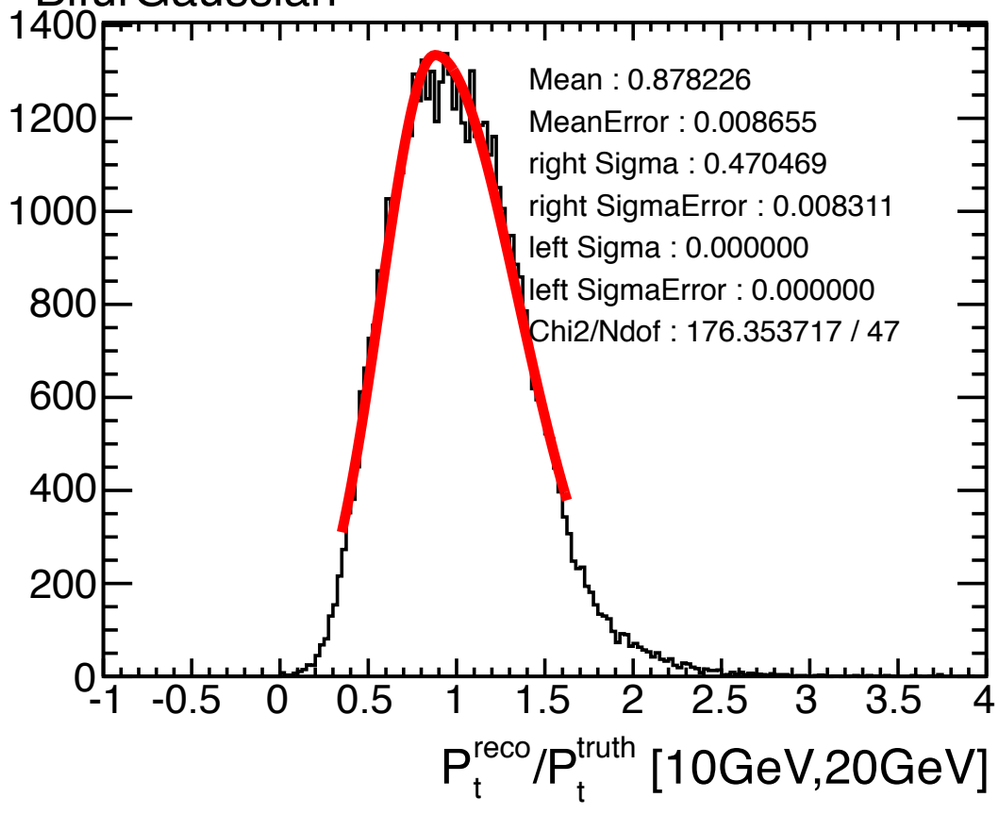

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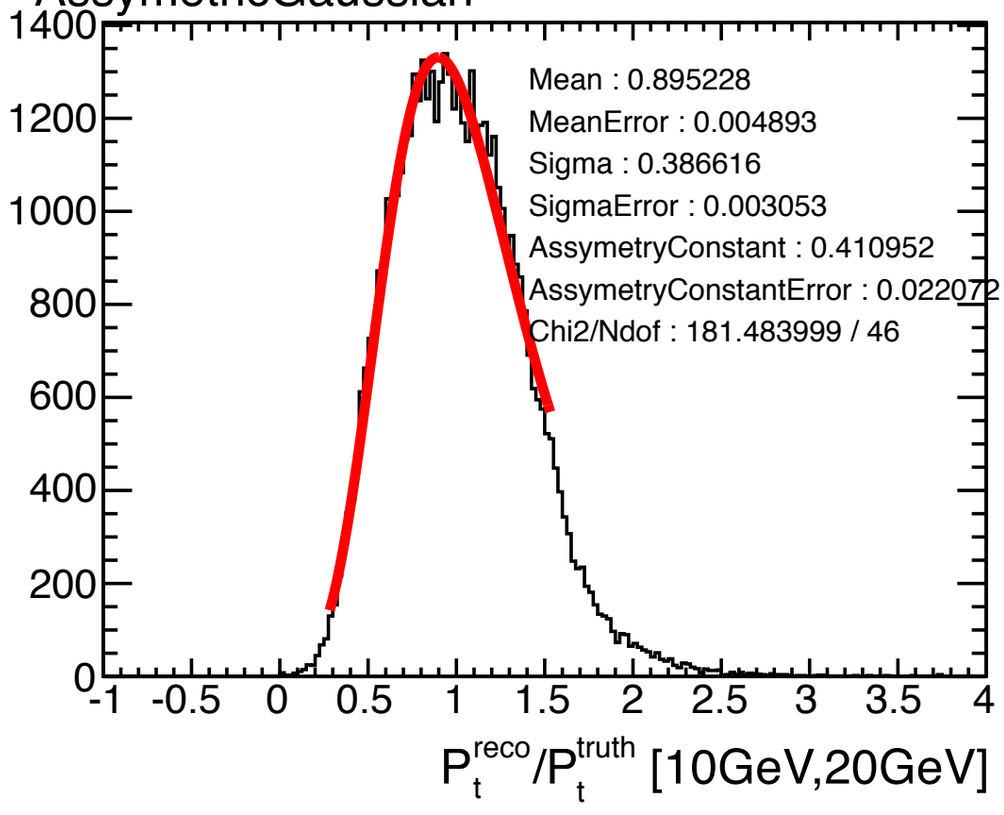

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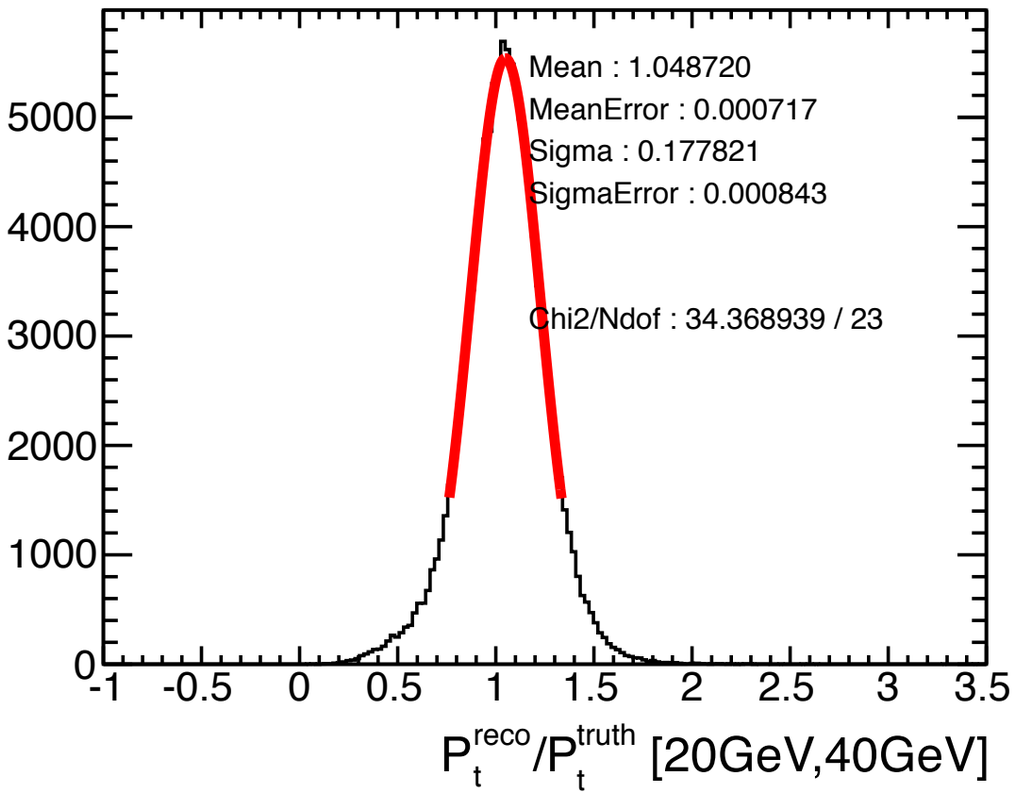
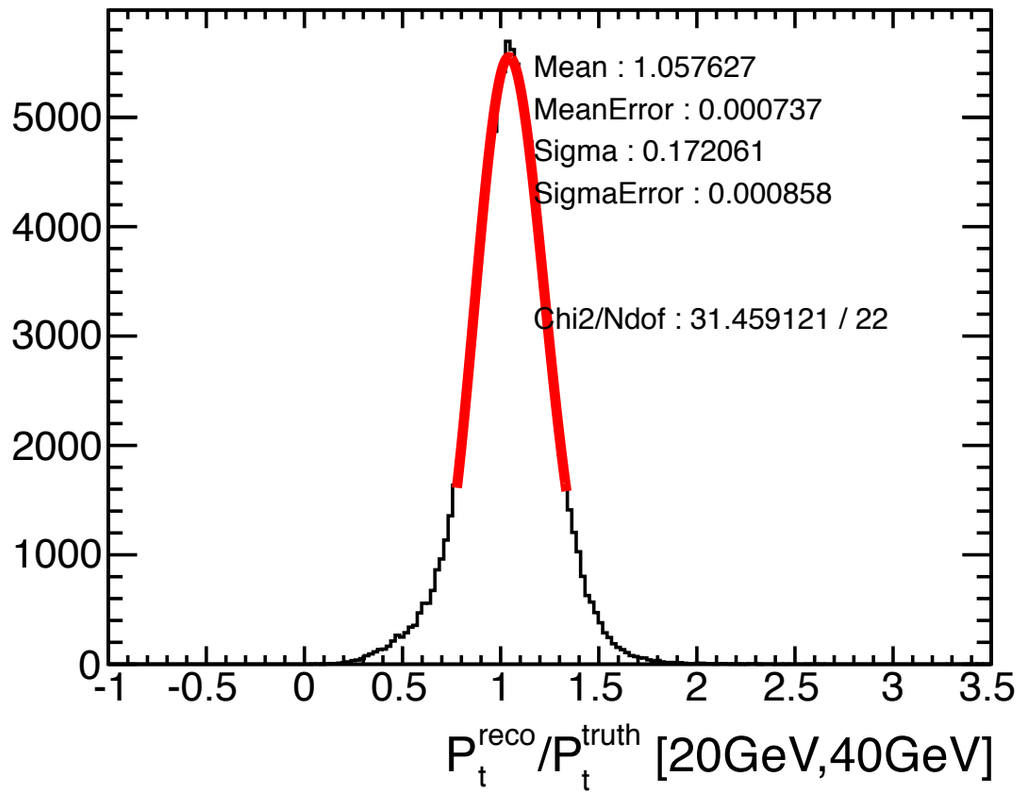


Poisson



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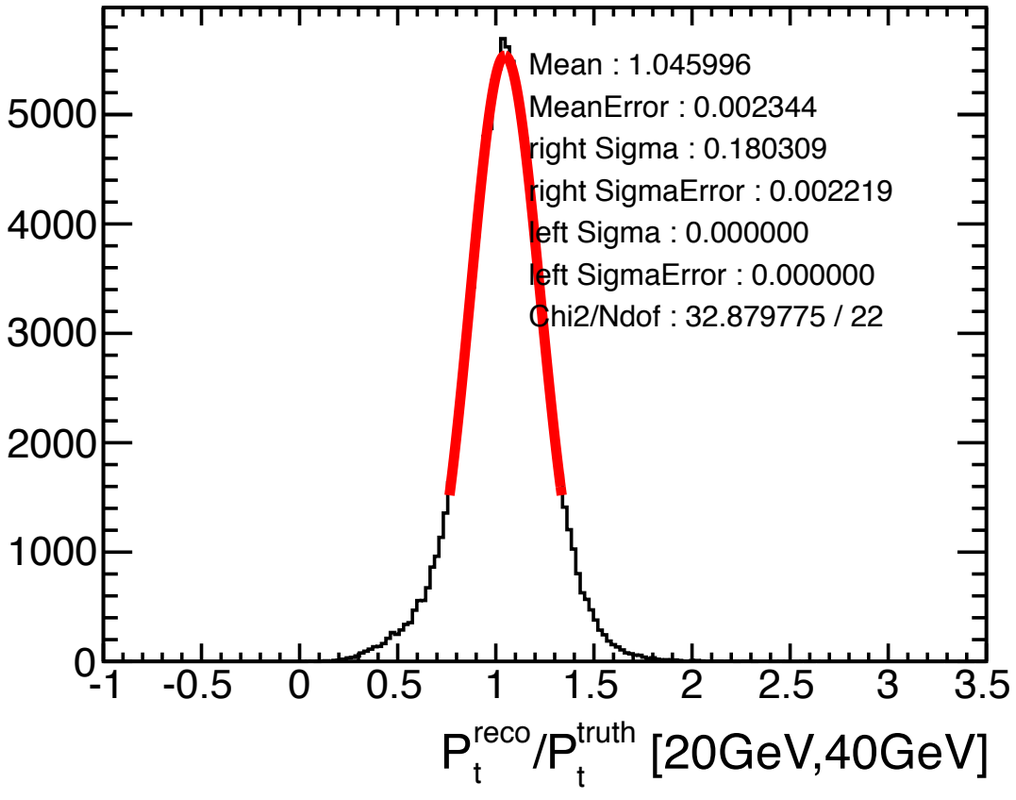

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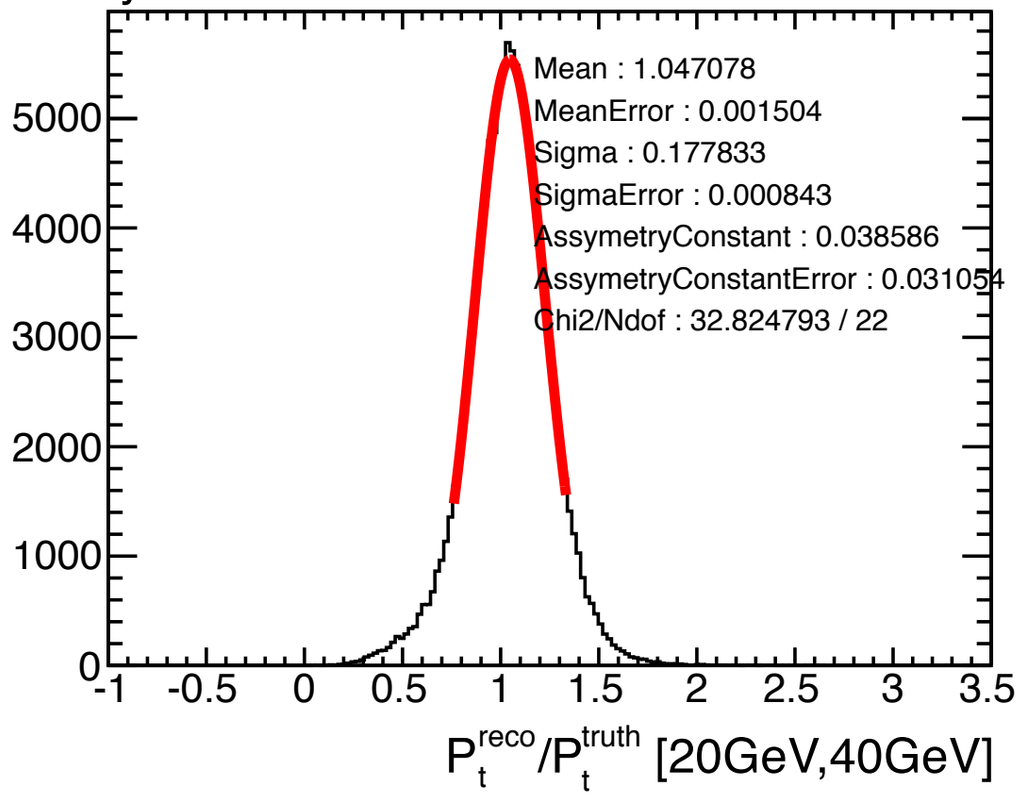
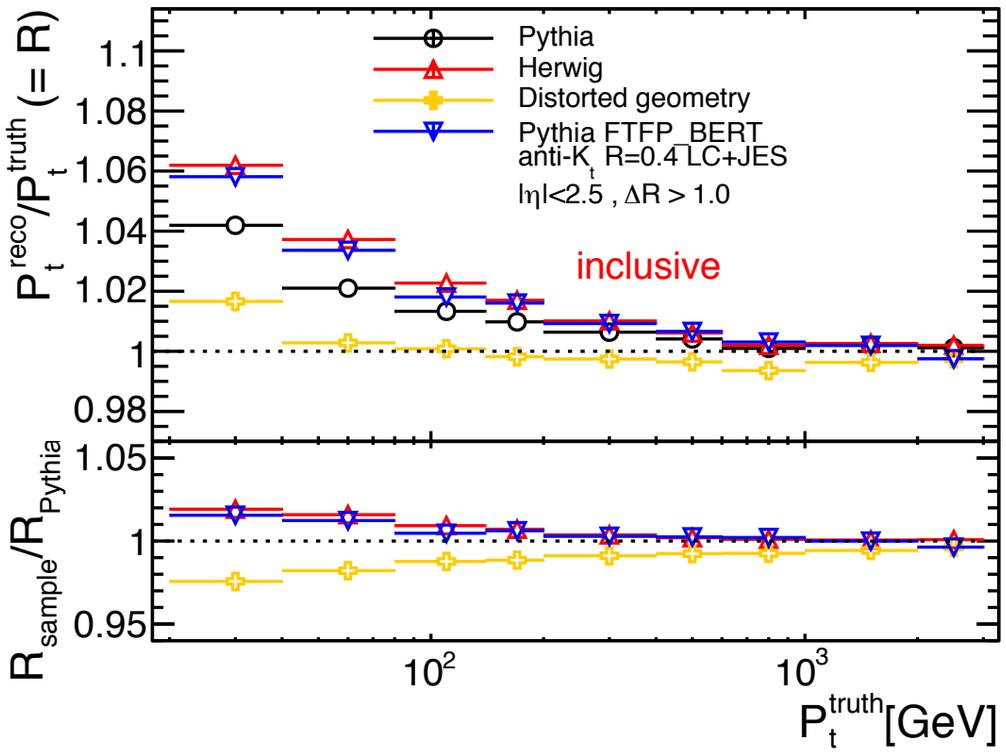
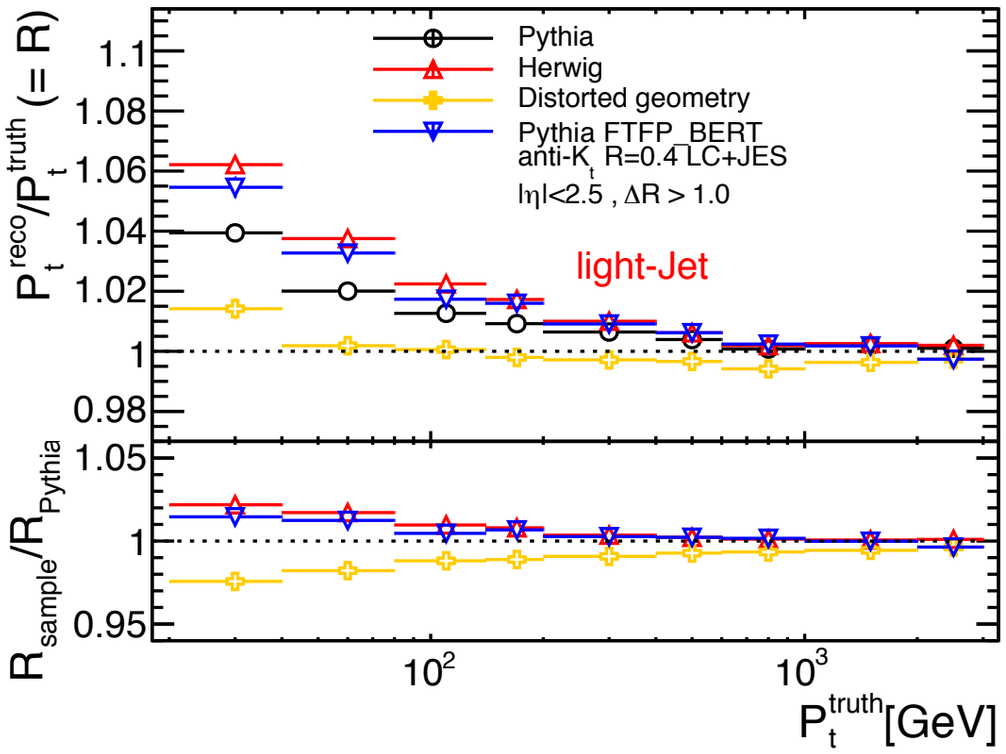
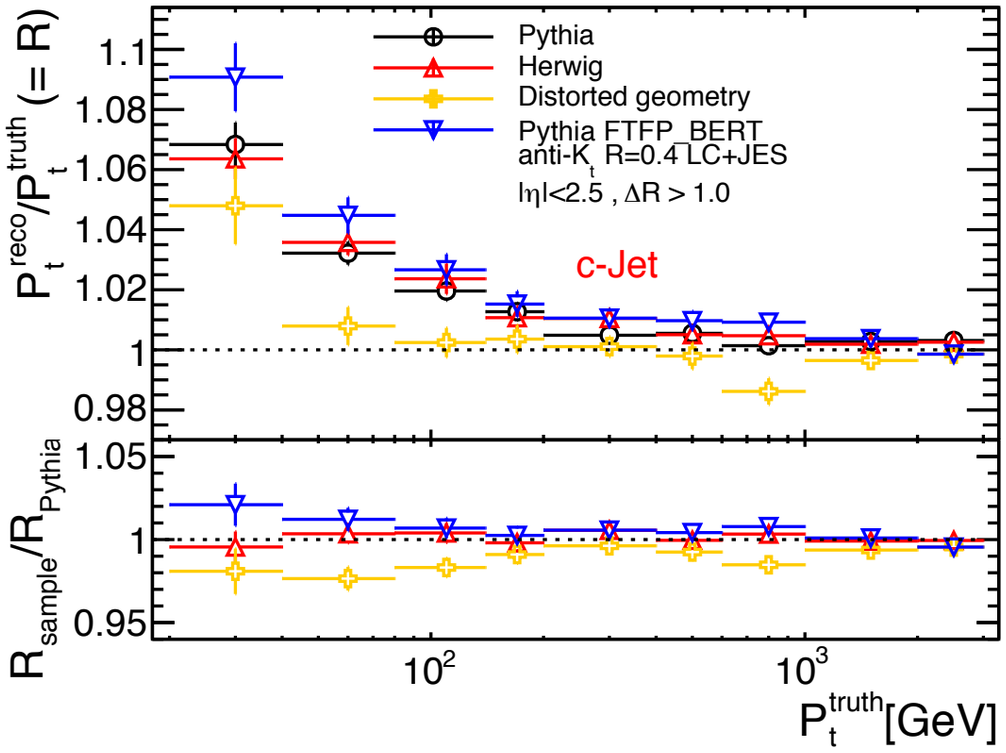


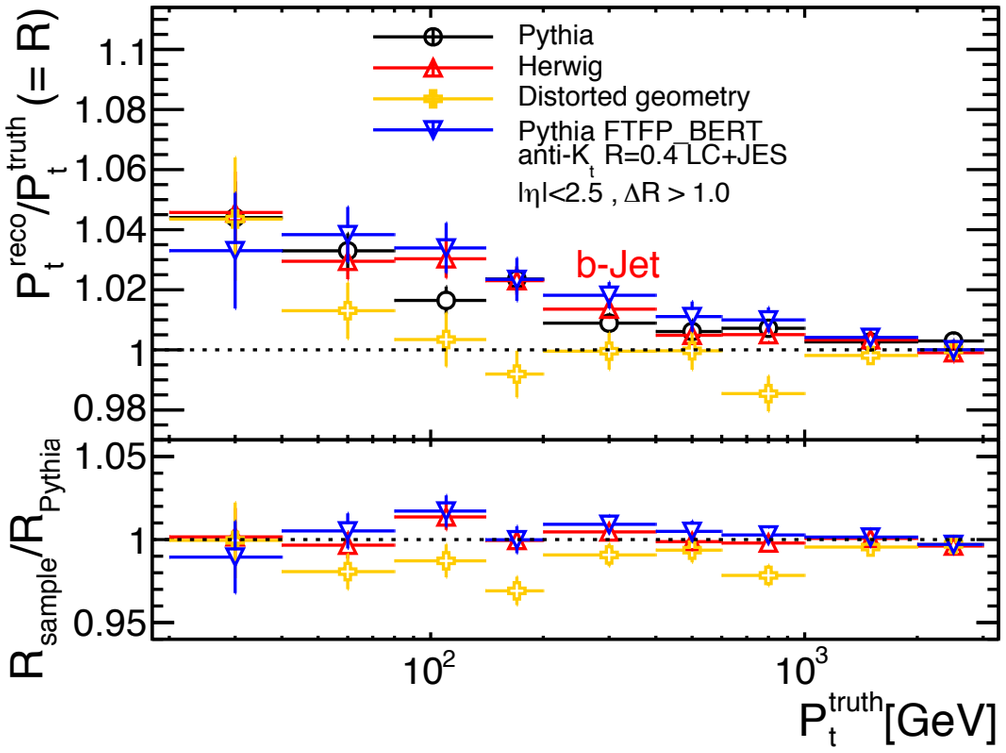
Fraction dependence to Pythia

Fraction dependence to Pythia



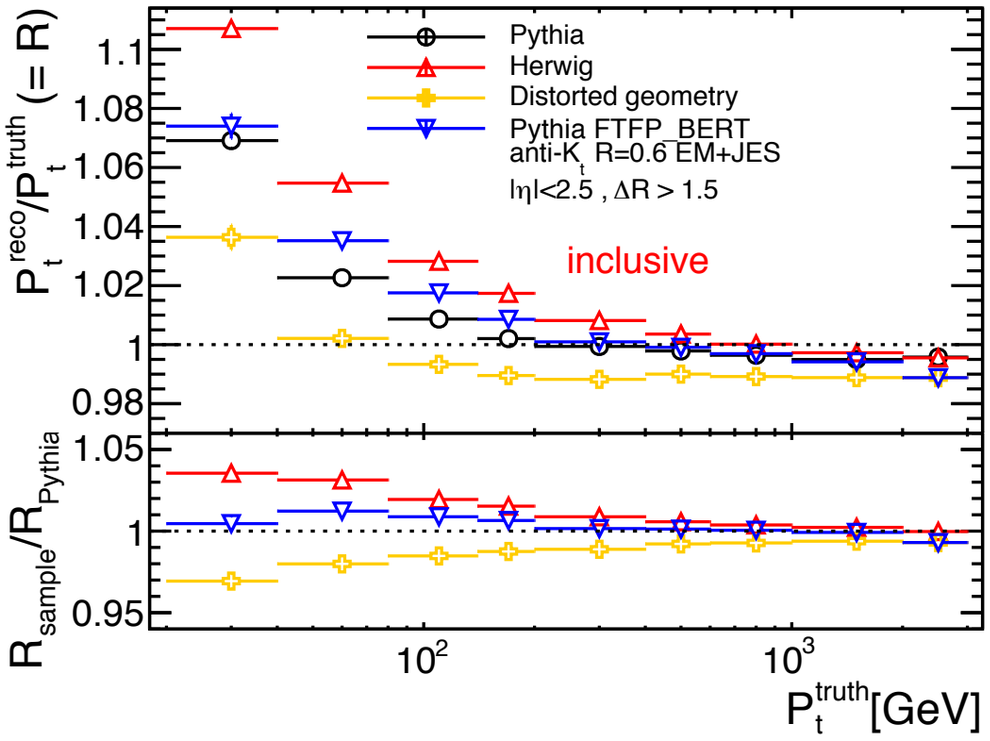


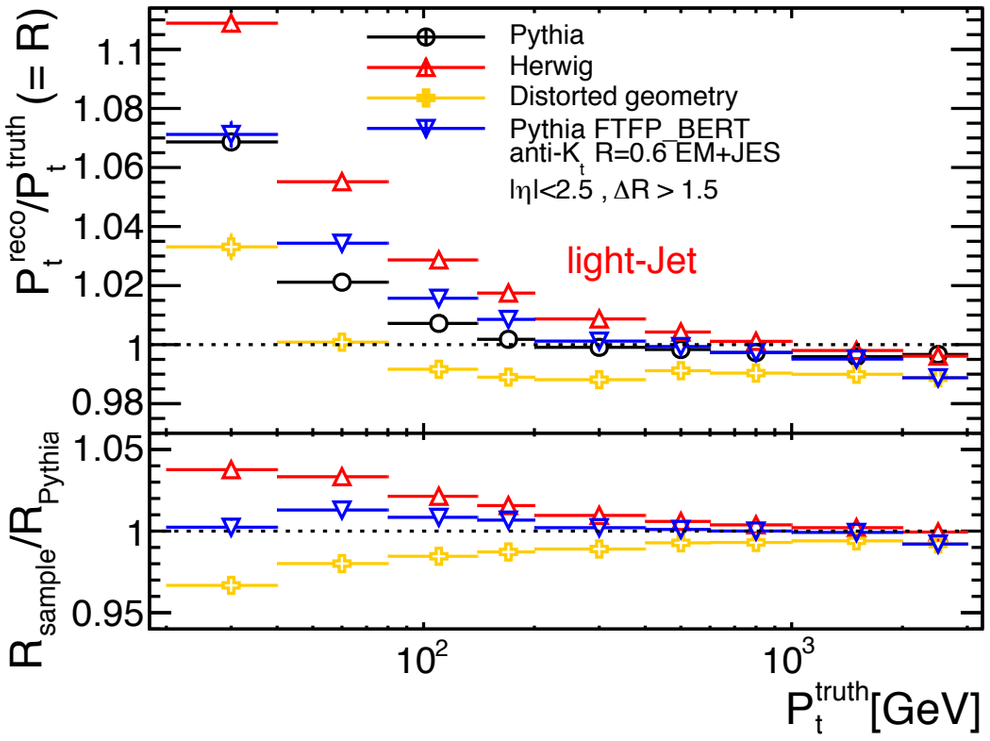


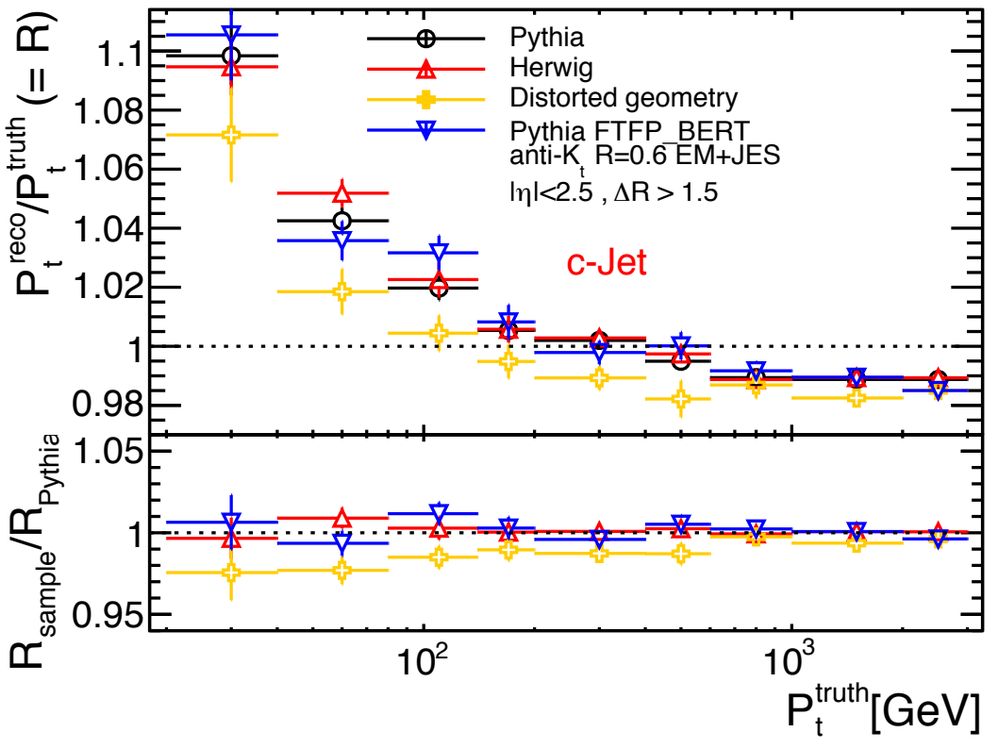


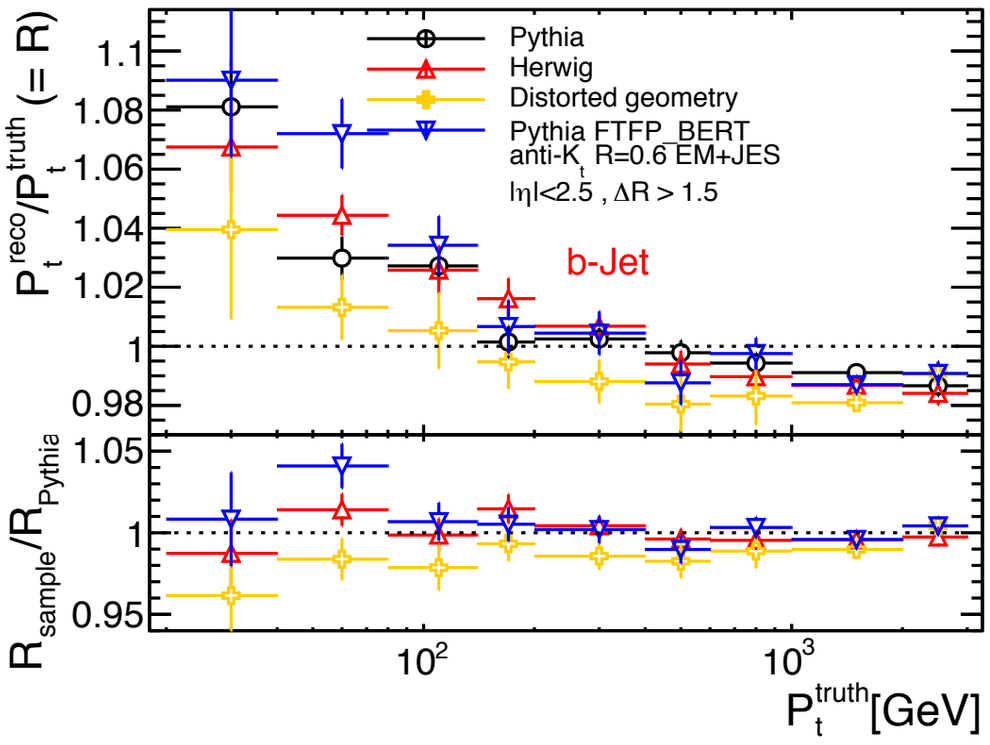
R=0.4 LC+JES

Fraction dependence to Pythia



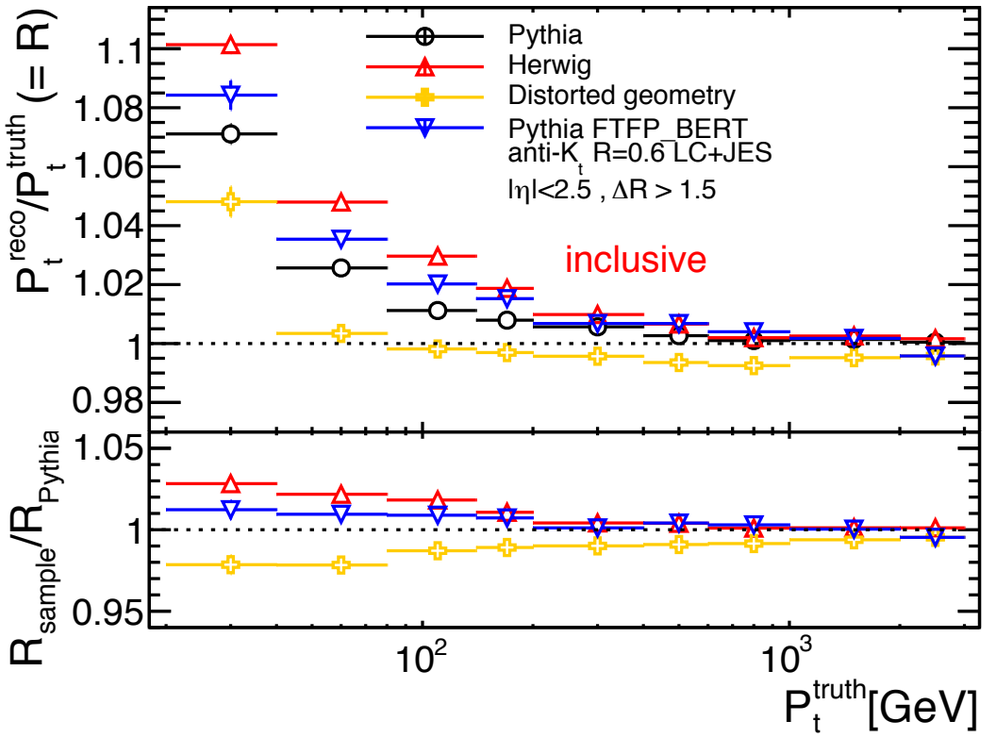


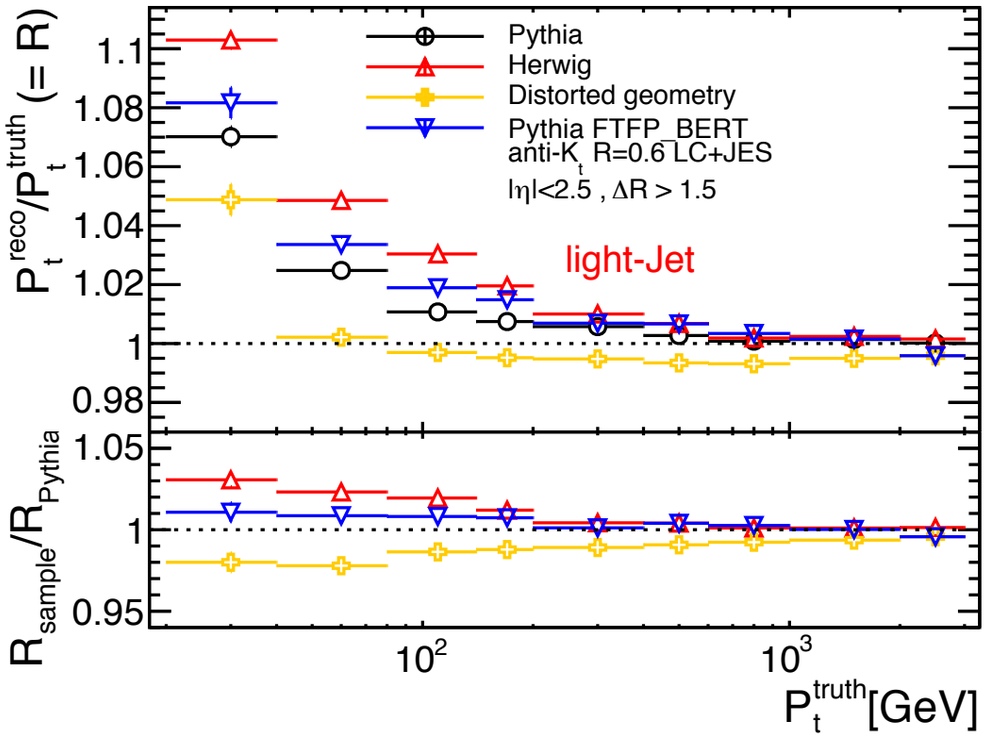


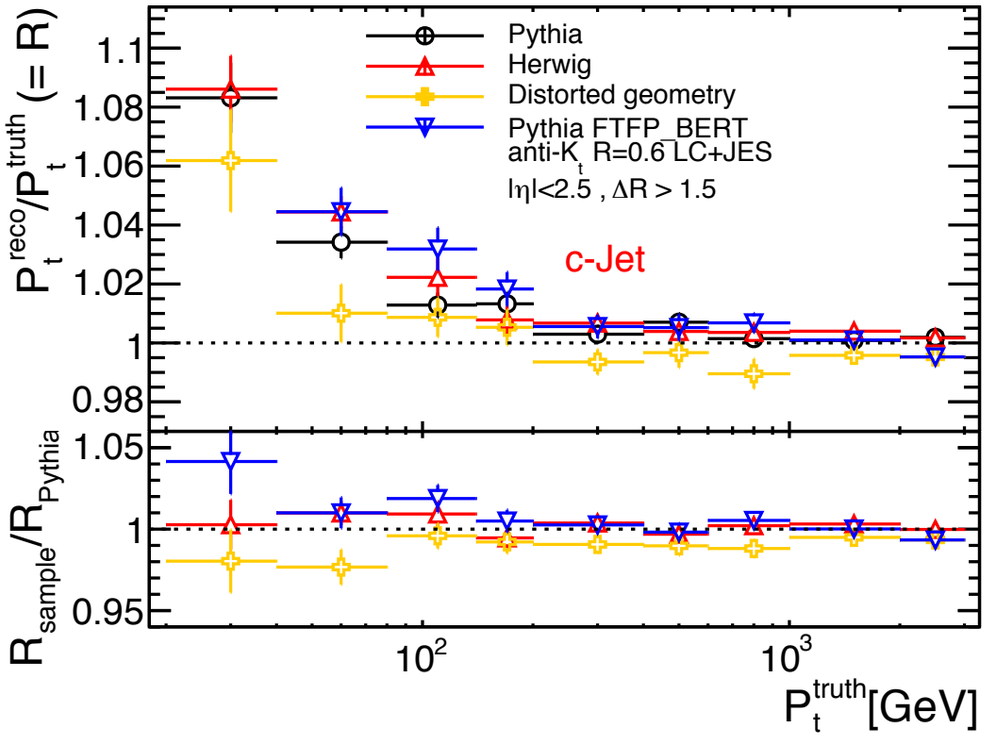


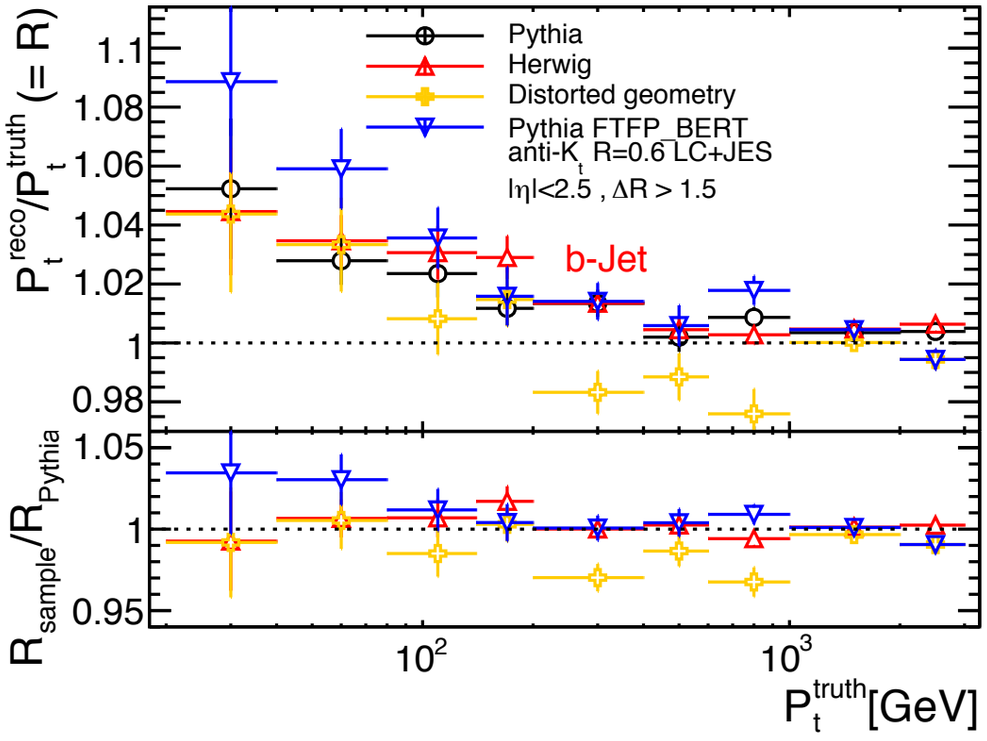
R=0.6 EM+JES

Fraction dependence to Pythia



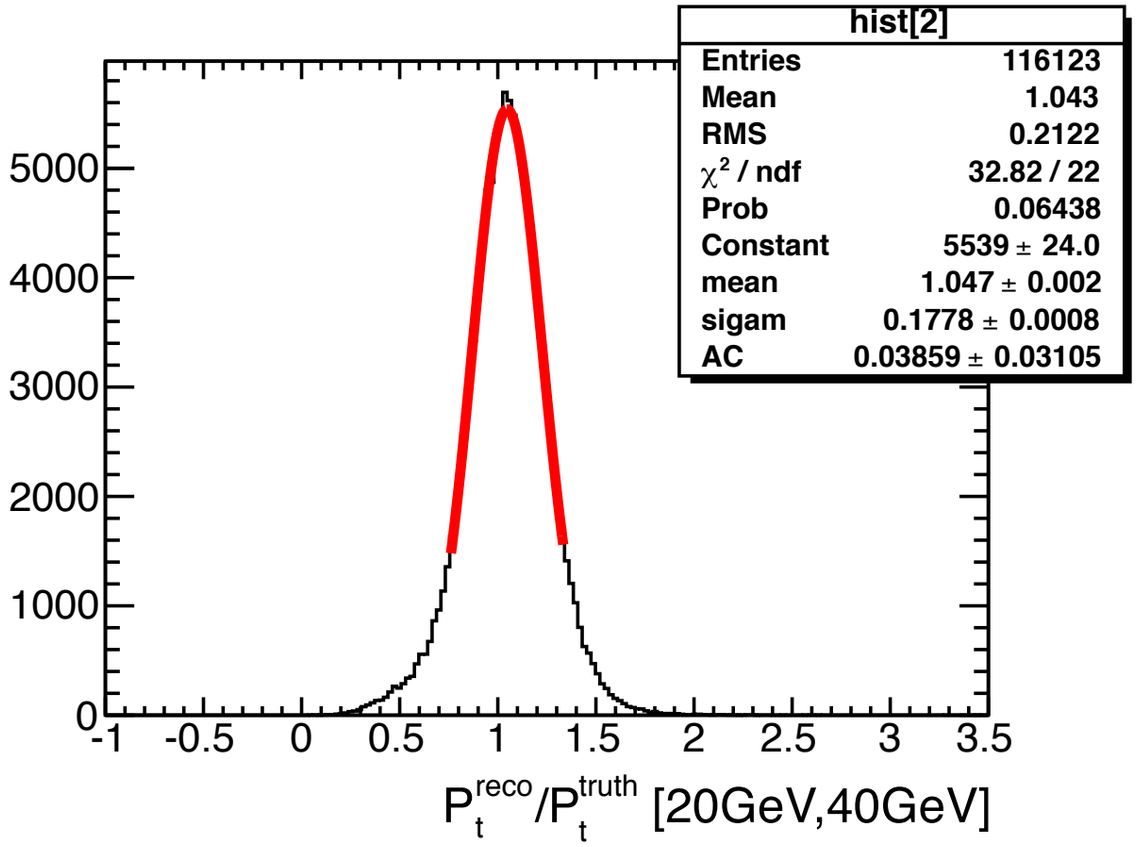


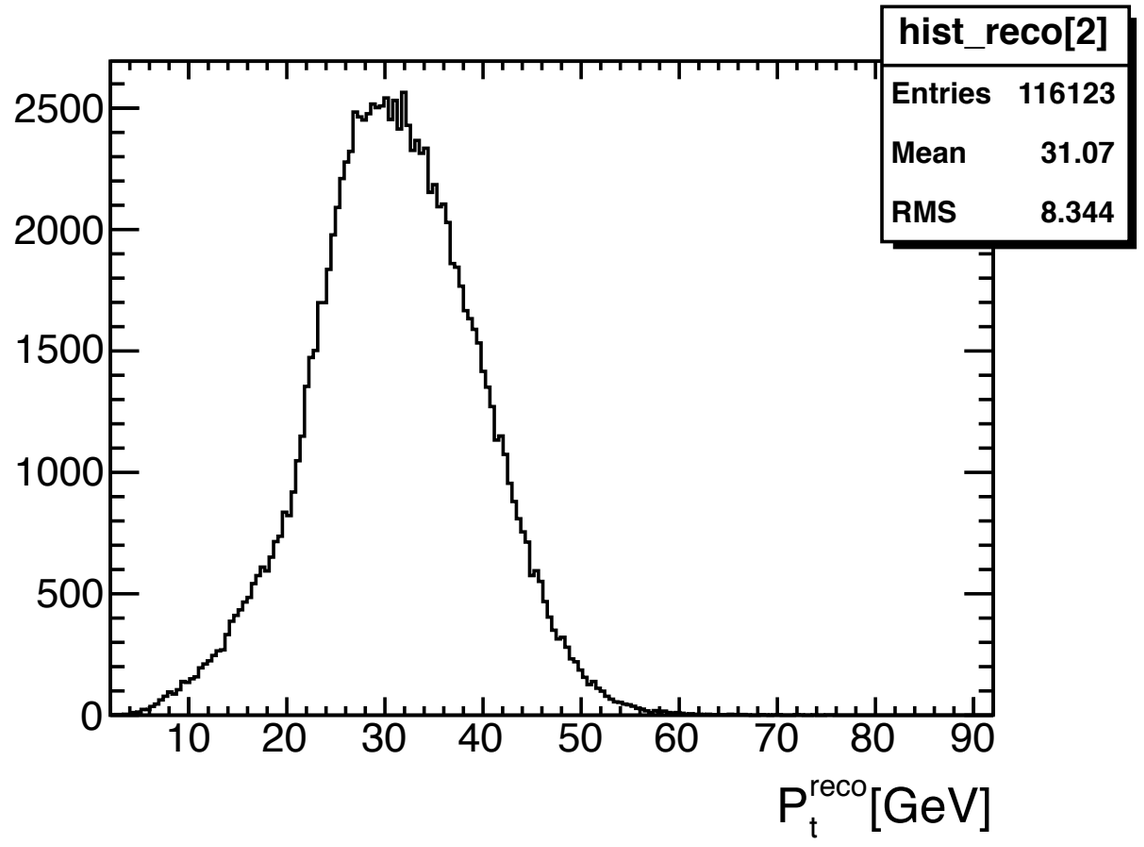


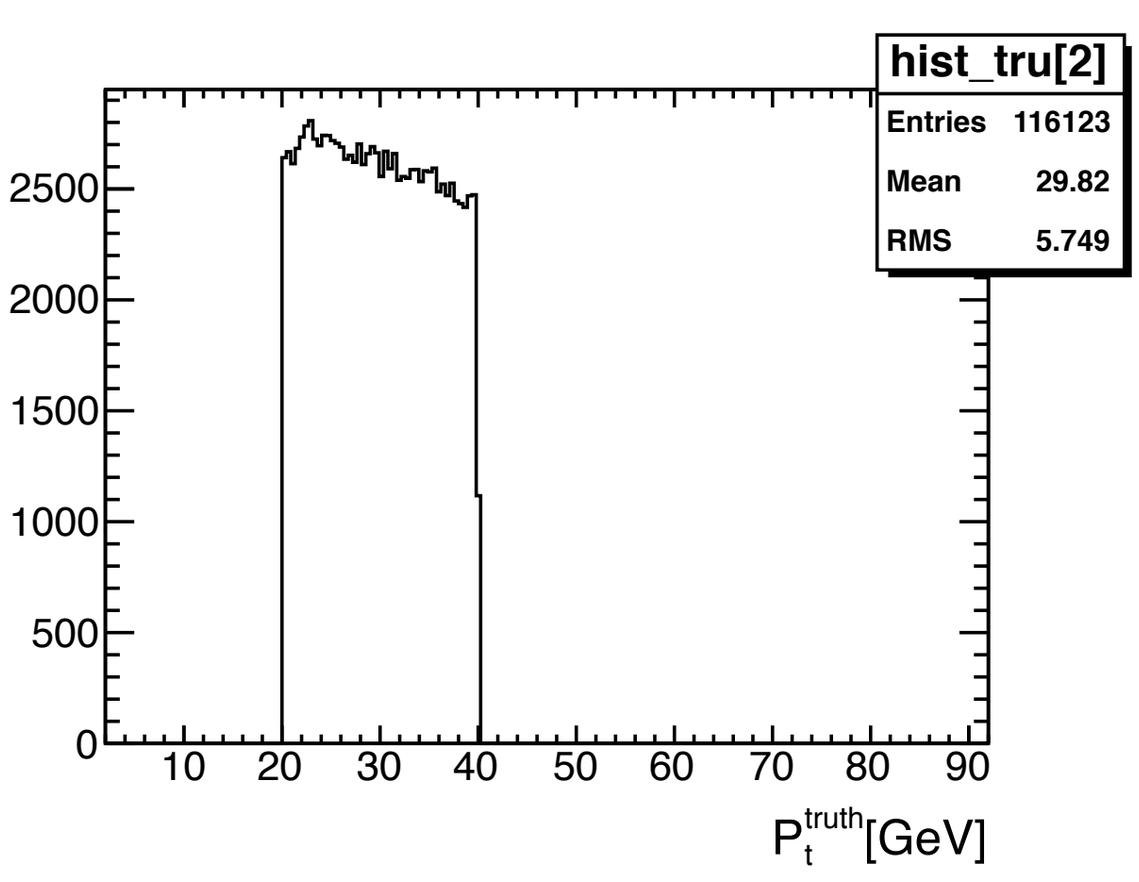


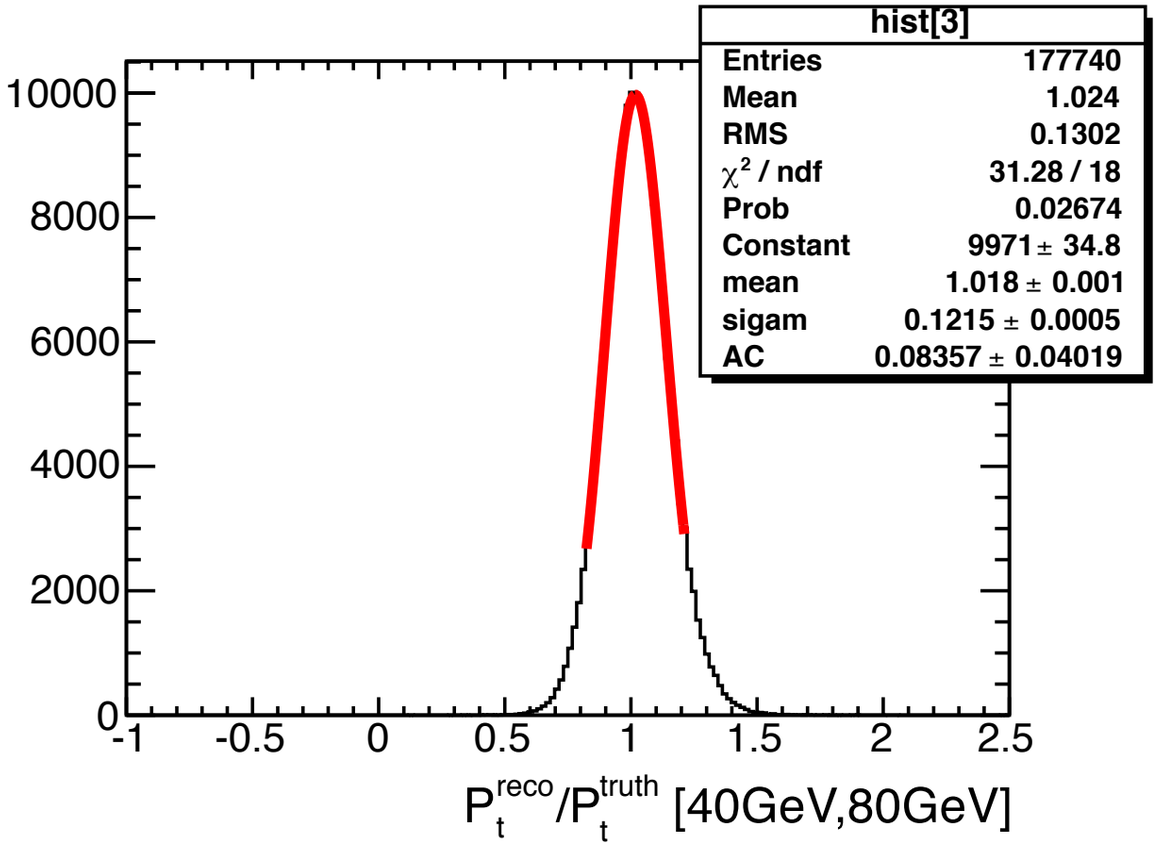
R=0.6 LC+JES

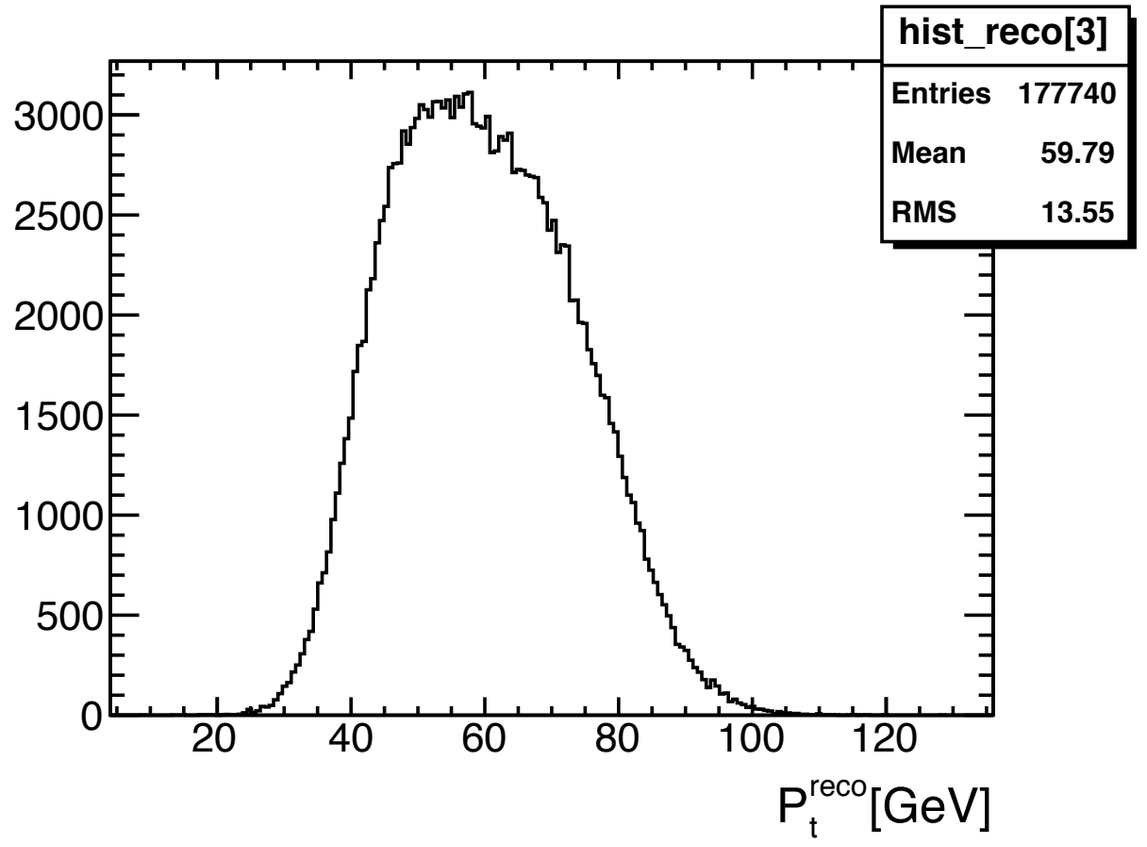
response and Pt distribution R=0.4,EM+JES inclusive-Jet

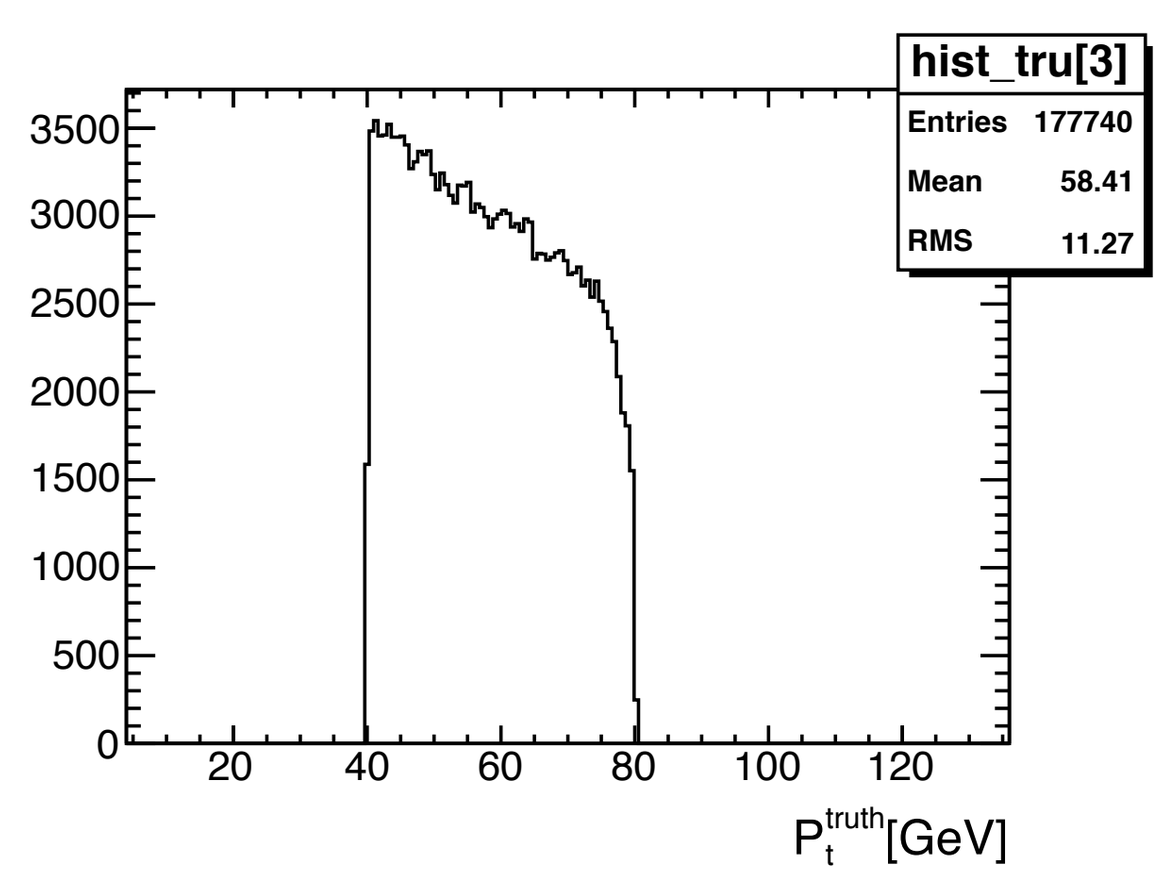

hist[2]
Entries 116123
Mean 1.043
RMS 0.2122
χ² / ndf 32.82 / 22
Prob 0.06438
Constant 5539 ± 24.0
mean 1.047 ± 0.002
sigam 0.1778 ± 0.0008
AC 0.03859 ± 0.03105
P_t^reco/P_t^truth [20GeV,40GeV]

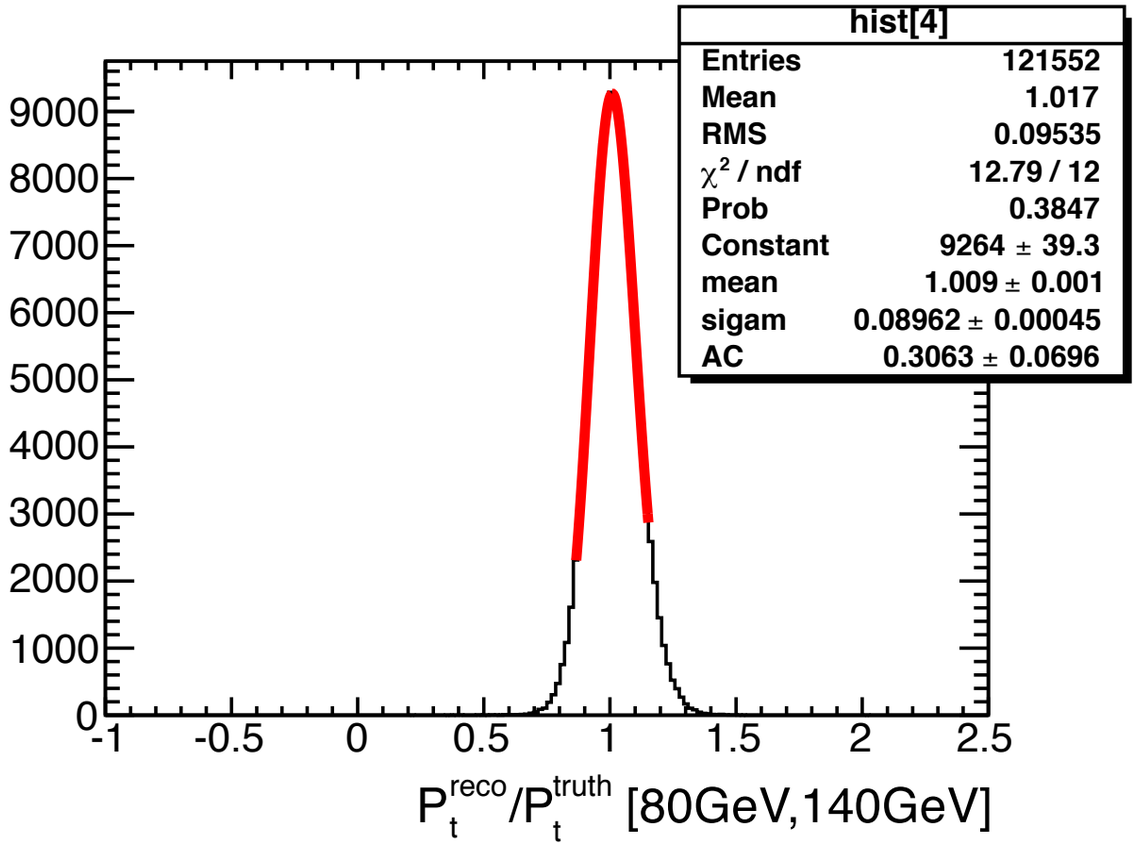

hist_reco[2]
Entries 116123
Mean 31.07
RMS 8.344
P_t^reco[GeV]

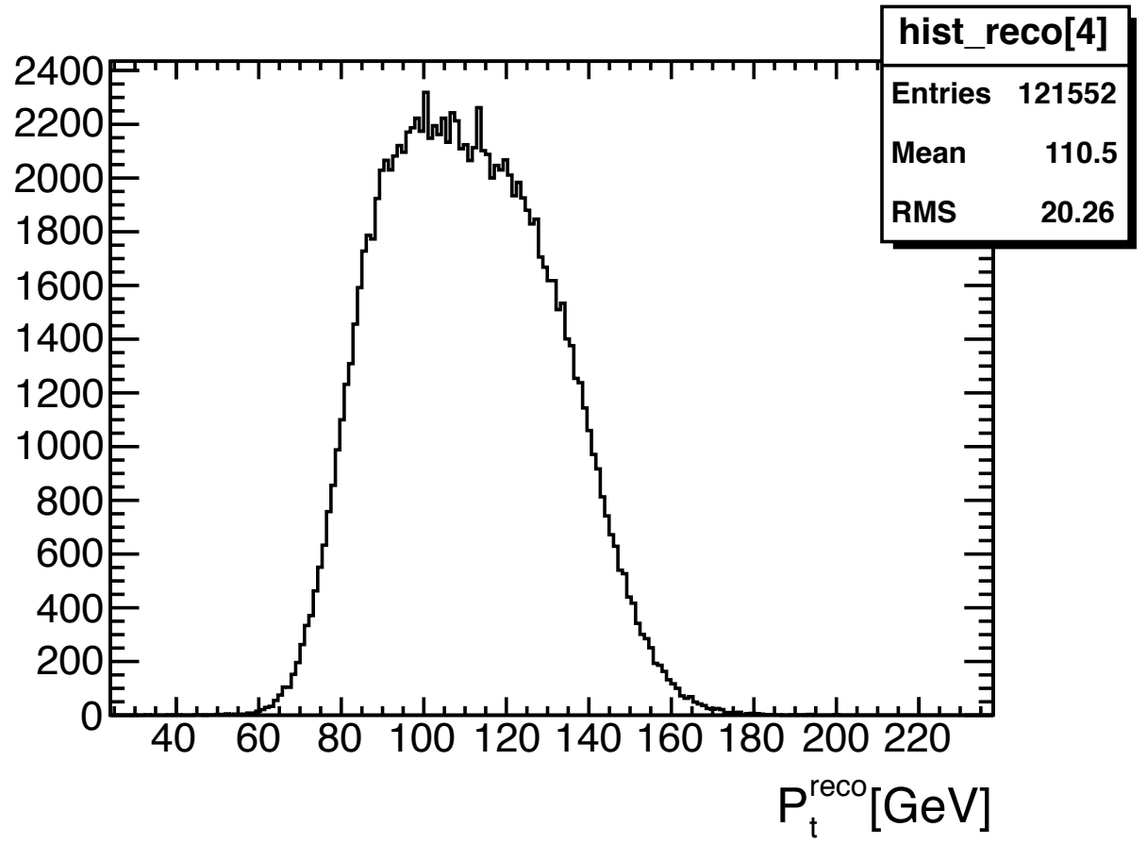

hist_tru[2]
Entries 116123
Mean 29.82
RMS 5.749
P_t^truth[GeV]

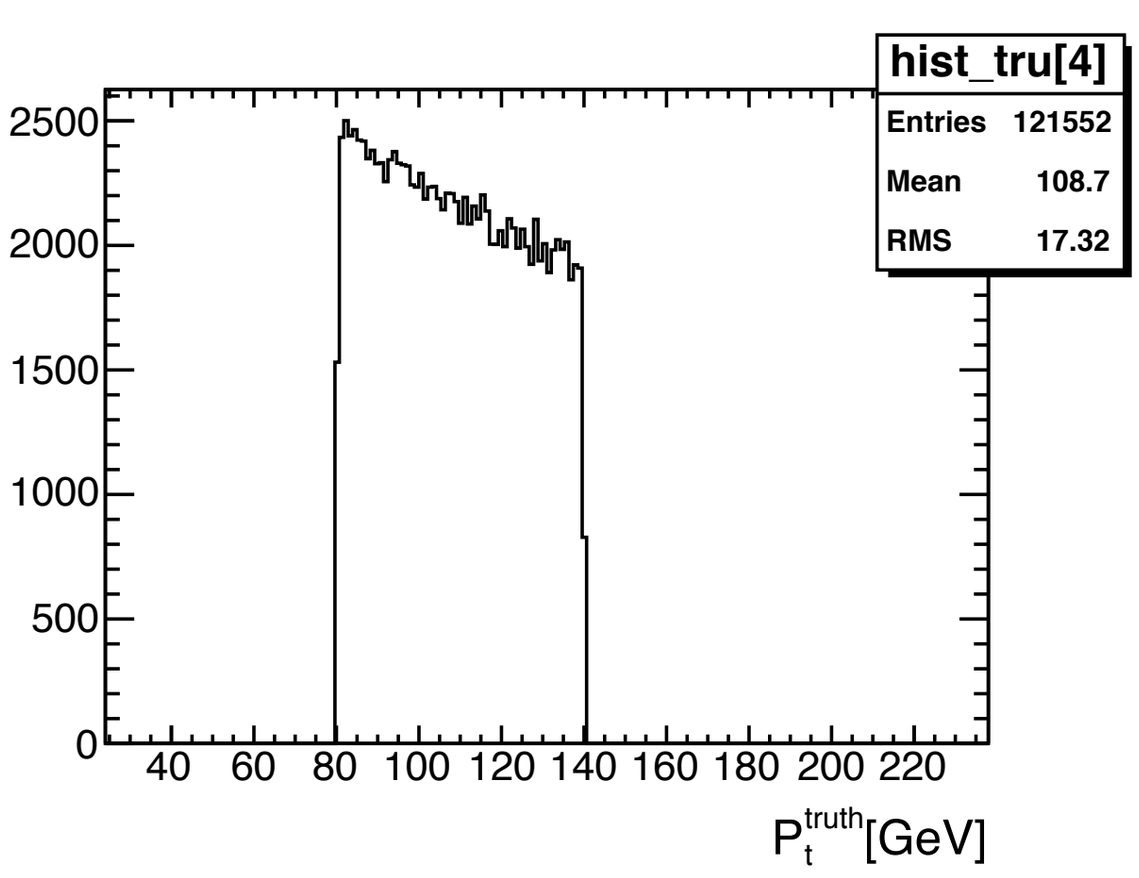

hist[3]
Entries 177740
Mean 1.024
RMS 0.1302
χ² / ndf 31.28 / 18
Prob 0.02674
Constant 9971 ± 34.8
mean 1.018 ± 0.001
sigam 0.1215 ± 0.0005
AC 0.08357 ± 0.04019
10000
8000
6000
4000
2000
0
-1
-0.5
0
0.5
1
1.5
2
2.5
P_t^reco/P_t^truth [40GeV,80GeV]

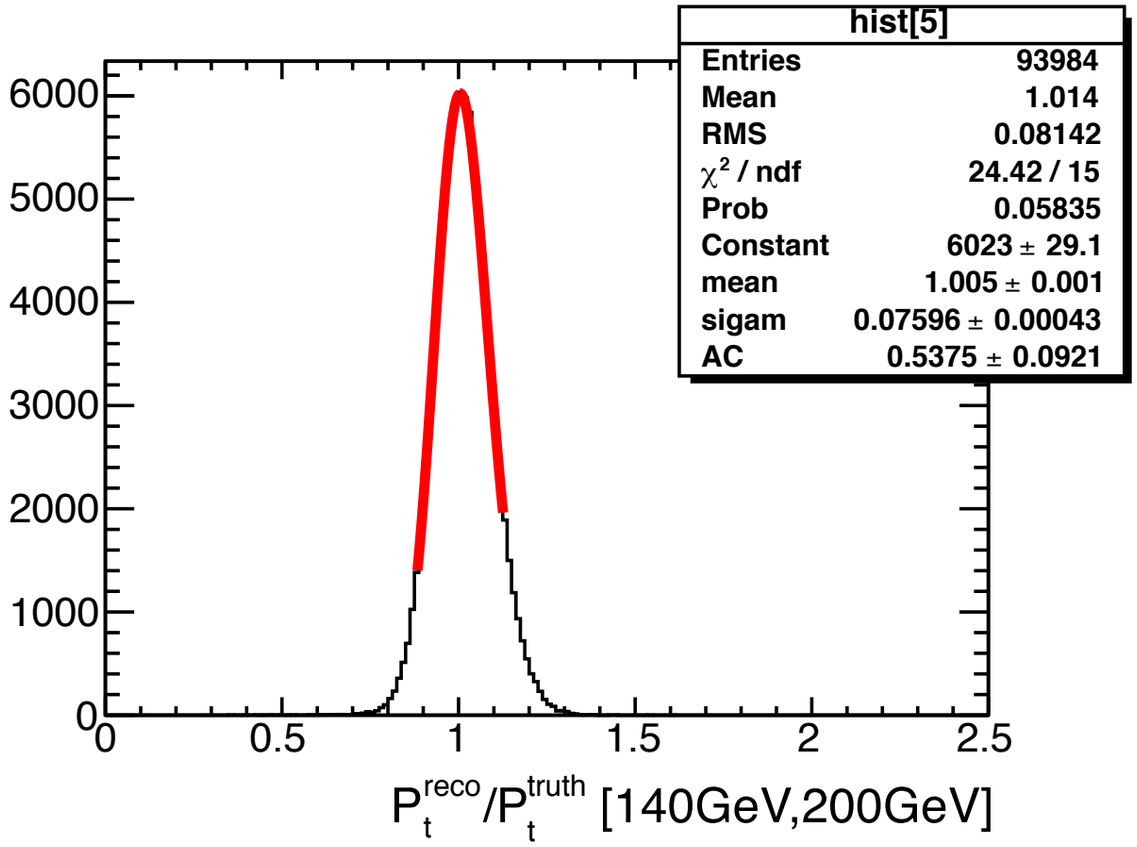

hist_reco[3]
Entries 177740
Mean 59.79
RMS 13.55
3000
2500
2000
1500
1000
500
0
20
40
60
80
100
120
P_t^reco[GeV]

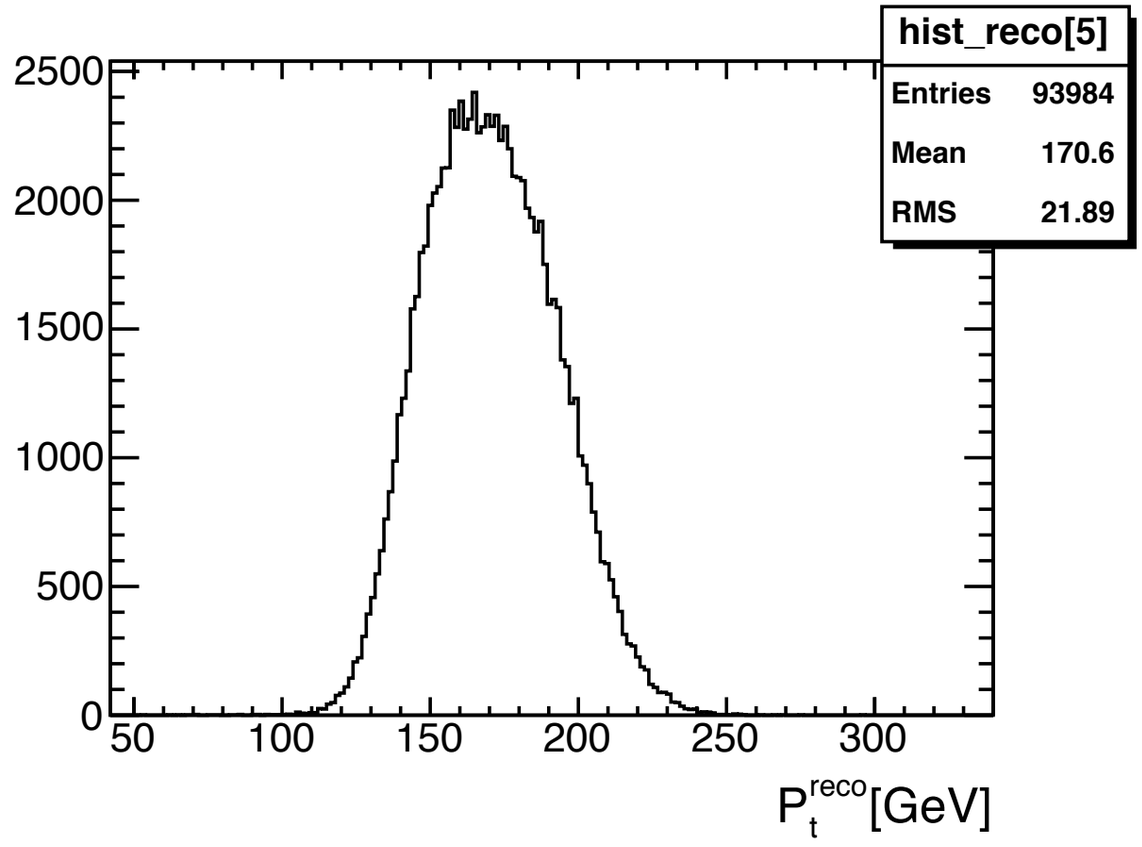

hist_tru[3]
Entries 177740
Mean 58.41
RMS 11.27
3500
3000
2500
2000
1500
1000
500
0
20
40
60
80
100
120
P_t^truth[GeV]

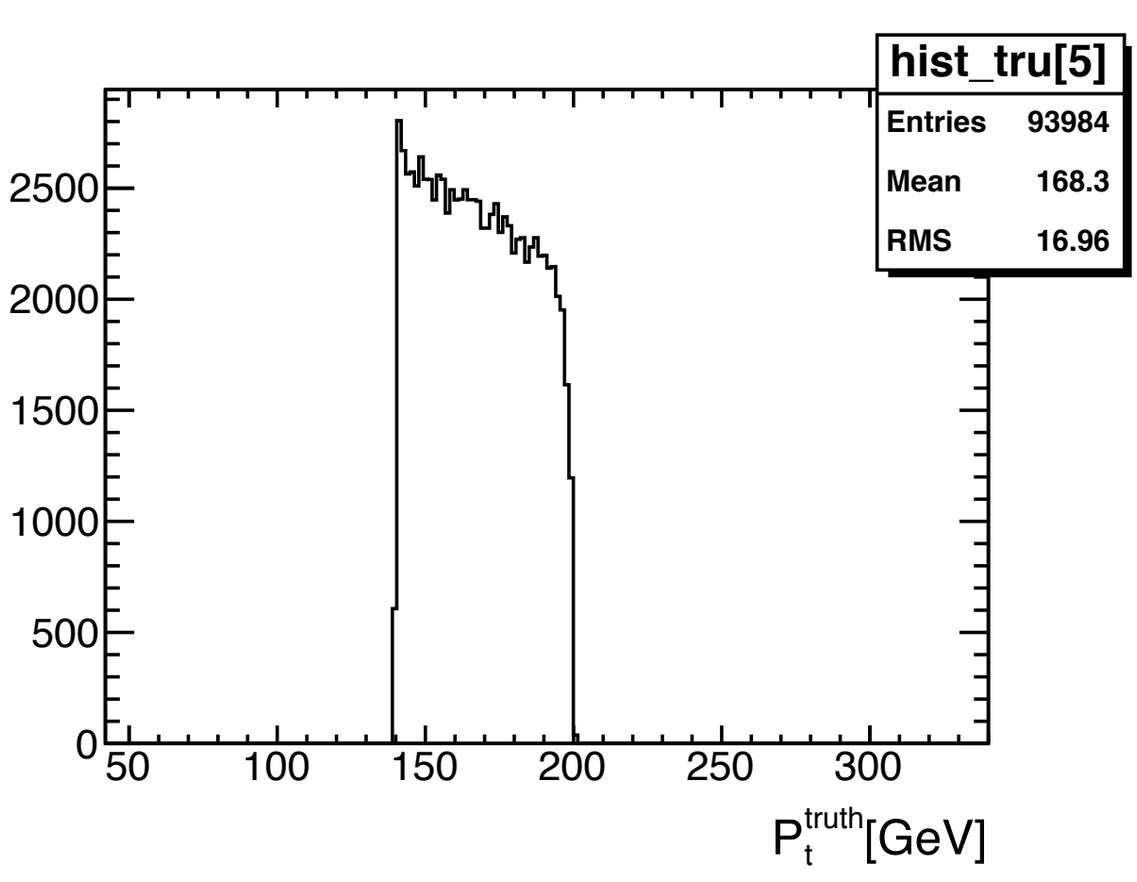

hist[4]
Entries 121552
Mean 1.017
RMS 0.09535
χ² / ndf 12.79 / 12
Prob 0.3847
Constant 9264 ± 39.3
mean 1.009 ± 0.001
sigam 0.08962 ± 0.00045
AC 0.3063 ± 0.0696
P_t^{reco}/P_t^{truth} [80GeV,140GeV]

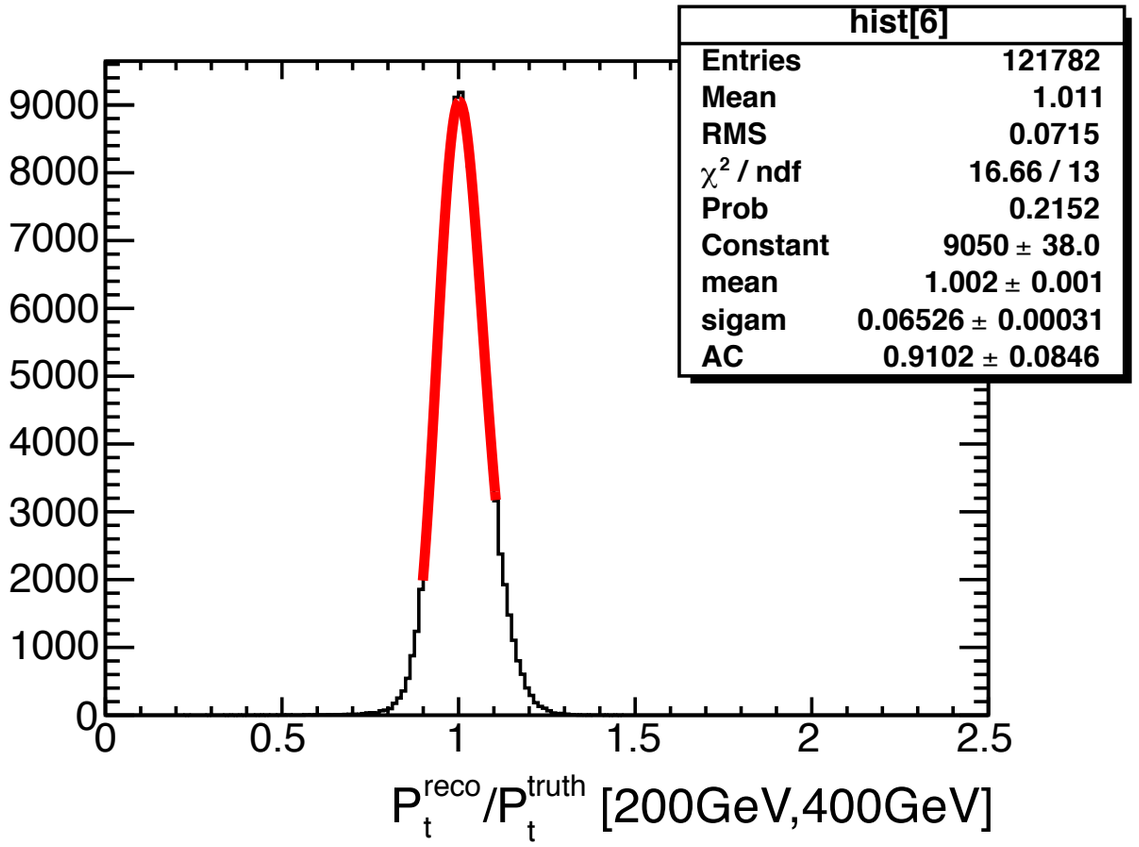

hist_reco[4]
Entries 121552
Mean 110.5
RMS 20.26
P_t^{reco}[GeV]

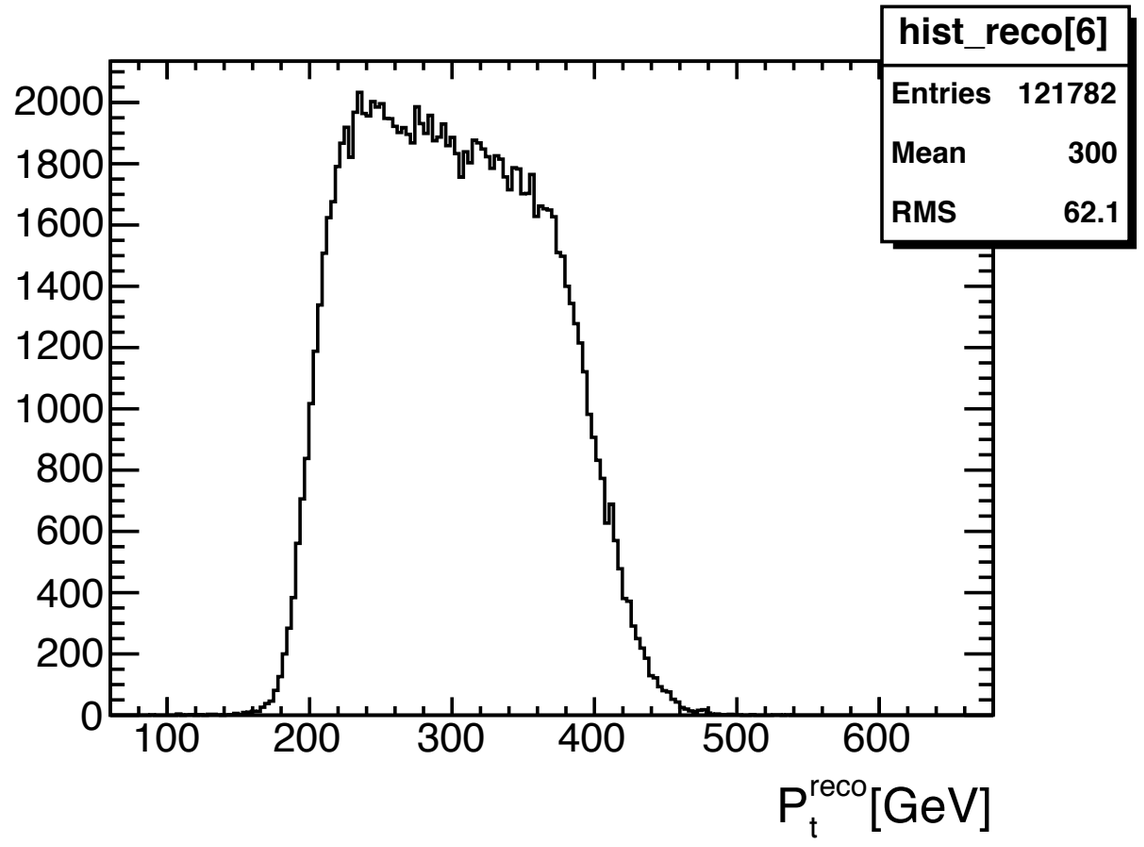

hist_tru[4]
Entries 121552
Mean 108.7
RMS 17.32
P_t^{truth}[GeV]

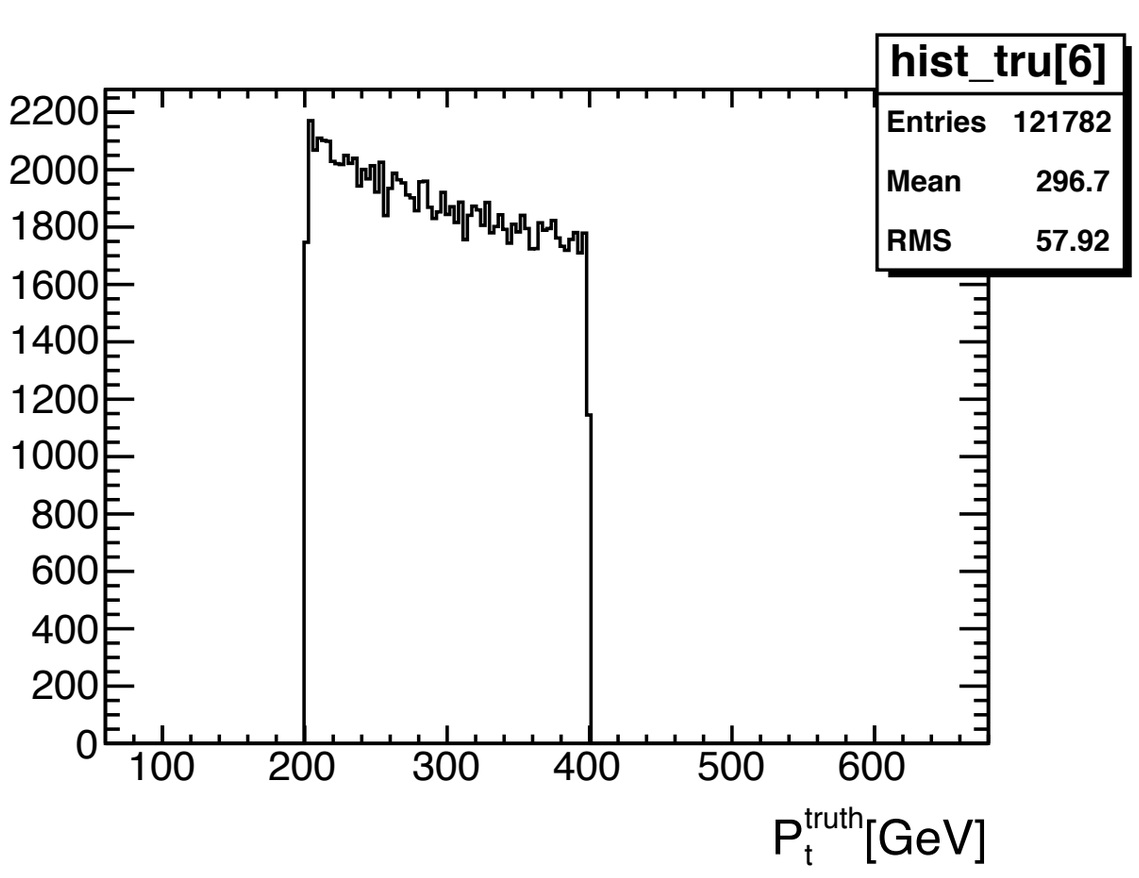

hist[5]
Entries 93984
Mean 1.014
RMS 0.08142
χ² / ndf 24.42 / 15
Prob 0.05835
Constant 6023 ± 29.1
mean 1.005 ± 0.001
sigam 0.07596 ± 0.00043
AC 0.5375 ± 0.0921
P_t^reco/P_t^truth [140GeV,200GeV]

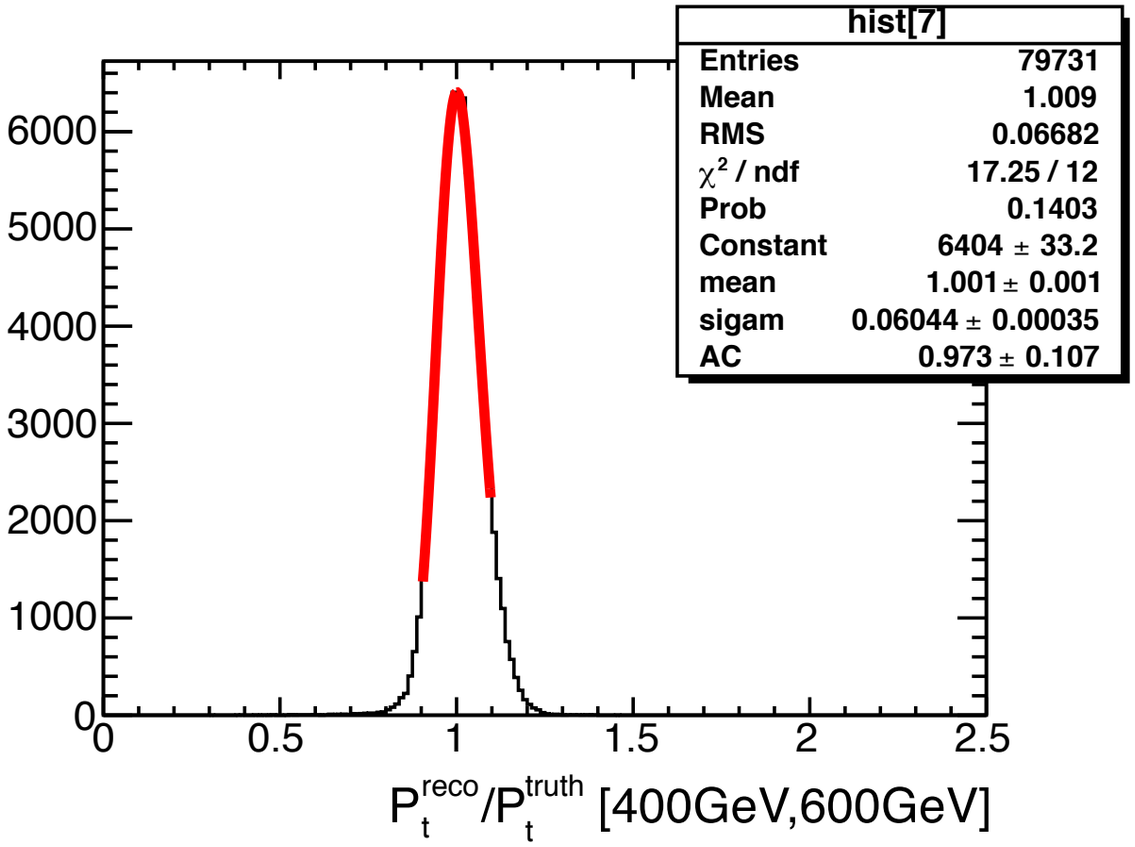

hist_reco[5]
Entries 93984
Mean 170.6
RMS 21.89
P_t^reco[GeV]

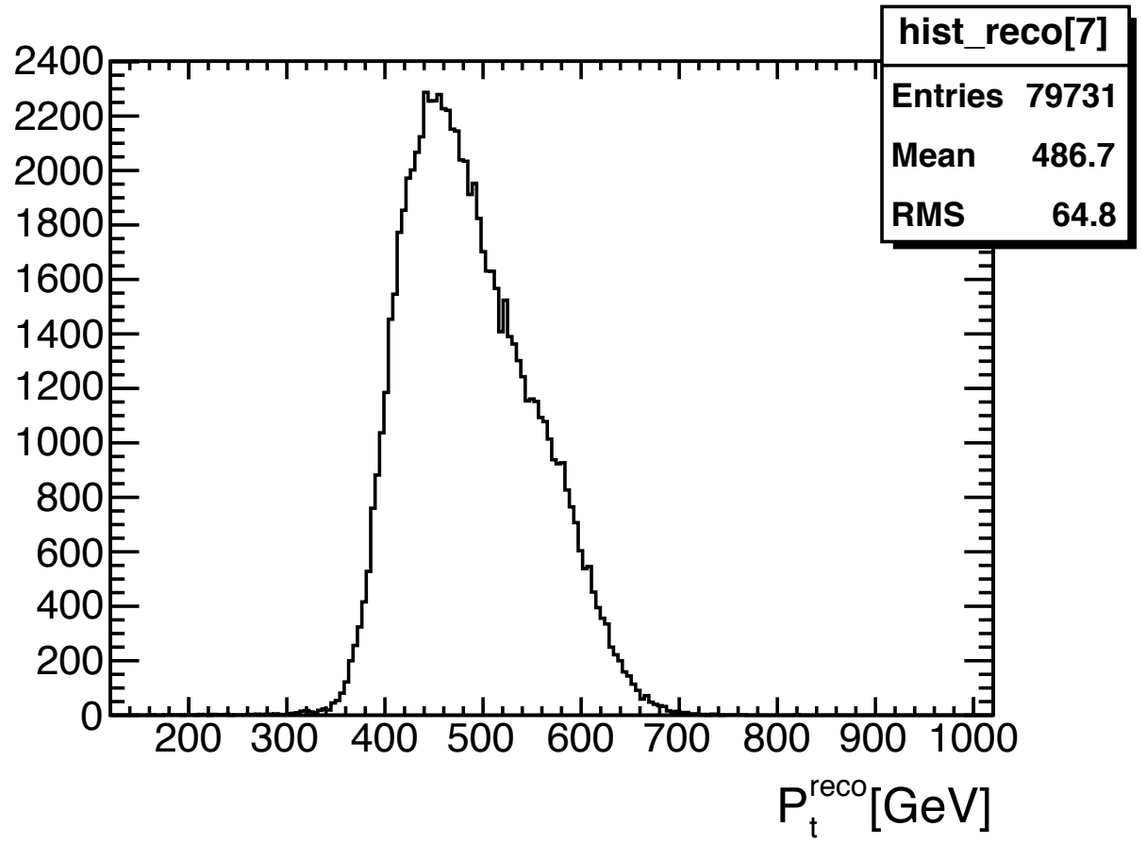

hist_tru[5]
Entries 93984
Mean 168.3
RMS 16.96
P_t^truth[GeV]

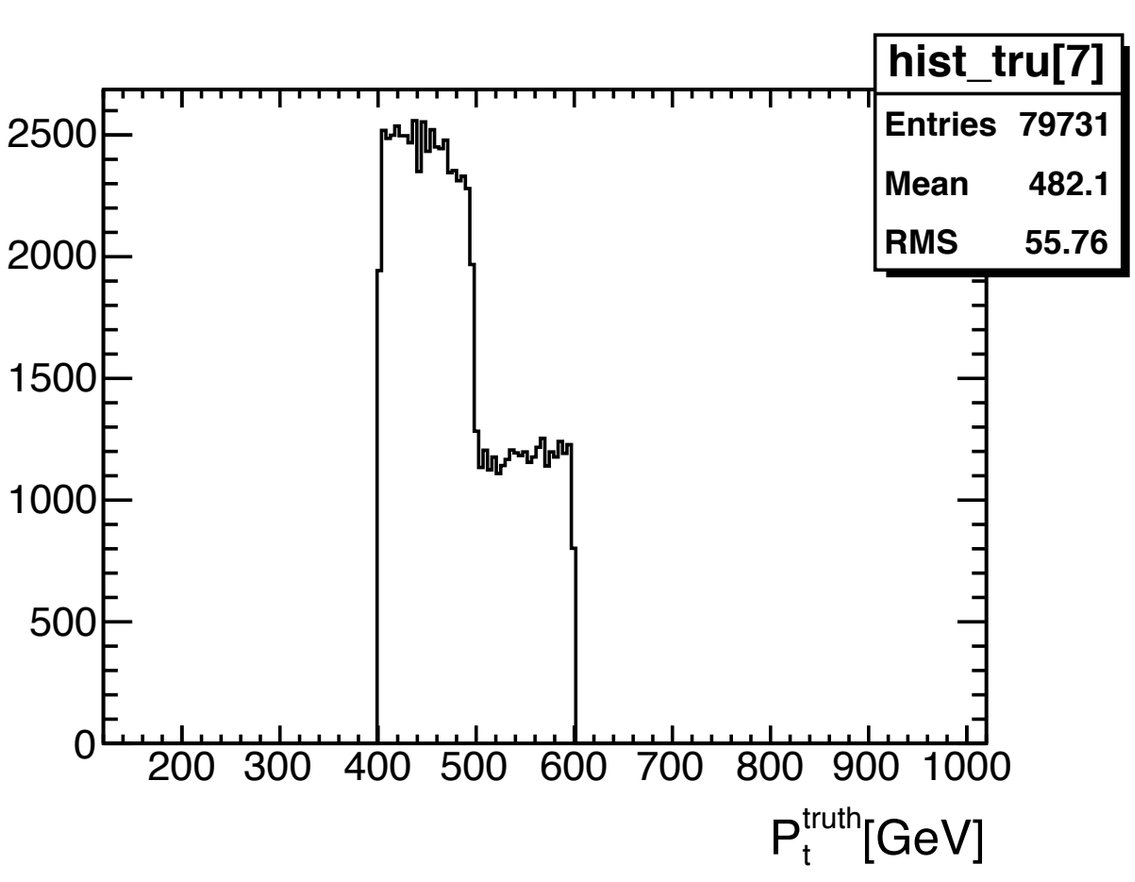

hist[6]
Entries 121782
Mean 1.011
RMS 0.0715
χ² / ndf 16.66 / 13
Prob 0.2152
Constant 9050 ± 38.0
mean 1.002 ± 0.001
sigam 0.06526 ± 0.00031
AC 0.9102 ± 0.0846
P_t^reco/P_t^truth [200GeV,400GeV]

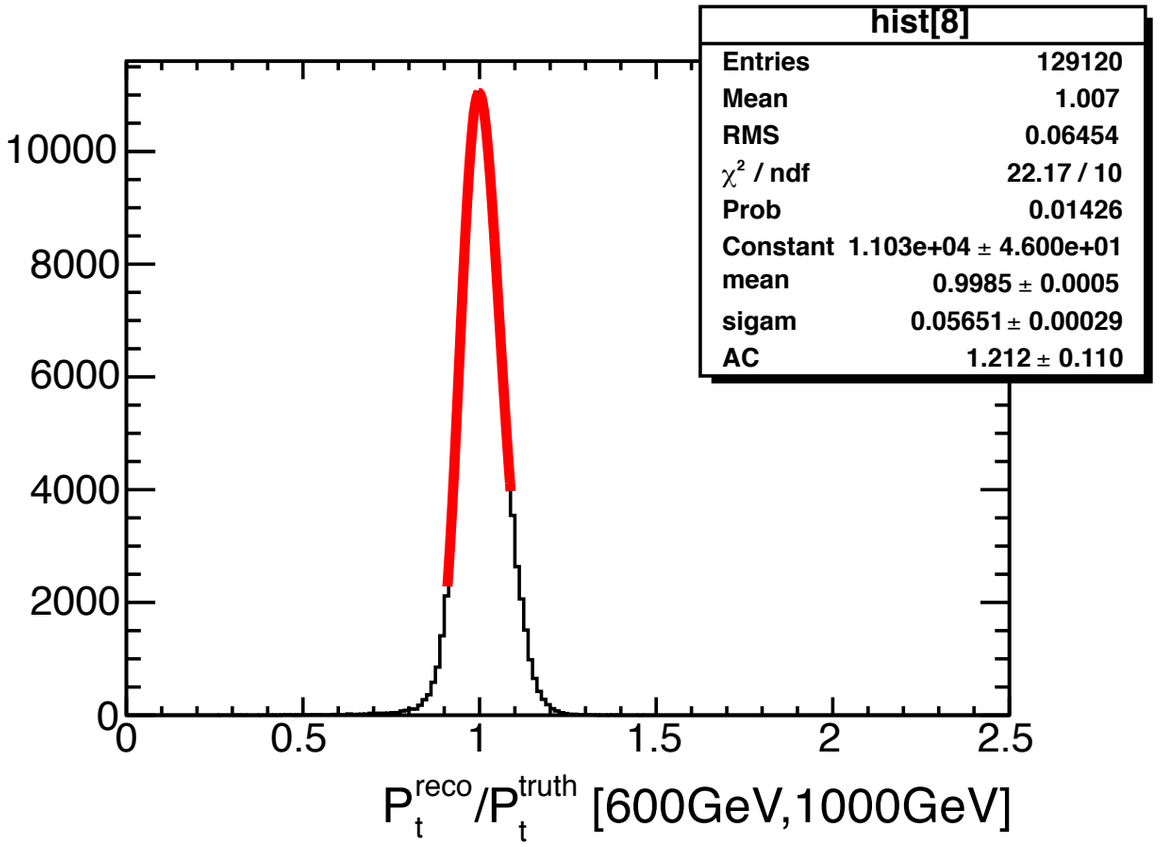

hist_reco[6]
Entries 121782
Mean 300
RMS 62.1
P_t^reco[GeV]

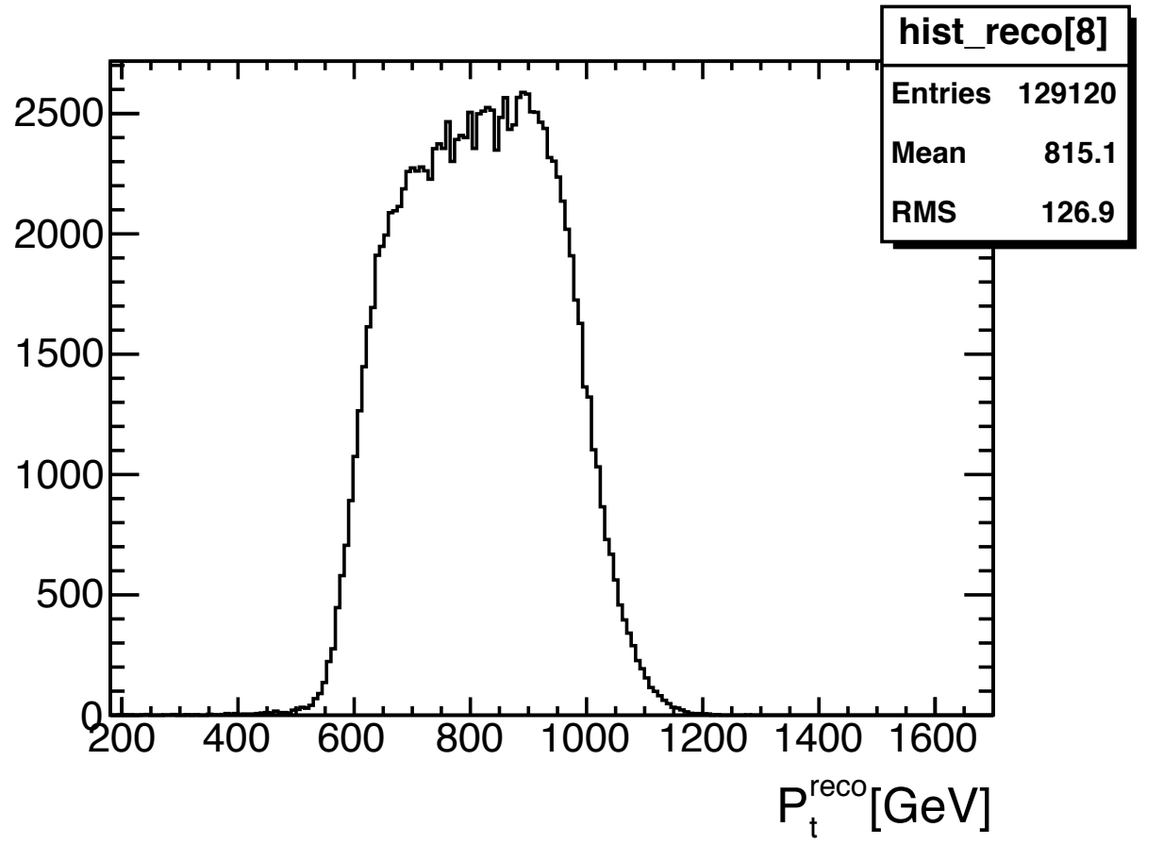

hist_tru[6]
Entries 121782
Mean 296.7
RMS 57.92
P_t^truth[GeV]

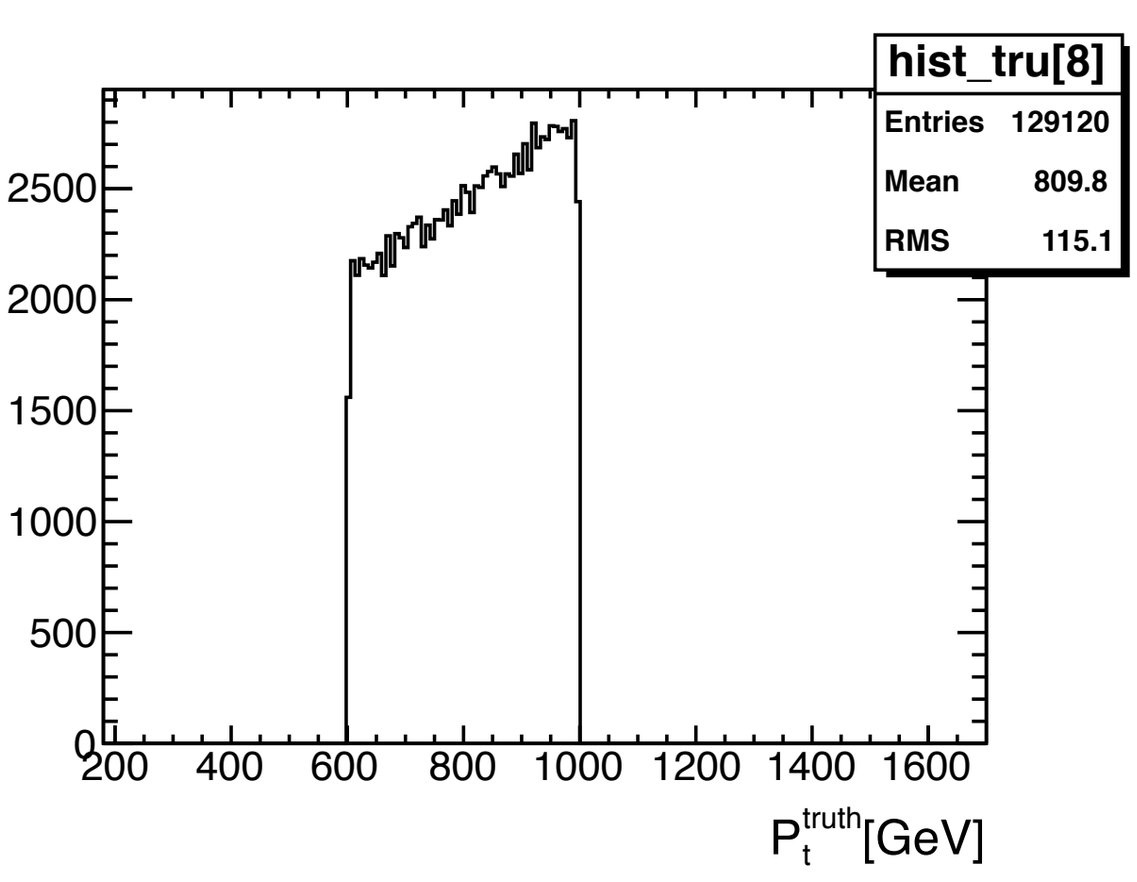

hist[7]
Entries 79731
Mean 1.009
RMS 0.06682
χ² / ndf 17.25 / 12
Prob 0.1403
Constant 6404 ± 33.2
mean 1.001 ± 0.001
sigam 0.06044 ± 0.00035
AC 0.973 ± 0.107
P_t^reco/P_t^truth [400GeV,600GeV]

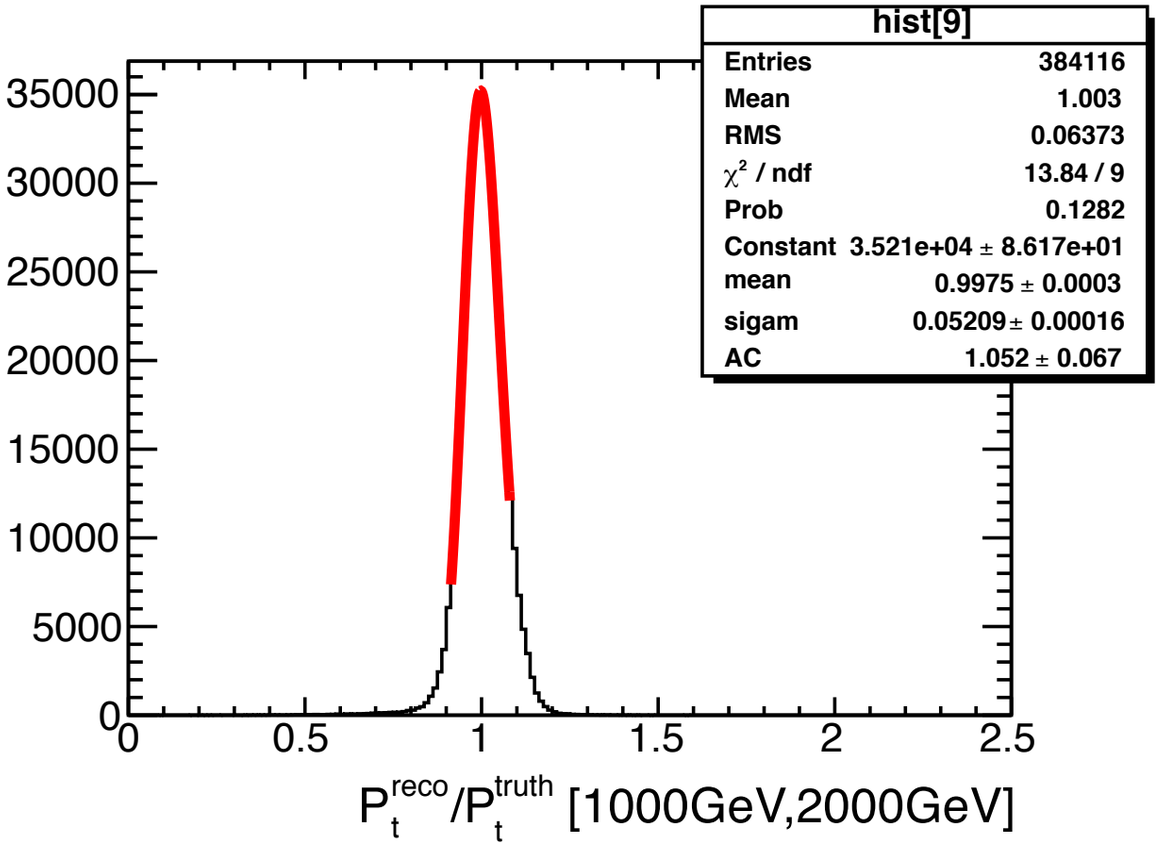

hist_reco[7]
Entries 79731
Mean 486.7
RMS 64.8
P_t^reco[GeV]

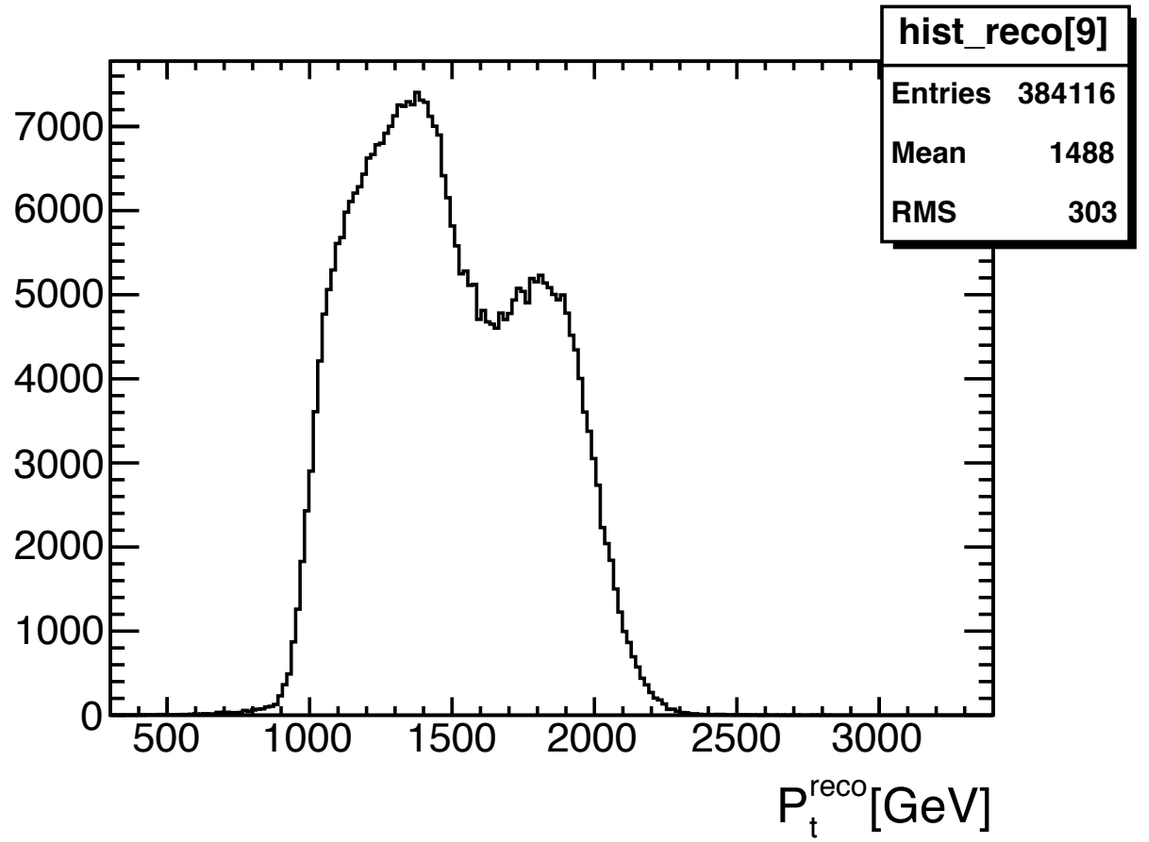

hist_tru[7]
Entries 79731
Mean 482.1
RMS 55.76
P_t^truth[GeV]

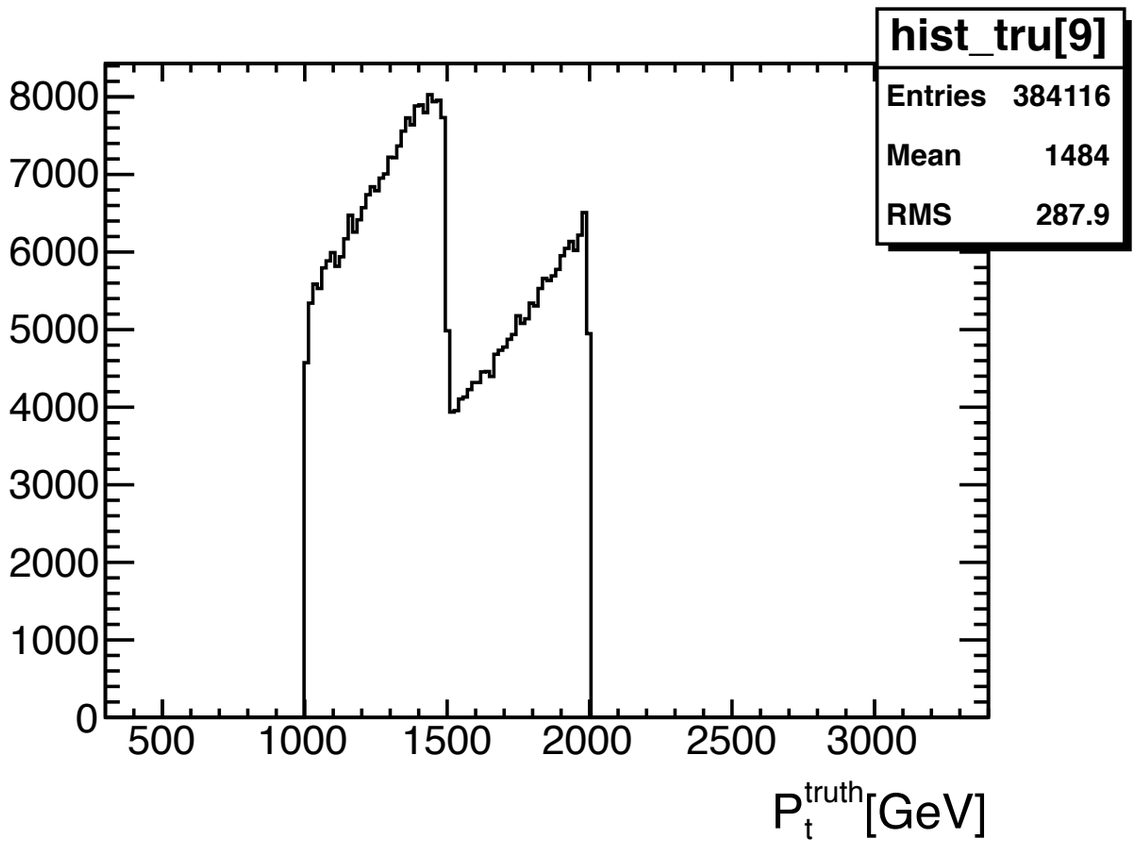

hist[8]
Entries 129120
Mean 1.007
RMS 0.06454
χ² / ndf 22.17 / 10
Prob 0.01426
Constant 1.103e+04 ± 4.600e+01
mean 0.9985 ± 0.0005
sigam 0.05651 ± 0.00029
AC 1.212 ± 0.110
P_t^reco/P_t^truth [600GeV,1000GeV]

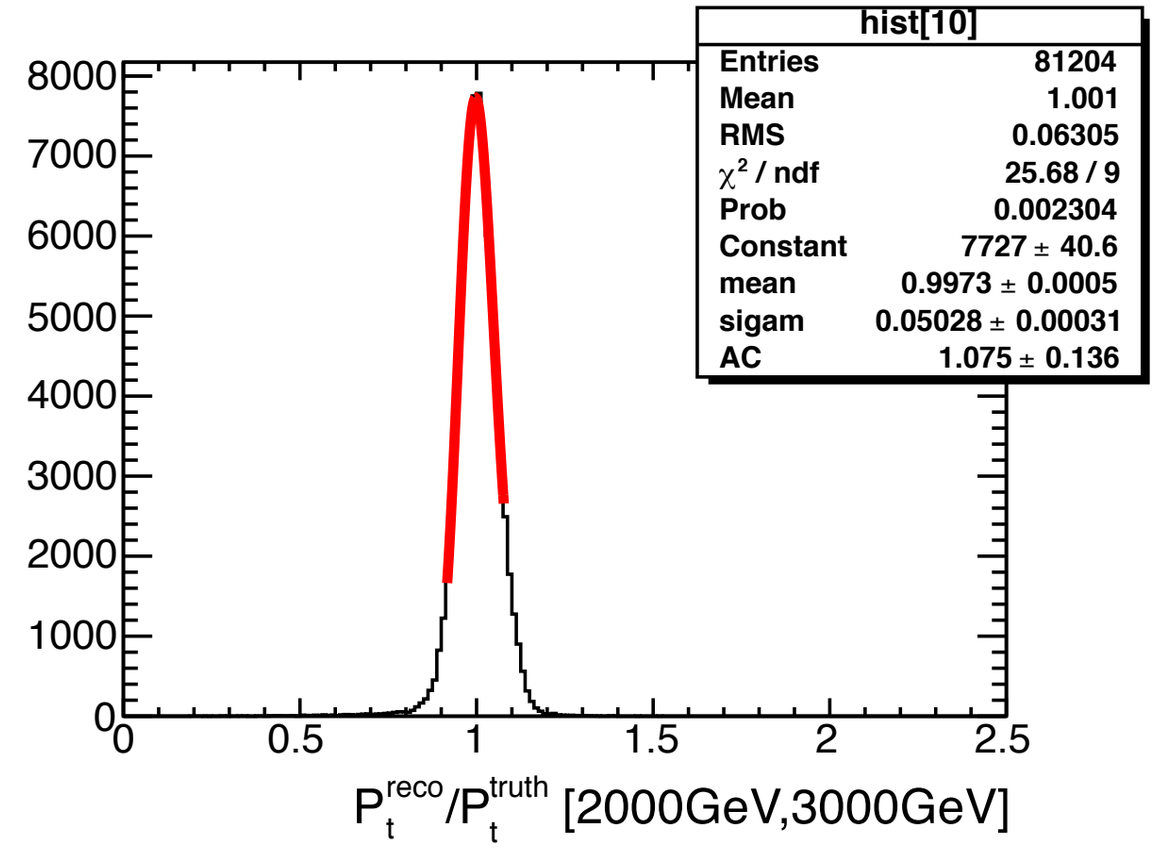

hist_reco[8]
Entries 129120
Mean 815.1
RMS 126.9
P_t^reco[GeV]

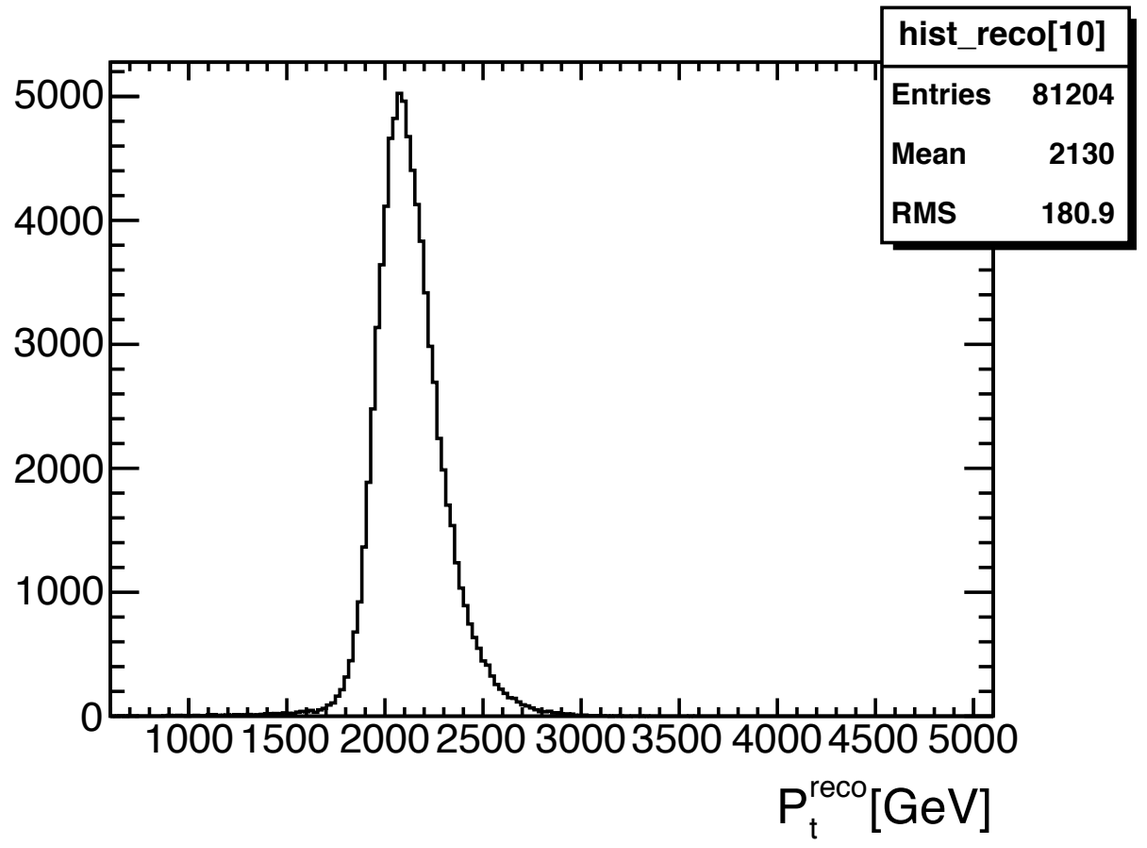

hist_tru[8]
Entries 129120
Mean 809.8
RMS 115.1
P_t^truth[GeV]

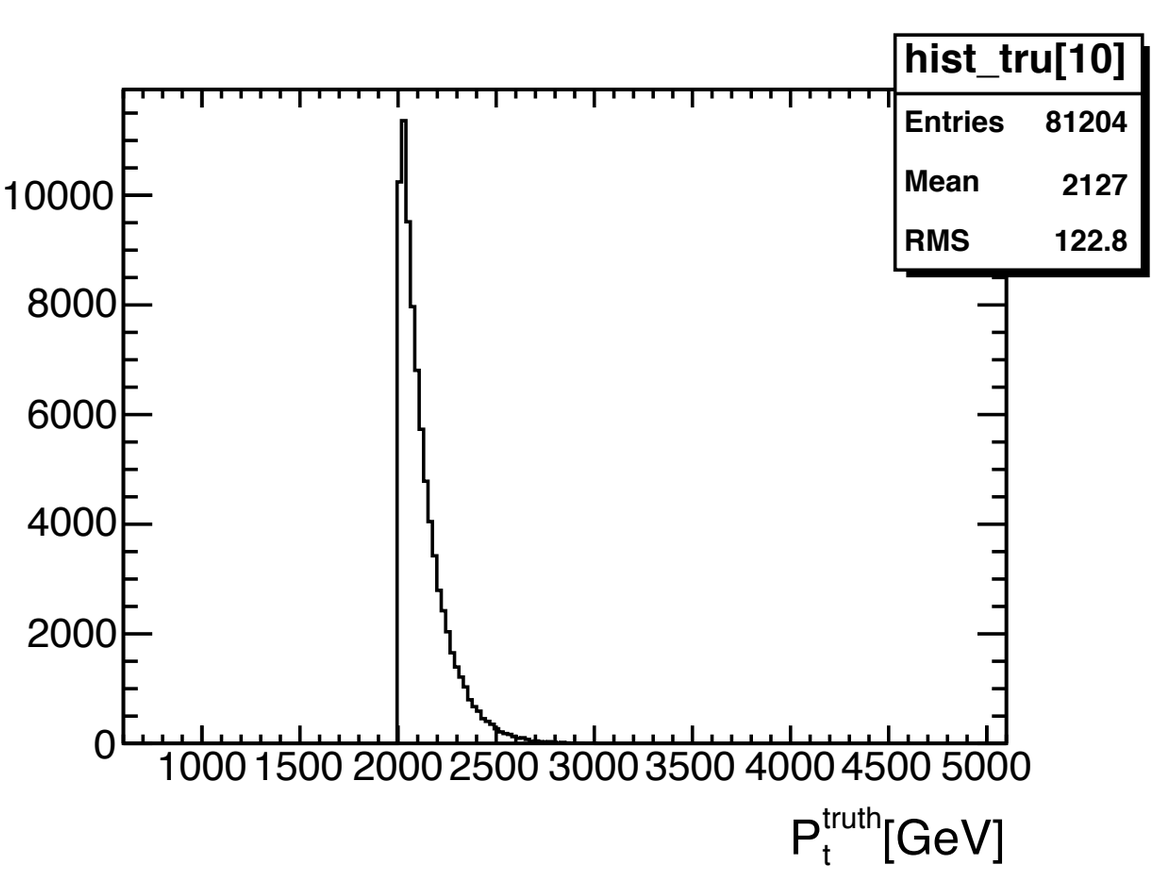

hist[9]
Entries 384116
Mean 1.003
RMS 0.06373
χ² / ndf 13.84 / 9
Prob 0.1282
Constant 3.521e+04 ± 8.617e+01
mean 0.9975 ± 0.0003
sigam 0.05209 ± 0.00016
AC 1.052 ± 0.067
P_t^reco/P_t^truth [1000GeV,2000GeV]


hist_reco[9]
Entries 384116
Mean 1488
RMS 303
P_t^reco[GeV]

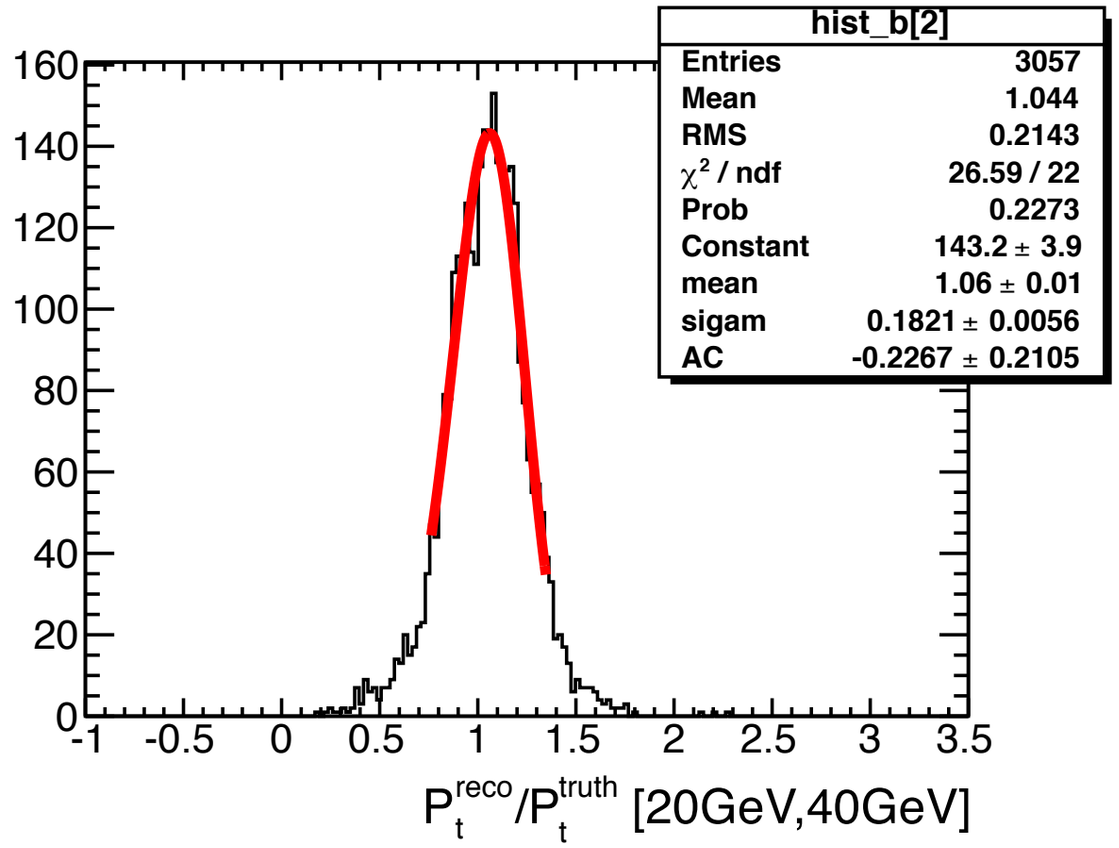

hist_tru[9]
Entries 384116
Mean 1484
RMS 287.9
P_t^truth[GeV]

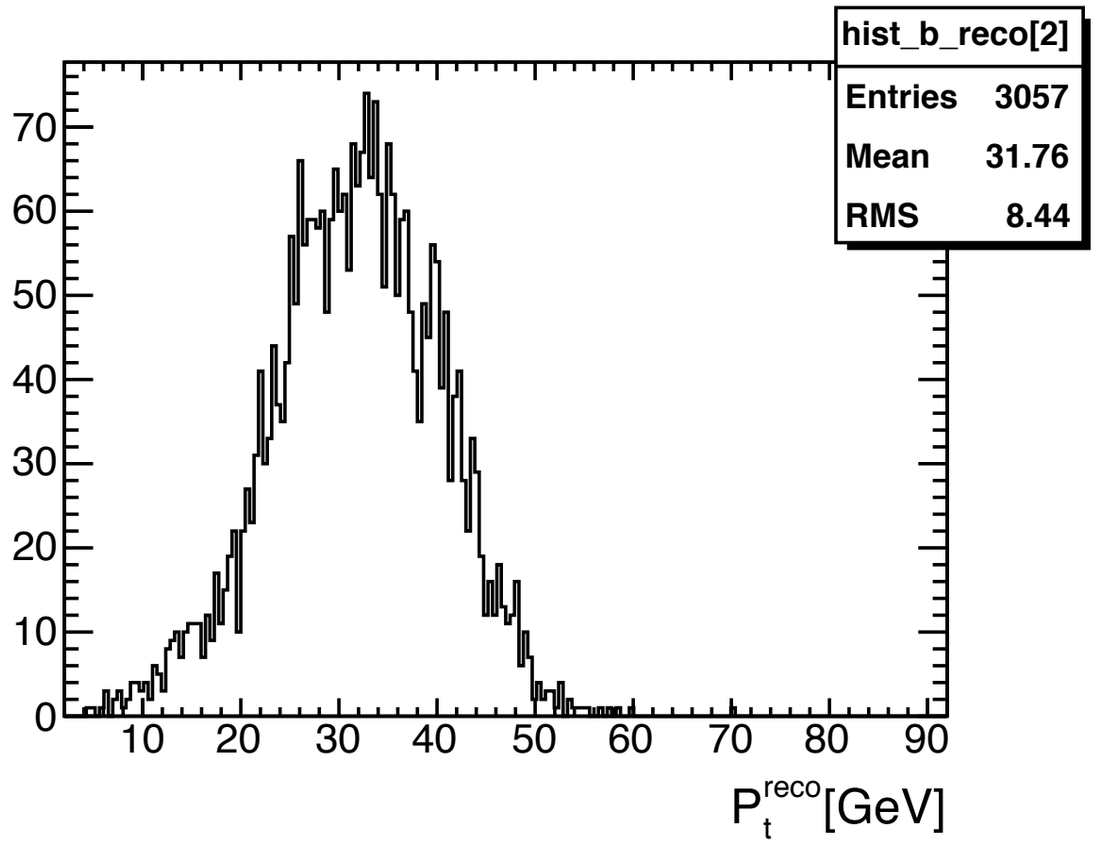

hist[10]
Entries 81204
Mean 1.001
RMS 0.06305
χ² / ndf 25.68 / 9
Prob 0.002304
Constant 7727 ± 40.6
mean 0.9973 ± 0.0005
sigam 0.05028 ± 0.00031
AC 1.075 ± 0.136
P_t^reco/P_t^truth [2000GeV,3000GeV]

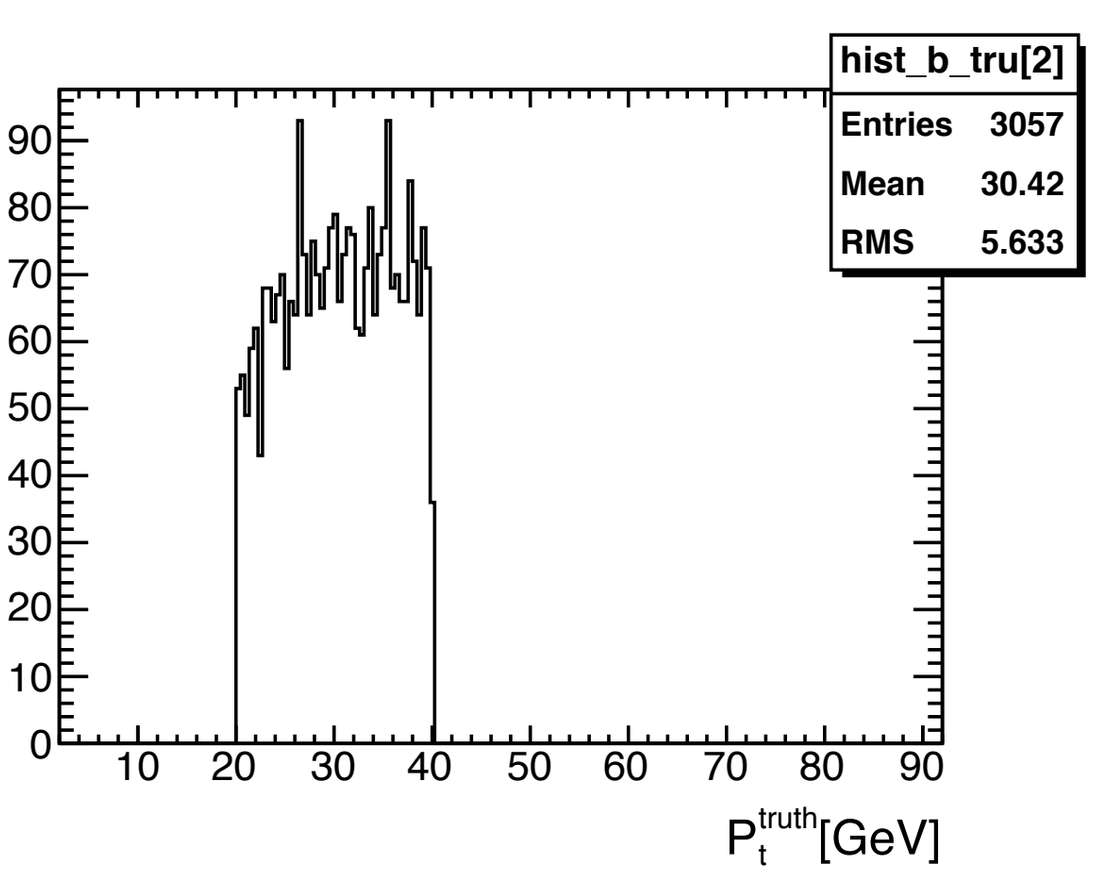

hist_reco[10]
Entries 81204
Mean 2130
RMS 180.9
P_t^reco[GeV]

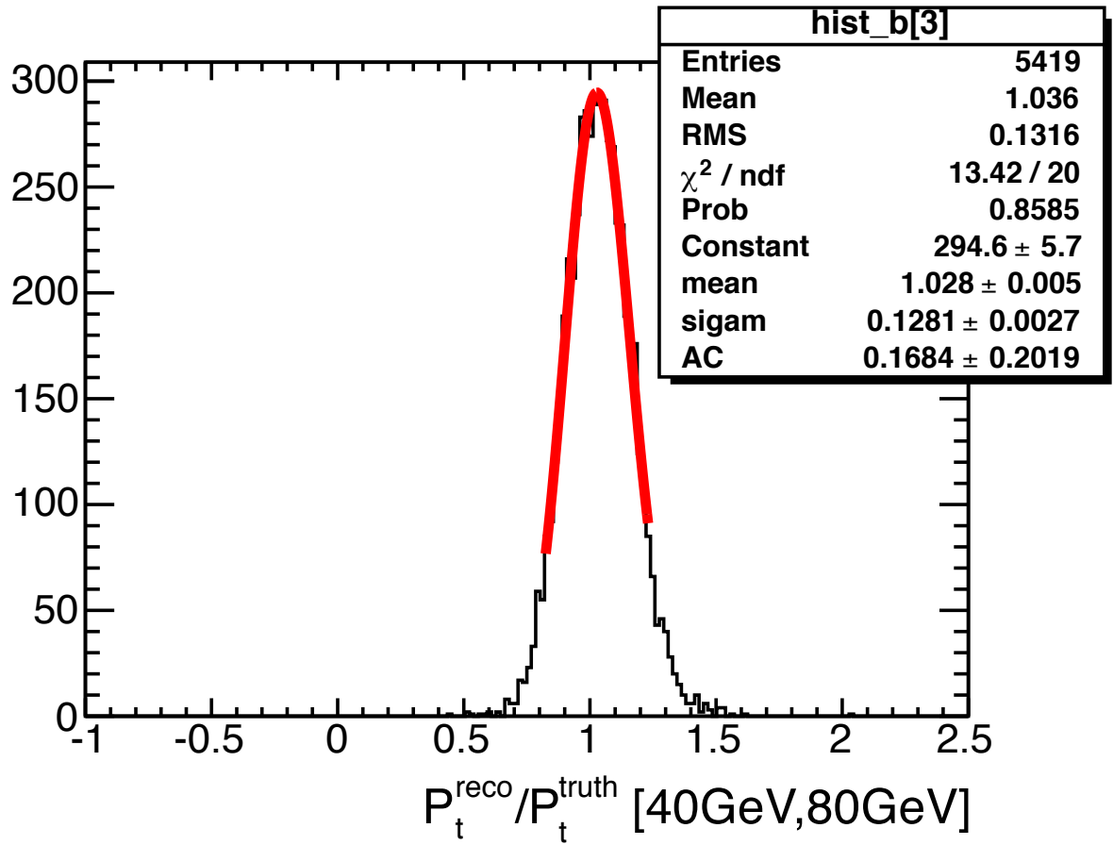

hist_tru[10]
Entries 81204
Mean 2127
RMS 122.8
P_t^truth[GeV]

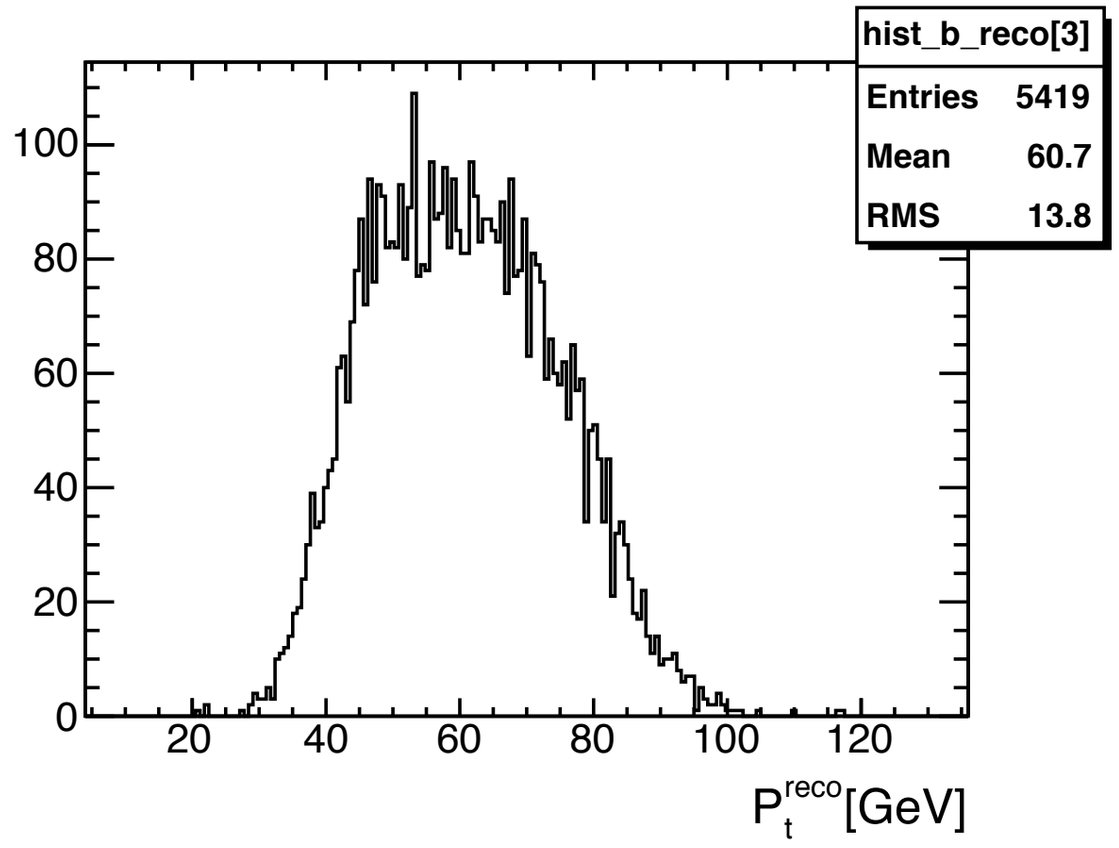
response and Pt distribution R=0.4,EM+JES b-Jet

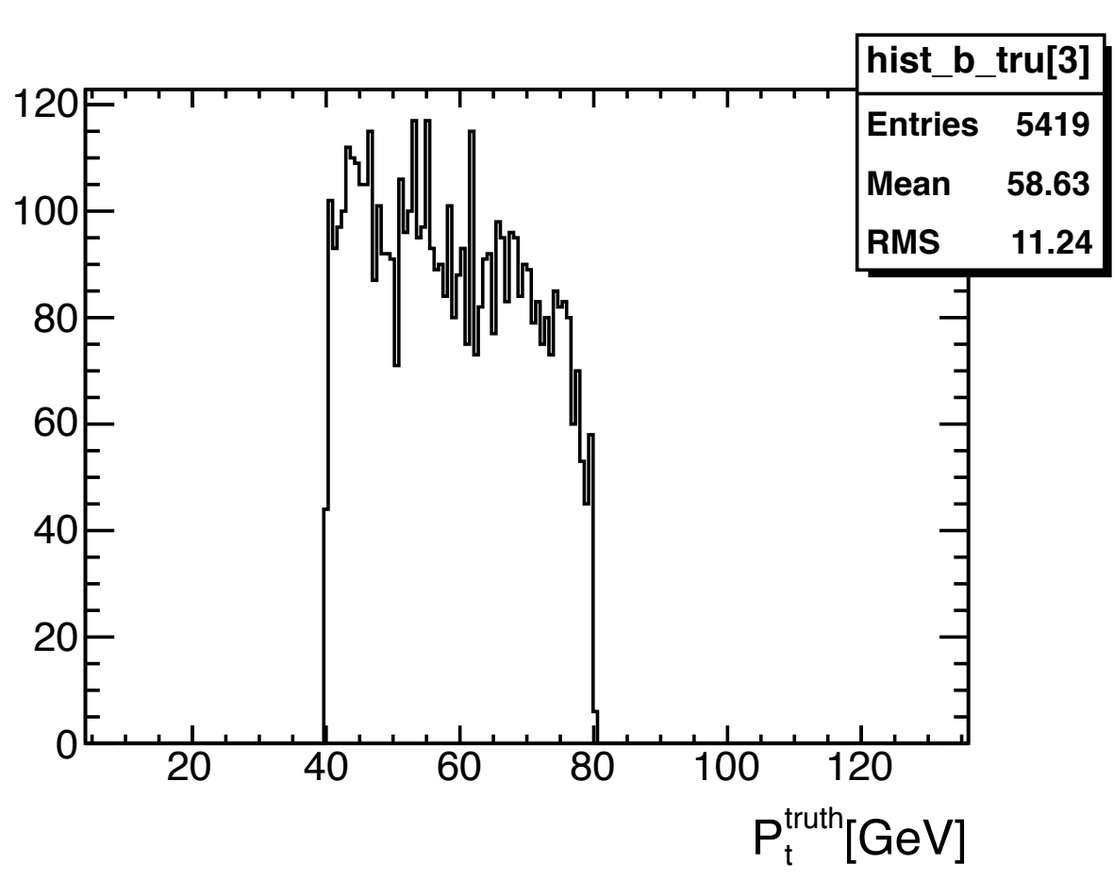

hist_b[2]
Entries 3057
Mean 1.044
RMS 0.2143
χ² / ndf 26.59 / 22
Prob 0.2273
Constant 143.2 ± 3.9
mean 1.06 ± 0.01
sigam 0.1821 ± 0.0056
AC -0.2267 ± 0.2105
P_t^reco/P_t^truth [20GeV,40GeV]

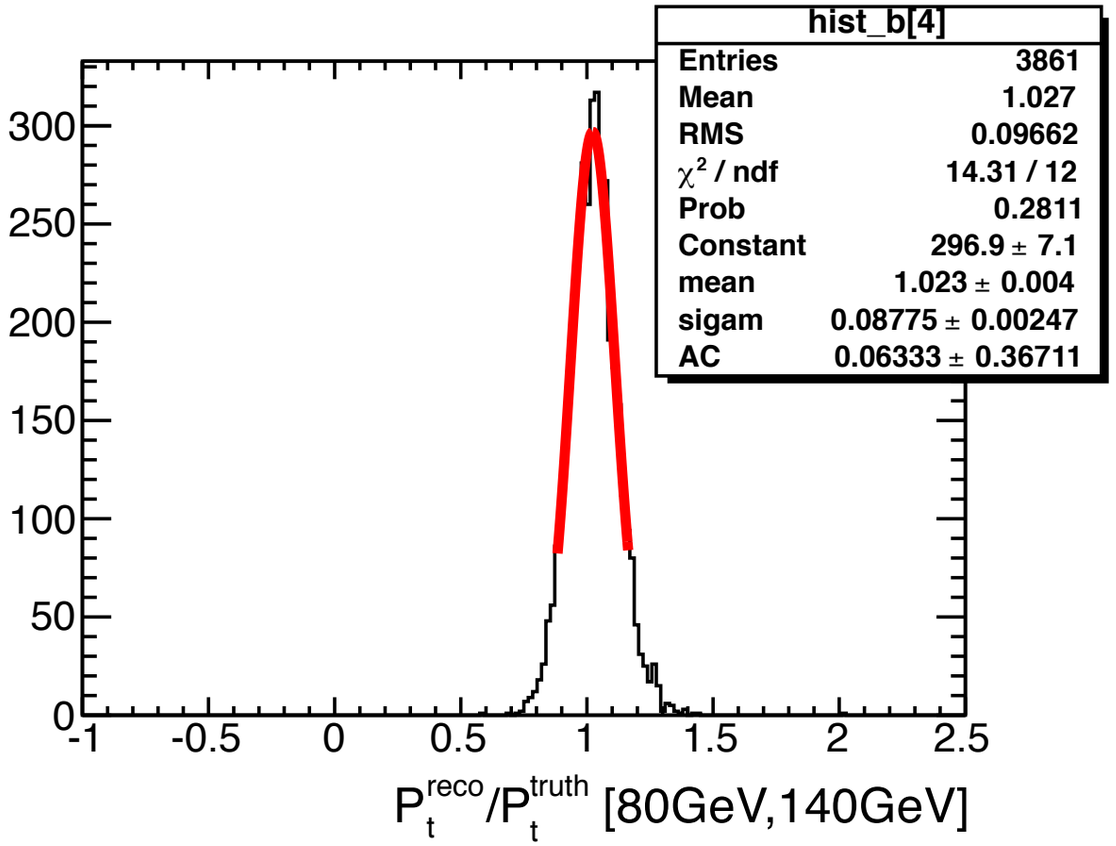

hist_b_reco[2]
Entries 3057
Mean 31.76
RMS 8.44
P_t^reco[GeV]

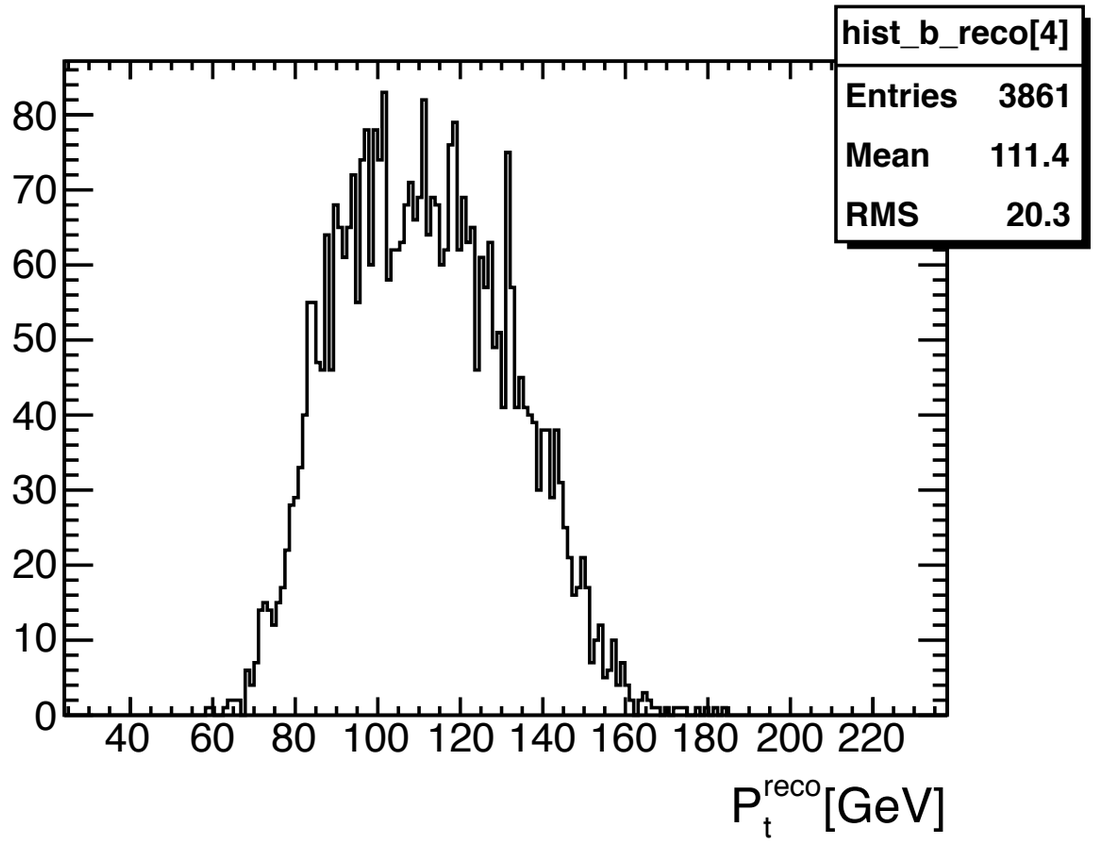

hist_b_tru[2]
Entries 3057
Mean 30.42
RMS 5.633
P_t^truth[GeV]

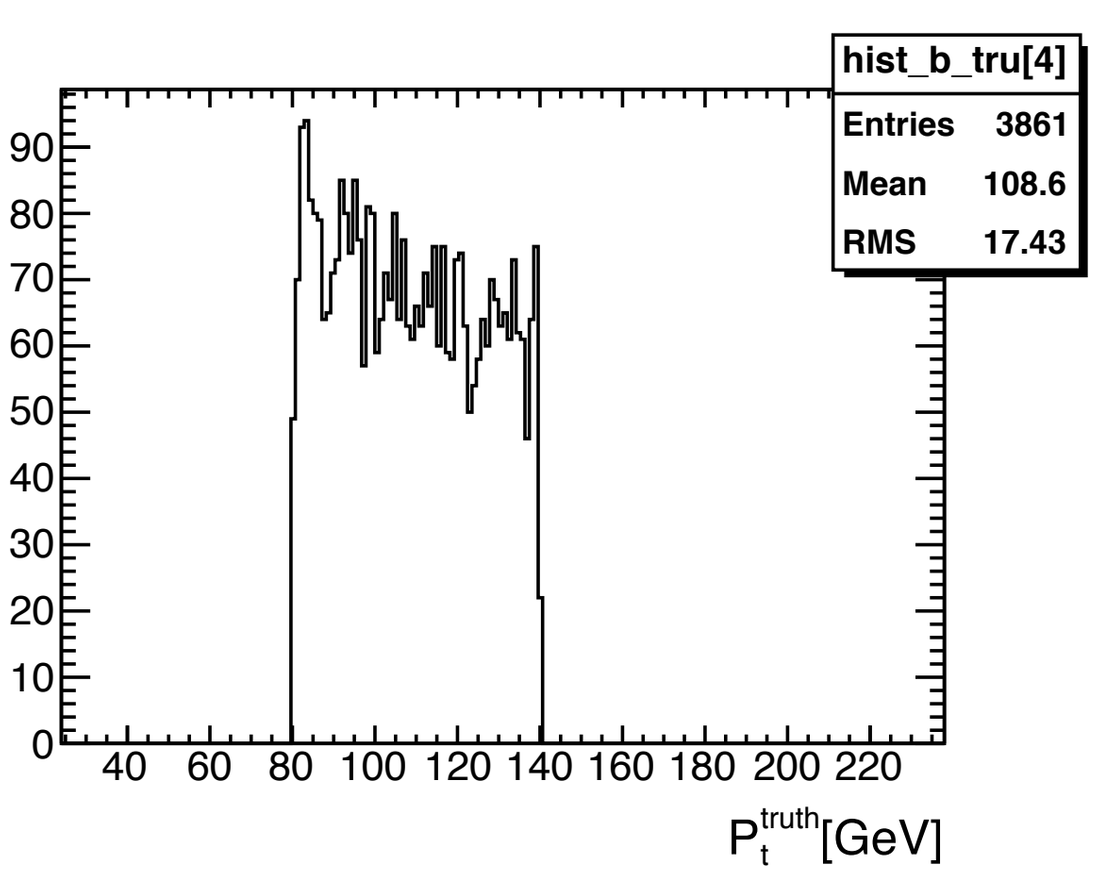

hist_b[3]
Entries 5419
Mean 1.036
RMS 0.1316
χ² / ndf 13.42 / 20
Prob 0.8585
Constant 294.6 ± 5.7
mean 1.028 ± 0.005
sigam 0.1281 ± 0.0027
AC 0.1684 ± 0.2019
P_t^reco/P_t^truth [40GeV,80GeV]

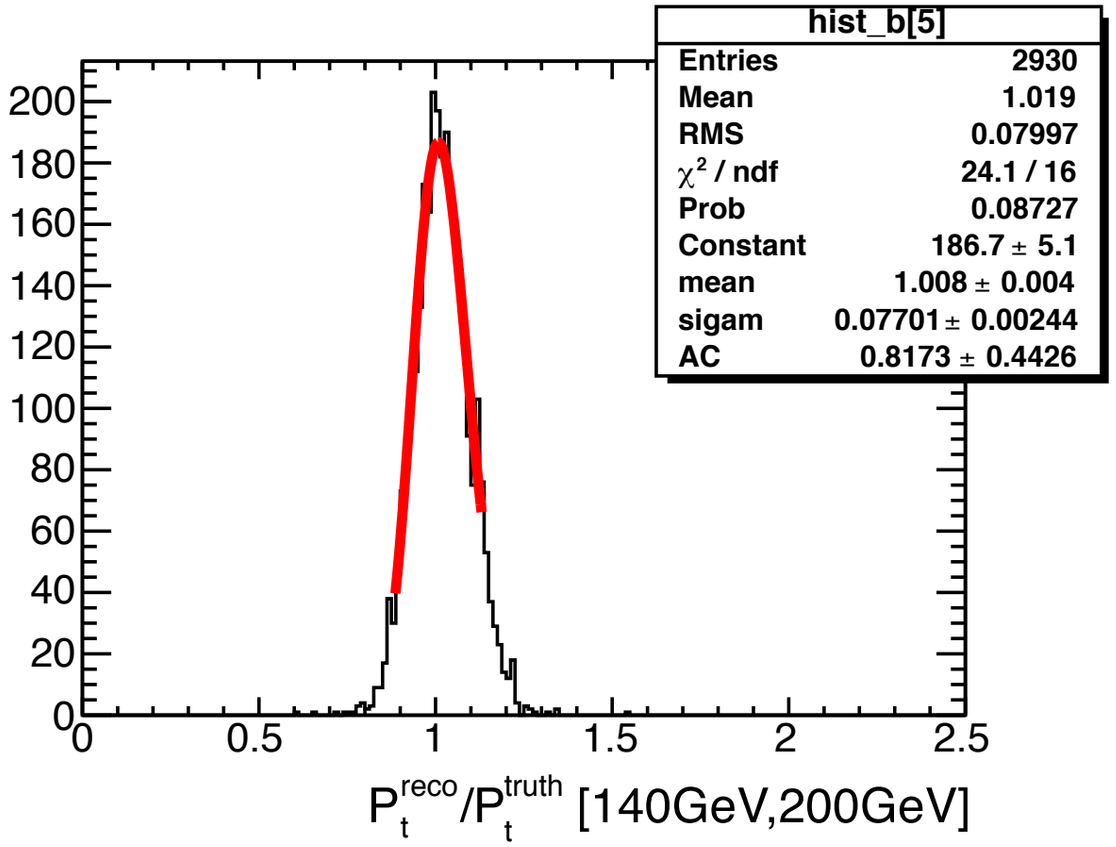

hist_b_reco[3]
Entries 5419
Mean 60.7
RMS 13.8
P_t^reco[GeV]

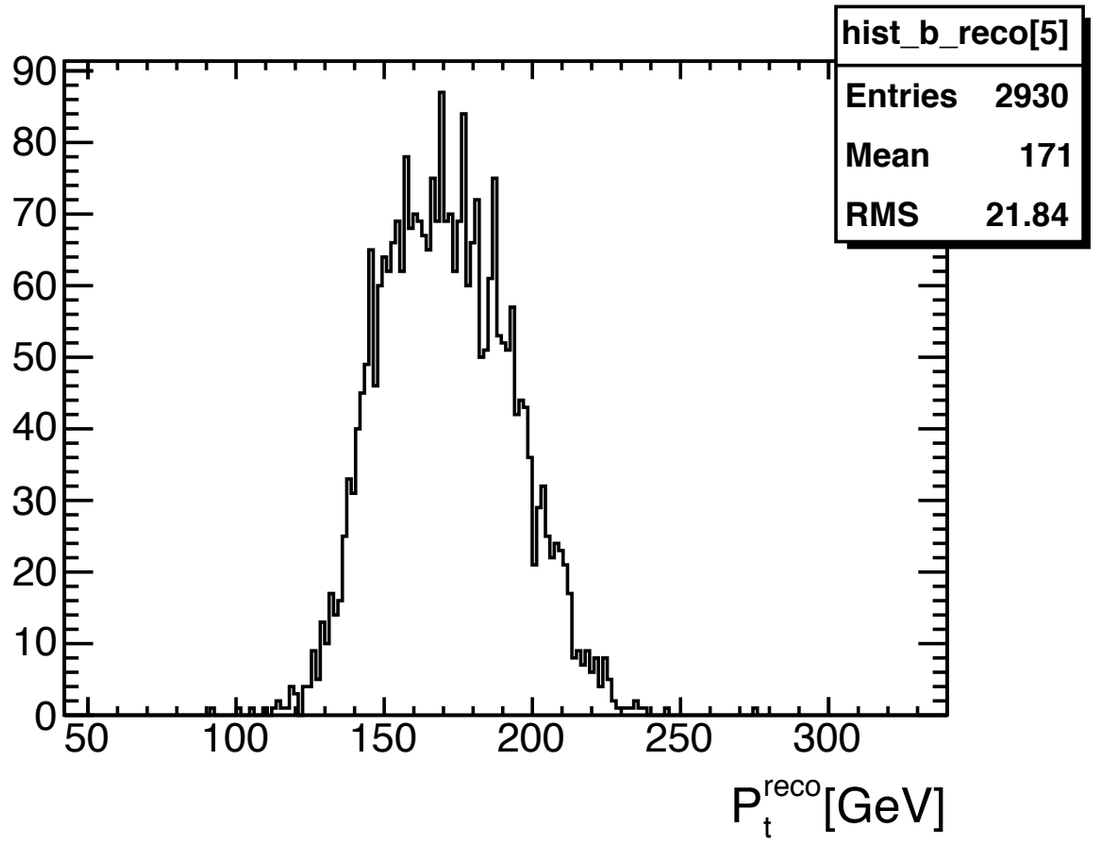

hist_b_tru[3]
Entries 5419
Mean 58.63
RMS 11.24
P_t^truth[GeV]

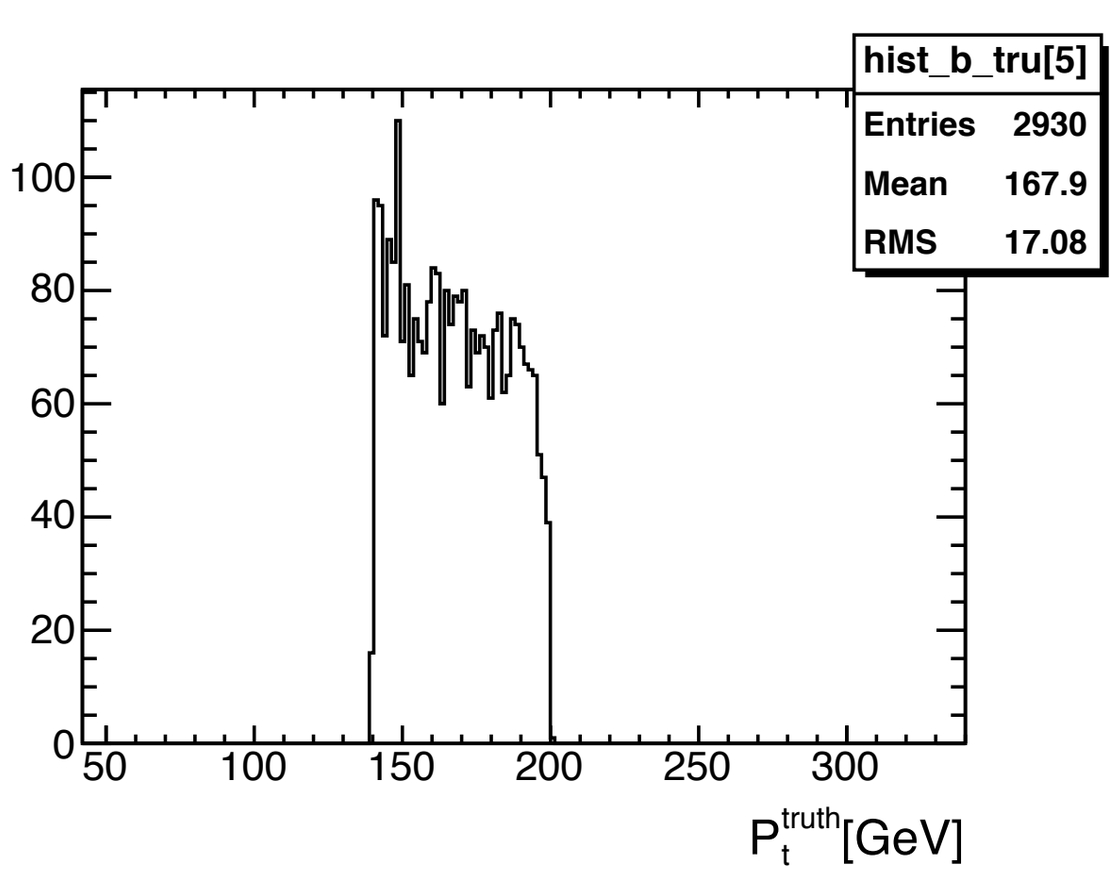

hist_b[4]
Entries 3861
Mean 1.027
RMS 0.09662
χ² / ndf 14.31 / 12
Prob 0.2811
Constant 296.9 ± 7.1
mean 1.023 ± 0.004
sigam 0.08775 ± 0.00247
AC 0.06333 ± 0.36711
P_t^reco/P_t^truth [80GeV,140GeV]

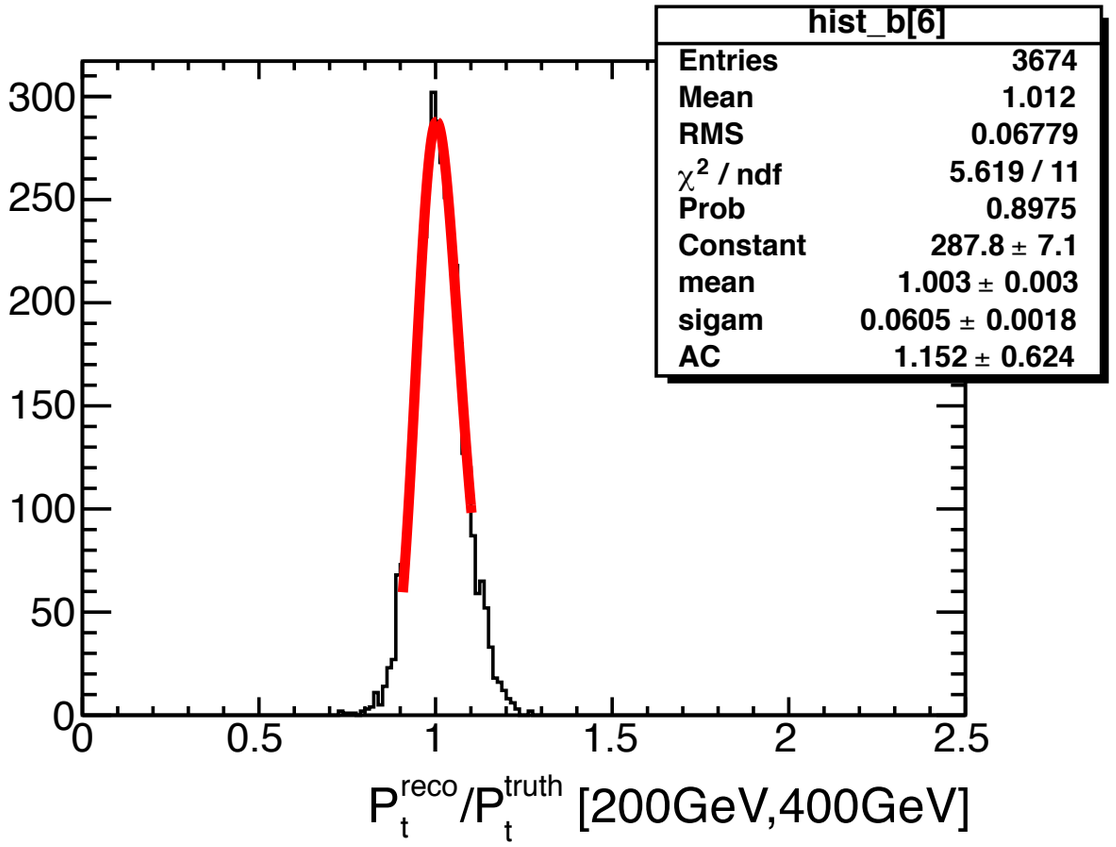

hist_b_reco[4]
Entries 3861
Mean 111.4
RMS 20.3
P_t^reco[GeV]

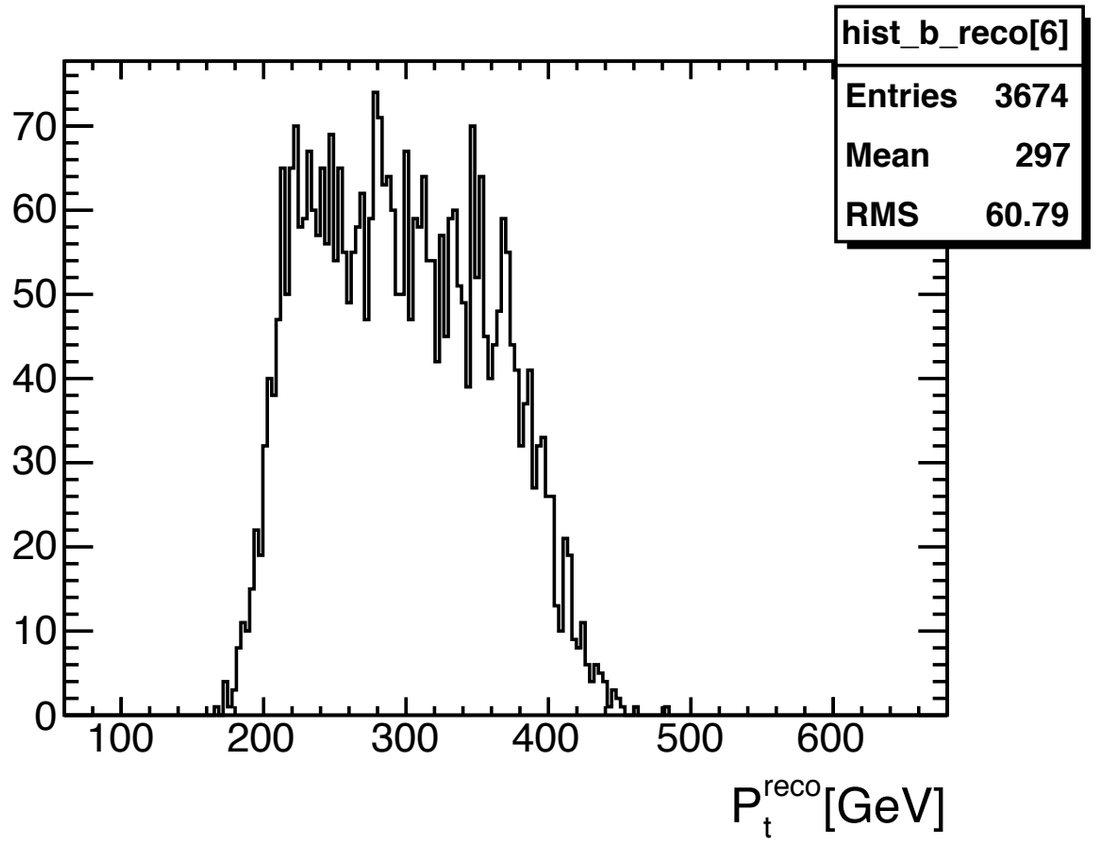

hist_b_tru[4]
Entries 3861
Mean 108.6
RMS 17.43
P_t^truth[GeV]

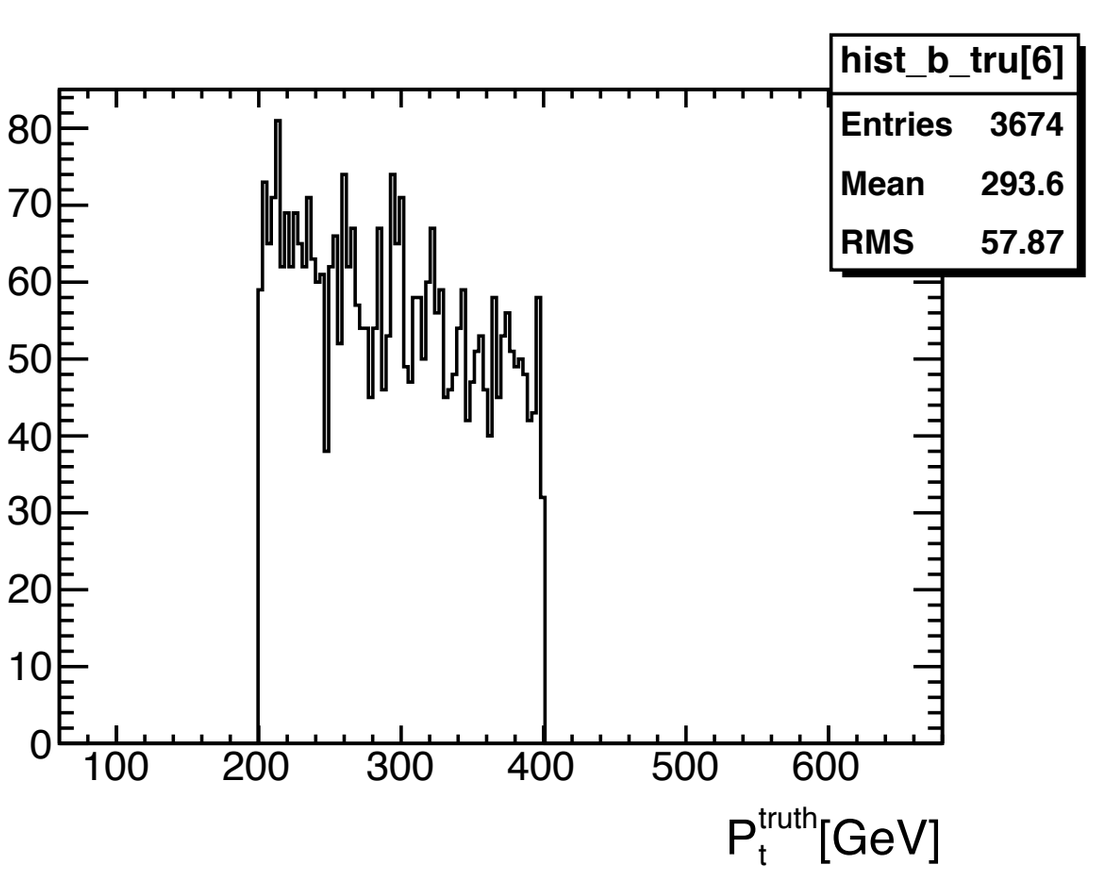

hist_b[5]
Entries 2930
Mean 1.019
RMS 0.07997
χ² / ndf 24.1 / 16
Prob 0.08727
Constant 186.7 ± 5.1
mean 1.008 ± 0.004
sigam 0.07701 ± 0.00244
AC 0.8173 ± 0.4426
P_t^reco/P_t^truth [140GeV,200GeV]

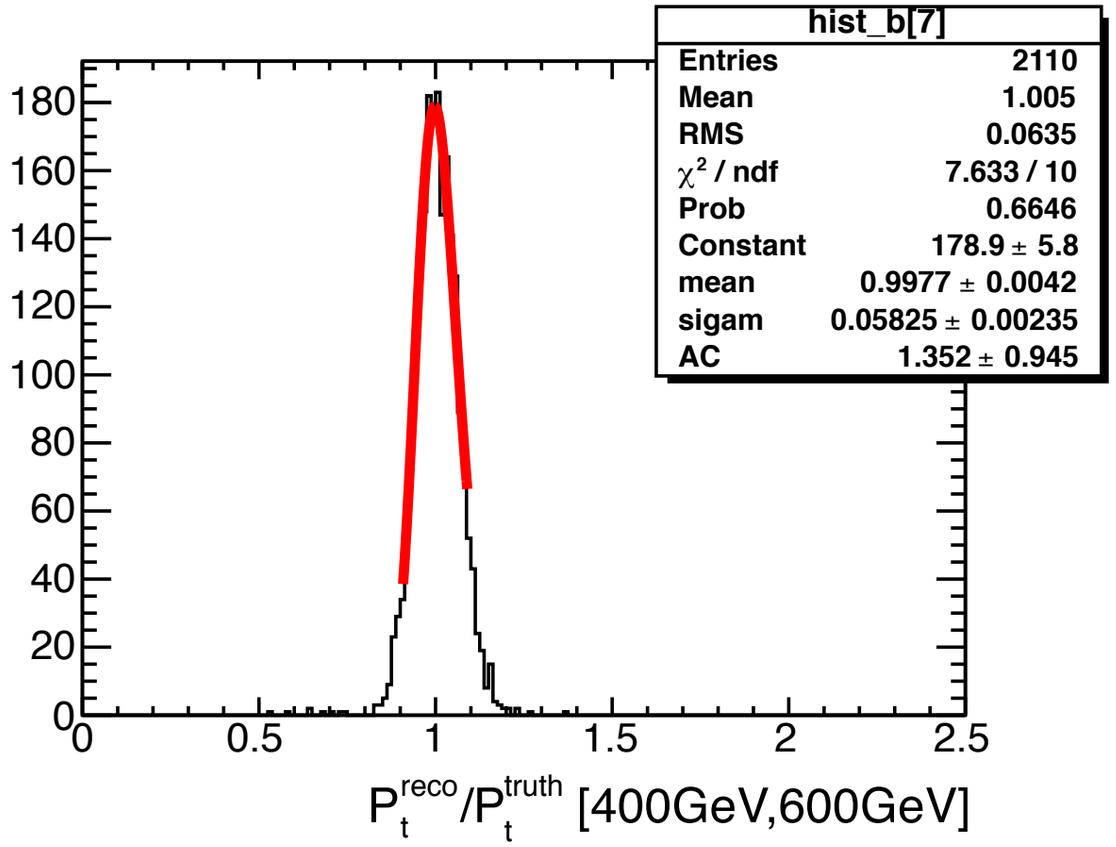

hist_b_reco[5]
Entries 2930
Mean 171
RMS 21.84
P_t^reco[GeV]

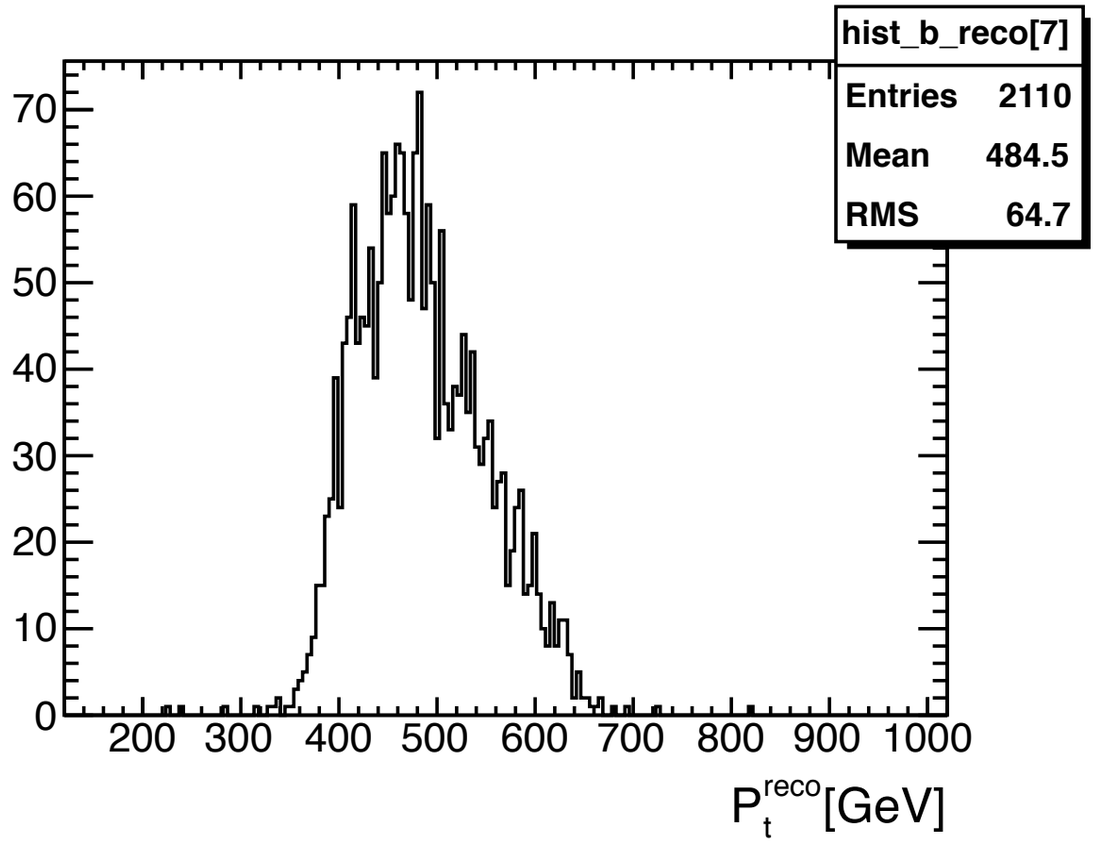

hist_b_tru[5]
Entries 2930
Mean 167.9
RMS 17.08
P_t^truth[GeV]

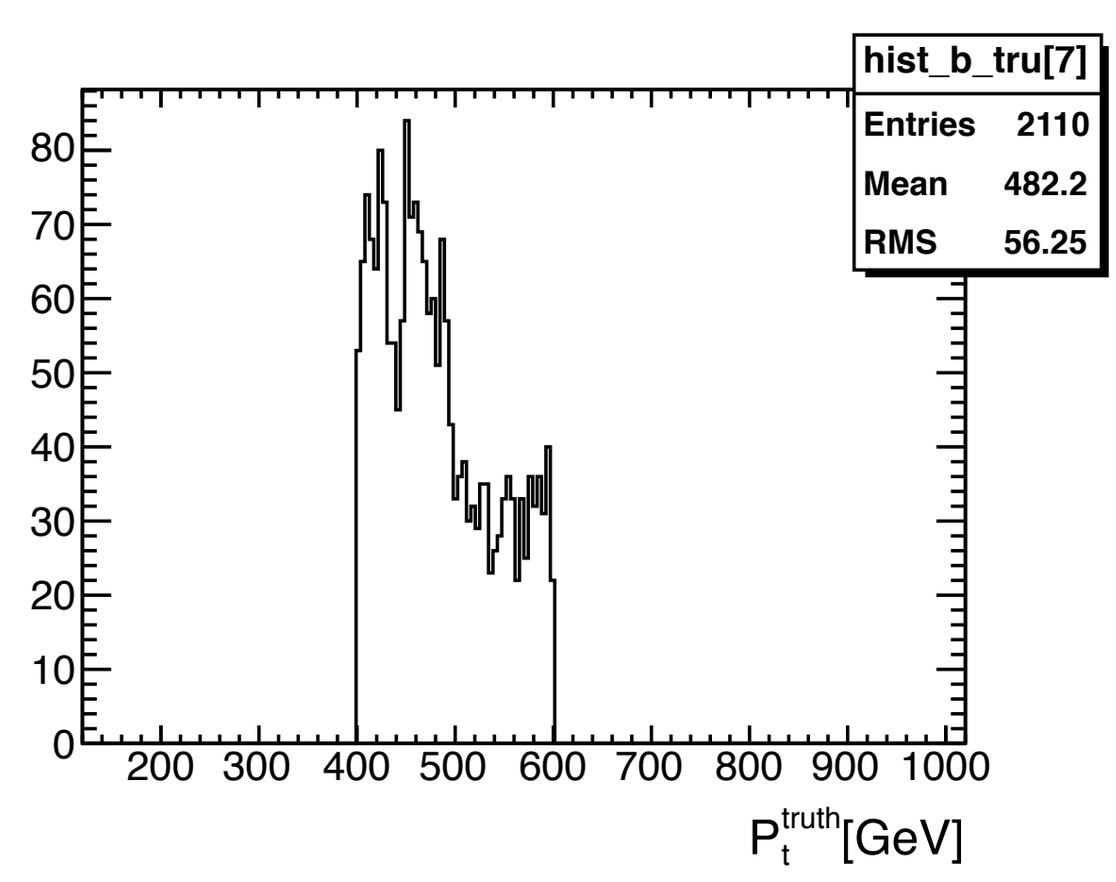

hist_b[6]
Entries 3674
Mean 1.012
RMS 0.06779
χ² / ndf 5.619 / 11
Prob 0.8975
Constant 287.8 ± 7.1
mean 1.003 ± 0.003
sigam 0.0605 ± 0.0018
AC 1.152 ± 0.624
P_t^reco/P_t^truth [200GeV,400GeV]

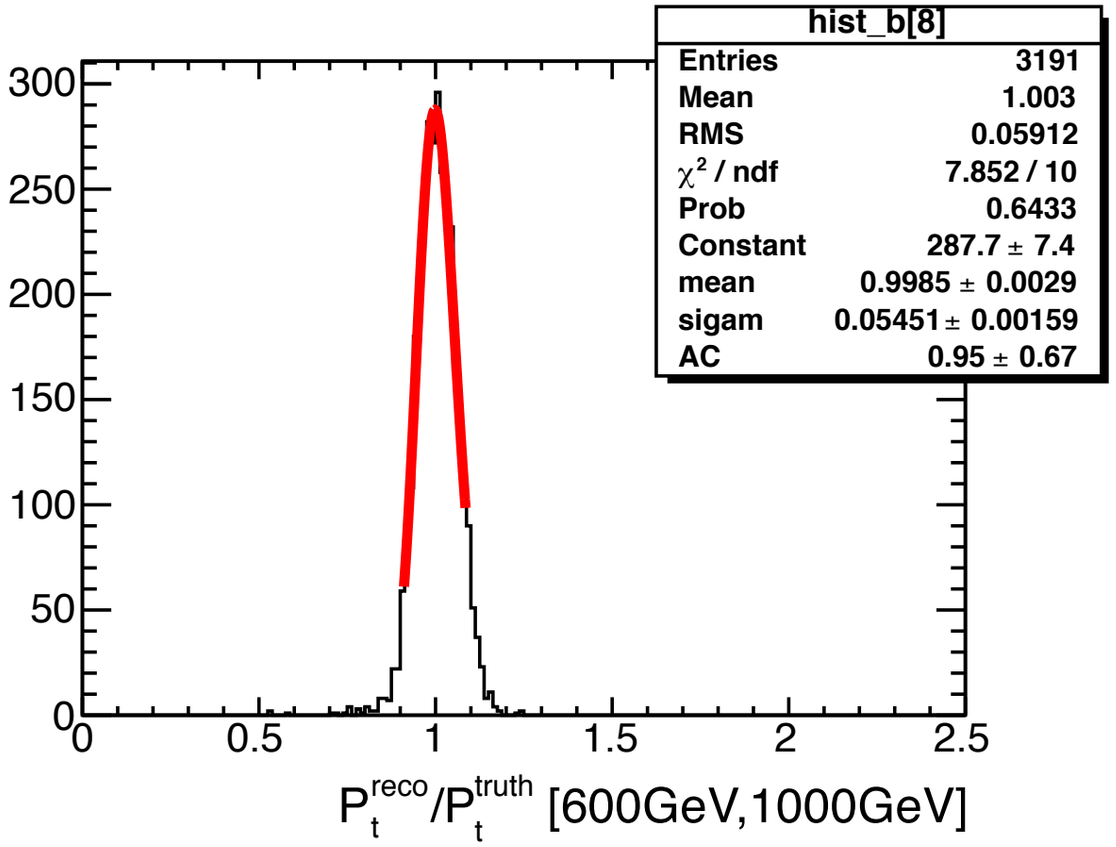

hist_b_reco[6]
Entries 3674
Mean 297
RMS 60.79
P_t^reco[GeV]

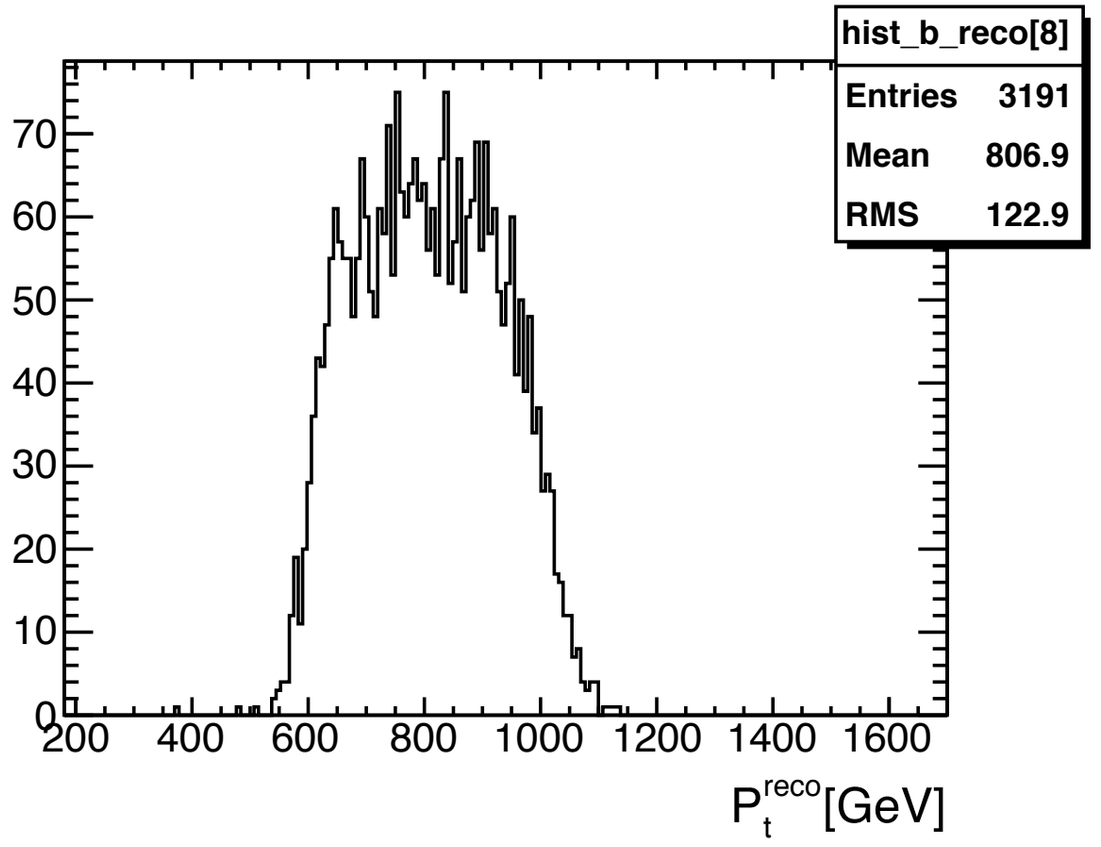

hist_b_tru[6]
Entries 3674
Mean 293.6
RMS 57.87
P_t^truth[GeV]

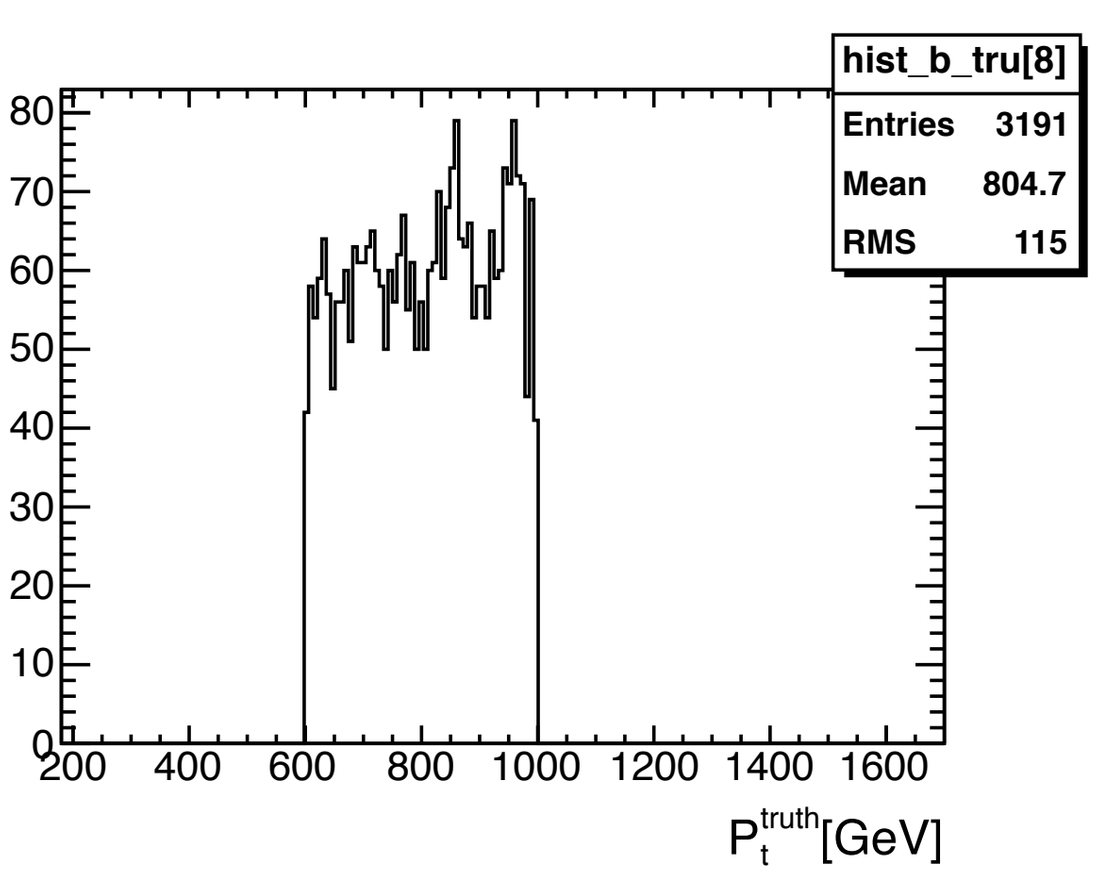

hist_b[7]
Entries 2110
Mean 1.005
RMS 0.0635
χ² / ndf 7.633 / 10
Prob 0.6646
Constant 178.9 ± 5.8
mean 0.9977 ± 0.0042
sigam 0.05825 ± 0.00235
AC 1.352 ± 0.945
P_t^reco/P_t^truth [400GeV,600GeV]

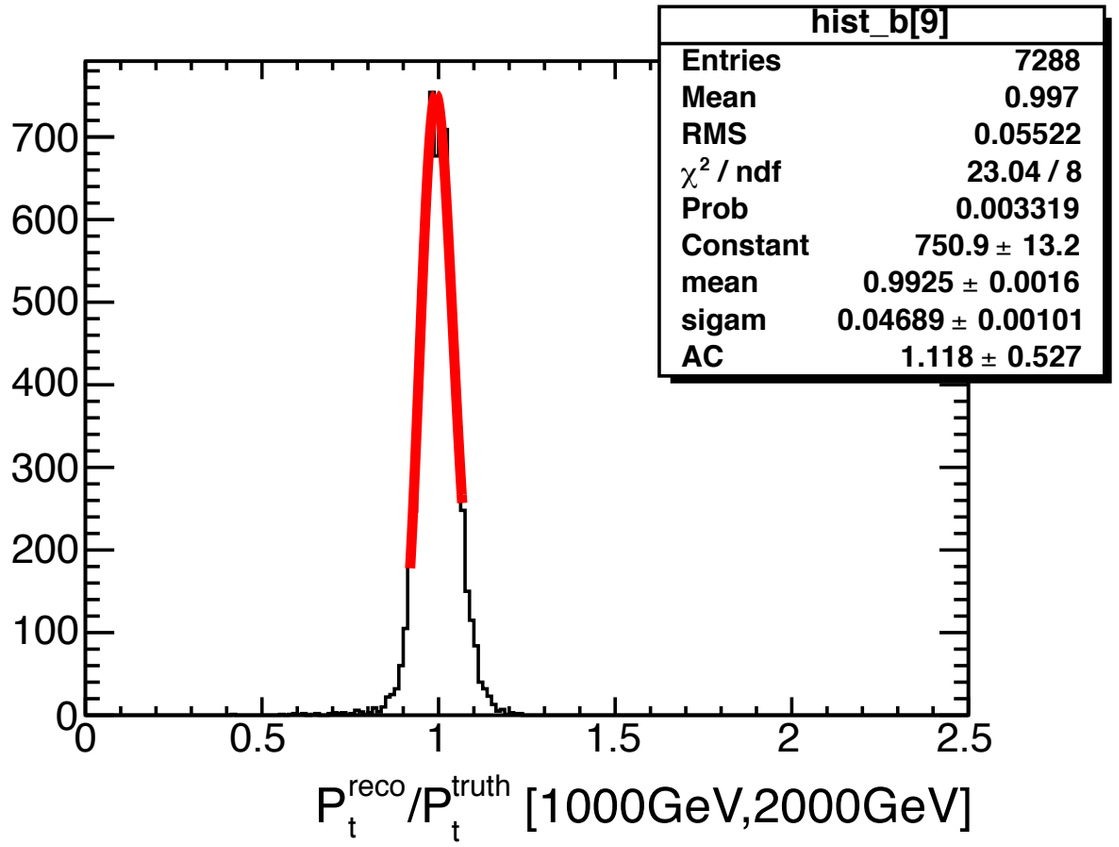

hist_b_reco[7]
Entries 2110
Mean 484.5
RMS 64.7
P_t^reco[GeV]

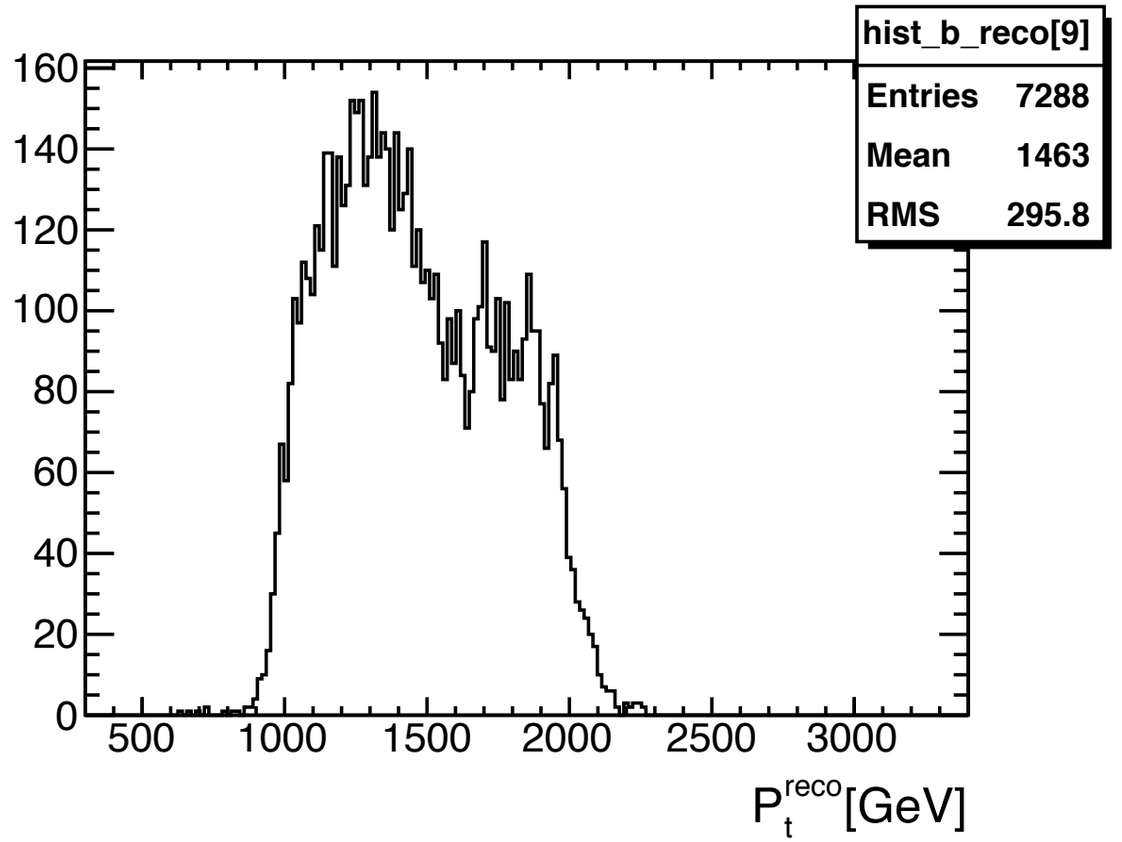

hist_b_tru[7]
Entries 2110
Mean 482.2
RMS 56.25
P_t^truth[GeV]

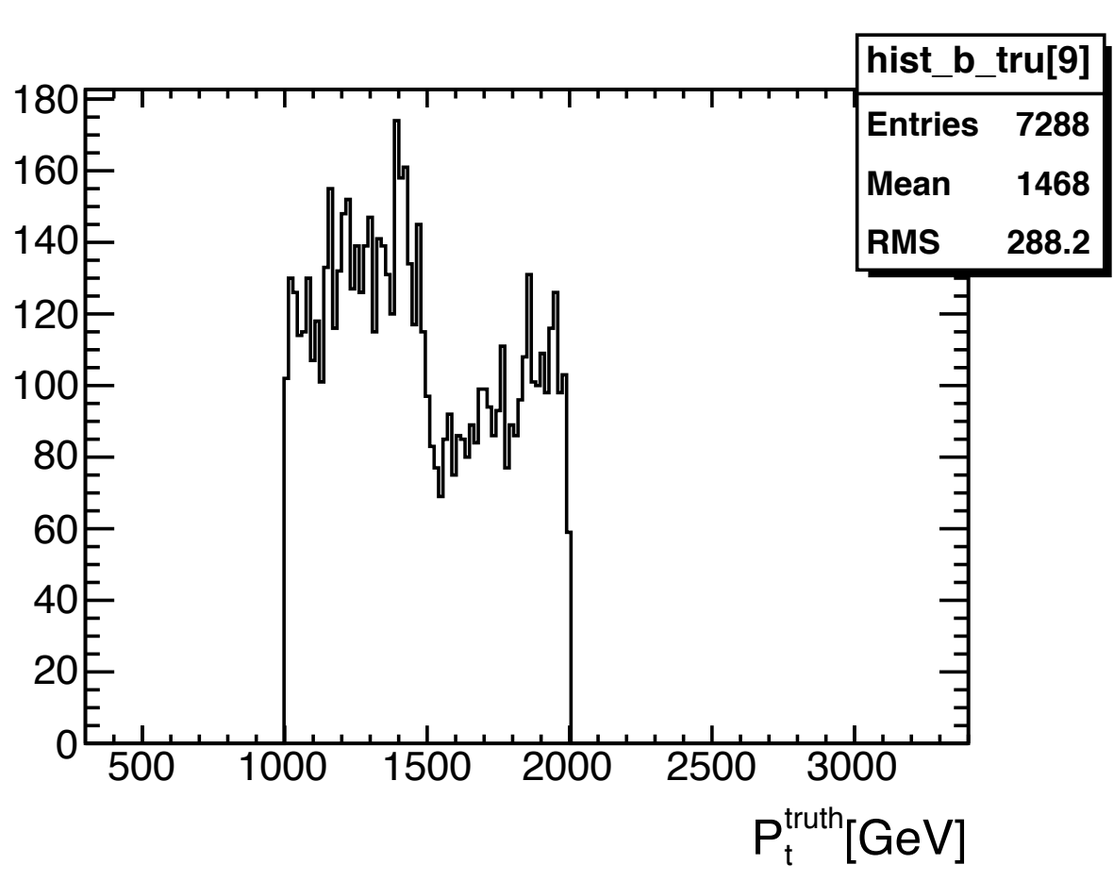

hist_b[8]
Entries 3191
Mean 1.003
RMS 0.05912
χ² / ndf 7.852 / 10
Prob 0.6433
Constant 287.7 ± 7.4
mean 0.9985 ± 0.0029
sigam 0.05451 ± 0.00159
AC 0.95 ± 0.67
P_t^reco/P_t^truth [600GeV,1000GeV]

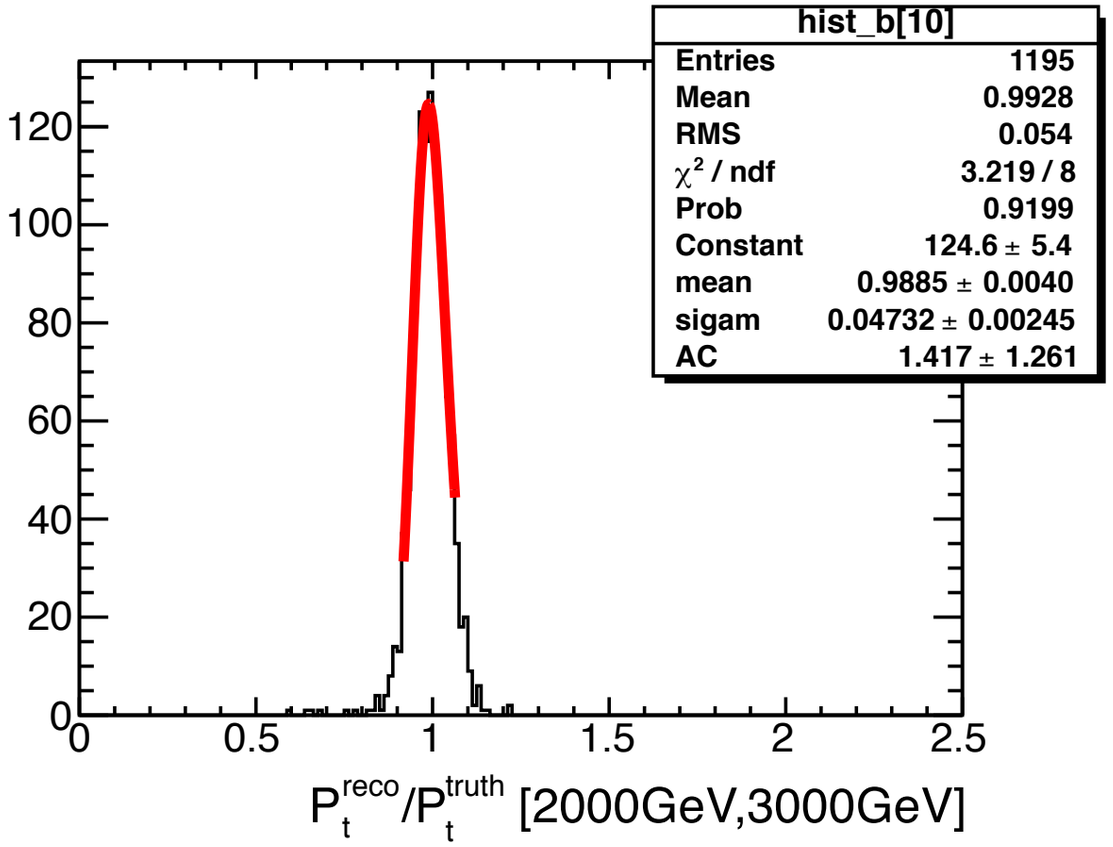

hist_b_reco[8]
Entries 3191
Mean 806.9
RMS 122.9
P_t^reco[GeV]

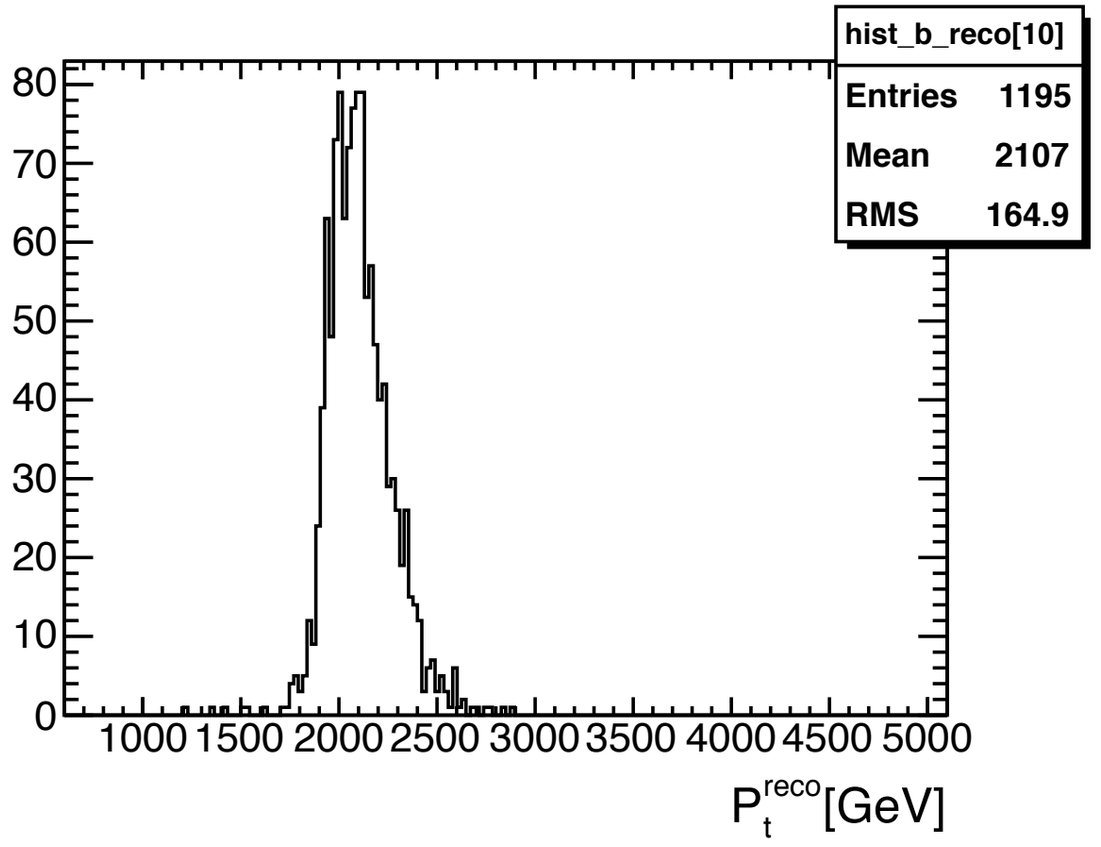

hist_b_tru[8]
Entries 3191
Mean 804.7
RMS 115
P_t^truth[GeV]

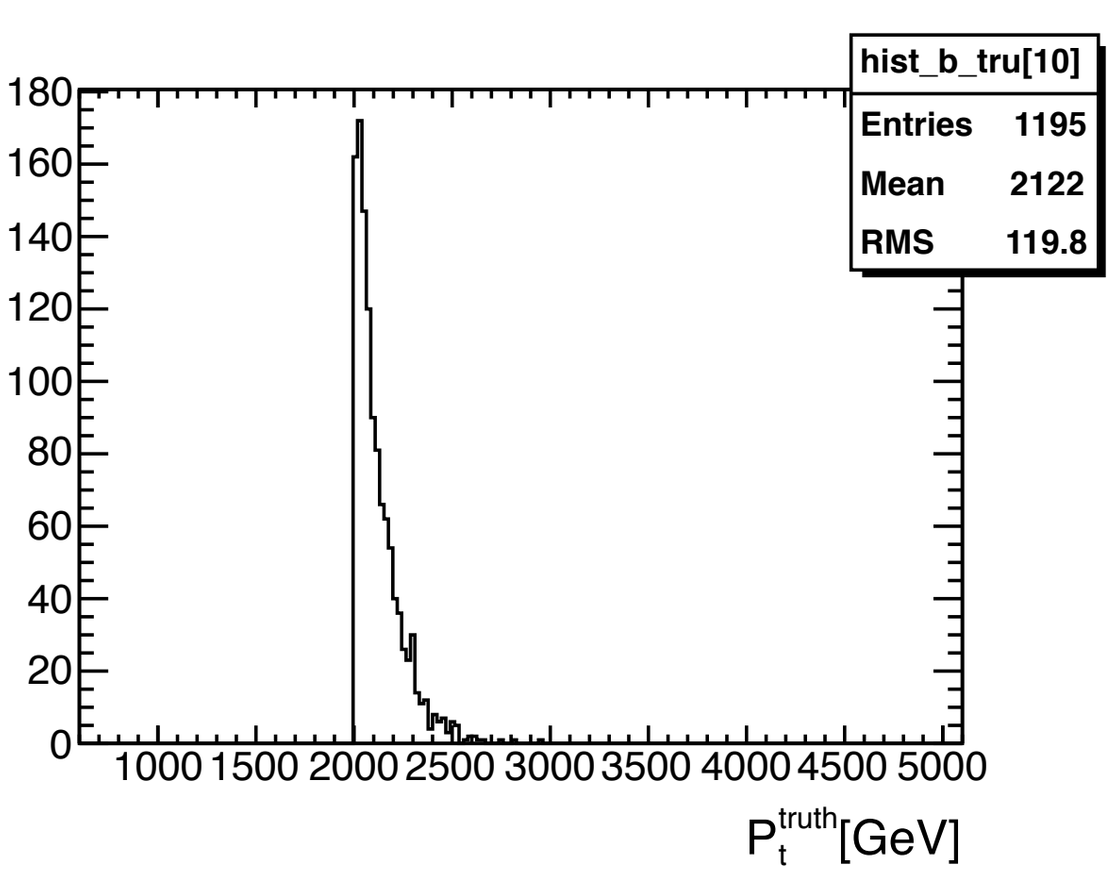

hist_b[9]
Entries 7288
Mean 0.997
RMS 0.05522
χ² / ndf 23.04 / 8
Prob 0.003319
Constant 750.9 ± 13.2
mean 0.9925 ± 0.0016
sigam 0.04689 ± 0.00101
AC 1.118 ± 0.527
P_t^reco/P_t^truth [1000GeV,2000GeV]


hist_b_reco[9]
Entries 7288
Mean 1463
RMS 295.8
P_t^reco[GeV]


hist_b_tru[9]
Entries 7288
Mean 1468
RMS 288.2
P_t^truth[GeV]


hist_b[10]
Entries 1195
Mean 0.9928
RMS 0.054
χ² / ndf 3.219 / 8
Prob 0.9199
Constant 124.6 ± 5.4
mean 0.9885 ± 0.0040
sigam 0.04732 ± 0.00245
AC 1.417 ± 1.261
P_t^reco/P_t^truth [2000GeV,3000GeV]


hist_b_reco[10]
Entries 1195
Mean 2107
RMS 164.9
P_t^reco[GeV]


hist_b_tru[10]
Entries 1195
Mean 2122
RMS 119.8
P_t^truth[GeV]