November 9 Group Meeting Understanding the Energy Resolution

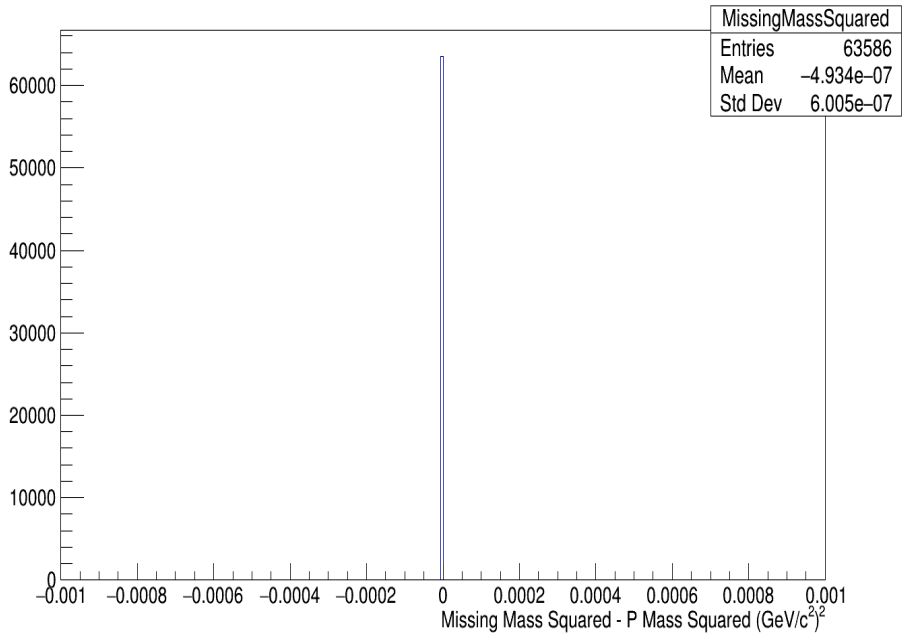
Andrew Schick

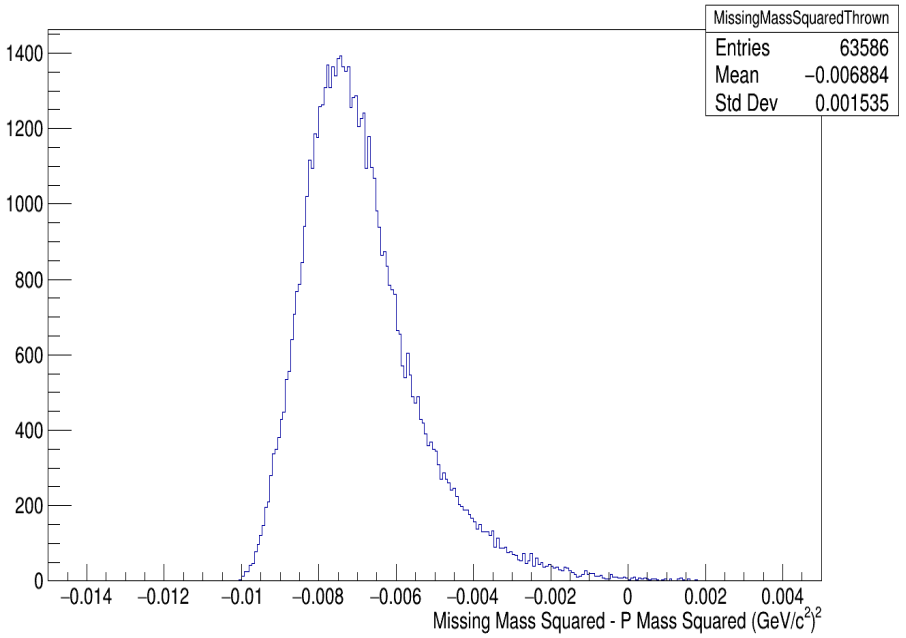
Status Update

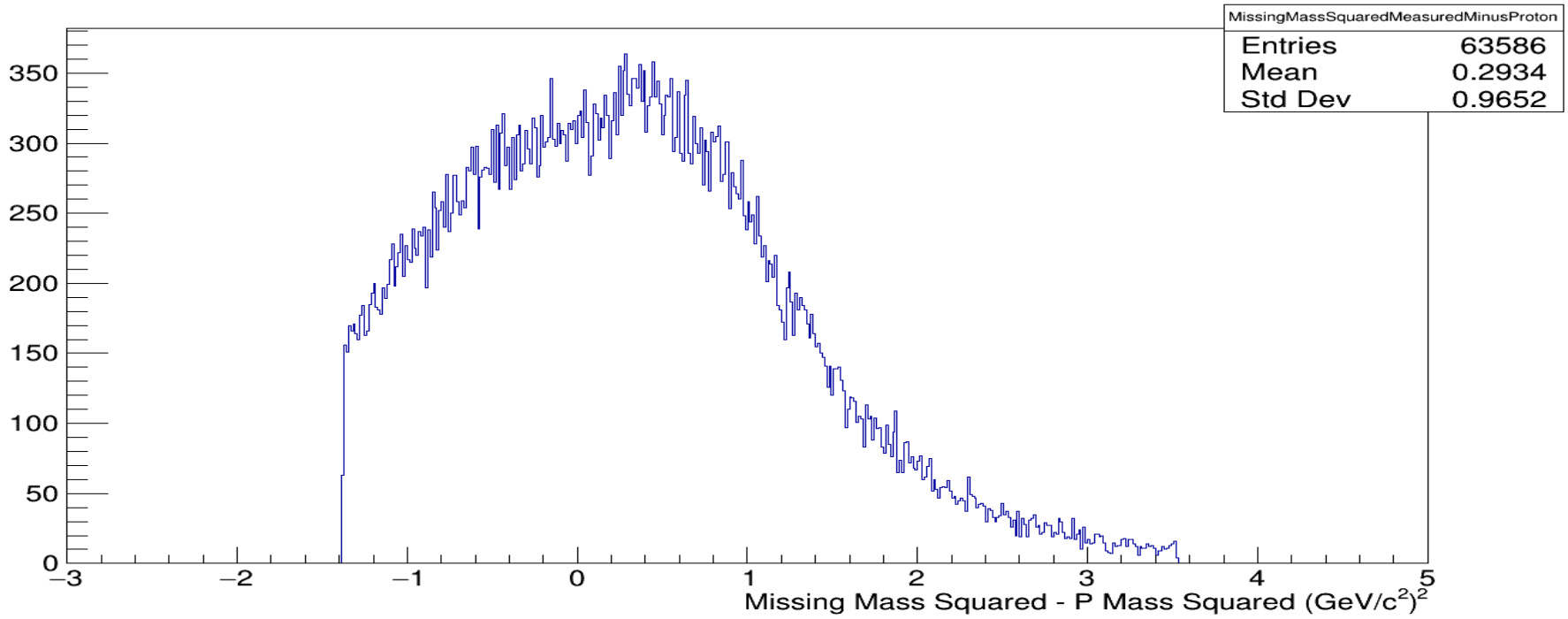
- Analysis of run data on hold
- Full effort is being applied to MC

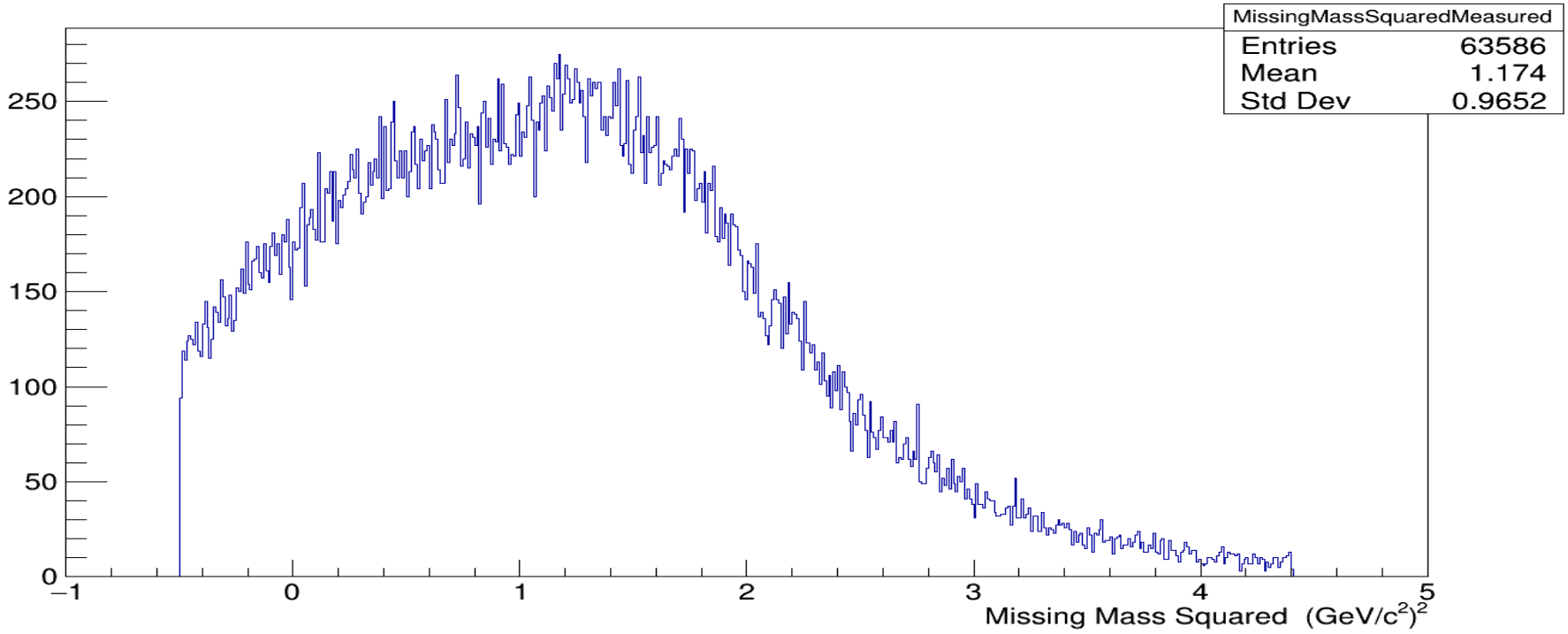
IN Progress:

- Including the FCAL and BCAL trig requirements into simulation
- Adding to my list of histograms the fractional variation: (thrown - fit)/thrown


MissingMassSquared
Entries 63586
Mean −4.934e−07
Std Dev 6.005e−07
Missing Mass Squared - P Mass Squared (GeV/c²)²


MissingMassSquaredThrown
Entries 63586
Mean −0.006884
Std Dev 0.001535
Missing Mass Squared - P Mass Squared (GeV/c²)²

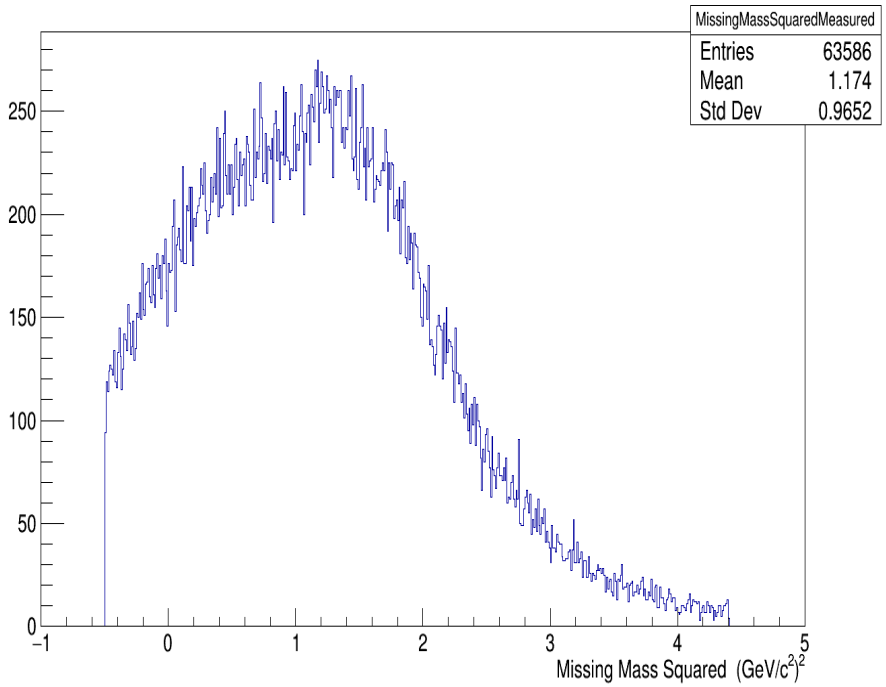

MissingMassSquaredMeasuredMinusProton
Entries 63586
Mean 0.2934
Std Dev 0.9652
Missing Mass Squared - P Mass Squared (GeV/c²)²

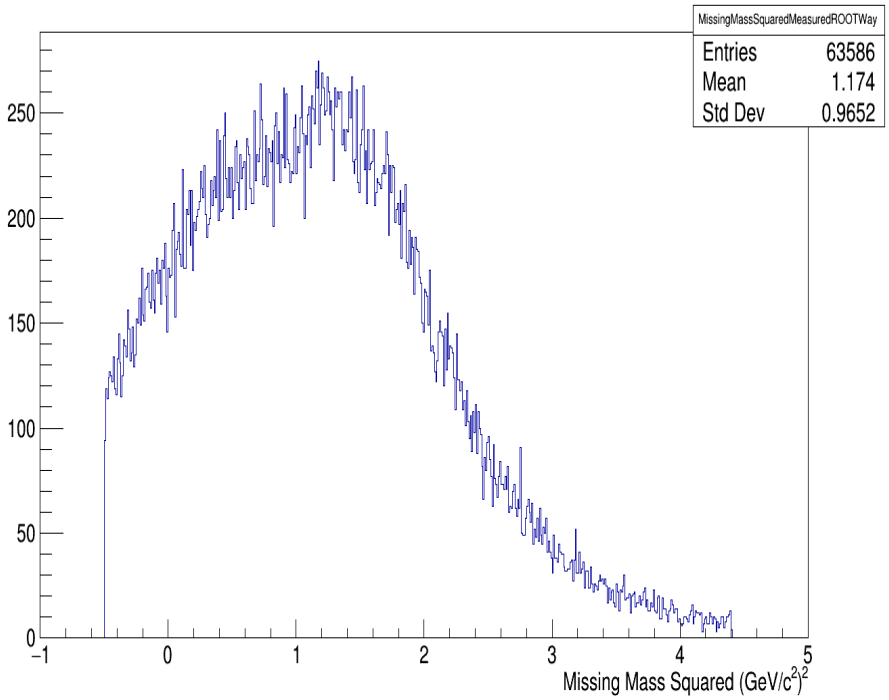


$$q_\gamma + m_p = p_{\pi+} + p_{\pi-} + k_p$$

$$(q_\gamma + m_p - p_{\pi+} - p_{\pi-})^2 = k_p^2 \approx m_p^2$$

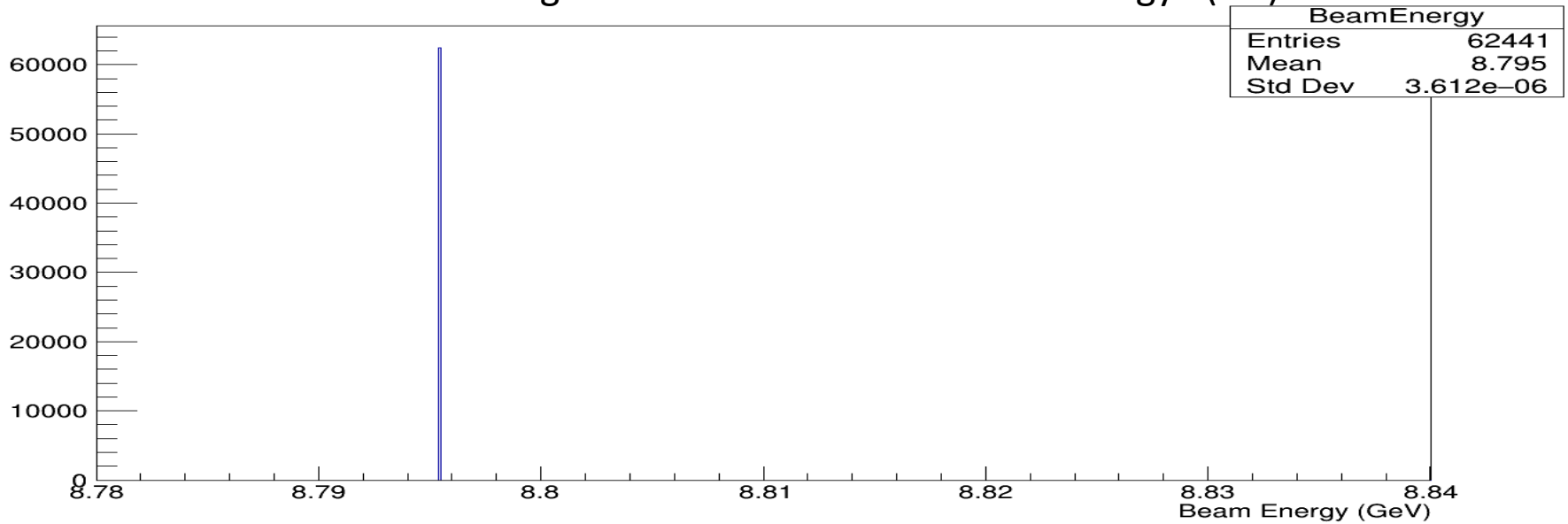
Something weird with root? (No)

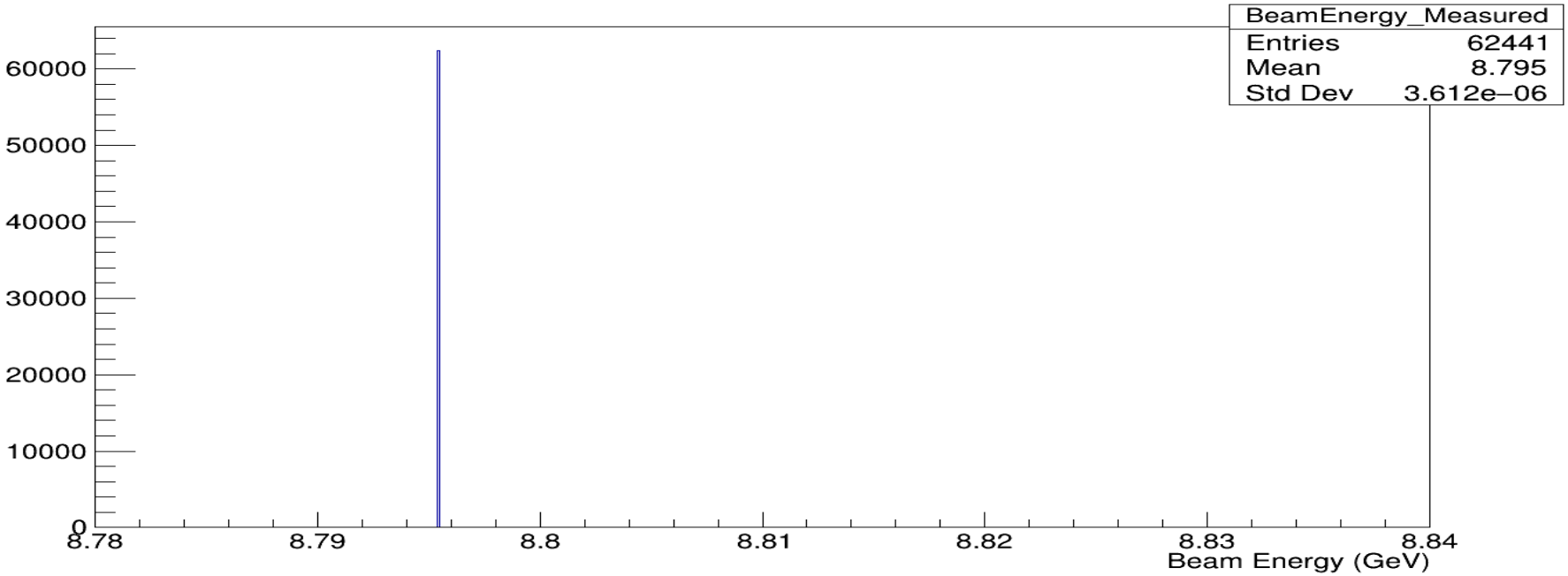




Done by hand VS Using .M2()

Something weird with Measured Beam Energy? (No)





Where could we be going wrong?

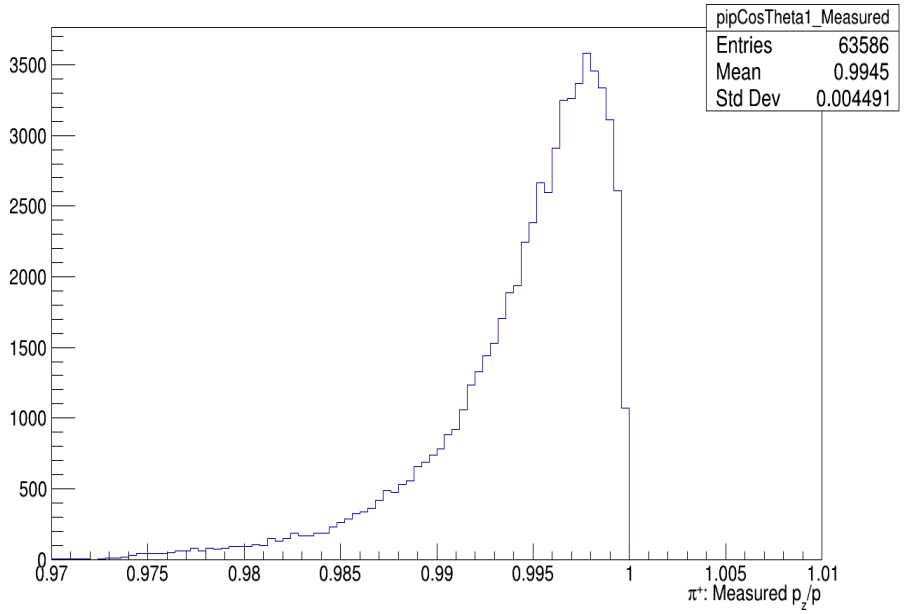
$$(q_\gamma + m_p - p_{\pi+} - p_{\pi-})^2 = k_p^2 \approx m_p^2$$

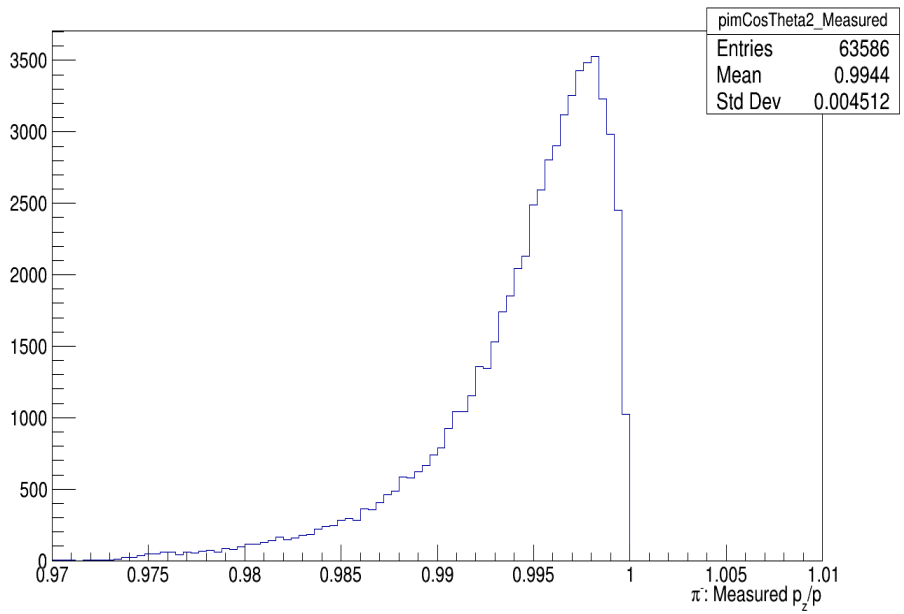
$$(q_\gamma + m_p)^2 + p_1^2 + p_2^2 - p_1 \cdot (q_\gamma + m_p) - p_2 \cdot (q_\gamma + m_p) + 2p_1 \cdot p_2 = k_p^2$$

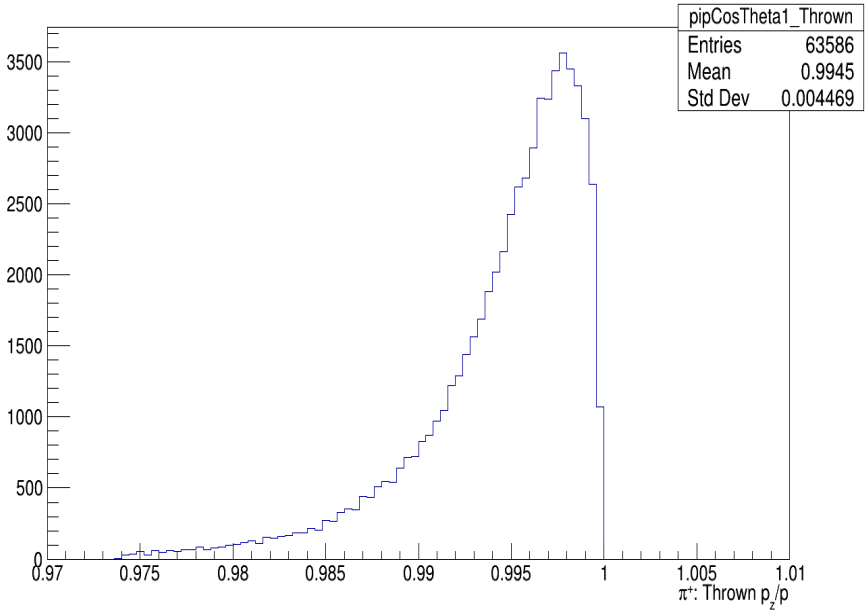
$$p_1 \cdot (q_\gamma + m) = E_1 m + E_1 E_\gamma - \mathbf{p}_1 \cdot E_\gamma \hat{z} \qquad \boxed{|\mathbf{p}_1| E_\gamma \cos\theta_1}$$

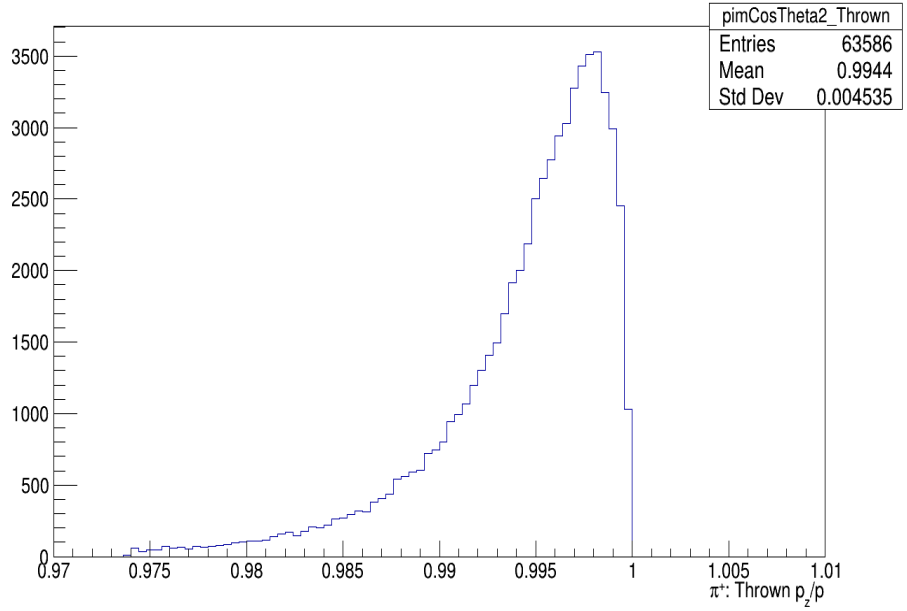
$$p_1 \cdot p_2 = E_1 E_2 - \mathbf{p}_1 \cdot \mathbf{p}_2 = E_1 E_2 - |\mathbf{p}_1||\mathbf{p}_2| \cos\theta_{\pi\pi} \qquad \boxed{|\mathbf{p}_1||\mathbf{p}_2| \cos\theta_{\pi\pi}}$$

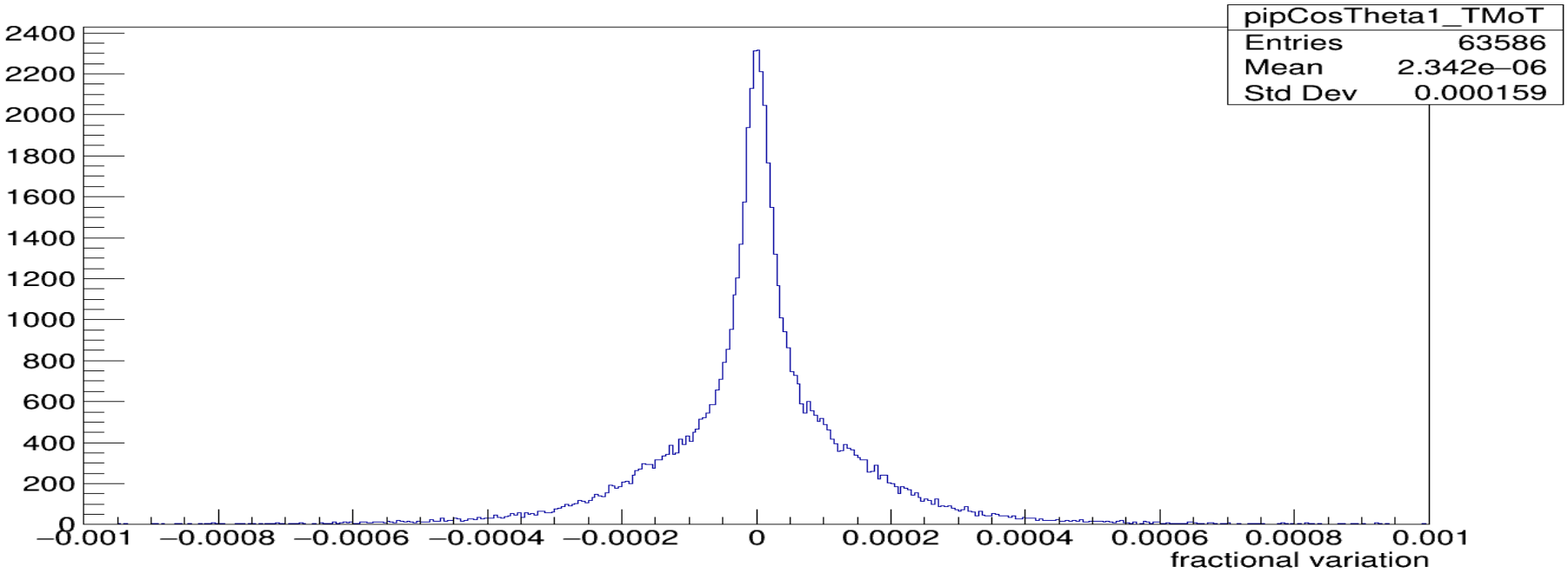
(And while we're at it, let's look at momenta in general)

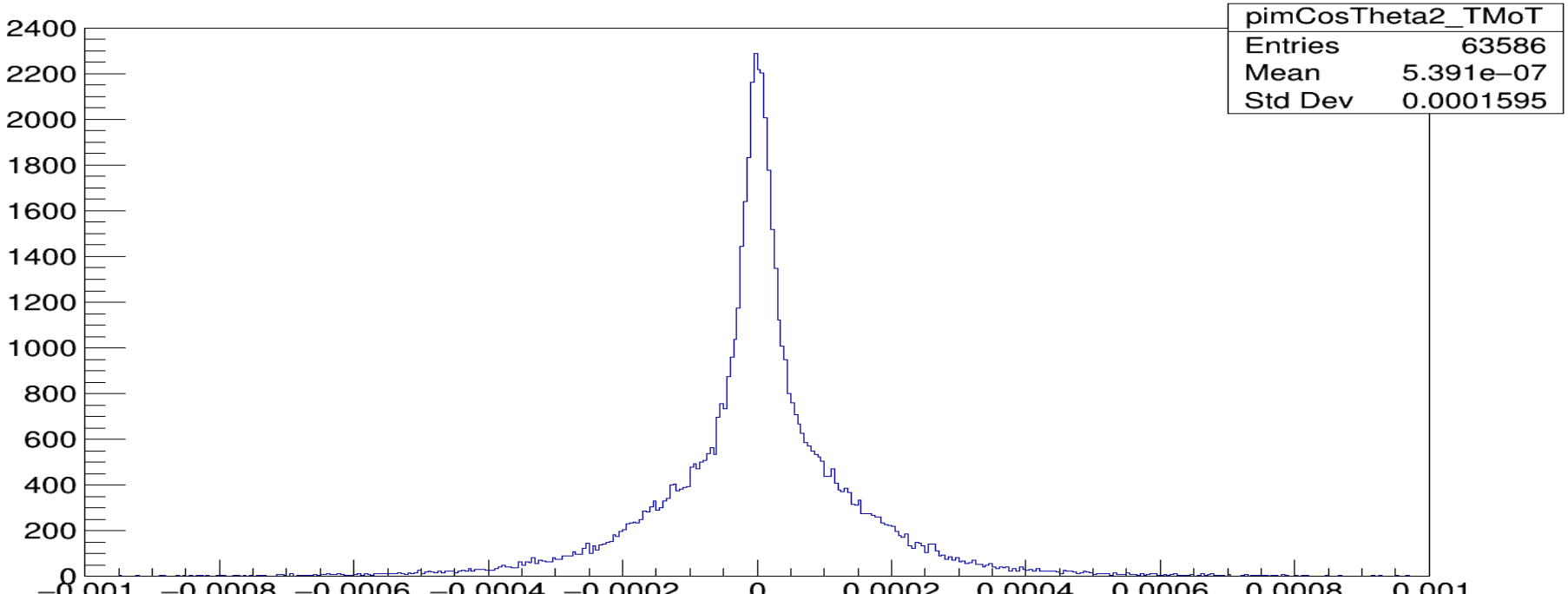

pipCosTheta1_Measured
Entries 63586
Mean 0.9945
Std Dev 0.004491
3500
3000
2500
2000
1500
1000
500
0
0.97
0.975
0.98
0.985
0.99
0.995
1
1.005
1.01
π⁺: Measured p_z/p

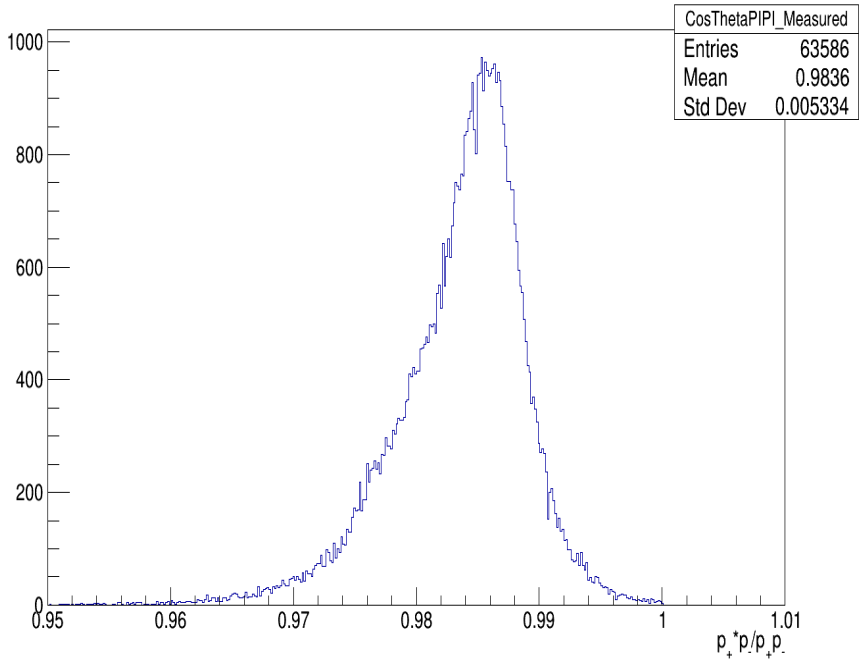

pimCosTheta2_Measured
Entries 63586
Mean 0.9944
Std Dev 0.004512
3500
3000
2500
2000
1500
1000
500
0
0.97
0.975
0.98
0.985
0.99
0.995
1
1.005
1.01
π⁻: Measured p_z/p

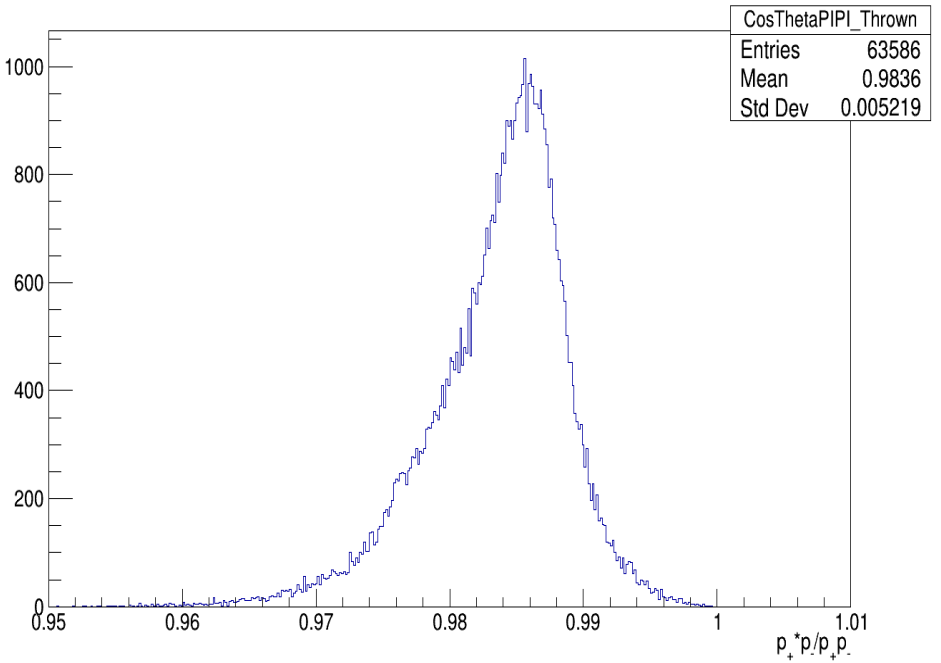

pipCosTheta1_Thrown
Entries 63586
Mean 0.9945
Std Dev 0.004469
3500
3000
2500
2000
1500
1000
500
0
0.97
0.975
0.98
0.985
0.99
0.995
1
1.005
1.01
π⁺: Thrown p_z/p

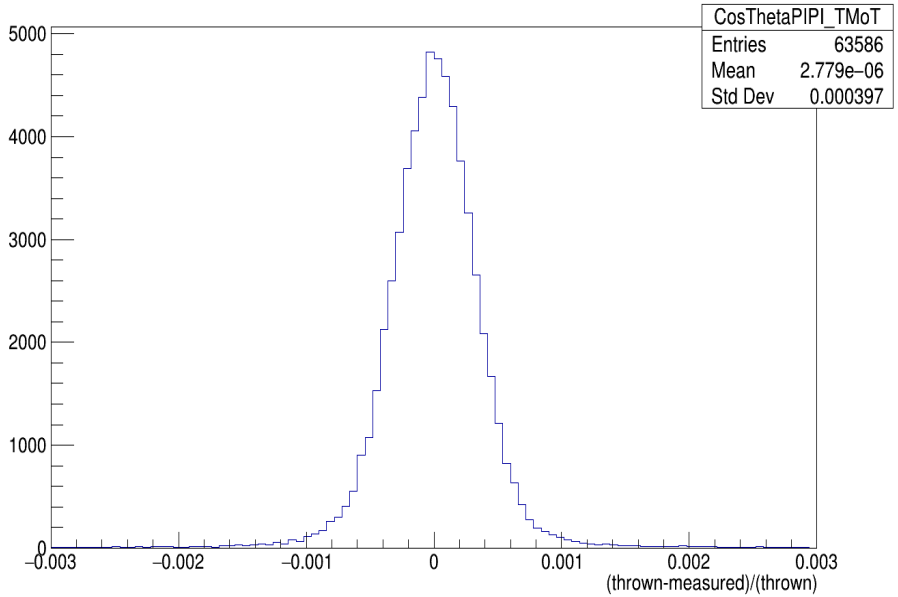

pimCosTheta2_Thrown
Entries 63586
Mean 0.9944
Std Dev 0.004535
3500
3000
2500
2000
1500
1000
500
0
0.97
0.975
0.98
0.985
0.99
0.995
1
1.005
1.01
π⁺: Thrown p_z/p


pipCosTheta1_TMoT
Entries 63586
Mean 2.342e−06
Std Dev 0.000159
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
−0.001
−0.0008
−0.0006
−0.0004
−0.0002
0
0.0002
0.0004
0.0006
0.0008
0.001
fractional variation


pimCosTheta2_TMoT
Entries 63586
Mean 5.391e−07
Std Dev 0.0001595
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0

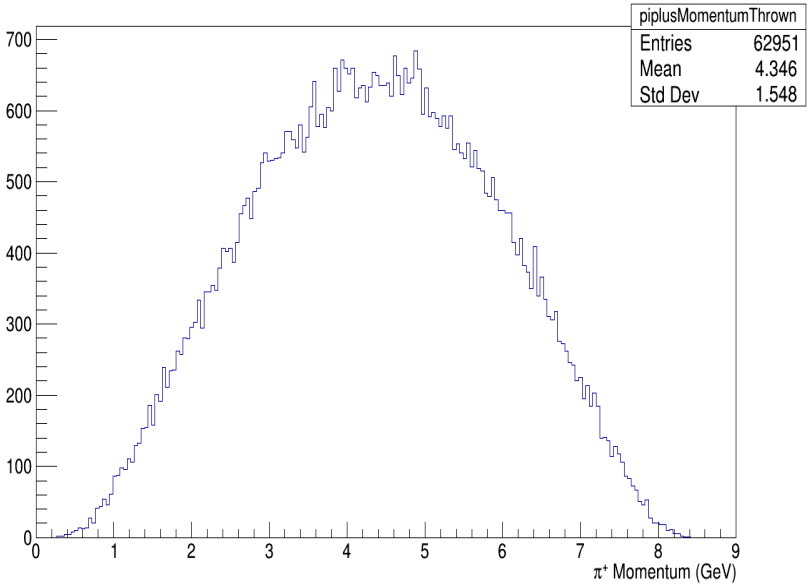


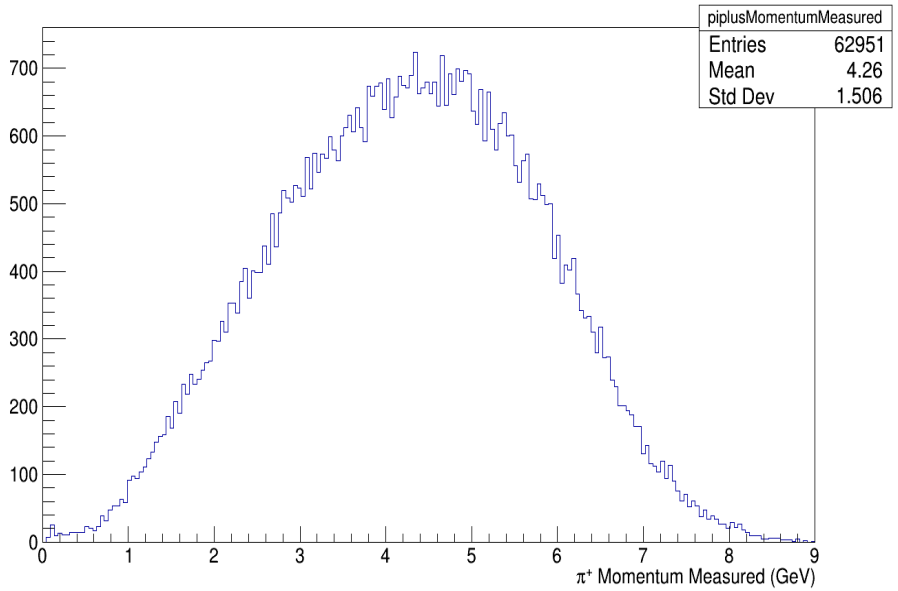


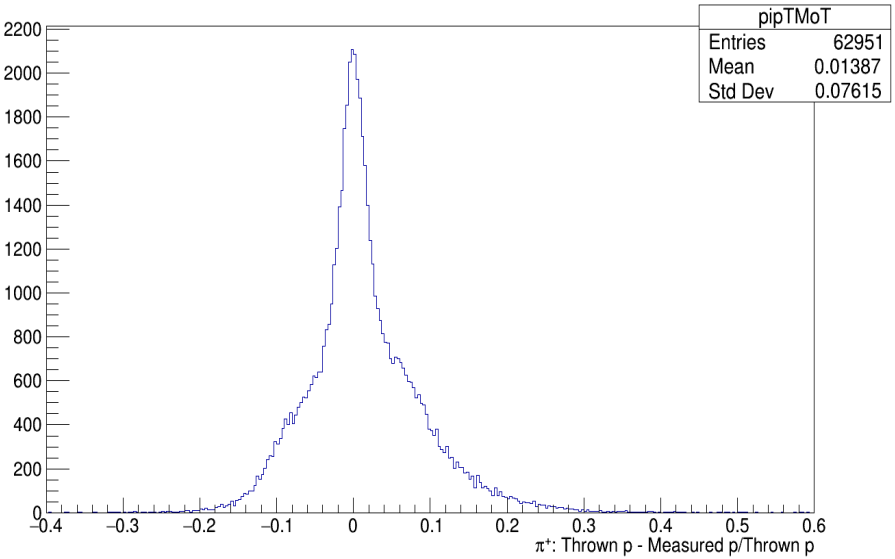


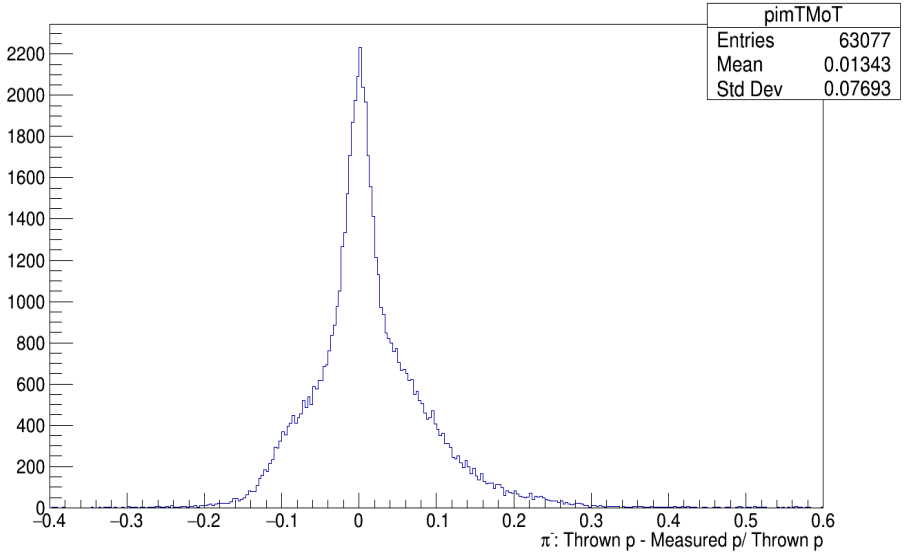
Angles look good...

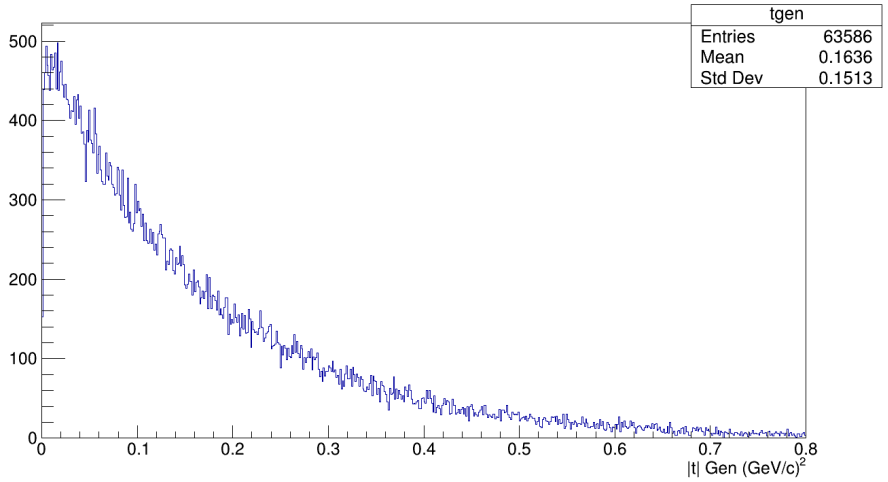
What about 3-Momentum?

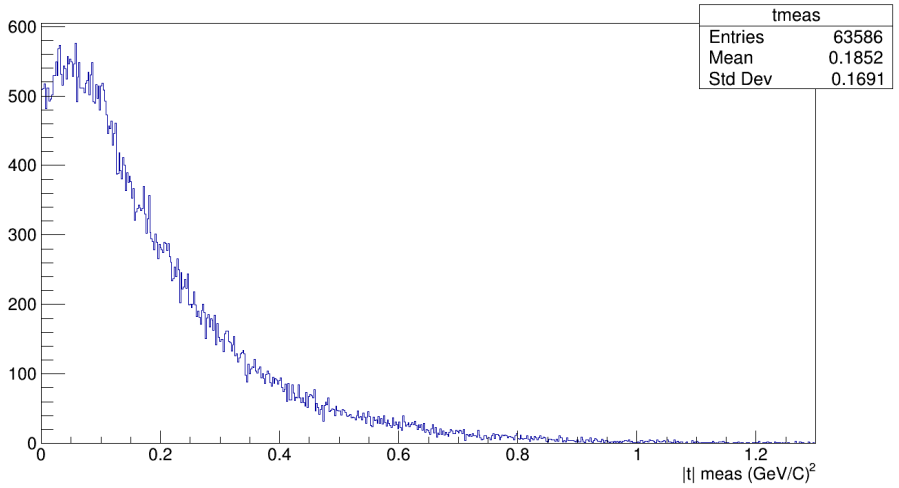


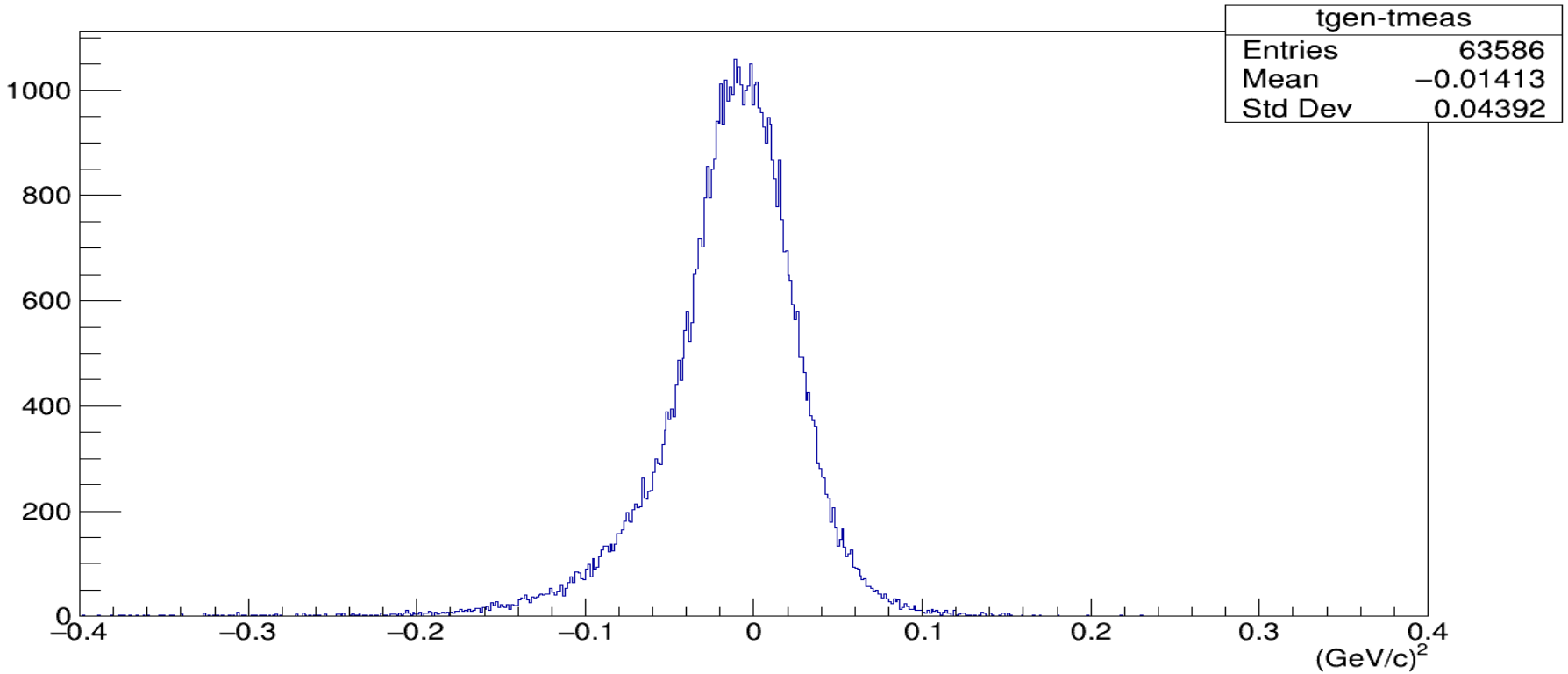




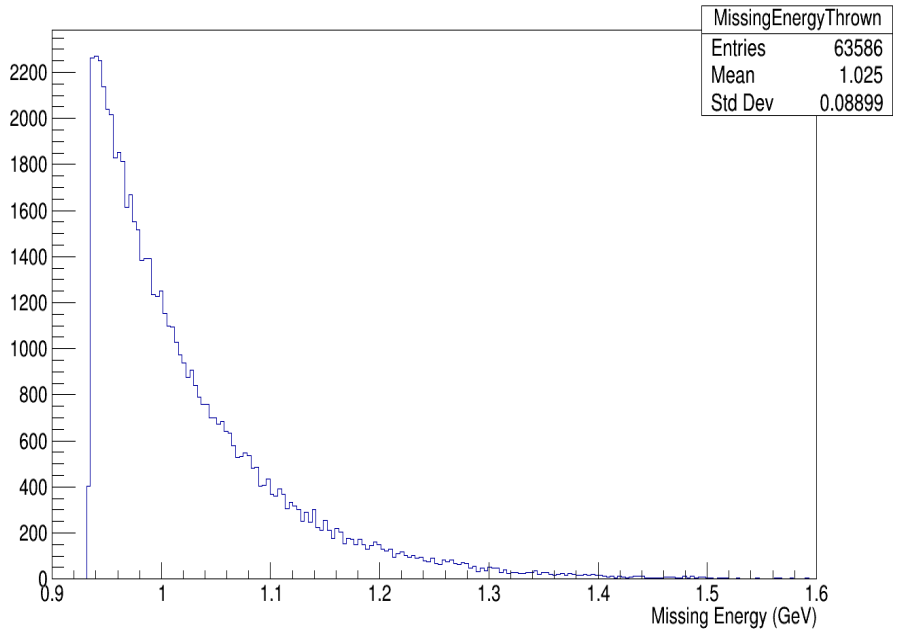


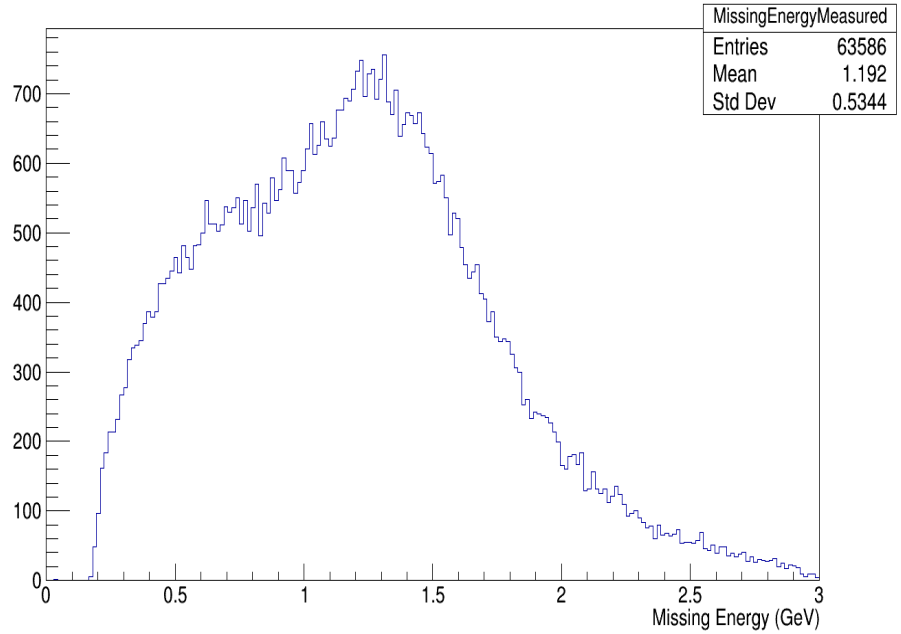

tgen
Entries 63586
Mean 0.1636
Std Dev 0.1513
|t| Gen (GeV/c)²

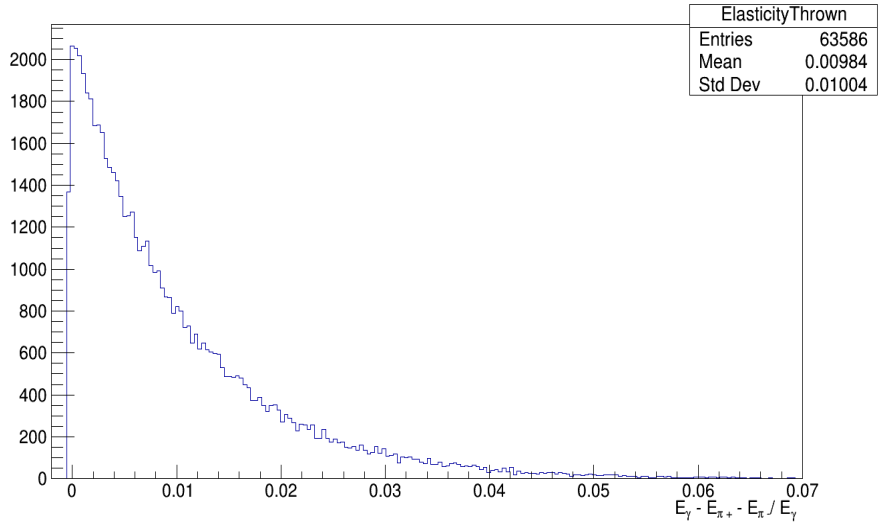

tmeas
Entries 63586
Mean 0.1852
Std Dev 0.1691
|t| meas (GeV/C)²

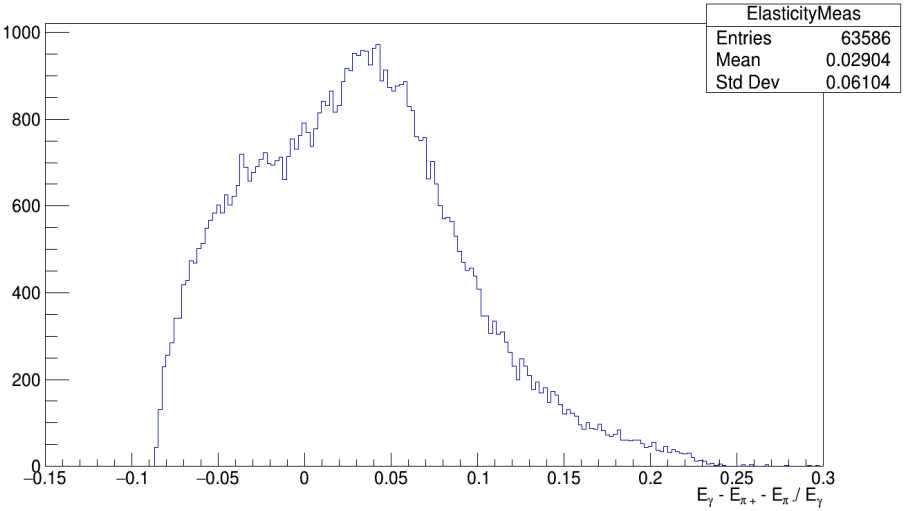

tgen-tmeas
Entries 63586
Mean −0.01413
Std Dev 0.04392
(GeV/c)²

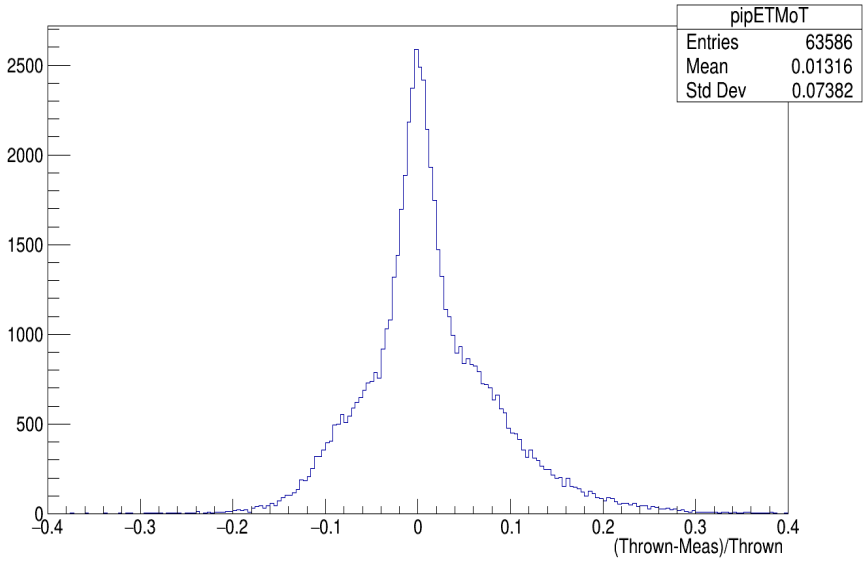
Ok, what about Energies?

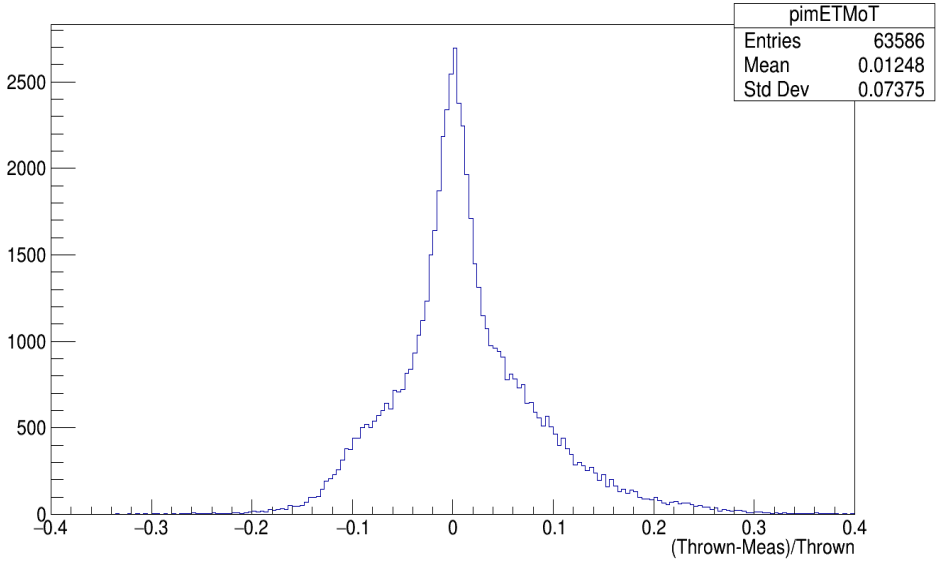


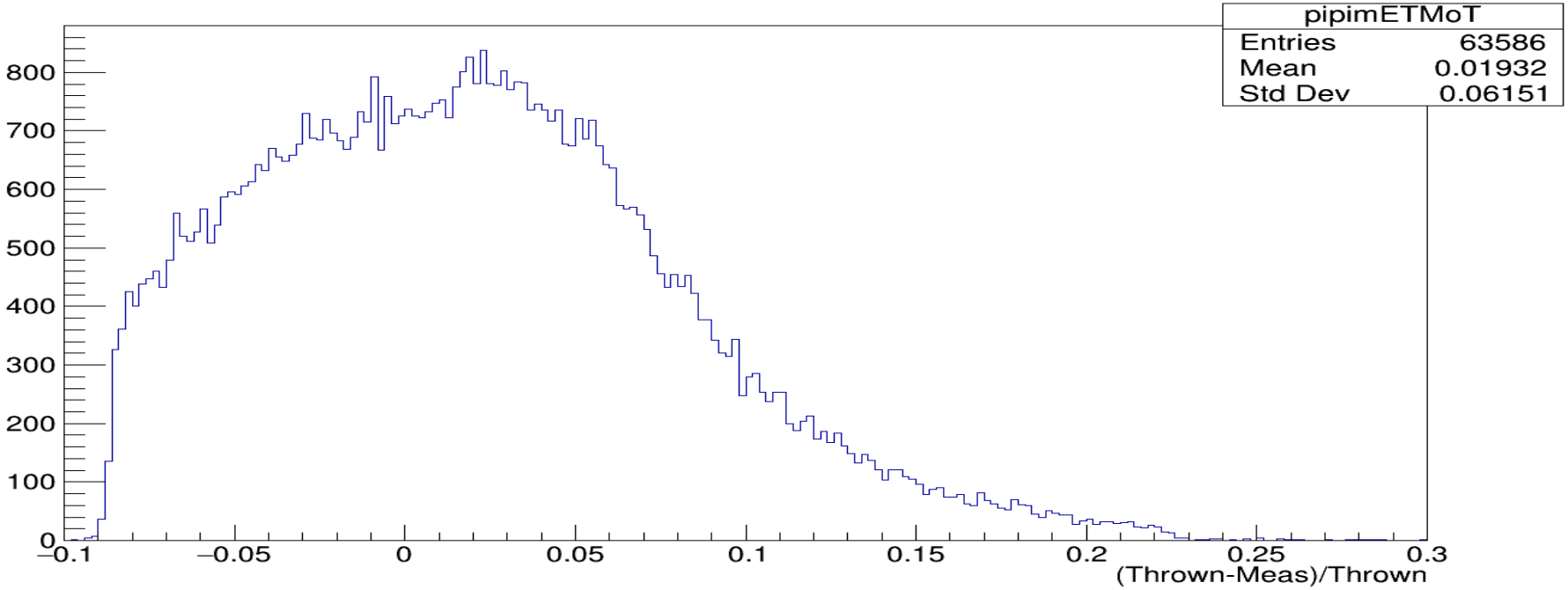


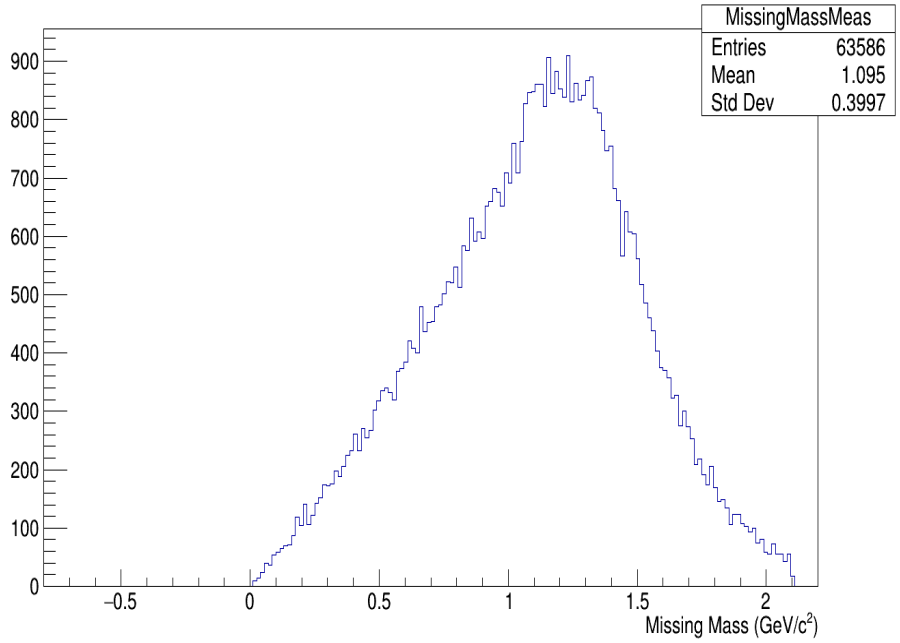


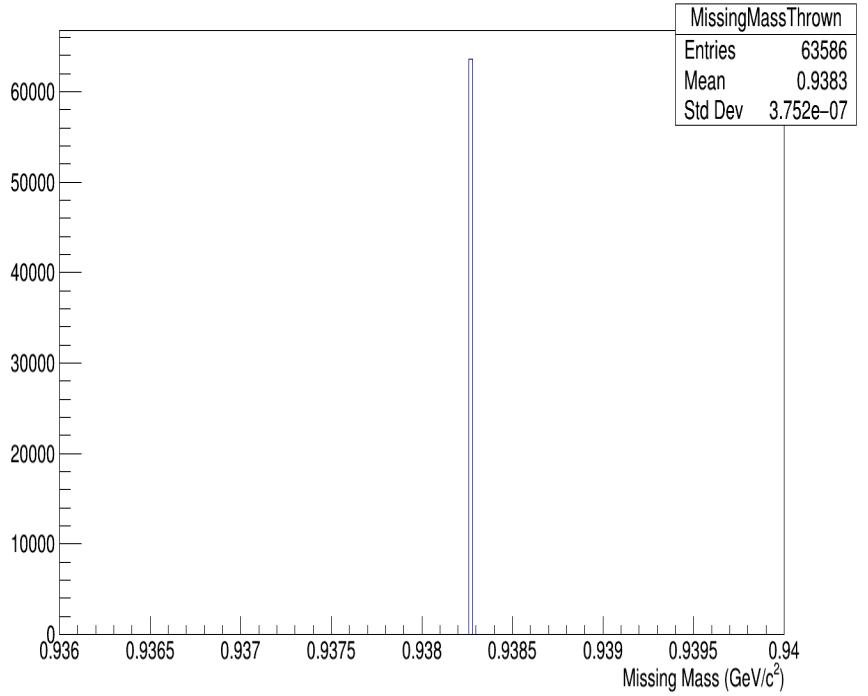


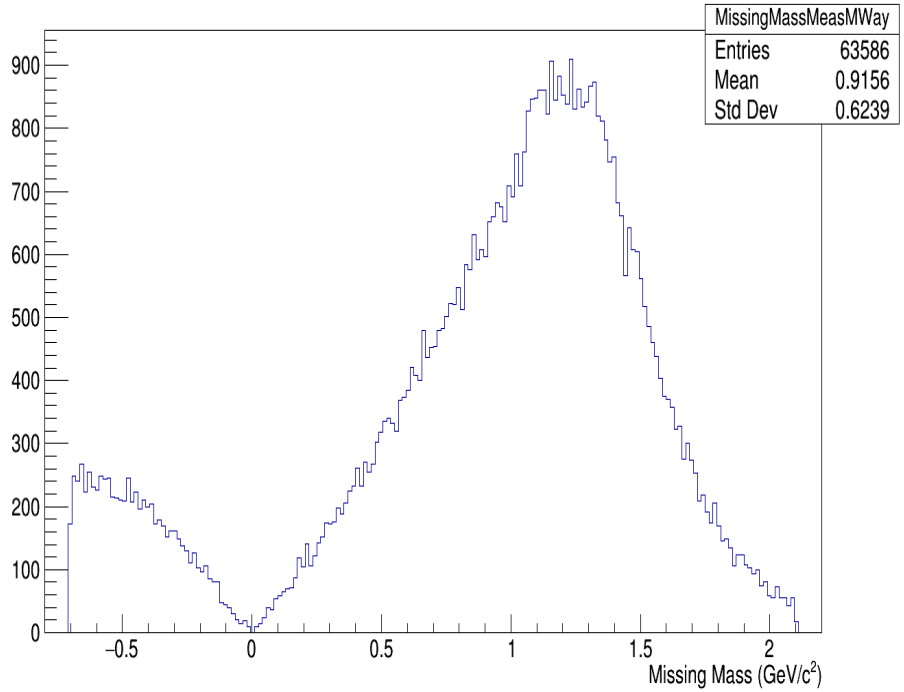

pipETMoT
Entries 63586
Mean 0.01316
Std Dev 0.07382
(Thrown-Meas)/Thrown

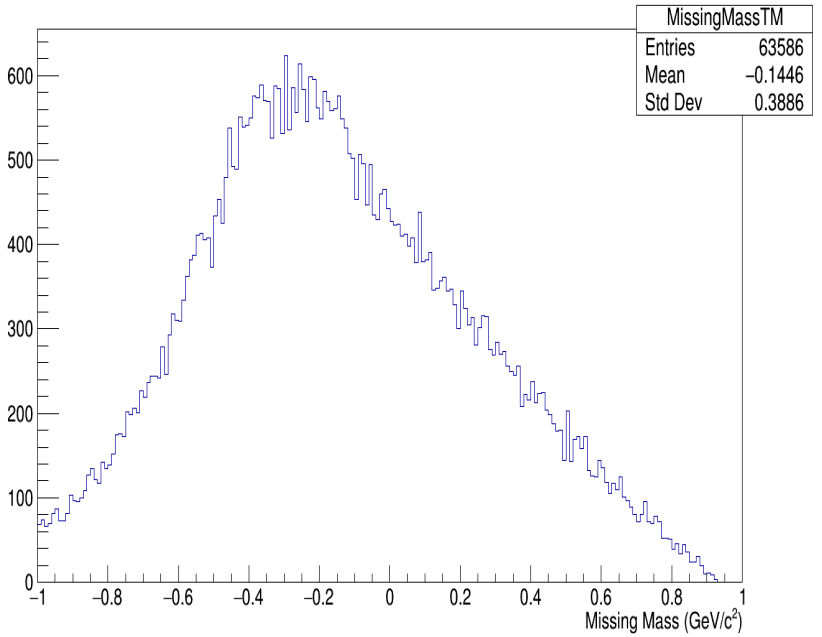

pimETMoT
Entries 63586
Mean 0.01248
Std Dev 0.07375
(Thrown-Meas)/Thrown

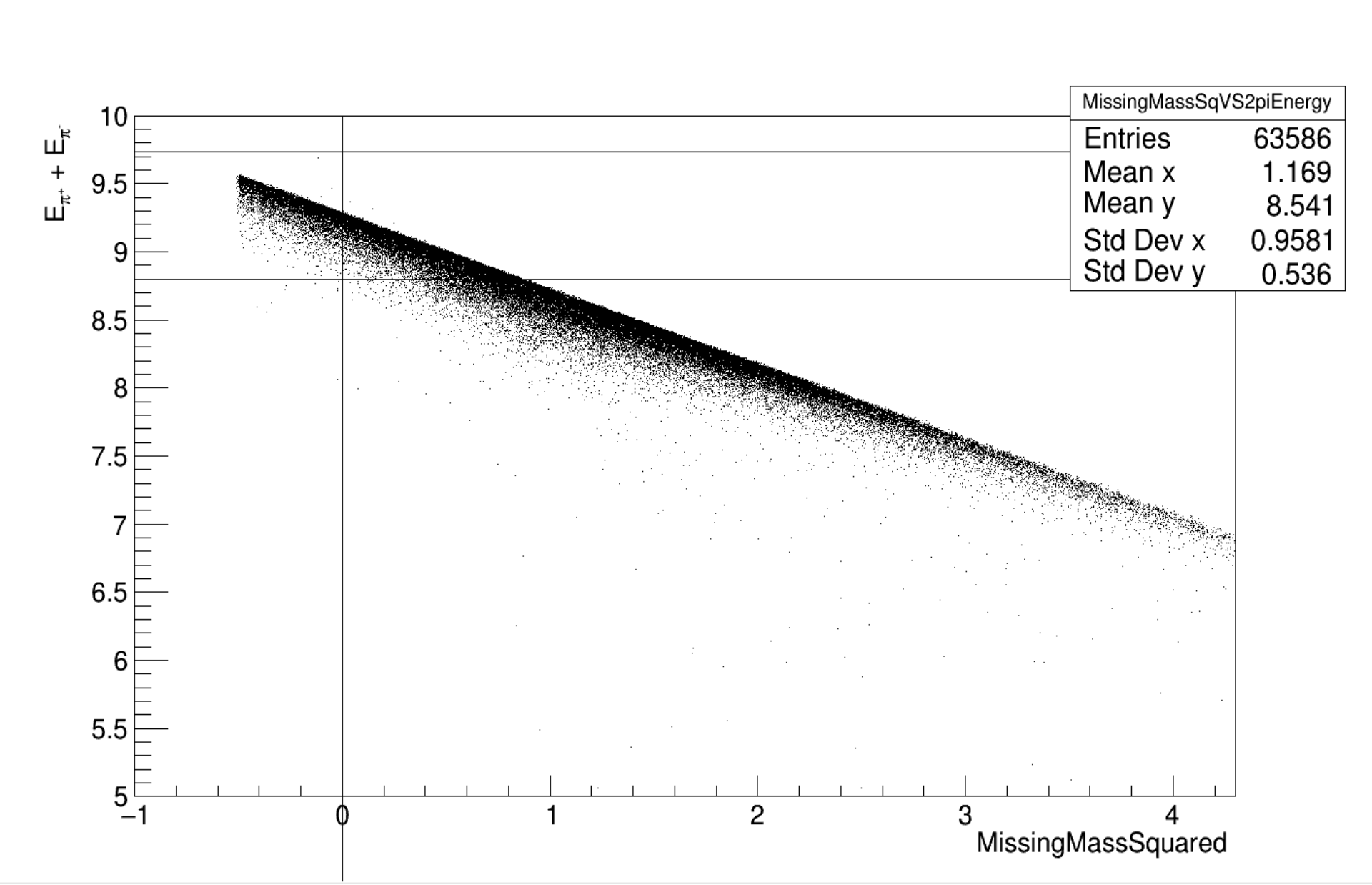

pipimETMoT
Entries 63586
Mean 0.01932
Std Dev 0.06151
(Thrown-Meas)/Thrown


MissingMassMeas
Entries 63586
Mean 1.095
Std Dev 0.3997
Missing Mass (GeV/c²)


MissingMassThrown
Entries 63586
Mean 0.9383
Std Dev 3.752e−07
Missing Mass (GeV/c²)


MissingMassMeasMWay
Entries 63586
Mean 0.9156
Std Dev 0.6239
Missing Mass (GeV/c²)


MissingMassTM
Entries 63586
Mean −0.1446
Std Dev 0.3886
Missing Mass (GeV/c²)


MissingMassSqVS2piEnergy
Entries 63586
Mean x 1.169
Mean y 8.541
Std Dev x 0.9581
Std Dev y 0.536
$E_{\pi^+} + E_{\pi^-}$
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
−1
0
1
2
3
4
MissingMassSquared