pXp analysis

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Mike Albrow (FNAL)

Overview

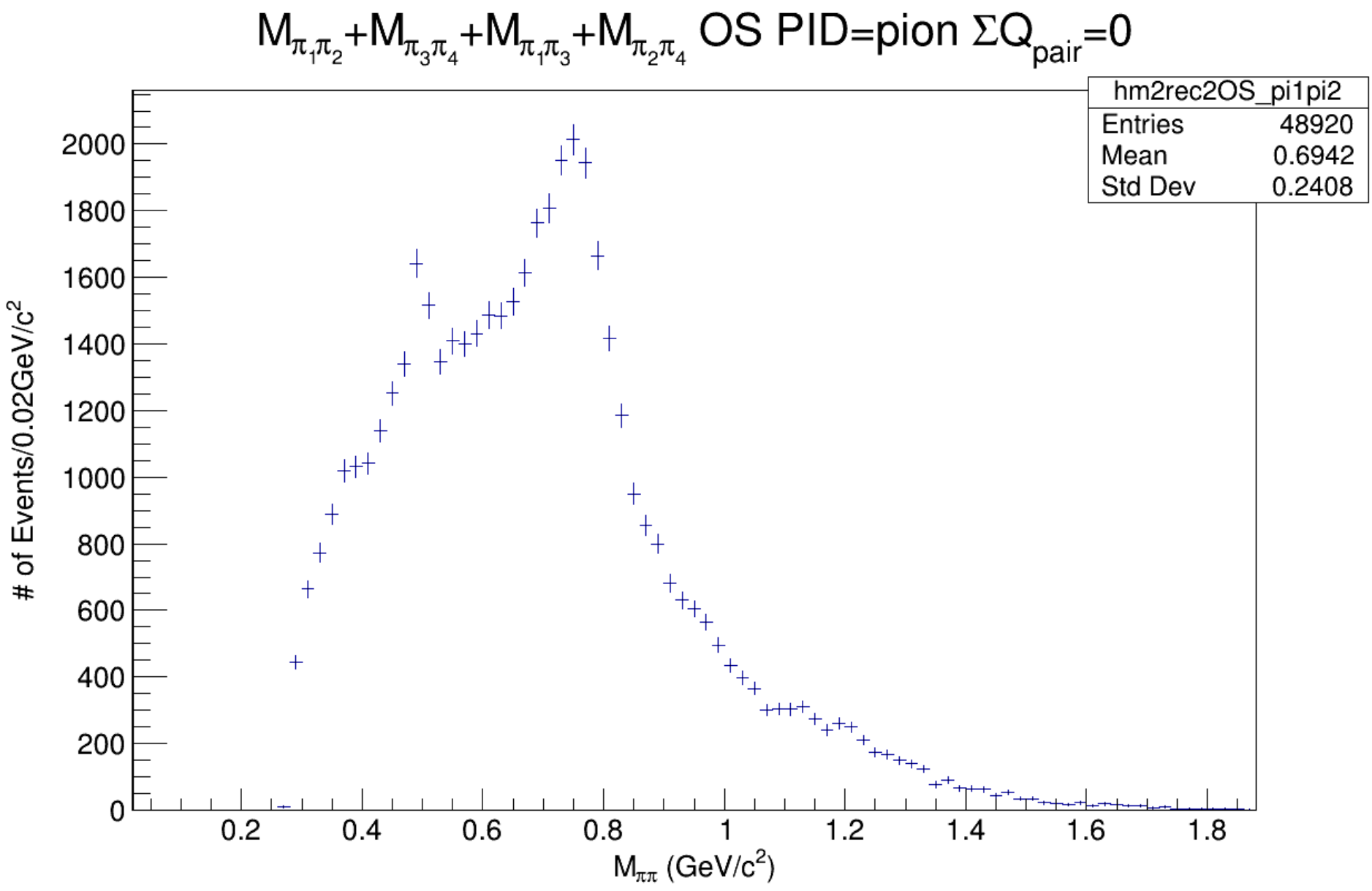
- Mike’s tasks

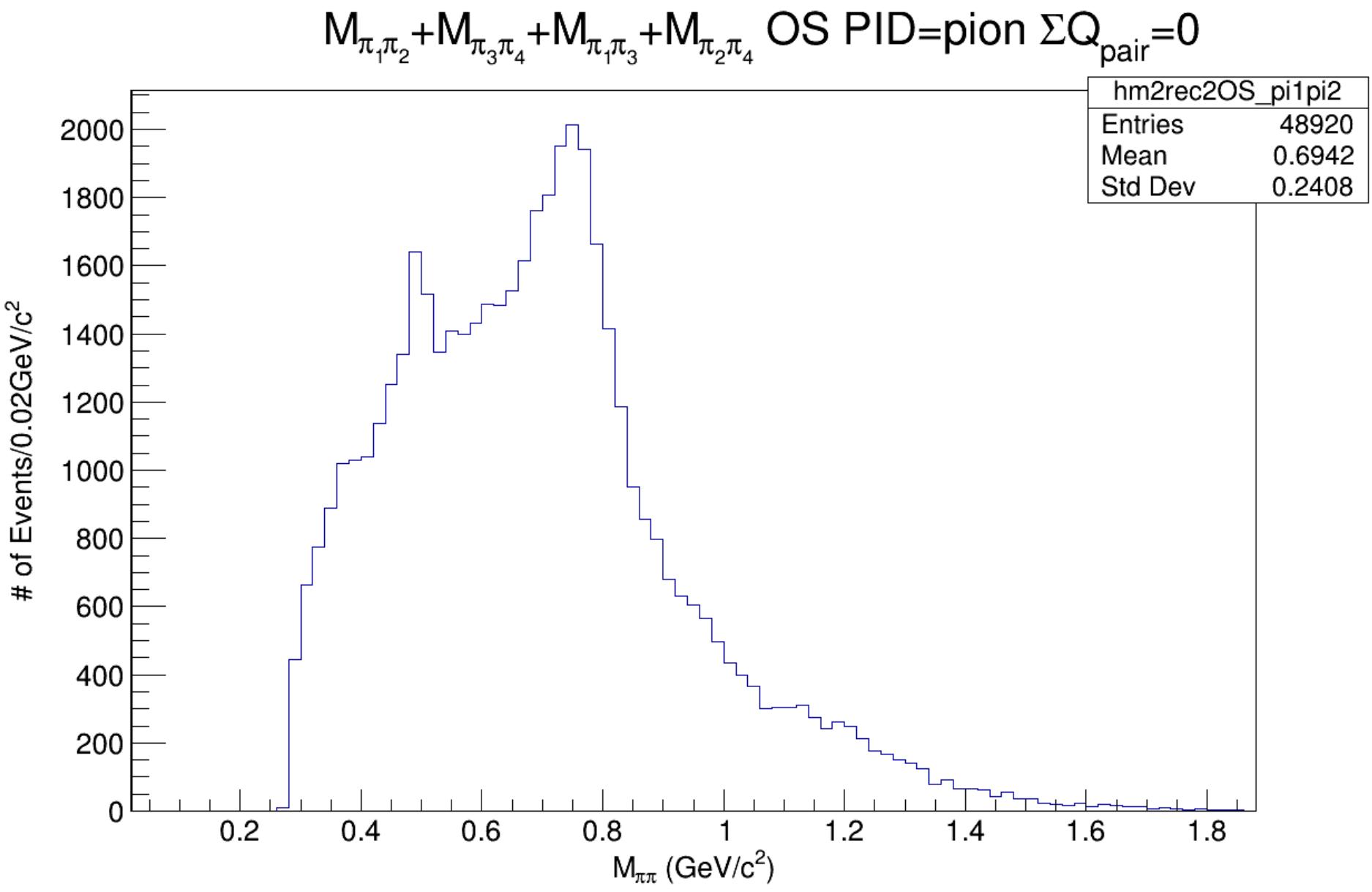
- new logic for the 4 pions mass distributions:
  ordering the pions by its momentum for the
  pair mass distributions (to do)

- using PID

- 4-track 2015 sample

- displacements: finding V0 class code on TOTEM Twiki


$M_{\pi_1\pi_2}+M_{\pi_3\pi_4}+M_{\pi_1\pi_3}+M_{\pi_2\pi_4}$ OS PID=pion $\Sigma Q_{pair}=0$
hm2rec2OS_pi1pi2
Entries 48920
Mean 0.6942
Std Dev 0.2408
# of Events/0.02GeV/c^2
$M_{\pi\pi}$ (GeV/c^2)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8


$M_{\pi_1\pi_2}+M_{\pi_3\pi_4}+M_{\pi_1\pi_3}+M_{\pi_2\pi_4}$ OS PID=pion $\Sigma Q_{pair}=0$
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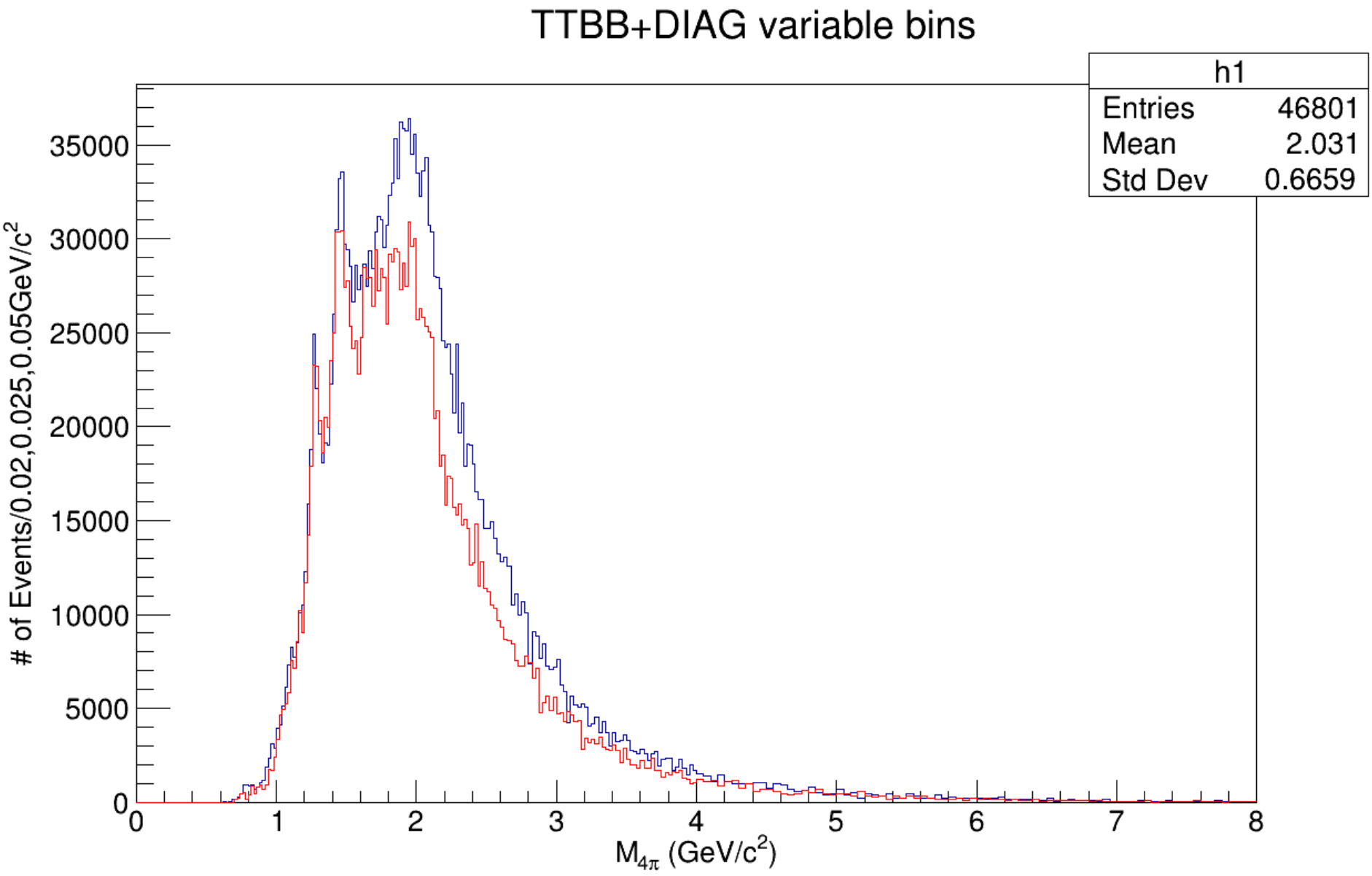
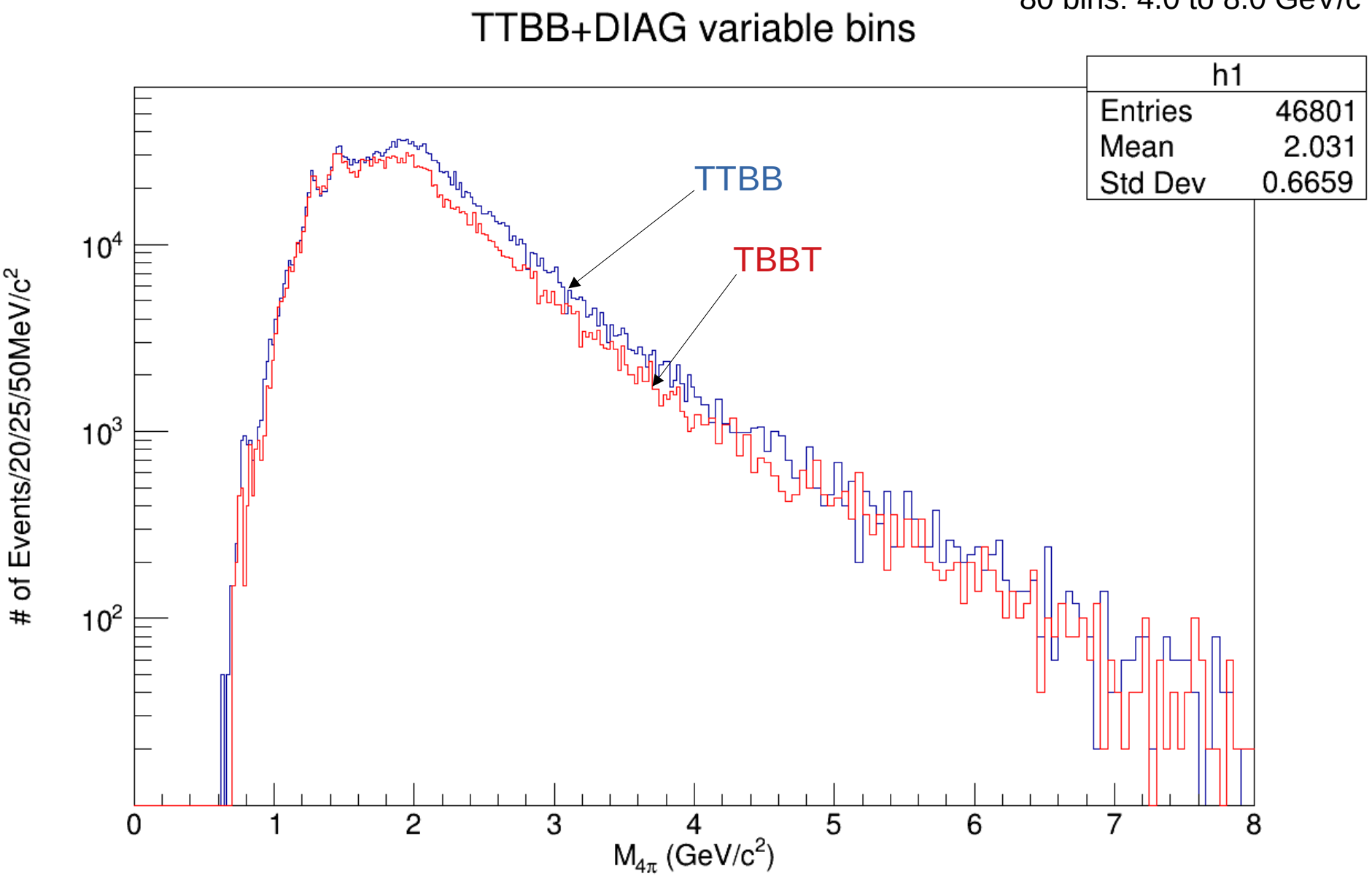
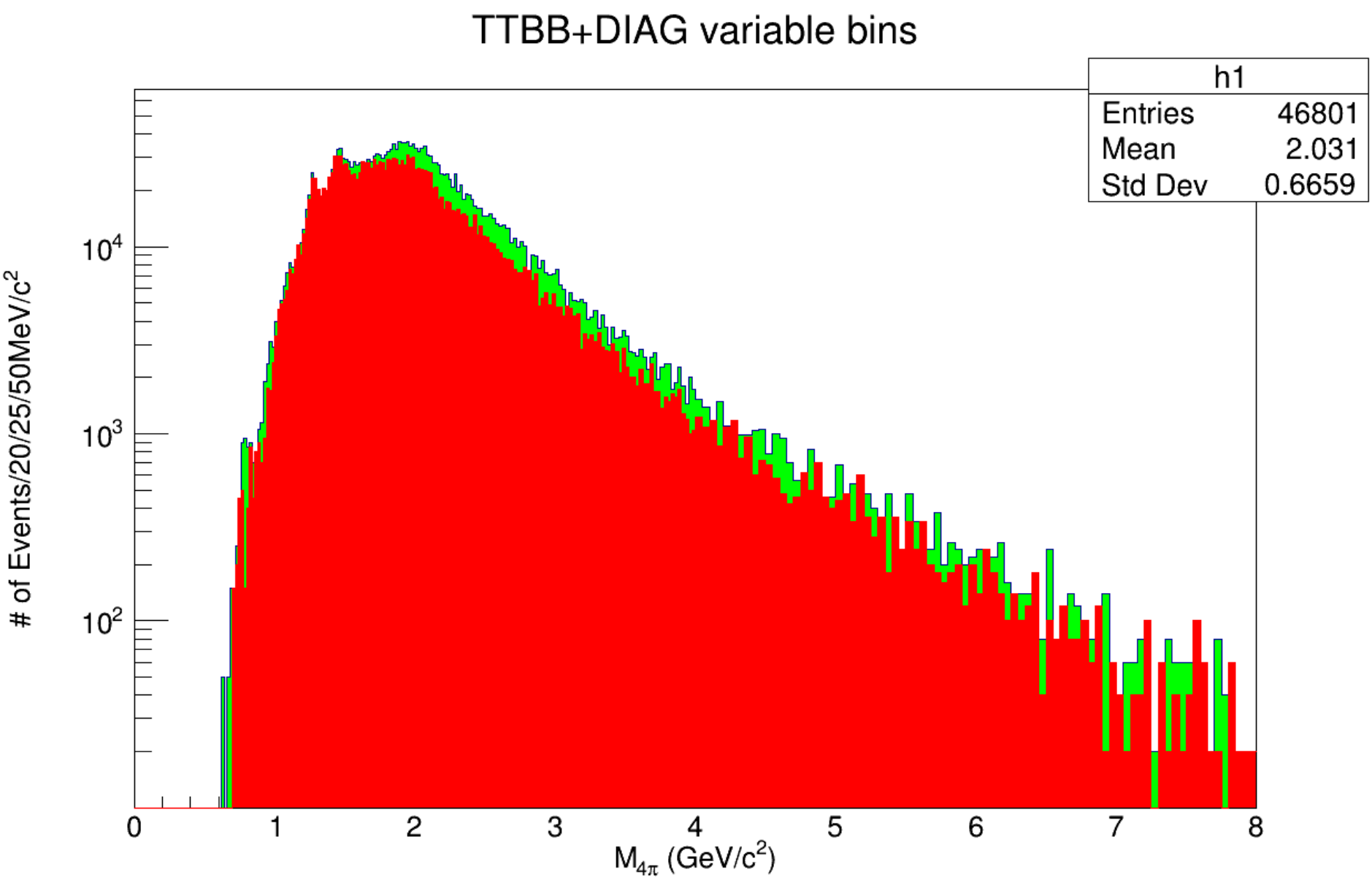
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

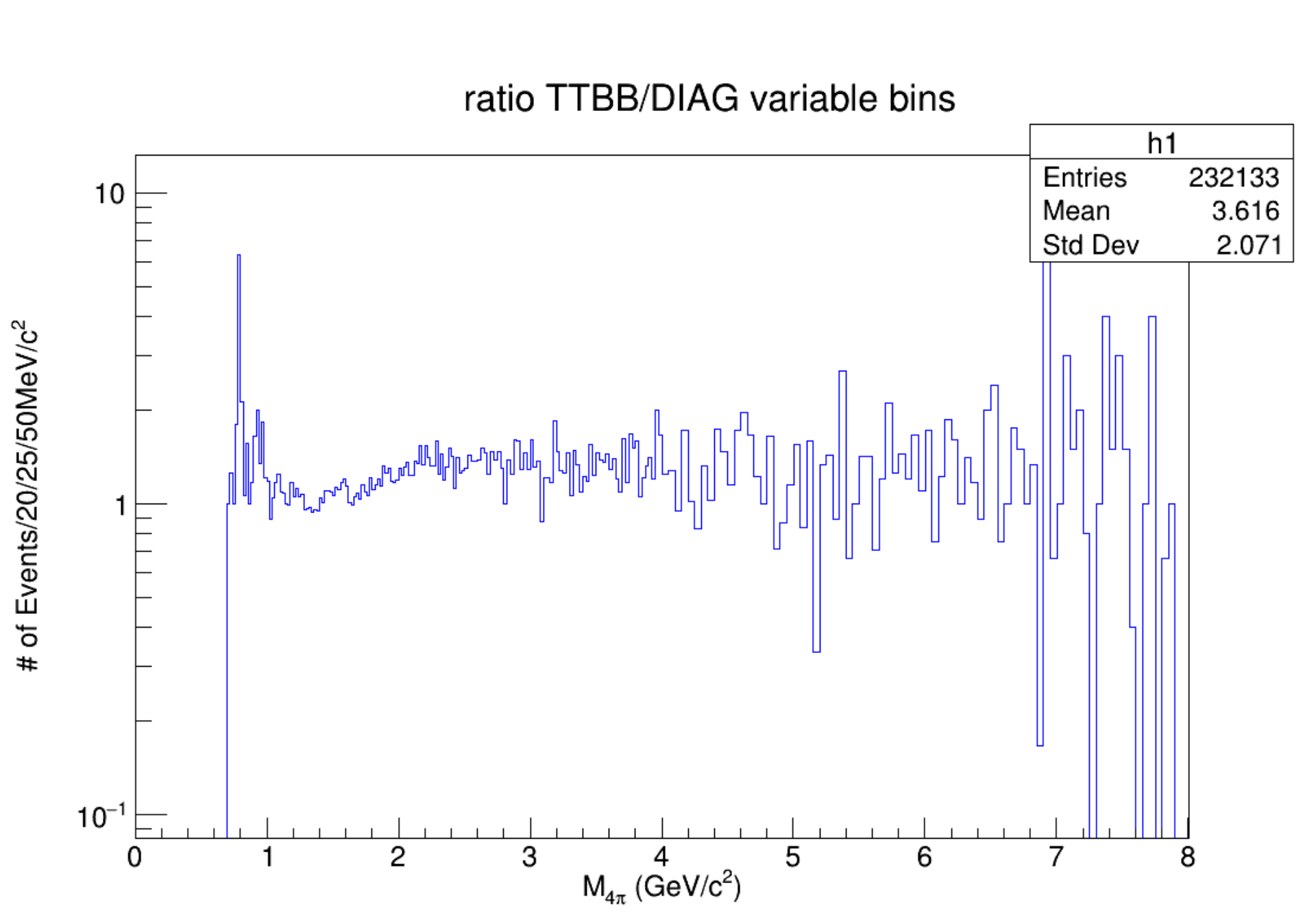

TTBB+DIAG variable bins
h1
Entries 46801
Mean 2.031
Std Dev 0.6659
# of Events/0.02,0.025,0.05GeV/c^2
$M_{4\pi}$ (GeV/c^2)
0
5000
10000
15000
20000
25000
30000
35000
0
1
2
3
4
5
6
7
8

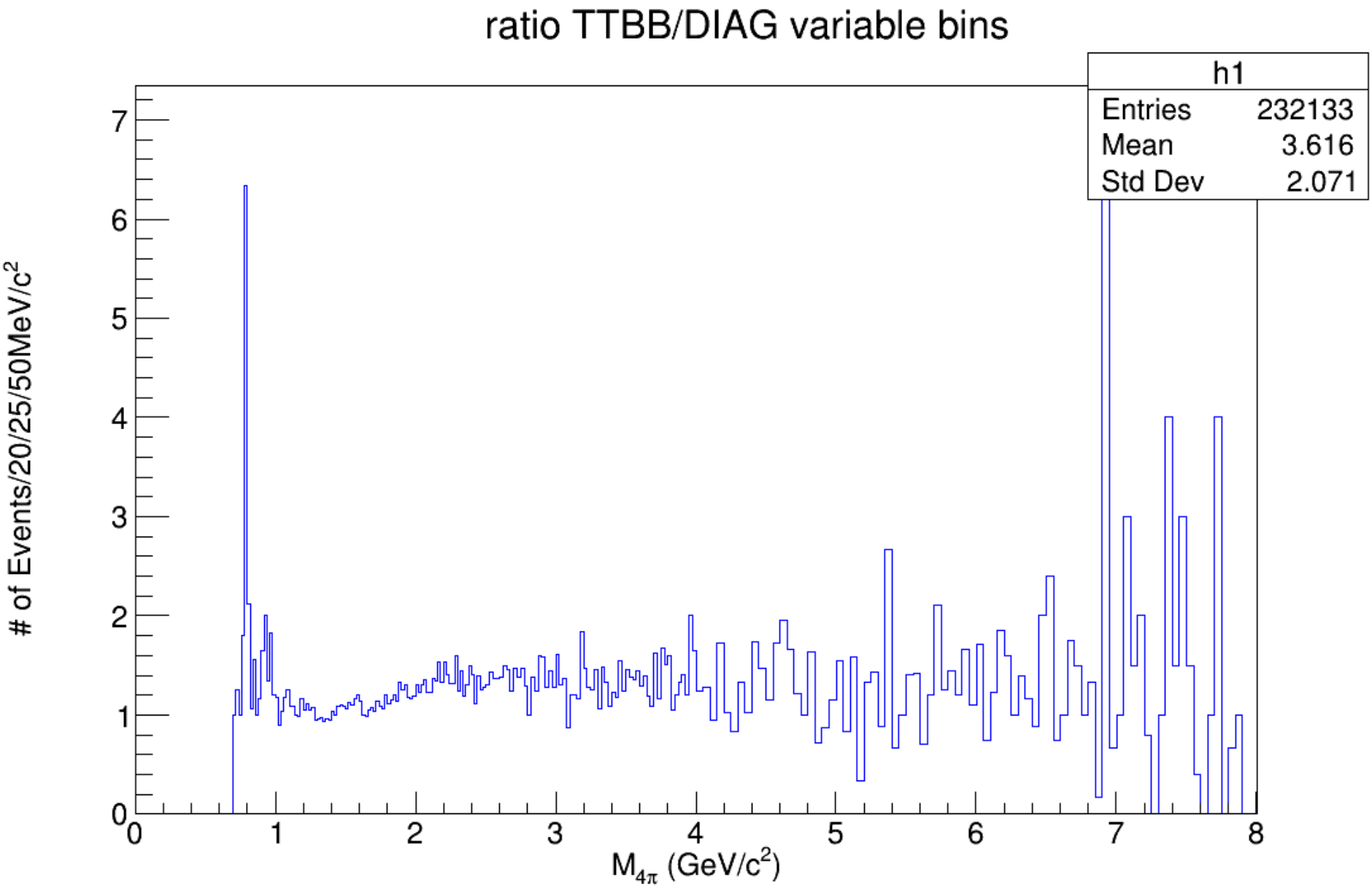
cut 2, Q=0

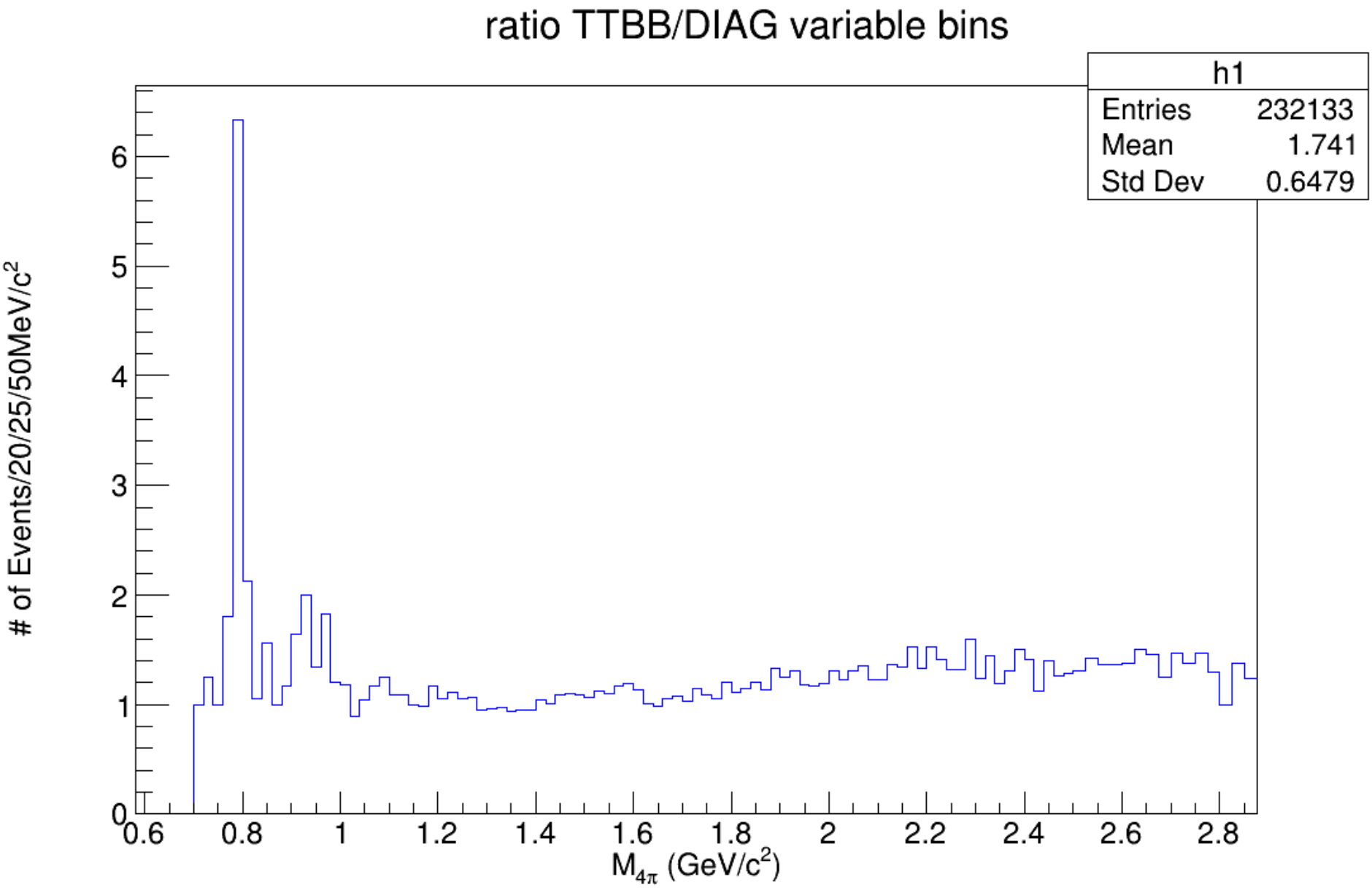
125 bins: 0.0 to 2.5 GeV/c²
60 bins: 2.5 to 4.0 GeV/c²
80 bins: 4.0 to 8.0 GeV/c²

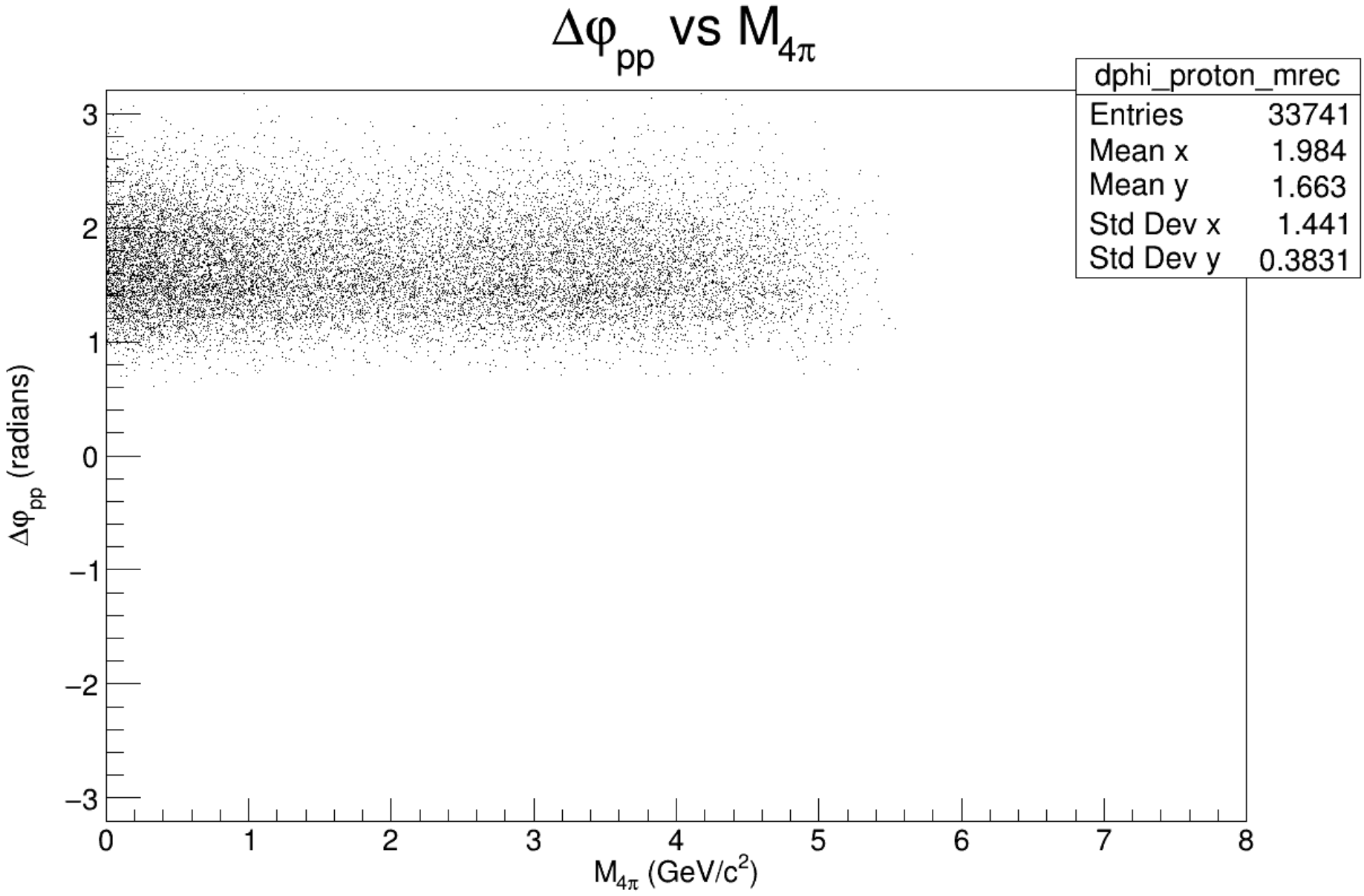


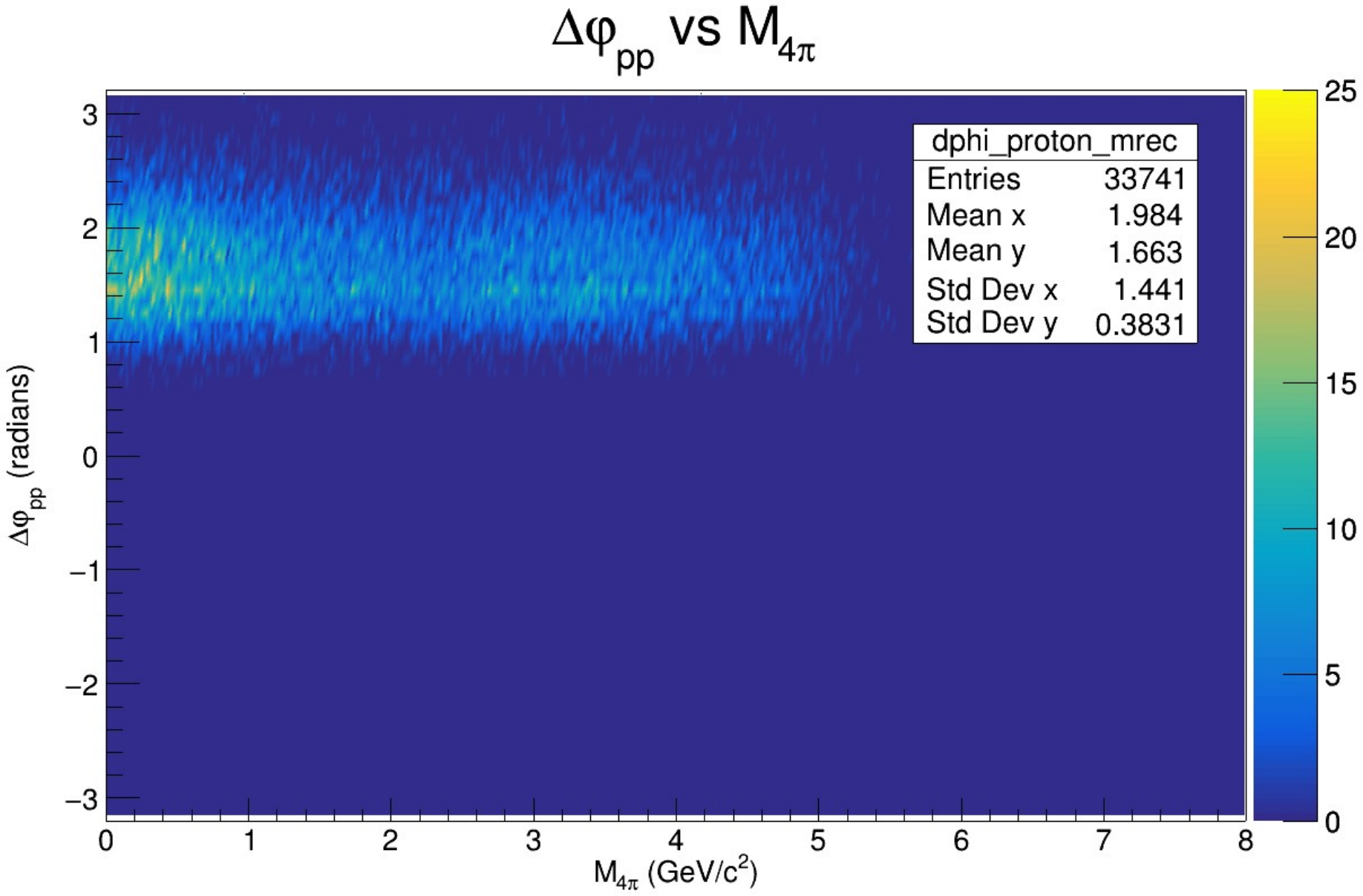

TTBB+DIAG variable bins
h1
Entries 46801
Mean 2.031
Std Dev 0.6659
# of Events/20/25/50MeV/c²
10⁴
10³
10²
0
1
2
3
4
5
6
7
8
M4π (GeV/c²)

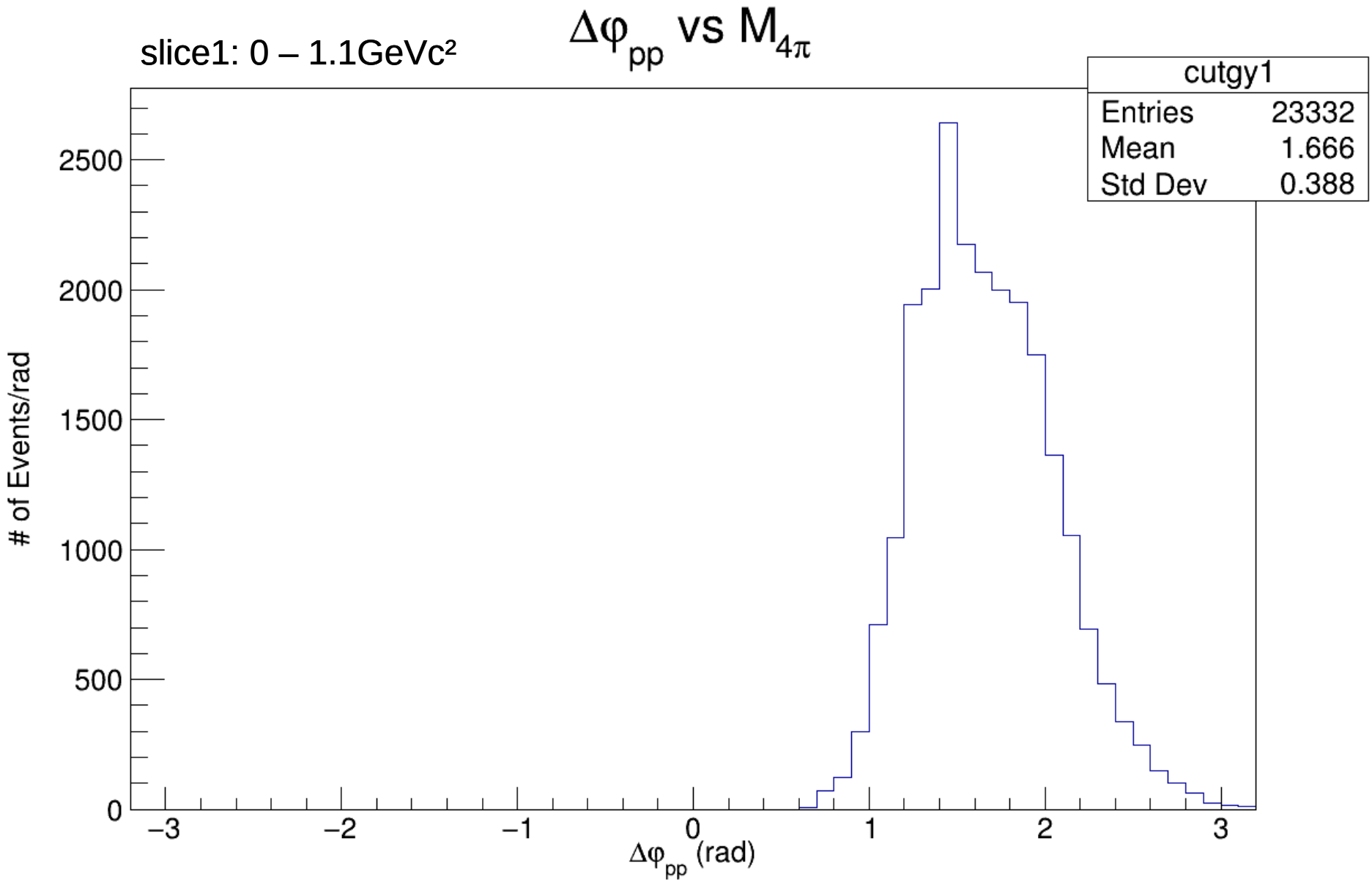

ratio TTBB/DIAG variable bins
h1
Entries 232133
Mean 3.616
Std Dev 2.071
# of Events/20/25/50MeV/c²
10
1
10⁻¹
0
1
2
3
4
5
6
7
8
M4π (GeV/c²)

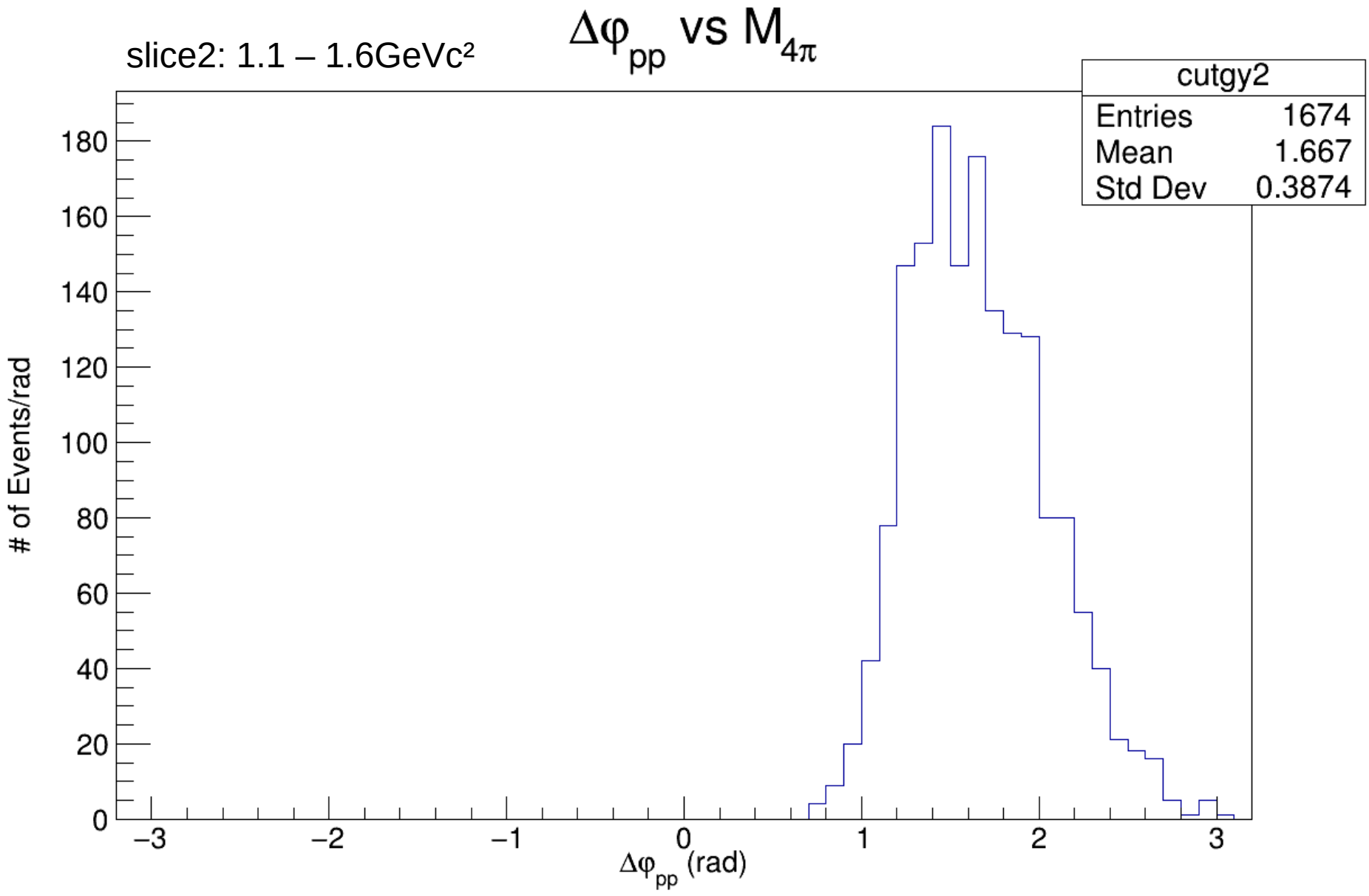

ratio TTBB/DIAG variable bins
h1
Entries 232133
Mean 3.616
Std Dev 2.071
# of Events/20/25/50MeV/c²
M4π (GeV/c²)
0
1
2
3
4
5
6
7
8

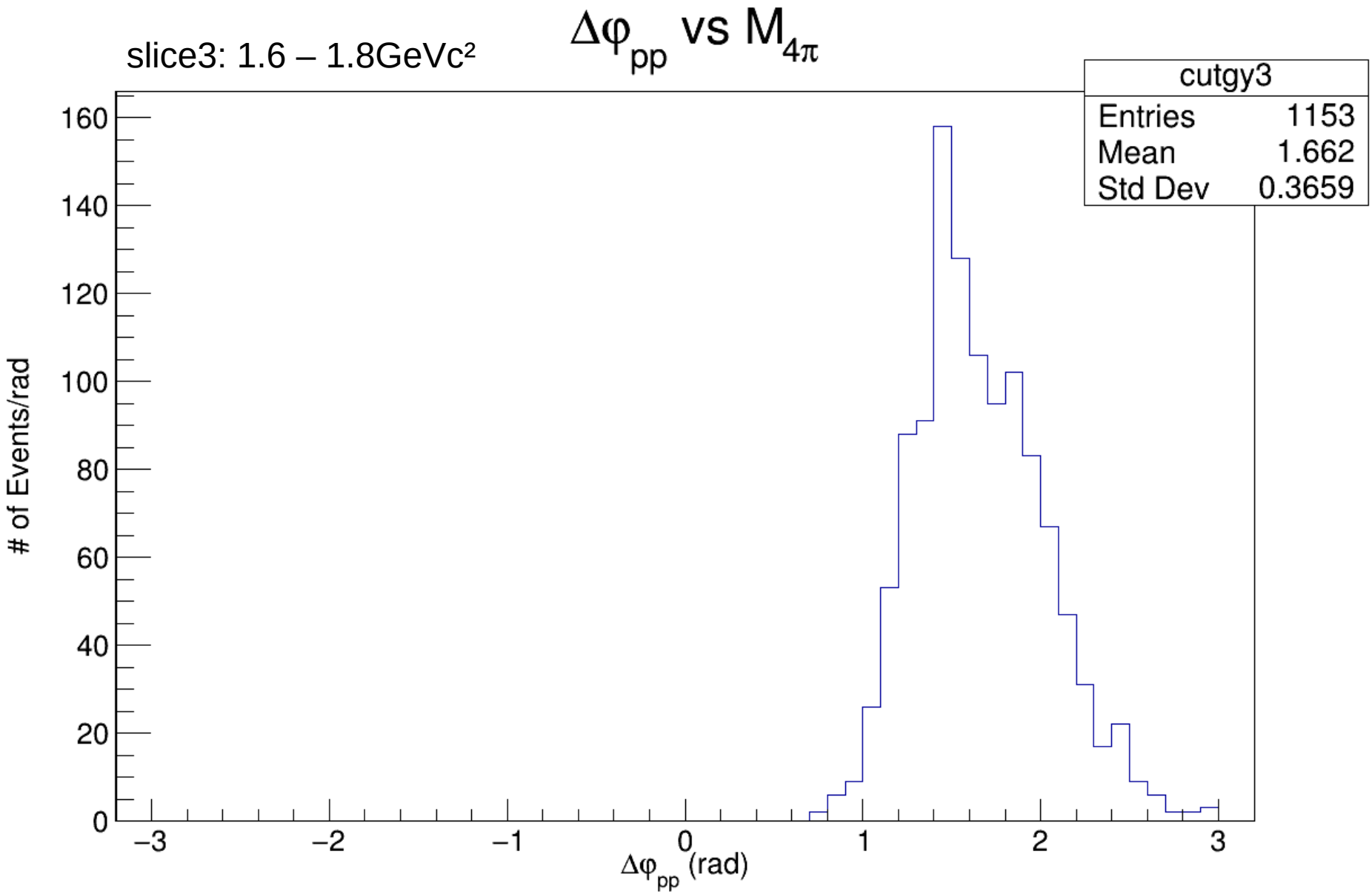

ratio TTBB/DIAG variable bins
h1
Entries 232133
Mean 1.741
Std Dev 0.6479
# of Events/20/25/50MeV/c²
M4π (GeV/c²)
0
1
2
3
4
5
6
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8

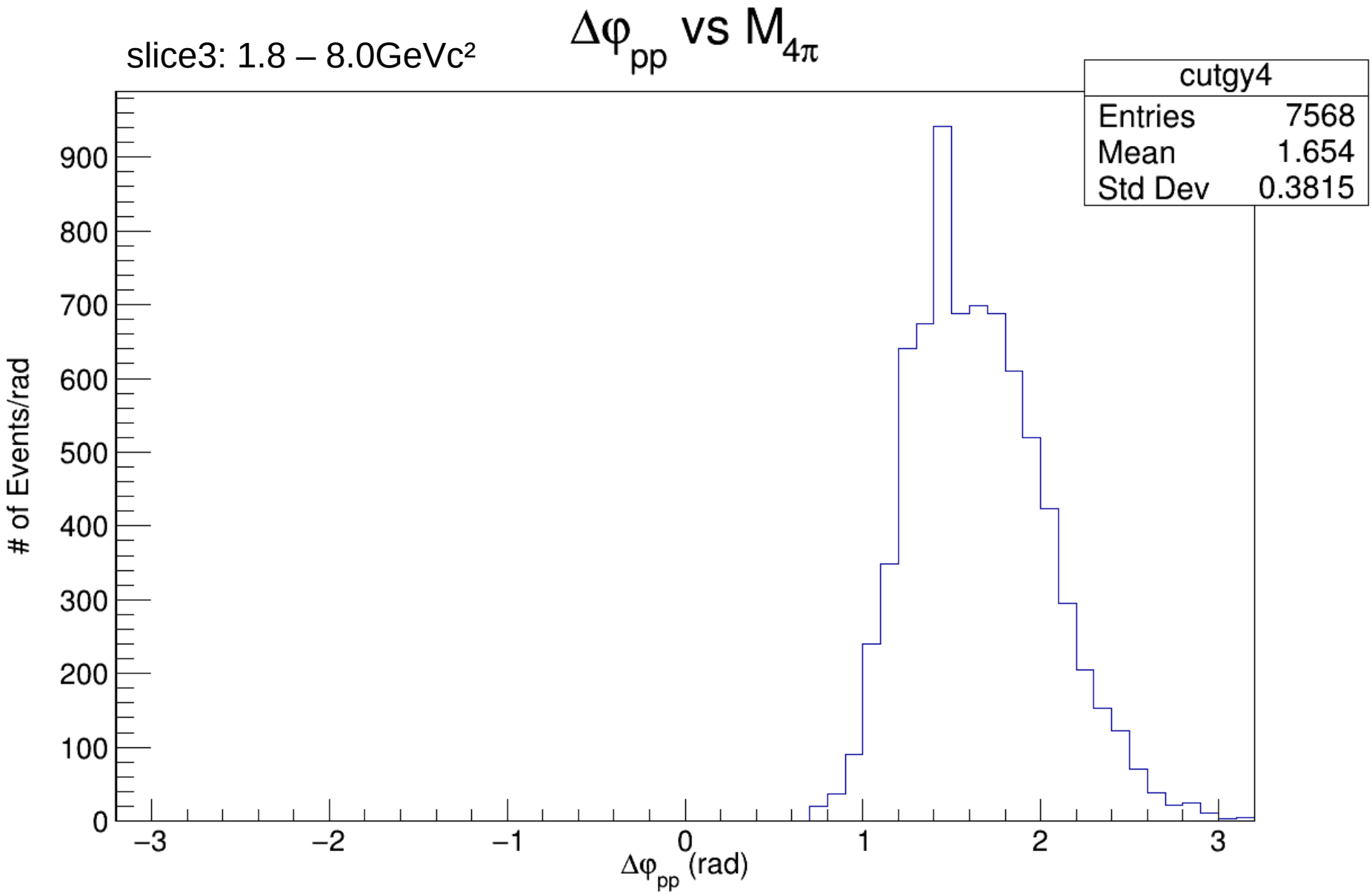

$\Delta\varphi_{pp}$ vs $M_{4\pi}$
dphi_proton_mrec
Entries 33741
Mean x 1.984
Mean y 1.663
Std Dev x 1.441
Std Dev y 0.3831
$\Delta\varphi_{pp}$ (radians)
$M_{4\pi}$ (GeV/c^2)
3
2
1
0
−1
−2
−3
0
1
2
3
4
5
6
7
8


$\Delta\varphi_{pp}$ vs $M_{4\pi}$
dphi_proton_mrec
Entries 33741
Mean x 1.984
Mean y 1.663
Std Dev x 1.441
Std Dev y 0.3831
$\Delta\varphi_{pp}$ (radians)
$M_{4\pi}$ (GeV/c^2)

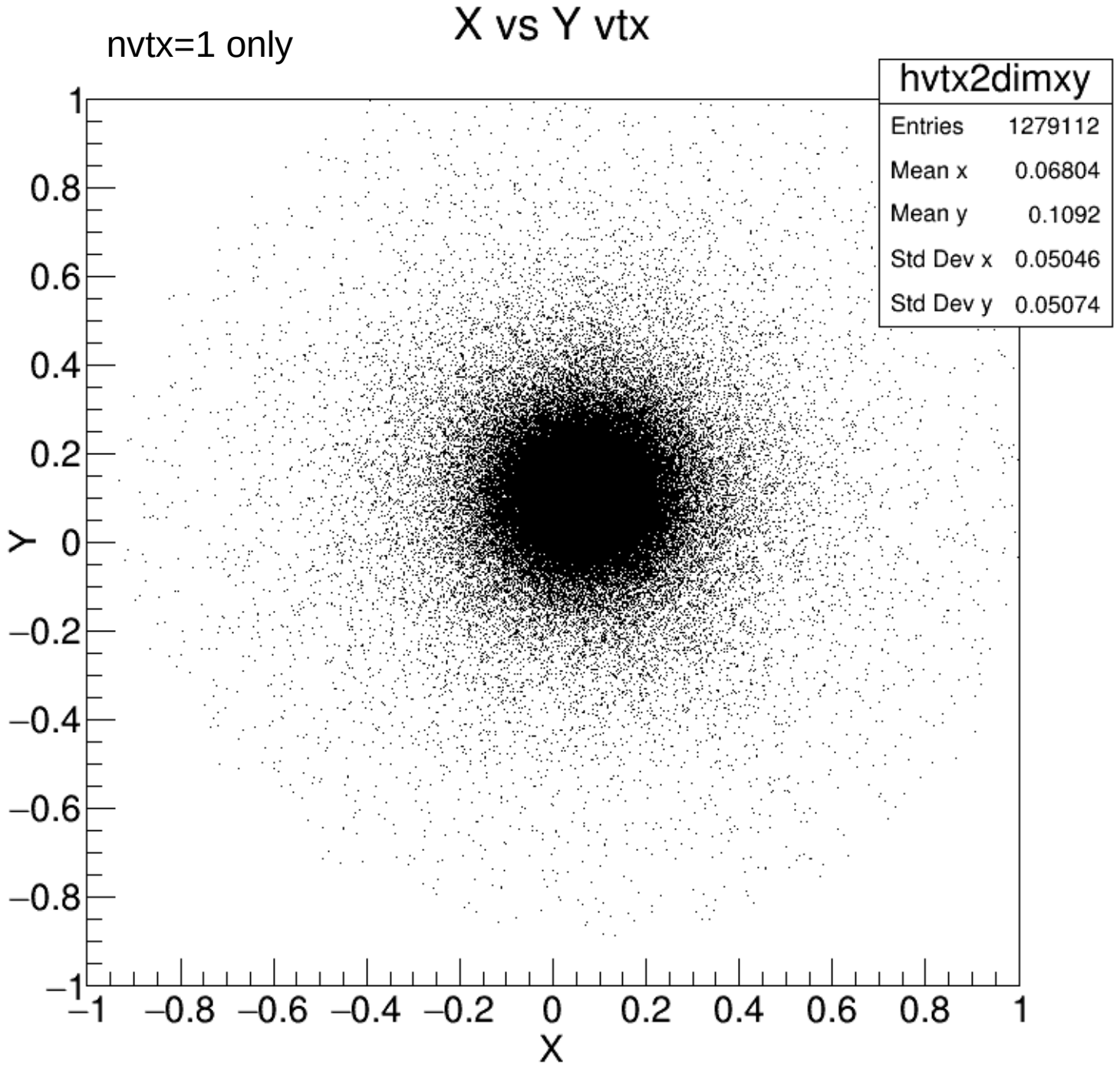

slice1: 0 – 1.1GeVc²
Δφpp vs M4π
cutgy1
Entries 23332
Mean 1.666
Std Dev 0.388
# of Events/rad
2500
2000
1500
1000
500
0
−3
−2
−1
0
1
2
3
Δφpp (rad)


slice2: 1.1 – 1.6GeVc²
Δφpp vs M4π
cutgy2
Entries 1674
Mean 1.667
Std Dev 0.3874
# of Events/rad
Δφpp (rad)
0
20
40
60
80
100
120
140
160
180
−3
−2
−1
0
1
2
3

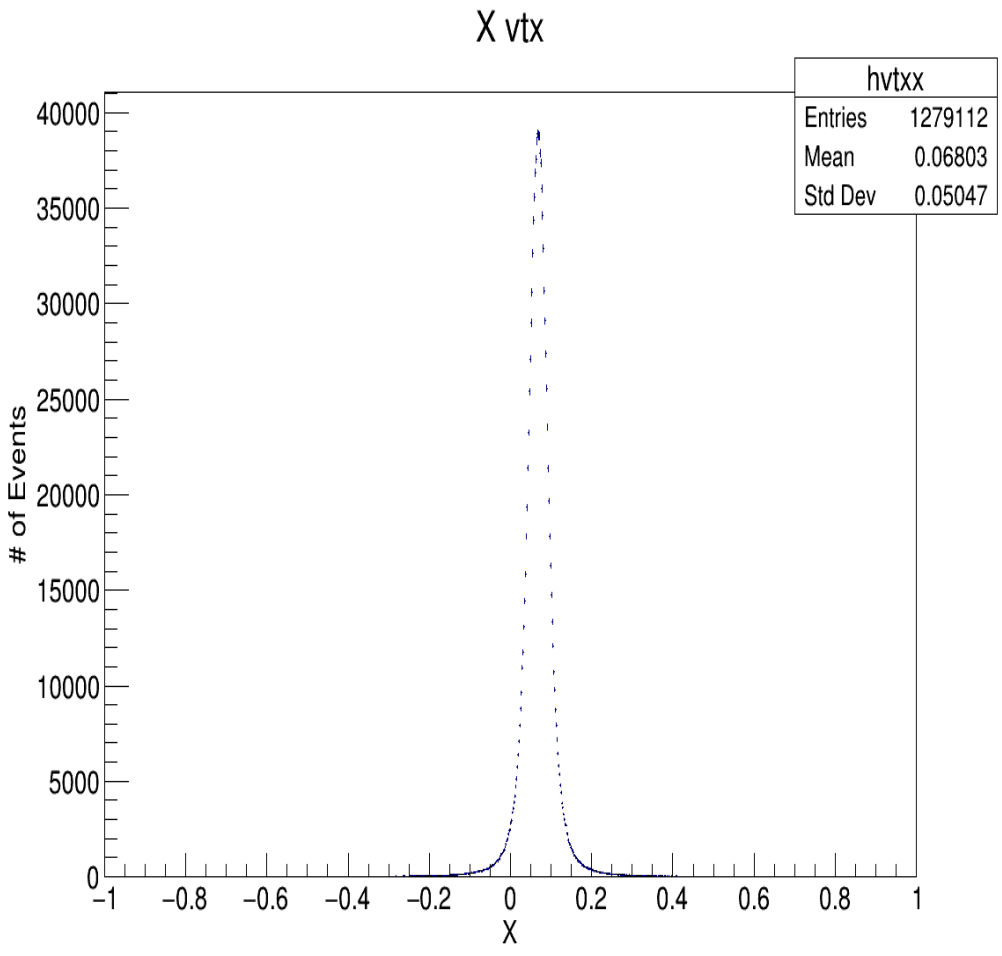

slice3: 1.6 – 1.8GeVc²
Δφpp vs M4π
cutgy3
Entries 1153
Mean 1.662
Std Dev 0.3659
# of Events/rad
Δφpp (rad)
0
20
40
60
80
100
120
140
160
−3
−2
−1
0
1
2
3

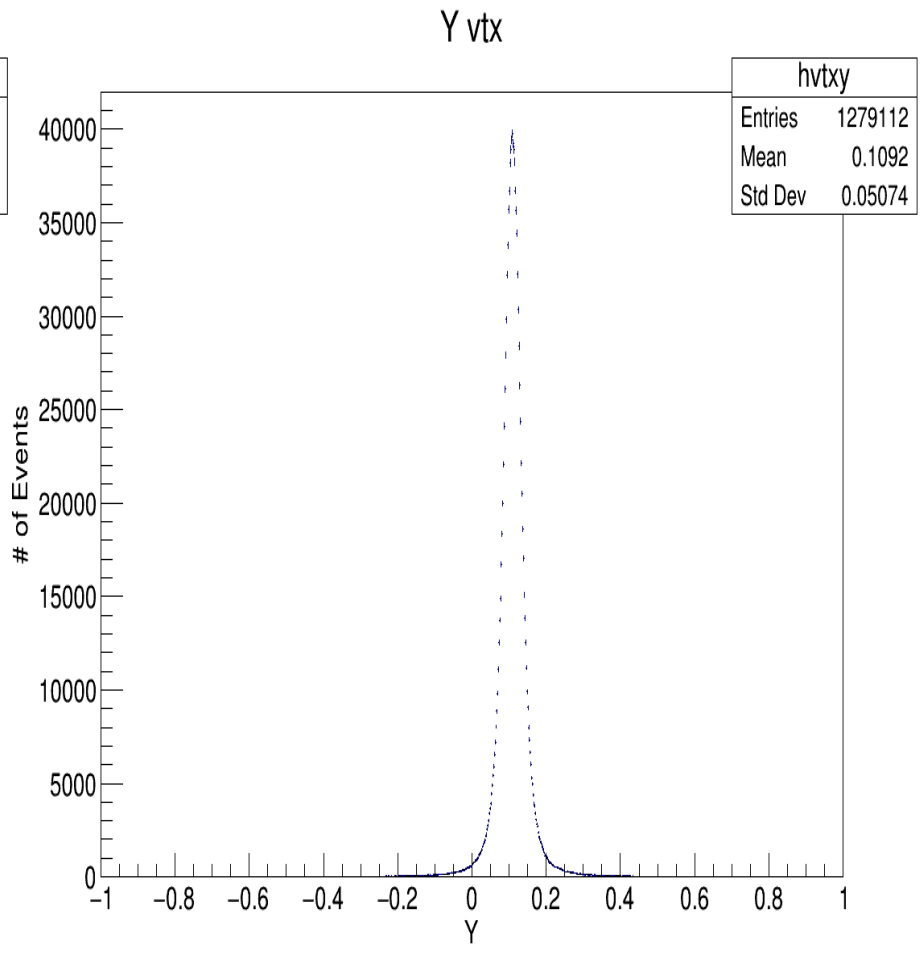

slice3: 1.8 – 8.0GeVc²
Δφpp vs M4π
cutgy4
Entries 7568
Mean 1.654
Std Dev 0.3815
# of Events/rad
Δφpp (rad)
0
100
200
300
400
500
600
700
800
900
−3
−2
−1
0
1
2
3

nvtx=1 only

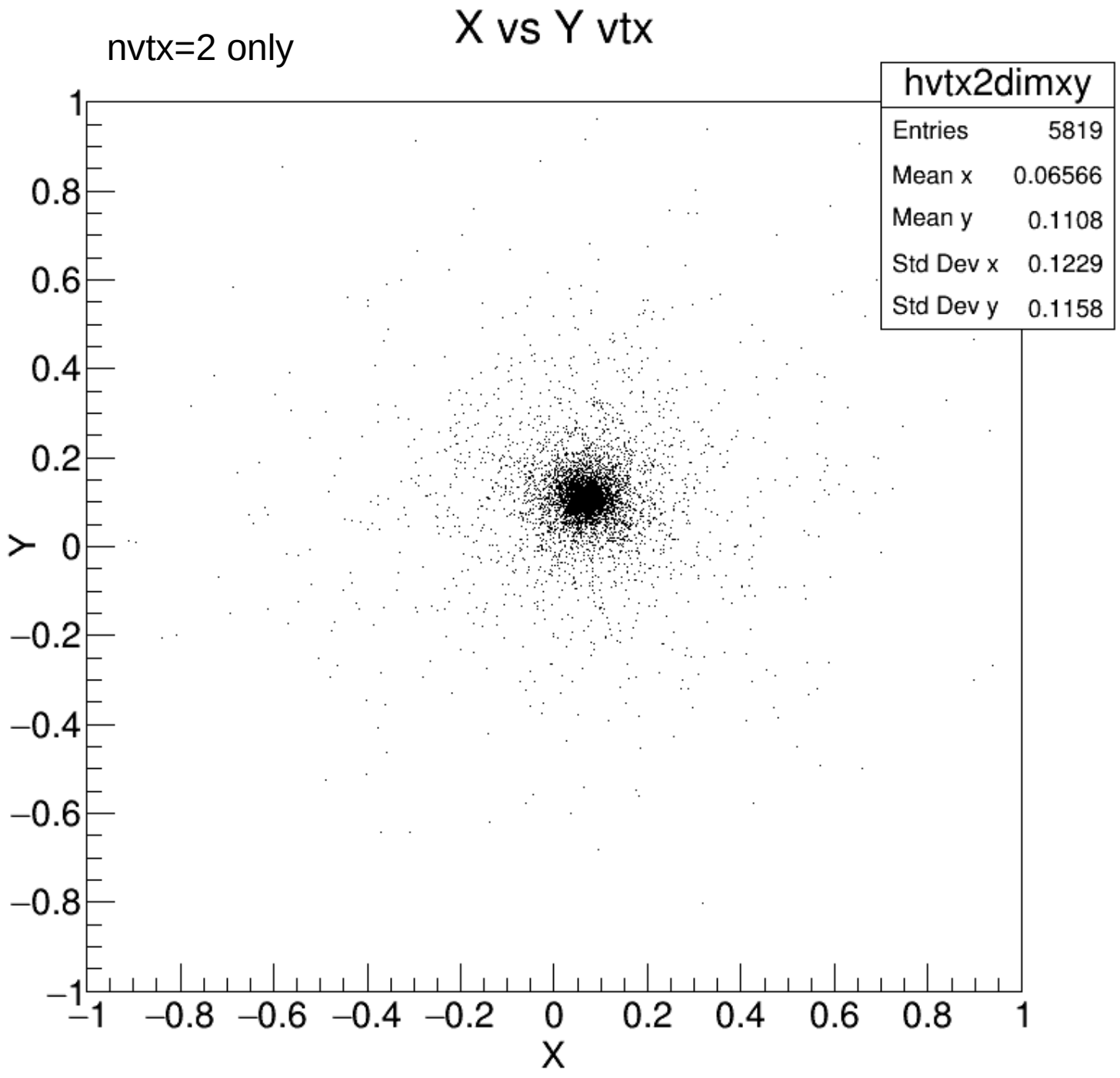

X vs Y vtx
hvtx2dimxy
Entries 1279112
Mean x 0.06804
Mean y 0.1092
Std Dev x 0.05046
Std Dev y 0.05074
Y
X
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1 −0.8 −0.6 −0.4 −0.2 0 0.2 0.4 0.6 0.8 1

nvtx=1 only

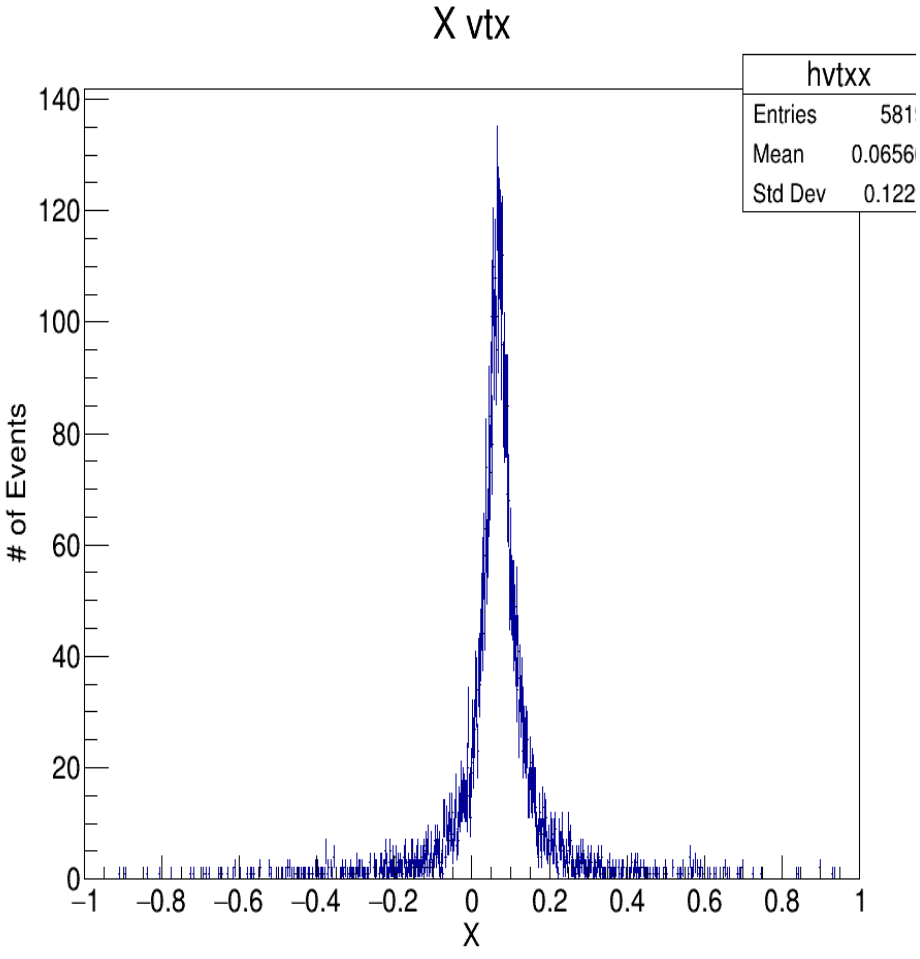

X vtx
hvtxx
Entries 1279112
Mean 0.06803
Std Dev 0.05047
# of Events
X
40000
35000
30000
25000
20000
15000
10000
5000
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

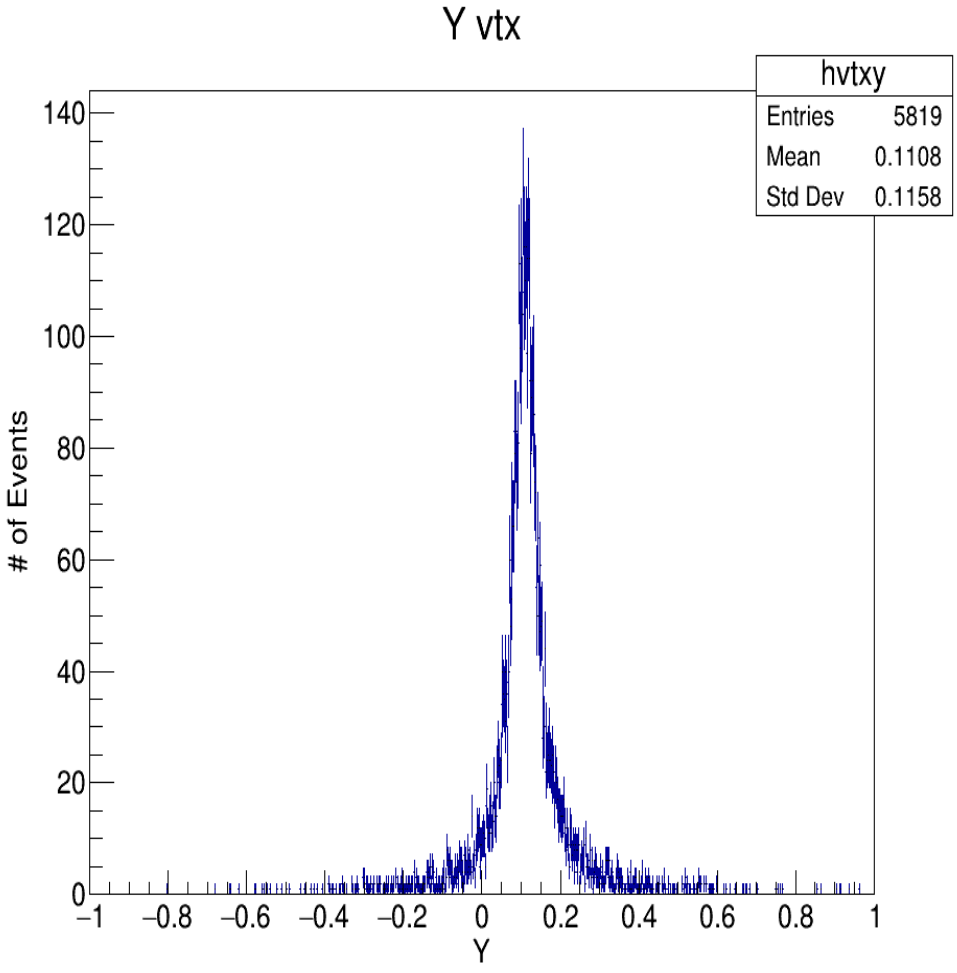

Y vtx
hvtxy
Entries 1279112
Mean 0.1092
Std Dev 0.05074
# of Events
Y
40000
35000
30000
25000
20000
15000
10000
5000
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

nvtx=2 only


X vs Y vtx
hvtx2dimxy
Entries 5819
Mean x 0.06566
Mean y 0.1108
Std Dev x 0.1229
Std Dev y 0.1158
Y
X
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1 −0.8 −0.6 −0.4 −0.2 0 0.2 0.4 0.6 0.8 1

nvtx=2 only


X vtx
hvtxx
Entries 581
Mean 0.0656
Std Dev 0.122
# of Events
X
140
120
100
80
60
40
20
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1


Y vtx
hvtxy
Entries 5819
Mean 0.1108
Std Dev 0.1158
# of Events
Y
140
120
100
80
60
40
20
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

need to do:

momenta px and py correlated to x and y vertices
for the central peaks and wings !

Plot a 2D x-y plot and the two 1D projections of the transverse position of that vertex:
1. Do that for the class where it said there was one vertex, and where it said there were two.
2. Do that for the events where you had a good px,py match, in the peaks and separately for the events outside those peaks in the wings.

We want to understand whether the events outside the central peaks are non-exclusive background (missing particles) or pile-up. (Not likely to be a bad track measurement I think).

to do:

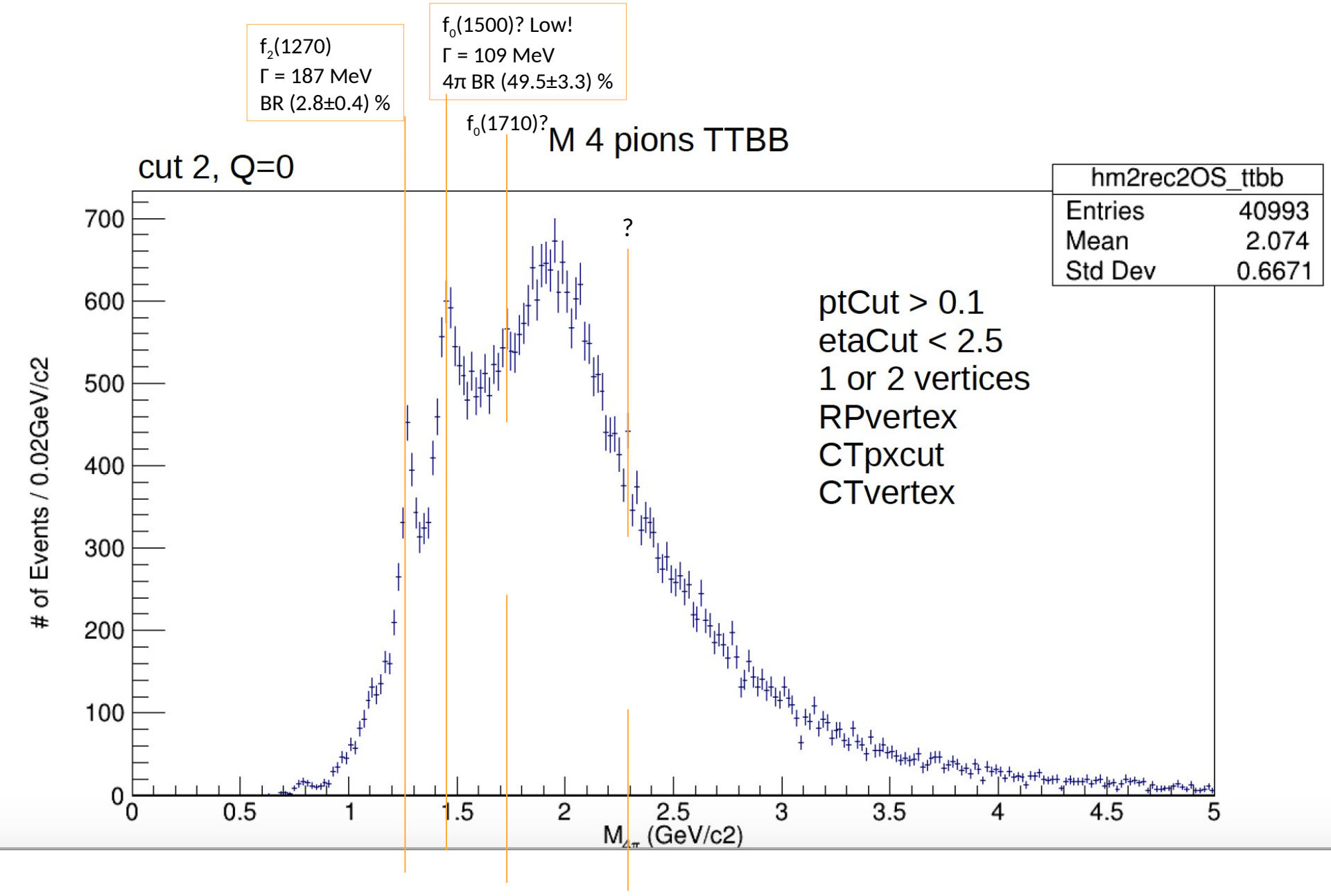
1. fits

2. t1 and t2

3. slices of delta_phi

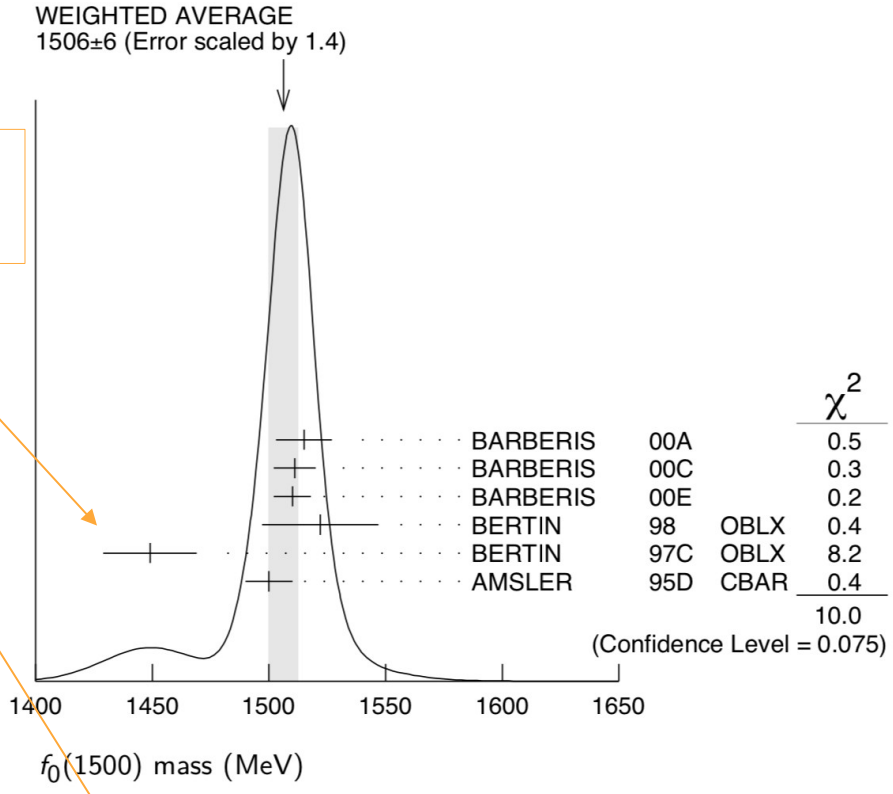
4. pt = sqrt(px^2+py^2)

from here I will keep Mike’s slides


f2(1270)
Γ = 187 MeV
BR (2.8±0.4) %
f0(1500)? Low!
Γ = 109 MeV
4π BR (49.5±3.3) %
f0(1710)?
M 4 pions TTBB
cut 2, Q=0
hm2rec2OS_ttbb
Entries 40993
Mean 2.074
Std Dev 0.6671
?
ptCut > 0.1
etaCut < 2.5
1 or 2 vertices
RPvertex
CTpxcut
CTvertex
# of Events / 0.02GeV/c2
M4π (GeV/c2)

From PDG 2018 big book on f0(1500)

Is this a bad measurement or a different state?



1505	±15	[18] AMSLER	95C	CBAR	0.0 $\bar{p}p \rightarrow \eta\eta\pi^0$
1445	± 5	[19] ANTINORI	95	OMEG	300,450 $pp \rightarrow pp2(\pi^+\pi^-)$
1497	±30	[11] ANTINORI	95	OMEG	300,450 $pp \rightarrow pp\pi^+\pi^-$
~ 1505		BUGG	95	MRK3	$J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$
1446	± 5	[11] ABATZIS	94	OMEG	450 $pp \rightarrow pp2(\pi^+\pi^-)$

Superceded by Antinori's later paper

Physics Letters B
Volume 353, Issue 4, 6 July 1995, Pages 589-594

A further study of the centrally produced $\pi^+\pi^-$ and $\pi^+\pi^-\pi^+\pi^-$ channels in pp interactions at 300 and 450 GeV/c

WA91 Collaboration, F. Antinori [d], D. Barberis [d], A. Bayes [c], W. Beusch [d], J.N. Carney [c], S. Clewer [c], J.P. Davies [c], D. Di Bari [b], C.J. Dodenhoff [c], D. Evans [c], D. Elia [b], R. Fini [b], B.R. French [d], B. Ghidini [b], A. Jacholkowski [d], J.B. Kinson [c], A. K [d] ... M.F. Votruba [c]

Abstract

An analysis of the centrally produced $\pi^+\pi^-$ and $\pi^+\pi^-\pi^+\pi^-$ mass spectra from the WA76 and WA91 experiments is presented, which shows that in the $\pi^+\pi^-\pi^+\pi^-$ channel there are two new states, the $f_0(1450)$ and $f_2(1900)$. There is another new state in the $\pi^+\pi^-$ channel with $M = 1497 \pm 30$ MeV and $\Gamma = 199 \pm 30$ MeV, which is compatible with the $f_0(1520)$ observed by the Crystal Barrel experiment. Another interpretation is discussed, where the 1450 and 1497 GeV structures are explained as being due to an interference effect between the $f_0(1365)$ and $f_0(1520)$.

Thanks for your kind help and attention !