Check with pi zero and photon cuts on three different samples

A sample of 100K following events generated.

$$B^+ \rightarrow K^+ \tau^- \mu^+$$
$$\tau^- \rightarrow \pi^- \nu_\tau$$

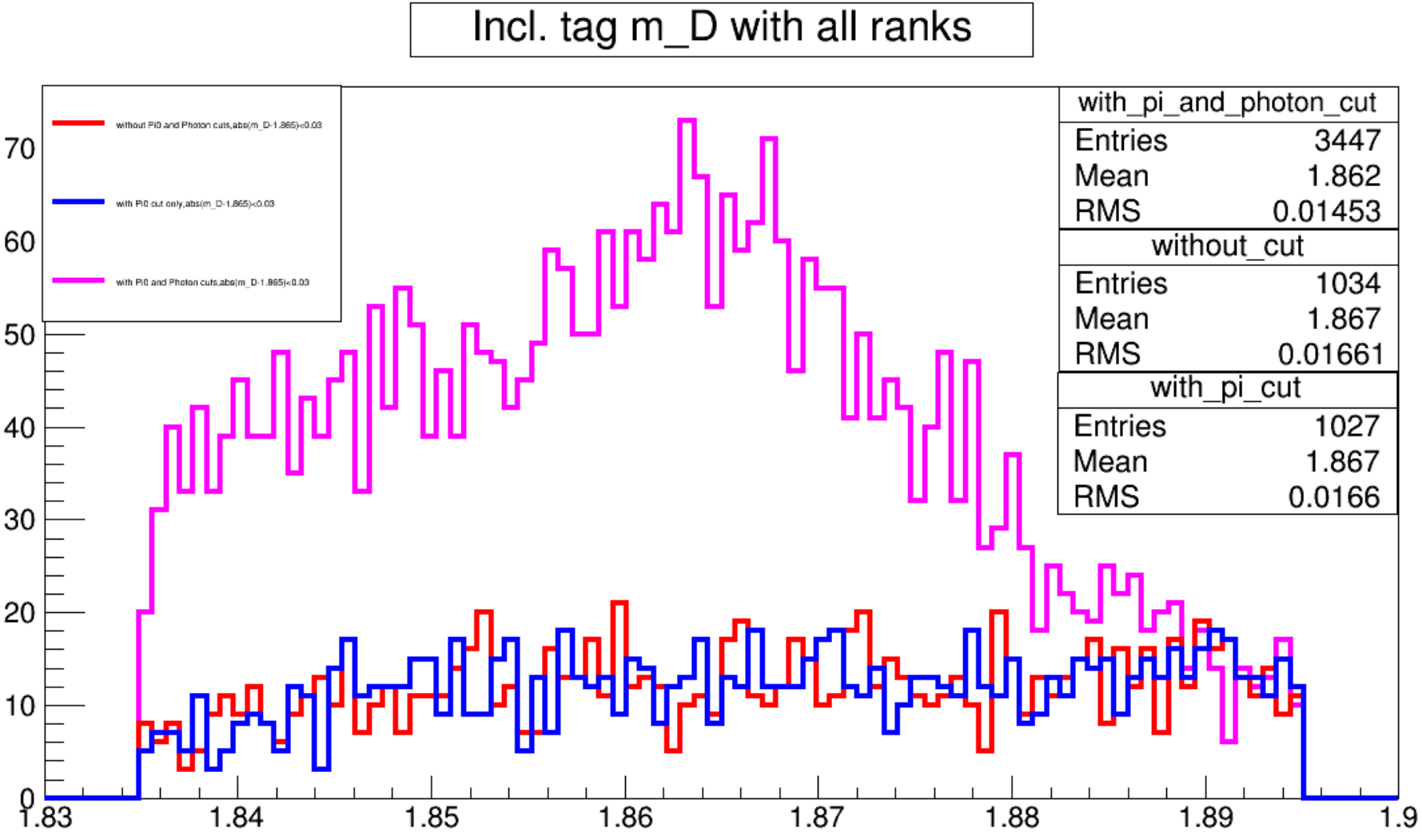
$$B^- \rightarrow D^0 \mu^- \bar{\nu}_\mu$$
$$D^0 \rightarrow K^- \pi^+ \pi^0$$

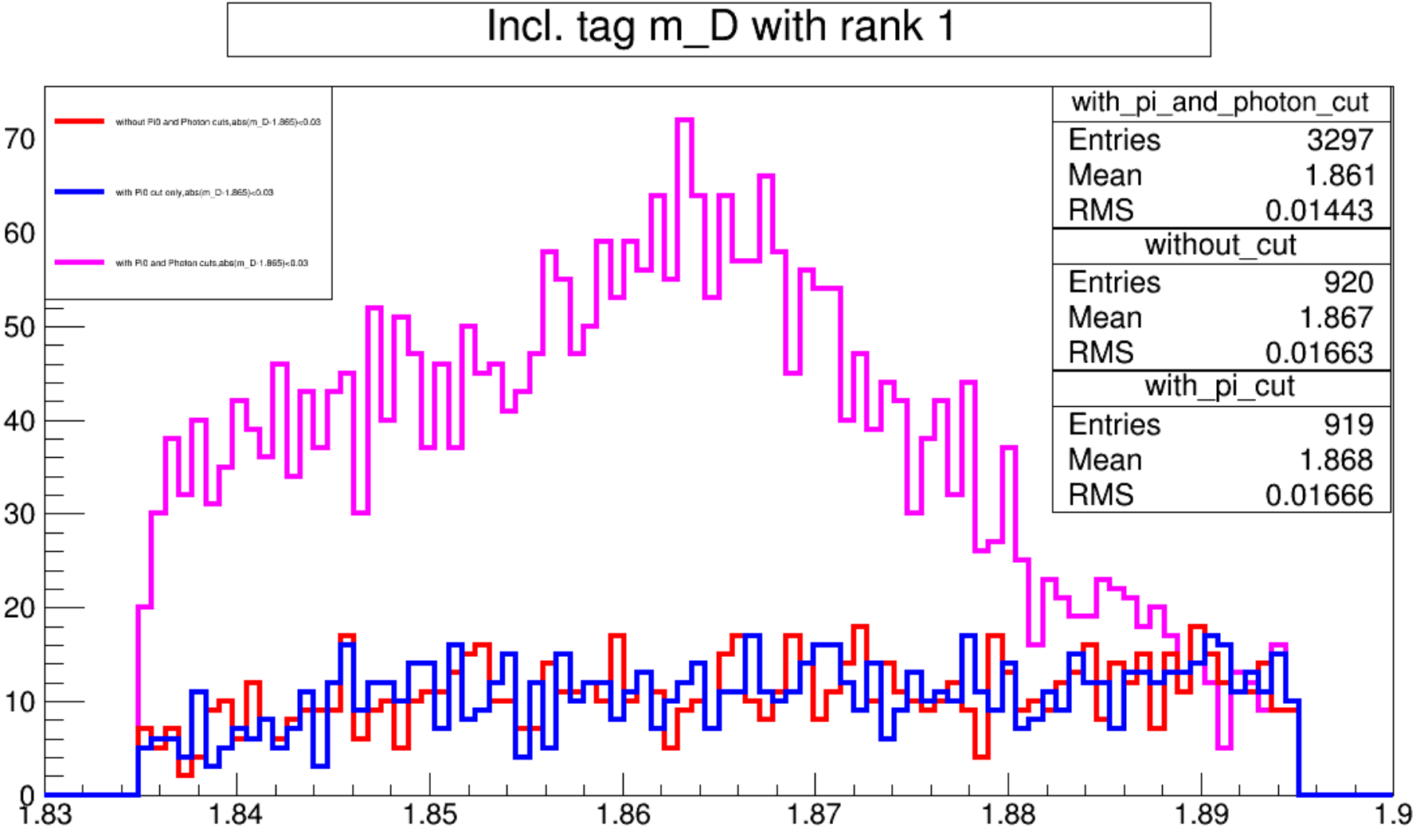
23/10/2023

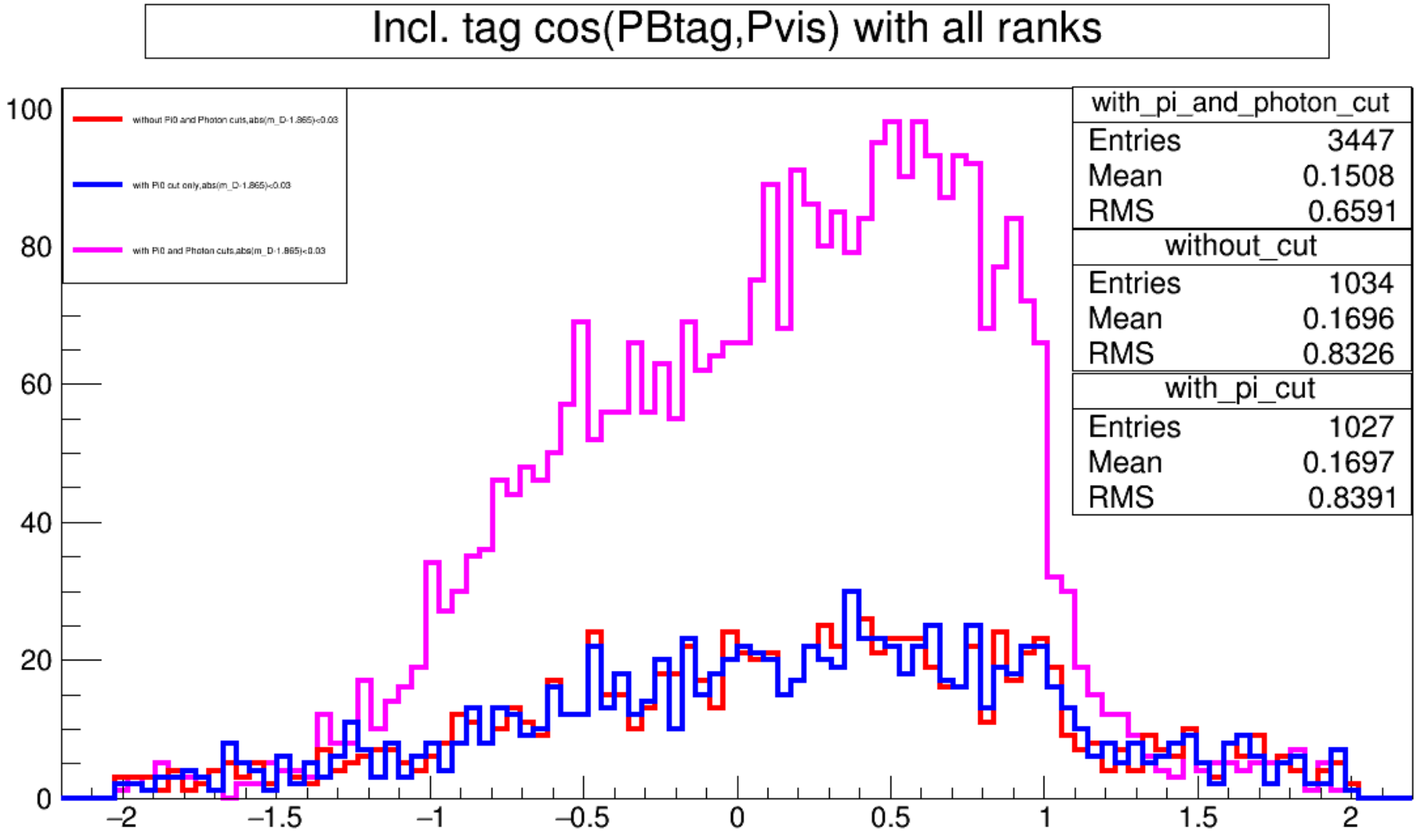
Pi zero and Photon cuts

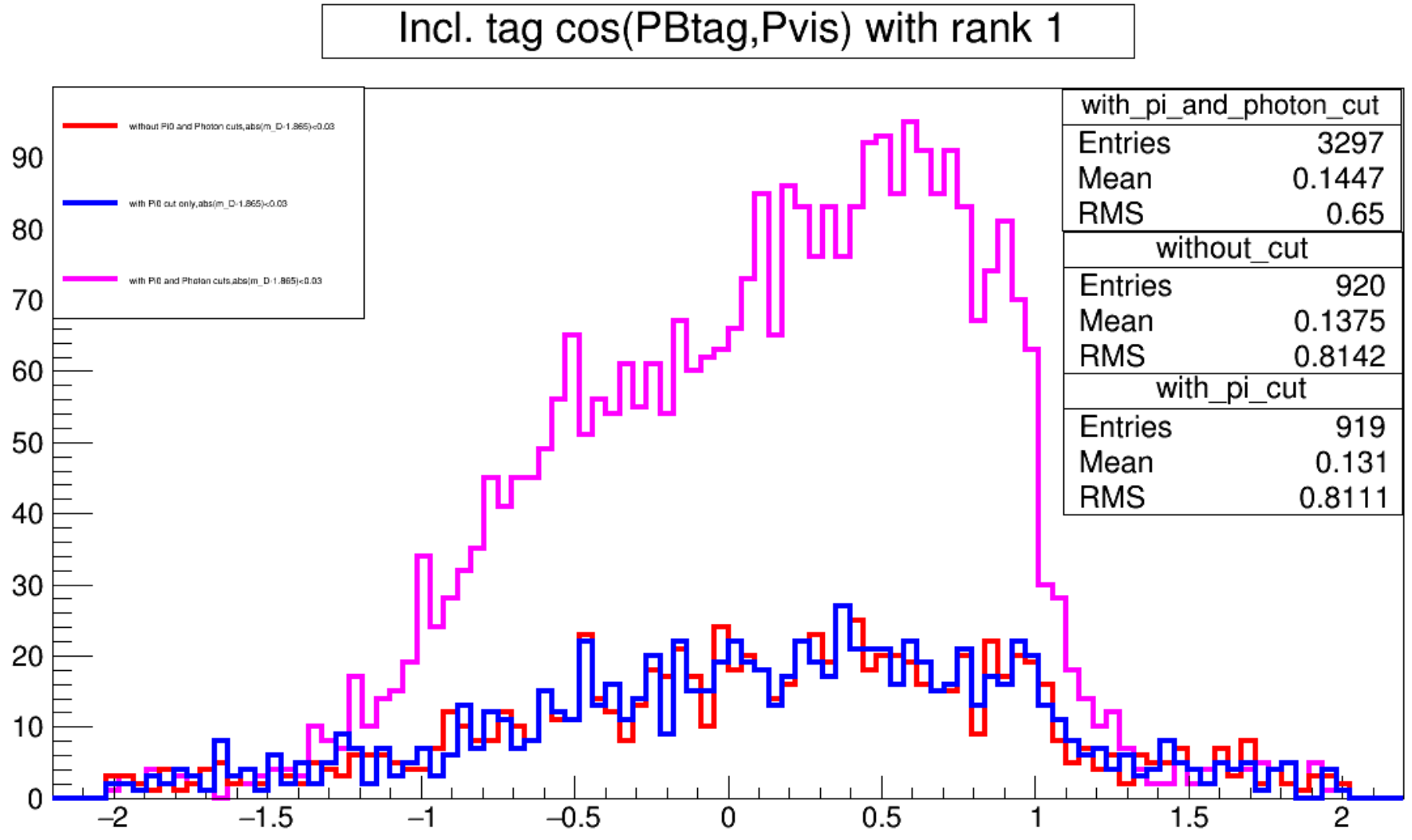
```
photon_cut = \
'passesCut( -0.75 < cosTheta <= 0.50 and E > 0.100) or \
 passesCut(  0.50 < cosTheta <= 0.60 and E > 0.160) or \
 passesCut(  0.60 < cosTheta <= 0.70 and E > 0.180) or \
 passesCut(  0.70 < cosTheta < 0.85 and E > 0.200)'
```

```
# pi0 selection

gamma1_cut = 'passesCut( -1.00 < daughter(0, cosTheta) <= -0.63 and daughter(0, E) > 0.100 ) \
          or  passesCut( -0.63 < daughter(0, cosTheta) <=  0.85 and daughter(0, E) > 0.060 ) \
          or  passesCut(  0.85 < daughter(0, cosTheta) <   1.00 and daughter(0, E) > 0.120 )'

gamma2_cut = 'passesCut( -1.00 < daughter(1, cosTheta) <= -0.63 and daughter(1, E) > 0.100 ) \
          or  passesCut( -0.63 < daughter(1, cosTheta) <=  0.85 and daughter(1, E) > 0.060 ) \
          or  passesCut(  0.85 < daughter(1, cosTheta) <   1.00 and daughter(1, E) > 0.120 )'

pi0_cut = 'passesCut(' + gamma1_cut + ' ) and passesCut( ' + gamma2_cut + ' )'

applyCuts('pi0:mdst', cut=pi0_cut, path=mypath)
```

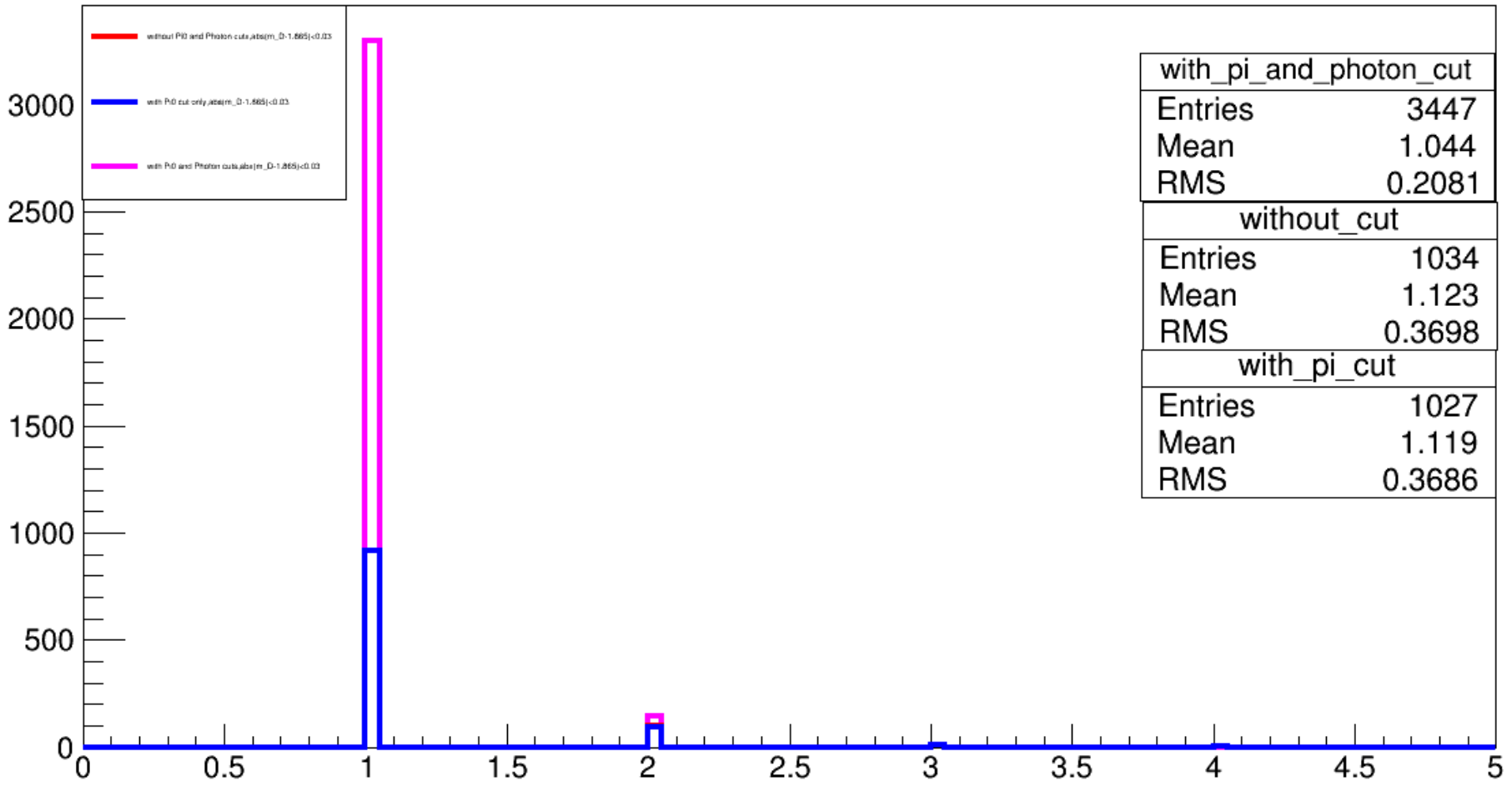

Incl. tag m_D with all ranks
without PI0 and Photon cuts,abs(m_D-1.865)<0.03
with PI0 cut only,abs(m_D-1.865)<0.03
with PI0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 3447
Mean 1.862
RMS 0.01453
without_cut
Entries 1034
Mean 1.867
RMS 0.01661
with_pi_cut
Entries 1027
Mean 1.867
RMS 0.0166
0
10
20
30
40
50
60
70
1.83
1.84
1.85
1.86
1.87
1.88
1.89
1.9

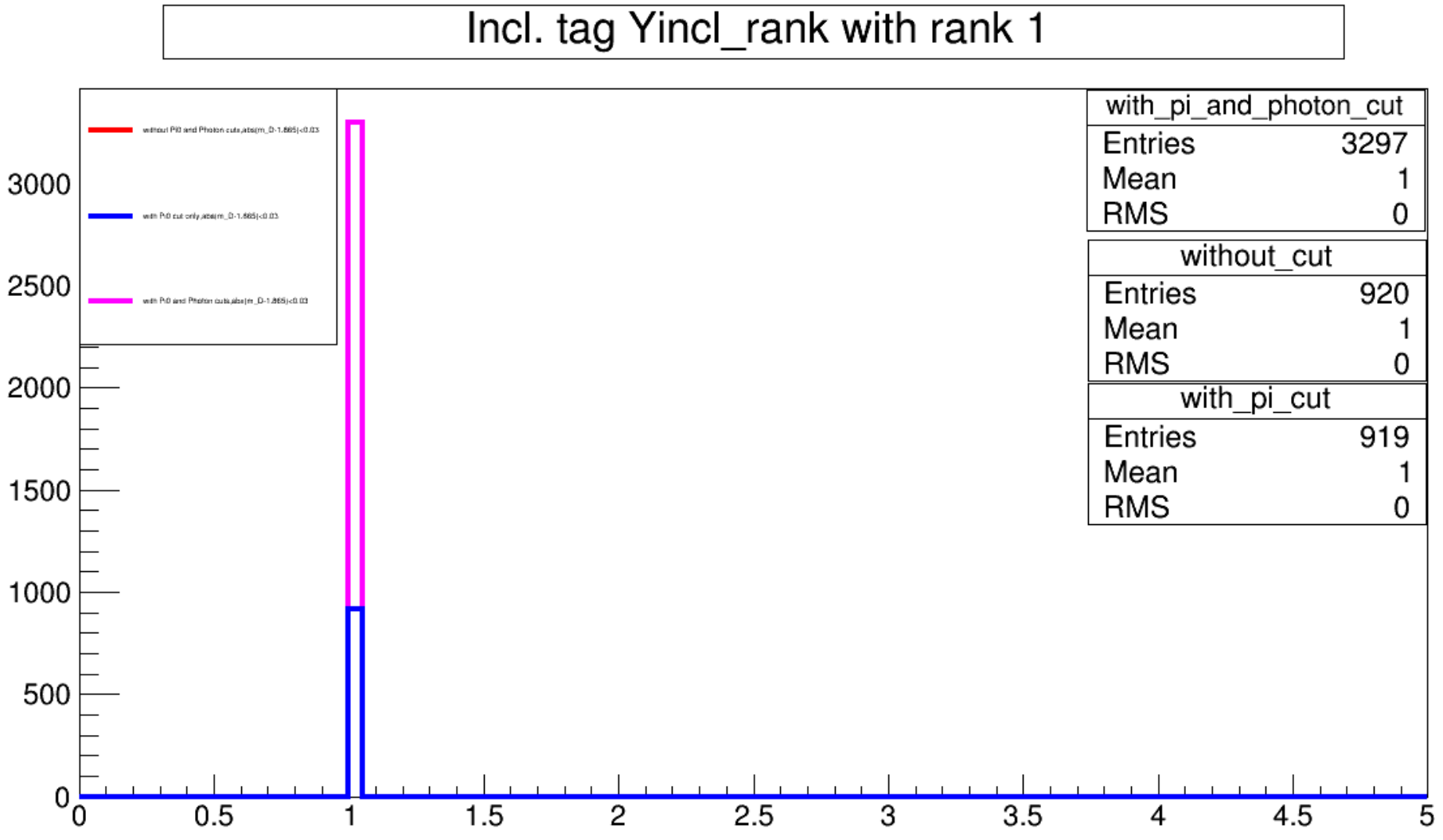

Incl. tag m_D with rank 1
without PI0 and Photon cuts,abs(m_D-1.865)<0.03
with PI0 cut only,abs(m_D-1.865)<0.03
with PI0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 3297
Mean 1.861
RMS 0.01443
without_cut
Entries 920
Mean 1.867
RMS 0.01663
with_pi_cut
Entries 919
Mean 1.868
RMS 0.01666
0
10
20
30
40
50
60
70
1.83
1.84
1.85
1.86
1.87
1.88
1.89
1.9


Incl. tag cos(PBtag,Pvis) with all ranks
without PI0 and Photon cuts,abs(m_D-1.865)<0.03
with PI0 cut only,abs(m_D-1.865)<0.03
with PI0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 3447
Mean 0.1508
RMS 0.6591
without_cut
Entries 1034
Mean 0.1696
RMS 0.8326
with_pi_cut
Entries 1027
Mean 0.1697
RMS 0.8391
100
80
60
40
20
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2

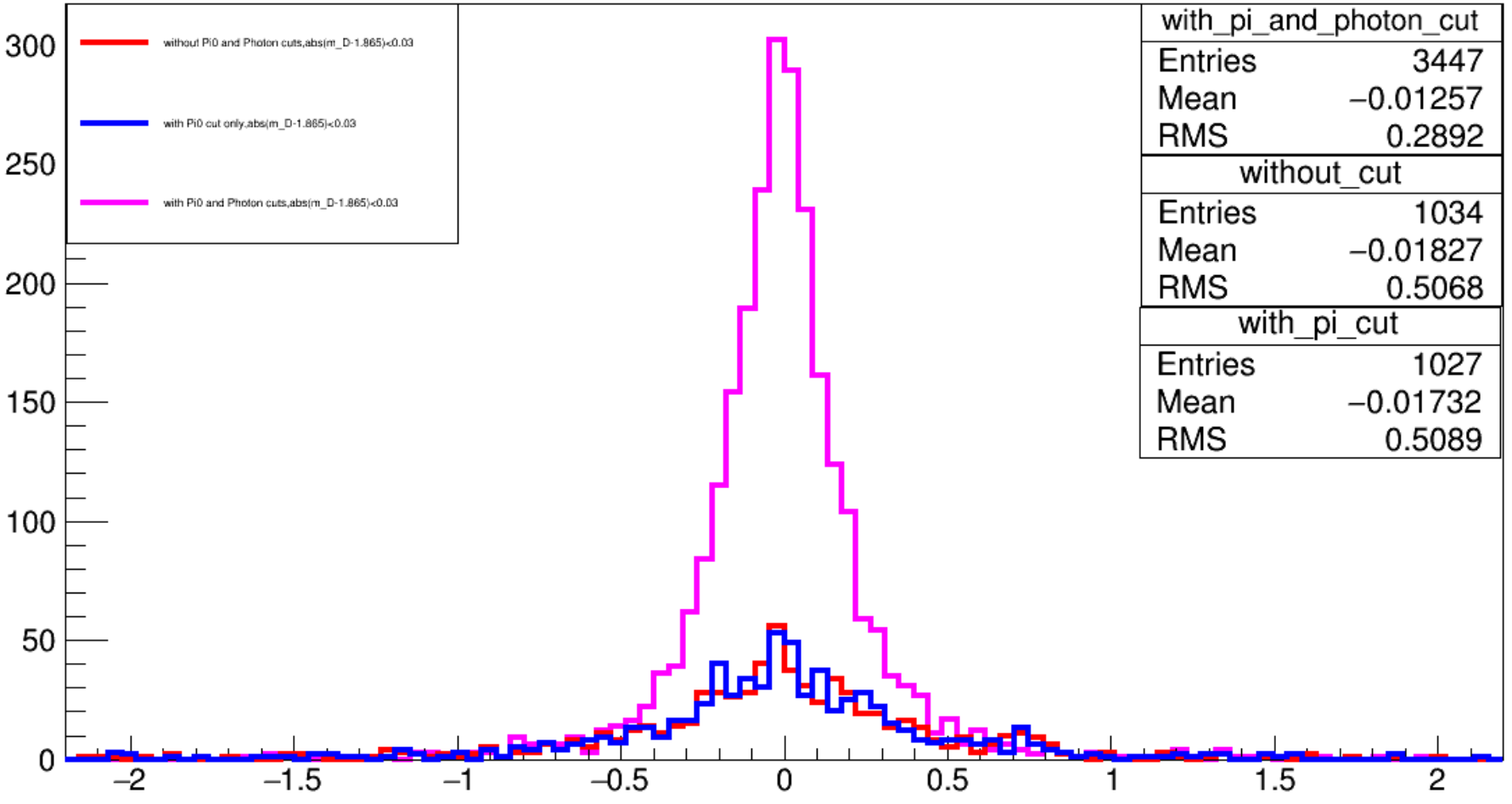

Incl. tag cos(PBtag,Pvis) with rank 1
without PI0 and Photon cuts,abs(m_D-1.865)<0.03
with PI0 cut only,abs(m_D-1.865)<0.03
with PI0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 3297
Mean 0.1447
RMS 0.65
without_cut
Entries 920
Mean 0.1375
RMS 0.8142
with_pi_cut
Entries 919
Mean 0.131
RMS 0.8111
0
10
20
30
40
50
60
70
80
90
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2

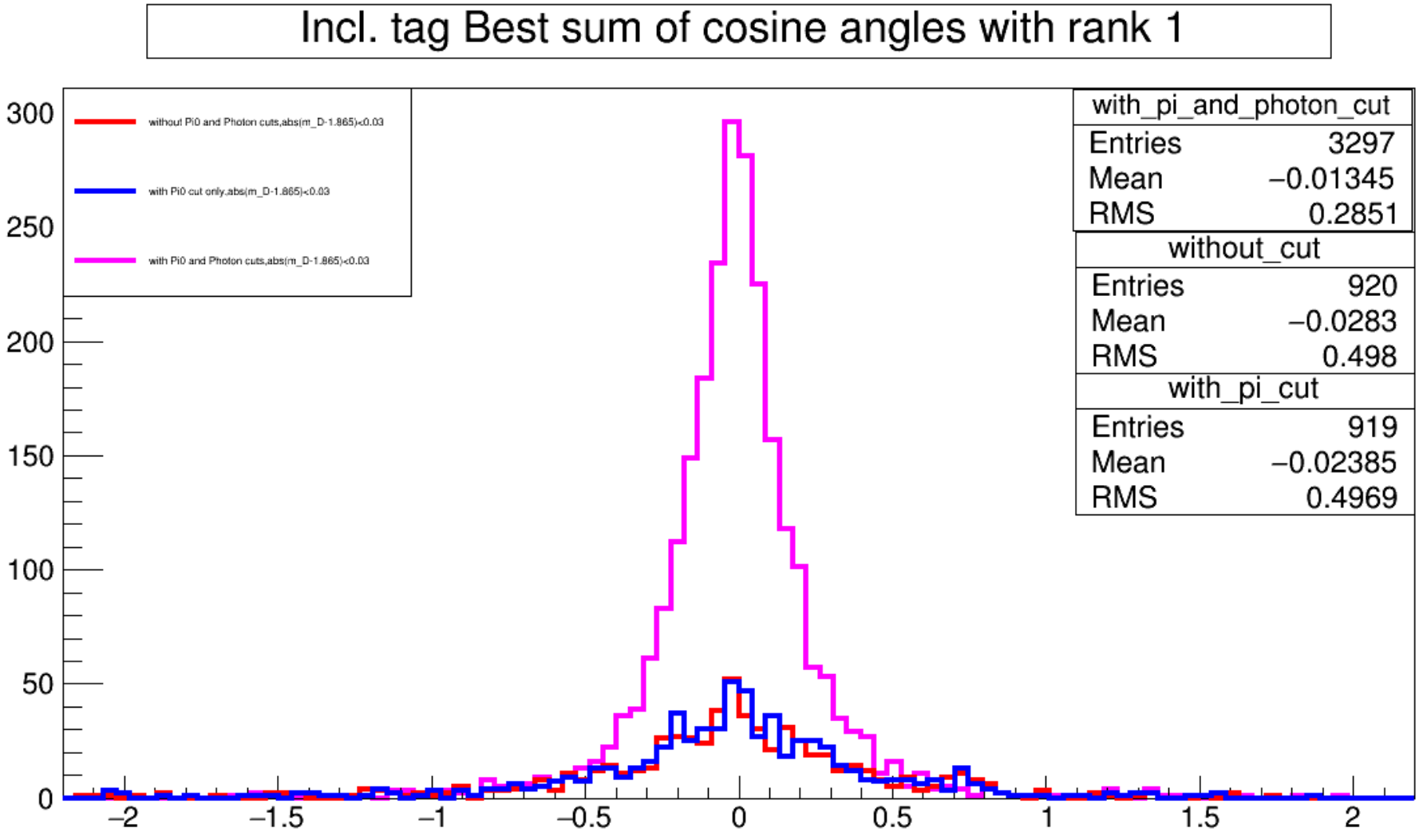
Incl. tag Yincl_rank with all ranks

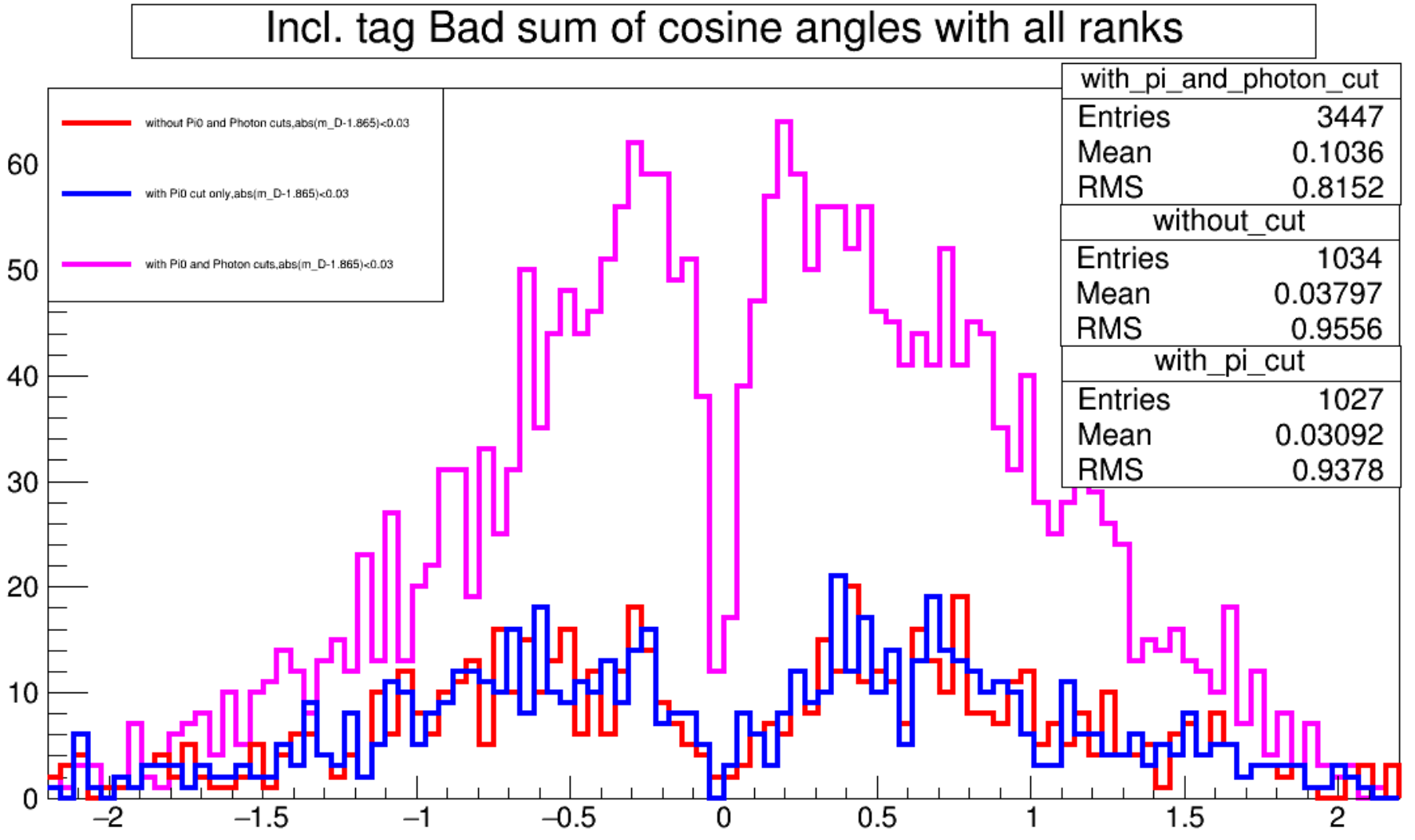


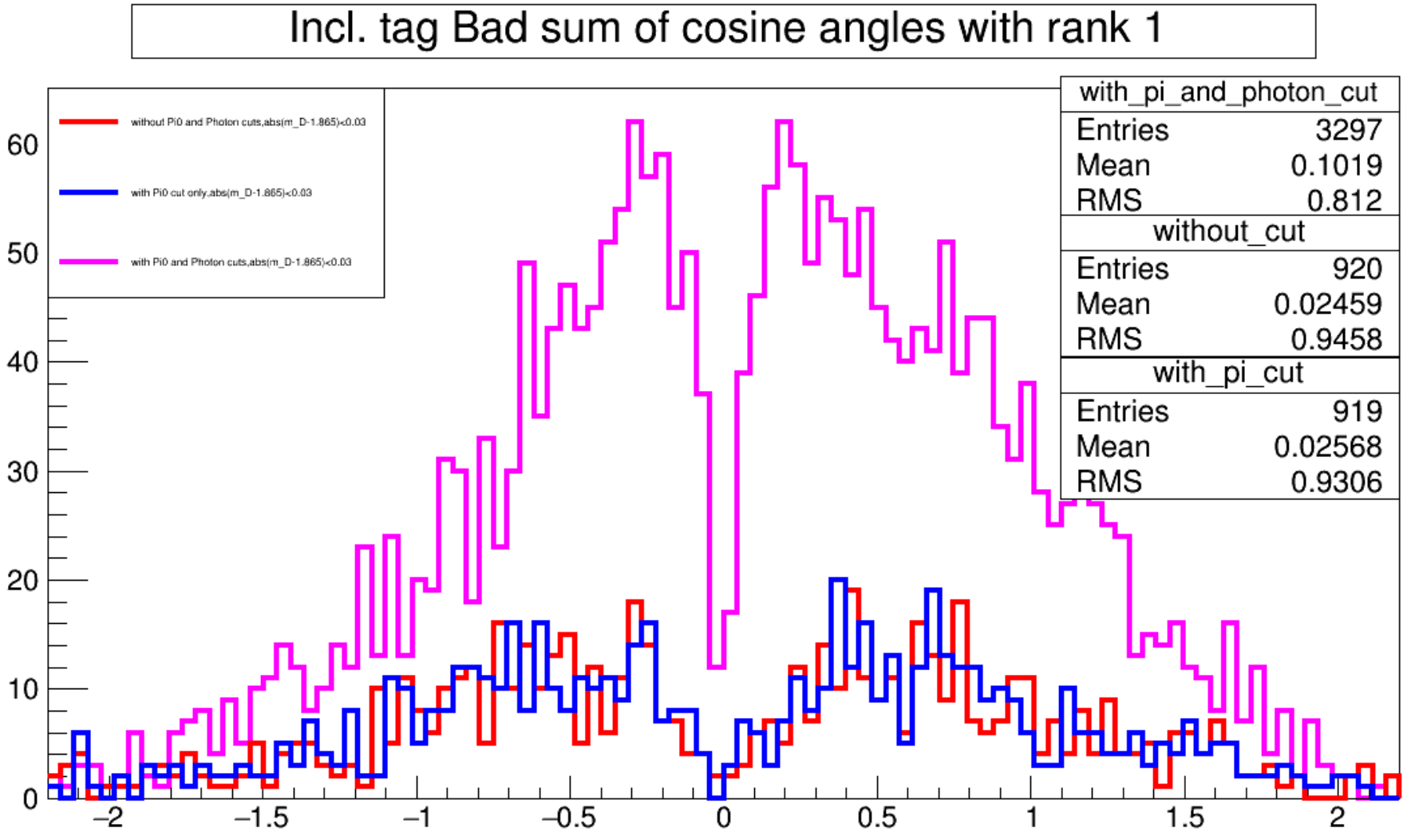

Incl. tag Yincl_rank with rank 1
without PI0 and Photon cuts,abs(m_D-1.865)<0.03
with PI0 cut only,abs(m_D-1.865)<0.03
with PI0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 3297
Mean 1
RMS 0
without_cut
Entries 920
Mean 1
RMS 0
with_pi_cut
Entries 919
Mean 1
RMS 0
3000
2500
2000
1500
1000
500
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Incl. tag Best sum of cosine angles with all ranks



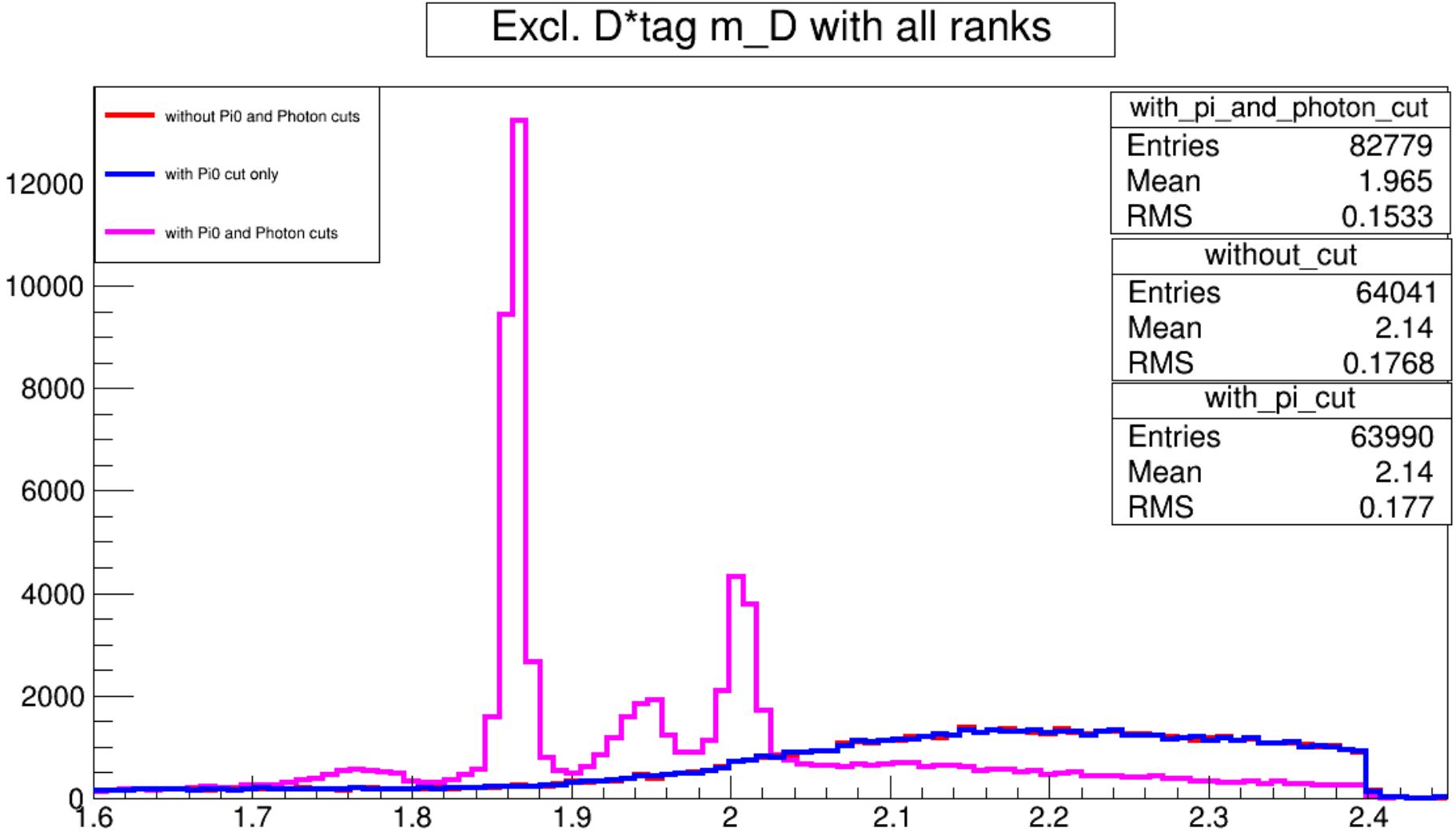

Incl. tag Best sum of cosine angles with rank 1
without Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with Pi0 cut only,abs(m_D-1.865)<0.03
with Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 3297
Mean −0.01345
RMS 0.2851
without_cut
Entries 920
Mean −0.0283
RMS 0.498
with_pi_cut
Entries 919
Mean −0.02385
RMS 0.4969
300
250
200
150
100
50
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2

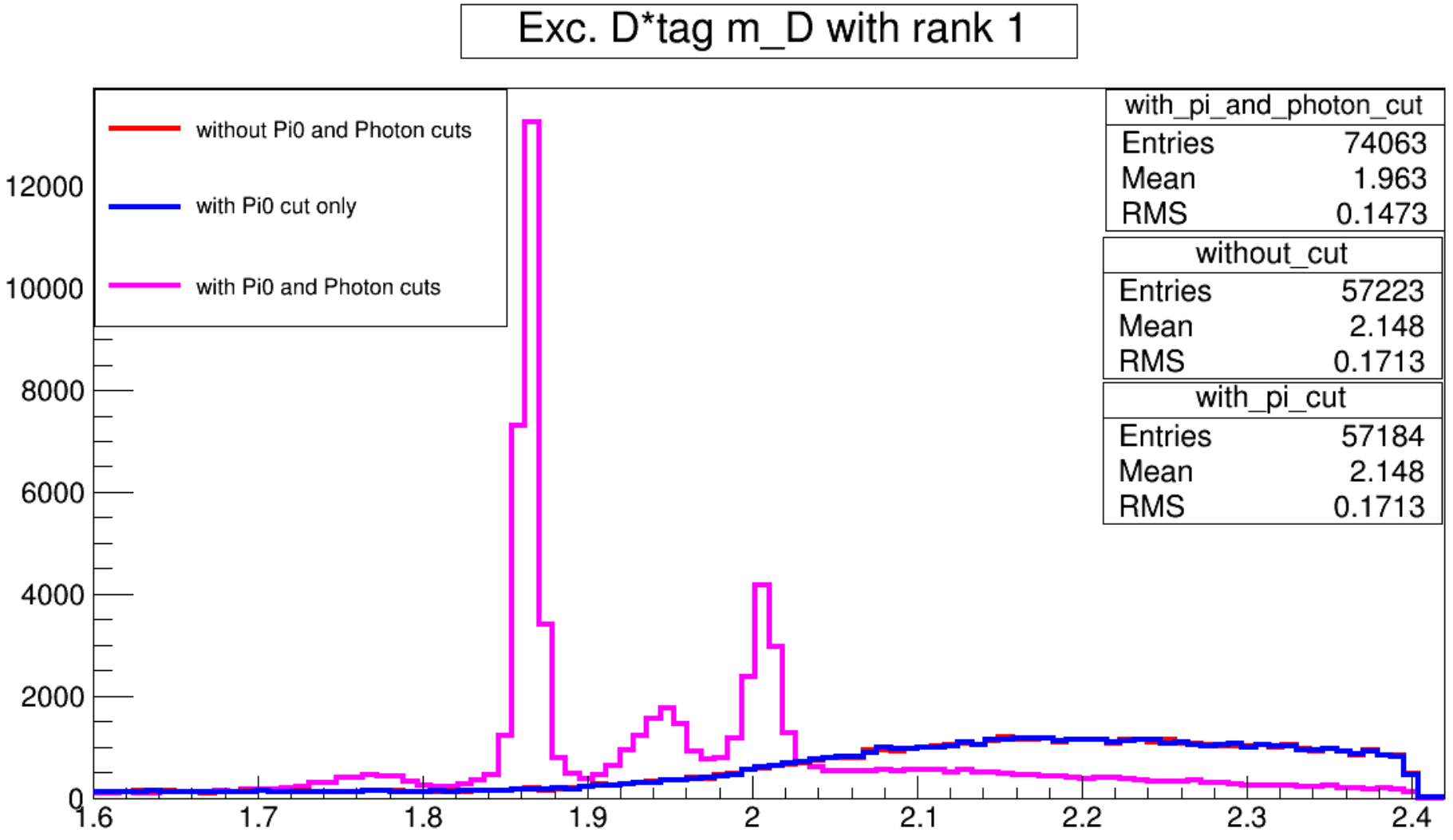

Incl. tag Bad sum of cosine angles with all ranks
without Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with Pi0 cut only,abs(m_D-1.865)<0.03
with Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 3447
Mean 0.1036
RMS 0.8152
without_cut
Entries 1034
Mean 0.03797
RMS 0.9556
with_pi_cut
Entries 1027
Mean 0.03092
RMS 0.9378
60
50
40
30
20
10
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2

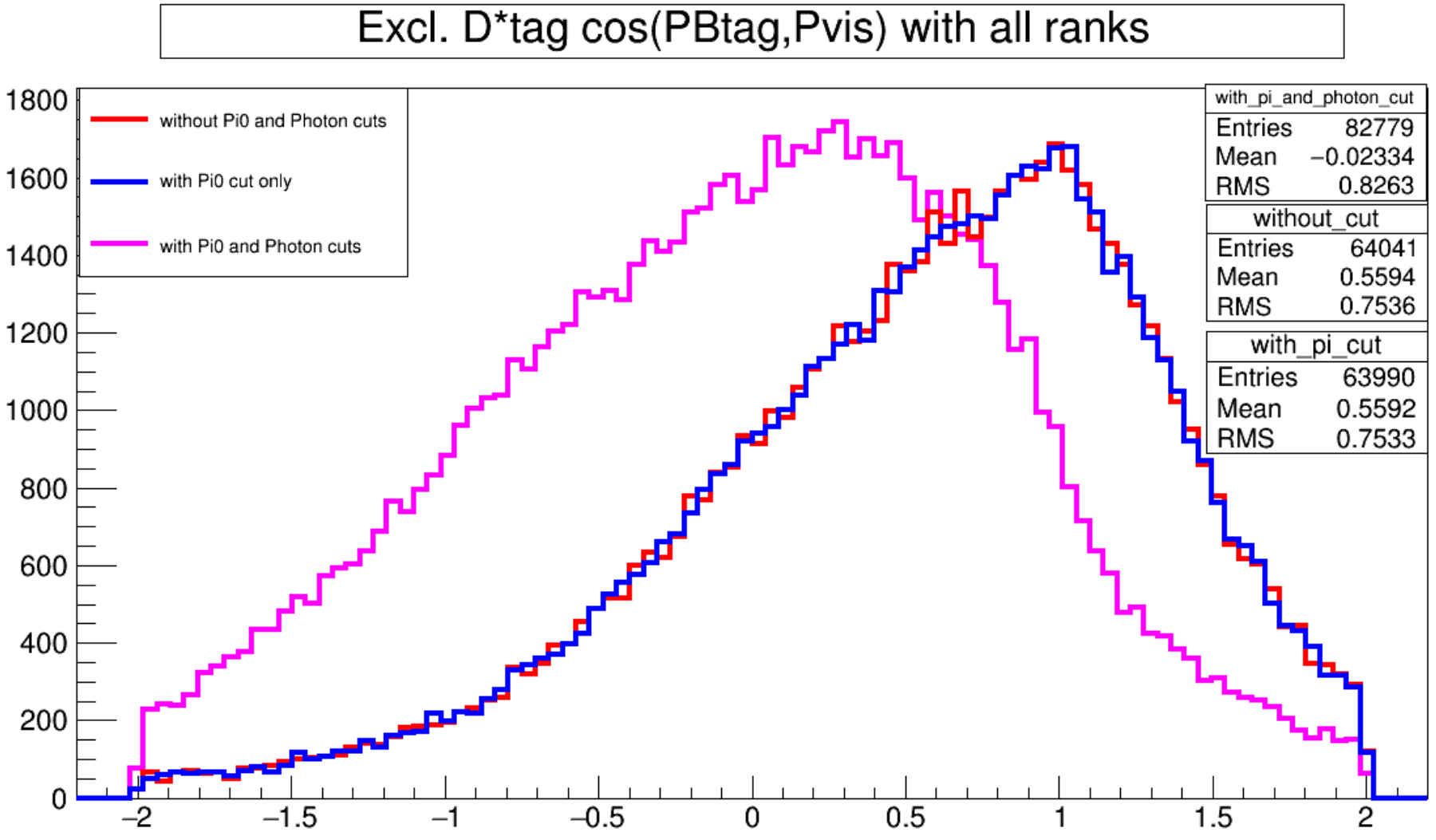

Incl. tag Bad sum of cosine angles with rank 1
without Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with Pi0 cut only,abs(m_D-1.865)<0.03
with Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 3297
Mean 0.1019
RMS 0.812
without_cut
Entries 920
Mean 0.02459
RMS 0.9458
with_pi_cut
Entries 919
Mean 0.02568
RMS 0.9306
60
50
40
30
20
10
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2

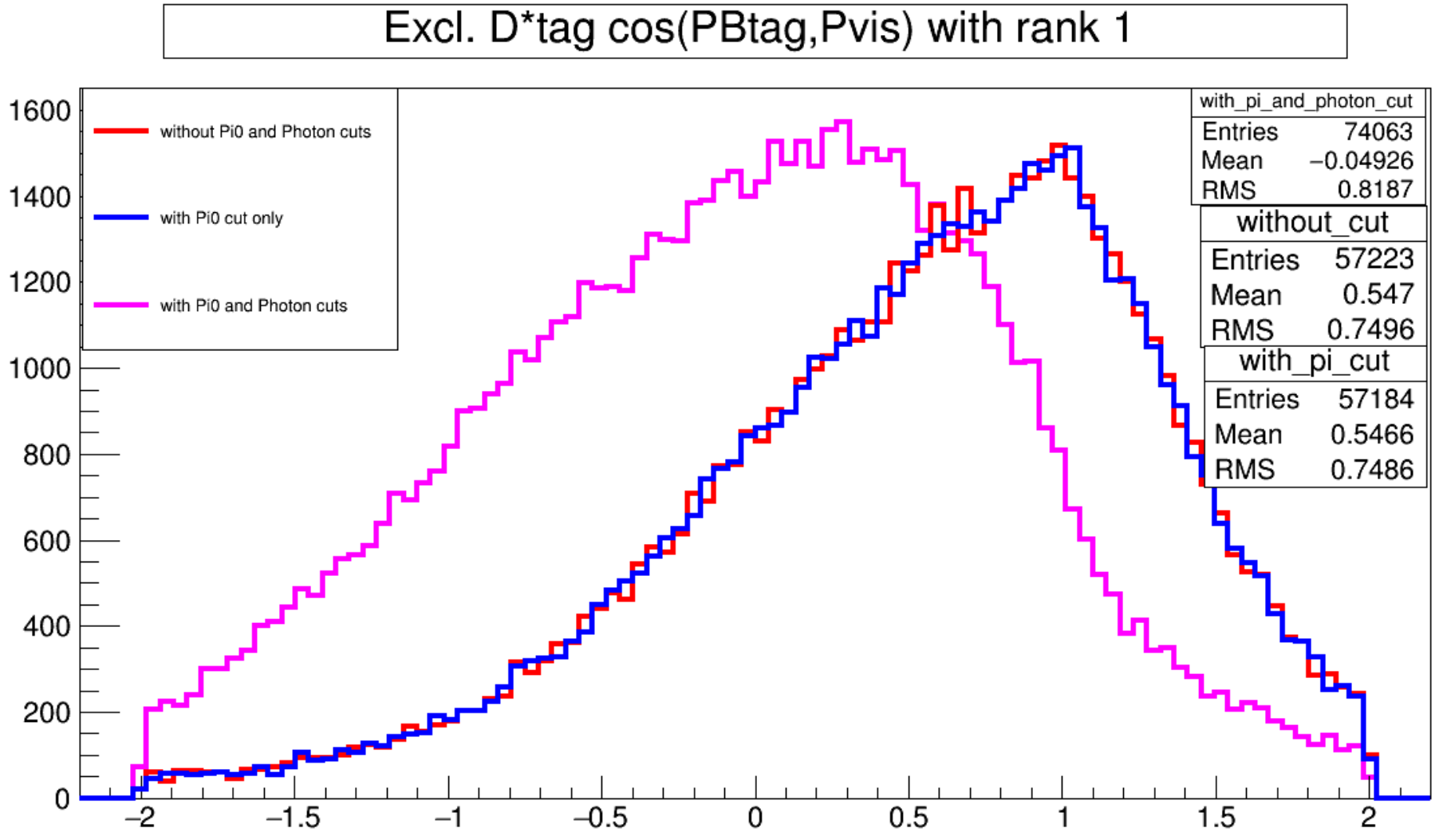
Sample 2 (400K events)

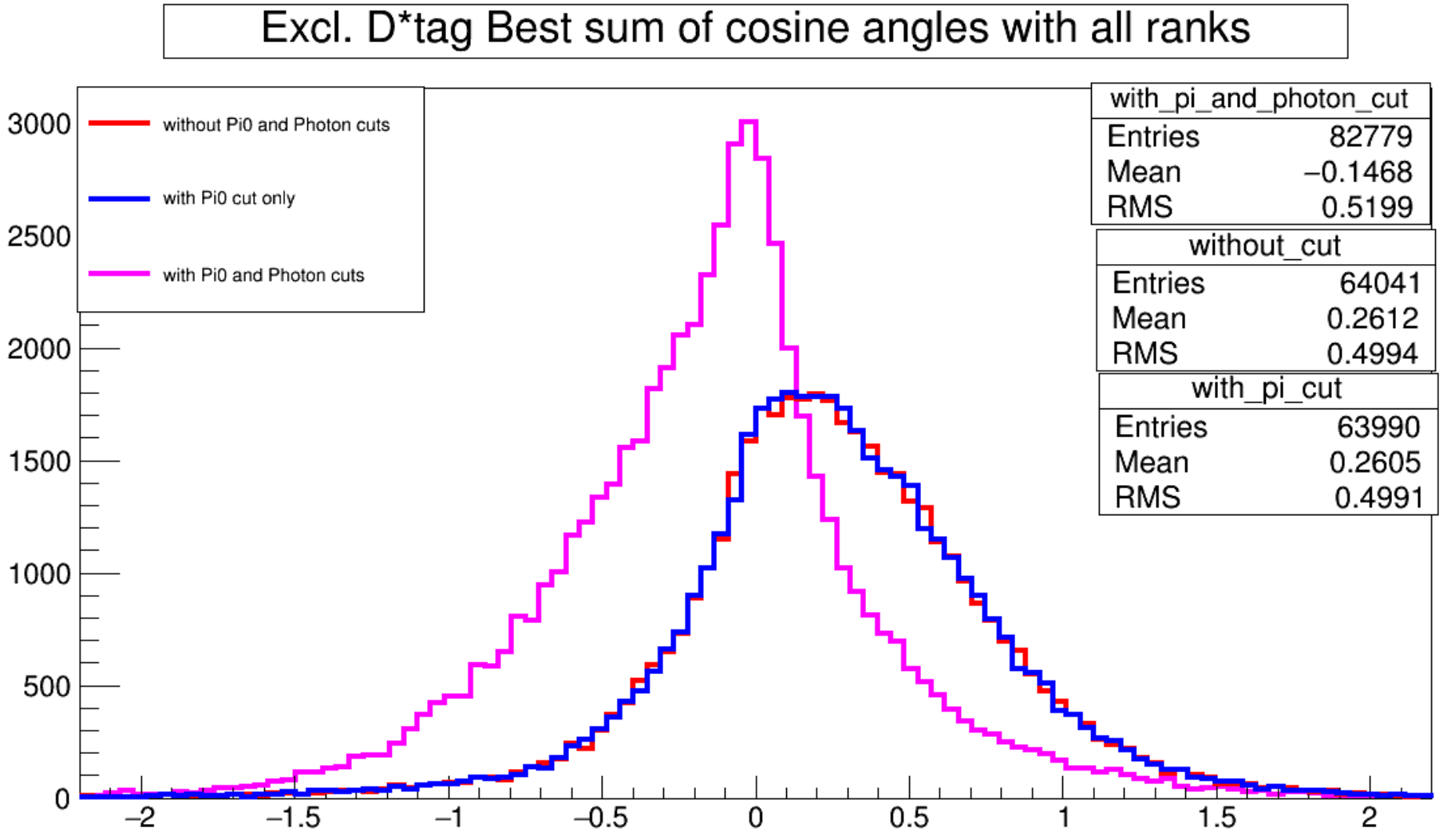
```
Decay B-tag
0.5   D*0       e-   anti-nu_e   PHOTOS  HQET2 1.3 1.18 0.71;
0.5   D*0       mu-  anti-nu_mu  PHOTOS  HQET2 1.3 1.18 0.71;
Enddecay
CDecay B+tag

# Decay D*0
Decay D*0
0.5 D0      gamma                                   VSP_PWAVE; #[Reconstructed PDG2011]
0.5 D0      pi0                                     VSS; #[Reconstructed PDG2011]
Enddecay
CDecay anti-D*0

#Decay D0
Decay D0
1.0 K-      pi+                                     PHSP;
Enddecay
CDecay anti-D0
```

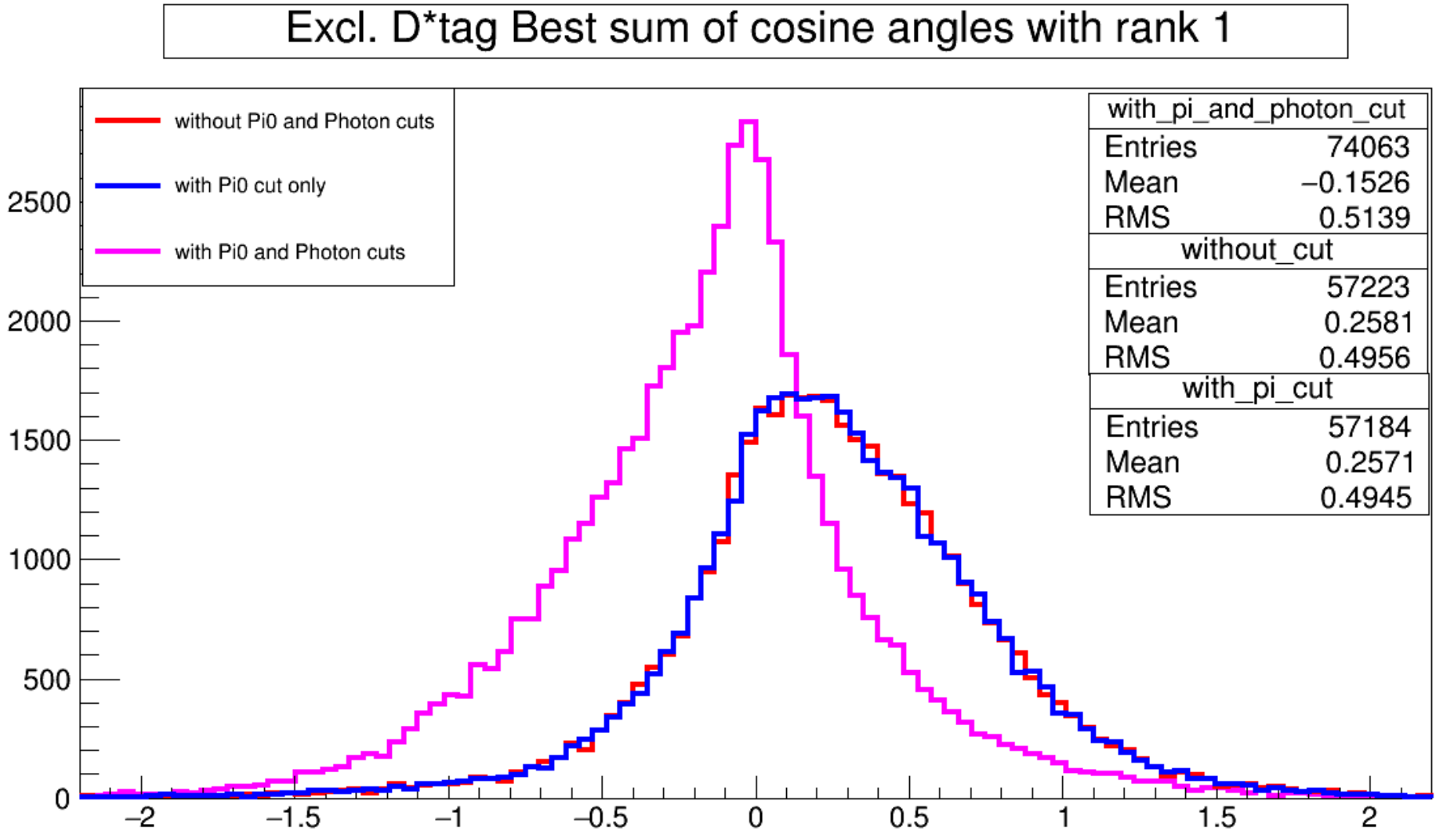

Excl. D*tag m_D with all ranks
without Pi0 and Photon cuts
with Pi0 cut only
with Pi0 and Photon cuts
with_pi_and_photon_cut
Entries 82779
Mean 1.965
RMS 0.1533
without_cut
Entries 64041
Mean 2.14
RMS 0.1768
with_pi_cut
Entries 63990
Mean 2.14
RMS 0.177
12000
10000
8000
6000
4000
2000
0
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4


Exc. D*tag m_D with rank 1
without Pi0 and Photon cuts
with Pi0 cut only
with Pi0 and Photon cuts
with_pi_and_photon_cut
Entries 74063
Mean 1.963
RMS 0.1473
without_cut
Entries 57223
Mean 2.148
RMS 0.1713
with_pi_cut
Entries 57184
Mean 2.148
RMS 0.1713
12000
10000
8000
6000
4000
2000
0
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4


Excl. D*tag cos(PBtag,Pvis) with all ranks
without Pi0 and Photon cuts
with Pi0 cut only
with Pi0 and Photon cuts
with_pi_and_photon_cut
Entries 82779
Mean −0.02334
RMS 0.8263
without_cut
Entries 64041
Mean 0.5594
RMS 0.7536
with_pi_cut
Entries 63990
Mean 0.5592
RMS 0.7533
1800
1600
1400
1200
1000
800
600
400
200
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2

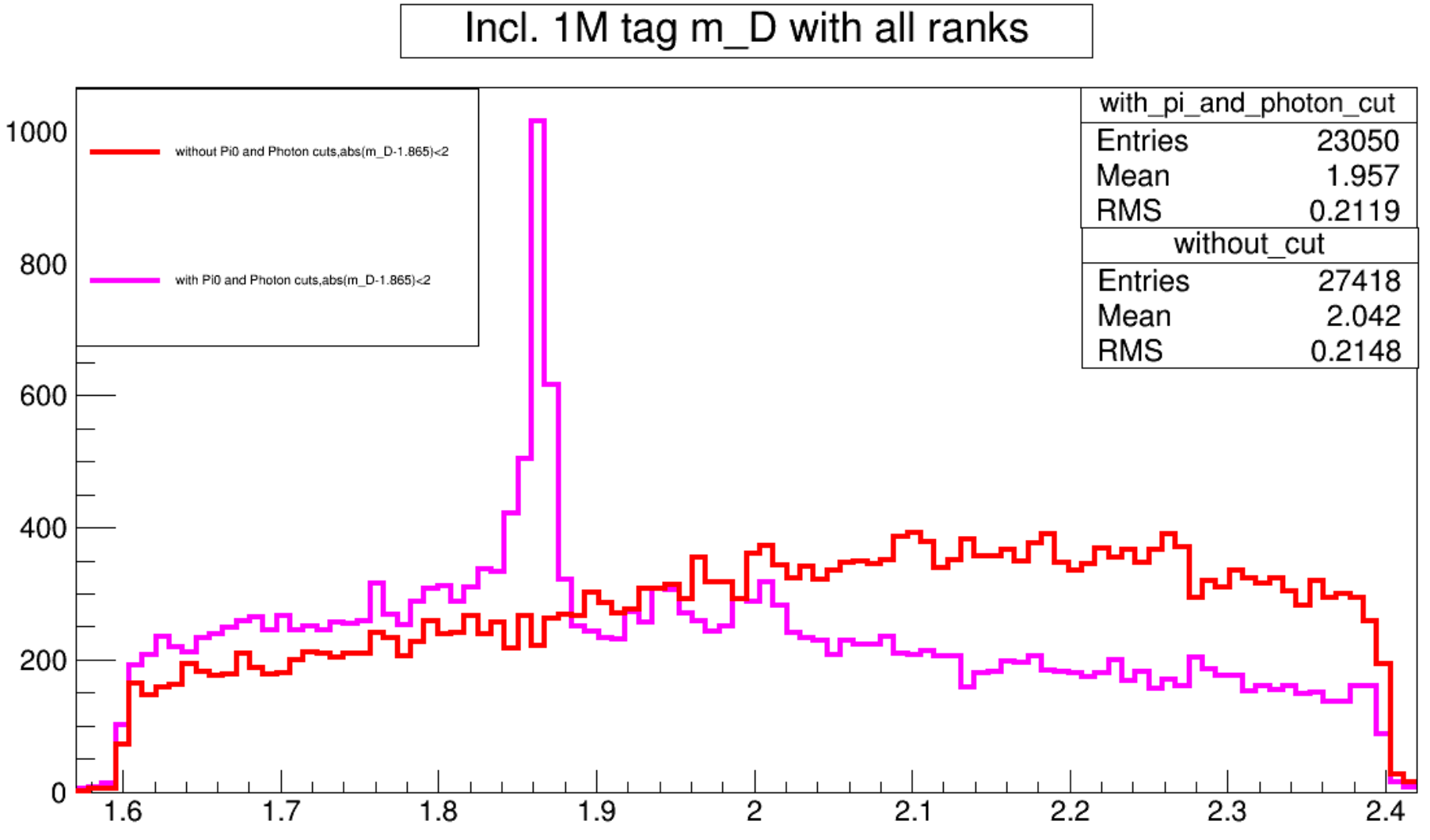

Excl. D*tag cos(PBtag,Pvis) with rank 1
without Pi0 and Photon cuts
with Pi0 cut only
with Pi0 and Photon cuts
with_pi_and_photon_cut
Entries 74063
Mean −0.04926
RMS 0.8187
without_cut
Entries 57223
Mean 0.547
RMS 0.7496
with_pi_cut
Entries 57184
Mean 0.5466
RMS 0.7486
1600
1400
1200
1000
800
600
400
200
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2

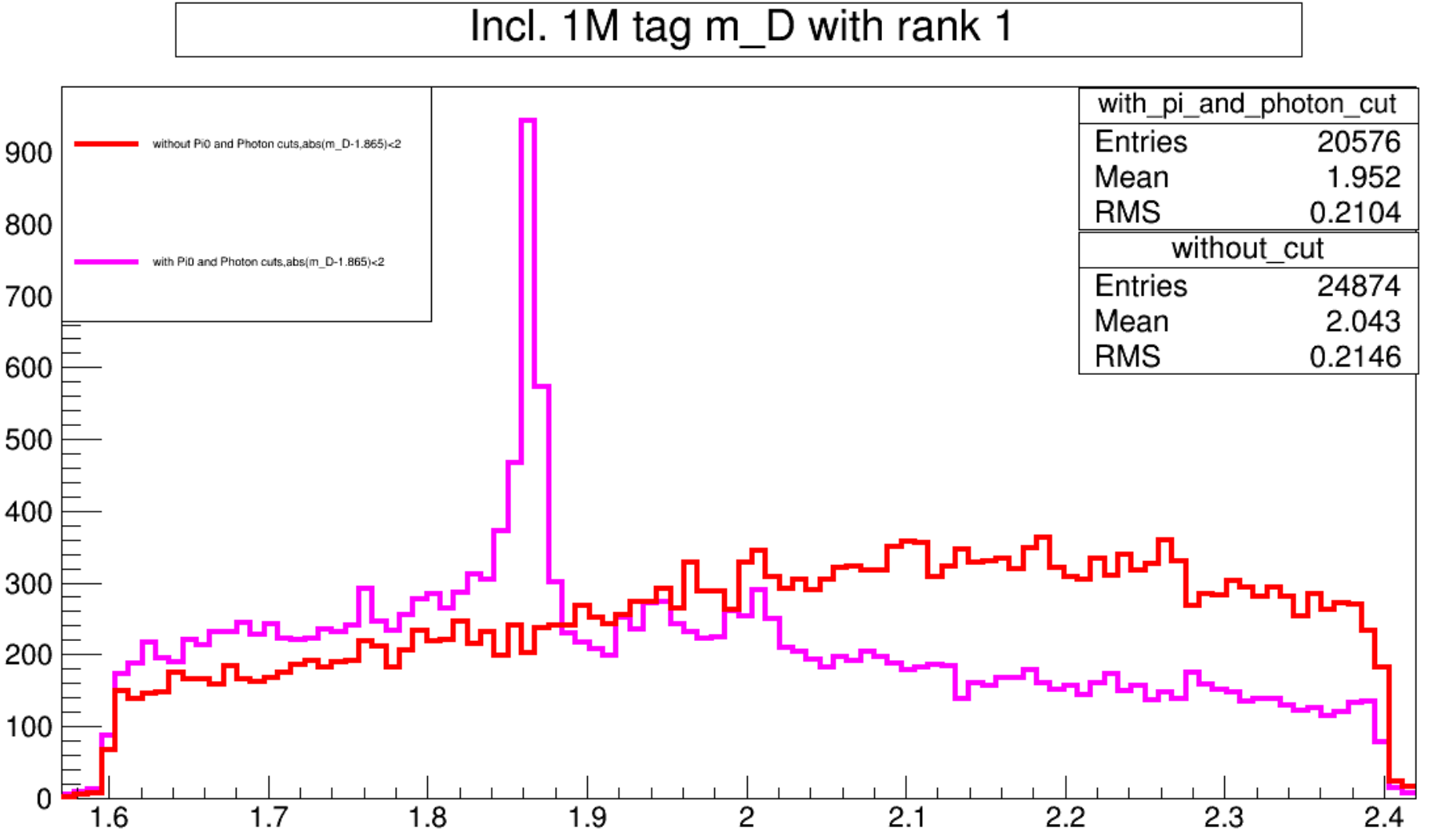

Excl. D*tag Best sum of cosine angles with all ranks
without Pi0 and Photon cuts
with Pi0 cut only
with Pi0 and Photon cuts
with_pi_and_photon_cut
Entries 82779
Mean −0.1468
RMS 0.5199
without_cut
Entries 64041
Mean 0.2612
RMS 0.4994
with_pi_cut
Entries 63990
Mean 0.2605
RMS 0.4991
3000
2500
2000
1500
1000
500
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2

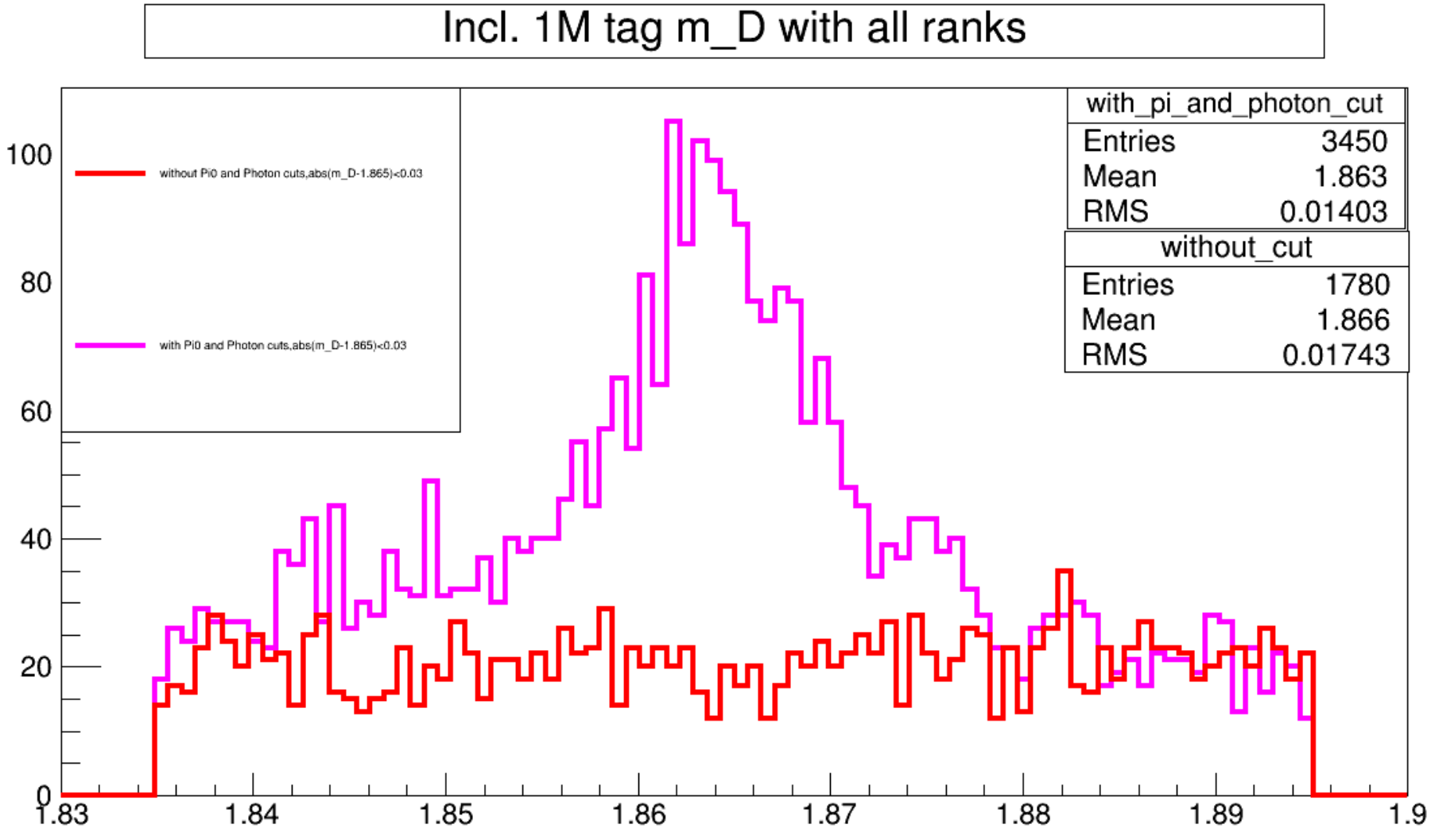

Excl. D*tag Best sum of cosine angles with rank 1
without Pi0 and Photon cuts
with Pi0 cut only
with Pi0 and Photon cuts
with_pi_and_photon_cut
Entries 74063
Mean −0.1526
RMS 0.5139
without_cut
Entries 57223
Mean 0.2581
RMS 0.4956
with_pi_cut
Entries 57184
Mean 0.2571
RMS 0.4945
2500
2000
1500
1000
500
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2

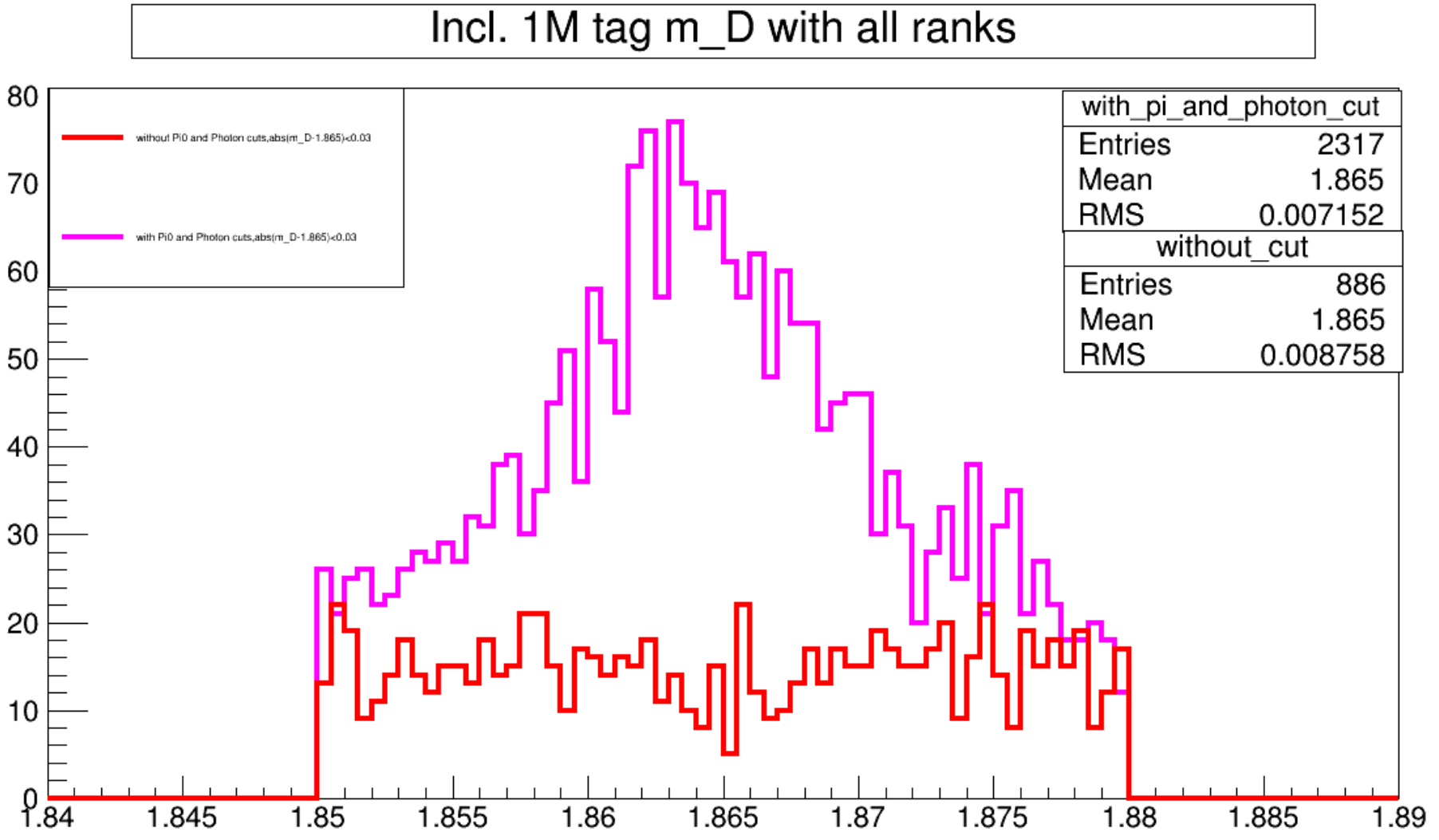
Sample 3

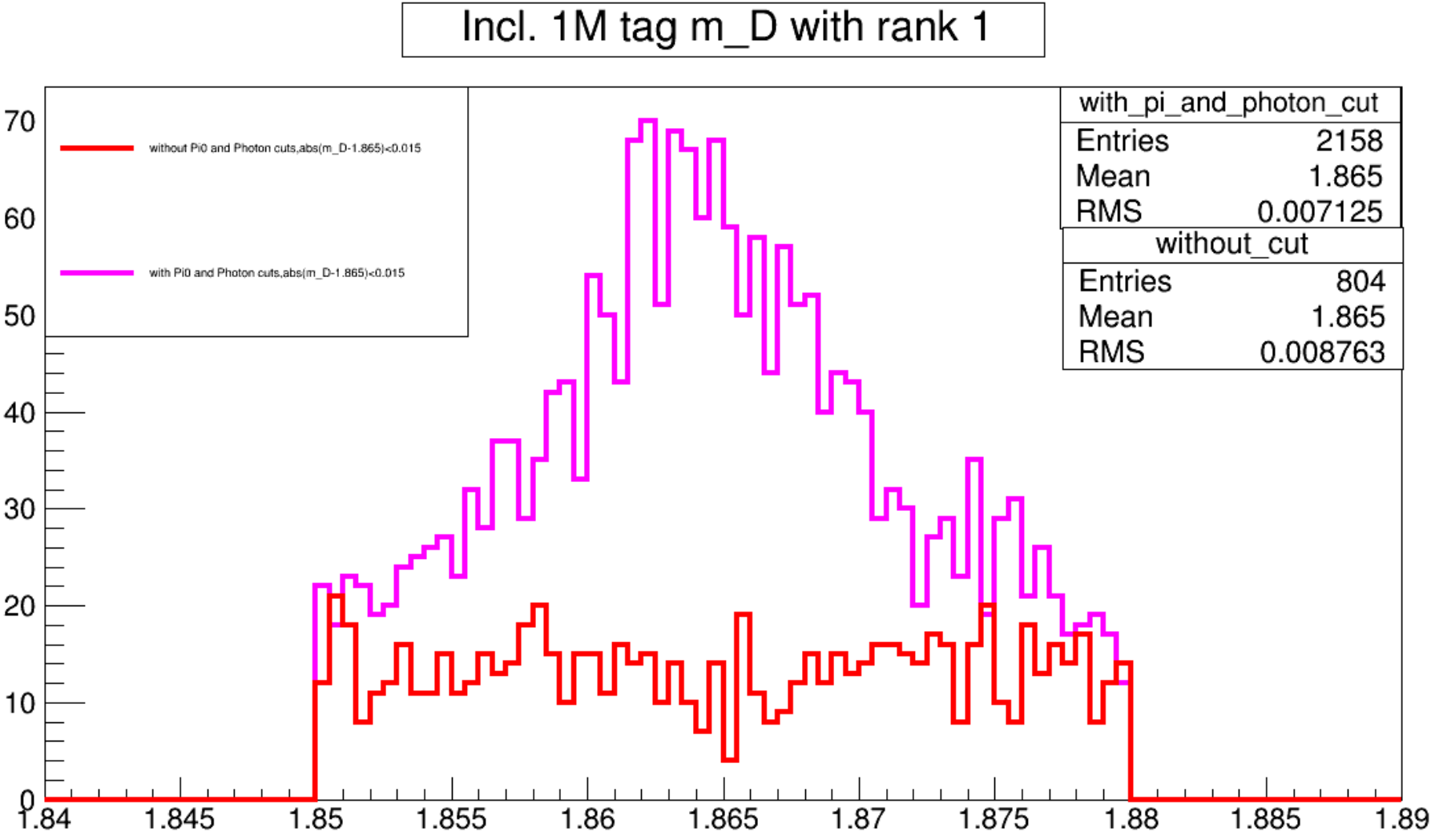
1M events with tag side inclusively generated

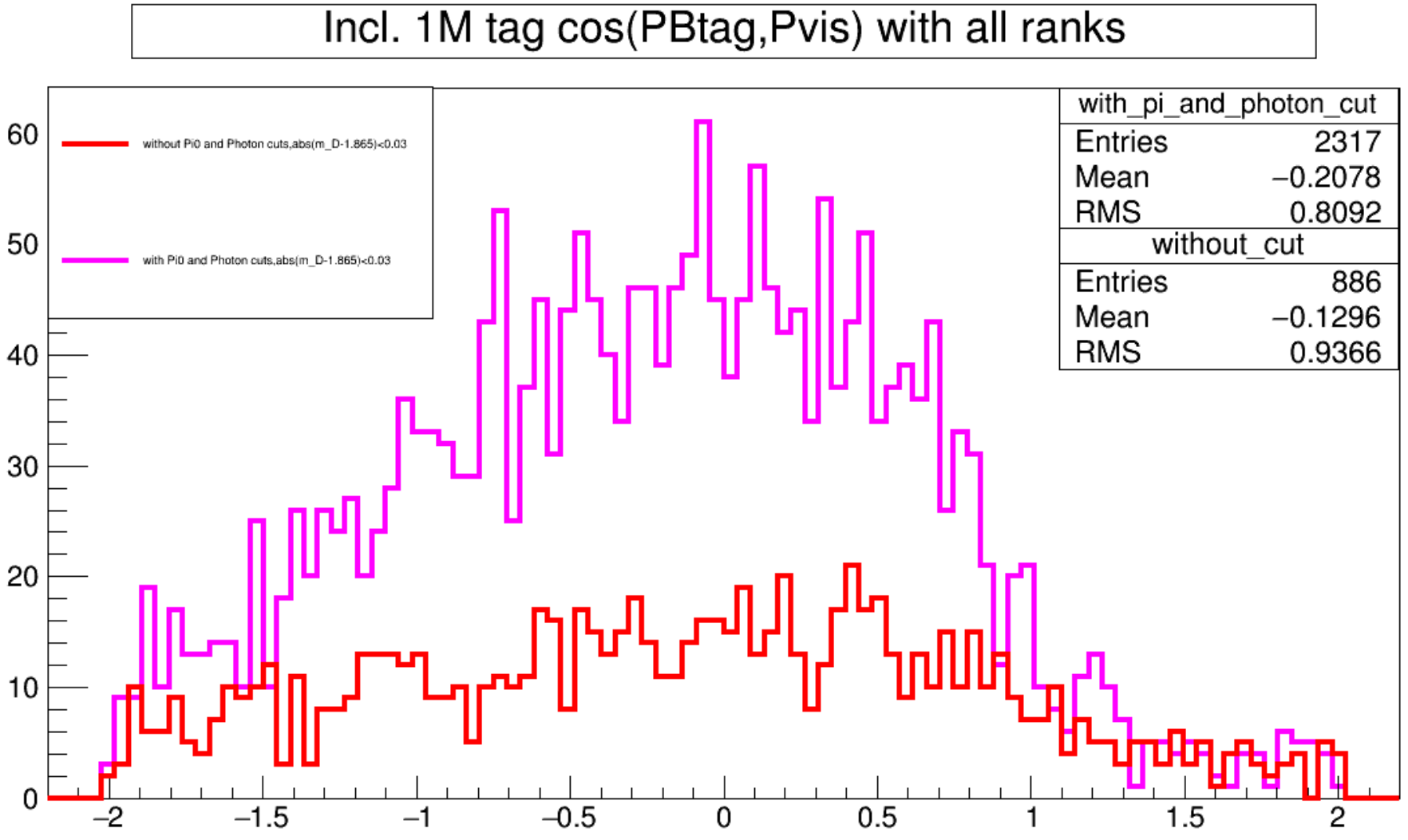

Incl. 1M tag m_D with all ranks
without Pi0 and Photon cuts,abs(m_D-1.865)<2
with Pi0 and Photon cuts,abs(m_D-1.865)<2
with_pi_and_photon_cut
Entries 23050
Mean 1.957
RMS 0.2119
without_cut
Entries 27418
Mean 2.042
RMS 0.2148
1000
800
600
400
200
0
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4

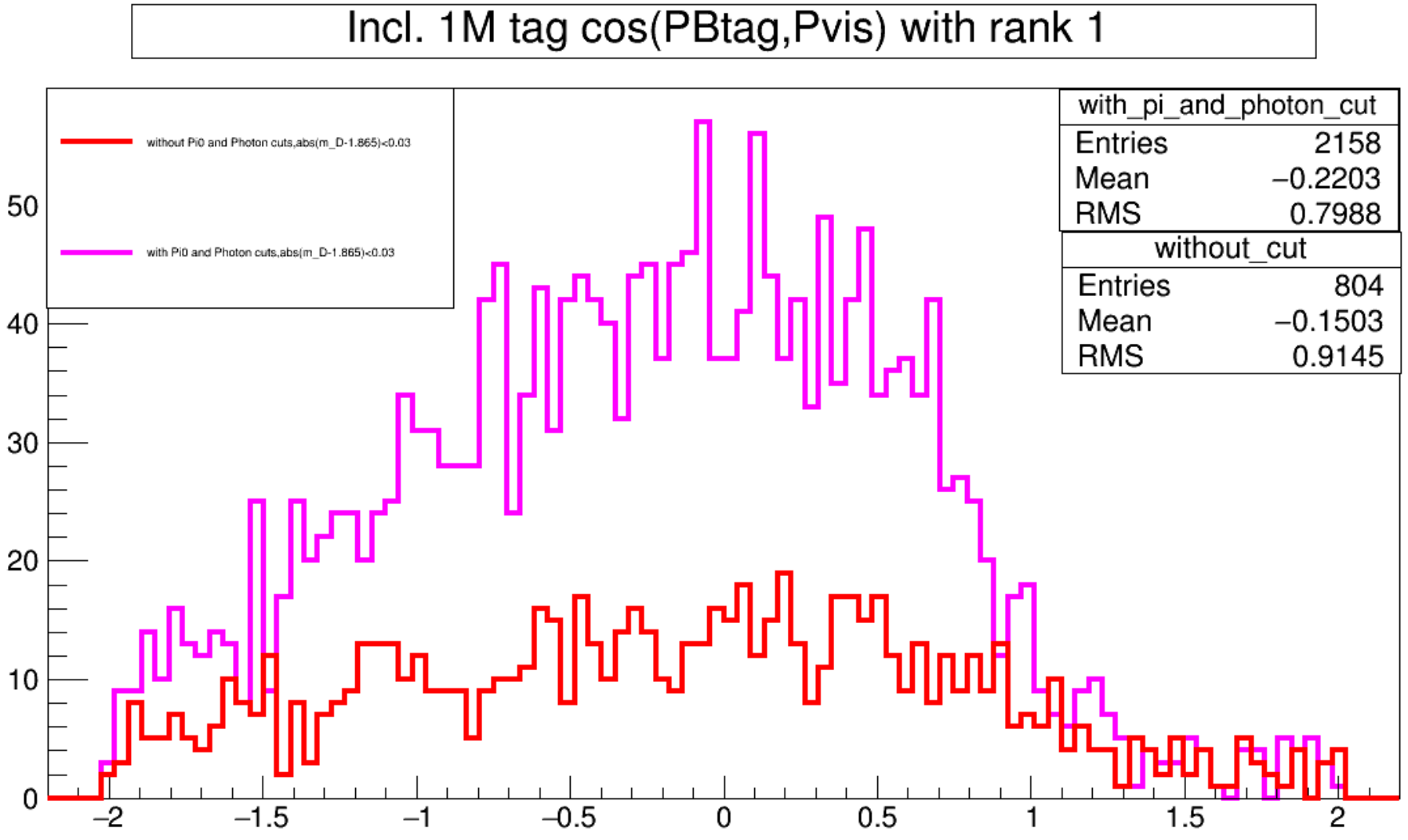

Incl. 1M tag m_D with rank 1
without Pi0 and Photon cuts,abs(m_D-1.865)<2
with Pi0 and Photon cuts,abs(m_D-1.865)<2
with_pi_and_photon_cut
Entries 20576
Mean 1.952
RMS 0.2104
without_cut
Entries 24874
Mean 2.043
RMS 0.2146
900
800
700
600
500
400
300
200
100
0
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4

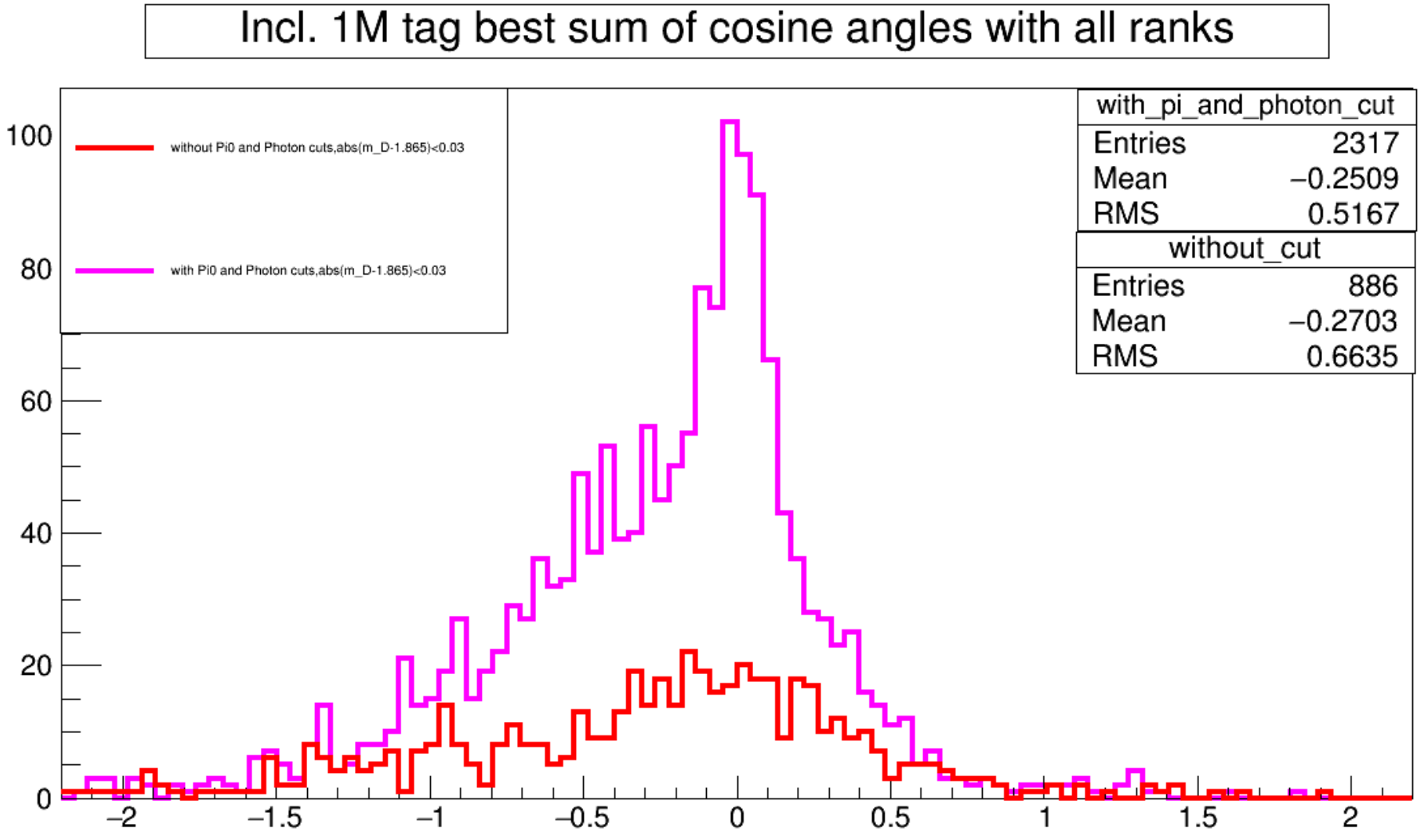

Incl. 1M tag m_D with all ranks
without Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 3450
Mean 1.863
RMS 0.01403
without_cut
Entries 1780
Mean 1.866
RMS 0.01743
100
80
60
40
20
0
1.83
1.84
1.85
1.86
1.87
1.88
1.89
1.9

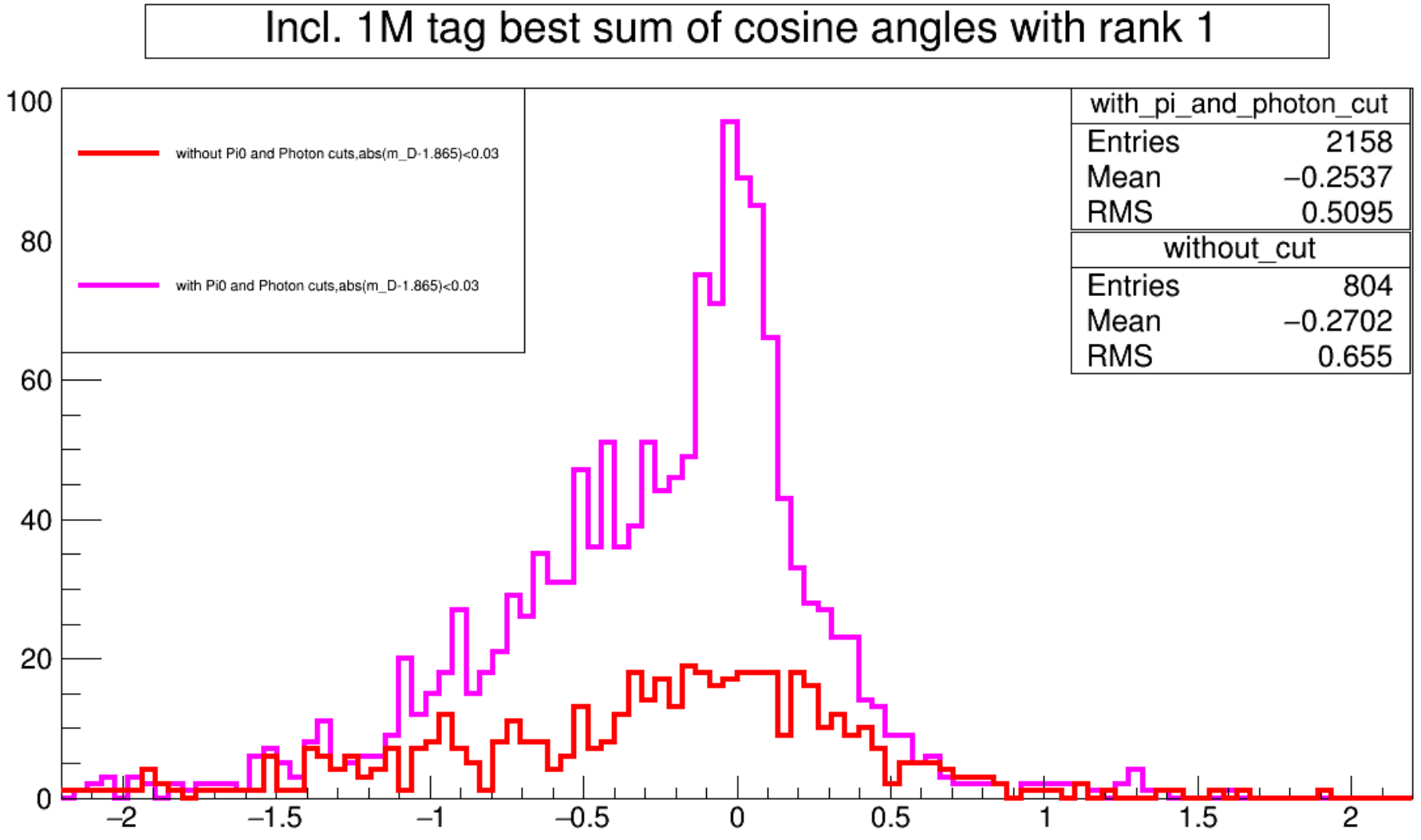

Incl. 1M tag m_D with all ranks
without Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 2317
Mean 1.865
RMS 0.007152
without_cut
Entries 886
Mean 1.865
RMS 0.008758
80
70
60
50
40
30
20
10
0
1.84
1.845
1.85
1.855
1.86
1.865
1.87
1.875
1.88
1.885
1.89

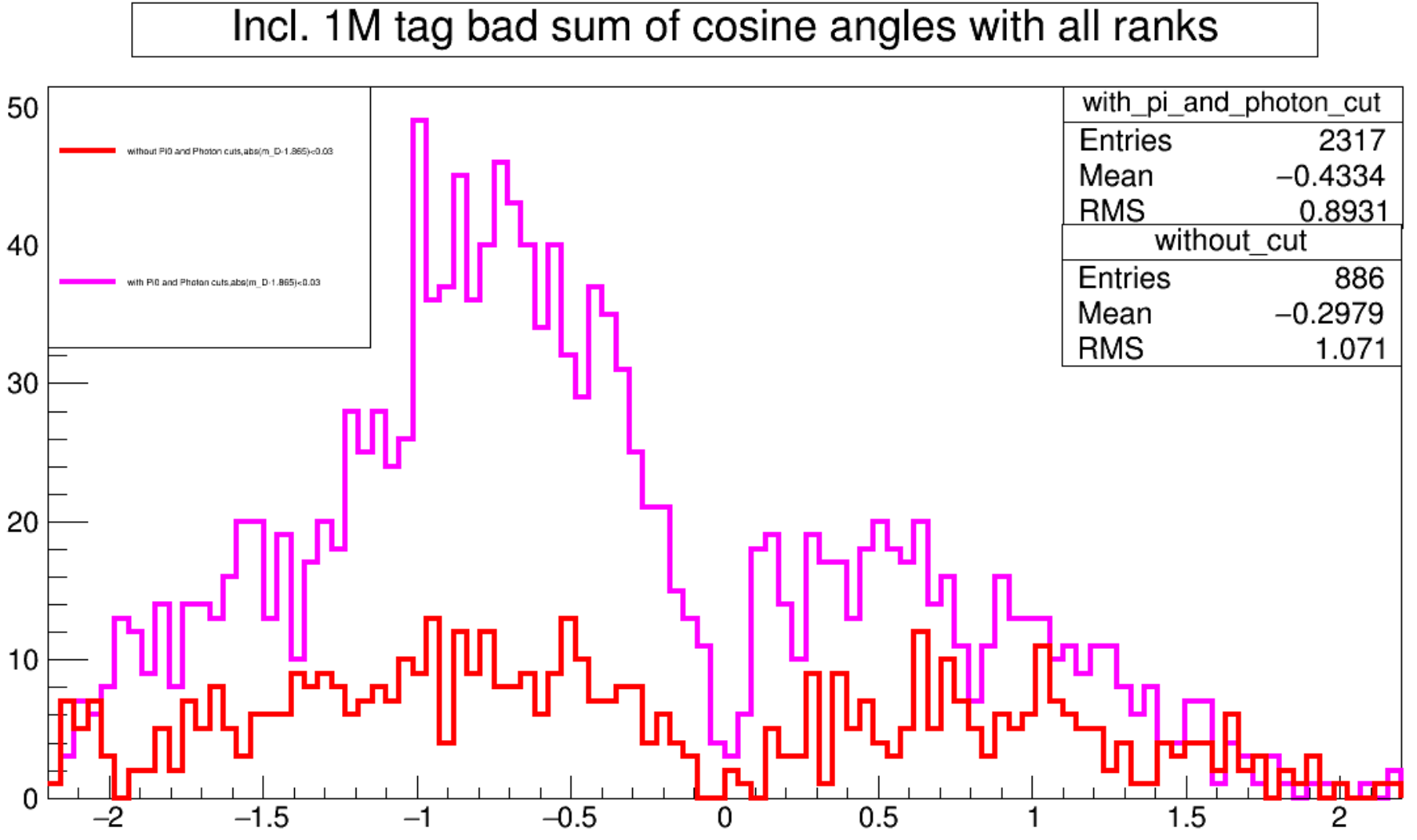

Incl. 1M tag m_D with rank 1
without Pi0 and Photon cuts,abs(m_D-1.865)<0.015
with Pi0 and Photon cuts,abs(m_D-1.865)<0.015
with_pi_and_photon_cut
Entries 2158
Mean 1.865
RMS 0.007125
without_cut
Entries 804
Mean 1.865
RMS 0.008763
70
60
50
40
30
20
10
0
1.84
1.845
1.85
1.855
1.86
1.865
1.87
1.875
1.88
1.885
1.89

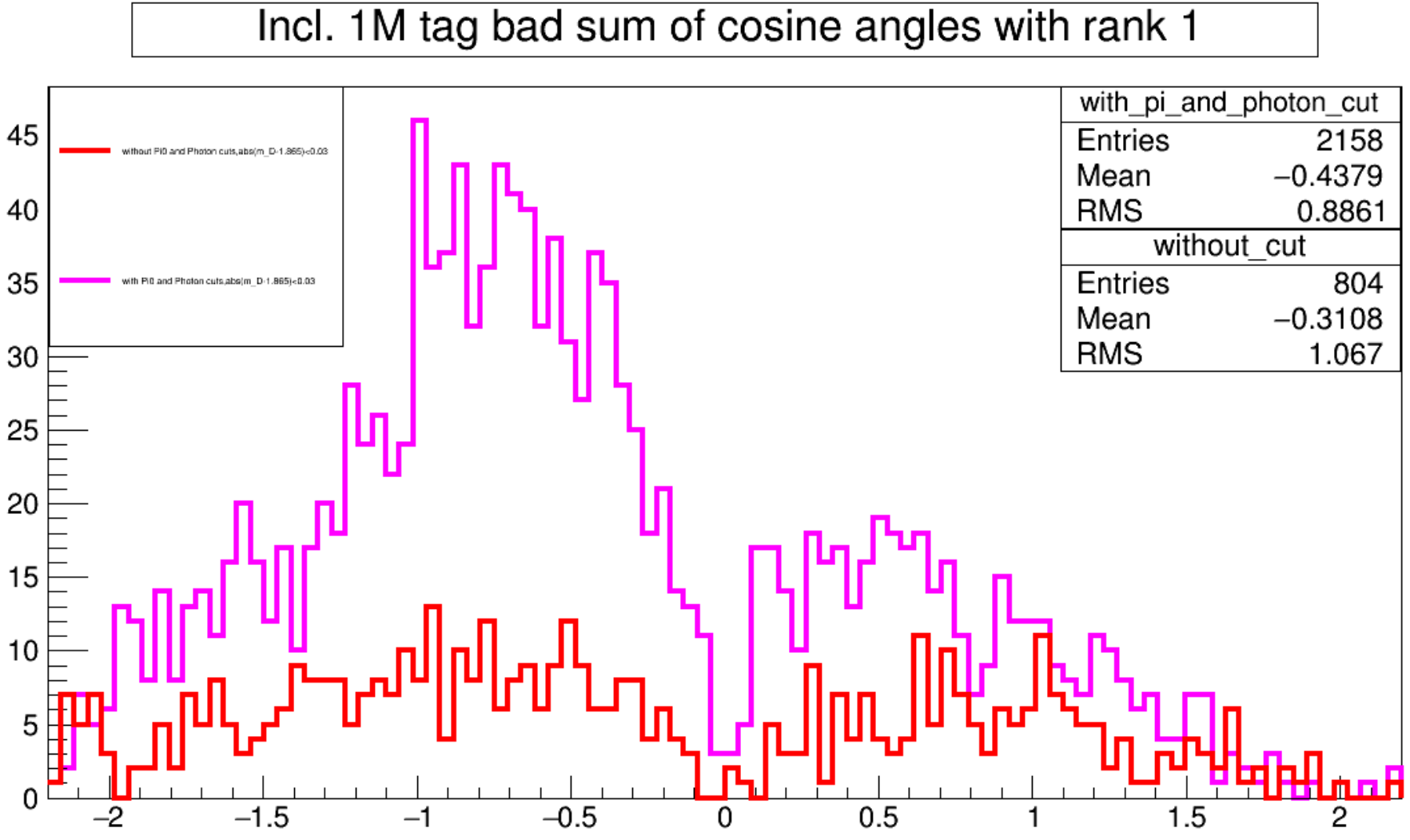

Incl. 1M tag cos(PBtag,Pvis) with all ranks
without Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 2317
Mean −0.2078
RMS 0.8092
without_cut
Entries 886
Mean −0.1296
RMS 0.9366
60
50
40
30
20
10
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2


Incl. 1M tag cos(PBtag,Pvis) with rank 1
without Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 2158
Mean −0.2203
RMS 0.7988
without_cut
Entries 804
Mean −0.1503
RMS 0.9145
50
40
30
20
10
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2


Incl. 1M tag best sum of cosine angles with all ranks
without Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 2317
Mean −0.2509
RMS 0.5167
without_cut
Entries 886
Mean −0.2703
RMS 0.6635
100
80
60
40
20
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2


Incl. 1M tag best sum of cosine angles with rank 1
without Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with Pi0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 2158
Mean −0.2537
RMS 0.5095
without_cut
Entries 804
Mean −0.2702
RMS 0.655
100
80
60
40
20
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2


Incl. 1M tag bad sum of cosine angles with all ranks
without PI0 and Photon cuts,abs(m_D-1.865)<0.03
with PI0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 2317
Mean −0.4334
RMS 0.8931
without_cut
Entries 886
Mean −0.2979
RMS 1.071
50
40
30
20
10
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2


Incl. 1M tag bad sum of cosine angles with rank 1
without PI0 and Photon cuts,abs(m_D-1.865)<0.03
with PI0 and Photon cuts,abs(m_D-1.865)<0.03
with_pi_and_photon_cut
Entries 2158
Mean −0.4379
RMS 0.8861
without_cut
Entries 804
Mean −0.3108
RMS 1.067
45
40
35
30
25
20
15
10
5
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2

Thanks