2023 INTT workshop
2nd flush report

Nov./14/2023 Misaki Hata (NWU)

dN/deta with cluster method

Misaki Hata
(NWU)

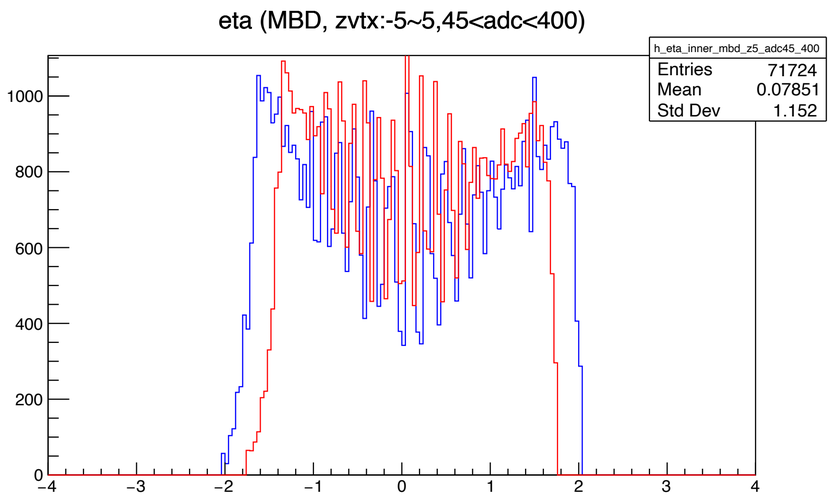
Analyzing dN/Deta using cluster method

Goal in this workshop: Analysis of raw data, Checking Simulation code

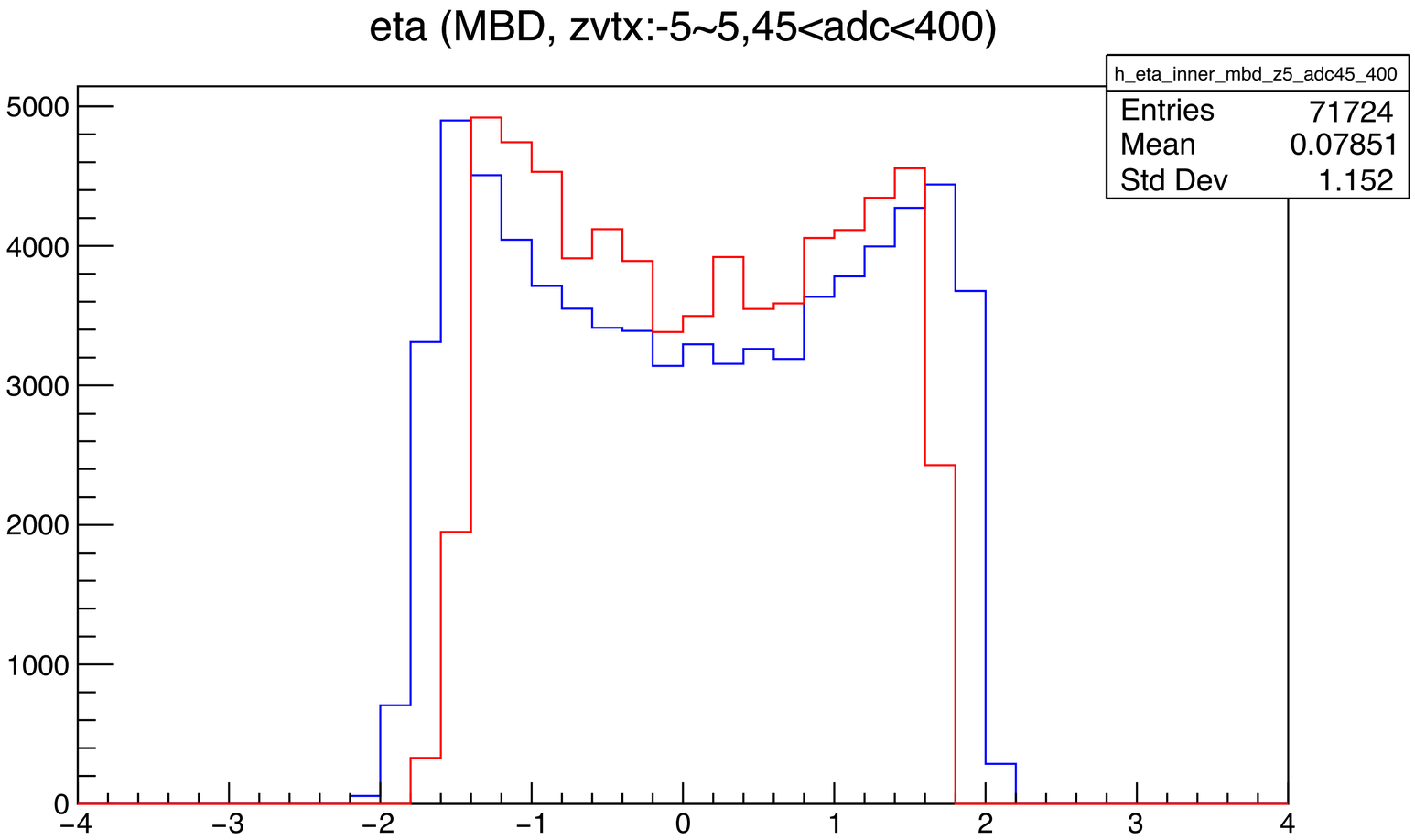
My To-Do List (Nov. 8, 2023)

- Analysis of raw data
  - Checking ADC distribution for each theta range (Draw) ->Done
  - Checking theta distribution cutting at Zvtx and ADC ->Done
  - Checking eta distribution after rebin ->Done
  - Fixing MBD charge vs INTT cluster 2D distribution ->Done
  - Checking ADC distribution cutting at ncluster
- Checking Simulation code
  - InttClusterizer.cc
  - PHG4InttDigitizer.cc
  - PHG4InttHitReco.cc
  - G4_TrkrSimulation.C
- Analysis of Simulation data
  - Doing same thing with raw data analysis (without distribution using ADC value)

eta distribution

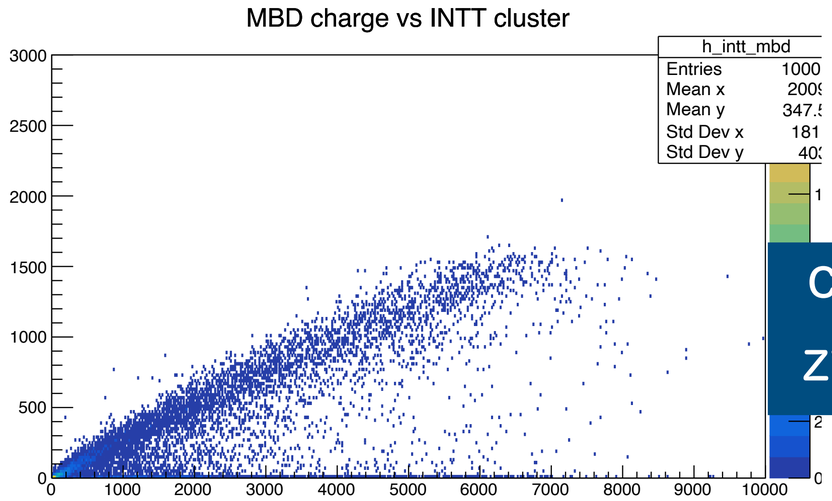


before rebin

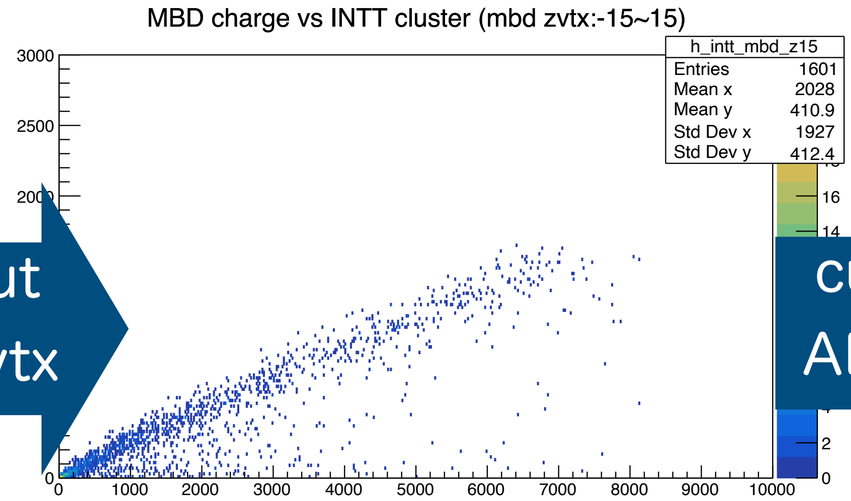


after rebin

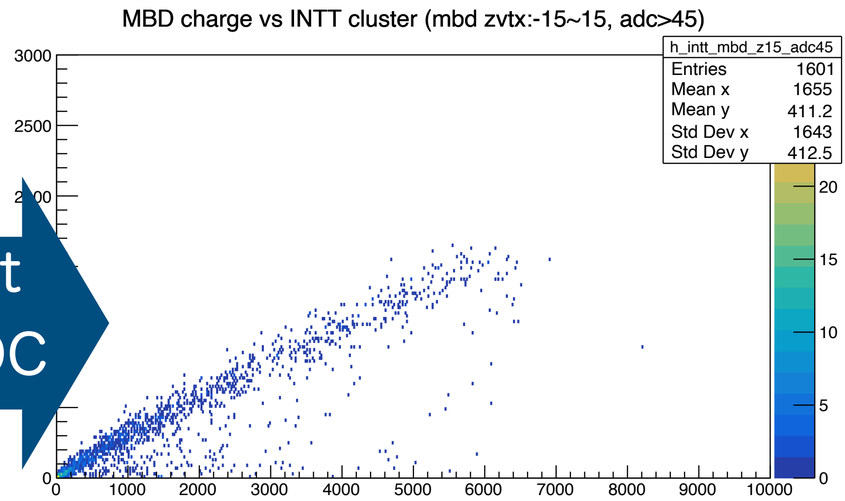
MBD charge vs INTT cluster

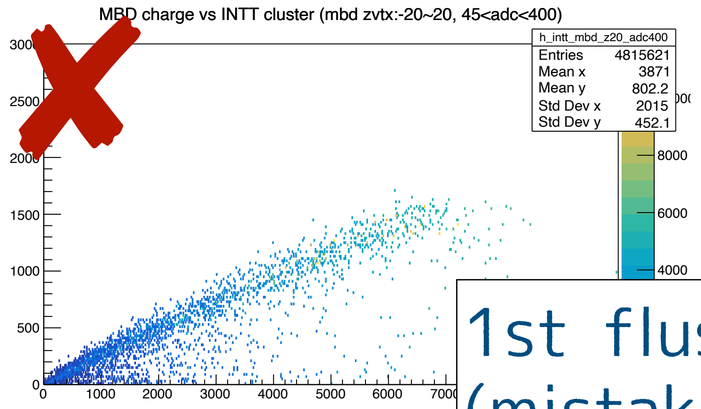


cut zvtx



cut ADC

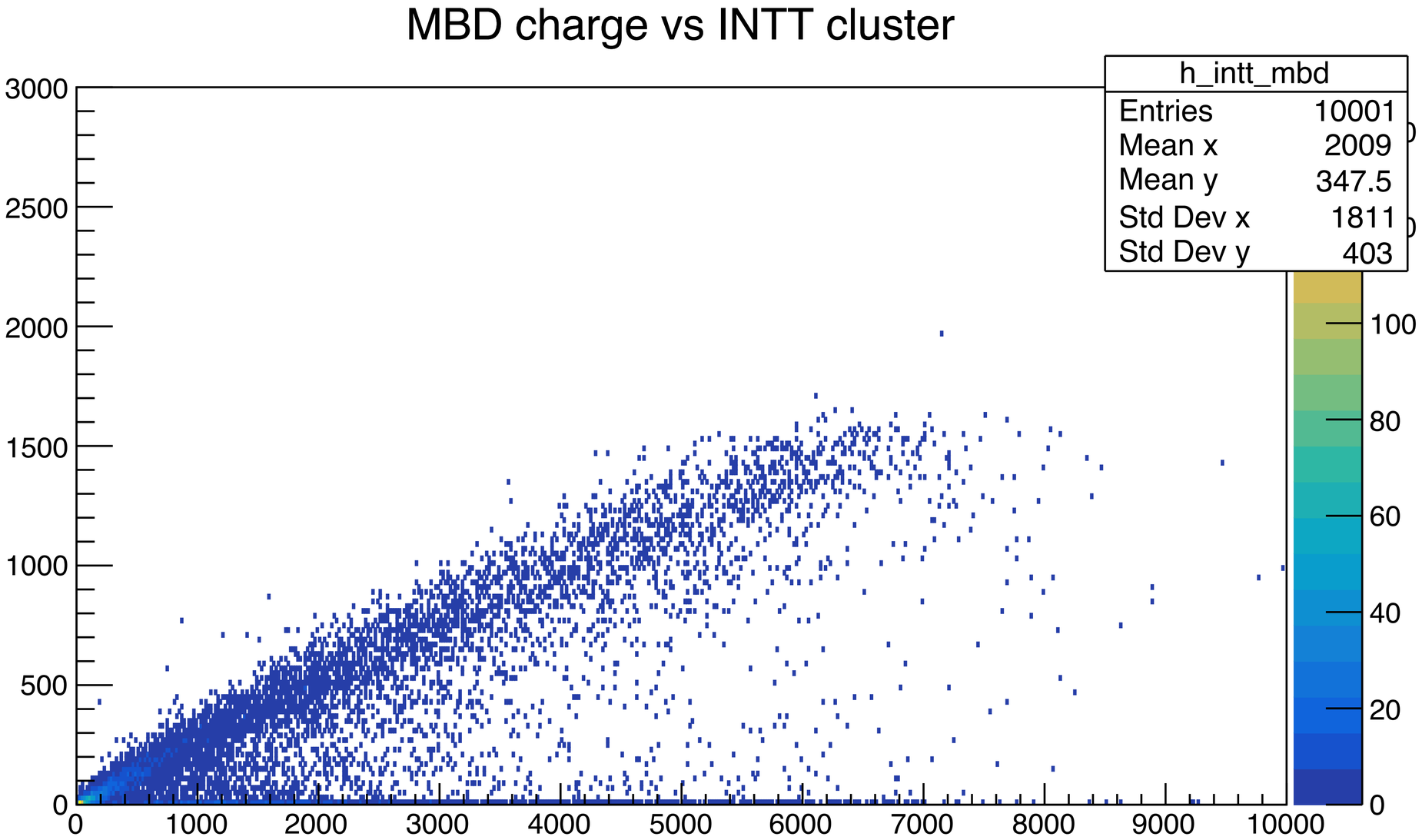




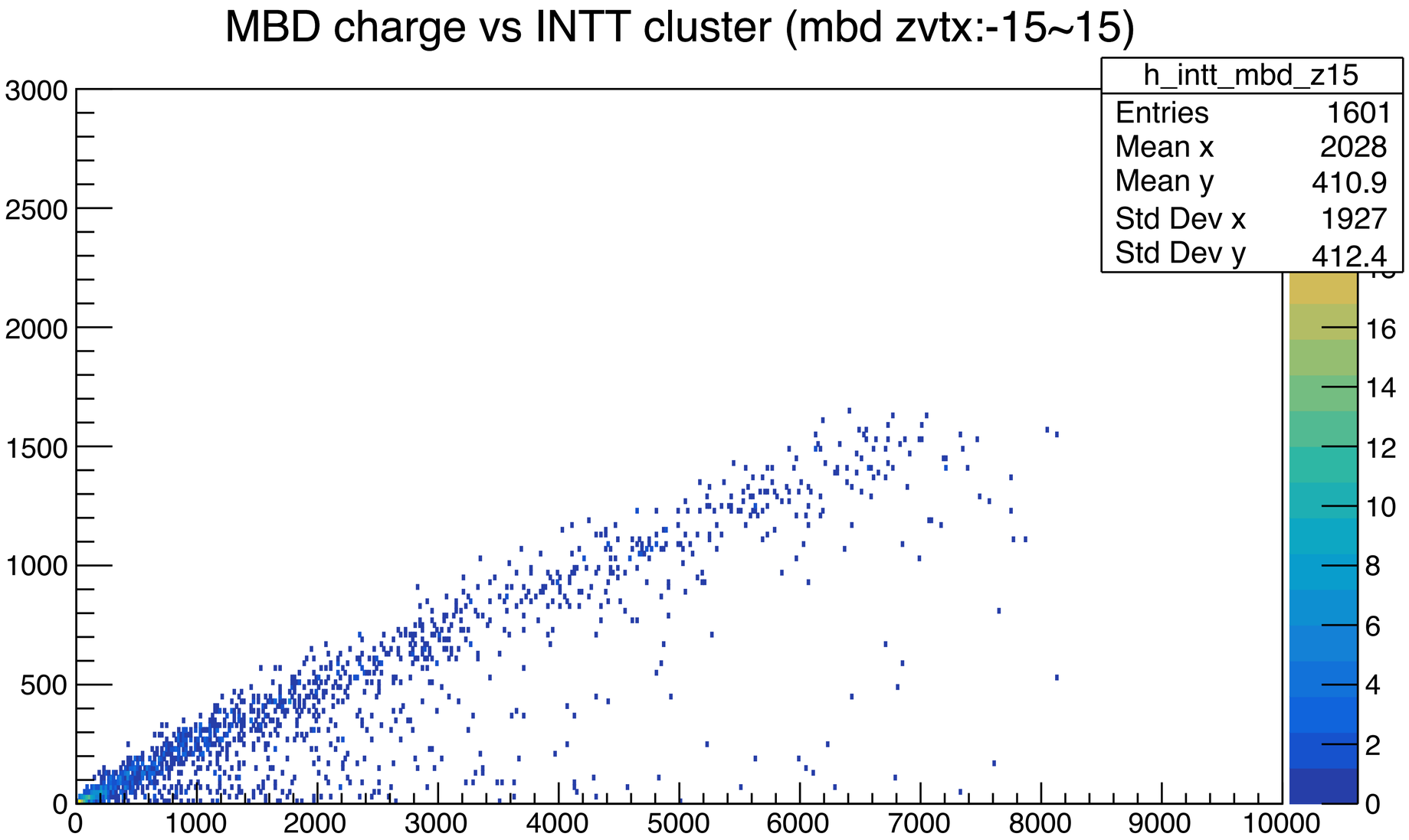
1st flush report (mistake)

- After cutting at Zvtx, MBD charge vs INTT cluster distribution is clearly than before.
- After cutting at ADC, MBD charge vs INTT cluster distribution is moved left than before.

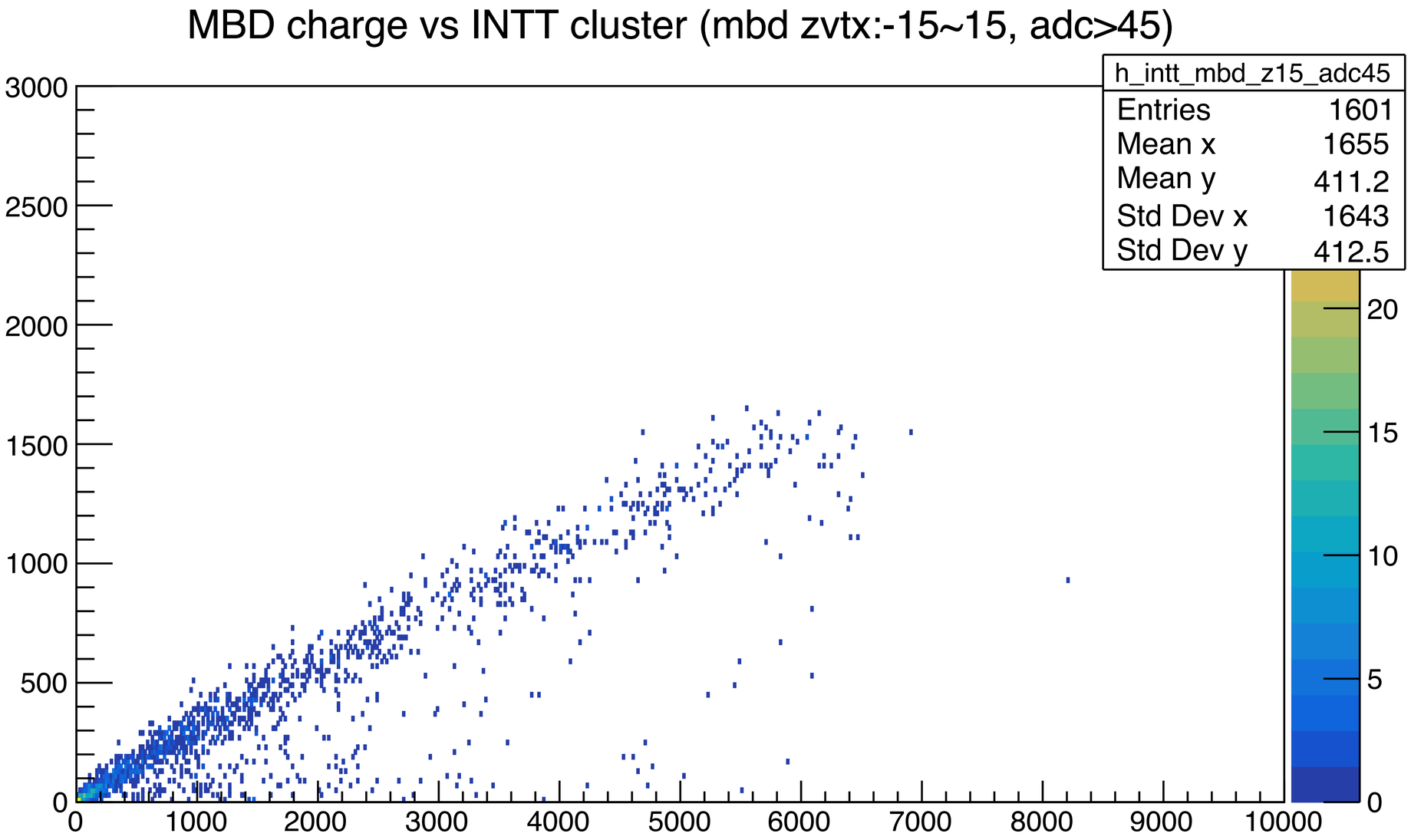
MBD charge vs INTT cluster (no cut)



MBD charge vs INTT cluster (Zvtx: -15~15)

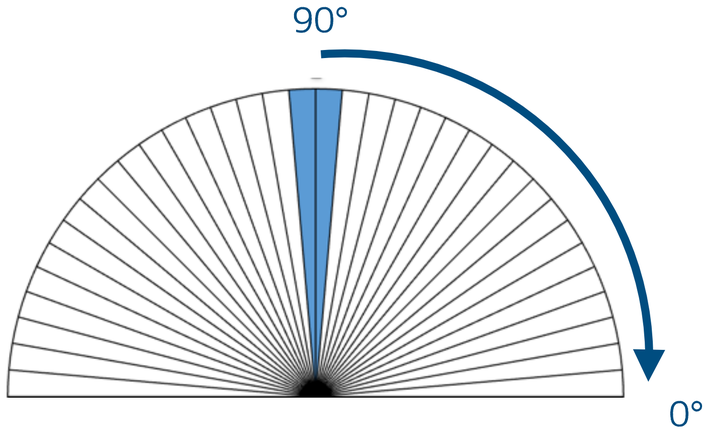


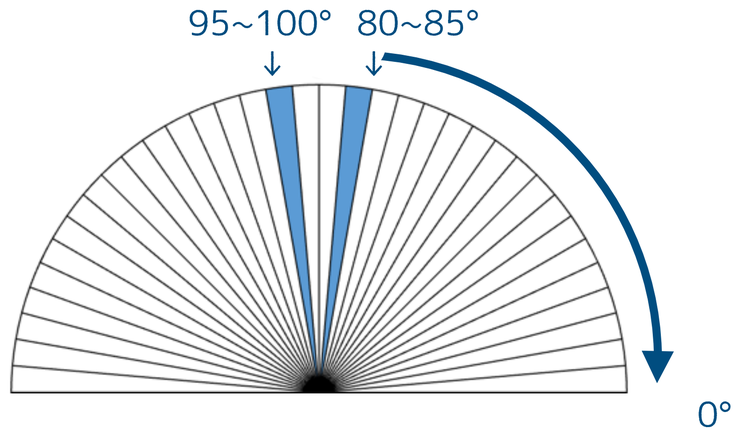
MBD charge vs INTT cluster (Zvtx:-15~15, ADC>45)



ADC distribution (each theta)

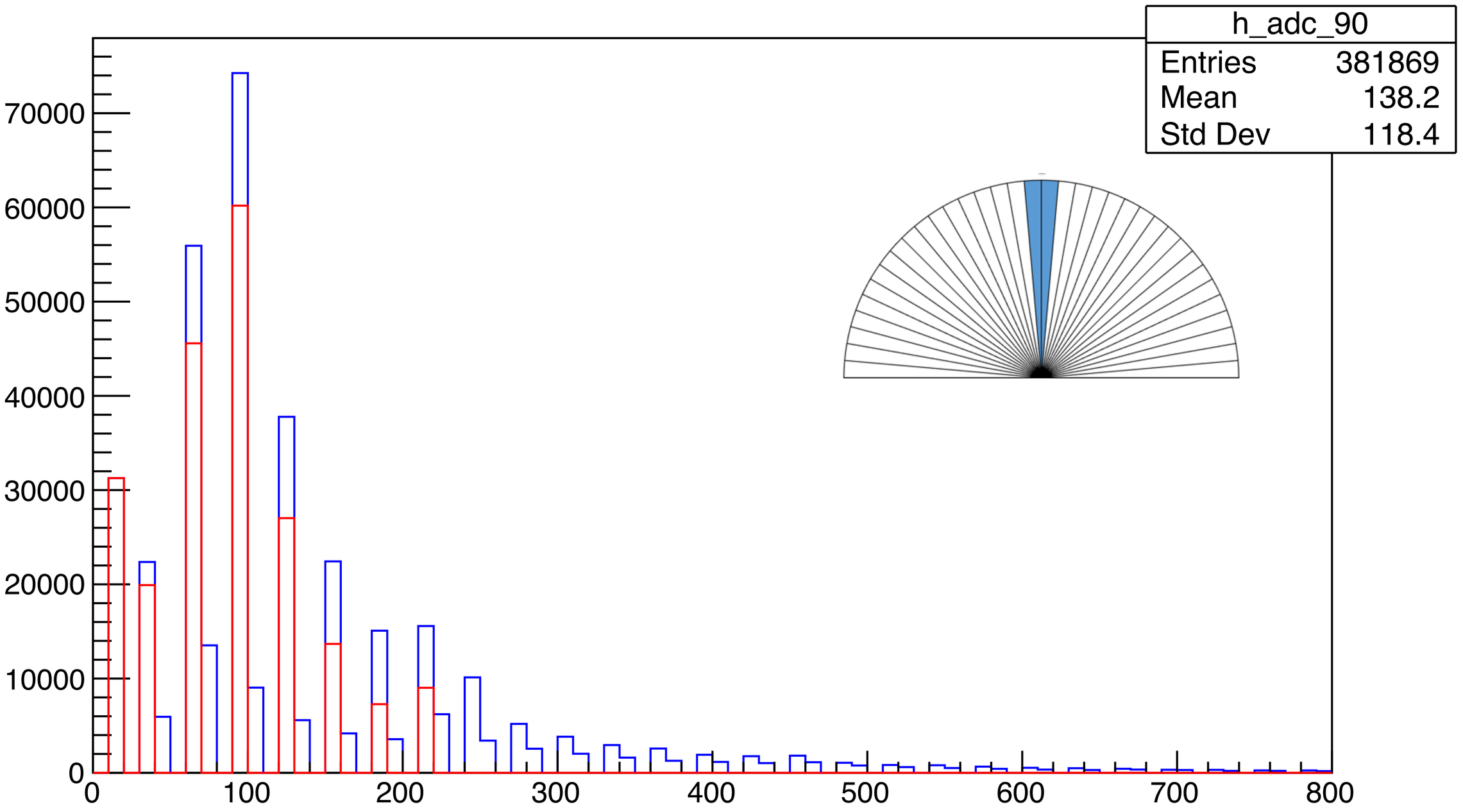
- I checked ADC distribution of each theta.
- Theta is changed like right figure.

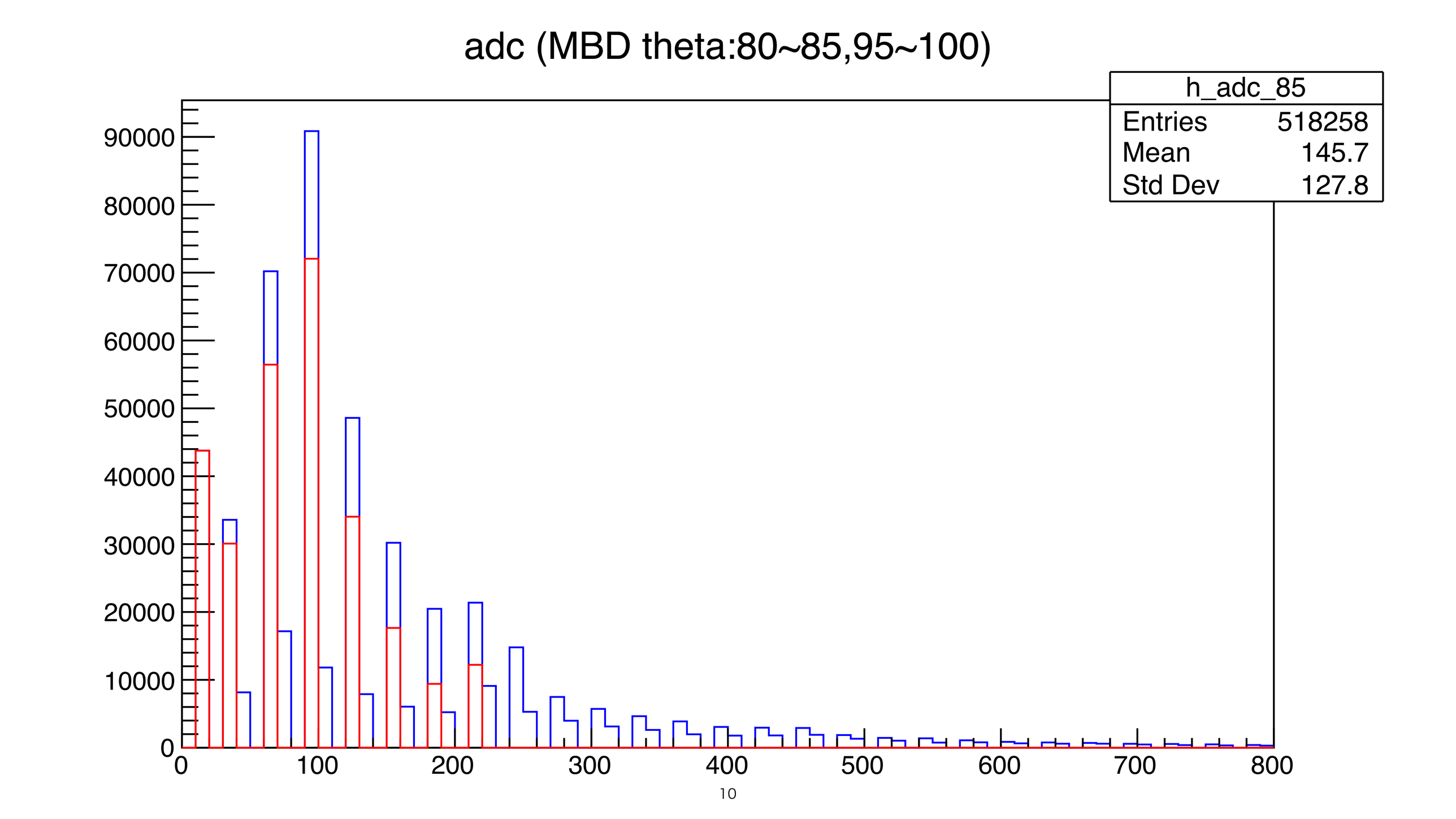


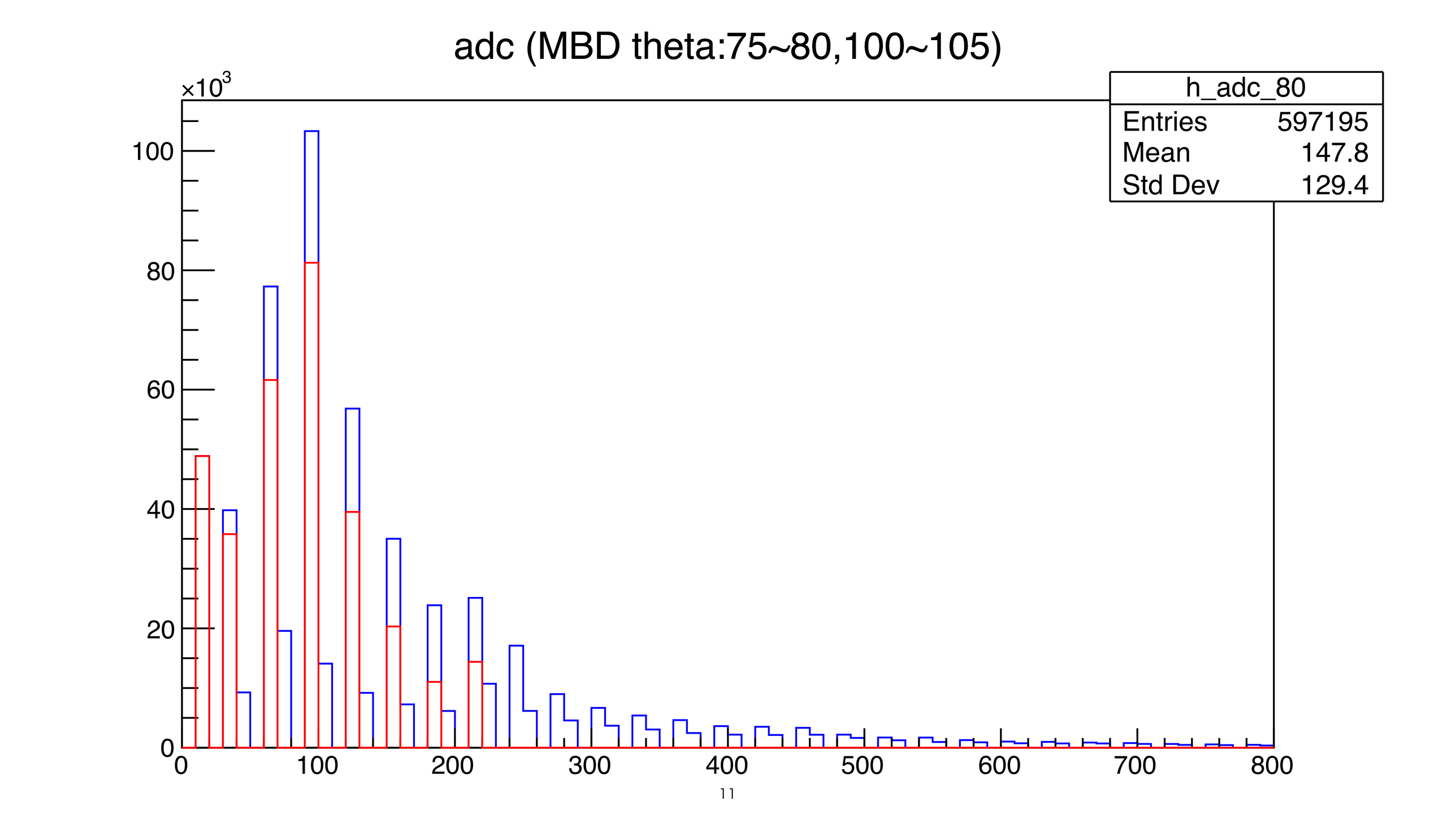


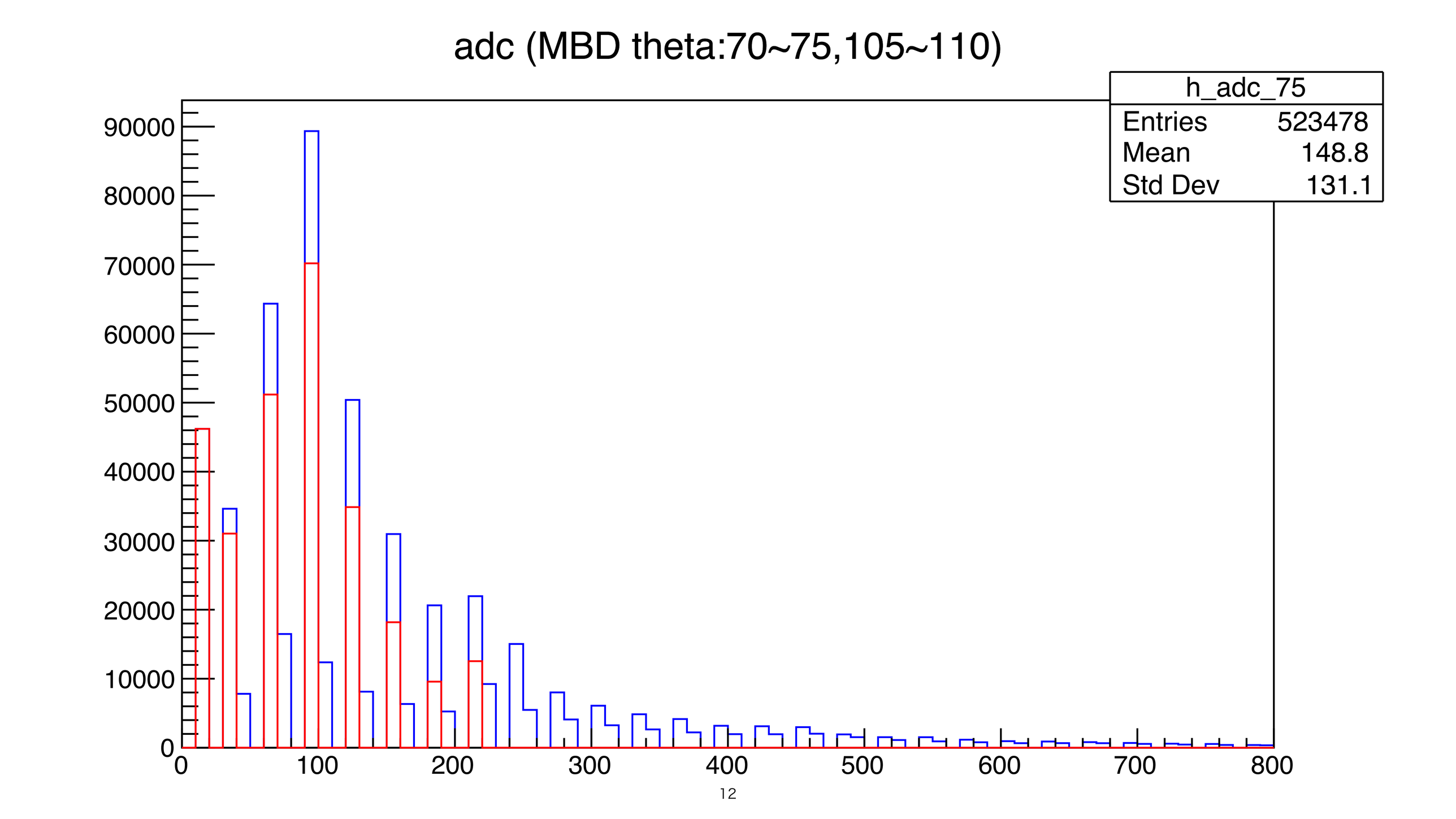
- The peak of ADC distribution moves to larger value if theta is changed from vertical to horizontal. (Next pages)

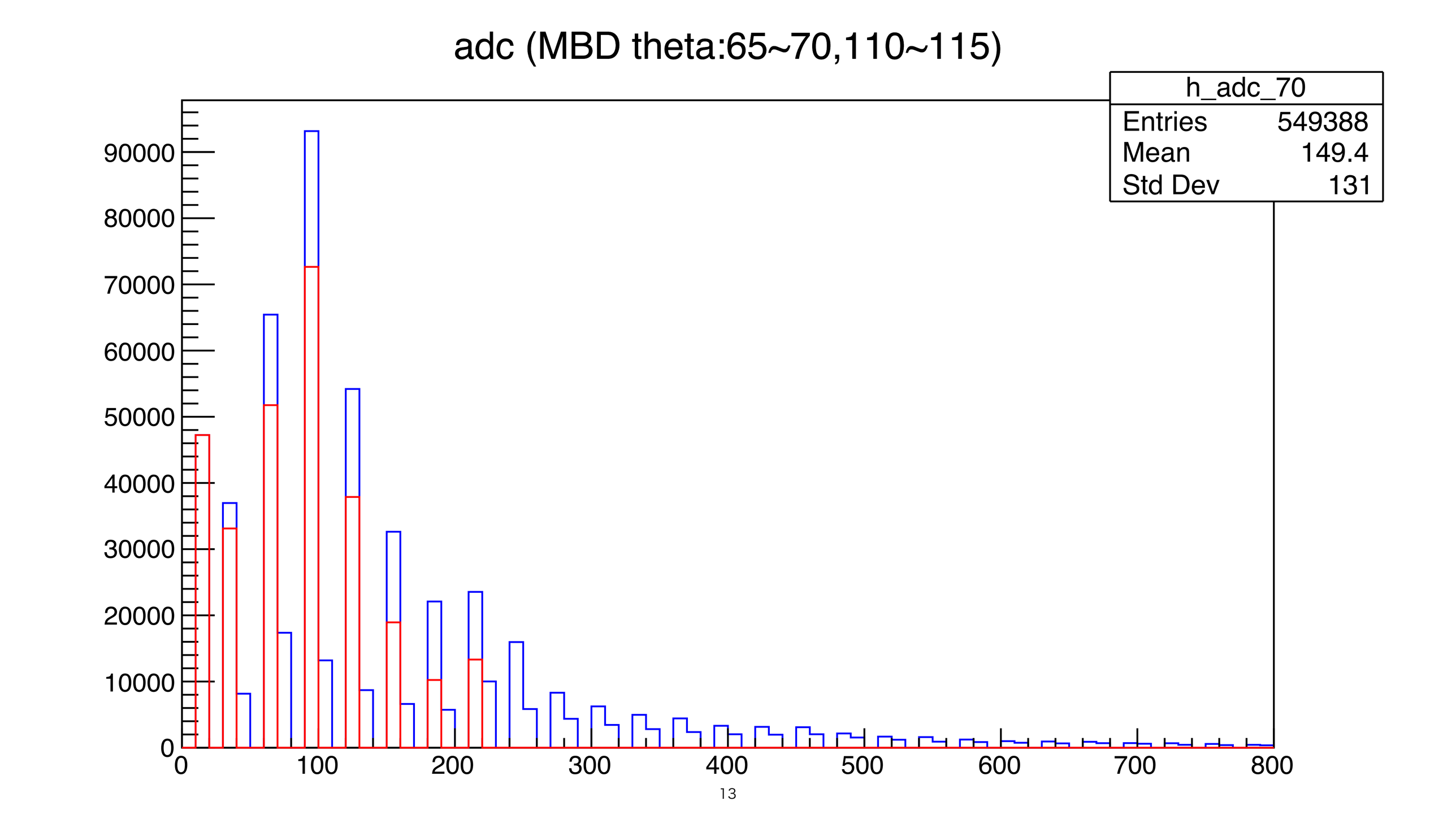
adc (MBD theta:85~95)

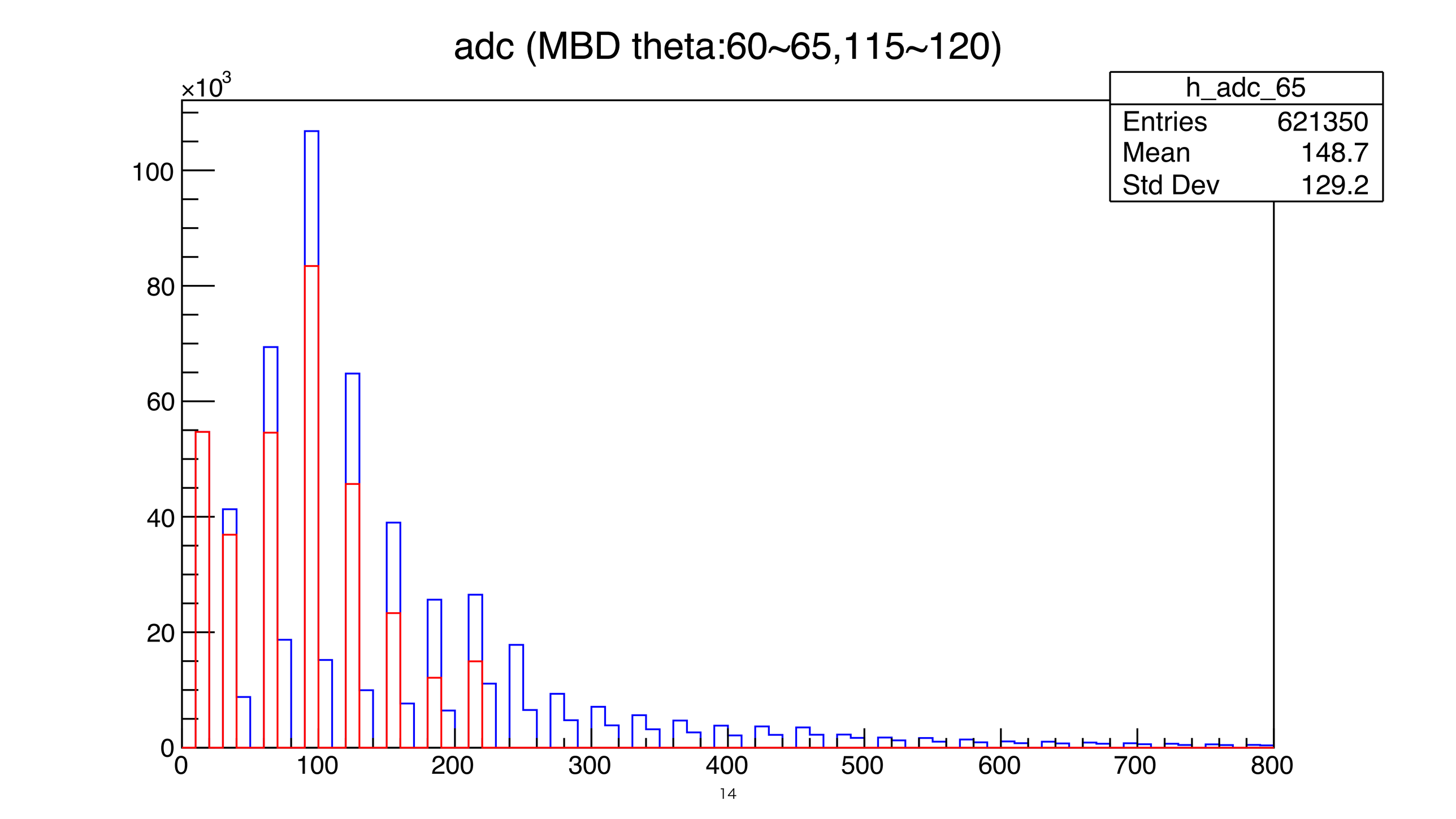


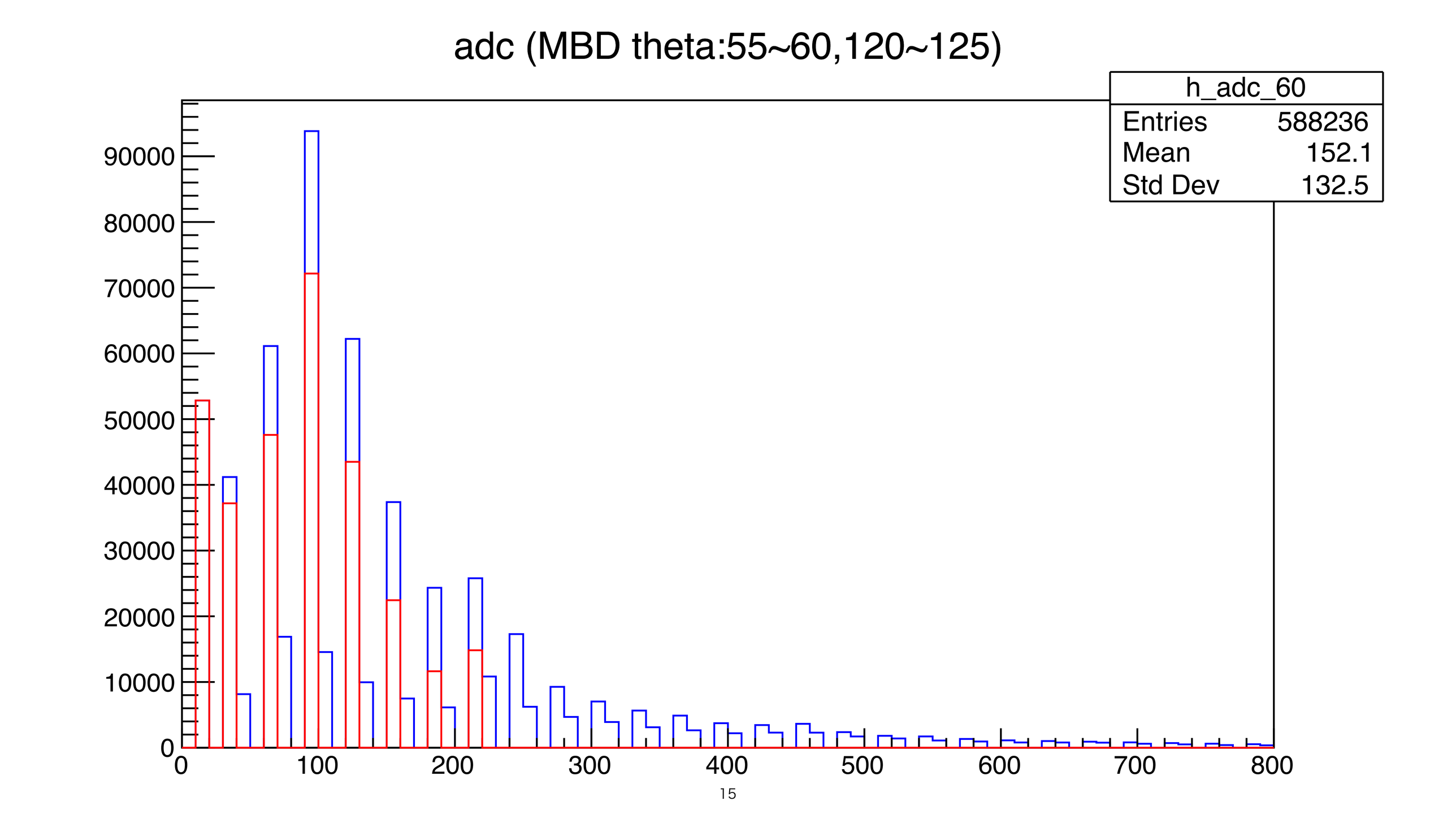

adc (MBD theta:80~85,95~100)
h_adc_85
Entries 518258
Mean 145.7
Std Dev 127.8
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
100
200
300
400
500
600
700
800

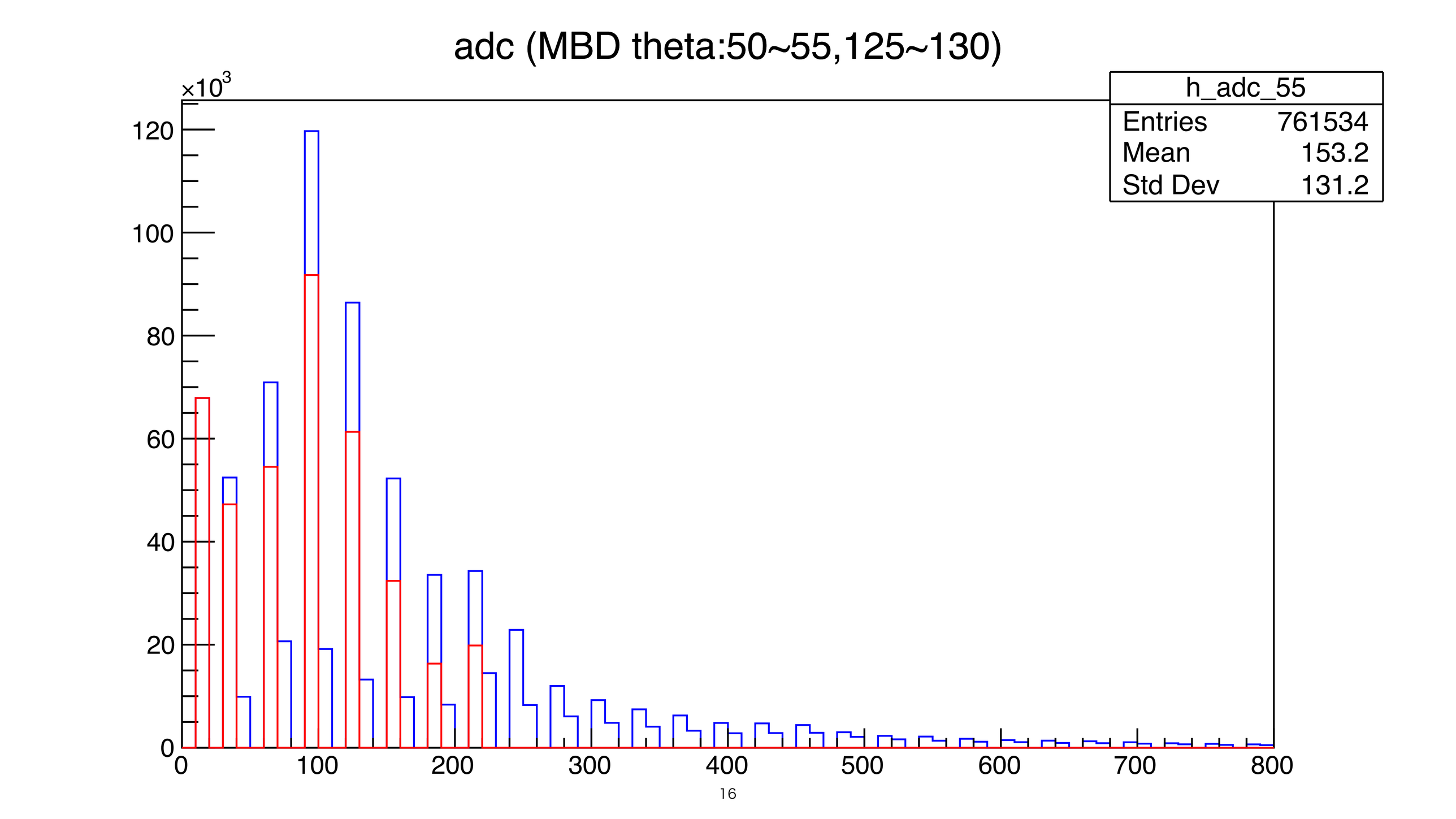

adc (MBD theta:75~80,100~105)
×10^3
h_adc_80
Entries 597195
Mean 147.8
Std Dev 129.4
100
80
60
40
20
0
0
100
200
300
400
500
600
700
800

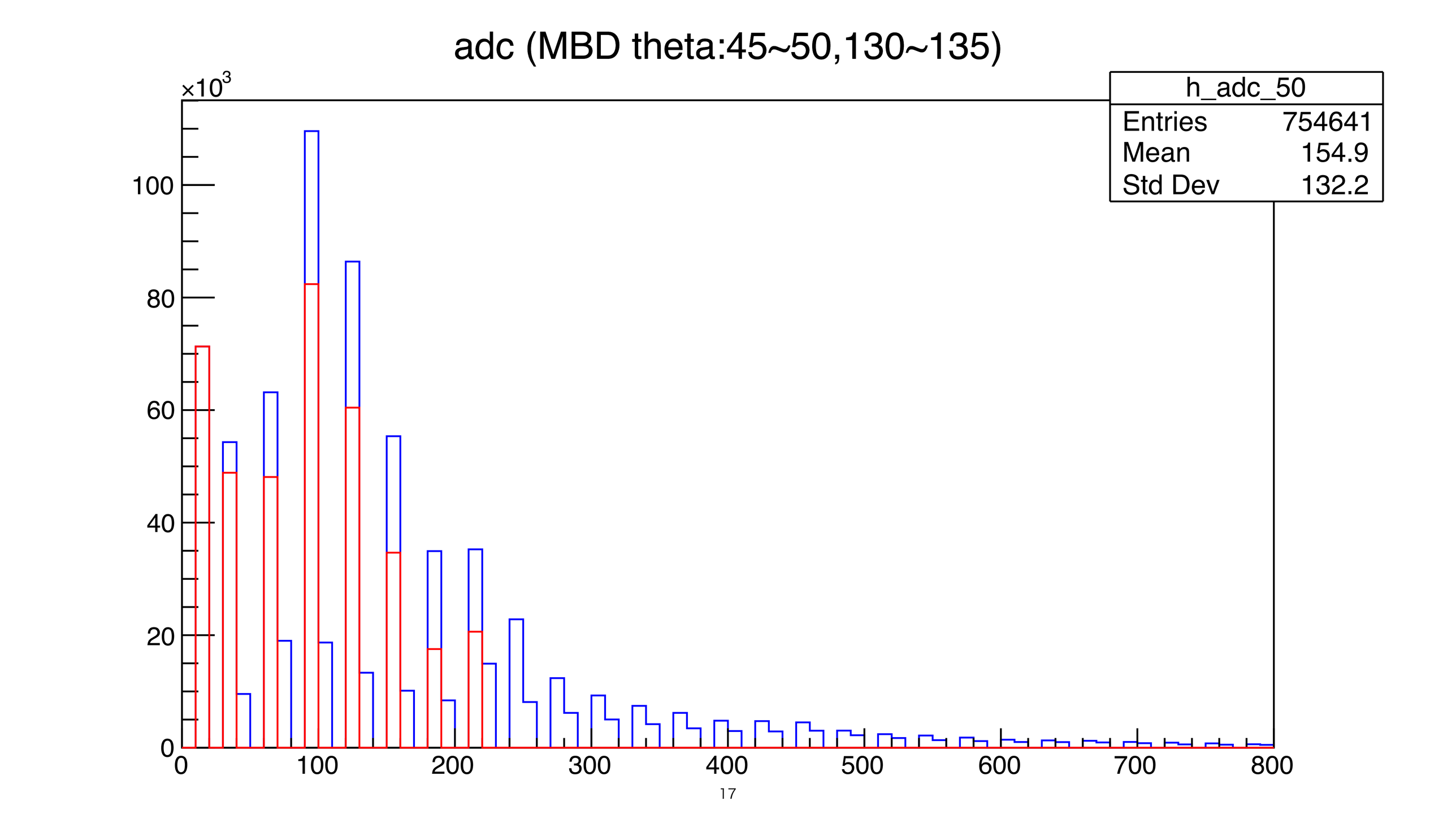

adc (MBD theta:70~75,105~110)
h_adc_75
Entries 523478
Mean 148.8
Std Dev 131.1
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
100
200
300
400
500
600
700
800

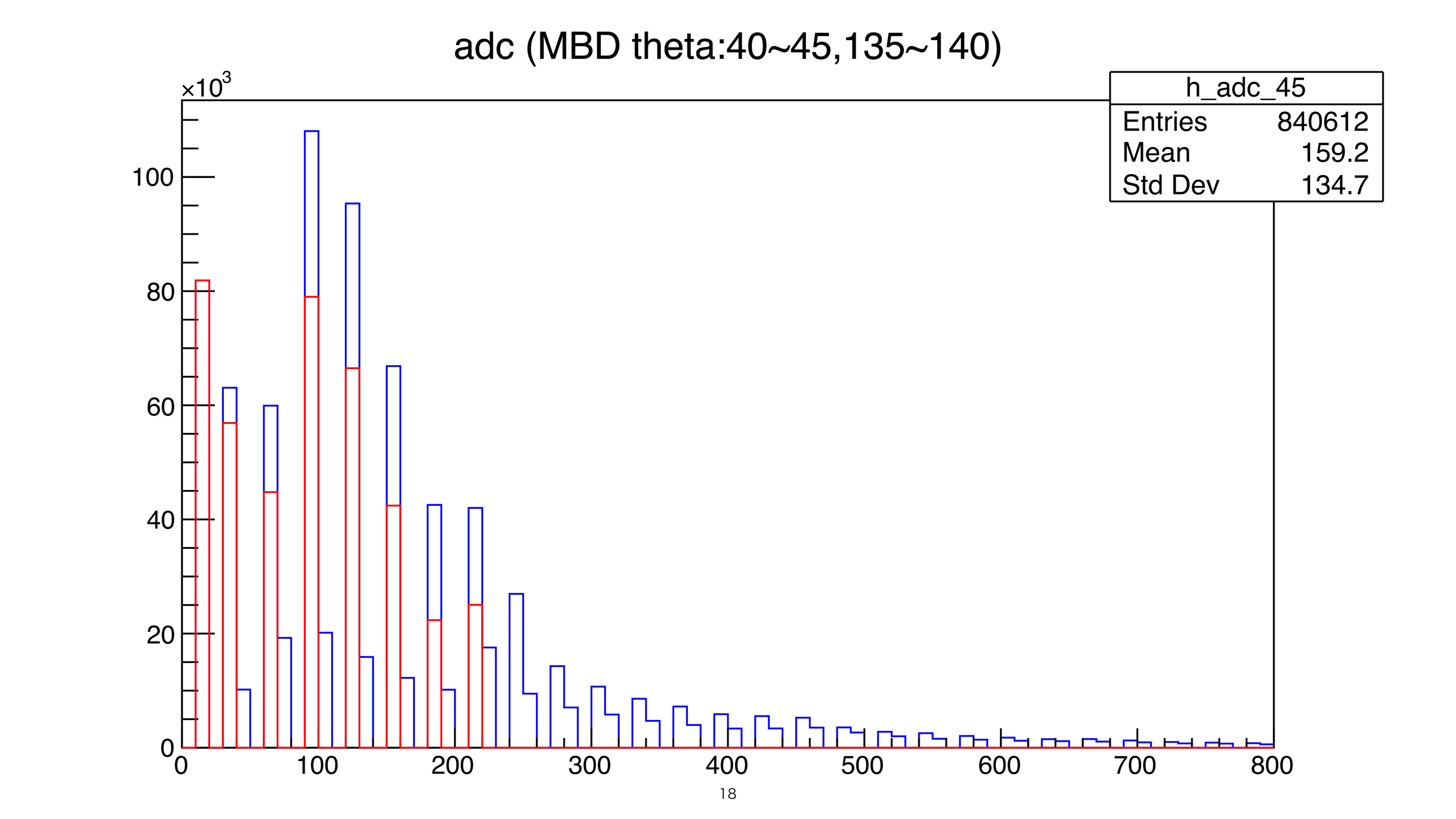

adc (MBD theta:65~70,110~115)
h_adc_70
Entries 549388
Mean 149.4
Std Dev 131
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
100
200
300
400
500
600
700
800

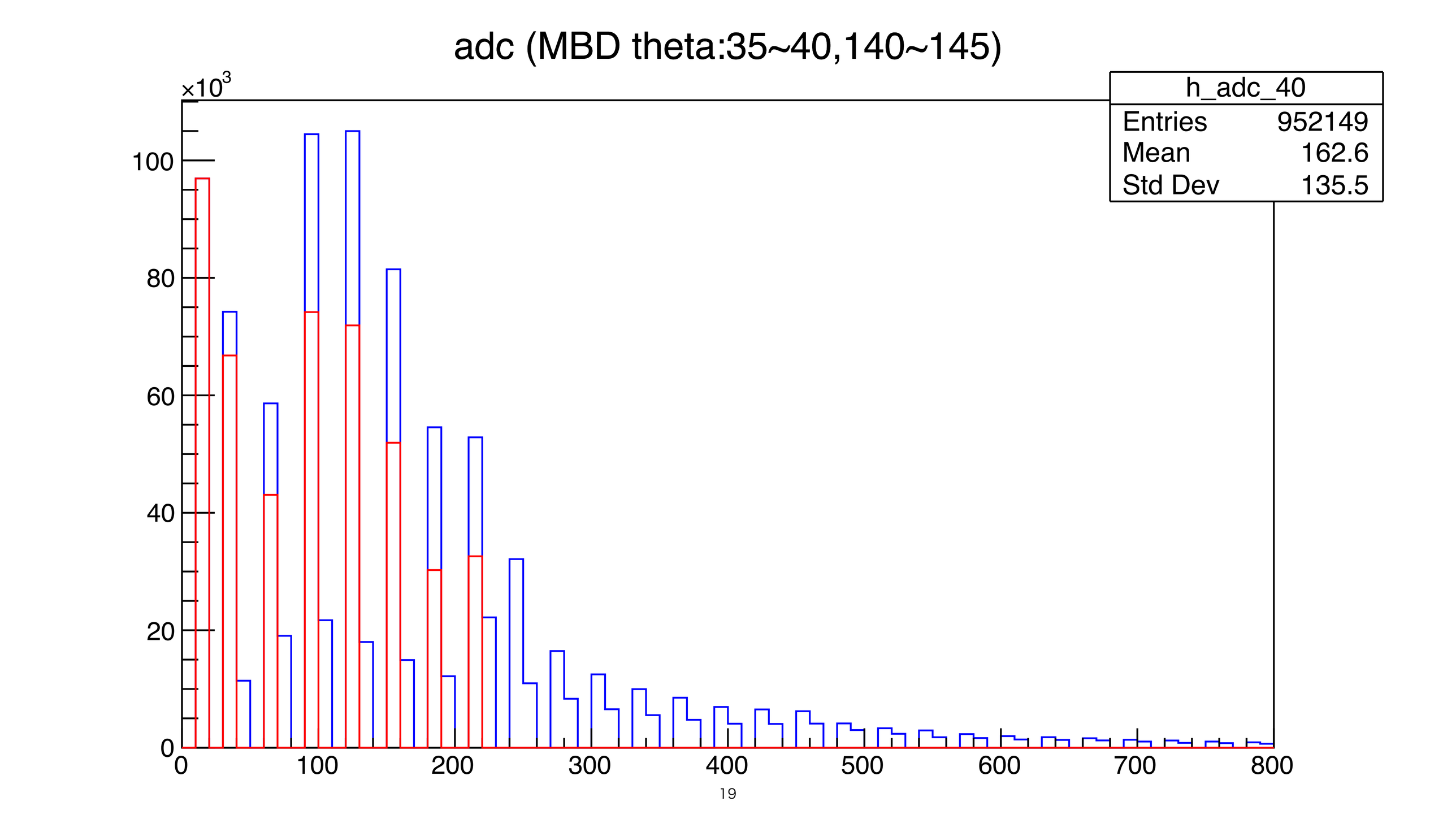

adc (MBD theta:60~65,115~120)
×10^3
h_adc_65
Entries 621350
Mean 148.7
Std Dev 129.2
0
20
40
60
80
100
0
100
200
300
400
500
600
700
800

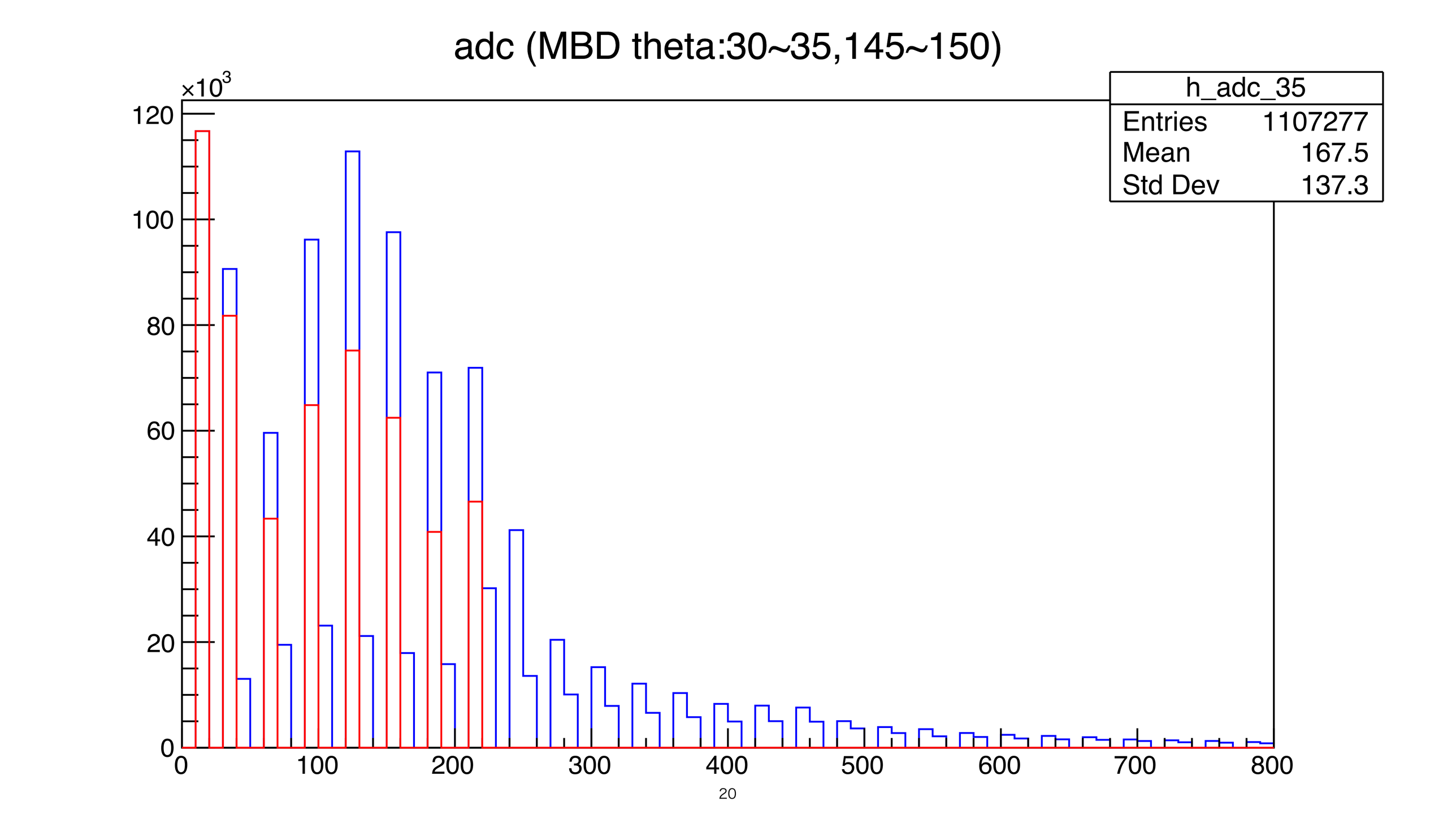

adc (MBD theta:55~60,120~125)
h_adc_60
Entries 588236
Mean 152.1
Std Dev 132.5
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
100
200
300
400
500
600
700
800

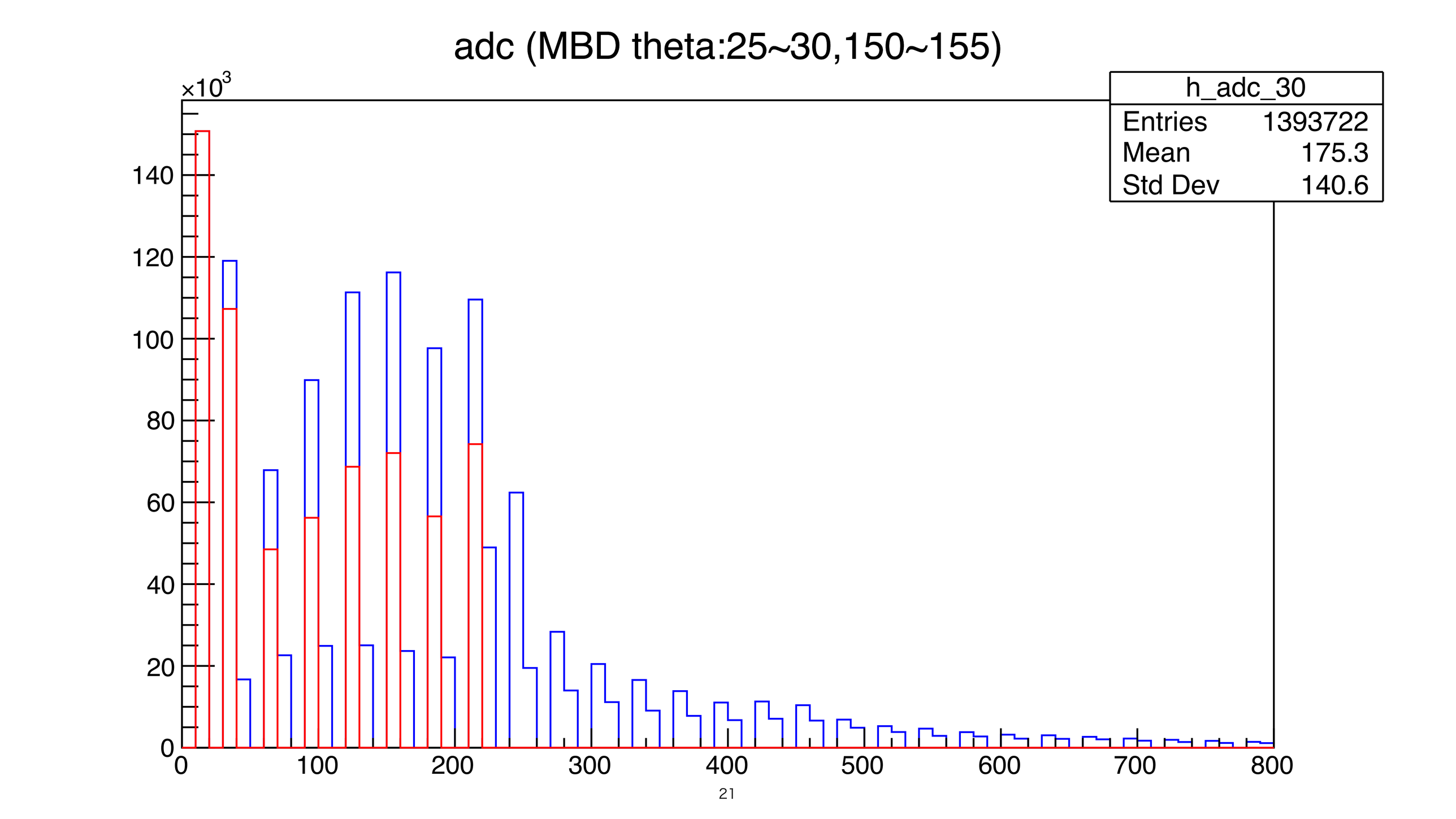

adc (MBD theta:50~55,125~130)
×10^3
h_adc_55
Entries 761534
Mean 153.2
Std Dev 131.2
120
100
80
60
40
20
0
0
100
200
300
400
500
600
700
800

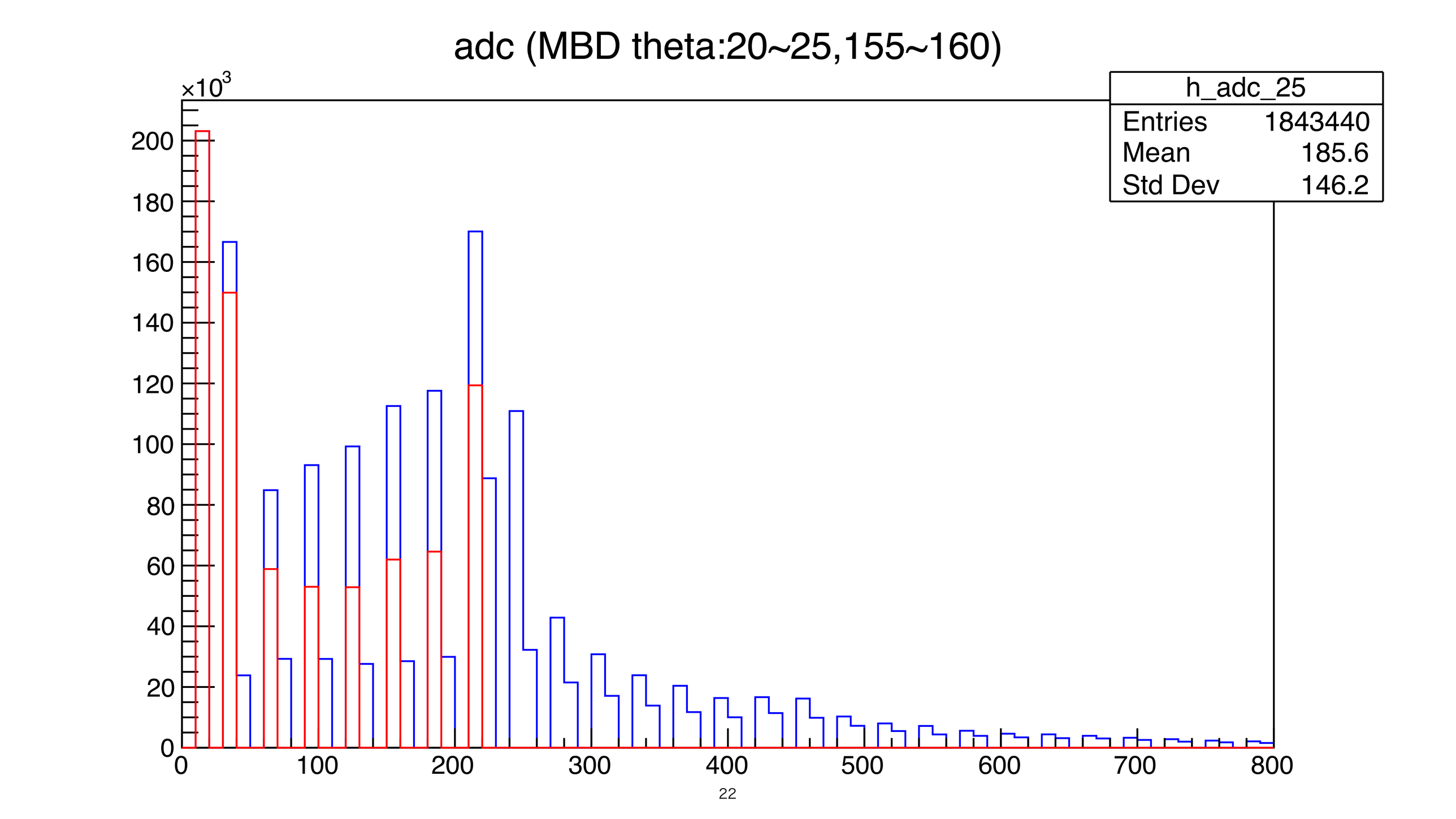

adc (MBD theta:45~50,130~135)
×10^3
h_adc_50
Entries 754641
Mean 154.9
Std Dev 132.2
0
20
40
60
80
100
0
100
200
300
400
500
600
700
800

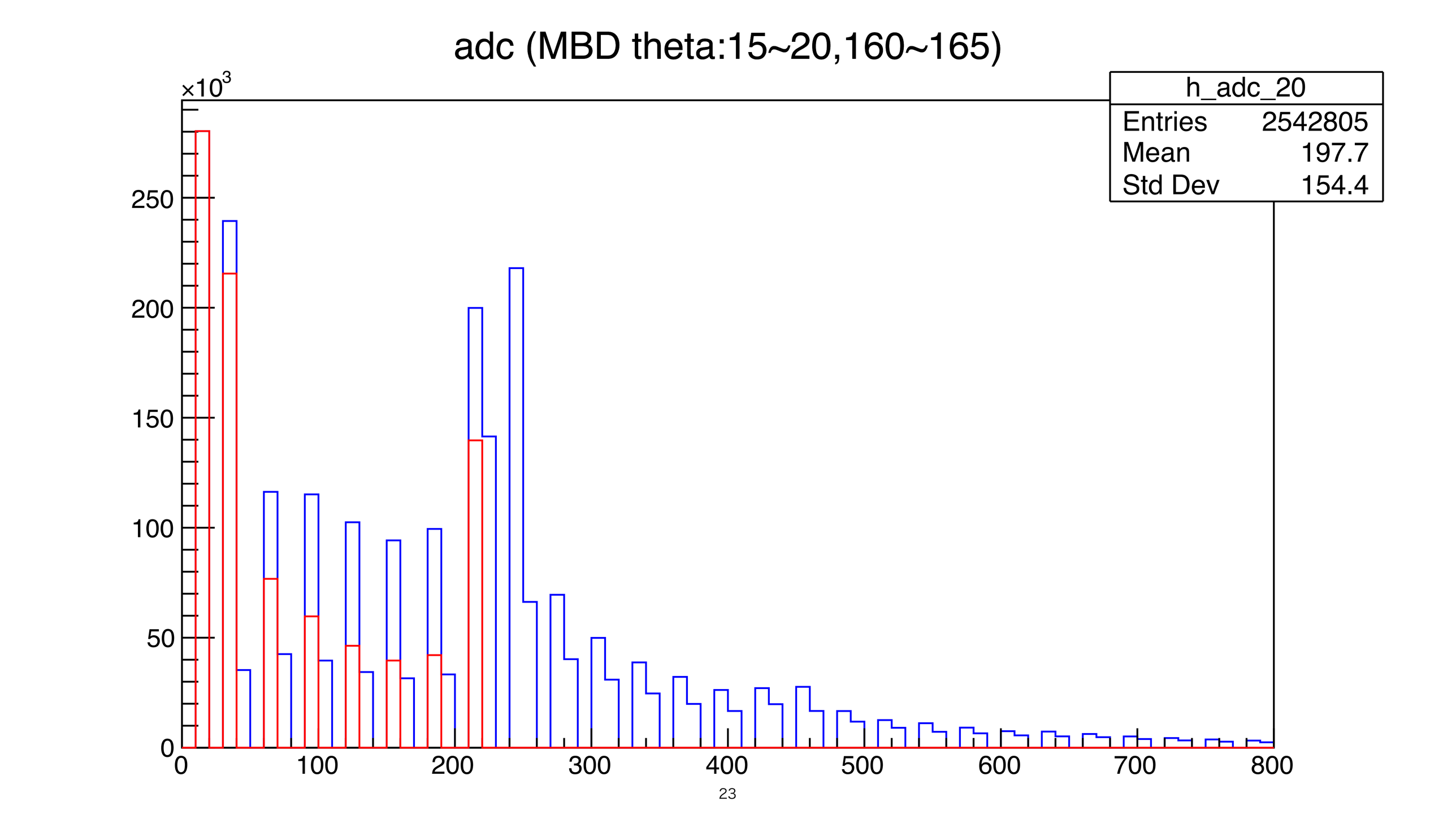

adc (MBD theta:40~45,135~140)
×10^3
h_adc_45
Entries 840612
Mean 159.2
Std Dev 134.7
0
20
40
60
80
100
0
100
200
300
400
500
600
700
800

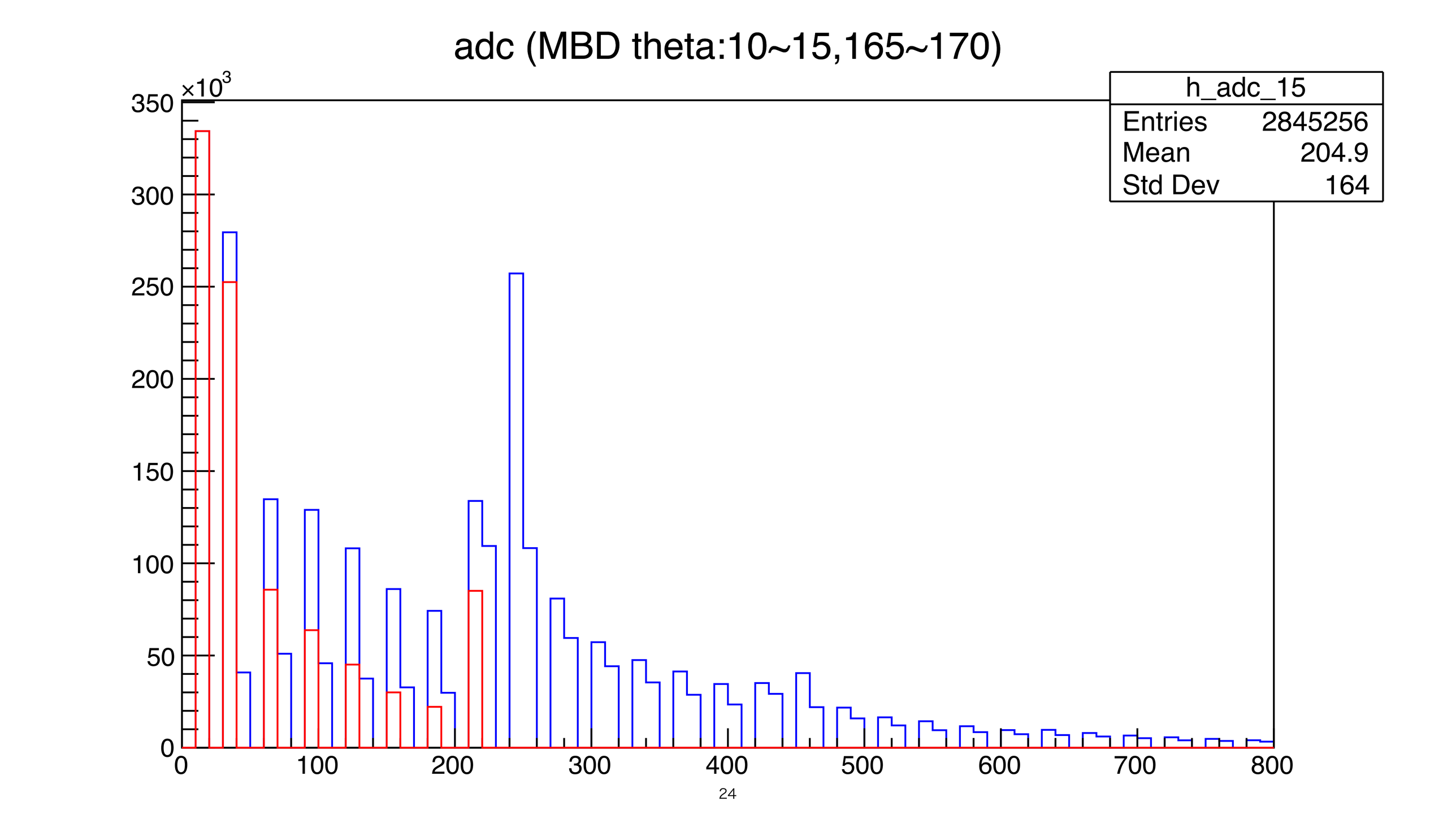

adc (MBD theta:35~40,140~145)
×10^3
h_adc_40
Entries 952149
Mean 162.6
Std Dev 135.5
0
20
40
60
80
100
0
100
200
300
400
500
600
700
800

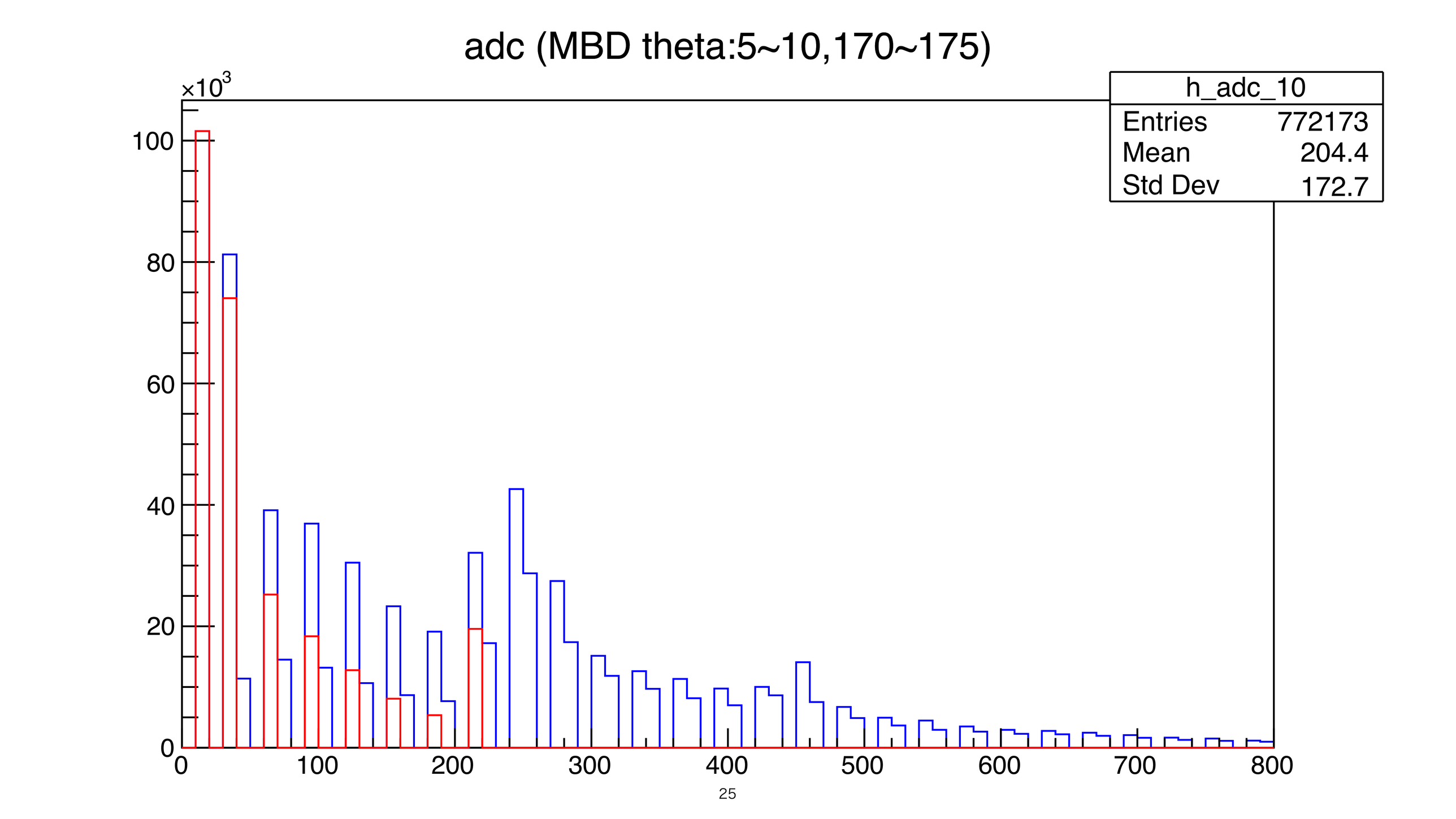

adc (MBD theta:30~35,145~150)
×10^3
120
100
80
60
40
20
0
0
100
200
300
400
500
600
700
800
h_adc_35
Entries 1107277
Mean 167.5
Std Dev 137.3


adc (MBD theta:25~30,150~155)
×10^3
h_adc_30
Entries 1393722
Mean 175.3
Std Dev 140.6
0
20
40
60
80
100
120
140
0
100
200
300
400
500
600
700
800

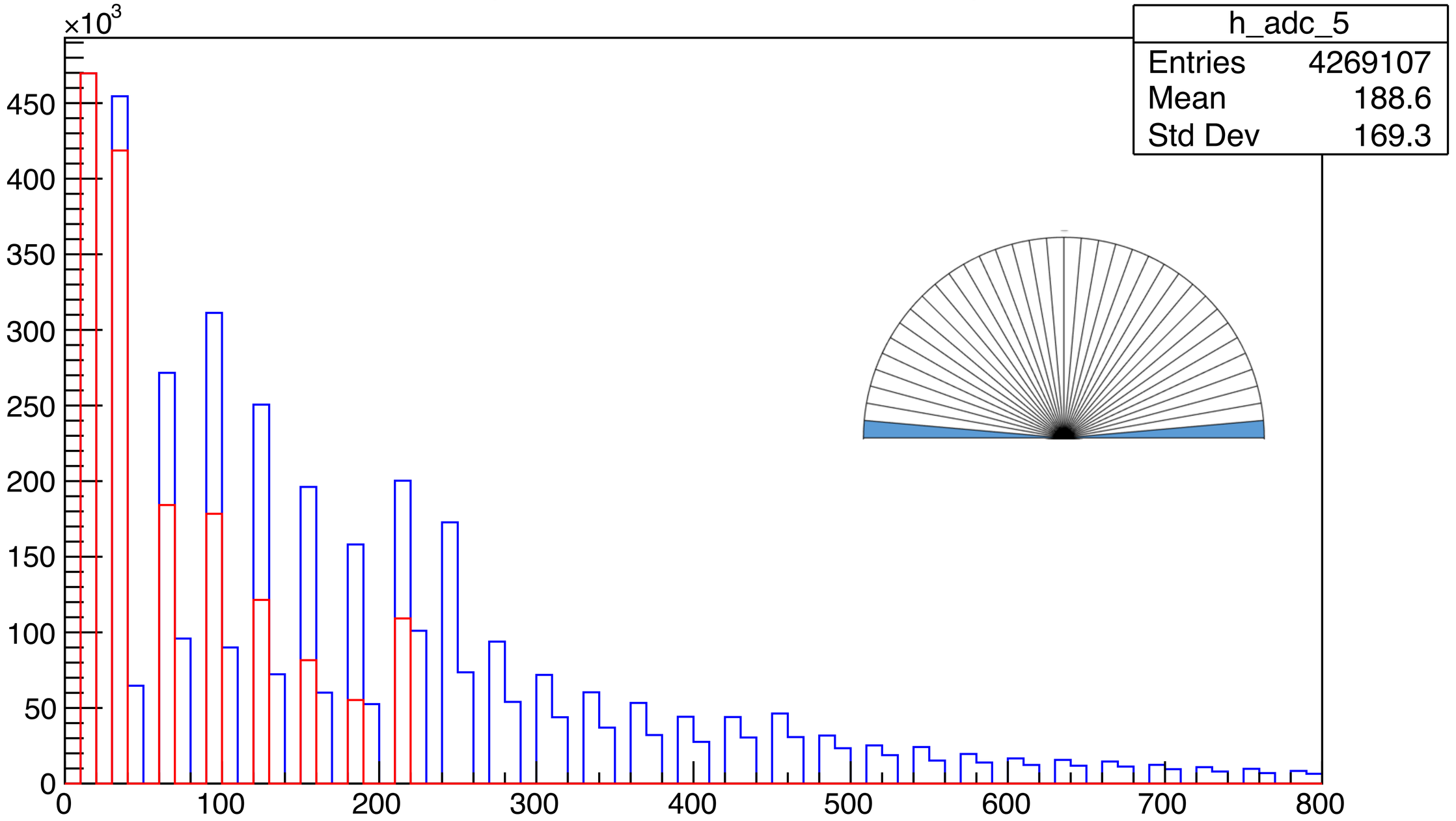

adc (MBD theta:20~25,155~160)
×10^3
h_adc_25
Entries 1843440
Mean 185.6
Std Dev 146.2
200
180
160
140
120
100
80
60
40
20
0
0
100
200
300
400
500
600
700
800


adc (MBD theta:15~20,160~165)
×10^3
h_adc_20
Entries 2542805
Mean 197.7
Std Dev 154.4
250
200
150
100
50
0
0
100
200
300
400
500
600
700
800

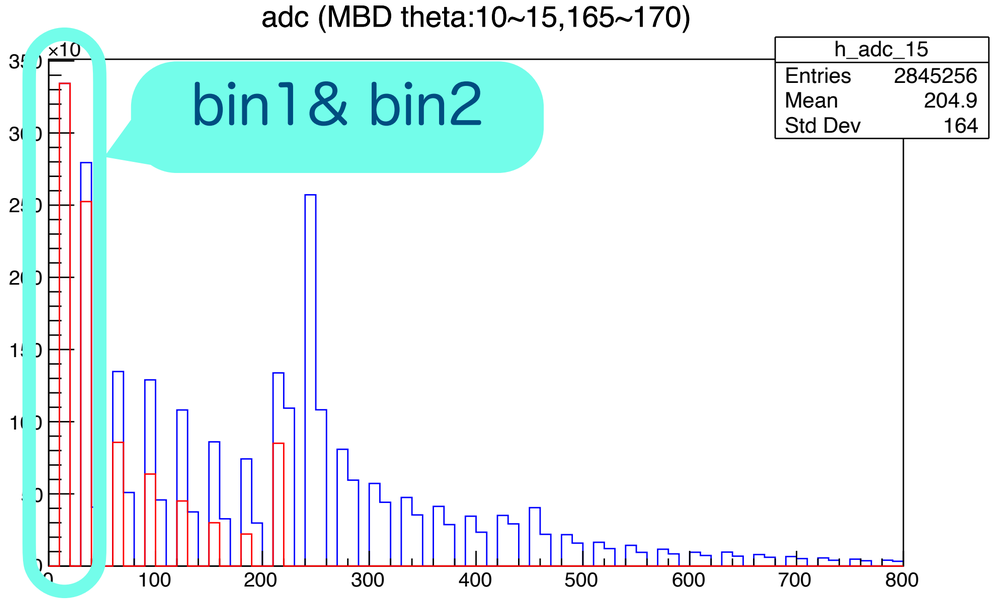

adc (MBD theta:10~15,165~170)
×10^3
350
300
250
200
150
100
50
0
0
100
200
300
400
500
600
700
800
h_adc_15
Entries 2845256
Mean 204.9
Std Dev 164

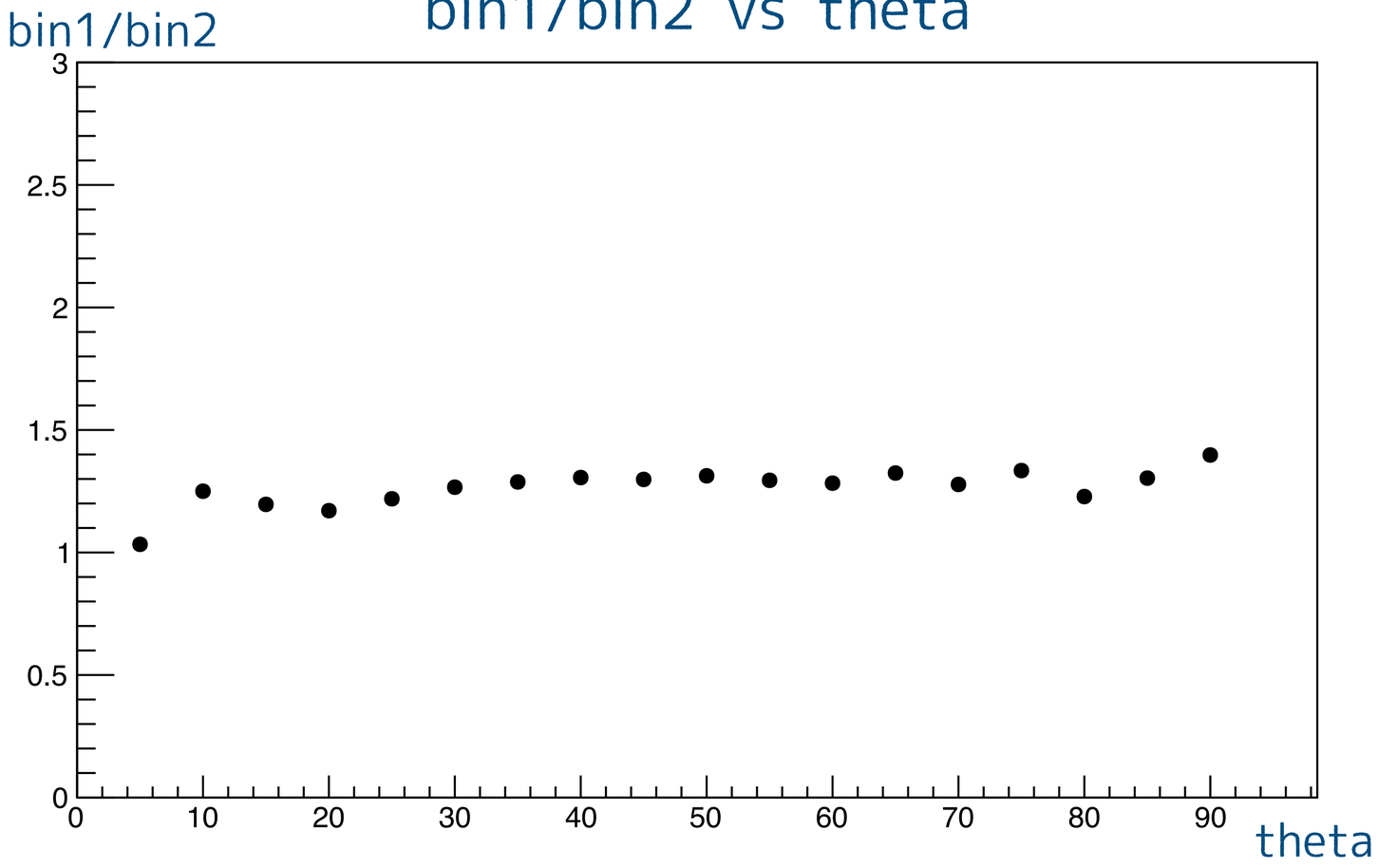

adc (MBD theta:5~10,170~175)
h_adc_10
Entries 772173
Mean 204.4
Std Dev 172.7
×10^3
100
80
60
40
20
0
0
100
200
300
400
500
600
700
800

adc (MBD theta:0~5,175~180)



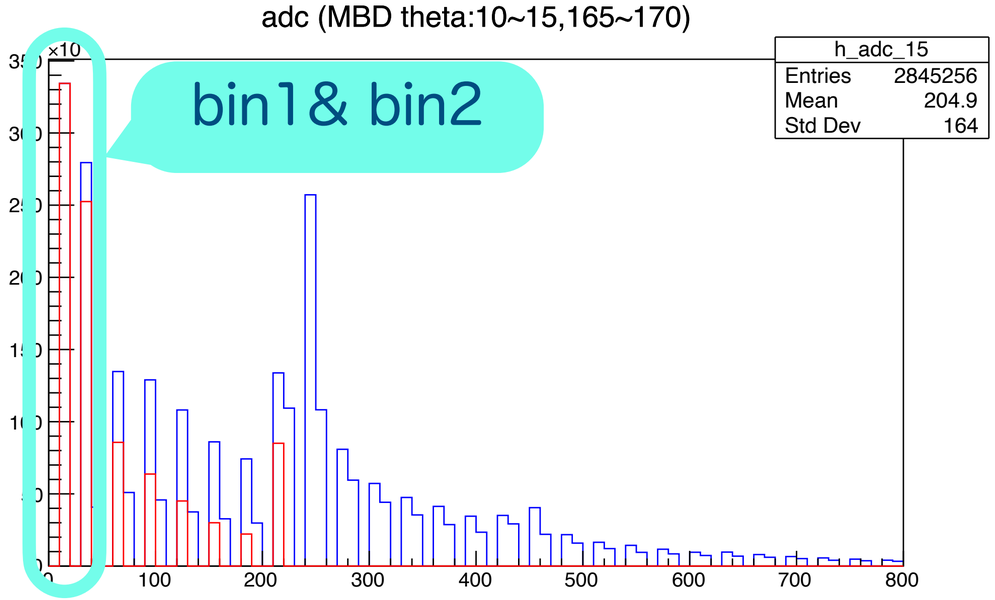
ADC distribution

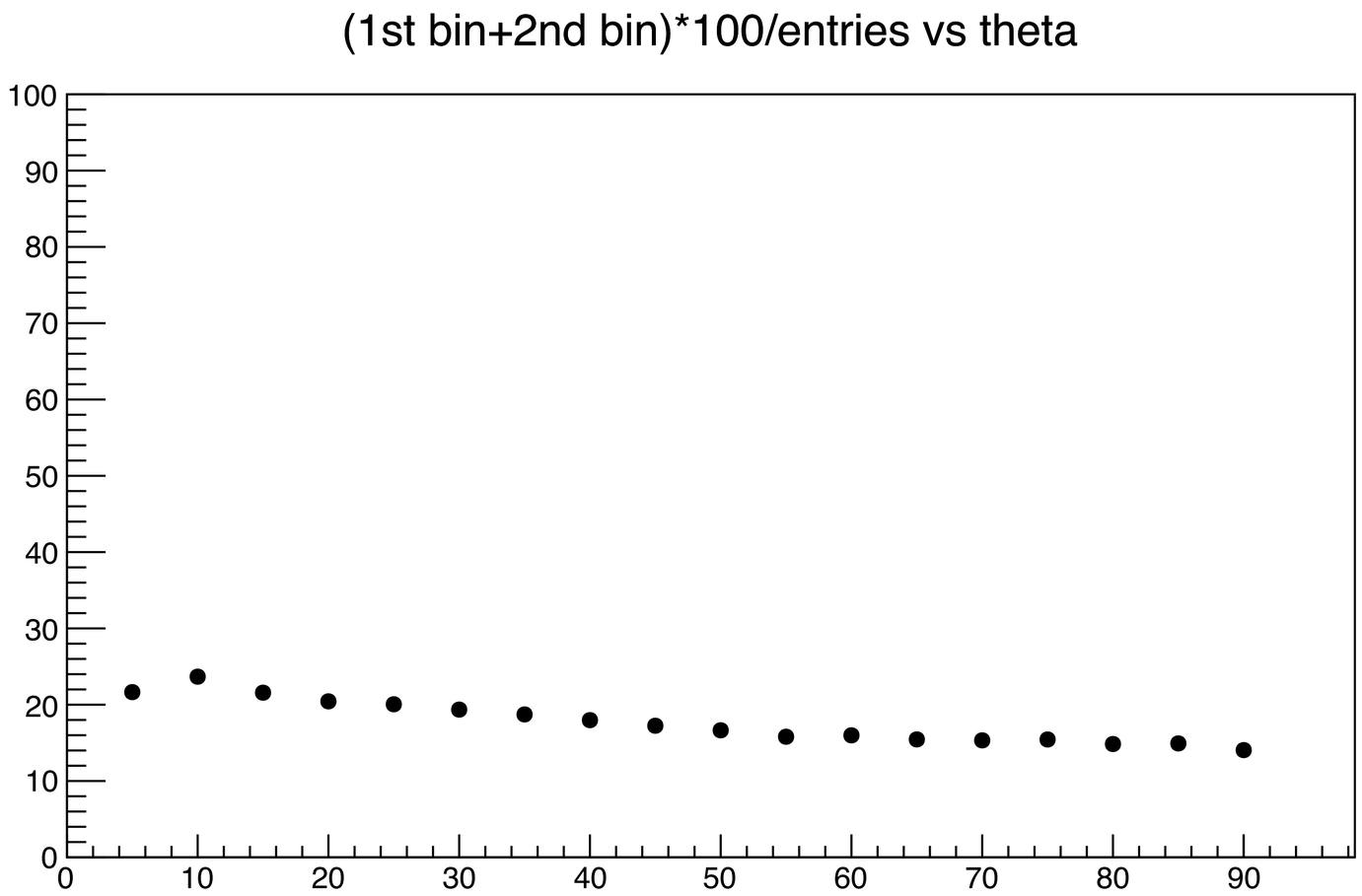




- bin1 and bin2 in ADC distribution (left figure) are expected to be noise. It is because ADC distribution of any angle has a peak bin1 and bin2.
- In right figure, bin1/bin2 of each theta is almost constant.

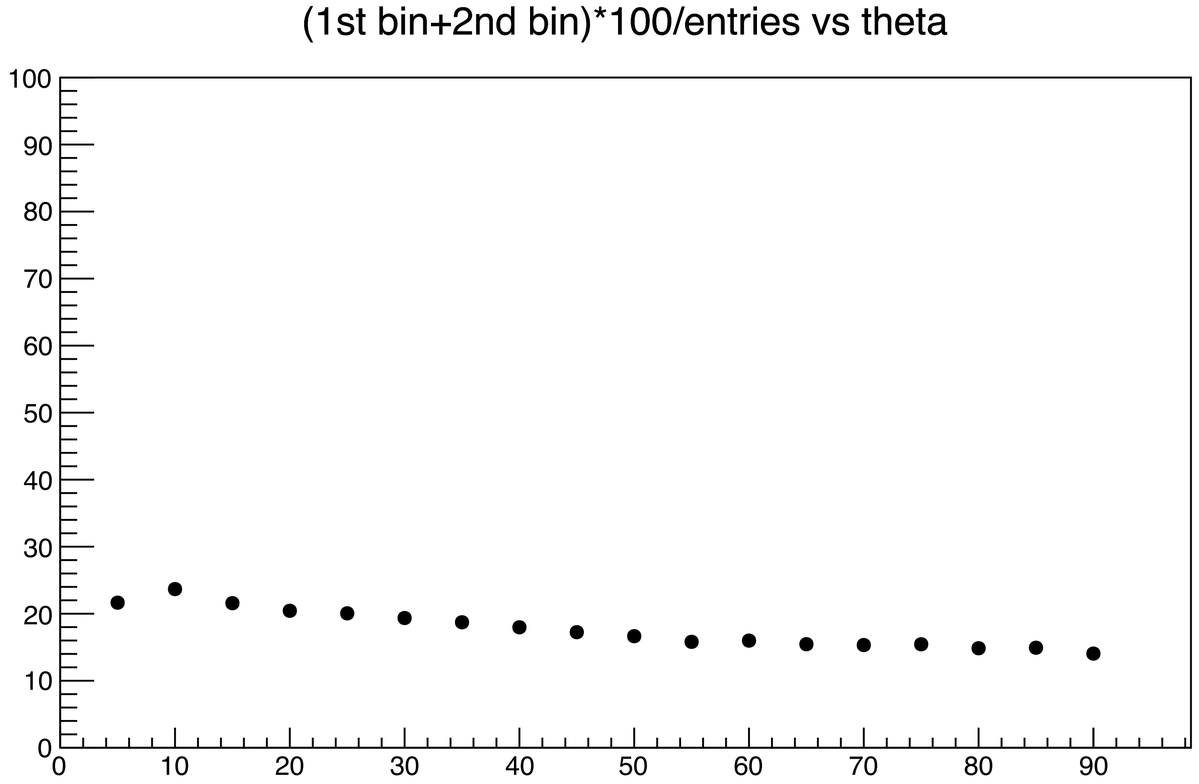
ADC distribution

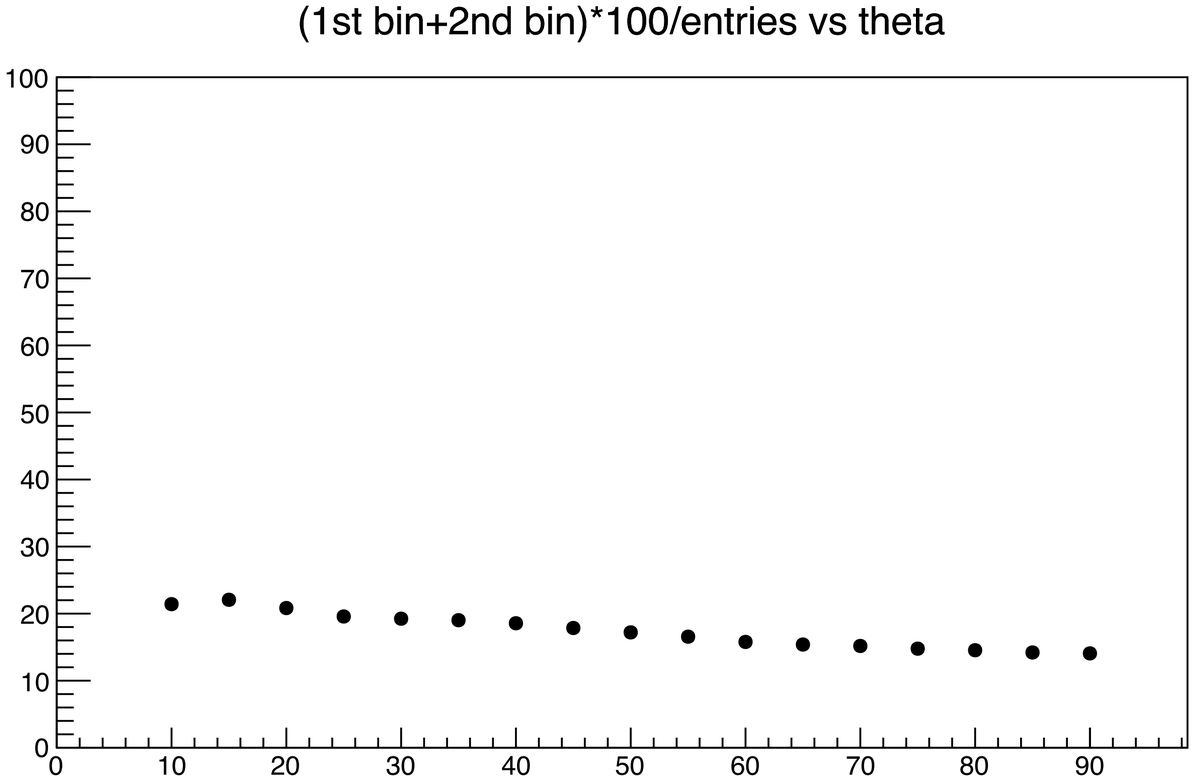




- In right figure, y-axis is ratio of number of entries in bin1 and bin2 to total number of entries. If bin1 and bin2 are noise, it should be constant. But it looks like not constant.
  - Maybe it will become constant after Zvtx cutting?

ADC distribution





- It's changed a little, but there's still slightly slope.
  - ->Why?

dN/deta with cluster method

Misaki Hata
(NWU)

Analyzing dN/Deta using cluster method

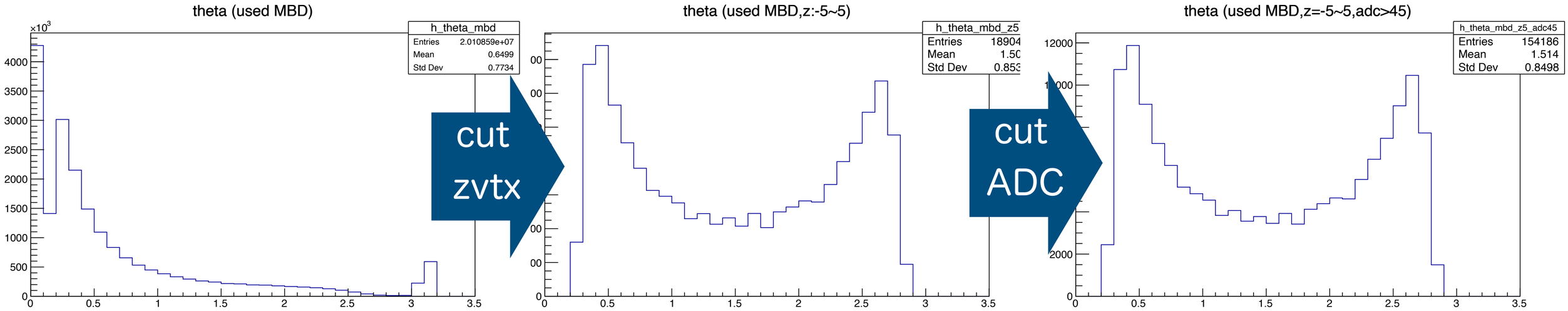
Goal in this workshop: Analysis of raw data, Checking Simulation code

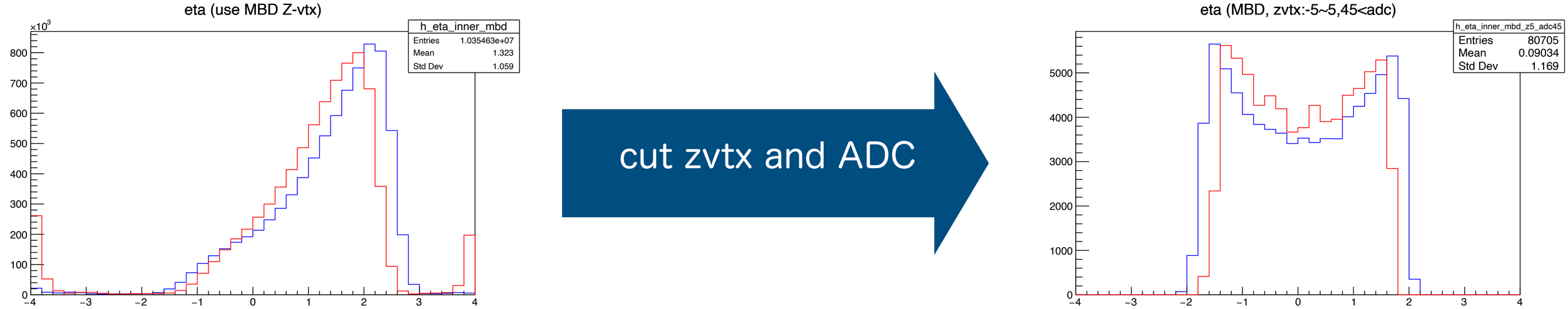
My To-Do List (now)

- Analysis of raw data
  - Checking ADC distribution cutting at ncluster
- Checking Simulation code
  - InttClusterizer.cc
  - PHG4InttDigitizer.cc
  - PHG4InttHitReco.cc
  - G4_TrkrSimulation.C
- Analysis of Simulation data
  - Doing same thing with raw data analysis (without distribution using ADC value)

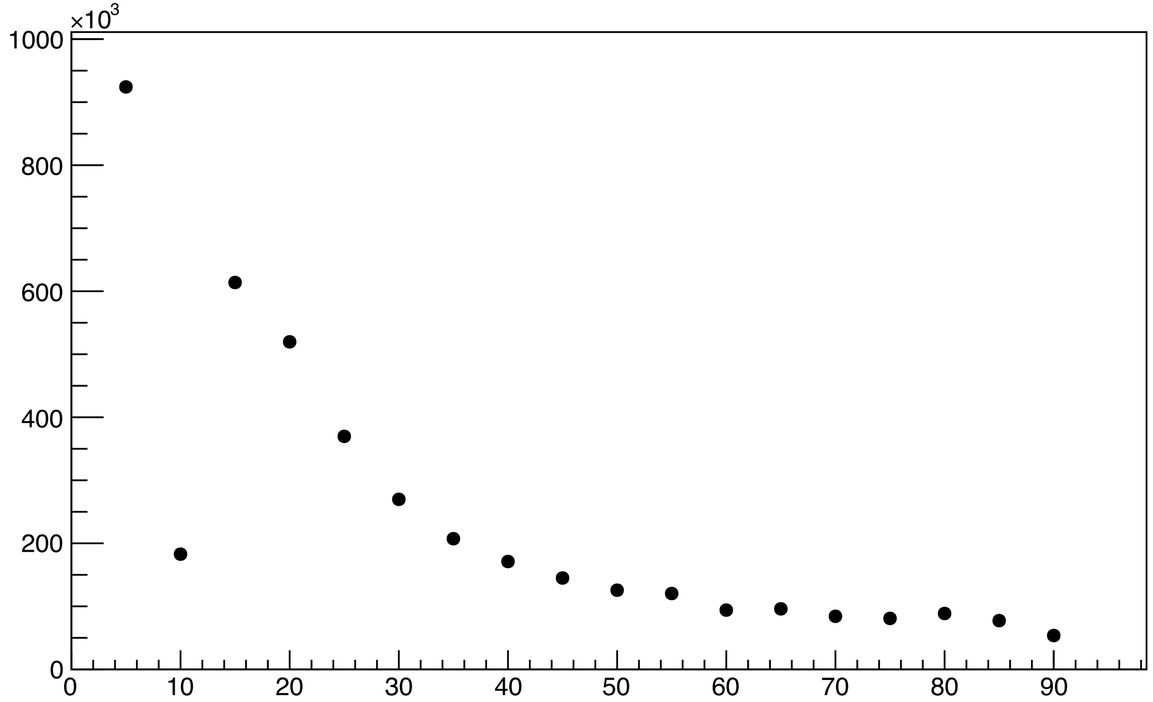
backup

theta distribution (cut at Zvtx and ADC)

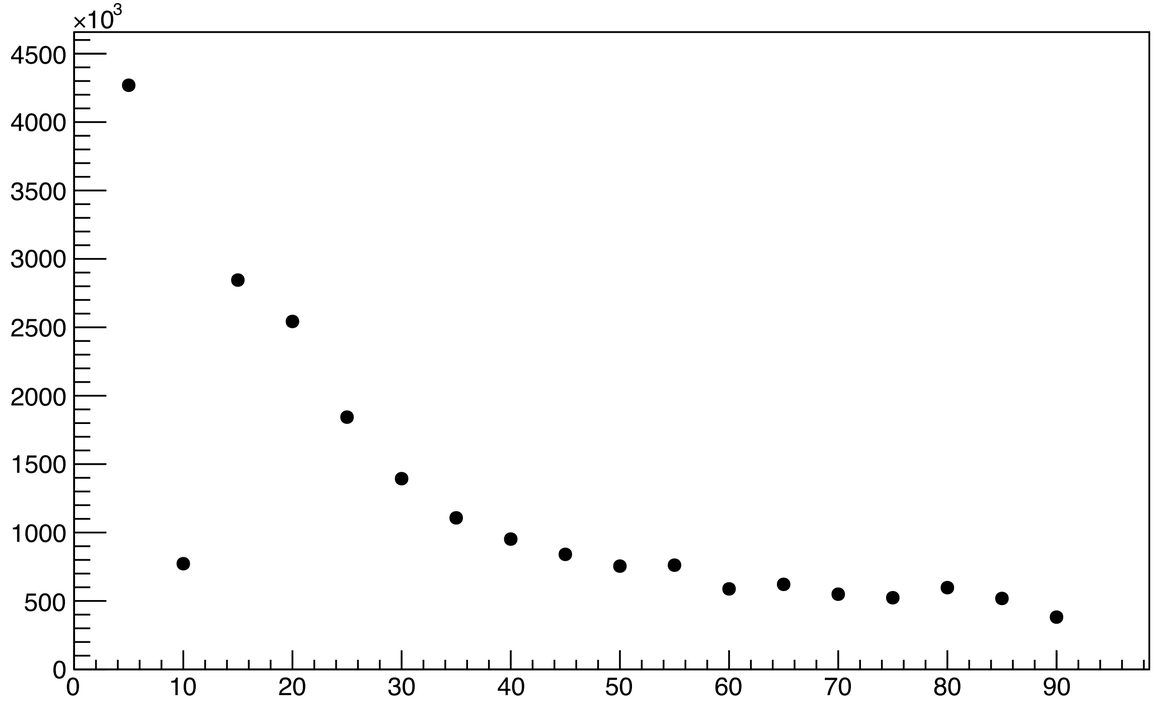




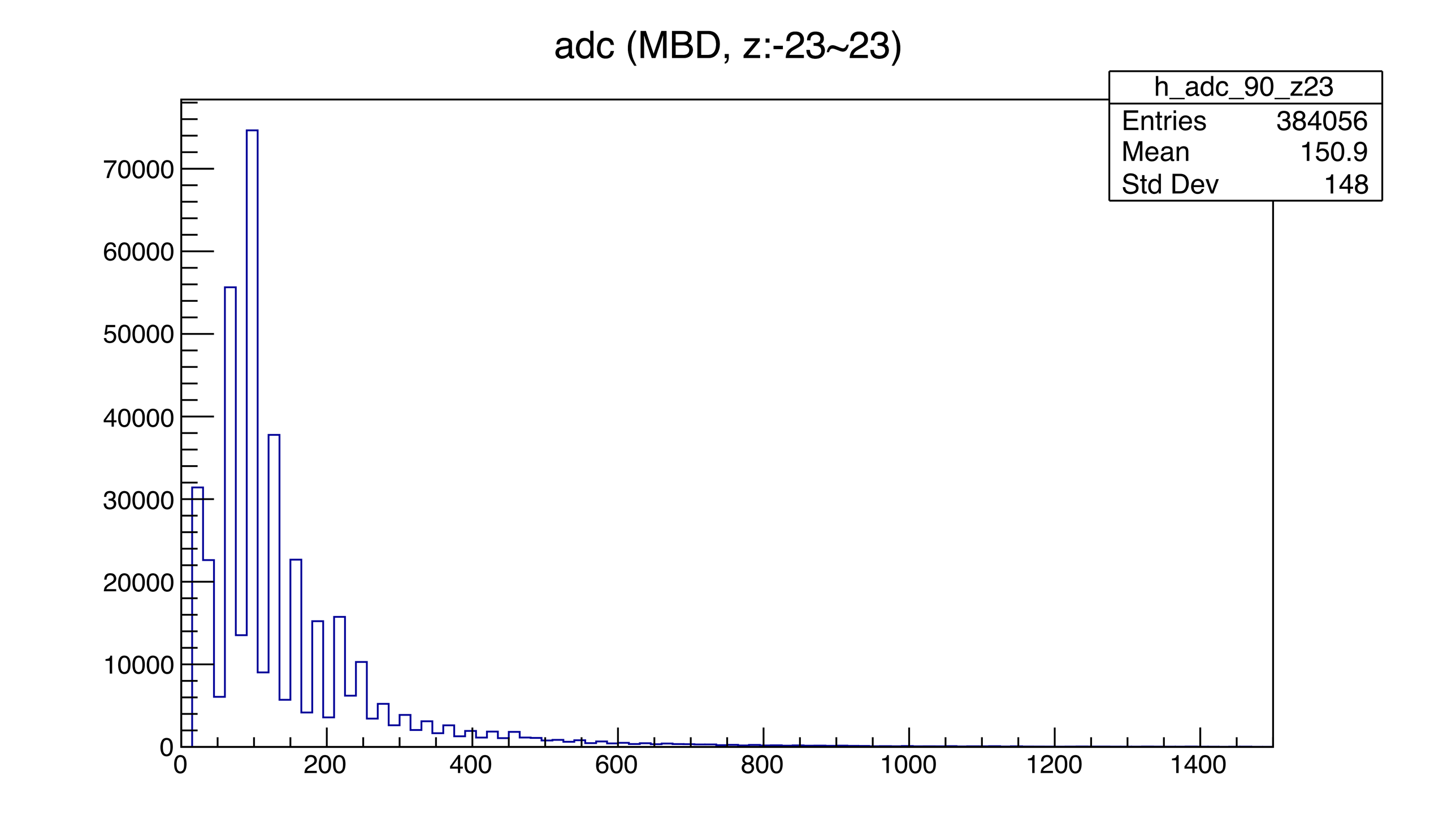
(1st bin + 2nd bin) vs theta

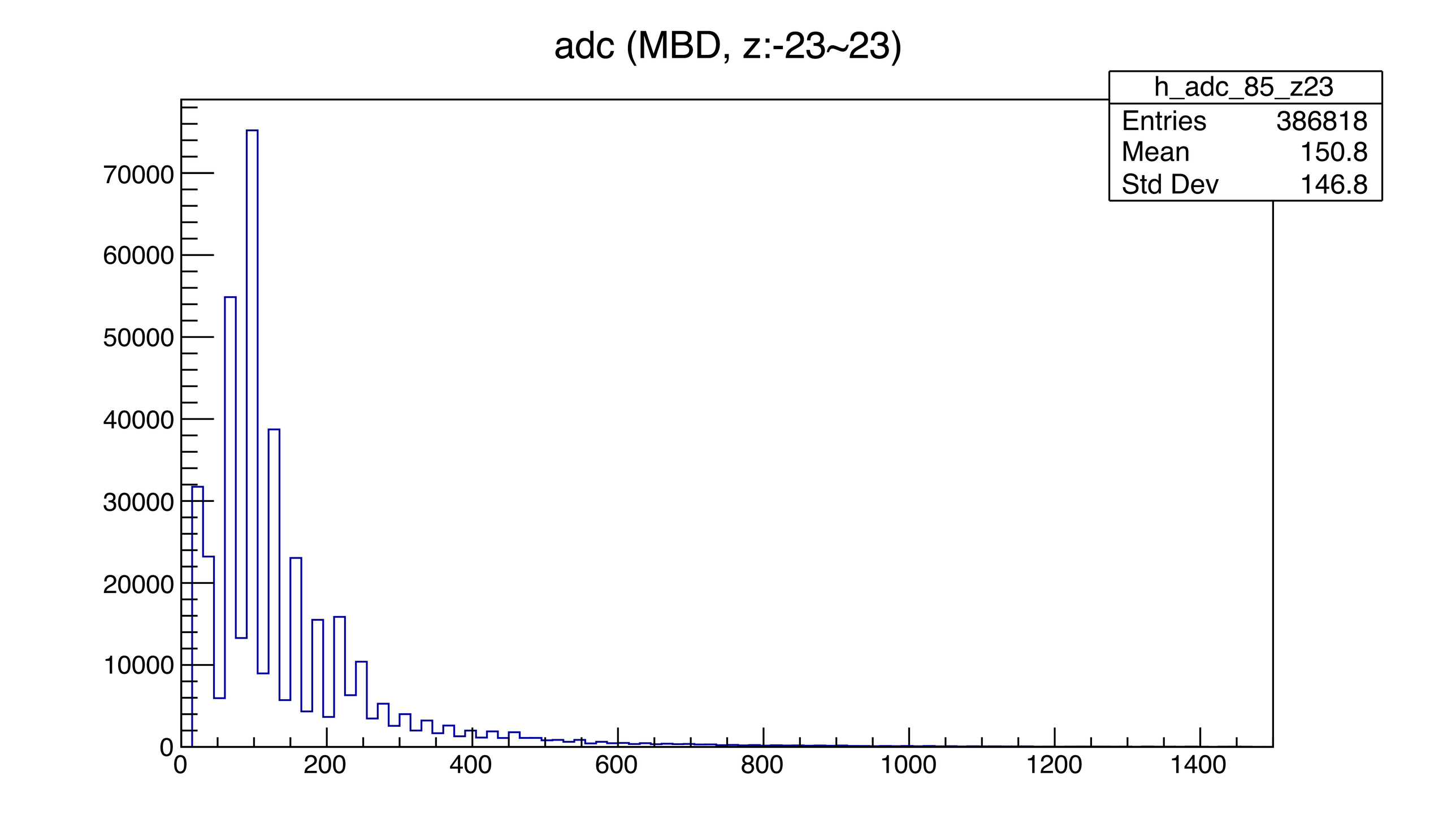


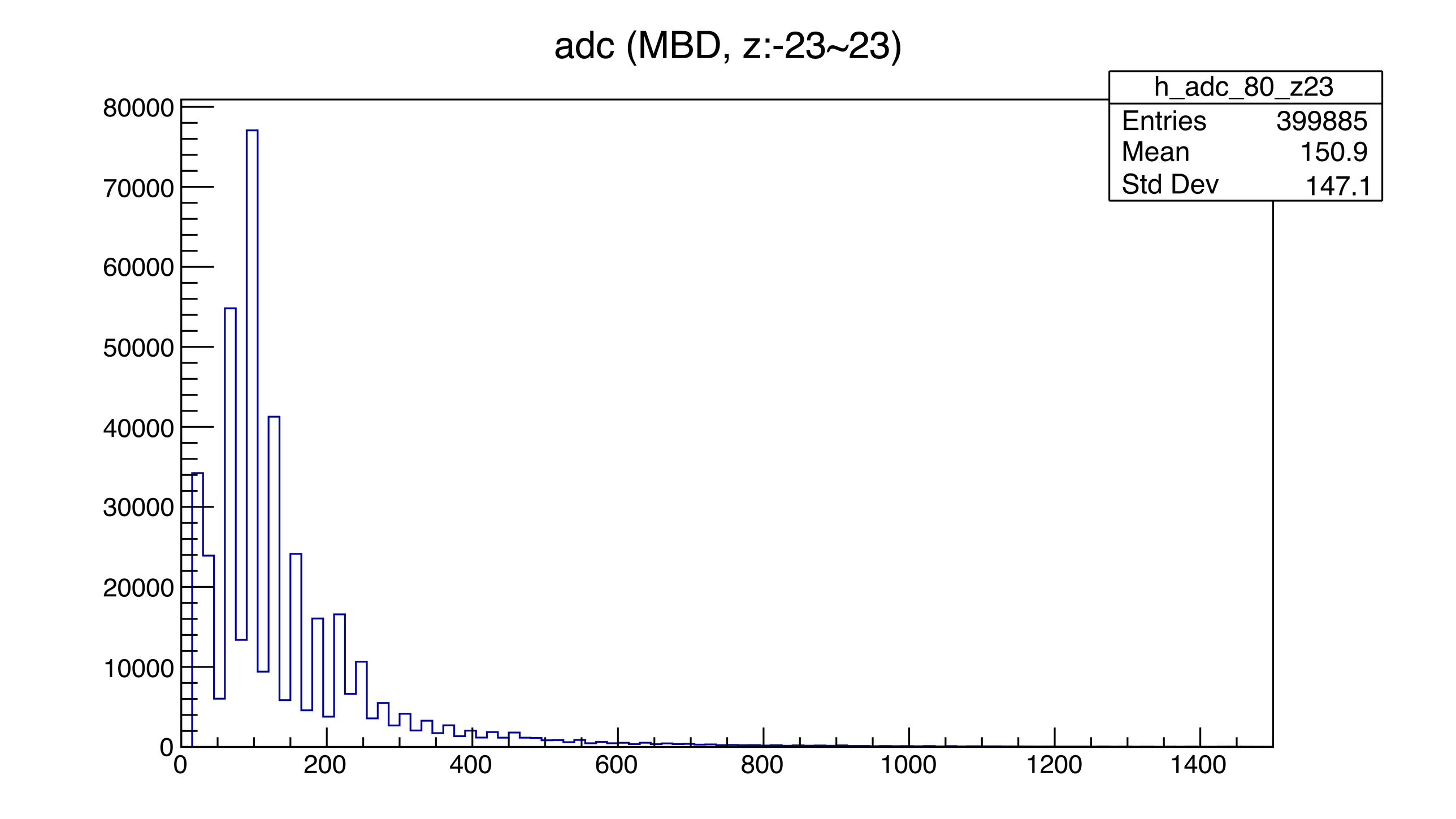
entries vs theta

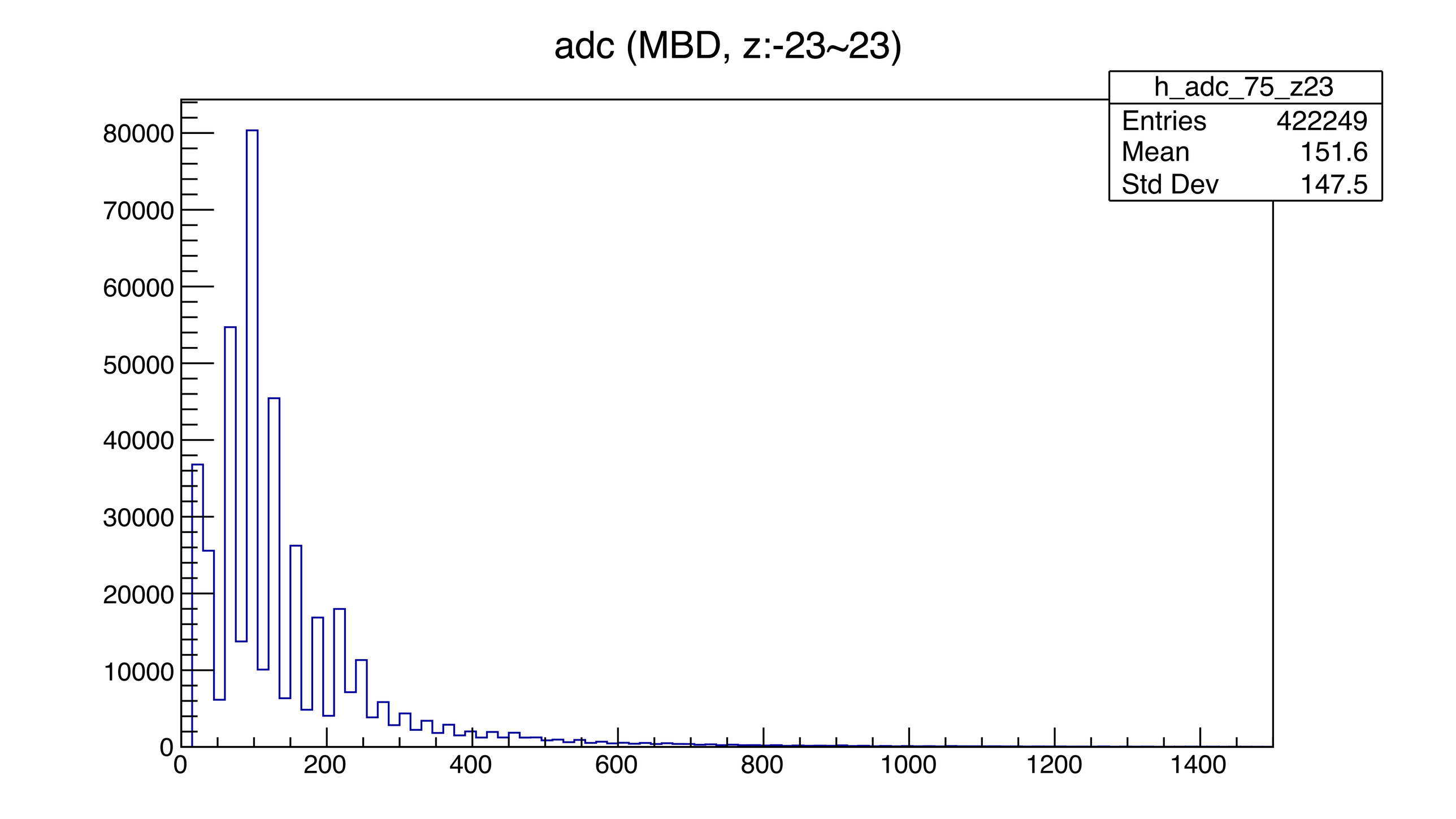


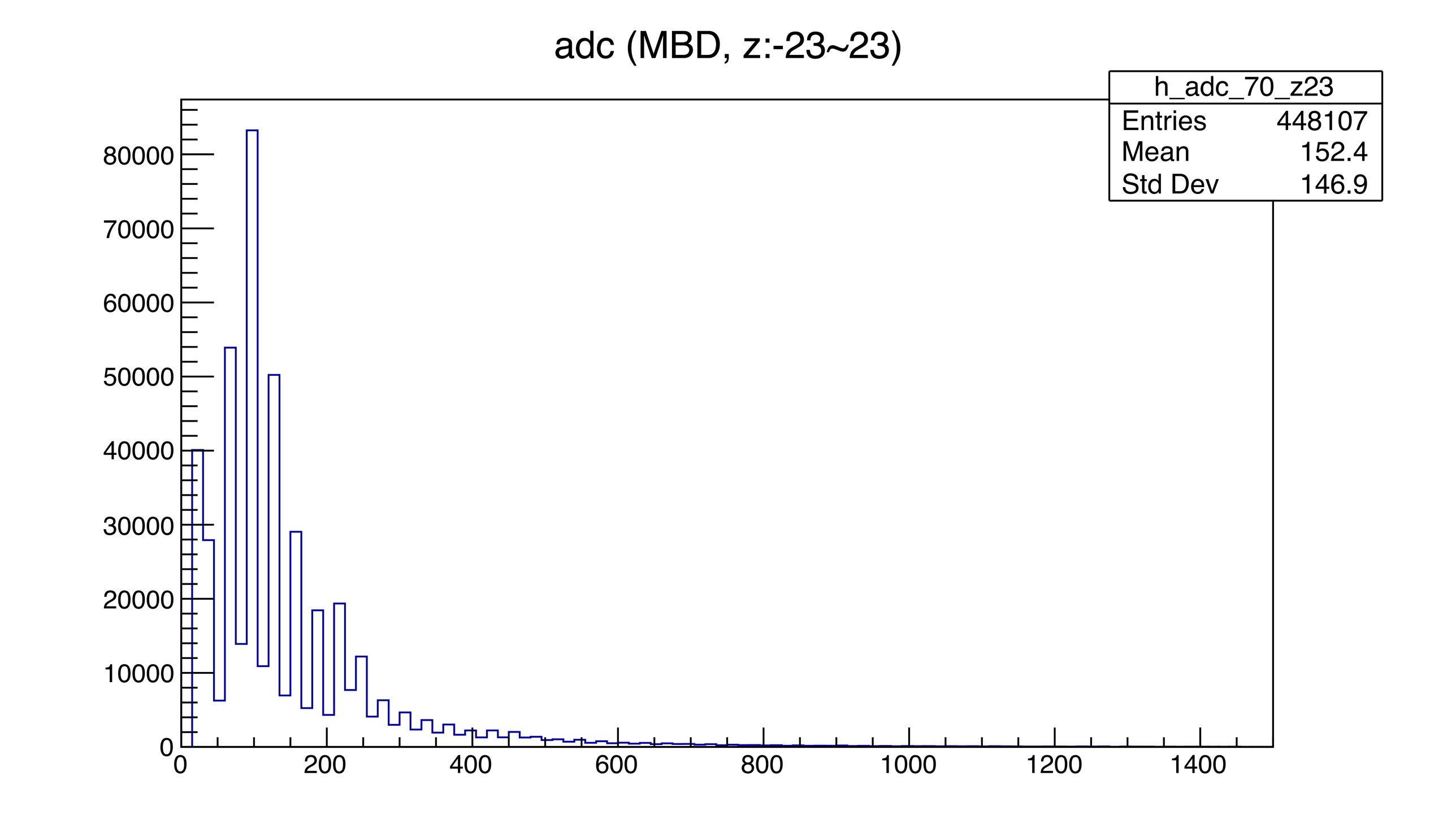
ADC distribution
(each theta, after Zvtx cutting)

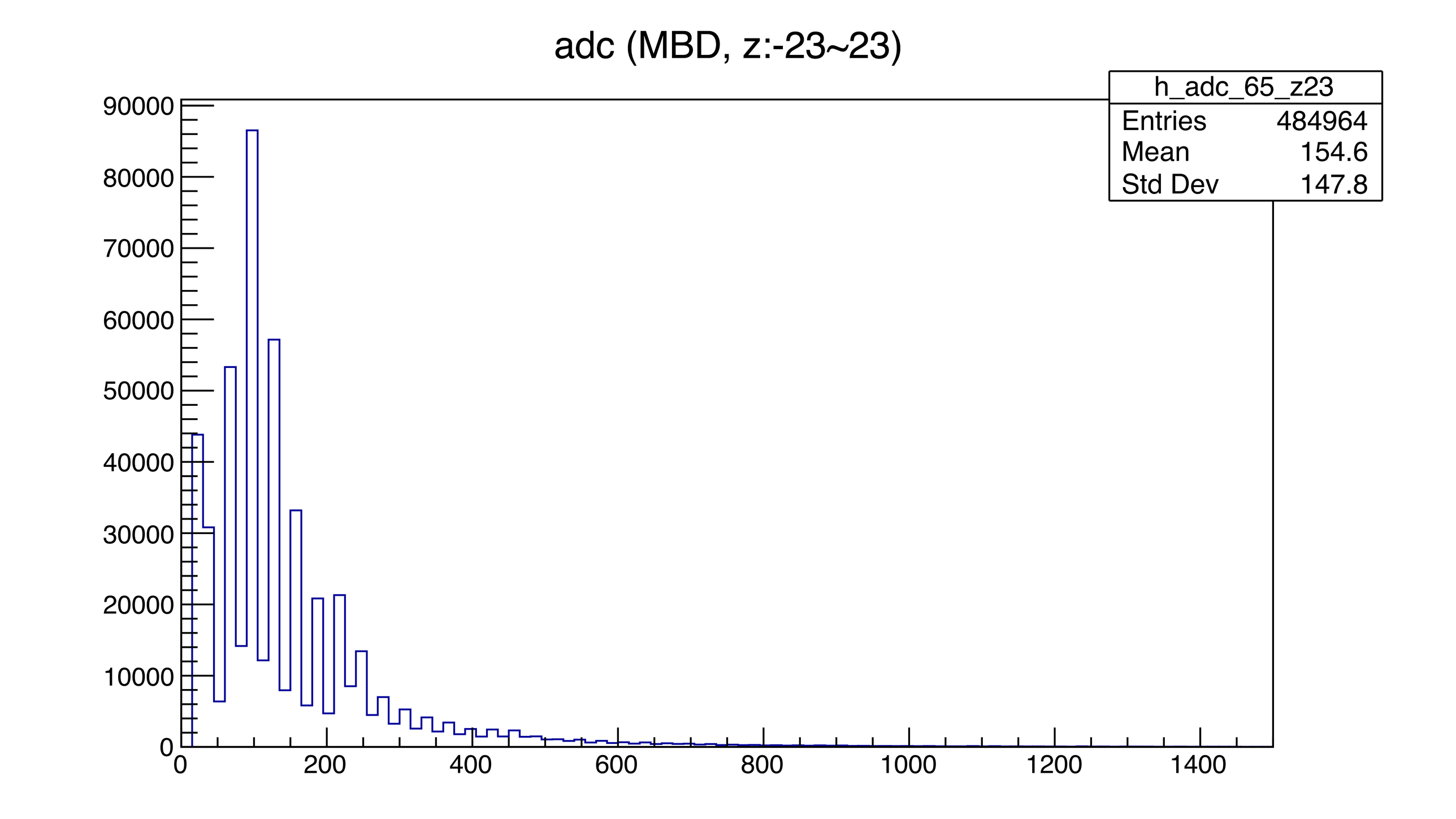

adc (MBD, z:-23~23)
h_adc_90_z23
Entries 384056
Mean 150.9
Std Dev 148
70000
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
1200
1400

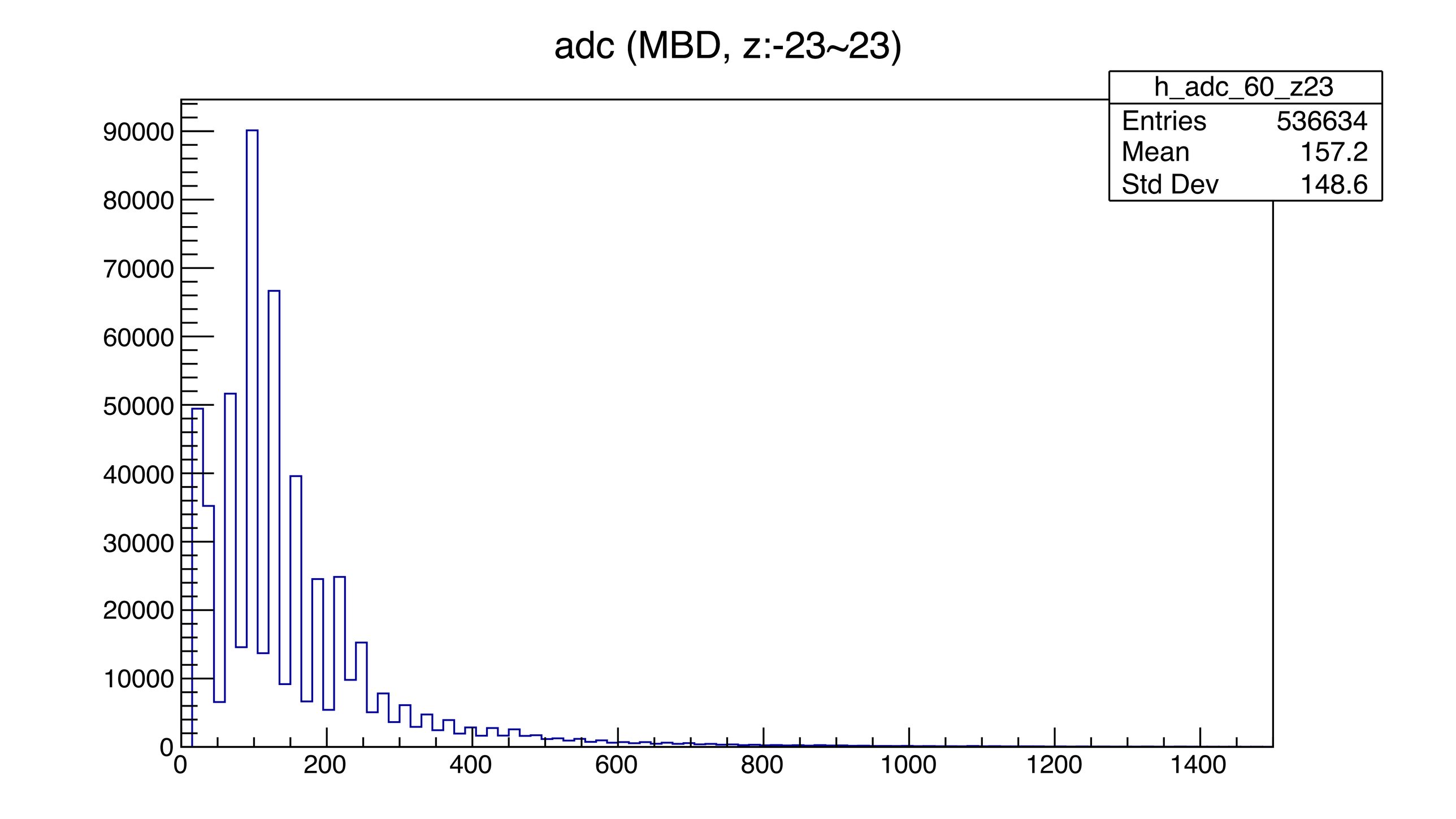

adc (MBD, z:-23~23)
h_adc_85_z23
Entries 386818
Mean 150.8
Std Dev 146.8
70000
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
1200
1400

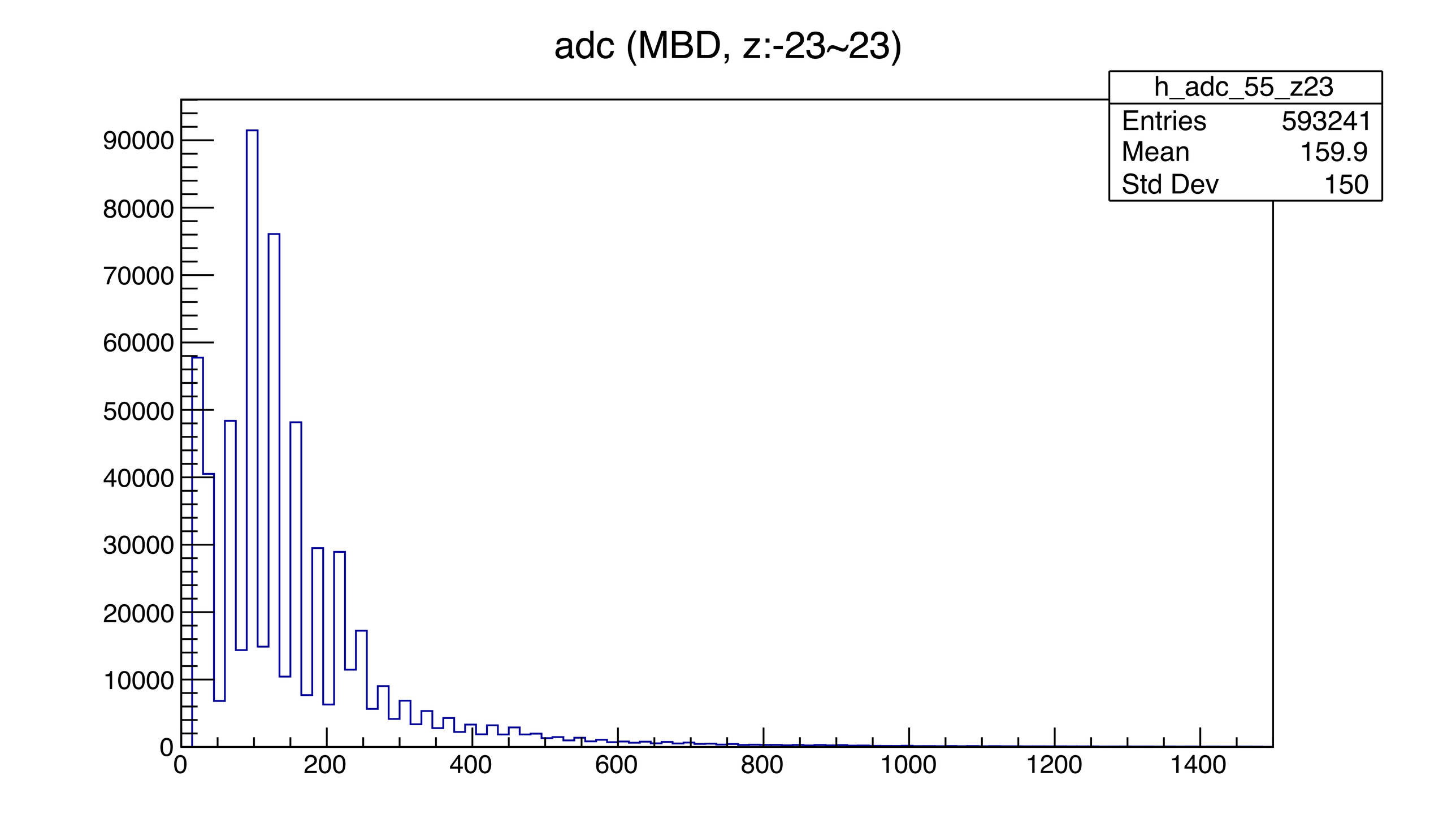

adc (MBD, z:-23~23)
h_adc_80_z23
Entries 399885
Mean 150.9
Std Dev 147.1
80000
70000
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
1200
1400

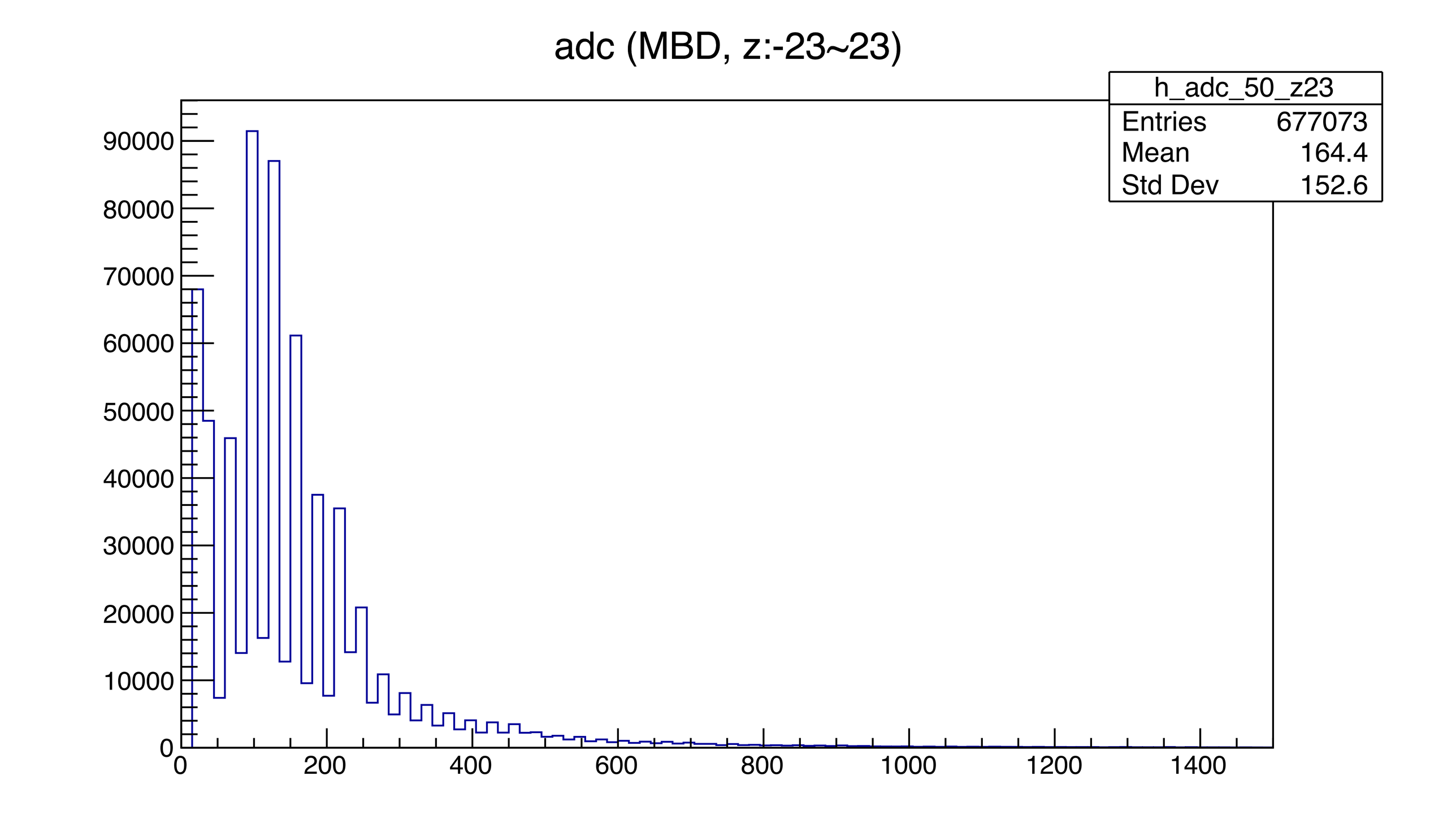

adc (MBD, z:-23~23)
h_adc_75_z23
Entries 422249
Mean 151.6
Std Dev 147.5
80000
70000
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
1200
1400

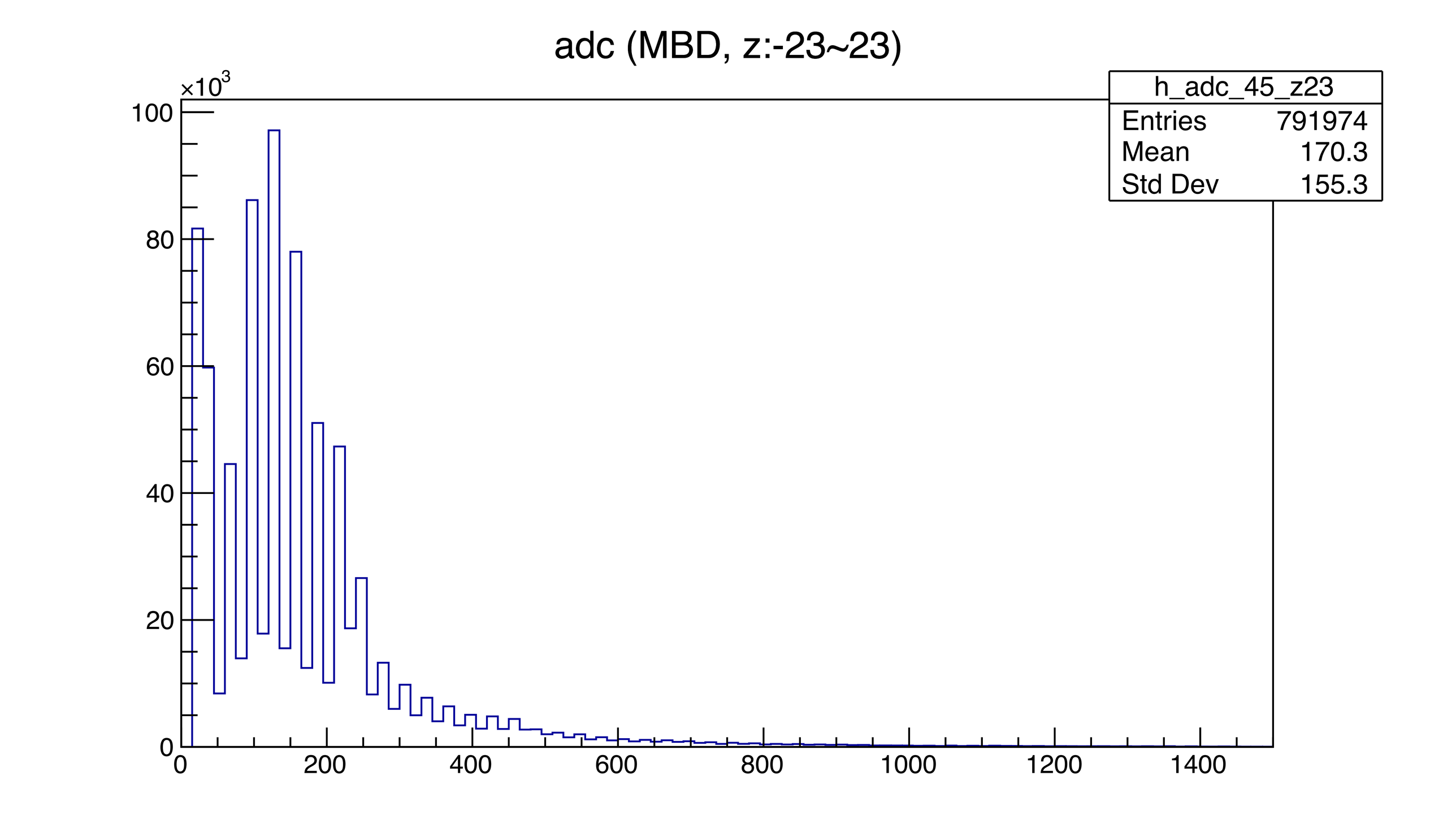

adc (MBD, z:-23~23)
h_adc_70_z23
Entries 448107
Mean 152.4
Std Dev 146.9
80000
70000
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
1200
1400

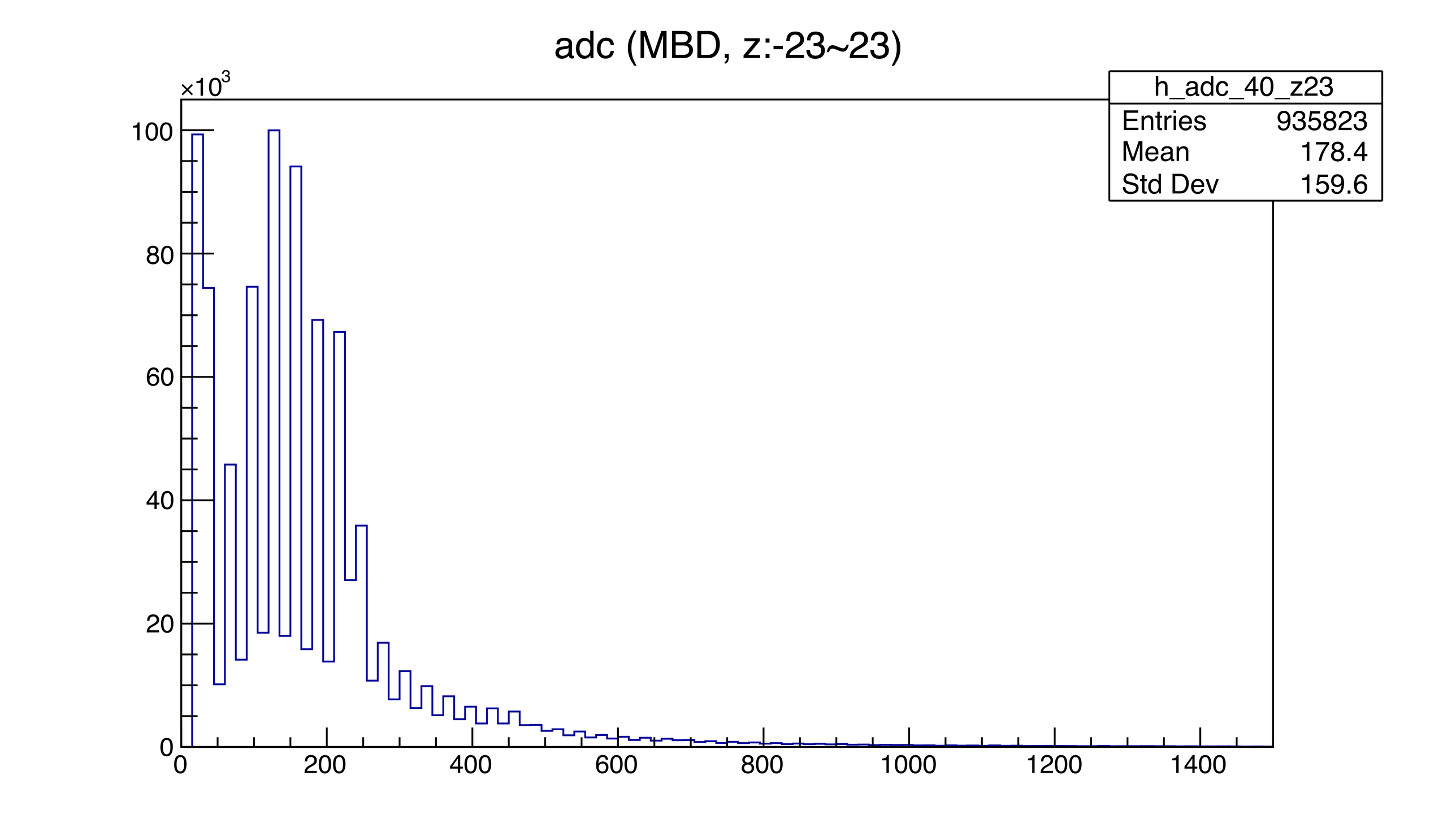

adc (MBD, z:-23~23)
h_adc_65_z23
Entries 484964
Mean 154.6
Std Dev 147.8
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
1200
1400

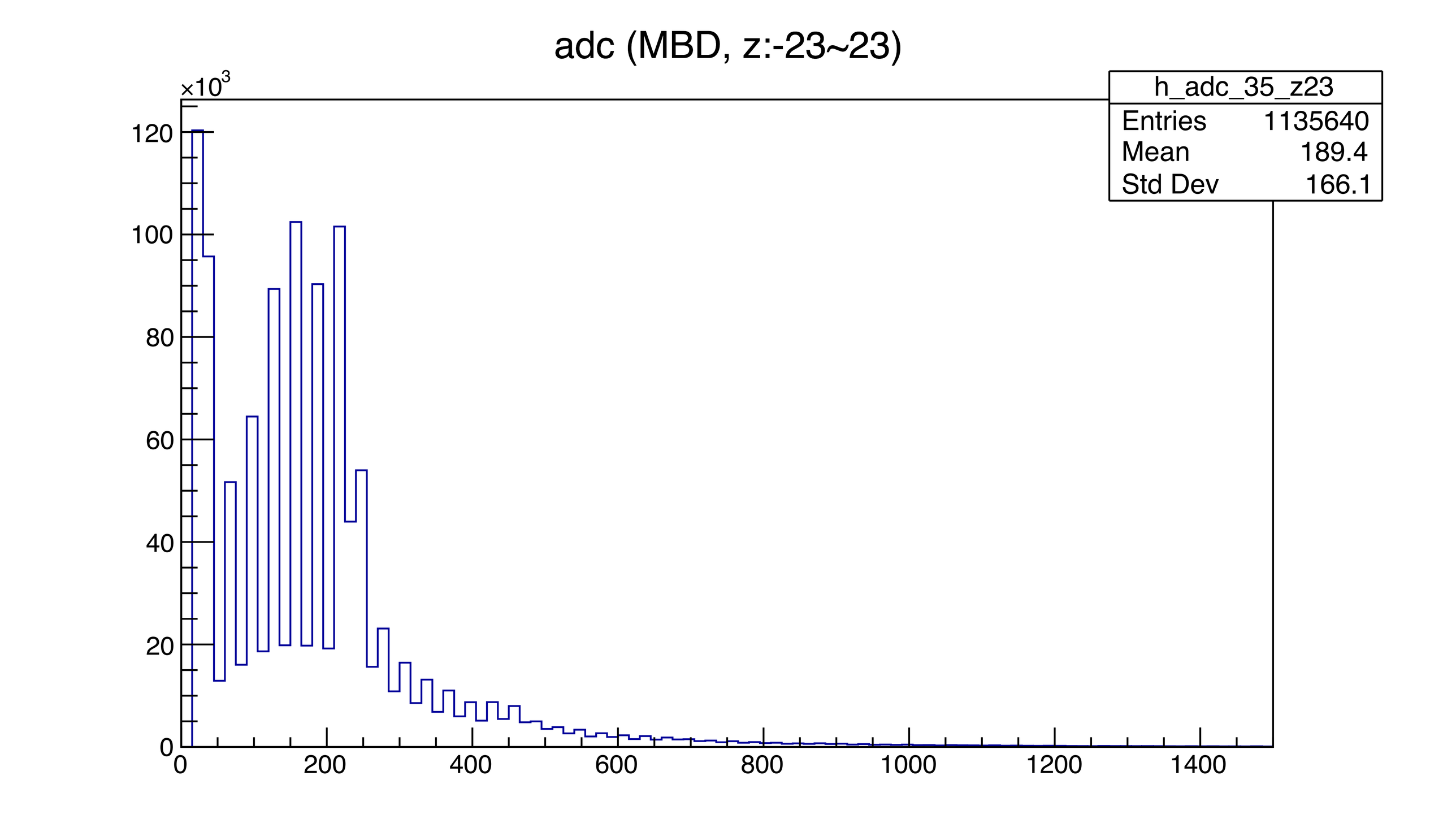

adc (MBD, z:-23~23)
h_adc_60_z23
Entries 536634
Mean 157.2
Std Dev 148.6
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
1200
1400

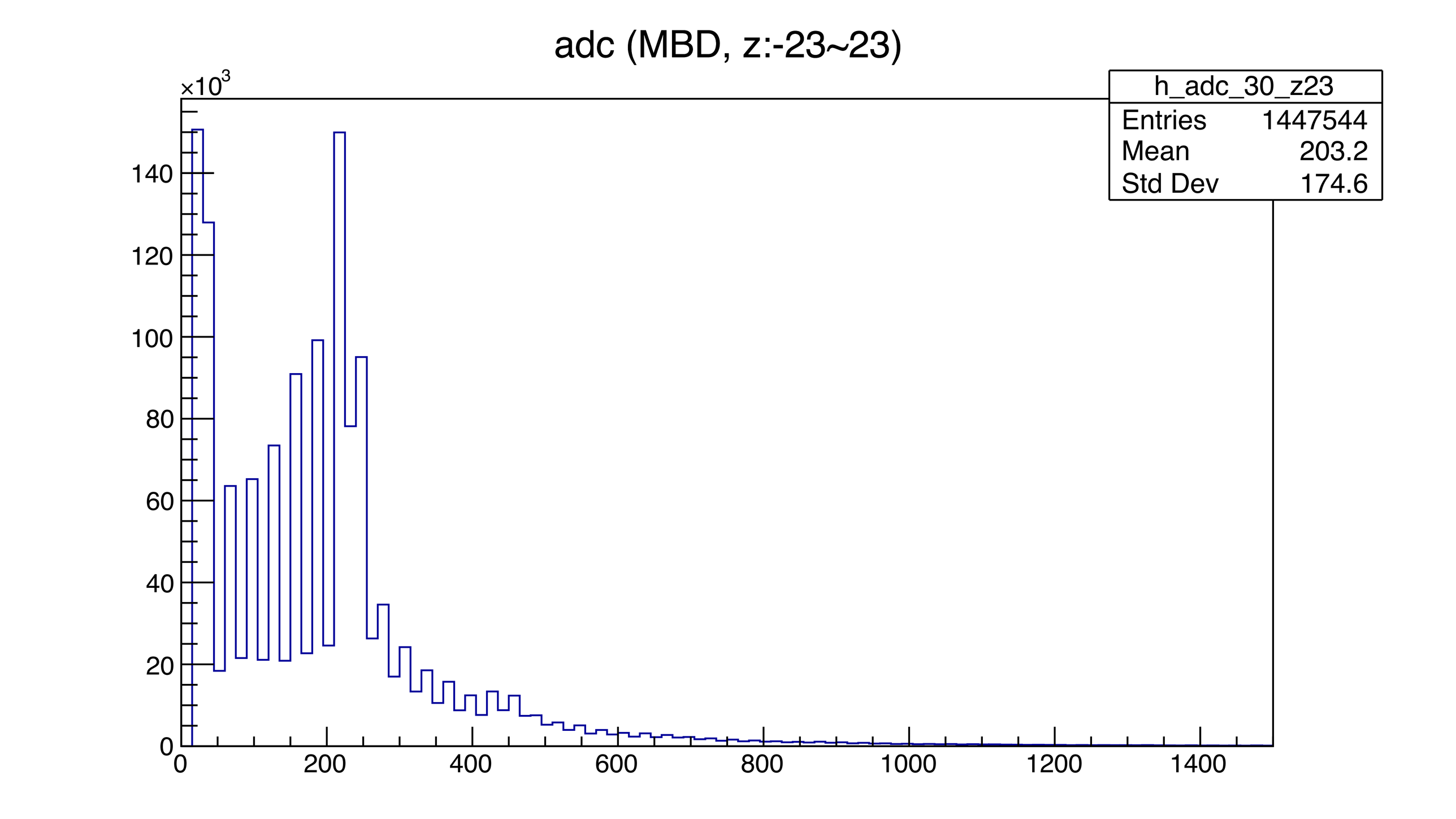

adc (MBD, z:-23~23)
h_adc_55_z23
Entries 593241
Mean 159.9
Std Dev 150
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
1200
1400

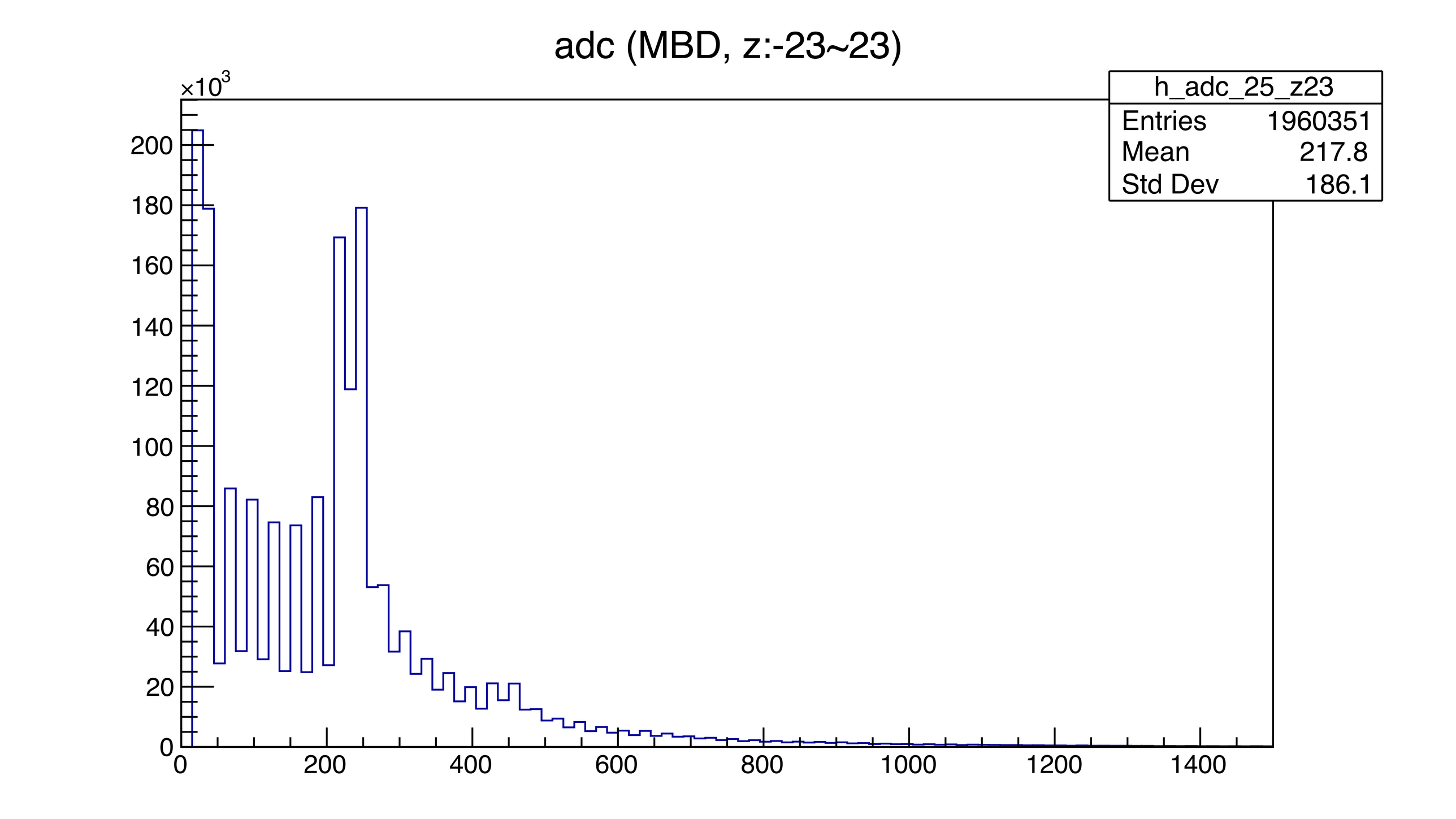

adc (MBD, z:-23~23)
h_adc_50_z23
Entries 677073
Mean 164.4
Std Dev 152.6
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
1200
1400

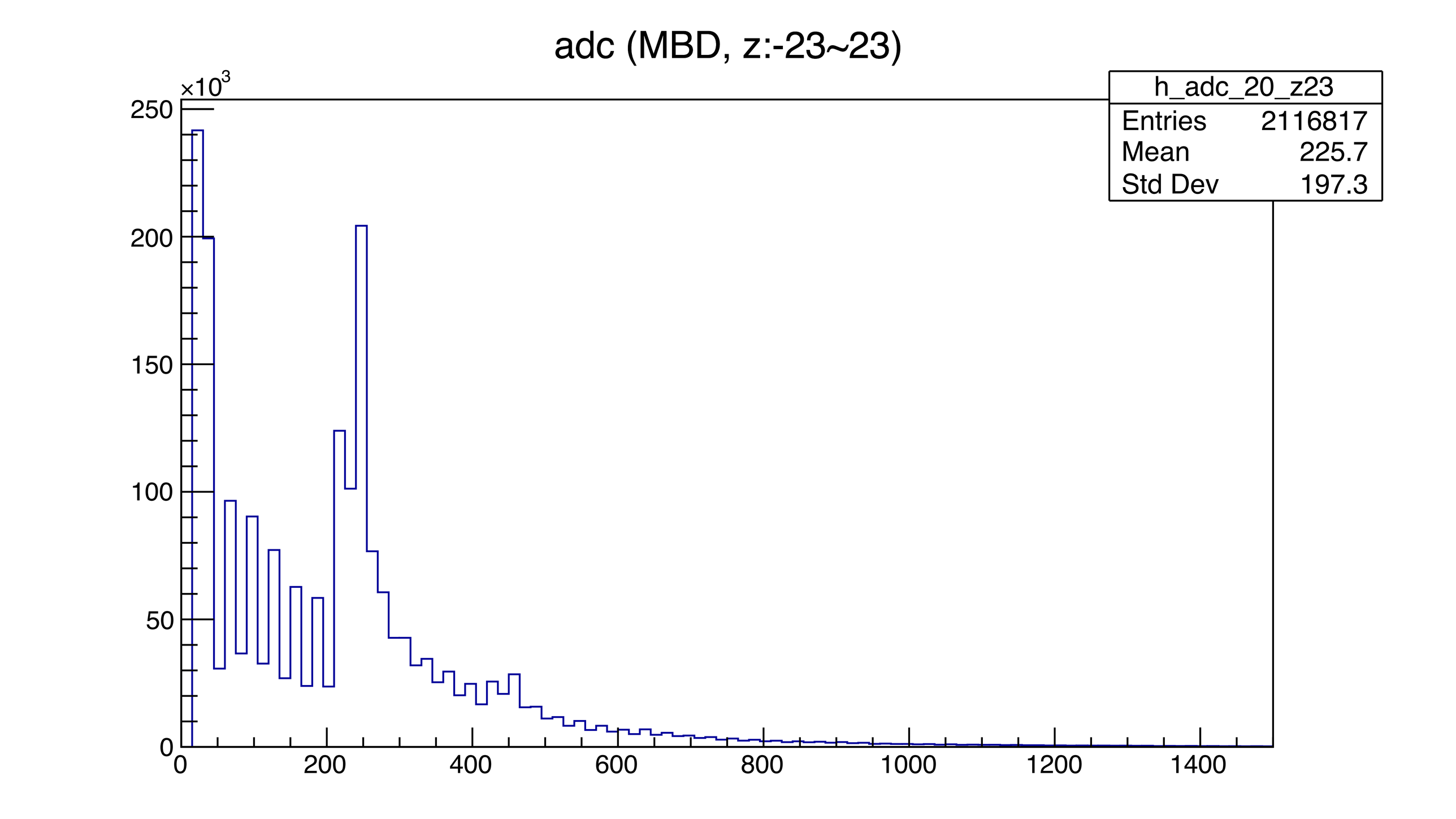

adc (MBD, z:-23~23)
×10^3
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400
h_adc_45_z23
Entries 791974
Mean 170.3
Std Dev 155.3

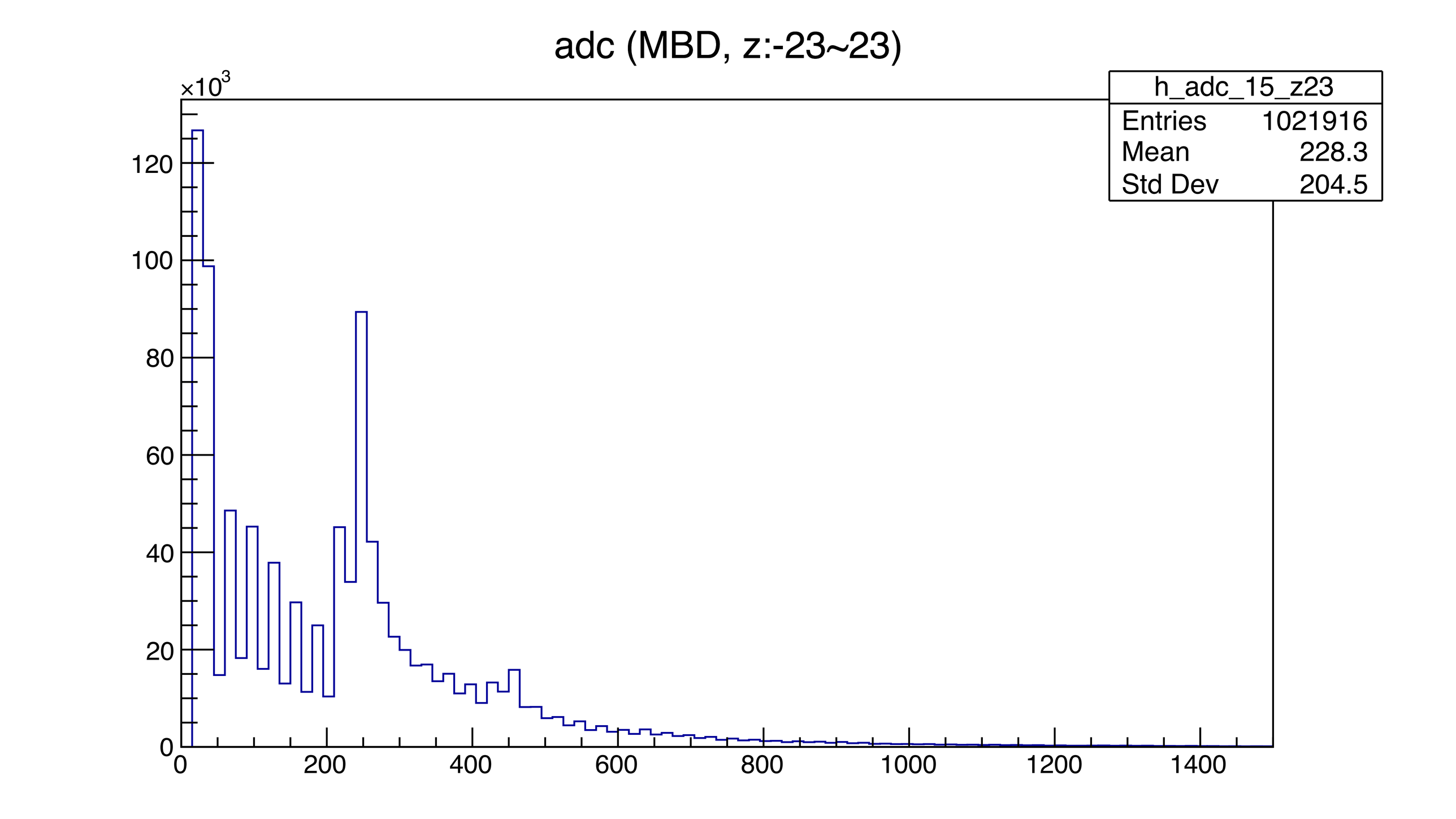

adc (MBD, z:-23~23)
×10^3
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400
h_adc_40_z23
Entries 935823
Mean 178.4
Std Dev 159.6

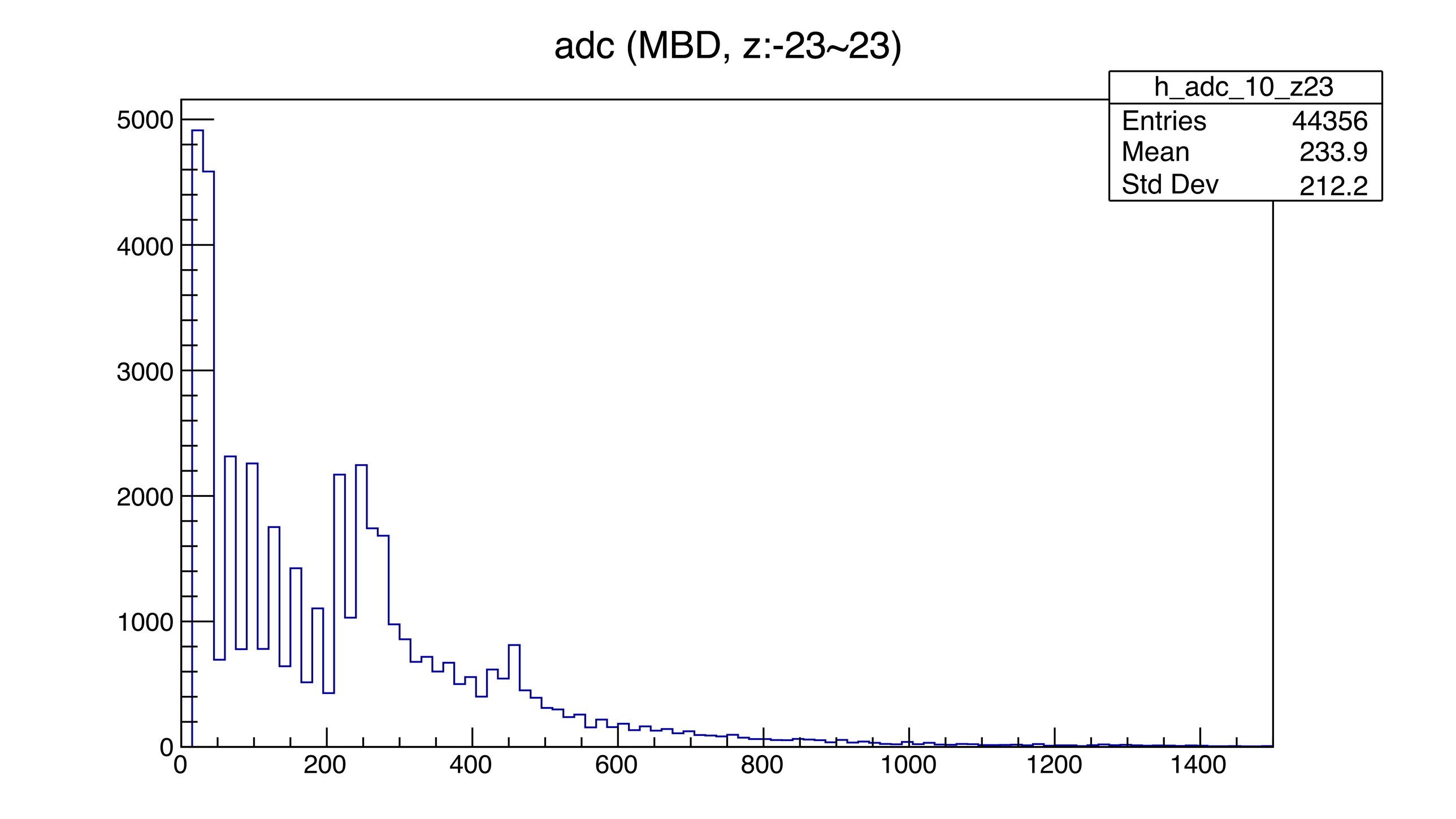

adc (MBD, z:-23~23)
h_adc_35_z23
Entries 1135640
Mean 189.4
Std Dev 166.1
×10^3
120
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400

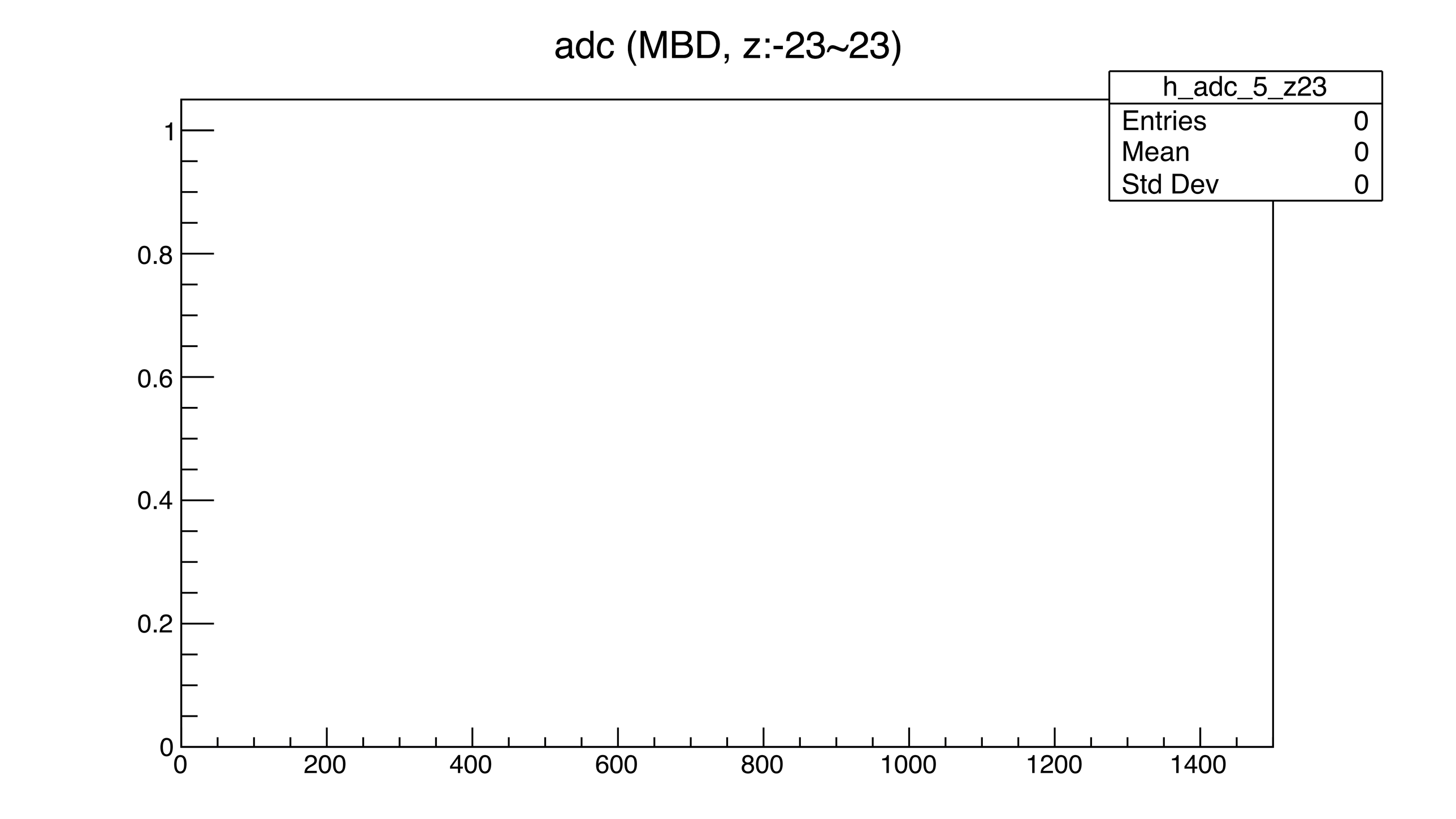

adc (MBD, z:-23~23)
×10^3
h_adc_30_z23
Entries 1447544
Mean 203.2
Std Dev 174.6
140
120
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400


adc (MBD, z:-23~23)
×10^3
h_adc_25_z23
Entries 1960351
Mean 217.8
Std Dev 186.1
200
180
160
140
120
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400


adc (MBD, z:-23~23)
×10^3
250
200
150
100
50
0
0
200
400
600
800
1000
1200
1400
h_adc_20_z23
Entries 2116817
Mean 225.7
Std Dev 197.3

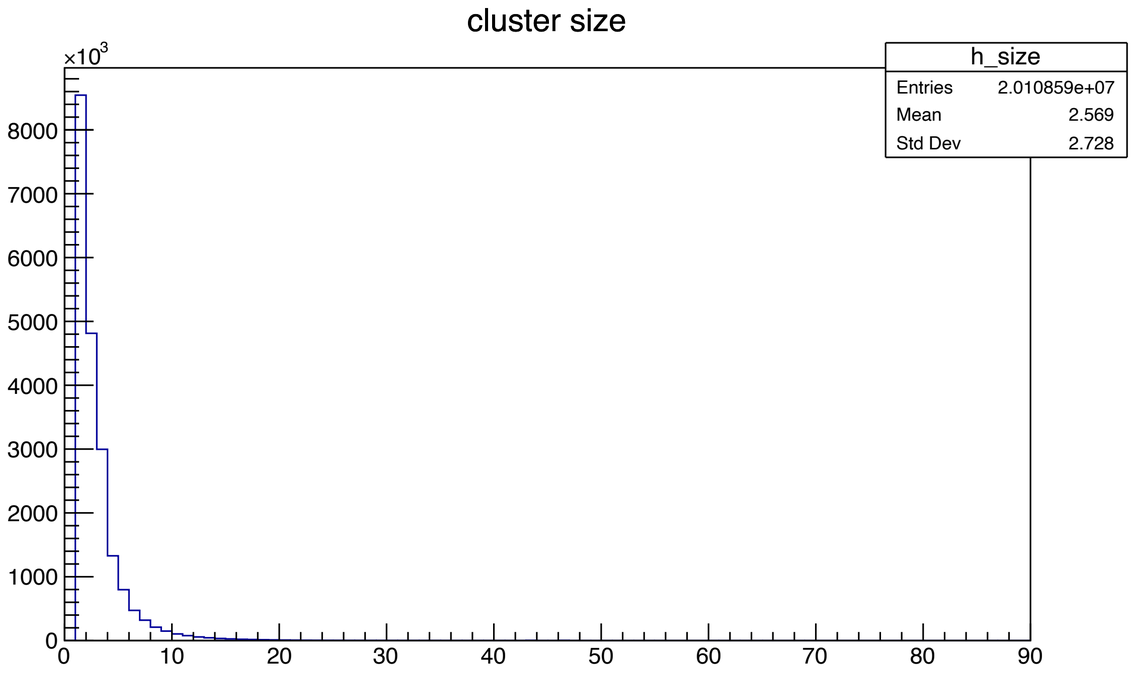

adc (MBD, z:-23~23)
×10^3
120
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400
h_adc_15_z23
Entries 1021916
Mean 228.3
Std Dev 204.5

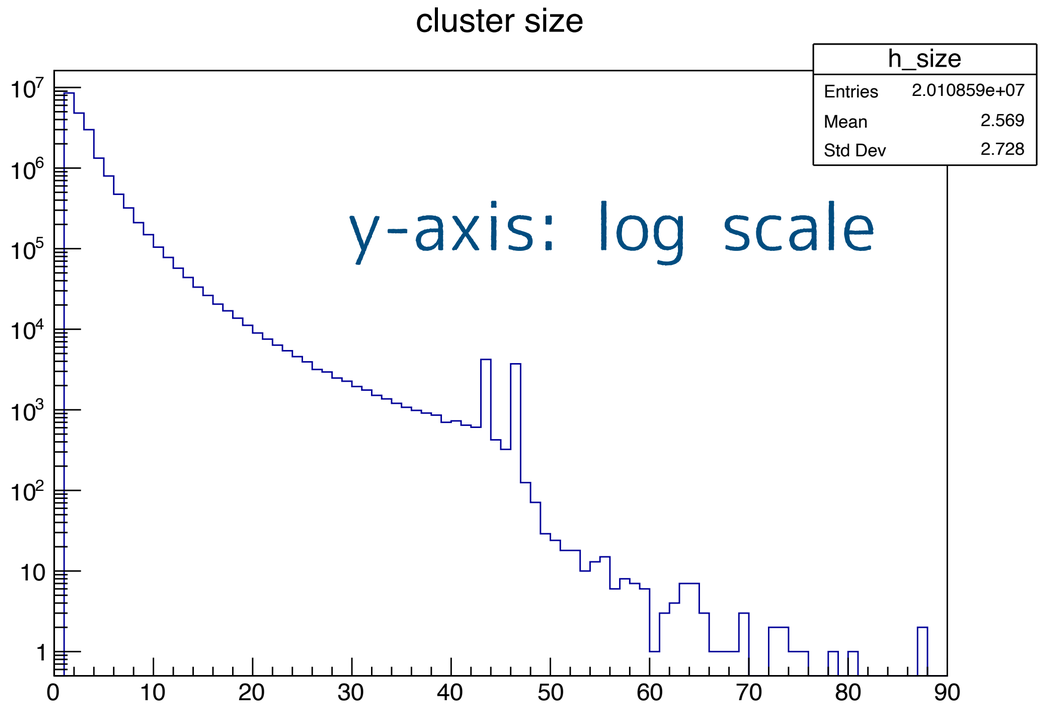

adc (MBD, z:-23~23)
h_adc_10_z23
Entries 44356
Mean 233.9
Std Dev 212.2
5000
4000
3000
2000
1000
0
0
200
400
600
800
1000
1200
1400


adc (MBD, z:-23~23)
h_adc_5_z23
Entries 0
Mean 0
Std Dev 0
1
0.8
0.6
0.4
0.2
0
0
200
400
600
800
1000
1200
1400

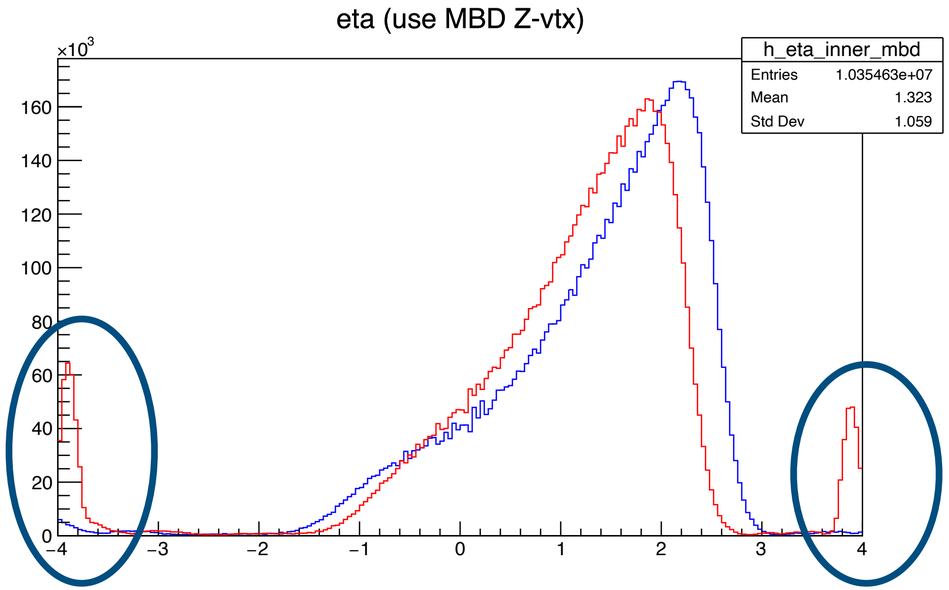
made in workshop

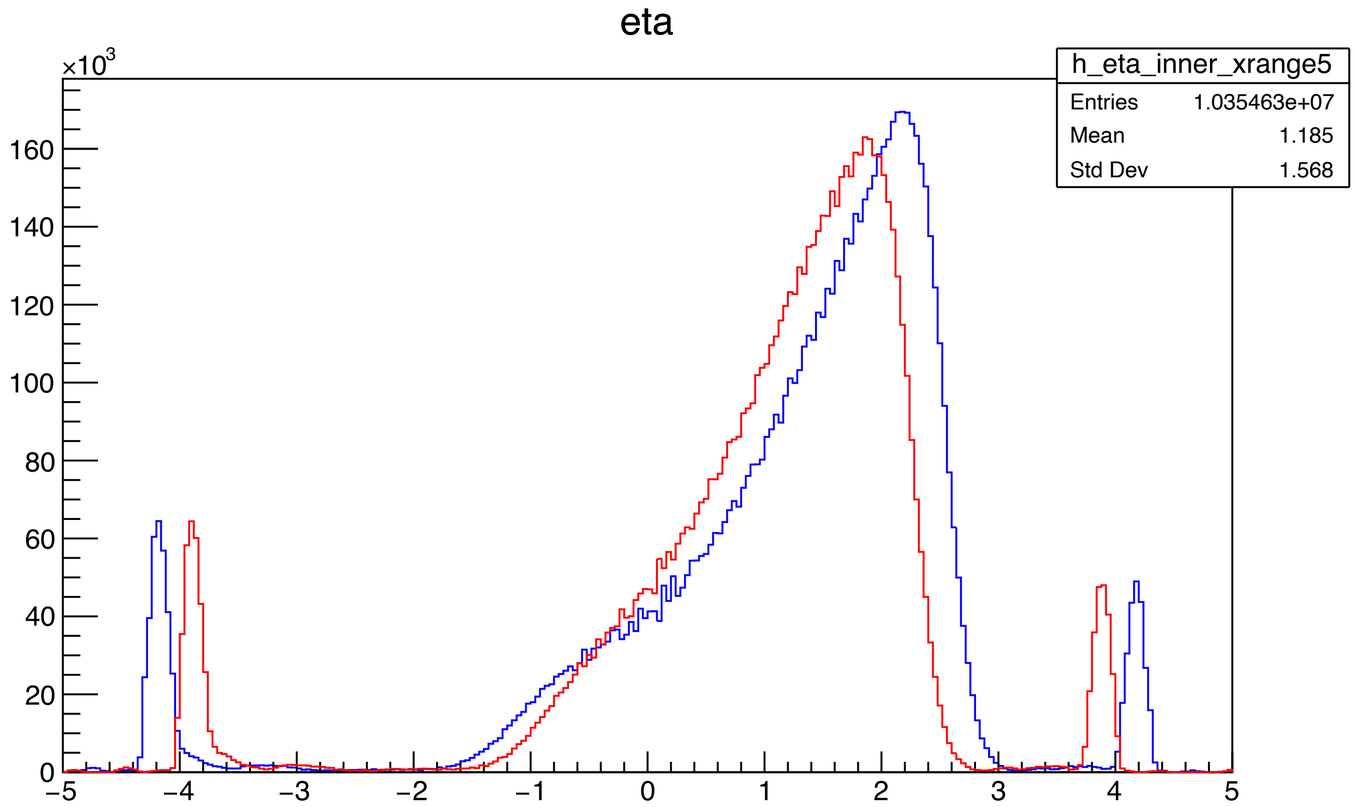
cluster size distribution





eta distribution (changing x-axis range)





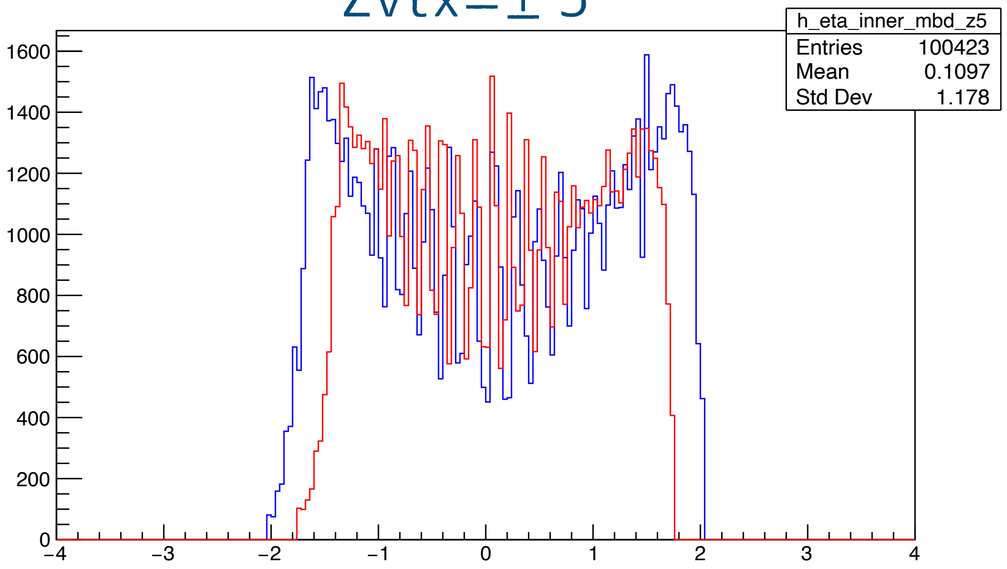
- I tried to change x-axis range.
  - ->Signal at the edge can become to see

blue: inner barrel
red: outer barrel

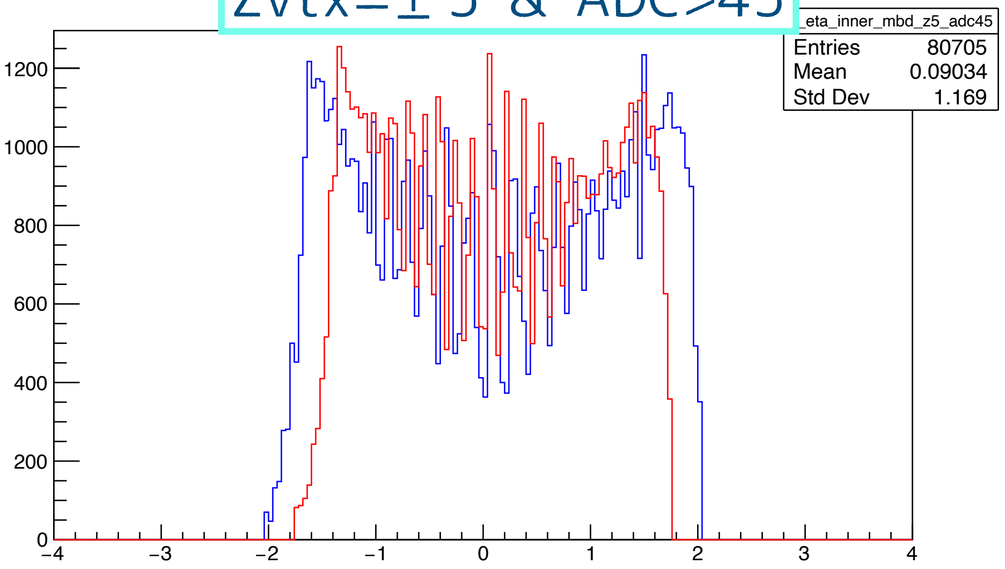
eta distribution (cutting Zvtx and ADC)

blue: inner barrel
red: outer barrel

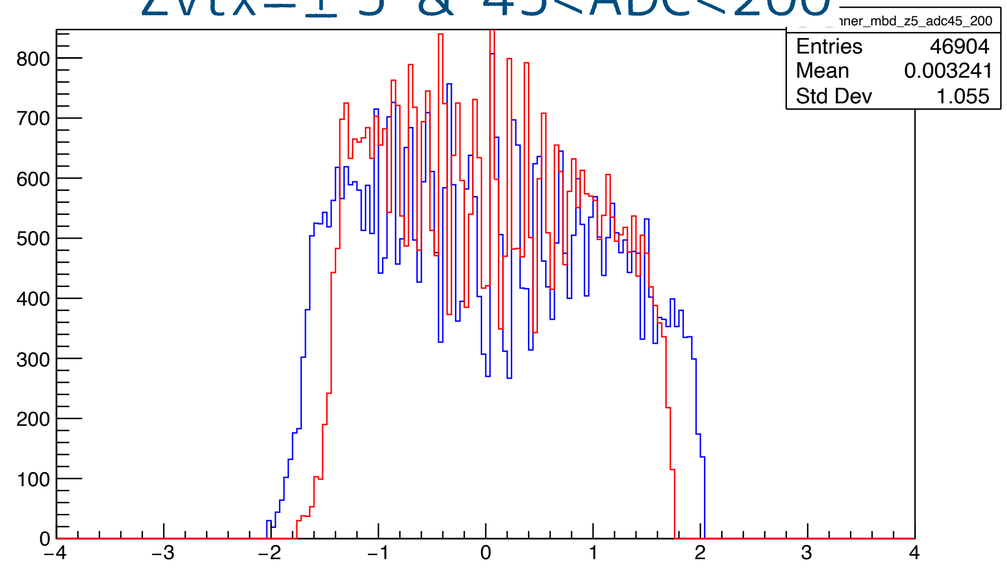
Zvtx=±5



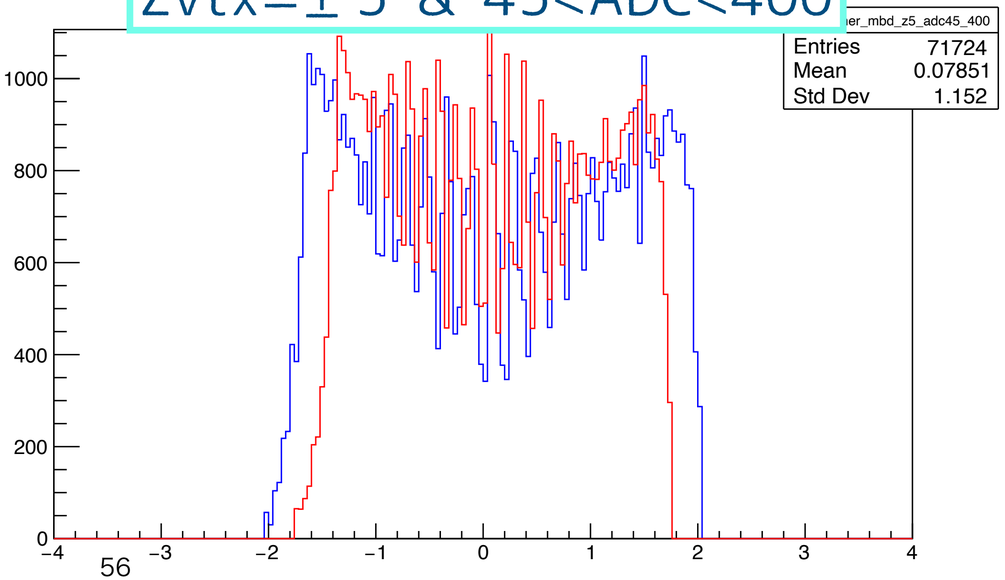
Zvtx=±5 & ADC>45

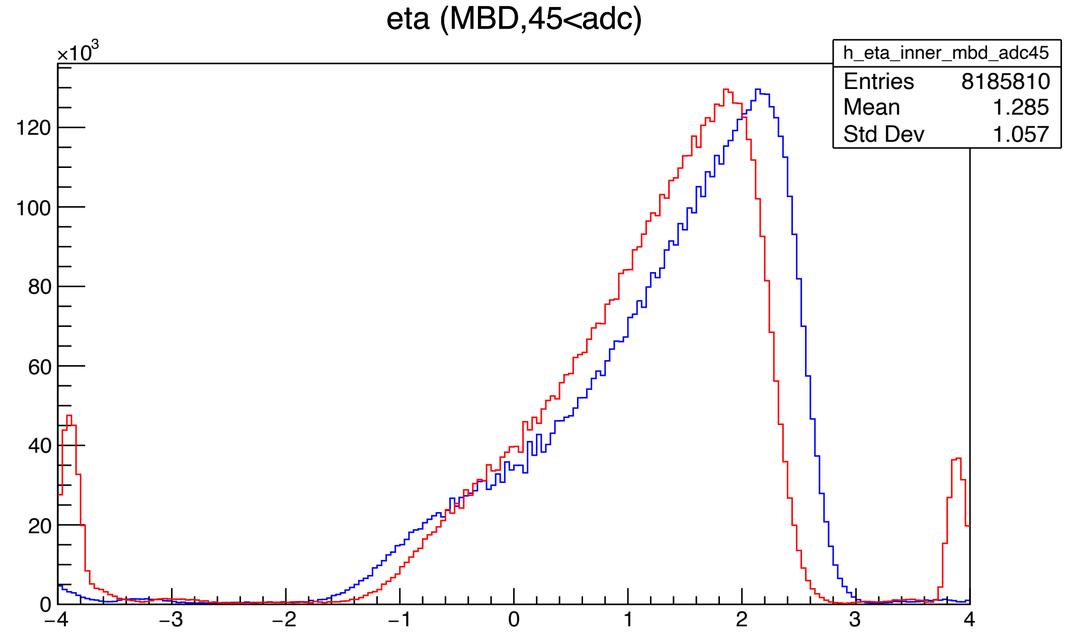


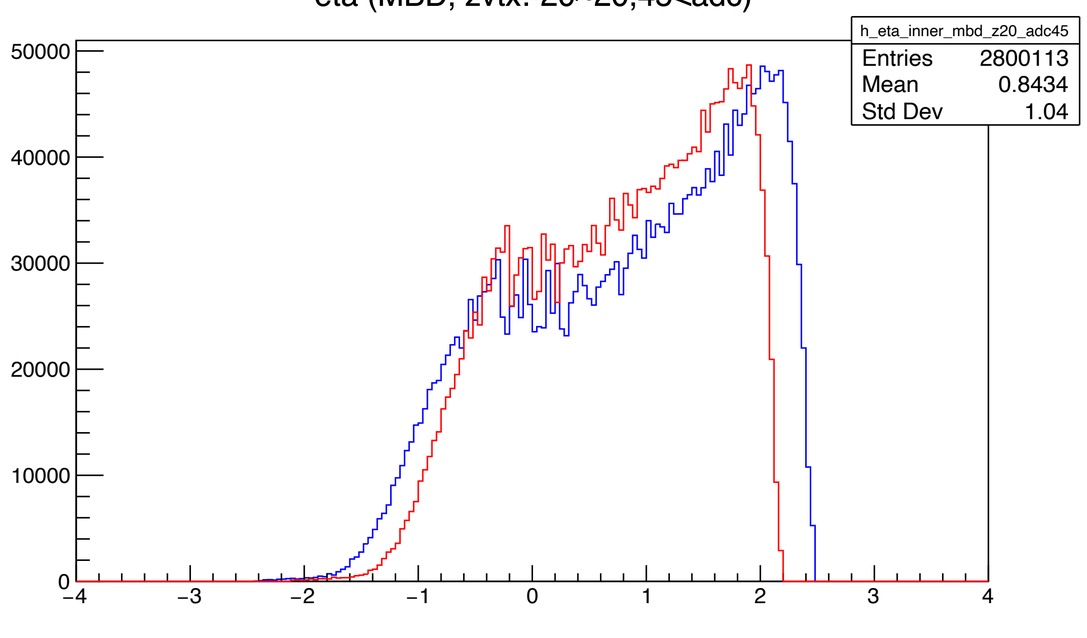
Zvtx=±5 & 45<ADC<200

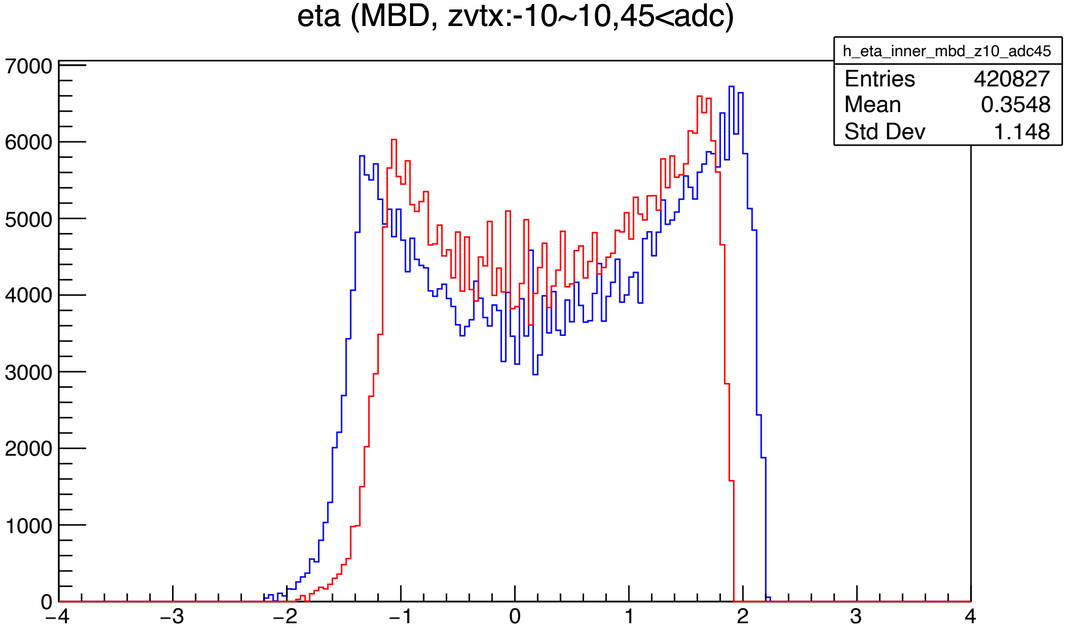


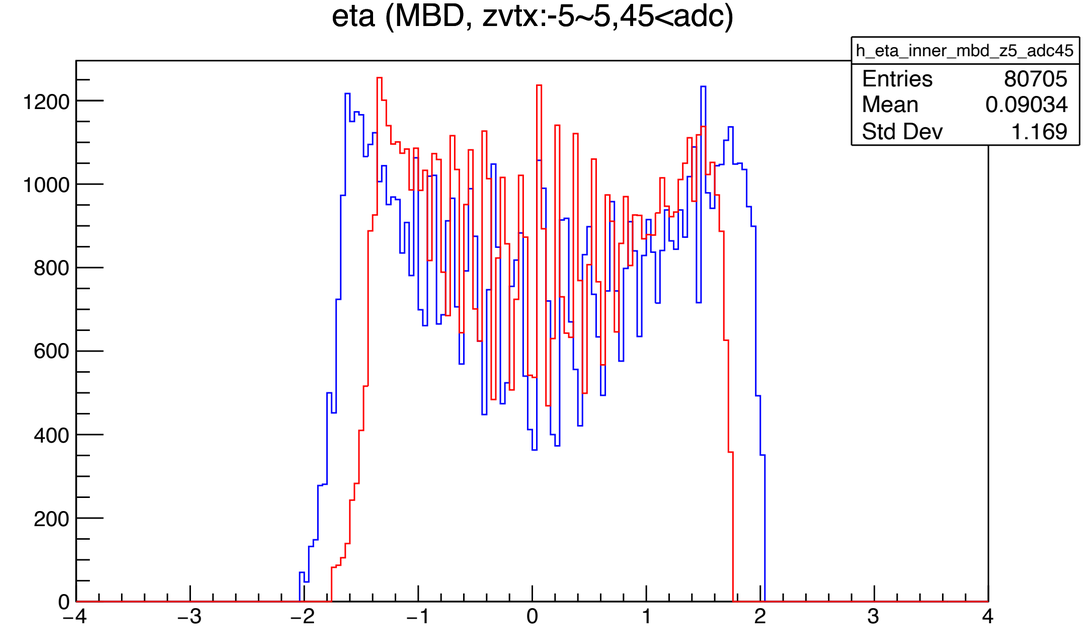
Zvtx=±5 & 45<ADC<400

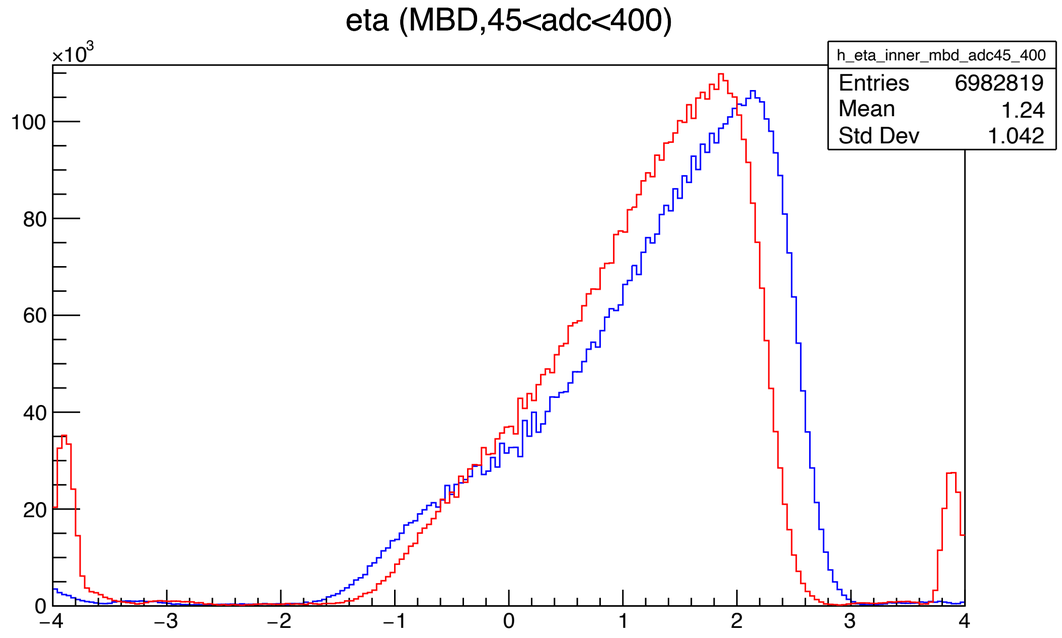


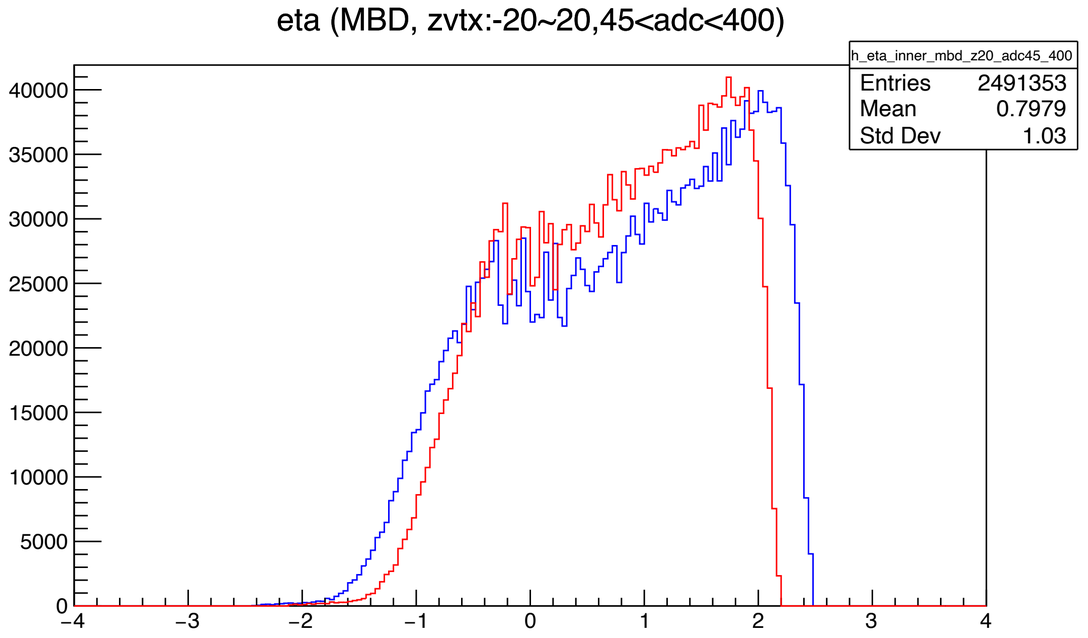

eta (MBD,45<adc)
h_eta_inner_mbd_adc45
Entries 8185810
Mean 1.285
Std Dev 1.057

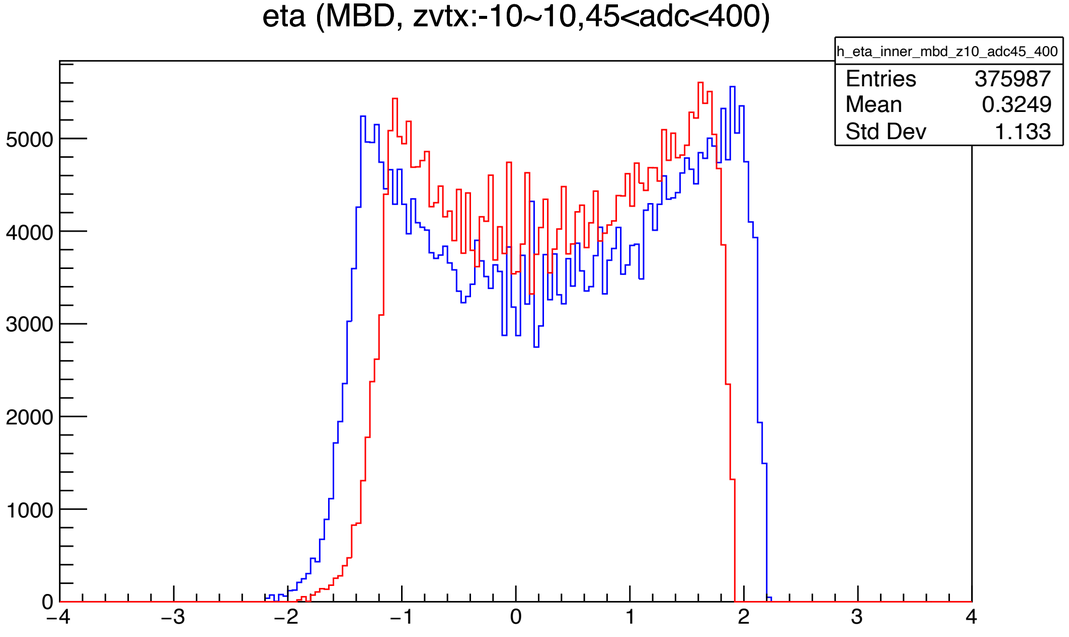

eta (MBD, zvtx:-20~20,45<adc)
h_eta_inner_mbd_z20_adc45
Entries 2800113
Mean 0.8434
Std Dev 1.04

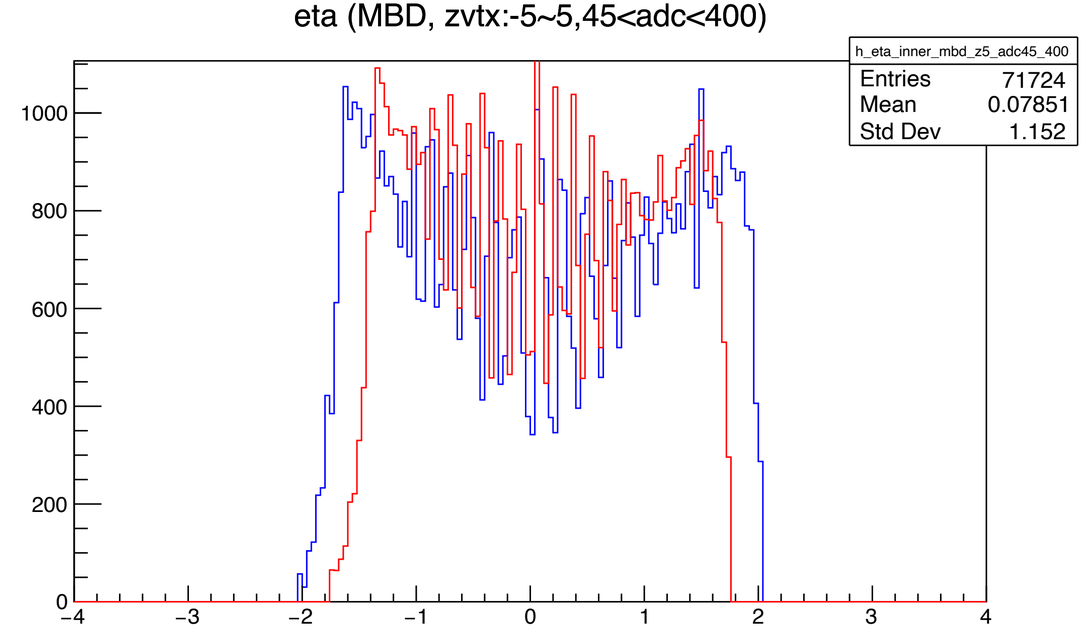

eta (MBD, zvtx:-10~10,45<adc)
h_eta_inner_mbd_z10_adc45
Entries 420827
Mean 0.3548
Std Dev 1.148


eta (MBD, zvtx:-5~5,45<adc)
h_eta_inner_mbd_z5_adc45
Entries 80705
Mean 0.09034
Std Dev 1.169


eta (MBD,45<adc<400)
h_eta_inner_mbd_adc45_400
Entries 6982819
Mean 1.24
Std Dev 1.042
×10^3


eta (MBD, zvtx:-20~20,45<adc<400)
h_eta_inner_mbd_z20_adc45_400
Entries 2491353
Mean 0.7979
Std Dev 1.03


eta (MBD, zvtx:-10~10,45<adc<400)
h_eta_inner_mbd_z10_adc45_400
Entries 375987
Mean 0.3249
Std Dev 1.133

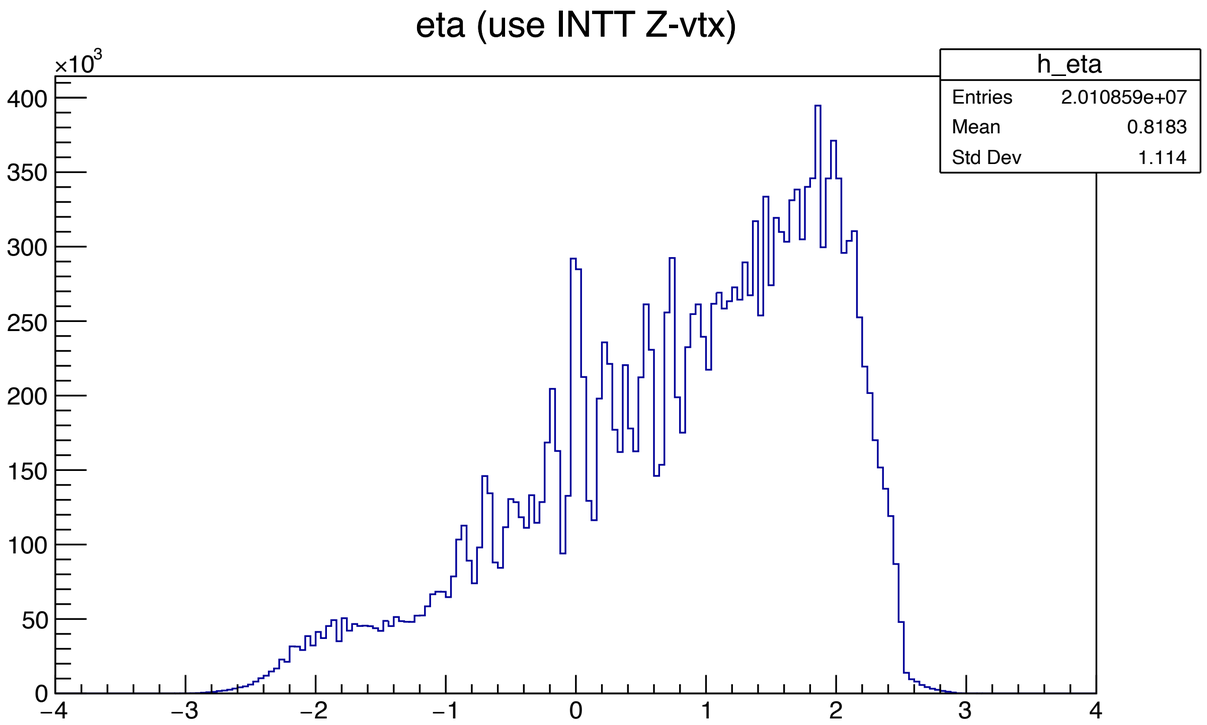

eta (MBD, zvtx:-5~5,45<adc<400)
h_eta_inner_mbd_z5_adc45_400
Entries 71724
Mean 0.07851
Std Dev 1.152

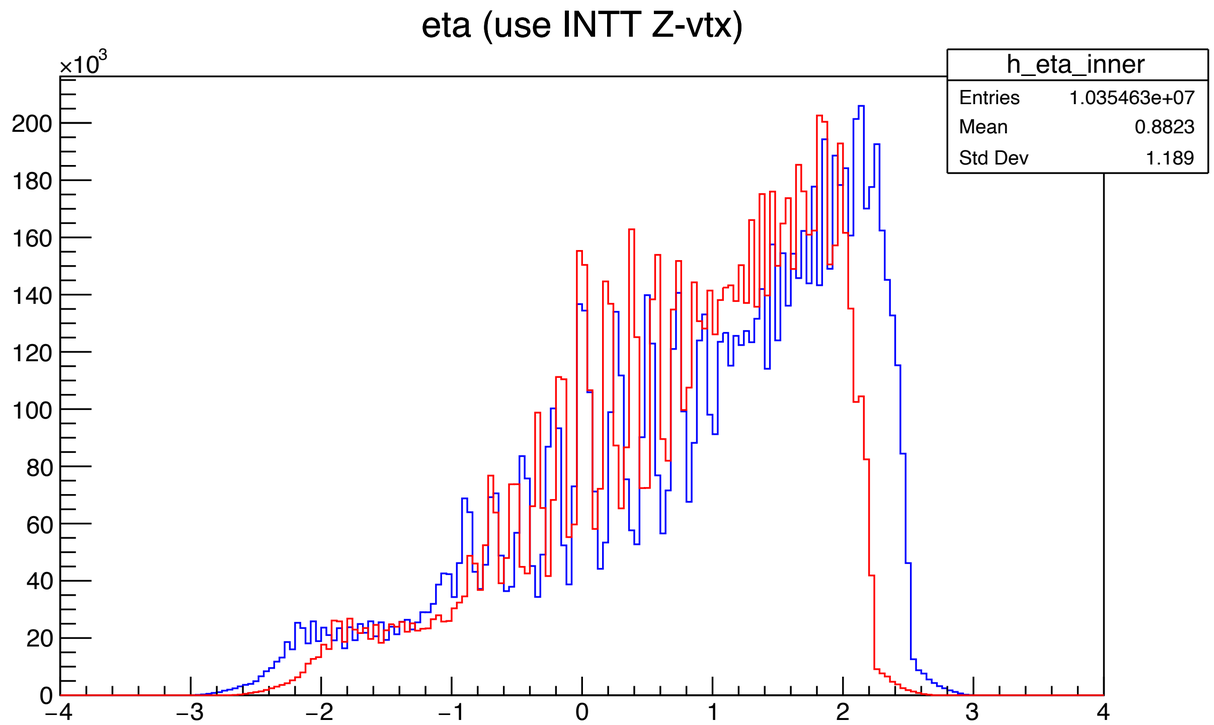
Before this workshop

eta distribution (use INTT Zvxt)

eta (no cut)

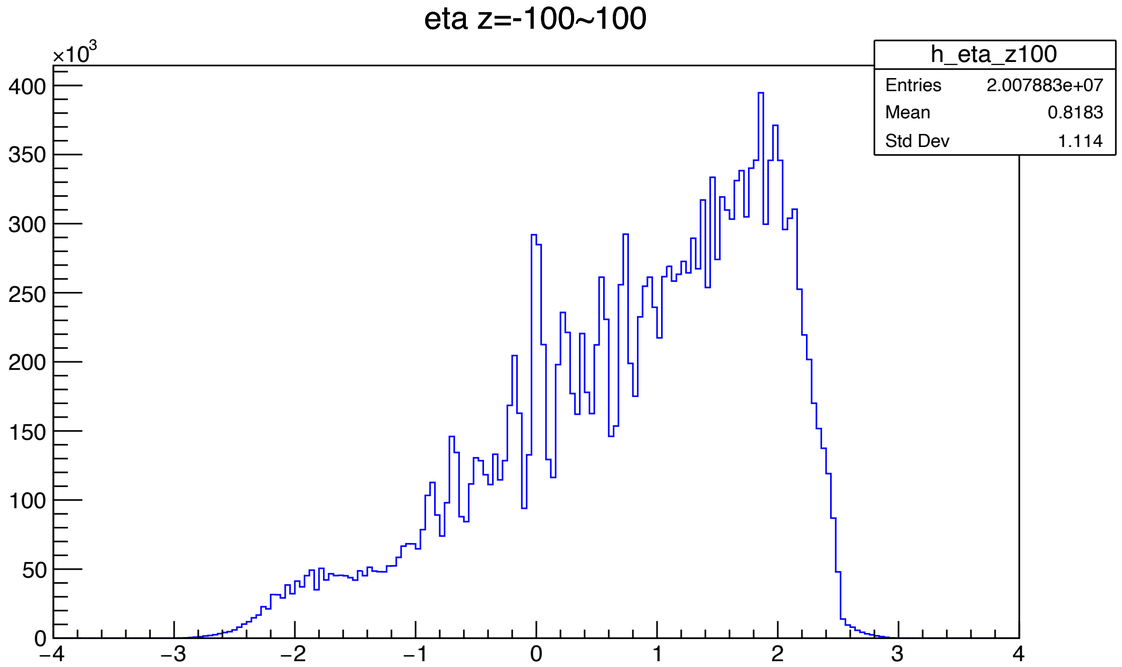
left: All, right: blue->inner barrel, red->outer barrel

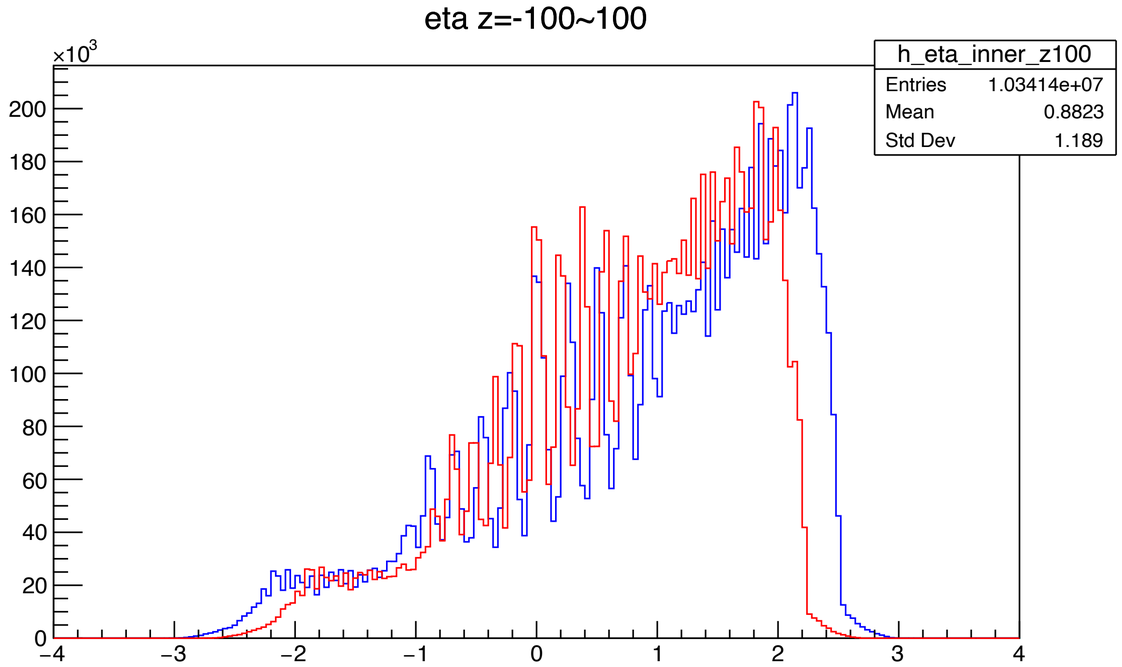




eta (Zvtx=±100cm)

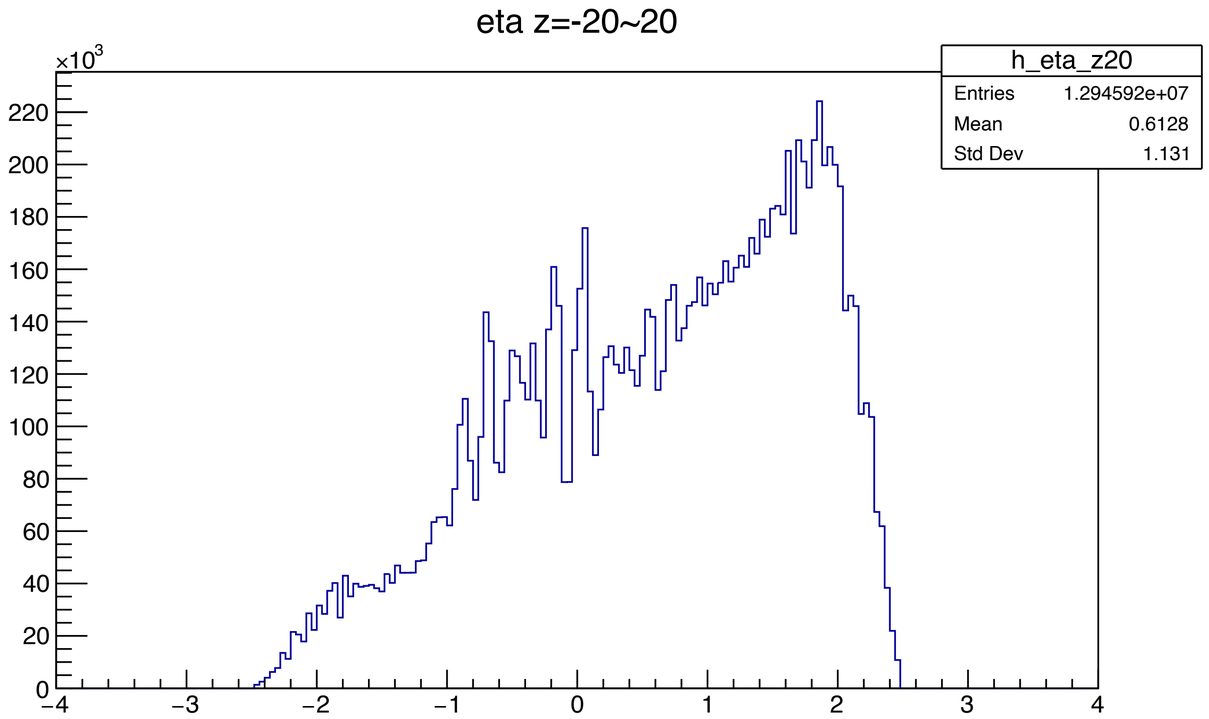
left: All, right: blue->inner barrel, red->outer barrel

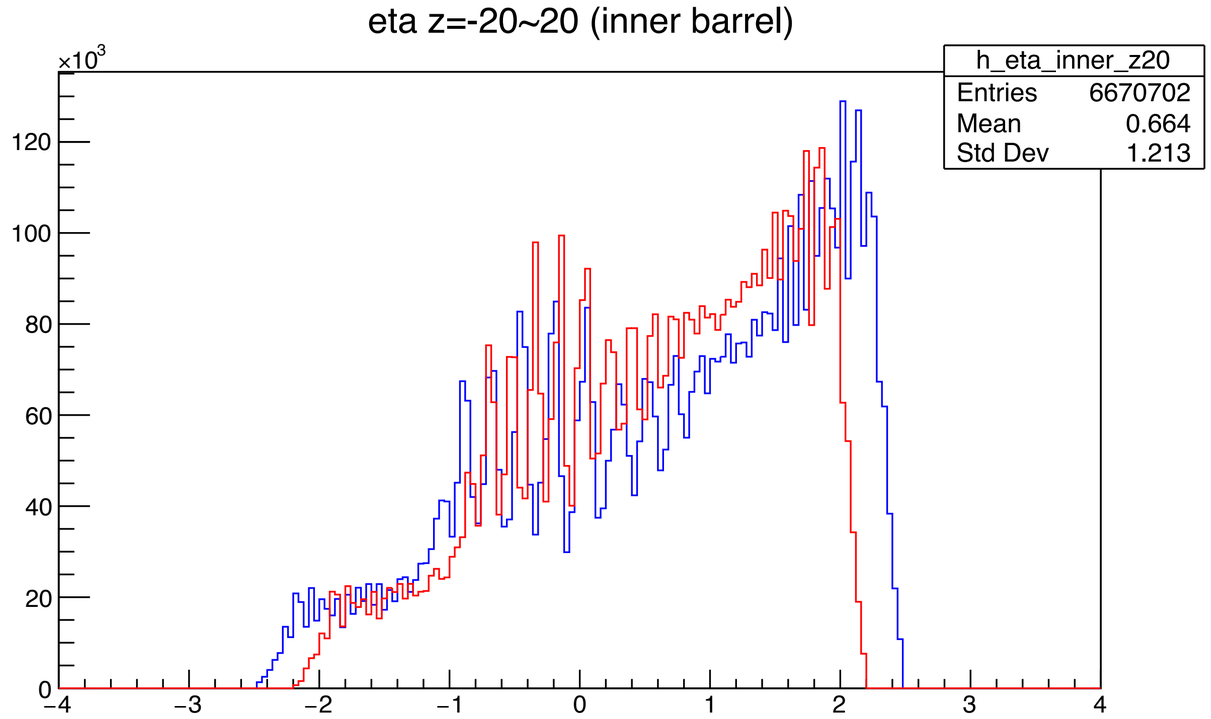




eta (Zvtx=±20cm)

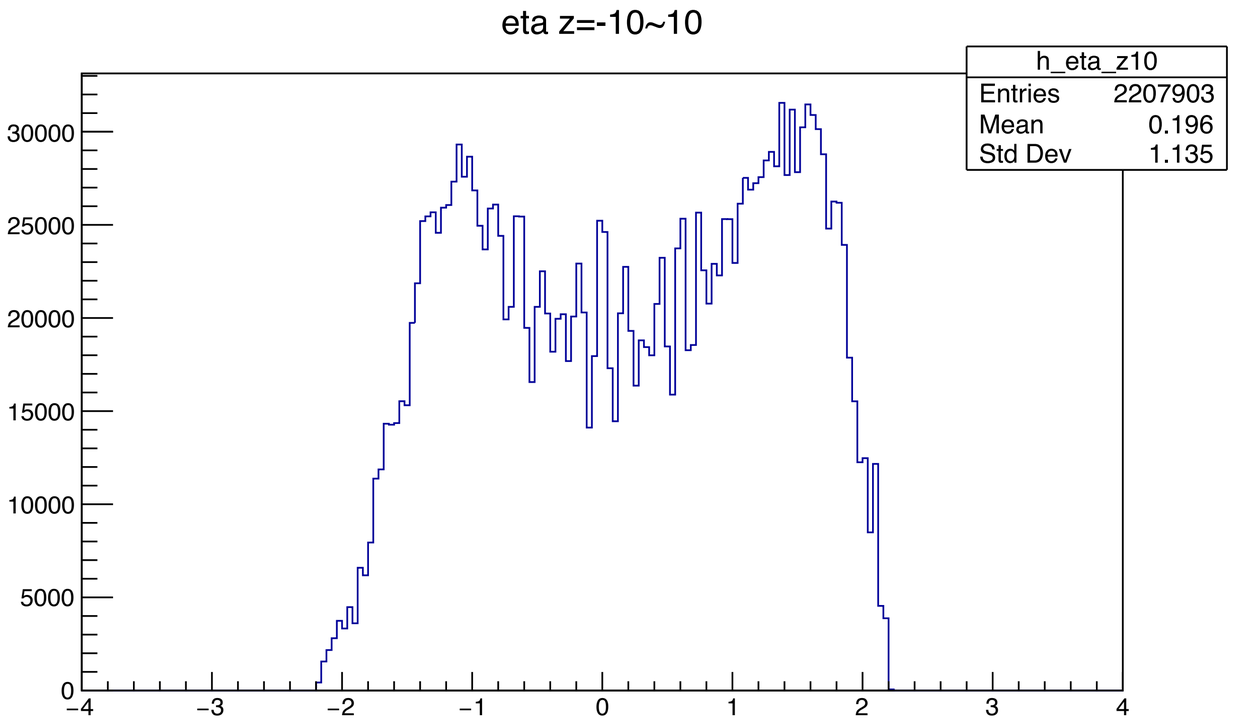
left: All, right: blue->inner barrel, red->outer barrel

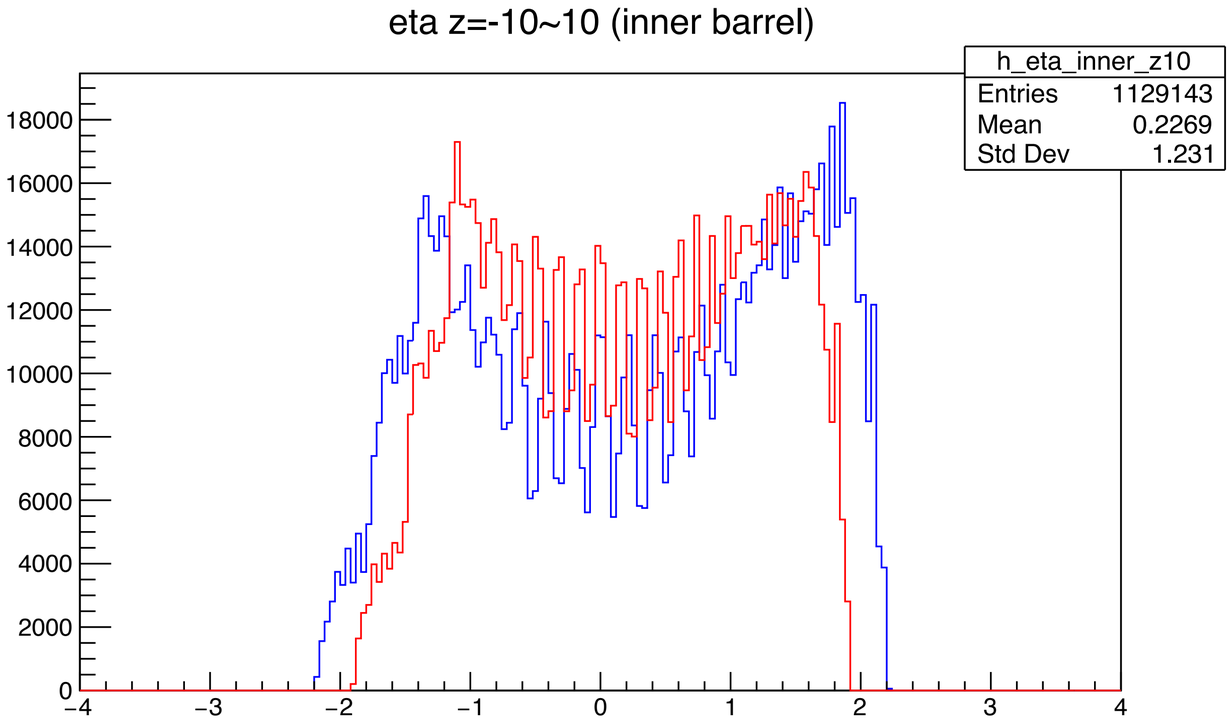




eta (Zvtx=±10cm)

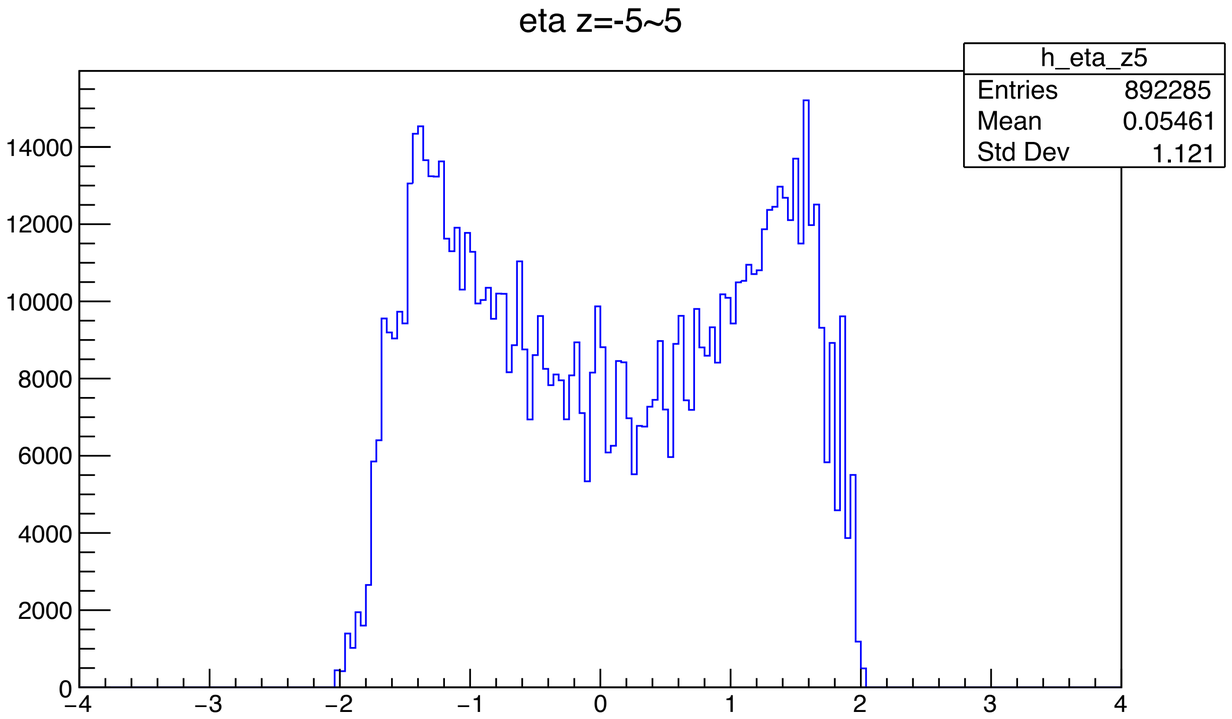
left: All, right: blue->inner barrel, red->outer barrel

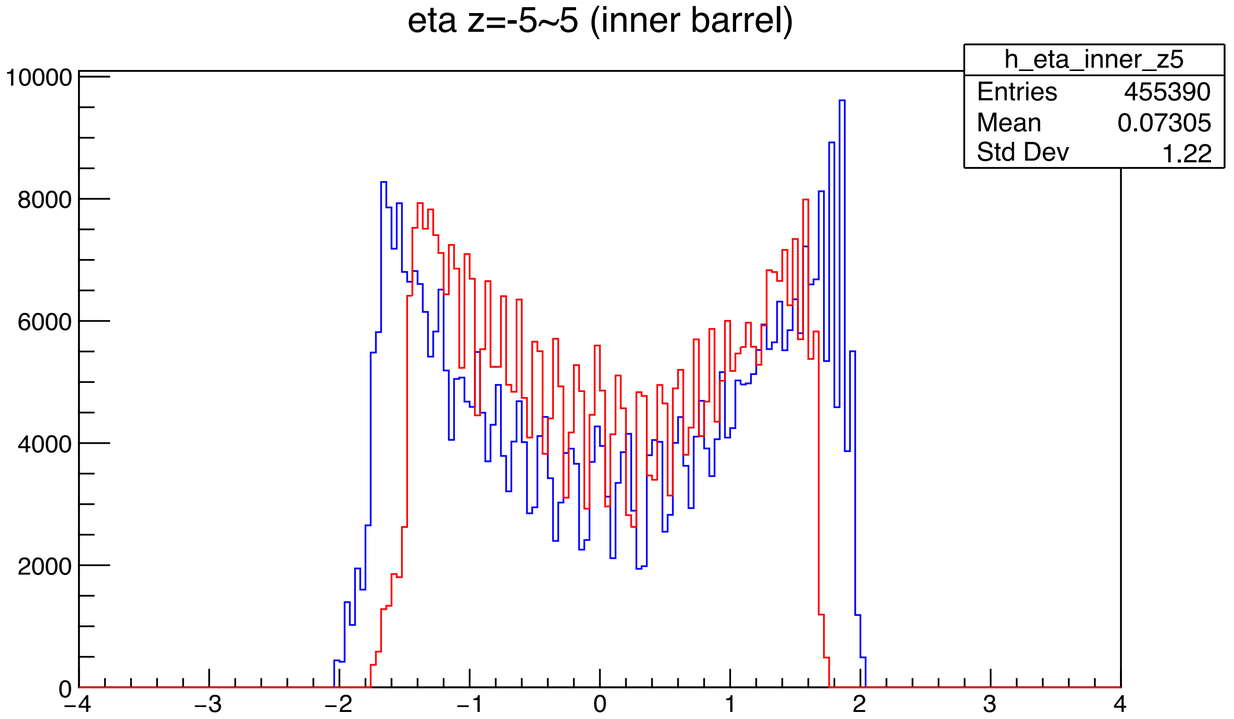




eta (Zvtx=±5cm)

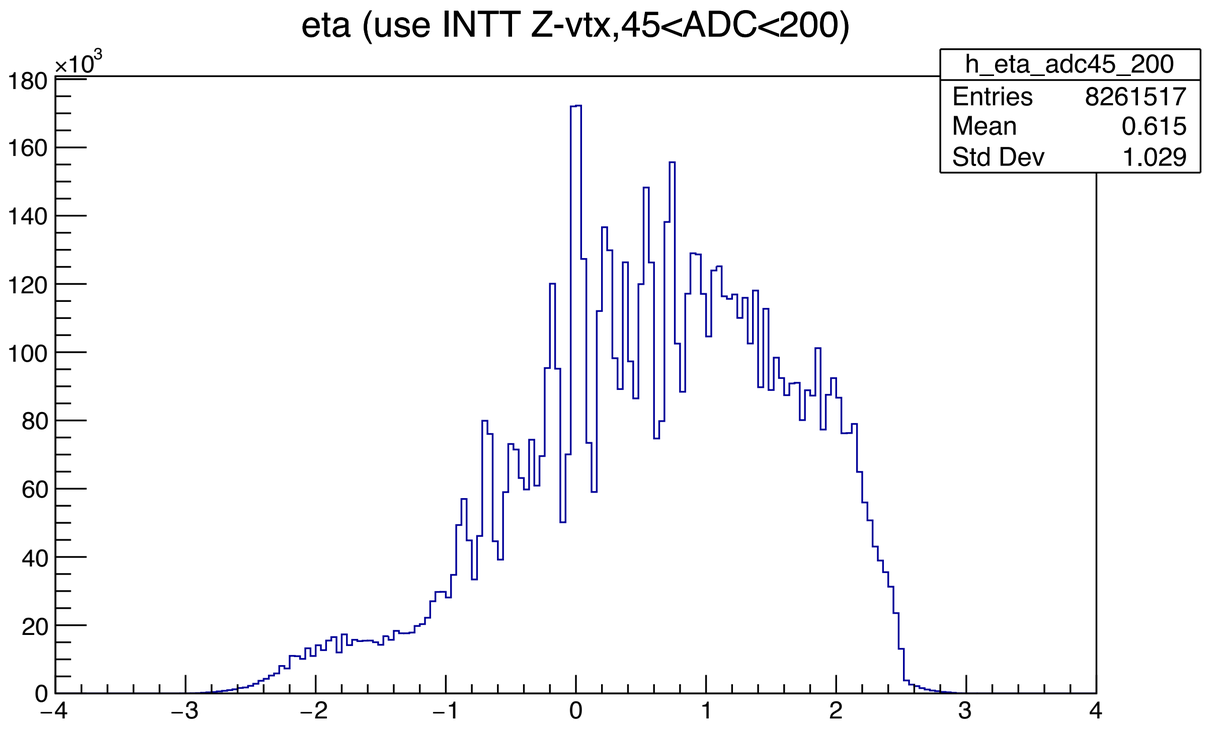
left: All, right: blue->inner barrel, red->outer barrel

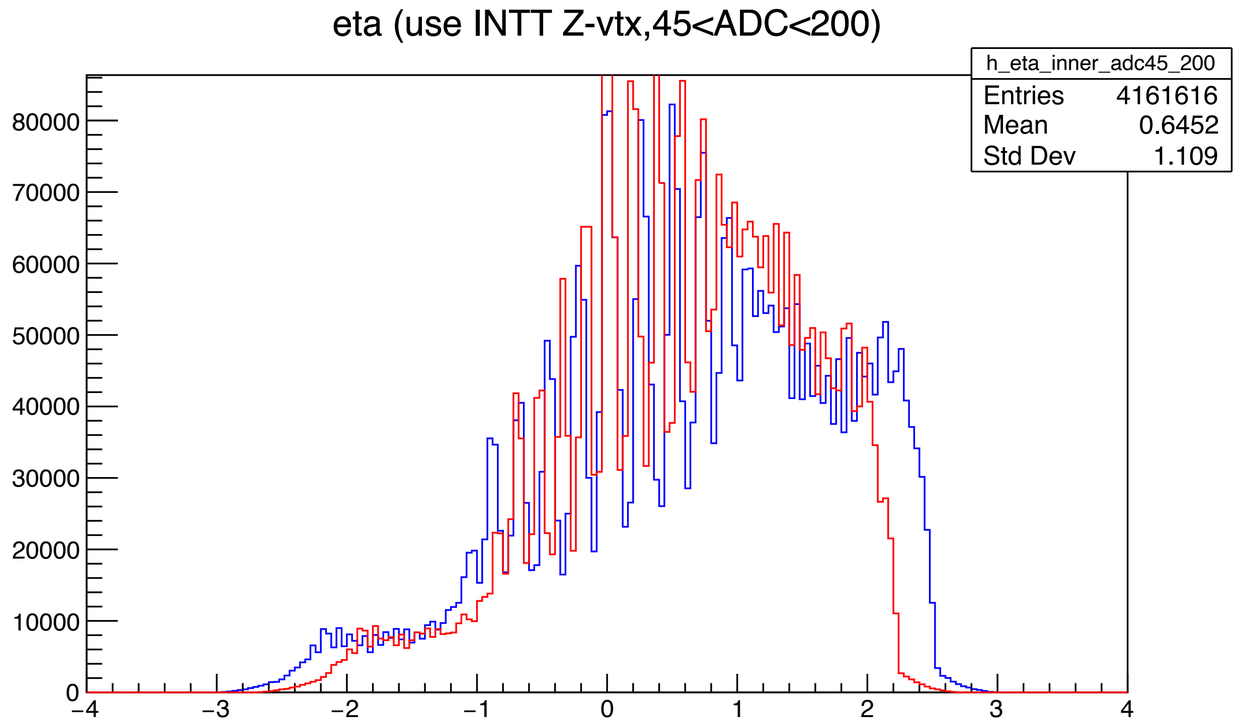




eta (45<ADC<200)

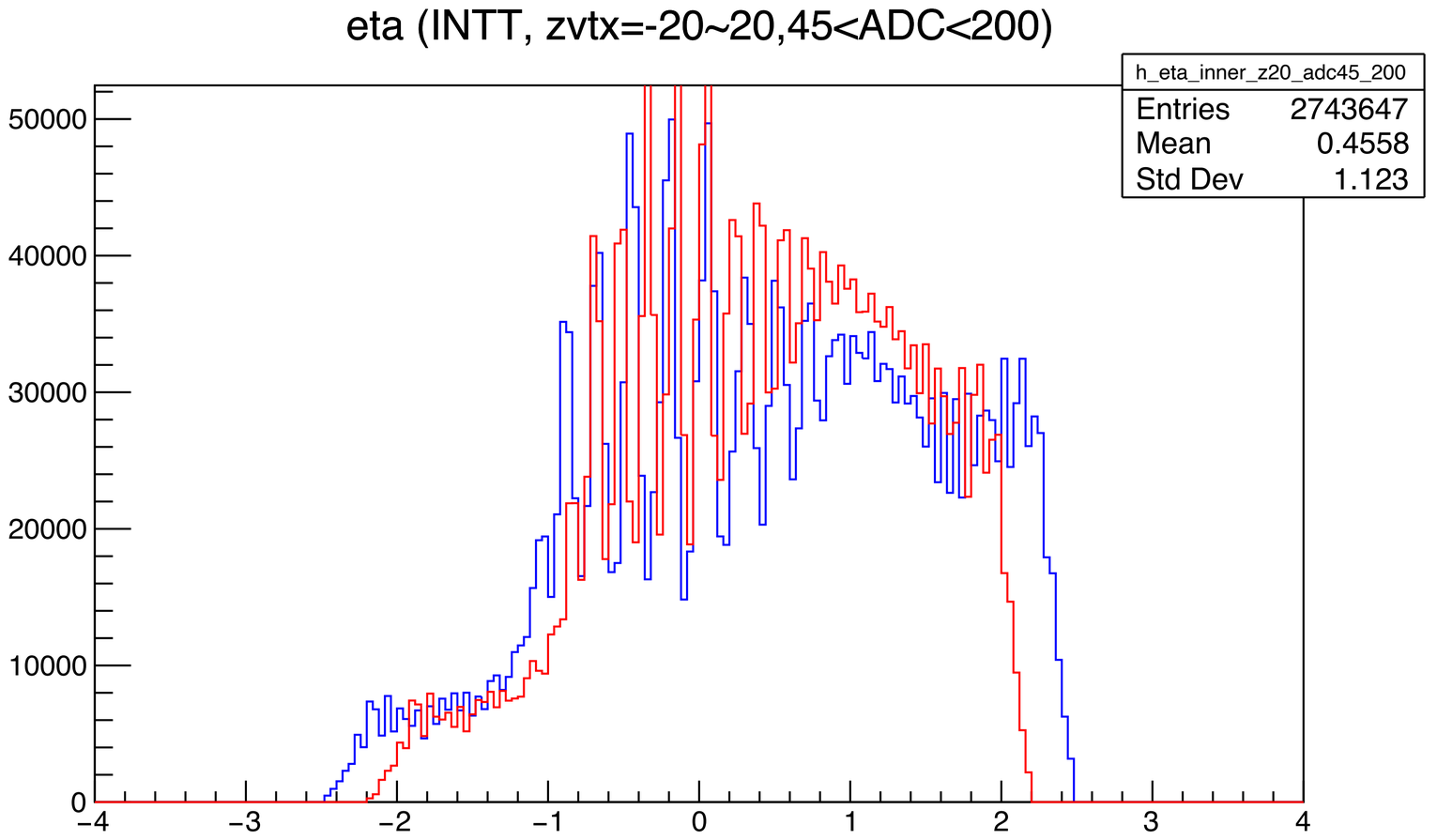
left: All, right: blue->inner barrel, red->outer barrel





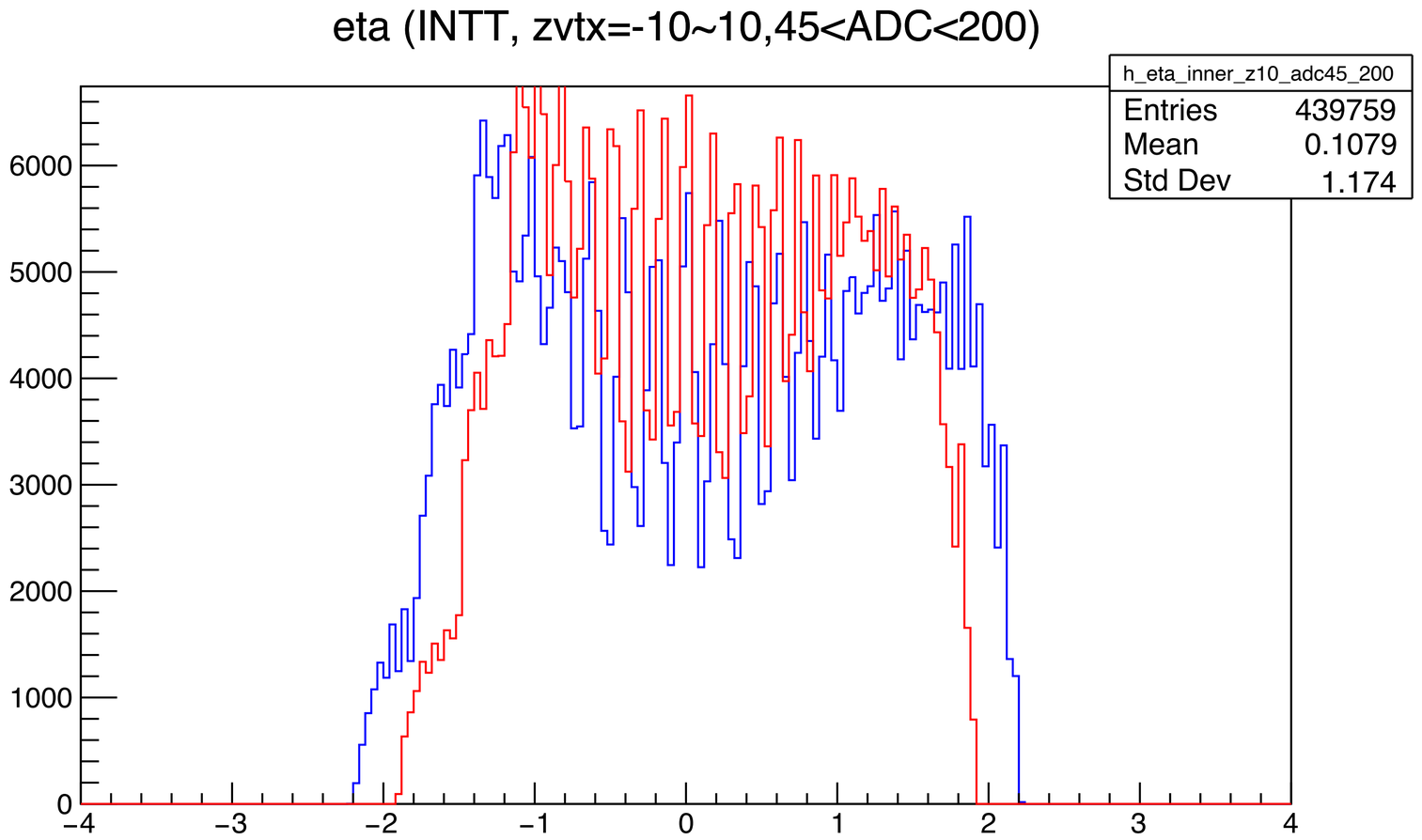
eta (Zvtx=±20cm & 45<ADC<200)

blue->inner barrel, red->outer barrel



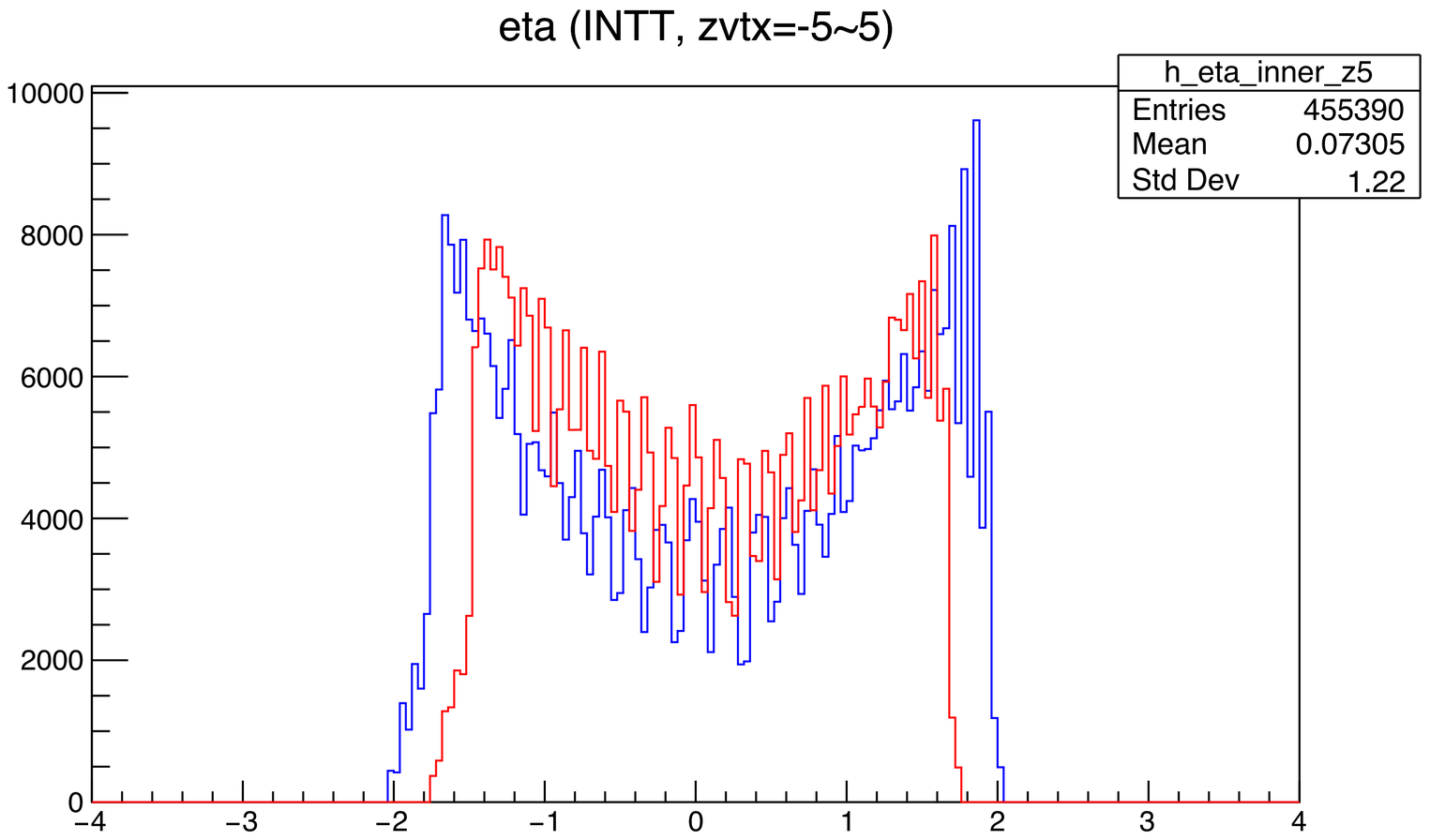
eta (Zvtx=±10cm & 45<ADC<200)

blue->inner barrel, red->outer barrel



eta (Zvtx=±5cm & 45<ADC<200)

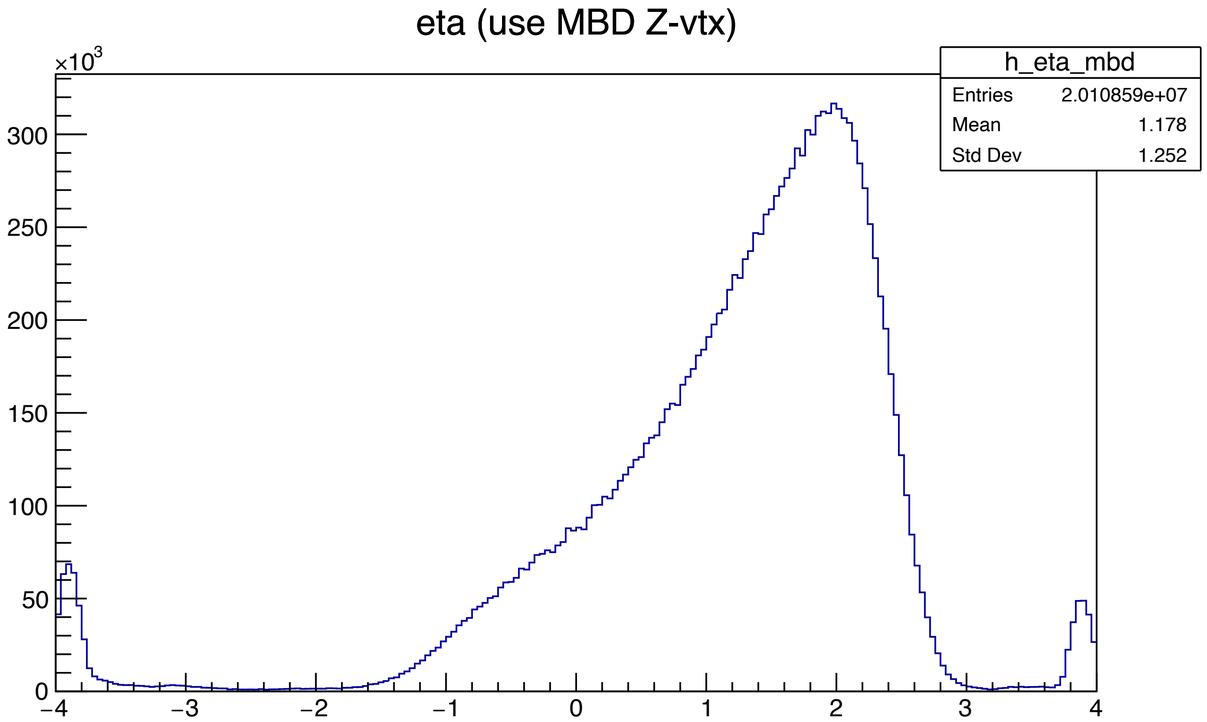
blue->inner barrel, red->outer barrel

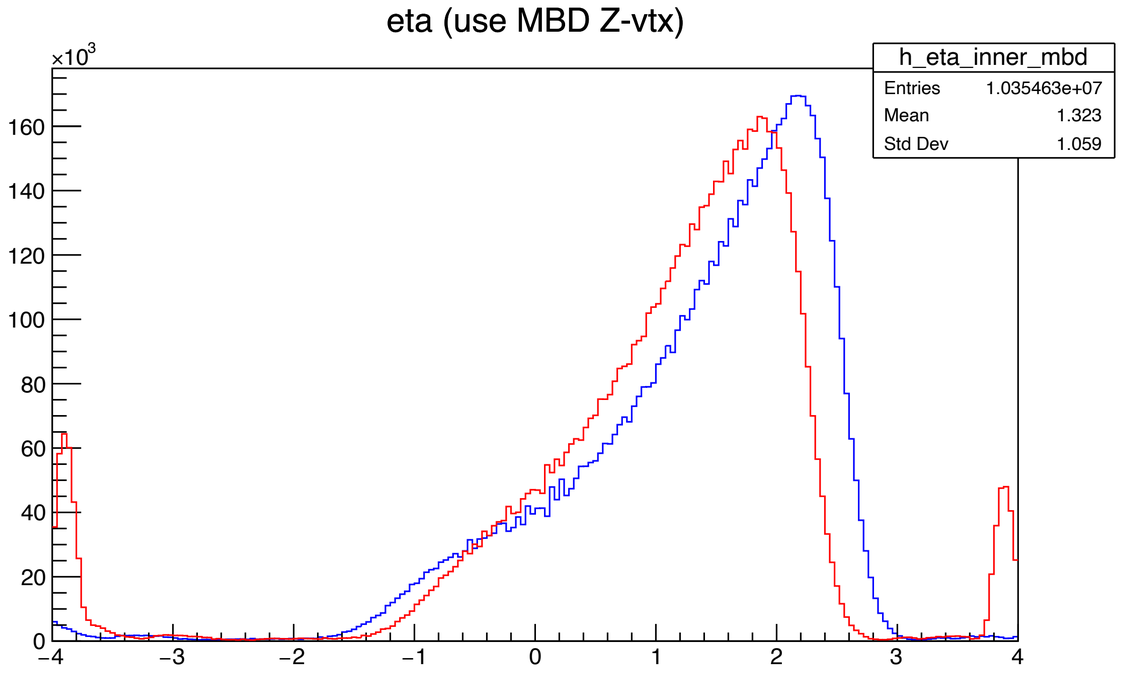


eta distribution (use MBD Zvxt)

eta (no cut)

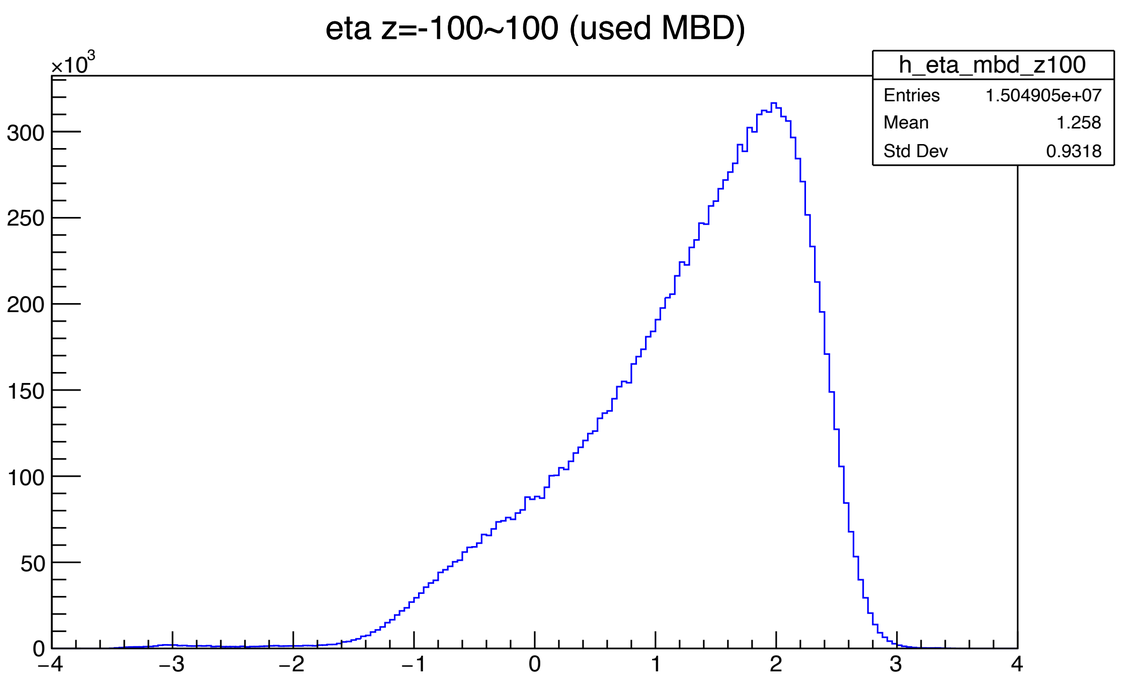
left: All, right: blue->inner barrel, red->outer barrel

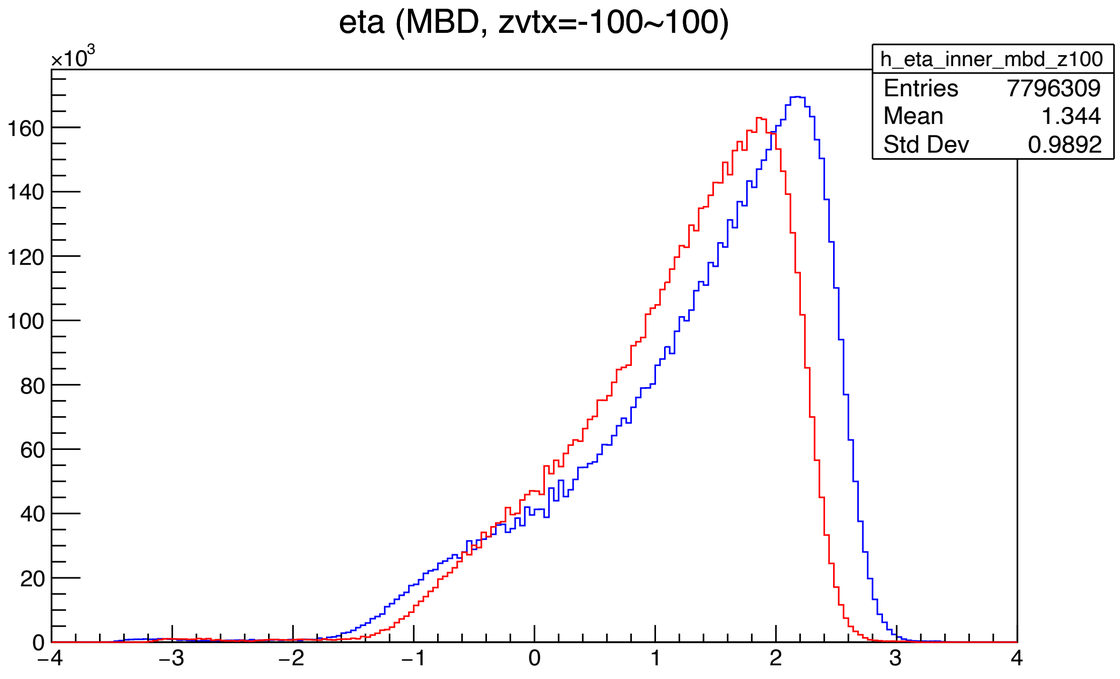




eta (Zvtx=±100cm)

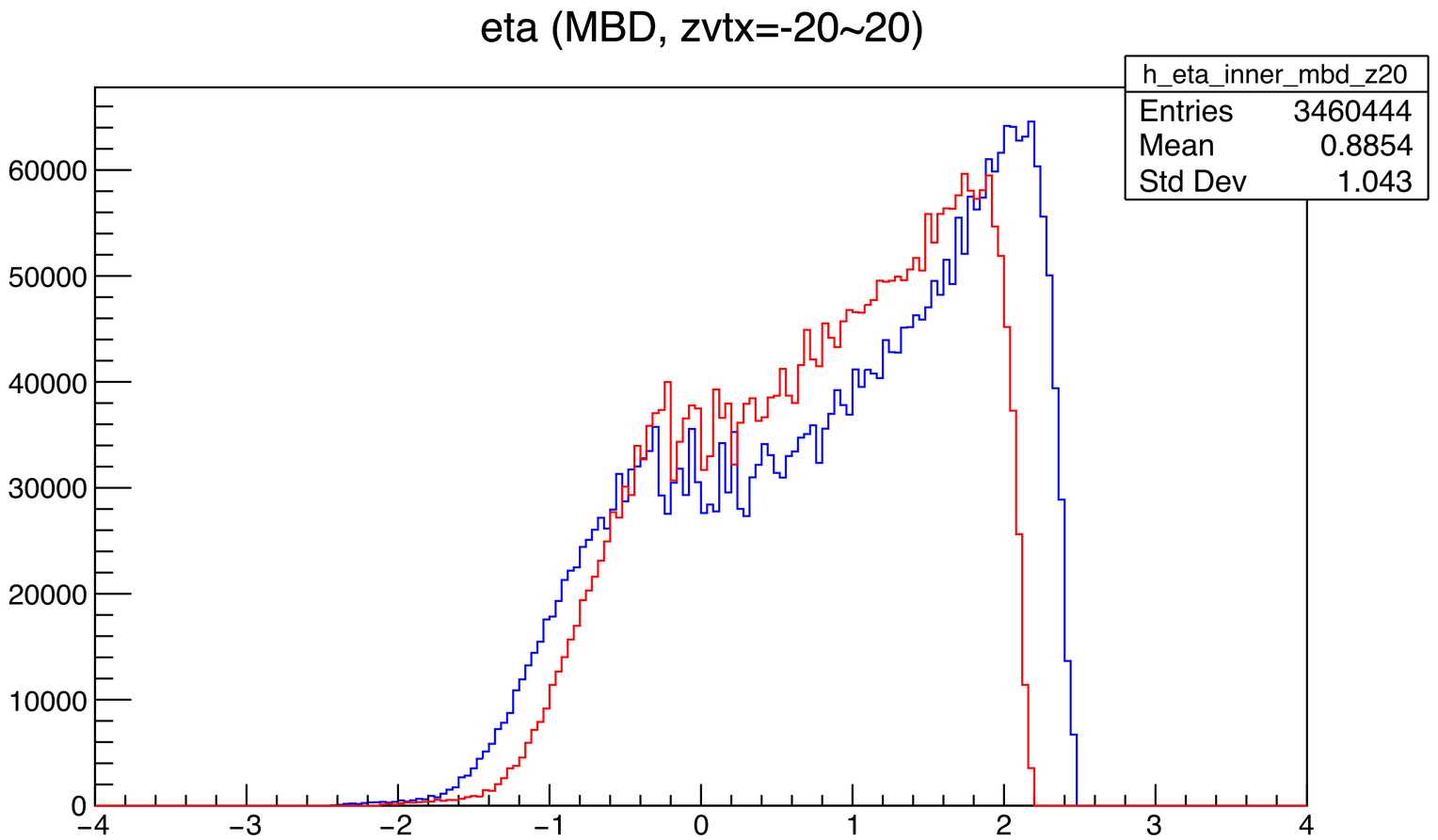
left: All, right: blue->inner barrel, red->outer barrel





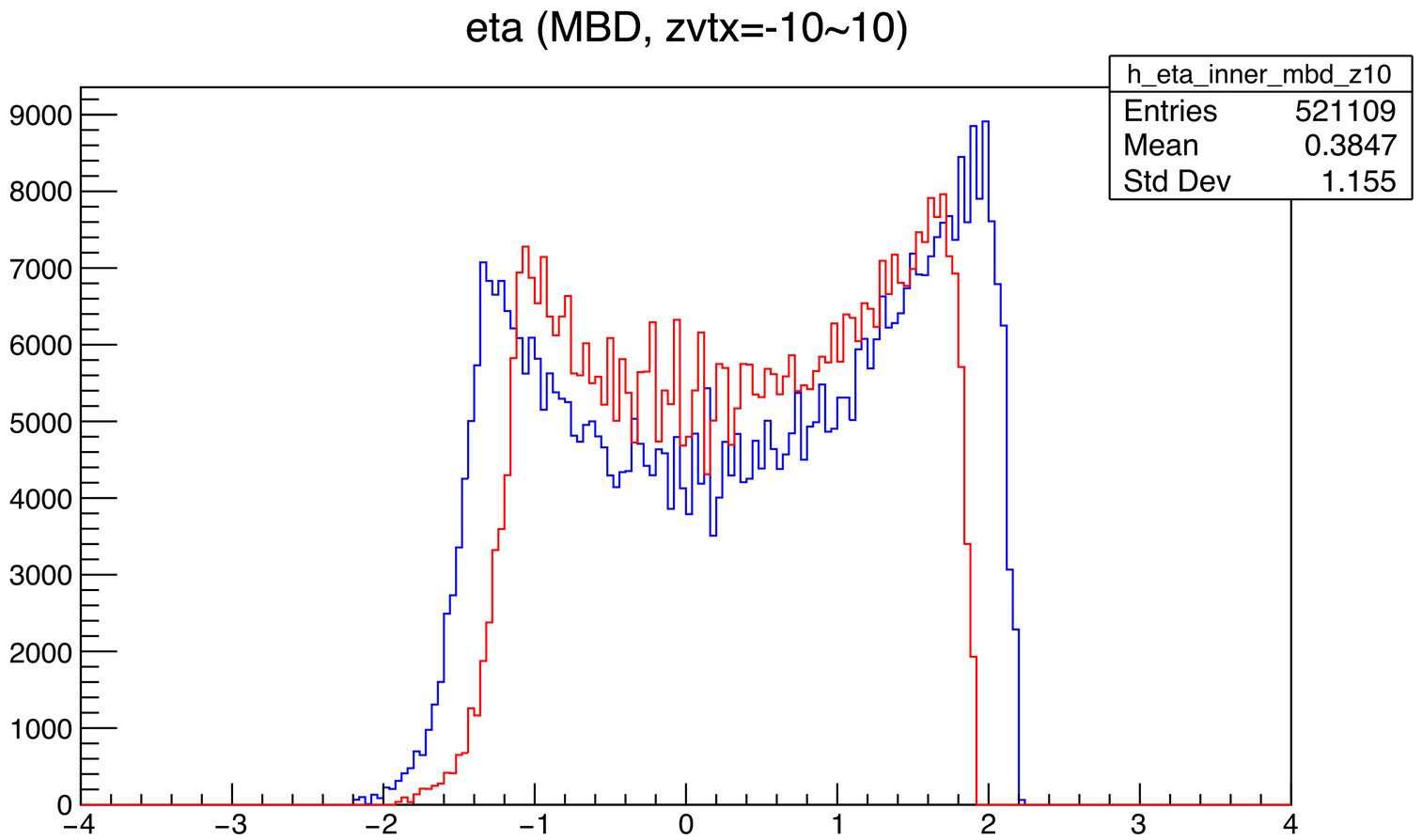
eta (Zvtx=±20cm)

blue->inner barrel, red->outer barrel



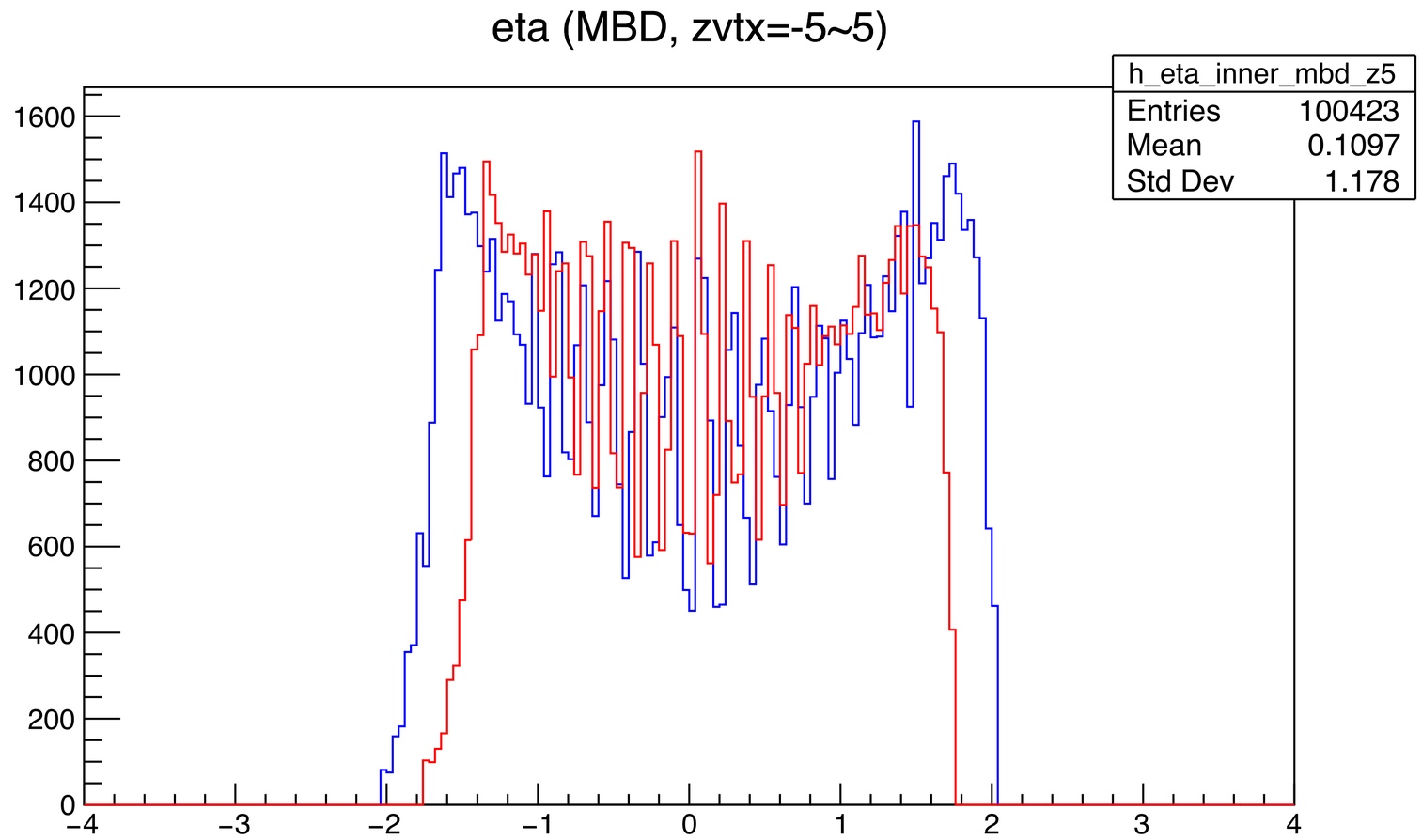
eta (Zvtx=±10cm)

blue->inner barrel, red->outer barrel



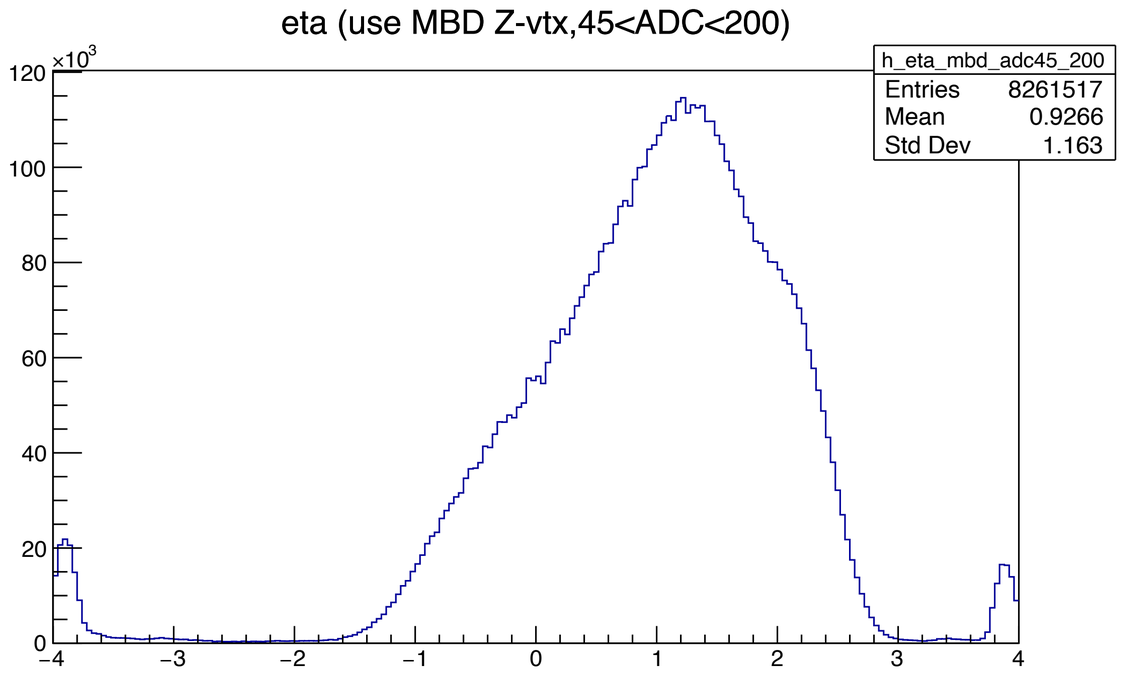
eta (Zvtx=±5cm)

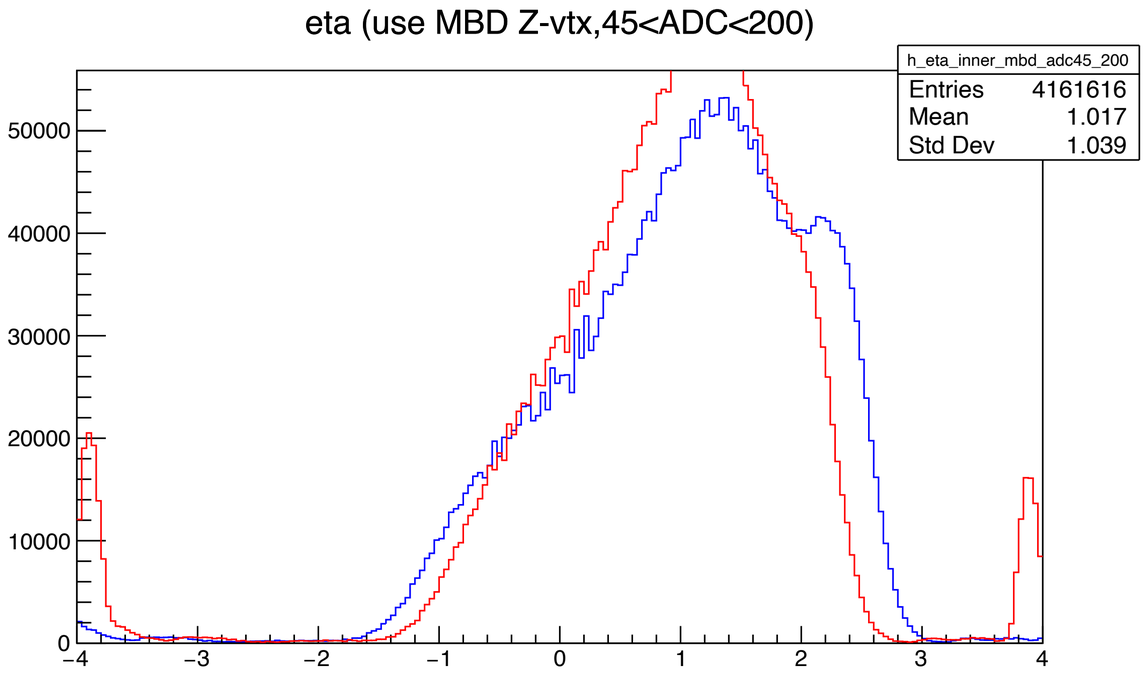
blue->inner barrel, red->outer barrel



eta (45<ADC<200)

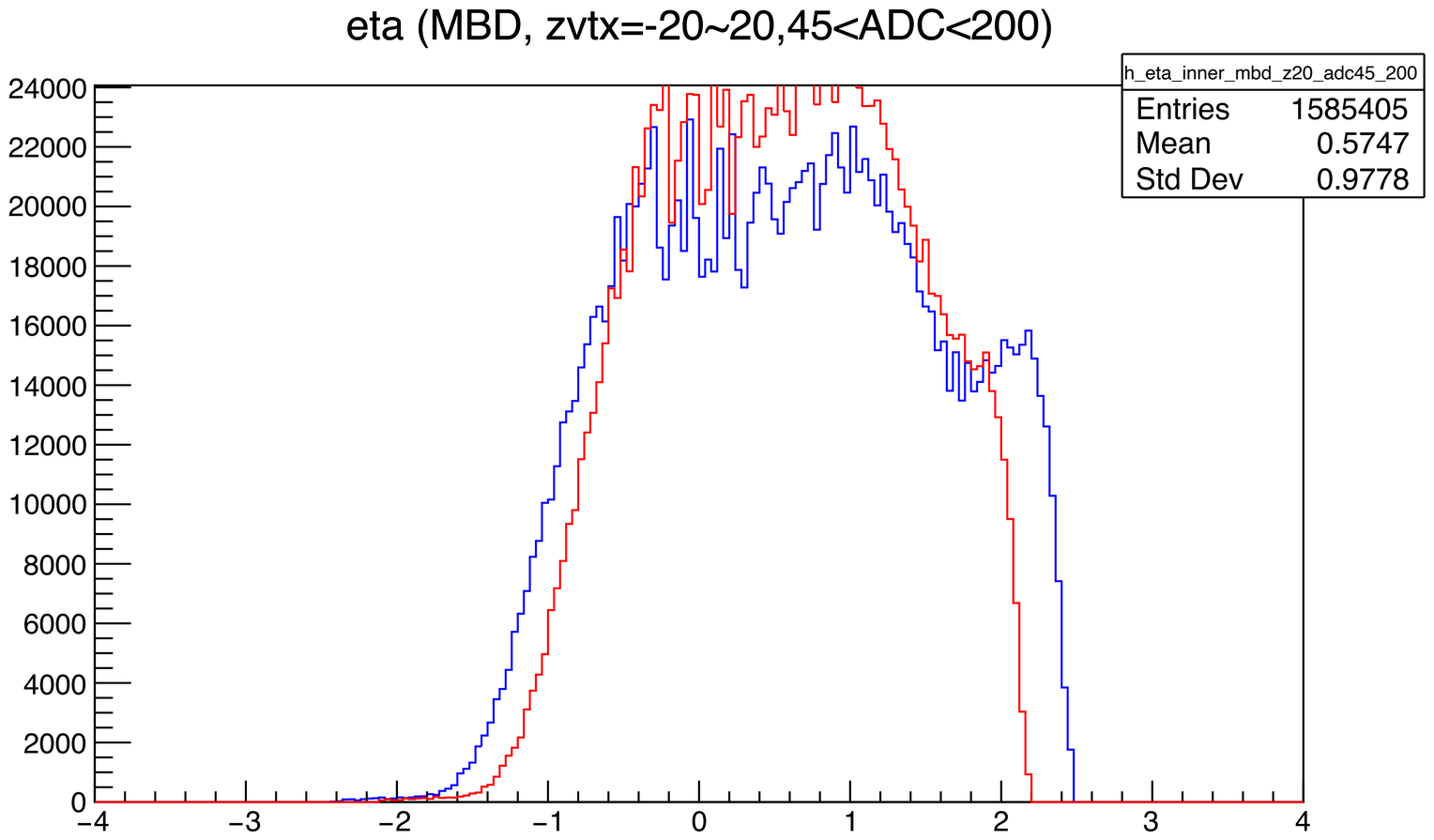
left: All, right: blue->inner barrel, red->outer barrel





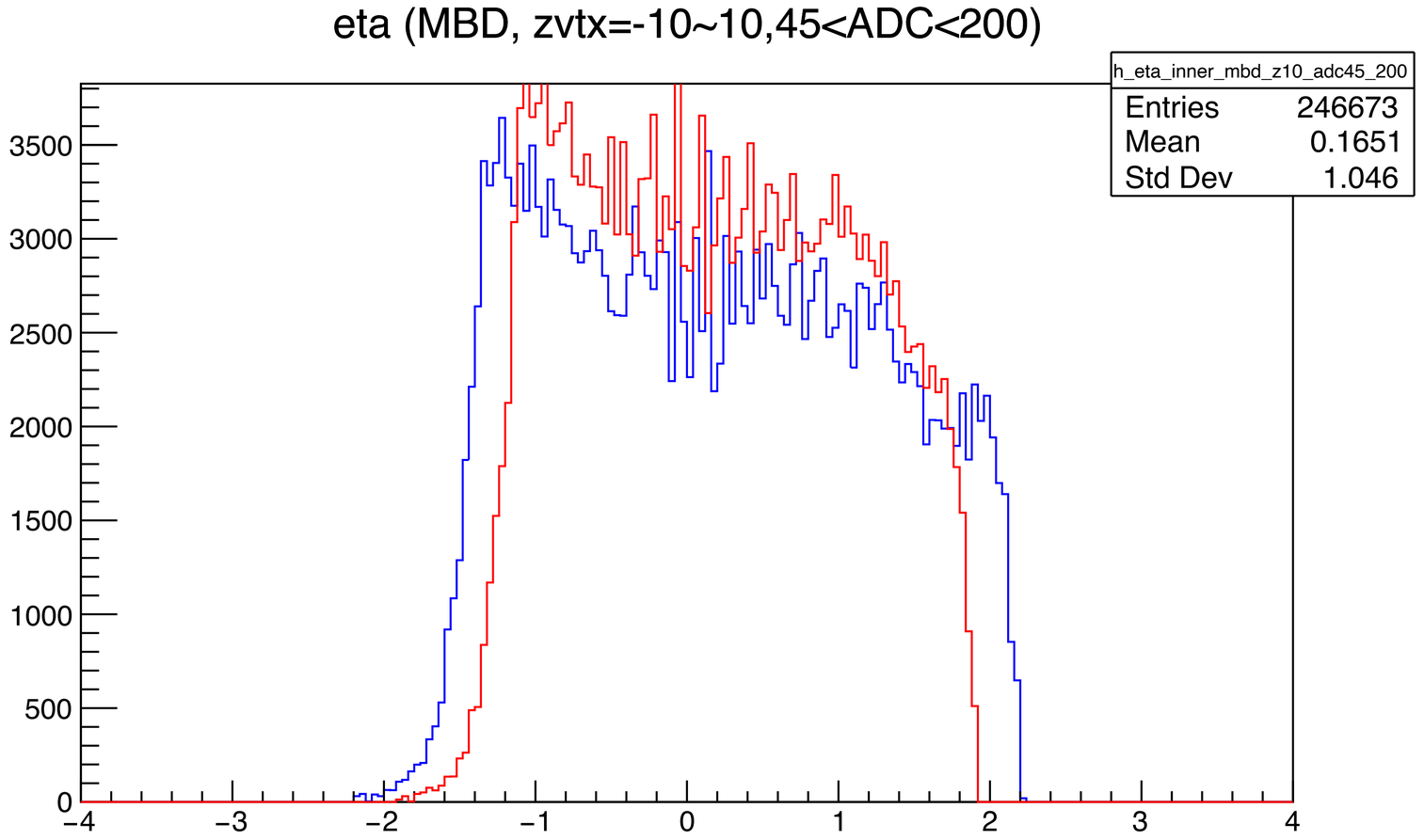
eta (Zvtx=±20cm & 45<ADC<200)

blue->inner barrel, red->outer barrel



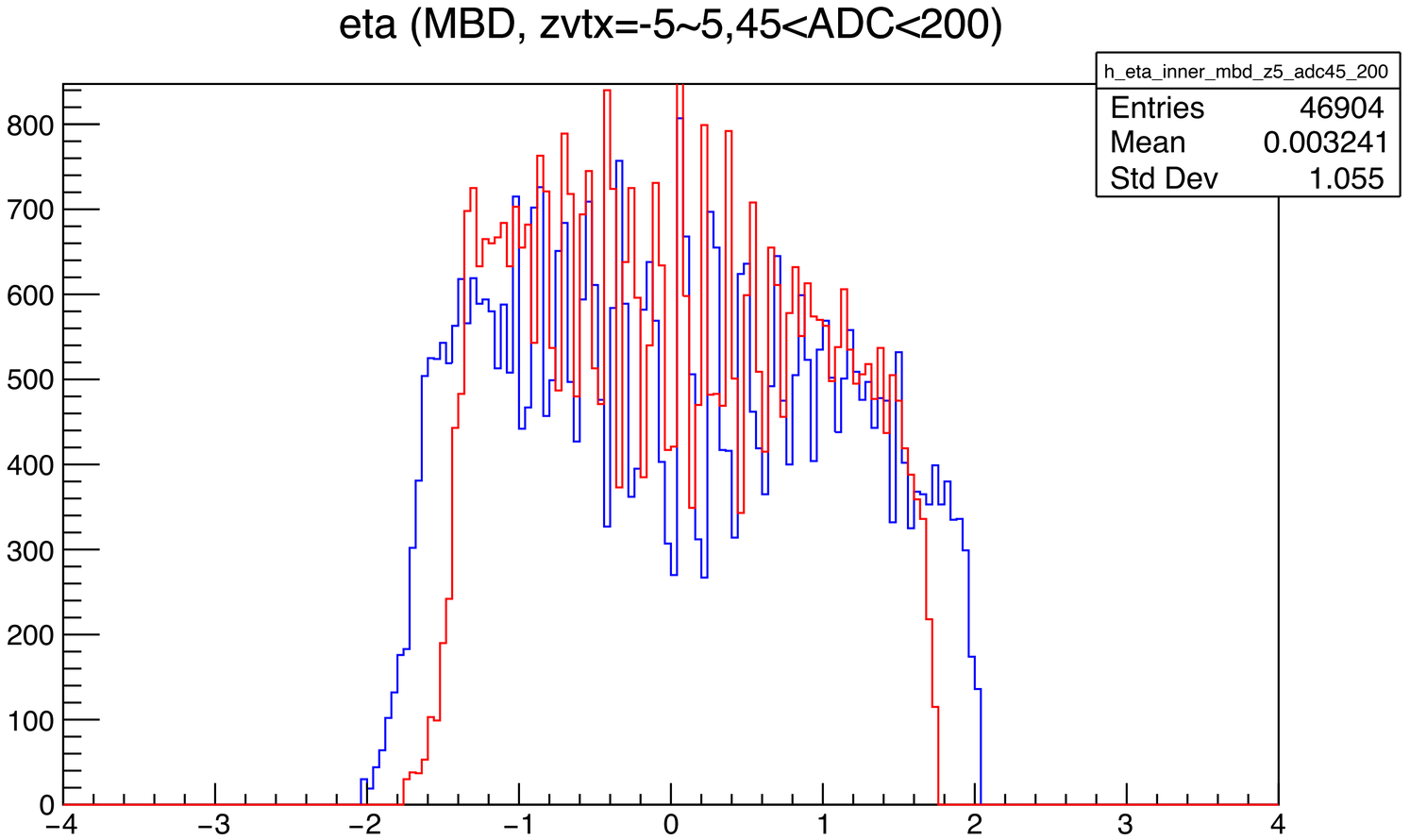
eta (Zvtx=±10cm & 45<ADC<200)

blue->inner barrel, red->outer barrel



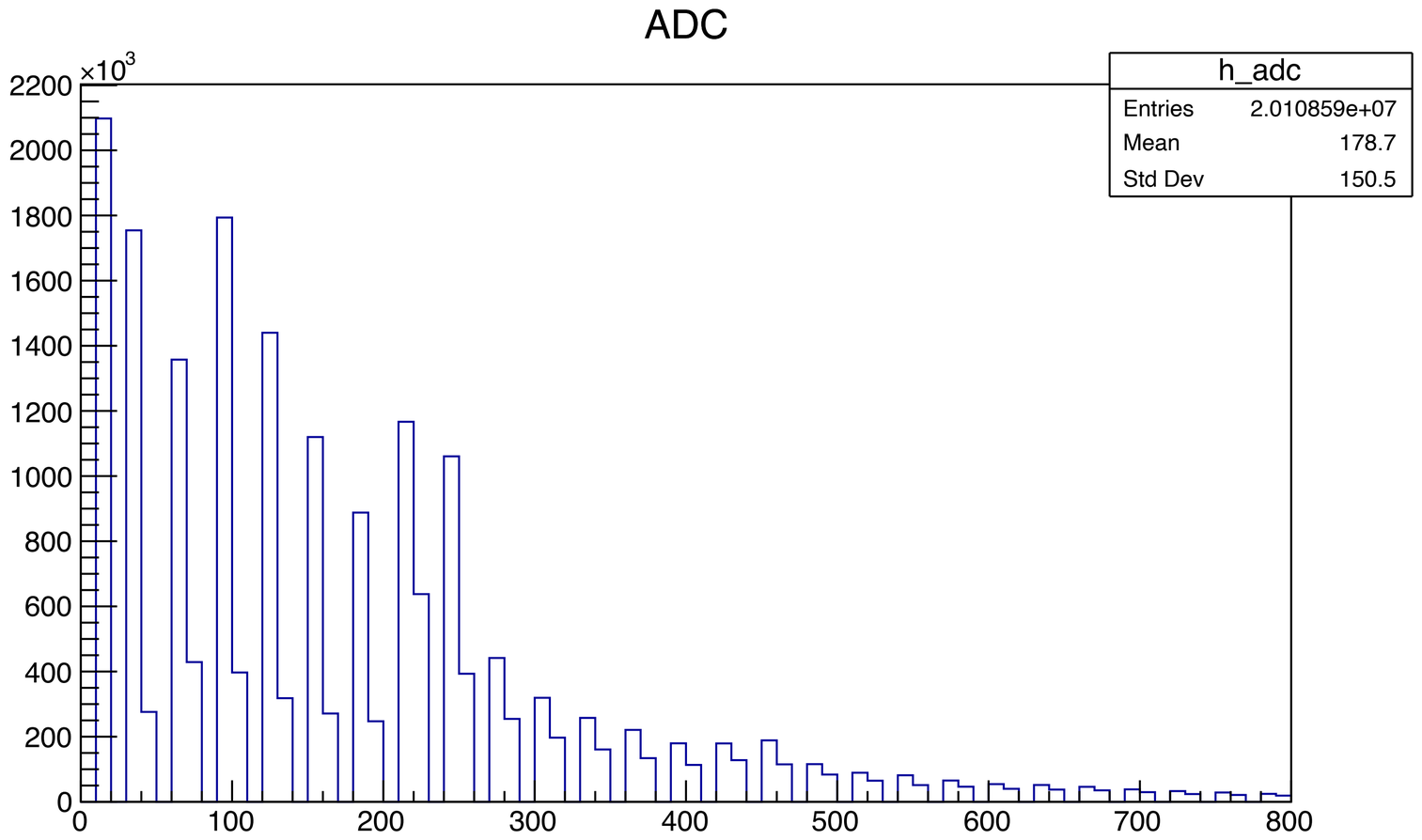
eta (Zvtx=±5cm & 45<ADC<200)

blue->inner barrel, red->outer barrel



ADC distribution (no Cut)

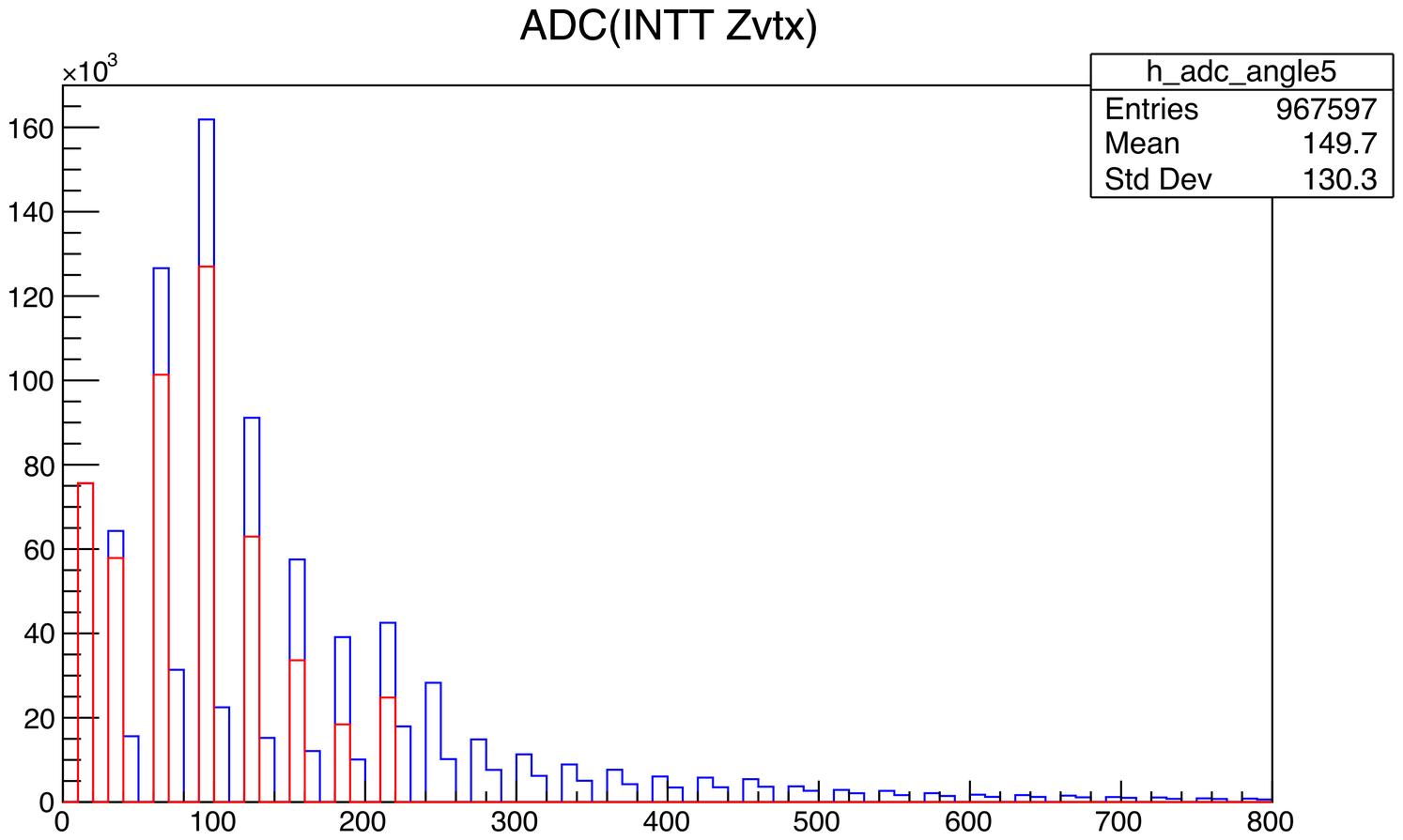
ADC (no cut)


ADC
h_adc
Entries 2.010859e+07
Mean 178.7
Std Dev 150.5
×10^3
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
100
200
300
400
500
600
700
800

ADC distribution (use INTT Zvxt)

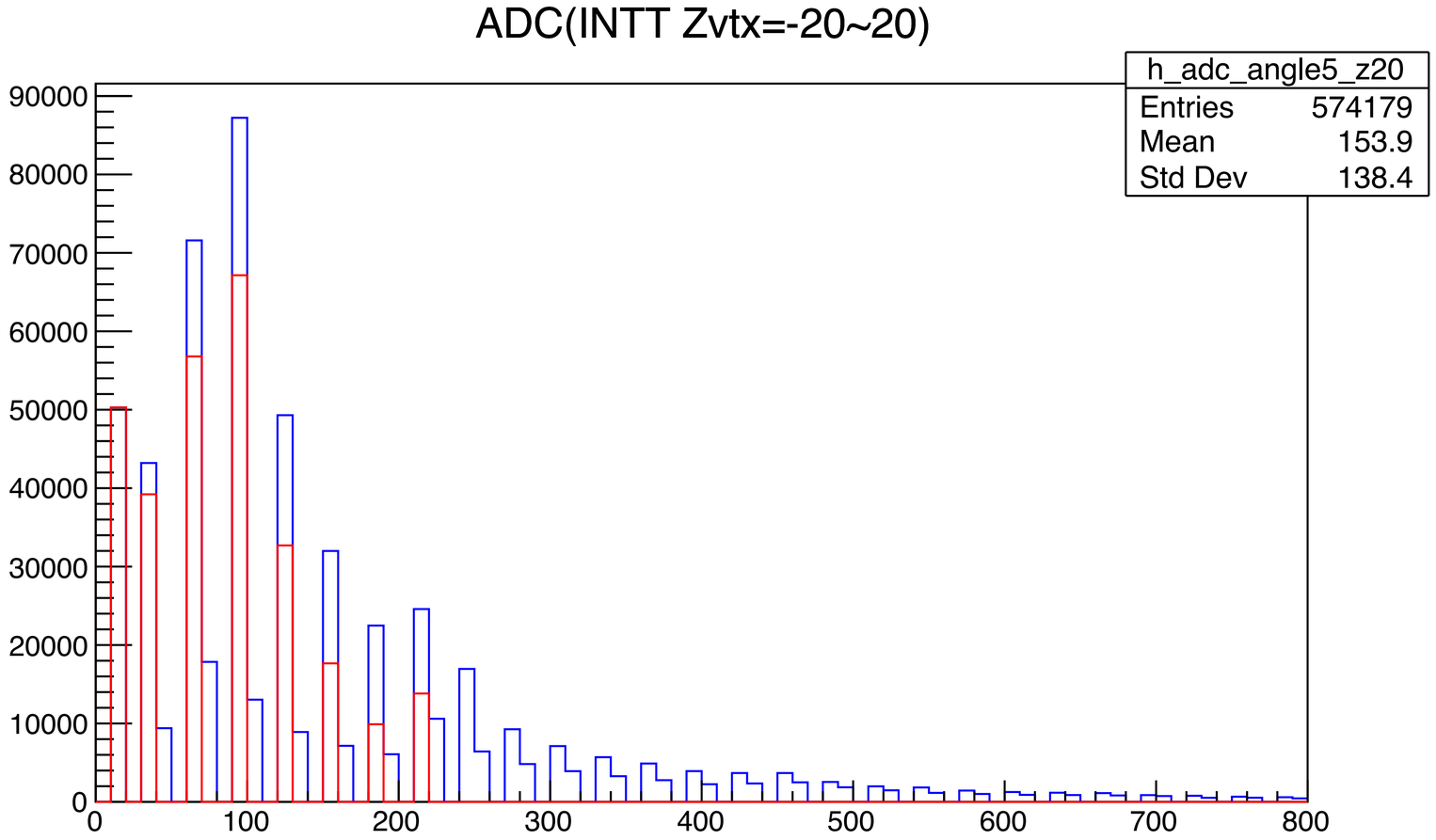
ADC (85< θ <95)

blue: all size, red: size=1



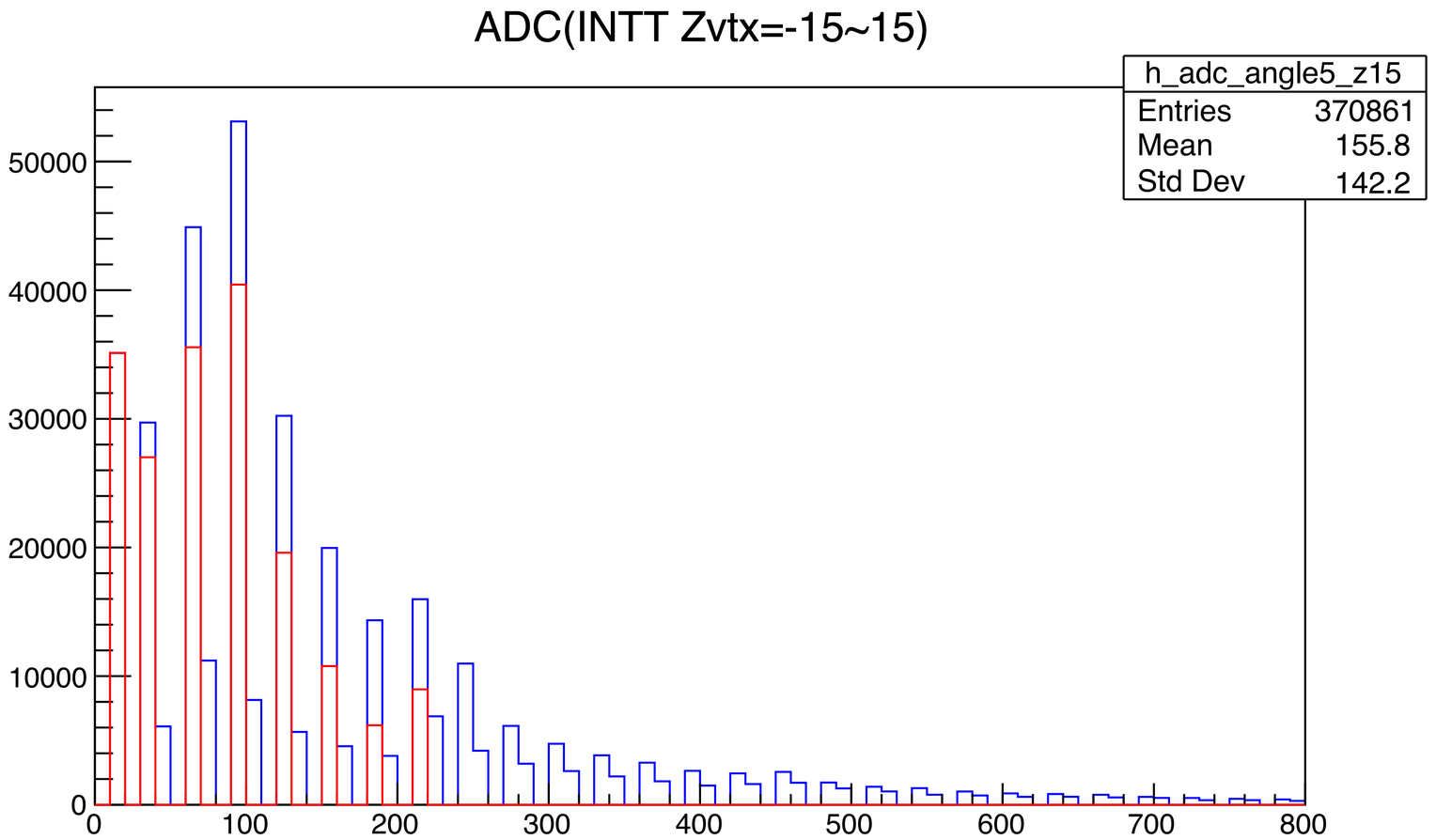
ADC (85< θ <95 & Zvtx=±20cm)

blue: all size, red: size=1



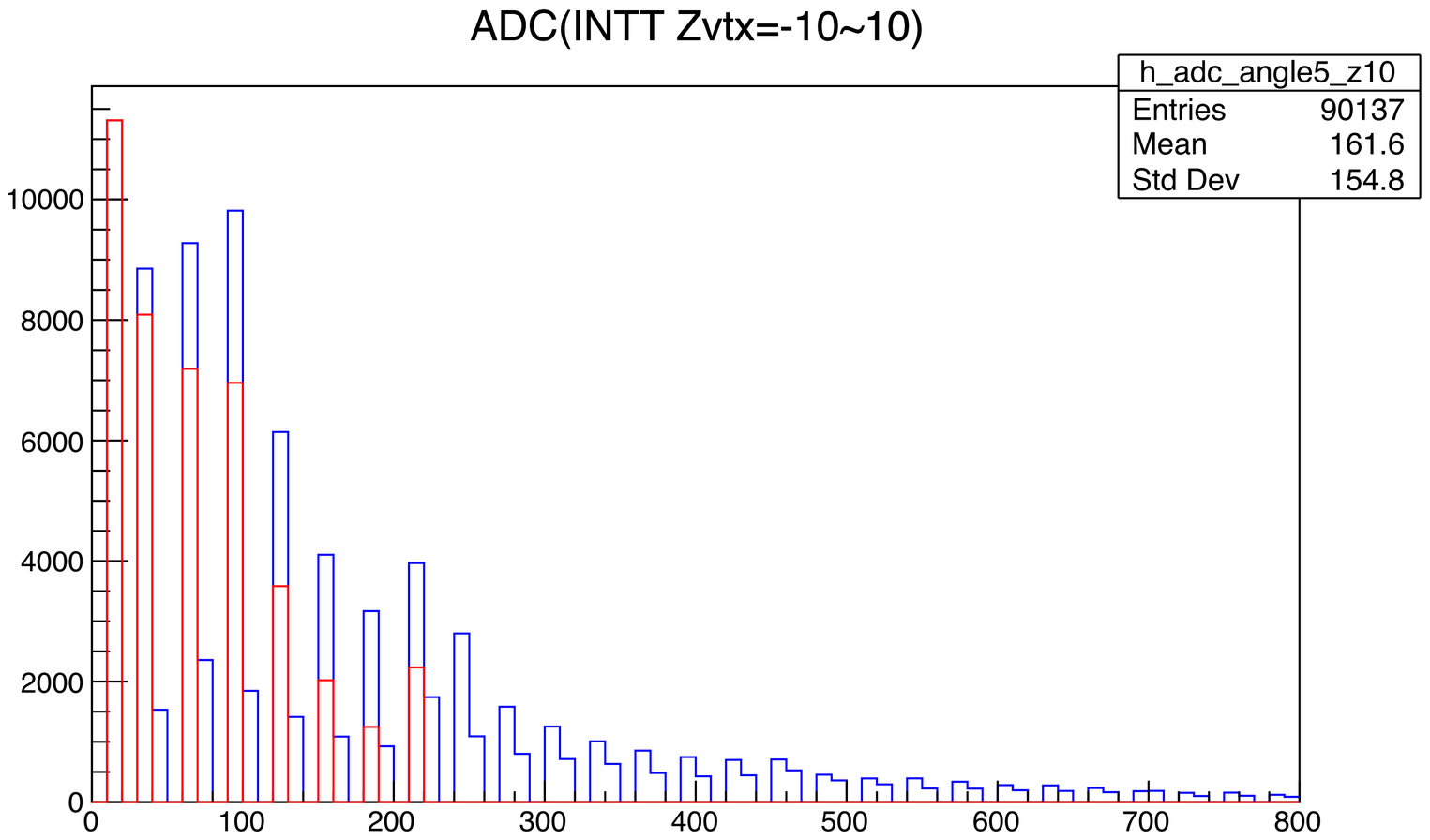
ADC (85< θ <95 & Zvtx=±15cm)

blue: all size, red: size=1



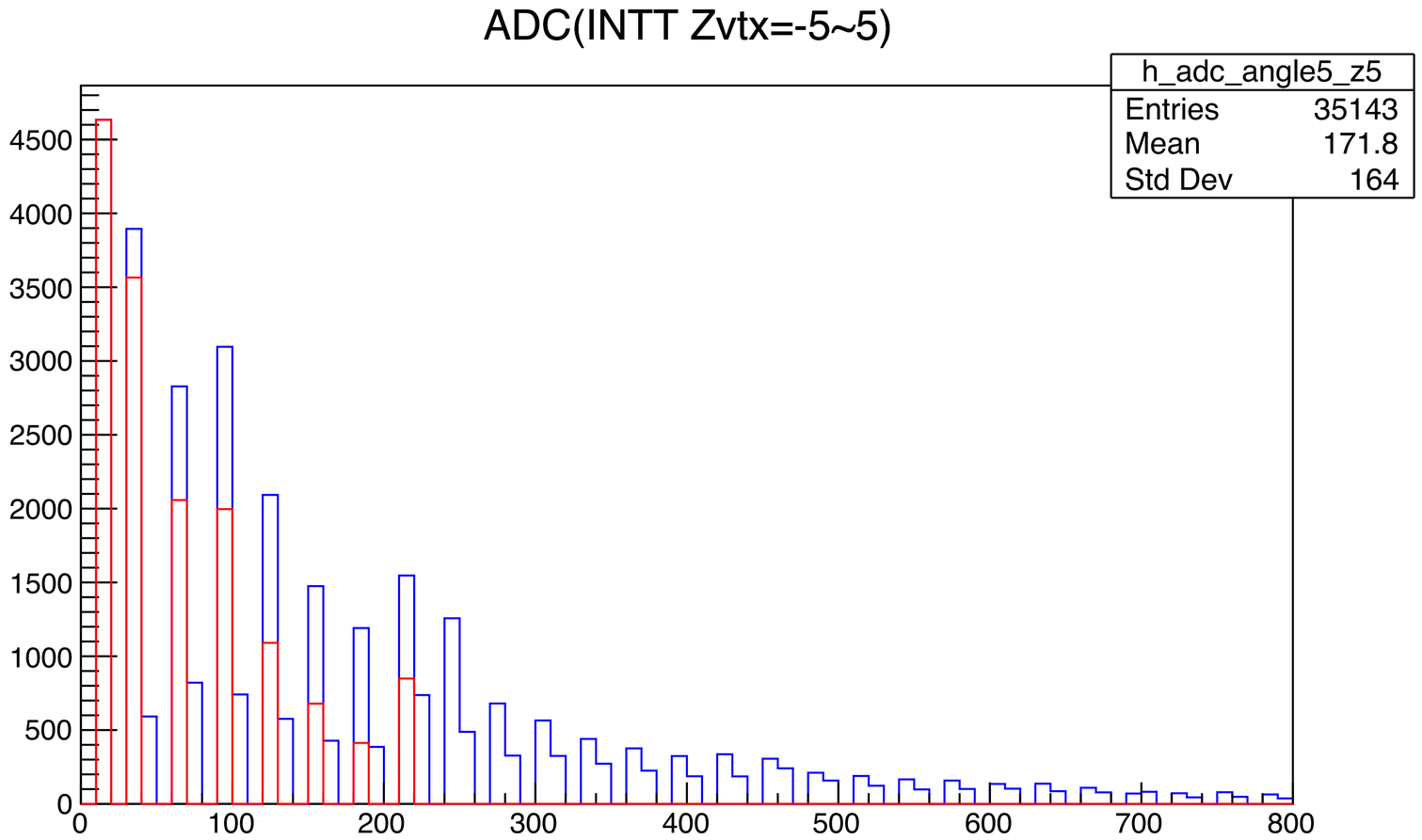
ADC (85< θ <95 & Zvtx=±10cm)

blue: all size, red: size=1



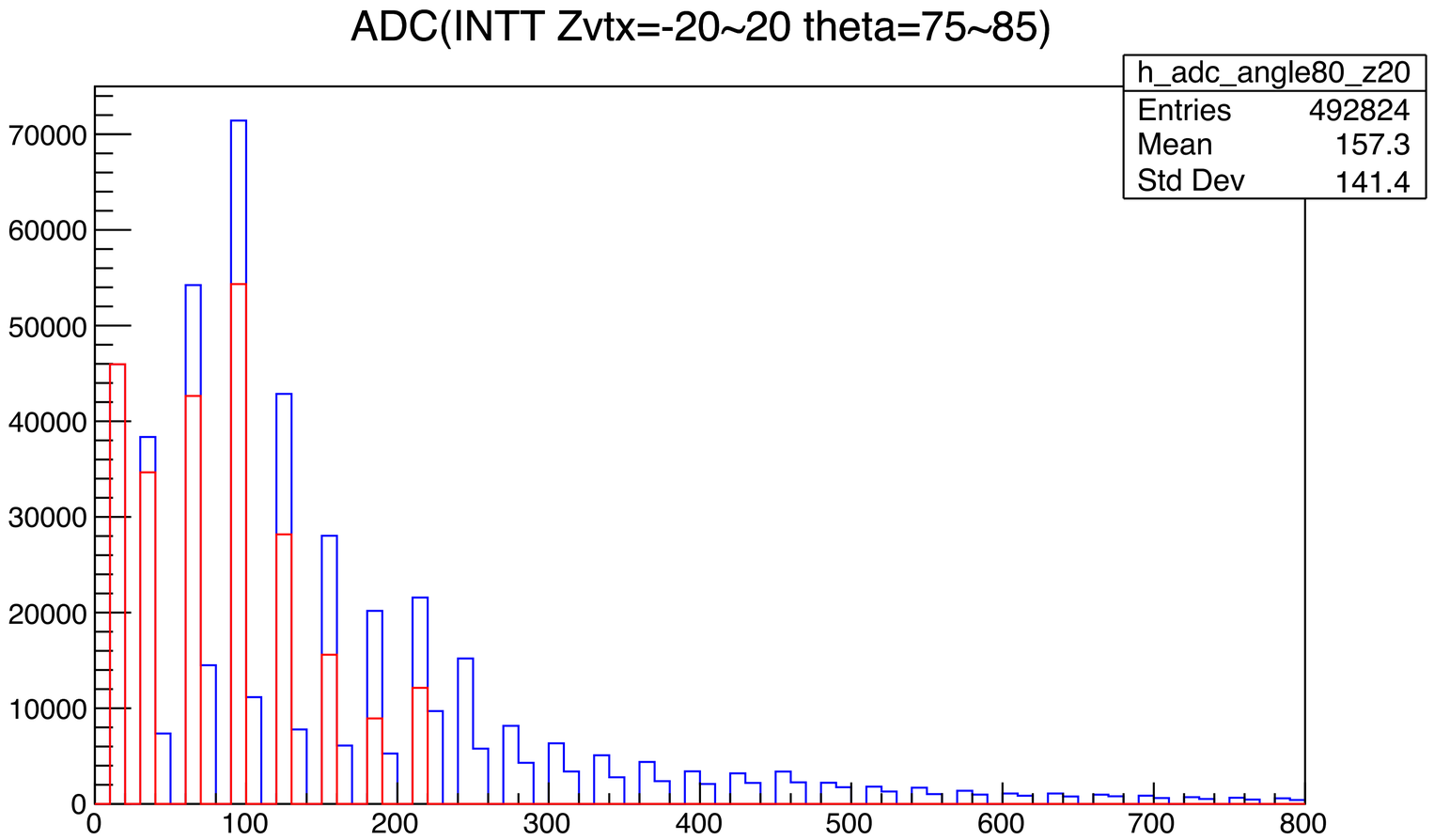
ADC (85< θ <95 & Zvtx=±5cm)

blue: all size, red: size=1



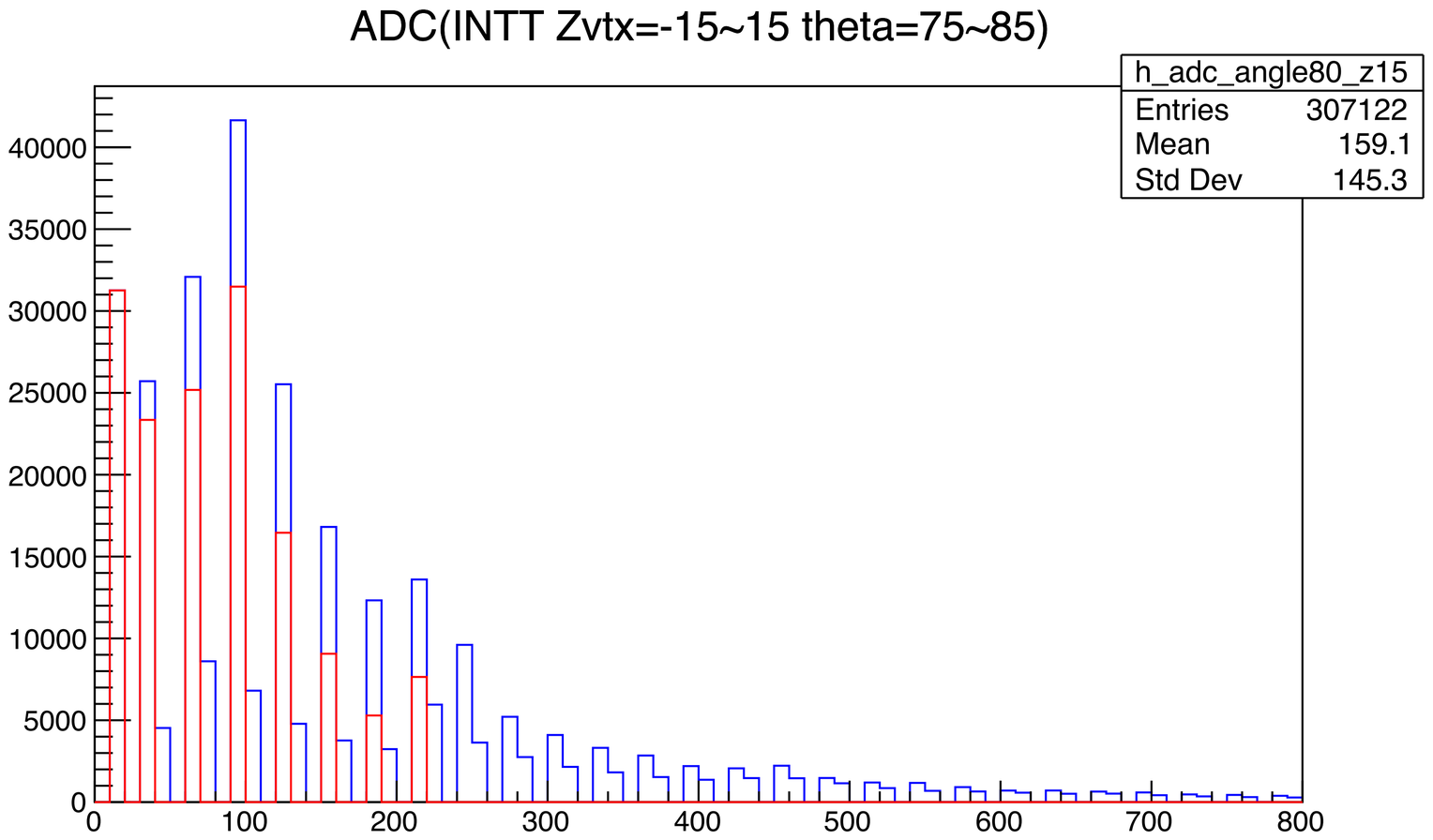
ADC (75< θ <85 & Zvtx=±20cm)

blue: all size, red: size=1



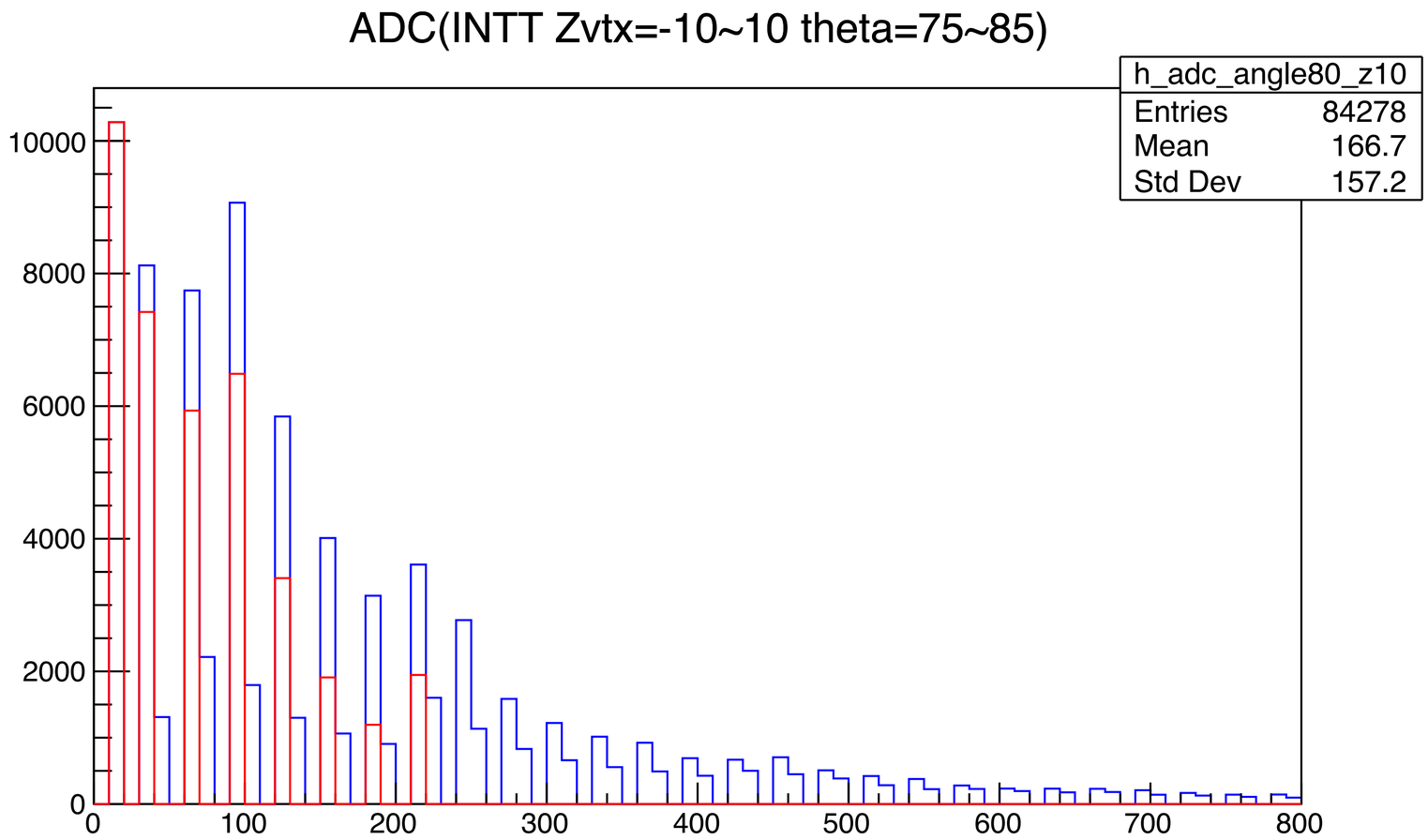
ADC (75< θ <85 & Zvtx=±15cm)

blue: all size, red: size=1



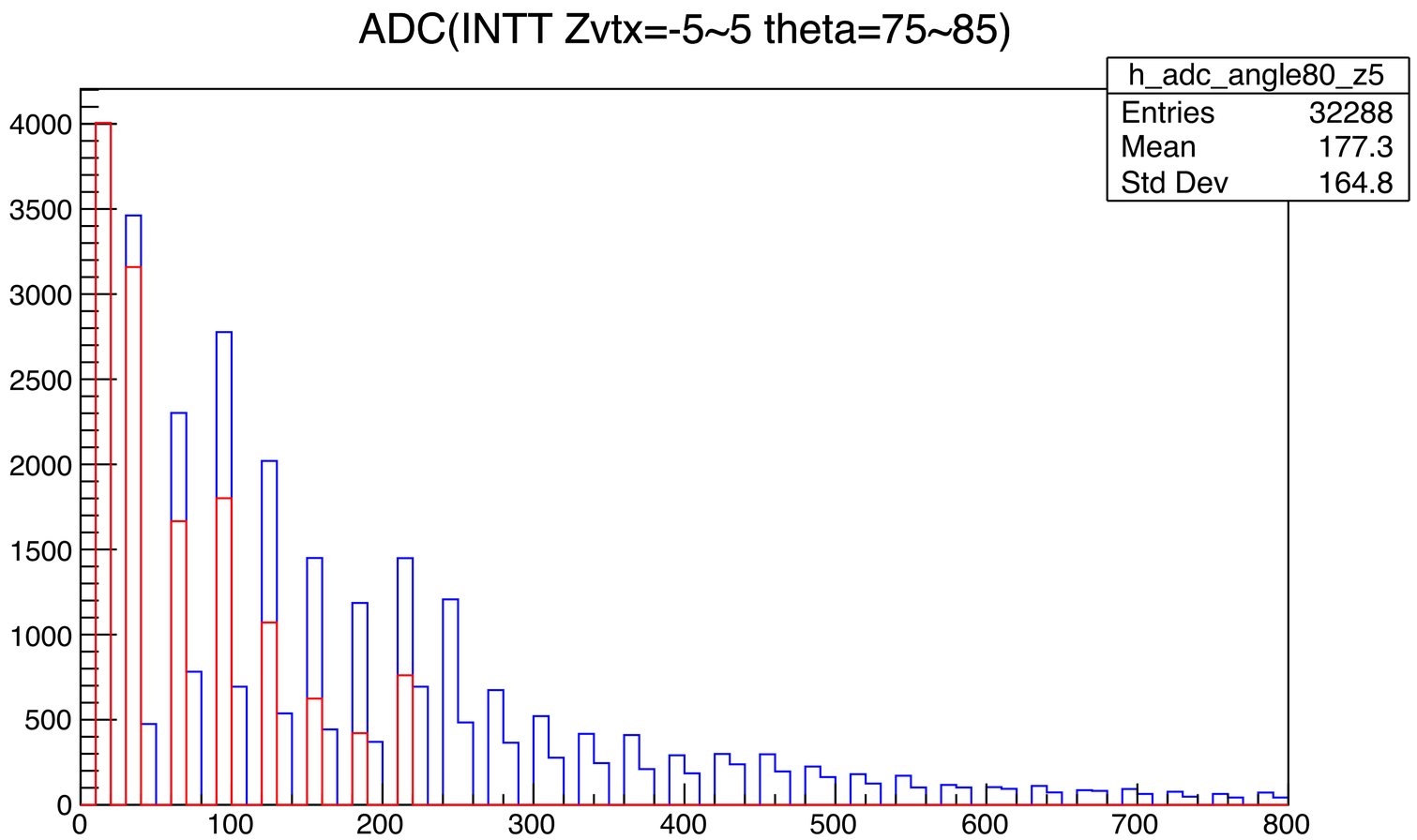
ADC (75<θ<85 & Zvtx=±10cm)

blue: all size, red: size=1



ADC (75< θ <85 & Zvtx=±5cm)

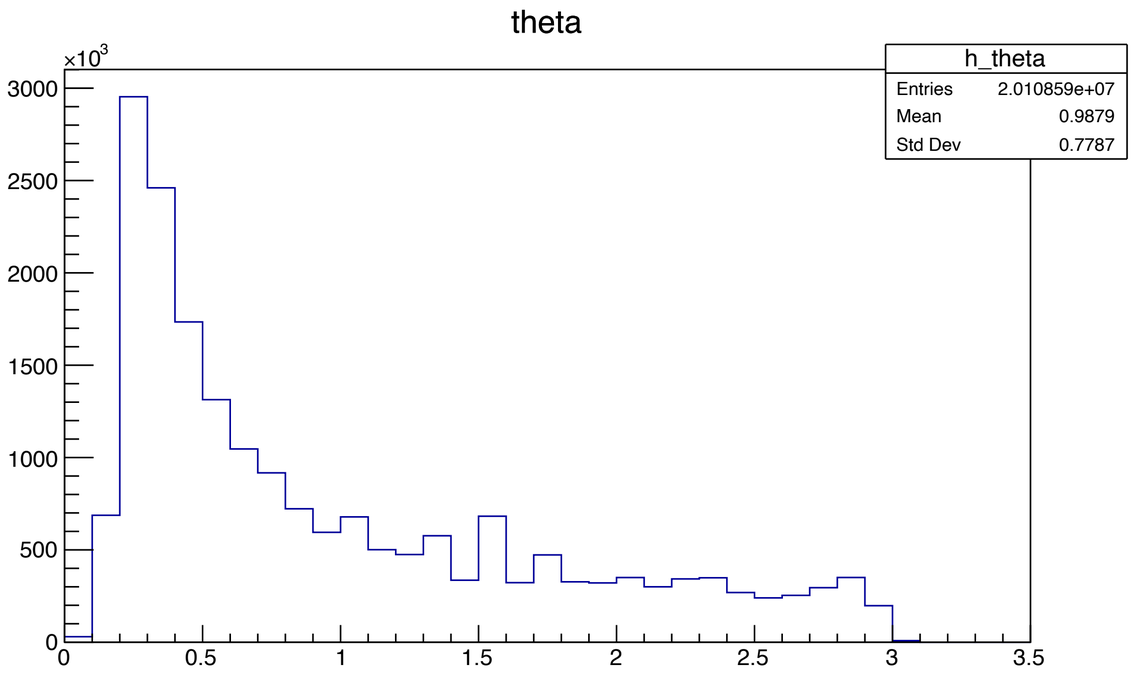
blue: all size, red: size=1

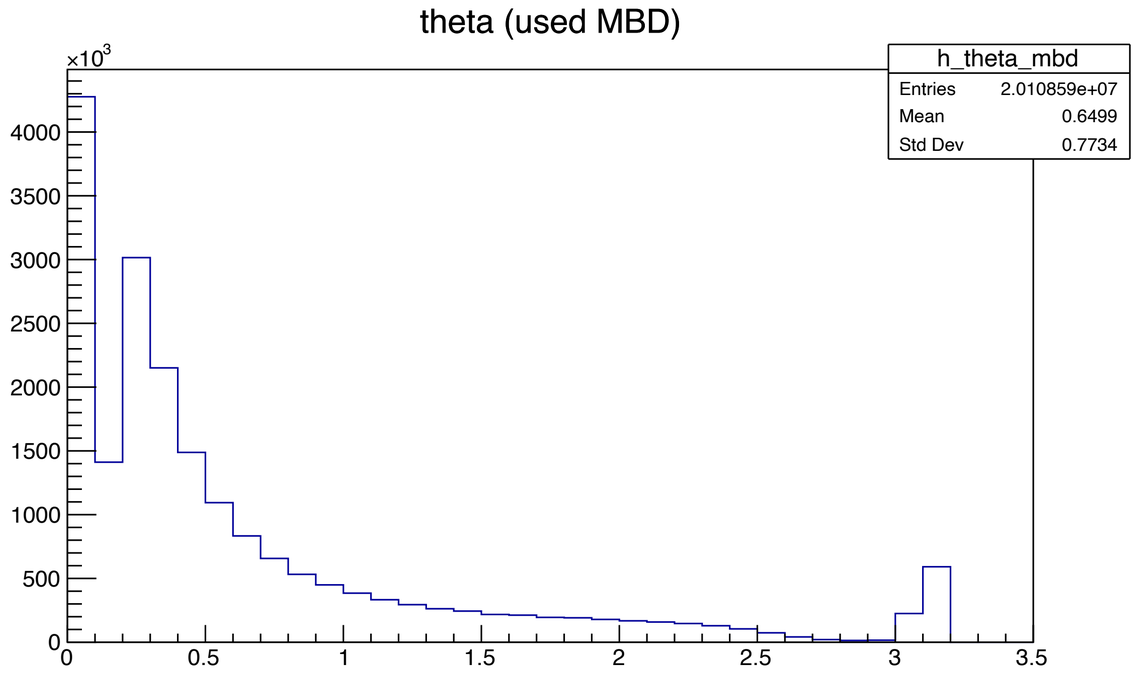


others

theta

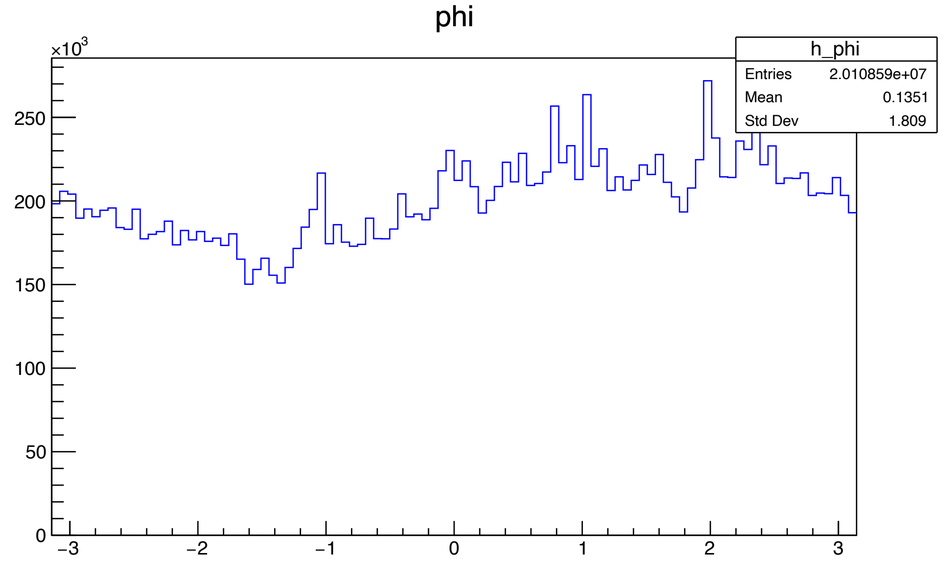
left: use INTT Zvtx right: use MBD Zvtx

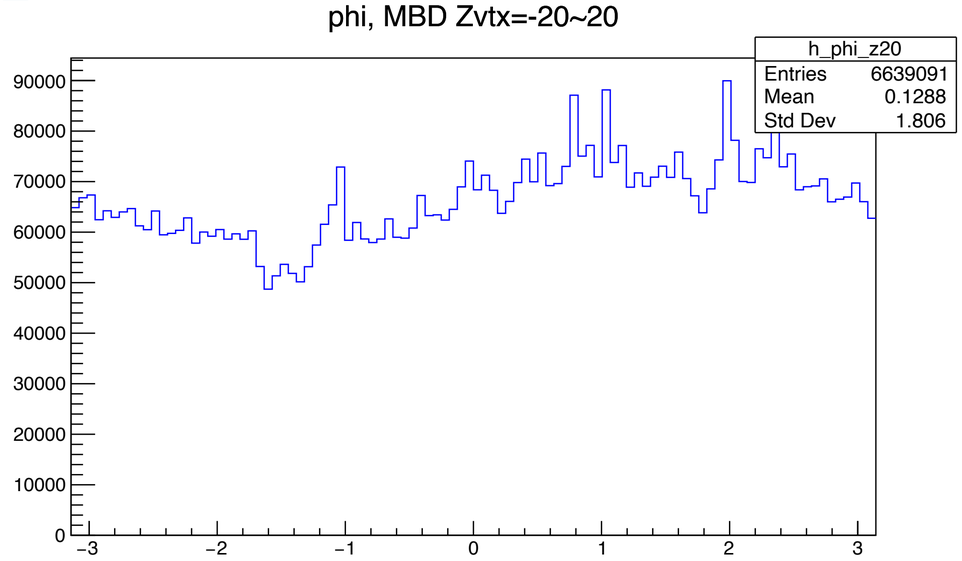


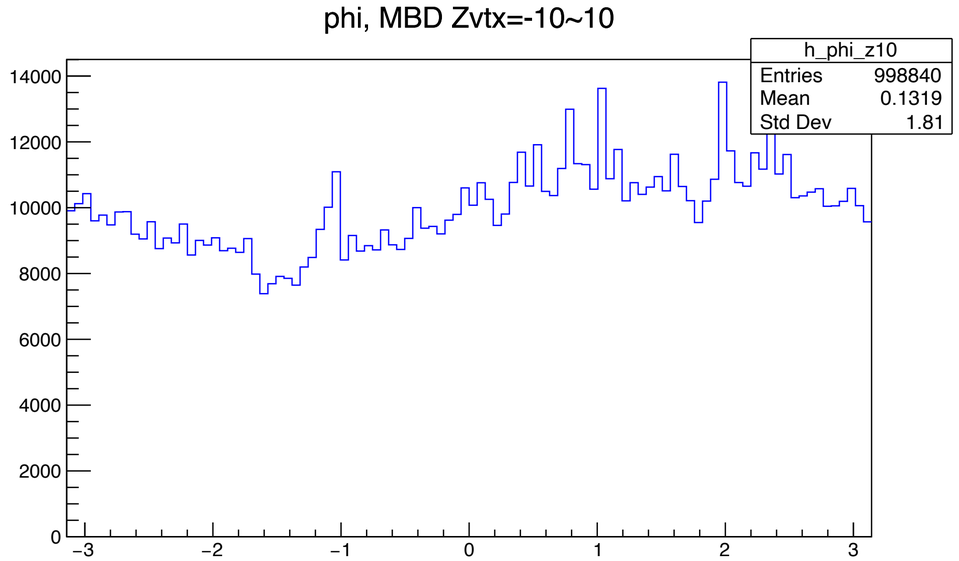


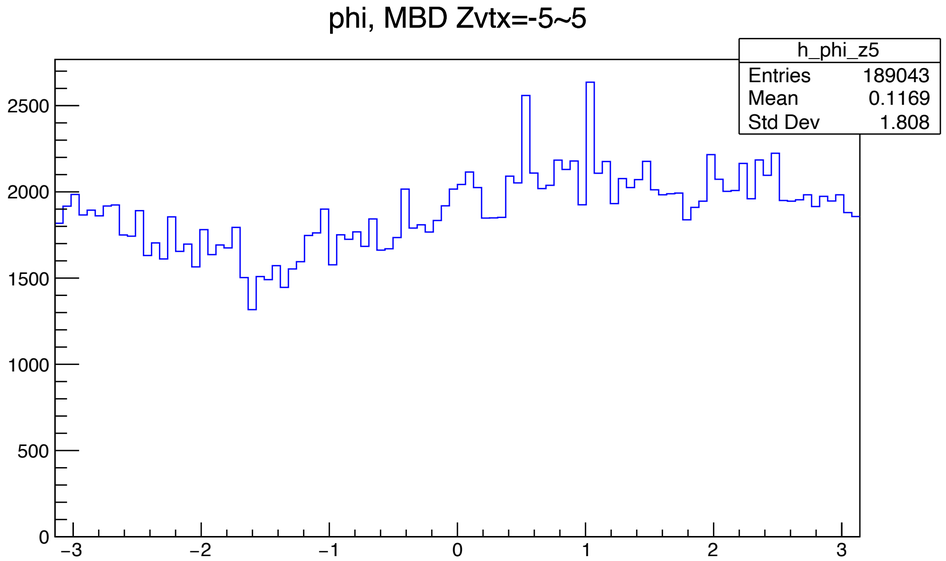
phi

left top: no cut, right top: Zvtx=±20cm,
left bottom: Zvtx=±10cm, right bottom: Zvtx=±5cm

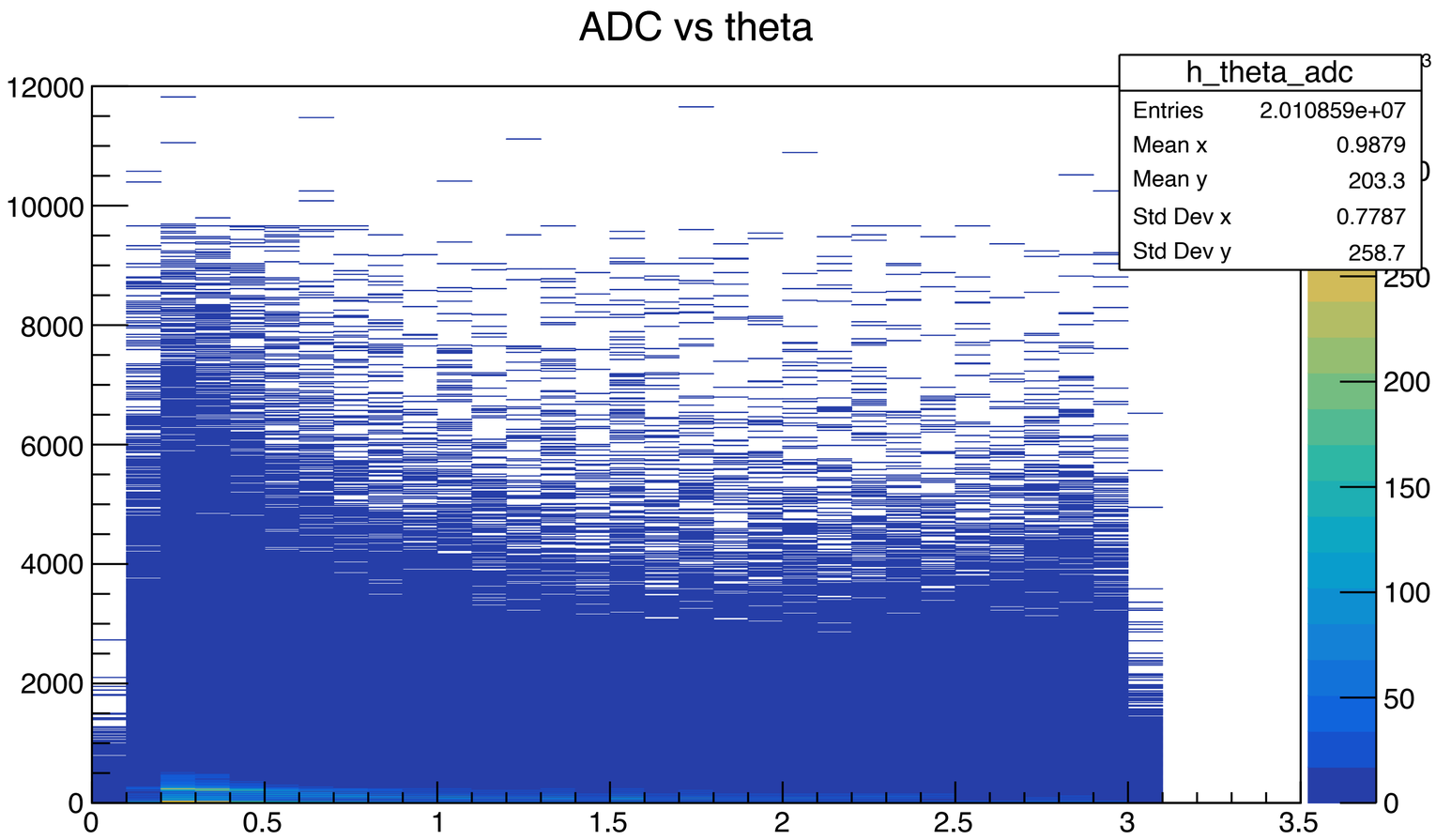




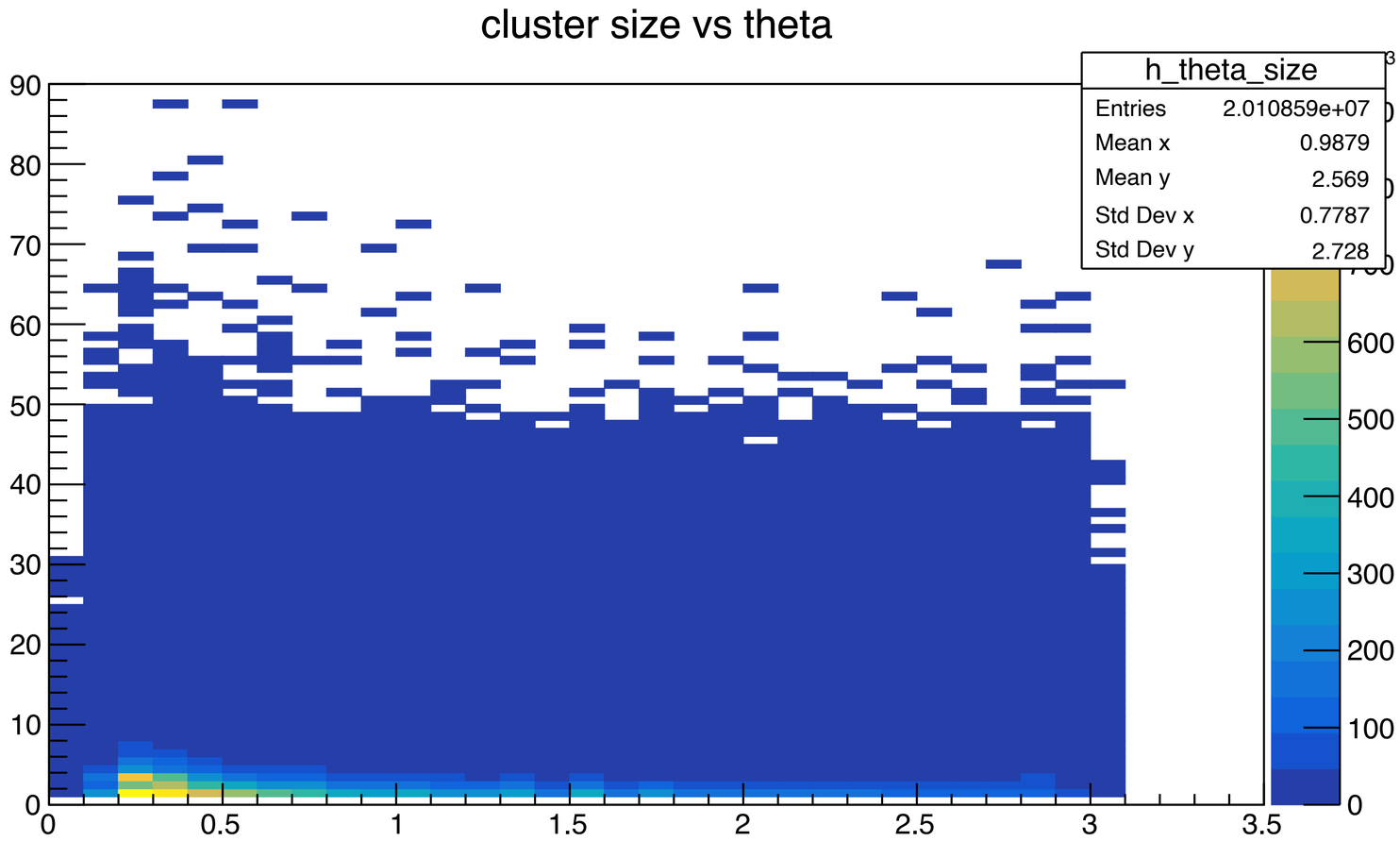




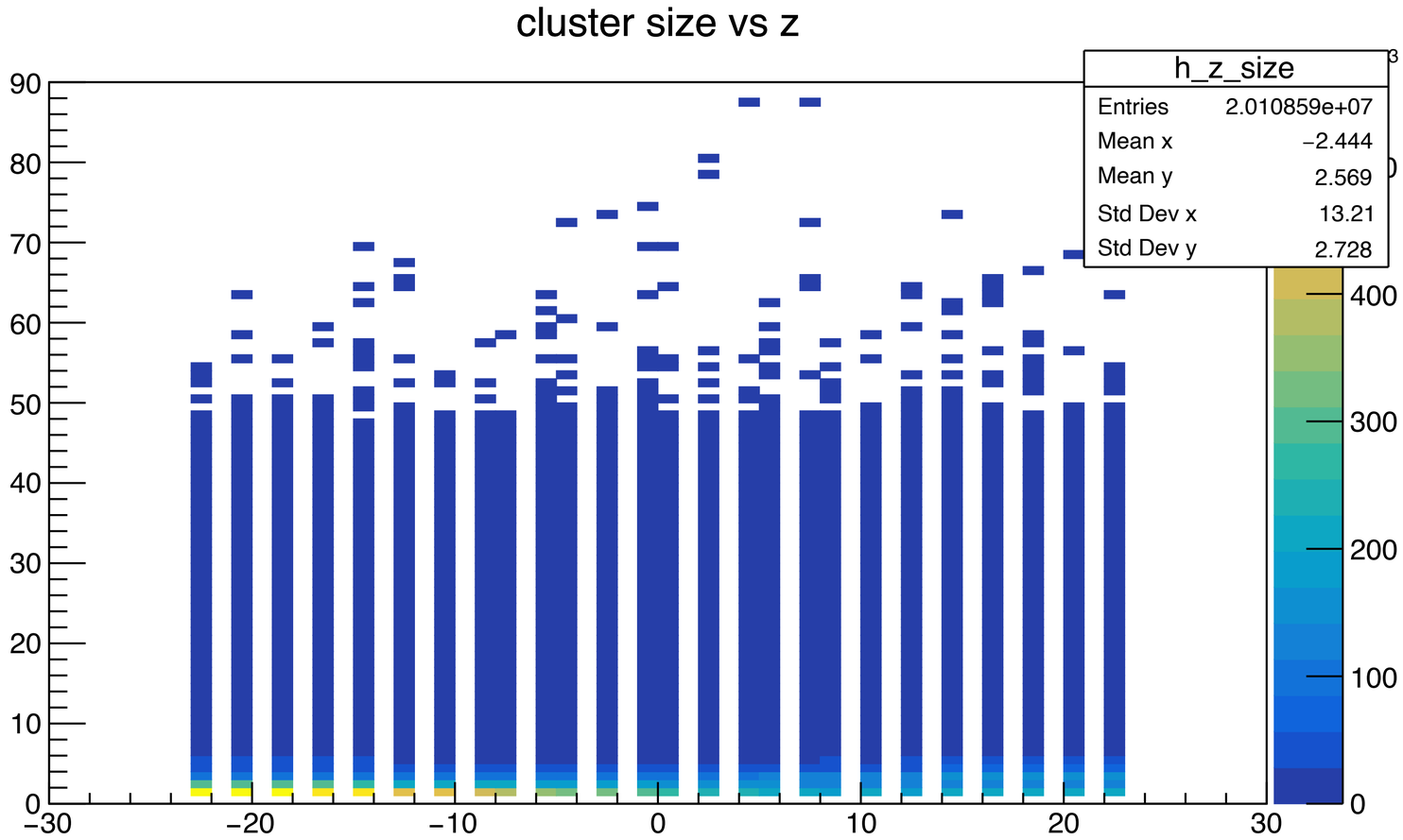
ADC vs theta (Zvtx: INTT)



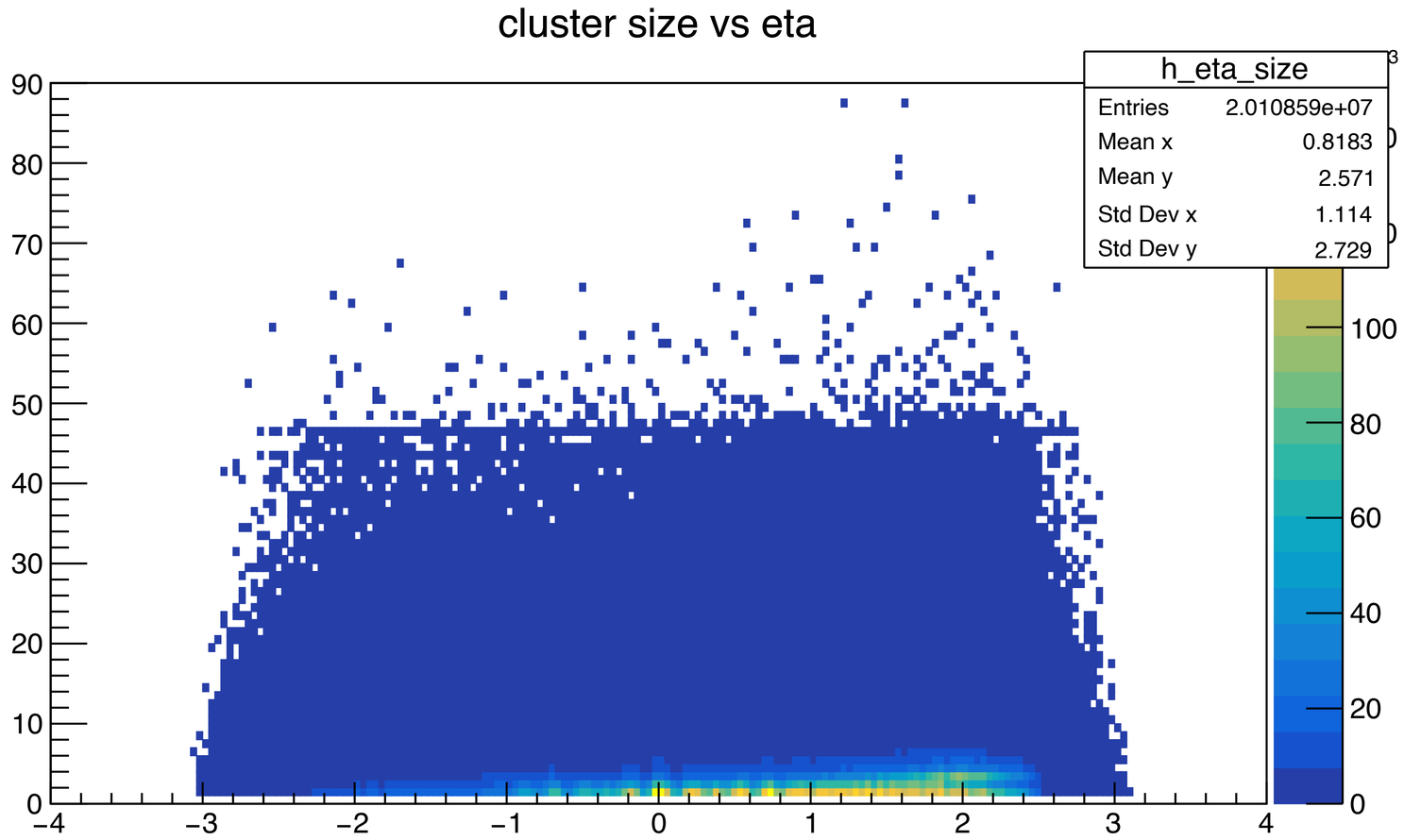
cluster size vs theta (Zvtx: INTT)



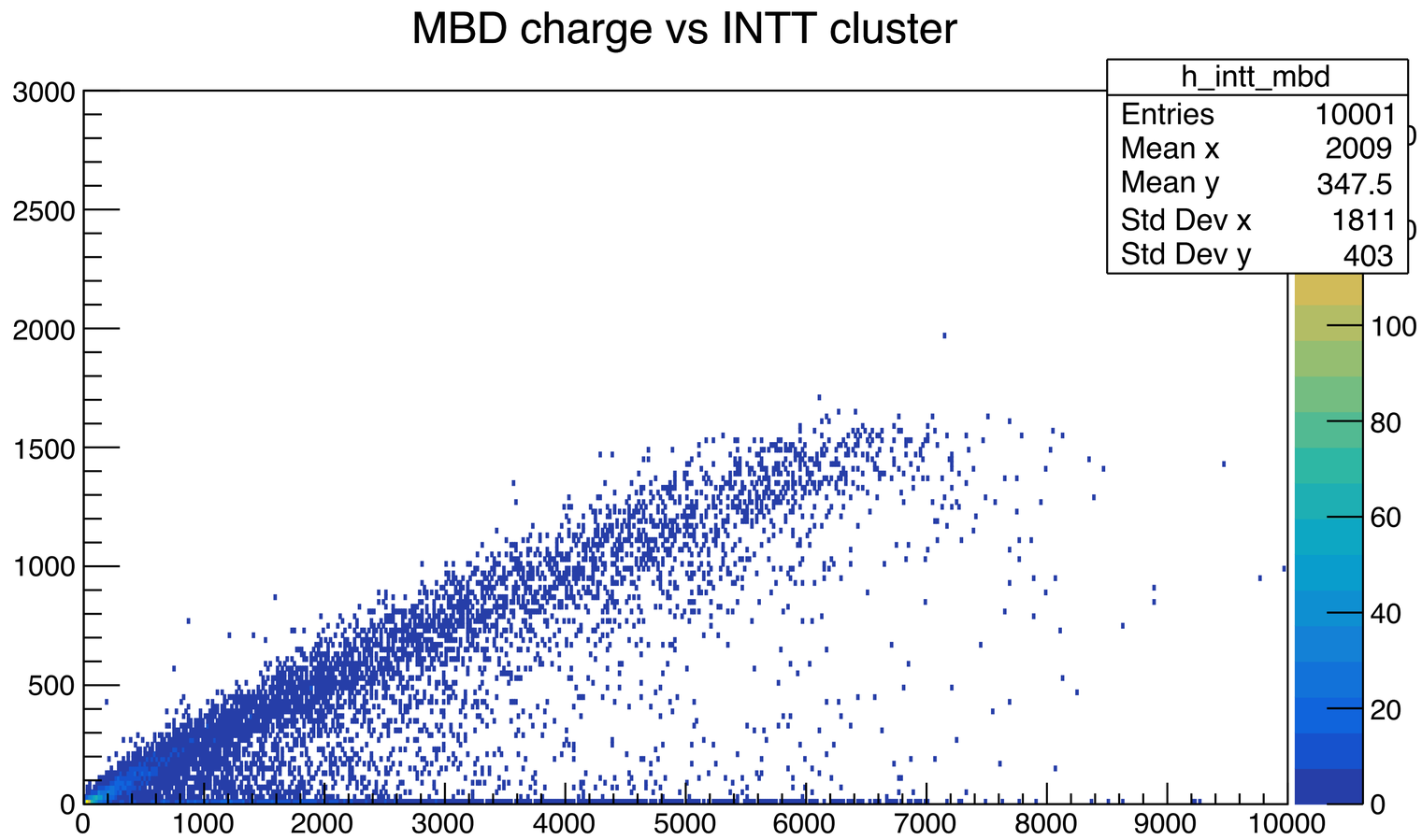
cluster size vs z



cluster size vs eta (Zvtx: INTT)

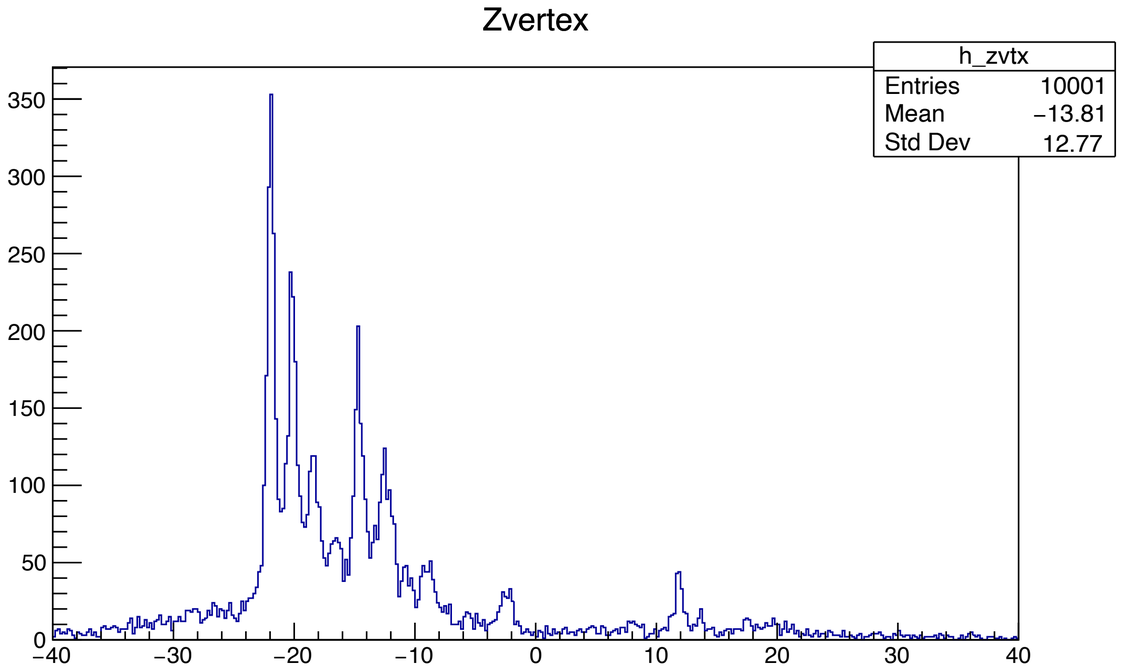


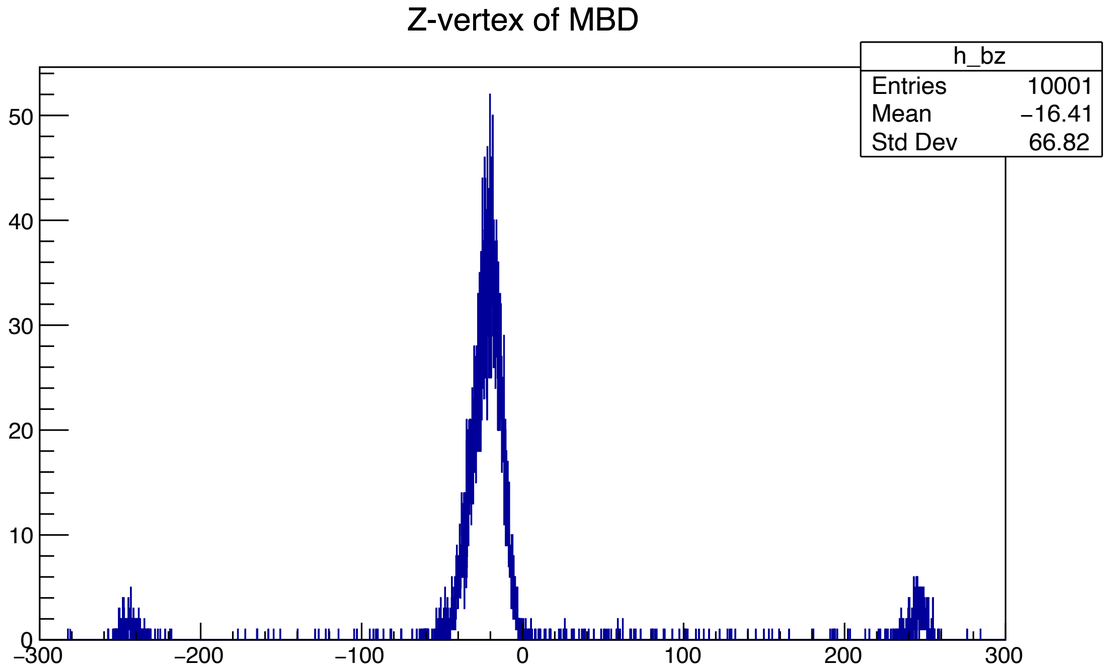
MBD charge vs INTT cluster



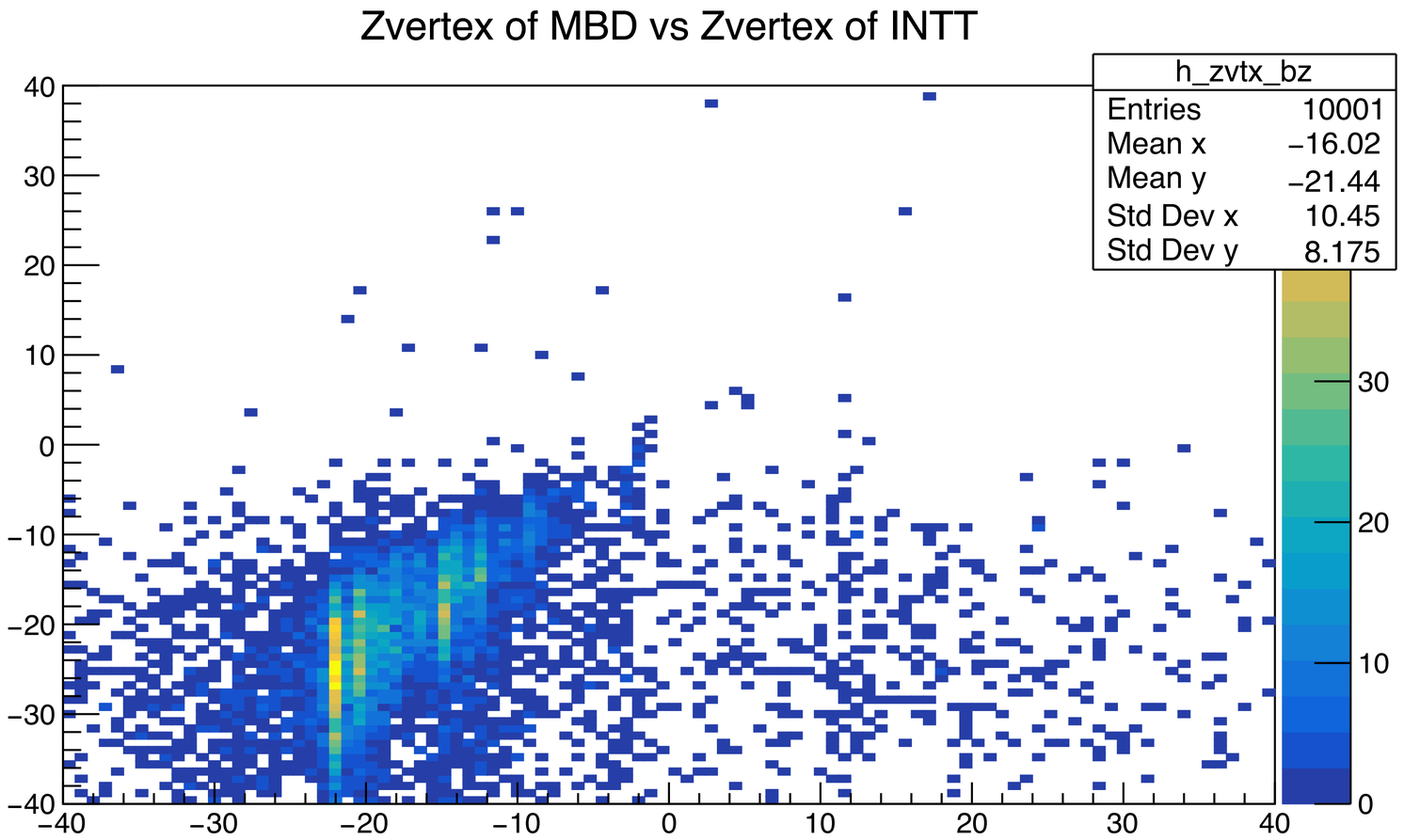
Zvtx

left: INTT, right: MBD





MBD Zvtx vs INTT Zvtx



Graph: deltaT vs number of event

deltaT = MBDCLK - BCO-Full