General information - Entire 2015 data:
Number of triggers = 9.2 x 10^7 or 91,666,500
Number of those events with exactly one valid proton in each direction = 6.4 x 10^7 or 64,248,100
Number of those events with exactly 4 tracks = 1.9 x 10^6 or 1,920,130
Number of events with exactly 4 tracks with Q=0 = 1.3 x 10^6 or 1,331,018
[Robert's analysis AN2017_268_v5 Fig.11R had about 900,000 events at this stage, 2015 data.]
Number of events with exactly 4 tracks fiducial with Q=0 = 1.2 x 10^6 or 1,240,530
Number that balance in px and py (between central system and forward portions: All: entries = 10,589,760
integral y= 6,557,000 dpy(-0.1,0.1) = 2,455.264
integral x= 6,637,000 dpx(-0.2,0.2) = 3,737,183
integral stands for bin sum subtracting underflow and overflow data
fiducialRegion: entries = 1,396,844
integral y= 917,800 dpy(-0.1,0.1) = 313,922
integral x= 927,200 dpx(-0.2,0.2) = 503,706
Number with one displaced vertex, 2 displaced vertices, or all 4 tracks on primary vertex (beam line): nks=1 3510 (1 primary vertex and 1 V0)
nks=2 15 (2 V0s)
ntrkvtx=4 1,887,660 (1 primary vertex 4 tracks)

General cuts applied to the reconstructed masses:

ptCut=0.0 etaCut=2.5

fiducialRegion:
pi1.Eta < etaCut, pi2.Eta < etaCut, pi3.Eta < etaCut, pi4.Eta < etaCut
fiducialRegionPt:
pi1.Pt > ptCut, pi2.Pt > ptCut, pi3.Pt > ptCut, pi4.Pt > ptCut

total charge: Q=0

number of tracks per event: ntrk = 4

pair charge: Qpair=0

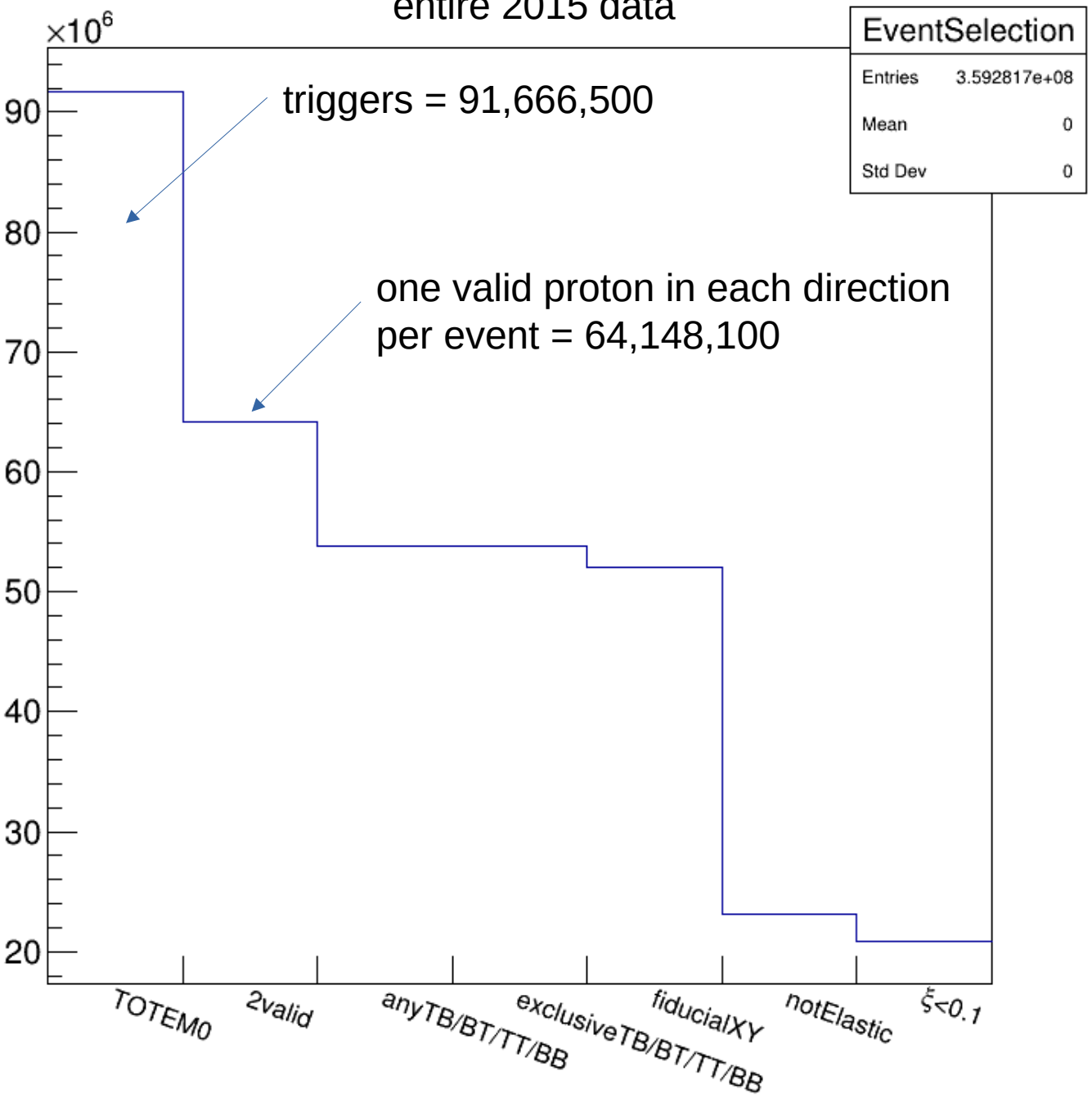
tracks are ordered by their Pt: index 1 the highest

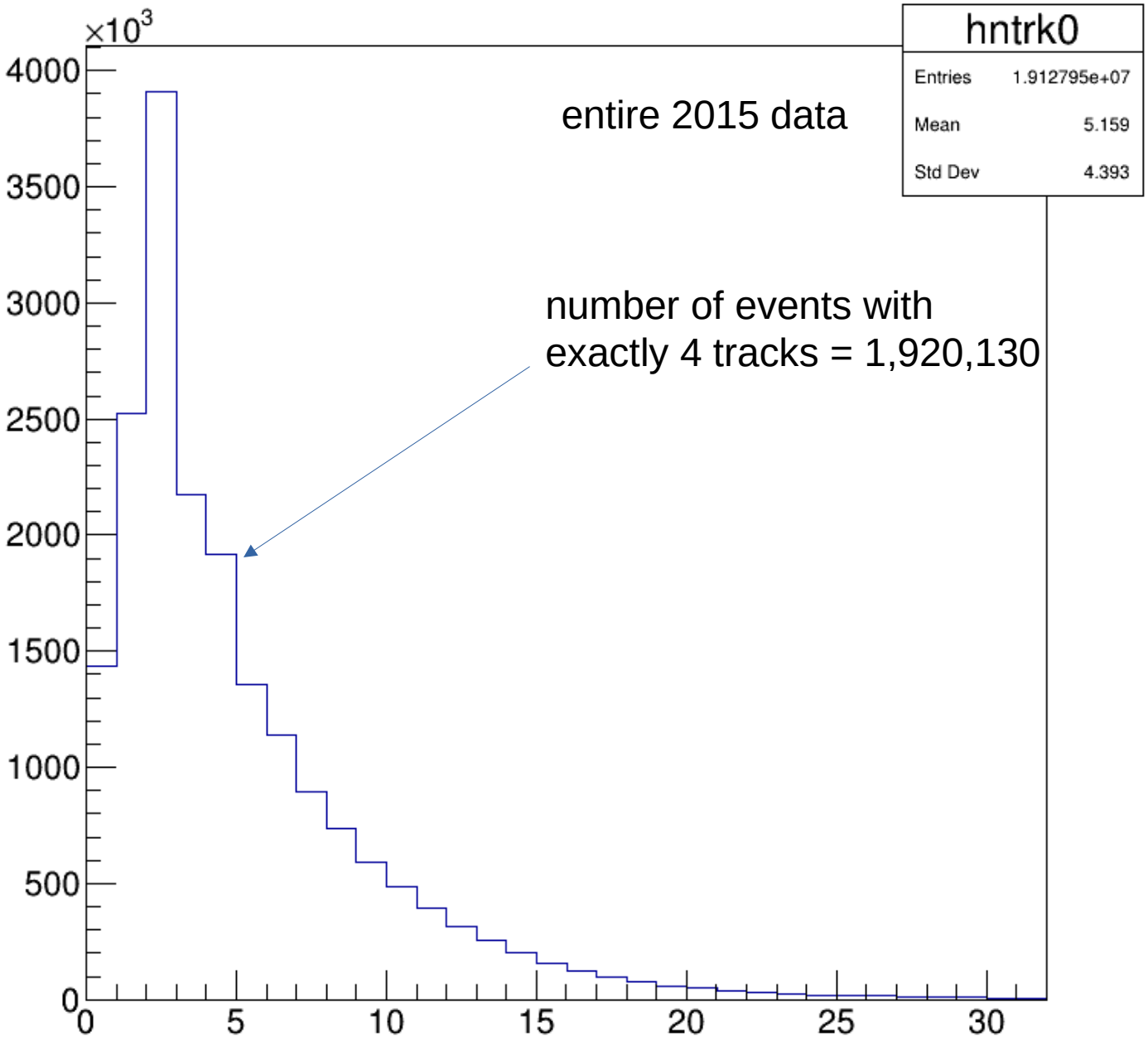
isKshort = true

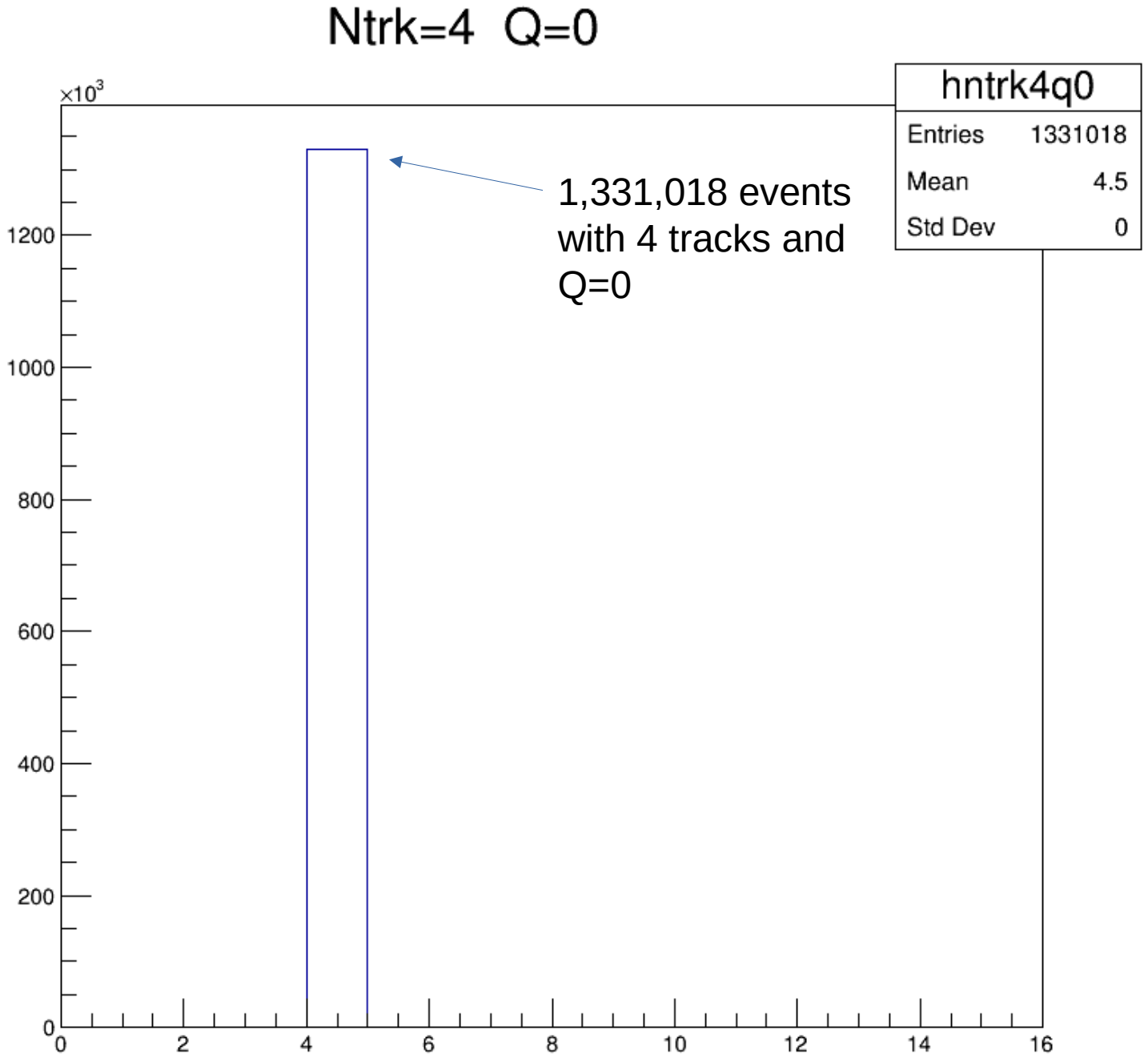
isLambda = false

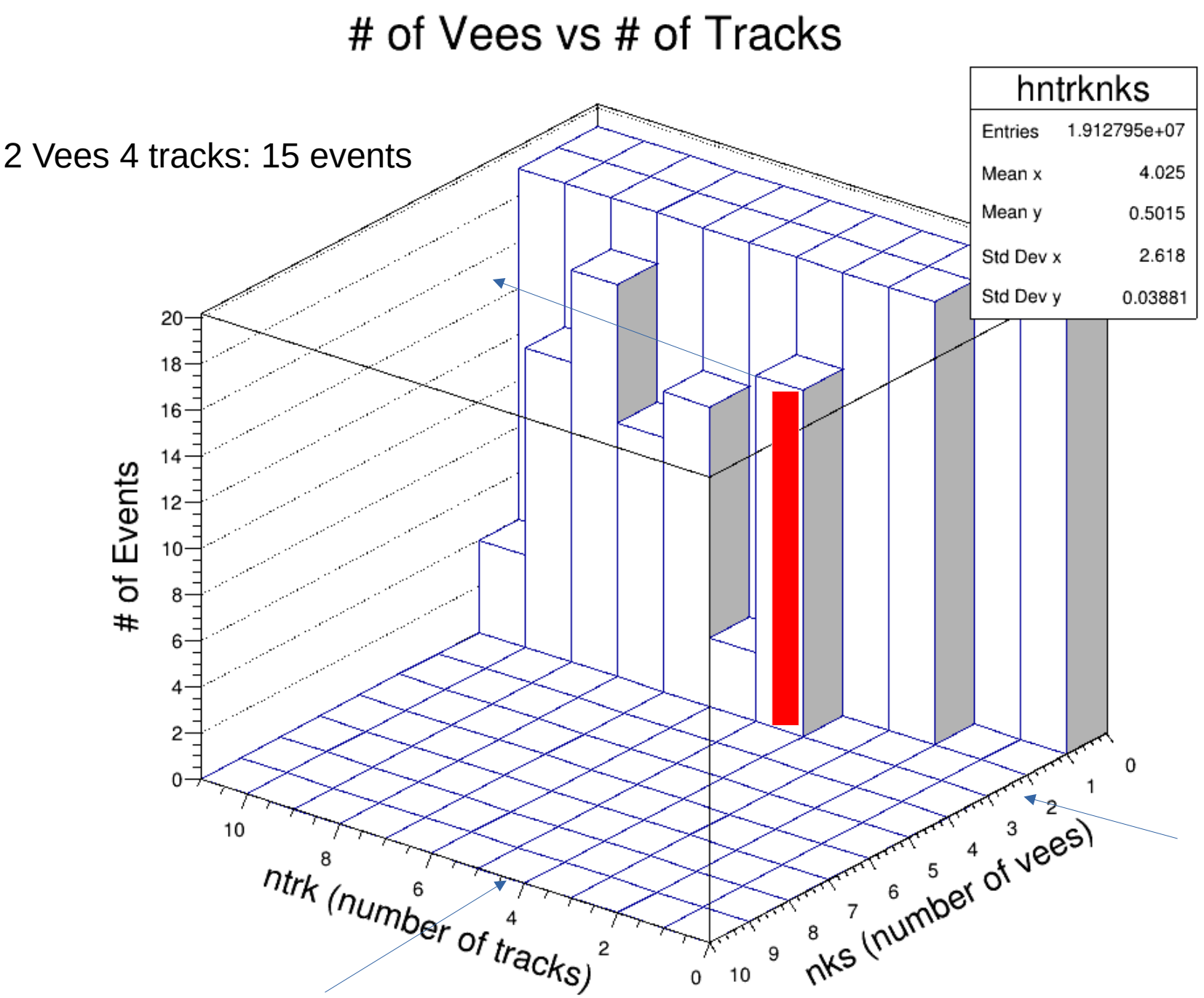
no npixelhits cut

entire 2015 data




Ntrk
×10^3
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
hntrk0
Entries 1.912795e+07
Mean 5.159
Std Dev 4.393
entire 2015 data
number of events with
exactly 4 tracks = 1,920,130

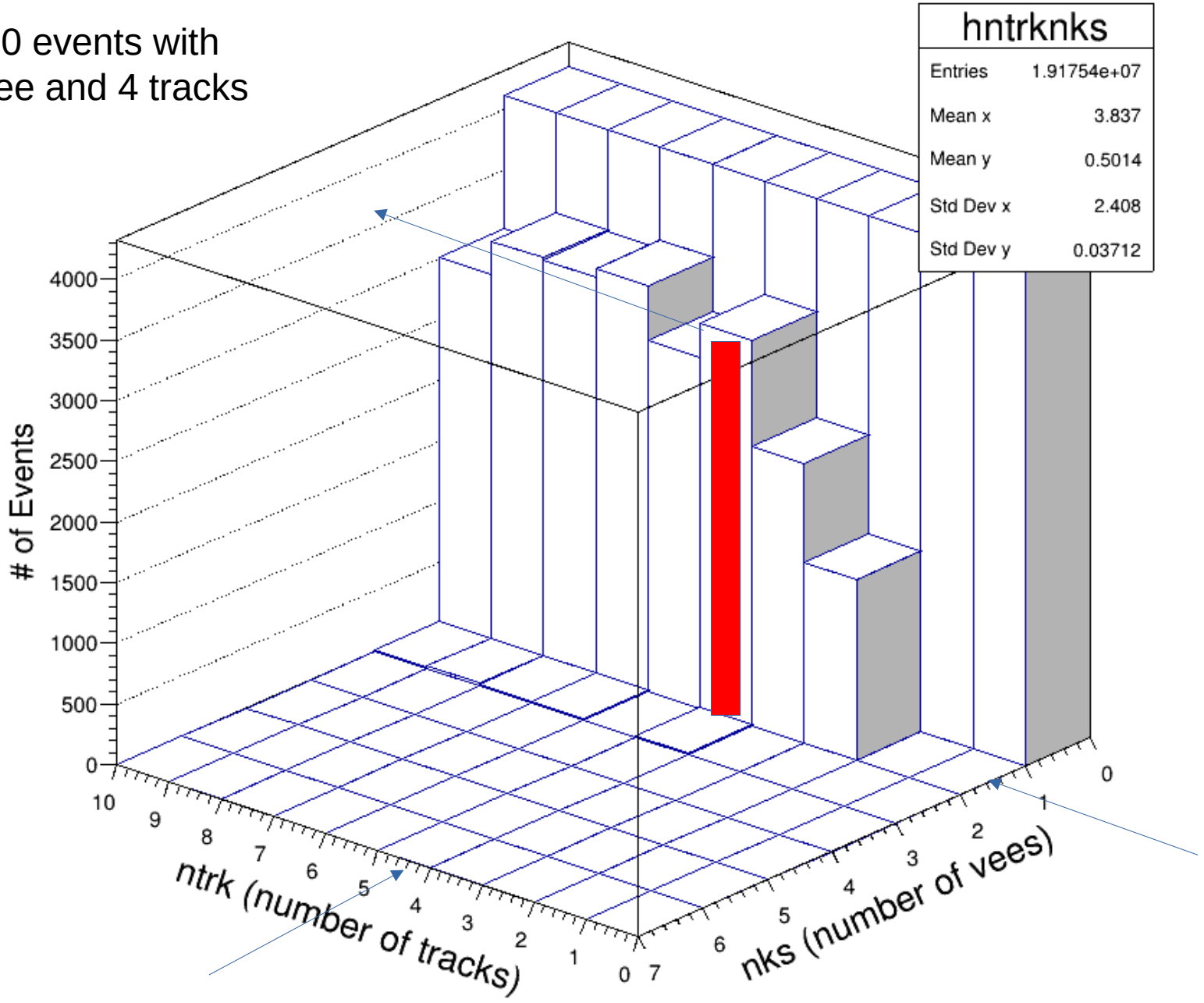

Ntrk=4 Q=0
hntrk4q0
Entries 1331018
Mean 4.5
Std Dev 0
1,331,018 events with 4 tracks and Q=0
×10^3
1200
1000
800
600
400
200
0
0
2
4
6
8
10
12
14
16



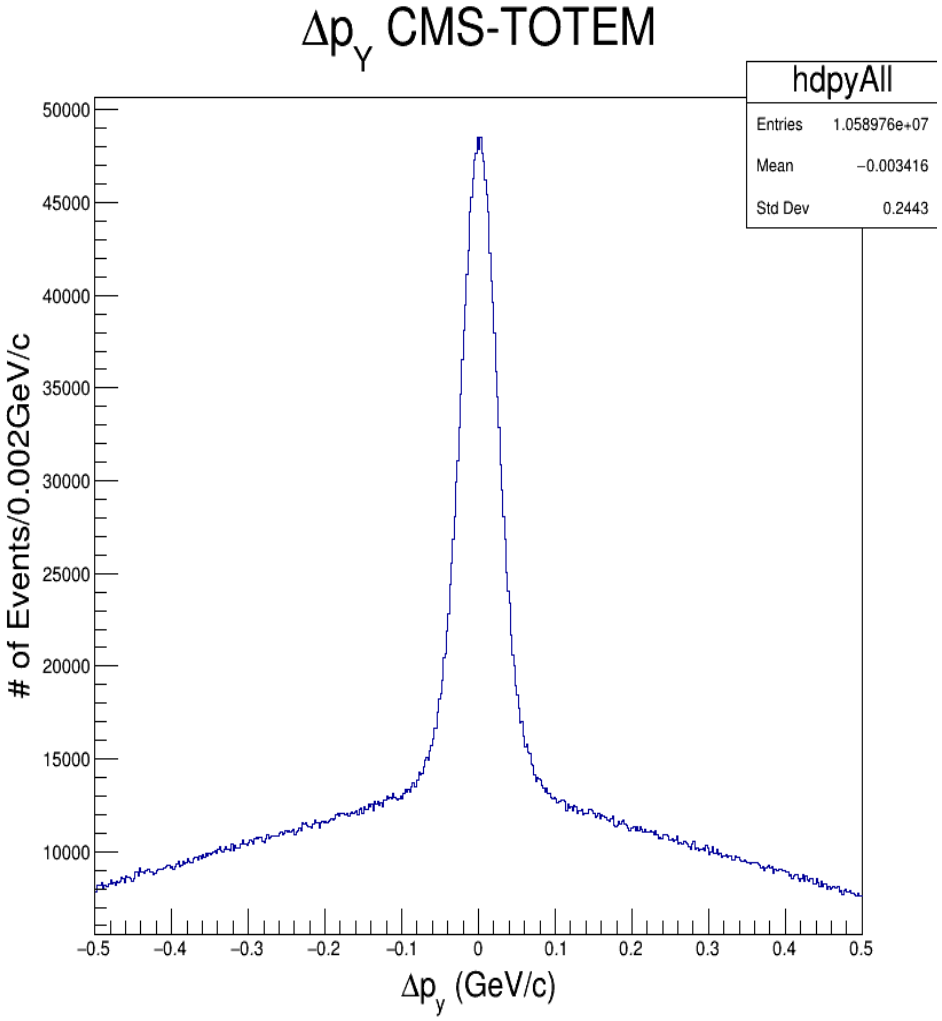
2 Vees 4 tracks: 15 events

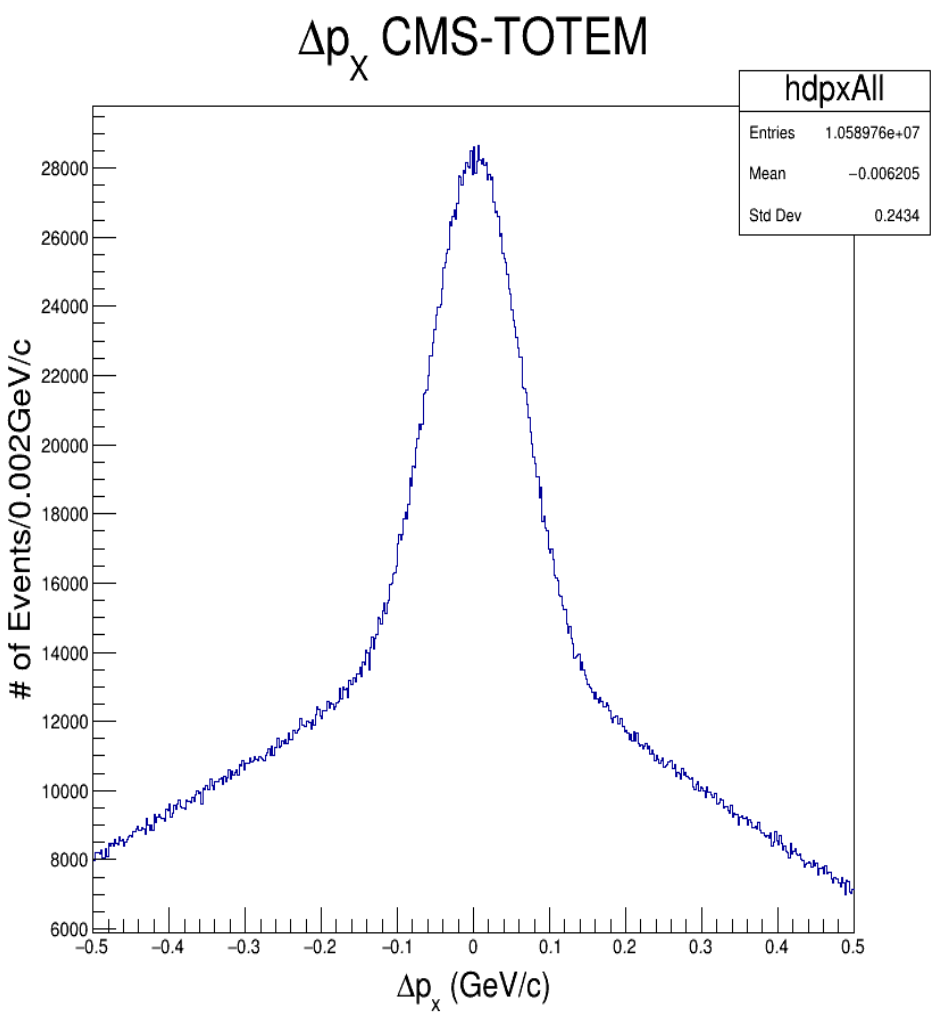
of K0s Vees vs # of Tracks

3510 events with
1 Vee and 4 tracks



Balance All



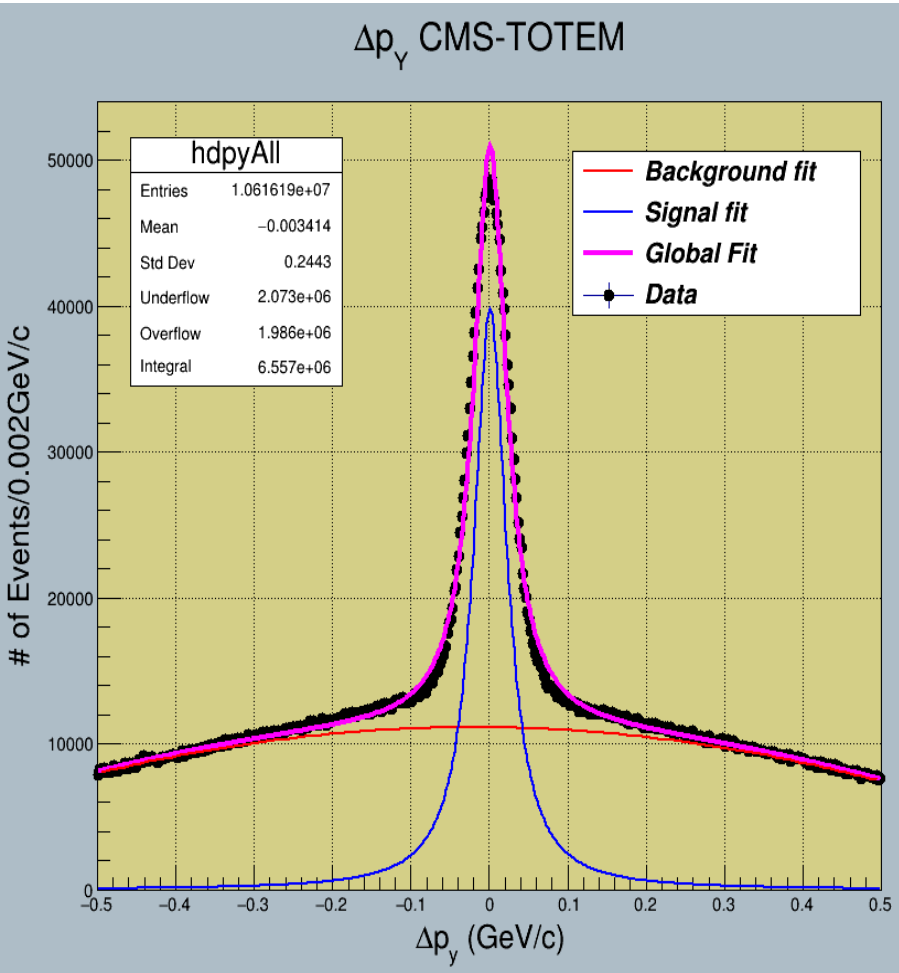


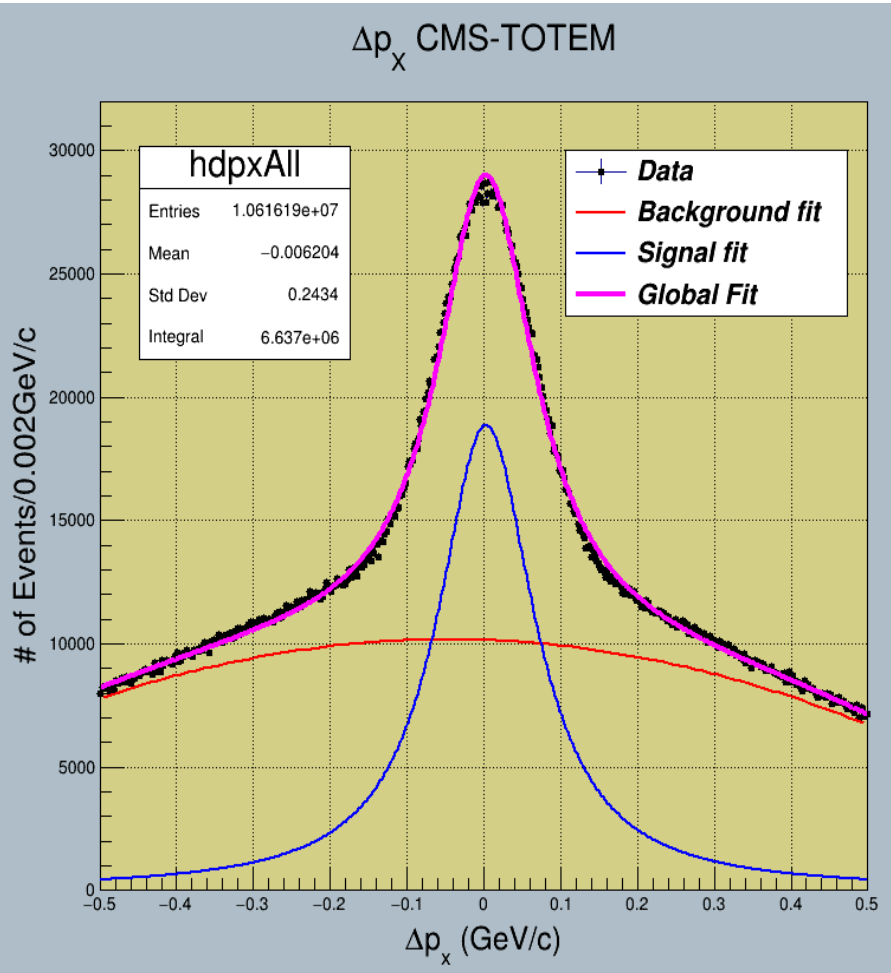
entire 2015 data

Balance All: comparing signals

signal+background integral = 2,455,264

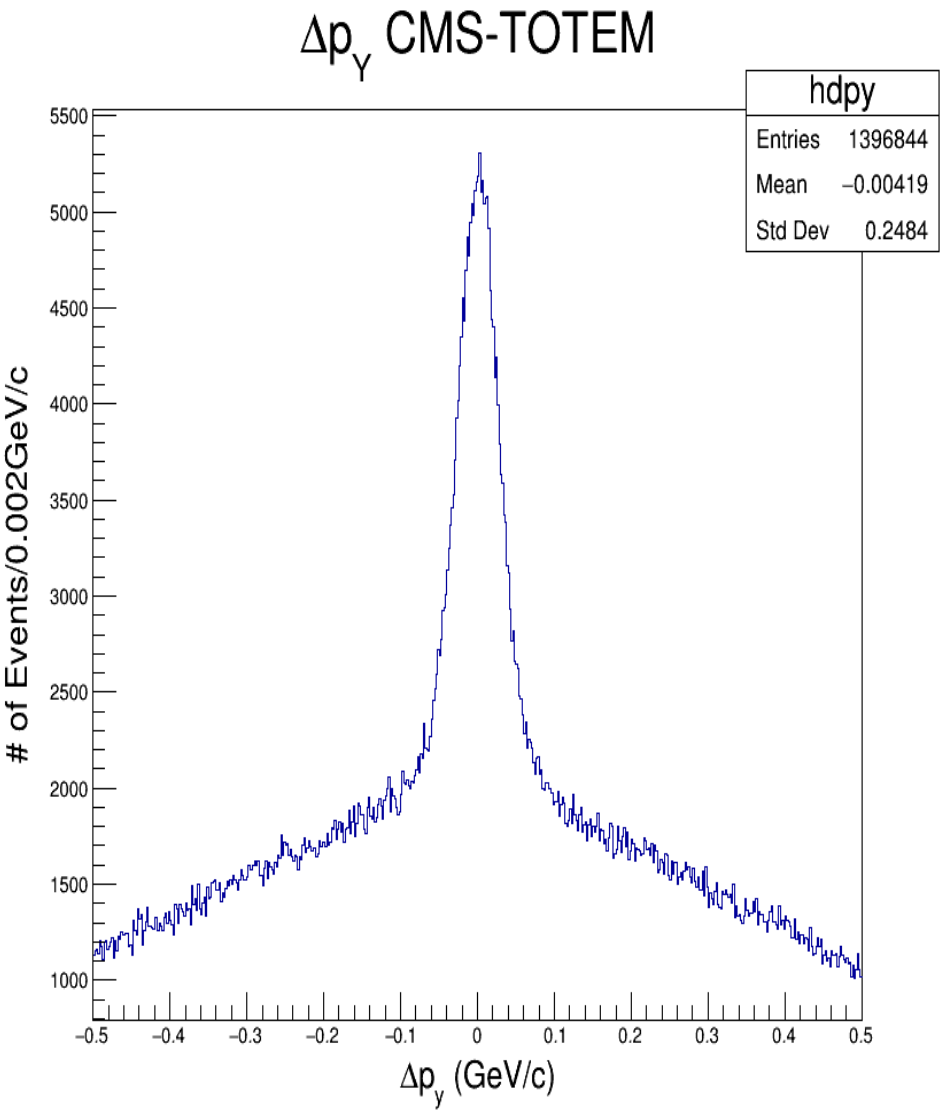
signal+background integral = 3,737,183

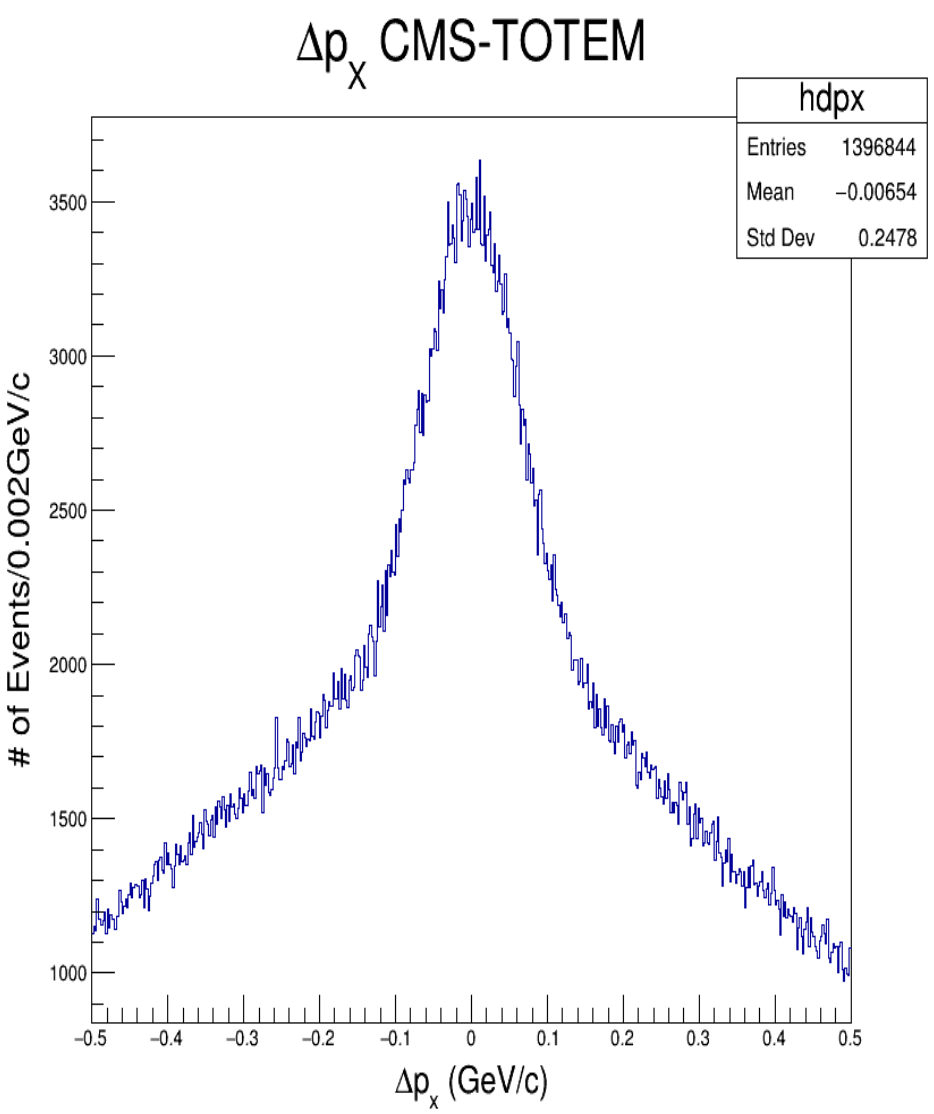




parabolic background
lorentzian signal

Balance fiducial ntrk=4



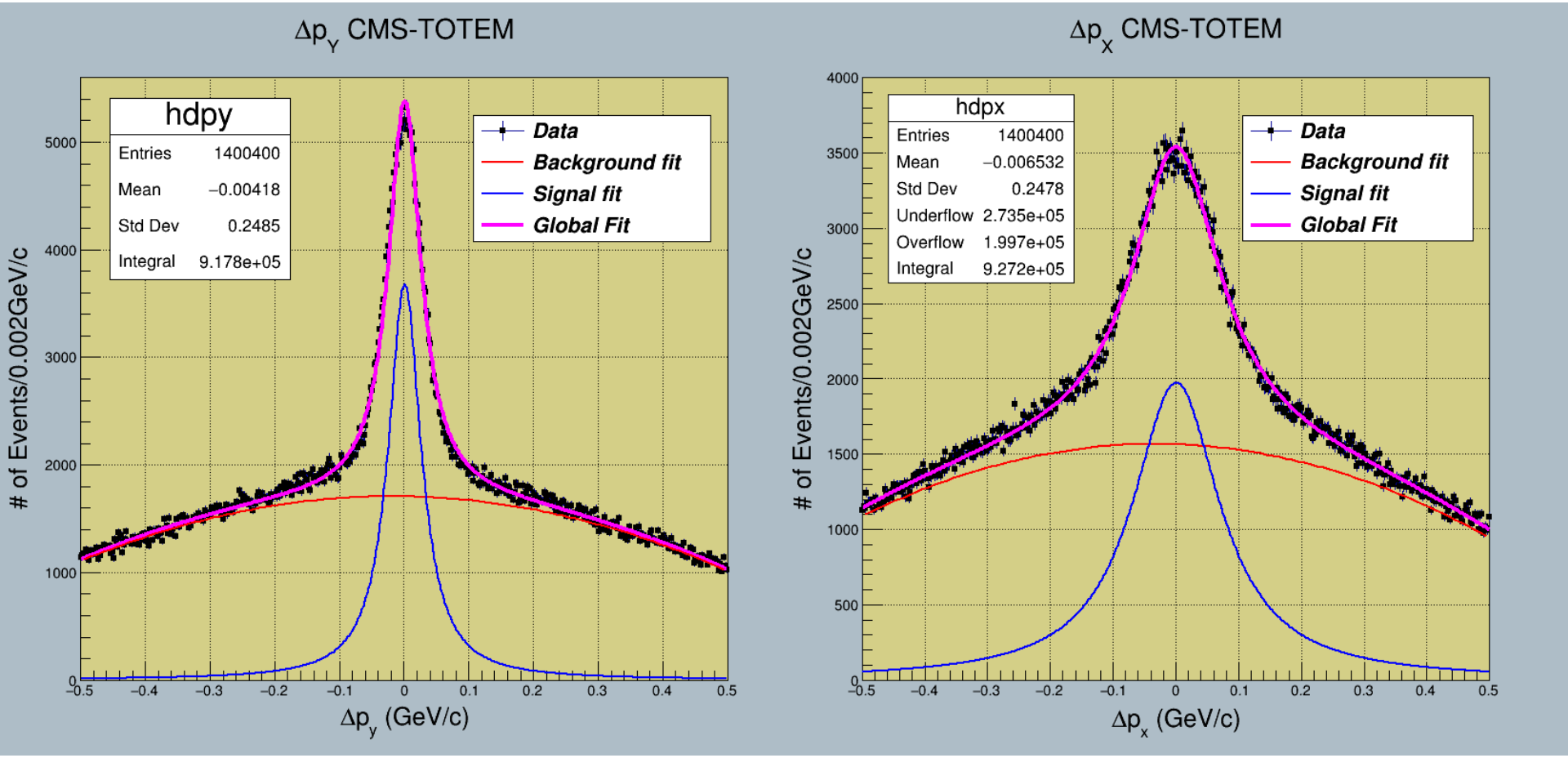


entire 2015 data

Balance fiducial ntrk=4: comparing signals

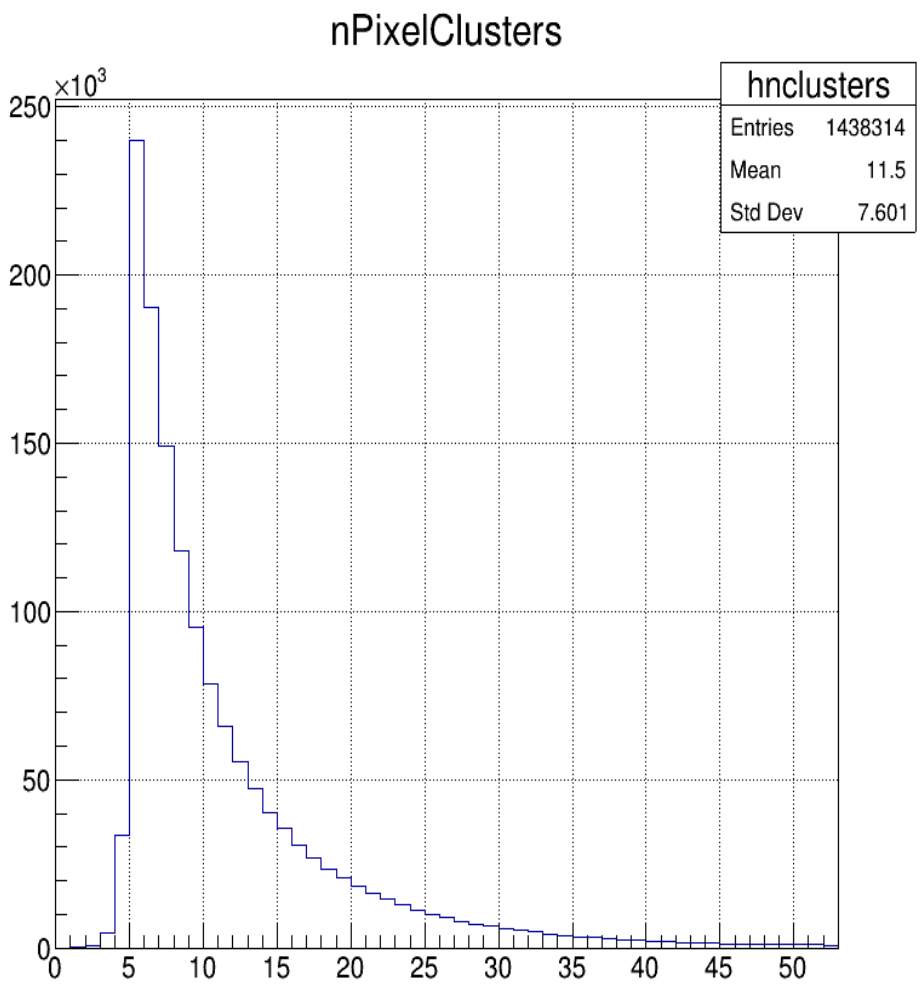
signal+background integral= 313,922

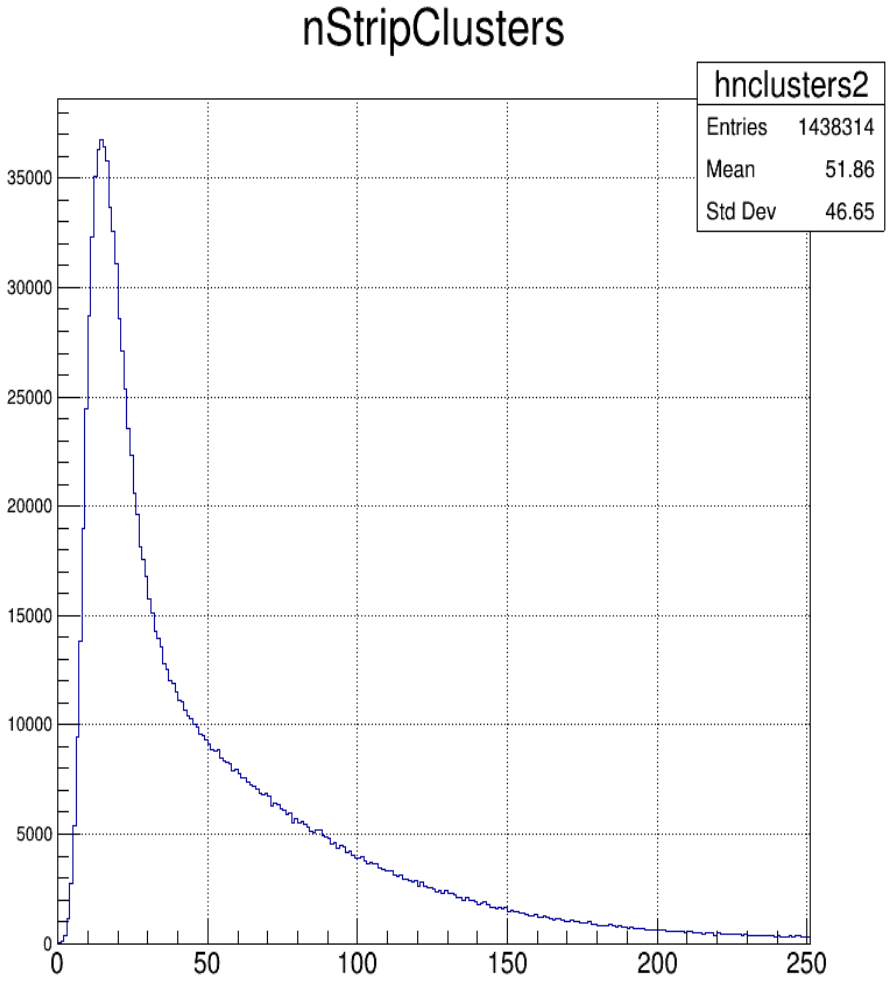
signal+background integral = 503,706

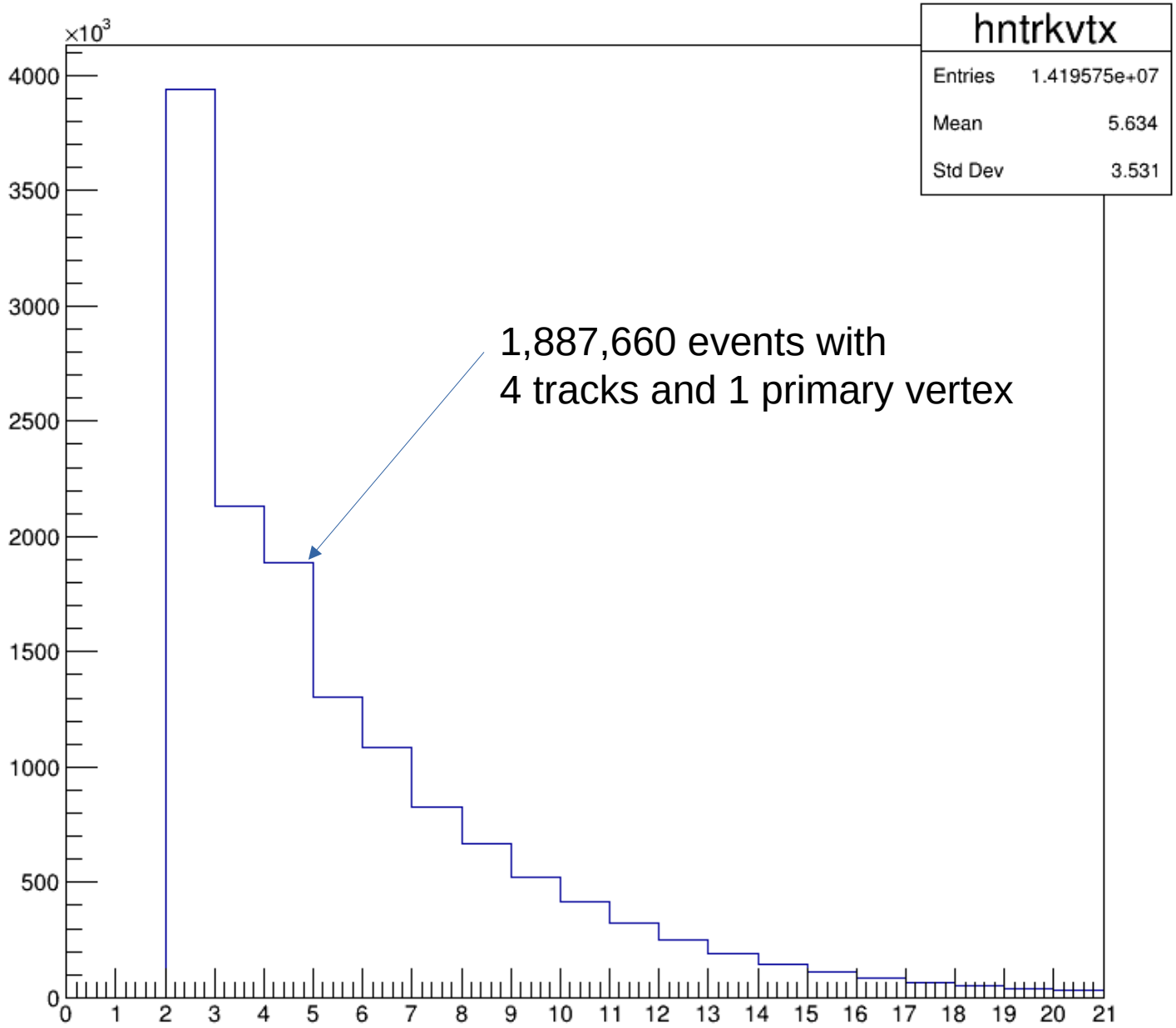


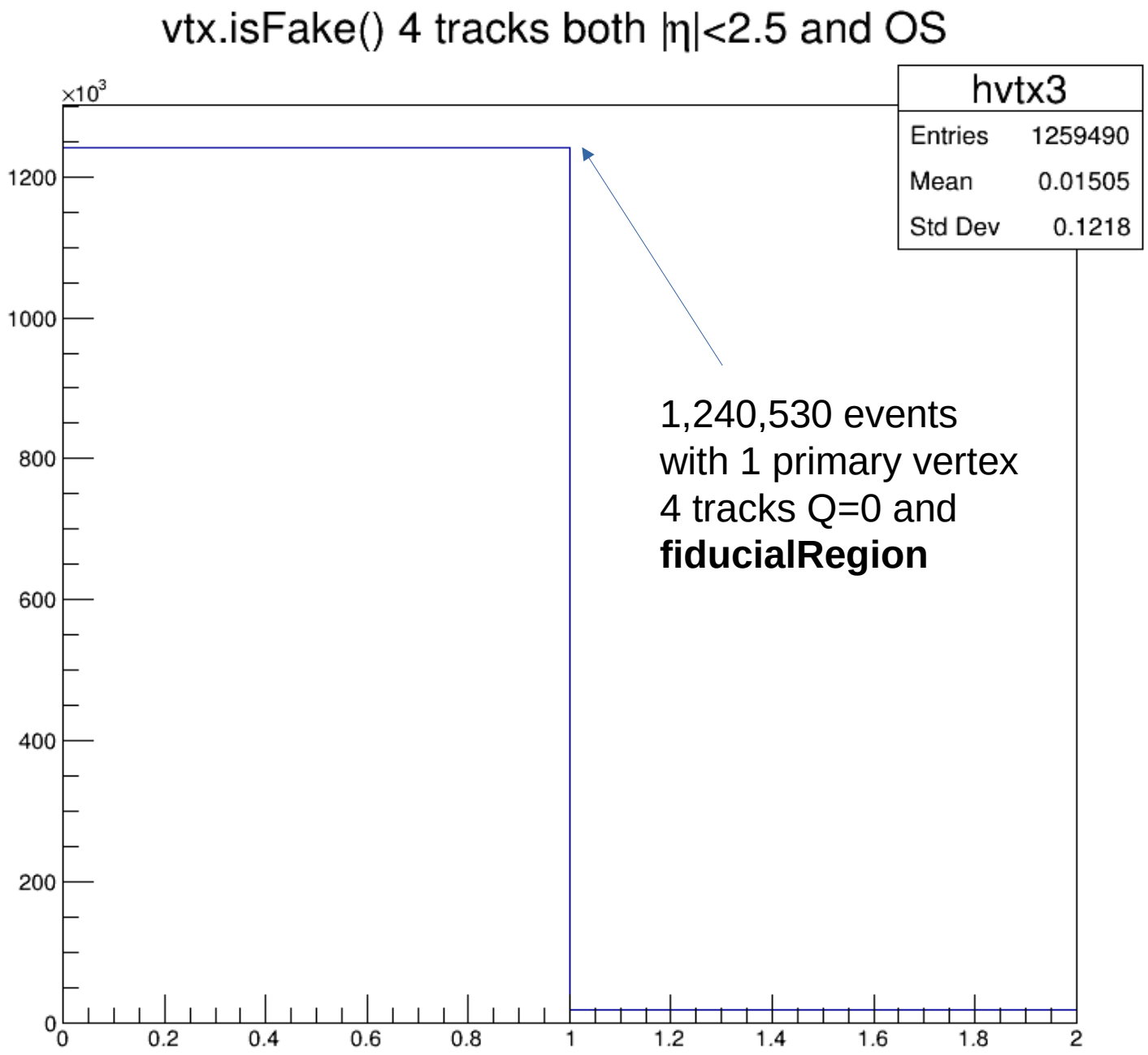
parabolic background
lorentzian signal

entire 2015 data






Ntrkvtx - tracks with only one primary vertex
hntrkvtx
Entries 1.419575e+07
Mean 5.634
Std Dev 3.531
×10^3
4000
3500
3000
2500
2000
1500
1000
500
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
1,887,660 events with
4 tracks and 1 primary vertex


vtx.isFake() 4 tracks both |η|<2.5 and OS
hvtx3
Entries 1259490
Mean 0.01505
Std Dev 0.1218
×10^3
1200
1000
800
600
400
200
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1,240,530 events
with 1 primary vertex
4 tracks Q=0 and
fiducialRegion

Notation:

type:02: no primary vertex and 2 V0s in 4 track events

type:11: 1 primary vertex and 1 V0 in 4 track events

vtxdxy: transverse impact parameter used to separate primary vertex tracks from the V0 tracks.

example: CMS Note 2006/019

The identification of jets containing b quarks relies on the properties of B hadrons decays. B hadrons have a lifetime $\tau_B \sim 1.6$ ps, which corresponds to a $c\tau_B \sim 500\mu$m, and they produce, on average, 5 charged particles per decay.

Lifetime information can be exploited in different ways. This note addresses methods based on tracks with large impact parameters. As shown in Fig. 1, tracks originating from B decays have large impact parameters since they come from a displaced vertex, while the impact parameters of tracks coming from the primary vertex are compatible with the tracking resolution. A complementary approach based on the reconstruction of secondary vertices is not investigated here.

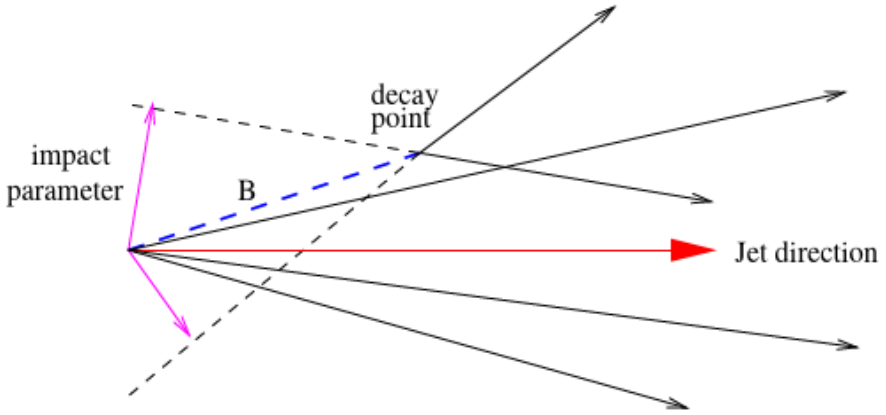
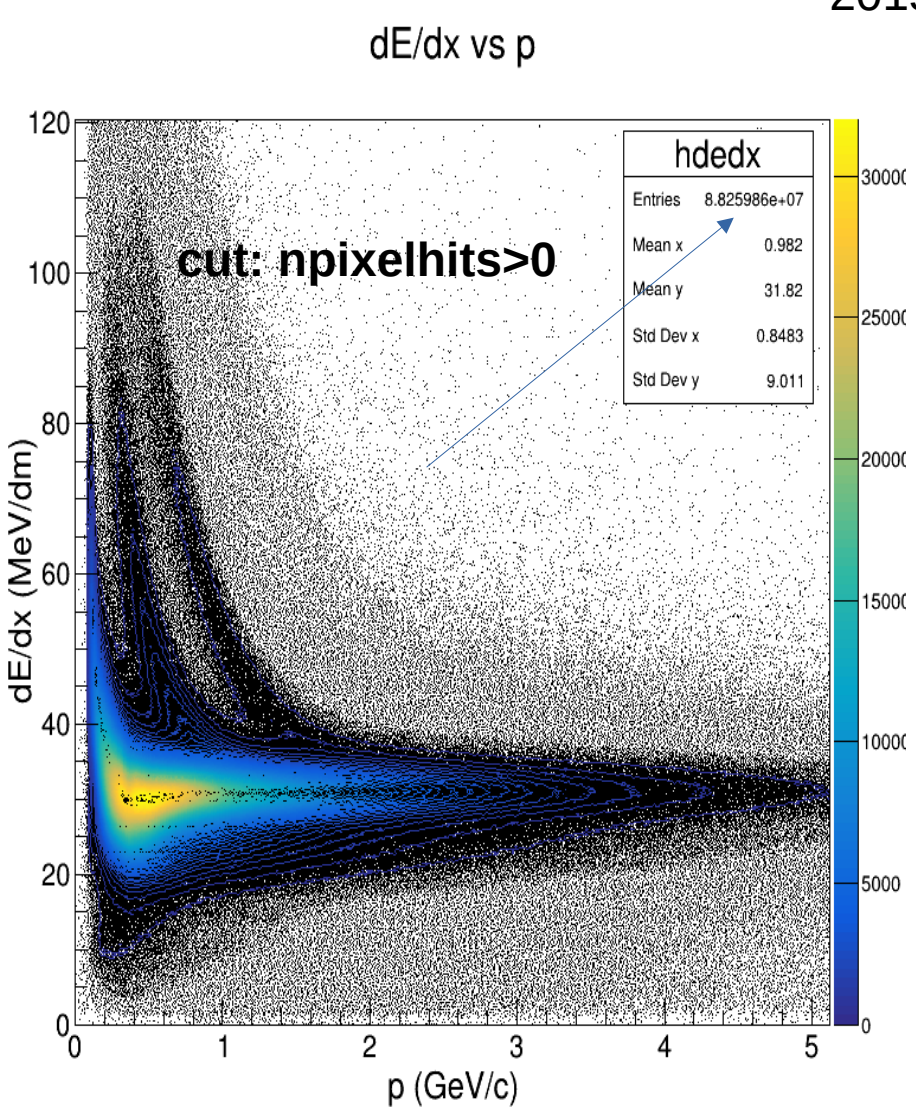
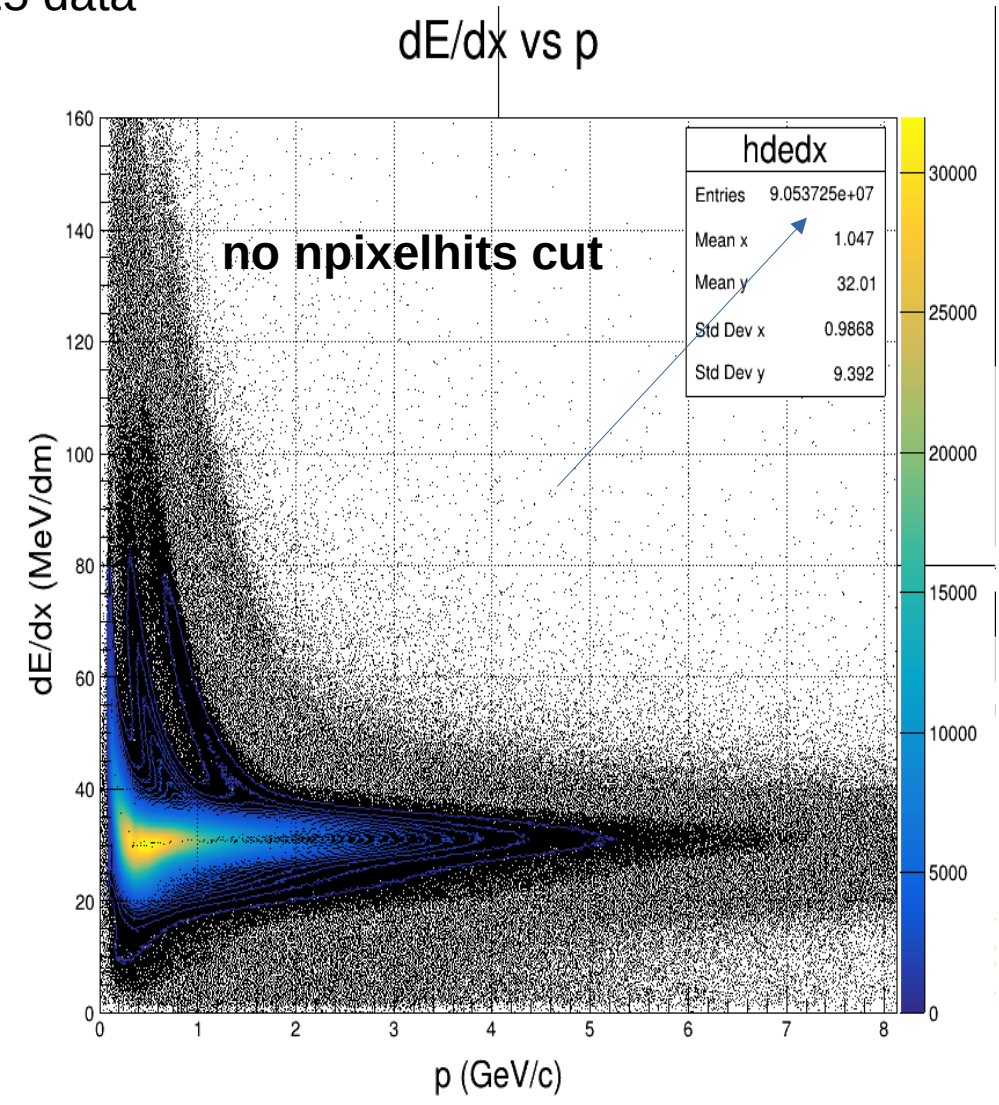


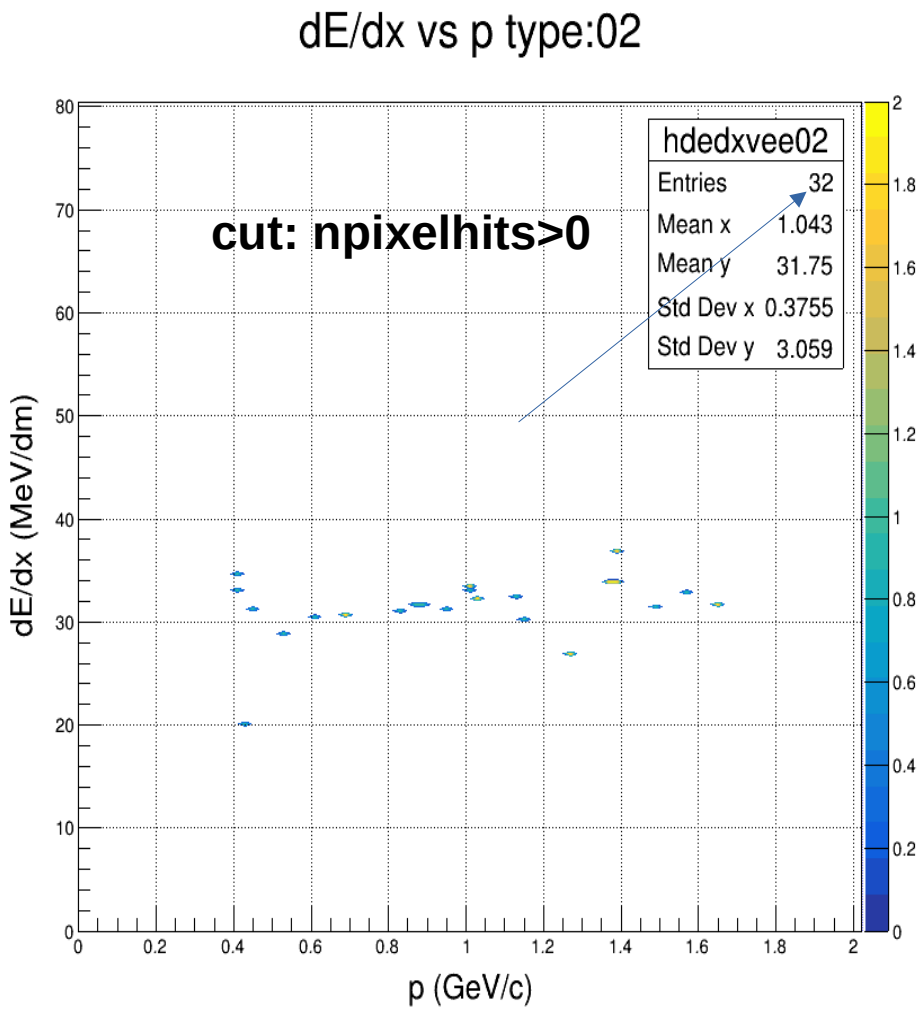
Figure 1: Representation (not to scale) of an hadronic jet originating from a b-quark.

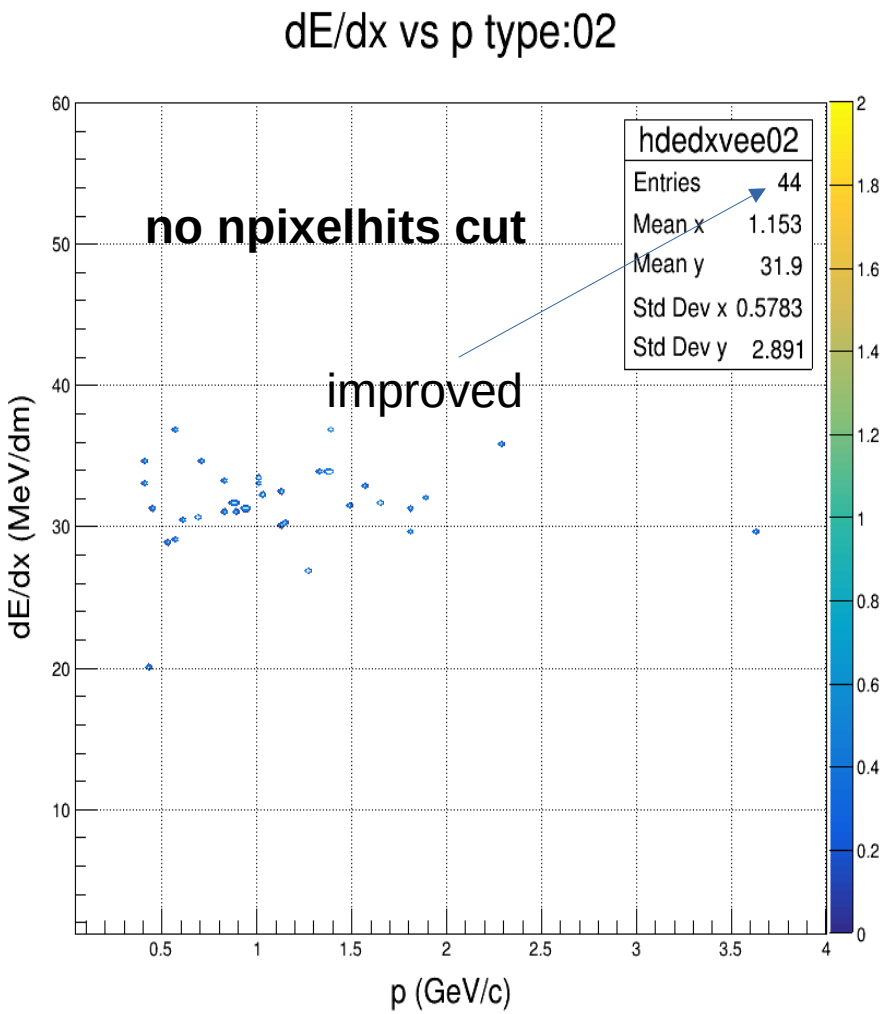
2015 data


dE/dx vs p
cut: npixelhits>0
hdedx
Entries 8.825986e+07
Mean x 0.982
Mean y 31.82
Std Dev x 0.8483
Std Dev y 9.011
dE/dx (MeV/dm)
p (GeV/c)

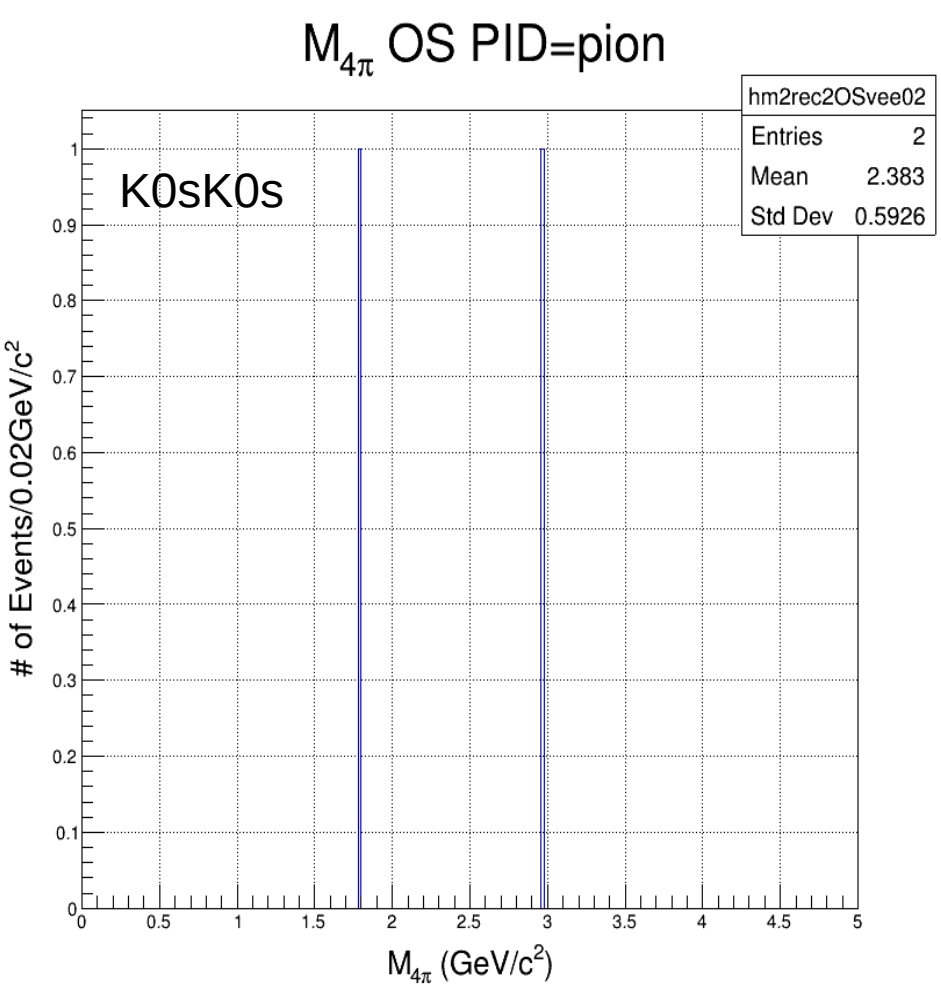

dE/dx vs p
no npixelhits cut
hdedx
Entries 9.053725e+07
Mean x 1.047
Mean y 32.01
Std Dev x 0.9868
Std Dev y 9.392
dE/dx (MeV/dm)
p (GeV/c)

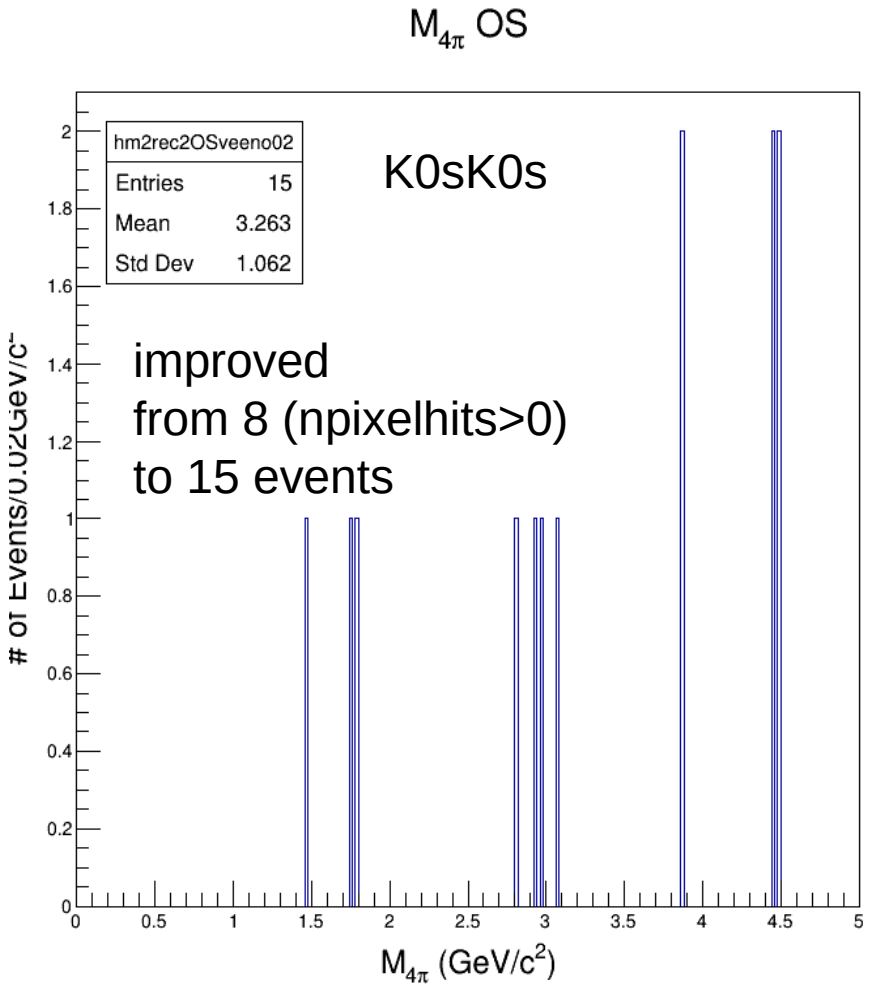
type:02 = 2 secondary vertices → K0sK0s





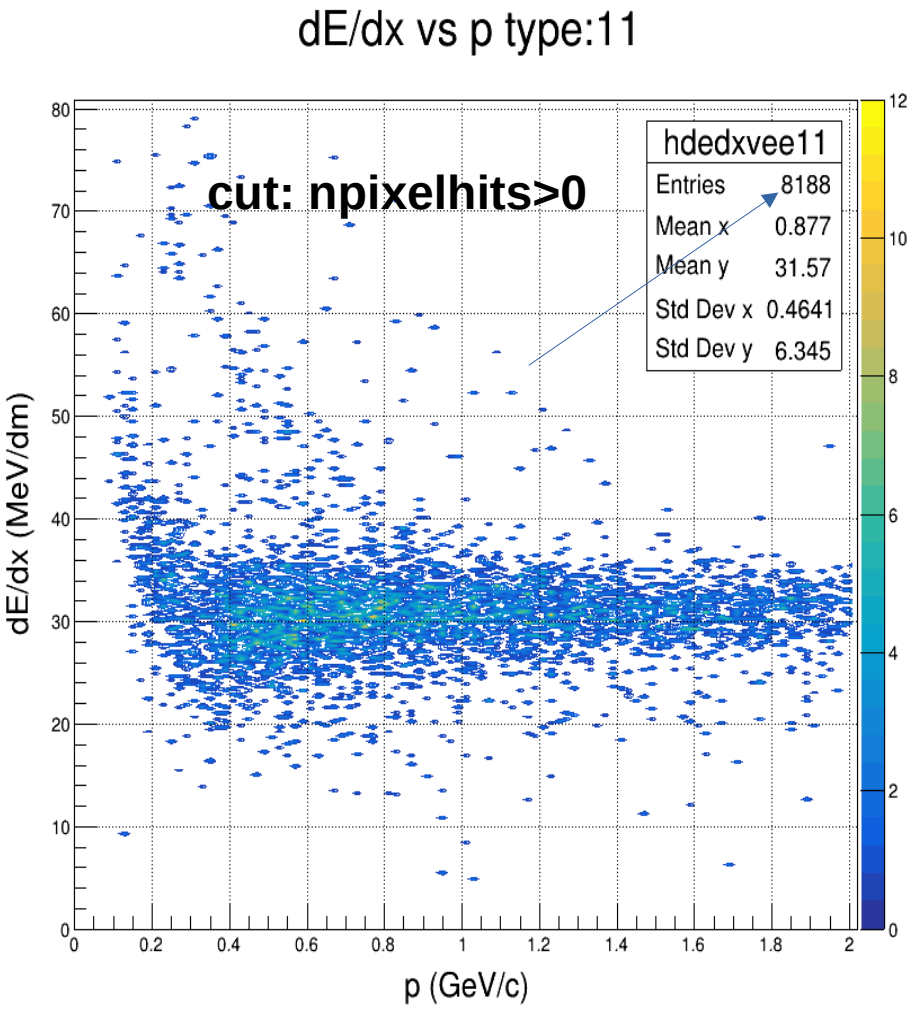
no npixelhits cut

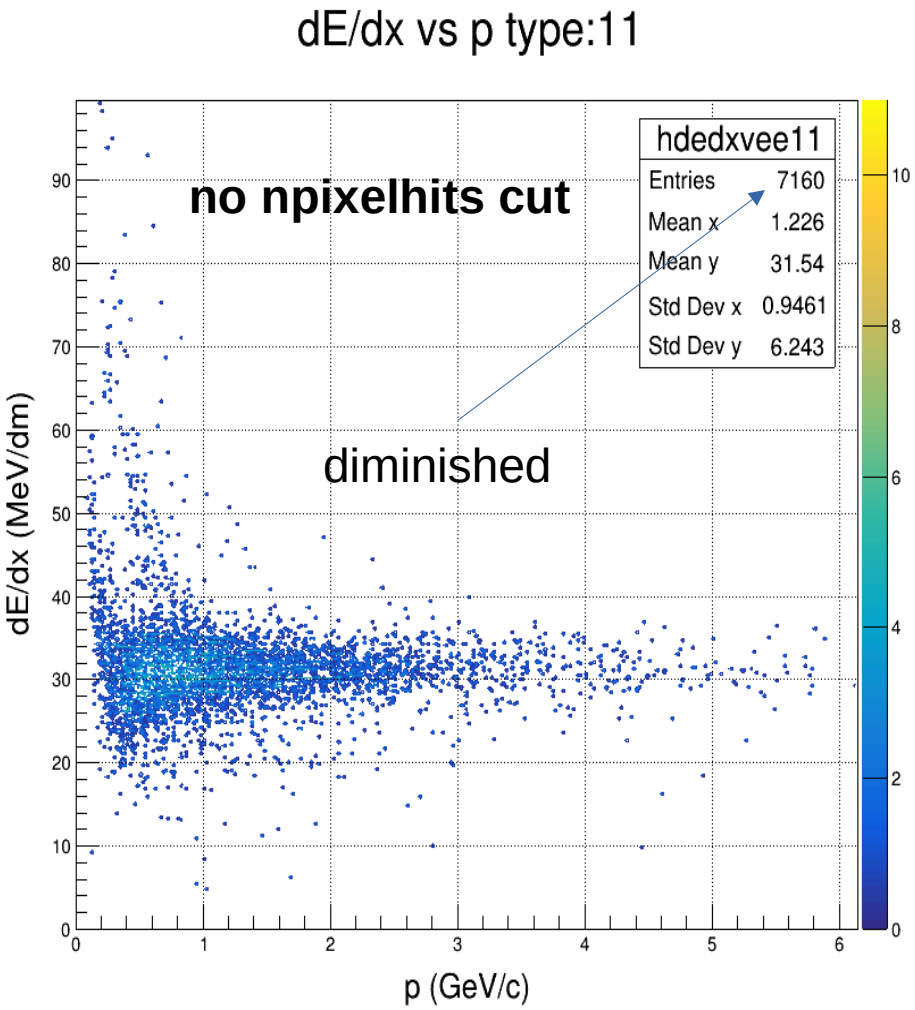




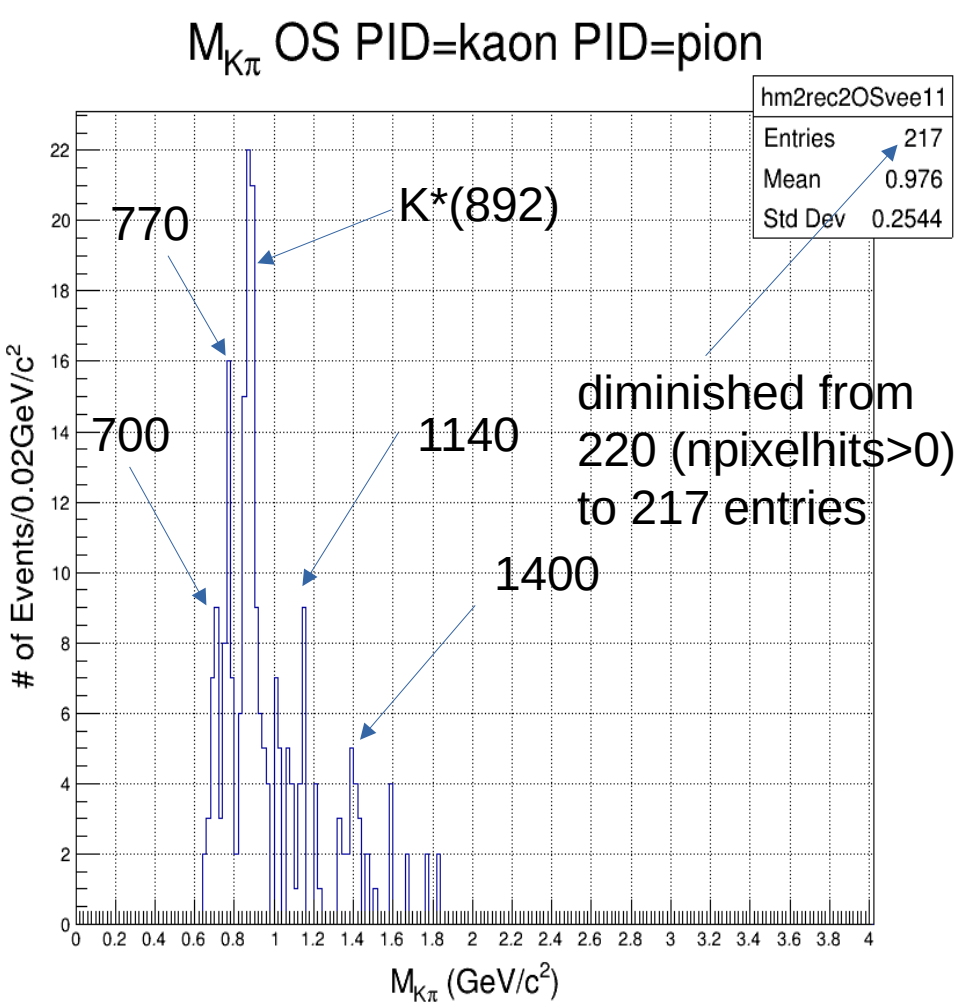
type:02 – 2 V0s

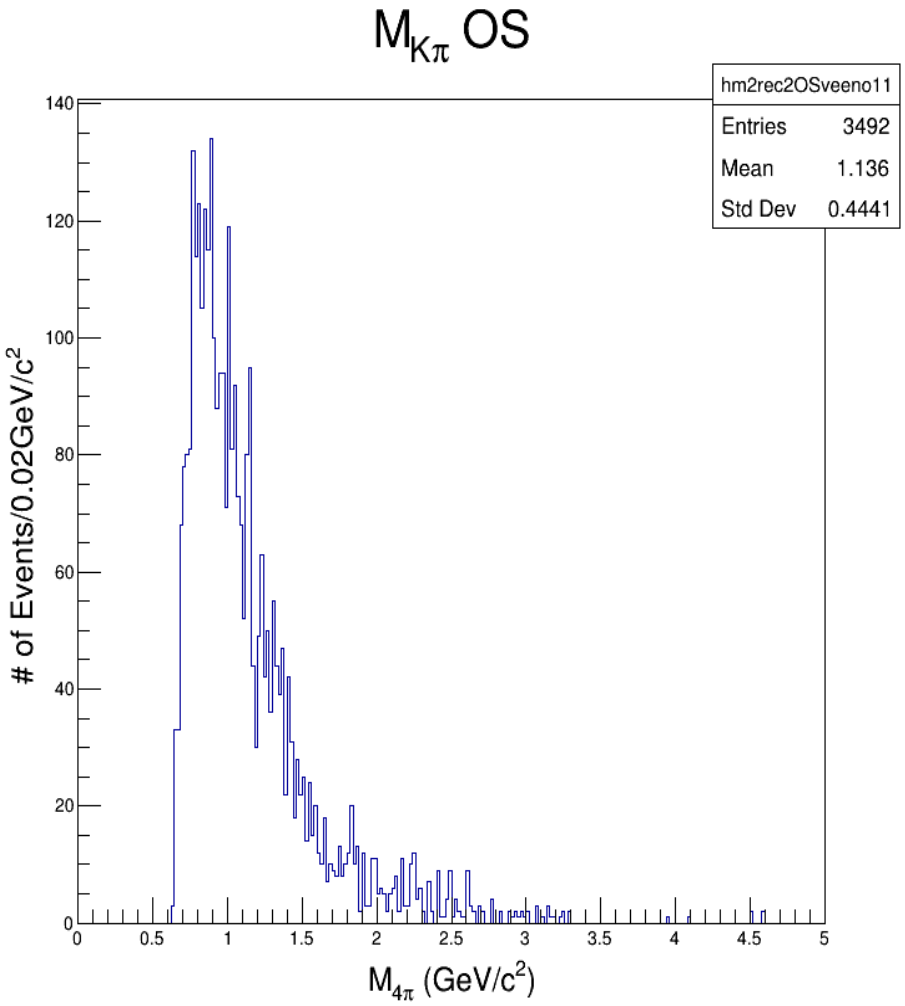
type:11 = 1 primary && 1 secondary vertex → K0sK*



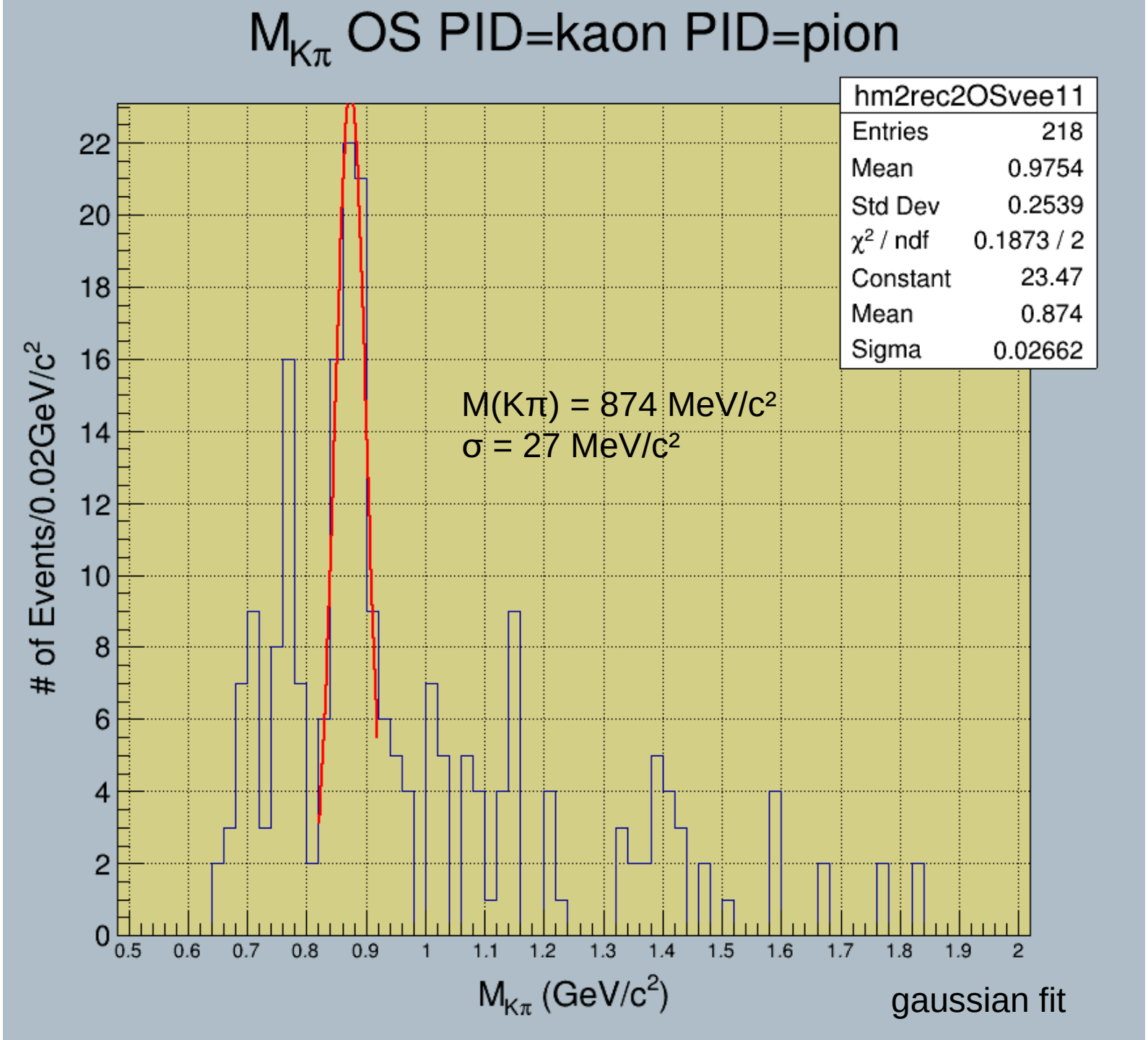


no npixelhits cut





type:11 – 1 primary 1 V0


$M_{K\pi}$ OS PID=kaon PID=pion
hm2rec2OSvee11
Entries 218
Mean 0.9754
Std Dev 0.2539
χ^2 / ndf 0.1873 / 2
Constant 23.47
Mean 0.874
Sigma 0.02662
M(Kπ) = 874 MeV/c²
σ = 27 MeV/c²
# of Events/0.02GeV/c²
$M_{K\pi}$ (GeV/c²)
gaussian fit