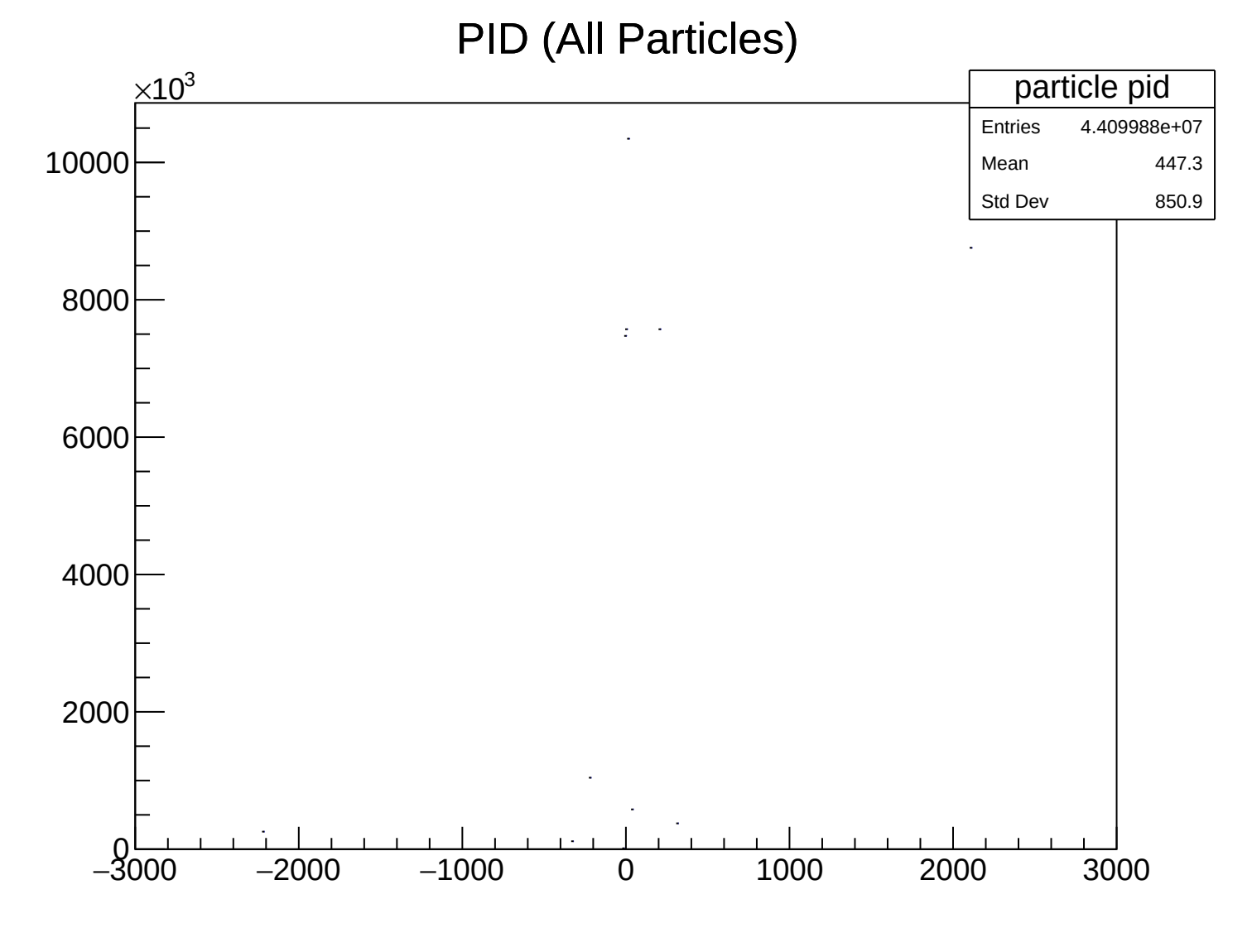
Basic electron cuts

Hydrogen

p(e,e'π^+)n

final state: 0p, 1pi+, 1e

θ_e **< 35**

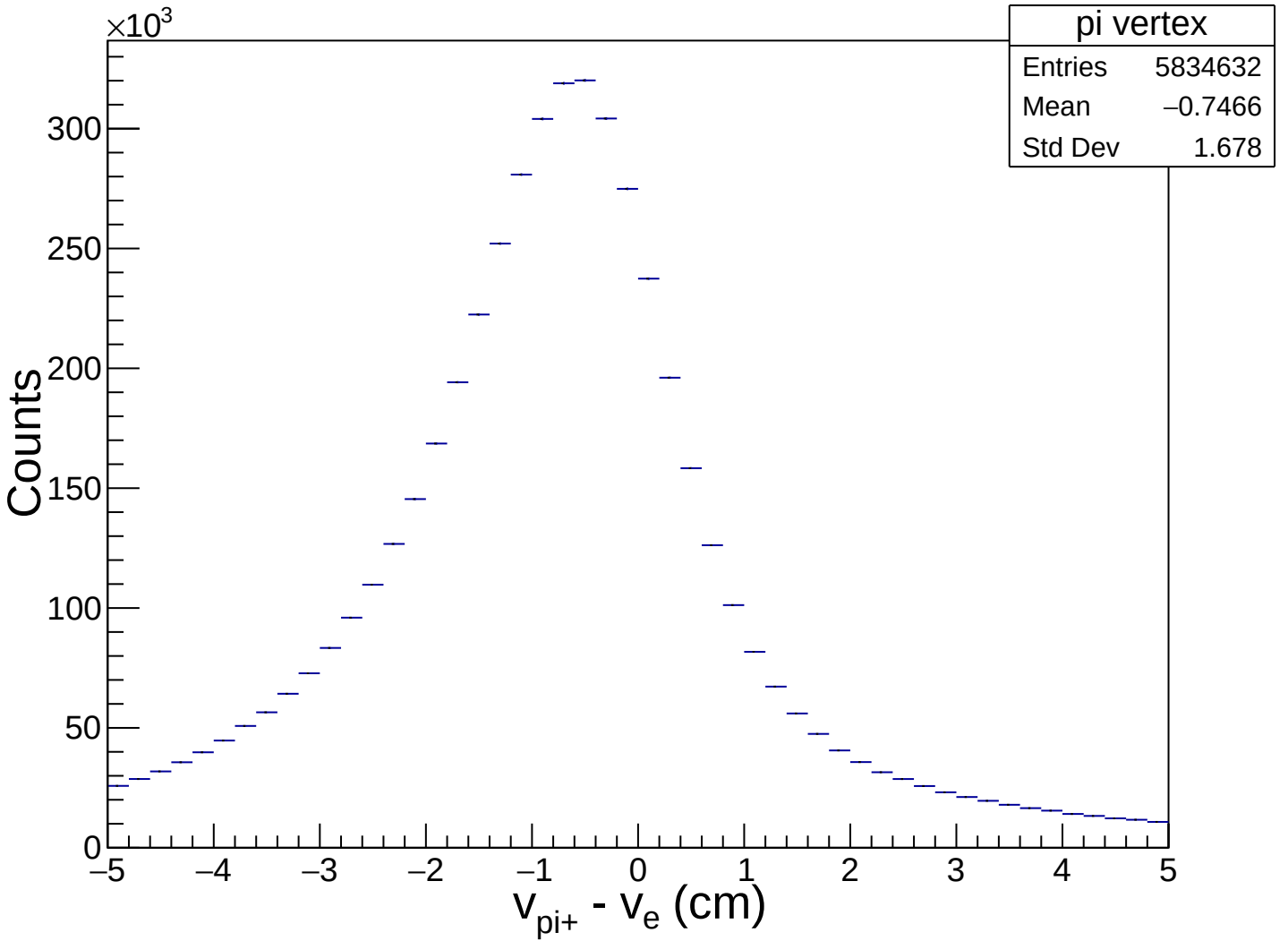

PID (All Particles)
particle pid
Entries 4.409988e+07
Mean 447.3
Std Dev 850.9
×10^3
10000
8000
6000
4000
2000
0
−3000
−2000
−1000
0
1000
2000
3000

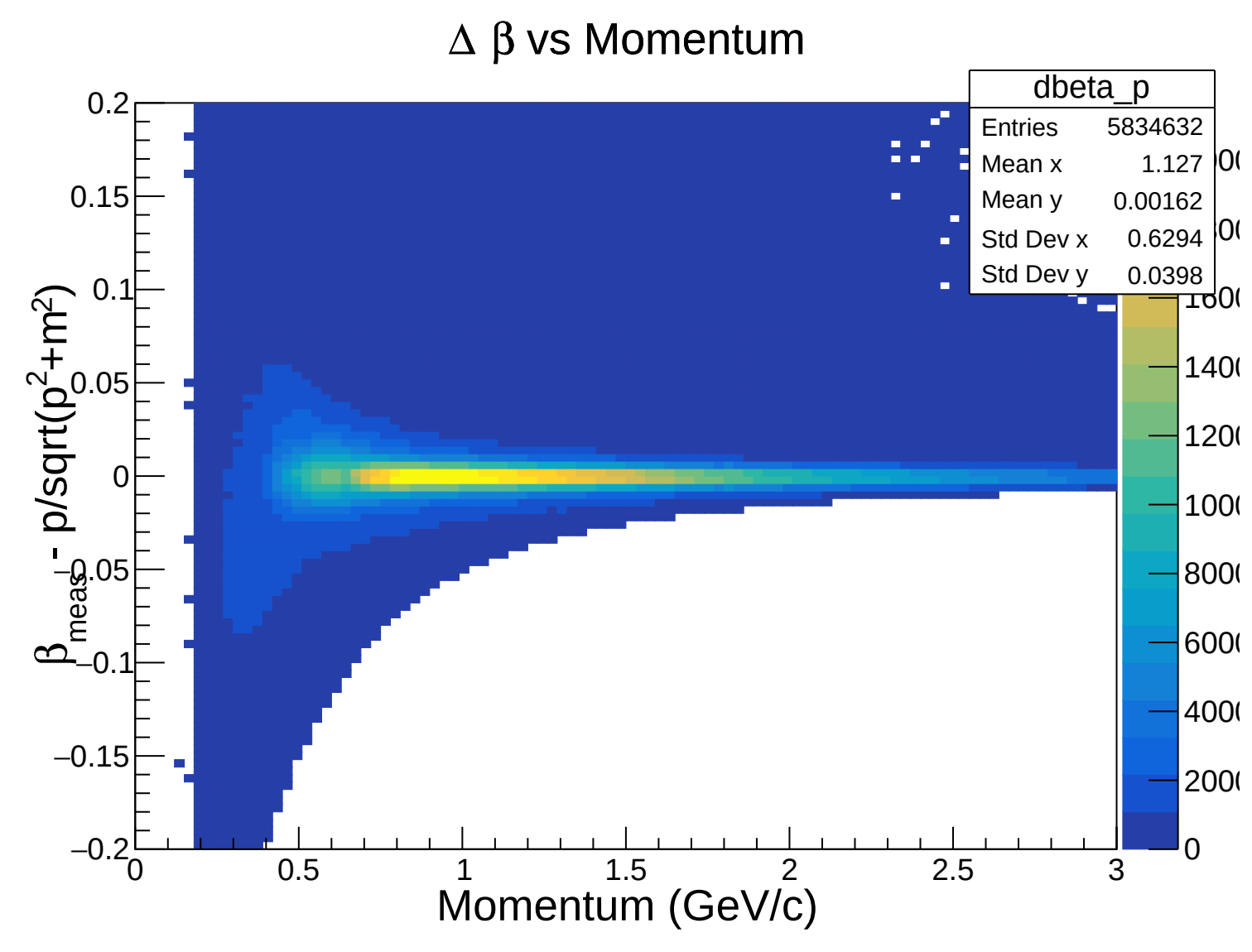
Basic electron cuts

Hydrogen

p(e,e'π^+)n

allow only PID=0,11,22,211,2112


Pion vertex - electron vertex
pi vertex
Entries 5834632
Mean −0.7466
Std Dev 1.678
×10^3
300
250
200
150
100
50
0
Counts
−5
−4
−3
−2
−1
0
1
2
3
4
5
v_pi+ - v_e (cm)


Δ β vs Momentum
dbeta_p
Entries 5834632
Mean x 1.127
Mean y 0.00162
Std Dev x 0.6294
Std Dev y 0.0398
β_meas - p/sqrt(p²+m²)
Momentum (GeV/c)
0.2
0.15
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
0
0.5
1
1.5
2
2.5
3
1600
1400
1200
1000
800
600
400
200
0

Basic electron cuts

Hydrogen run 015017

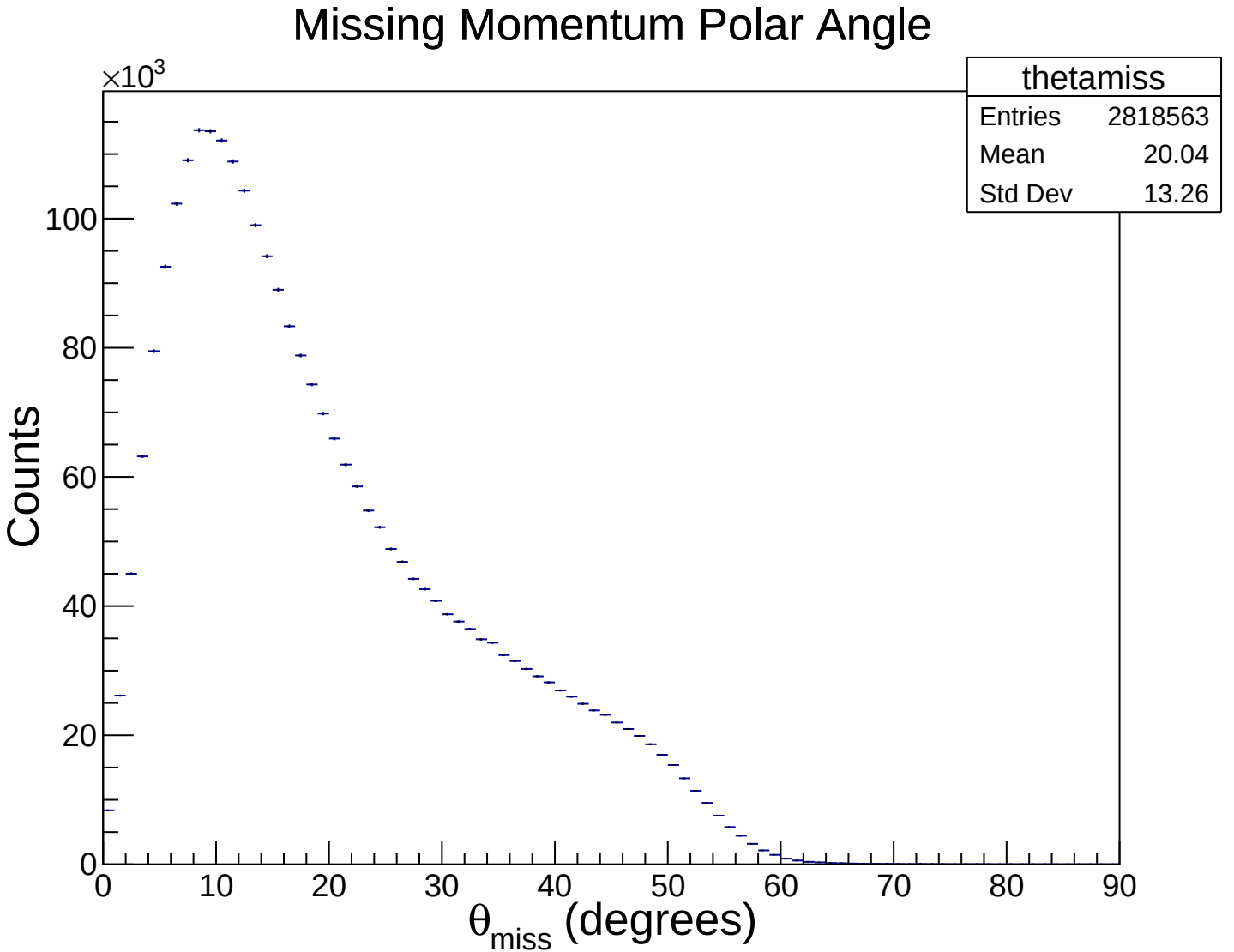
p(e,e'π^+)n

-4 cm < $v_{\pi+}$-v_e < 2 cm

-0.03 < $\Delta\ \beta$ < 0.03

$p_{\pi+}$ > 0.4 GeV/c

θ_π < 35


Missing Momentum Polar Angle
thetamiss
Entries 2818563
Mean 20.04
Std Dev 13.26
×10^3
Counts
θmiss (degrees)
0
20
40
60
80
100
0
10
20
30
40
50
60
70
80
90

Basic electron cuts

Hydrogen run 015017

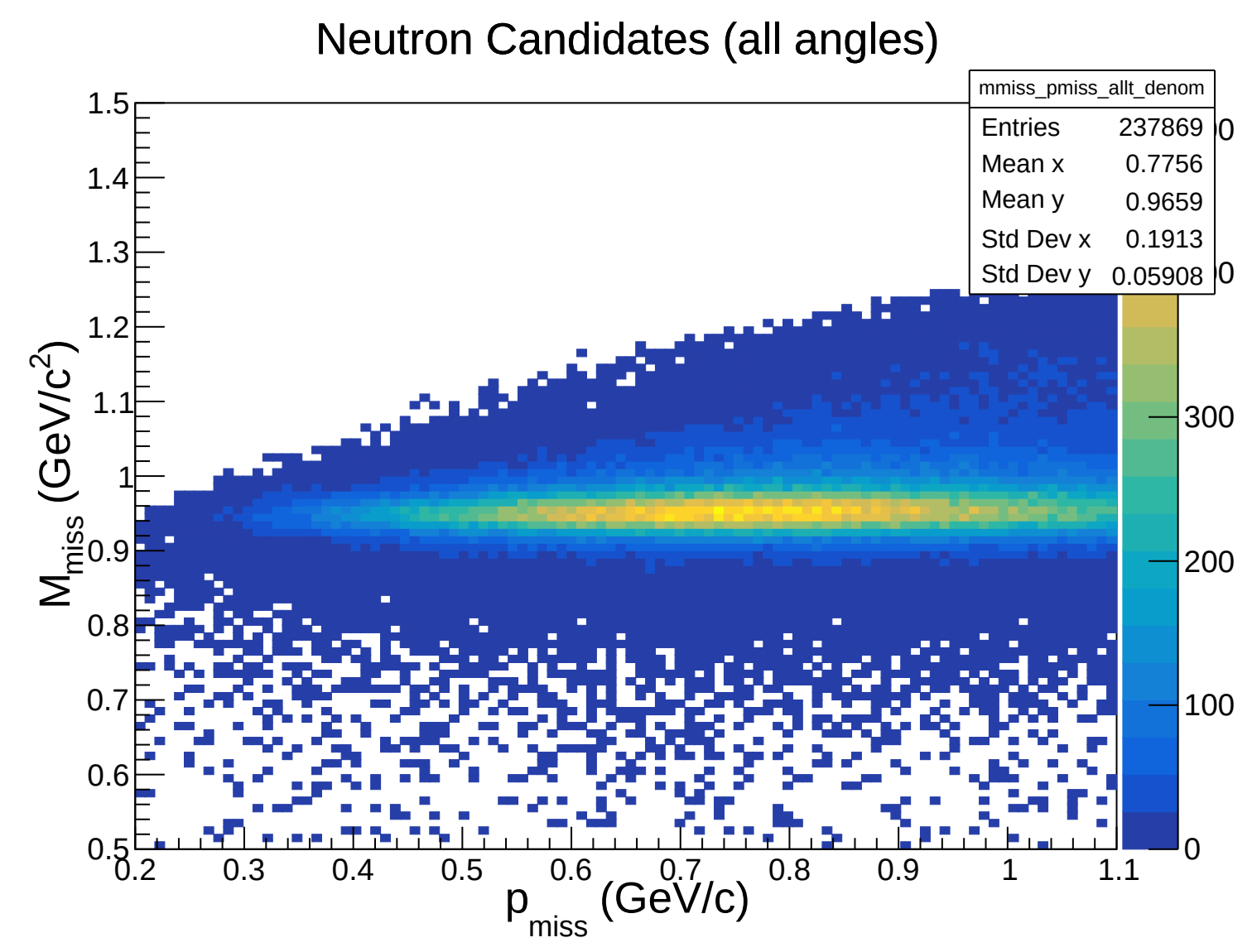
p(e,e'π^+)n

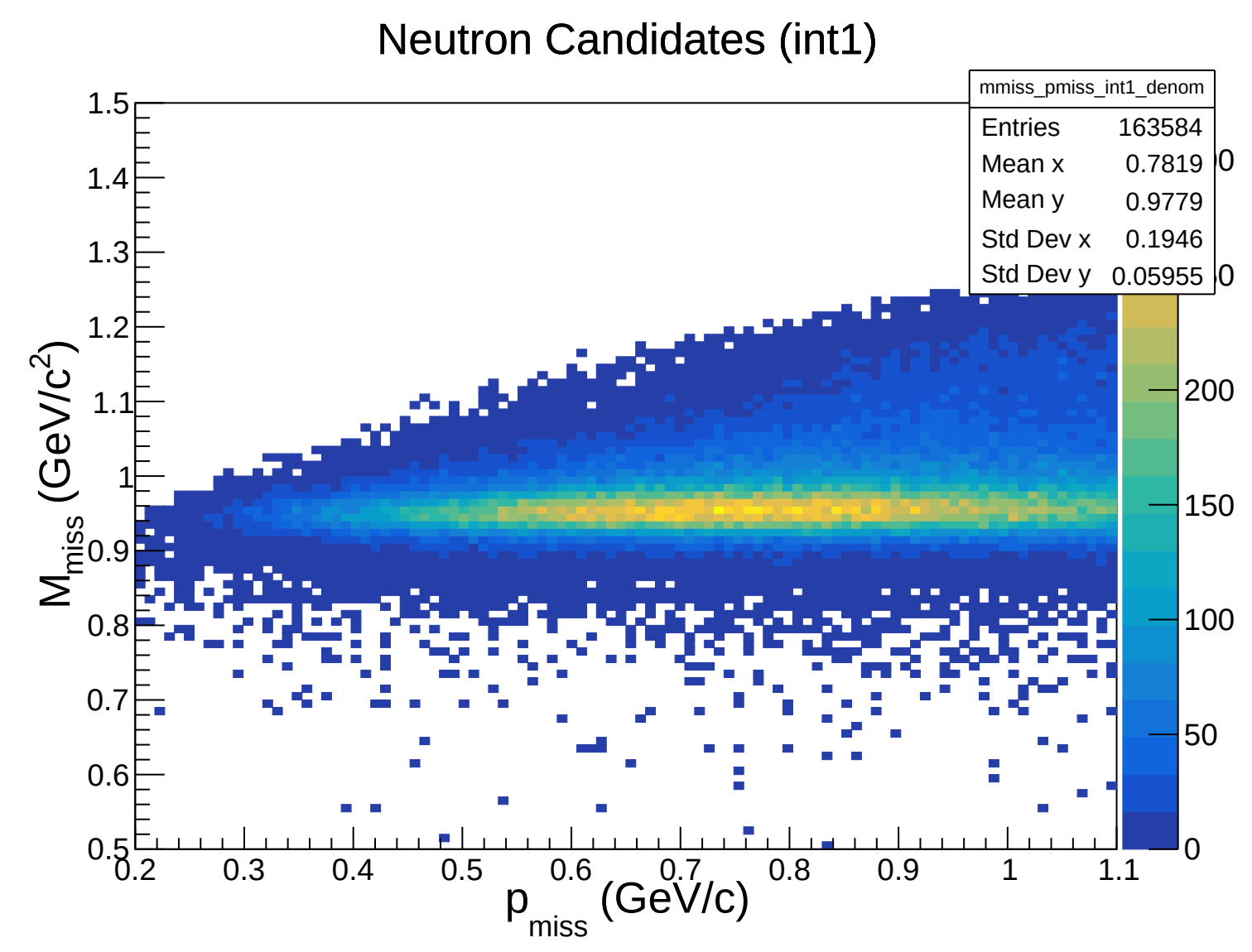
pion cuts

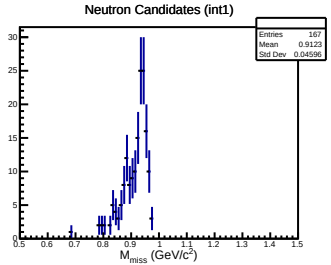
40 deg < θ_{miss} < 140 deg

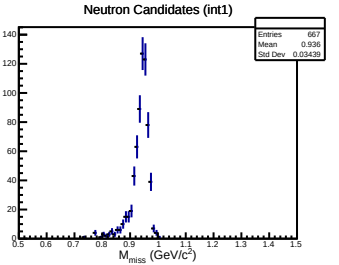
0.094 GeV/c < p_{miss} < 1.25 GeV/c

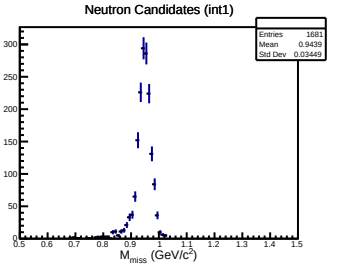
Get n_{eff} vs p (denominator)

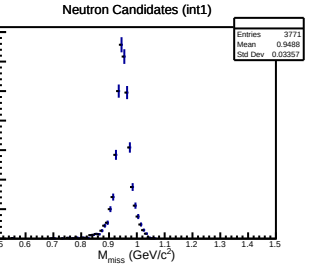

Neutron Candidates (all angles)
mmiss_pmiss_allt_denom
Entries 237869
Mean x 0.7756
Mean y 0.9659
Std Dev x 0.1913
Std Dev y 0.05908
M_miss (GeV/c^2)
p_miss (GeV/c)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
300
200
100
0

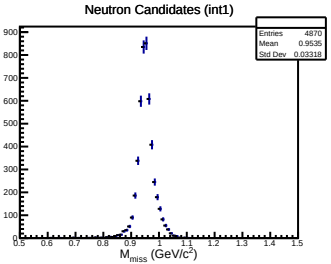

Neutron Candidates (int1)
mmiss_pmiss_int1_denom
Entries 163584
Mean x 0.7819
Mean y 0.9779
Std Dev x 0.1946
Std Dev y 0.05955
M_miss (GeV/c^2)
p_miss (GeV/c)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
200
150
100
50
0

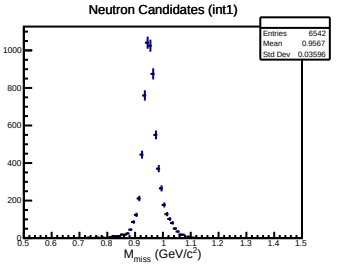

Neutron Candidates (int1)
Entries 167
Mean 0.9123
Std Dev 0.04596
M_miss (GeV/c²)

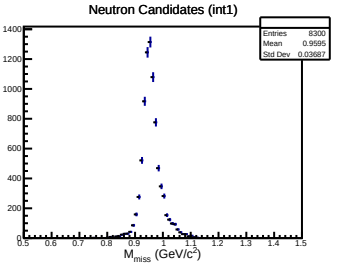

Neutron Candidates (int1)
Entries 667
Mean 0.936
Std Dev 0.03439
M_miss (GeV/c²)

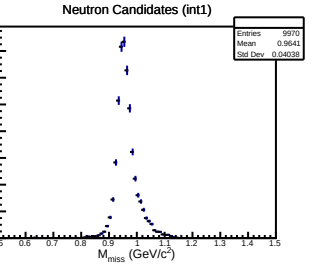

Neutron Candidates (int1)
Entries 1681
Mean 0.9439
Std Dev 0.03449
M_miss (GeV/c²)

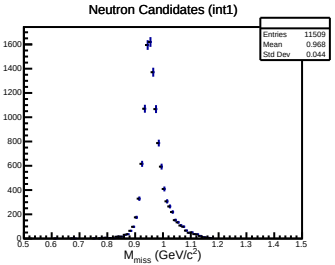

Neutron Candidates (int1)
Entries 3771
Mean 0.9488
Std Dev 0.03357
M_miss (GeV/c²)

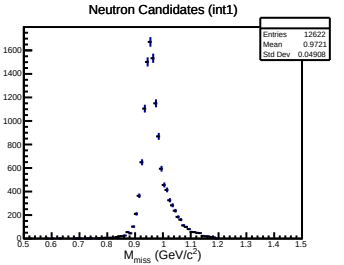

Neutron Candidates (int1)
Entries 4870
Mean 0.9535
Std Dev 0.03318
M_miss (GeV/c²)

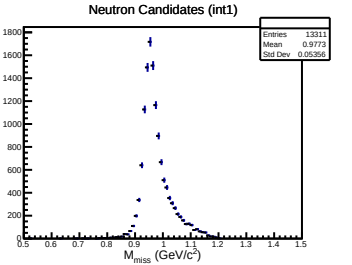

Neutron Candidates (int1)
Entries 6542
Mean 0.9567
Std Dev 0.03596
M_miss (GeV/c²)

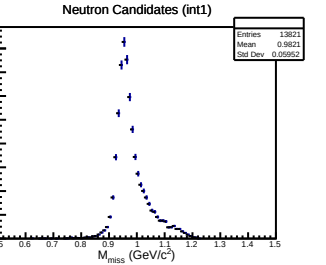

Neutron Candidates (int1)
Entries 8300
Mean 0.9595
Std Dev 0.03687
M_miss (GeV/c²)

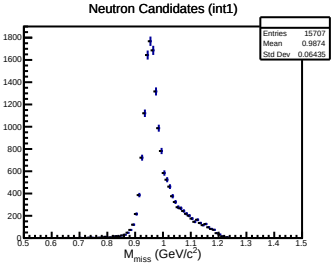

Neutron Candidates (int1)
Entries 9970
Mean 0.9641
Std Dev 0.04038
M_miss (GeV/c²)

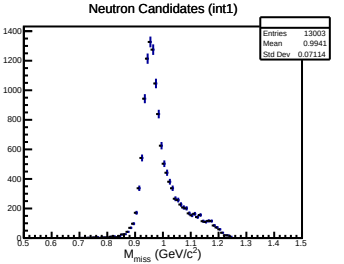

Neutron Candidates (int1)
Entries 11509
Mean 0.968
Std Dev 0.044
M_miss (GeV/c²)

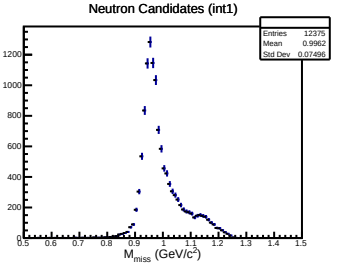

Neutron Candidates (int1)
Entries 12622
Mean 0.9721
Std Dev 0.04908
M_miss (GeV/c²)

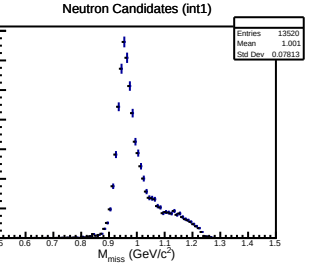

Neutron Candidates (int1)
Entries 13311
Mean 0.9773
Std Dev 0.05356
M_miss (GeV/c²)

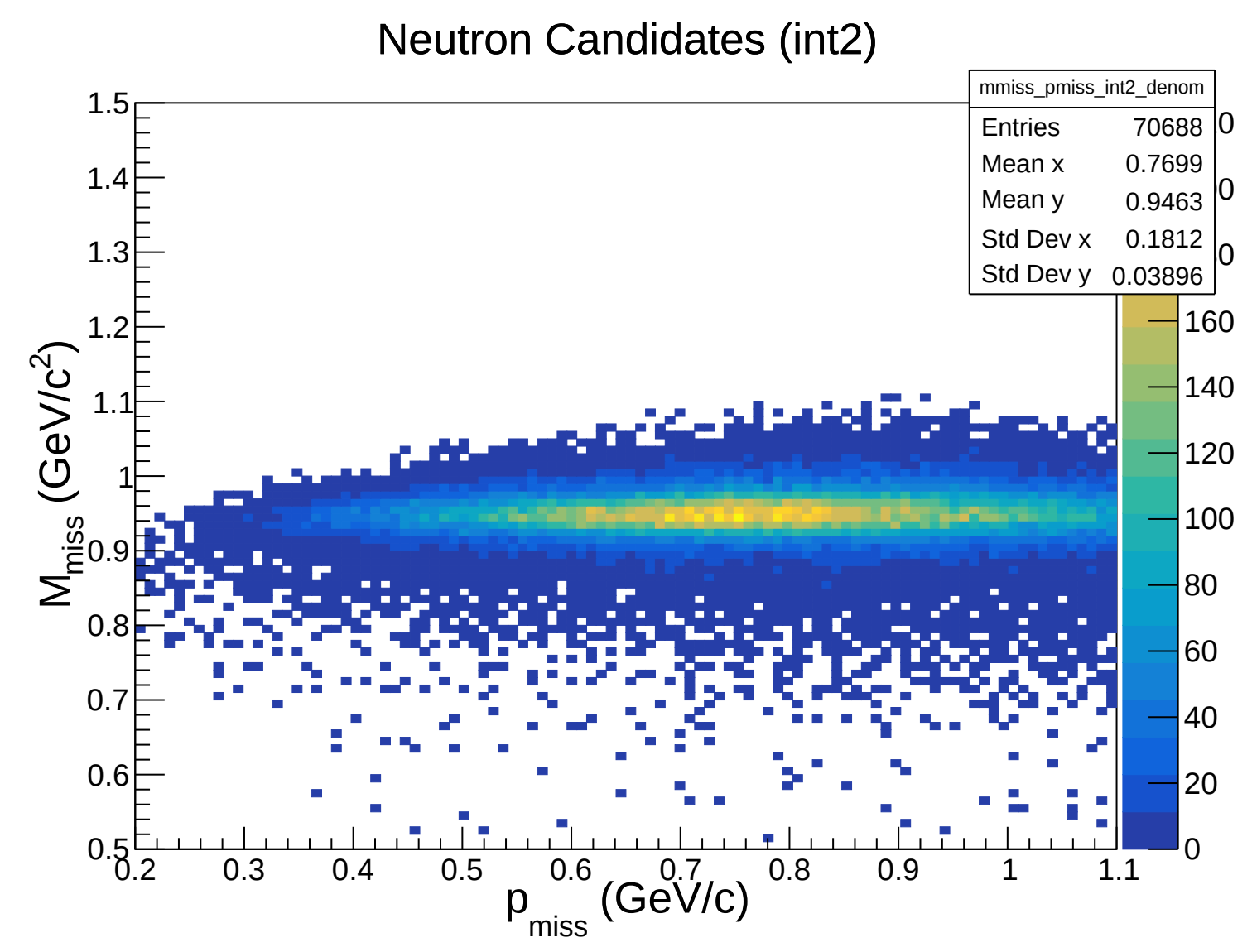

Neutron Candidates (int1)
Entries 13821
Mean 0.9821
Std Dev 0.05952
M_miss (GeV/c²)

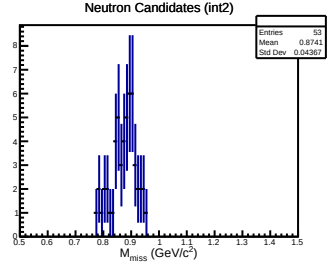

Neutron Candidates (int1)
Entries 15707
Mean 0.9874
Std Dev 0.06435
M_miss (GeV/c²)

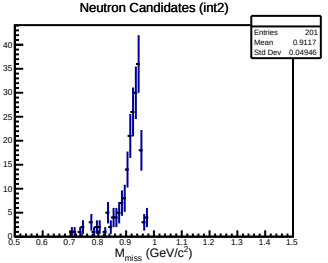

Neutron Candidates (int1)
Entries 13003
Mean 0.9941
Std Dev 0.07114
M_miss (GeV/c²)

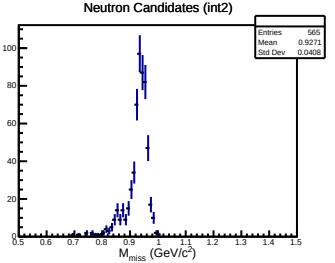

Neutron Candidates (int1)
Entries 12375
Mean 0.9962
Std Dev 0.07496
M_miss (GeV/c²)

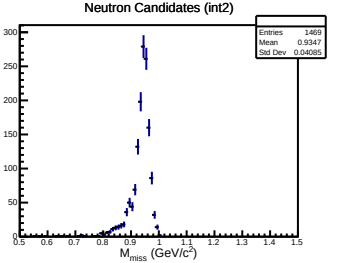

Neutron Candidates (int1)
Entries 13520
Mean 1.001
Std Dev 0.07813
M_miss (GeV/c²)

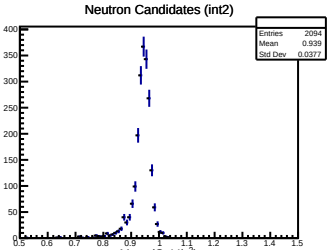

Neutron Candidates (int2)
mmiss_pmiss_int2_denom
Entries 70688
Mean x 0.7699
Mean y 0.9463
Std Dev x 0.1812
Std Dev y 0.03896
M_miss (GeV/c^2)
p_miss (GeV/c)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
160
140
120
100
80
60
40
20
0

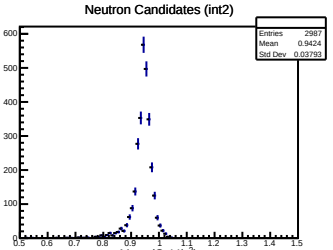

Neutron Candidates (int2)
Entries 53
Mean 0.8741
Std Dev 0.04367
M_miss (GeV/c²)

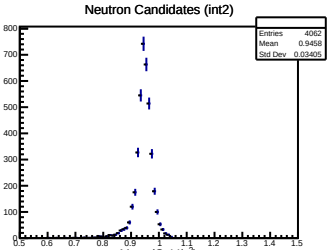

Neutron Candidates (int2)
Entries 201
Mean 0.9117
Std Dev 0.04946
M_miss (GeV/c²)

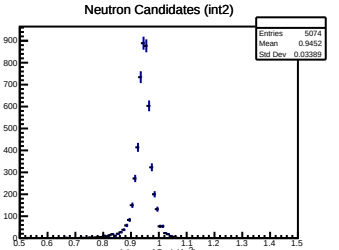

Neutron Candidates (int2)
Entries 565
Mean 0.9271
Std Dev 0.0408
M_miss (GeV/c²)

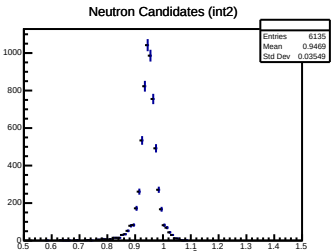

Neutron Candidates (int2)
Entries 1469
Mean 0.9347
Std Dev 0.04085
M_miss (GeV/c²)

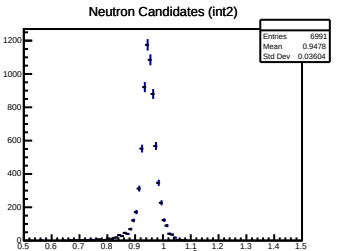

Neutron Candidates (int2)
Entries 2094
Mean 0.939
Std Dev 0.0377
M_miss (GeV/c²)

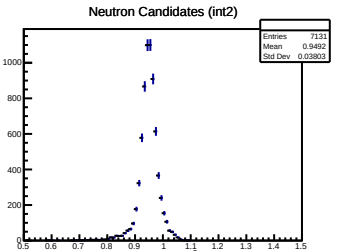

Neutron Candidates (int2)
Entries 2987
Mean 0.9424
Std Dev 0.03793
M_miss (GeV/c²)

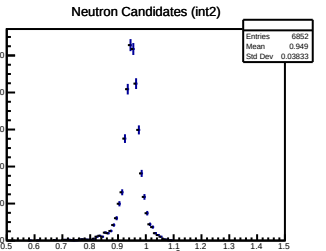

Neutron Candidates (int2)
Entries 4062
Mean 0.9458
Std Dev 0.03405
M_miss (GeV/c²)

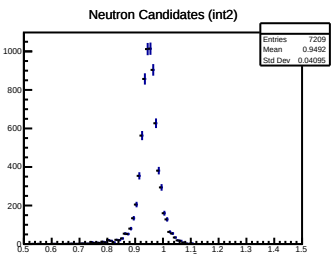

Neutron Candidates (int2)
Entries 5074
Mean 0.9452
Std Dev 0.03389
M_miss (GeV/c²)

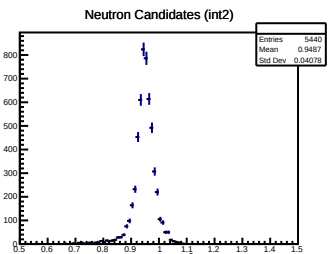

Neutron Candidates (int2)
Entries 6135
Mean 0.9469
Std Dev 0.03549
M_miss (GeV/c²)

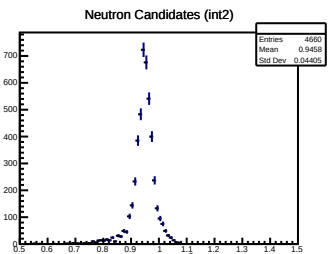

Neutron Candidates (int2)
Entries 6991
Mean 0.9478
Std Dev 0.03604
M_miss (GeV/c²)

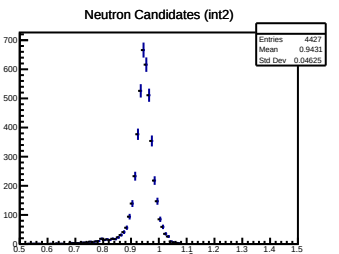

Neutron Candidates (int2)
Entries 7131
Mean 0.9492
Std Dev 0.03803
M_miss (GeV/c²)

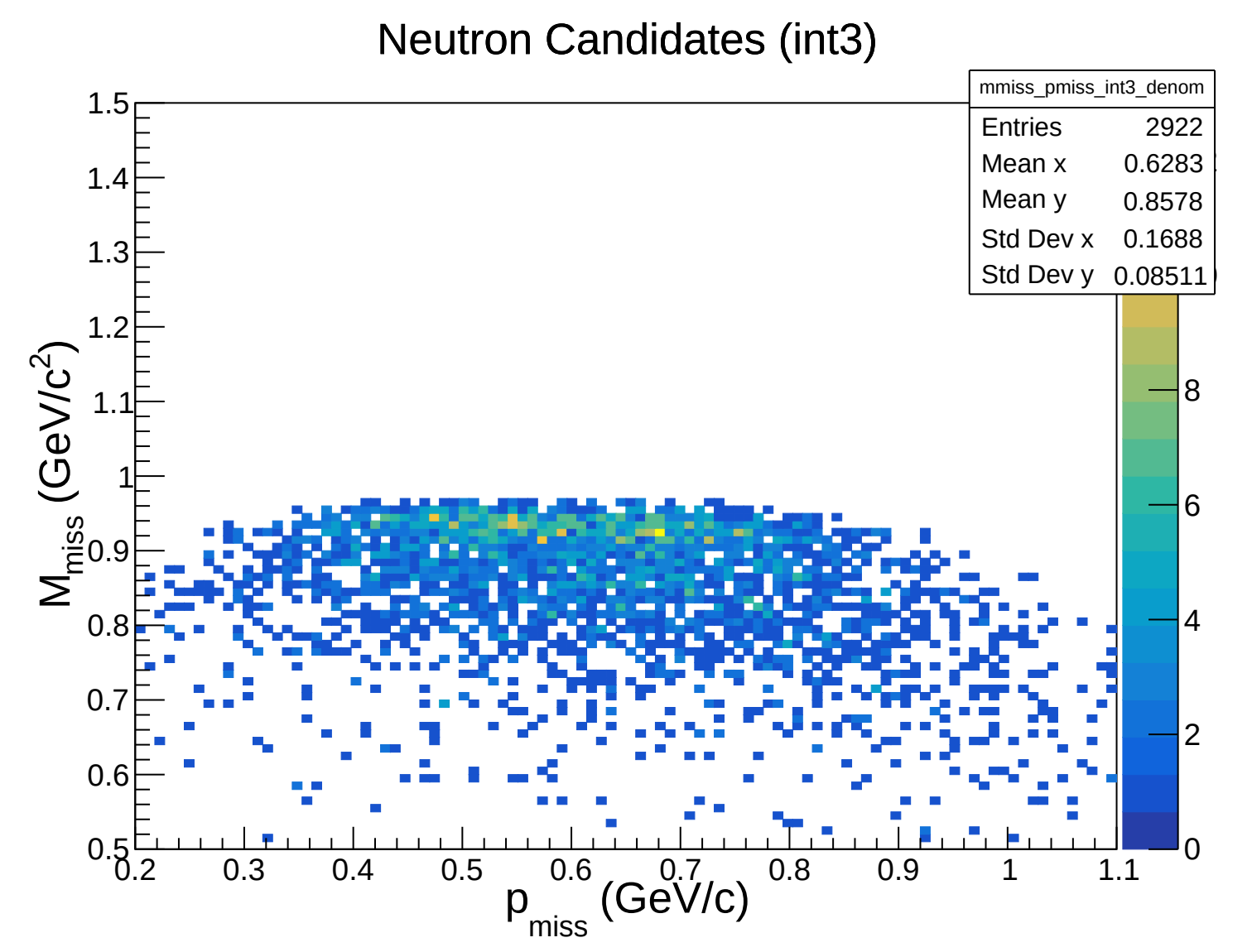

Neutron Candidates (int2)
Entries 6852
Mean 0.949
Std Dev 0.03833
M_miss (GeV/c²)

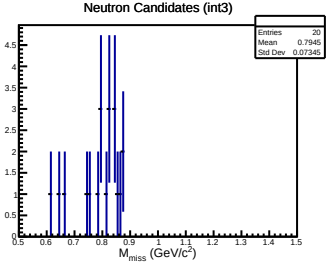

Neutron Candidates (int2)
Entries 7209
Mean 0.9492
Std Dev 0.04095
M_miss (GeV/c²)

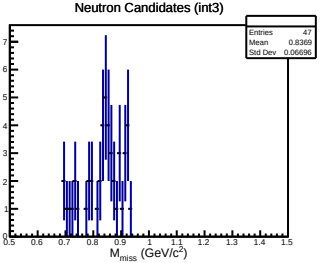

Neutron Candidates (int2)
Entries 5440
Mean 0.9487
Std Dev 0.04078
M_miss (GeV/c²)

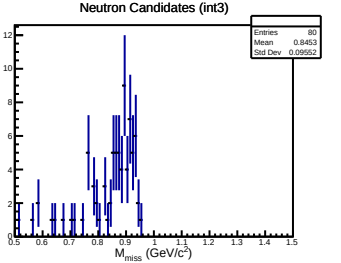

Neutron Candidates (int2)
Entries 4660
Mean 0.9458
Std Dev 0.04405
M_miss (GeV/c²)

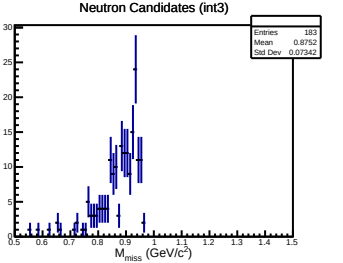

Neutron Candidates (int2)
Entries 4427
Mean 0.9431
Std Dev 0.04625
M_miss (GeV/c²)

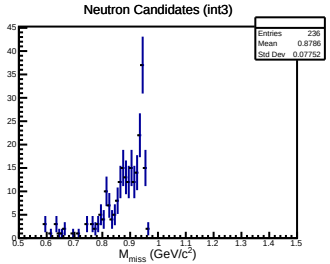

Neutron Candidates (int3)
mmiss_pmiss_int3_denom
Entries 2922
Mean x 0.6283
Mean y 0.8578
Std Dev x 0.1688
Std Dev y 0.08511
M_miss (GeV/c^2)
p_miss (GeV/c)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
8
6
4
2
0

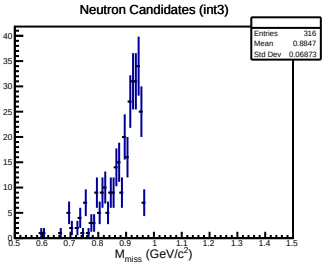

Neutron Candidates (int3)
Entries 20
Mean 0.7945
Std Dev 0.07345
M_miss (GeV/c²)

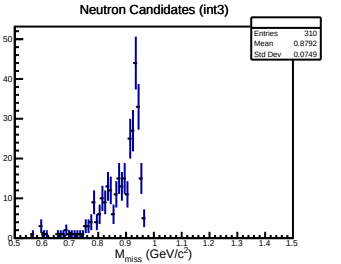

Neutron Candidates (int3)
Entries 47
Mean 0.8369
Std Dev 0.06696
M_miss (GeV/c²)

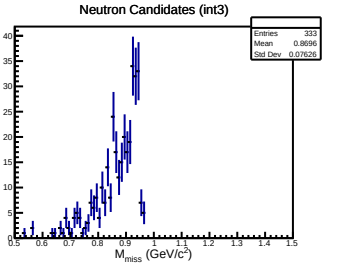

Neutron Candidates (int3)
Entries 80
Mean 0.8453
Std Dev 0.09552
M_miss (GeV/c²)

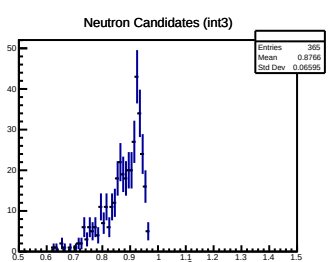

Neutron Candidates (int3)
Entries 183
Mean 0.8752
Std Dev 0.07342
M_miss (GeV/c²)

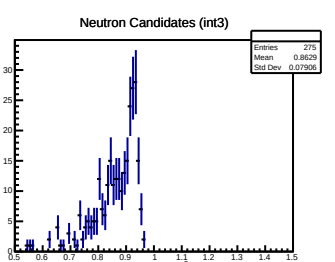

Neutron Candidates (int3)
Entries 236
Mean 0.8786
Std Dev 0.07752
M_miss (GeV/c²)

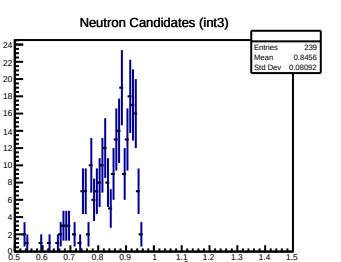

Neutron Candidates (int3)
Entries 316
Mean 0.8847
Std Dev 0.06873
M_miss (GeV/c²)

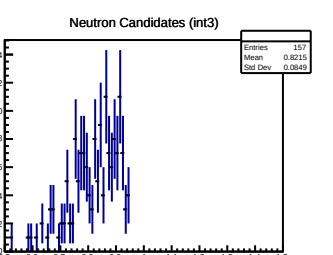

Neutron Candidates (int3)
Entries 310
Mean 0.8792
Std Dev 0.0749
M_miss (GeV/c²)

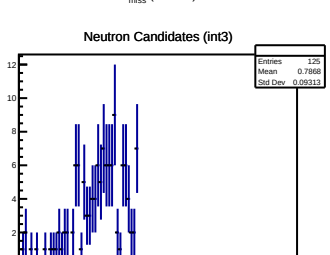

Neutron Candidates (int3)
Entries 333
Mean 0.8696
Std Dev 0.07626
M_miss (GeV/c²)

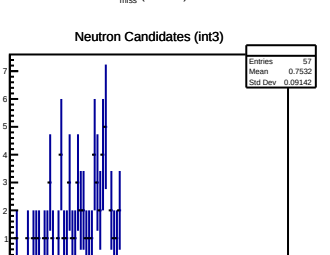

Neutron Candidates (int3)
Entries 365
Mean 0.8766
Std Dev 0.06595
M_miss (GeV/c²)

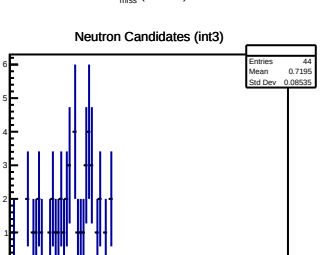

Neutron Candidates (int3)
Entries 275
Mean 0.8629
Std Dev 0.07906
M_miss (GeV/c²)

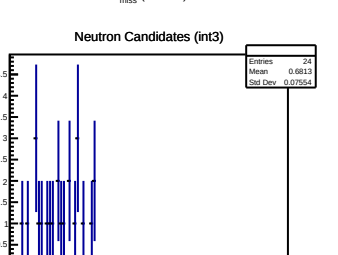

Neutron Candidates (int3)
Entries 239
Mean 0.8456
Std Dev 0.08092
M_miss (GeV/c²)

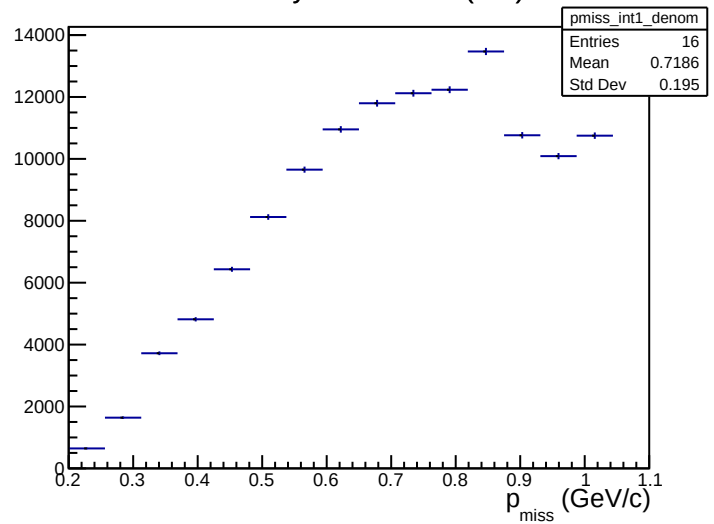

Neutron Candidates (int3)
Entries 157
Mean 0.8215
Std Dev 0.0849
M_miss (GeV/c²)

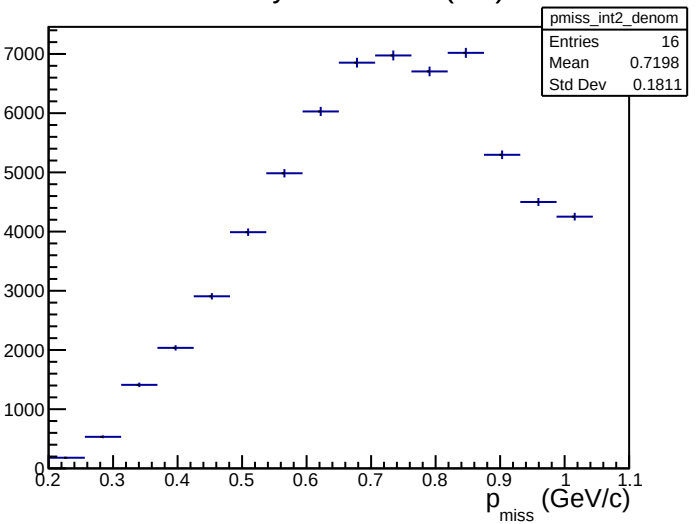

Neutron Candidates (int3)
Entries 125
Mean 0.7868
Std Dev 0.09313
M_miss (GeV/c²)

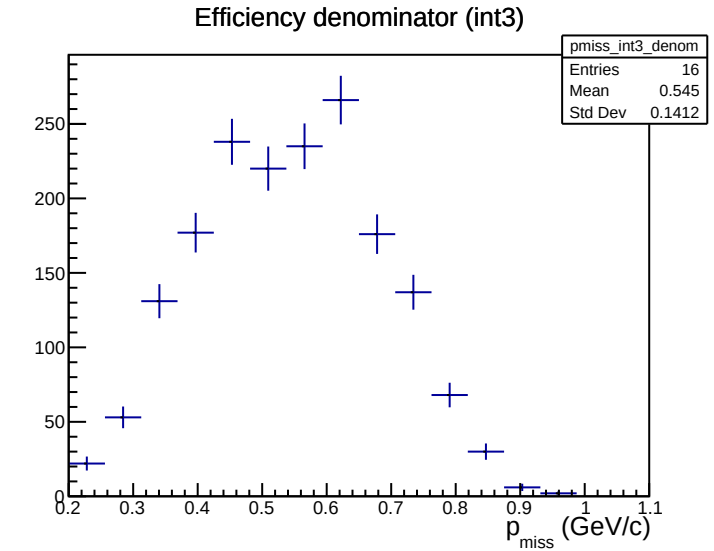

Neutron Candidates (int3)
Entries 57
Mean 0.7532
Std Dev 0.09142
M_miss (GeV/c²)


Neutron Candidates (int3)
Entries 44
Mean 0.7195
Std Dev 0.08535
M_miss (GeV/c²)


Neutron Candidates (int3)
Entries 24
Mean 0.6813
Std Dev 0.07554
M_miss (GeV/c²)

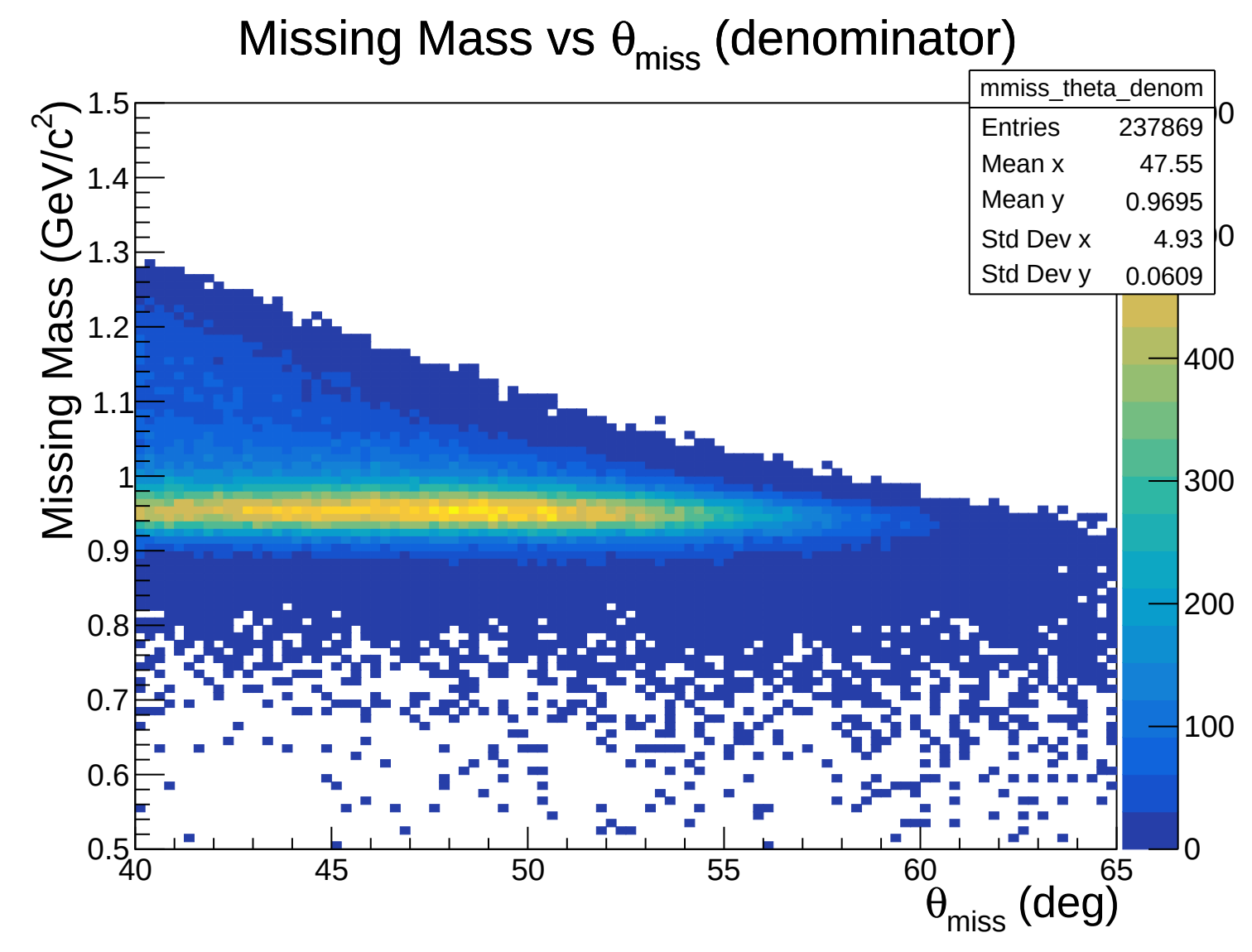

Efficiency denominator (int1)
pmiss_int1_denom
Entries 16
Mean 0.7186
Std Dev 0.195
14000
12000
10000
8000
6000
4000
2000
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
p_miss (GeV/c)

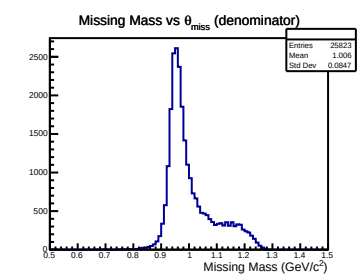

Efficiency denominator (int2)
pmiss_int2_denom
Entries 16
Mean 0.7198
Std Dev 0.1811
7000
6000
5000
4000
3000
2000
1000
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
p_miss (GeV/c)

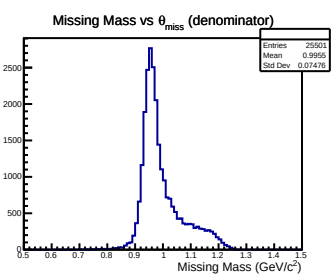

Efficiency denominator (int3)
pmiss_int3_denom
Entries 16
Mean 0.545
Std Dev 0.1412
250
200
150
100
50
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
p_miss (GeV/c)

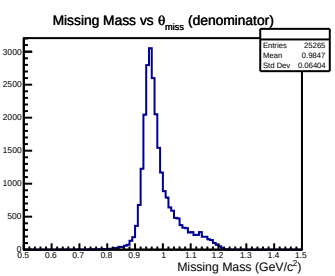
Get n_{eff} vs θ (denominator)

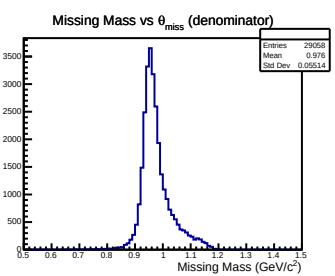
Theta denominator

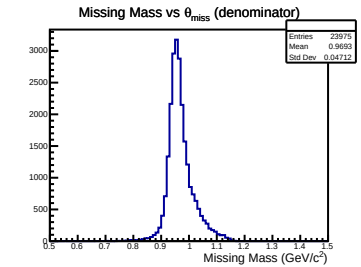

Missing Mass vs θmiss (denominator)
mmiss_theta_denom
Entries 237869
Mean x 47.55
Mean y 0.9695
Std Dev x 4.93
Std Dev y 0.0609
Missing Mass (GeV/c2)
θmiss (deg)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
40
45
50
55
60
65
400
300
200
100
0

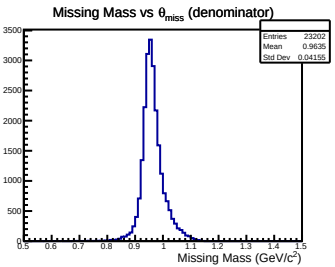

Missing Mass vs θmiss (denominator)
Entries 25823
Mean 1.006
Std Dev 0.0847
Missing Mass (GeV/c²)

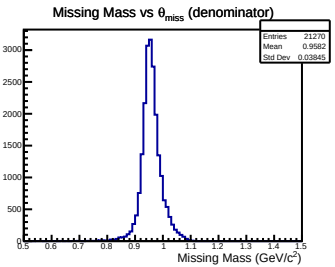

Missing Mass vs θmiss (denominator)
Entries 25501
Mean 0.9955
Std Dev 0.07476
Missing Mass (GeV/c²)

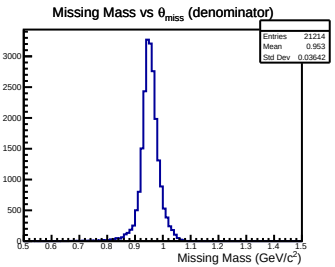

Missing Mass vs θmiss (denominator)
Entries 25265
Mean 0.9847
Std Dev 0.06404
Missing Mass (GeV/c²)

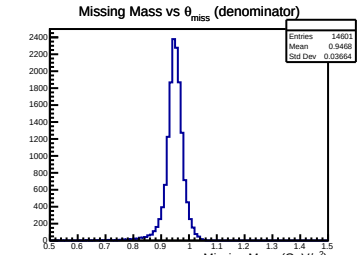

Missing Mass vs θmiss (denominator)
Entries 25058
Mean 0.976
Std Dev 0.05514
Missing Mass (GeV/c²)

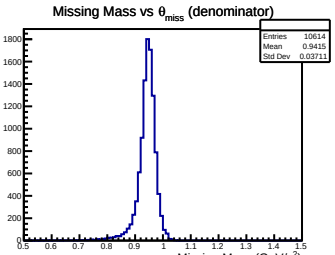

Missing Mass vs θmiss (denominator)
Entries 23975
Mean 0.9693
Std Dev 0.04712
Missing Mass (GeV/c²)

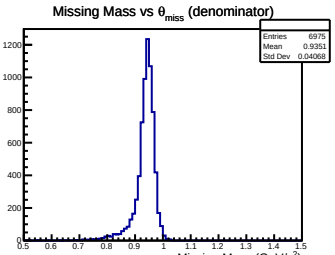

Missing Mass vs θmiss (denominator)
Entries 23202
Mean 0.9635
Std Dev 0.04155
Missing Mass (GeV/c²)

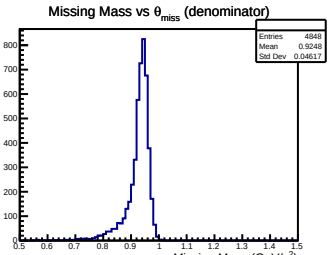

Missing Mass vs θmiss (denominator)
Entries 21270
Mean 0.9582
Std Dev 0.03845
Missing Mass (GeV/c²)

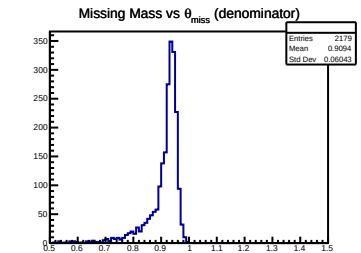

Missing Mass vs θmiss (denominator)
Entries 21214
Mean 0.953
Std Dev 0.03642
Missing Mass (GeV/c²)

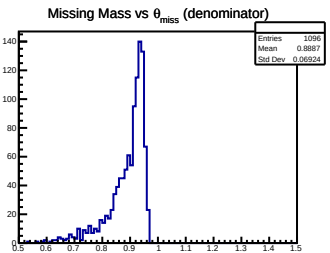

Missing Mass vs θmiss (denominator)
Entries 14601
Mean 0.9468
Std Dev 0.03664
Missing Mass (GeV/c²)

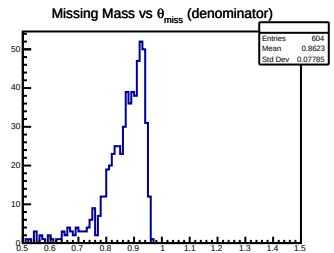

Missing Mass vs θmiss (denominator)
Entries 10614
Mean 0.9415
Std Dev 0.03711
Missing Mass (GeV/c²)

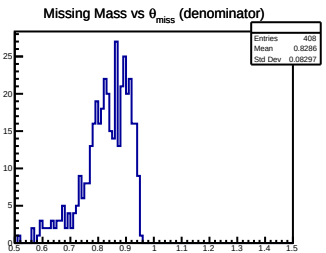

Missing Mass vs θmiss (denominator)
Entries 6975
Mean 0.9351
Std Dev 0.04068
Missing Mass (GeV/c²)


Missing Mass vs θmiss (denominator)
Entries 4848
Mean 0.9248
Std Dev 0.04617
Missing Mass (GeV/c²)

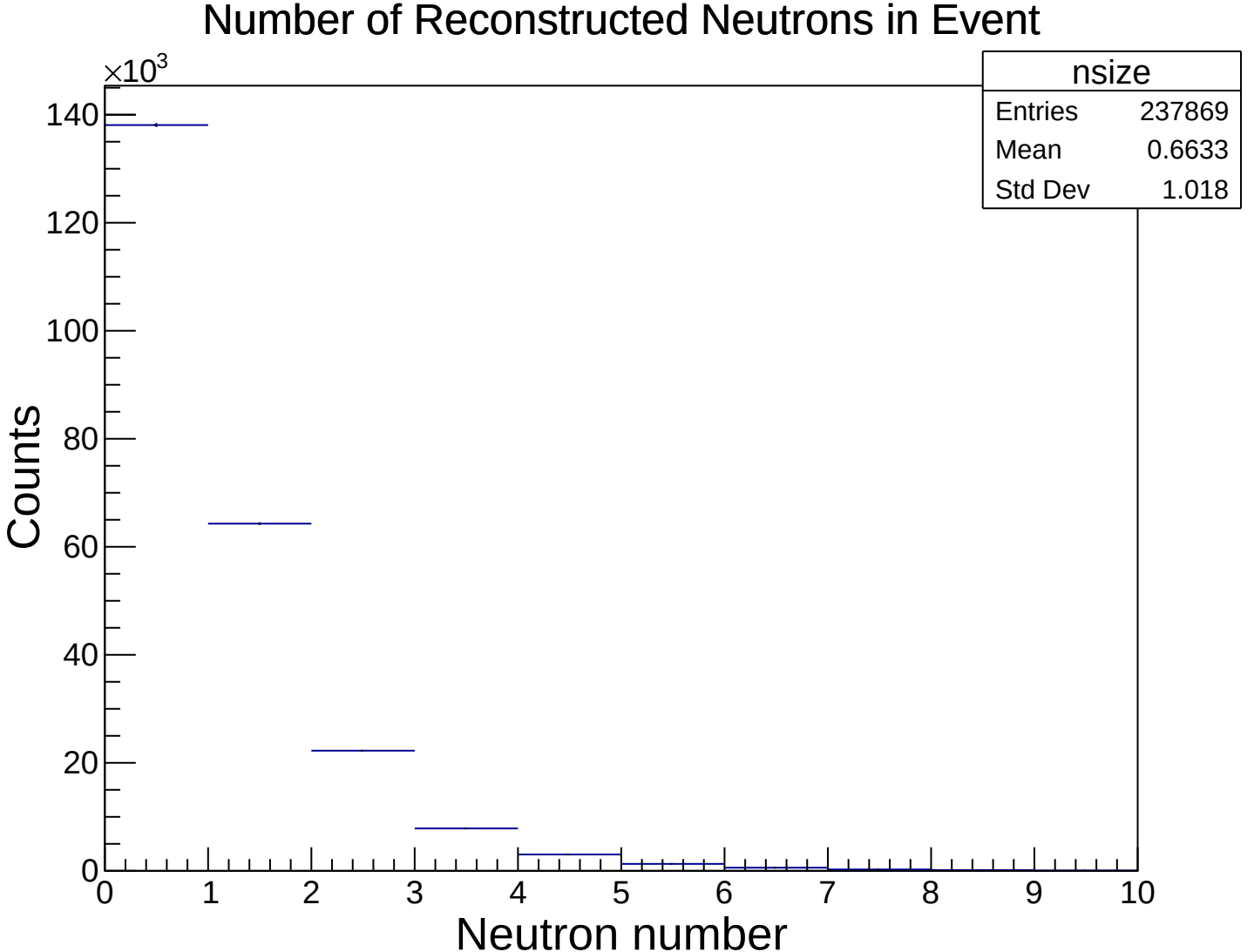

Missing Mass vs θmiss (denominator)
Entries 2179
Mean 0.9094
Std Dev 0.06043
Missing Mass (GeV/c²)


Missing Mass vs θmiss (denominator)
Entries 1096
Mean 0.8887
Std Dev 0.06924
Missing Mass (GeV/c²)


Missing Mass vs θmiss (denominator)
Entries 604
Mean 0.8623
Std Dev 0.07785
Missing Mass (GeV/c²)


Missing Mass vs θmiss (denominator)
Entries 408
Mean 0.8286
Std Dev 0.08297
Missing Mass (GeV/c²)

p(e,e'π^+n)


Number of Reconstructed Neutrons in Event
nsize
Entries 237869
Mean 0.6633
Std Dev 1.018
×10^3
140
120
100
80
60
40
20
0
Counts
0
1
2
3
4
5
6
7
8
9
10
Neutron number

Basic electron cuts

Hydrogen run 015017

p(e,e'π^+)n

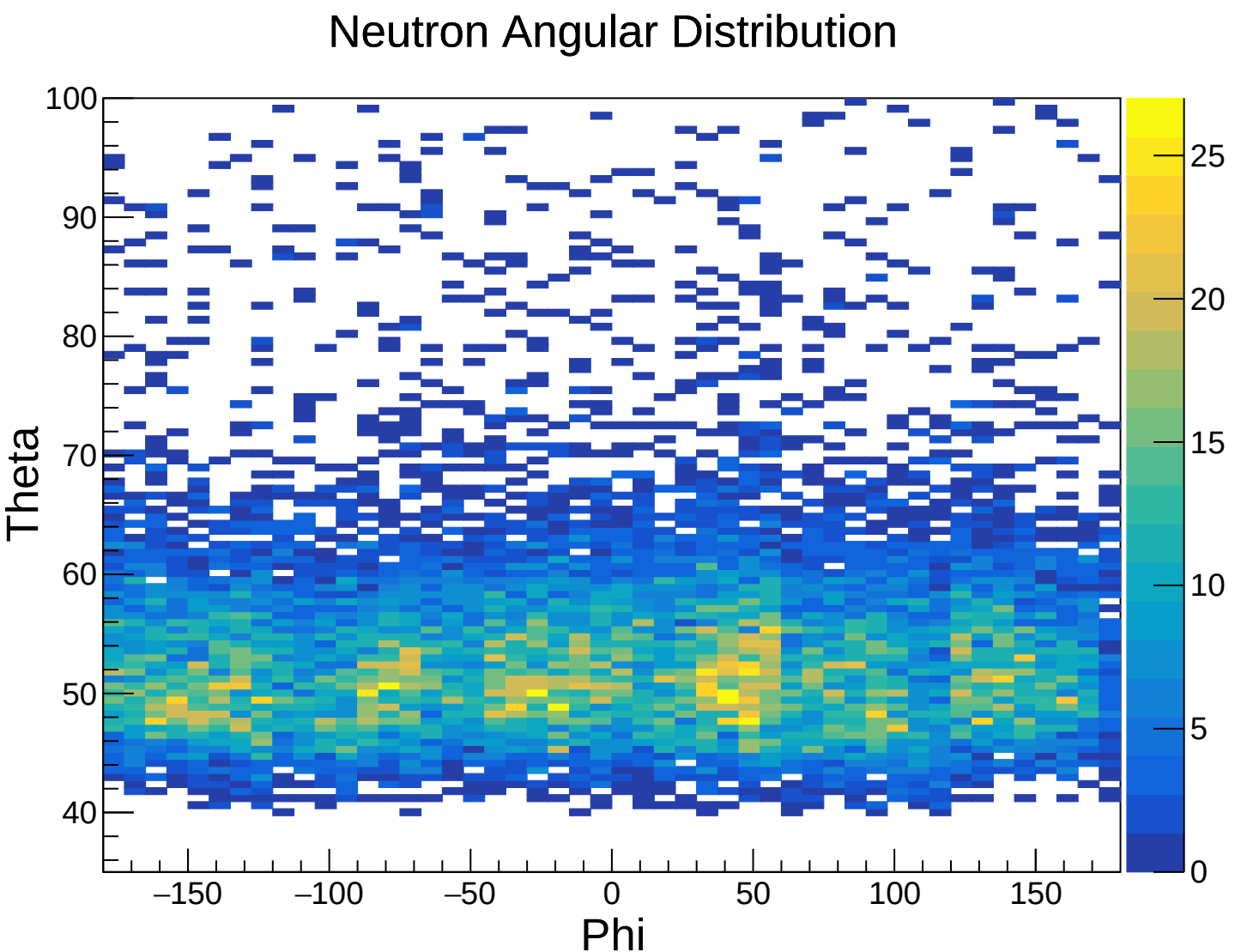
pion cuts

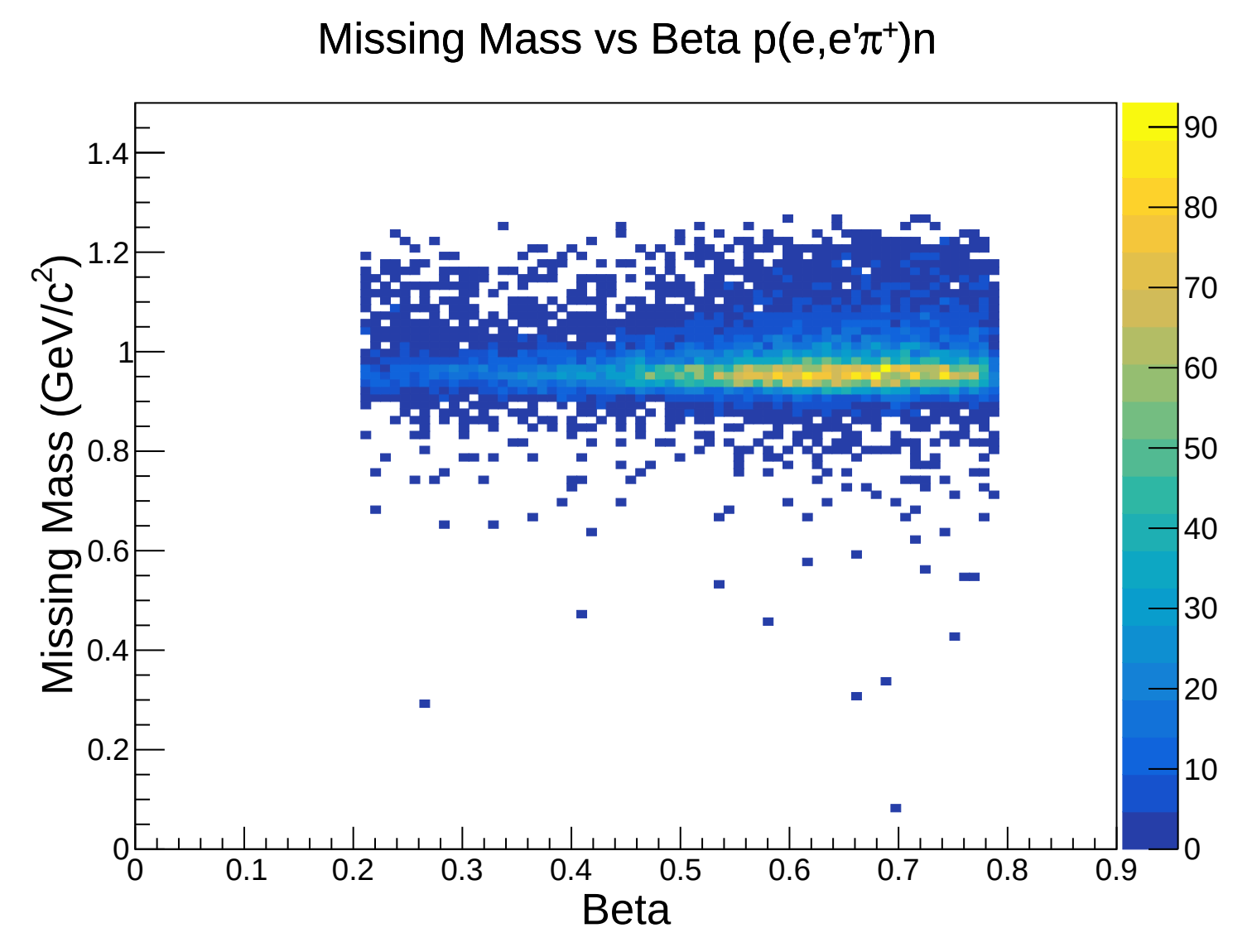
p_{miss}, M_{miss} cuts

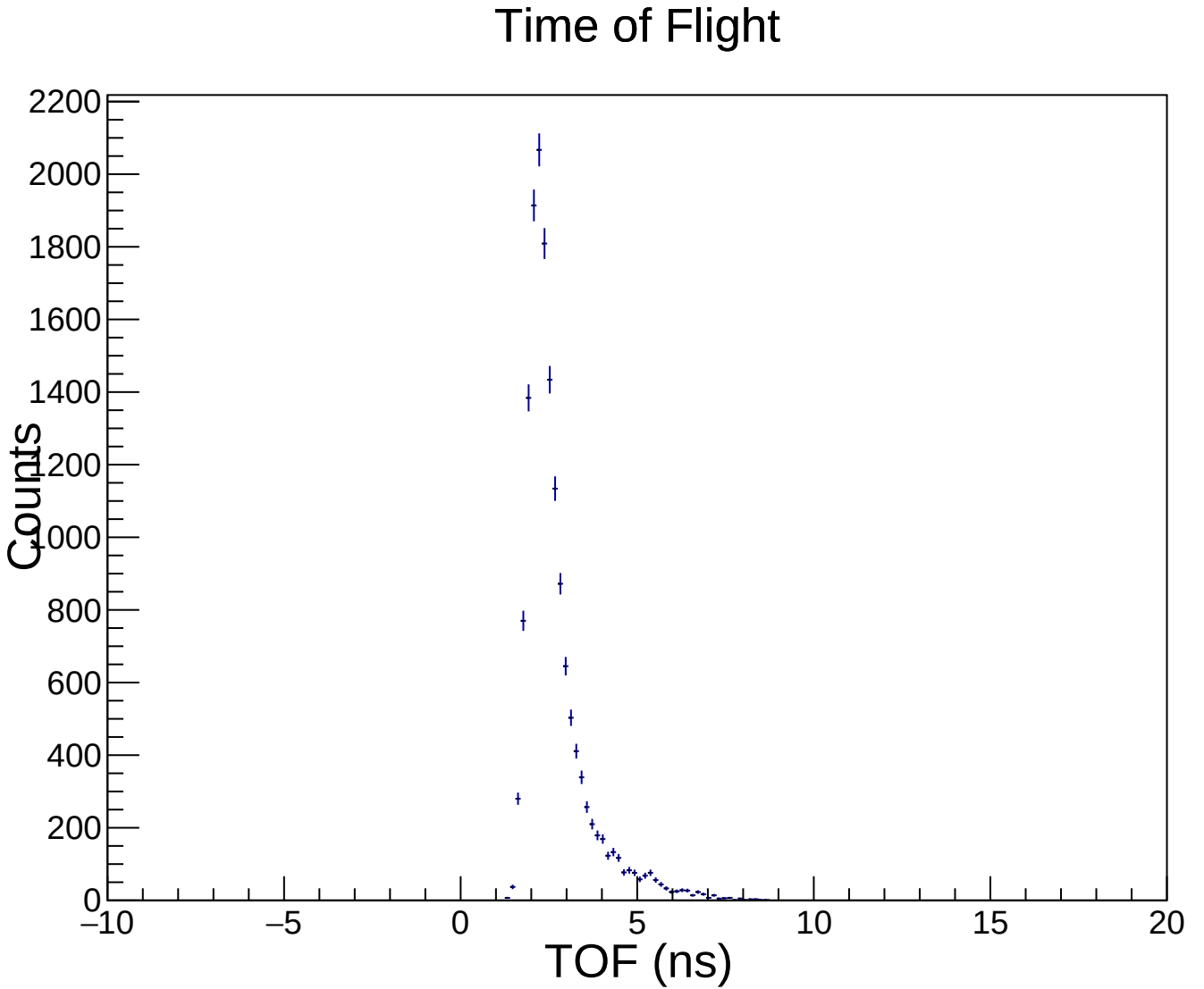
Require at least 1 neutron in CND

Neutron in at least 1 lever of CND

Pick neutron closest to p_{miss} in ϕ


Neutron Angular Distribution
Theta
Phi
100
90
80
70
60
50
40
–150
–100
–50
0
50
100
150
25
20
15
10
5
0


Missing Mass vs Beta p(e,e'π+)n
Missing Mass (GeV/c2)
Beta
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0.1
0.3
0.5
0.7
0.9
10
20
30
40
50
60
70
80
90


Time of Flight
Counts
TOF (ns)
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
–10
–5
0
5
10
15
20

Basic electron cuts

Hydrogen run 015017

p(e,e'π^+)n

pion cuts

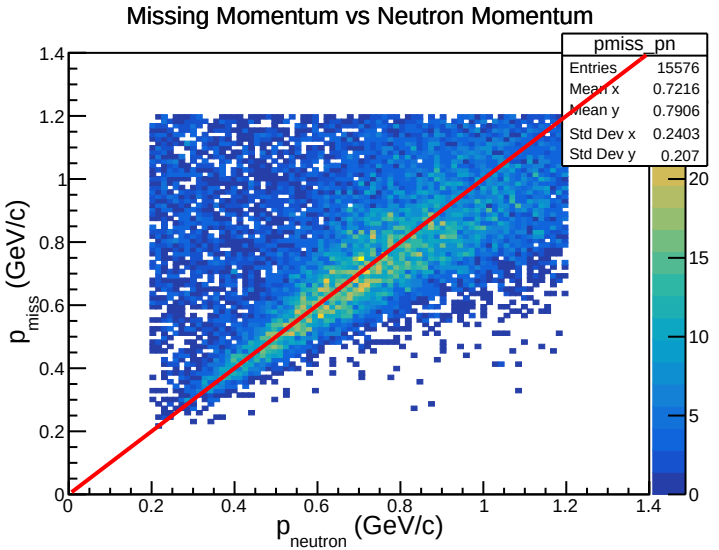
p_{miss}, M_{miss} cuts

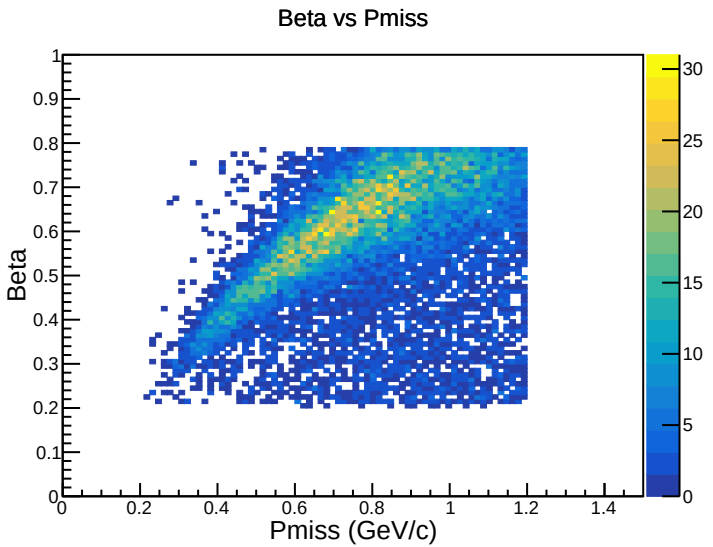
Require 1 neutron in CND

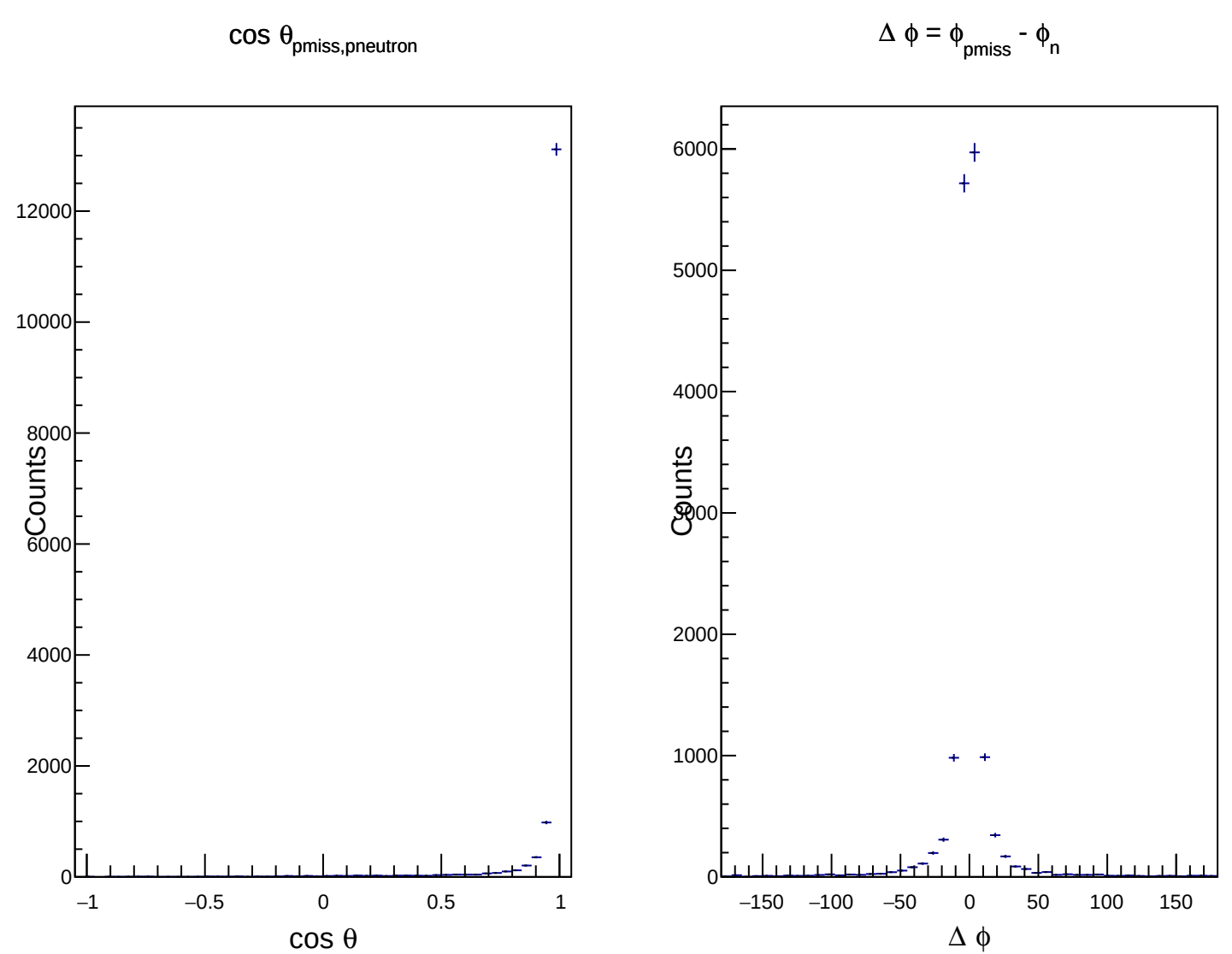
exclude θ_n=0, ϕ_n=0

40 deg < θ_n < 140 deg

0.1 < β_n < 0.8


Missing Momentum vs Neutron Momentum
pmiss_pn
Entries 15576
Mean x 0.7216
Mean y 0.7906
Std Dev x 0.2403
Std Dev y 0.207
p_miss (GeV/c)
p_neutron (GeV/c)


Beta vs Pmiss
Beta
Pmiss (GeV/c)


cos θ pmiss,pneutron
Counts
cos θ
Δ ϕ = ϕ pmiss - ϕ n
Counts
Δ ϕ

Basic electron cuts

Hydrogen run 015017

p(e,e'π^+)n

pion cuts

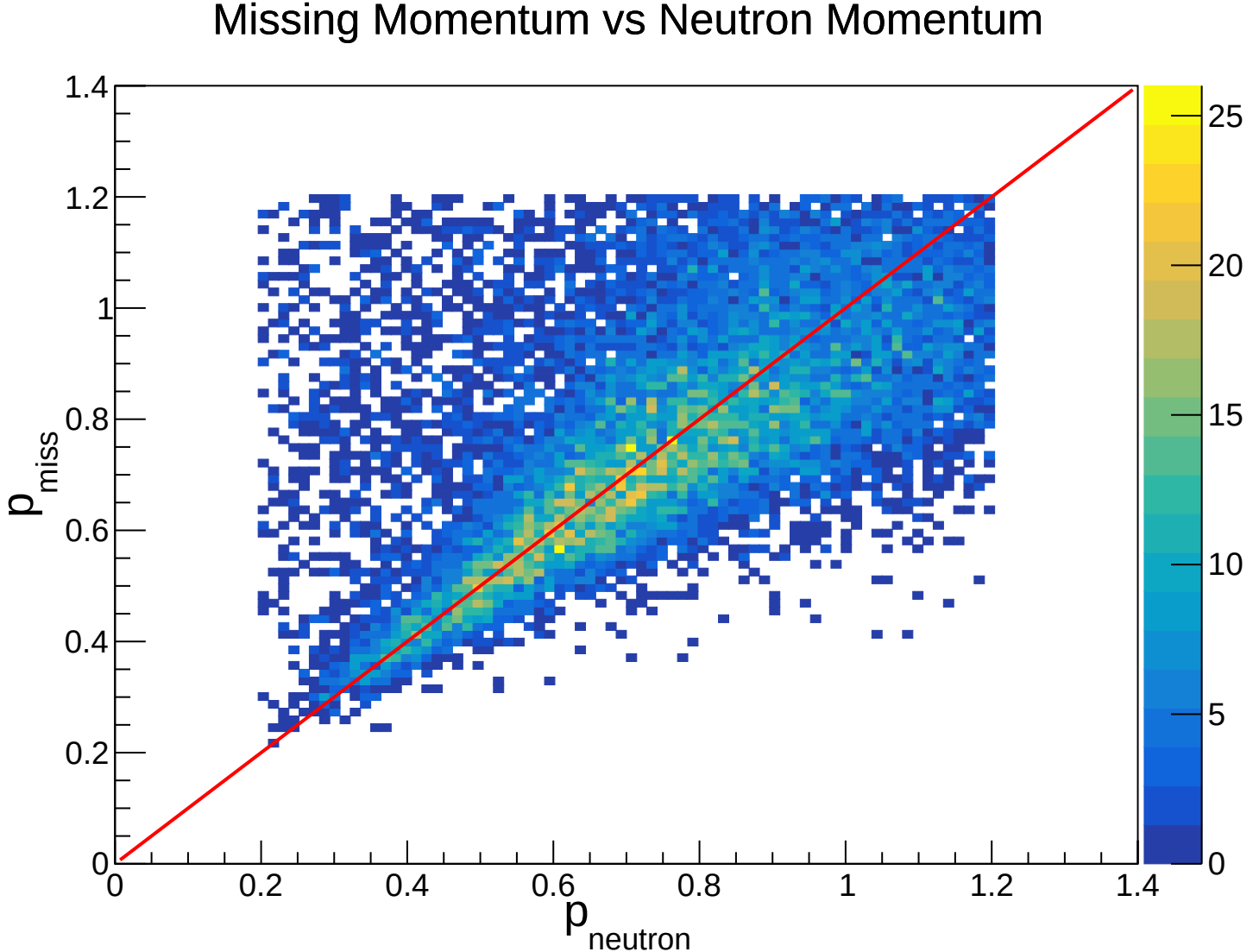
p_{miss}, M_{miss} cuts

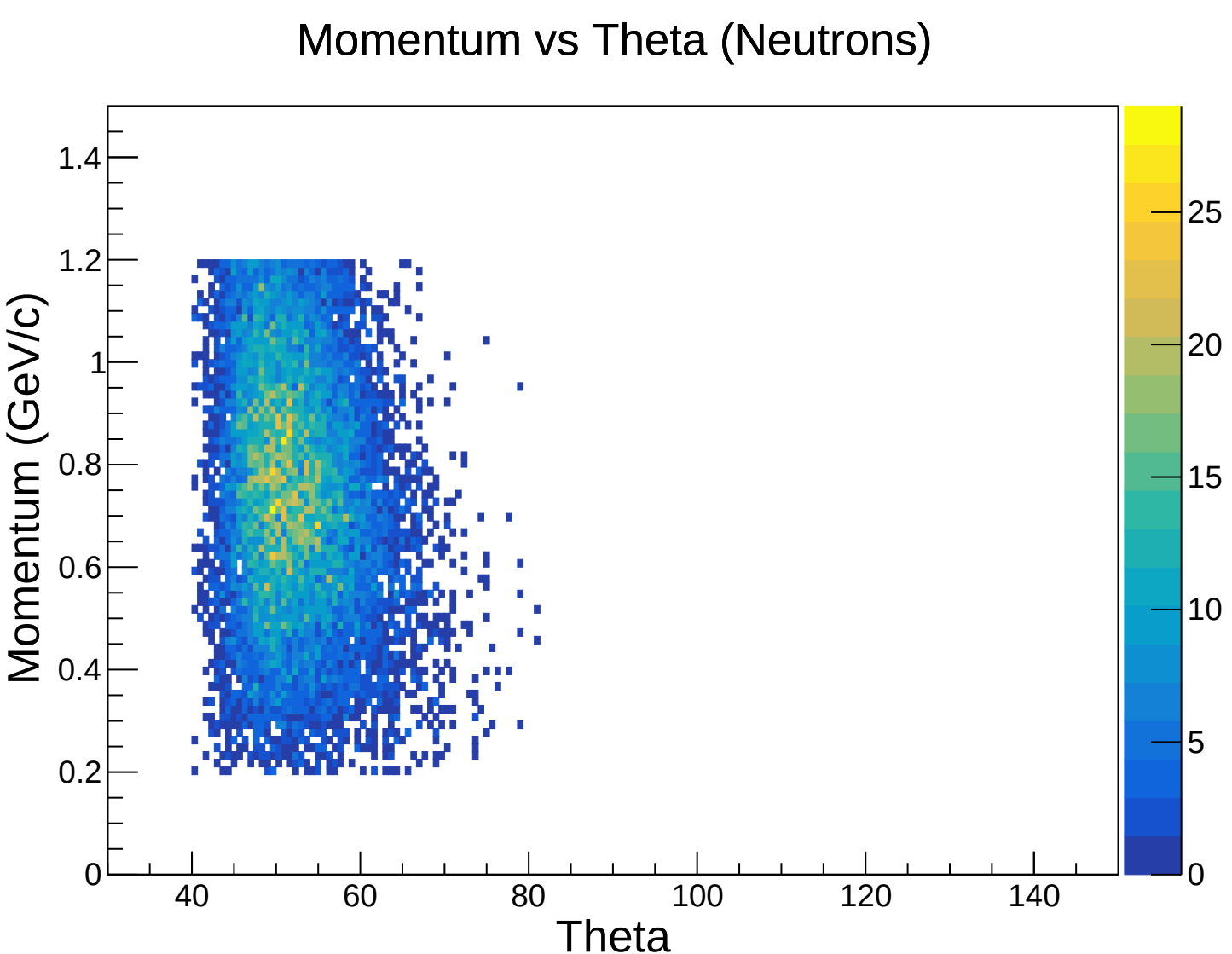
exclude θ_n=0, ϕ_n=0

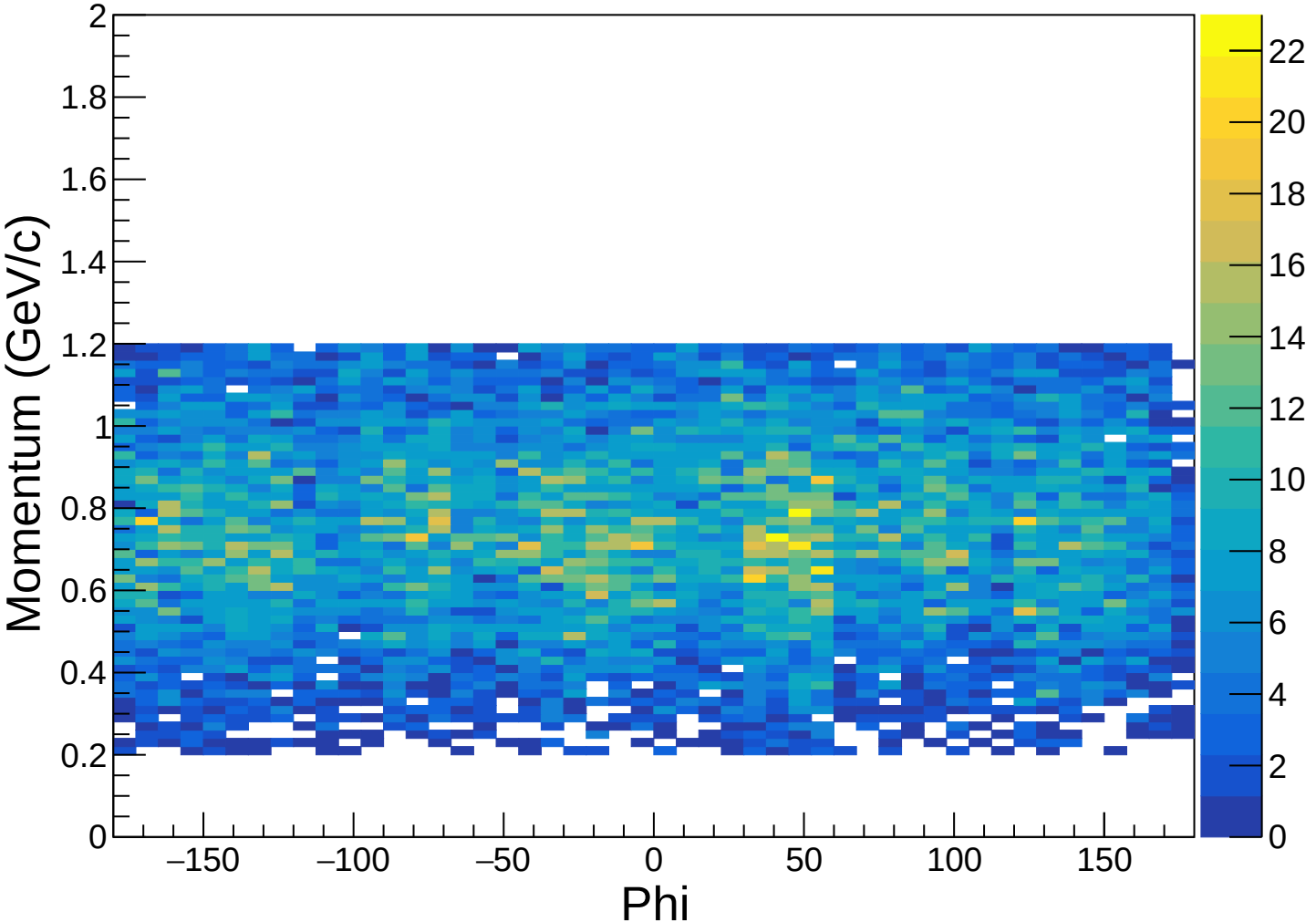
40 deg < θ_n < 140 deg

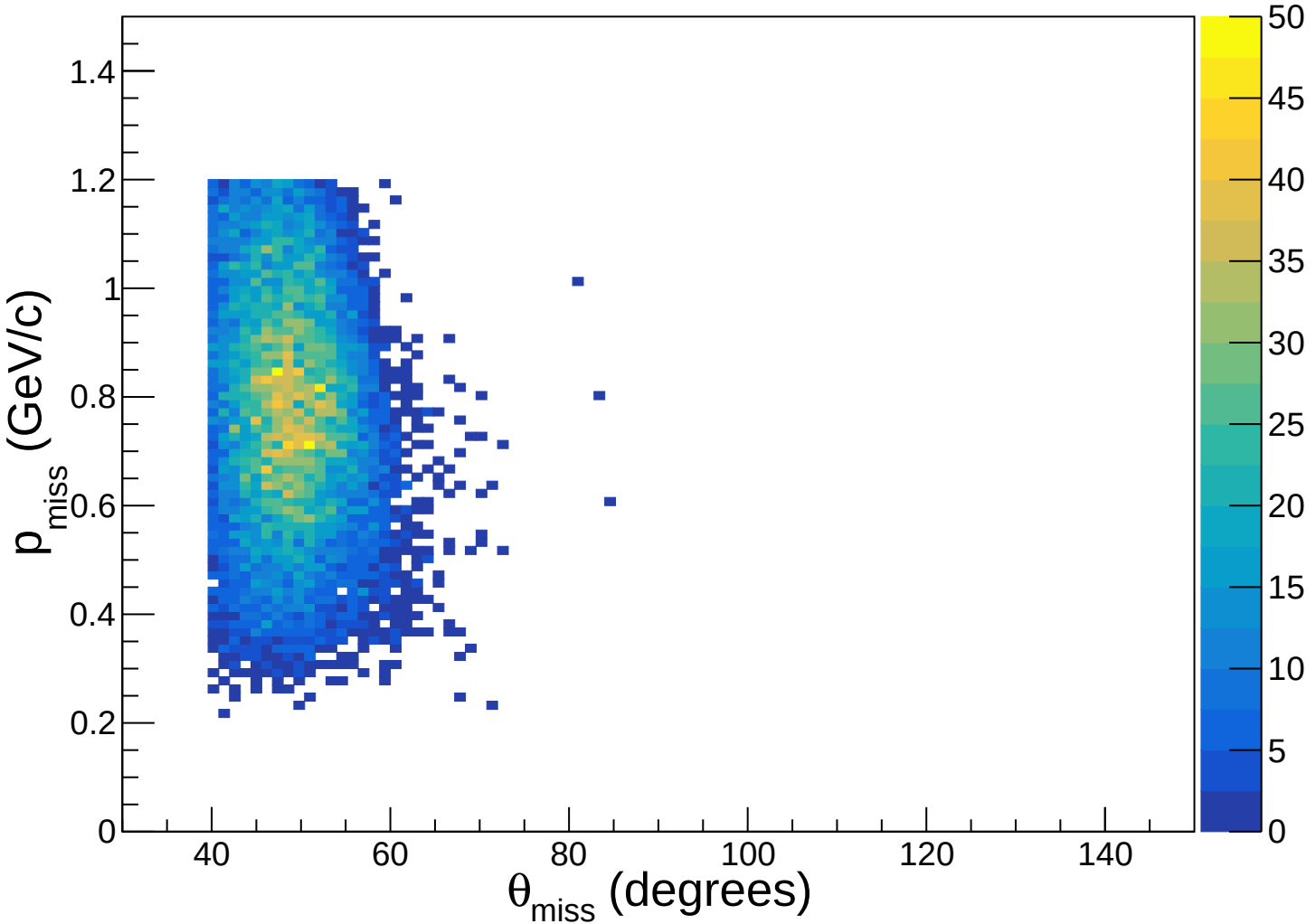
0.1 < β_n < 0.8

cos $\theta_{pmiss,pn}$ > 0.9

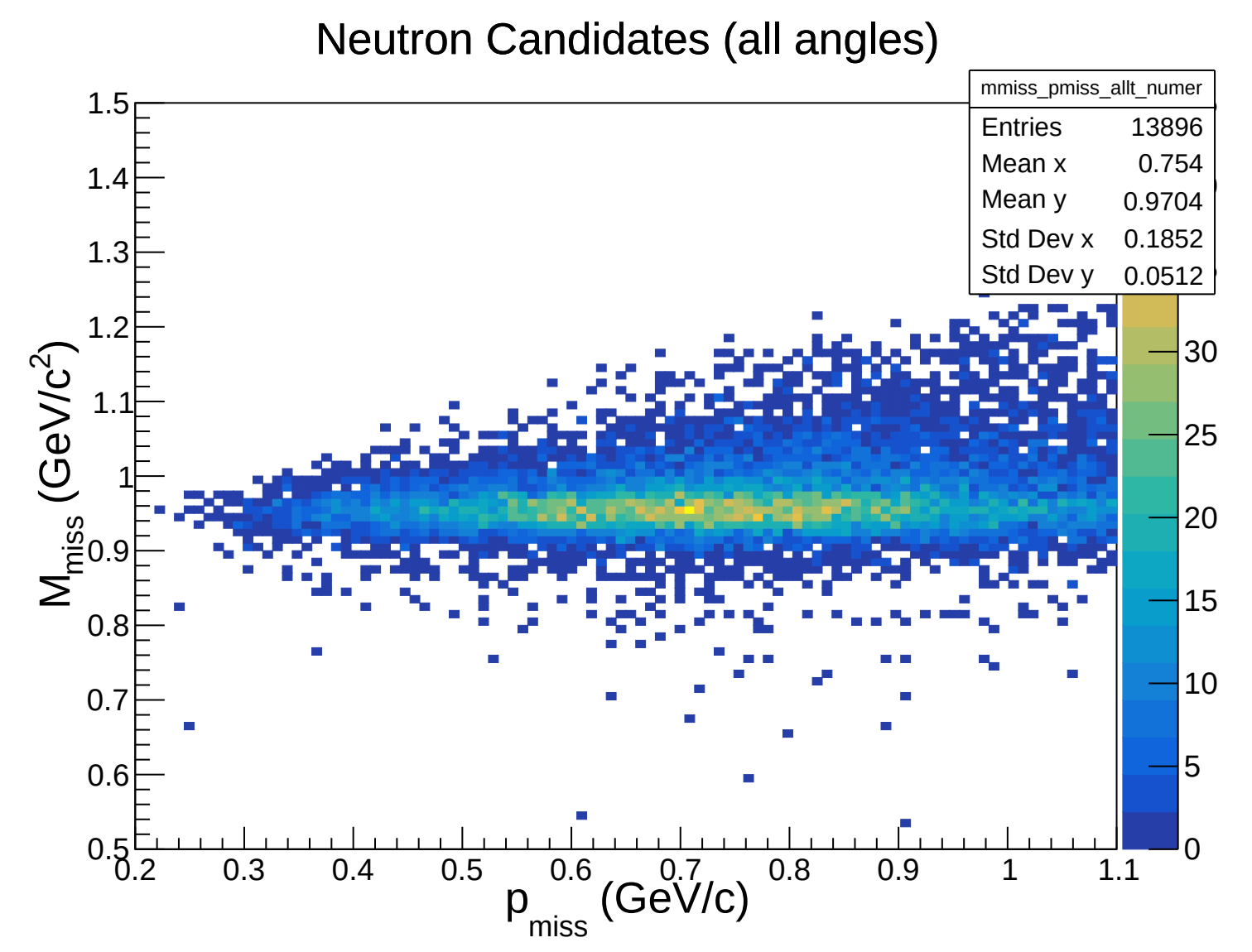

Missing Momentum vs Neutron Momentum
p miss
p neutron
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0
5
10
15
20
25

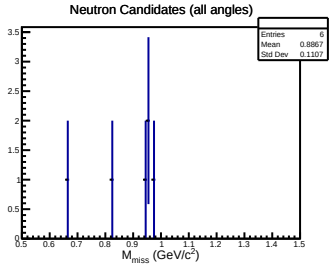

Momentum vs Theta (Neutrons)
Momentum (GeV/c)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
40
60
80
100
120
140
Theta
25
20
15
10
5
0

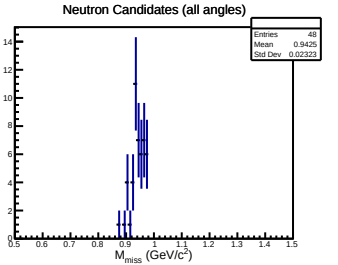

Momentum vs Phi (Neutrons)
Momentum (GeV/c)
Phi
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
–150
–100
–50
0
50
100
150
22
20
18
16
14
12
10
8
6
4
2
0

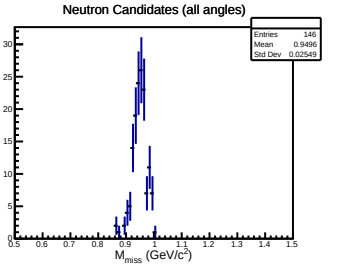

Missing Momentum vs p_{miss} Polar Angle
p_{miss} (GeV/c)
θ_{miss} (degrees)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
40
60
80
100
120
140
0
5
10
15
20
25
30
35
40
45
50

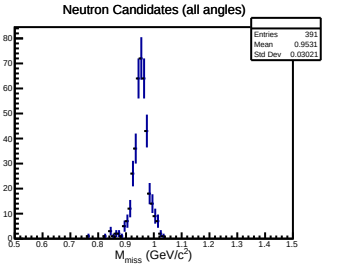
Get n_{eff} vs p (numerator)

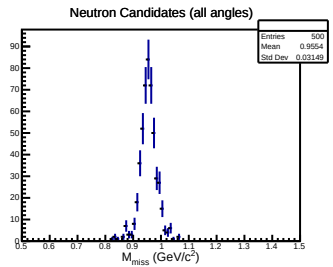

Neutron Candidates (all angles)
mmiss_pmiss_allt_numer
Entries 13896
Mean x 0.754
Mean y 0.9704
Std Dev x 0.1852
Std Dev y 0.0512
M_miss (GeV/c^2)
p_miss (GeV/c)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
30
25
20
15
10
5
0

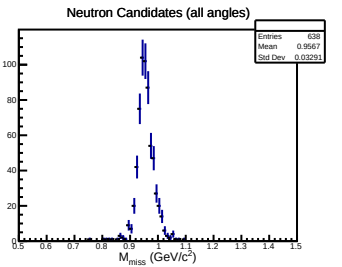

Neutron Candidates (all angles)
Entries 6
Mean 0.8867
Std Dev 0.1107
M_{miss} (GeV/c^2)

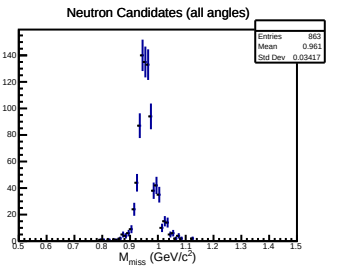

Neutron Candidates (all angles)
Entries 48
Mean 0.9426
Std Dev 0.02323
M_{miss} (GeV/c^2)

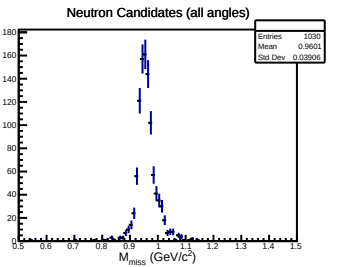

Neutron Candidates (all angles)
Entries 146
Mean 0.9496
Std Dev 0.02549
M_{miss} (GeV/c^2)

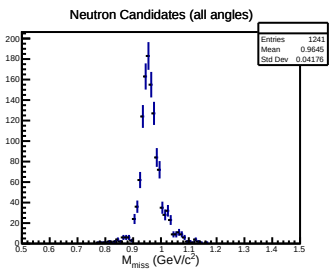

Neutron Candidates (all angles)
Entries 391
Mean 0.9531
Std Dev 0.03021
M_{miss} (GeV/c^2)

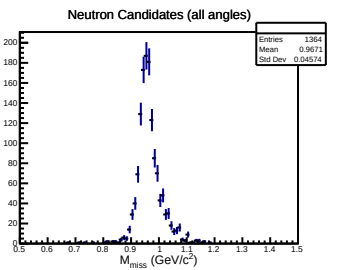

Neutron Candidates (all angles)
Entries 500
Mean 0.9554
Std Dev 0.03149
M_{miss} (GeV/c^2)

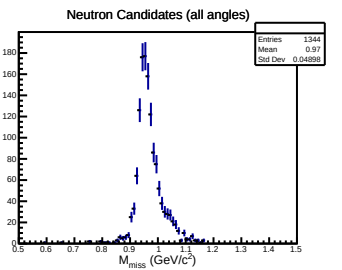

Neutron Candidates (all angles)
Entries 638
Mean 0.9567
Std Dev 0.03291
M_{miss} (GeV/c^2)

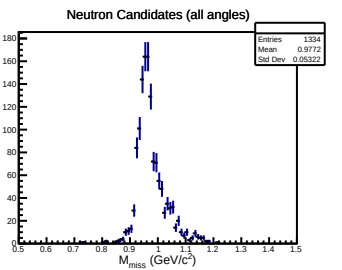

Neutron Candidates (all angles)
Entries 863
Mean 0.961
Std Dev 0.03417
M_{miss} (GeV/c^2)

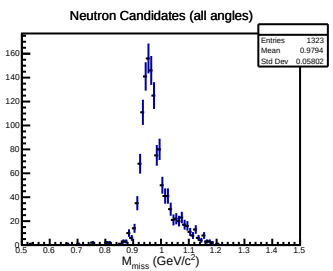

Neutron Candidates (all angles)
Entries 1030
Mean 0.9601
Std Dev 0.03906
M_{miss} (GeV/c^2)

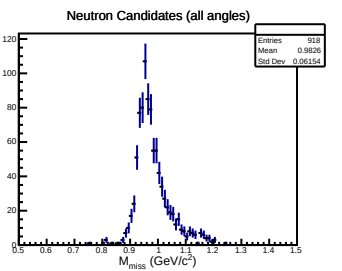

Neutron Candidates (all angles)
Entries 1241
Mean 0.9645
Std Dev 0.04176
M_{miss} (GeV/c^2)

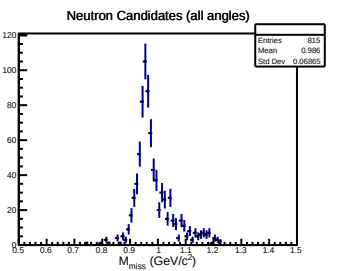

Neutron Candidates (all angles)
Entries 1364
Mean 0.9671
Std Dev 0.04574
M_{miss} (GeV/c^2)

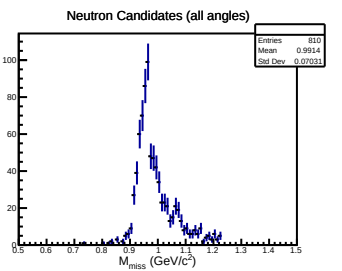

Neutron Candidates (all angles)
Entries 1344
Mean 0.97
Std Dev 0.04898
M_{miss} (GeV/c^2)

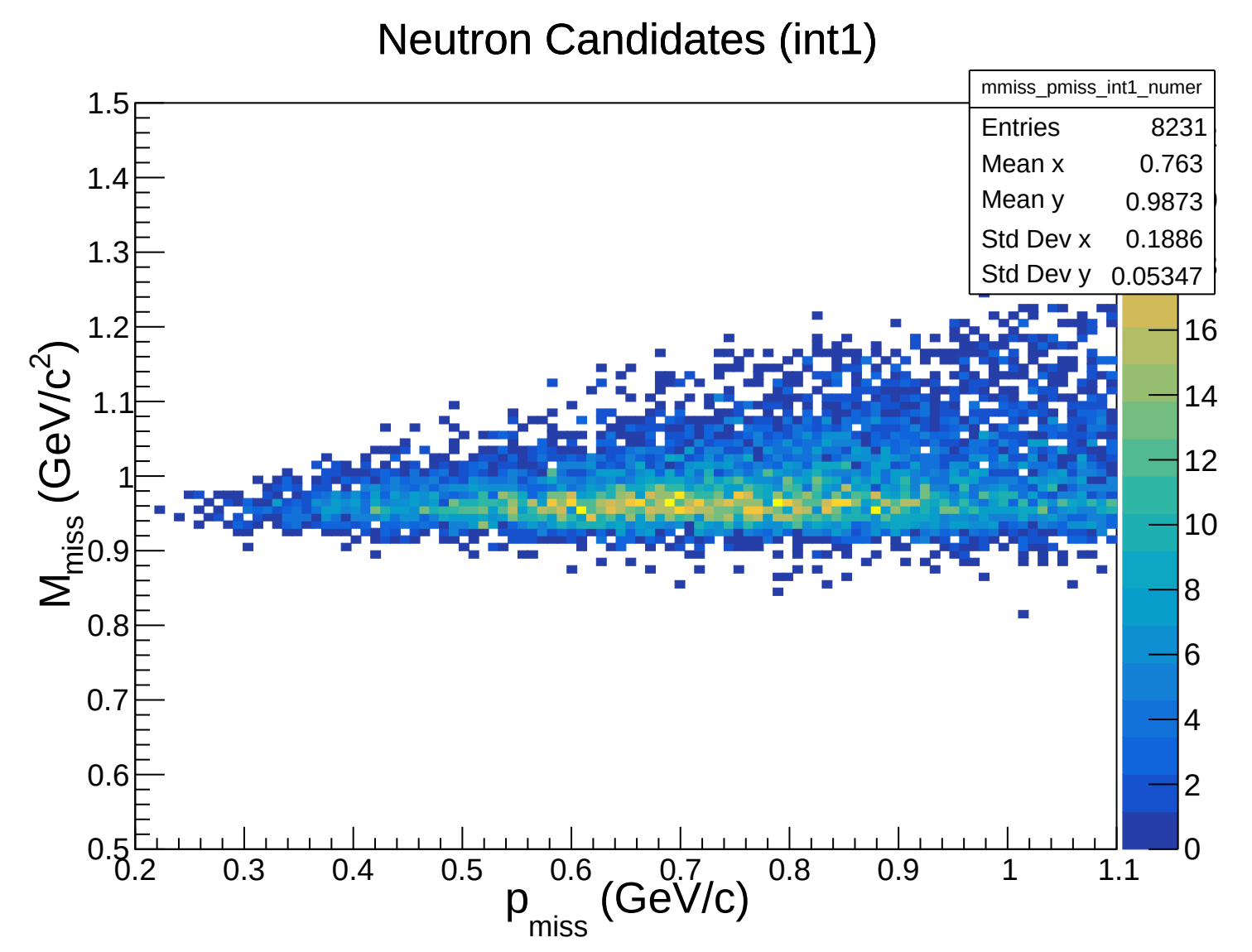

Neutron Candidates (all angles)
Entries 1334
Mean 0.9772
Std Dev 0.05222
M_{miss} (GeV/c^2)

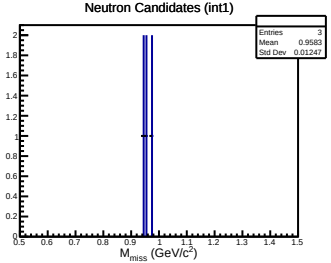

Neutron Candidates (all angles)
Entries 1323
Mean 0.9794
Std Dev 0.05802
M_{miss} (GeV/c^2)

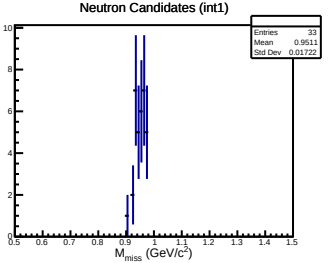

Neutron Candidates (all angles)
Entries 918
Mean 0.9826
Std Dev 0.06154
M_{miss} (GeV/c^2)

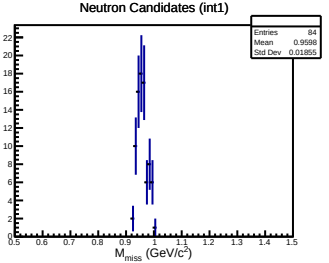

Neutron Candidates (all angles)
Entries 815
Mean 0.986
Std Dev 0.06865
M_{miss} (GeV/c^2)

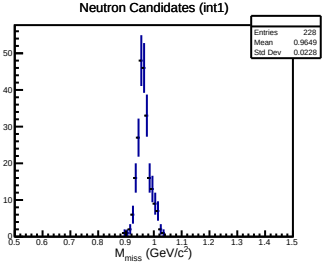

Neutron Candidates (all angles)
Entries 810
Mean 0.9914
Std Dev 0.07031
M_{miss} (GeV/c^2)

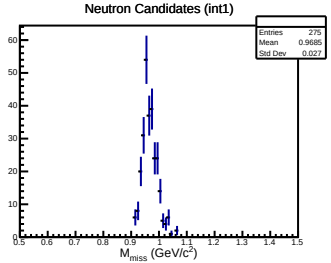

Neutron Candidates (int1)
mmiss_pmiss_int1_numer
Entries 8231
Mean x 0.763
Mean y 0.9873
Std Dev x 0.1886
Std Dev y 0.05347
M_miss (GeV/c^2)
p_miss (GeV/c)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
16
14
12
10
8
6
4
2
0

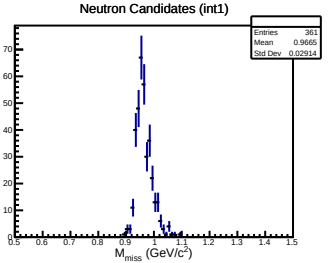

Neutron Candidates (int1)
Entries 3
Mean 0.9583
Std Dev 0.01247
M_miss (GeV/c²)

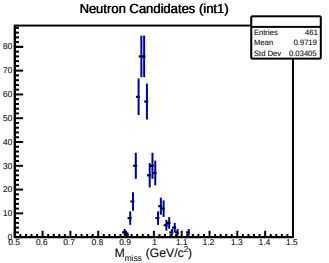

Neutron Candidates (int1)
Entries 33
Mean 0.9511
Std Dev 0.01722
M_miss (GeV/c²)

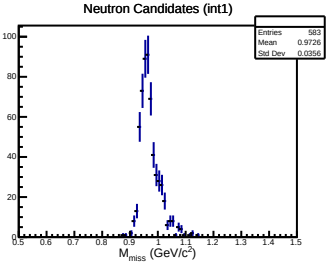

Neutron Candidates (int1)
Entries 84
Mean 0.9598
Std Dev 0.01855
M_miss (GeV/c²)

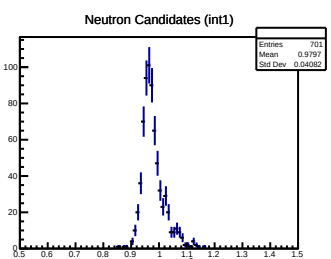

Neutron Candidates (int1)
Entries 228
Mean 0.9649
Std Dev 0.0228
M_miss (GeV/c²)

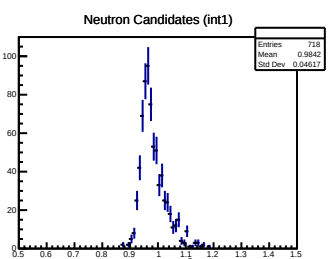

Neutron Candidates (int1)
Entries 275
Mean 0.9685
Std Dev 0.027
M_miss (GeV/c²)

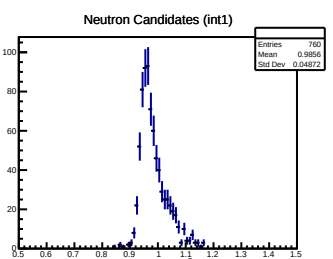

Neutron Candidates (int1)
Entries 361
Mean 0.9665
Std Dev 0.02914
M_miss (GeV/c²)

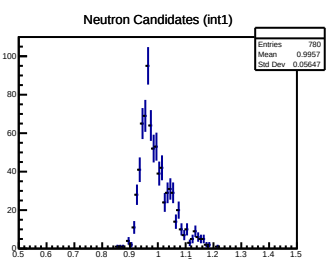

Neutron Candidates (int1)
Entries 461
Mean 0.9719
Std Dev 0.03405
M_miss (GeV/c²)

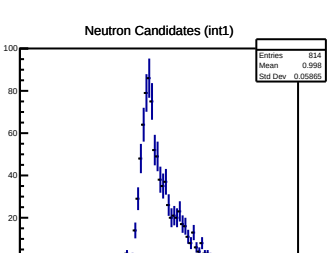

Neutron Candidates (int1)
Entries 583
Mean 0.9726
Std Dev 0.0356
M_miss (GeV/c²)

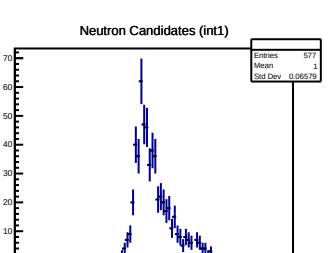

Neutron Candidates (int1)
Entries 701
Mean 0.9797
Std Dev 0.04082
M_miss (GeV/c²)

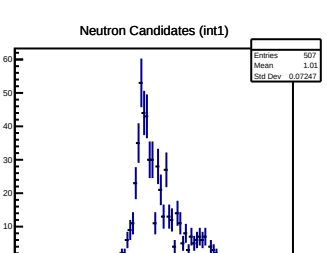

Neutron Candidates (int1)
Entries 718
Mean 0.9842
Std Dev 0.04617
M_miss (GeV/c²)

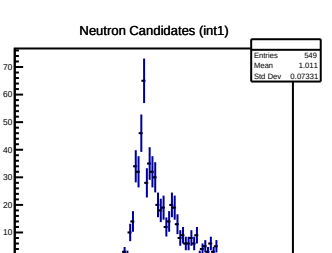

Neutron Candidates (int1)
Entries 760
Mean 0.9856
Std Dev 0.04872
M_miss (GeV/c²)

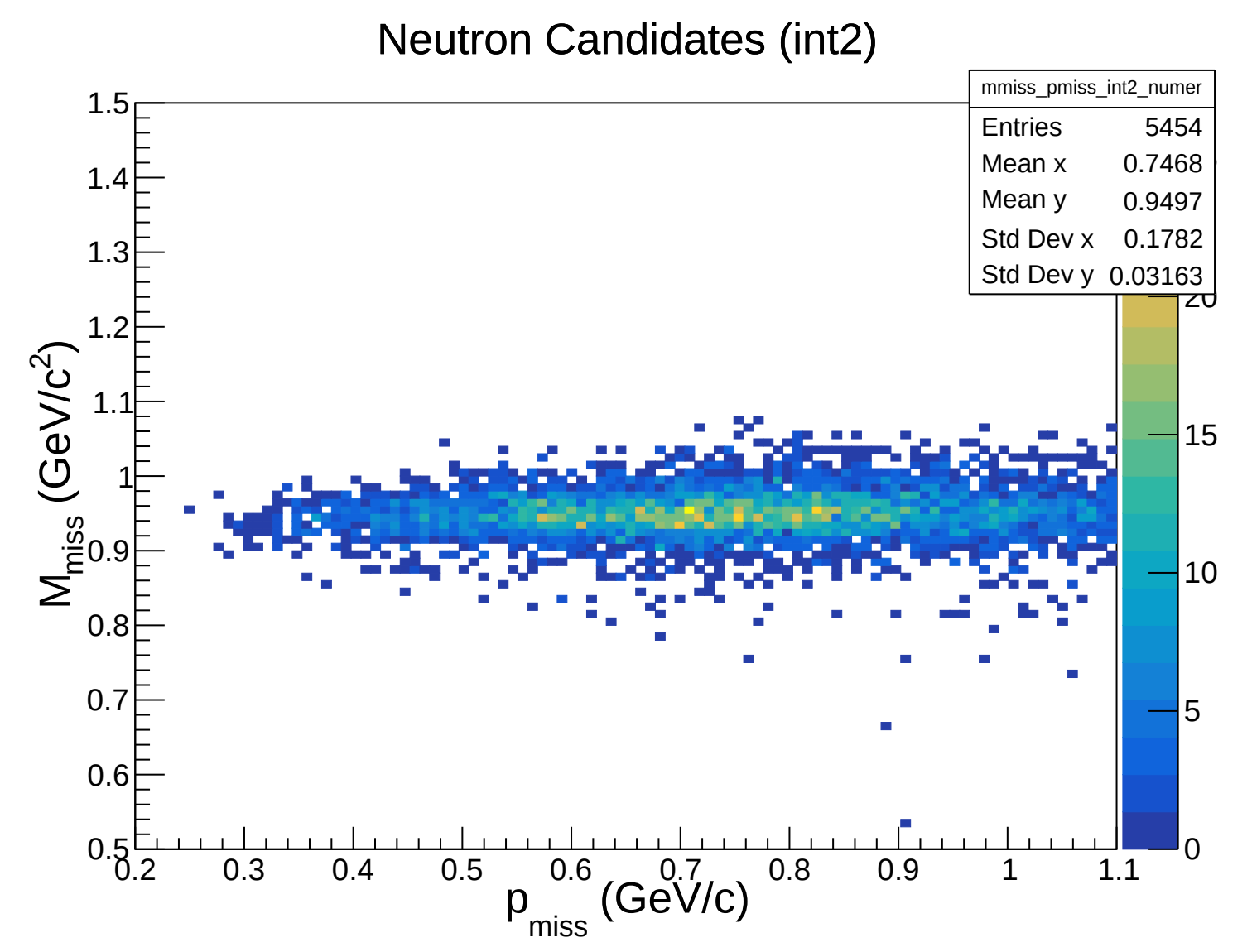

Neutron Candidates (int1)
Entries 780
Mean 0.9957
Std Dev 0.05647
M_miss (GeV/c²)

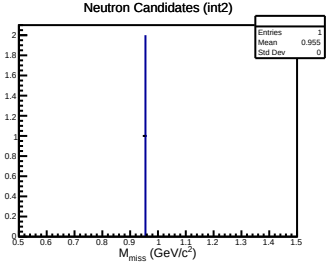

Neutron Candidates (int1)
Entries 814
Mean 0.998
Std Dev 0.05865
M_miss (GeV/c²)

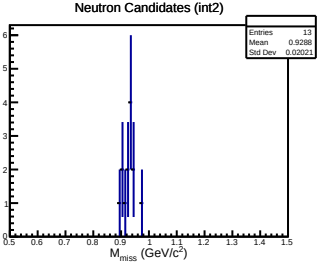

Neutron Candidates (int1)
Entries 577
Mean 1
Std Dev 0.06579
M_miss (GeV/c²)

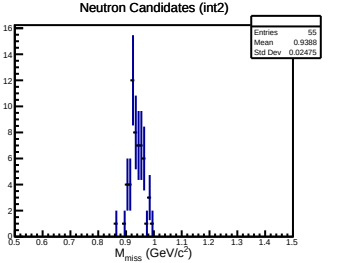

Neutron Candidates (int1)
Entries 507
Mean 1.01
Std Dev 0.07247
M_miss (GeV/c²)

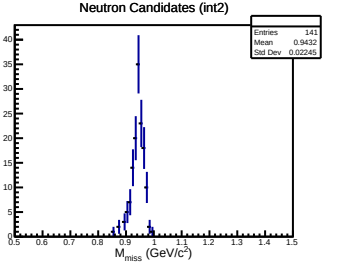

Neutron Candidates (int1)
Entries 549
Mean 1.011
Std Dev 0.07331
M_miss (GeV/c²)

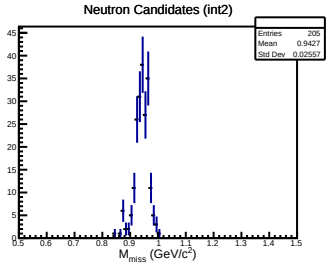

Neutron Candidates (int2)
mmiss_pmiss_int2_numer
Entries 5454
Mean x 0.7468
Mean y 0.9497
Std Dev x 0.1782
Std Dev y 0.03163
M_miss (GeV/c^2)
p_miss (GeV/c)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
20
15
10
5
0

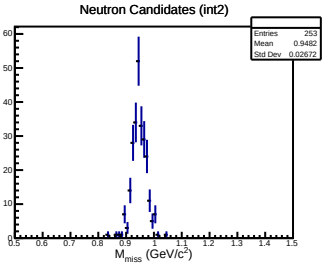

Neutron Candidates (int2)
Entries 1
Mean 0.956
Std Dev 0
M_miss (GeV/c²)

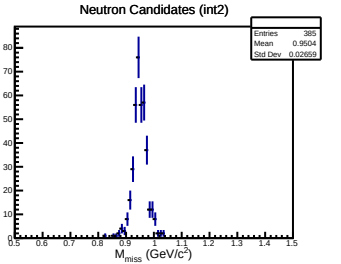

Neutron Candidates (int2)
Entries 13
Mean 0.9288
Std Dev 0.02021
M_miss (GeV/c²)

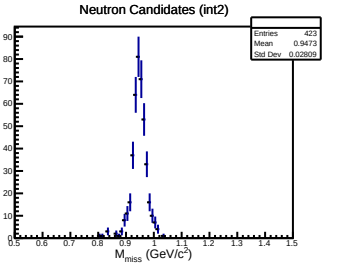

Neutron Candidates (int2)
Entries 55
Mean 0.9388
Std Dev 0.02475
M_miss (GeV/c²)

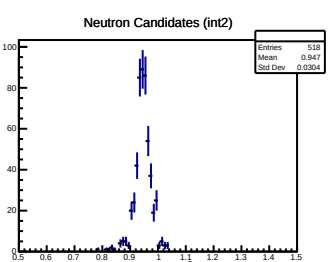

Neutron Candidates (int2)
Entries 141
Mean 0.9432
Std Dev 0.02245
M_miss (GeV/c²)

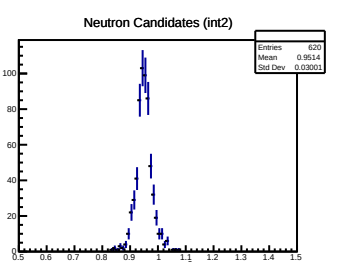

Neutron Candidates (int2)
Entries 205
Mean 0.9427
Std Dev 0.02557
M_miss (GeV/c²)

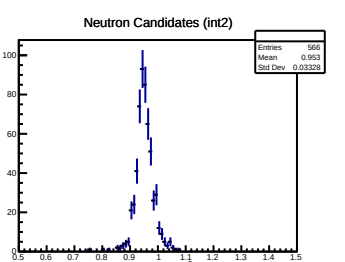

Neutron Candidates (int2)
Entries 253
Mean 0.9482
Std Dev 0.02672
M_miss (GeV/c²)

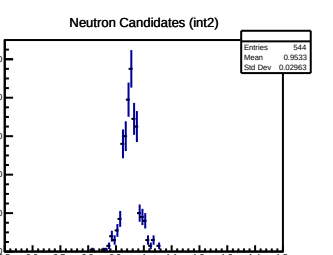

Neutron Candidates (int2)
Entries 385
Mean 0.9504
Std Dev 0.02659
M_miss (GeV/c²)

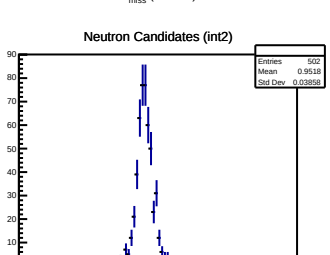

Neutron Candidates (int2)
Entries 423
Mean 0.9473
Std Dev 0.02809
M_miss (GeV/c²)

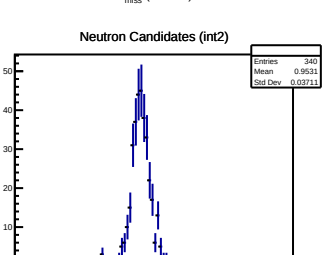

Neutron Candidates (int2)
Entries 518
Mean 0.947
Std Dev 0.0304
M_miss (GeV/c²)

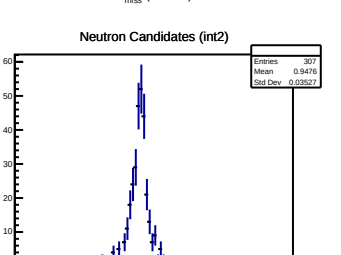

Neutron Candidates (int2)
Entries 620
Mean 0.9514
Std Dev 0.03001
M_miss (GeV/c²)

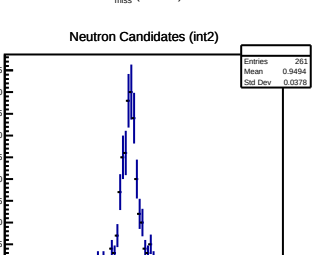

Neutron Candidates (int2)
Entries 566
Mean 0.953
Std Dev 0.03328
M_miss (GeV/c²)

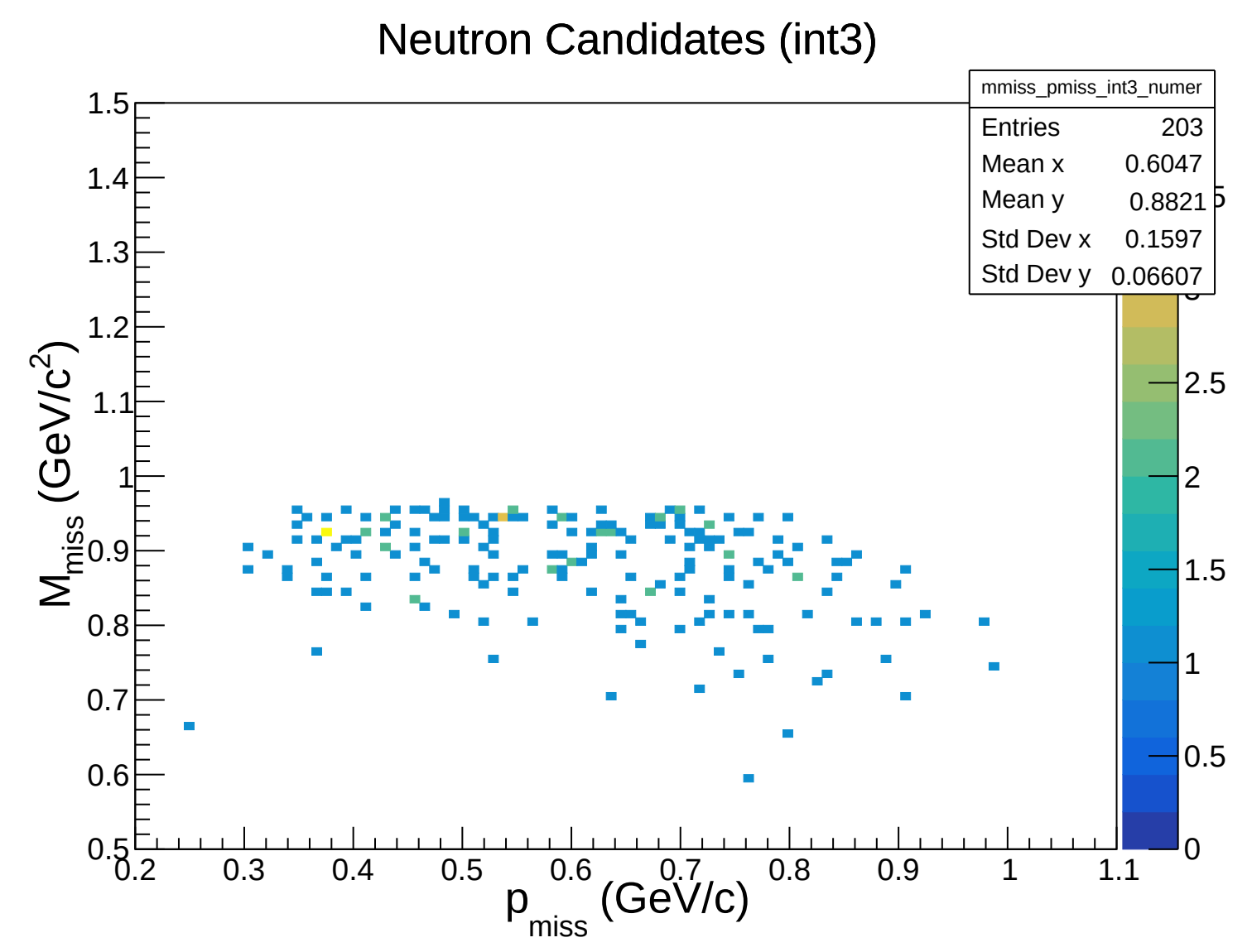

Neutron Candidates (int2)
Entries 544
Mean 0.9533
Std Dev 0.02963
M_miss (GeV/c²)

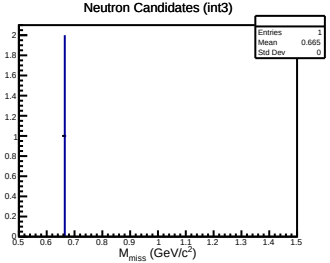

Neutron Candidates (int2)
Entries 502
Mean 0.9518
Std Dev 0.03858
M_miss (GeV/c²)

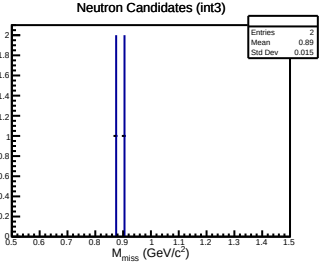

Neutron Candidates (int2)
Entries 340
Mean 0.9531
Std Dev 0.03711
M_miss (GeV/c²)

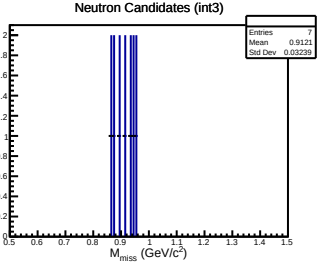

Neutron Candidates (int2)
Entries 307
Mean 0.9476
Std Dev 0.03527
M_miss (GeV/c²)

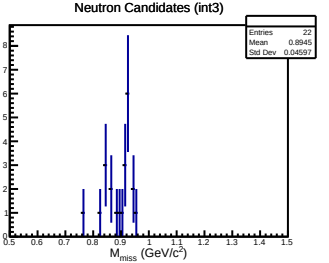

Neutron Candidates (int2)
Entries 261
Mean 0.9494
Std Dev 0.0378
M_miss (GeV/c²)

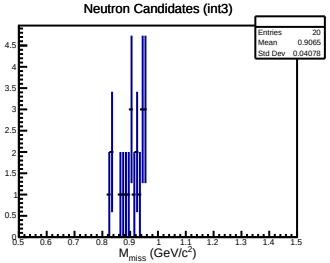

Neutron Candidates (int3)
mmiss_pmiss_int3_numer
Entries 203
Mean x 0.6047
Mean y 0.8821
Std Dev x 0.1597
Std Dev y 0.06607
M_miss (GeV/c^2)
p_miss (GeV/c)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
2.5
2
1.5
1
0.5
0

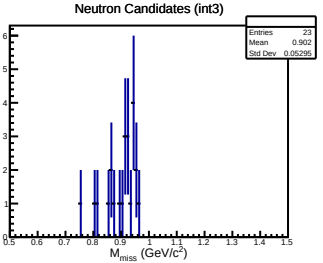

Neutron Candidates (int3)
Entries 1
Mean 0.665
Std Dev 0
M_miss (GeV/c²)

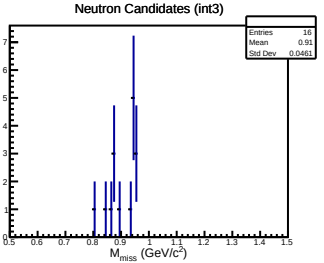

Neutron Candidates (int3)
Entries 2
Mean 0.89
Std Dev 0.015
M_miss (GeV/c²)

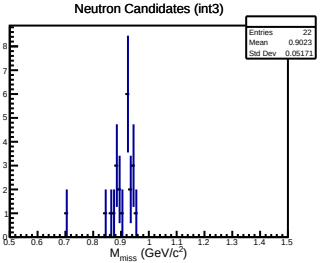

Neutron Candidates (int3)
Entries 7
Mean 0.9121
Std Dev 0.03239
M_miss (GeV/c²)

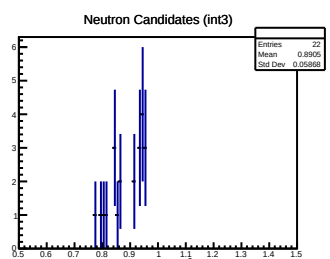

Neutron Candidates (int3)
Entries 22
Mean 0.8945
Std Dev 0.04597
M_miss (GeV/c²)

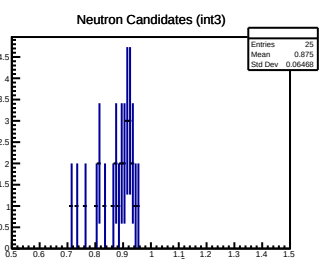

Neutron Candidates (int3)
Entries 20
Mean 0.9065
Std Dev 0.04078
M_miss (GeV/c²)

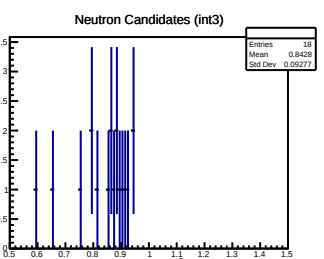

Neutron Candidates (int3)
Entries 23
Mean 0.902
Std Dev 0.05295
M_miss (GeV/c²)

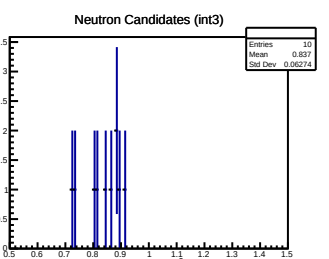

Neutron Candidates (int3)
Entries 16
Mean 0.91
Std Dev 0.0461
M_miss (GeV/c²)

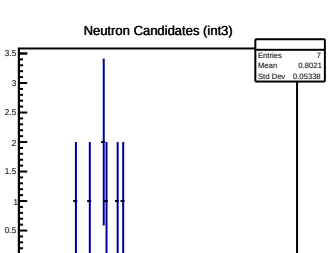

Neutron Candidates (int3)
Entries 22
Mean 0.9023
Std Dev 0.05171
M_miss (GeV/c²)

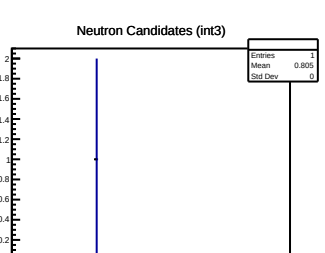

Neutron Candidates (int3)
Entries 22
Mean 0.8905
Std Dev 0.05868
M_miss (GeV/c²)

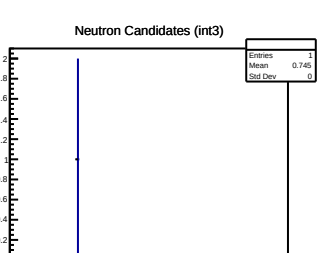

Neutron Candidates (int3)
Entries 25
Mean 0.875
Std Dev 0.06468
M_miss (GeV/c²)

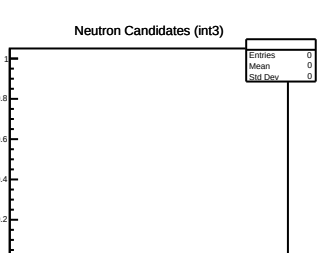

Neutron Candidates (int3)
Entries 18
Mean 0.8428
Std Dev 0.09277
M_miss (GeV/c²)

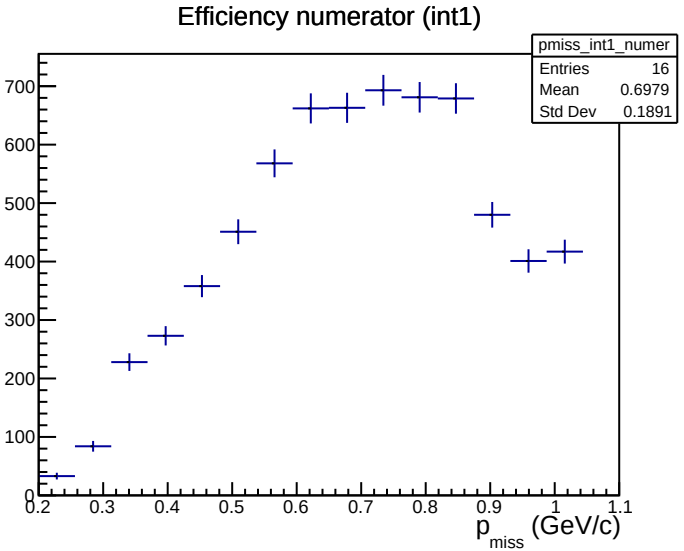

Neutron Candidates (int3)
Entries 10
Mean 0.837
Std Dev 0.06274
M_miss (GeV/c²)

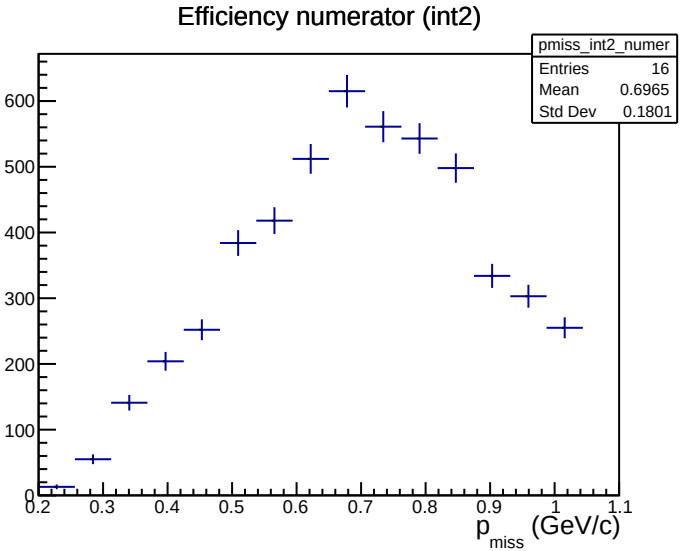

Neutron Candidates (int3)
Entries 7
Mean 0.8021
Std Dev 0.05338
M_miss (GeV/c²)

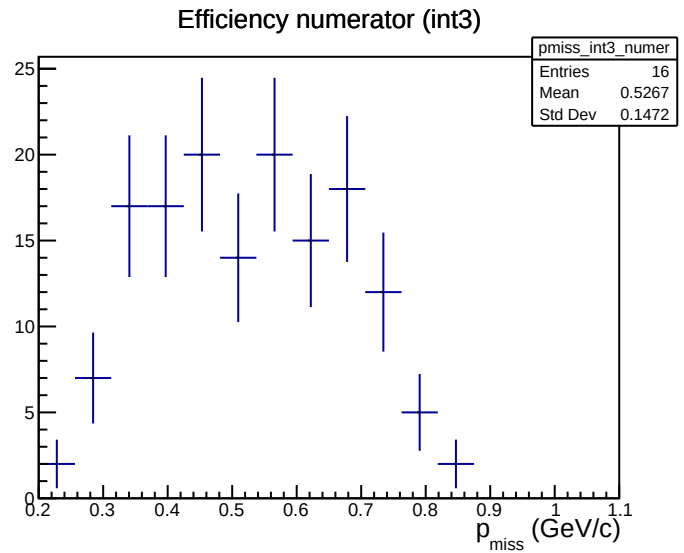

Neutron Candidates (int3)
Entries 1
Mean 0.805
Std Dev 0
M_miss (GeV/c²)


Neutron Candidates (int3)
Entries 1
Mean 0.745
Std Dev 0
M_miss (GeV/c²)

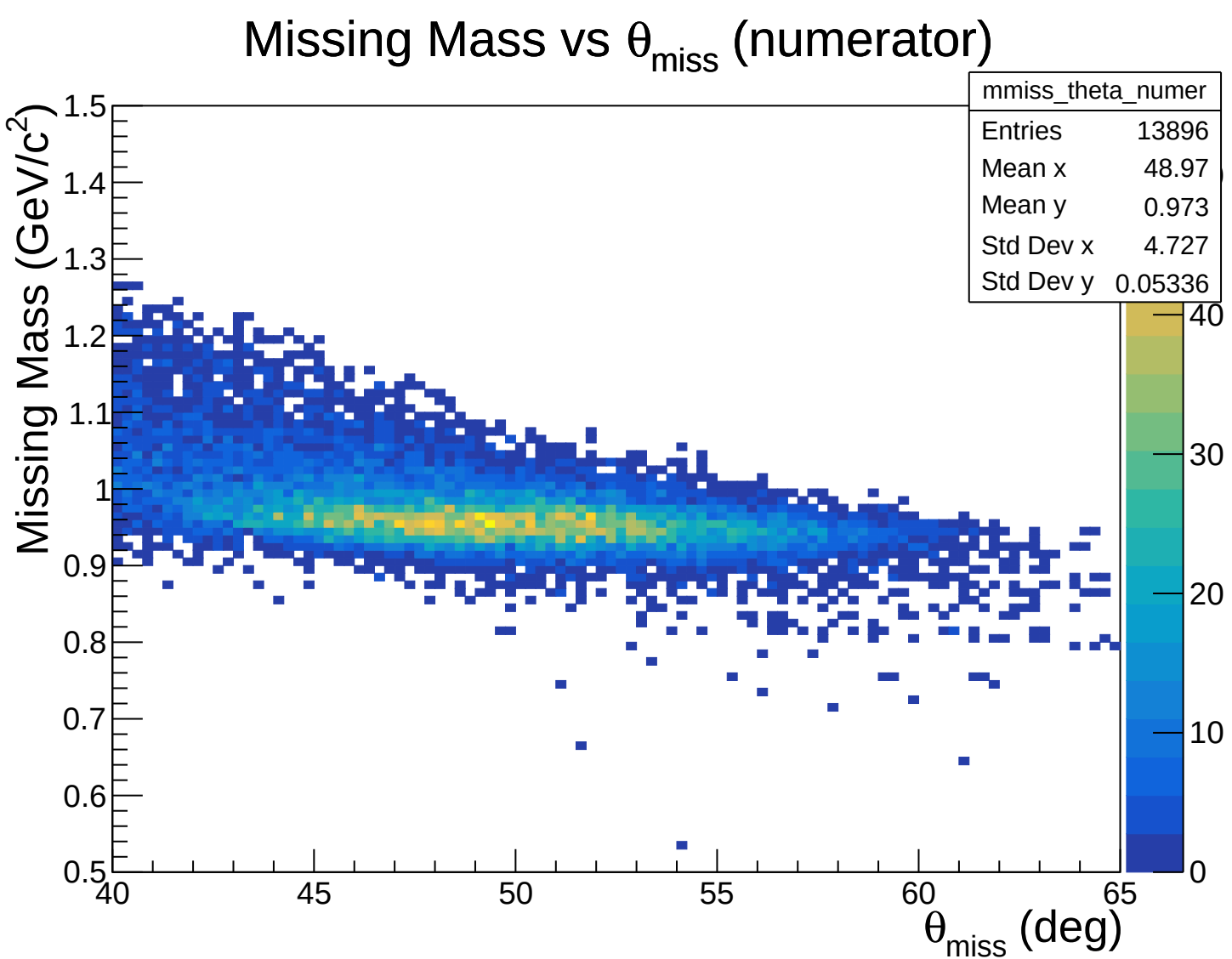

Neutron Candidates (int3)
Entries 0
Mean 0
Std Dev 0
M_miss (GeV/c²)

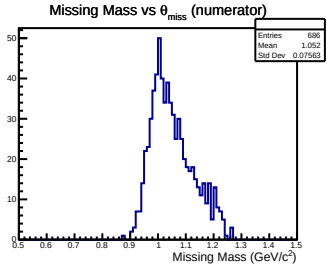

Efficiency numerator (int1)
pmiss_int1_numer
Entries 16
Mean 0.6979
Std Dev 0.1891
p_miss (GeV/c)

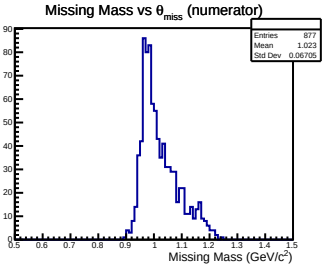

Efficiency numerator (int2)
pmiss_int2_numer
Entries 16
Mean 0.6965
Std Dev 0.1801
p_miss (GeV/c)

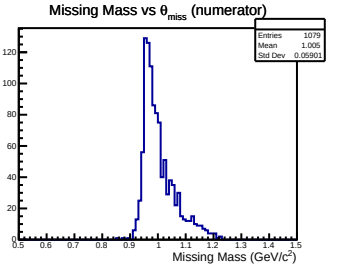

Efficiency numerator (int3)
pmiss_int3_numer
Entries 16
Mean 0.5267
Std Dev 0.1472
p_miss (GeV/c)

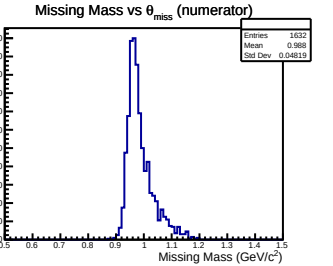
Theta numerator

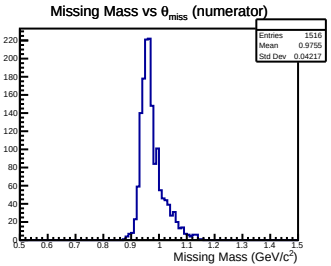

Missing Mass vs θmiss (numerator)
mmiss_theta_numer
Entries 13896
Mean x 48.97
Mean y 0.973
Std Dev x 4.727
Std Dev y 0.05336
Missing Mass (GeV/c2)
θmiss (deg)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
40
45
50
55
60
65
40
30
20
10
0

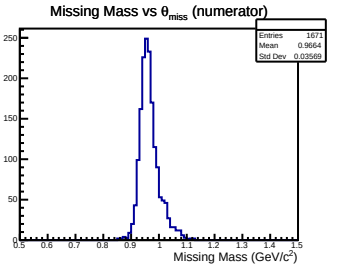

Missing Mass vs θmiss (numerator)
Entries 686
Mean 1.052
Std Dev 0.07563
Missing Mass (GeV/c2)

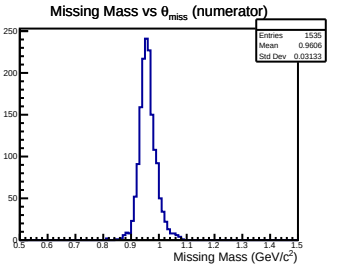

Missing Mass vs θmiss (numerator)
Entries 877
Mean 1.023
Std Dev 0.06705
Missing Mass (GeV/c2)

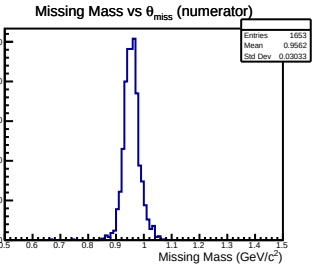

Missing Mass vs θmiss (numerator)
Entries 1079
Mean 1.005
Std Dev 0.05901
Missing Mass (GeV/c2)

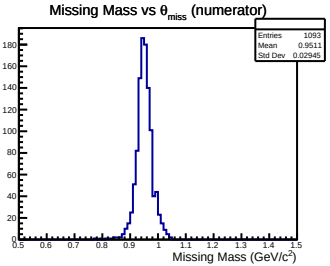

Missing Mass vs θmiss (numerator)
Entries 1632
Mean 0.988
Std Dev 0.04819
Missing Mass (GeV/c2)

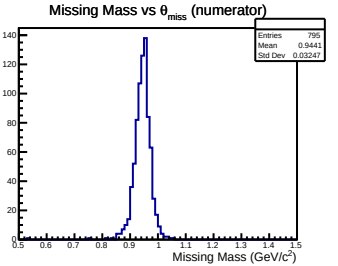

Missing Mass vs θmiss (numerator)
Entries 1516
Mean 0.9755
Std Dev 0.04217
Missing Mass (GeV/c2)

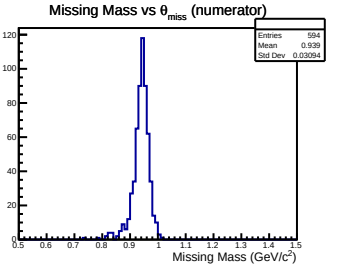

Missing Mass vs θmiss (numerator)
Entries 1671
Mean 0.9664
Std Dev 0.03569
Missing Mass (GeV/c2)

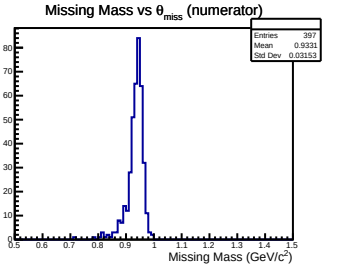

Missing Mass vs θmiss (numerator)
Entries 1535
Mean 0.9606
Std Dev 0.03133
Missing Mass (GeV/c2)

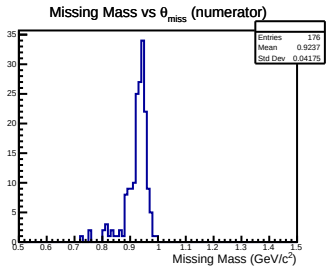

Missing Mass vs θmiss (numerator)
Entries 1653
Mean 0.9562
Std Dev 0.03033
Missing Mass (GeV/c2)

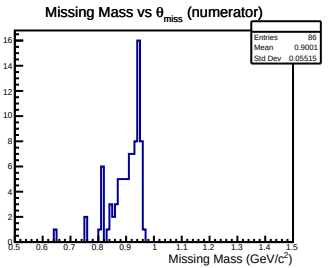

Missing Mass vs θmiss (numerator)
Entries 1093
Mean 0.9511
Std Dev 0.02945
Missing Mass (GeV/c2)

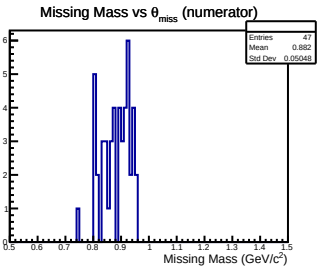

Missing Mass vs θmiss (numerator)
Entries 795
Mean 0.9441
Std Dev 0.03247
Missing Mass (GeV/c2)

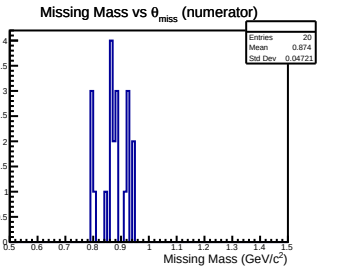

Missing Mass vs θmiss (numerator)
Entries 594
Mean 0.939
Std Dev 0.03094
Missing Mass (GeV/c2)

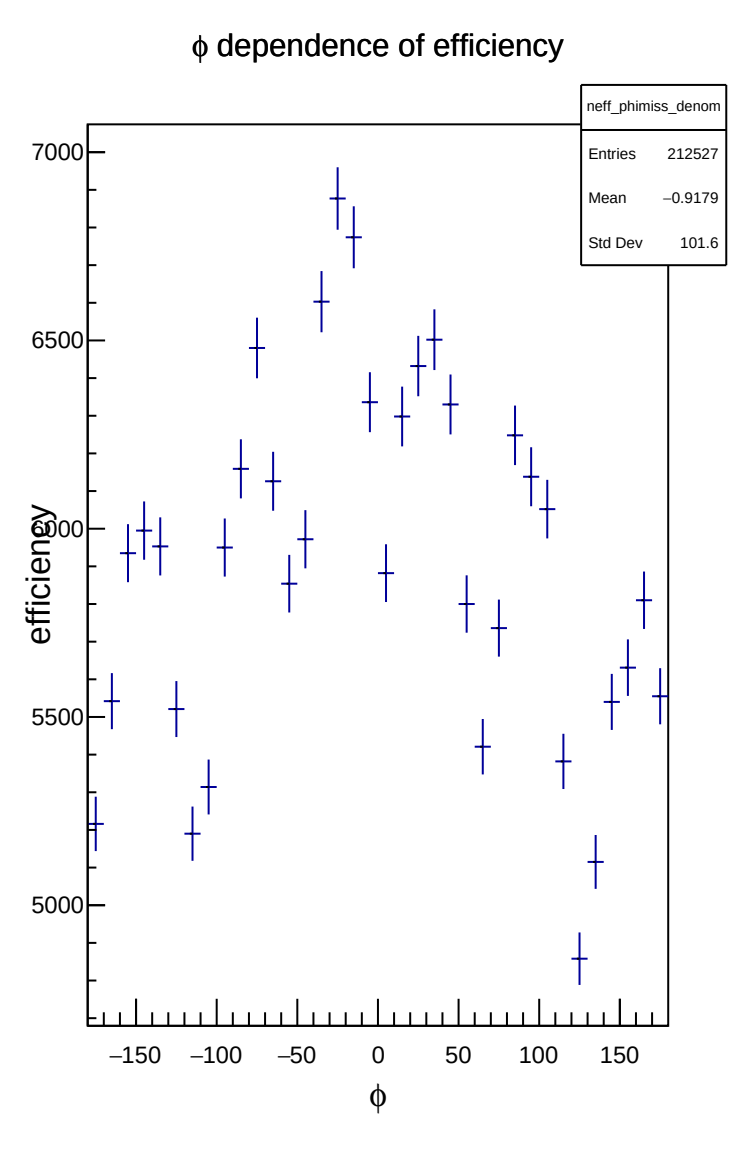

Missing Mass vs θmiss (numerator)
Entries 397
Mean 0.9331
Std Dev 0.03153
Missing Mass (GeV/c2)

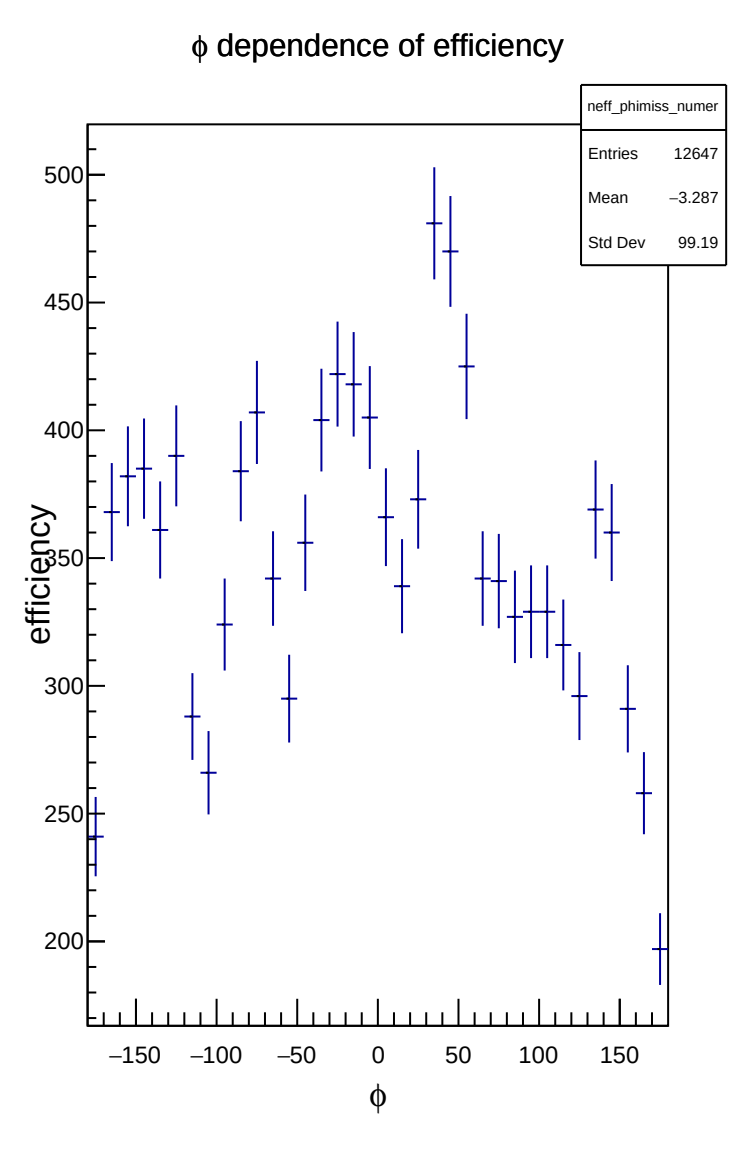

Missing Mass vs θmiss (numerator)
Entries 176
Mean 0.9237
Std Dev 0.04175
Missing Mass (GeV/c2)

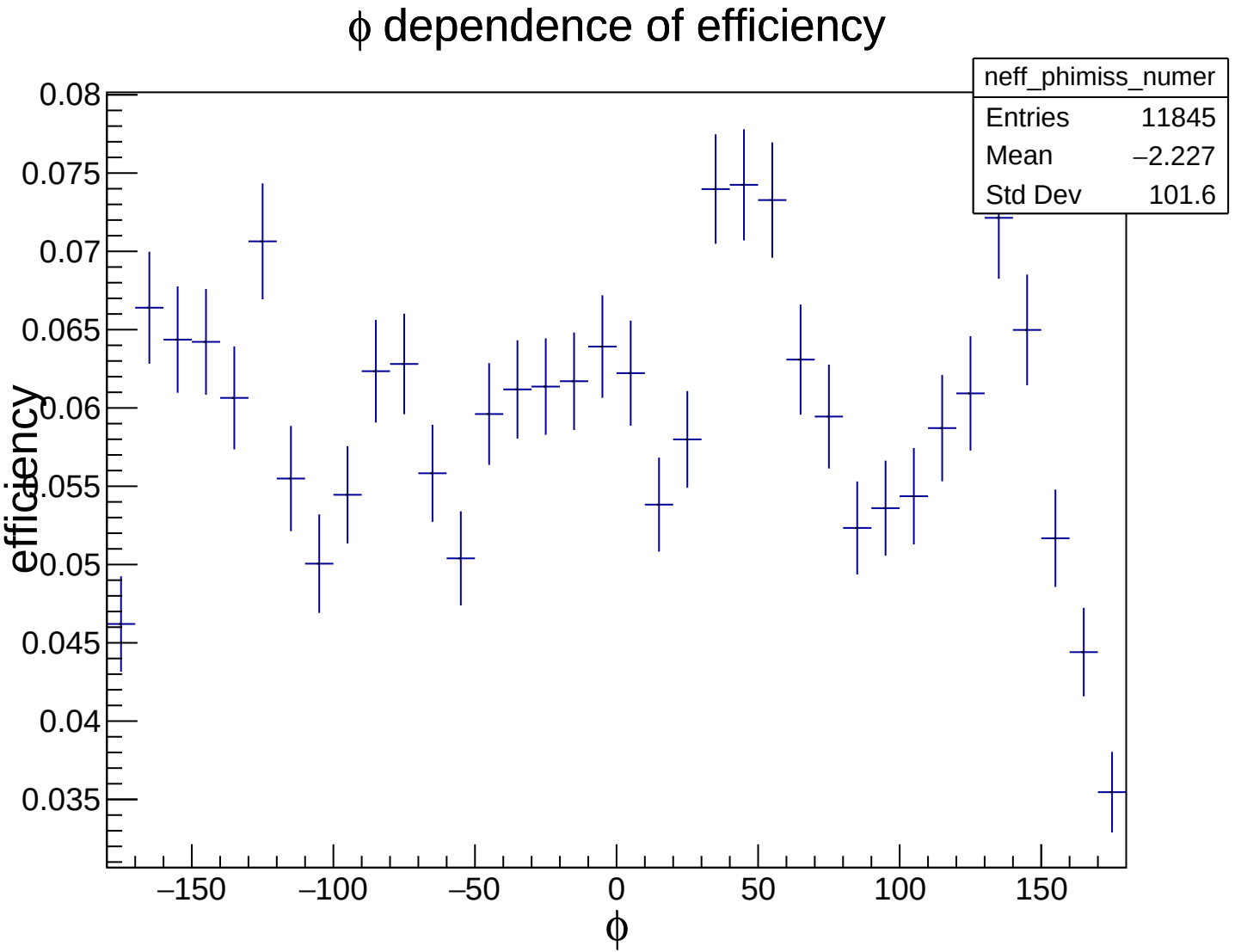

Missing Mass vs θmiss (numerator)
Entries 86
Mean 0.9001
Std Dev 0.05515
Missing Mass (GeV/c2)


Missing Mass vs θmiss (numerator)
Entries 47
Mean 0.882
Std Dev 0.05048
Missing Mass (GeV/c2)

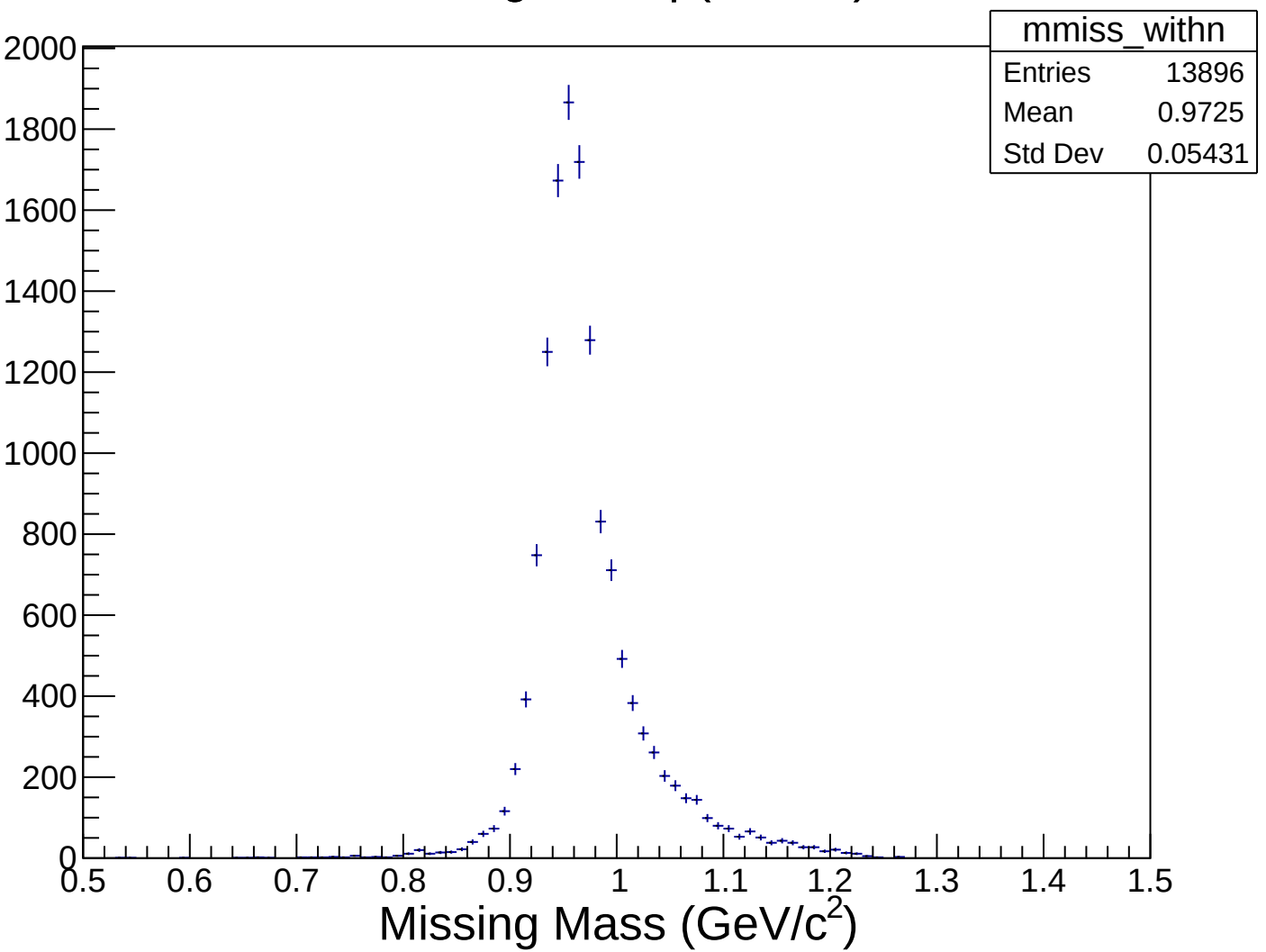

Missing Mass vs θmiss (numerator)
Entries 20
Mean 0.874
Std Dev 0.04721
Missing Mass (GeV/c2)

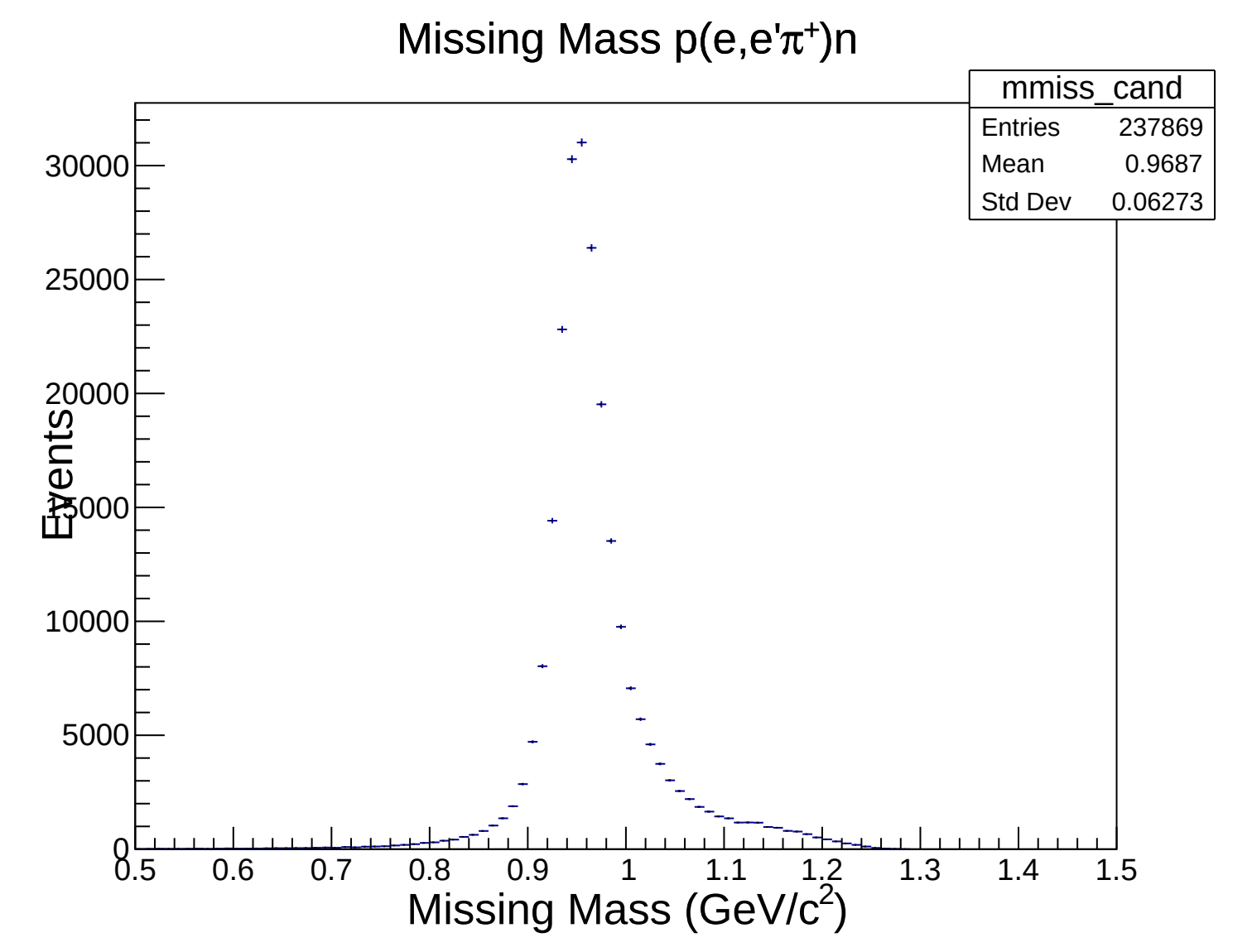

ϕ dependence of efficiency
neff_phimiss_denom
Entries 212527
Mean −0.9179
Std Dev 101.6
efficiency
ϕ
7000
6500
6000
5500
5000
−150
−100
−50
0
50
100
150


ϕ dependence of efficiency
neff_phimiss_numer
Entries 12647
Mean −3.287
Std Dev 99.19
efficiency
ϕ
500
450
400
350
300
250
200
−150
−100
−50
0
50
100
150

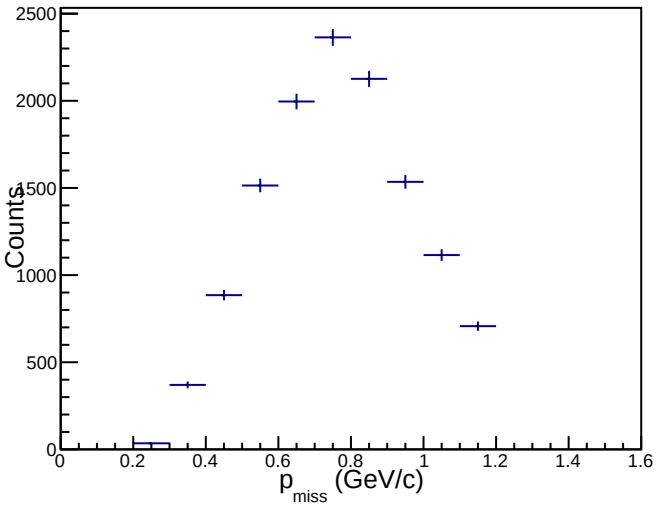

ϕ dependence of efficiency
neff_phimiss_numer
Entries 11845
Mean −2.227
Std Dev 101.6
efficiency
0.08
0.075
0.07
0.065
0.06
0.055
0.05
0.045
0.04
0.035
−150
−100
−50
0
50
100
150
ϕ

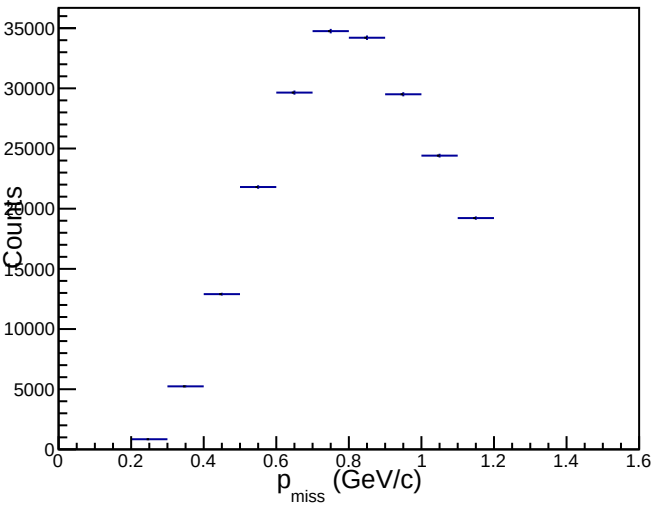
Denominator and numerator missing mass

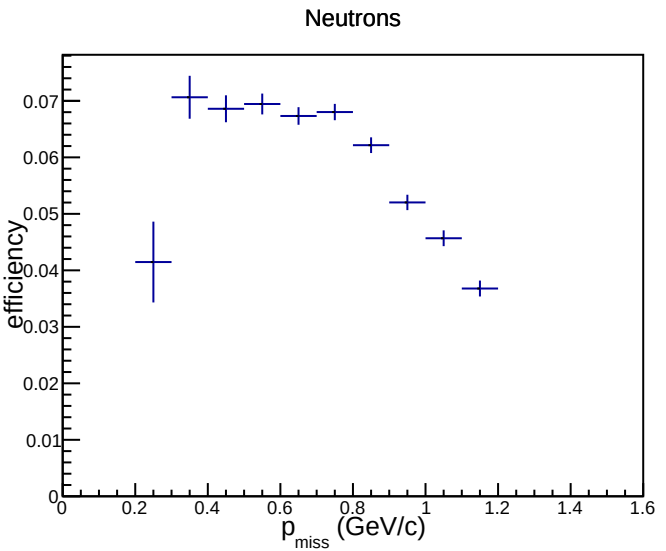

Missing Mass p(e,e'π⁺n)
mmiss_withn
Entries 13896
Mean 0.9725
Std Dev 0.05431
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
Missing Mass (GeV/c²)

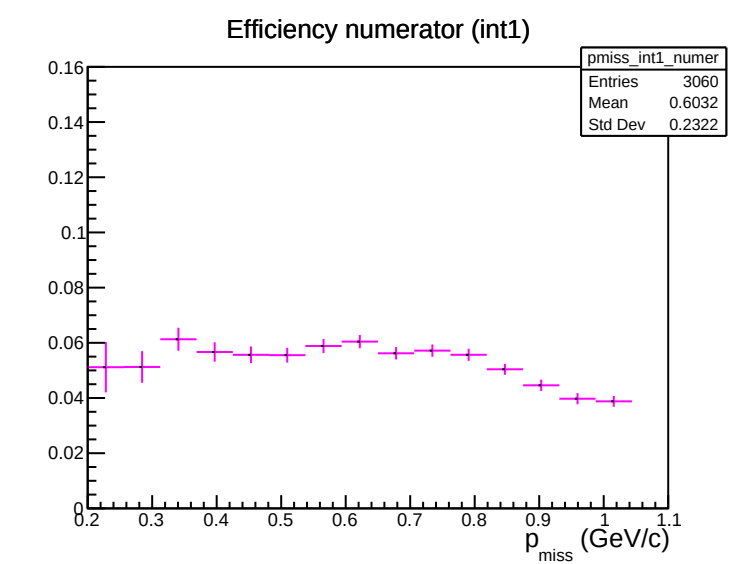

Missing Mass p(e,e'π+)n
mmiss_cand
Entries 237869
Mean 0.9687
Std Dev 0.06273
Events
30000
25000
20000
15000
10000
5000
0
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
Missing Mass (GeV/c2)

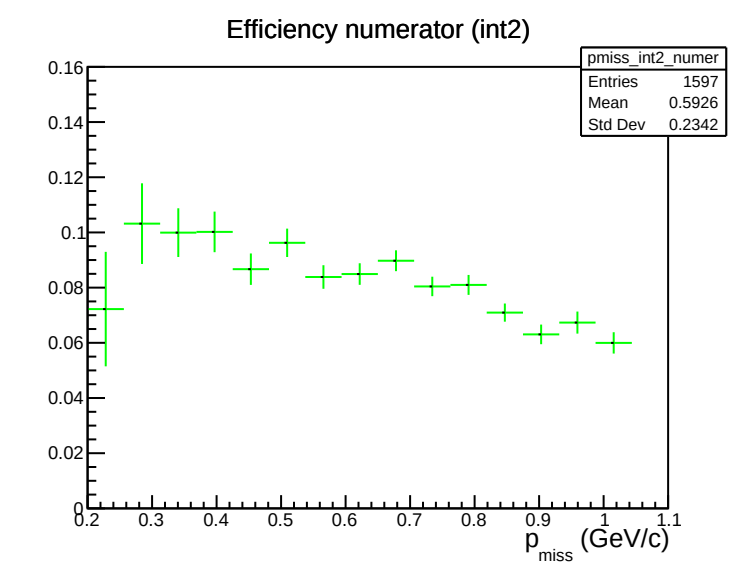
Efficiency results

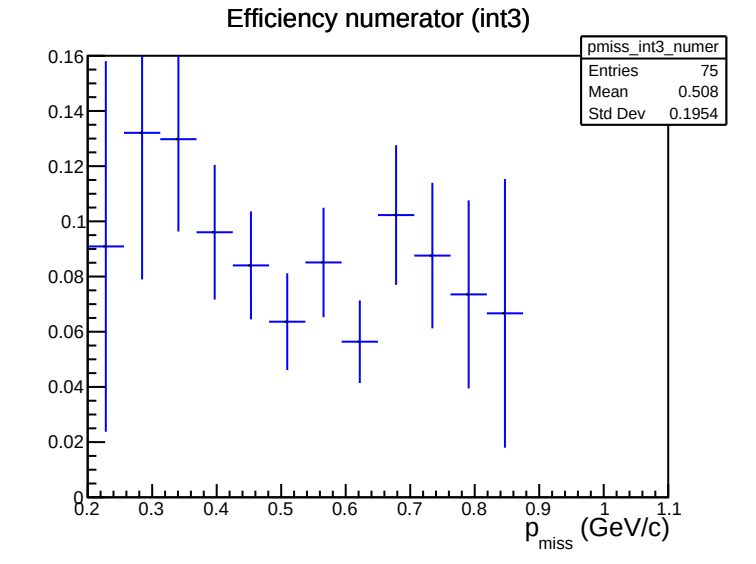

Neutrons
Counts
2500
2000
1500
1000
500
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
p miss (GeV/c)

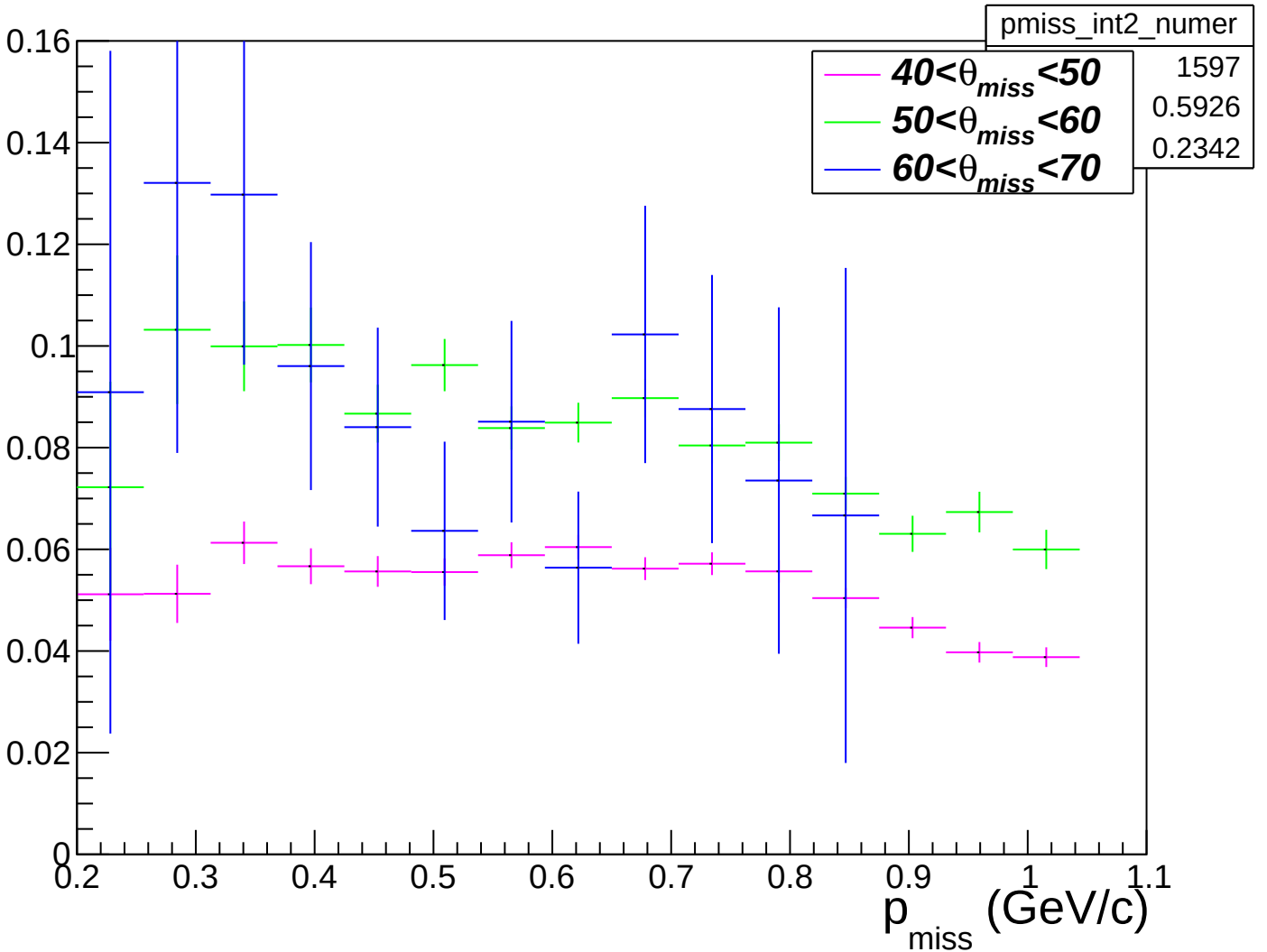

Neutron Candidates
Counts
35000
30000
25000
20000
15000
10000
5000
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
p miss (GeV/c)

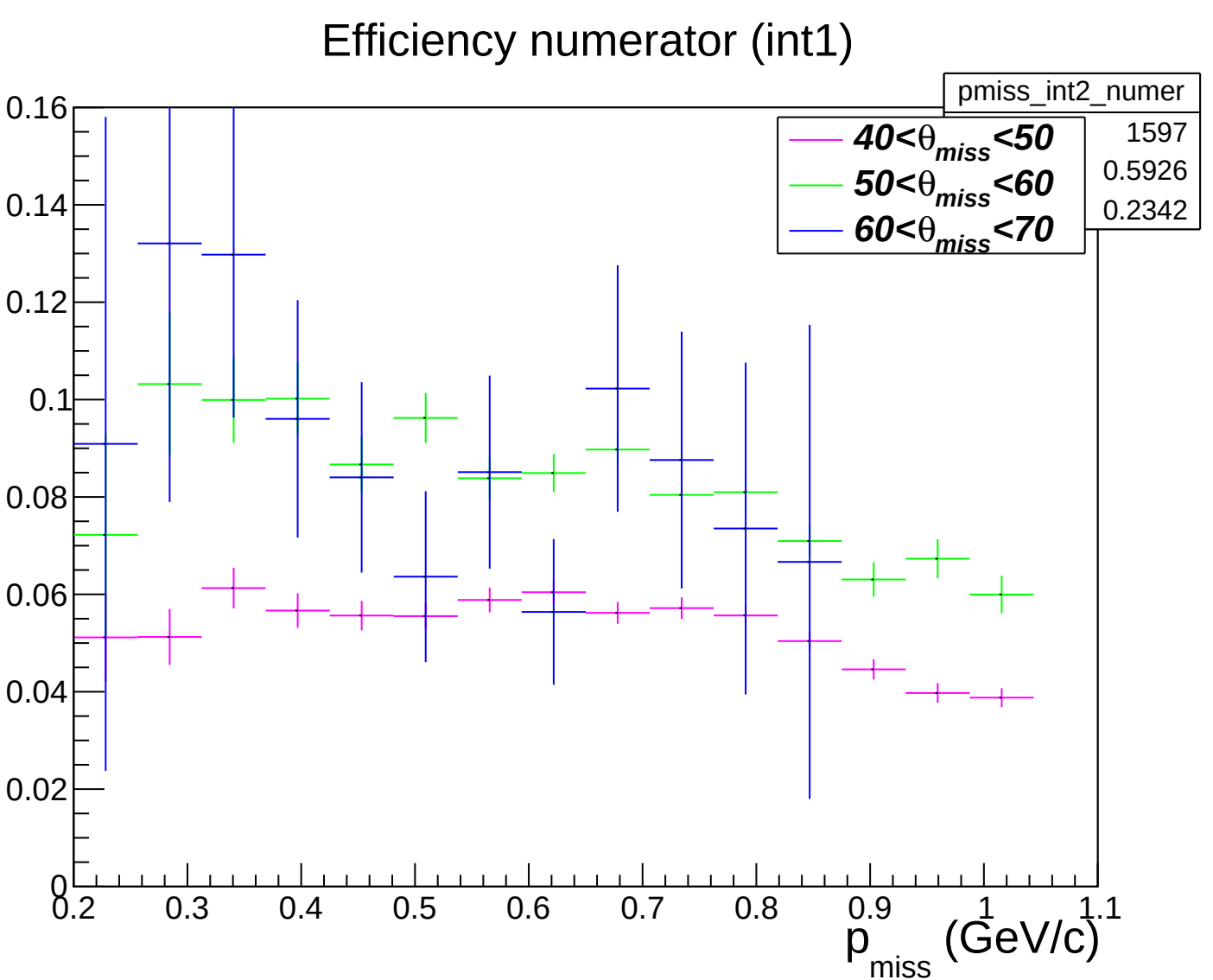

Neutrons
efficiency
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
p miss (GeV/c)

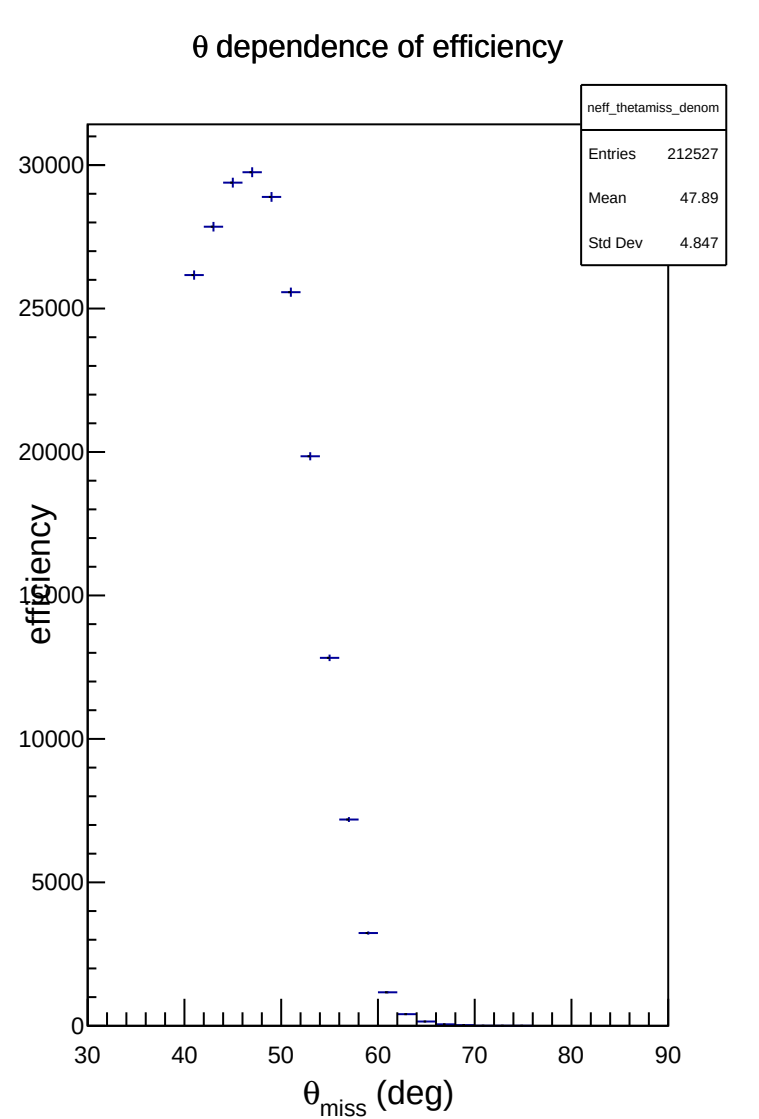

Efficiency numerator (int1)
pmiss_int1_numer
Entries 3060
Mean 0.6032
Std Dev 0.2322
p_miss (GeV/c)

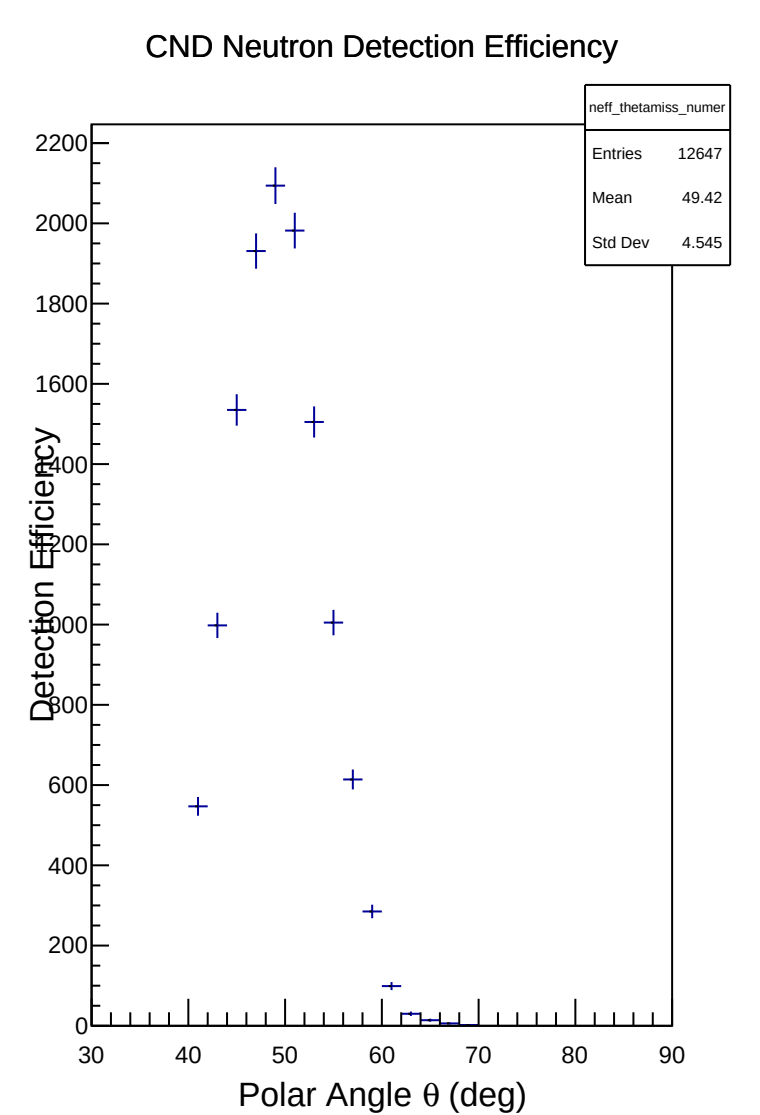

Efficiency numerator (int2)
pmiss_int2_numer
Entries 1597
Mean 0.5926
Std Dev 0.2342
p_miss (GeV/c)

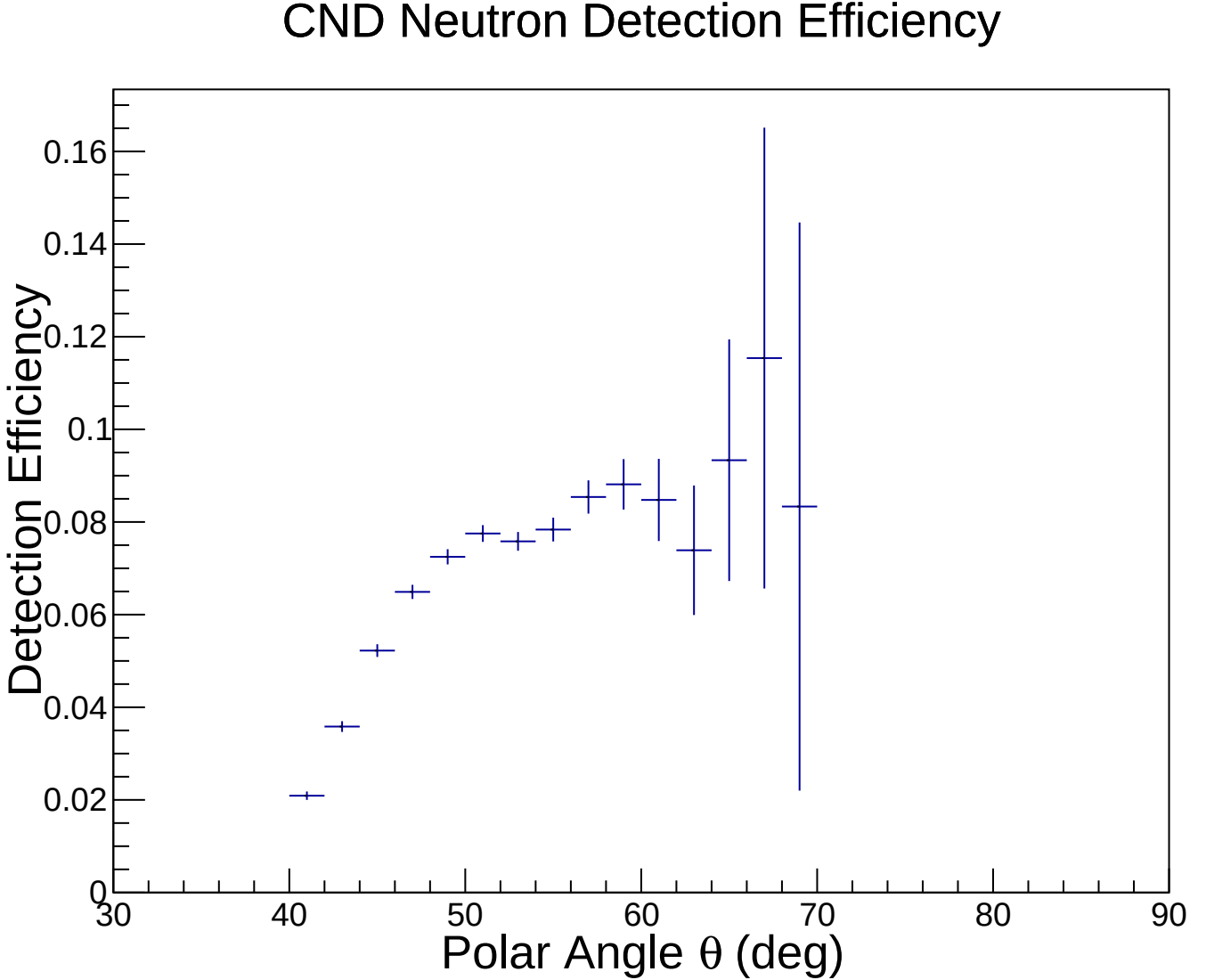

Efficiency numerator (int3)
pmiss_int3_numer
Entries 75
Mean 0.508
Std Dev 0.1954
p_miss (GeV/c)

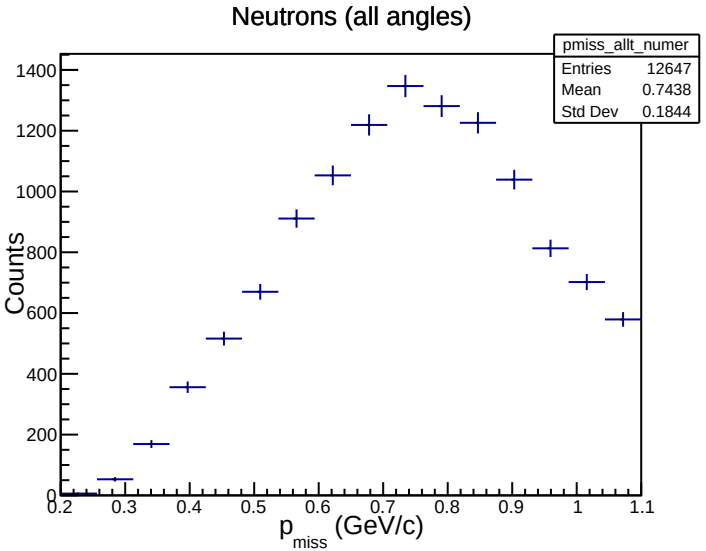

Efficiency numerator (int1)
pmiss_int2_numer
1597
0.5926
0.2342
40<θmiss<50
50<θmiss<60
60<θmiss<70
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
pmiss (GeV/c)

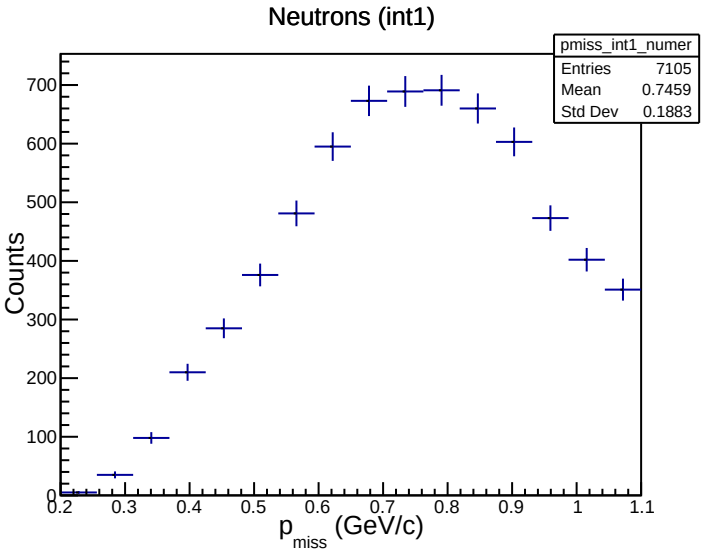

Efficiency numerator (int1)
pmiss_int2_numer
1597
0.5926
0.2342
40<θmiss<50
50<θmiss<60
60<θmiss<70
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
pmiss (GeV/c)

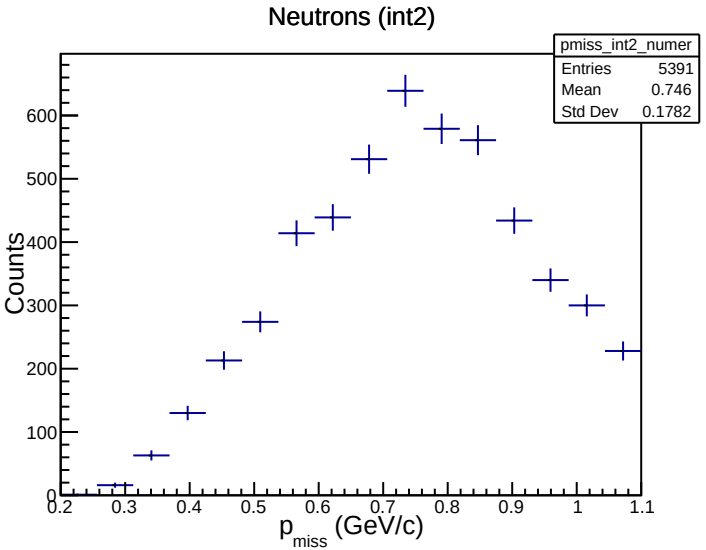

θ dependence of efficiency
neff_thetamiss_denom
Entries 212527
Mean 47.89
Std Dev 4.847
efficiency
θmiss (deg)

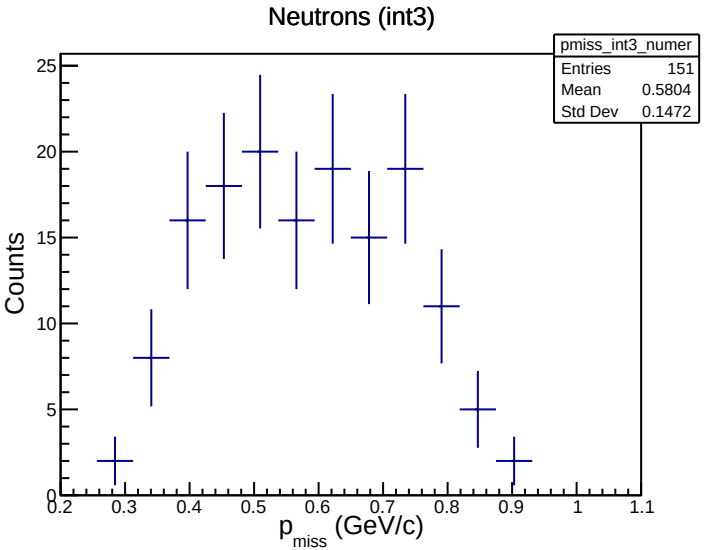

CND Neutron Detection Efficiency
neff_thetamiss_numer
Entries 12647
Mean 49.42
Std Dev 4.545
Detection Efficiency
Polar Angle θ (deg)

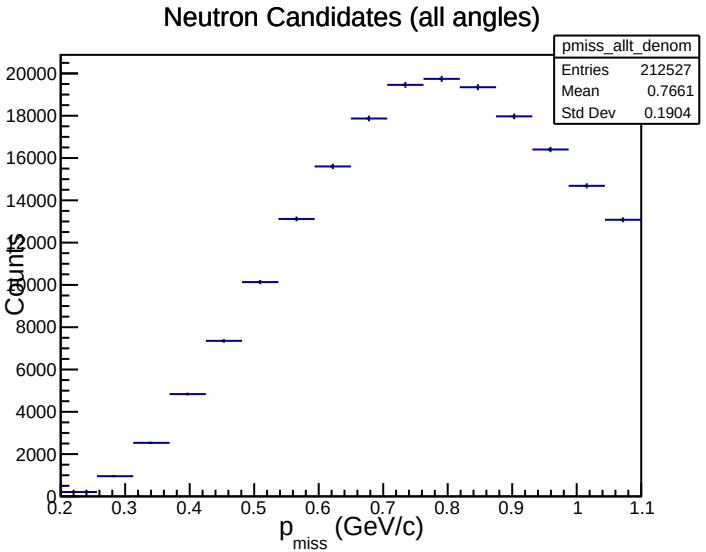

CND Neutron Detection Efficiency
Detection Efficiency
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
30
40
50
60
70
80
90
Polar Angle θ (deg)

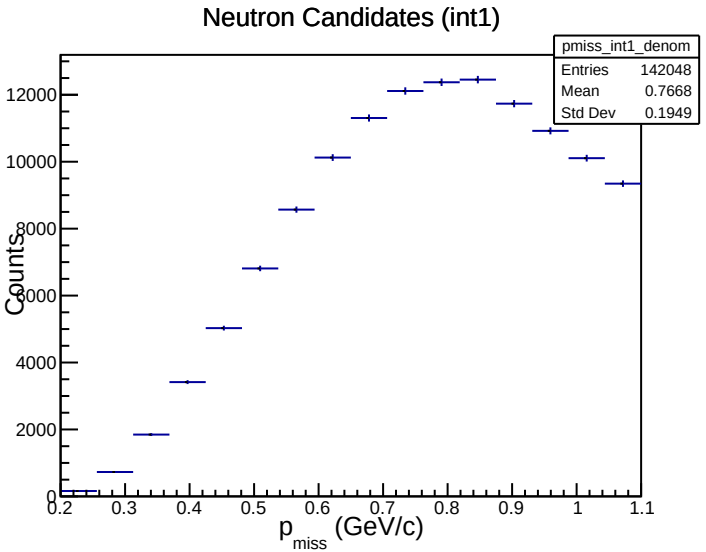

Neutrons (all angles)
pmiss_allt_numer
Entries 12647
Mean 0.7438
Std Dev 0.1844
Counts
p miss (GeV/c)

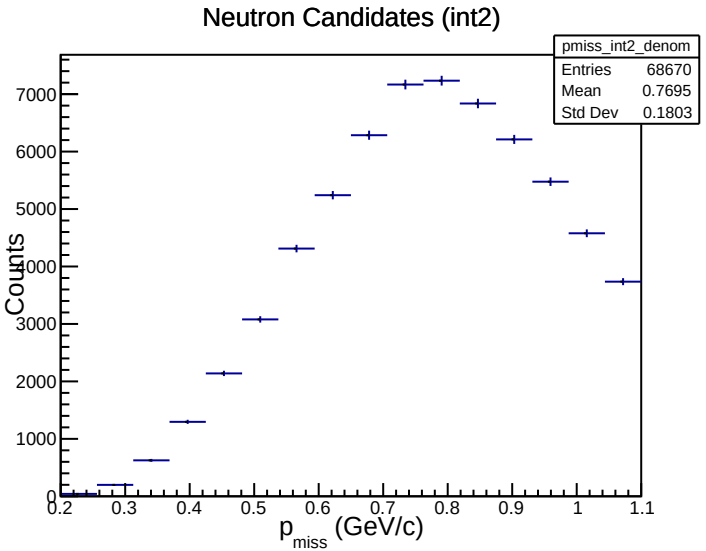

Neutrons (int1)
pmiss_int1_numer
Entries 7105
Mean 0.7459
Std Dev 0.1883
Counts
p miss (GeV/c)

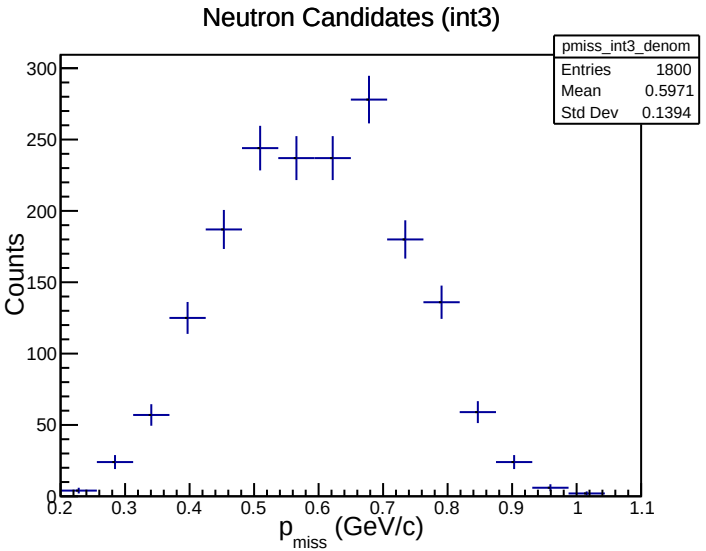

Neutrons (int2)
pmiss_int2_numer
Entries 5391
Mean 0.746
Std Dev 0.1782
Counts
p miss (GeV/c)

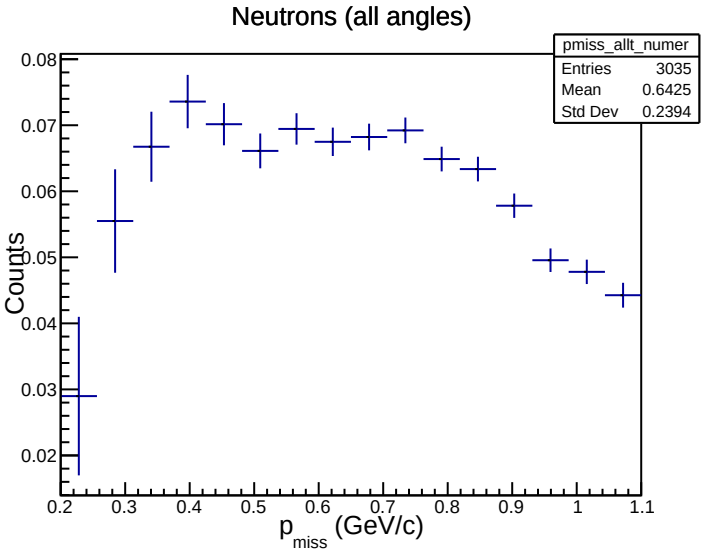

Neutrons (int3)
pmiss_int3_numer
Entries 151
Mean 0.5804
Std Dev 0.1472
Counts
p miss (GeV/c)

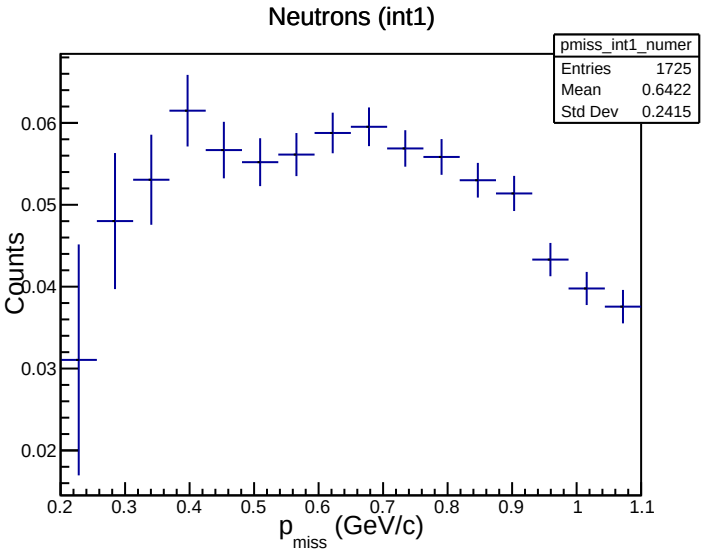

Neutron Candidates (all angles)
pmiss_allt_denom
Entries 212527
Mean 0.7661
Std Dev 0.1904
Counts
p miss (GeV/c)

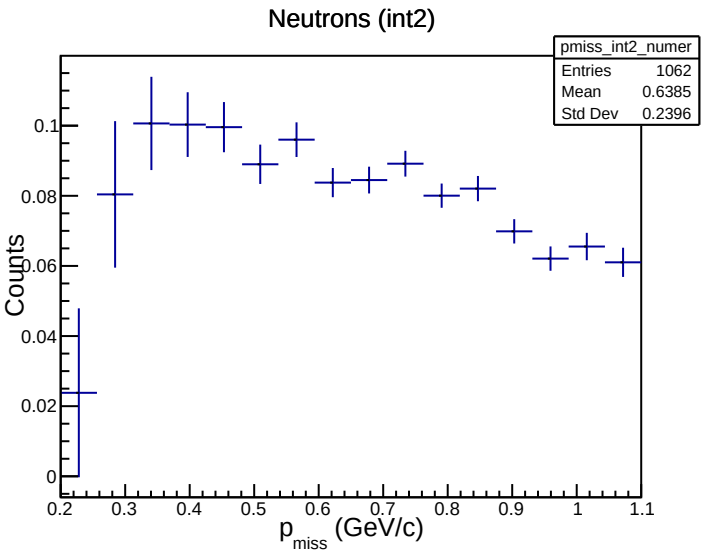

Neutron Candidates (int1)
pmiss_int1_denom
Entries 142048
Mean 0.7668
Std Dev 0.1949
Counts
p miss (GeV/c)

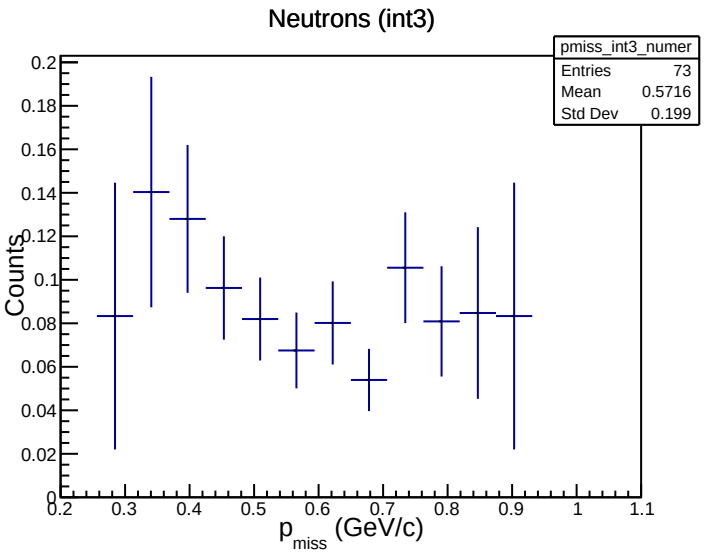

Neutron Candidates (int2)
pmiss_int2_denom
Entries 68670
Mean 0.7695
Std Dev 0.1803
Counts
p miss (GeV/c)

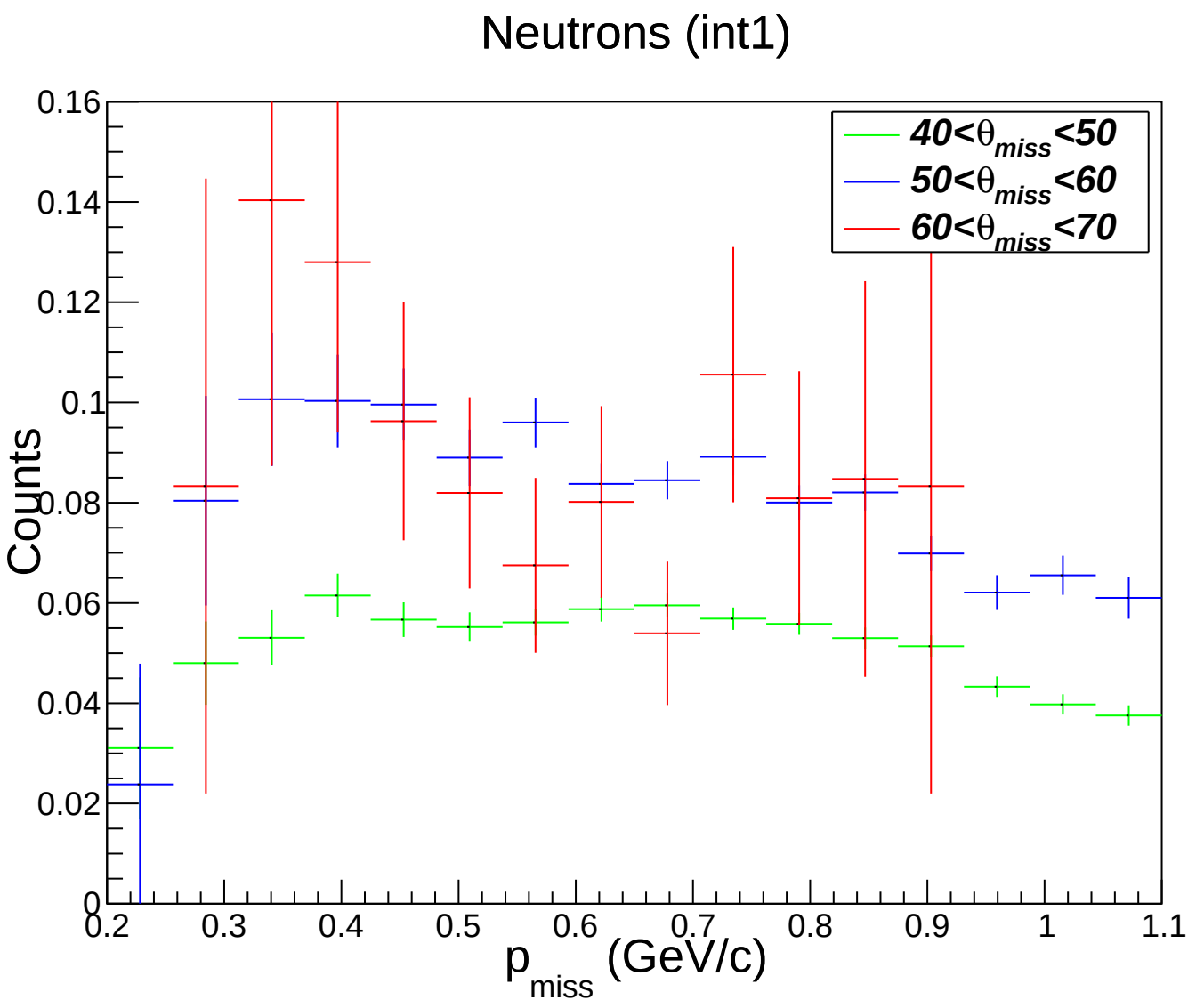

Neutron Candidates (int3)
pmiss_int3_denom
Entries 1800
Mean 0.5971
Std Dev 0.1394
Counts
p miss (GeV/c)


Neutrons (all angles)
pmiss_allt_numer
Entries 3035
Mean 0.6425
Std Dev 0.2394
Counts
p miss (GeV/c)


Neutrons (int1)
pmiss_int1_numer
Entries 1725
Mean 0.6422
Std Dev 0.2415
Counts
p miss (GeV/c)


Neutrons (int2)
pmiss_int2_numer
Entries 1062
Mean 0.6385
Std Dev 0.2396
Counts
p miss (GeV/c)


Neutrons (int3)
pmiss_int3_numer
Entries 73
Mean 0.5716
Std Dev 0.199
Counts
p miss (GeV/c)


Neutrons (int1)
40<θmiss<50
50<θmiss<60
60<θmiss<70
Counts
pmiss (GeV/c)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1