K^0_S Analysis

by Kevin Ludwick, Sanjib Mishra, and Carl Rosenfeld

The method that involves MC generated K^0_S:

First, I get the variables I need:

```
MIPPMCSummary* mcevt = new MIPPMCSummary;
MIPPMCTrackSummary* mctrk = new MIPPMCTrackSummary;
```

Which allows me to get the events from MCTruth:

```
evtTree->SetBranchAddress("fMCTruth.", &mcevt);
```

Then I loop over all mctrks from mcevt->GetTrk(). If the pid_pdg is 310 (the number for K_short), I plot the energy.

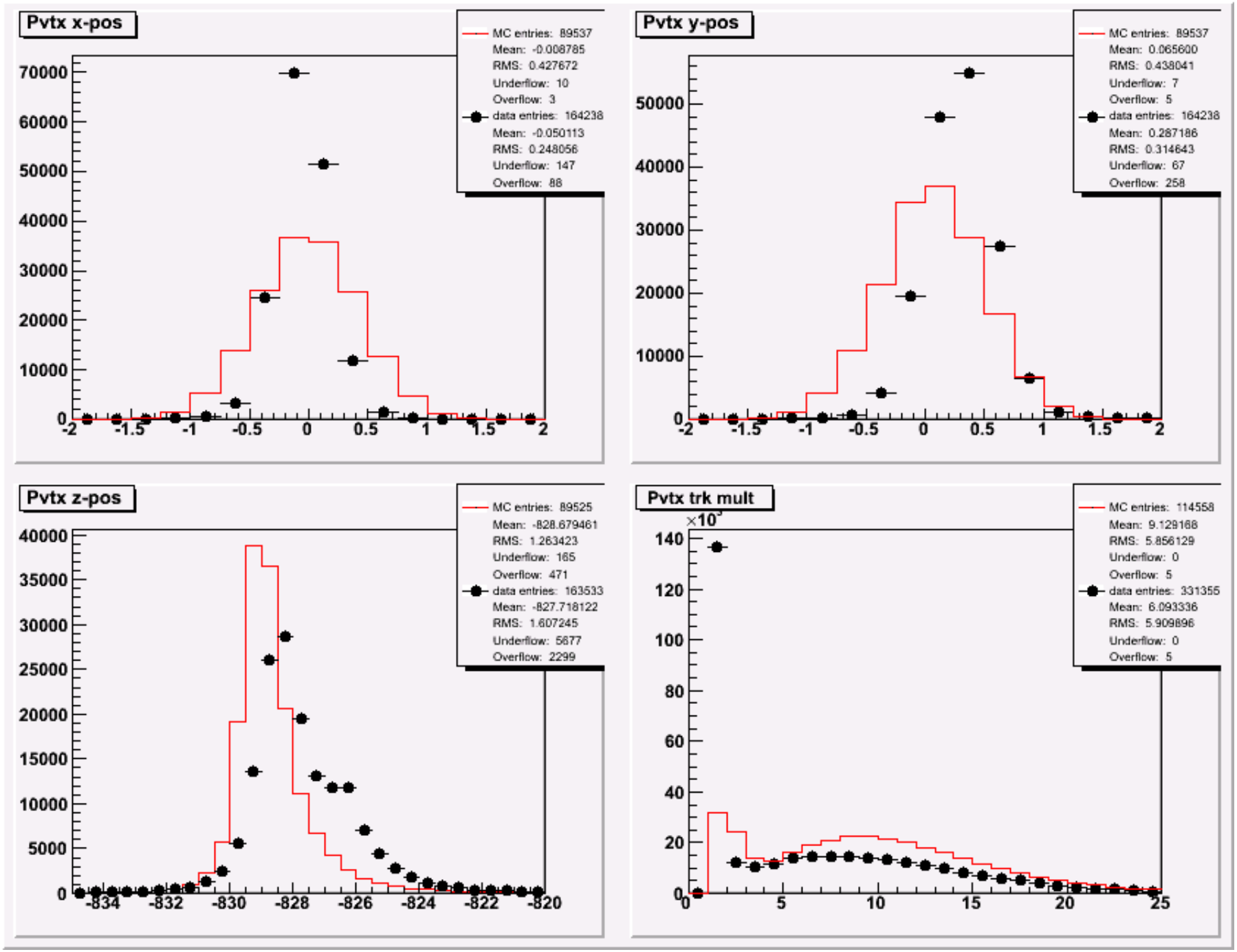
C 2% 120

		data	MC
2	events with 1 bmtrk	331355	114558
3	Pvtx # trks >= 3	182624	95129
4	Pvtx at least 3 trks gof >= 0.05	164238	89537
5	[(x-pos)^2 + (y-pos)^2] < 4.0	163533	89525
6	Pvtx z-pos within -825 to -830	141302	81607

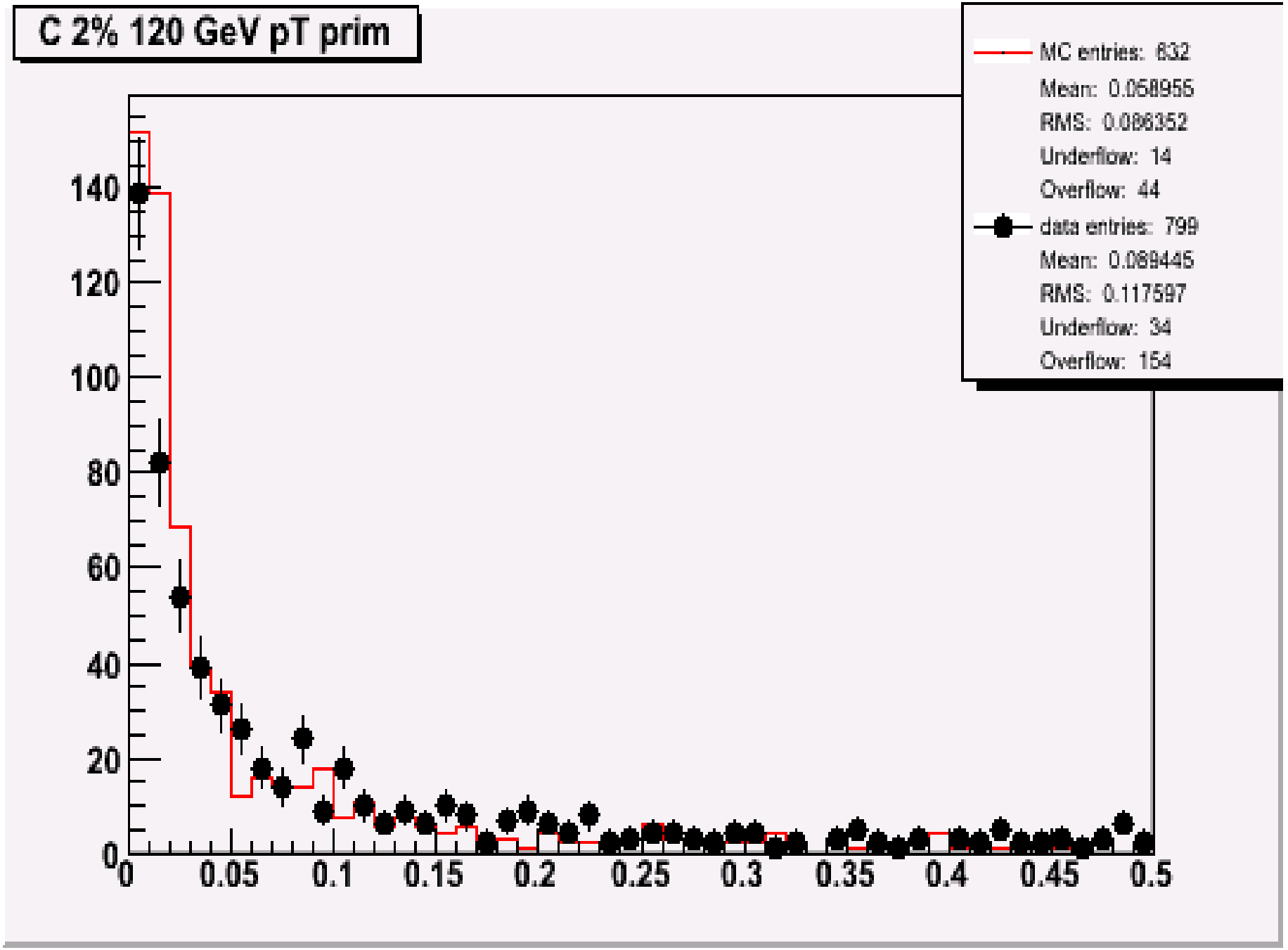
Secondary vertex loop:

7	Svtx 2 trks	18984	6042
8	Svtx downstream of Pvtx	17430	5377
9	Svtx neutral	8277	2866
10	Svtx trks gof > 0.01	799	632
11	pT prim < 0.15	519	525
12	|Svtx mom| > 0.8 GeV	196	173
# of incident particles on target		484133	114558
# of generated MC K^0_s			32766

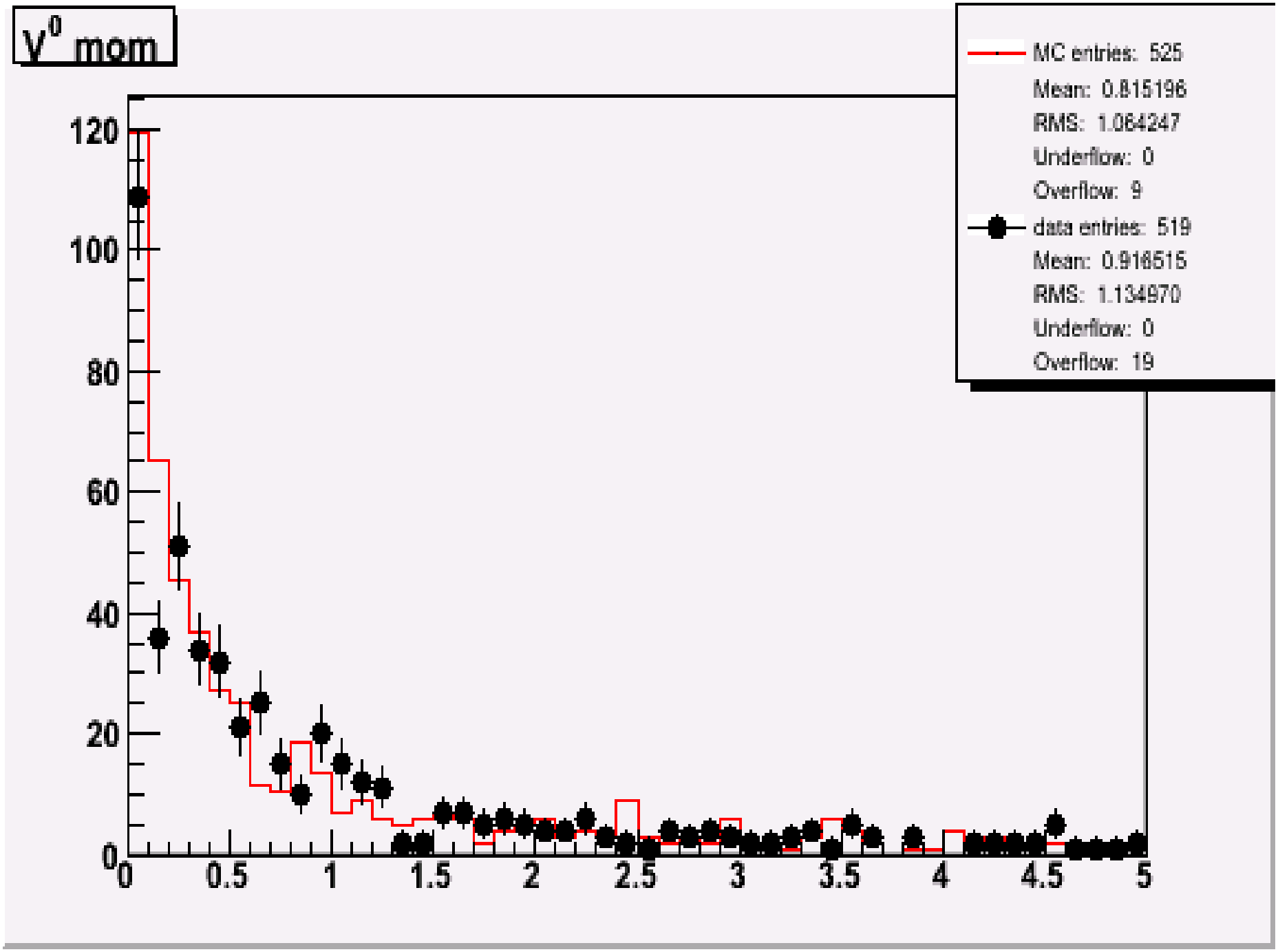
Cut Variable Plots
C 2% 120



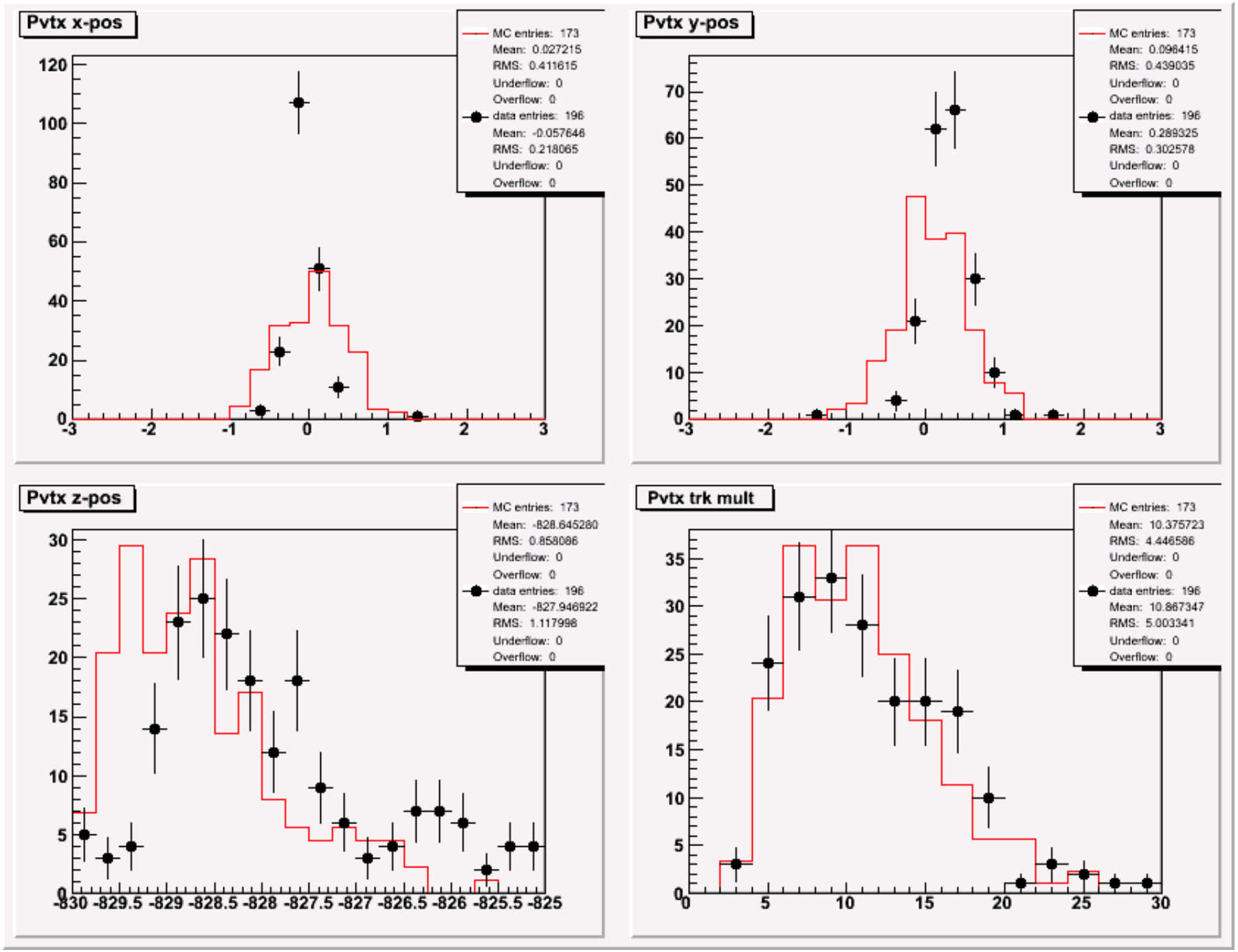
C 2% 120


C 2% 120 GeV pT prim
MC entries: 832
Mean: 0.058955
RMS: 0.086352
Underflow: 14
Overflow: 44
data entries: 799
Mean: 0.089445
RMS: 0.117597
Underflow: 34
Overflow: 154
0
20
40
60
80
100
120
140
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5

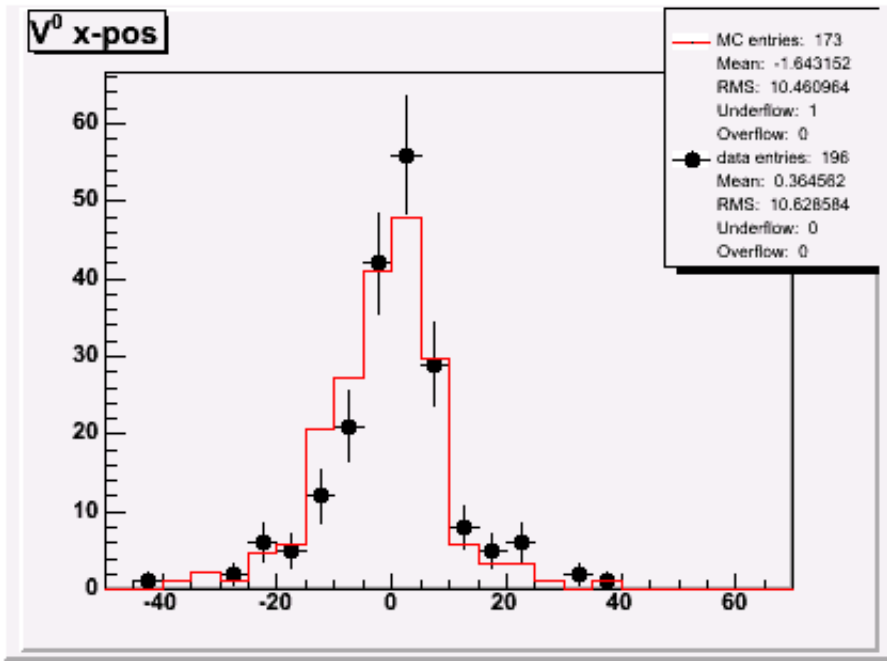
C 2% 120

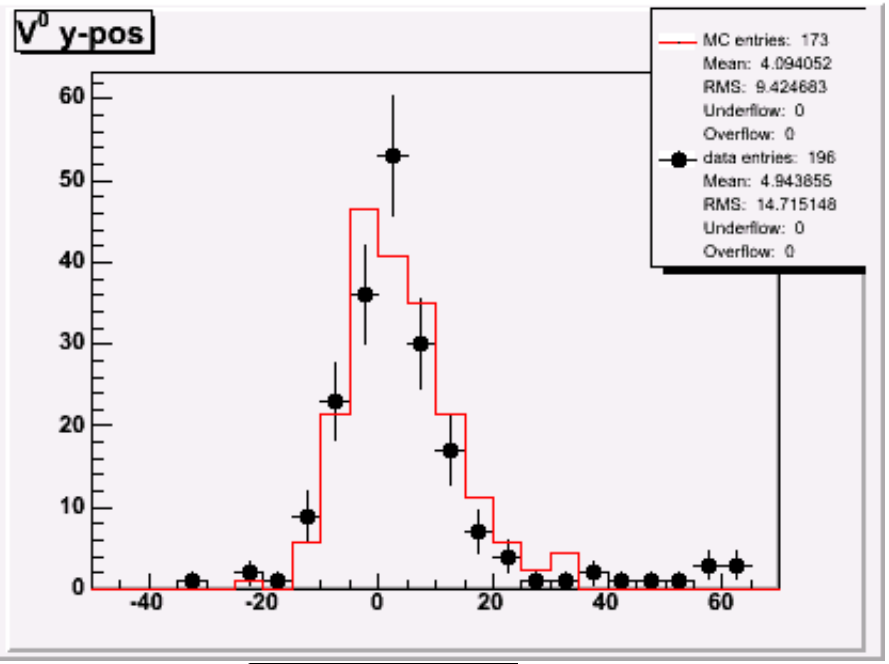

V^0 mom
MC entries: 525
Mean: 0.815196
RMS: 1.064247
Underflow: 0
Overflow: 9
data entries: 519
Mean: 0.918515
RMS: 1.134970
Underflow: 0
Overflow: 19
120
100
80
60
40
20
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

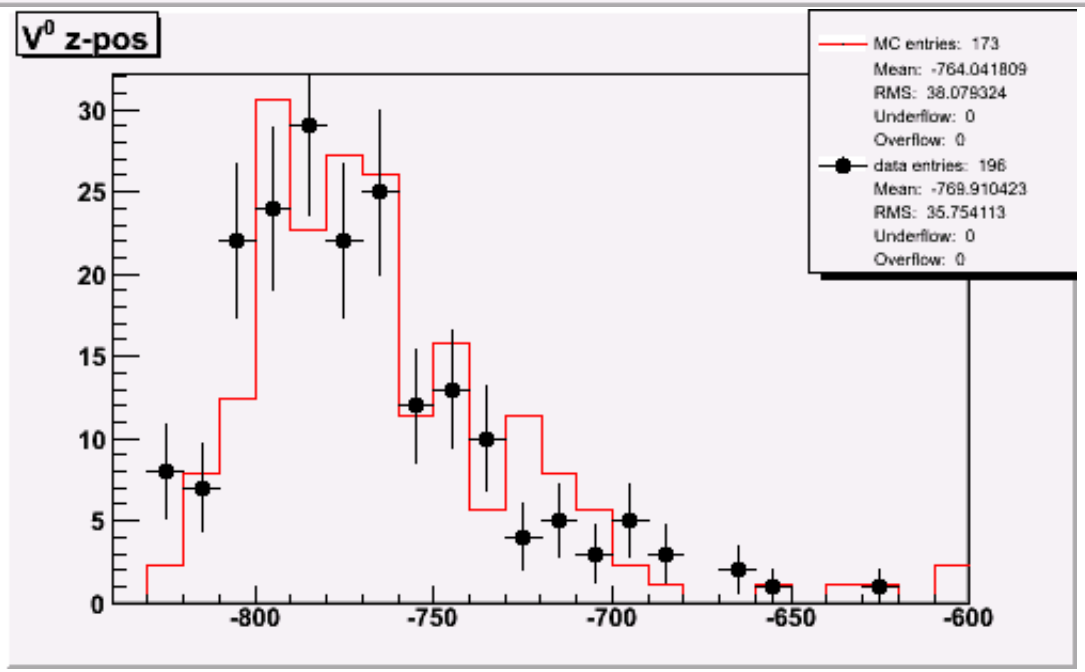
V0 Plots (after all cuts)
C 2% 120



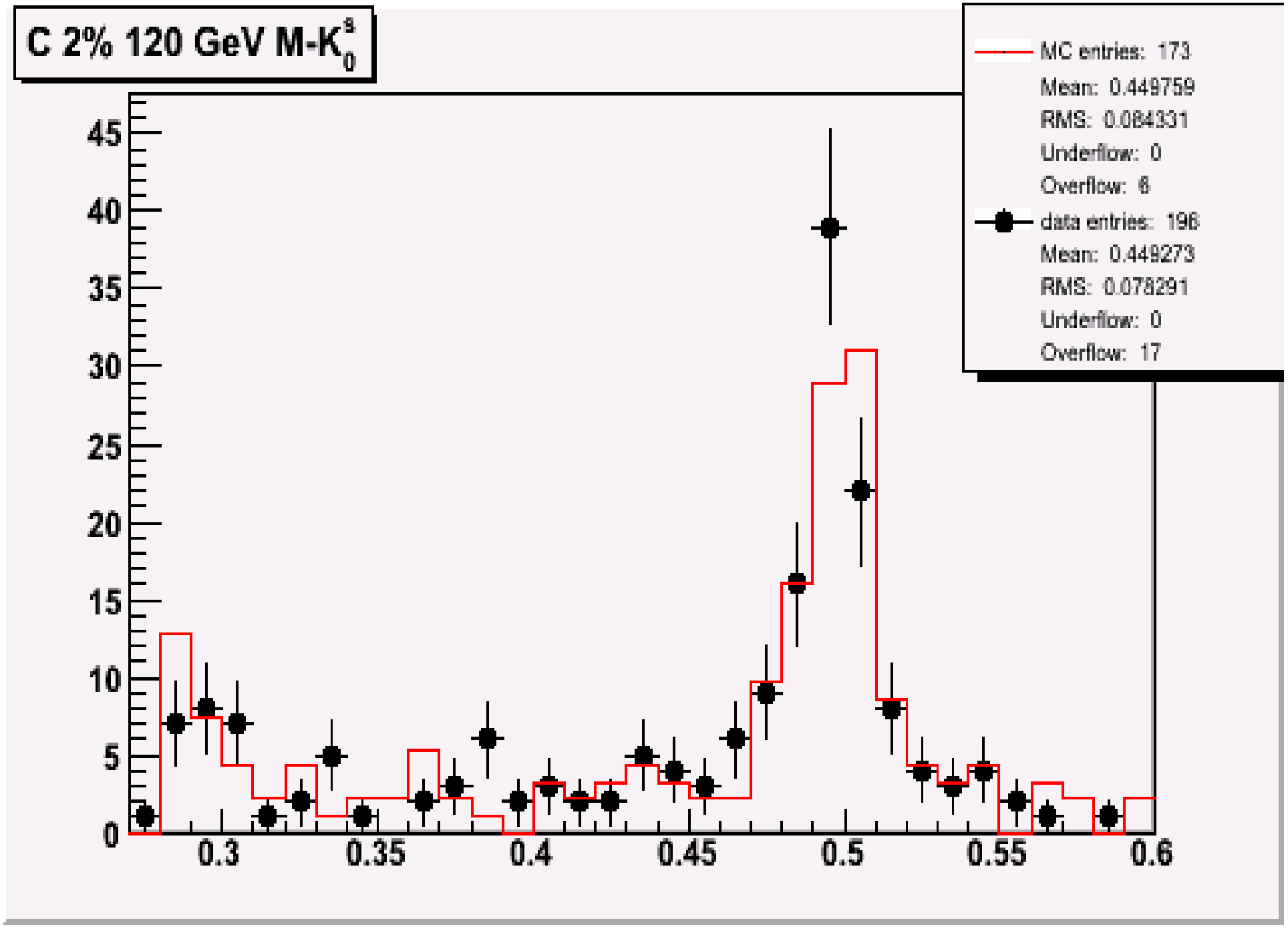
C 2% 120


V0 x-pos
MC entries: 173
Mean: -1.643152
RMS: 10.460964
Underflow: 1
Overflow: 0
data entries: 196
Mean: 0.364562
RMS: 10.628584
Underflow: 0
Overflow: 0

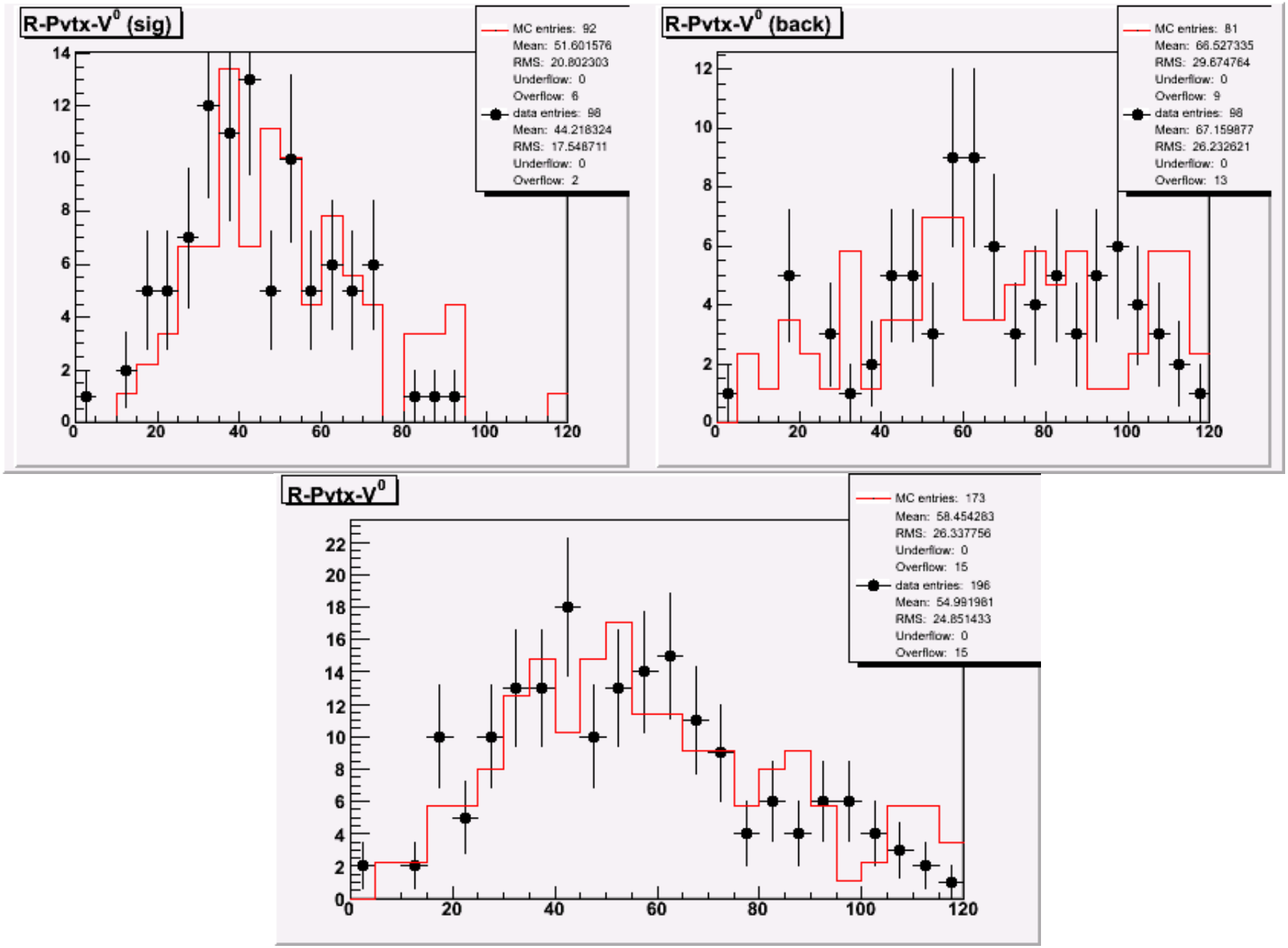

V0 y-pos
MC entries: 173
Mean: 4.094052
RMS: 9.424683
Underflow: 0
Overflow: 0
data entries: 196
Mean: 4.943855
RMS: 14.715148
Underflow: 0
Overflow: 0


V0 z-pos
MC entries: 173
Mean: -764.041809
RMS: 38.079324
Underflow: 0
Overflow: 0
data entries: 196
Mean: -769.910423
RMS: 35.754113
Underflow: 0
Overflow: 0

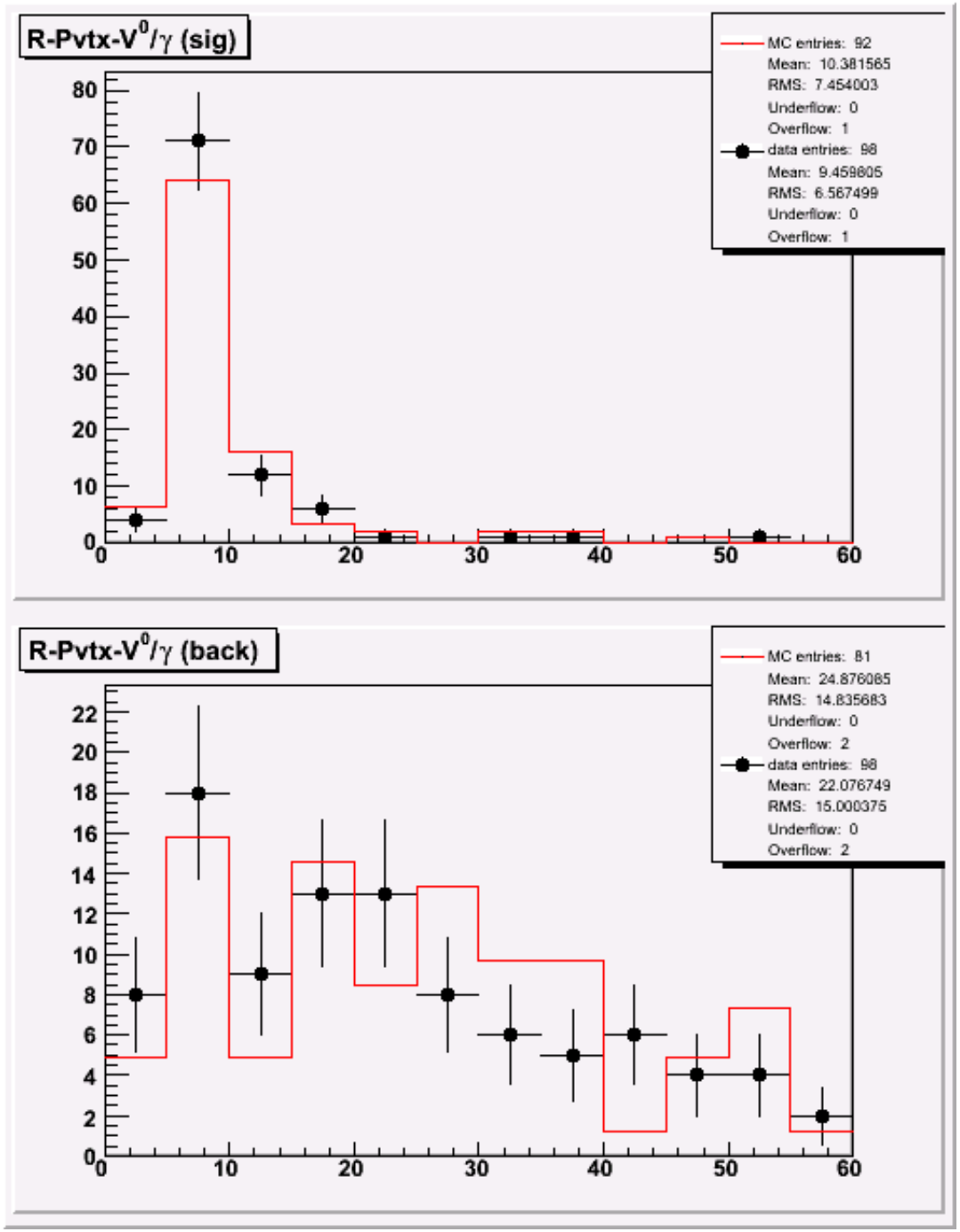
C 2% 120


C 2% 120 GeV M-K^s_0
MC entries: 173
Mean: 0.449759
RMS: 0.084331
Underflow: 0
Overflow: 8
data entries: 196
Mean: 0.449273
RMS: 0.078291
Underflow: 0
Overflow: 17
45
40
35
30
25
20
15
10
5
0
0.3
0.35
0.4
0.45
0.5
0.55
0.6

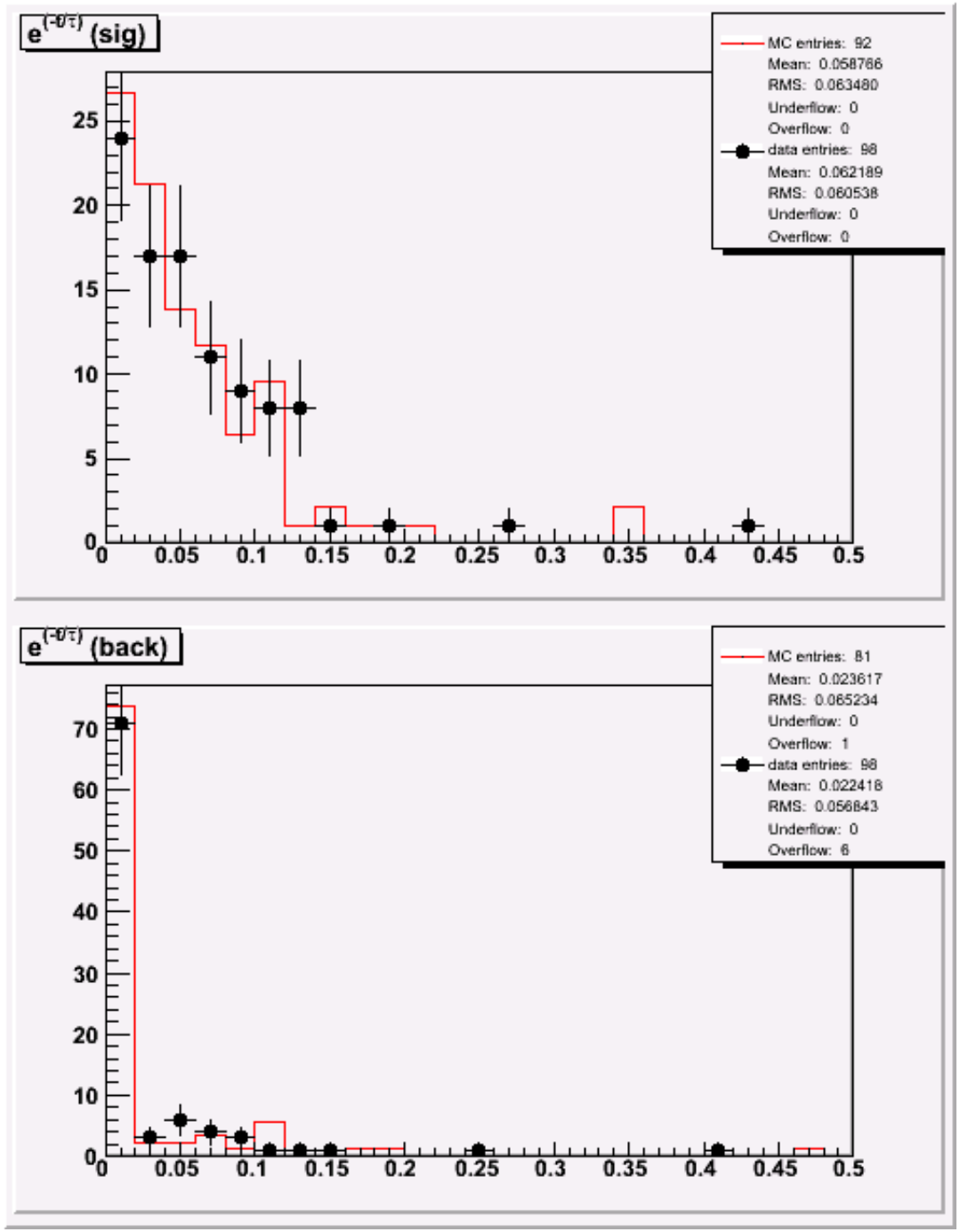
C 2% 120


R-Pvtx-V^0 (sig)
MC entries: 92
Mean: 51.601576
RMS: 20.802303
Underflow: 0
Overflow: 6
data entries: 98
Mean: 44.218324
RMS: 17.548711
Underflow: 0
Overflow: 2
R-Pvtx-V^0 (back)
MC entries: 81
Mean: 66.527335
RMS: 29.674764
Underflow: 0
Overflow: 9
data entries: 98
Mean: 67.159877
RMS: 26.232621
Underflow: 0
Overflow: 13
R-Pvtx-V^0
MC entries: 173
Mean: 58.454283
RMS: 26.337756
Underflow: 0
Overflow: 15
data entries: 196
Mean: 54.991981
RMS: 24.851433
Underflow: 0
Overflow: 15

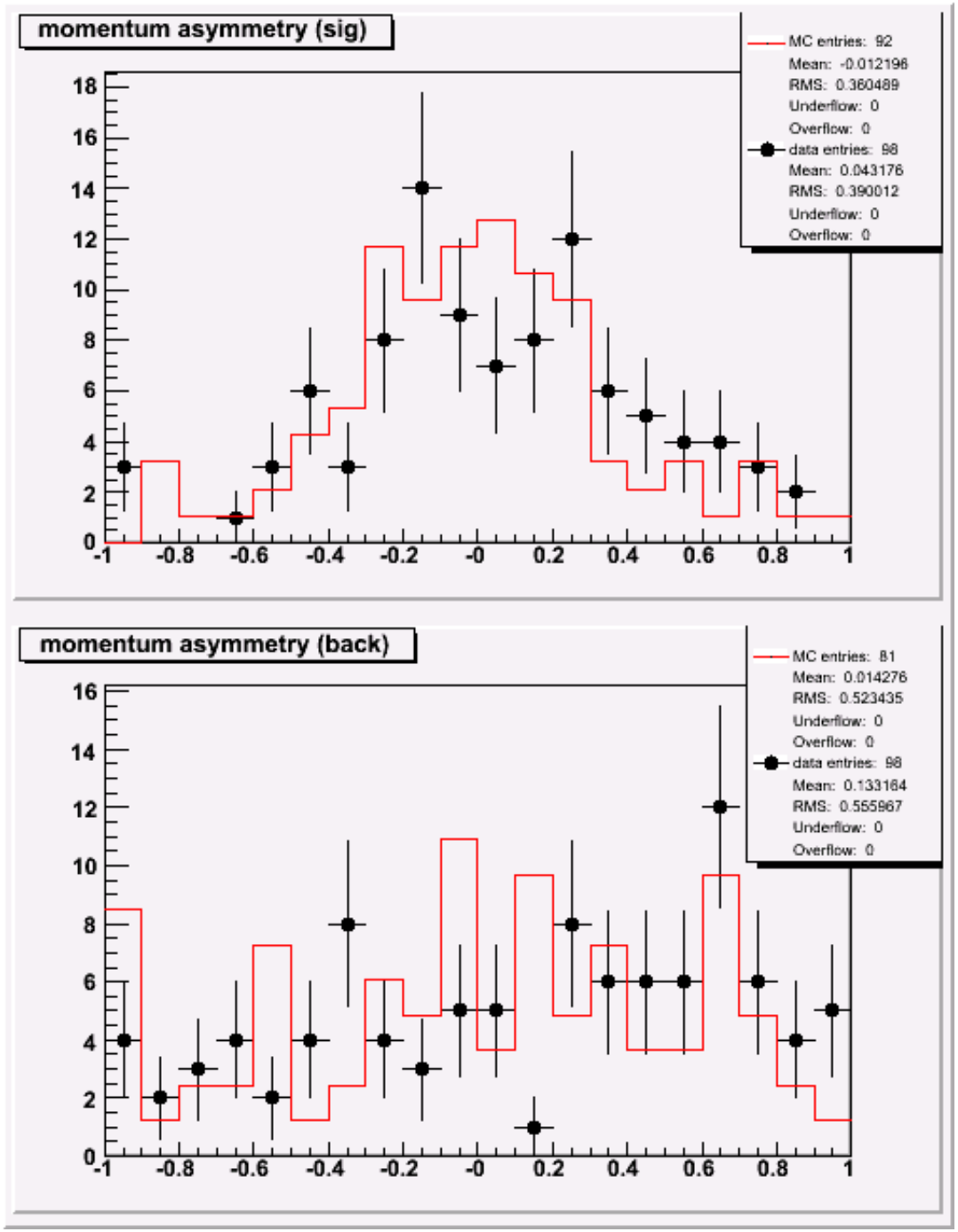
C 2% 120


R-Pvtx-V^0/γ (sig)
MC entries: 92
Mean: 10.381565
RMS: 7.454003
Underflow: 0
Overflow: 1
data entries: 98
Mean: 9.459805
RMS: 6.567499
Underflow: 0
Overflow: 1
R-Pvtx-V^0/γ (back)
MC entries: 81
Mean: 24.876085
RMS: 14.835683
Underflow: 0
Overflow: 2
data entries: 98
Mean: 22.076749
RMS: 15.000375
Underflow: 0
Overflow: 2

C 2% 120


$e^{(-\theta/\tau)}$ (sig)
MC entries: 92
Mean: 0.058766
RMS: 0.063480
Underflow: 0
Overflow: 0
data entries: 98
Mean: 0.062189
RMS: 0.060538
Underflow: 0
Overflow: 0
$e^{(-\theta/\tau)}$ (back)
MC entries: 81
Mean: 0.023617
RMS: 0.065234
Underflow: 0
Overflow: 1
data entries: 98
Mean: 0.022418
RMS: 0.056843
Underflow: 0
Overflow: 6

C 2% 120


momentum asymmetry (sig)
MC entries: 92
Mean: -0.012196
RMS: 0.360489
Underflow: 0
Overflow: 0
data entries: 98
Mean: 0.043176
RMS: 0.390012
Underflow: 0
Overflow: 0
momentum asymmetry (back)
MC entries: 81
Mean: 0.014276
RMS: 0.523435
Underflow: 0
Overflow: 0
data entries: 98
Mean: 0.133164
RMS: 0.555967
Underflow: 0
Overflow: 0

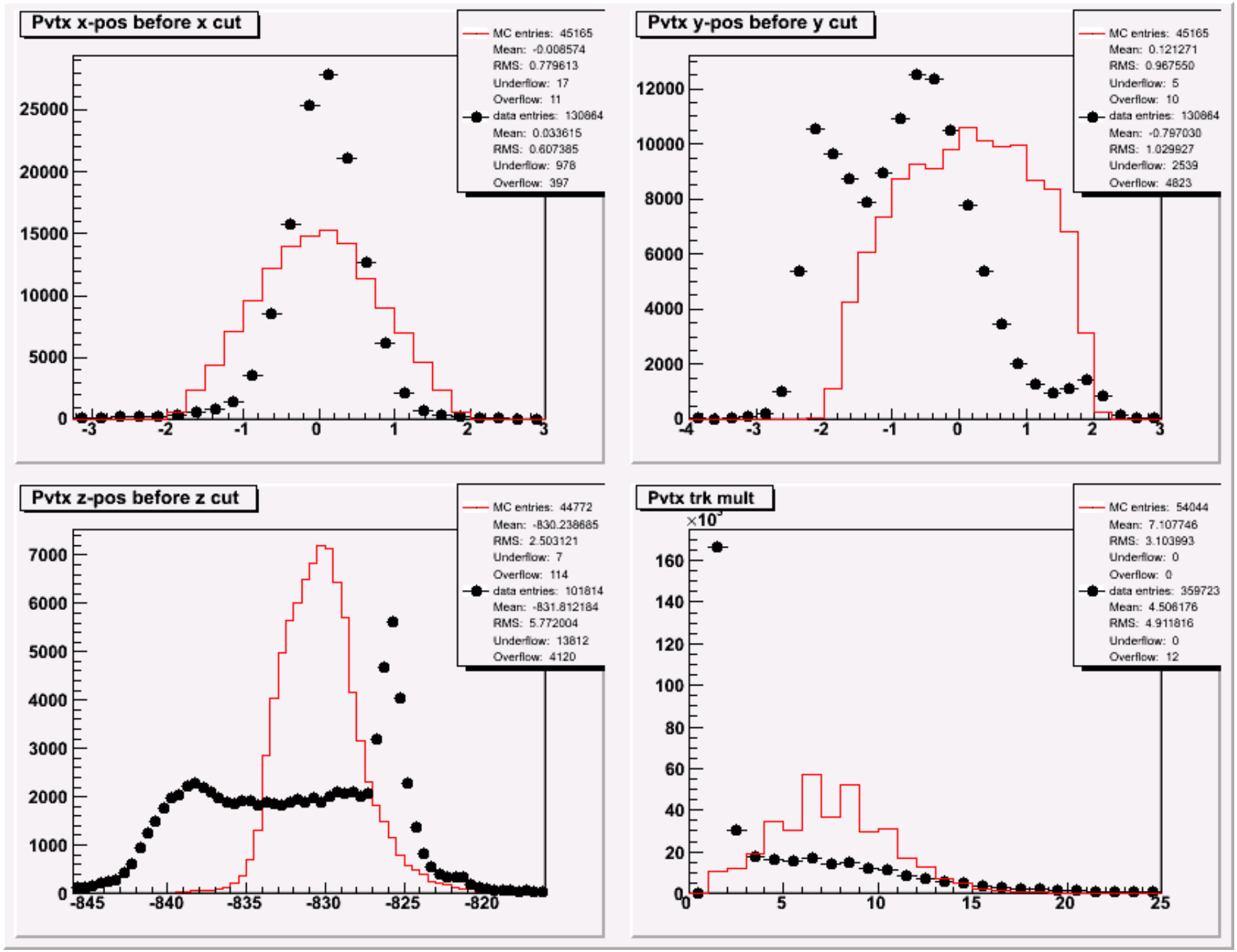
LH2 84 data/85 MC

		data	MC
2	events with 1 bmtrk	359723	54044
3	Pvtx # trks >= 3	162910	50628
4	Pvtx at least 3 trks gof >= 0.05	130864	45165
5	[(x-pos)^2 + (y-pos)^2] < 4.0	101814	44772
6	Pvtx zpos within -823 to -843	80625	44254

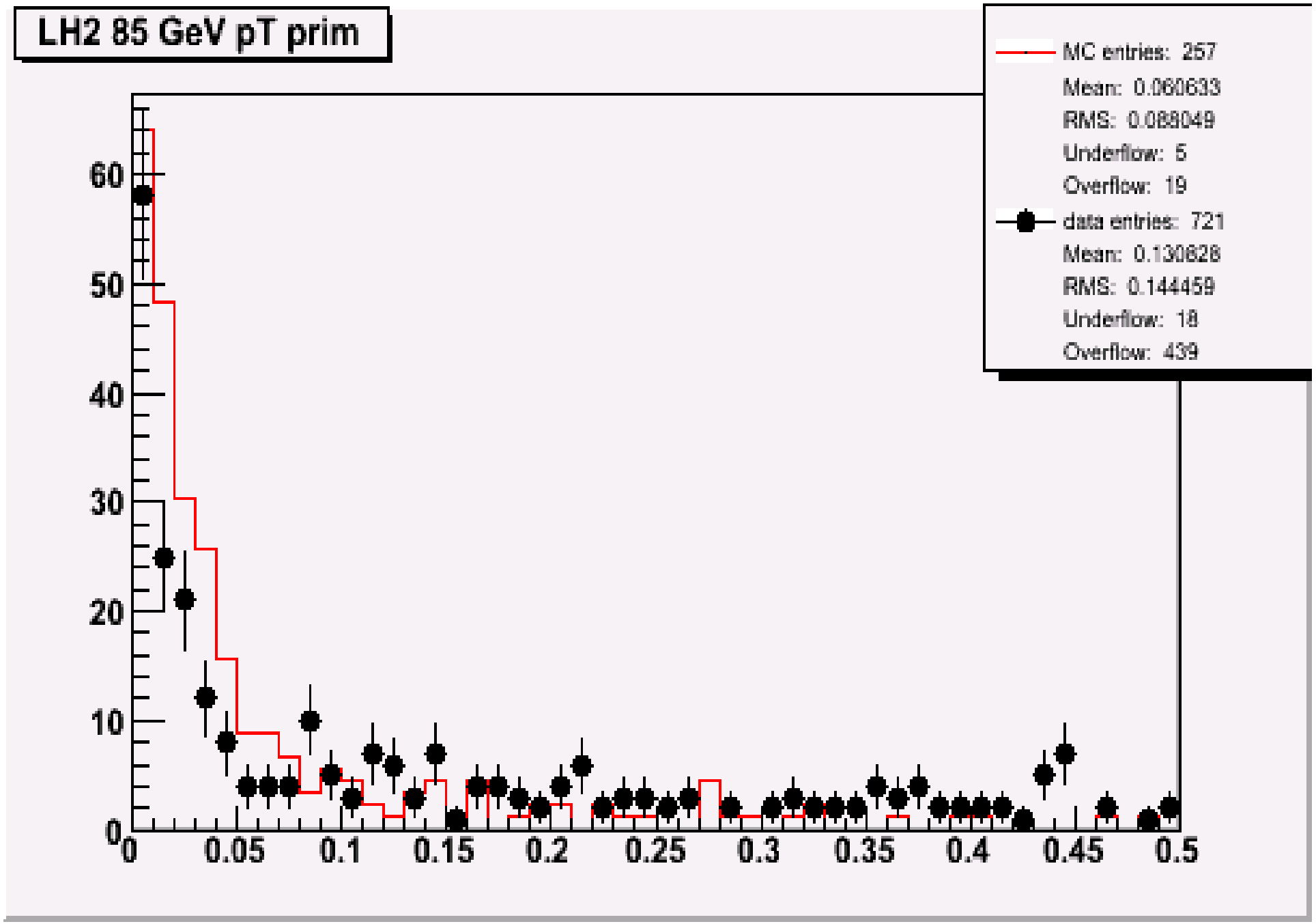
Secondary vertex loop:

7	Svtx 2 trks	15893	1948
8	Svtx downstream of Pvtx	13390	1808
9	Svtx neutral	6708	1068
10	Svtx gof > 0.01	721	257
11	pT prim < 0.15	195	213
12	|sec vtx mom| > 0.8 GeV	78	87
# of incident particles on target		578101	54044
# of generated K^0_s			19091

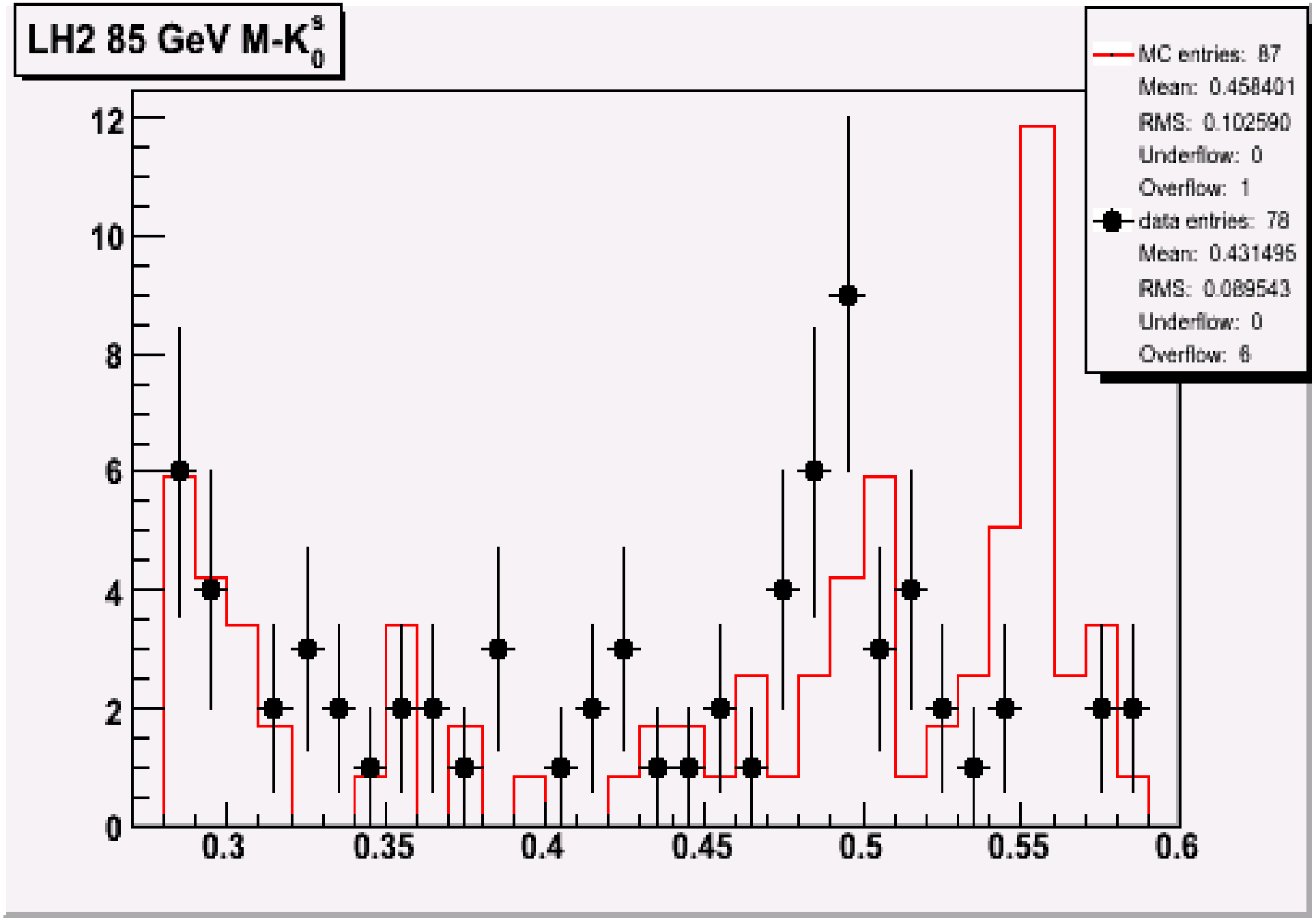
Cut Variable Plots
LH2 84 data/85 MC



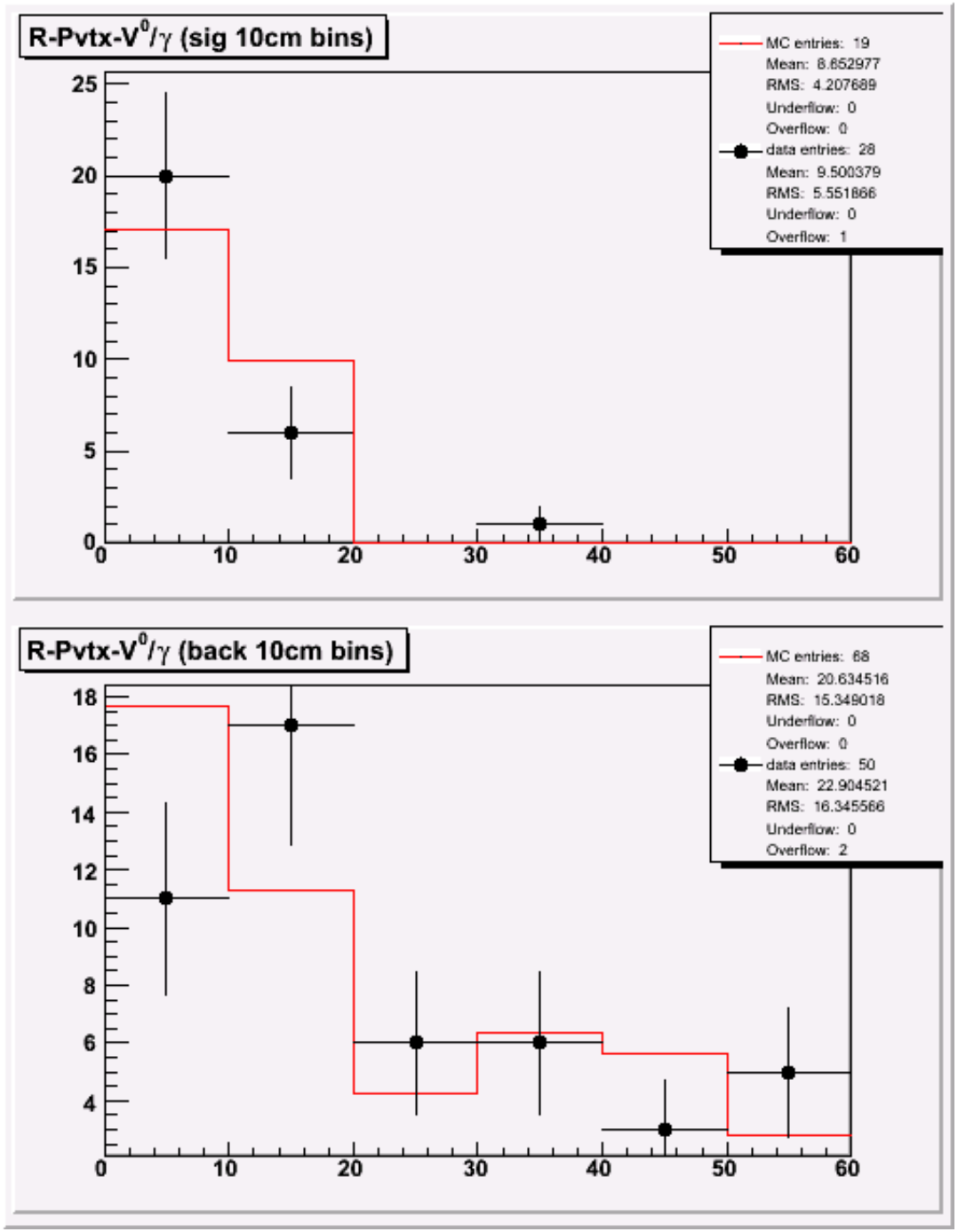
LH2 84 data/85 MC



LH2 84 data/85 MC



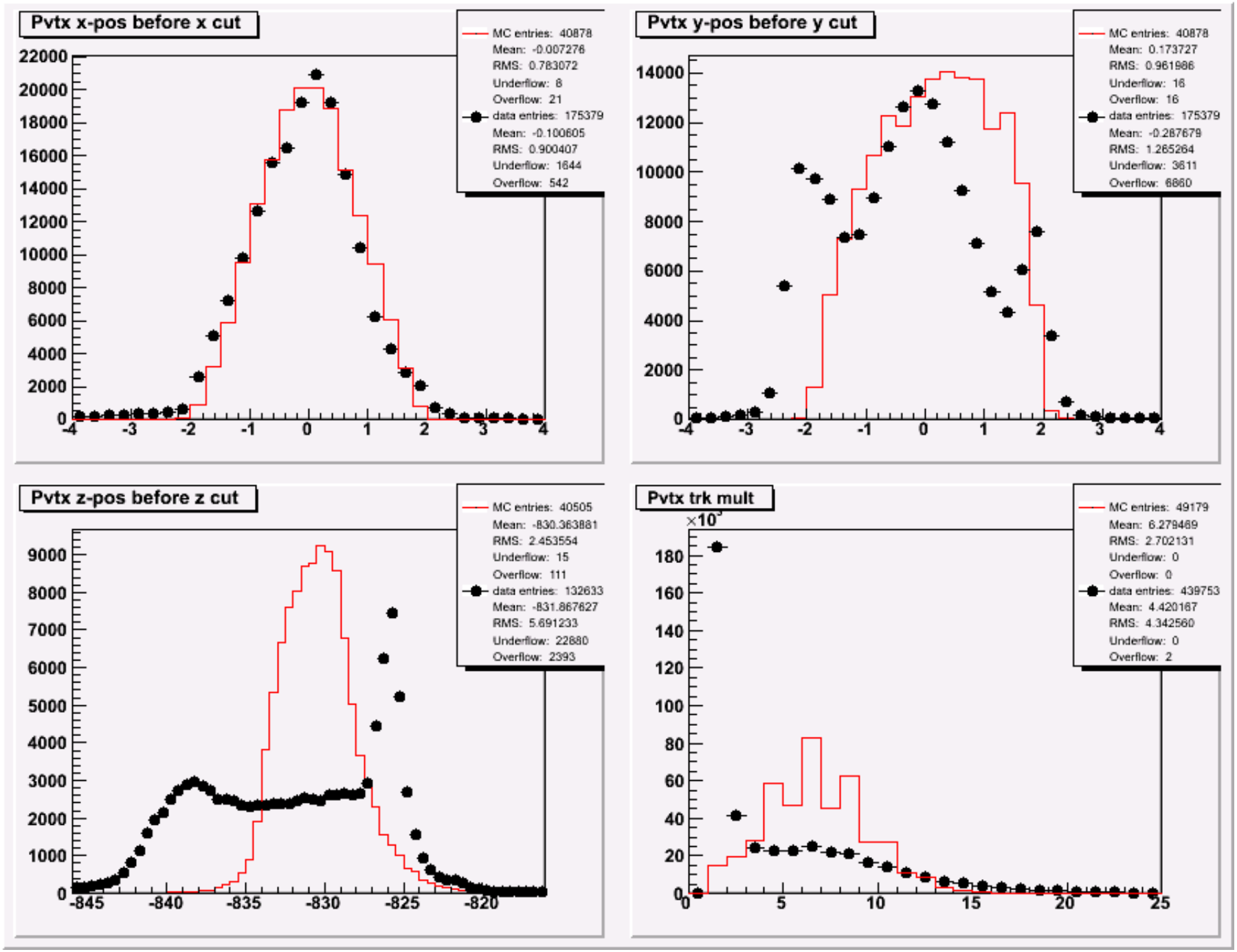
LH2 84 data/85 MC



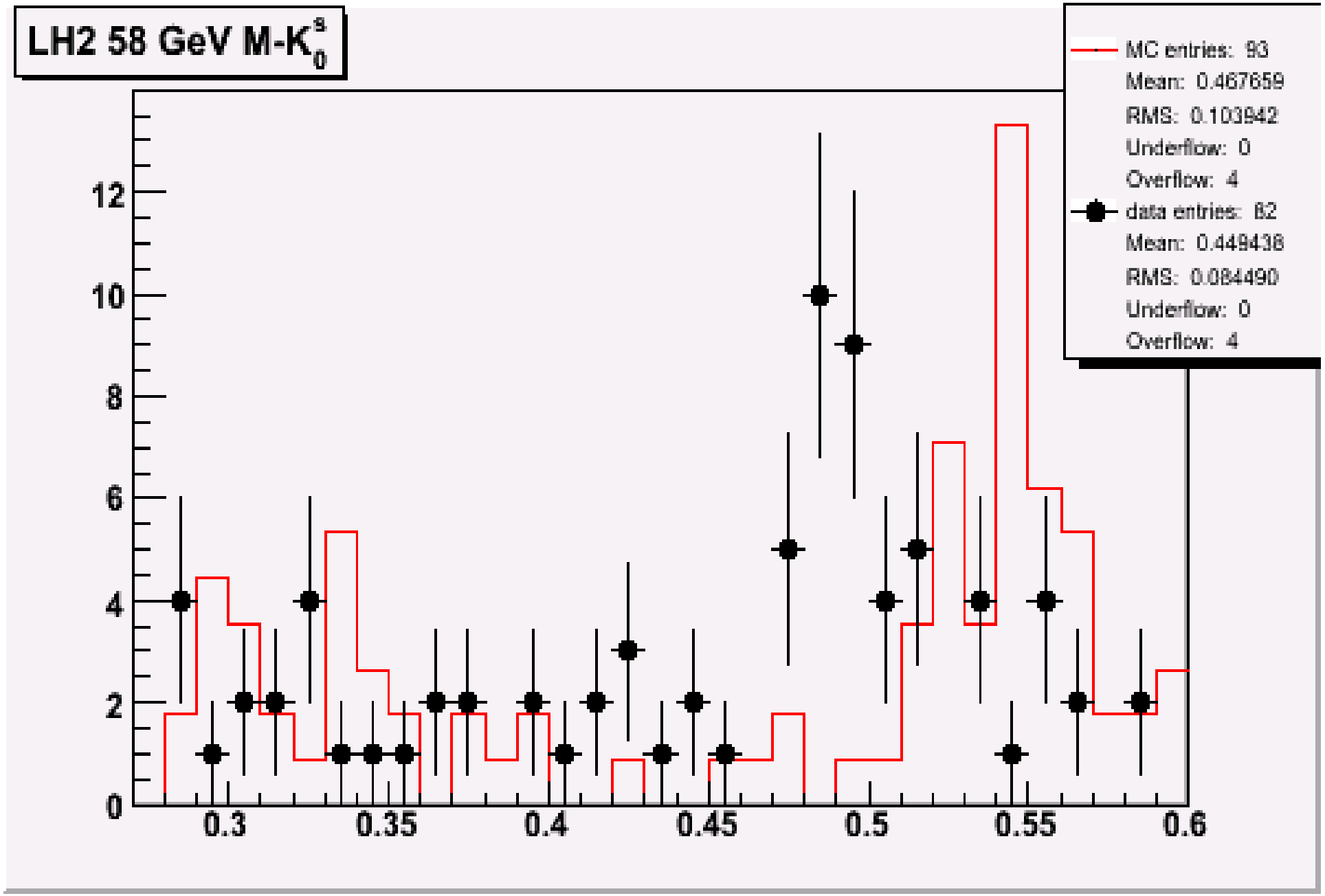
LH2 58

		data	MC
2	events with 1 bmtrk	439753	49179
3	Pvtx # trks >= 3	213801	45318
4	Pvtx at least 3 trks gof >= 0.05	175379	40878
5	[(x-pos)^2 + (y-pos)^2] < 4.0	132633	40505
6	Pvtx zpos within -823 to -843	103918	40123
Secondary vertex loop:			
7	Svtx 2 trks	22660	1612
8	Svtx downstream of Pvtx	18919	1492
9	Svtx neutral	9922	927
10	Svtx gof > 0.01	1227	267
11	pT prim < 0.15	242	225
12	|sec vtx mom| > 0.8 GeV	82	93
# of incident particles on target		828373	49179
# of generated K^0_S			16903

Cut Variable Plots
LH2 58



V0 Plots (after all cuts)
LH2 58



NuMI 120

		data	MC
2	events with 1 bmtrk	570571	3913907
3	(one Pvtx) Pvtx # trks >= 3	820271	4192509
4	(one Pvtx) Pvtx at least 3 trks gof >= 0.05	564739	3522841
5	(one Pvtx) [(x-pos)^2 + (y-pos)^2] < 1.0	480491	3329770
6	(one Pvtx) Pvtx z-pos within -940 to -830	468897	3275545

Secondary vertex loop:

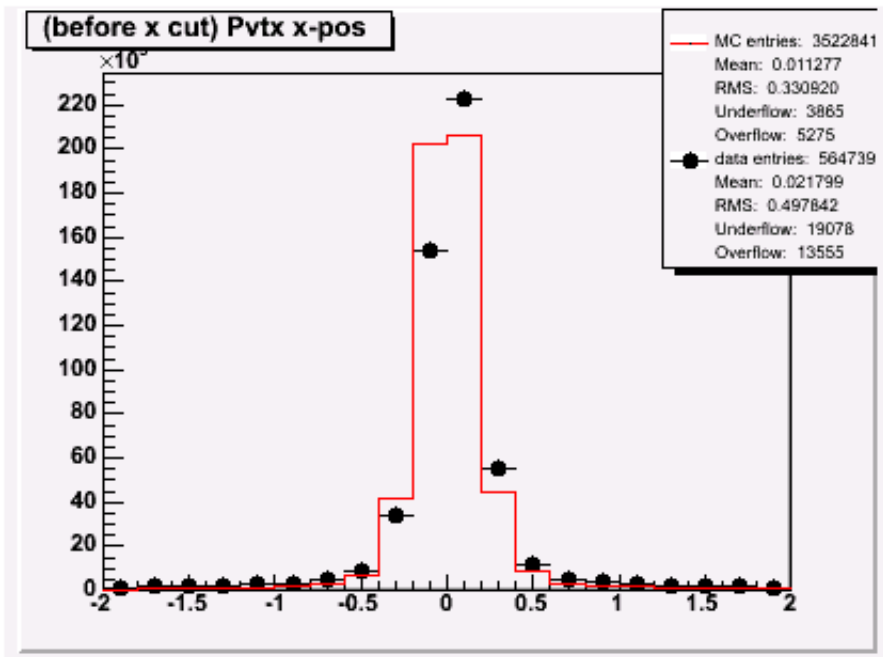
7	(one Pvtx) Svtx 2 trks	207691	1035504
8	(one Pvtx) Svtx downstream of Pvtx	176181	823270
9	(one Pvtx) Svtx neutral	80518	389270
10	(one Pvtx) Svtx trks gof > 0.01	19490	118974
11	(one Pvtx) pT prim < 0.3	11141	71092
12	(one Pvtx) |Svtx mom| > 0.8	5185	29264
13	(one Pvtx) |mom asym| < 0.8	3200	23064

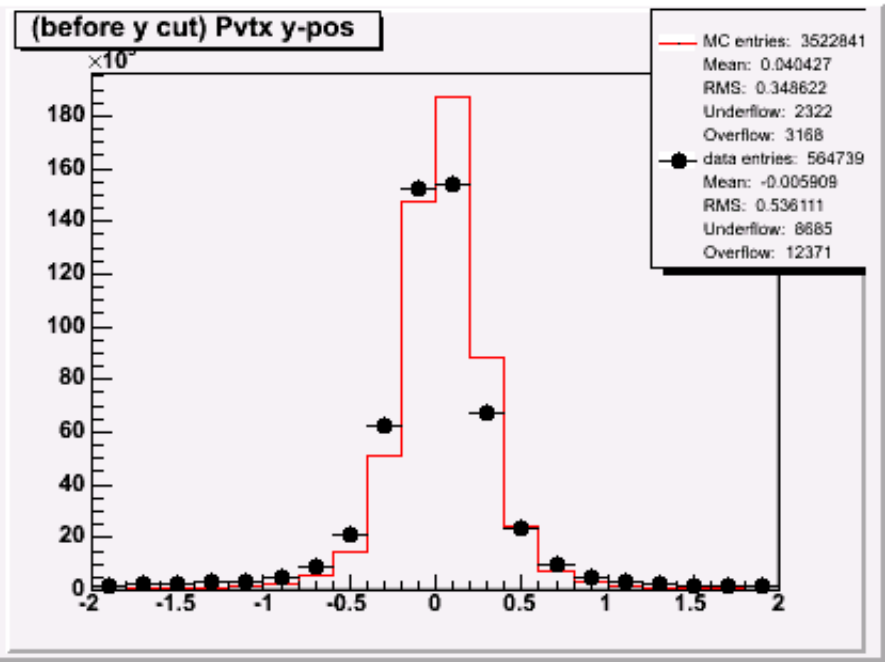
Secondary vertex loop:

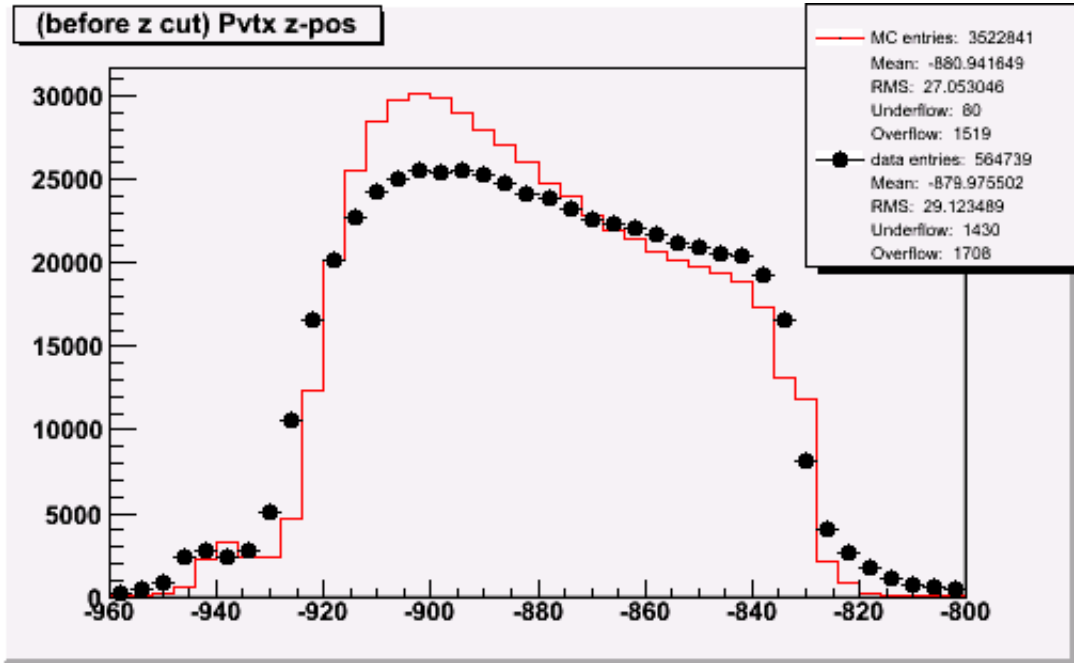
7	(most trks) Svtx 2 trks	22169	70012
8	(most trks) Svtx downstream of Pvtx	18765	52727
9	(most trks) Svtx neutral	8197	24159
10	(most trks) Svtx trks gof > 0.01	1807	6738
11	(most trks) pT prim < 0.3	1095	3721
12	(most trks) |Svtx mom| > 0.8	481	1246
13	(most trks) |mom asym| < 0.8	251	943

# of incident particles on target	626737	3913927
# of generated K^0_S		1359393

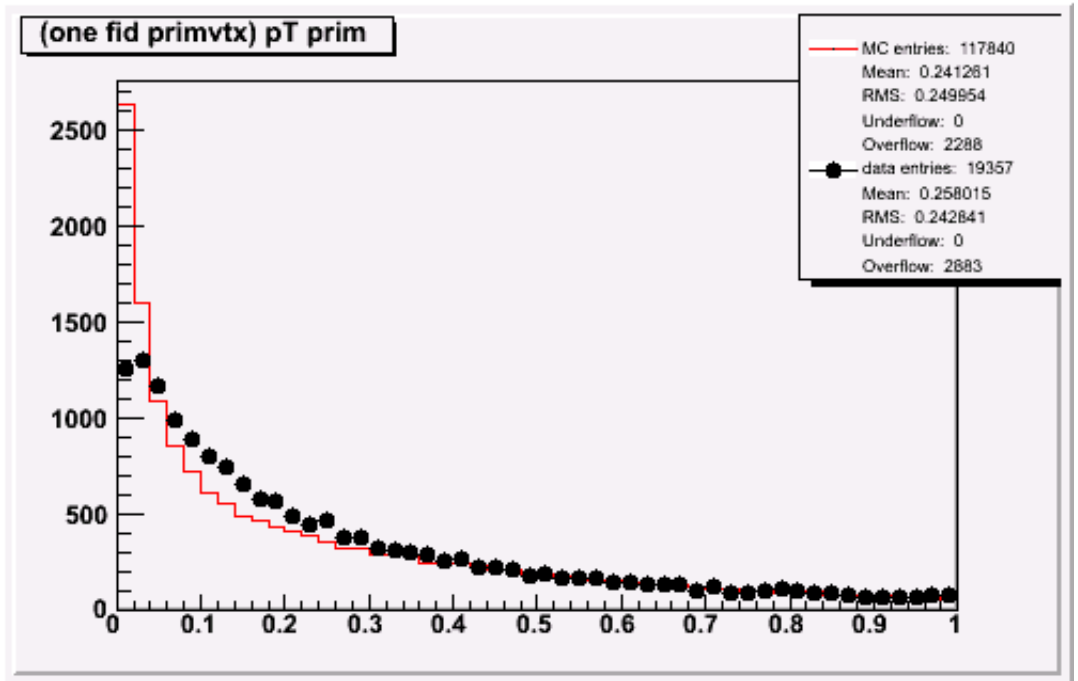
Cut Variable Plots
NuMI 120



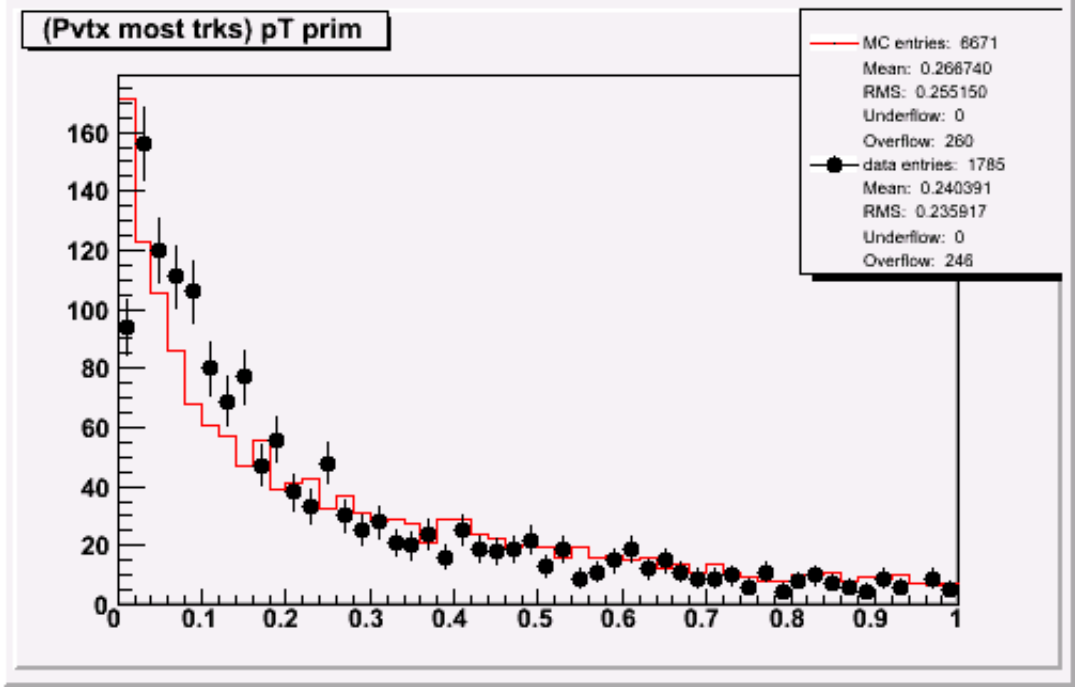




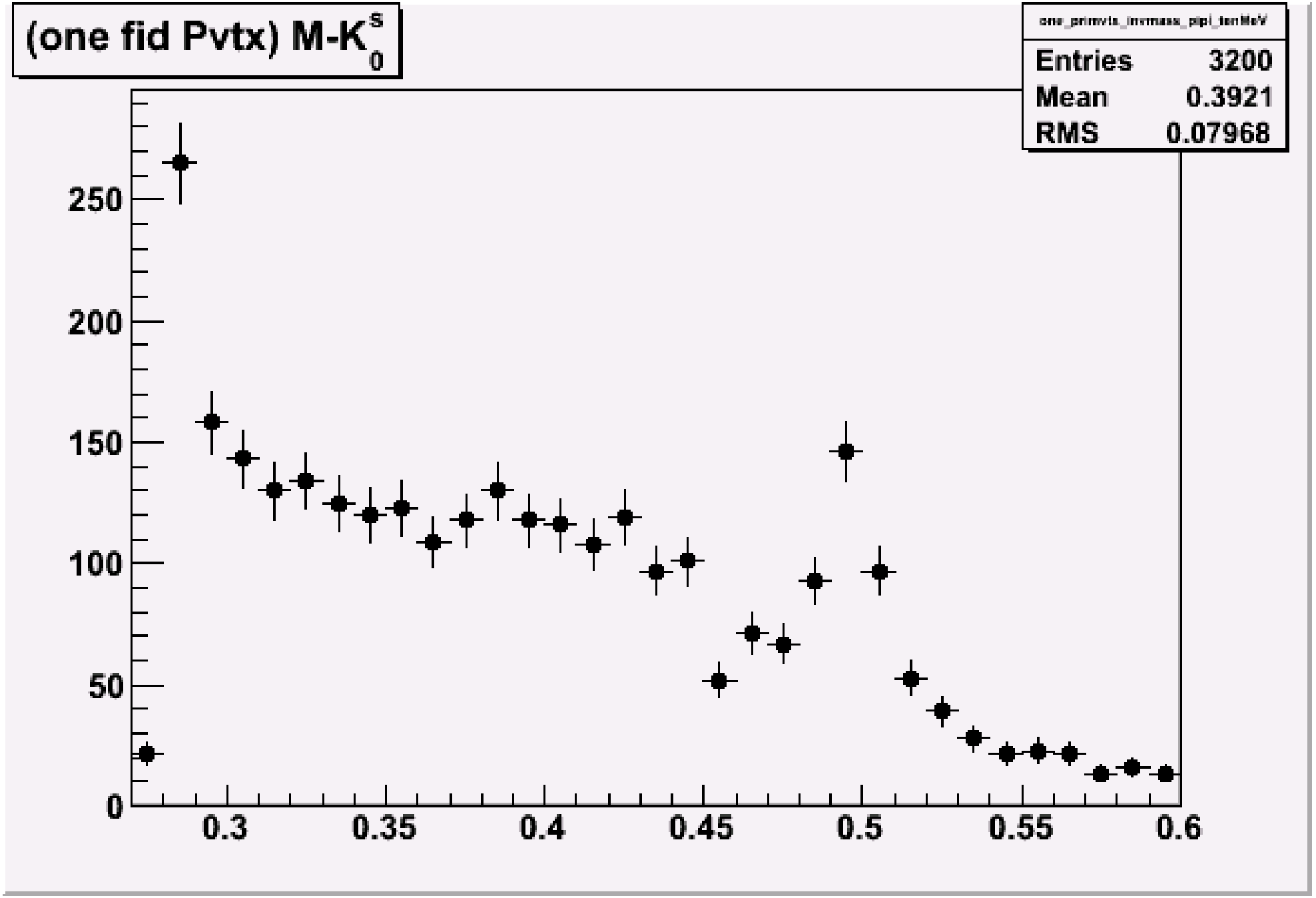
V0 Plots (after all cuts)
NuMI 120



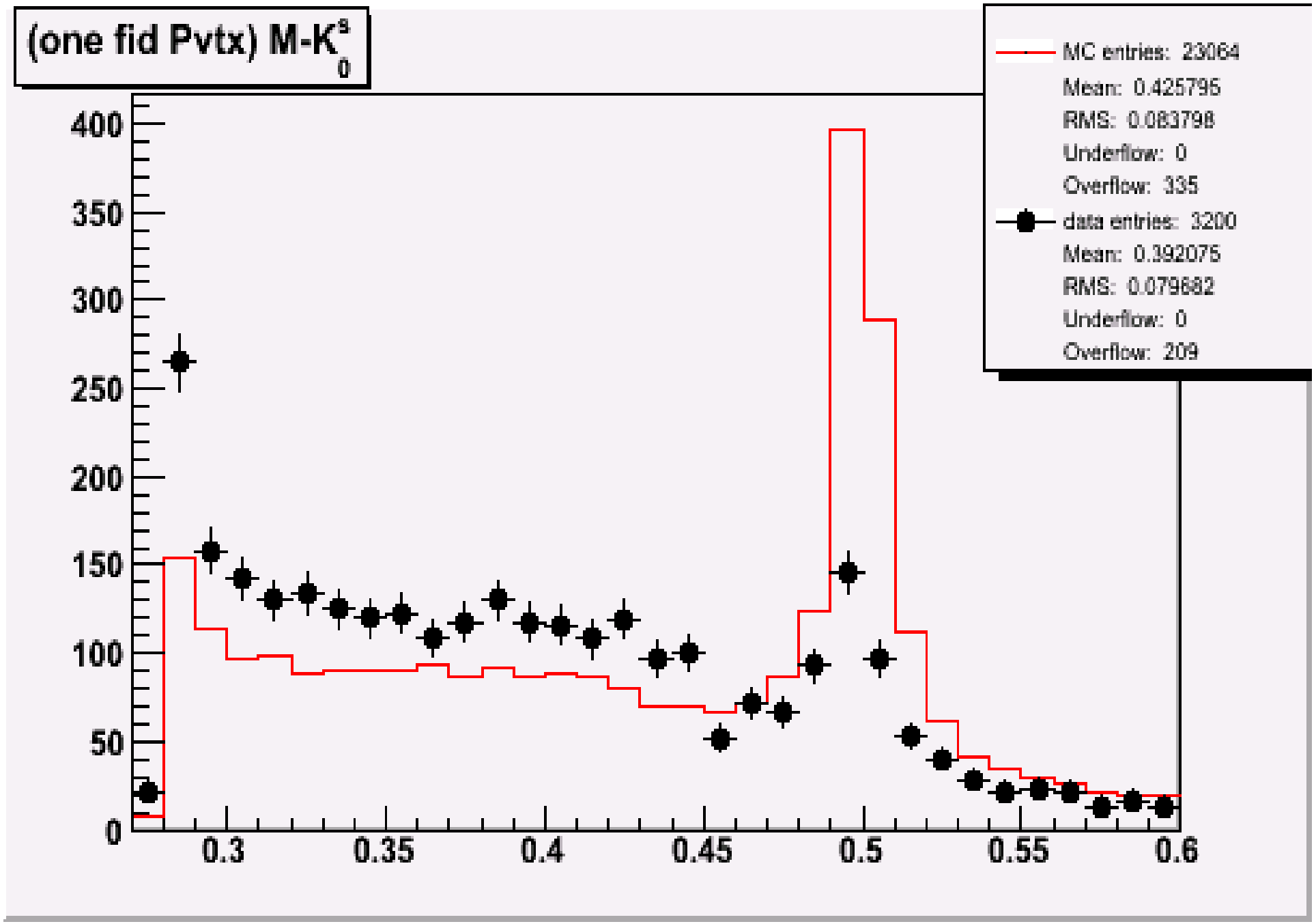
>= 2 Pvtx



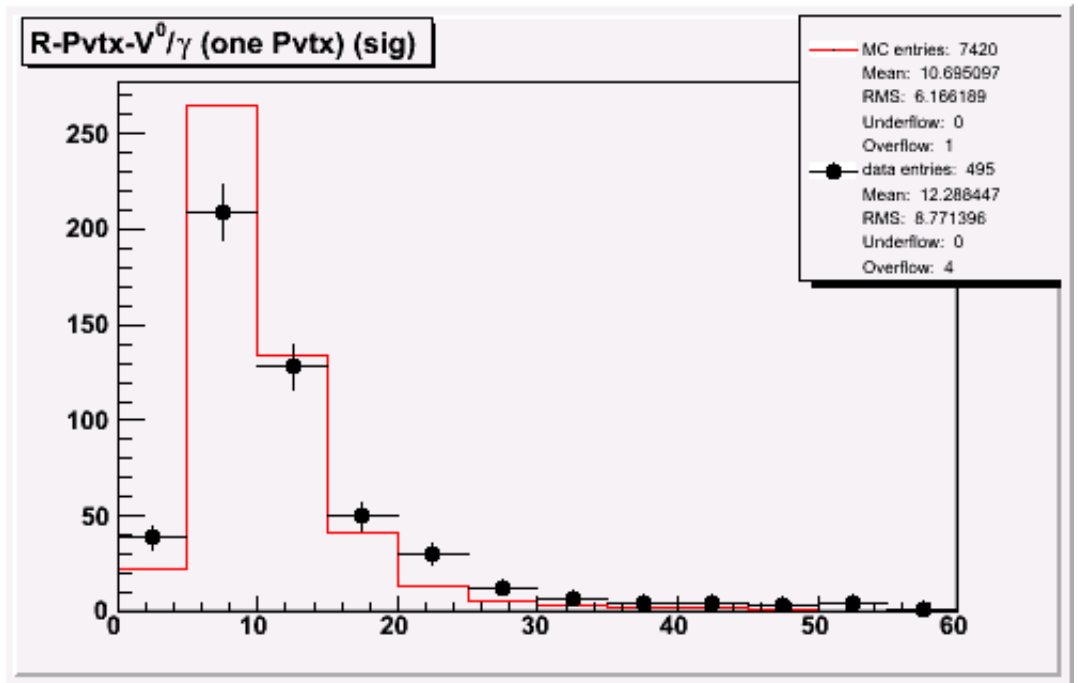
NuMI 120

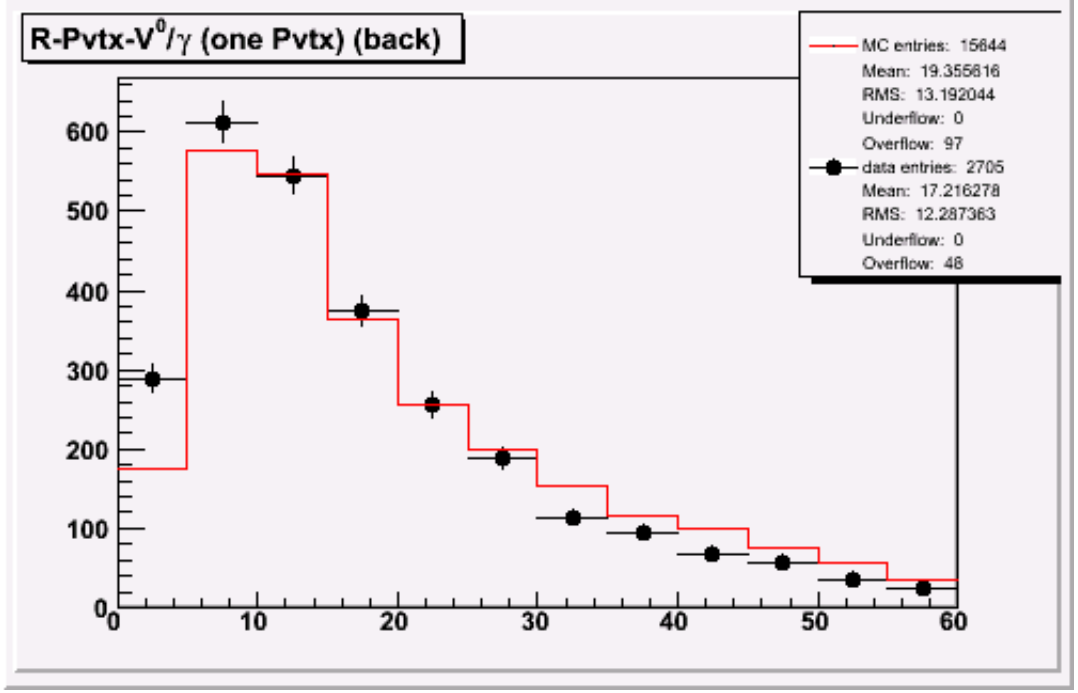

(one fid Pvtx) M-K$^S_0$
one_primvtx_invmass_pipi_ten MeV
Entries 3200
Mean 0.3921
RMS 0.07968
250
200
150
100
50
0
0.3
0.35
0.4
0.45
0.5
0.55
0.6

NuMI 120


(one fid Pvtx) M-K$^s_0$
MC entries: 23064
Mean: 0.425795
RMS: 0.083798
Underflow: 0
Overflow: 335
data entries: 3200
Mean: 0.392075
RMS: 0.079682
Underflow: 0
Overflow: 209
400
350
300
250
200
150
100
50
0
0.3
0.35
0.4
0.45
0.5
0.55
0.6

NuMI 120


R-Pvtx-V^0/γ (one Pvtx) (sig)
MC entries: 7420
Mean: 10.695097
RMS: 6.166189
Underflow: 0
Overflow: 1
data entries: 495
Mean: 12.288447
RMS: 8.771396
Underflow: 0
Overflow: 4
0
50
100
150
200
250
0
10
20
30
40
50
60


R-Pvtx-V^0/γ (one Pvtx) (back)
MC entries: 15644
Mean: 19.355616
RMS: 13.192044
Underflow: 0
Overflow: 97
data entries: 2705
Mean: 17.216278
RMS: 12.287363
Underflow: 0
Overflow: 48
0
100
200
300
400
500
600
0
10
20
30
40
50
60

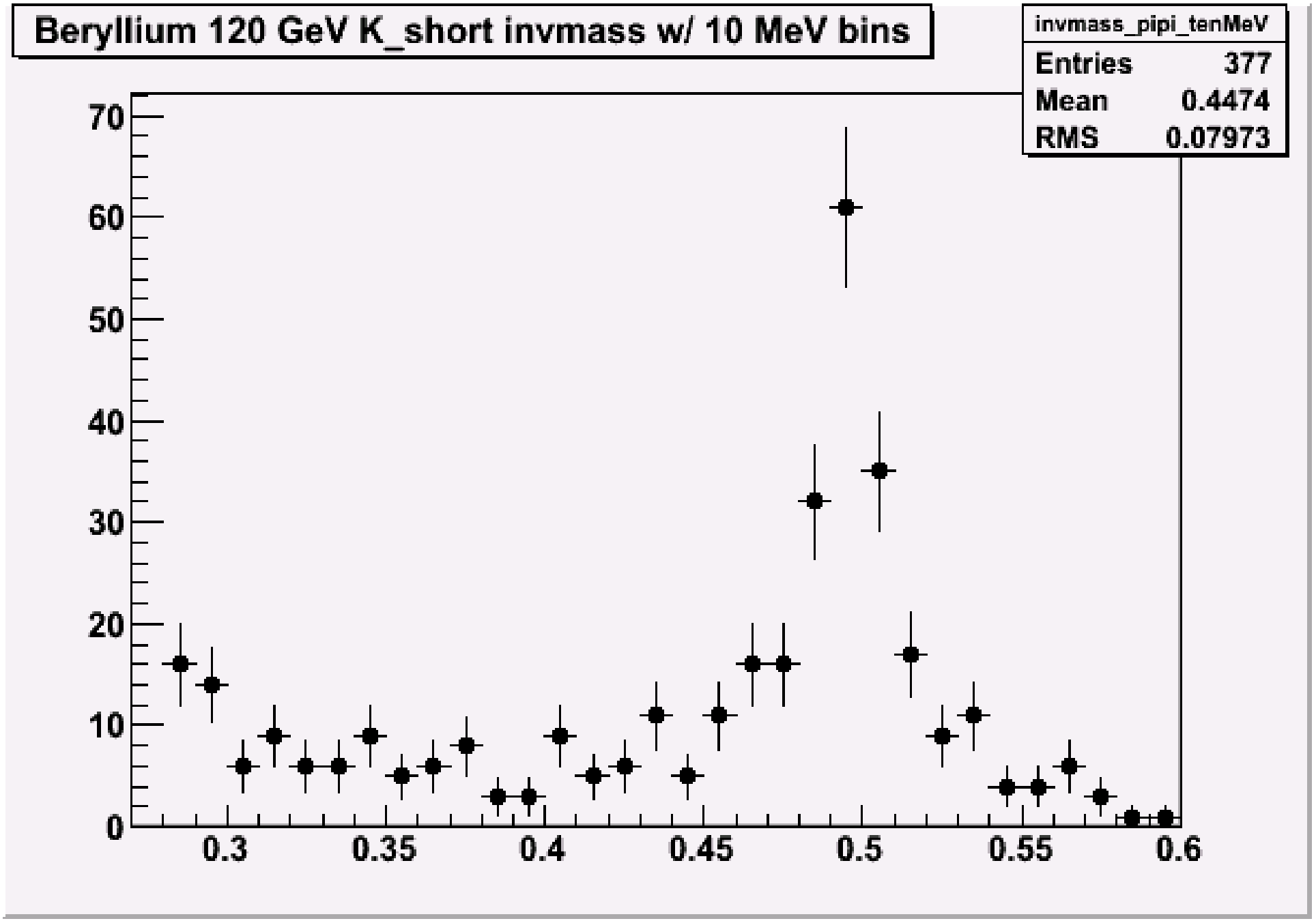
Beryllium 120 (data only)

		Data
0	total events	1102495
1	events with tracks	1035913
2	events with 1 bmtrk	805373
3	[(x-pos)^2 + (y-pos)^2] < 4.0	795946
4	Pvtx # trks >= 3	381273
5	Pvtx at least 3 trks gof >= 0.05	337888
6	Pvtx z-pos within -831 to -820	304451

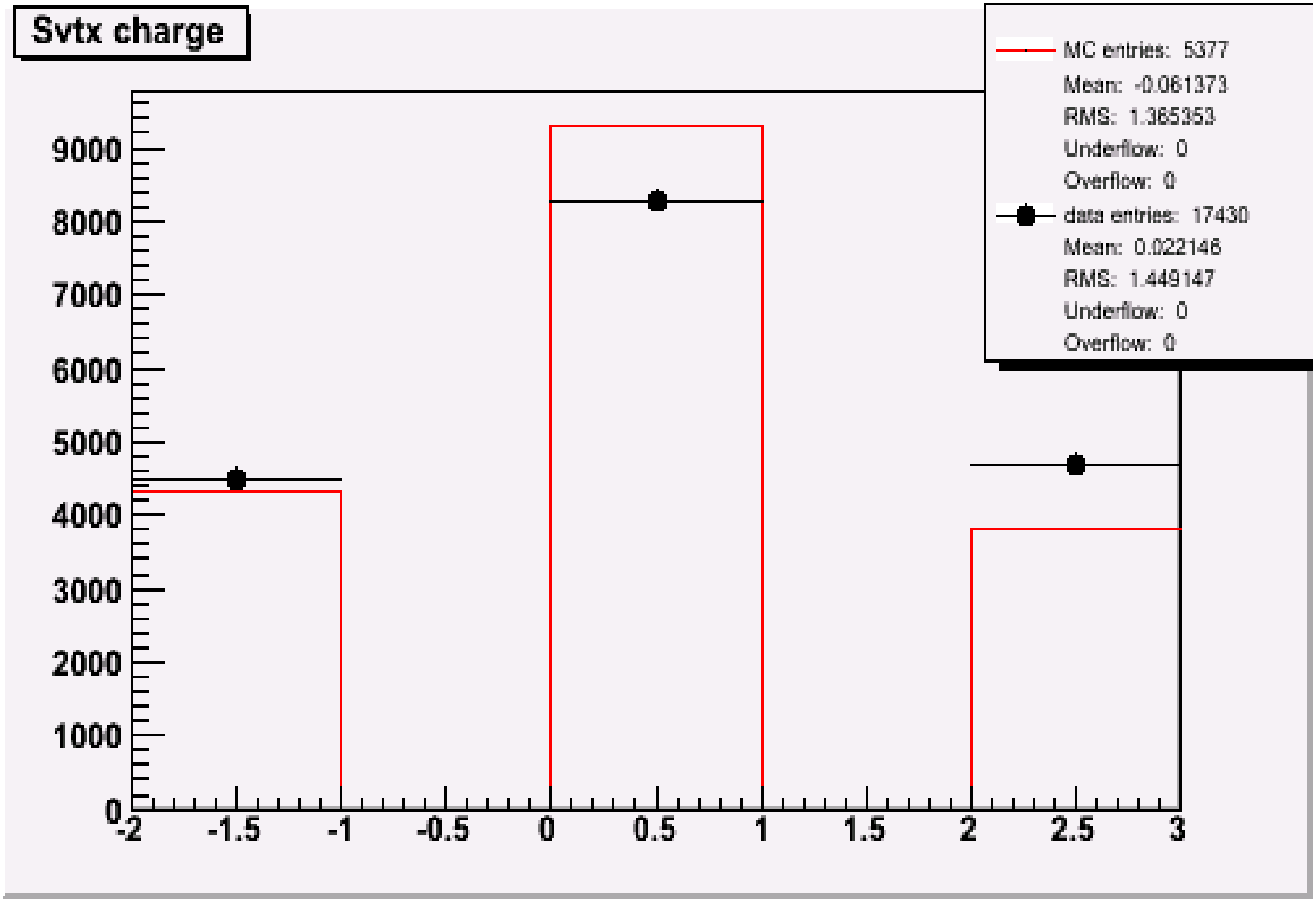
Secondary vertex loop:

7	Svtx 2 trks	38768
8	Svtx downstream of Pvtx	35618
9	Svtx neutral	17224
10	Svtx trks gof > 0.01	1607
11	pT prim < 0.15	1056
12	|sec vtx mom| > 0.8 GeV	377
# of incident particles on target		1247431

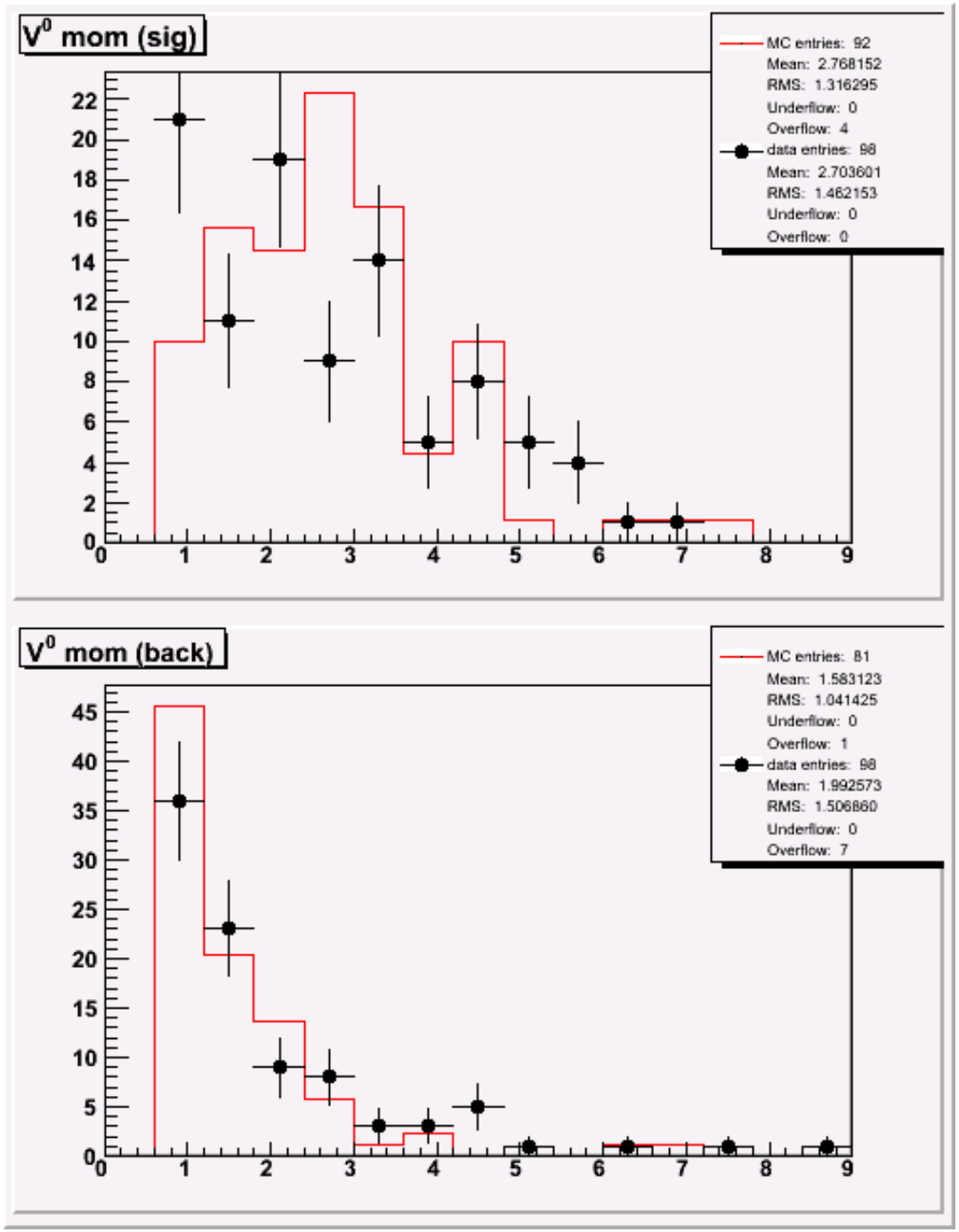
Beryllium 120



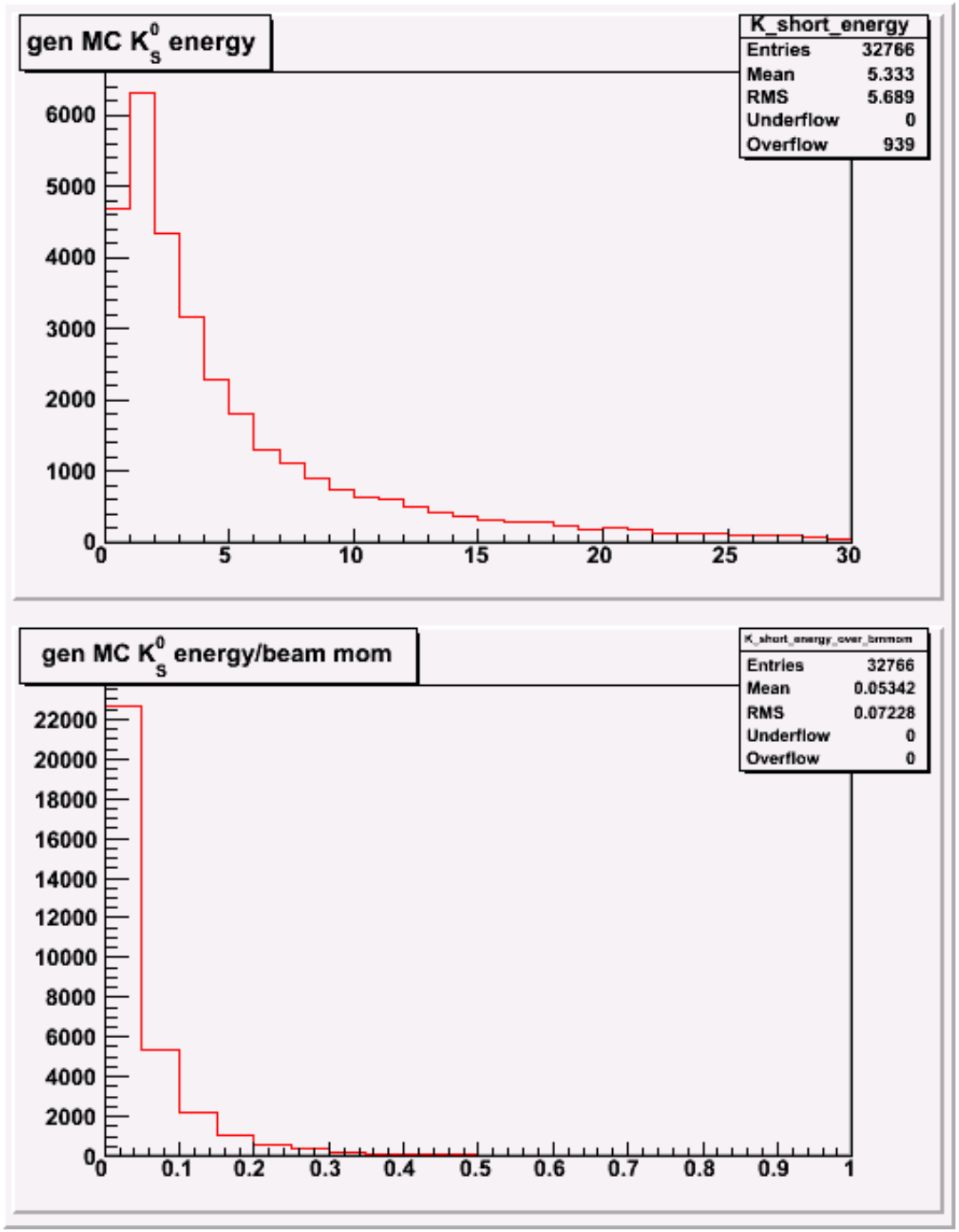
Backup Slides
C 2% 120



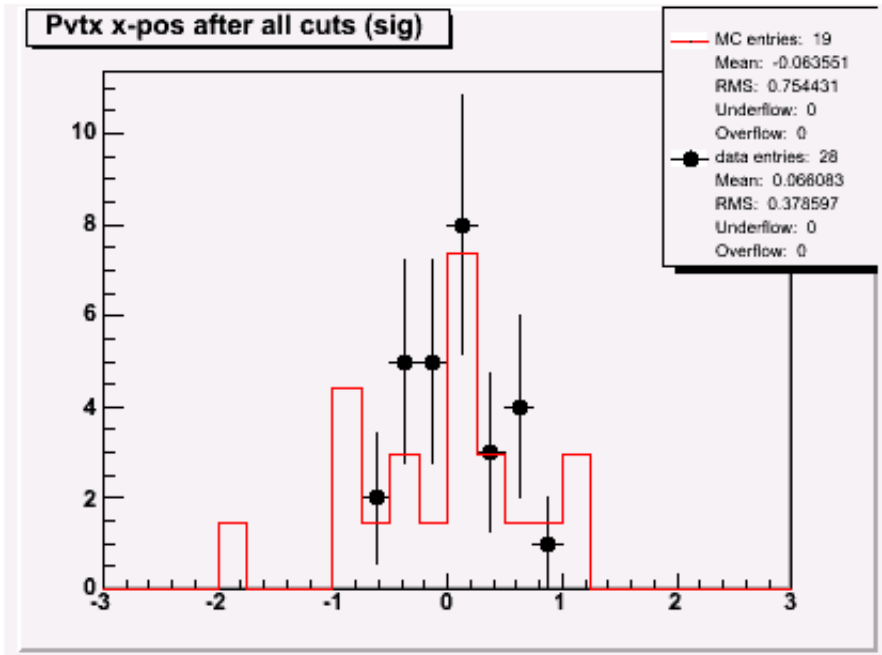
C 2% 120

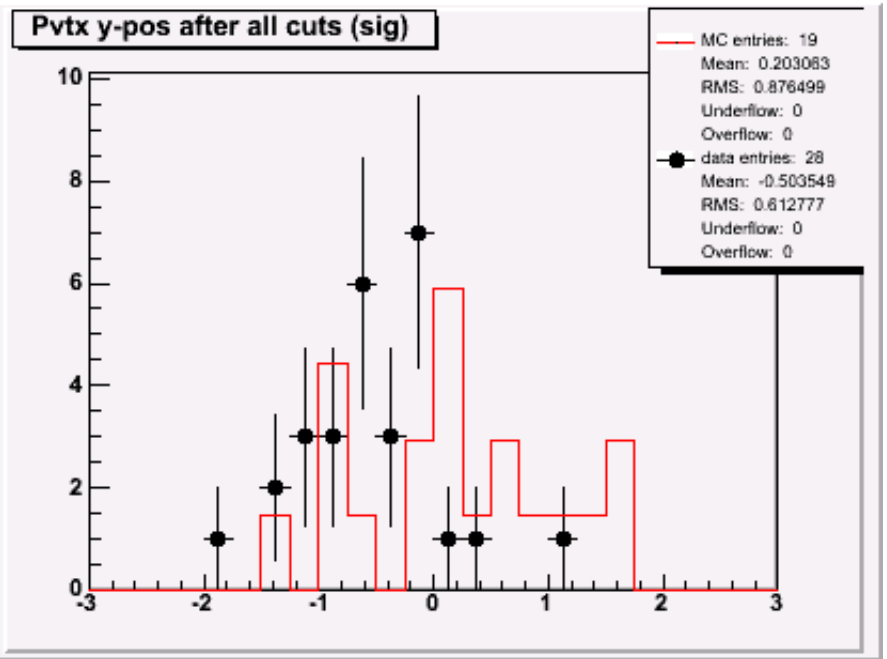

V0 mom (sig)
MC entries: 92
Mean: 2.768152
RMS: 1.316295
Underflow: 0
Overflow: 4
data entries: 98
Mean: 2.703601
RMS: 1.462153
Underflow: 0
Overflow: 0
V0 mom (back)
MC entries: 81
Mean: 1.583123
RMS: 1.041425
Underflow: 0
Overflow: 1
data entries: 98
Mean: 1.992573
RMS: 1.506860
Underflow: 0
Overflow: 7

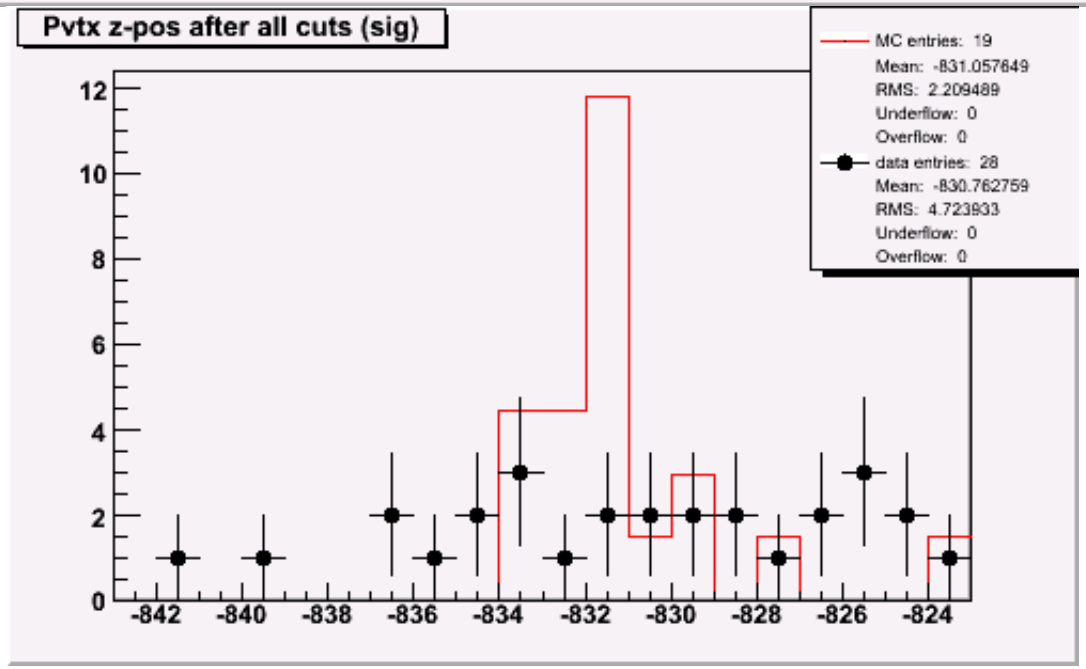
C 2% 120


gen MC K^0_S energy
K_short_energy
Entries 32766
Mean 5.333
RMS 5.689
Underflow 0
Overflow 939
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
25
30
gen MC K^0_S energy/beam mom
K_short_energy_over_bmmom
Entries 32766
Mean 0.05342
RMS 0.07228
Underflow 0
Overflow 0
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

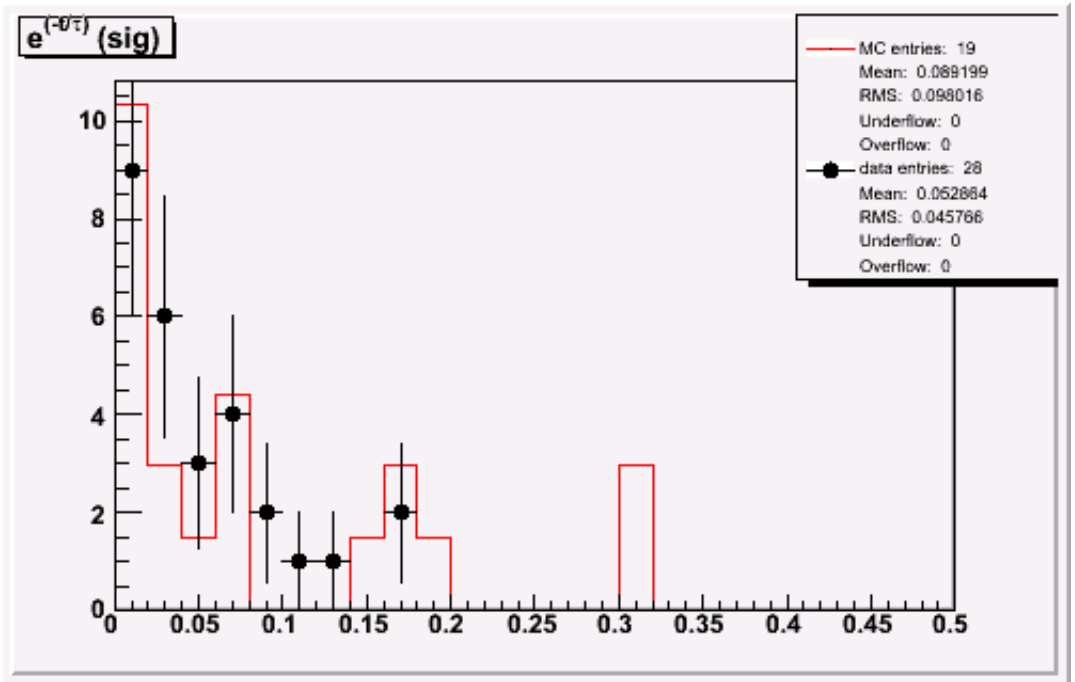
V0 Plots (after all cuts)
LH2 84 data/85 MC

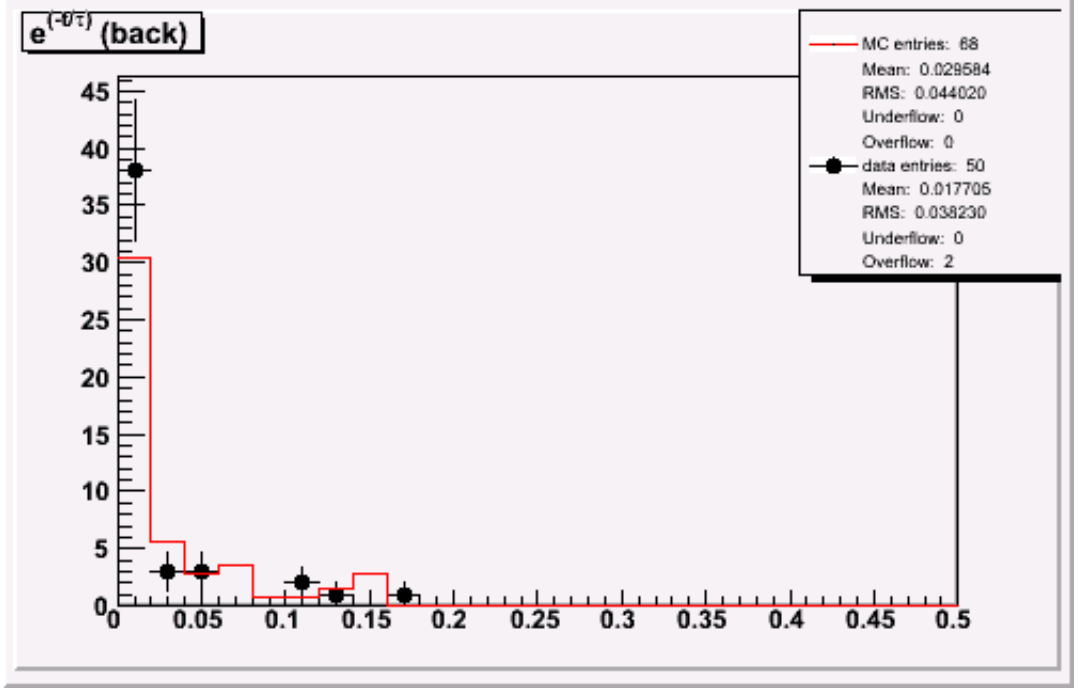




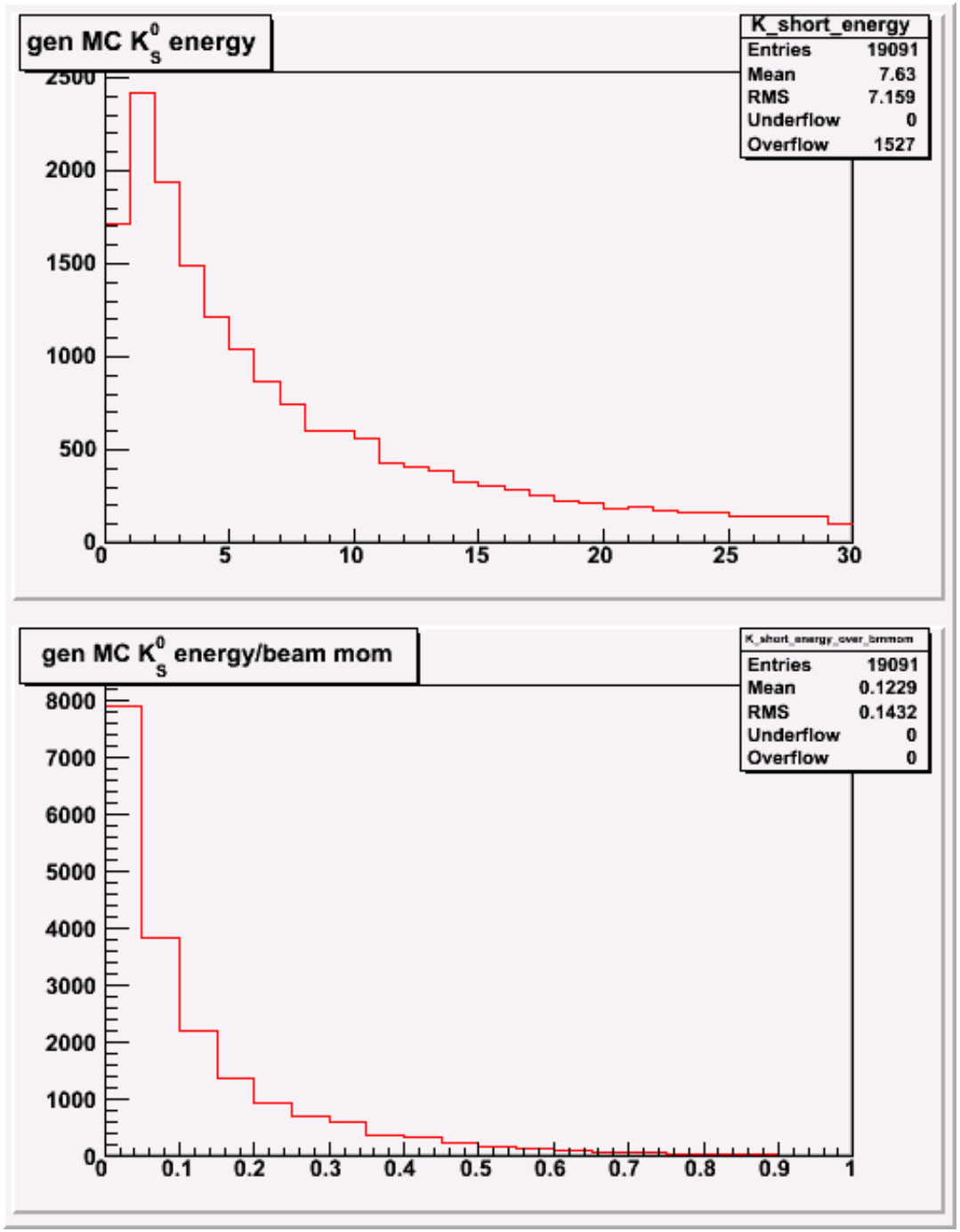


LH2 84 data/85 MC

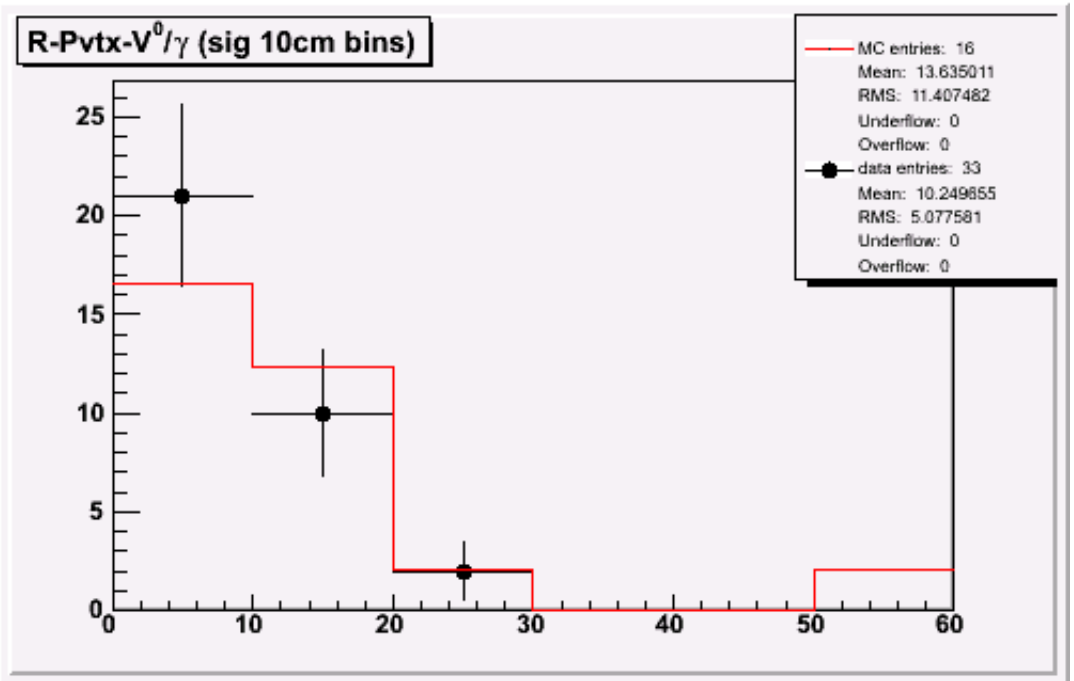


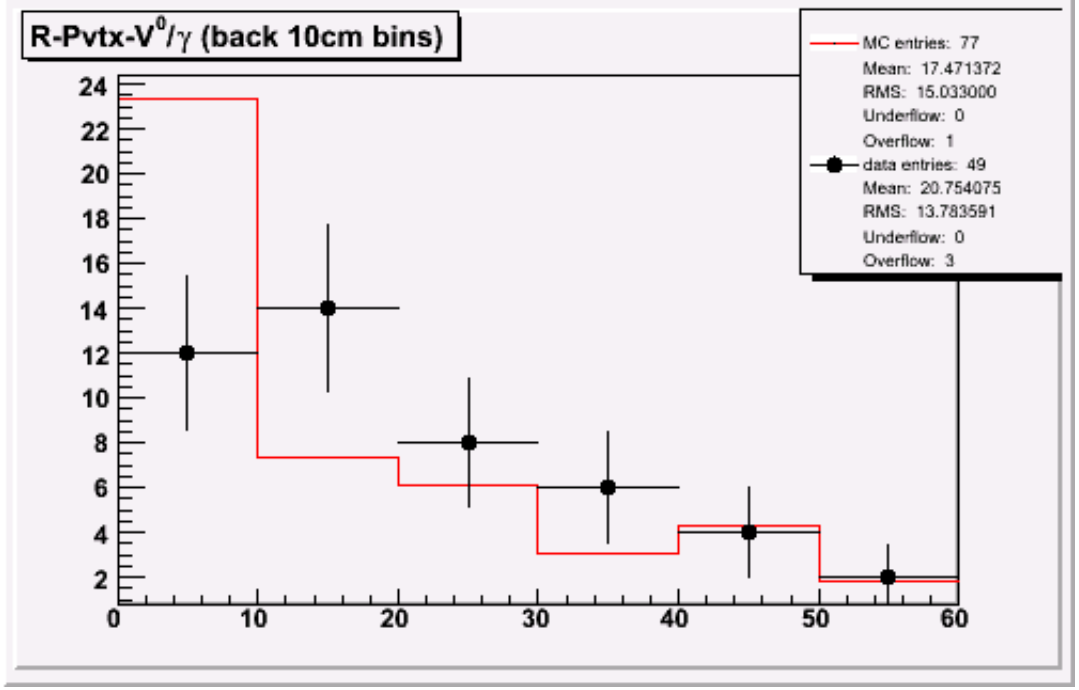


LH2 84 data/85 MC

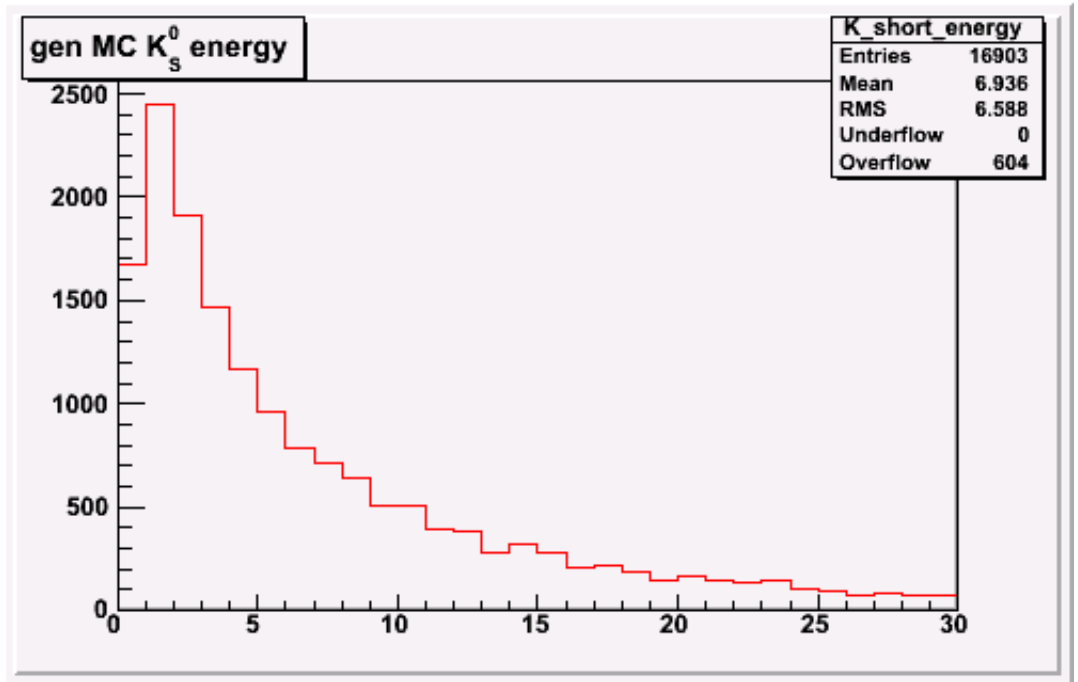


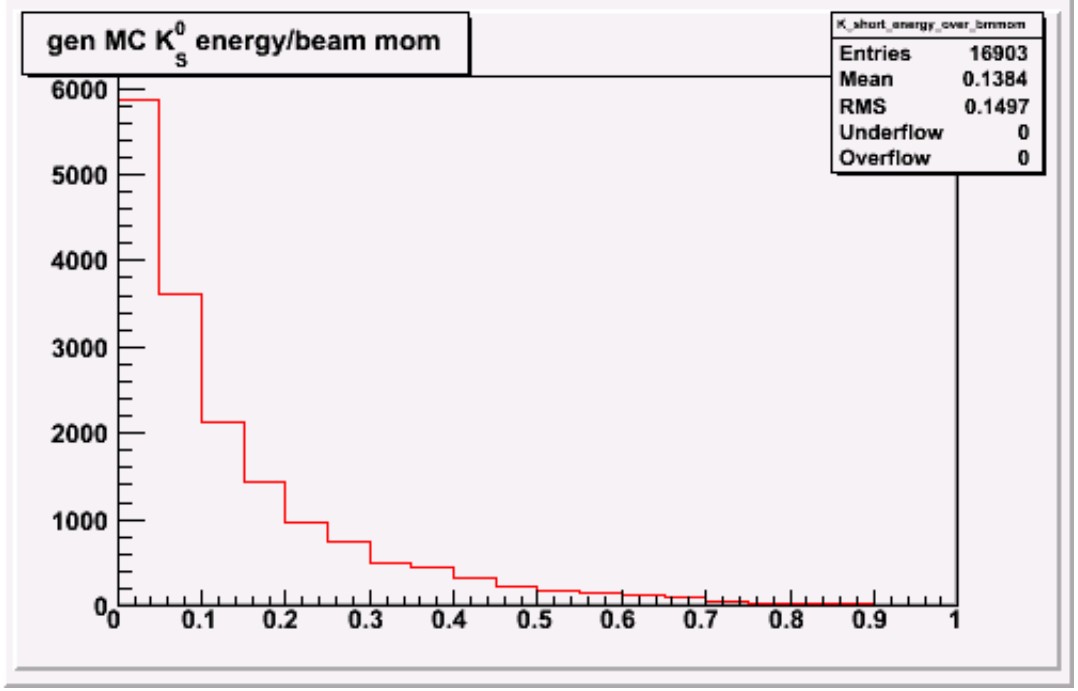
LH2 58


R-Pvtx-V^0/γ (sig 10cm bins)
MC entries: 16
Mean: 13.635011
RMS: 11.407482
Underflow: 0
Overflow: 0
data entries: 33
Mean: 10.249855
RMS: 5.077581
Underflow: 0
Overflow: 0
0
5
10
15
20
25
0
10
20
30
40
50
60

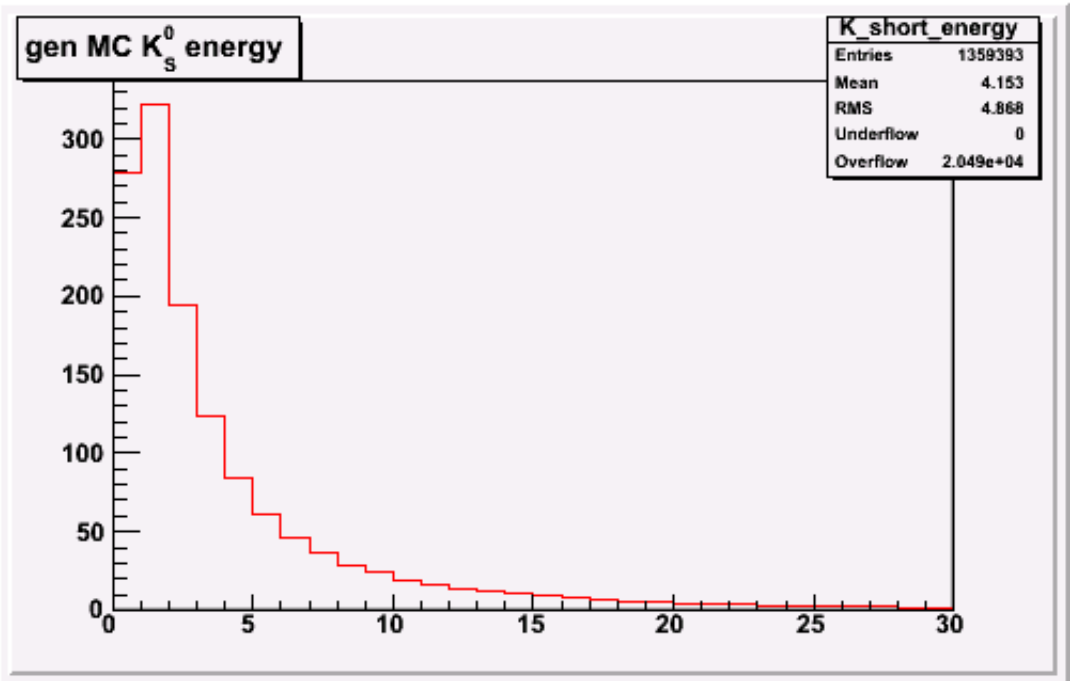

R-Pvtx-V^0/γ (back 10cm bins)
MC entries: 77
Mean: 17.471372
RMS: 15.033000
Underflow: 0
Overflow: 1
data entries: 49
Mean: 20.754075
RMS: 13.783591
Underflow: 0
Overflow: 3
0
2
4
6
8
10
12
14
16
18
20
22
24
0
10
20
30
40
50
60

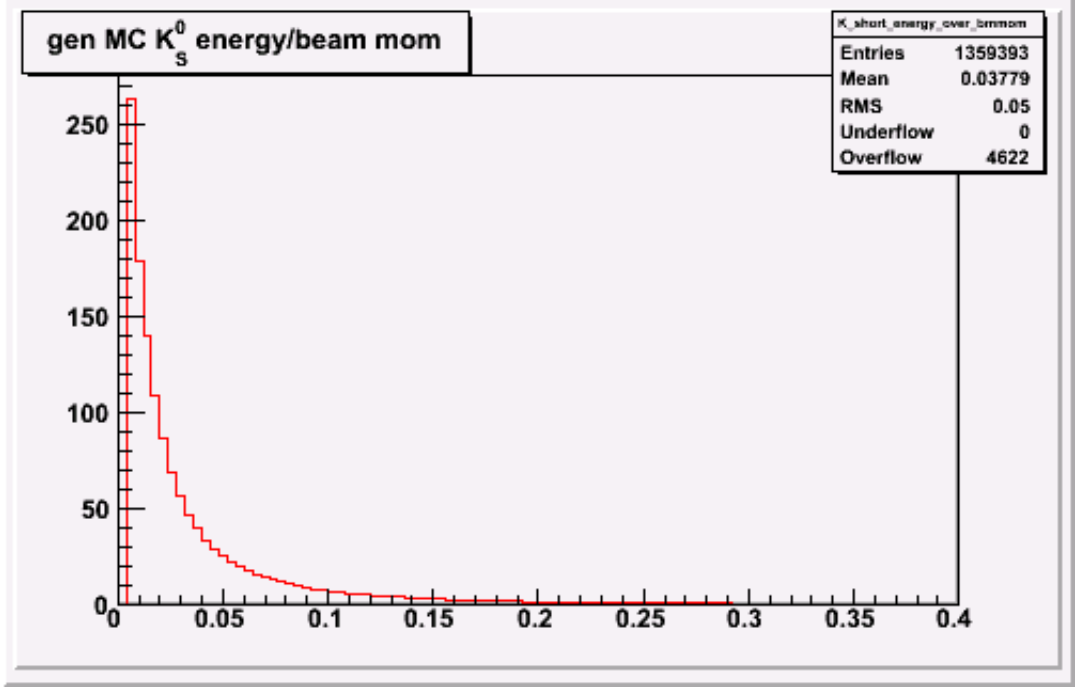
LH2 58


gen MC K^0_S energy
K_short_energy
Entries 16903
Mean 6.936
RMS 6.588
Underflow 0
Overflow 604
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30


gen MC K^0_S energy/beam mom
K_short_energy_over_bmmom
Entries 16903
Mean 0.1384
RMS 0.1497
Underflow 0
Overflow 0
6000
5000
4000
3000
2000
1000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

NuMI 120


gen MC K^0_S energy
K_short_energy
Entries 1359393
Mean 4.153
RMS 4.868
Underflow 0
Overflow 2.049e+04
300
250
200
150
100
50
0
0
5
10
15
20
25
30


gen MC K^0_S energy/beam mom
K_short_energy_over_bmmom
Entries 1359393
Mean 0.03779
RMS 0.05
Underflow 0
Overflow 4622
250
200
150
100
50
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4