P̄ANDA Backward Electromagnetic Calorimeter Studies with BaBar-like framework

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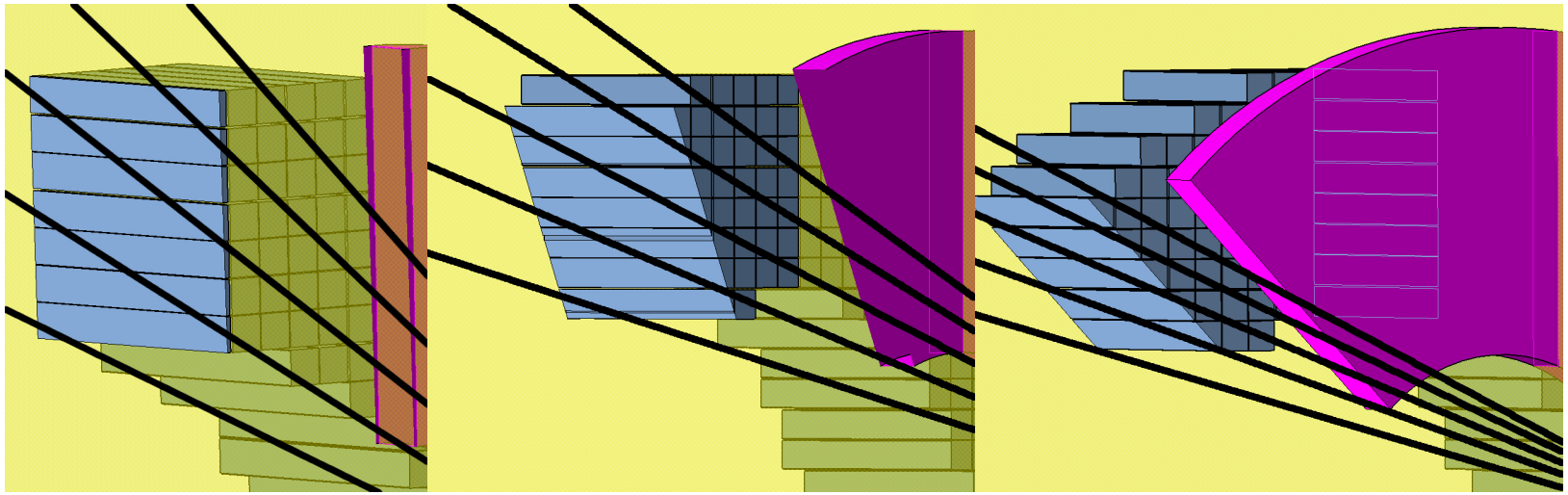
Outline

1. Introduction
2. Analysis done
3. Comparison with PandaROOT
4. Conclusions and outlook

Simulation characteristics: Single gamma.

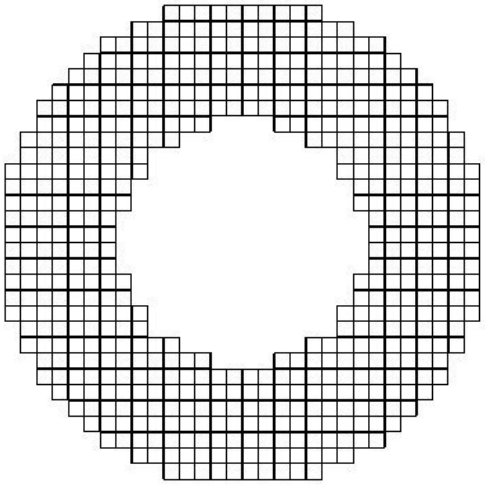
- Energies: 0.03, 0.1, 0.25, 0.5 and 0.7 GeV
- Angles:
  - θ: 145°, 150°, 155°, 160° and 165°
  - ϕ: 0°, 22.5° and 45°

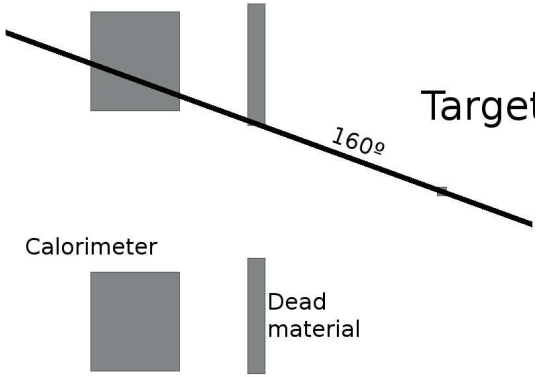


1° 22.5° 45°

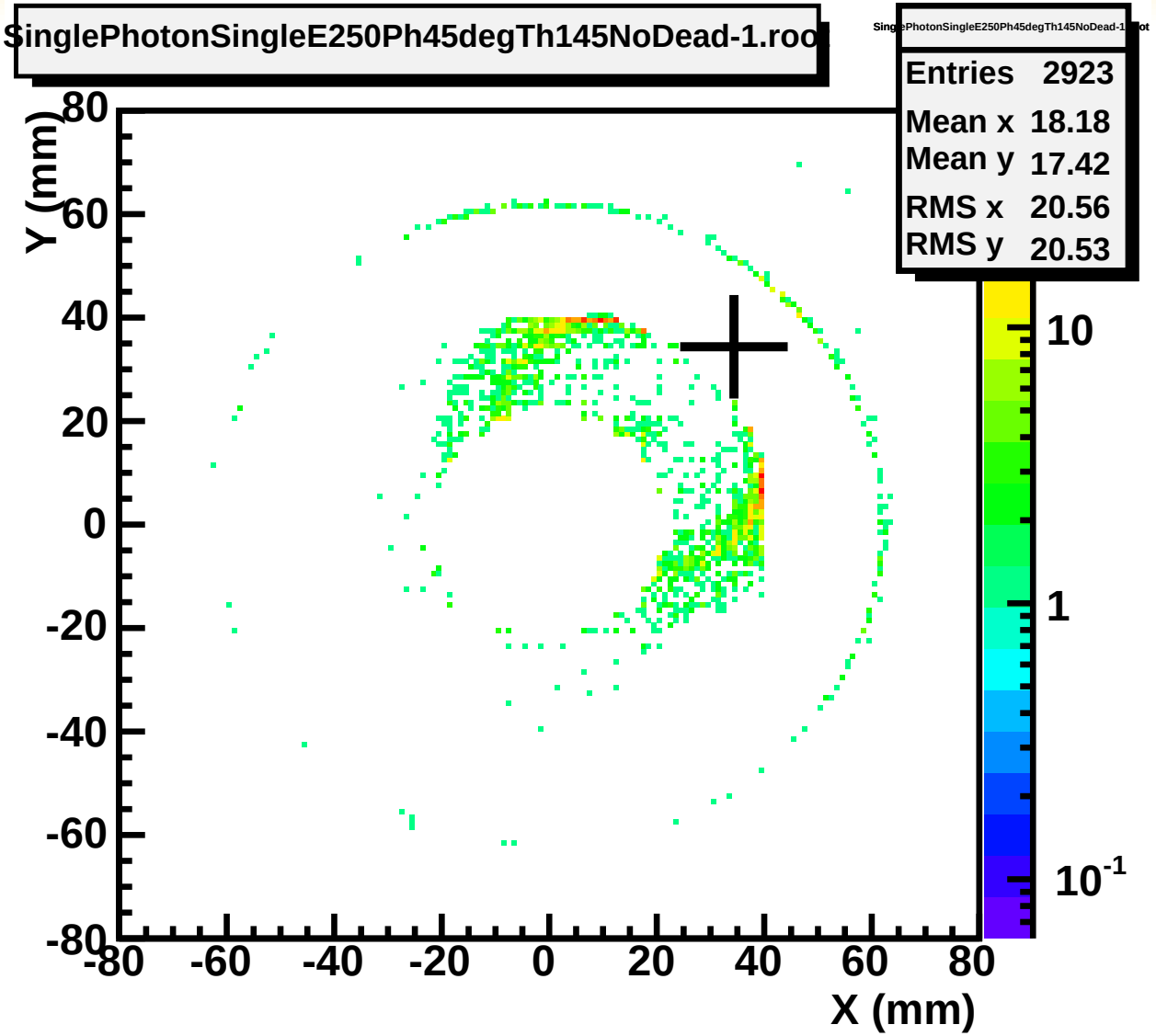
Simulation characteristics: Single gamma.

- Calorimeter: 20 cm long crystals (2.24 cm×2.24 cm), r_{min} =182 mm, r_{max} =406 mm, at z= -594 mm.
  Full angular range: 145.65°, 167.09°.
- Dead material:
  - Nothing.
  - Low: Al, 2 cm r_{min} =150 mm, r_{max} =418 mm, at z= -400 mm from the target. Behind STT.
  - High: Al, 4 cm r_{min} =150 mm, r_{max} =418 mm, at z= -400 mm from the target. Behind STT.

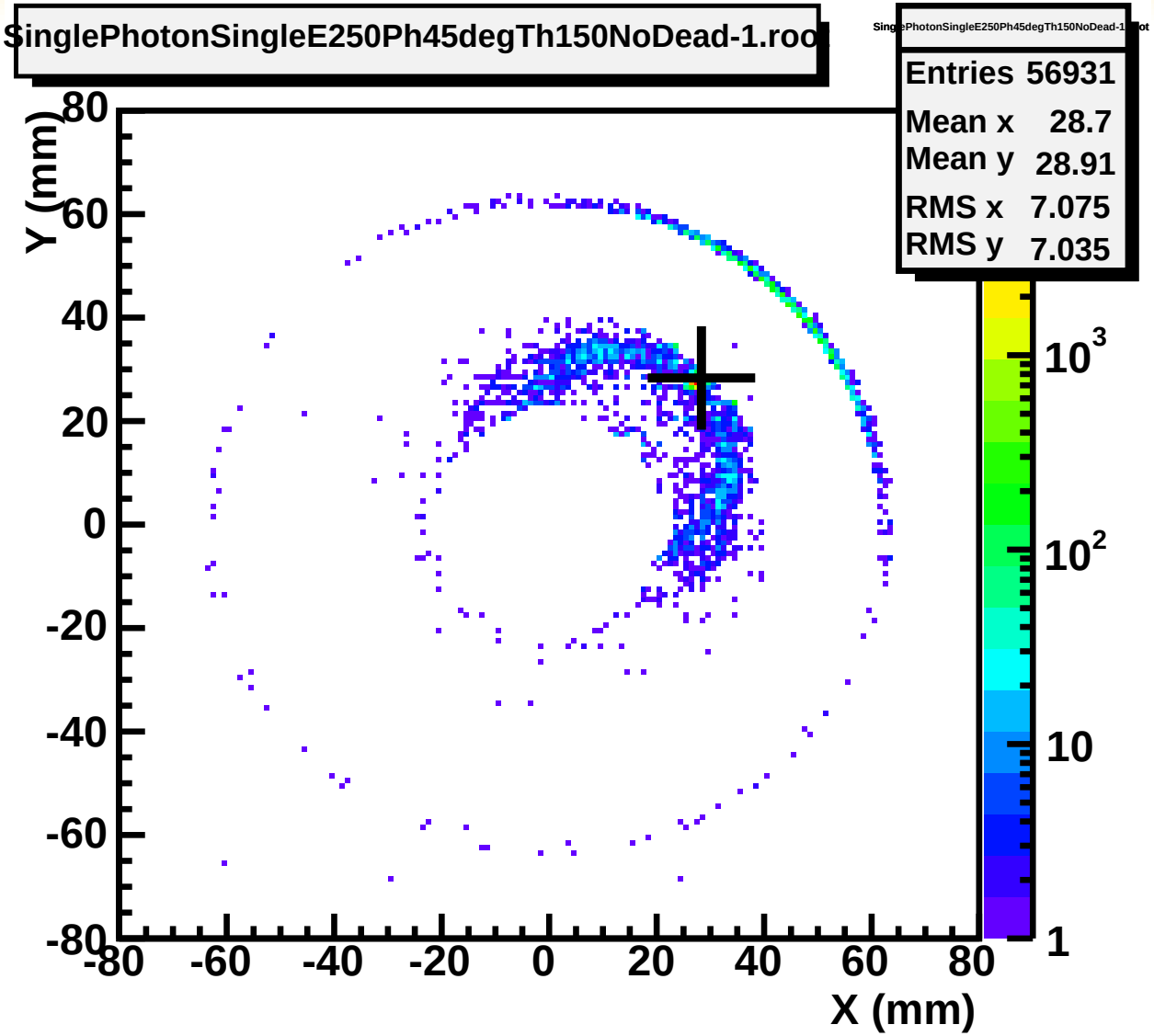




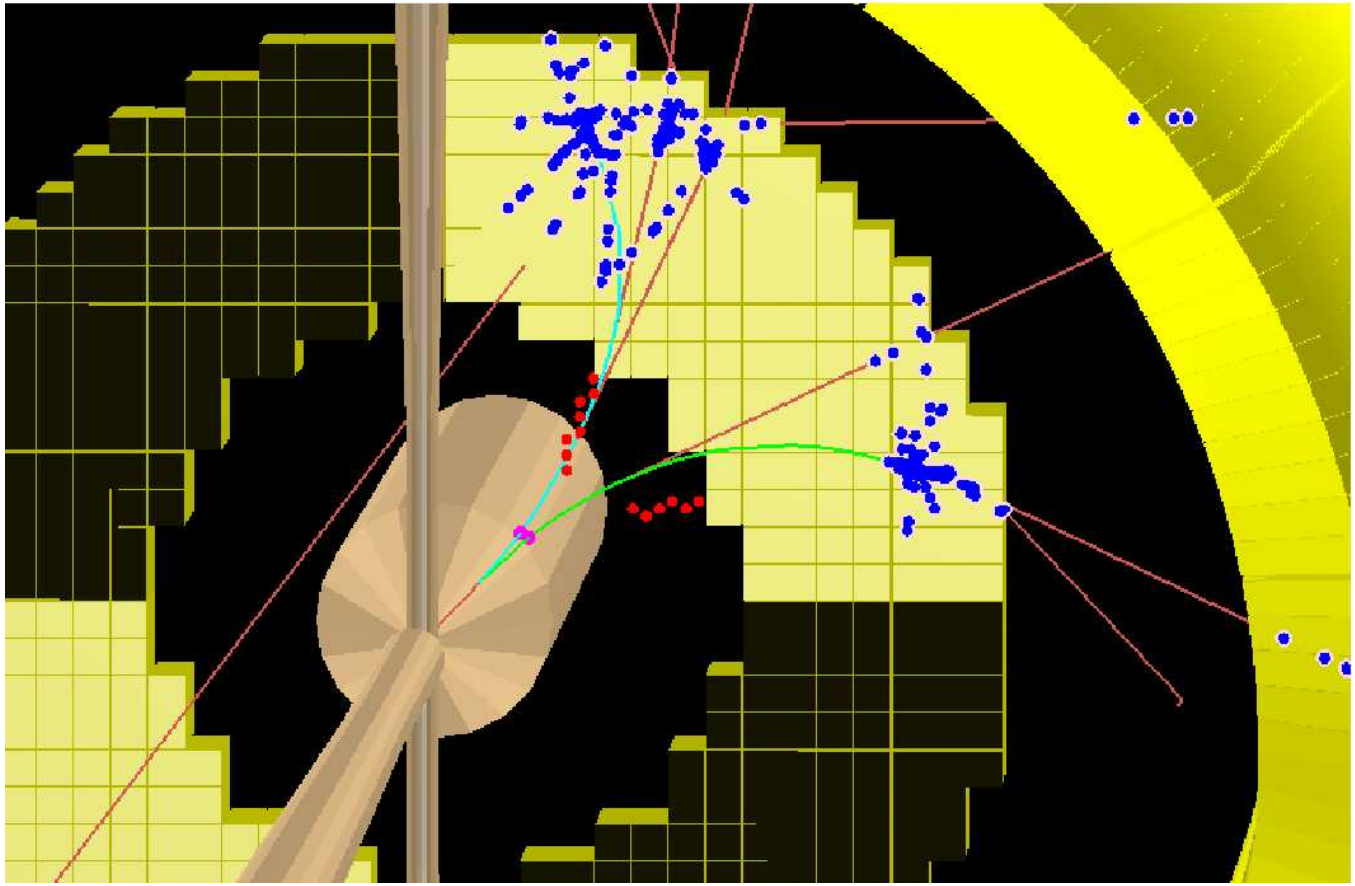
Hits: No dead material, 250 MeV, ϕ =45°, θ =145°



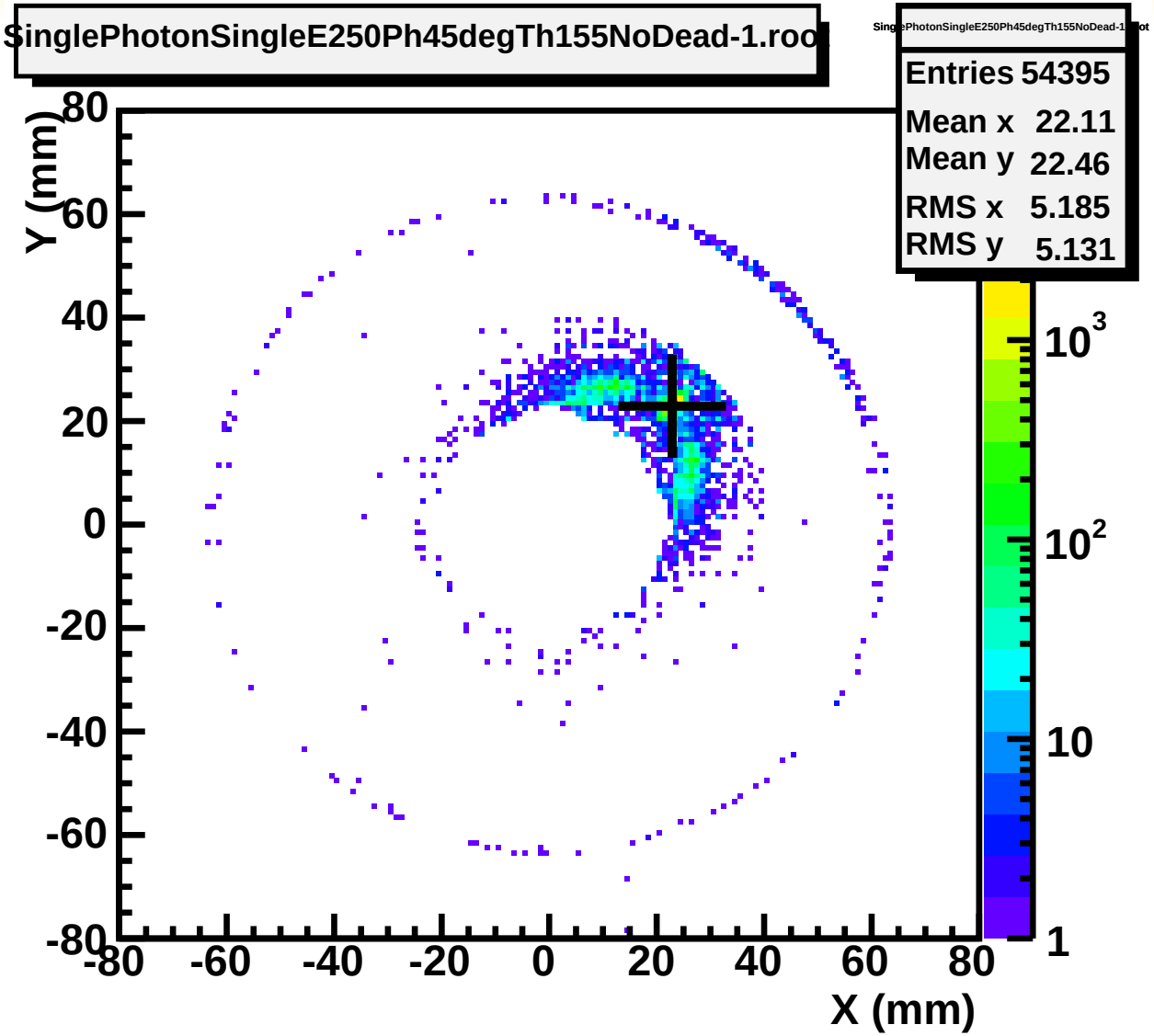
Hits: No dead material, 250 MeV, ϕ =45°, θ =150°



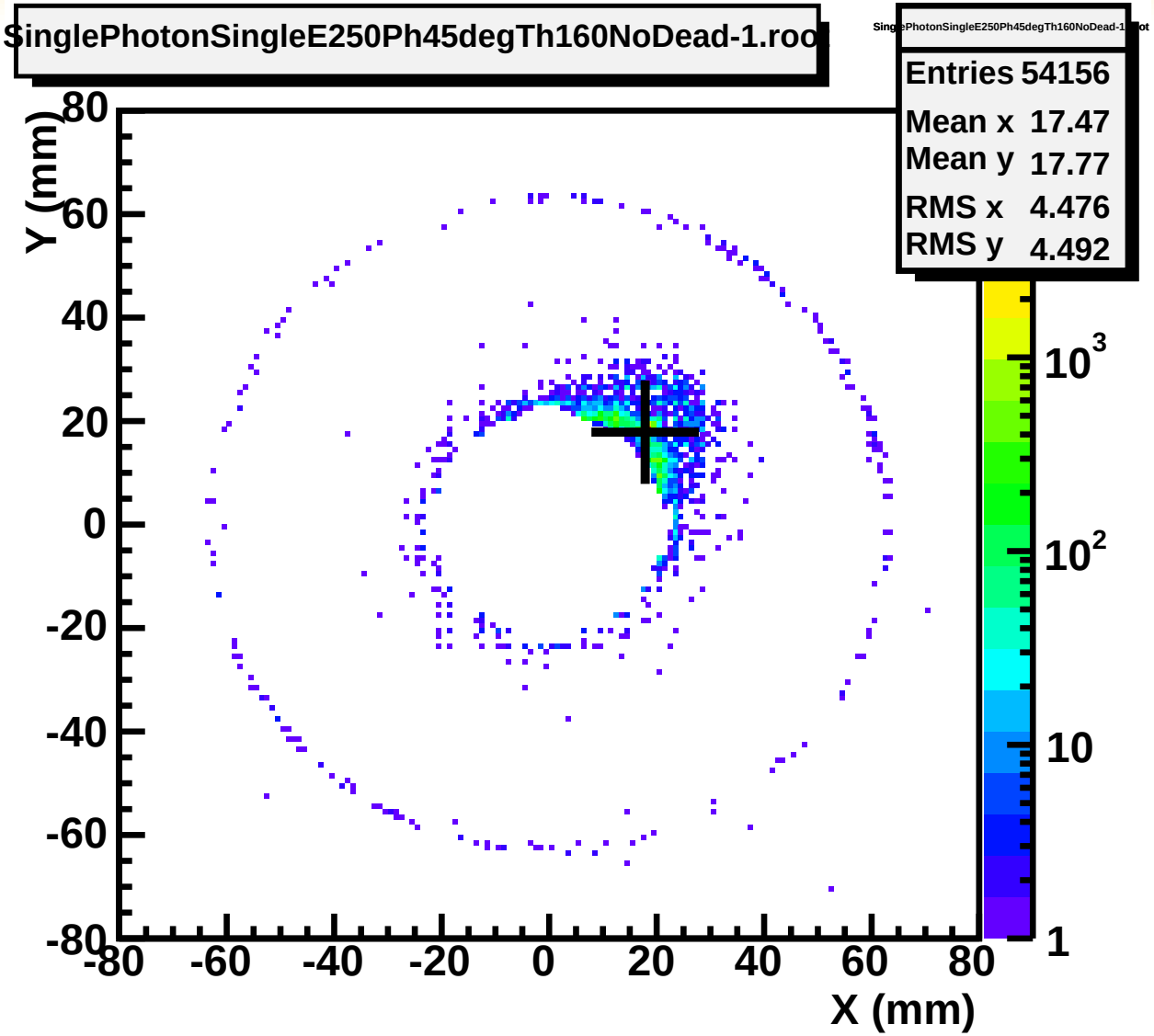
What is the circular structure?



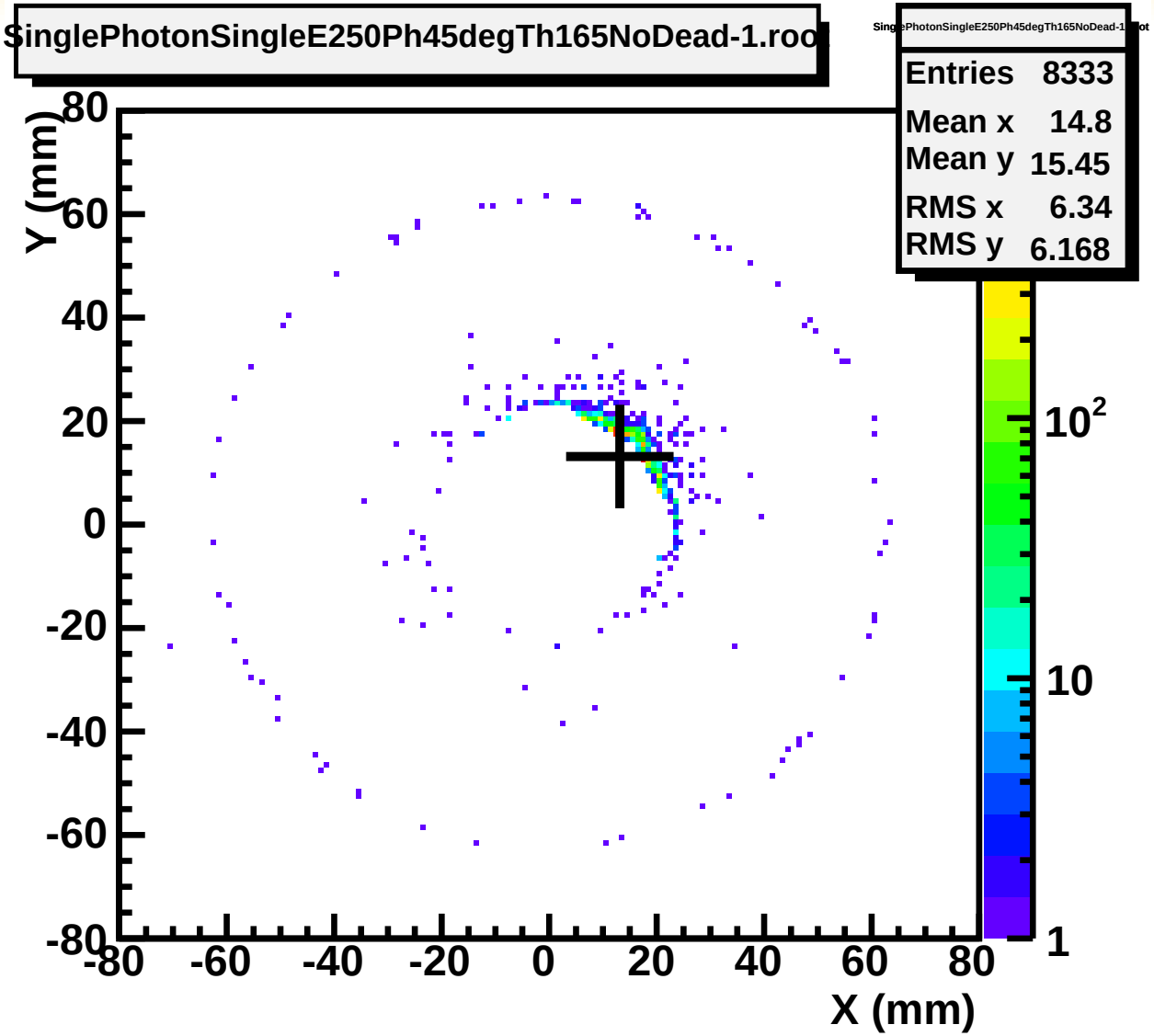
Hits: No dead material, 250 MeV, ϕ =45°, θ =155°



Hits: No dead material, 250 MeV, ϕ =45°, θ =160°



Hits: No dead material, 250 MeV, ϕ =45°, θ =165°



Analysis

NOVOSIBIRSK FUNCTION:

$$f(E) = A \exp\left\{-\frac{1}{2}\left[\frac{\ln^2\left[1+\Lambda\tau(E-E_0)\right]}{\tau^2} + \tau^2\right]\right\}$$

with

$$\Lambda = \frac{\sinh\left(\tau\sqrt{\ln(4)}\right)}{\sigma\tau\sqrt{ln(4)}}$$

Analysis

CUTS:

- Bump with highest energy per event

ANALYSIS:

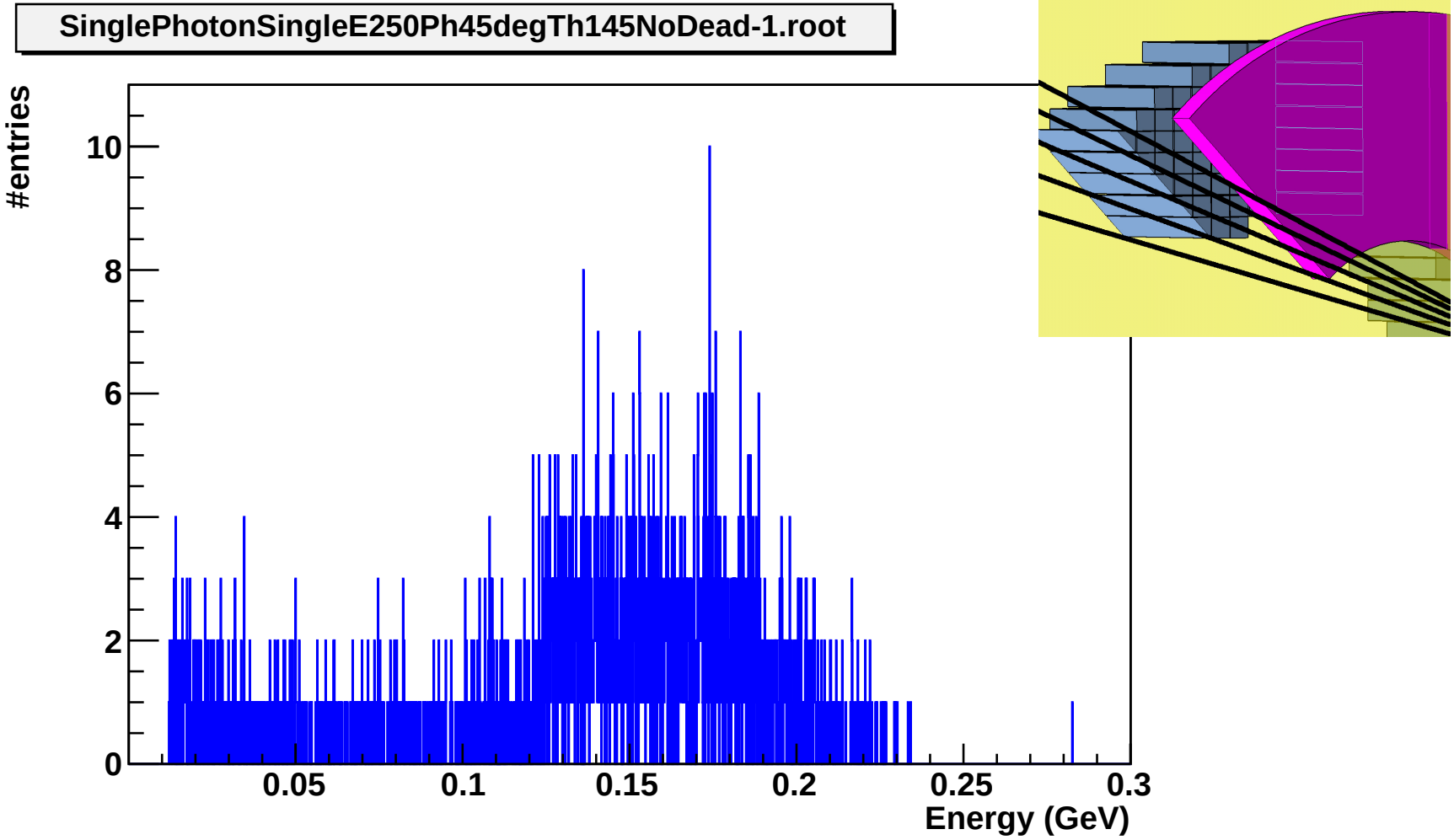
- Energy resolution of the backward end cap:

$$E_{res} = \frac{2.35\sigma}{\mu}$$

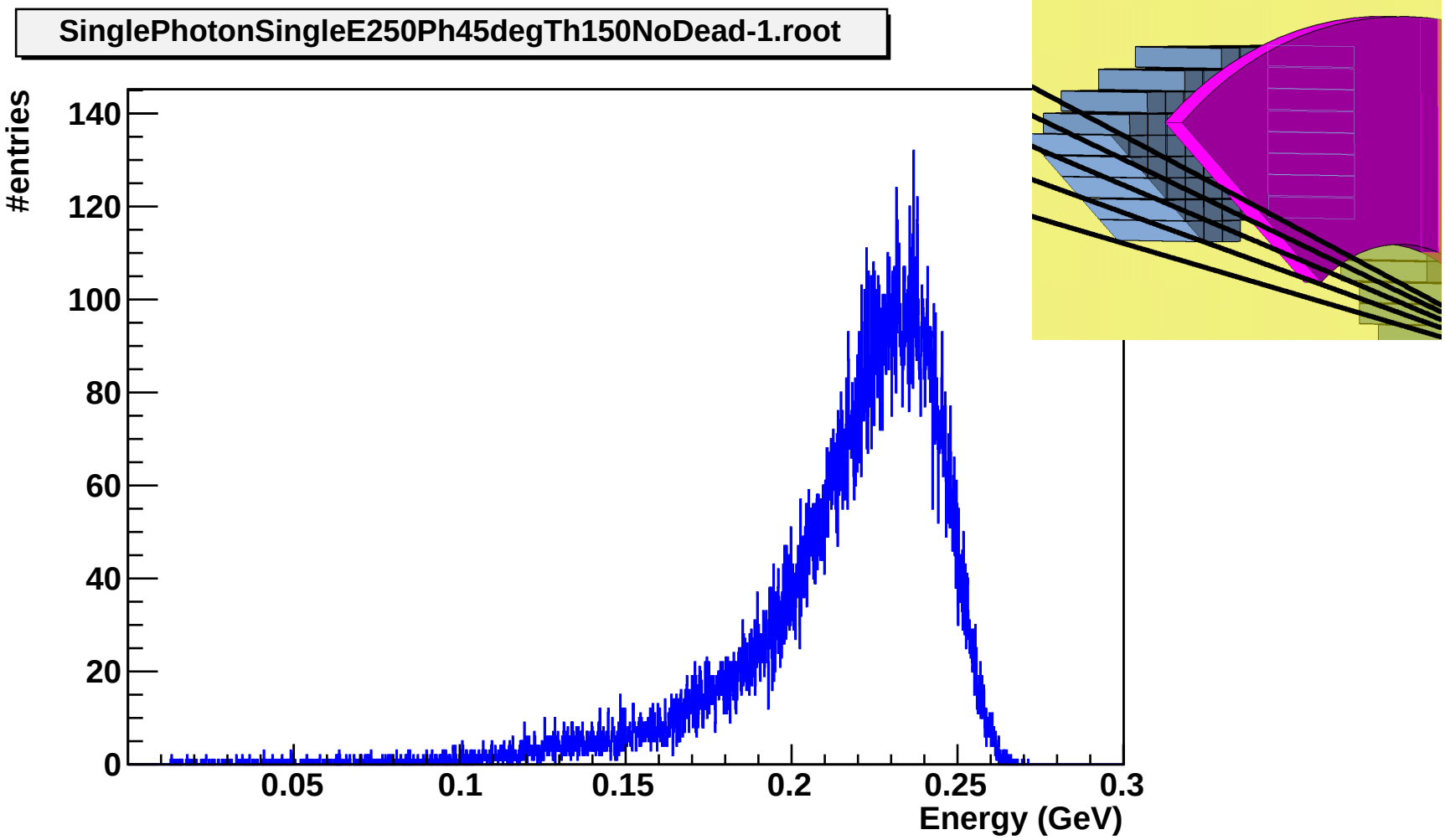
- Efficiency of the backward end cap:

$$Eff = \frac{1}{50000} \int_{\mu-3\sigma}^{\mu+2\sigma} f(E)dE$$

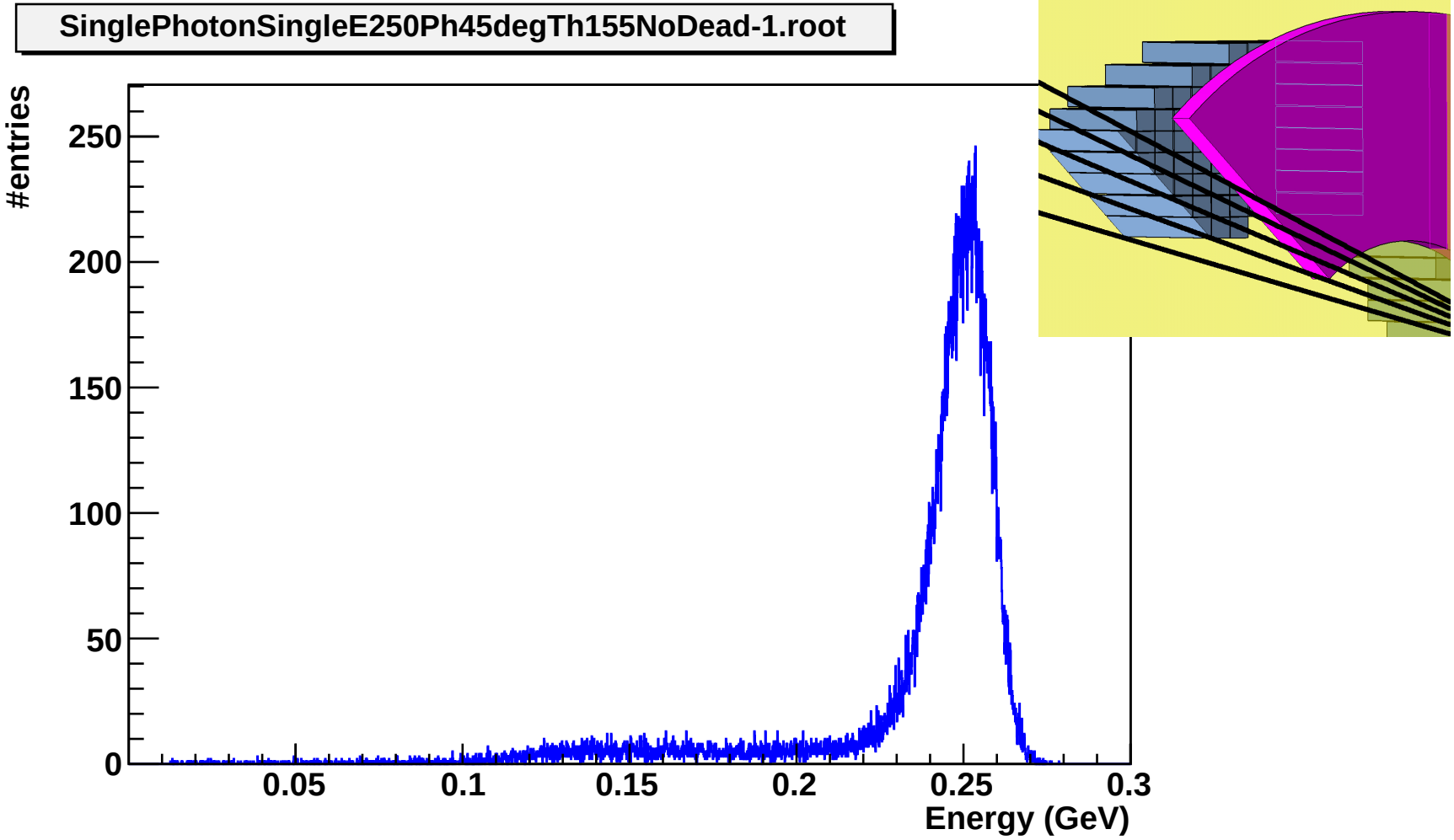
Phi =45°, θ =145°; Outside the calorimeter



Phi =45°, θ =150°; Partially inside the calorimeter



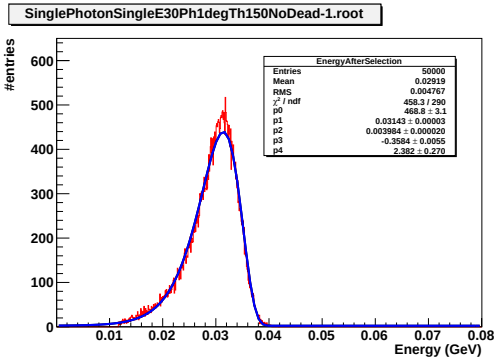
Phi =45°, θ =155°; Fully inside the calorimeter

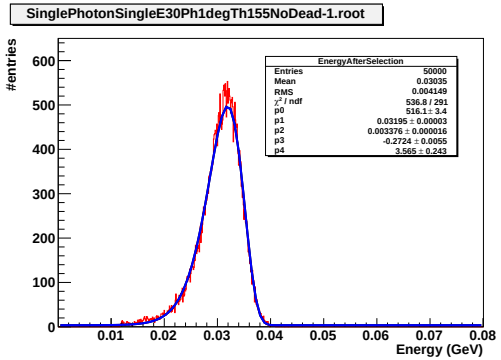


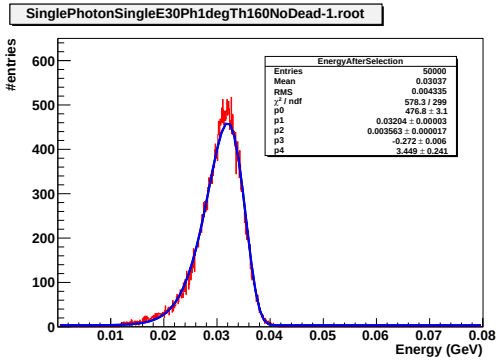
No dead material 30 MeV

$\theta = 150^\circ$ | $\theta = 155^\circ$ | $\theta = 160^\circ$

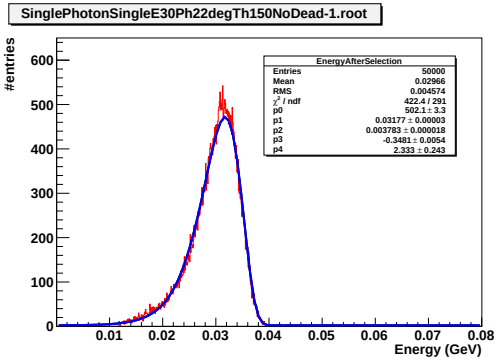
$\phi = 1^\circ$

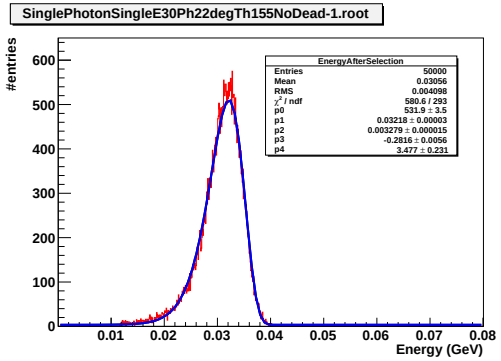


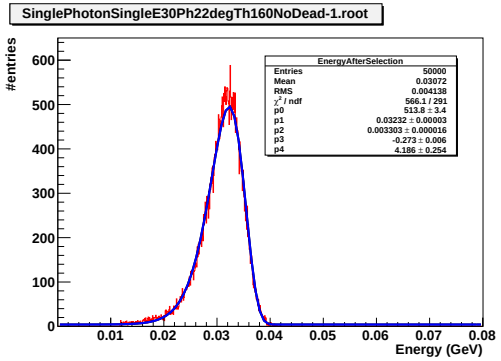


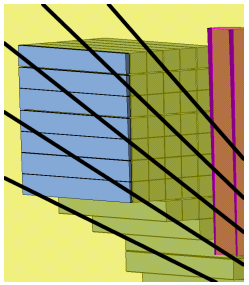


$\phi = 22.5^\circ$

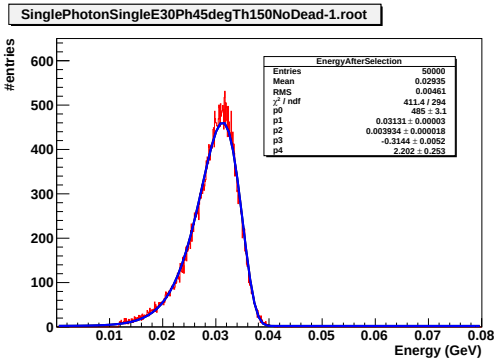


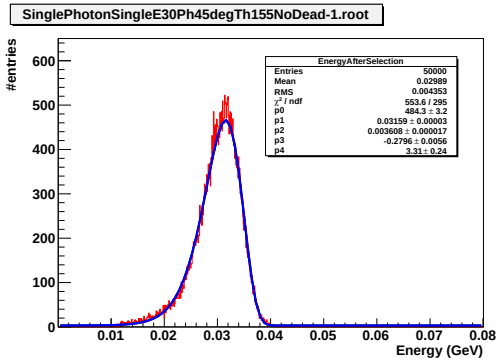


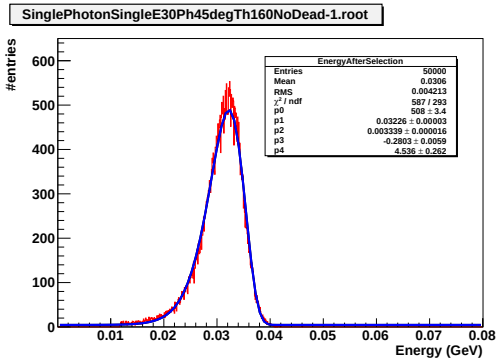




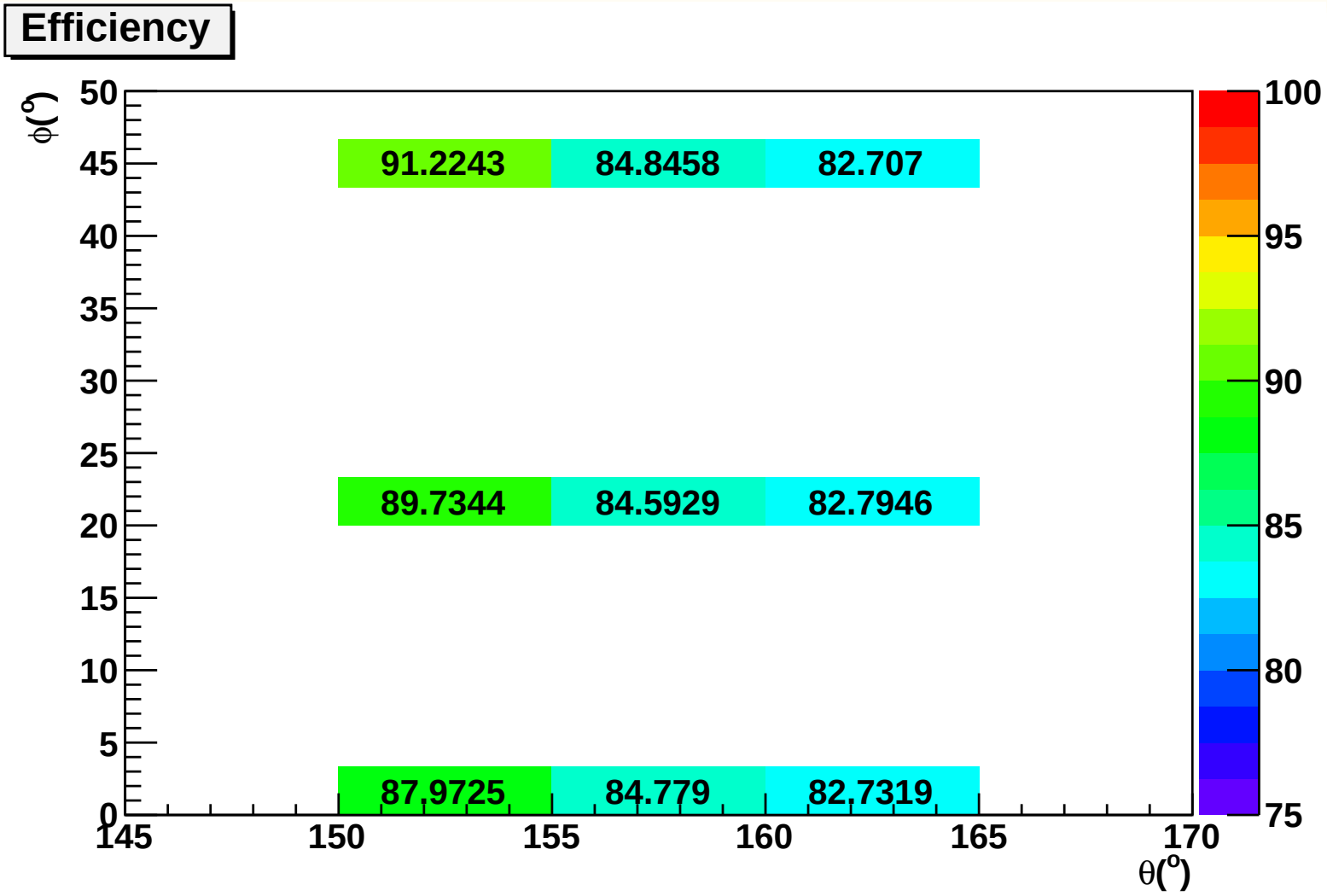
$\phi = 45^\circ$



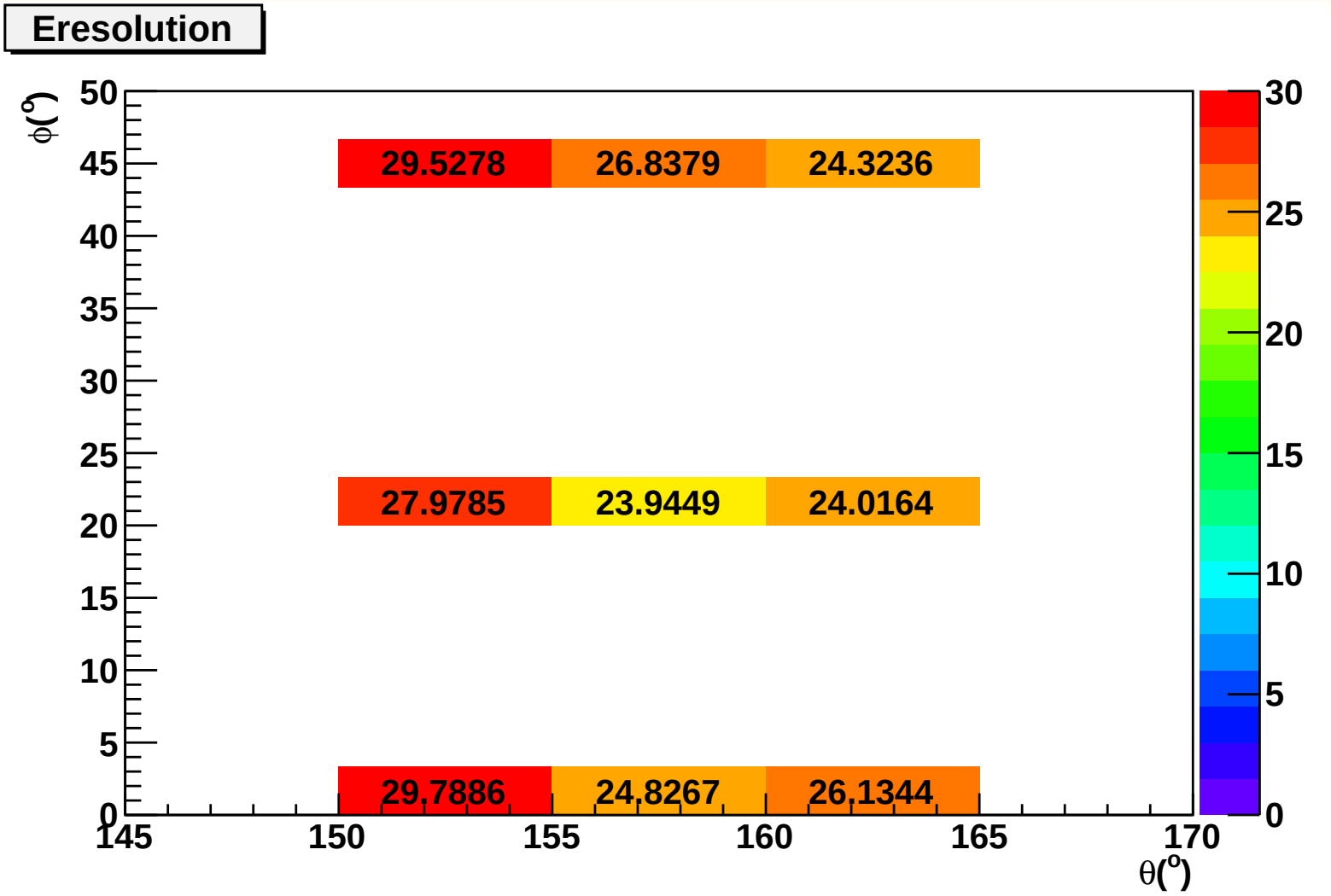




30 MeV; No dead material



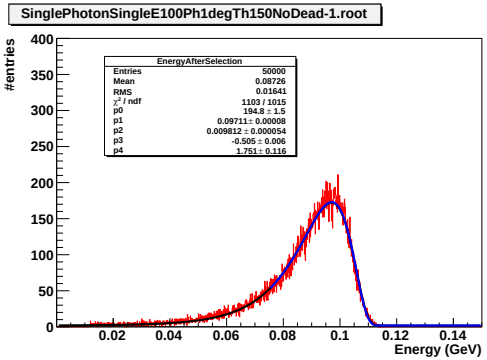
30 MeV; No dead material

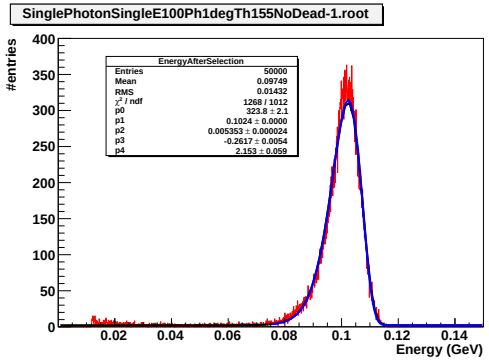


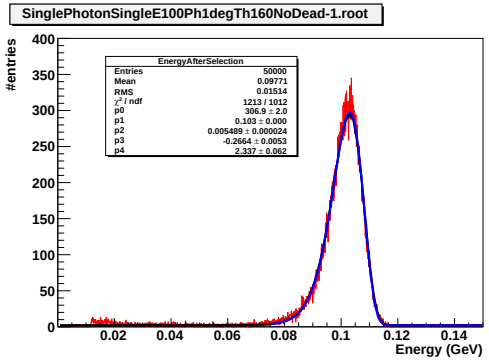
No dead material 100 MeV

$\theta = 150^\circ$ | $\theta = 155^\circ$ | $\theta = 160^\circ$

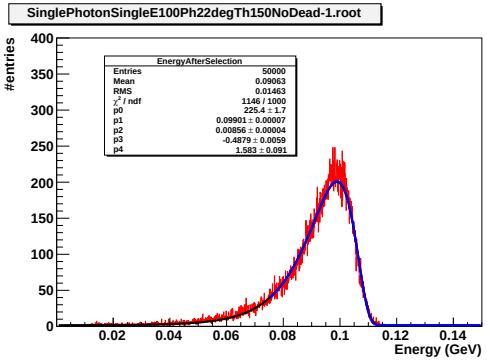
$\phi = 1^\circ$

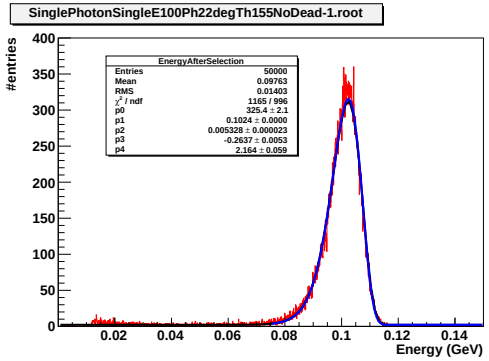


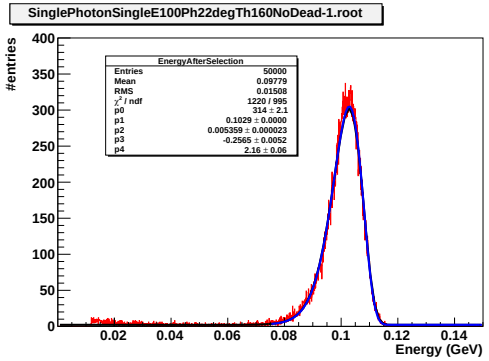


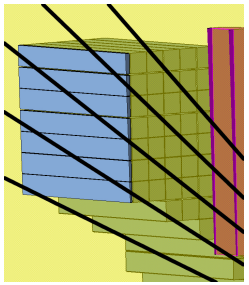


$\phi = 22.5^\circ$

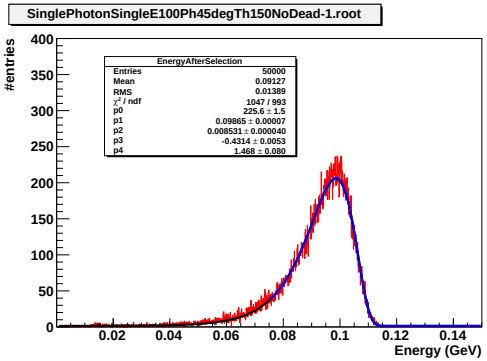


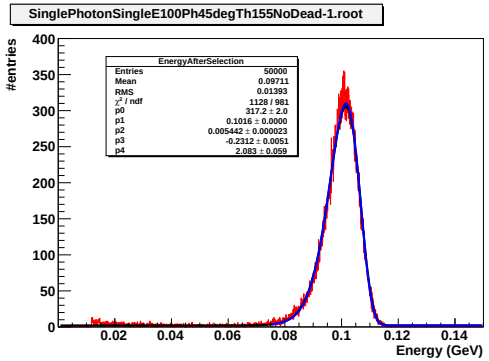


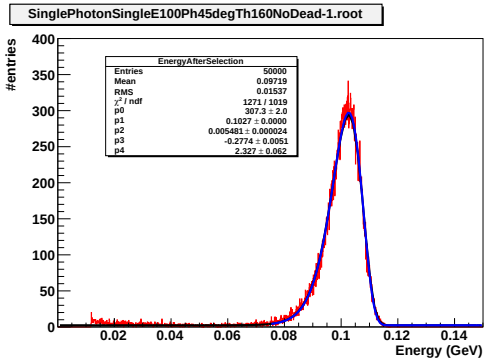




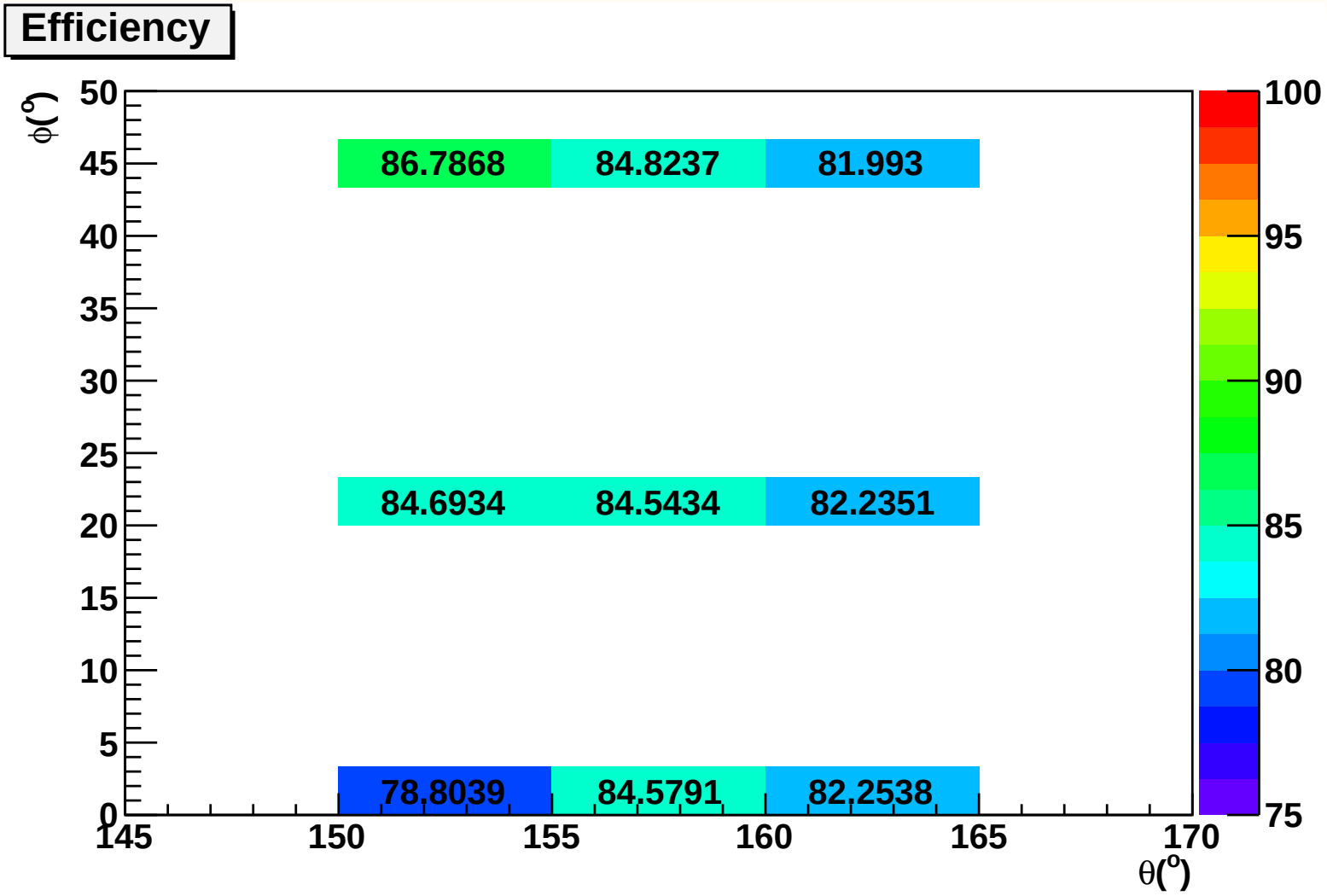
$\phi = 45^\circ$



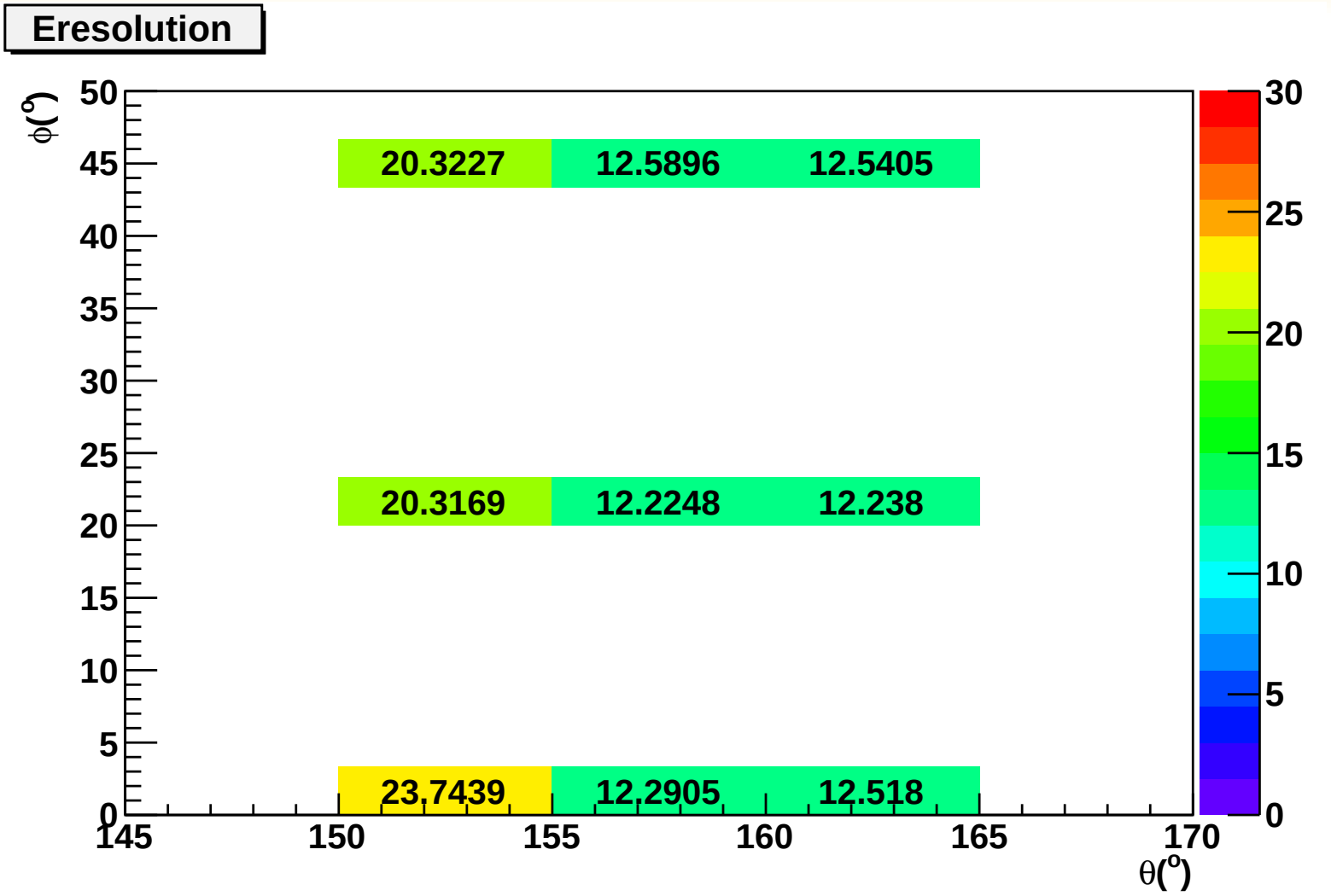




100 MeV; No dead material



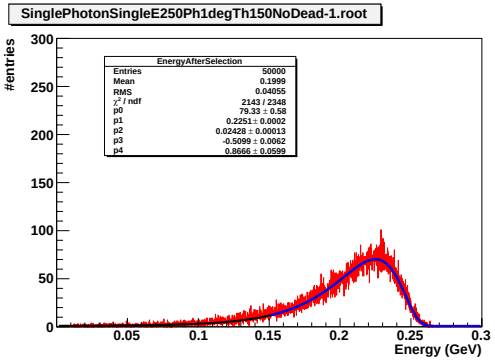
100 MeV; No dead material

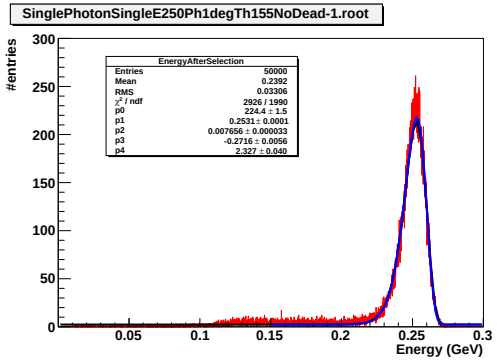


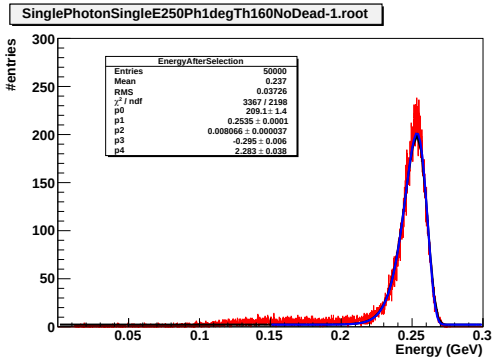
No dead material 250 MeV

$\theta = 150^\circ$ | $\theta = 155^\circ$ | $\theta = 160^\circ$

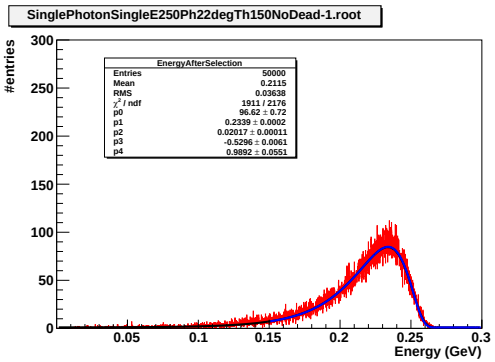
$\phi = 1^\circ$

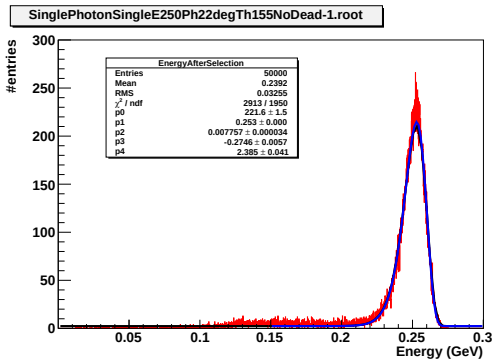


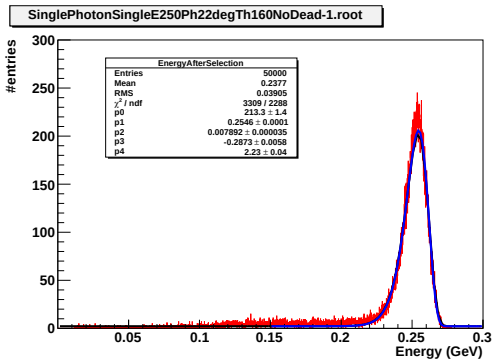


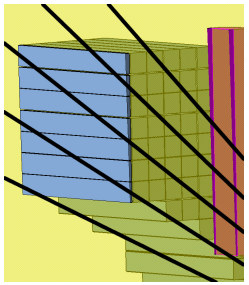


$\phi = 22.5^\circ$

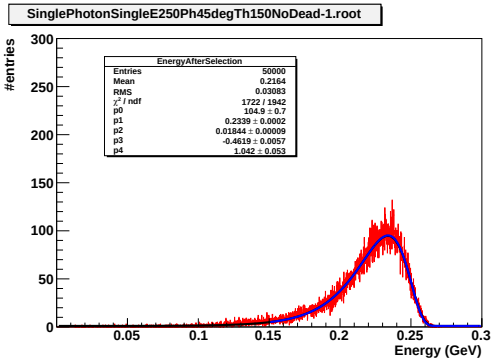


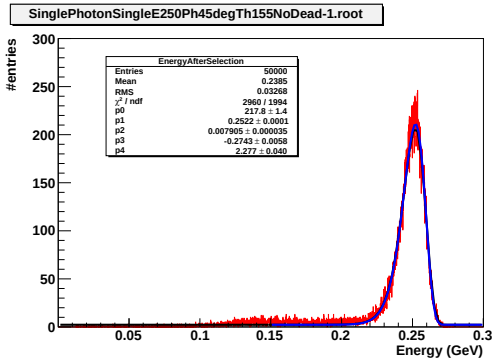


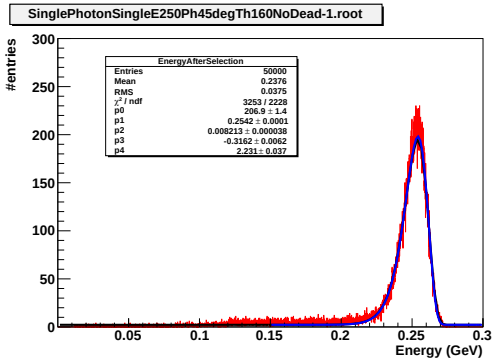




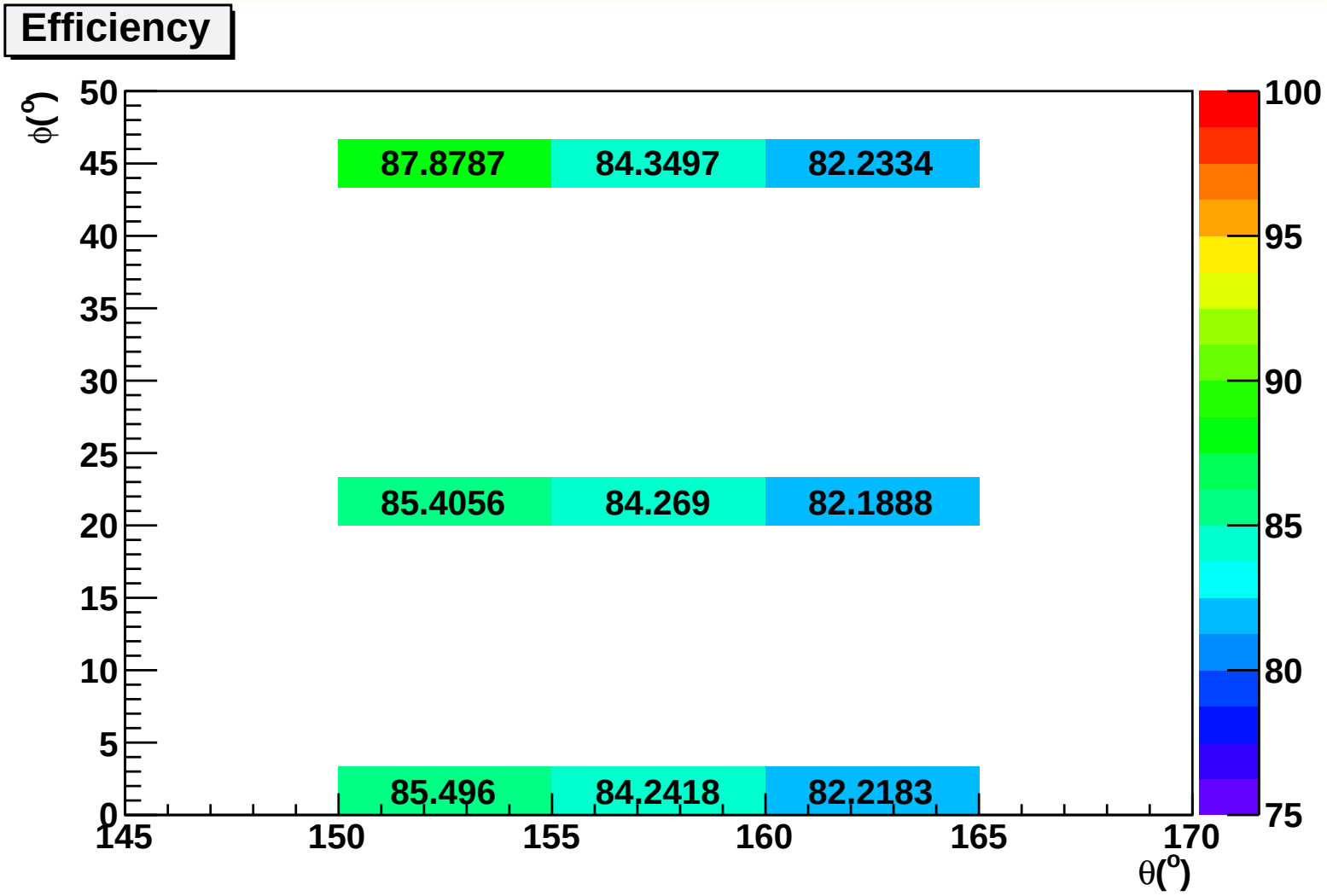
$\phi = 45^\circ$







250 MeV; No dead material



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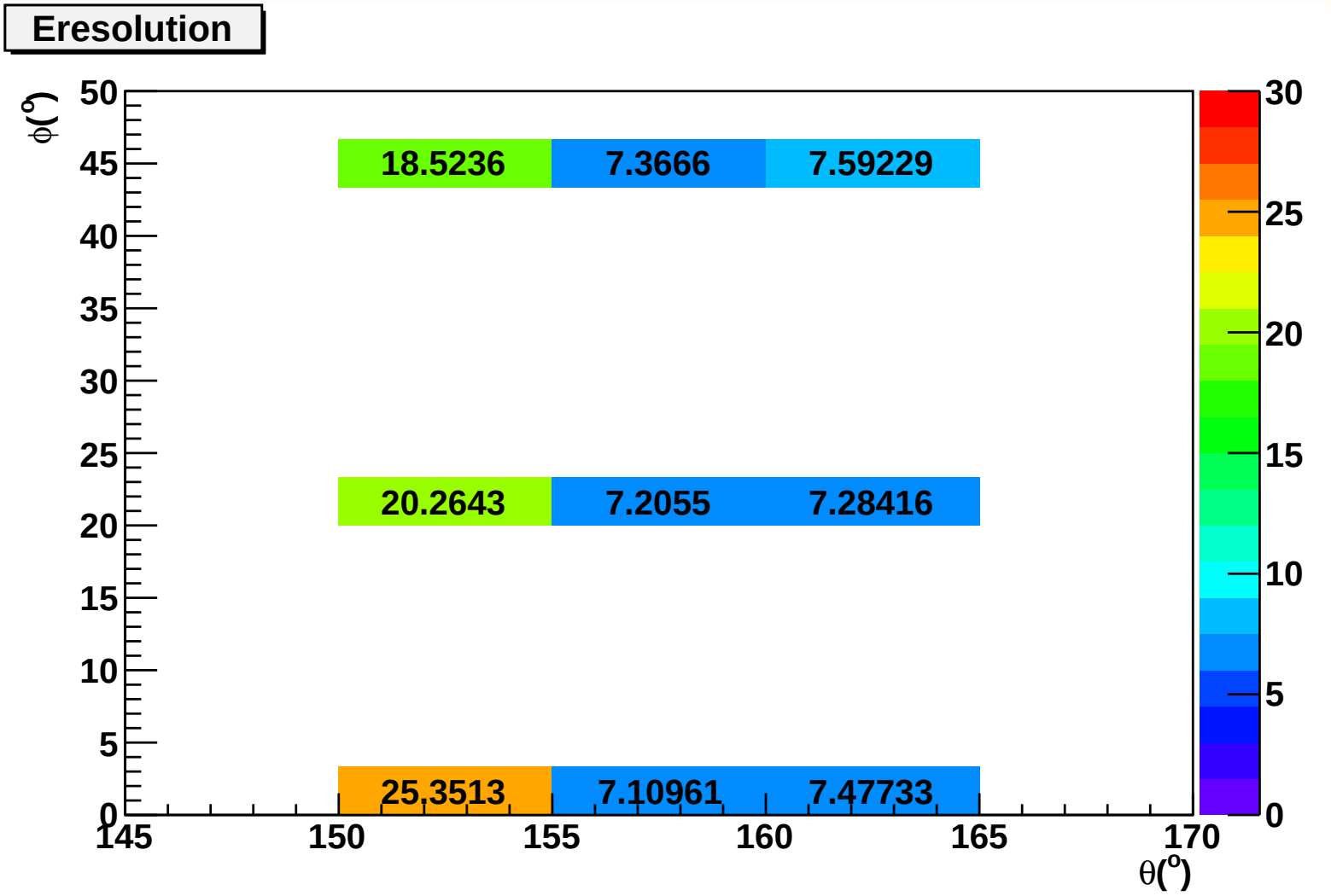
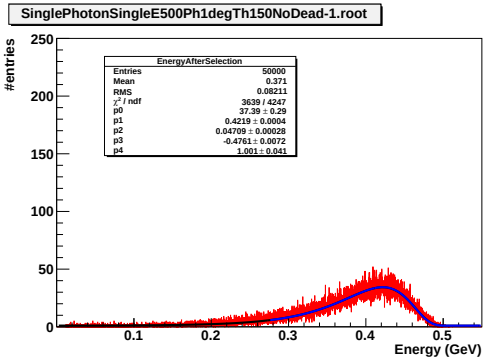
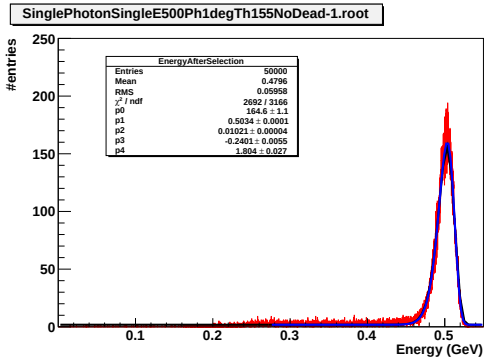


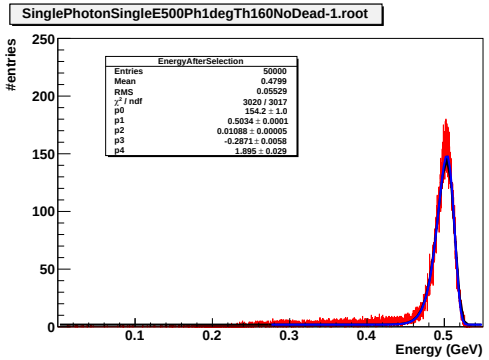
No dead material 500 MeV

$\theta = 150^\circ$ | $\theta = 155^\circ$ | $\theta = 160^\circ$

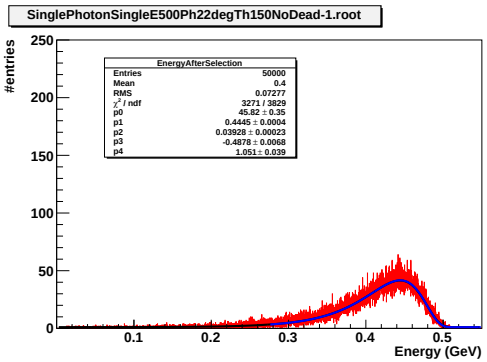
$\phi = 1^\circ$

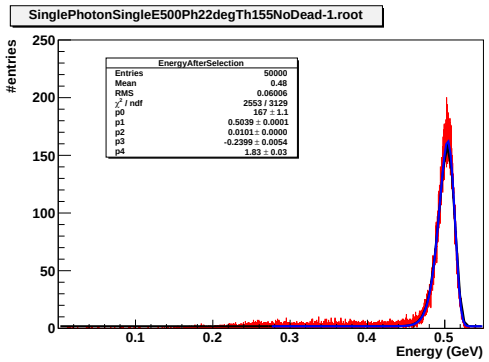


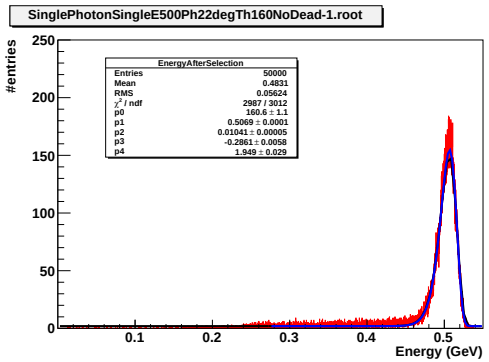


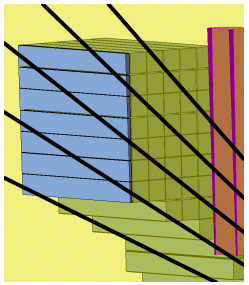


$\phi = 22.5^\circ$

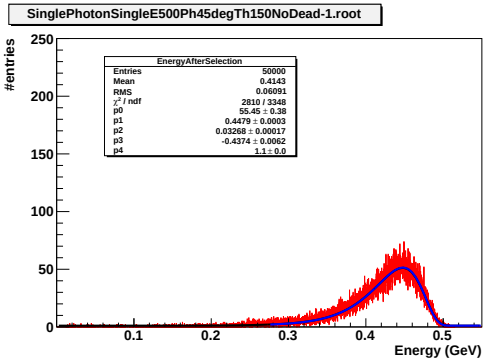


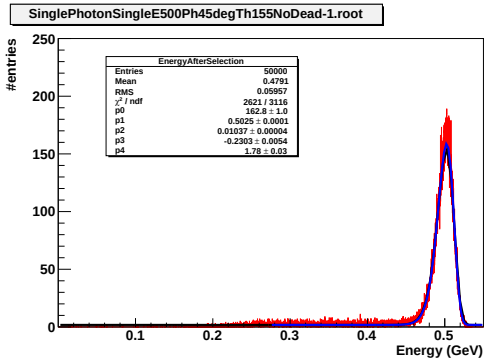


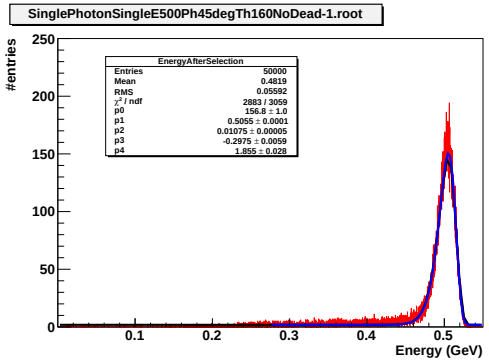




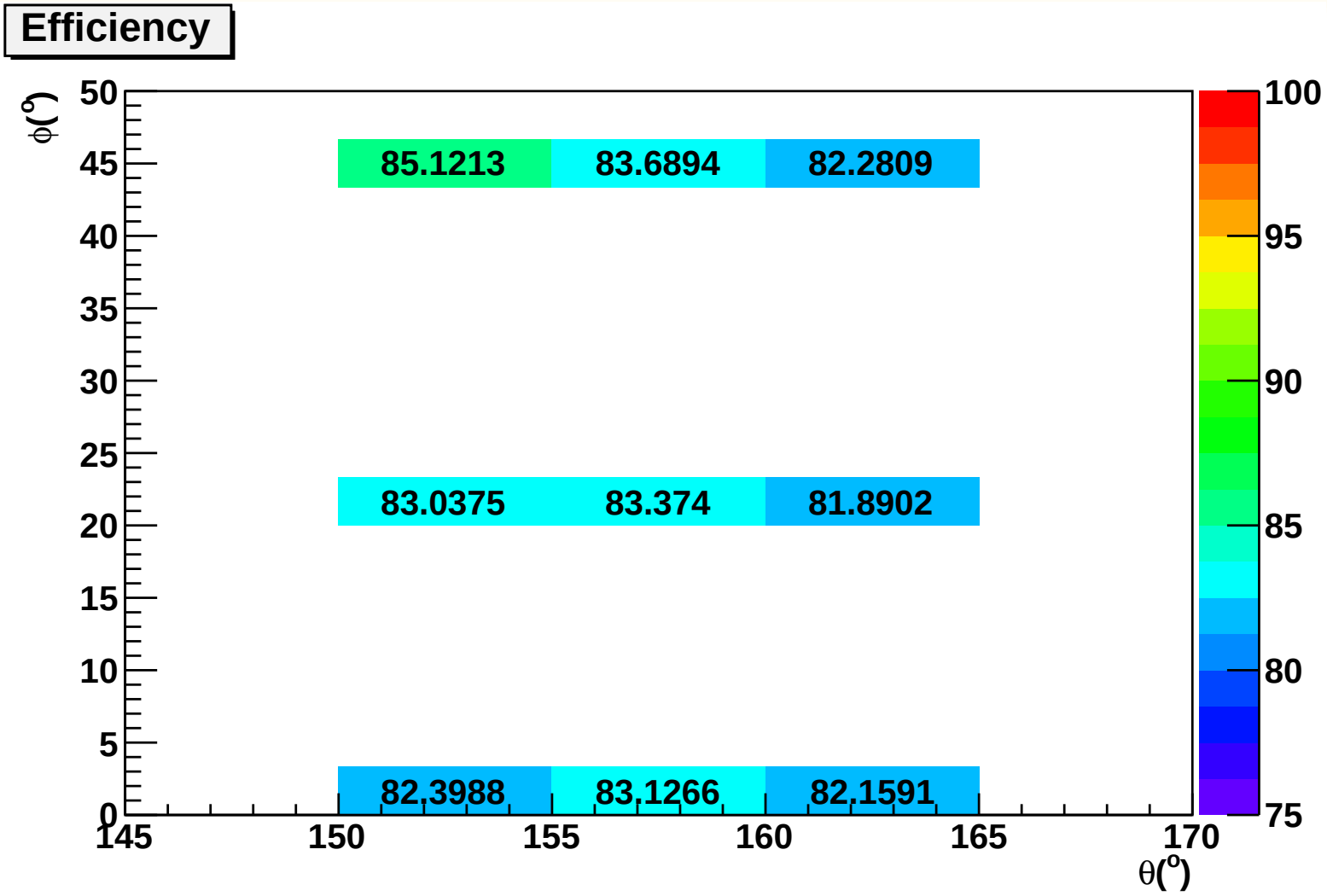
$\phi = 45^\circ$



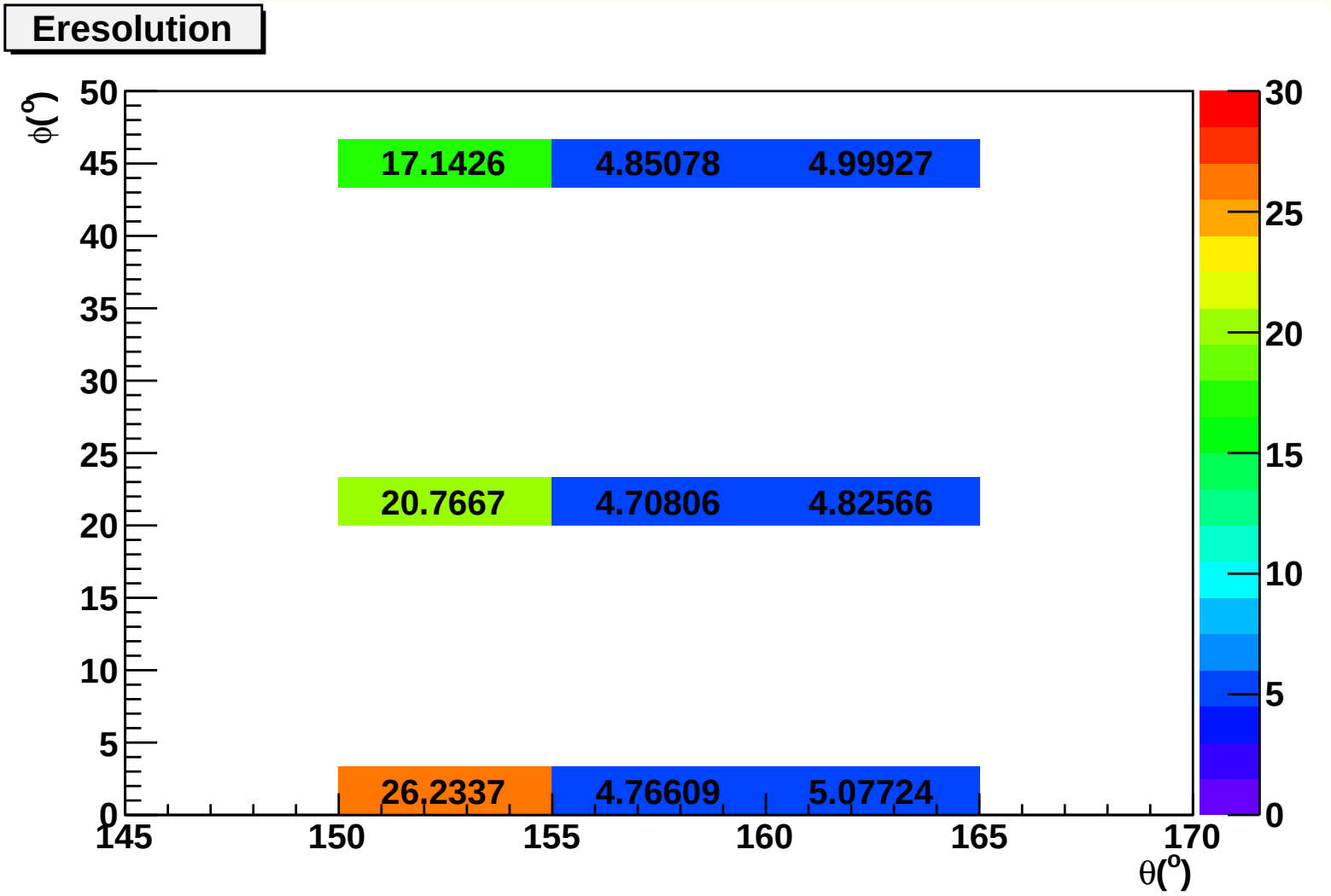




500 MeV; No dead material



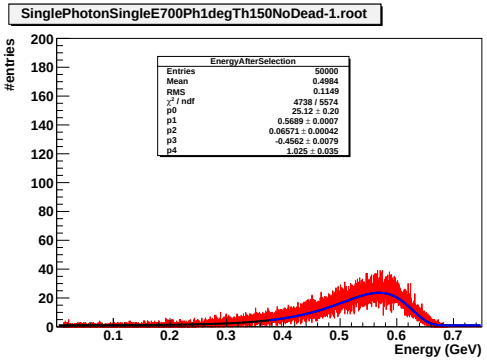
500 MeV; No dead material

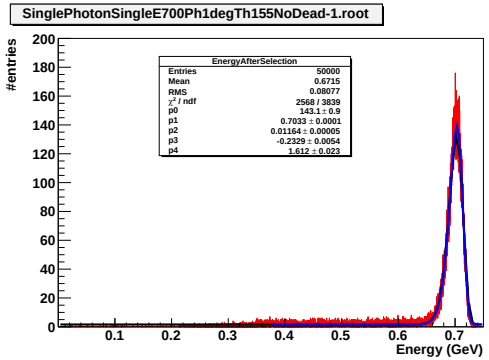


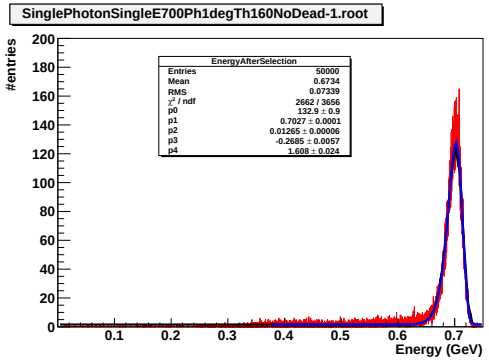
No dead material 700 MeV

$\theta = 150^\circ$ | $\theta = 155^\circ$ | $\theta = 160^\circ$

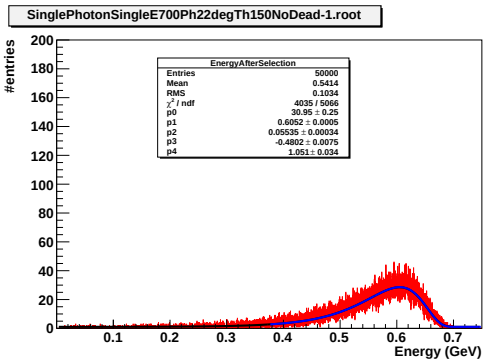
$\phi = 1^\circ$

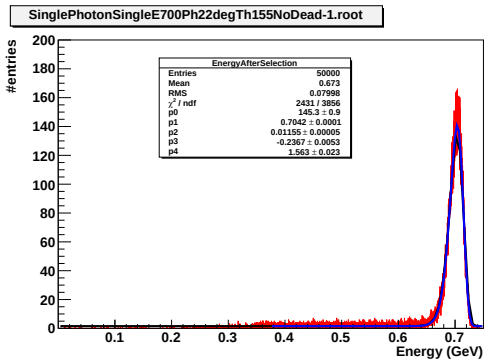


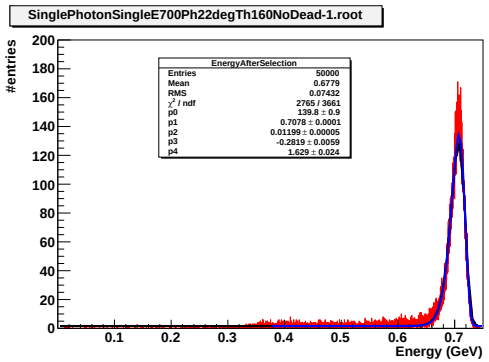


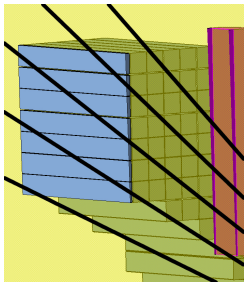


$\phi = 22.5^\circ$

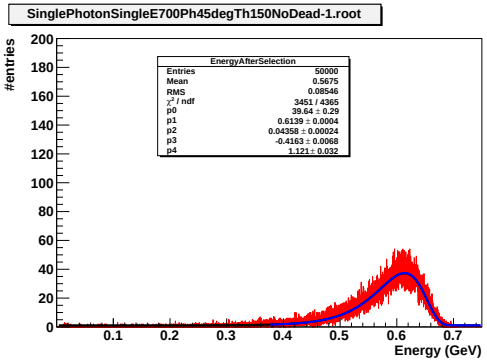


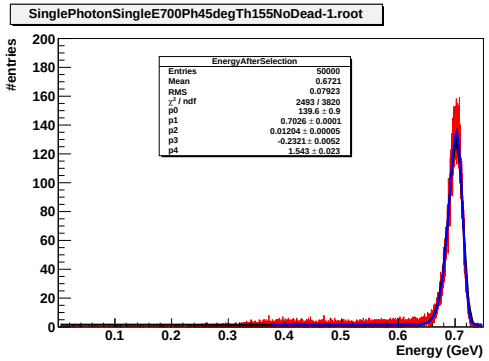


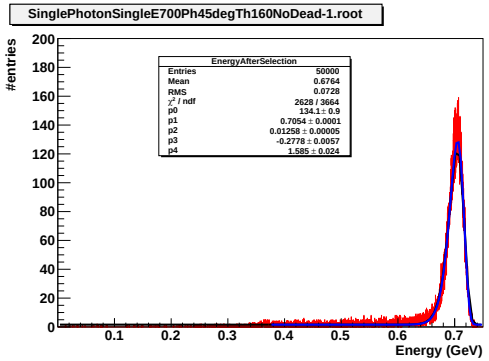




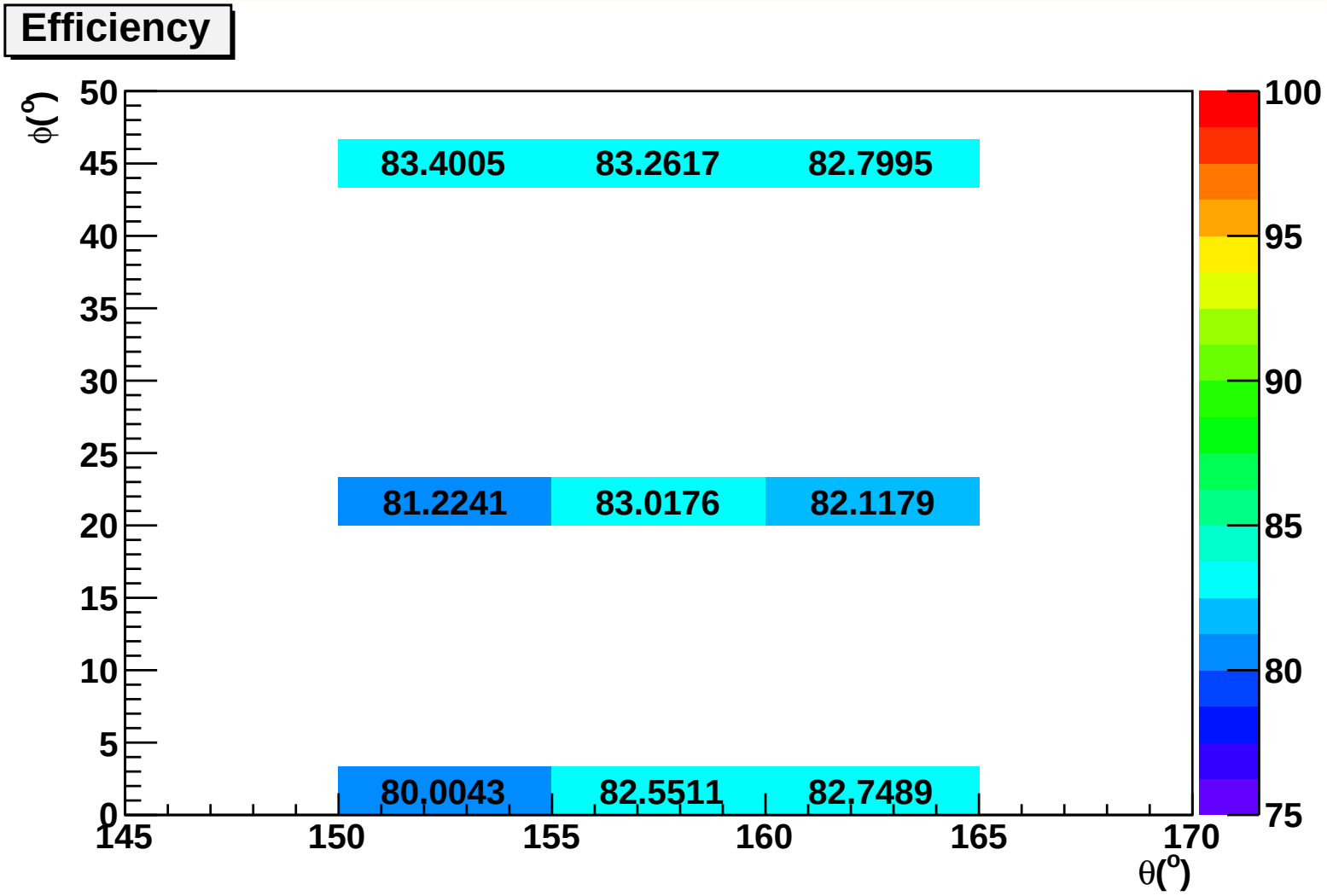
$\phi = 45^\circ$



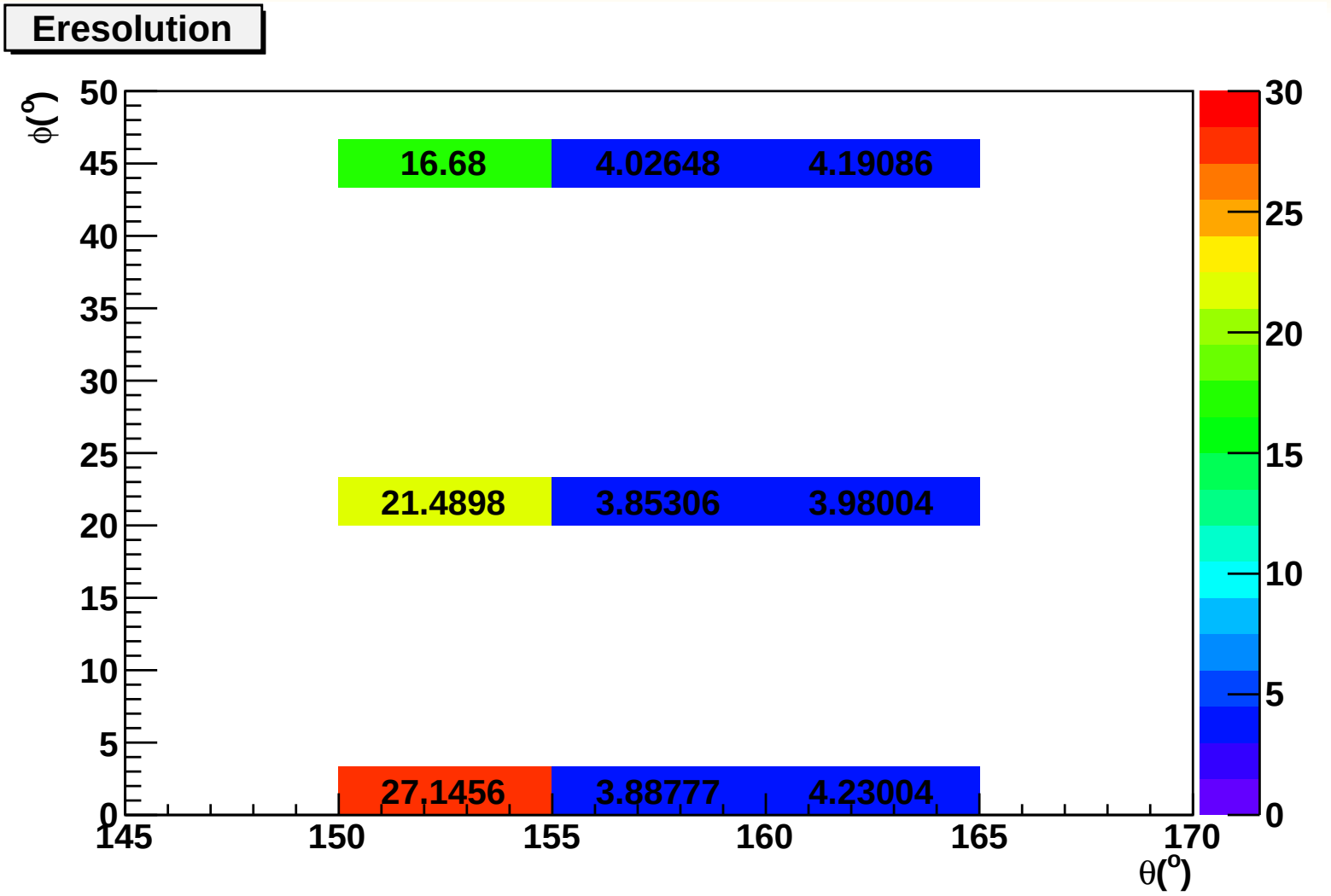




700 MeV; No dead material

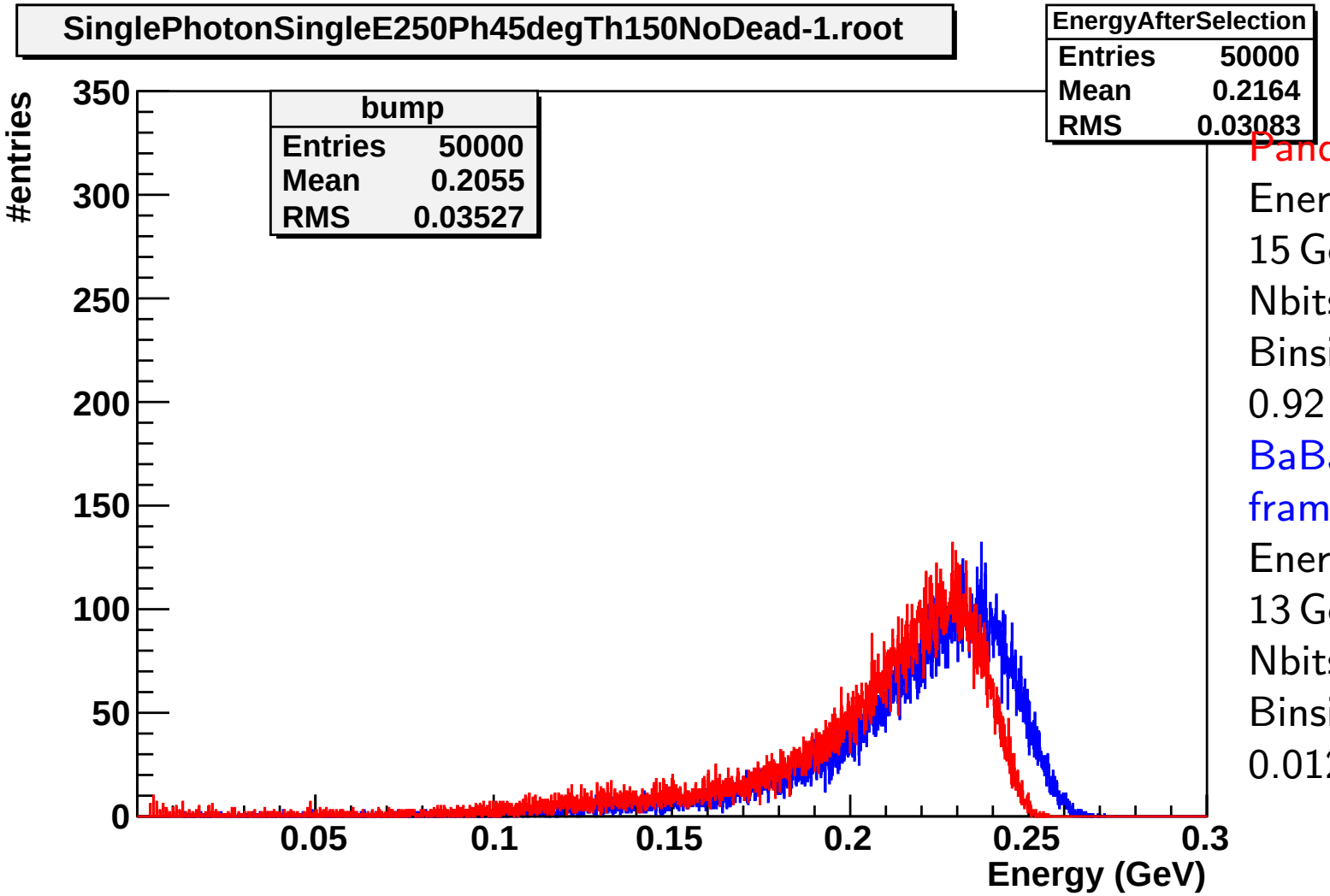


700 MeV; No dead material



Comparison with PandaROOT

First comparison

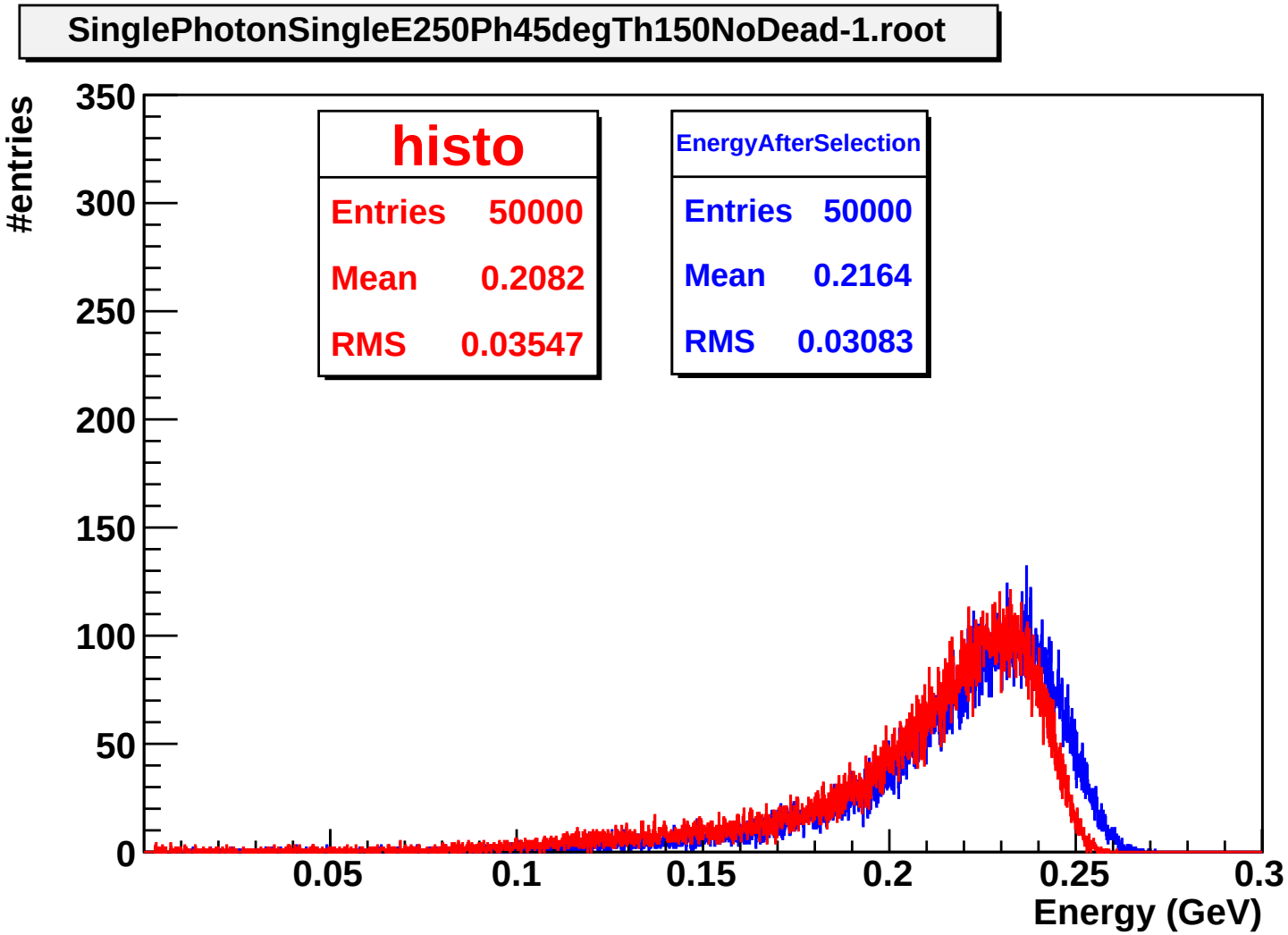


PandaROOT
Energy range: 15 GeV
Nbits: 14
Binsize: 0.92 MeV

BaBar-Like framework
Energy range: 13 GeV
Nbits: 20
Binsize: 0.012 MeV

Comparison with PandaROOT

Second comparison

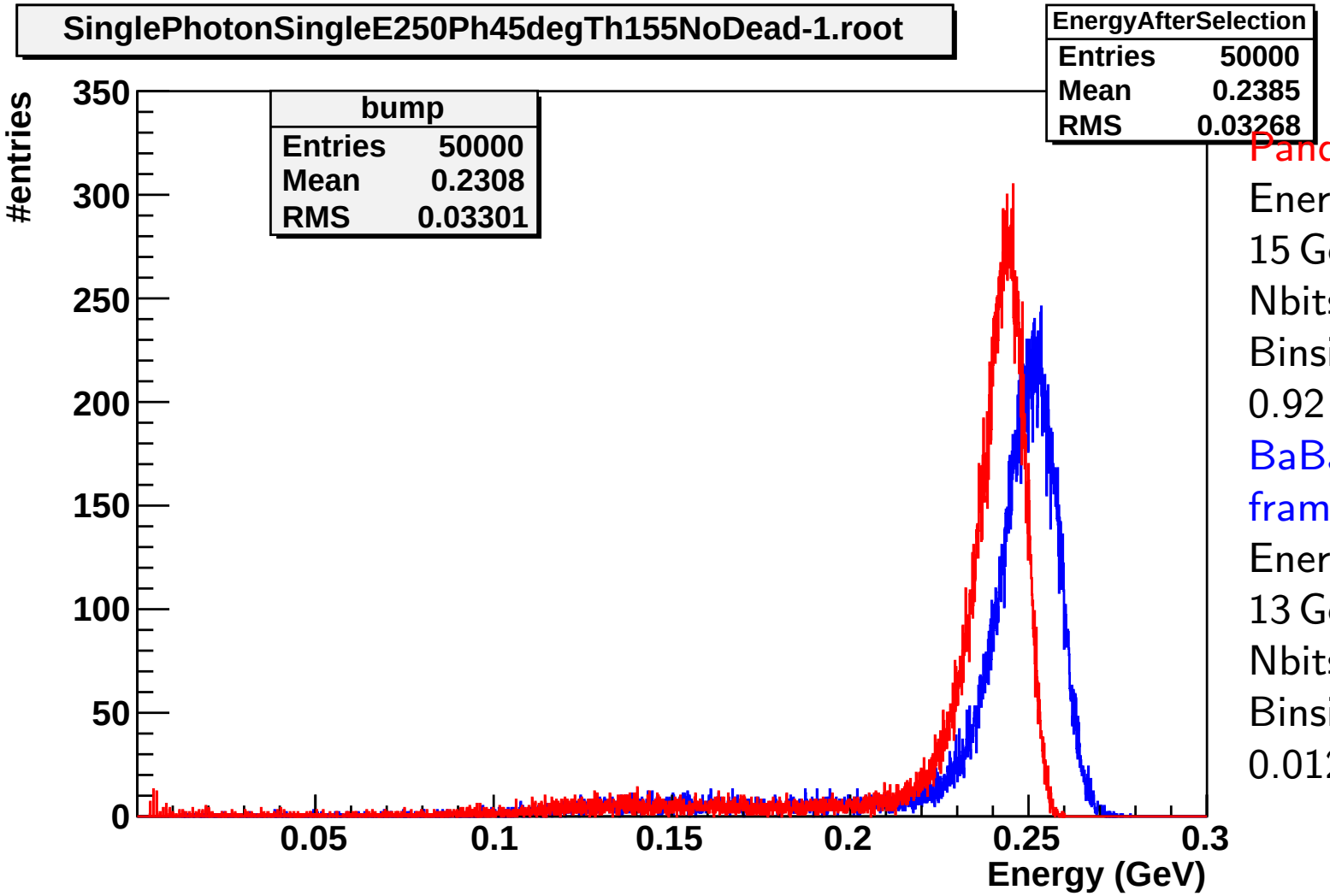


PandaROOT
Energy range: 15 GeV
Nbits: 14
Binsize: 0.18 MeV

BaBar-Like framework
Energy range: 13 GeV
Nbits: 20
Binsize: 0.012 MeV

Comparison with PandaROOT

First comparison

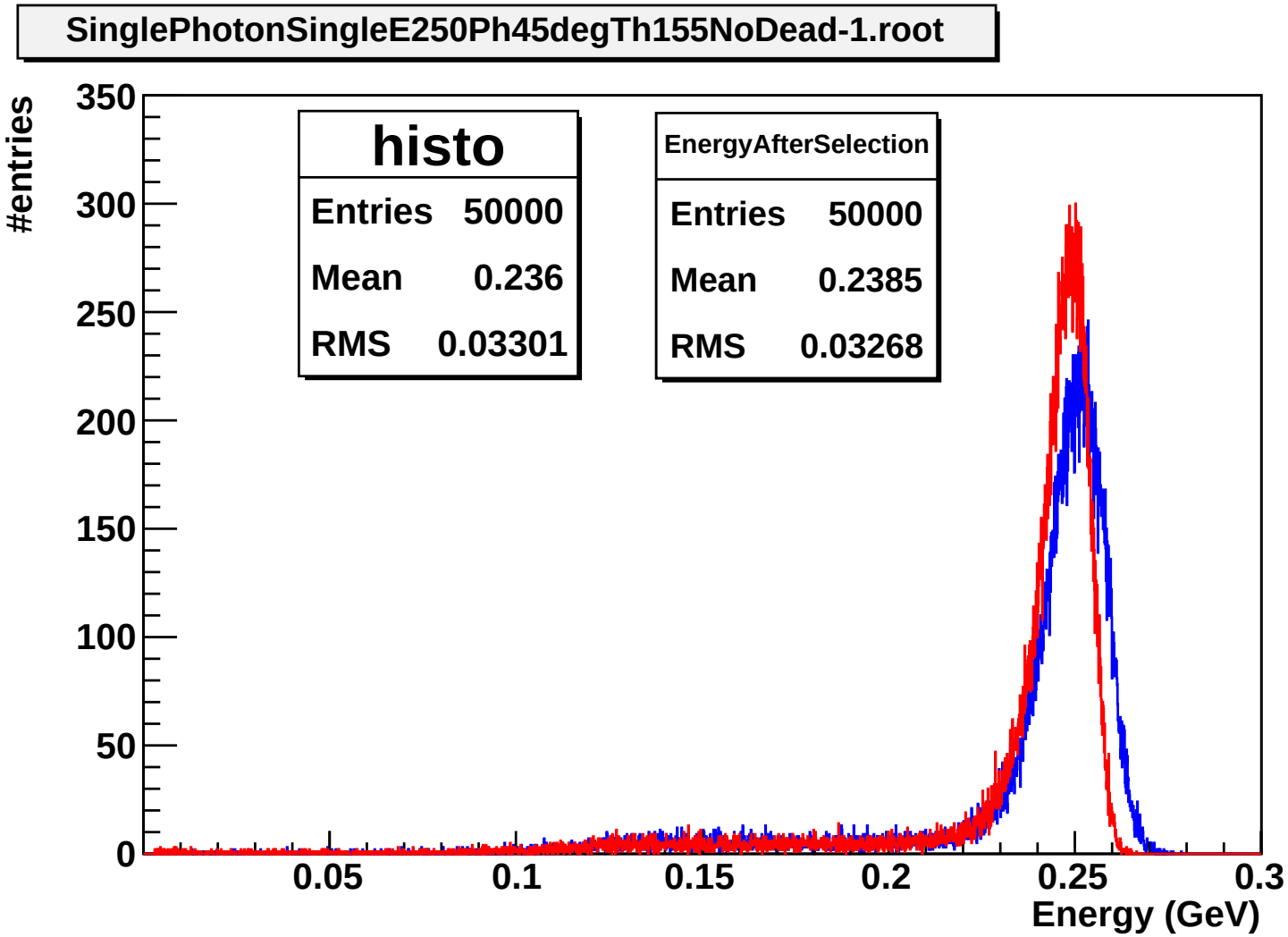


PandaROOT
Energy range: 15 GeV
Nbits: 14
Binsize: 0.92 MeV

BaBar-Like framework
Energy range: 13 GeV
Nbits: 20
Binsize: 0.012 MeV

Comparison with PandaROOT

Second comparison



PandaROOT
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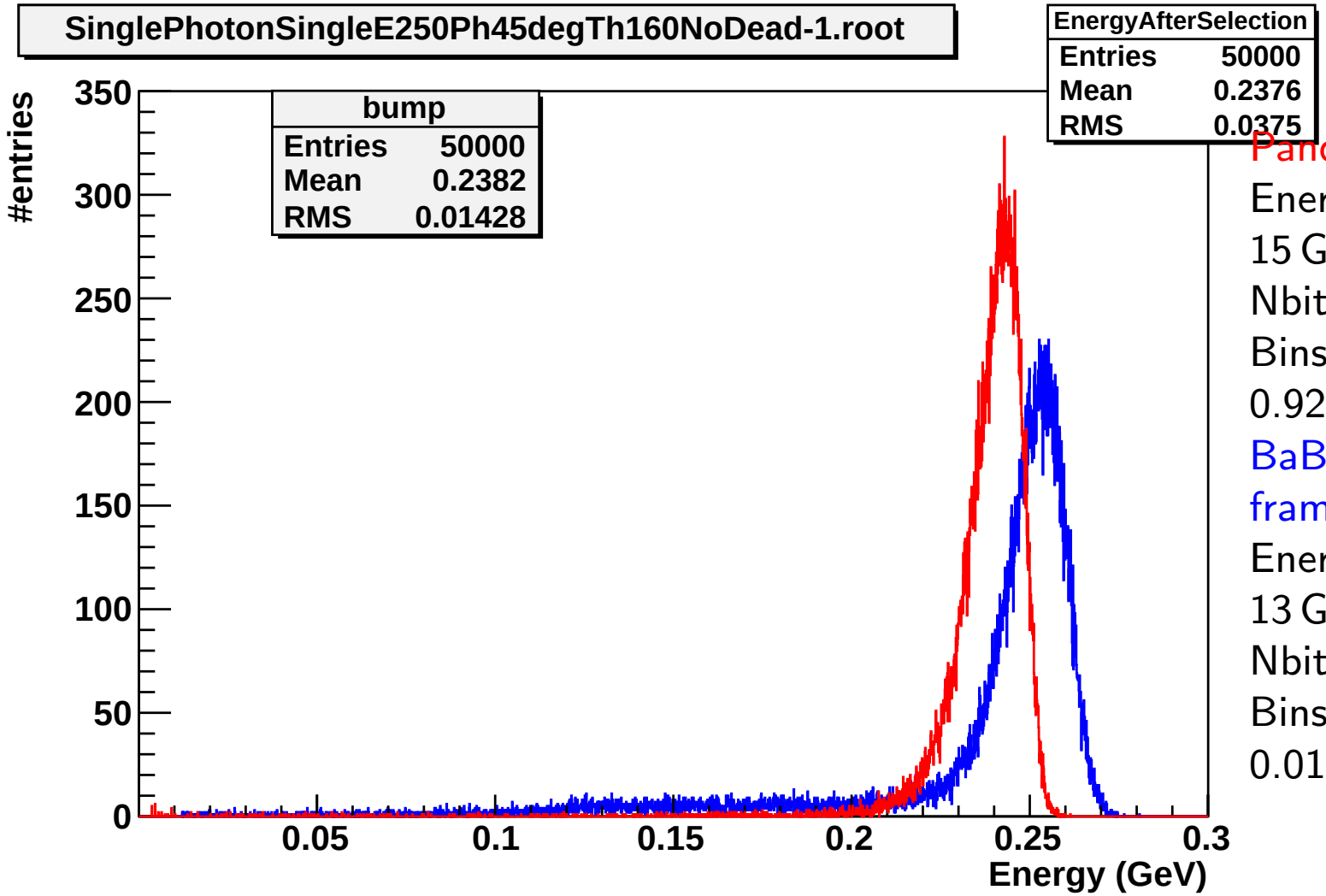
Comparison with PandaROOT

First comparison

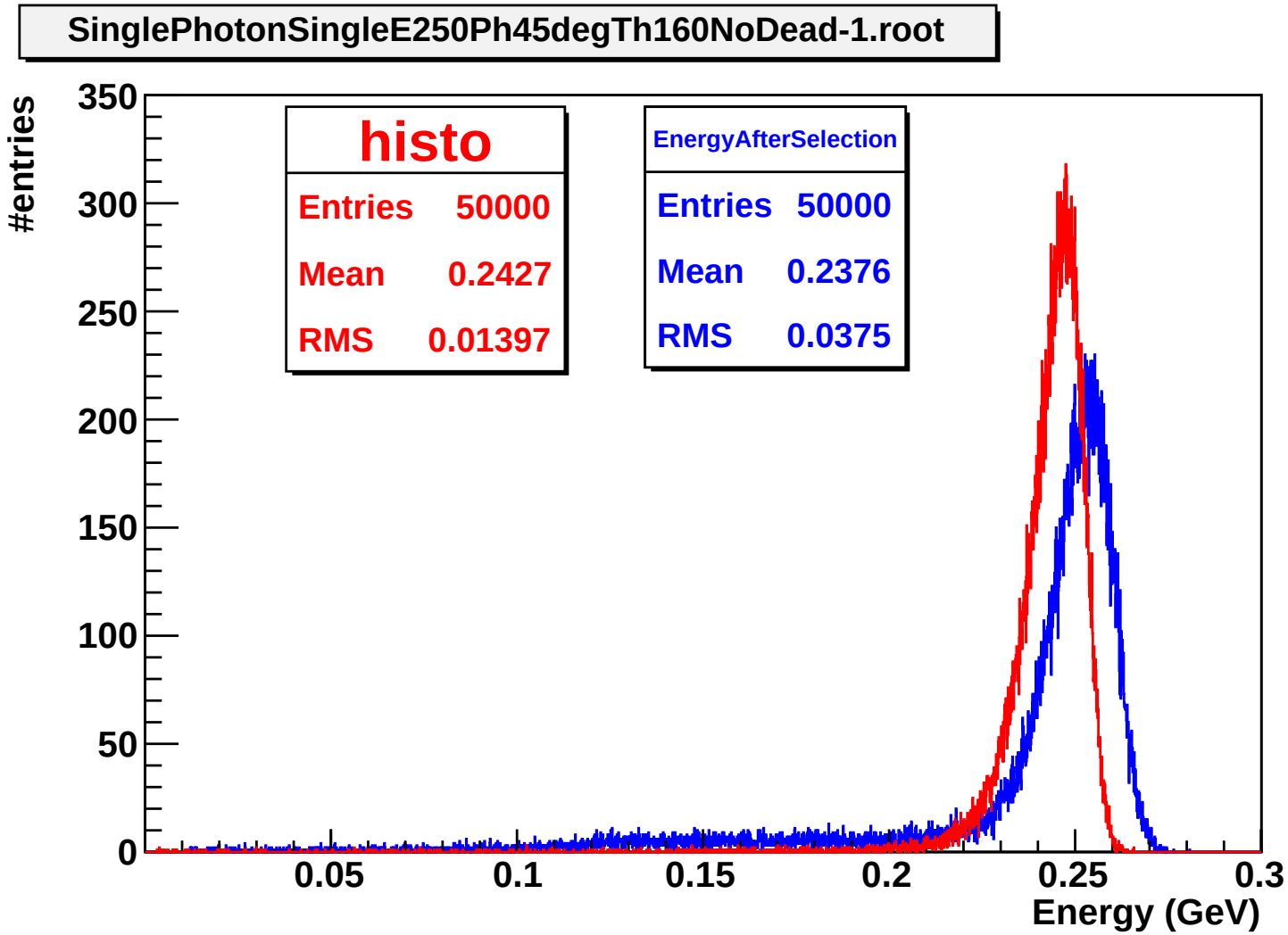


PandaROOT
Energy range: 15 GeV
Nbits: 14
Binsize: 0.92 MeV

BaBar-Like framework
Energy range: 13 GeV
Nbits: 20
Binsize: 0.012 MeV

Comparison with PandaROOT

Second comparison



PandaROOT
Energy range: 15 GeV
Nbits: 14
Binsize: 0.18 MeV

BaBar-Like framework
Energy range: 13 GeV
Nbits: 20
Binsize: 0.012 MeV

What is the reason for the difference

- Physics quantities due to different simulation packages?
- Production cuts used in the simulation?
- Different digitization algorithm?

TO BE CHECKED...

Conclusions and outlook

CONCLUSIONS

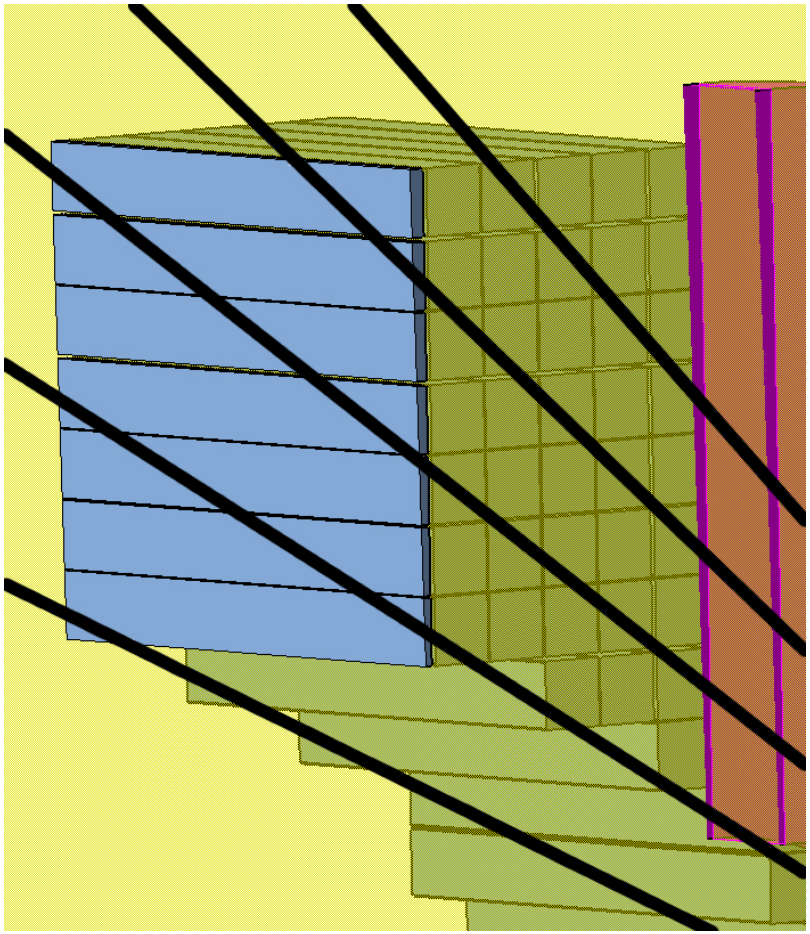
- First results for energy resolution and efficiency have been presented for the backward end cap calorimeter
- Comparison of the results with the BaBar-like software with the new PandaROOT framework have been done
- The reason for the difference has not yet been found

OUTLOOK

- More work is necesary: Include other dead materials front of the calorimeter (MVD)
- Next step is the analysis of $e^+e^-\pi^0$

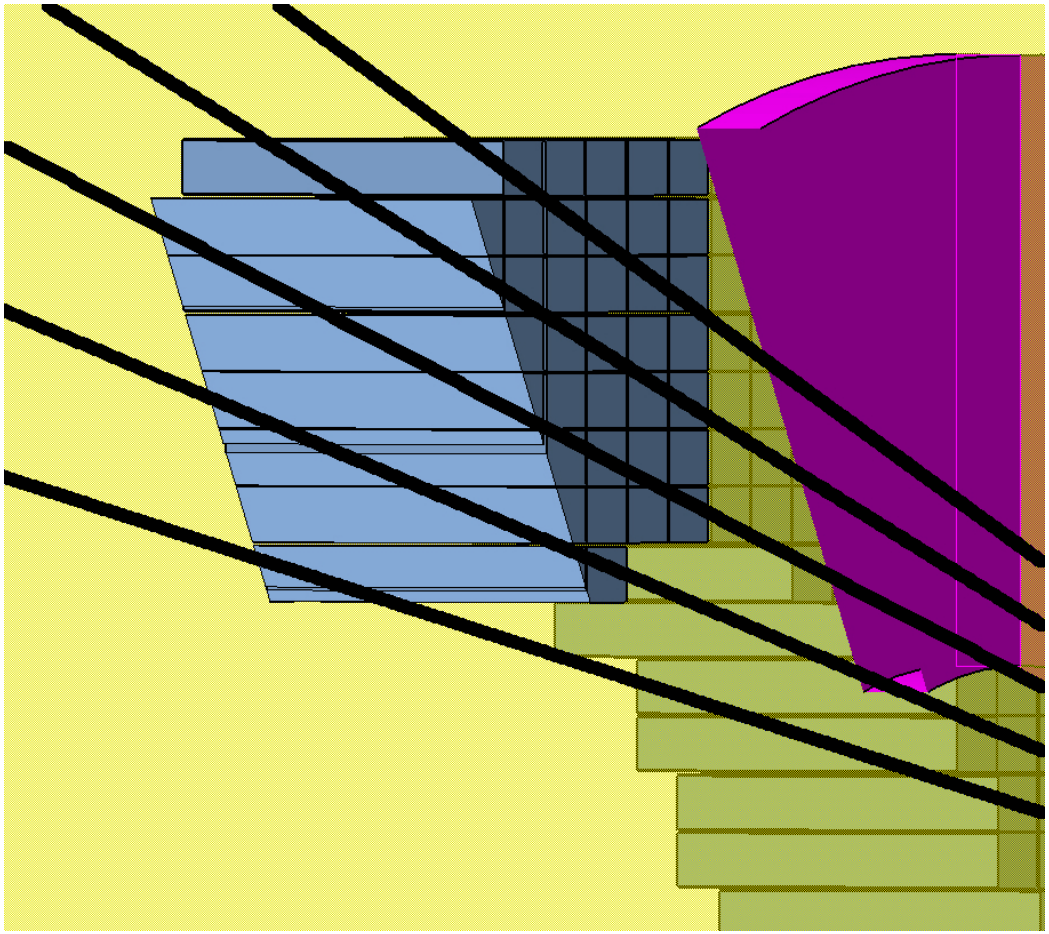
backup

1°



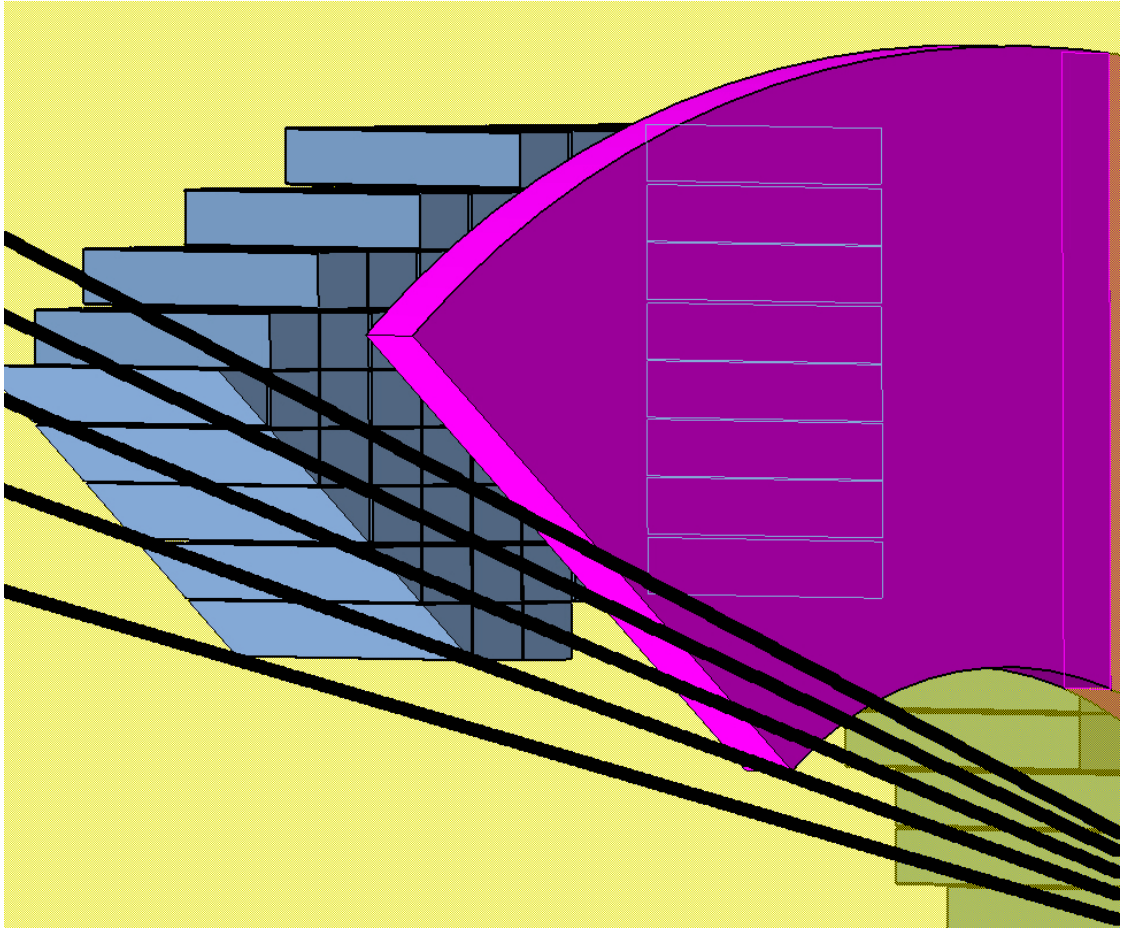
Back

22.5°

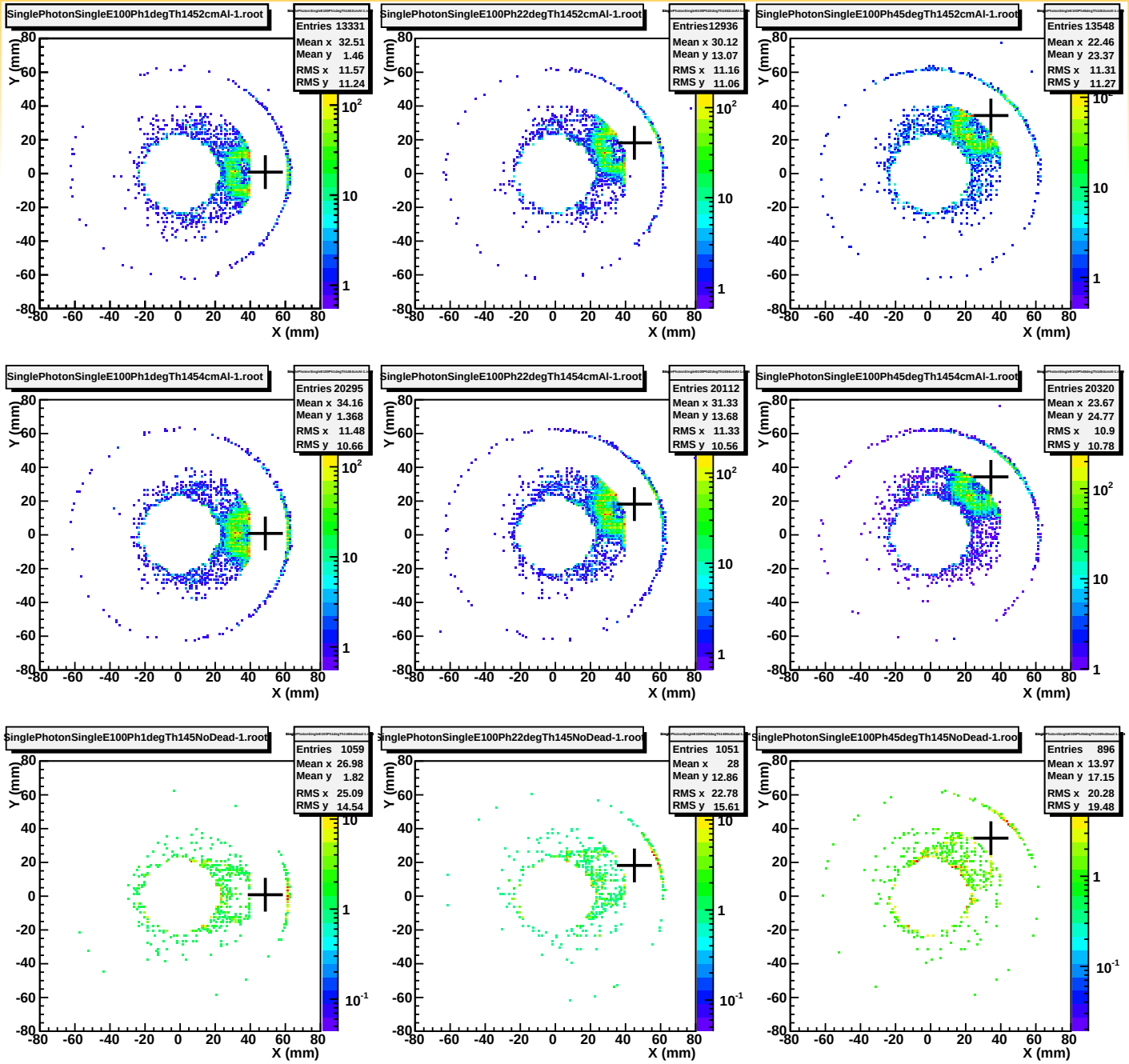


Back

45°



Back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RMS y 11.24
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Entries 12936
Mean x 30.12
Mean y 13.07
RMS x 11.16
RMS y 11.06
SinglePhotonSingleE100Ph45degTh1452cmAl-1.root
Entries 13548
Mean x 22.46
Mean y 23.37
RMS x 11.31
RMS y 11.27
SinglePhotonSingleE100Ph1degTh1454cmAl-1.root
Entries 20295
Mean x 34.16
Mean y 1.368
RMS x 11.48
RMS y 10.66
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Entries 20112
Mean x 31.33
Mean y 13.68
RMS x 11.33
RMS y 10.56
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Entries 20320
Mean x 23.67
Mean y 24.77
RMS x 10.9
RMS y 10.78
SinglePhotonSingleE100Ph1degTh145NoDead-1.root
Entries 1059
Mean x 26.98
Mean y 1.82
RMS x 25.09
RMS y 14.54
SinglePhotonSingleE100Ph22degTh145NoDead-1.root
Entries 1051
Mean x 28
Mean y 12.86
RMS x 22.78
RMS y 15.61
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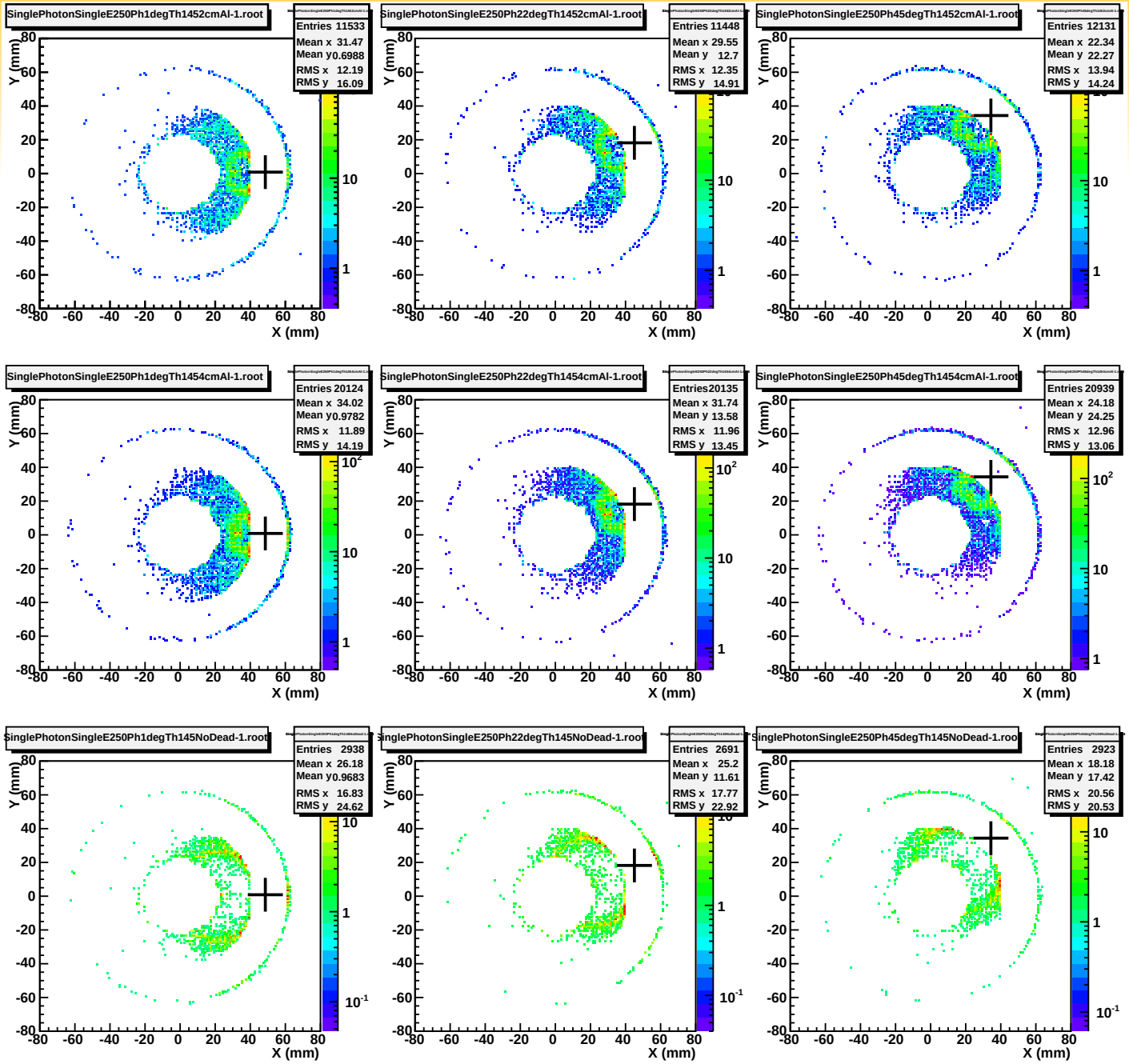
Mean y 17.15
RMS x 20.28
RMS y 19.48
Y (mm)
X (mm)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Entries 11448
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Mean y 12.7
RMS x 12.35
RMS y 14.91
SinglePhotonSingleE250Ph45degTh1452cmAl-1.root
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Mean x 22.34
Mean y 22.27
RMS x 13.94
RMS y 14.24
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Entries 20124
Mean x 34.02
Mean y 0.9782
RMS x 11.89
RMS y 14.19
SinglePhotonSingleE250Ph22degTh1454cmAl-1.root
Entries 20135
Mean x 31.74
Mean y 13.58
RMS x 11.96
RMS y 13.45
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Mean x 24.18
Mean y 24.25
RMS x 12.96
RMS y 13.06
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Entries 2938
Mean x 26.18
Mean y 0.9683
RMS x 16.83
RMS y 24.62
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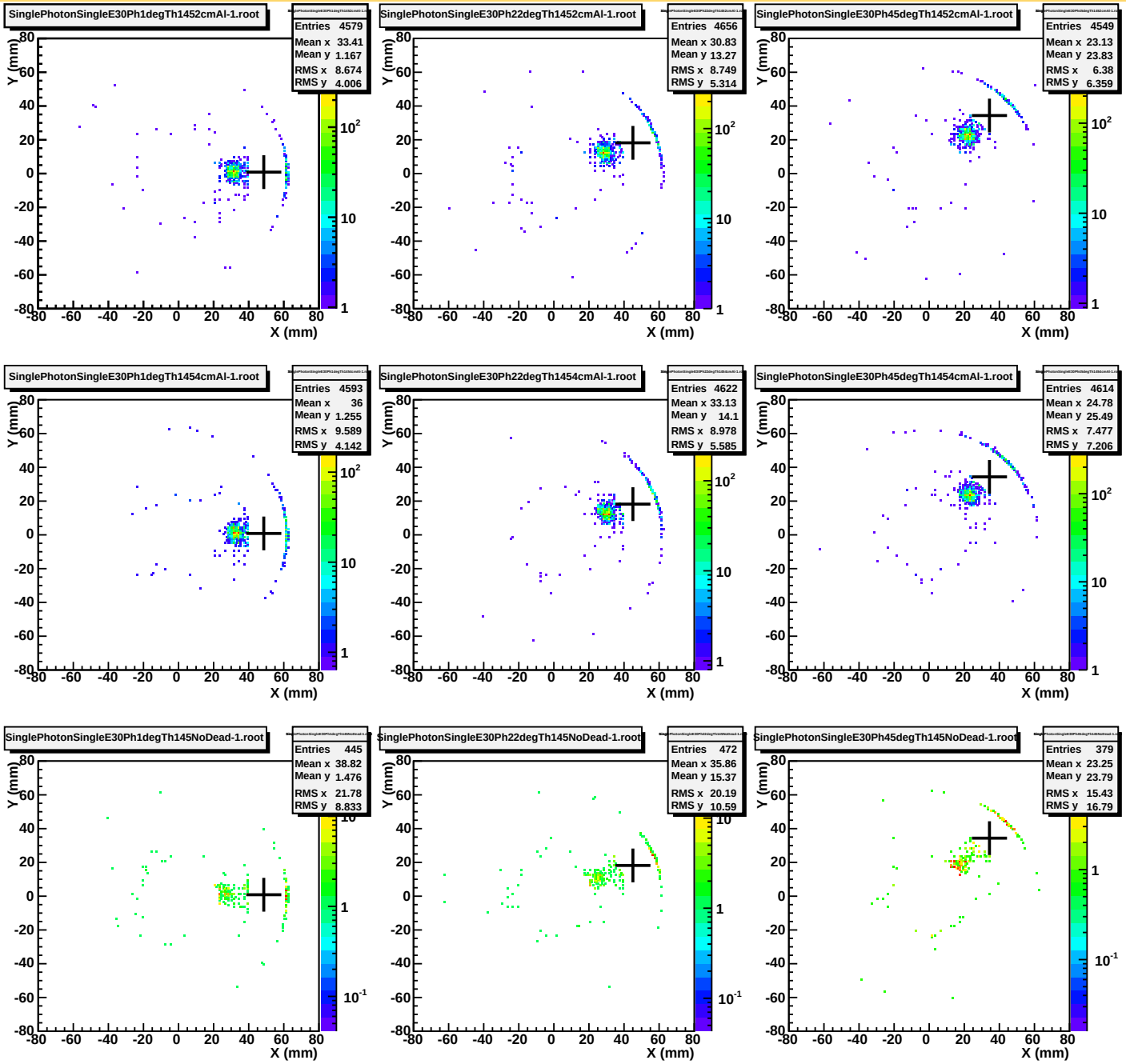
Entries 2691
Mean x 25.2
Mean y 11.61
RMS x 17.77
RMS y 22.92
SinglePhotonSingleE250Ph45degTh145NoDead-1.root
Entries 2923
Mean x 18.18
Mean y 17.42
RMS x 20.56
RMS y 20.53
Y (mm)
X (mm)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Mean y 1.167
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SinglePhotonSingleE30Ph22degTh1452cmAl-1.root
Entries 4656
Mean x 30.83
Mean y 13.27
RMS x 8.749
RMS y 5.314
SinglePhotonSingleE30Ph45degTh1452cmAl-1.root
Entries 4549
Mean x 23.13
Mean y 23.83
RMS x 6.38
RMS y 6.359
SinglePhotonSingleE30Ph1degTh1454cmAl-1.root
Entries 4593
Mean x 36
Mean y 1.255
RMS x 9.589
RMS y 4.142
SinglePhotonSingleE30Ph22degTh1454cmAl-1.root
Entries 4622
Mean x 33.13
Mean y 14.1
RMS x 8.978
RMS y 5.585
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Entries 4614
Mean x 24.78
Mean y 25.49
RMS x 7.477
RMS y 7.206
SinglePhotonSingleE30Ph1degTh145NoDead-1.root
Entries 445
Mean x 38.82
Mean y 1.476
RMS x 21.78
RMS y 8.833
SinglePhotonSingleE30Ph22degTh145NoDead-1.root
Entries 472
Mean x 35.86
Mean y 15.37
RMS x 20.19
RMS y 10.59
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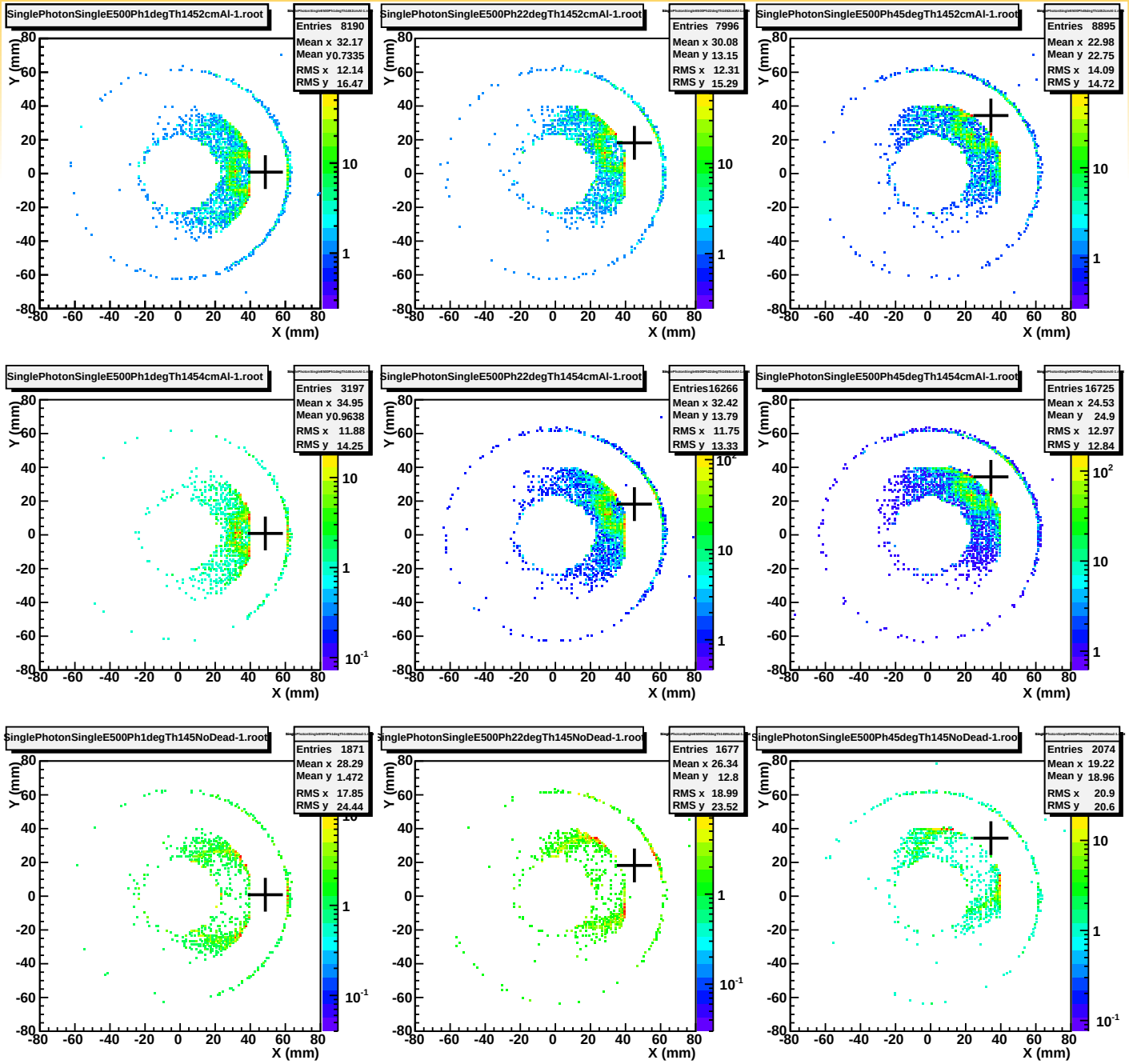
RMS x 15.43
RMS y 16.79
Y (mm)
X (mm)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Mean y 0.7335
RMS x 12.14
RMS y 16.47
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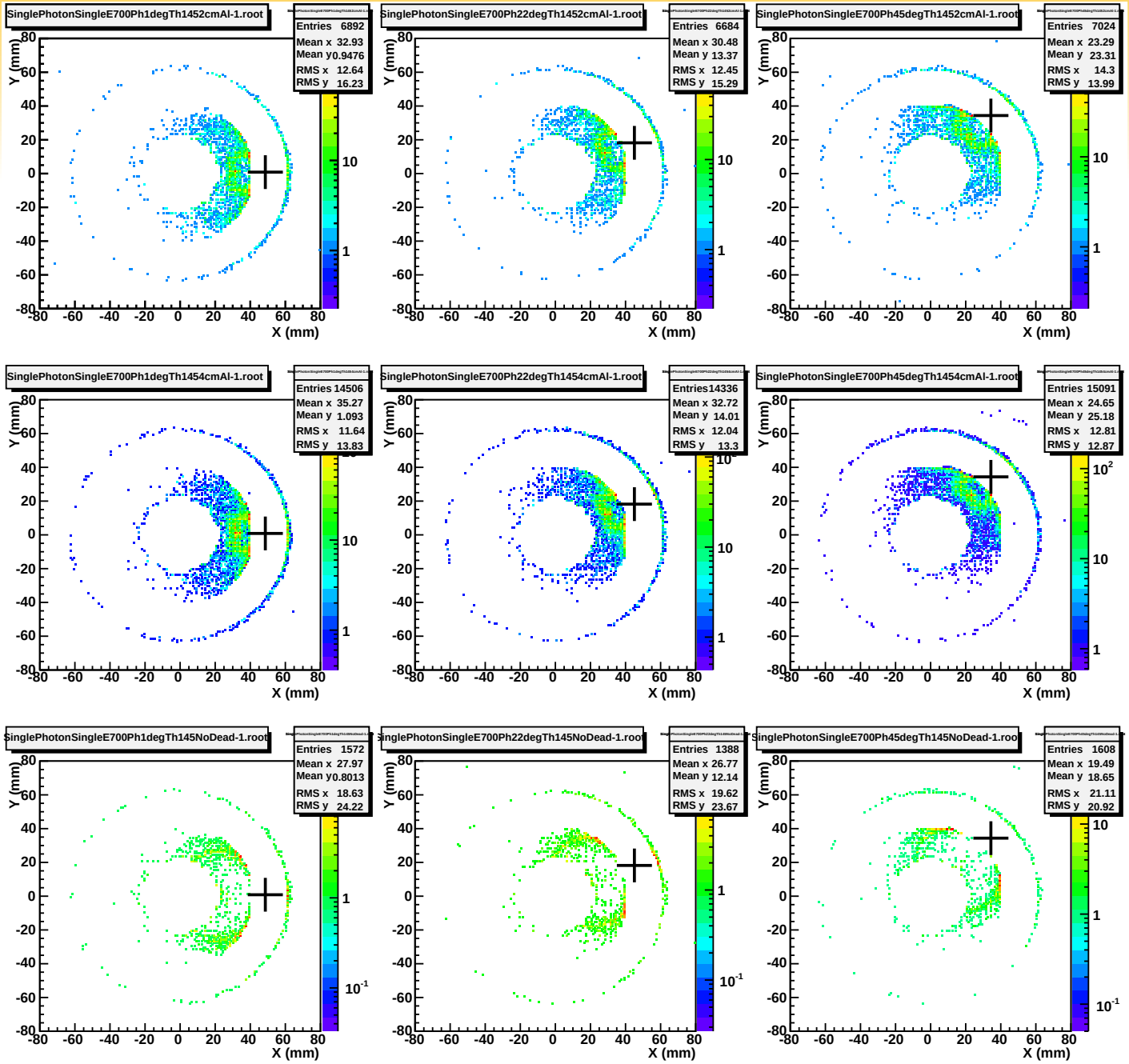
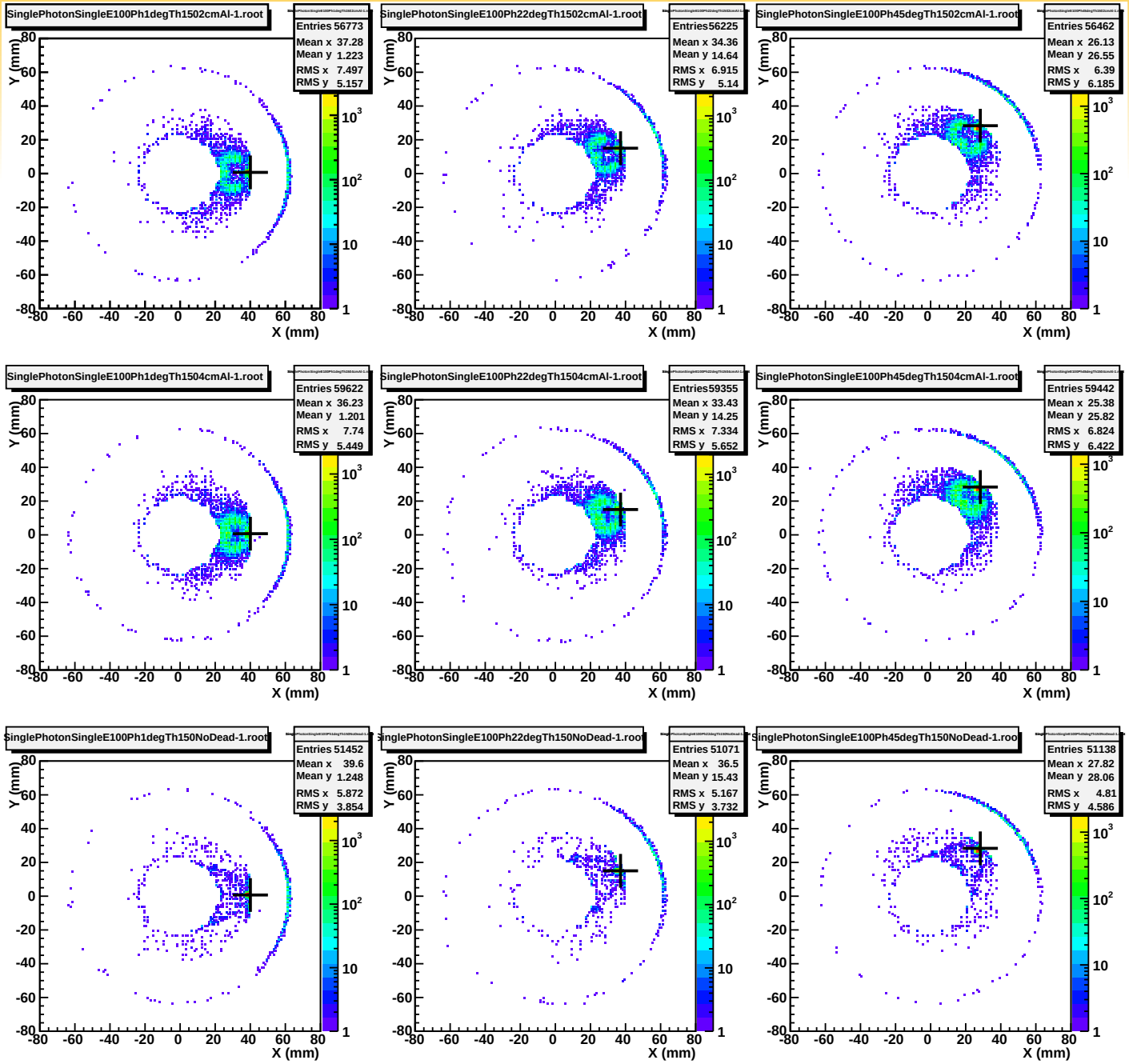
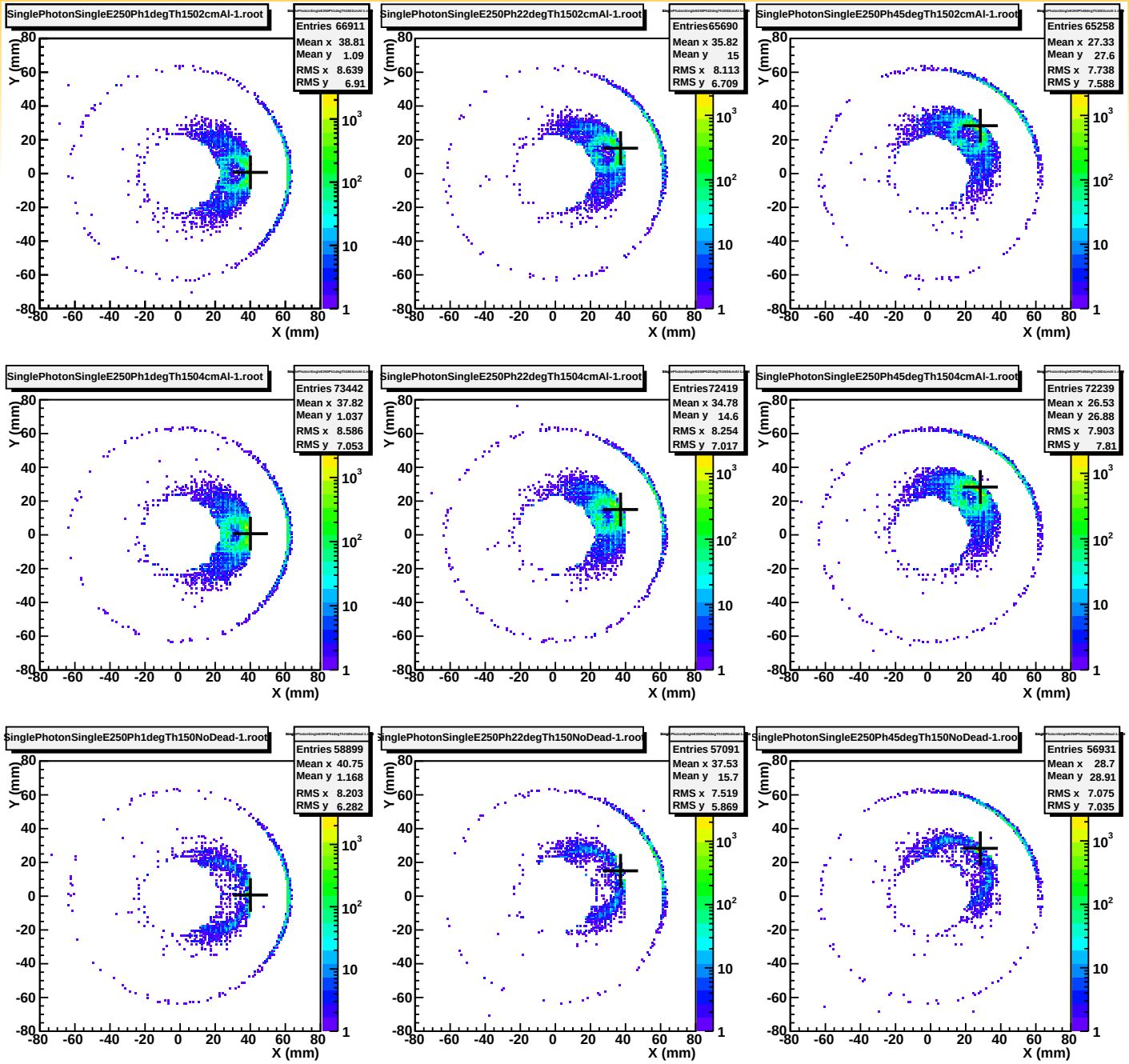
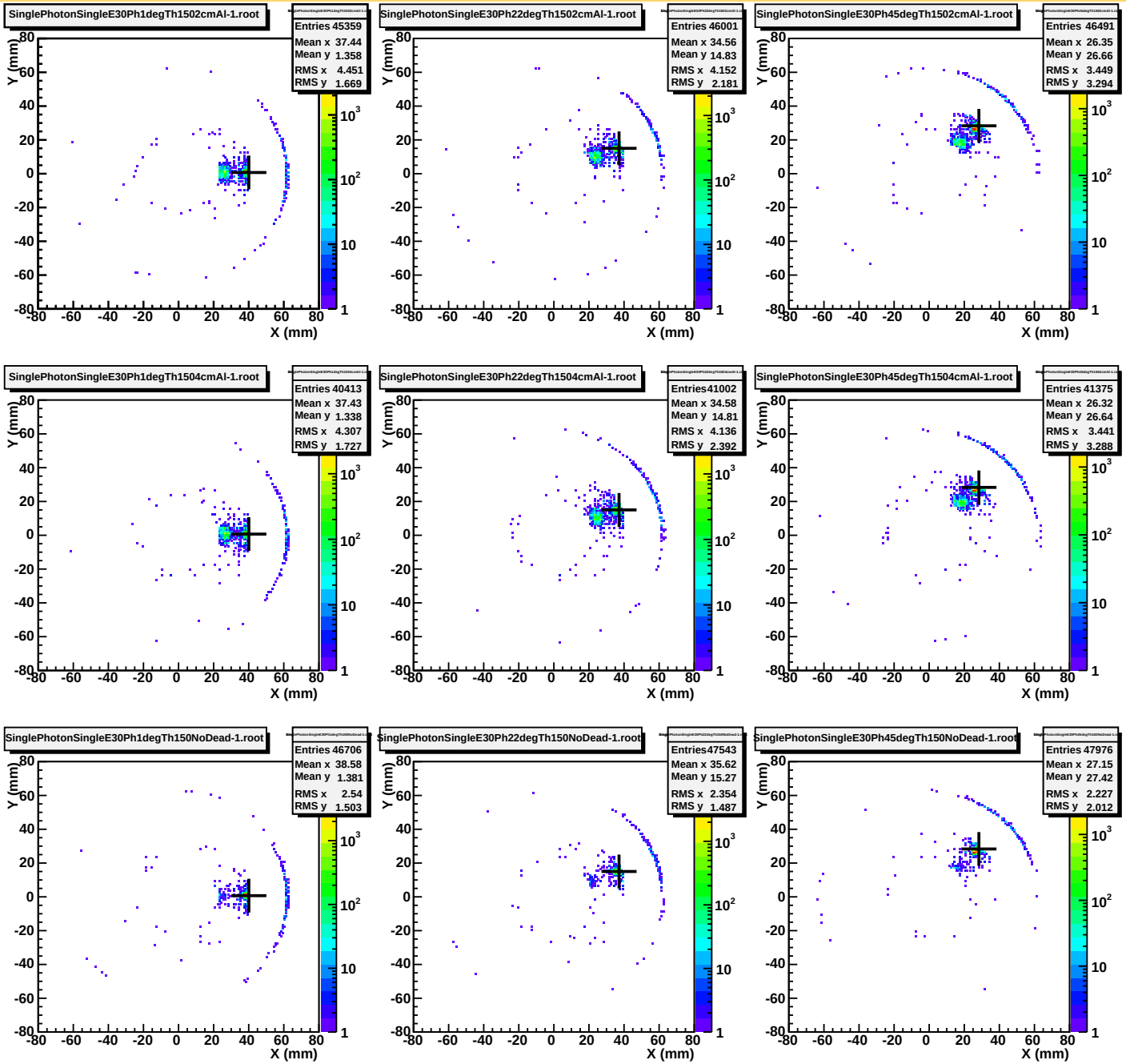
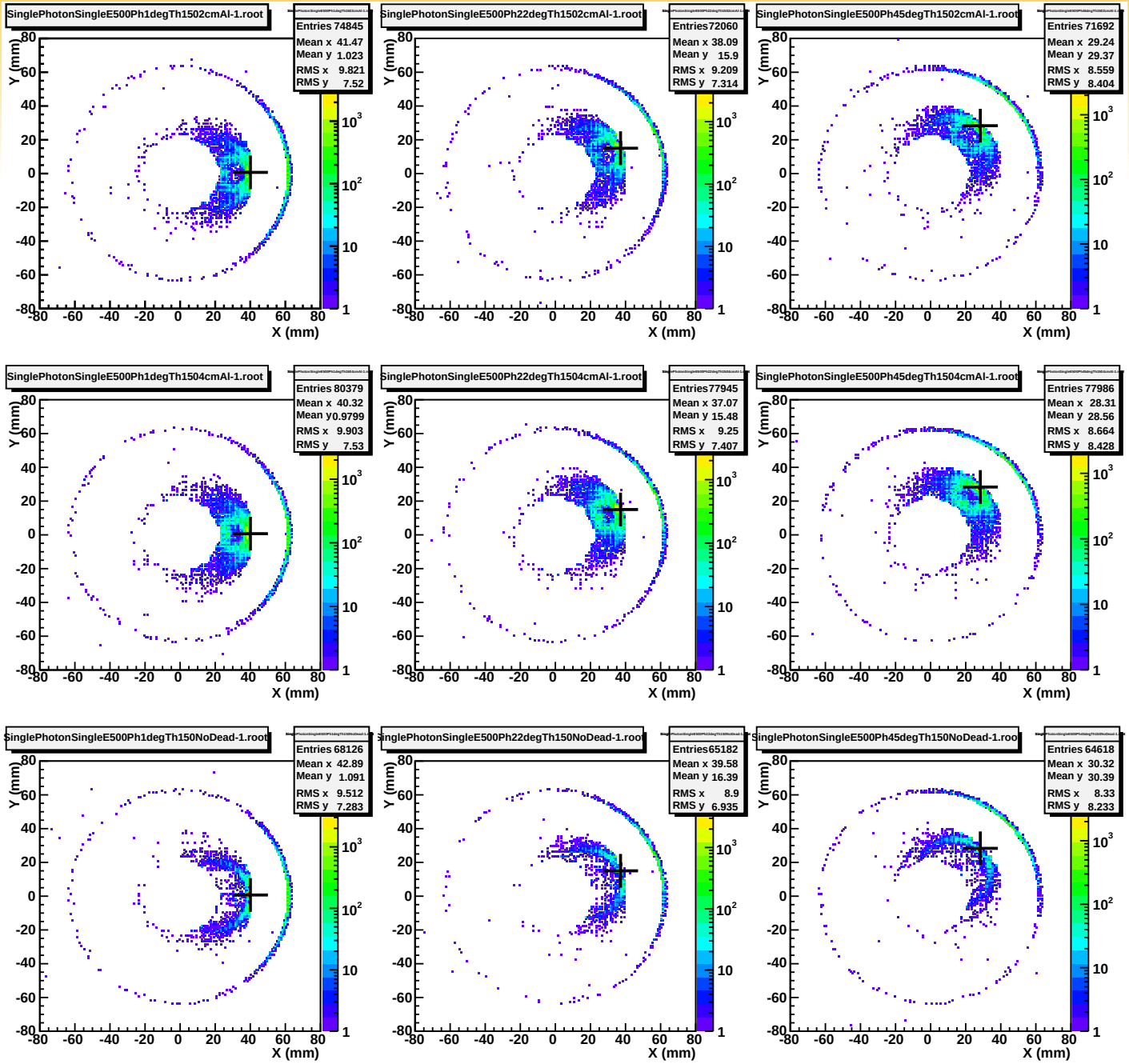
Entries 7996
Mean x 30.08
Mean y 13.15
RMS x 12.31
RMS y 15.29
SinglePhotonSingleE500Ph45degTh1452cmAl-1.root
Entries 8895
Mean x 22.98
Mean y 22.75
RMS x 14.09
RMS y 14.72
SinglePhotonSingleE500Ph1degTh1454cmAl-1.root
Entries 3197
Mean x 34.95
Mean y 0.9638
RMS x 11.88
RMS y 14.25
SinglePhotonSingleE500Ph22degTh1454cmAl-1.root
Entries 16266
Mean x 32.42
Mean y 13.79
RMS x 11.75
RMS y 13.33
SinglePhotonSingleE500Ph45degTh1454cmAl-1.root
Entries 16725
Mean x 24.53
Mean y 24.9
RMS x 12.97
RMS y 12.84
SinglePhotonSingleE500Ph1degTh145NoDead-1.root
Entries 1871
Mean x 28.29
Mean y 1.472
RMS x 17.85
RMS y 24.44
SinglePhotonSingleE500Ph22degTh145NoDead-1.root
Entries 1677
Mean x 26.34
Mean y 12.8
RMS x 18.99
RMS y 23.52
SinglePhotonSingleE500Ph45degTh145NoDead-1.root
Entries 2074
Mean x 19.22
Mean y 18.96
RMS x 20.9
RMS y 20.6
Y (mm)
X (mm)

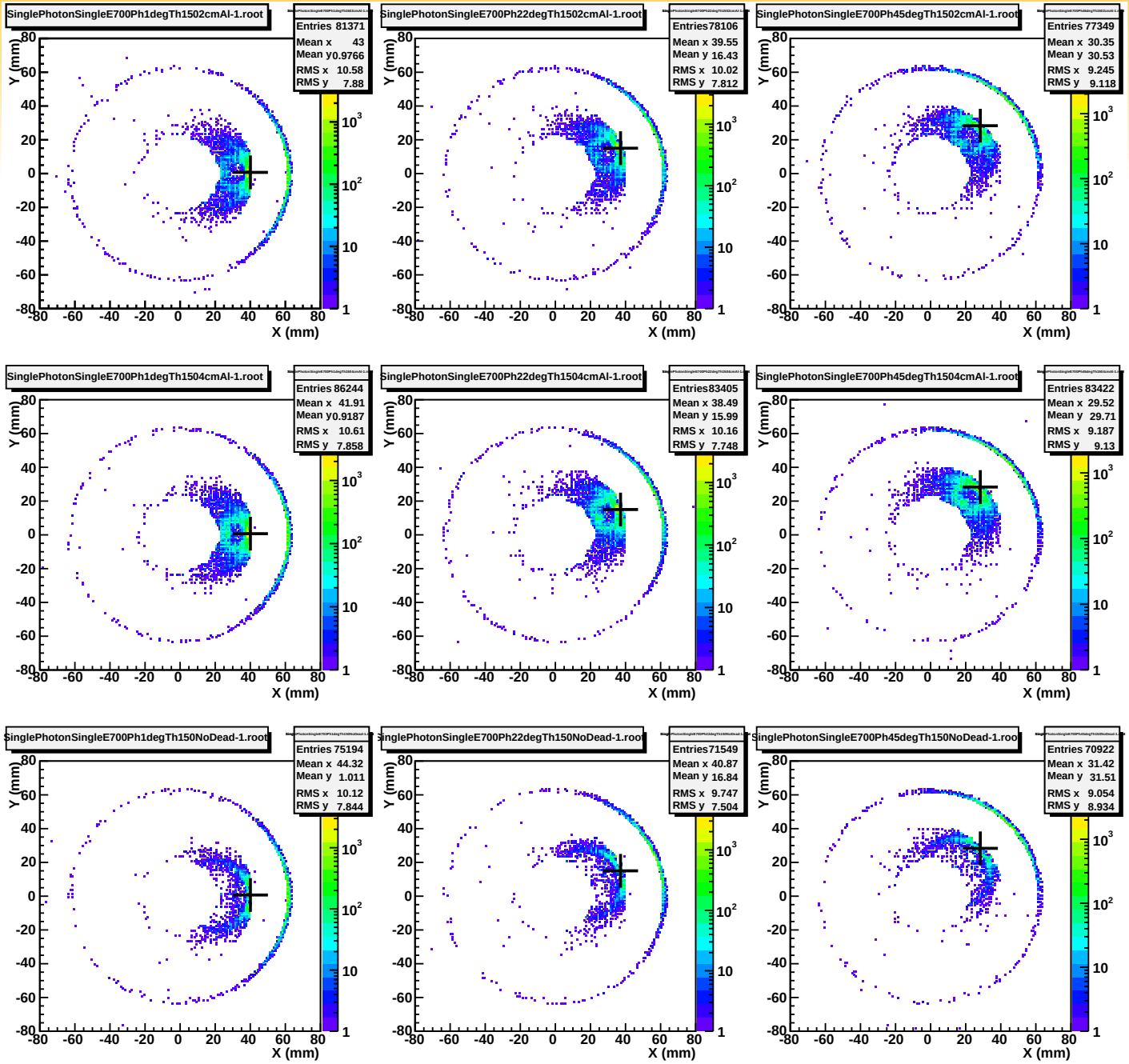

SinglePhotonSingleE700Ph1degTh1452cmAl-1.root
Entries 6892
Mean x 32.93
Mean y 0.9476
RMS x 12.64
RMS y 16.23
SinglePhotonSingleE700Ph22degTh1452cmAl-1.root
Entries 6684
Mean x 30.48
Mean y 13.37
RMS x 12.45
RMS y 15.29
SinglePhotonSingleE700Ph45degTh1452cmAl-1.root
Entries 7024
Mean x 23.29
Mean y 23.31
RMS x 14.3
RMS y 13.99
SinglePhotonSingleE700Ph1degTh1454cmAl-1.root
Entries 14506
Mean x 35.27
Mean y 1.093
RMS x 11.64
RMS y 13.83
SinglePhotonSingleE700Ph22degTh1454cmAl-1.root
Entries 14336
Mean x 32.72
Mean y 14.01
RMS x 12.04
RMS y 13.3
SinglePhotonSingleE700Ph45degTh1454cmAl-1.root
Entries 15091
Mean x 24.65
Mean y 25.18
RMS x 12.81
RMS y 12.87
SinglePhotonSingleE700Ph1degTh145NoDead-1.root
Entries 1572
Mean x 27.97
Mean y 0.8013
RMS x 18.63
RMS y 24.22
SinglePhotonSingleE700Ph22degTh145NoDead-1.root
Entries 1388
Mean x 26.77
Mean y 12.14
RMS x 19.62
RMS y 23.67
SinglePhotonSingleE700Ph45degTh145NoDead-1.root
Entries 1608
Mean x 19.49
Mean y 18.65
RMS x 21.11
RMS y 20.92
Y (mm)
X (mm)

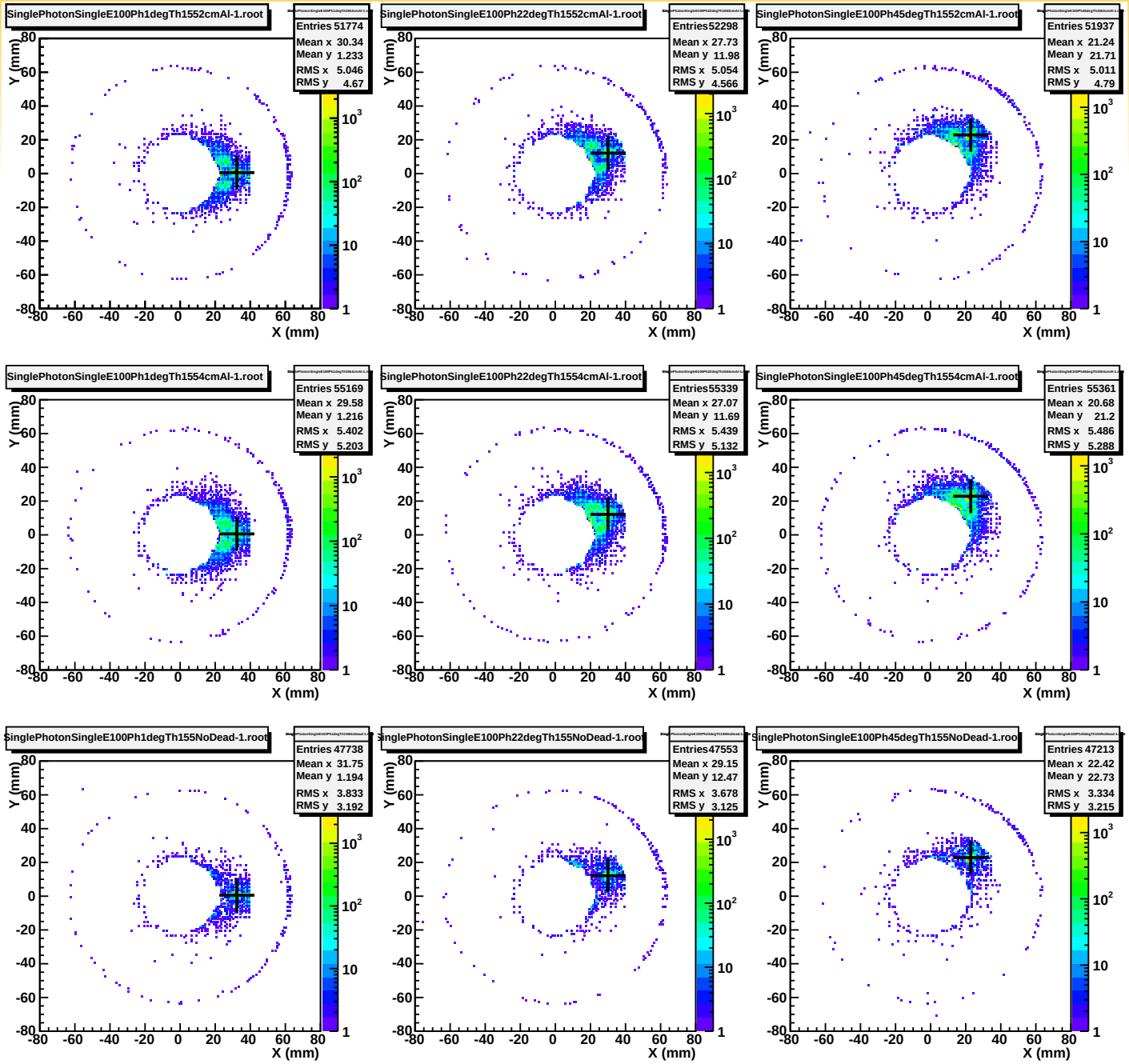

SinglePhotonSingleE100Ph1degTh1502cmAl-1.root
Entries 56773
Mean x 37.28
Mean y 1.223
RMS x 7.497
RMS y 5.157
SinglePhotonSingleE100Ph22degTh1502cmAl-1.root
Entries 56225
Mean x 34.36
Mean y 14.64
RMS x 6.915
RMS y 5.14
SinglePhotonSingleE100Ph45degTh1502cmAl-1.root
Entries 56462
Mean x 26.13
Mean y 26.55
RMS x 6.39
RMS y 6.185
SinglePhotonSingleE100Ph1degTh1504cmAl-1.root
Entries 59622
Mean x 36.23
Mean y 1.201
RMS x 7.74
RMS y 5.449
SinglePhotonSingleE100Ph22degTh1504cmAl-1.root
Entries 59355
Mean x 33.43
Mean y 14.25
RMS x 7.334
RMS y 5.652
SinglePhotonSingleE100Ph45degTh1504cmAl-1.root
Entries 59442
Mean x 25.38
Mean y 25.82
RMS x 6.824
RMS y 6.422
SinglePhotonSingleE100Ph1degTh150NoDead-1.root
Entries 51452
Mean x 39.6
Mean y 1.248
RMS x 5.872
RMS y 3.854
SinglePhotonSingleE100Ph22degTh150NoDead-1.root
Entries 51071
Mean x 36.5
Mean y 15.43
RMS x 5.167
RMS y 3.732
SinglePhotonSingleE100Ph45degTh150NoDead-1.root
Entries 51138
Mean x 27.82
Mean y 28.06
RMS x 4.81
RMS y 4.586
Y (mm)
X (mm)

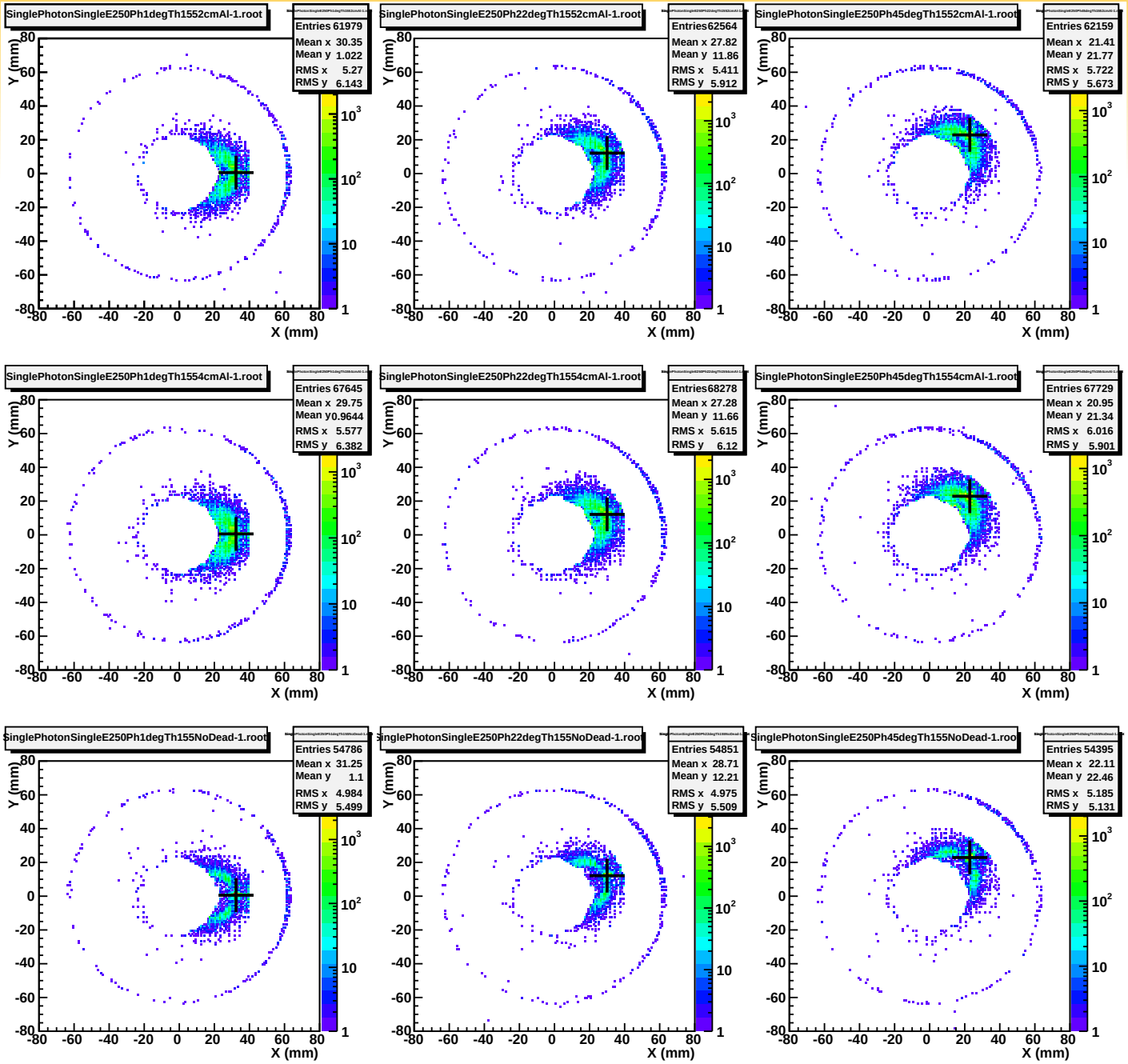

SinglePhotonSingleE250Ph1degTh1502cmAl-1.root
Entries 66911
Mean x 38.81
Mean y 1.09
RMS x 8.639
RMS y 6.91
SinglePhotonSingleE250Ph22degTh1502cmAl-1.root
Entries 65690
Mean x 35.82
Mean y 15
RMS x 8.113
RMS y 6.709
SinglePhotonSingleE250Ph45degTh1502cmAl-1.root
Entries 65258
Mean x 27.33
Mean y 27.6
RMS x 7.738
RMS y 7.588
SinglePhotonSingleE250Ph1degTh1504cmAl-1.root
Entries 73442
Mean x 37.82
Mean y 1.037
RMS x 8.586
RMS y 7.053
SinglePhotonSingleE250Ph22degTh1504cmAl-1.root
Entries 72419
Mean x 34.78
Mean y 14.6
RMS x 8.254
RMS y 7.017
SinglePhotonSingleE250Ph45degTh1504cmAl-1.root
Entries 72239
Mean x 26.53
Mean y 26.88
RMS x 7.903
RMS y 7.81
SinglePhotonSingleE250Ph1degTh150NoDead-1.root
Entries 58899
Mean x 40.75
Mean y 1.168
RMS x 8.203
RMS y 6.282
SinglePhotonSingleE250Ph22degTh150NoDead-1.root
Entries 57091
Mean x 37.53
Mean y 15.7
RMS x 7.519
RMS y 5.869
SinglePhotonSingleE250Ph45degTh150NoDead-1.root
Entries 56931
Mean x 28.7
Mean y 28.91
RMS x 7.075
RMS y 7.035
Y (mm)
X (mm)

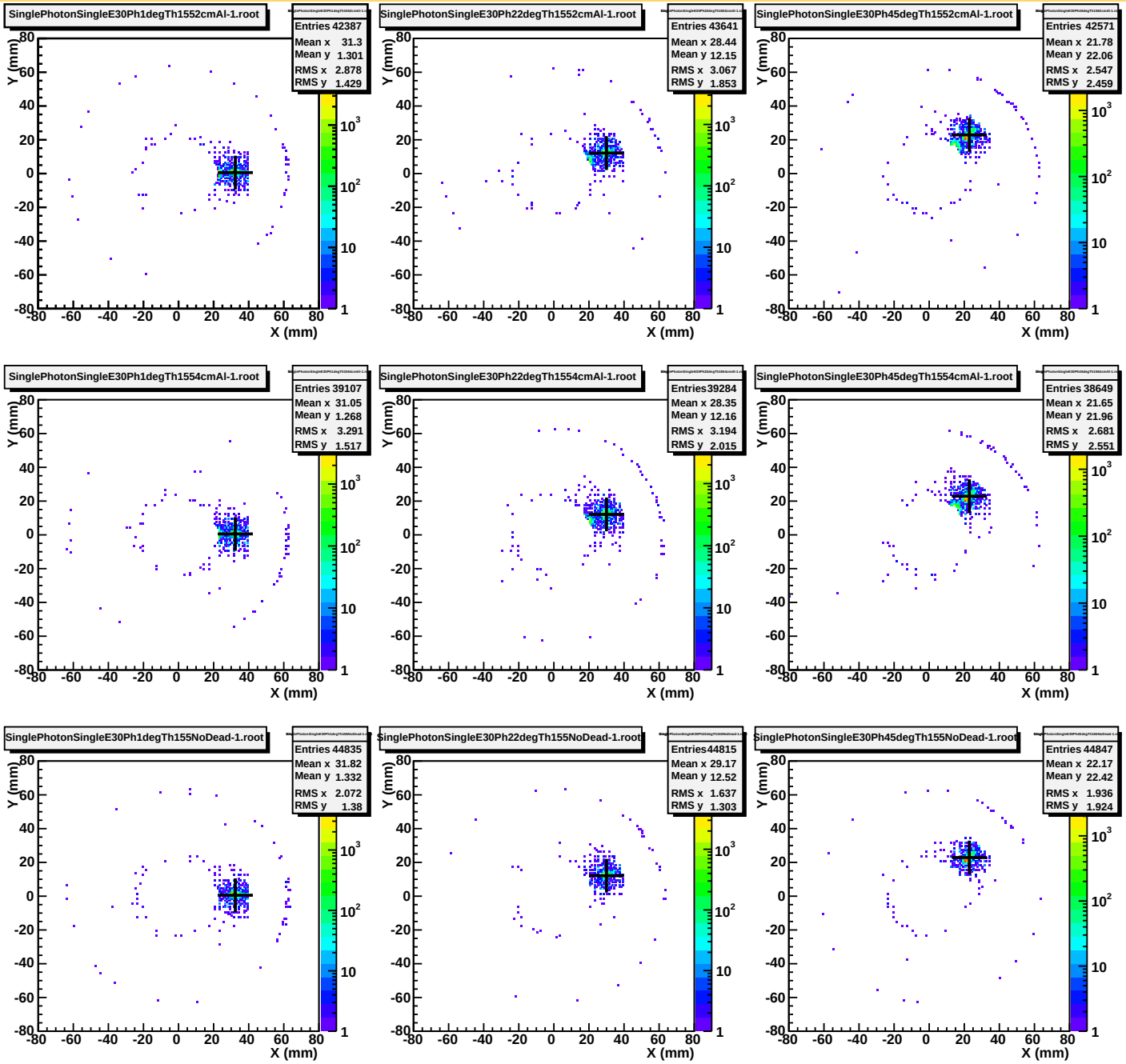

SinglePhotonSingleE30Ph1degTh1502cmAl-1.root
Entries 45359
Mean x 37.44
Mean y 1.358
RMS x 4.451
RMS y 1.669
SinglePhotonSingleE30Ph22degTh1502cmAl-1.root
Entries 46001
Mean x 34.56
Mean y 14.83
RMS x 4.152
RMS y 2.181
SinglePhotonSingleE30Ph45degTh1502cmAl-1.root
Entries 46491
Mean x 26.35
Mean y 26.66
RMS x 3.449
RMS y 3.294
SinglePhotonSingleE30Ph1degTh1504cmAl-1.root
Entries 40413
Mean x 37.43
Mean y 1.338
RMS x 4.307
RMS y 1.727
SinglePhotonSingleE30Ph22degTh1504cmAl-1.root
Entries 41002
Mean x 34.58
Mean y 14.81
RMS x 4.136
RMS y 2.392
SinglePhotonSingleE30Ph45degTh1504cmAl-1.root
Entries 41375
Mean x 26.32
Mean y 26.64
RMS x 3.441
RMS y 3.288
SinglePhotonSingleE30Ph1degTh150NoDead-1.root
Entries 46706
Mean x 38.58
Mean y 1.381
RMS x 2.54
RMS y 1.503
SinglePhotonSingleE30Ph22degTh150NoDead-1.root
Entries 47543
Mean x 35.62
Mean y 15.27
RMS x 2.354
RMS y 1.487
SinglePhotonSingleE30Ph45degTh150NoDead-1.root
Entries 47976
Mean x 27.15
Mean y 27.42
RMS x 2.227
RMS y 2.012
Y (mm)
X (mm)

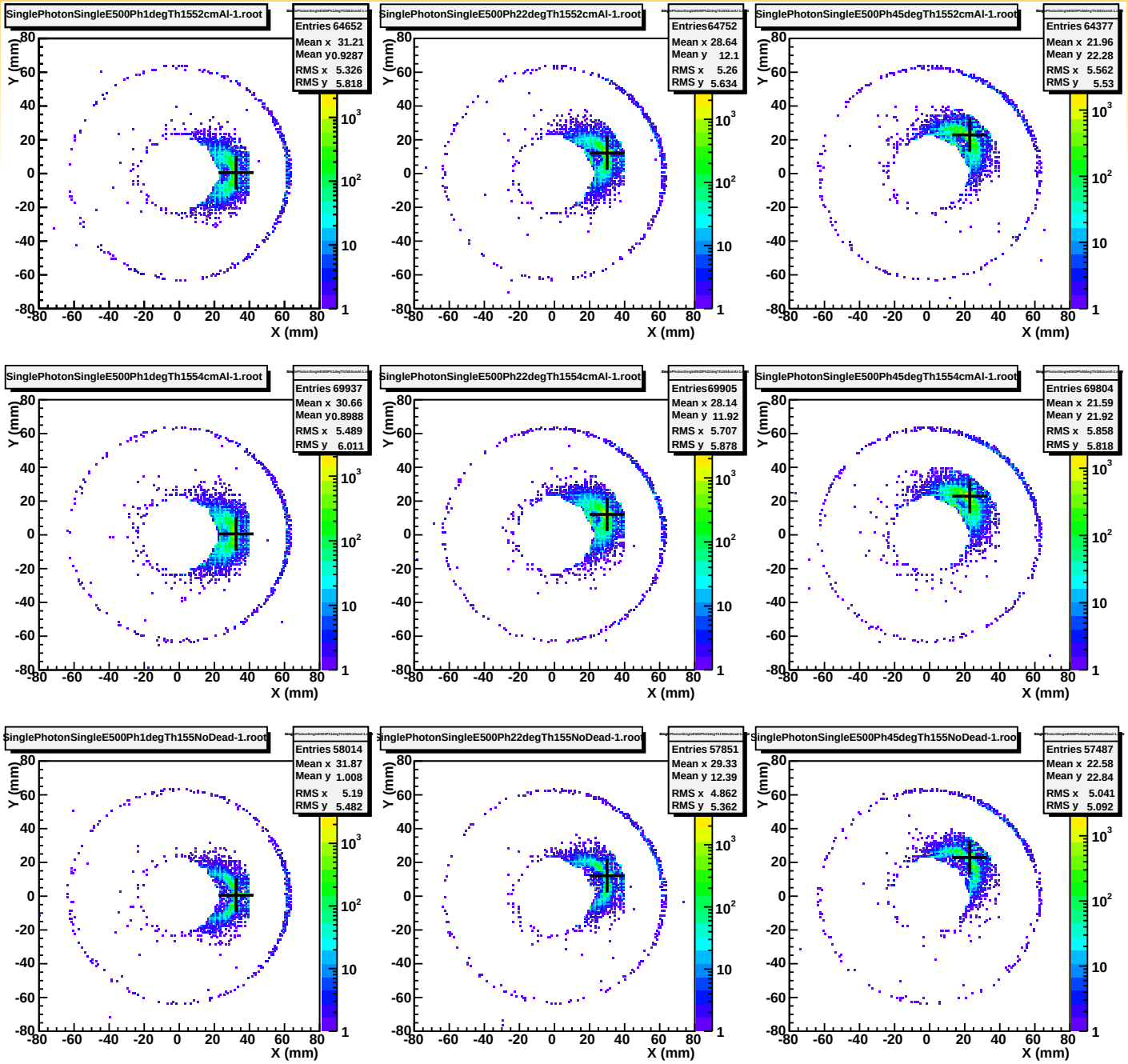

SinglePhotonSingleE500Ph1degTh1502cmAl-1.root
Entries 74845
Mean x 41.47
Mean y 1.023
RMS x 9.821
RMS y 7.52
SinglePhotonSingleE500Ph22degTh1502cmAl-1.root
Entries 72060
Mean x 38.09
Mean y 15.9
RMS x 9.209
RMS y 7.314
SinglePhotonSingleE500Ph45degTh1502cmAl-1.root
Entries 71692
Mean x 29.24
Mean y 29.37
RMS x 8.559
RMS y 8.404
SinglePhotonSingleE500Ph1degTh1504cmAl-1.root
Entries 80379
Mean x 40.32
Mean y 0.9799
RMS x 9.903
RMS y 7.53
SinglePhotonSingleE500Ph22degTh1504cmAl-1.root
Entries 77945
Mean x 37.07
Mean y 15.48
RMS x 9.25
RMS y 7.407
SinglePhotonSingleE500Ph45degTh1504cmAl-1.root
Entries 77986
Mean x 28.31
Mean y 28.56
RMS x 8.664
RMS y 8.428
SinglePhotonSingleE500Ph1degTh150NoDead-1.root
Entries 68126
Mean x 42.89
Mean y 1.091
RMS x 9.512
RMS y 7.283
SinglePhotonSingleE500Ph22degTh150NoDead-1.root
Entries 65182
Mean x 39.58
Mean y 16.39
RMS x 8.9
RMS y 6.935
SinglePhotonSingleE500Ph45degTh150NoDead-1.root
Entries 64618
Mean x 30.32
Mean y 30.39
RMS x 8.33
RMS y 8.233
Y (mm)
X (mm)

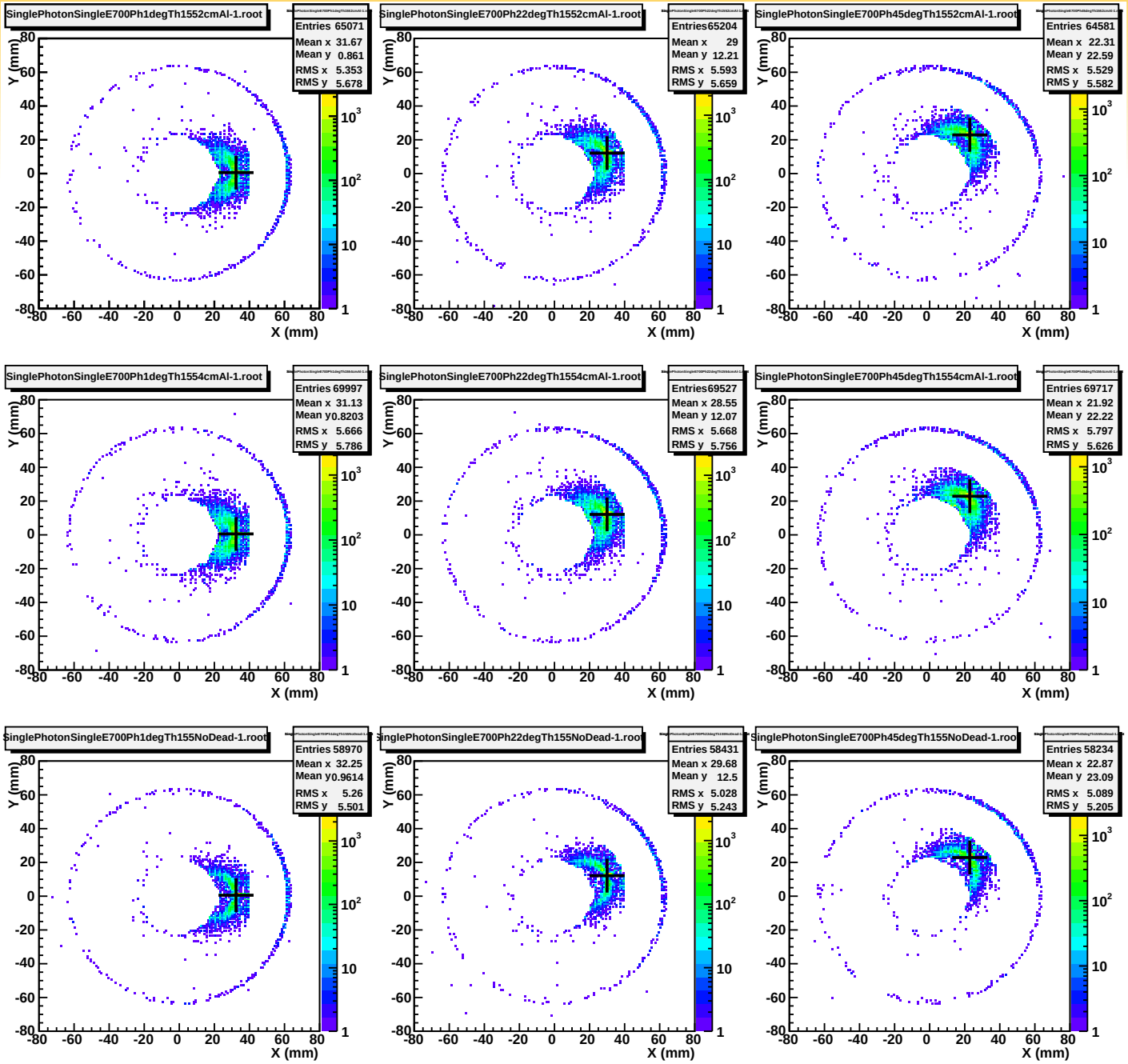

SinglePhotonSingleE700Ph1degTh1502cmAl-1.root
Entries 81371
Mean x 43
Mean y 0.9766
RMS x 10.58
RMS y 7.88
SinglePhotonSingleE700Ph22degTh1502cmAl-1.root
Entries 78106
Mean x 39.55
Mean y 16.43
RMS x 10.02
RMS y 7.812
SinglePhotonSingleE700Ph45degTh1502cmAl-1.root
Entries 77349
Mean x 30.35
Mean y 30.53
RMS x 9.245
RMS y 9.118
SinglePhotonSingleE700Ph1degTh1504cmAl-1.root
Entries 86244
Mean x 41.91
Mean y 0.9187
RMS x 10.61
RMS y 7.858
SinglePhotonSingleE700Ph22degTh1504cmAl-1.root
Entries 83405
Mean x 38.49
Mean y 15.99
RMS x 10.16
RMS y 7.748
SinglePhotonSingleE700Ph45degTh1504cmAl-1.root
Entries 83422
Mean x 29.52
Mean y 29.71
RMS x 9.187
RMS y 9.13
SinglePhotonSingleE700Ph1degTh150NoDead-1.root
Entries 75194
Mean x 44.32
Mean y 1.011
RMS x 10.12
RMS y 7.844
SinglePhotonSingleE700Ph22degTh150NoDead-1.root
Entries 71549
Mean x 40.87
Mean y 16.84
RMS x 9.747
RMS y 7.504
SinglePhotonSingleE700Ph45degTh150NoDead-1.root
Entries 70922
Mean x 31.42
Mean y 31.51
RMS x 9.054
RMS y 8.934
Y (mm)
X (mm)

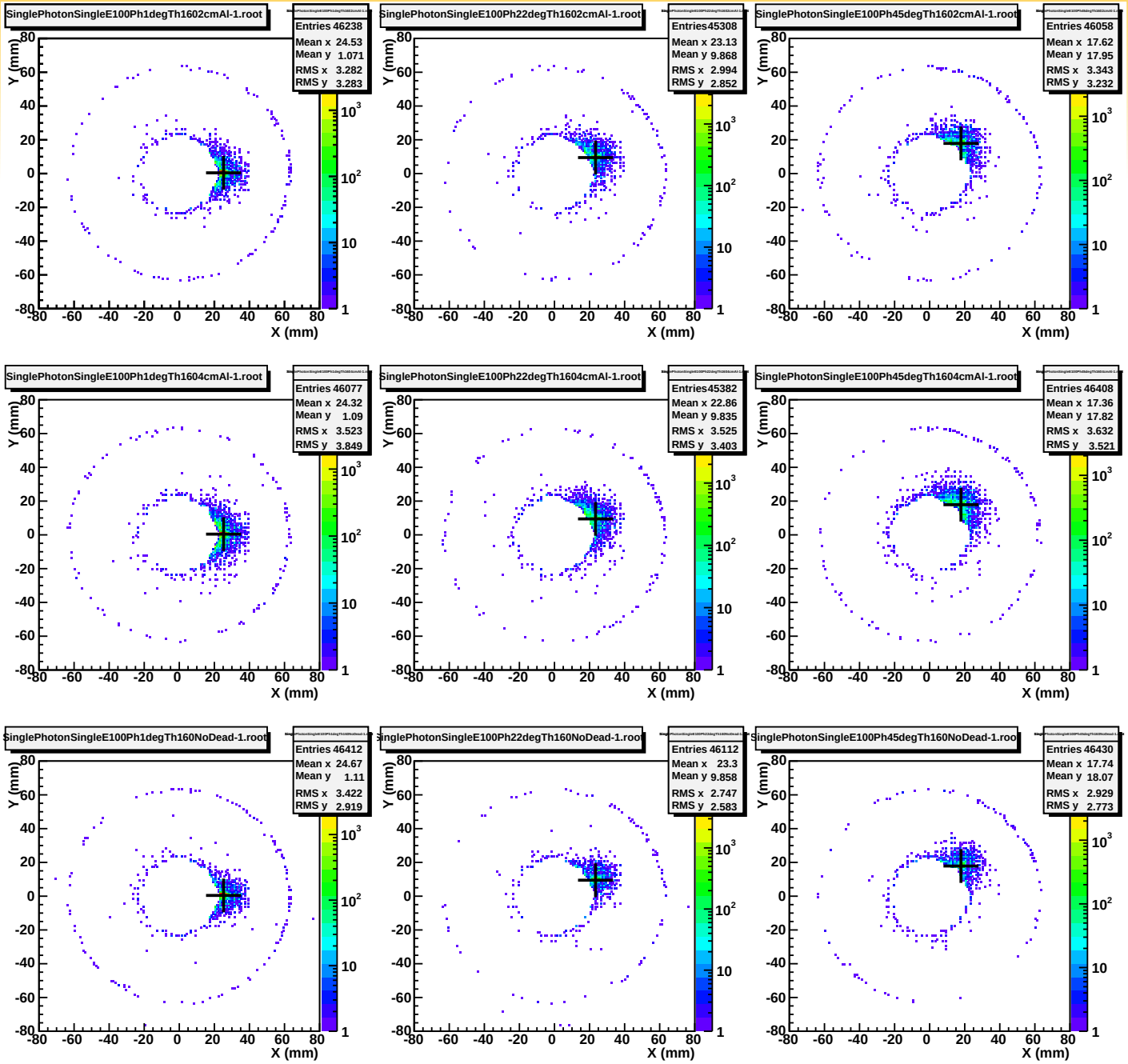

SinglePhotonSingleE100Ph1degTh1552cmAl-1.root
Entries 51774
Mean x 30.34
Mean y 1.233
RMS x 5.046
RMS y 4.67
SinglePhotonSingleE100Ph22degTh1552cmAl-1.root
Entries 52298
Mean x 27.73
Mean y 11.98
RMS x 5.054
RMS y 4.566
SinglePhotonSingleE100Ph45degTh1552cmAl-1.root
Entries 51937
Mean x 21.24
Mean y 21.71
RMS x 5.011
RMS y 4.79
SinglePhotonSingleE100Ph1degTh1554cmAl-1.root
Entries 55169
Mean x 29.58
Mean y 1.216
RMS x 5.402
RMS y 5.203
SinglePhotonSingleE100Ph22degTh1554cmAl-1.root
Entries 55339
Mean x 27.07
Mean y 11.69
RMS x 5.439
RMS y 5.132
SinglePhotonSingleE100Ph45degTh1554cmAl-1.root
Entries 55361
Mean x 20.68
Mean y 21.2
RMS x 5.486
RMS y 5.288
SinglePhotonSingleE100Ph1degTh155NoDead-1.root
Entries 47738
Mean x 31.75
Mean y 1.194
RMS x 3.833
RMS y 3.192
SinglePhotonSingleE100Ph22degTh155NoDead-1.root
Entries 47553
Mean x 29.15
Mean y 12.47
RMS x 3.678
RMS y 3.125
SinglePhotonSingleE100Ph45degTh155NoDead-1.root
Entries 47213
Mean x 22.42
Mean y 22.73
RMS x 3.334
RMS y 3.215
Y (mm)
X (mm)

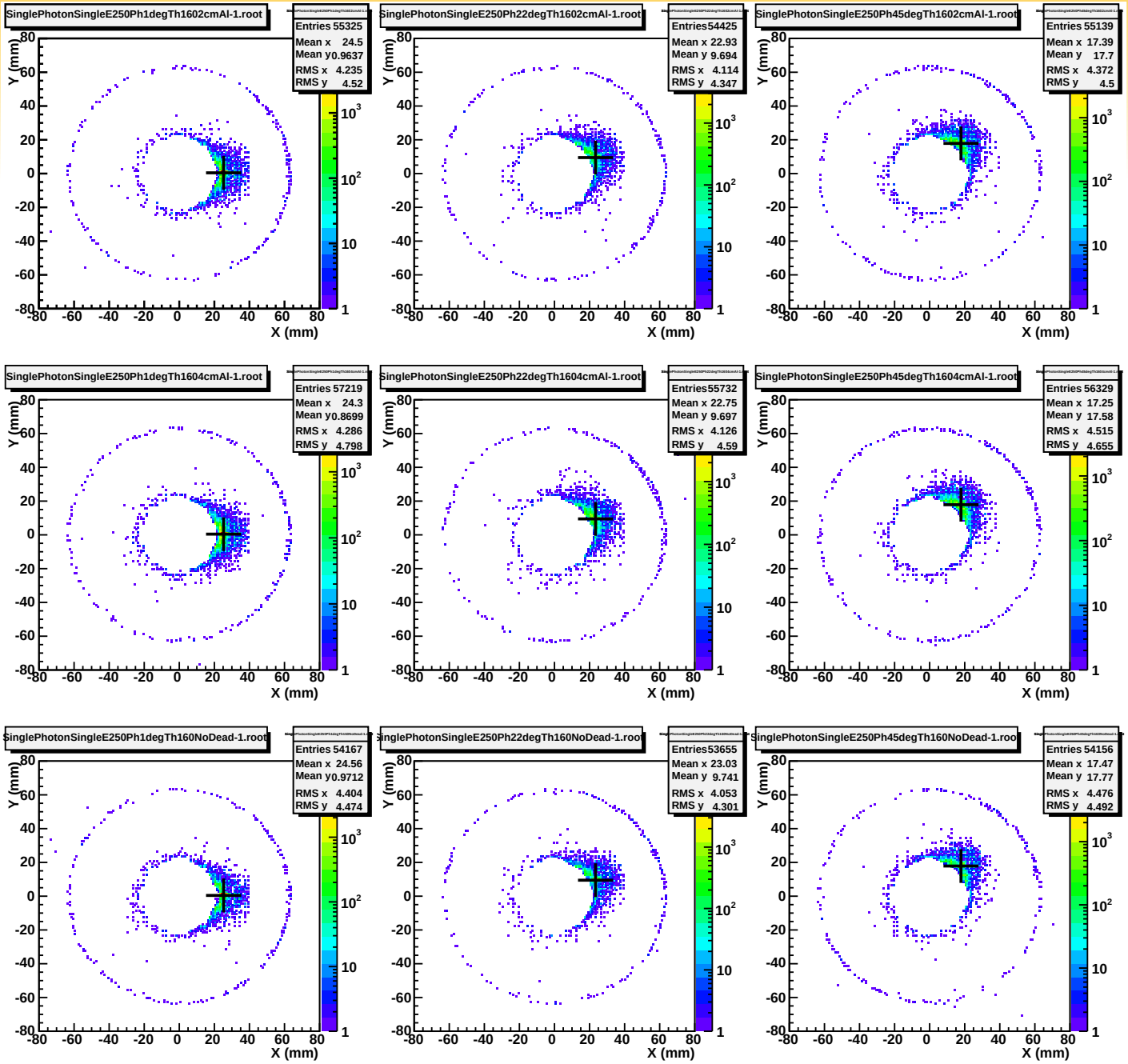

SinglePhotonSingleE250Ph1degTh1552cmAl-1.root
Entries 61979
Mean x 30.35
Mean y 1.022
RMS x 5.27
RMS y 6.143
SinglePhotonSingleE250Ph22degTh1552cmAl-1.root
Entries 62564
Mean x 27.82
Mean y 11.86
RMS x 5.411
RMS y 5.912
SinglePhotonSingleE250Ph45degTh1552cmAl-1.root
Entries 62159
Mean x 21.41
Mean y 21.77
RMS x 5.722
RMS y 5.673
SinglePhotonSingleE250Ph1degTh1554cmAl-1.root
Entries 67645
Mean x 29.75
Mean y 0.9644
RMS x 5.577
RMS y 6.382
SinglePhotonSingleE250Ph22degTh1554cmAl-1.root
Entries 68278
Mean x 27.28
Mean y 11.66
RMS x 5.615
RMS y 6.12
SinglePhotonSingleE250Ph45degTh1554cmAl-1.root
Entries 67729
Mean x 20.95
Mean y 21.34
RMS x 6.016
RMS y 5.901
SinglePhotonSingleE250Ph1degTh155NoDead-1.root
Entries 54786
Mean x 31.25
Mean y 1.1
RMS x 4.984
RMS y 5.499
SinglePhotonSingleE250Ph22degTh155NoDead-1.root
Entries 54851
Mean x 28.71
Mean y 12.21
RMS x 4.975
RMS y 5.509
SinglePhotonSingleE250Ph45degTh155NoDead-1.root
Entries 54395
Mean x 22.11
Mean y 22.46
RMS x 5.185
RMS y 5.131
Y (mm)
X (mm)

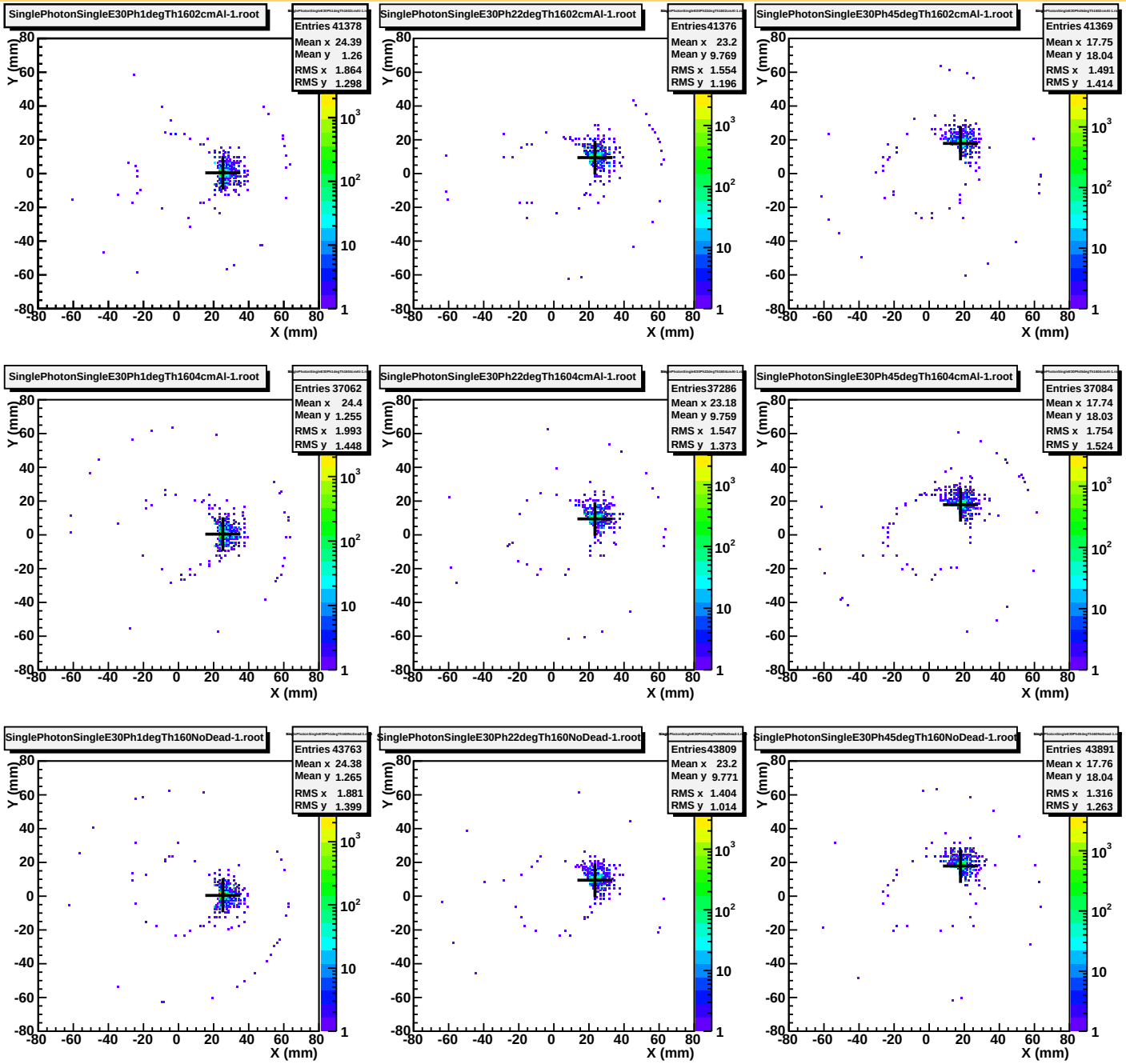

SinglePhotonSingleE30Ph1degTh1552cmAl-1.root
Entries 42387
Mean x 31.3
Mean y 1.301
RMS x 2.878
RMS y 1.429
SinglePhotonSingleE30Ph22degTh1552cmAl-1.root
Entries 43641
Mean x 28.44
Mean y 12.15
RMS x 3.067
RMS y 1.853
SinglePhotonSingleE30Ph45degTh1552cmAl-1.root
Entries 42571
Mean x 21.78
Mean y 22.06
RMS x 2.547
RMS y 2.459
SinglePhotonSingleE30Ph1degTh1554cmAl-1.root
Entries 39107
Mean x 31.05
Mean y 1.268
RMS x 3.291
RMS y 1.517
SinglePhotonSingleE30Ph22degTh1554cmAl-1.root
Entries 39284
Mean x 28.35
Mean y 12.16
RMS x 3.194
RMS y 2.015
SinglePhotonSingleE30Ph45degTh1554cmAl-1.root
Entries 38649
Mean x 21.65
Mean y 21.96
RMS x 2.681
RMS y 2.551
SinglePhotonSingleE30Ph1degTh155NoDead-1.root
Entries 44835
Mean x 31.82
Mean y 1.332
RMS x 2.072
RMS y 1.38
SinglePhotonSingleE30Ph22degTh155NoDead-1.root
Entries 44815
Mean x 29.17
Mean y 12.52
RMS x 1.637
RMS y 1.303
SinglePhotonSingleE30Ph45degTh155NoDead-1.root
Entries 44847
Mean x 22.17
Mean y 22.42
RMS x 1.936
RMS y 1.924
Y (mm)
X (mm)

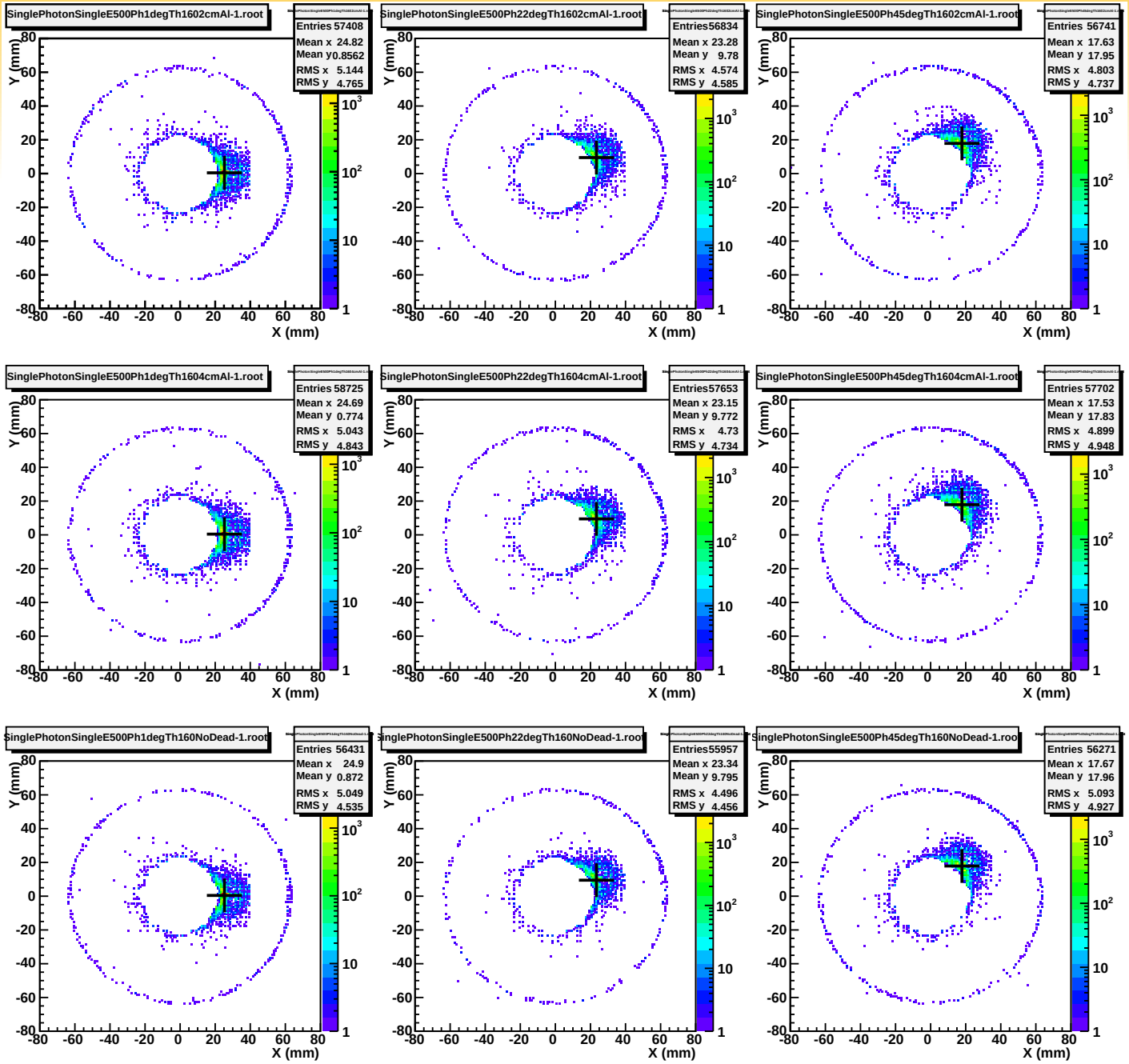

SinglePhotonSingleE500Ph1degTh1552cmAl-1.root
Entries 64652
Mean x 31.21
Mean y 0.9287
RMS x 5.326
RMS y 5.818
SinglePhotonSingleE500Ph22degTh1552cmAl-1.root
Entries 64752
Mean x 28.64
Mean y 12.1
RMS x 5.26
RMS y 5.634
SinglePhotonSingleE500Ph45degTh1552cmAl-1.root
Entries 64377
Mean x 21.96
Mean y 22.28
RMS x 5.562
RMS y 5.53
SinglePhotonSingleE500Ph1degTh1554cmAl-1.root
Entries 69937
Mean x 30.66
Mean y 0.8988
RMS x 5.489
RMS y 6.011
SinglePhotonSingleE500Ph22degTh1554cmAl-1.root
Entries 69905
Mean x 28.14
Mean y 11.92
RMS x 5.707
RMS y 5.878
SinglePhotonSingleE500Ph45degTh1554cmAl-1.root
Entries 69804
Mean x 21.59
Mean y 21.92
RMS x 5.858
RMS y 5.818
SinglePhotonSingleE500Ph1degTh155NoDead-1.root
Entries 58014
Mean x 31.87
Mean y 1.008
RMS x 5.19
RMS y 5.482
SinglePhotonSingleE500Ph22degTh155NoDead-1.root
Entries 57851
Mean x 29.33
Mean y 12.39
RMS x 4.862
RMS y 5.362
SinglePhotonSingleE500Ph45degTh155NoDead-1.root
Entries 57487
Mean x 22.58
Mean y 22.84
RMS x 5.041
RMS y 5.092
X (mm)
Y (mm)

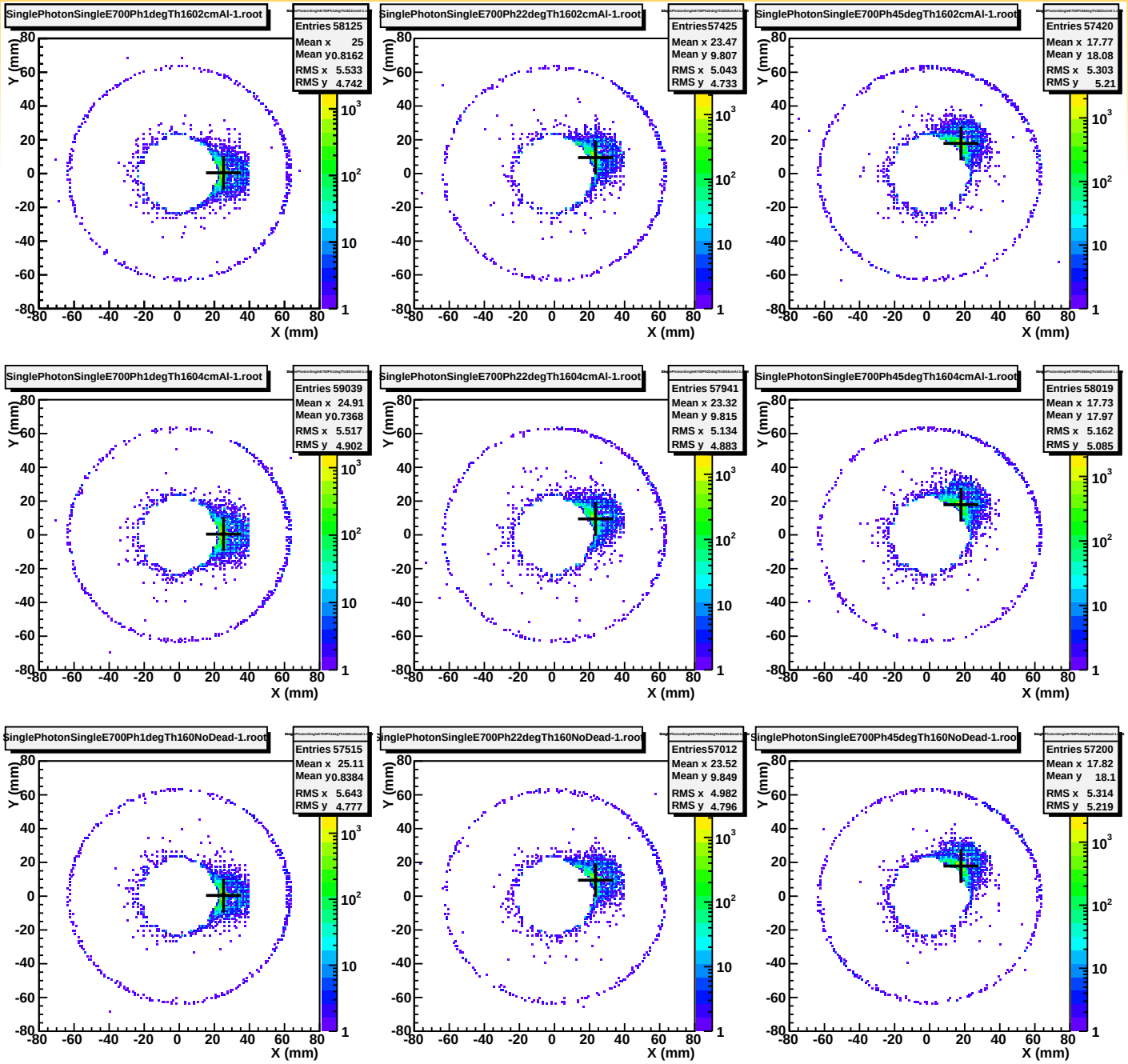

SinglePhotonSingleE700Ph1degTh1552cmAl-1.root
Entries 65071
Mean x 31.67
Mean y 0.861
RMS x 5.353
RMS y 5.678
SinglePhotonSingleE700Ph22degTh1552cmAl-1.root
Entries 65204
Mean x 29
Mean y 12.21
RMS x 5.593
RMS y 5.659
SinglePhotonSingleE700Ph45degTh1552cmAl-1.root
Entries 64581
Mean x 22.31
Mean y 22.59
RMS x 5.529
RMS y 5.582
SinglePhotonSingleE700Ph1degTh1554cmAl-1.root
Entries 69997
Mean x 31.13
Mean y 0.8203
RMS x 5.666
RMS y 5.786
SinglePhotonSingleE700Ph22degTh1554cmAl-1.root
Entries 69527
Mean x 28.55
Mean y 12.07
RMS x 5.668
RMS y 5.756
SinglePhotonSingleE700Ph45degTh1554cmAl-1.root
Entries 69717
Mean x 21.92
Mean y 22.22
RMS x 5.797
RMS y 5.626
SinglePhotonSingleE700Ph1degTh155NoDead-1.root
Entries 58970
Mean x 32.25
Mean y 0.9614
RMS x 5.26
RMS y 5.501
SinglePhotonSingleE700Ph22degTh155NoDead-1.root
Entries 58431
Mean x 29.68
Mean y 12.5
RMS x 5.028
RMS y 5.243
SinglePhotonSingleE700Ph45degTh155NoDead-1.root
Entries 58234
Mean x 22.87
Mean y 23.09
RMS x 5.089
RMS y 5.205
Y (mm)
X (mm)

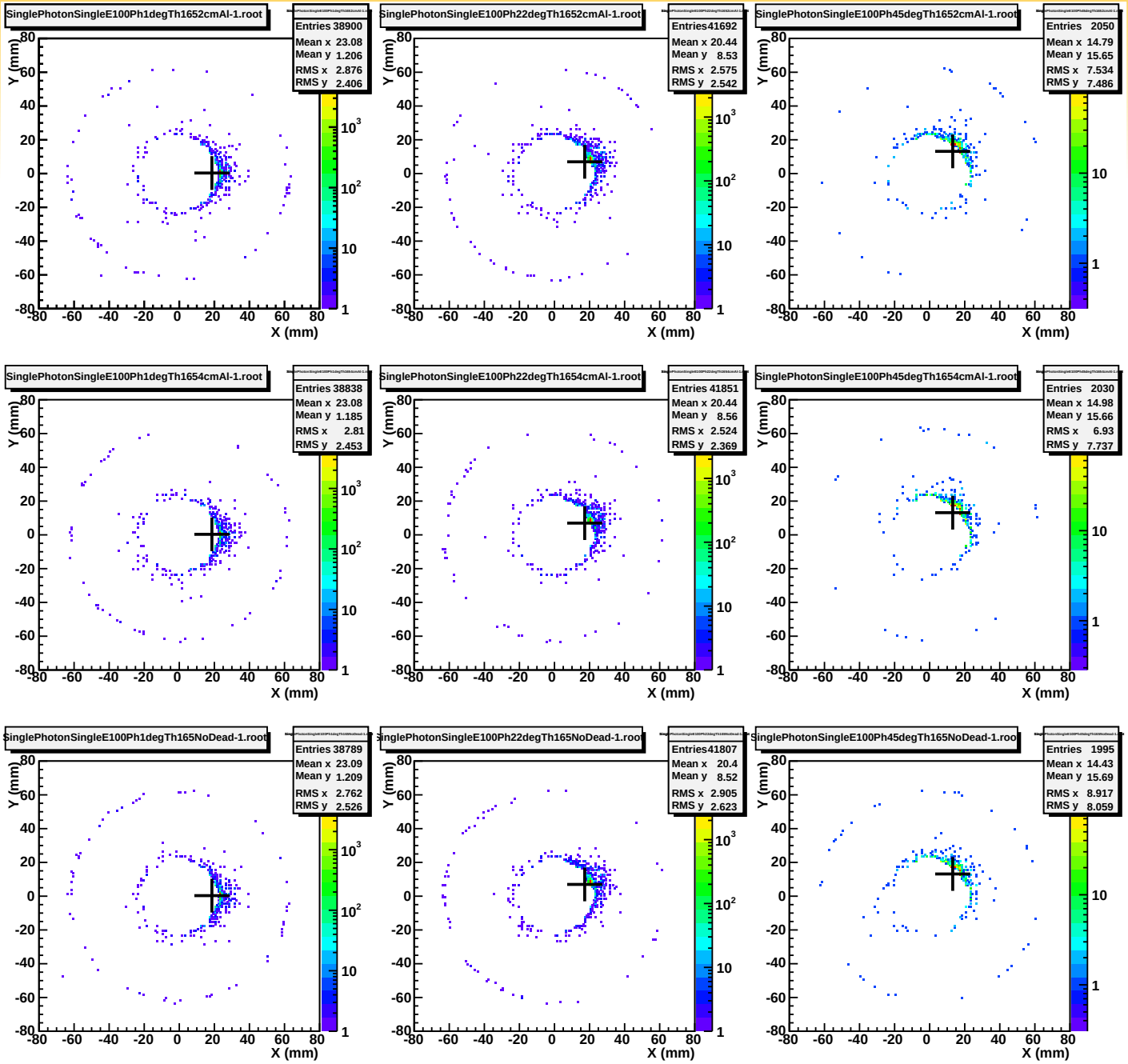

SinglePhotonSingleE100Ph1degTh1602cmAl-1.root
Entries 46238
Mean x 24.53
Mean y 1.071
RMS x 3.282
RMS y 3.283
SinglePhotonSingleE100Ph22degTh1602cmAl-1.root
Entries 45308
Mean x 23.13
Mean y 9.868
RMS x 2.994
RMS y 2.852
SinglePhotonSingleE100Ph45degTh1602cmAl-1.root
Entries 46058
Mean x 17.62
Mean y 17.95
RMS x 3.343
RMS y 3.232
SinglePhotonSingleE100Ph1degTh1604cmAl-1.root
Entries 46077
Mean x 24.32
Mean y 1.09
RMS x 3.523
RMS y 3.849
SinglePhotonSingleE100Ph22degTh1604cmAl-1.root
Entries 45382
Mean x 22.86
Mean y 9.835
RMS x 3.525
RMS y 3.403
SinglePhotonSingleE100Ph45degTh1604cmAl-1.root
Entries 46408
Mean x 17.36
Mean y 17.82
RMS x 3.632
RMS y 3.521
SinglePhotonSingleE100Ph1degTh160NoDead-1.root
Entries 46412
Mean x 24.67
Mean y 1.11
RMS x 3.422
RMS y 2.919
SinglePhotonSingleE100Ph22degTh160NoDead-1.root
Entries 46112
Mean x 23.3
Mean y 9.858
RMS x 2.747
RMS y 2.583
SinglePhotonSingleE100Ph45degTh160NoDead-1.root
Entries 46430
Mean x 17.74
Mean y 18.07
RMS x 2.929
RMS y 2.773
Y (mm)
X (mm)

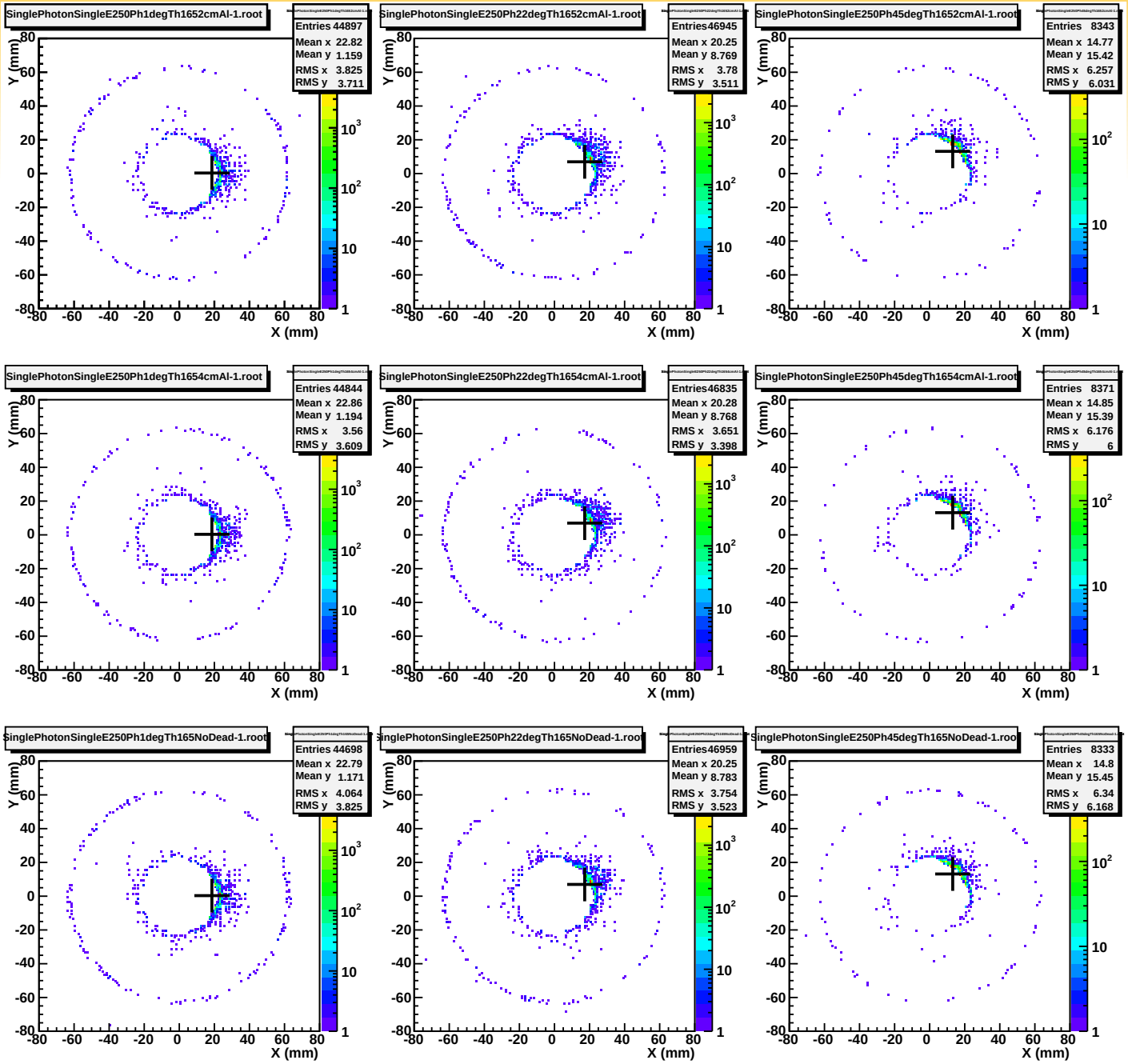

SinglePhotonSingleE250Ph1degTh1602cmAl-1.root
Entries 55325
Mean x 24.5
Mean y 0.9637
RMS x 4.235
RMS y 4.52
SinglePhotonSingleE250Ph22degTh1602cmAl-1.root
Entries 54425
Mean x 22.93
Mean y 9.694
RMS x 4.114
RMS y 4.347
SinglePhotonSingleE250Ph45degTh1602cmAl-1.root
Entries 55139
Mean x 17.39
Mean y 17.7
RMS x 4.372
RMS y 4.5
SinglePhotonSingleE250Ph1degTh1604cmAl-1.root
Entries 57219
Mean x 24.3
Mean y 0.8699
RMS x 4.286
RMS y 4.798
SinglePhotonSingleE250Ph22degTh1604cmAl-1.root
Entries 55732
Mean x 22.75
Mean y 9.697
RMS x 4.126
RMS y 4.59
SinglePhotonSingleE250Ph45degTh1604cmAl-1.root
Entries 56329
Mean x 17.25
Mean y 17.58
RMS x 4.515
RMS y 4.655
SinglePhotonSingleE250Ph1degTh160NoDead-1.root
Entries 54167
Mean x 24.56
Mean y 0.9712
RMS x 4.404
RMS y 4.474
SinglePhotonSingleE250Ph22degTh160NoDead-1.root
Entries 53655
Mean x 23.03
Mean y 9.741
RMS x 4.053
RMS y 4.301
SinglePhotonSingleE250Ph45degTh160NoDead-1.root
Entries 54156
Mean x 17.47
Mean y 17.77
RMS x 4.476
RMS y 4.492
Y (mm)
X (mm)

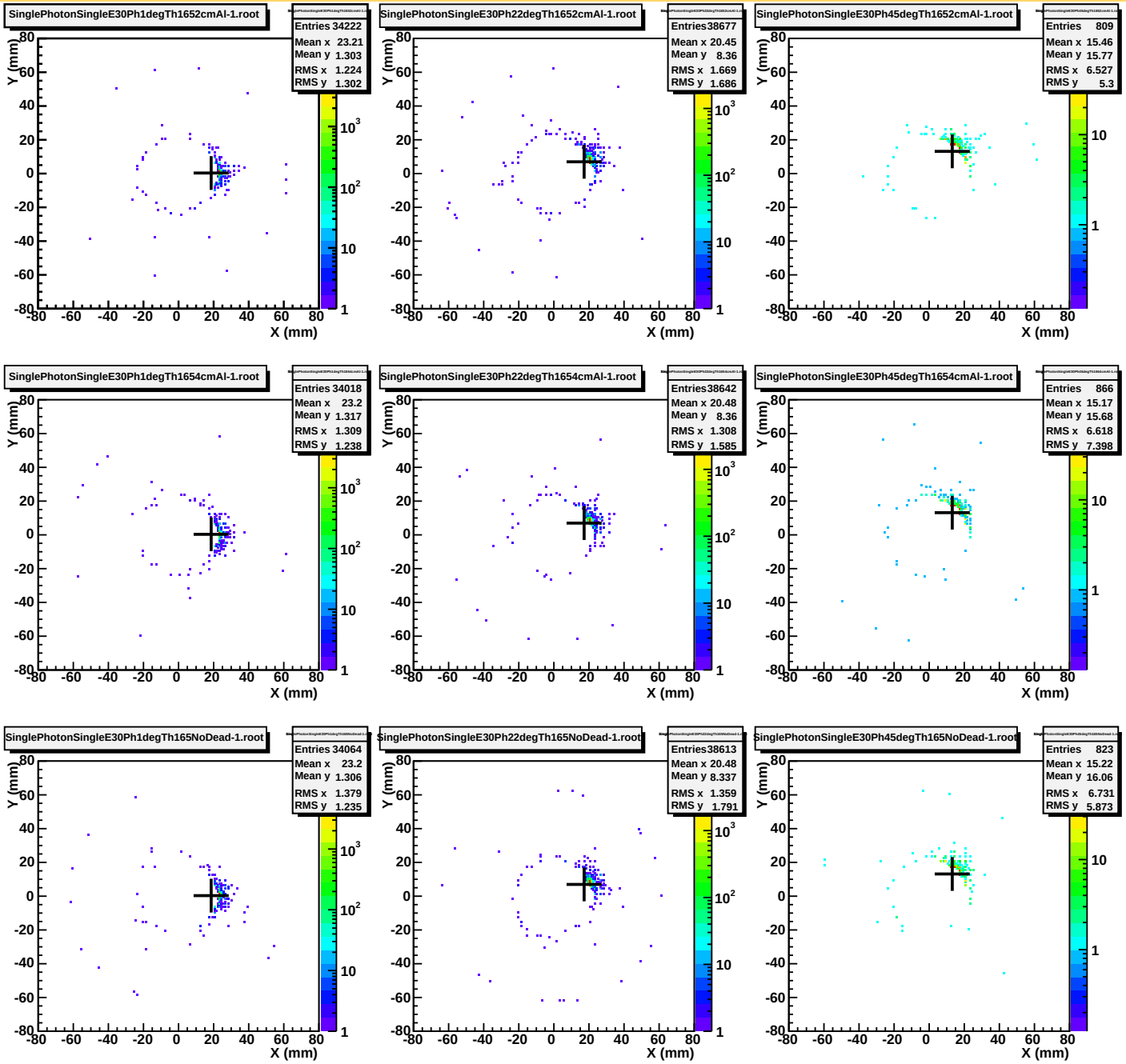

SinglePhotonSingleE30Ph1degTh1602cmAl-1.root
Entries 41378
Mean x 24.39
Mean y 1.26
RMS x 1.864
RMS y 1.298
SinglePhotonSingleE30Ph22degTh1602cmAl-1.root
Entries 41376
Mean x 23.2
Mean y 9.769
RMS x 1.554
RMS y 1.196
SinglePhotonSingleE30Ph45degTh1602cmAl-1.root
Entries 41369
Mean x 17.75
Mean y 18.04
RMS x 1.491
RMS y 1.414
SinglePhotonSingleE30Ph1degTh1604cmAl-1.root
Entries 37062
Mean x 24.4
Mean y 1.255
RMS x 1.993
RMS y 1.448
SinglePhotonSingleE30Ph22degTh1604cmAl-1.root
Entries 37286
Mean x 23.18
Mean y 9.759
RMS x 1.547
RMS y 1.373
SinglePhotonSingleE30Ph45degTh1604cmAl-1.root
Entries 37084
Mean x 17.74
Mean y 18.03
RMS x 1.754
RMS y 1.524
SinglePhotonSingleE30Ph1degTh160NoDead-1.root
Entries 43763
Mean x 24.38
Mean y 1.265
RMS x 1.881
RMS y 1.399
SinglePhotonSingleE30Ph22degTh160NoDead-1.root
Entries 43809
Mean x 23.2
Mean y 9.771
RMS x 1.404
RMS y 1.014
SinglePhotonSingleE30Ph45degTh160NoDead-1.root
Entries 43891
Mean x 17.76
Mean y 18.04
RMS x 1.316
RMS y 1.263
Y (mm)
X (mm)

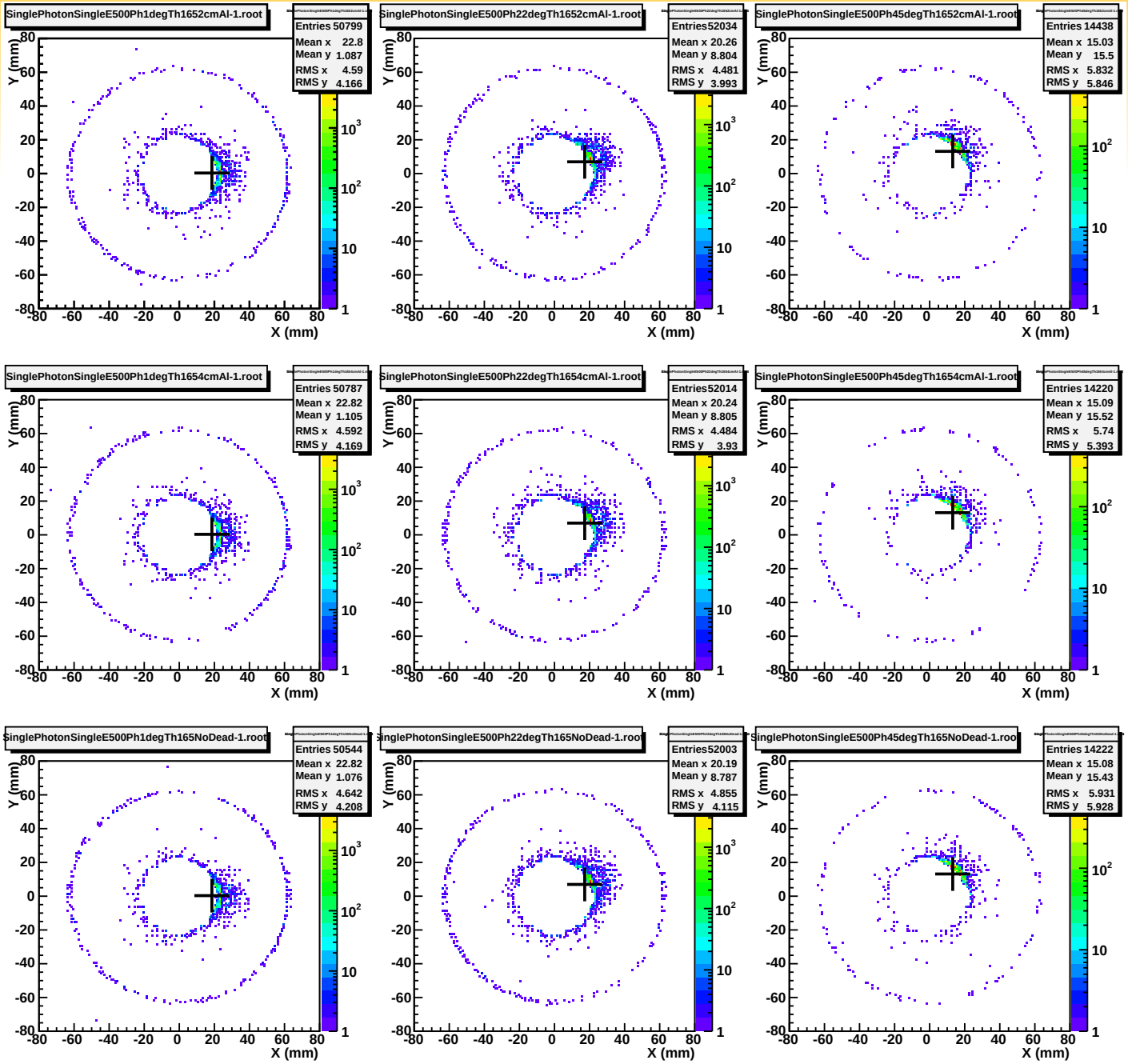

SinglePhotonSingleE500Ph1degTh1602cmAl-1.root
Entries 57408
Mean x 24.82
Mean y 0.8562
RMS x 5.144
RMS y 4.765
SinglePhotonSingleE500Ph22degTh1602cmAl-1.root
Entries 56834
Mean x 23.28
Mean y 9.78
RMS x 4.574
RMS y 4.585
SinglePhotonSingleE500Ph45degTh1602cmAl-1.root
Entries 56741
Mean x 17.63
Mean y 17.95
RMS x 4.803
RMS y 4.737
SinglePhotonSingleE500Ph1degTh1604cmAl-1.root
Entries 58725
Mean x 24.69
Mean y 0.774
RMS x 5.043
RMS y 4.843
SinglePhotonSingleE500Ph22degTh1604cmAl-1.root
Entries 57653
Mean x 23.15
Mean y 9.772
RMS x 4.73
RMS y 4.734
SinglePhotonSingleE500Ph45degTh1604cmAl-1.root
Entries 57702
Mean x 17.53
Mean y 17.83
RMS x 4.899
RMS y 4.948
SinglePhotonSingleE500Ph1degTh160NoDead-1.root
Entries 56431
Mean x 24.9
Mean y 0.872
RMS x 5.049
RMS y 4.535
SinglePhotonSingleE500Ph22degTh160NoDead-1.root
Entries 55957
Mean x 23.34
Mean y 9.795
RMS x 4.496
RMS y 4.456
SinglePhotonSingleE500Ph45degTh160NoDead-1.root
Entries 56271
Mean x 17.67
Mean y 17.96
RMS x 5.093
RMS y 4.927
Y (mm)
X (mm)

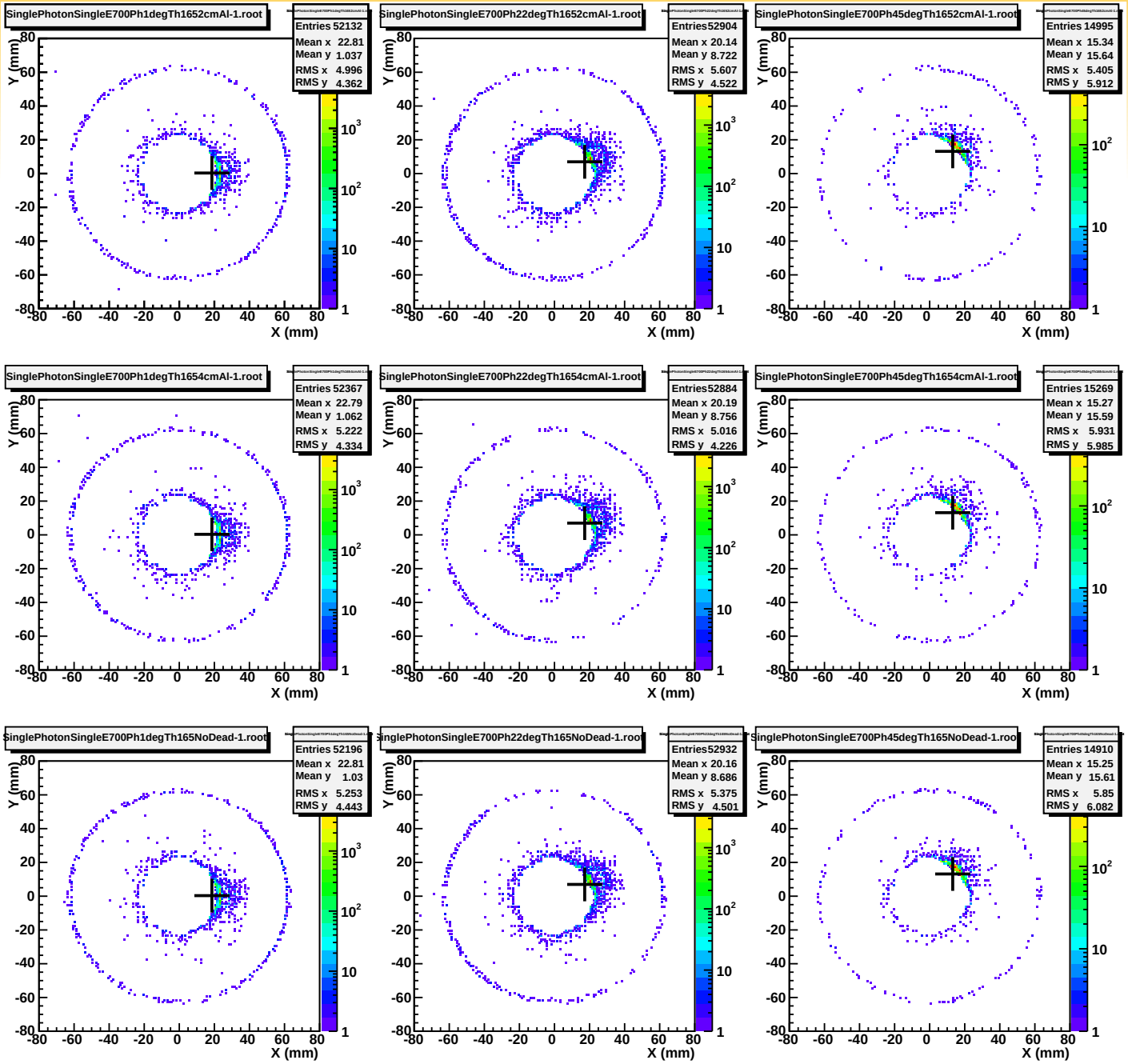

SinglePhotonSingleE700Ph1degTh1602cmAl-1.root
Entries 58125
Mean x 25
Mean y 0.8162
RMS x 5.533
RMS y 4.742
SinglePhotonSingleE700Ph22degTh1602cmAl-1.root
Entries 57425
Mean x 23.47
Mean y 9.807
RMS x 5.043
RMS y 4.733
SinglePhotonSingleE700Ph45degTh1602cmAl-1.root
Entries 57420
Mean x 17.77
Mean y 18.08
RMS x 5.303
RMS y 5.21
SinglePhotonSingleE700Ph1degTh1604cmAl-1.root
Entries 59039
Mean x 24.91
Mean y 0.7368
RMS x 5.517
RMS y 4.902
SinglePhotonSingleE700Ph22degTh1604cmAl-1.root
Entries 57941
Mean x 23.32
Mean y 9.815
RMS x 5.134
RMS y 4.883
SinglePhotonSingleE700Ph45degTh1604cmAl-1.root
Entries 58019
Mean x 17.73
Mean y 17.97
RMS x 5.162
RMS y 5.085
SinglePhotonSingleE700Ph1degTh160NoDead-1.root
Entries 57515
Mean x 25.11
Mean y 0.8384
RMS x 5.643
RMS y 4.777
SinglePhotonSingleE700Ph22degTh160NoDead-1.root
Entries 57012
Mean x 23.52
Mean y 9.849
RMS x 4.982
RMS y 4.796
SinglePhotonSingleE700Ph45degTh160NoDead-1.root
Entries 57200
Mean x 17.82
Mean y 18.1
RMS x 5.314
RMS y 5.219
Y (mm)
X (mm)


SinglePhotonSingleE100Ph1degTh1652cmAl-1.root
Entries 38900
Mean x 23.08
Mean y 1.206
RMS x 2.876
RMS y 2.406
SinglePhotonSingleE100Ph22degTh1652cmAl-1.root
Entries 41692
Mean x 20.44
Mean y 8.53
RMS x 2.575
RMS y 2.542
SinglePhotonSingleE100Ph45degTh1652cmAl-1.root
Entries 2050
Mean x 14.79
Mean y 15.65
RMS x 7.534
RMS y 7.486
SinglePhotonSingleE100Ph1degTh1654cmAl-1.root
Entries 38838
Mean x 23.08
Mean y 1.185
RMS x 2.81
RMS y 2.453
SinglePhotonSingleE100Ph22degTh1654cmAl-1.root
Entries 41851
Mean x 20.44
Mean y 8.56
RMS x 2.524
RMS y 2.369
SinglePhotonSingleE100Ph45degTh1654cmAl-1.root
Entries 2030
Mean x 14.98
Mean y 15.66
RMS x 6.93
RMS y 7.737
SinglePhotonSingleE100Ph1degTh165NoDead-1.root
Entries 38789
Mean x 23.09
Mean y 1.209
RMS x 2.762
RMS y 2.526
SinglePhotonSingleE100Ph22degTh165NoDead-1.root
Entries 41807
Mean x 20.4
Mean y 8.52
RMS x 2.905
RMS y 2.623
SinglePhotonSingleE100Ph45degTh165NoDead-1.root
Entries 1995
Mean x 14.43
Mean y 15.69
RMS x 8.917
RMS y 8.059
Y (mm)
X (mm)


SinglePhotonSingleE250Ph1degTh1652cmAl-1.root
Entries 44897
Mean x 22.82
Mean y 1.159
RMS x 3.825
RMS y 3.711
SinglePhotonSingleE250Ph22degTh1652cmAl-1.root
Entries 46945
Mean x 20.25
Mean y 8.769
RMS x 3.78
RMS y 3.511
SinglePhotonSingleE250Ph45degTh1652cmAl-1.root
Entries 8343
Mean x 14.77
Mean y 15.42
RMS x 6.257
RMS y 6.031
SinglePhotonSingleE250Ph1degTh1654cmAl-1.root
Entries 44844
Mean x 22.86
Mean y 1.194
RMS x 3.56
RMS y 3.609
SinglePhotonSingleE250Ph22degTh1654cmAl-1.root
Entries 46835
Mean x 20.28
Mean y 8.768
RMS x 3.651
RMS y 3.398
SinglePhotonSingleE250Ph45degTh1654cmAl-1.root
Entries 8371
Mean x 14.85
Mean y 15.39
RMS x 6.176
RMS y 6
SinglePhotonSingleE250Ph1degTh165NoDead-1.root
Entries 44698
Mean x 22.79
Mean y 1.171
RMS x 4.064
RMS y 3.825
SinglePhotonSingleE250Ph22degTh165NoDead-1.root
Entries 46959
Mean x 20.25
Mean y 8.783
RMS x 3.754
RMS y 3.523
SinglePhotonSingleE250Ph45degTh165NoDead-1.root
Entries 8333
Mean x 14.8
Mean y 15.45
RMS x 6.34
RMS y 6.168
Y (mm)
X (mm)


SinglePhotonSingleE30Ph1degTh1652cmAl-1.root
Entries 34222
Mean x 23.21
Mean y 1.303
RMS x 1.224
RMS y 1.302
SinglePhotonSingleE30Ph22degTh1652cmAl-1.root
Entries 38677
Mean x 20.45
Mean y 8.36
RMS x 1.669
RMS y 1.686
SinglePhotonSingleE30Ph45degTh1652cmAl-1.root
Entries 809
Mean x 15.46
Mean y 15.77
RMS x 6.527
RMS y 5.3
SinglePhotonSingleE30Ph1degTh1654cmAl-1.root
Entries 34018
Mean x 23.2
Mean y 1.317
RMS x 1.309
RMS y 1.238
SinglePhotonSingleE30Ph22degTh1654cmAl-1.root
Entries 38642
Mean x 20.48
Mean y 8.36
RMS x 1.308
RMS y 1.585
SinglePhotonSingleE30Ph45degTh1654cmAl-1.root
Entries 866
Mean x 15.17
Mean y 15.68
RMS x 6.618
RMS y 7.398
SinglePhotonSingleE30Ph1degTh165NoDead-1.root
Entries 34064
Mean x 23.2
Mean y 1.306
RMS x 1.379
RMS y 1.235
SinglePhotonSingleE30Ph22degTh165NoDead-1.root
Entries 38613
Mean x 20.48
Mean y 8.337
RMS x 1.359
RMS y 1.791
SinglePhotonSingleE30Ph45degTh165NoDead-1.root
Entries 823
Mean x 15.22
Mean y 16.06
RMS x 6.731
RMS y 5.873
Y (mm)
X (mm)


SinglePhotonSingleE500Ph1degTh1652cmAl-1.root
Entries 50799
Mean x 22.8
Mean y 1.087
RMS x 4.59
RMS y 4.166
SinglePhotonSingleE500Ph22degTh1652cmAl-1.root
Entries 52034
Mean x 20.26
Mean y 8.804
RMS x 4.481
RMS y 3.993
SinglePhotonSingleE500Ph45degTh1652cmAl-1.root
Entries 14438
Mean x 15.03
Mean y 15.5
RMS x 5.832
RMS y 5.846
SinglePhotonSingleE500Ph1degTh1654cmAl-1.root
Entries 50787
Mean x 22.82
Mean y 1.105
RMS x 4.592
RMS y 4.169
SinglePhotonSingleE500Ph22degTh1654cmAl-1.root
Entries 52014
Mean x 20.24
Mean y 8.805
RMS x 4.484
RMS y 3.93
SinglePhotonSingleE500Ph45degTh1654cmAl-1.root
Entries 14220
Mean x 15.09
Mean y 15.52
RMS x 5.74
RMS y 5.393
SinglePhotonSingleE500Ph1degTh165NoDead-1.root
Entries 50544
Mean x 22.82
Mean y 1.076
RMS x 4.642
RMS y 4.208
SinglePhotonSingleE500Ph22degTh165NoDead-1.root
Entries 52003
Mean x 20.19
Mean y 8.787
RMS x 4.855
RMS y 4.115
SinglePhotonSingleE500Ph45degTh165NoDead-1.root
Entries 14222
Mean x 15.08
Mean y 15.43
RMS x 5.931
RMS y 5.928
Y (mm)
X (mm)


SinglePhotonSingleE700Ph1degTh1652cmAl-1.root
Entries 52132
Mean x 22.81
Mean y 1.037
RMS x 4.996
RMS y 4.362
SinglePhotonSingleE700Ph22degTh1652cmAl-1.root
Entries 52904
Mean x 20.14
Mean y 8.722
RMS x 5.607
RMS y 4.522
SinglePhotonSingleE700Ph45degTh1652cmAl-1.root
Entries 14995
Mean x 15.34
Mean y 15.64
RMS x 5.405
RMS y 5.912
SinglePhotonSingleE700Ph1degTh1654cmAl-1.root
Entries 52367
Mean x 22.79
Mean y 1.062
RMS x 5.222
RMS y 4.334
SinglePhotonSingleE700Ph22degTh1654cmAl-1.root
Entries 52884
Mean x 20.19
Mean y 8.756
RMS x 5.016
RMS y 4.226
SinglePhotonSingleE700Ph45degTh1654cmAl-1.root
Entries 15269
Mean x 15.27
Mean y 15.59
RMS x 5.931
RMS y 5.985
SinglePhotonSingleE700Ph1degTh165NoDead-1.root
Entries 52196
Mean x 22.81
Mean y 1.03
RMS x 5.253
RMS y 4.443
SinglePhotonSingleE700Ph22degTh165NoDead-1.root
Entries 52932
Mean x 20.16
Mean y 8.686
RMS x 5.375
RMS y 4.501
SinglePhotonSingleE700Ph45degTh165NoDead-1.root
Entries 14910
Mean x 15.25
Mean y 15.61
RMS x 5.85
RMS y 6.082
Y (mm)
X (mm)