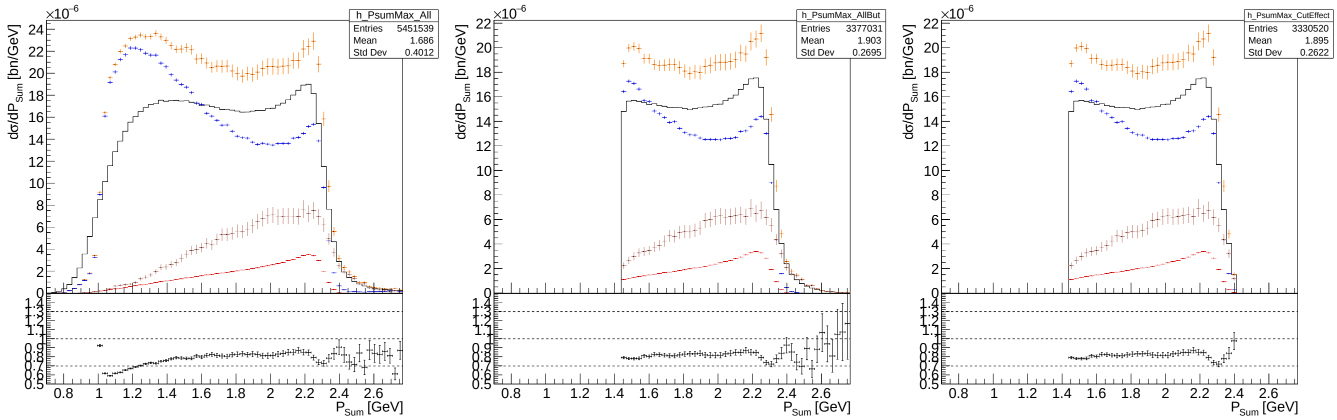


Figure 1: Progress of P_{Sum} Max cut.

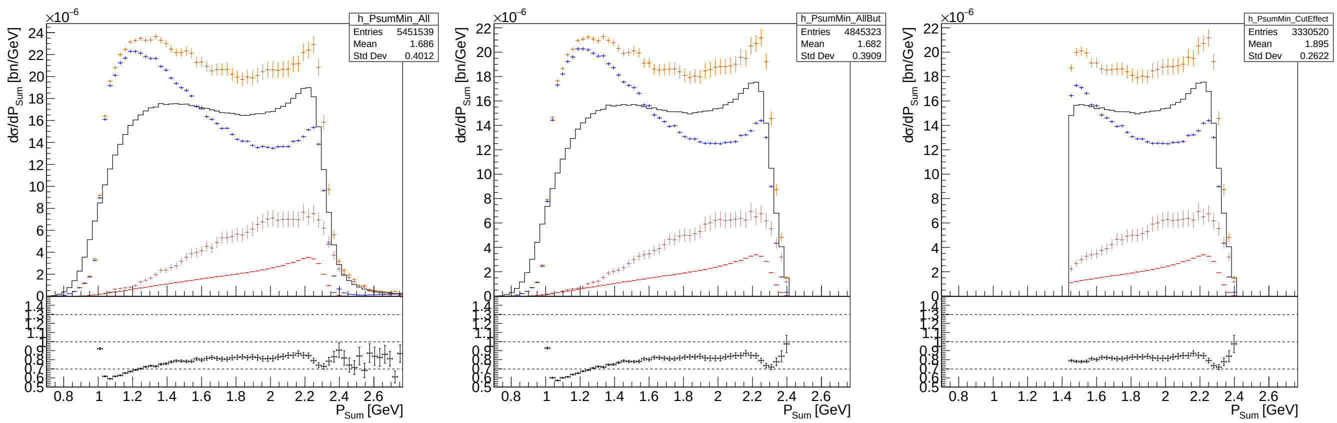


Figure 2: Progress of P_{Sum} Min cut.

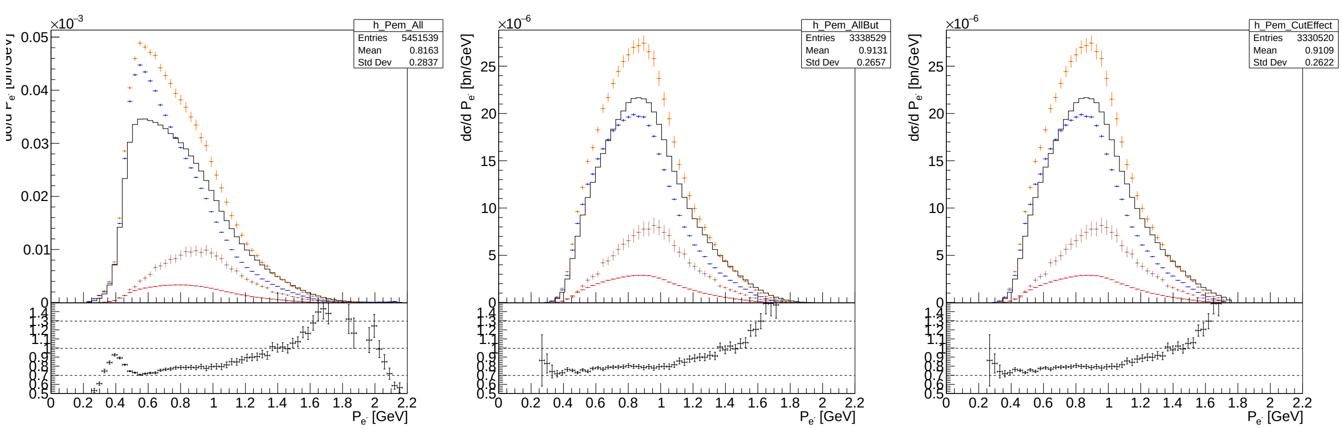


Figure 3: Progress of P_{e^-} cut.

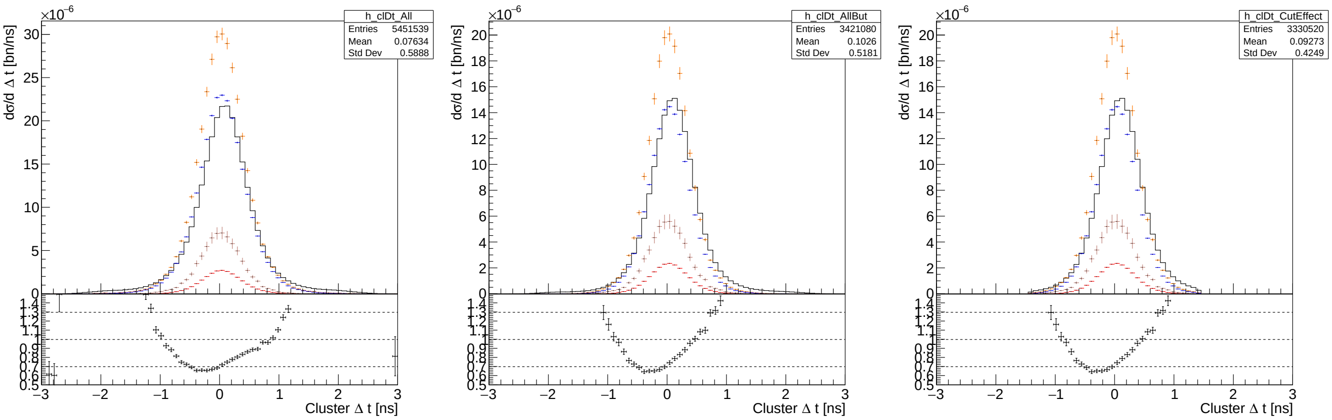


Figure 4: Progress of Cluster time difference cut.

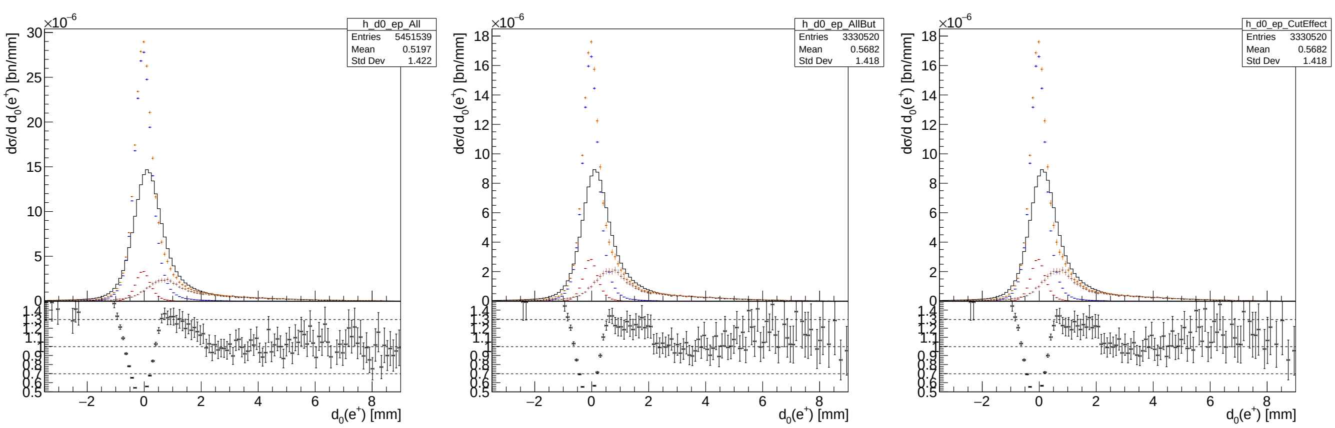


Figure 5: Progress of positron d_0 cut.

1 Cluster - Track time difference plots

1.1 Electrons: Non separated

There is no distinction on whether the cluster is on the top ot bottom half of the detector.

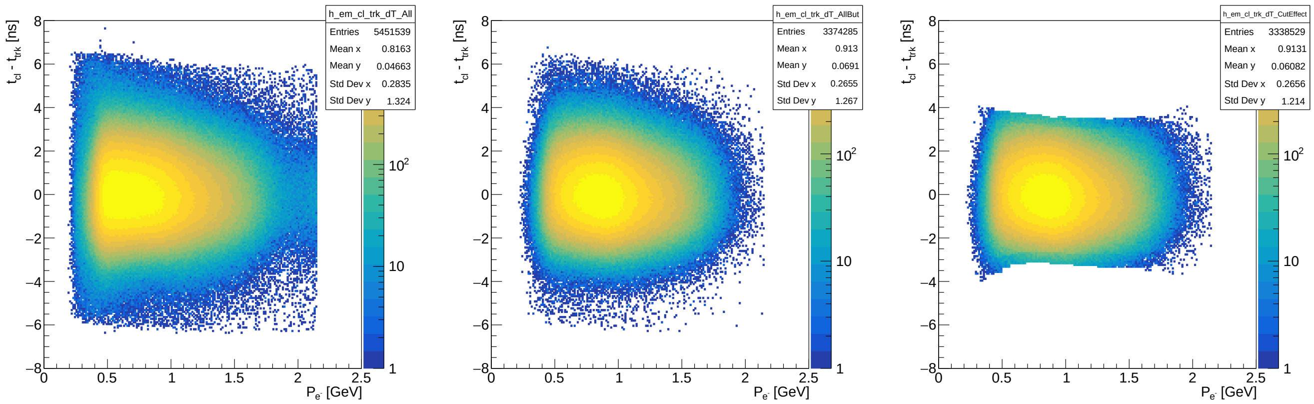


Figure 6: Electrons Data: Cluster track time difference as a function of Momentum.

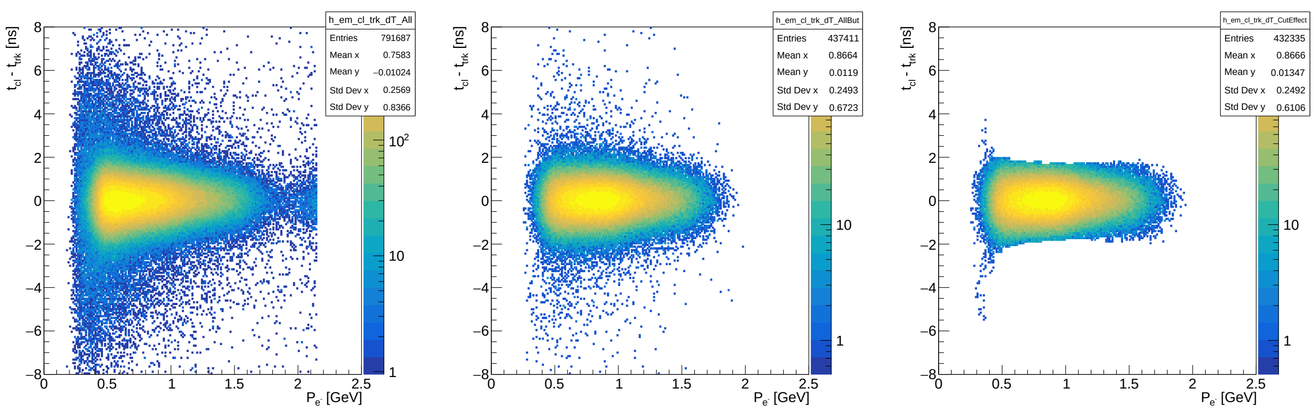


Figure 7: Electrons Tridents: Cluster track time difference as a function of Momentum.

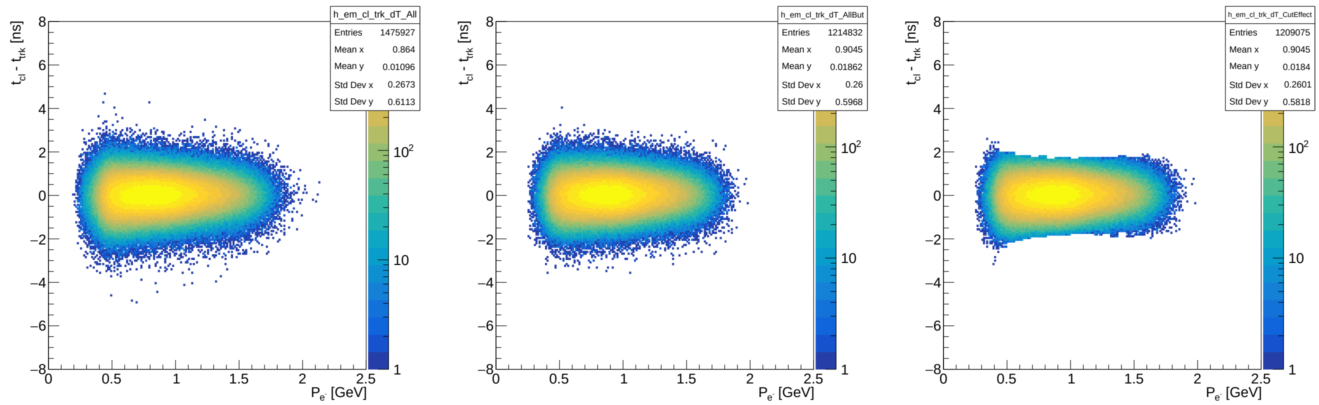


Figure 8: Electrons Rad Tridents: Cluster track time difference as a function of Momentum.

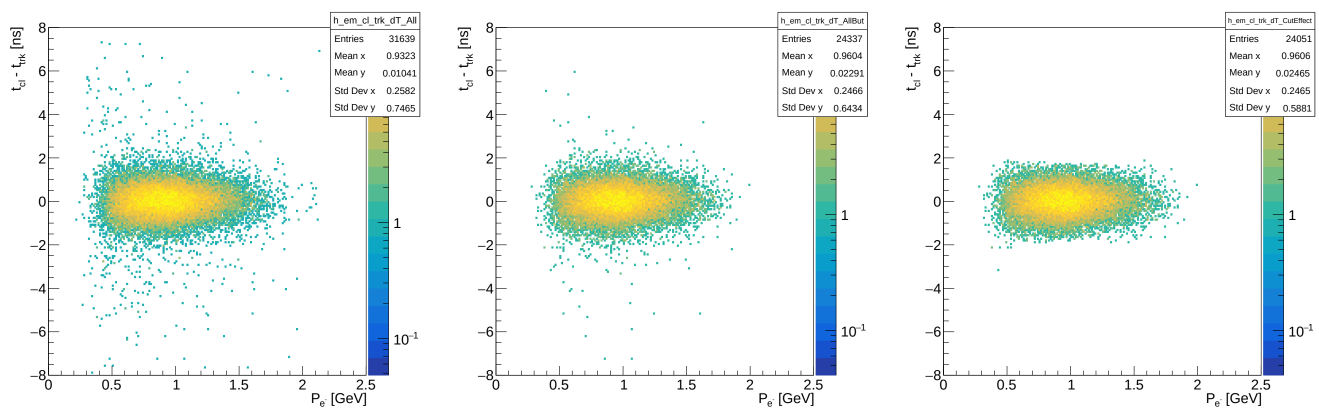


Figure 9: Electrons WABs: Cluster track time difference as a function of Momentum.

1.2 Positrons: Non separated

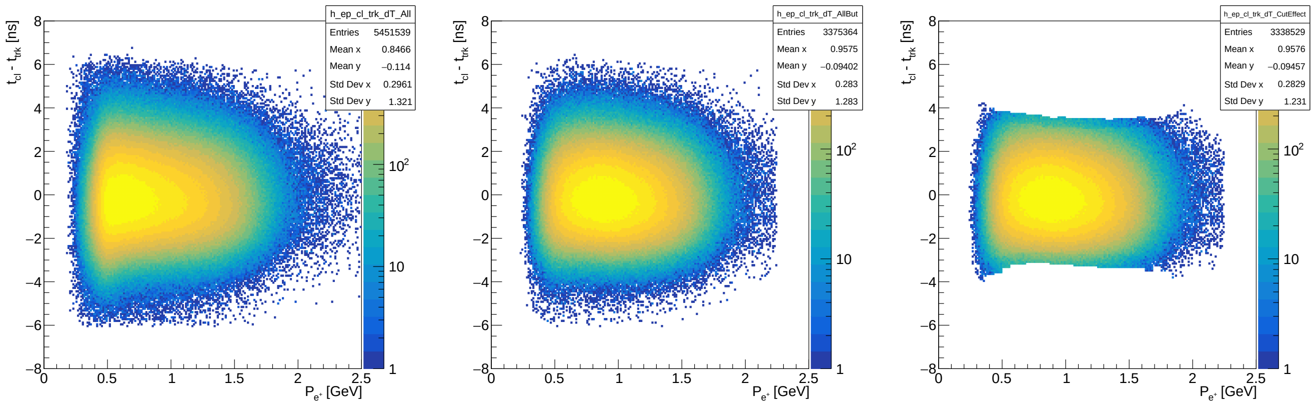


Figure 10: Positrons Data: Cluster track time difference as a function of Momentum.

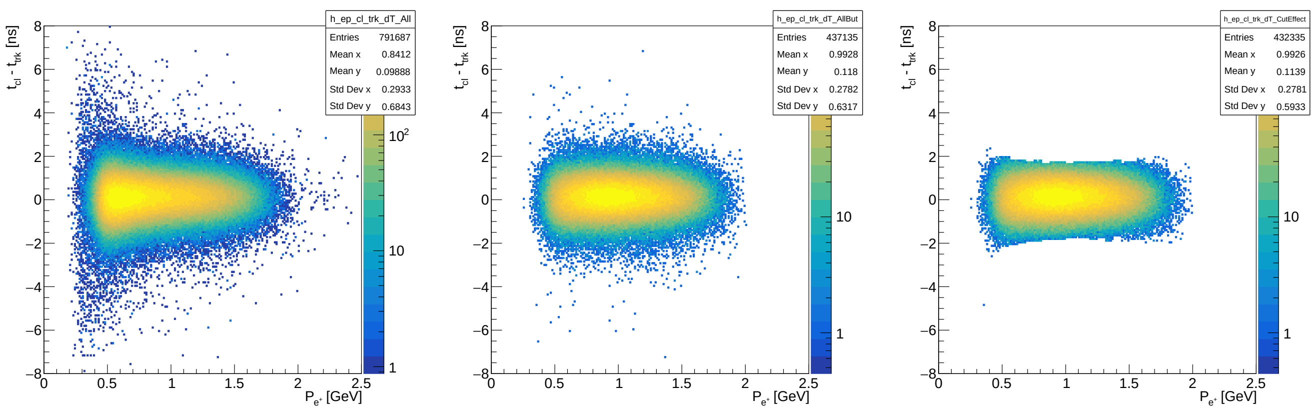


Figure 11: Positrons Tridents: Cluster track time difference as a function of Momentum.

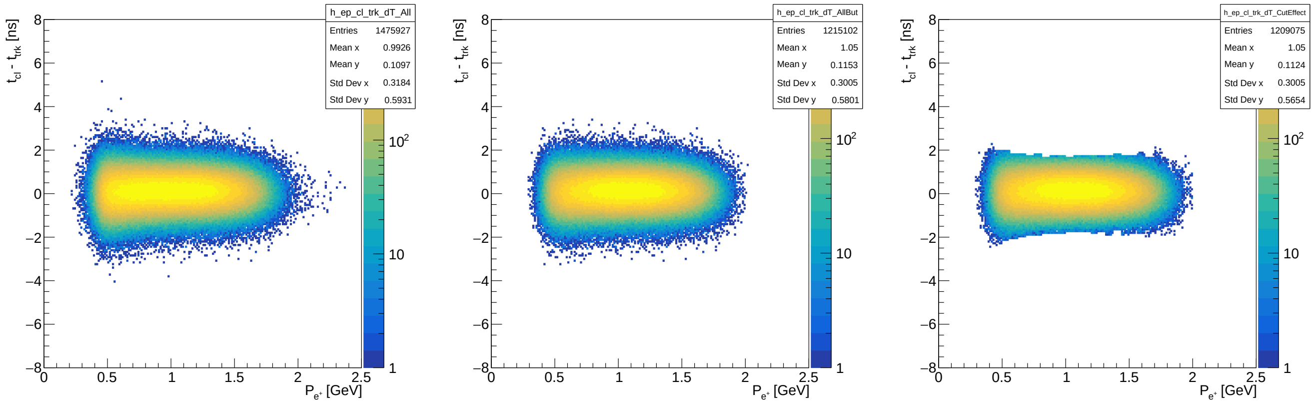


Figure 12: Positrons Rad Tridents: Cluster track time difference as a function of Momentum.

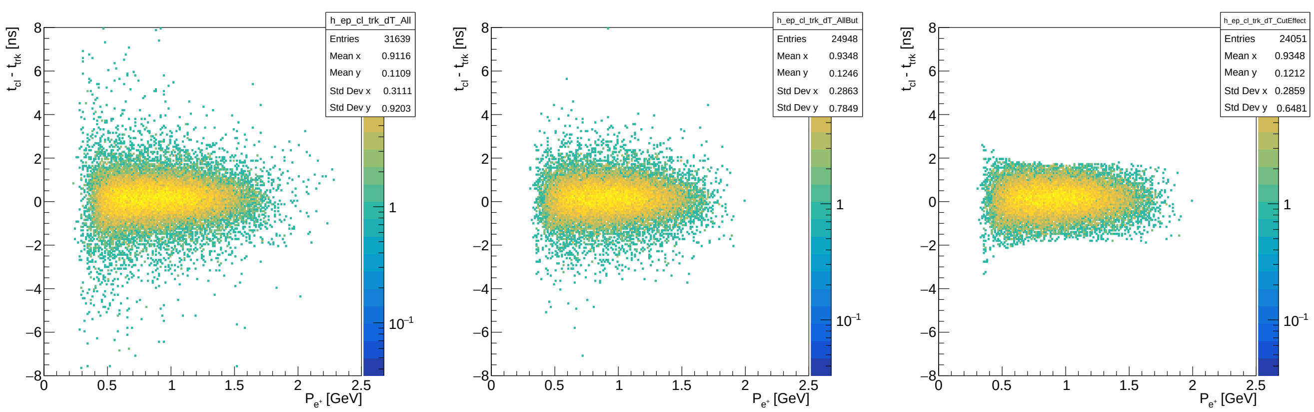


Figure 13: Positrons WABs: Cluster track time difference as a function of Momentum.

1.3 Electrons: Separated

Plots in this section are separated, depending the cluster is in the top or bottom half of the detector. See caption of plots in order to determine which detector half it represents.

1.3.1 Top Half

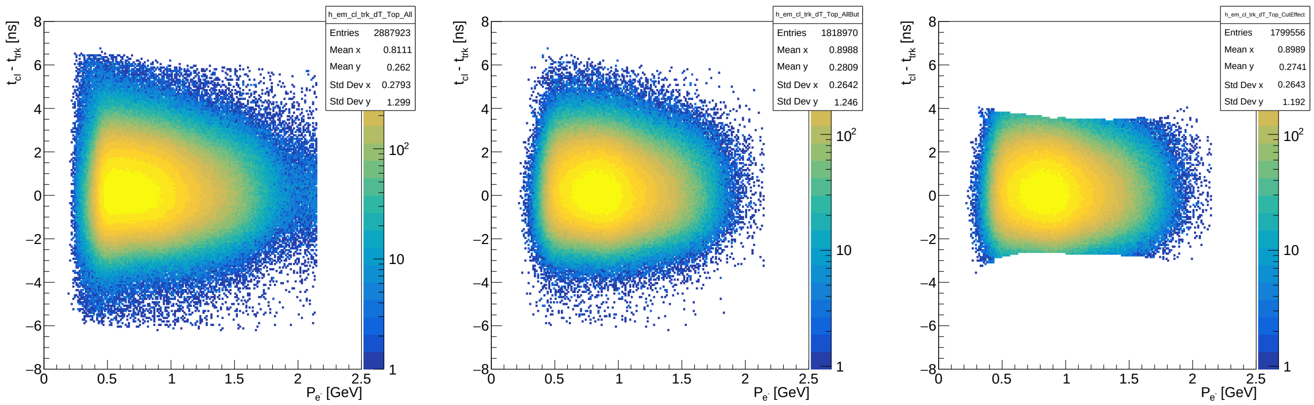


Figure 14: Electrons Data: Cluster track time difference as a function of Momentum. for clusters in the top half.

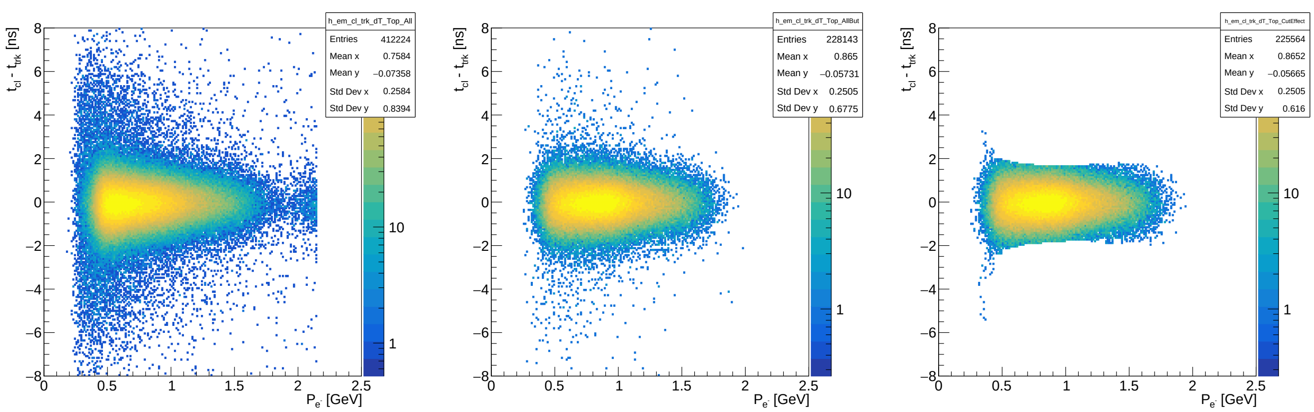


Figure 15: Electrons Tri: Cluster track time difference as a function of Momentum. for clusters in the top half.

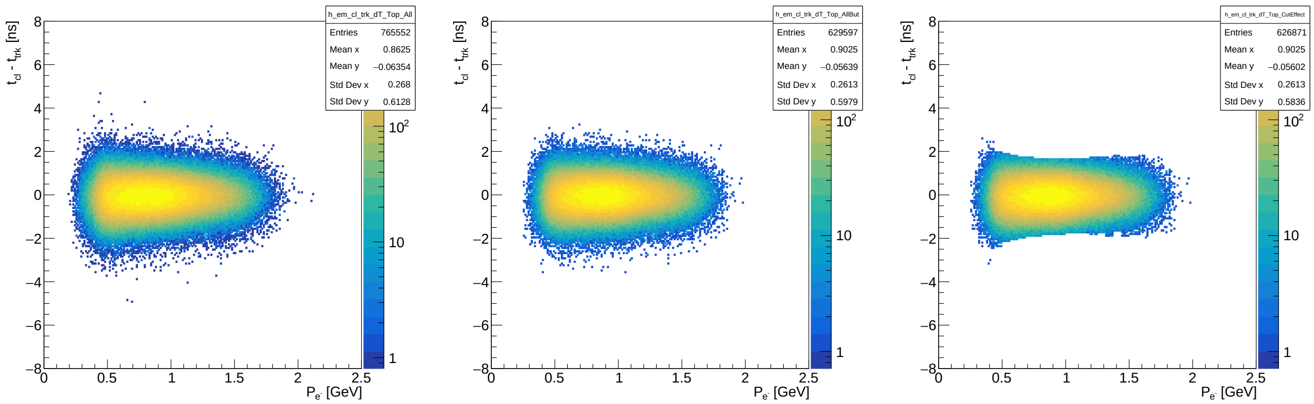


Figure 16: Electrons Rad: Cluster track time difference as a function of Momentum. for clusters in the top half.

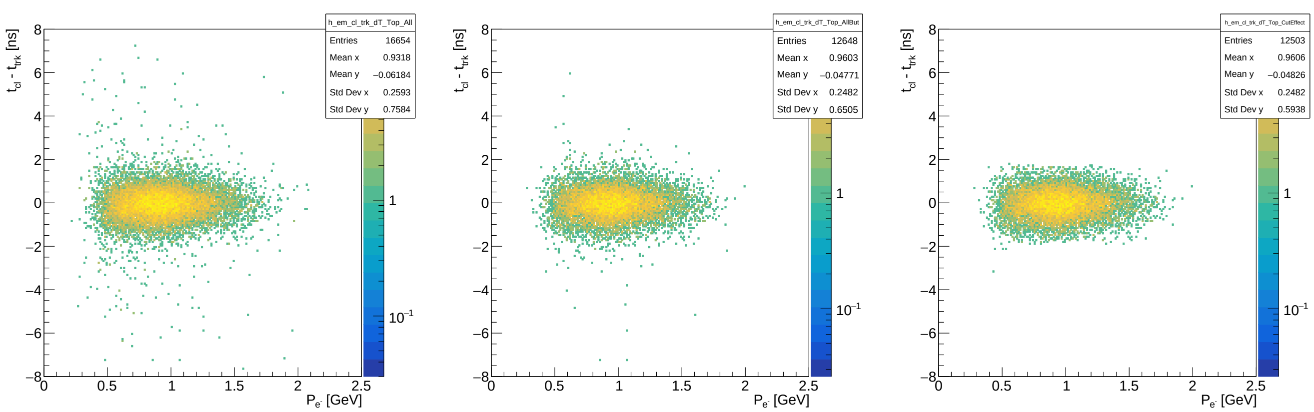


Figure 17: Electrons WAB: Cluster track time difference as a function of Momentum. for clusters in the top half.

1.3.2 Bottom Half

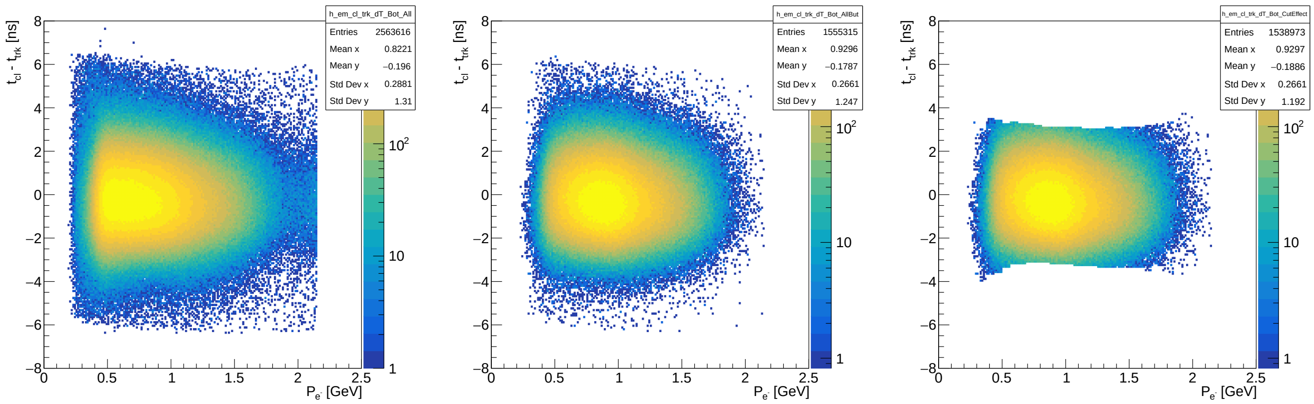


Figure 18: Electrons Data: Cluster track time difference as a function of Momentum. for clusters in the bottom half.

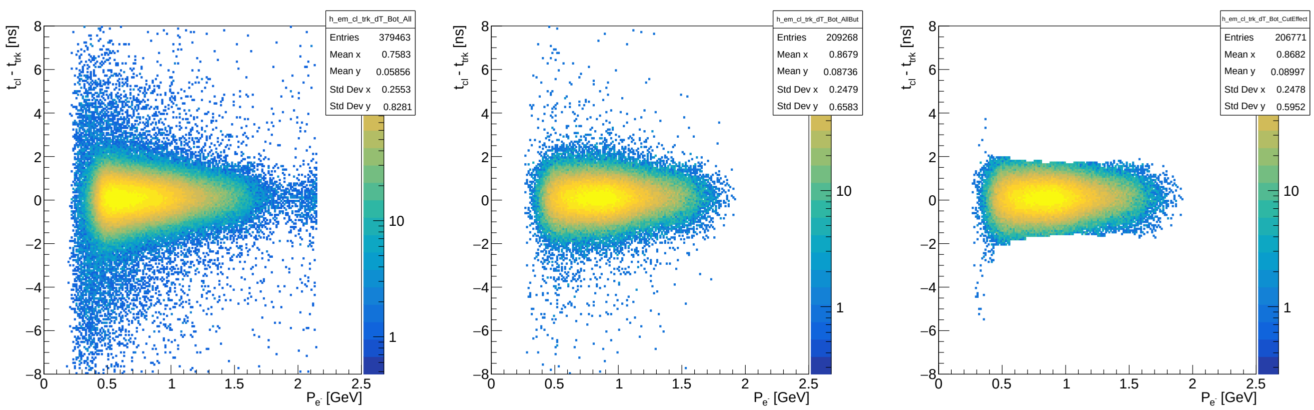


Figure 19: Electrons Tri: Cluster track time difference as a function of Momentum. for clusters in the bottom half.

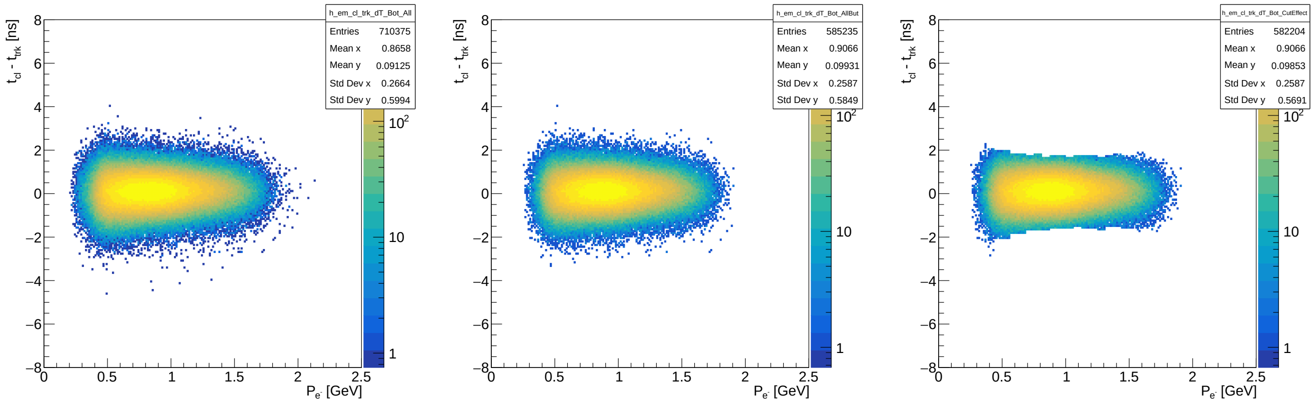


Figure 20: Electrons Rad: Cluster track time difference as a function of Momentum. for clusters in the bottom half.

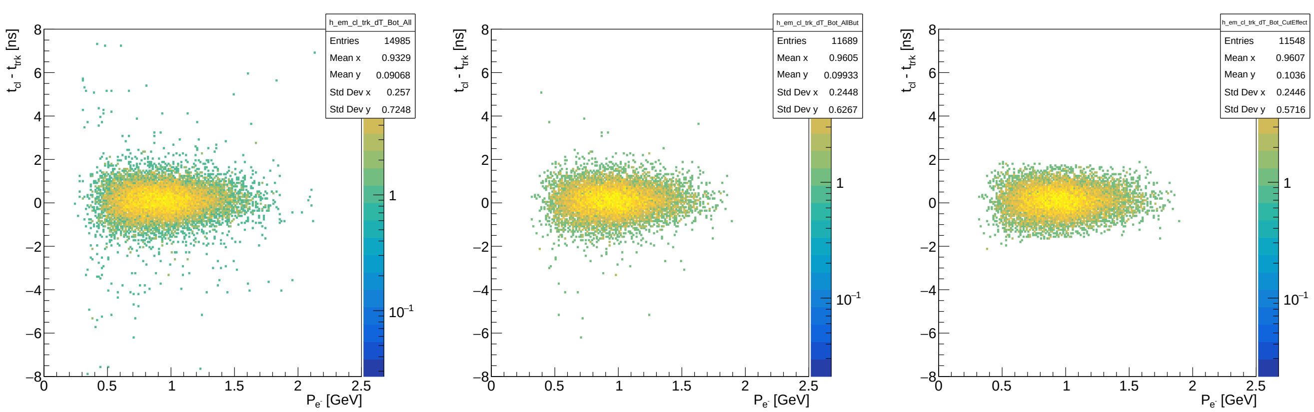


Figure 21: Electrons WAB: Cluster track time difference as a function of Momentum. for clusters in the bottom half.

1.4 Positrons: Separated

Plots in this section are separated, depending the cluster is in the top or bottom half of the detector. See caption of plots in order to determine which detector half it represents.

1.4.1 Top Half

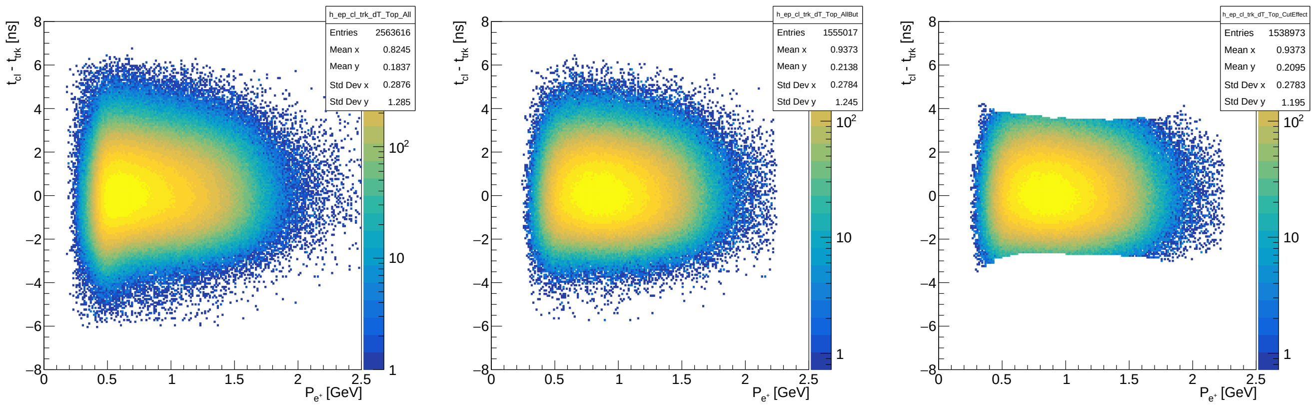


Figure 22: Positrons Data: Cluster track time difference as a function of Momentum. for clusters in the top half.

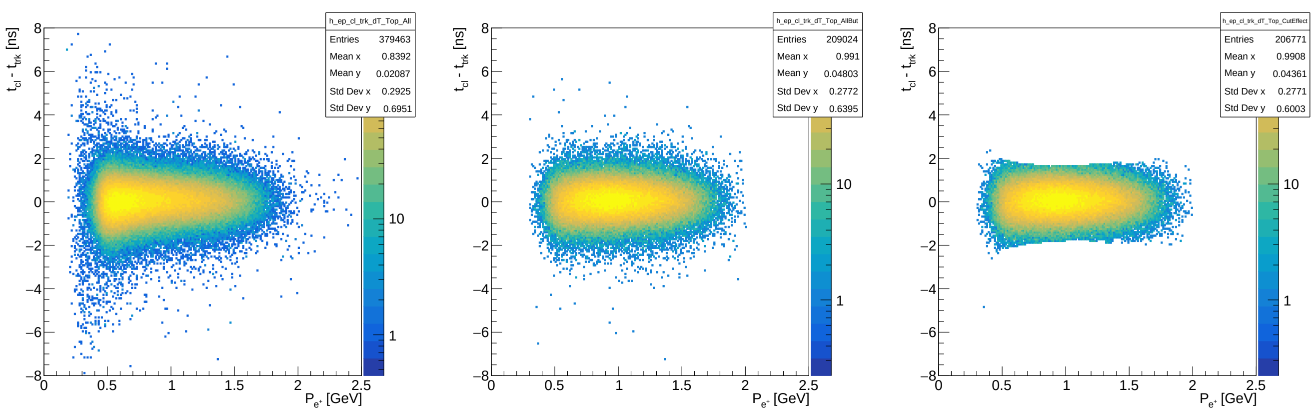


Figure 23: Positrons Tri: Cluster track time difference as a function of Momentum. for clusters in the top half.

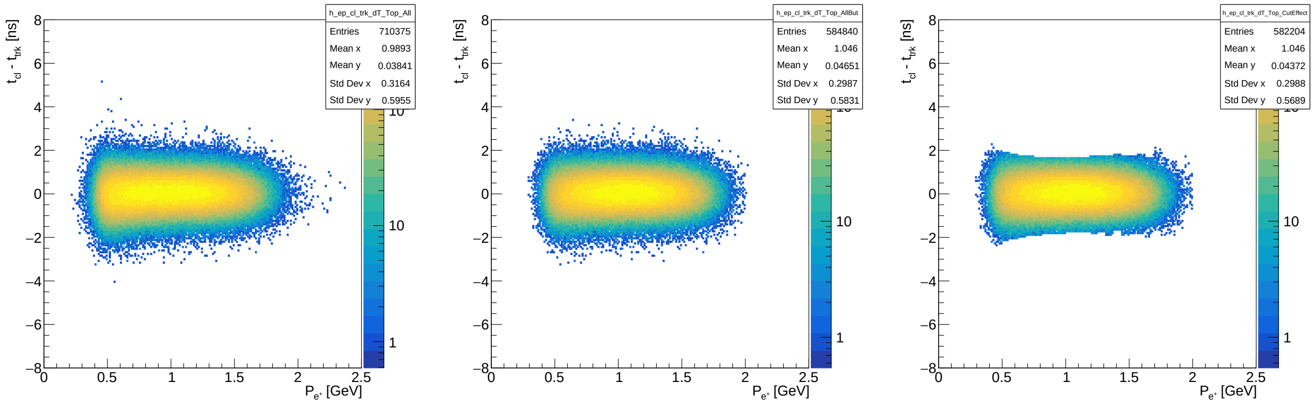


Figure 24: Positrons Rad: Cluster track time difference as a function of Momentum. for clusters in the top half.

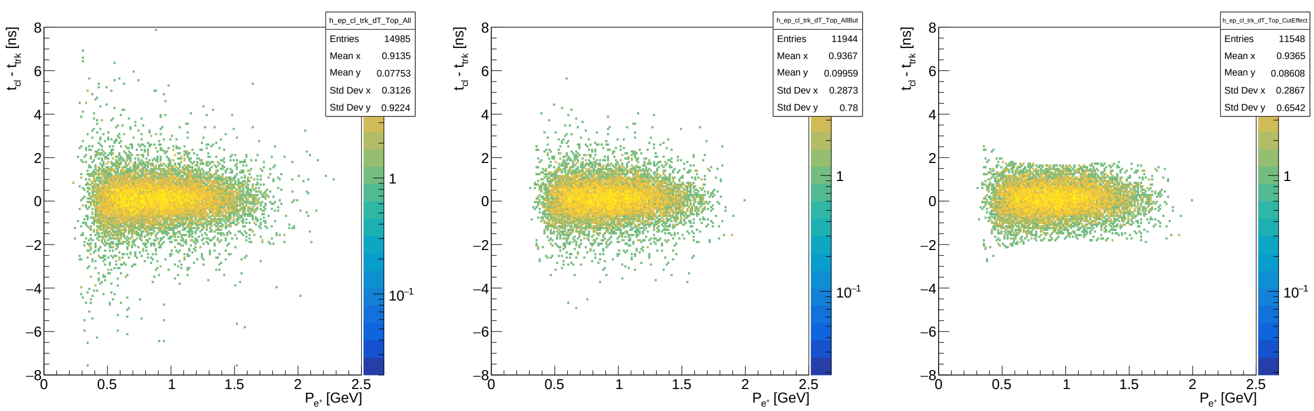


Figure 25: Positrons WAB: Cluster track time difference as a function of Momentum. for clusters in the top half.

1.4.2 Bottom Half

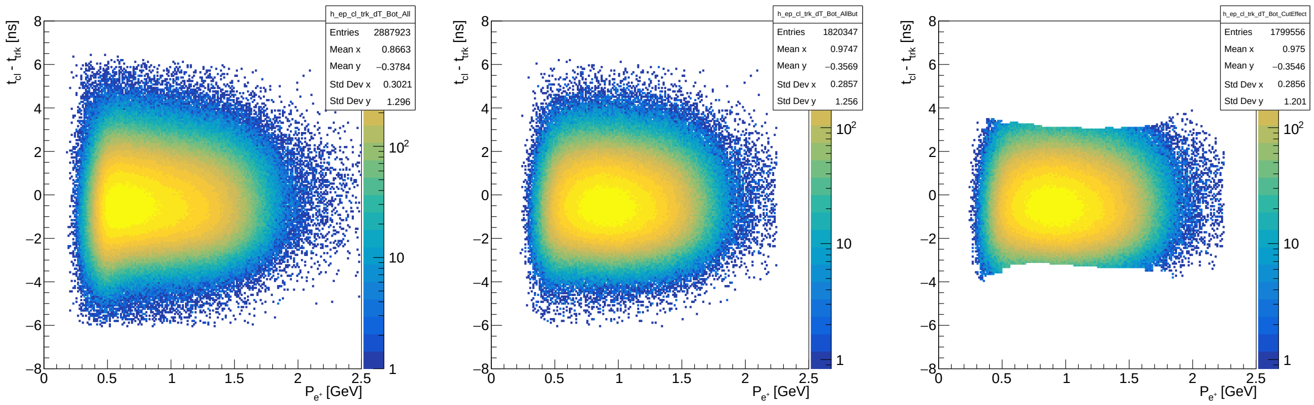


Figure 26: Positrons Data: Cluster track time difference as a function of Momentum. for clusters in the bottom half.

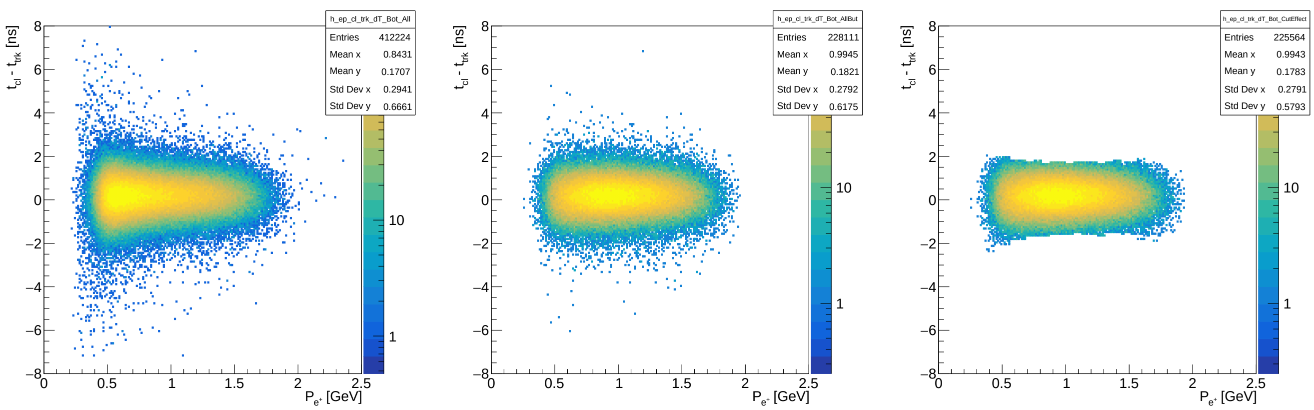


Figure 27: Positrons Tri: Cluster track time difference as a function of Momentum. for clusters in the bottom half.

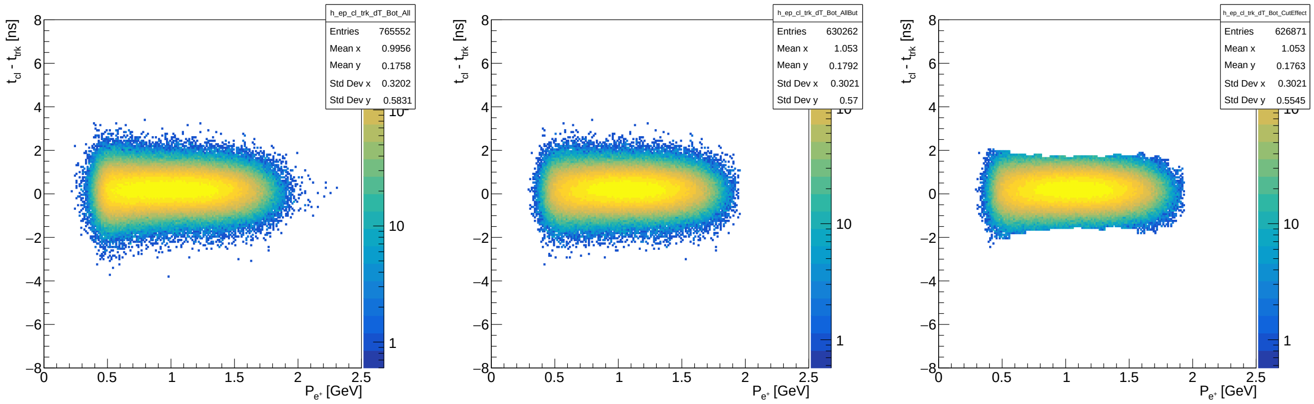


Figure 28: Positrons Rad: Cluster track time difference as a function of Momentum. for clusters in the bottom half.

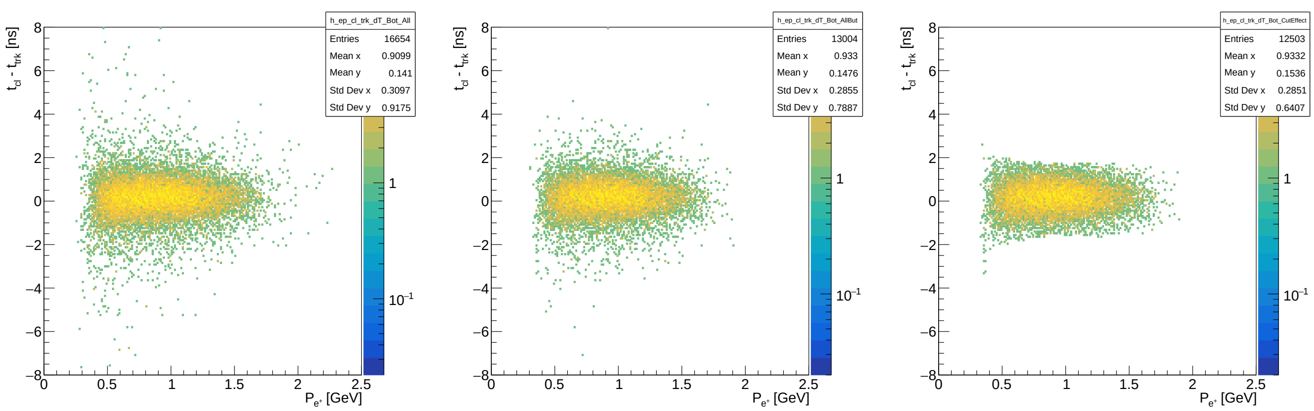


Figure 29: Positrons WAB: Cluster track time difference as a function of Momentum. for clusters in the bottom half.

2 Cluster - Track “X” coordinate difference

Plots in this section represent cluster and Track X coordinate difference as a function of the track momentum.

2.1 Unseparated Electrons

This subsection represents electrons without distinguishing in which halfe the particle went, and whether it had a hit in L6.

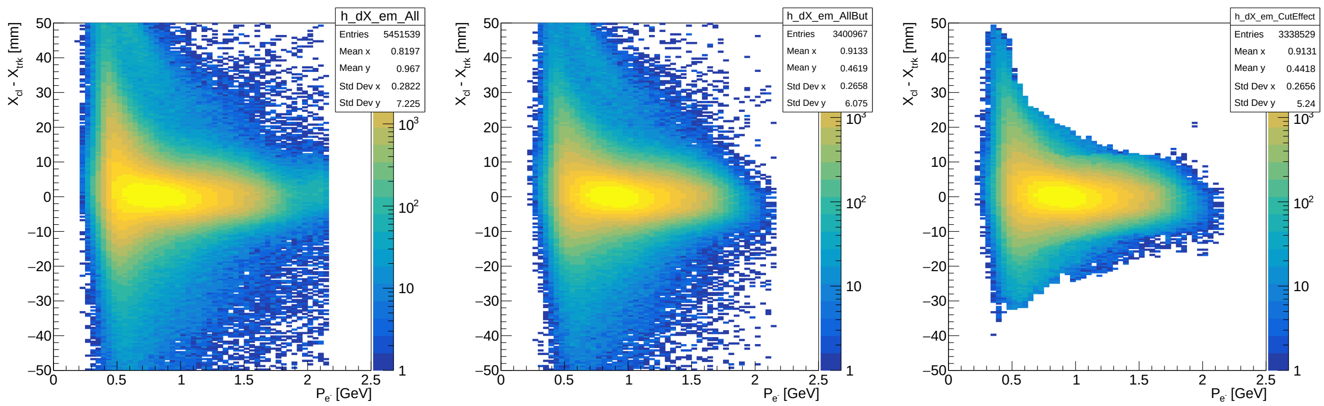


Figure 30: Electrons Data: Cluster track X coordinate difference as a function of momentum.

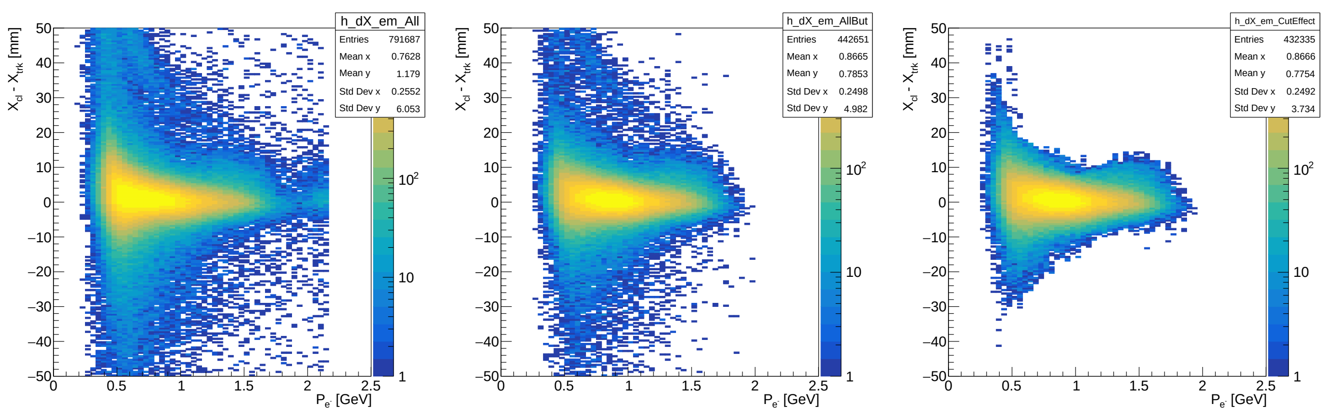


Figure 31: Electrons Tridents: Cluster track X coordinate difference as a function of momentum.

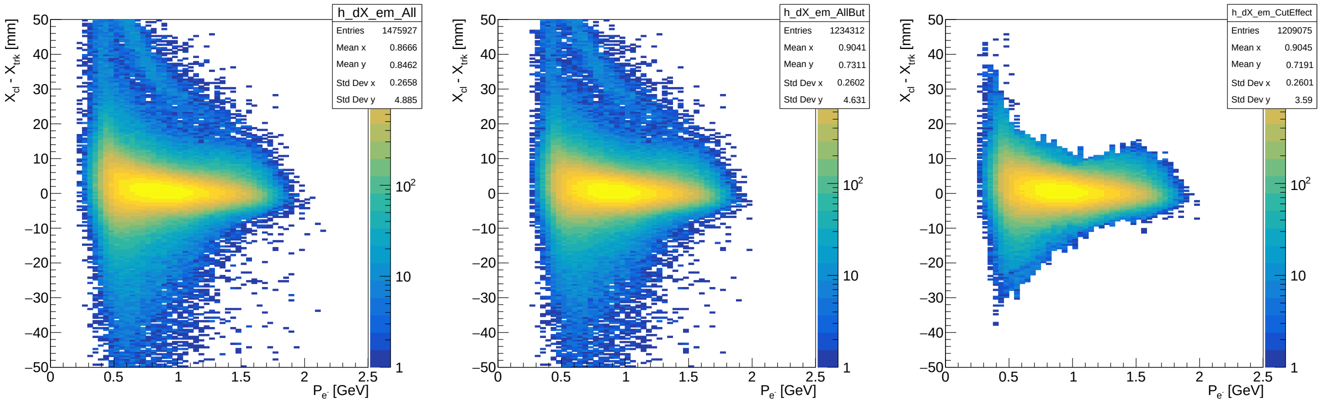


Figure 32: Electrons Rad Tridents: Cluster track X coordinate difference as a function of momentum.

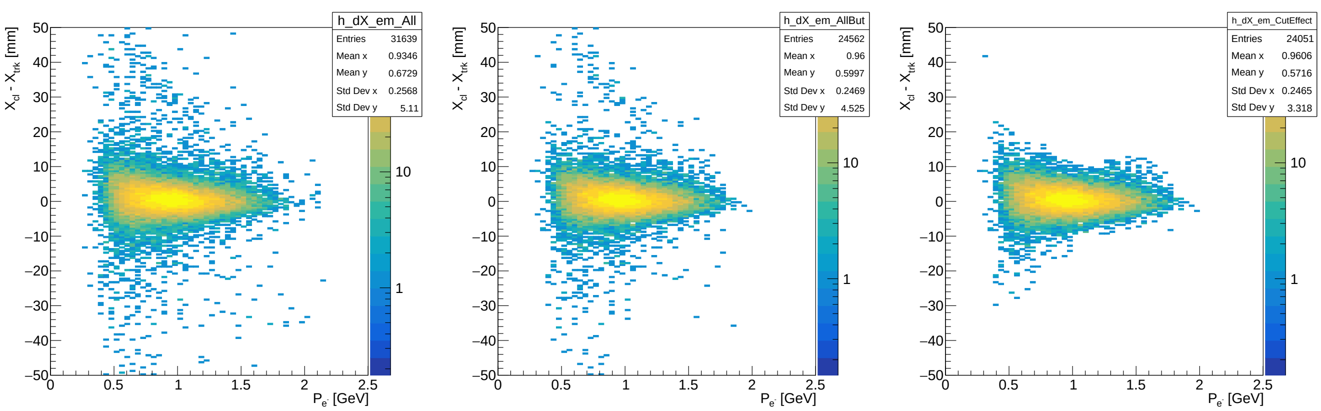


Figure 33: Positrons Rad Tridents: Cluster track X coordinate difference as a function of momentum.

2.2 Unseparated Positrons

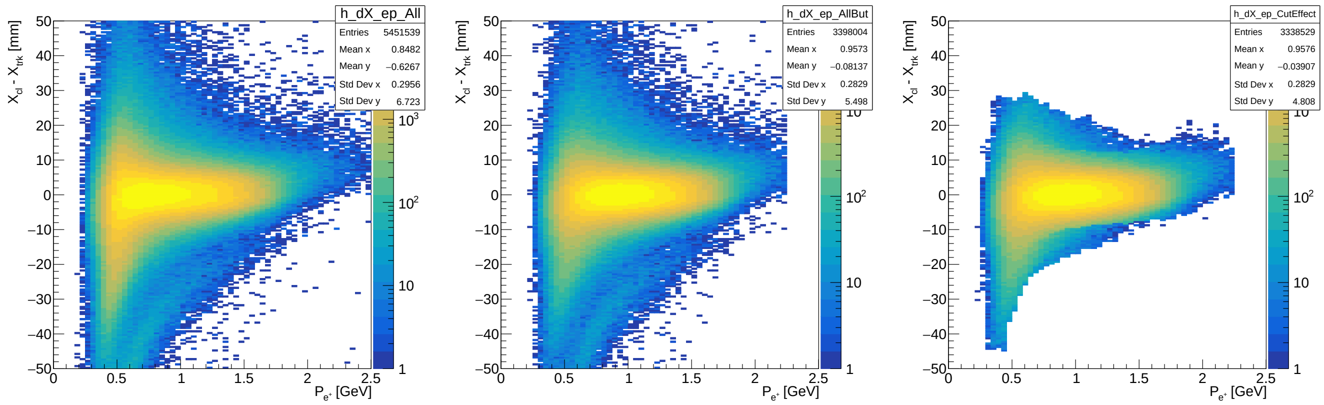


Figure 34: Positrons Data: Cluster track X coordinate difference as a function of momentum.

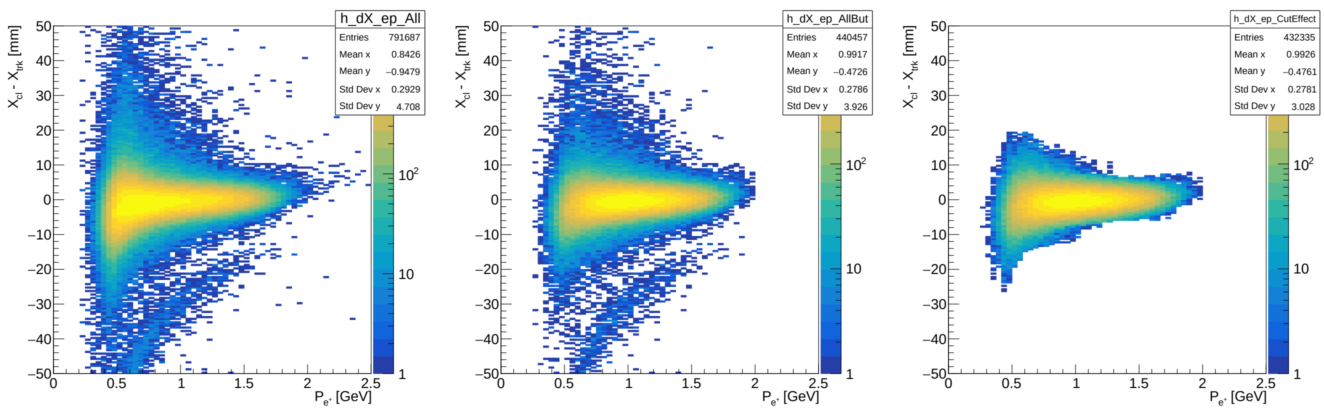


Figure 35: Positrons Tridents: Cluster track X coordinate difference as a function of momentum.

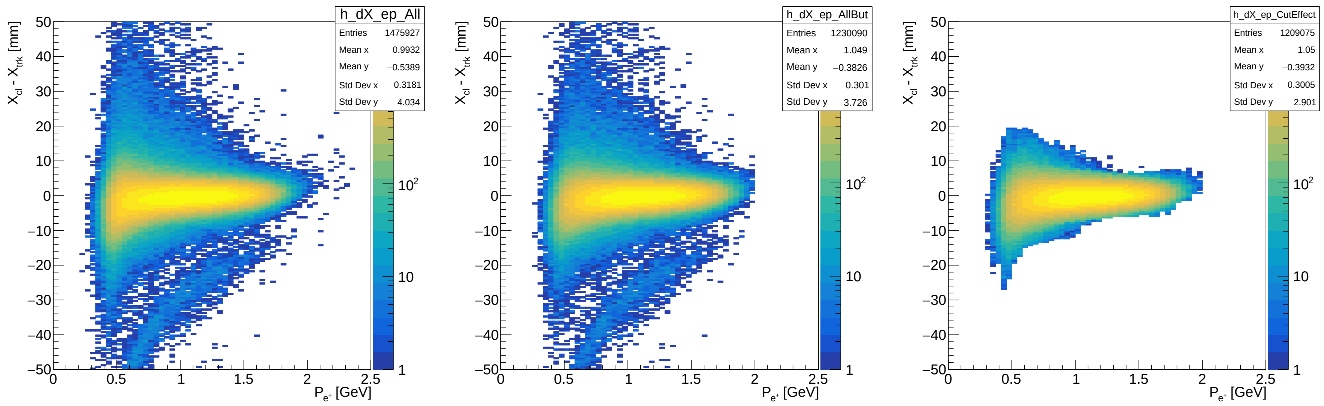


Figure 36: Positrons Rad Tridents: Cluster track X coordinate difference as a function of momentum.

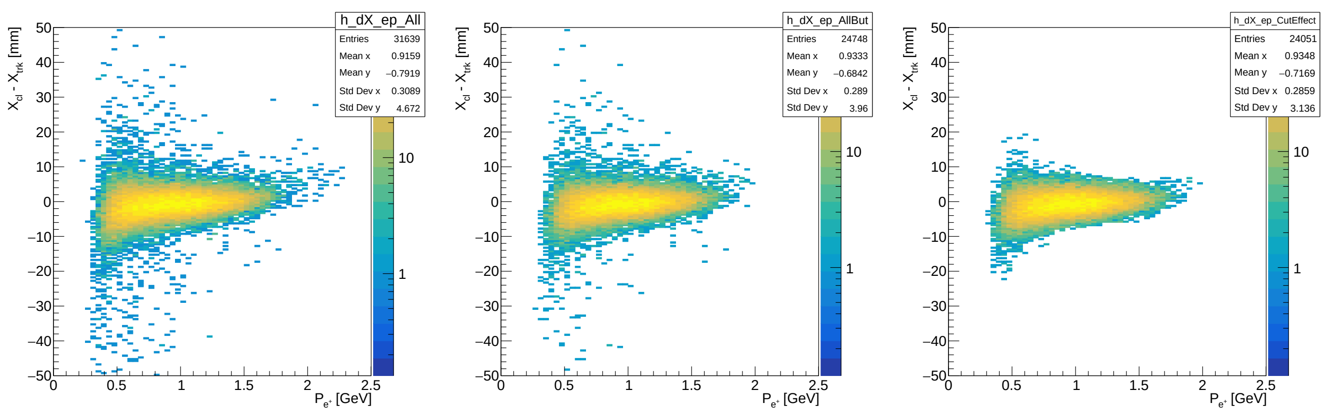


Figure 37: Positrons Rad Tridents: Cluster track X coordinate difference as a function of momentum.

2.3 Electrons: Separated

Figures in this section are separated depending on which half they belong to, and whether they have hit in L6.

2.3.1 Electrons: Top With L6 hit

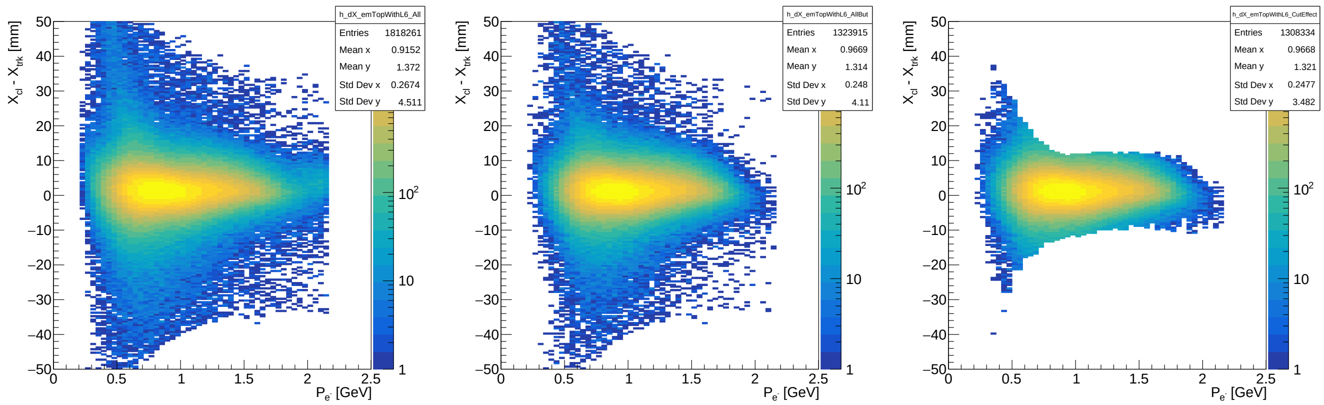


Figure 38: Electrons, Top with L6, Data: Cluster track X coordinate difference as a function of momentum.

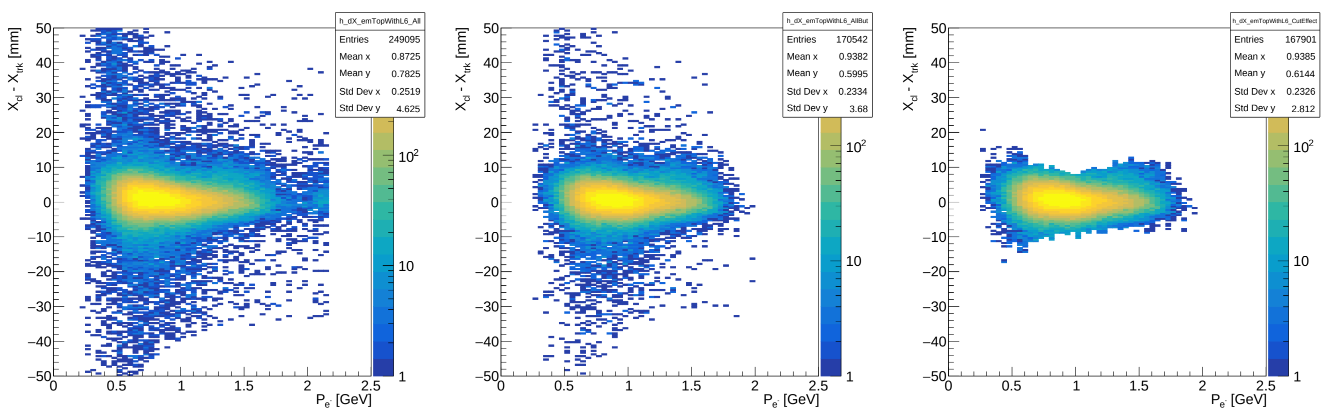


Figure 39: Electrons, Top with L6, Tri: Cluster track X coordinate difference as a function of momentum.

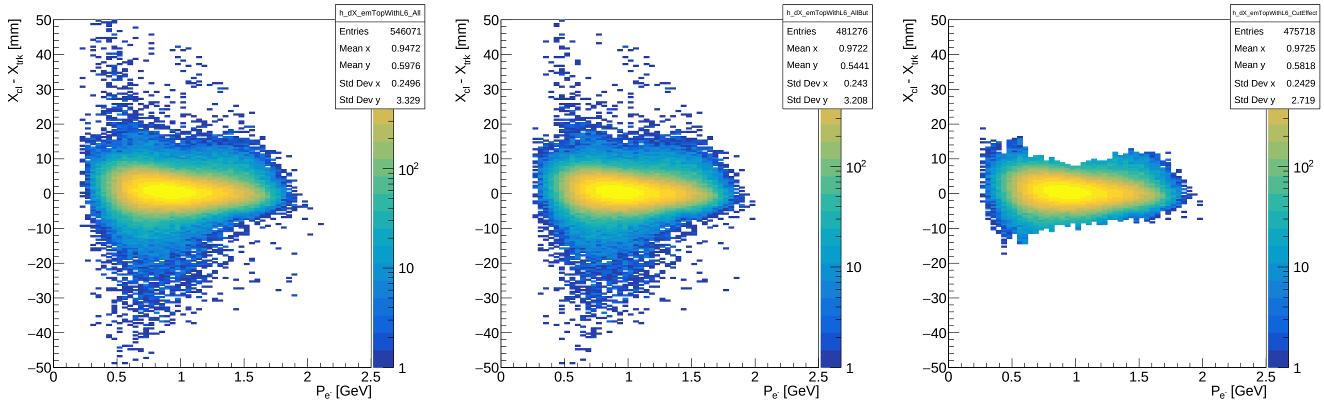


Figure 40: Electrons, Top with L6, Rad: Cluster track X coordinate difference as a function of momentum.

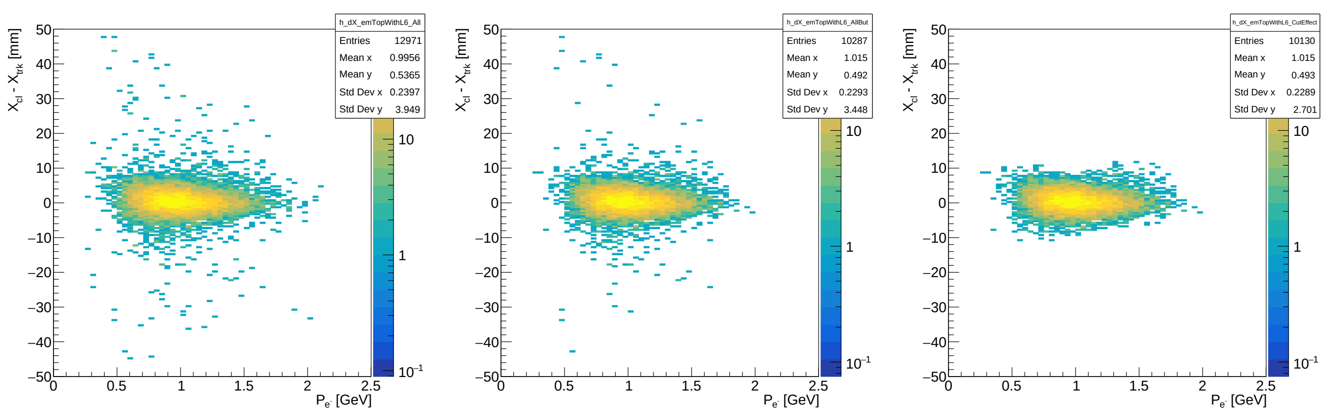


Figure 41: Electrons, Top with L6, WAB: Cluster track X coordinate difference as a function of momentum.

2.3.2 Electrons: Top No L6 hit

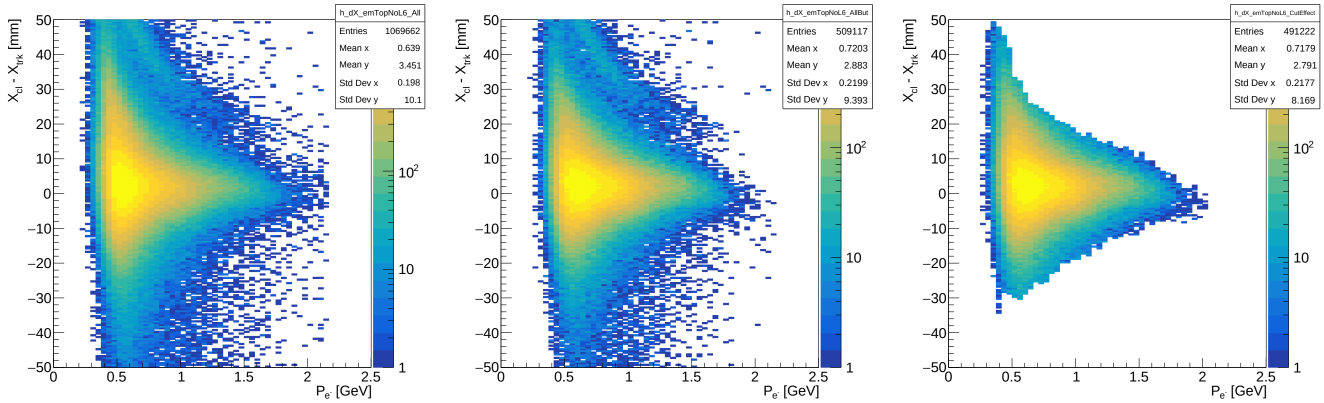


Figure 42: Electrons, Top No L6, Data: Cluster track X coordinate difference as a function of momentum.

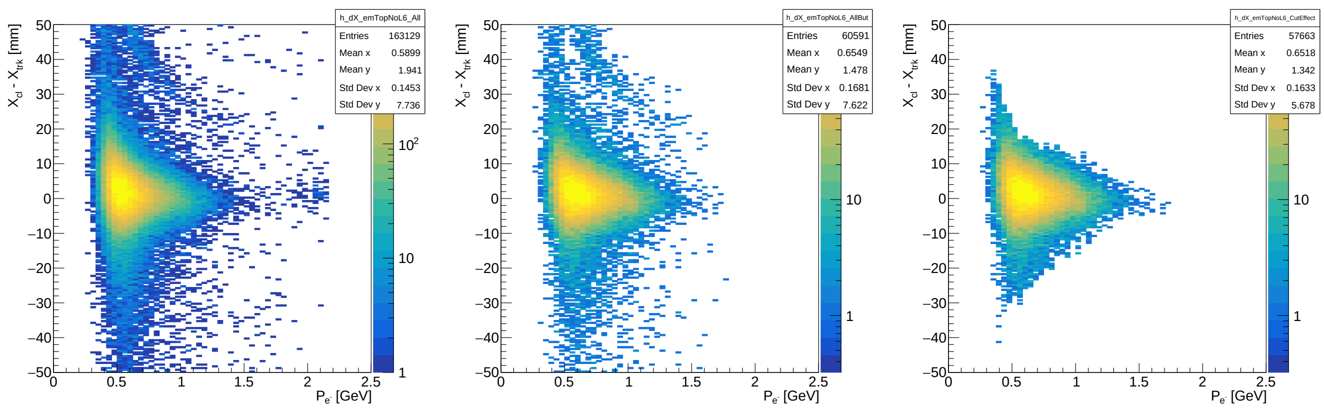


Figure 43: Electrons, Top No L6, Tri: Cluster track X coordinate difference as a function of momentum.

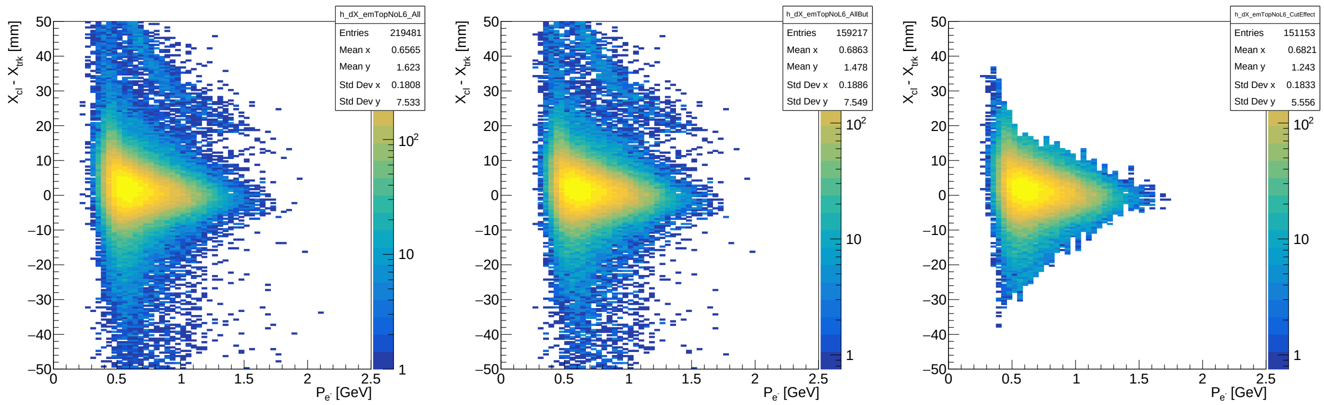


Figure 44: Electrons, Top No L6, Rad: Cluster track X coordinate difference as a function of momentum.

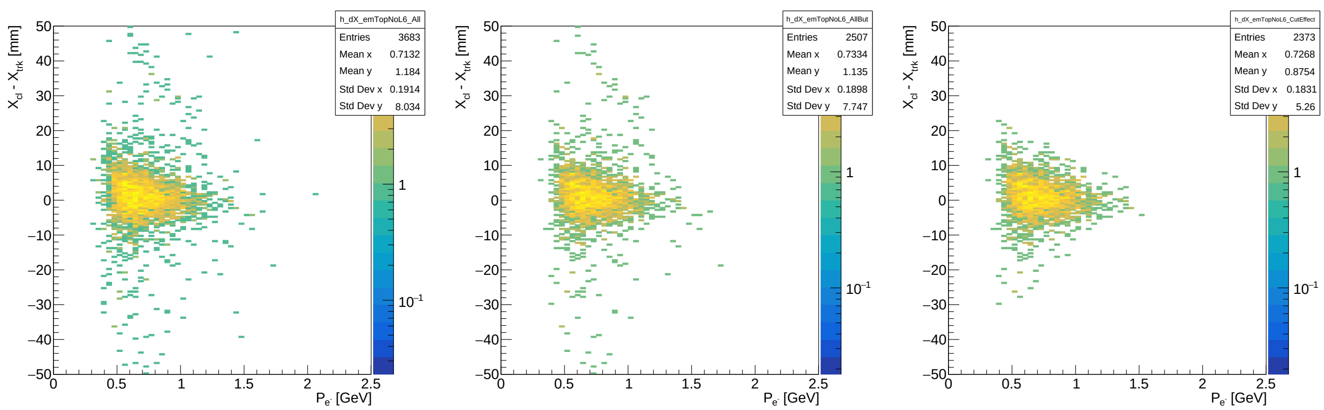


Figure 45: Electrons, Top No L6, WAB: Cluster track X coordinate difference as a function of momentum.

2.3.3 Electrons: Bot With L6 hit

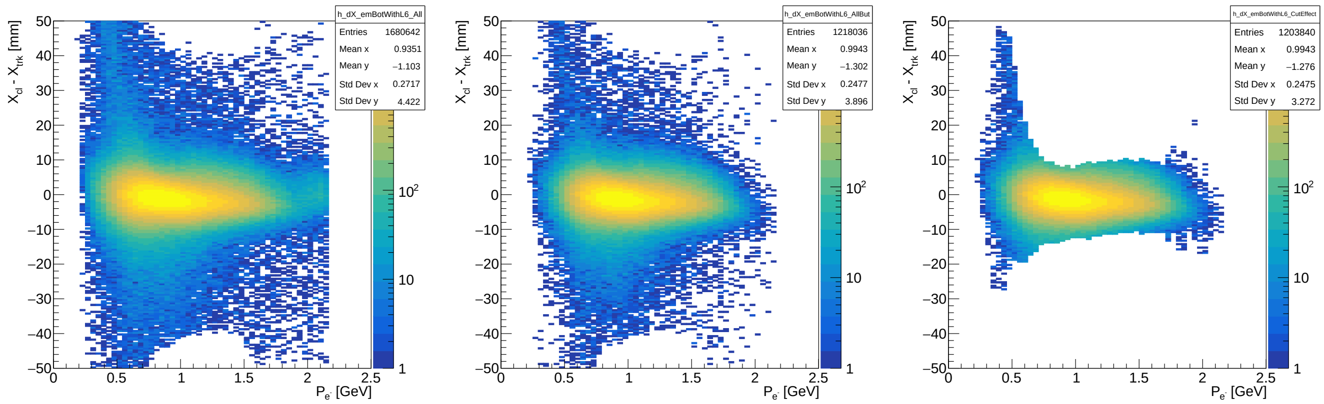


Figure 46: Electrons, Bot with L6, Data: Cluster track X coordinate difference as a function of momentum.

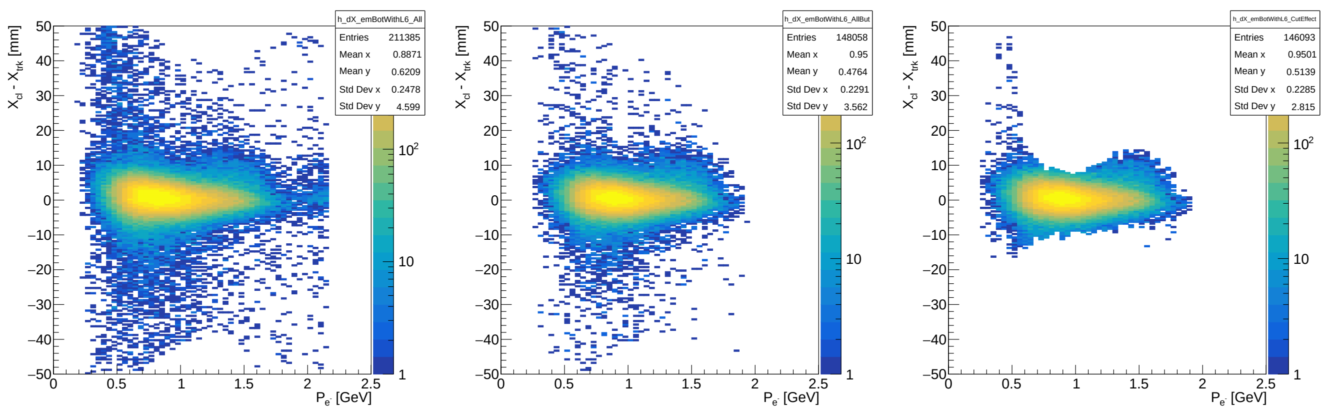


Figure 47: Electrons, Bot with L6, Tri: Cluster track X coordinate difference as a function of momentum.

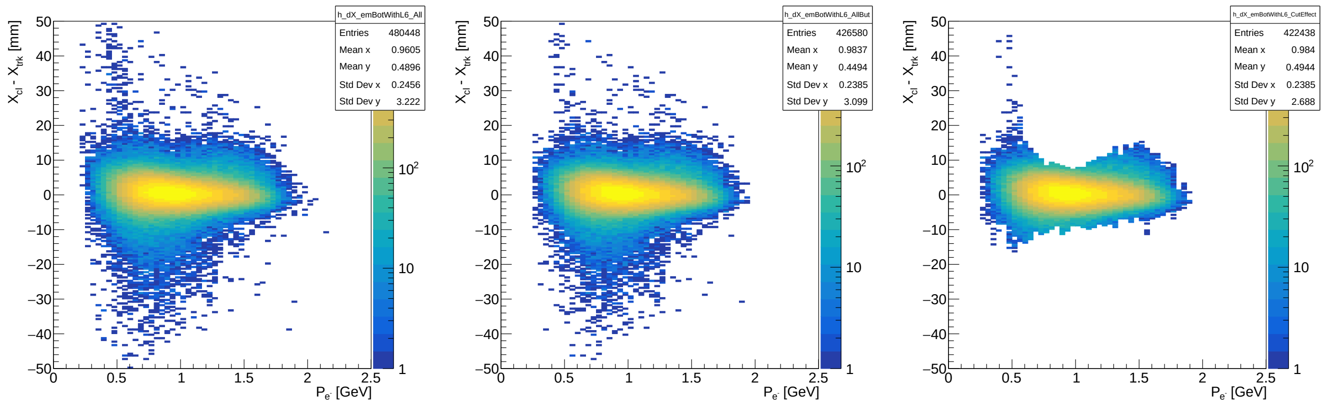


Figure 48: Electrons, Bot with L6, Rad: Cluster track X coordinate difference as a function of momentum.

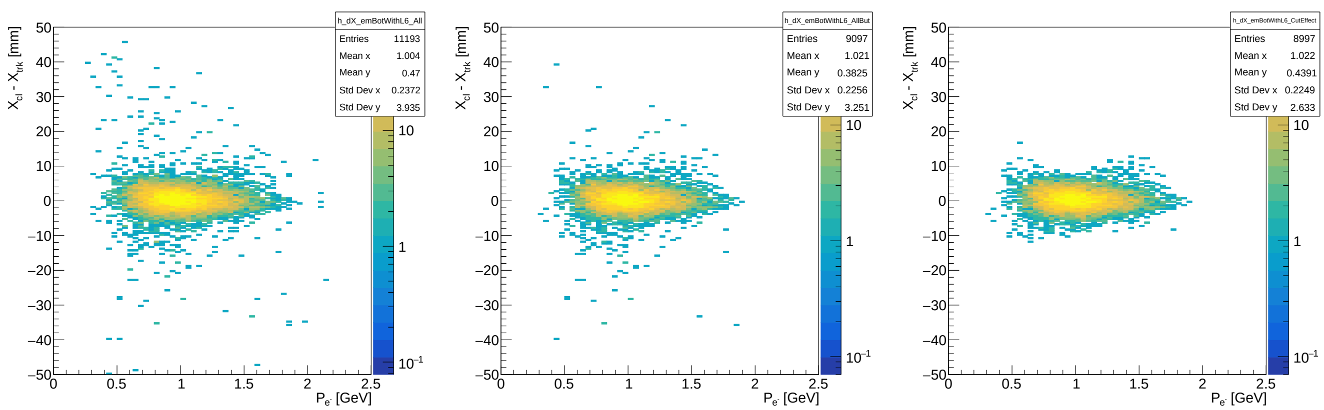


Figure 49: Electrons, Bot with L6, WAB: Cluster track X coordinate difference as a function of momentum.

2.3.4 Electrons: Bot No L6 hit

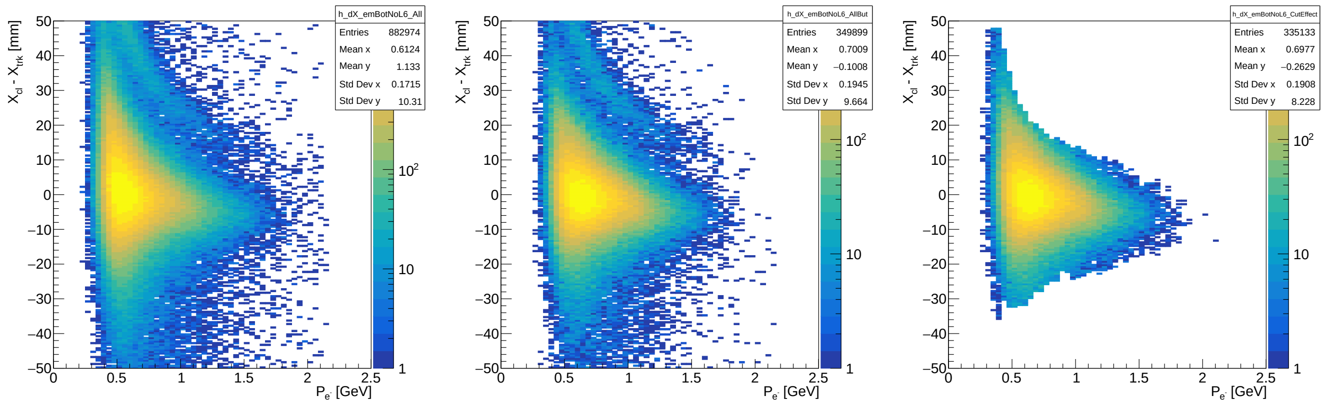


Figure 50: Electrons, Bot No L6, Data: Cluster track X coordinate difference as a function of momentum.

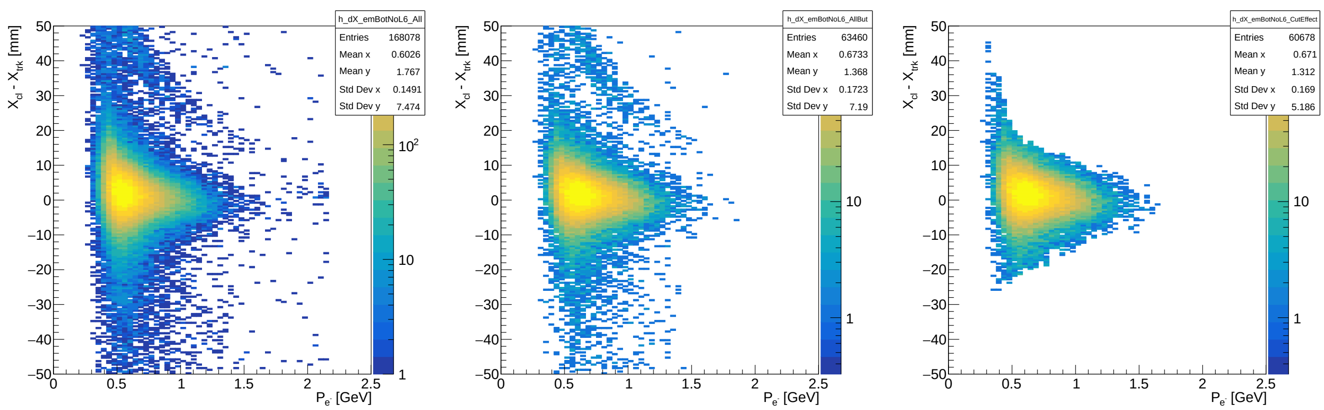


Figure 51: Electrons, Bot No L6, Tri: Cluster track X coordinate difference as a function of momentum.

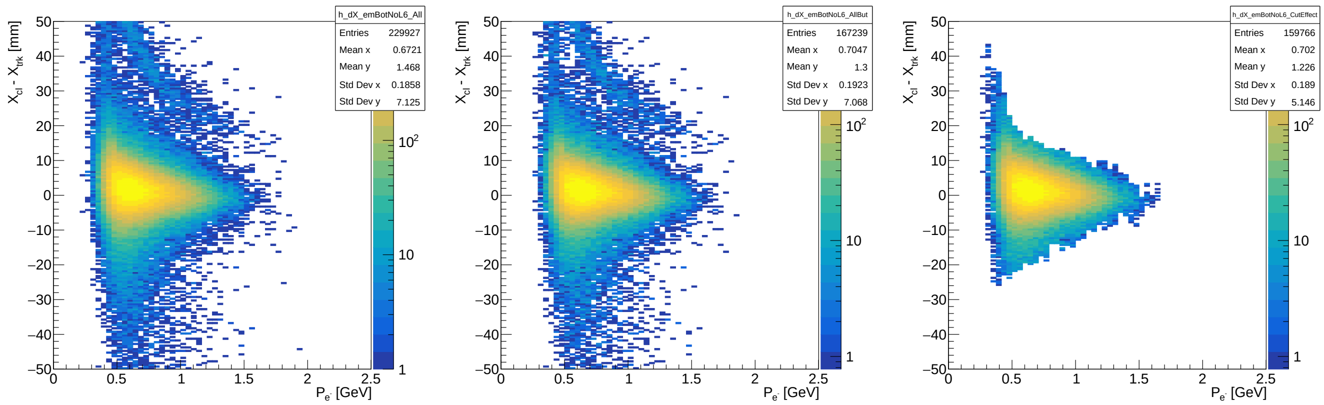


Figure 52: Electrons, Bot No L6, Rad: Cluster track X coordinate difference as a function of momentum.

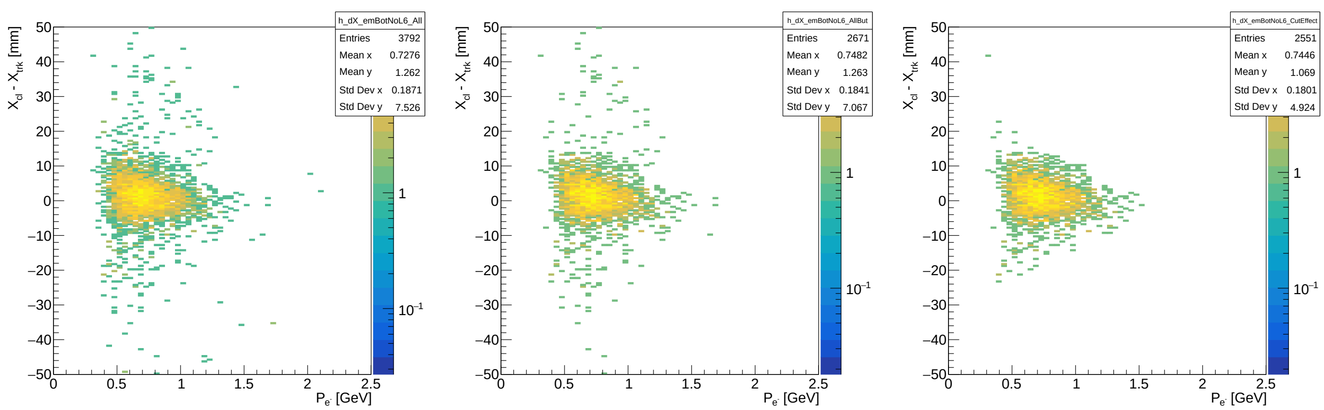


Figure 53: Electrons, Bot No L6, WAB: Cluster track X coordinate difference as a function of momentum.

2.4 Positrons: Separated

Figures in this section are separated depending on which half they belong to, and whether they have hit in L6.

2.4.1 Positrons: Top With L6 hit

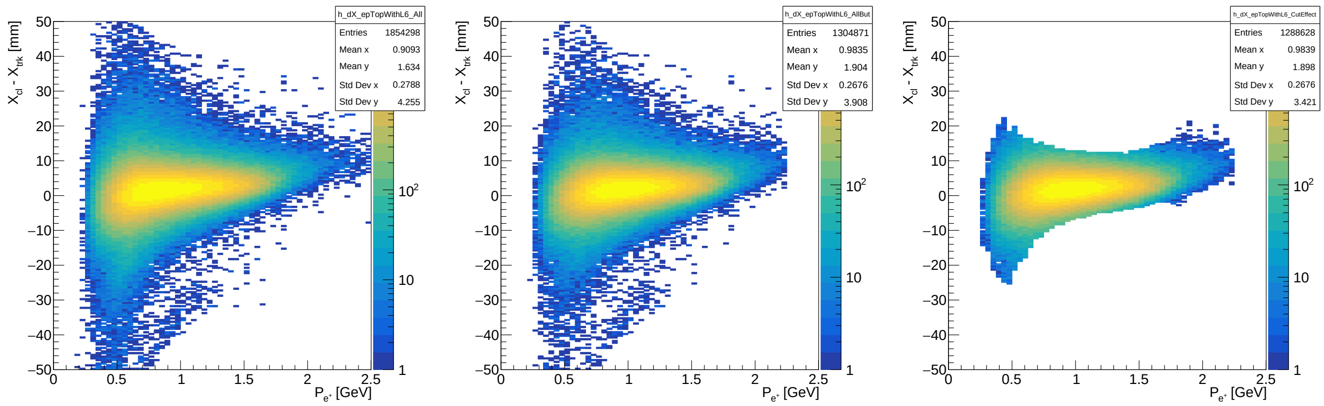


Figure 54: Positrons, Top with L6, Data: Cluster track X coordinate difference as a function of momentum.

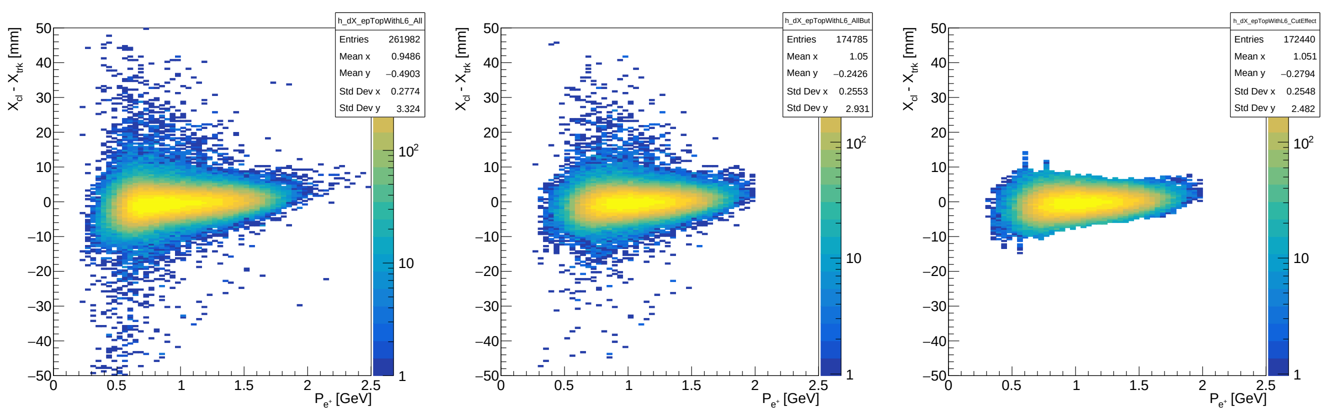


Figure 55: Positrons, Top with L6, Tri: Cluster track X coordinate difference as a function of momentum.

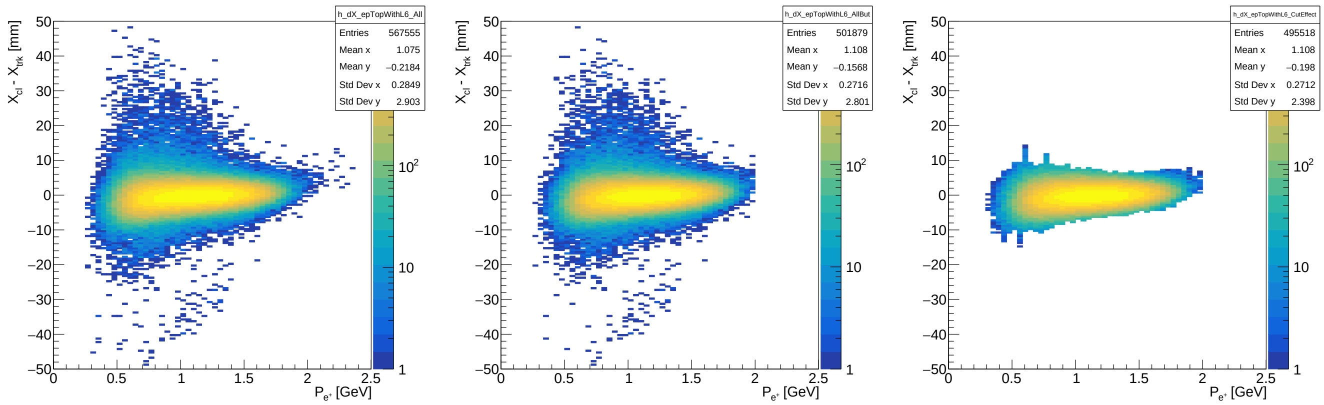


Figure 56: Positrons, Top with L6, Rad: Cluster track X coordinate difference as a function of momentum.

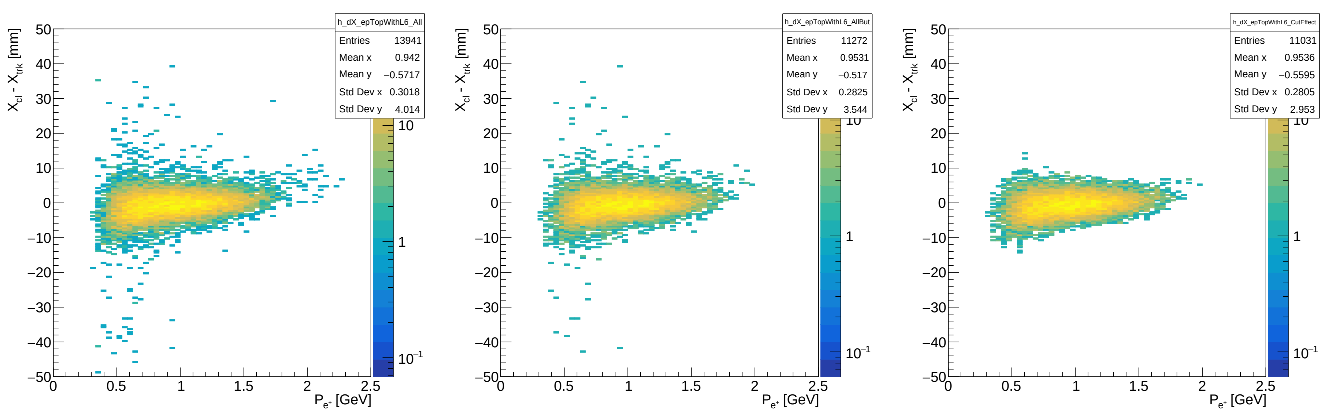


Figure 57: Positrons, Top with L6, WAB: Cluster track X coordinate difference as a function of momentum.

33 2.4.2 Positrons: Top No L6 hit

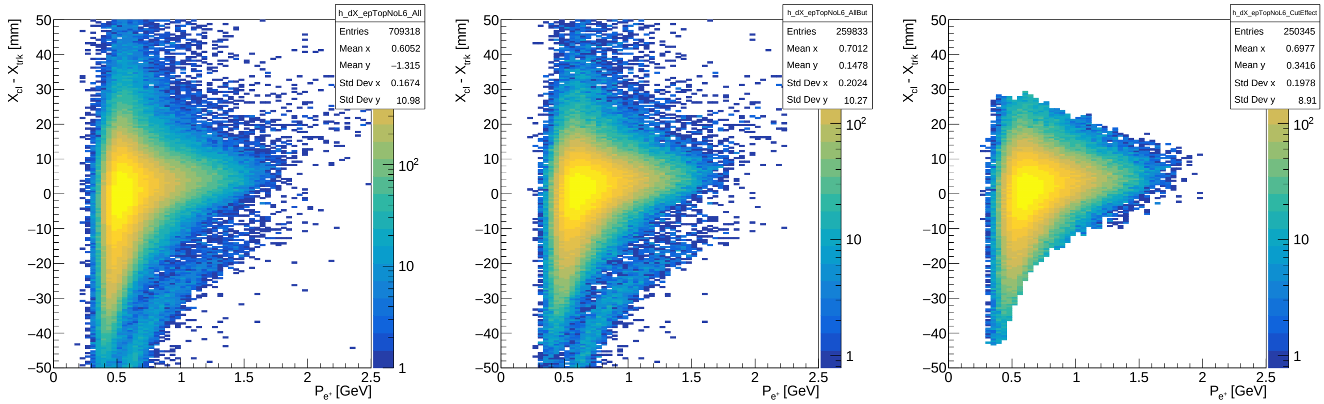


Figure 58: Positrons, Top No L6, Data: Cluster track X coordinate difference as a function of momentum.

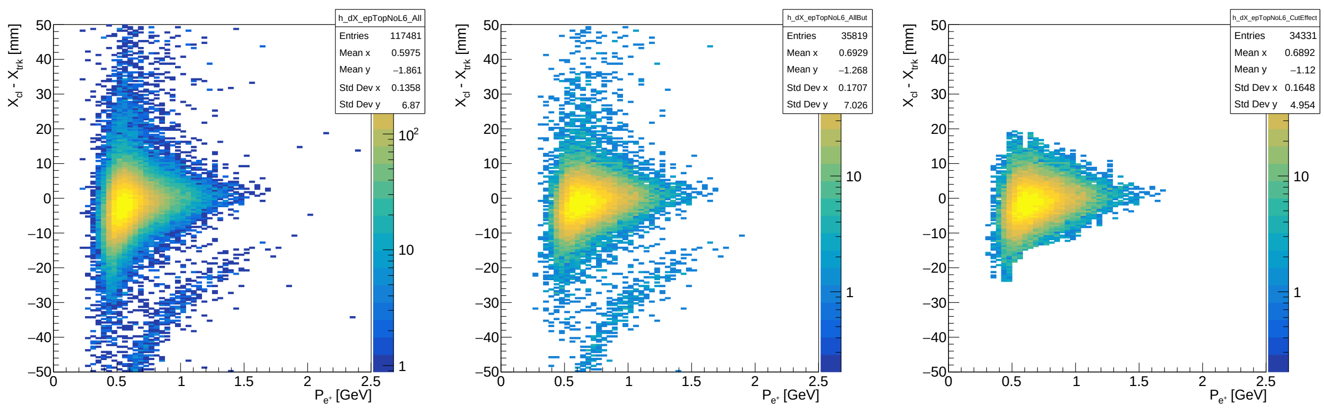


Figure 59: Positrons, Top No L6, Tri: Cluster track X coordinate difference as a function of momentum.

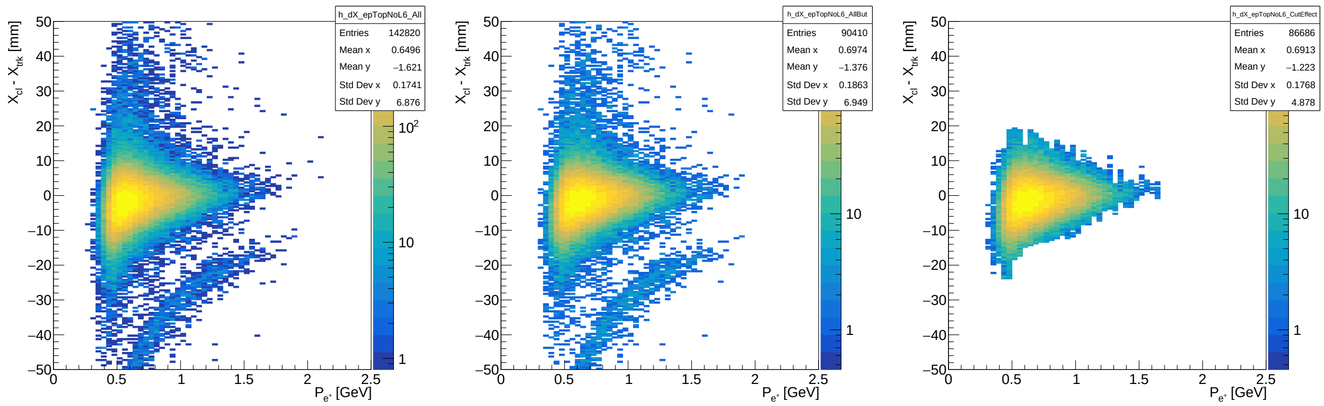


Figure 60: Positrons, Top No L6, Rad: Cluster track X coordinate difference as a function of momentum.

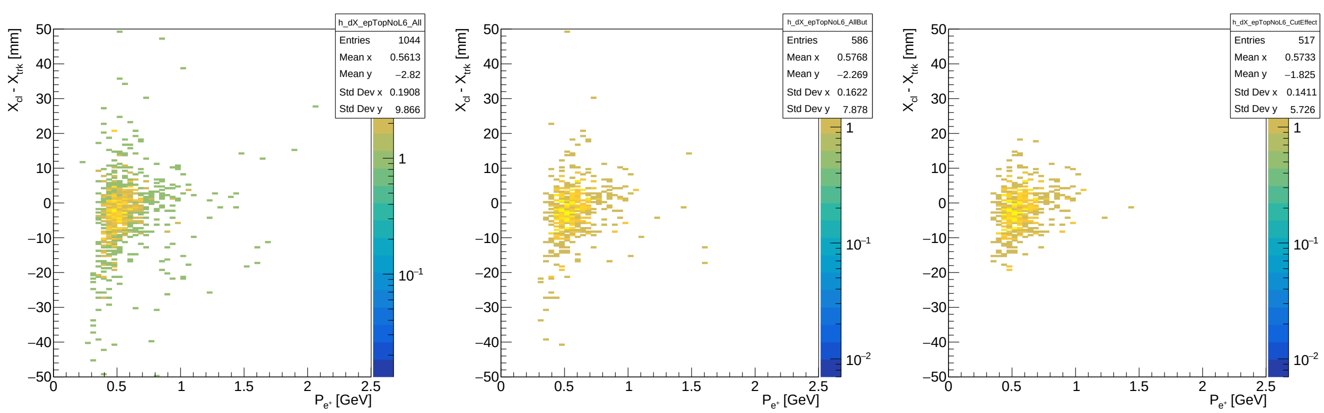


Figure 61: Positrons, Top No L6, WAB: Cluster track X coordinate difference as a function of momentum.

2.4.3 Positrons: Bot With L6 hit

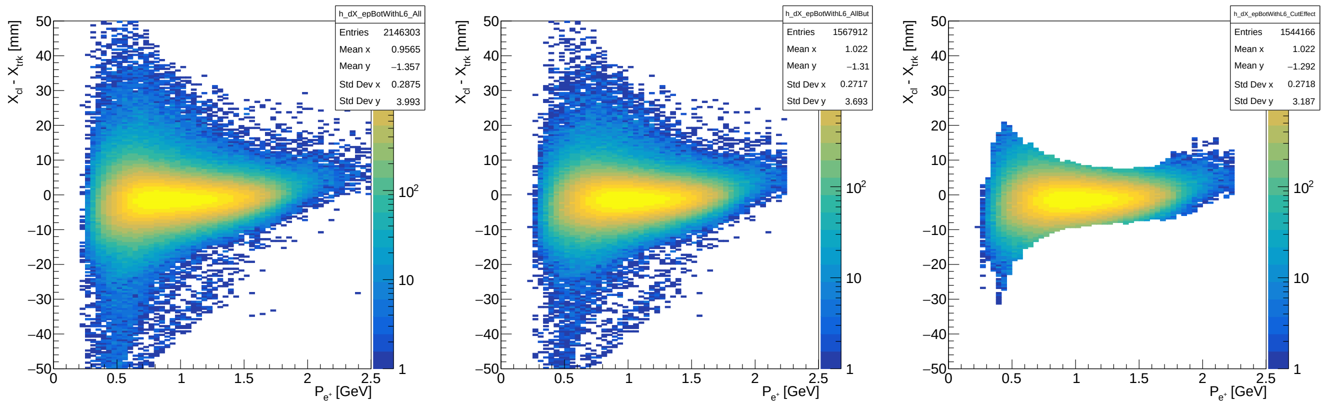


Figure 62: Positrons, Bot with L6, Data: Cluster track X coordinate difference as a function of momentum.

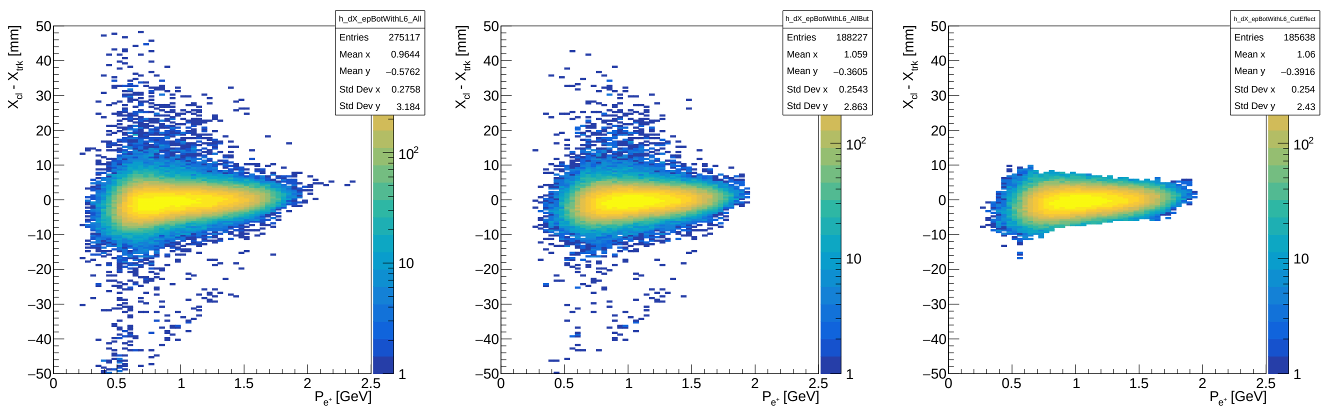


Figure 63: Positrons, Bot with L6, Tri: Cluster track X coordinate difference as a function of momentum.

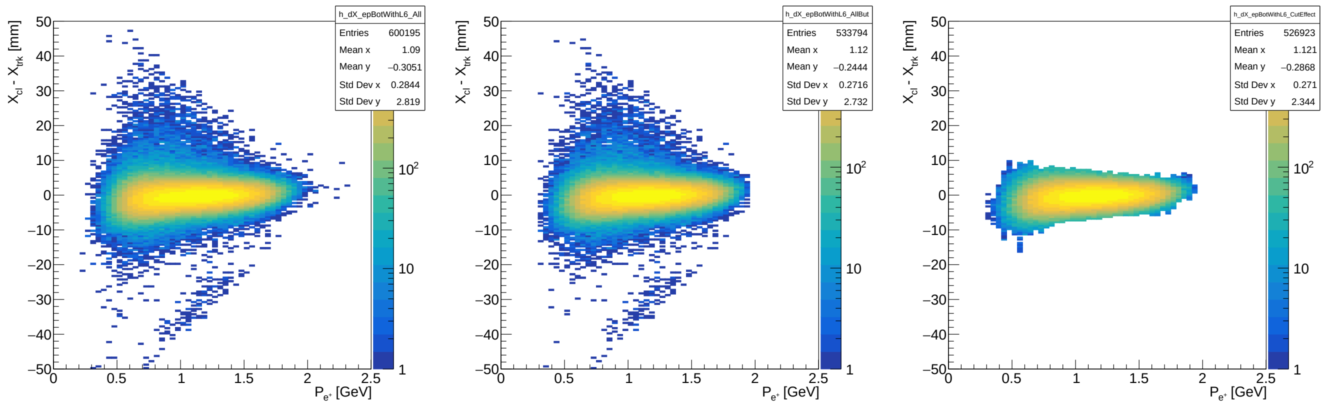


Figure 64: Positrons, Bot with L6, Rad: Cluster track X coordinate difference as a function of momentum.

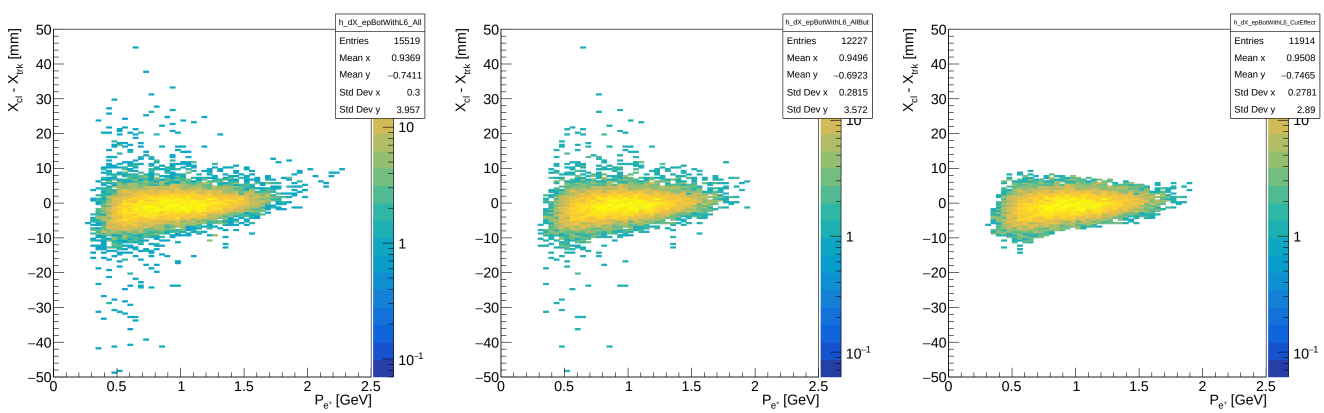


Figure 65: Positrons, Bot with L6, WAB: Cluster track X coordinate difference as a function of momentum.

2.4.4 Positrons: Bot No L6 hit

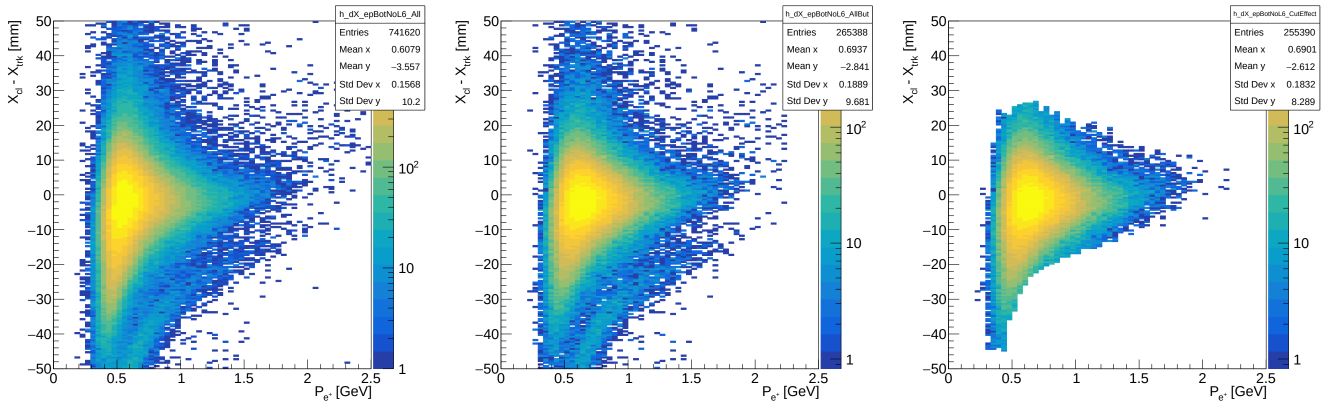


Figure 66: Positrons, Bot No L6, Data: Cluster track X coordinate difference as a function of momentum.

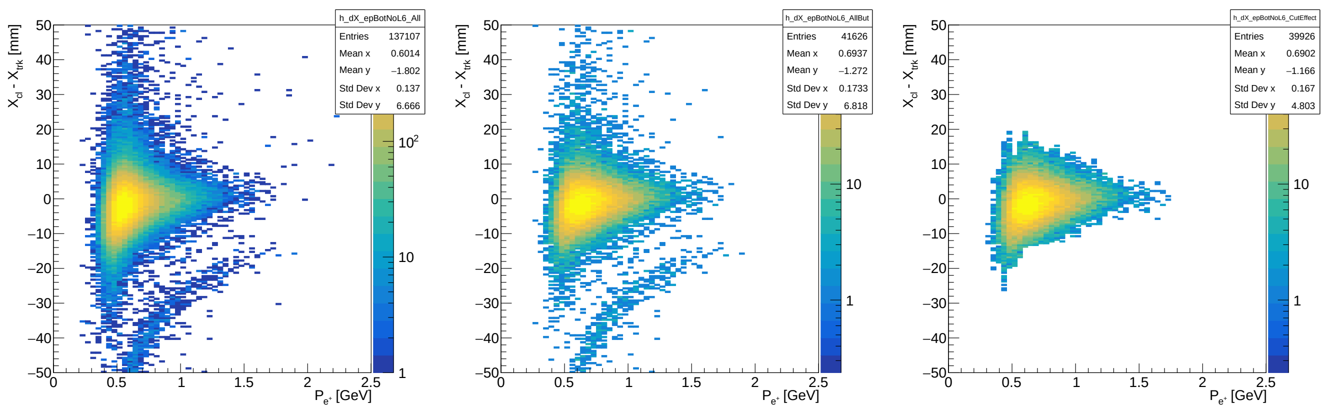


Figure 67: Positrons, Bot No L6, Tri: Cluster track X coordinate difference as a function of momentum.

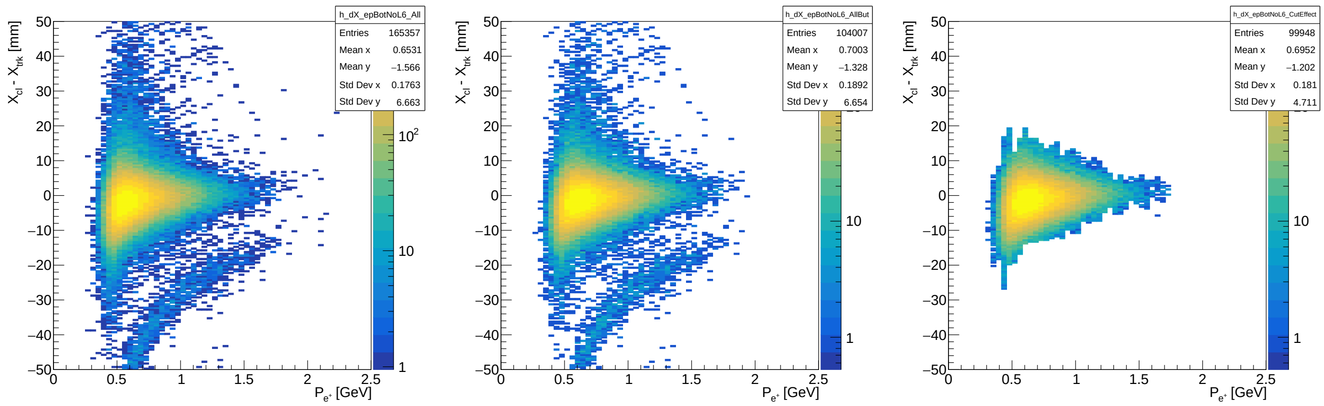


Figure 68: Positrons, Bot No L6, Rad: Cluster track X coordinate difference as a function of momentum.

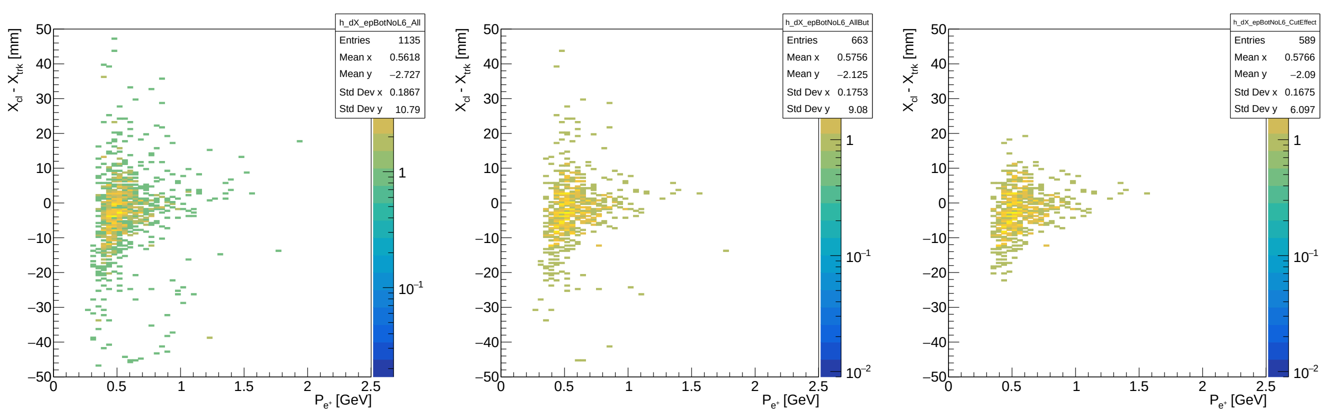


Figure 69: Positrons, Bot No L6, WAB: Cluster track X coordinate difference as a function of momentum.

36 PSum comparison for different mass bins

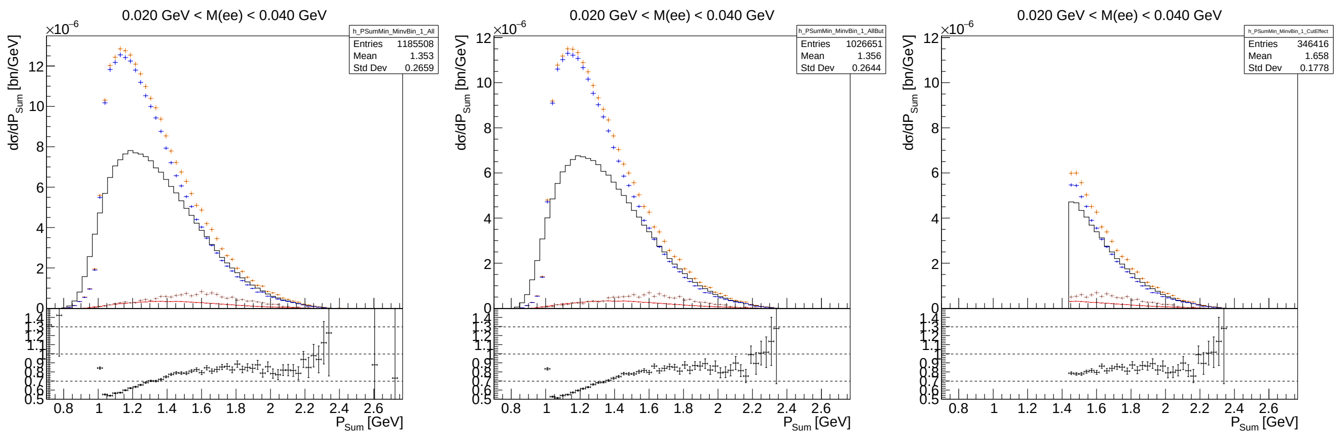


Figure 70: Progress of P_{Sum} Min cut, for the 20 MeV < M(ee) < 40 MeV

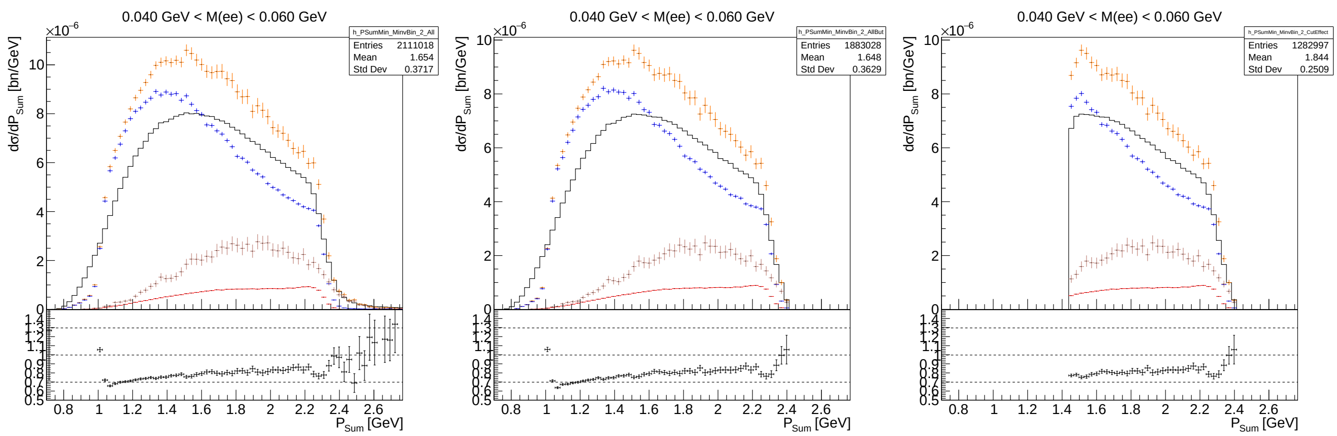


Figure 71: Progress of P_{Sum} Min cut, for the 40 MeV < M(ee) < 60 MeV

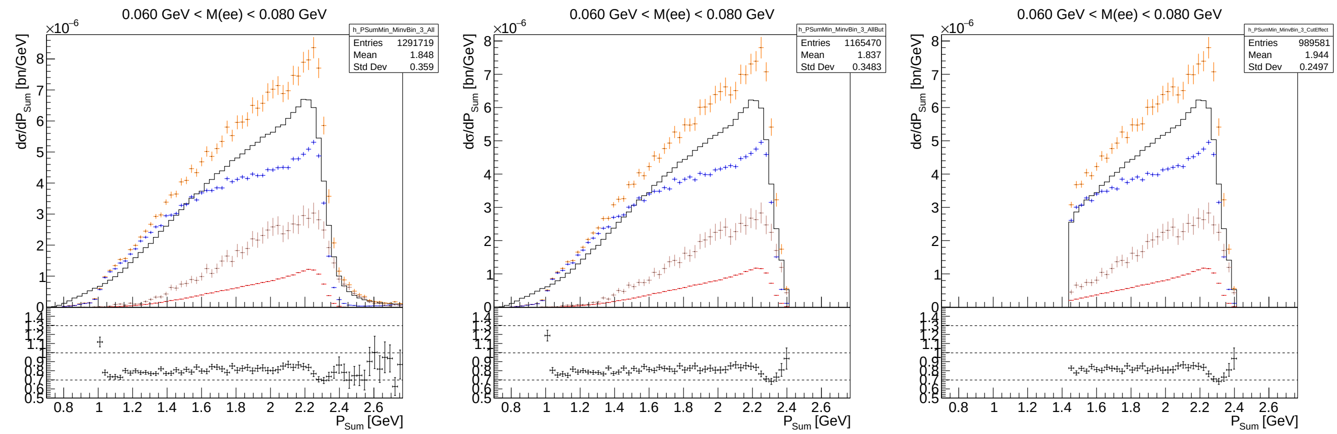


Figure 72: Progress of P_{Sum} Min cut, for the 60 MeV $<$ M(ee) $<$ 80 MeV

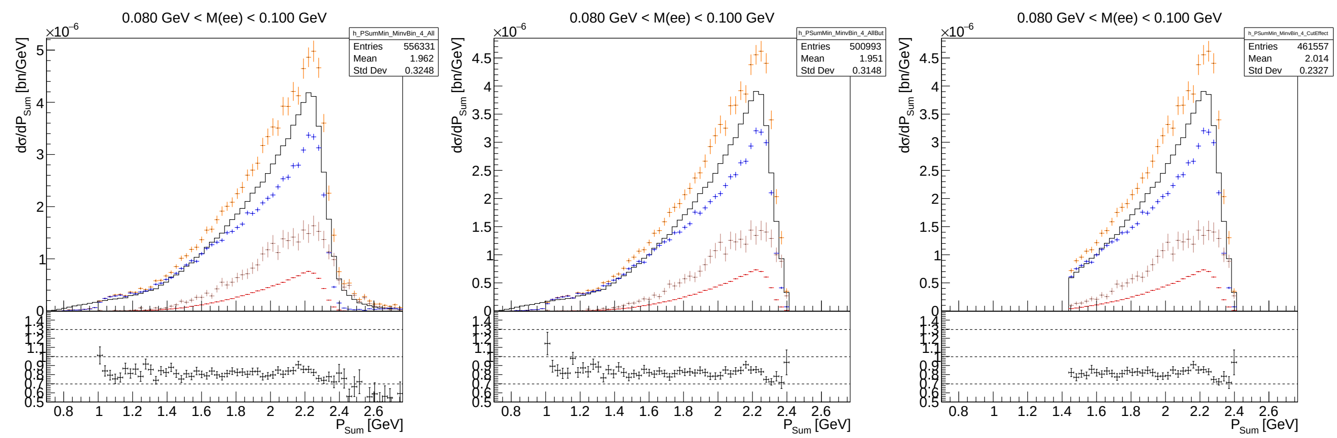


Figure 73: Progress of P_{Sum} Min cut, for the 80 MeV $<$ M(ee) $<$ 100 MeV

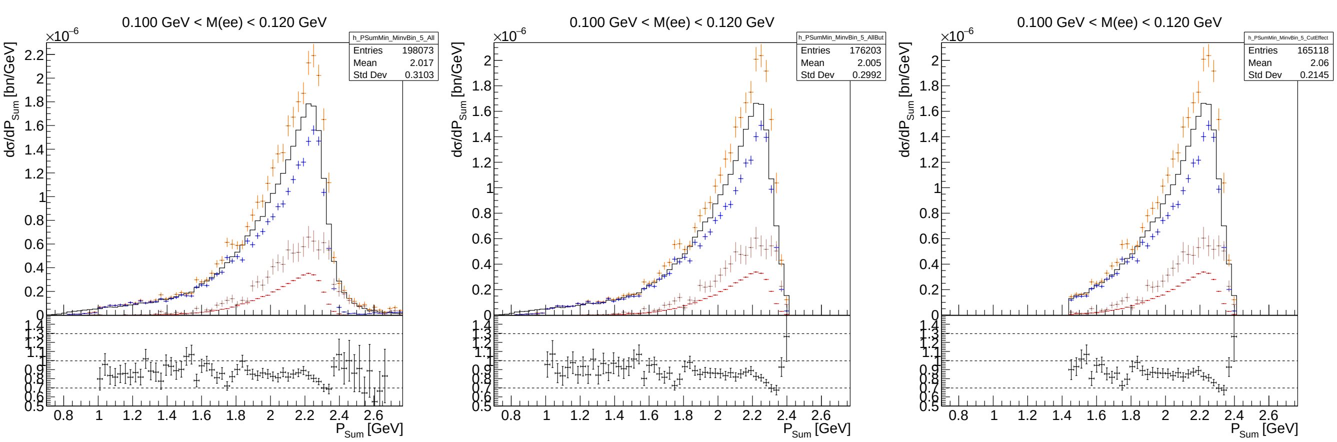


Figure 74: Progress of P_{Sum} Min cut, for the 100 MeV $<$ M(ee) $<$ 120 MeV

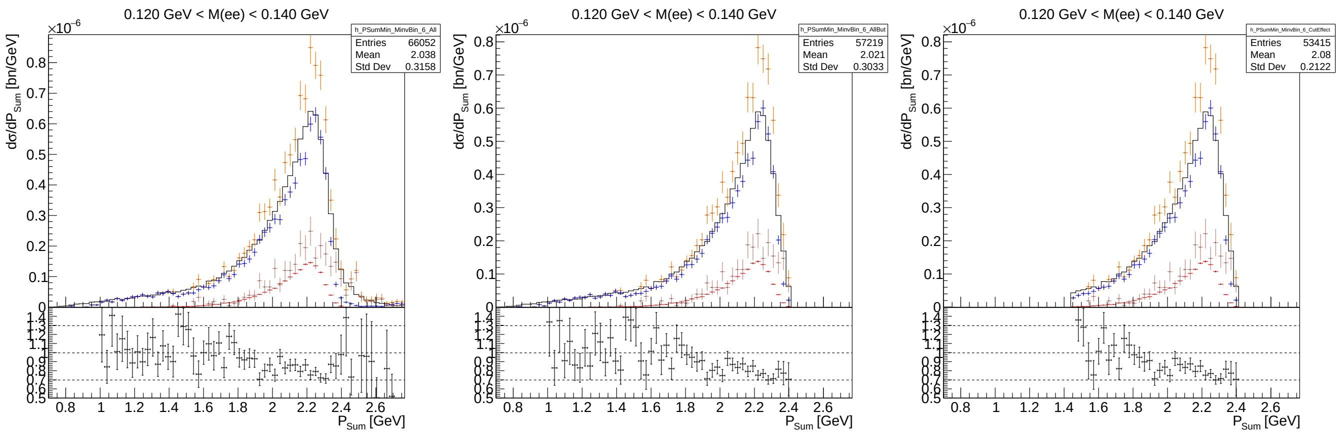


Figure 75: Progress of P_{Sum} Min cut, for the 120 MeV < M(ee) < 140 MeV

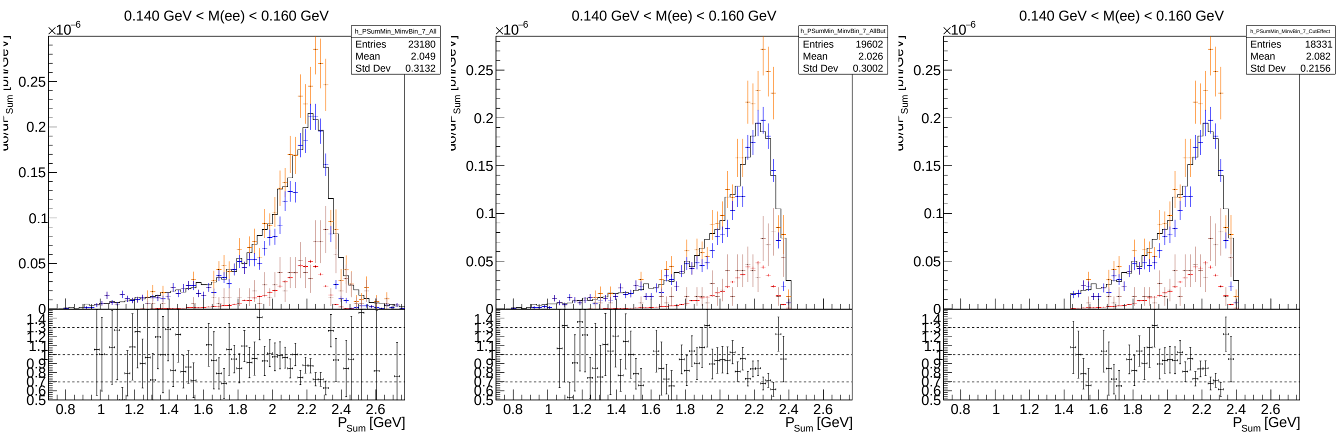


Figure 76: Progress of P_{Sum} Min cut, for the 140 MeV < M(ee) < 160 MeV

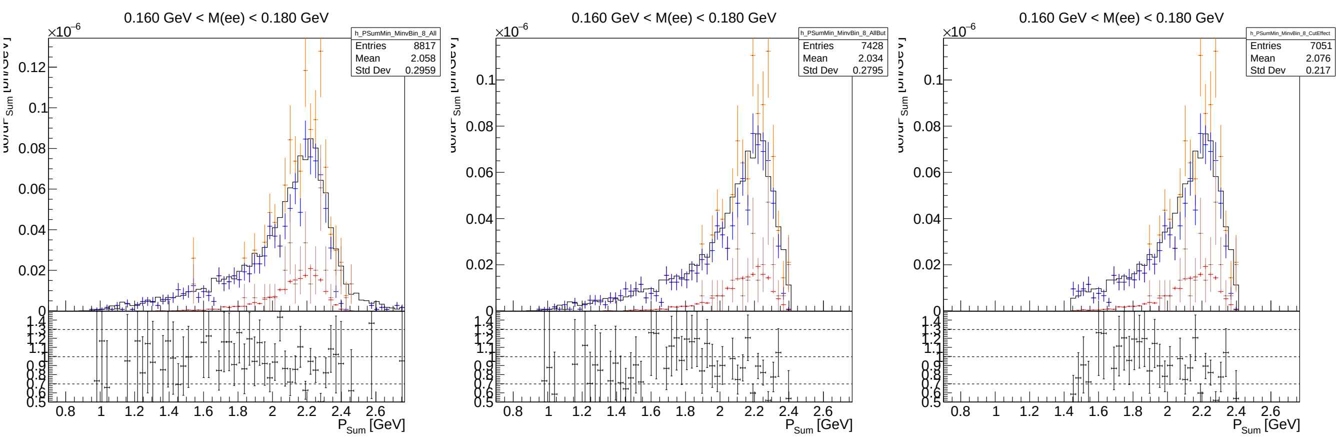


Figure 77: Progress of P_{Sum} Min cut, for the 160 MeV < M(ee) < 180 MeV

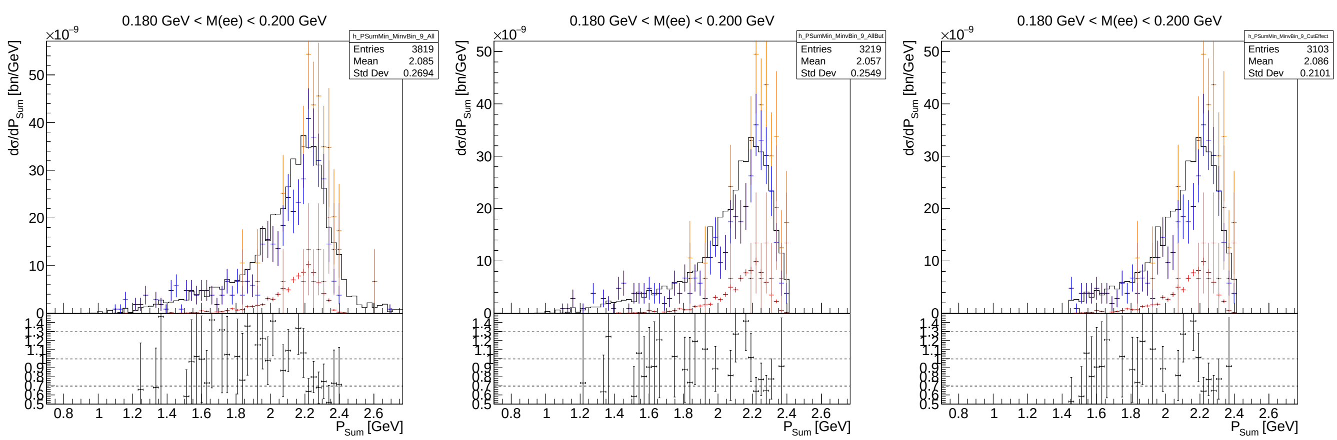


Figure 78: Progress of $\mathrm{P_{Sum}}$ Min cut, for the 180 MeV < M(ee) < 200 MeV

CutEfficiencies

CutDescription	Data	Tri-beam	Rad-beam	Wab-beam	Tri + Wab
PsumMax	0.996642	0.998874	0.99886	0.986888	0.99791
PsumMin	0.577276	0.539613	0.82845	0.904647	0.557511
clDt	0.973965	0.99436	0.997402	0.992964	0.994249
Pem	0.999911	0.999972	0.999969	1	0.999975
d0_ep	0.922387	0.958224	0.970544	0.495193	0.892889
em_cl_trk_dT	0.991506	0.998557	0.999986	0.999115	0.998602
ep_cl_trk_dT	0.993081	0.999867	0.999992	0.996909	0.999631
dX_em	0.971858	0.978334	0.983098	0.979822	0.978452
dX_ep	0.970964	0.982677	0.980798	0.959015	0.980751
PSumMin_MinvBin_0	0	0	0	-nan	0
PSumMin_MinvBin_1	0.19857	0.186411	0.406967	0.569364	0.191415
PSumMin_MinvBin_2	0.546532	0.537062	0.785559	0.871142	0.553007
PSumMin_MinvBin_3	0.769339	0.765048	0.916863	0.959658	0.779528
PSumMin_MinvBin_4	0.883268	0.882856	0.964886	0.977893	0.890604
PSumMin_MinvBin_5	0.916717	0.916973	0.979517	0.981481	0.922139
PSumMin_MinvBin_6	0.913699	0.922699	0.984234	1	0.928075
PSumMin_MinvBin_7	0.912254	0.917006	0.983266	0.966667	0.920878
PSumMin_MinvBin_8	0.924821	0.917559	0.987507	1	0.922718
PSumMin_MinvBin_9	0.935687	0.917333	0.993248	1	0.920279
PSumMin_MinvBin_10	0.963074	0.964912	1	1	0.966279
PSumMin_MinvBin_11	0.97546	1	0.98951	1	1

Rad Fraction

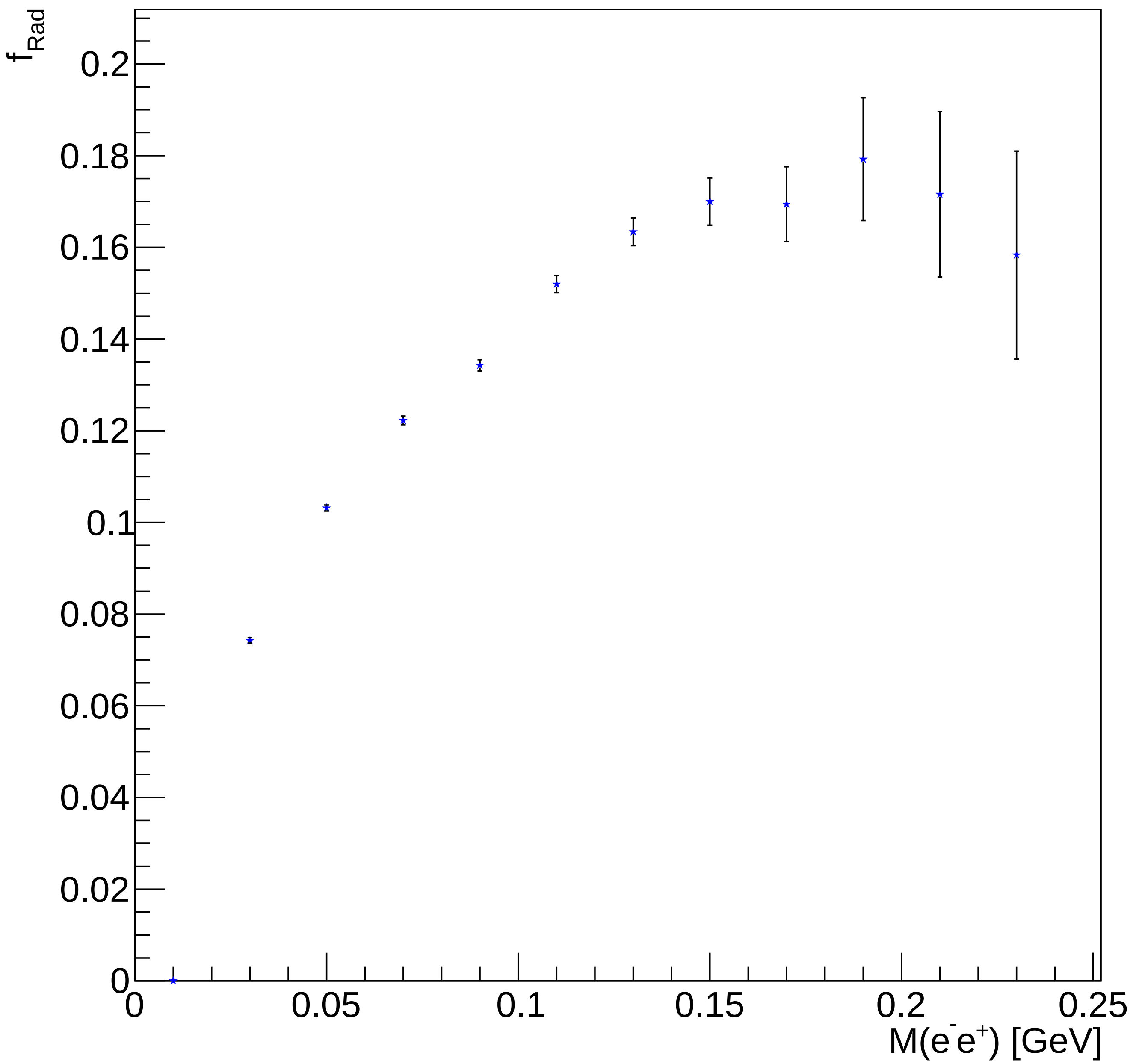


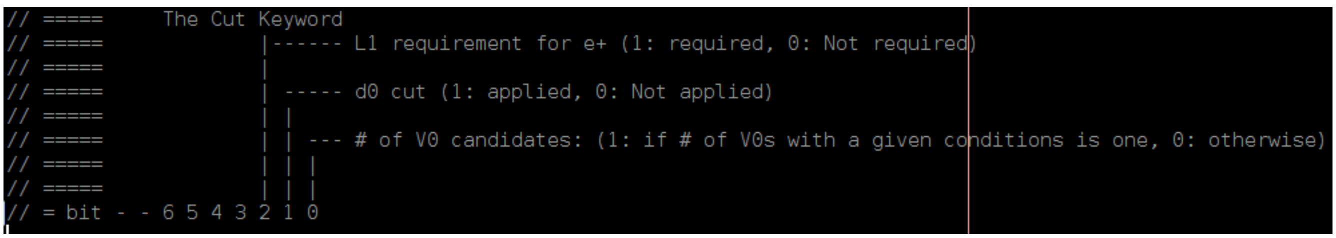
Figure 79: Radiative fraction as a function of mass.

Cut Categories

Final selection of events were categorized depending which cuts a givem V0 is passed. A single integer number is a representation of what cuts were passed for a given V0 candidate.

- If the bit 0 is set, it means there is only on V0 that pass all the given set of cuts. otherwise it is not set
- If the bit 1 is set, it means the d_0 cut is applie to the e^+ of a given V0, otherwise it is not set.
- If the bit 2 is set, it means a L1 required for given V0 candidate.

The figure below show the cut and bit correspondence. As an axample the Cut category 5 is “101”, and it means L1 is required for e^+, No cut on d_0 and there is only one V0 in the event that pass the given set of cuts.



```
// =====     The Cut Keyword
// =====             |------ L1 requirement for e+ (1: required, 0: Not required)
// =====             |
// =====             | ----- d0 cut (1: applied, 0: Not applied)
// =====             | |
// =====             | | --- # of V0 candidates: (1: if # of V0s with a given conditions is one, 0: otherwise)
// =====             | | |
// =====             | | |
// = bit - - 6 5 4 3 2 1 0
```

Figure 80: Bit representation of cut set.

Invariant mass distributions

Figures in this section represent 10% of all 2016 run data, more preciesly fils that have file number ending eith 0.

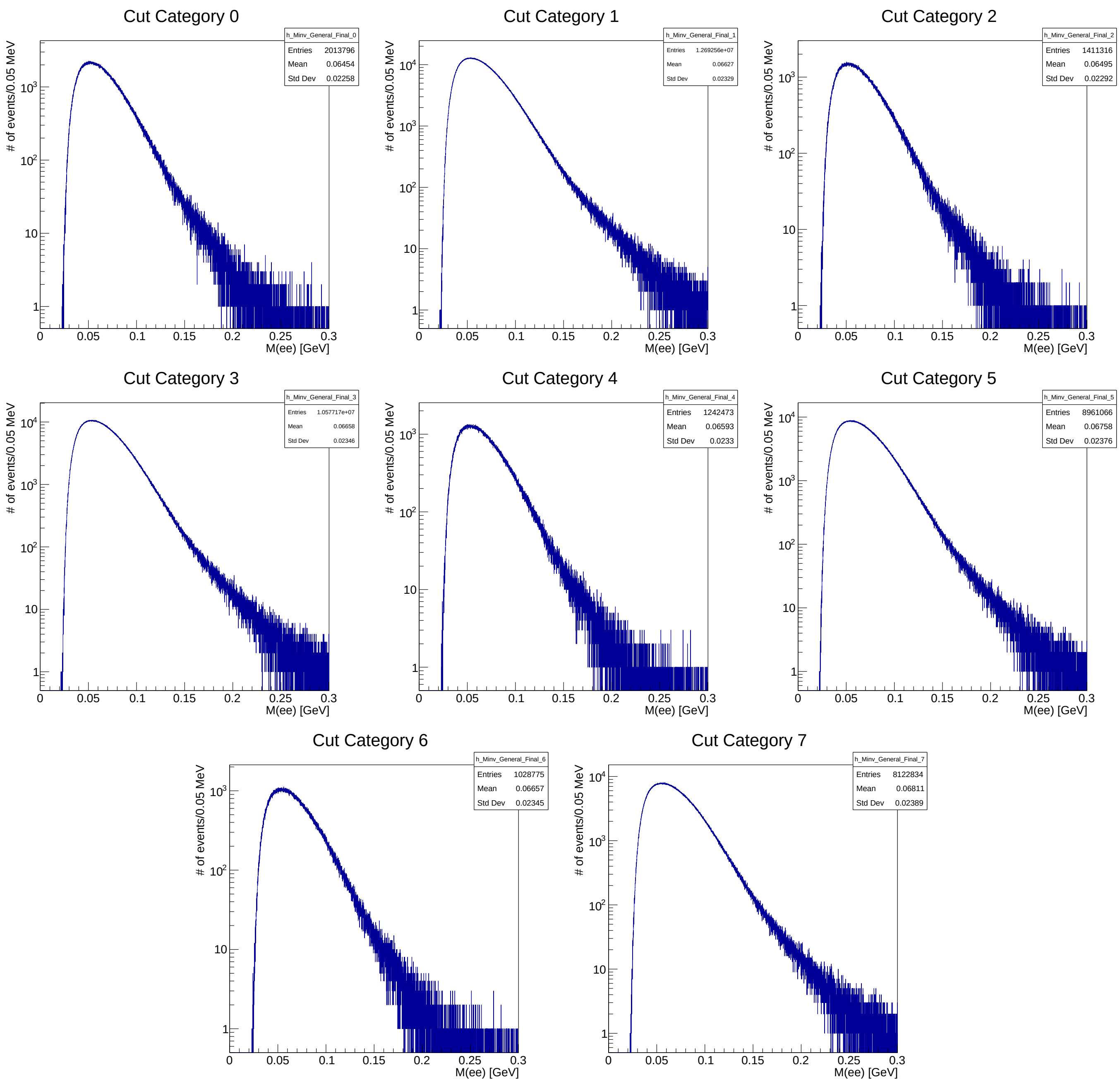


Figure 81: The mass distributions for difference cut categories. These figures represent the blinded 10% sample of rh 2016 Run.

Run By Run Variations

Note the Run 8043 is excluded from these plots, I think the luminosity is not properly calculated for this particular run. it's normalization is about $\times 4$ is off from the rest of runs.

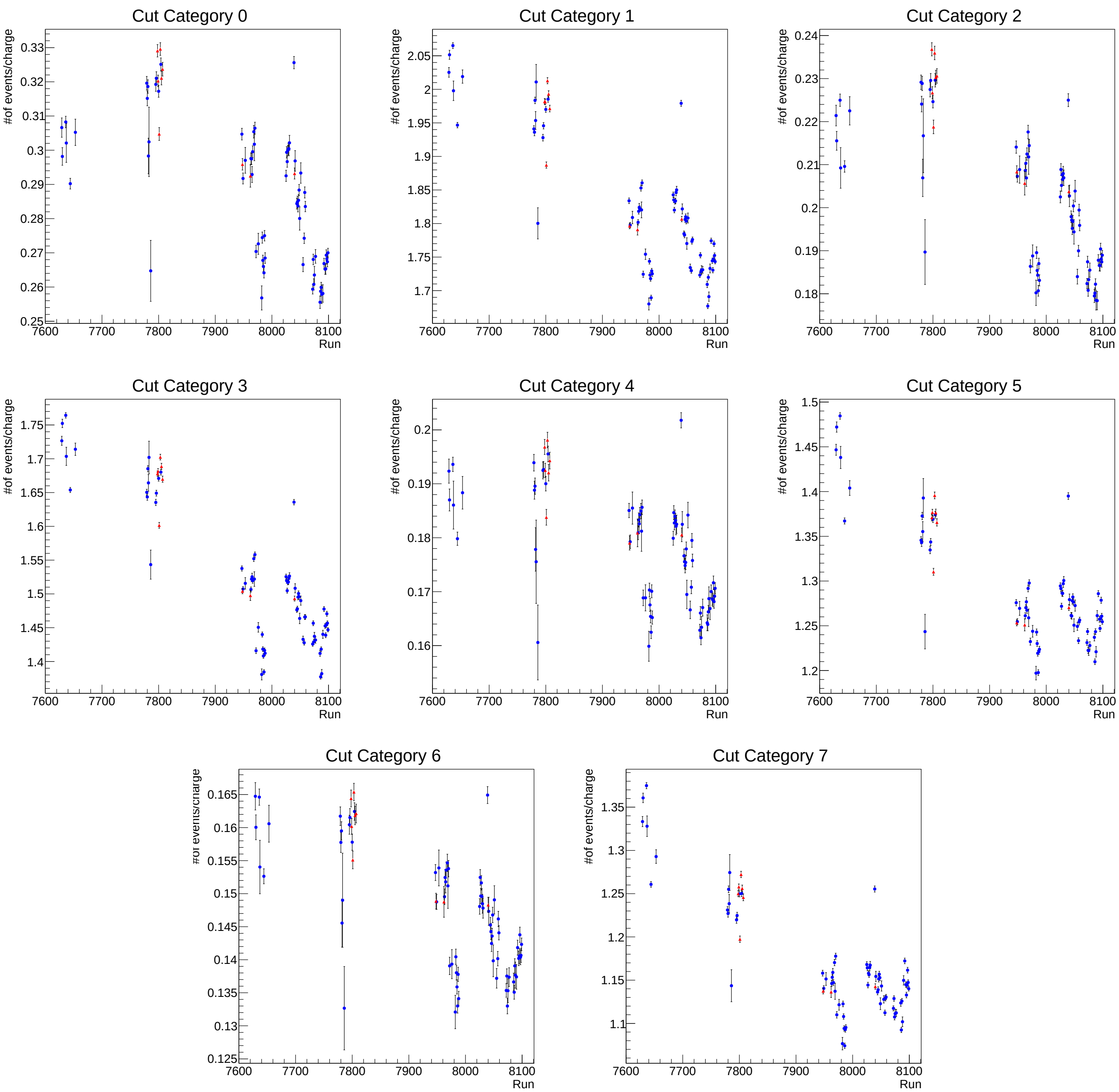
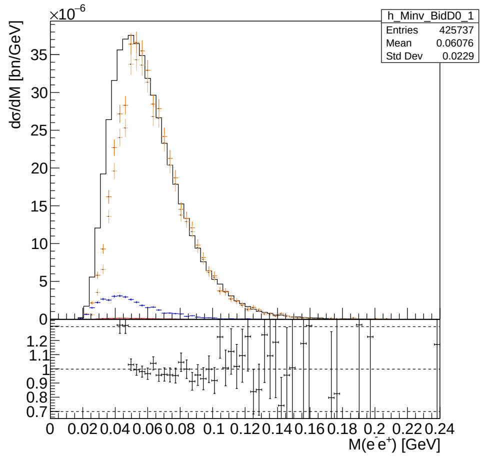
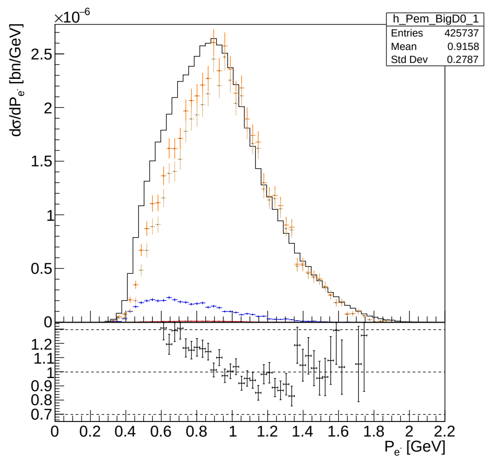
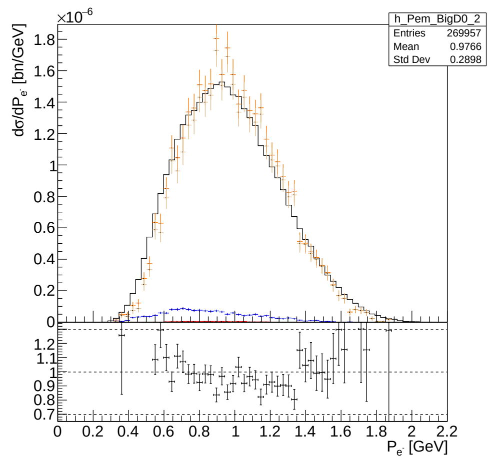
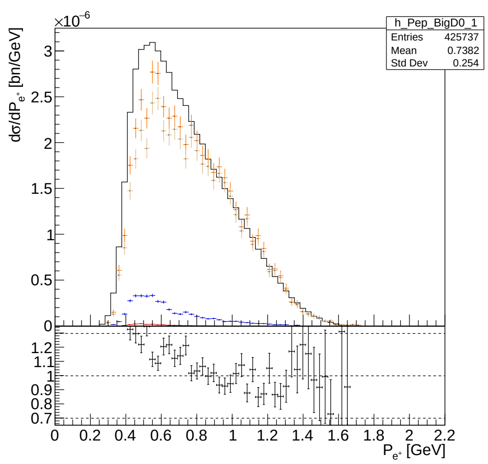


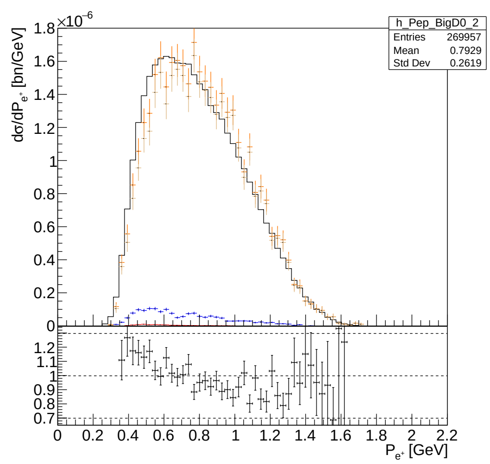
Figure 82: Integrated number of final events normalized by charge for different runs. different plots represent different cut categoried.

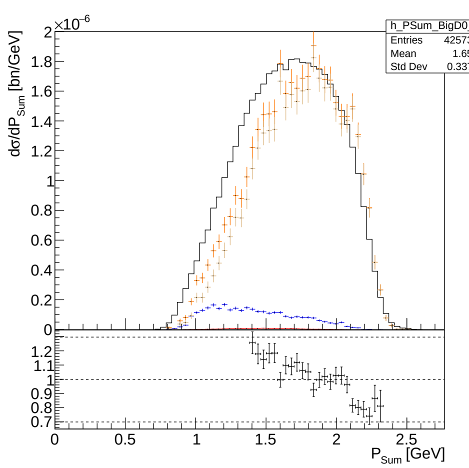

h_Minv_BidD0_1
Entries 425737
Mean 0.06076
Std Dev 0.0229
×10^-6
dσ/dM [bn/GeV]
M(e⁻e⁺) [GeV]

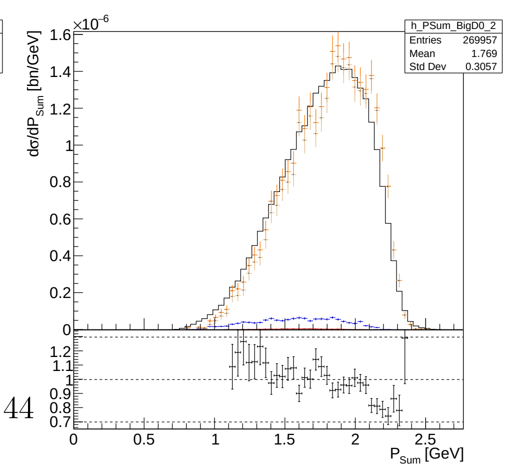

h_Pem_BigD0_1
Entries 425737
Mean 0.9158
Std Dev 0.2787
×10^-6
dσ/dP_e [bn/GeV]
P_e [GeV]


h_Pem_BigD0_2
Entries 269957
Mean 0.9766
Std Dev 0.2898
×10^-6
dσ/dP_e [bn/GeV]
P_e [GeV]


h_Pep_BigD0_1
Entries 425737
Mean 0.7382
Std Dev 0.254
×10^-6
dσ/dP_e+ [bn/GeV]
P_e+ [GeV]


h_Pep_BigD0_2
Entries 269957
Mean 0.7929
Std Dev 0.2619
×10^-6
dσ/dP_e+ [bn/GeV]
P_e+ [GeV]


h_PSum_BigD0_1
Entries 425737
Mean 1.654
Std Dev 0.3375
×10^-6
dσ/dP_Sum [bn/GeV]
P_Sum [GeV]


h_PSum_BigD0_2
Entries 269957
Mean 1.769
Std Dev 0.3057
×10^-6
dσ/dP_Sum [bn/GeV]
P_Sum [GeV]