SIMPS 2016 Preselection

10/17/2023

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Introduction

- Analysis note is ready for review up through the Preselection stage
  - Includes Intro, Theory, Expected Signal Calculation, Data/MC Info
- Will submit note to Analysis Committee today (after a last quick pass over)
- Thanks Cam, Matt, and Tom for helping guide and polish
- Presentation shows Preselection Cutflow N-1 plots, and Preselection Cutflow Efficiencies for Data sample, MC, and two signal points (40 MeV and 100 MeV Dark Vectors)
- Plan on pushing the Tight Selection development while the committee approves the first stage

Data and MC Info

- 2016 Lumi: 10703.81 nb^{-1}
- Used ~10% Data sample (BLPass4c) to establish Preselection
  - 1096.27nb^{-1}
- MC BKG Samples (w Ttongs trigger energy res smearing algo)

Sample	μ of ICS	σ of ICS	# of good files	# of generated events per file
RAD	66.36 µb	0.6678 µb	9940	10k
Trident-Trig	1.416 mb	0.004310 mb	9755	50k
WAB	0.1985 b	0.01973 b	9769	100k

Table 2: Normalization parameters for the RAD, Trident-Trig and WAB samples

- Signal MC: Generated with constant lifetime (cTau=200mm), mixed with beam

Reconstruction Level Cuts

Cut Description	Requirement
ECal clusters in opposite volumes	$y_{e^-Cluster} \times y_{e^-Cluster} < 0$
Track-Cluster Time Difference (Data)	$\lvert t_{Track} - t_{Cluster} - 56ns \rvert < 10$ ns
Track-Cluster Time Difference (MC)	$\lvert t_{Track} - t_{Cluster} - 43ns \rvert < 10$ ns
Track-Cluster X Position Difference	$\lvert x_{TrackatEcal} - x_{Cluster} \rvert < 20.0$ mm
Track-Cluster Y Position Difference	$\lvert y_{TrackatEcal} - y_{Cluster} \rvert < 20.0$ mm
Track-Cluster Time Difference	$\lvert t_{Track} - t_{Cluster} \rvert < 6.0$ ns
Cluster Time Difference	$\lvert t_{e^+Cluster} - t_{e^-Cluster} \rvert < 2.5$ ns
Beam electron cut	$p(e^-) < 2.15$ GeV
Vertex Momentum	$p_{Vertex} < 2.8GeV$

Table 3: Reconstruction level requirements. Track-Cluster time difference in MC and data is corrected using offsets calibrated in [7]. The track positions are found by extrapolating the track from the last layer hit to the face of the ECal.

Preselection Cutflow

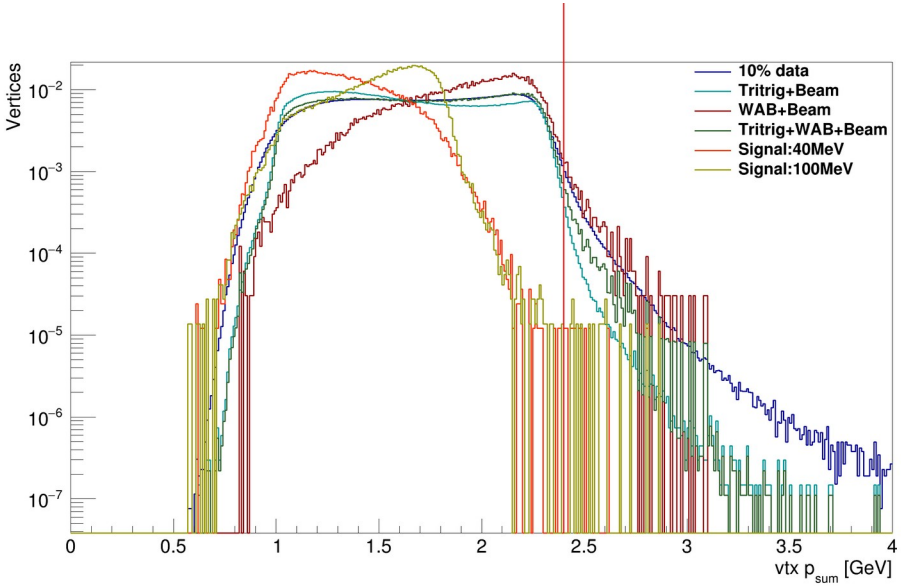
Cut Description	Requirement
Trigger	Pair1
Track Time	$\lvert t_{track} \rvert < 6$ ns
Cluster Time Difference	$\lvert t_{e^+Cluster} - t_{e^-Cluster} \rvert < 1.45$ ns
Track-Cluster Time Difference	$\lvert t_{e^+Track} - t_{e^+Cluster} -$ offset$\rvert < 4$ ns
Track Quality	$\chi^2/dof < 20$
Beam electron cut	$p(e^-) < 1.75$ GeV
Minimum Hits on Track	$n_{2dHitsOnTrack} > 7$
Vertex Momentum	$p(e^-) + p(e^+) < 2.4GeV$
Unconstrained Vertex Quality	$\chi^2_{unc} < 20$

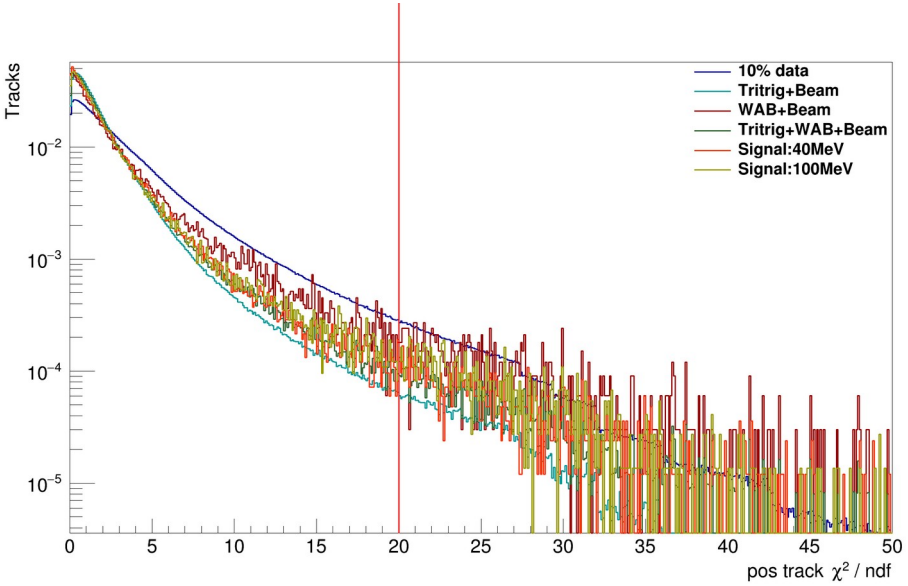
Preselection N-1 Plots

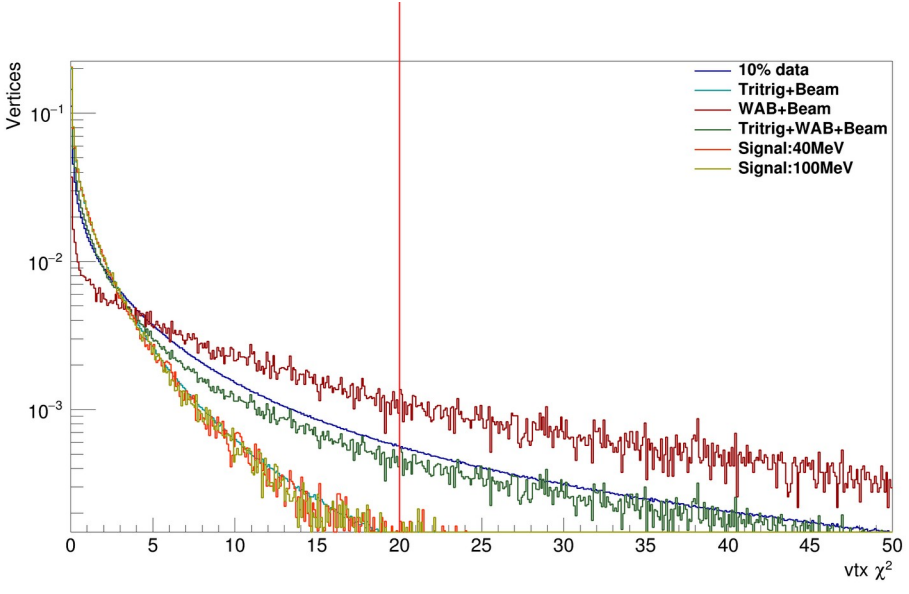
Preselection N-1 Cutflow Efficiency

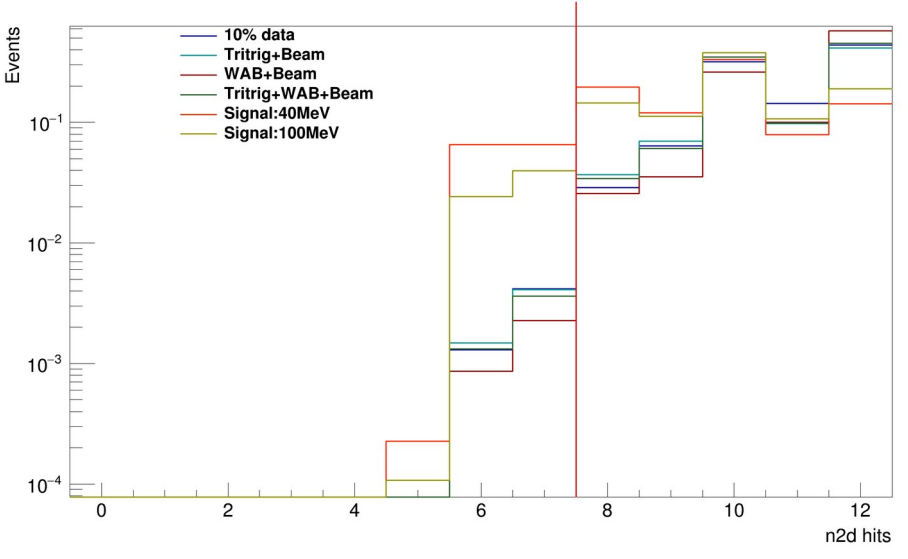
	Data Eff	Tritrig-Beam Eff	WAB-Beam Eff	Tritrig-WAB-Beam Eff	40 MeV Signal Eff	100 MeV Signal Eff
$\lvert e^- Track_t \rvert < 6.0$	0.997	1	0.999	1	0.999	1
$\lvert e^+ Track_t \rvert < 6.0$	0.997	0.999	0.999	0.999	0.999	1
$\Delta_t(cluster_{e^-}, cluster_{e^+} < 1.45$	0.961	0.991	0.992	0.991	0.98	0.98
$e^- \Delta_t(track, cluster) < 4.0$	0.991	0.998	0.999	0.998	0.997	0.999
$e^+ \Delta_t(track, cluster) < 4.0$	0.988	0.998	0.991	0.997	0.997	0.999
$e^- Track^2/n.d.f. < 20.0$	0.987	0.996	0.996	0.996	0.99	0.989
$e^+ Track^2/n.d.f. < 20.0$	0.981	0.996	0.982	0.992	0.991	0.988
$p_{e^-} < 1.75$	0.998	1	0.998	0.999	1	1
$N_{2dhits} one^-_{Track} > 7.0$	0.999	0.998	0.999	0.999	0.934	0.976
$N_{2dhits} one^+_{Track} > 7.0$	0.981	0.997	0.94	0.982	0.933	0.967
$Vtx_2 < 20.0$	0.832	0.972	0.645	0.861	0.968	0.973
$p_{e^- + e^+} < 2.4$	0.992	0.998	0.989	0.996	1	1

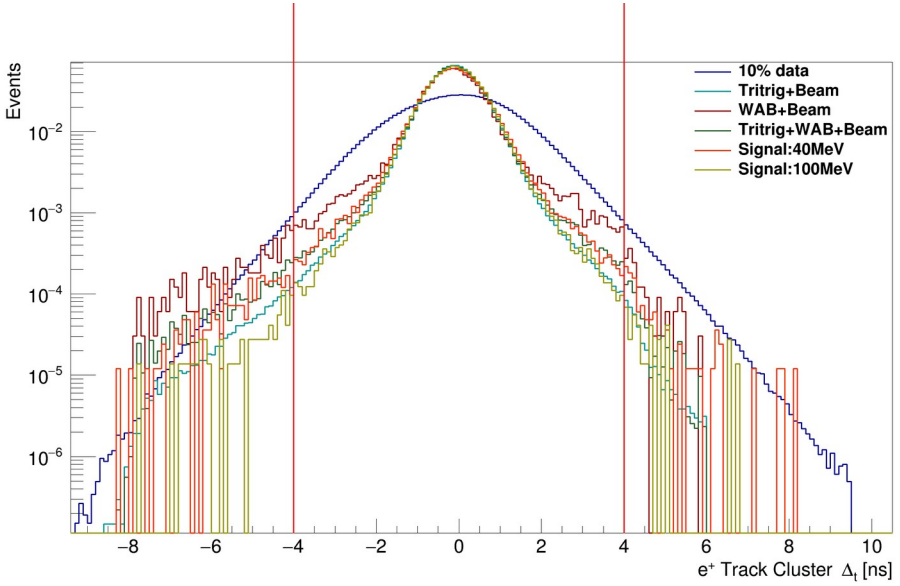
Table 5: "n-1" cut efficiency. The efficiency of the cut under consideration is calculated assuming that all other cuts applied correspond to an efficiency of 100%.

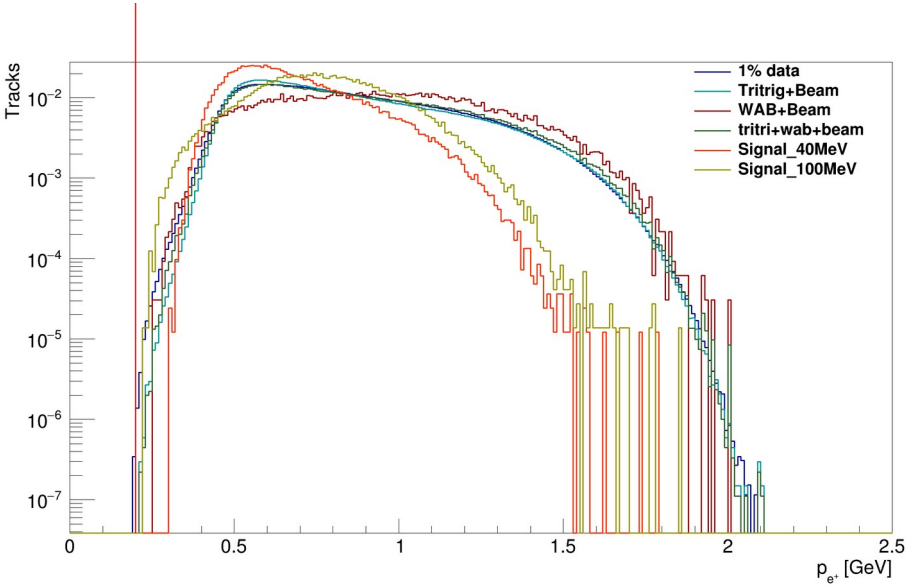

Vertices
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
vtx p_{sum} [GeV]

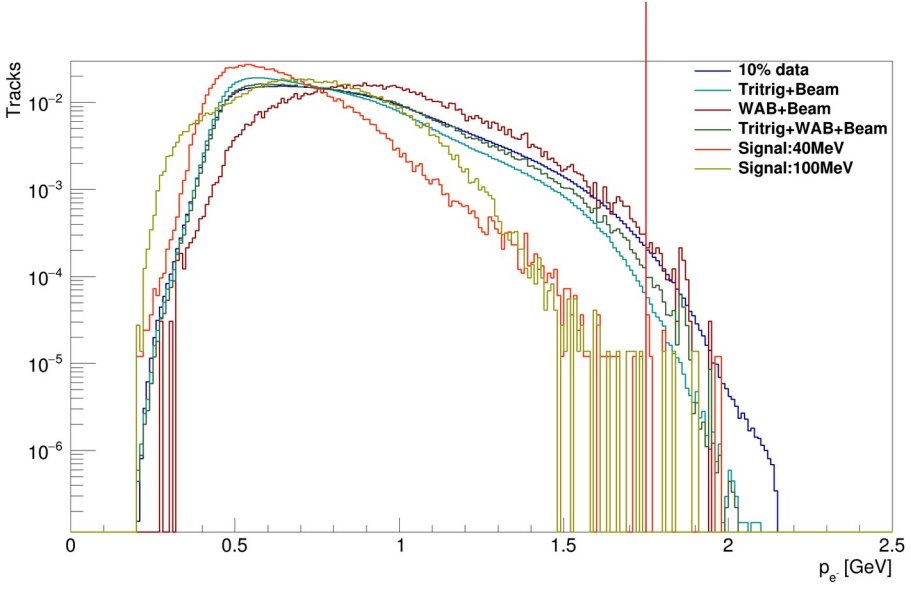

Tracks
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
pos track χ^2 / ndf

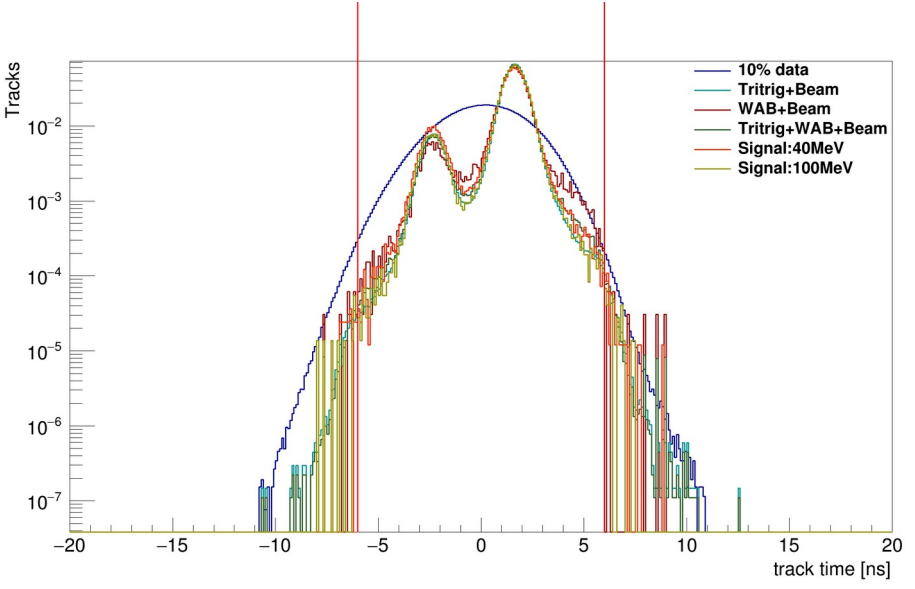

Vertices
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
vtx χ^2

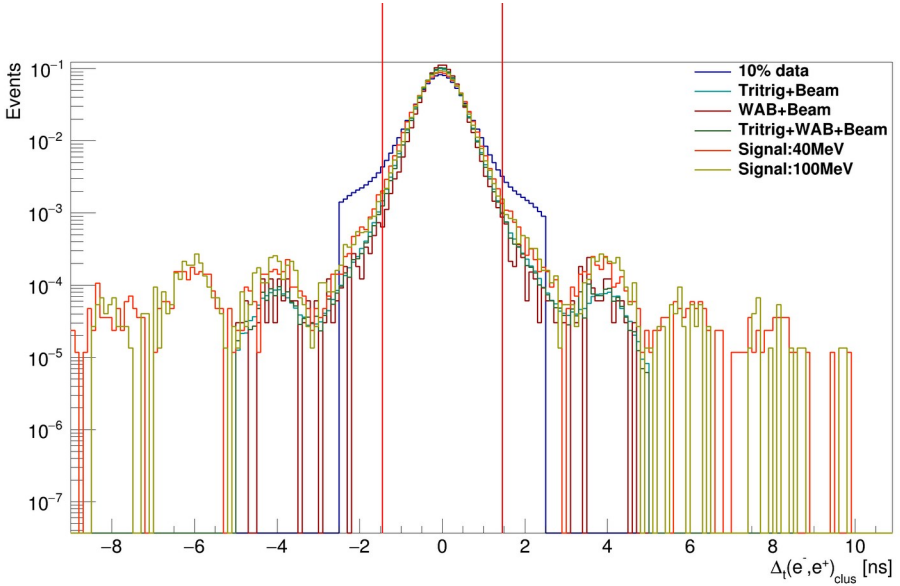

Events
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
n2d hits

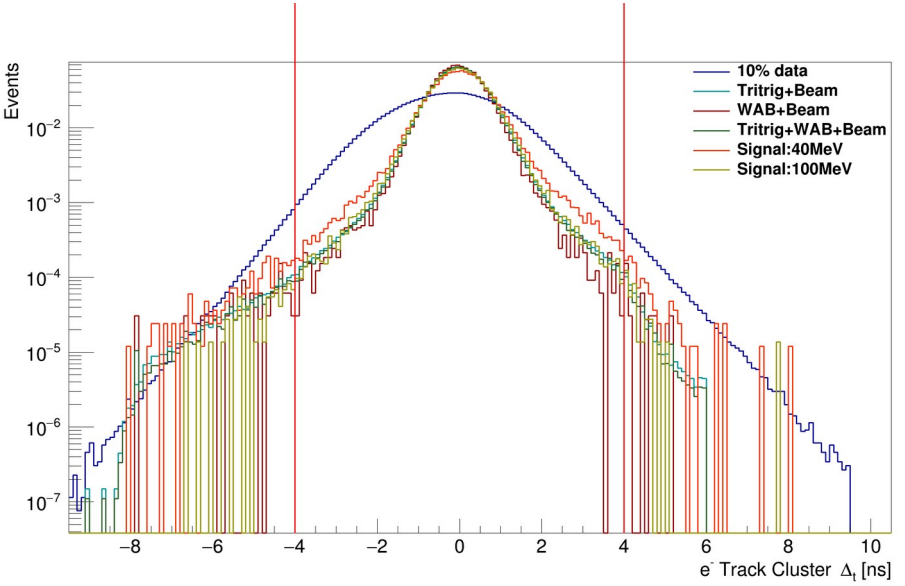

Events
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
e⁺ Track Cluster Δt [ns]

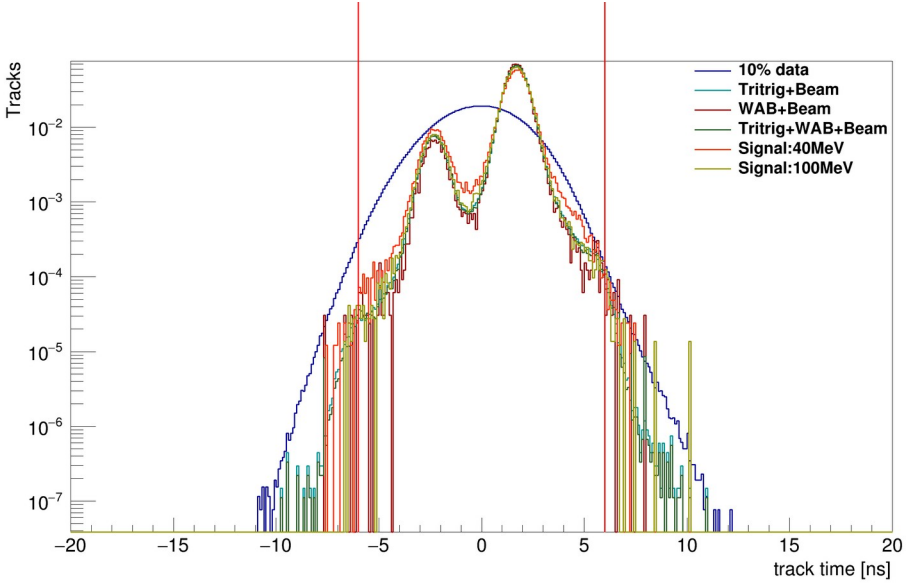

Tracks
1% data
Tritrig+Beam
WAB+Beam
tritri+wab+beam
Signal_40MeV
Signal_100MeV
p e⁺ [GeV]

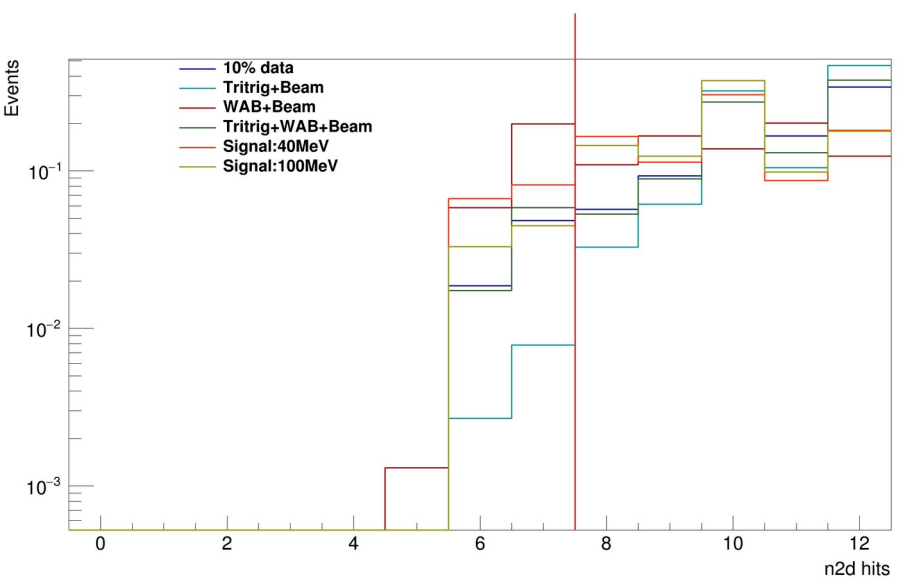

Tracks
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
p e⁻ [GeV]

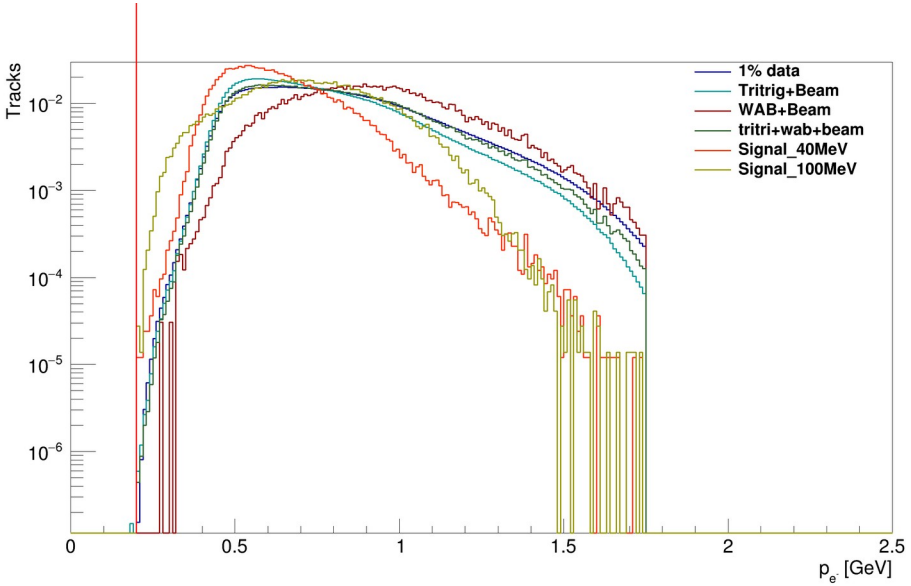

Tracks
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
track time [ns]

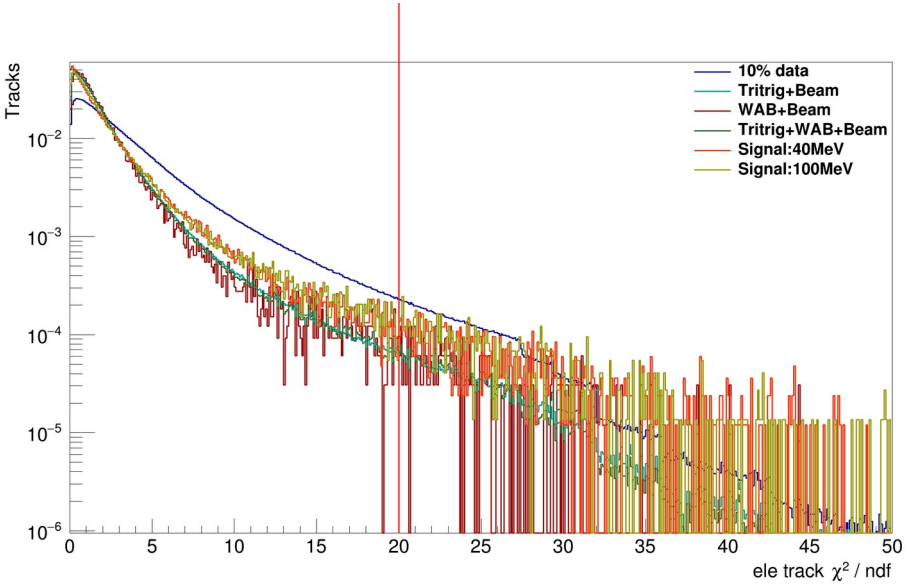

Events
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
$\Delta_t(e^-,e^+)_{clus}$ [ns]


Events
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
e^- Track Cluster Δ_t [ns]


Tracks
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
track time [ns]


Events
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
n2d hits


Tracks
1% data
Tritrig+Beam
WAB+Beam
tritri+wab+beam
Signal_40MeV
Signal_100MeV
p_{e^-} [GeV]

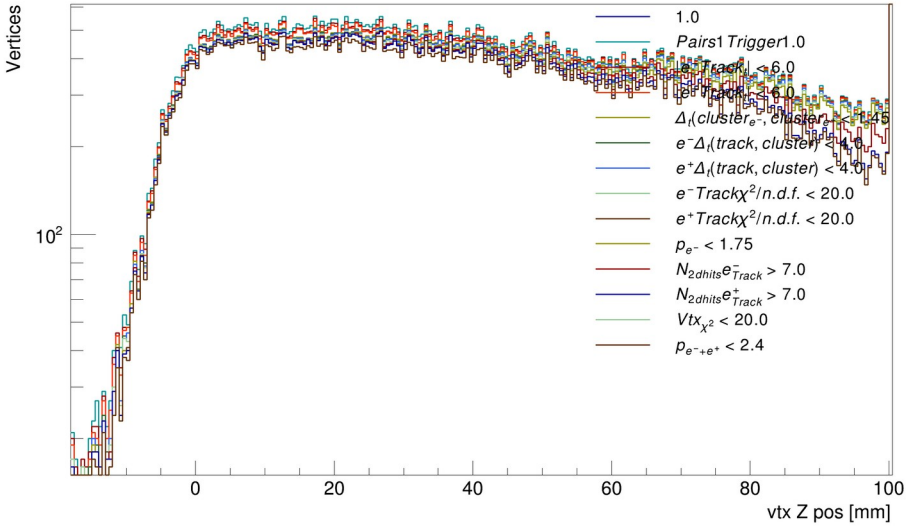

Tracks
10% data
Tritrig+Beam
WAB+Beam
Tritrig+WAB+Beam
Signal:40MeV
Signal:100MeV
ele track χ^2 / ndf

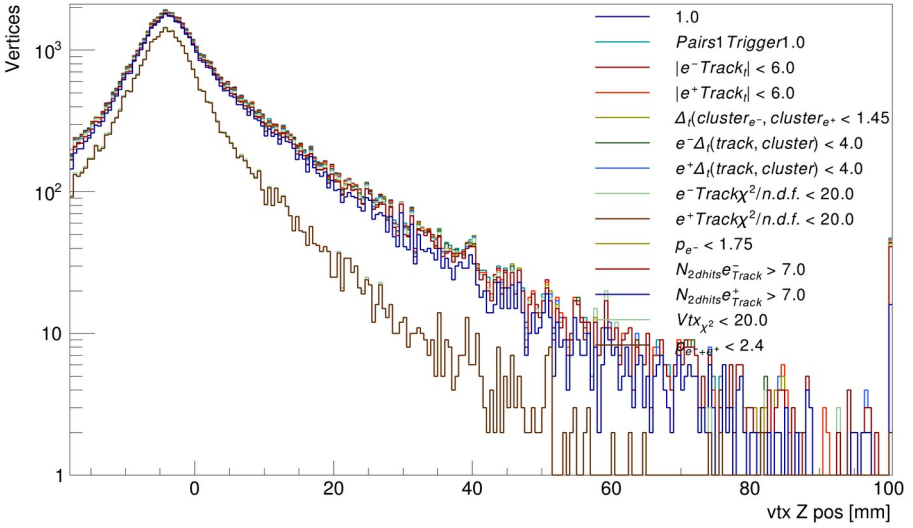
Preselection Cutflow

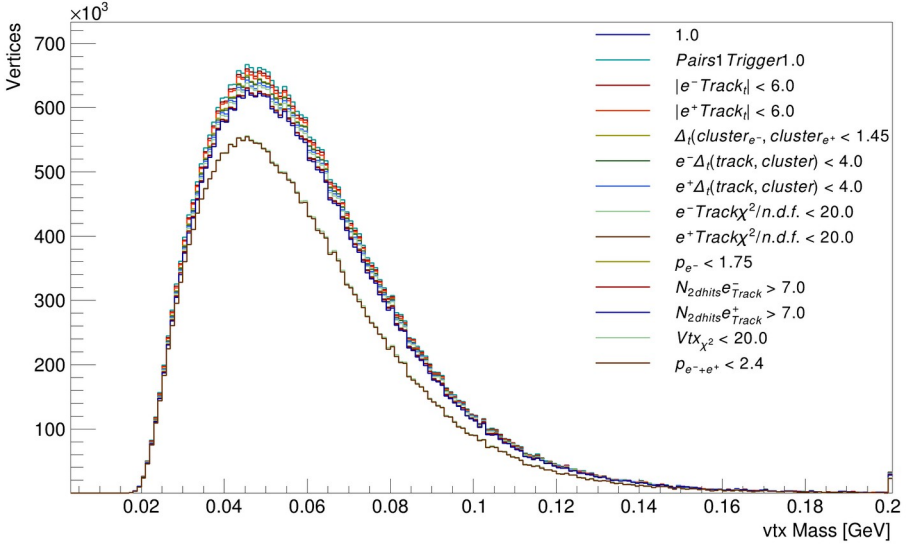
Preselection Cutflow Efficiency

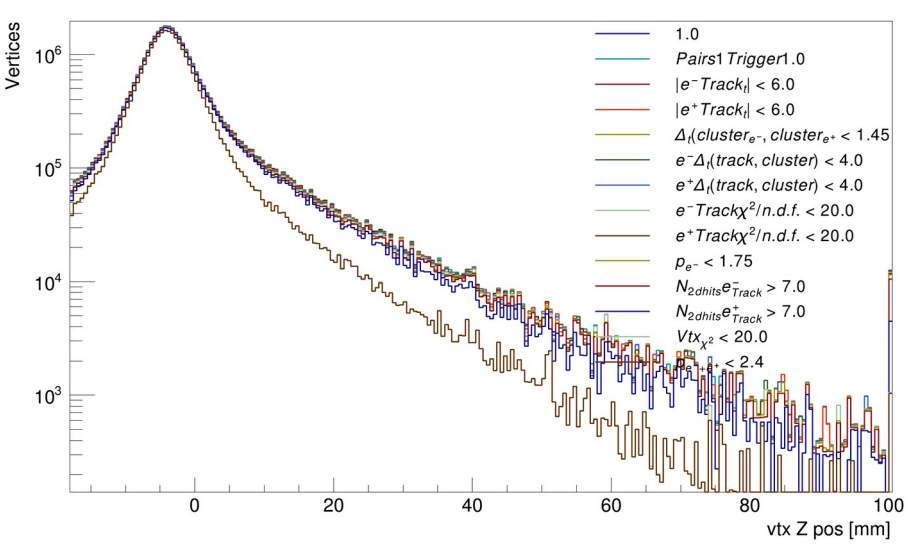
	Data	Eff	Tritrig-Beam	Eff	WAB-Beam	Eff	Tritrig-WAB-Beam	Eff	40 MeV Signal	Eff	100 MeV Signal	Eff
1.0	3.8328e+07	1	7.31364e+06	1	59196	1	3.55889e+07	1	108200	1	87633	1
$Pairs1Trigger1.0$	3.82279e+07	1	7.31364e+06	1	59196	1	3.55889e+07	1	108200	1	87633	1
$\lvert e^{-}Track_{t}\rvert < 6.0$	3.76094e+07	0.98	7.24228e+06	0.99	58656	0.99	3.52498e+07	0.99	105878	0.98	85862	0.98
$\lvert e^{+}Track_{t}\rvert < 6.0$	3.71464e+07	0.97	7.22328e+06	0.99	58079	0.98	3.50654e+07	0.99	104908	0.97	85004	0.97
$\Delta_{t}(cluster_{e^-}, cluster_{e^+} < 1.45$	3.53385e+07	0.92	7.13085e+06	0.98	57439	0.97	3.46391e+07	0.97	101999	0.94	82205	0.94
$e^{-}\Delta_{t}(track, cluster) < 4.0$	3.49091e+07	0.91	7.10968e+06	0.97	57347	0.97	3.45534e+07	0.97	101442	0.94	82043	0.94
$e^{+}\Delta_{t}(track, cluster) < 4.0$	3.42158e+07	0.89	7.08966e+06	0.97	56420	0.95	3.42896e+07	0.96	100844	0.93	81853	0.93
$e^{-}Track\chi^2/n.d.f. < 20.0$	3.36416e+07	0.88	7.04596e+06	0.96	56102	0.95	3.40847e+07	0.96	99417	0.92	80639	0.92
$e^{+}Track\chi^2/n.d.f. < 20.0$	3.26225e+07	0.85	6.99543e+06	0.96	54423	0.92	3.35627e+07	0.94	98087	0.91	79315	0.91
$p_{e^-} < 1.75$	3.24534e+07	0.85	6.9883e+06	0.96	54254	0.92	3.35038e+07	0.94	97986	0.91	79244	0.9
$N_{2dhits}e^{-}_{Track} > 7.0$	3.24111e+07	0.85	6.97724e+06	0.95	54212	0.92	3.34604e+07	0.94	91414	0.84	77312	0.88
$N_{2dhits}e^{+}_{Track} > 7.0$	3.17285e+07	0.83	6.95771e+06	0.95	51328	0.87	3.27726e+07	0.92	85459	0.79	74772	0.85
$Vtx_{\chi^2} < 20.0$	2.62837e+07	0.69	6.75204e+06	0.92	32982	0.56	2.8145e+07	0.79	82675	0.76	72744	0.83
$p_{e^-+e^+} < 2.4$	2.60451e+07	0.68	6.73881e+06	0.92	32579	0.55	2.80163e+07	0.79	82664	0.76	72728	0.83

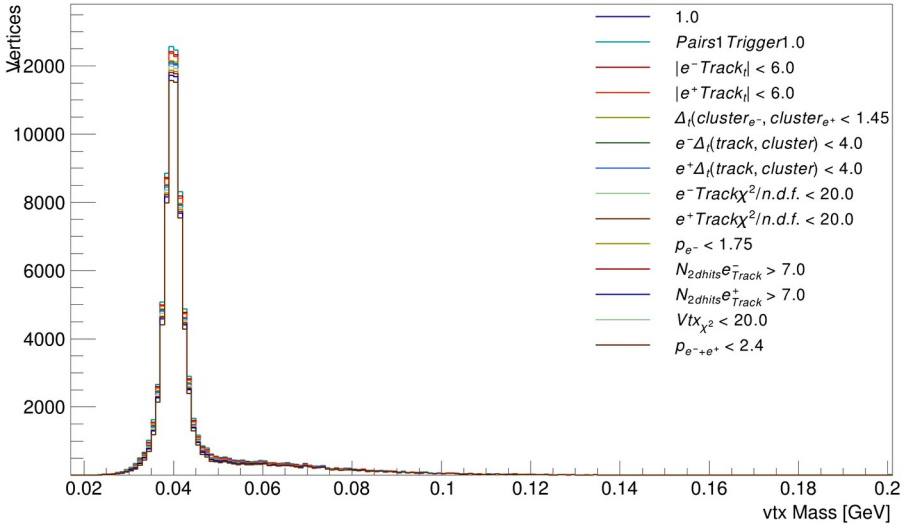
Table 6: The Preselection cutflow efficiency after each cut is applied in order.

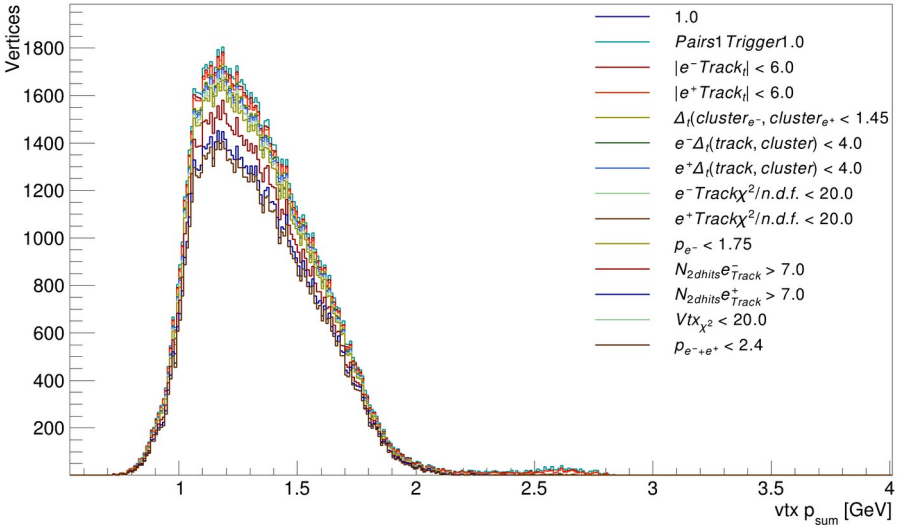

Vertices
10^2
0
20
40
60
80
100
vtx Z pos [mm]
1.0
Pairs1 Trigger1.0
$|e^-Track_{fl}| < 6.0$
$|e^+Track_{fl}| < 6.0$
$\Delta_{fl}(cluster_{e^-}, cluster_{e^+} < 1.45$
$e^-\Delta_{fl}(track, cluster) < 4.0$
$e^+\Delta_{fl}(track, cluster) < 4.0$
$e^-Track\chi^2/n.d.f. < 20.0$
$e^+Track\chi^2/n.d.f. < 20.0$
$p_{e^-} < 1.75$
$N_{2dhits}e^-_{Track} > 7.0$
$N_{2dhits}e^+_{Track} > 7.0$
$Vtx_{\chi^2} < 20.0$
$p_{e^-+e^+} < 2.4$

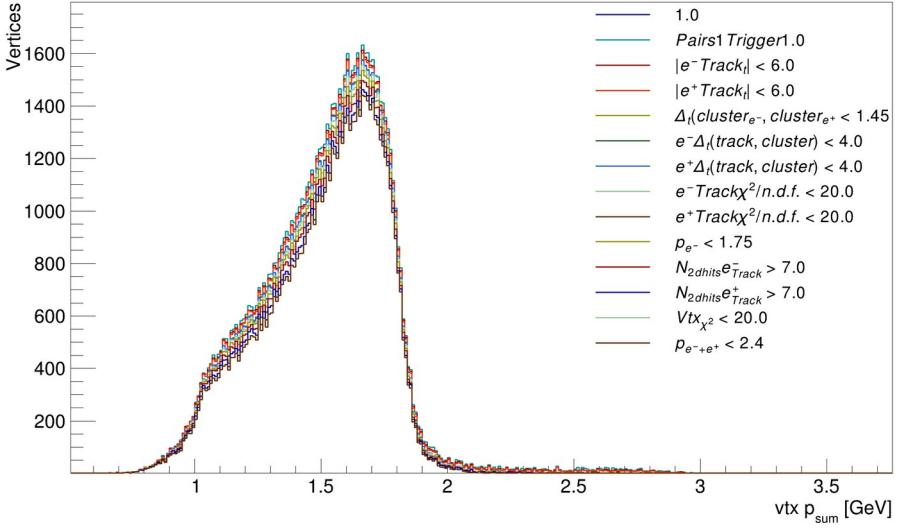

Vertices
10^3
10^2
10
1
0
20
40
60
80
100
vtx Z pos [mm]
1.0
Pairs1 Trigger1.0
$|e^-Track_{fl}| < 6.0$
$|e^+Track_{fl}| < 6.0$
$\Delta_{fl}(cluster_{e^-}, cluster_{e^+} < 1.45$
$e^-\Delta_{fl}(track, cluster) < 4.0$
$e^+\Delta_{fl}(track, cluster) < 4.0$
$e^-Track\chi^2/n.d.f. < 20.0$
$e^+Track\chi^2/n.d.f. < 20.0$
$p_{e^-} < 1.75$
$N_{2dhits}e^-_{Track} > 7.0$
$N_{2dhits}e^+_{Track} > 7.0$
$Vtx_{\chi^2} < 20.0$
$p_{e^-+e^+} < 2.4$

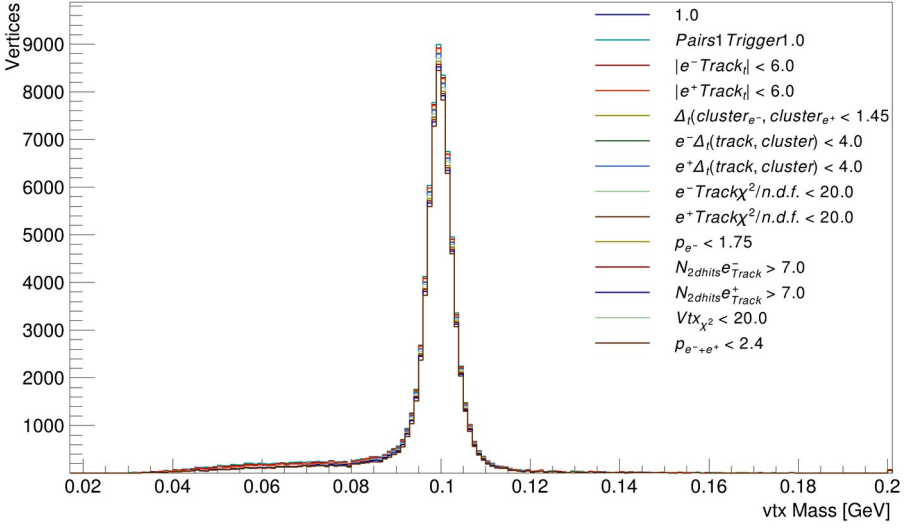

Vertices
$\times 10^3$
700
600
500
400
300
200
100
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
vtx Mass [GeV]
1.0
Pairs1 Trigger1.0
$|e^-Track_{fl}| < 6.0$
$|e^+Track_{fl}| < 6.0$
$\Delta_{fl}(cluster_{e^-}, cluster_{e^+} < 1.45$
$e^-\Delta_{fl}(track, cluster) < 4.0$
$e^+\Delta_{fl}(track, cluster) < 4.0$
$e^-Track\chi^2/n.d.f. < 20.0$
$e^+Track\chi^2/n.d.f. < 20.0$
$p_{e^-} < 1.75$
$N_{2dhits}e^-_{Track} > 7.0$
$N_{2dhits}e^+_{Track} > 7.0$
$Vtx_{\chi^2} < 20.0$
$p_{e^-+e^+} < 2.4$

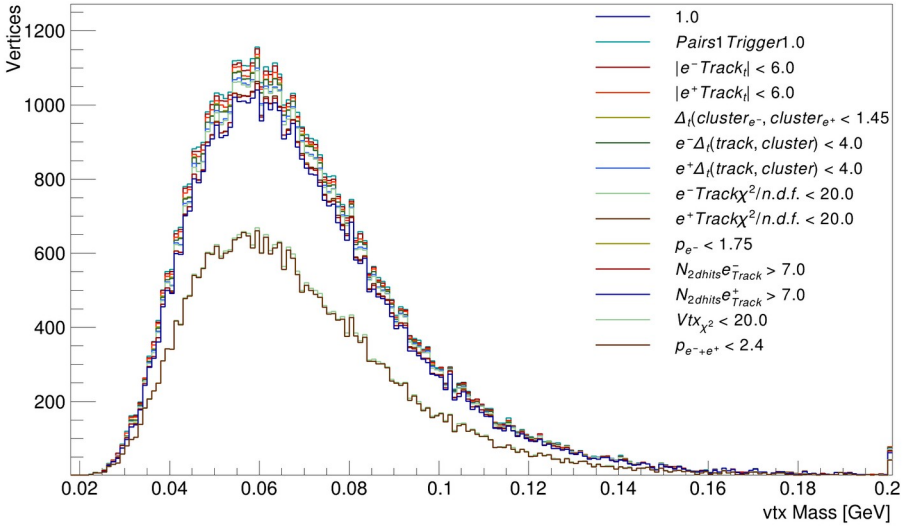

Vertices
10^6
10^5
10^4
10^3
0
20
40
60
80
100
vtx Z pos [mm]
1.0
Pairs1 Trigger1.0
$|e^-Track_{fl}| < 6.0$
$|e^+Track_{fl}| < 6.0$
$\Delta_{fl}(cluster_{e^-}, cluster_{e^+} < 1.45$
$e^-\Delta_{fl}(track, cluster) < 4.0$
$e^+\Delta_{fl}(track, cluster) < 4.0$
$e^-Track\chi^2/n.d.f. < 20.0$
$e^+Track\chi^2/n.d.f. < 20.0$
$p_{e^-} < 1.75$
$N_{2dhits}e^-_{Track} > 7.0$
$N_{2dhits}e^+_{Track} > 7.0$
$Vtx_{\chi^2} < 20.0$
$p_{e^-+e^+} < 2.4$

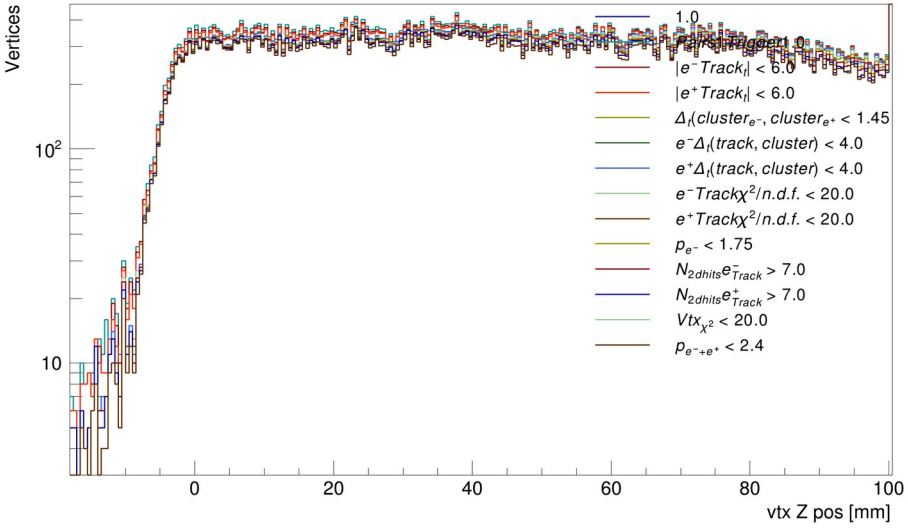

Vertices
vtx Mass [GeV]
1.0
Pairs1 Trigger1.0
|e⁻Track_η| < 6.0
|e⁺Track_η| < 6.0
Δ_η(cluster_e⁻, cluster_e⁺ < 1.45
e⁻Δ_η(track, cluster) < 4.0
e⁺Δ_η(track, cluster) < 4.0
e⁻Trackχ²/n.d.f. < 20.0
e⁺Trackχ²/n.d.f. < 20.0
p_e⁻ < 1.75
N_2dhits e⁻_Track > 7.0
N_2dhits e⁺_Track > 7.0
Vtx_χ² < 20.0
p_e⁻⁺e⁺ < 2.4

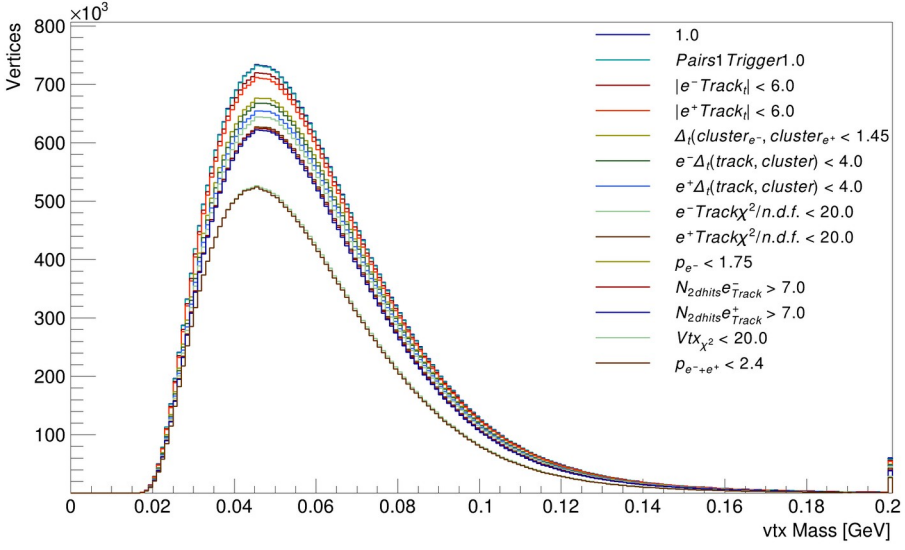

Vertices
vtx p_sum [GeV]
1.0
Pairs1 Trigger1.0
|e⁻Track_η| < 6.0
|e⁺Track_η| < 6.0
Δ_η(cluster_e⁻, cluster_e⁺ < 1.45
e⁻Δ_η(track, cluster) < 4.0
e⁺Δ_η(track, cluster) < 4.0
e⁻Trackχ²/n.d.f. < 20.0
e⁺Trackχ²/n.d.f. < 20.0
p_e⁻ < 1.75
N_2dhits e⁻_Track > 7.0
N_2dhits e⁺_Track > 7.0
Vtx_χ² < 20.0
p_e⁻⁺e⁺ < 2.4

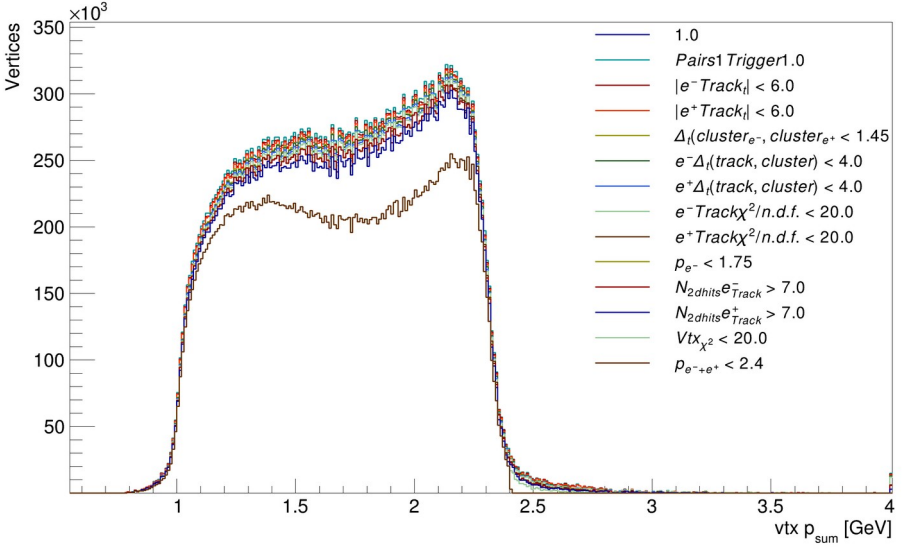

Vertices
vtx p_sum [GeV]
1.0
Pairs1 Trigger1.0
|e⁻Track_η| < 6.0
|e⁺Track_η| < 6.0
Δ_η(cluster_e⁻, cluster_e⁺ < 1.45
e⁻Δ_η(track, cluster) < 4.0
e⁺Δ_η(track, cluster) < 4.0
e⁻Trackχ²/n.d.f. < 20.0
e⁺Trackχ²/n.d.f. < 20.0
p_e⁻ < 1.75
N_2dhits e⁻_Track > 7.0
N_2dhits e⁺_Track > 7.0
Vtx_χ² < 20.0
p_e⁻⁺e⁺ < 2.4

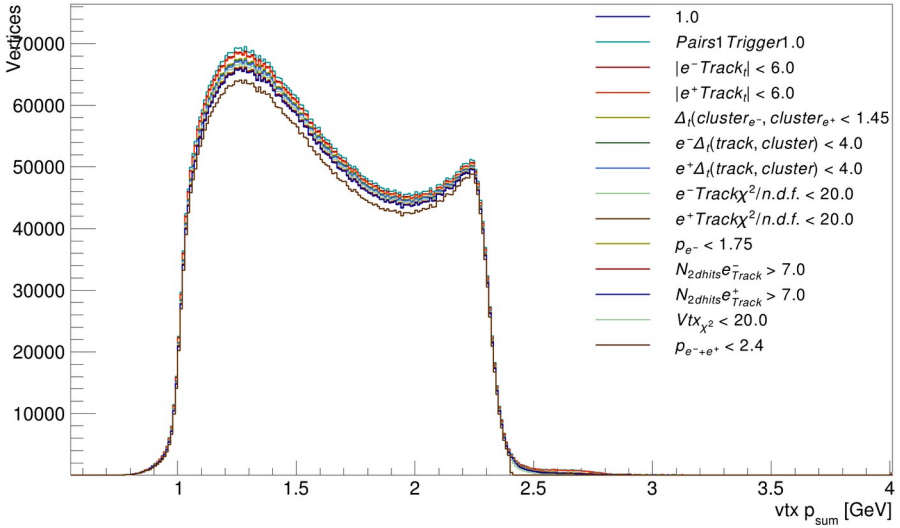

Vertices
vtx Mass [GeV]
1.0
Pairs1 Trigger1.0
|e⁻Track_η| < 6.0
|e⁺Track_η| < 6.0
Δ_η(cluster_e⁻, cluster_e⁺ < 1.45
e⁻Δ_η(track, cluster) < 4.0
e⁺Δ_η(track, cluster) < 4.0
e⁻Trackχ²/n.d.f. < 20.0
e⁺Trackχ²/n.d.f. < 20.0
p_e⁻ < 1.75
N_2dhits e⁻_Track > 7.0
N_2dhits e⁺_Track > 7.0
Vtx_χ² < 20.0
p_e⁻⁺e⁺ < 2.4

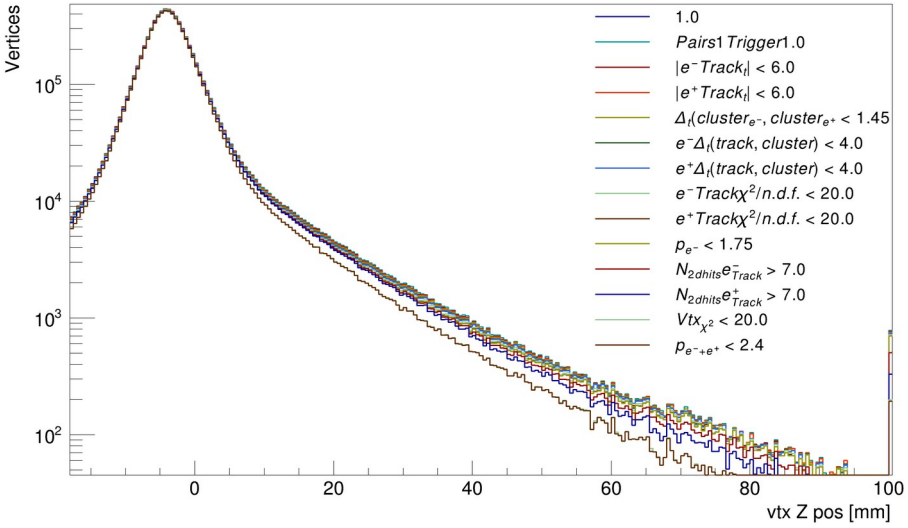

Vertices
1200
1000
800
600
400
200
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
vtx Mass [GeV]
1.0
Pairs1 Trigger1.0
|e⁻Track_η| < 6.0
|e⁺Track_η| < 6.0
Δ_η(cluster_e⁻, cluster_e⁺ < 1.45
e⁻Δ_η(track, cluster) < 4.0
e⁺Δ_η(track, cluster) < 4.0
e⁻Trackχ²/n.d.f. < 20.0
e⁺Trackχ²/n.d.f. < 20.0
p_e⁻ < 1.75
N_2dhits e⁻_Track > 7.0
N_2dhits e⁺_Track > 7.0
Vtx_χ² < 20.0
p_e⁻⁺e⁺ < 2.4

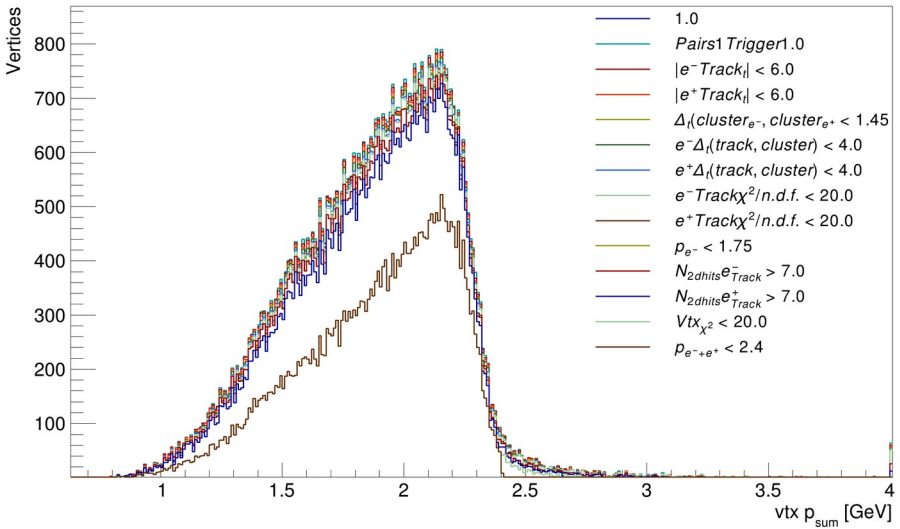

Vertices
10²
10
0
20
40
60
80
100
vtx Z pos [mm]
1.0
Pairs1 Trigger1.0
|e⁻Track_η| < 6.0
|e⁺Track_η| < 6.0
Δ_η(cluster_e⁻, cluster_e⁺ < 1.45
e⁻Δ_η(track, cluster) < 4.0
e⁺Δ_η(track, cluster) < 4.0
e⁻Trackχ²/n.d.f. < 20.0
e⁺Trackχ²/n.d.f. < 20.0
p_e⁻ < 1.75
N_2dhits e⁻_Track > 7.0
N_2dhits e⁺_Track > 7.0
Vtx_χ² < 20.0
p_e⁻⁺e⁺ < 2.4

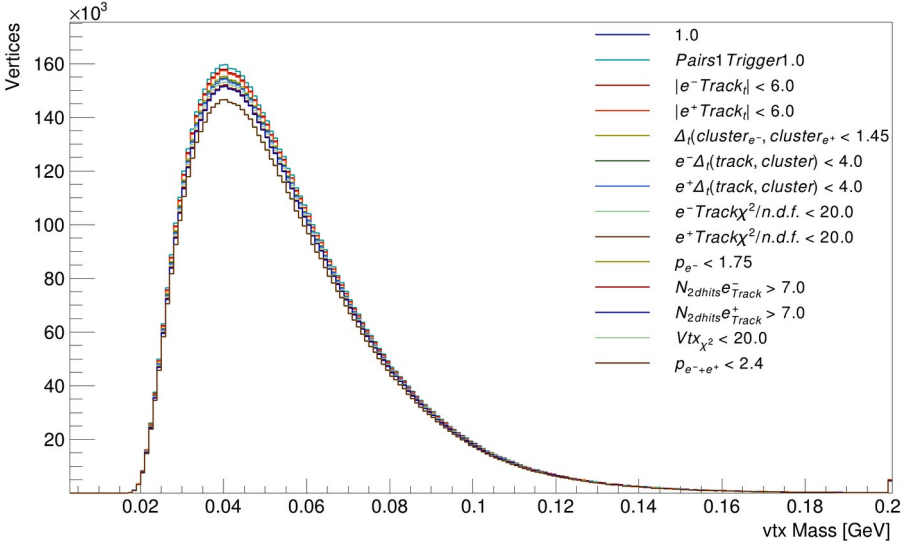

×10³
Vertices
800
700
600
500
400
300
200
100
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
vtx Mass [GeV]
1.0
Pairs1 Trigger1.0
|e⁻Track_η| < 6.0
|e⁺Track_η| < 6.0
Δ_η(cluster_e⁻, cluster_e⁺ < 1.45
e⁻Δ_η(track, cluster) < 4.0
e⁺Δ_η(track, cluster) < 4.0
e⁻Trackχ²/n.d.f. < 20.0
e⁺Trackχ²/n.d.f. < 20.0
p_e⁻ < 1.75
N_2dhits e⁻_Track > 7.0
N_2dhits e⁺_Track > 7.0
Vtx_χ² < 20.0
p_e⁻⁺e⁺ < 2.4

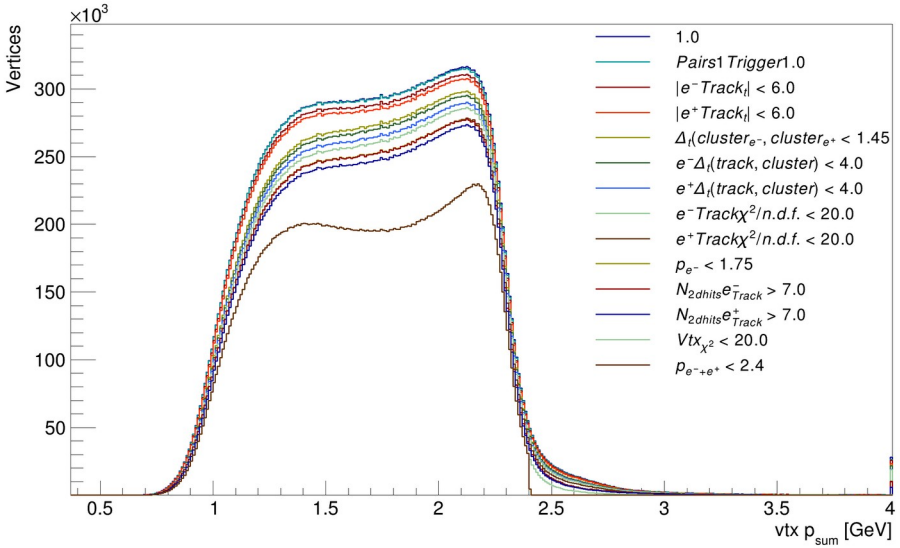

×10³
Vertices
350
300
250
200
150
100
50
1
1.5
2
2.5
3
3.5
4
vtx p_sum [GeV]
1.0
Pairs1 Trigger1.0
|e⁻Track_η| < 6.0
|e⁺Track_η| < 6.0
Δ_η(cluster_e⁻, cluster_e⁺ < 1.45
e⁻Δ_η(track, cluster) < 4.0
e⁺Δ_η(track, cluster) < 4.0
e⁻Trackχ²/n.d.f. < 20.0
e⁺Trackχ²/n.d.f. < 20.0
p_e⁻ < 1.75
N_2dhits e⁻_Track > 7.0
N_2dhits e⁺_Track > 7.0
Vtx_χ² < 20.0
p_e⁻⁺e⁺ < 2.4

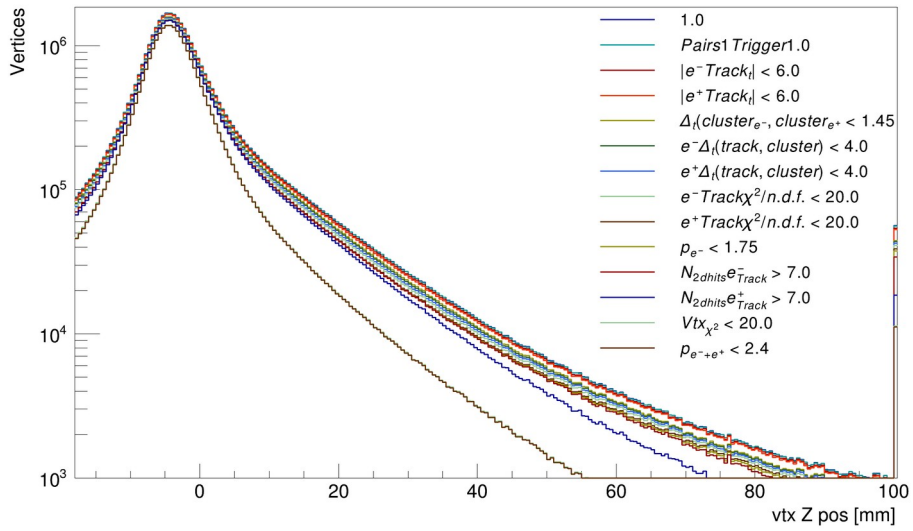

Vertices
vtx p_{sum} [GeV]
1.0
Pairs1 Trigger1.0
$|e^- Track_t| < 6.0$
$|e^+ Track_t| < 6.0$
$\Delta_t(cluster_{e^-}, cluster_{e^+} < 1.45$
$e^-\Delta_t(track, cluster) < 4.0$
$e^+\Delta_t(track, cluster) < 4.0$
$e^- Track\chi^2/n.d.f. < 20.0$
$e^+ Track\chi^2/n.d.f. < 20.0$
$p_{e^-} < 1.75$
$N_{2dhits}e^-_{Track} > 7.0$
$N_{2dhits}e^+_{Track} > 7.0$
$Vtx_{\chi^2} < 20.0$
$p_{e^-+e^+} < 2.4$


Vertices
vtx Z pos [mm]
1.0
Pairs1 Trigger1.0
$|e^- Track_t| < 6.0$
$|e^+ Track_t| < 6.0$
$\Delta_t(cluster_{e^-}, cluster_{e^+} < 1.45$
$e^-\Delta_t(track, cluster) < 4.0$
$e^+\Delta_t(track, cluster) < 4.0$
$e^- Track\chi^2/n.d.f. < 20.0$
$e^+ Track\chi^2/n.d.f. < 20.0$
$p_{e^-} < 1.75$
$N_{2dhits}e^-_{Track} > 7.0$
$N_{2dhits}e^+_{Track} > 7.0$
$Vtx_{\chi^2} < 20.0$
$p_{e^-+e^+} < 2.4$


Vertices
vtx p_{sum} [GeV]
1.0
Pairs1 Trigger1.0
$|e^- Track_t| < 6.0$
$|e^+ Track_t| < 6.0$
$\Delta_t(cluster_{e^-}, cluster_{e^+} < 1.45$
$e^-\Delta_t(track, cluster) < 4.0$
$e^+\Delta_t(track, cluster) < 4.0$
$e^- Track\chi^2/n.d.f. < 20.0$
$e^+ Track\chi^2/n.d.f. < 20.0$
$p_{e^-} < 1.75$
$N_{2dhits}e^-_{Track} > 7.0$
$N_{2dhits}e^+_{Track} > 7.0$
$Vtx_{\chi^2} < 20.0$
$p_{e^-+e^+} < 2.4$


$\times 10^3$
Vertices
vtx Mass [GeV]
1.0
Pairs1 Trigger1.0
$|e^- Track_t| < 6.0$
$|e^+ Track_t| < 6.0$
$\Delta_t(cluster_{e^-}, cluster_{e^+} < 1.45$
$e^-\Delta_t(track, cluster) < 4.0$
$e^+\Delta_t(track, cluster) < 4.0$
$e^- Track\chi^2/n.d.f. < 20.0$
$e^+ Track\chi^2/n.d.f. < 20.0$
$p_{e^-} < 1.75$
$N_{2dhits}e^-_{Track} > 7.0$
$N_{2dhits}e^+_{Track} > 7.0$
$Vtx_{\chi^2} < 20.0$
$p_{e^-+e^+} < 2.4$


×10^3
Vertices
300
250
200
150
100
50
0.5
1
1.5
2
2.5
3
3.5
4
vtx p_sum [GeV]
1.0
Pairs1 Trigger1.0
|e⁻Track_t| < 6.0
|e⁺Track_t| < 6.0
Δ_t(cluster_e⁻, cluster_e⁺ < 1.45
e⁻Δ_t(track, cluster) < 4.0
e⁺Δ_t(track, cluster) < 4.0
e⁻Trackχ²/n.d.f. < 20.0
e⁺Trackχ²/n.d.f. < 20.0
p_e⁻ < 1.75
N_2dhits e⁻_Track > 7.0
N_2dhits e⁺_Track > 7.0
Vtx_χ² < 20.0
p_e⁻⁺e⁺ < 2.4


Vertices
10^6
10^5
10^4
10^3
0
20
40
60
80
100
vtx Z pos [mm]
1.0
Pairs1 Trigger1.0
|e⁻Track_t| < 6.0
|e⁺Track_t| < 6.0
Δ_t(cluster_e⁻, cluster_e⁺ < 1.45
e⁻Δ_t(track, cluster) < 4.0
e⁺Δ_t(track, cluster) < 4.0
e⁻Trackχ²/n.d.f. < 20.0
e⁺Trackχ²/n.d.f. < 20.0
p_e⁻ < 1.75
N_2dhits e⁻_Track > 7.0
N_2dhits e⁺_Track > 7.0
Vtx_χ² < 20.0
p_e⁻⁺e⁺ < 2.4