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HPS collaboration meeting: Oct 26-28 1015 JLab

Some kinematics distribution for tridents: MC and data

Data: Run 5772, and others

MC: BH, Raiative tridents and BH

Selection of coincident pairs

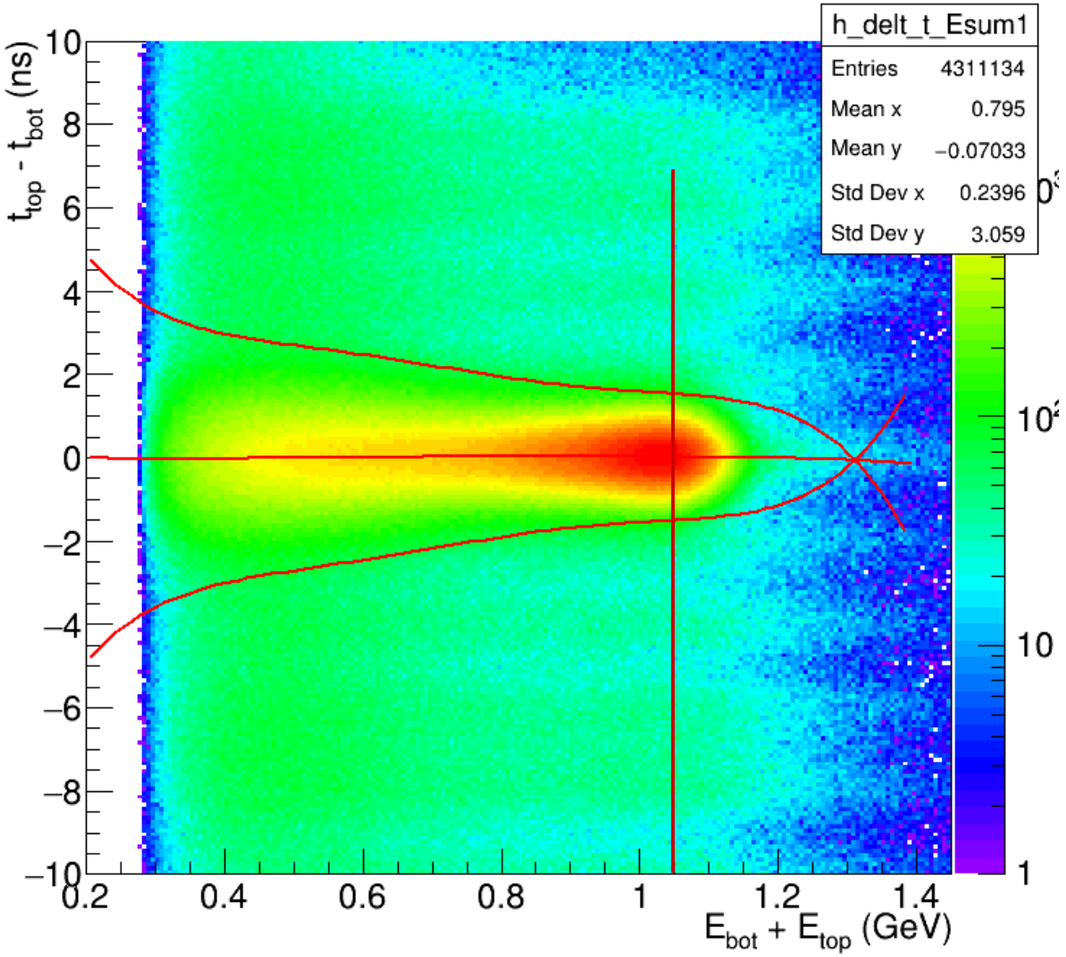
5th degree polynom

$$f = a + x(b + x(c + x(d + x(e + xf))))$$

	a	b	c	d	e	f
Data mean	0.289337	-2.81998	9.03475	-12.93	8.71476	-2.26969
Data sigm	4.3987	-24.2371	68.9567	-98.2586	67.562	-17.8987
MC mean	-0.096122	0.499844	-0.663104	-0.119054	0.70637	-0.329191
MC sigm	0.80133	-2.93574	3.87869	0.302066	-3.84445	1.90058

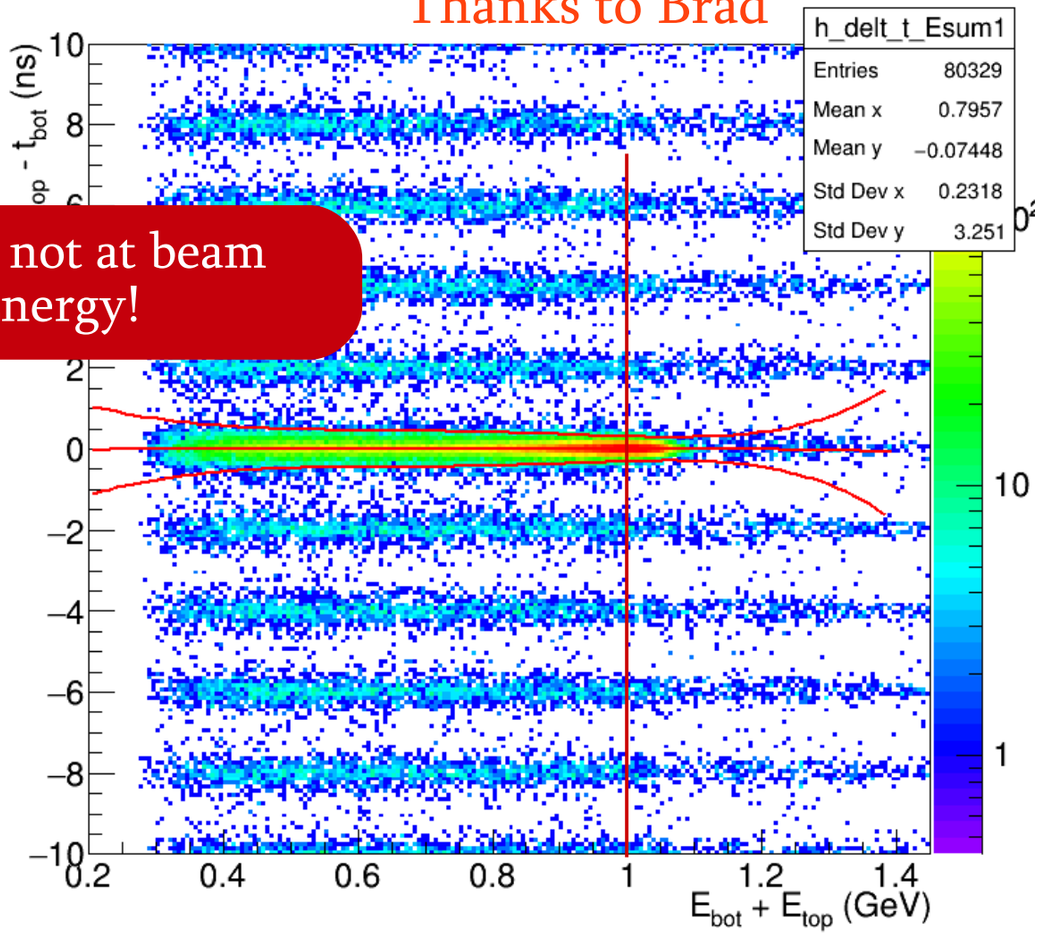
3σ cut around the mean value

For E_tot > 1.2 GeV events, the value at 1.2 GeV was used



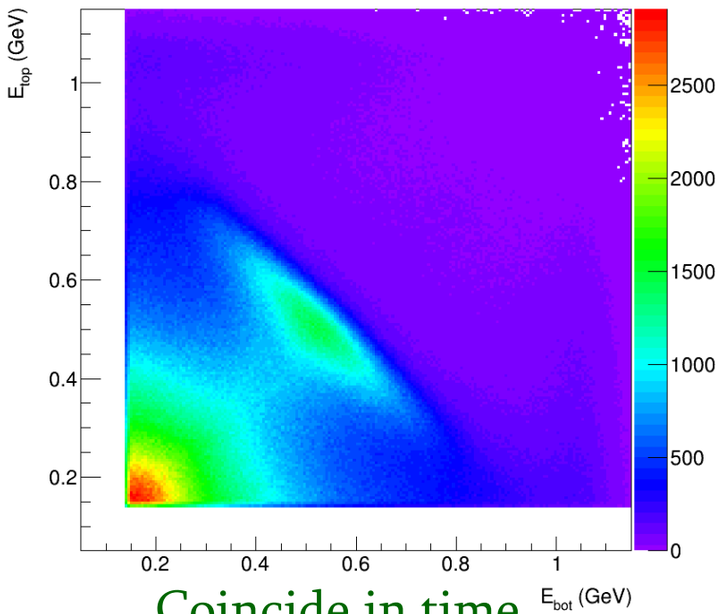
Beam-tri: includes WAB
Thanks to Brad

Peak is not at beam Energy!

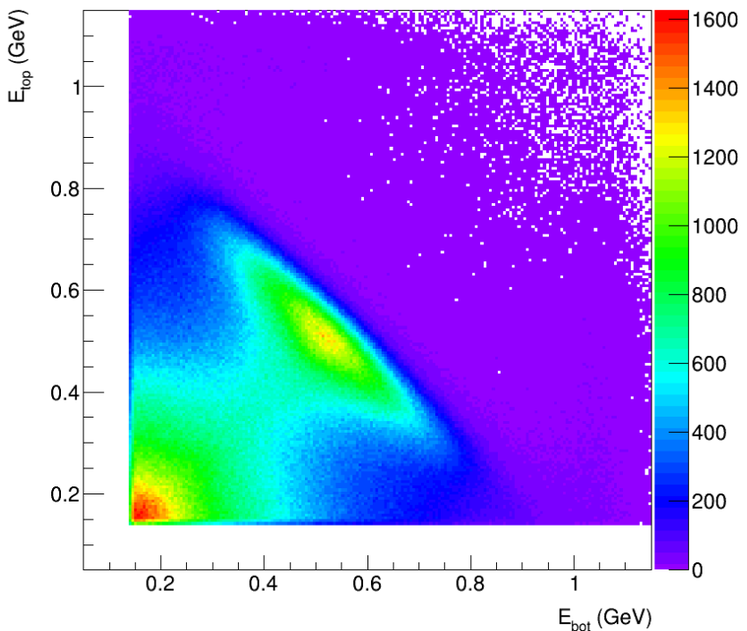


ECal only

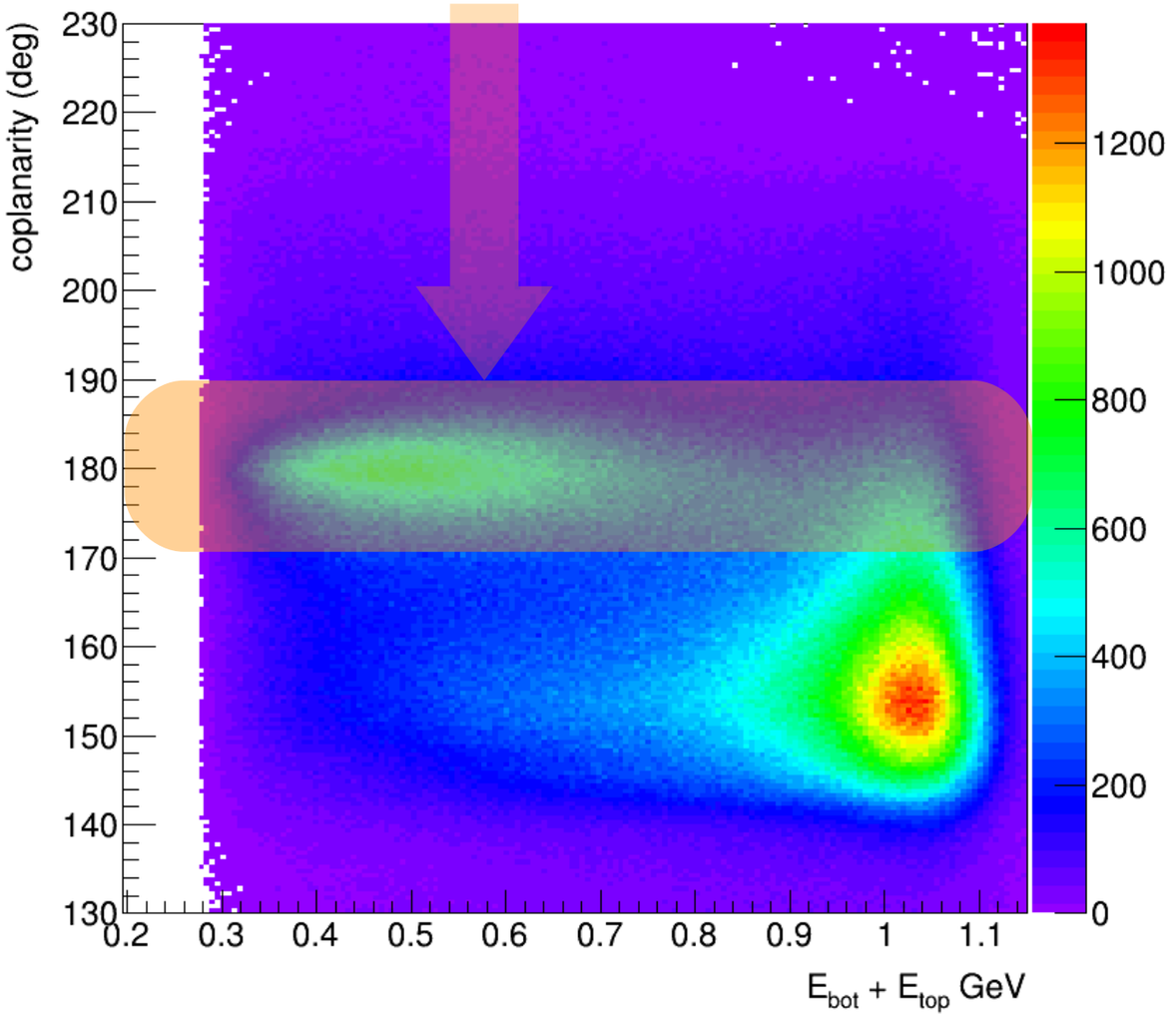
All top-bot combinations



Coincide in time



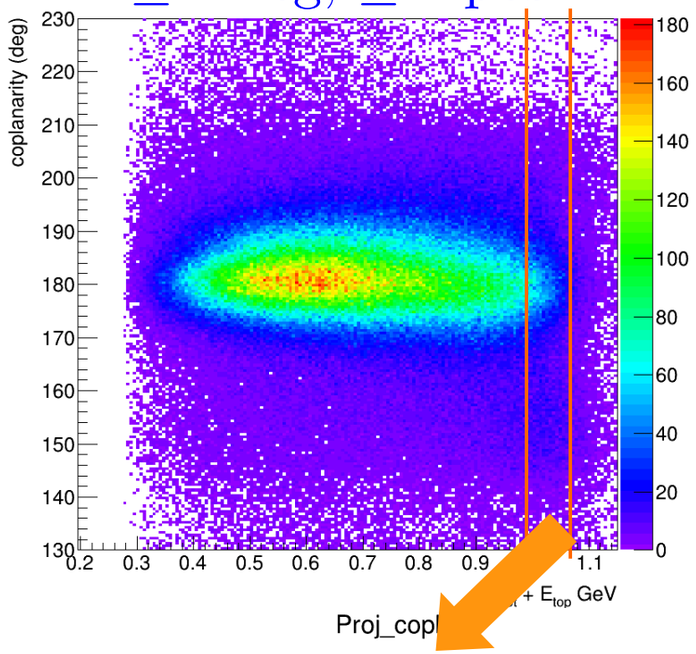
Co-planar events: these are trident candidates

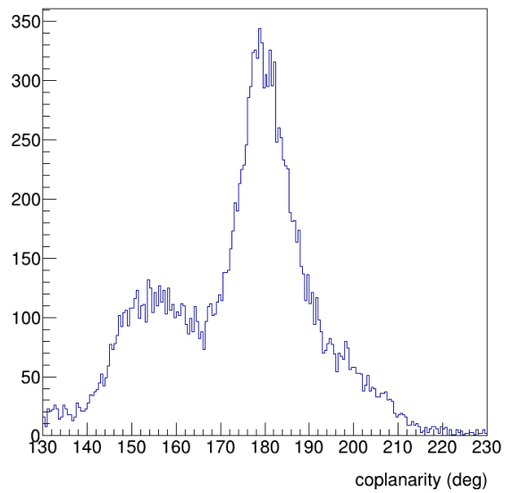


Using SVT

ECal: ≥ 1 bot, ≥ 1 top

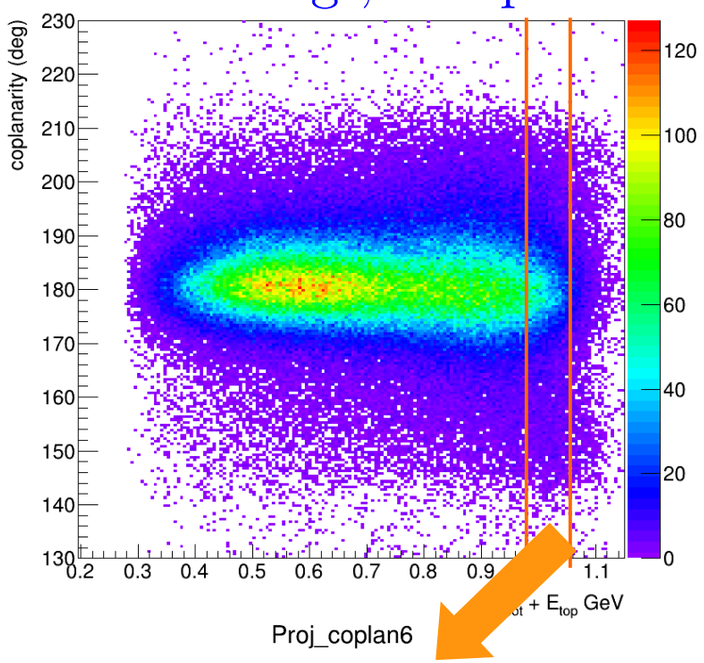
SVT: ≥ 1 bot, ≥ 1 top
≥ 1 neg, ≥ 1 pos

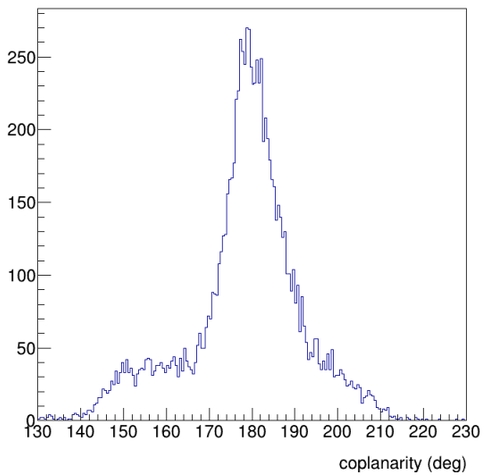




ECal: ≥ 1 bot, ≥ 1 top

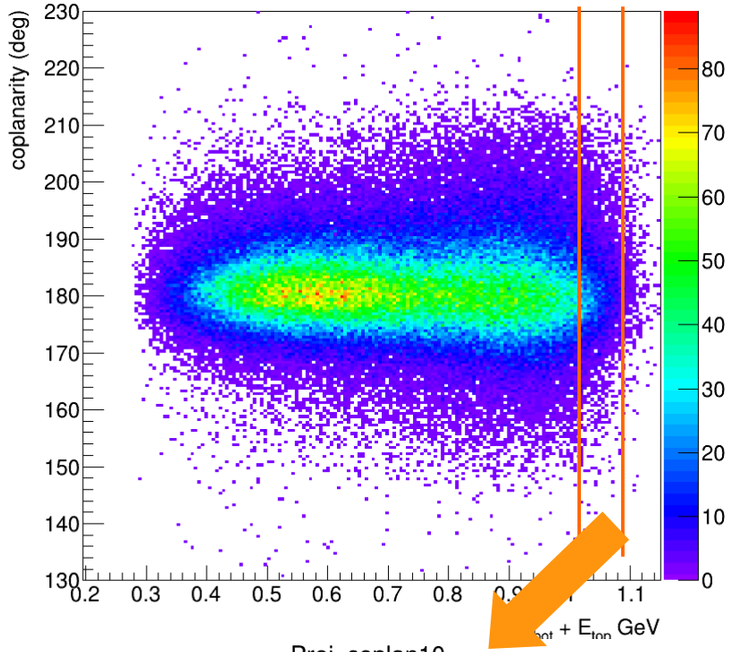
SVT: $= 1$ bot , $= 1$ top
$= 1$ neg , $= 1$ pos

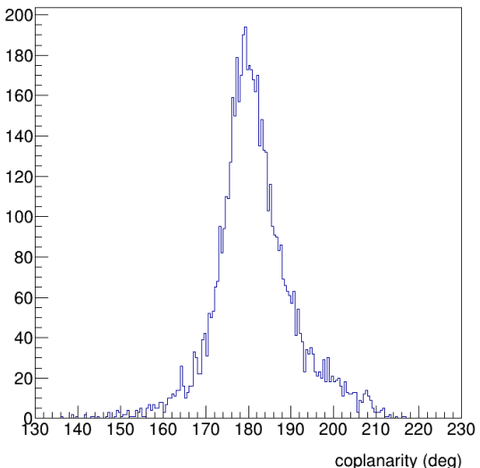




ECal: $= 1$ bot, $= 1$ top

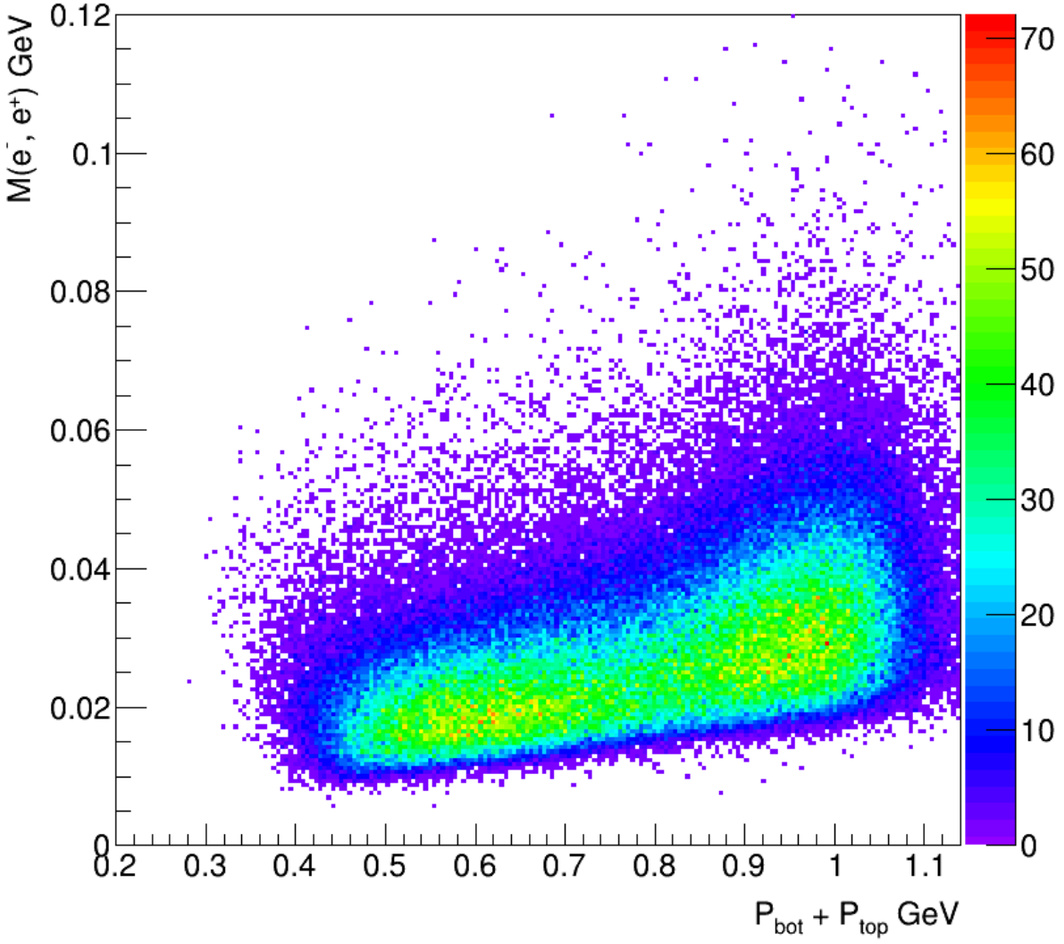
SVT: $= 1$ bot , $= 1$ top
$= 1$ neg , $= 1$ pos

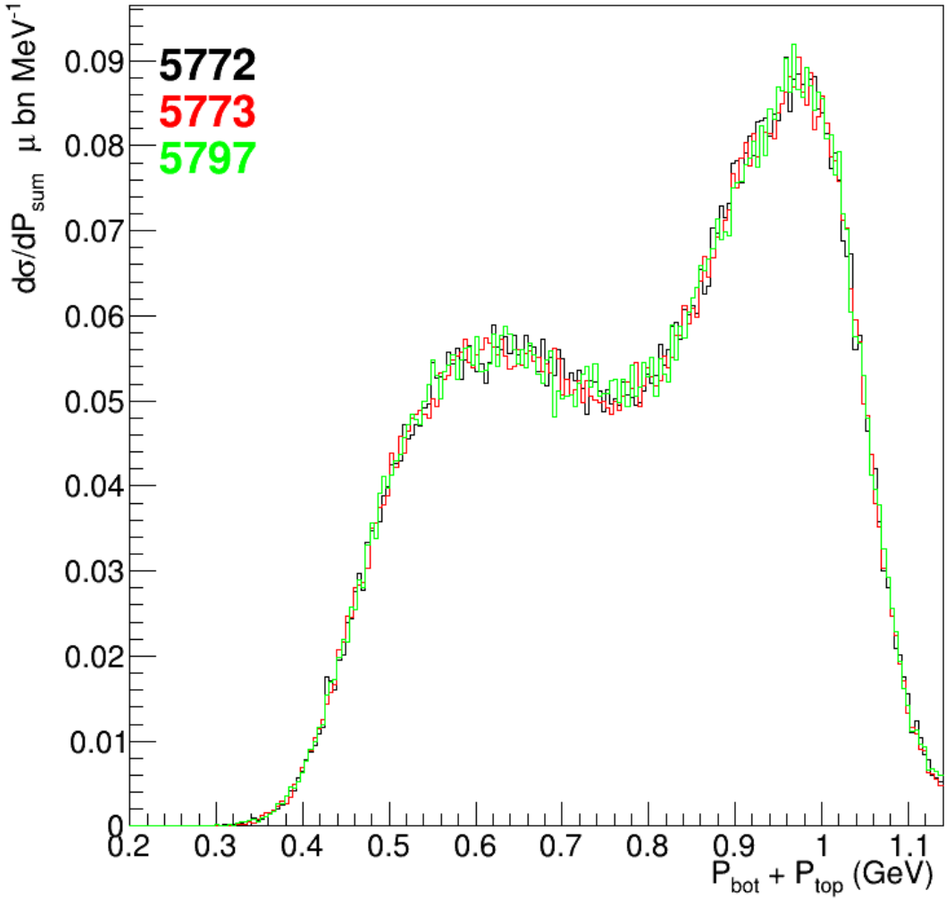




Selected trident samples

Run: 5772

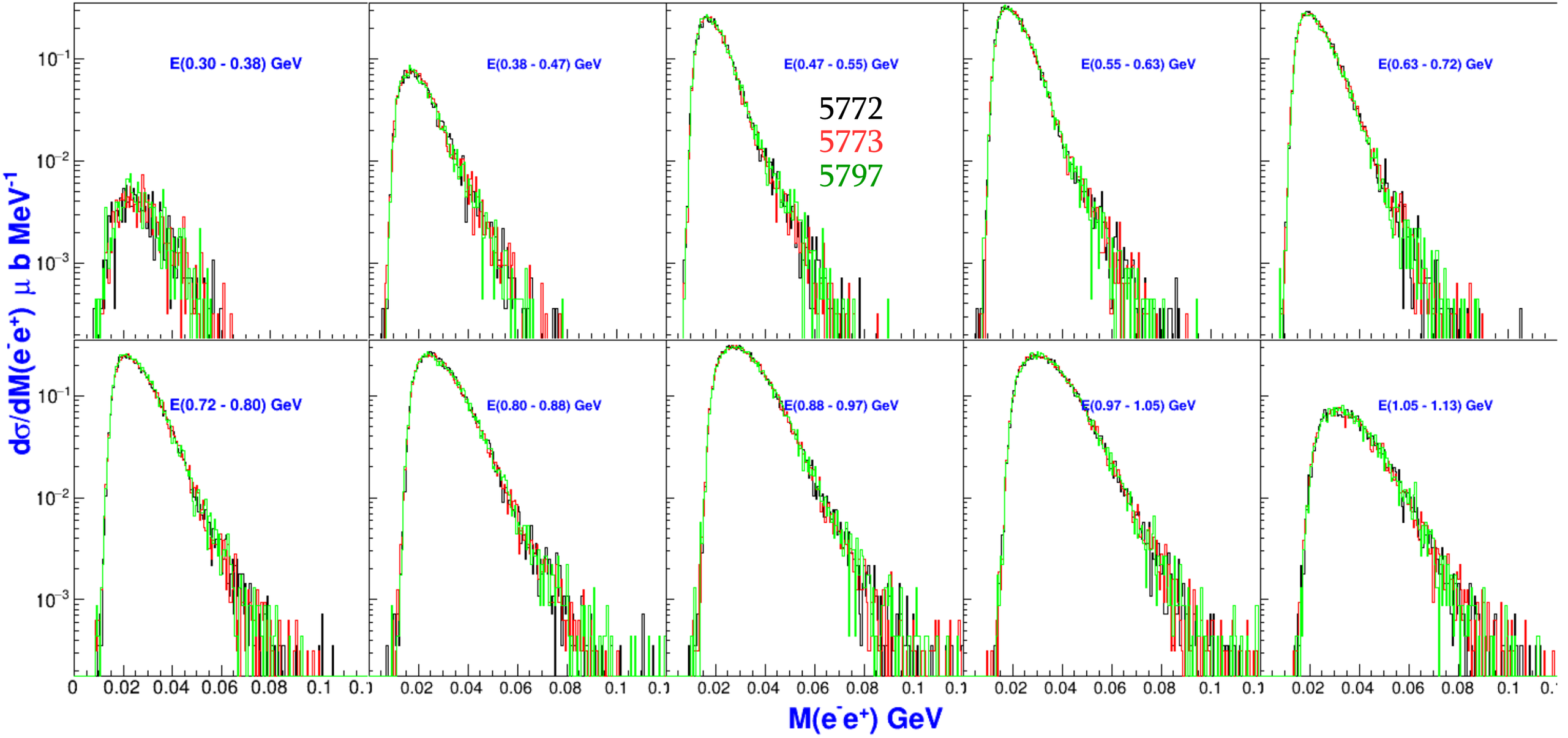




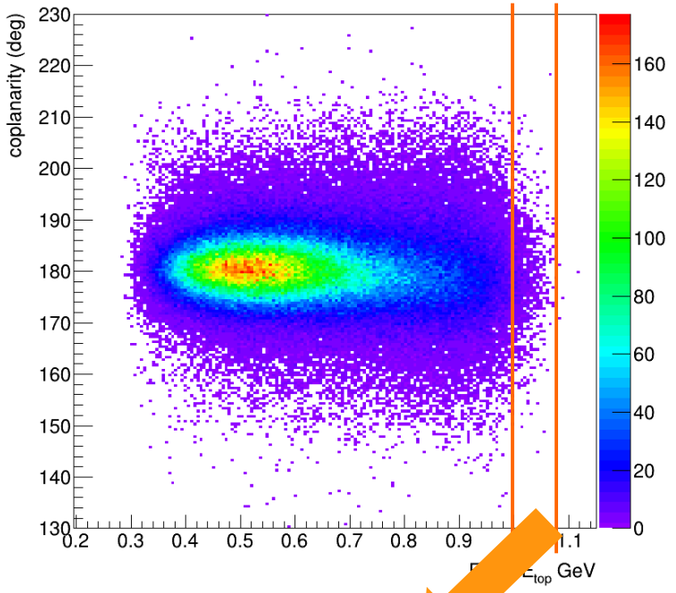
Using Sho's table for Luminosity, detected cross sections are computed for different runs

Energy dependence of detected cross sections from different runs are in a good agreement with each other

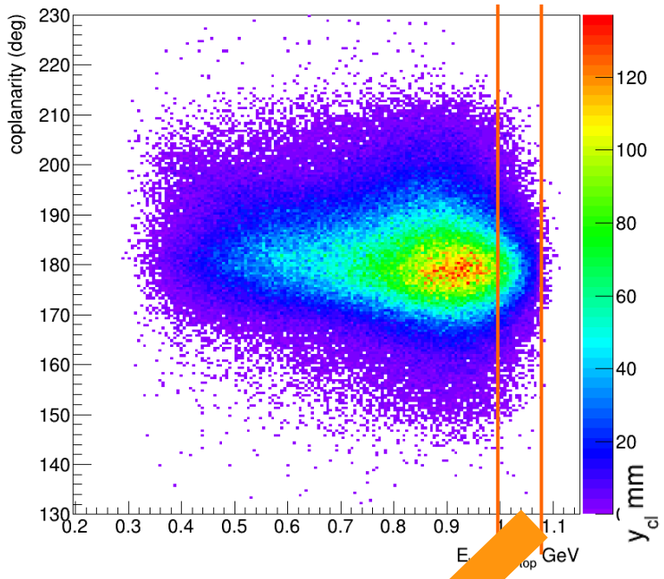
Selected trident samples



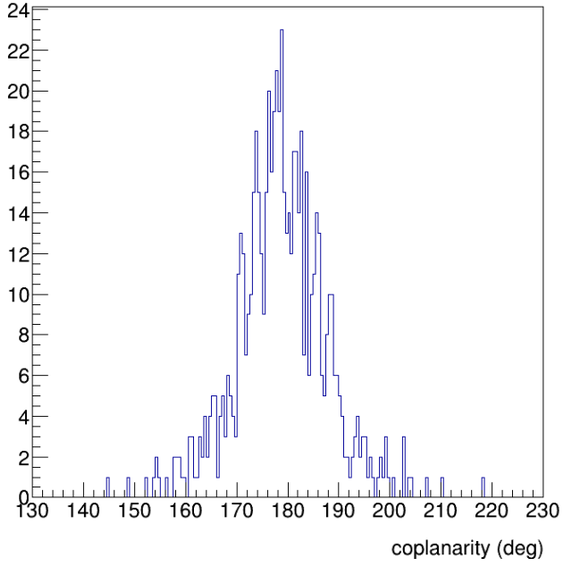
BH



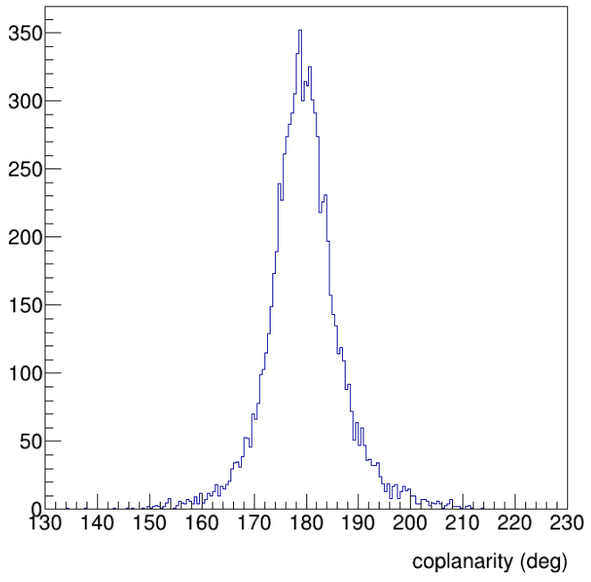
Rad-Tridents



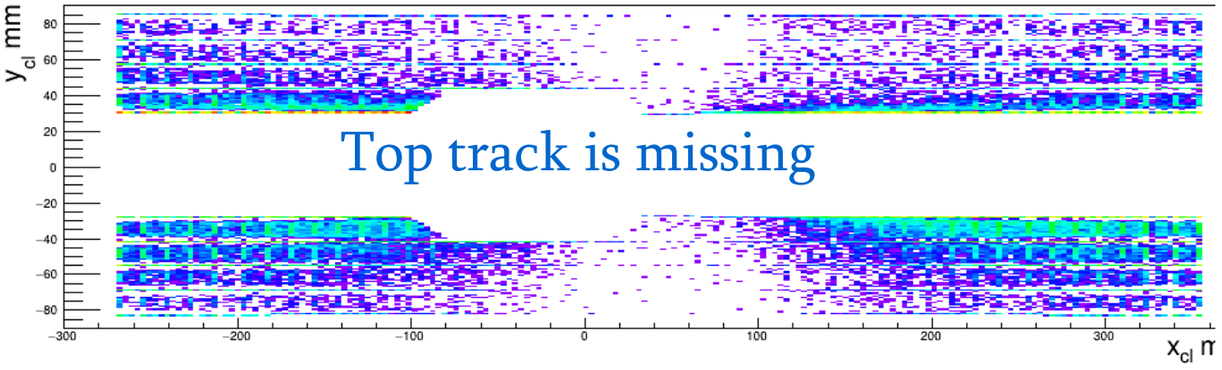
Proj_coplan6



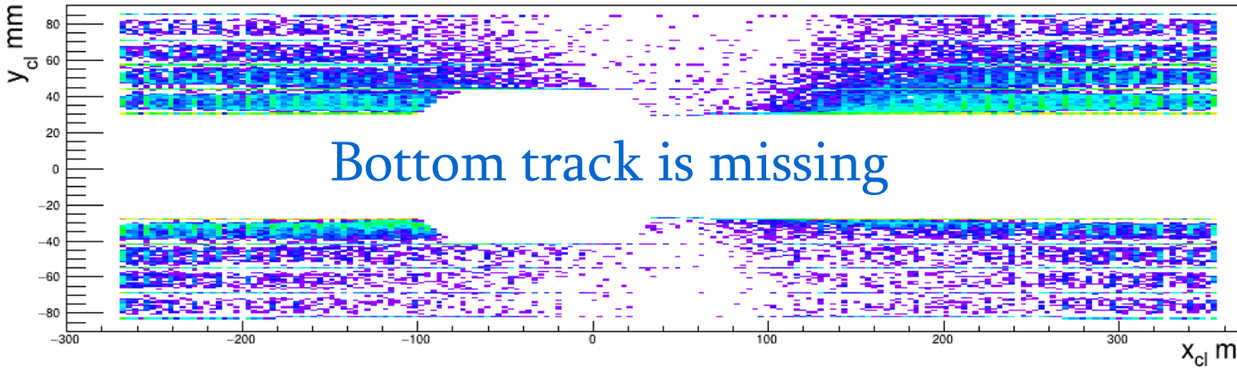
Proj_coplan10



Cut Efficiencies			
	BH %	Rad %	tri_trig %
At leas 1bot 1 top	100.0	100.0	100.0
≥ 1 bot 1top 1neg 1pos trk	57.5	66.9	62.0
Only 1 bot 1top 1neg 1pos trk	87.6	68.0	89.5
Only 1 bot and top clusters	89.3	84.5	89.9

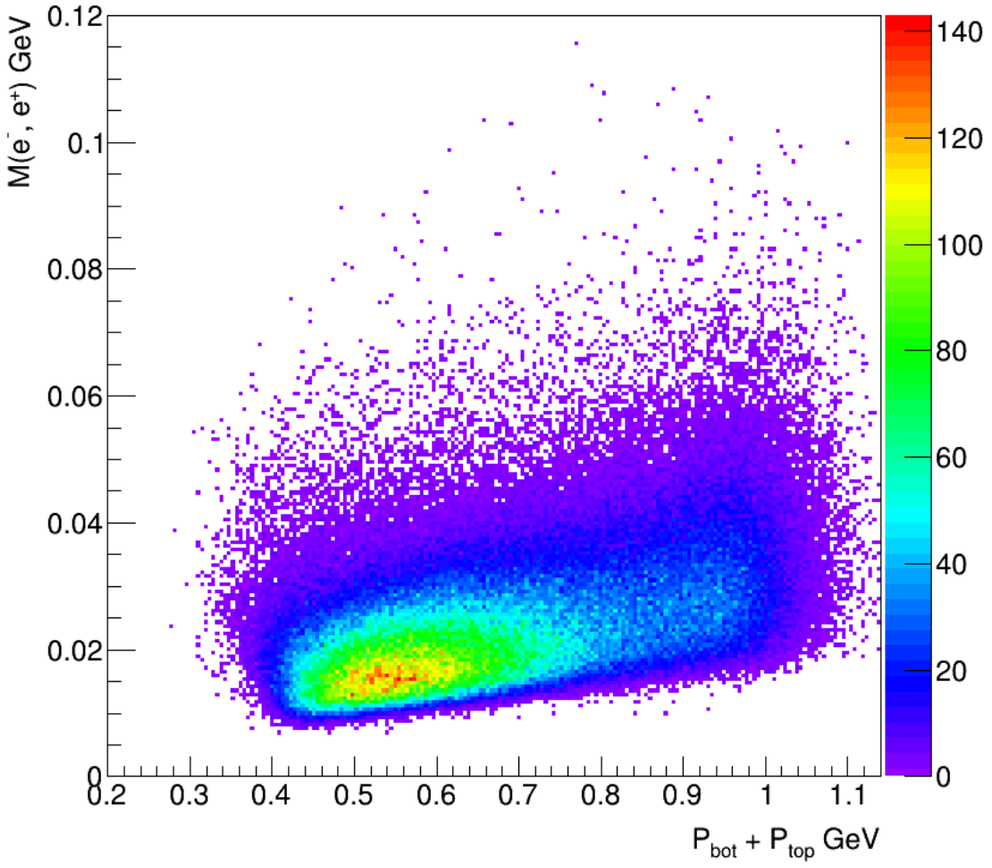


Top track is missing

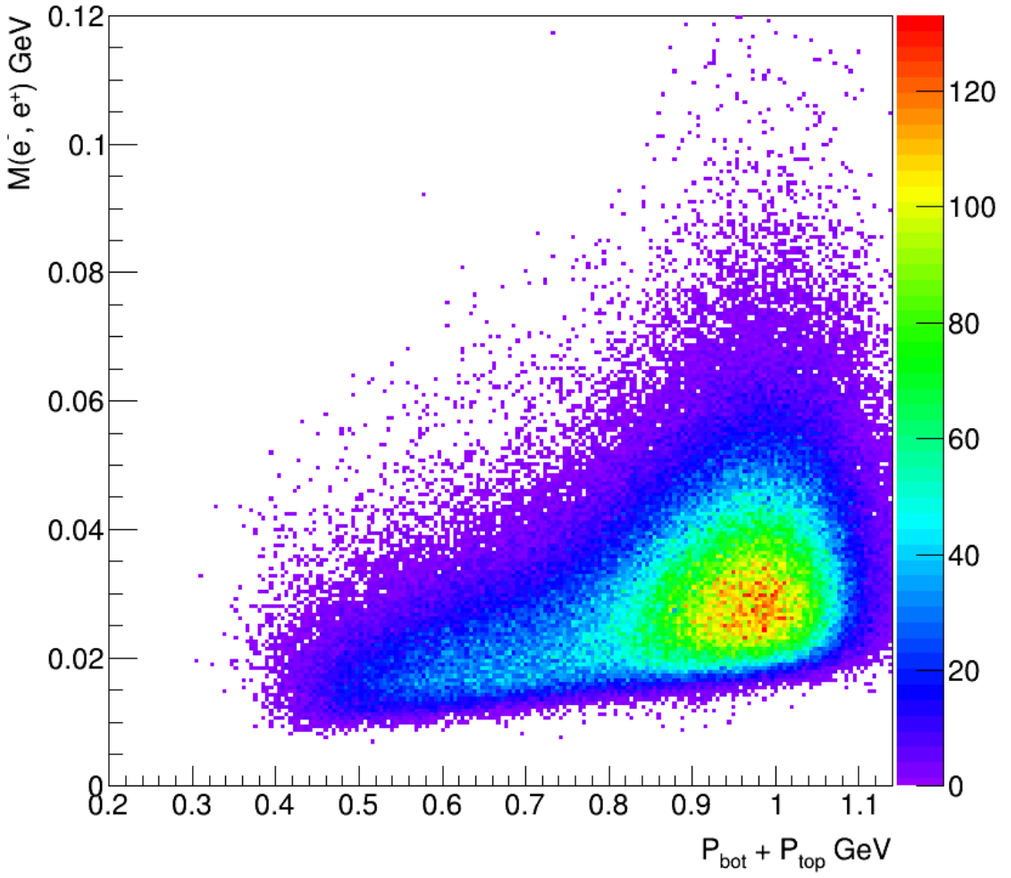


Bottom track is missing

BH

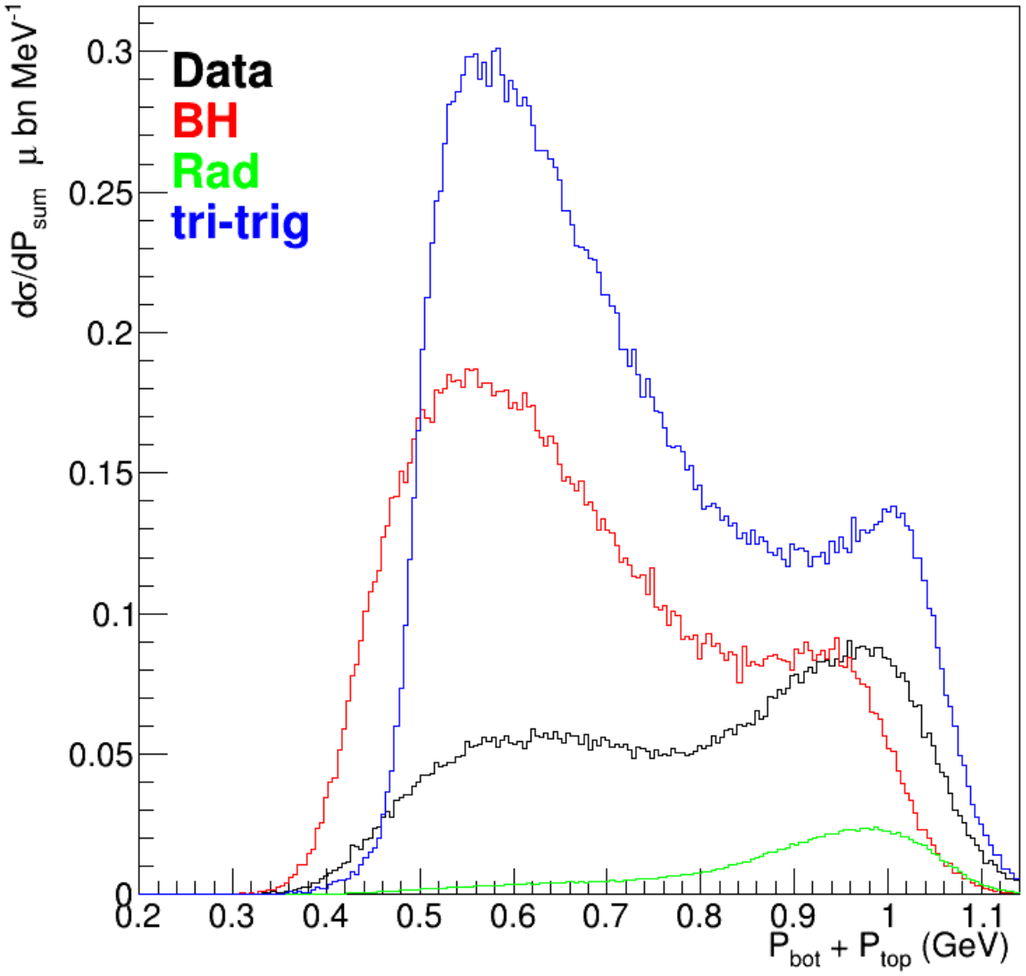

M(e⁻, e⁺) GeV
0.12
0.1
0.08
0.06
0.04
0.02
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
P_bot + P_top GeV
140
120
100
80
60
40
20
0

RAD

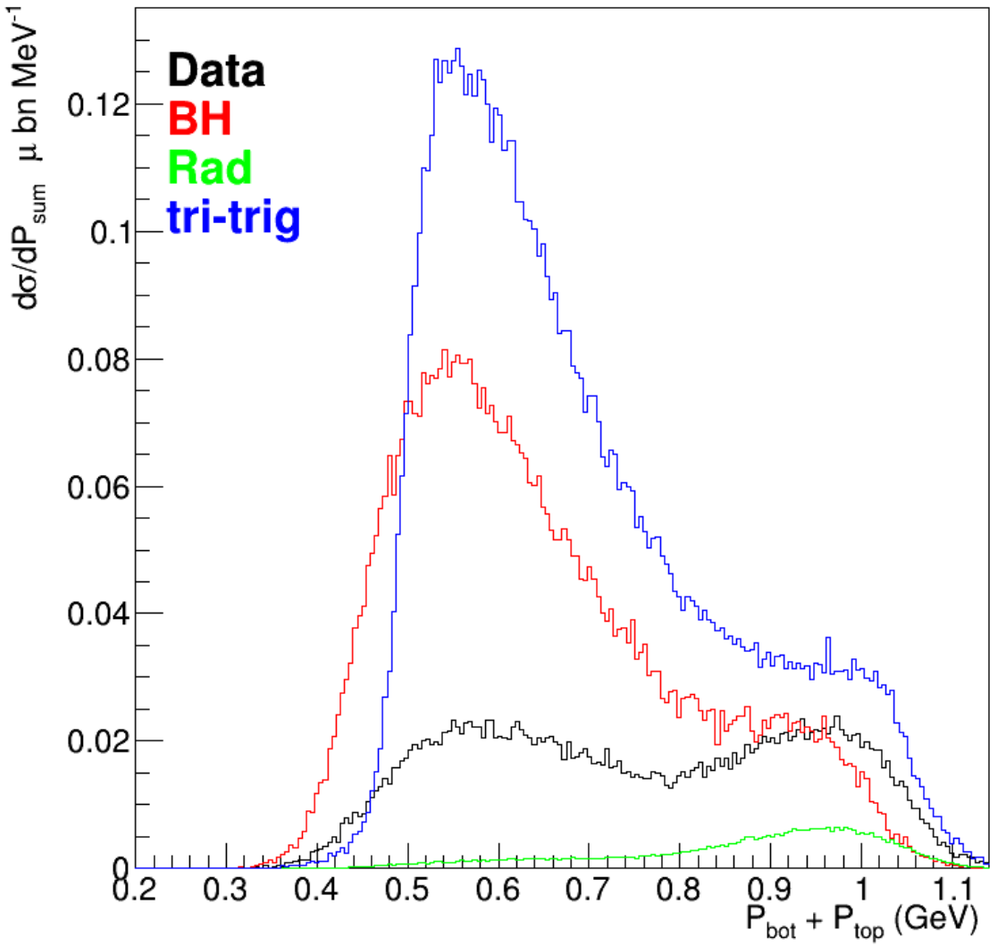

M(e⁻, e⁺) GeV
0.12
0.1
0.08
0.06
0.04
0.02
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
P_bot + P_top GeV
120
100
80
60
40
20
0

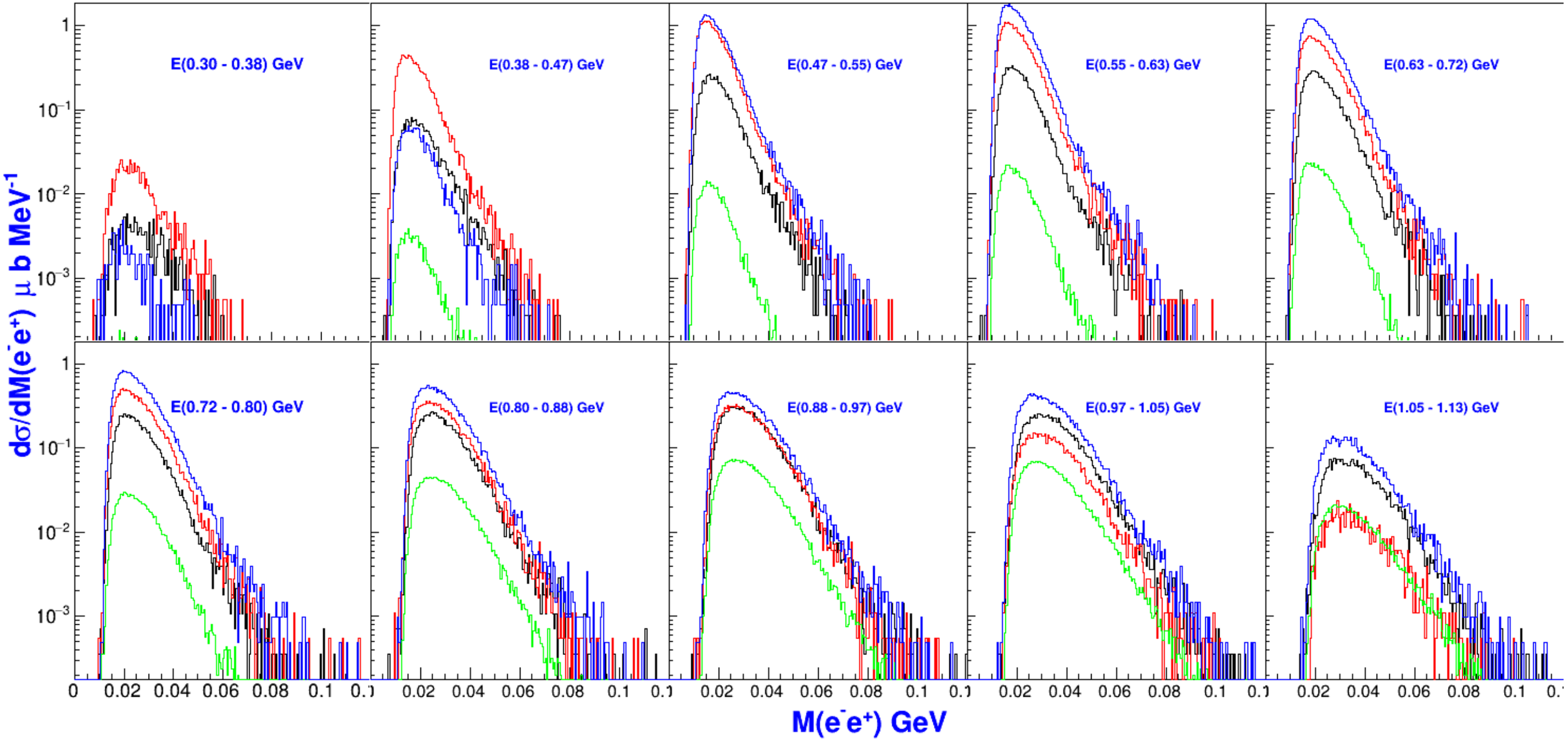
Detected cross section comparison with MC

All Events



Clusters are in a Fiducial region




E(0.30 - 0.38) GeV
E(0.38 - 0.47) GeV
E(0.47 - 0.55) GeV
E(0.55 - 0.63) GeV
E(0.63 - 0.72) GeV
E(0.72 - 0.80) GeV
E(0.80 - 0.88) GeV
E(0.88 - 0.97) GeV
E(0.97 - 1.05) GeV
E(1.05 - 1.13) GeV
dσ/dM(e⁻e⁺) μb MeV⁻¹
M(e⁻e⁺) GeV
1
10⁻¹
10⁻²
10⁻³
0
0.02
0.04
0.06
0.08
0.1

Analyze of pair0

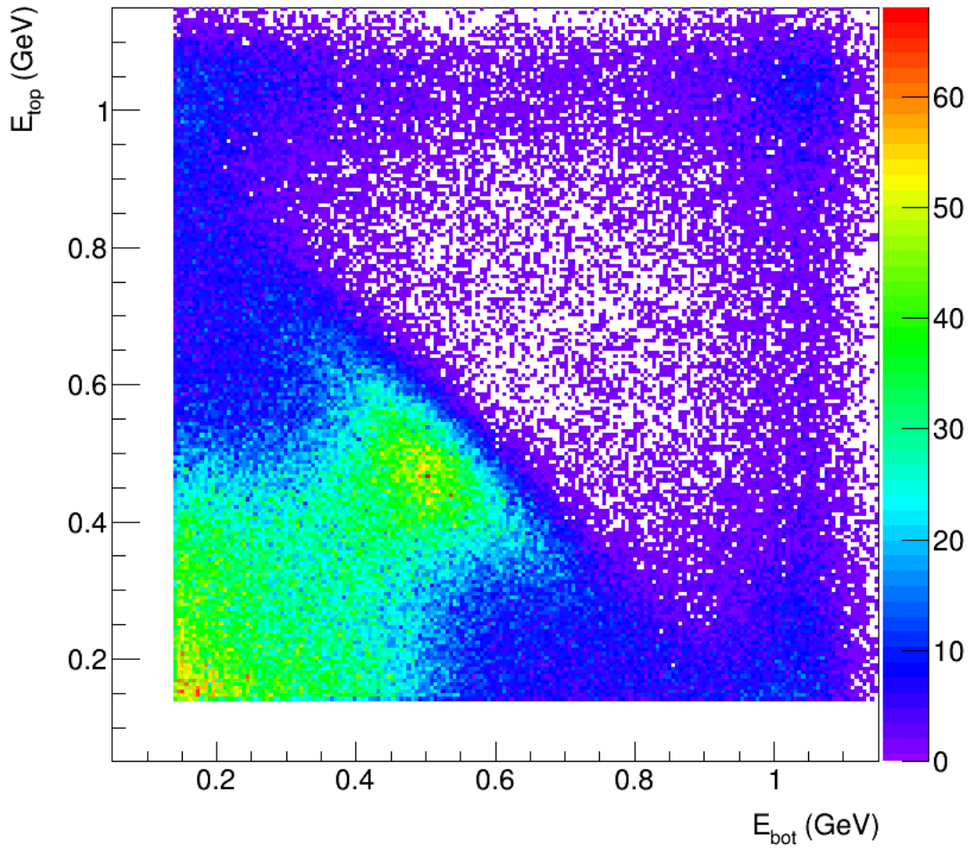
To determine whether the discrepancy between data and MC is related to trigger inefficiency at lower energies, Data from the loose trigger (pair0) was used

Prescale 2×10^{11}: Rates are low, more statistics is needed

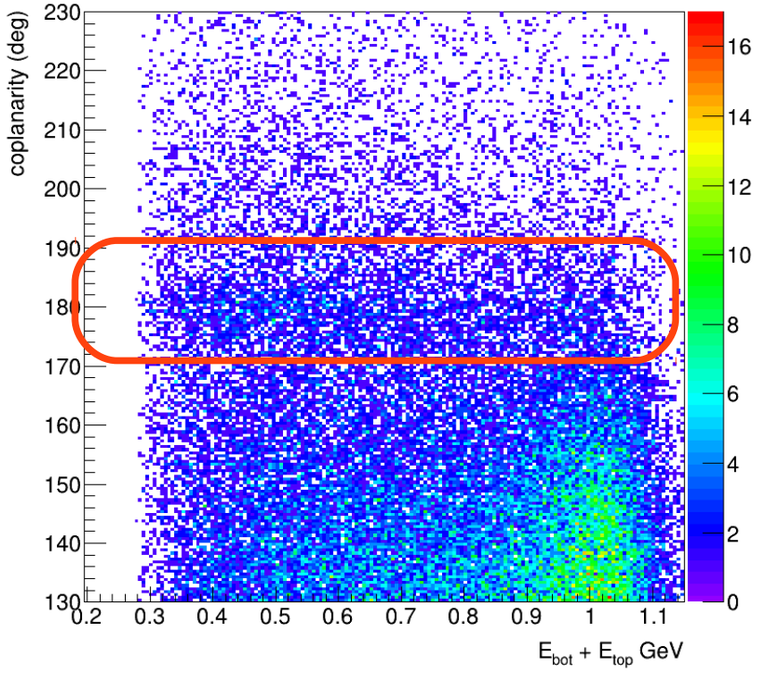
6 Runs: 5770, 5772, 5773, 5795, 5796, 5797

```
# Pairs 0 trigger
SSP_HPS_PAIRS_TIMECOINCIDENCE  0  4
SSP_HPS_PAIRS_EMIN             0  54
SSP_HPS_PAIRS_EMAX             0  1100
SSP_HPS_PAIRS_NMIN             0  1
SSP_HPS_PAIRS_SUMMAX_MIN       0  2000 120 1
SSP_HPS_PAIRS_DIFFMAX          0  1000   1
SSP_HPS_PAIRS_COPLANARITY      0  180    0
SSP_HPS_PAIRS_ENERGYDIST       0  5.5  100 0
```

Pair0 triggers: All time coincident pairs

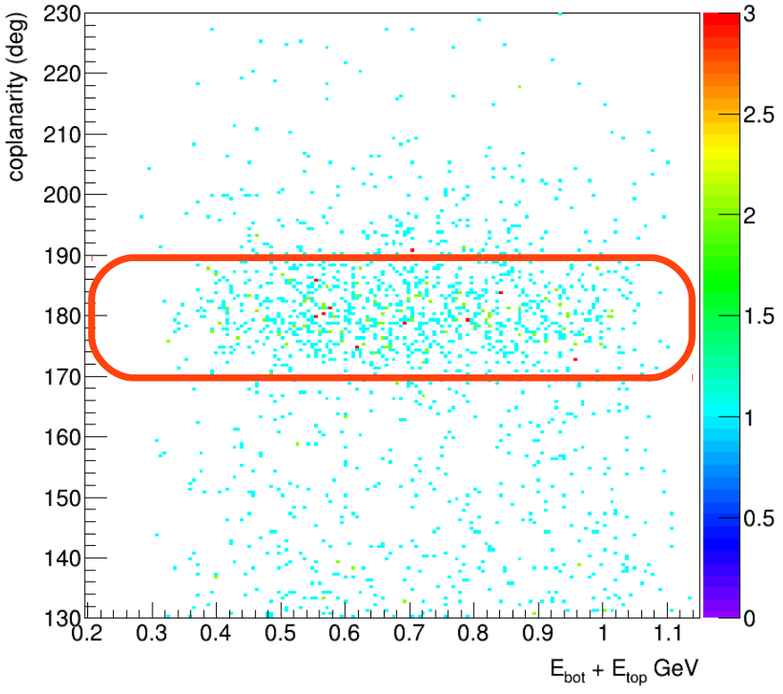


Ecal only, coincident pairs



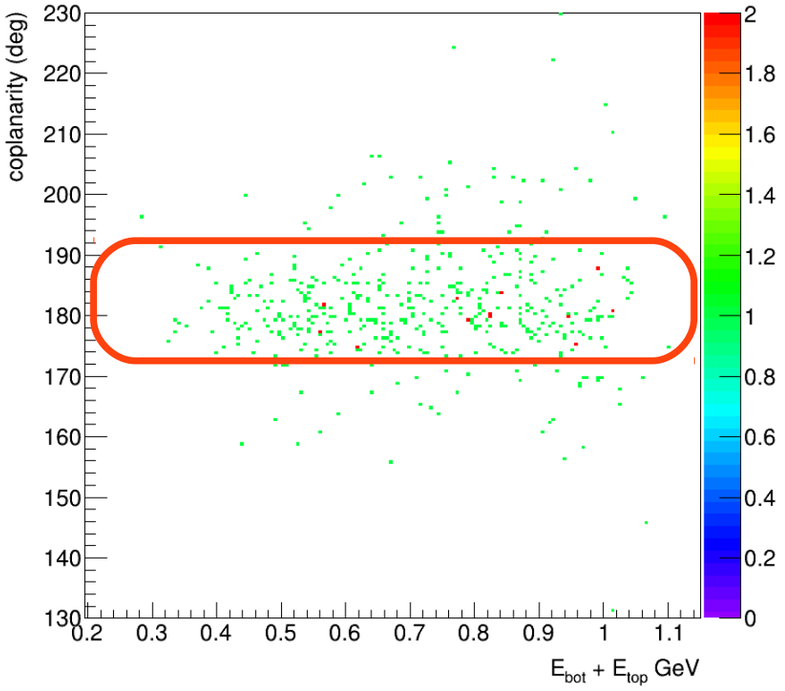
268K events

Bot/top, neg/pos >= 1



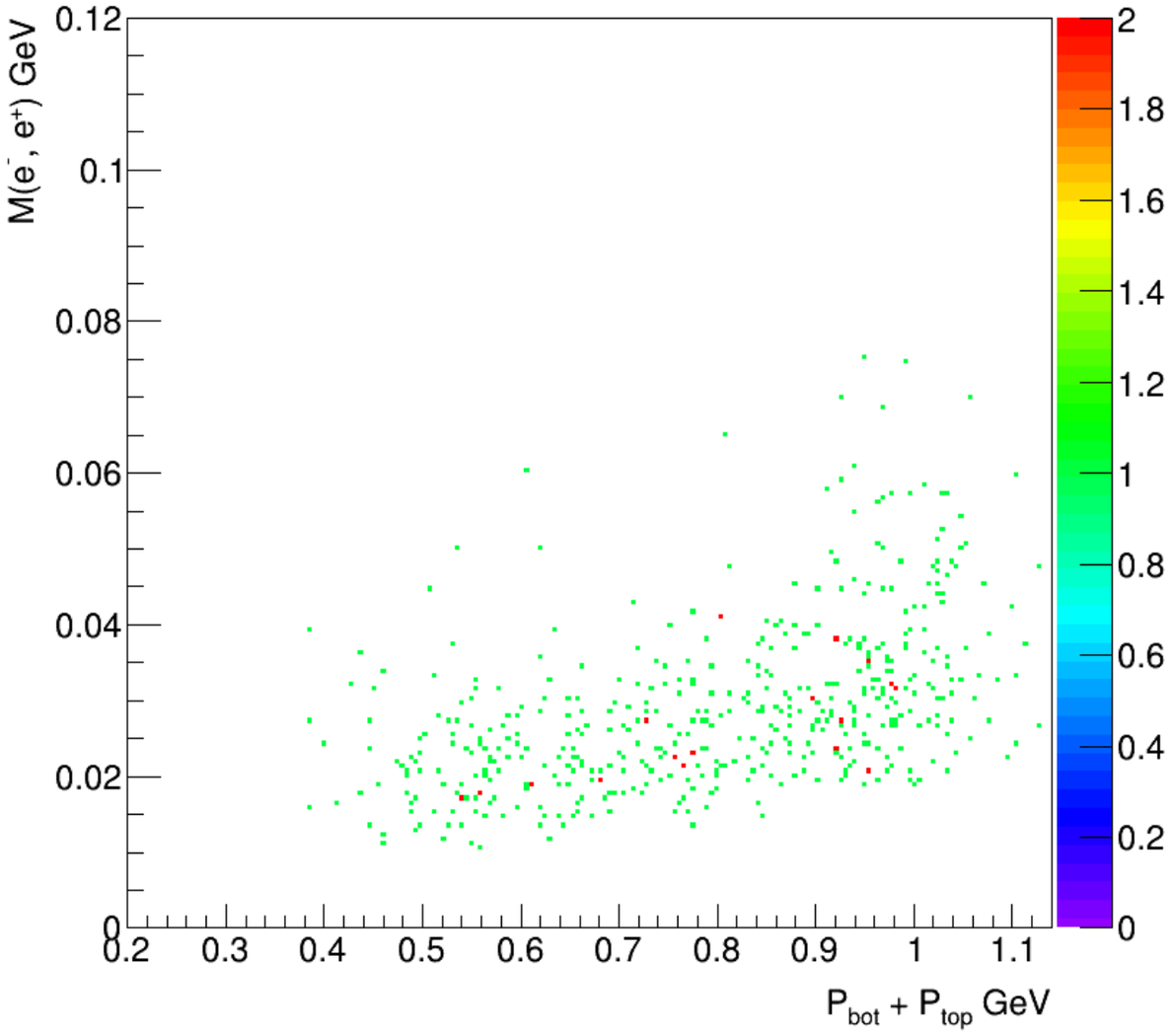
9370 events

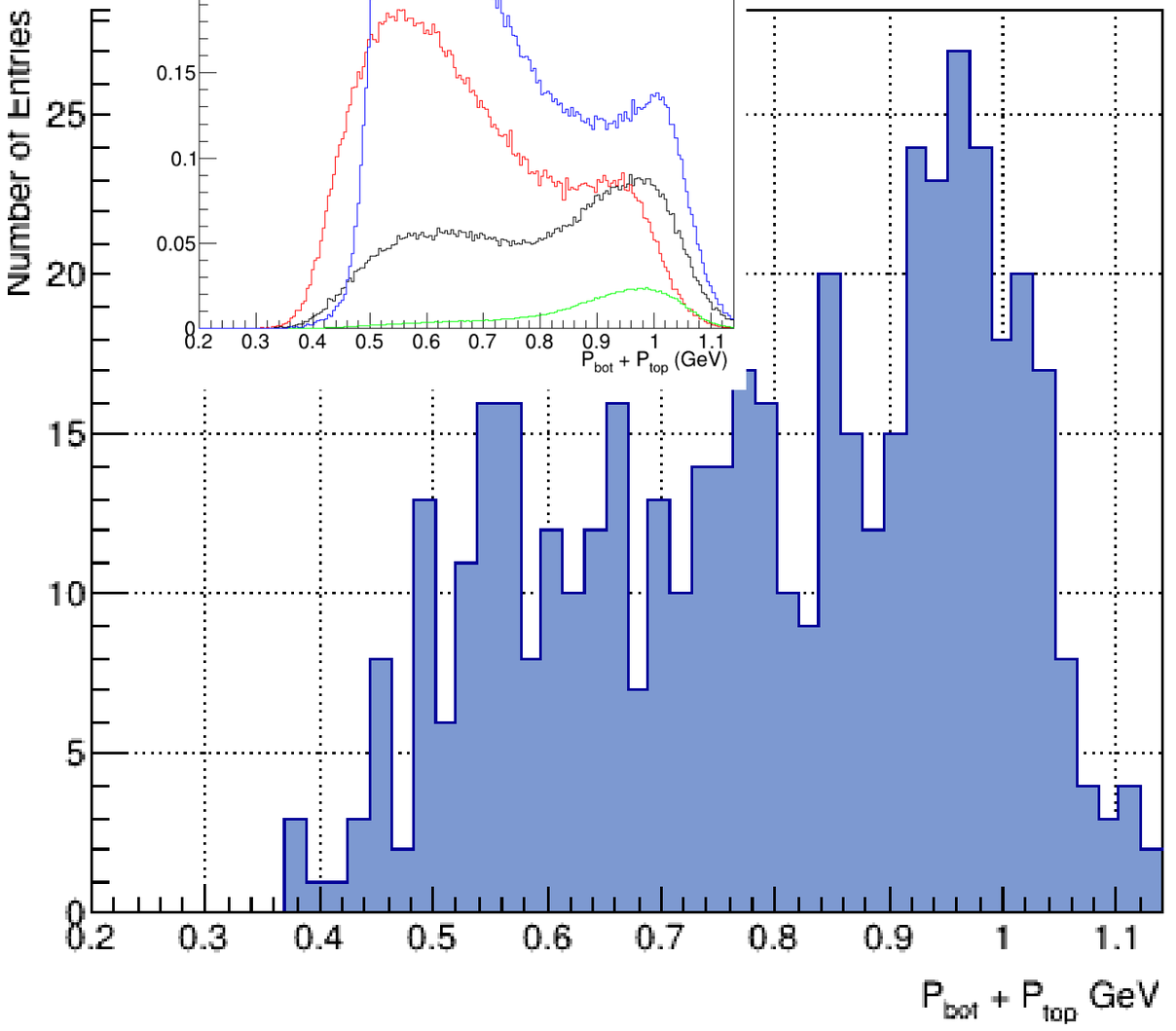
Trident sampls



498 events

Pair0


M(e⁻, e⁺) GeV
0.12
0.1
0.08
0.06
0.04
0.02
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
P_bot + P_top GeV
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0


Number of Entries
25
20
15
10
5
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
P_bot + P_top GeV

dσ/dP_sum μ bn MeV⁻¹
Data
BH
Rad
tri-trig
0.3
0.25
0.2
0.15
0.1
0.05
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
P_bot + P_top (GeV)

Summary

The discussed method seems select tridents samples cleanly, but should be studied more carefully
To improve selection efficiencies

Kinematic distributions and absolute normalizations from different runs are quite consistent
with each other.

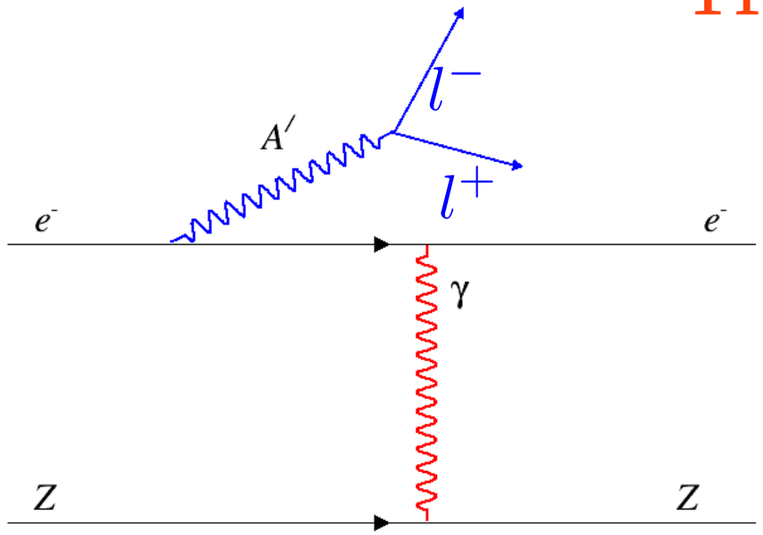
However, data is not described with Monte Carlo simulations

Analyzing pair0 trigger data, seems the trigger is not the main cause of the MC/Data discrepancy,
and probably it is from the generator.

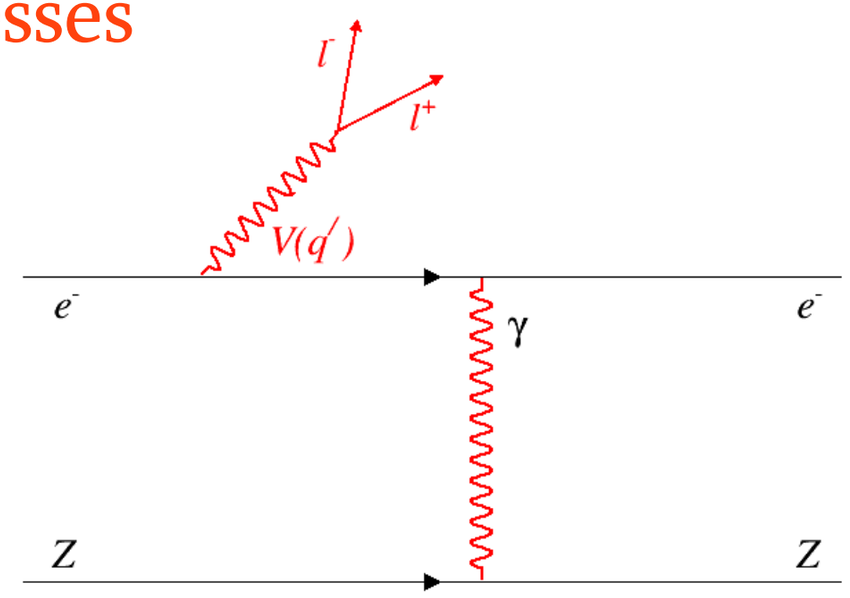
Serious effort should be devoted on understanding/modifying the event generator to
match the data.

Buckups

Tridents: sub processes



Bremsstrahlung of heavy photons



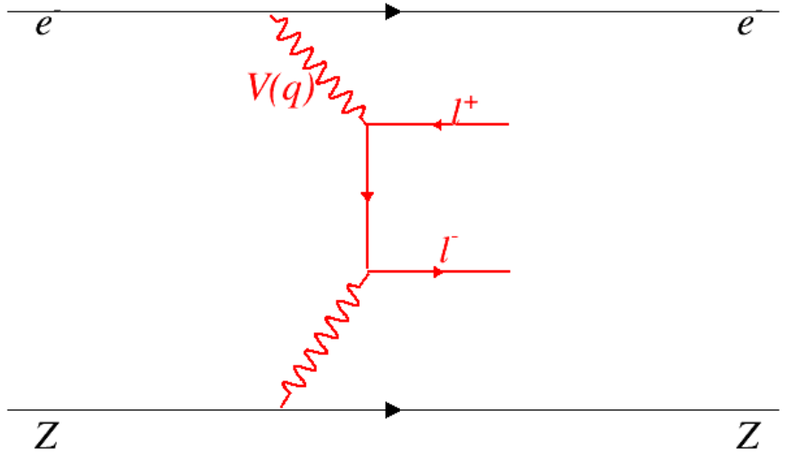
Radiation of time-like photon

The Final State

$$e + p \rightarrow e' e^- e^+ p$$

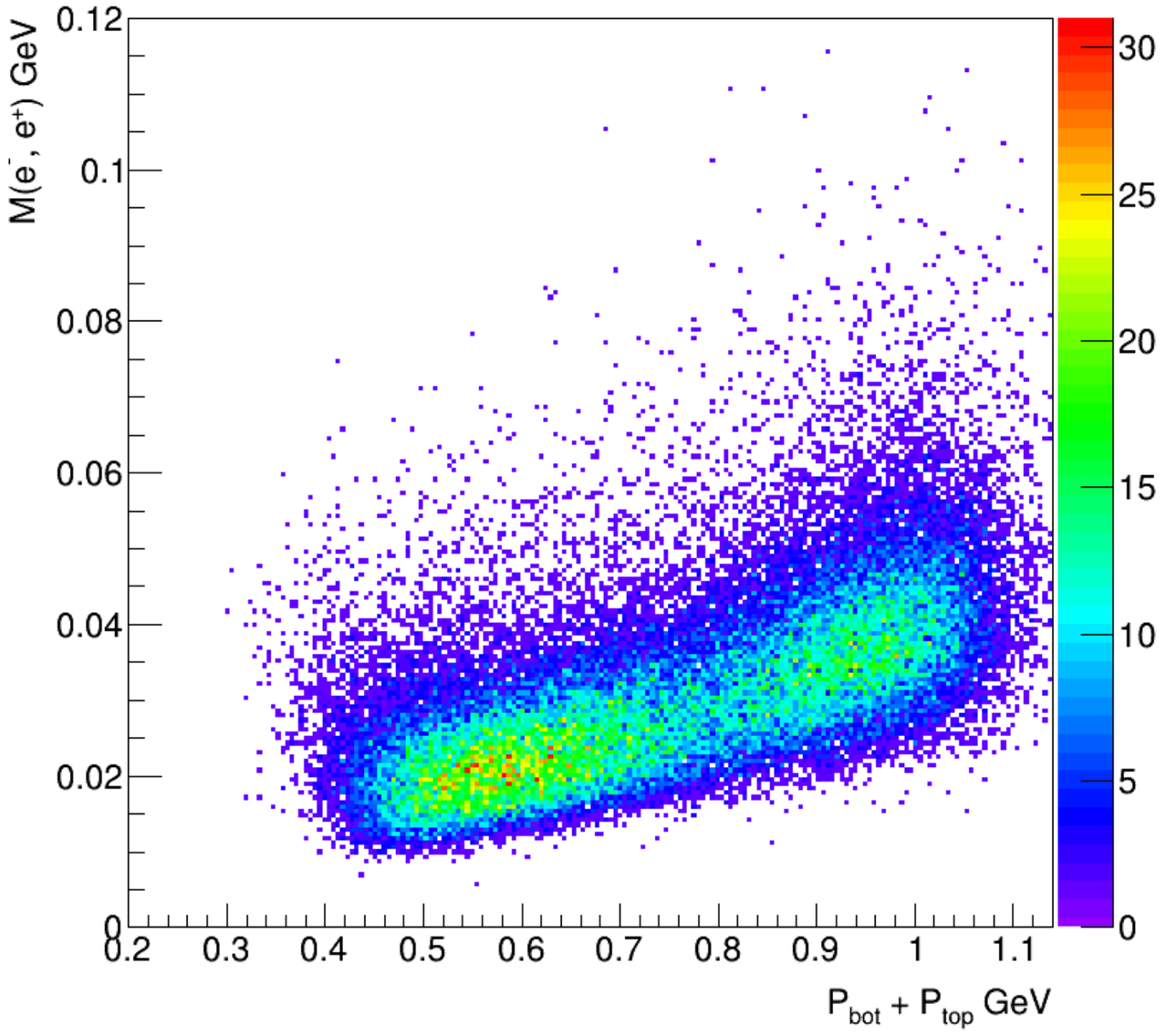
- Signal and the timelike photon production have similar kinematics, and peaked at $E_{\gamma', A'} \sim E_b$, and beam e^- will have small energy and will escape detection in HPS setup

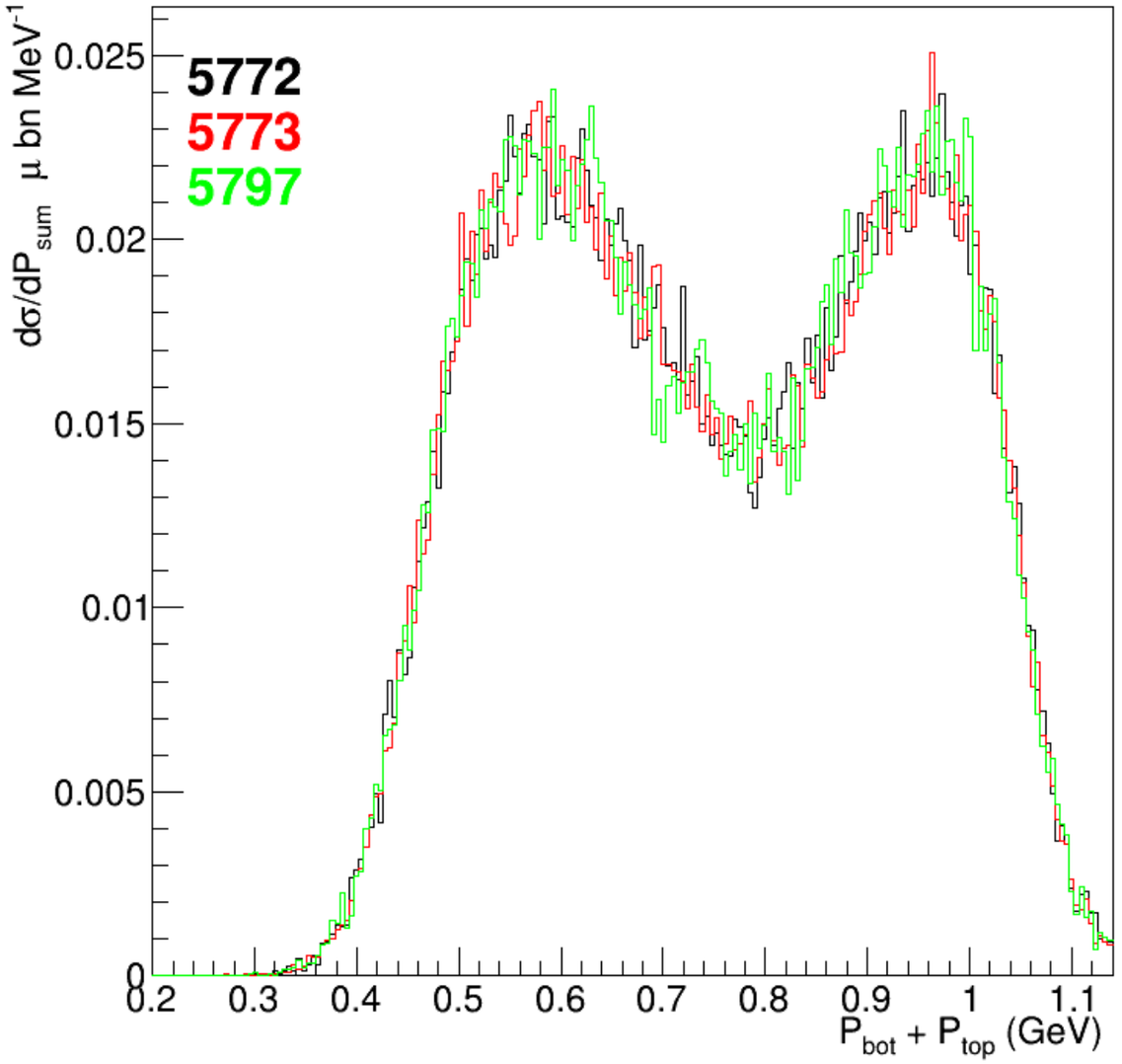
- BH has much larger cross-section but has different kinematics, and peaked et low energies



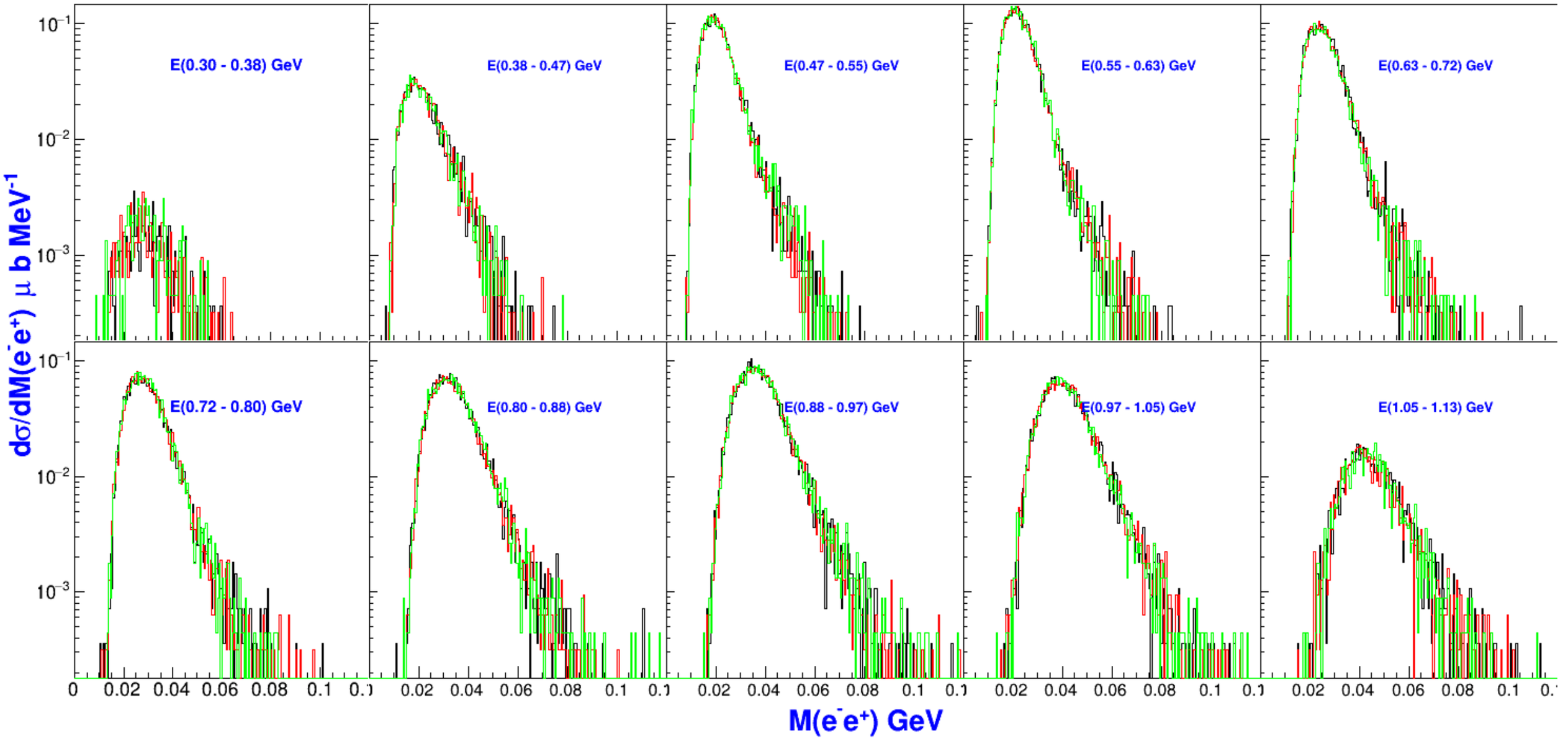
Bethe Heitler

In Fiducial region



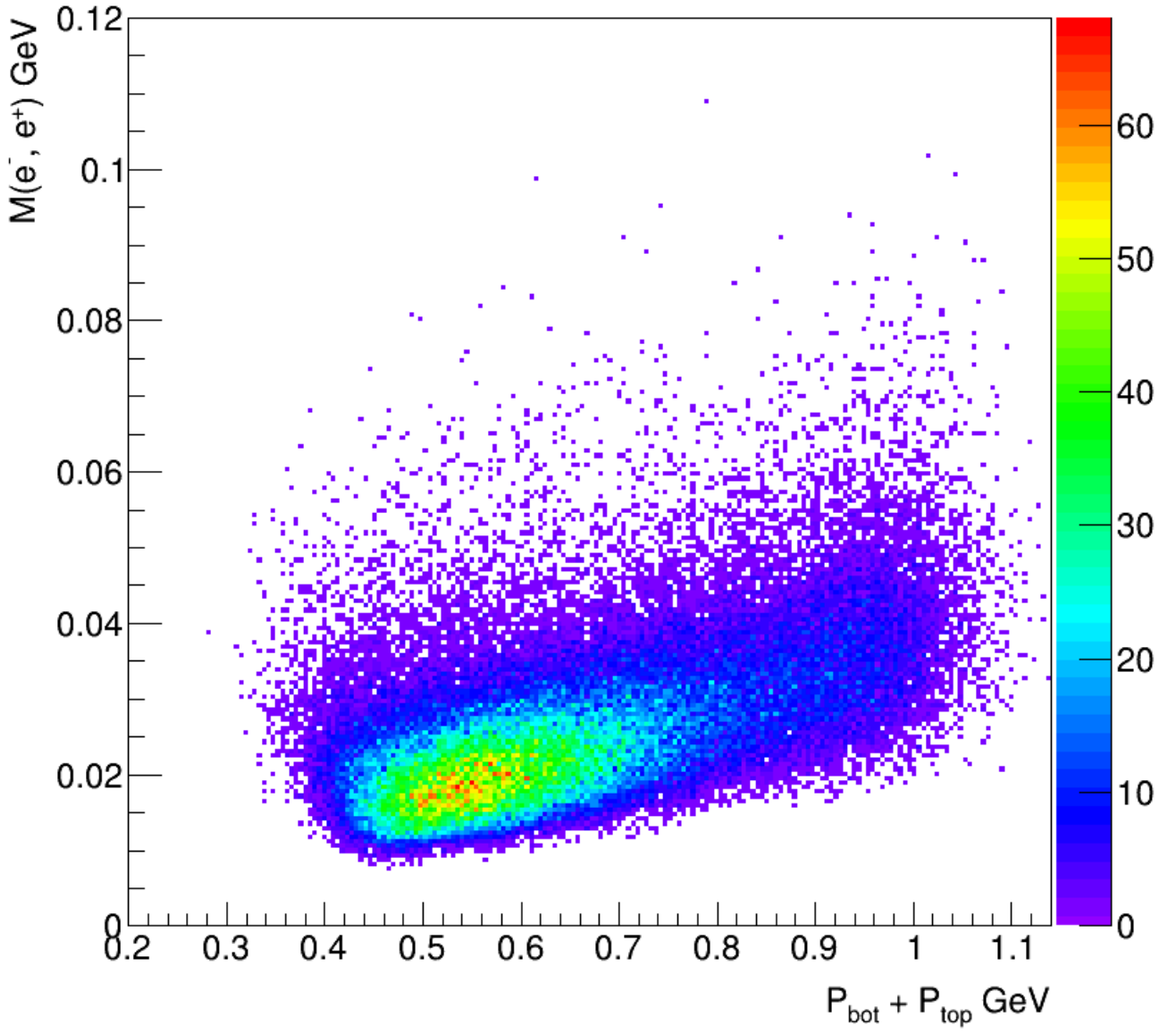


In Fiducial region

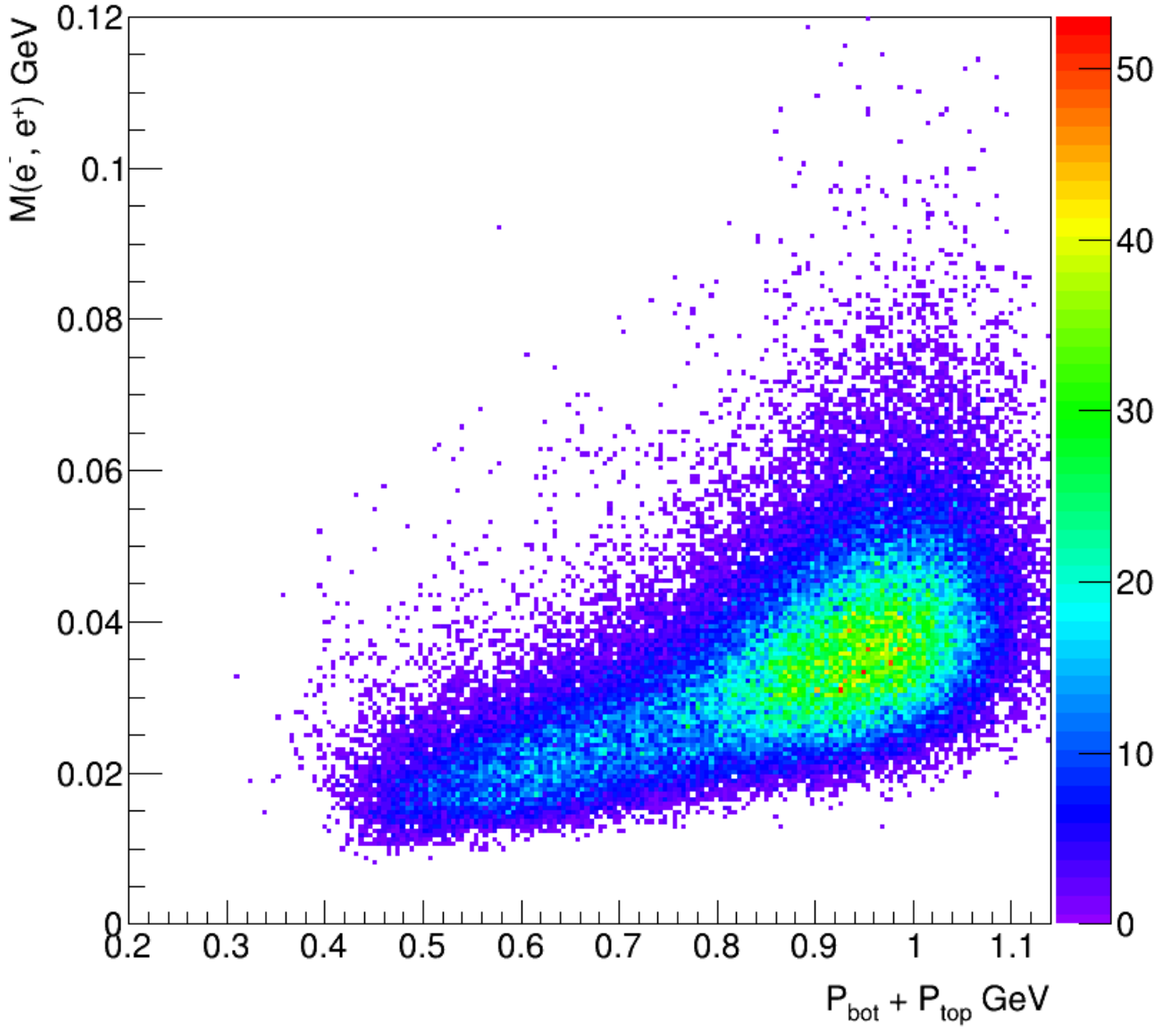


In Fiducial region

BH



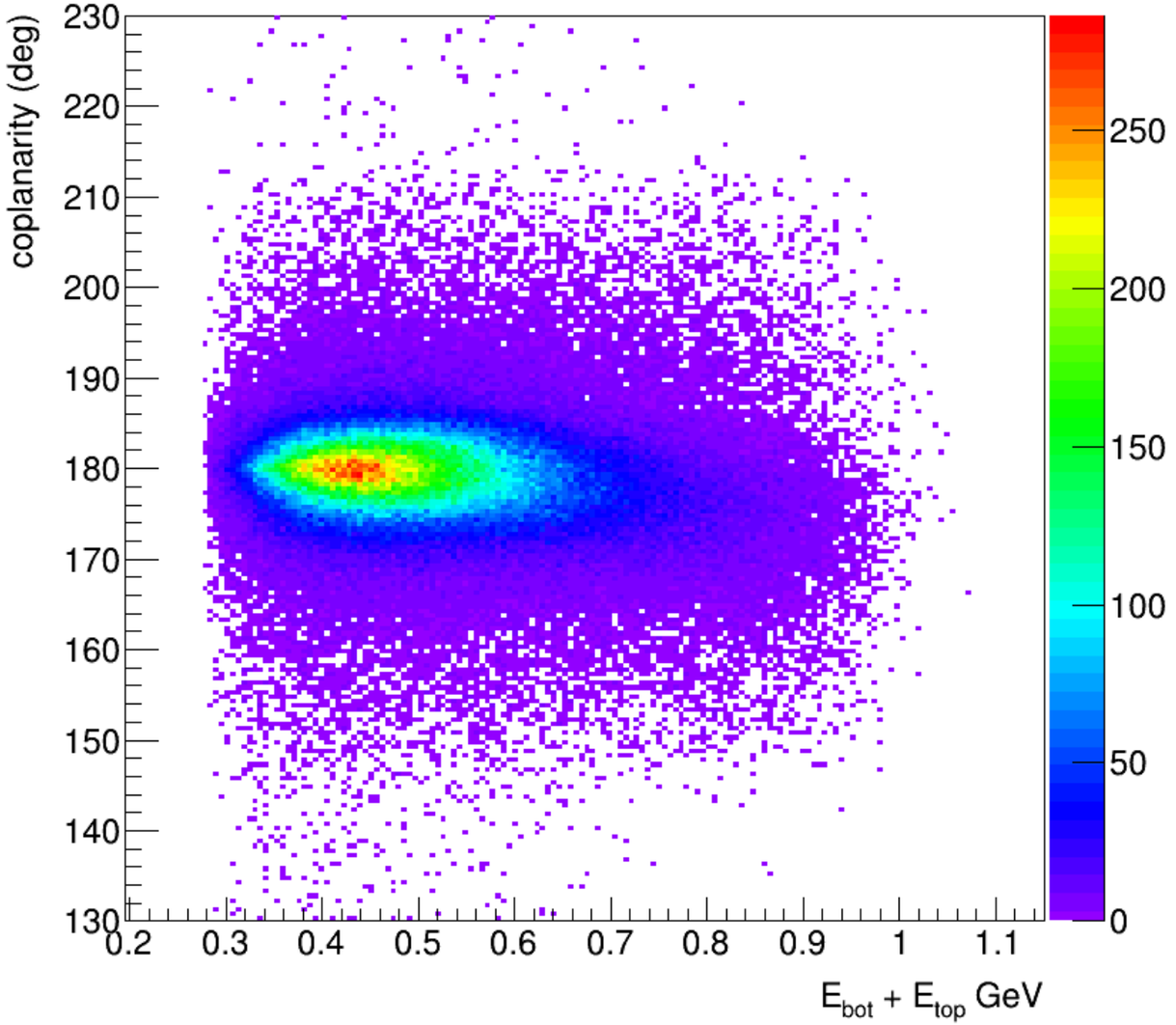
Radiative tridents



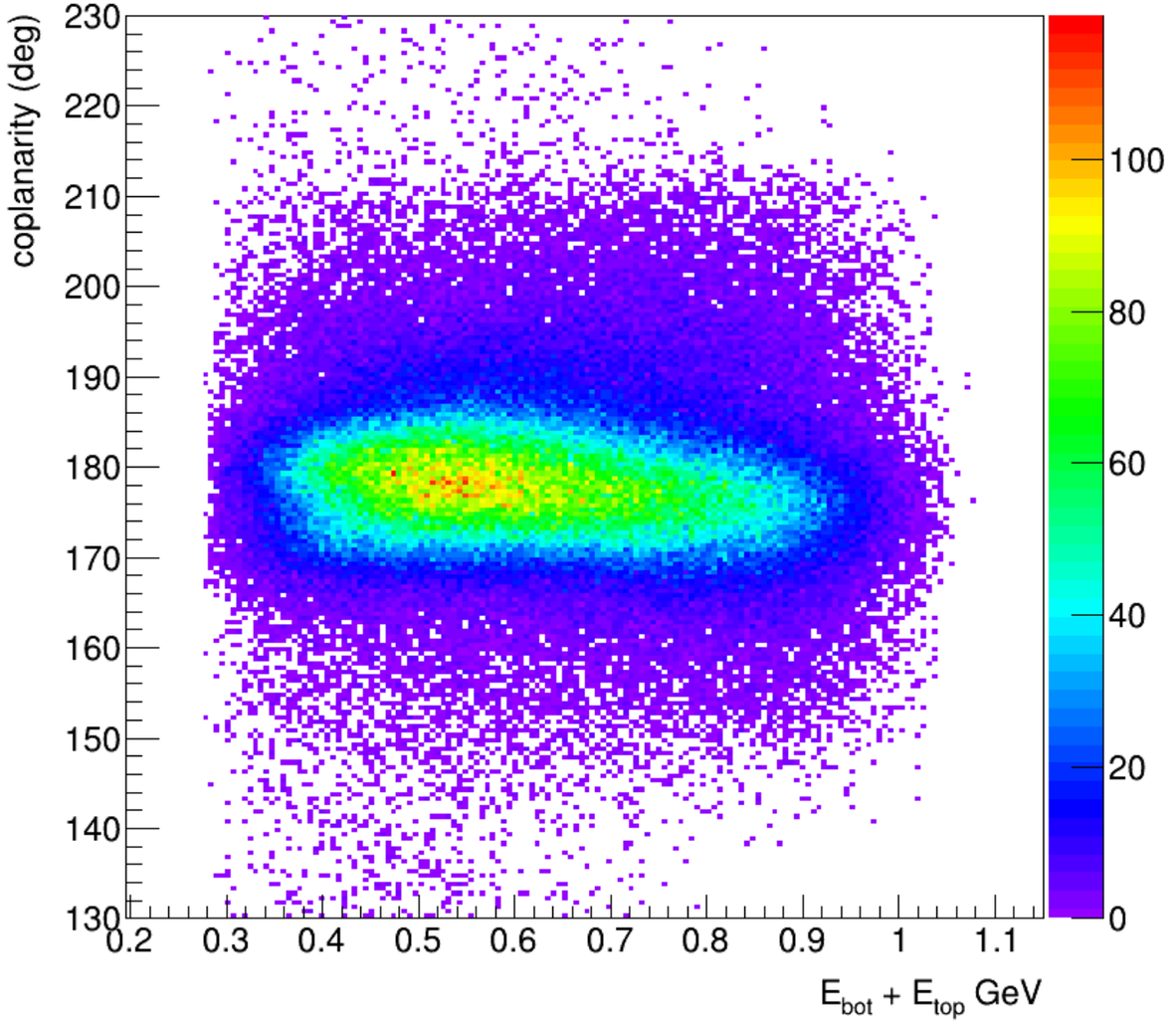
Events that fail at “least 1 bot 1 top 1 neg 1pos track“

Because tracks hit 1st level rows, because of shower leakage energy is shifted to the lower energy part

BH

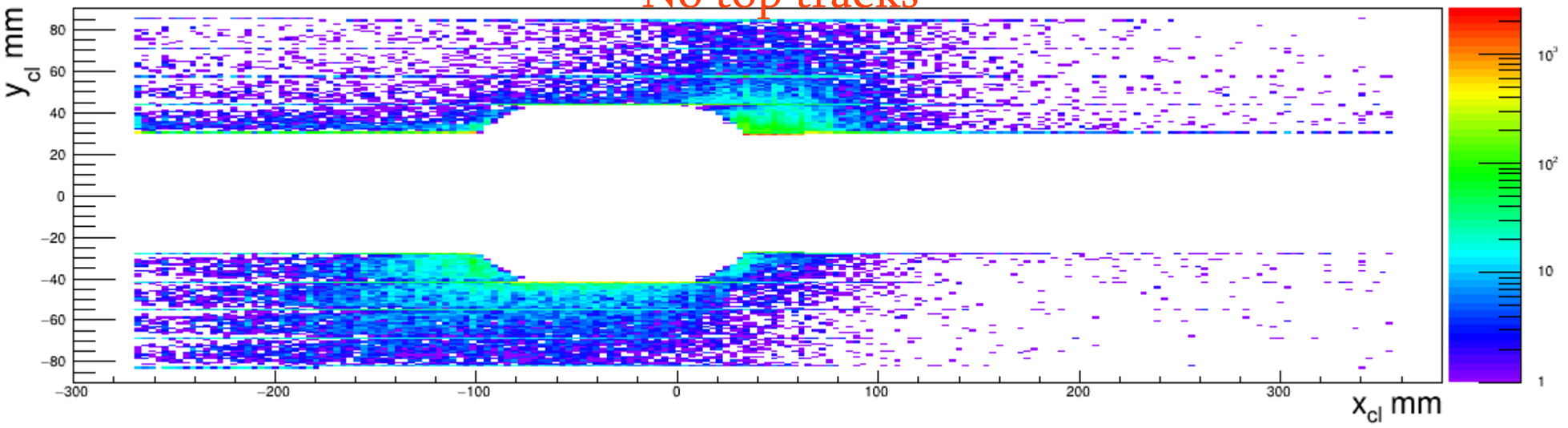


Radiative tridents

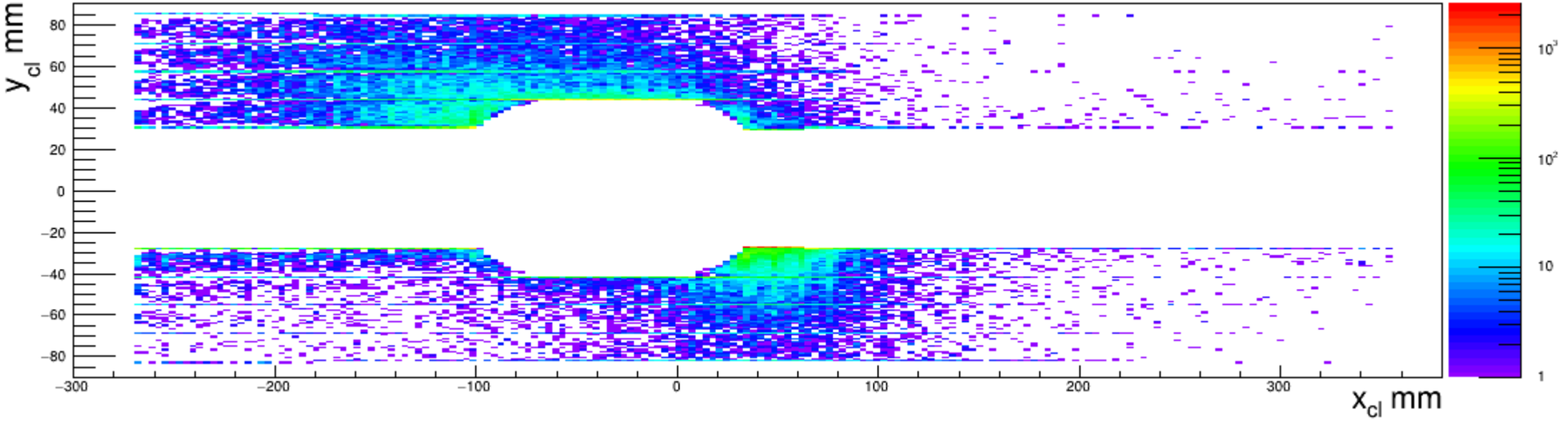


Pair0

No top tracks

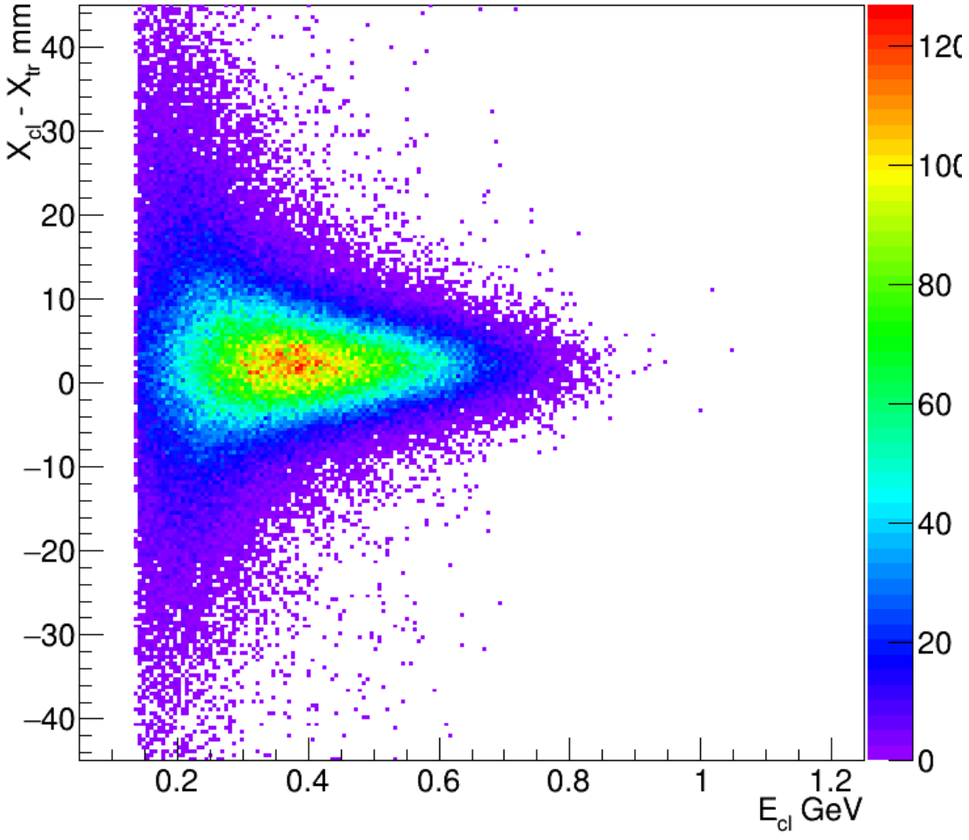


No Bottom tracks



Track-cluster matching for the selected pairs

Bottom



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