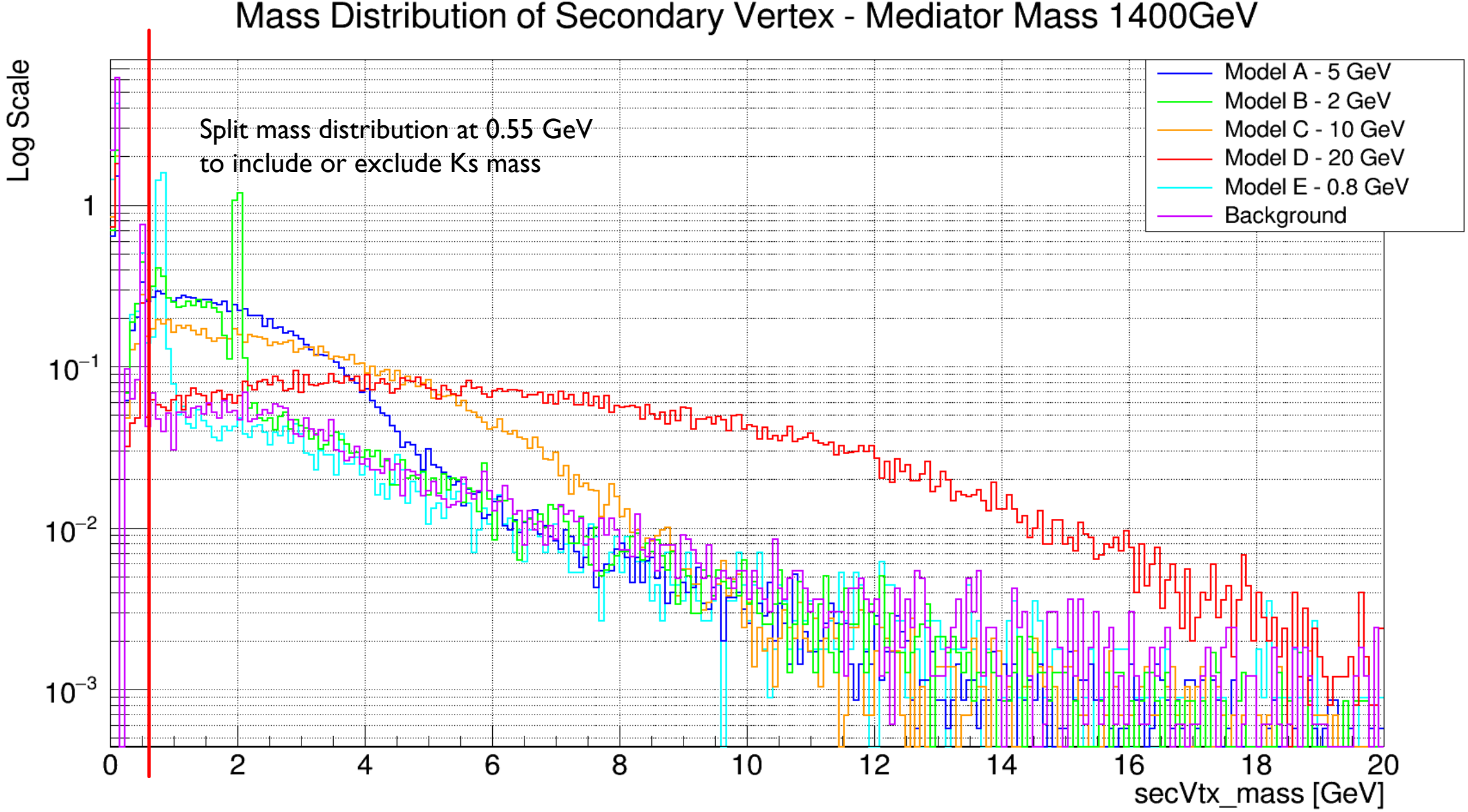
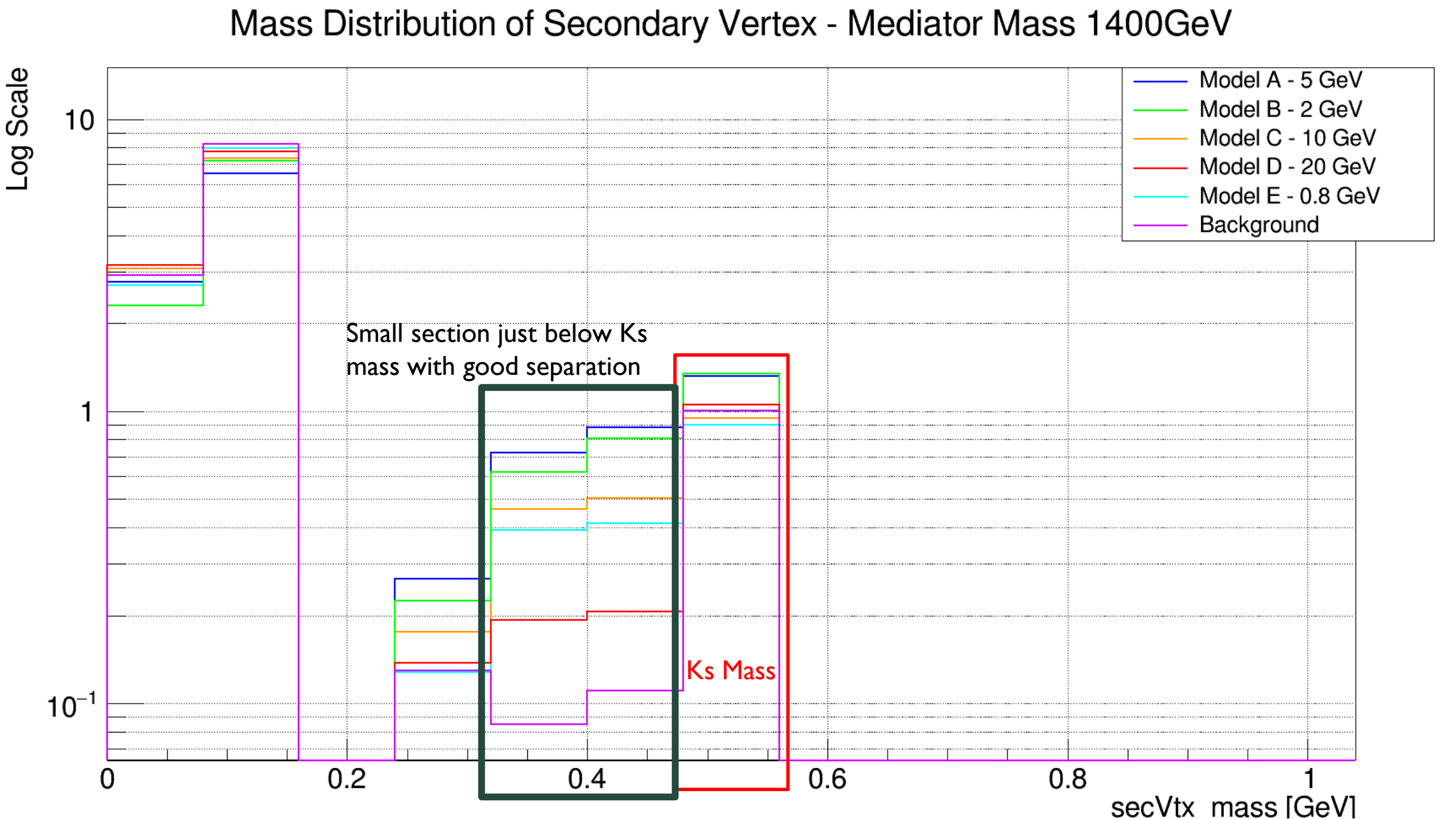
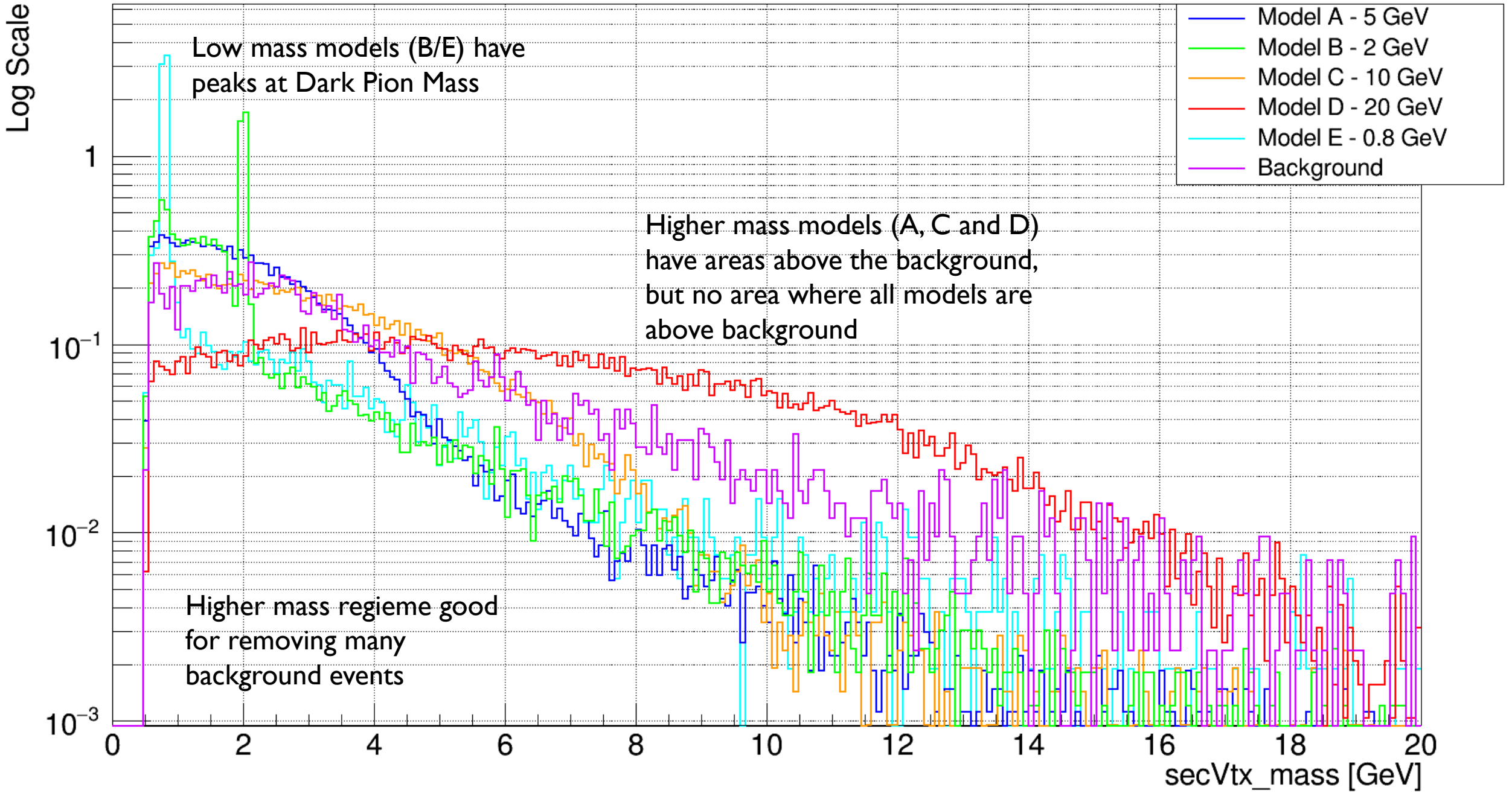
POTENTIAL SECONDARY VERTEX DISCRIMINATORS

MAY 28, 2020

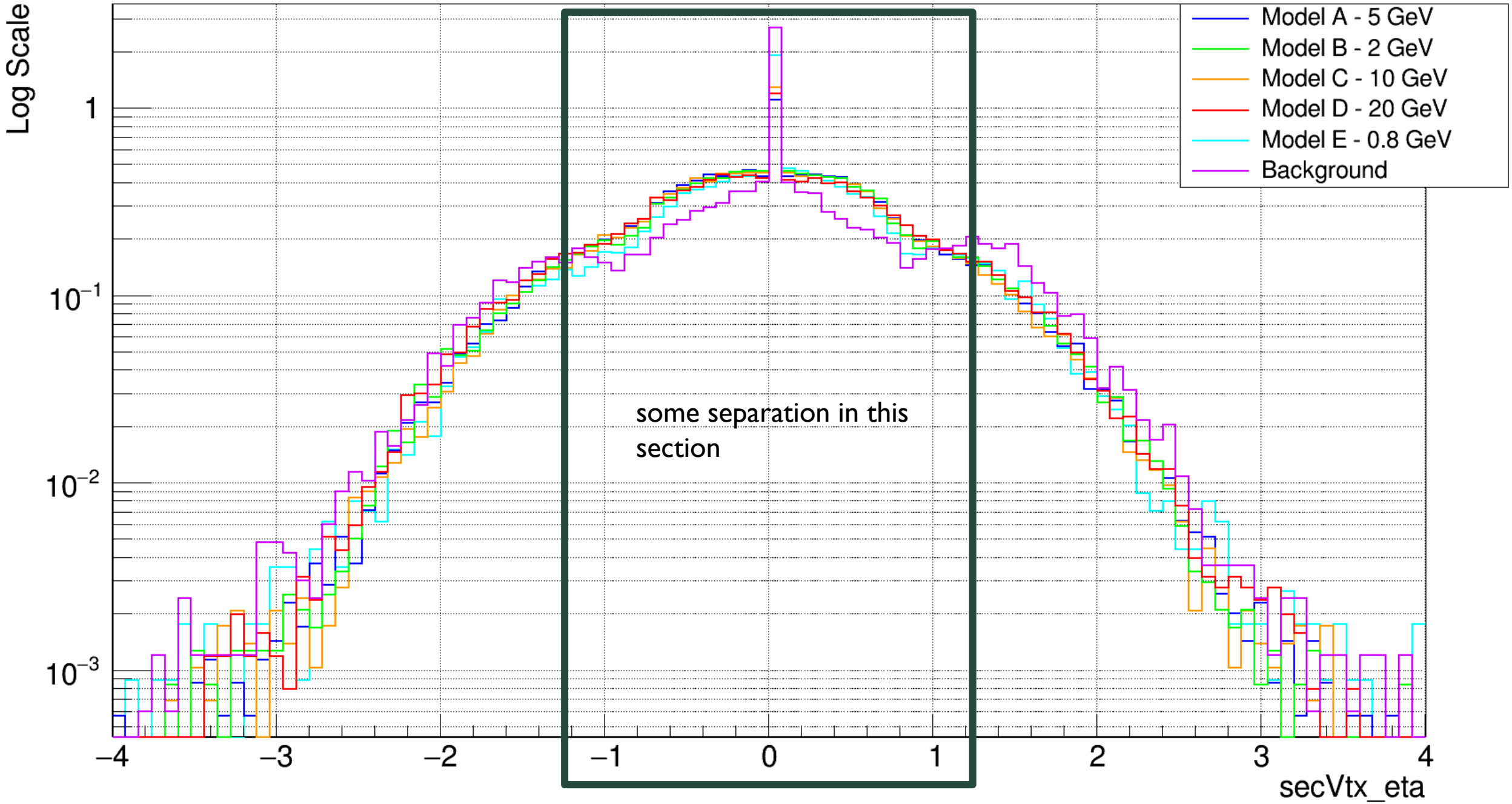

Mass Distribution of Secondary Vertex - Mediator Mass 1400GeV
Log Scale
Split mass distribution at 0.55 GeV
to include or exclude Ks mass
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
1
10^{-1}
10^{-2}
10^{-3}
0
2
4
6
8
10
12
14
16
18
20
secVtx_mass [GeV]


Mass Distribution of Secondary Vertex - Mediator Mass 1400GeV
Log Scale
10
1
10^{-1}
0
0.2
0.4
0.6
0.8
1
secVtx mass [GeV]
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
Small section just below Ks mass with good separation
Ks Mass

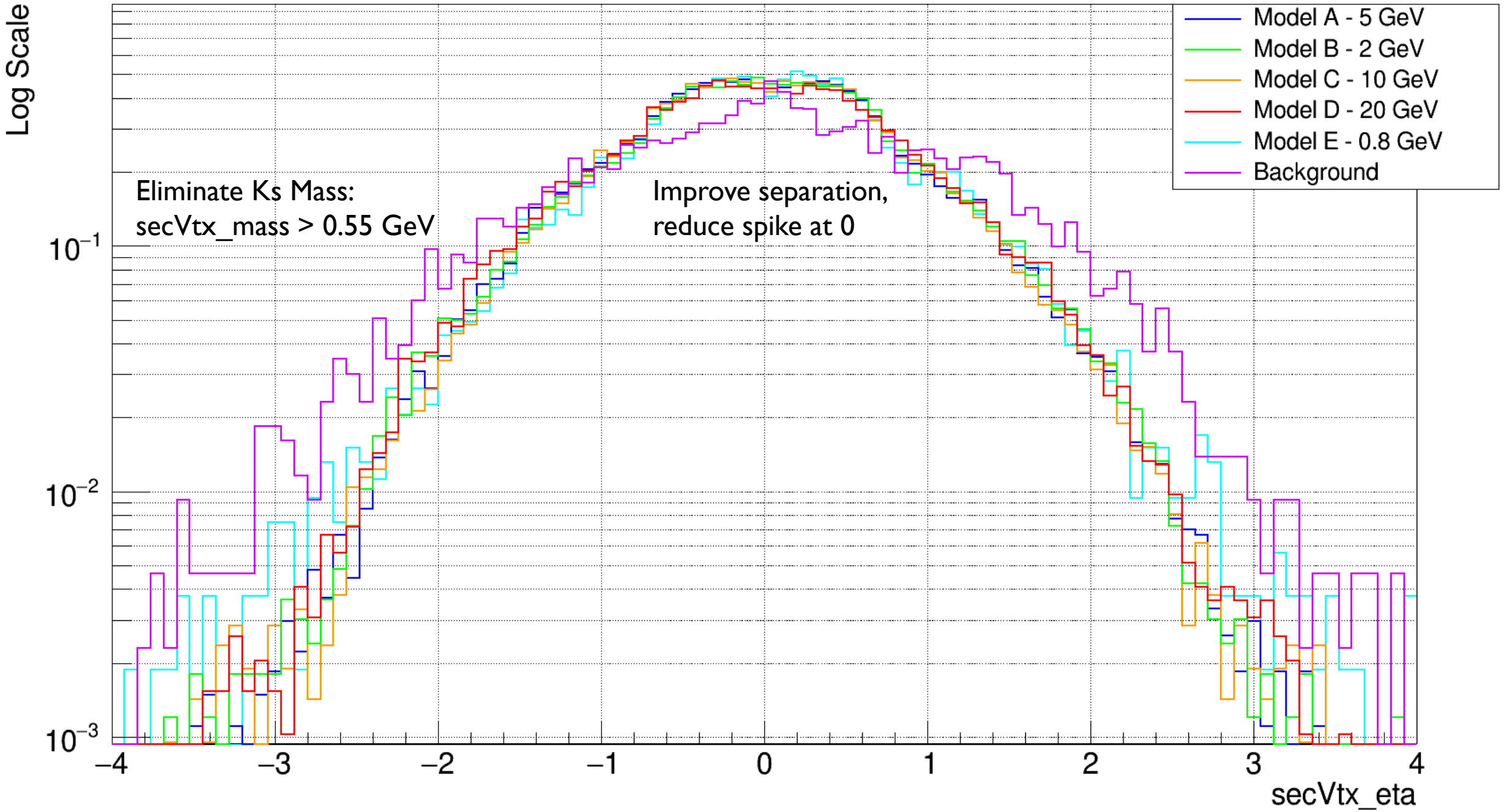
Mass Distribution of Secondary Vertex - Mediator Mass 1400GeV

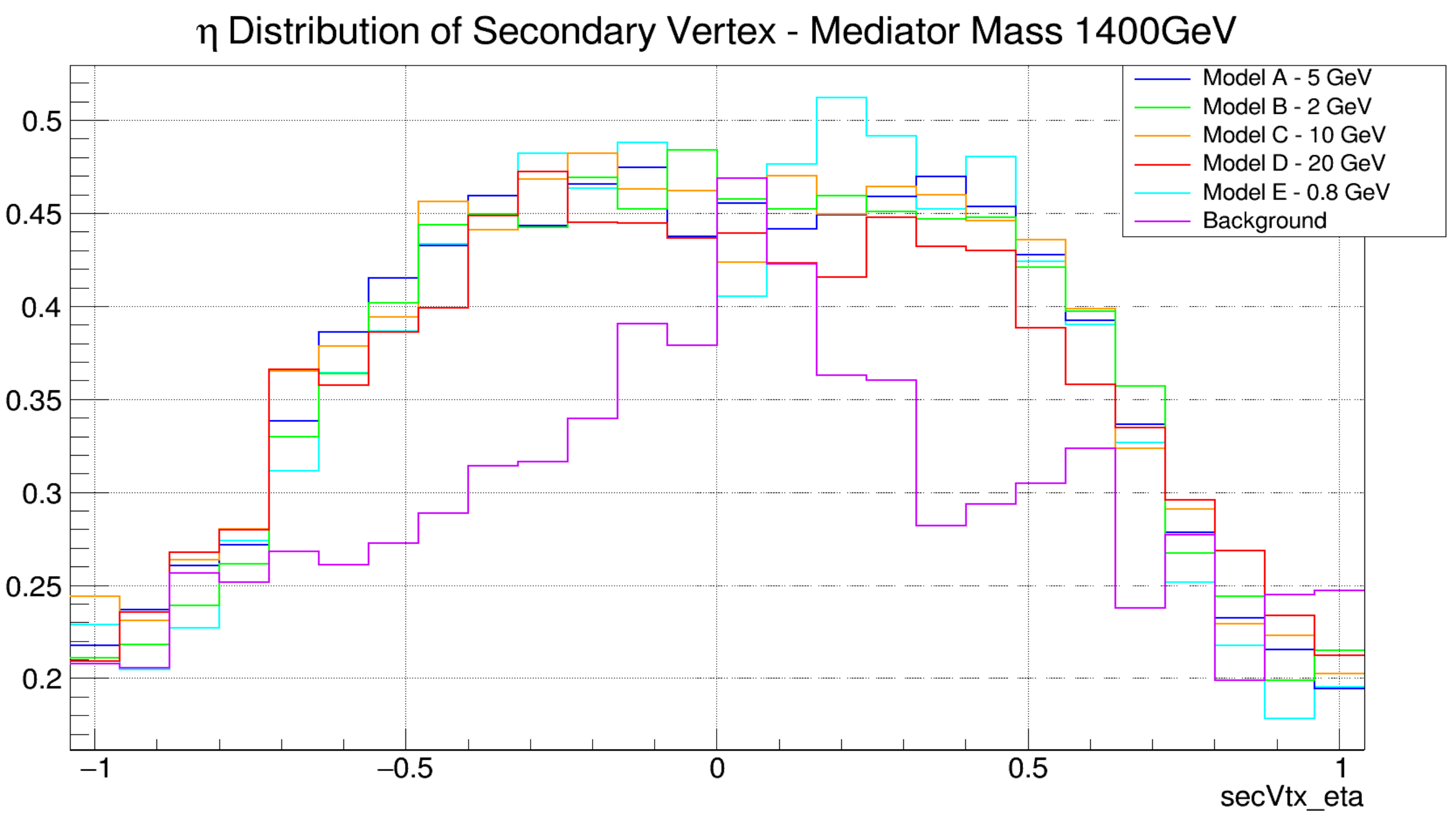


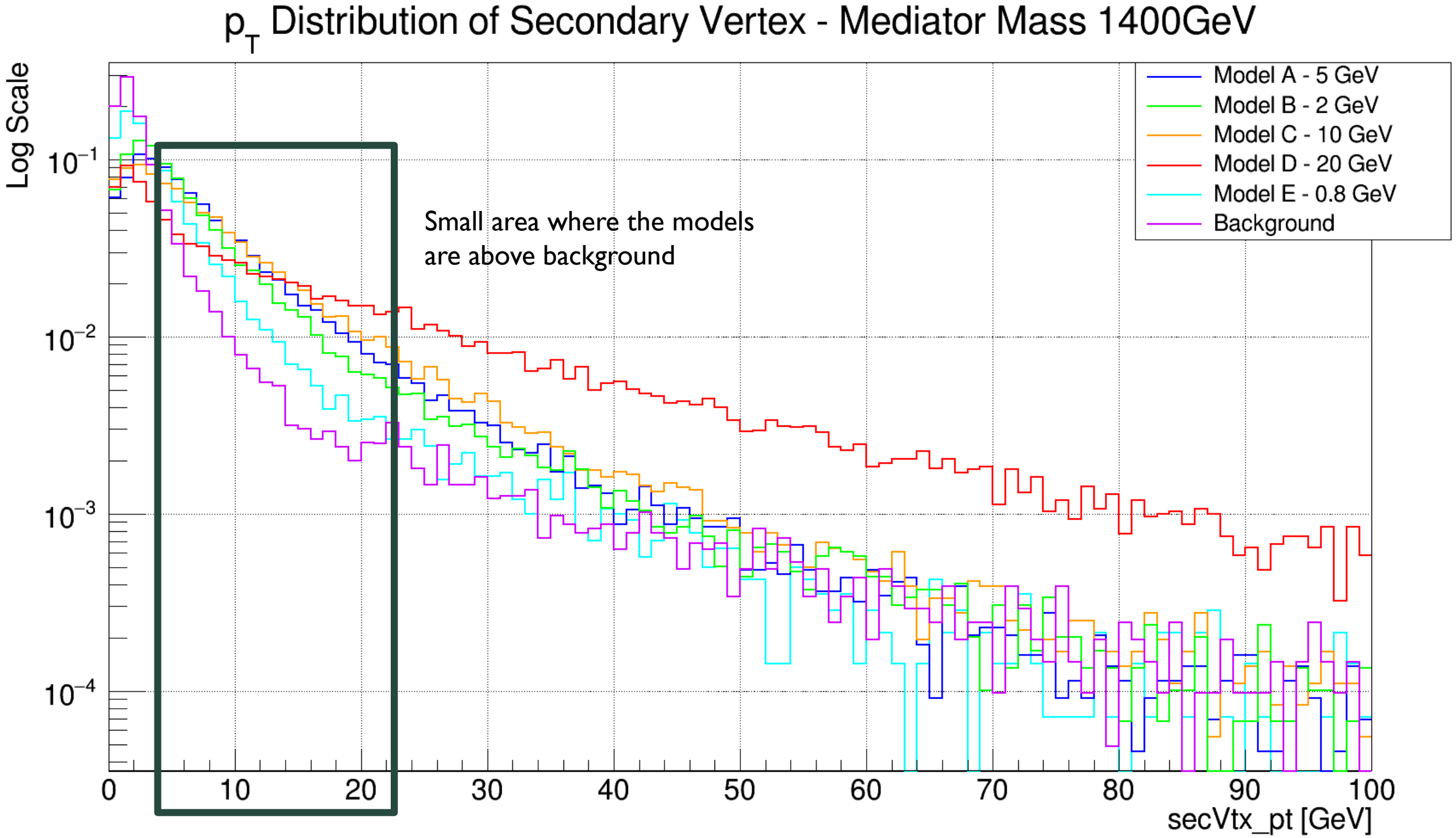
η Distribution of Secondary Vertex - Mediator Mass 1400GeV

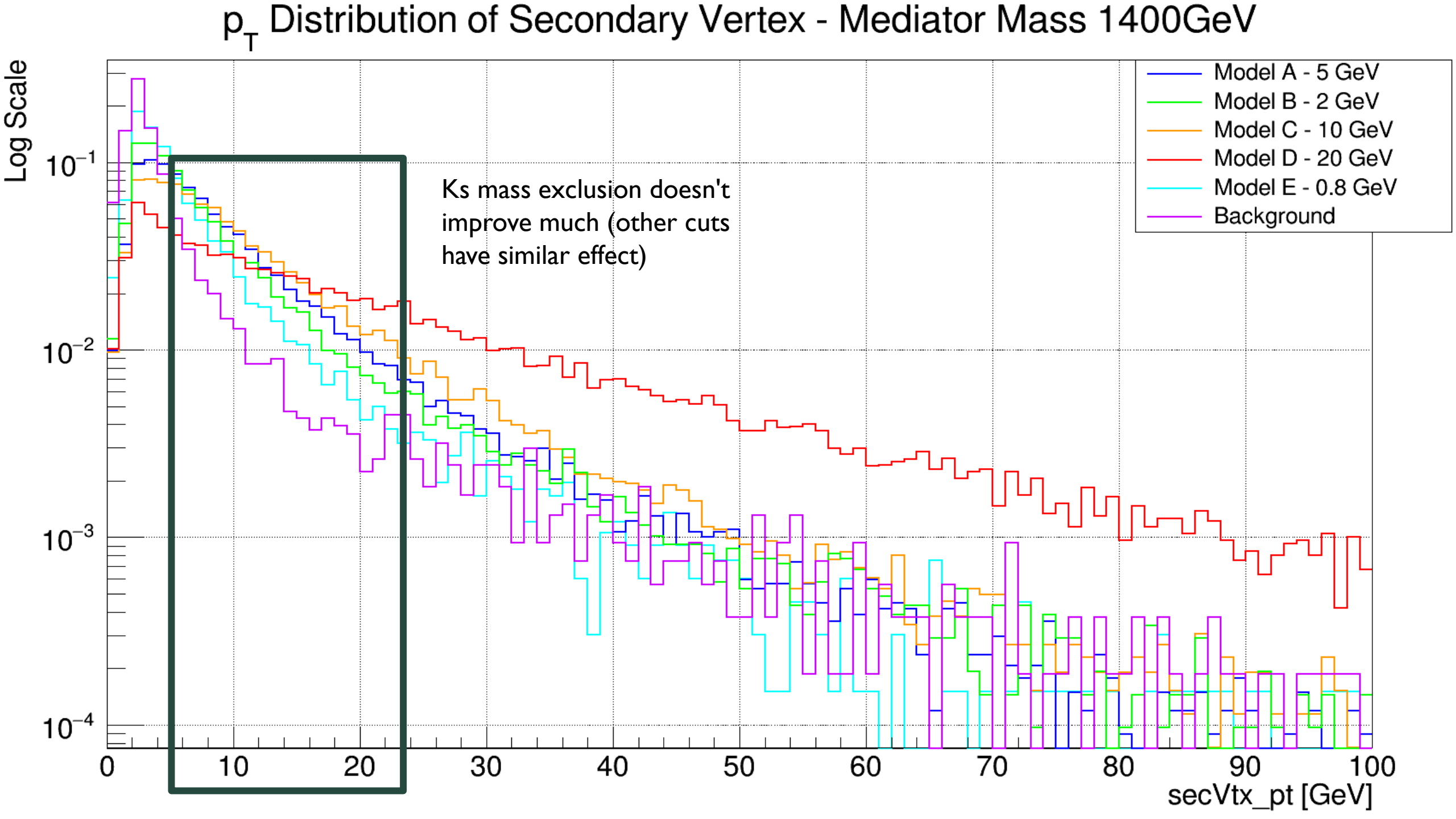


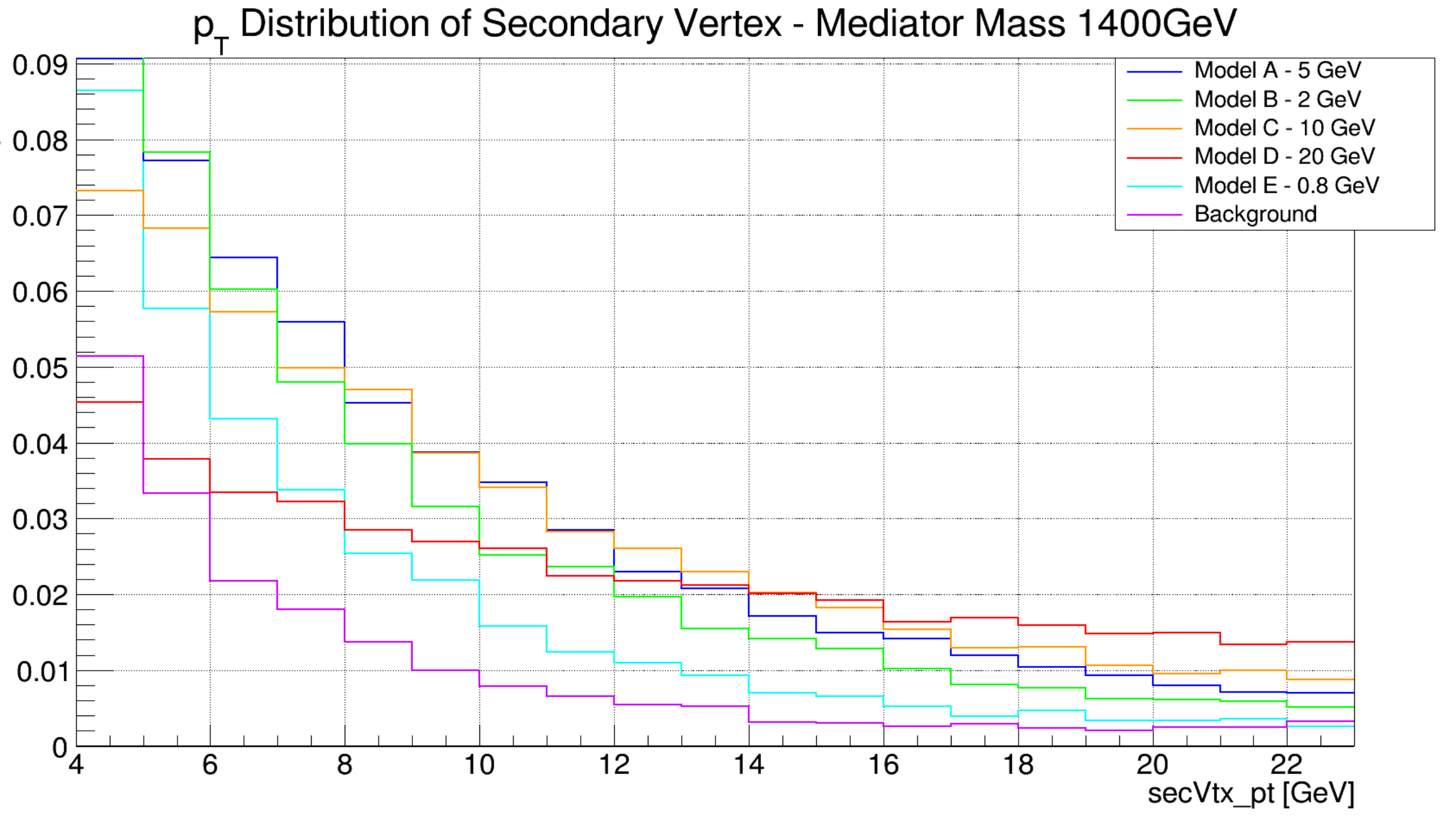
η Distribution of Secondary Vertex - Mediator Mass 1400GeV

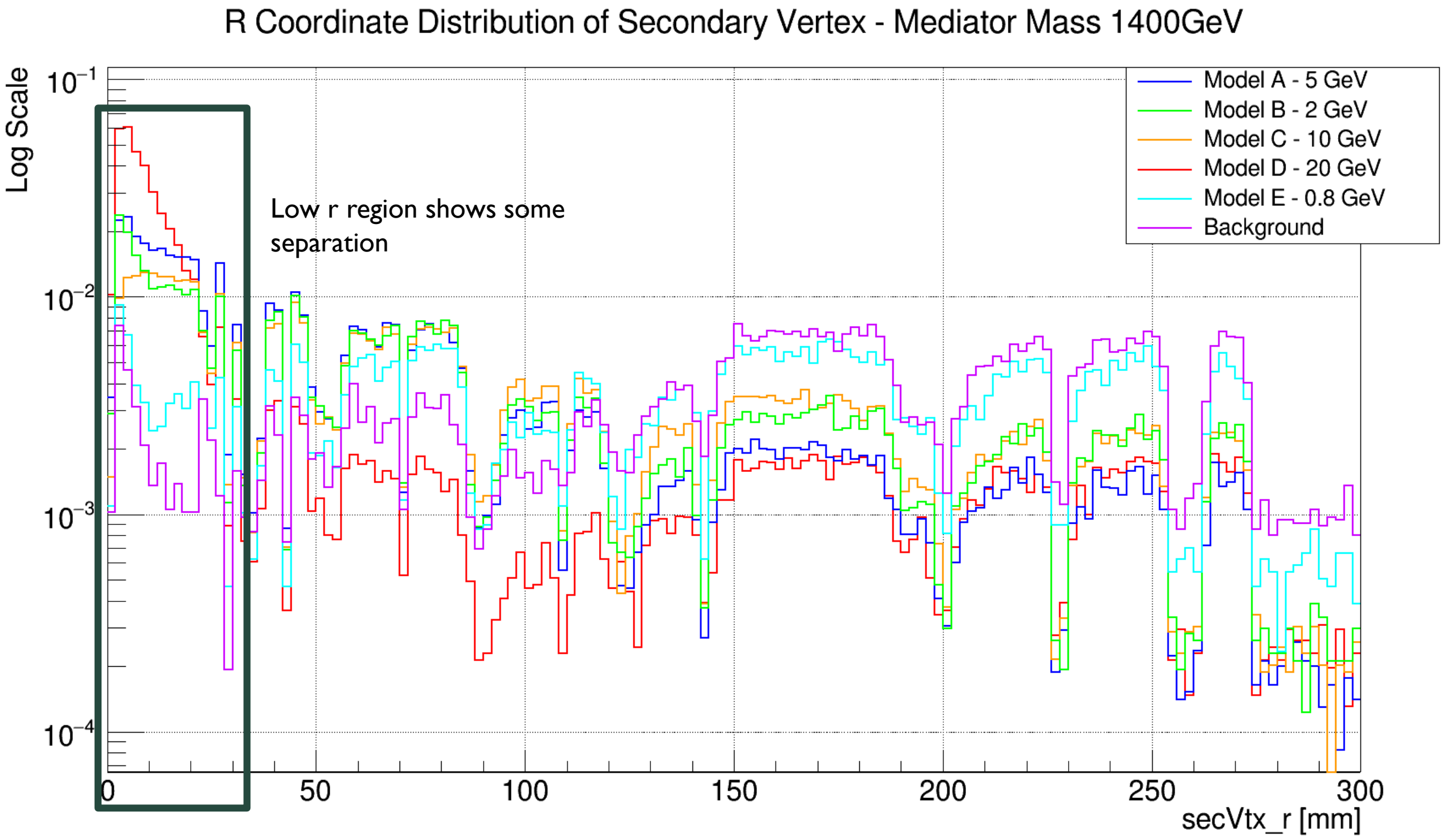


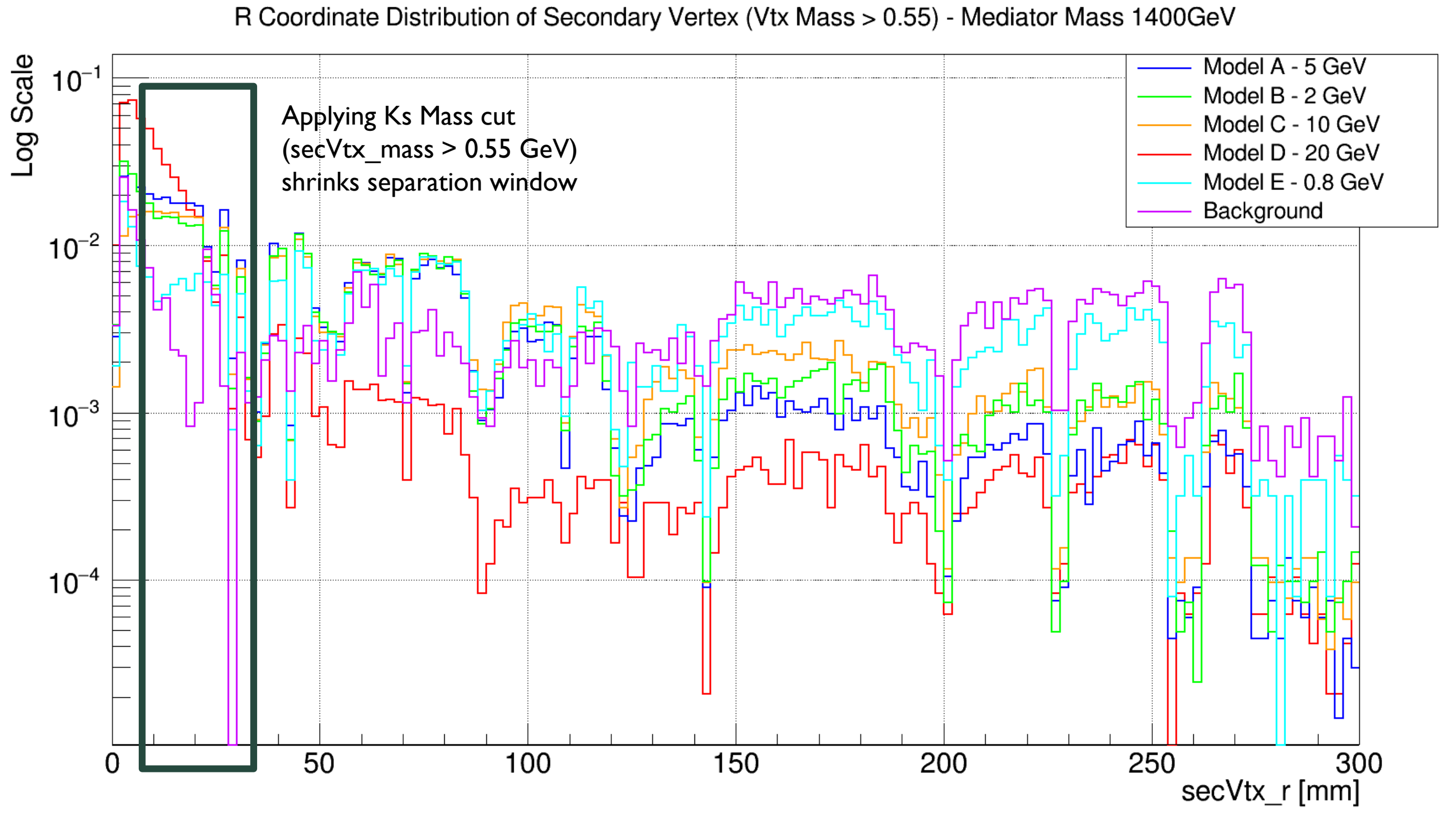

η Distribution of Secondary Vertex - Mediator Mass 1400GeV
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
0.5
0.45
0.4
0.35
0.3
0.25
0.2
−1
−0.5
0
0.5
1
secVtx_eta

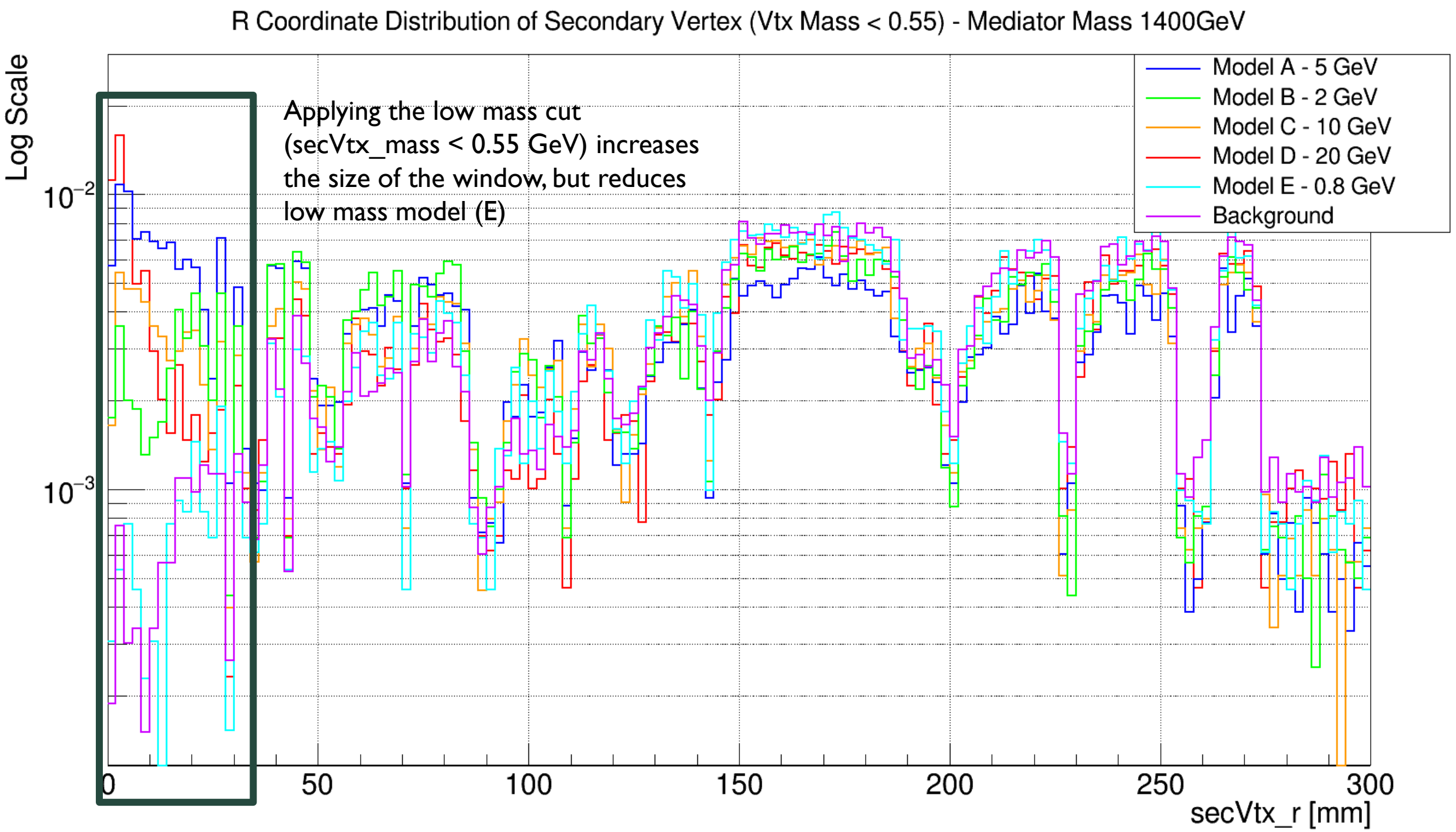

p_T Distribution of Secondary Vertex - Mediator Mass 1400GeV
Log Scale
10^{-1}
10^{-2}
10^{-3}
10^{-4}
Small area where the models
are above background
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
0
10
20
30
40
50
60
70
80
90
100
secVtx_pt [GeV]

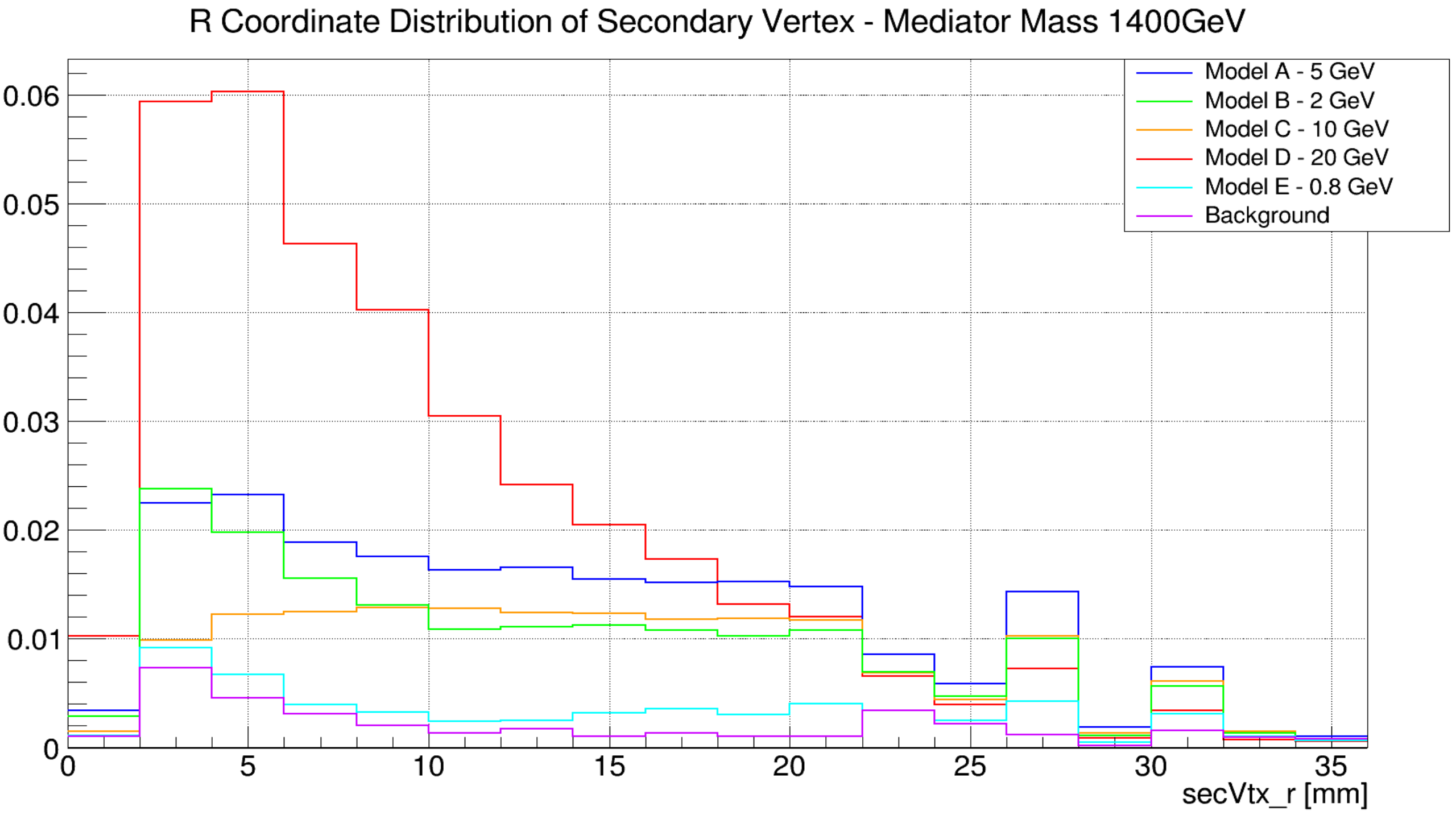

p_T Distribution of Secondary Vertex - Mediator Mass 1400GeV
Log Scale
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
10
20
30
40
50
60
70
80
90
100
secVtx_pt [GeV]
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
Ks mass exclusion doesn't improve much (other cuts have similar effect)


p_T Distribution of Secondary Vertex - Mediator Mass 1400GeV
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
4
6
8
10
12
14
16
18
20
22
secVtx_pt [GeV]

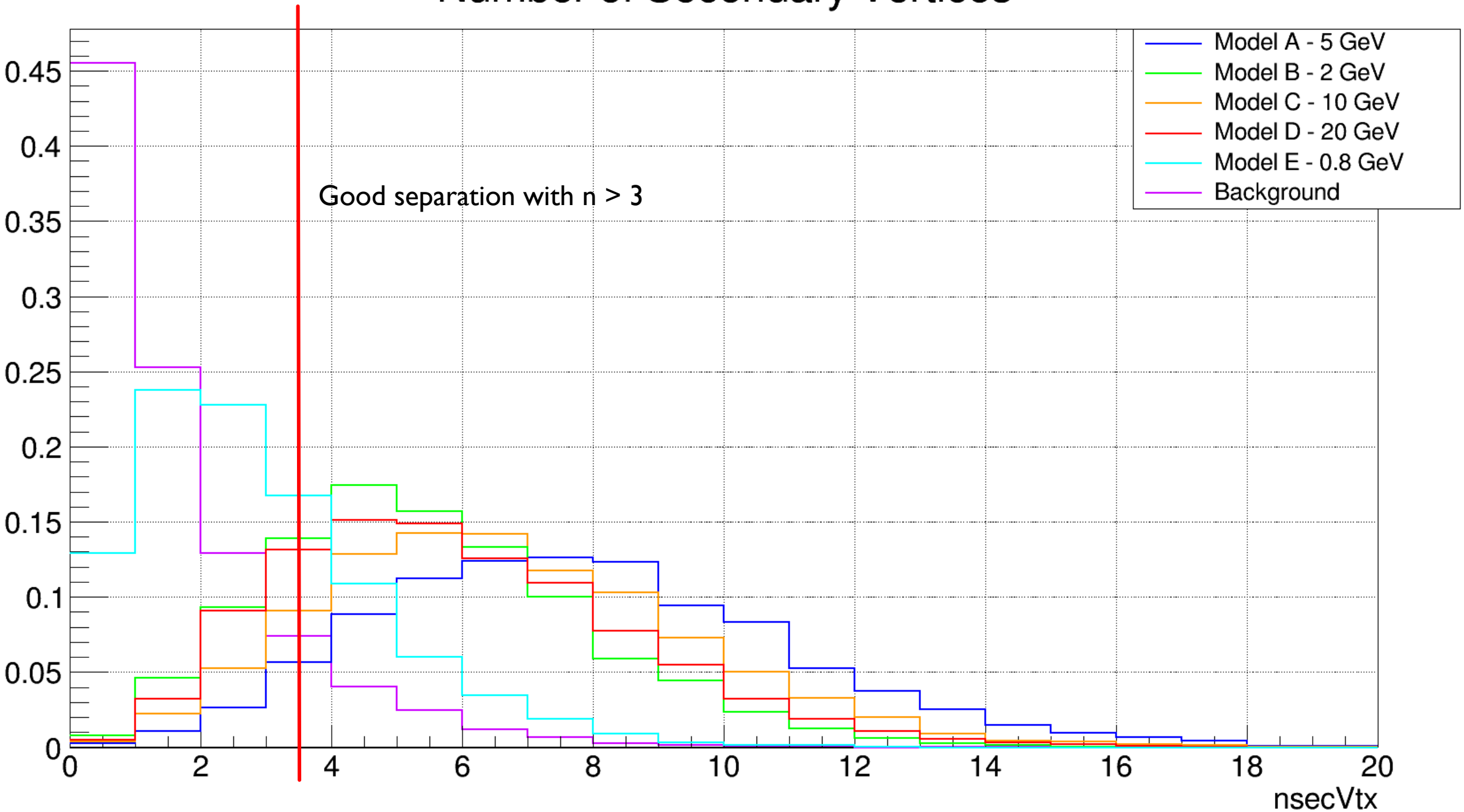

R Coordinate Distribution of Secondary Vertex - Mediator Mass 1400GeV
Log Scale
10^{-1}
10^{-2}
10^{-3}
10^{-4}
Low r region shows some separation
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
0
50
100
150
200
250
300
secVtx_r [mm]

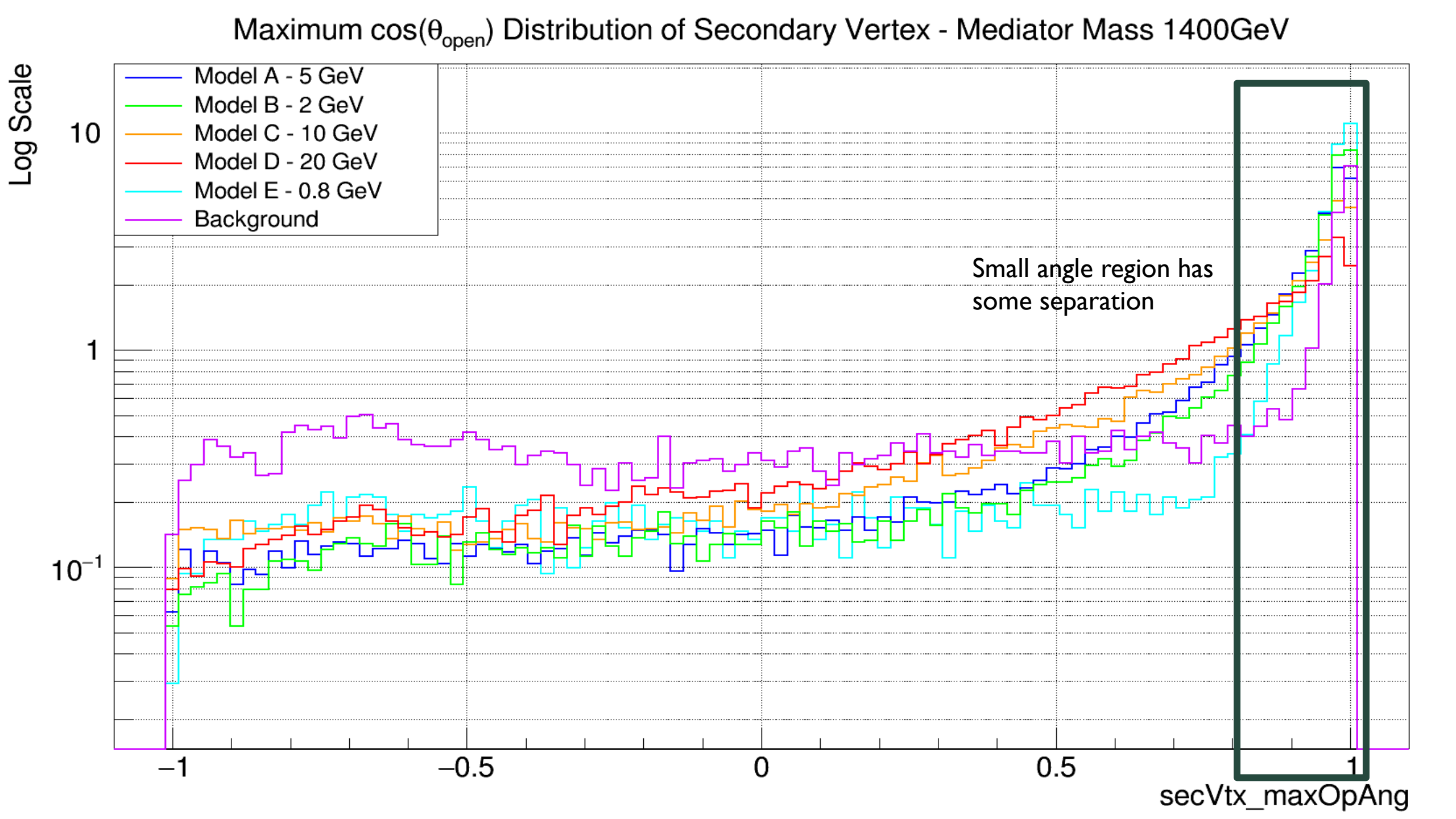

R Coordinate Distribution of Secondary Vertex (Vtx Mass > 0.55) - Mediator Mass 1400GeV
Log Scale
10^{-1}
10^{-2}
10^{-3}
10^{-4}
Applying Ks Mass cut
(secVtx_mass > 0.55 GeV)
shrinks separation window
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
0
50
100
150
200
250
300
secVtx_r [mm]

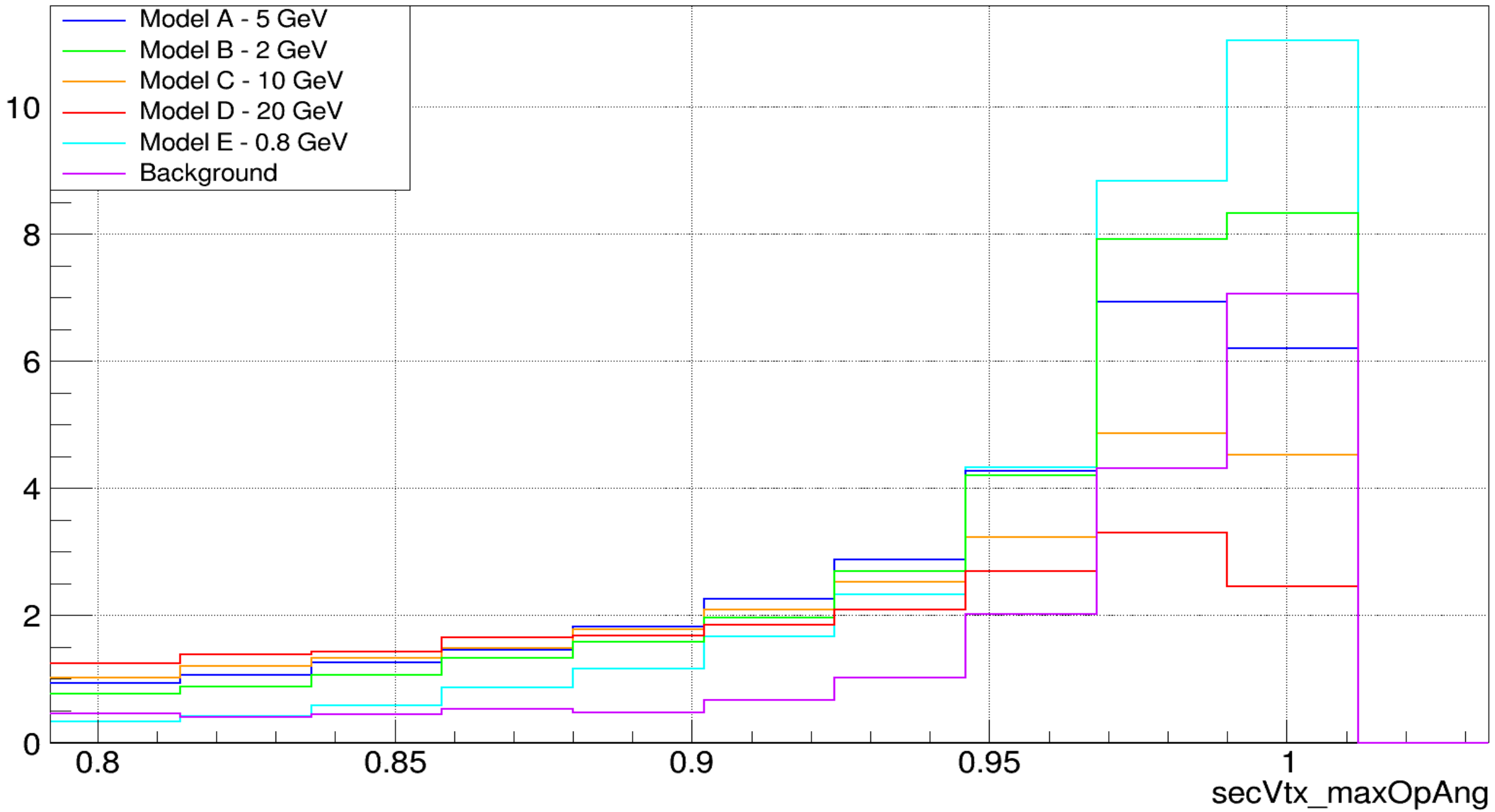

R Coordinate Distribution of Secondary Vertex (Vtx Mass < 0.55) - Mediator Mass 1400GeV
Log Scale
10^{-2}
10^{-3}
Applying the low mass cut
(secVtx_mass < 0.55 GeV) increases
the size of the window, but reduces
low mass model (E)
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
0
50
100
150
200
250
300
secVtx_r [mm]


R Coordinate Distribution of Secondary Vertex - Mediator Mass 1400GeV
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
0.06
0.05
0.04
0.03
0.02
0.01
0
0
5
10
15
20
25
30
35
secVtx_r [mm]

Number of Secondary Vertices




Maximum cos(θopen) Distribution of Secondary Vertex - Mediator Mass 1400GeV
Log Scale
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
10
1
10−1
Small angle region has some separation
−1
−0.5
0
0.5
1
secVtx_maxOpAng


Maximum cos(θopen) Distribution of Secondary Vertex - Mediator Mass 1400GeV
Model A - 5 GeV
Model B - 2 GeV
Model C - 10 GeV
Model D - 20 GeV
Model E - 0.8 GeV
Background
0
2
4
6
8
10
0.8
0.85
0.9
0.95
1
secVtx_maxOpAng

SUGGESTED CUTS

- Ks exclusion Cut: mass > 0.55 [GeV]
- Low mass window: 0.3 [GeV] $<$ mass < 0.45 [GeV]
- $|\eta| < 1$
  - Better results with Ks exclusion
- 6 [GeV] $< p_T < 22$ [GeV]
- 6 [mm] $<$ r < 22 [mm] (without other cuts)
- 14 [mm] $<$ r < 22 [mm] (with Ks mass cut)
- Number of secondary vertices > 3
- $0.8 < \theta_{open} < 0.95$

- All cases involve mediator mass 1400 [GeV]
- Plots for 1000 [GeV] mediator mass are very similar
- Still need to investigate 600 [GeV] mediator mass
- Still need to investigate Jet (dark/qcd) matched variables