Jet Performance at CEPC

Presented by [1]Pei-Zhu Lai（賴培築）

Supervisor: [2]Man-Qi Ruan, [2]Gang Li, [1]Chia-Ming Kuo

[1]National Central University, Taiwan

[2]Institute of High Energy Physics, China

Group Meeting, NCU, Taiwan

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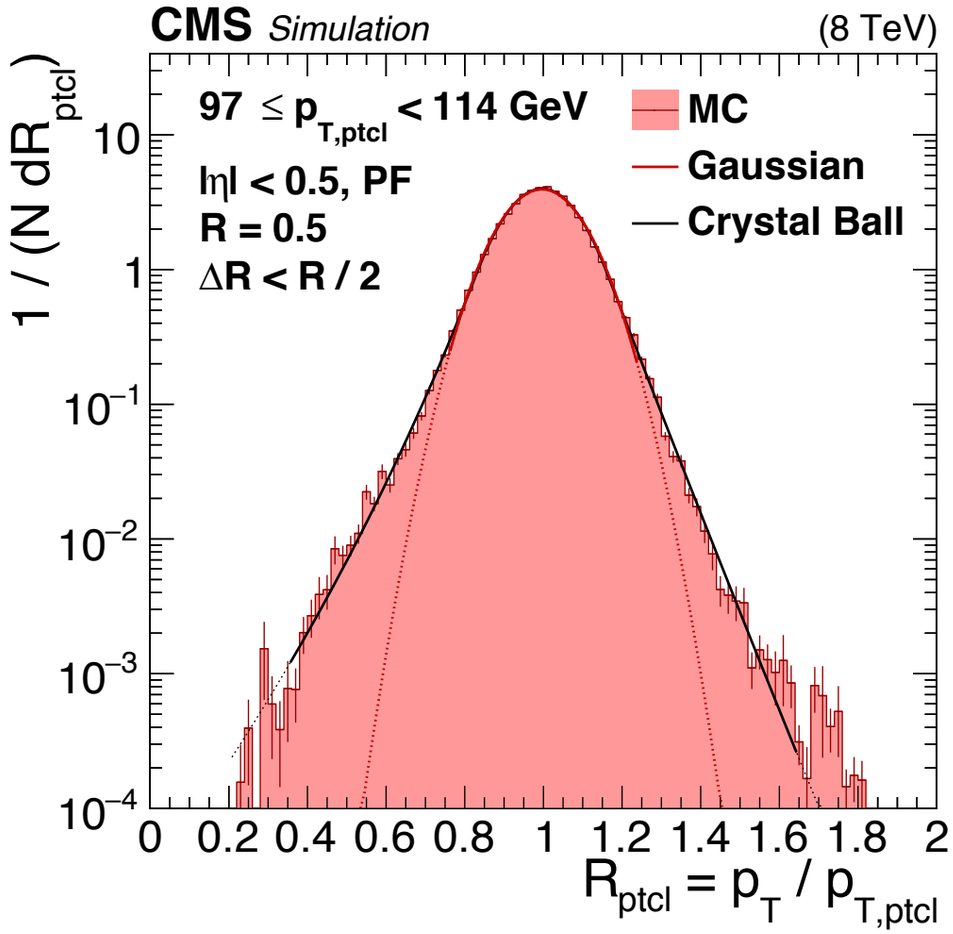
Matching Approach

- Only ΔR match was applied in CMS paper.



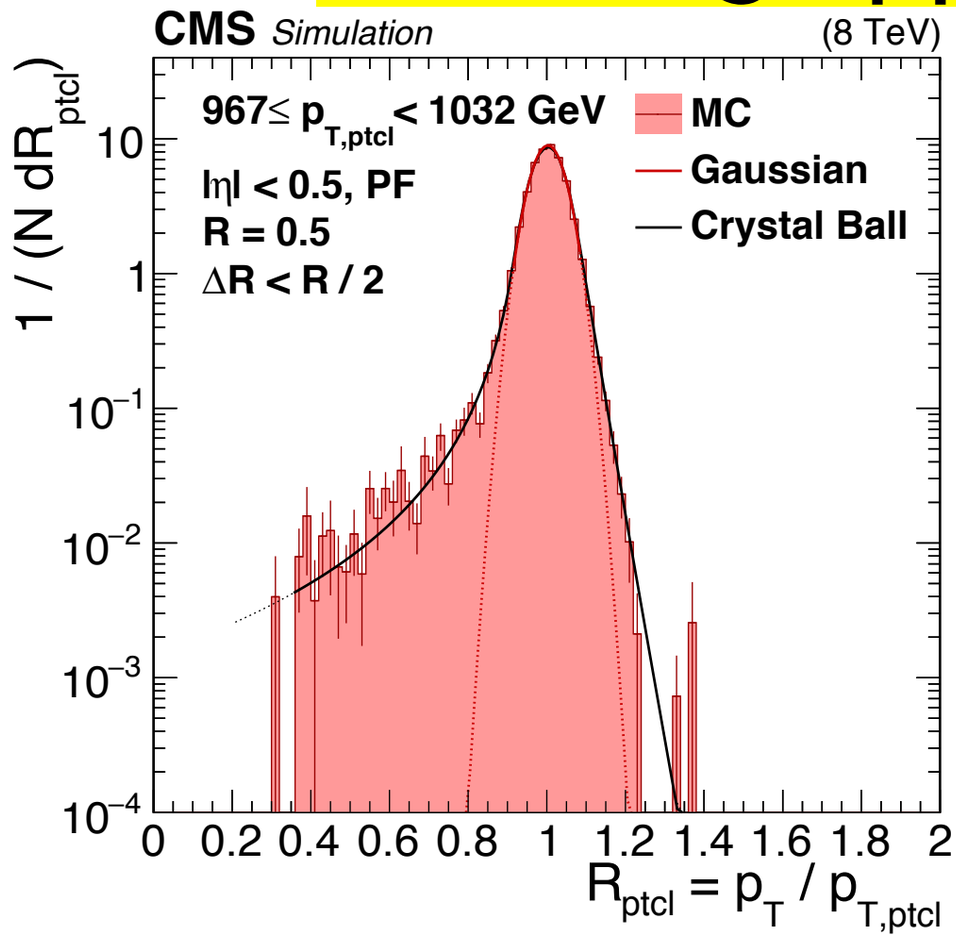


Figure 35: Jet p_{T} resolution distributions in the barrel for two bins of jet p_{T}. ΔR indicates the distance parameter value used for matching reconstructed jets to the corresponding particle-level jets. The nongaussian tails due to inactive areas of the ECAL and HCAL punchthrough become more visible for narrow high-p_{T} jets with small core resolution. The Gaussian core resolution is fit to within $\pm 2\sigma$ (solid line) and its extrapolation is indicated with a dotted line. The tails are well modeled by a double-sided Crystal Ball function.

We define the particle-level JER in simulation as the σ of a Gaussian fit to the $p_{\mathrm{T,\,reco}}/p_{\mathrm{T,\,ptcl}}$ distribution in the range $[m-2\sigma, m+2\sigma]$, where $p_{\mathrm{T,\,reco}}$ and $p_{\mathrm{T,\,ptcl}}$ are the reconstructed jet p_{T} and generated particle-level jet p_{T}, respectively, and m and σ are the mean and width of the Gaussian fit, determined with an iterative procedure. To maximize matching efficiency while still ensuring a unique match, the reconstructed and the generated jets are required to be within $\Delta R < R/2$ of each other, with R being the jet distance parameter.

Reference

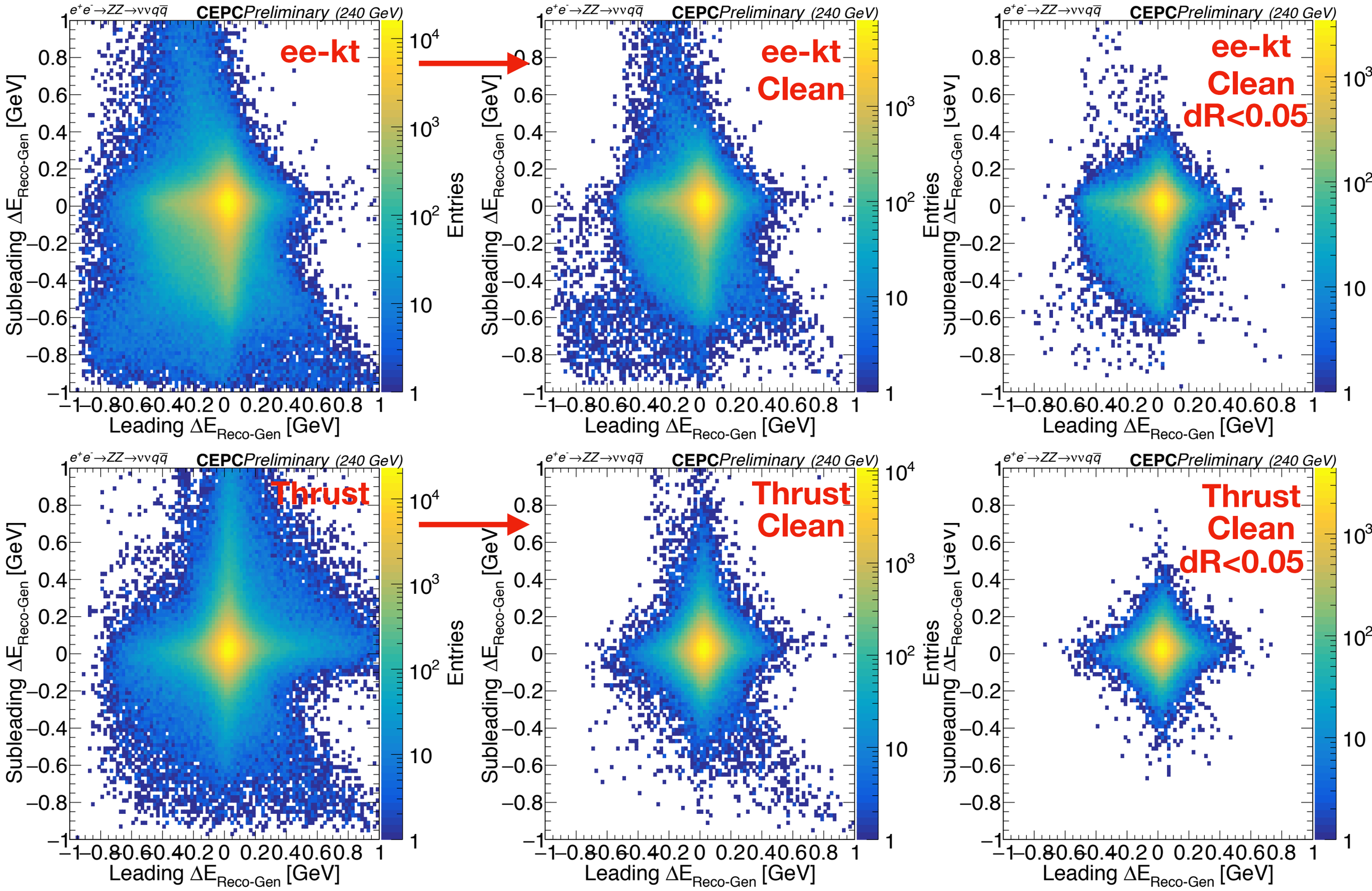
Matching Reverse Ratio

- Under 2-jet condition. Only two combinations could be chose and one of them must be correct.
- Firstly, match the RecoJet and GenJet according their energy.
- Compare the $\Delta R_{Lead-Lead}$ and $\Delta R_{Lead-Sub\text{-}lead}$, if $\Delta R_{Lead-Sub\text{-}lead} < \Delta R_{Lead-Lead}$ counter +1.
- Reverse Ratio = counter / total # of event.

Process \ Reverse Ratio (%)	ee-kt	Thrust
ΔR	6.91	3.94
ΔR + ΔE	6.56	3.88

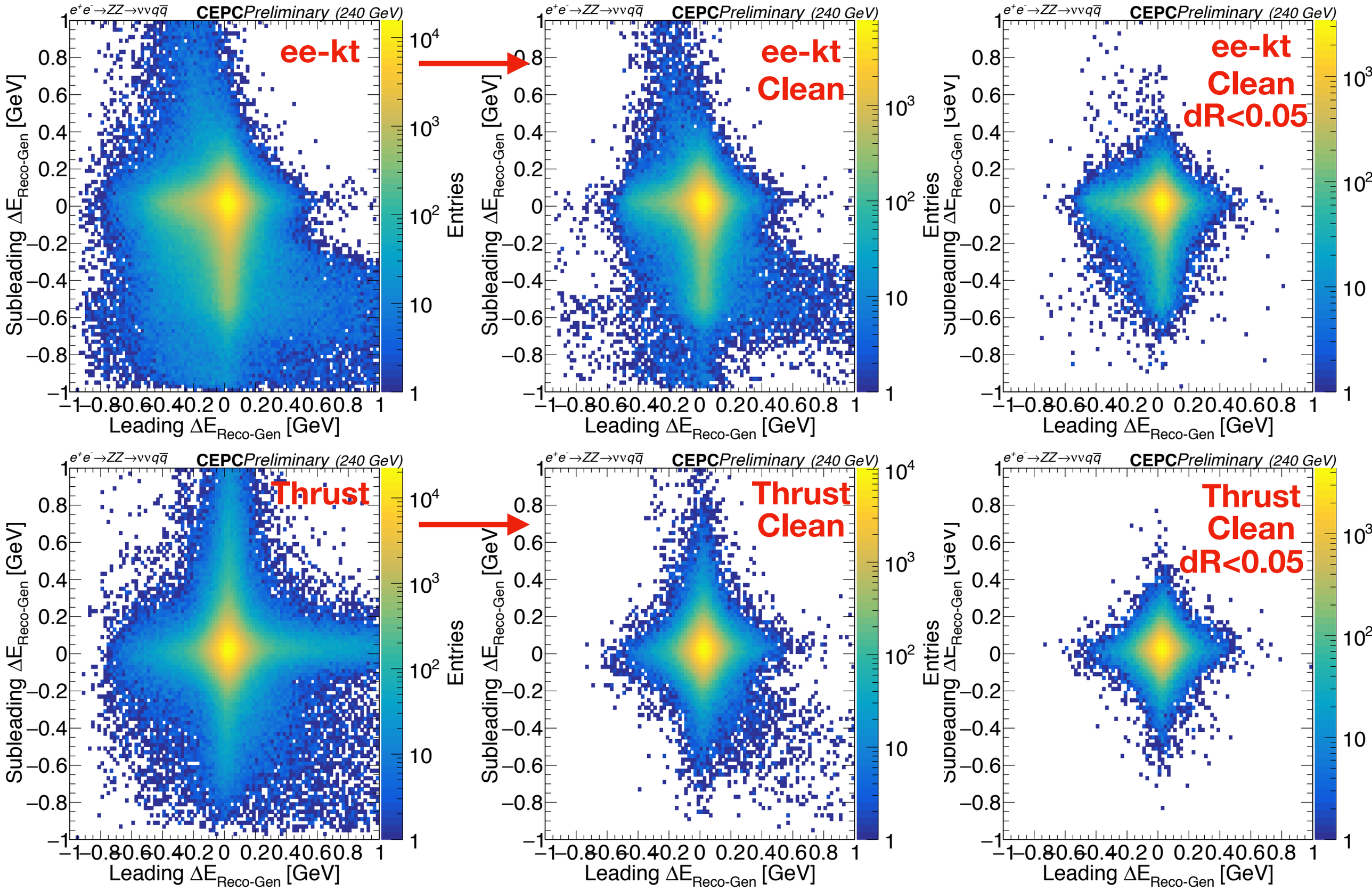
Match only by Energy

2D ΔE Distribution



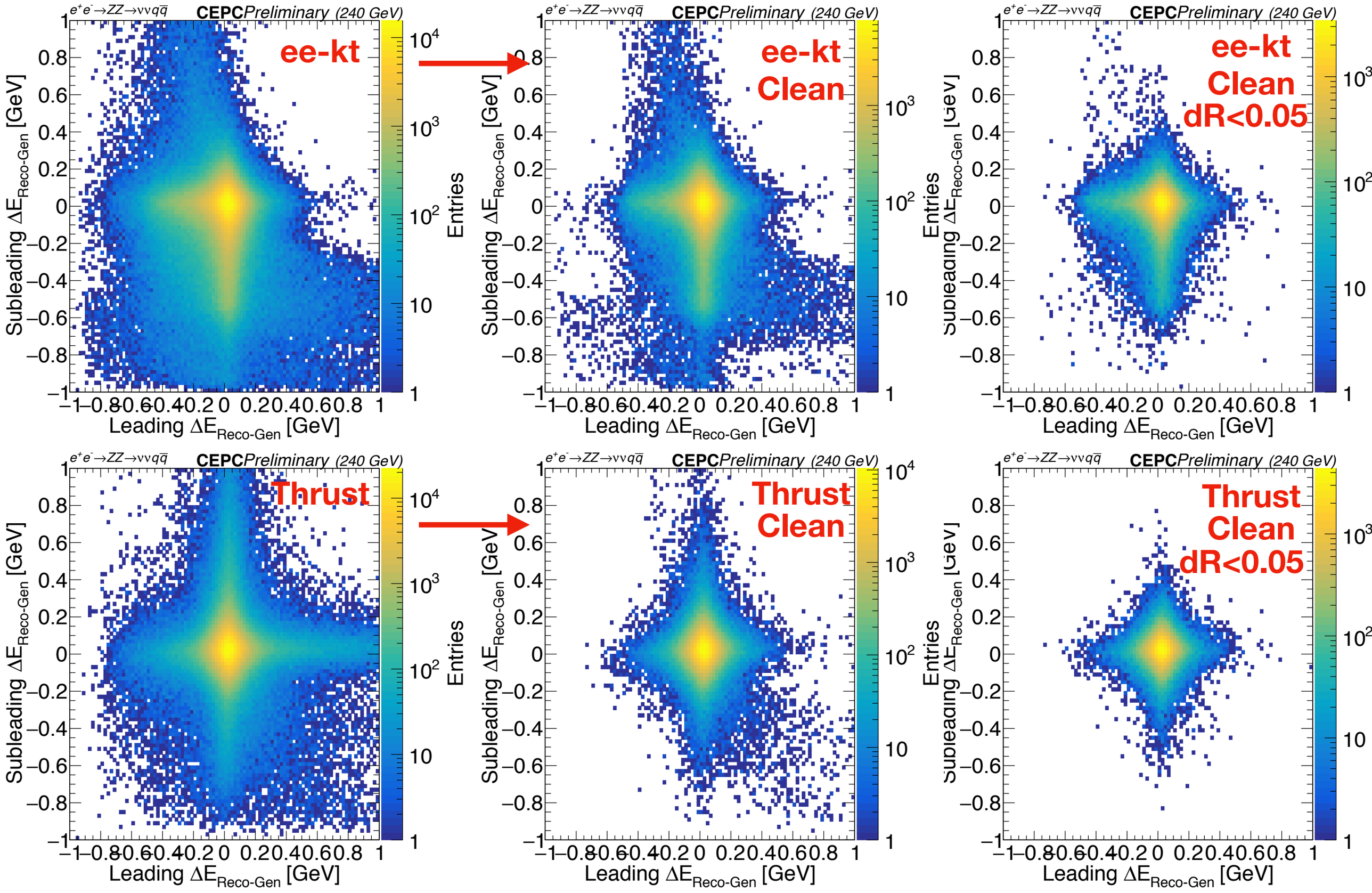
Match by Energy and ΔR reverse

2D ΔE Distribution



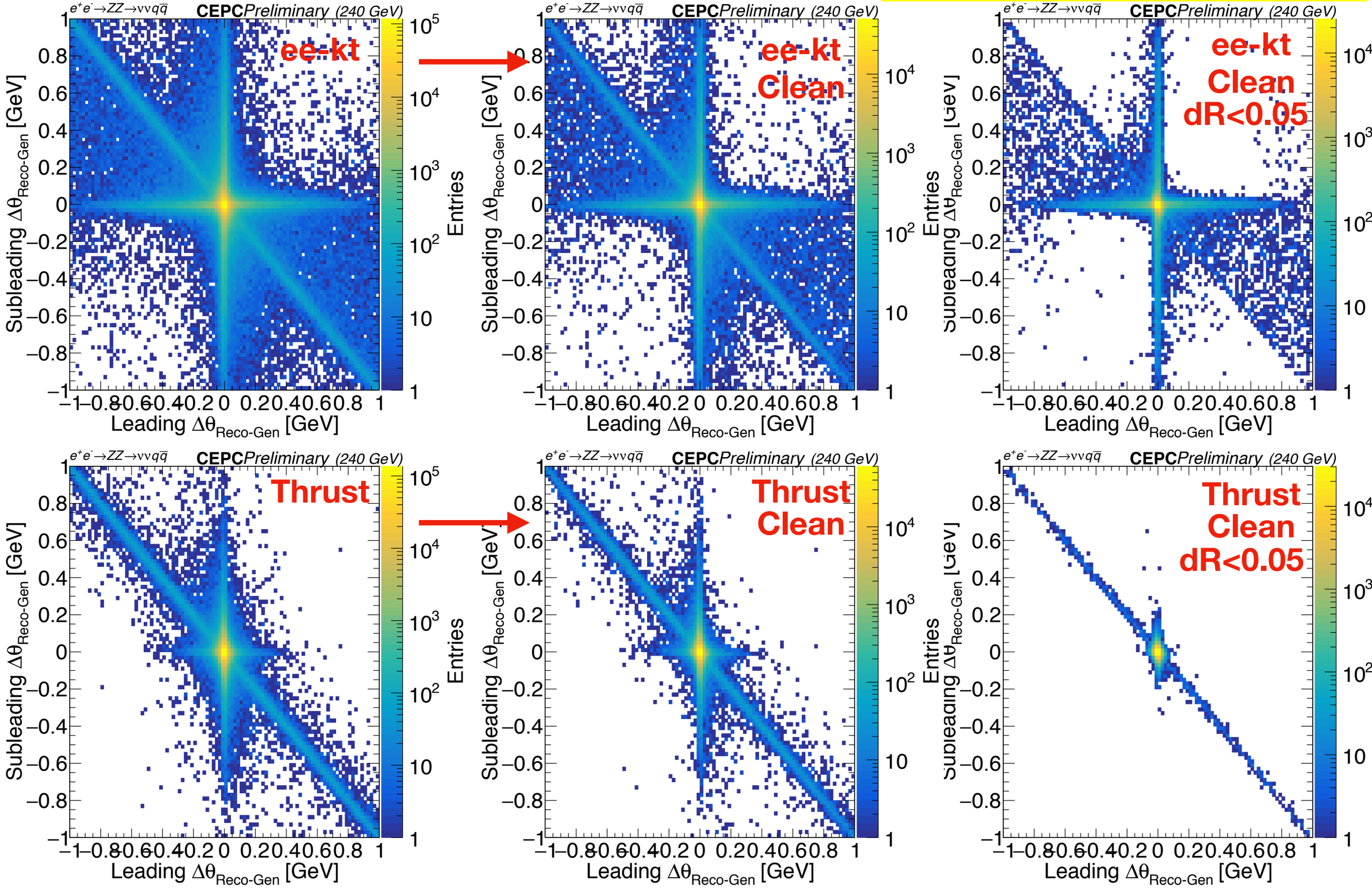
Match by Energy and ΔR+ ΔE reverse

2D ΔE Distribution



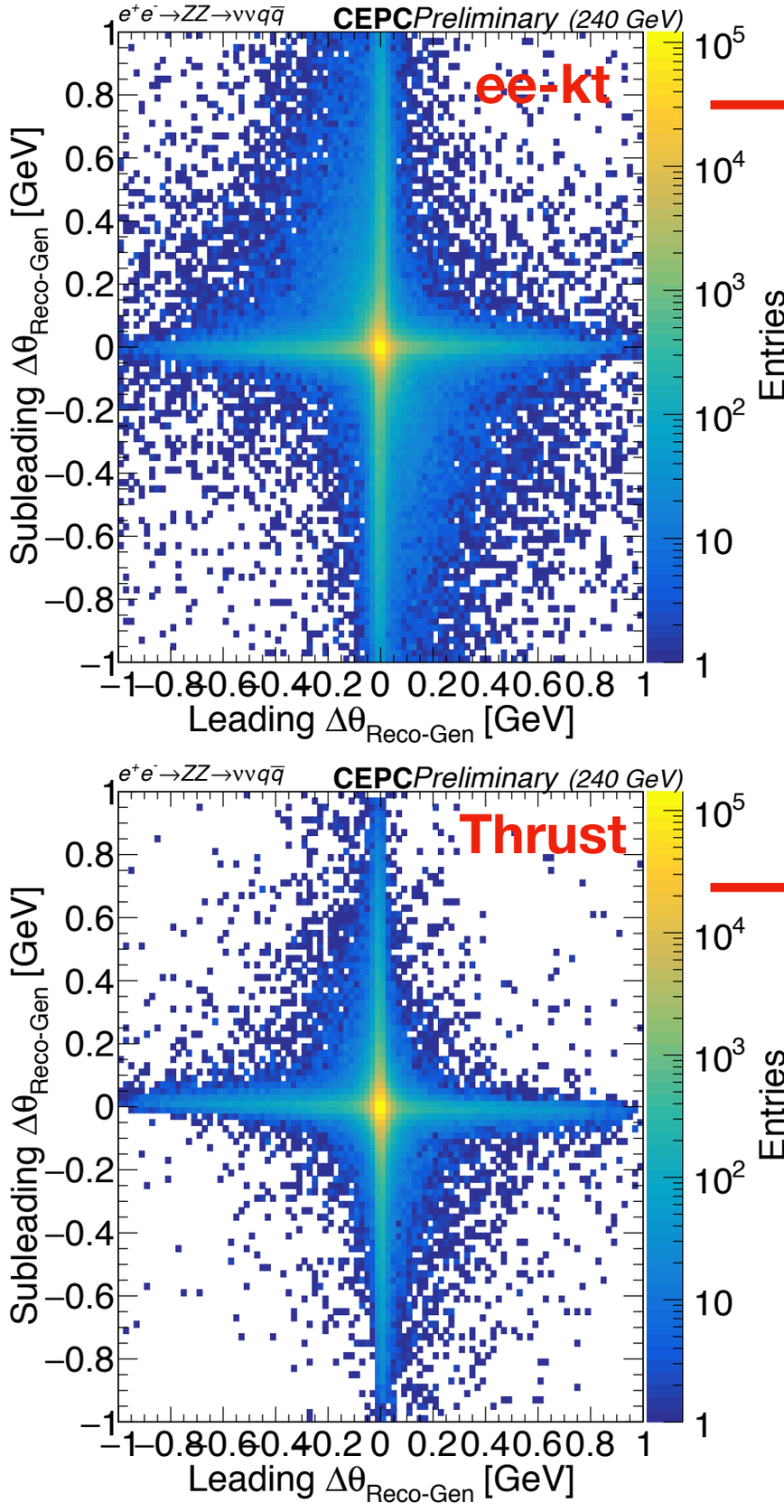
2D $\Delta\theta$ Distribution

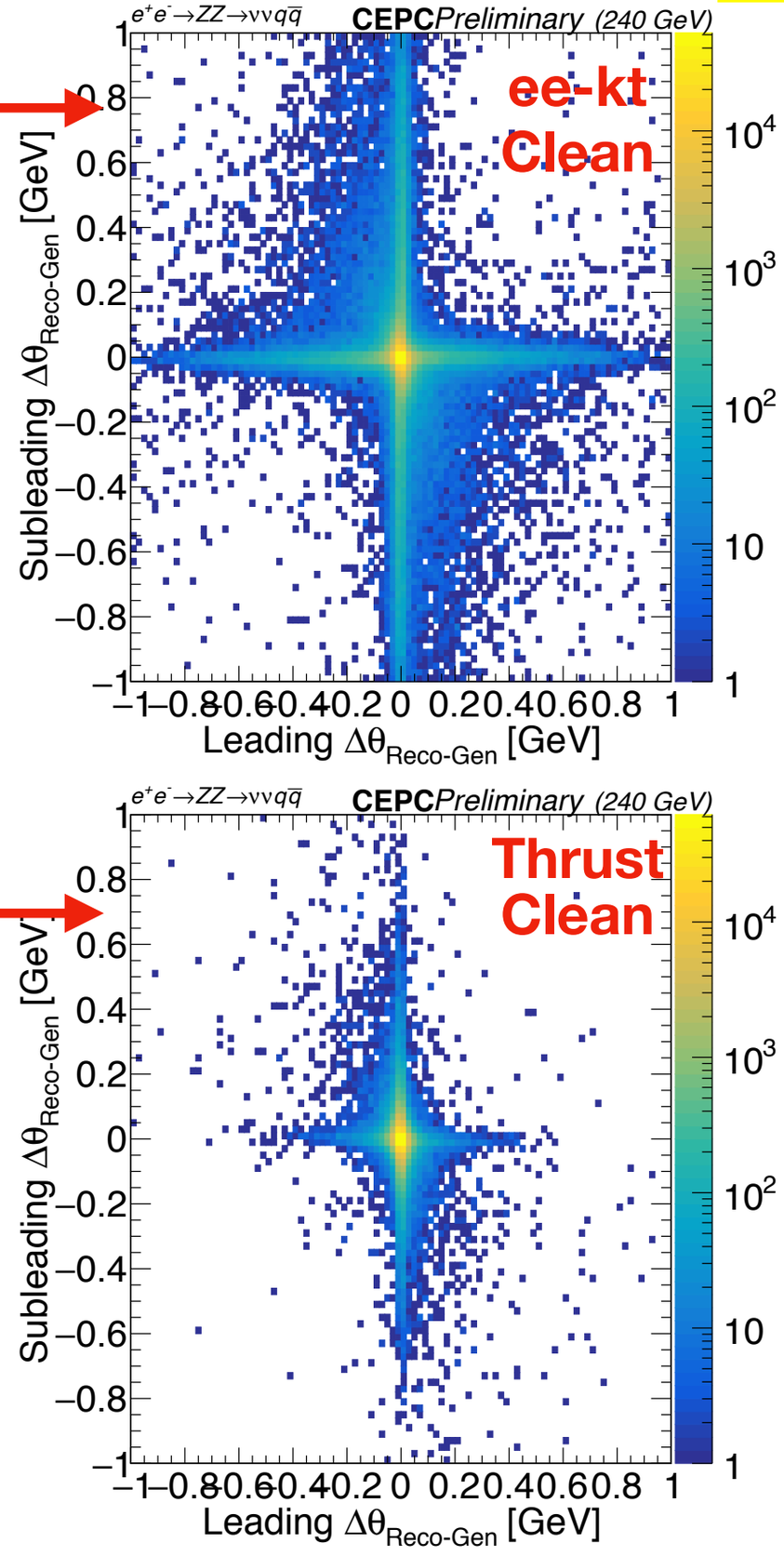
Match only by Energy

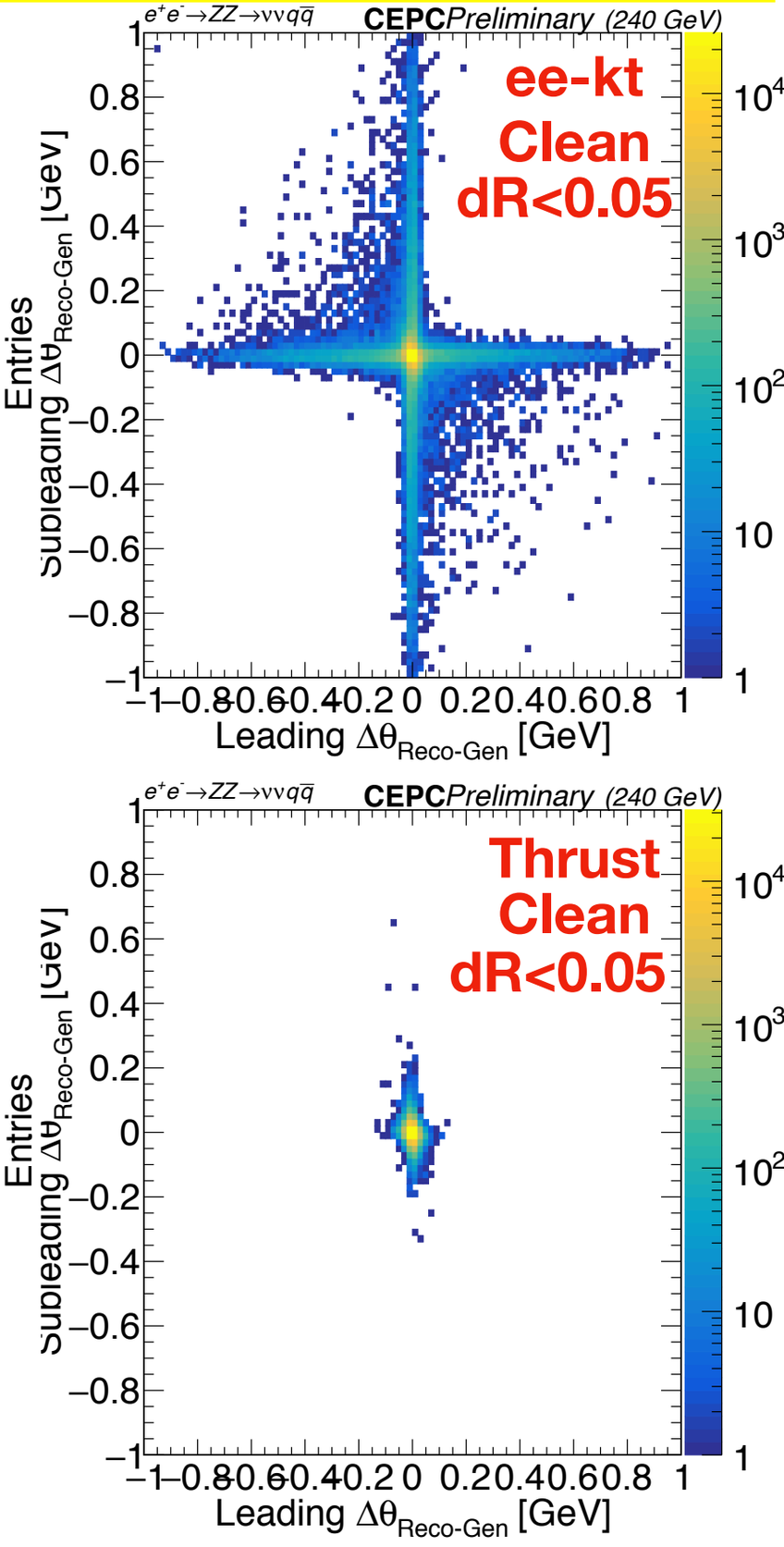


Match by Energy and ΔR reverse

2D $\Delta\theta$ Distribution

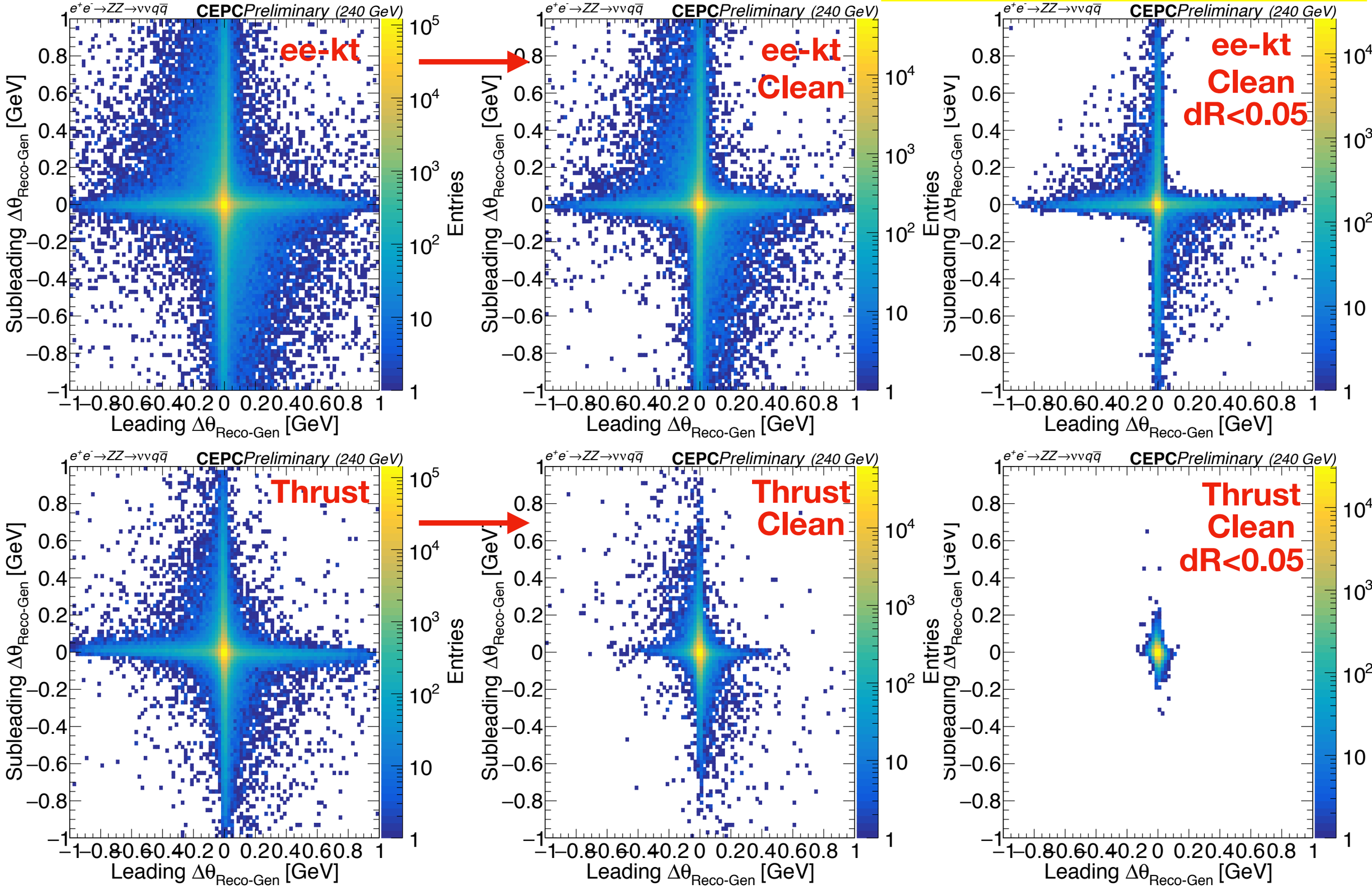






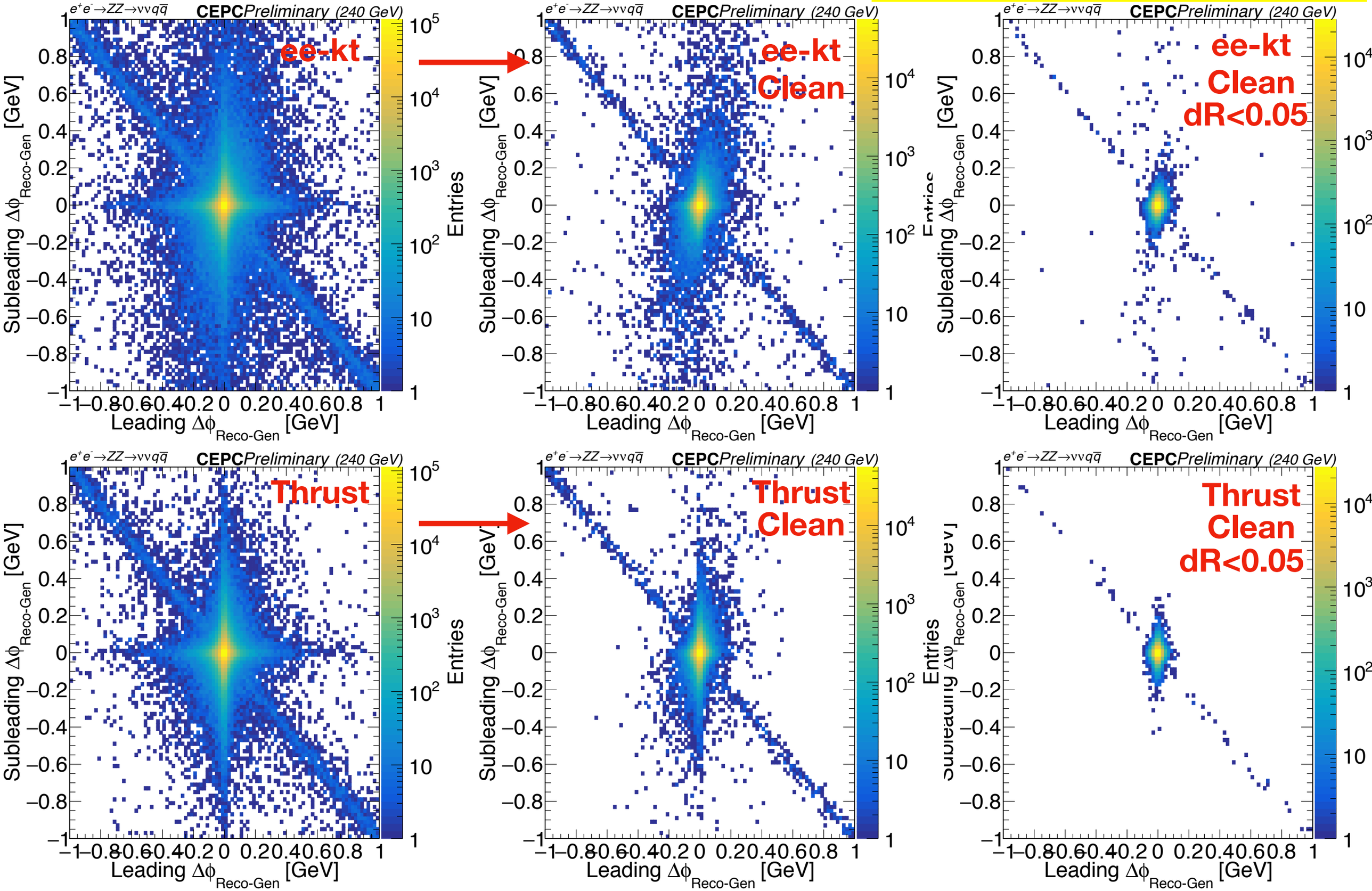
Match by Energy and ΔR+ ΔE reverse

2D $\Delta\theta$ Distribution



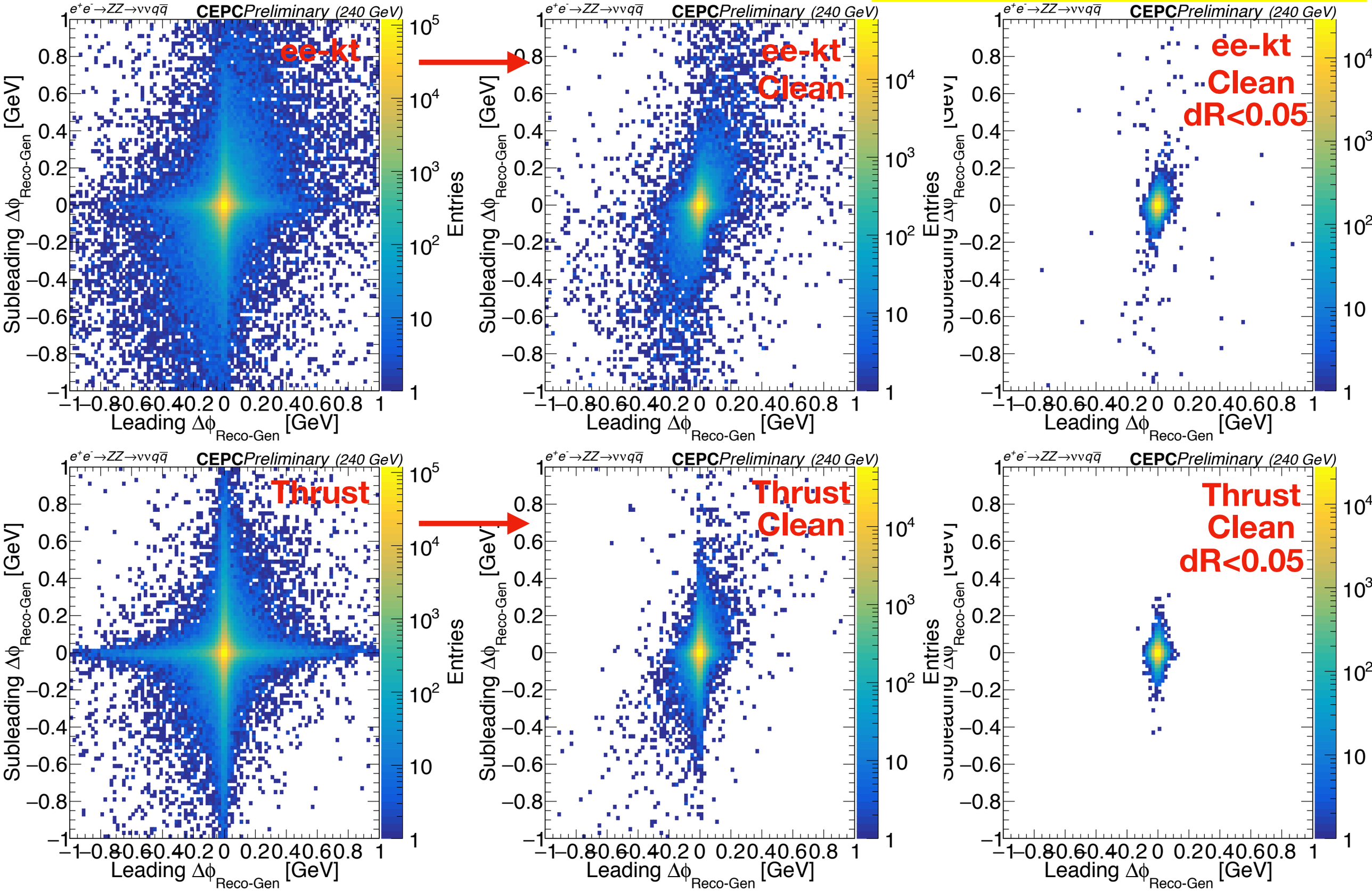
2D $\Delta\phi$ Distribution

Match only by Energy



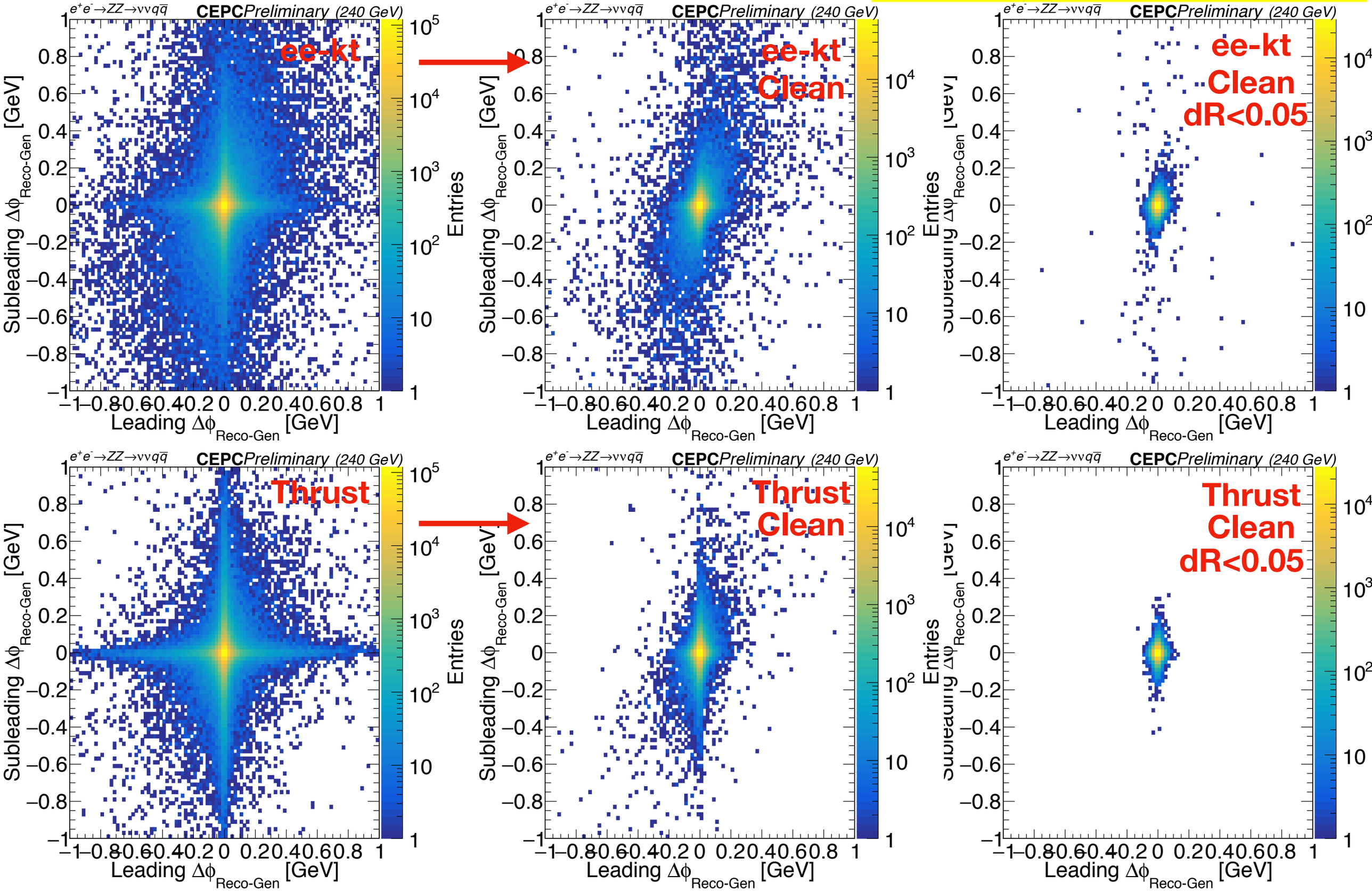
Match by Energy and ΔR reverse

2D $\Delta\phi$ Distribution



Match by Energy and ΔR+ ΔE reverse

2D $\Delta\phi$ Distribution



Matching Reverse Ratio

- Under 4-jet condition. The matching situation becomes more complex.
- Firstly, match the RecoJet and GenJet according their energy.
- Test the reverse behavior between them which judge from the “diagonal pattern”.
- Reverse behavior could penetrate three order of the energy sort.

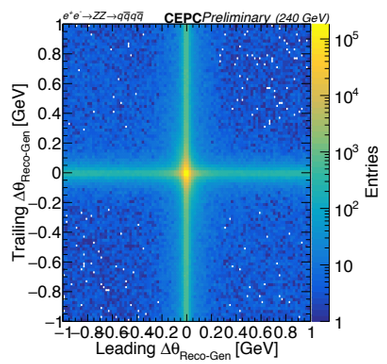
RecoJet		GenJet	Combination
Leading	⟷	Leading	Leading(1)
Sub-leading	⟷	Sub-leading	Sub-leading(2)
Third	⟷	Third	Third(3)
Trailing	⟷	Trailing	Trailing(4)

ΔE, $\Delta\theta$, $\Delta\phi$

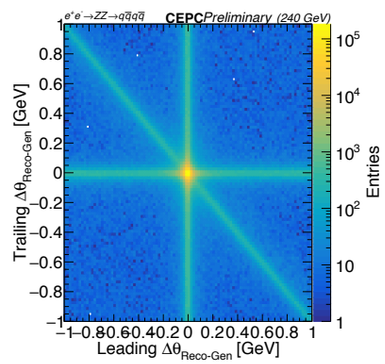
Reverse behavior	
1-4	(x)
2-3	(o)
1-3	(o) slight
2-4	(o) slight
1-2	(o)
3-4	(o)

Process \ Reverse Ratio (%)	ee-kt
ΔR	35.47
$\Delta R + \Delta E$	34.79

(x)



(o)



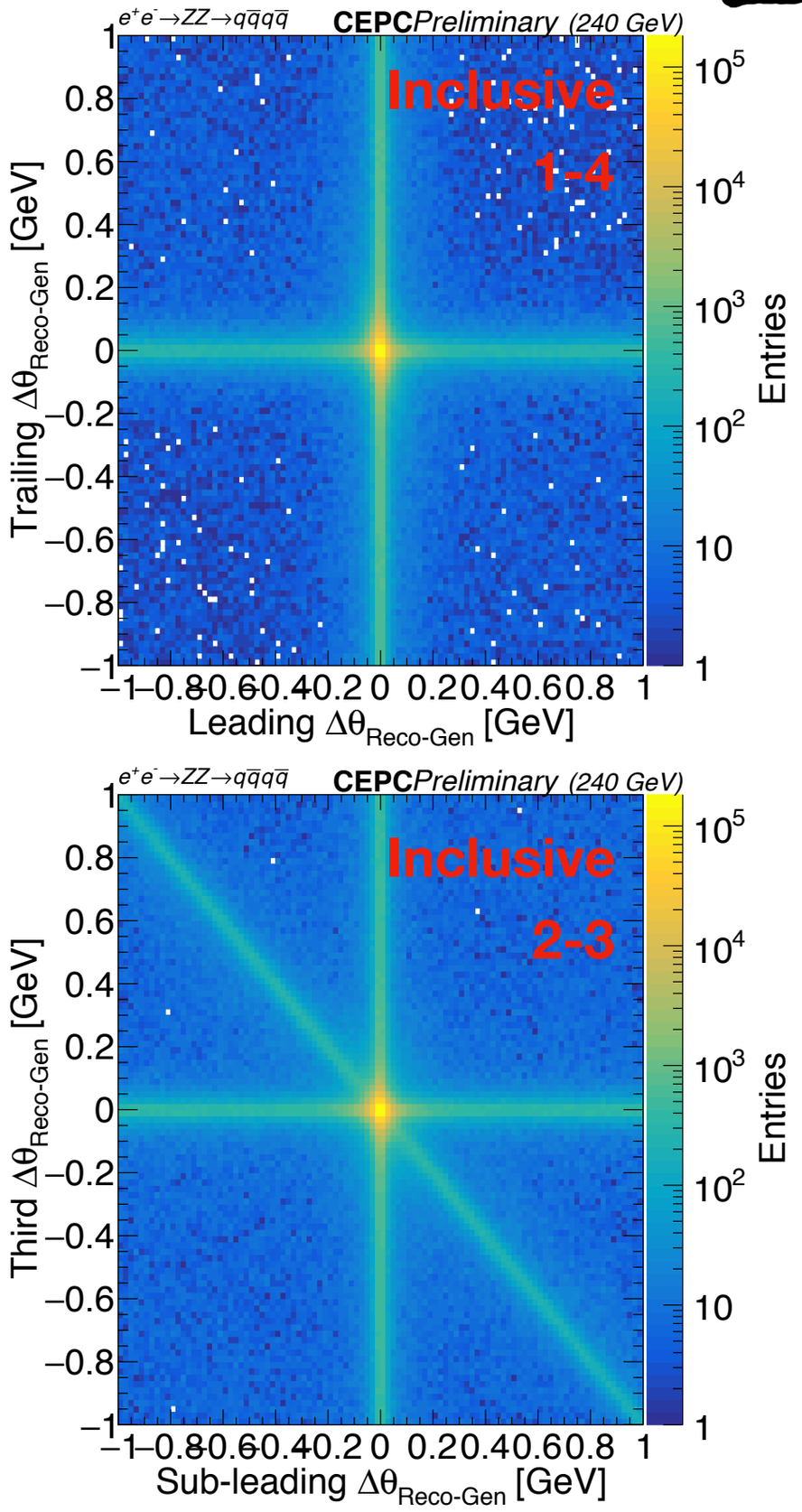
2D $\Delta\theta$ Distribution

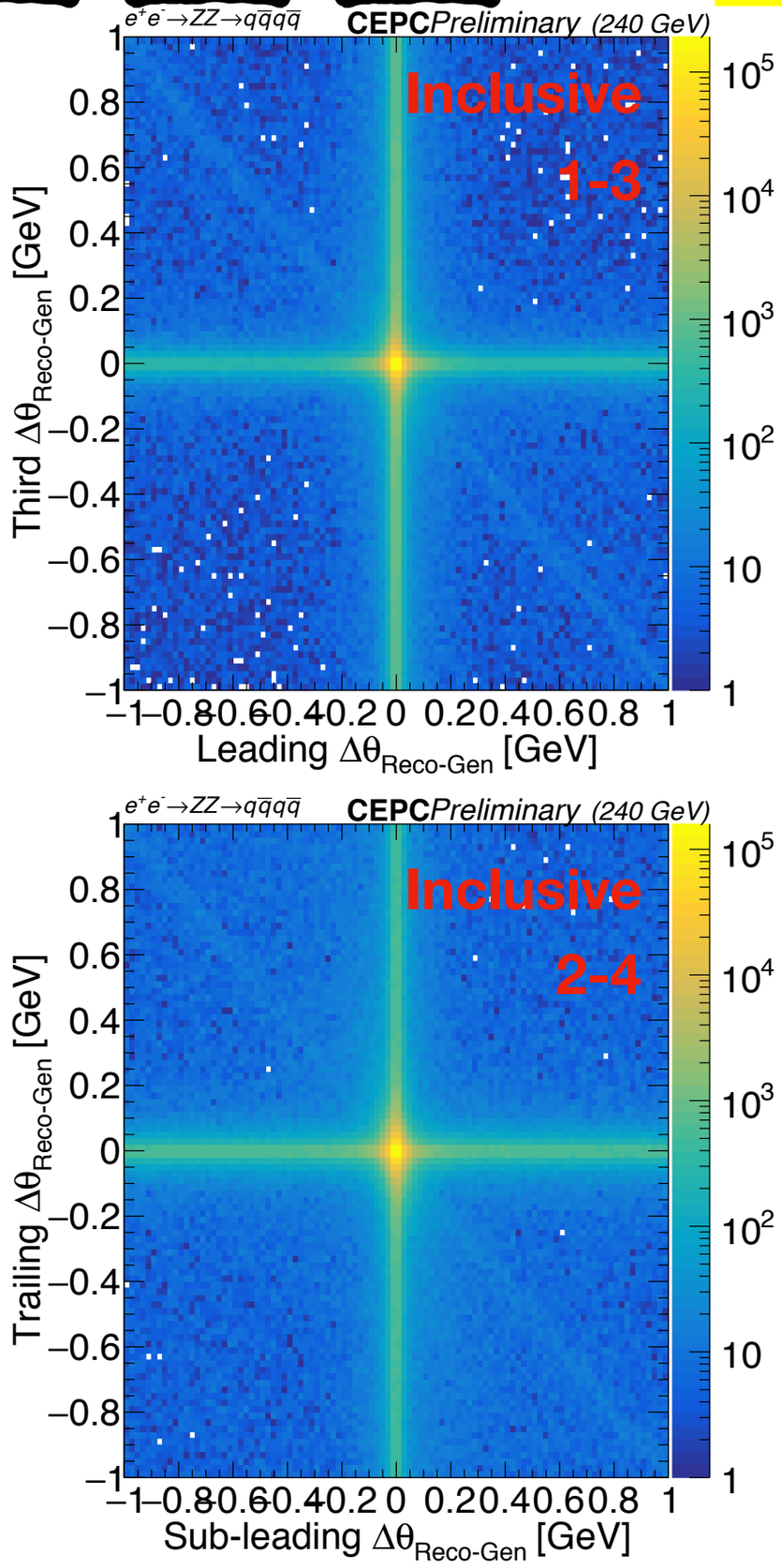
Match only by Energy

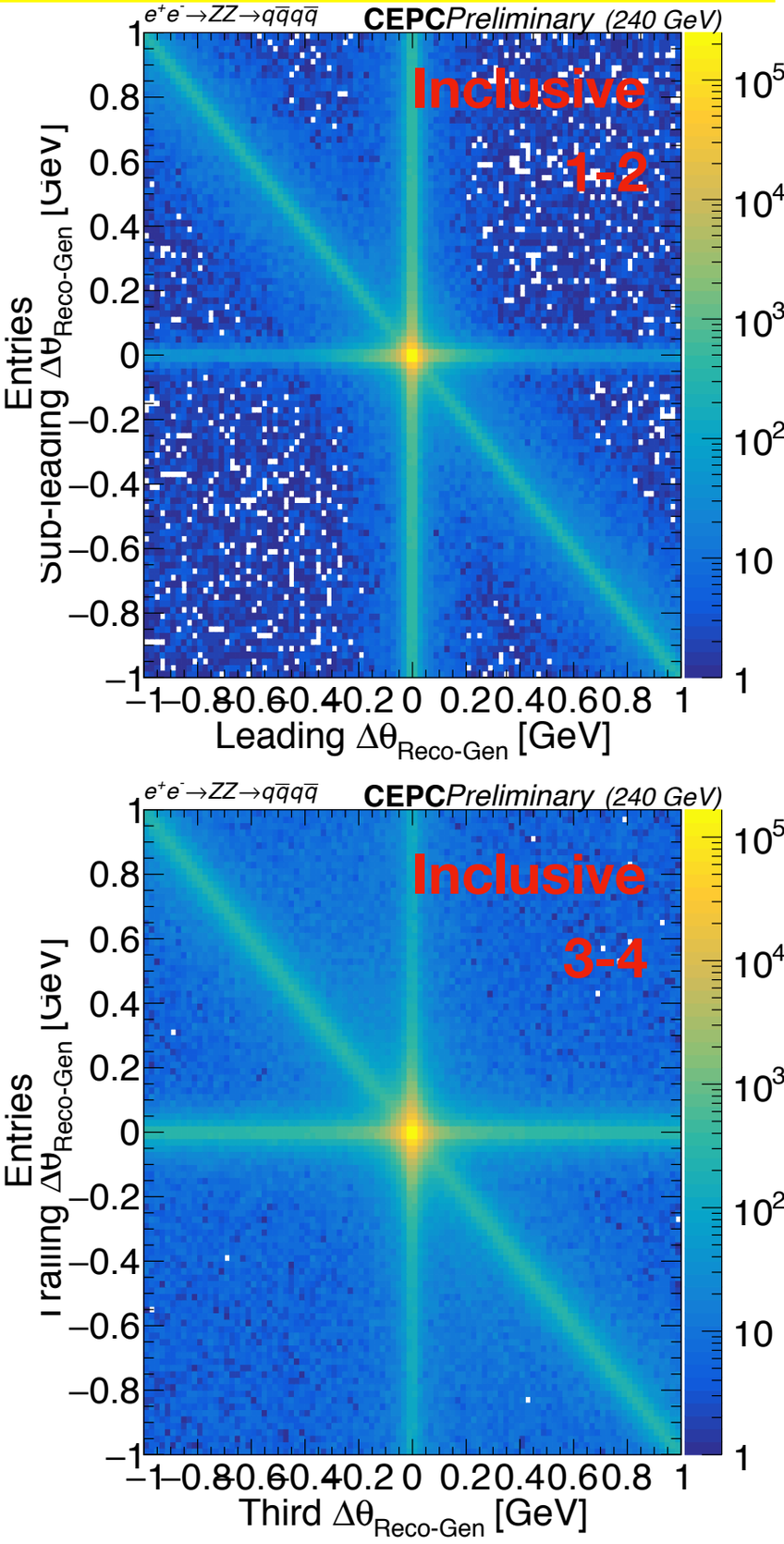
1-4
2-3

1-3
2-4

1-2
3-4







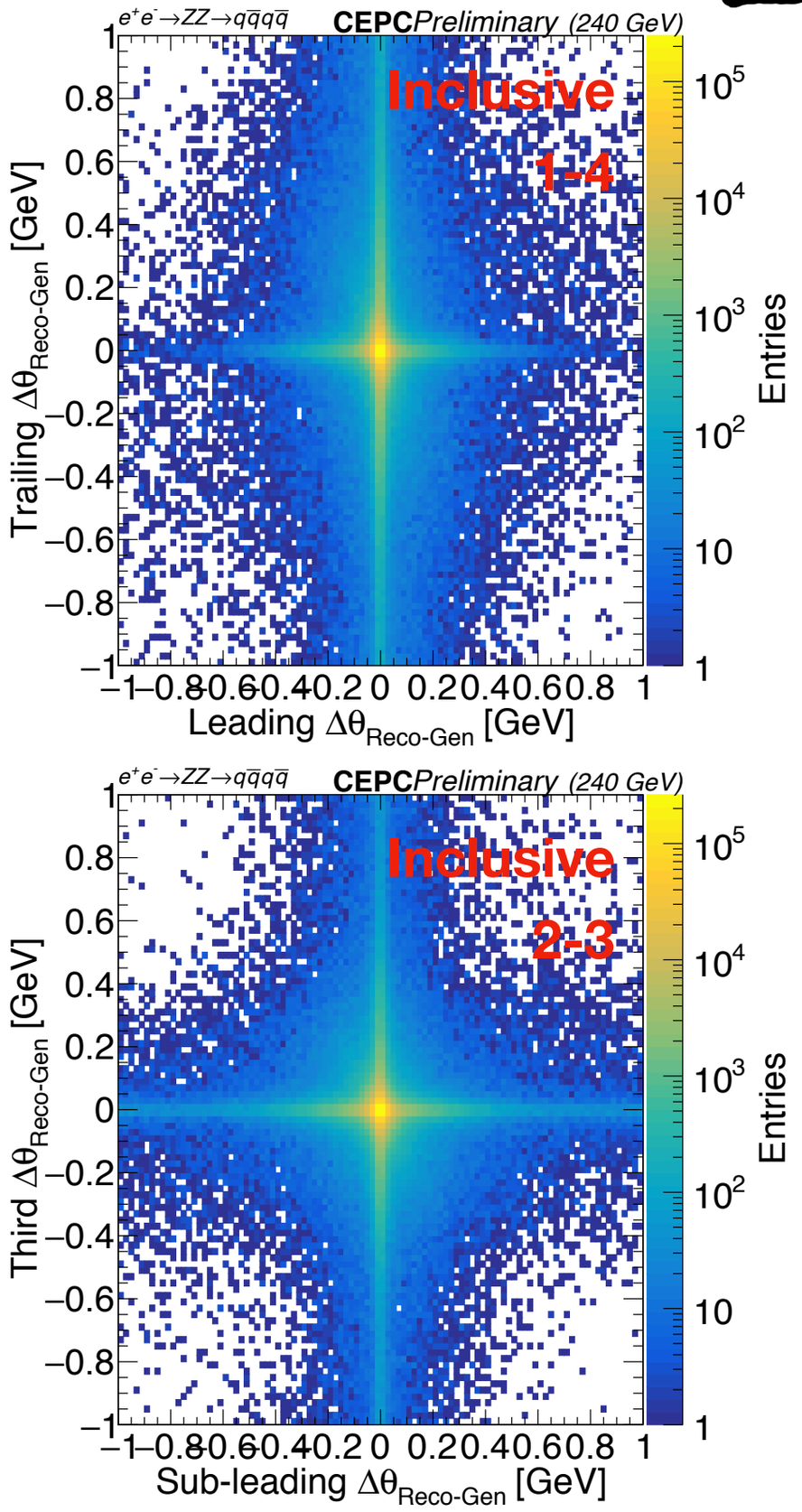
2D $\Delta\theta$ Distribution

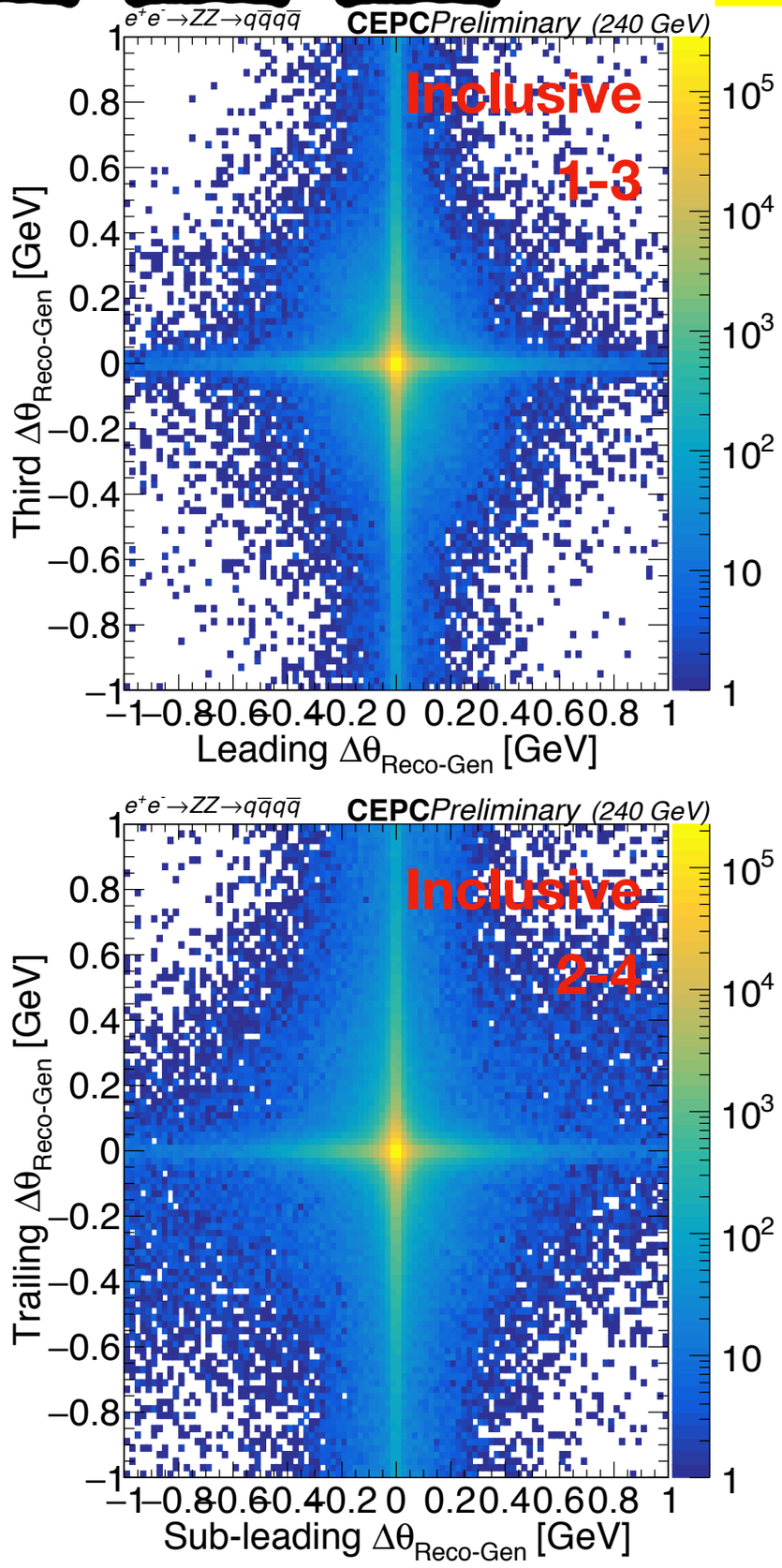
Match by Energy and ΔR reverse

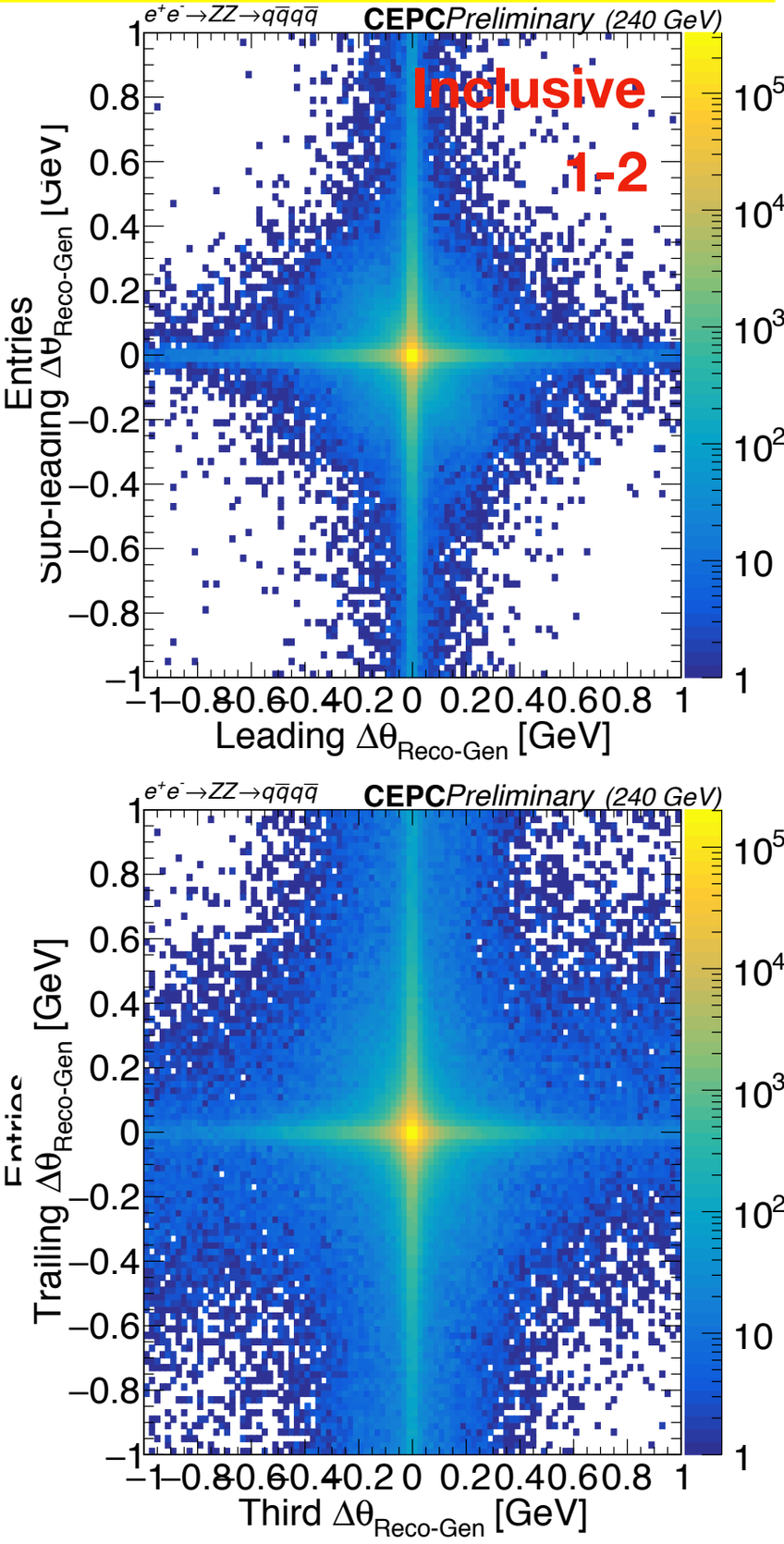
1-4
2-3

1-3
2-4

1-2
3-4



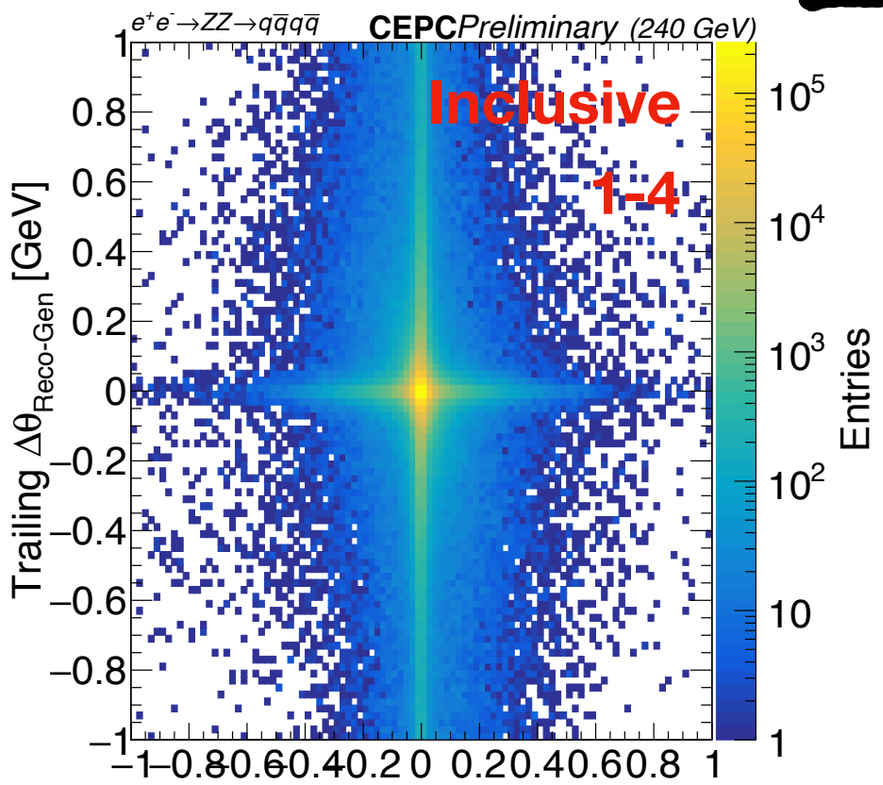


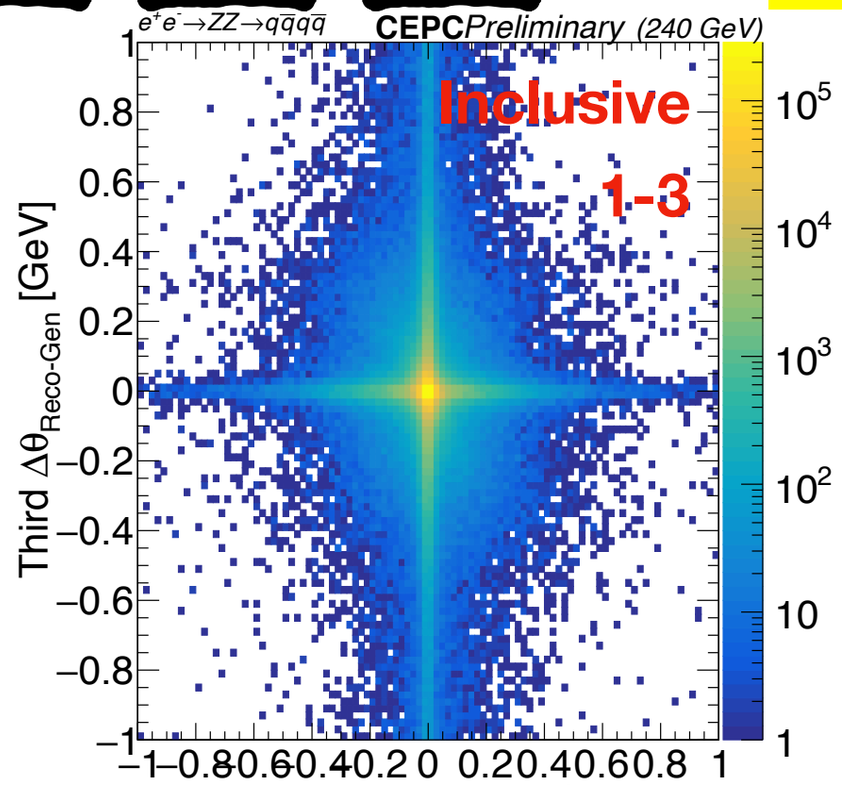


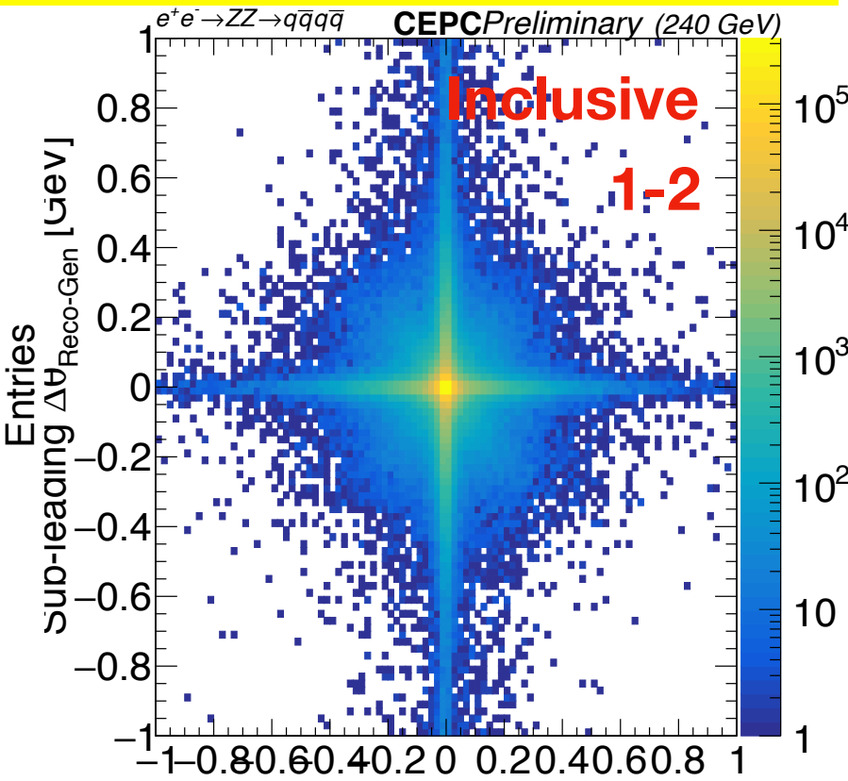
2D $\Delta\theta$ Distribution

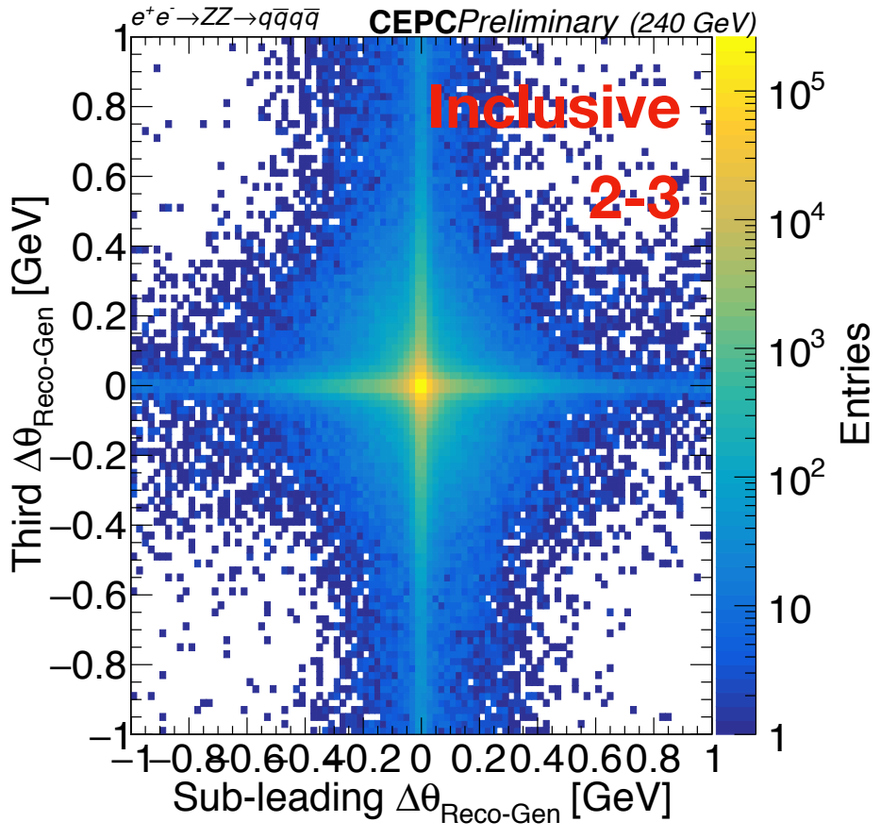
Match by Energy and ΔR+ ΔE reverse

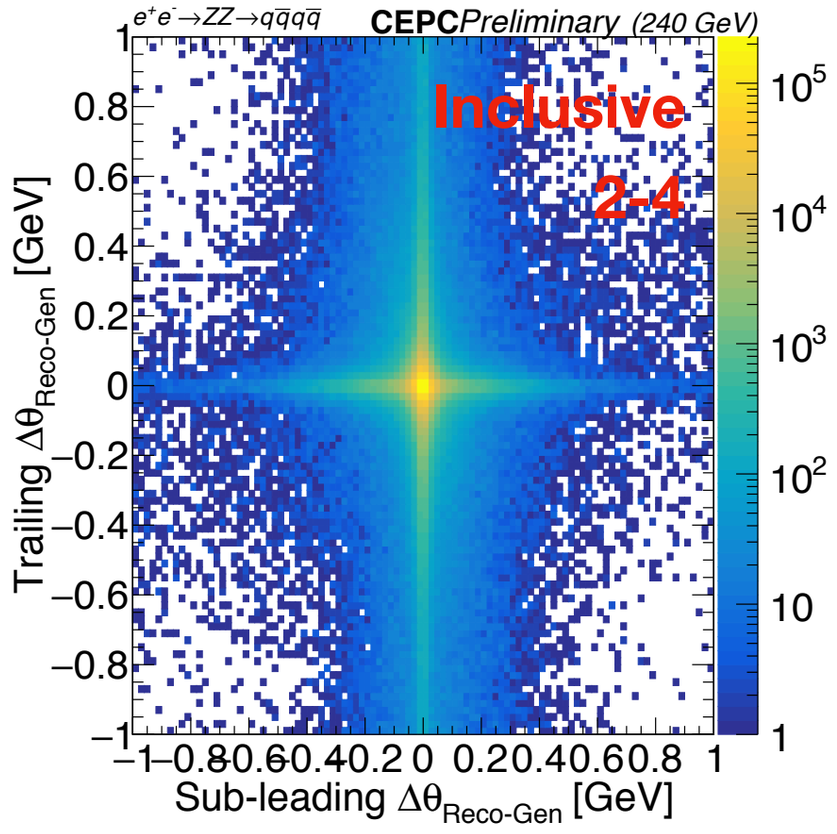
1-4	1-3	1-2
2-3	2-4	3-4

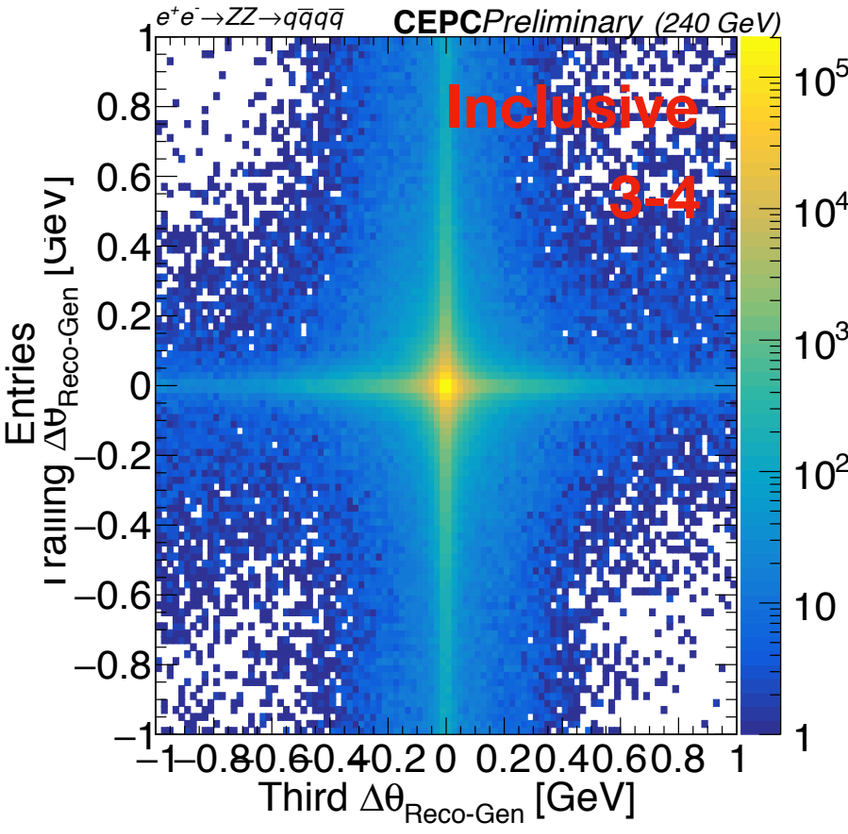








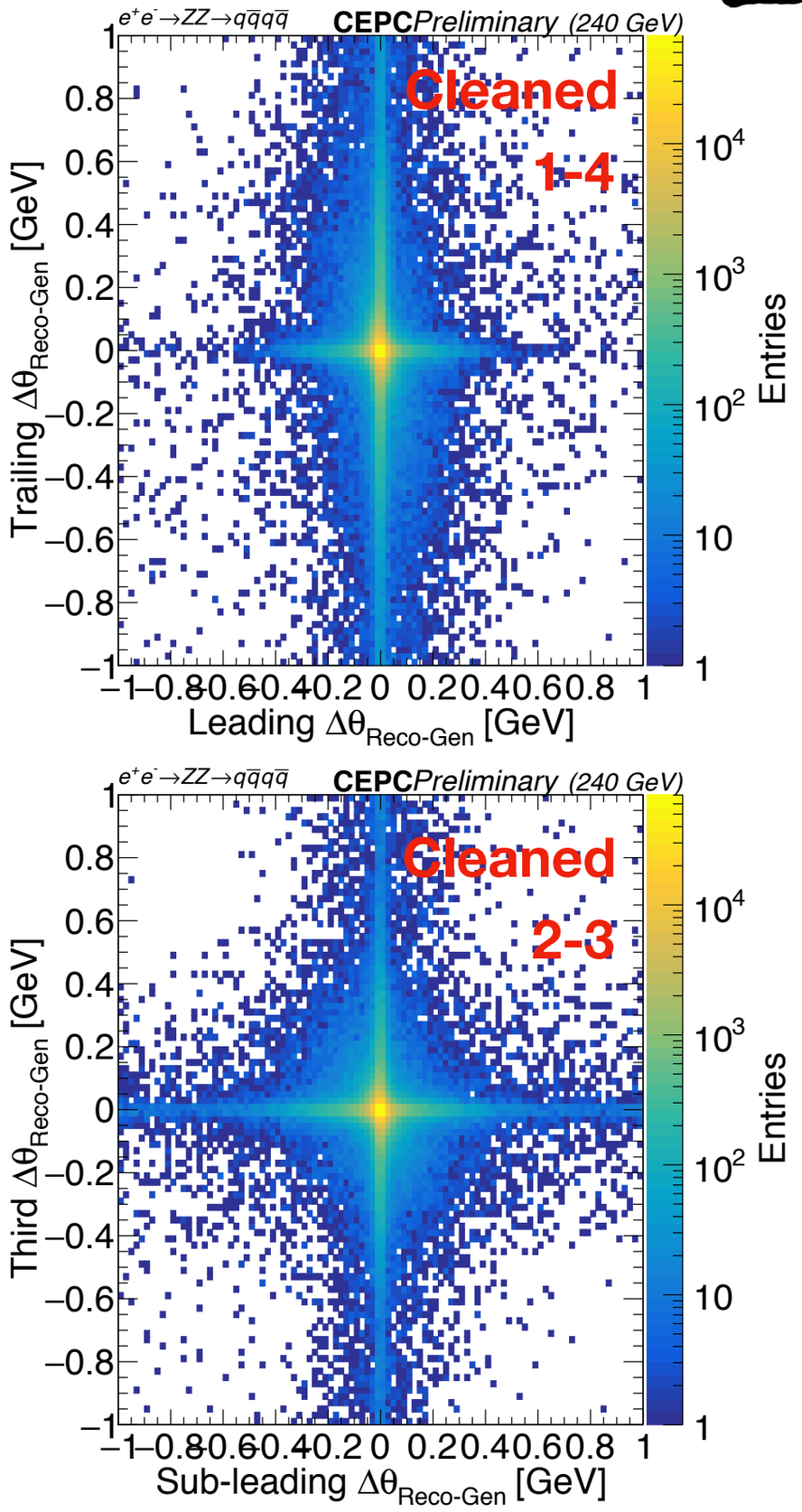


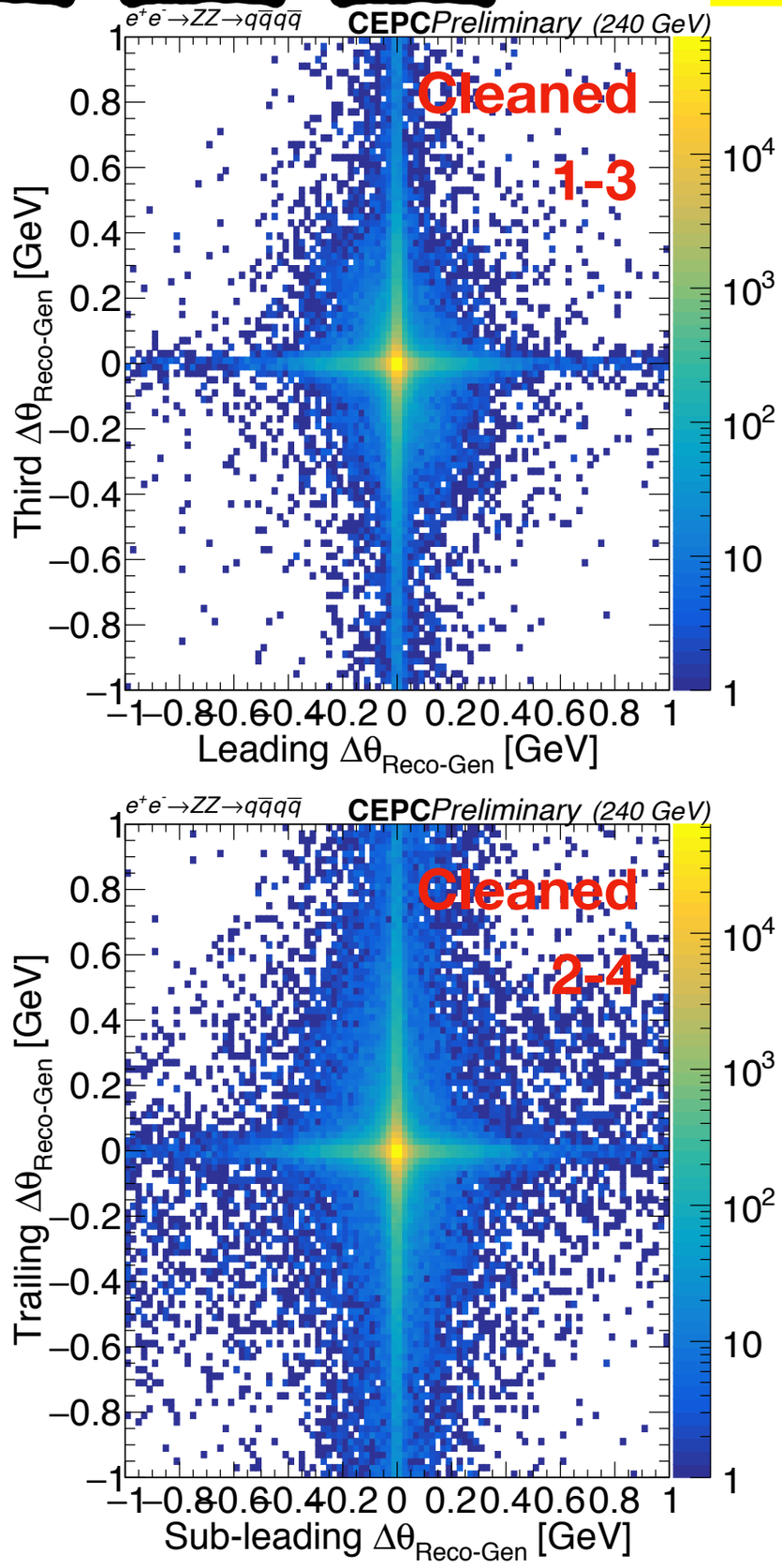


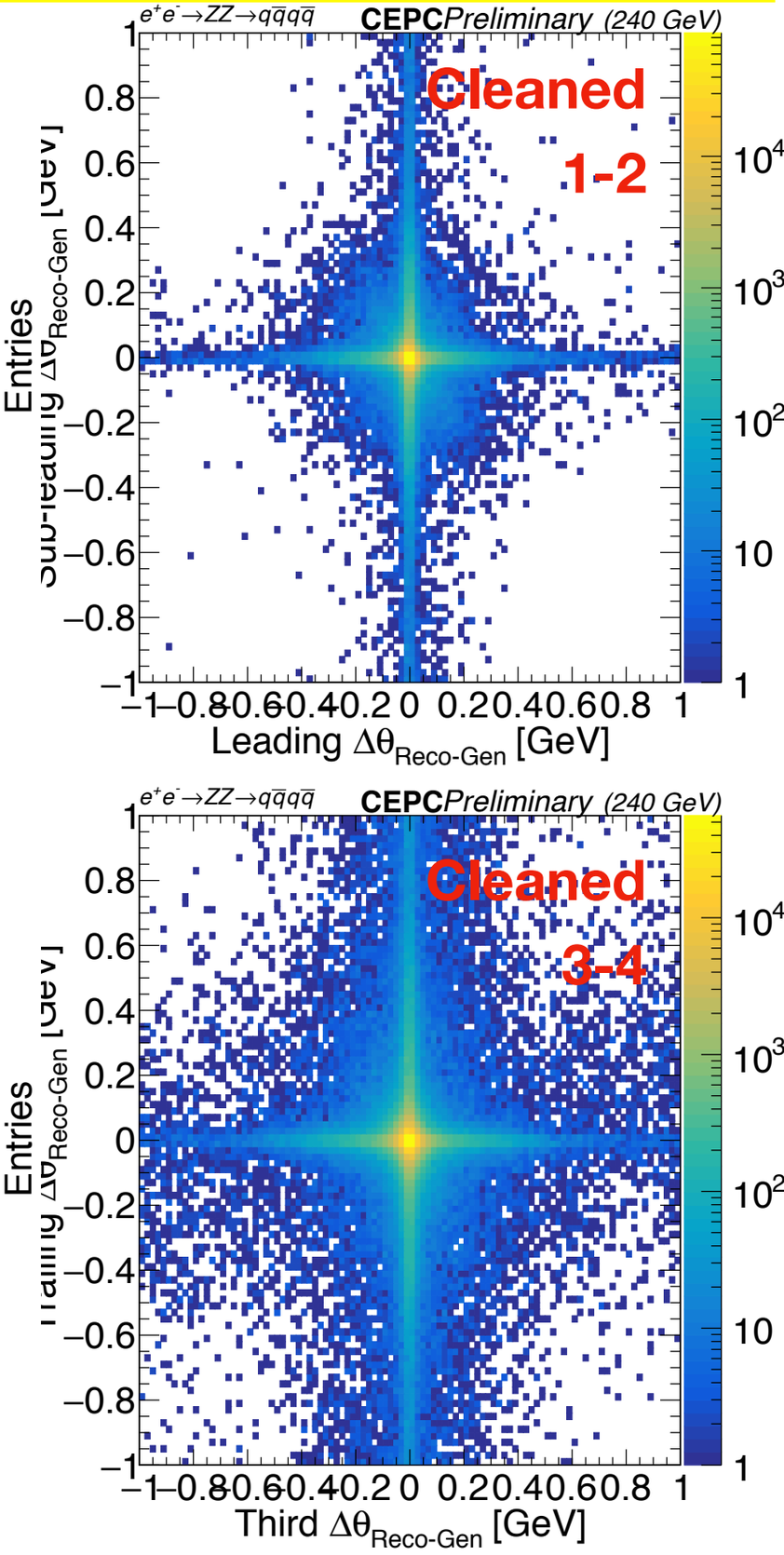
2D $\Delta\theta$ Distribution

Match by Energy and ΔR reverse

1-4	1-3	1-2
2-3	2-4	3-4



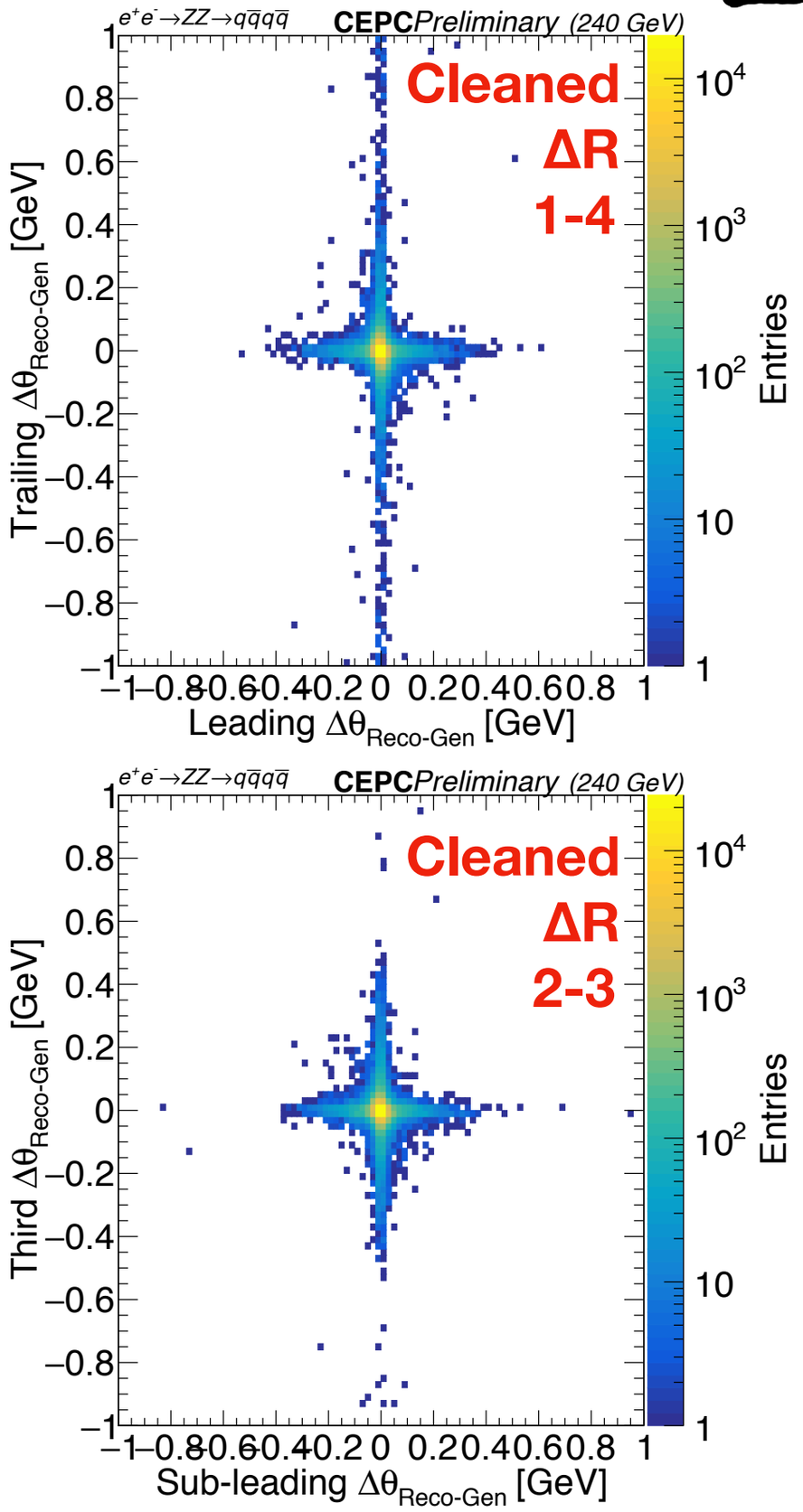


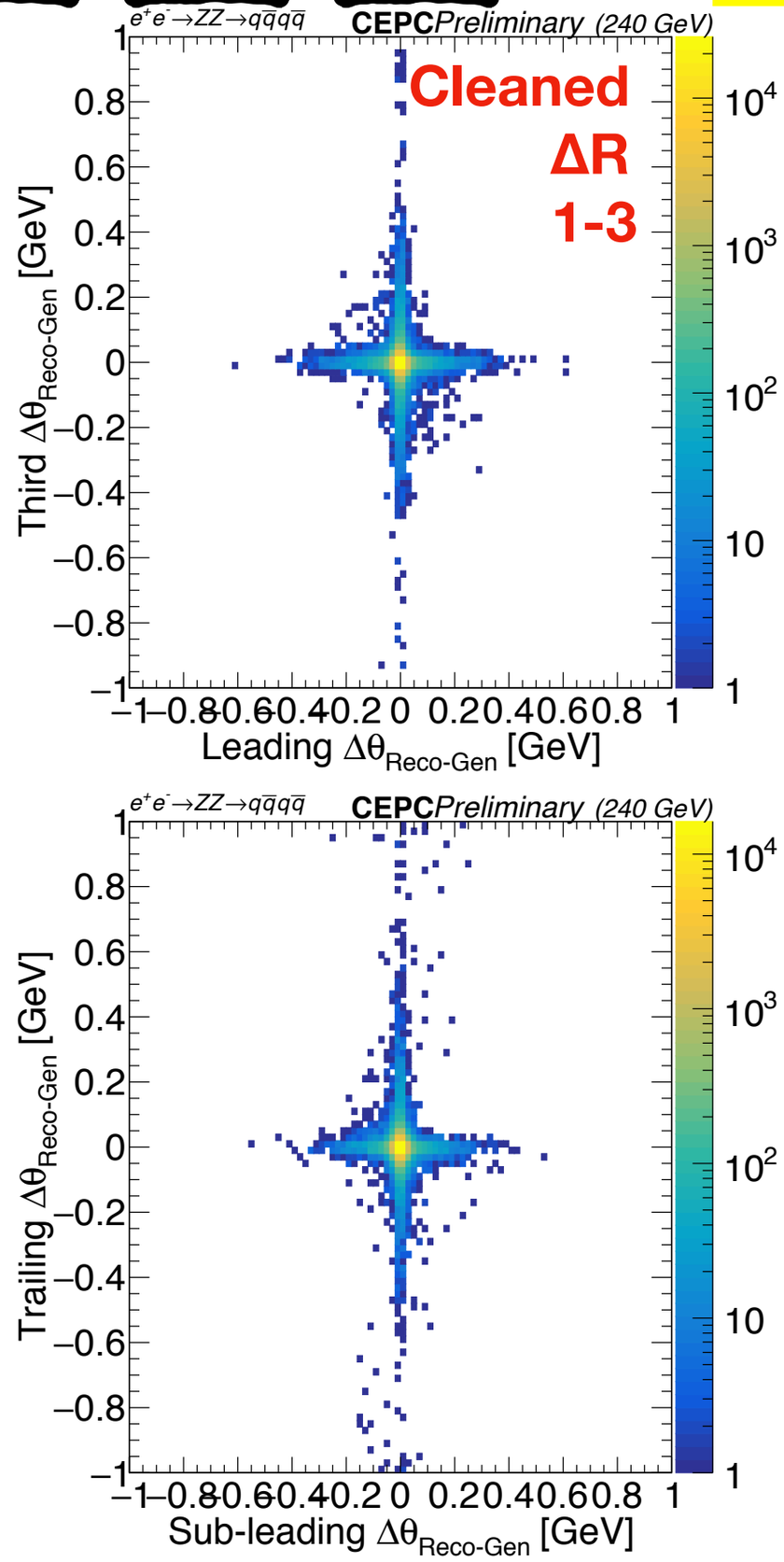


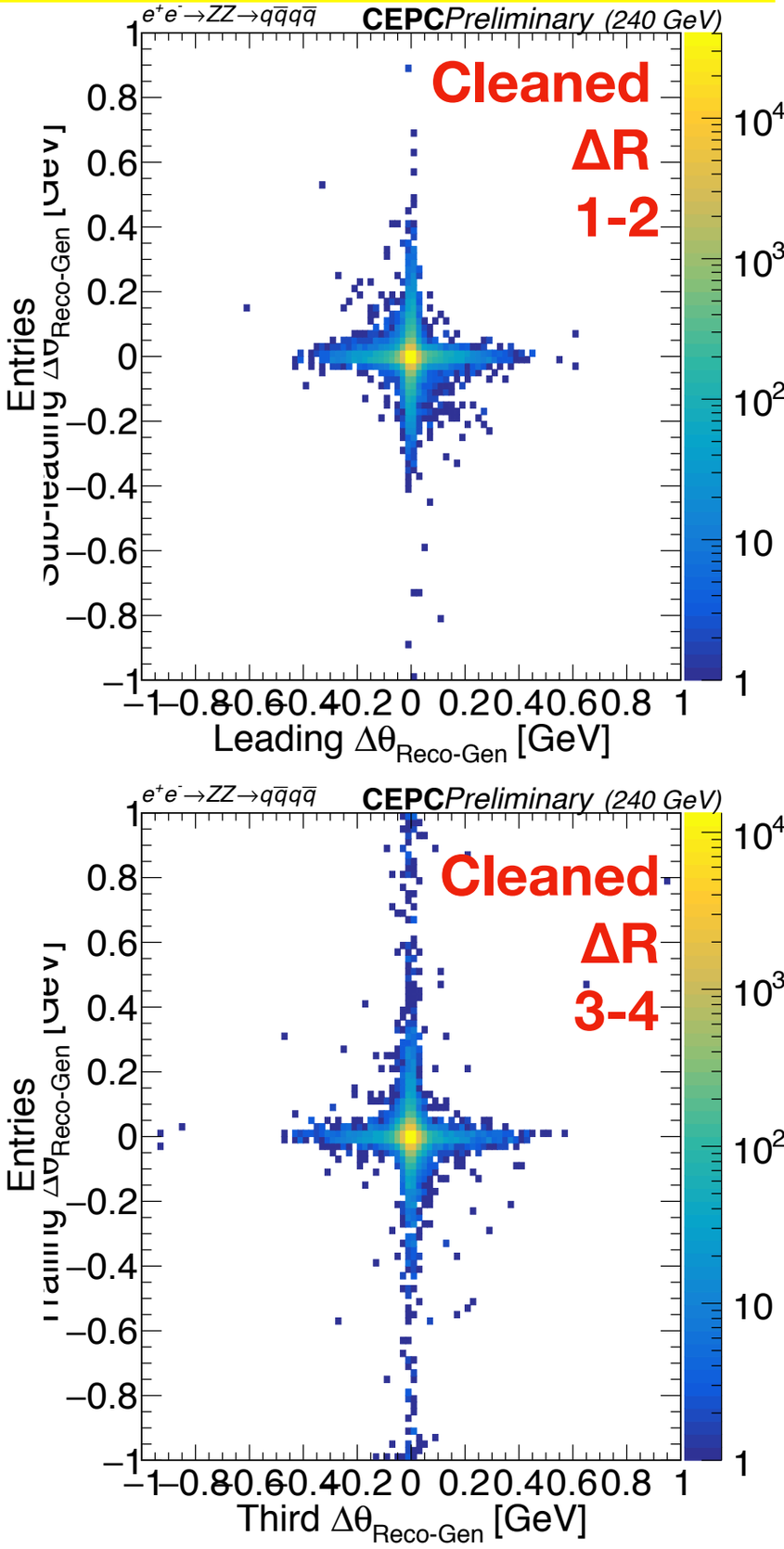
2D $\Delta\theta$ Distribution

Match by Energy and ΔR reverse

1-4	1-3	1-2
2-3	2-4	3-4







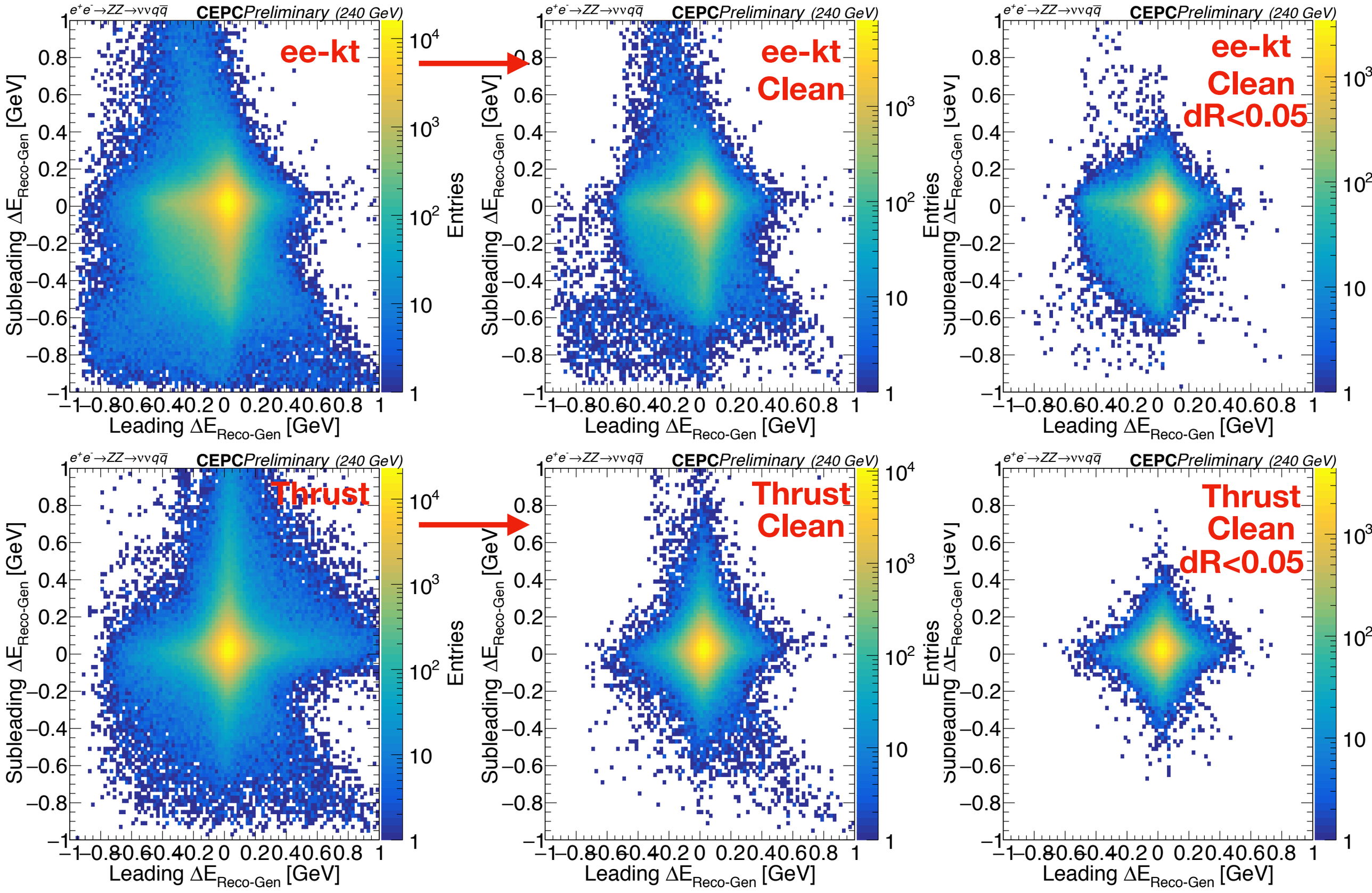
Summary

- Match Reco and Gen by energy and reverse by ΔR (or ΔR + ΔE) is a better approach than only using energy.
- Will perform the matching efficiency to determine ΔR (or ΔR + ΔE) is the best one.

Back up

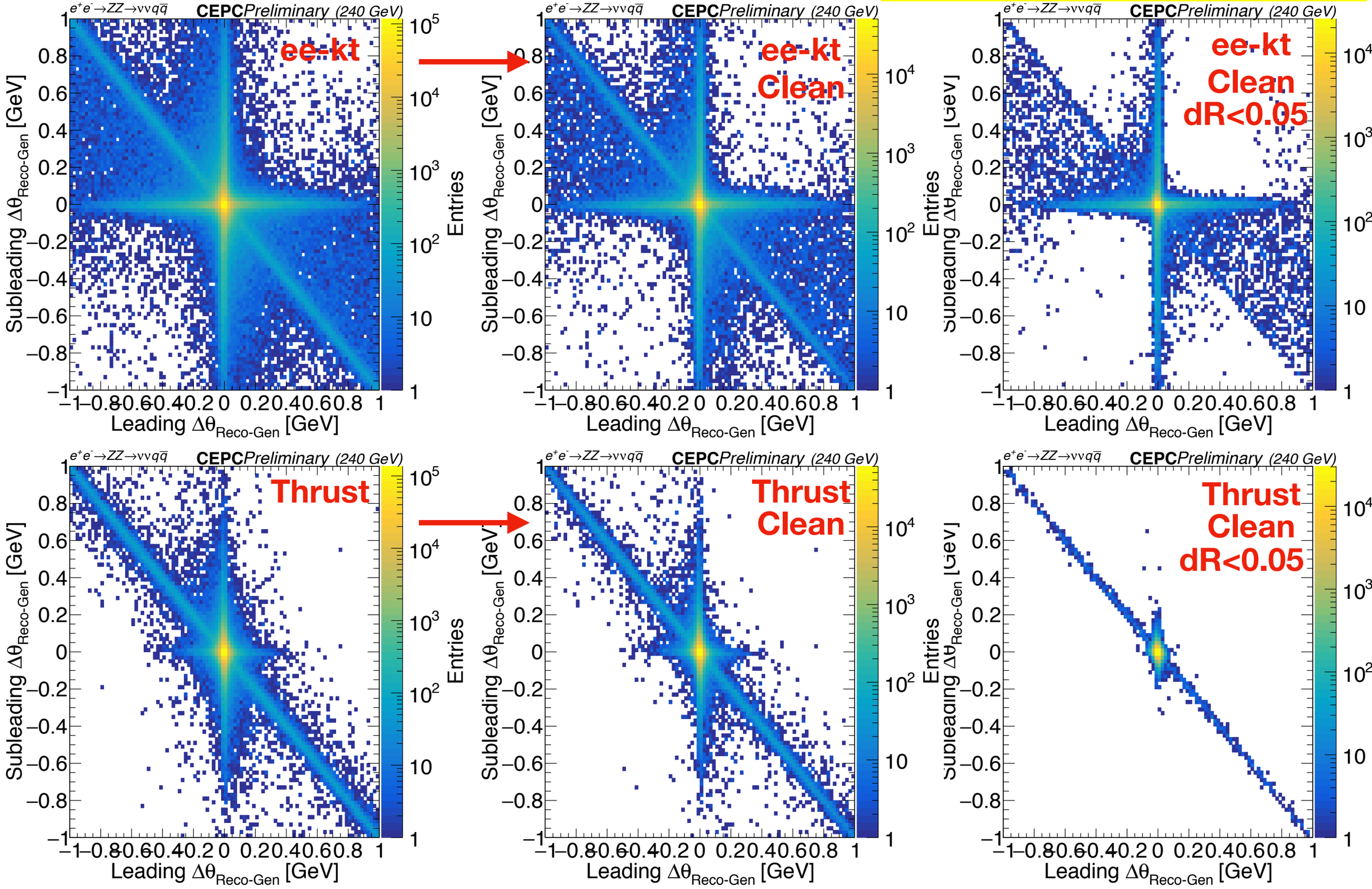
Match only by Energy

2D ΔE Distribution



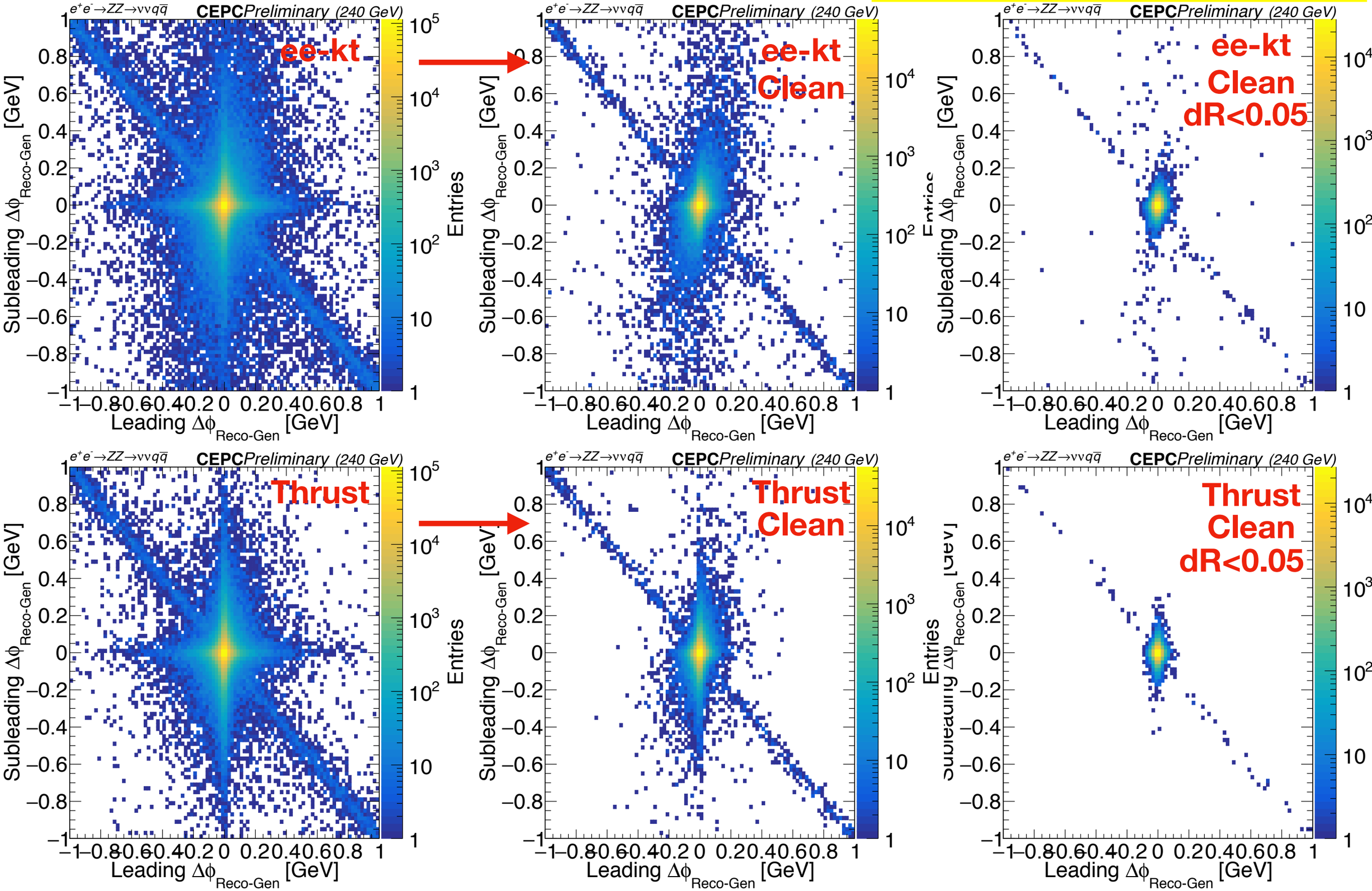
2D $\Delta\theta$ Distribution

Match only by Energy



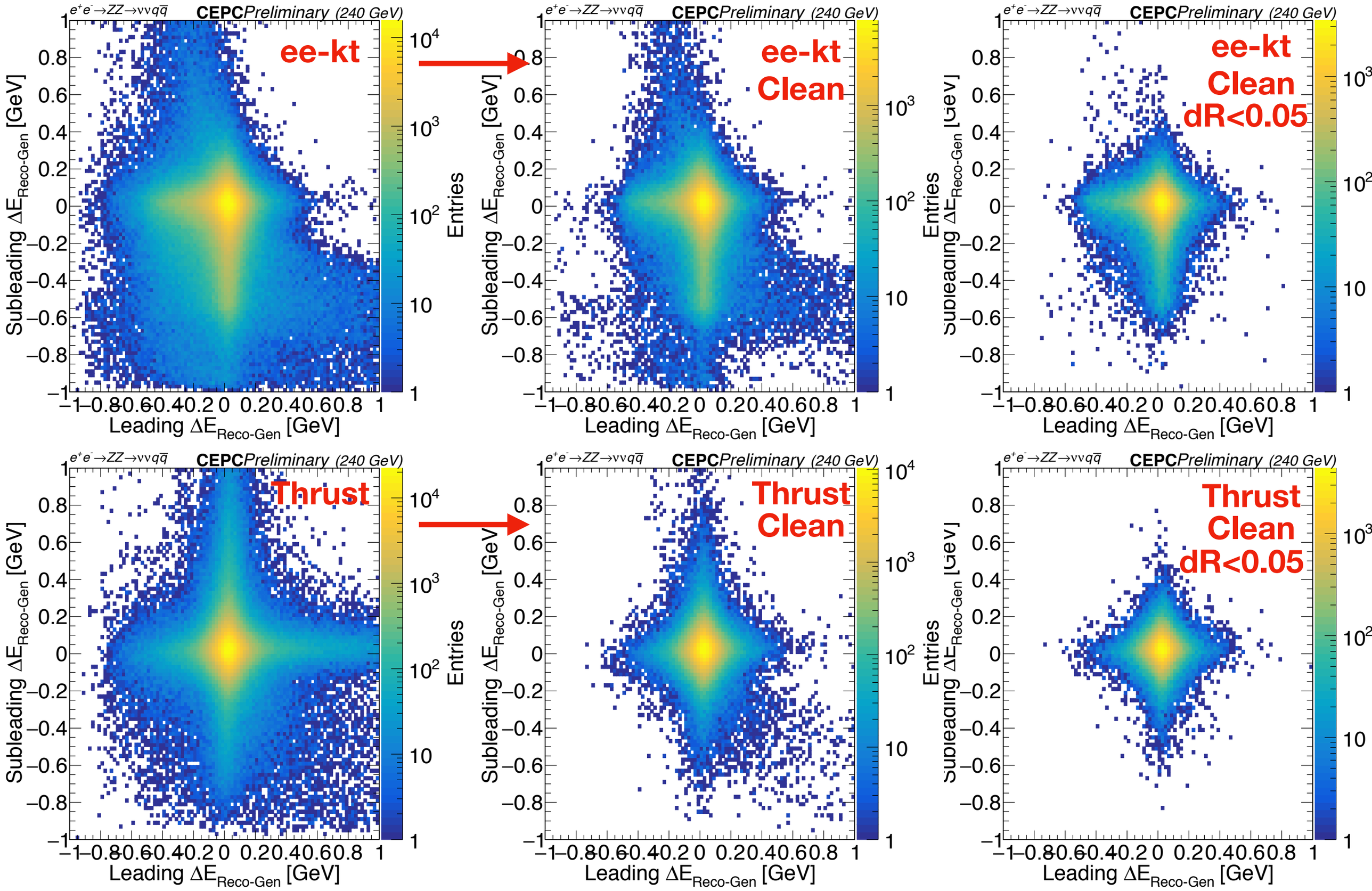
2D $\Delta\phi$ Distribution

Match only by Energy



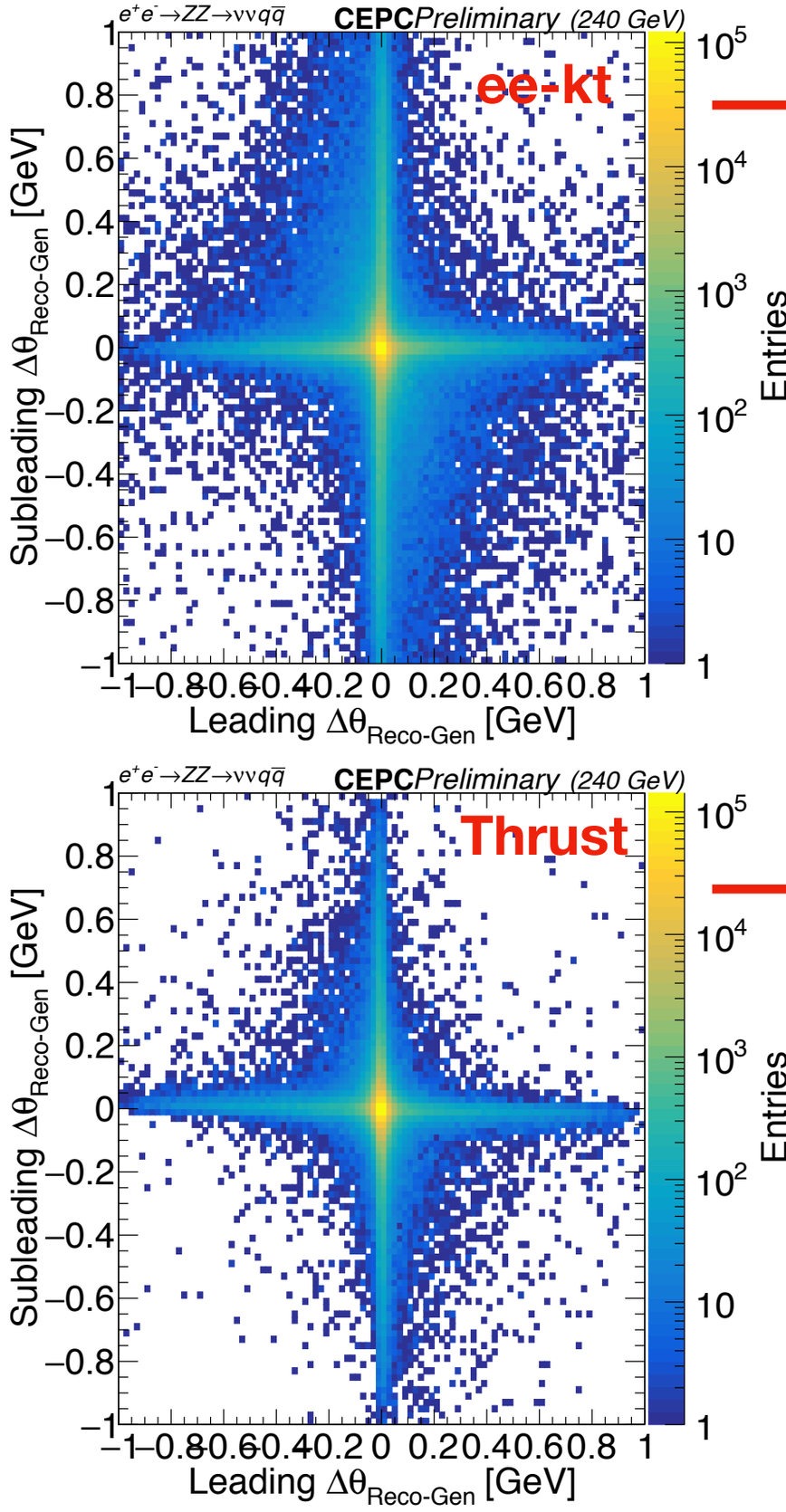
Match by Energy and ΔR reverse

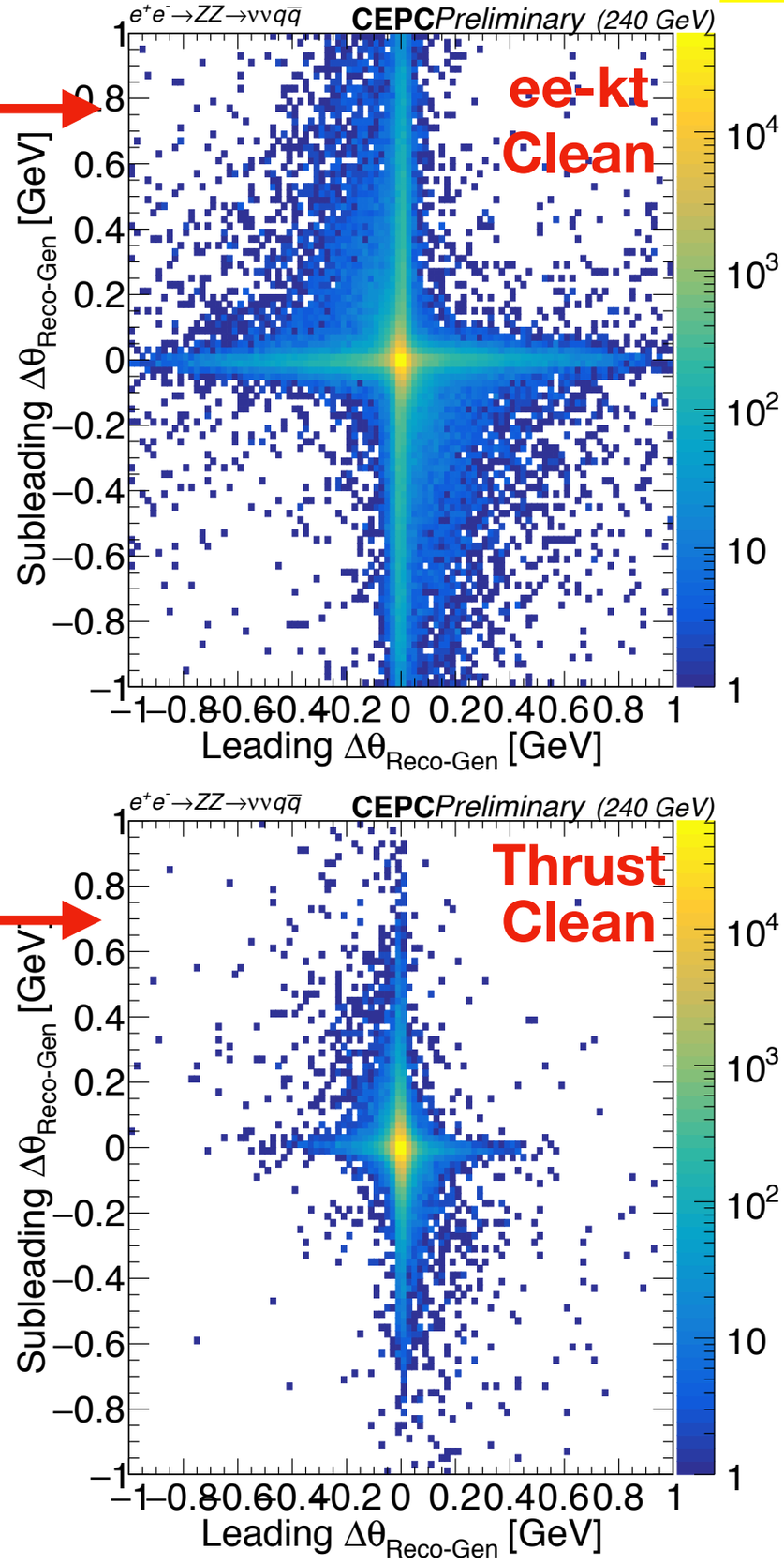
2D ΔE Distribution

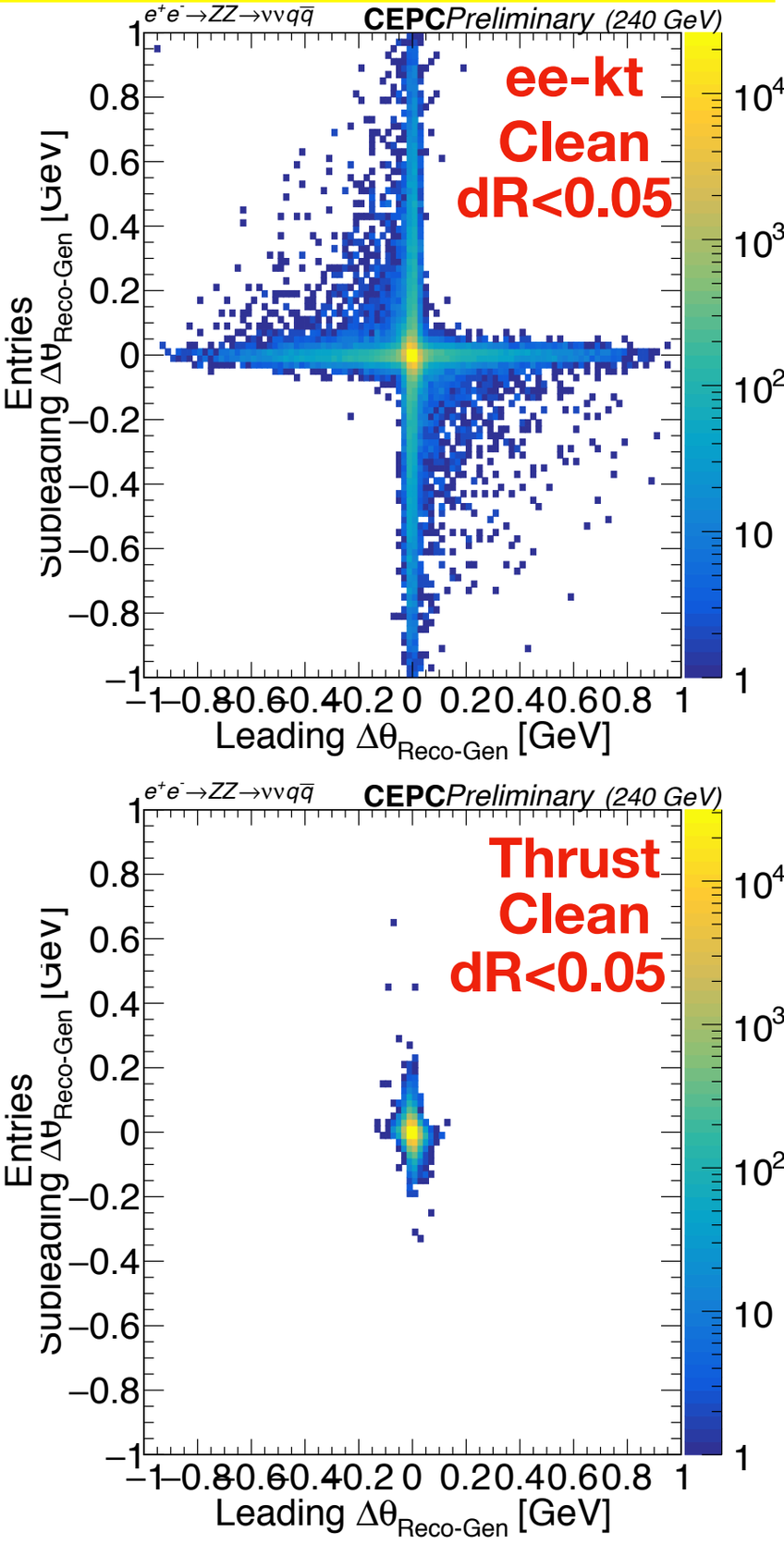


Match by Energy and ΔR reverse

2D $\Delta\theta$ Distribution

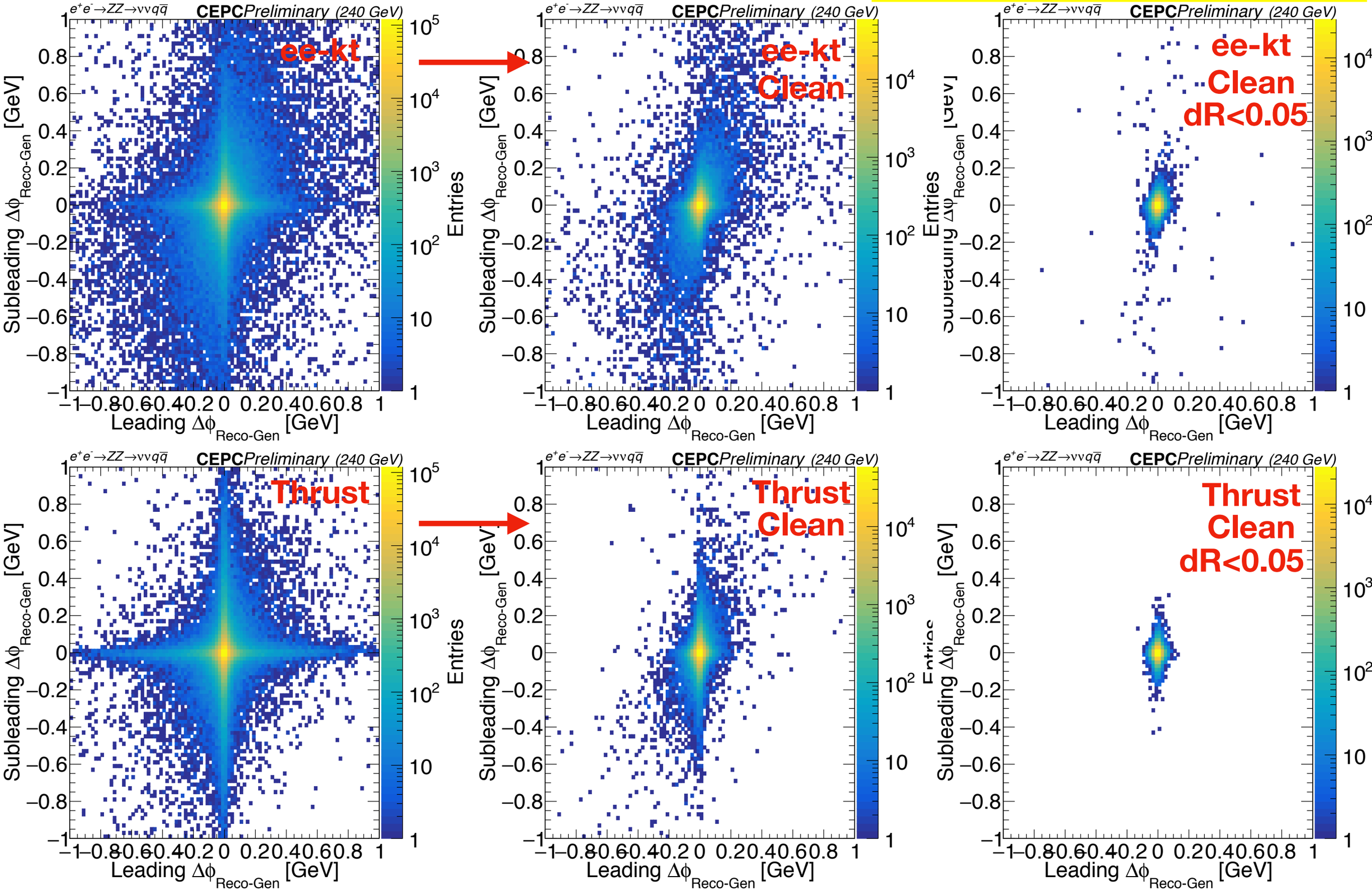






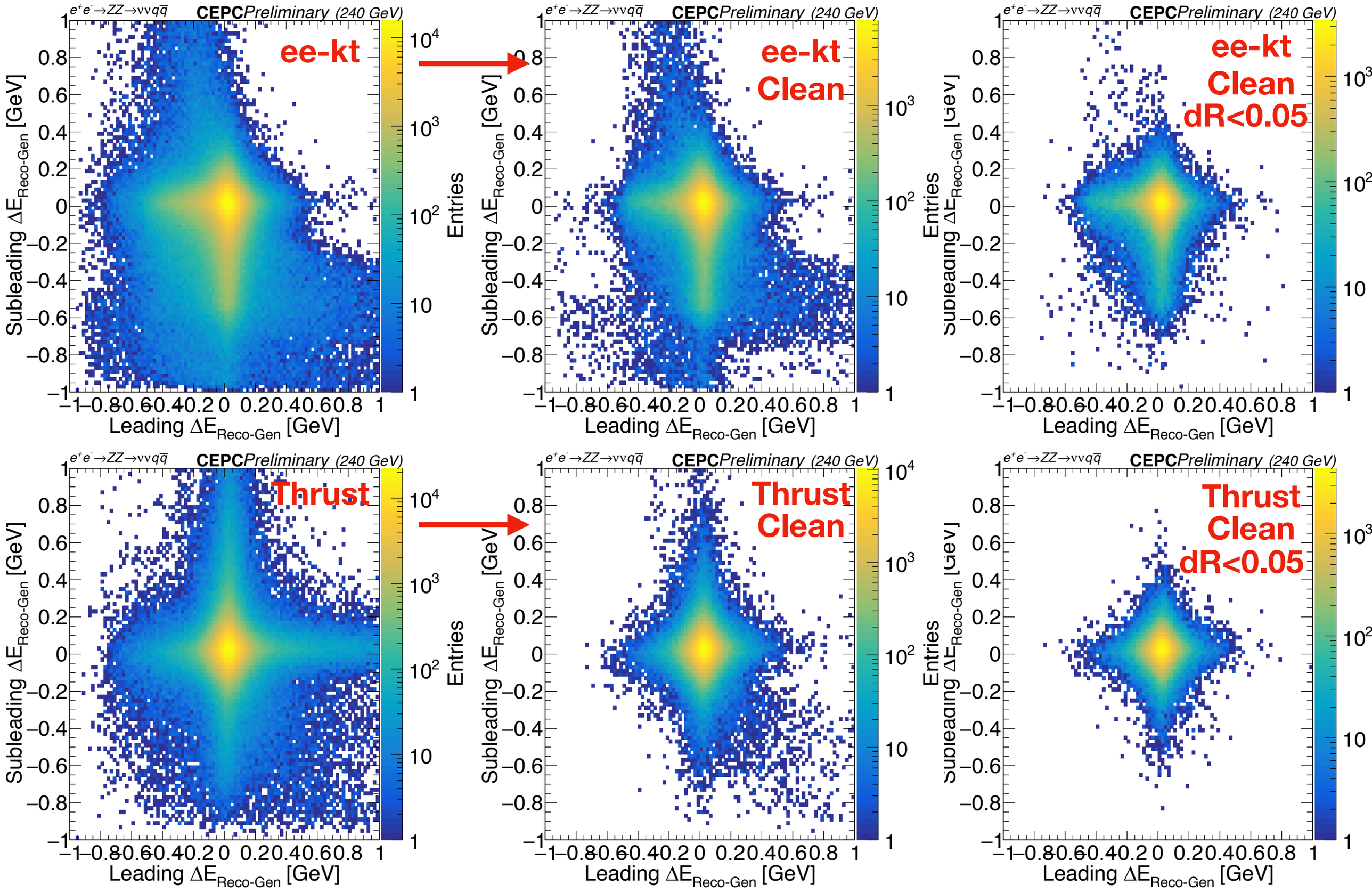
Match by Energy and ΔR reverse

2D $\Delta\phi$ Distribution



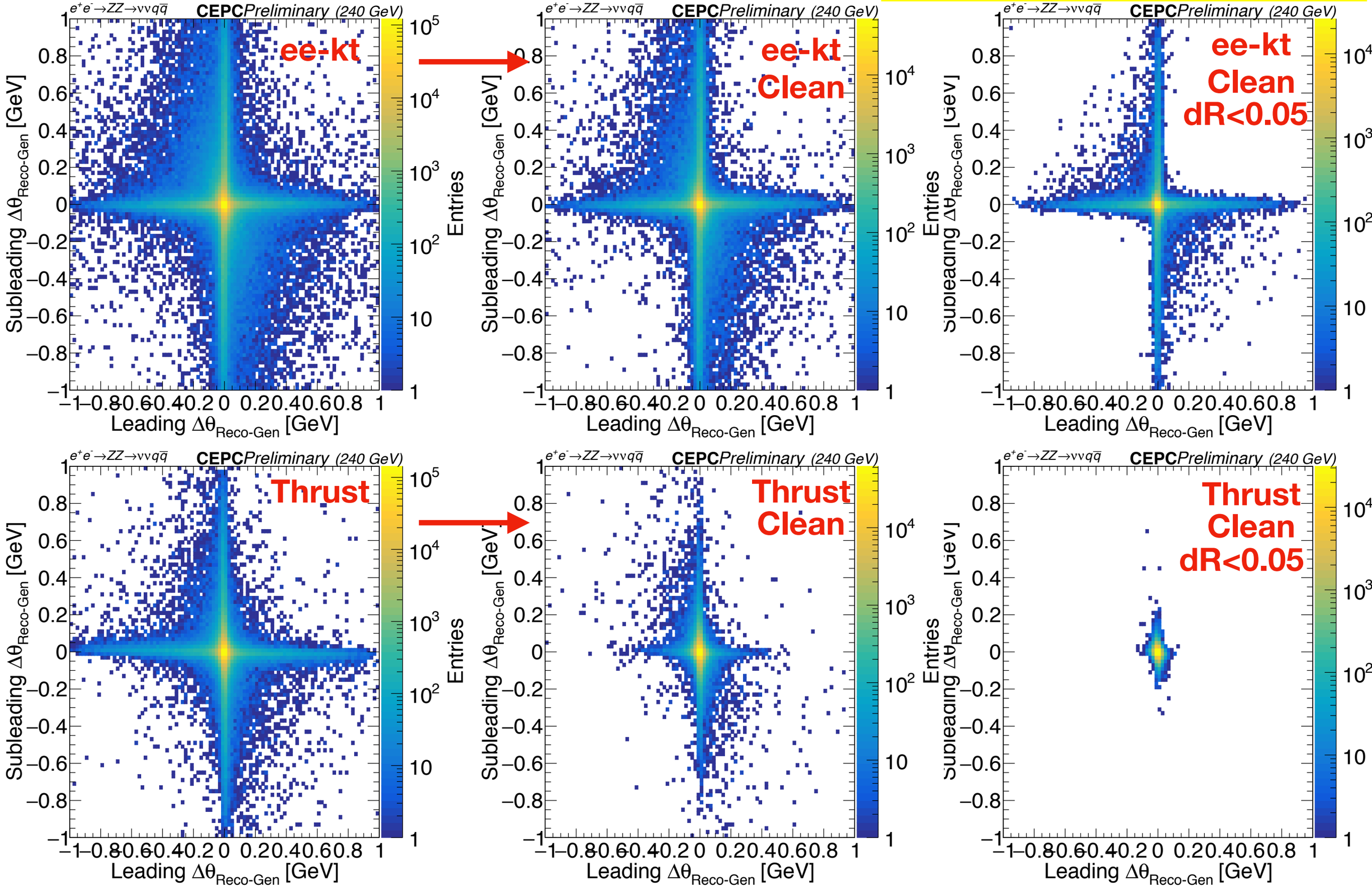
Match by Energy and ΔR+ ΔE reverse

2D ΔE Distribution



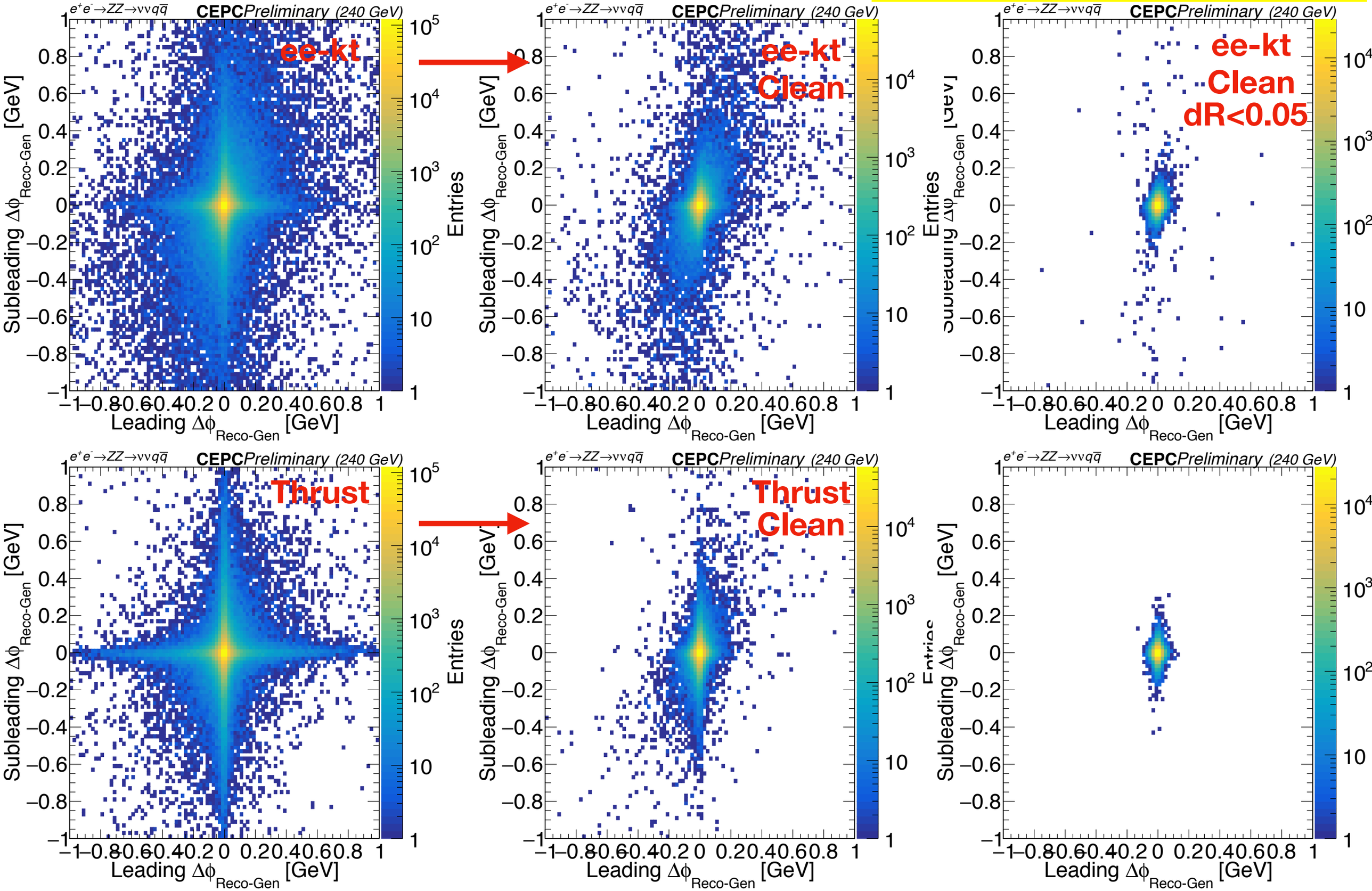
Match by Energy and ΔR+ ΔE reverse

2D $\Delta\theta$ Distribution



Match by Energy and ΔR+ ΔE reverse

2D $\Delta\phi$ Distribution

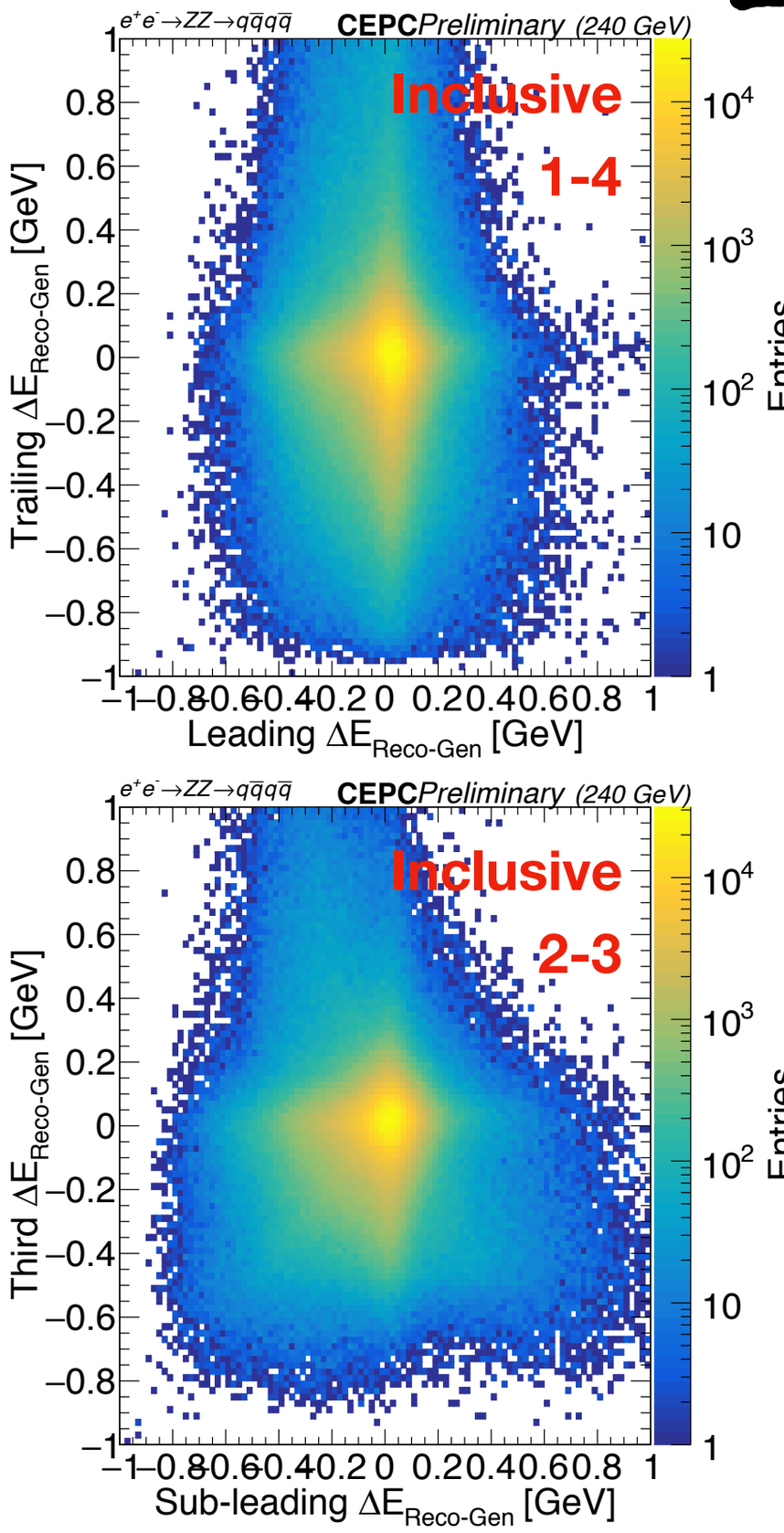


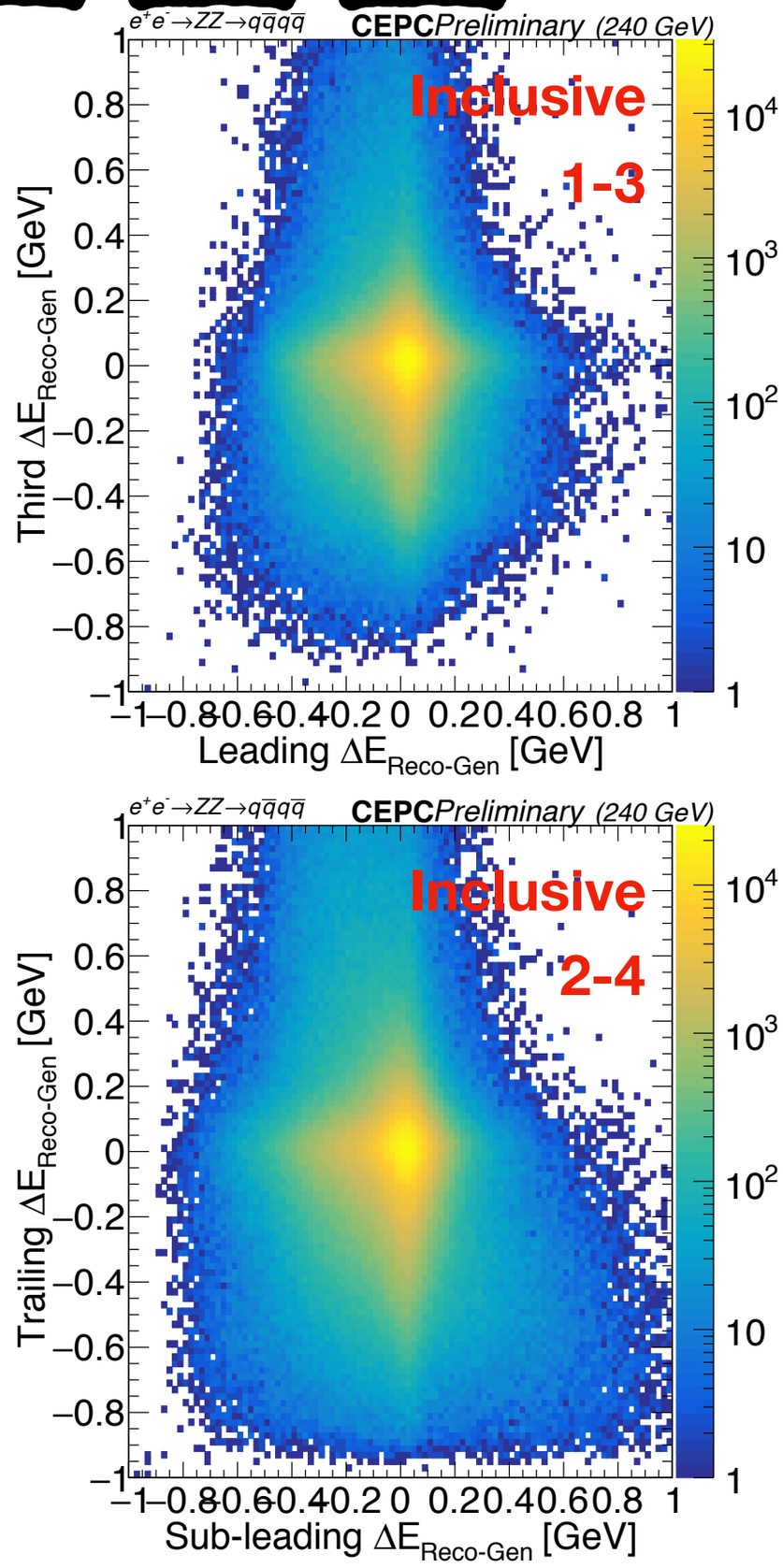
4-jet Condition

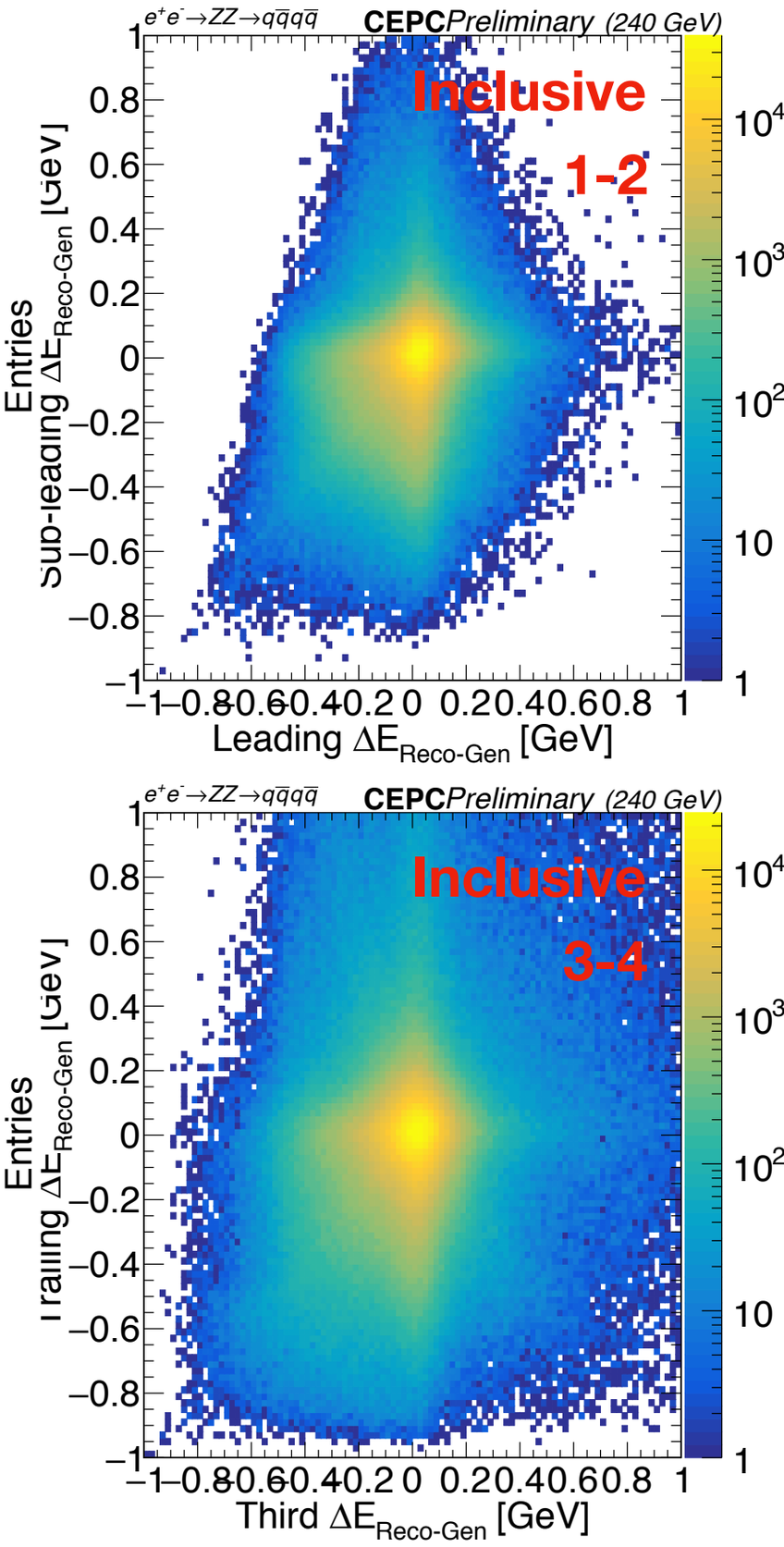
2D ΔE Distribution

Match only by Energy

1-4 2-3	1-3 2-4	1-2 3-4



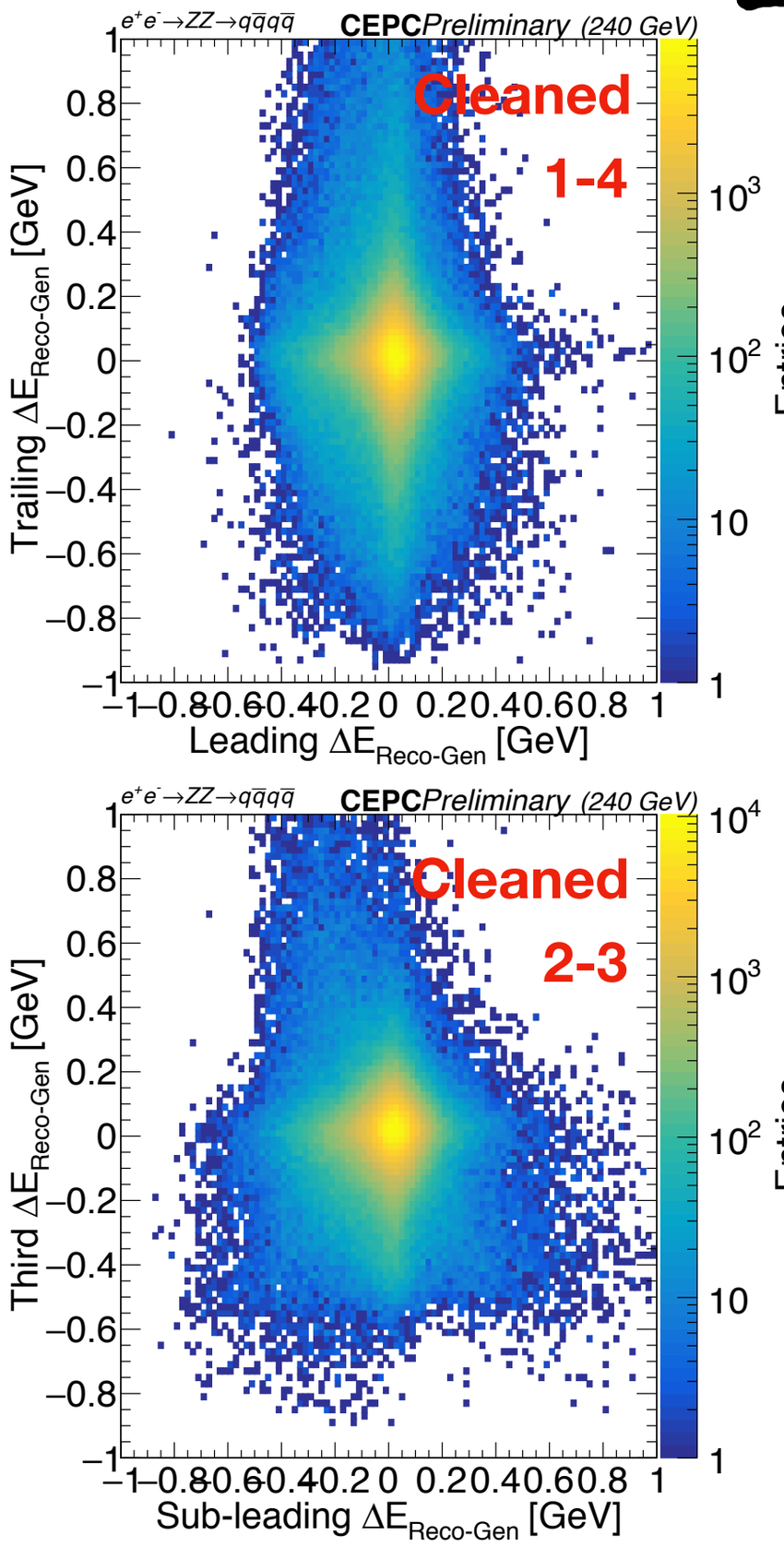


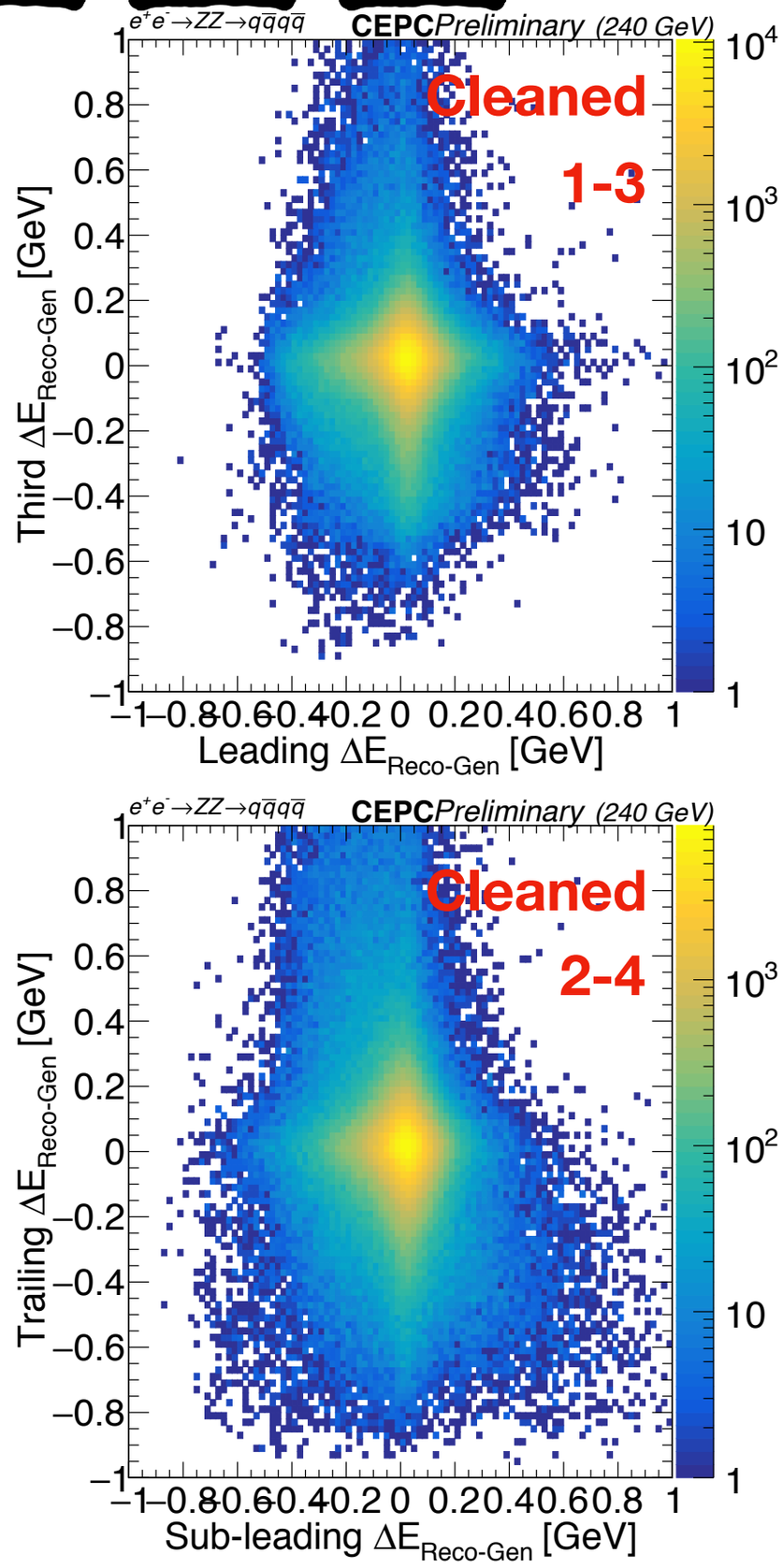


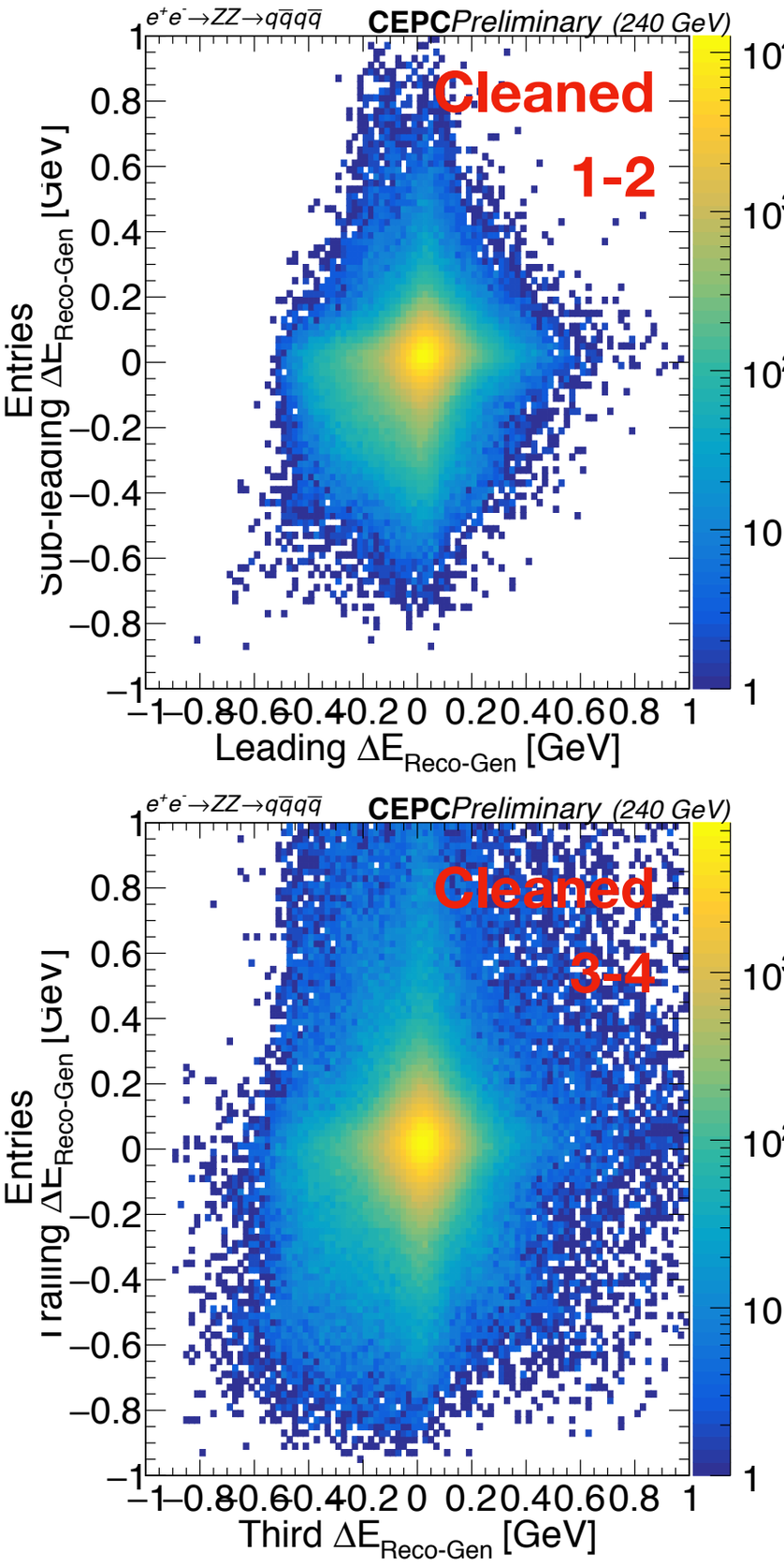
2D ΔE Distribution

Match only by Energy

1-4 2-3	1-3 2-4	1-2 3-4







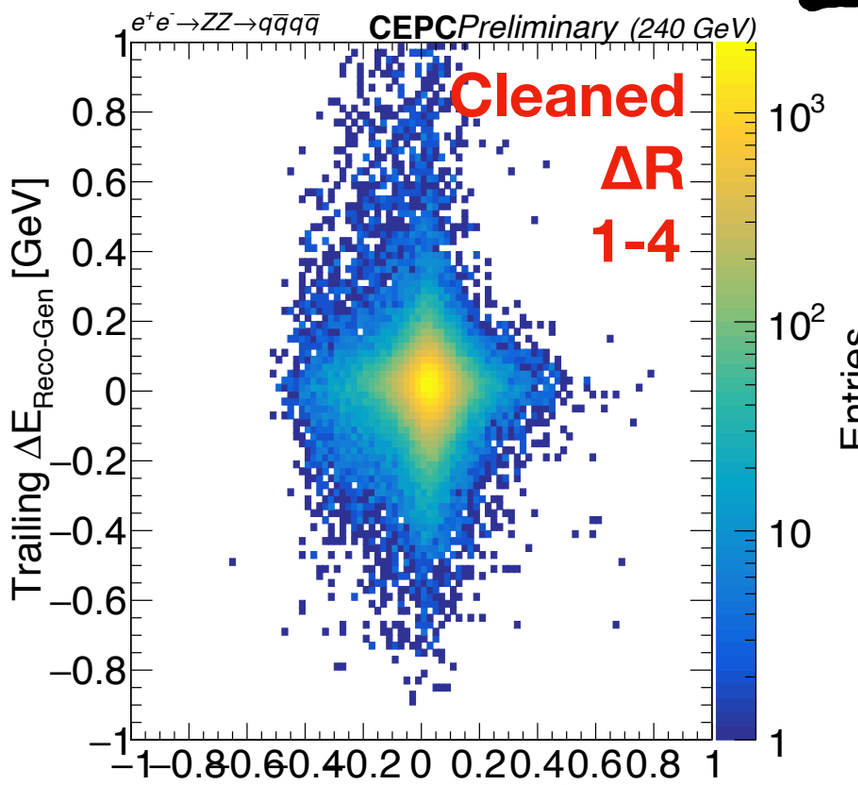
2D ΔE Distribution

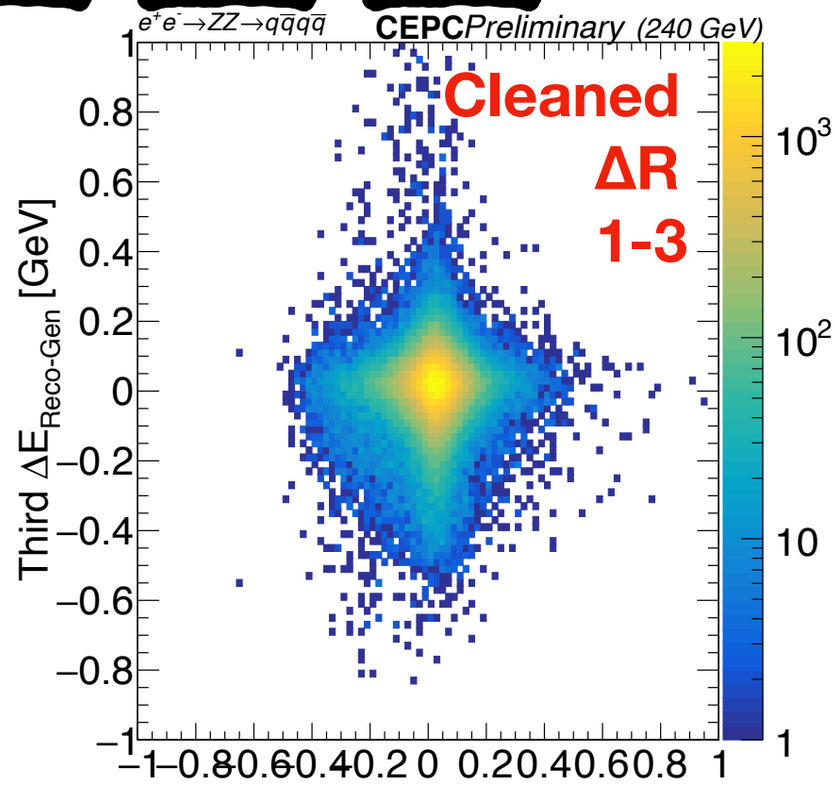
Match only by Energy

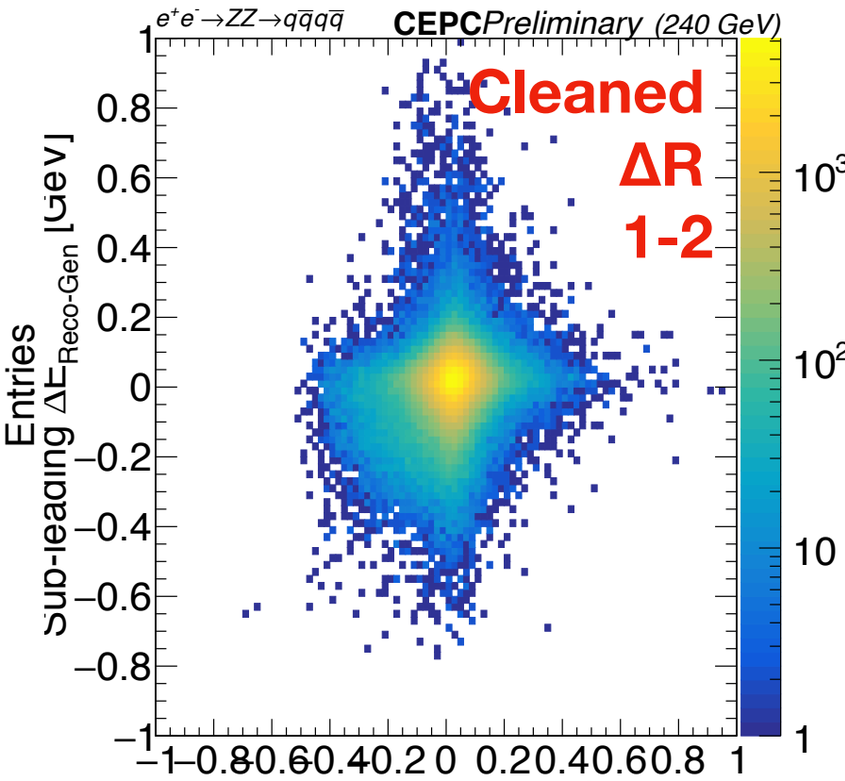
1-4
2-3

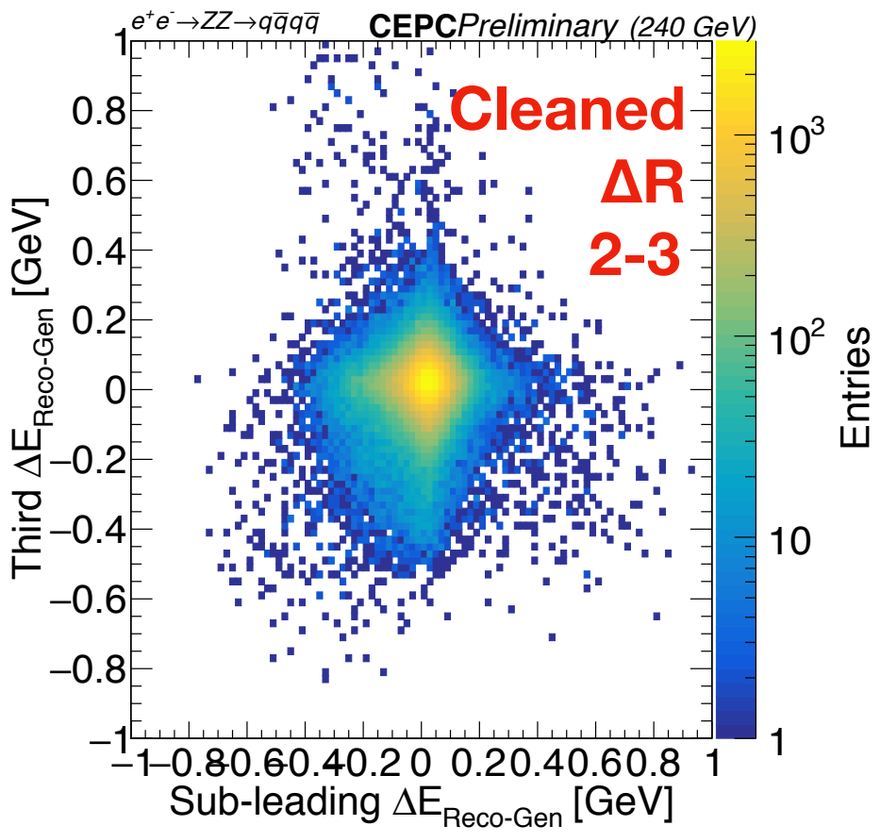
1-3
2-4

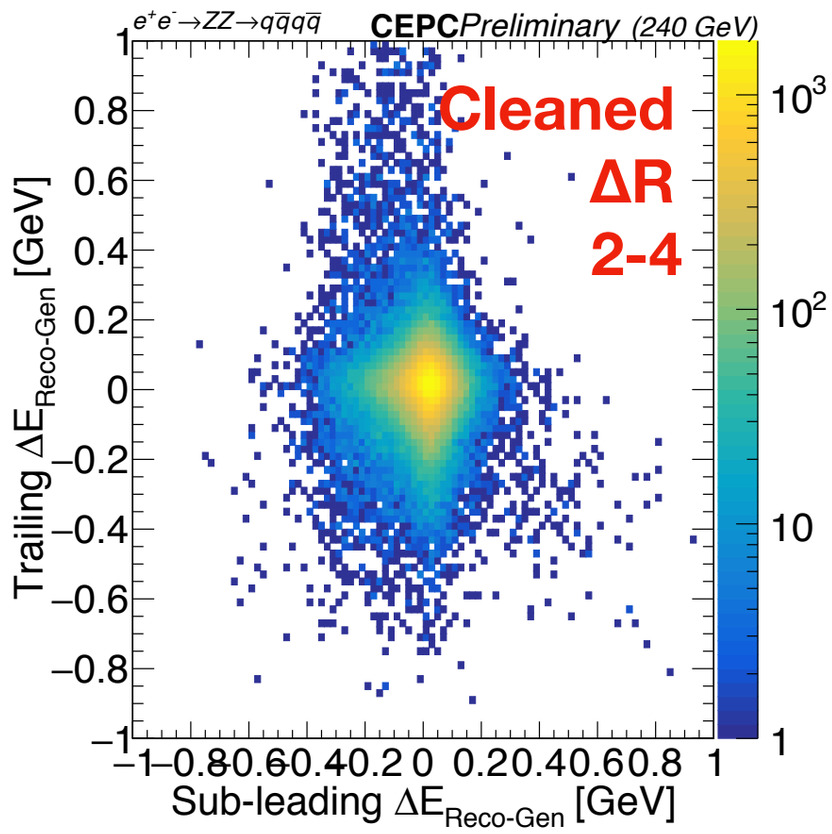
1-2
3-4

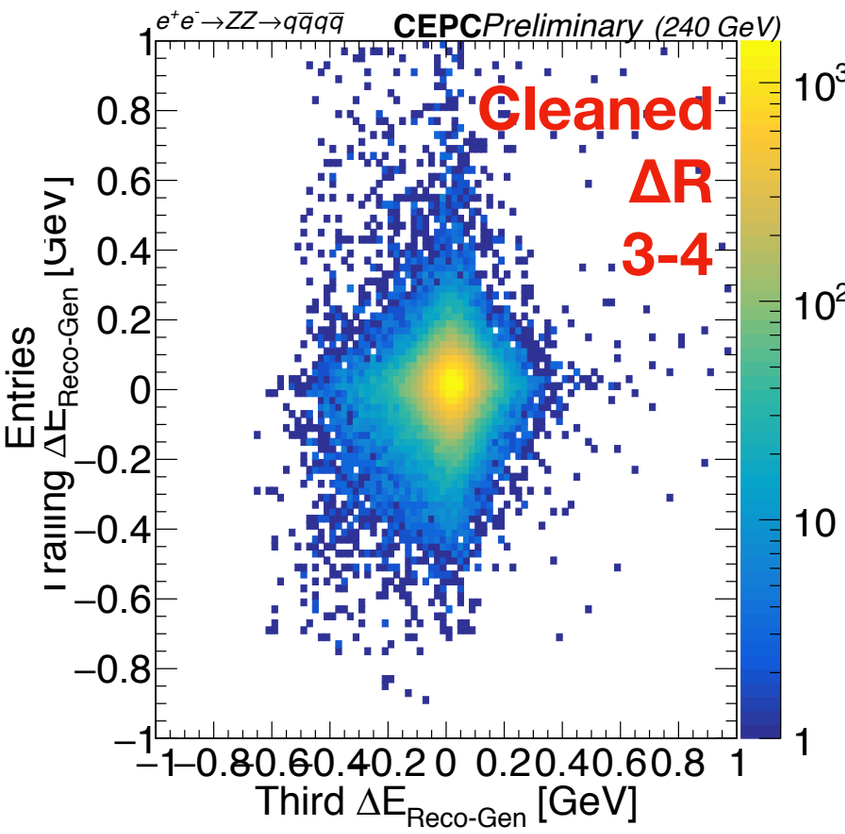












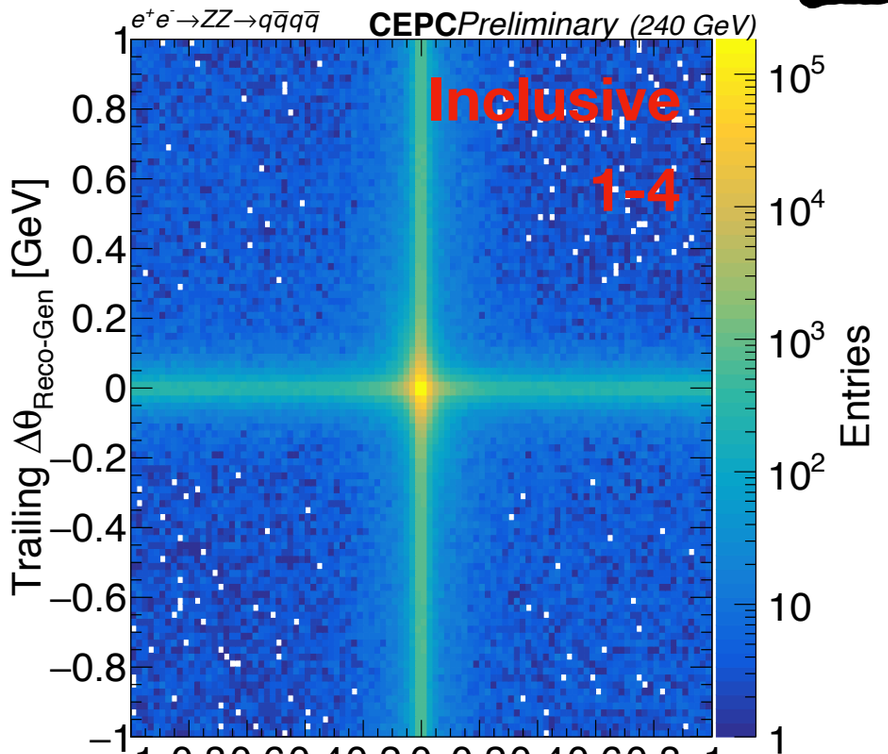
2D $\Delta\theta$ Distribution

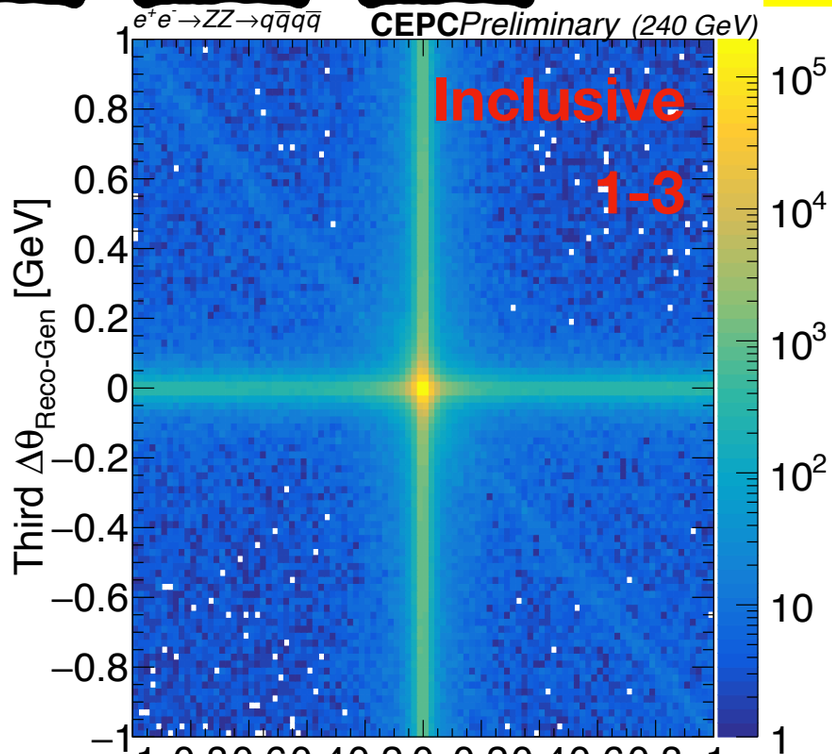
Match only by Energy

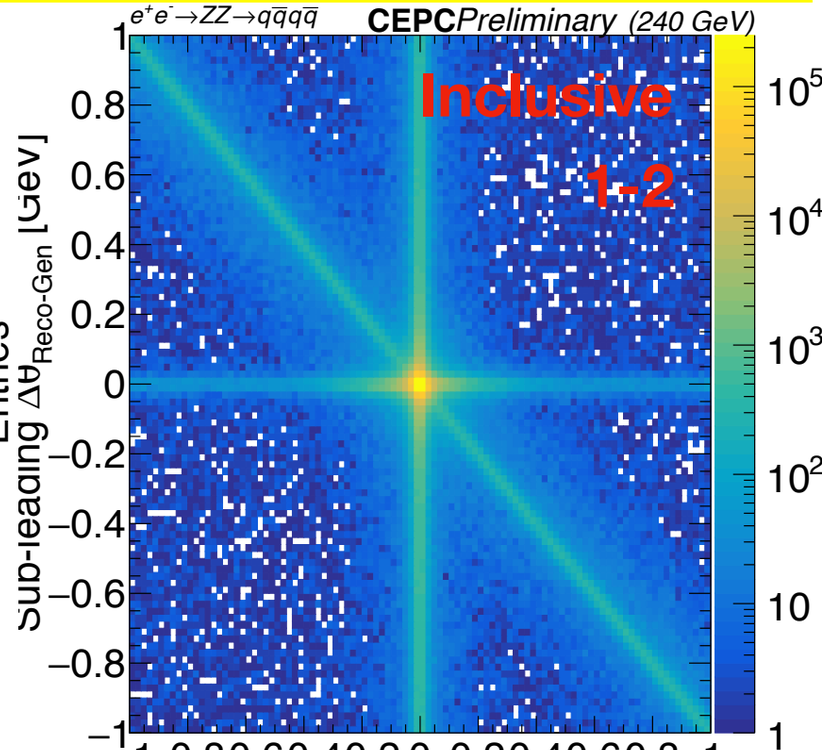
1-4
2-3

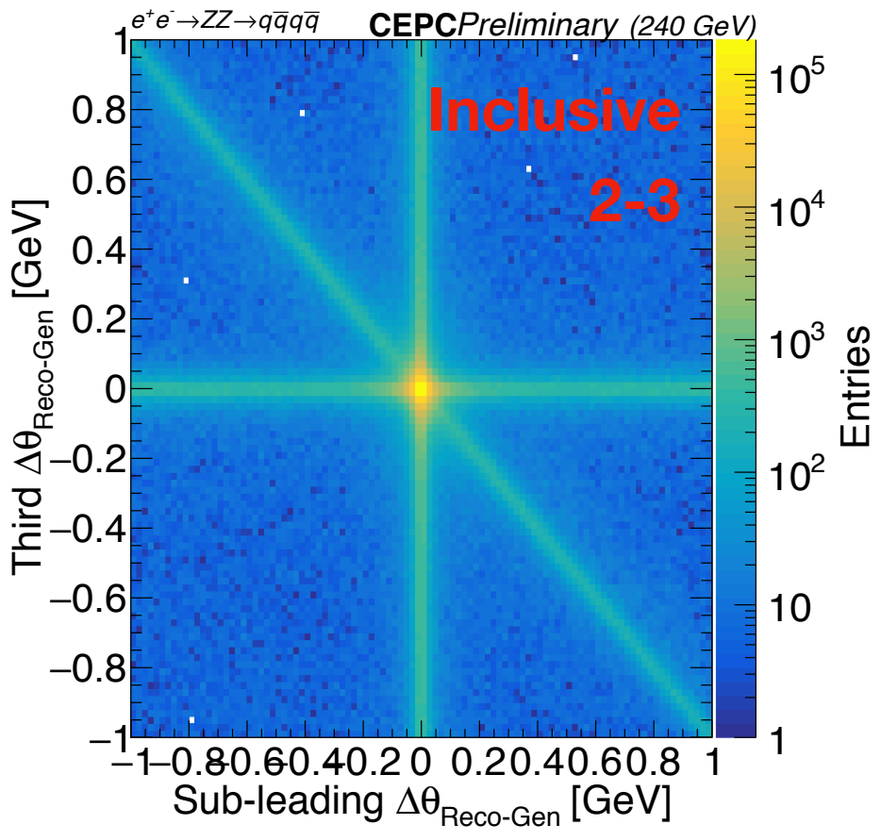
1-3
2-4

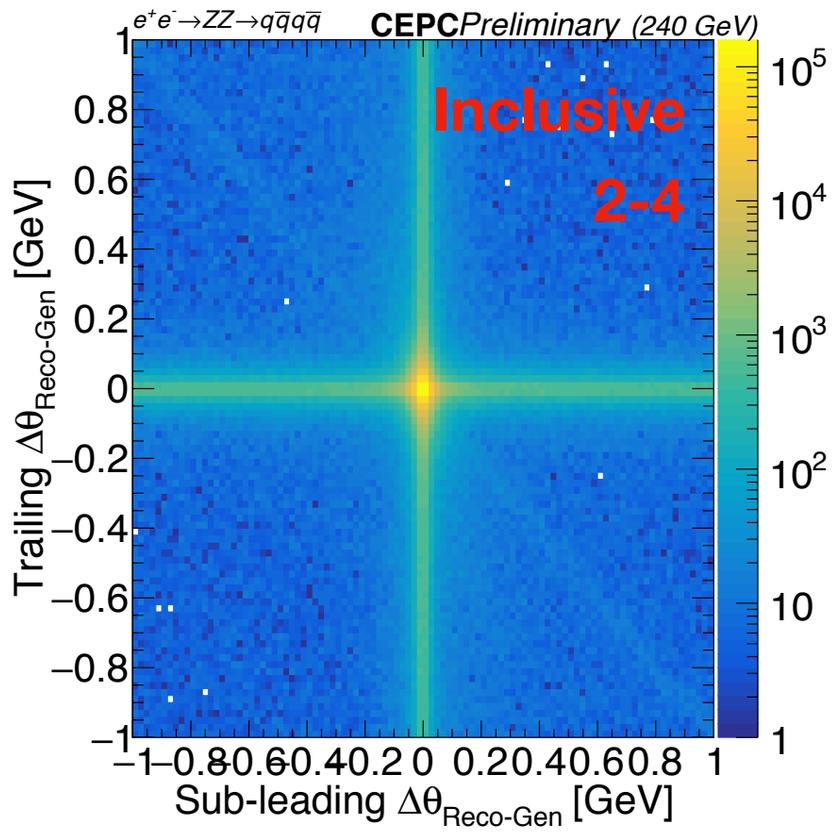
1-2
3-4

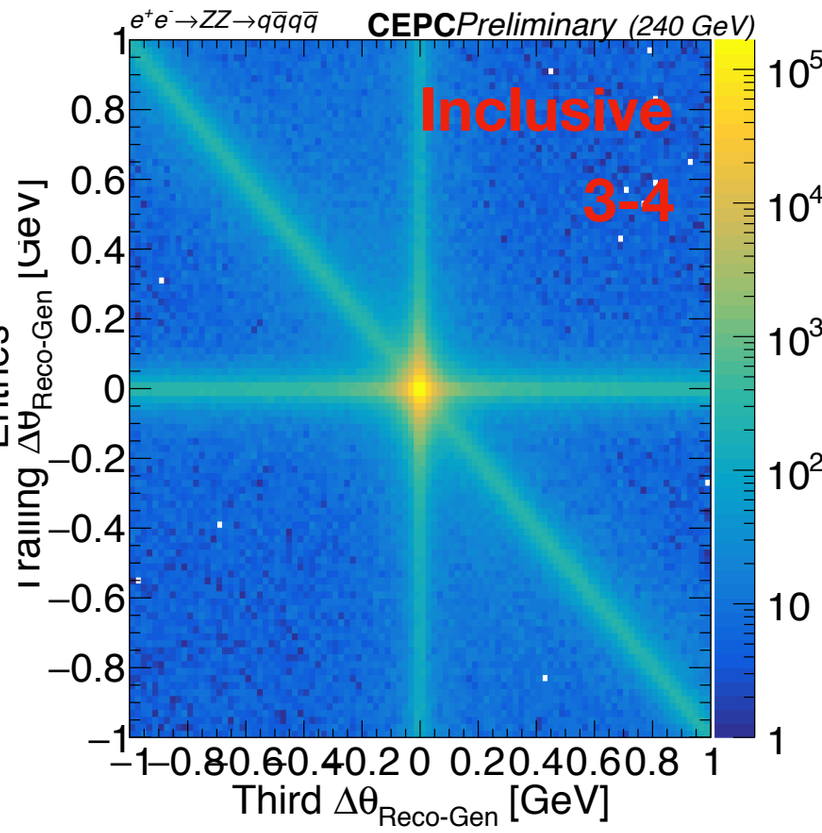












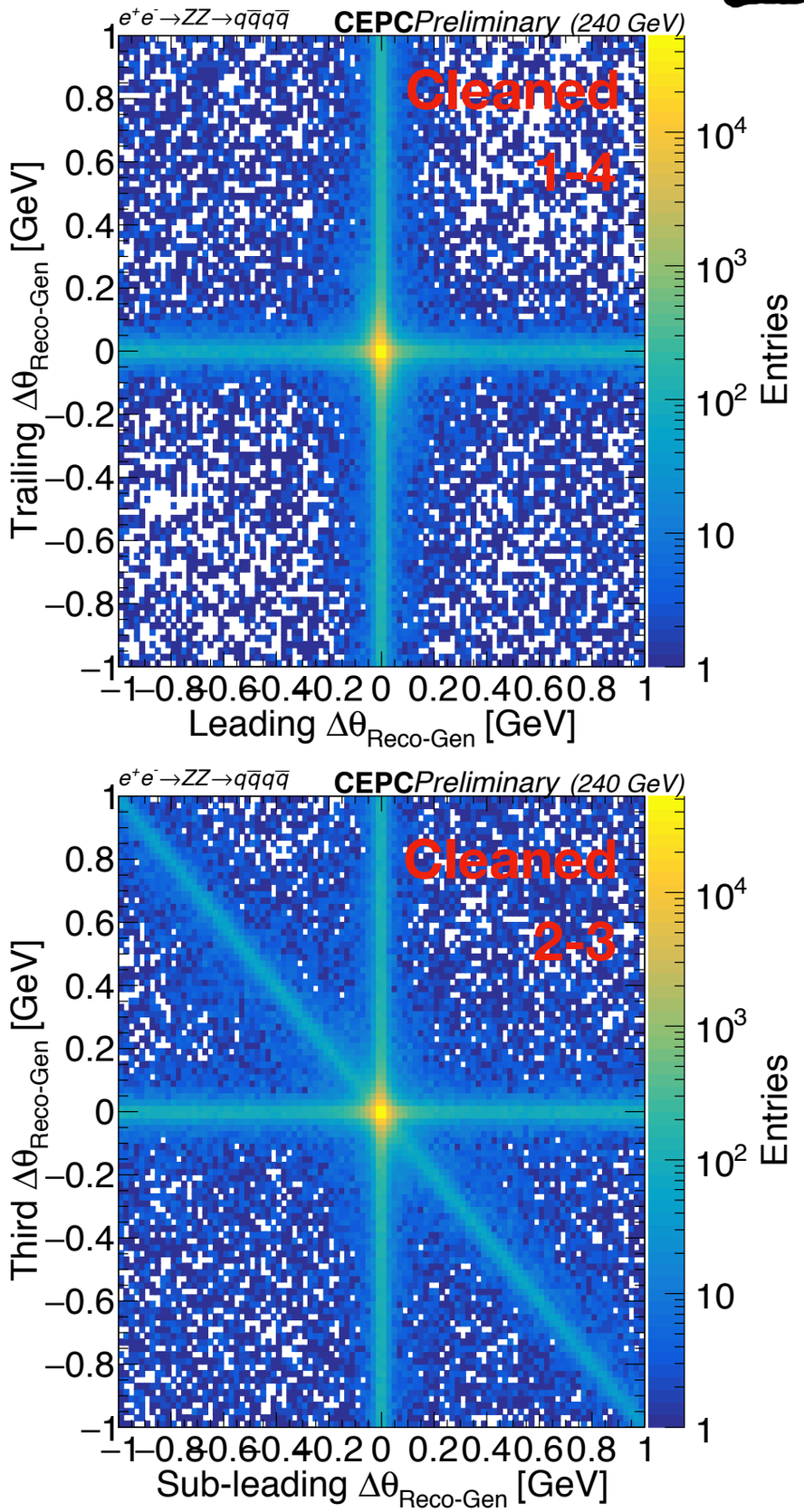
2D $\Delta\theta$ Distribution

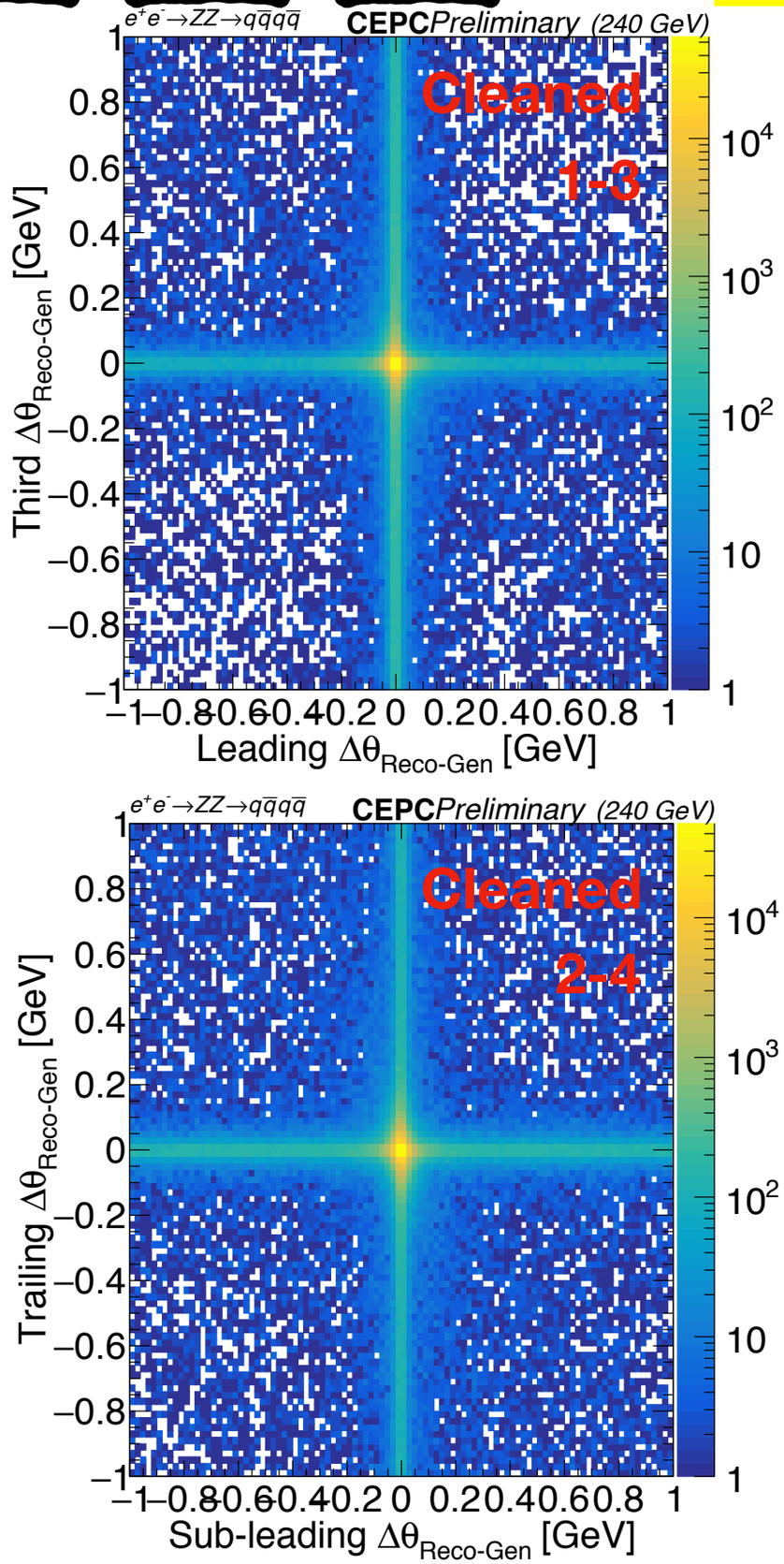
Match only by Energy

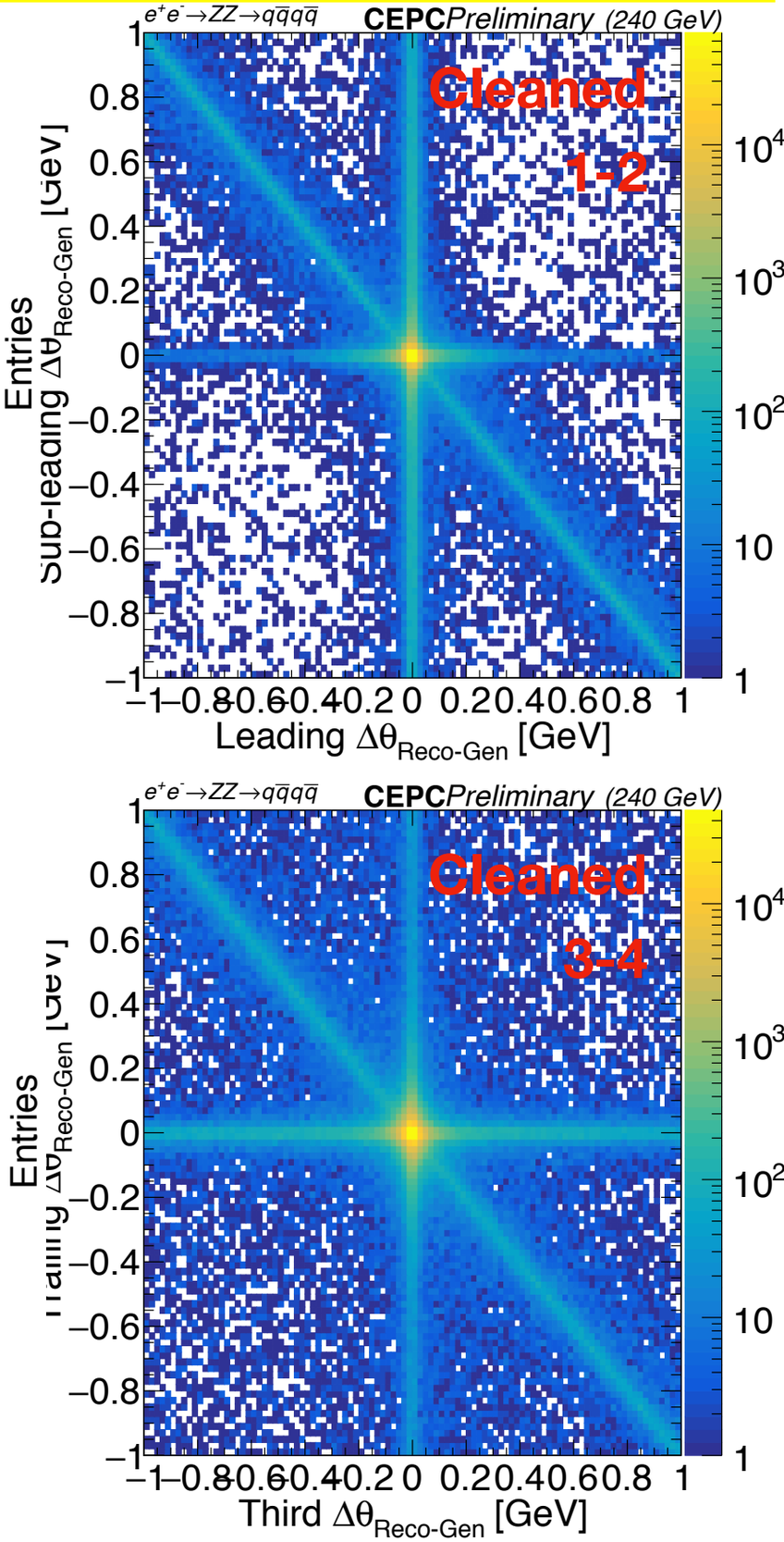
1-4
2-3

1-3
2-4

1-2
3-4



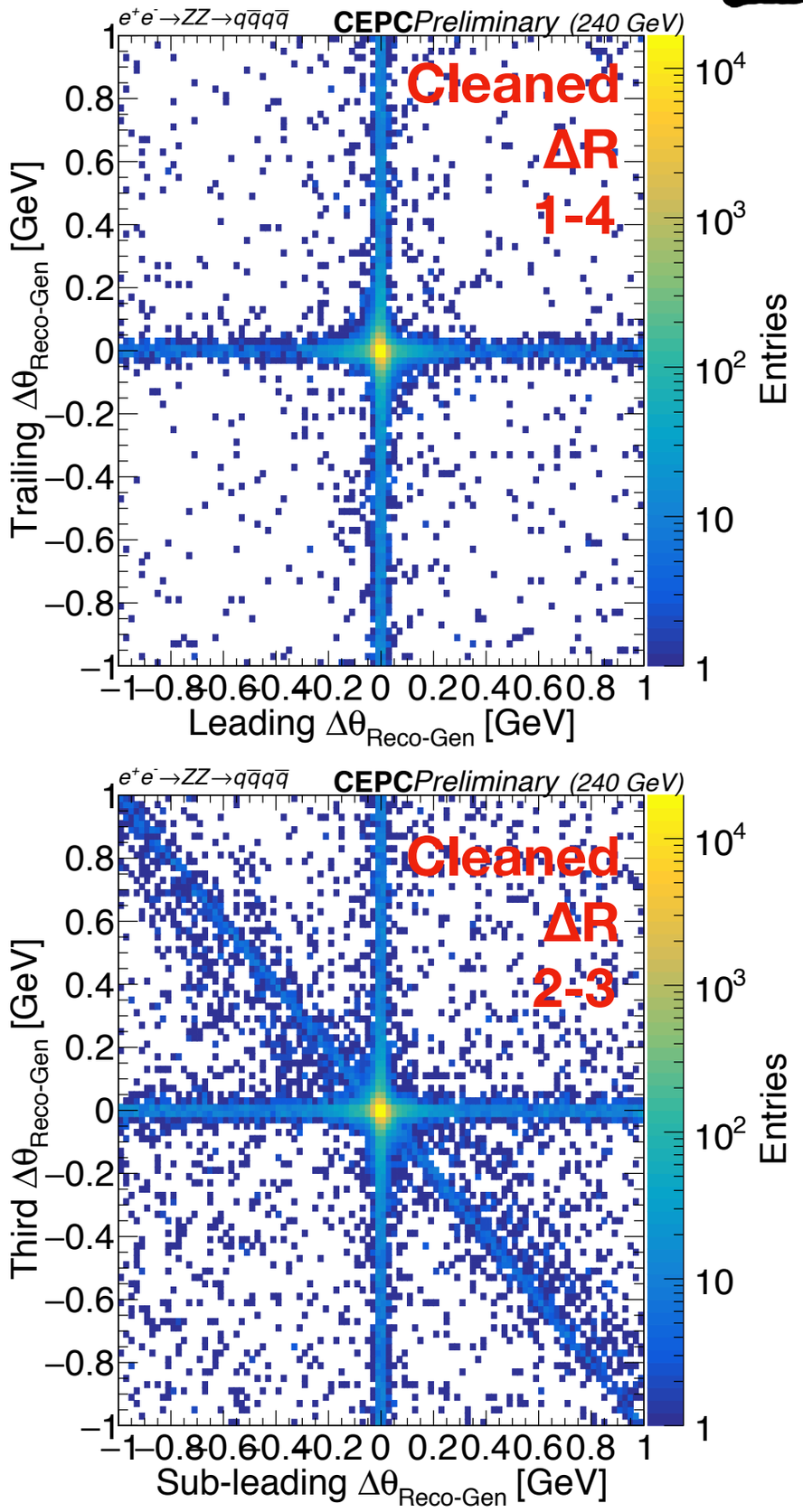


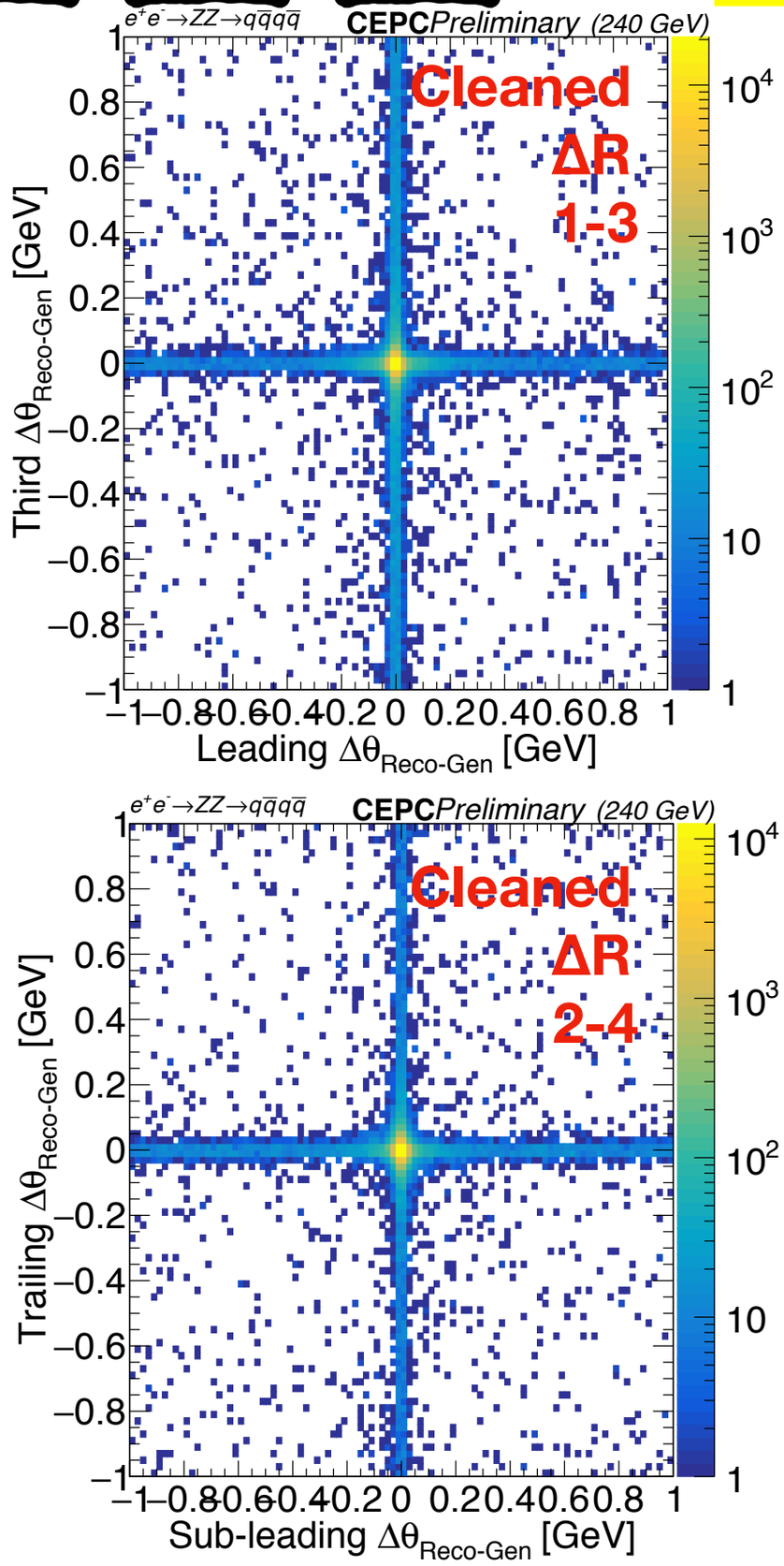


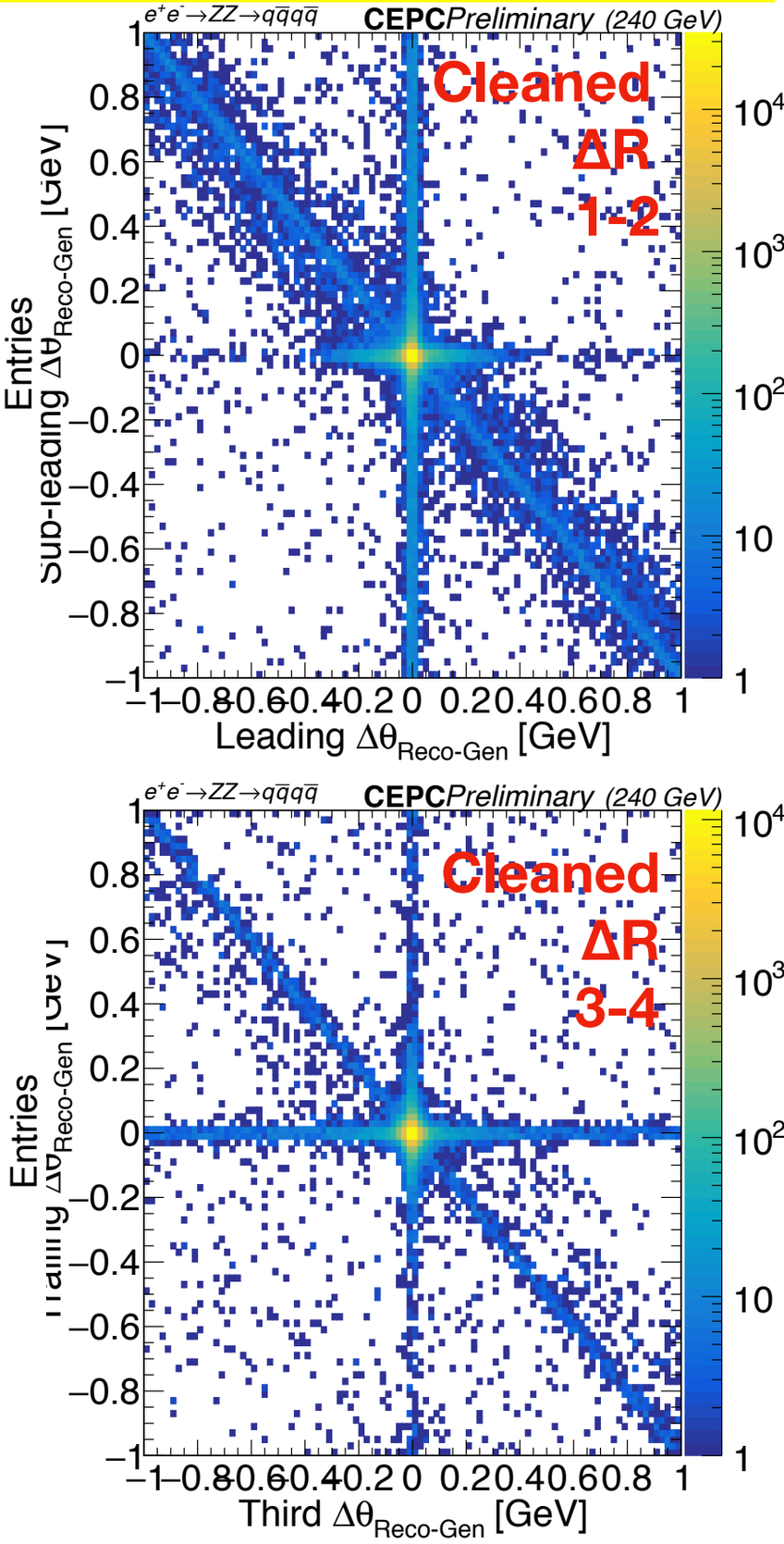
2D $\Delta\theta$ Distribution

Match only by Energy

1-4 2-3	1-3 2-4	1-2 3-4



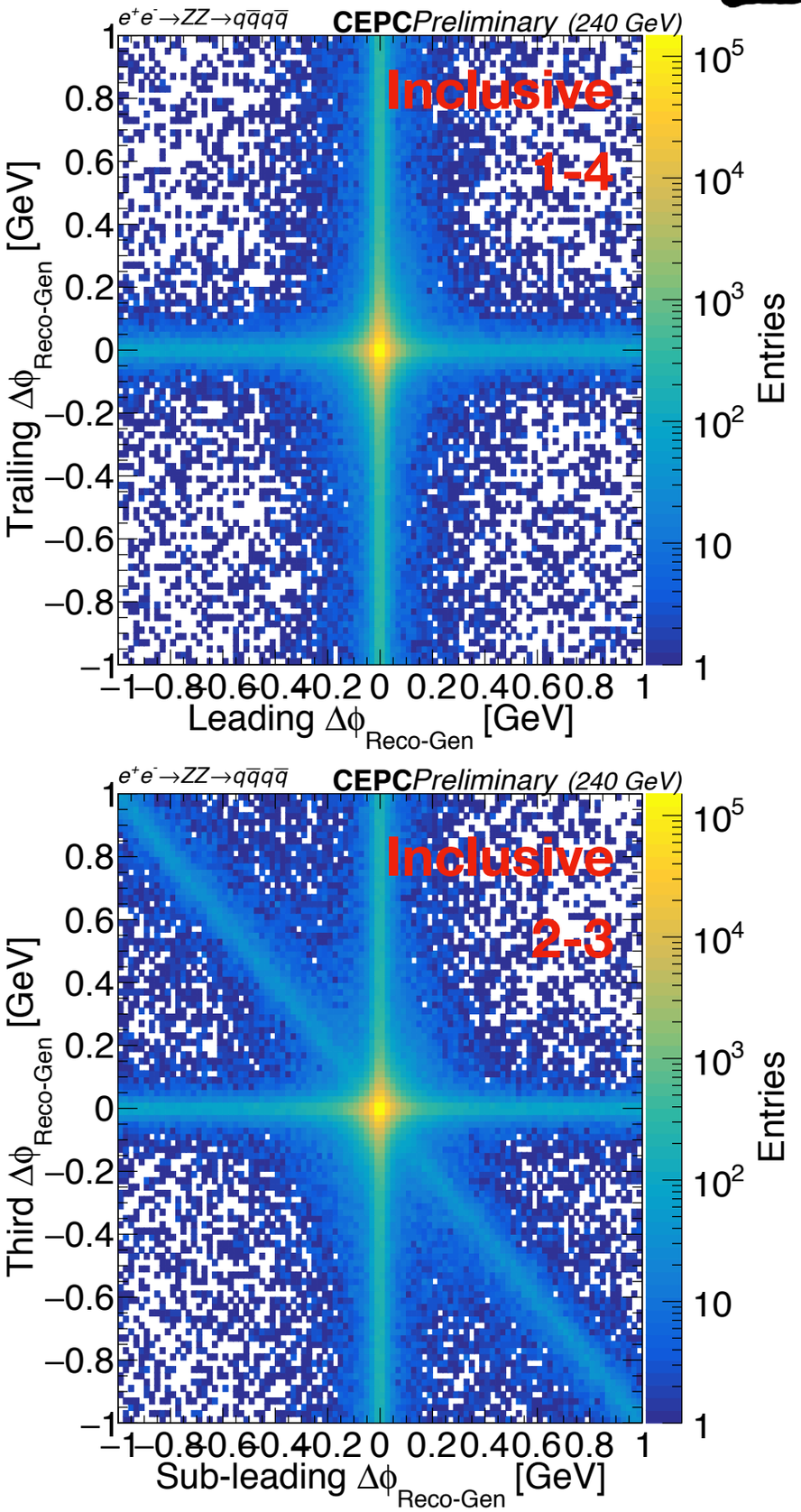


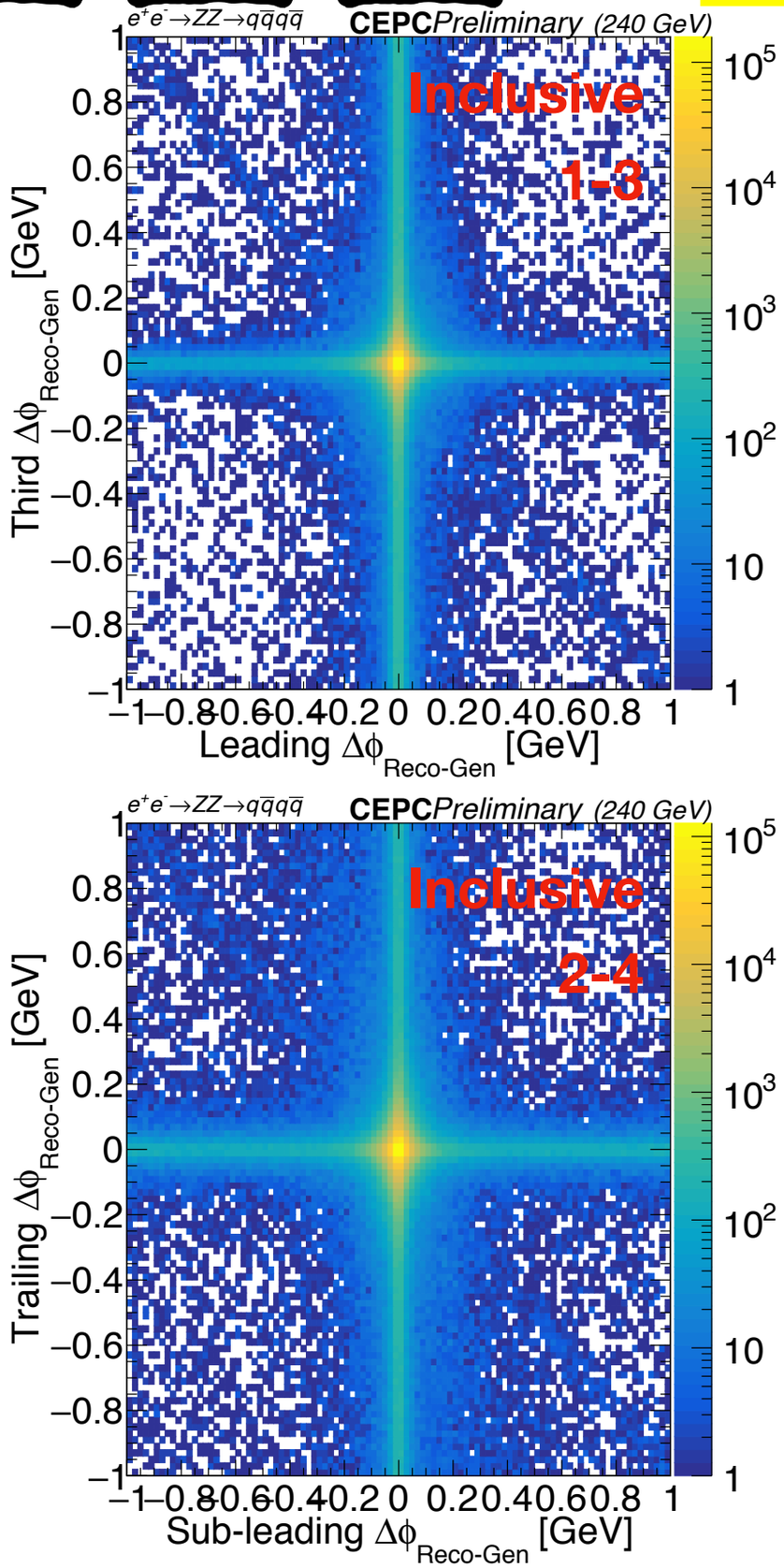


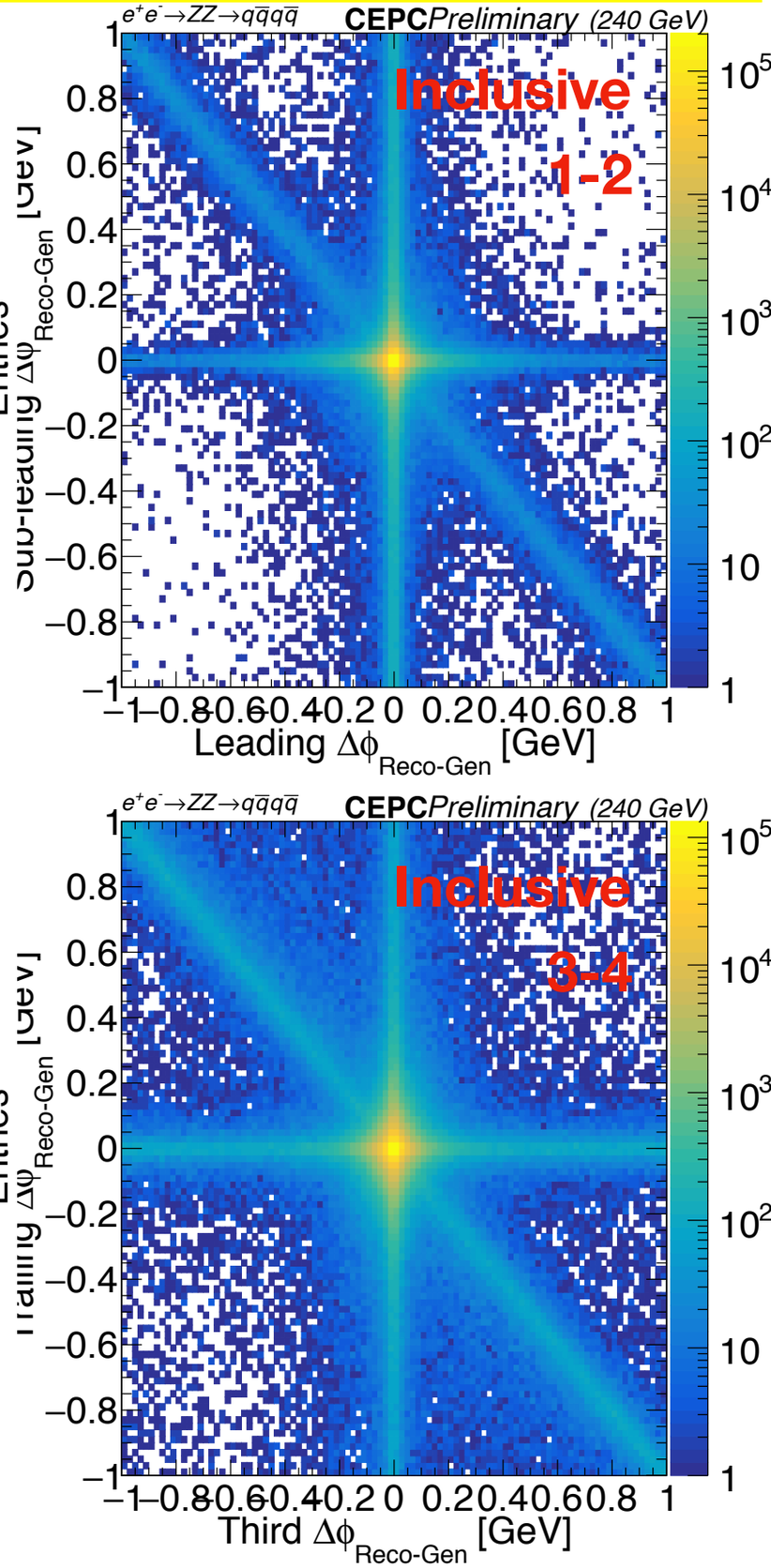
2D $\Delta\phi$ Distribution

Match only by Energy

1-4	1-3	1-2
2-3	2-4	3-4



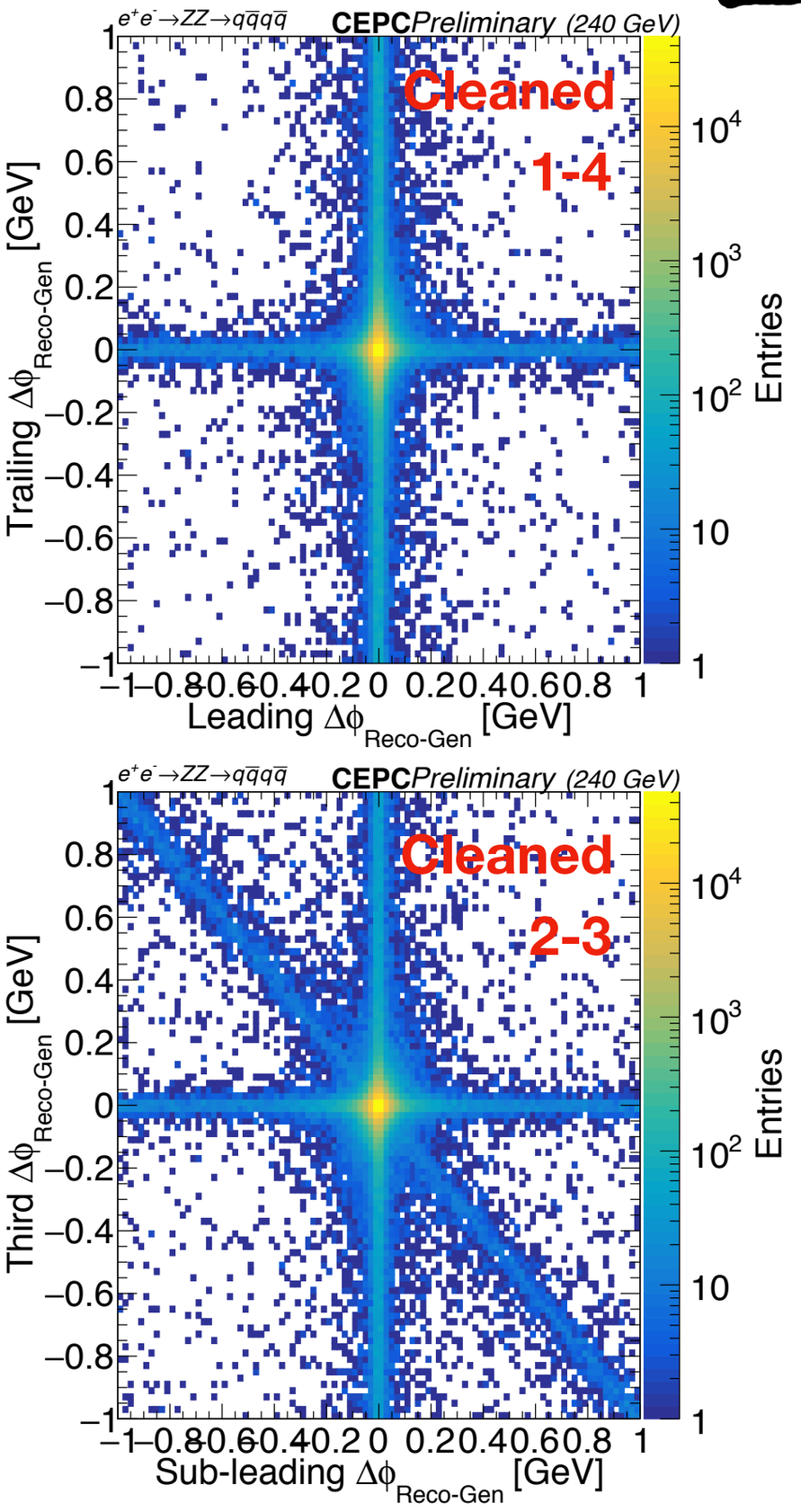


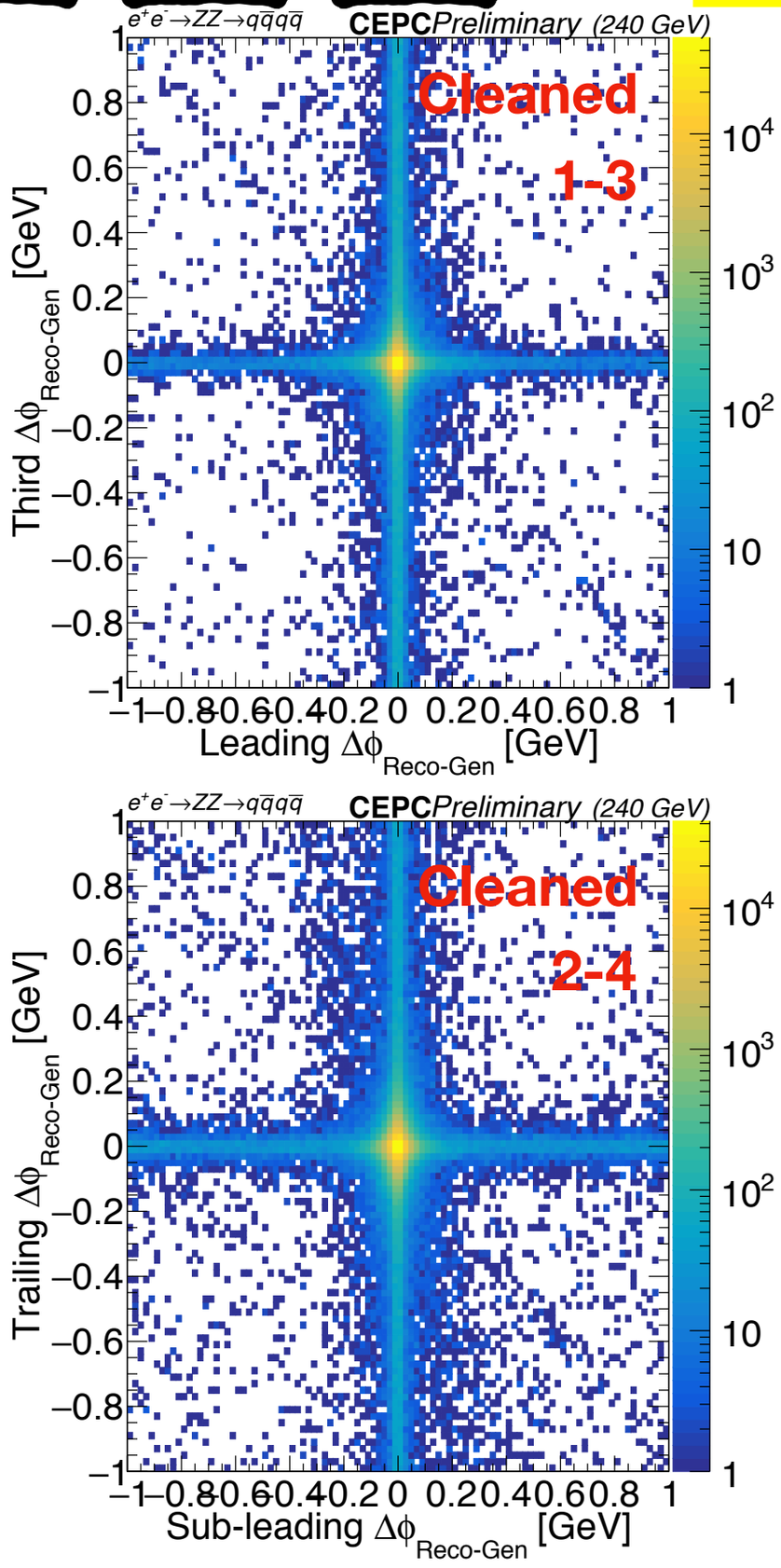


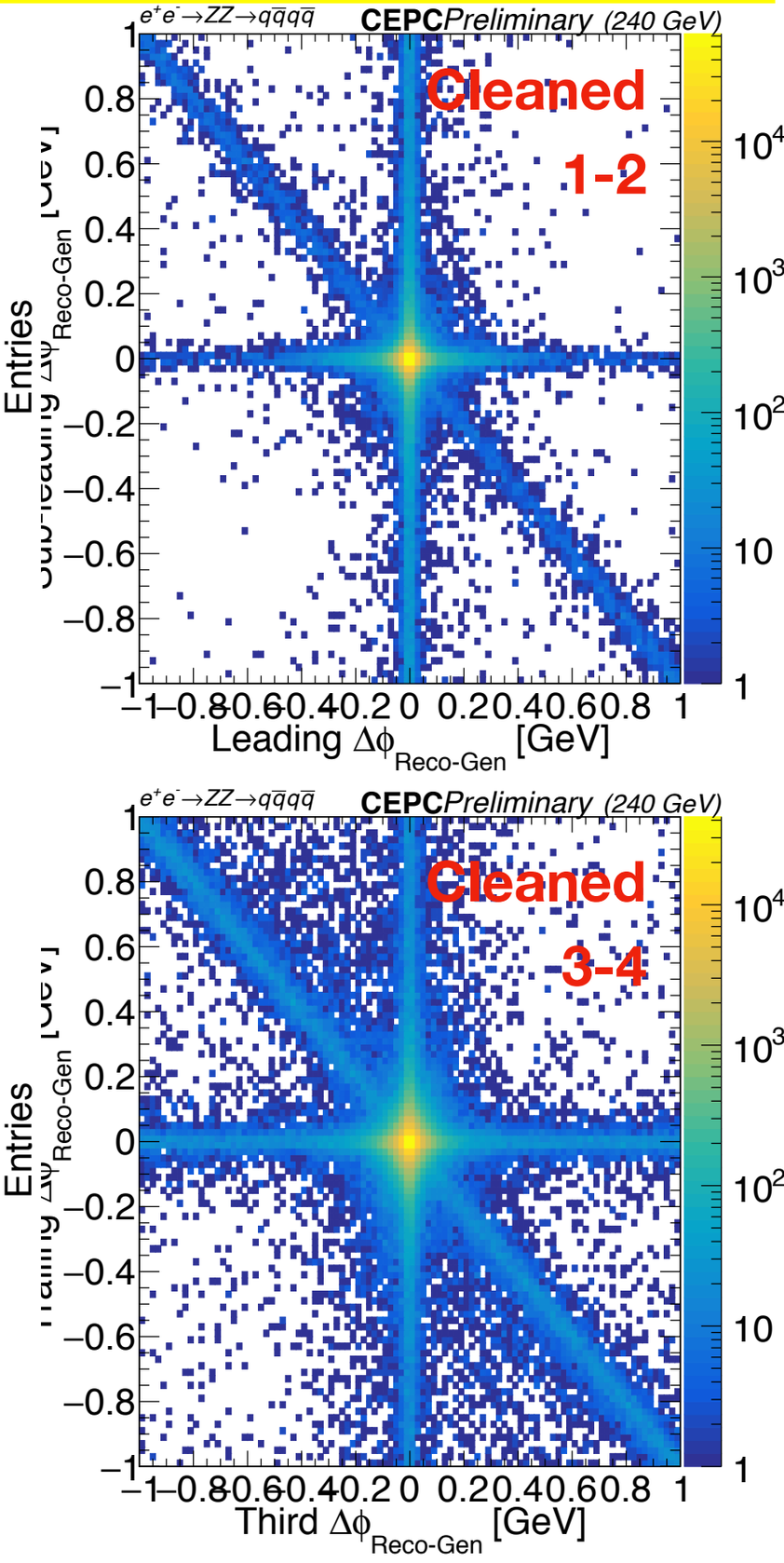
2D $\Delta\phi$ Distribution

Match only by Energy

1-4	1-3	1-2
2-3	2-4	3-4



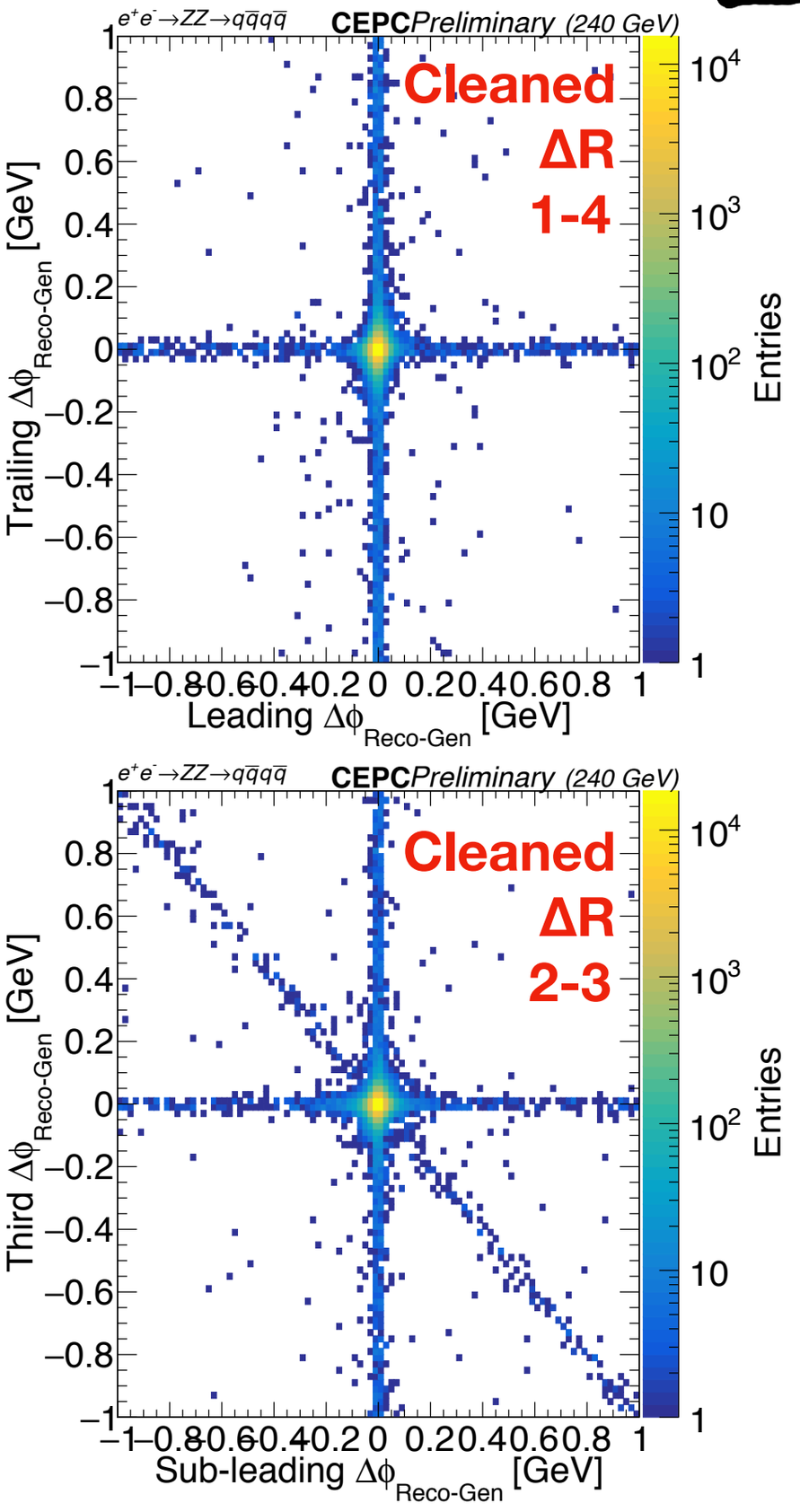


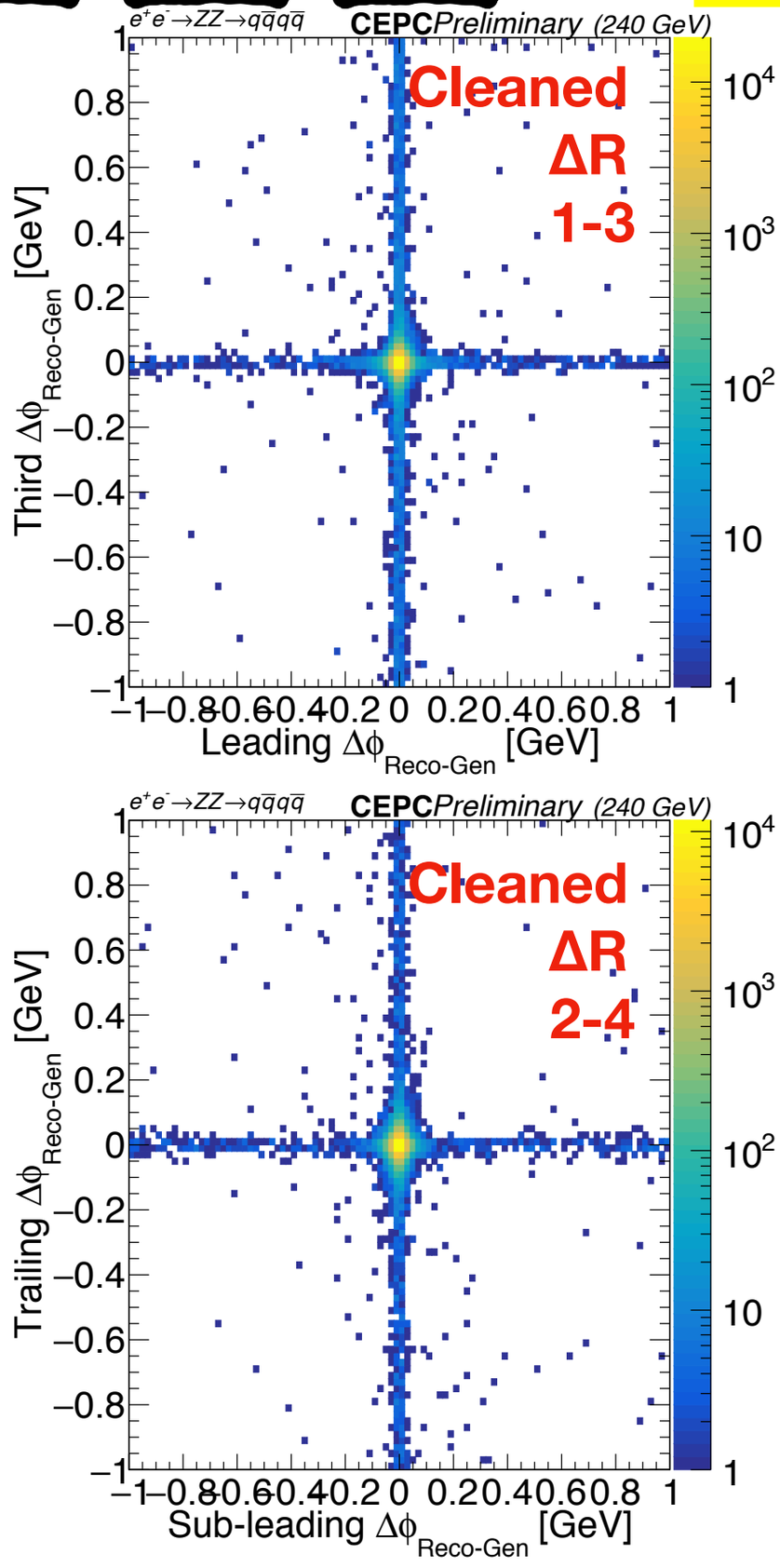


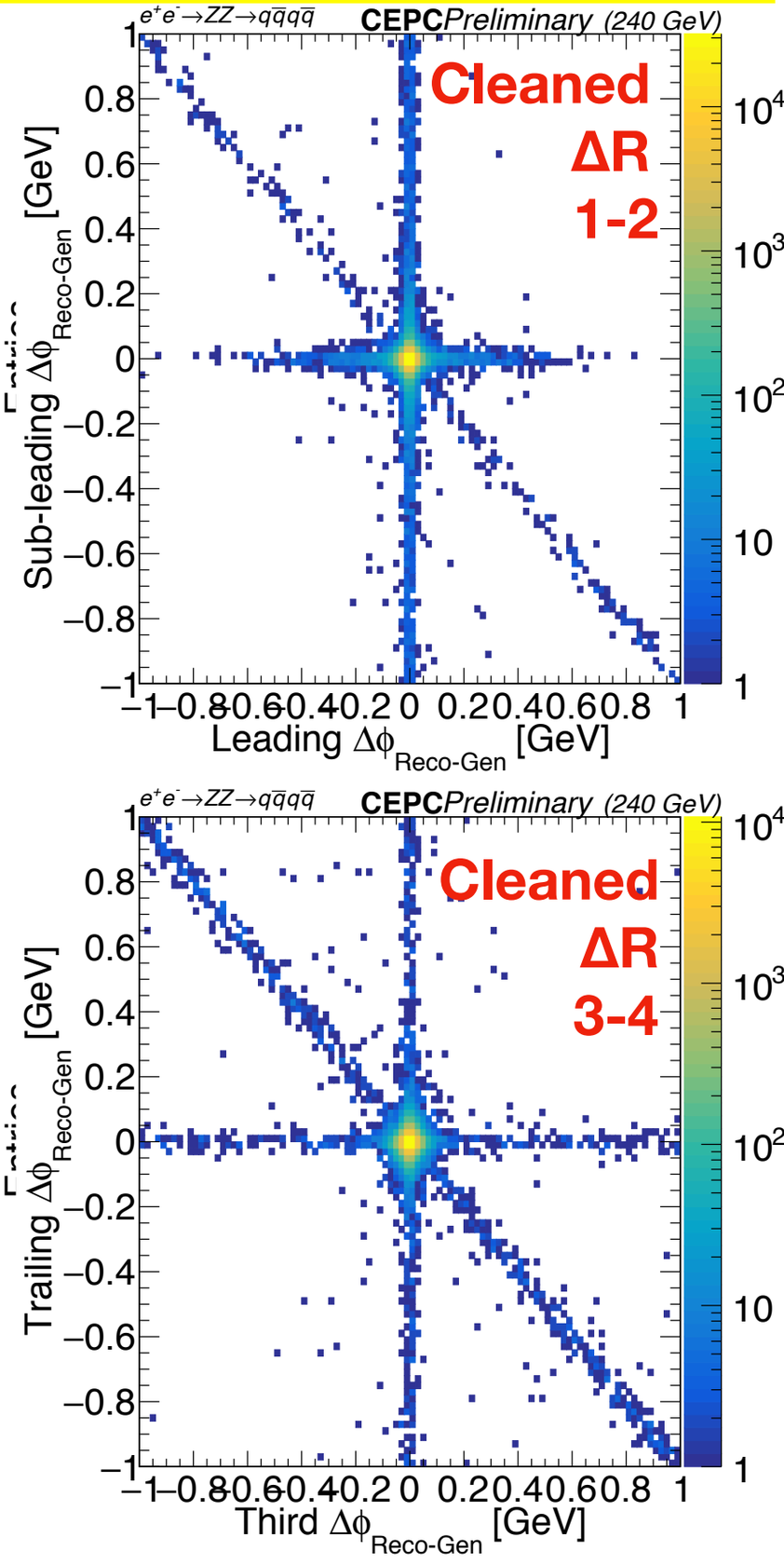
2D $\Delta\phi$ Distribution

Match only by Energy

1-4 2-3	1-3 2-4	1-2 3-4







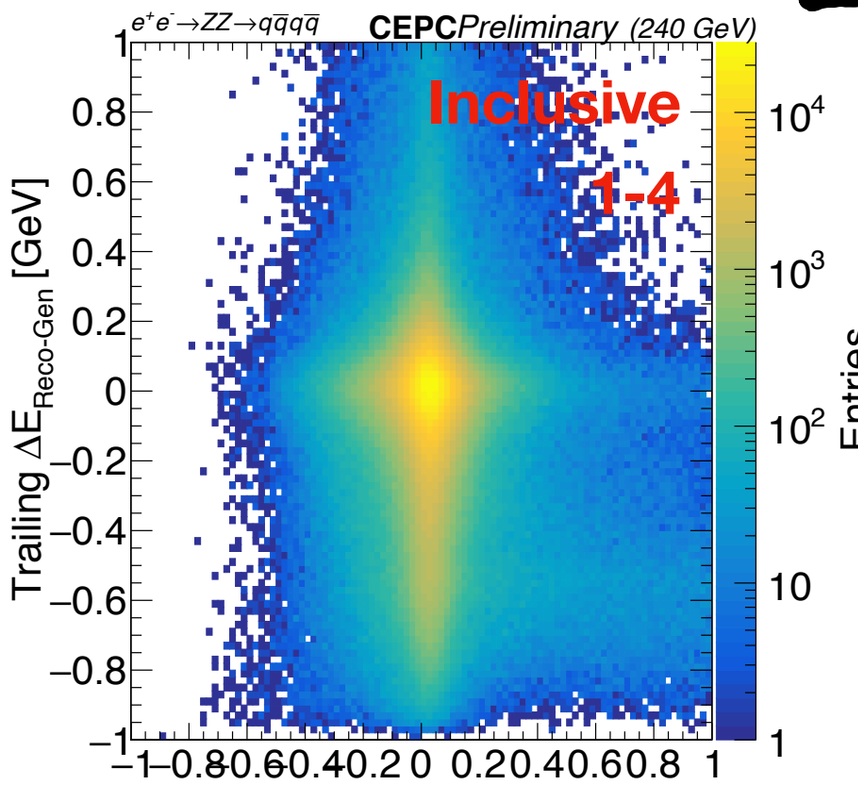
2D ΔE Distribution

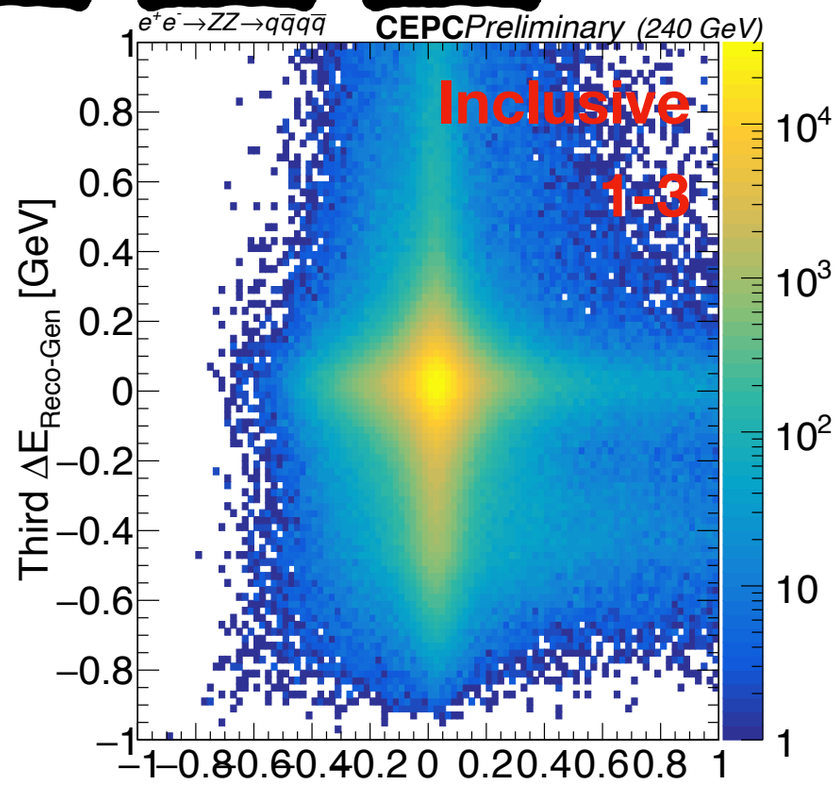
Match by Energy and ΔR reverse

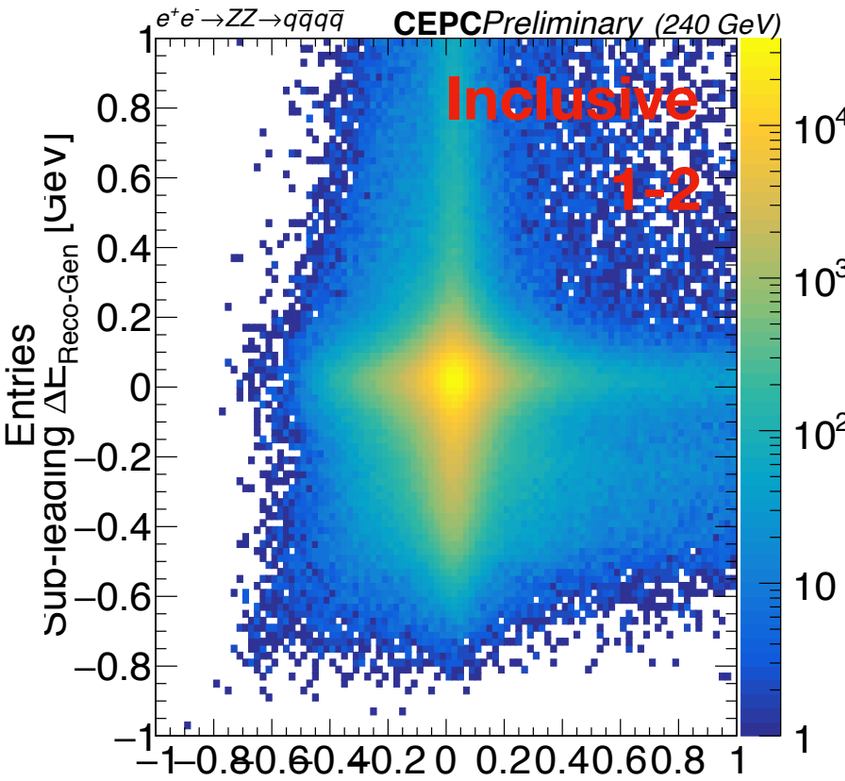
1-4
2-3

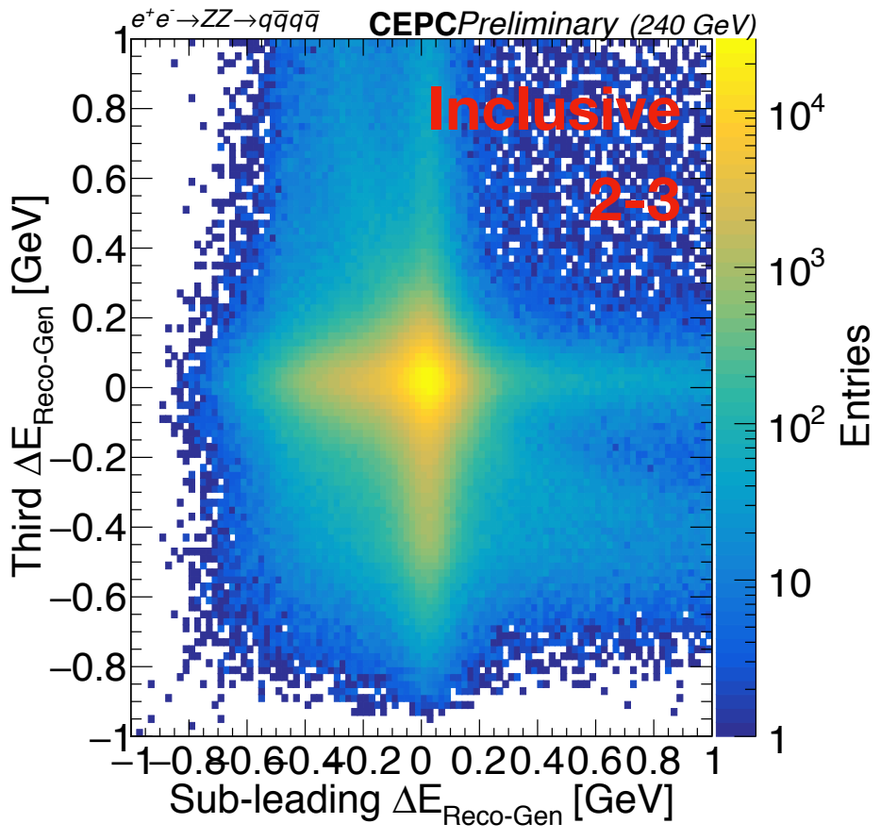
1-3
2-4

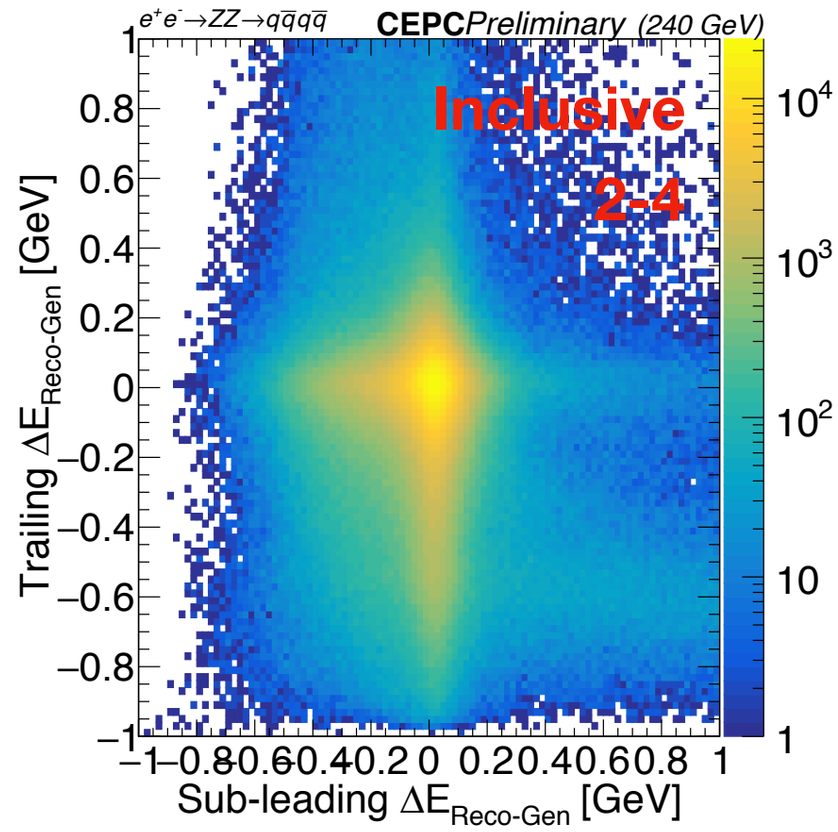
1-2
3-4

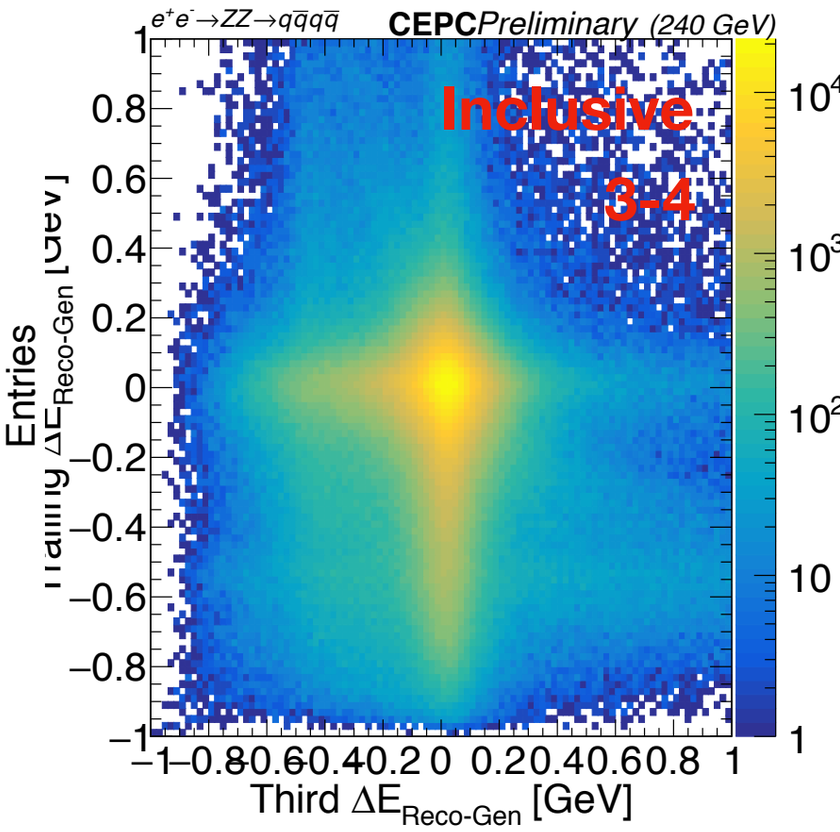












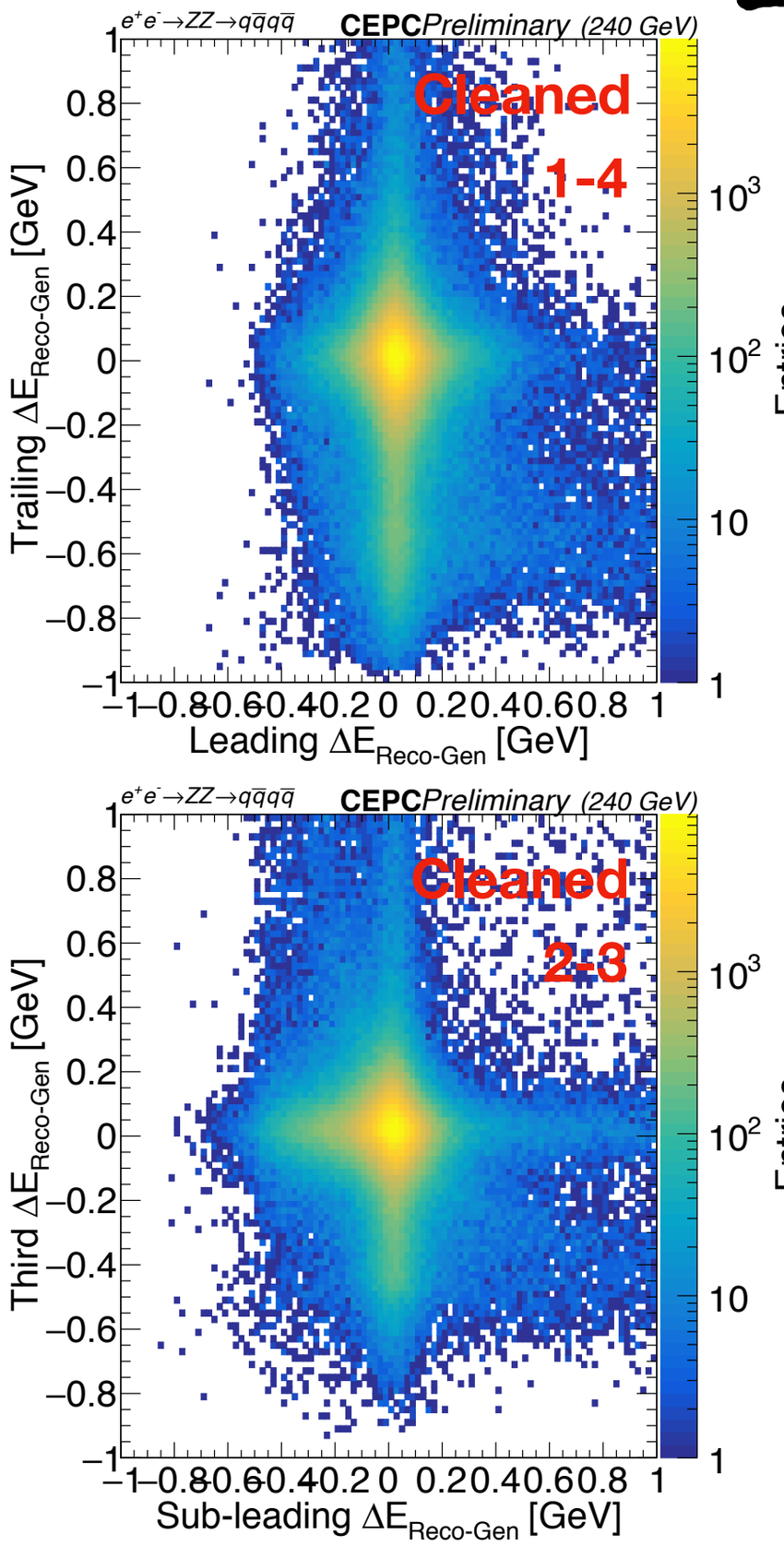
2D ΔE Distribution

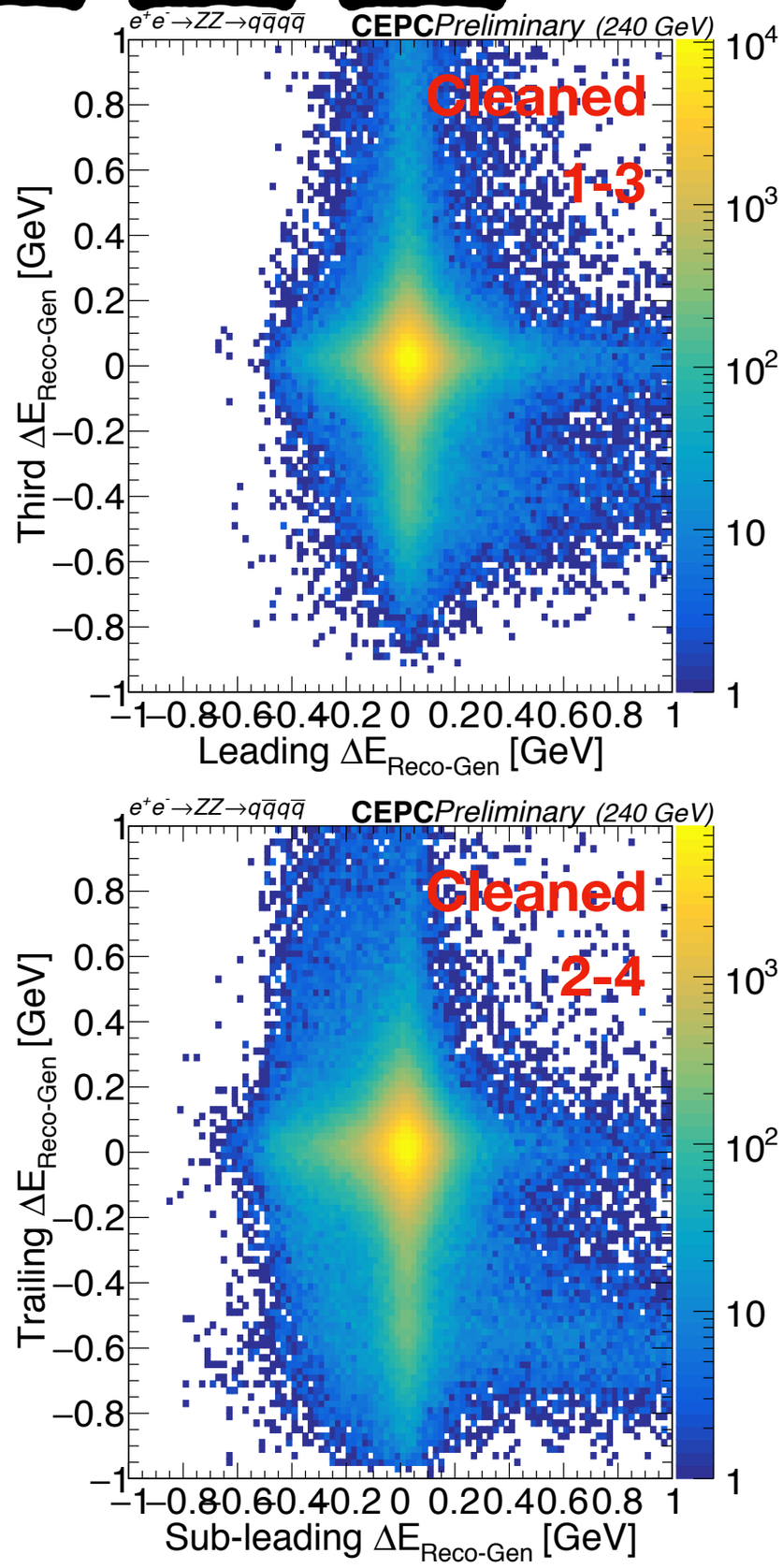
Match by Energy and ΔR reverse

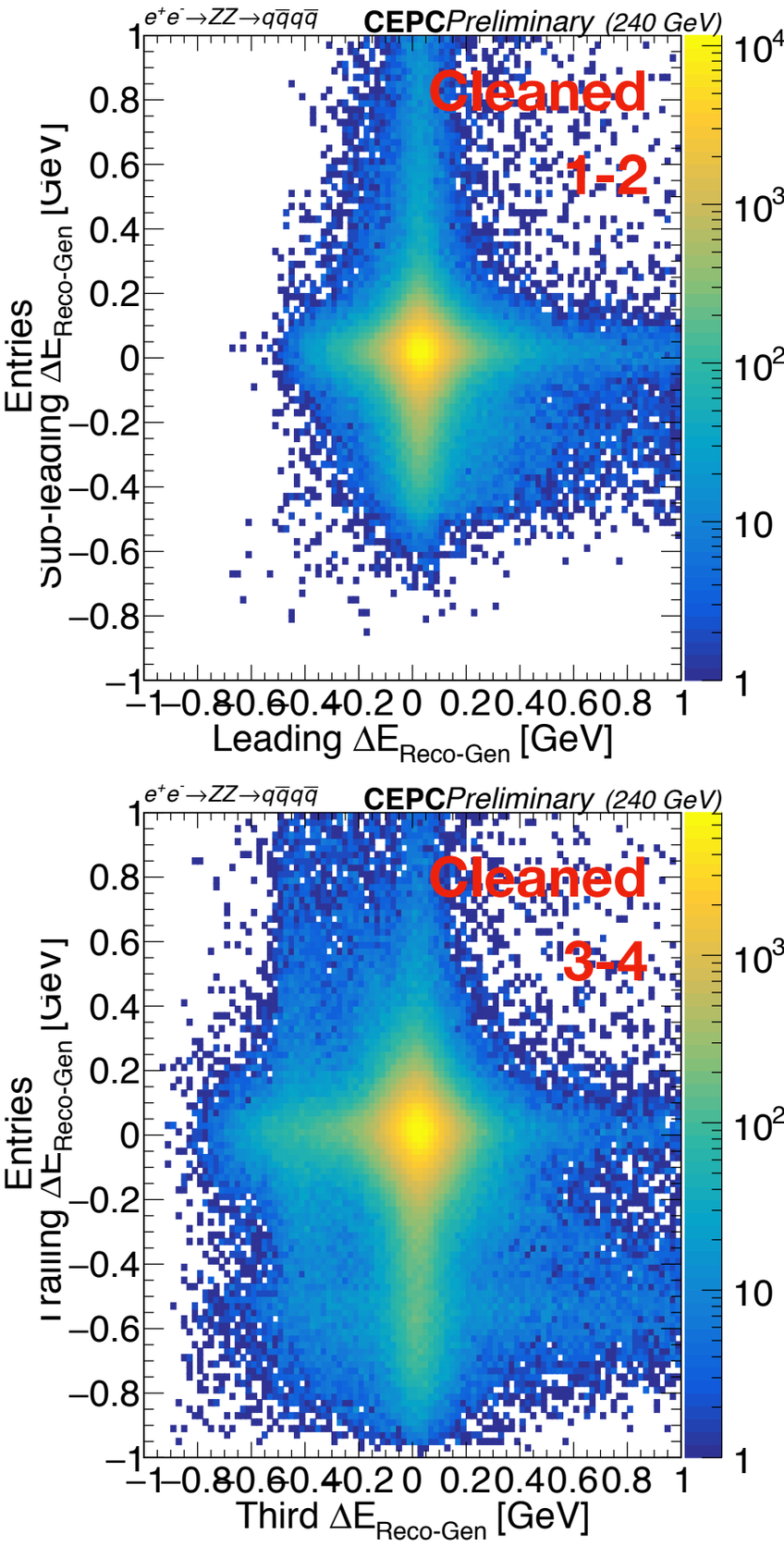
1-4
2-3

1-3
2-4

1-2
3-4







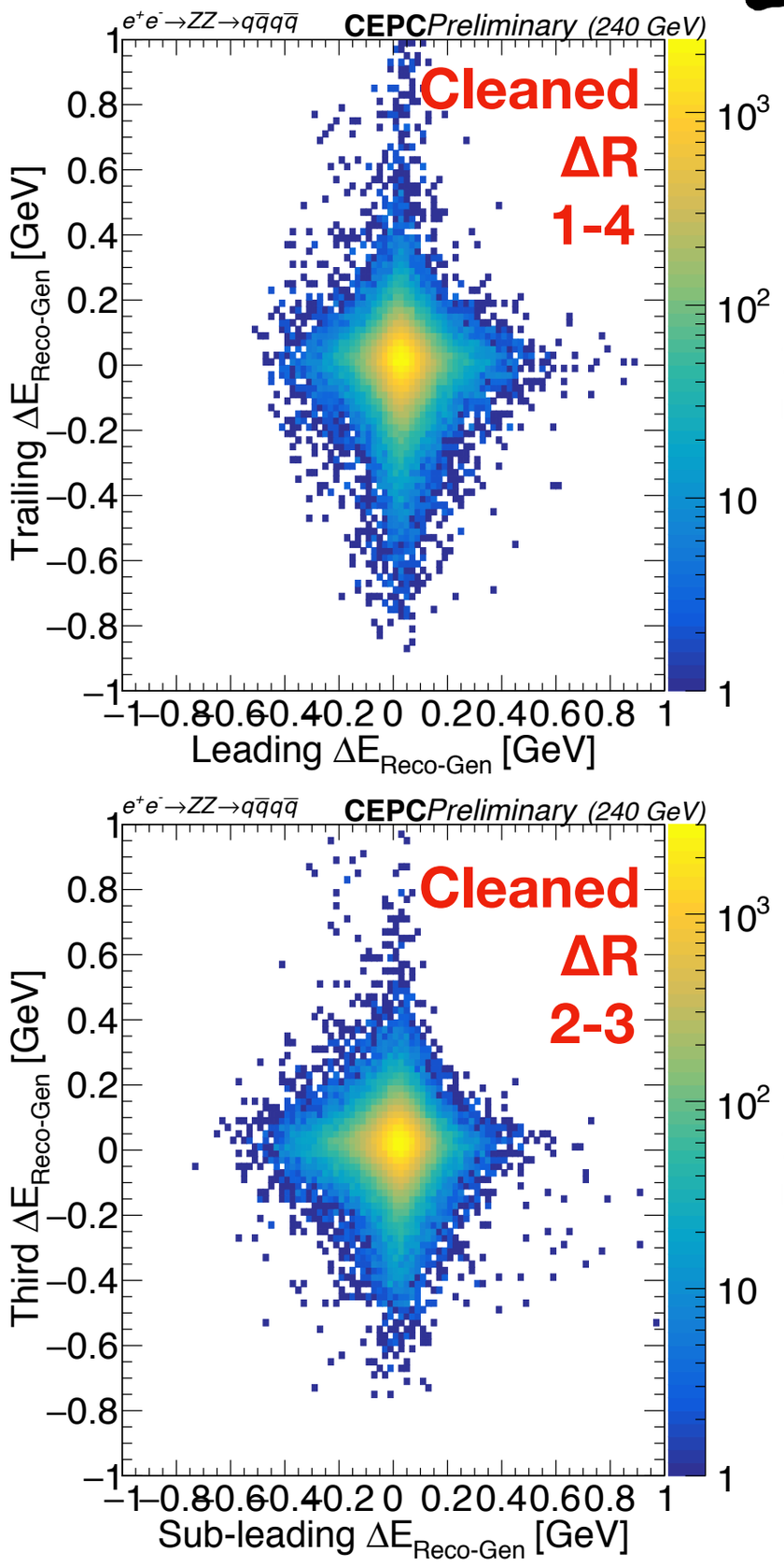
2D ΔE Distribution

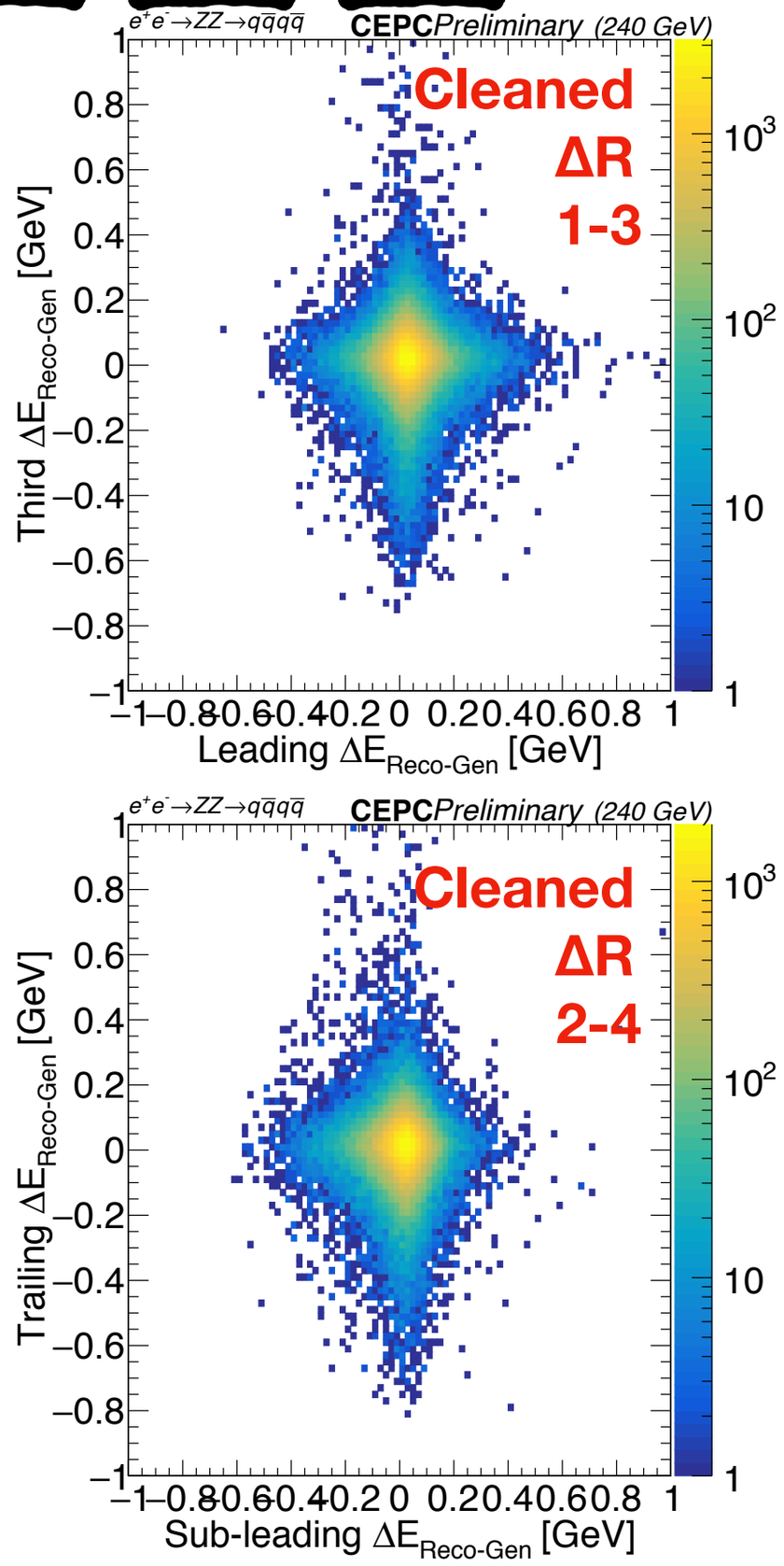
Match by Energy and ΔR reverse

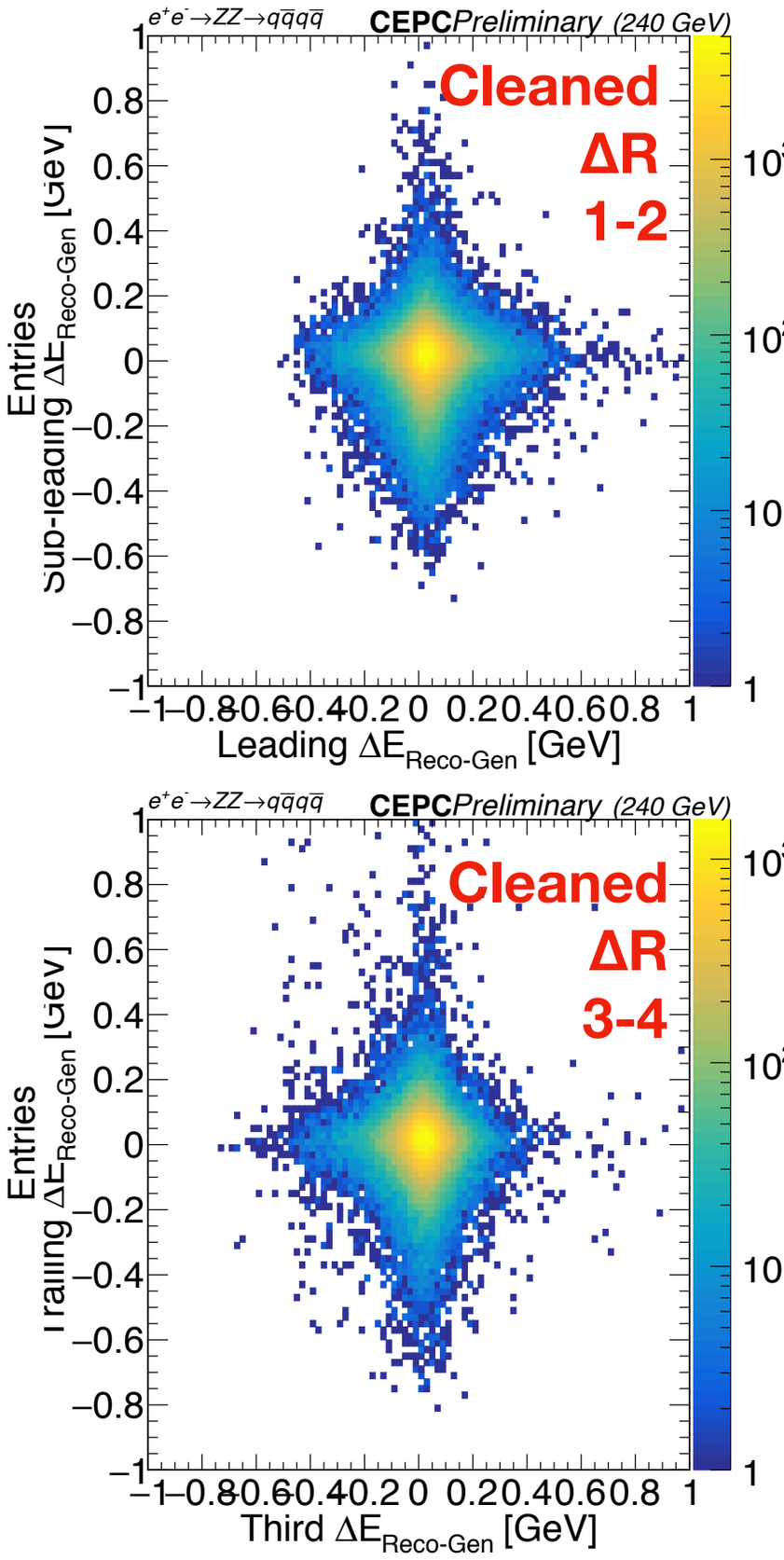
1-4
2-3

1-3
2-4

1-2
3-4







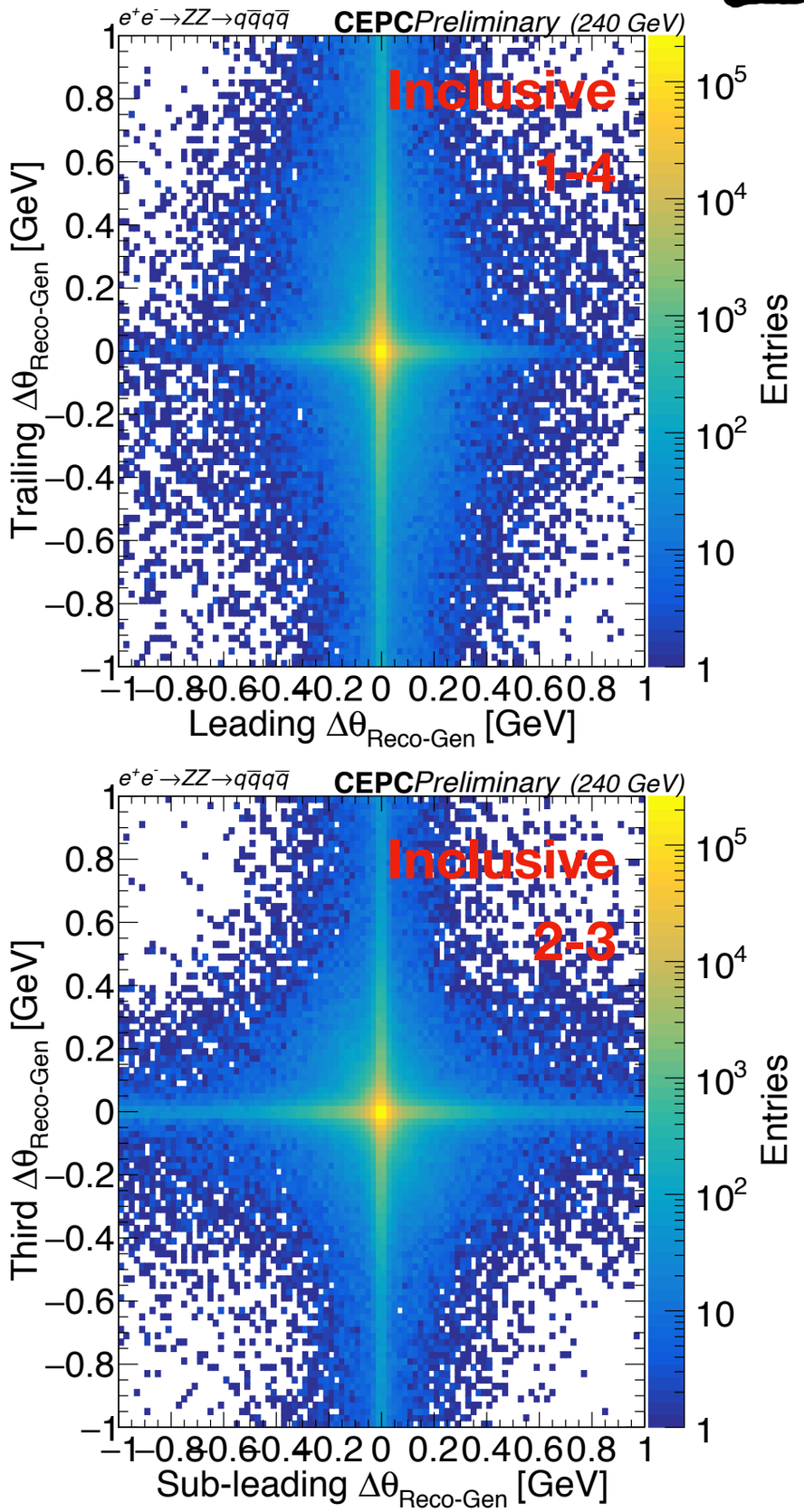
2D $\Delta\theta$ Distribution

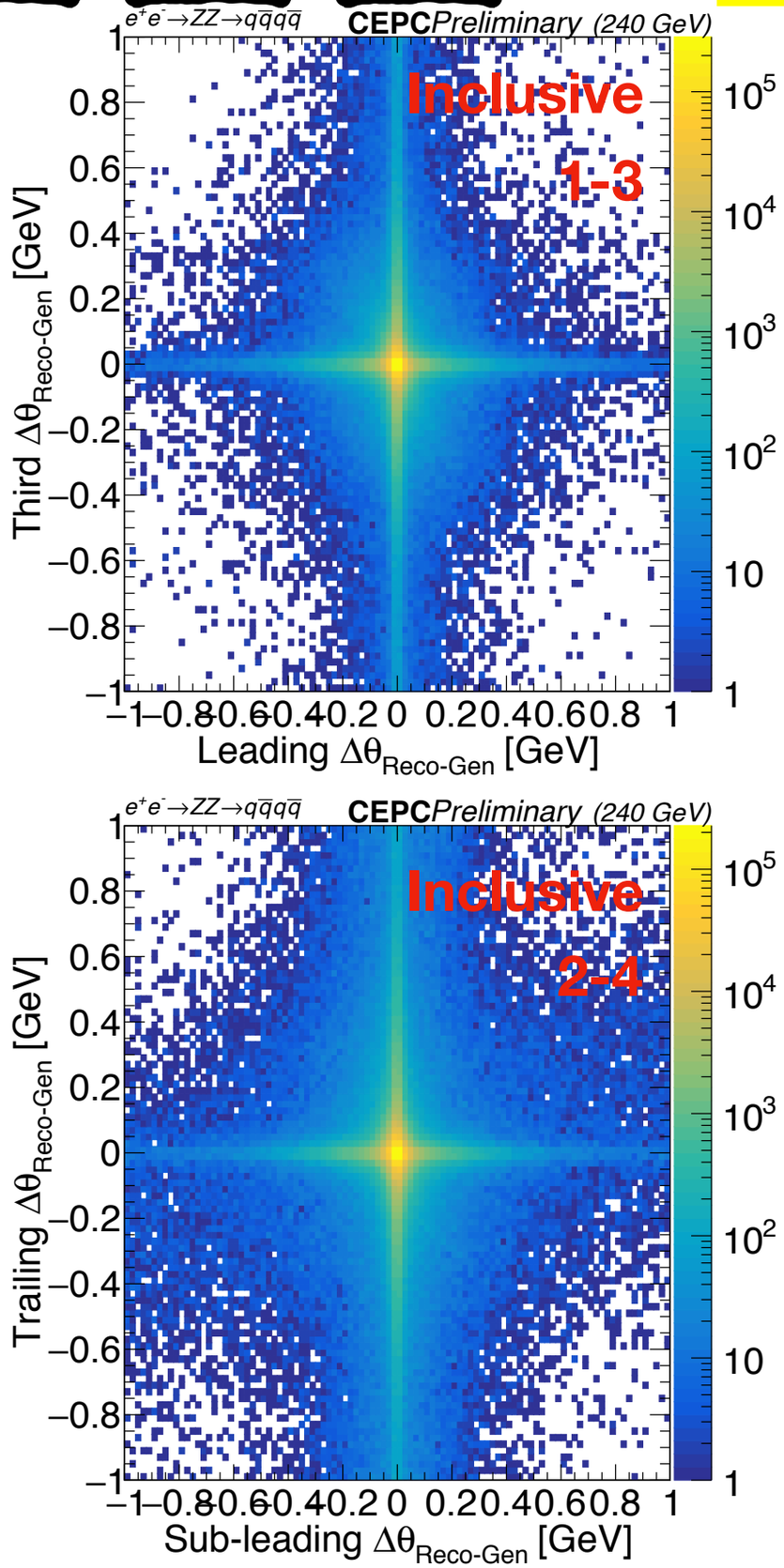
Match by Energy and ΔR reverse

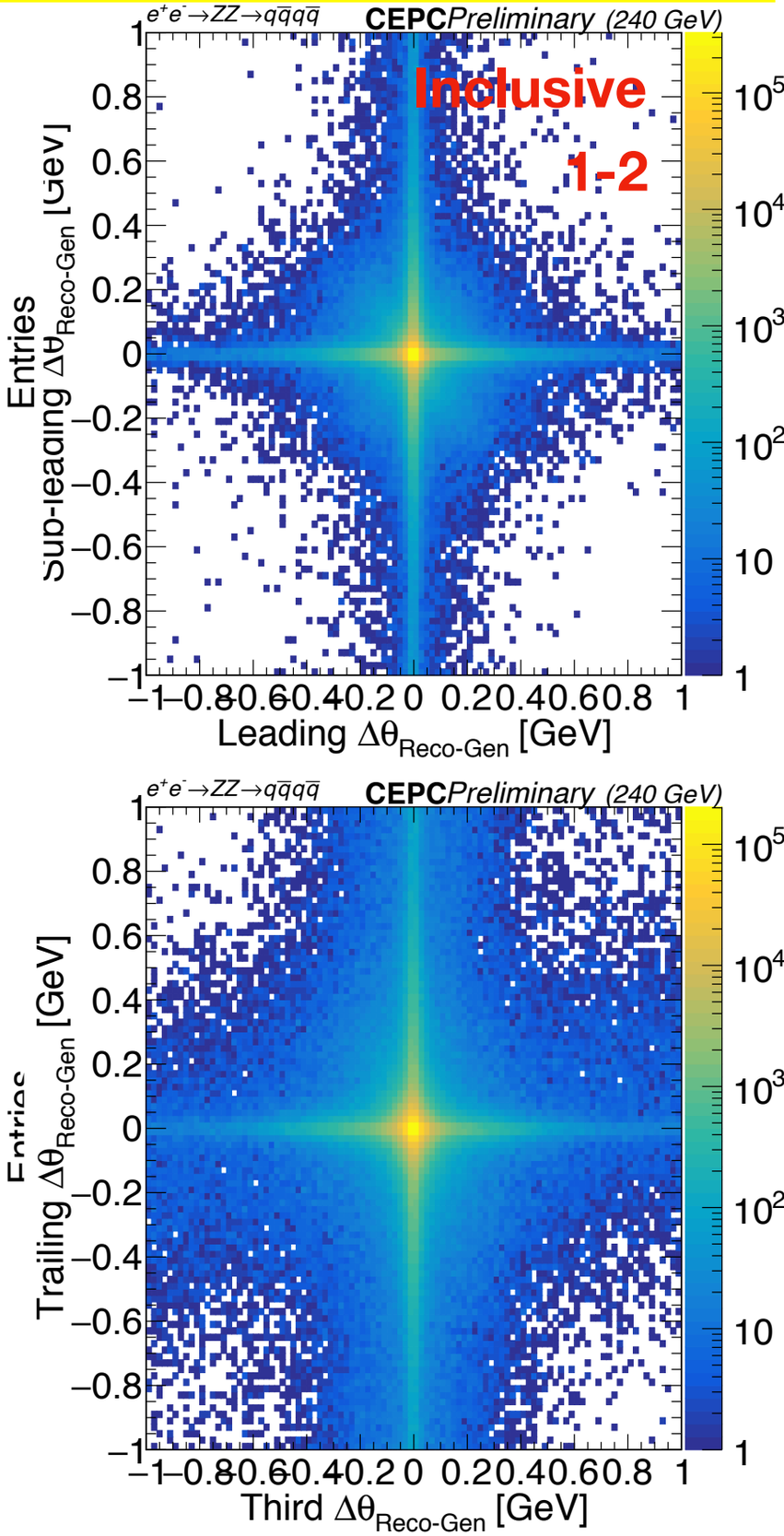
1-4
2-3

1-3
2-4

1-2
3-4



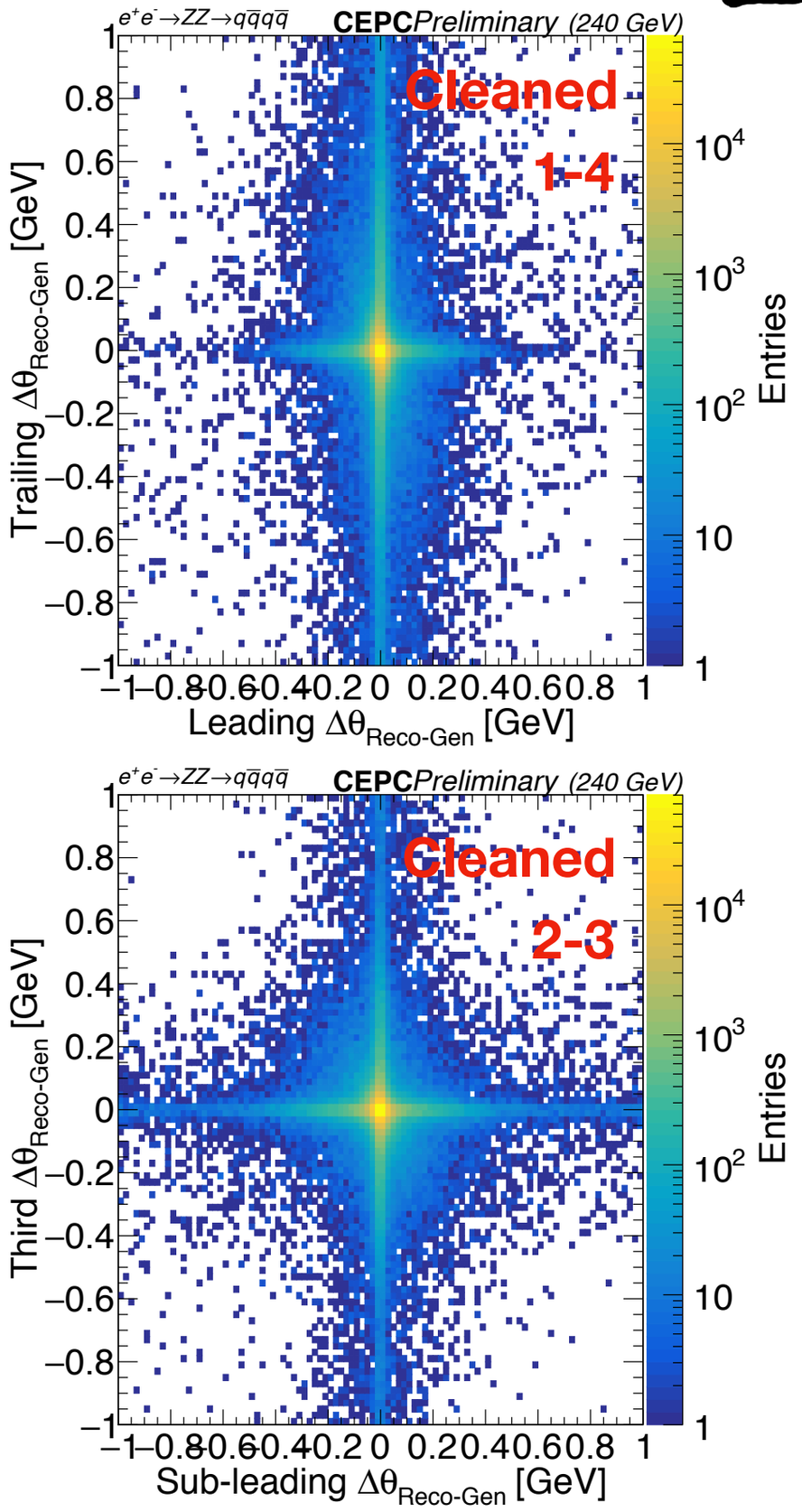


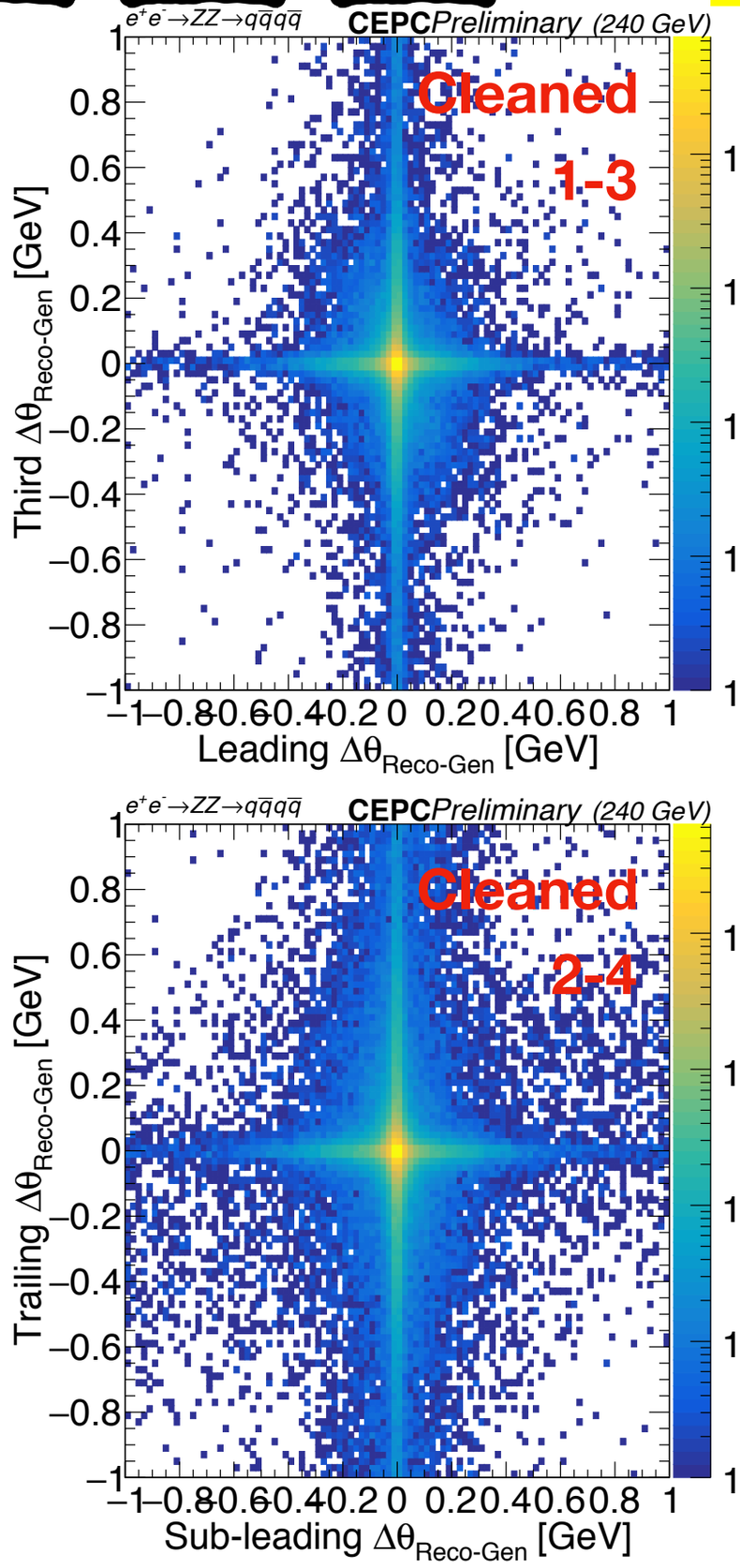


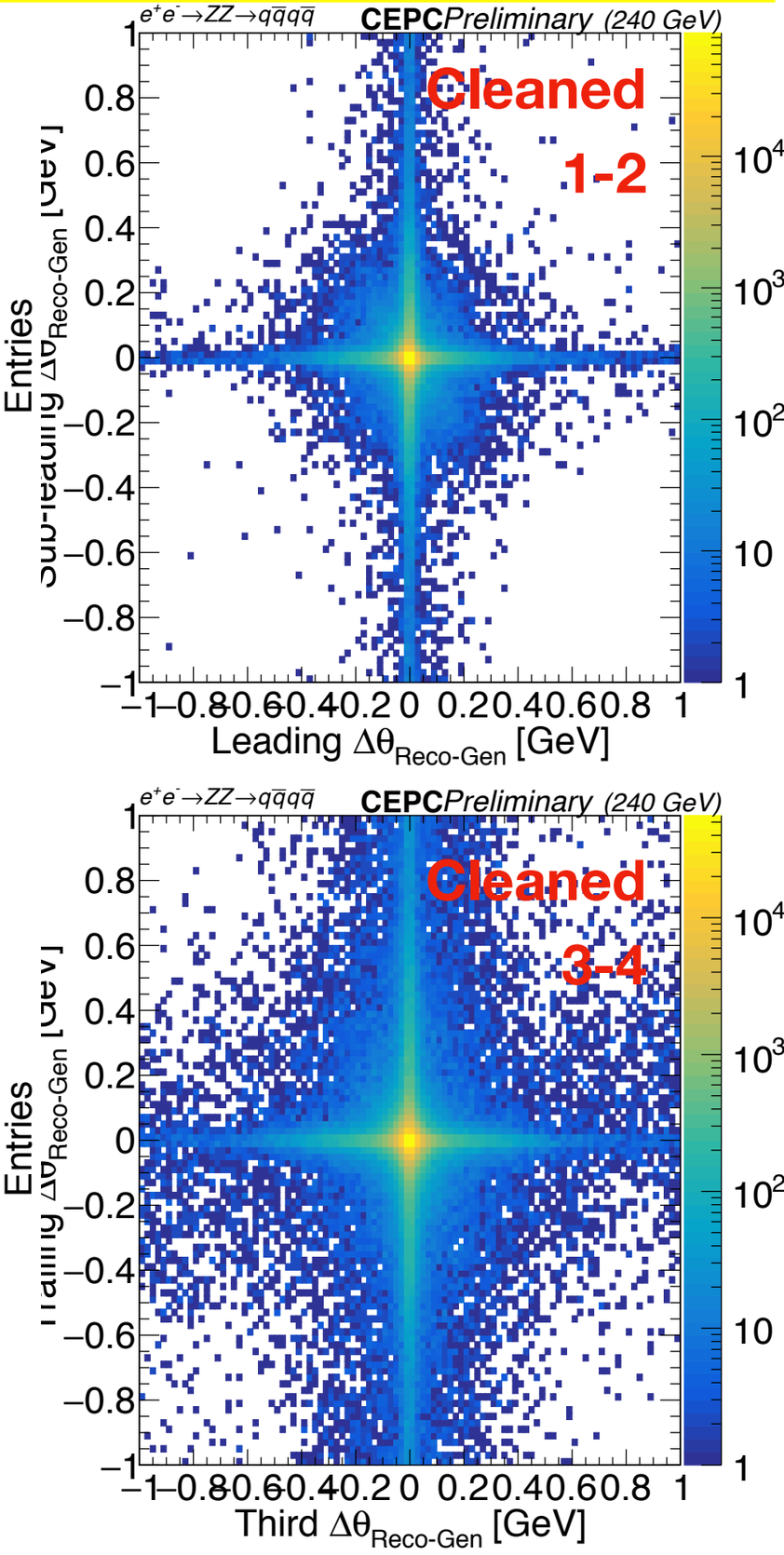
2D $\Delta\theta$ Distribution

Match by Energy and ΔR reverse

1-4	1-3	1-2
2-3	2-4	3-4



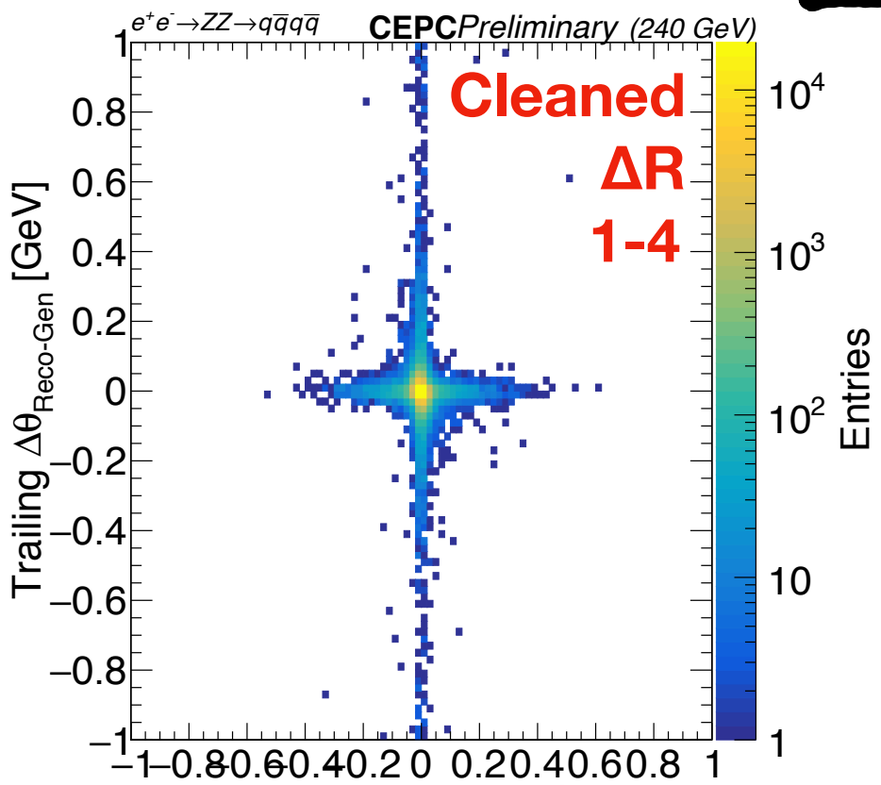


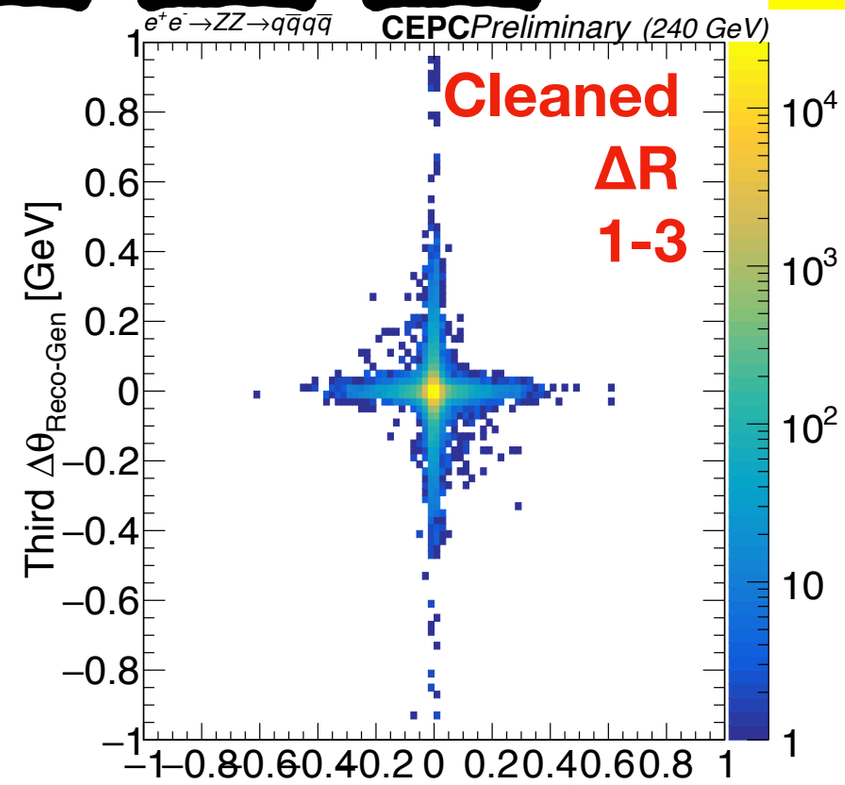


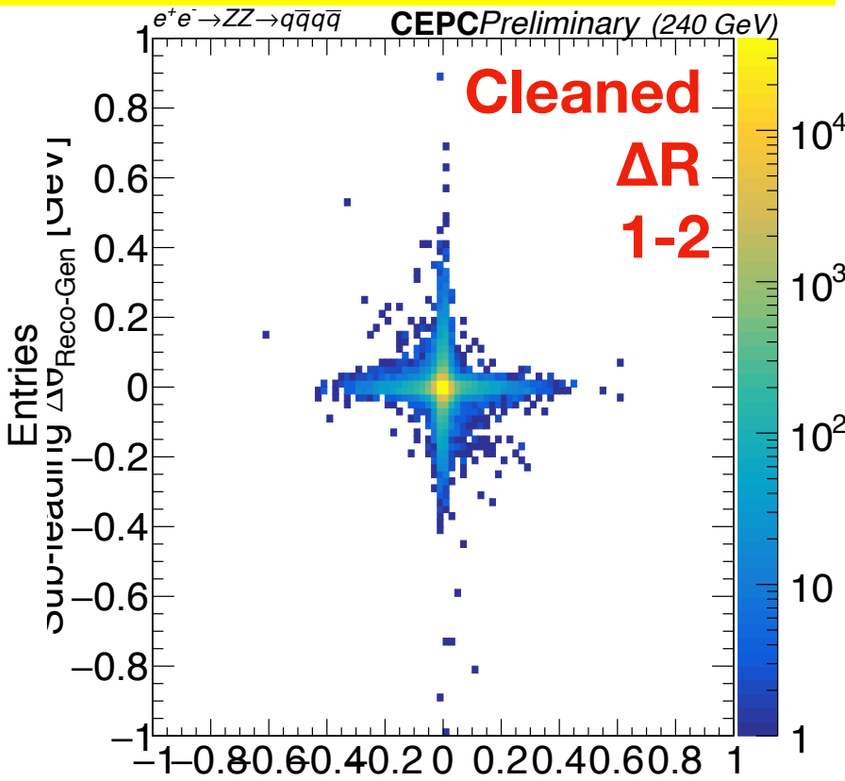
2D $\Delta\theta$ Distribution

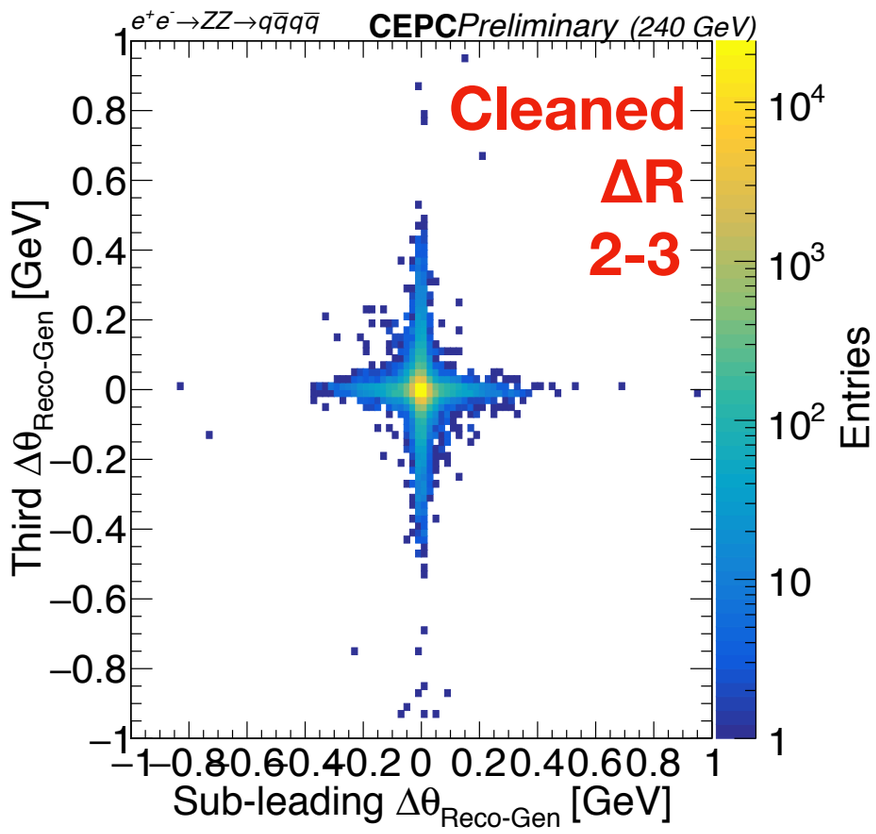
Match by Energy and ΔR reverse

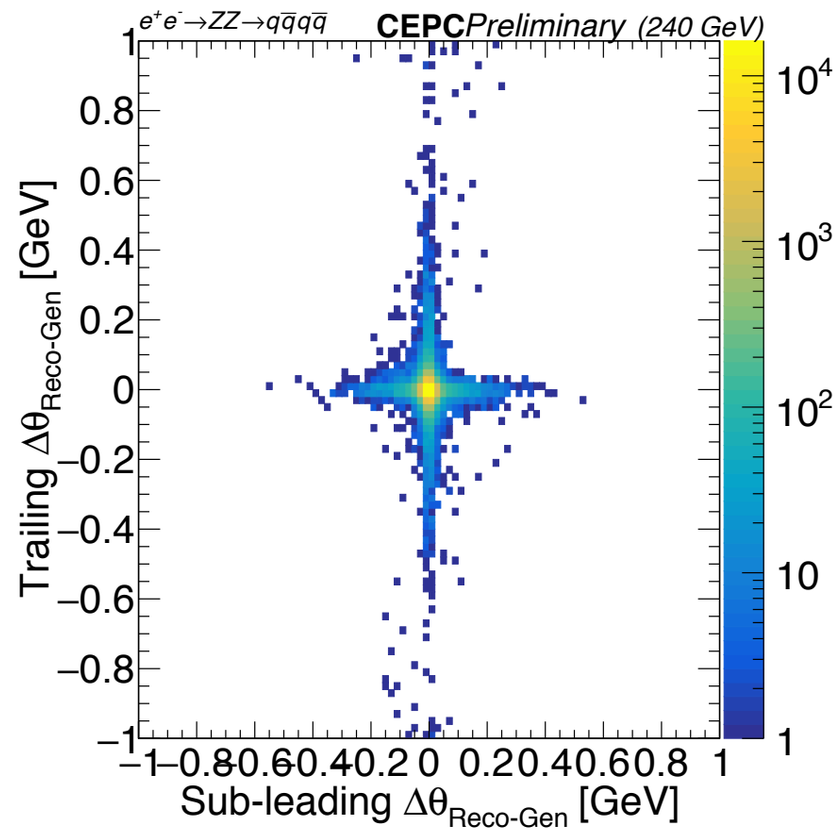
1-4	1-3	1-2
2-3	2-4	3-4

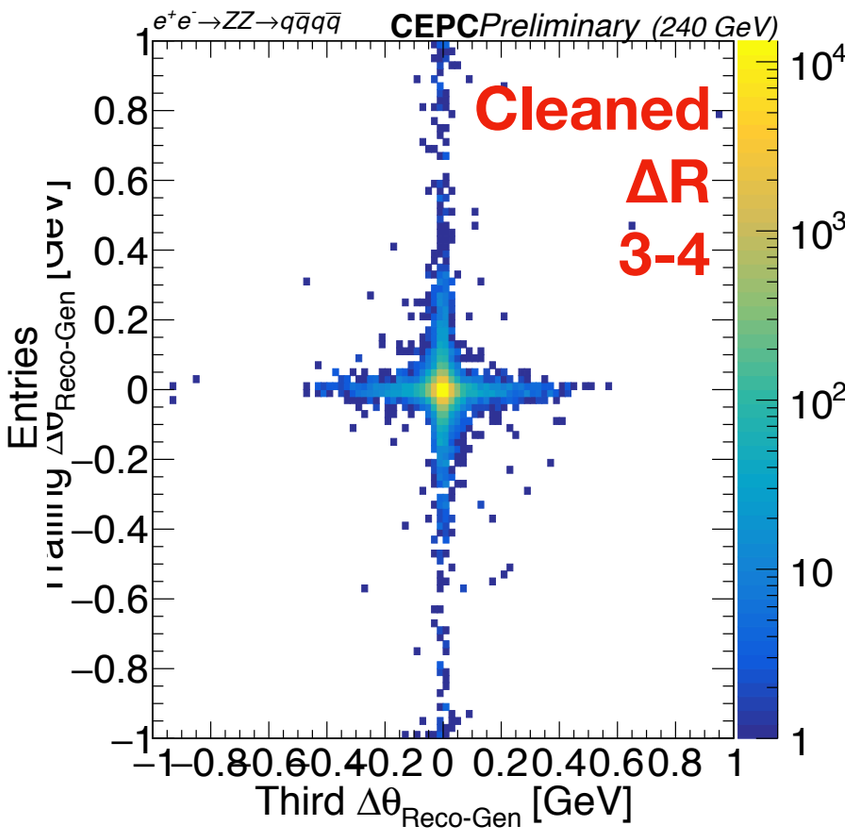








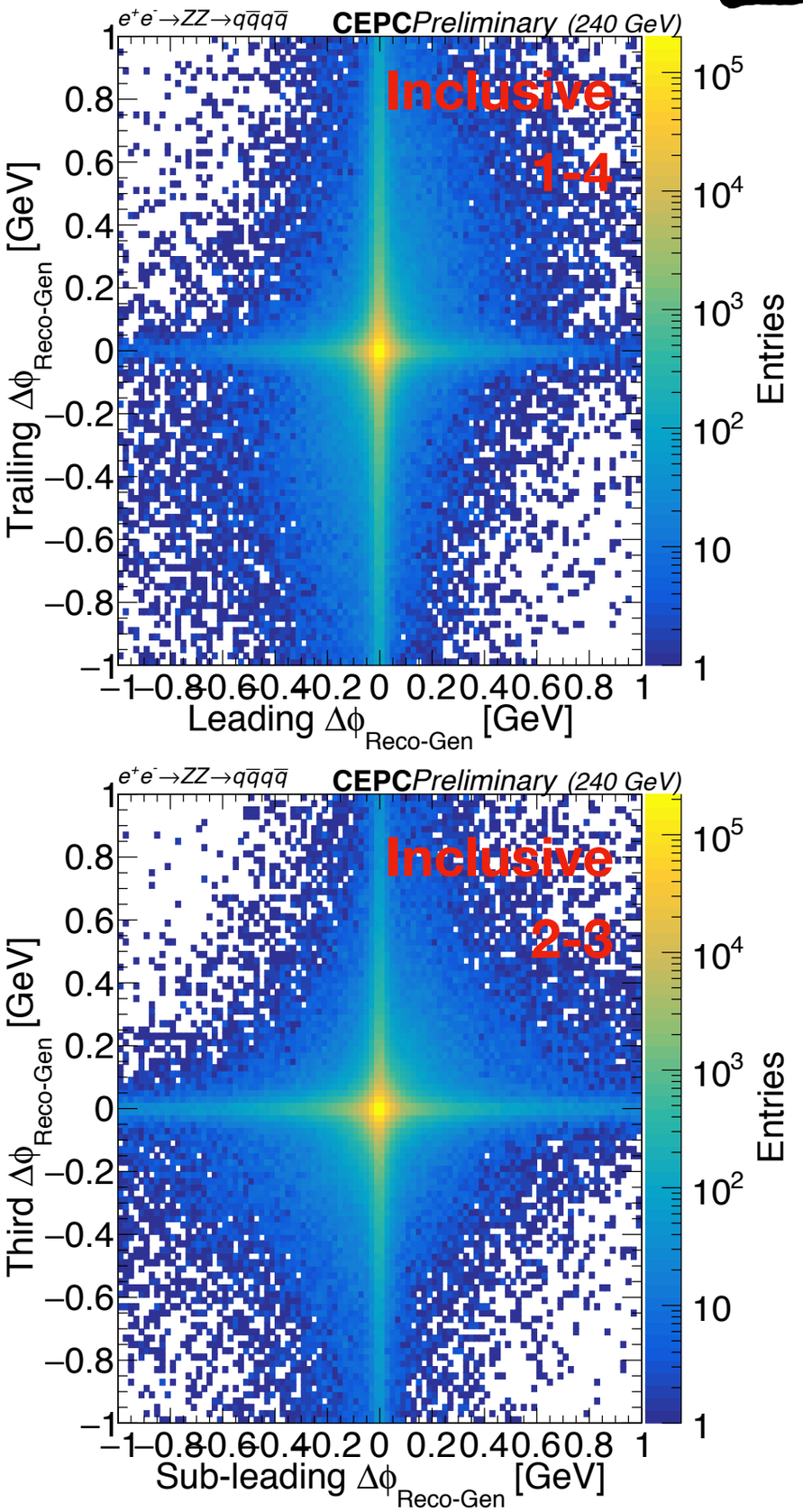


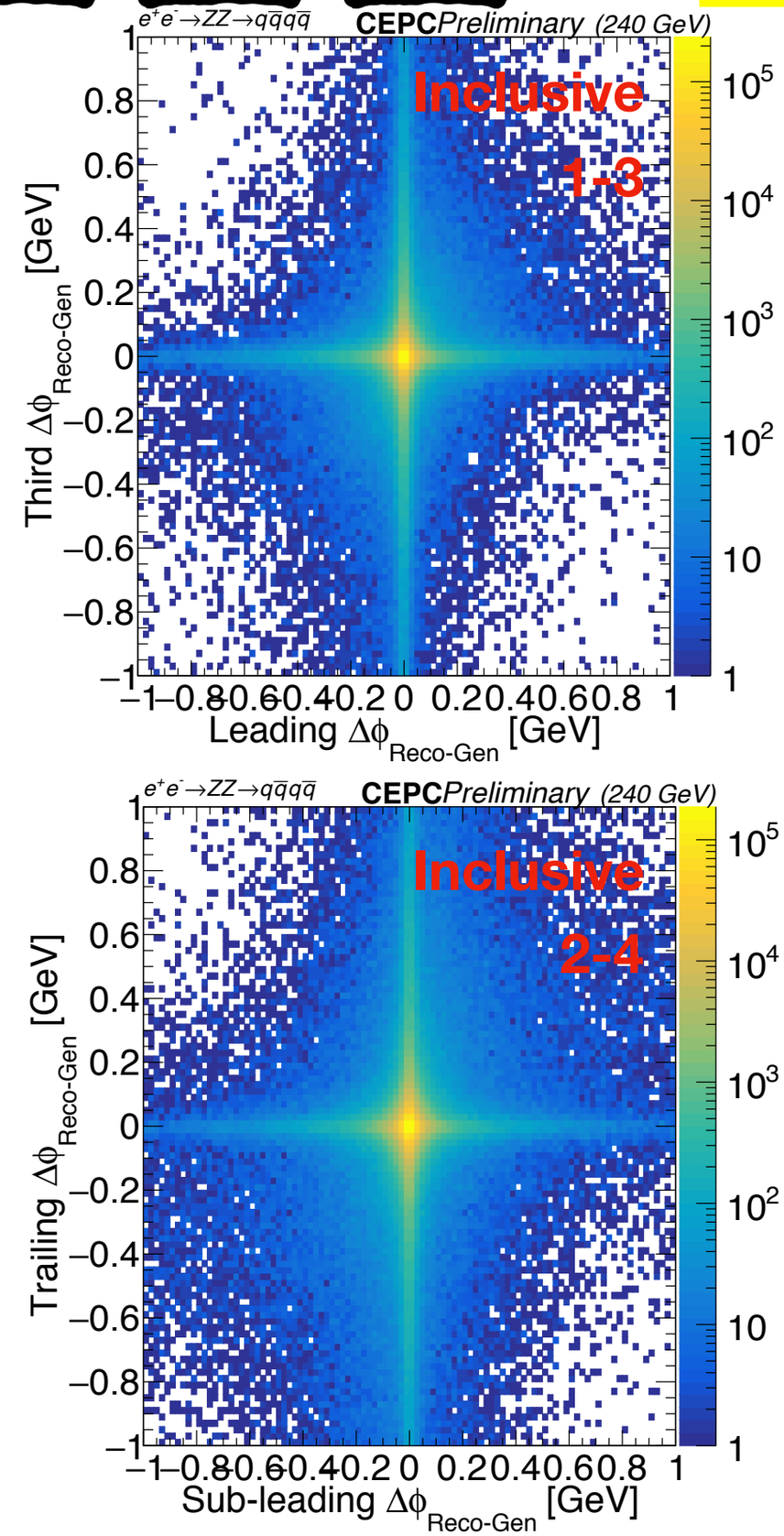


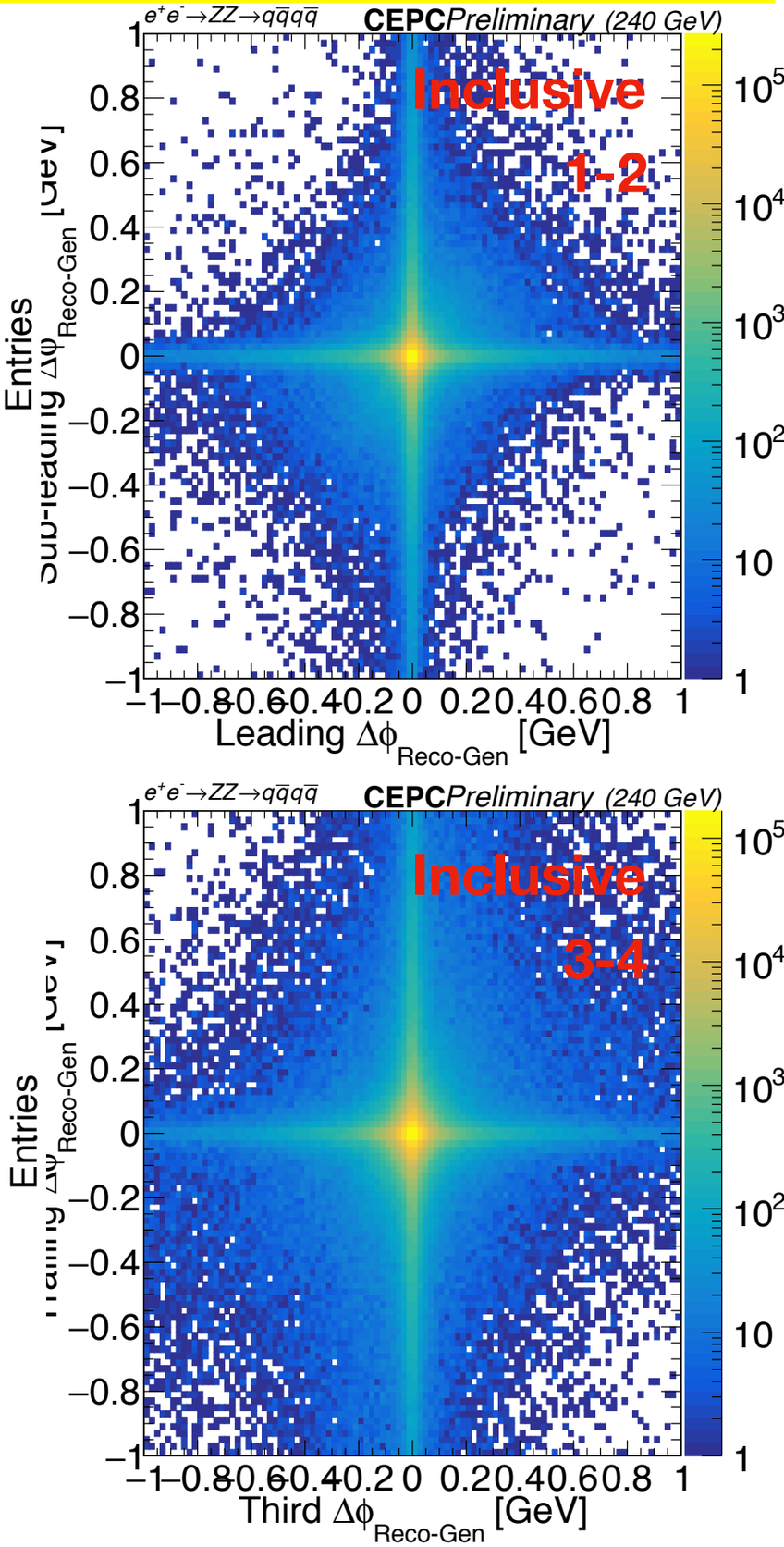
2D $\Delta\phi$ Distribution

Match by Energy and ΔR reverse

1-4	1-3	1-2
2-3	2-4	3-4



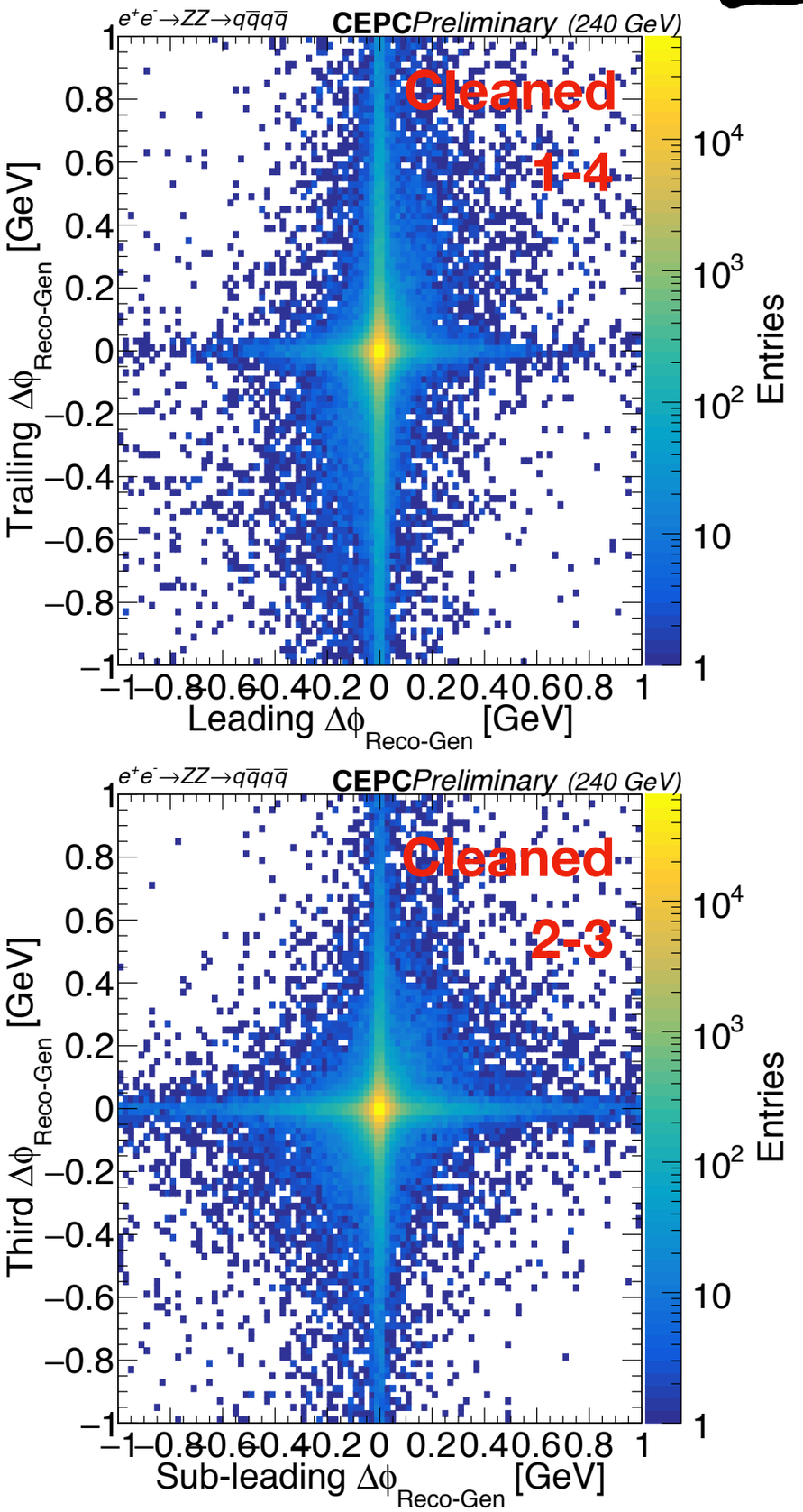


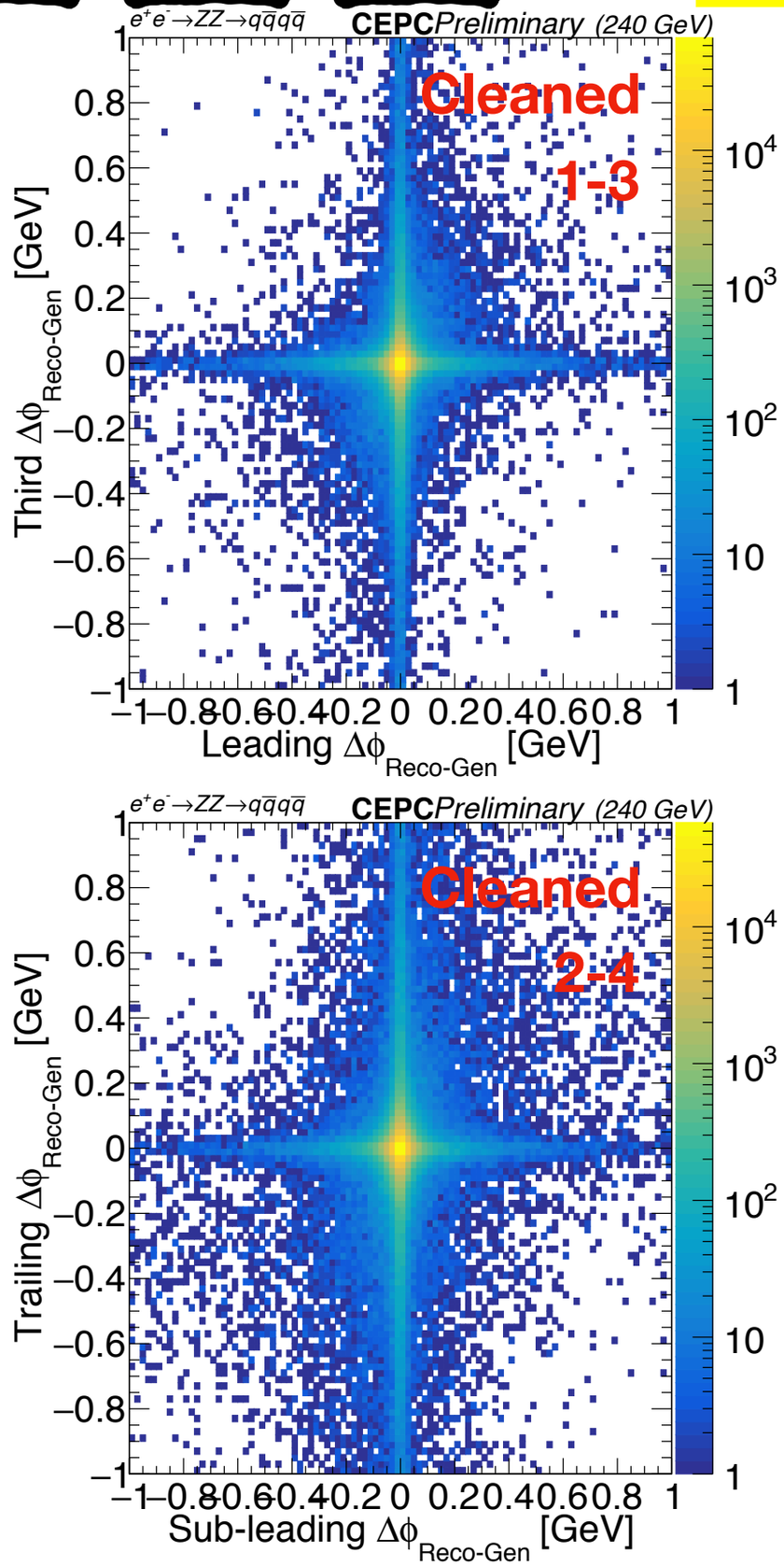


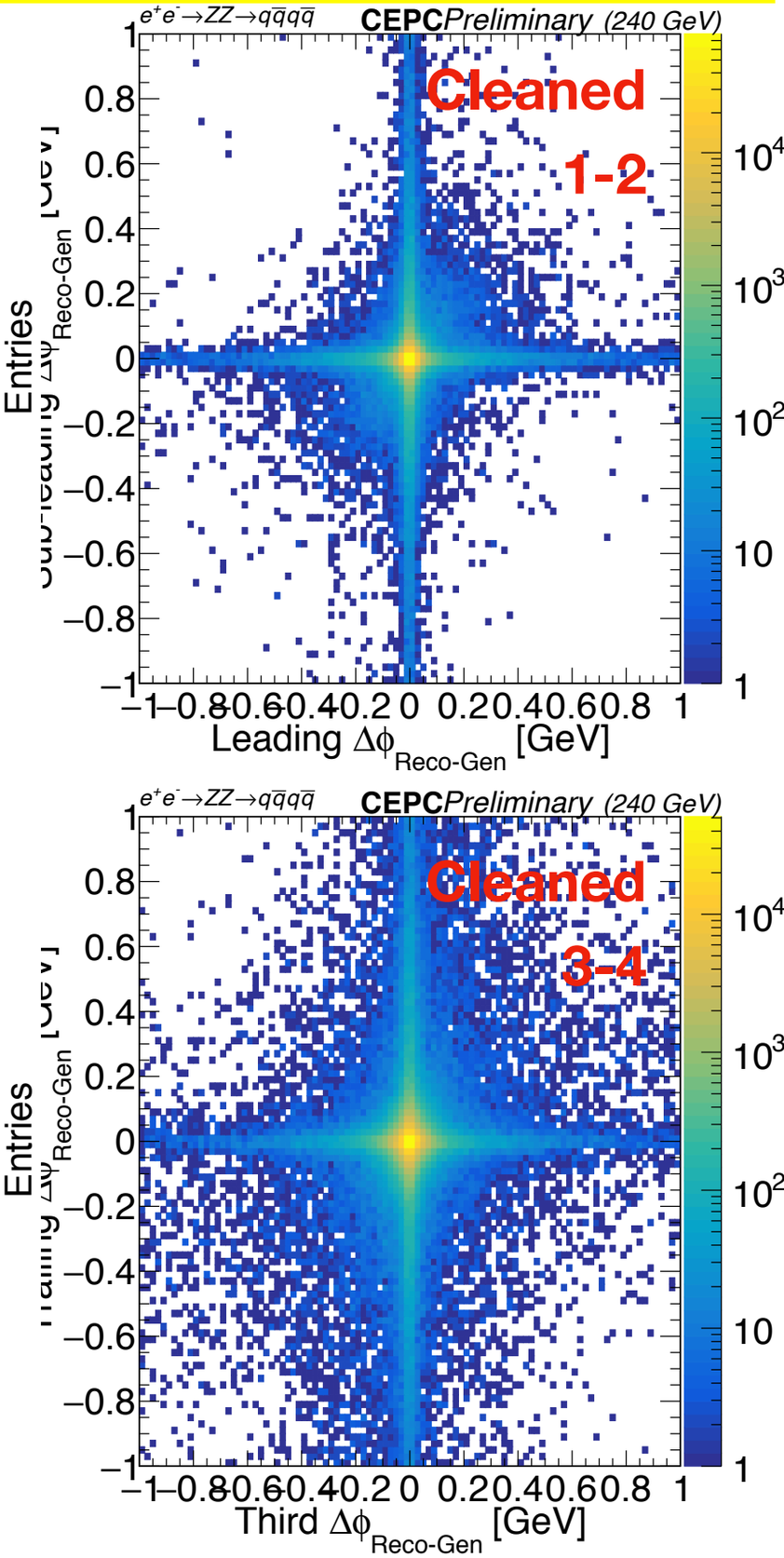
2D $\Delta\phi$ Distribution

Match by Energy and ΔR reverse

1-4	1-3	1-2
2-3	2-4	3-4







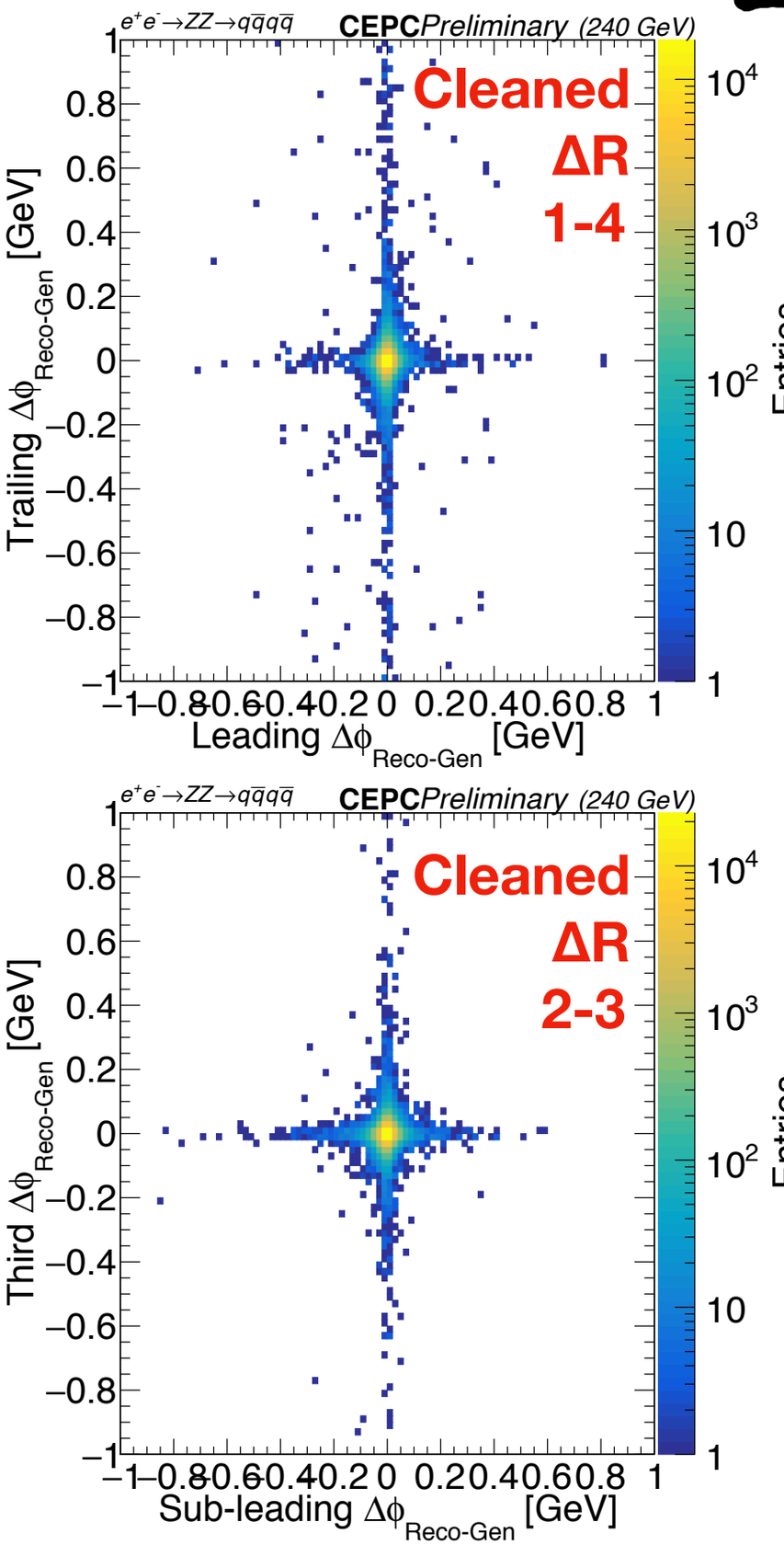
2D $\Delta\phi$ Distribution

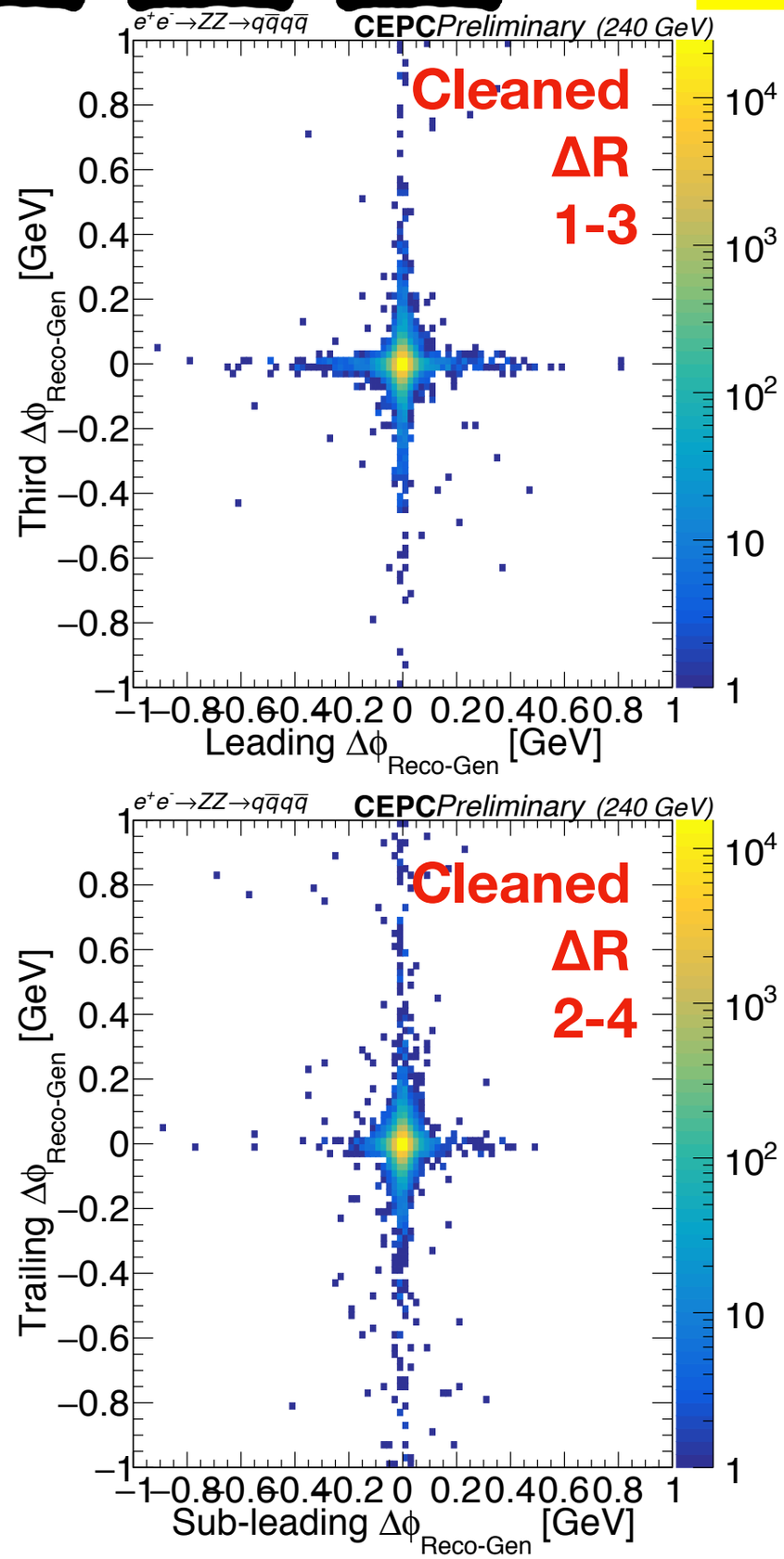
Match by Energy and ΔR reverse

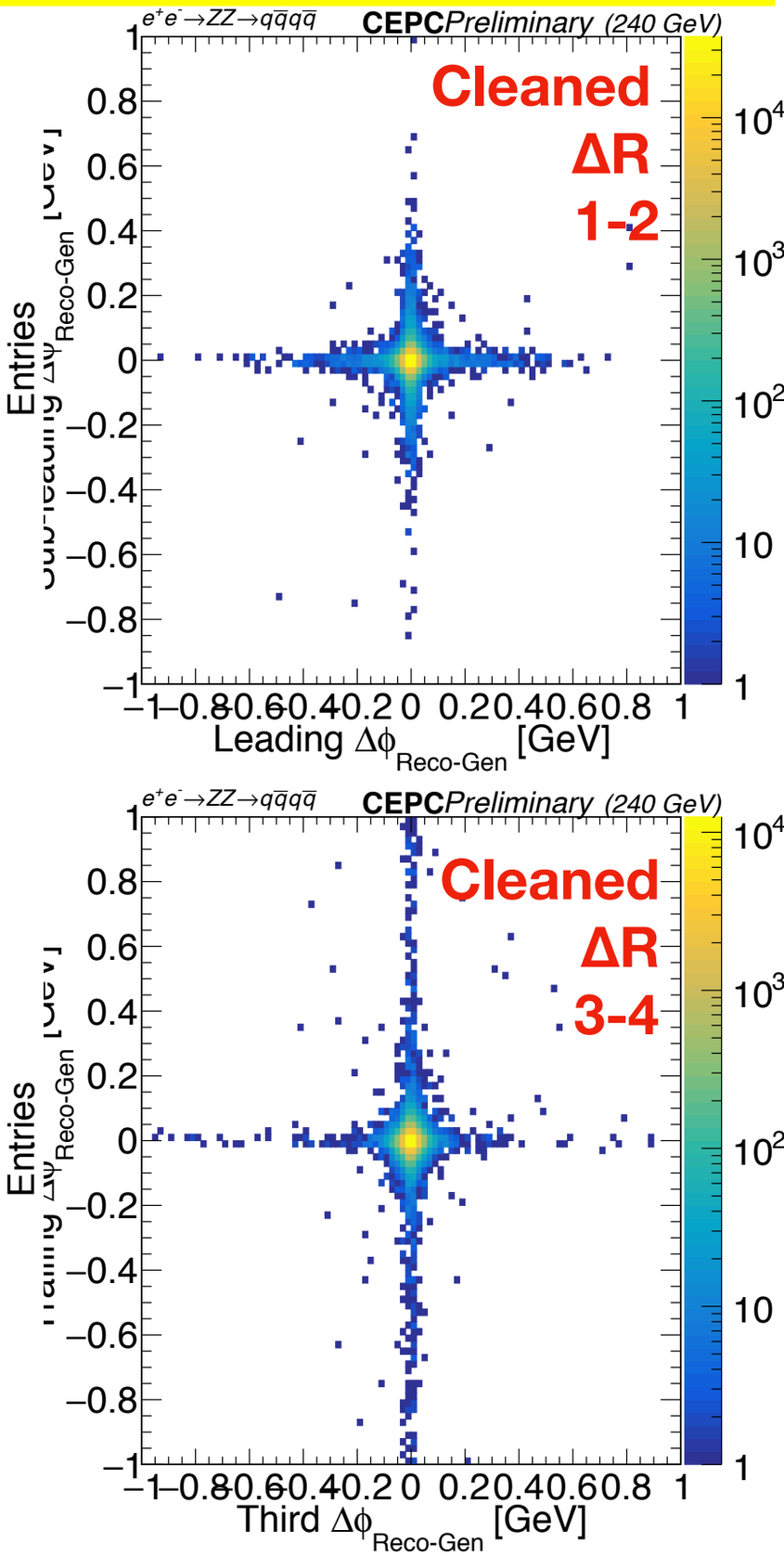
1-4
2-3

1-3
2-4

1-2
3-4







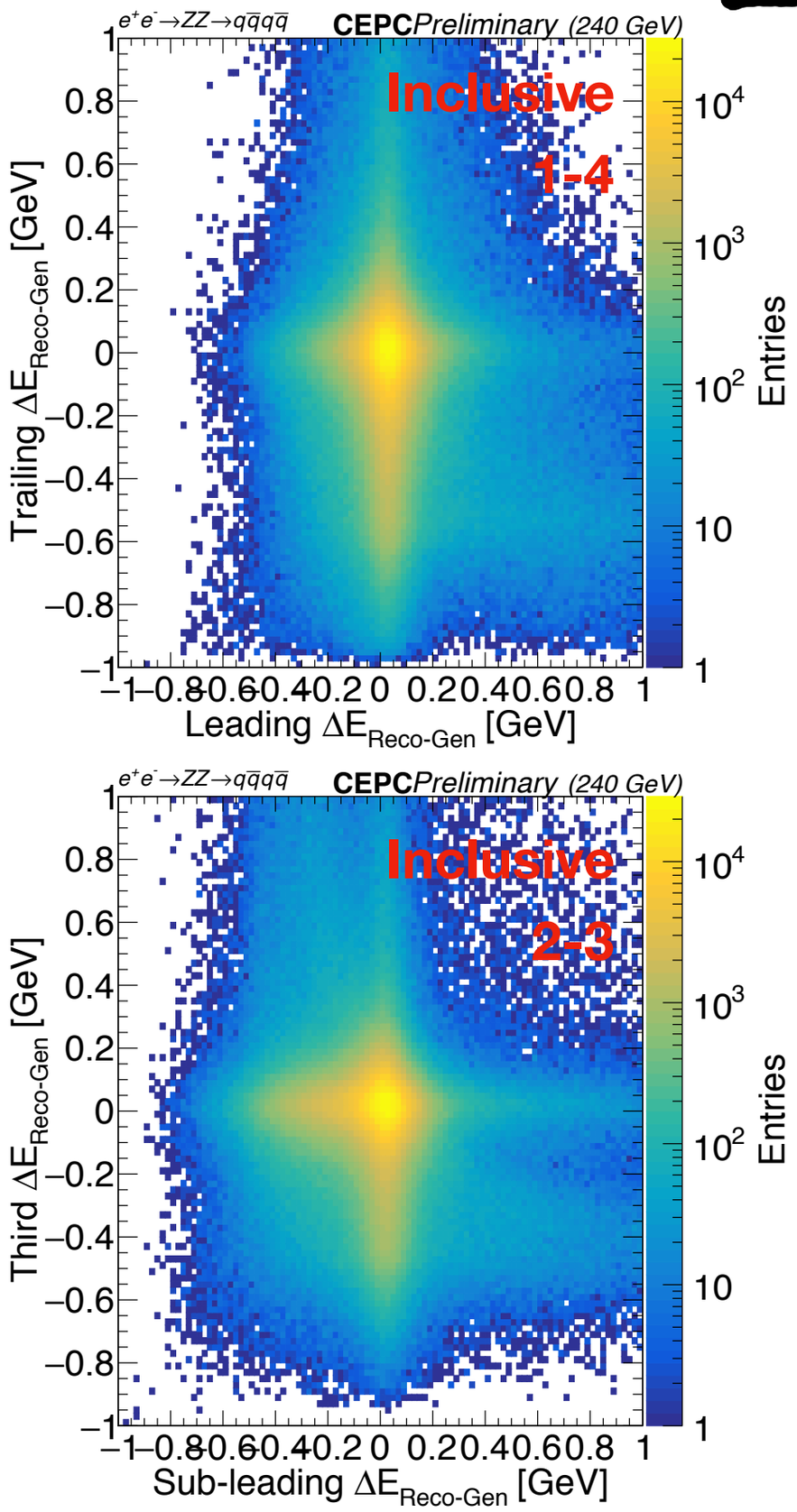
Match by Energy and ΔR+ ΔE reverse

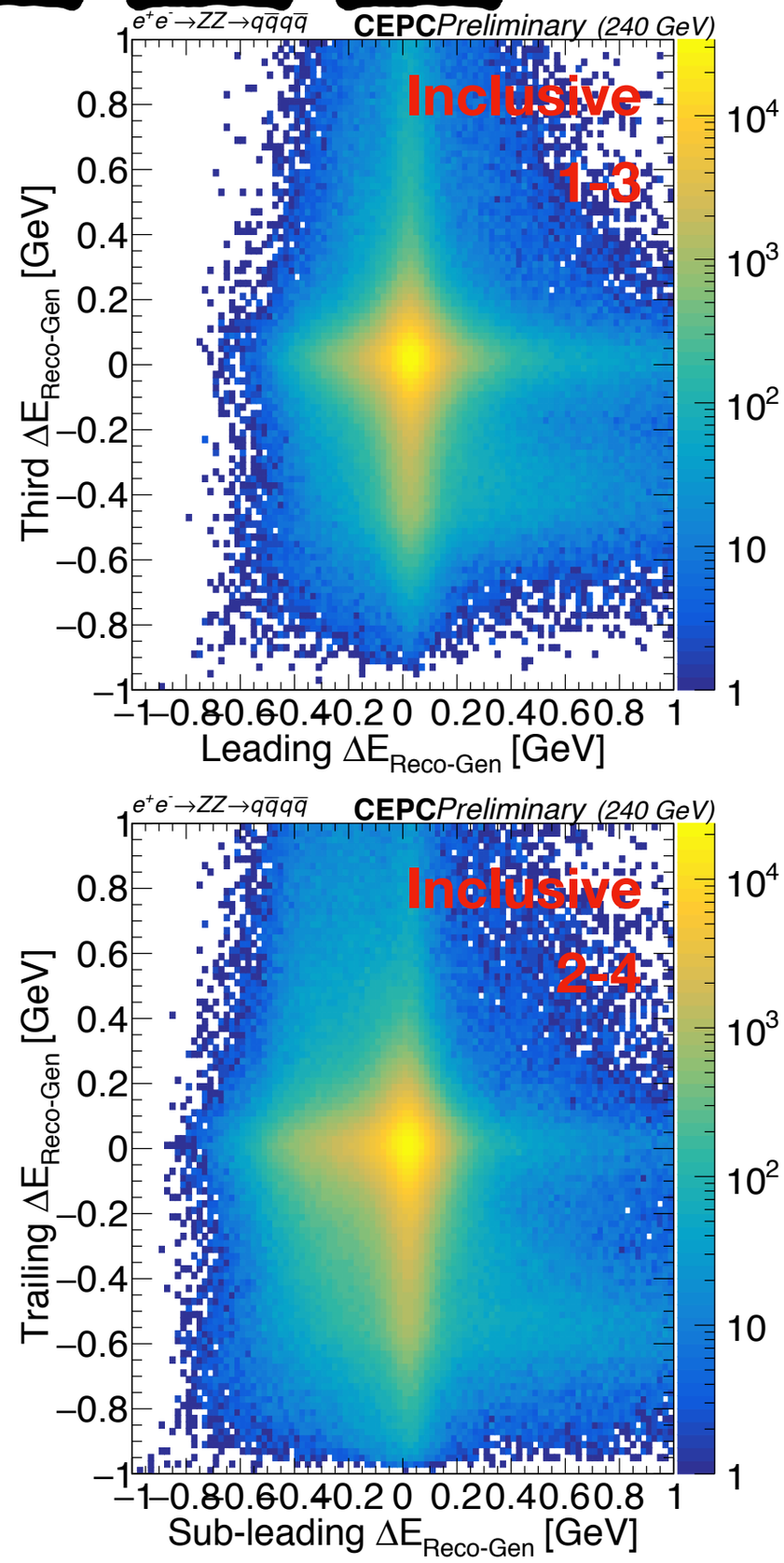
1-4
2-3

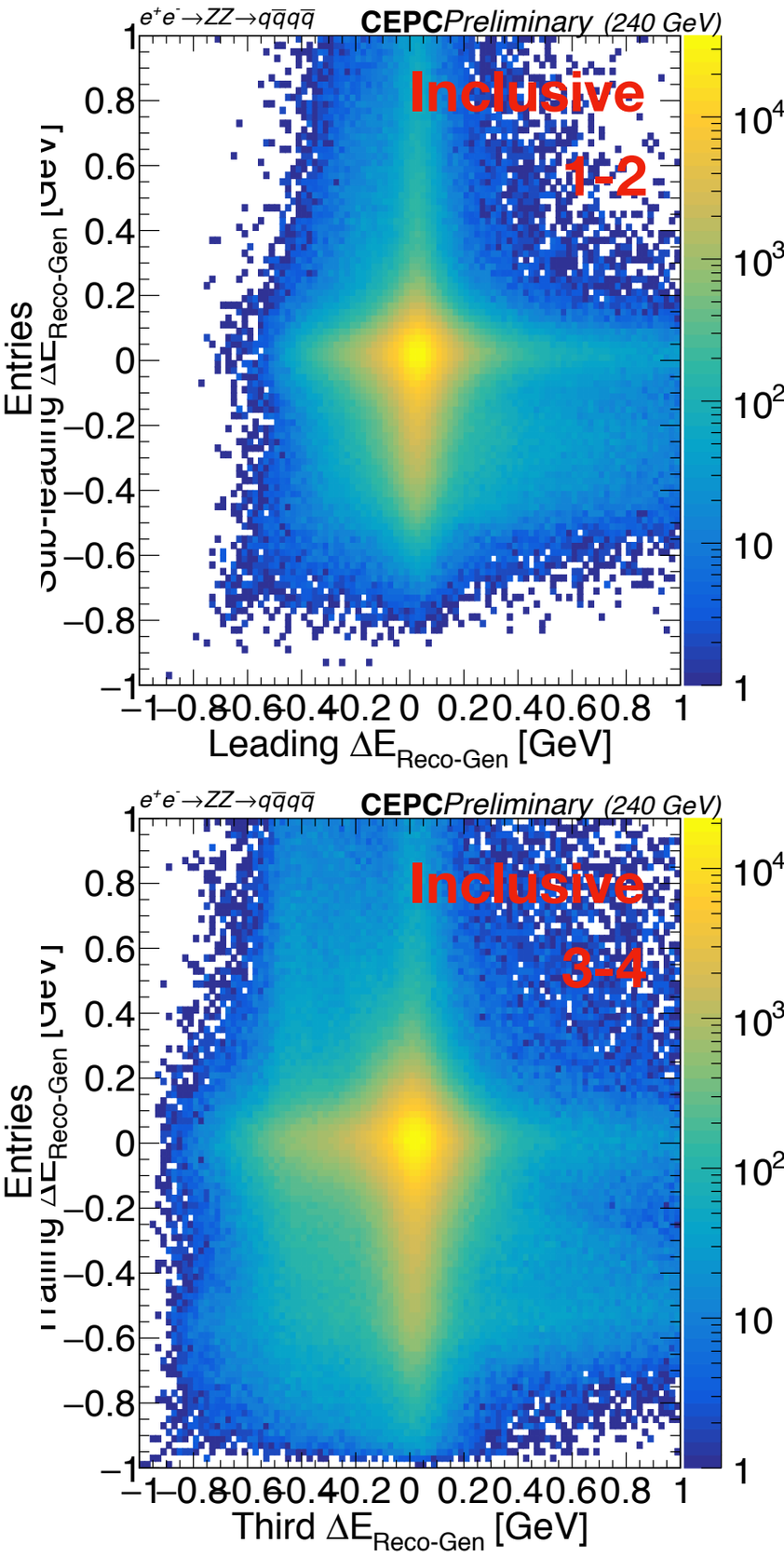
1-3
2-4

1-2
3-4

2D ΔE Distribution







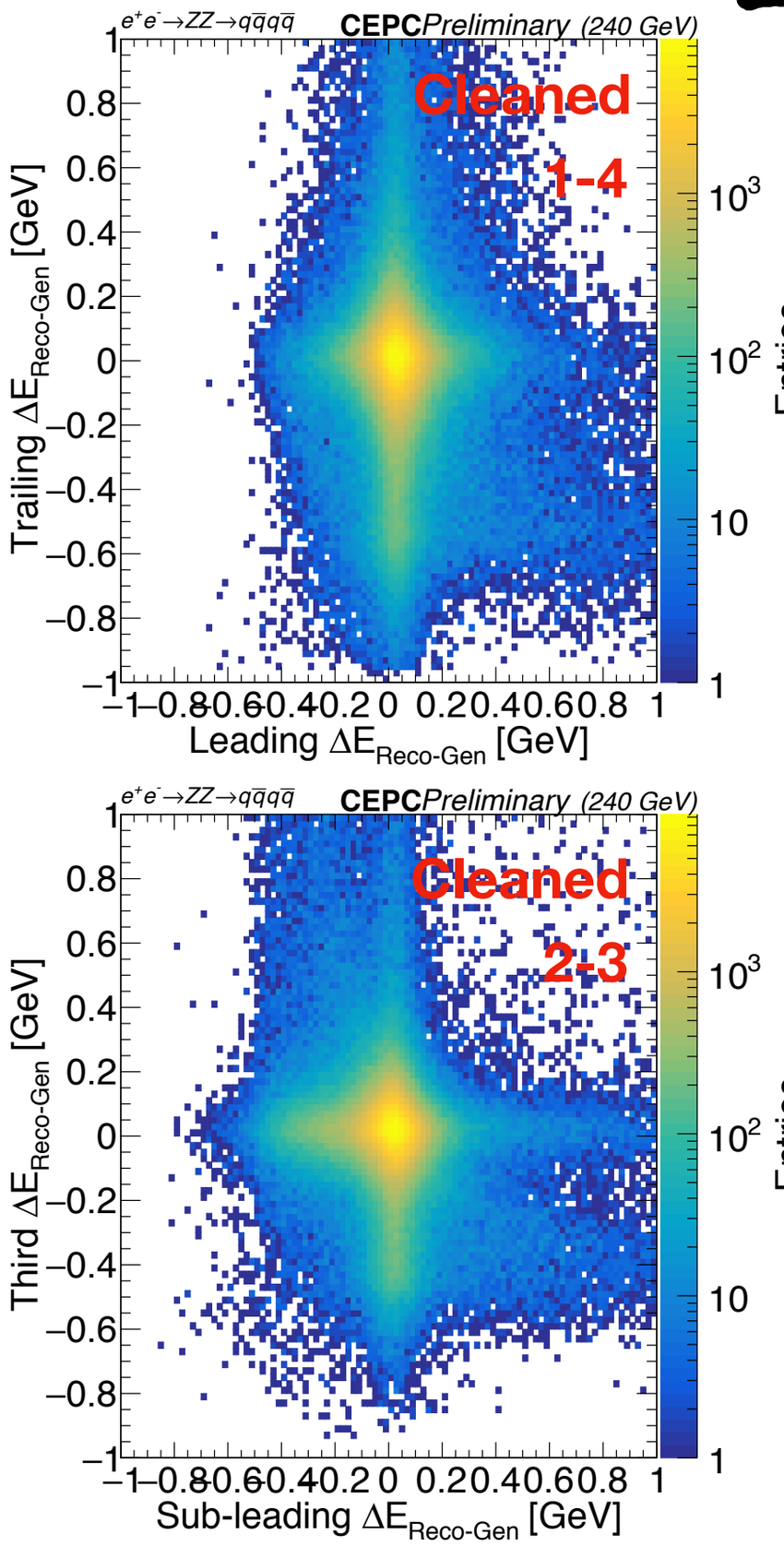
Match by Energy and ΔR+ ΔE reverse

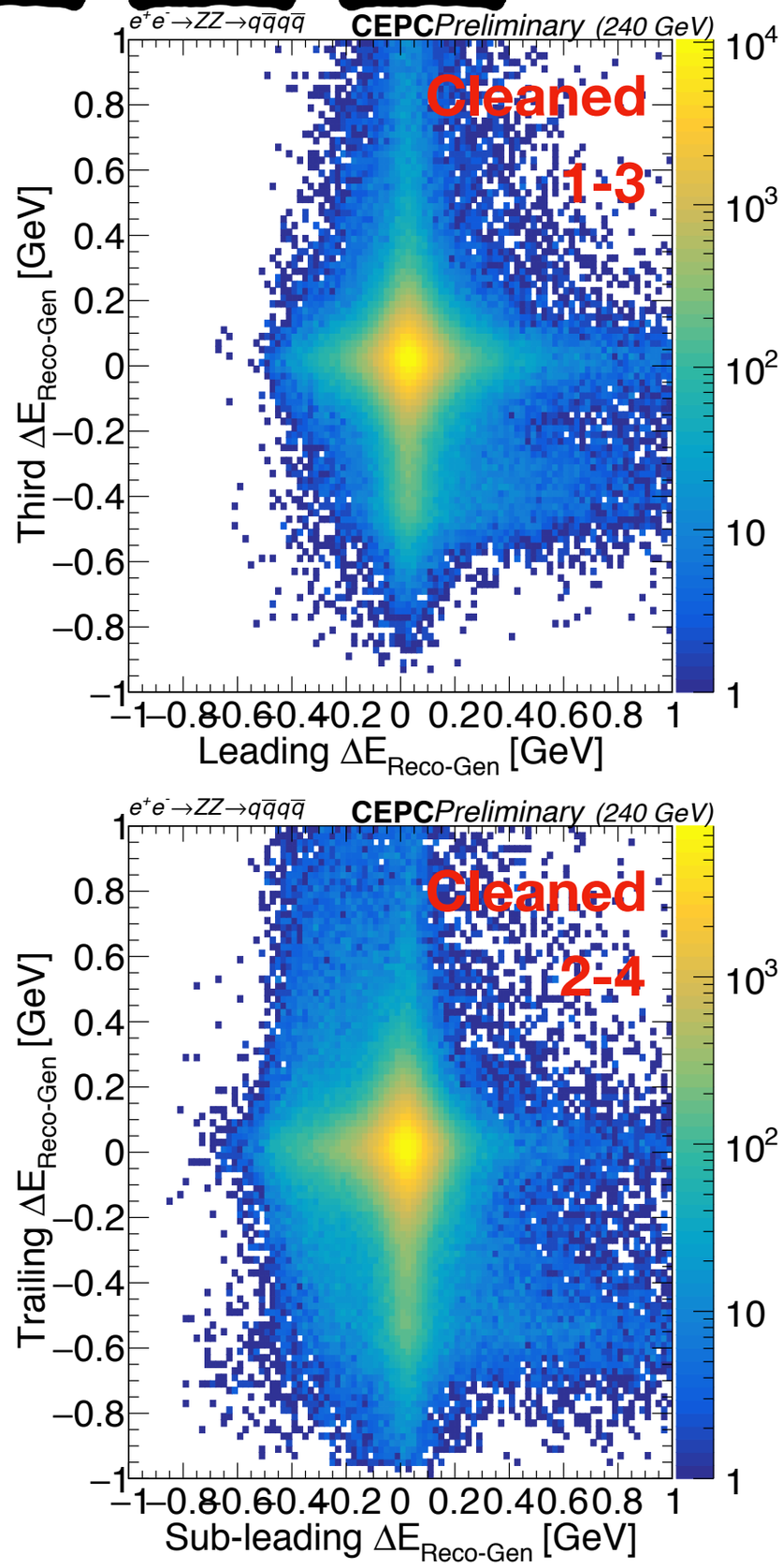
1-4
2-3

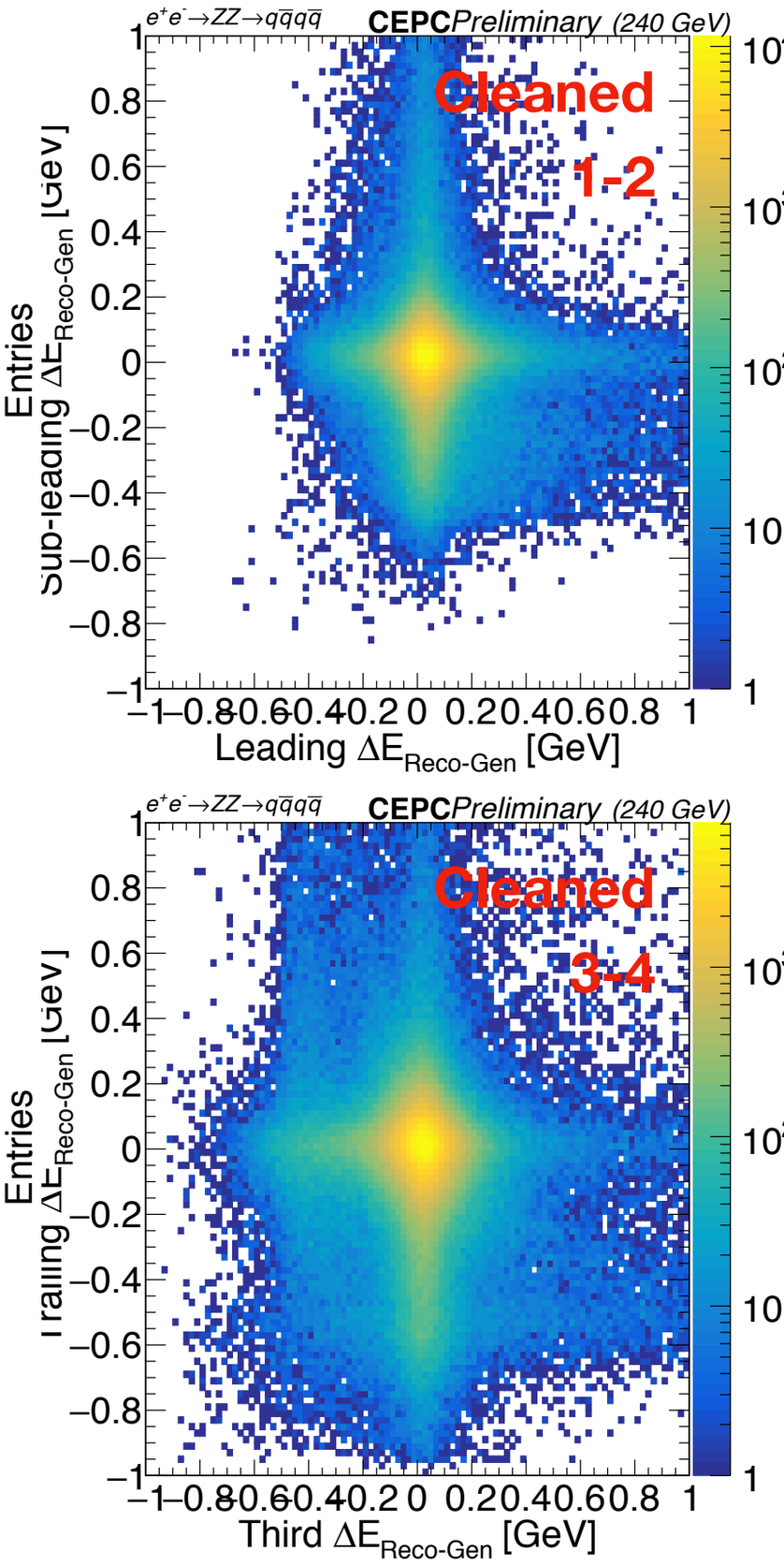
1-3
2-4

1-2
3-4

2D ΔE Distribution







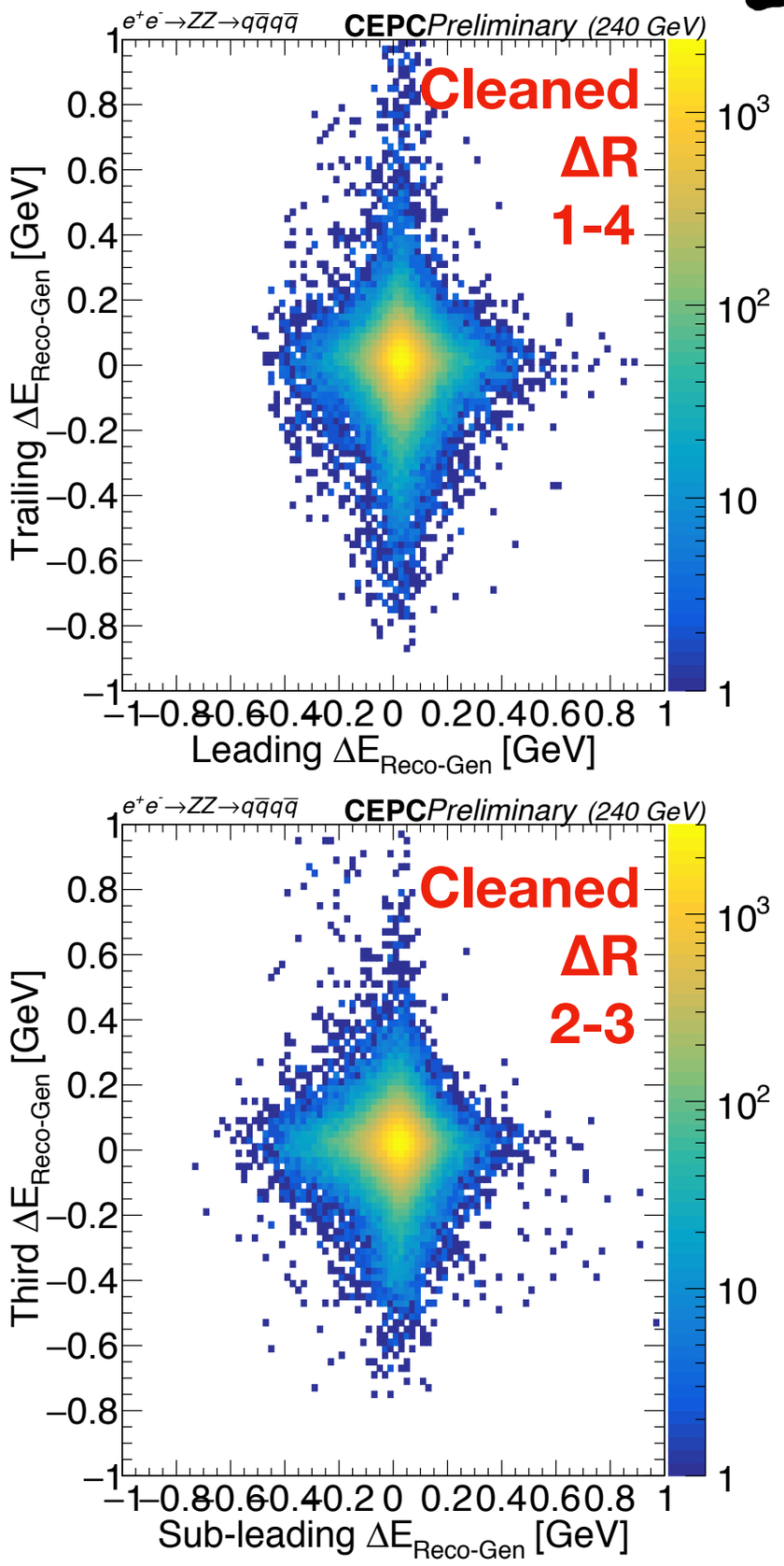
Match by Energy and ΔR+ ΔE reverse

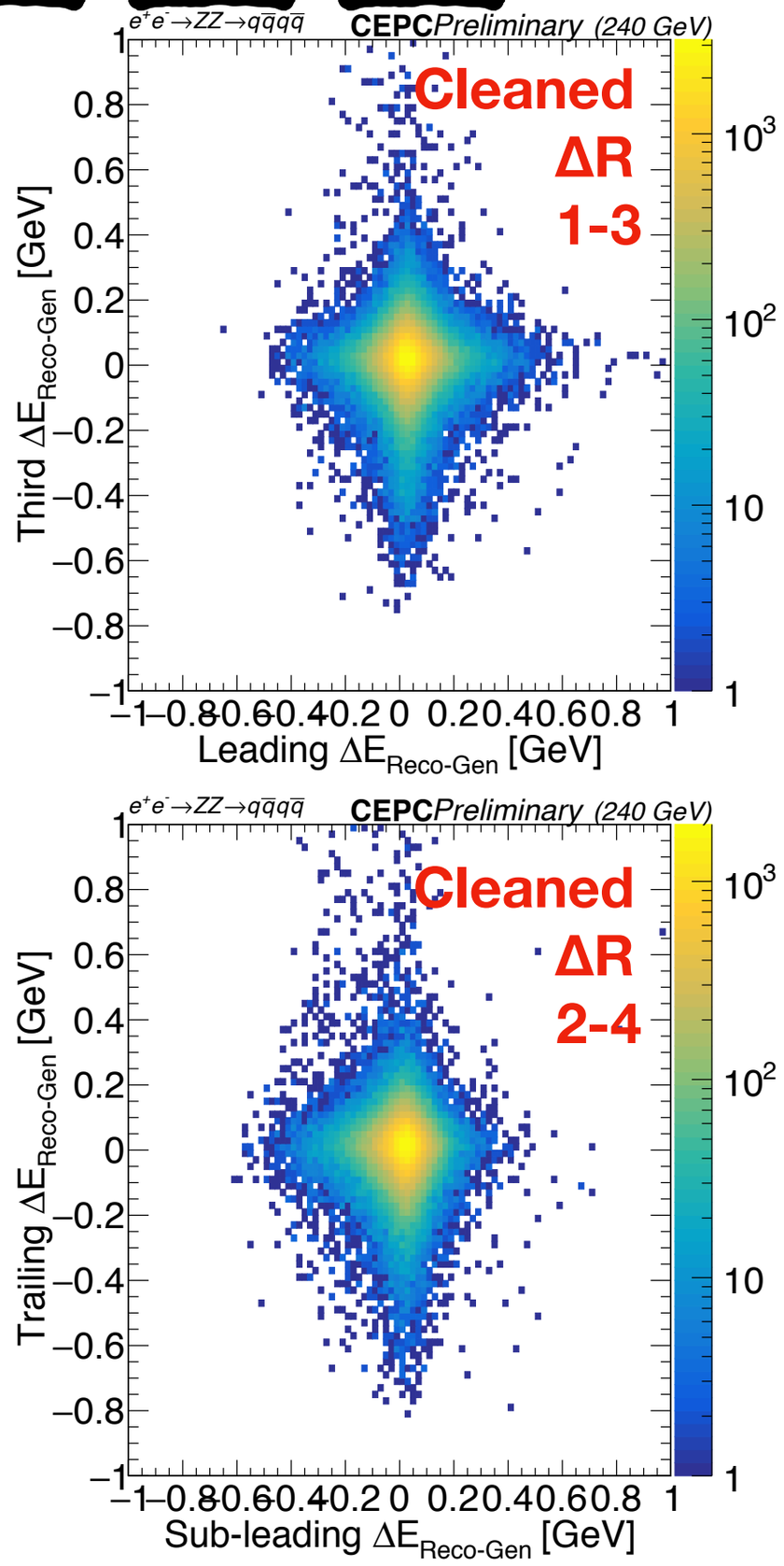
1-4
2-3

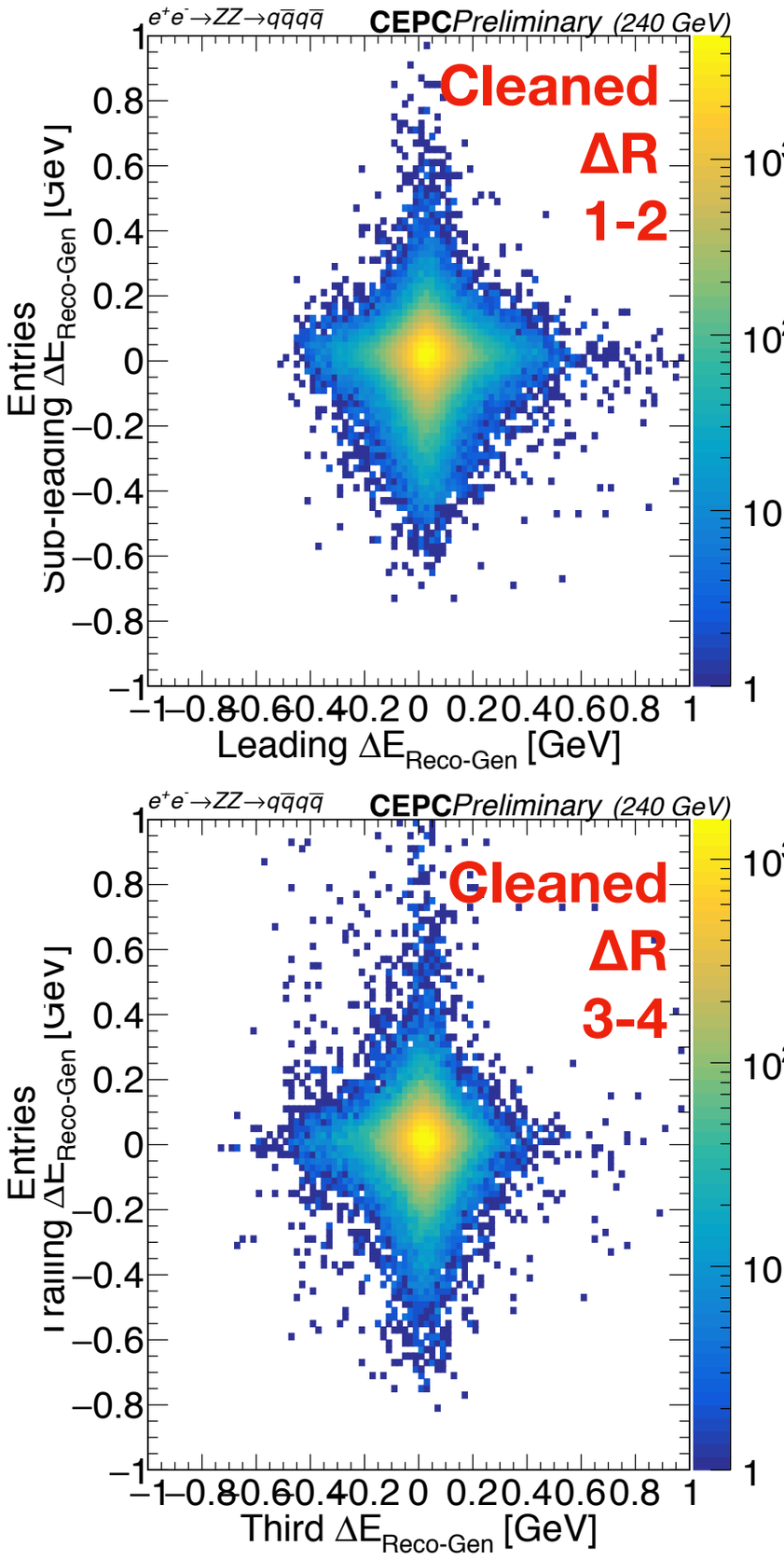
1-3
2-4

1-2
3-4

2D ΔE Distribution







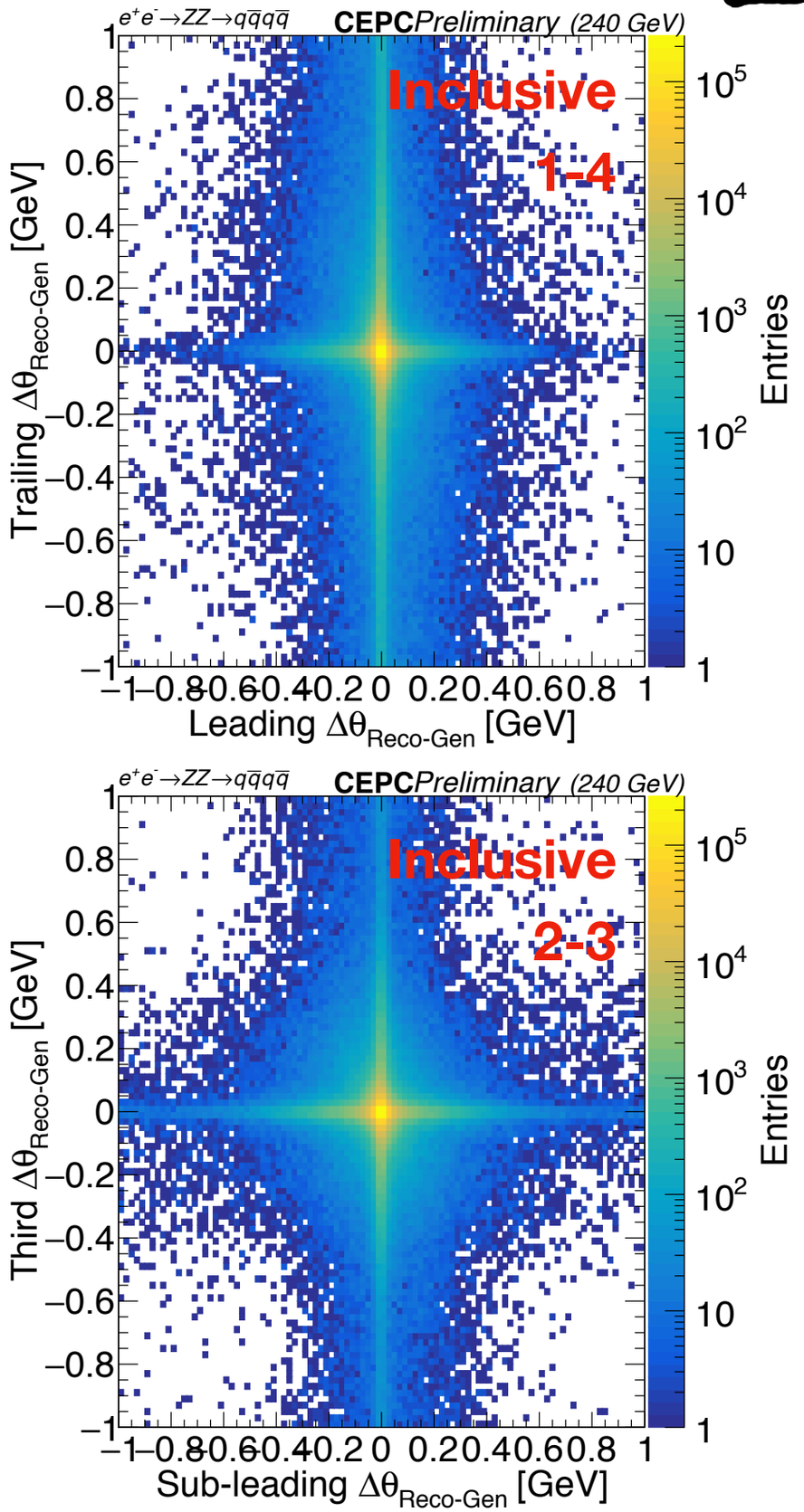
Match by Energy and ΔR+ ΔE reverse

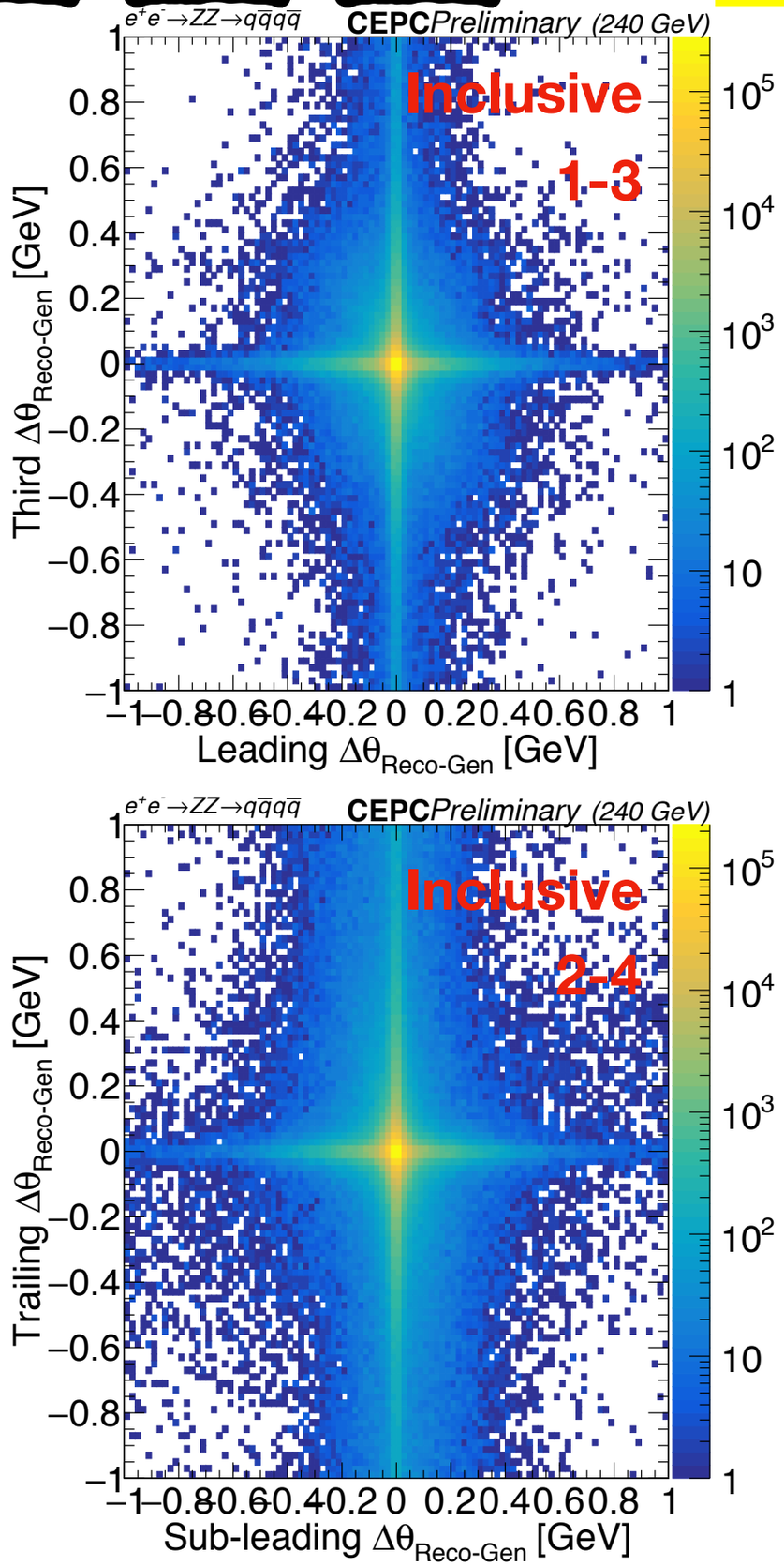
1-4
2-3

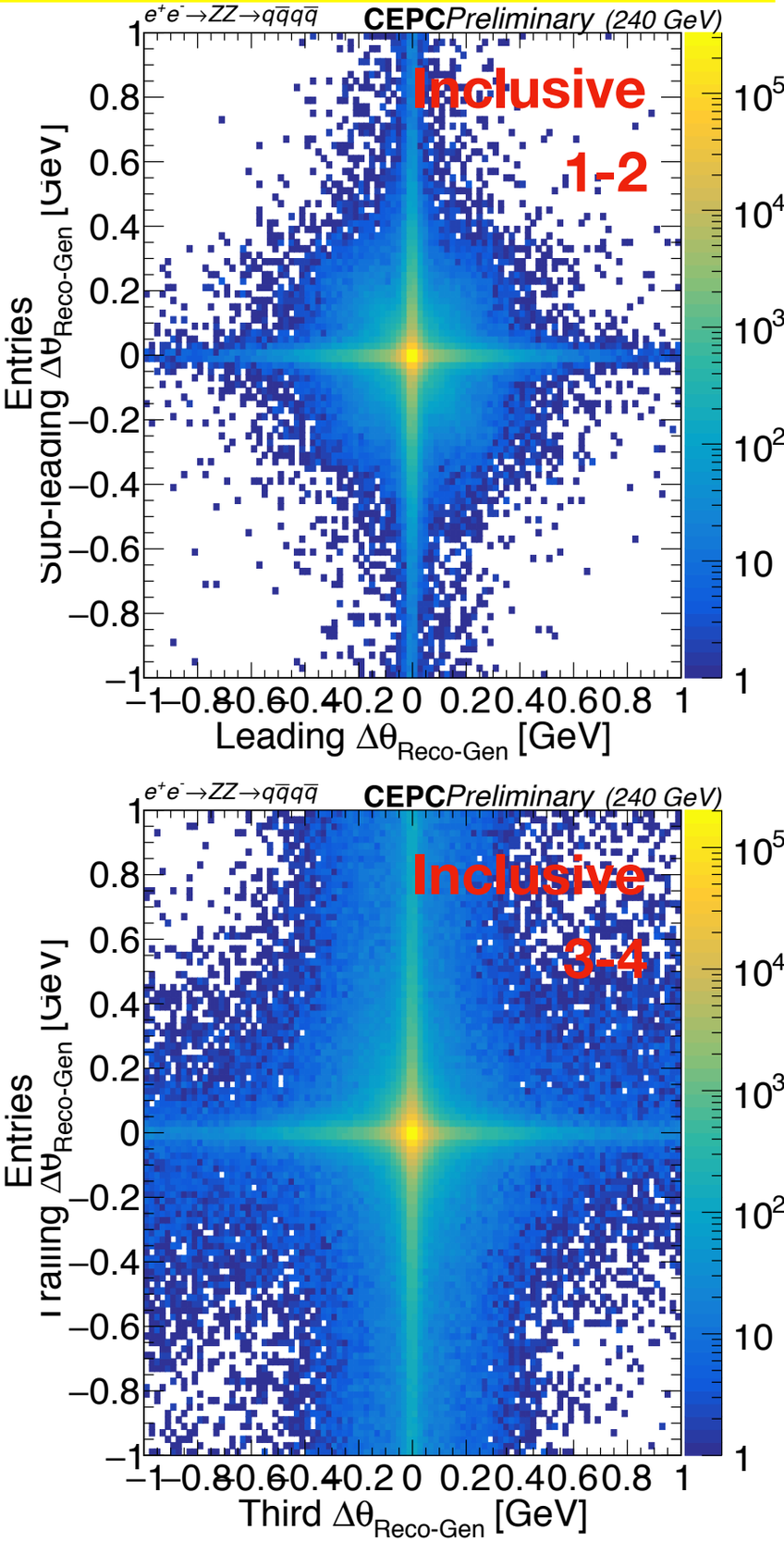
1-3
2-4

1-2
3-4

2D $\Delta\theta$ Distribution



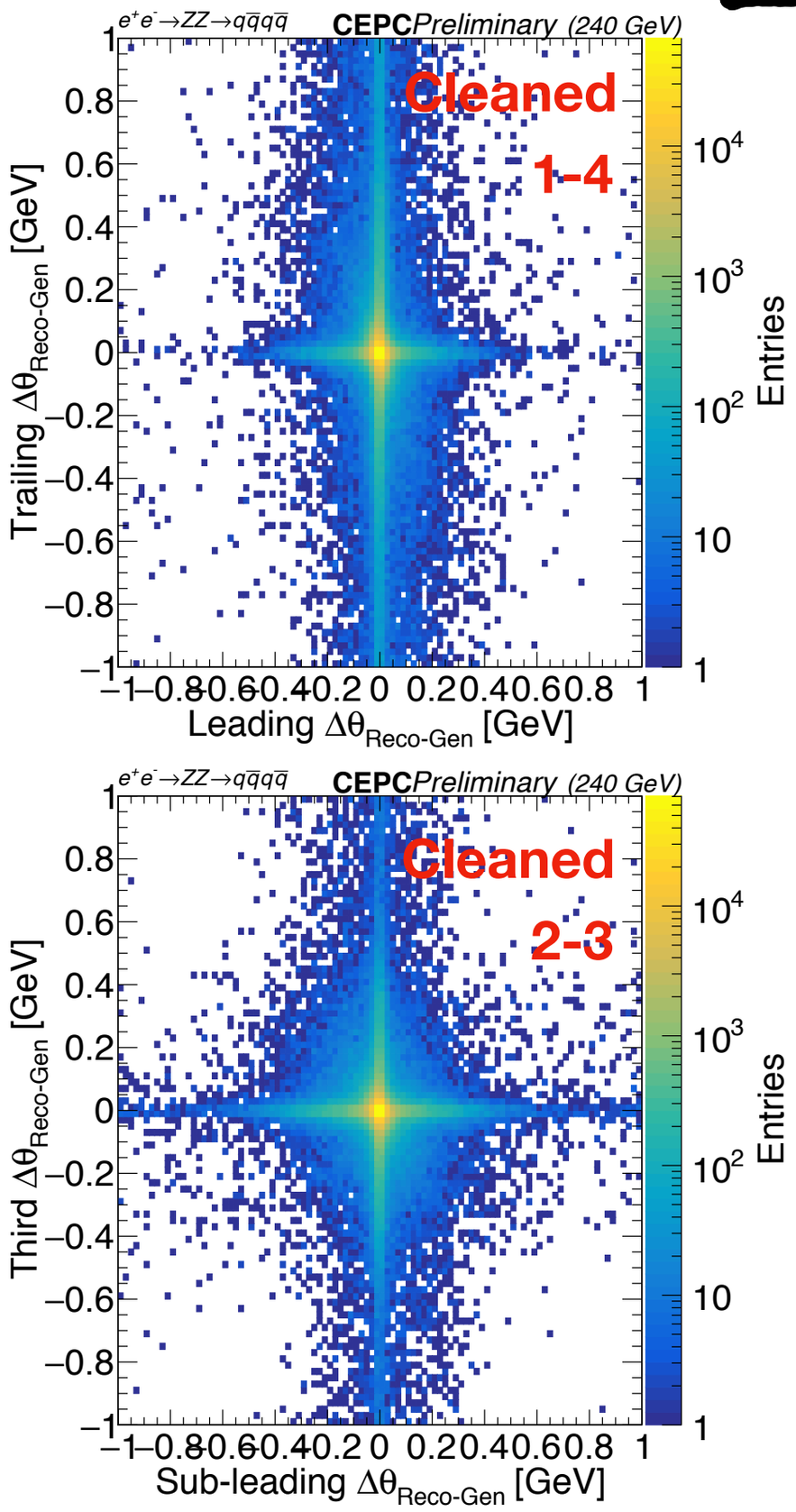


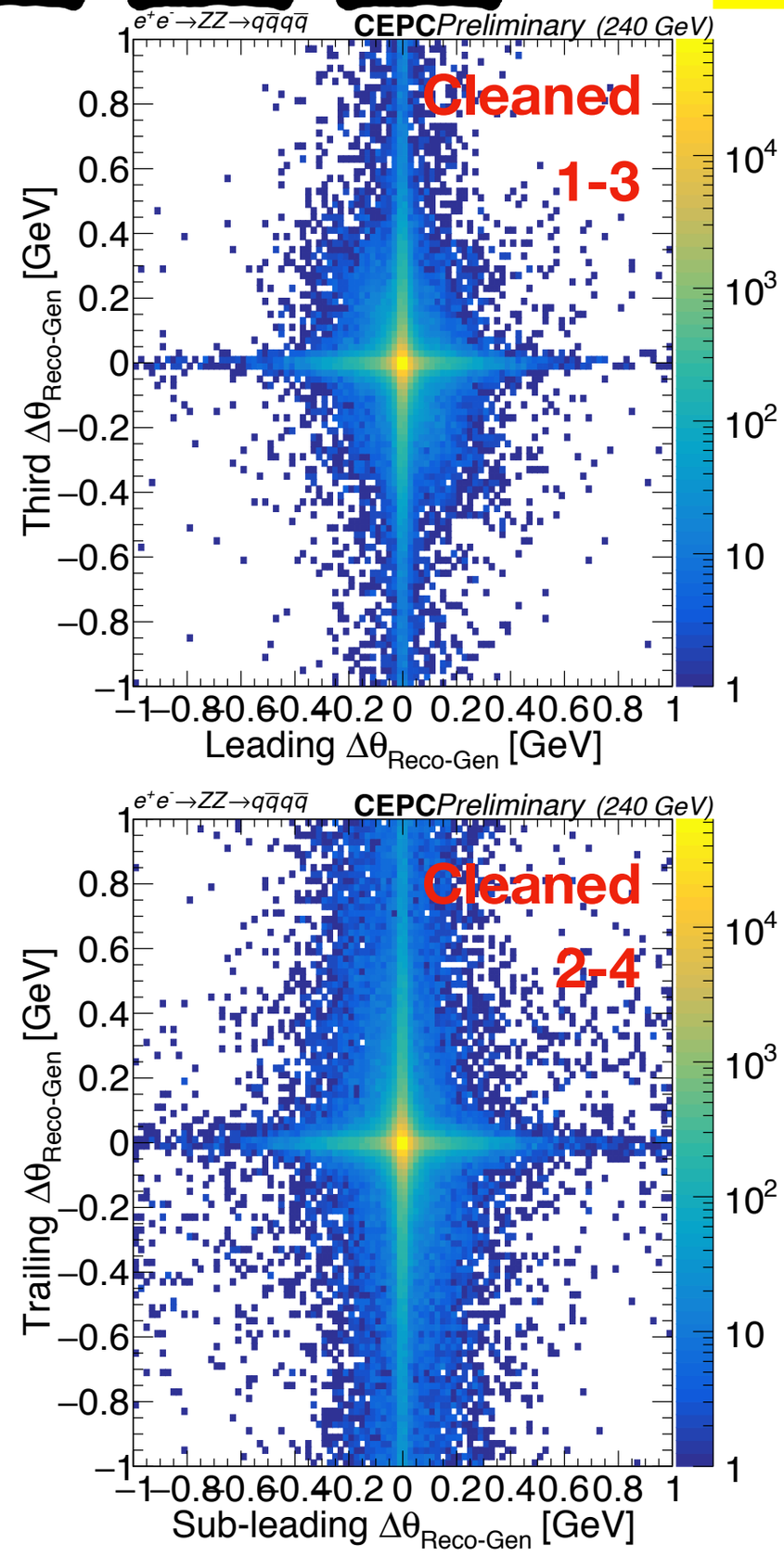


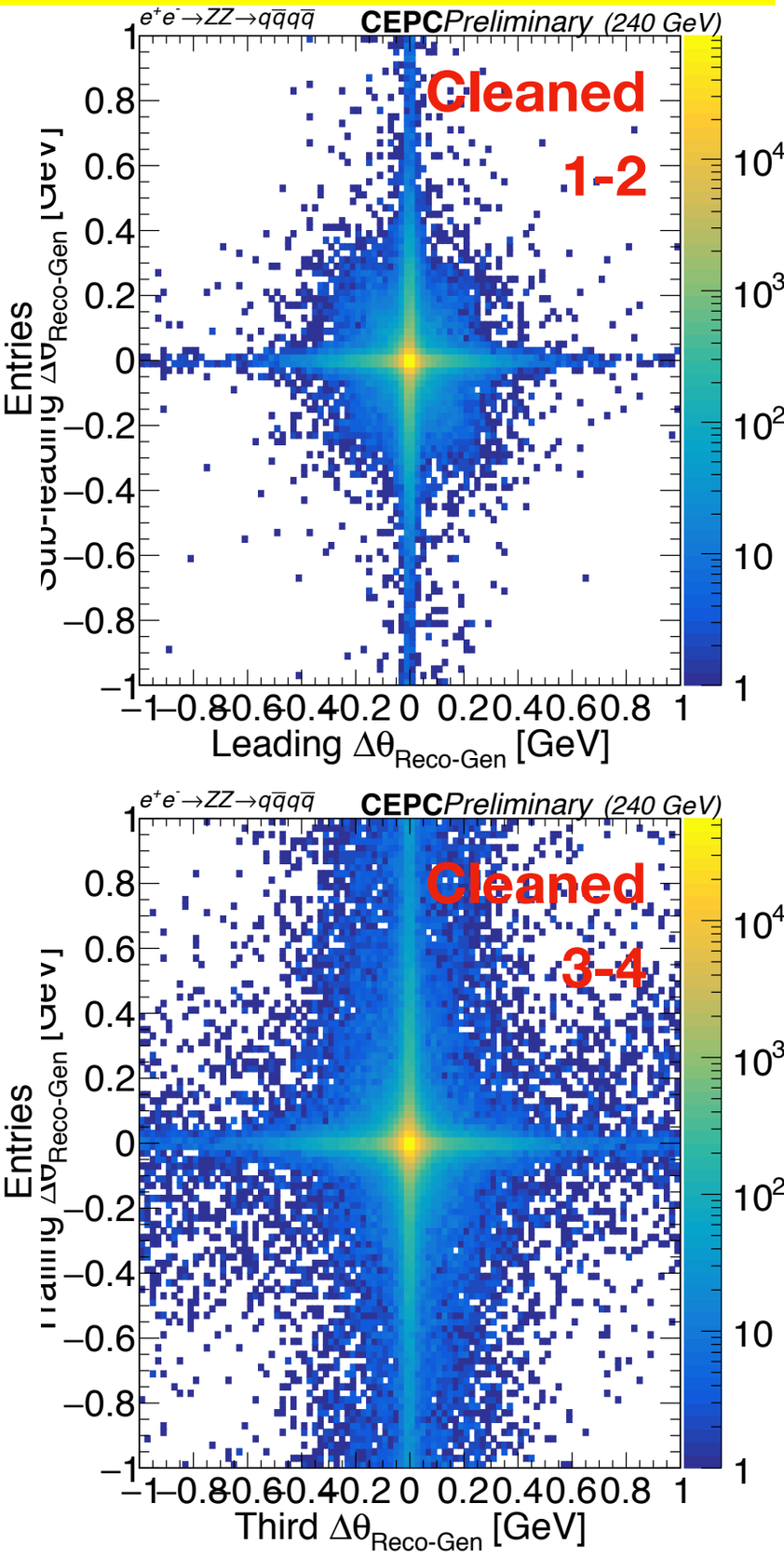
2D $\Delta\theta$ Distribution

Match by Energy and ΔR+ ΔE reverse

1-4	1-3	1-2
2-3	2-4	3-4







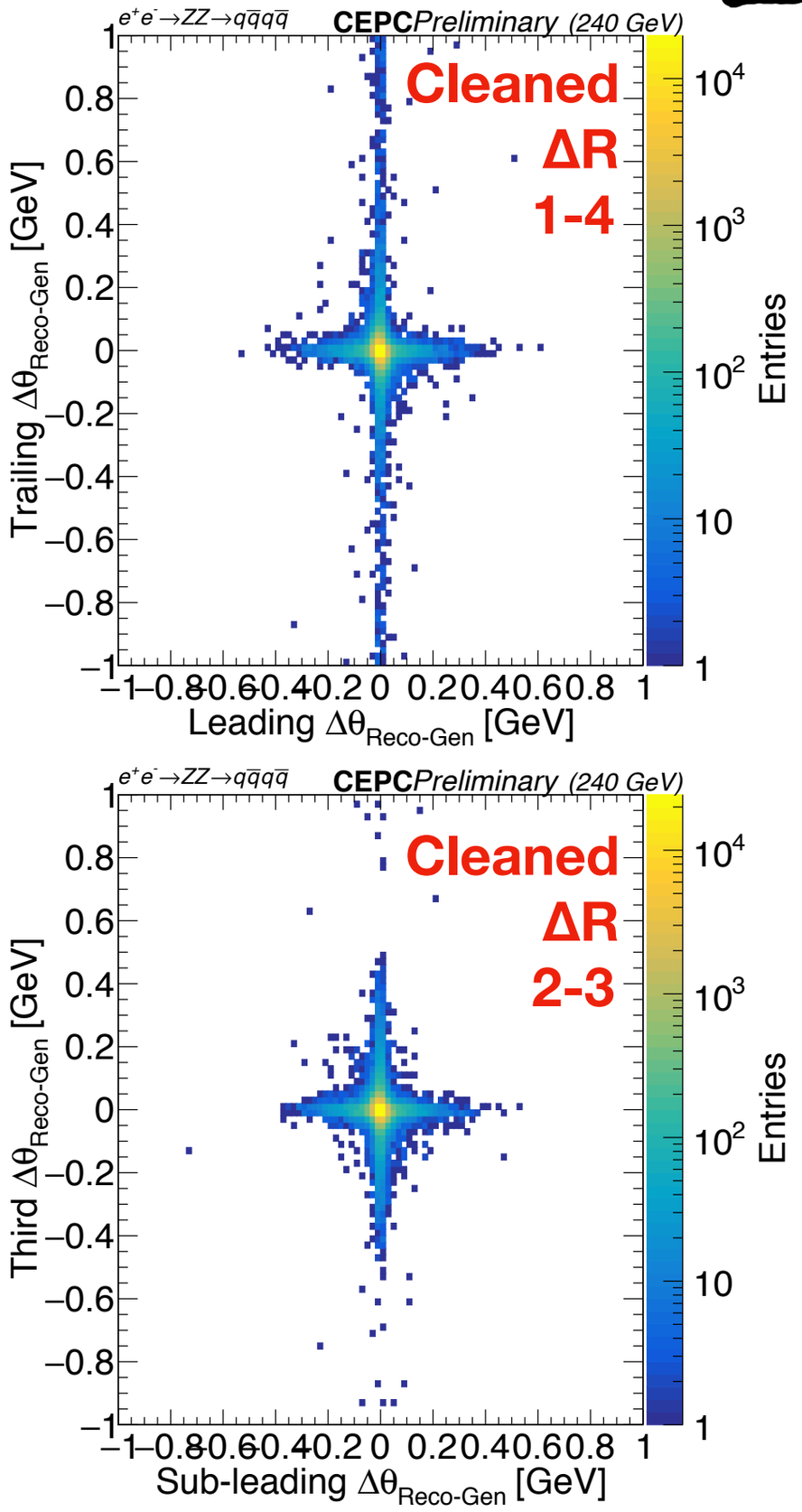
2D $\Delta\theta$ Distribution

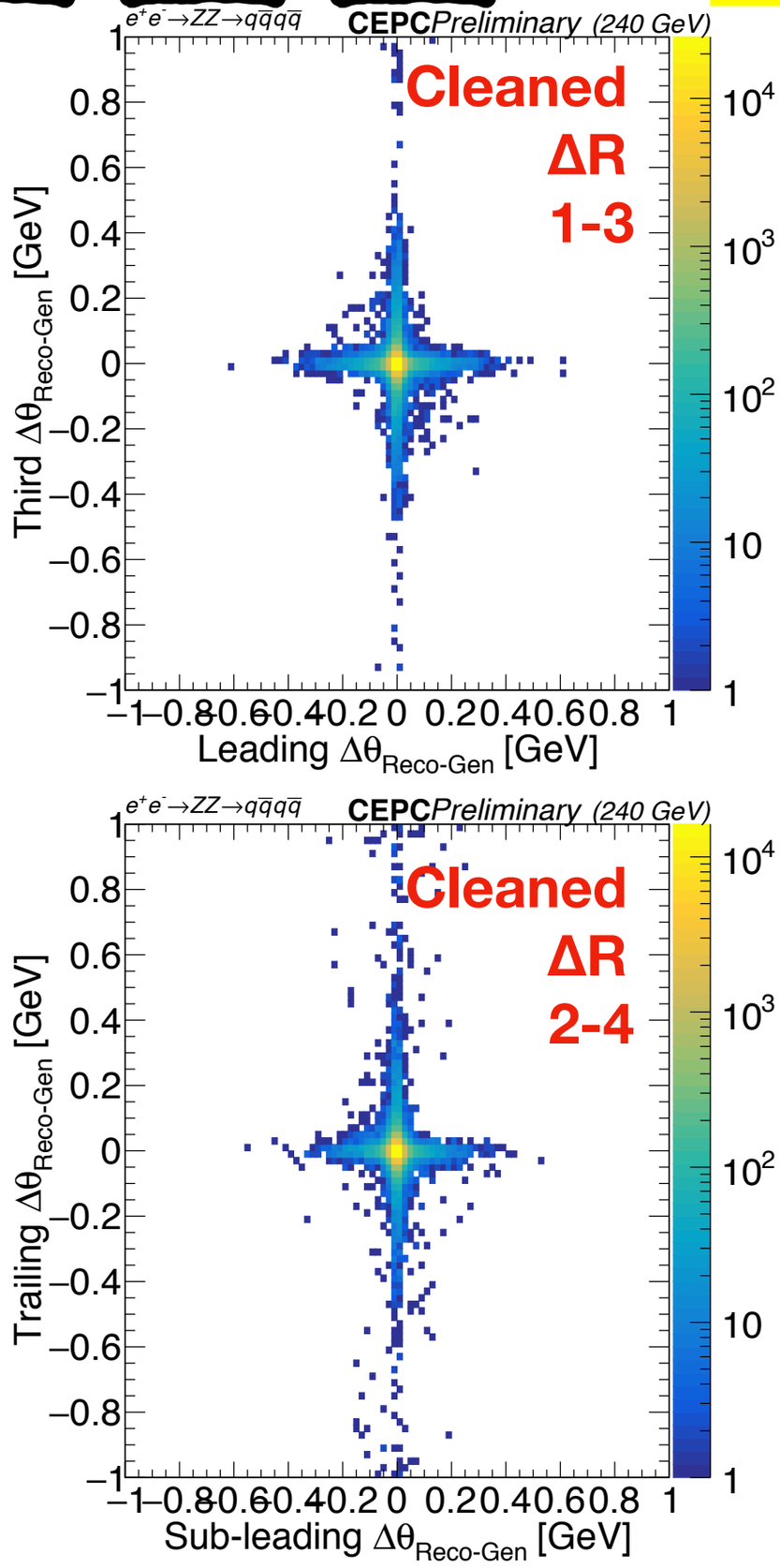
Match by Energy and ΔR+ ΔE reverse

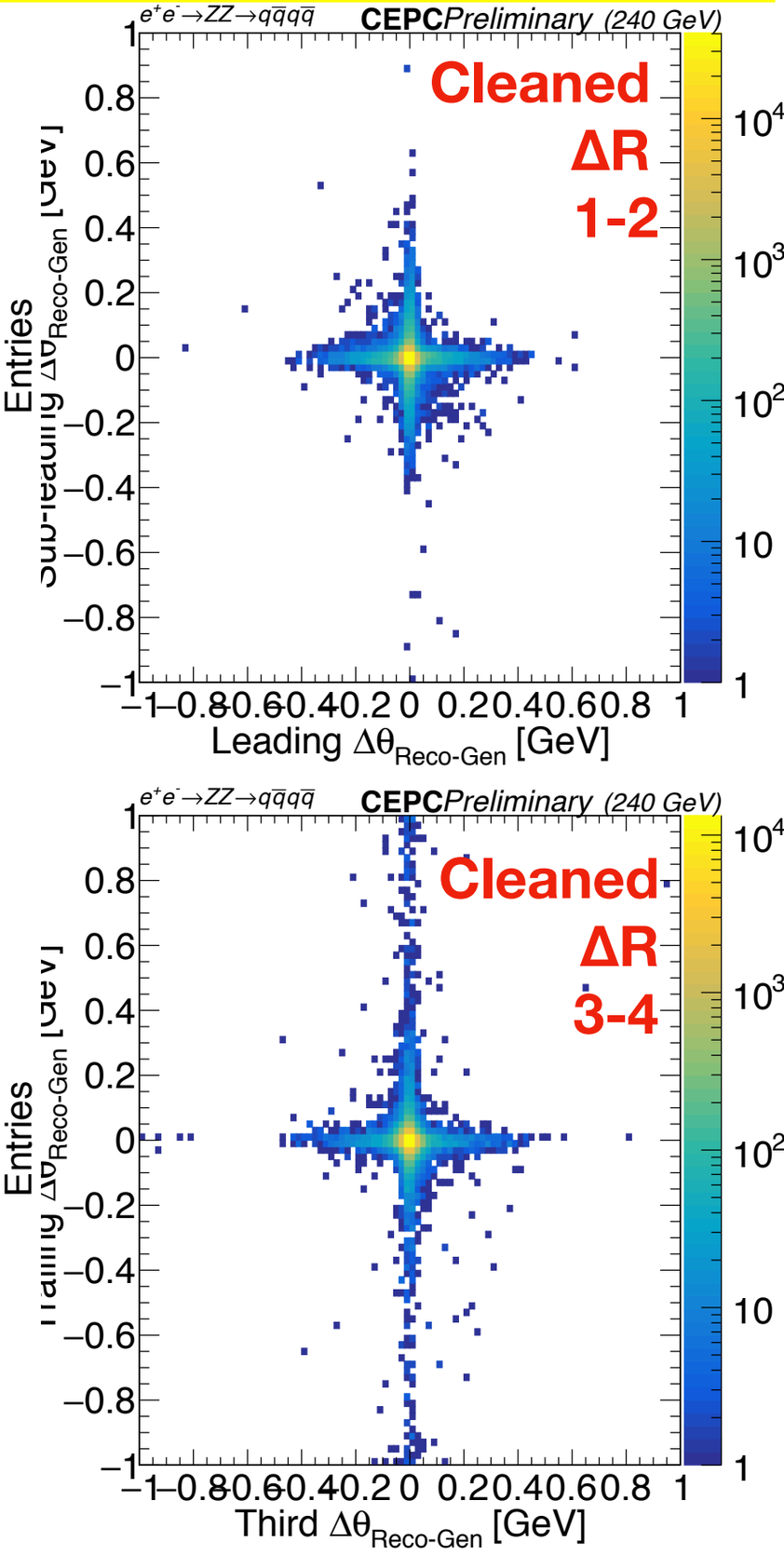
1-4
2-3

1-3
2-4

1-2
3-4



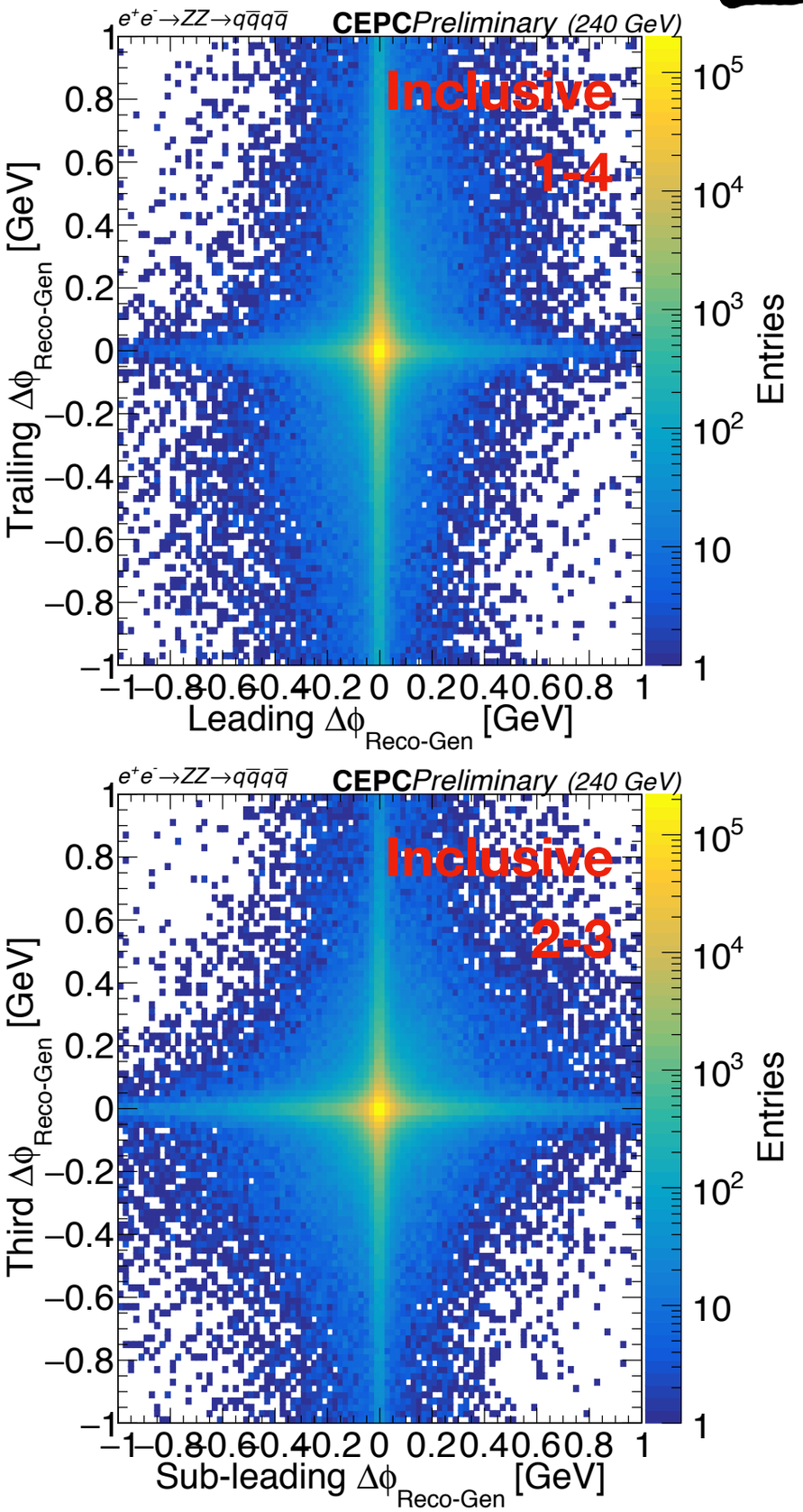


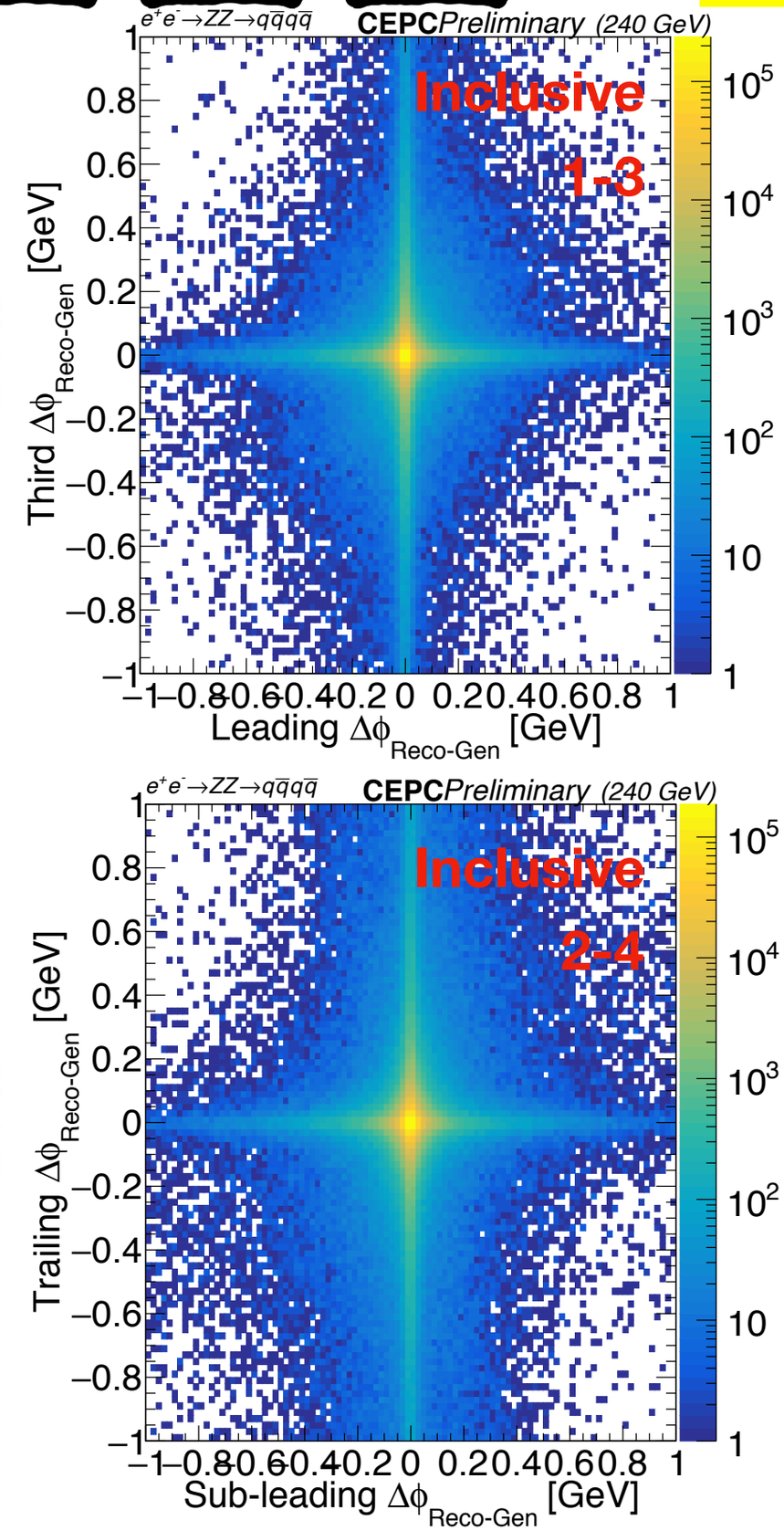


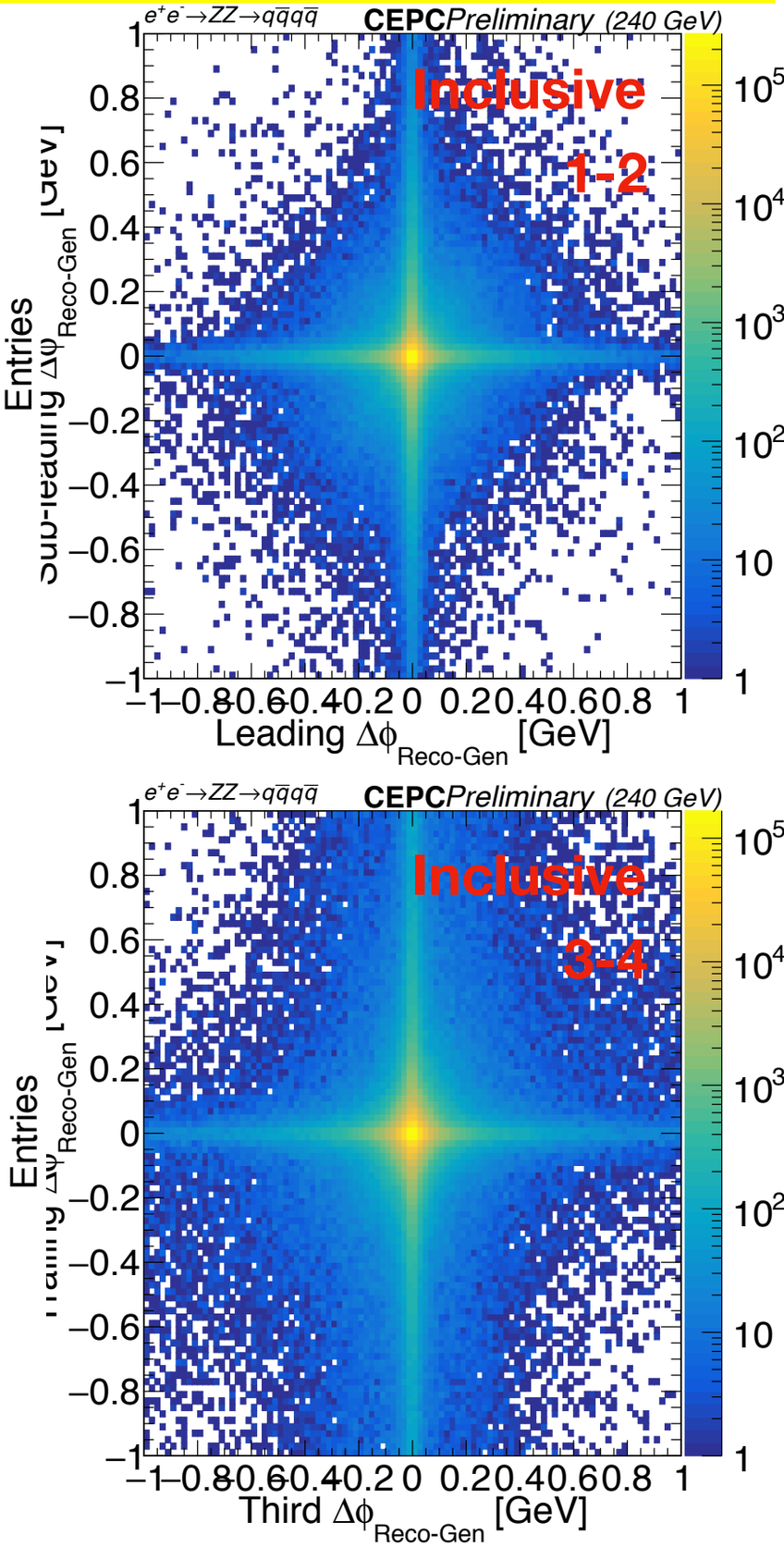
2D $\Delta\phi$ Distribution

Match by Energy and ΔR+ ΔE reverse

1-4	1-3	1-2
2-3	2-4	3-4







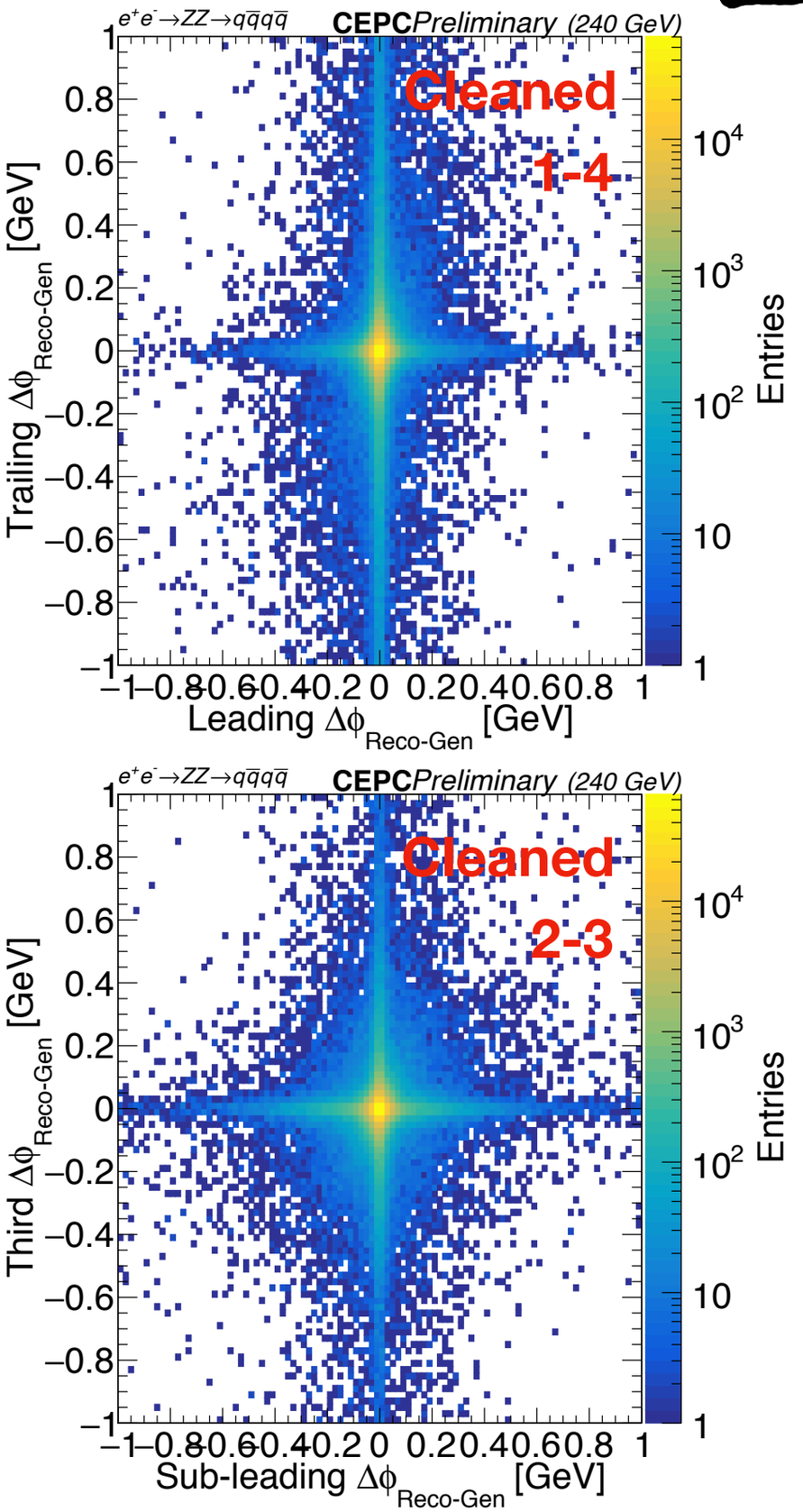
Match by Energy and ΔR+ ΔE reverse

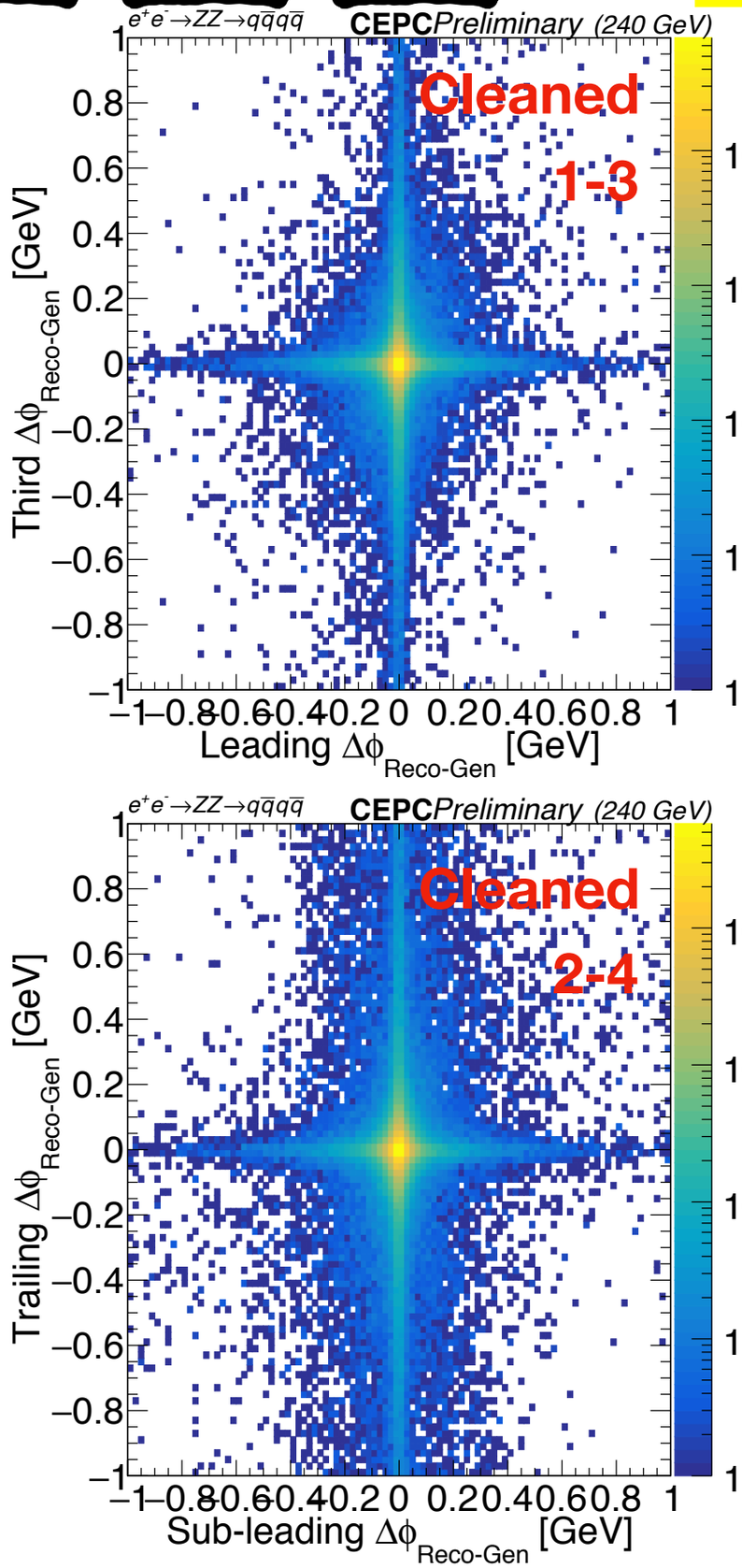
1-4
2-3

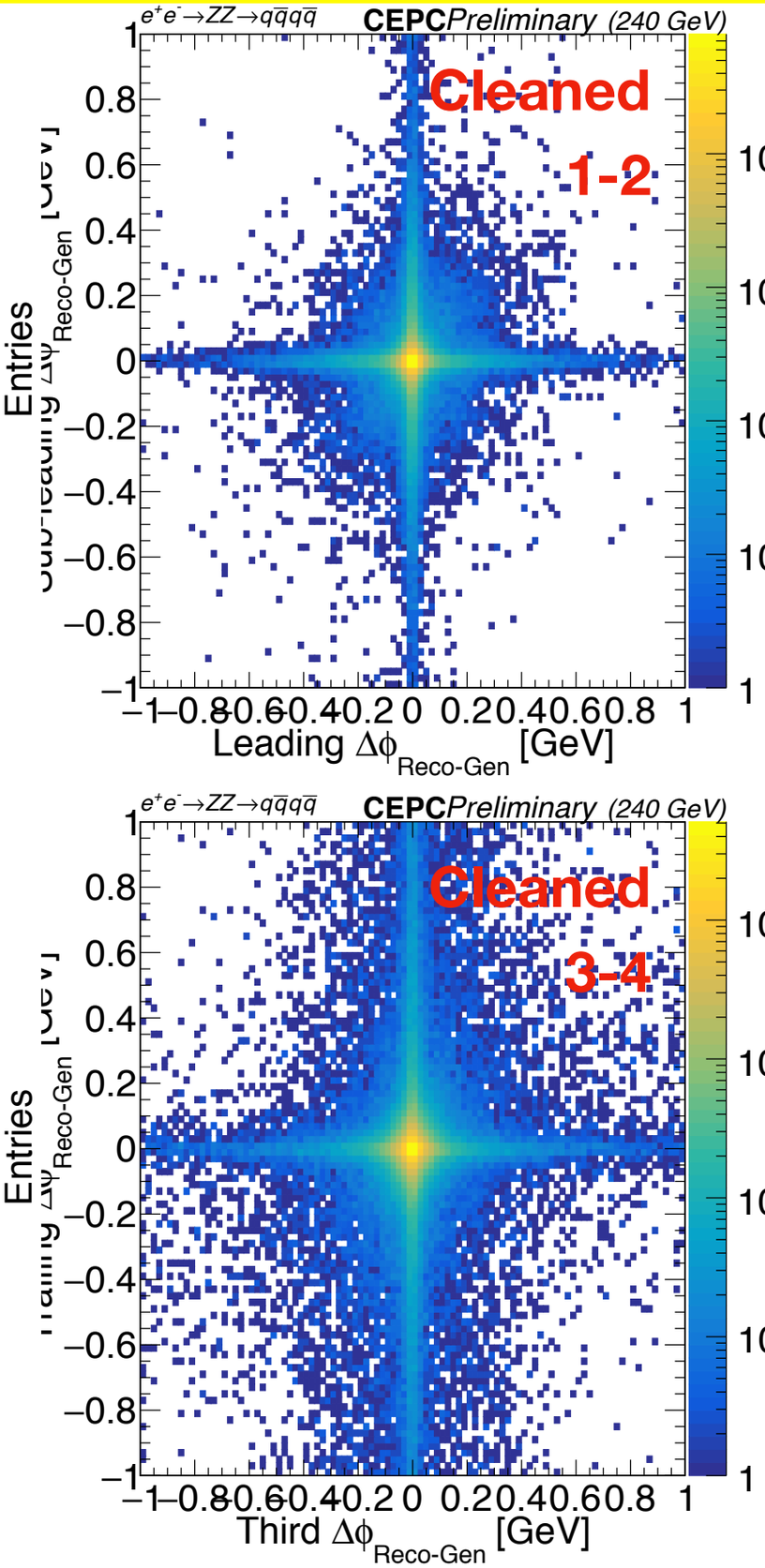
1-3
2-4

1-2
3-4

2D $\Delta\phi$ Distribution







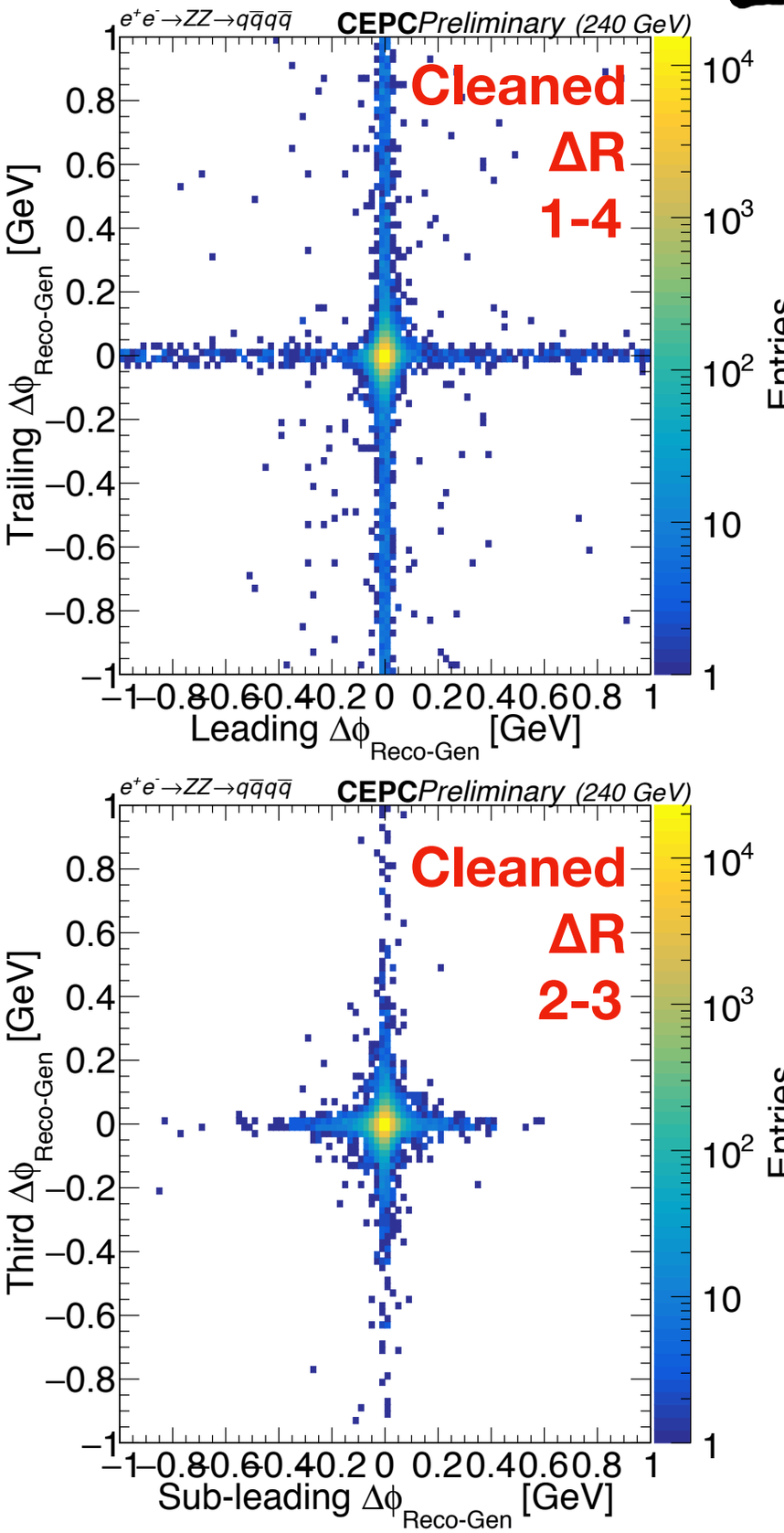
2D $\Delta\phi$ Distribution

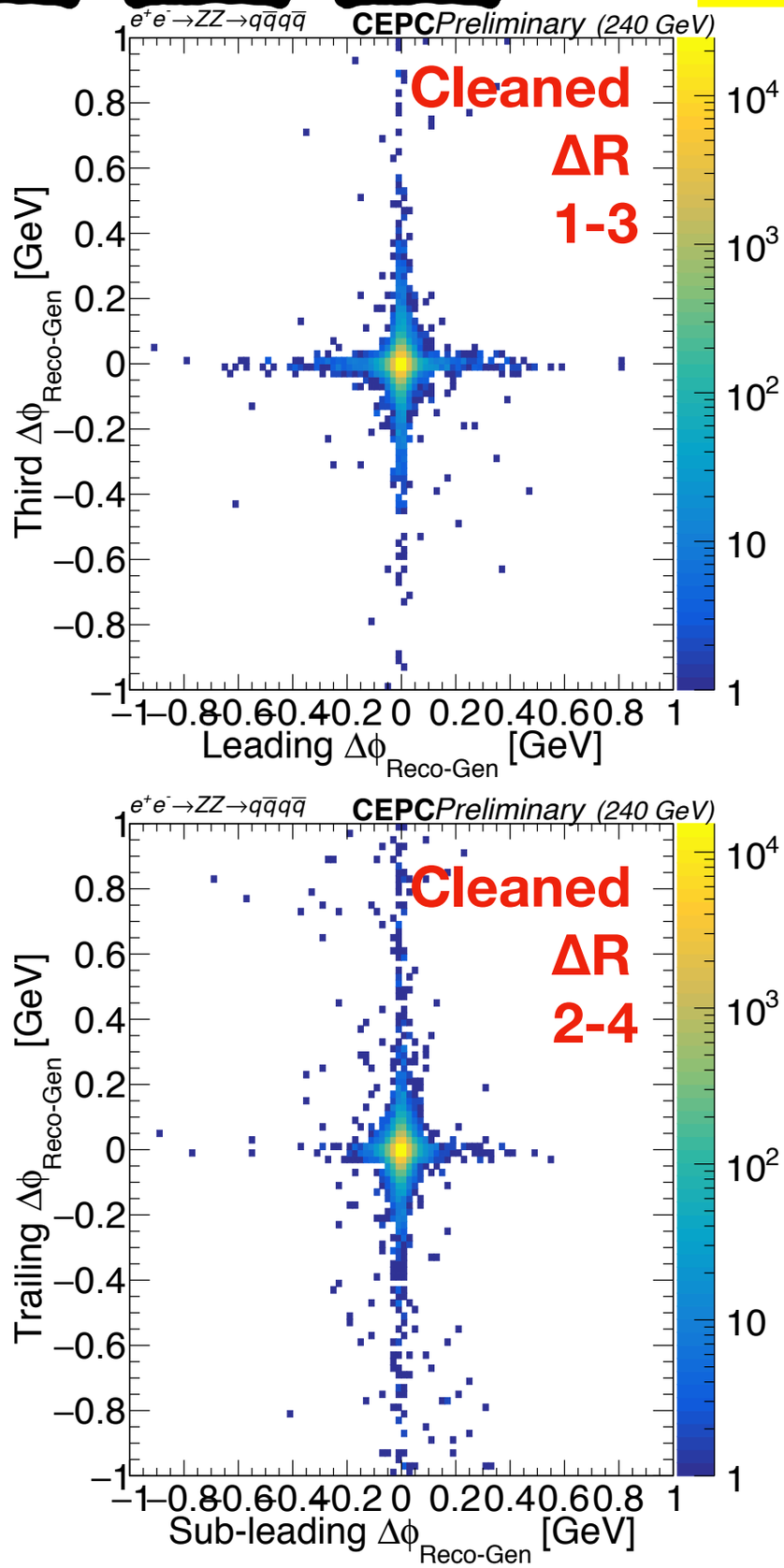
Match by Energy and ΔR+ ΔE reverse

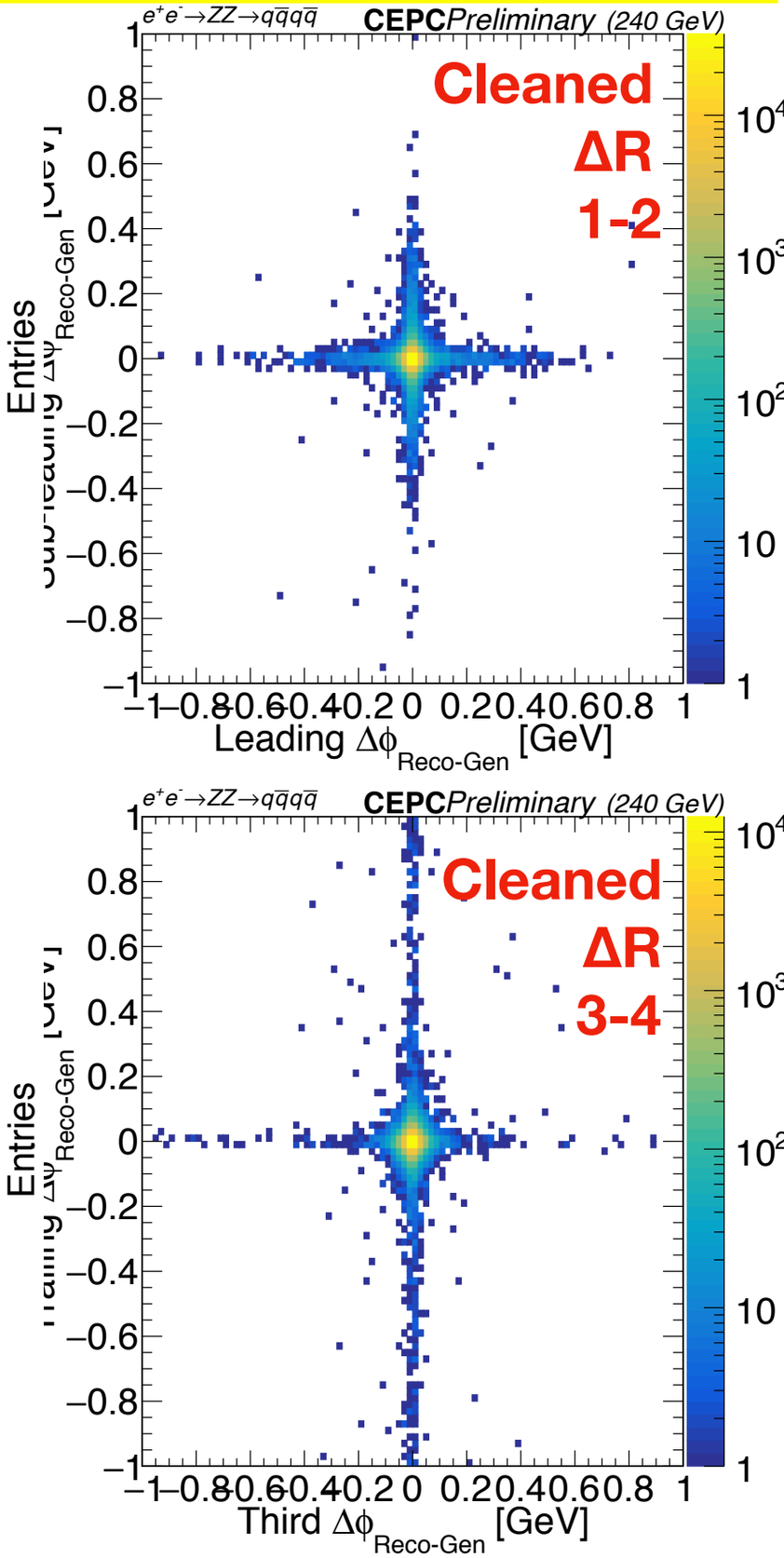
1-4
2-3

1-3
2-4

1-2
3-4







ΔR Distribution (Z-pole)

Gen-Parton

Process \ ΔR<0.05 Ratio (%)	ee-kt	Thrust
Z pole → qq	35.1	35.3
ZZ→ννqq	0.6	0.7
WW→μνqq	0.7	0.8
ZH→ννqq	0.5	0.5
ZZ→qqqq	0.6	0.7
WW→qqqq	0.7	0.7
ZH→qqqq	0.5	0.5
The times it win	0	4

Reco-Gen

Process \ ΔR<0.05 Ratio (%)	ee-kt	Thrust
Z pole → qq	49.5	26.1
ZZ→ννqq	55.9	54.5
WW→μνqq	60.6	55.4
ZH→ννqq	43.7	43.5
ZZ→qqqq	55.4	54.5
WW→qqqq	60.6	55.4
ZH→qqqq	43.7	43.5
The times it win	7	0

Reco-Parton

Process \ ΔR<0.05 Ratio (%)	ee-kt	Thrust
Z pole → qq	28.3	13.8
ZZ→ννqq	31.7	31.4
WW→μνqq	34.3	31.6
ZH→ννqq	22.2	21.7
ZZ→qqqq	31.7	31.4
WW→qqqq	34.3	31.6
ZH→qqqq	22.2	21.7
The times it win	7	0

- Match the different level jet according their energy. Thrust based algorithm does do better than ee-kt