nHcal update

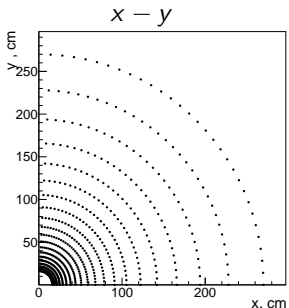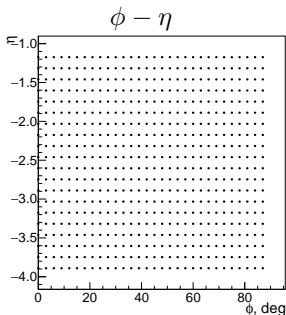**Alexandr Prozorov**, Subhadip Pal, Leszek Kosarzewski

Faculty of Nuclear Sciences and Physical Engineering Czech Technical University in Prague

February 21, 2024

Outline

- position Resolution 0(update from here)
- position Resolution 1 (update from here)

$\phi - \theta$ scan points

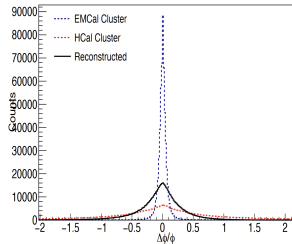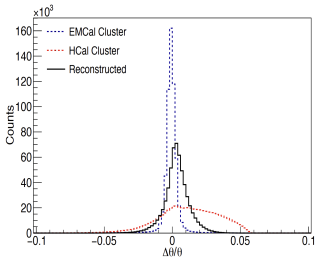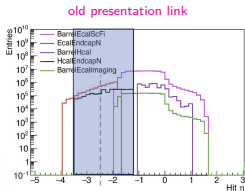600 points for a quarter in azimuthal angle ϕ with equal distance
$\Delta\phi = 3°$ and $\Delta\eta \approx 0.14$
Used tile size 10 cm $\times$ 10 cm

- Neutrons
- $p = 5$ GeV
- full EPIC geometry
- 50k events

The maximum energy cluster
is taken from the category as
a reconstructed cluster

Reminder

old presentation link

Requirement of hits in both Hcal && Ecal → the particle has been scattered in Ecal first.

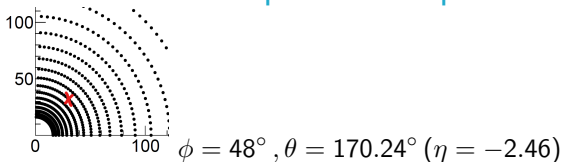$\Theta_{reco} = (w_{EMCal} * \Theta_{EMCal}) + (w_{HCal} * \Theta_{HCal})$

$\phi_{reco} = (w_{EMCal} * \phi_{EMCal}) + (w_{HCal} * \phi_{HCal})$

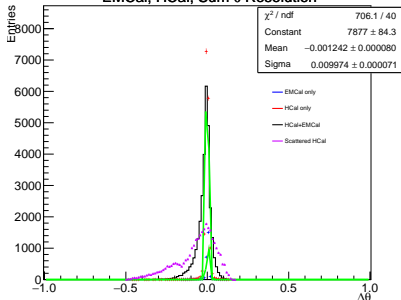$$w_{EMCal} = \frac{1.49 * E_{Emcal}}{E_{reco}} \; ; \; w_{HCal} = \frac{E_{Hcal}}{E_{reco}}$$

$$E_{reco} = 1.49 * E_{EMCal} + E_{HCal}$$
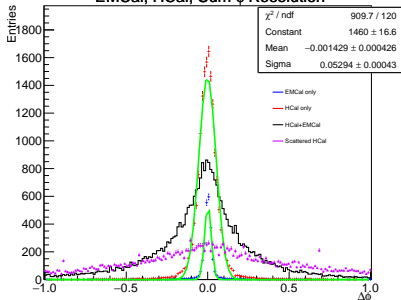
Used reconstructed energy fractions as weights to combine truth cluster positions

Example of One point analysis

$\phi = 48°, \theta = 170.24° (\eta = -2.46)$
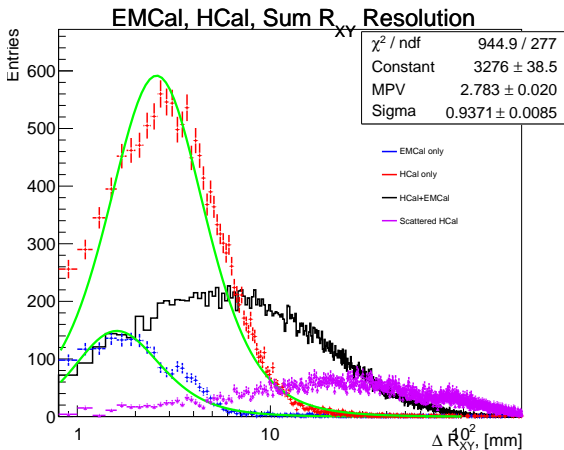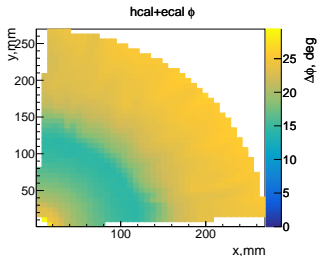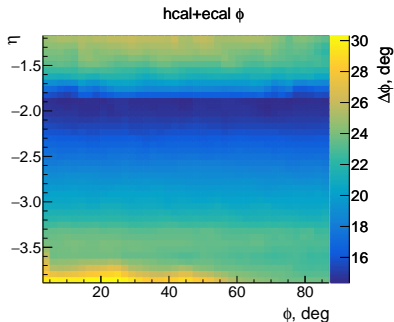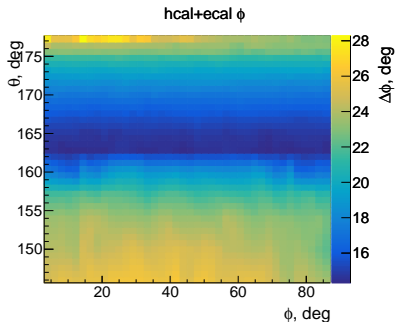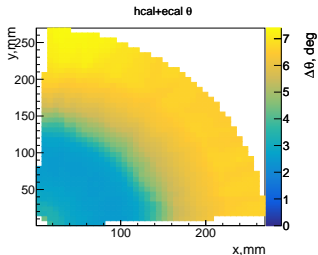

Scattered HCal means the same as HCal + EMCal hit but no weighted sum was used, only raw HCal reco cluster.

Example of One point analysis

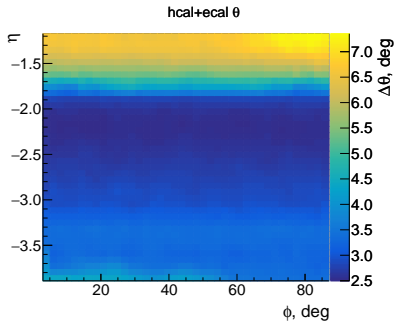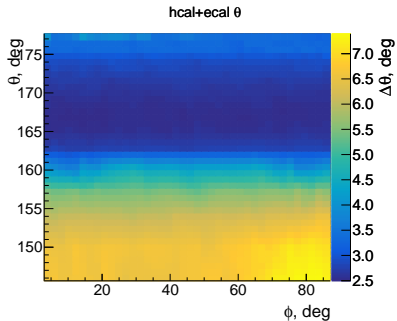Scattered HCal means the same as HCal + EMCal hit but no weighted
sum was used, only raw HCal reco cluster.

Hcal+Ecal ϕ resolution

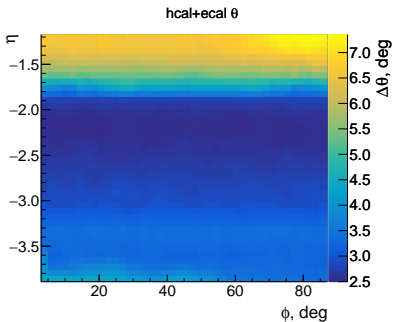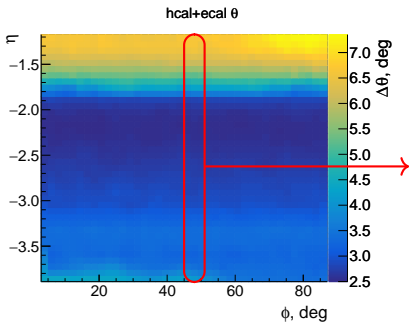# Hcal+Ecal θ resolution

Hcal+Ecal R_{xy} resolution

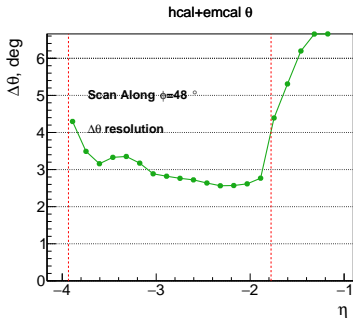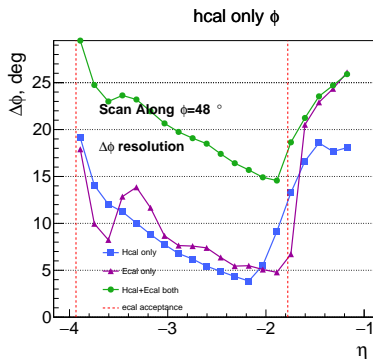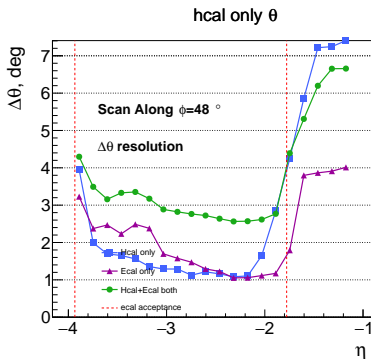# 1D projection along single ϕ angle

hcal+ecal θ
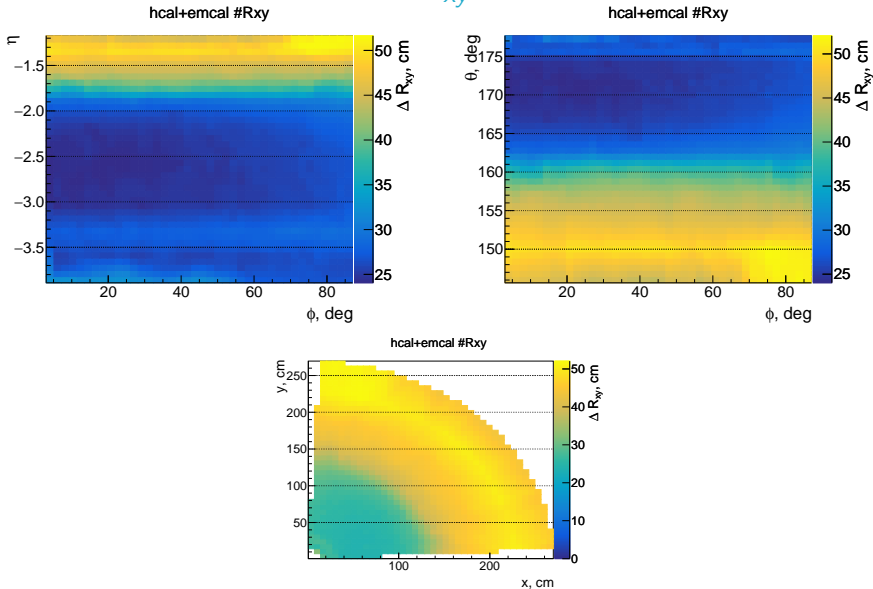
1D projection along single ϕ angle
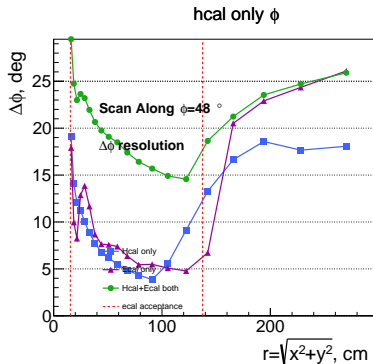
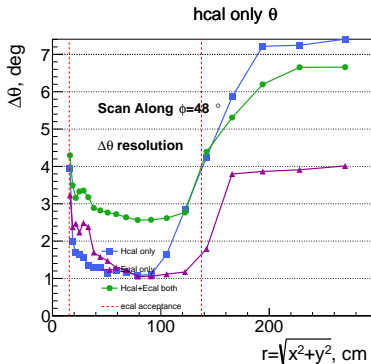# 1D projection along single ϕ angle
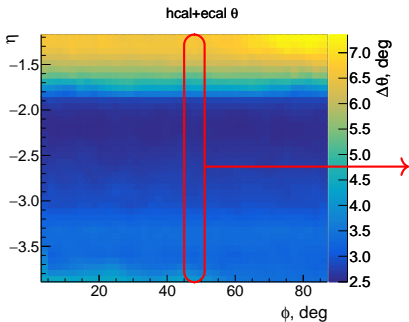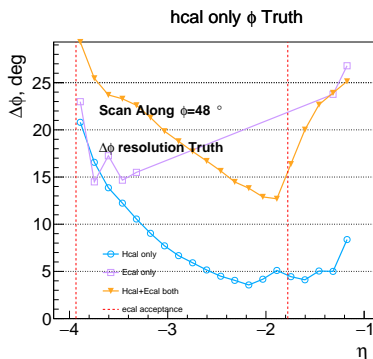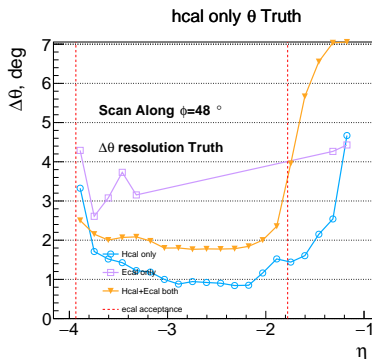
Reco clusters vs η

Decrease in resolution is expected because of constant tile size

Question - why is there a rise in resolution for $\eta > -1.9$?
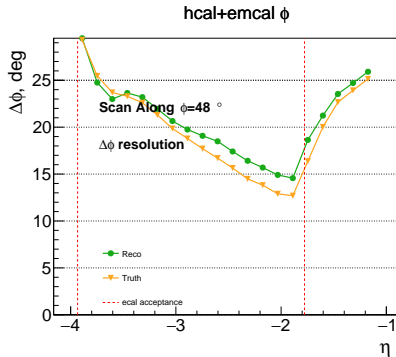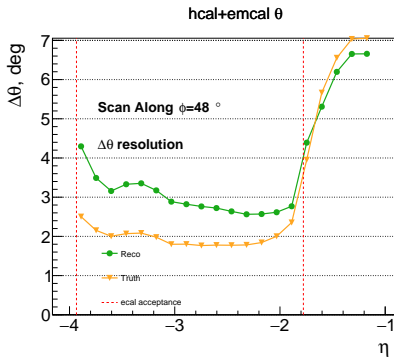
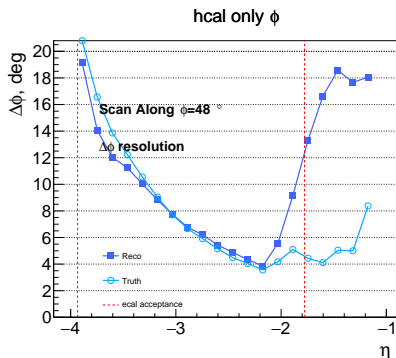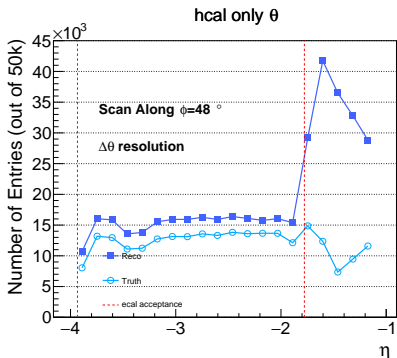# Reco clusters vs r

Truth clusters

Clustering needs optimization because of the large discrepancy between reco and truth clusters
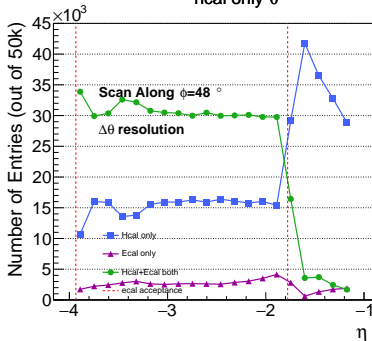
Comparison with Truth clusters - Hcal + Ecal

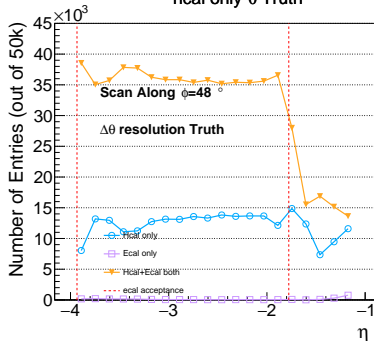# Comparison with Truth clusters - Hcal only

Question - why do they differ so much outside Ecal acceptance?

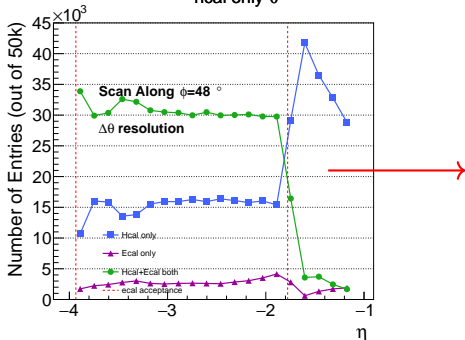# Number of Entries(Interactions) out of 50k events

Question - why are there almost no Ecal Truth clusters?

Ratio of Reco Interactions
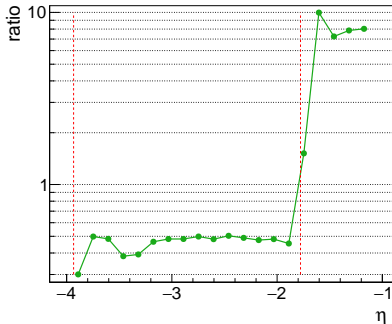
The extended part of barrel EMCal absorbs or scatters some neutrons, because the total number of clusters decreases, even though HCal clusters increase.
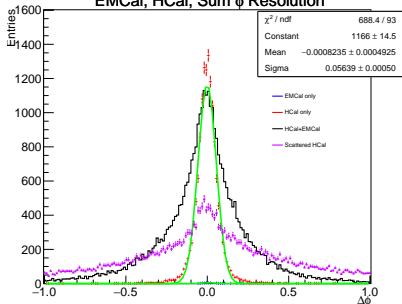
Summary

- new design of Hcal is used for simulations (LFHCAL-like)

- 1D study exploiting ϕ symmetry can be used (has been verified)
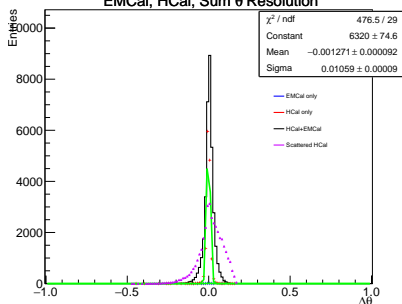
- Something is off with Ecal truth clusters

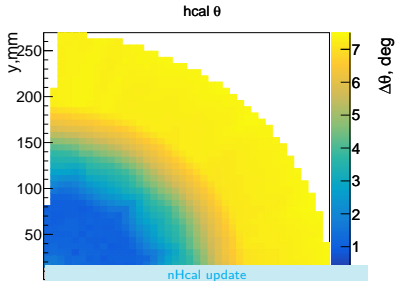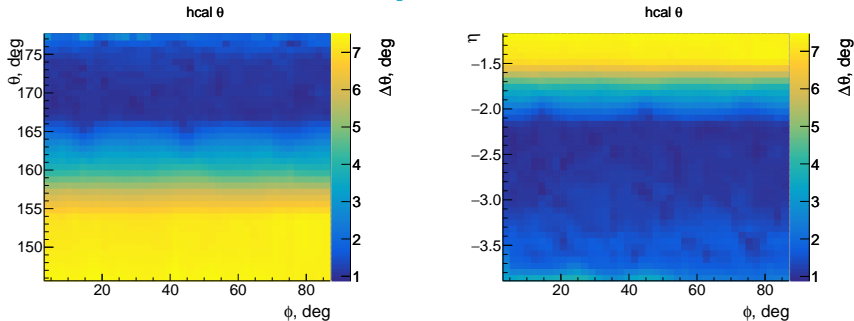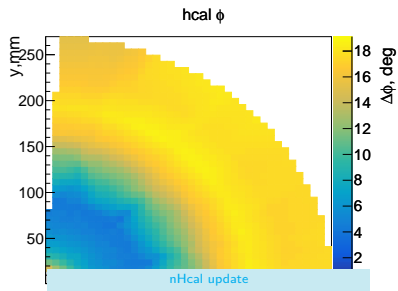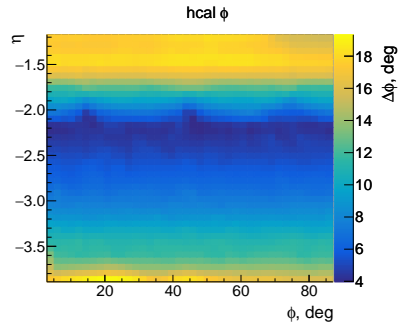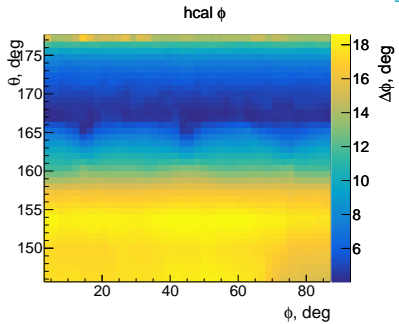# Example of One point analysis

Truth clusters

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Hcal only θ resolution

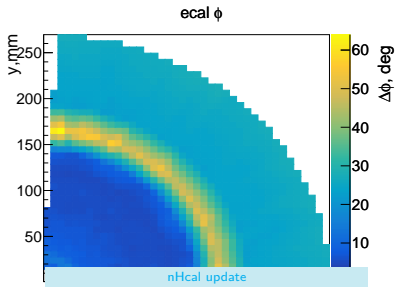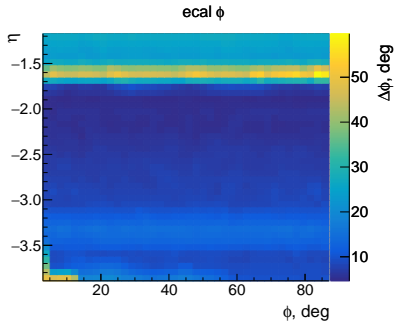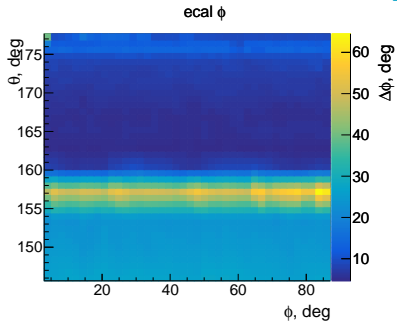# Hcal only ϕ resolution
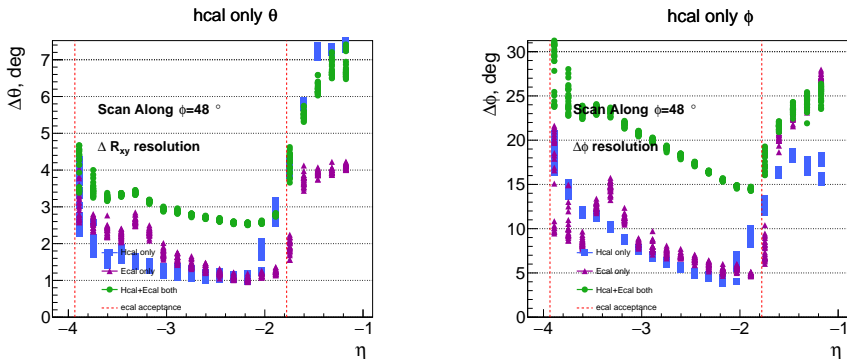
Ecal only θ resolution
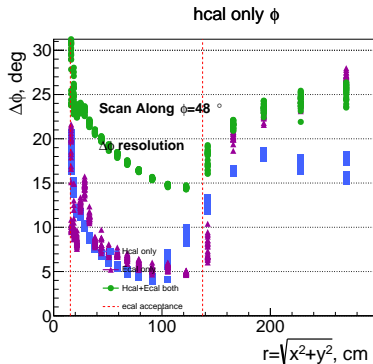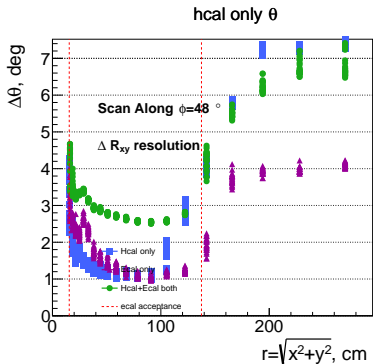
Ecal only ϕ resolution

All pointsReco clusters vs η

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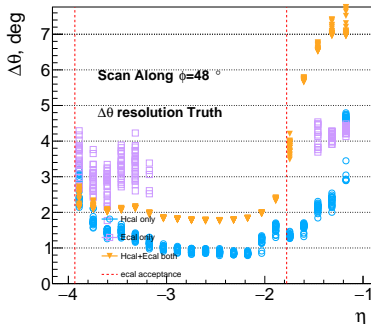
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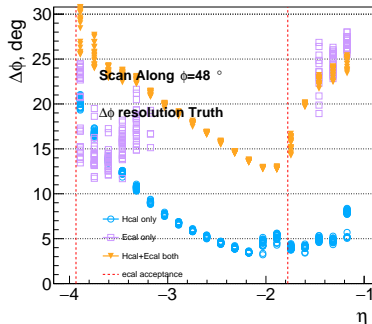
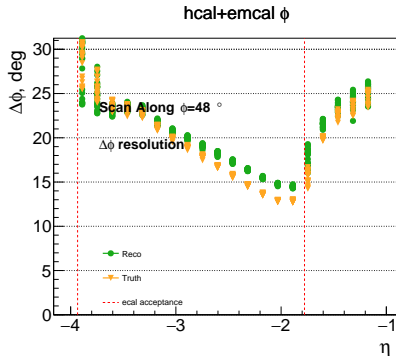# All pointsReco clusters vs *r*

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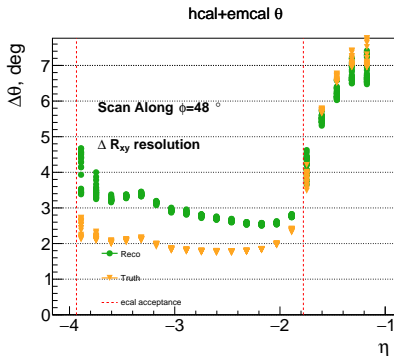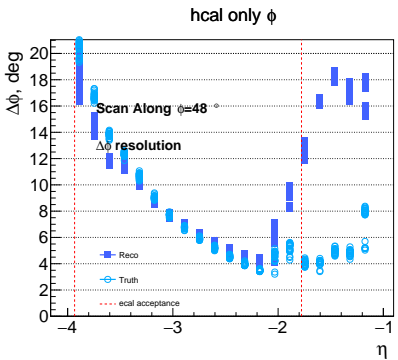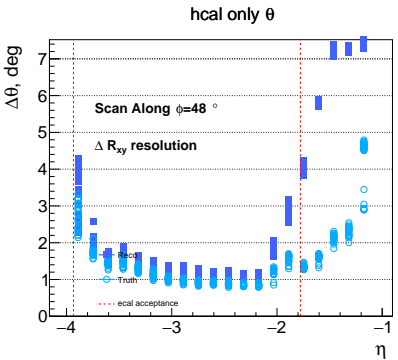

Clustering needs optimization because of the large discrepancy between reco and truth clusters

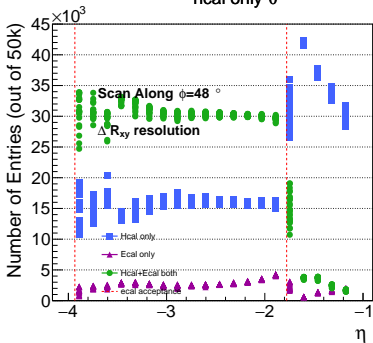# All pointsComparison with Truth clusters - Hcal + Ecal
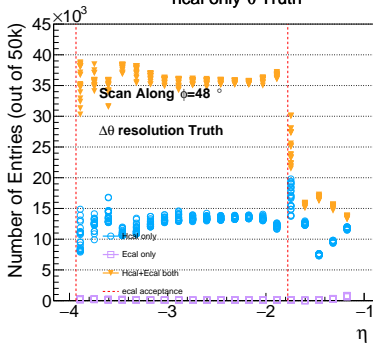
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All pointsNumber of Entries(Interactions) out of 50k events

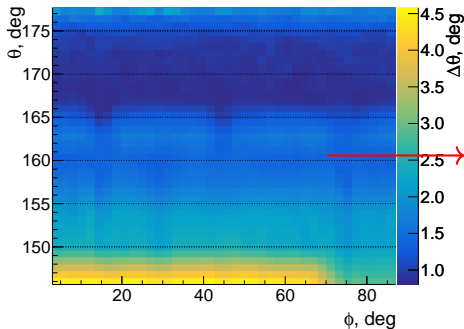Question - why are there almost no Ecal Truth clusters?

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