nHcal update

Alexandr Prozorov, Subhadip Pal, Leszek Kosarzewski

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

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Outline

- Geometry update (update from here)
- position Resolution (update from here)

Geometry

STAR EMC tiles

- STAR EMC scintillator megatiles will be reused
- 24 layers of plastic scintillators
- $-2.0 \leq \eta \leq -1.086$; $\Delta\phi = 6^\circ$ placed at z_{STAR} = -2.7 m
- ePIC nHCal will have 10 layers placed at z_{epic} = -3.8 m

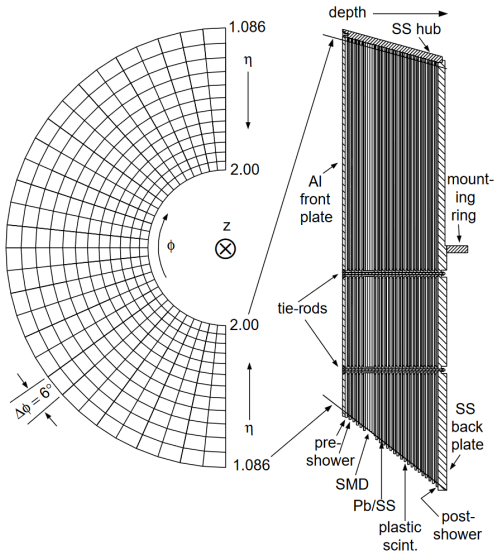
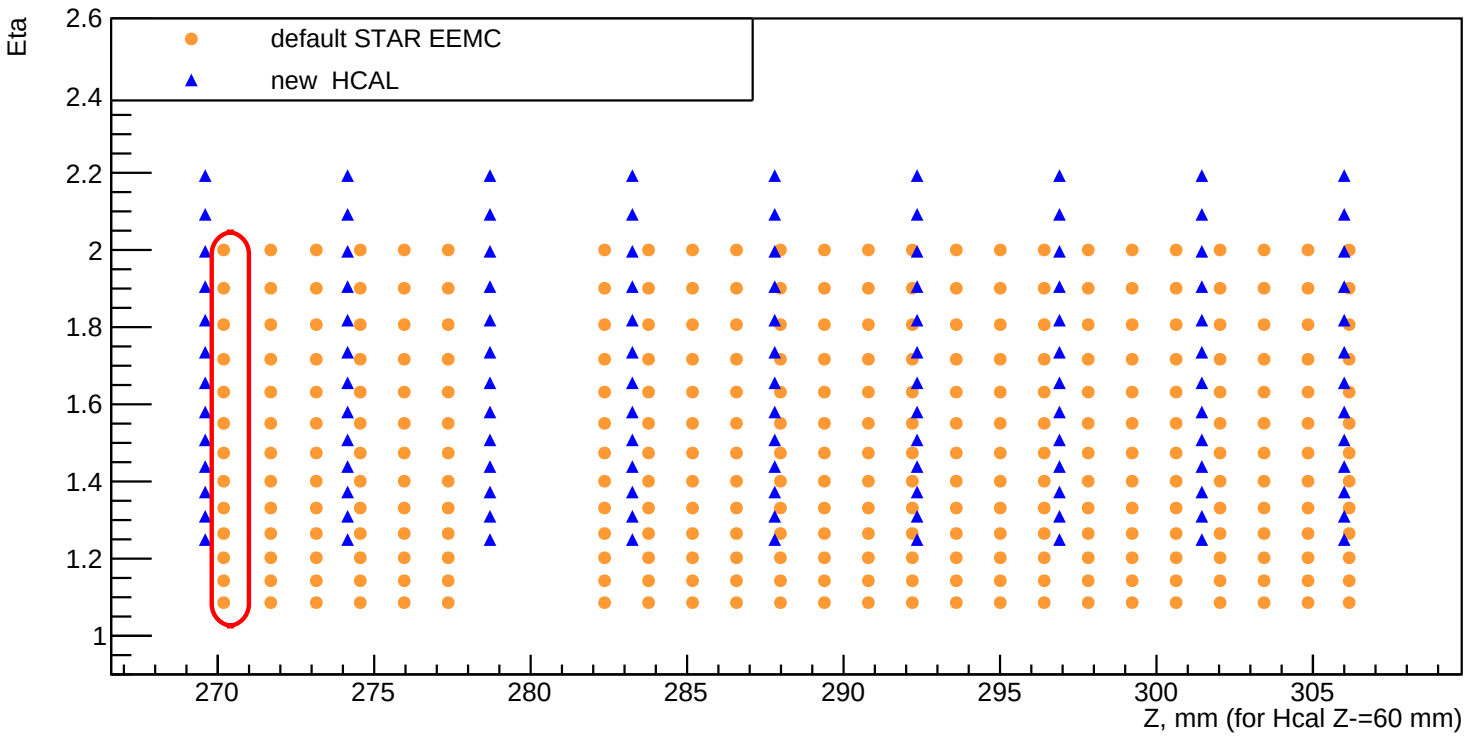


Fig. 1. Schematic EEMC tower structure. The left-hand view shows the subdivision into half of the total 720 towers. The towers are projective, with edges aligned with the center of the beam intersection region, 2.7 m distant along the z-axis from the EEMC front face. Towers span $\Delta\phi = 0.1$ in azimuthal angle, and varying size in pseudorapidity ($\Delta\eta = 0.057$ to 0.099). The two halves of the EEMC will actually be mounted in STAR with their dividing line 15° away from horizontal. The right view, drawn with a different scale, represents a cross-section at constant ϕ, showing the depth (z-) profile of the calorimeter and the structural tie-rods used at 30° intervals in ϕ. Each tower has 23 layers of lead/stainless steel absorber interleaved with 24 layers of plastic scintillator. Also indicated are the preshower, post-shower and shower-maximum detector layers, and the stainless steel mounting ring that will be inserted into a poletip recess to partially support the weight of the lower half EEMC.

Recalculated eta ranges



Physical tile sizes of the first STAR EEMC = first layer in nHCAL

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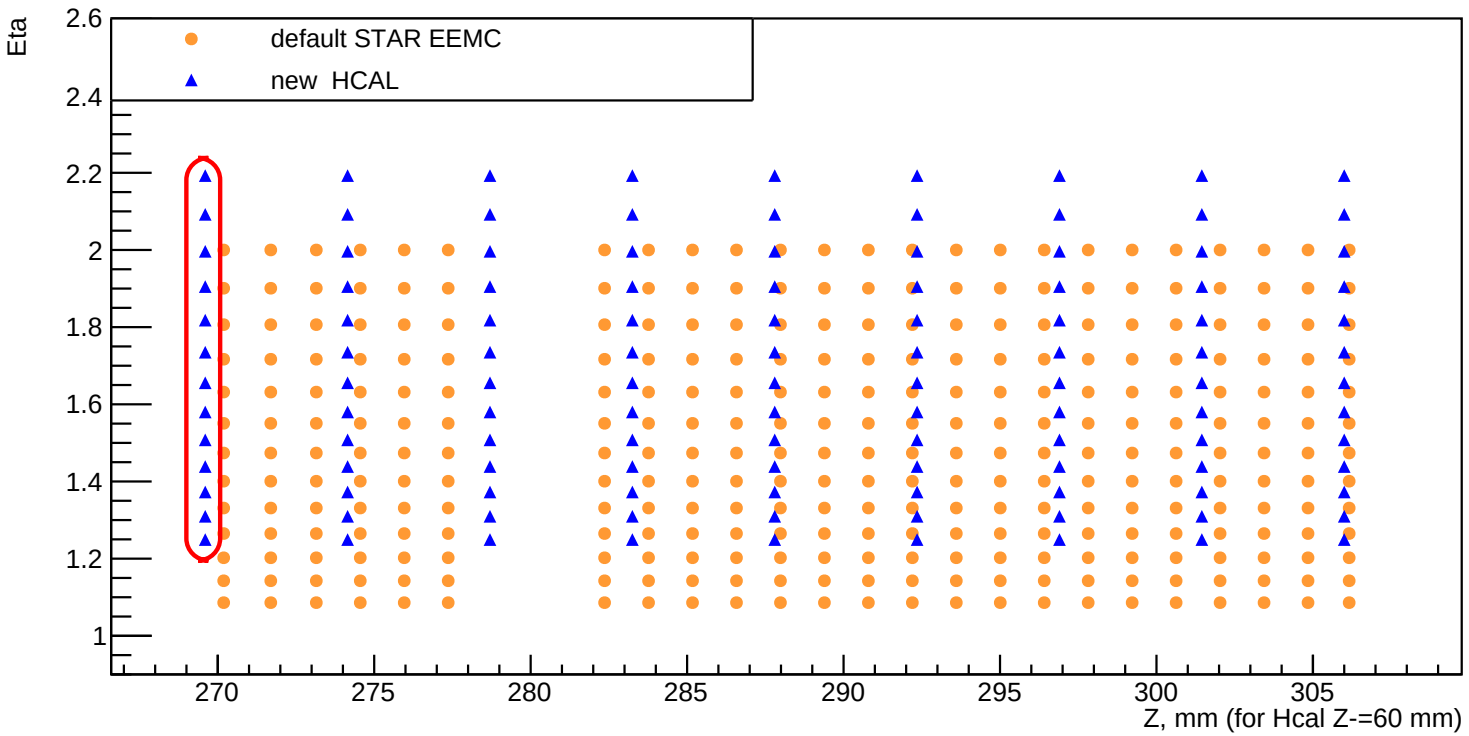

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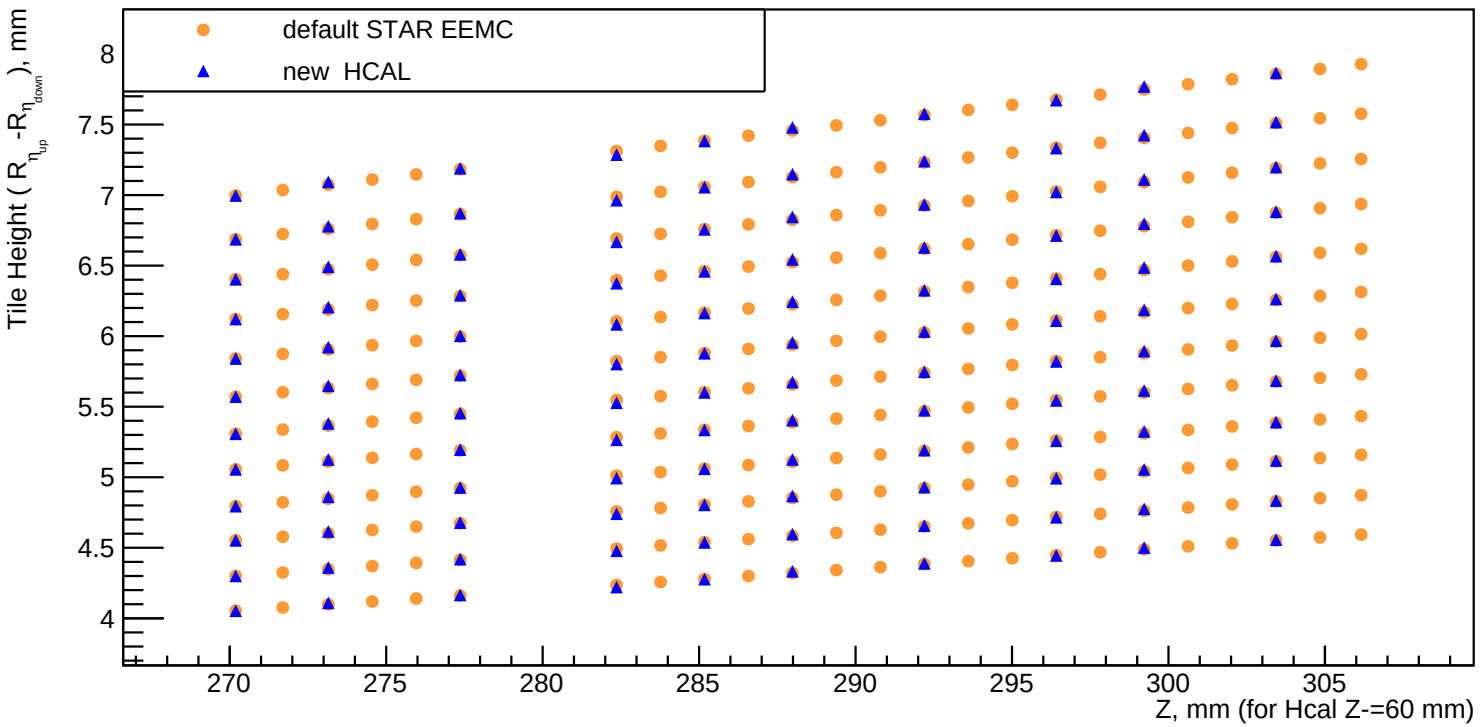
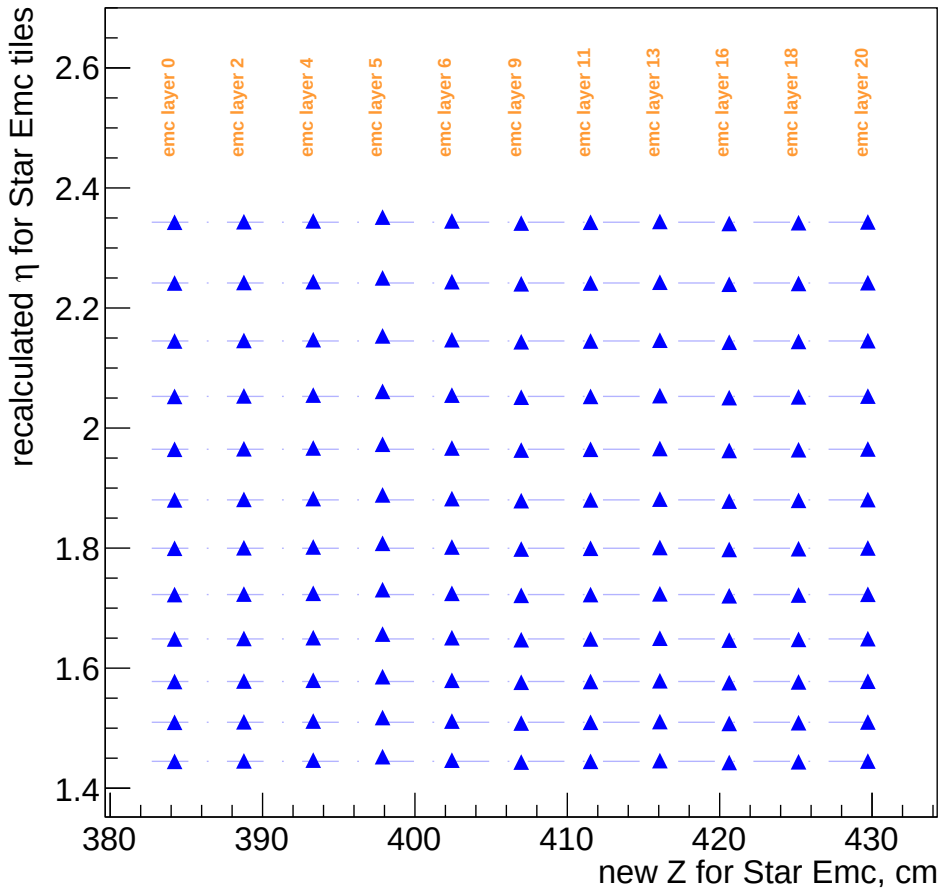


HCAL layer 0 = EMC layer 0

Self-consistency check

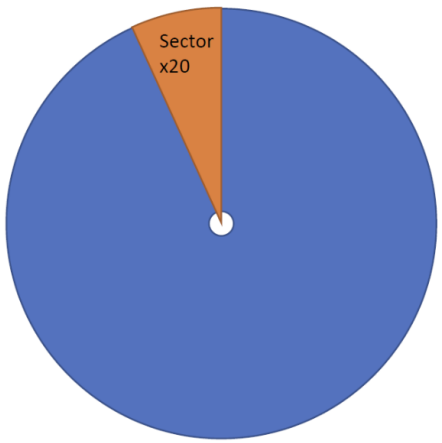


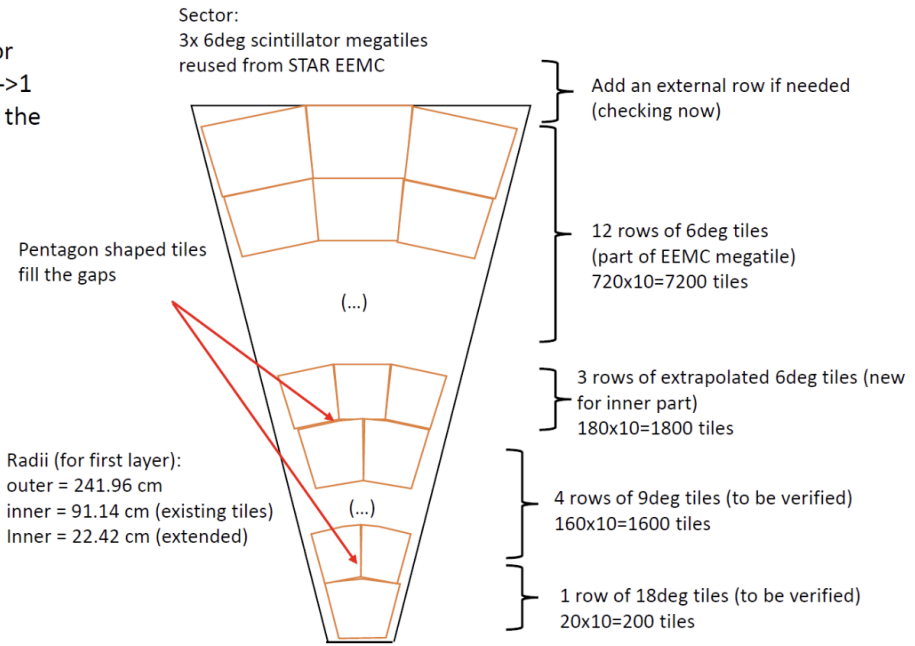
What will be the η range of STAR EMC tiles when they are shifted into HCAL positions?

Leszek's original design idea (deprecated)

Options for sector/tile arrangement - version 3

Layout version 3 – full length sector
1. 3 EEMC megatiles per outer sector
2. Inner part with tiles merged 3->2->1
3. Pentagon-shaped tiles used to fill the gaps

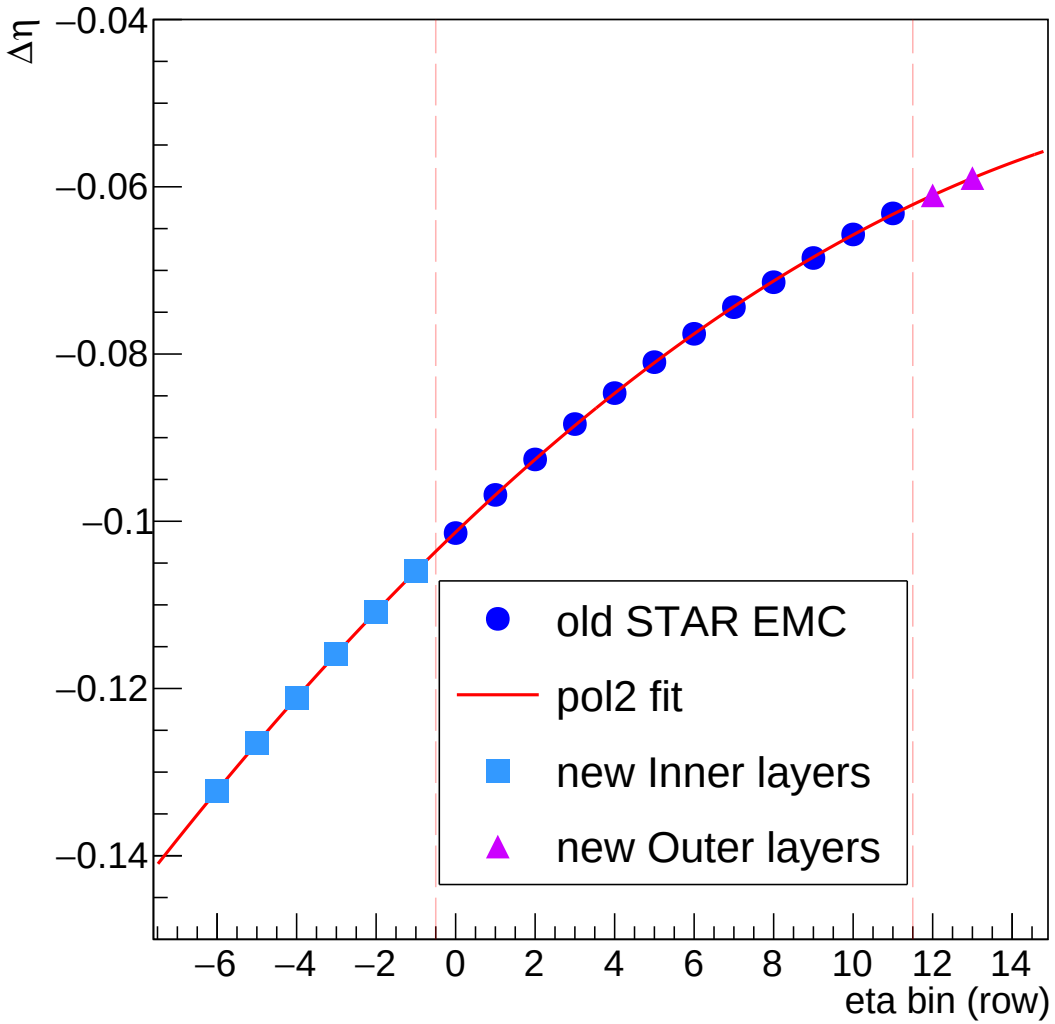




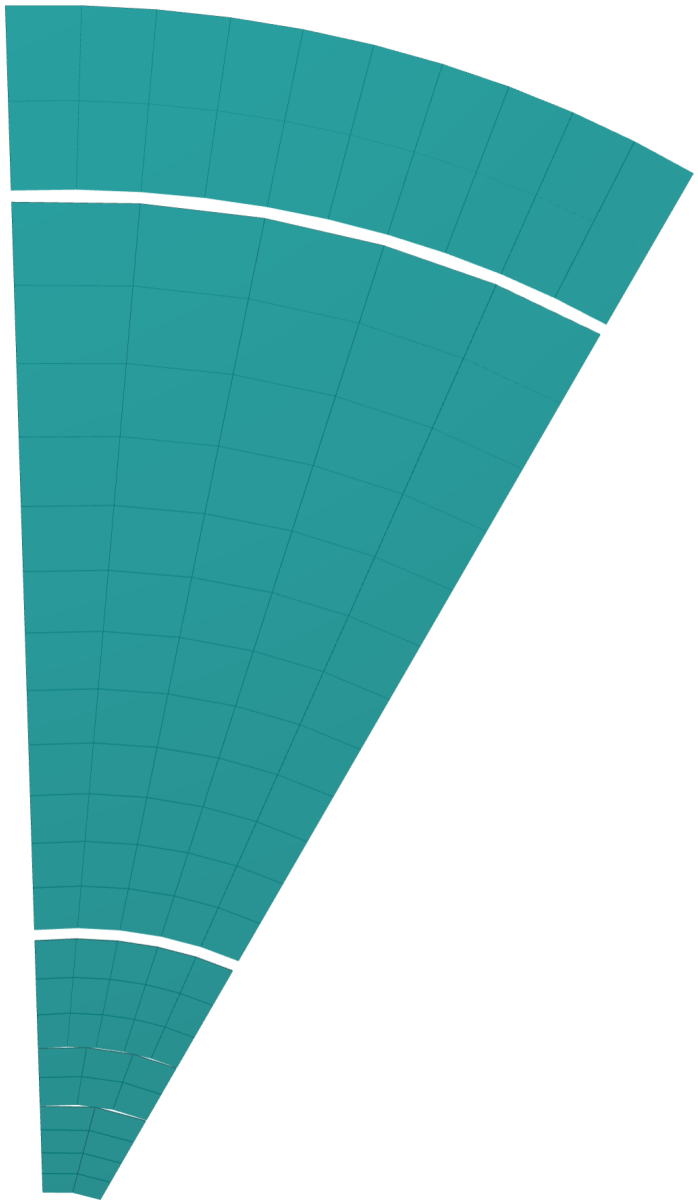
Total tiles:
7200 existing ones + 3600 inner tiles = 10800 tiles
10 types x 10 layers = 100 different shapes of new tiles to be manufactured

3

Extension in eta range



Current design



30° sector (out of 12) with 109 tiles

- STAR EMC tiles
- 3 rows same STAR EMC design (N_{tiles}=5/row)
- 2 rows with 10° tiles(N_{tiles}=3/row)
- 4 rows with 15° tiles (N_{tiles}=2/row)
- 2 rows with 3° tiles(N_{tiles}=10/row)

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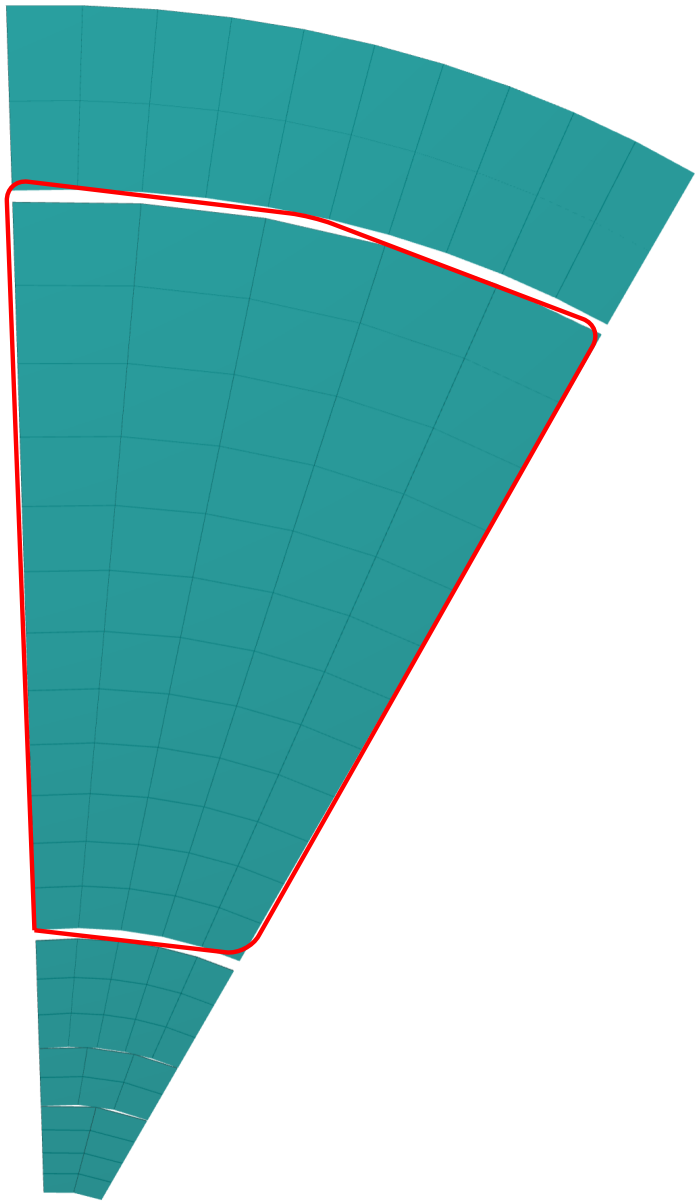

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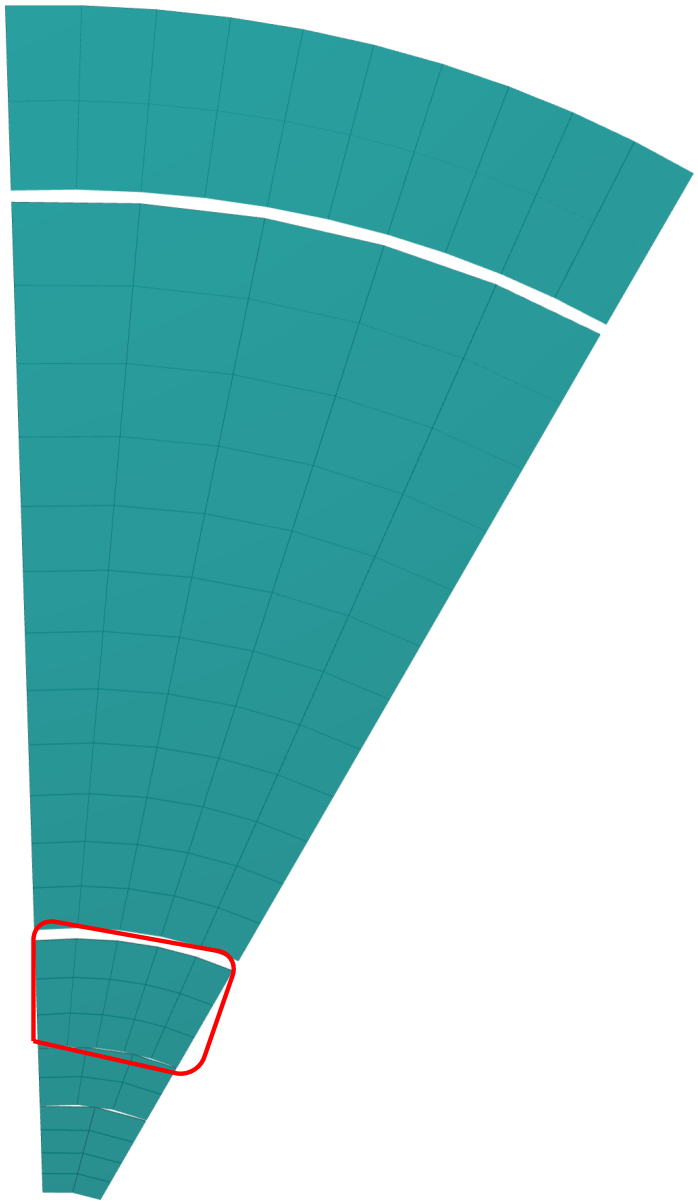

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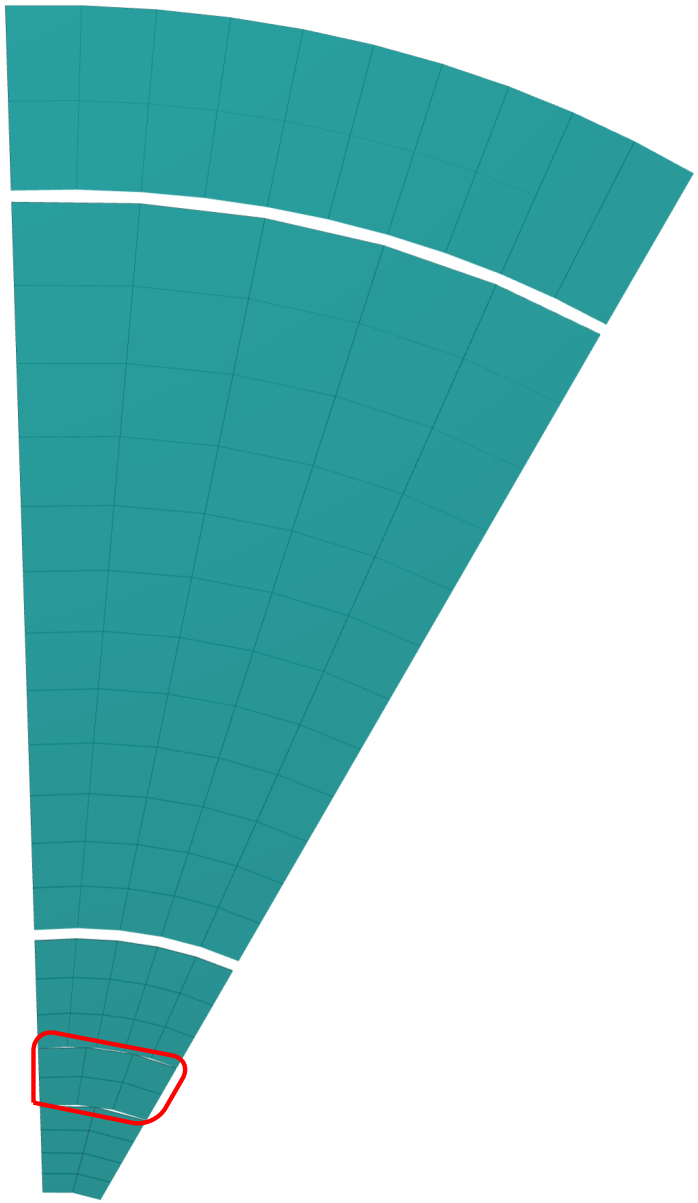

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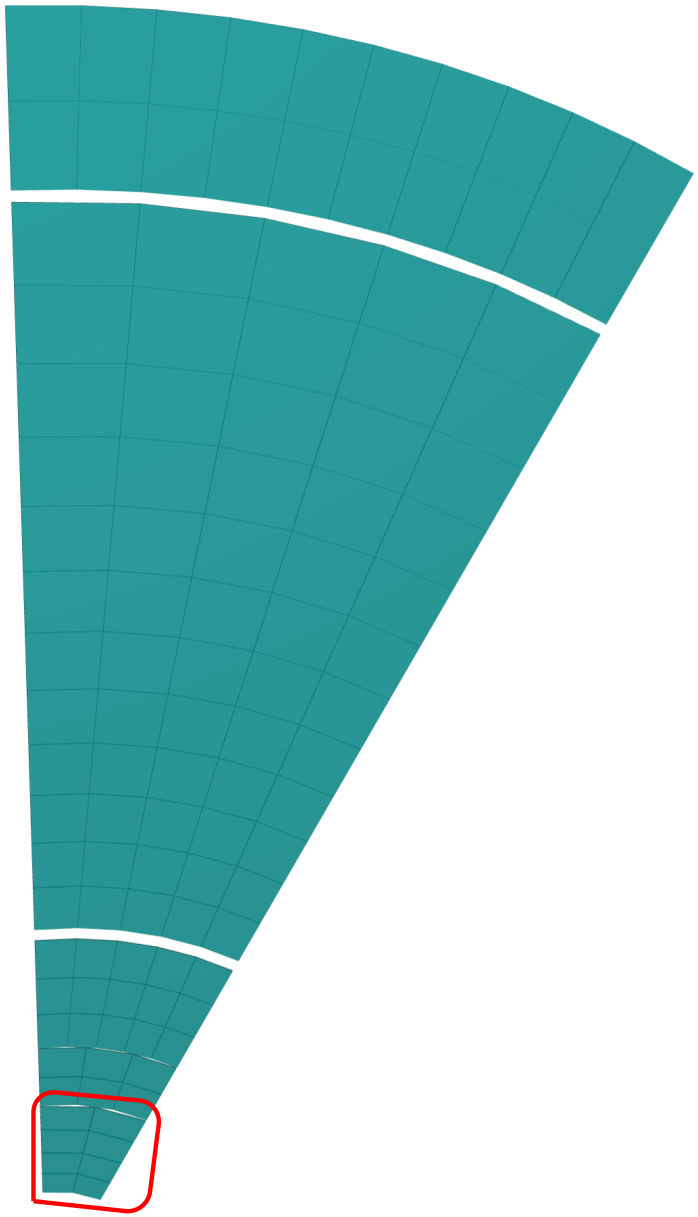

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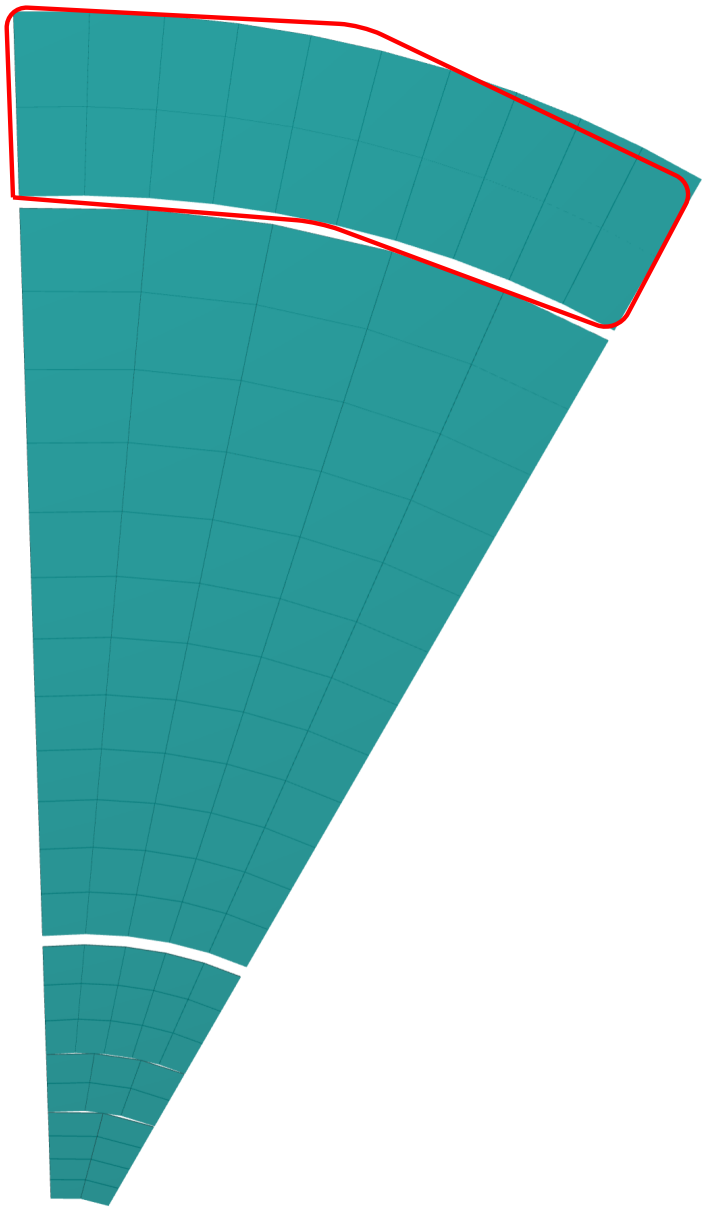

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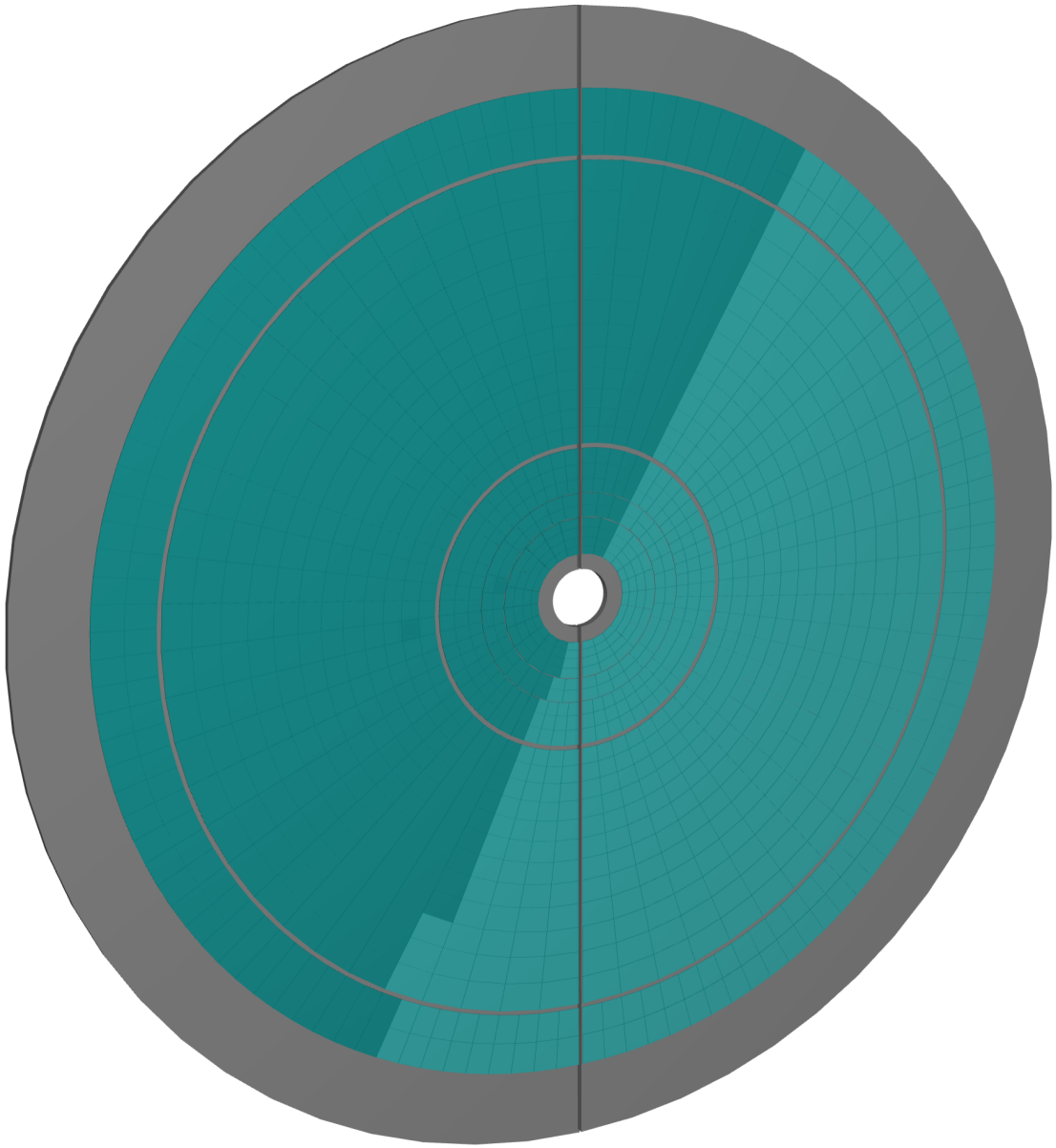
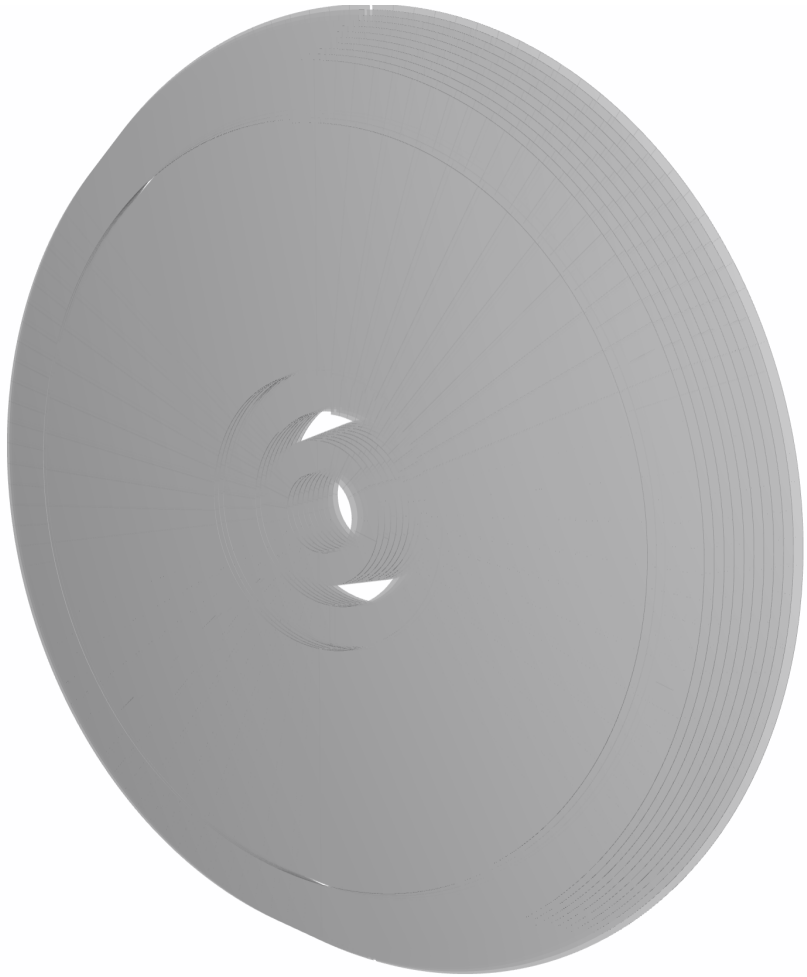


Projective structure

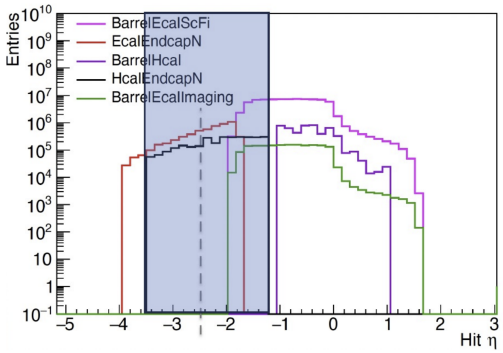


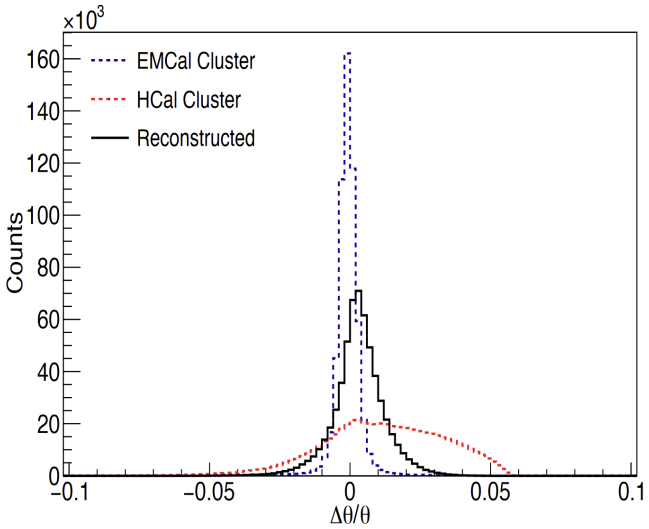
In total 14388 tiles for all 11 layers of nHcal.

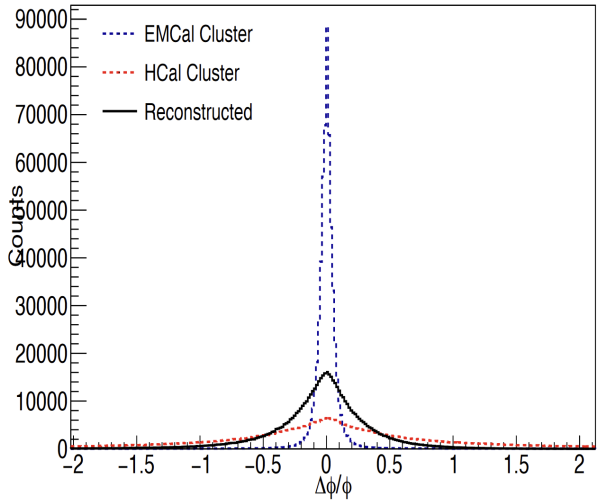
Position Resolution

Reminder

old presentation link







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

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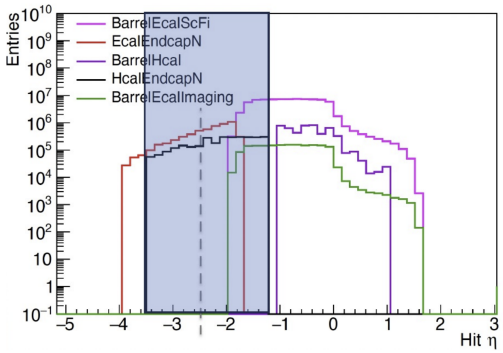
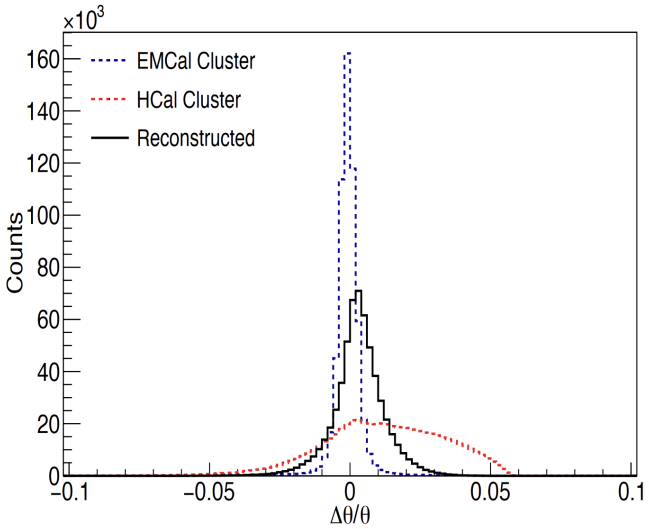
Used reconstructed energy fractions as weights to combine truth cluster positions

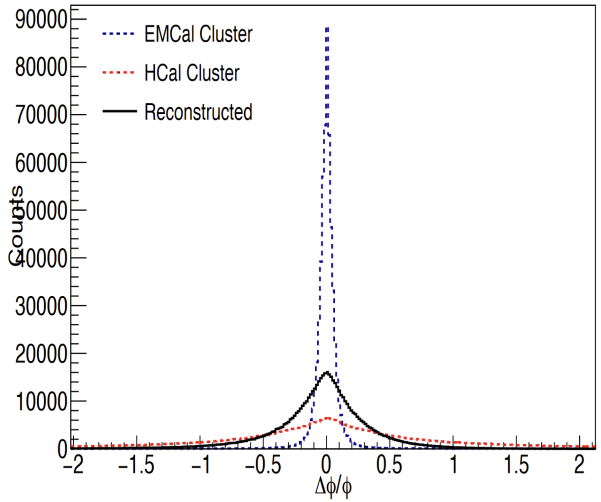
Reminder

old presentation link



However, presented data is biased by requirement of hits in both Hcal && Ecal





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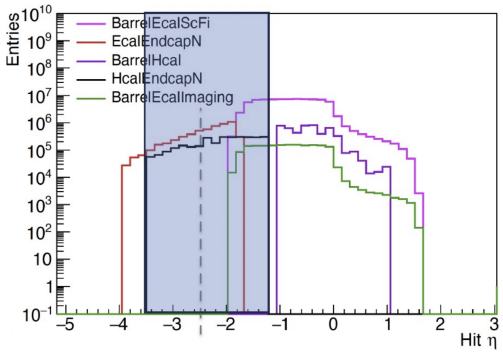

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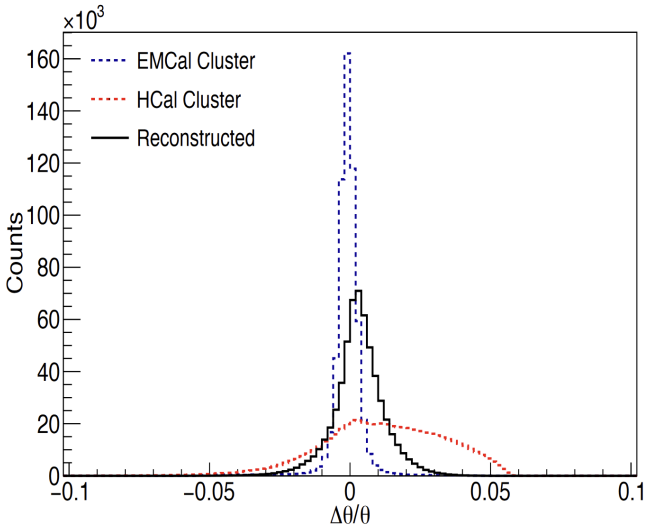
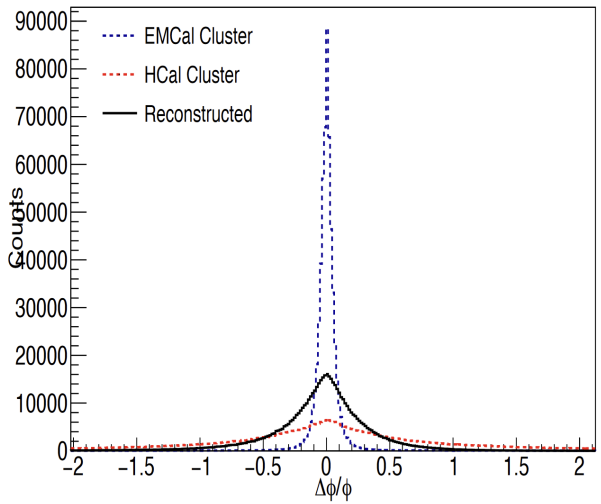
$\rightarrow$ the particle has been scattered in Ecal first.





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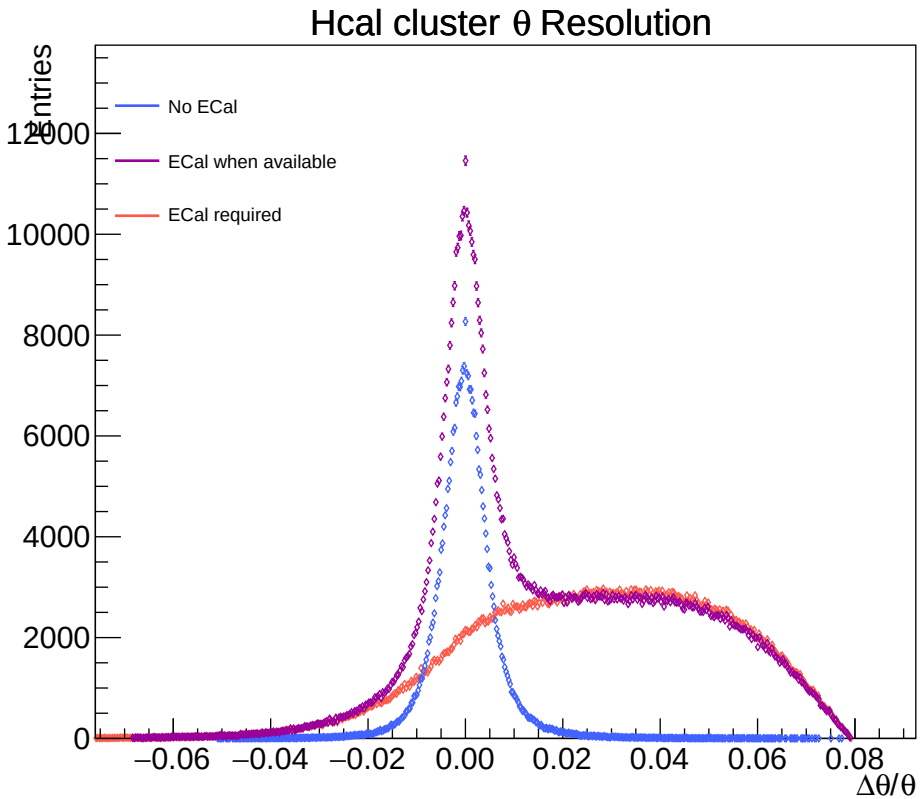
More study on Ecal+Hcal hits



- Previous study used a condition "ECal required"
- "ECal required" has a lower resolution because of the scattering in Ecal
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- Split analysis for "Hcal only" and "Hcal+Ecal(Ecal required)"

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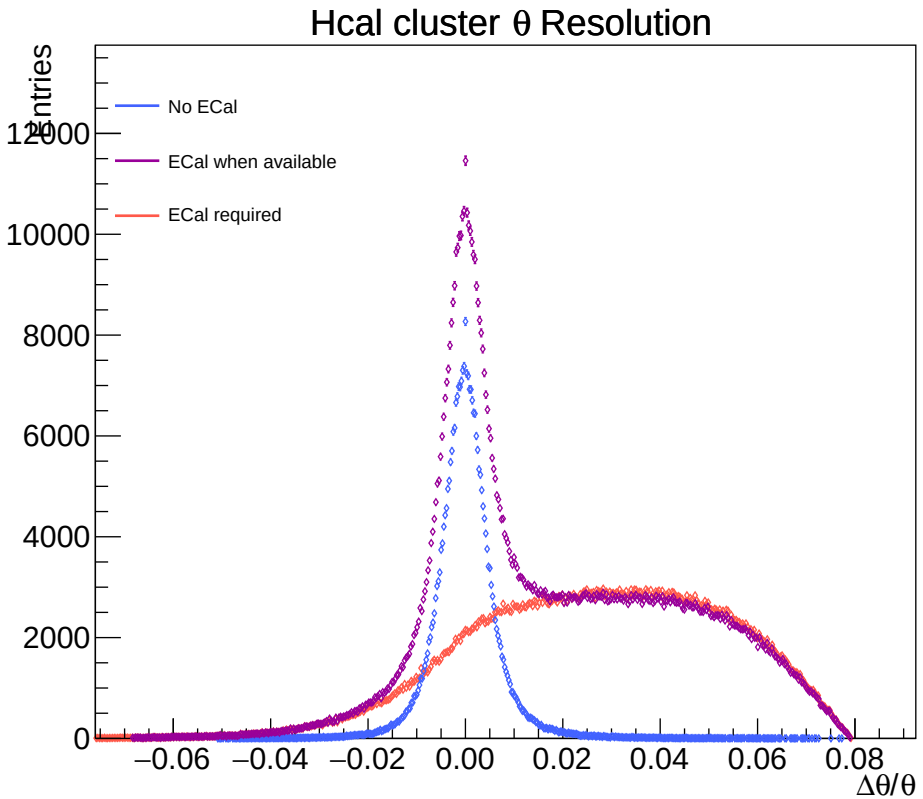

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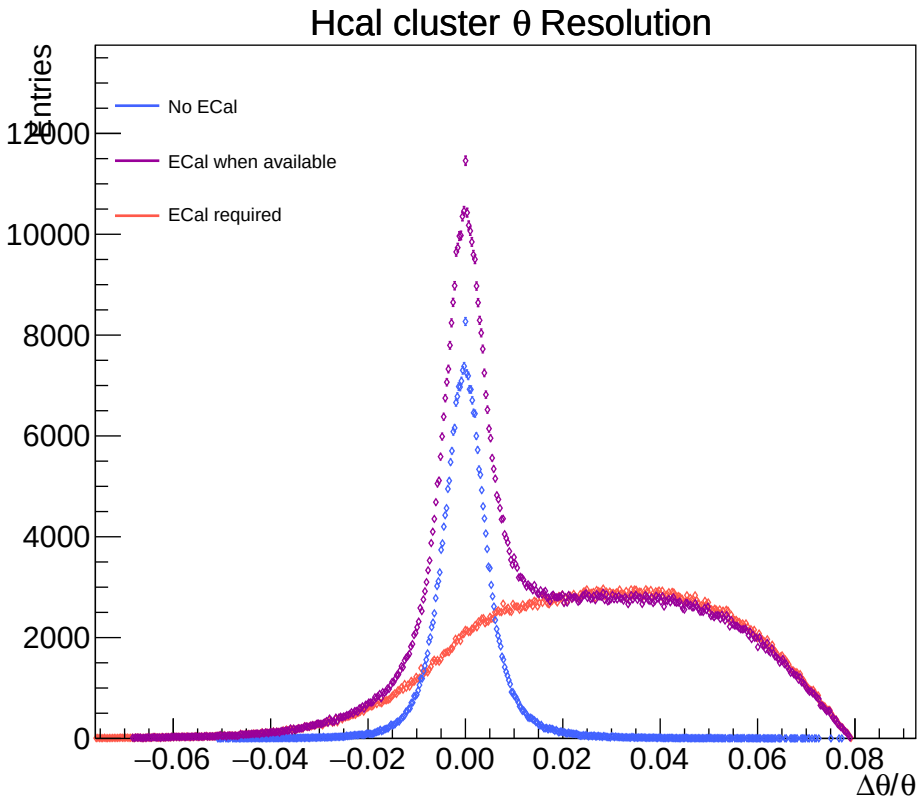

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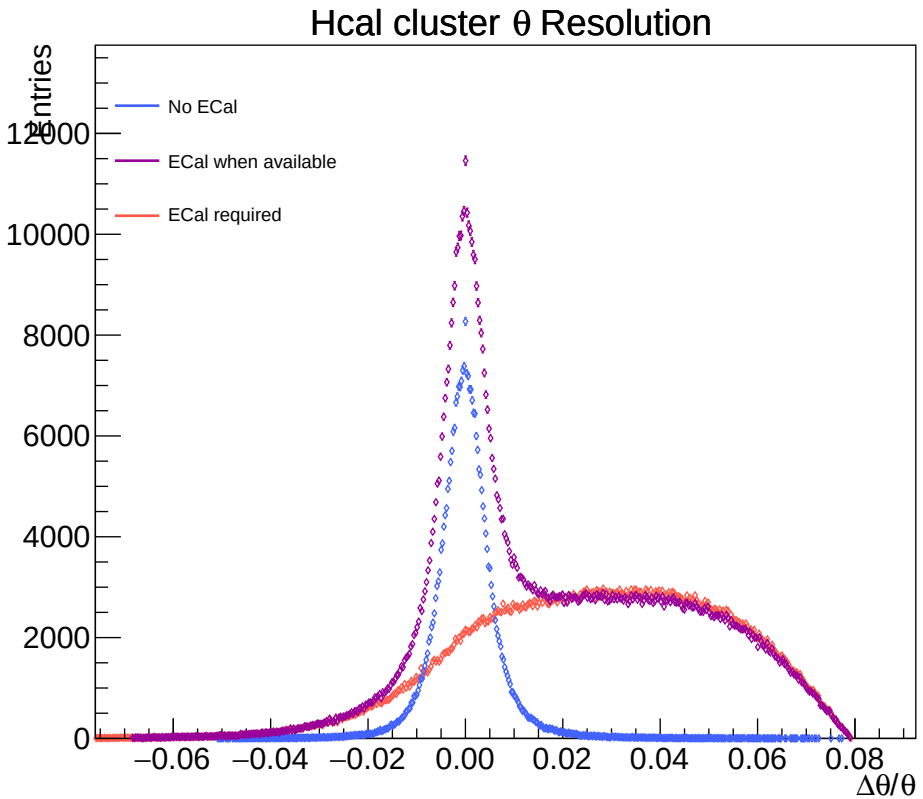

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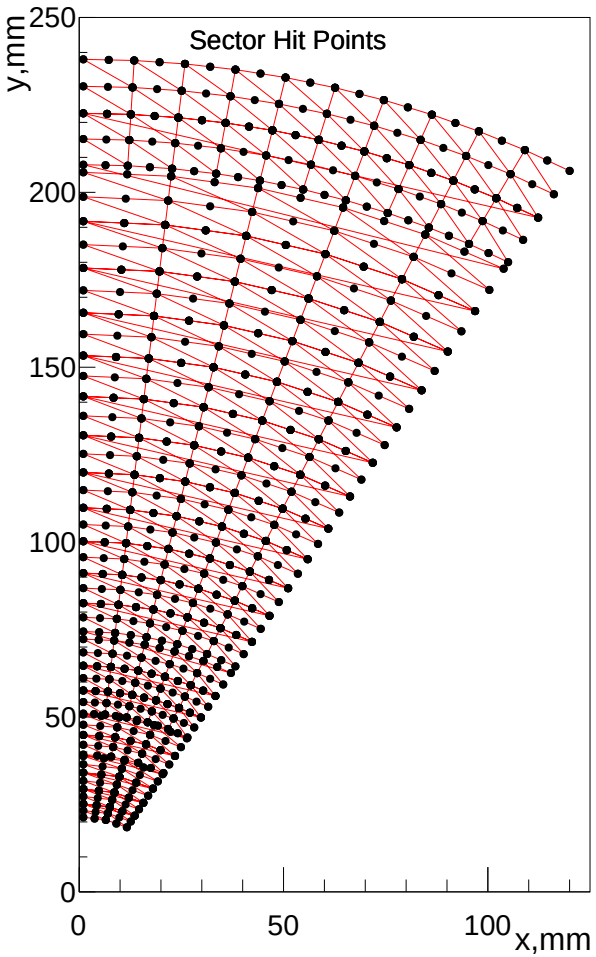
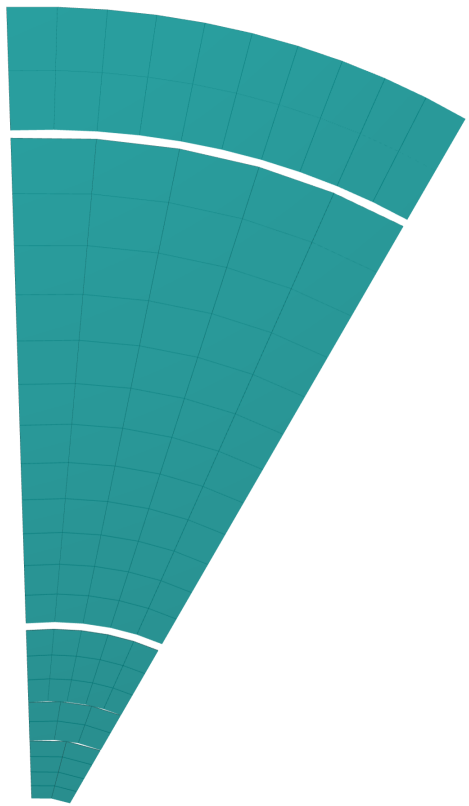
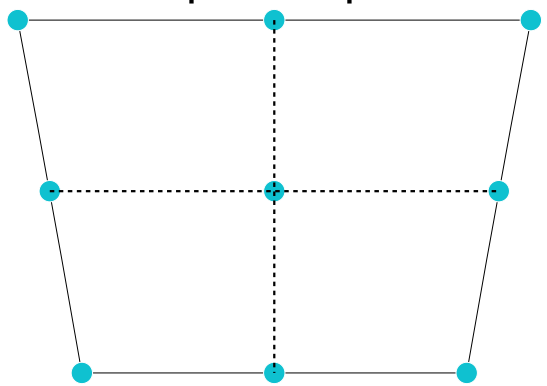
$\phi - \theta$ scan points (can be uniform)



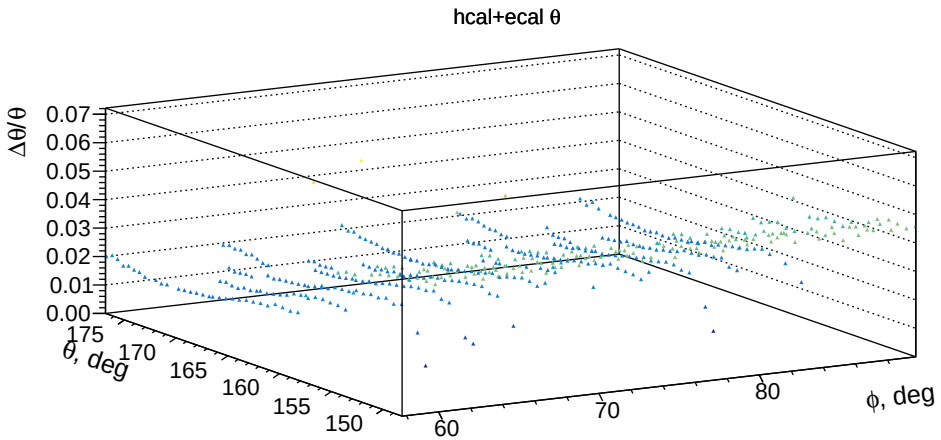


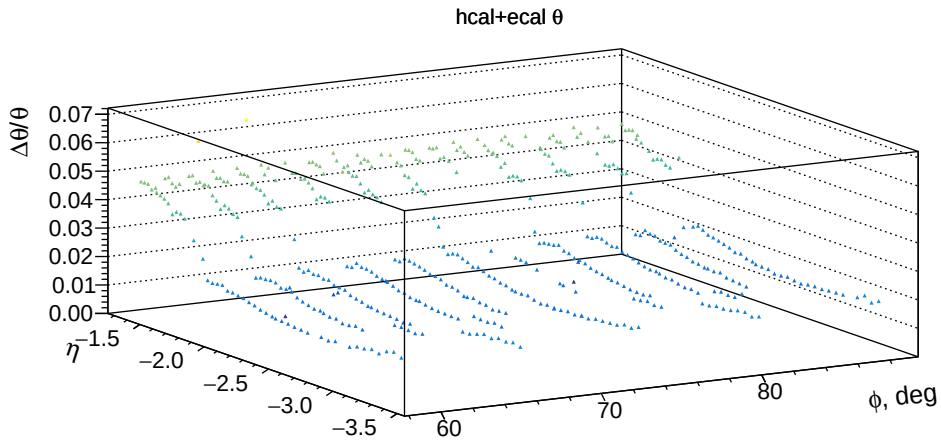
3x3 hit points per each tile:

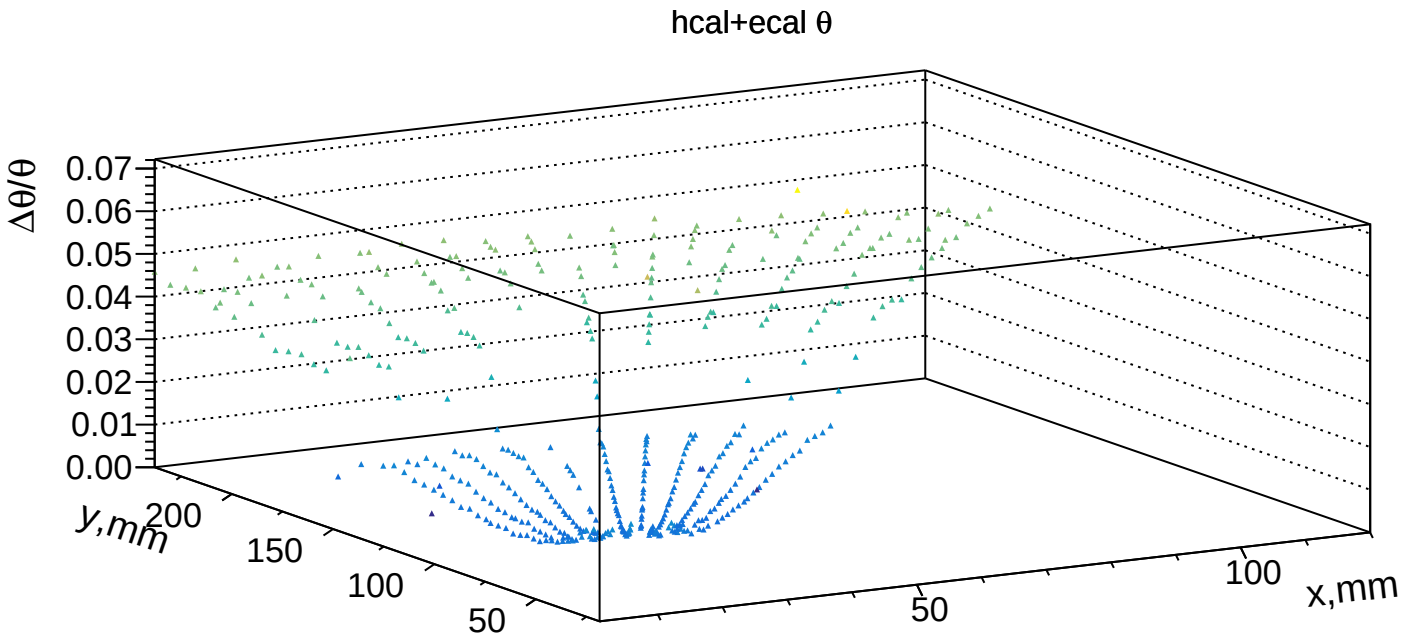


- Neutrons
- p =5 GeV
- full EPIC geometry
- 50k events
- 580 points sector

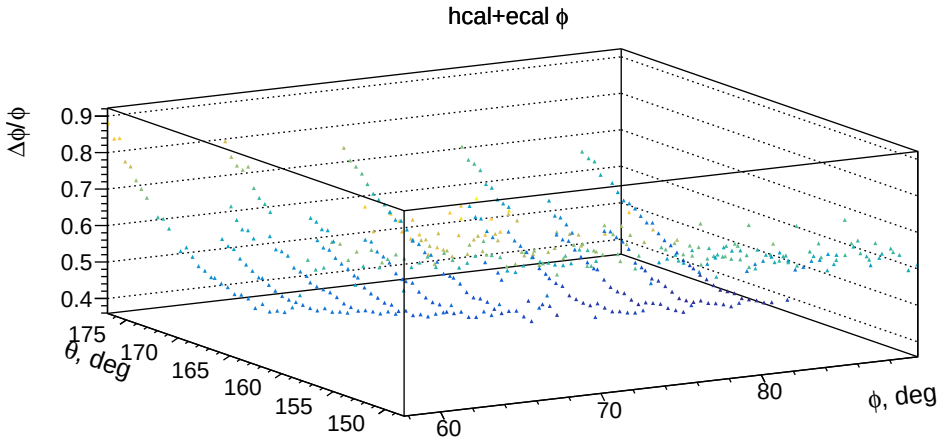
Hcal+Ecal θ resolution

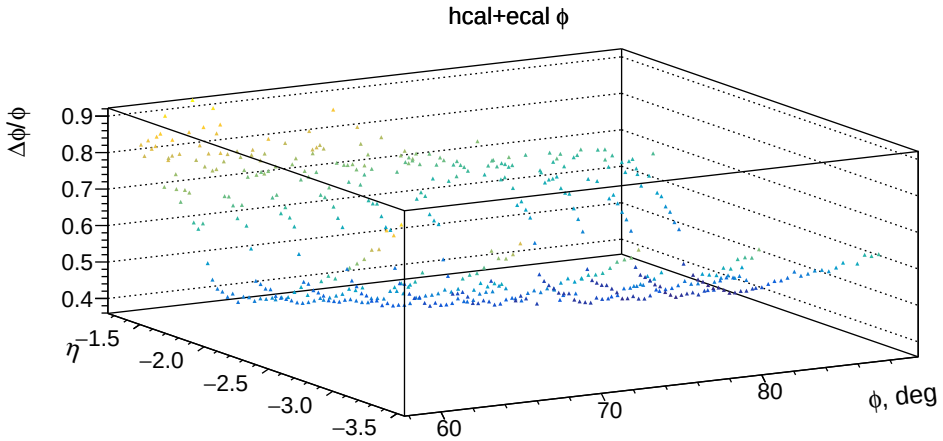


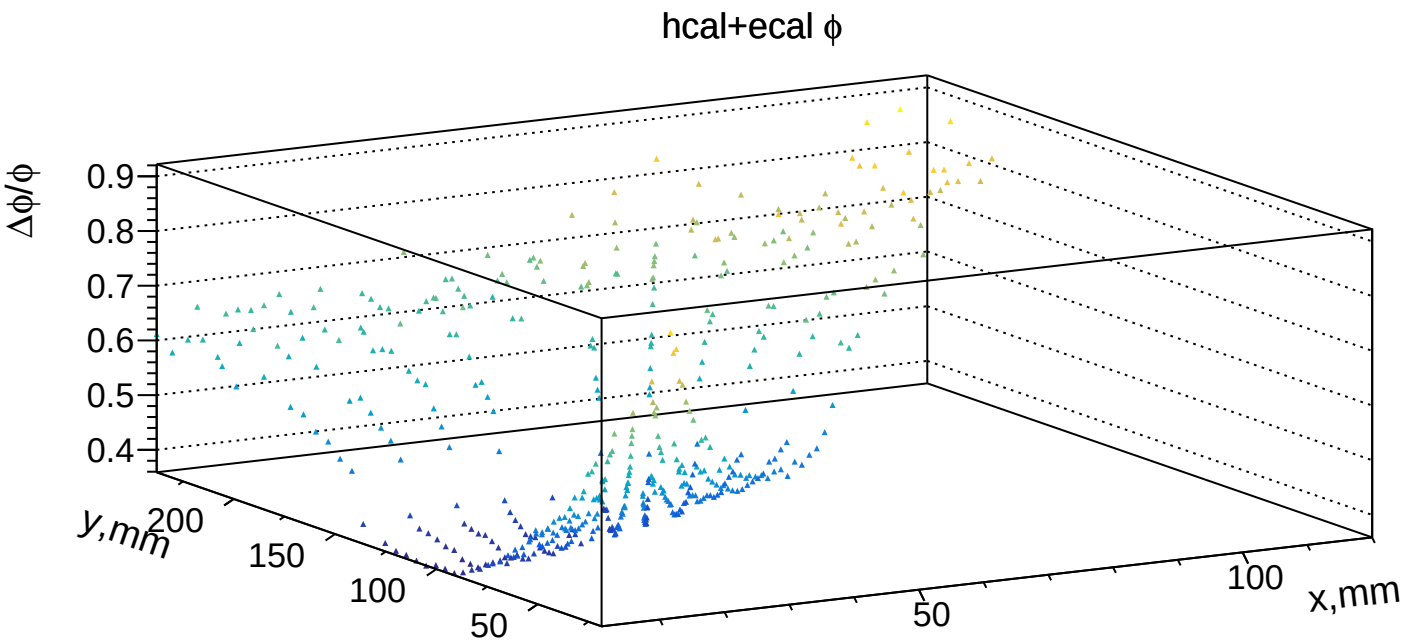




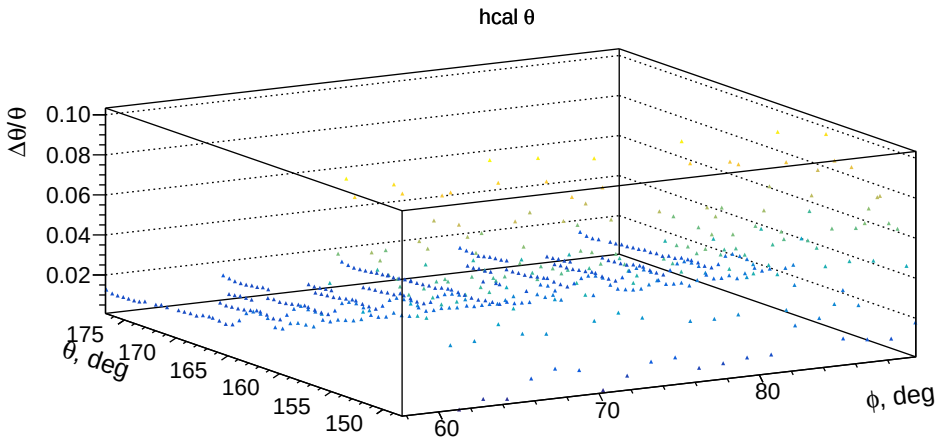
Hcal+Ecal ϕ resolution

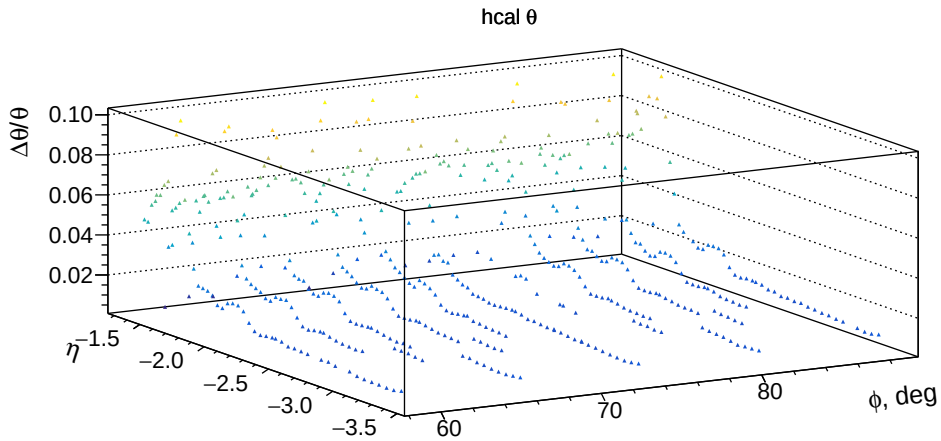


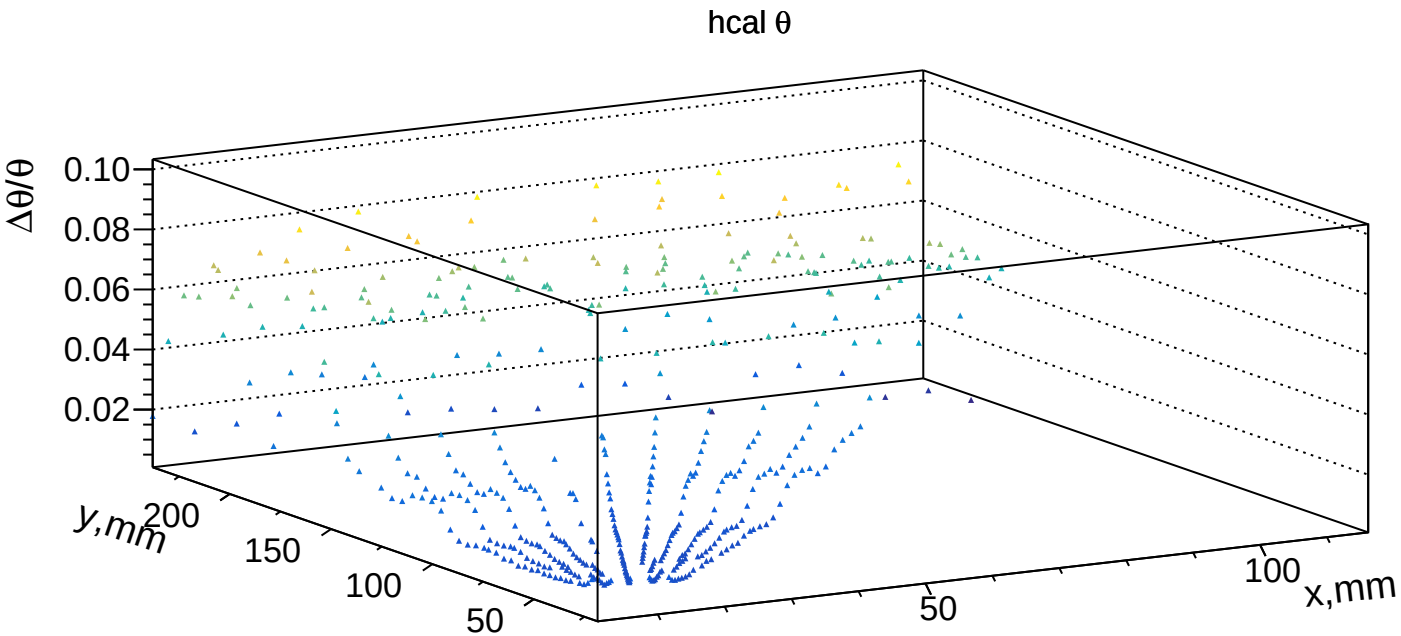




Hcal only θ resolution







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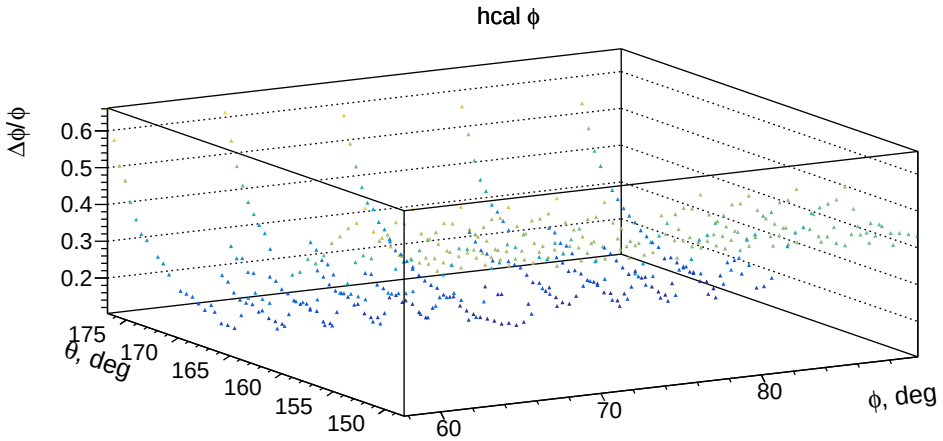
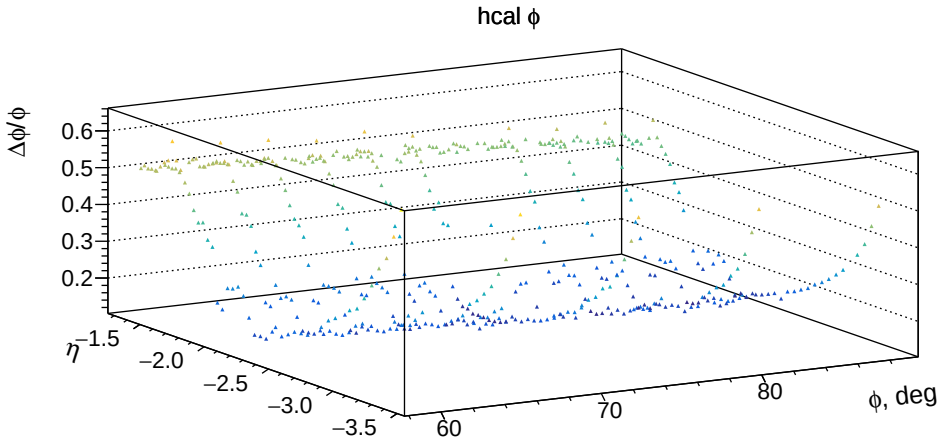
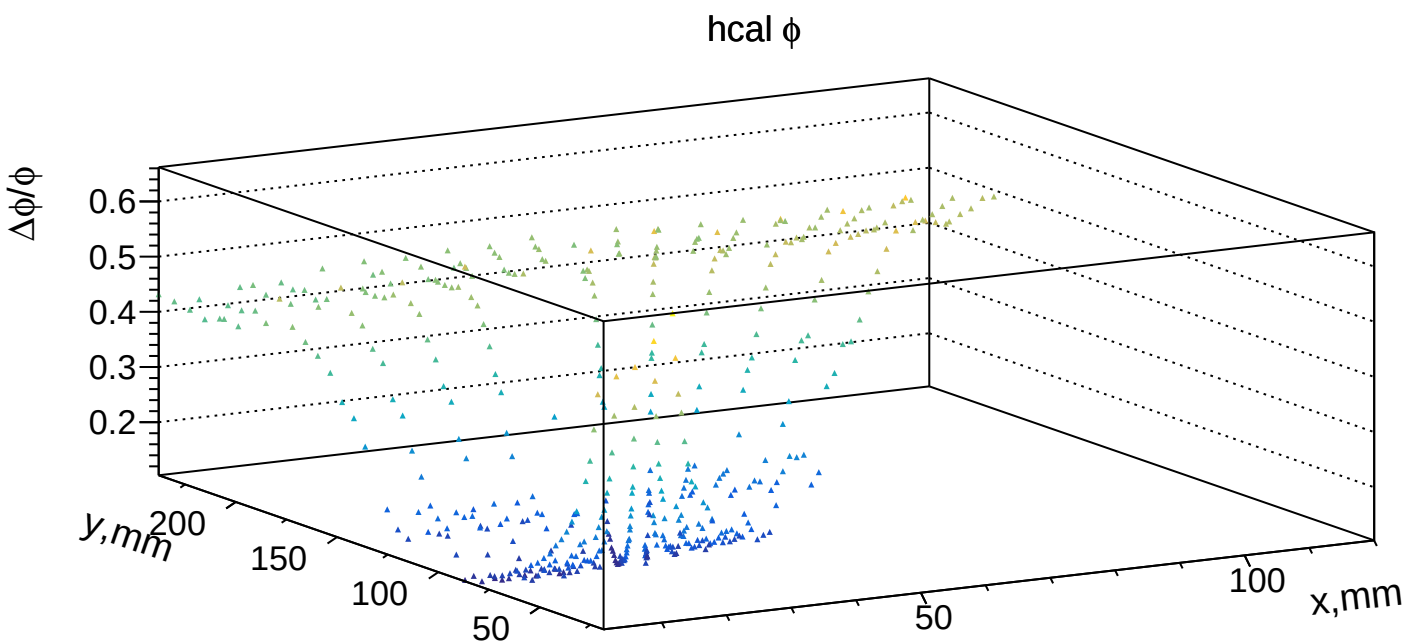
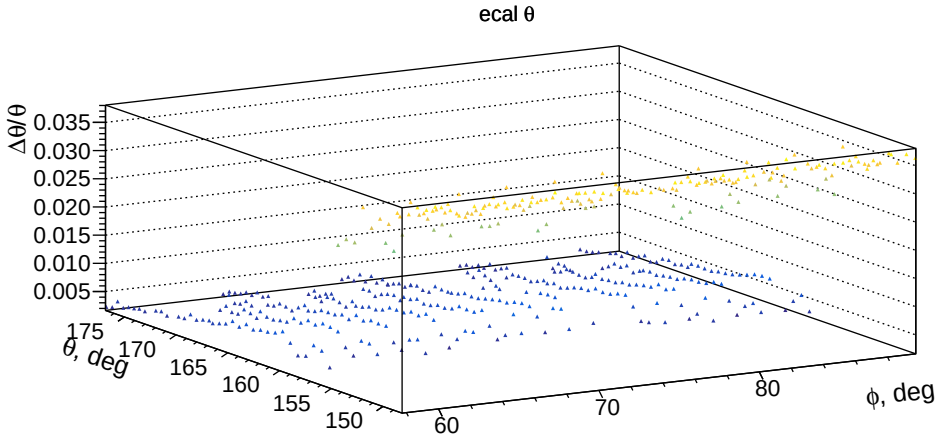
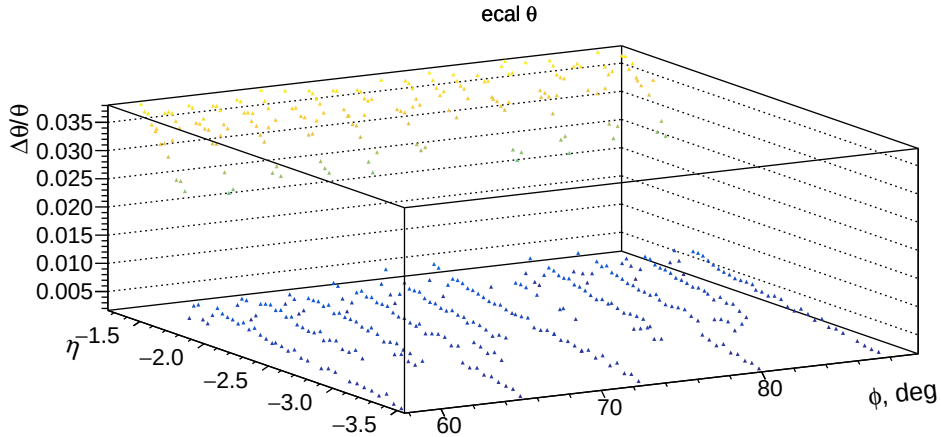


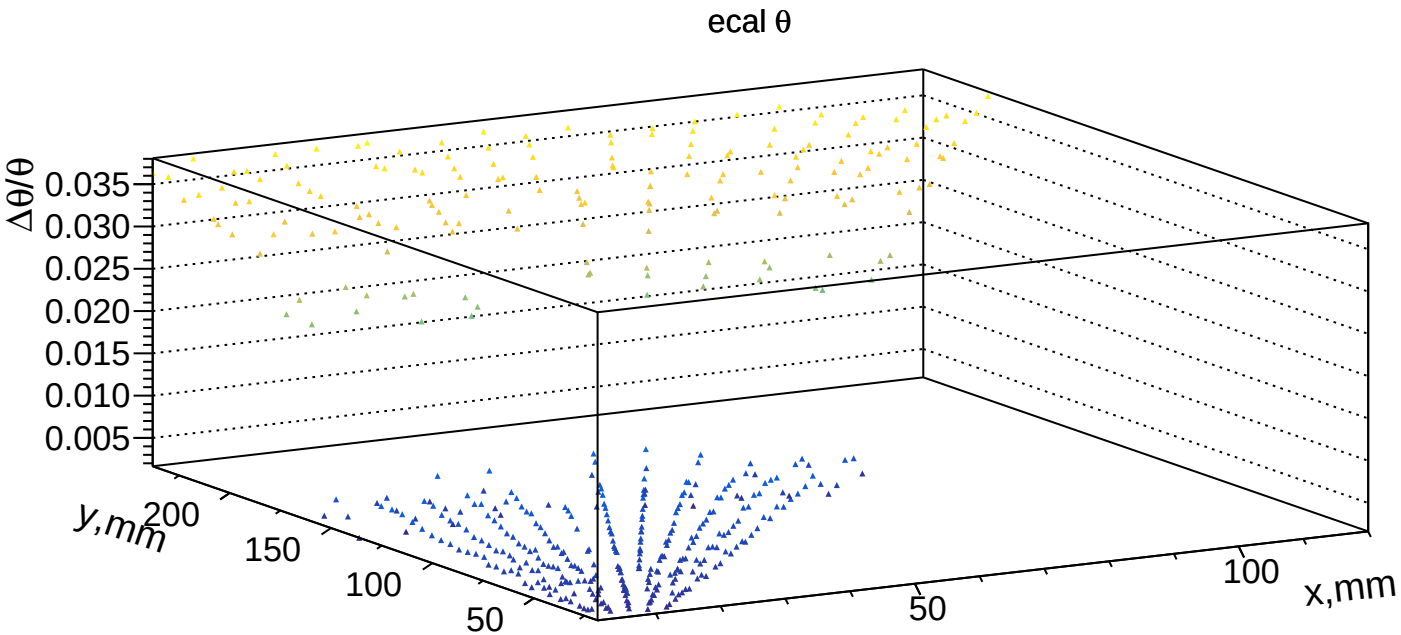




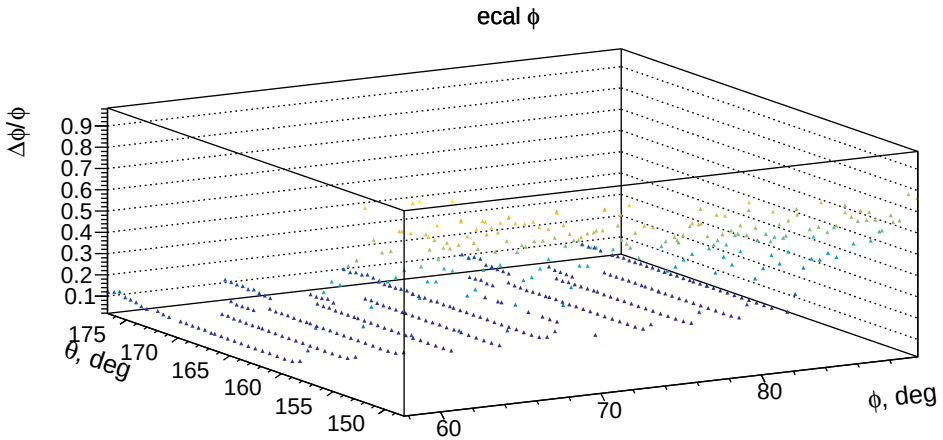
Ecal only θ resolution

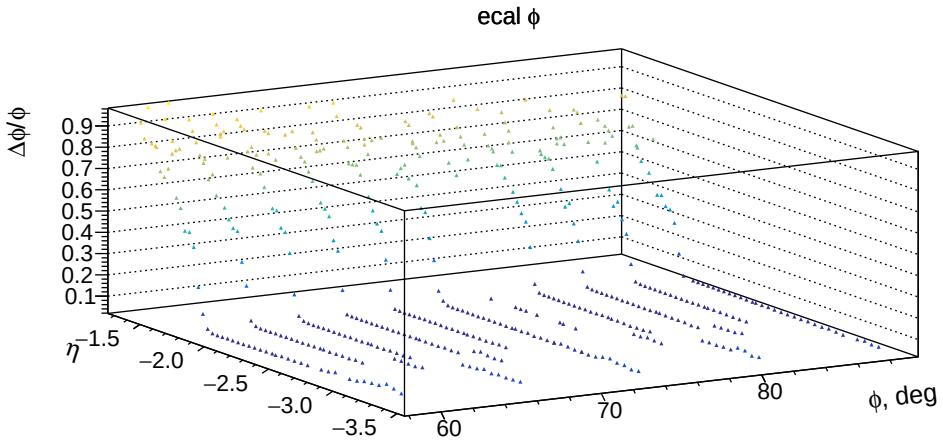


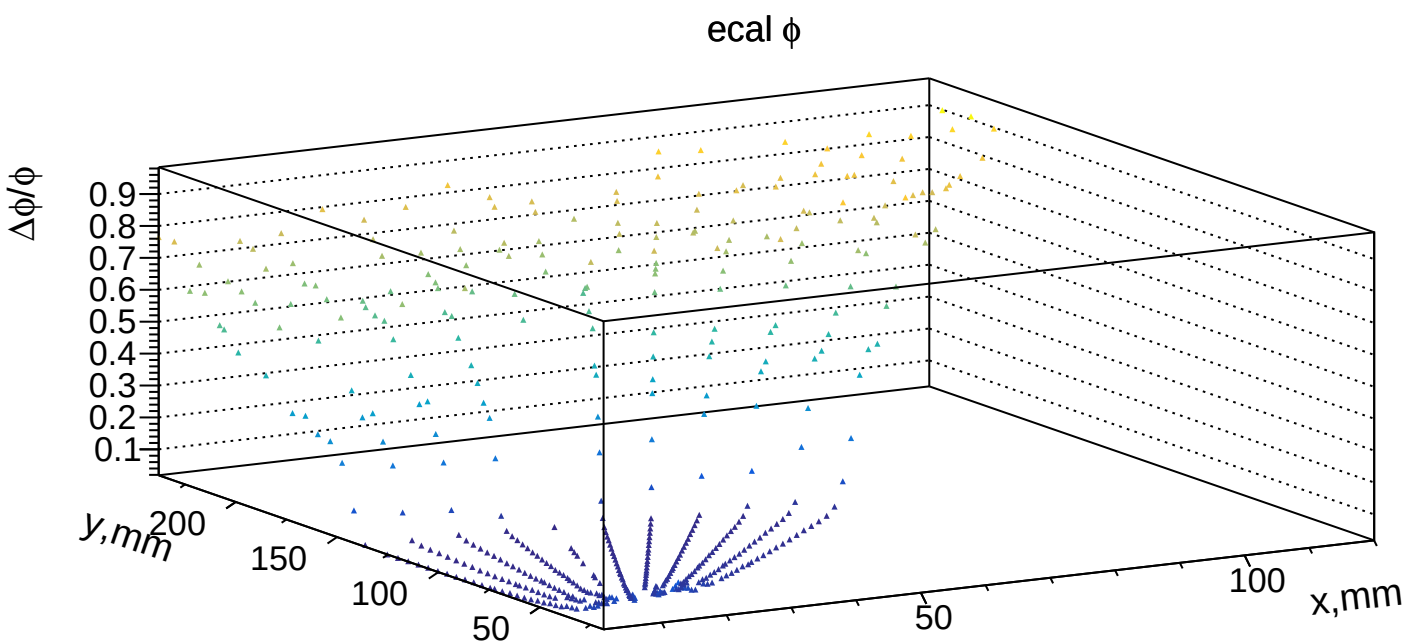




Ecal only ϕ resolution



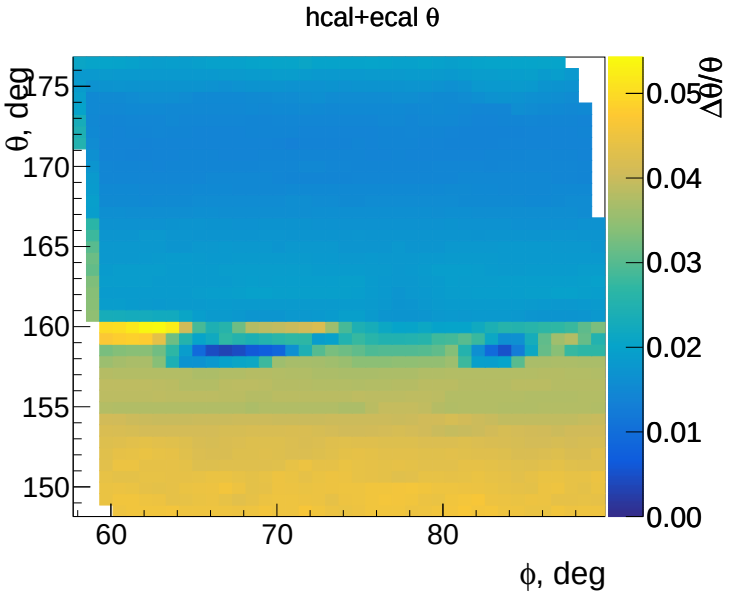


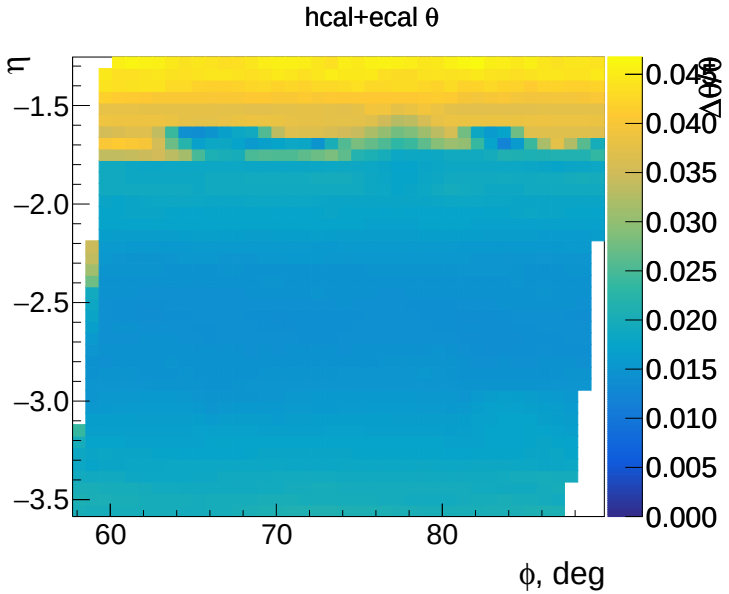


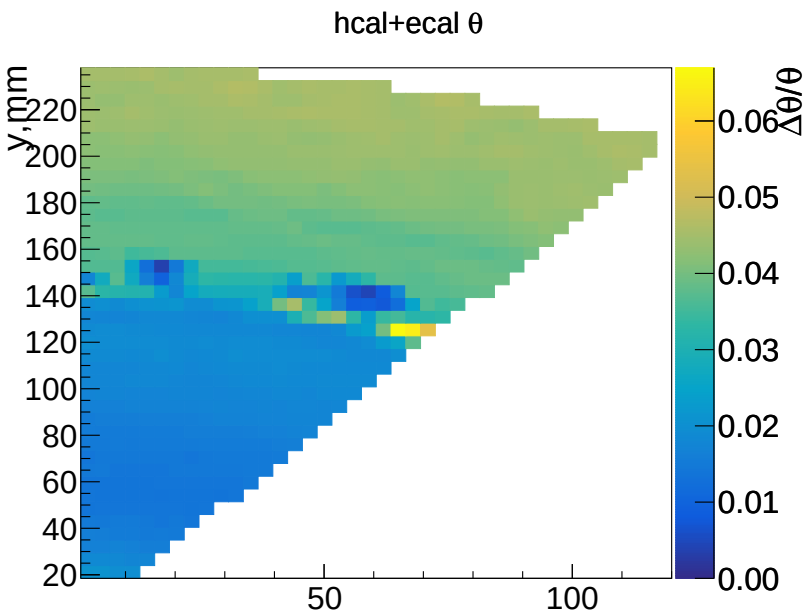
Study is ongoing:

- Include other calorimeter systems within the same acceptance (BarrelEcal).
- Change island-clustering parameters
- Change tile sizes with a new geometry approach (LFHCAL style)
- Investigate the e/h response

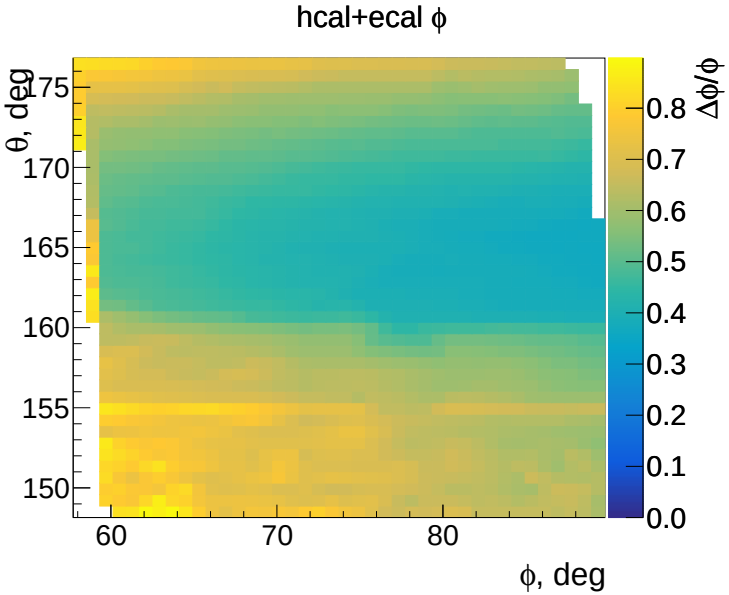
Hcal+Ecal θ resolution

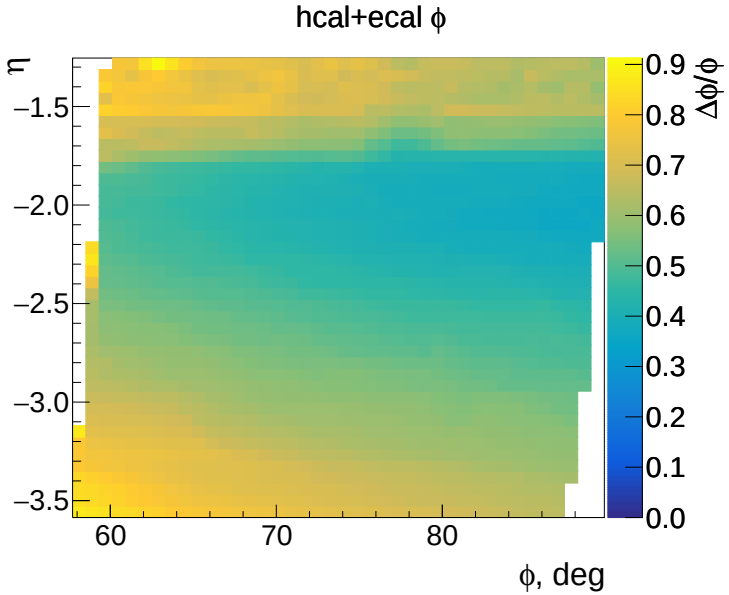


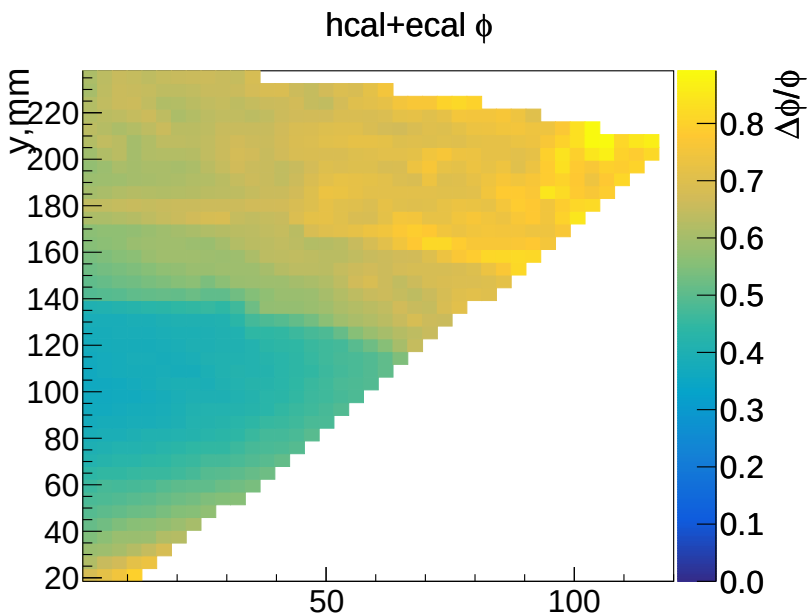




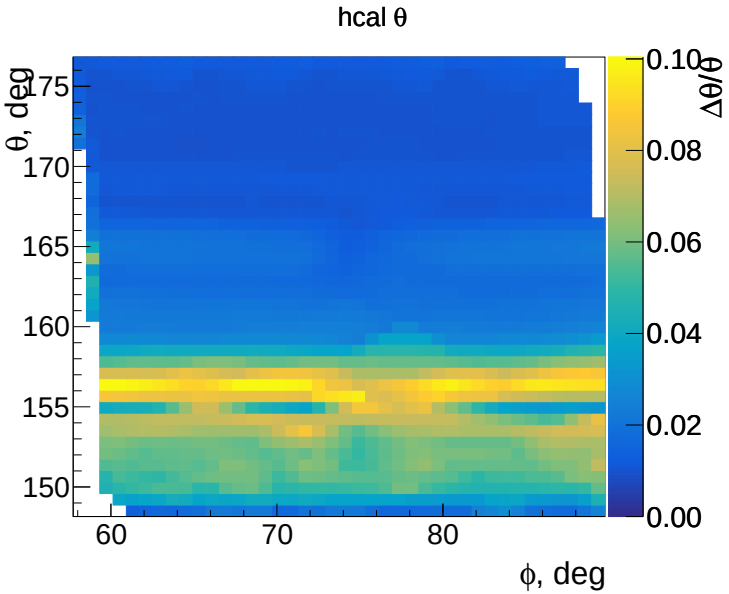
Hcal+Ecal ϕ resolution

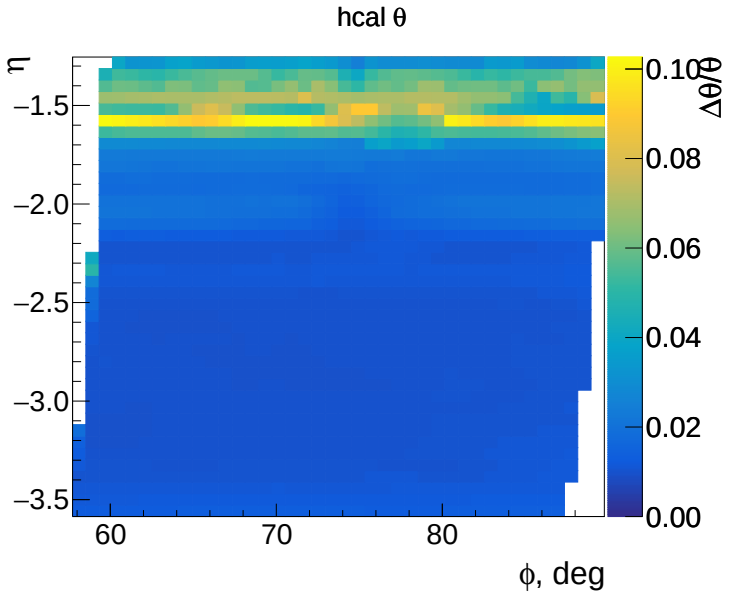


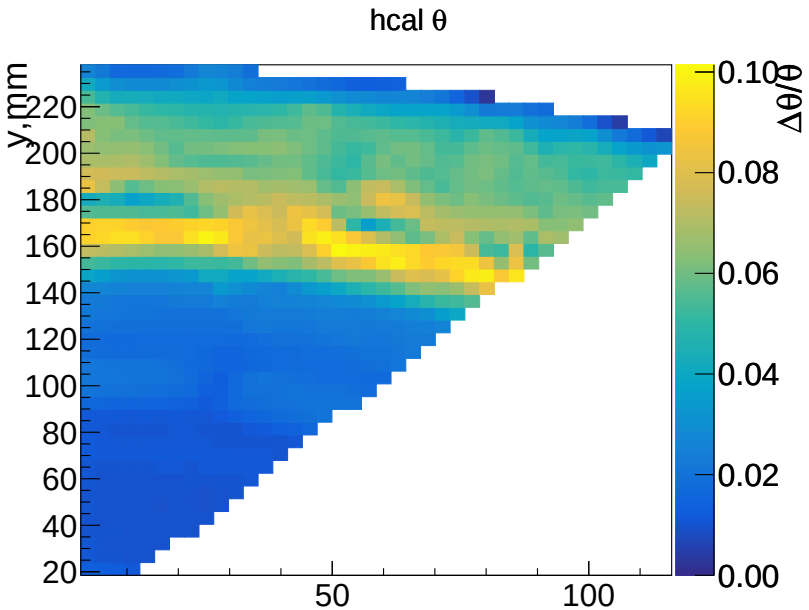




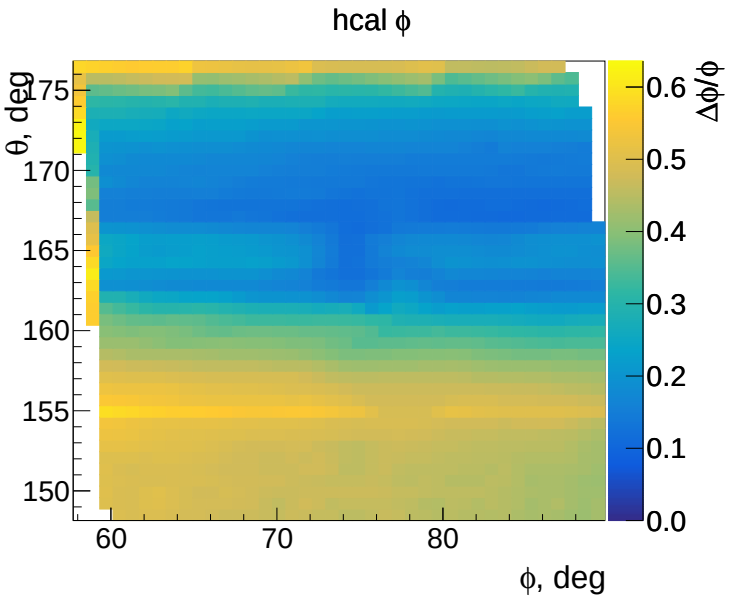
Hcal only θ resolution

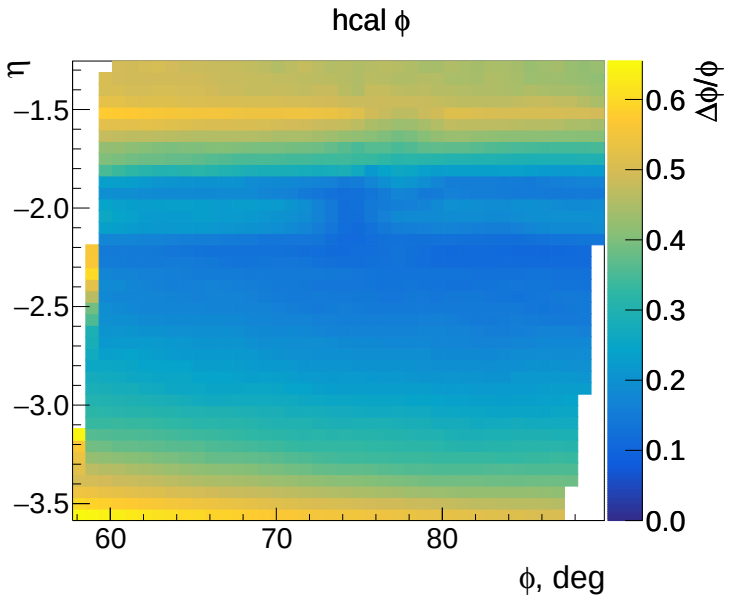


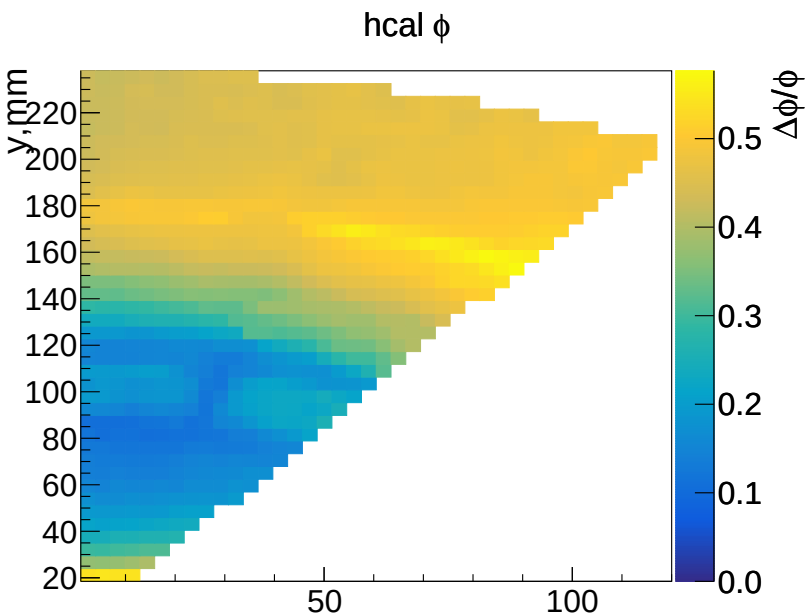




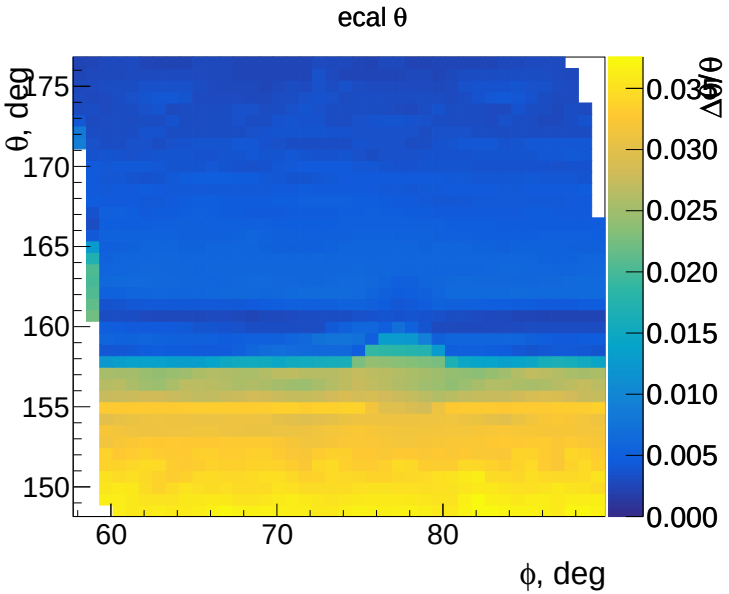
Hcal only ϕ resolution

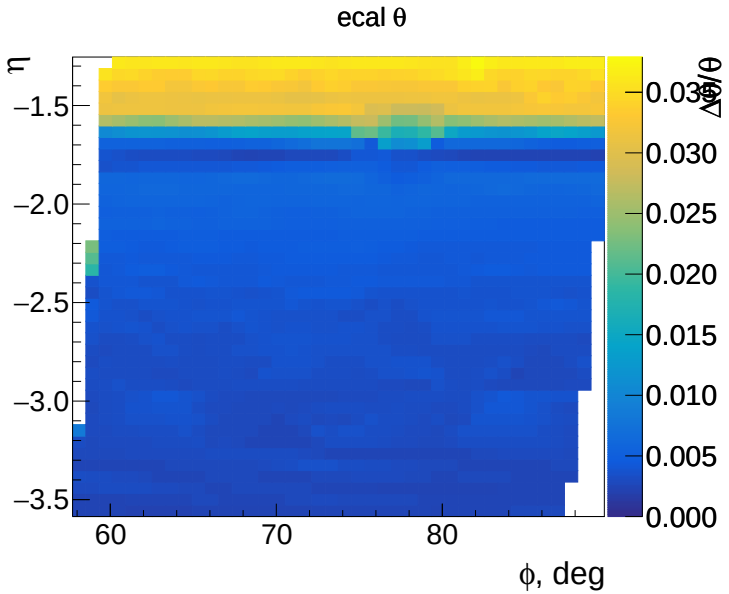


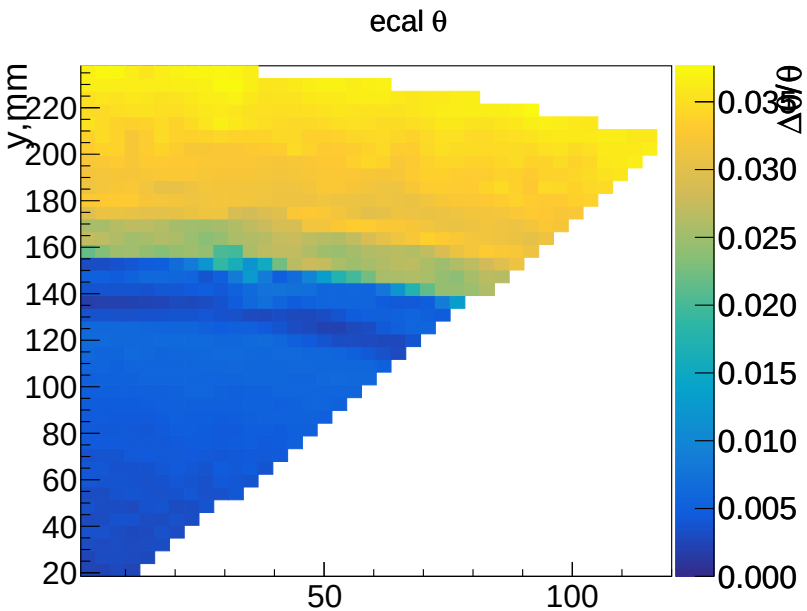




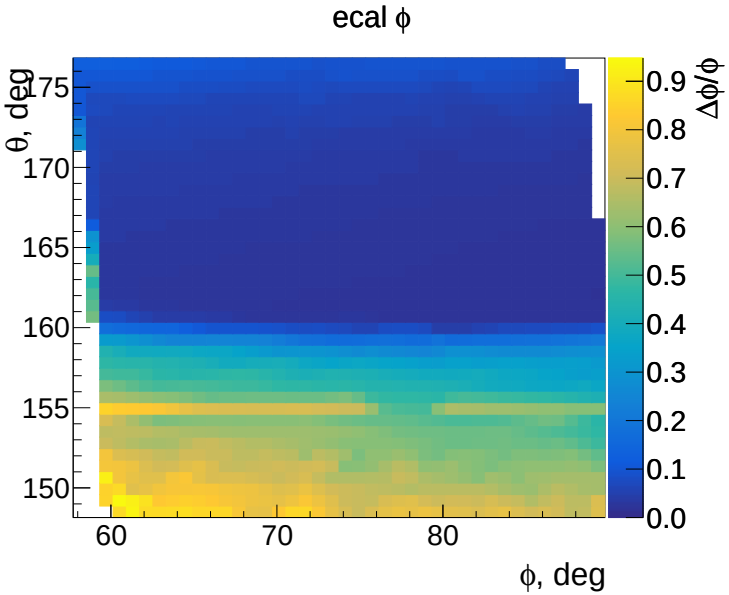
Ecal only θ resolution

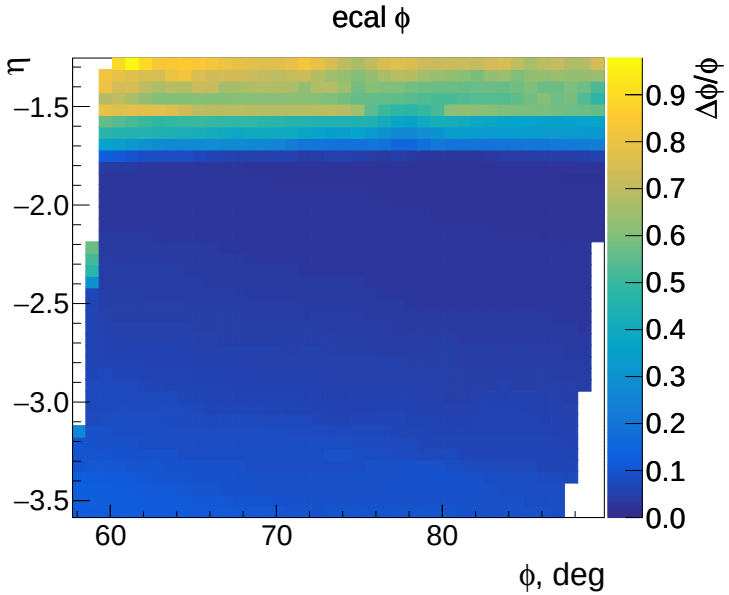


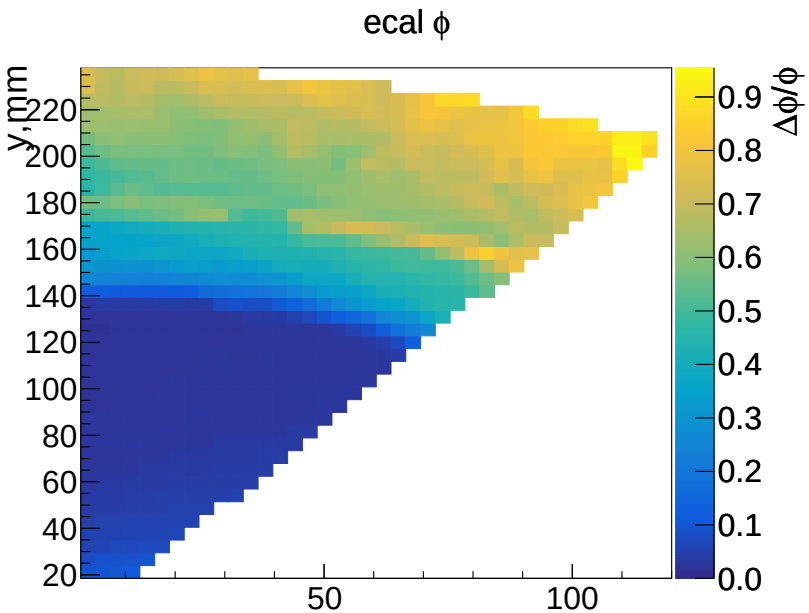




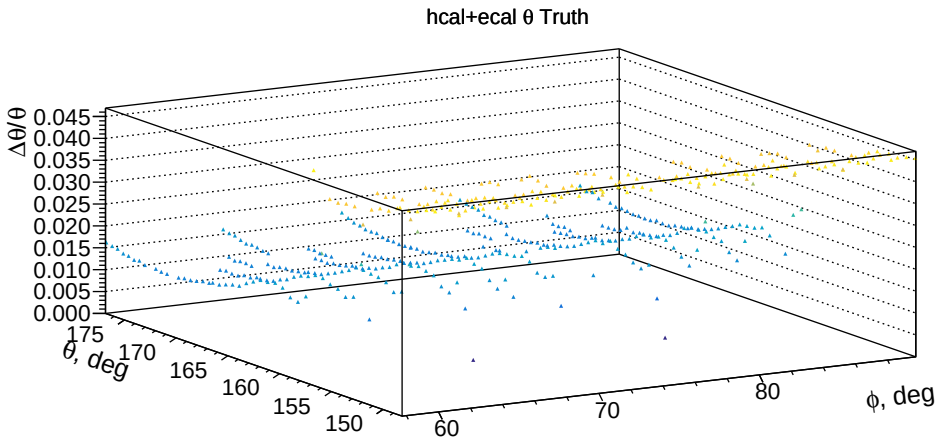
Ecal only ϕ resolution

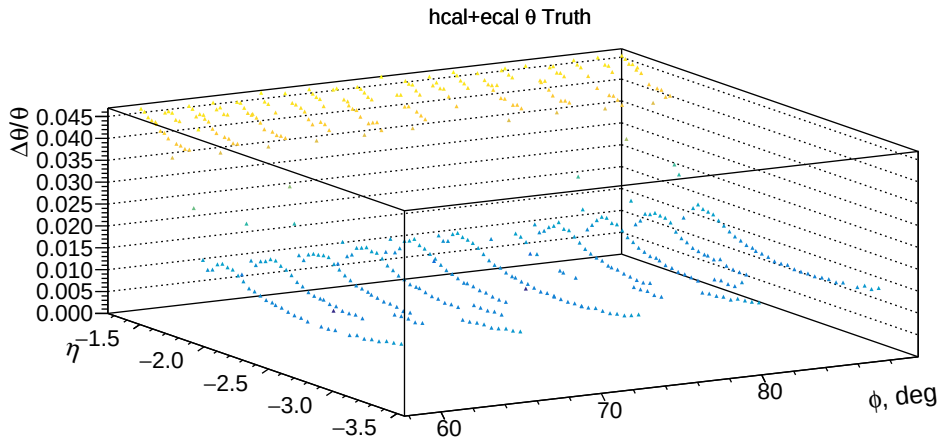


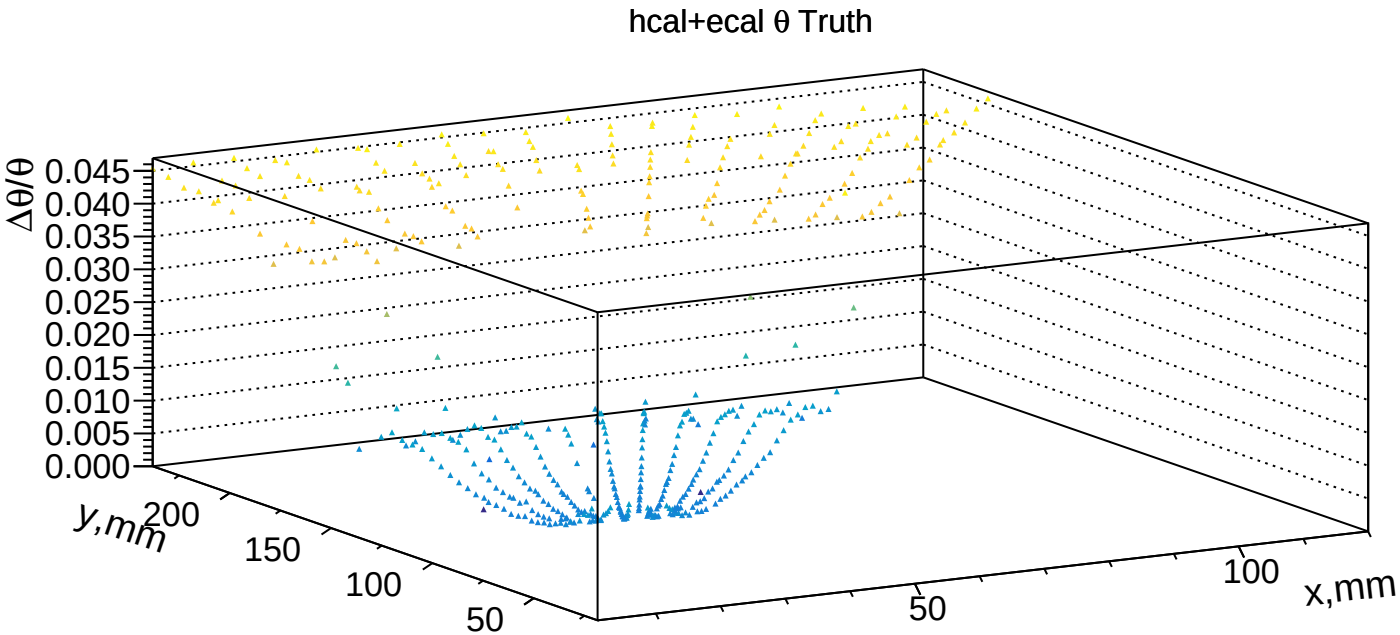




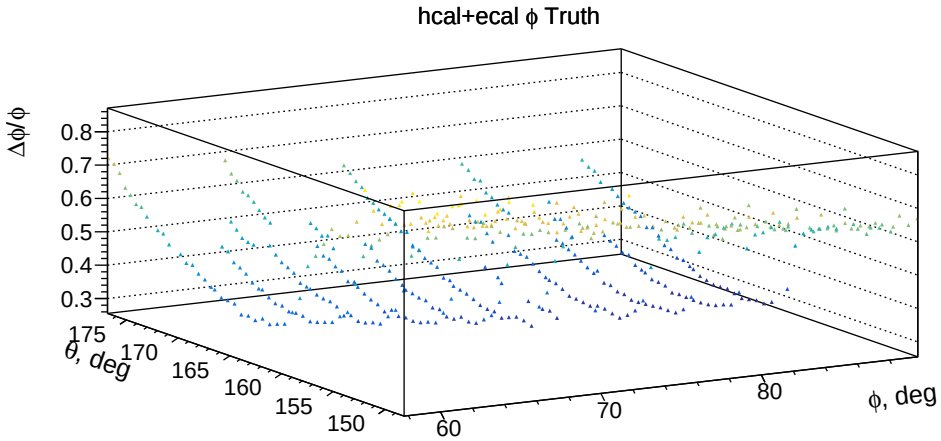
Hcal+Ecal θ truth resolution

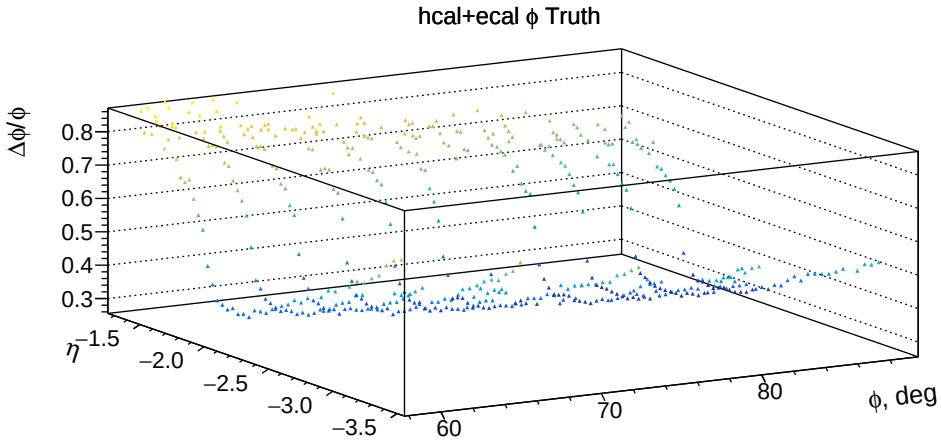


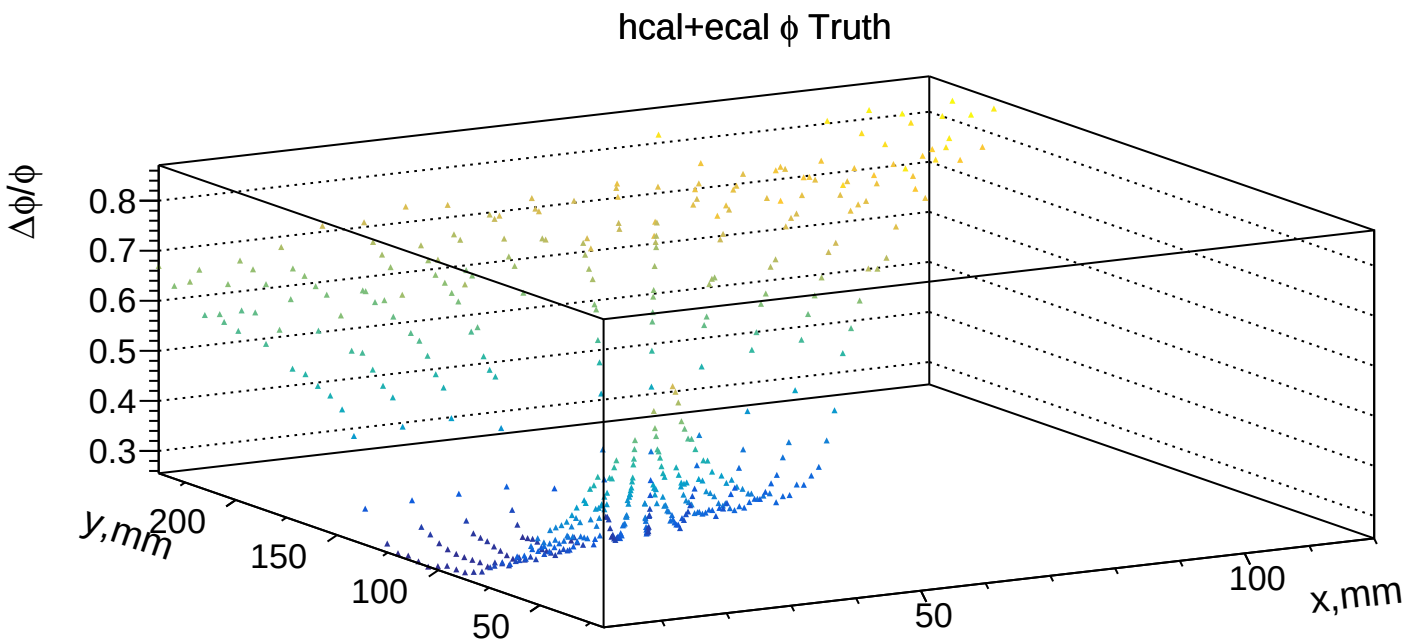




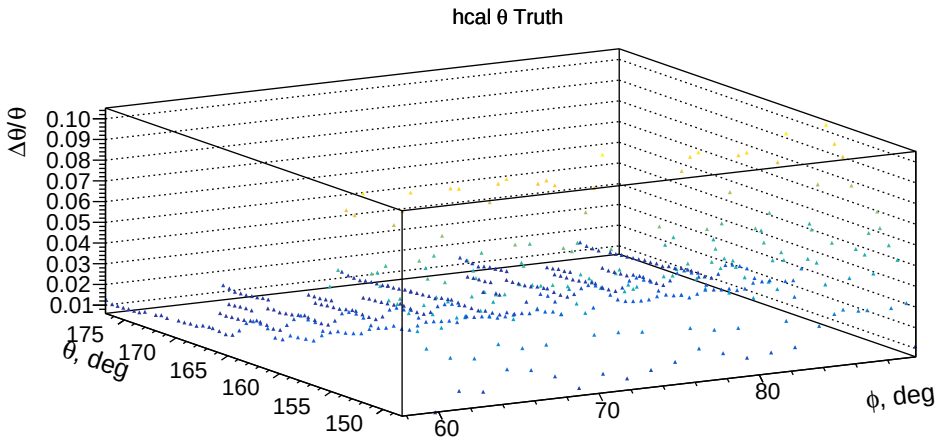
Hcal+Ecal ϕ truth resolution

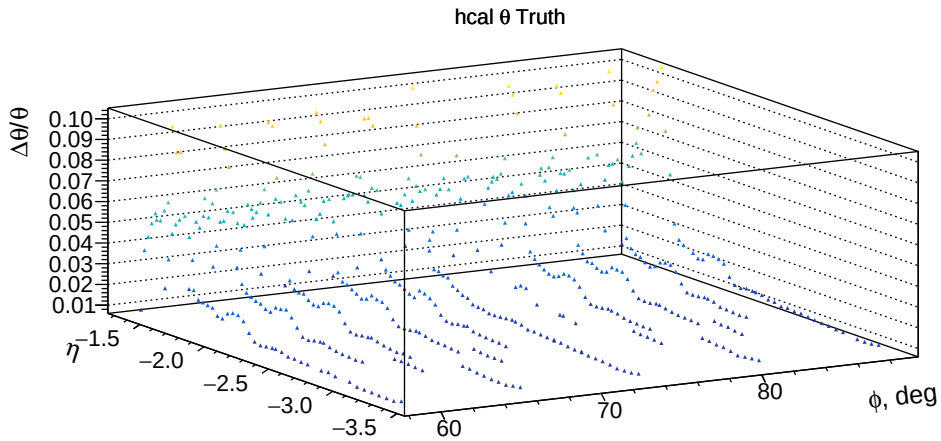


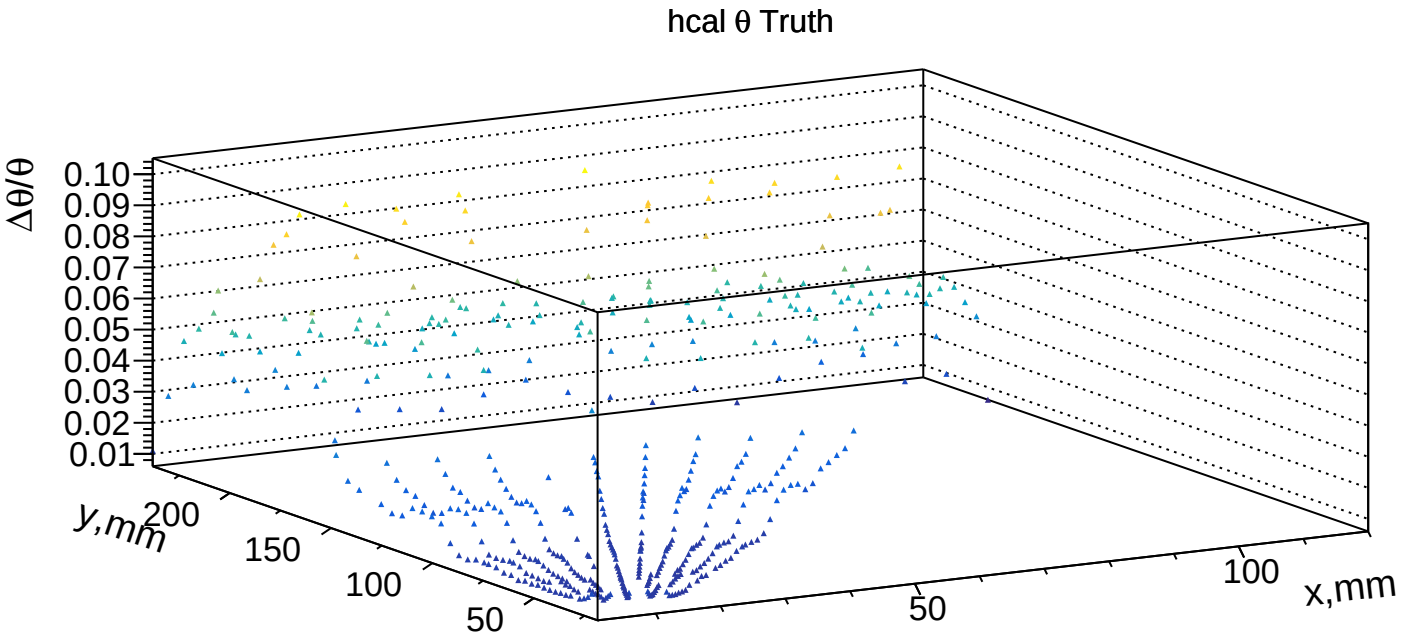




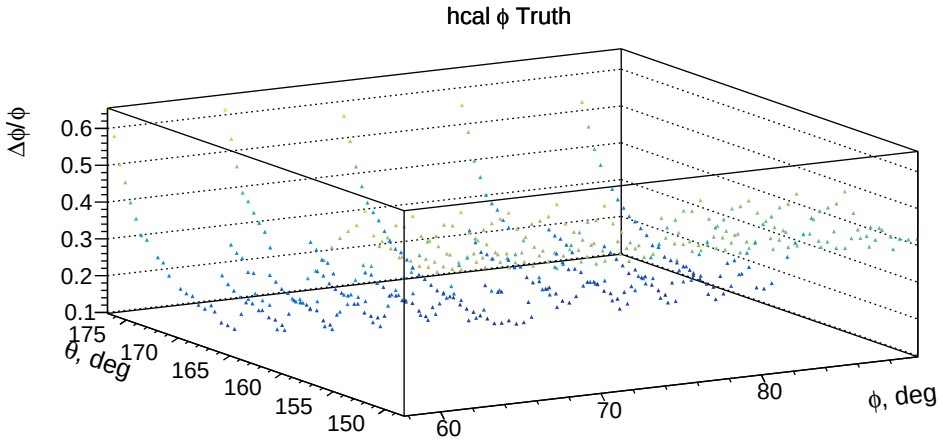
Hcal only θ truth resolution

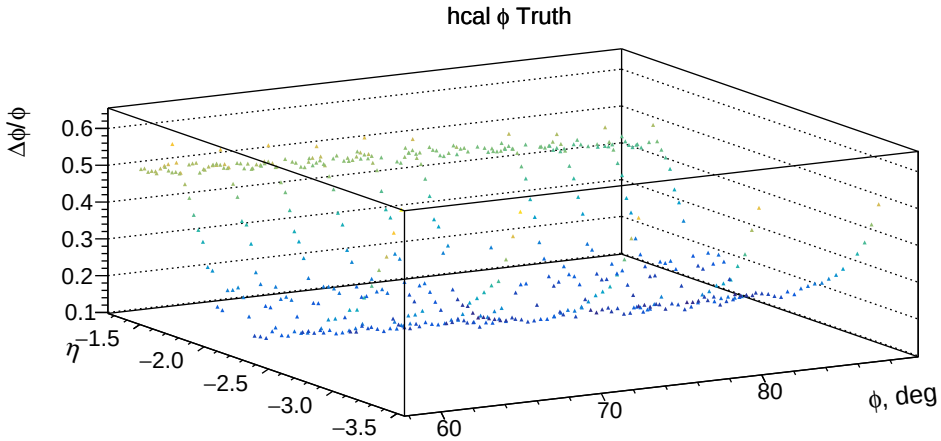


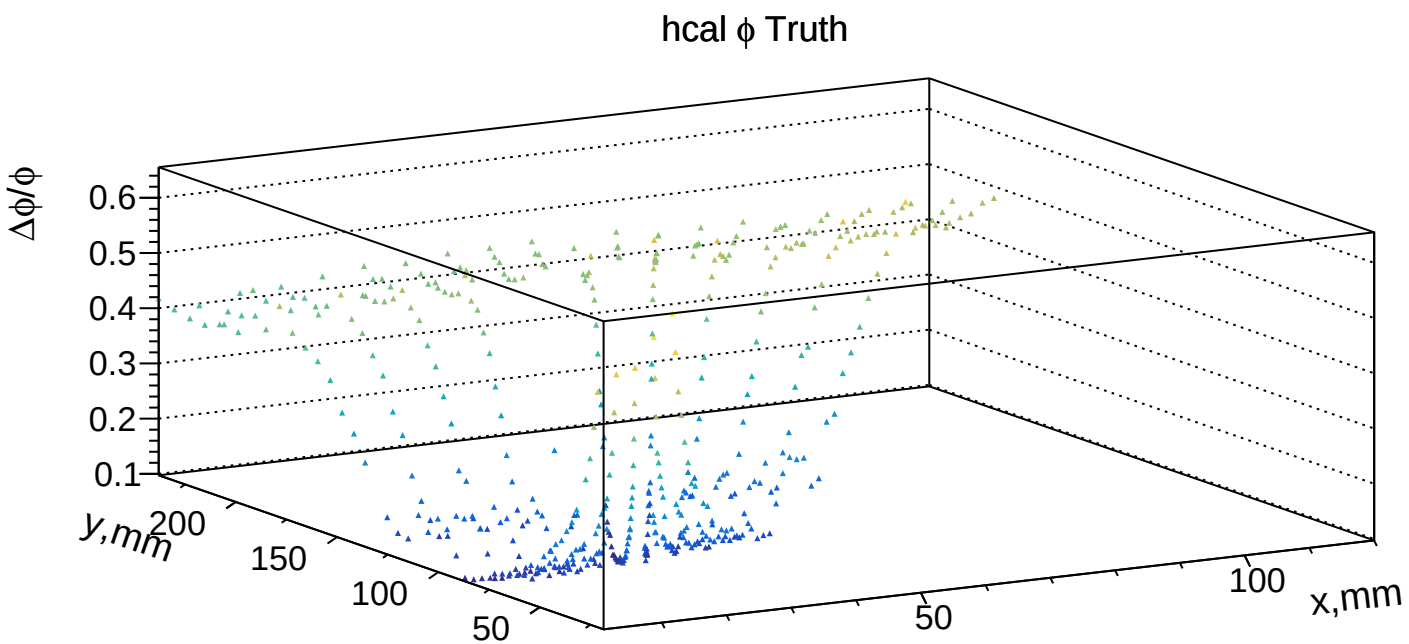




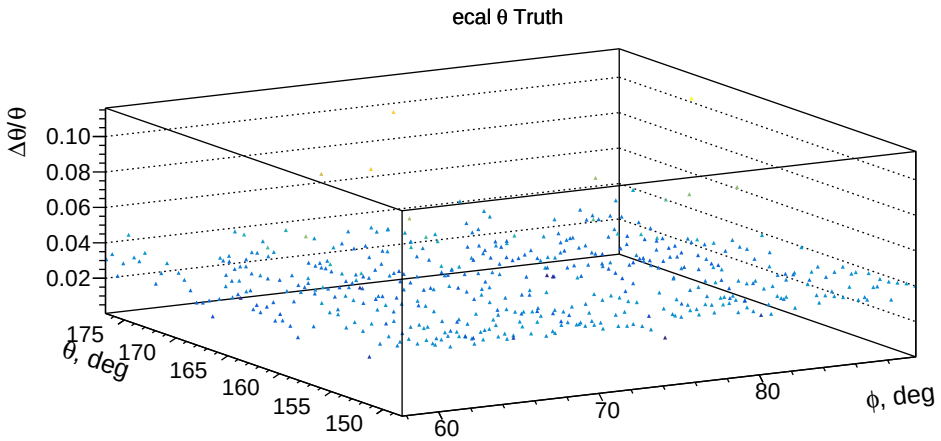
Hcal only ϕ truth resolution

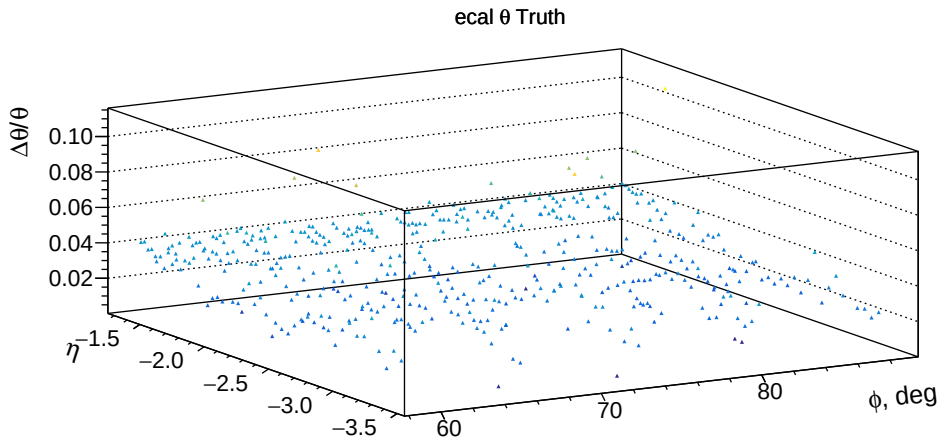


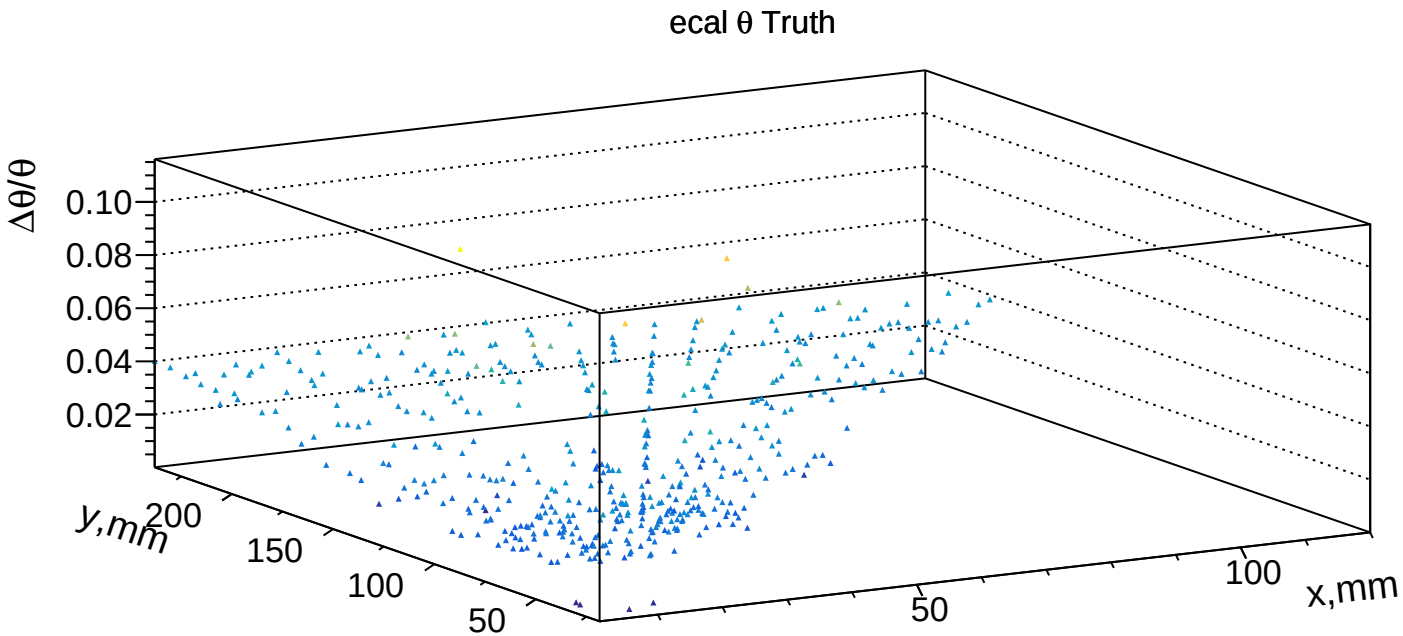




Ecal only θ truth resolution







Ecal only ϕ truth resolution