

TPC DD4HEP Detector Model

Updates and Final Model

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Dimensions

- > ECal needs 3.82cm (thicker electronics) → It will be taken from the TPC for the barrel region
- > For this reason, there have been some adjustments to the TPC dimensions
- > TPC uninstrumented region reduced from 3cm for inner and outer region to 1.81cm
 - If full region (3cm) was removed, it created overlaps with the cathode rings
 - Frank thinks there is no background/occupancy problem by moving the TPC 1.19 cm closer to IP
- > 2 pad rows were removed. There are now 220 pads instead of 222
- > Air in outer field cage has been reduced by 5mm (from 57.66 mm to 52.66)



Dimensions (2)

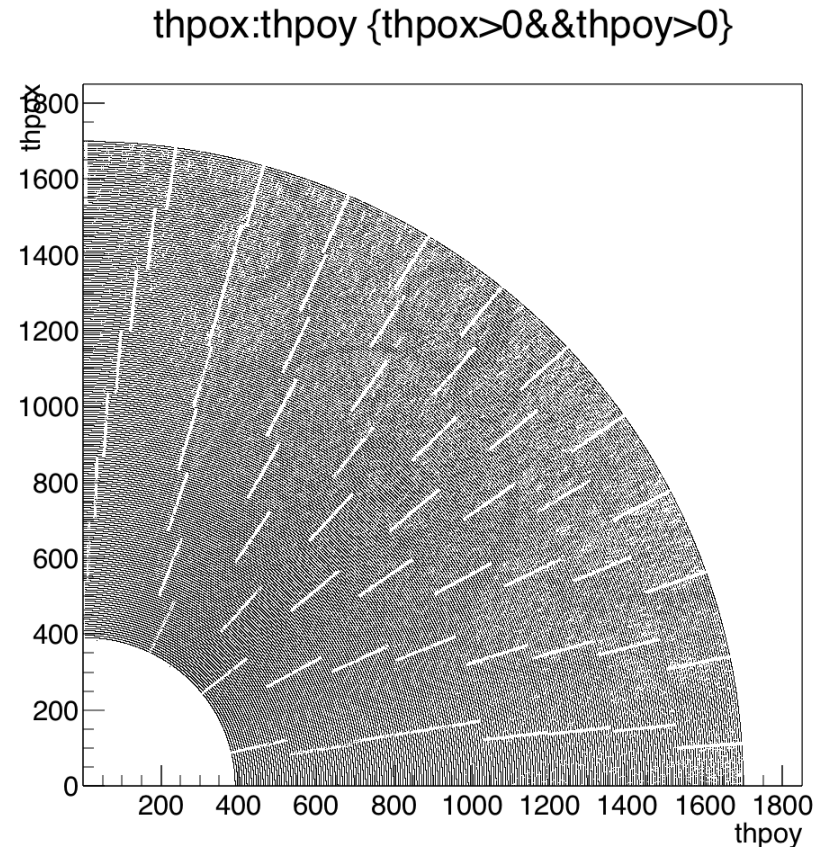
- > Overall, outer TPC radius moved from 1808mm to 1769.8mm (corresponding to the 3.82cm for the Ecal thickness)
 - Note: 4.6mm available in the sensitive region (not enough space to make a new pad)

- > All new changes implemented in ILD_I/s4_v02 model



Geometry

- > Gaps between TPC modules implemented by Frank only in the radial direction
- > Gaps are 1mm thick
- > In the plot, they are 20mm thick in order to be visible



Summary of single hit resolution formula

> Summary of previous discussions and Keisuke's mail

Single hit resolution in $r\phi$

$$\sigma_{r\phi}^2 = \frac{A}{N_{\text{eff}}} + \frac{L^2}{12 \hat{N}_{\text{eff}}} \tan^2 \phi + \frac{D_t^2}{N_{\text{eff}}} \quad (1)$$

The following equations hold true:

$$(2) \quad \sigma_0^2 = \frac{A}{N_{\text{eff}}}$$

$$(3) \quad N_{\text{eff}} \approx \frac{N_{\text{eff}}(\theta=90^\circ)}{\sin \theta}$$

$$(4) \quad \hat{N}_{\text{eff}} \approx \frac{\hat{N}_{\text{eff}}(\theta=90^\circ)}{\sin \theta}$$

$$(5) \quad \tan^2 \phi \approx \sin^2 \phi \quad \text{for small } \phi \text{ angles}$$

$$(6) \quad D_t \approx D_t^{(B=4T)} \frac{4T}{B}$$

$$(1) \xrightarrow{\substack{(2)(3)(4) \\ (5)(6)}} \sigma_{r\phi}^2 = \sigma_0^2 + \frac{L^2 \sin \theta}{12 \hat{N}_{\text{eff}}(\theta=90^\circ)} \sin^2 \phi + \frac{D_t^{(B=4T)^2}}{N_{\text{eff}}(\theta=90^\circ)} \left(\frac{4T}{B}\right)^2 \sin \theta \quad (7)$$



Summary of single hit resolution formula (2)

$$\textcircled{1} \begin{matrix} \textcircled{2} \textcircled{3} \textcircled{4} \\ \textcircled{5} \textcircled{6} \end{matrix} \rightarrow \sigma_{\text{req}}^2 = \sigma_0^2 + \frac{L^2 \sin\theta}{12 N_{\text{eff}}(\theta=90^\circ)} \sin^2\varphi + \frac{D_t^2 (10^{-4})}{N_{\text{eff}}(\theta=90^\circ)} \left(\frac{4}{B}\right)^2 \sin\theta \cdot z$$

Values used for the different quantities

$$\sigma_0^2 = 50^2 \mu\text{m}^2$$

$$N_{\text{eff}} = 22$$

$$\frac{L^2}{12 N_{\text{eff}}} = 900^2 \mu\text{m}^2$$

$$D_t = 25$$

⑧

Using the values in ⑧ and eq(7), we get

$$\sigma_{\text{req}}^2 = 50^2 + 900^2 \sin\theta \sin^2\varphi + \frac{25^2}{22} \left(\frac{4}{B}\right)^2 \sin\theta \cdot z$$

What is currently implemented in the simulation

$$\sigma_{\text{req}}^2 = 50^2 + 900^2 \sin^2\varphi + \frac{25^2}{22} \left(\frac{4}{B}\right)^2 \sin\theta \cdot z$$

Questions:

> Sinθ is missing on the 2nd term of the resolution formula in the simulation. It is there on the 3rd term. Add it on the 2nd?

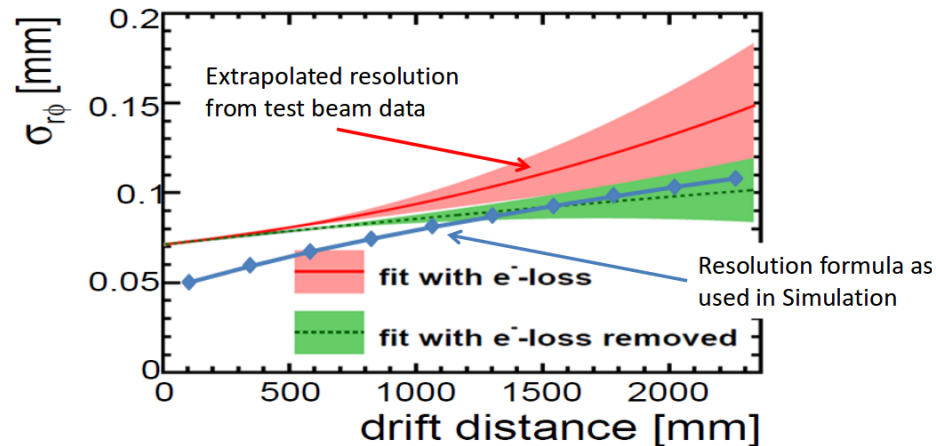
- It doesn't appear in the DBD formula either on the 2nd term

> Why are we making the approximation from tanφ to sinφ?



Point resolution: Measurements vs simulation

> Presented by Ties in AWLC



- > We wanted to be conservative but this is not the case for ~half the TPC volume
- > Best measurement for σ_0 at 55 μ m
- > Older measurement give σ_0 ~70 μ m
- > 50 μ m is used in the simulation



Overview

- > Model dimensions updated to account for ECal increased thickness
- > Radial gaps between models added
- > Resolution formula updated according to what was discussed last time

- > Model frozen yesterday. Do we want to make changes?
- > If so, that should should be done this week! Next week (or even this week) we will have a small validation production



Back-Up

