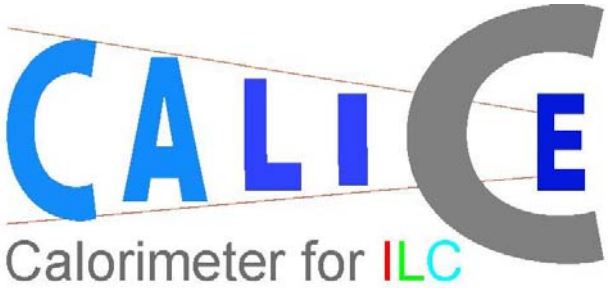


Angular and Position resolution

Michele Faucci Giannelli

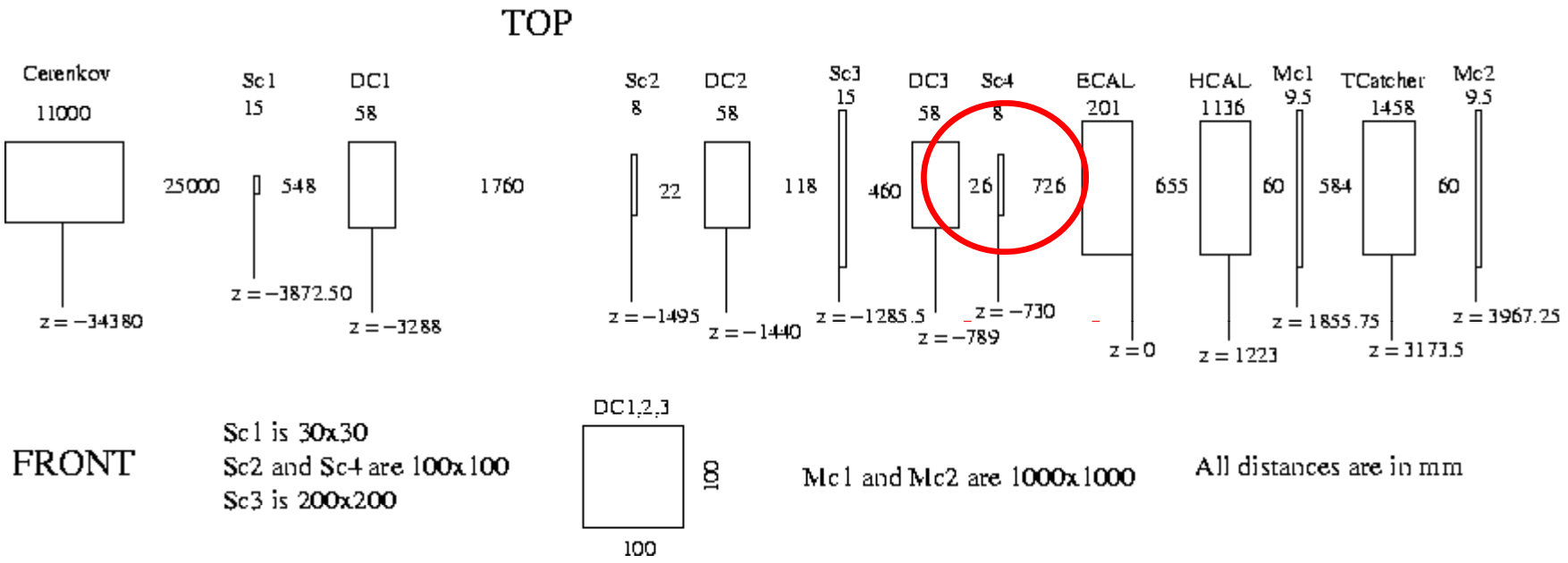
SiW ECAL Meeting, UCL, 8th June 2009

Overview

- Introduction:
  - Beam line in 2006
- Event selection
- Angular resolution
- Position resolution
  - S-curve correction
- First look at systematic errors:
  - Tracking
  - Selection effect
- Conclusion

Beam Line in 2006

H6 Area at CERN

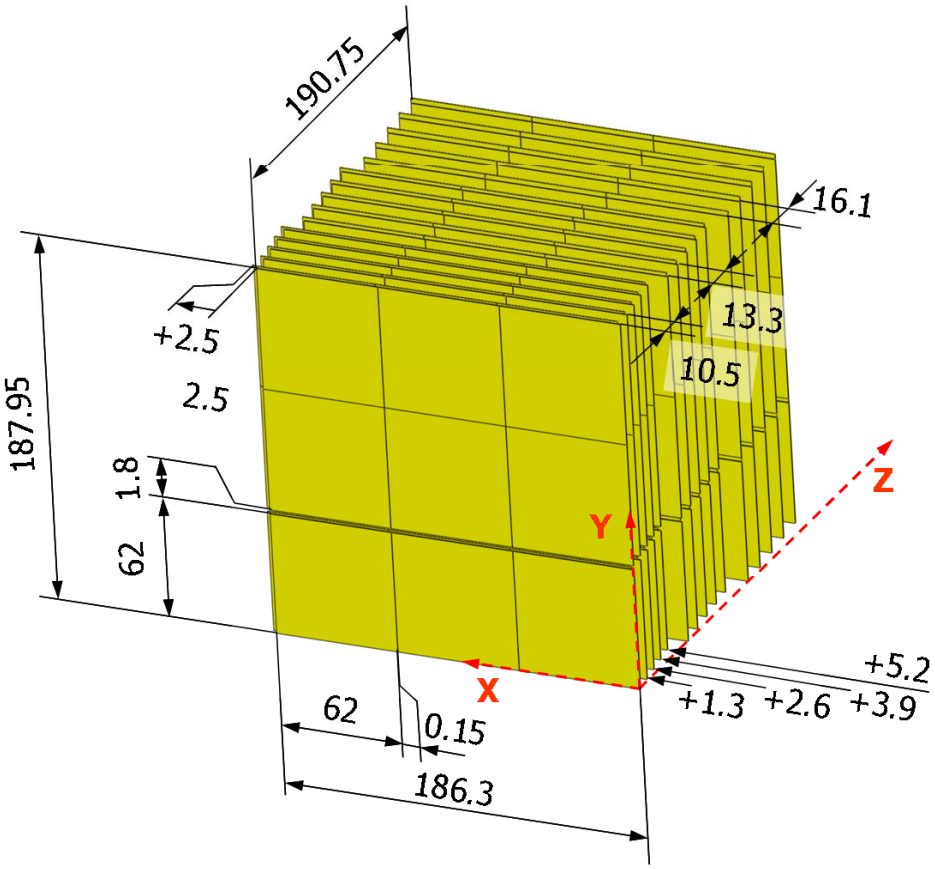


In principle this is the best period to study position resolution as the DC3-Ecal distance was the smallest among all test beam periods

No survey for tracking alignment
No Calibration for the drift chambers (2007 values should be usable)

ECAL in 2006

- Only top 3×2 wafers installed
- Staggering on X
  - 2.5 mm between the two layers in a slab
  - 1.3 mm between slabs in each sector
- No staggering on Y



Run and event selection

- The same runs used for the energy resolution paper were used for this study

Run	Energy (GeV)
300670	6
300672	10
300235	15
300236	20
300207	30
300202	40
300208	45

- Reconstruction version is the latest available: reco_v0406
- Electrons were selected in each run using the paper selection:
  - 0.6 MIP threshold
  - $0.5\ E_{peak} < E < 1.5\ E_{peak}$
  - Cherenkov
  - Single cluster: T_{max}

Tracking

- Official tracking is available for these runs
  - Some parameters still need to be fine-tuned
- Required both direction to be well reconstructed
  - Chi - Probability > 0.1
- If more than one track is reconstructed, the best one (highest probability) is chosen
- Both directions are required or the event is discarded

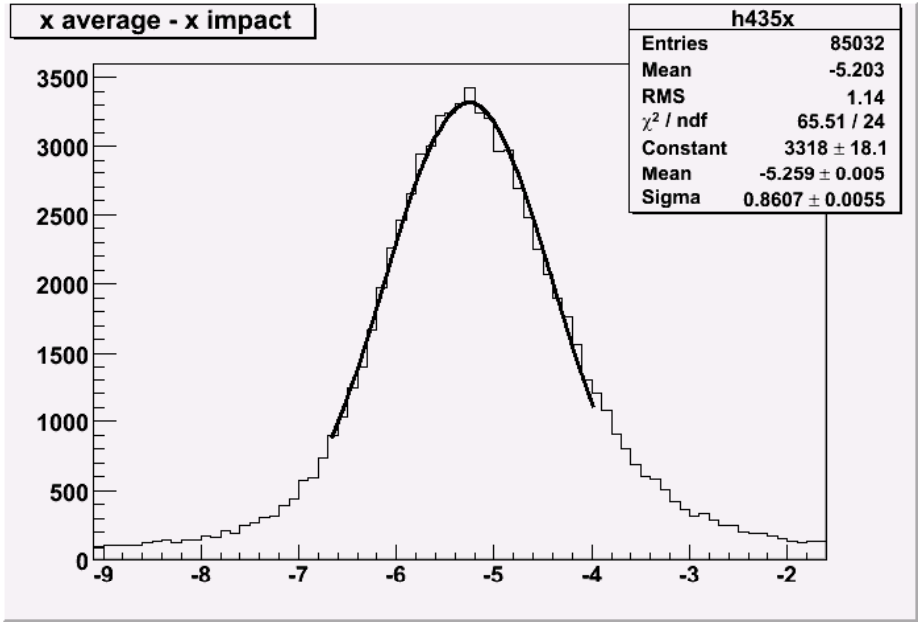
Resolutions

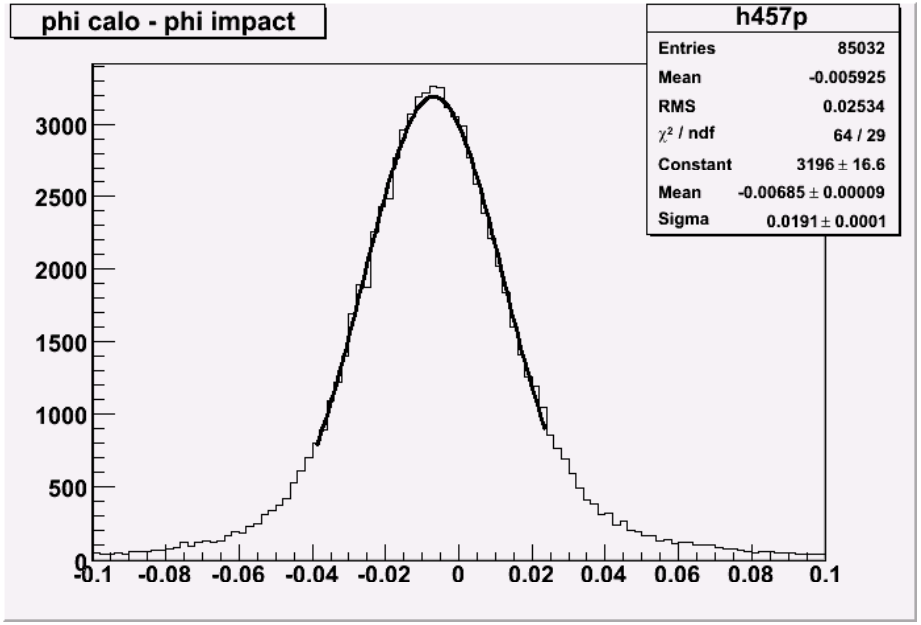
The position resolution is evaluated from the distribution of

$$X_{ECAL} - X_{Track}$$

The same is done for the angles along the planes X-Z and Y-Z

$$Angle_{ECAL} - Angle_{Track}$$

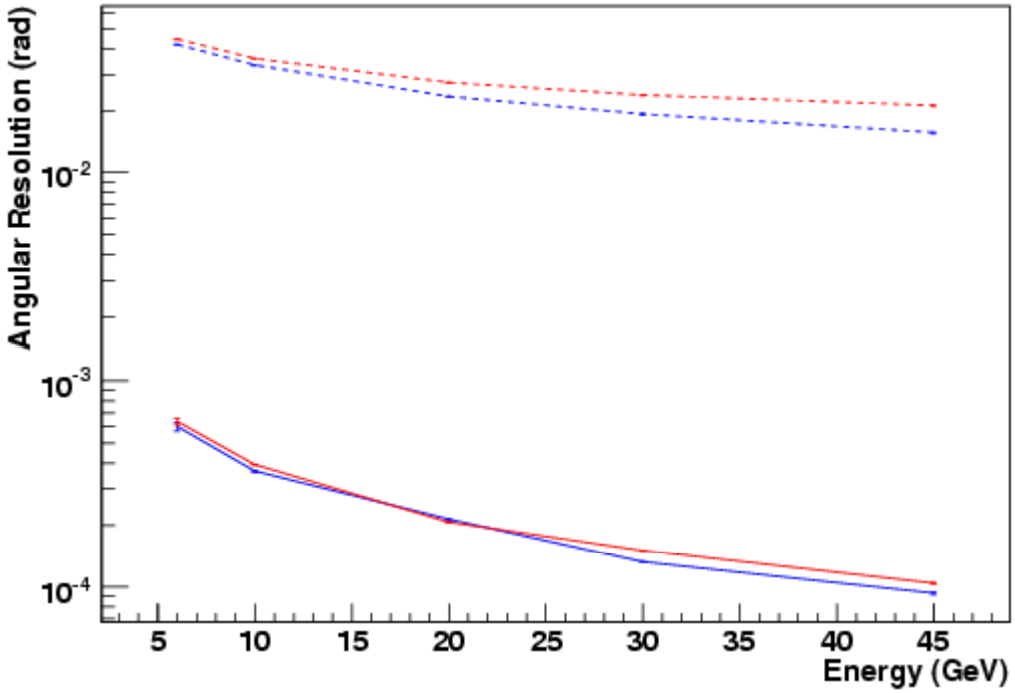




A first fit is performed without imposing a range, then the fit is iterated in the range (–σ,+σ) until the difference between the fitted mean and the previous one is smaller than the error on the mean.
The sigma of the latest fit is the resolution.

Angular resolution

In MC, TRUE entry point and entry angle are compared to reconstructed value from ECAL and Tracking

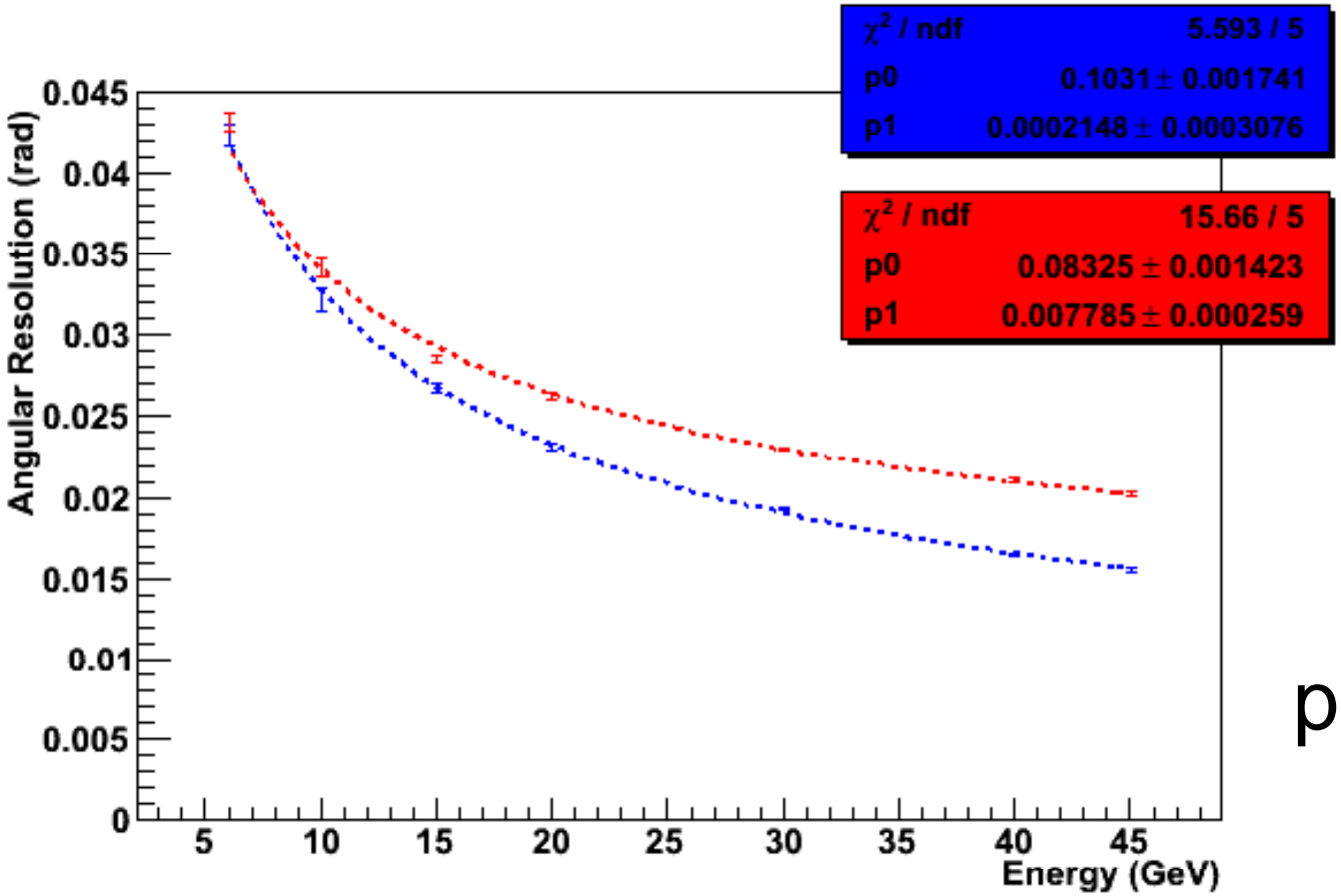


ECAL

Tracking

Tracking should not affect the angular resolution

Angular resolution



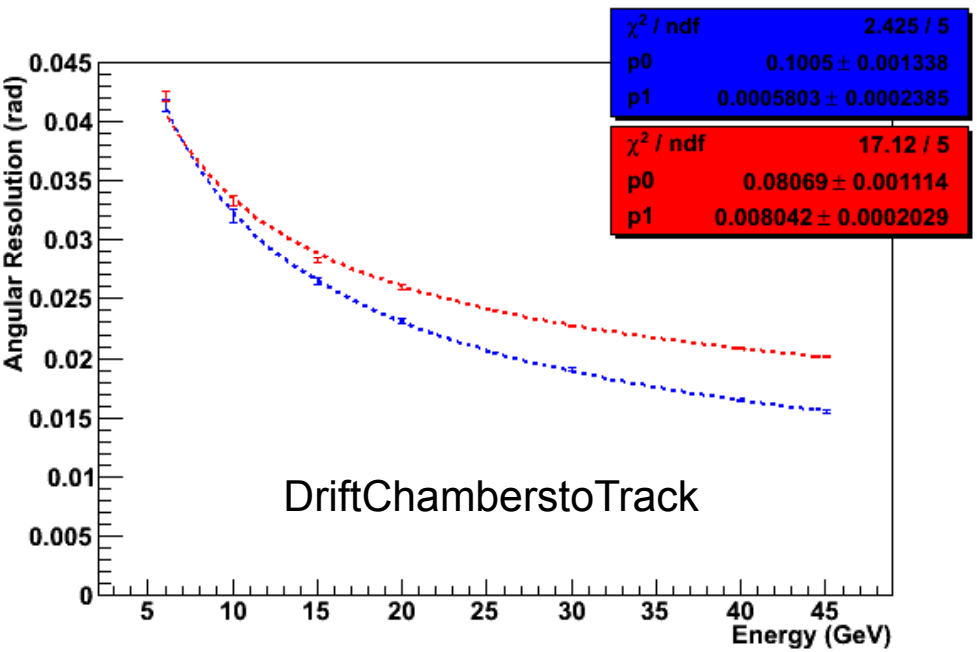
X axis

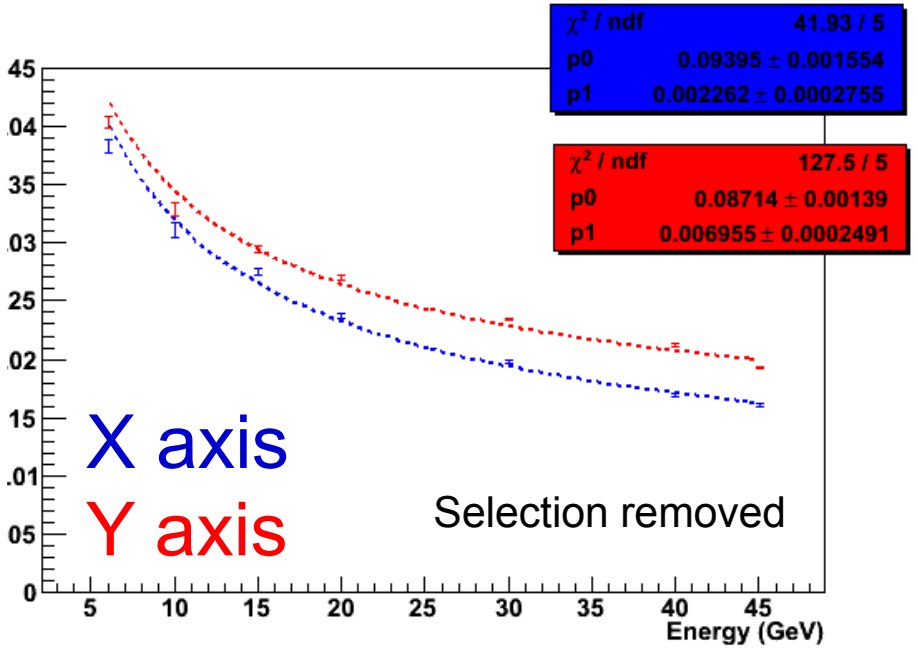
Y axis

$p0/\sqrt{E} + p1$

- The difference between axis is explained by the different width of the ECAL:
  - 2 wafers along Y, 3 along X

Angular resolution





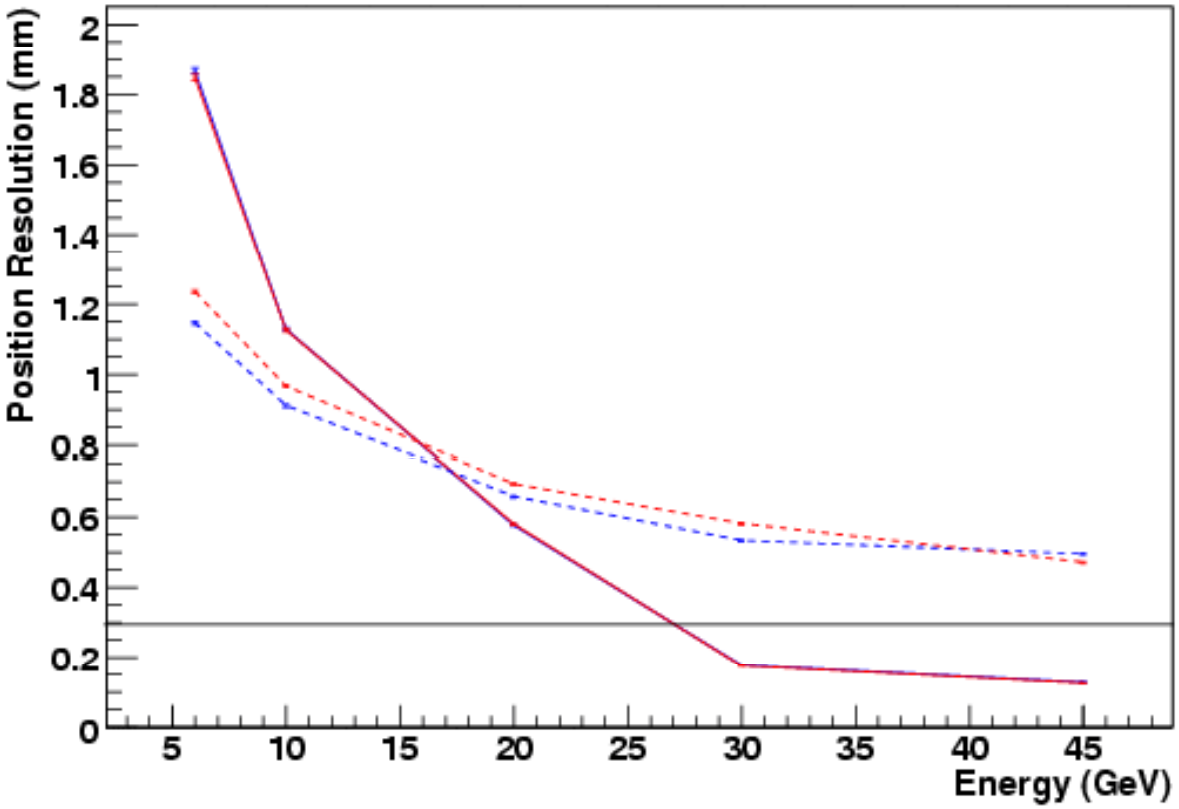
Comparison along X axis

Tracking	Official	Simple	No selection
p0 (mrad)	103.1 ± 1.7	100.5 ± 1.3	94 ± 2
p1 (mrad)	0.2 ± 0.3	0.6 ± 0.2	2.2 ± 0.3

Selection has larger effect than tracking (as expected)

Position resolution

From MC is possible to evaluate the different contributions to the position resolutions



ECAL

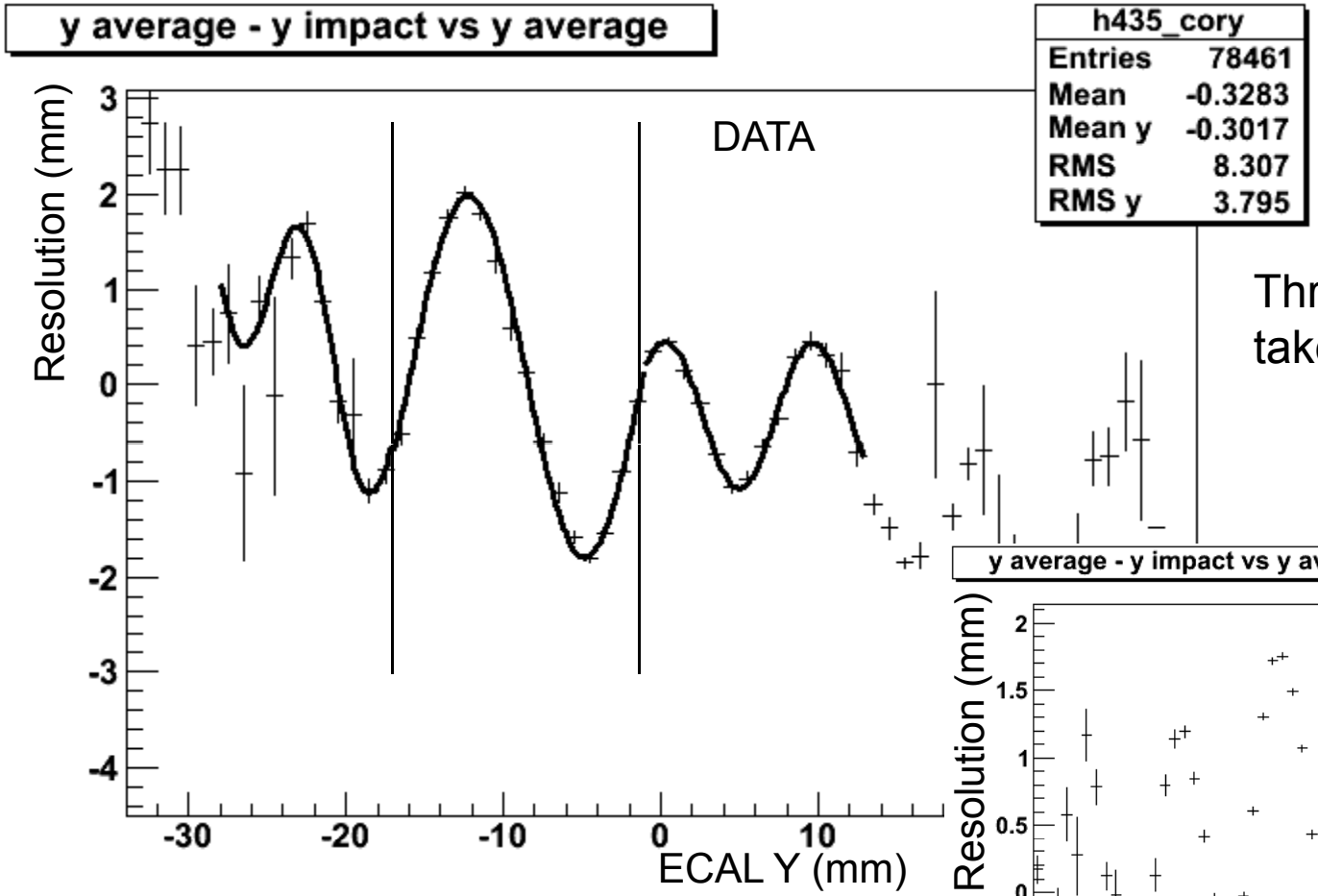
Tracking

The continuous line is the contribution from intrinsic resolution of tracking chambers

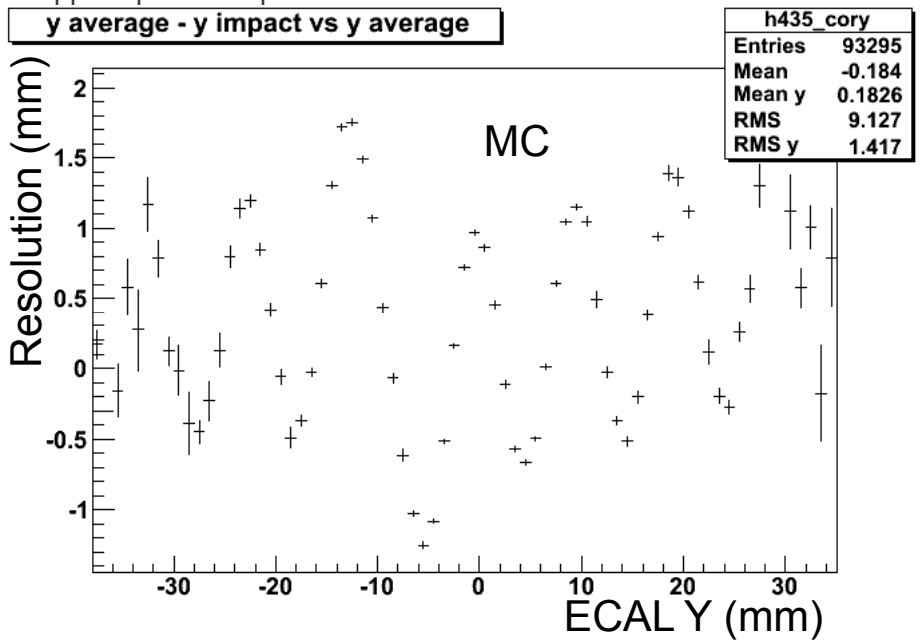
S-curve

- Cell structure of ECAL causes an increase of the ECAL resolution
- The resolution ($X_{ECAL} - X_{Track}$) is zero if the particle hits the centre of a cell but is different from zero (thus increasing the sigma of the distribution) if the hit happens anywhere else
- Plotted as a function of the ECAL position, the resolution has a sinusoidal behavior
- The presence of gaps between wafers has to be taken into account

S-curve (Y)

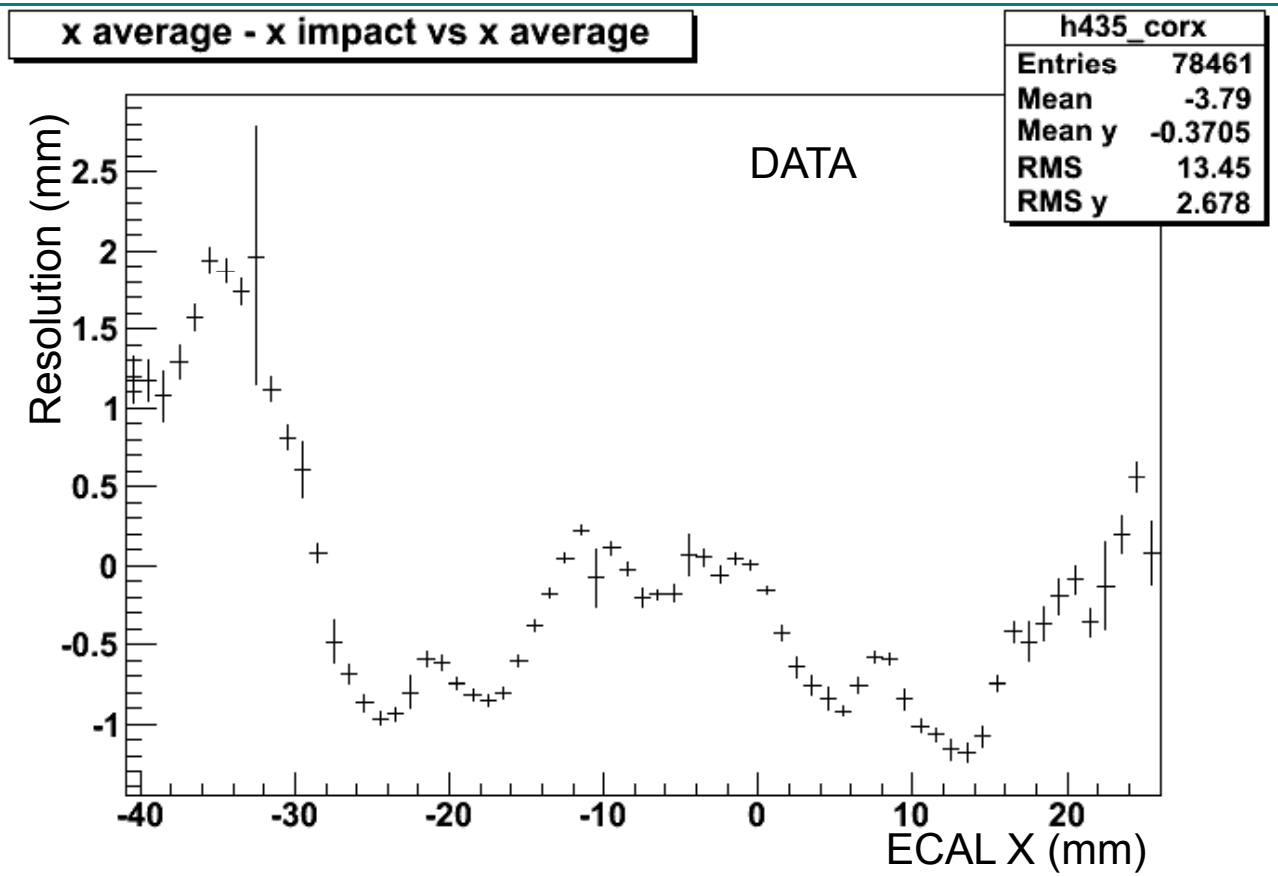


Three region of fit to take in account the gap

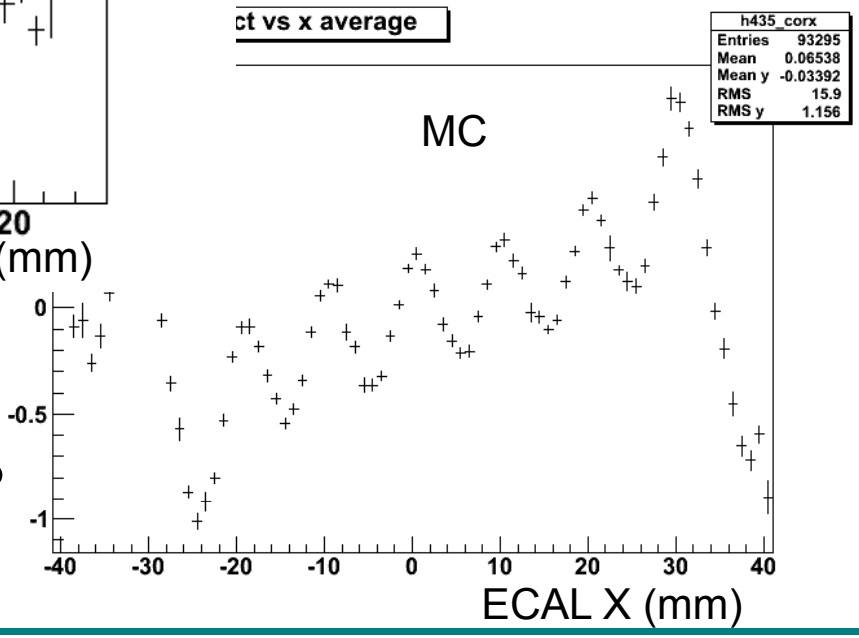


Good agreement with MC

S-curve (X)

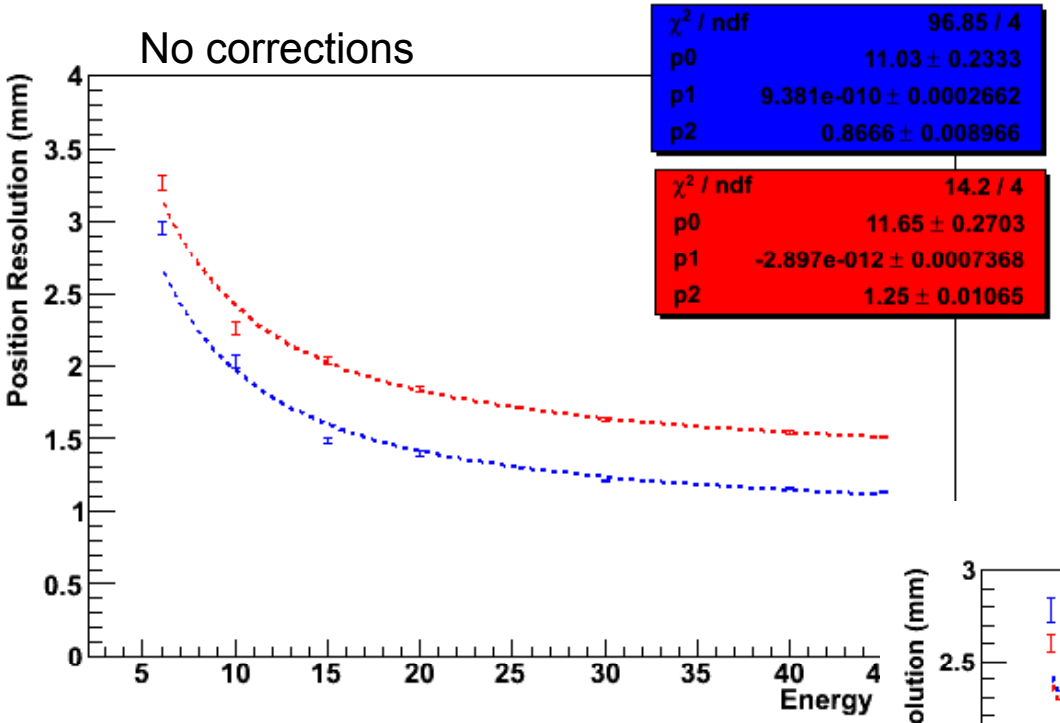


Difficult to correct for cell structure



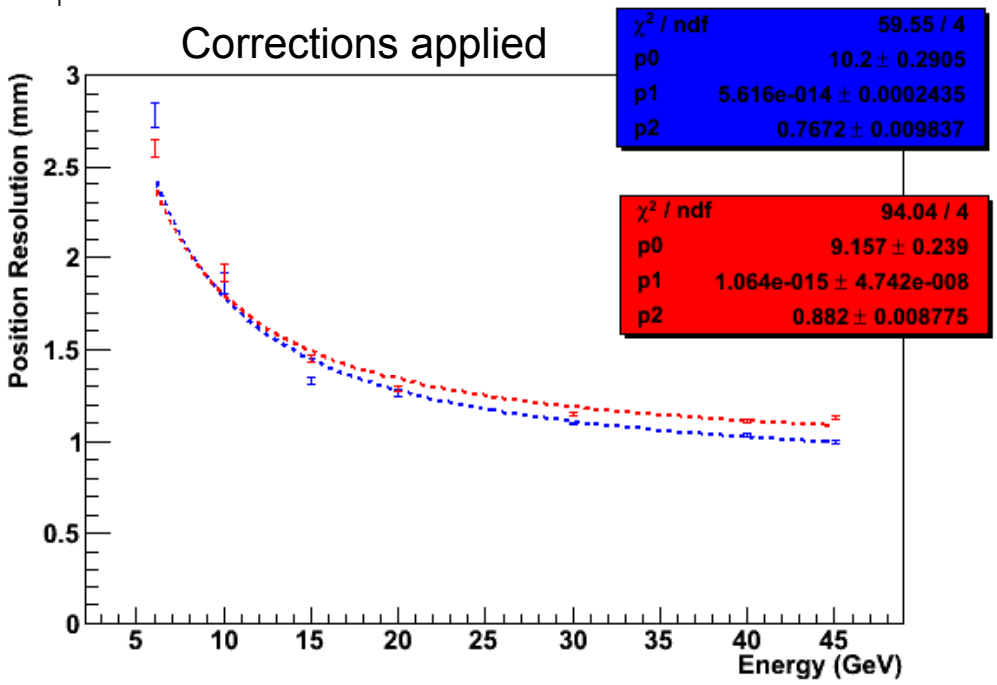
Does the MC include all staggering?

Effect of correction



X axis

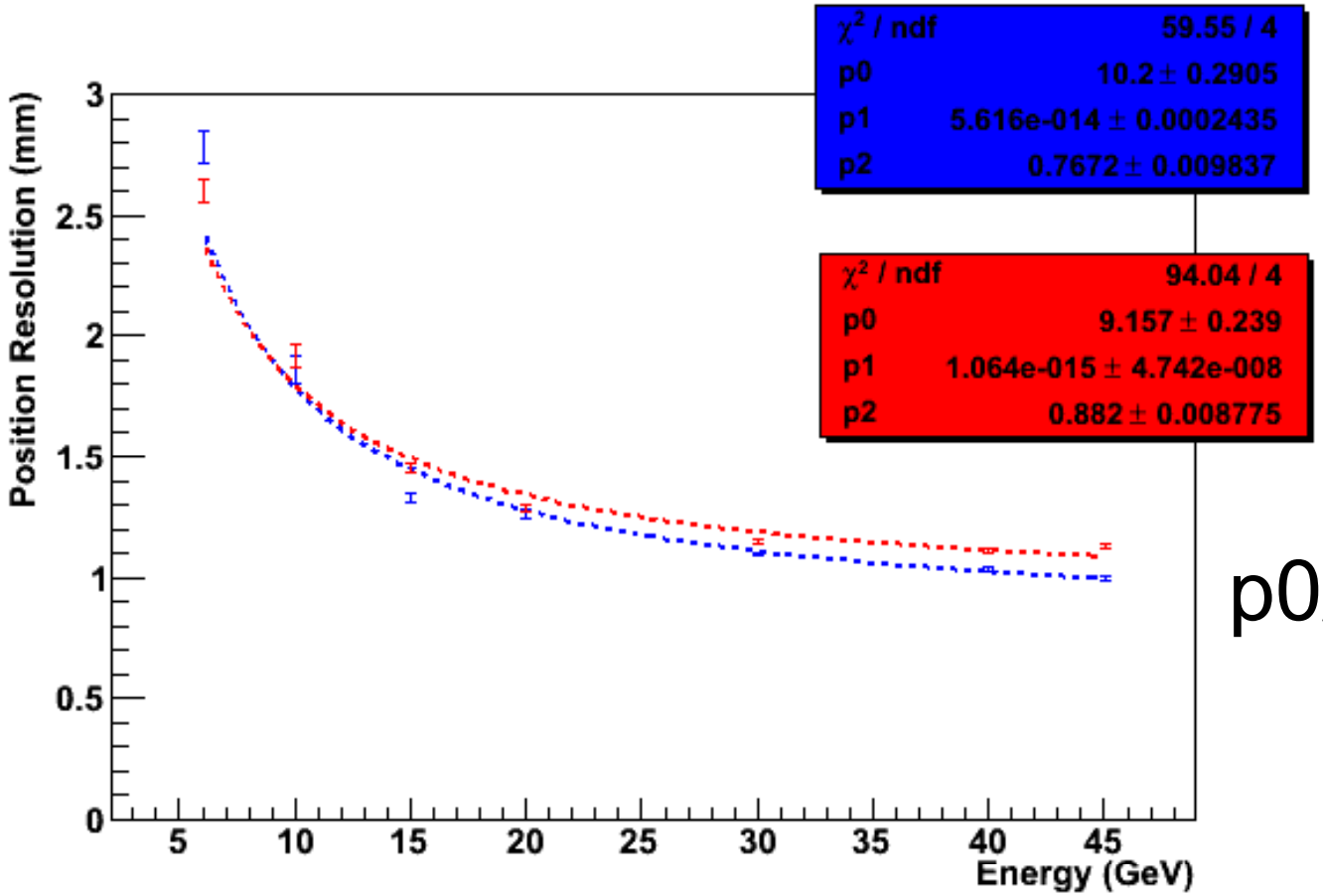
Y axis



Large improvement especially along Y

(at 45 GeV from 1.6 mm to 1.2 mm)

Position resolution



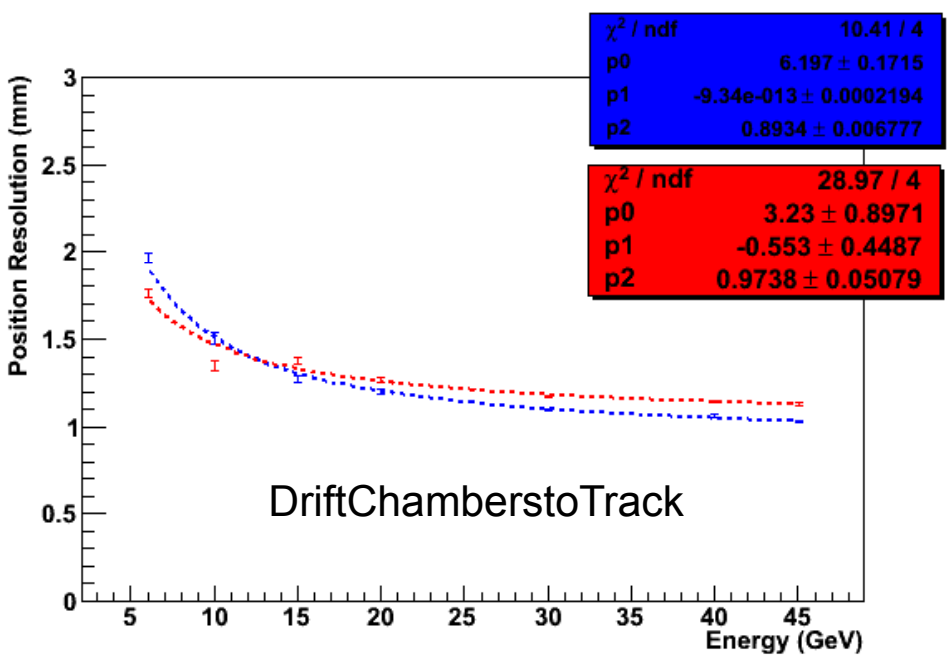
X axis

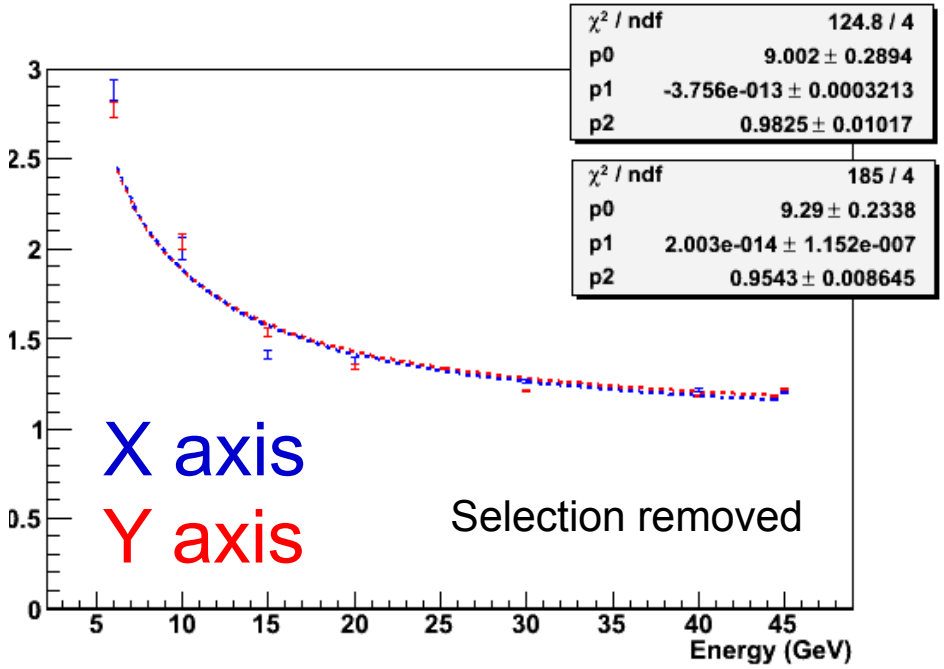
Y axis

$p0/E+p1/\sqrt{E}+p2$

Fit has poor quality and term scaling as $1/\sqrt{E}$ is 0
Likely due to a high contribution from tracking

Position resolution





For the points not affected by MS (above 20 GeV) the results from simple tracking and official tracking are similar, the fit is different because of the low energy points

The selection of the electrons has a larger impact on the results
Need to perform a deeper study to find what is the main cause and how our cut are affected

Conclusion

- Position and angular resolution are under study:
  - several problems to be understood
  - the core of analysis is ready and it is possible to study several effects
- Focus on systematic errors:
  - Large effect from selection: pions or pre-shower? how much dependent on cut values?
  - Hit threshold
  - Limits of fits (S-curve, final fit, Gauss fit)
- Need the updated MC files
  - with reconstructed tracks and entry point in ECAL