ECAL analysis and very first comparisons with MC simulations

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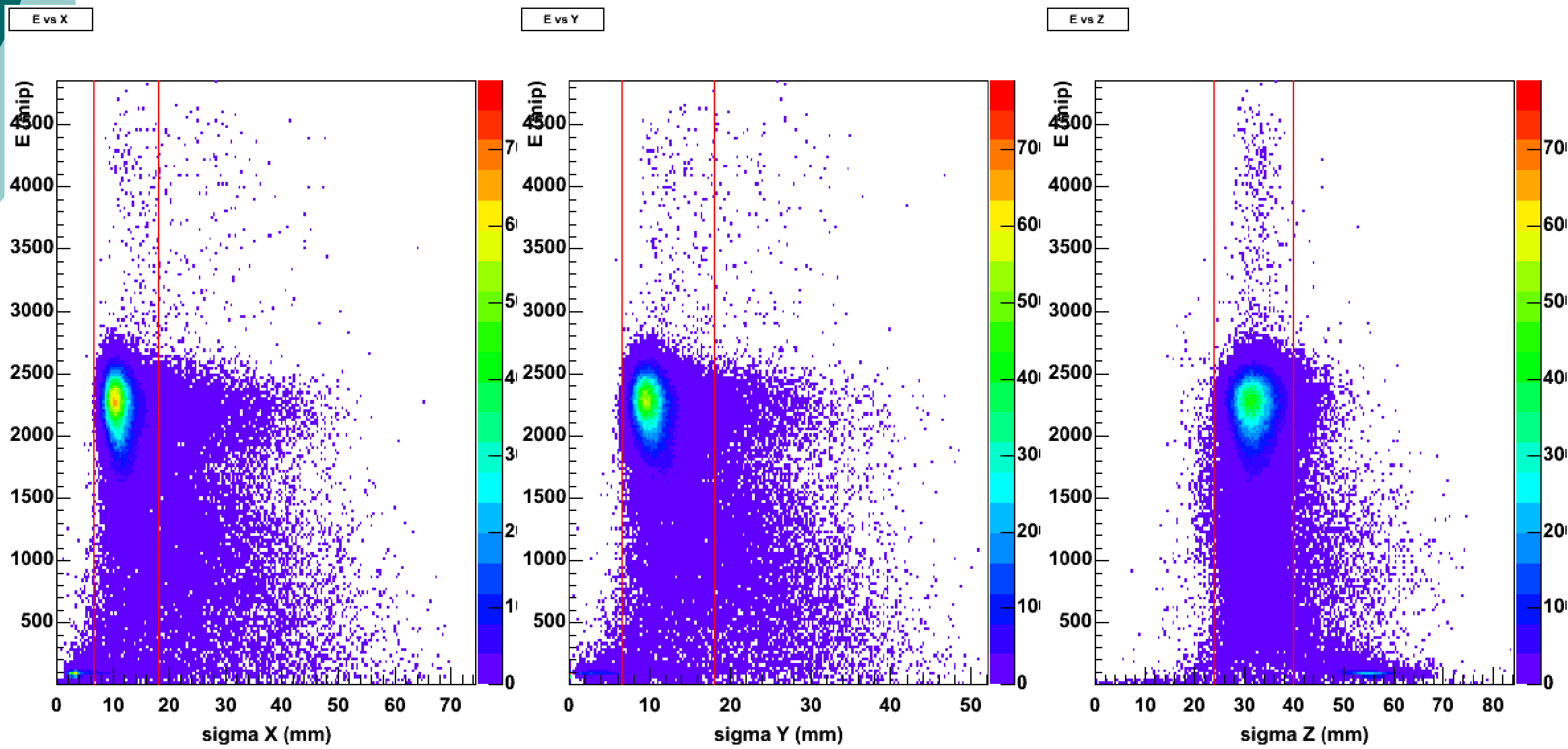
Inside the CERN data

- Focus on e^- inside the Ecal at 0 degree and at 20, 30 and 45 degrees
- Version 04.02 of calice_reco

Electron selection (i.e. rejection of other particles) with the shower shape

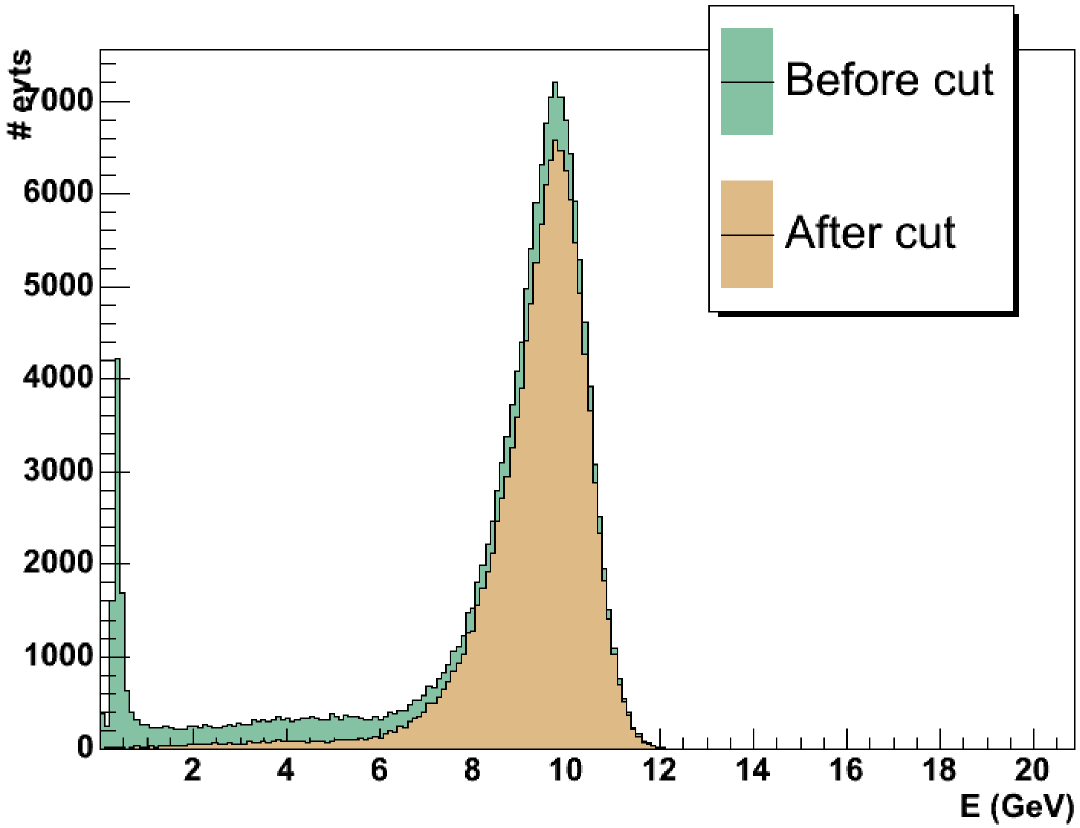
Sigma X,Y,Z = root mean square in X,Y,Z of the shower



Run 300672 e⁻ **10 GeV**

Electron selection (i.e. rejection of other particles)

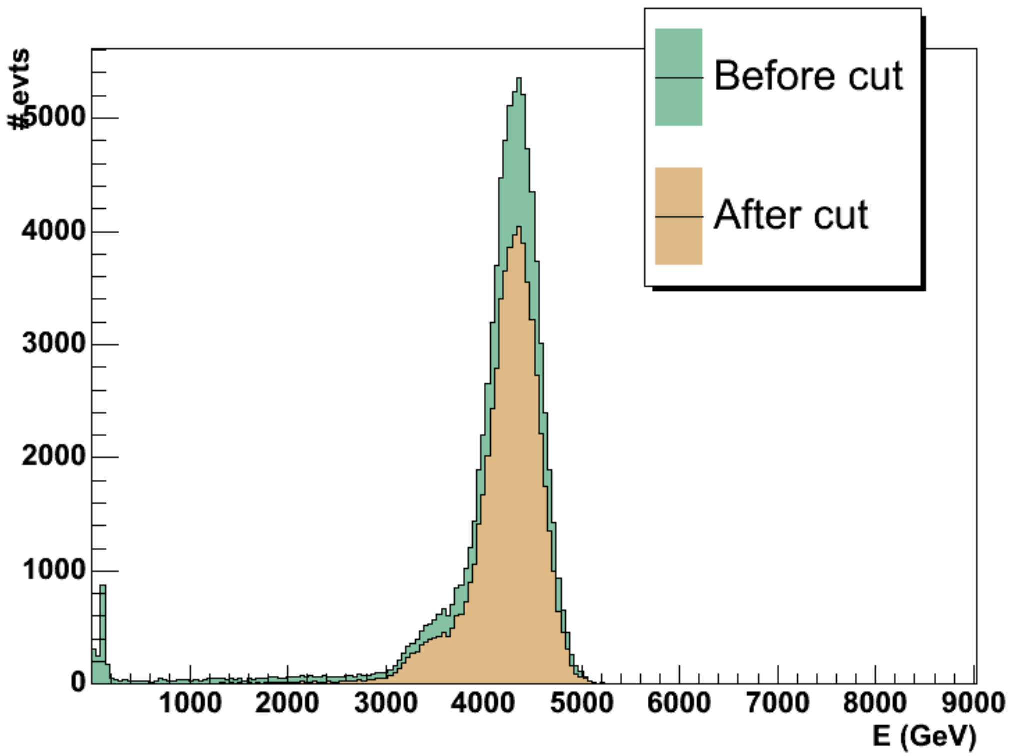
- Very clean separation (few e^- lost)
- Still a tail at low energy



Run 300762 e^- **10 GeV**

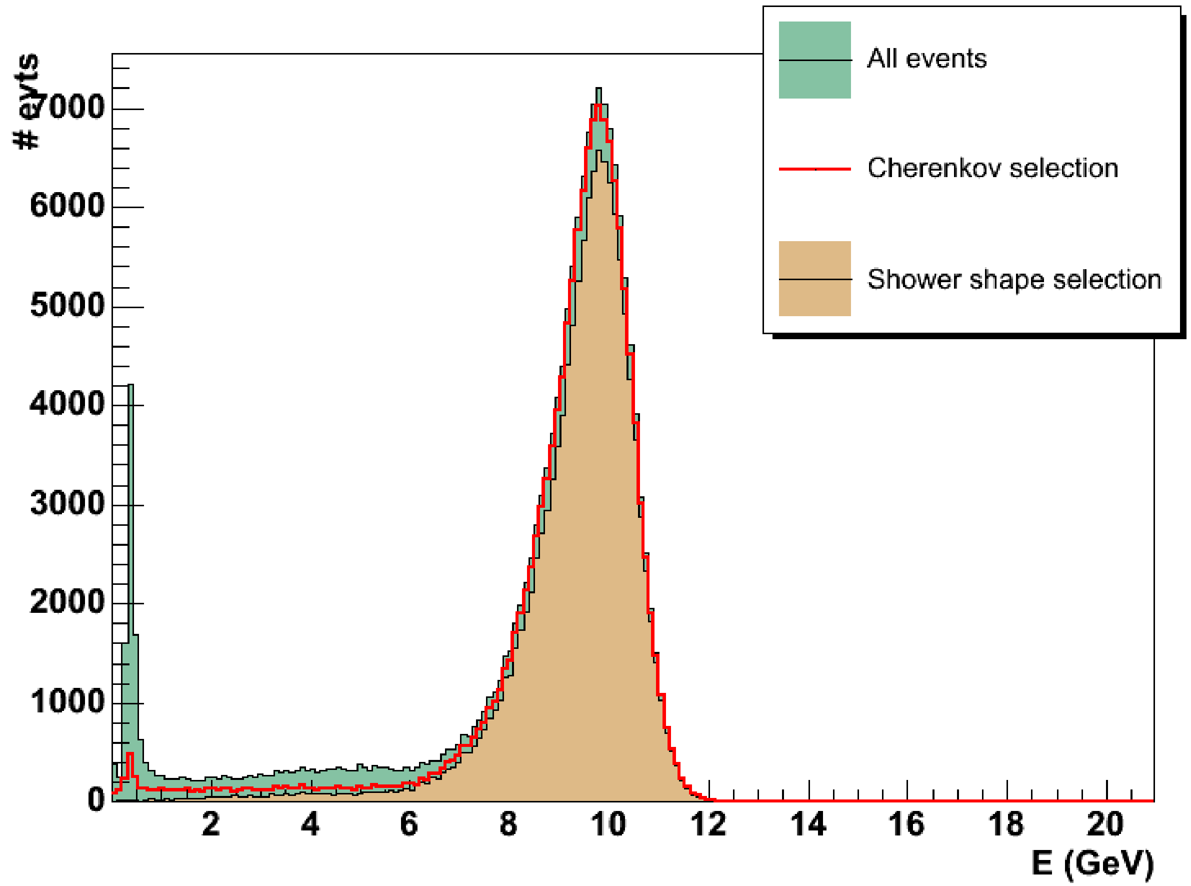
Electron selection (i.e. rejection of other particles) with rotated ECal

- All we needed is Ecal angle from the beam line.
- This selection is still available with non-normal particle
- θ=20,30,45 deg.



Run300304 (20 GeV e-)
θ(Ecal) = 45 deg.

Comparison with the Cherenkov

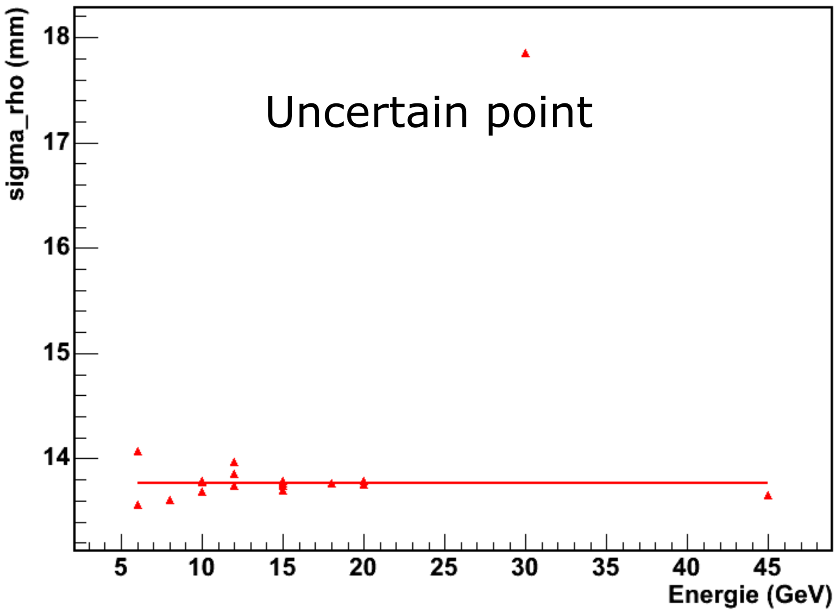


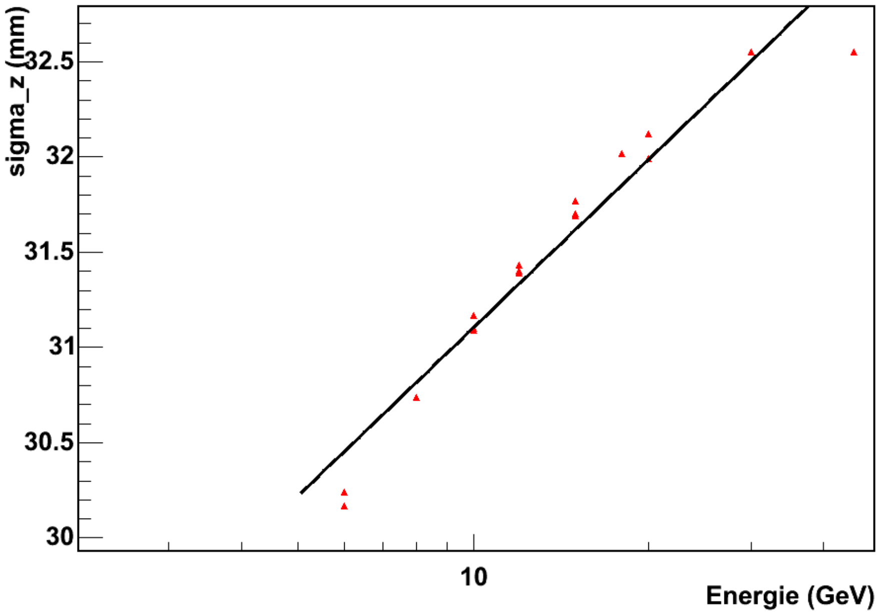
Run 300672 e⁻ **10 GeV**

Evolution of the shower shape as a function of the energy

- $\sigma_\rho=(\sigma_x^2+\sigma_y^2)^{1/2}$ has practically no variation with E
- σ_z increases as log(E)

$\Rightarrow$ Good criterion to identify electrons





Remark

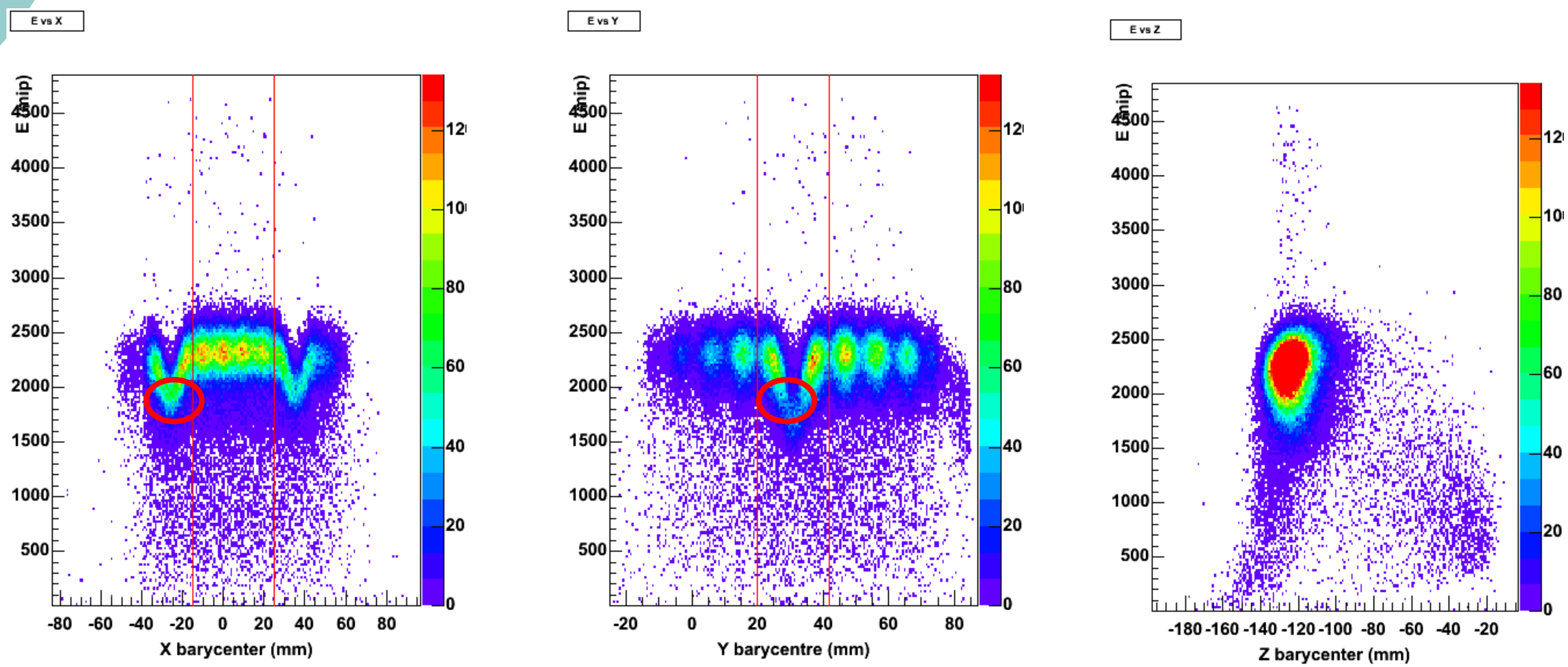
- We observed that:

  σ_x (~11.2mm) > σ_y (~10.2mm)

  Probably due to a misalignment in X of the different active layers
- Maybe the new reconstruction code will improve this alignment

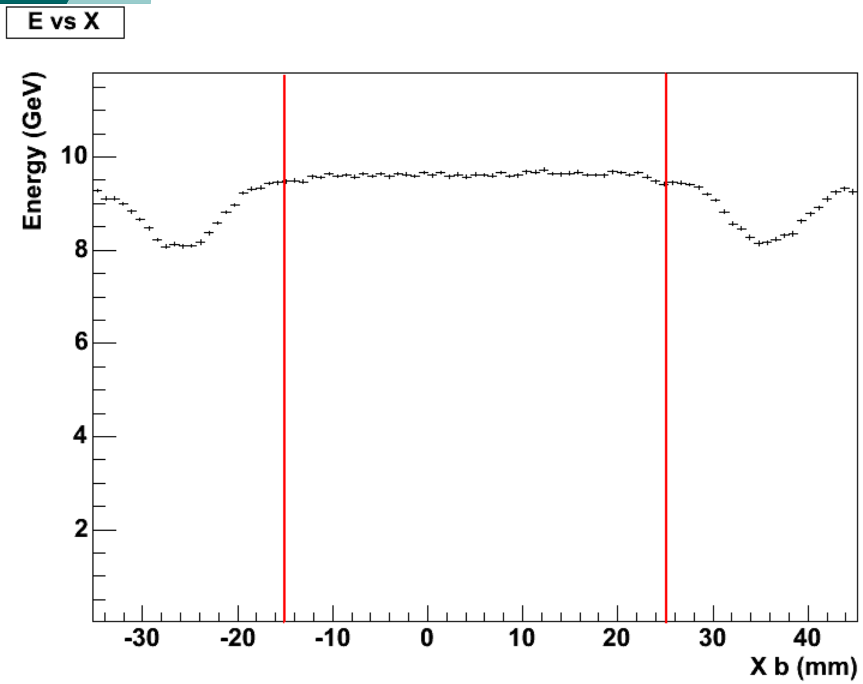
Mapping of the e⁻ reconstructed energy

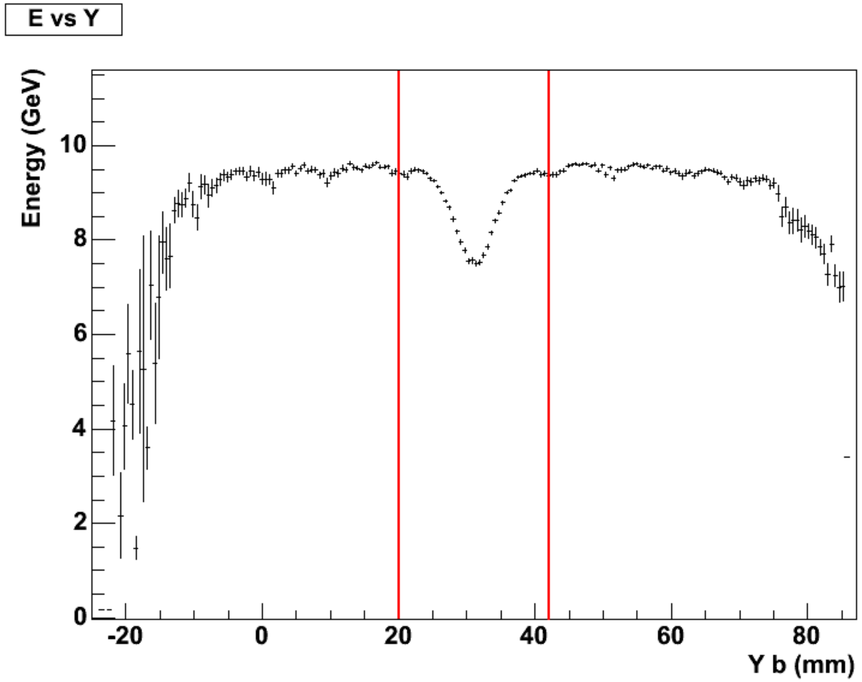
- Tails at low energy due to the guard rings
- New cuts in order to reject the events affected by the inefficiency of the guard rings



Run 300762 e⁻ 10 GeV

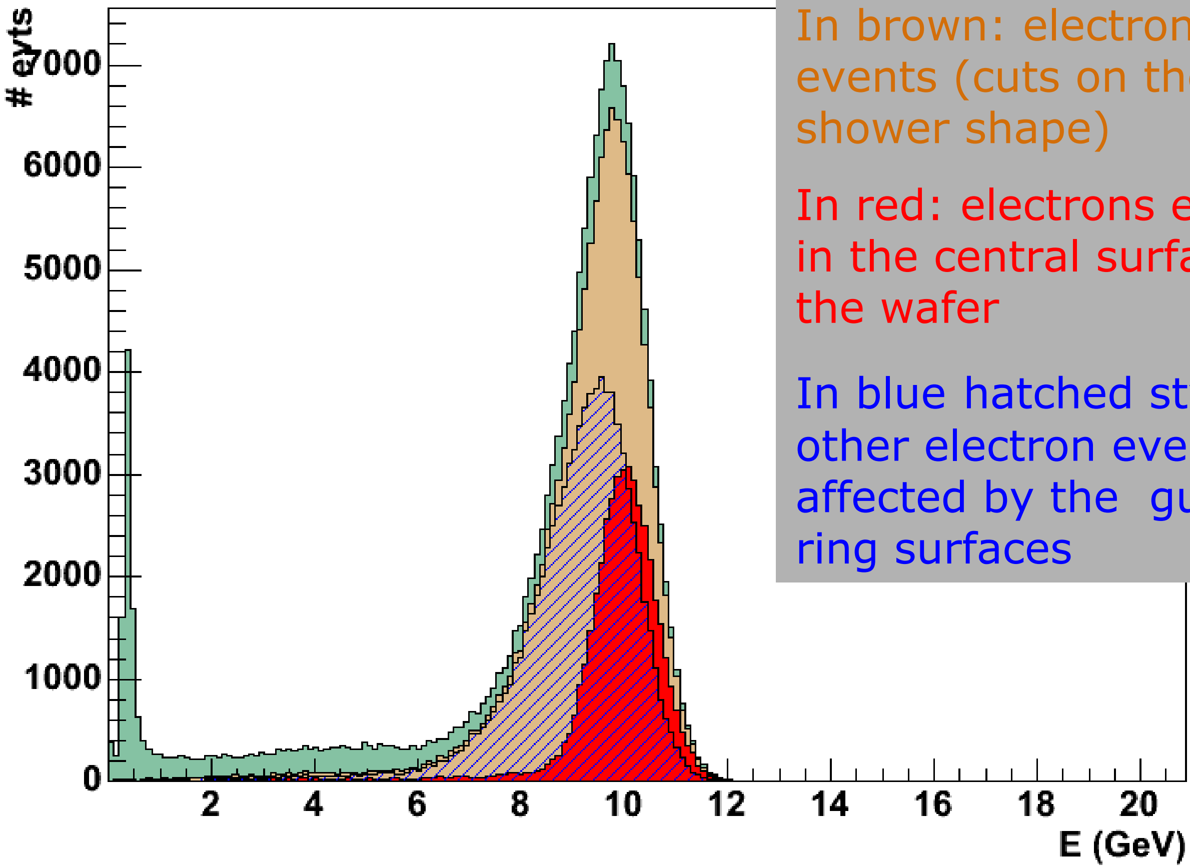
Checking: cuts on the e^- barycentre distributions





Run 300762 e^- **10 GeV**

Energy spectra



In green: all events

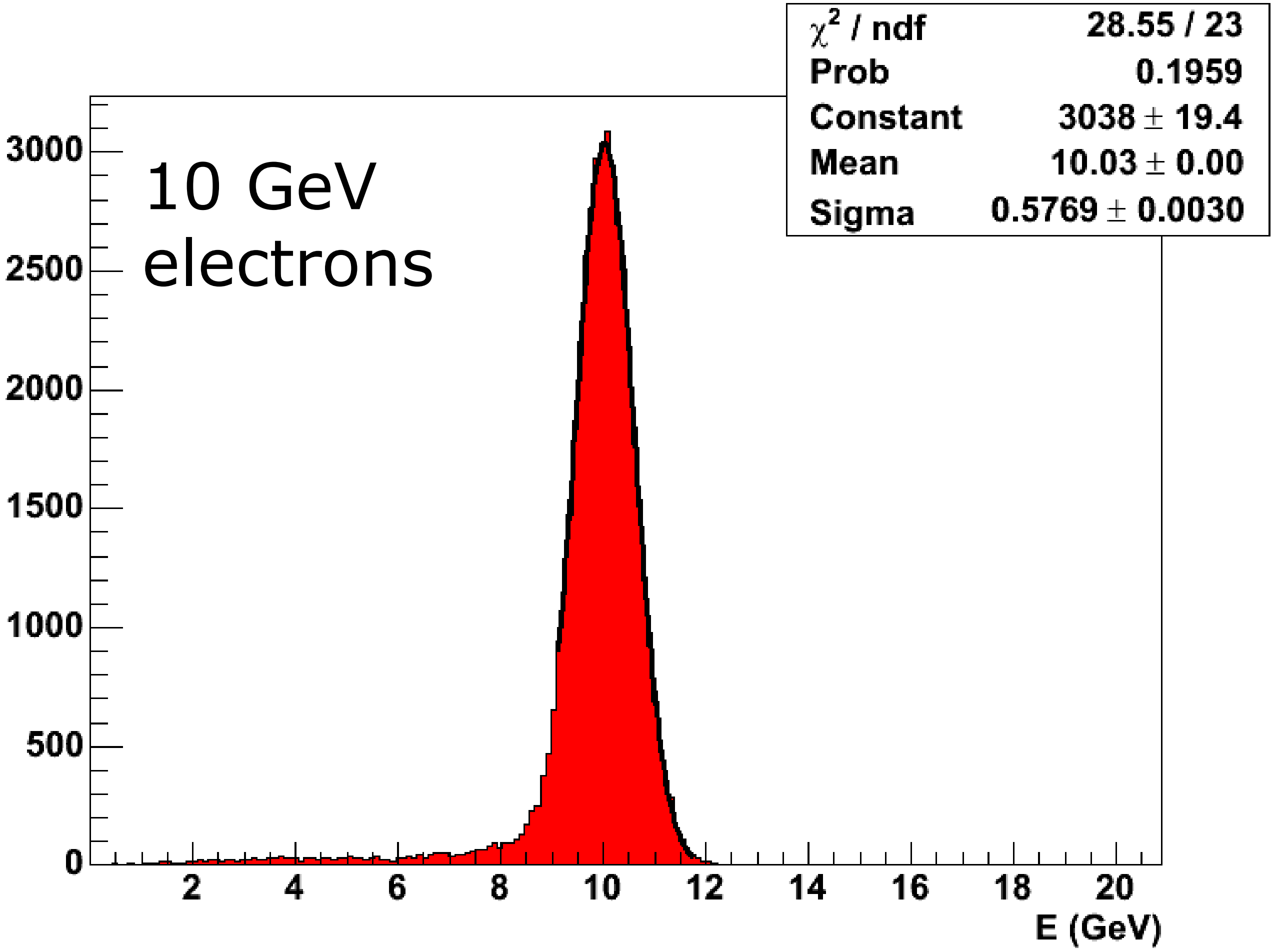
In brown: electrons events (cuts on the shower shape)

In red: electrons events in the central surface of the wafer

In blue hatched style : other electron events affected by the guard ring surfaces

Run 300762 e$^-$ **10 GeV**

Energy resolution : Gaussian fit (-1.5 σ,3 σ)

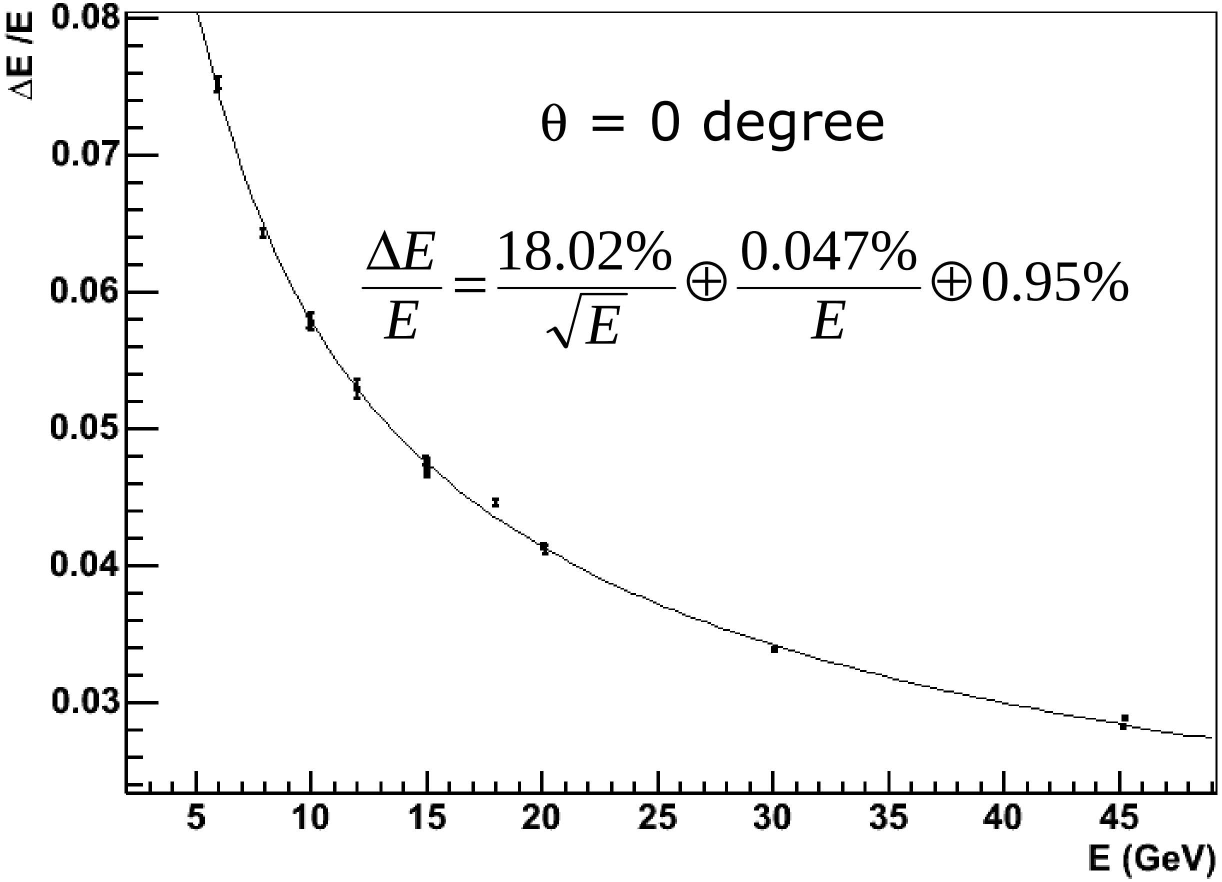


$$\frac{\sigma}{E} \approx \frac{a}{\sqrt{E}}$$

With
a ≈ 18.2 %

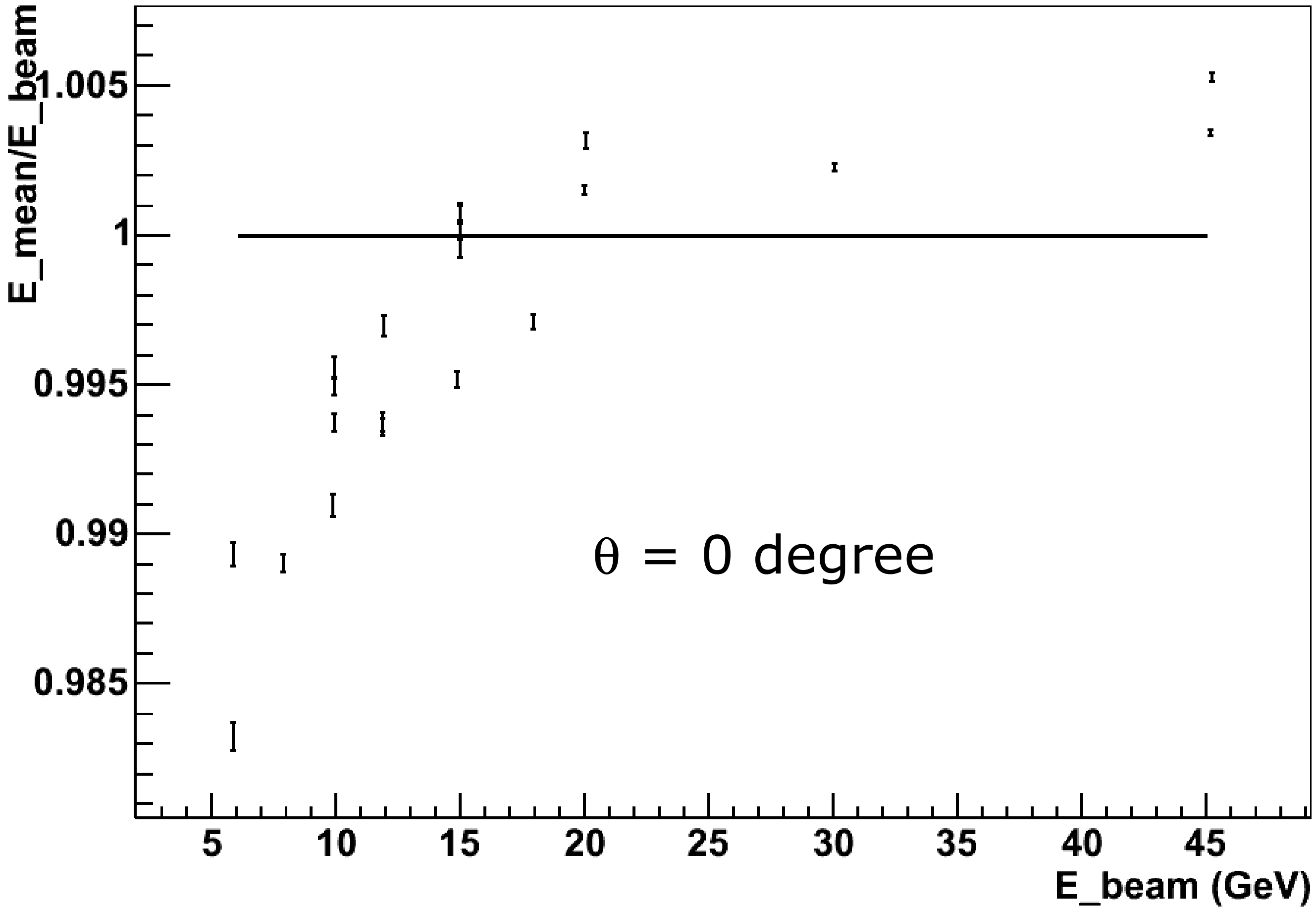
Run 300762 e⁻ 10 GeV

Energy resolution



$$\frac{\Delta E}{E} = \frac{18.02\%}{\sqrt{E}} \oplus \frac{0.047\%}{E} \oplus 0.95\%$$

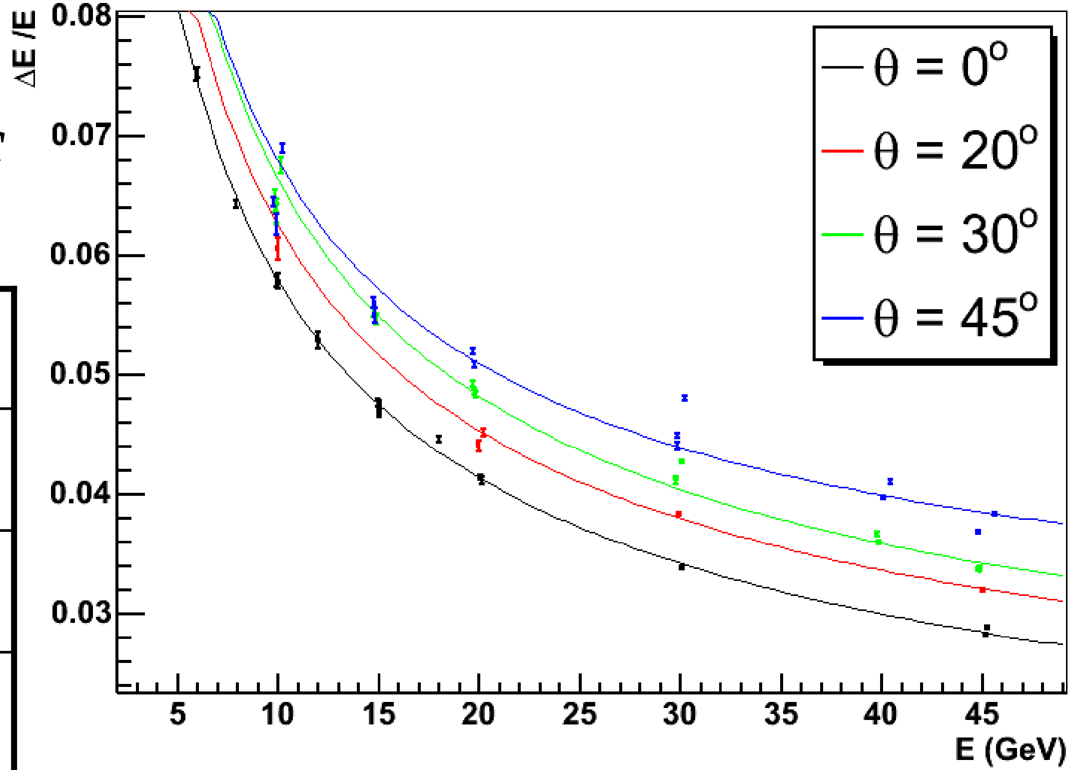
Linearity


E_mean/E_beam
1.005
1
0.995
0.99
0.985
5
10
15
20
25
30
35
40
45
E_beam (GeV)
θ = 0 degree

Energy resolution with rotated Ecal

$$\frac{\Delta E}{E} = \frac{a}{\sqrt{E}} \oplus \frac{0.047}{E} \oplus c$$

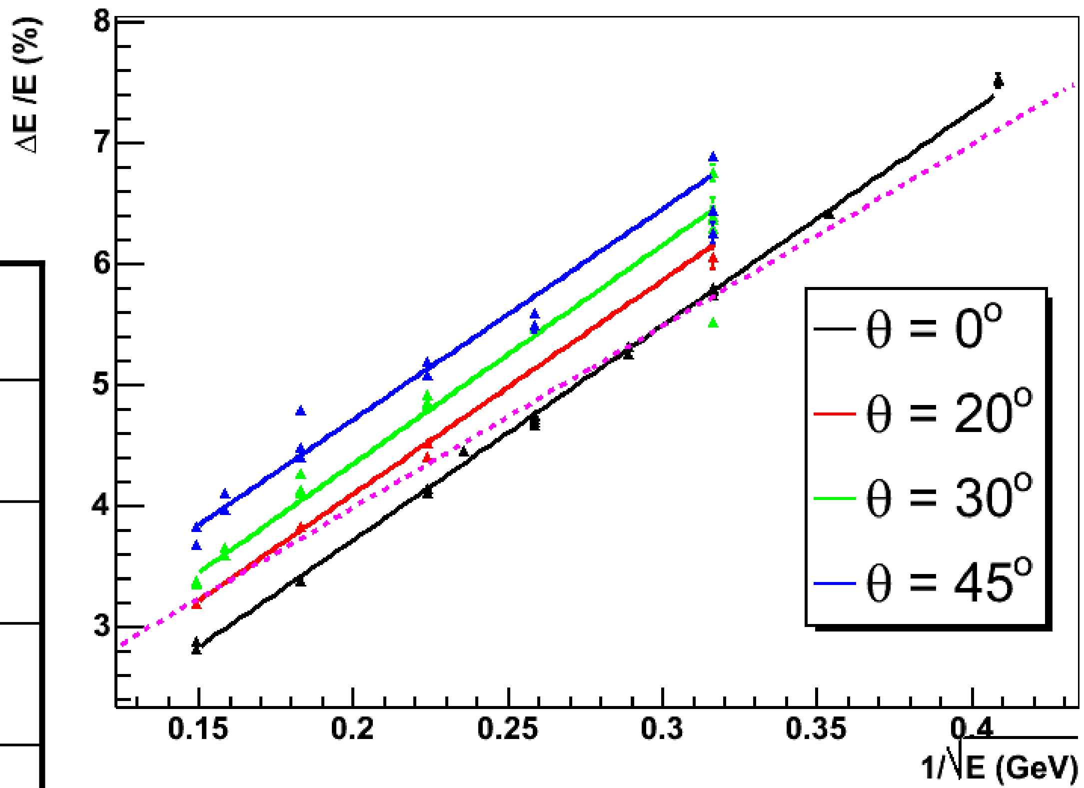
Angle	a (%)	c (%)
0	18.02 ± 0.05	0.95 ± 0.04
20	19.18 ± 0.16	1.47 ± 0.06
30	20.33 ± 0.06	1.61 ± 0.02
45	19.99 ± 0.08	2.4 ± 0.02



Energy resolution with rotated Ecal

$$\frac{\Delta E}{E} = \frac{a}{\sqrt{E}} + c$$

Angle	a (%)	c (%)
0	17.69 ± 0.09	0.19± 0.02
20	17.65 ± 0.28	1.76 ± 0.05
30	18.04 ± 0.10	0.76 ± 0.02
45	17.7 ± 0.13	1.2 ± 0.02



Beam contribution (in progress)

- From the CERN manual of H6 beam :

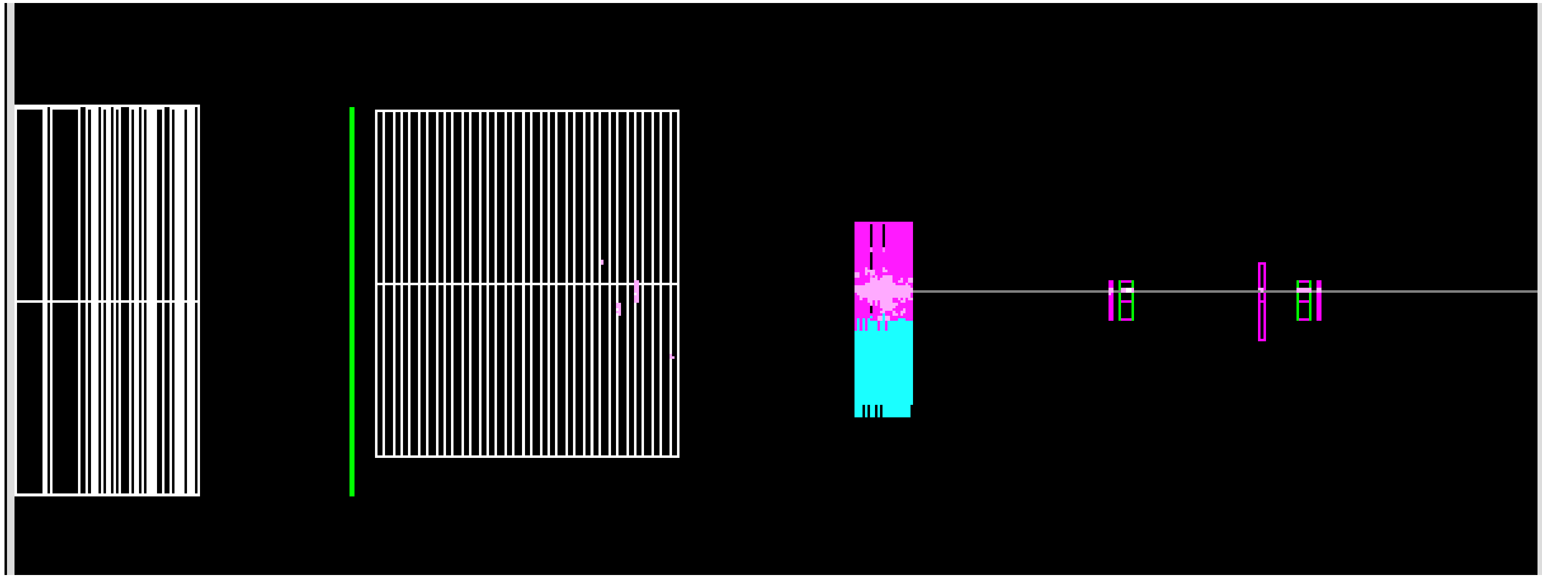
$$\frac{\Delta p}{p} = \frac{\sqrt{C3^2 + C8^2}}{19.4\%}$$

  Where C3 and C8 are the full width opening of collimators

- C3 and C8 are stored in the TB dB, that I don't know how to use it

First step inside Monte-Carlo Simulation (θ =0 degree)

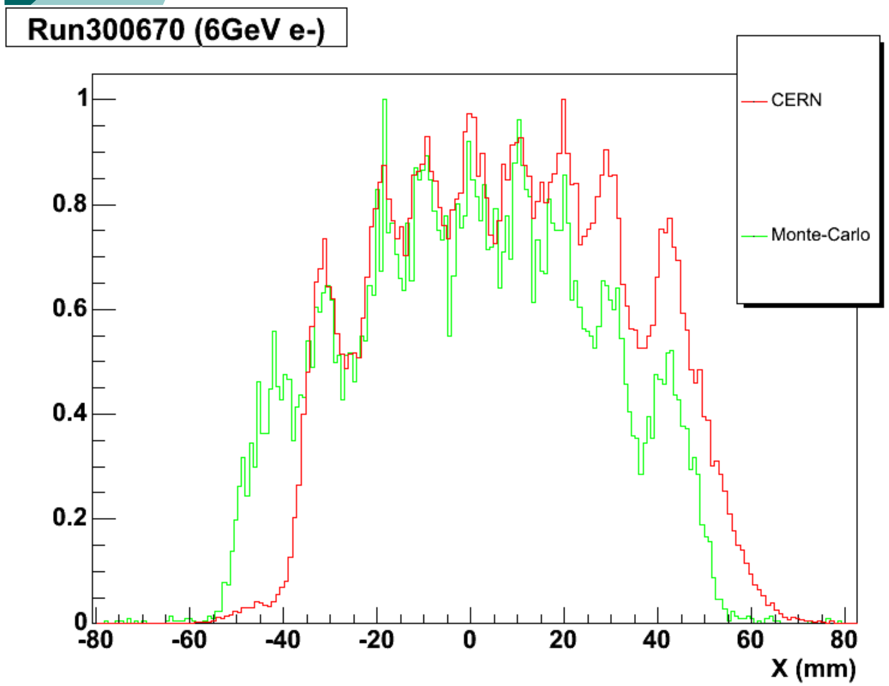
- Using Mokka with the detectors model TB0806

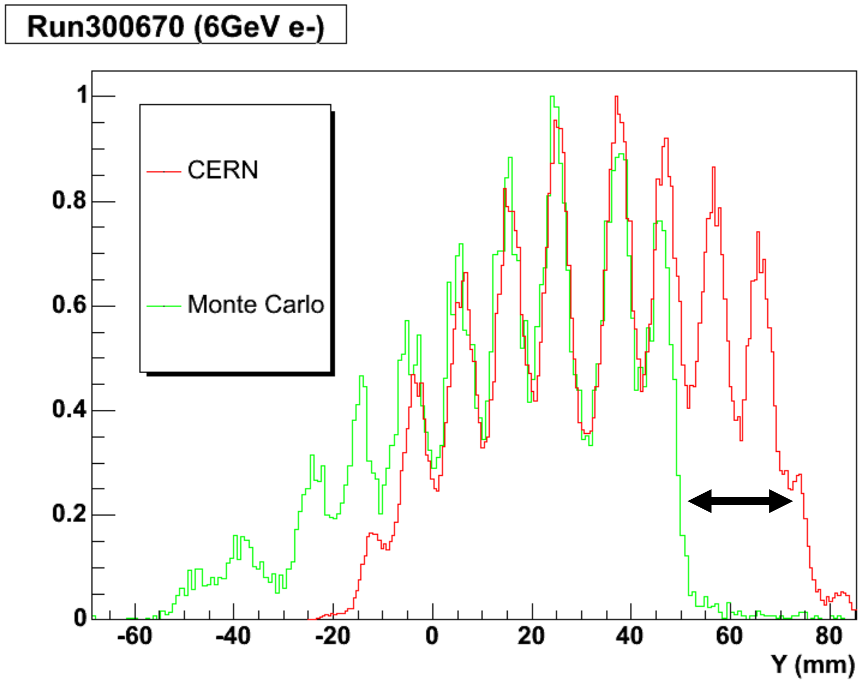


Visualization of an e- event

Beam profile

- We use SC2 and SC4 in coincidence to reproduce the trigger signal

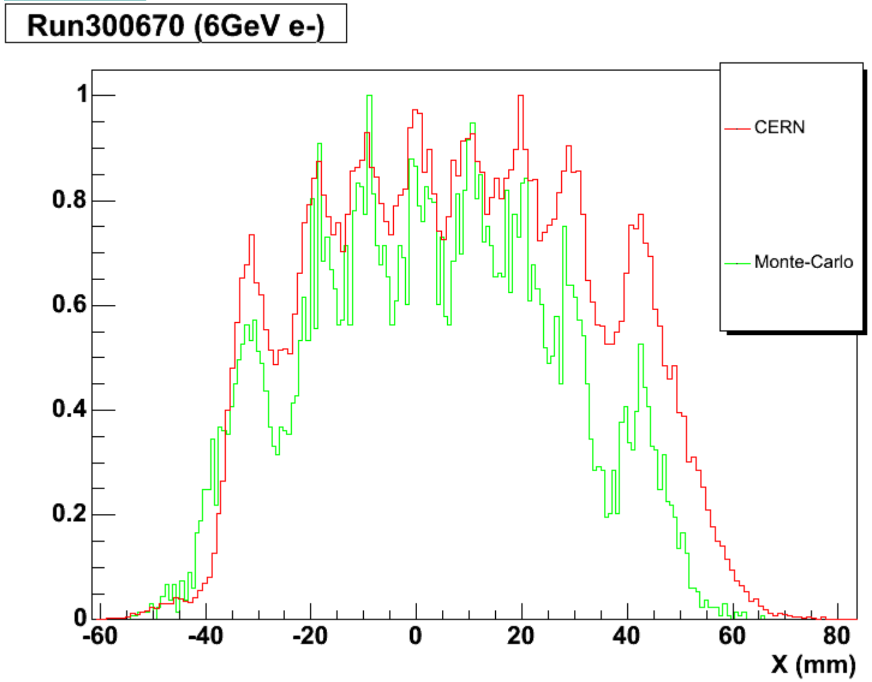


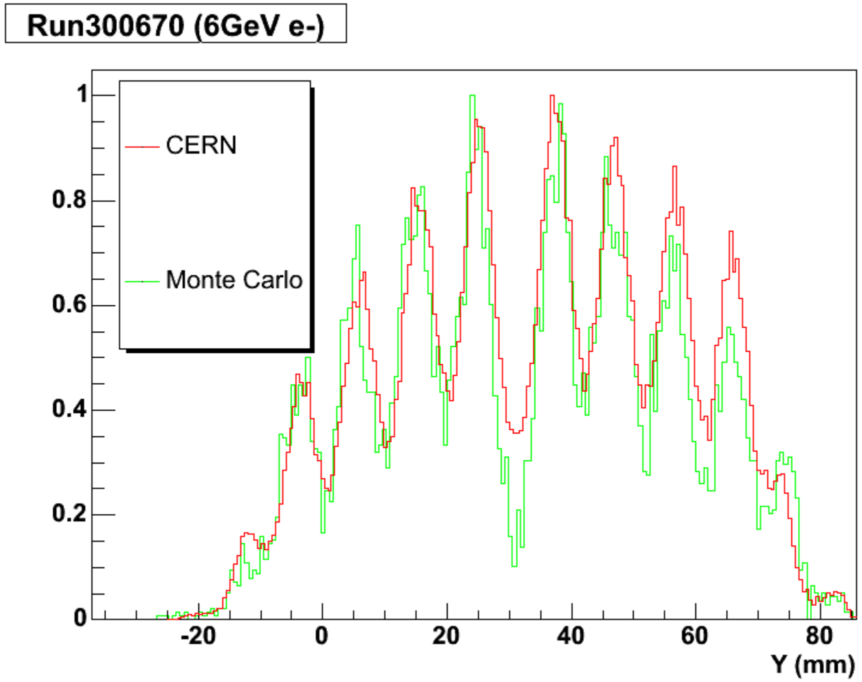


Shift of about 30 mm

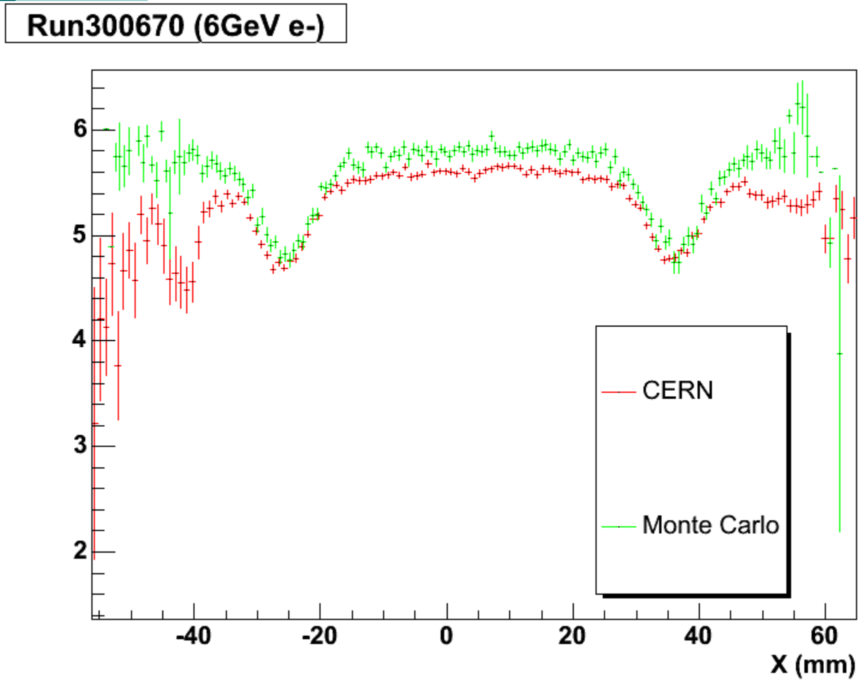
Beam profile

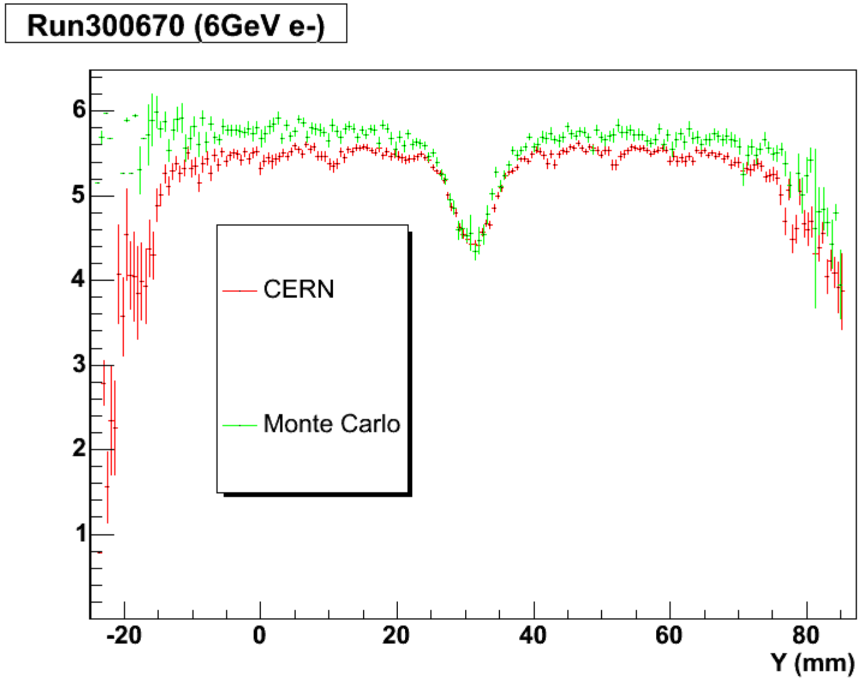
- We use selection of the simulated particles position to reproduce the trigger



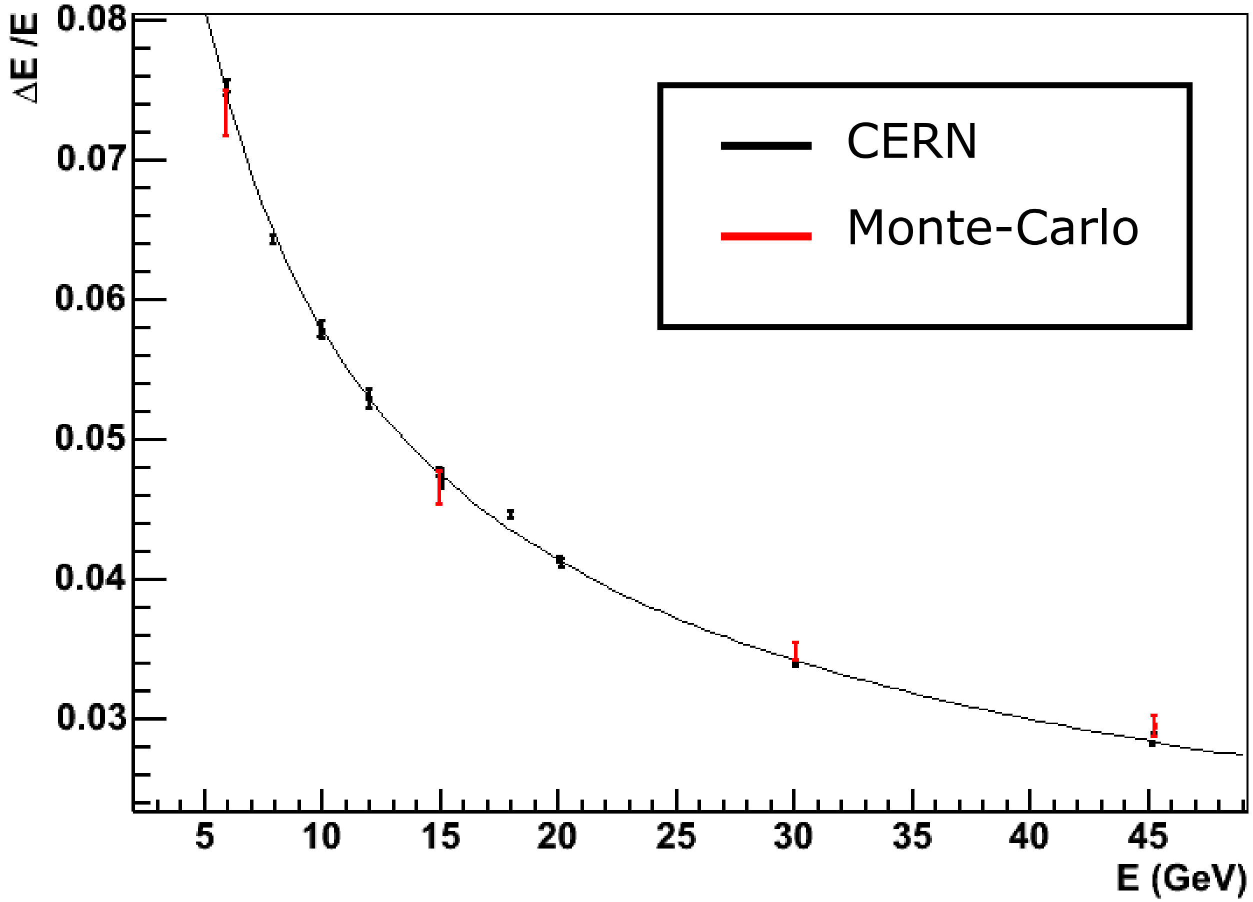


Energy profiles obtained with the experimental data and with simulations





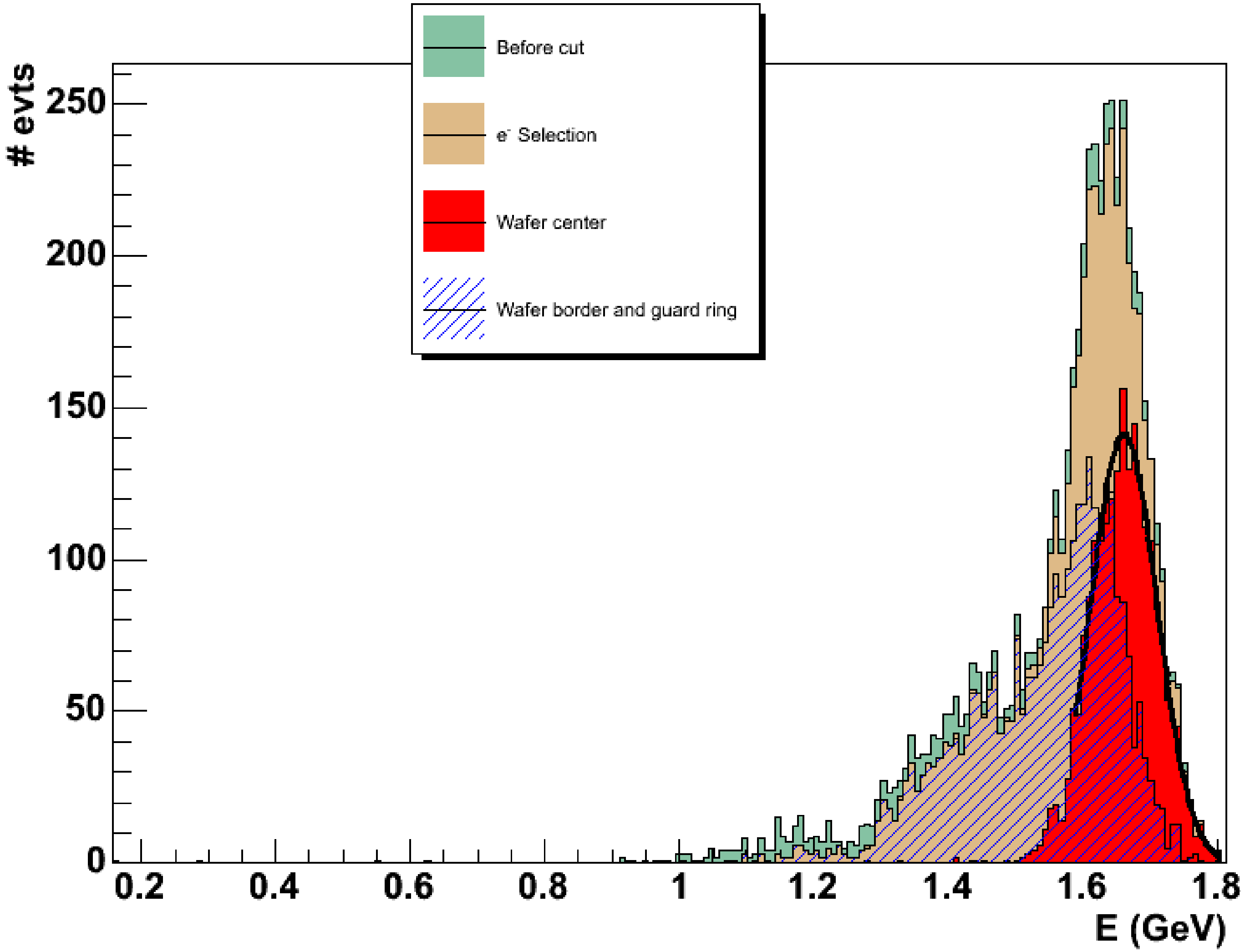
Energy resolution (comparison with MC)

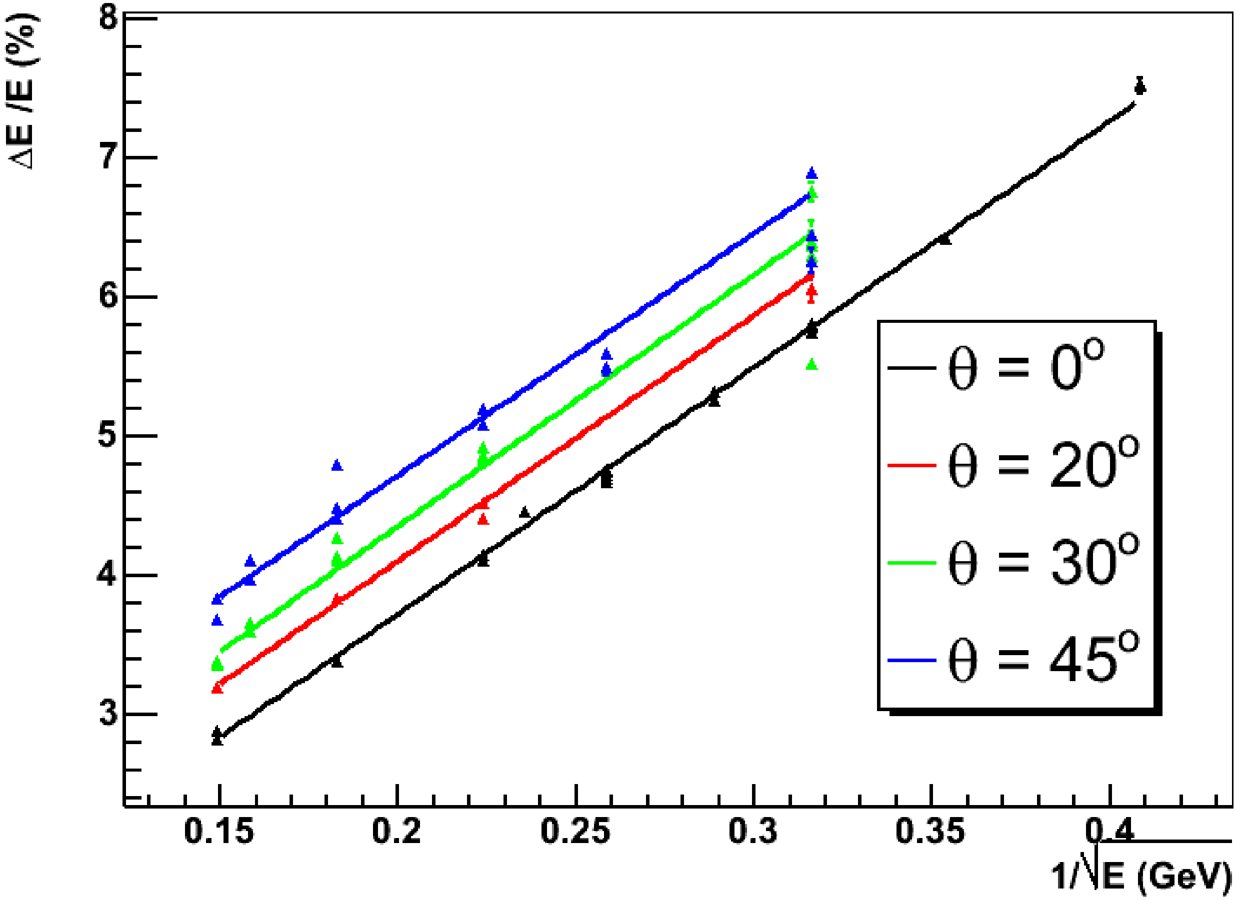


Summary

- The electrons can be identified from the shower shape even if the Ecal is rotated
- Because the beam is aligned to the Ecal prototype structure, the reconstructed energy peak is asymmetric (tail at low energy due to the guard-rings)
  To reject the guard ring effect leads to optimistic results.
- The sampling term, without subtracting the momentum spread of the beam is about 18 %.
- The Monte-Carlo predictions and the test beam results seem to be close.

Energy distributions of simulated electrons at 45 GeV




ΔE /E (%)
8
7
6
5
4
3
0.15
0.2
0.25
0.3
0.35
0.4
1/√E (GeV)
θ = 0°
θ = 20°
θ = 30°
θ = 45°