Status of the ECAL analyis paper

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Road Map decided upon in Prague

Aiming for two analysis papers using the 2006 data (to be merged eventually depending on the achieved timescales)

- Response to normally incident electrons
  (resolution, linearity, uniformity, ...)

- Shower radial and longitudinal development

First paper was to

- [x] follow closely the hardware paper
- [ ] be ready by January

Title :

Response of the CALICE Si-W Physics Prototype to Electrons

Data:

Normally incident electrons/positrons
August and October CERN campaigns

Results:

- Data/MC comparisons
- Resolution and linearity (out of gap events)
- ECAL only corrections for the interwafer gap (global / layered)

1. Introduction

2. Experimental setup and collected data

3. The ECAL prototype

4. Monte Carlo simulation
5. Electron Selection
6. Performance studies
7. Interwafer gaps correction
8. Conclusion

Paper layout

1. Introduction
   - ILC physics highlights
   - ECAL performance goals
   - Prototyping and testbeam

2. Experimental setup and collected data

3. The ECAL prototype

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1. Introduction
    - ILC physics highlights
    - ECAL performance goals
    - Prototyping and testbeam
2. Experimental setup and collected data
    - Testbeam setup
    - Mechanical alignment
    - Summary of the collected data
3. The ECAL prototype
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1. Introduction
    - ILC physics highlights
    - ECAL performance goals
    - Prototyping and testbeam

2. Experimental setup and collected data
    - Testbeam setup
    - Mechanical alignment
    - Summary of the collected data

3. The ECAL prototype
    - Conclusion of the hardware paper on the detector performance
    - Number of dead cells
    - Noise level
    - Stability

4. Monte Carlo simulation
5. Electron Selection
6. Performance studies
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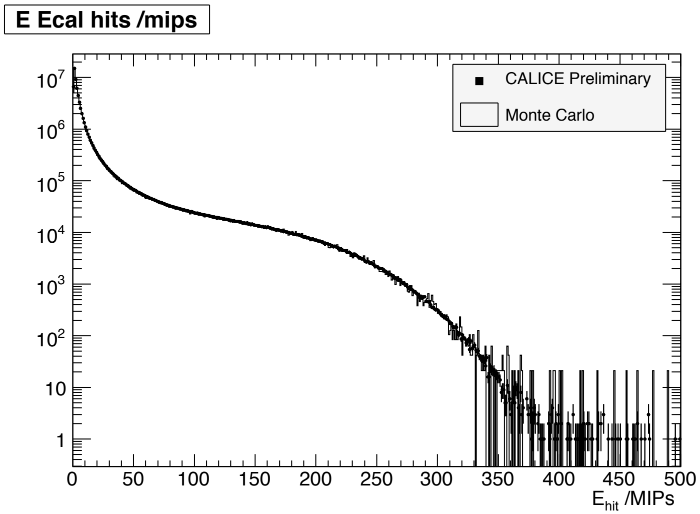
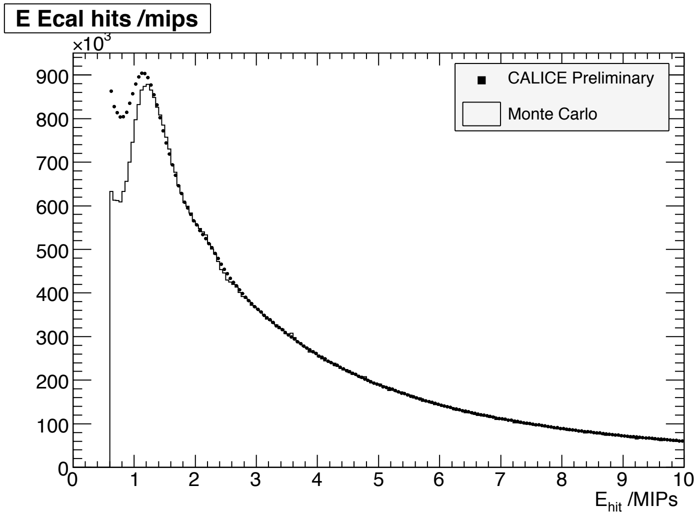
Monte Carlo simulation

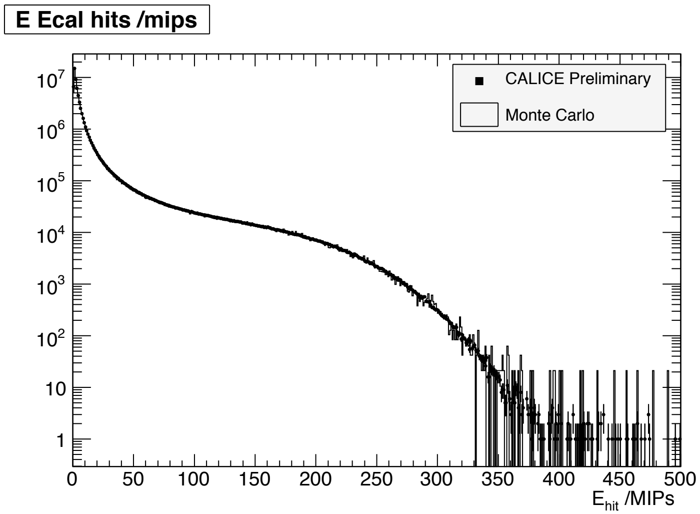


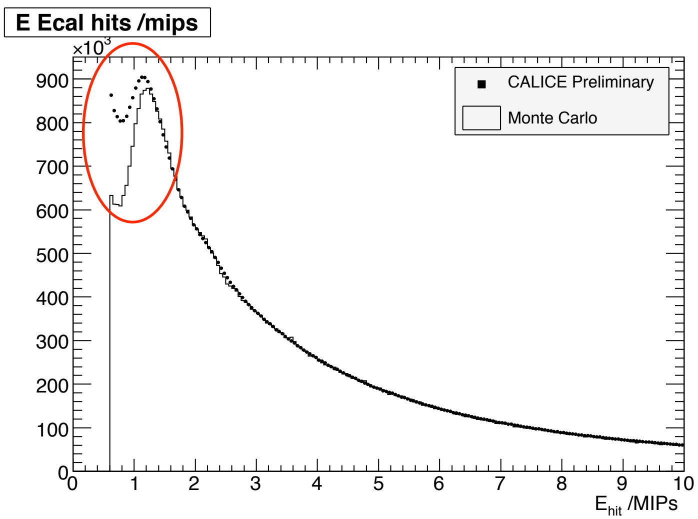


1. Mokka
   beam description

2. Digitisation
   drift chambers
   ECAL

3. Data / MC comparison





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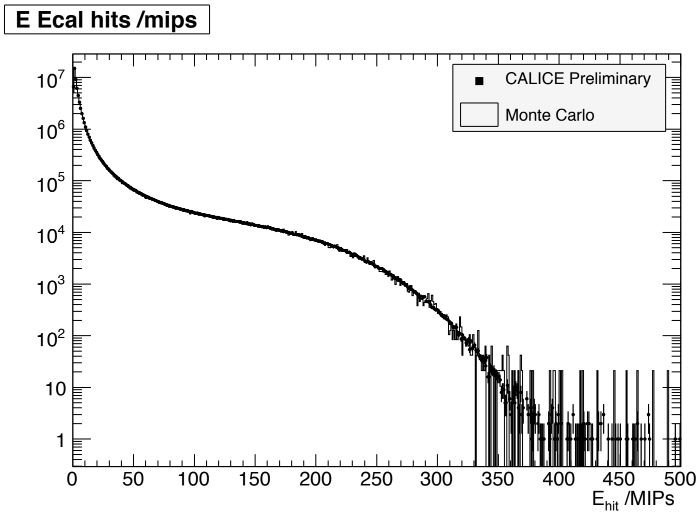
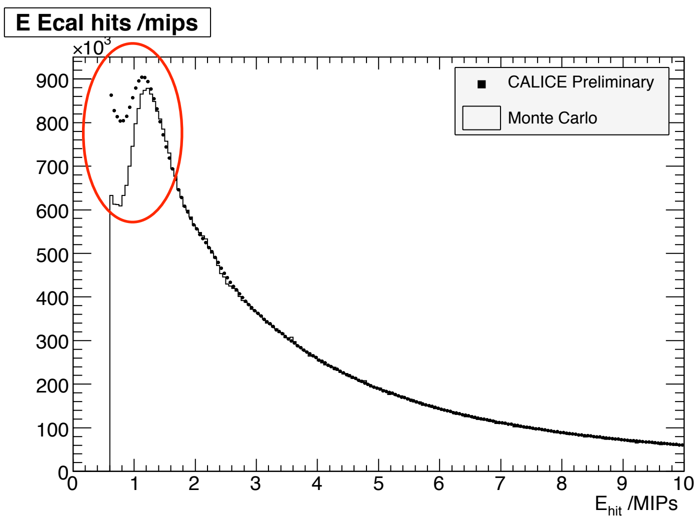
Long standing item

Waiting anxiously for the digitization effect

Trying to link it to square events

Monte Carlo simulation





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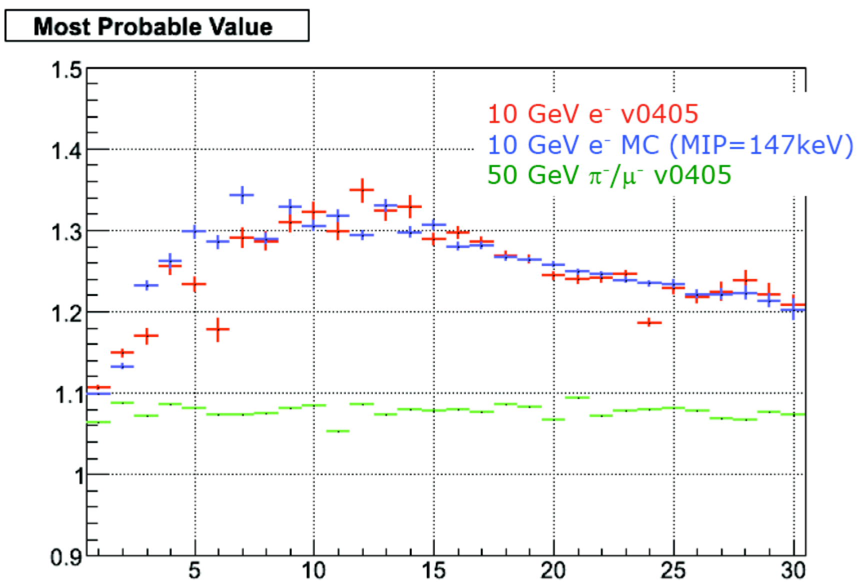

Long standing item
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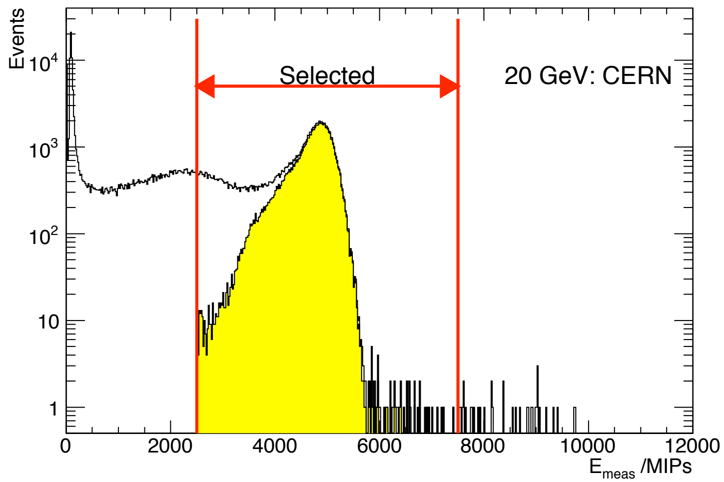
Electron Selection

1. Electron selection based mainly on total energy deposit in ECAL



use of Cerenkov gives about the same results as ECAL only selections

2. Rejection of electrons showering in front of ECAL

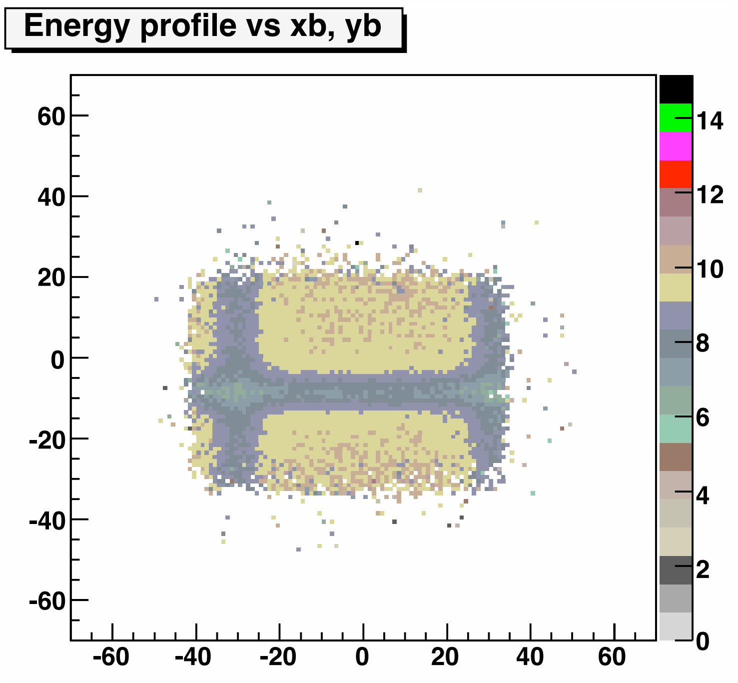
asks for only one cluster in ECAL

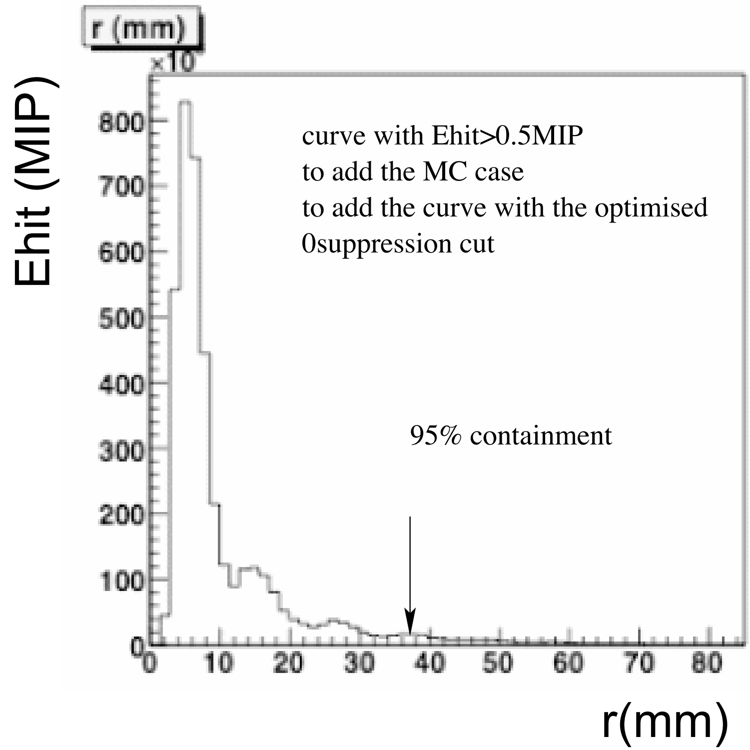
3. Tracks outside the gaps

4. Showers well contained in ECAL

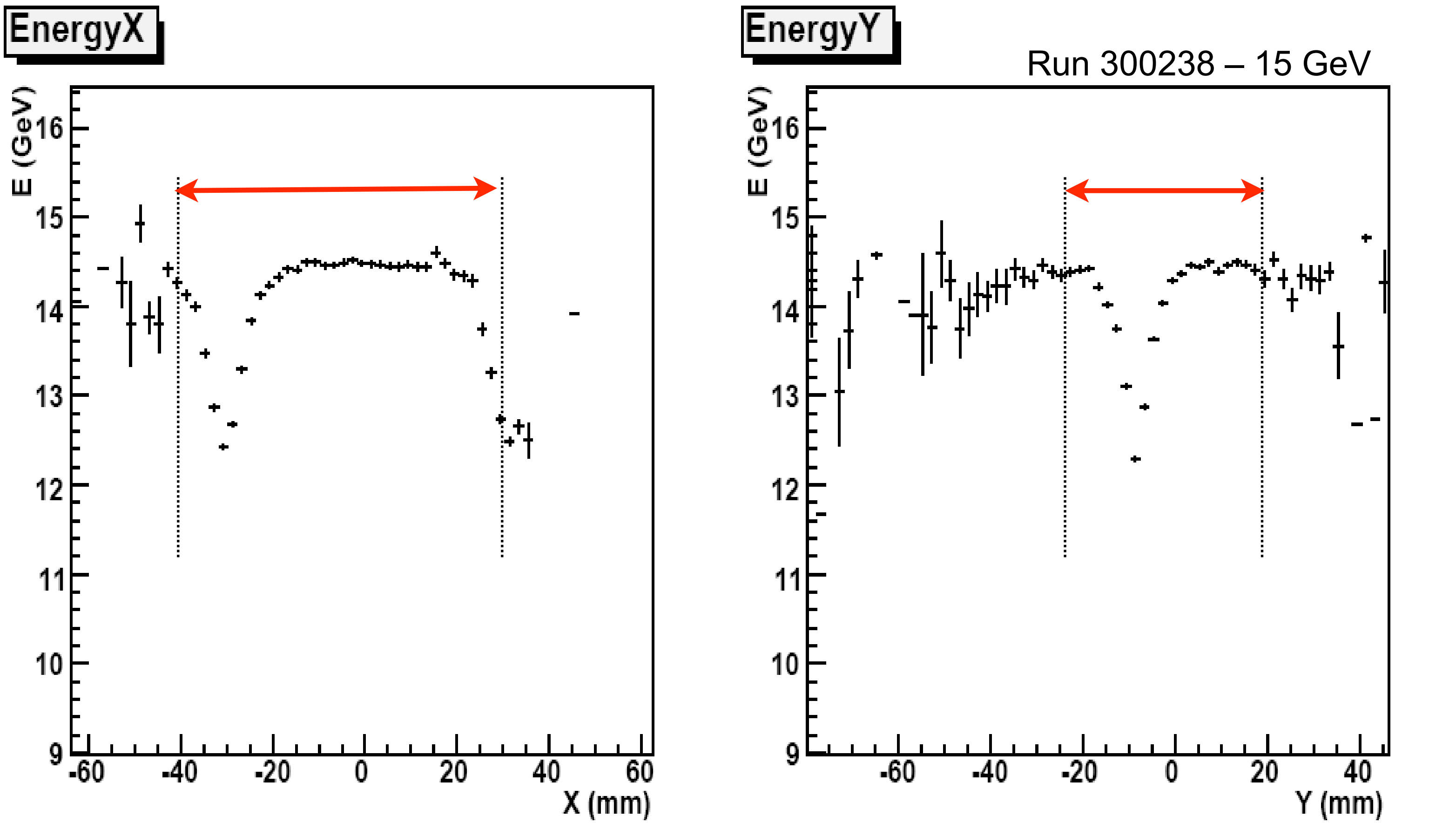
6. Rejection of the beam halo per run basis
7. Reconstructed track position in agreement with the shower barycentre

Electron Selection -





Electron Selection



1. ECAL Sampling fraction scheme

2. Resolution

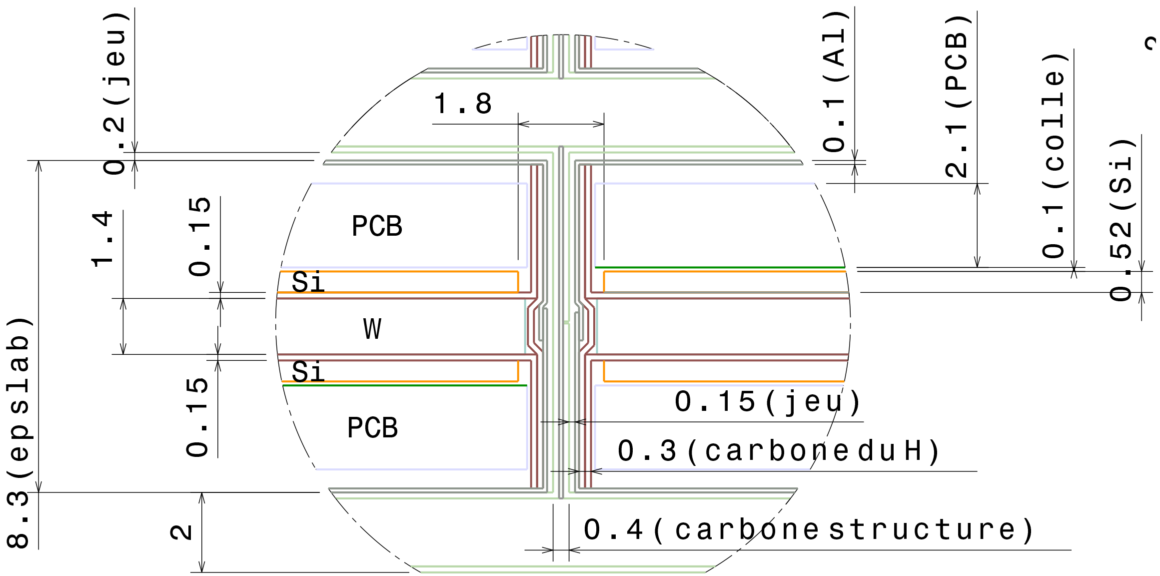
3. Linearity

Systematic effects
(pads noise& gain, tracking, beam spread)

Consistency checks (time stability, e+/e- comparison)

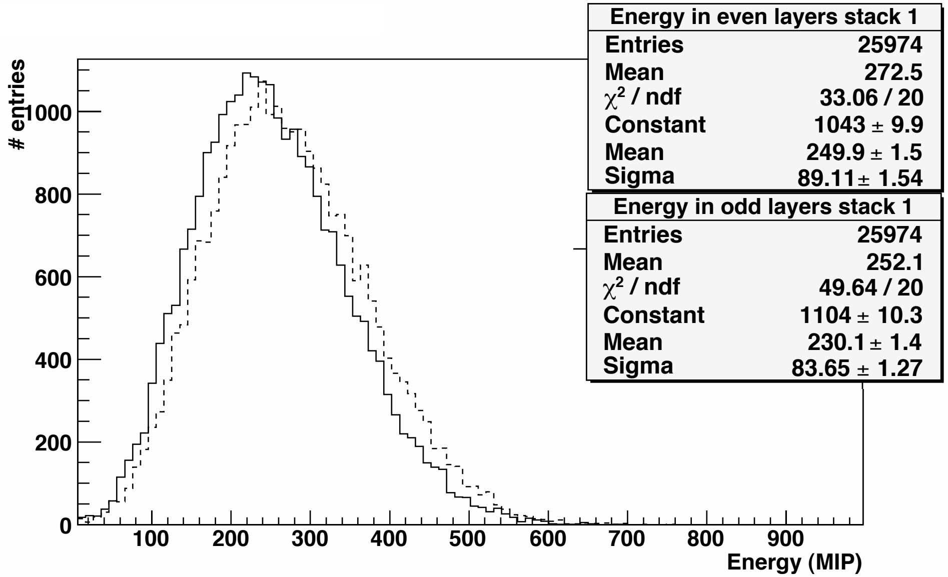
Performance - Sampling scheme

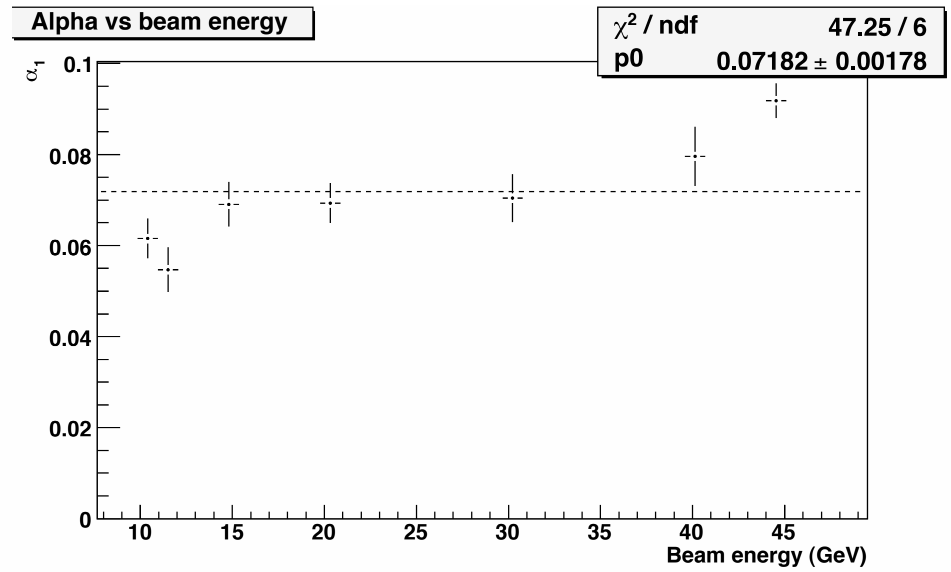
$$E_{meas} = (\alpha_1 \, E(1\text{-}10) + \alpha_2 \, E(10\text{-}20) + \alpha_3 \, E(21\text{-}30)) / \beta$$



$$X_0^{\mathrm{W1}} \times \begin{pmatrix} 1 \\ 1+\alpha \\ 1 \\ 1+\alpha \\ \vdots \\ 1+\alpha \end{pmatrix} \begin{pmatrix} \alpha_{10} \\ \alpha_{10}+\alpha \\ \alpha_{10} \\ \alpha_{10}+\alpha \\ \vdots \\ \alpha_{10}+\alpha \end{pmatrix} \begin{pmatrix} \alpha_{20} \\ \alpha_{20}+\alpha \\ \alpha_{20} \\ \alpha_{20}+\alpha \\ \vdots \\ \alpha_{20}+\alpha \end{pmatrix}$$

$$X_0^{\mathrm{W1}} = \frac{0.4\mathrm{mm}}{3.5\mathrm{mm}}, \; \alpha_{10} \simeq 2 \text{ and } \alpha_{20} \simeq 3.$$





CIN-002 ``Radiation length of the Si-W calorimeter components and impact on the energy resolution'' , D. Boumediene, https://twiki.cern.ch/twiki/pub/CALICE/CaliceInternalNotes/

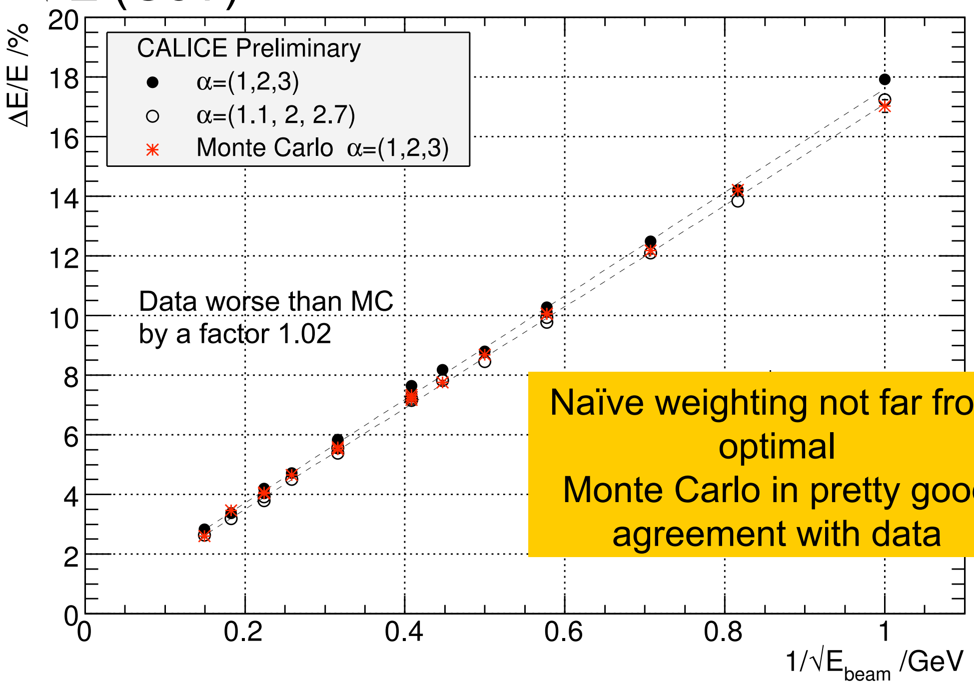
$$\alpha_{2006\ \mathtt{CERN}} = (7.2 \pm 0.18 \pm 1.7)\%$$

The improvement of the order of 0.3% on the sampling term (ct term not affected)

Resolution (outside gaps)

$$\frac{\Delta E}{E}(\%) = \frac{17.7 \pm 0.07}{\sqrt{E\,(\mathrm{GeV})}} \oplus (1.1 \pm 0.08)$$

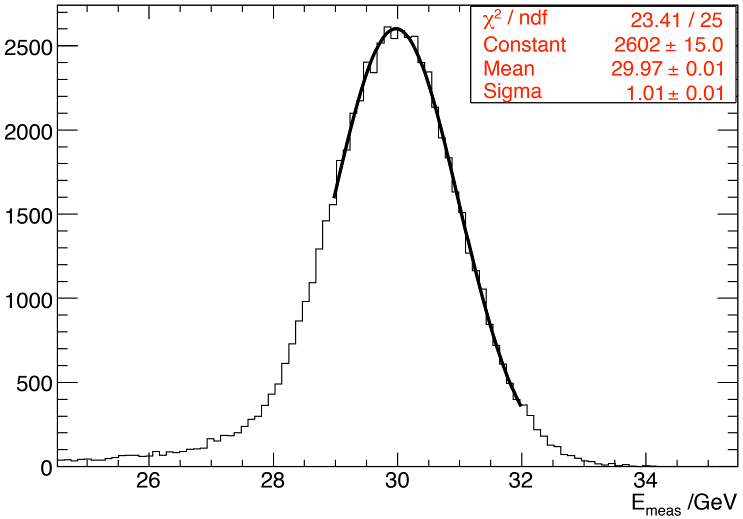
$(\alpha_1, \alpha_2, \alpha_3) = (1, 2, 3)$

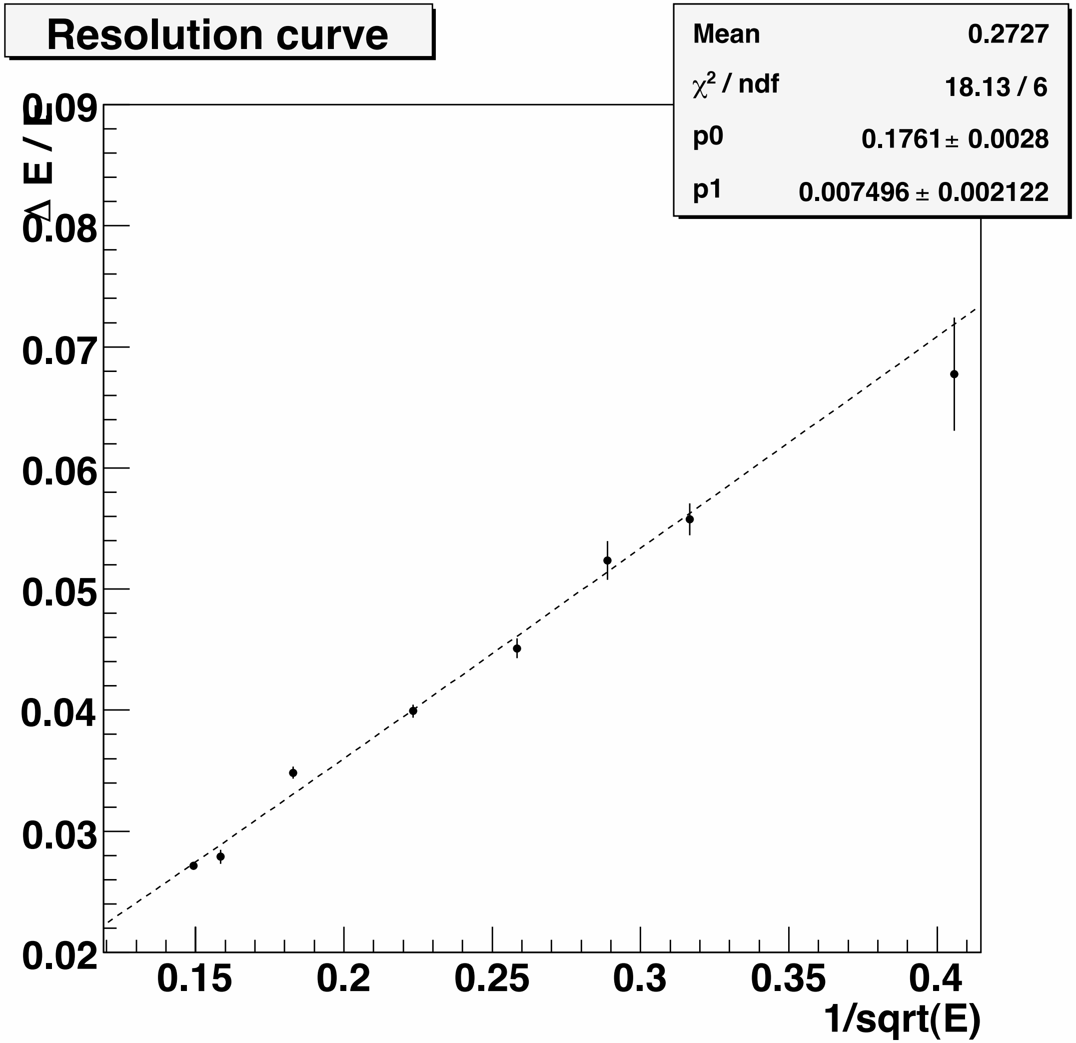


Naïve weighting not far from optimal
Monte Carlo in pretty good agreement with data

$$\frac{\Delta E}{E}(\%) = \frac{17.1 \pm 0.07}{\sqrt{E\,(\mathrm{GeV})}} \oplus (0.5 \pm 0.15)$$

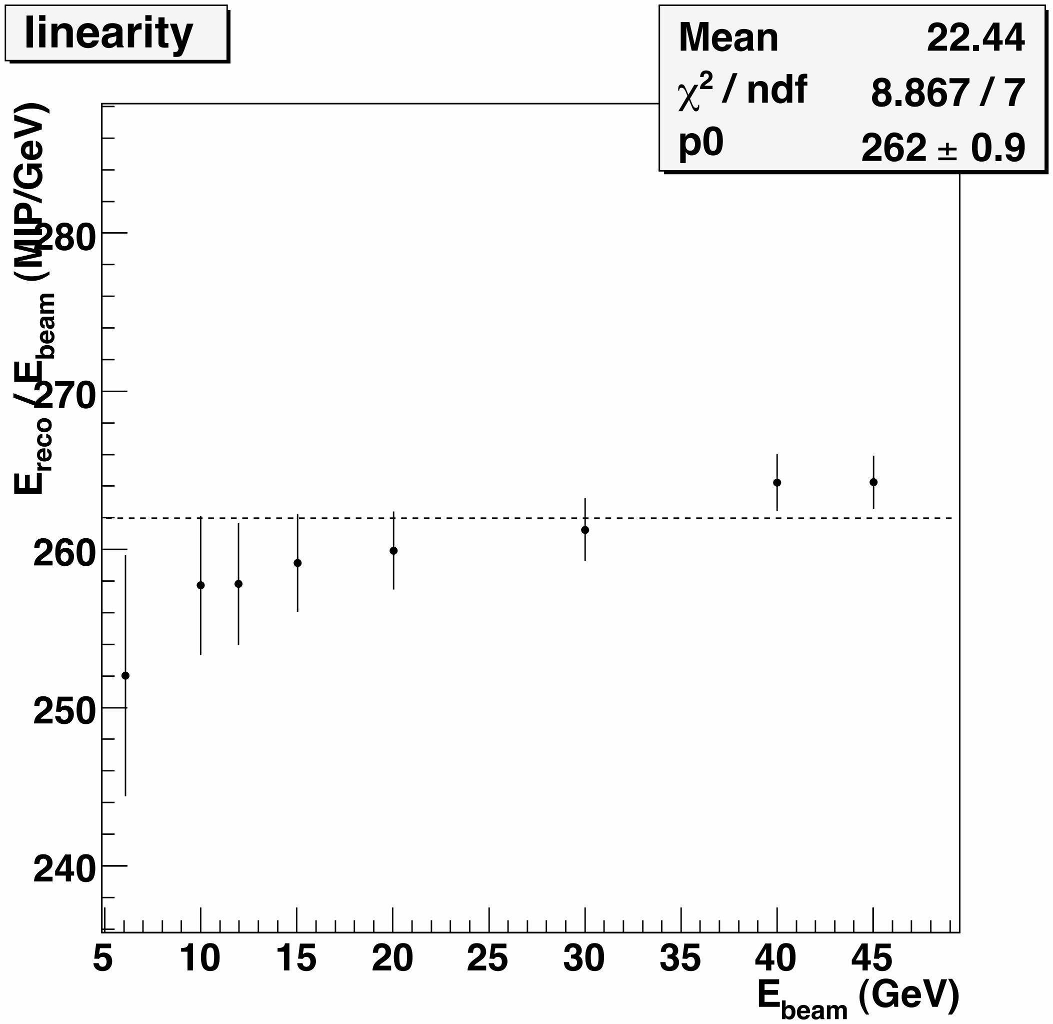
$(\alpha_1, \alpha_2, \alpha_3) = (1.1, 2, 2.7)$





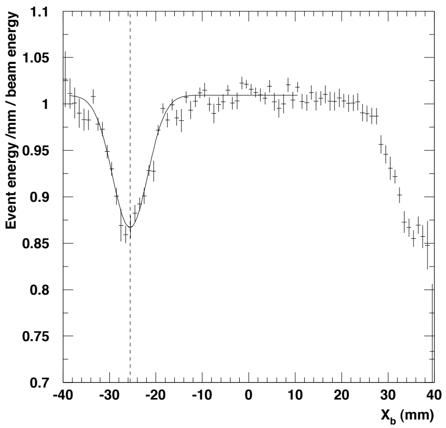
$$\frac{\Delta E}{E}(\%) = \frac{17.6 \pm 0.3}{\sqrt{E\,(\mathrm{GeV})}} \oplus (0.75 \pm 0.21)$$

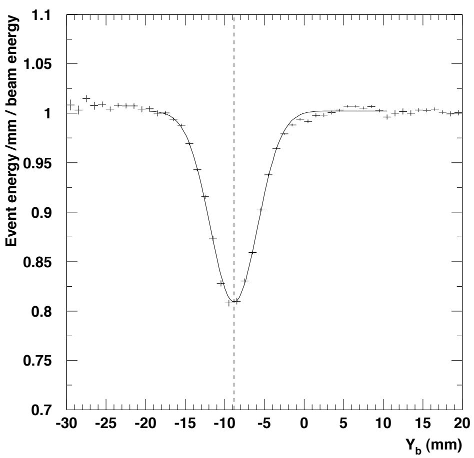
$(\alpha_1, \alpha_2, \alpha_3) = (1, 2, 3)$



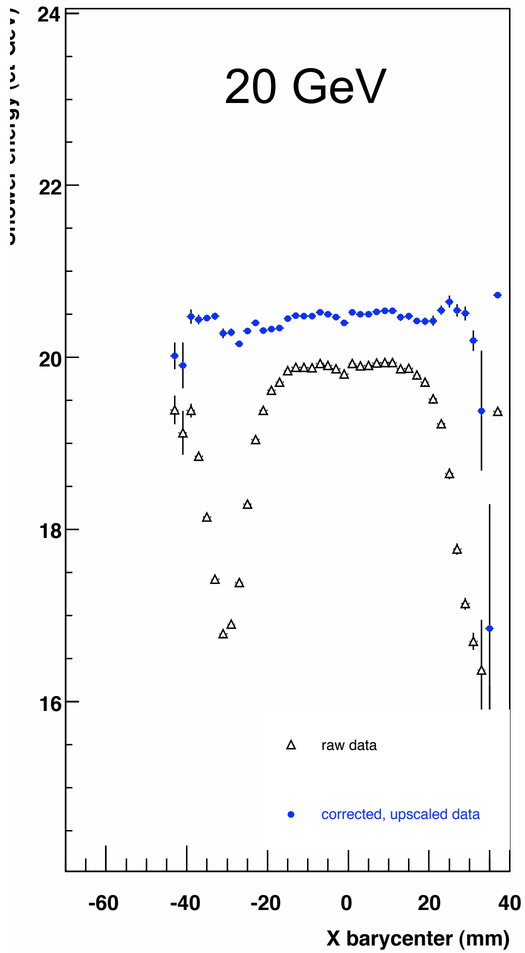
Error on the beam: $\frac{\Delta E}{E} = 0.5\% \oplus \frac{0.15\ \mathrm{GeV}}{E}$

Correction of gaps -global

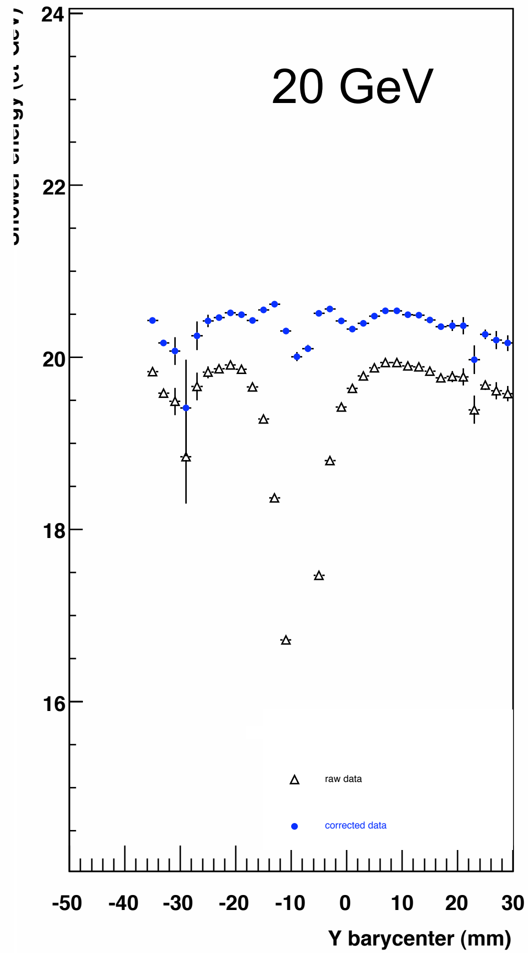




Energy profile vs xb



Energy profile vs yb

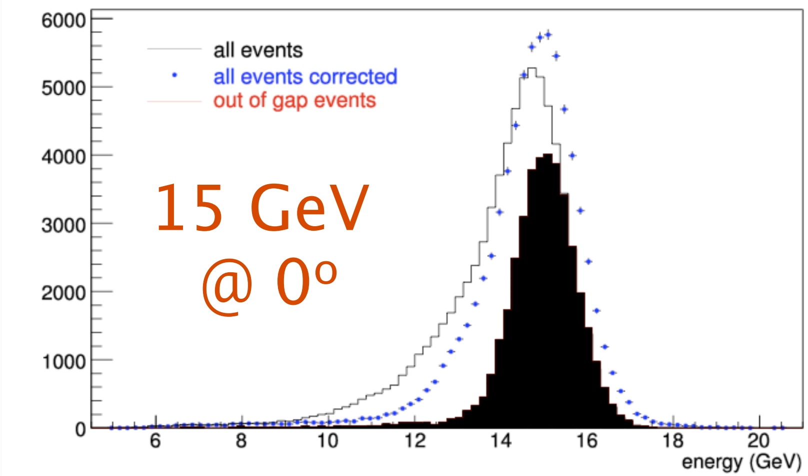


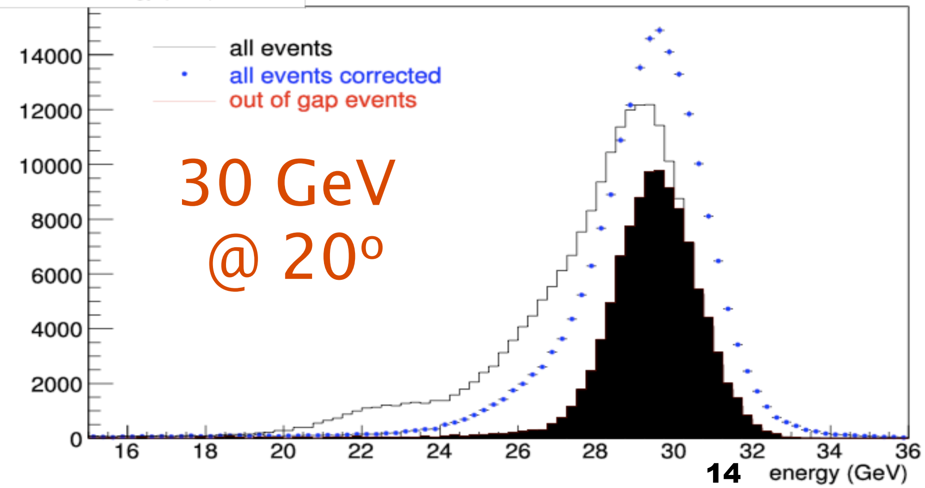
Layer per Layer correction

- AIM
  - Fit a correction for each layer
  - Width fixed : $\sigma_x=\sigma_y$ and taken from global y correction
  - Amplitude : fitted in the 2 dimensions
  - Position :
    - Y : fixed, taken from global fit
    - X : fitted for each layer
  - Translate layer number (+ angle) to a number of X_0 $\Rightarrow$ defines a correction that can be applied at any beam angle
- X_{bl}, Y_{bl} (= barycenter on the layer) could be replaced with tracking information (intersection track-layer) … not yet possible for CERN data

D. Boumediene, Calice Collaboration Meeting, Prague 09/11/2007 12

Effect on the energy distribution (2006 data)





D. Boumediene, Calice Collaboration Mee

Correction of gaps - alignment

As you heard in Djamel's talk, the gaps can be used to inter-align the ECAL layers

also

mis-alignment leads to differences in gap description between MC and data

Now we can check these effects since Mokka was modified in order to take into account *x* and *y* misalignments

(see Gabriel's talk on Monday)

Conclusion

The data analysis "almost" finalised - MC/data comparison still missing
- still to perform the consistency checks

If MC available begining of next week (and the results comprehensible), first draft should be circulated before end of the month

It was agreed to include the shower development analysis and we aim for a complete draft by mid April.