Gaps correction

LPC – Clermont-Ferrand

Introduction

- Method : energy (global, layer, stack) correction factor:

$$(1 - a_x \exp \frac{-(x_b - x_c)^2}{2\sigma_x^2}) \times (1 - a_y \exp \frac{-(y_b - y_c)^2}{2\sigma_y^2}).$$

  - a_x, a_y, σ_x, σ_y are fitted
  - no tracking info (only ECAL)
  - no explicit dependence on the measured energy

- Energy dependence in the global correction
  - Using CERN data 2006 @ 10, 15, 20 & 30 GeV
  - Using CERN data 2007 @ 10, 20, 30 & 40 GeV

- Layer per layer correction
  - Using CERN data @ 10, 15, 20 & 30 GeV

Event Selection

- Selection criteria
  - Layer of maximum energy between 7 and 27.
  - Presence of a cluster in 3 mains stacks around the shower maximum.
  - Only one cluster in the main stack
  - Reject MIPs with a MIP Estimator

- Efficiency on 2006 data : from 80% to 95%
- Efficiency on 2007 data : from **40%** to 96%

Event Selection (2007)

Run #	Ene. (GeV)	Beam pos.	N. d'ev^t beam run	N. d'év^t sélect.	N. d'év$^{t.}$ *bad*	$\frac{\Delta E}{E}$ (%)	$\frac{RMS}{E}$ (%)	$\bar{X}_b$[RMS] (mm)	$\bar{Y}_b$[RMS] (mm)	$\bar{N}_{hits}$
330420	25	(6,0)	56k	47700 (85.2%)	950 (1.7%)	4.1	9.84	-39 [19.5]	20 [9.24]	304
330430	30	(0,0)	244k	233240 (95.6%)	3631 (1.49%)	3.59	7.77	-4.13 [12.3]	14.6 [9.04]	348
330428	50	(0,0)	190k	176553 (92.9%)	5691 (3%)	2.91	9.55	21.4 [15.7]	16.6 [8.03]	468
330454	20	(0,3)	229k	213510 (93.2%)	3078 (1.34%)	4.85	11.1	10 [20.5]	34 [10.8]	277
330456	30	(0,3)	226k	213996 (94.7%)	3444 (1.52%)	3.83	9.27	-3.4 [12.2]	34.1 [9.34]	354
330474	30	(-3,3)	228k	217087 (95.2%)	3730 (1.64%)	4.23	9.93	34.2 [13]	34.6 [9.42]	356
330429	40	(0,0)	253k	244106 (96.5%)	4370 (1.73%)	3.32	8.99	25.9 [13.2]	16.1 [7.71]	411
330937	6	(0,0)	253k	162450 (64.2%)	53425 (21.1%) double=6.23% layer max=7.94% no cluster=5.05% layer min=1.9%	8.13	16.7	13.8 [26.8]	8.54 [22.9]	131
330876	10	(-6,0)	250k	163441 (65.4%)	47261 (18.9%) double=4.06% layer max=6.18% no cluster=7.15% layer min=1.51%	6.61	25.1	60.1 [13.8]	3.17 [16.6]	158
330664	10	(0,0)	222k	182135 (82%)	32222 (14.5%) double=3.96% layer max=7.32% no cluster=2.28% layer min=0.943%	6.37	14.8	18.3 [25.6]	11.6 [19.9]	183
330825	10	(6,0)	257k	182400 (71%)	39702 (15.4%) double=5.71% layer max=5.7% no cluster=3.27% layer min=0.77%	5.69	17.1	-43.5 [20.3]	12.9 [14.6]	192
330890	20	(-6,0)	250k	100064 (40%)	97405 (39%) double=20.4% layer max=8.35% no cluster=8.28% layer min=1.93%	4.77	28.3	64.9 [11.2]	12.6 [8.51]	222
330751	10	(-3,3)	229k	195403 (85.3%)	27827 (12.2%) double=3.46% layer max=5.93% no cluster=1.92% layer min=0.838%	6.99	13.4	37.3 [22.5]	28.8 [17.1]	188
330658	20	(0,0)	229k	91532 (40%)	105919 (46.3%) double=24.2% layer max=11.2% no cluster=8.87% layer min=1.94%	4.39	25.3	17.6 [19]	11.6 [10]	252

Event Selection (2007)

Run #	Ene. (GeV)	Beam pos.	N. d'ev^t beam run	N. d'év^t sélect.	N. d'év$^{t.}$ *bad*	$\frac{\Delta E}{E}$ (%)	$\frac{RMS}{E}$ (%)	$\bar{X}_b$[RMS] (mm)	$\bar{Y}_b$[RMS] (mm)	$\bar{N}_{hits}$
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330428	50	(0,0)	190k	176553 (92.9%)	5691 (3%)	2.91	9.55	21.4 [15.7]	16.6 [8.03]	468
330454	20	(0,3)	229k	213510 (93.2%)	3078 (1.34%)	4.85	11.1	10 [20.5]	34 [10.8]	277
330456	30	(0,3)	226k	213996 (94.7%)	3444 (1.52%)	3.83	9.27	-3.4 [12.2]	34.1 [9.34]	354
330474	30	(-3,3)	228k	217087 (95.2%)	3730 (1.64%)	4.23	9.93	34.2 [13]	34.6 [9.42]	356
330429	40	(0,0)	253k	244106 (96.5%)	4370 (1.73%)	3.32	8.99	25.9 [13.2]	16.1 [7.71]	411
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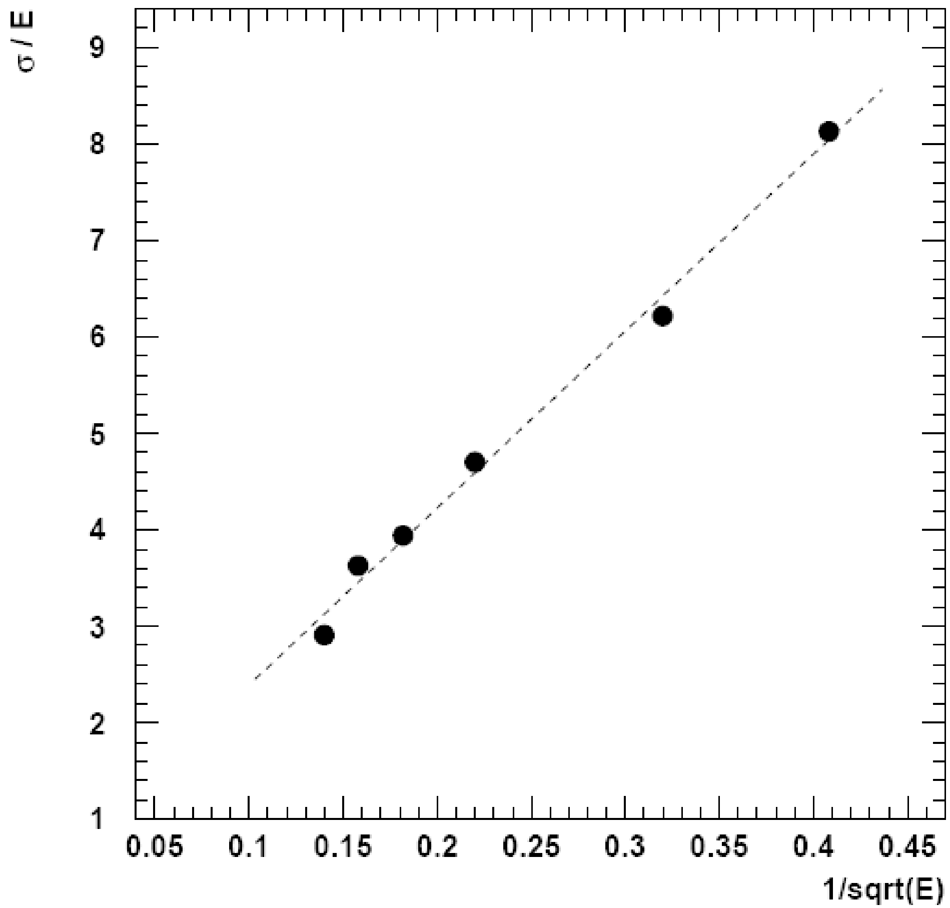
330876	10	(-6,0)	250k	163441 (65.4%)	47261 (18.9%) double=4.06% layer max=6.18% no cluster=7.15% layer min=1.51%	6.61	25.1	60.1 [13.8]	3.17 [16.6]	158
330664	10	(0,0)	222k	182135 (82%)	32222 (14.5%) double=3.96% layer max=7.32% no cluster=2.28% layer min=0.943%	6.37	14.8	18.3 [25.6]	11.6 [19.9]	183
330825	10	(6,0)	257k	182400 (71%)	24% double evts	5.69	17.1	-43.5 [20.3]	12.9 [14.6]	192
330890		(-6,0)	250k	100064 (40%)		4.77	28.3	64.9 [11.2]	12.6 [8.51]	222
330751	10	(-3,3)	229k	195403 (85.3%)		6.99	13.4	37.3 [22.5]	28.8 [17.1]	188
330658		(0,0)	229k	91532 (40%)	20% double evts	4.39	25.3	17.6 [19]	11.6 [10]	252

Event Selection (2007)

Run #	Ene. (GeV)	Beam pos.	N. d'ev^t beam run	N. d'év^t sélect.	N. d'év$^{t.}$ *bad*	$\frac{\Delta E}{E}$ (%)	$\frac{RMS}{E}$ (%)	$\bar{X}_b$[RMS] (mm)	$\bar{Y}_b$[RMS] (mm)	$\bar{N}_{hits}$
330423	20	(6,0)	229k	214806 (93.8%)	5885 (2.57%)	4.75	10.6	-42.8 [19.8]	18.2 [10.7]	264
330506	20	(3,3)	182k	169412 (93.1%)	5097 (2.8%)	4.9	11.3	-18.5 [21.3]	33.7 [10.8]	275
330477	20	(-3,3)	238k	224274 (94.2%)	6689 (2.81%)	4.99	11.8	40.8 [20.2]	34.1 [10.9]	272
330471	40	(-3,3)	229k	220679 (96.4%)	4146 (1.81%)	3.94	10.6	45.6 [13.2]	36 [7.84]	419
330499	30	(3,3)	182k	169577 (93.2%)	2983 (1.64%)	4.11	9.78	-24.9 [13.1]	34.3 [9.44]	355
330461	40	(0,3)	228k	220902 (96.9%)	3925 (1.72%)	3.77	10.6	25.1 [13]	35.9 [7.93]	425
330418	40	(6,0)	229k	220312 (96.2%)	4141 (1.81%)	3.48	9.42	-23.8 [13.5]	19.8 [7.72]	410
330419	30	(6,0)	229k	214660 (93.7%)	3838 (1.68%)	3.89	8.67	-54.5 [11.9]	18.4 [8.68]	326
330422	25	(6,0)	188k	177474 (94.4%)	3623 (1.93%)	4.22	9.81	-39 [19.5]	20 [9.28]	304
330413	50	(6,0)	228k	211997 (93%)	6709 (2.94%)	3.13	9.92	-28.5 [15.7]	20.2 [8.09]	461
330488	50	(-3,3)	183k	170295 (93.1%)	5404 (2.95%)	3.33	11	-18.2 [15.8]	36 [8.03]	485

On 2006 data, efficiency varies from 80% to 95%

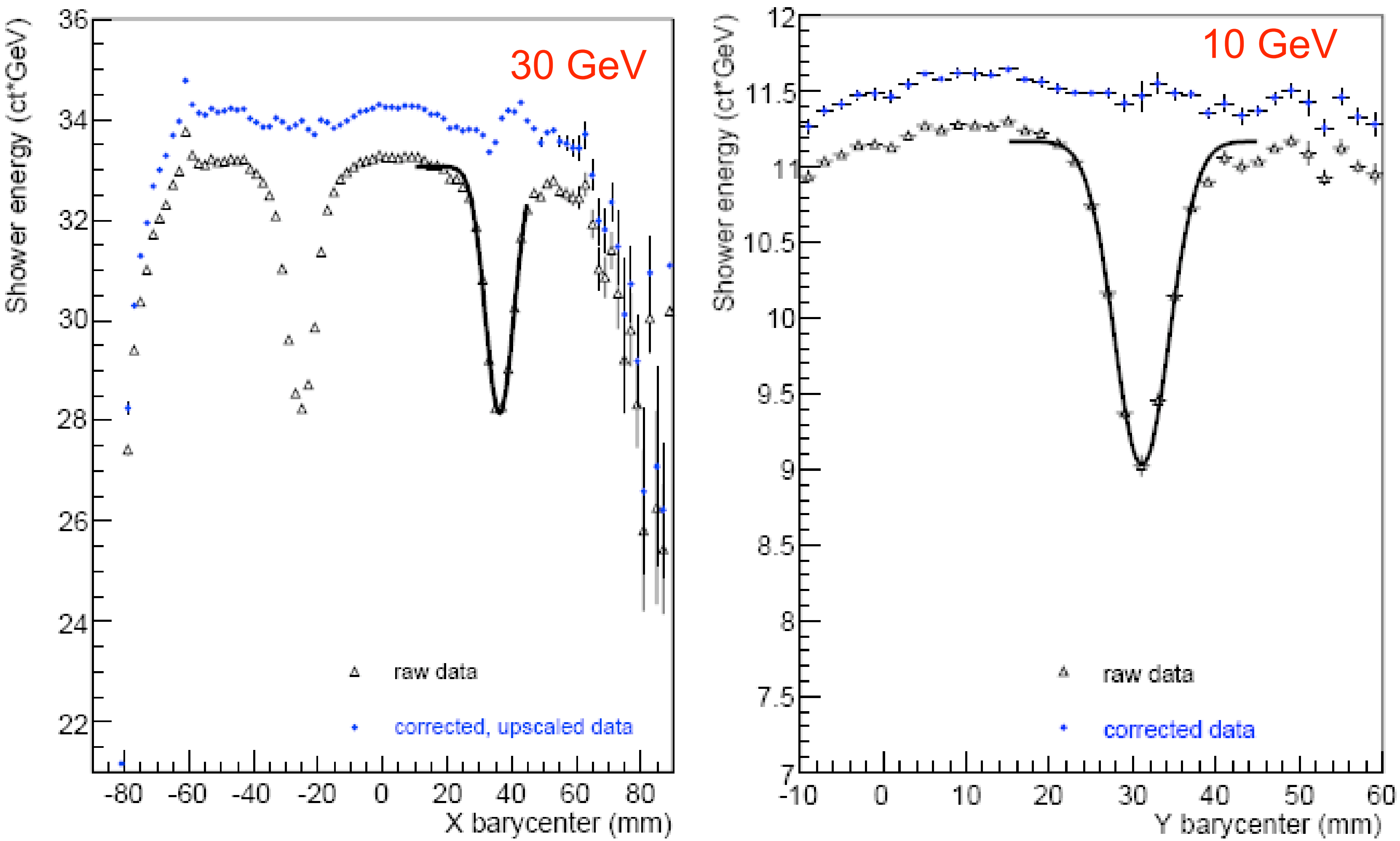
Detector resolution



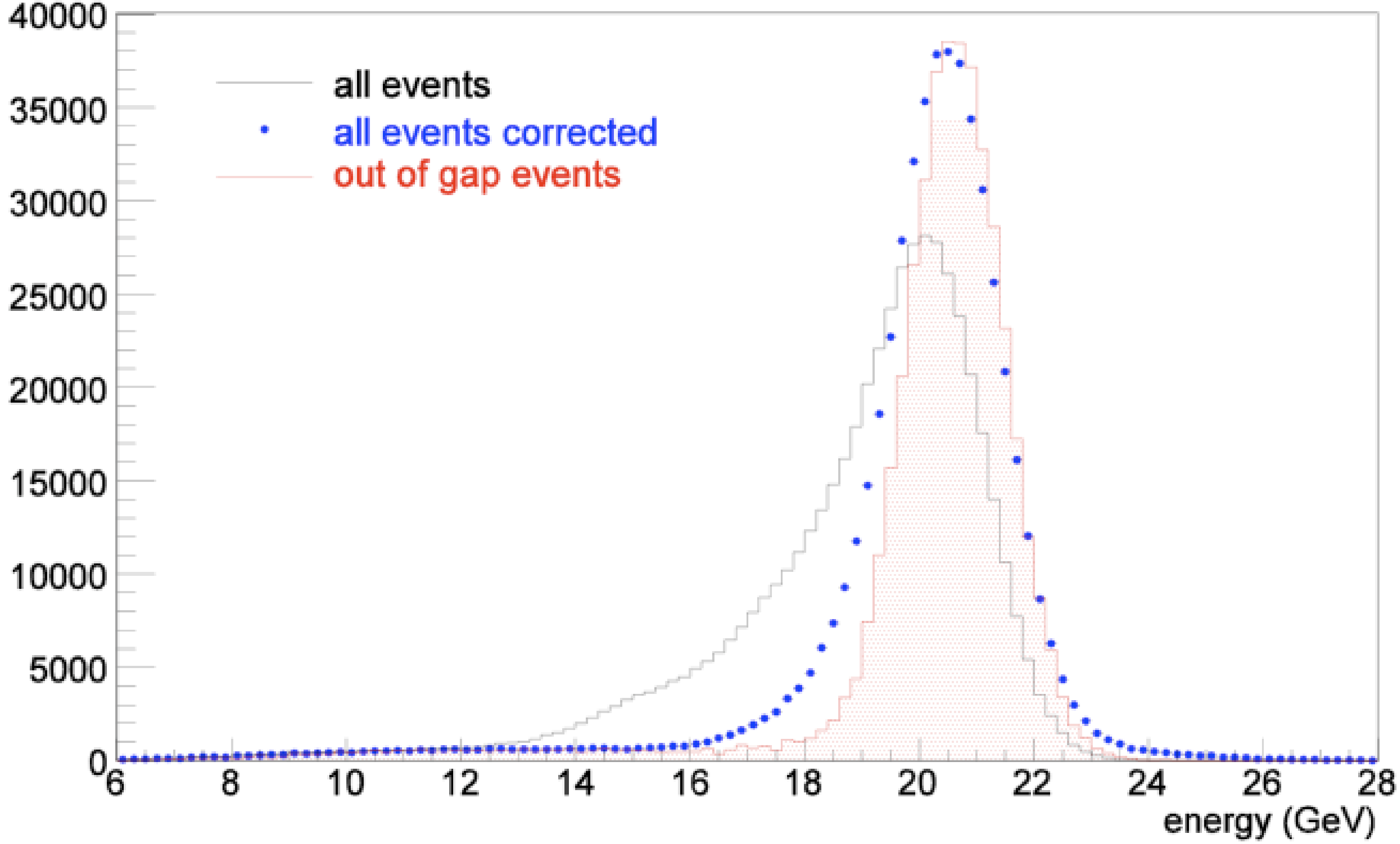
- No gap correction
- Resolution taken after event selection

$$\frac{\sigma_E}{E} = \frac{18\%}{\sqrt{E}} + 0.55$$

Energy scan of the ECAL, 2007 data



Effect on the energy distribution, norm. incid. (2007 @ 20 GeV)



Comparison 2007 – 2006

<Amplitude> : maximal energy loss in a gap (in %)

The mean value is taken over different beam energies

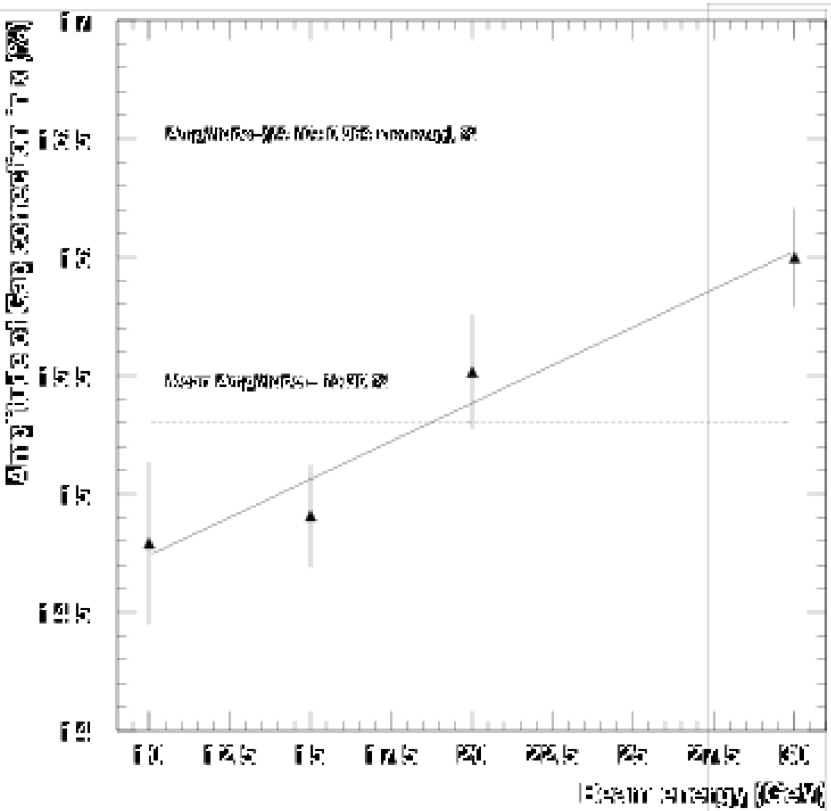
<Width>: effective gap width

Amplitude: max. energy loss in a gap (in %) considering the energy dependence

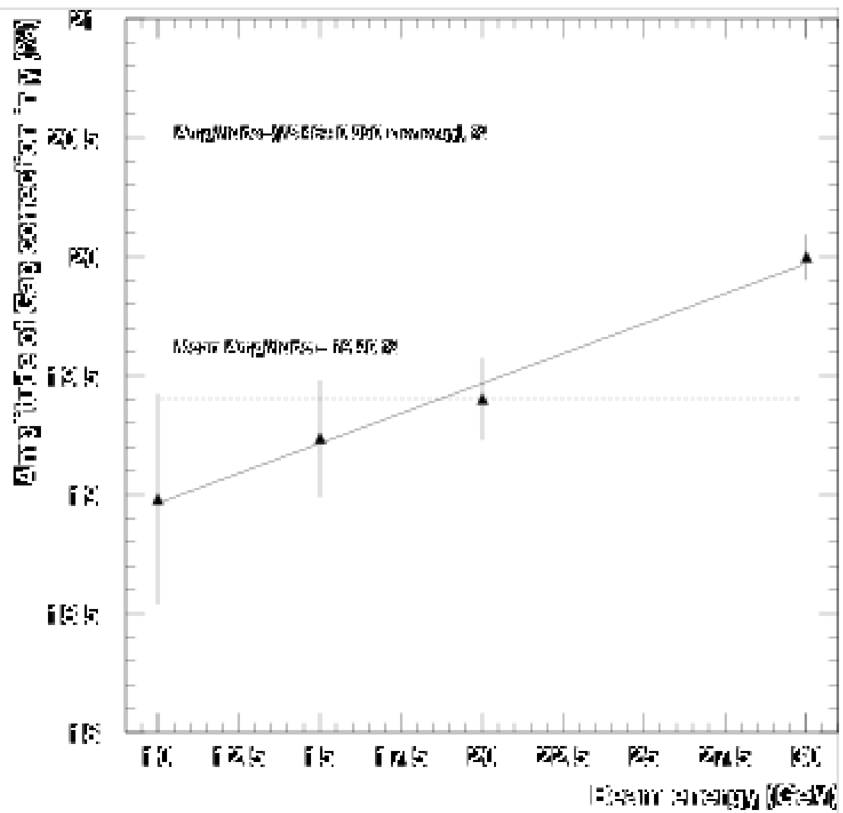
		2006	2007
Y Axis	<Amplitude>	19,4 %	20,7%
	<Width>	3,1 mm	3,3 mm
	Amplitude	$(18{,}5 + 0{,}05\ E_{beam})$ %	$(18{,}1 + 0{,}11\ E_{beam})$%
X Axis	<Amplitude>	15,3 %	14,5%
	<Width>	4,8 mm	4,5 mm
	Amplitude	$(14{,}1 + 0{,}06\ E_{beam})$ %	$(13{,}0 + 0{,}06\ E_{beam})$ %

Energy loss (amplitude correction) vs. beam energy on 2006 data

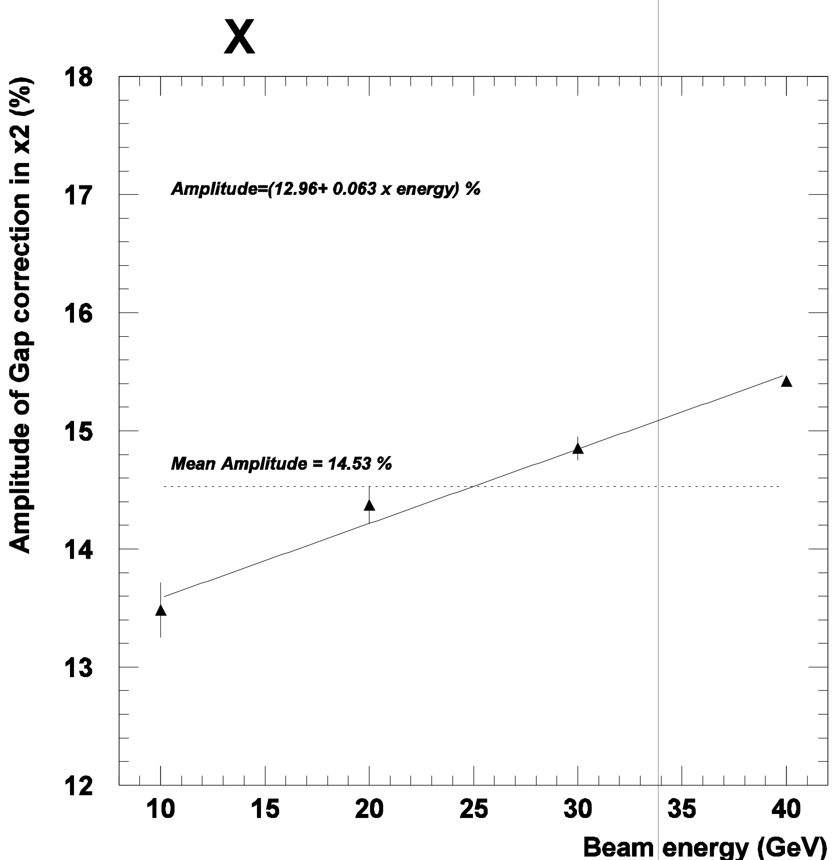
X

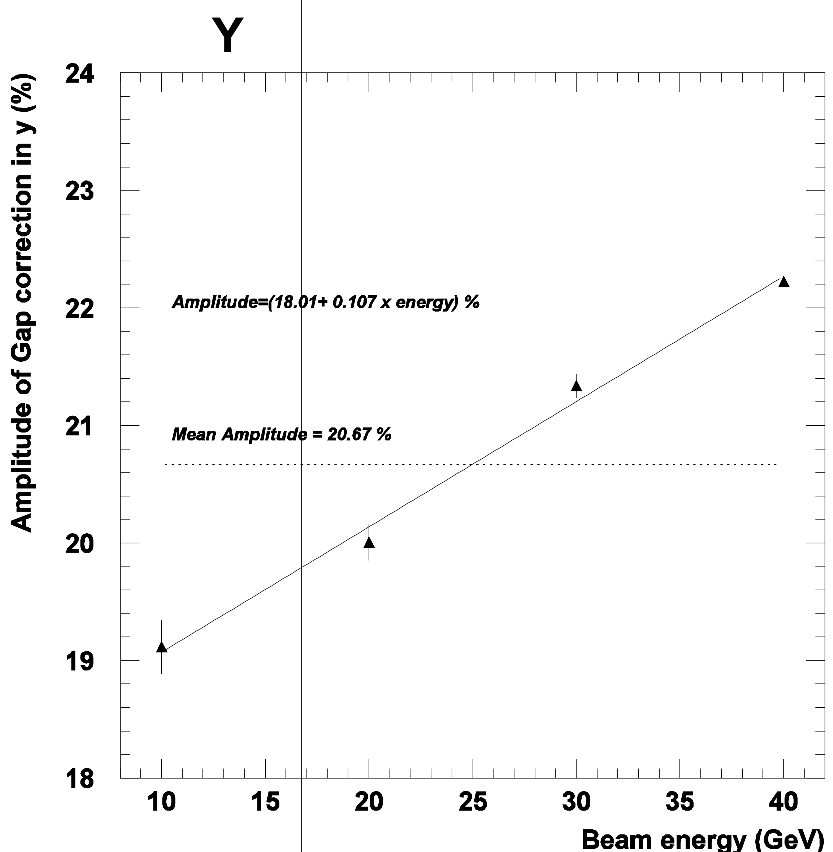


Y



Energy loss (correction amplitude) versus beam energy on 2007 data



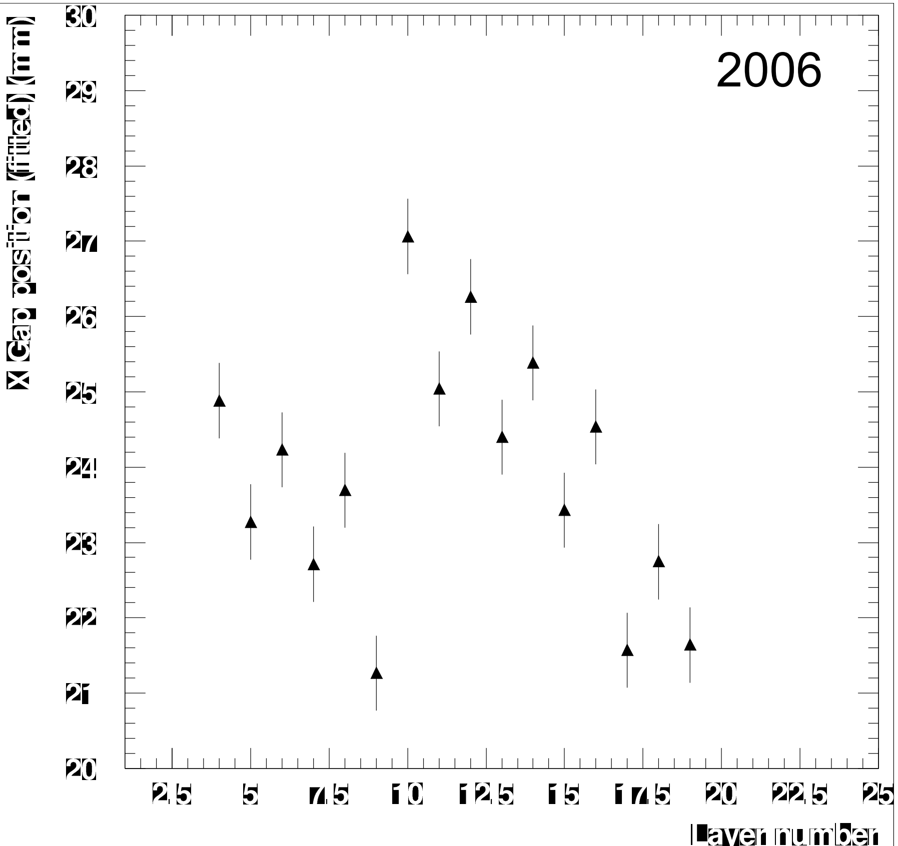


Layer per Layer correction

- 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

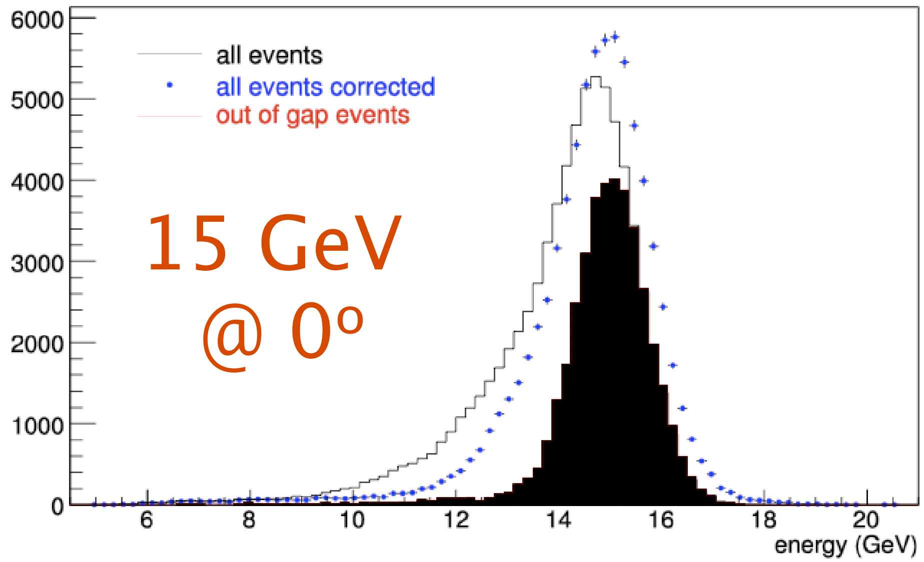
- X_{bl}, Y_{bl} (= barycenter on the layer) could be replaced with tracking information (intersection track-layer) … not yet possible for CERN data

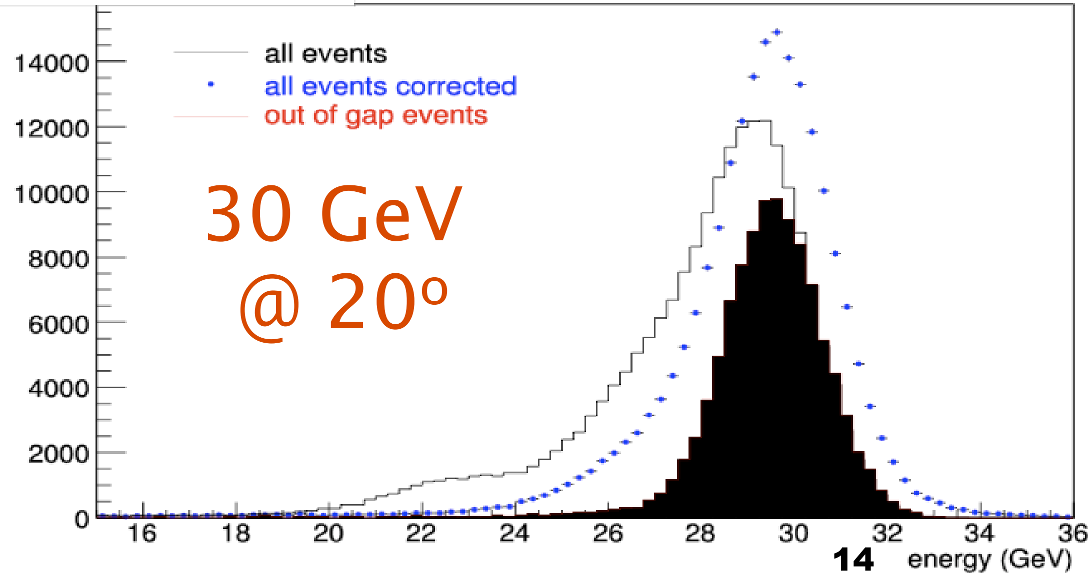
Fitted gap positions in X



- Fitted position compatible with the expected gap position
- Precision is about 0,6 mm

Effect on the energy distribution (2006 data)

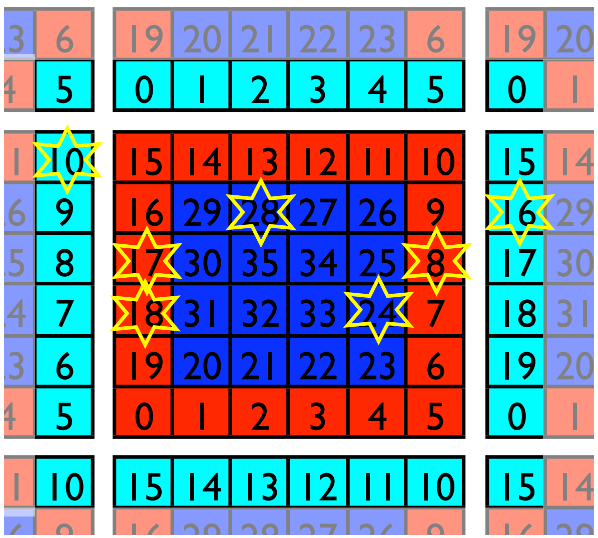


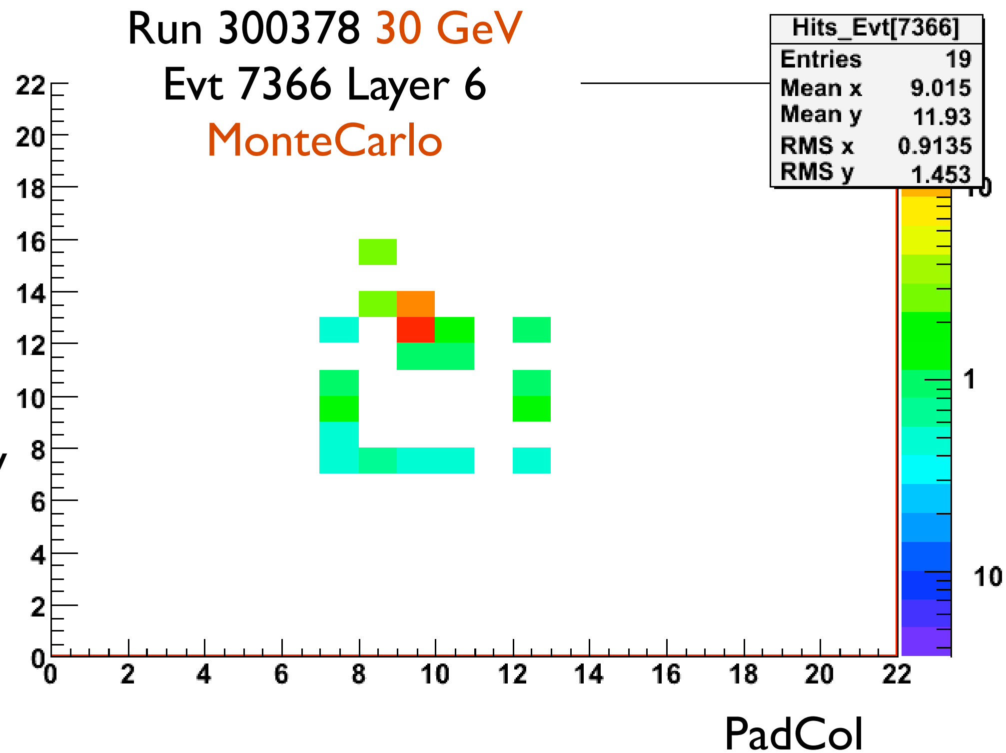


Study of ECAL square events

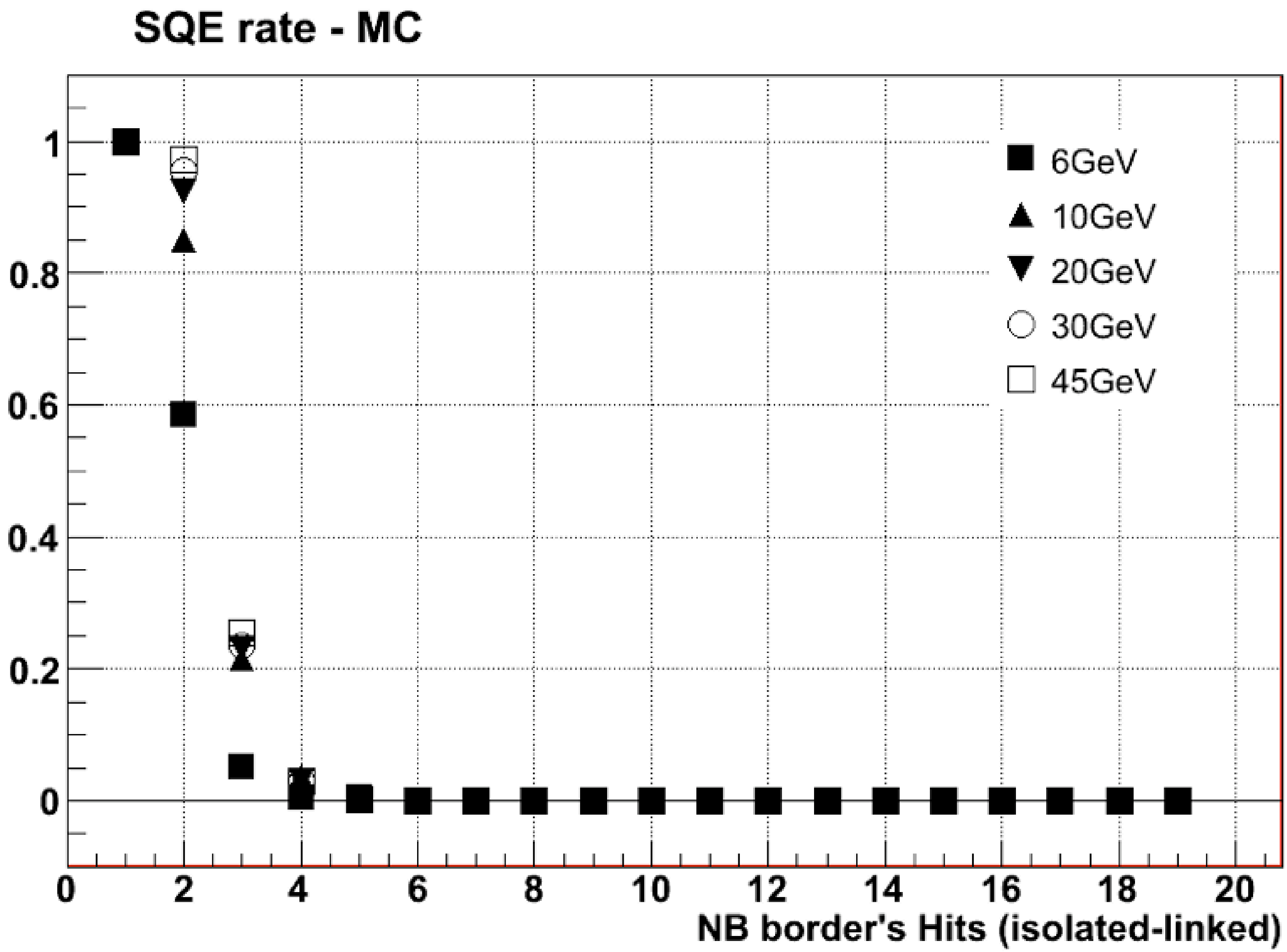
ILC group - LPC Clermont-Ferrand

A chosen number of border hits which must be linked (no gap between them) & isolated (no neighbors)



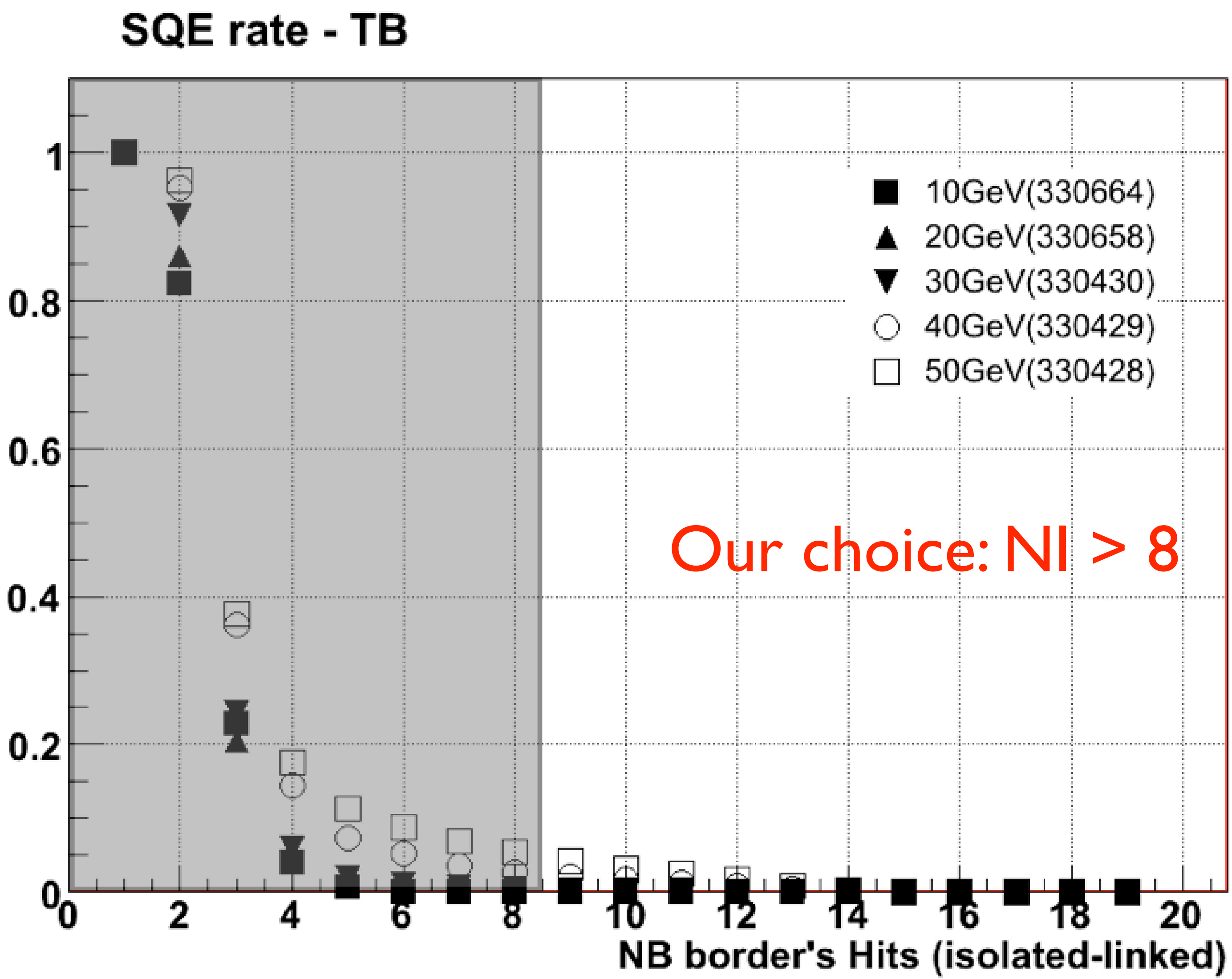


Selection



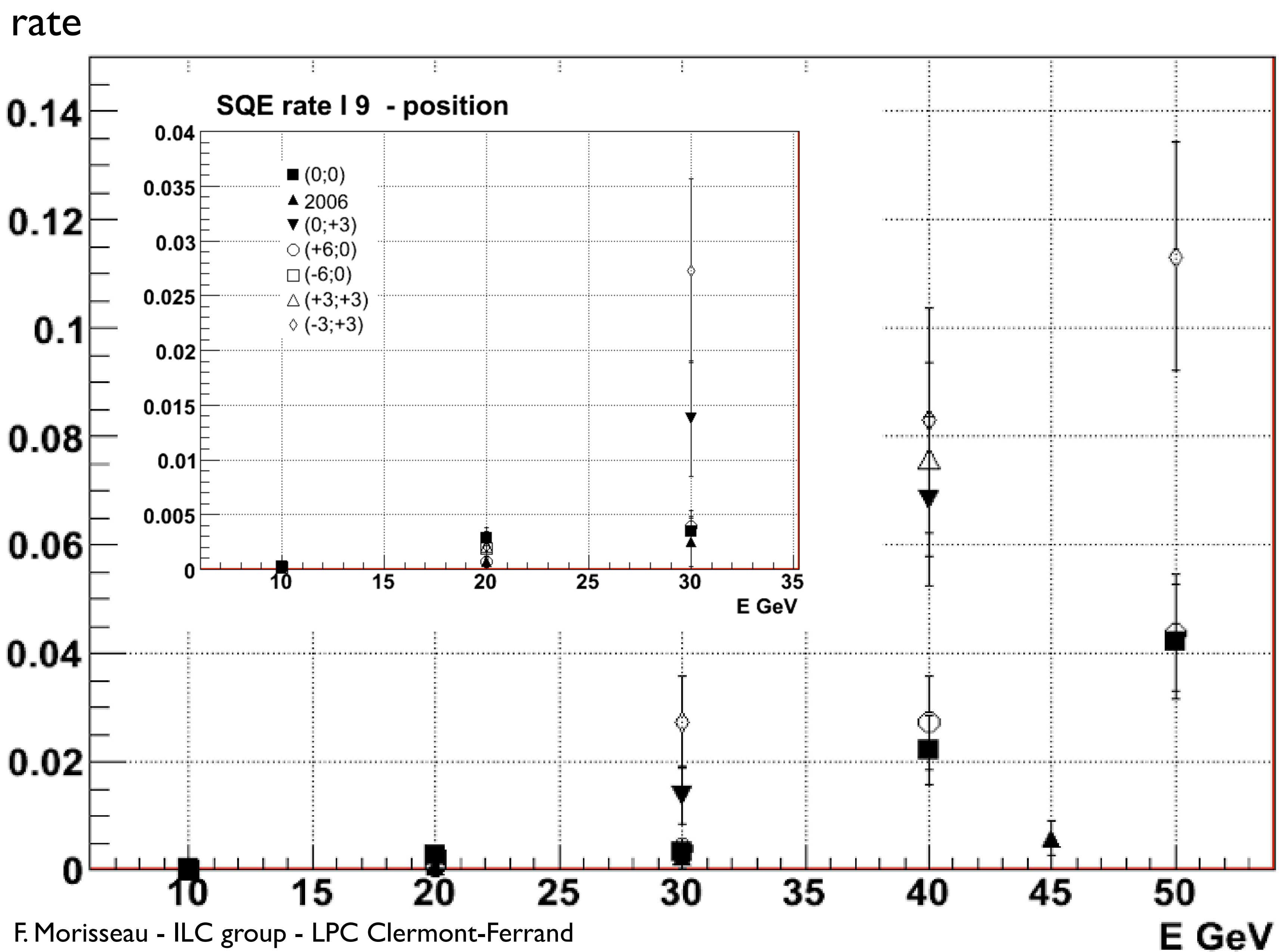
SQE rate - MC
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
12
14
16
18
20
NB border's Hits (isolated-linked)
6GeV
10GeV
20GeV
30GeV
45GeV

Selection



SQE rate - TB
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
12
14
16
18
20
NB border's Hits (isolated-linked)
10GeV(330664)
20GeV(330658)
30GeV(330430)
40GeV(330429)
50GeV(330428)
Our choice: NI > 8

SQE rate (2006 & 2007)



Conclusion

- More quantitative results expected soon.
- SQ events rate looks higher in 2007 e^- data than in 2006 for energies > 30 GeV.
- The rate higher when the electron hits the guard ring, instead of the centre of the wafer.
- Energy characterisation of the SQ events underway.