Si-W Resolution /CERN 2006/

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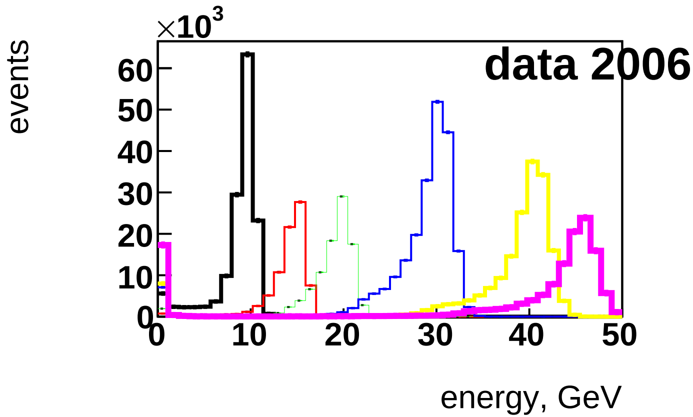
LPSC

position resolution

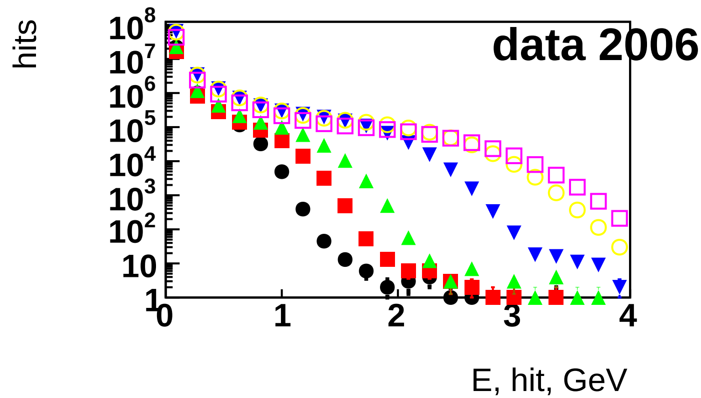
1. Calculate energy weighted mean shower position, $\vec{b} = \sum_{hits} \vec{r}_i w_i / \sum_{hits} w_i$
2. Use track reconstructed in drift chambers as reference
3. Measure the distance from $\vec{b}$ to reference track
4. Fit distance distribution to Gaus

** From previous measurements at LPSC
** MC predicts better resolution (0.8mm)
I will add noise to the hits in drift chambers for MC
to account for the finite resolution of the drift chambers

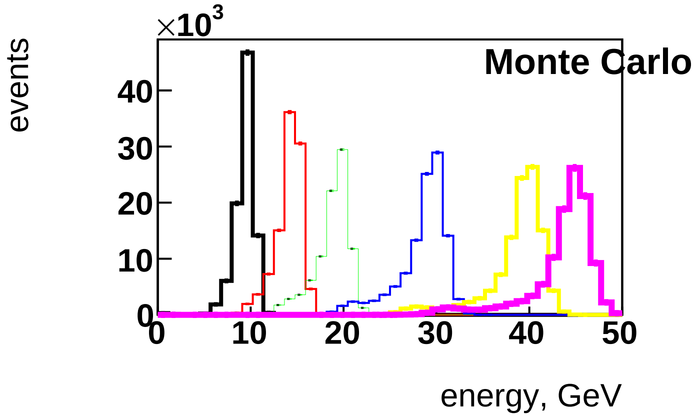
data



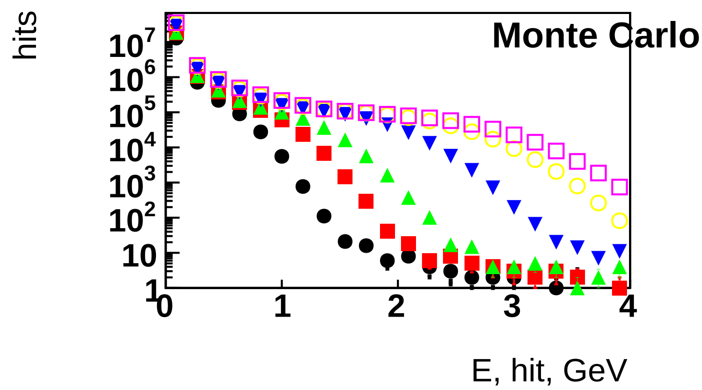
events
$\times 10^3$
data 2006
0
10
20
30
40
50
60
0
10
20
30
40
50
energy, GeV



hits
data 2006
1
10
10^2
10^3
10^4
10^5
10^6
10^7
10^8
0
1
2
3
4
E, hit, GeV



events
$\times 10^3$
Monte Carlo
0
10
20
30
40
0
10
20
30
40
50
energy, GeV



hits
Monte Carlo
1
10
10^2
10^3
10^4
10^5
10^6
10^7
0
1
2
3
4
E, hit, GeV

data from:

/grid/calice/tb-cern/rec/rec_v0406/Run310056_rec.0406.000.slcio

/grid/calice/tb-cern/rec/rec_v0406/Run300202_rec.0406.000.slcio

/grid/calice/tb-cern/rec/rec_v0406/Run300236_rec.0406.000.slcio

/grid/calice/tb-cern/rec/rec_v0406/Run300207_rec.0406.000.slcio

/grid/calice/tb-cern/rec/rec_v0406/Run300235_rec.0406.000.slcio

/grid/calice/tb-cern/rec/rec_v0406/Run300384_rec.0406.000.slcio

official Monte Carlo (Thanks to Shaojun!):

/grid/calice/shaojun

analysis

/*** parameters *****/**

//const Double_t alpha[3] = {1.1, 2, 2.7}//compensation coefficients

const Double_t alpha[3] = {1, 2, 3}//compensation coefficients

const Double_t beta = 250//MIP/GeV

const Double_t gamma = 7000//MIP/GeV(Monte Carlo)

//

/*** selection ******/**

E_hit > 0.6 MIP

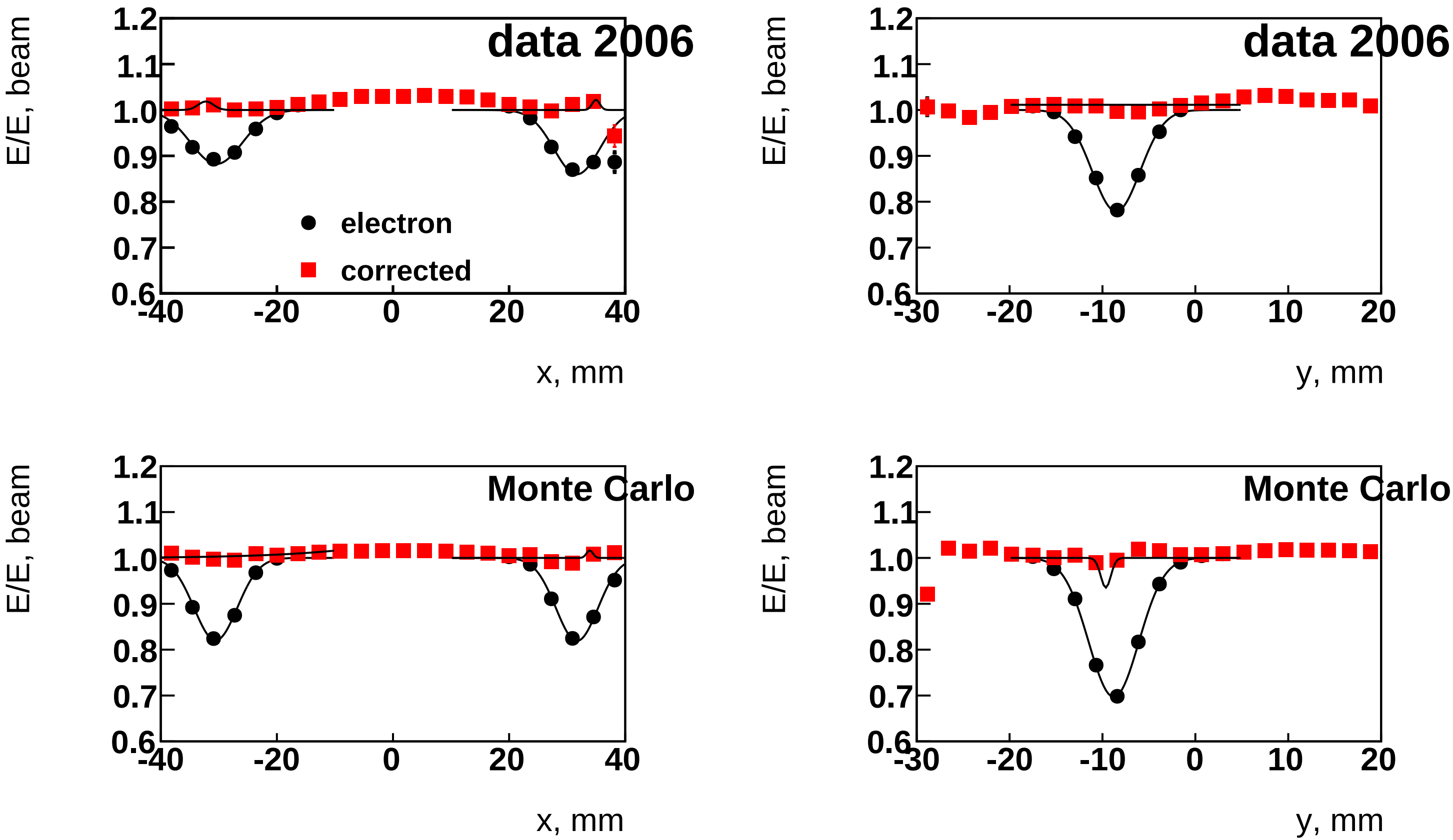
0.8 * E_beam < E < 1.2 * E_beam

b_x - gap_x > 17.2

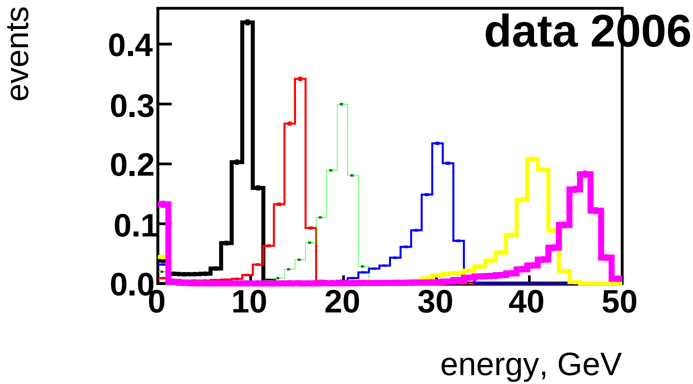
b_y - gap_y > 12.76

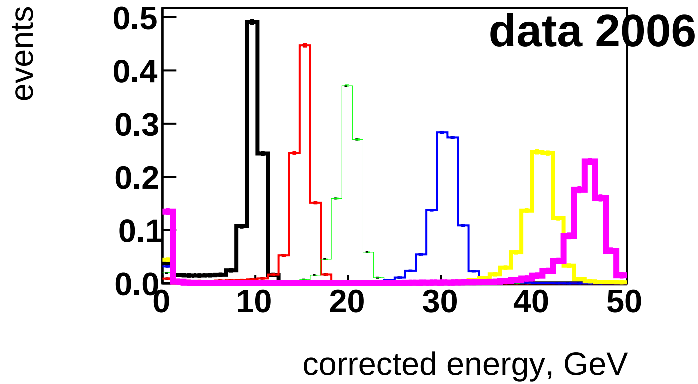
n_tracks = 1

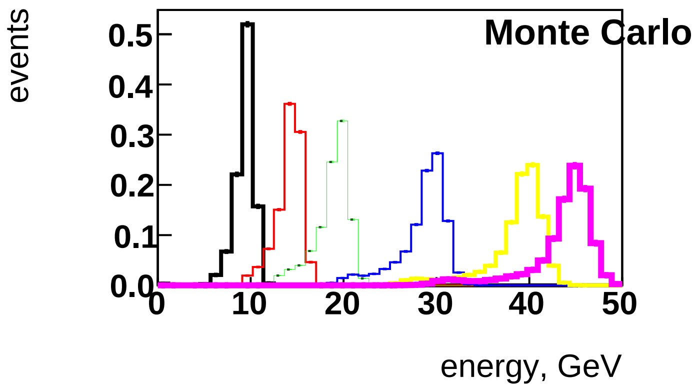
wafer gaps correction

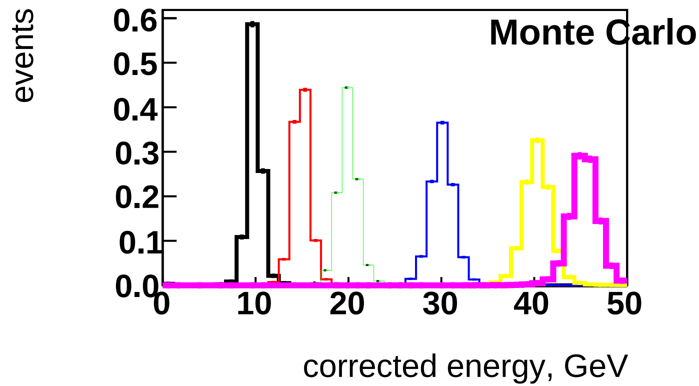


wafer gaps correction effect

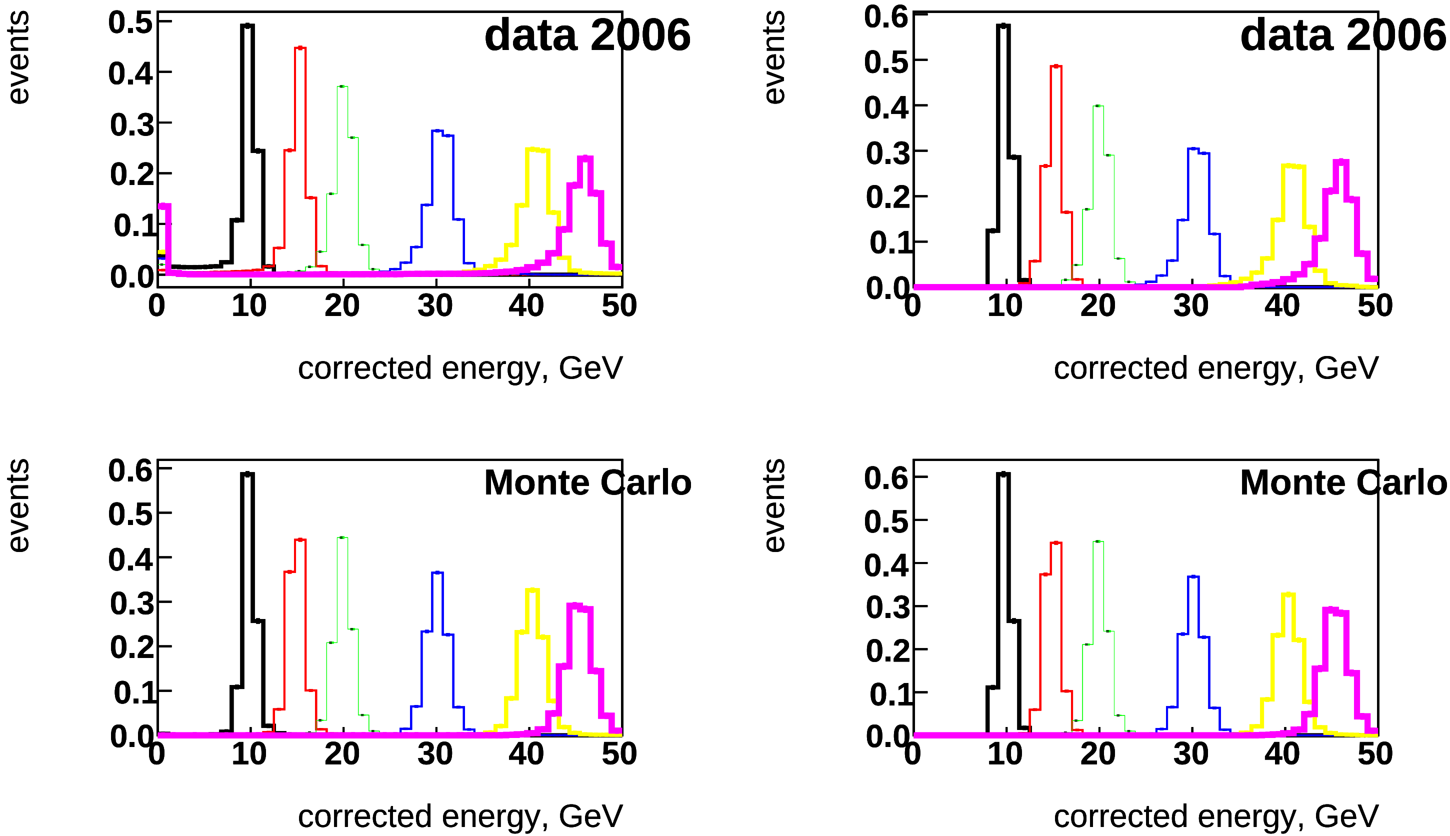






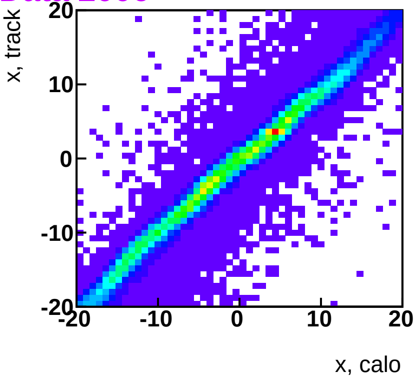


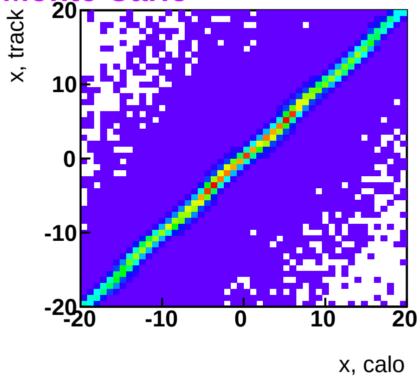
electron selection

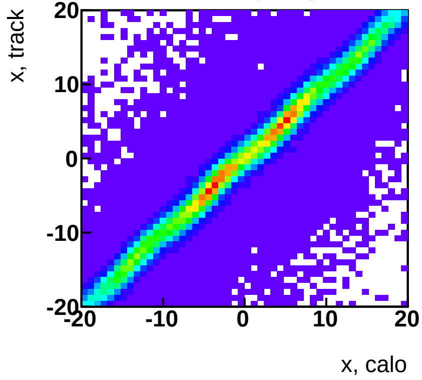


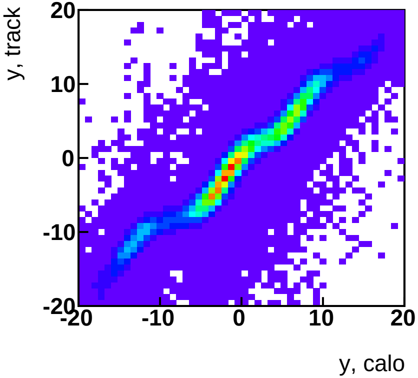
track correlation

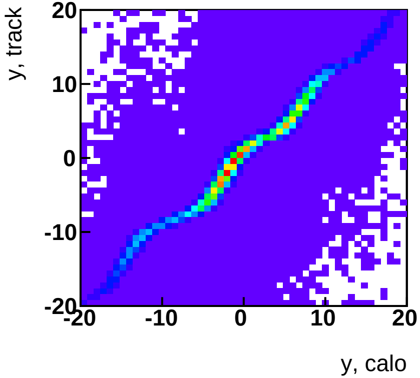
Data 2006 | **Monte Carlo** | **Monte Carlo + random.gaus(x_dc, 1 mm)**

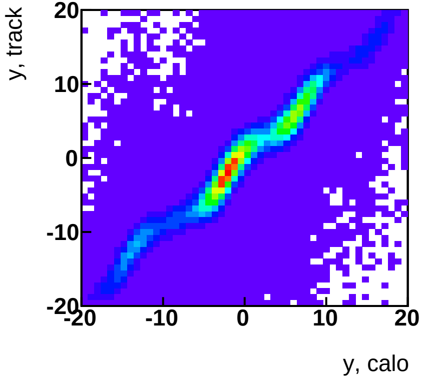






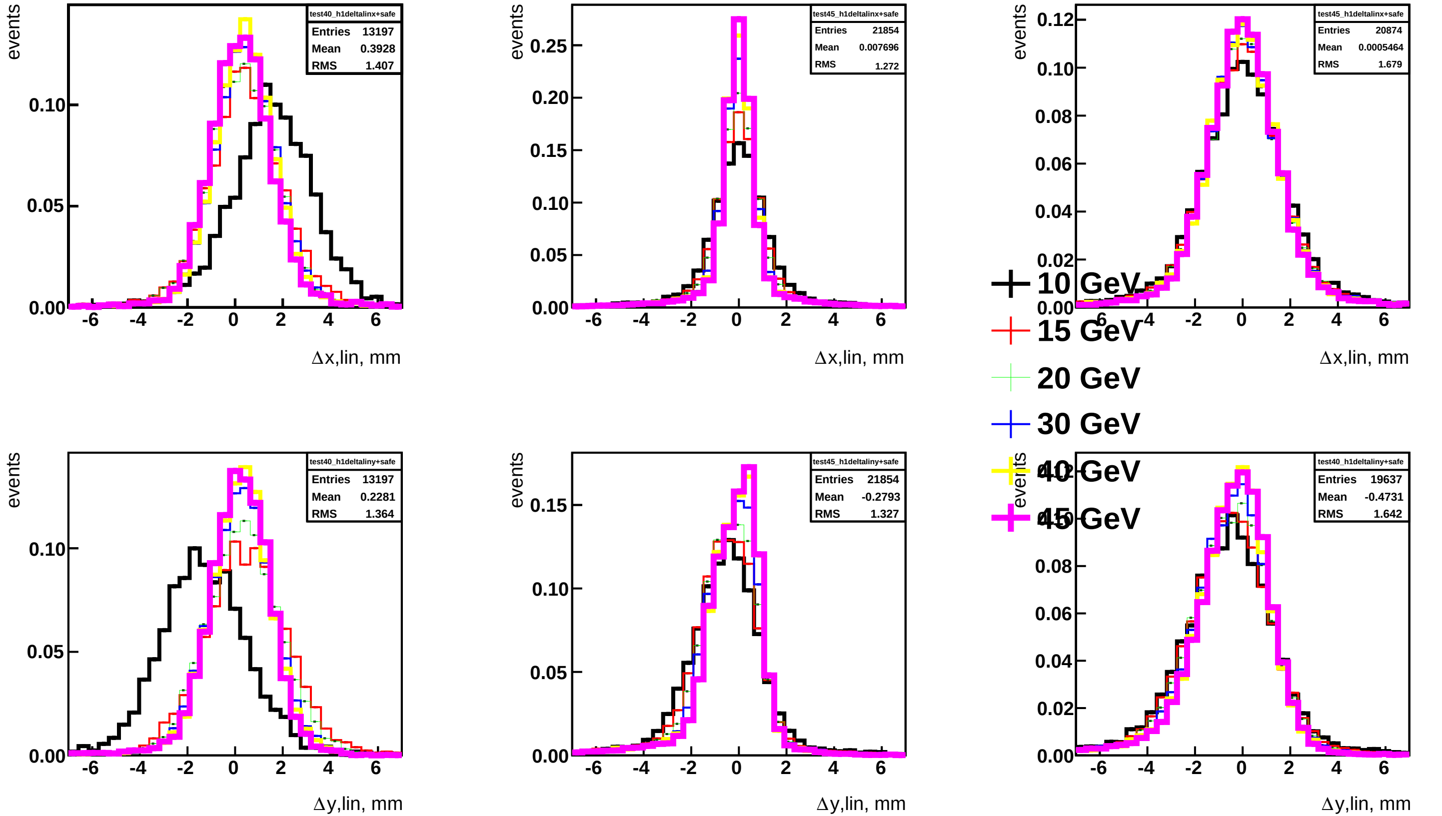


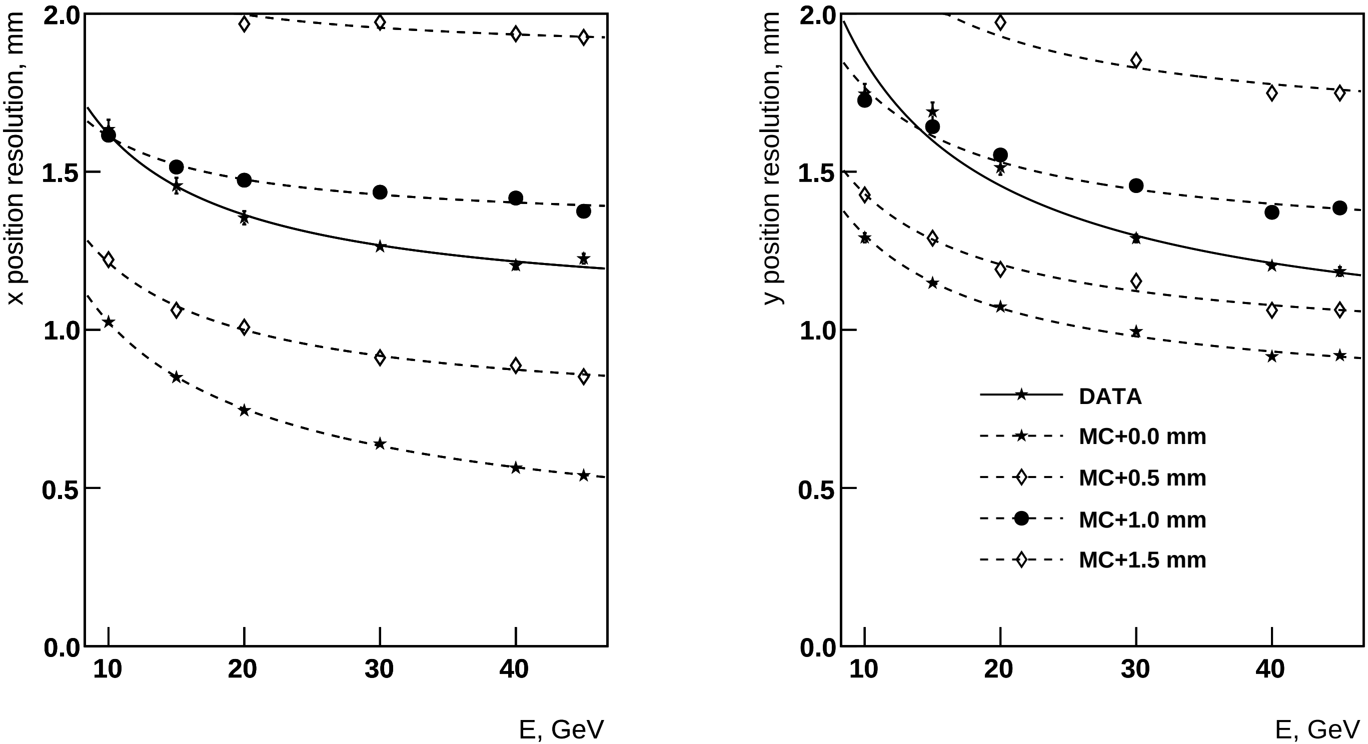




measurement

Data 2006 | Monte Carlo | Monte Carlo + random.gaus(x_dc, 1 mm)





x position resolution, mm
y position resolution, mm
2.0
1.5
1.0
0.5
0.0
10
20
30
40
E, GeV
DATA
MC+0.0 mm
MC+0.5 mm
MC+1.0 mm
MC+1.5 mm

summary & conclusions

The Si-W ECAL position resolution is NOT described by MC.

The reason is NOT known yet.

Account for the finite resolution of drift chambers by smearing hit position.

1. Resolution as measured from data is reached at ~ 0.8 mm

but drift chambers are expected to have better resolution.

2. The shape is different.

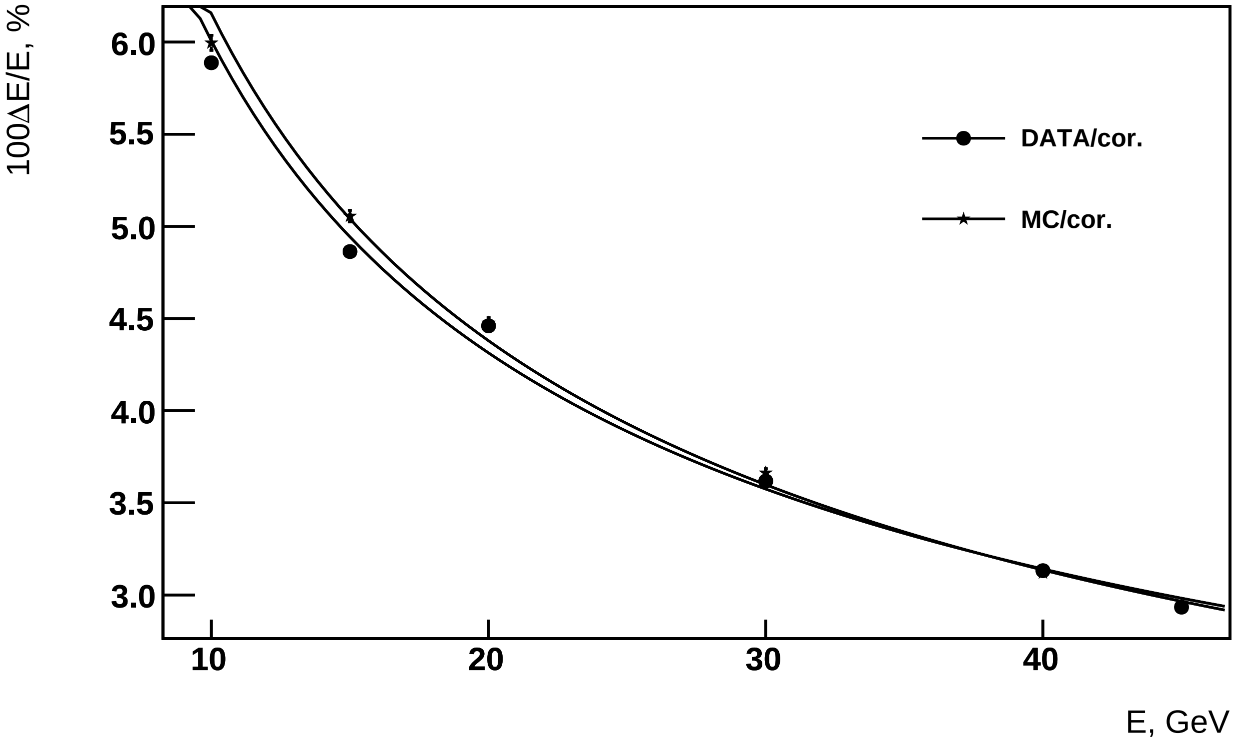
-> The resolution of the drift chambers is not

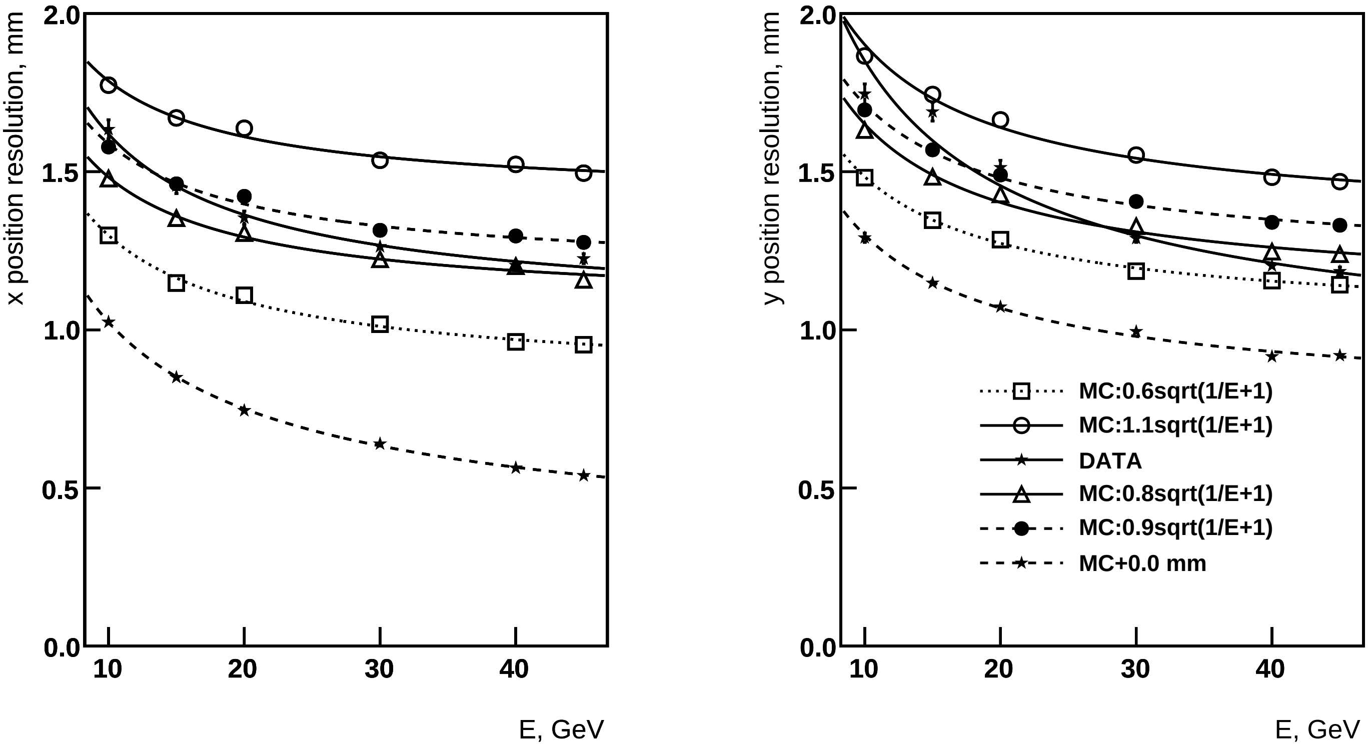
the (only) reason for the discrepancy

Thanks for suggestions.

APPENDIX

Energy resolution




x position resolution, mm
2.0
1.5
1.0
0.5
0.0
10
20
30
40
E, GeV
y position resolution, mm
2.0
1.5
1.0
0.5
0.0
10
20
30
40
E, GeV
MC:0.6sqrt(1/E+1)
MC:1.1sqrt(1/E+1)
DATA
MC:0.8sqrt(1/E+1)
MC:0.9sqrt(1/E+1)
MC+0.0 mm

Energy resolution fits

FCN=19.8098 FROM MIGRAD STATUS=CONVERGED 125 CALLS 126 TOTAL

EDM=1.56568e-09 STRATEGY= 1 ERROR MATRIX ACCURATE

EXT PARAMETER				STEP	FIRST
NO.	NAME	VALUE	ERROR	SIZE	DERIVATIVE
1	stochastic term	1.75415e+01	1.75089e-01	1.79635e-04	4.40296e-04
2	constant term	1.34411e+00	8.30989e-02	8.52606e-05	3.02976e-04

FCN=20.5331 FROM MIGRAD STATUS=CONVERGED 55 CALLS 56 TOTAL

EDM=1.60969e-13 STRATEGY= 1 ERROR MATRIX ACCURATE

EXT PARAMETER				STEP	FIRST
NO.	NAME	VALUE	ERROR	SIZE	DERIVATIVE
1	stochastic term	1.78916e+01	2.86953e-01	2.93390e-04	-1.09676e-06
2	constant term	1.06027e+00	1.66300e-01	1.70023e-04	1.61443e-06

Position resolution fits

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	MC+1.5 mm, stochastic term	2.72273e+00	6.69013e-01	2.97743e-04	-4.63676e-08
2	MC+1.5 mm, constant term	1.89385e+00	4.82803e-02	2.14868e-05	3.35487e-06

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	MC+1.0 mm, stochastic term	2.82332e+00	3.68079e-01	1.59769e-04	-6.00873e-07
2	MC+1.0 mm, constant term	1.34425e+00	3.70366e-02	1.60760e-05	-1.16887e-05

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	DATA, stochastic term	3.99324e+00	2.40932e-01	1.46730e-04	-1.07543e-05
2	DATA, constant term	1.01903e+00	3.95992e-02	2.41161e-05	-5.24213e-05

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	MC+0.5 mm, stochastic term	3.10440e+00	1.66791e-01	6.57173e-05	-4.33366e-05
2	MC+0.5 mm, constant term	7.17150e-01	2.96096e-02	1.16663e-05	-2.12919e-04

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	MC+0.0 mm, stochastic term	3.07511e+00	9.02601e-02	3.69390e-05	-1.27883e-04
2	MC+0.0 mm, constant term	2.42639e-01	4.09618e-02	1.67619e-05	8.76821e-04