Presentation and discussion about the energy measurement in the ECAL

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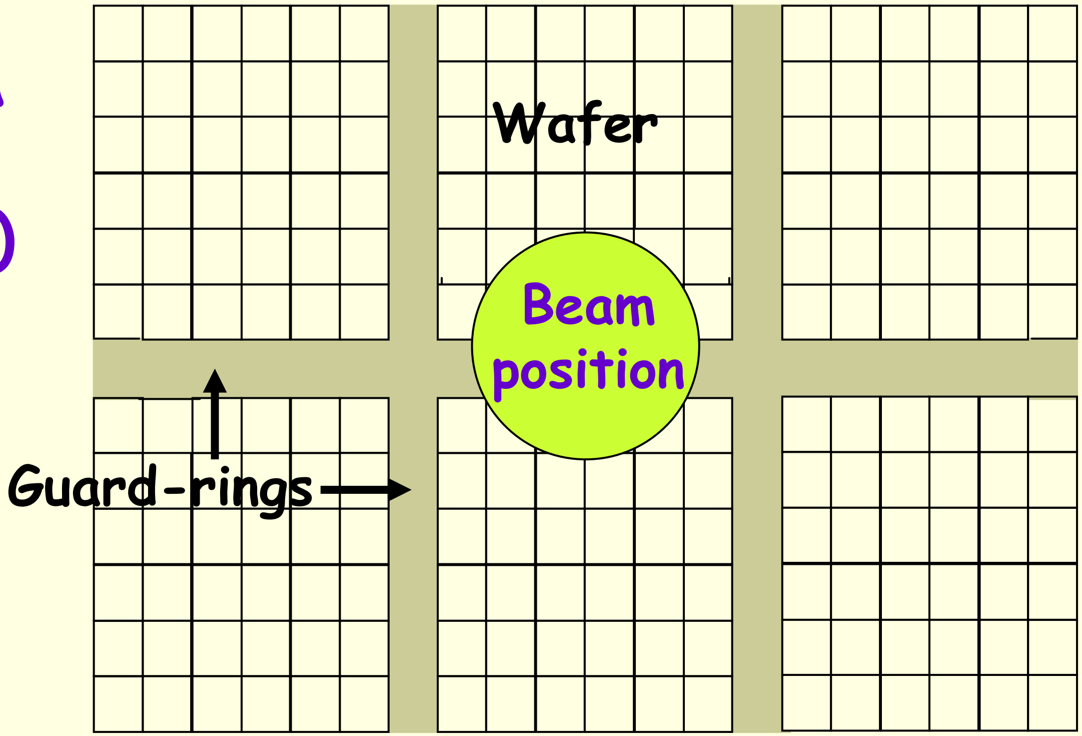
Problem: existence of the guard-rings

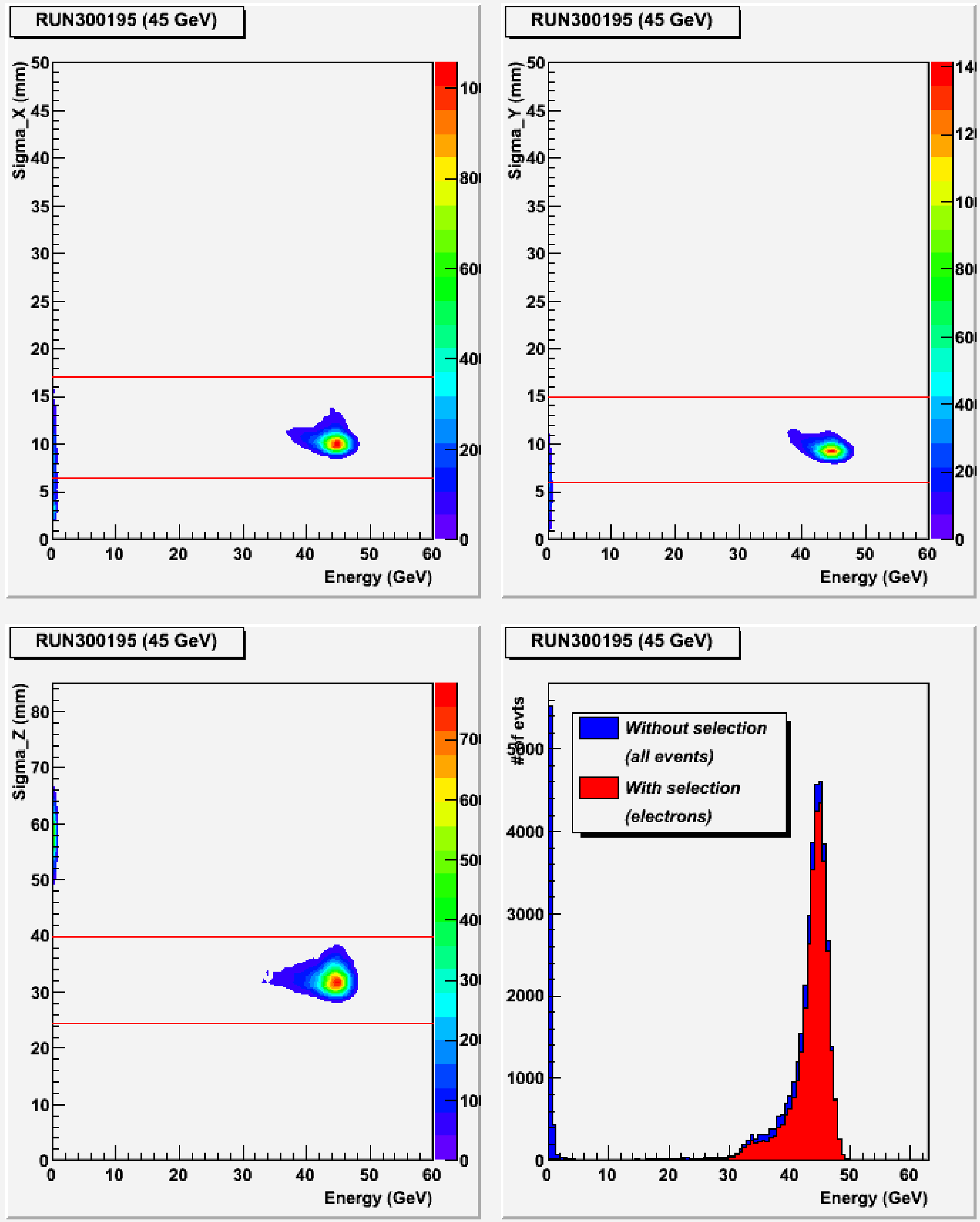
CERN DATA

(θ=0 degree)

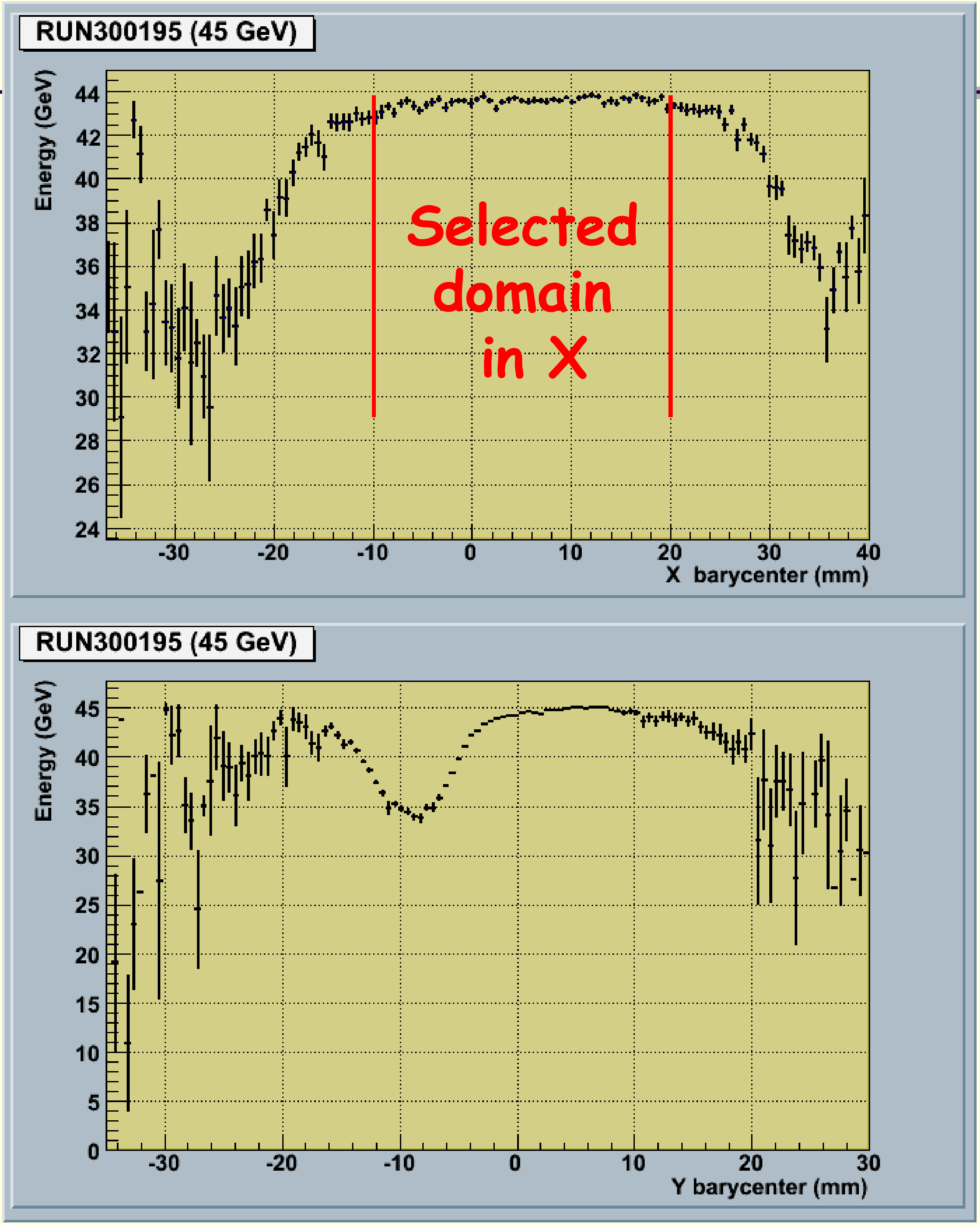


Selection of the electrons

Obtained from the shape of the showers (σ_x, σ_y and σ_z)



Effect of the guard-rings (drawings of the profiles)



Correction in Y

$$Fit:$$

$$Plateau\ (1\ parameter) - Gaussian\ (3\ parameters)$$

$$[3]-[0]\cdot e^{-\frac{(Y-[1])^2}{2.[2]^2}}$$

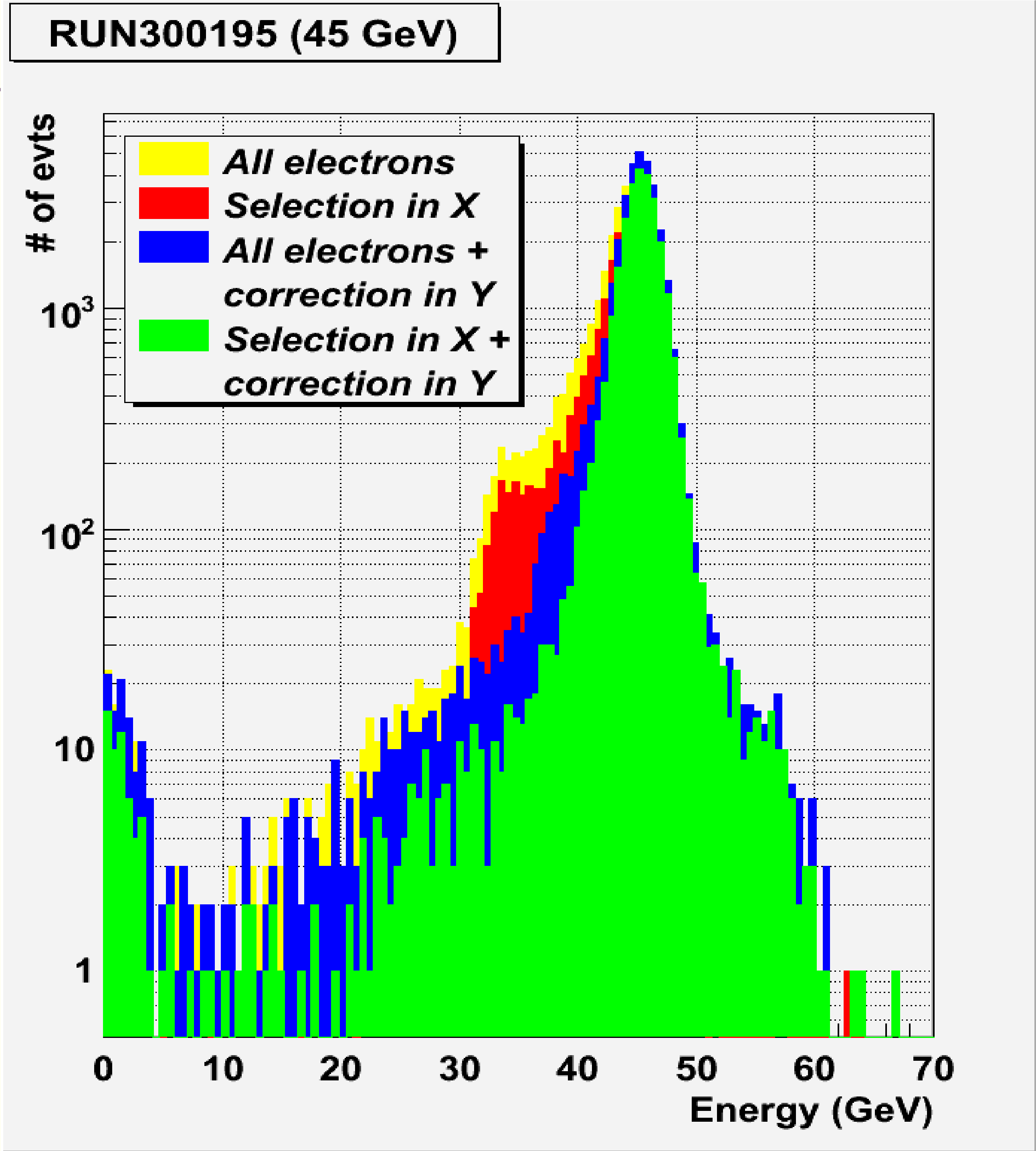
$$(where\ parameter\ [2] = RMS)$$

$$Fonction\ of\ correction:$$

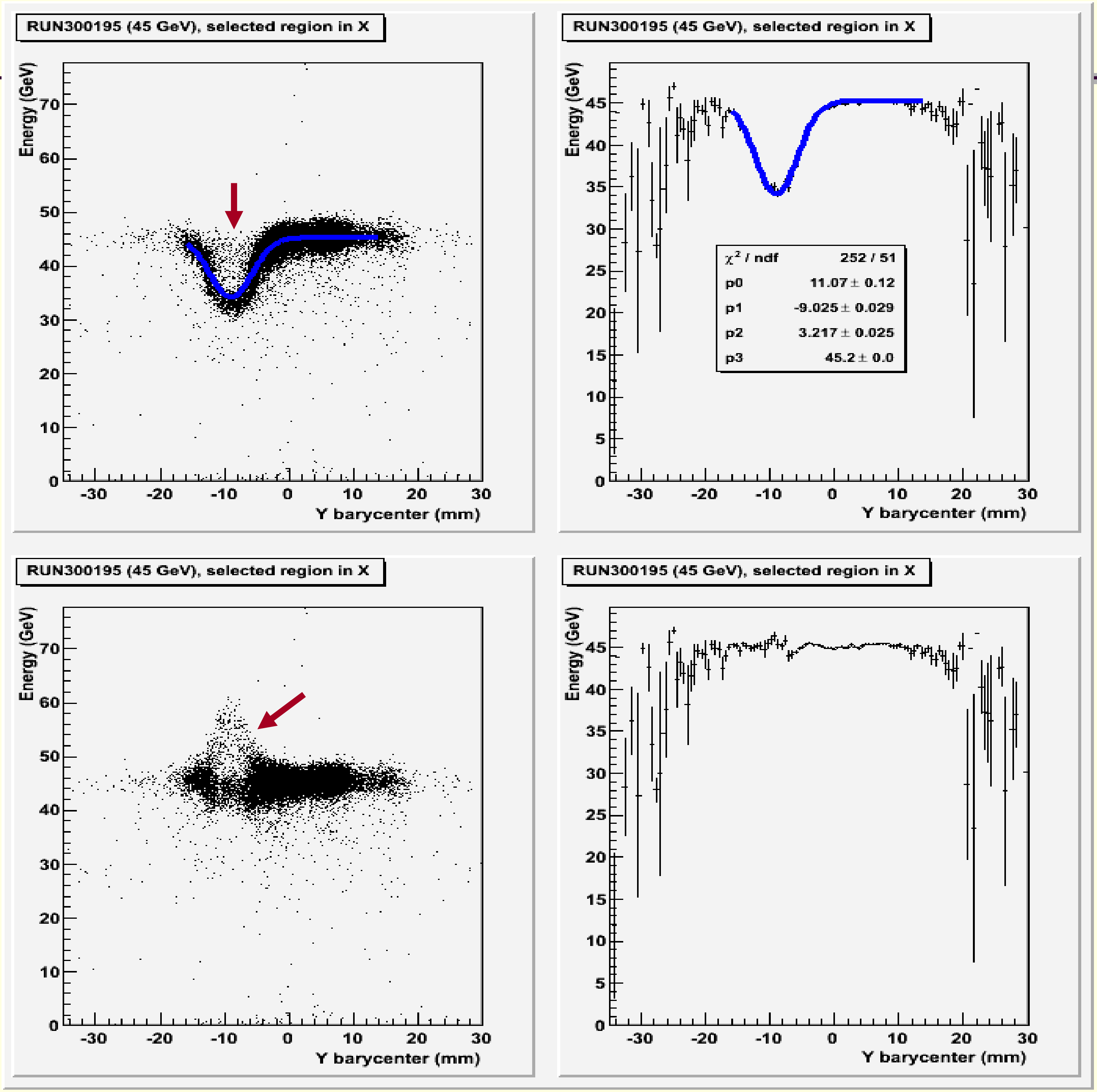
$$(only\ 3\ parameters)$$

$$\frac{[3]}{[3]-[0]\cdot e^{-\frac{(Y-[1])^2}{2.[2]^2}}} = \frac{1}{1-[0']\cdot e^{-\frac{(Y-[1])^2}{2.[2]^2}}}$$

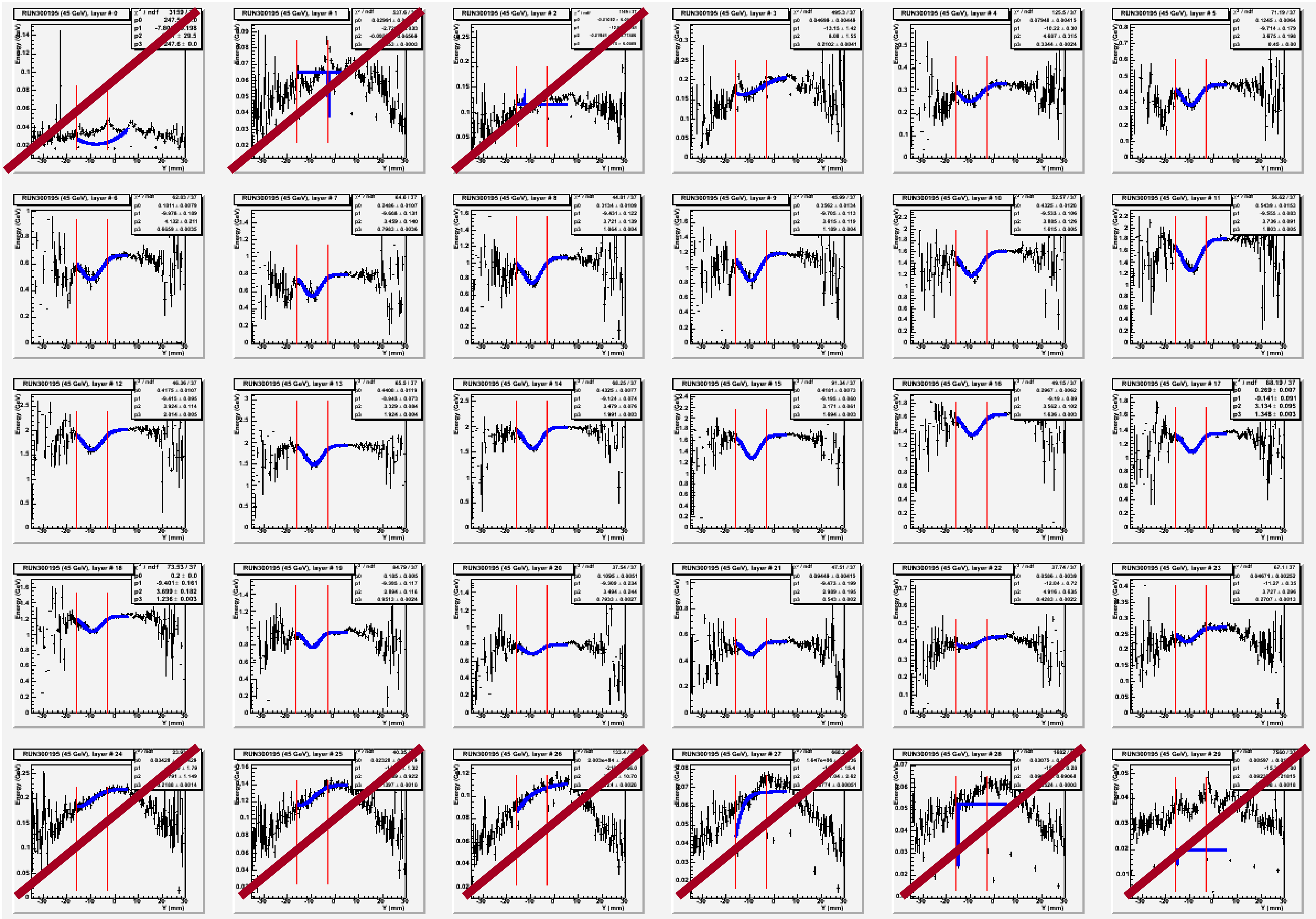
Results: global correction in Y



Some troubles



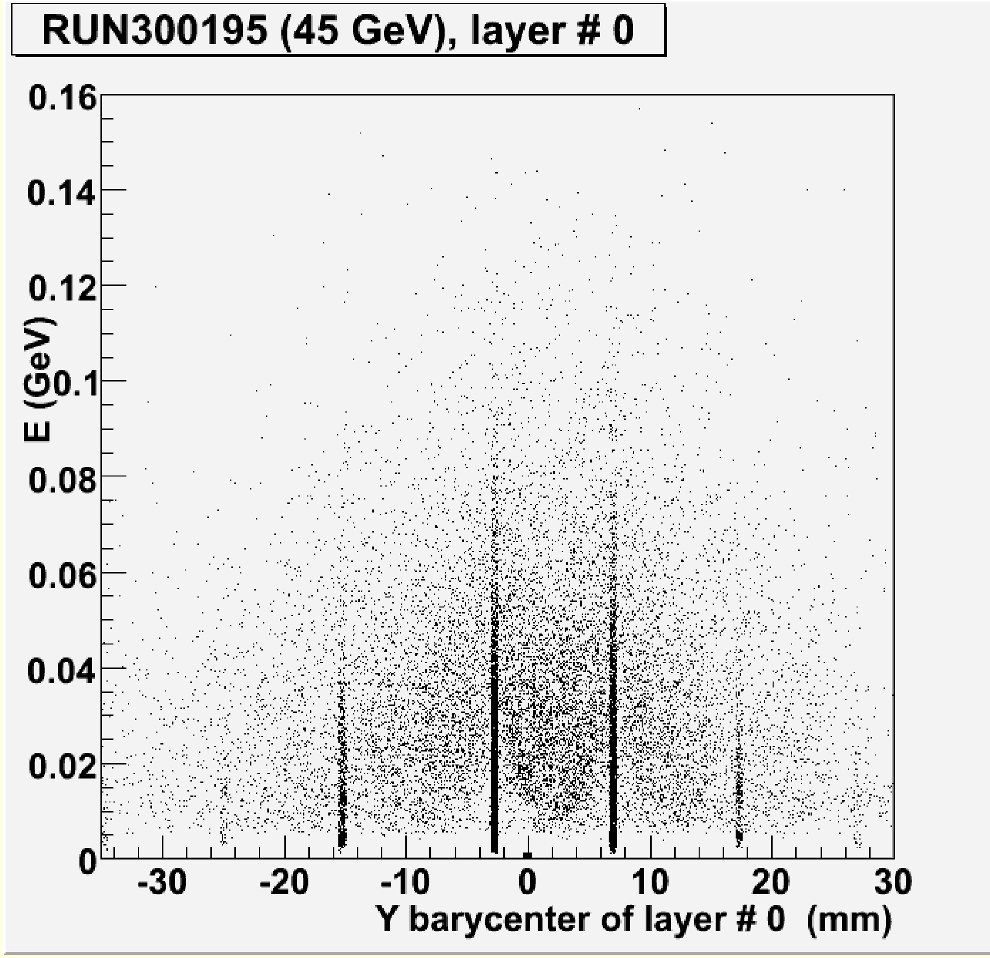
Layer per layer correction



Remarks:

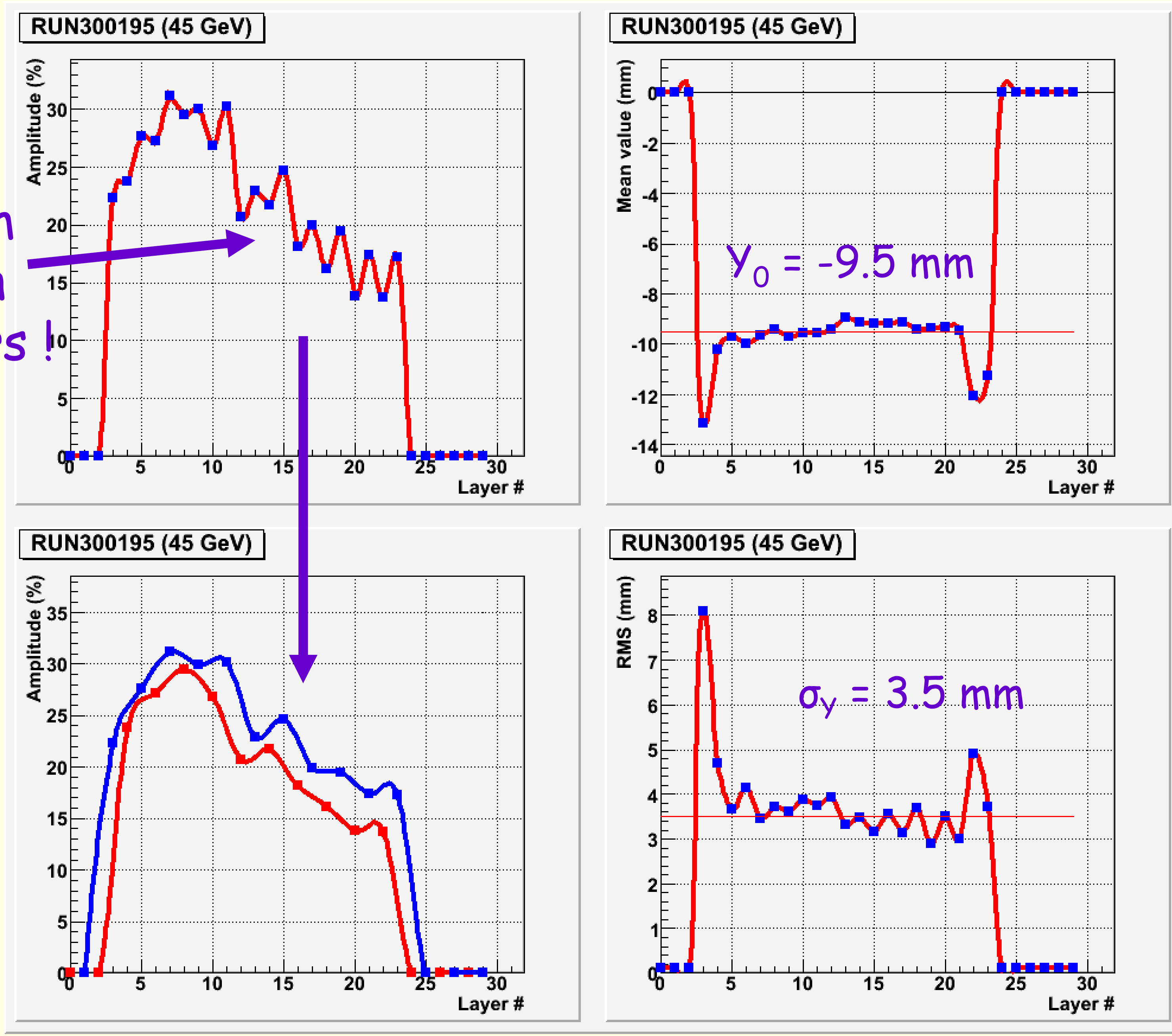
In the previous histograms :
Y = Y barycenter calculated in the studied layer
Energy = Energy deposited in the studied layer

It is not always possible to fit the response of each layer, for instance : layer # 0. In that case, for these layers, there will be no correction in Y.

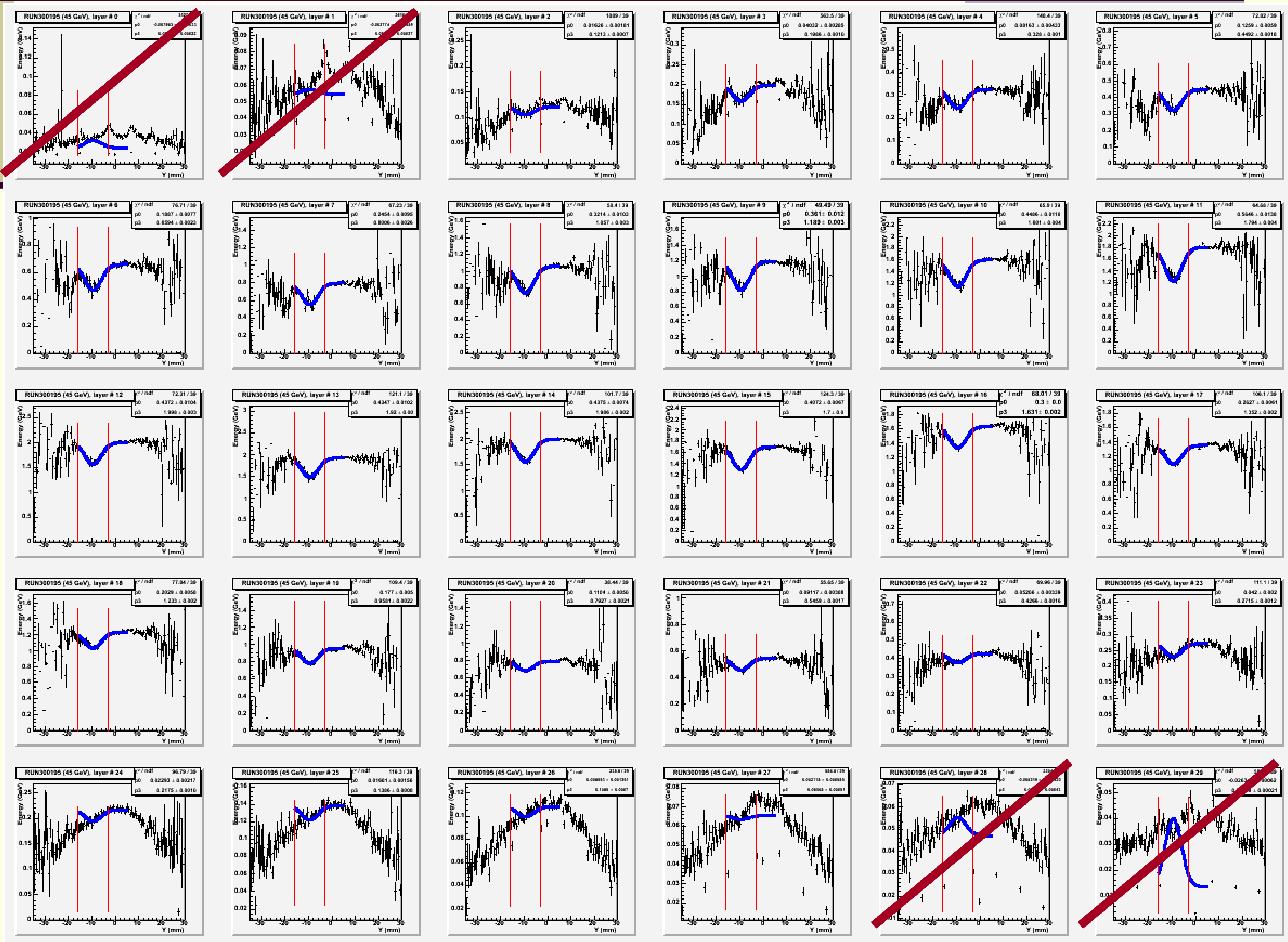


Fitting parameters (45 GeV)

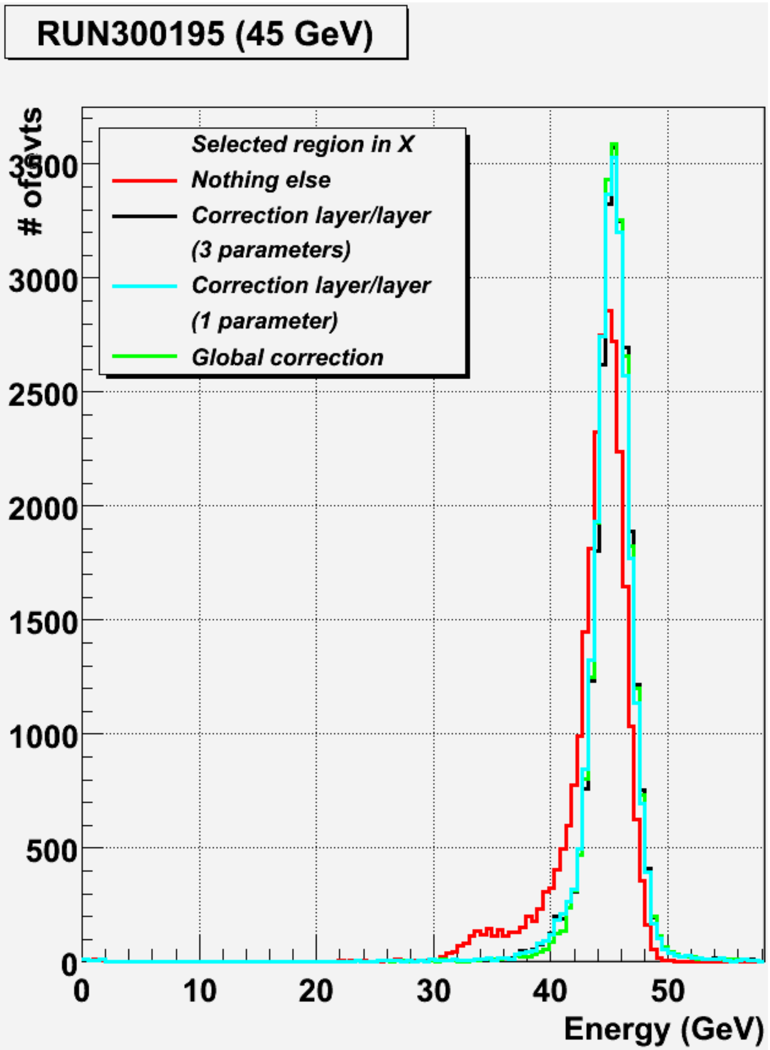
Not the same sampling term between even and odd layers !

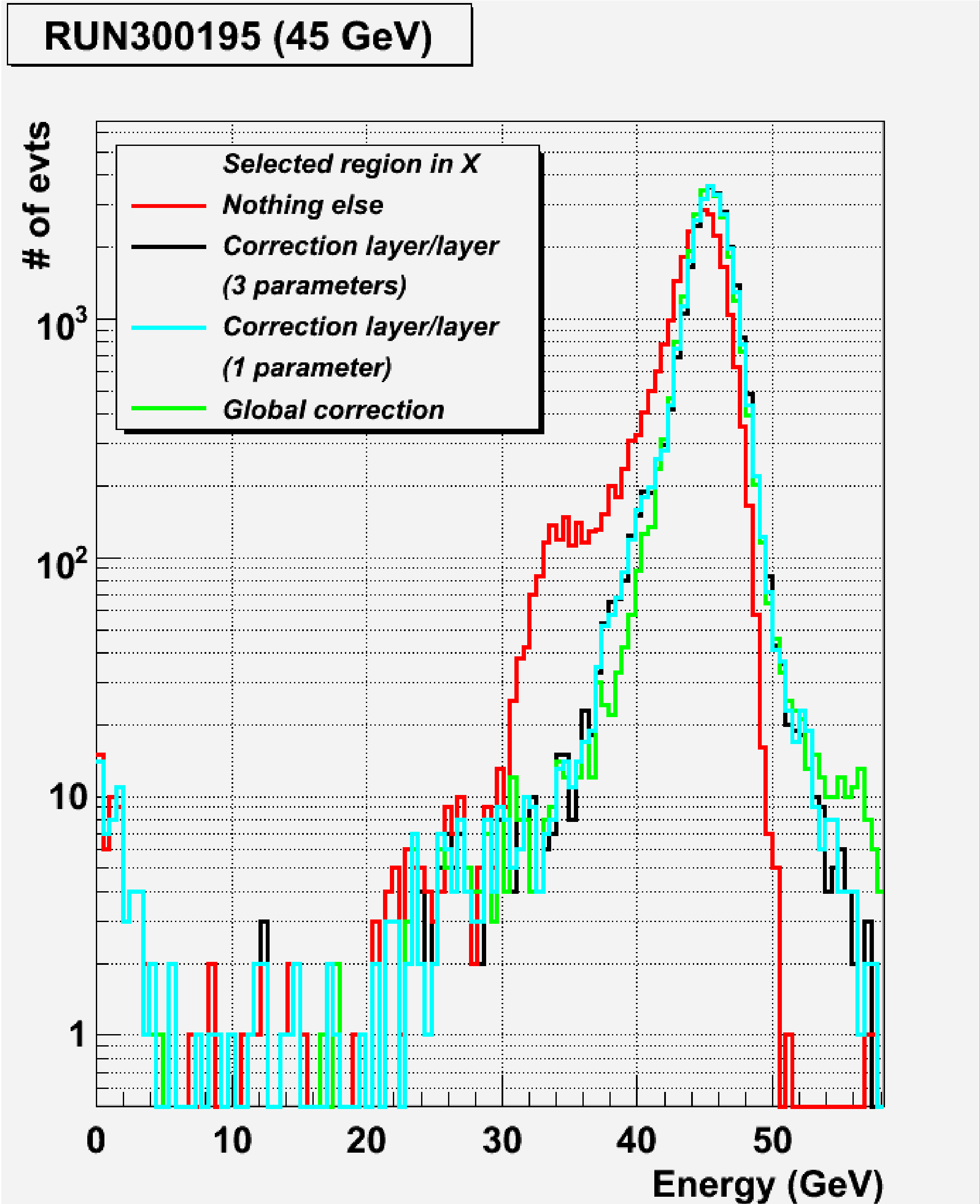


With only 2 param. (⇒ 1 param. for the corrective function)

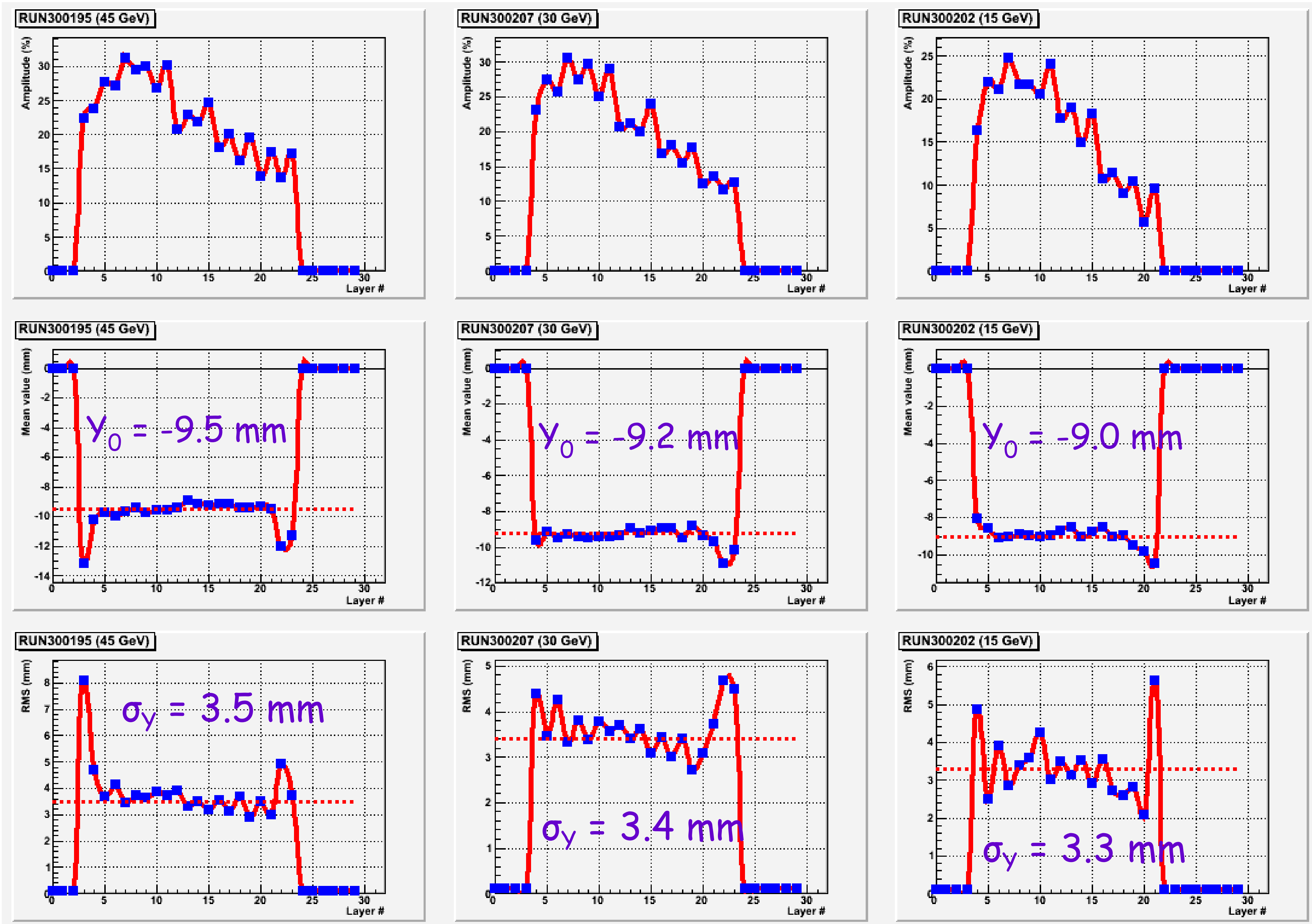


Results (45 GeV)

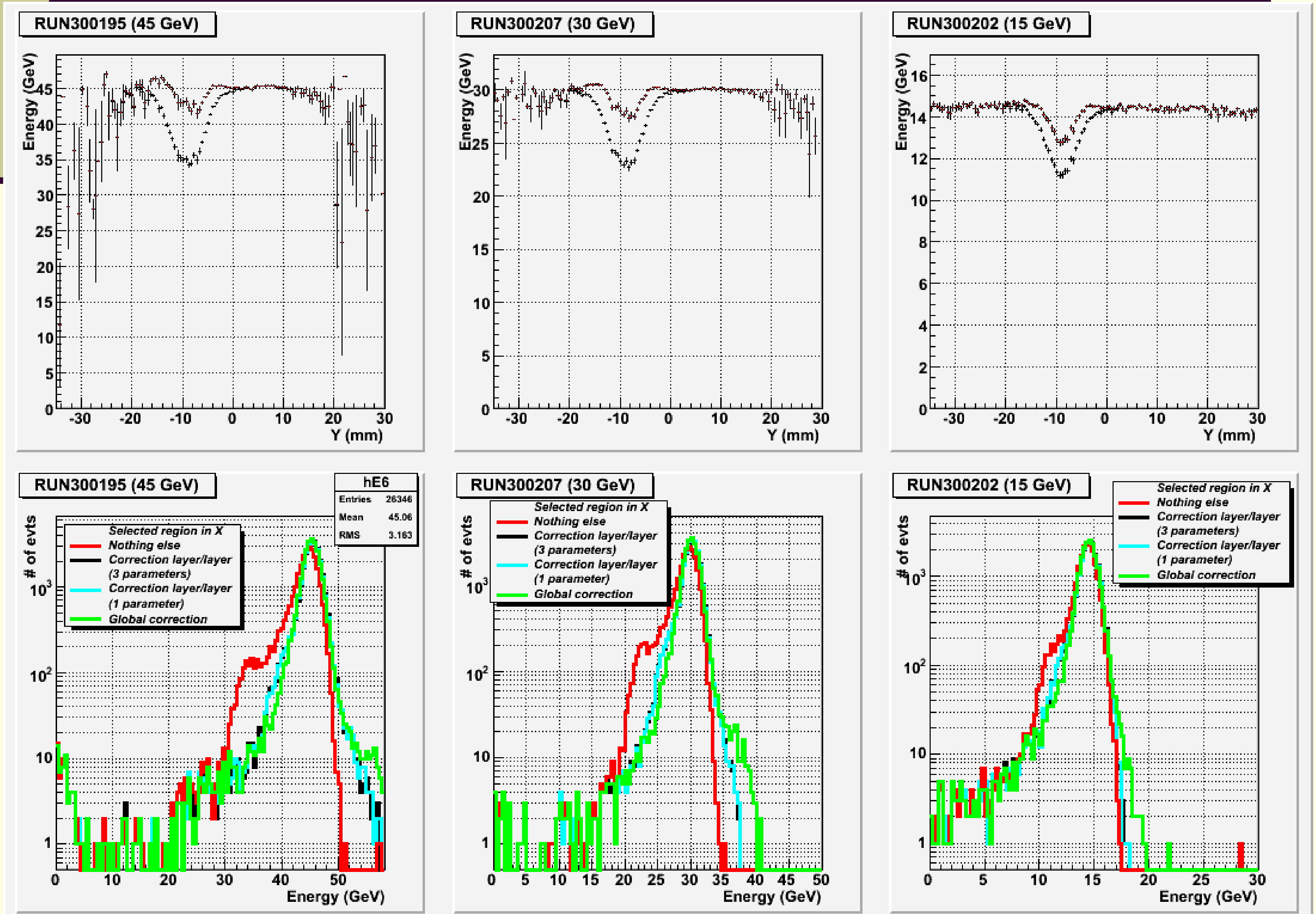




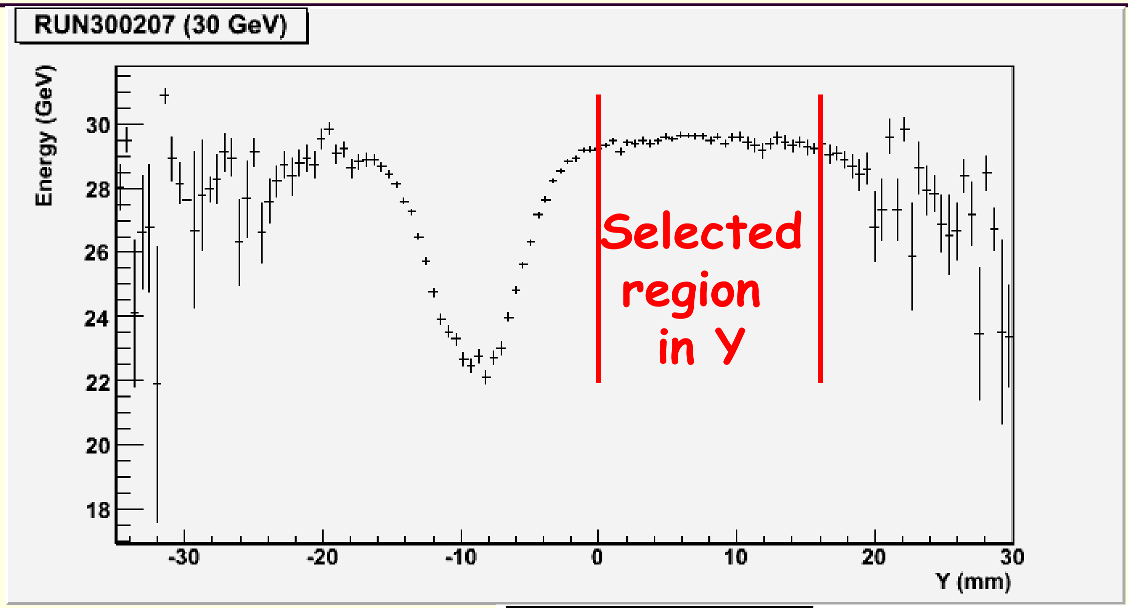
Comparisons: 45 GeV, 30 GeV and 15 GeV (layer/layer)



Results: 45 GeV, 30 GeV and 15 GeV (selected region in X)



Correction in X ($\Rightarrow$ selected region in Y)

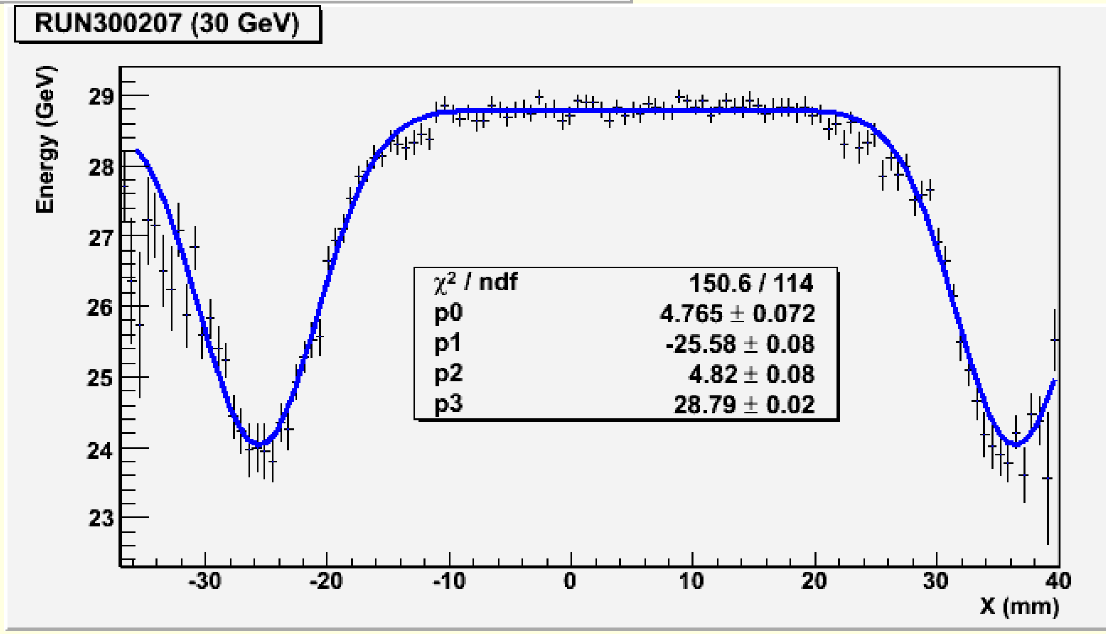


$$Fit:$$

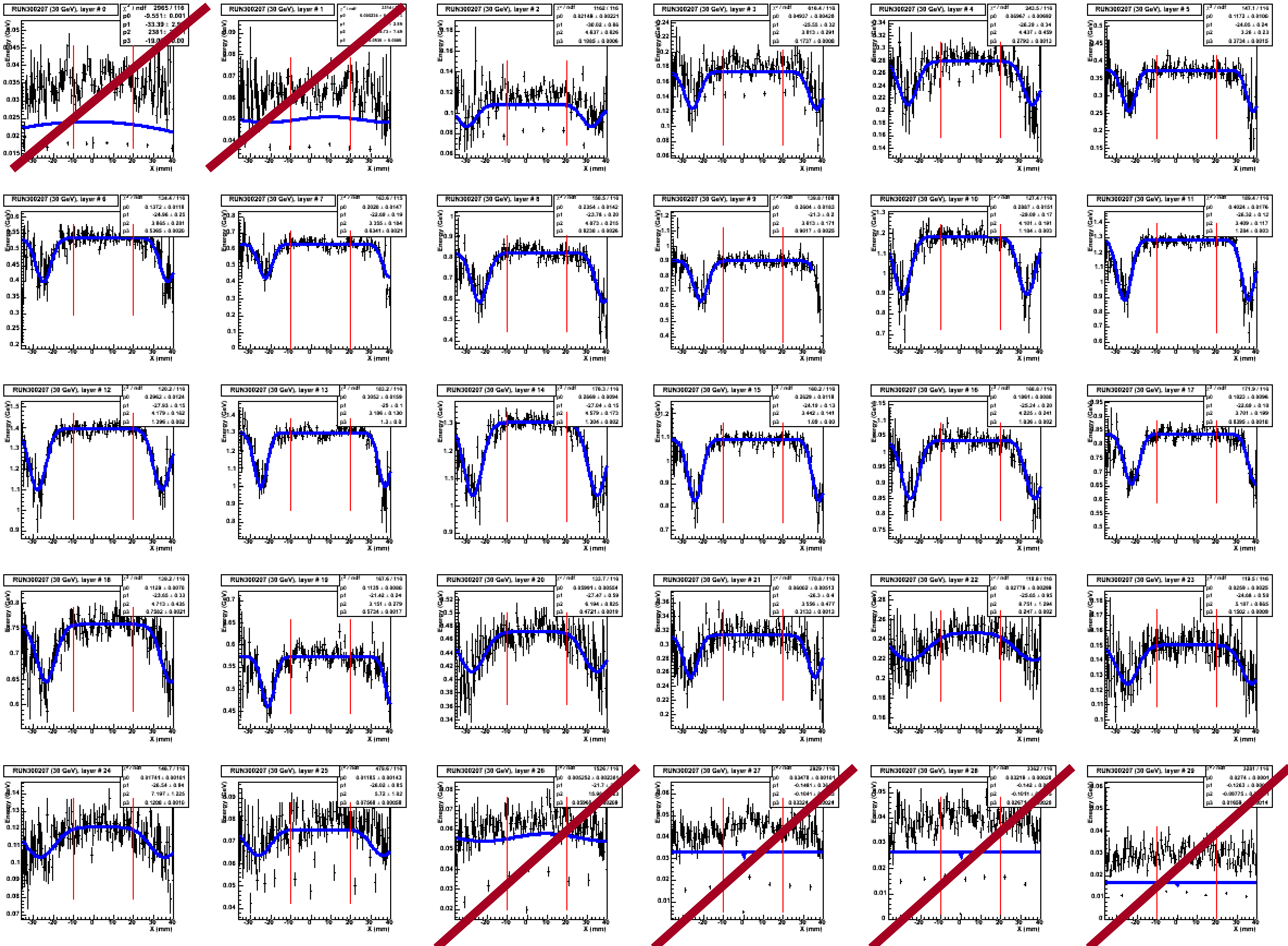
$$Plateau - Gaussian\_1 - Gaussian\_2$$

$$[3]-[0]\cdot\left(e^{-\frac{(Y-[1])^2}{2.[2]^2}} + e^{-\frac{(Y-([1]+62mm))^2}{2.[2]^2}} \right)$$

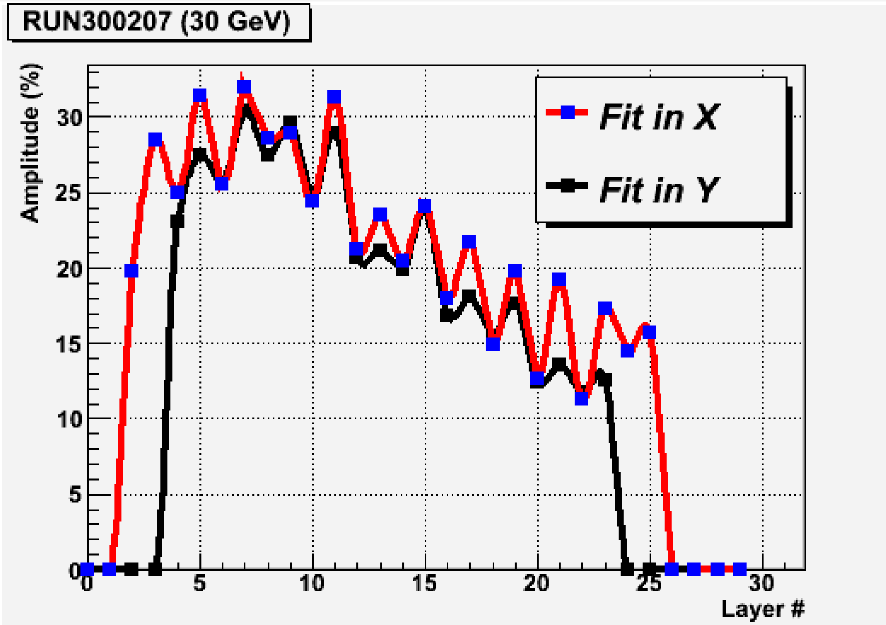
$$(\Rightarrow 4\ parameters)$$

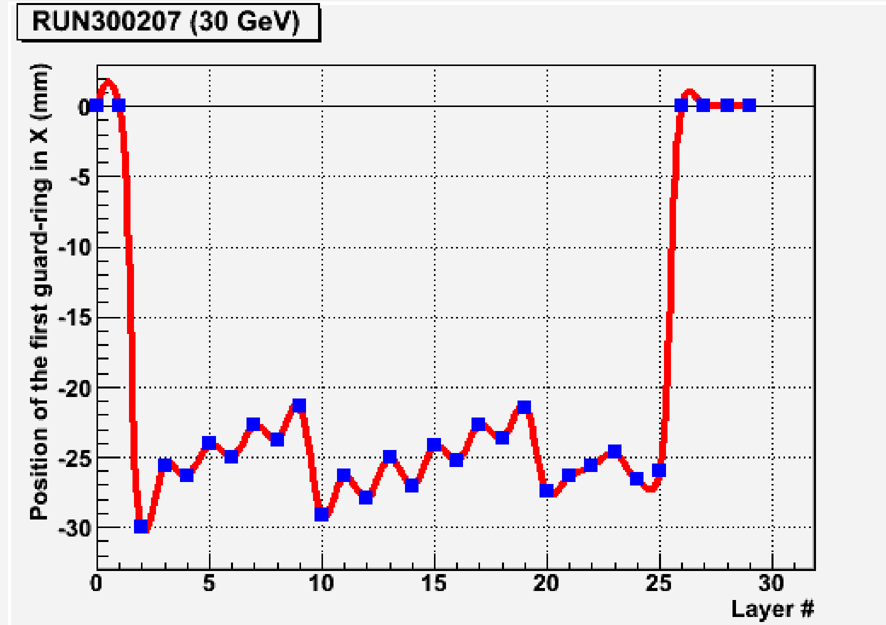


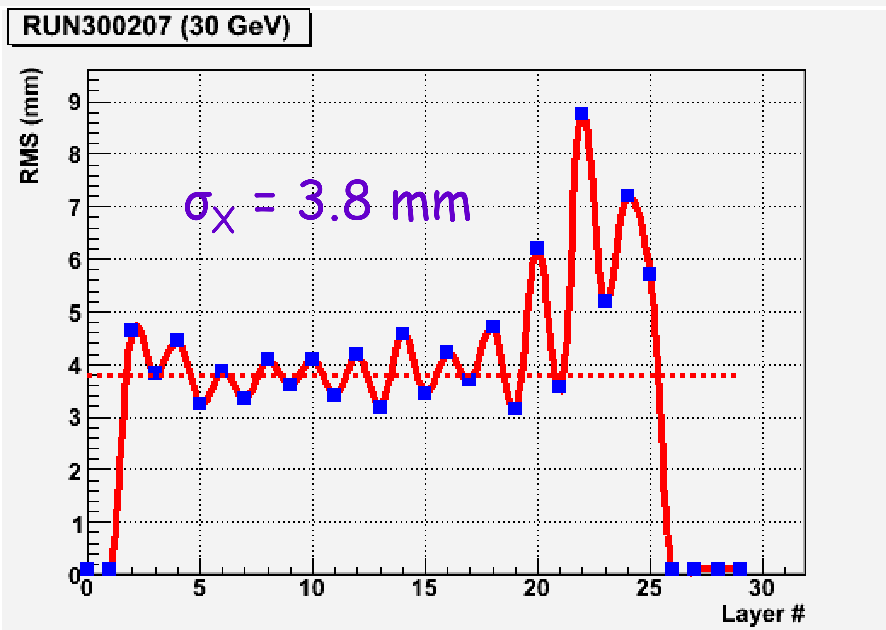
Layer per layer correction in X (4 parameters)



Remarks:

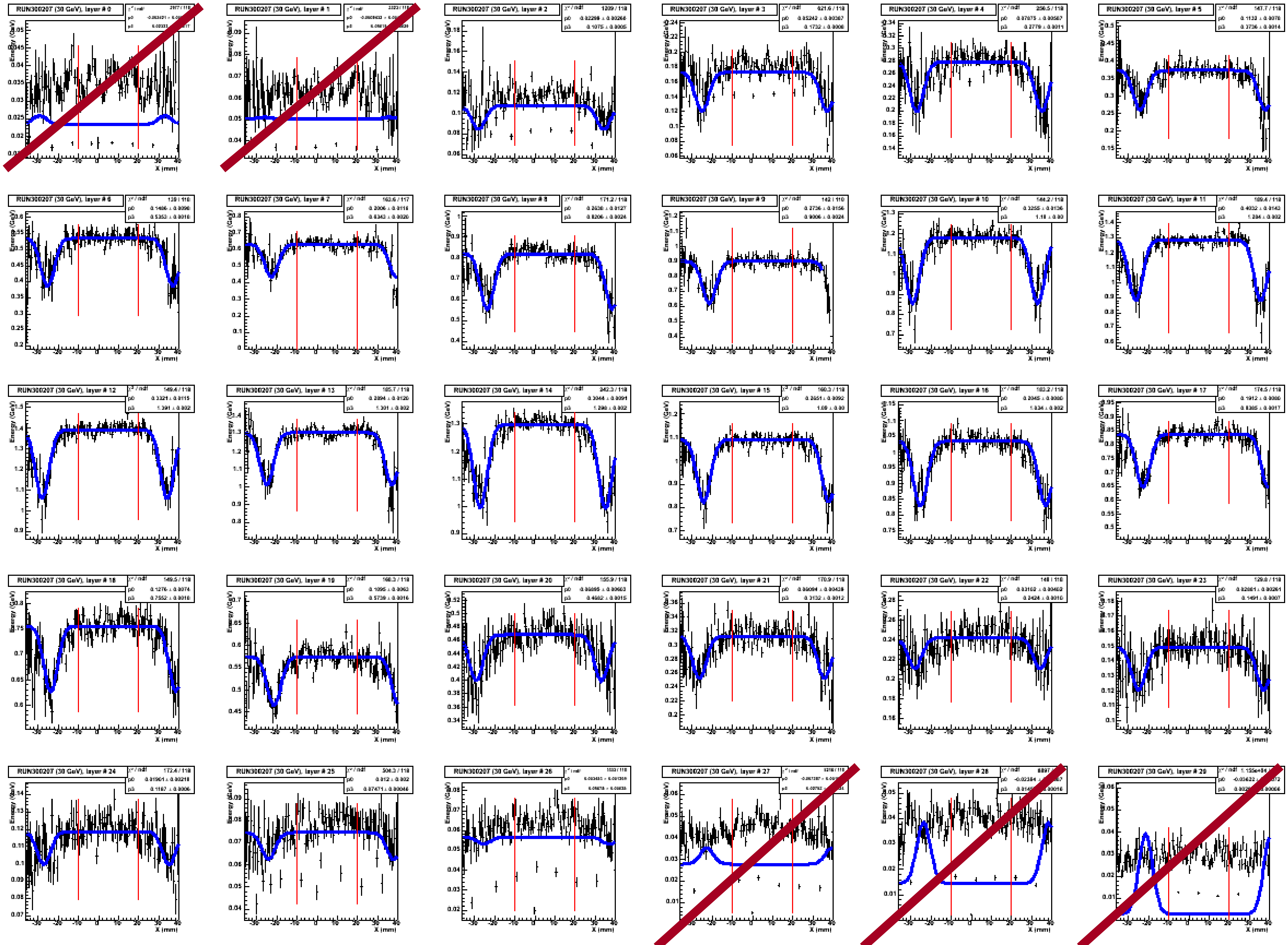






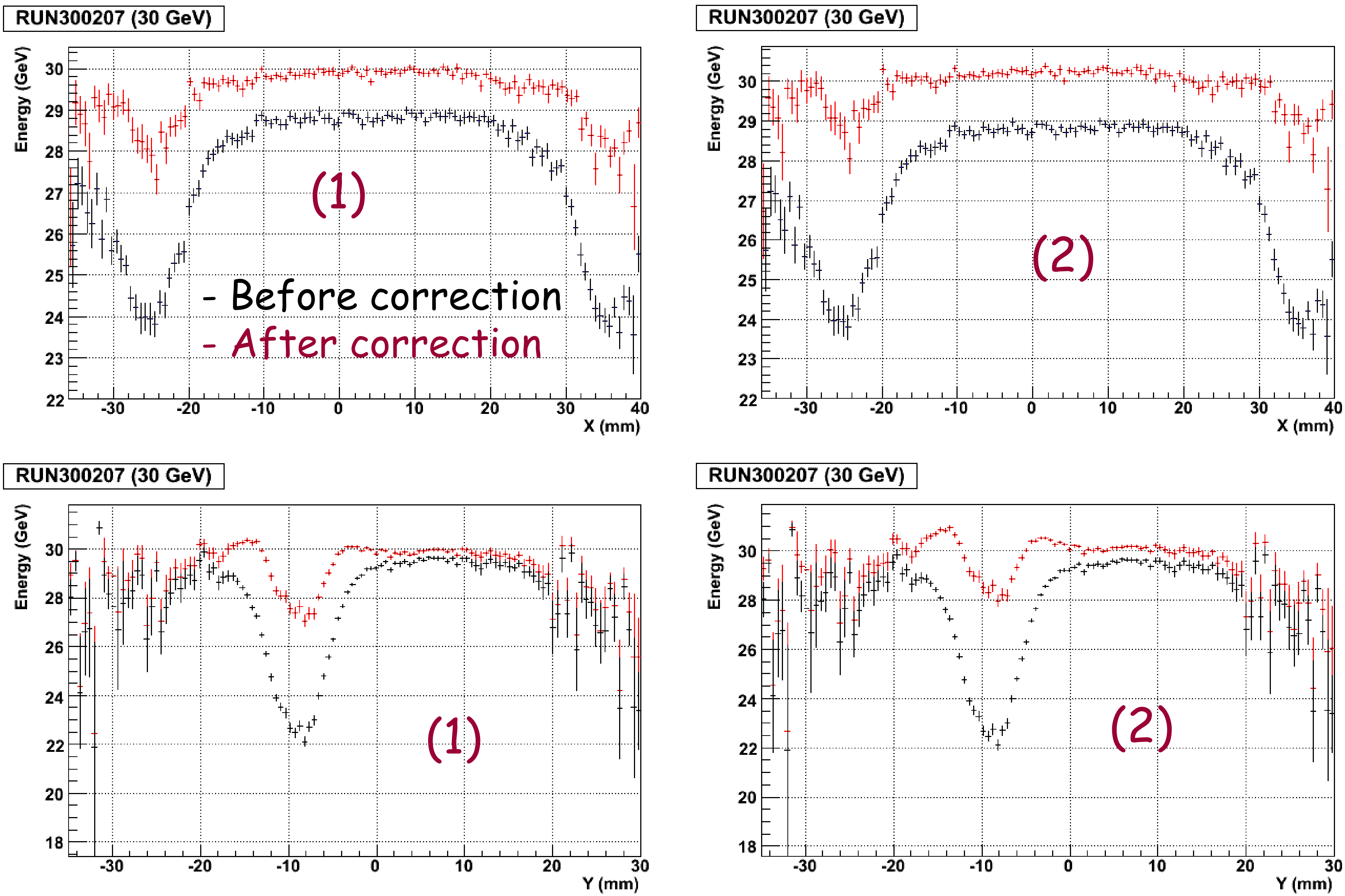
σ_X = 3.8 mm but σ_X = 3.4 leads to good fits →

Layer per layer correction in X (2 parameters)



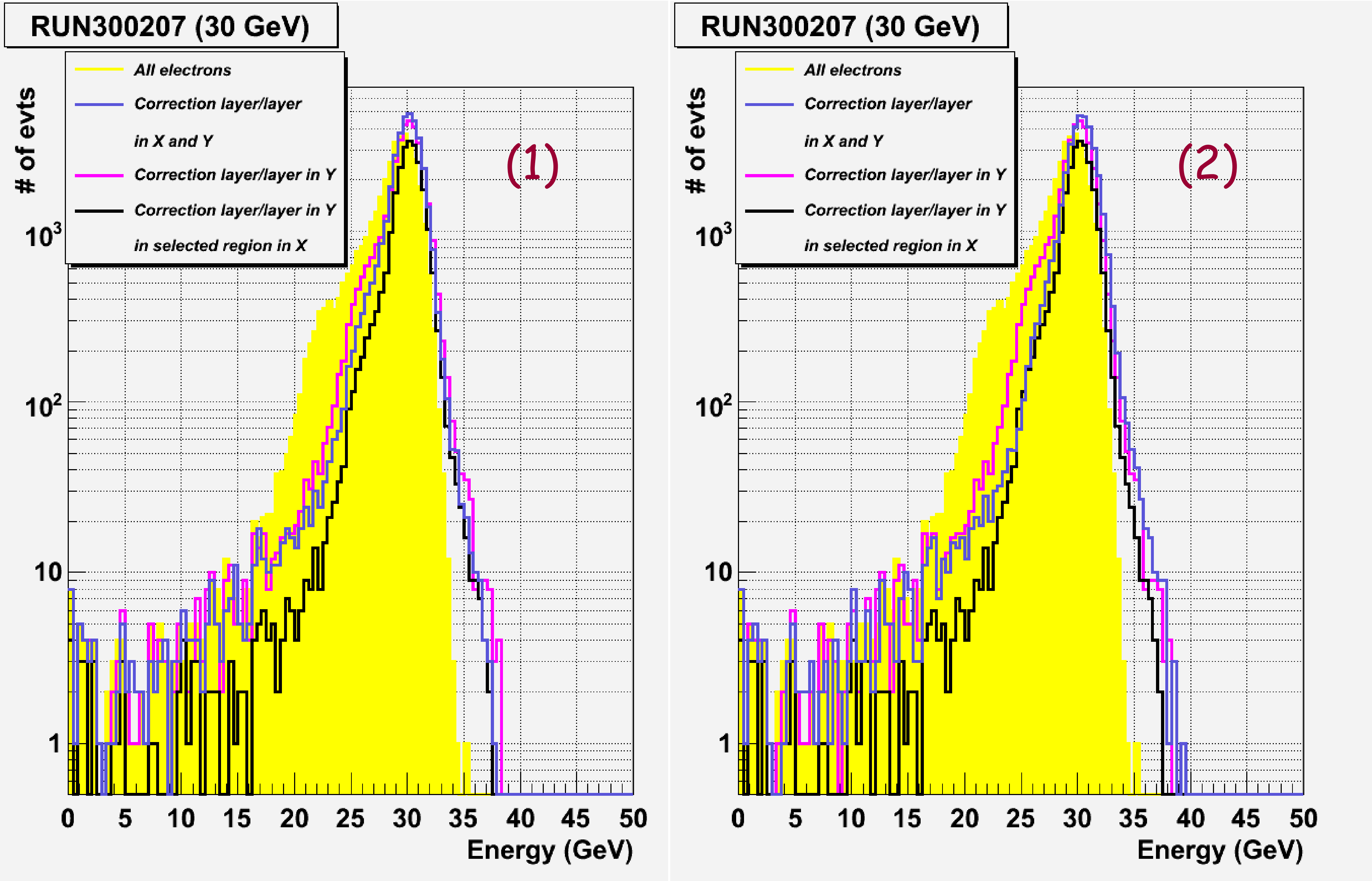
Profiles (corrections in Y and X)

(1) from para. obtained in Y; (2) from para. obtained in X

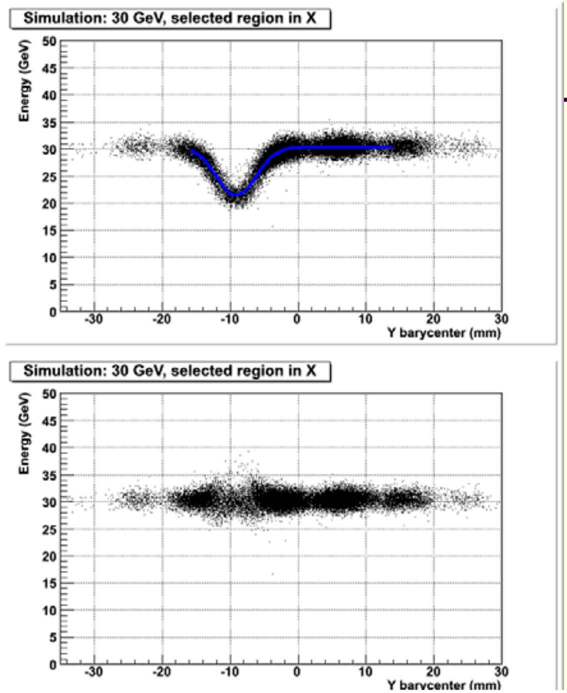


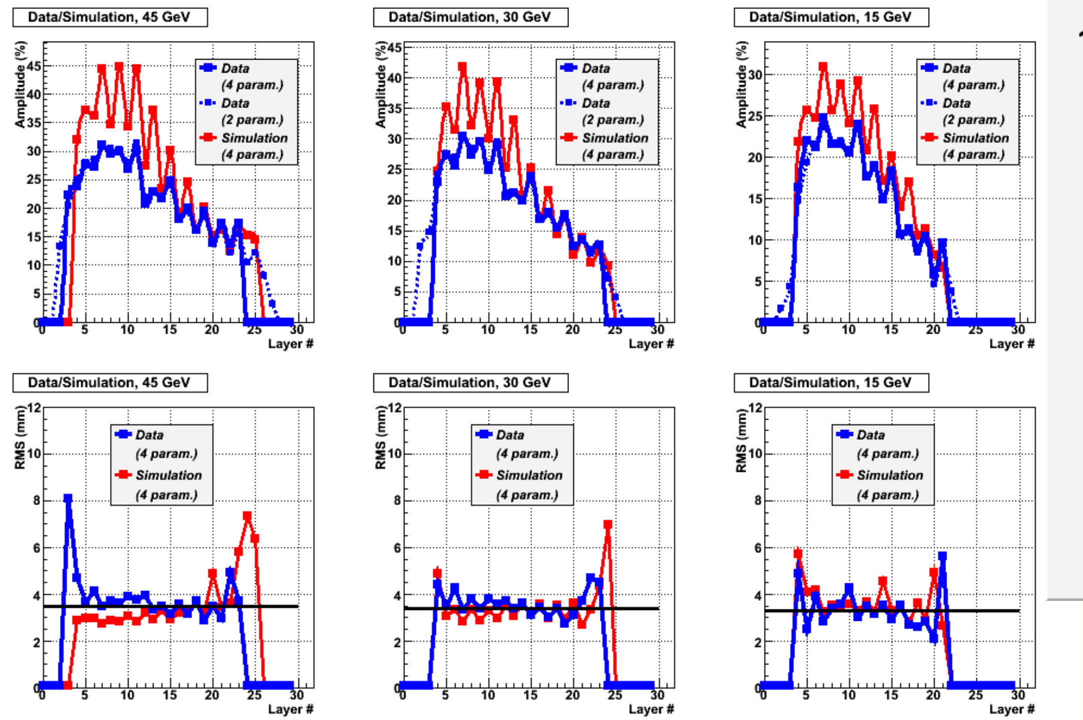
Distributions in energy (corrections in Y and X)

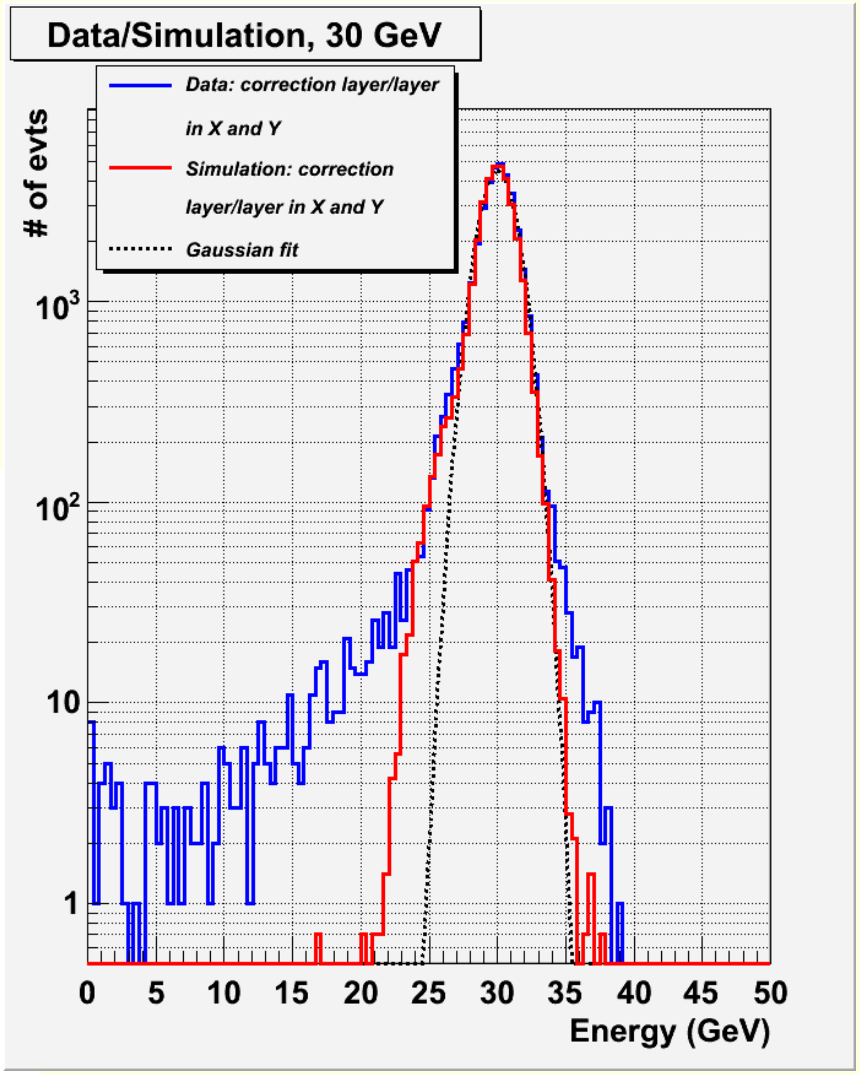
(1) from para. obtained in Y; (2) from para. obtained in X



Comparison with simulations



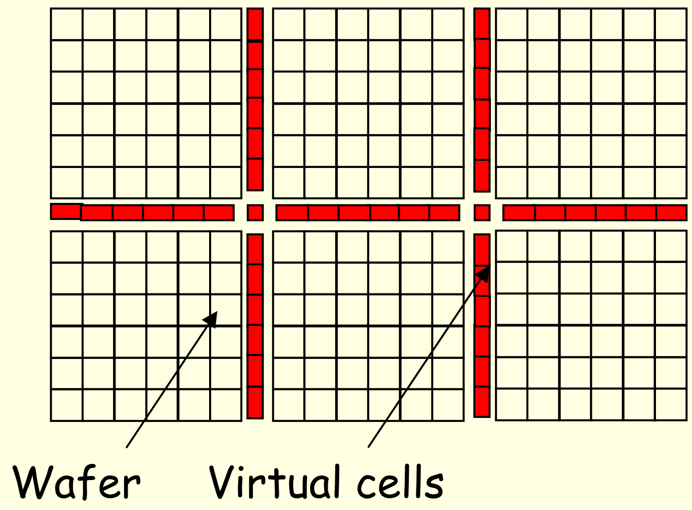




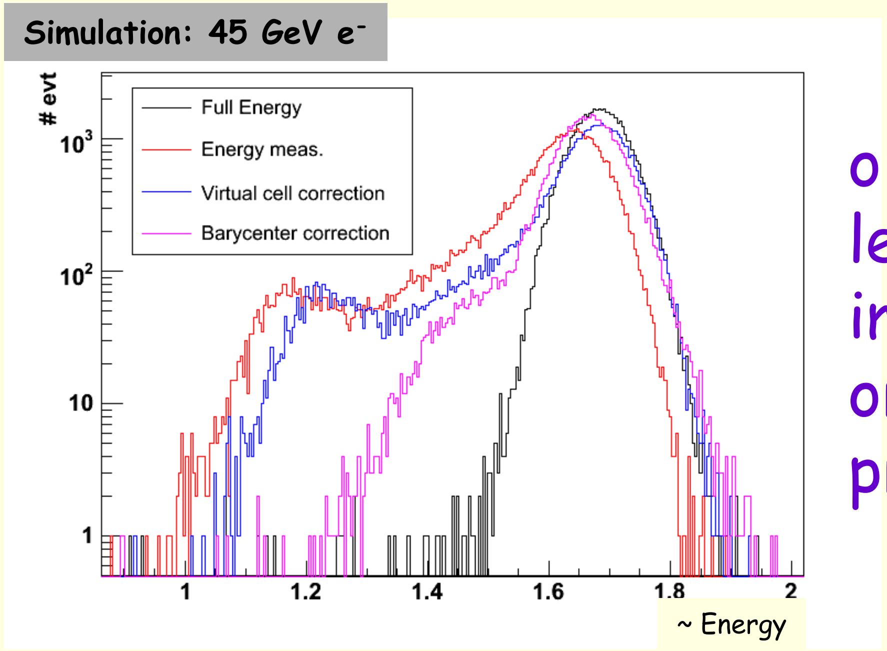
Other methods: 1. virtual cells

o In order to estimate the energy lost in the inter-wafer gaps virtual cells are added

o The virtual cell energy is calculated from the interpolation of the deposited energies in the 2 closest cells:



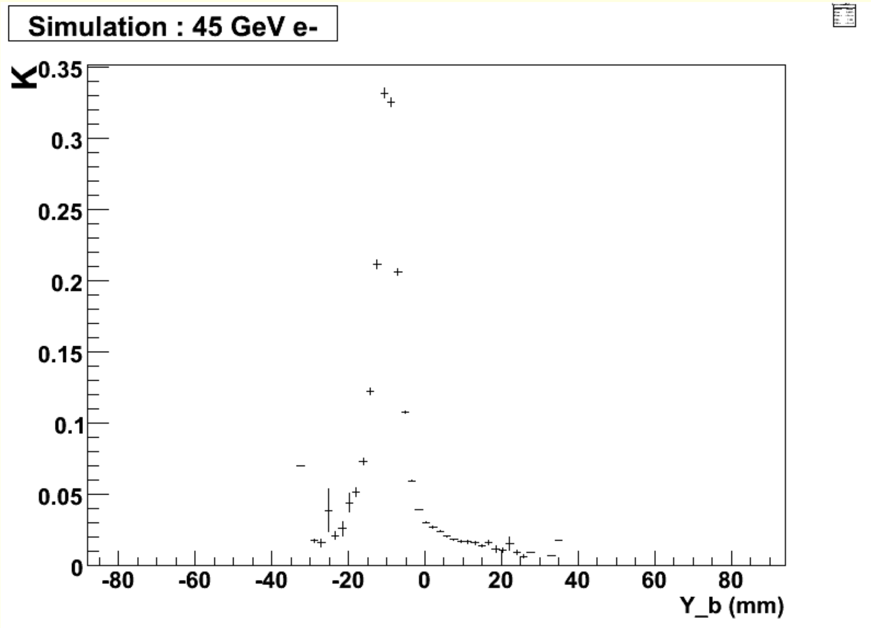
$$E_{virtual} = K \cdot (E_{i-1} + E_{i+1})$$



o This method is quite simple, it leads to an energy resolution improvement but do not really or sufficiently correct the gap problem

Virtual cell method

- Actually the value of the factor K depends on the shower barycenter in each layer and therefore this method looses one of its big advantage

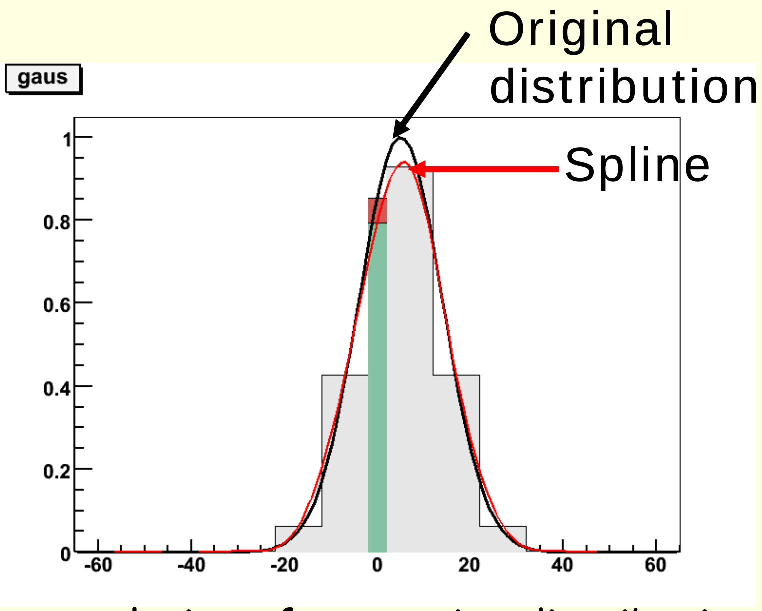


$$E_{virtual} = K(X_b, Y_b) \cdot (E_{i-1} + E_{i+1})$$

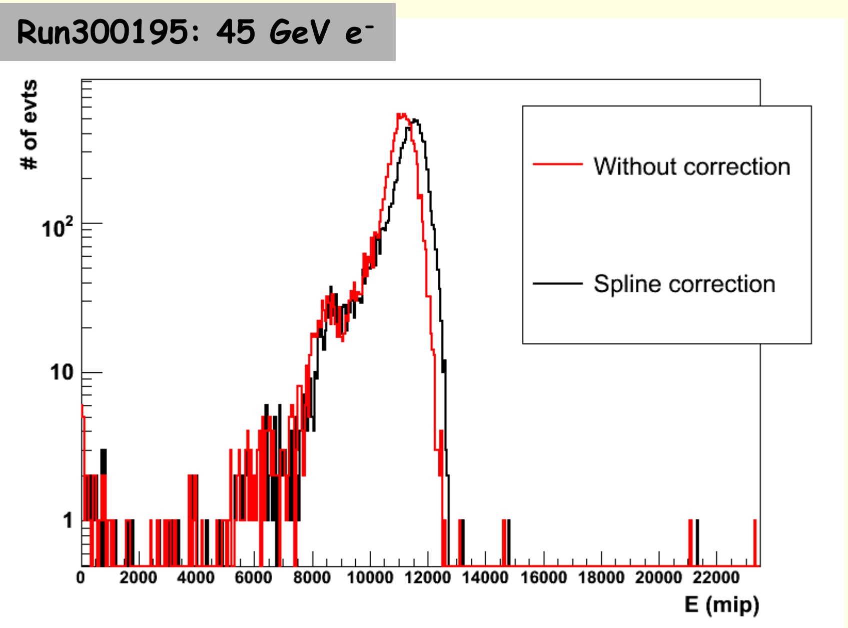
But what happens if the pad size changes :
i.e. 1 cm x 1cm → 5 mm x 5 mm
?

2. Spline interpolation method

- o A spline is an interpolation defined piecewise by polynomials
- o A spline (actually, third spline polynomial term) has been used to make interpolation with each row and each column of cells



Interpolation of a gaussian distribution by a spline



- o Again the energy resolution is improved, but the tail at low energy is not well corrected
- o It gives results close to what was obtained with the virtual cell method

Conclusion

Effect of the guard rings can be corrected thanks to a correction method using the barycenter calculated layer per layer. But this technique requires lots of parameters and is a little « heavy »

Other simpler methods have been tested, but for the time being, they does not lead to a good improvement for 1 cm x 1 cm pads

MOKKA with 5 mm x 5mm pads is needed in order to test these methods in a more realistic case