Absolute energy calibration

V. Morgunov

DESY, Hamburg and ITEP, Moscow

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The copy of this talk one can find at the http://www.desy.de/˜morgunov

Introduction

I would like to show the first results for the fresh simulated events by Mokka at the GRID.

And a new absolute energy calibration method.

How to get calorimeter energy conversion coeffs?

Easy:

One should run muons in Monte–Carlo, take whole energy in absorber and scintillator, and divide it by energy in the scintillator.

The reason for this is: if one particle crosses one sampling layer it should deposit the whole energy, but we can measure the scintillator energy only.

But: the cascade in matter consists of not only pure particles (track–like) but rather dense electromagnetic showers and a mixture of the photoeffect's and compton scattered electrons together with pure track–like energy deposition.

This leads to the co–called e/π ratio for the calorimeter response for different types of particles.

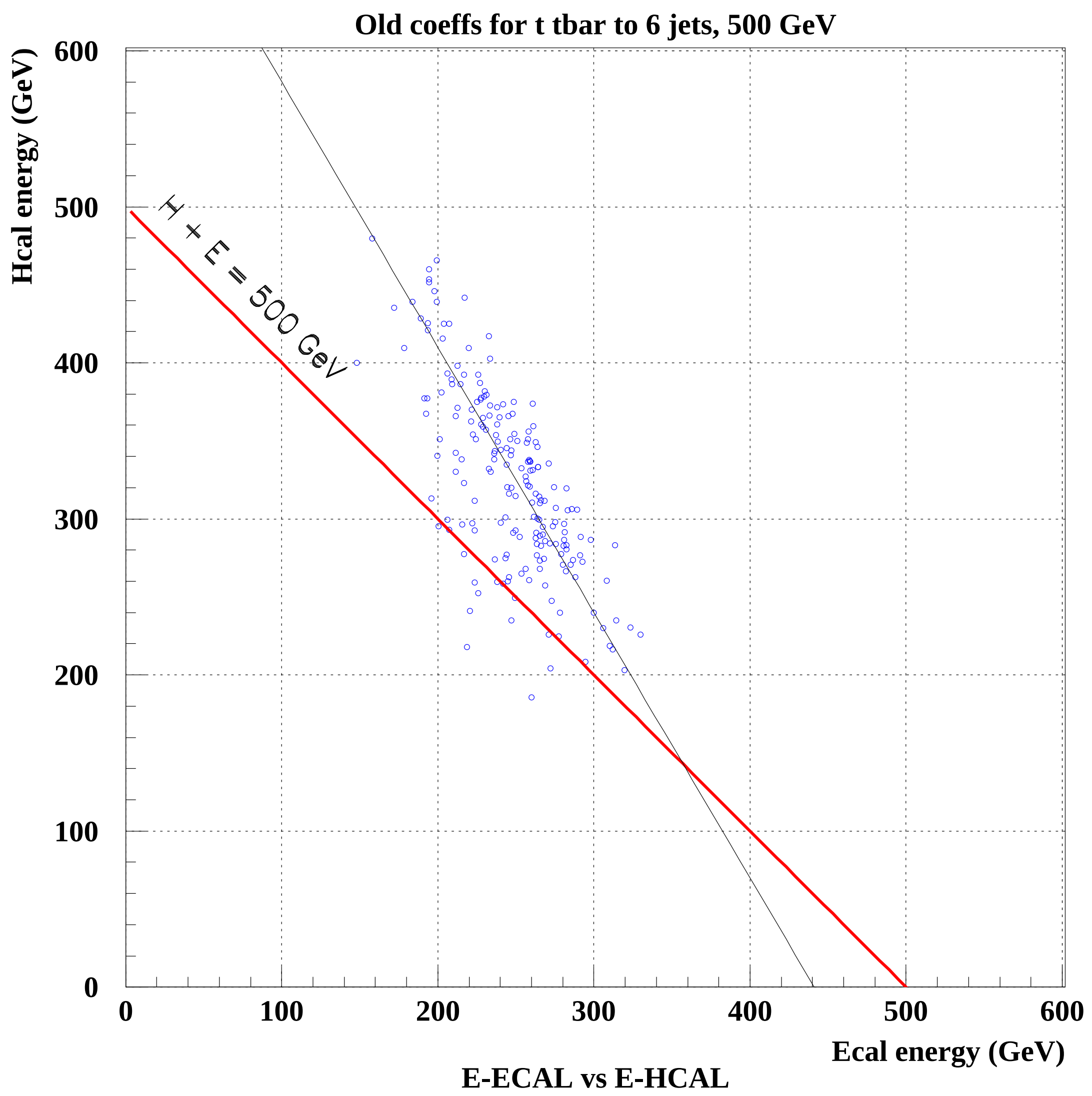
The using of the complex calorimeter, which we have in LDC detector, leads to even more tricky procedure for the calibration, because it needs to define the coeffs for each part of the calorimeter with different samplings and then choose the correct ratio between that coeffs to get a correct whole measured energy.

So, let us start from the coeffs defined by muon run in the simulation.

$$\mathcal{C} = \mathbf{E_{whole}}/\mathbf{E_{visible}}$$

for each sampling structures, that is in our case three of them.

How to get a whole event energy conservation?



The simple formula should give us an answer

$$E_{Ecal} + E_{Hcal} = E_{CM}$$

but, we have no this – see a picture.

So, let us "rotate" the black line to the position of the red one by rescaling the coefficient of energy conversion (see previous slide). **"Rotation" actually means of the affine transformation of this 2–D space. (see next slide)**

These "rotated" coeffs consist of all the "properties" of the whole LDC calorimeters as well as the flavor's containment of the jets!

How to “rotate”?

The black line equation is:

$$a_0 E_{Ecal} + E_{Hcal} = a_0(c_1 E_{vis1} + c_2 E_{vis2}) + c_3 H_{vis} = E_0$$

where: c_1, c_2 **and** c_3 **is an initial energy conversion coeffs,** a_0 **is the slope which give us the minimal energy width.** E_0 **is some constant – the line should come through the most probable value of the initial energy sum.**

By the way; if the initial coeffs were bad fitted to the intrinsic mutual calorimeter properties (bad inter–calibration), one will never get the sharp top right edge of the energy distribution as well as the most probable “line”!

The red line equation is: $E^{calib}_{ECAL} + E^{calib}_{HCAL} = E_{CM}$ **– energy conservation law.**

Let us require $E_0 = E_{CM}$ **and** $a_0 = 1$ **exactly.**

Then we got the new coeffs:

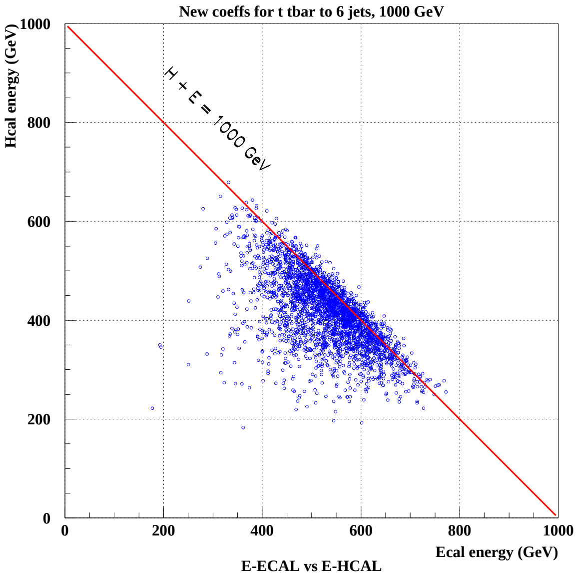
$$c_1^{calib} = f a_0 c_1, \;\; c_2^{calib} = f a_0 c_2 \;\; and \;\; c_3^{calib} = f c_3;$$

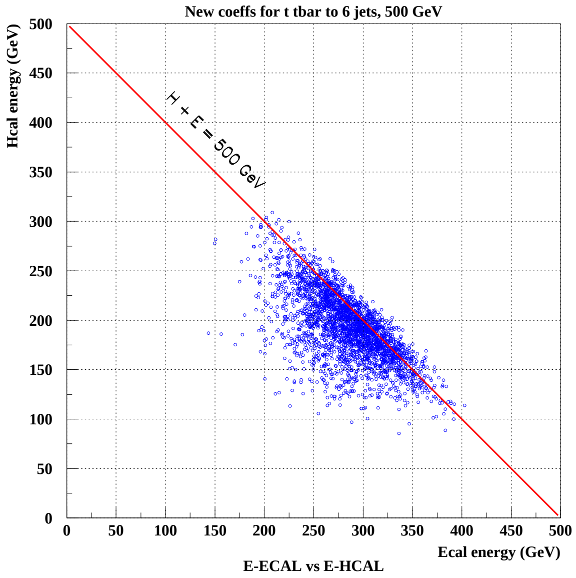
where: $f = E_{CM}/E_0$ **; and**

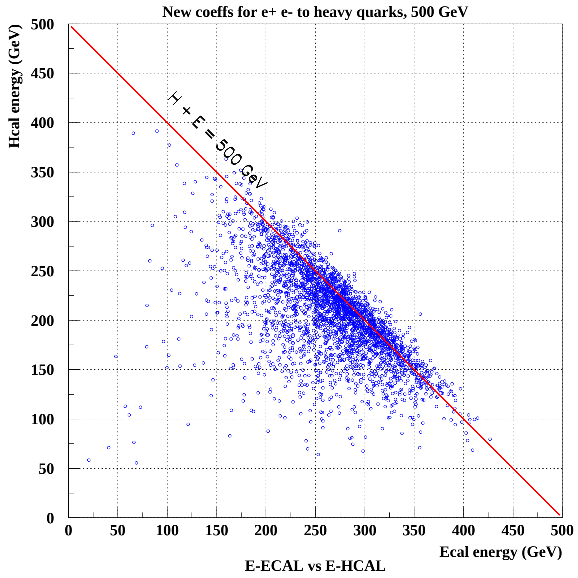
$$c_1^{calib} E_{vis1} + c_2^{calib} E_{vis2} + c_3^{calib} H_{vis} = E_{CM} \quad \textbf{along the most probable line}$$

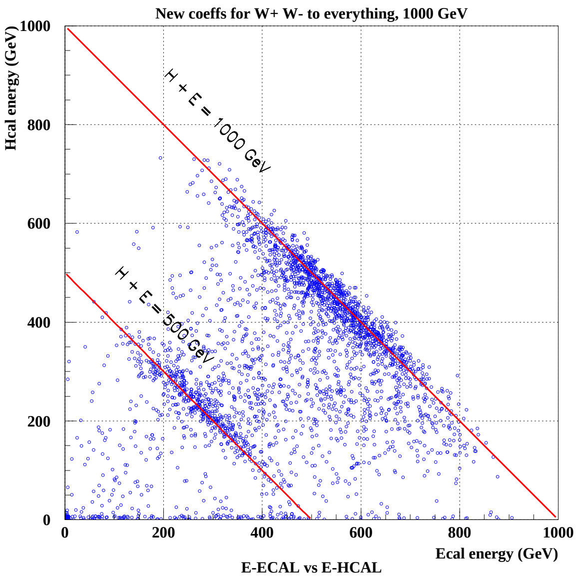
These three coeffs will be applied latter on to each hit in the particular sampling regions of the calorimeter.

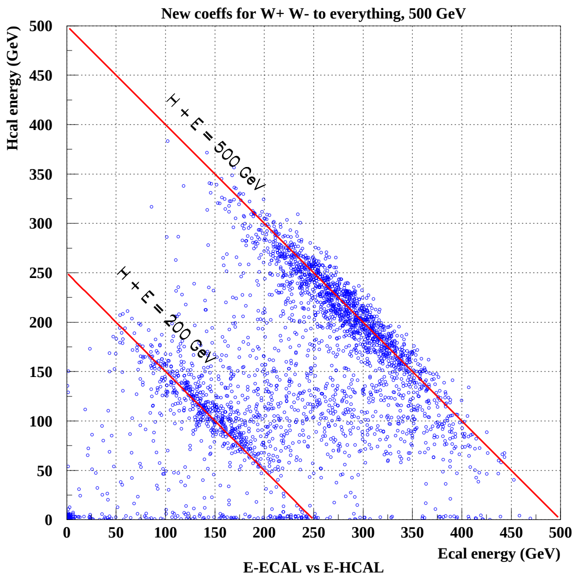
The results of "rotation/rescaling" are

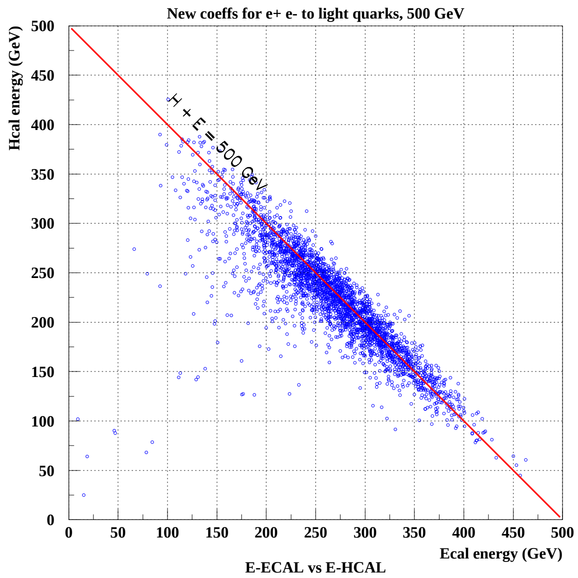




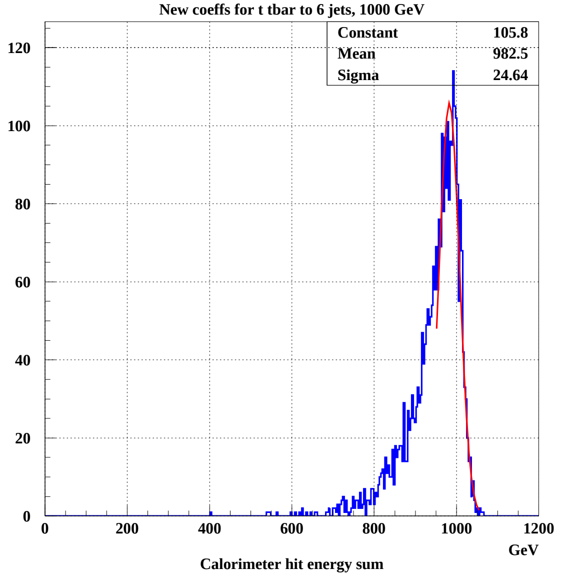


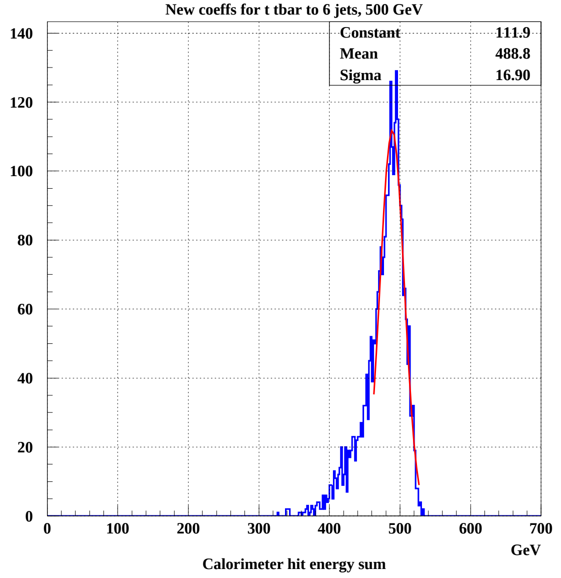


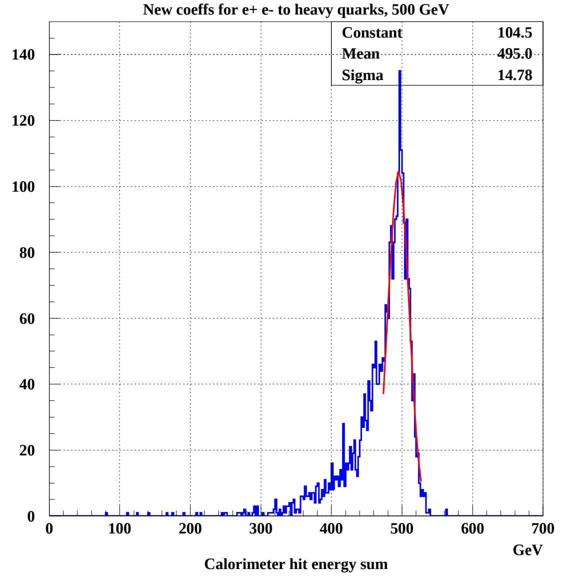


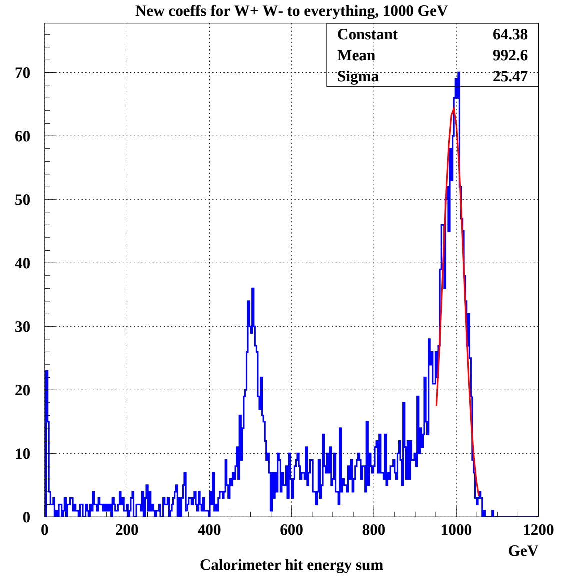


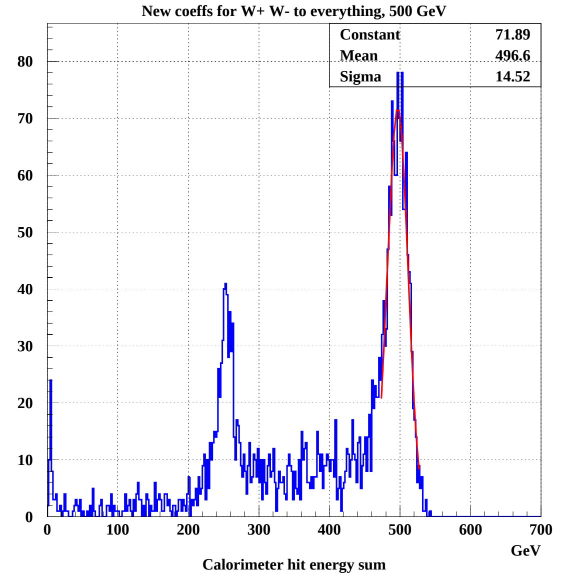
Calorimeter energy sum

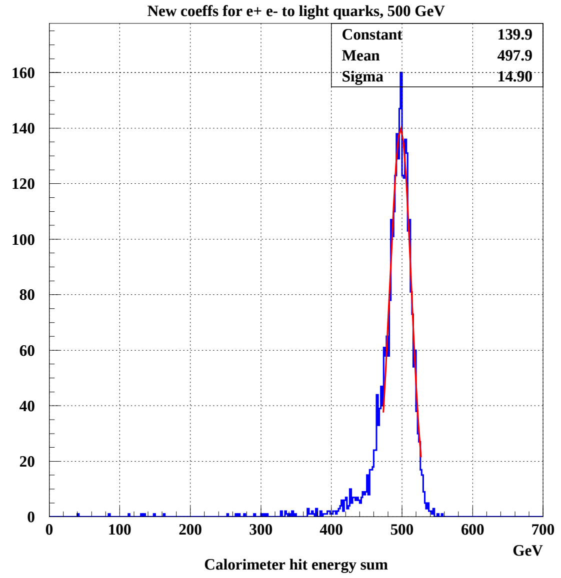




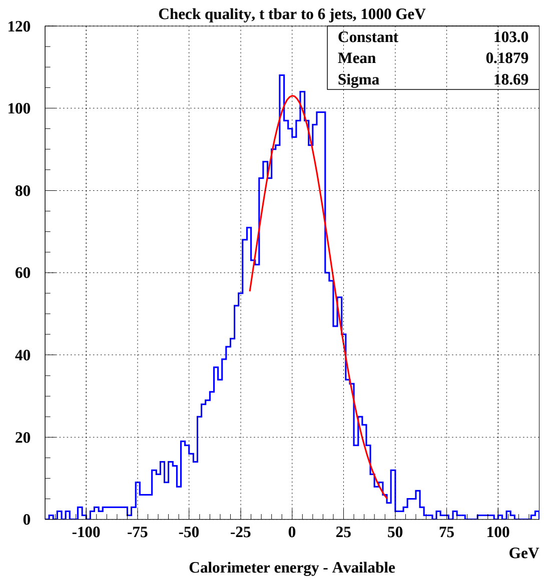


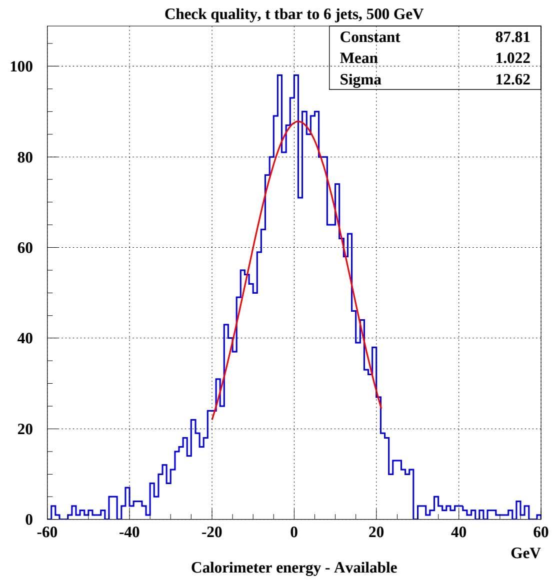


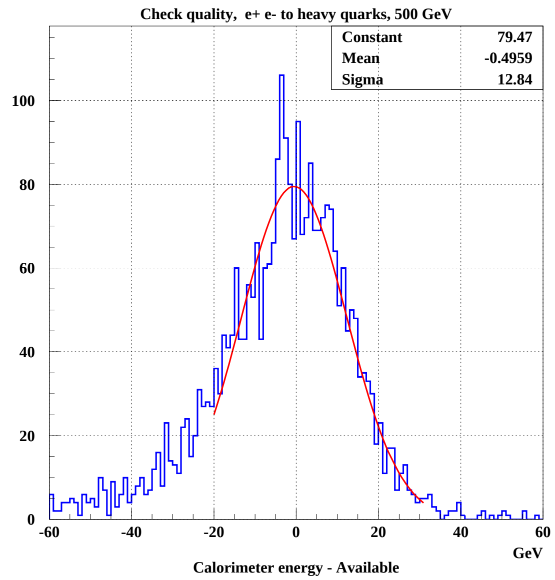


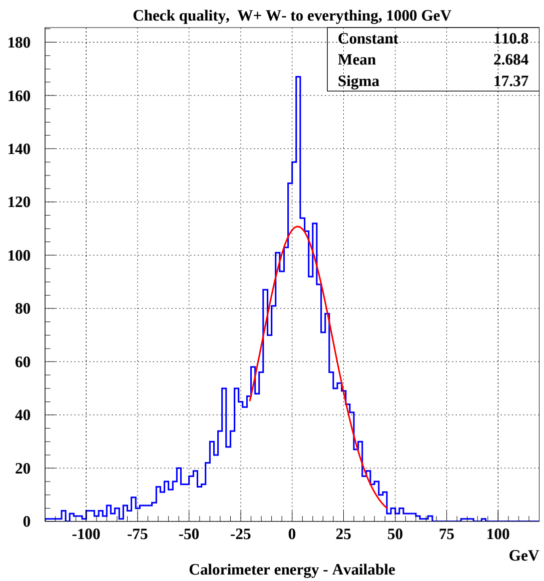


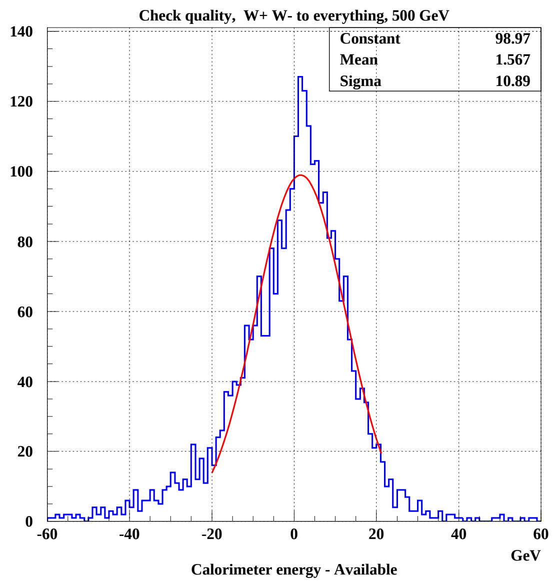
Check plots

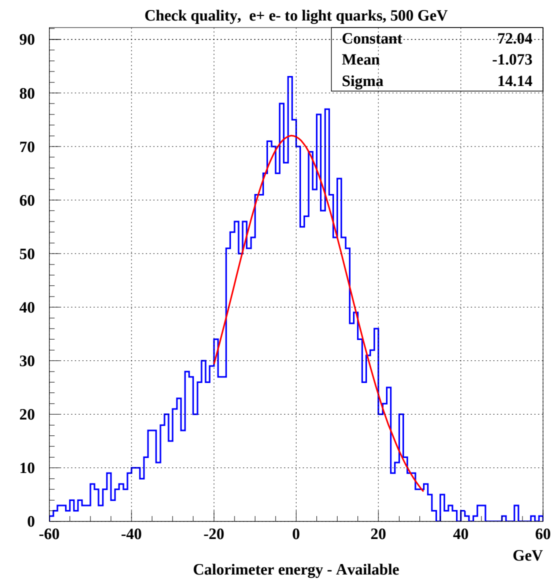

Check quality, t tbar to 6 jets, 1000 GeV
Constant 103.0
Mean 0.1879
Sigma 18.69
Calorimeter energy - Available
GeV


Check quality, t tbar to 6 jets, 500 GeV
Constant 87.81
Mean 1.022
Sigma 12.62
Calorimeter energy - Available
GeV

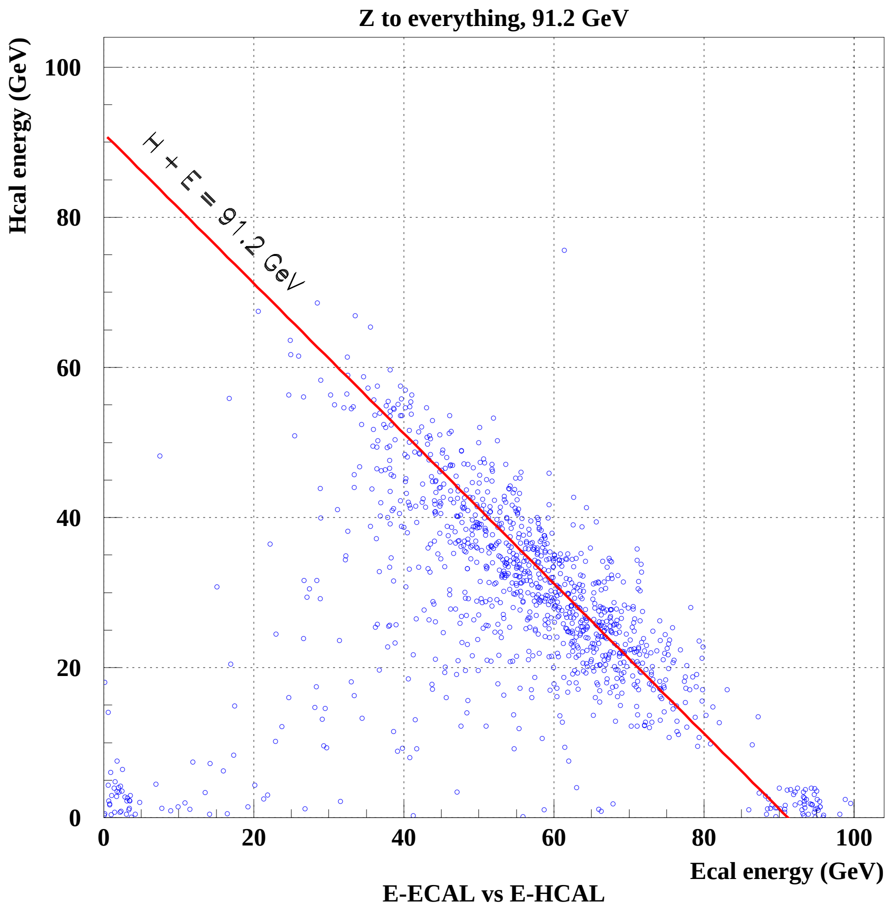

Check quality, e+ e- to heavy quarks, 500 GeV
Constant 79.47
Mean -0.4959
Sigma 12.84
Calorimeter energy - Available
GeV

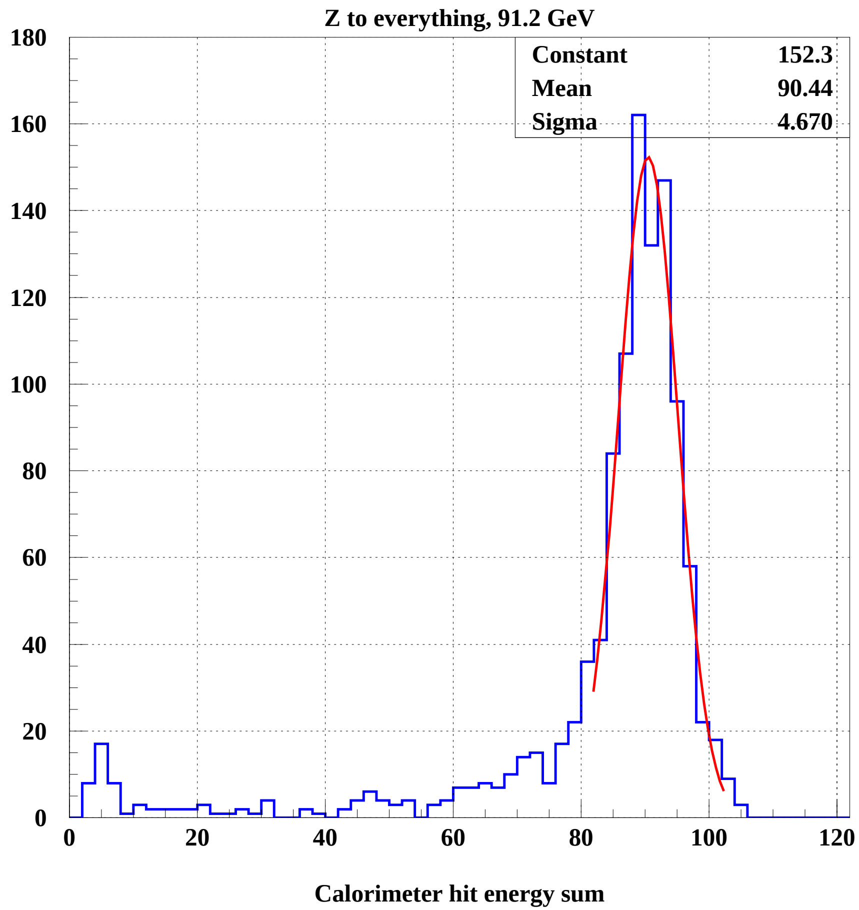

Check quality, W+ W- to everything, 1000 GeV
Constant 110.8
Mean 2.684
Sigma 17.37
Calorimeter energy - Available
GeV


Check quality, W+ W- to everything, 500 GeV
Constant 98.97
Mean 1.567
Sigma 10.89
Calorimeter energy - Available
GeV


Check quality, e+ e- to light quarks, 500 GeV
Constant 72.04
Mean -1.073
Sigma 14.14
Calorimeter energy - Available
GeV

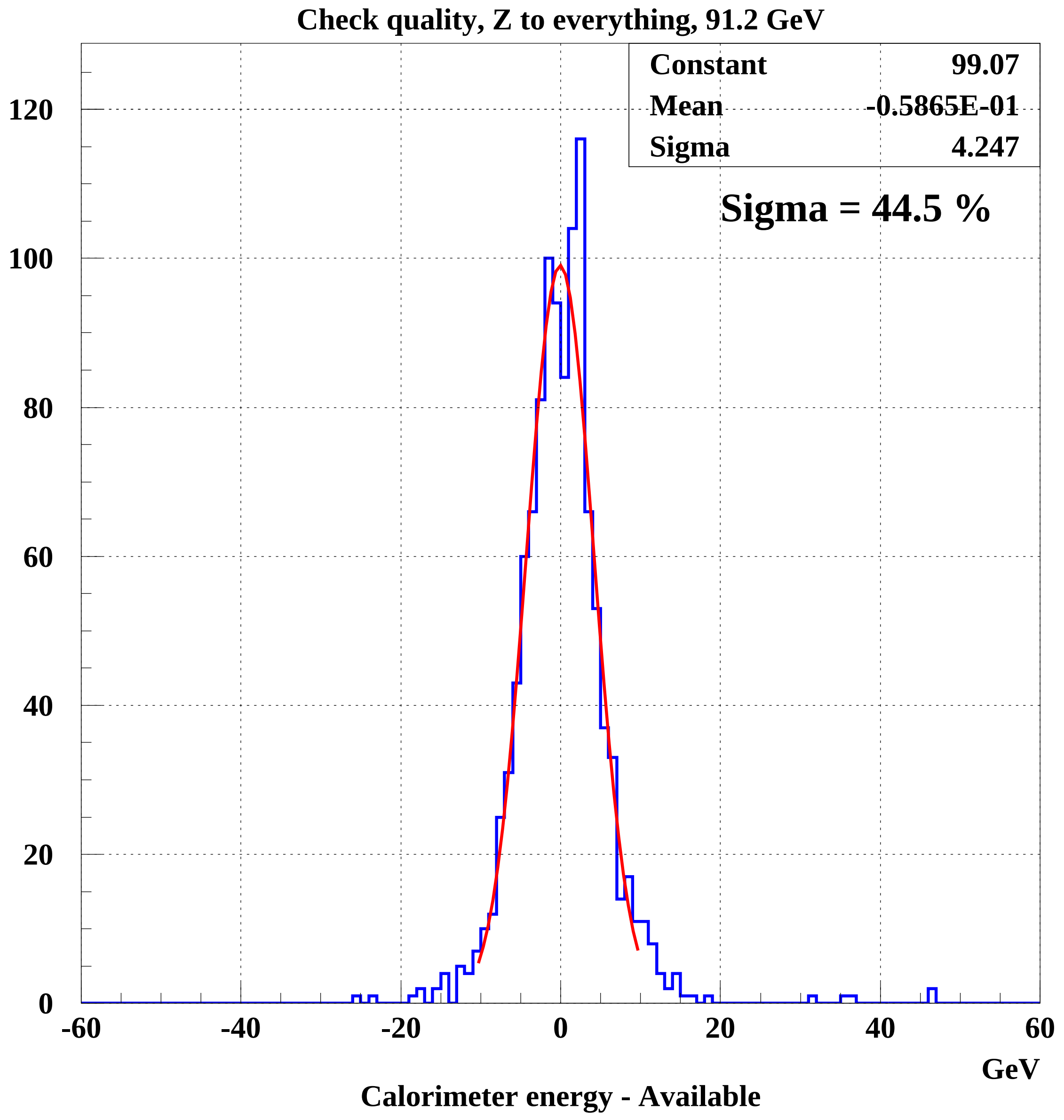
For “reference” Z–pole reaction



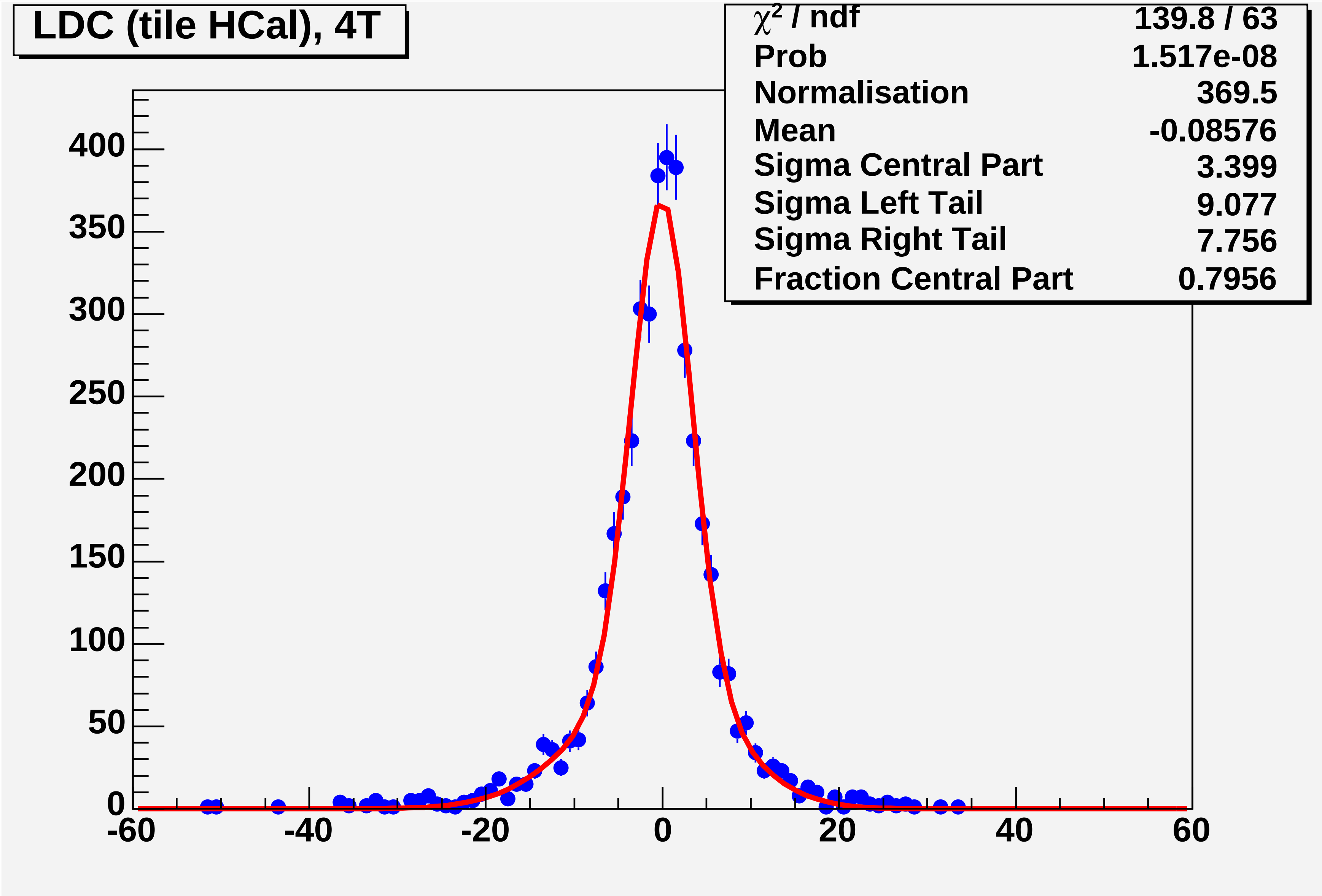


All decay channels are allowed.

Let us check the result



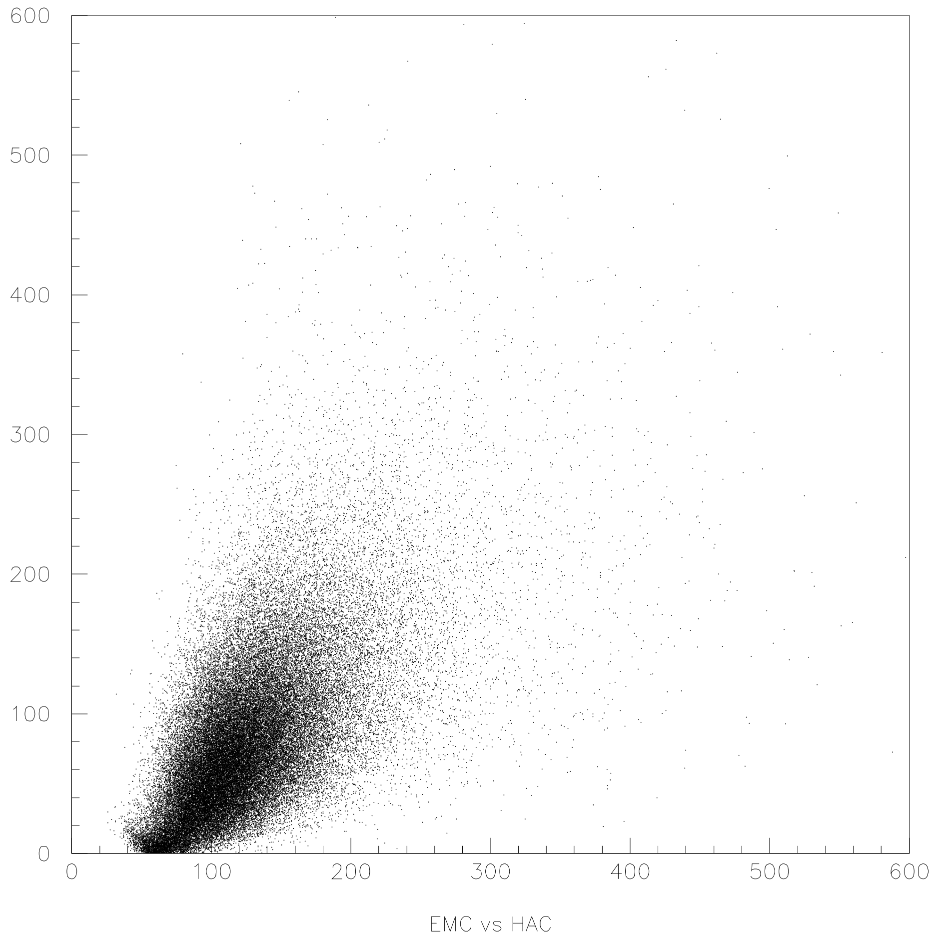
Marlin Reco also knows about this



Conclusion

Let us use the energy conservation law with its full power.

After the conclusion



Picture from ZEUS experiment at HERA. Here is no one “line” can be used to “rotate” coeffs.

But much more complex method is still available for this case for the absolute energy calibration.

Only Linear Collider might give us a possibility to use energy conservation law.