Calorimeter Intercalibration

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Calibration Meeting

- Principle of intercalibration
- Methods studied
- Tests and results

Principle

- All physic process are ϕ independant.

  $\Rightarrow$ what we measure must be ϕ independant.

- For η fixed, differences in ϕ are related to ϕ-intercalibration constants.

Events

We planned to use 2 types of events:

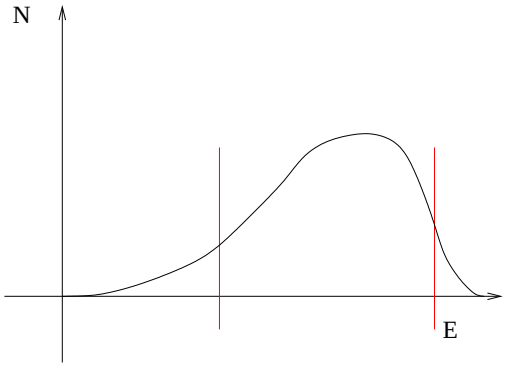
- Inclusive QCD.

$$\Rightarrow \text{2 algorithms}$$

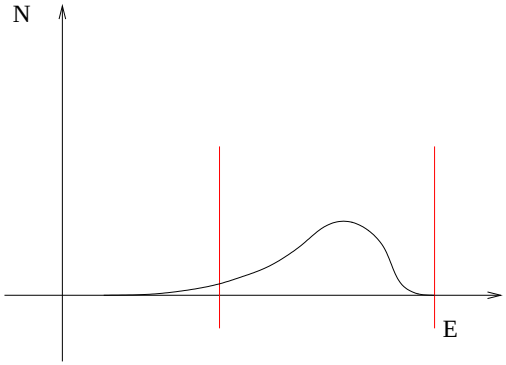
- W events.

$$\Rightarrow \text{1 algorithm}$$

W events



e^- energy distribution at η fixed



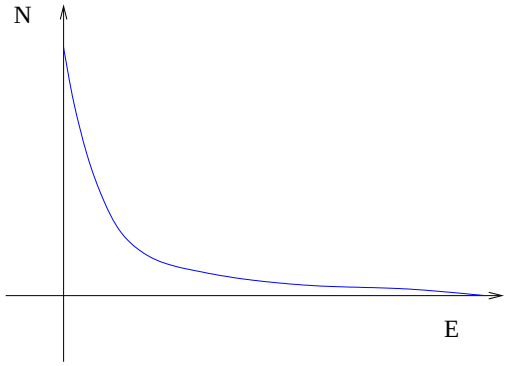
e^- energy distribution at η fixed in the ϕ_i module.

$$\text{for each } i \ \alpha_i = \frac{E_i}{E}$$

Iterative method (α are threshold-dependant)

QCD inclusive events

We expect an exponential distribution in energy.

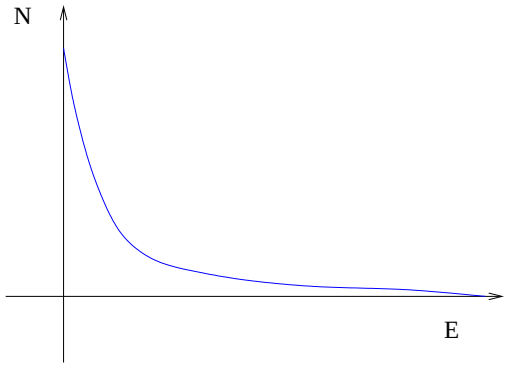


We have tested 2 algorithms:

method 1 Comparing some number of events :"N method"

method 2 Comparing energies (similar as with W events) :"E method"

N method



$\rightarrow$ in reference, $N(E_{ref})$ =Number of events with energy $> E_{ref}$

$\rightarrow$ in unit i, $N_i(E_i)$ =Number of events with energy $> E_i$

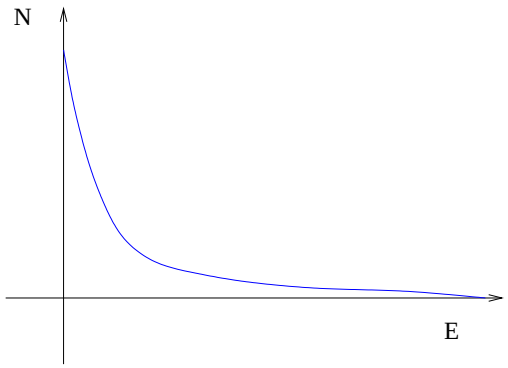
Intercalibration constant α_i : event with a measured energy E_{ref} in reference, has a measured energy $E_i = \alpha_i E_{ref}$ in unit.

$$N_i(E_i) = N(E_{ref}) \Rightarrow E_i = \alpha_i E_{ref}$$

Algorithm

- Choose a reference E_{ref}
- In unit i find E_i such as $N(E_i) = N(E_{ref})$
- $\alpha_i = \frac{E_i}{E_{ref}}$

E method



$\rightarrow$ in reference, $S(E_{ref})$ =Sum of energies $> E_{ref}$

$\rightarrow$ in unit i, $S_i(E_i)$ =Sum of energies $> E_i$

Intercalibration constant α_i : event with a measured energy E_{ref} in reference, has a measured energy $E_i = \alpha_i E_{ref}$ in unit.

$$S_i(E_i) = \alpha_i S(E_{ref}) \Rightarrow E_i = \alpha_i E_{ref}$$

Algorithm

- Choose a reference E_{ref}
- In unit i find E_i such as $\frac{S_i(E_i)}{S(E_{ref})} = \frac{E_i}{E_{ref}}$
- $\alpha_i = \frac{E_i}{E_{ref}}$

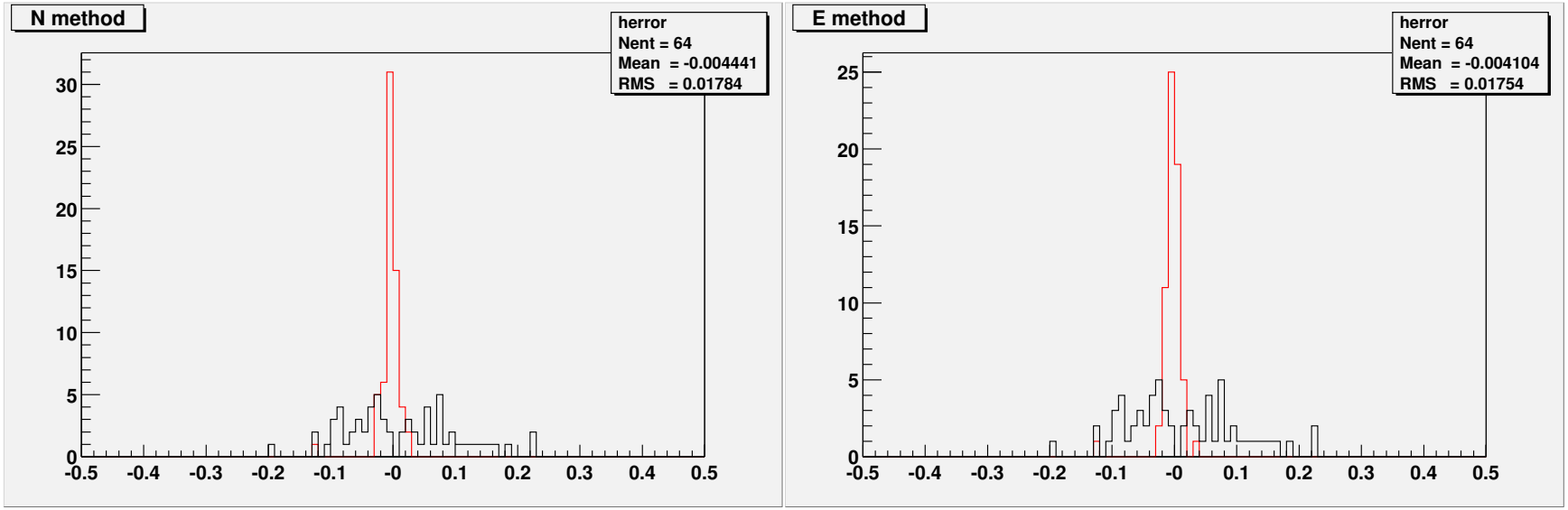
Tests

- Generate a random distribution of events
  - W events : events simulated with ATLFast
  - Inclusive QCD : exponential distribution.
- Choose constant and uncalibrate.
- Apply algorithms to re-find IC constants

Results

Inclusive QCD events

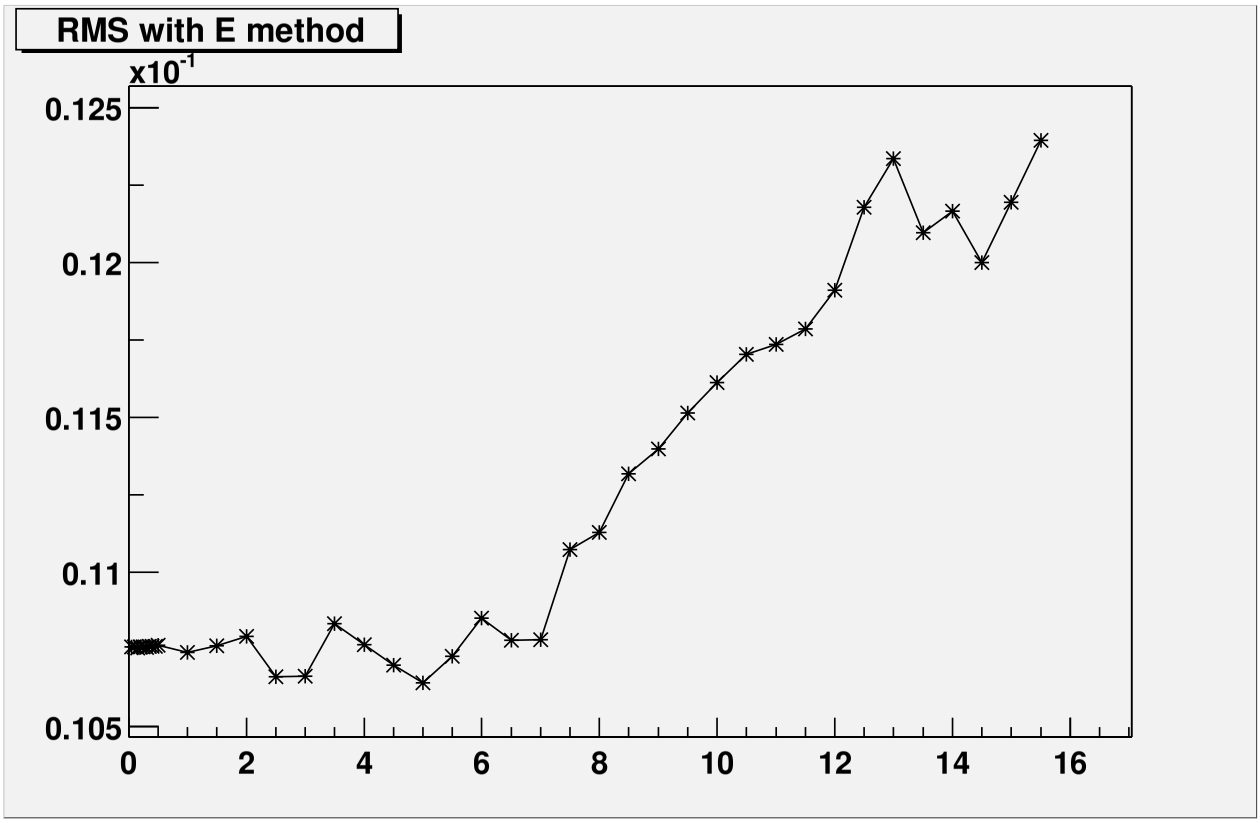
- 10000 events
- Random α (with $\sigma = 0.1$)
- Exponantial distribution : $\sim e^{-\beta E}$

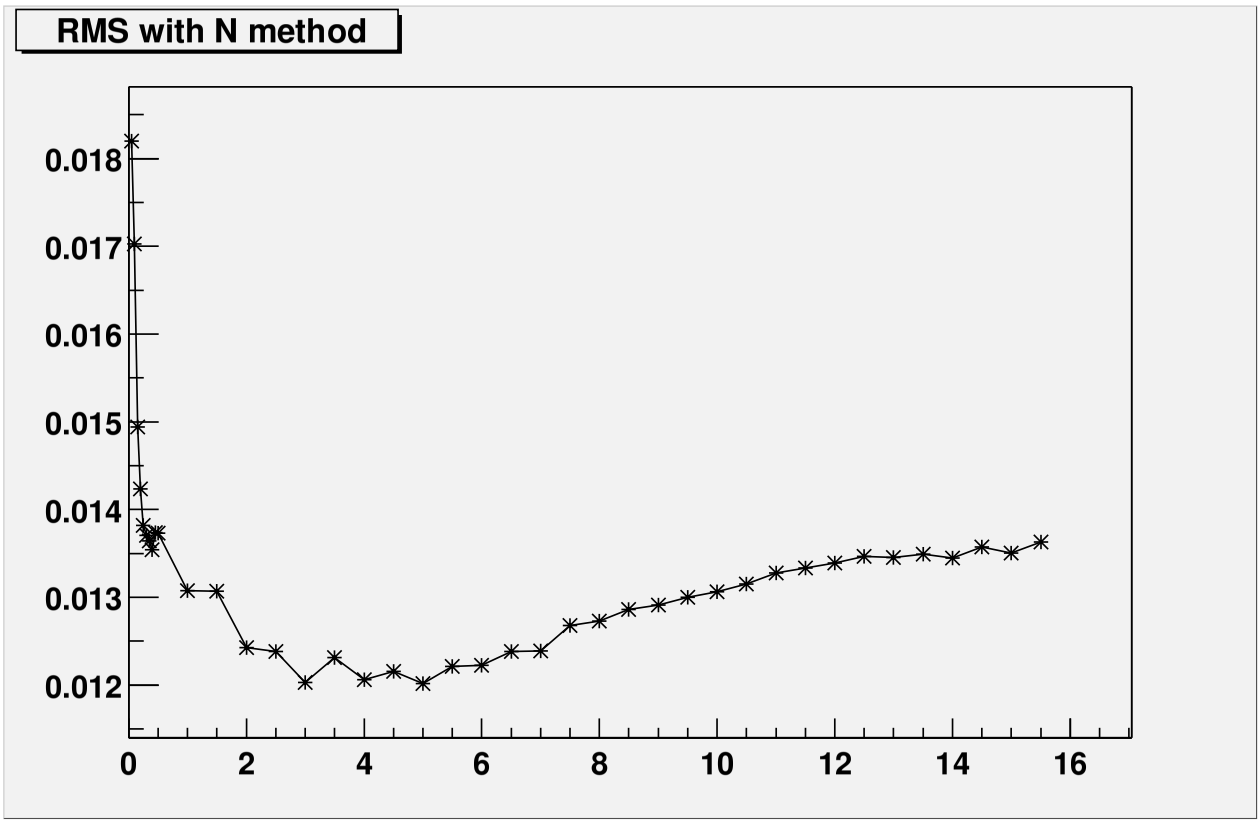


Corrected α

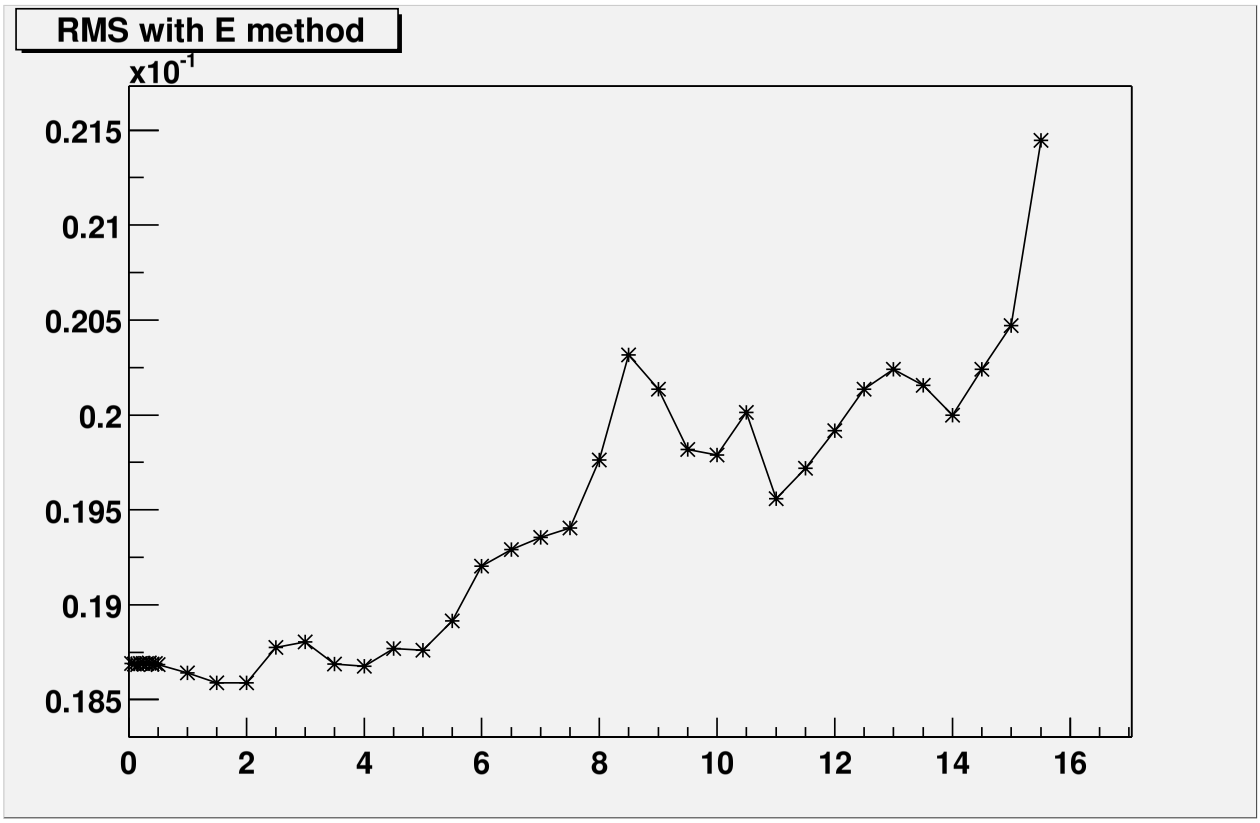
($\beta = 0.3 \mathrm{Gev}^{-1}$)

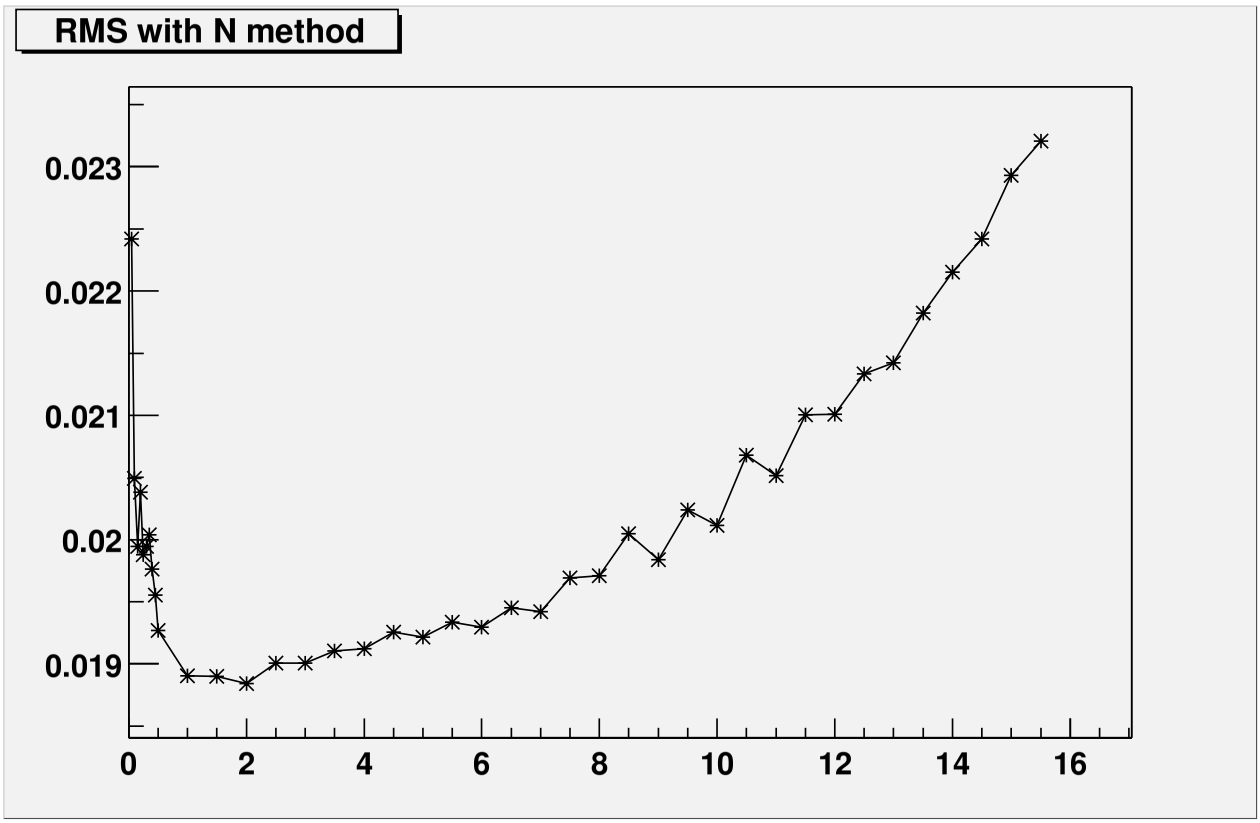
Results


RMS with E method
x10^-1
0.125
0.12
0.115
0.11
0.105
0
2
4
6
8
10
12
14
16


RMS with N method
0.018
0.017
0.016
0.015
0.014
0.013
0.012
0
2
4
6
8
10
12
14
16

Results


RMS with E method
x10^-1
0.215
0.21
0.205
0.2
0.195
0.19
0.185
0
2
4
6
8
10
12
14
16


RMS with N method
0.023
0.022
0.021
0.02
0.019
0
2
4
6
8
10
12
14
16

Conclusions

For inclusive QCD methods :

- Need lots of events to be precise.
- Best precision : $\frac{1-2}{\sqrt{N}}$
- Will intercalibrate on low energies.