Electron energy calibration using Template method for ATLAS detector with $Z \rightarrow ee$ events for high and low mu data

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ATLAS EXPERIMENT

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Outline

- Introduction.
- Template method for energy Calibration.
- Electron & photon energy calibration.
- Extrapolation study.
- Conclusion.

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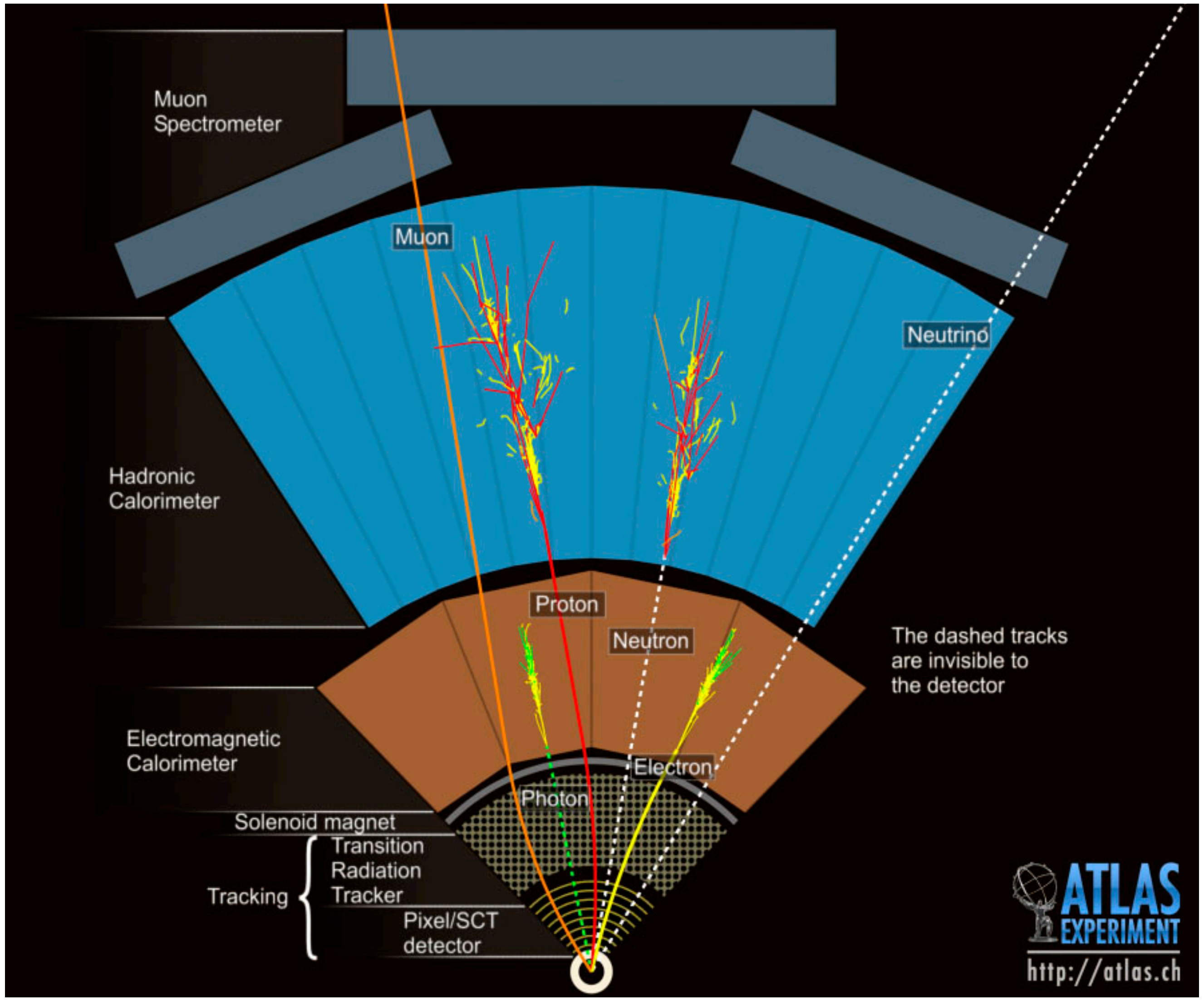
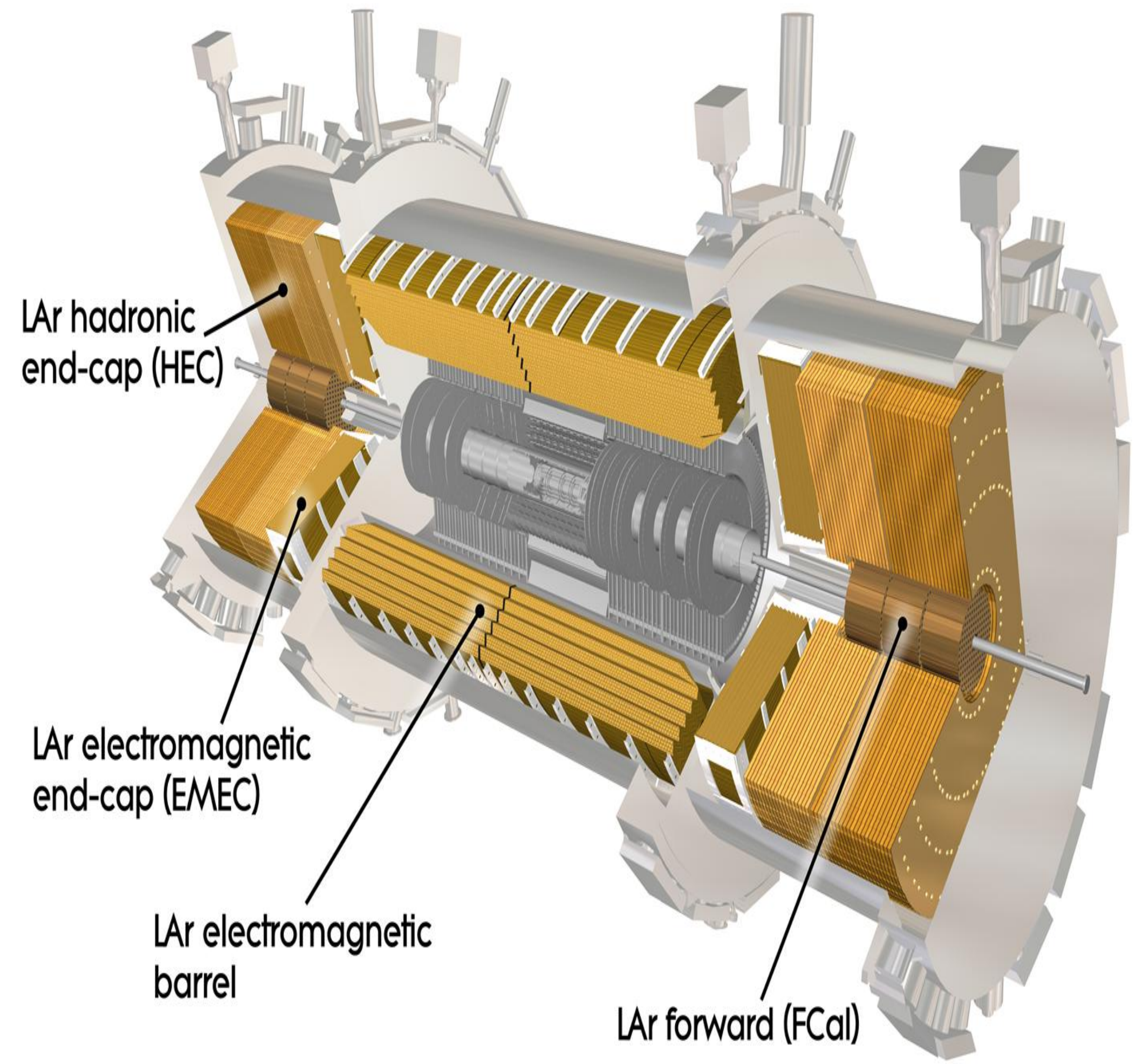
Introduction : What we want to do ?





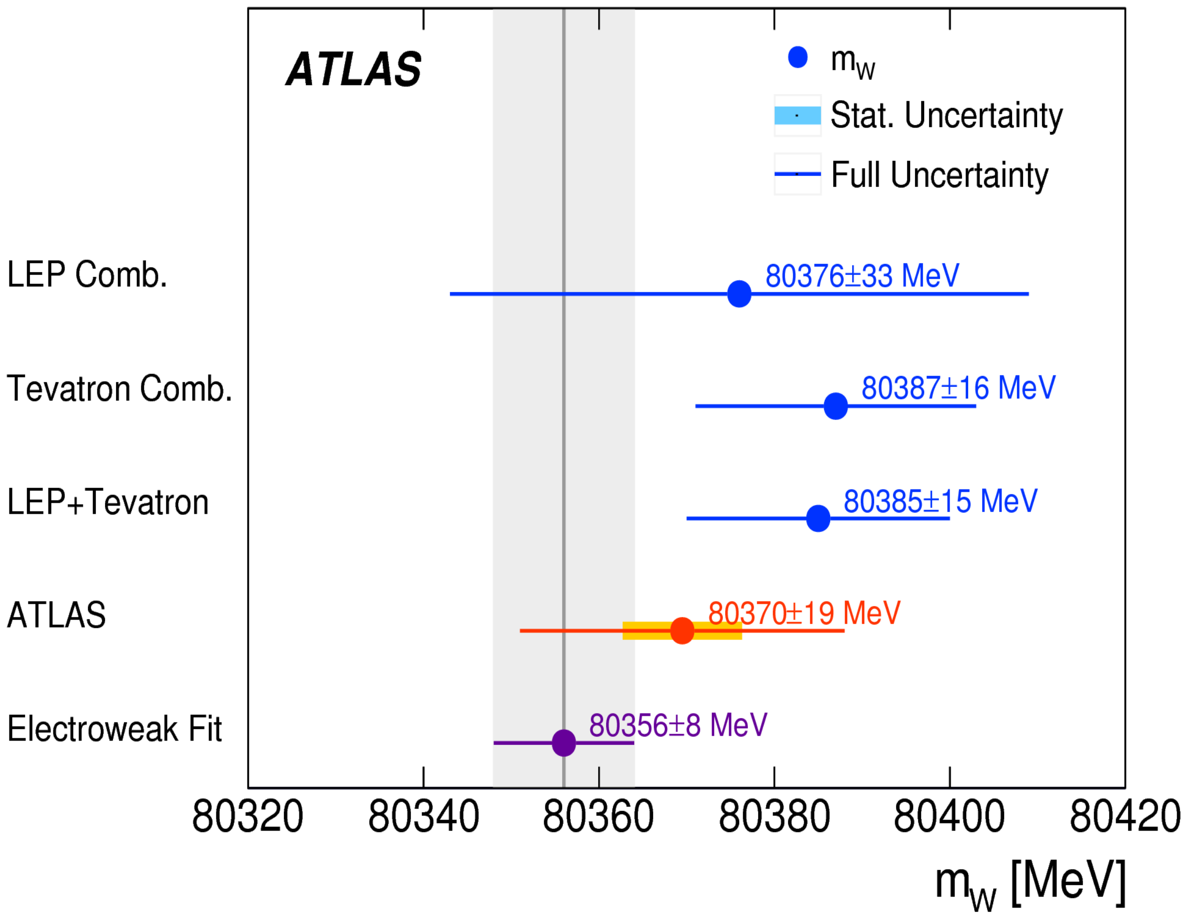
ATLAS reconstructs physics objects (electrons, photons, jets, MET) based on a combination of sub-detectors: tracker, electromagnetic and hadronic calorimeters, muon spectrometer.

Goal : We want to calibrate the EM calorimeter !

Introduction : Why we need to do this ?

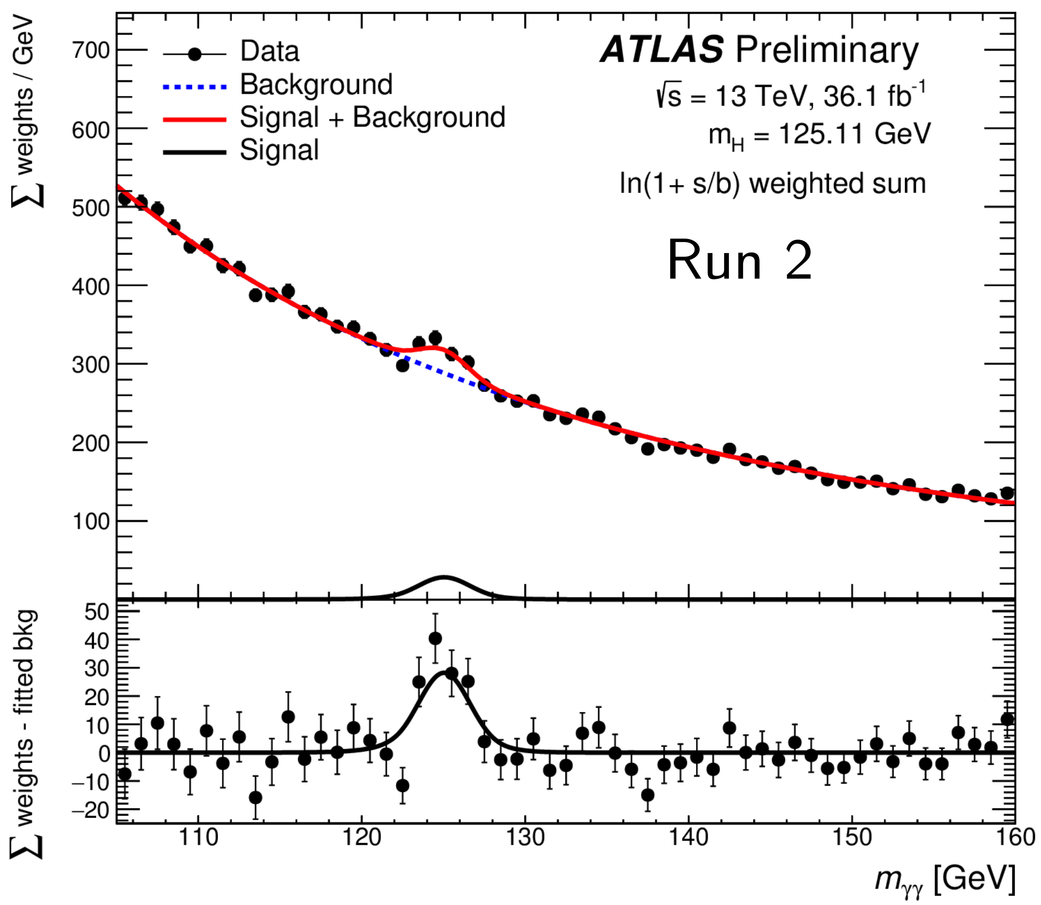
- **Electromagnetic particles are heavily used in precision measurements due to the high precision reachable by the electromagnetic calorimeter (EM) :**

Measuring the mass of the W boson with an uncertainty less than 19 MeV



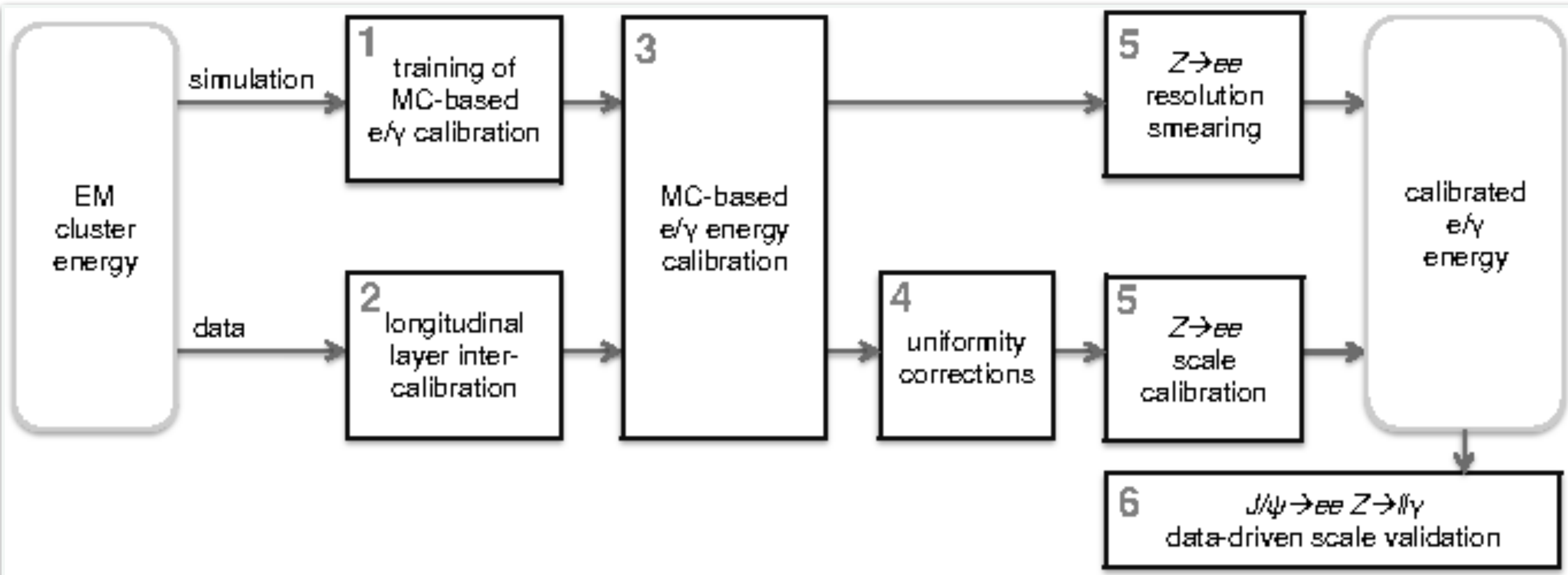
The measurement of the properties of the Higgs boson ($H \to \gamma\gamma$ and $H \to 4l$)

arXiv:1806.00242 (M_H=124.97±0.24GeV)



To reach a high precision in property measurements, a precise calibration of the energy of electrons and photons is required.

- **The calibration procedure can be resumed in 6 steps :**



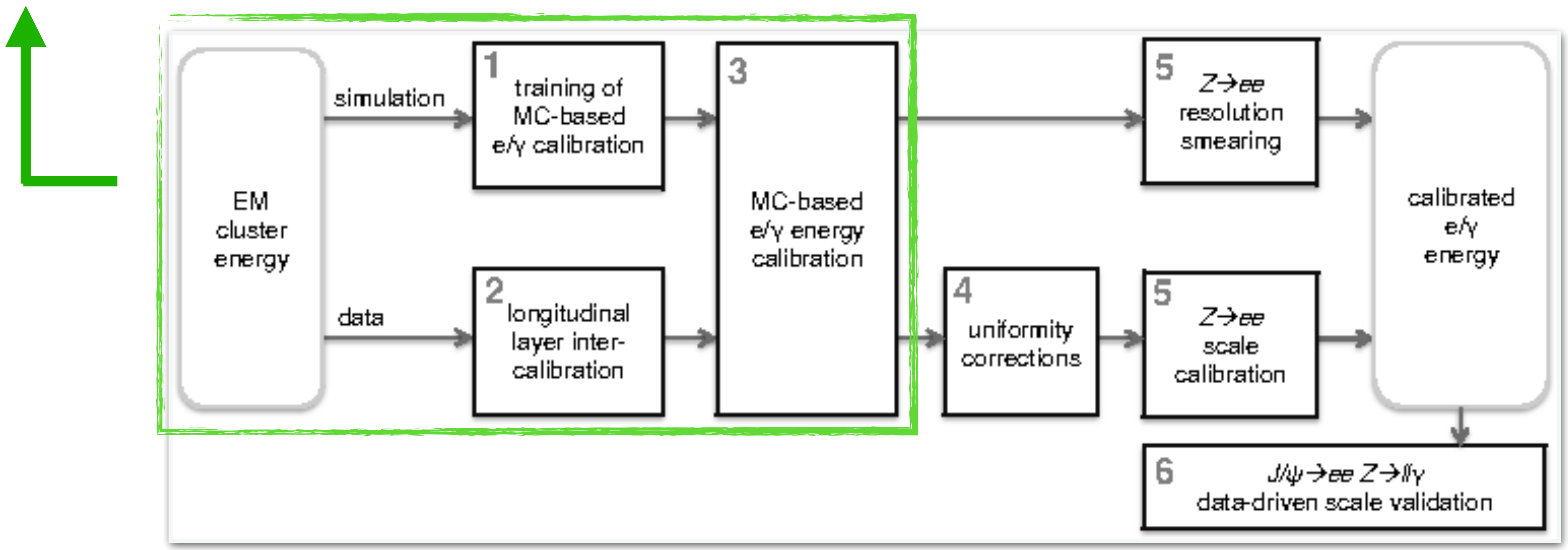
Introduction : Calibration Procedure

MC based calibration :

❶ **The EM cluster properties are calibrated to the original electron and photon energy in simulated MC samples using multivariate techniques.**

❷ **Since the EM calorimeter is longitudinally segmented : Equalise scales of different longitudinal layers between data/MC.**

❸ **Apply MC response on data/mc clusters.**



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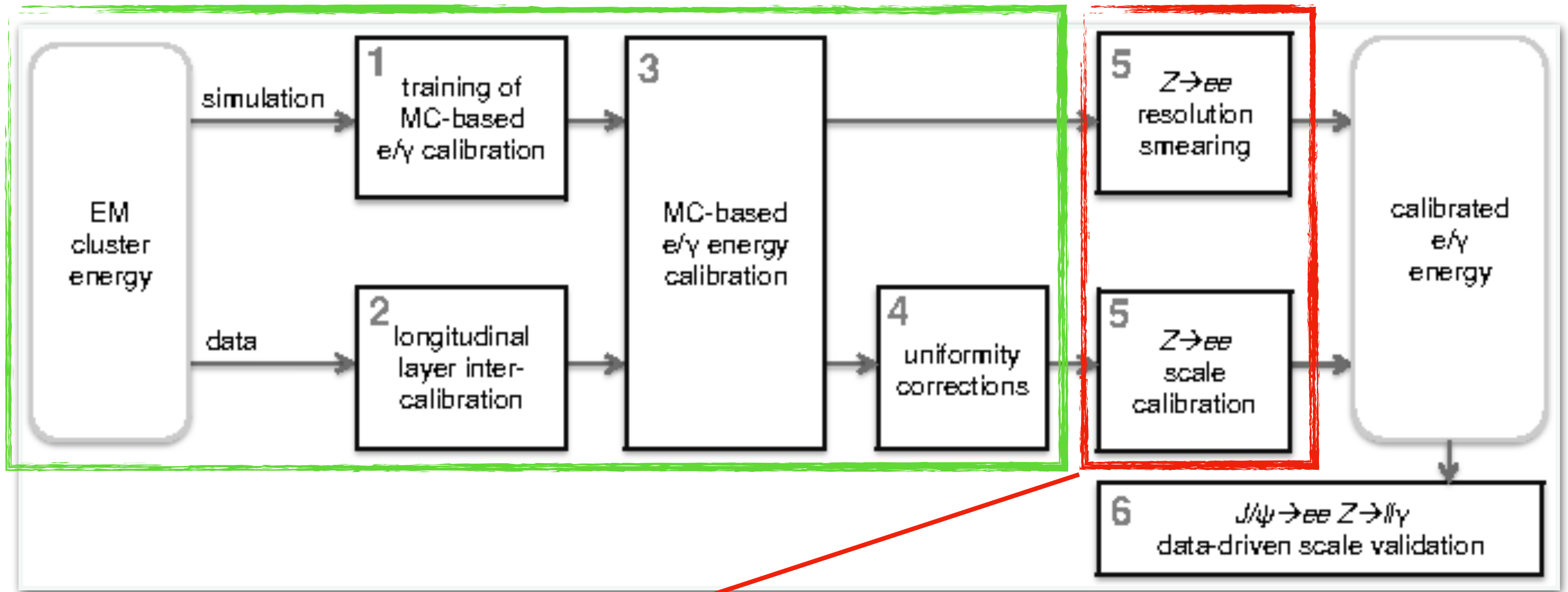

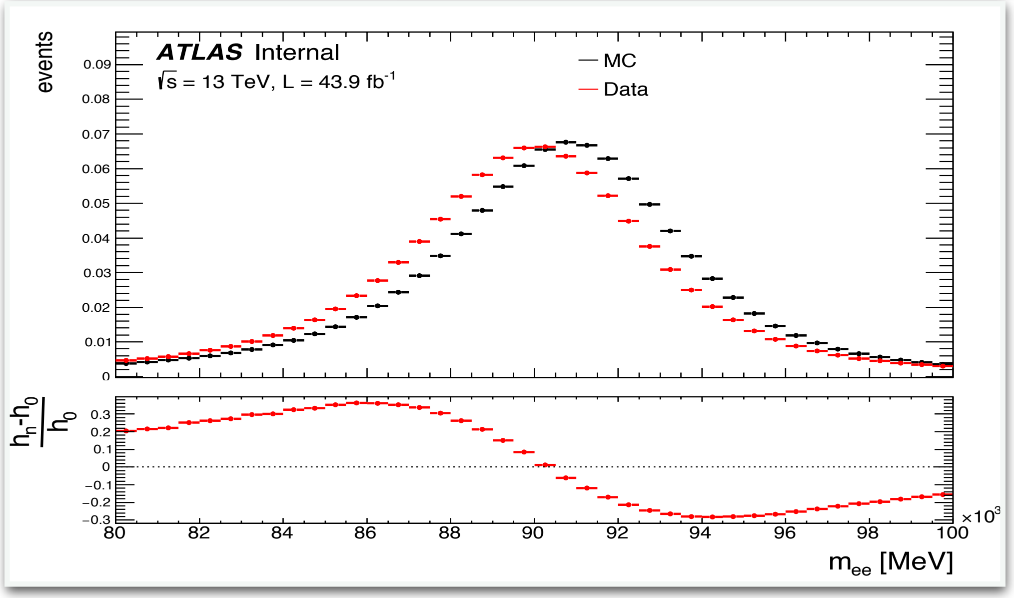

Difference data/mc

Difference between Data & MC :

- **Peak shifted → distributions do not have the same energy response.**
- **the two distributions do not have the same resolution.**

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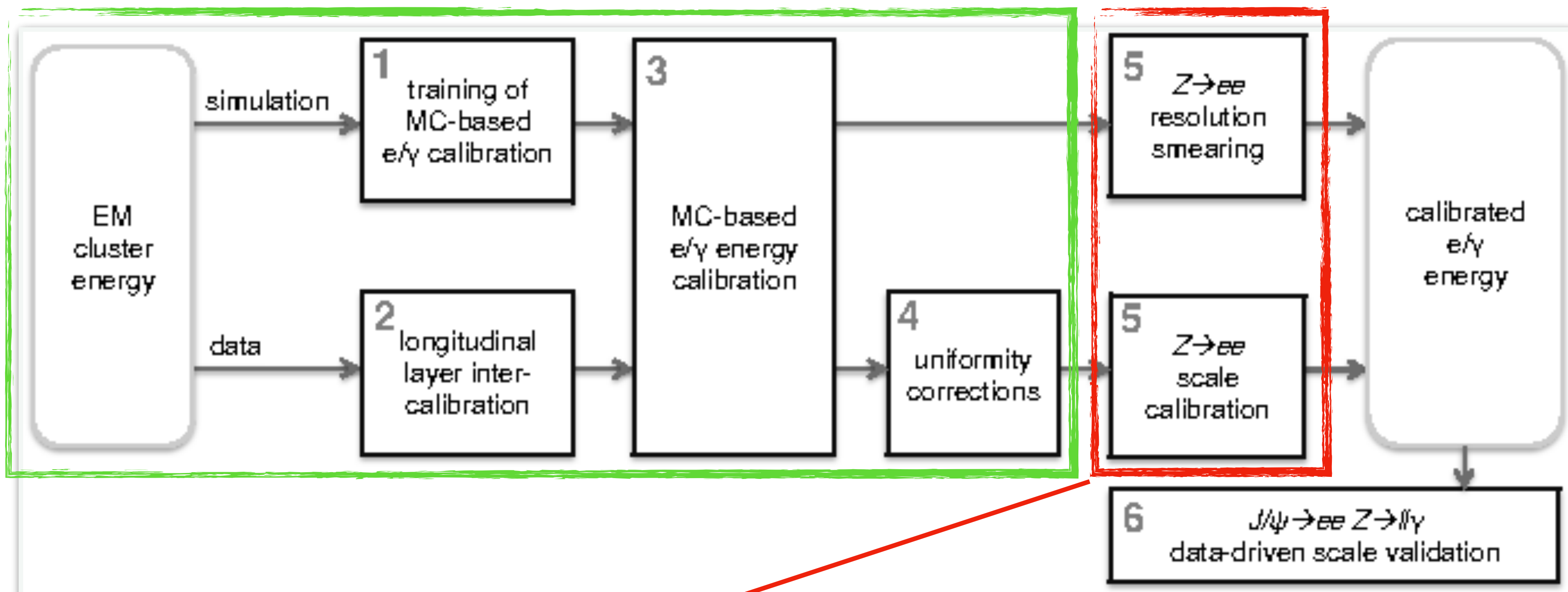

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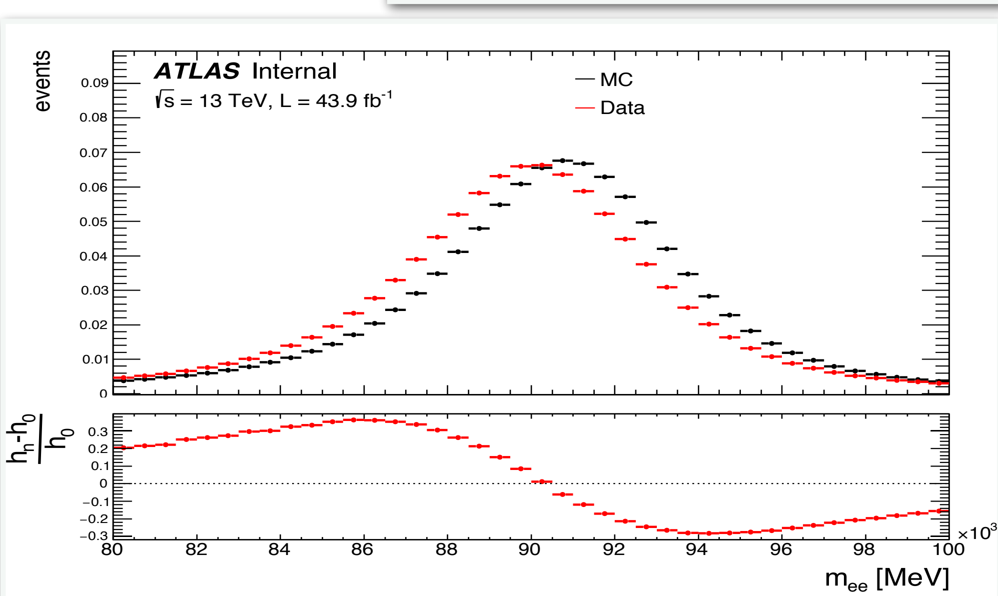
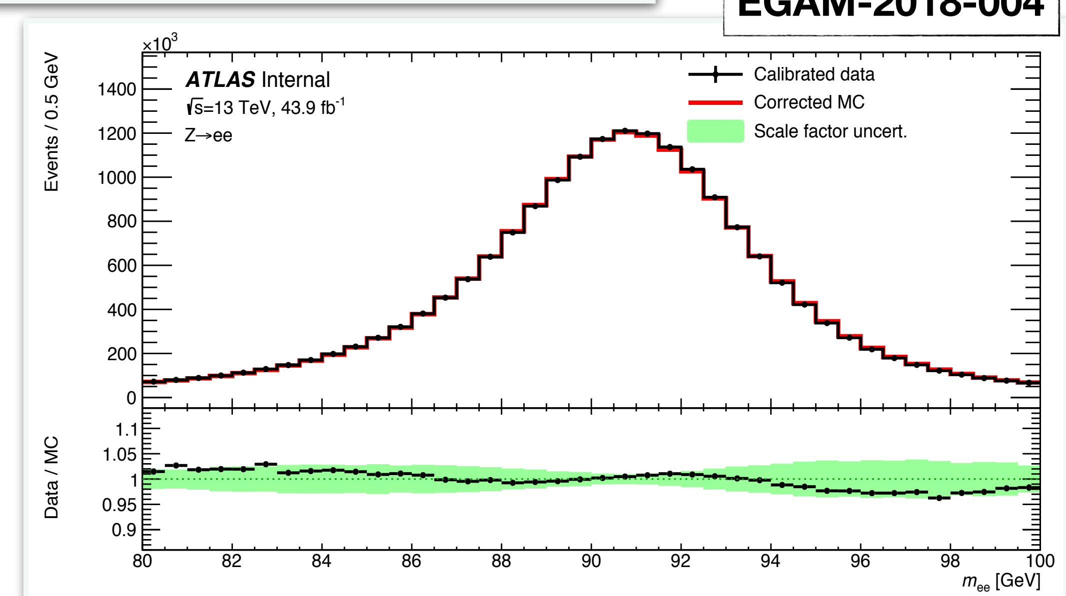


After Correction

with the Template method



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Template method for the in-situ Calibration : OverView

To correct the residual discrepancies between data and Monte Carlo, we apply two correction Scale factors :

1. **<u>The energy scale factors</u> (α) : shift the absolute energy scale of each electron in data to match energy response of Monte Carlo.**

Energy scales

$$E_i^{\text{data}} = E_i^{\text{MC}} \cdot (1 + \alpha_i)$$

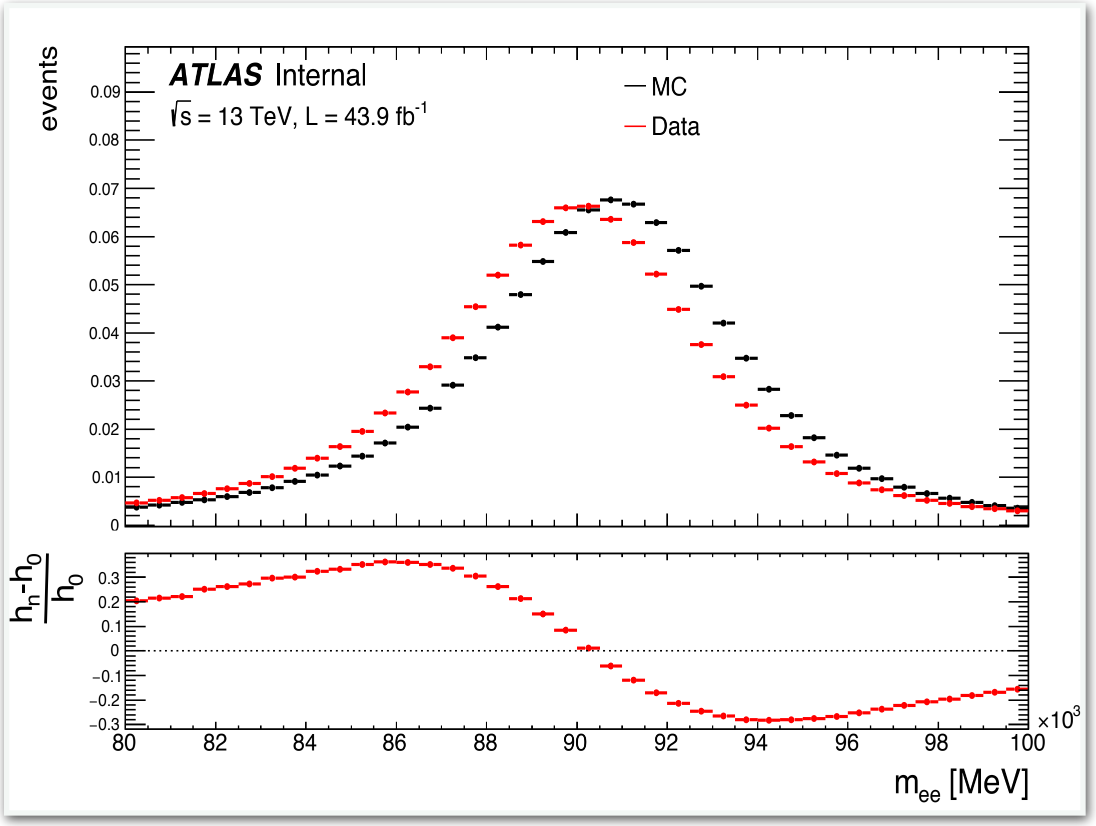
$$m_{ij}^{\text{data}} = m_{ij}^{\text{MC}} \cdot \sqrt{(1+\alpha_i)(1+\alpha_j)}$$

2. **<u>The additional constant term</u> (c) : is added to the Monte Carlo resolution, to account for the larger resolution of the data.**

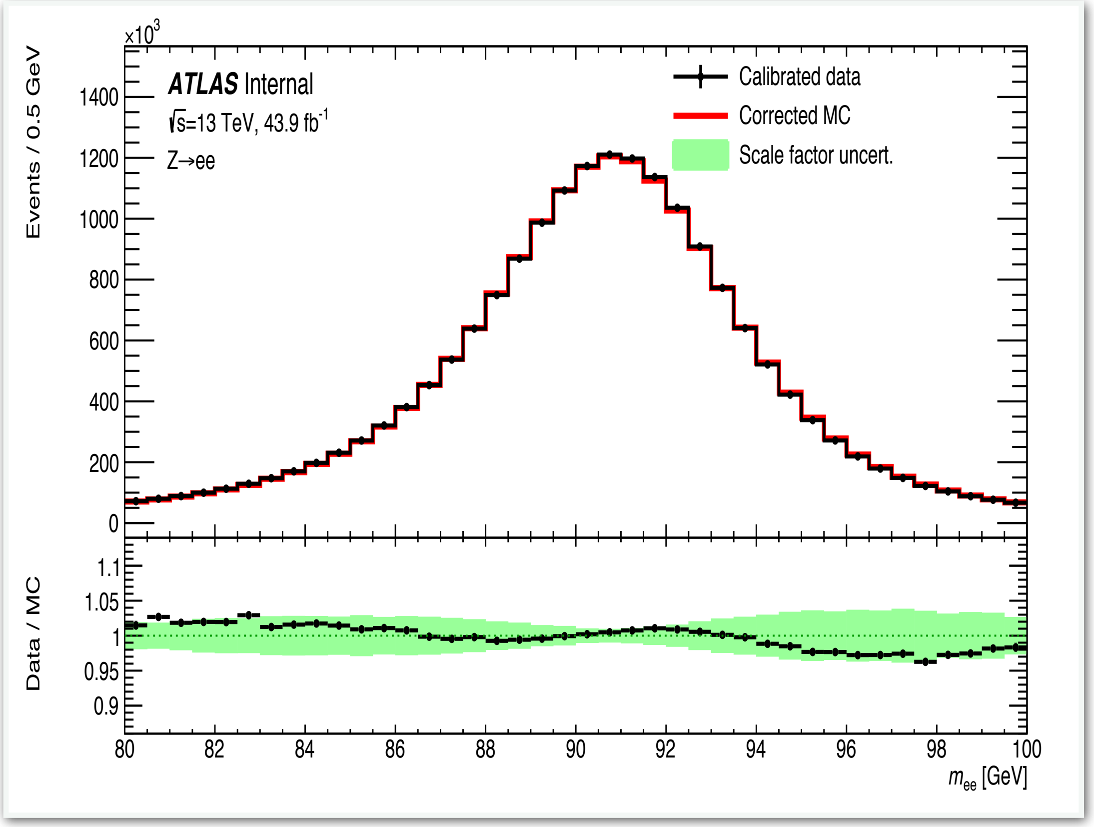
Additional constant term

$$E_i^{\text{data}} = E_i^{\text{MC}} \cdot (1 + N(0, c_i))$$

$$m_{ij}^{\text{data}} = m_{ij}^{\text{MC}} \sqrt{(1+N_i(0,c_i))(1+N_j(0,c_j))}$$



After Correction



Template method for the in-situ Calibration :

- **Both Scale Factors, Energy scales and Additional constant term, are applied in bin of eta electron η_{calo} :**

Energy scales

$$E_i^{\text{data}} = E_i^{\text{MC}} \cdot (1 + \alpha_i)$$

$$m_{ij}^{\text{data}} = m_{ij}^{\text{MC}} \cdot \sqrt{(1 + \alpha_i)(1 + \alpha_j)}$$

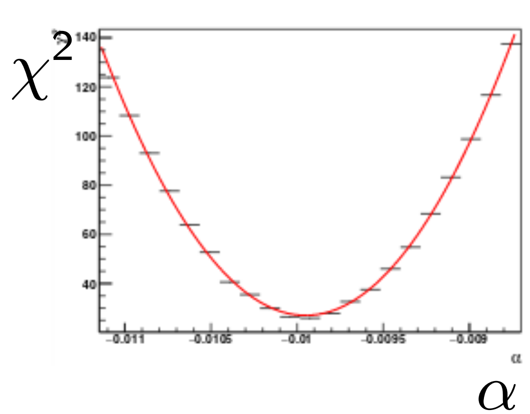
Additional constant term

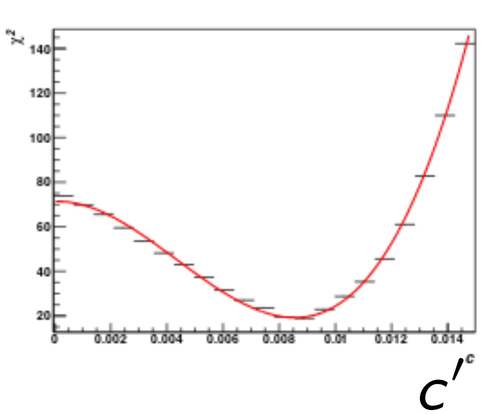
$$E_i^{\text{data}} = E_i^{\text{MC}} \cdot (1 + N(0, c_i))$$

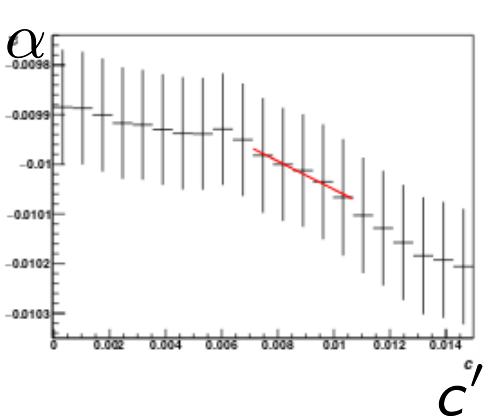
$$m_{ij}^{\text{data}} = m_{ij}^{\text{MC}} \sqrt{(1 + N_i(0, c_i))(1 + N_j(0, c_j))}$$

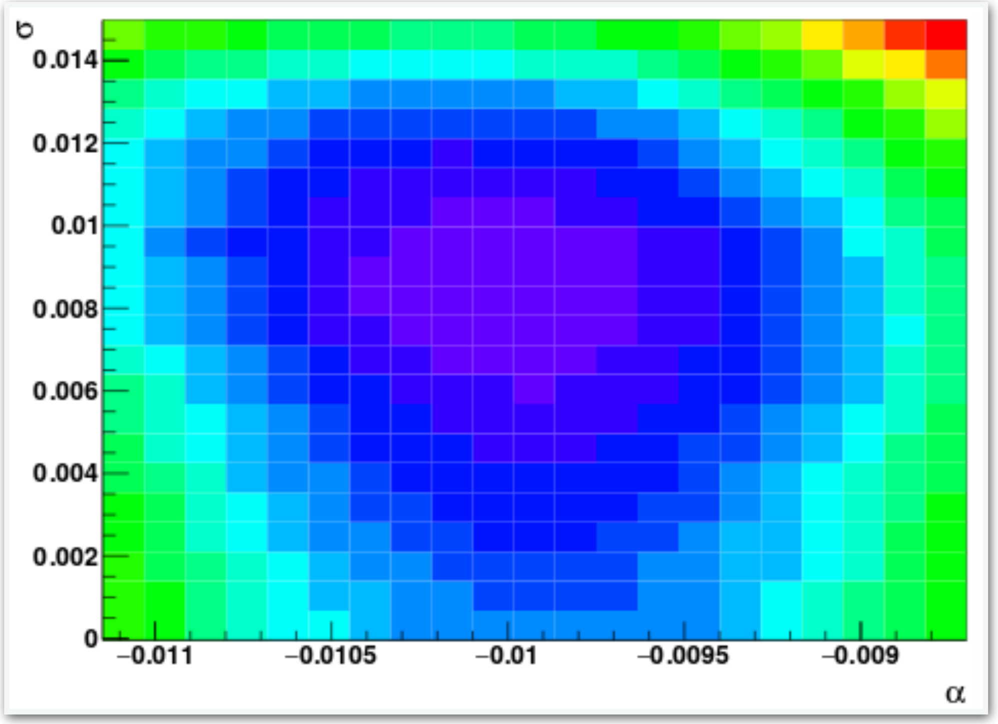
- **A several 1D fit are used to determine the minimum of Chi-2, corresponds to the best agreement between the Template and simulation.**

$$\chi^2 = \sum_{k=1}^{N_{bins}} \frac{(m_{ee,k}^{\text{MC}} - m_{ee,k}^{\text{data}})^2}{(\sigma_k^{\text{MC}})^2 + (\sigma_k^{\text{data}})^2}$$









- **The idea used for the in-situ calibration can be resumed in 2 steps :**

invariant mass distribution - data → Templates ↔ invariant mass distribution - MC

inject several correction factors to construct Templates

a Chi-2 Test is used to determine the best correction factor

we inject 2 corrections factor (α,c) to correct the energy response in data and the resolution in simulation.

A procedure using several 1D fits is used to determine the minimum of the Chi-2 distribution.

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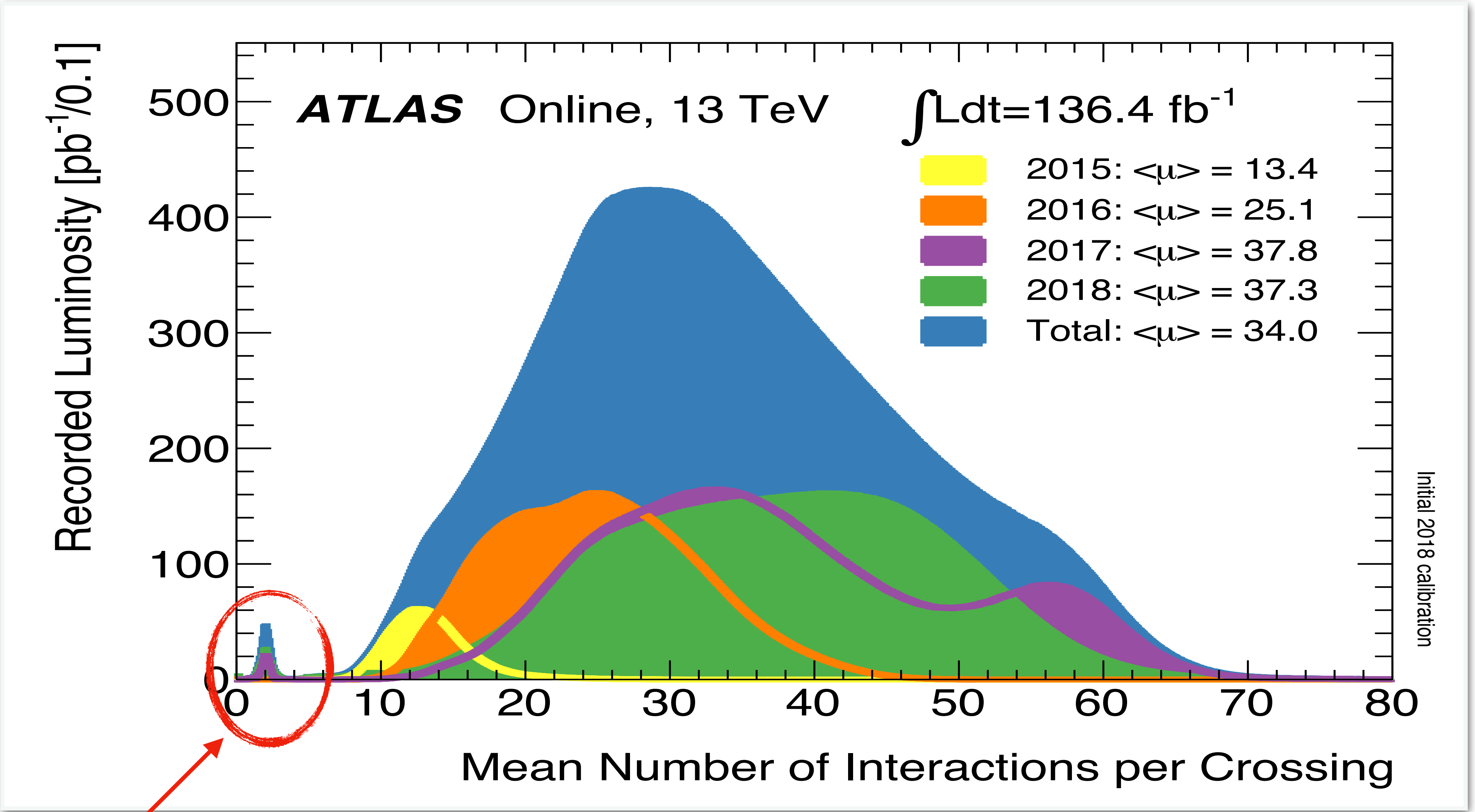
Electron & photon energy calibration for high-mu data : data-set

- **Pile-up** : proton-proton collisions in addition to the collision of interest.



***Low-mu DataSet* :**

Used for precision measurements :

- **W mass measurement.**
- **pT(W) and pT(Z) measurement.**
- **...**

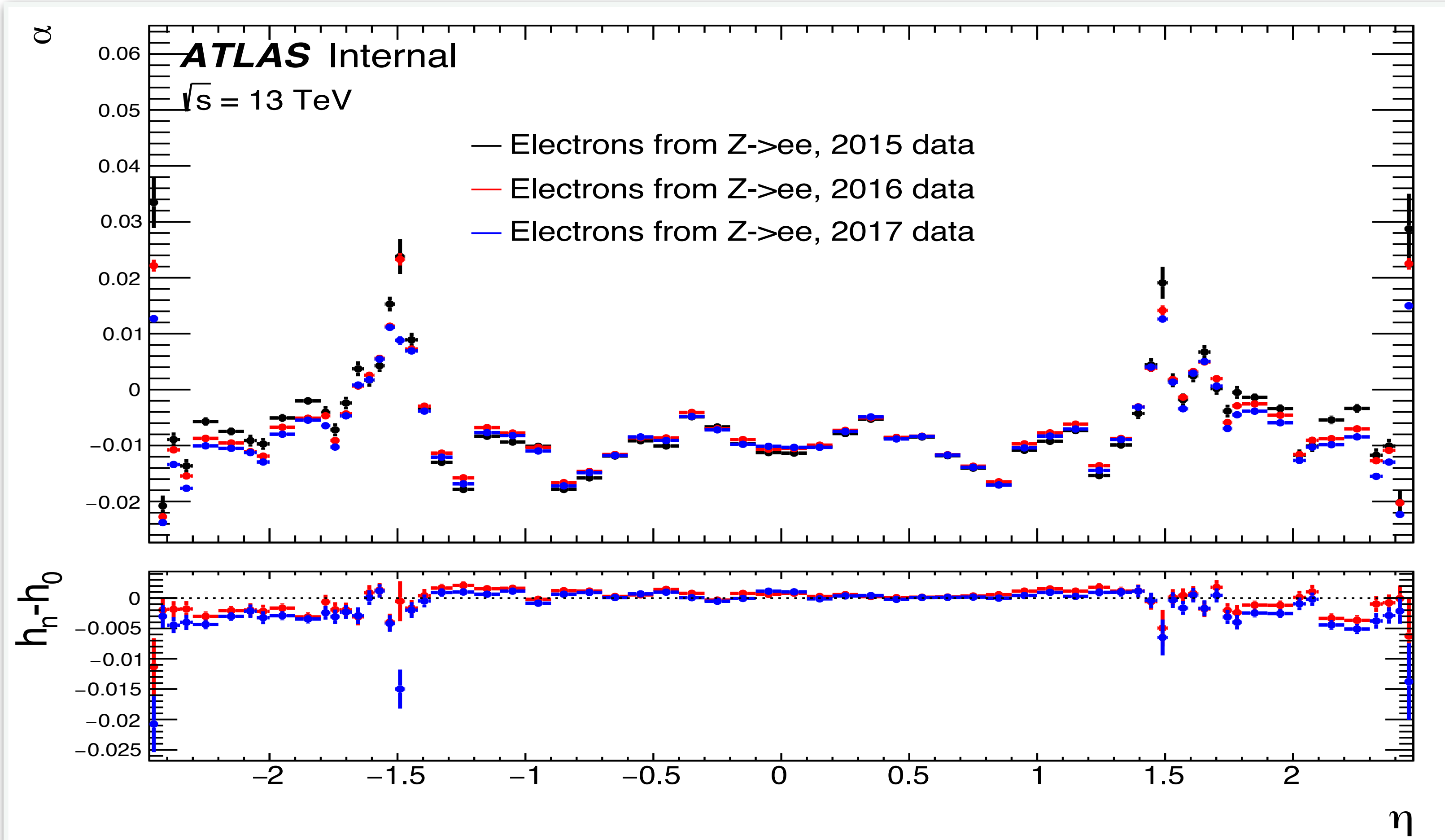
***High-mu DataSet* :**

Used for standard analyses:

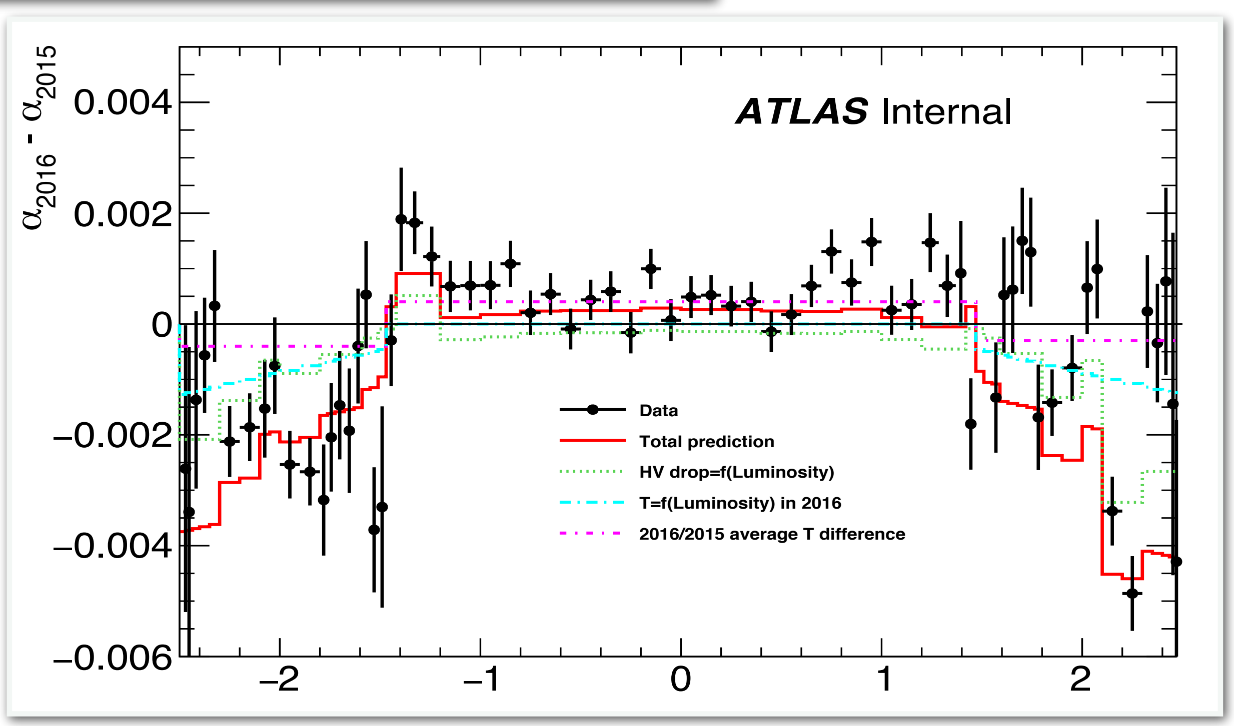
- **Study of the Higgs boson properties.**
- **Search for new physics.**
- **...**

Electron & photon energy calibration for high-mu data : Results

- **The correction scale factors for 2015, 2016 and 2017 :**

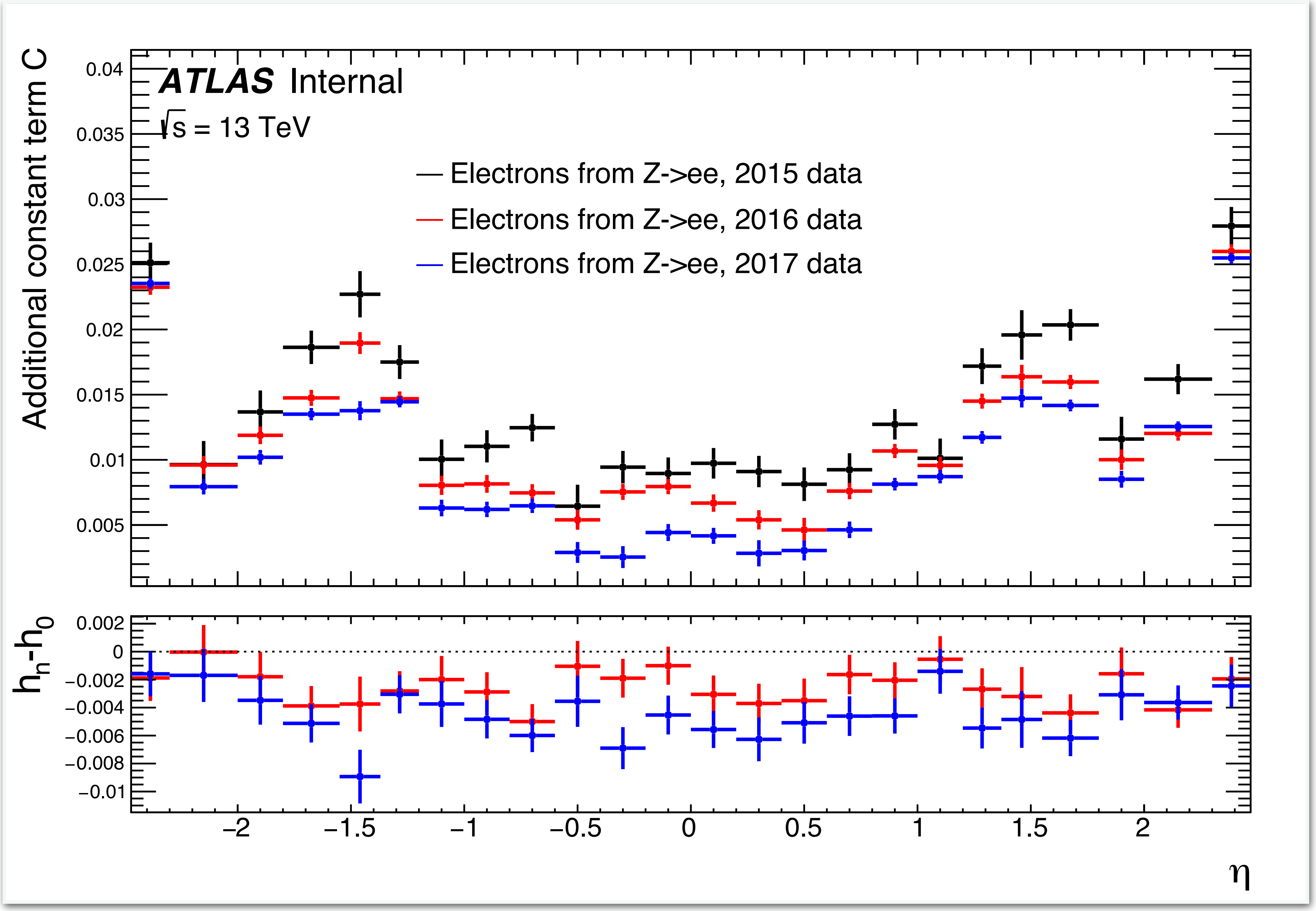


- **The difference between 2016 and 2015 in the end-cap (due to a luminosity effect – right plot) is smaller than the difference between 2017 and 2015 because the luminosity in 2017 is bigger than in 2016.**
- **Since the response in the end-cap is luminosity dependent, one can understand why the SF of 2017 are more different.**



Electron & photon energy calibration for high-mu data : Results

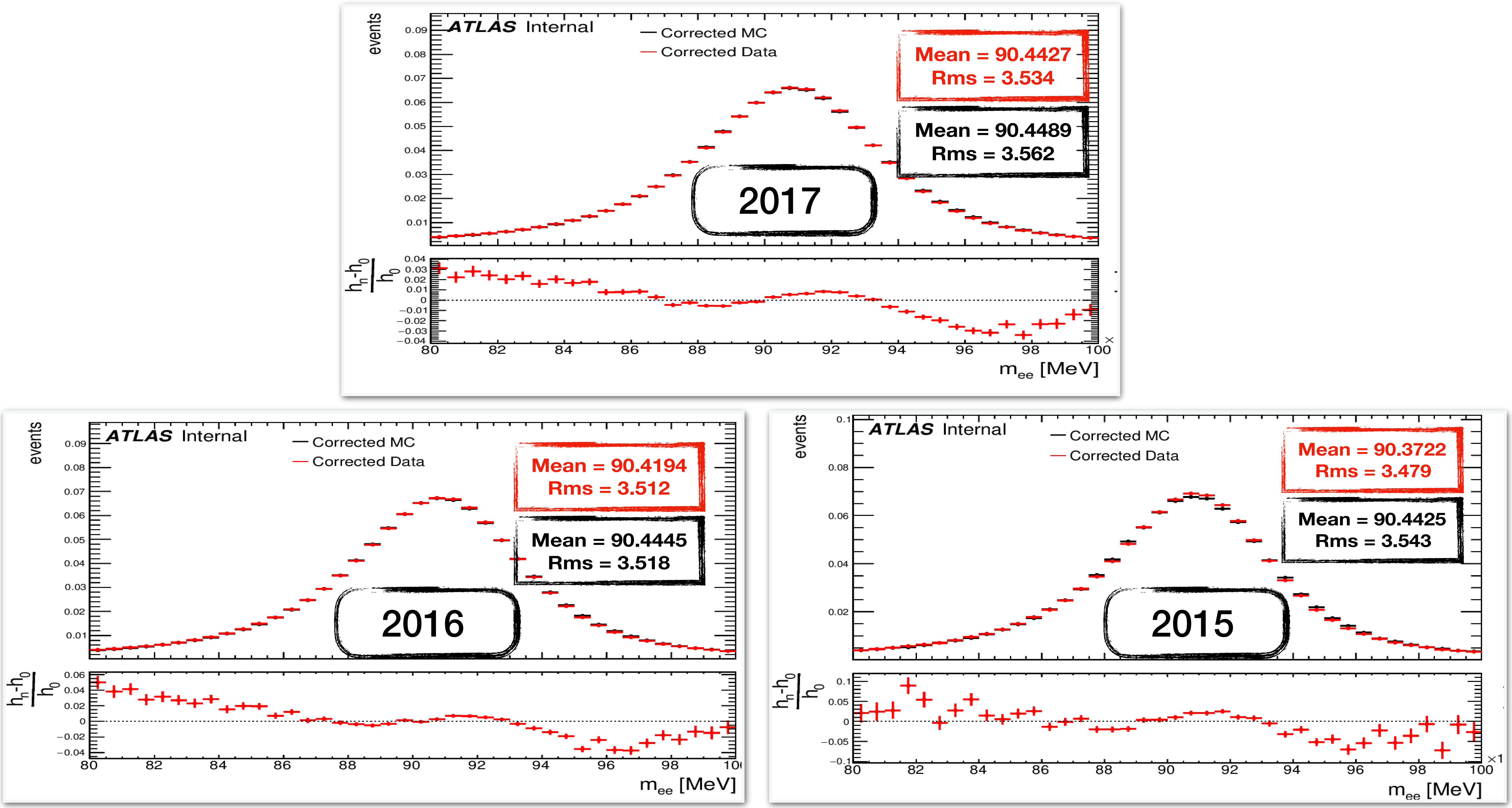
- **The Additional constant terms for 2015, 2016 and 2017 :**



- **The additional constant terms : Lower values with 2017 data than 2016 data because the pile-up in the Calorimeter from MC Is mis-modeling the data. Therefore the additional constant term absorbs this mis-modeling.**

Electron & photon energy calibration for high-mu data : Results

- **Comparison Data/MC after correction :**



Better agreement in 2017 results than the 2016 and 2015, related principally to the high statistic of 2017.

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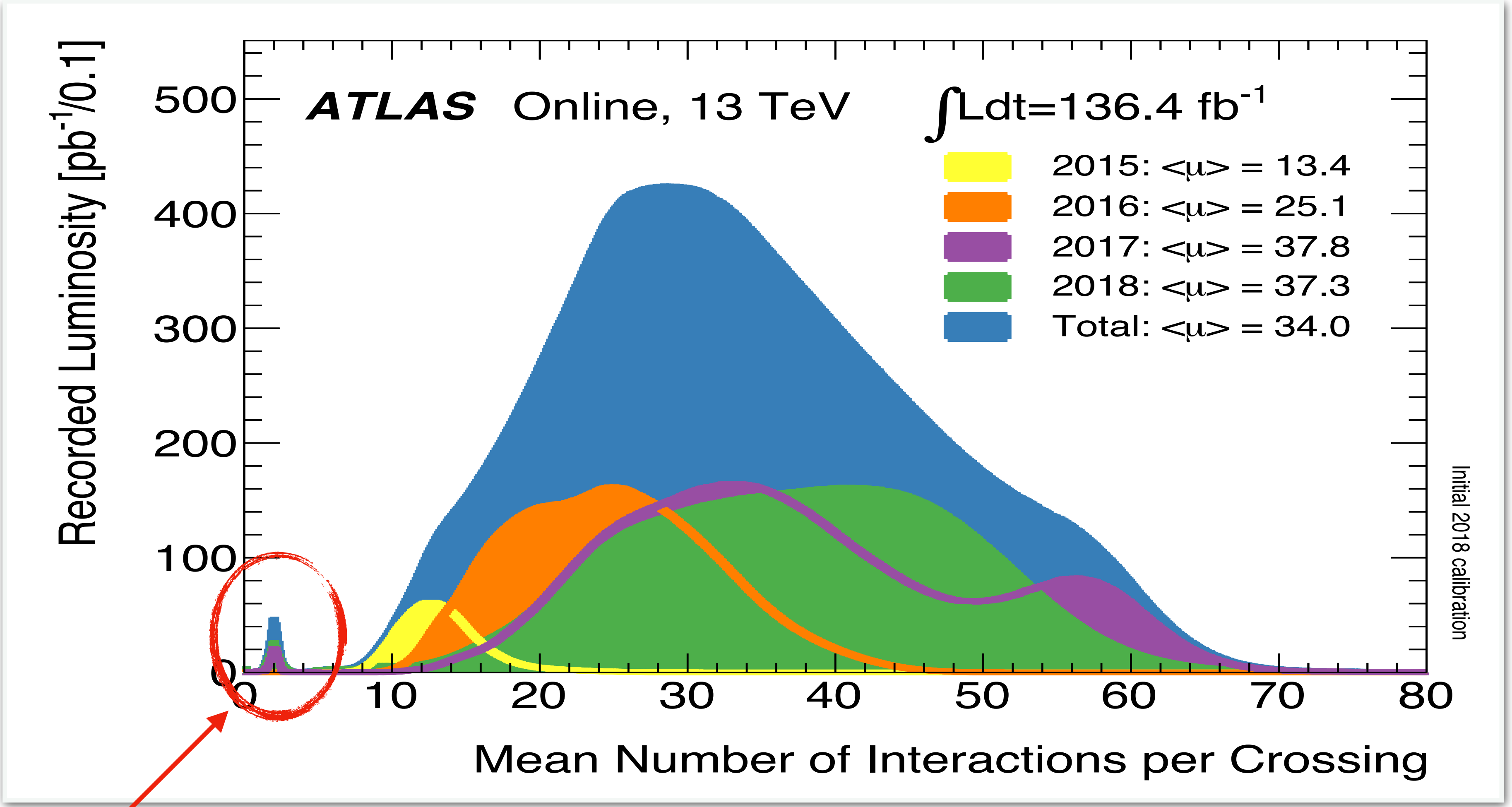
Electron & photon energy calibration for low-mu data :



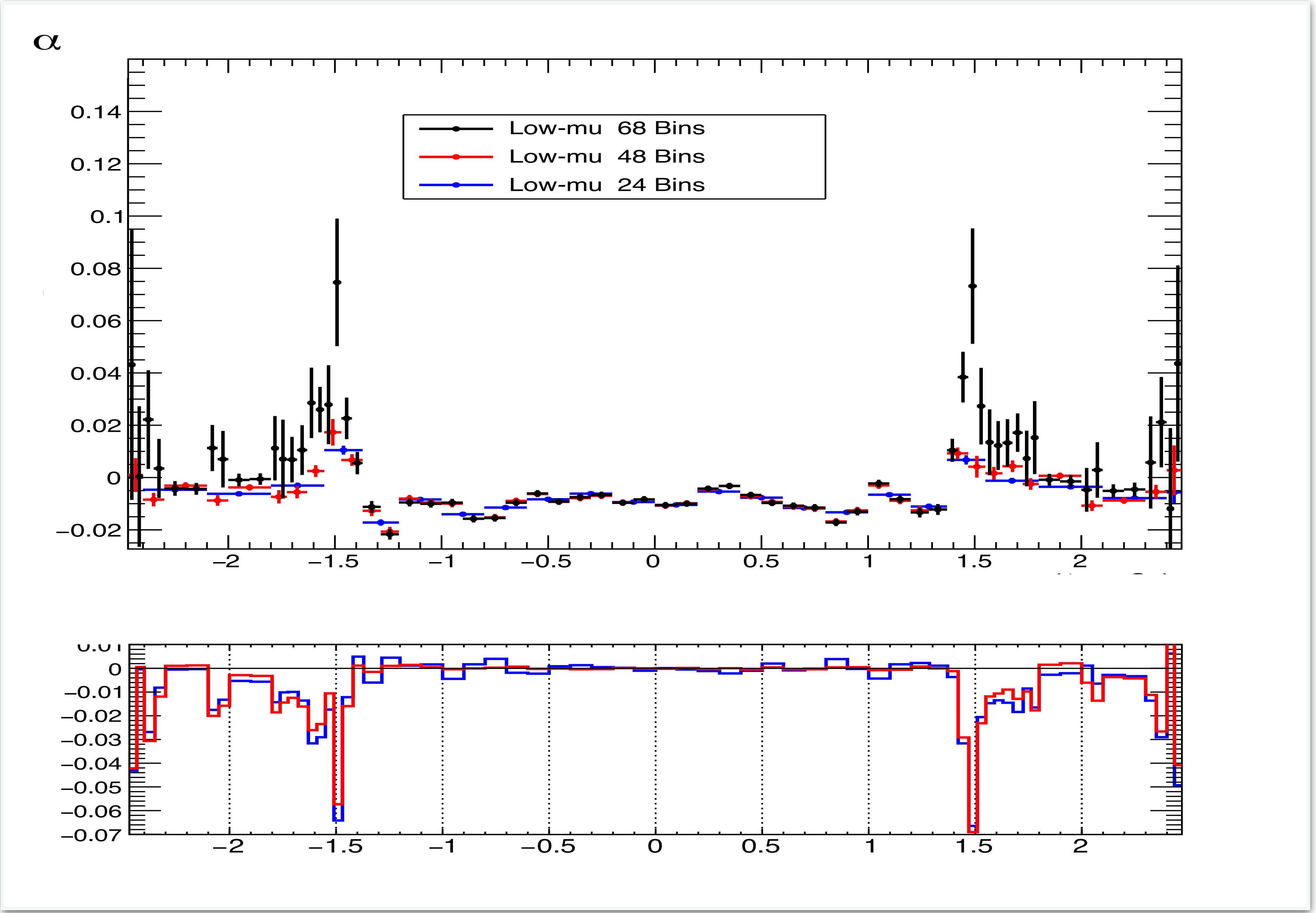
low mu dataSet

- **The same procedure applied to correct the difference observed between data and simulation for the high-mu dataset is applied also for the low-mu dataset.**
- **Because of some problems in the correction procedure used for the low-mu dataset, related principally to the low-stat of low-mu dataset, another approach is used to calibration the low-mu dataset.**
- **The approach used for the low-mu dataset, is based principally on the extrapolation of high-mu results to the low-mu.**

Electron & photon energy calibration for low-mu data : bais study

- **The number of bins chosen for the high-mu analysis : 68 bins, and because of the low-stat of low-mu runs, we change the number of bins to 48 bins ➔ Wider bins are used in the EC.**

- **There is one idea to use wider bins - 24 bins, and the results are similar with 48bins in the barrel ➔ there seems still to be a small bias in the end-cap.**



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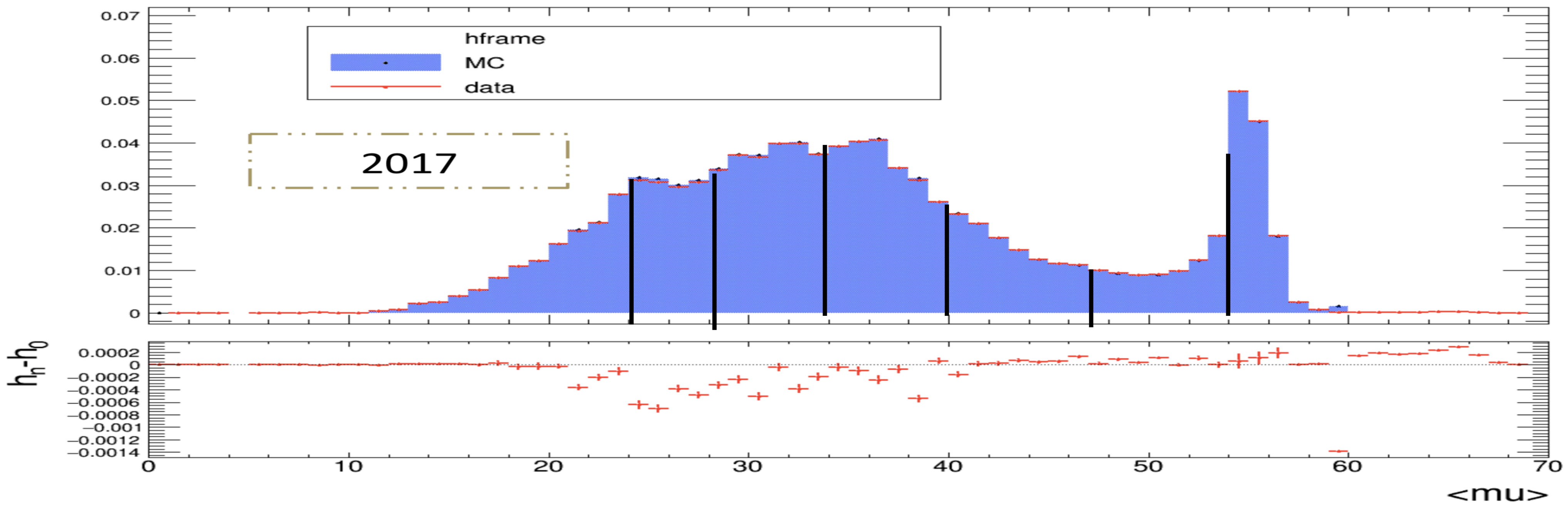
Extrapolation from the high-mu results to low-mu : Idea

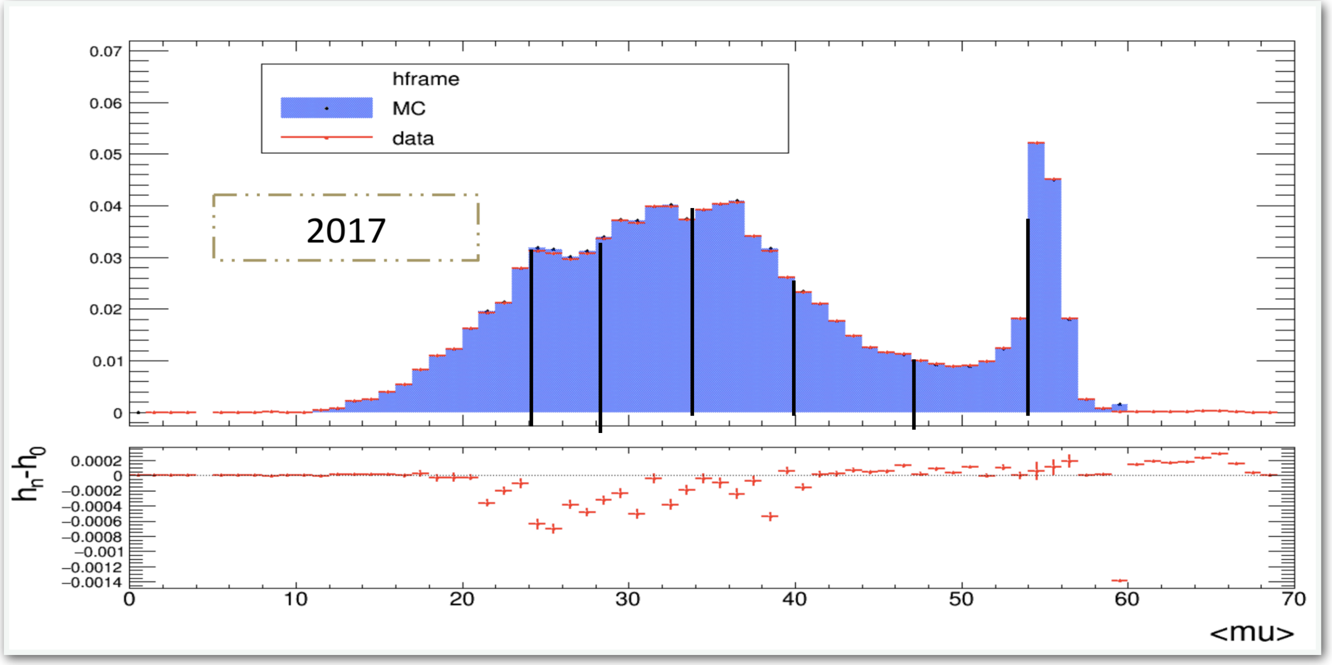
- **Because of some problems in the correction procedure used for the low-mu dataset, related principally to the low-stat of low-mu dataset, another approach is used to calibration the low-mu dataset.**

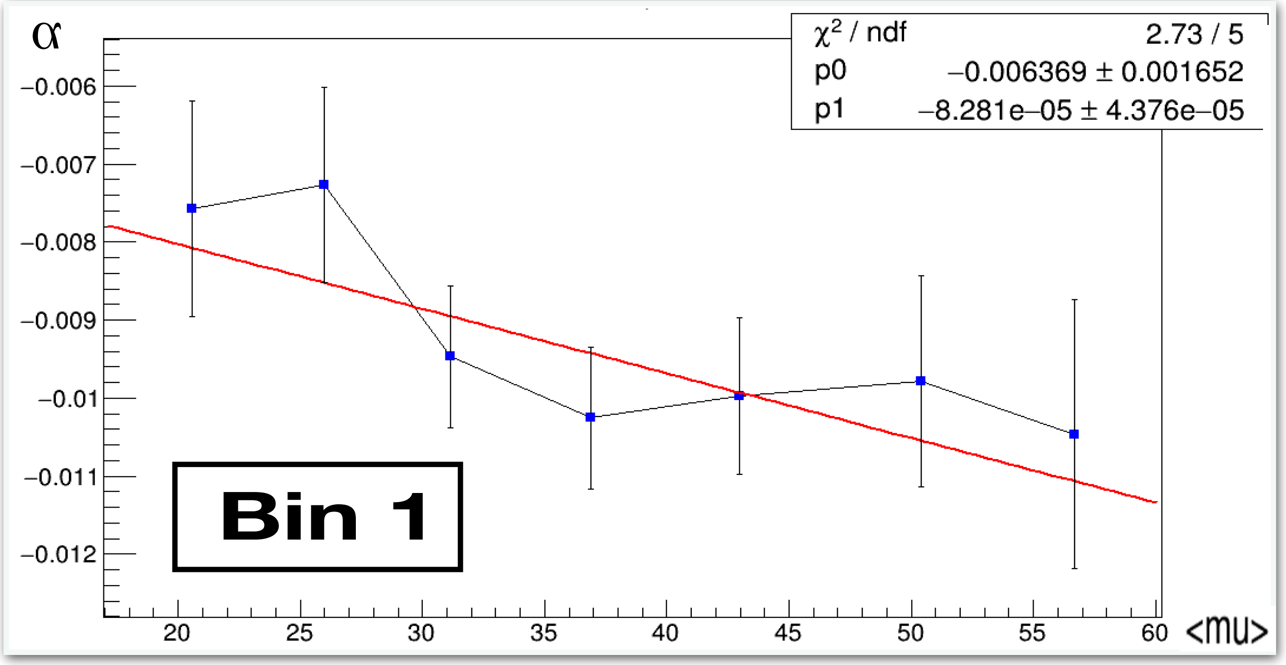
- **The approach used for the low-mu dataset, is based principally on the extrapolation of high-mu results to the low-mu.**

interval	<mu>	Events
[0 : 24]	20.55	11 %
[24 : 28]	26.00	12 %
[28 : 34]	31.14	22 %
[34 : 40]	36.91	21 %
[40 : 47]	42.95	13 %
[47 : 54]	50.43	7 %
[54 : ....]	56.66	14 %



Extrapolation from the high-mu results to low-mu : Example





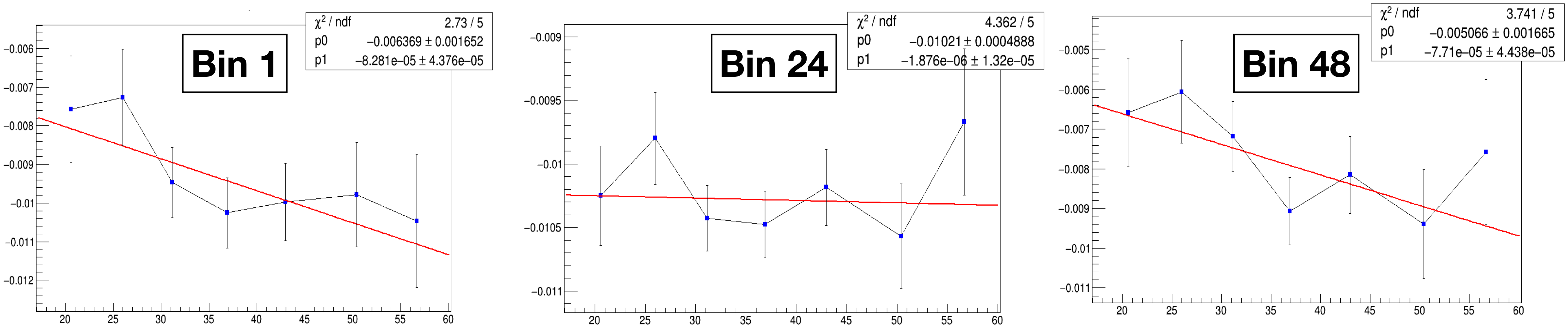
<u>Different interval used of the distribution of mu</u>

<u>Exemple of Extrapolation for bin=1 in eta : [-2.47 : - 2.44]</u>

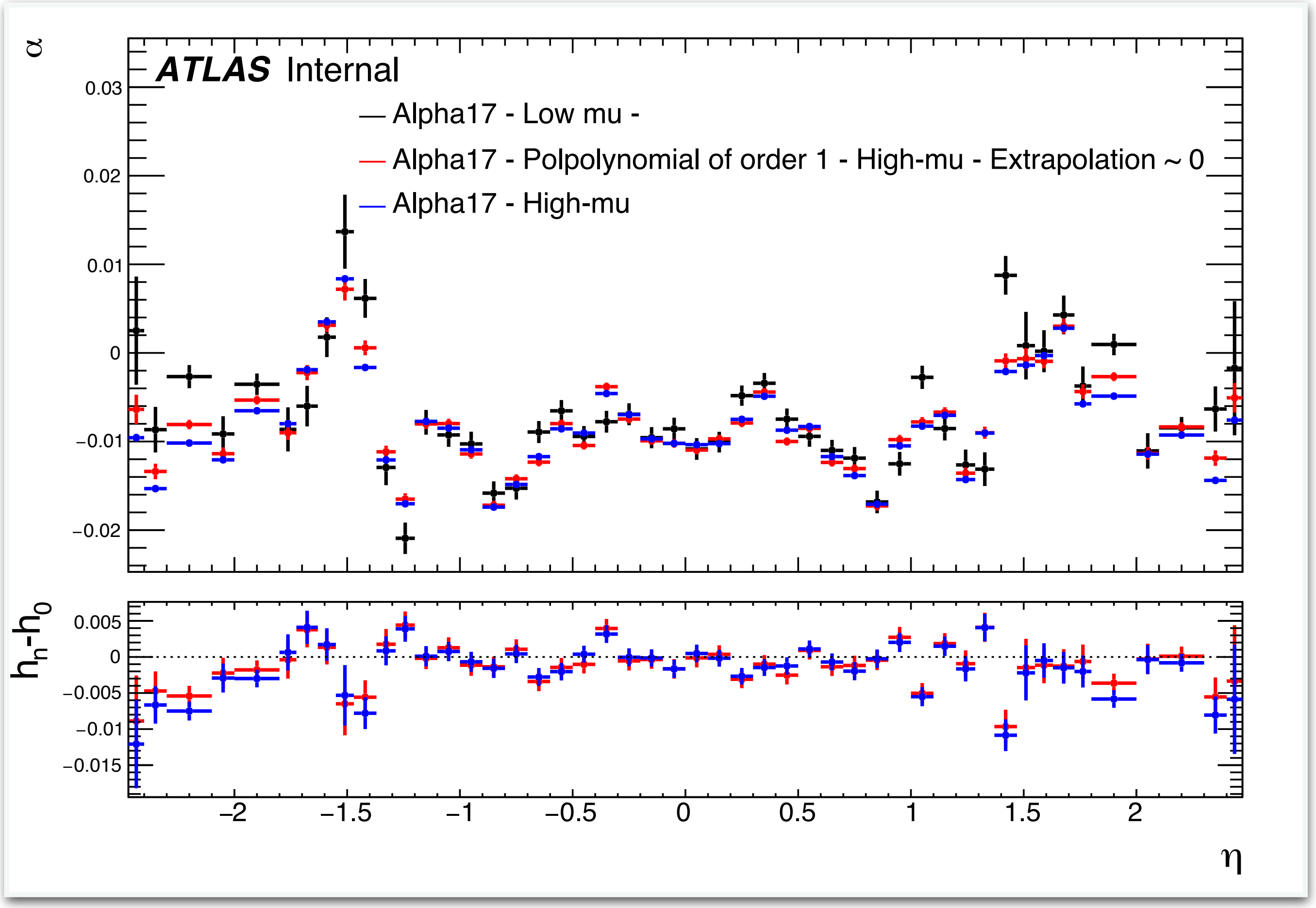
Procedure

1. **We extract the SF's (alpha, c) for each interval of mu (the plot at the top).**
2. **For a precise bin, we plot the different SF as a function of <mu>.**
3. **A polynomial function is used to extrapolate the SF to <mu> = 0.**

Extrapolation from the high-mu results to low-mu :

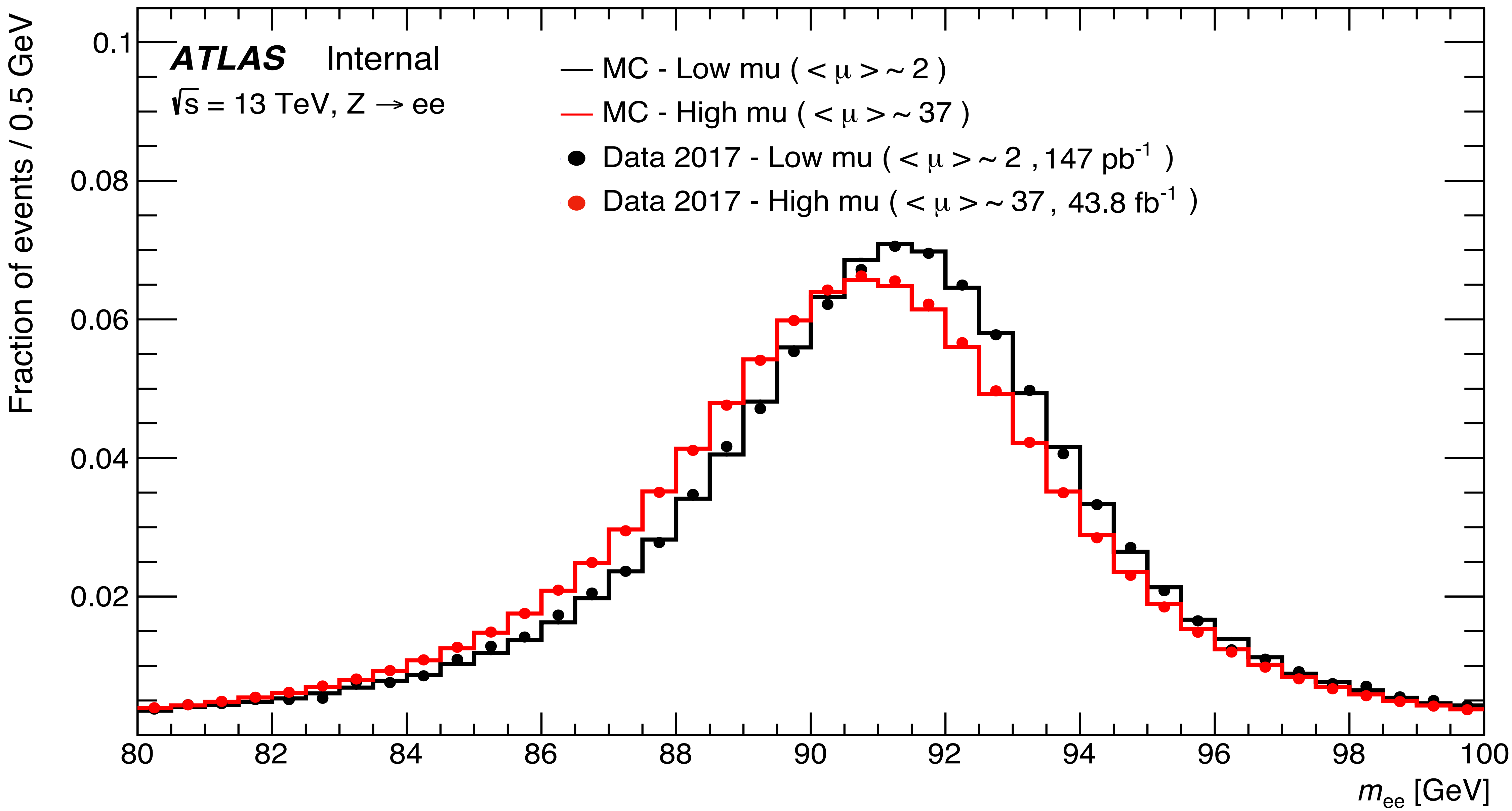


- **For the extrapolation, we use polynomial function of order 1. with higher order of the polynomial function, the results start to diverge.**
- **The extrapolation results (red) must be closer to the low-mu results (black).**
- **residual difference to be understood (low μ extraction problems due to number of bins, bais ...)**
- **The extrapolation results must be corrected with the difference of threshold between high and low mu runs.**



Extrapolation from the high-mu results to low-mu : Difference of Threshold

- **For high and low pile-up runs, we use different threshold for the energy collected in the cluster.**
- **The difference of threshold can be illustrated in the plot below : for the low luminosity data, the thresholds for the energy cluster extension are lower and thus more energy is collected in the cluster and the reconstructed invariant mass is higher on average.**



Extrapolation from the high-mu results to low-mu : Difference of Threshold

➤ For the extrapolation results, we want to take into account the difference between the high-mu runs and low-mu runs, because of the difference of noise threshold.

- we can compare the difference between the alphas low-mu : [$\Delta\alpha = \alpha$ (low-TC) - α (high-TC)] and subtract this difference $\Delta\alpha$ from the extrapolation results. (**Option 1**)

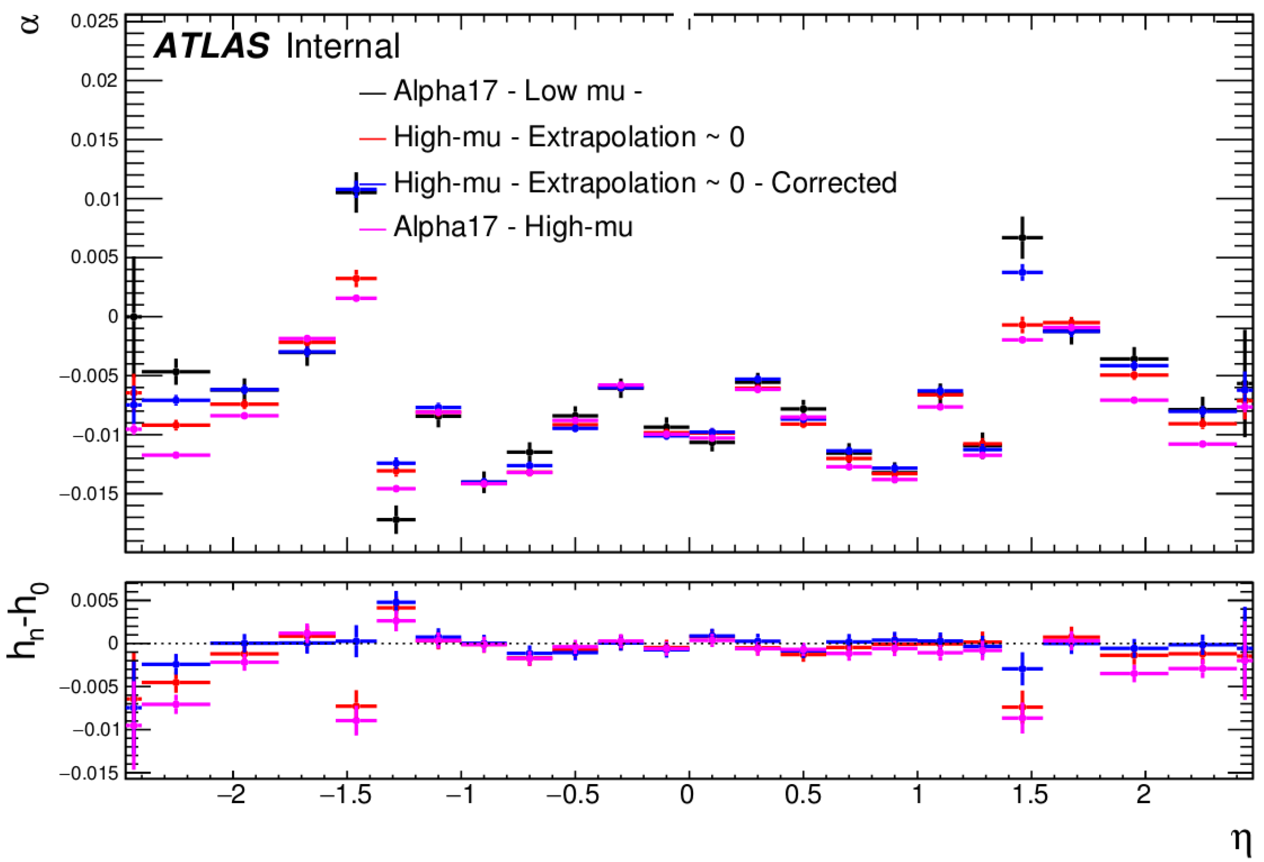
- we can also compare the difference between the energy of high and low noise threshold event-by-event ($\Delta E / E$). in this case, the difference $\Delta\alpha$ can be written in this form :

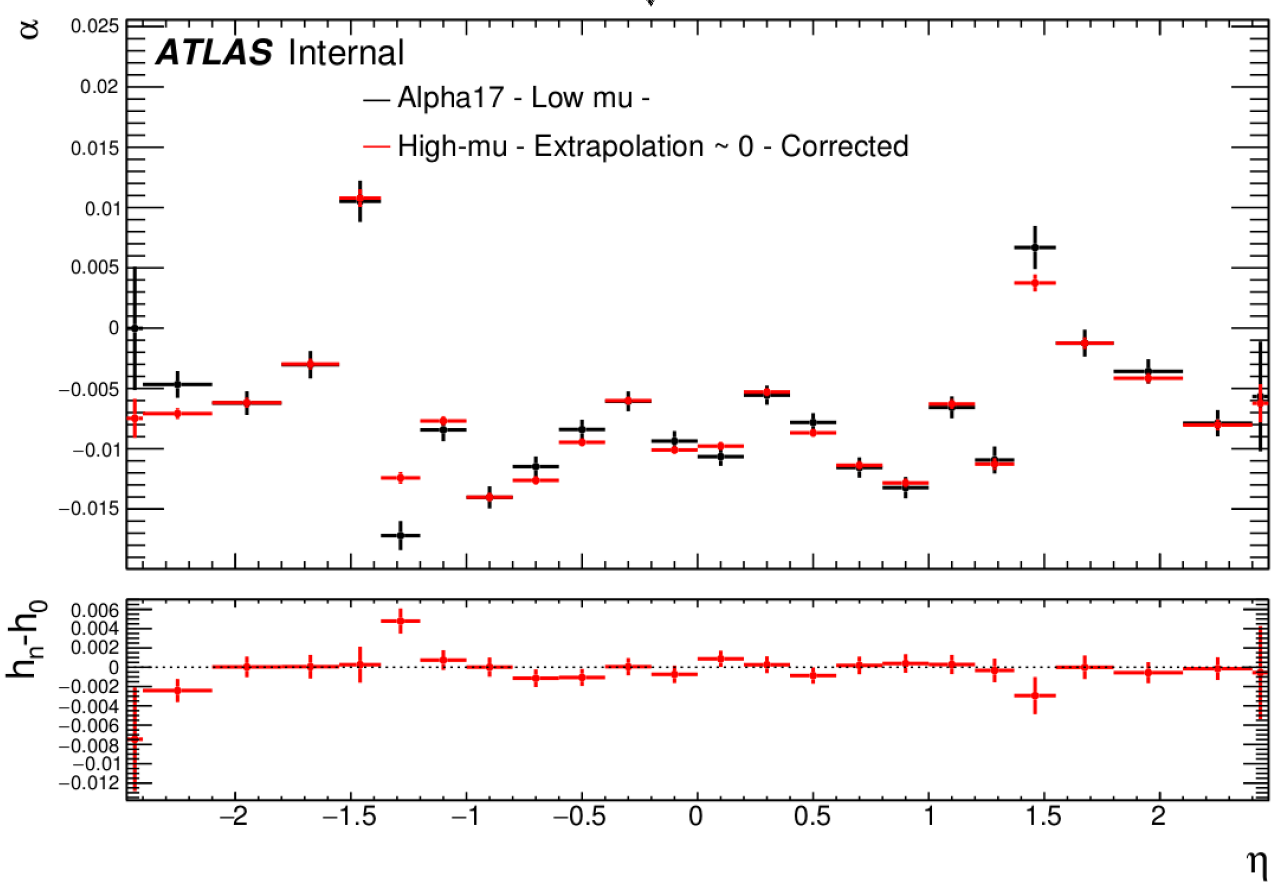
$$\Delta\alpha = [(\Delta E / E)^{data} - (\Delta E / E)^{mc}]$$ (**Option 2**)

➤ We want to compare the high-mu results extrapolated to "0", after subtraction of the difference $\Delta\alpha$, to the low-mu results.

This plots show the comparison between the results of :
- Low-mu runs.
- High-mu runs extrapolated to 0.
- High-mu runs extrapolated to 0 after correction.
- High-mu runs.

Comparison direct between the results of :
- Low-mu runs.
- High-mu runs extrapolated to 0 after correction.



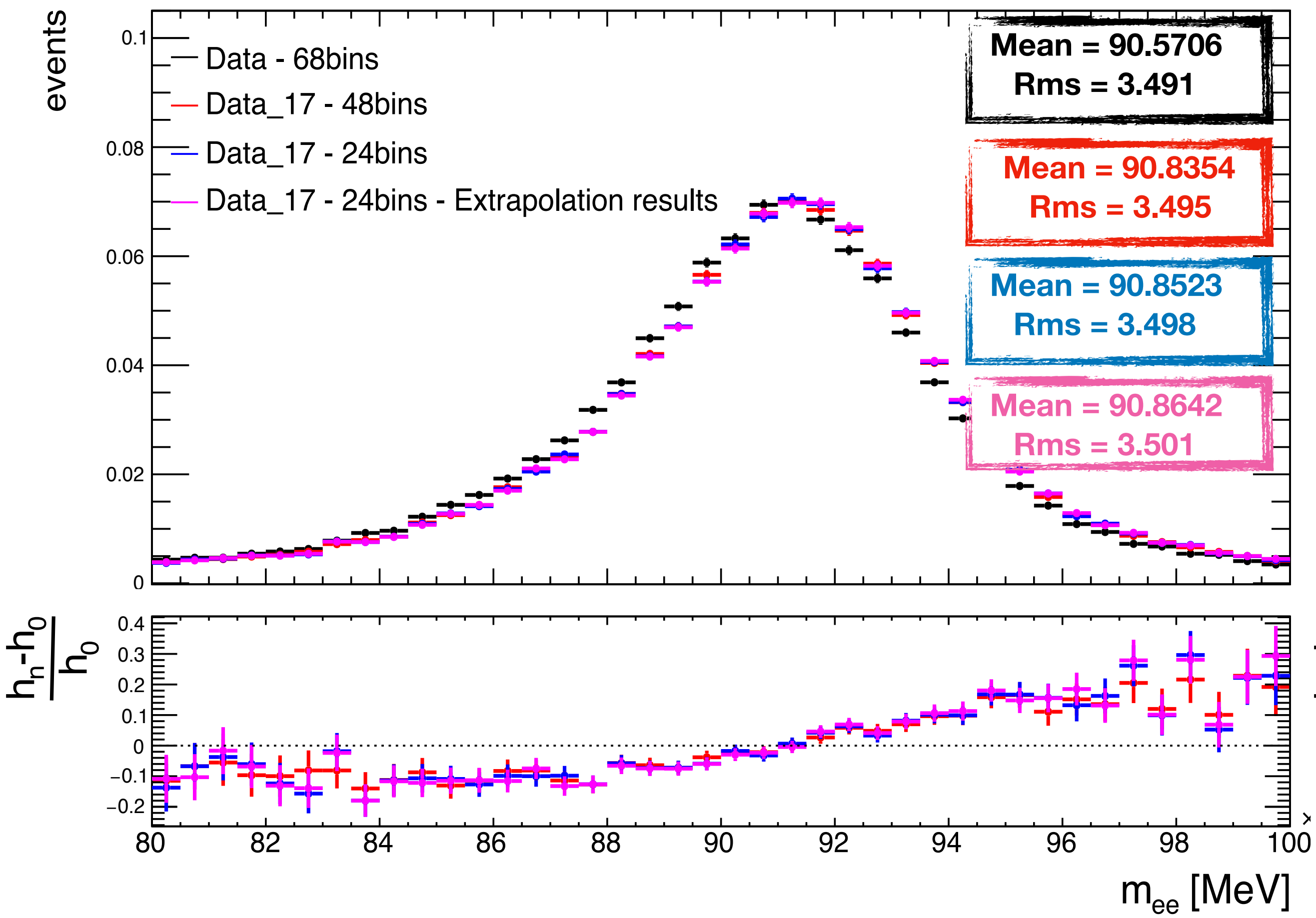


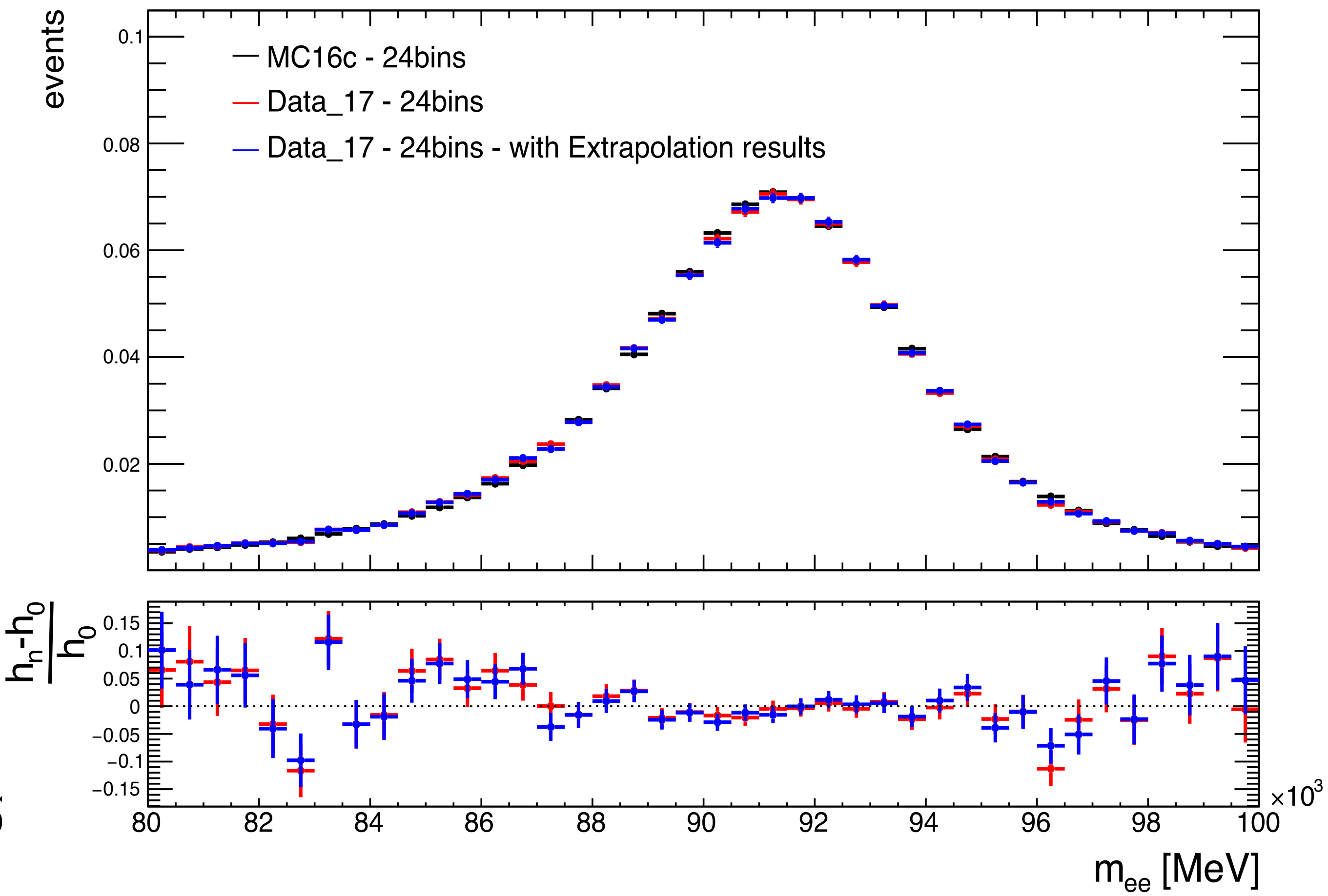
➜ **If we exclude the crack, it seems that the extrapolation results are similar to low-mu results, with a difference of the order of 1e-3.**

Extrapolation from the high-mu results to low-mu : Validation

Strategy :

- **Apply the extrapolation results on data and compare them to to the corrected data with the standard results of low-pile up runs. (left plot)**
- **Compare the corrected data to simulation. (right plot)**





Results & remarks:

- **Difference of ~ 11.9 MeV between the data corrected with extrapolation and data corrected with the standard results of low-pile up runs, to be compared to do statistical error of low-mu ~12.9 MeV.**
- **The comparison Data/Mc same to be similar for the extrapolation and the standard results of low-pile up runs.**

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Conclusion :

Electron momentum Calibration :

- Some discrepancies are observed between data/simulation : energy response & resolution.
- The Template method is used to correct these discrepancies.
- The template method use several 1D fit to extract the correction scale factors.
- The correction scale factors are luminosity dependent.

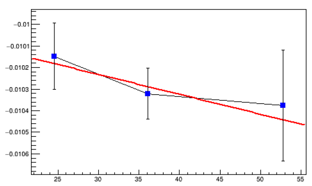
Electron momentum Calibration for Low-mu runs :

- Low-mu energy calibration is based on high-mu calibration with additional extrapolation and correction.
- Energy scales factor difference $\delta\alpha$ between high/low noise threshold is directly measured with low-mu data and MC.
- α central value is extrapolated from high-mu calibration with a linear fit.

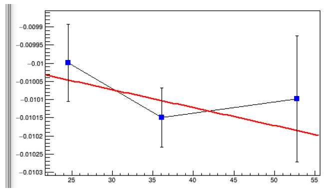
Back-up

Back-up : Extrapolation

Bin-1

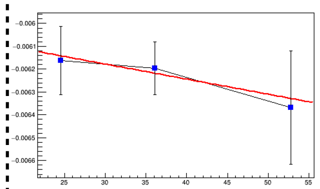


24 Bins

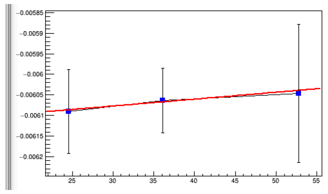


24 Bins + symmetrisation

Bin-2

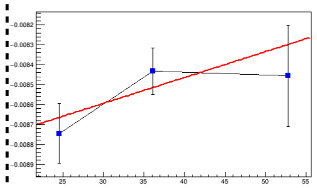


24 Bins

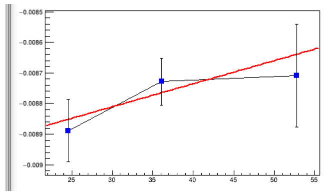


24 Bins + symmetrisation

Bin-3

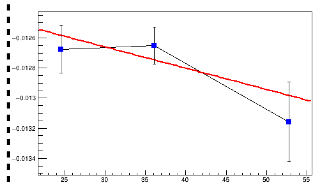


24 Bins

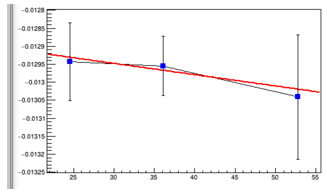


24 Bins + symmetrisation

Bin-4

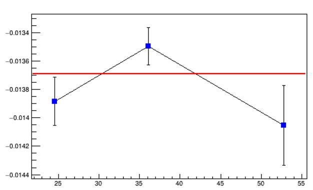


24 Bins

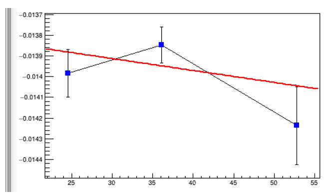


24 Bins + symmetrisation

Bin-5

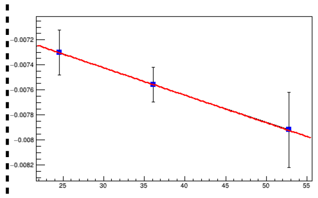


24 Bins

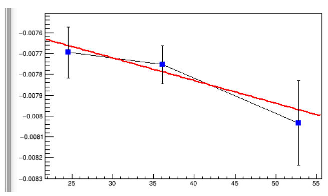


24 Bins + symmetrisation

Bin-6

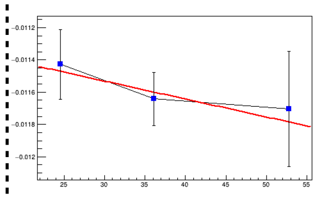


24 Bins

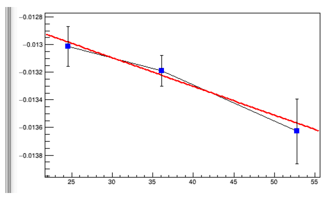


24 Bins + symmetrisation

Bin-7

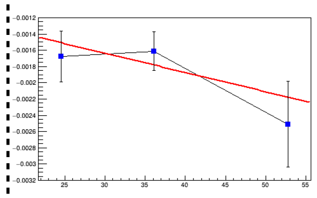


24 Bins

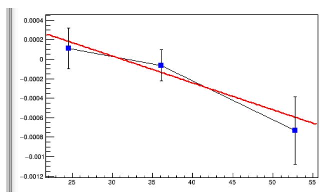


24 Bins + symmetrisation

Bin-8

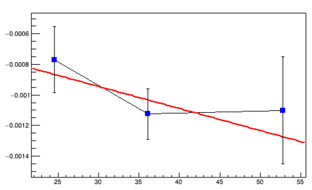


24 Bins

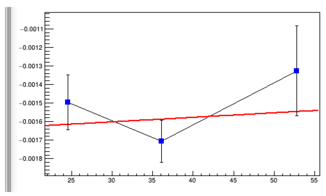


24 Bins + symmetrisation

Bin-9

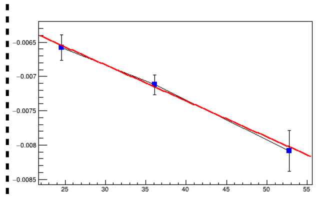


24 Bins

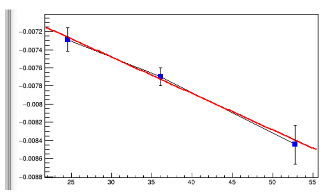


24 Bins + symmetrisation

Bin-10

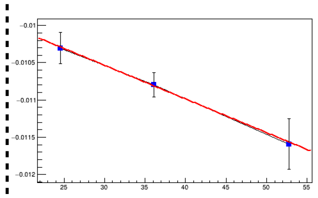


24 Bins

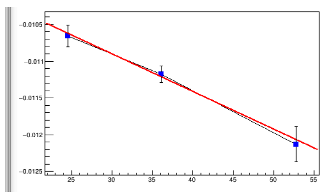


24 Bins + symmetrisation

Bin-11

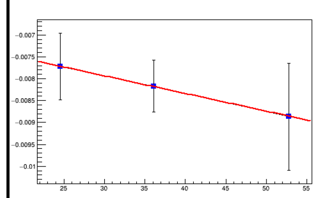


24 Bins

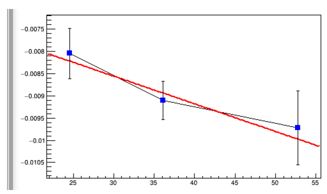


24 Bins + symmetrisation

Bin-12



24 Bins



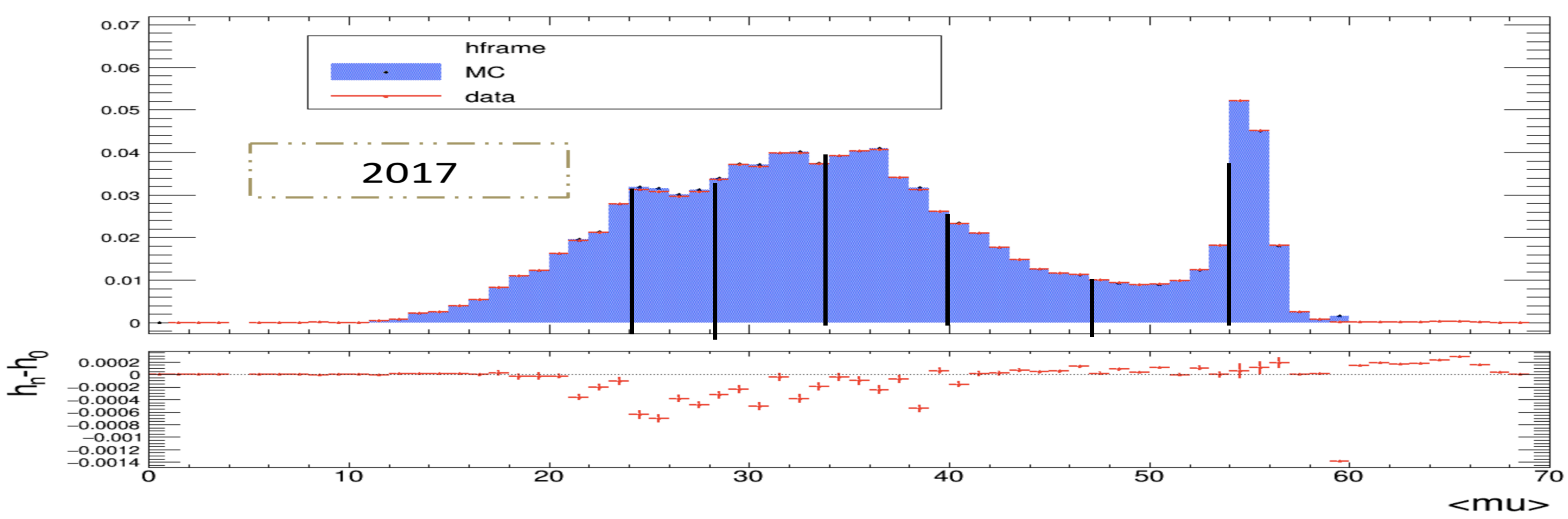
24 Bins + symmetrisation

Extrapolation from the high-mu results to low-mu :

Idea :

- Because of some problems in the correction procedure used for the low-mu dataset, related principally to the low-stat of low-mu dataset, another approche is used to calibration the low-mu dataset.
- The approche used for the low-mu dataset, is based principally on the extrapolation of high-mu results to the low-mu.

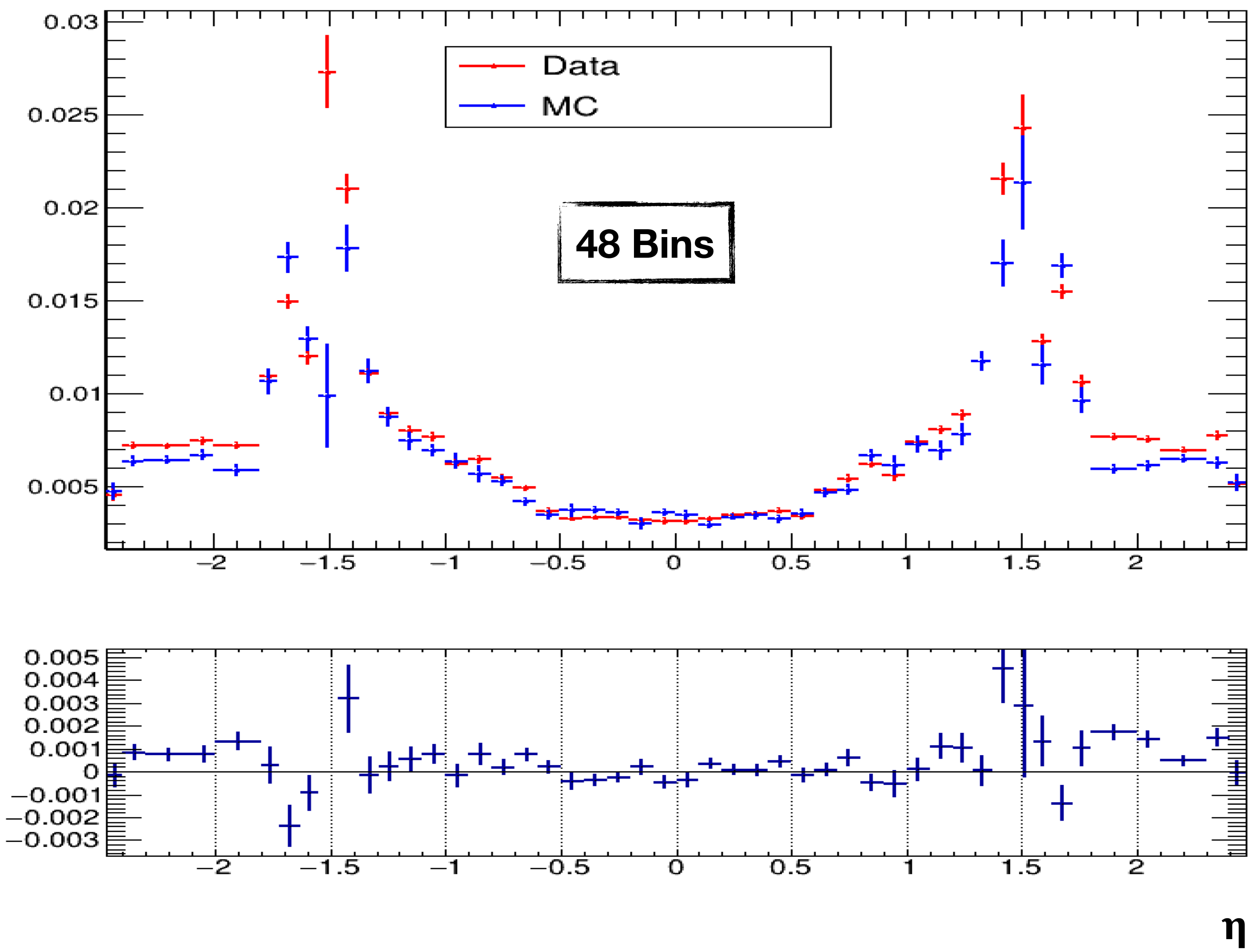
interval	<mu>	Events
[0 : 24]	20.55	2265964
[24 : 28]	26.00	2136139
[28 : 34]	31.14	4089130
[34 : 40]	36.91	4190953
[40 : 47]	42.95	2452957
[47 : 54]	50.43	1303397
[54 : ....]	56.66	2810652



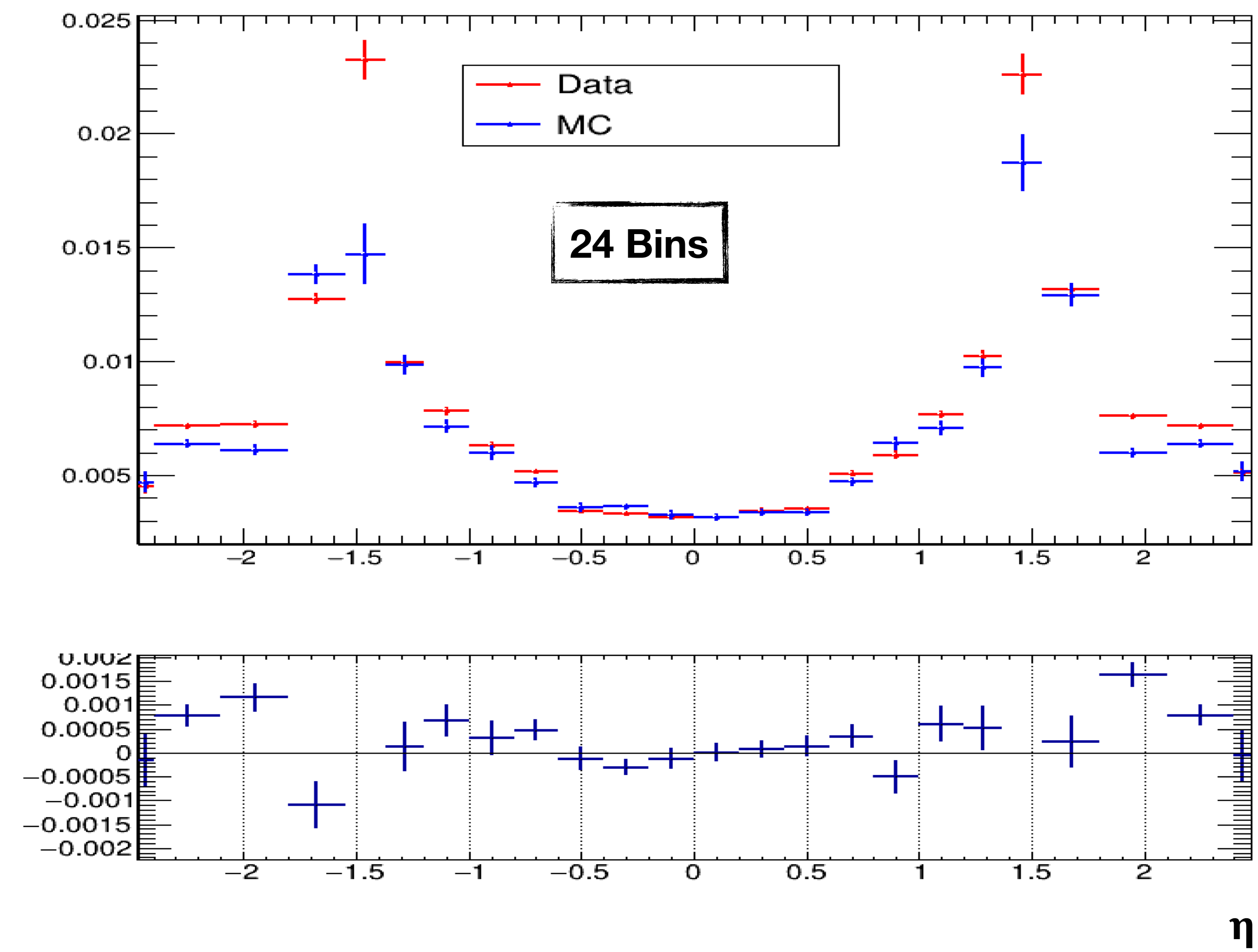
Extrapolation from the high-mu results to low-mu : Difference of Threshold

The difference between the high-noise threshold and low-noise threshold using (**Option 2**)

[E(TC~0) - E(TC~40)] / E(TC~0)

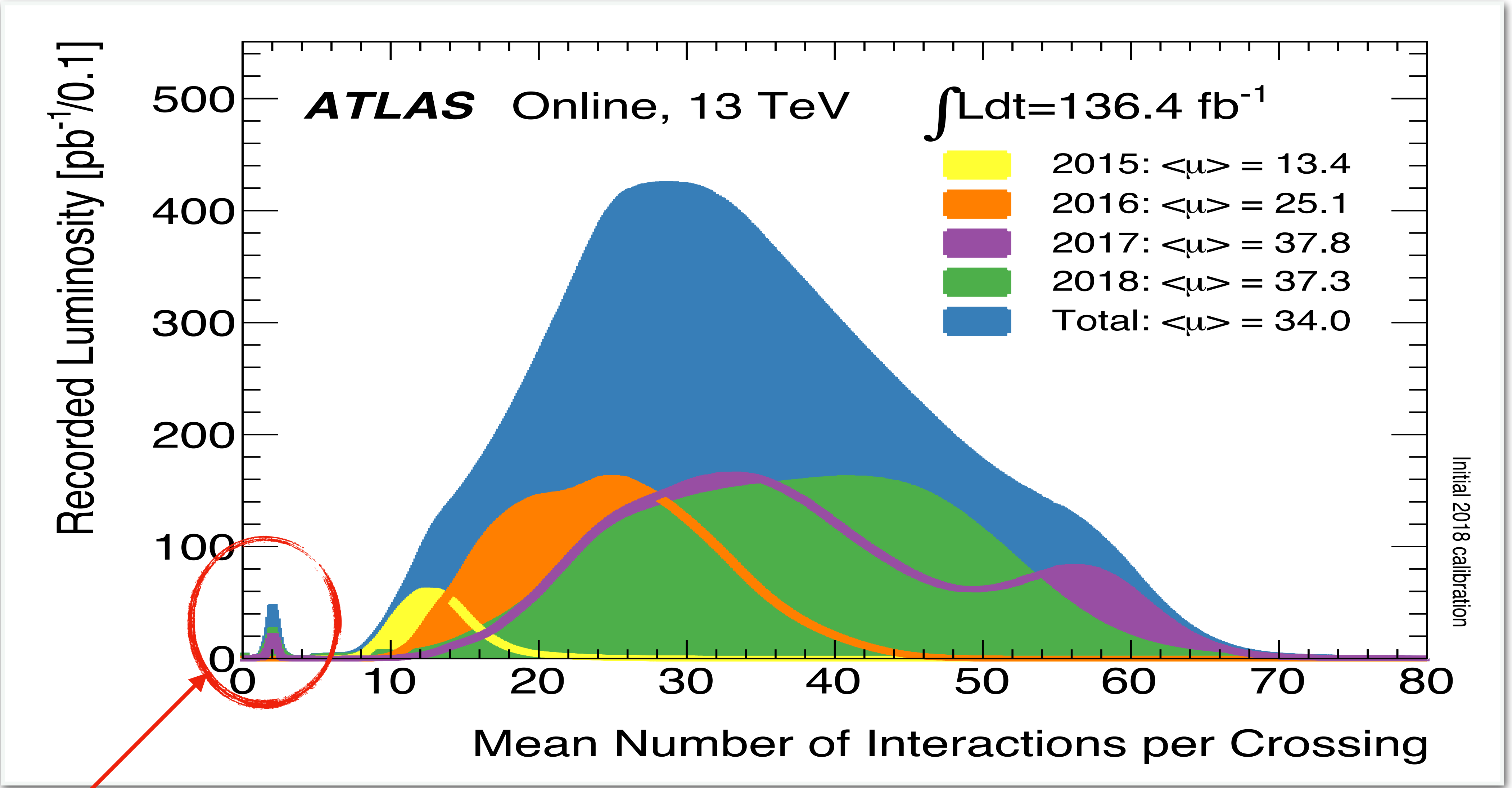


[E(TC~0) - E(TC~40)] / E(TC~0)



- **The difference plot in the bottom panel, present the Δα : difference between low and high noise threshold.**
- **The difference is of the order of 1e-3 in the end-cap, and less than 1e-3 in the barrel.**

backup : Data-set



low mu DataSet :

data 2017 (146.6 pb^{-1})	1.628 M
data 2018 (193.2 pb^{-1})	15.6 M
simulation 2017	*6.53 M*
simulation 2018	*18.5 M*

High mu DataSet :

data 2015 (3.21 fb^{-1})	1.628 M
data 2016 (32.9 fb^{-1})	15.6 M
data 2017 (43.9 fb^{-1})	19.24 M
simulation 2015 + 2016	*6.53 M*
simulation 2017	*18.5 M*

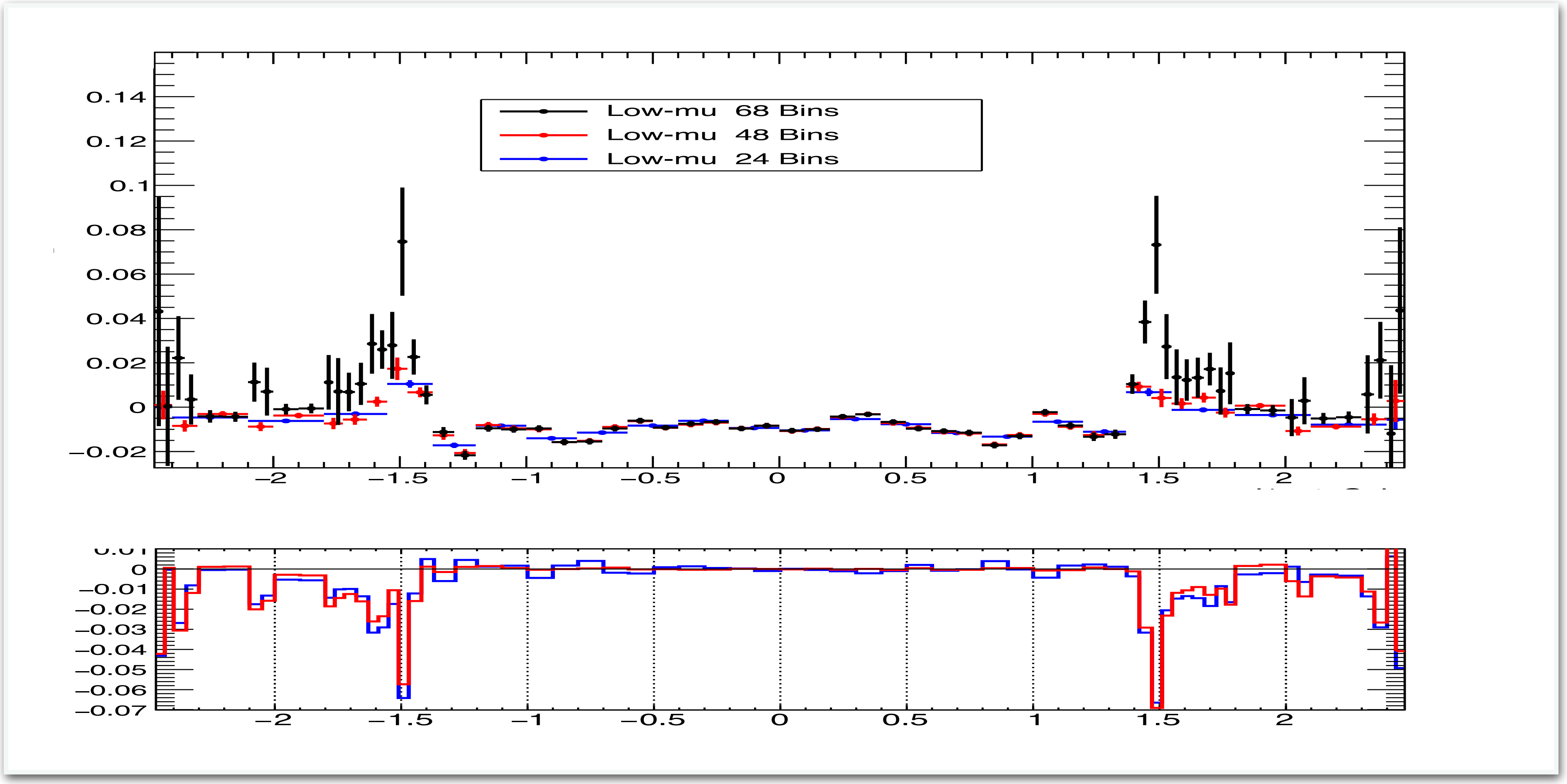
backup : bais study

- The number of bins chosen for the high-mu analysis : 68❶, and because of the low-stat of low-mu runs, we change the number of bins to 48❷ ➔ Wider bins are used in the EC.
- There is one idea to use wider bin - 24❸ bins, and the results are similar with 48bins in the barrel ➔ there seems still to be a small bais in the end-cap.

❶ 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.285 1.37 1.42 1.47 1.51 1.55 1.59 1.63 1.6775 1.725 1.7625 1.8 1.9 2 2.05 2.1 2.2 2.3 2.35 2.4 2.435 2.47

❷ 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.285 1.37 1.42 1.47 1.51 1.55 1.59 1.63 1.6775 1.725 1.7625 1.8 1.9 2 2.05 2.1 2.2 2.3 2.35 2.4 2.435 2.47

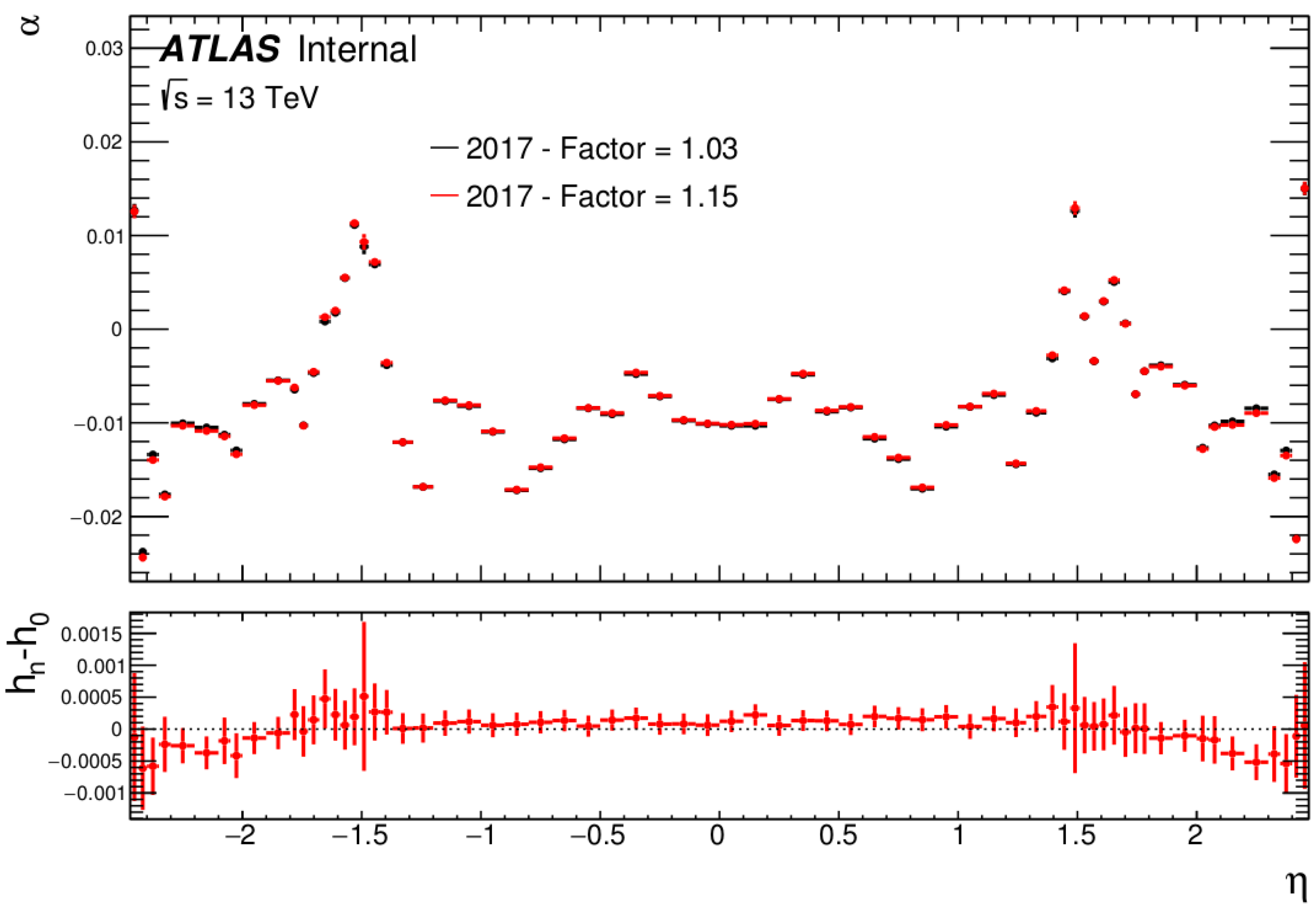
❸ 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.285 1.37 1.42 1.47 1.51 1.55 1.59 1.63 1.6775 1.725 1.7625 1.8 1.9 2 2.05 2.1 2.2 2.3 2.35 2.4 2.435 2.47

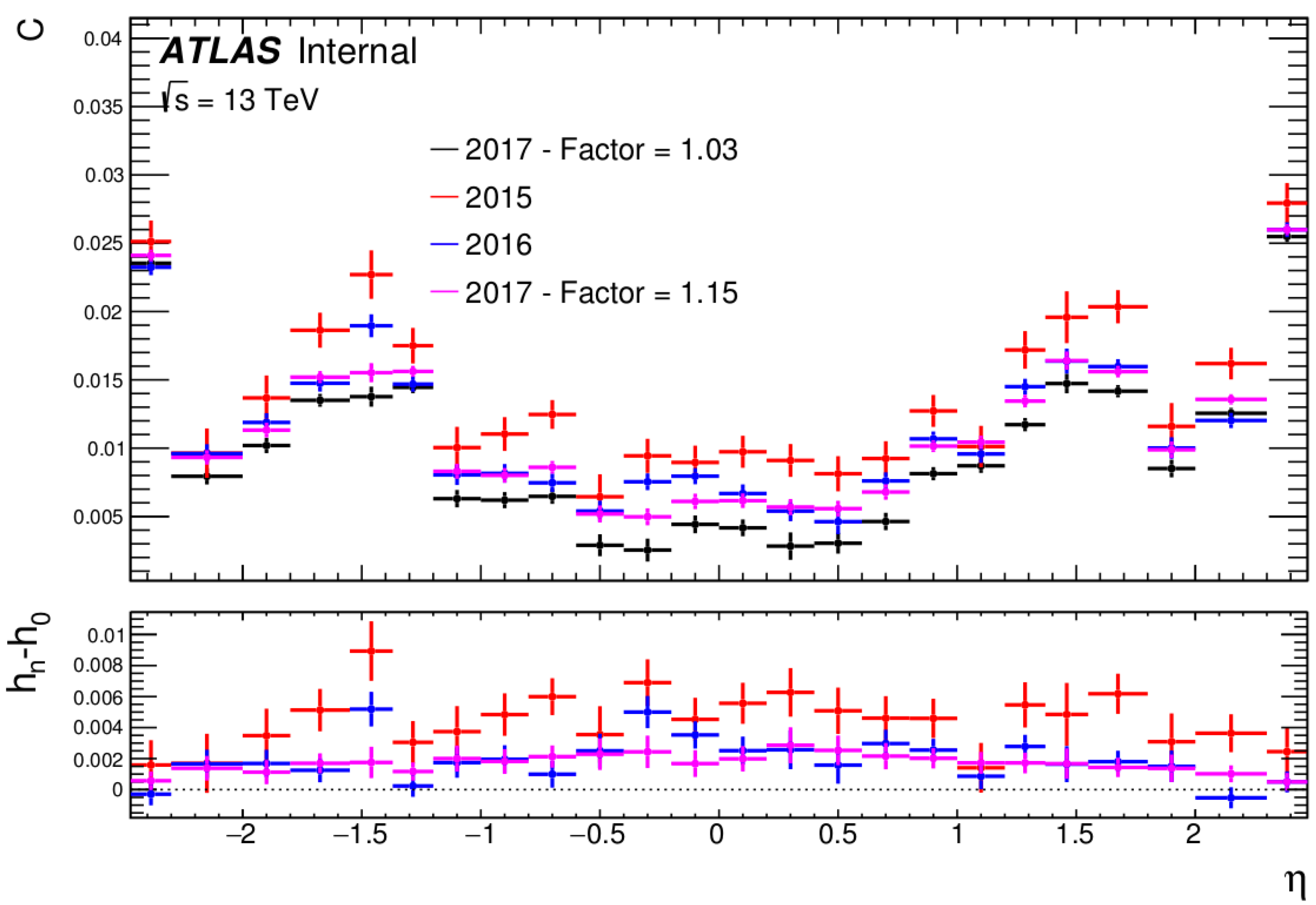


backup : bais study

Comparison of 2017 results(alpha) using correction factor of 1.03 and 1.15

Comparison of 2017 results(C) using correction factor of 1.03 & 1.15 with 2015 and 2016

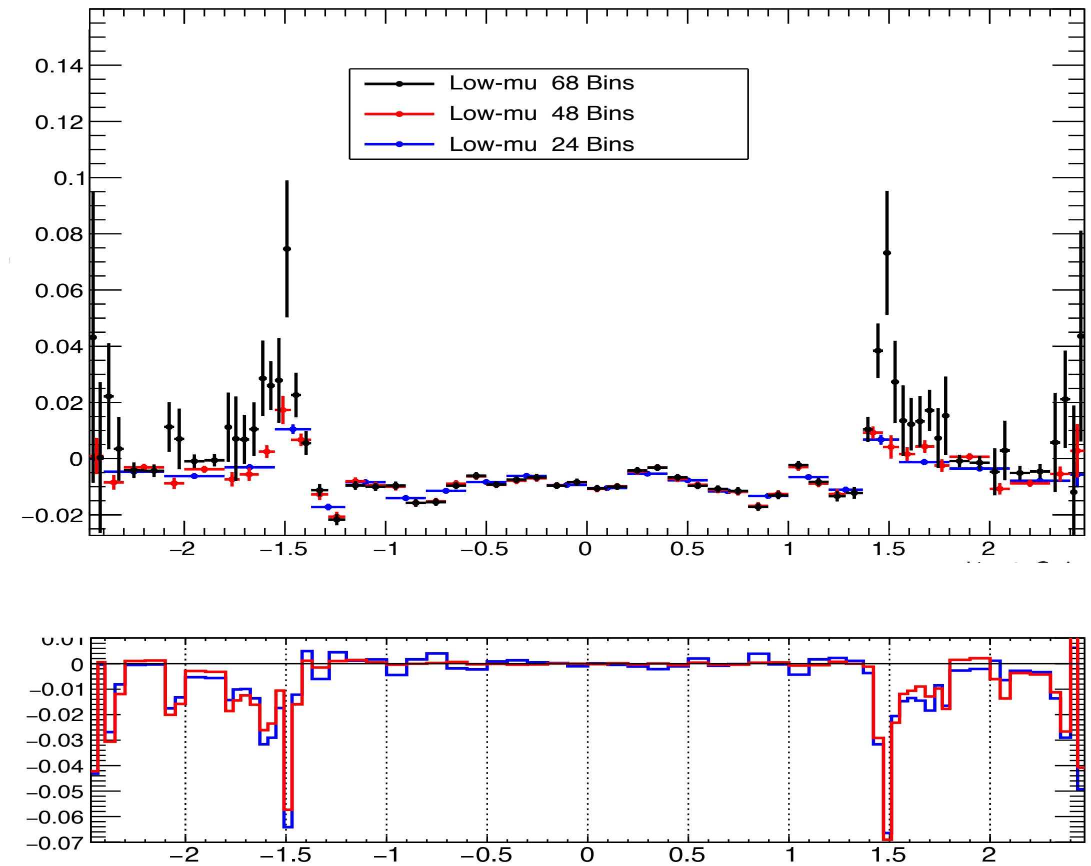


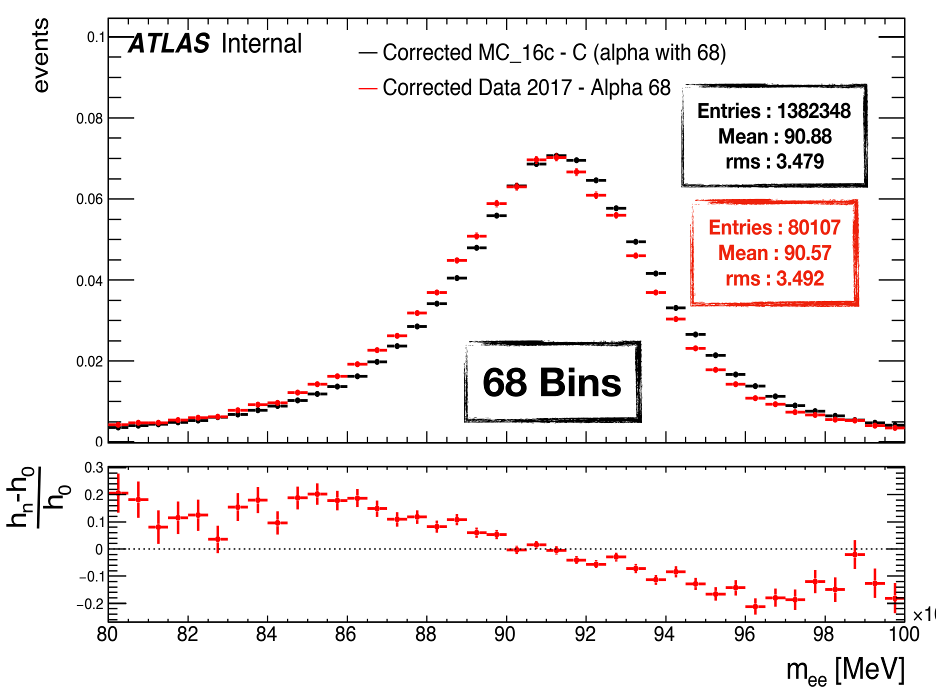


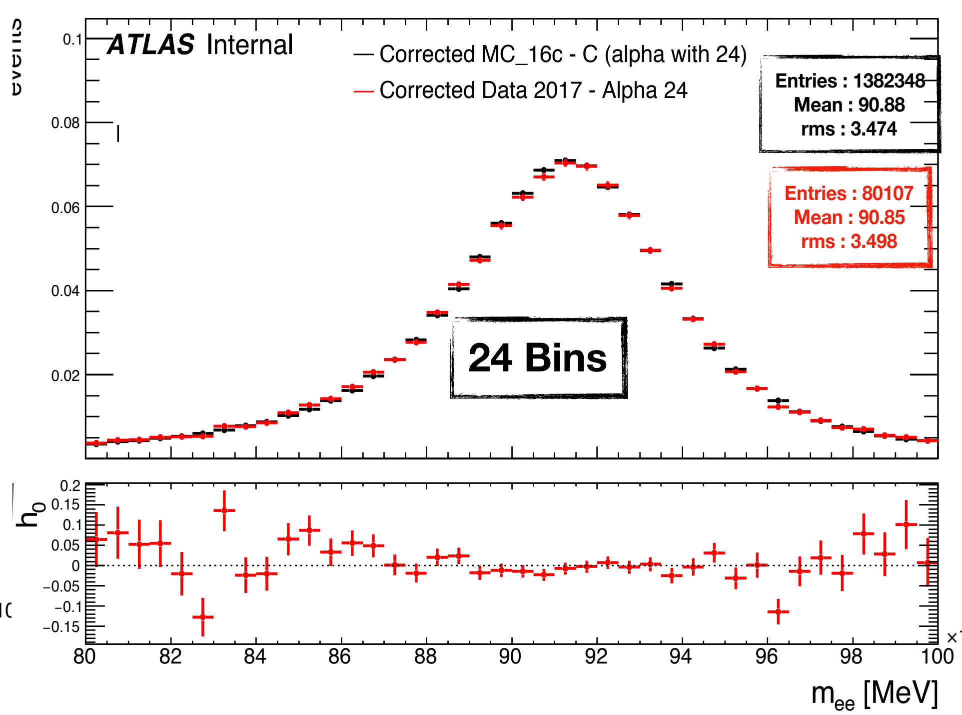
Low-mu run : bias between 24 and 48 bins.

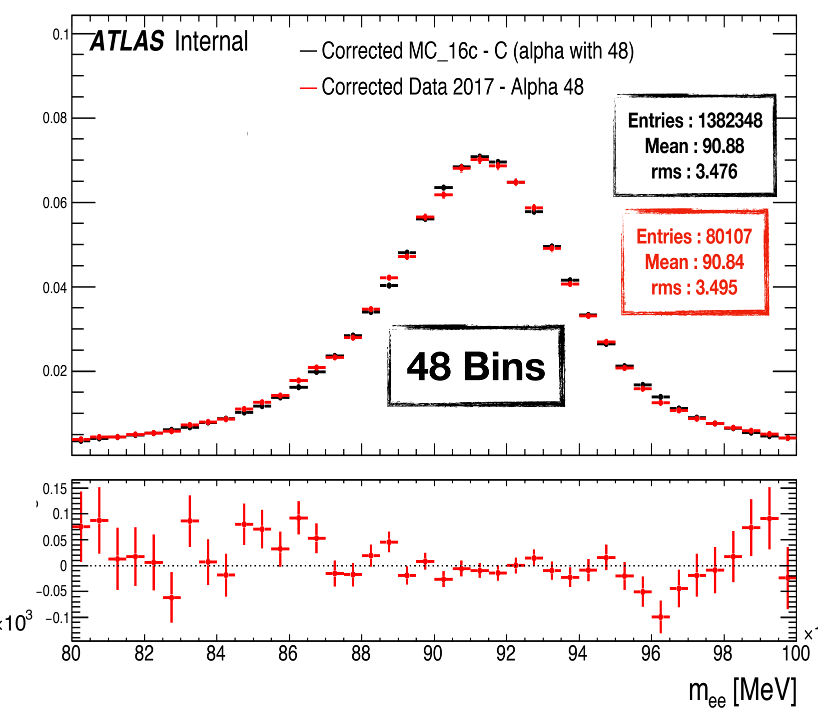
For 68 bins there is a bais

- **the number of bins chosen for the high-mu analysis : 68, and because of the stat of low-mu runs, we change the number of bins to 48 -- Wider bins are used in the EC.**
- **there is one idea to use wider bins - 24 Bins, and the results are similar with 48 Bins in the barrel. there seems still to be a small biais in the End-Cap (to be understood).**
- **Average of Data is changing with number of bins and the difference Data/mc > 3e-4**



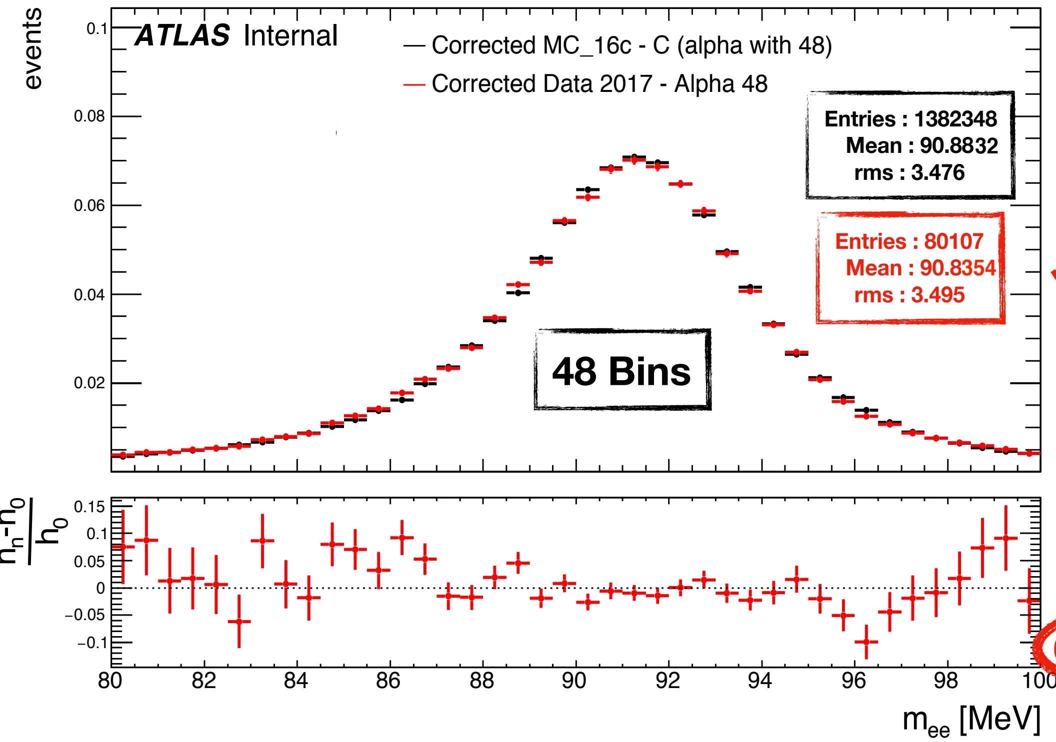




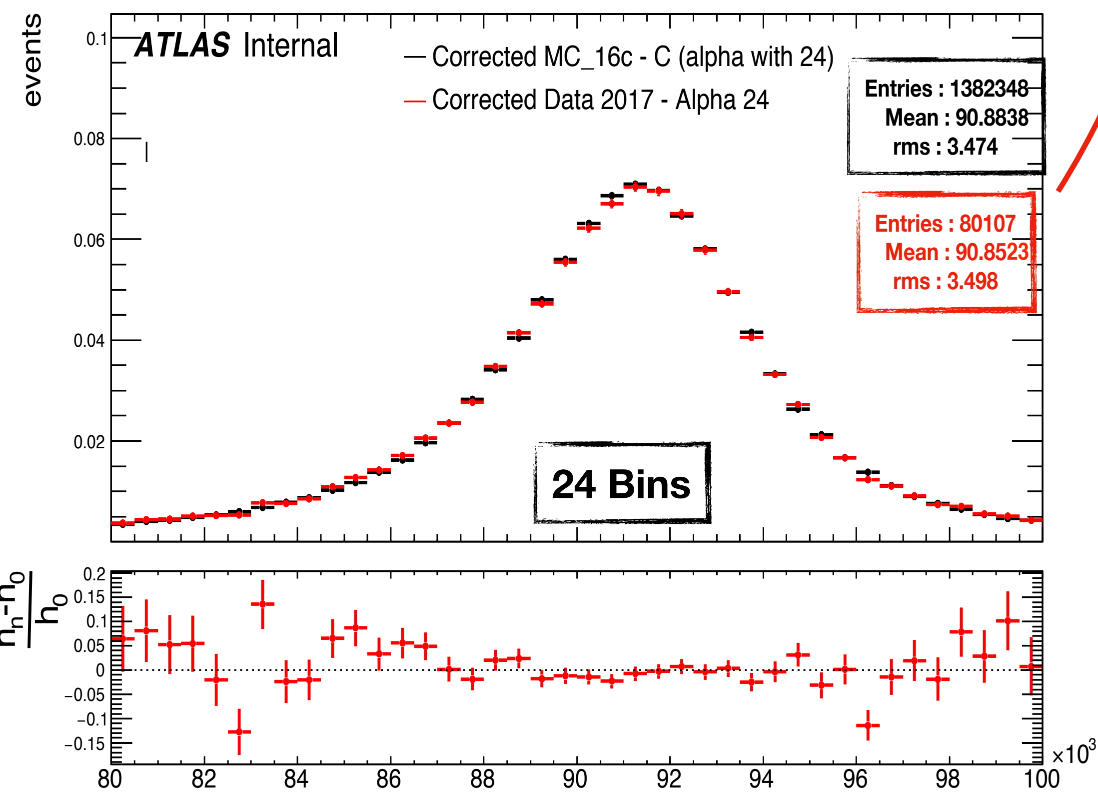


Electron & photon energy calibration for low-mu data : bais study

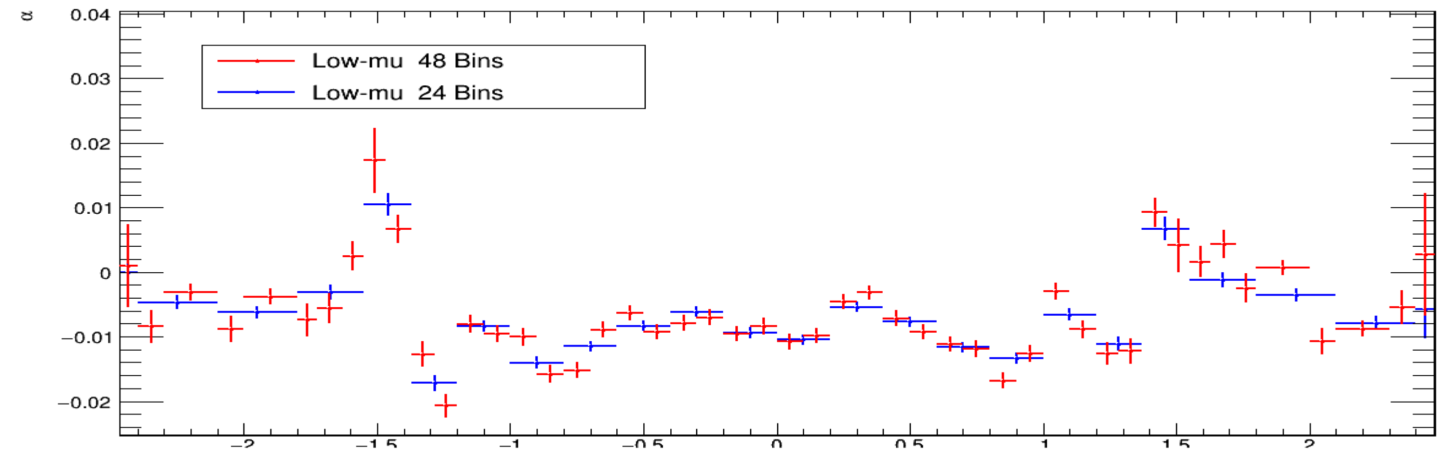
comparison : Corrected Data / Corrected MC for 48 bins and 24 bins d'alpha.

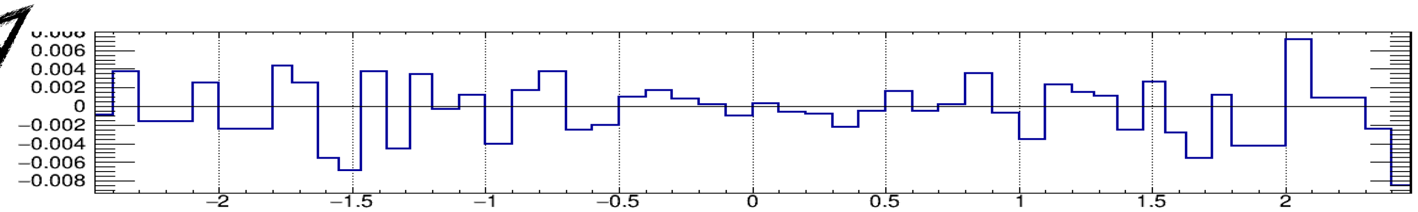


0.0169 GeV



Difference between 24 and 48 bins for low mu runs:



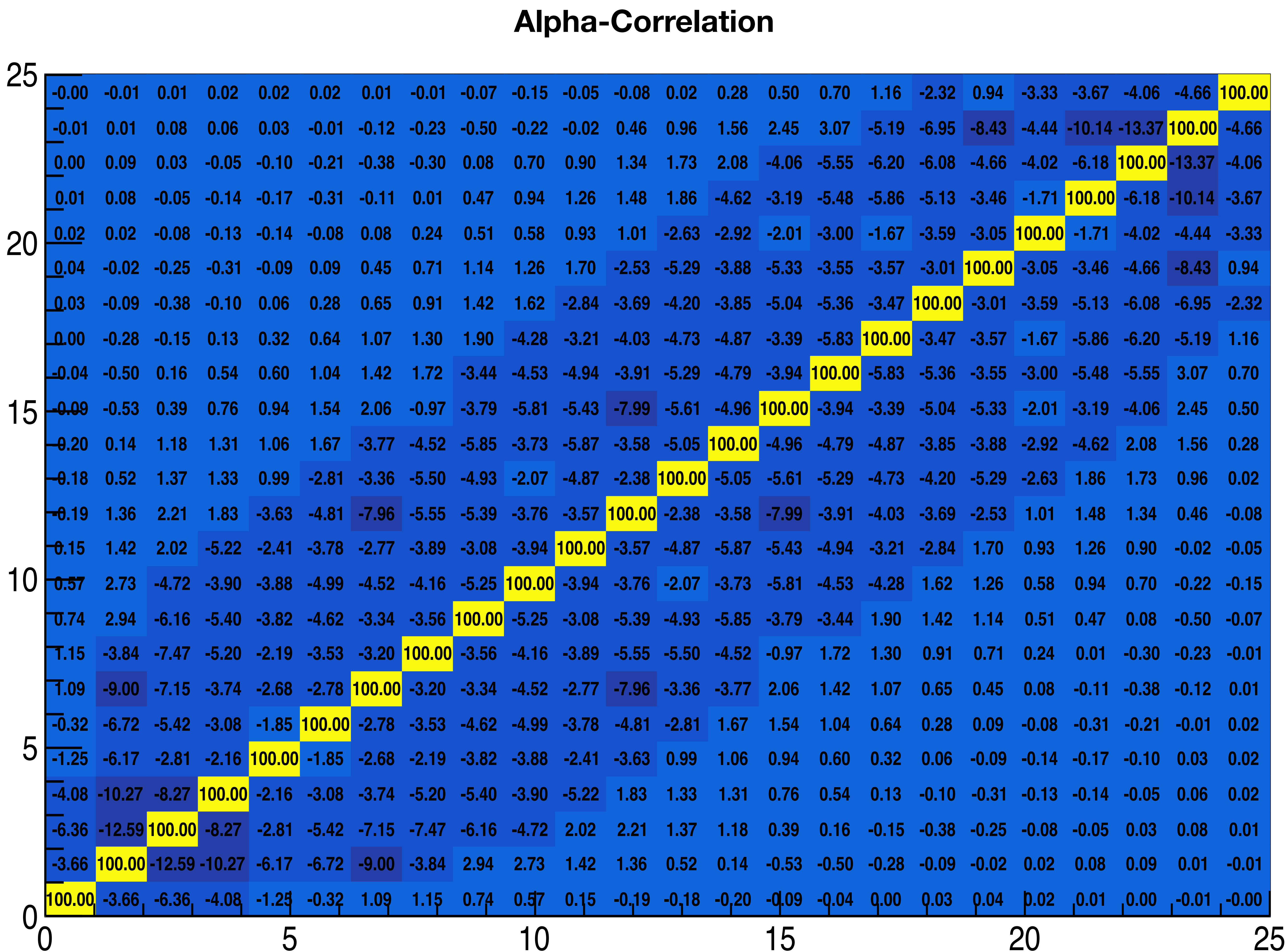


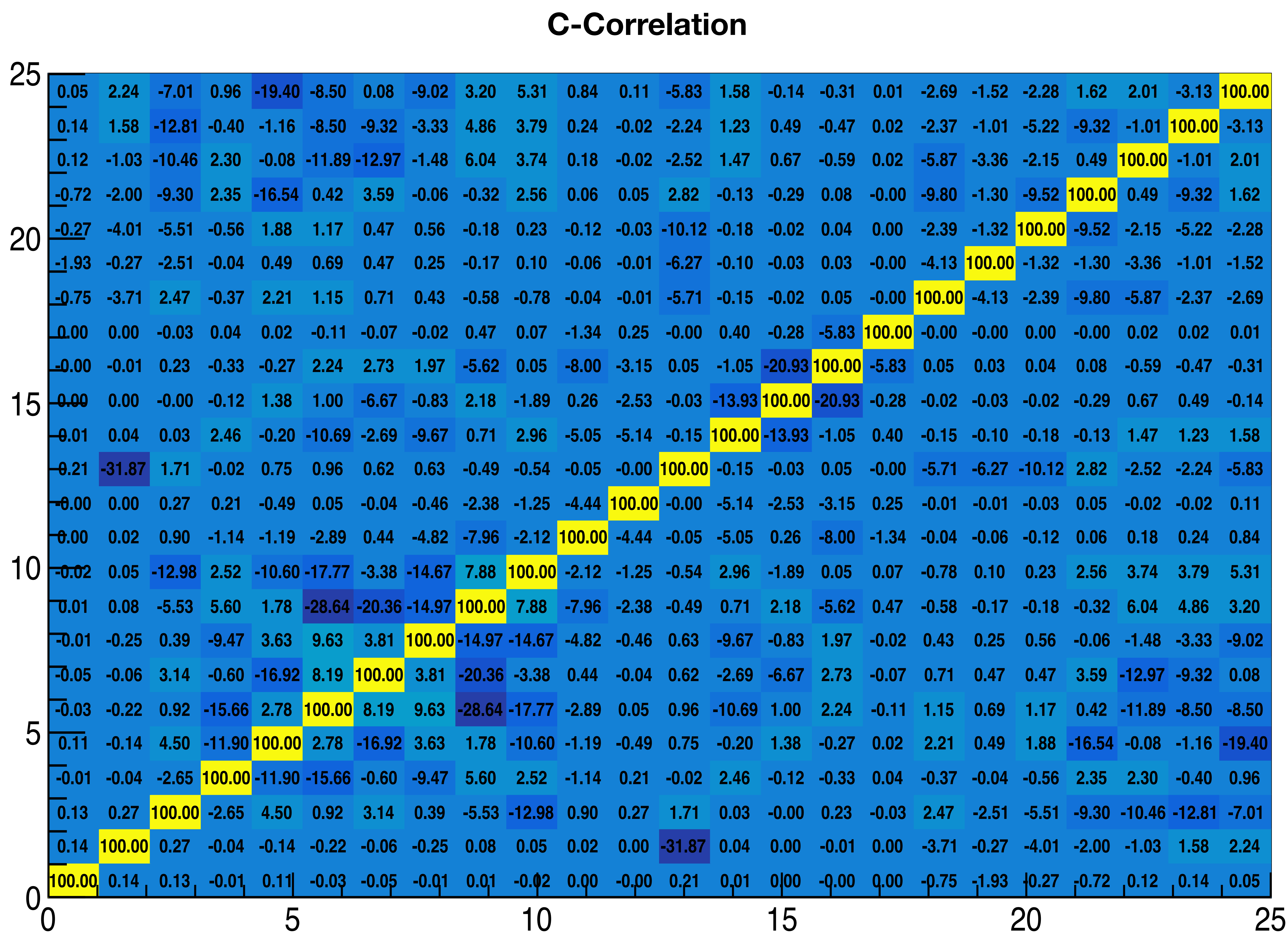
- by comparing the corrected Data of low-mu runs, where alpha is calculated with **48** ou **24 bins**, it seems that there is a **difference** of **0.0169GeV**.

[alpha(24)-alpha(48)] ~ 1.8e-4

➜ **Idea** : we can directly compare the results of alpha of 24 bins with the results of 48 weighted to 24 bins ➜ **Alpha_weighted**.

- Alpha_weighted : the results of 48 bins are weighted to 24 bins (weighted with the stat erreur).


Alpha-Correlation
-0.00 -0.01 0.01 0.02 0.02 0.02 0.01 -0.01 -0.07 -0.15 -0.05 -0.08 0.02 0.28 0.50 0.70 1.16 -2.32 0.94 -3.33 -3.67 -4.06 -4.66 100.00
-0.01 0.01 0.08 0.06 0.03 -0.01 -0.12 -0.23 -0.50 -0.22 -0.02 0.46 0.96 1.56 2.45 3.07 -5.19 -6.95 -8.43 -4.44 -10.14 -13.37 100.00 -4.66
0.00 0.09 0.03 -0.05 -0.10 -0.21 -0.38 -0.30 0.08 0.70 0.90 1.34 1.73 2.08 -4.06 -5.55 -6.20 -6.08 -4.66 -4.02 -6.18 100.00 -13.37 -4.06
0.01 0.08 -0.05 -0.14 -0.17 -0.31 -0.11 0.01 0.47 0.94 1.26 1.48 1.86 -4.62 -3.19 -5.48 -5.86 -5.13 -3.46 -1.71 100.00 -6.18 -10.14 -3.67
0.02 0.02 -0.08 -0.13 -0.14 -0.08 0.08 0.24 0.51 0.58 0.93 1.01 -2.63 -2.92 -2.01 -3.00 -1.67 -3.59 -3.05 100.00 -1.71 -4.02 -4.44 -3.33
0.04 -0.02 -0.25 -0.31 -0.09 0.09 0.45 0.71 1.14 1.26 1.70 -2.53 -5.29 -3.88 -5.33 -3.55 -3.57 -3.01 100.00 -3.05 -3.46 -4.66 -8.43 0.94
0.03 -0.09 -0.38 -0.10 0.06 0.28 0.65 0.91 1.42 1.62 -2.84 -3.69 -4.20 -3.85 -5.04 -5.36 -3.47 100.00 -3.01 -3.59 -5.13 -6.08 -6.95 -2.32
0.00 -0.28 -0.15 0.13 0.32 0.64 1.07 1.30 1.90 -4.28 -3.21 -4.03 -4.73 -4.87 -3.39 -5.83 100.00 -3.47 -3.57 -1.67 -5.86 -6.20 -5.19 1.16
-0.04 -0.50 0.16 0.54 0.60 1.04 1.42 1.72 -3.44 -4.53 -4.94 -3.91 -5.29 -4.79 -3.94 100.00 -5.83 -5.36 -3.55 -3.00 -5.48 -5.55 3.07 0.70
-0.09 -0.53 0.39 0.76 0.94 1.54 2.06 -0.97 -3.79 -5.81 -5.43 -7.99 -5.61 -4.96 100.00 -3.94 -3.39 -5.04 -5.33 -2.01 -3.19 -4.06 2.45 0.50
-0.20 0.14 1.18 1.31 1.06 1.67 -3.77 -4.52 -5.85 -3.73 -5.87 -3.58 -5.05 100.00 -4.96 -4.79 -4.87 -3.85 -3.88 -2.92 -4.62 2.08 1.56 0.28
-0.18 0.52 1.37 1.33 0.99 -2.81 -3.36 -5.50 -4.93 -2.07 -4.87 -2.38 100.00 -5.05 -5.61 -5.29 -4.73 -4.20 -5.29 -2.63 1.86 1.73 0.96 0.02
-0.19 1.36 2.21 1.83 -3.63 -4.81 -7.96 -5.55 -5.39 -3.76 -3.57 100.00 -2.38 -3.58 -7.99 -3.91 -4.03 -3.69 -2.53 1.01 1.48 1.34 0.46 -0.08
0.15 1.42 2.02 -5.22 -2.41 -3.78 -2.77 -3.89 -3.08 -3.94 100.00 -3.57 -4.87 -5.87 -5.43 -4.94 -3.21 -2.84 1.70 0.93 1.26 0.90 -0.02 -0.05
0.57 2.73 -4.72 -3.90 -3.88 -4.99 -4.52 -4.16 -5.25 100.00 -3.94 -3.76 -2.07 -3.73 -5.81 -4.53 -4.28 1.62 1.26 0.58 0.94 0.70 -0.22 -0.15
0.74 2.94 -6.16 -5.40 -3.82 -4.62 -3.34 -3.56 100.00 -5.25 -3.08 -5.39 -4.93 -5.85 -3.79 -3.44 1.90 1.42 1.14 0.51 0.47 0.08 -0.50 -0.07
1.15 -3.84 -7.47 -5.20 -2.19 -3.53 -3.20 100.00 -3.56 -4.16 -3.89 -5.55 -5.50 -4.52 -0.97 1.72 1.30 0.91 0.71 0.24 0.01 -0.30 -0.23 -0.01
1.09 -9.00 -7.15 -3.74 -2.68 -2.78 100.00 -3.20 -3.34 -4.52 -2.77 -7.96 -3.36 -3.77 2.06 1.42 1.07 0.65 0.45 0.08 -0.11 -0.38 -0.12 0.01
-0.32 -6.72 -5.42 -3.08 -1.85 100.00 -2.78 -3.53 -4.62 -4.99 -3.78 -4.81 -2.81 1.67 1.54 1.04 0.64 0.28 0.09 -0.08 -0.31 -0.21 -0.01 0.02
-1.25 -6.17 -2.81 -2.16 100.00 -1.85 -2.68 -2.19 -3.82 -3.88 -2.41 -3.63 0.99 1.06 0.94 0.60 0.32 0.06 -0.09 -0.14 -0.17 -0.10 0.03 0.02
-4.08 -10.27 -8.27 100.00 -2.16 -3.08 -3.74 -5.20 -5.40 -3.90 -5.22 1.83 1.33 1.31 0.76 0.54 0.13 -0.10 -0.31 -0.13 -0.14 -0.05 0.06 0.02
-6.36 -12.59 100.00 -8.27 -2.81 -5.42 -7.15 -7.47 -6.16 -4.72 2.02 2.21 1.37 1.18 0.39 0.16 -0.15 -0.38 -0.25 -0.08 -0.05 0.03 0.08 0.01
-3.66 100.00 -12.59 -10.27 -6.17 -6.72 -9.00 -3.84 2.94 2.73 1.42 1.36 0.52 0.14 -0.53 -0.50 -0.28 -0.09 -0.02 0.02 0.08 0.09 0.01 -0.01
100.00 -3.66 -6.36 -4.08 -1.25 -0.32 1.09 1.15 0.74 0.57 0.15 -0.19 -0.18 -0.20 -0.09 -0.04 0.00 0.03 0.04 0.02 0.01 0.00 -0.01 -0.00
25 20 15 10 5 0
0 5 10 15 20 25


C-Correlation
0.05 2.24 -7.01 0.96 -19.40 -8.50 0.08 -9.02 3.20 5.31 0.84 0.11 -5.83 1.58 -0.14 -0.31 0.01 -2.69 -1.52 -2.28 1.62 2.01 -3.13 100.00
0.14 1.58 -12.81 -0.40 -1.16 -8.50 -9.32 -3.33 4.86 3.79 0.24 -0.02 -2.24 1.23 0.49 -0.47 0.02 -2.37 -1.01 -5.22 -9.32 -1.01 100.00 -3.13
0.12 -1.03 -10.46 2.30 -0.08 -11.89 -12.97 -1.48 6.04 3.74 0.18 -0.02 -2.52 1.47 0.67 -0.59 0.02 -5.87 -3.36 -2.15 0.49 100.00 -1.01 2.01
-0.72 -2.00 -9.30 2.35 -16.54 0.42 3.59 -0.06 -0.32 2.56 0.06 0.05 2.82 -0.13 -0.29 0.08 -0.00 -9.80 -1.30 -9.52 100.00 0.49 -9.32 1.62
-0.27 -4.01 -5.51 -0.56 1.88 1.17 0.47 0.56 -0.18 0.23 -0.12 -0.03 -10.12 -0.18 -0.02 0.04 0.00 -2.39 -1.32 100.00 -9.52 -2.15 -5.22 -2.28
-1.93 -0.27 -2.51 -0.04 0.49 0.69 0.47 0.25 -0.17 0.10 -0.06 -0.01 -6.27 -0.10 -0.03 0.03 -0.00 -4.13 100.00 -1.32 -1.30 -3.36 -1.01 -1.52
-0.75 -3.71 2.47 -0.37 2.21 1.15 0.71 0.43 -0.58 -0.78 -0.04 -0.01 -5.71 -0.15 -0.02 0.05 -0.00 100.00 -4.13 -2.39 -9.80 -5.87 -2.37 -2.69
0.00 0.00 -0.03 0.04 0.02 -0.11 -0.07 -0.02 0.47 0.07 -1.34 0.25 -0.00 0.40 -0.28 -5.83 100.00 -0.00 -0.00 0.00 -0.00 0.02 0.02 0.01
-0.00 -0.01 0.23 -0.33 -0.27 2.24 2.73 1.97 -5.62 0.05 -8.00 -3.15 0.05 -1.05 -20.93 100.00 -5.83 0.05 0.03 0.04 0.08 -0.59 -0.47 -0.31
0.00 0.00 -0.00 -0.12 1.38 1.00 -6.67 -0.83 2.18 -1.89 0.26 -2.53 -0.03 -13.93 100.00 -20.93 -0.28 -0.02 -0.03 -0.02 -0.29 0.67 0.49 -0.14
0.01 0.04 0.03 2.46 -0.20 -10.69 -2.69 -9.67 0.71 2.96 -5.05 -5.14 -0.15 100.00 -13.93 -1.05 0.40 -0.15 -0.10 -0.18 -0.13 1.47 1.23 1.58
0.21 -31.87 1.71 -0.02 0.75 0.96 0.62 0.63 -0.49 -0.54 -0.05 -0.00 100.00 -0.15 -0.03 0.05 -0.00 -5.71 -6.27 -10.12 2.82 -2.52 -2.24 -5.83
-0.00 0.00 0.27 0.21 -0.49 0.05 -0.04 -0.46 -2.38 -1.25 -4.44 100.00 -0.00 -5.14 -2.53 -3.15 0.25 -0.01 -0.01 -0.03 0.05 -0.02 -0.02 0.11
0.00 0.02 0.90 -1.14 -1.19 -2.89 0.44 -4.82 -7.96 -2.12 100.00 -4.44 -0.05 -5.05 0.26 -8.00 -1.34 -0.04 -0.06 -0.12 0.06 0.18 0.24 0.84
-0.02 0.05 -12.98 2.52 -10.60 -17.77 -3.38 -14.67 7.88 100.00 -2.12 -1.25 -0.54 2.96 -1.89 0.05 0.07 -0.78 0.10 0.23 2.56 3.74 3.79 5.31
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