RESULTS FOR CEMC + HCALOUT
&
LOOKING FOR THE ROOT OF PROBLEM IN BARREL CALIBRATION

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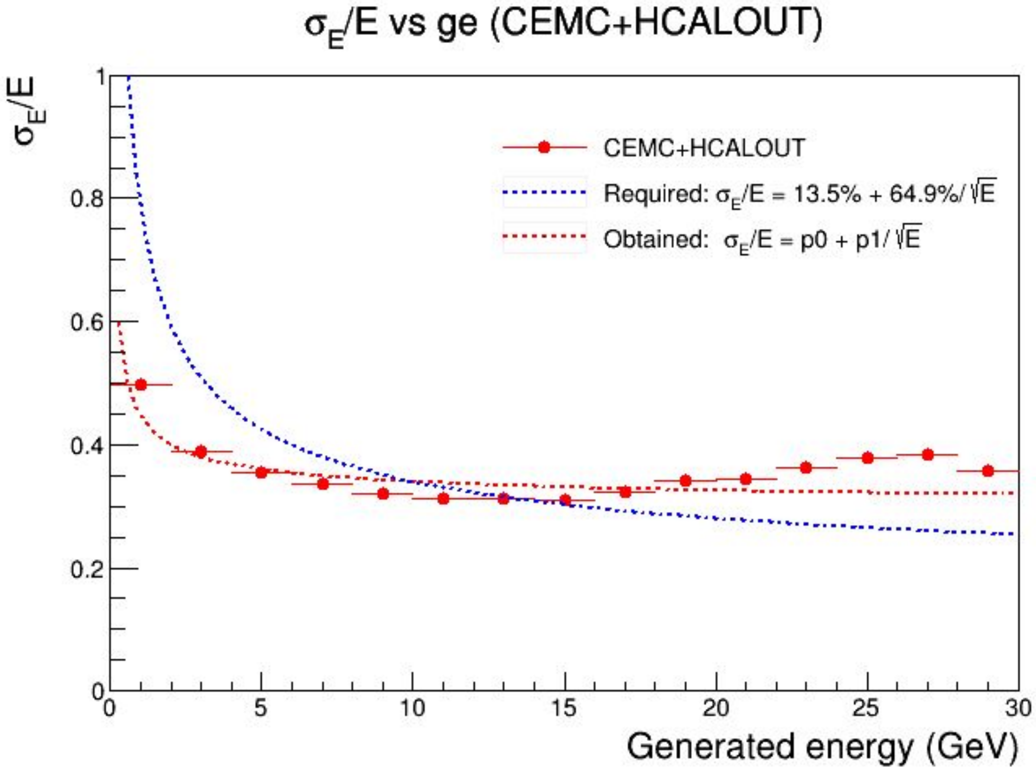
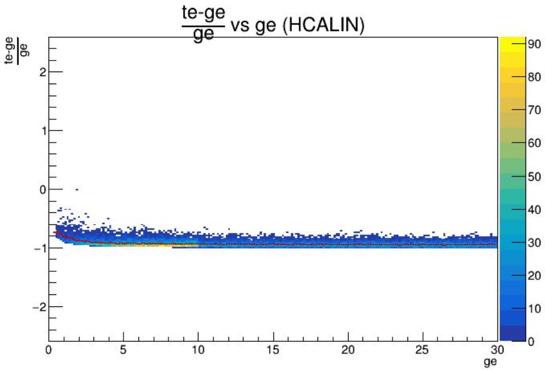
Results for CEMC+ HCALOUT (Pion)
(HCALIN excluded)

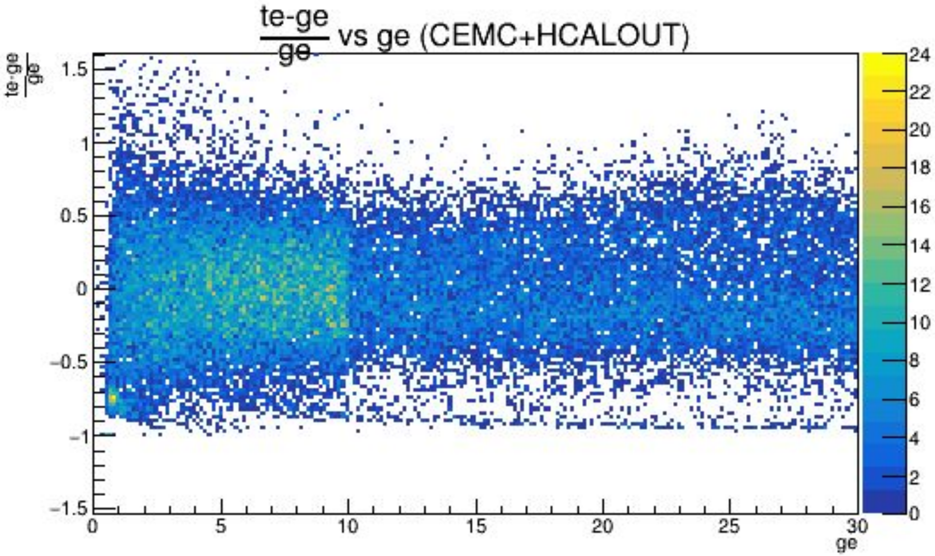


- Not much change in the resolution behaviour
- HCALIN not responsible for problem in sigma at high energies
- Also, contribution of HCALIN to the total energy is also very small

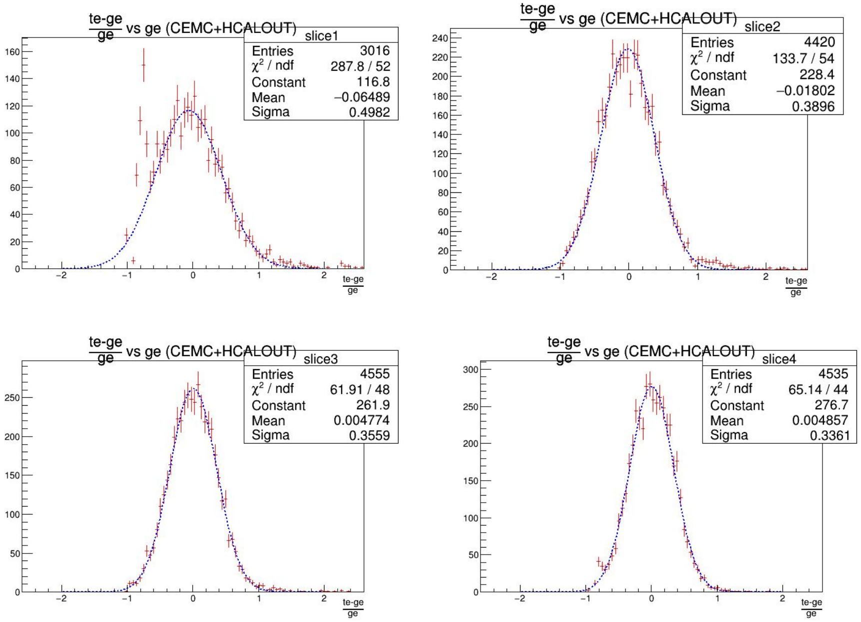


Results for CEMC+ HCALIN (Pion)
(HCALIN excluded)

Further details



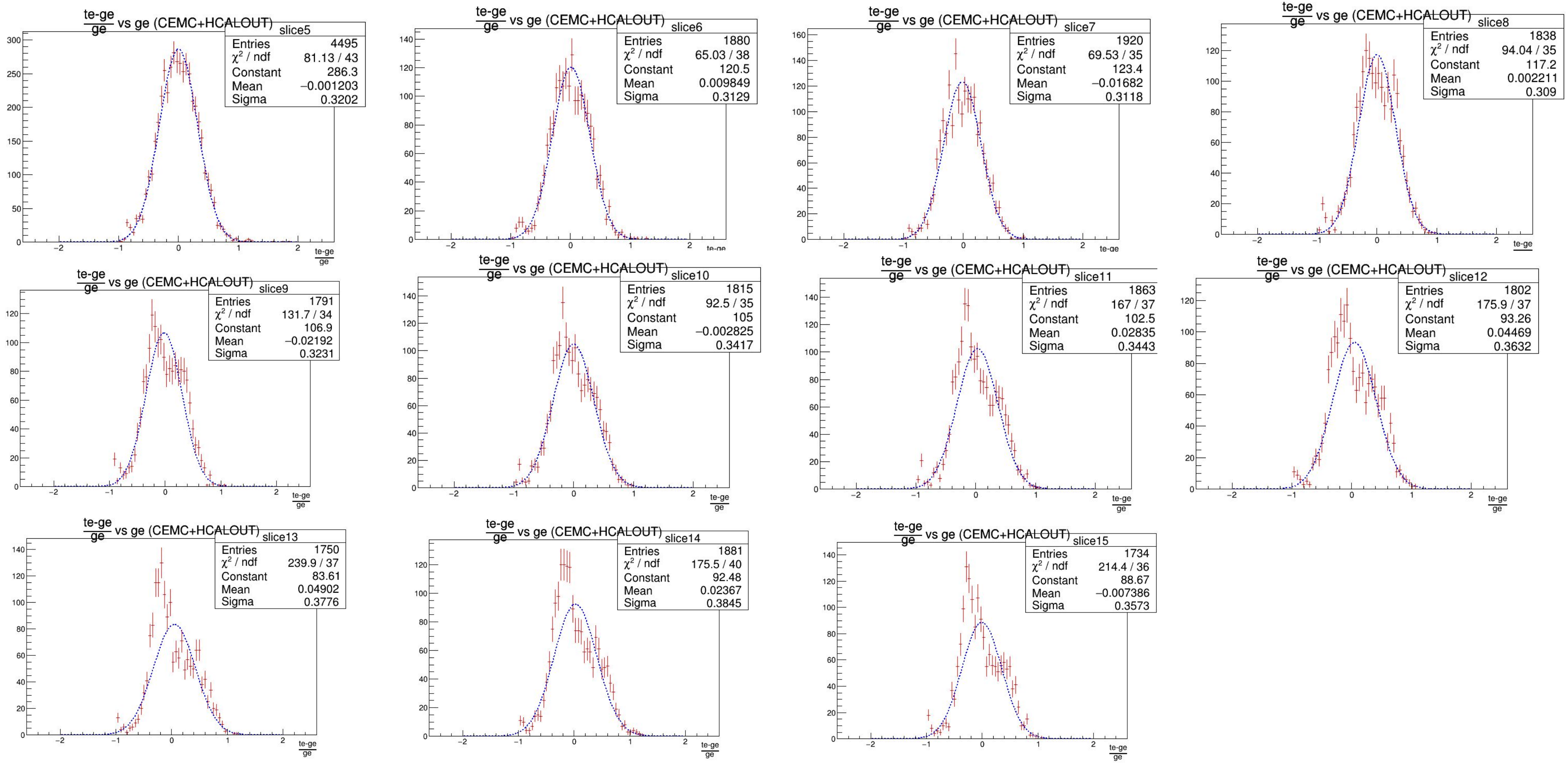
Slices



Results for CEMC+ HCALIN (Pion)(HCALIN excluded)

Further details

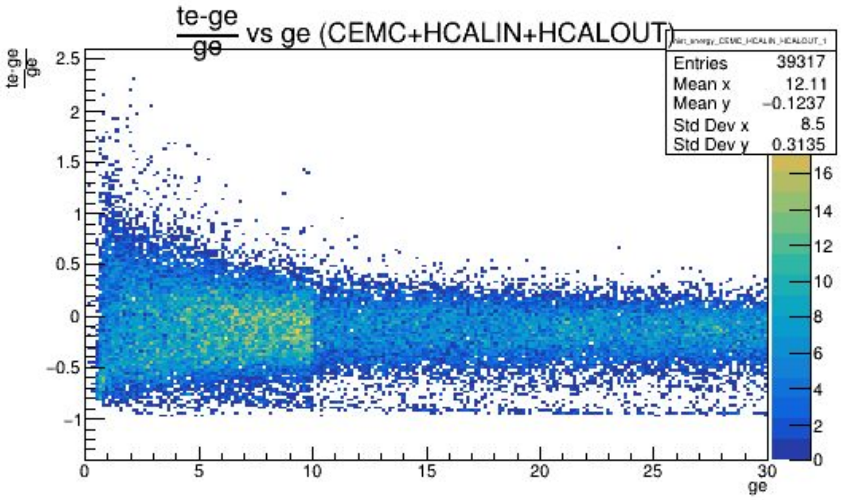
Slices



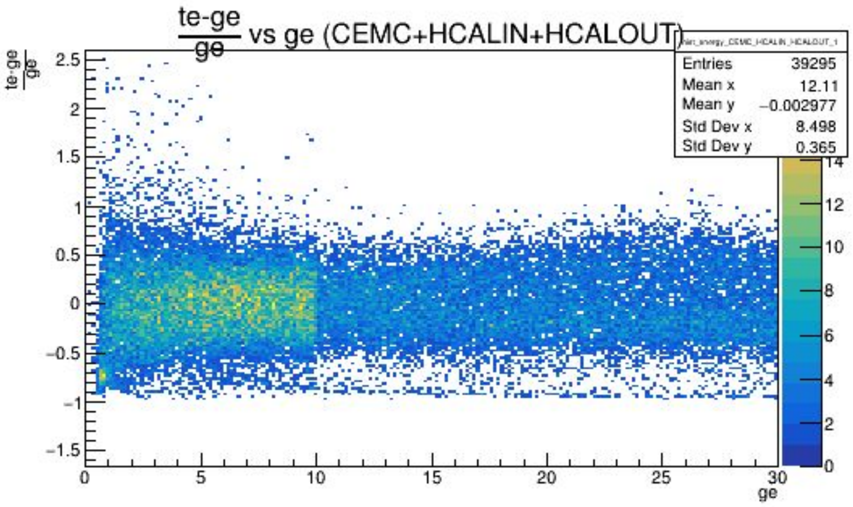
TRYING TO FIND THE ROOT OF THE PROBLEM...

- Either CEMC or HCALOUT responsible for our problem

Before Calibration



After Calibration



- the energies recorded beyond ~15 GeV are greater than what they used to be,
- they may be getting **multiplied** by a number which is causing second peaks.

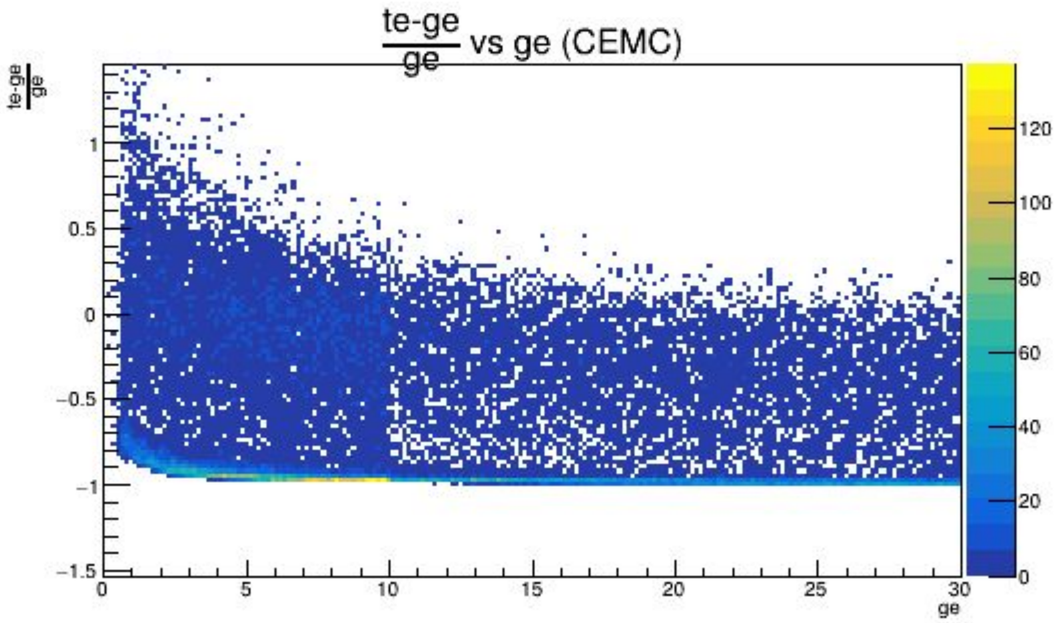
- Formula used for calibration:

te(calibrated) = te(original) * **(Overall Mean or weight / fit function)**
(for te/ge plots)

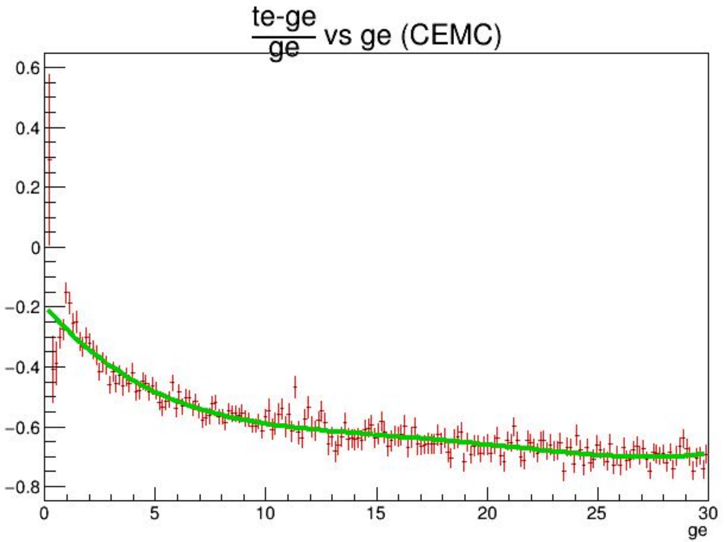
- the bold term is what is getting multiplied and must be increasing the final energy leading to the second peak.

Lets see how the above term is affecting the original tower energy for CEMC and HCALOUT ->

1. CEMC
   Original plot:



Fit Function for the tprofile of the left plot is as follows:



Overall mean ~ -0.6 for (te-ge)/ge plot   (= 0.4 for te/ge plot)

Let us take one of the te values from the original plot:

Te/ge = 1

For low energies (<15GeV): (I will use rough estimate of the fit function at low energy)
te/ge (calibrated) = 1*(0.4 / 0.7) ~ 0.57 **(energy gets scaled down)**

For high energies (>15GeV): (I will use rough estimate of fit function at high energy)
te/ge (calibrated) = 1*(0.4 / 0.3) ~ 1.33 **(energy gets scaled up)**

Let's try another point:

Te/ge = 0.5

For low energies (<15GeV): (I will use rough estimate of the fit function at low energy)
te/ge (calibrated) = 0.5*(0.4 / 0.7) ~ 0.28 **(energy got scaled down)**

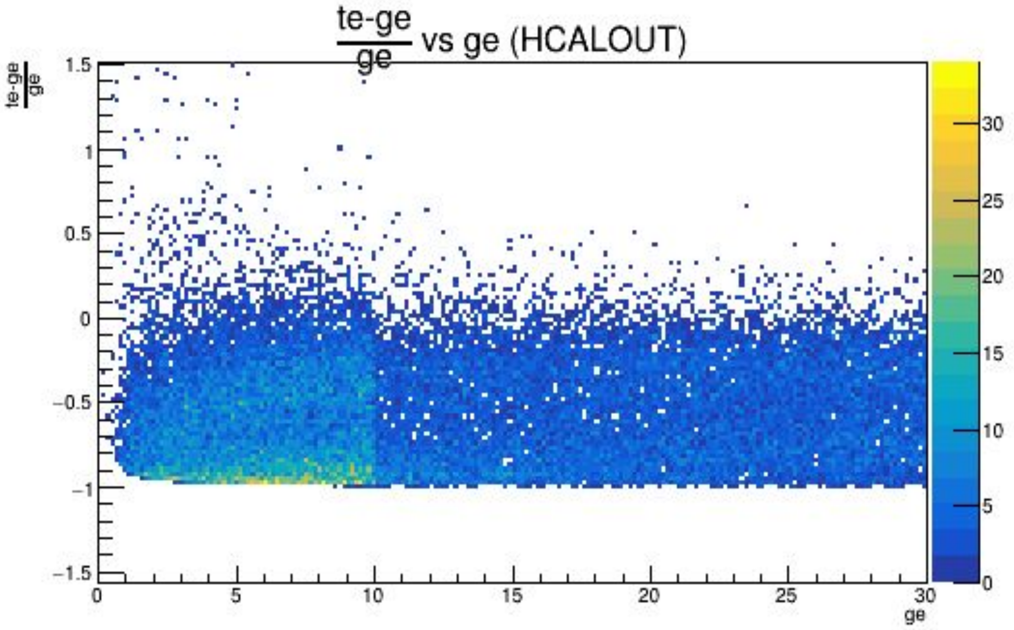
For high energies (>15GeV): (I will use rough estimate of fit function at high energy)
te/ge (calibrated) = 0.5*(0.4 / 0.3) ~ 0.7 **(energy got scaled up)**

Basically, the energies that are below ~15 GeV get scaled down after calibration while energies beyond ~15GeV get scaled up after calibration.

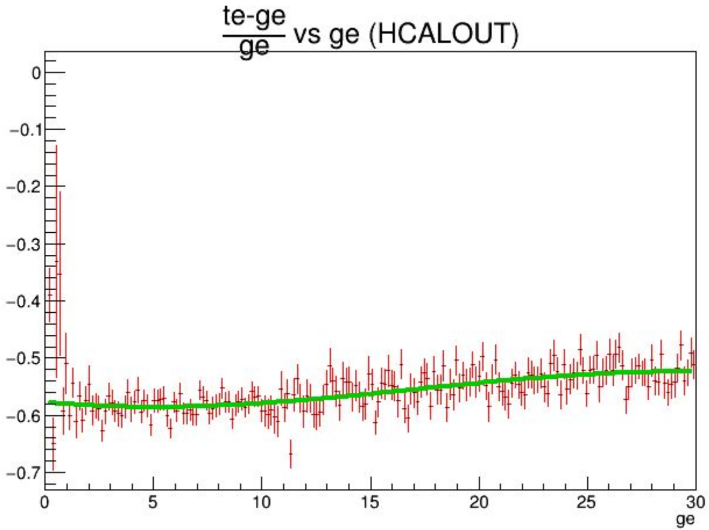
- **THIS IS WHAT MIGHT BE CAUSING SECOND PEAKS IN OUR FINAL DISTRIBUTION AFTER CALIBRATION**

2. HCALOUT

Original plot:



Fit Function for the tprofile of the above plot is as follows:



Overall mean ~ -0.6 for (te-ge)/ge plot (= 0.4 (for te/ge))

If I repeat the same procedure for HCALOUT, I get following:

Te/ge = 1

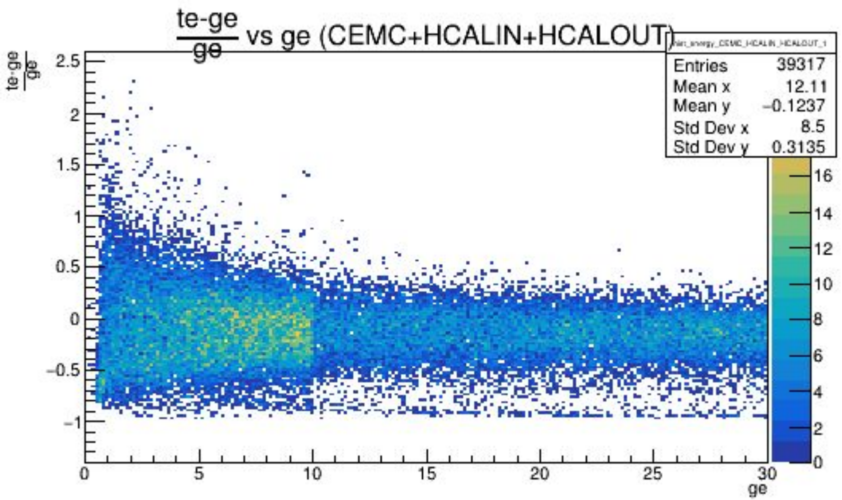
For low energies (<15GeV): (I will use rough estimate of the fit function at low energy)
te/ge (calibrated) = 1*(0.4 / 0.42) ~ 1 **(not much change in energy after calibration)**

For high energies (>15GeV): (I will use rough estimate of fit function at high energy)
te/ge (calibrated) = 1*(0.4 / 0.47) ~ 1 **(not much change in energy after calibration)**

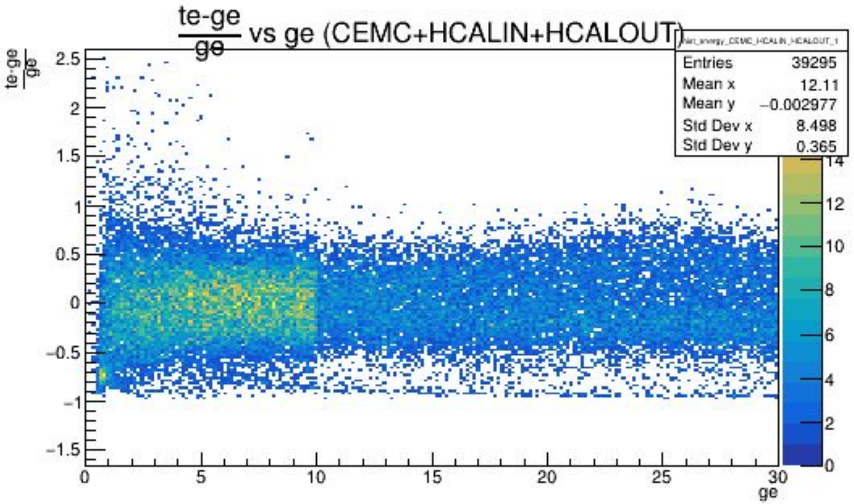
Because overall mean and mean from fit function have comparable values there isn't much change in energy after calibration

- In case of **CEMC**, not only energies are increasing at high energy after calibration, they are also reducing at low energies.
- Looking at the following plots again, it becomes visible that earlier < 15 GeV the distribution was wider but it shrank a little after calibration while the opposite is true for energies > 15 GeV

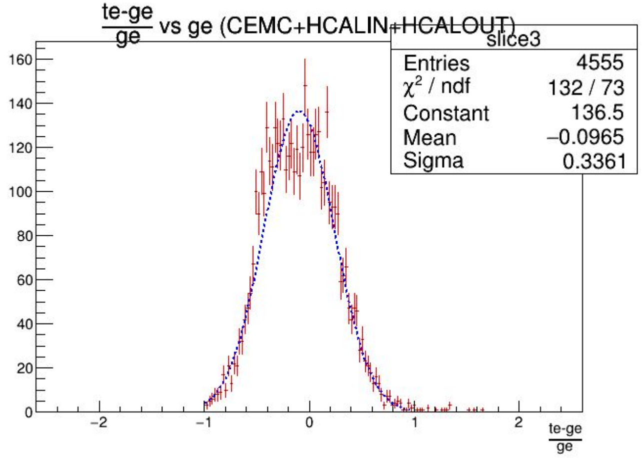
Before Calibration

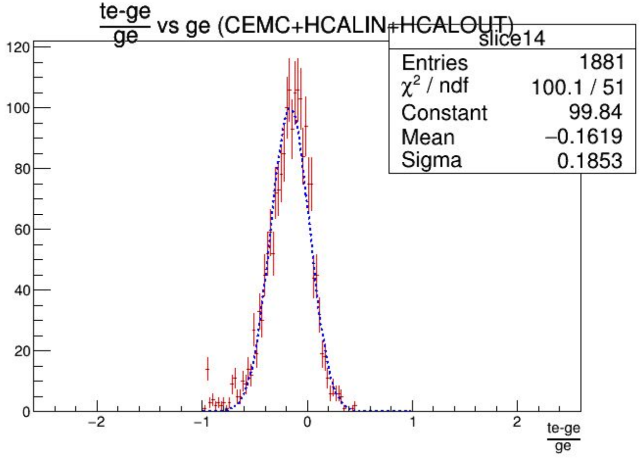


After Calibration

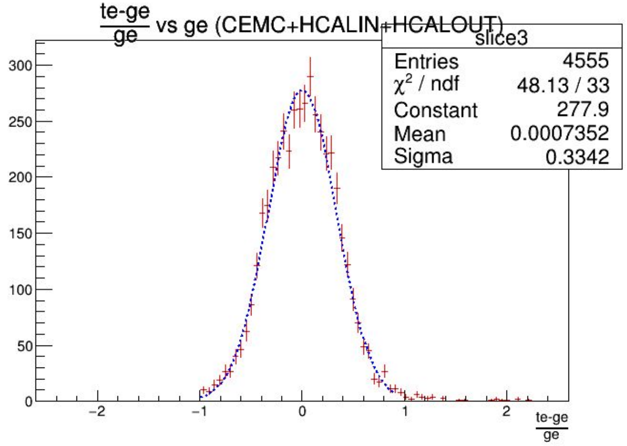


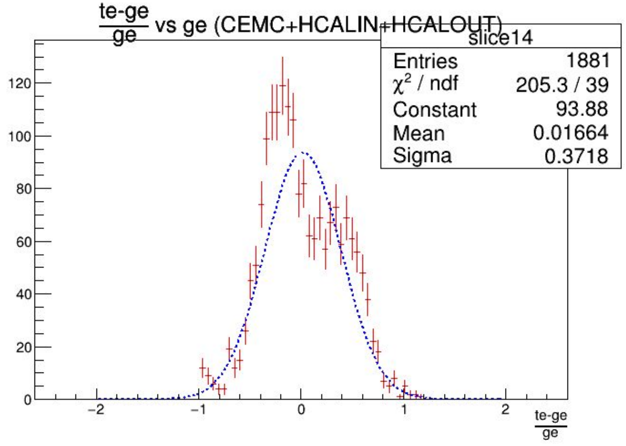
Before Calibration





After Calibration

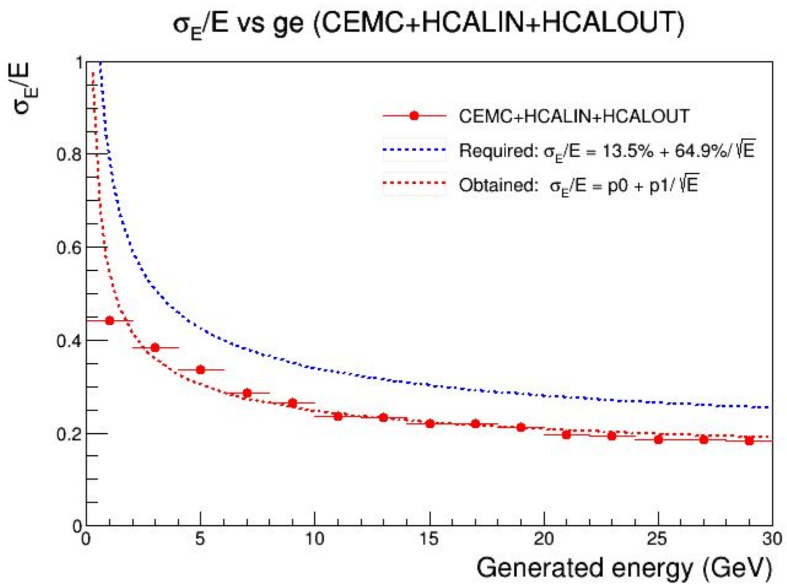




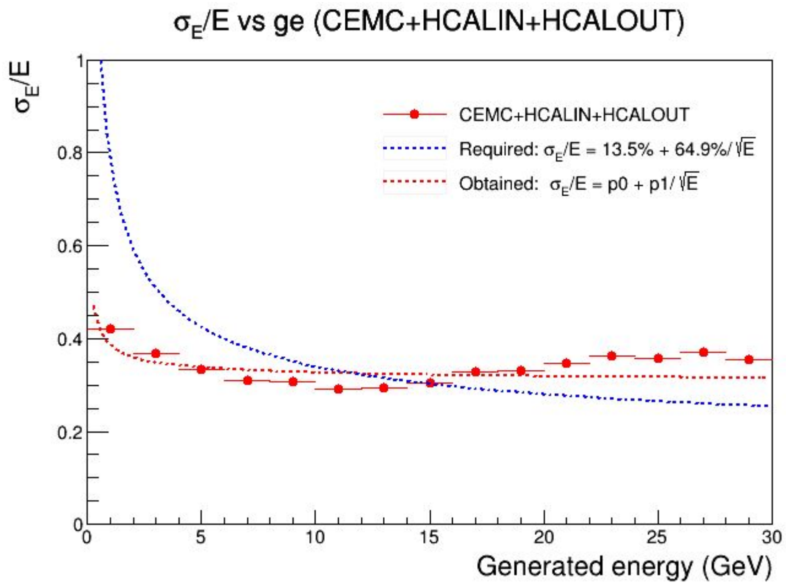
Sigma decreases

Sigma increases

Before Calibration



After Calibration



- I speculate that problem is with CEMC
- the function and overall mean are not comparable with each other at low and high energies and end up scaling up/down our original energies
- Also, this is not the case in HCALOUT, where fit function values and the overall mean are comparable to each other)

(Also if we look at forward calorimeters, their respective weights are comparable with the values provided by fit function, so we don’t face similar problem while calibrating them)

Cause of mismatching in CEMC?

Is it because of the nature of this calorimeter that it behaves this way?

- Looking at the right plot, it appears that hadrons don't deposit much energy in CEMC as apparent from high density of points near -1 (note that 100 MeV is already implemented)
- But there are also other points showing more deposition of hadron energy ----- Or are they just fluctuations in this sampling calorimeter?
- Do we need a different type of cut?