

Calibration and performances of Calorimeter



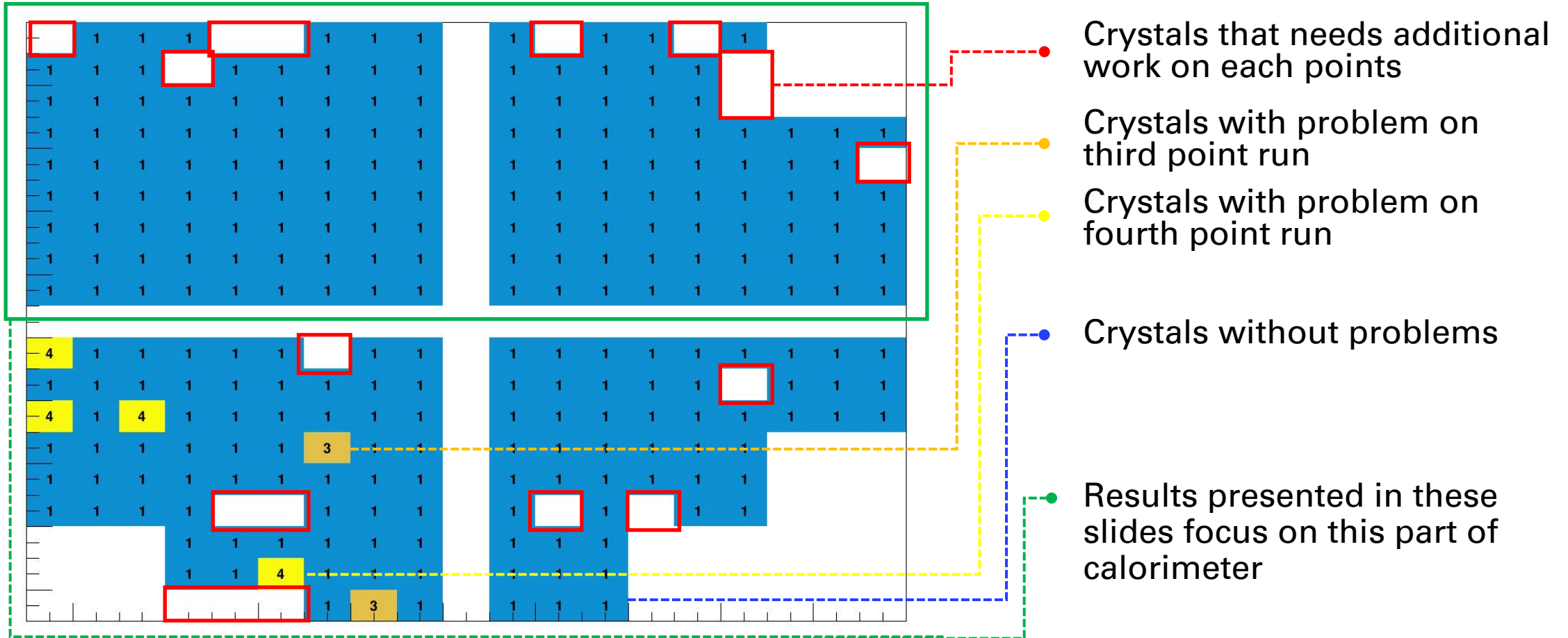
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On behalf of the Turin group



CNAO2023 Screensaver Runs: a quick reminder

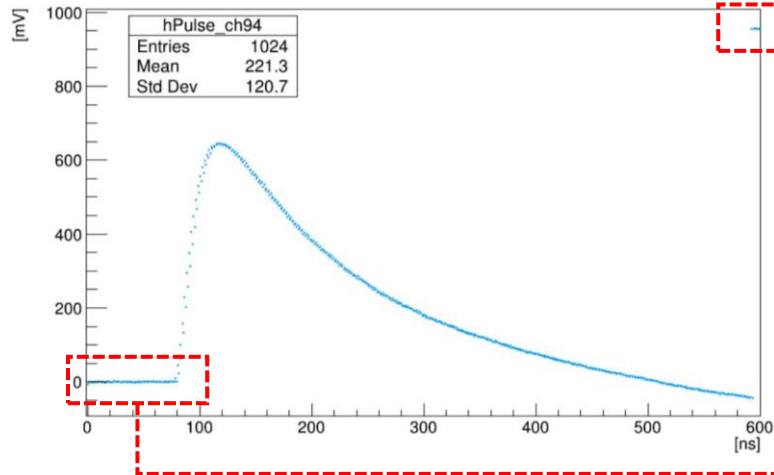
Calorimeter has been subdivided in four different sections





Waveform Cleaning

This was the amplitude distribution after the decoding chain

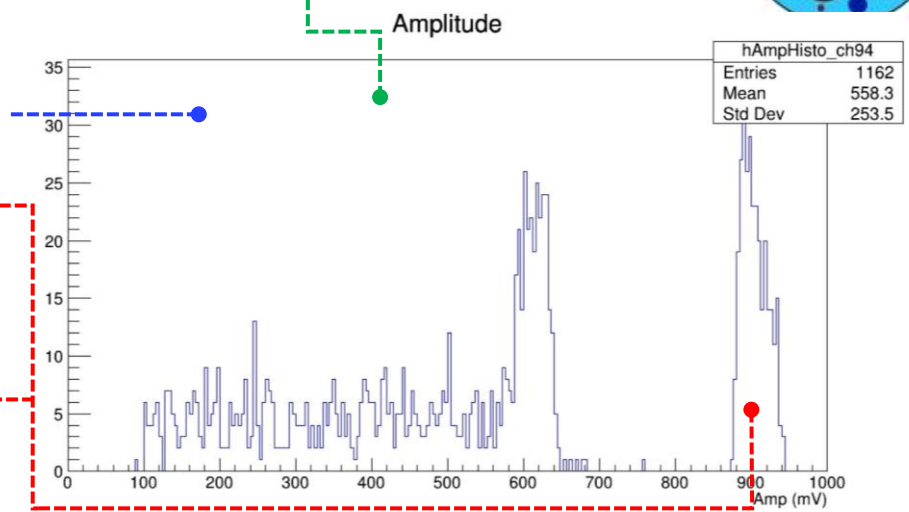


Incorrect RMS, baseline and amplitude evaluation

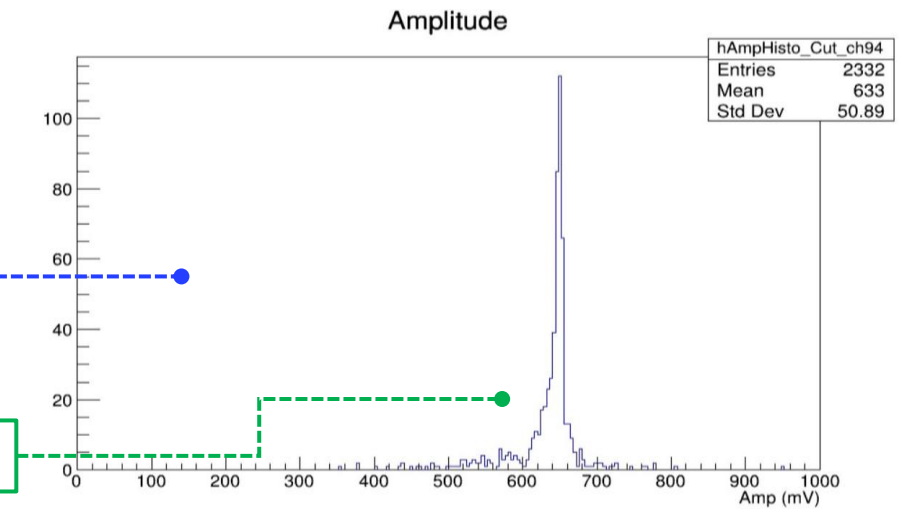
• Usual baseline and waveform range did not work this time

After range correction, the usual multiplicity and RMS cuts have been applied

Not even the worst distribution

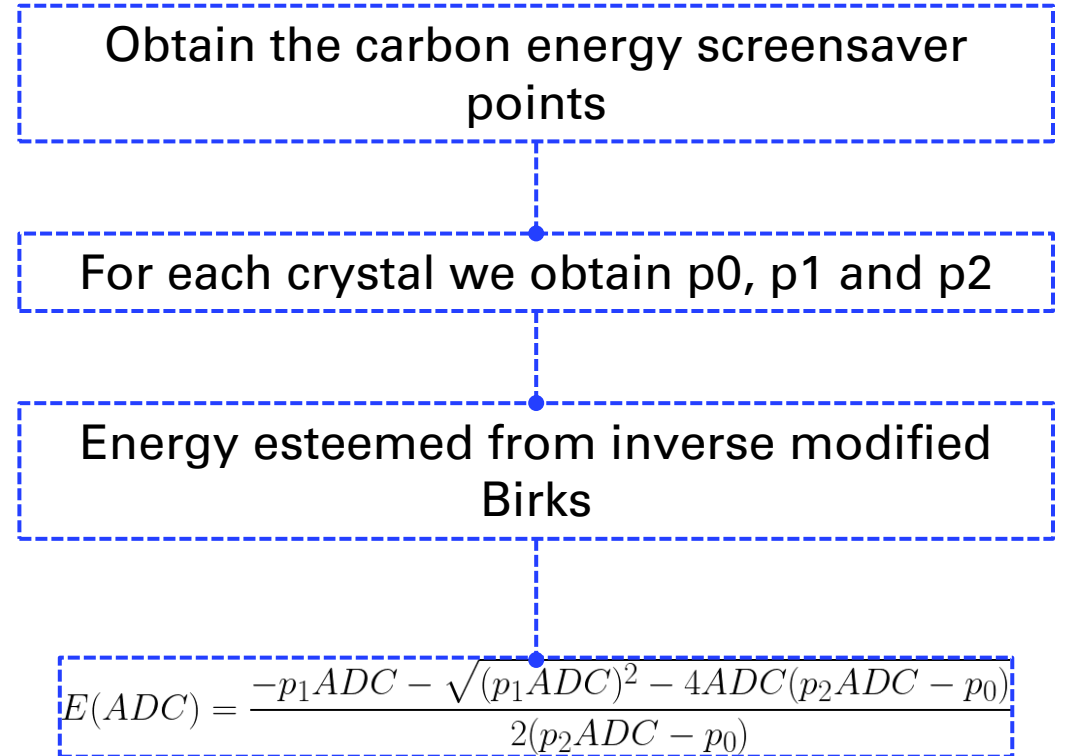
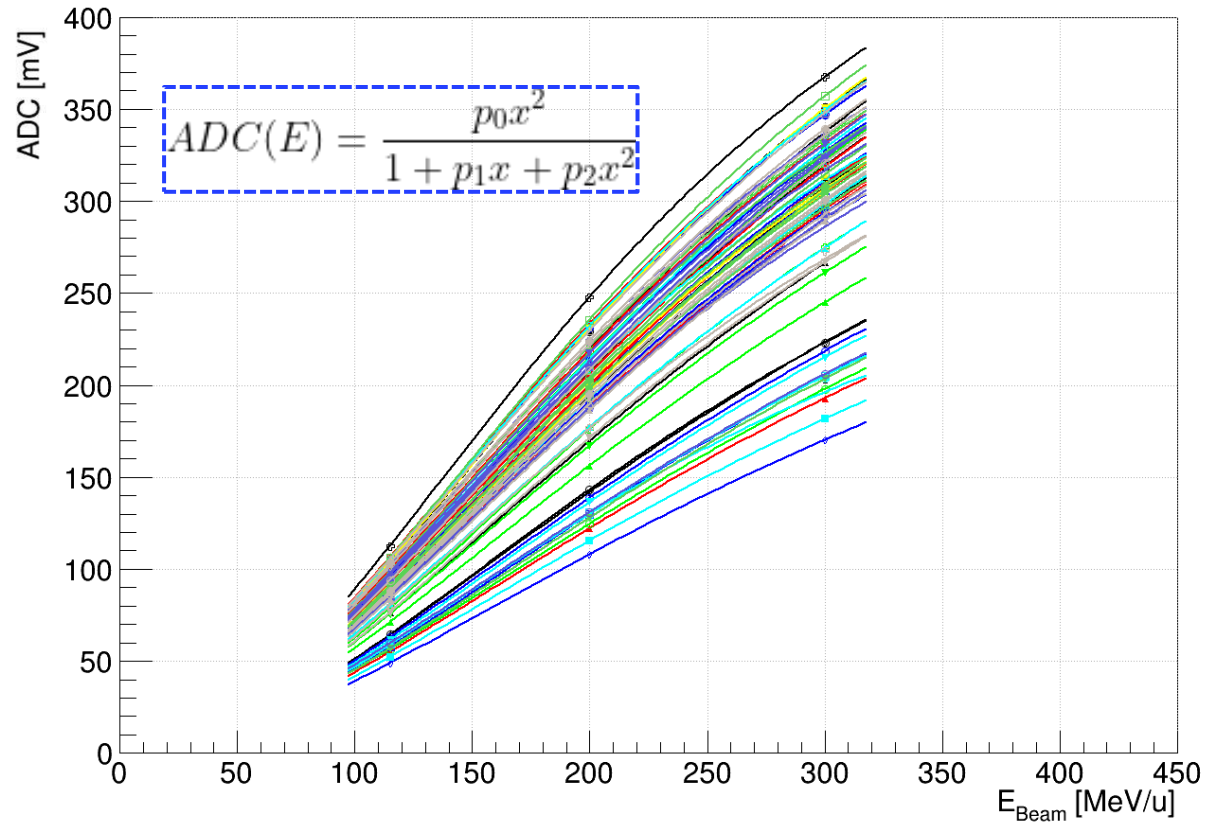


Looks better





Equalisation Strategy: another quick reminder



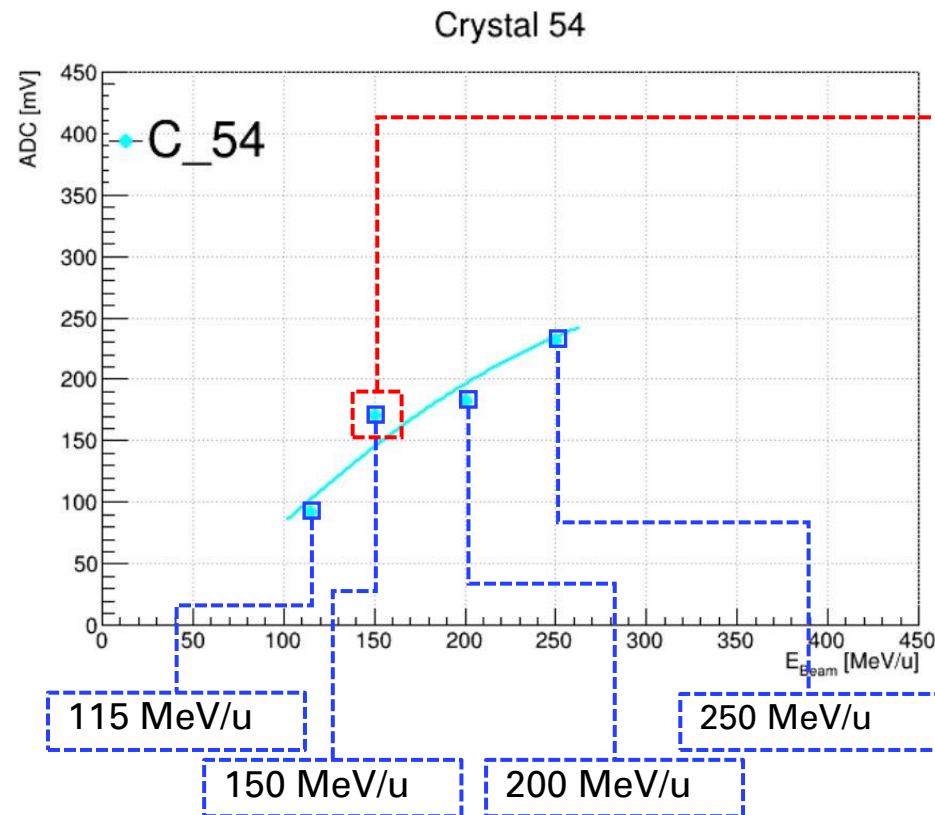
This strategy achieved better integral resolution results than using a single intercalibration factor

Way less than our 2% goal



Birks fitting

While fitting the four screensaver carbon point with Birks something “odd” was found



150 MeV/u points do not follow Birks function

After careful checking all the decoding and fitting steps needed to extract this points no evidence of error was found.

This kind of behavior is present in all the analyzed crystals



Birks fitting

A simple experiment has been made

p_0 , p_1 and p_2 has been evaluated

$$E(ADC) = \frac{-p_1 ADC - \sqrt{(p_1 ADC)^2 - 4ADC(p_2 ADC - p_0)}}{2(p_2 ADC - p_0)}$$

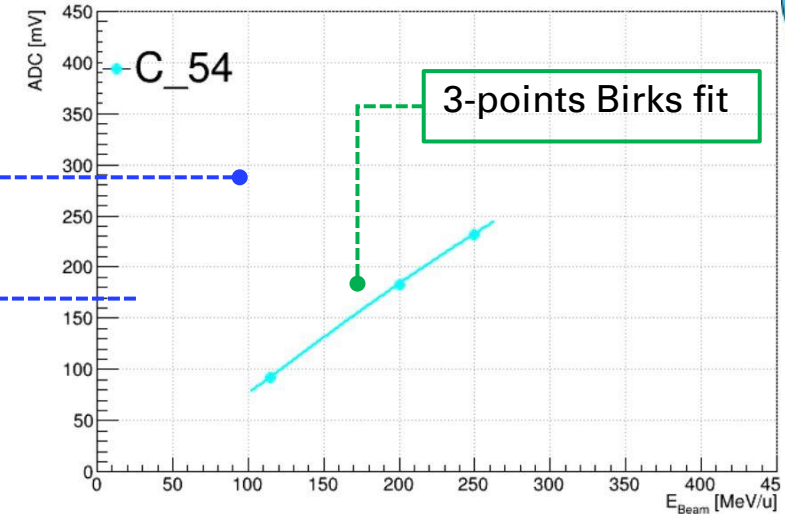
ADC value measured at 150 MeV/u for each crystal

It is very likely that CNAO delivered a 190 MeV/u carbon beam

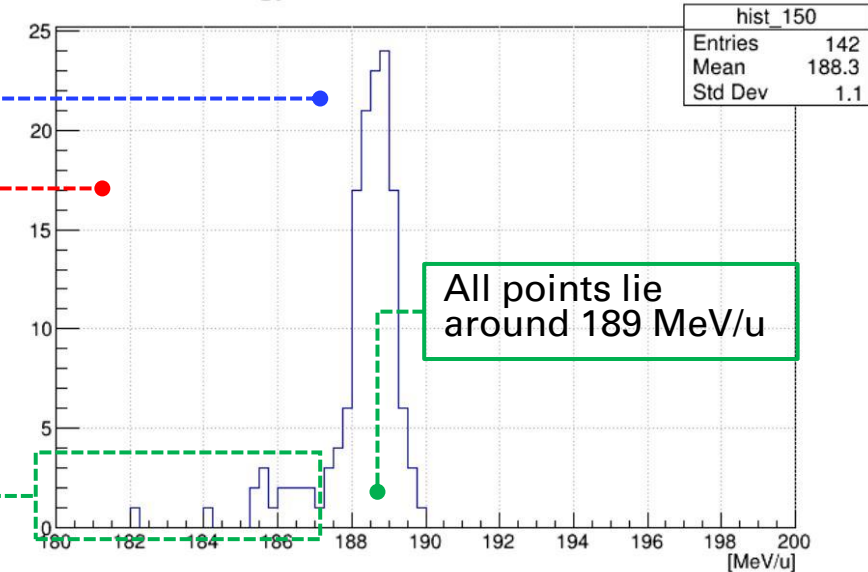
Good news: we can esteem an unknown energy with a 0.5% systematic error

We can exploit this method to identify the worst calibrated crystals

Crystal 54



Energy from inverse Birks function



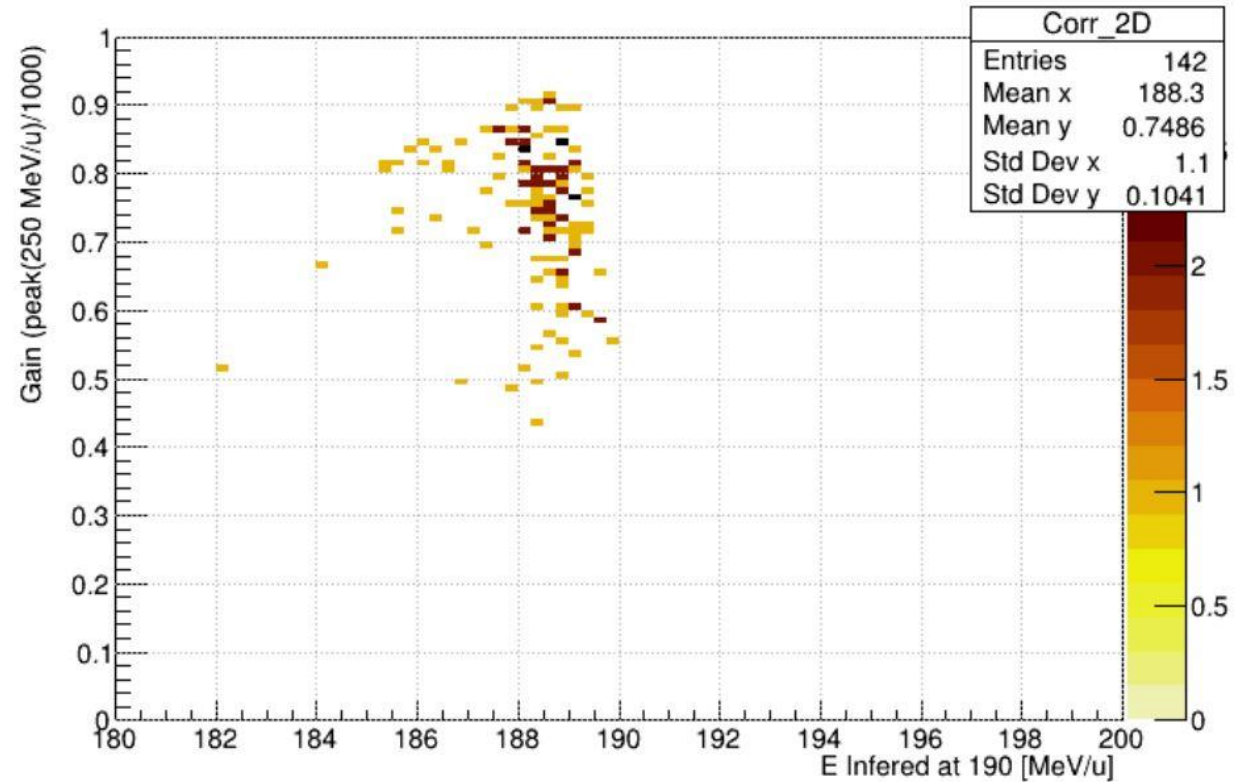
All points lie around 189 MeV/u



Problematic crystals identification

Scatter plot obtained from gain and the energy calculated for the unknown energy per each crystals

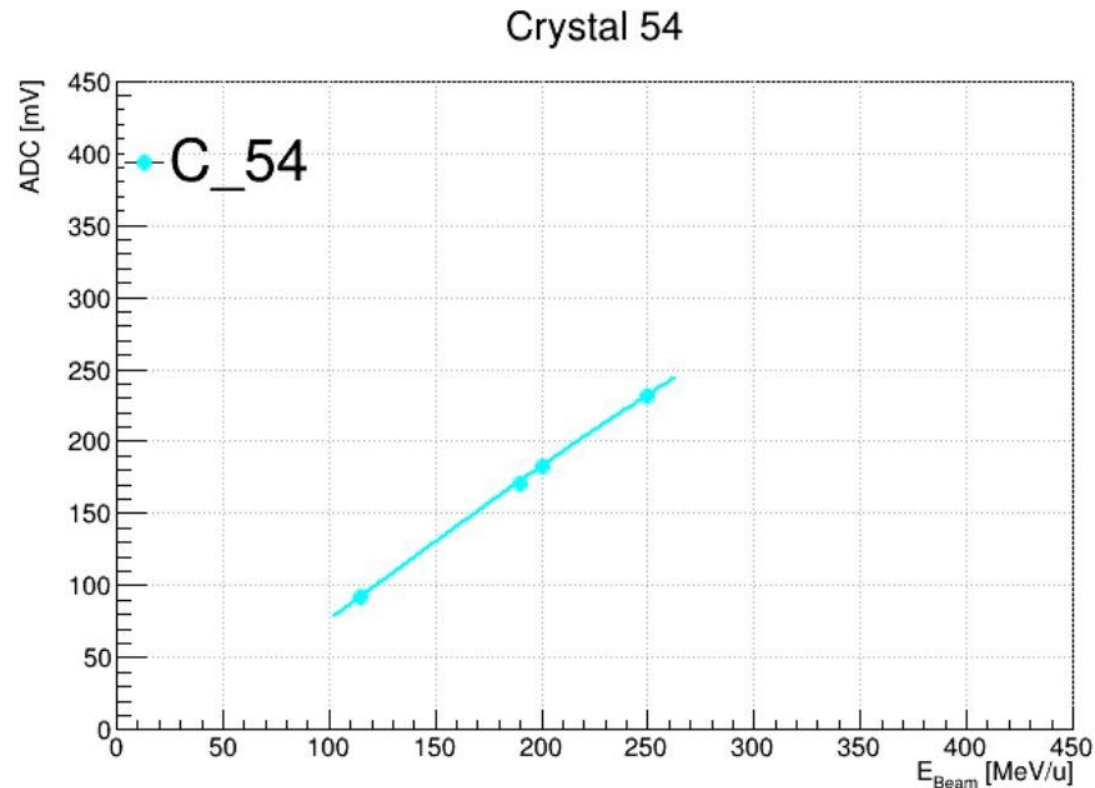
No evidence of a clear correlation





Birks fitting

By changing the energy value from 150 to 190 MeV/u we achieve a perfect 4-point fit for each crystal



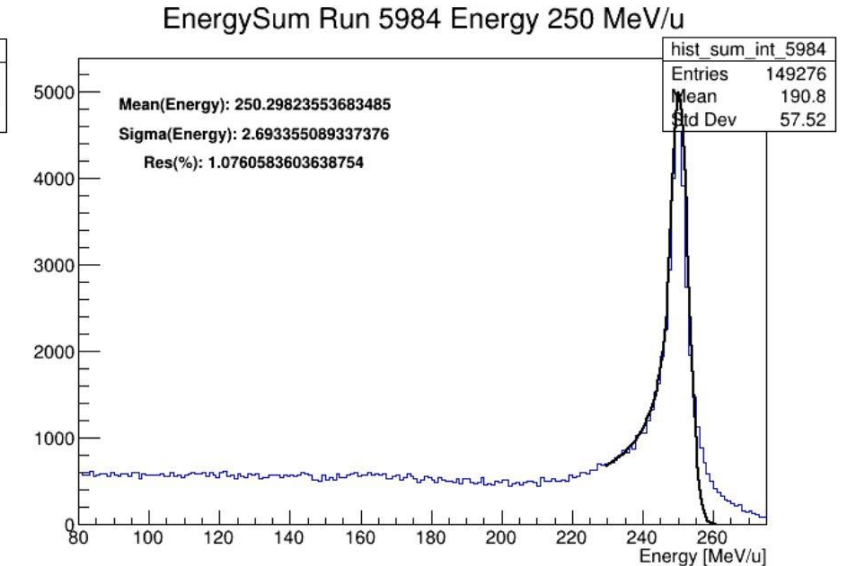
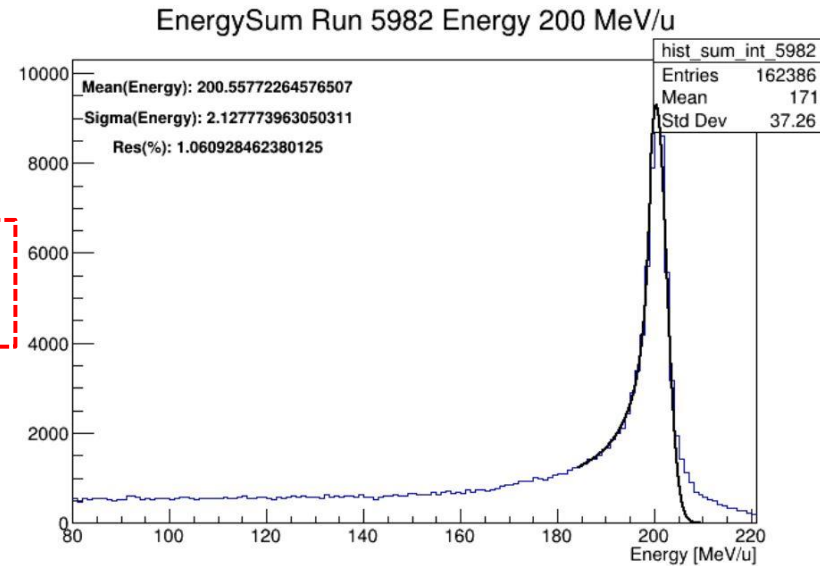
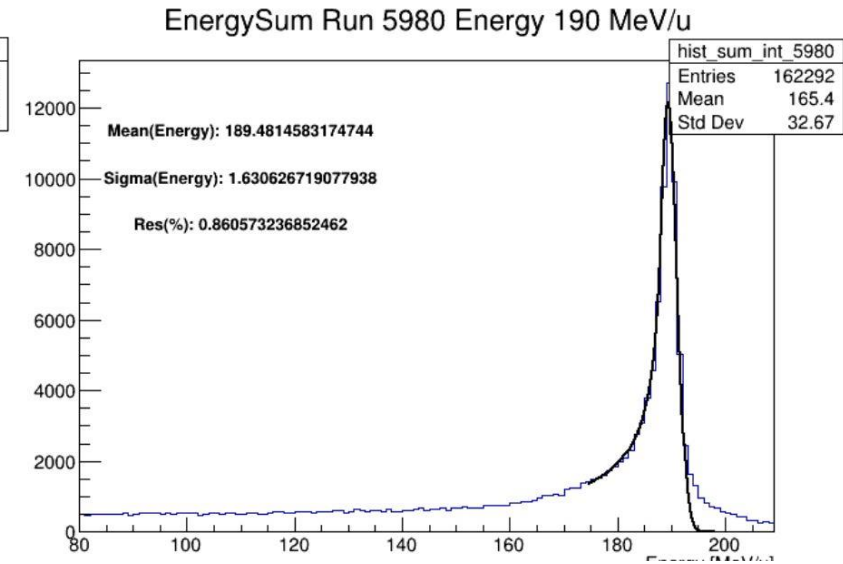
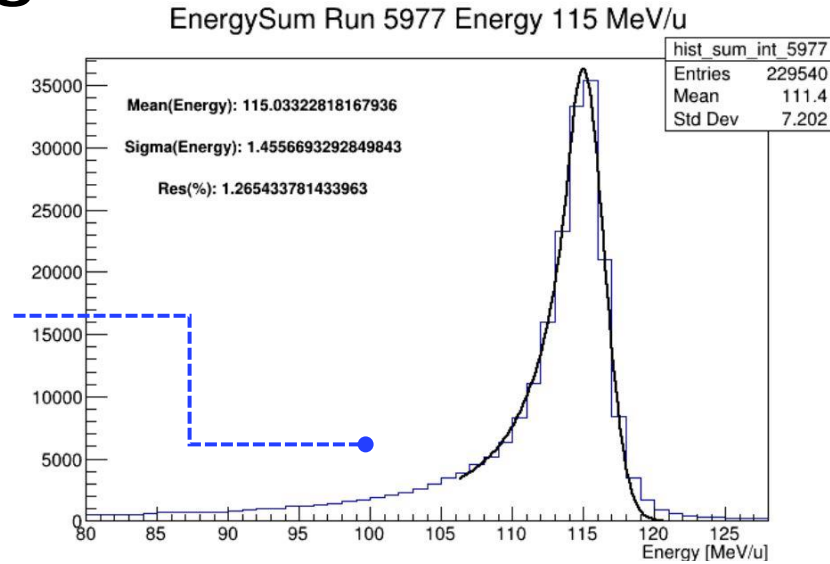
Except for a couple of crystals we have all the parameter triplets ready to be added to SHOE

But how well our intercalibration perform?



Calorimeter integral resolution

Sum Energy distribution of all crystal after ADC to Energy conversion to esteem the total calorimeter resolution



All resolution value around 1%



Summary

What have we done:

- ✓ Equalization parameter for almost the whole calorimeter have been calculated
- ✓ Capability to measure with a 0.5% systematic error an unknown energy value
- ✓ Simple strategy to identify the worst calibrated crystals

Next steps:

- ✓ Measure HIT masses with information from CALO and TOF