TW calibration update @ CNAO2023

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Dataset

- For the calibration, all the available runs with both targets and both triggers schemes were used (only if the magnet was in place), in detail:

  - Minimum bias – Carbon target: [6124 6135 6136 6138 6139 6172 6173 6175 6176 6177 6178];

  - Fragmentation – Carbon target: [6140 6141 6142 6144 6146 6148 6180 6183 6184 6186 6187 6189 6190 6193 6194 6195 6197 6199 6203 6204 6205 6206 6212];

  - Minimum bias – C_2H_4 target: [6224 6225 6226 6227 6230 6231 6310];

  - Fragmentation – C_2H_4 target: [6228 6232 6234 6235 6241 6243 6245 6248 6249 6251 6252 6311 6312];

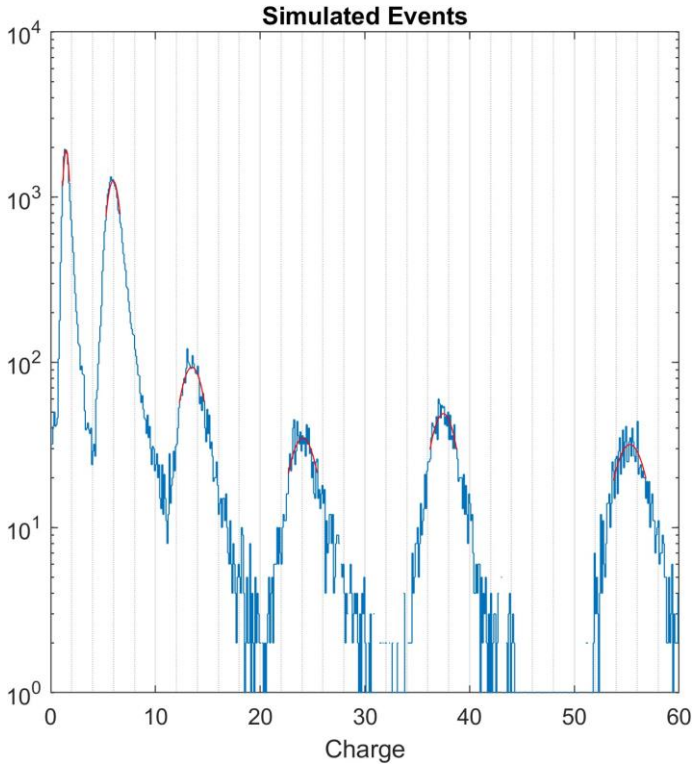
- The TW scan has not been used yet the moment

- A bar-per-bar calibration has been implemented

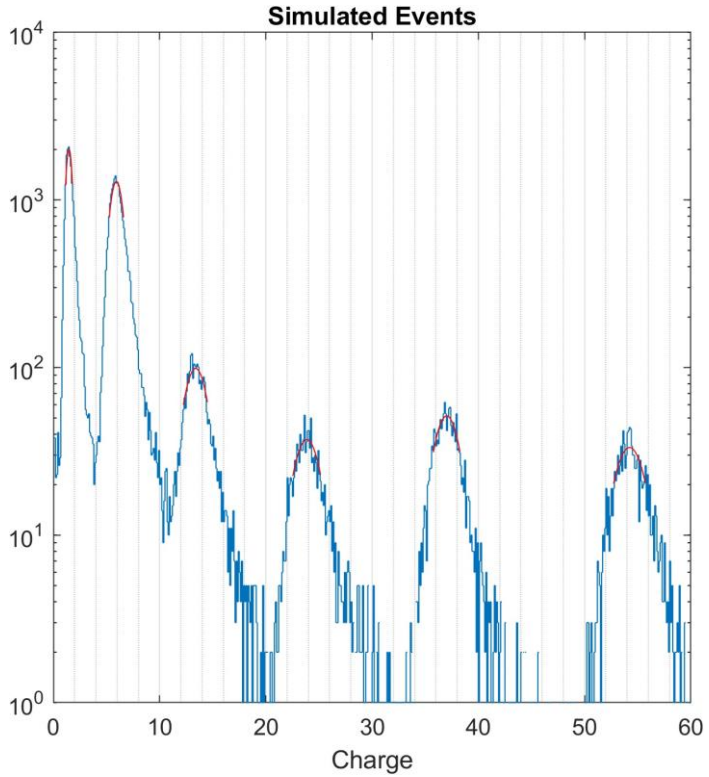
Simulated data (energy calibration)

The fragment energy has been evaluated separately for the two layers. In the simulation, no differences between bars were considered.

Layer 0



Layer 1



Layer 0

Ion	Peak_pos
H	1.47 +/- 0.01
He	5.96 +/- 0.02
Li	13.48 +/- 0.08
Be	24.07 +/- 0.06
B	37.49 +/- 0.03
C	55.31 +/- 0.04

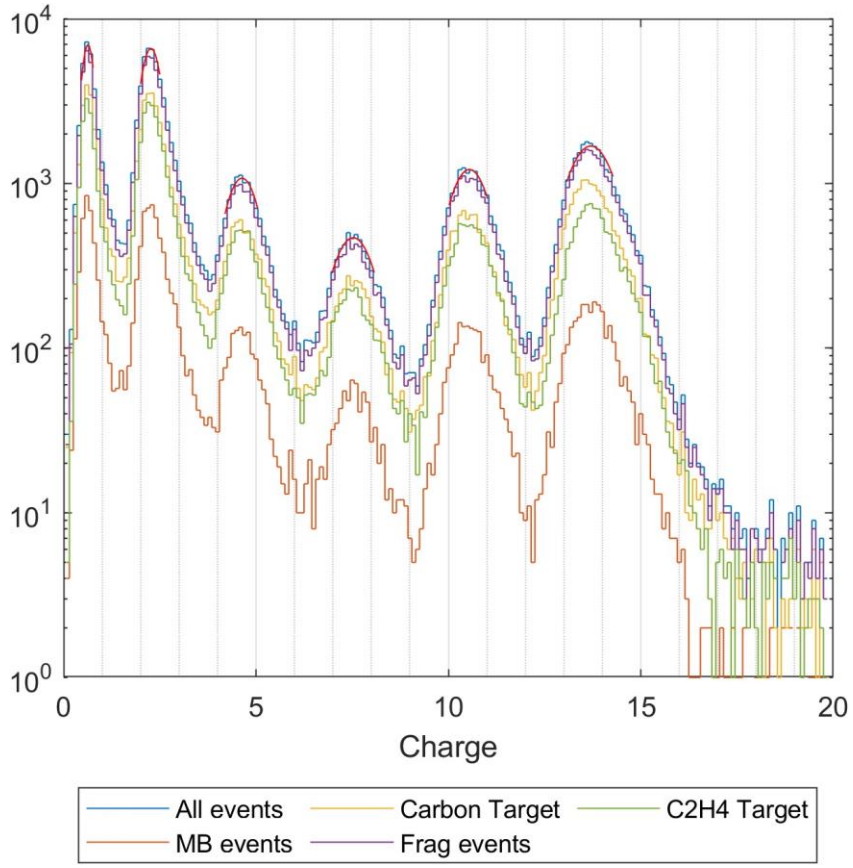
Layer 1

Ion	Peak_pos
H	1.47 +/- 0.01
He	5.93 +/- 0.02
Li	13.39 +/- 0.07
Be	23.85 +/- 0.05
B	37.02 +/- 0.03
C	54.24 +/- 0.04

Experimental data (energy calibration)

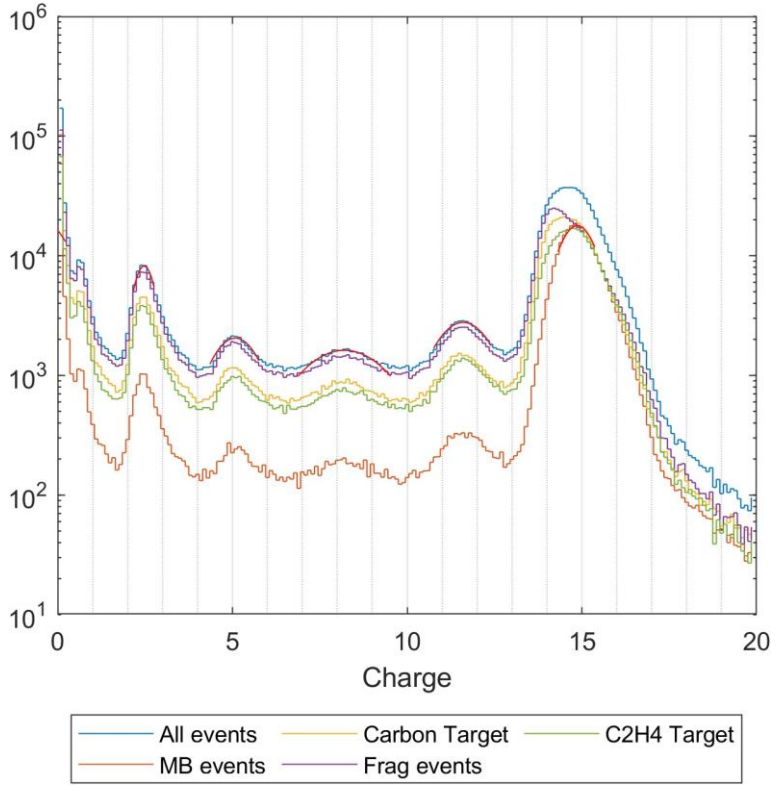
Event Selection

All data were used together for the calibration to improve the population of the heavier fragments on each bar.
No differences were observed in the distribution using different targets or trigger schemes:



With an important exception...

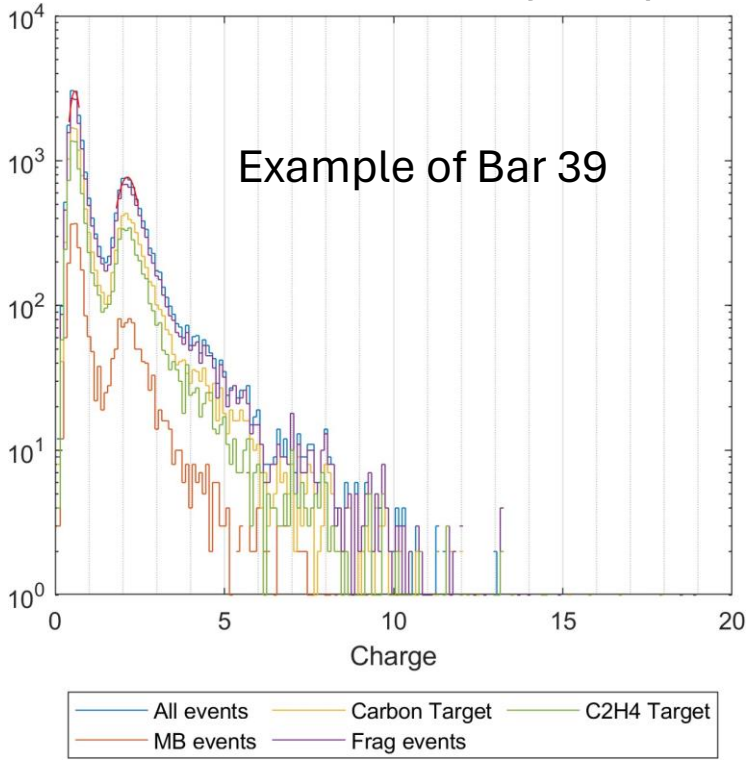
In the 3 + 3 central bars the Carbon peak has to be fitted using MB events only.



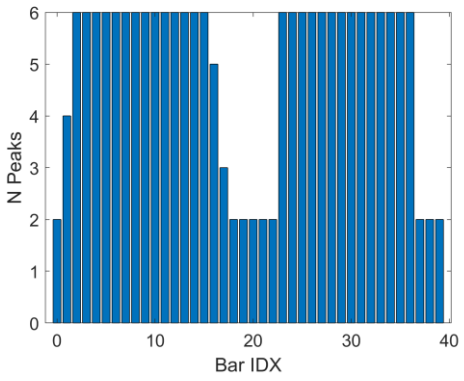
Experimental data (energy calibration)

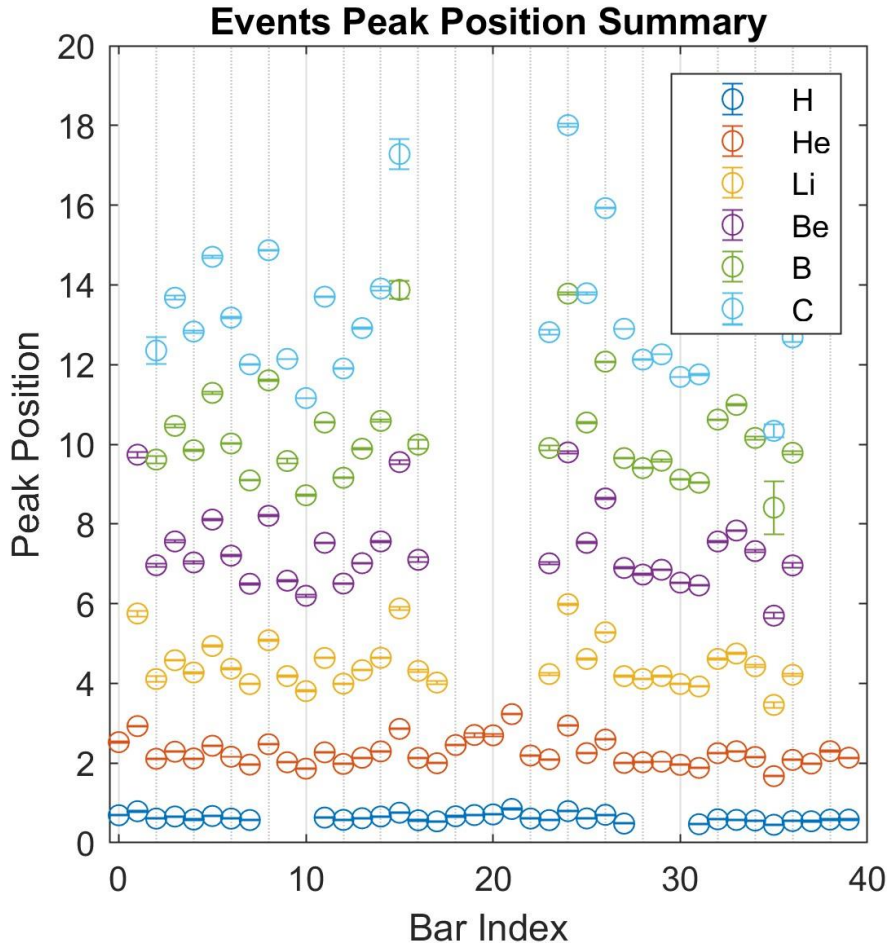
Fitted peaks

The number of fitted peaks in some peripherical bars is very low, in the future the TW scan data will add a point in those bars, but so far some bars have only two peaks...



In the central bars sometimes the proton peak cannot be fitted (not a problem since we have all other peaks in that region)

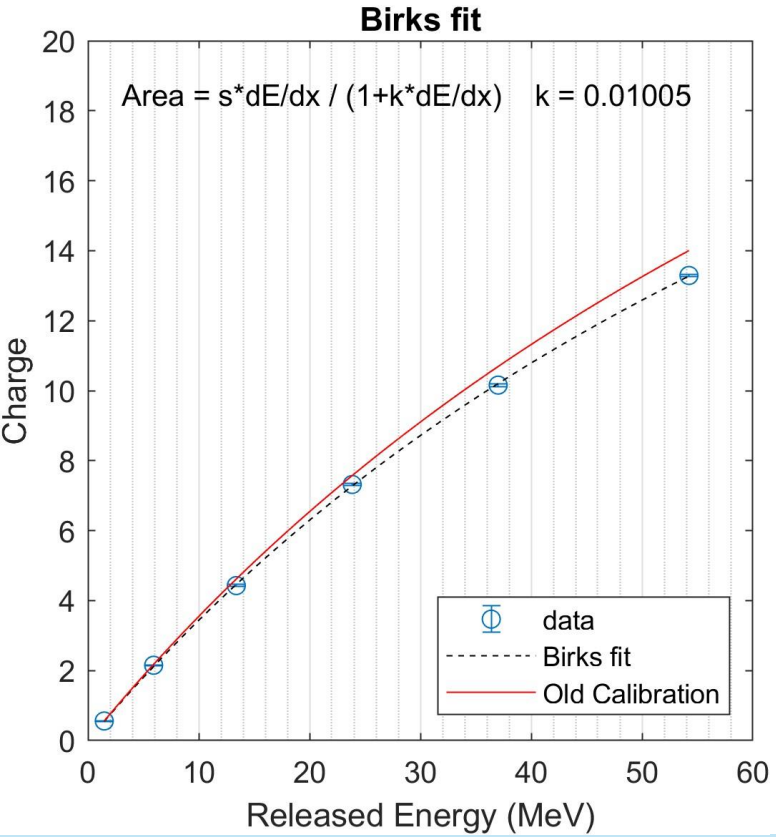


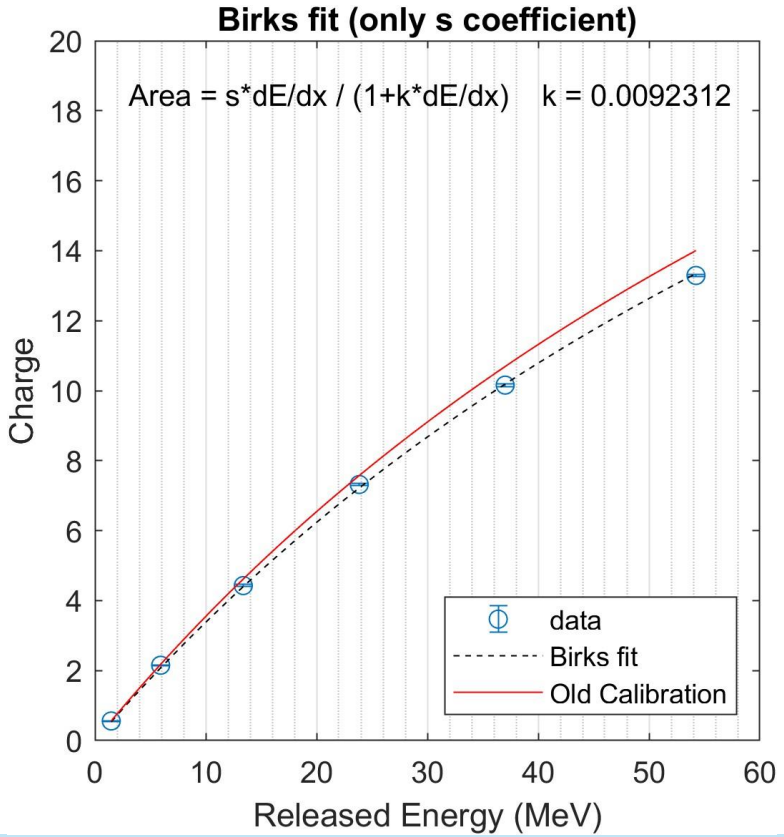


Experimental data (energy calibration)

Birks fit

For each bar two different Birks fits were performed: one using the standard equation and another imposing the k birks coefficient equal to the GSI2021 calibration and using «s» as the only free parameter. Fits converge very well in both cases





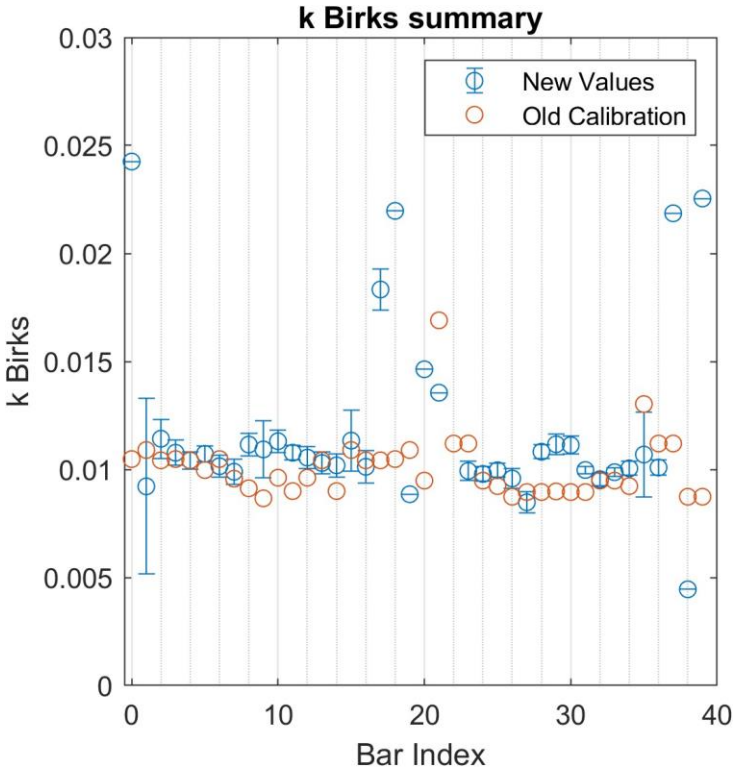
If the k parameter found in the two-parameter fit differs by more than 50% from the GSI value, the k value of the GSI and the new *s* value from the fit were used instead of the two-parameter fit results.
This was the case in 7 bars at the periphery of the detector.

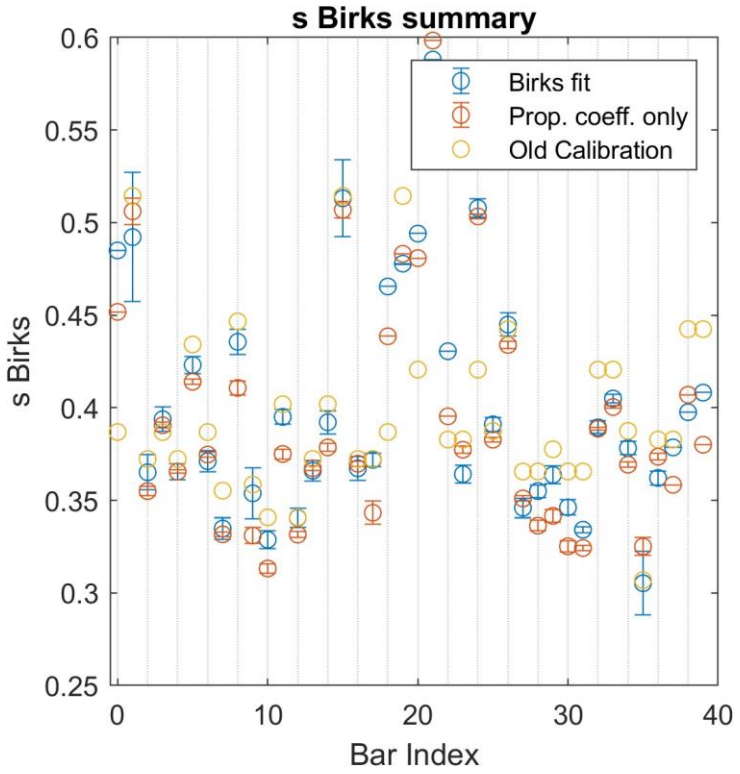
Experimental data (energy calibration)

Birks fit results

K values are usually quite close to the previous values and quite uniform in the detector, except for some outliers.

Proportionality values are usually a bit lower compared to the GSI2021… It was a different ion and energy, but a comparison with CNAO2022 will be interesting

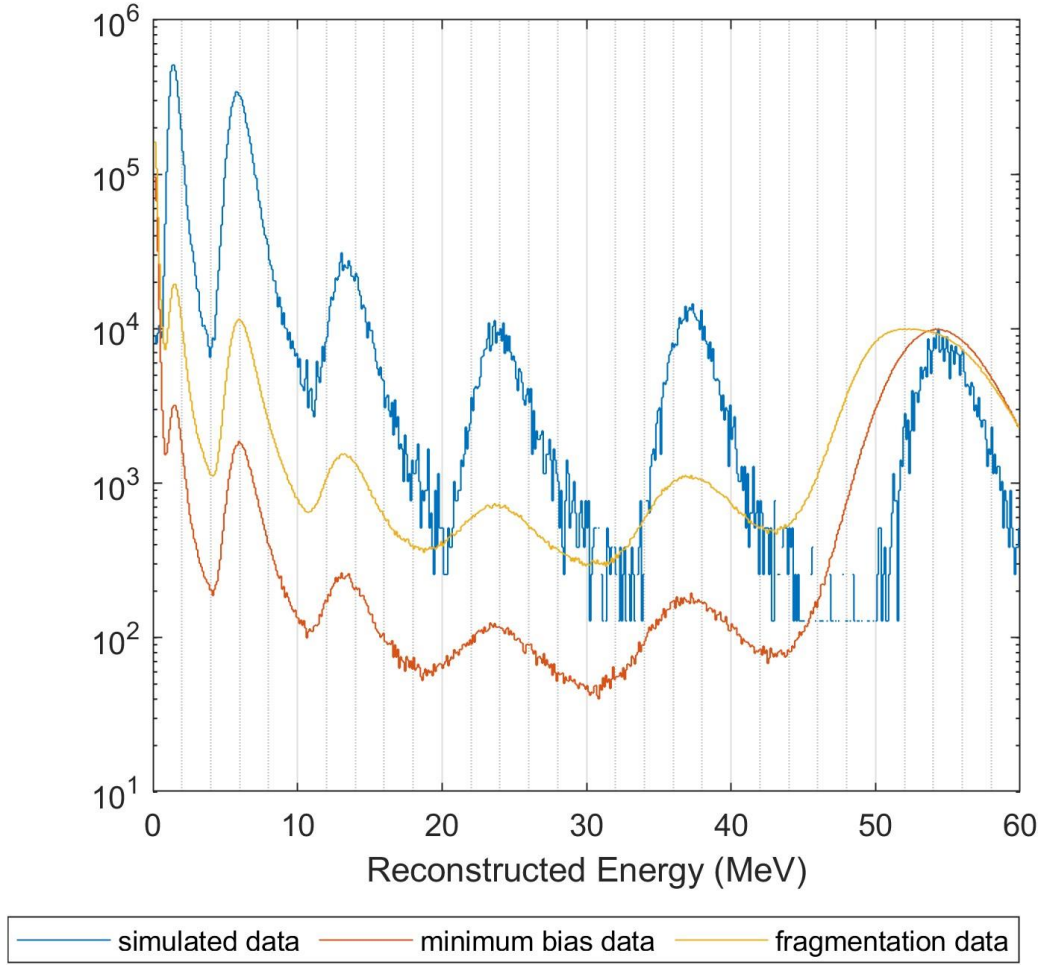




Experimental data (energy calibration)

Reconstructed spectra

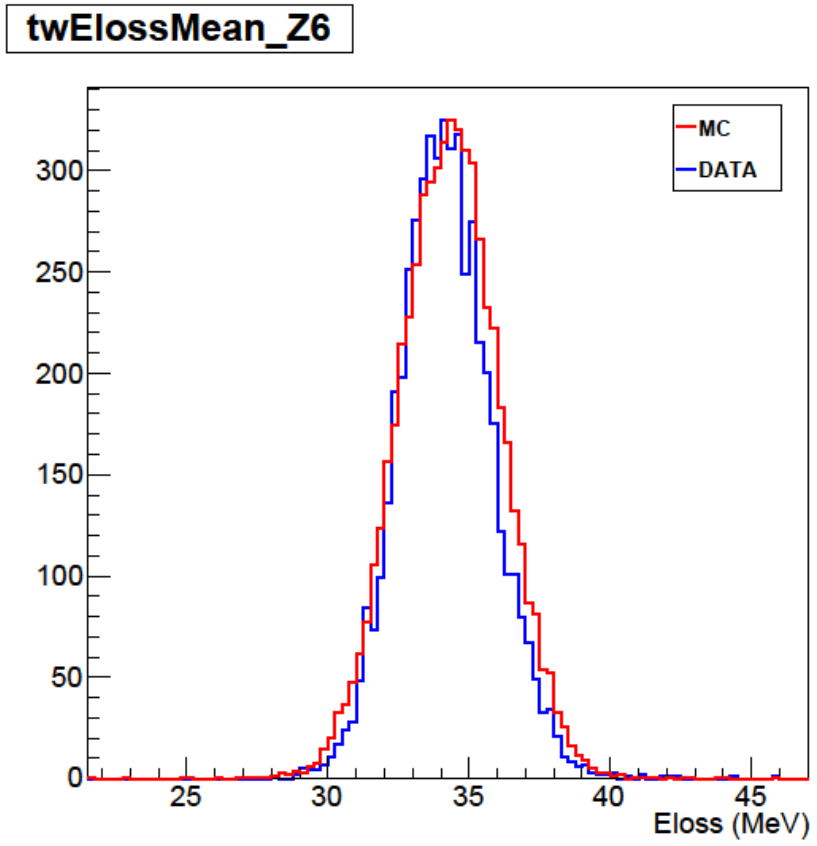
Just for a double check, events were converted applying the calibration and the energy spectra were reconstructed separately for MB and Fragmentation.



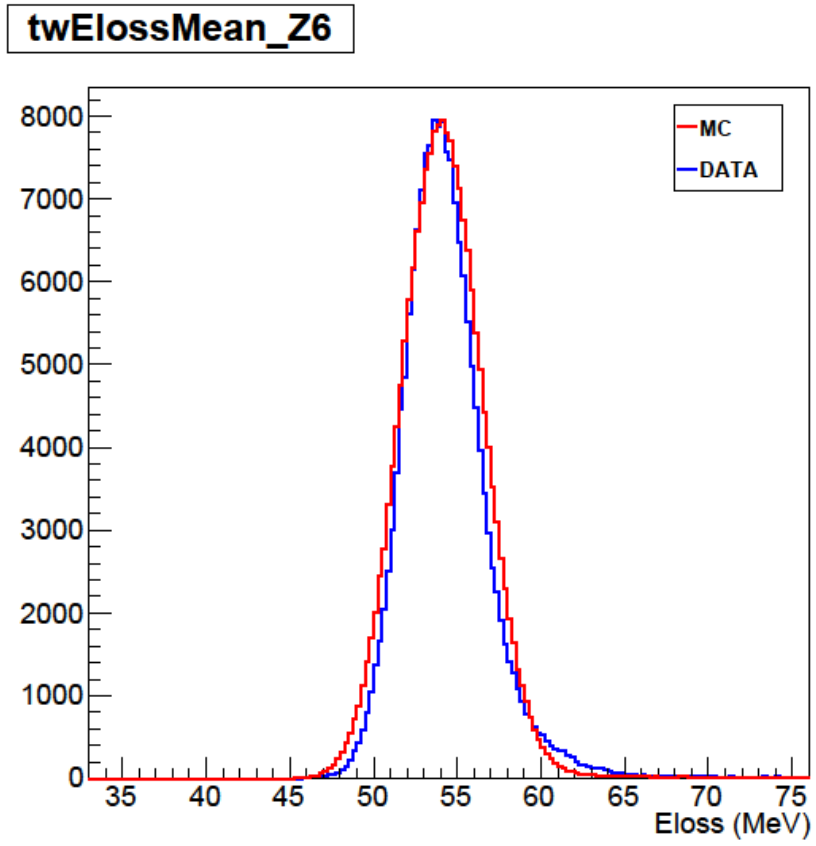
Experimental data (energy calibration)

Comparison with GSI (Z=6)

GSI



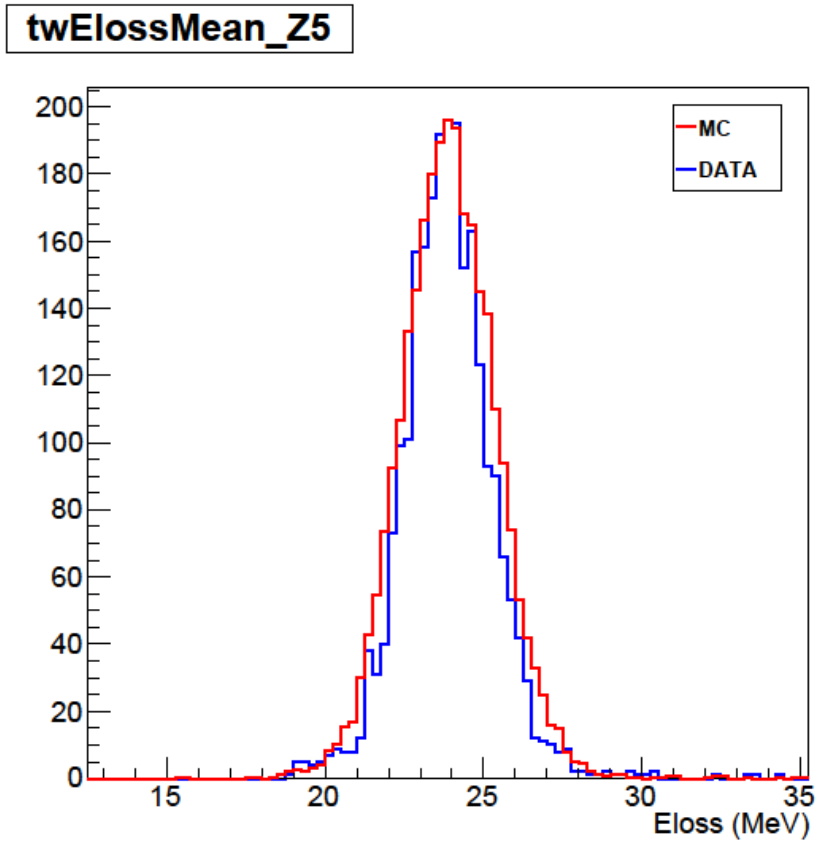
CNAO



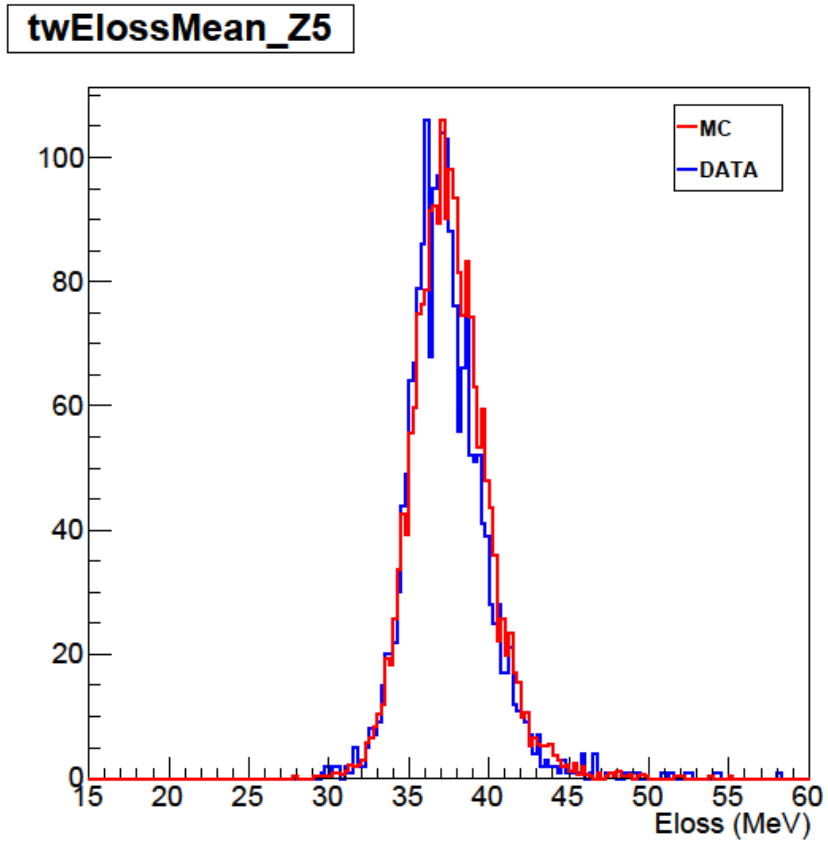
Experimental data (energy calibration)

Comparison with GSI (Z=5)

GSI



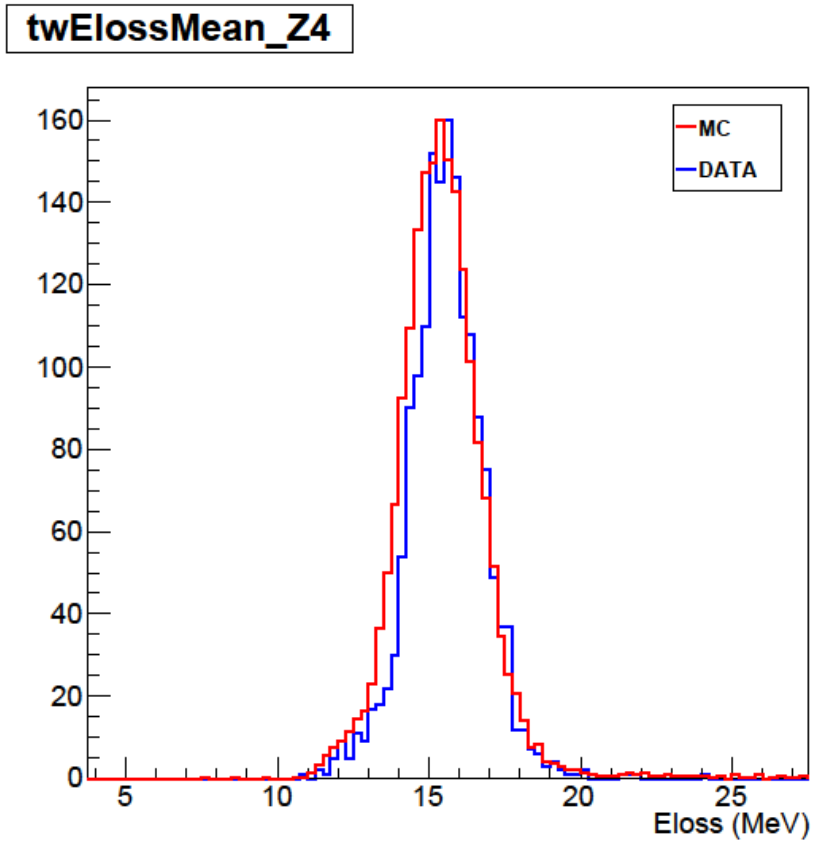
CNAO



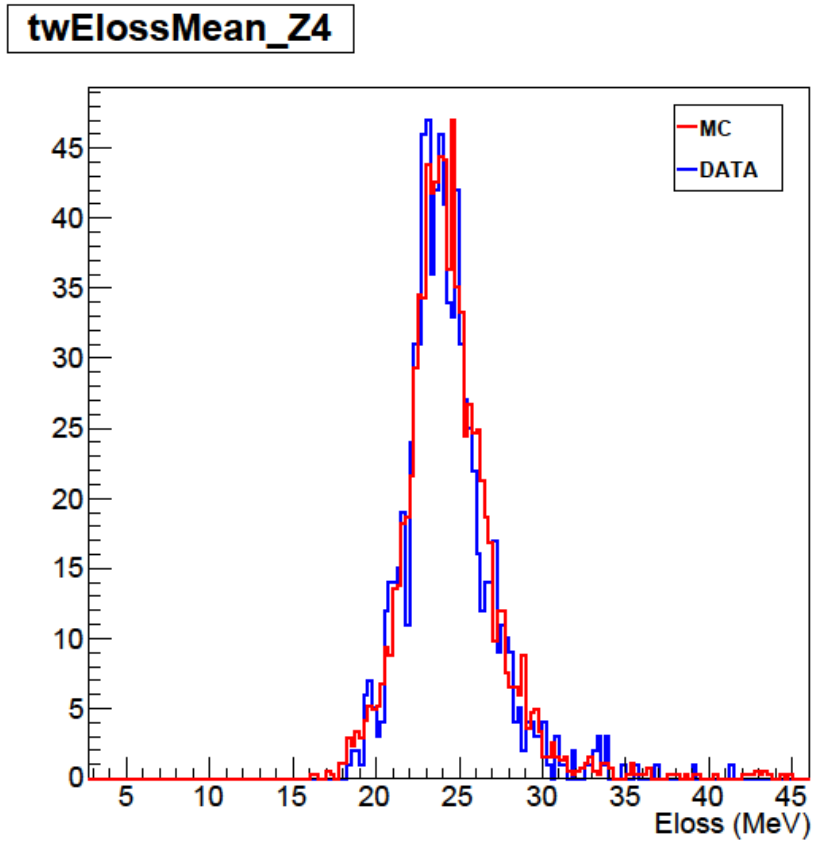
Experimental data (energy calibration)

Comparison with GSI (Z=4)

GSI



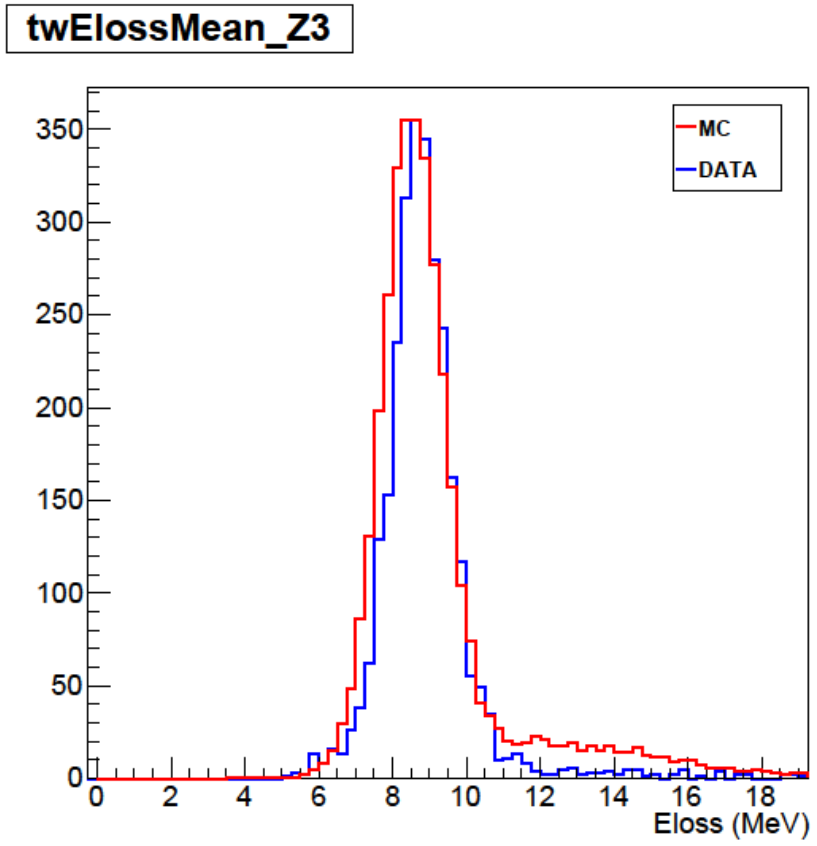
CNAO



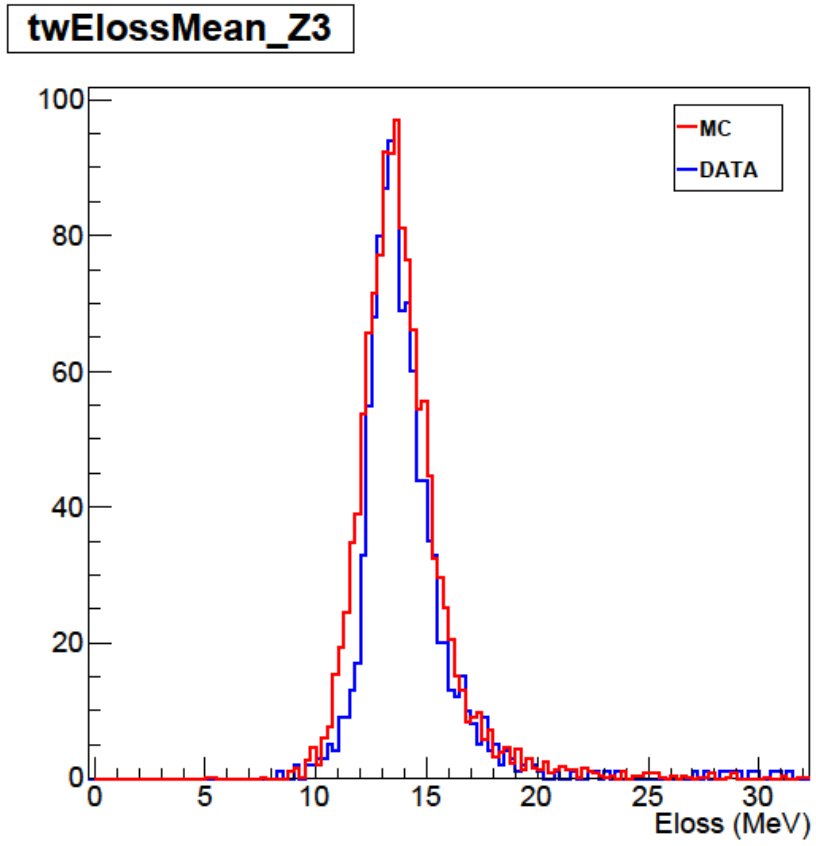
Experimental data (energy calibration)

Comparison with GSI (Z=3)

GSI



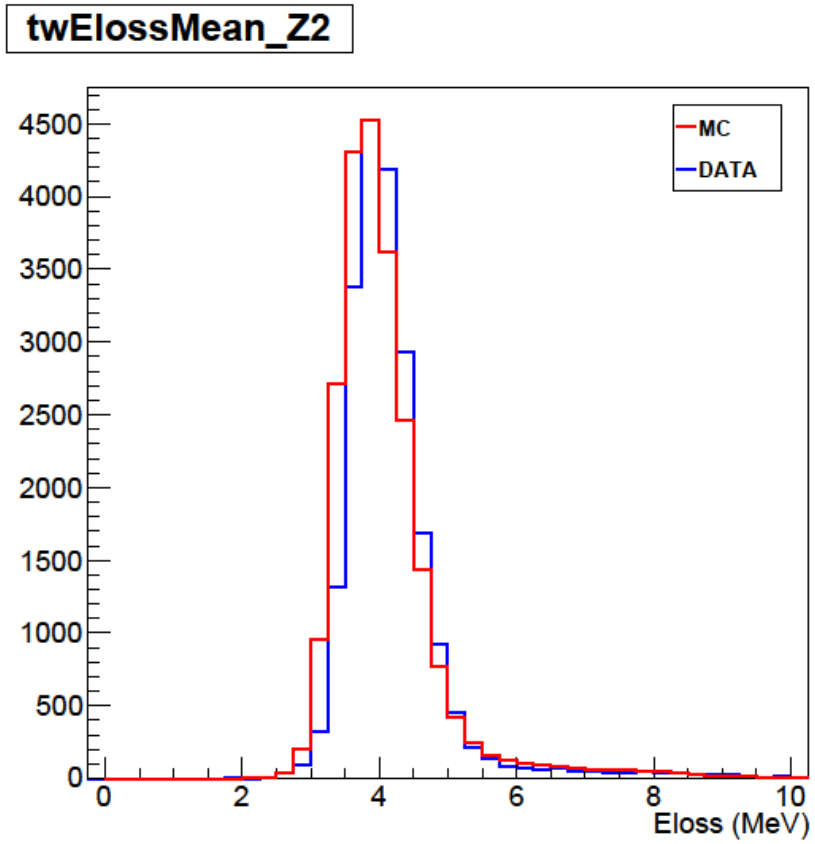
CNAO



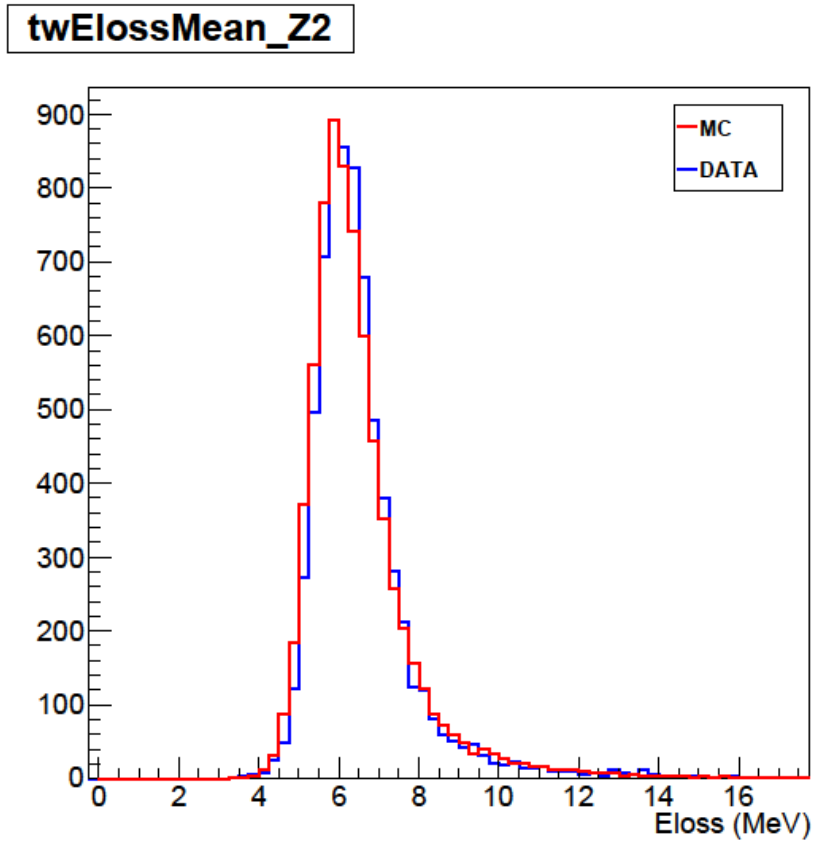
Experimental data (energy calibration)

Comparison with GSI (Z=2)

GSI

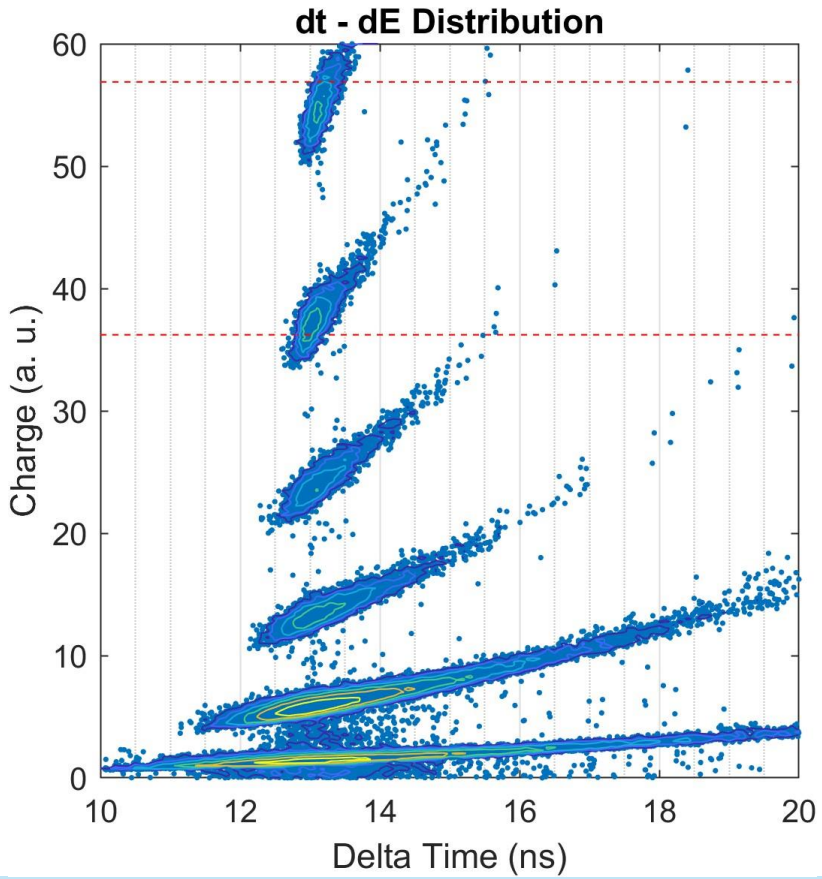


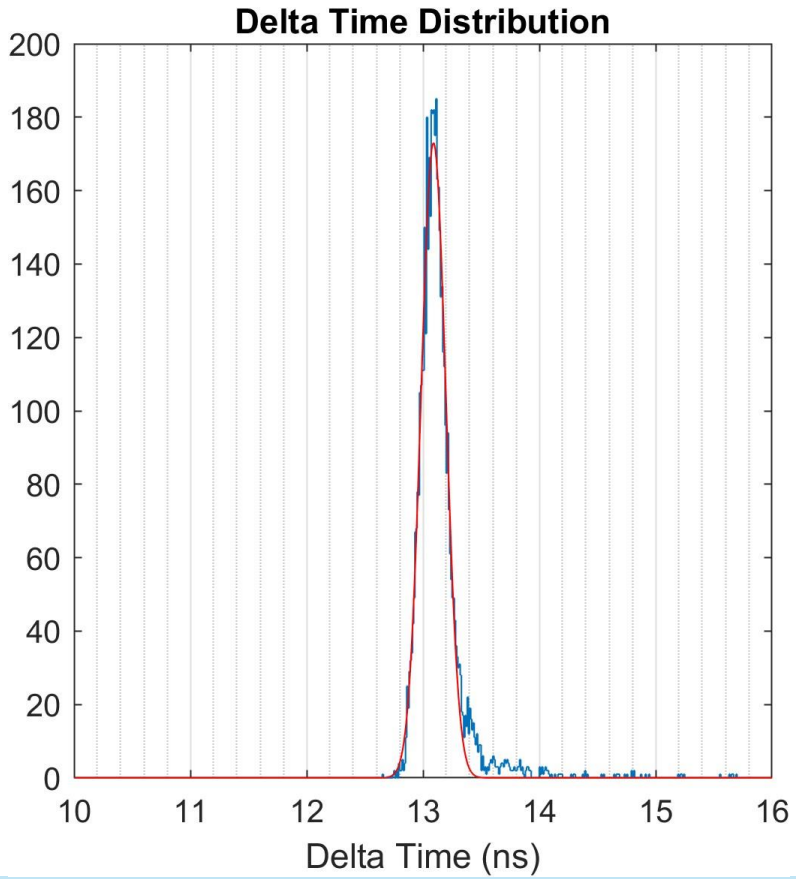
CNAO



Simulated data (time calibration)

Only the Z=5,6 events were used to evaluate the mean TOF in the simulation



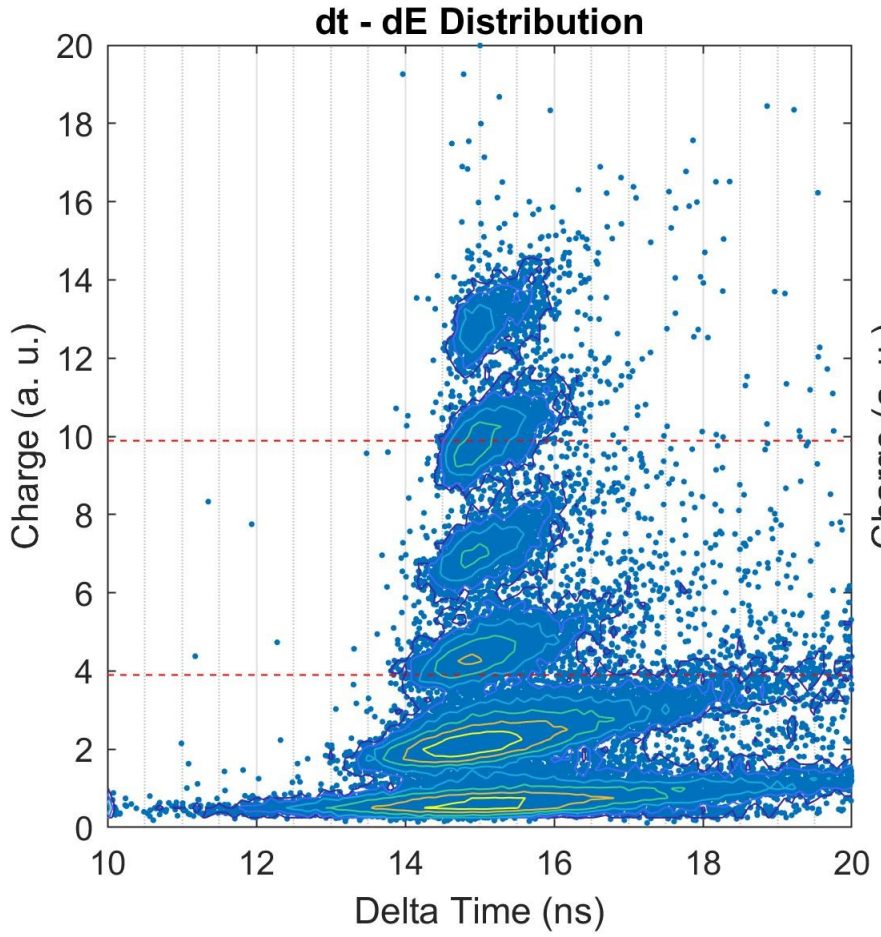


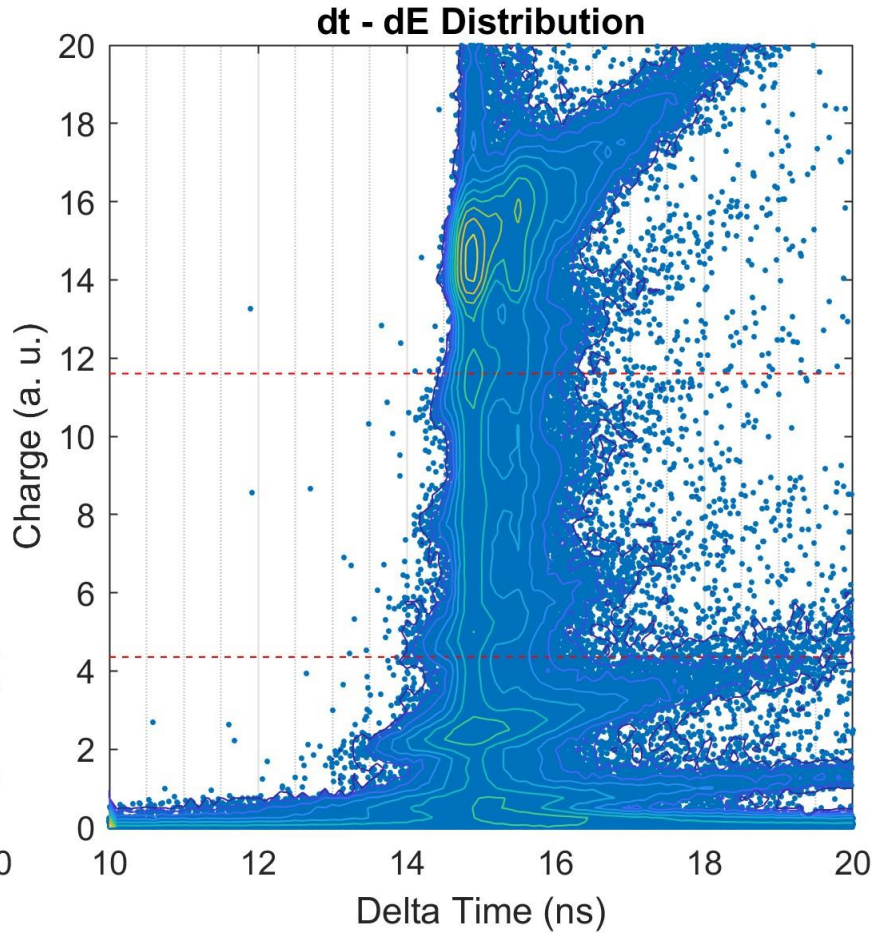
Experimental data (time calibration)

Event Selection

Event selection for bar delay evaluation depends on each bar, in general:

- Protons are never used
- He events are used only if less than 4 fragment are present in the bars
- Carbon events are not used in the central bars

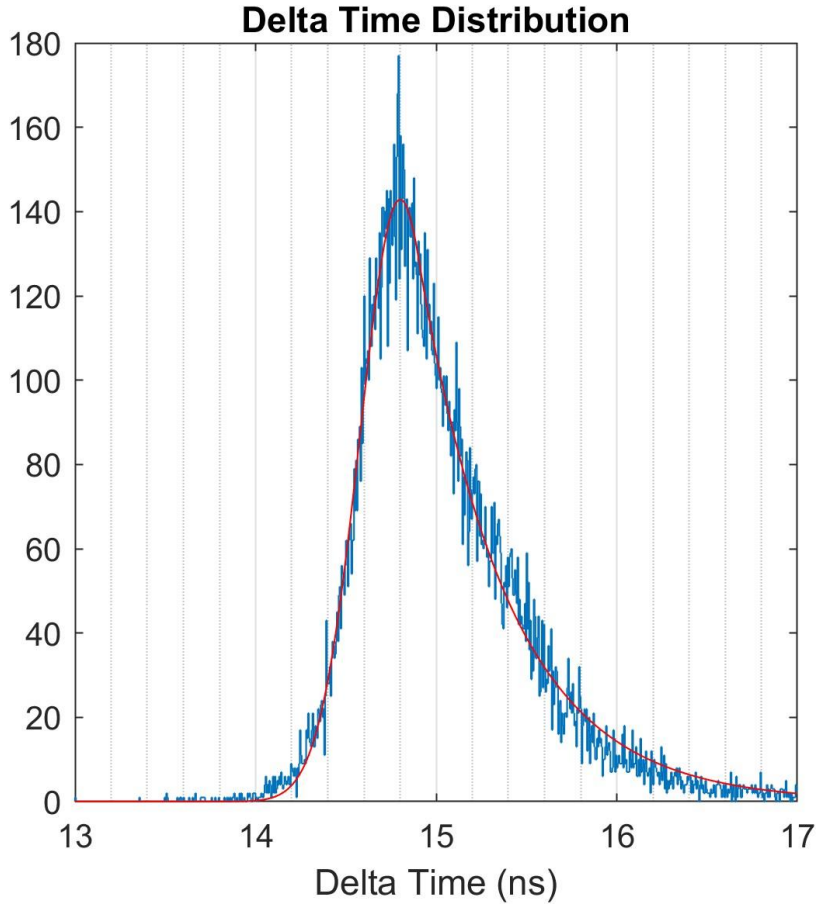


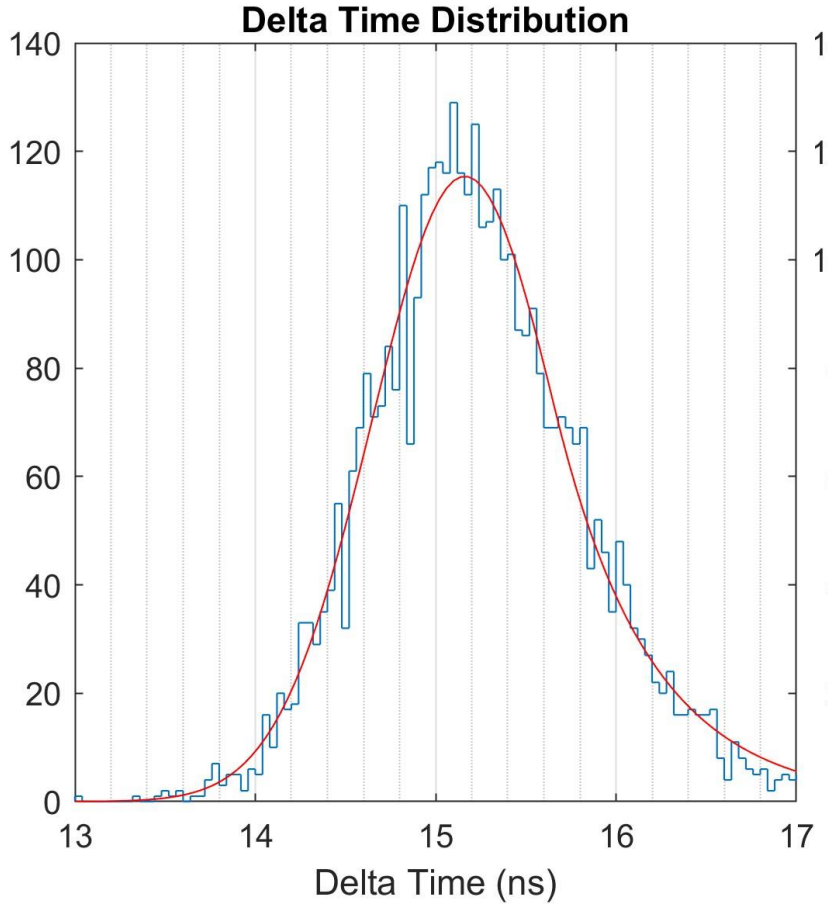


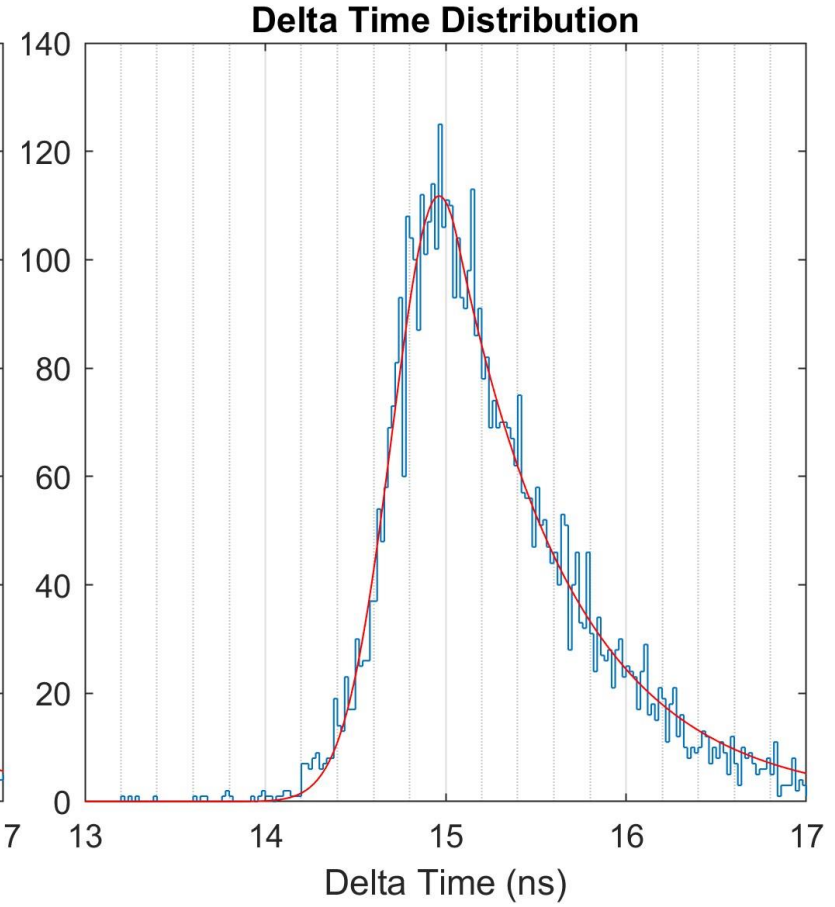
Experimental data (time calibration)

Event fitting

A tail in the right-side of the distrubution is sometimes present, a Gaussian merged with and exp function is used.





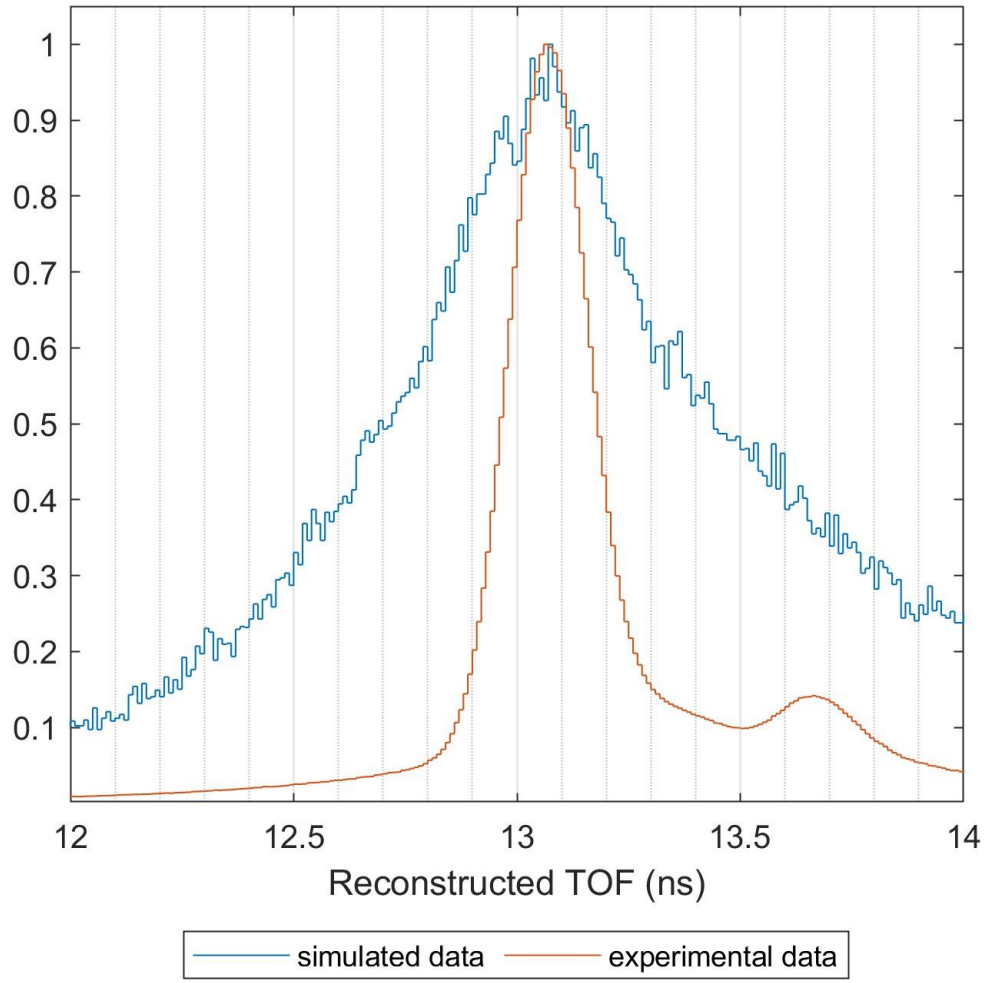


Experimental data (time calibration)

Reconstructed delta-time

Same check as before, but we still nedd to put the calibration into SHOE and verify the results...

WORK IN PROGRESS



To Do

- Finalize the checks on the time calibration
- Use the information of the TW scan to verify if some improvements on the energy calibration are possible
- Compare the energy calibration with that one of the CNAO 2022 campaign
- Verify that the peaks positions is constant in every run