

Coulomb Dissociation of ^{16}O into ^{12}C and ^4He Status of Analysis s494

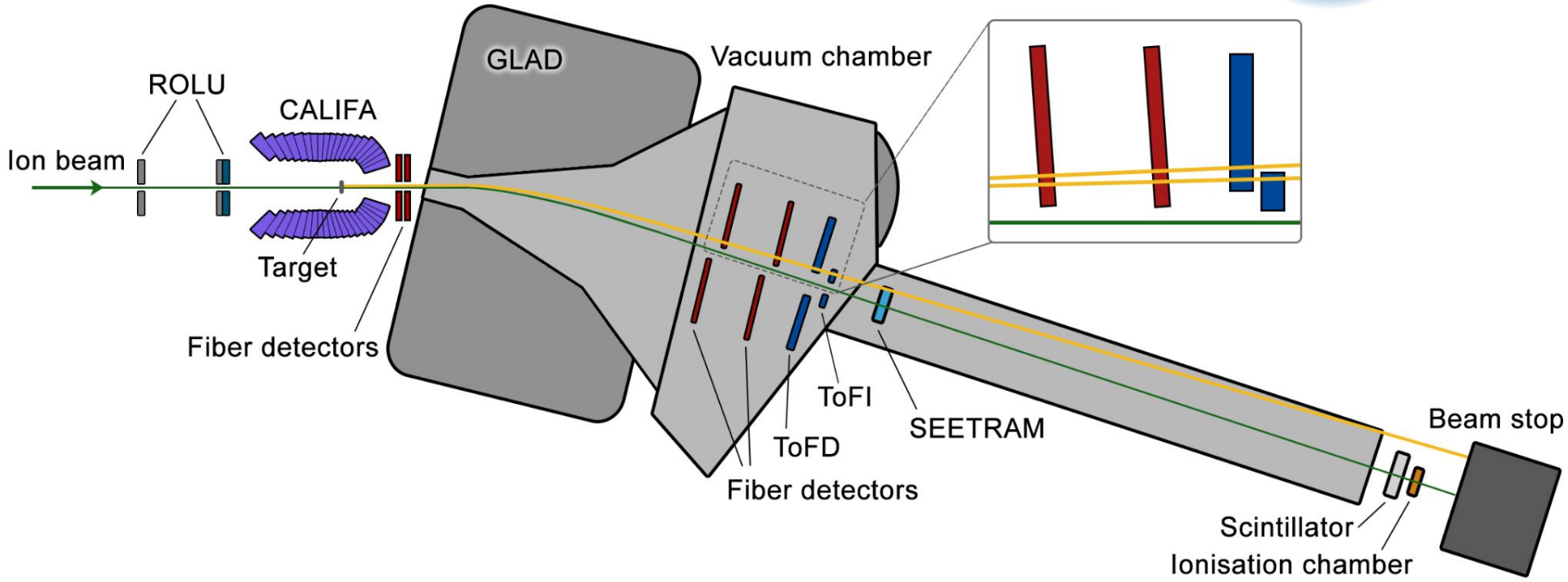
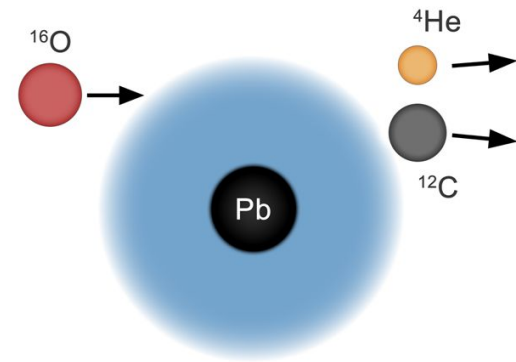
L. Bott, M. Heil, A. Kelić-Heil

R³B collaboration meeting Budapest, May 2023



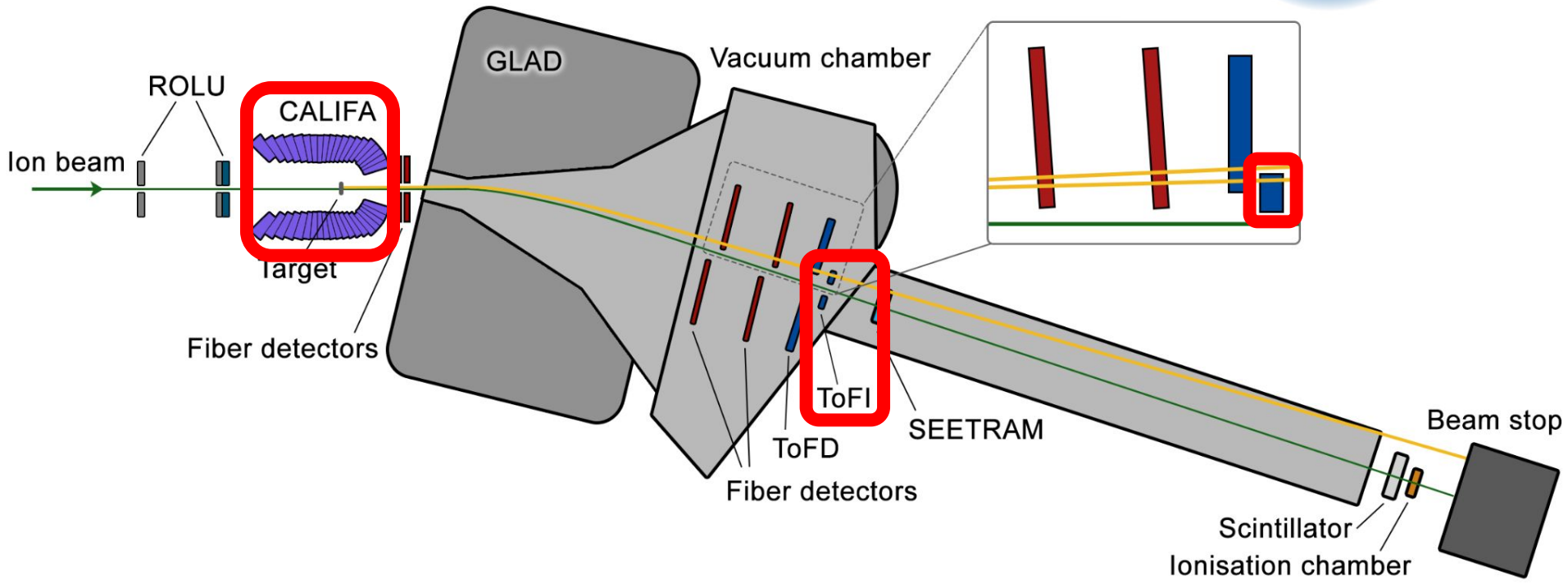
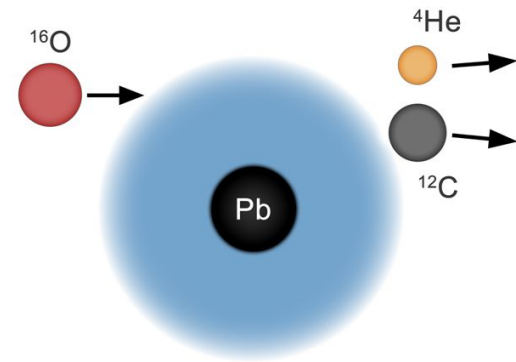
Experimental setup of s494 - Reminder

Goal: Measure Coulomb dissociation of ^{16}O into ^{12}C and ^4He



Experimental setup of s494 - Reminder

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Status at the meeting last year:

- Parameters for detector calibrations determined.
- Two trackers (Runge-Kutta and matrix tracker) developed.
- New data level “pretrack” to speed up tracking with Runge-Kutta has been introduced.
- Started with scripts for quality assurance of data.
- Only few runs analysed in order to test trackers.

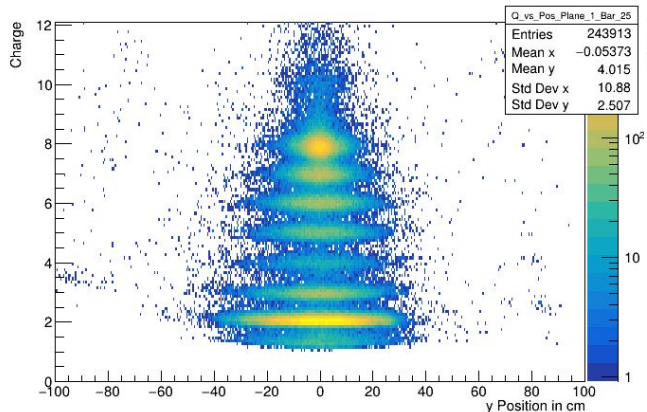
What has been done since the last meeting:

- ToFI data have been combined with ToFD data.
- Califa analysis has been included.
- All runs analysed using GSI hpc cluster.
- Extracting CD contribution to Erel.
- Subtracted contribution from excited states in $^{12}\text{C}^*$.
- Developed scripts for quality control.
- Comparison with the cdxsp theoretical model from Stefan Typel.

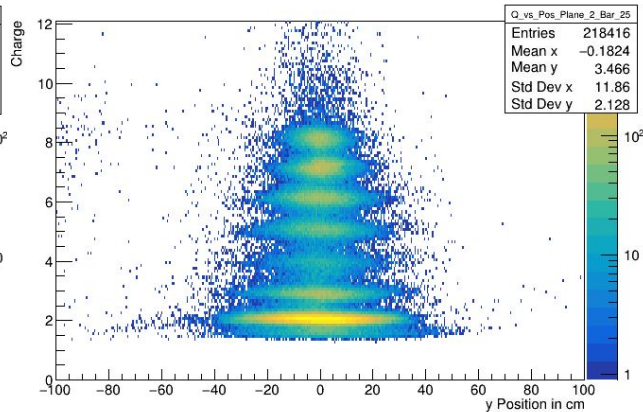
ToFI included

New cal2hit task, which writes both ToFD (planes 1&2) and ToFI (plane 3) data in the same hit branch.

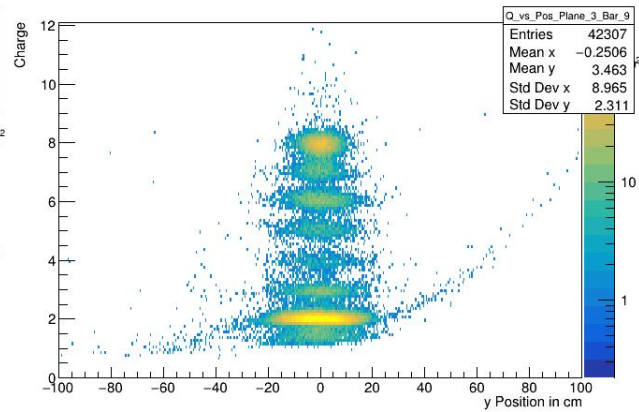
ToFD
Plane 1:



ToFD
Plane 2:

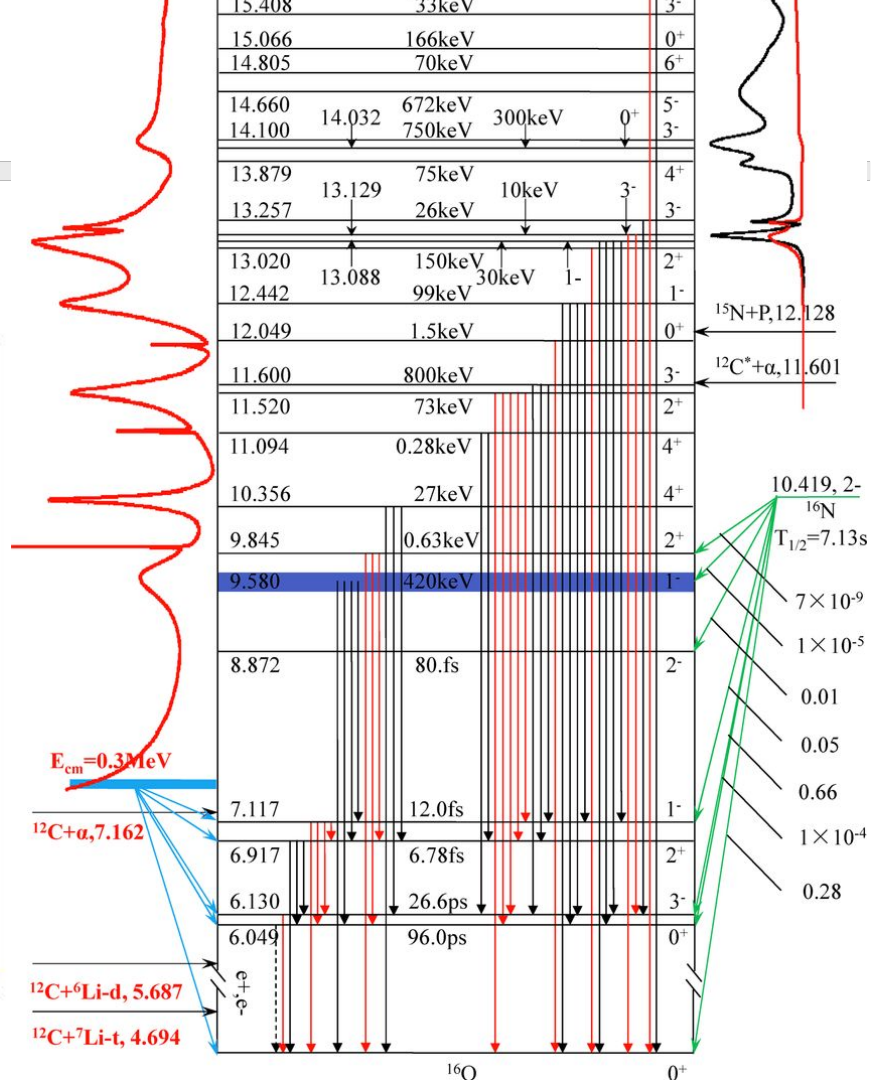
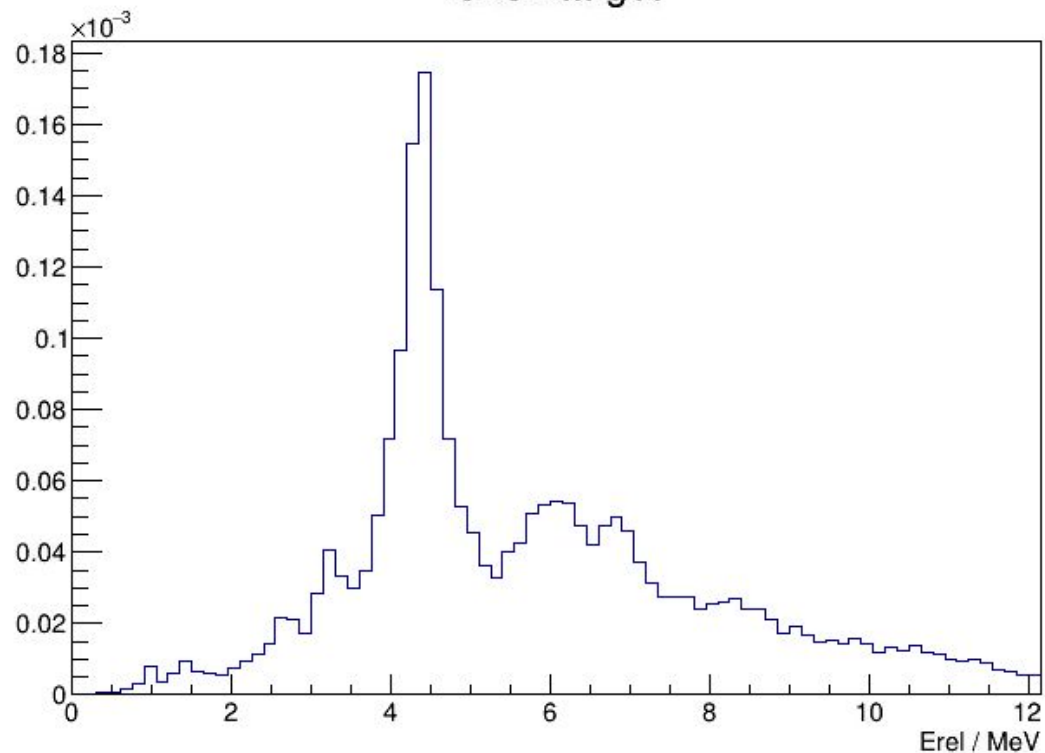


ToFI
Plane 3:

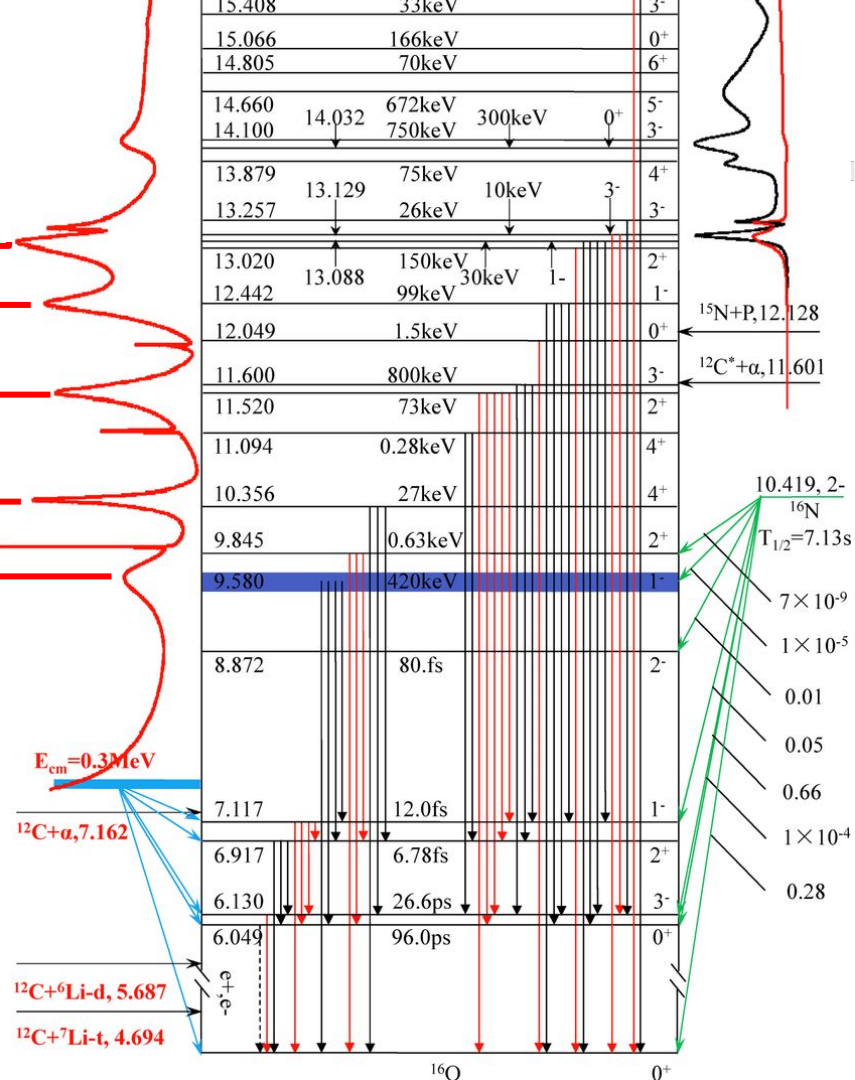
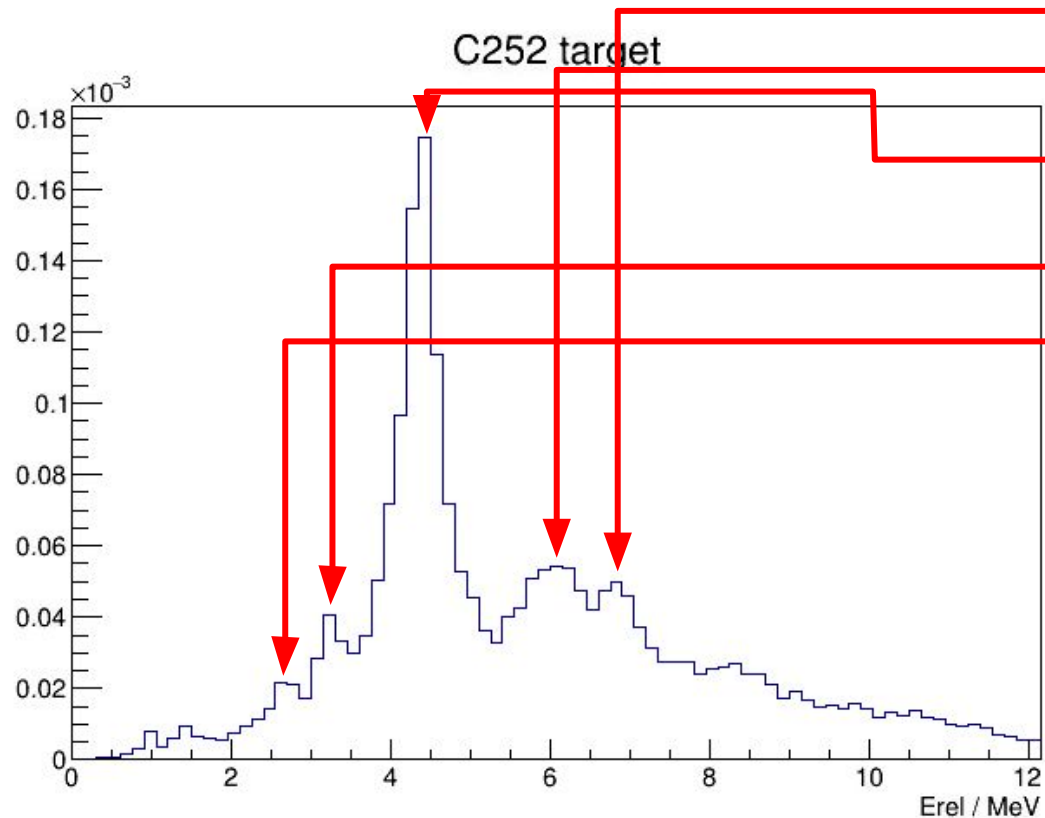


Erel to date...

C252 target



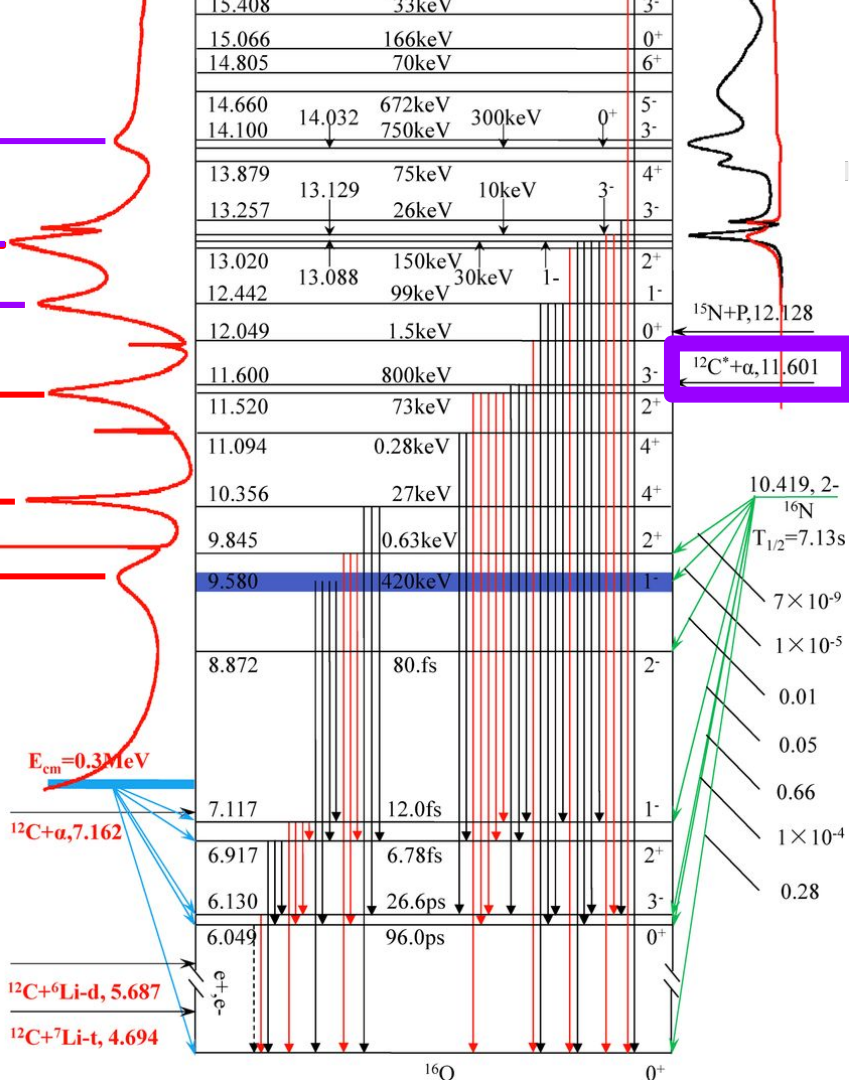
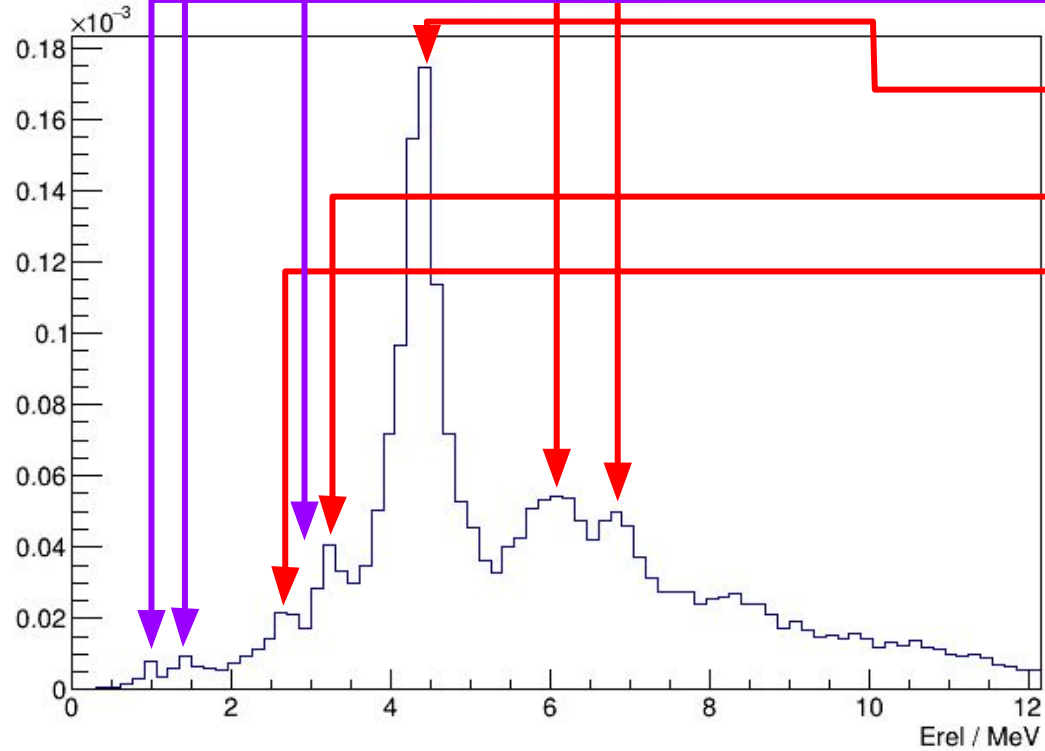
Erel to date...



Erel to date...

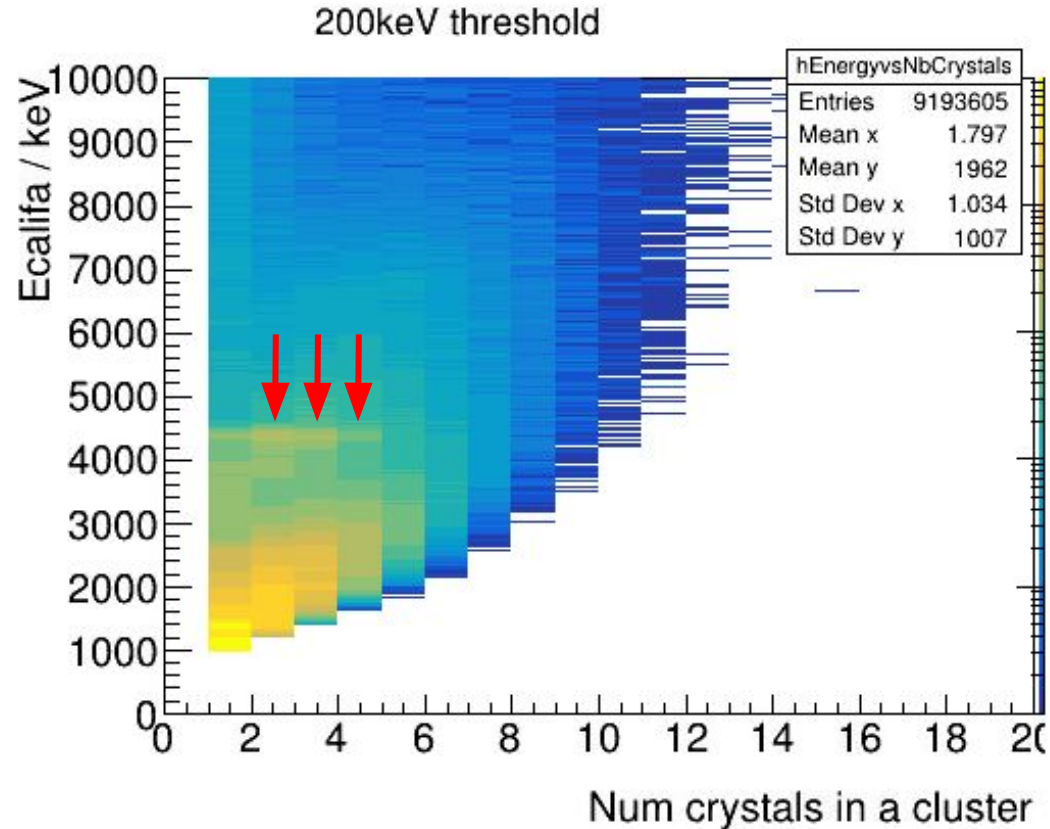
?

C252 target

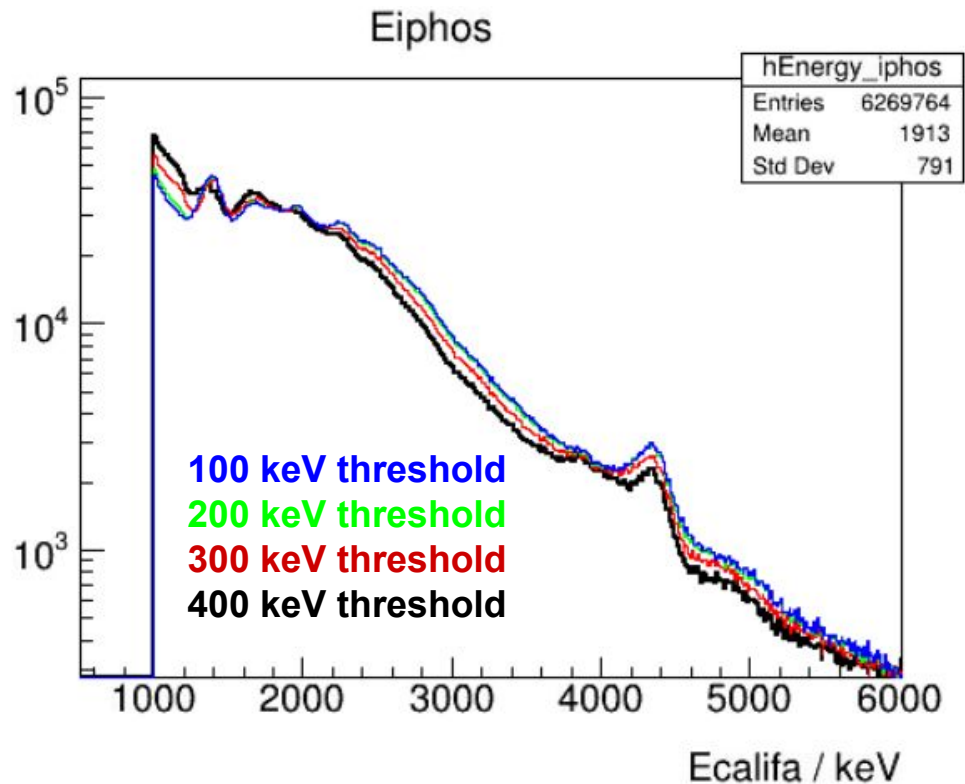
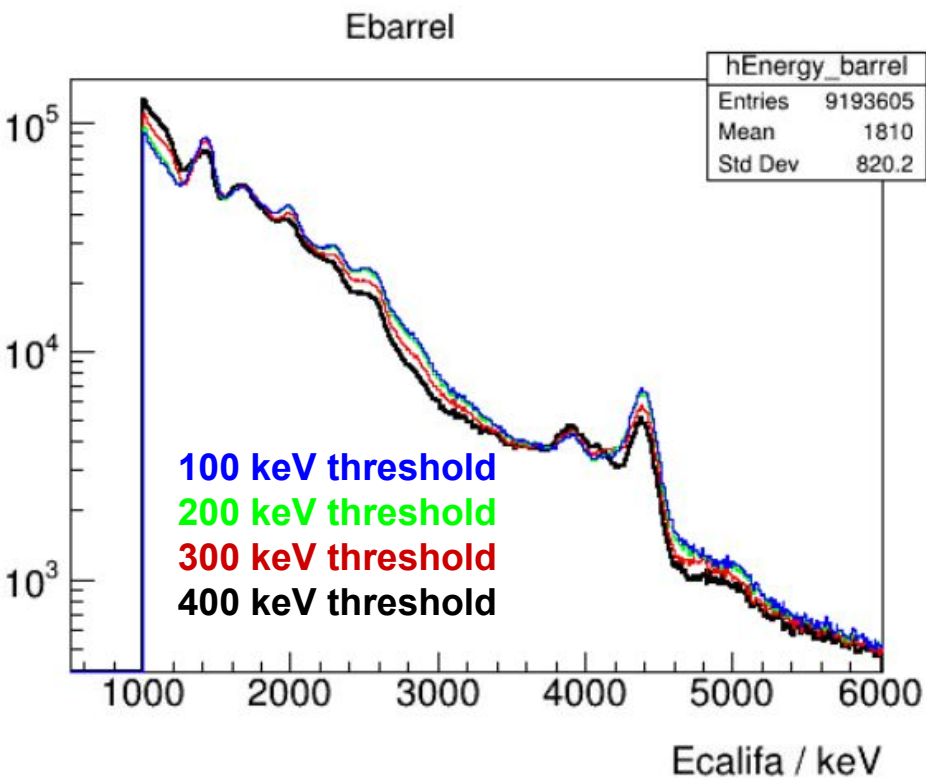


Califa included

- Calibration parameters:
/u/land/r3broot/202105_s494/online_macros/parameter/calibpar_jluis_s494_22Na_ascii_ver2.par
- Clustering method from Gabriel
- Checking with run 938 with Am-Be source



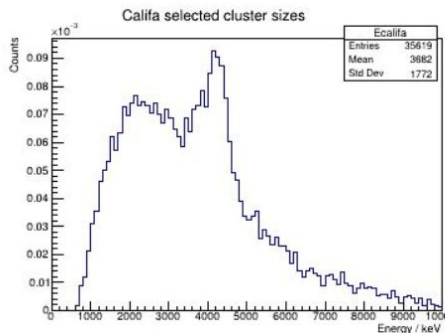
Califa included



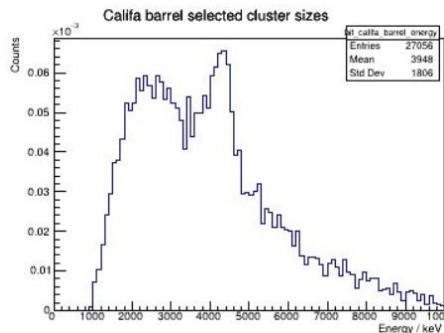
Califa included

- Examples of Califa spectra for Pb 38 μm target (top) and C 252 μm (bottom):

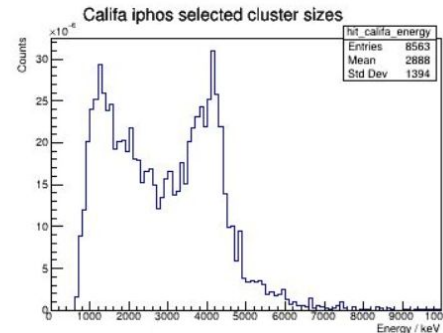
Sum:



Barrel:

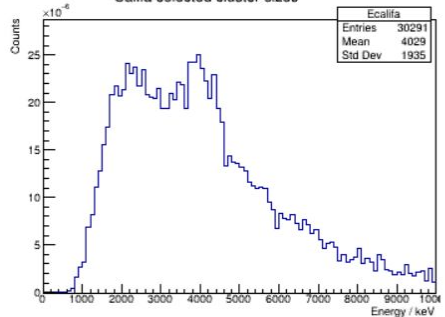


Iphos:



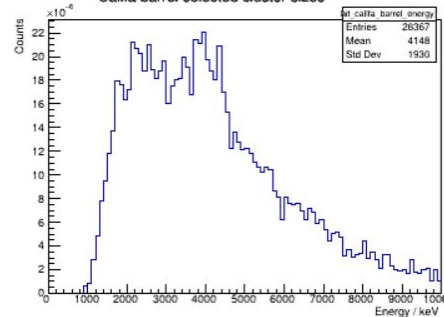
Pb target:

Califa selected cluster sizes

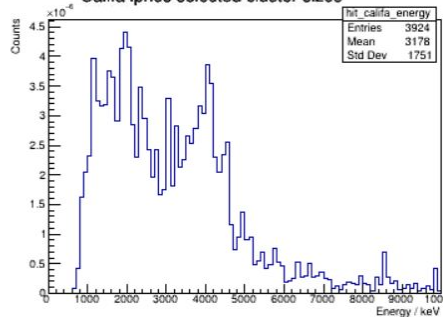


C target:

Califa barrel selected cluster sizes



Califa iphos selected cluster sizes



Using time difference Califa-ToFD

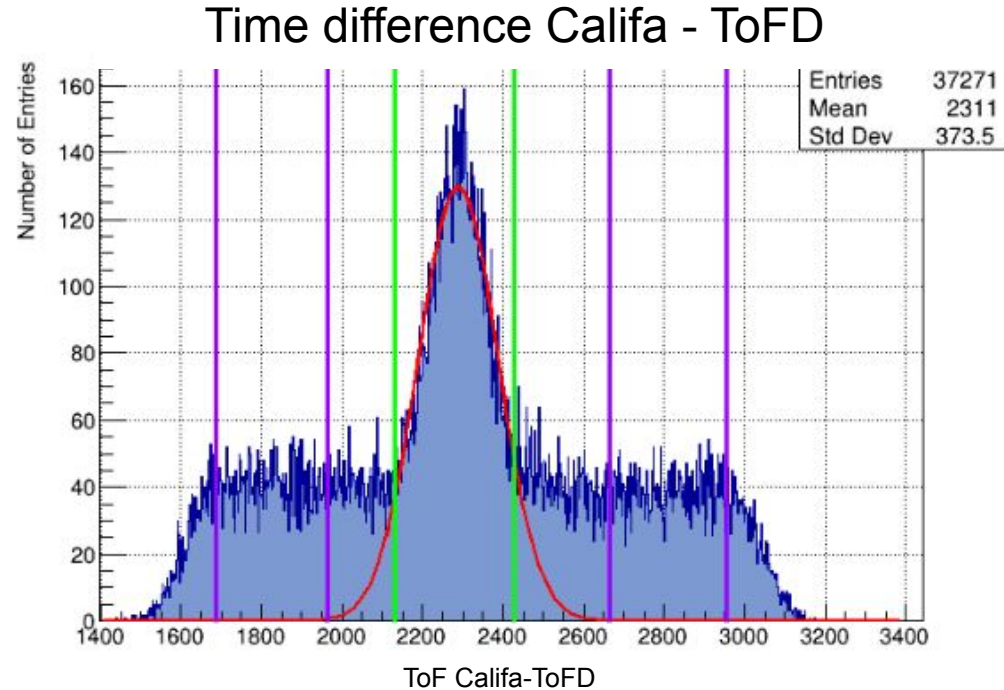
Mean: 2288 ns

Sigma: 10 ns

Mean \pm 3sigma: (1891-2586) ns

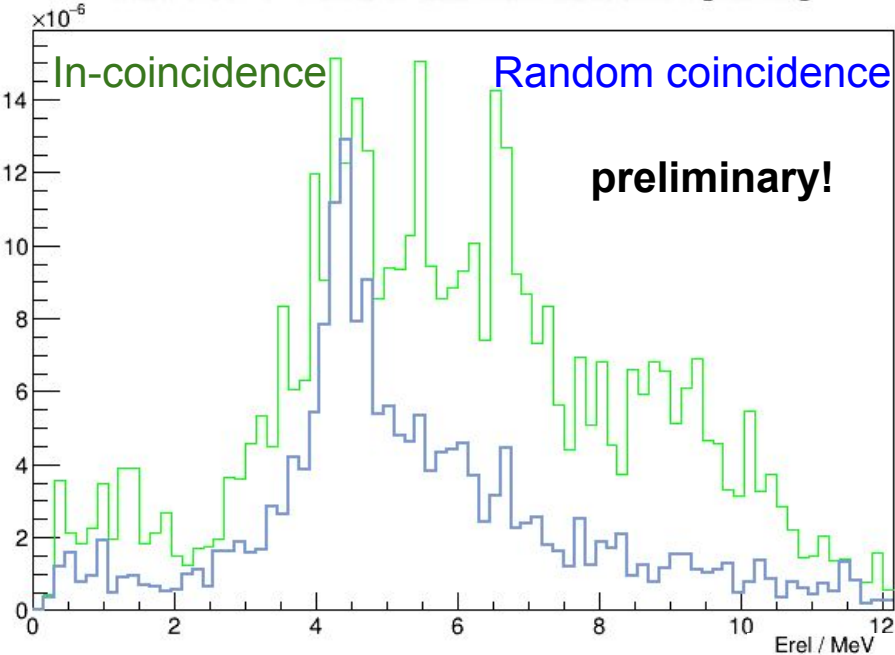
In-coincidence: tof=(2138,2440) ns

Random coinc: tof=(1665,1967) ns
(2656,2958) ns

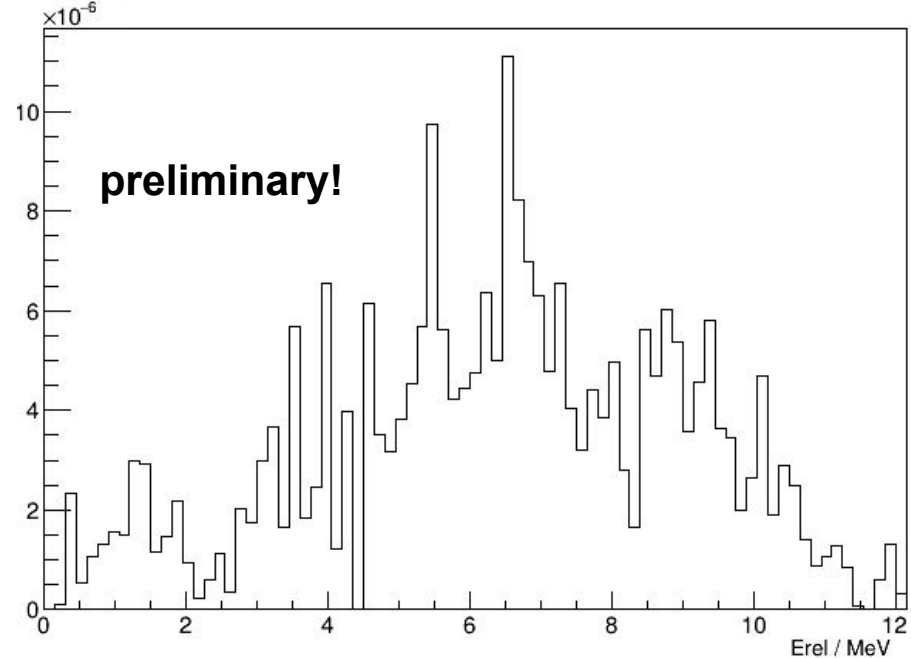


Excited-states contribution

Erel with 4.4MeV cut in Califa, below grazing



Difference between the two:



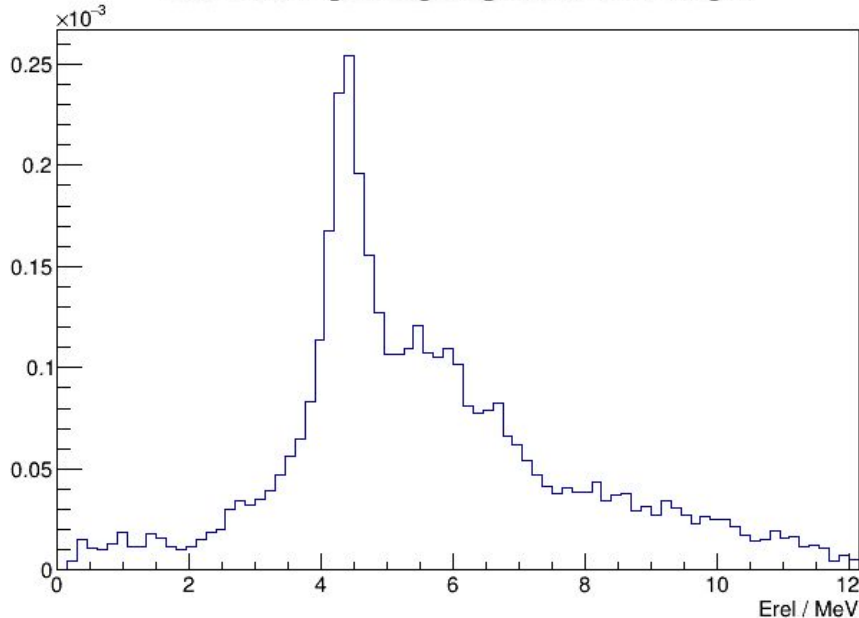
low statistics in Califa due to:

- crystals not mounted / read out
- **one half of the detector missing for most physics runs**

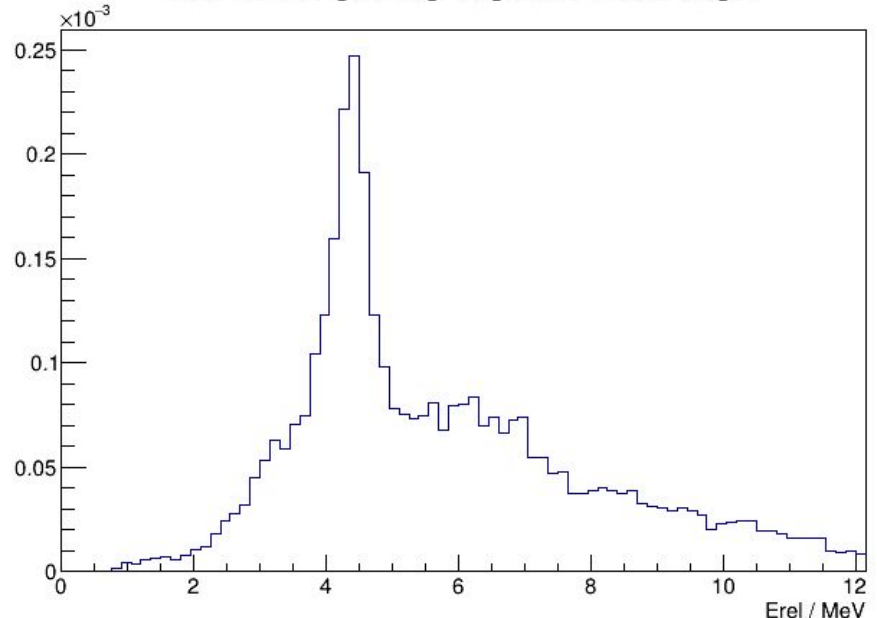
Extracting CD contribution

- Method 1: using grazing angle
below grazing angle: CD contribution, above grazing angle: nuclear.
- Spectra are shown before subtracting excited states in $^{12}\text{C}^*$

Erel below grazing angle for Pb38 target



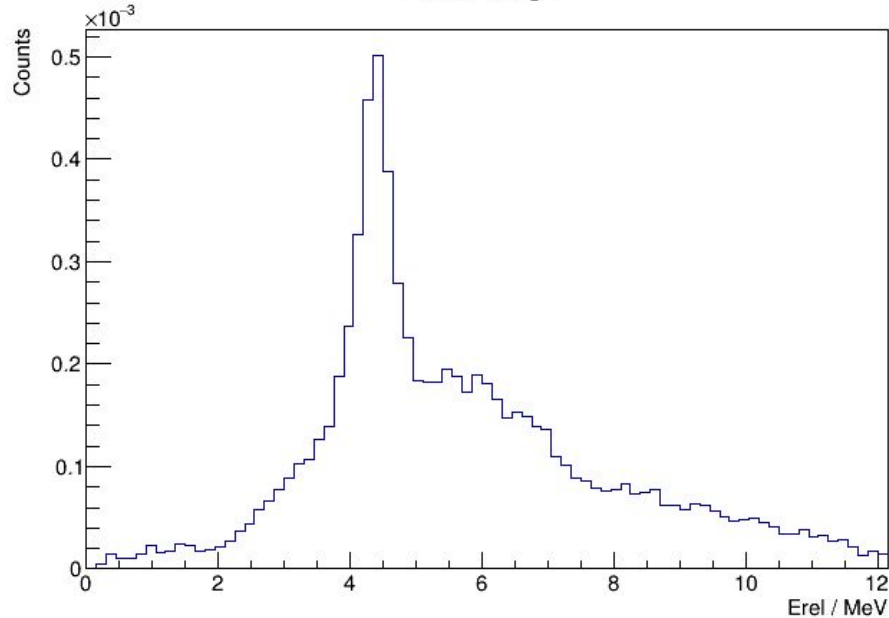
Erel above grazing angle for Pb38 target



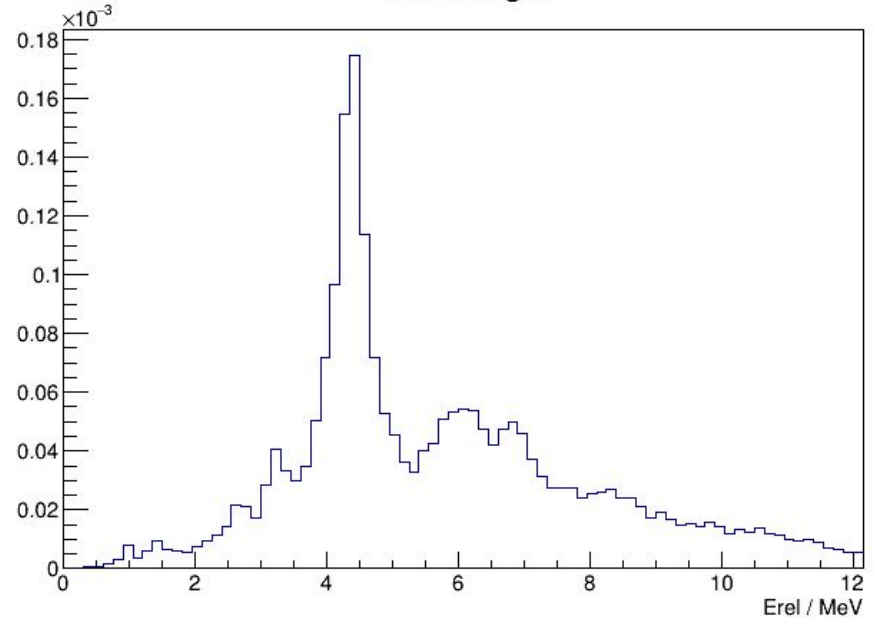
Extracting CD contribution

- Method 2: using C-target runs for subtracting nuclear contribution
- Spectra are shown before subtracting excited states in $^{12}\text{C}^*$

Pb38 target

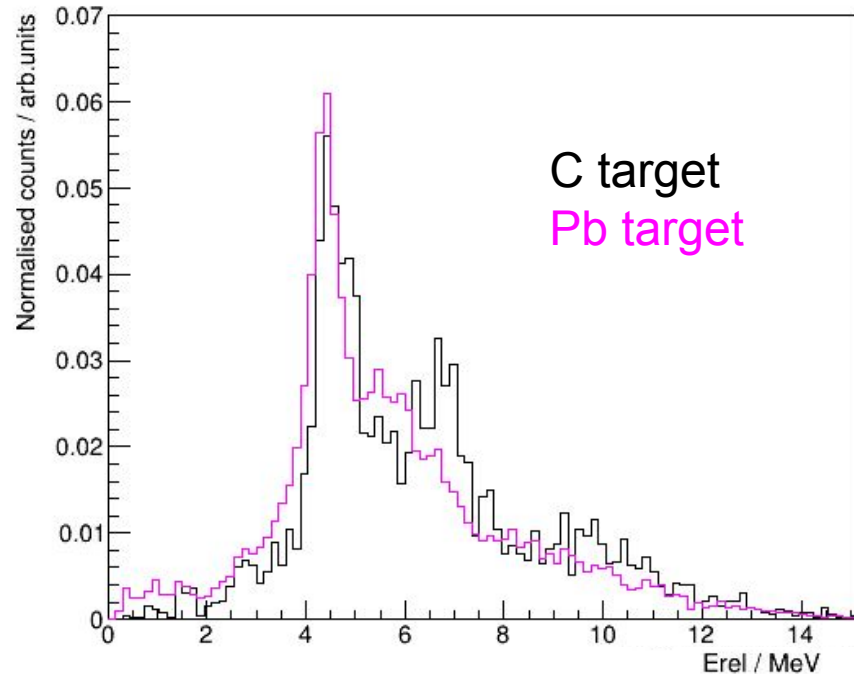


C252 target

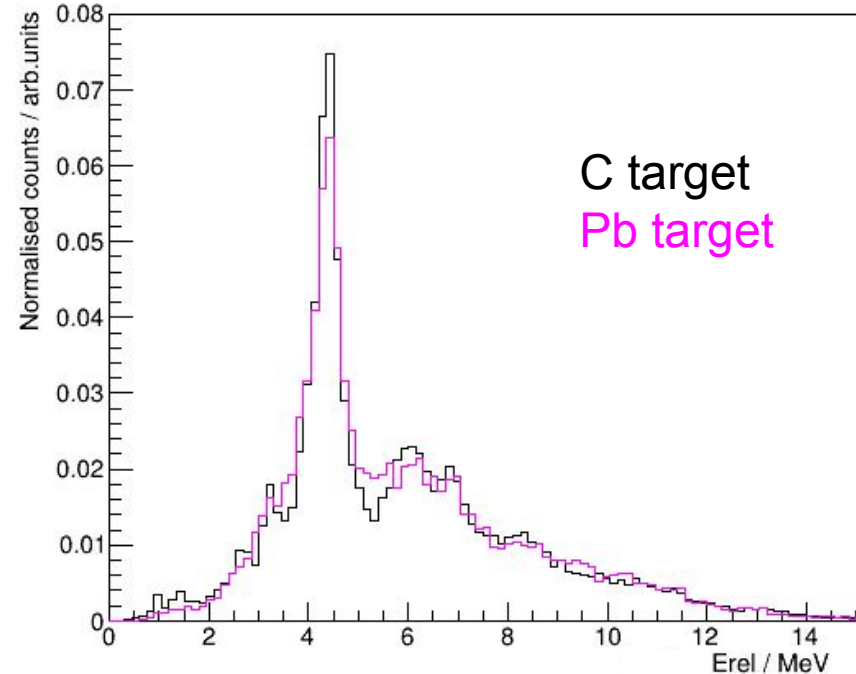


Attention: CD contribution of C target present

Below grazing angle

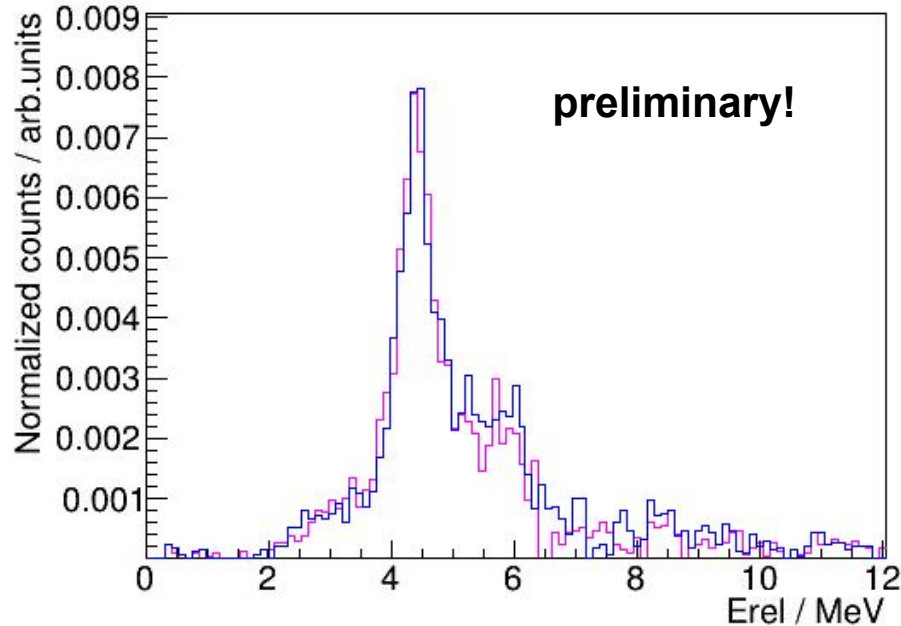


Above grazing angle



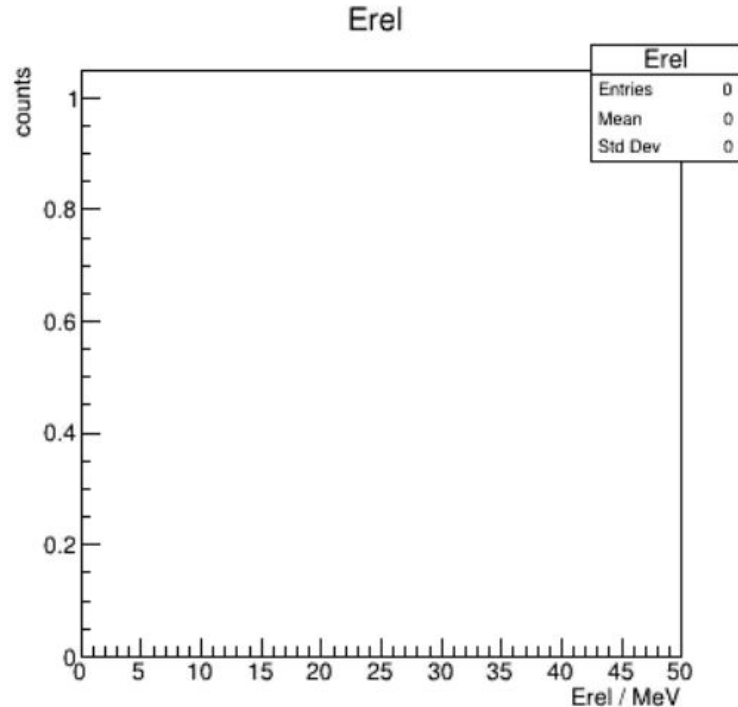
Extracting CD contribution to relative energy

- [Method 1](#): using grazing angle.
- [Method 2](#): using C-target runs for subtracting nuclear contribution.
- Contribution from excited states is (preliminary!) subtracted in spectra below.

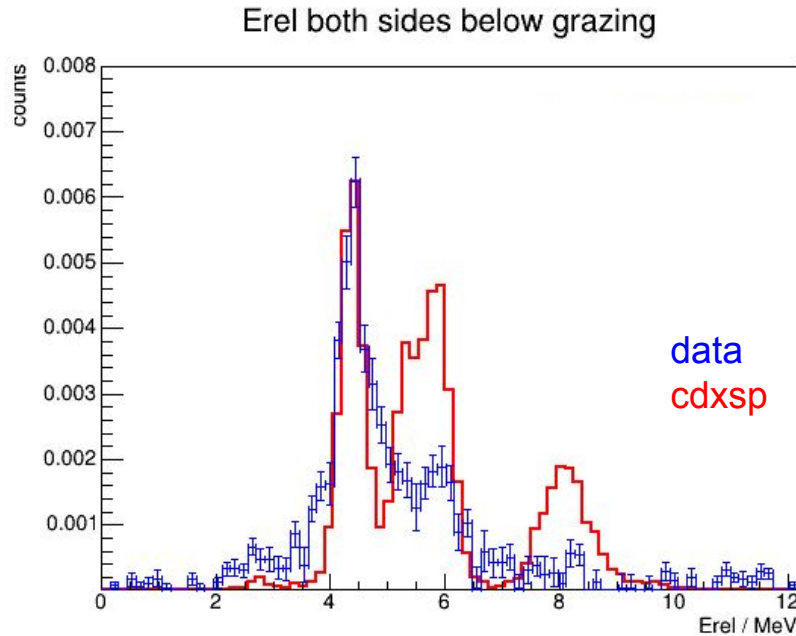


Empty target run (sum of all empty-target runs)

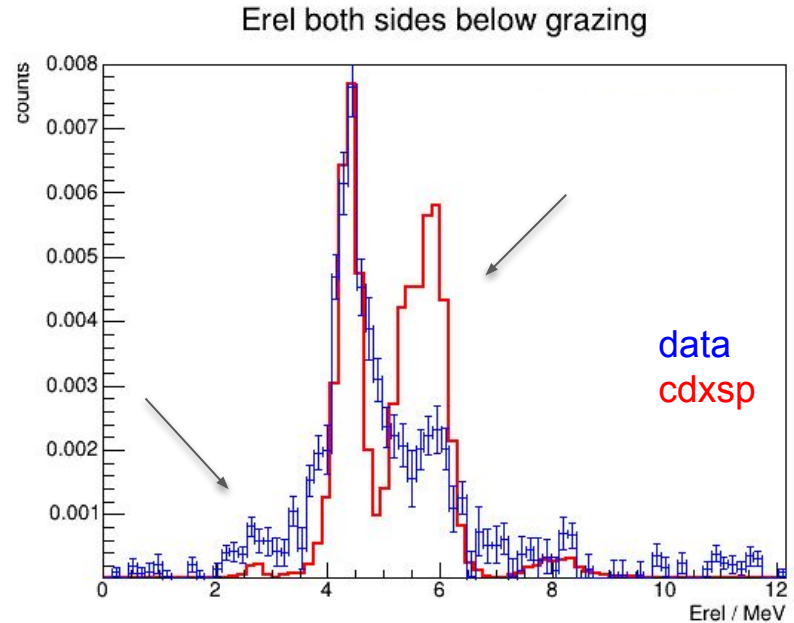
- As expected, empty runs were really “empty” - no events in Erel spectrum.
- Thus, no need for subtracting contribution from empty-target runs.



Comparison with theory - cdxsp model from Stefan Typel



standard parameter as starting point

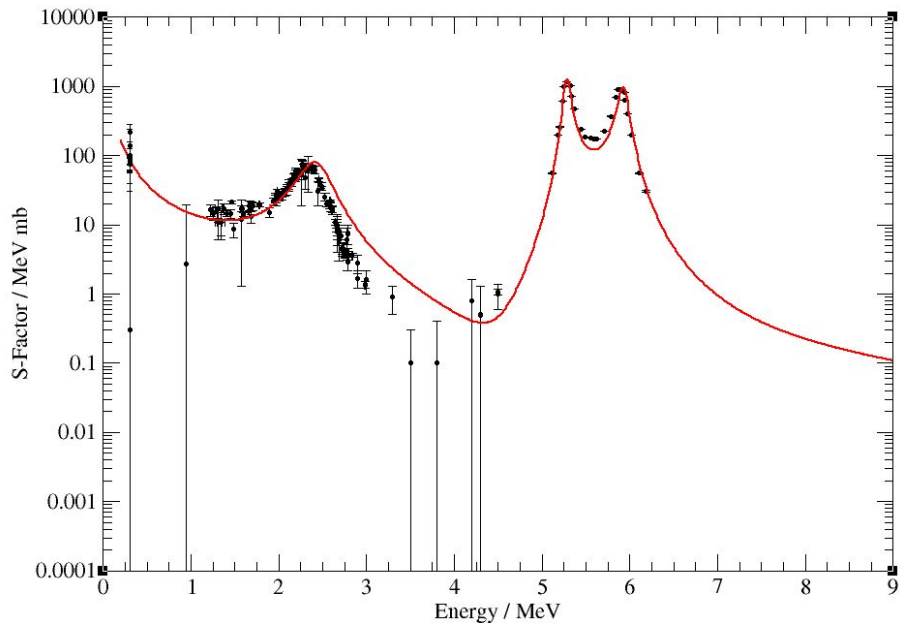


preliminary results after starting to adjust parameters

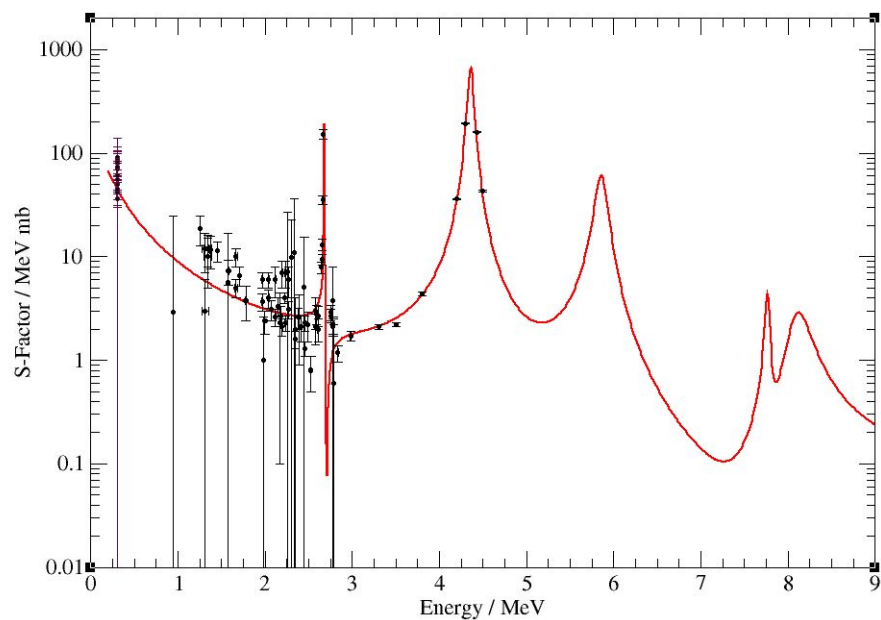
- Still to do: new calibration of the tracker (after GLAD measurements) and more detailed procedure of subtracting contribution of excited states.

Comparison of S-factor with previous data

S-Factor E1



S-Factor E2

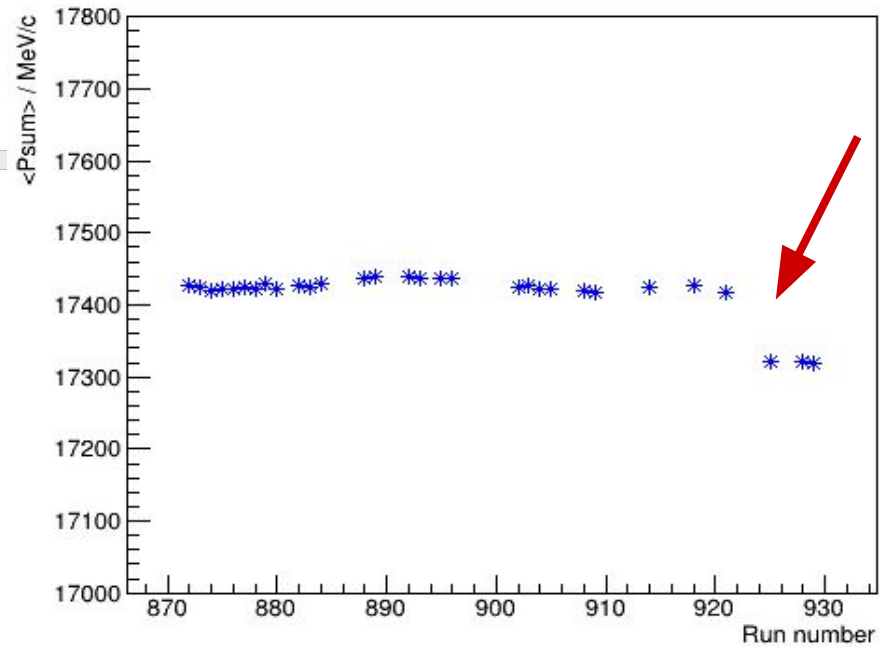
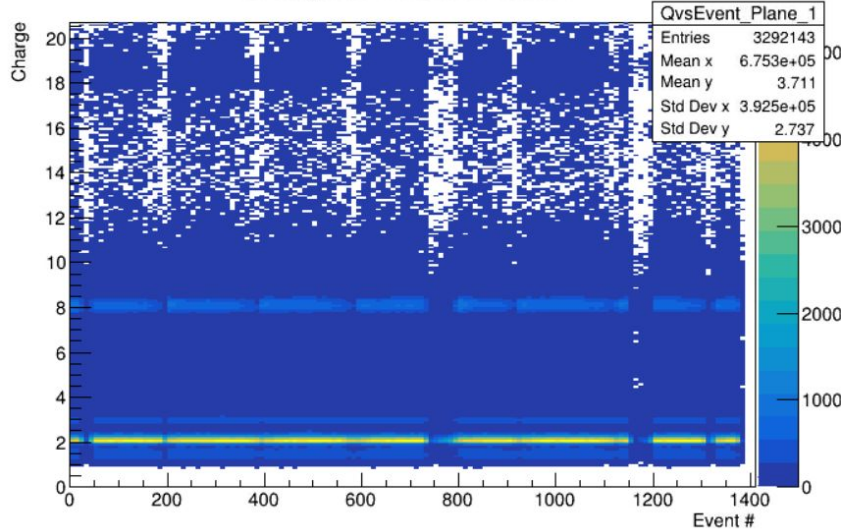


preliminary results after starting to adjust parameters

Quality control

- Example of a quality-control script checking the stability of nuclear charge in ToFD:

Charge vs Event # Plane 1



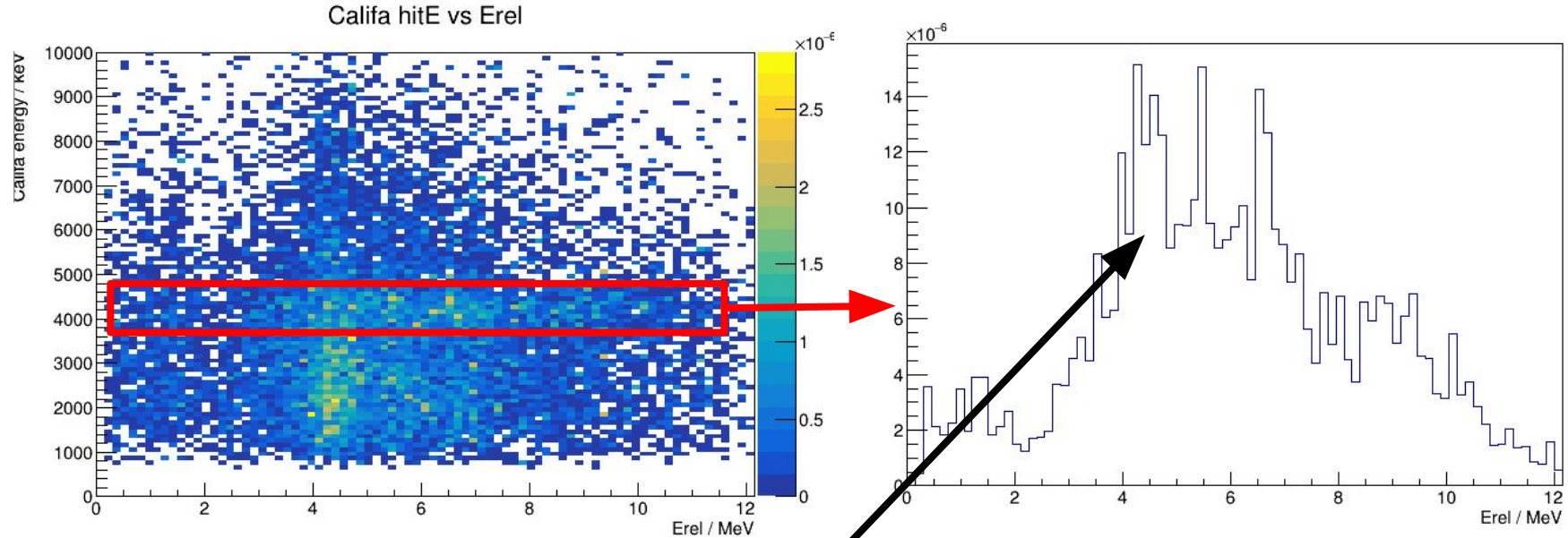
- Example of a shift in the average value of $\langle P_{sum} \rangle$: shift appeared after beam was given to mini-cbm, and consequent re-optimization of the beam during run 924. Afterwards, there is a shift in total momentum.

Outlook

- Further calibrations of tracker, especially after new field measurements of the GLAD magnet become available.
- Separation of E1 and E2 contributions.
- Detailed comparison with theory, including not only relative energy but also other observables.
- Finalising database including quality-control results.

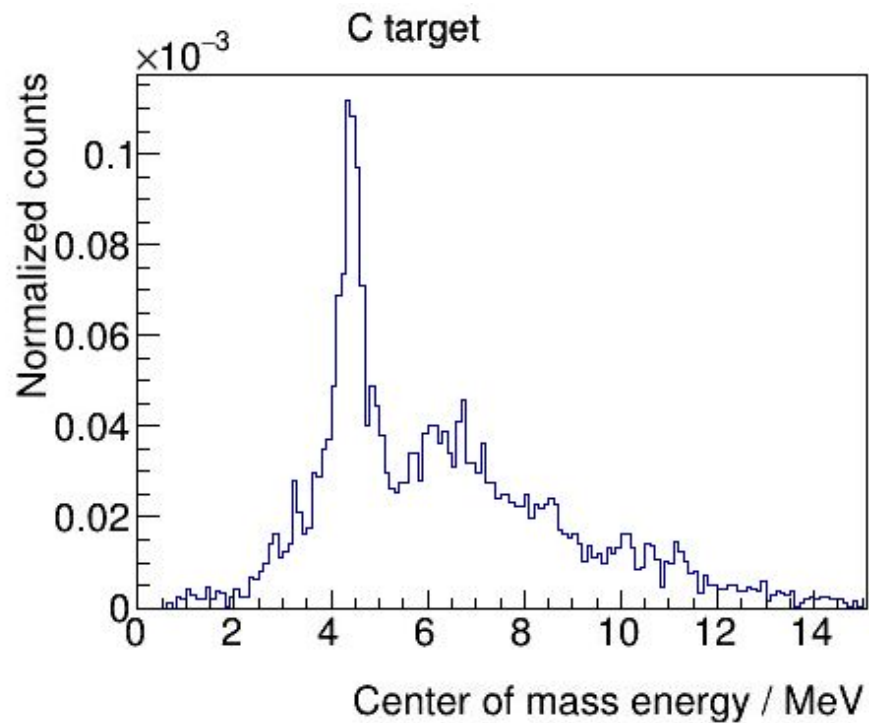
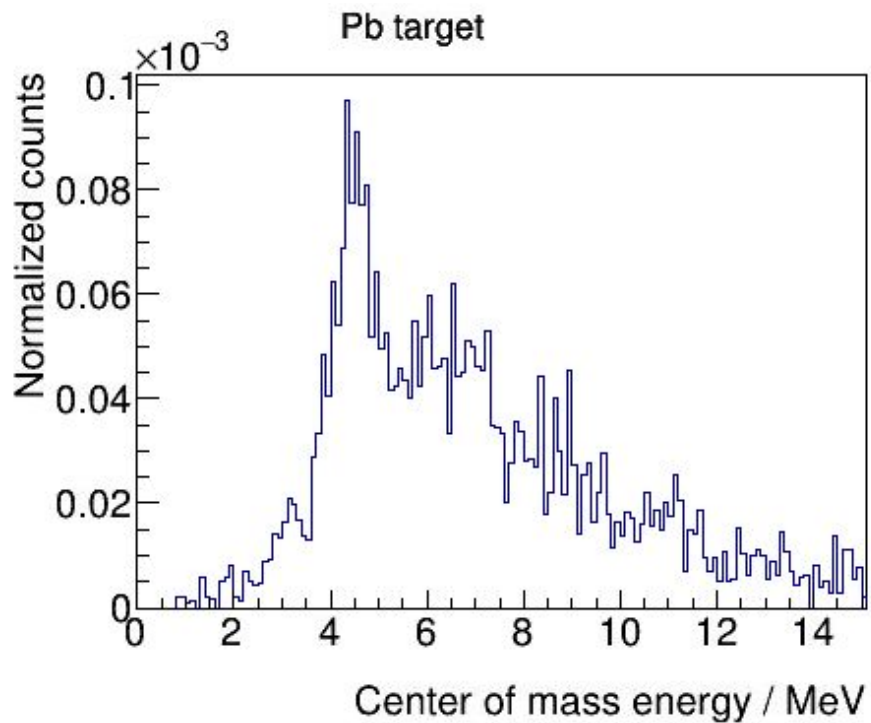
backup slides

Erel in coincidence with Califa - contribution from excited states in $^{12}\text{C}^*$

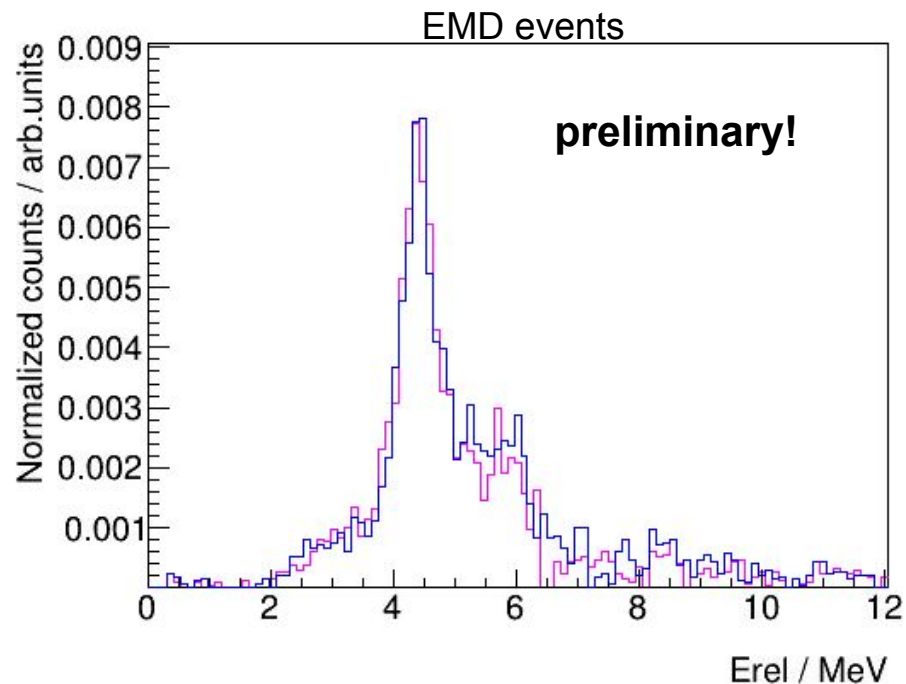
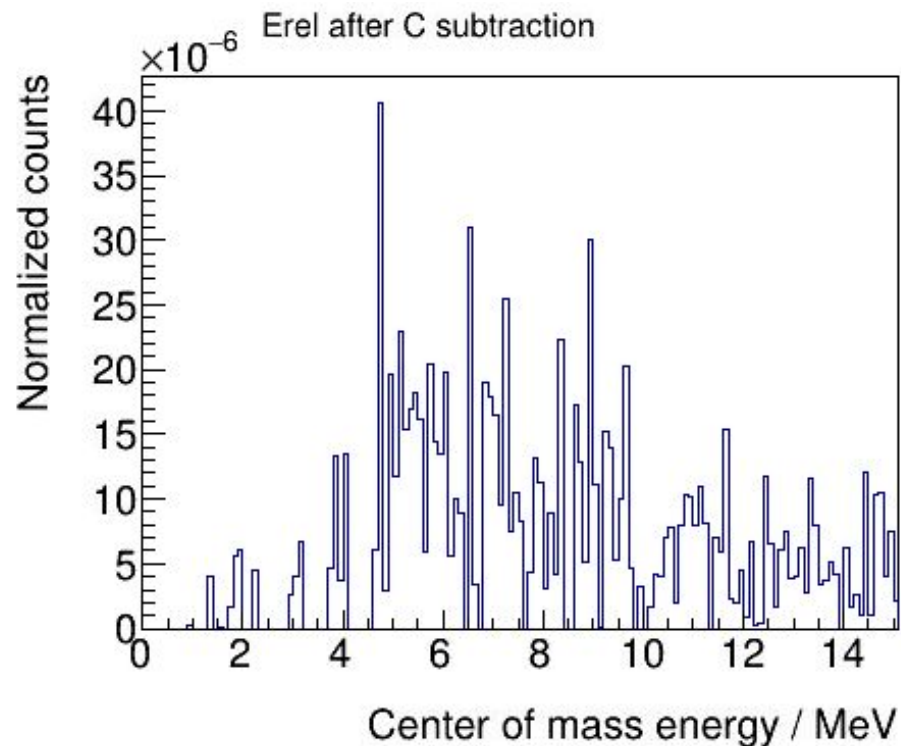


- Random coincidences still present.
- To remove them, we use a time difference between Califa and ToFD.

Erel Catania

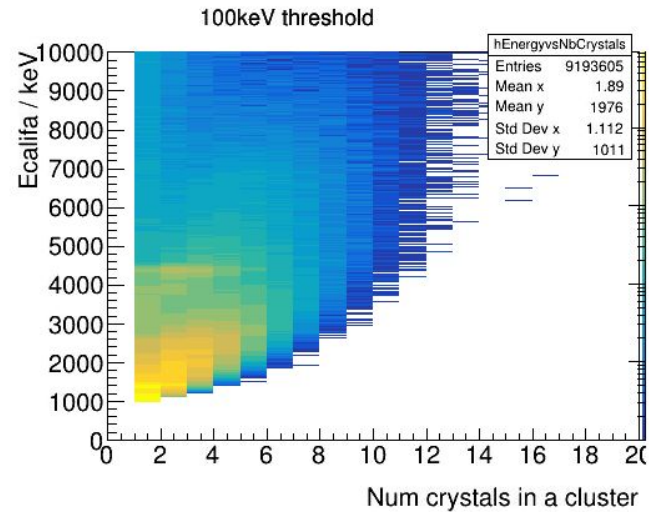
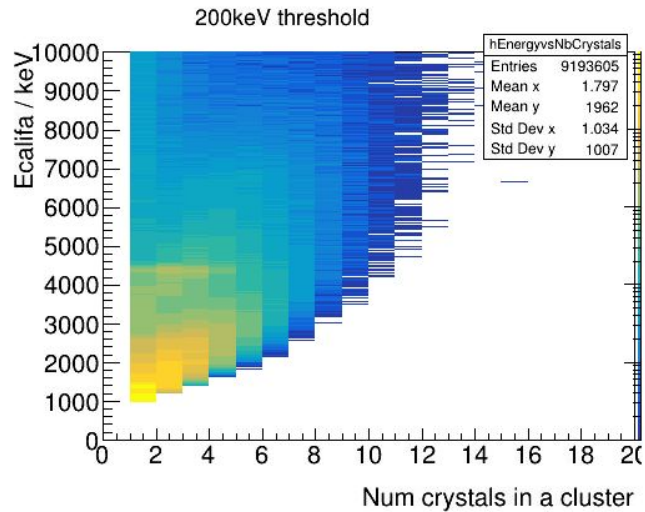
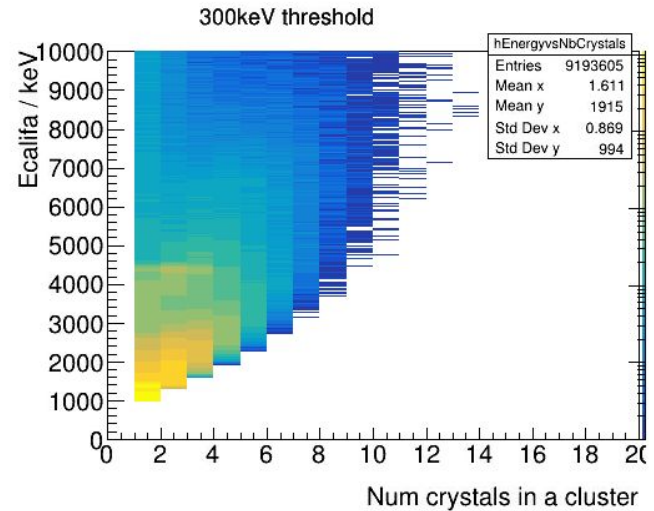
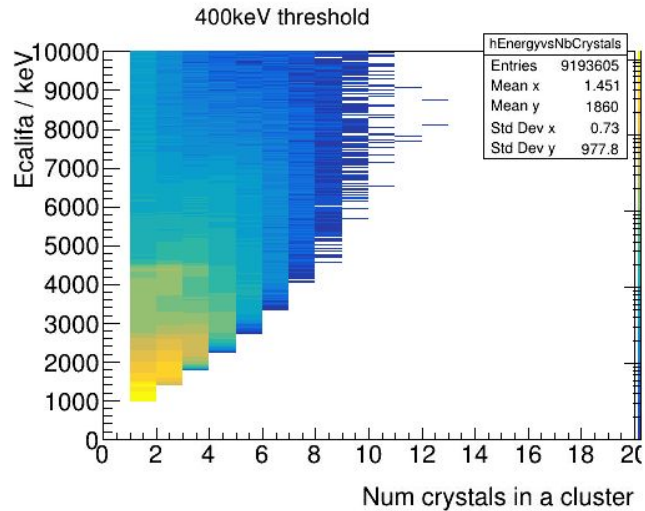


Erel Catania

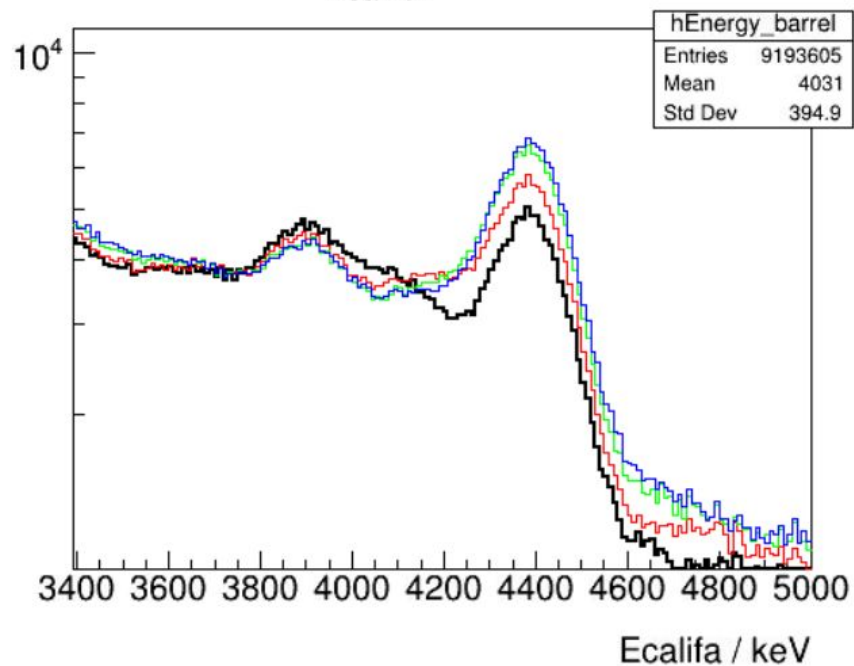


[Method 1](#): using grazing angle.

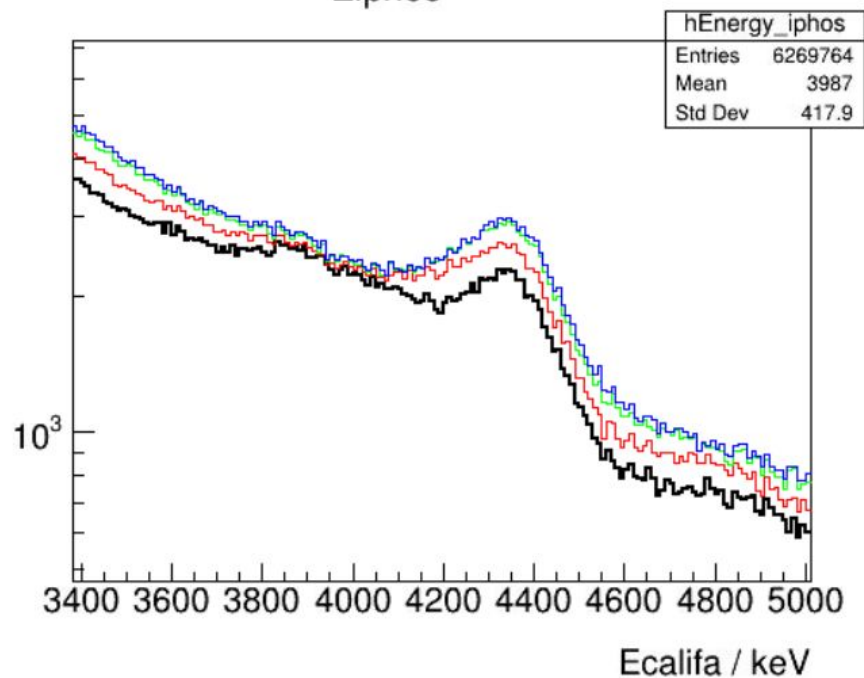
[Method 2](#): using C-target runs for subtracting



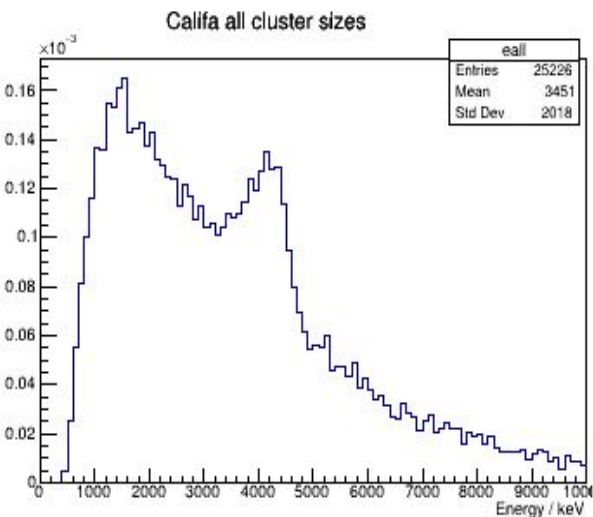
Ebarrel



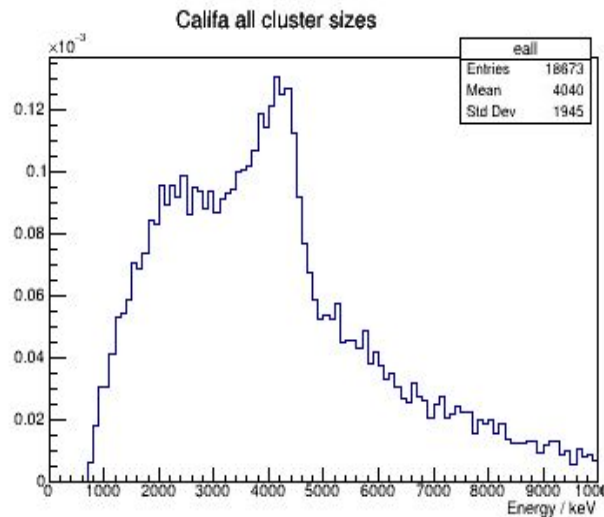
Eiphos



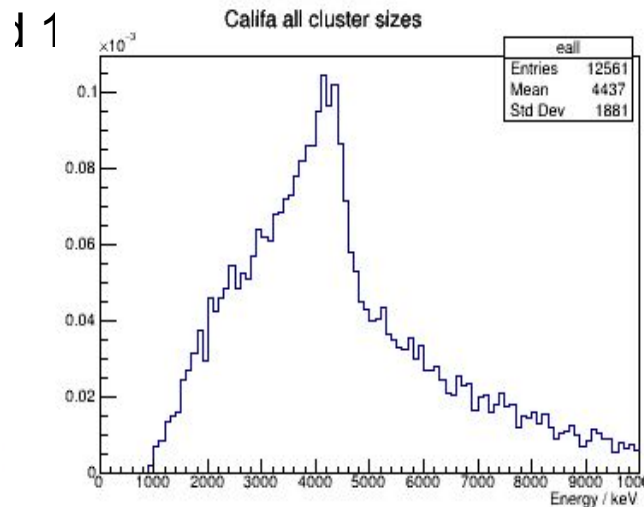
Pb target runs



cluster threshold 1.0MeV



cluster threshold 1.5MeV



cluster threshold 2.0MeV