Update on trigger

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Goal

- Limitated acquisition rate of the experiment ⟶ ~1 kHz —Fragmentation = 5%→ ~50 Hz

- **Goal** : select interesting events introducing a Trigger on data

- The idea is to introduce in the MC a threshold in Energy loss (that can be tuned from real data acquiring some events in MB trigger and after apply Eloss calibration)

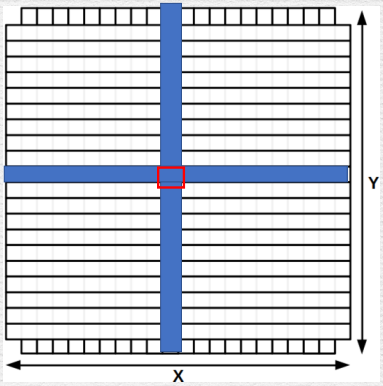
- **File** : ^{12}C (200 MeV) ⟶ C_2H_4

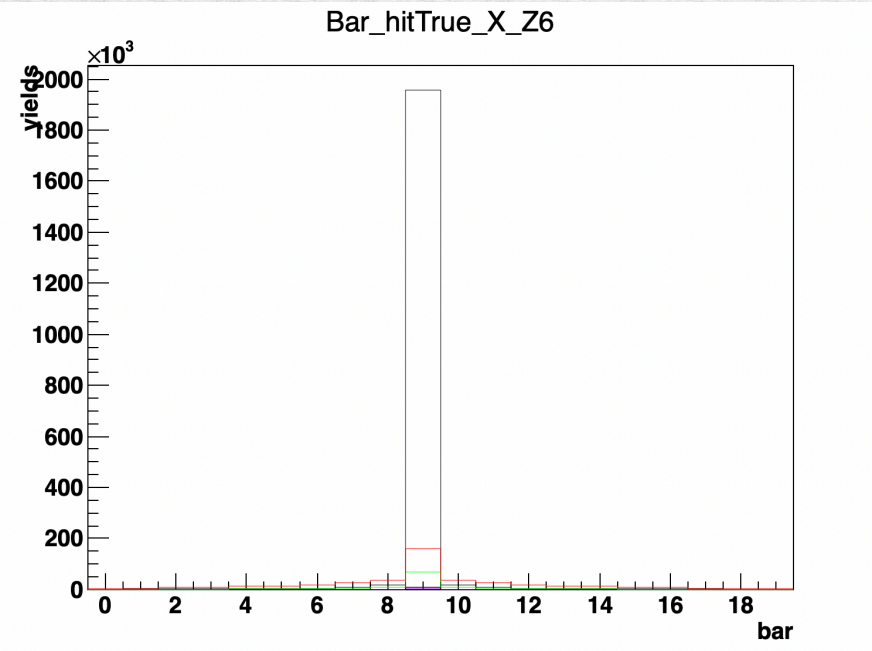
  $2 * 10^6$ events

  Untriggered (all primaries included)

MB trigger vs TW trigger

- We want to compare the **Minimum Bias** trigger to the one in which we introduce a veto using the central bars (n° 9) of the **Tof Wall**

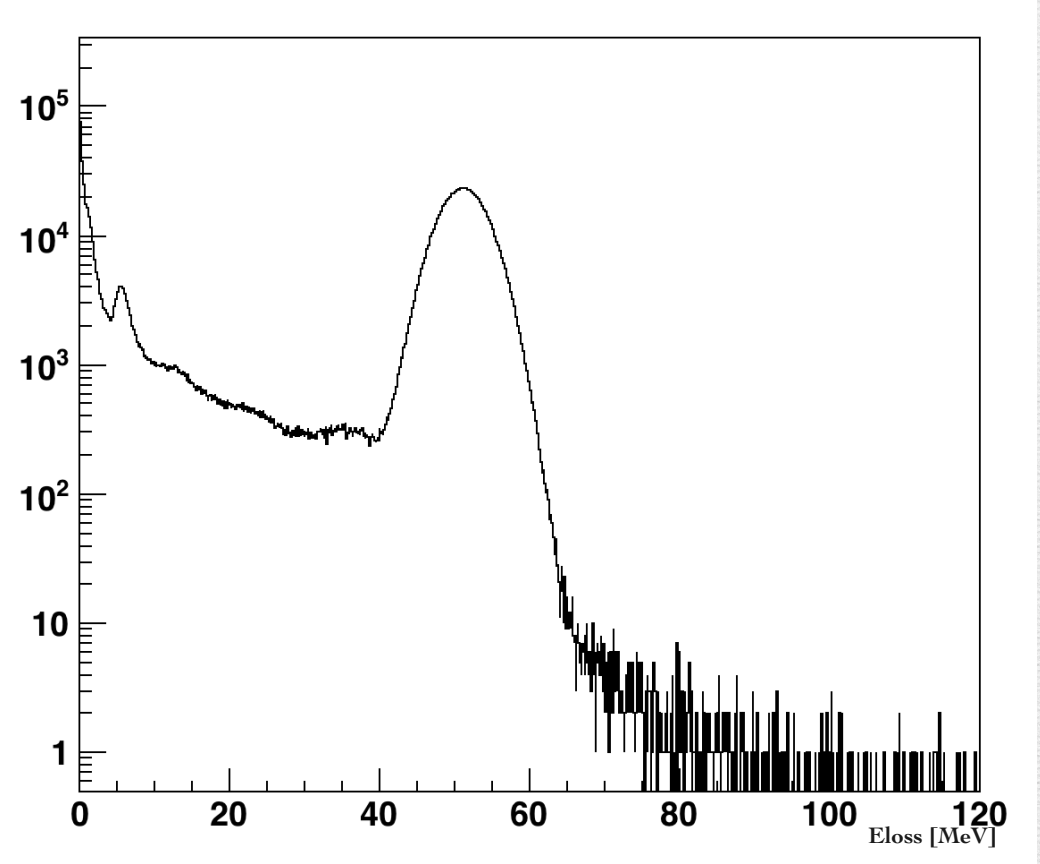




Cut away most of the primary ions

Yields of Energy Loss

- Untriggerd files are quite different from the triggered ones (lot of background)
- Looking at the Energy Loss yields, in order to clean our sample, we make some cuts:



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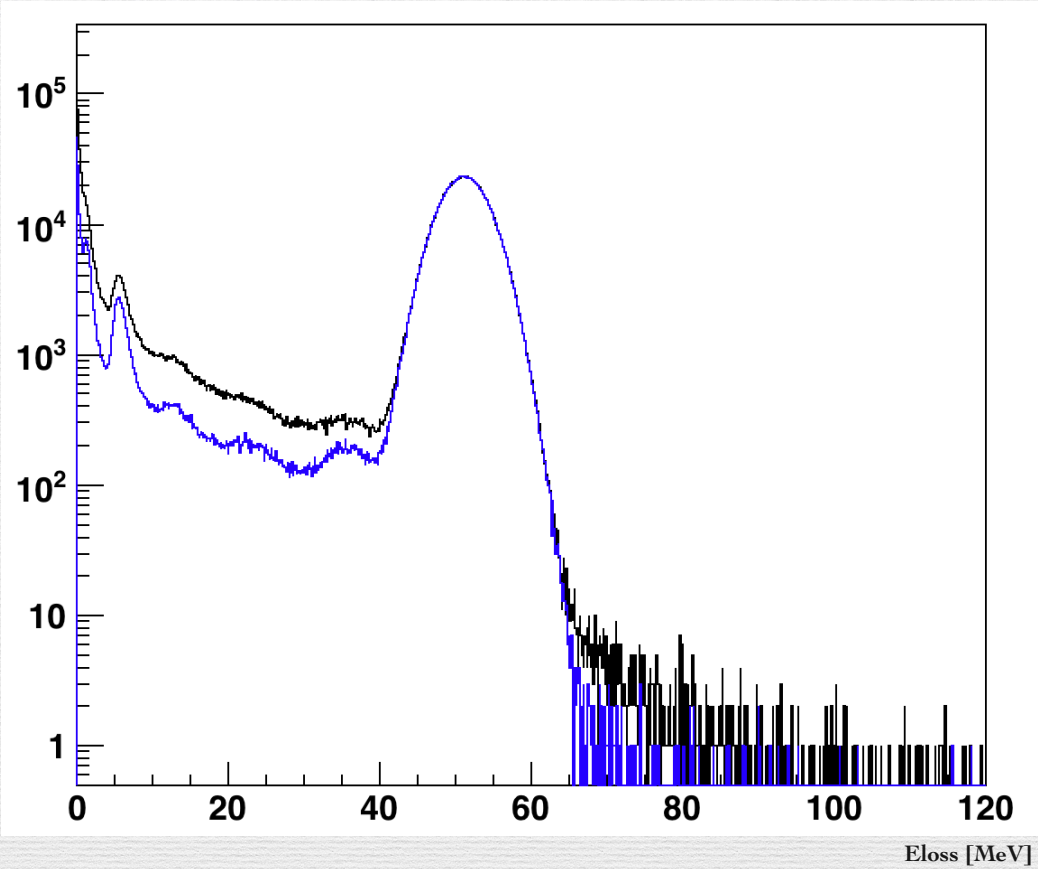
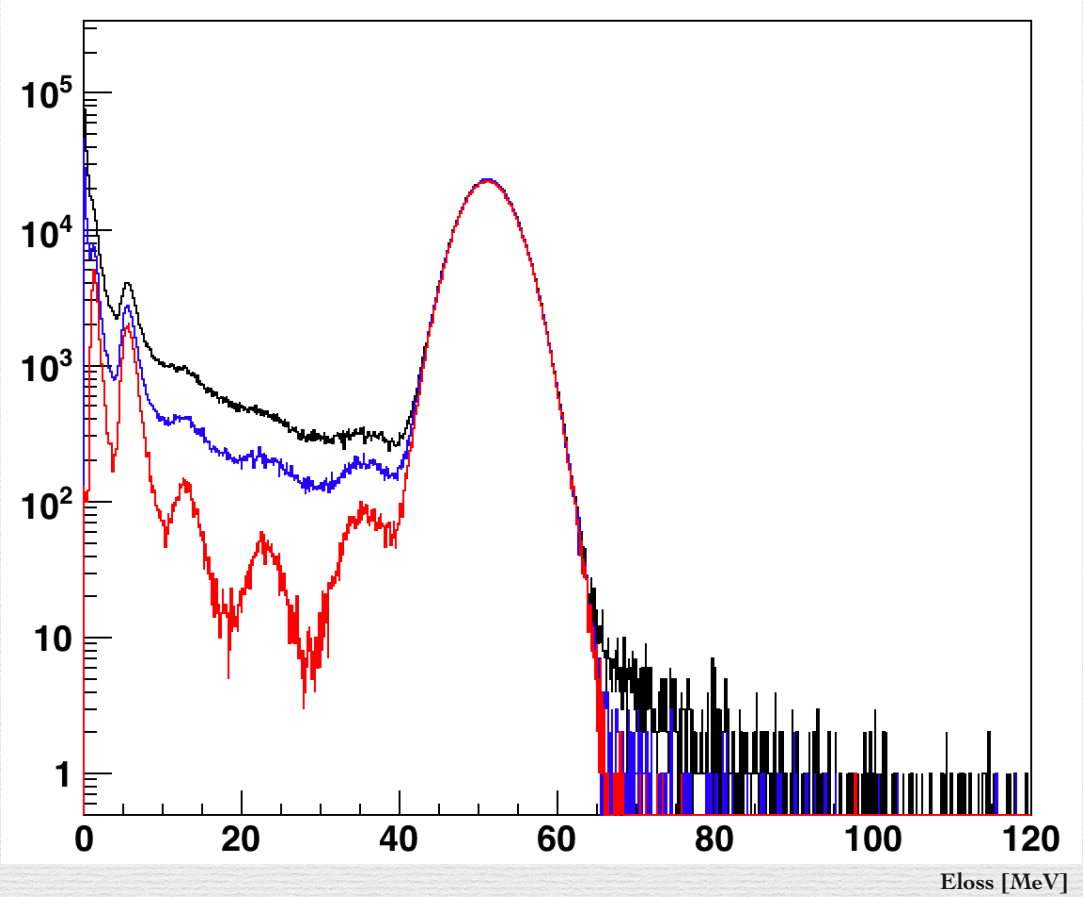
  1. No Multi hit



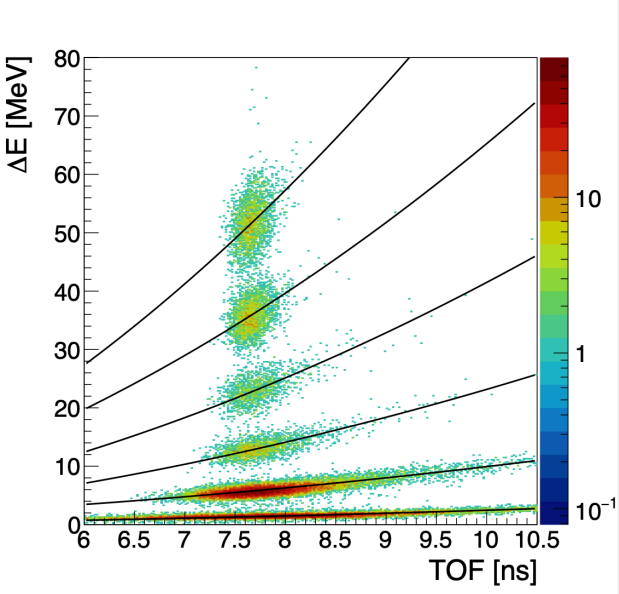
Yields of Energy Loss

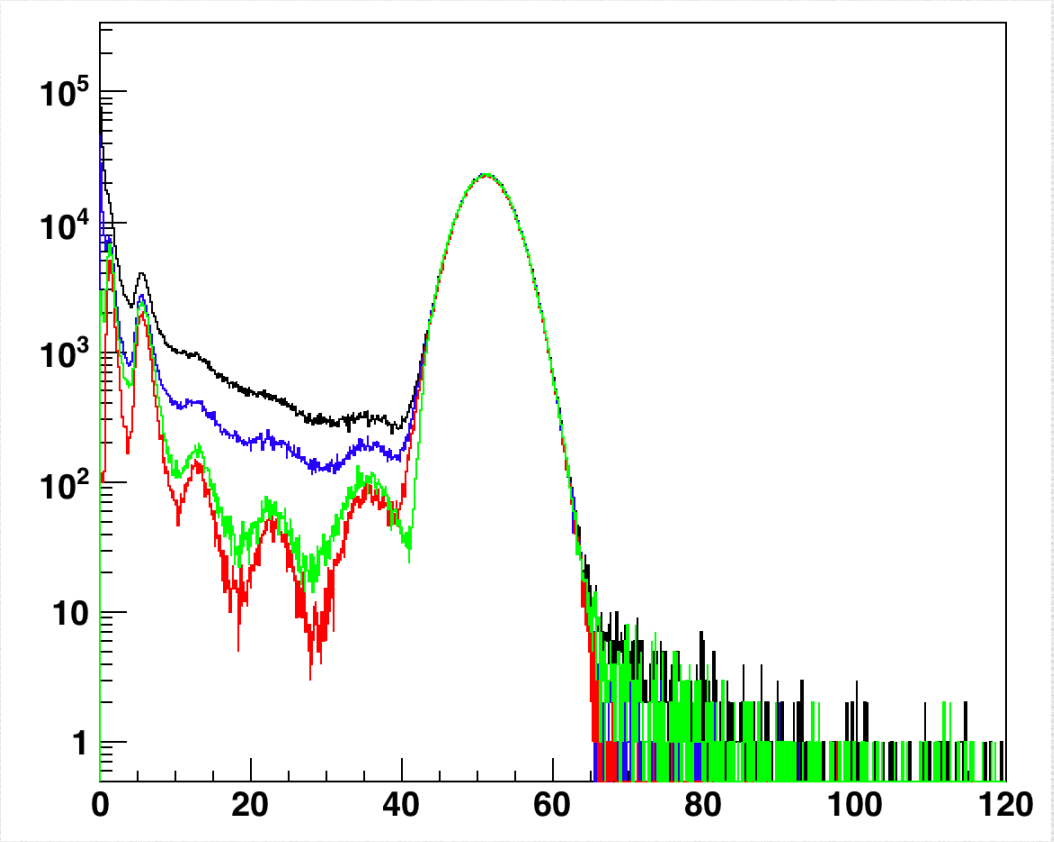
- Untriggerd files are quite different from the triggered ones (lot of background)
- Looking at the Energy Loss yields, in order to clean our sample, we make some cuts:
  1. No Multi hit
  2. Z <= Z beam



Yields of Energy Loss

3. We have tuned the charge reconstruction algorithm also for CNAO campaign as already done for other campaigns in shoe [GSI, full geo: 12C_200, 16O_200]



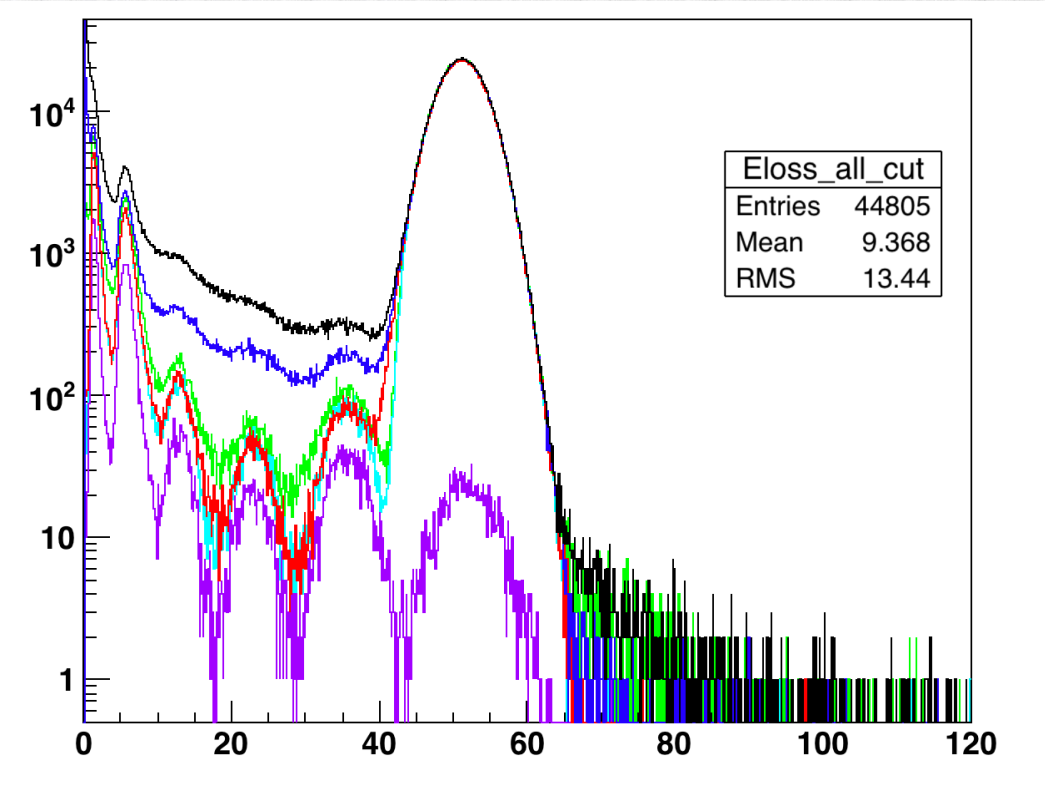


Yields of Energy Loss

- Requiring for Zrec all the primary fragments produced in the TG arriving on the TW we obtain these distributions

This tells us the primary fragmentation is

~ 2.2%



Yields of Energy Loss

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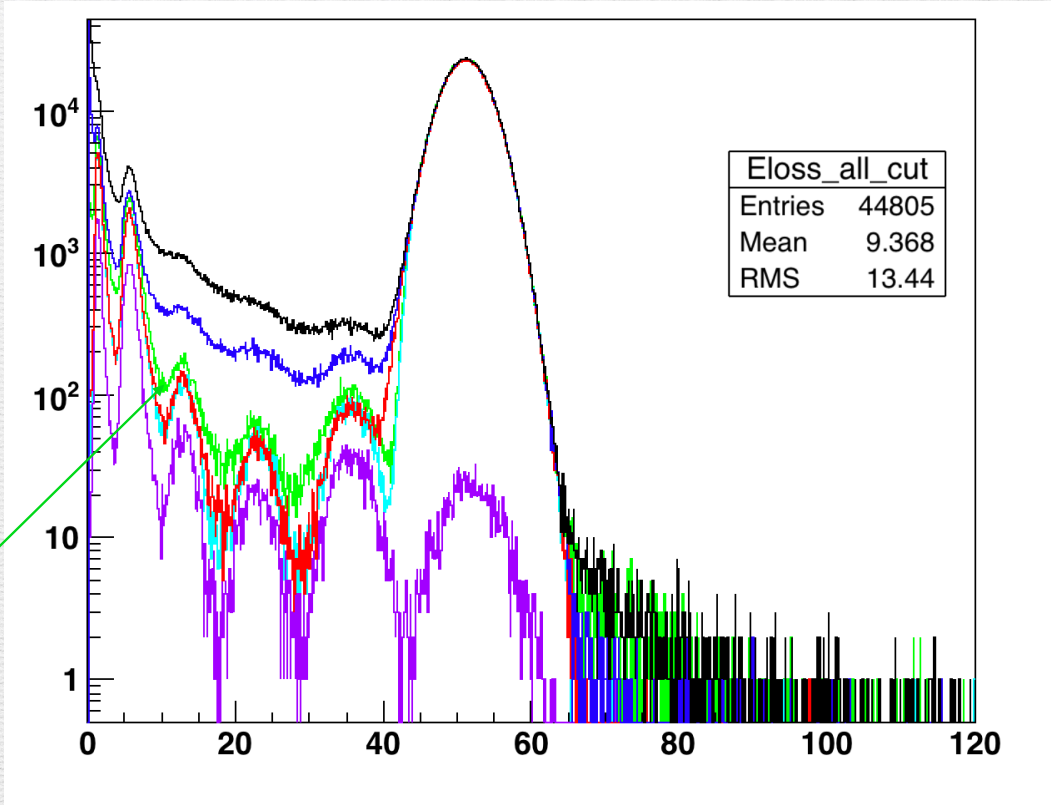
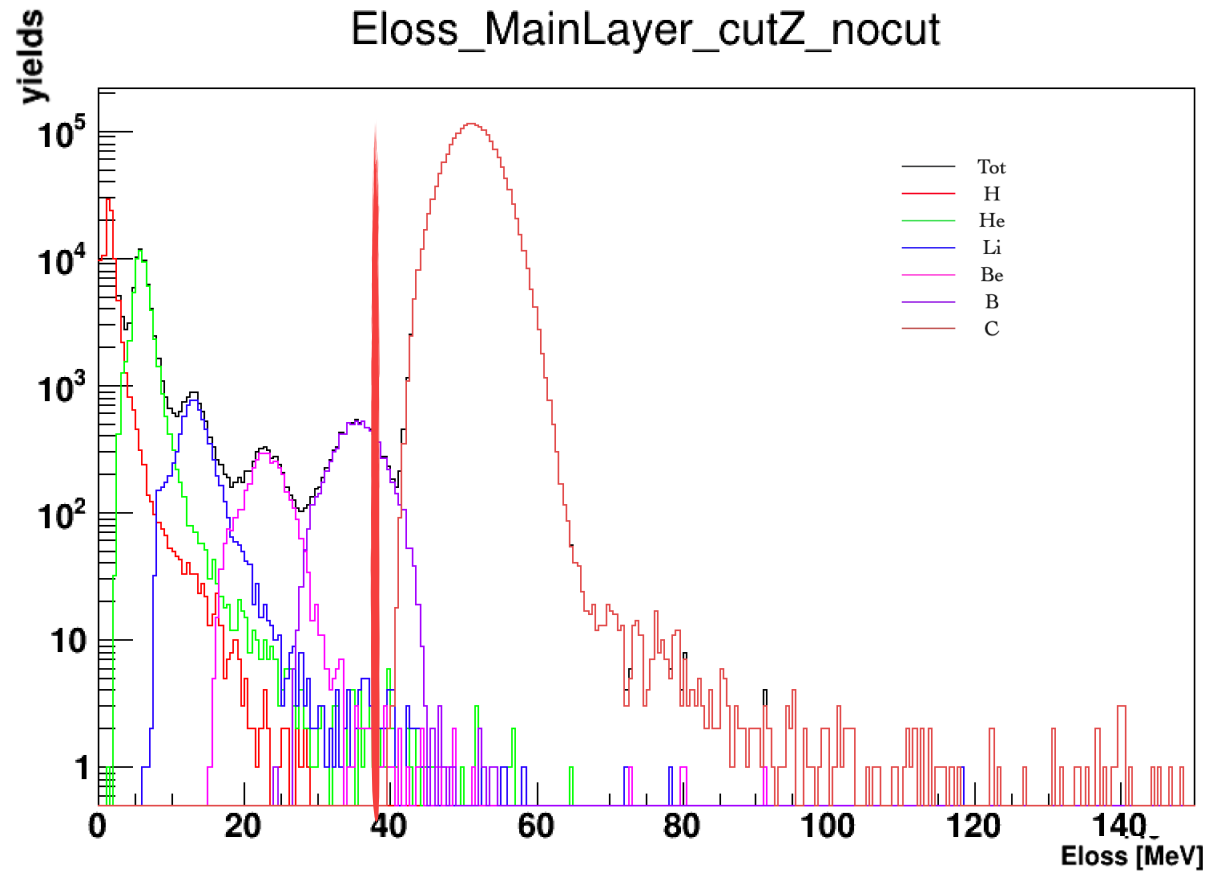
- For this study we decide to take the more data-like situation



Thresholds

- Starting from these yields we have chosen **3 different** thresholds to study:

1. Eloss = 38 MeV
2. Eloss = 42 MeV
3. Eloss = 46 MeV



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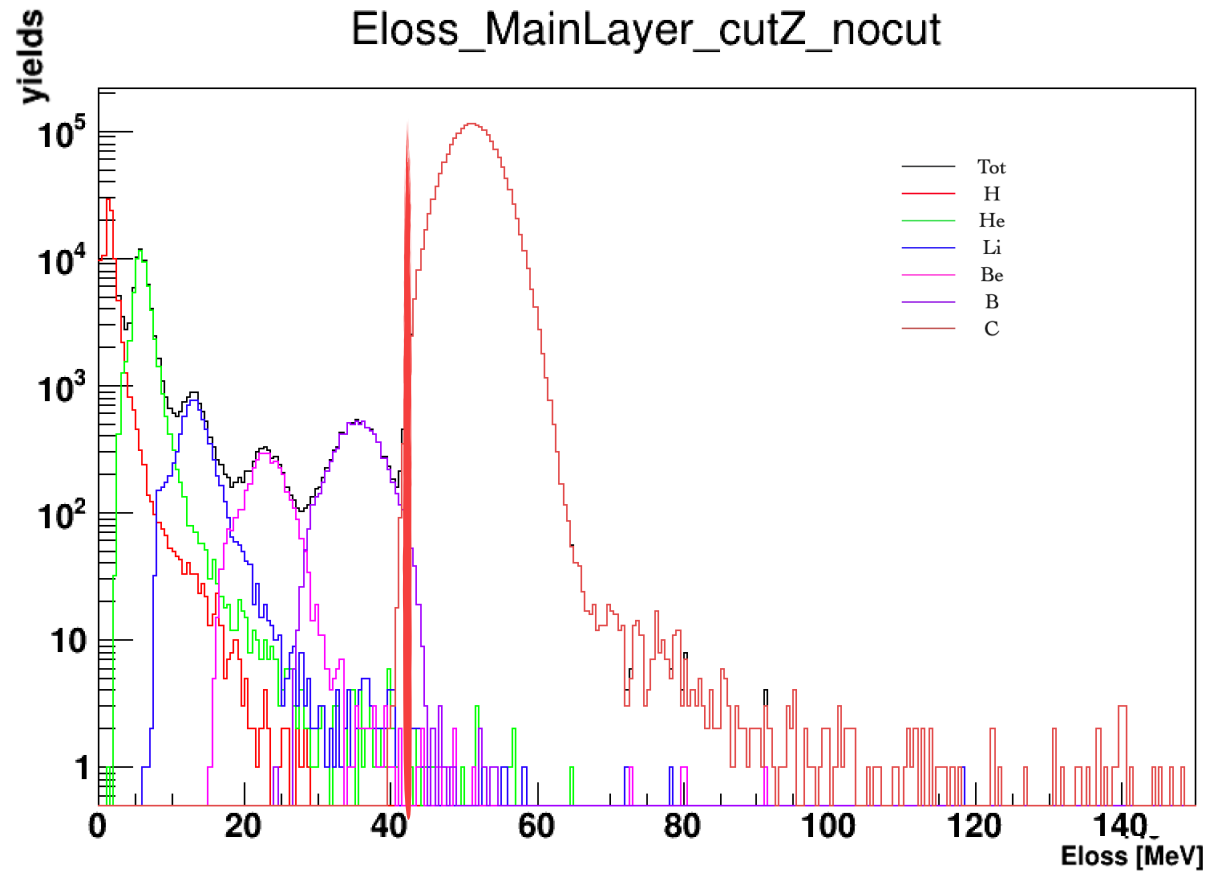

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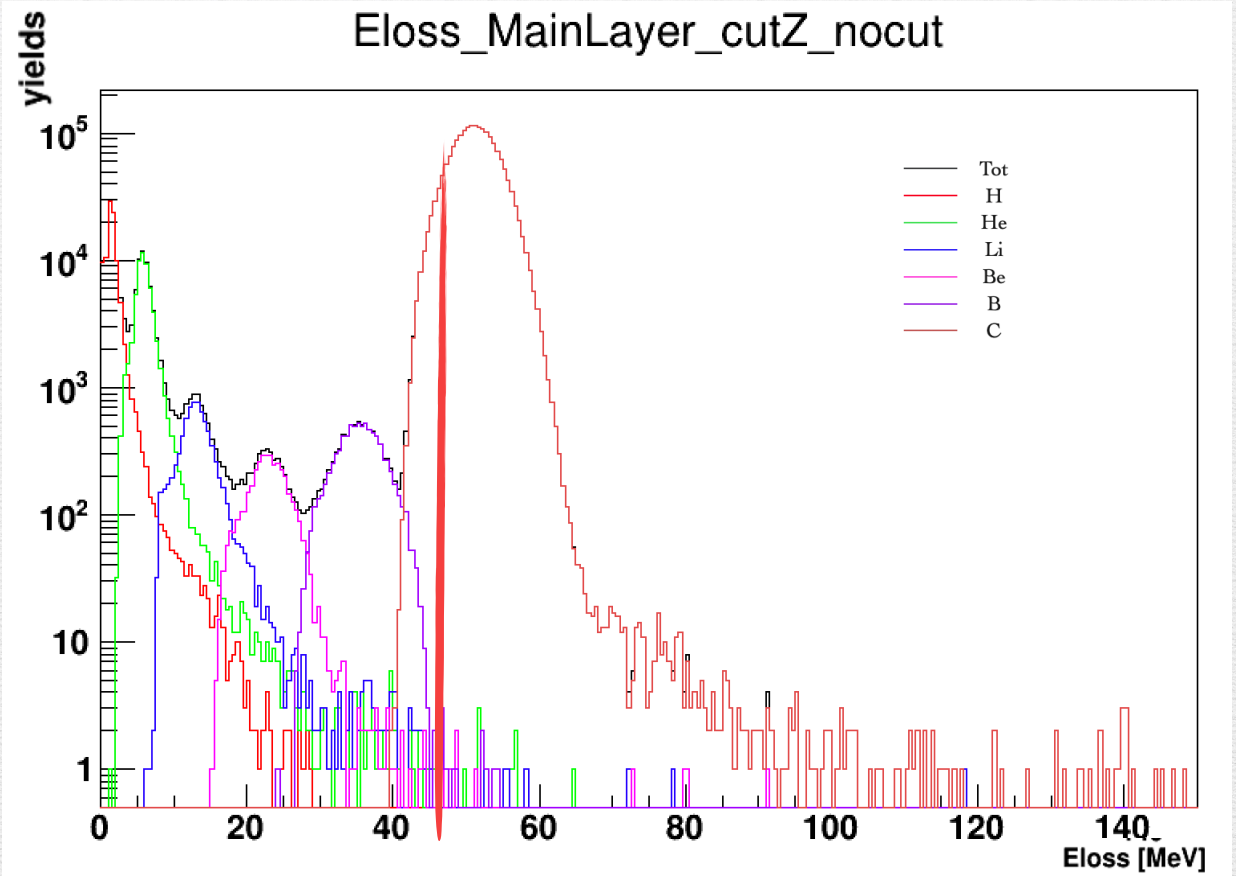
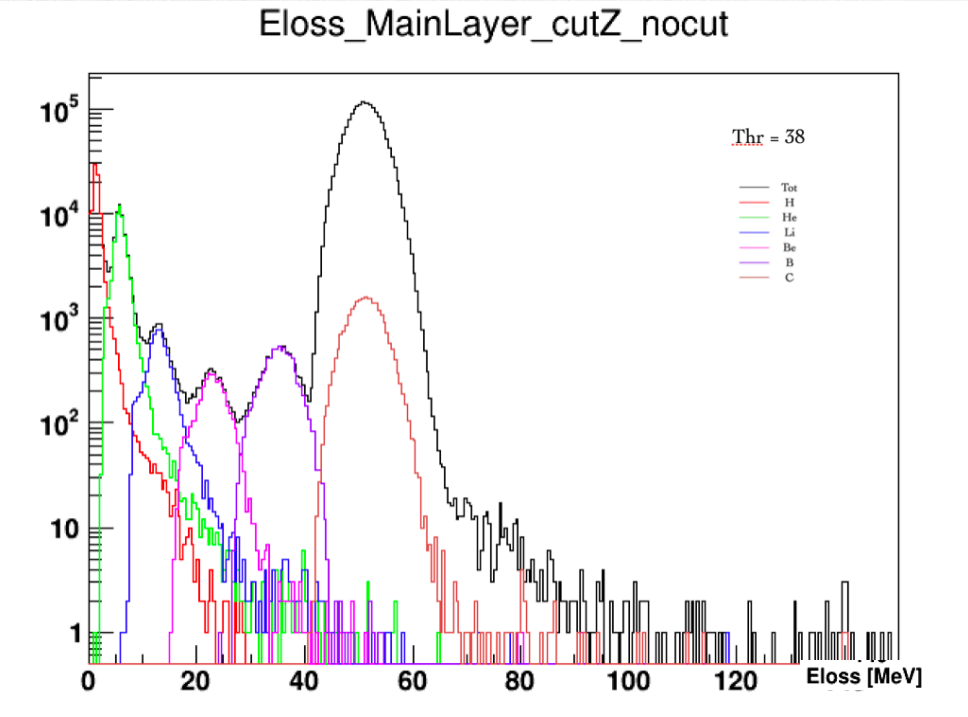


TW Trigger

The TW trigger is performed → We take all fragments arriving on the TW except the ones hitting the bars n° 9 (front and rear) with energy losses (front e rear) above the threshold



The ratio between the events in MB trigger and the events in TW trigger tells us what we are selecting

$$\frac{TW}{MB}\Big|_{Zrec} = 0.085215$$

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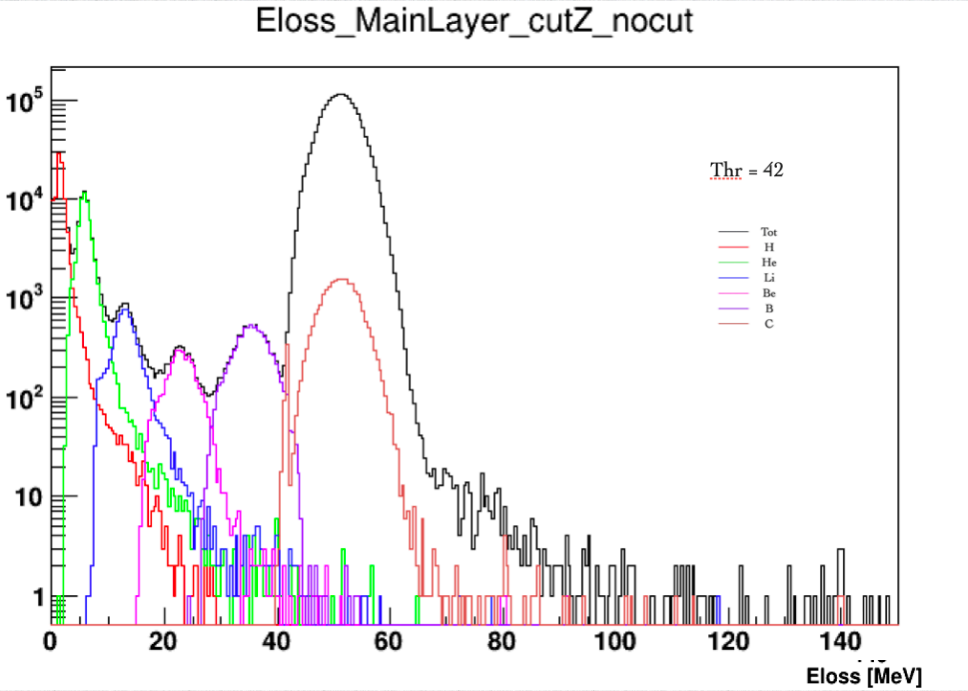

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$$\frac{TW}{MB}\Big|_{Zrec} = 0.085638$$

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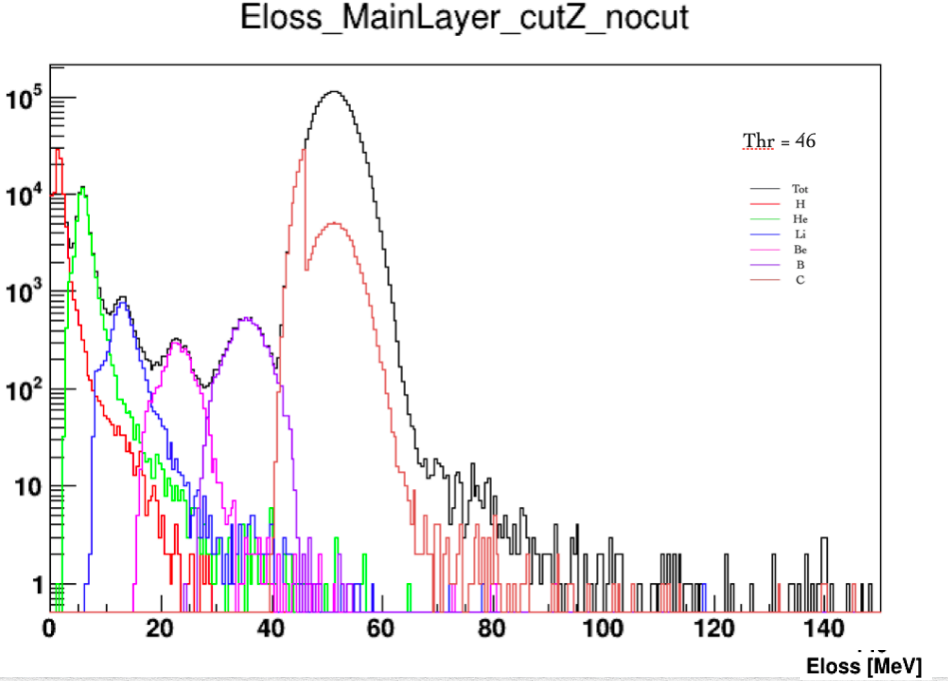

The ratio between the events in MB trigger and the events in TW trigger tells us what we are selecting

$$\frac{TW}{MB}\Big|_{Zrec} = 0.159727$$

TW Trigger

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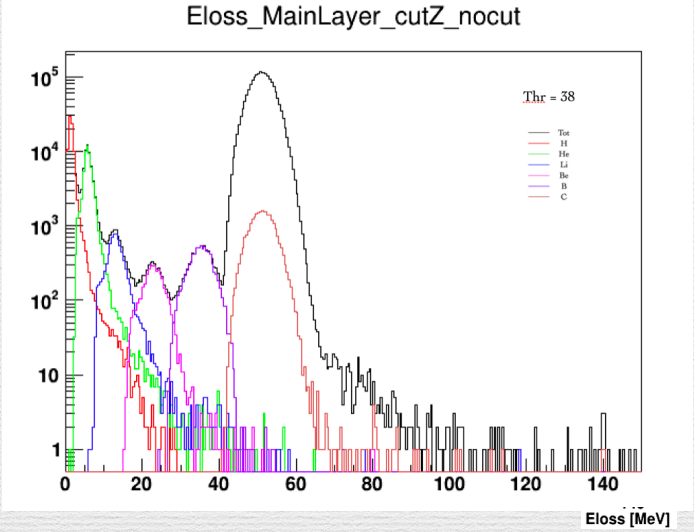
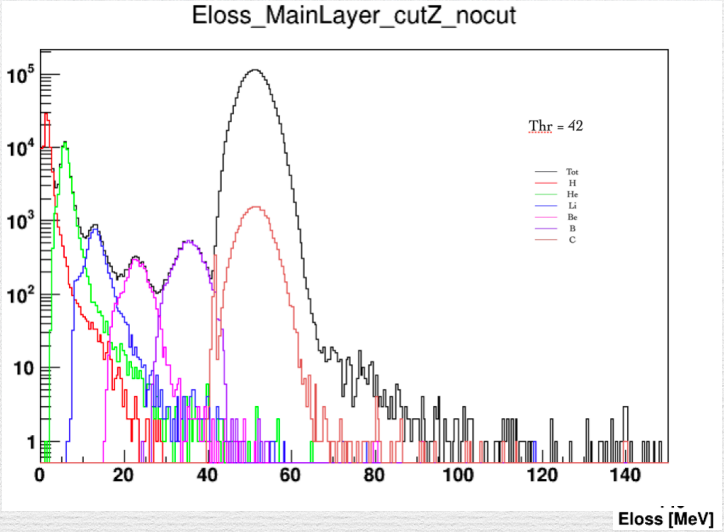
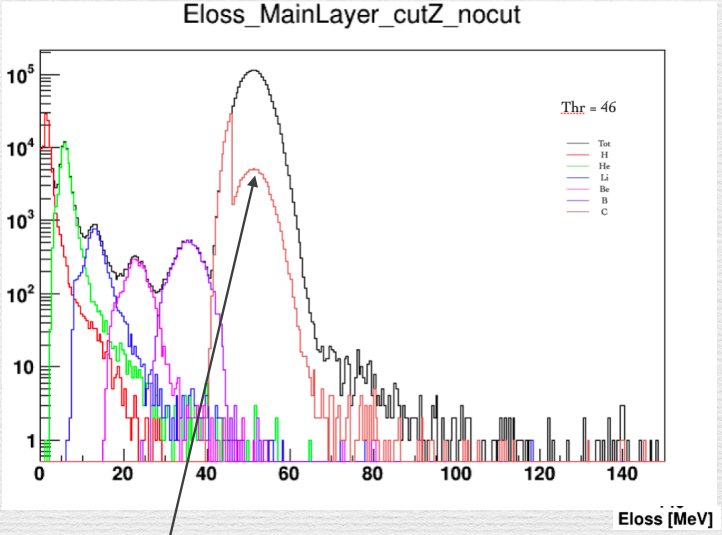






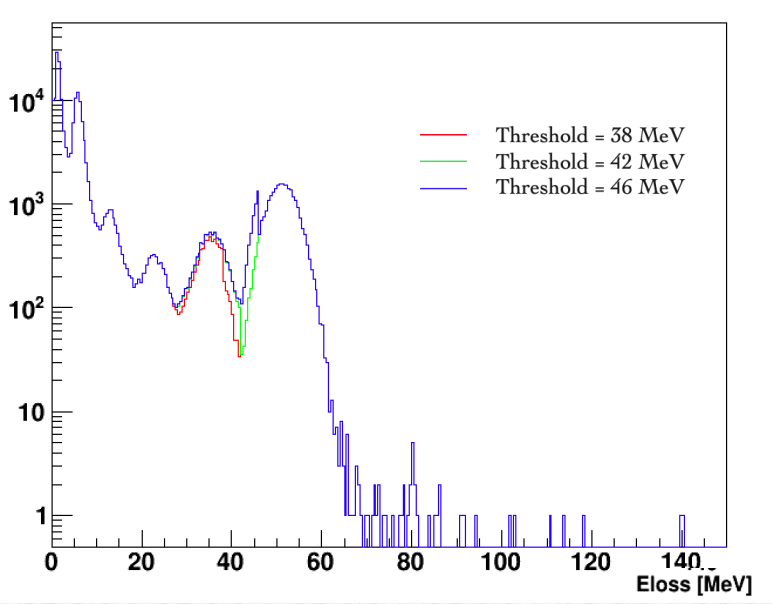
Increase of 1%

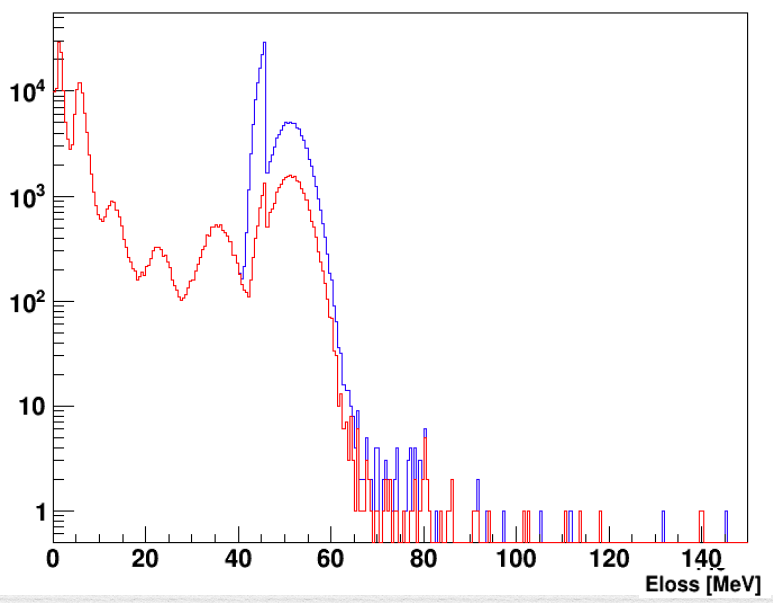
TW Trigger

- The algorithm requires :
  -not bars °9-9
  -not eloss of both layers > threshold

  ⟶ This means we're taking also the events in which one of the eloss > threshold (more entries)

- Requiring eloss front OR eloss rear < threshold the entries remains the same.
  Both choices are valid and have pro and cons





Minimum Bias Trigger

- Using the distributions we can calculate the fragmentation percentage for each fragment using a minimum bias trigger

MB	
H	0.046048
He	0.028705
Li	0.003831
Be	0.001895
B	0.004068
C	0.915454
Total Fragments	0.087442

$$\frac{N(Z)}{N_{tot}}\Big|_{MB}$$

All fragments except ^{12}C (including ^{10}C and ^{11}C)

TW Trigger

- …and using the TW trigger, for each threshold:

$$\frac{N(Z)}{N_{tot}}\Big|_{TW}$$

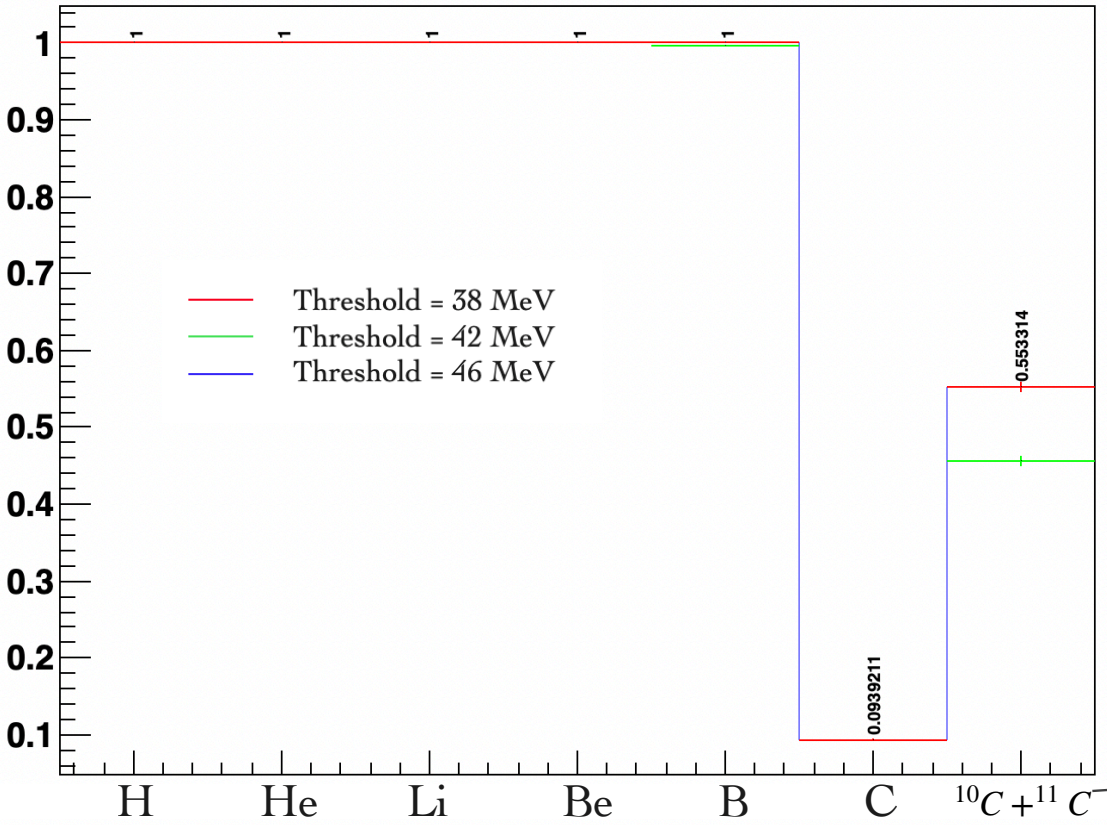
Threshold: 38	
H	0.473993
He	0.295476
Li	0.039433
Be	0.019504
B	0.04013
C	0.131460
Total Fragments	0.866449

Threshold: 42	
H	0.471871
He	0.294153
Li	0.039257
Be	0.019417
B	0.041552
C	0.133750
Total Fragments	0.863894

Threshold: 46	
H	0.269626
He	0.168079
Li	0.022431
Be	0.011095
B	0.023817
C	0.504953
Total Fragments	0.497827

- **A choice needs to be taken**: a compromise between the number of fragments we want to take and the bias we'll introduce

Trigger efficiency



- Trigger efficiency: for each charge we calculate the ratio between the number of fragments with TW trigger and the number of fragments with MB trigger

$$\frac{Y(Z)_{TW}}{Y(Z)_{MB}}$$

Sum of fragments with charge = 6 and baryon number = 10-11

TW Trigger Efficiencies

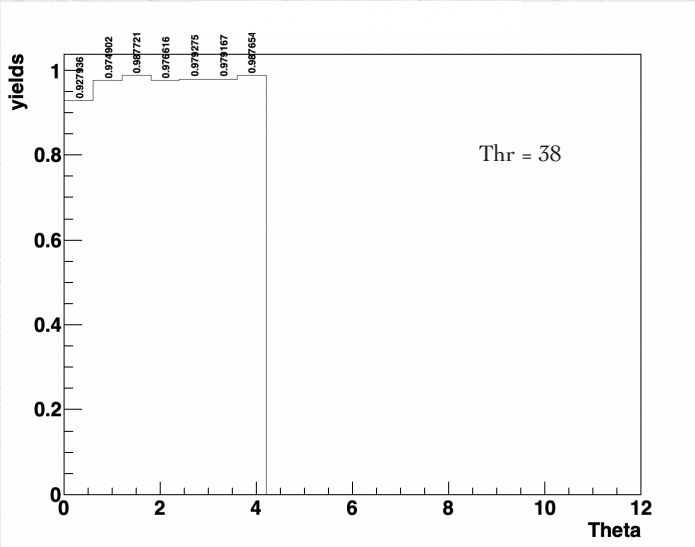
Threshold: 38	
H	1
He	1
Li	1
Be	1
B	0.959713
C	0.0137378
$^{10}C + ^{11}C$	0.454251

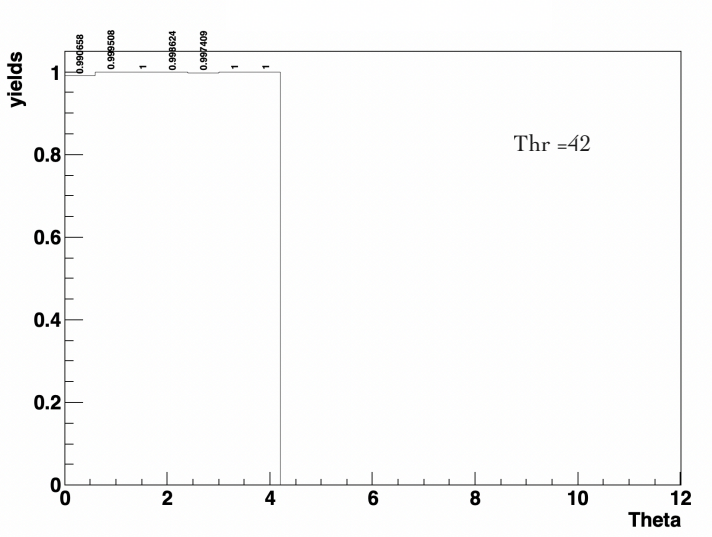
Threshold: 42	
H	1
He	1
Li	1
Be	1
B	0.996741
C	0.0140434
$^{10}C + ^{11}C$	0.456772

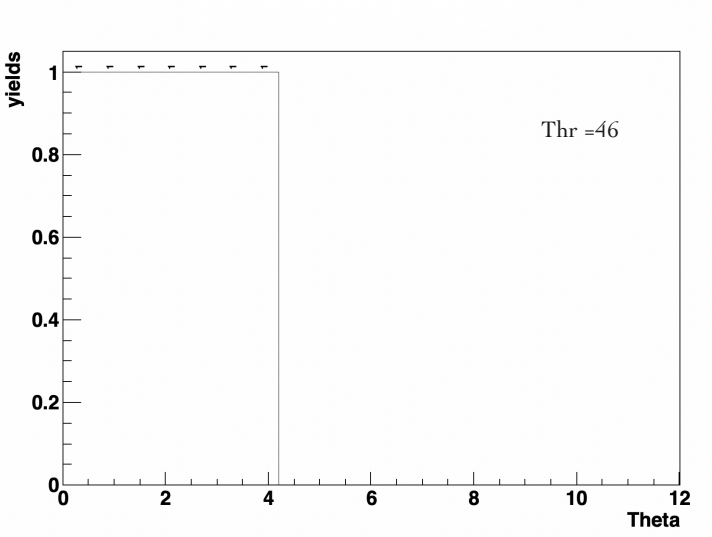
Threshold: 46	
H	1
He	1
Li	1
Be	1
B	1
C	0.0939211
$^{10}C + ^{11}C$	0.553314

Ratio in Angle

- Efficiencies in angle and kinetic energy for each threshold: B

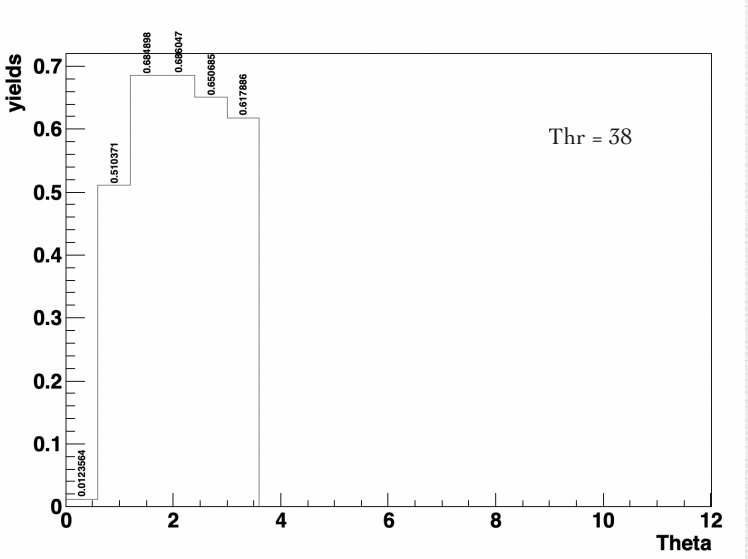


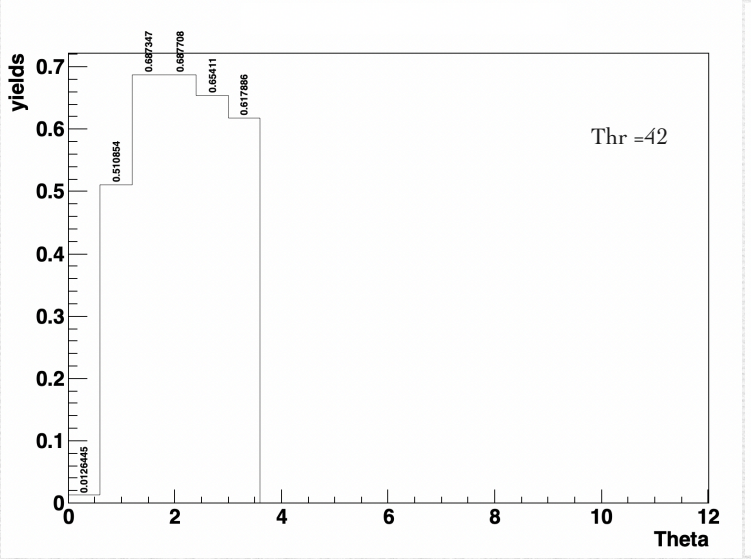


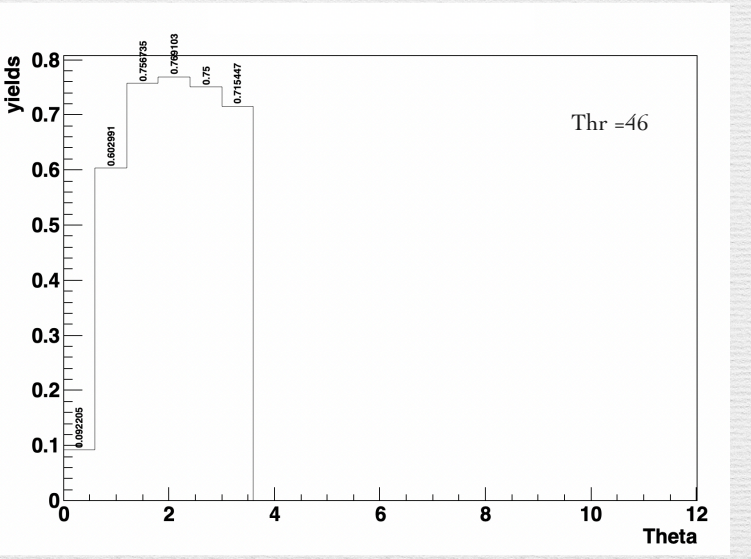


Ratio in Angle

- Efficiencies in angle and kinetic energy for each threshold: C

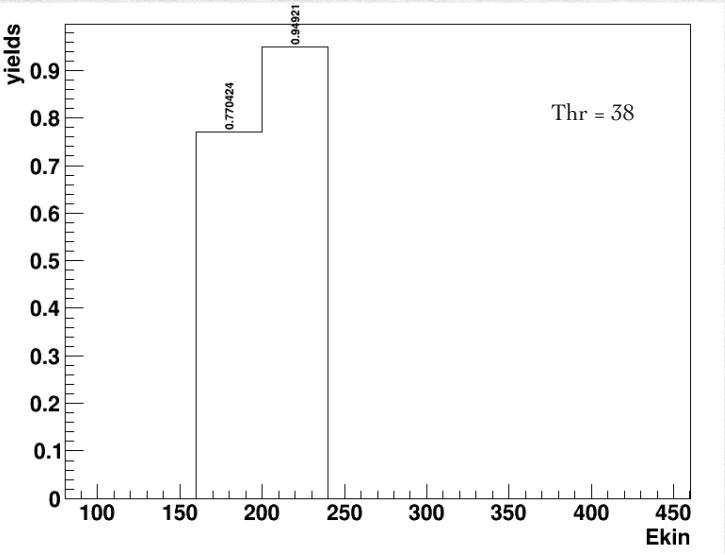


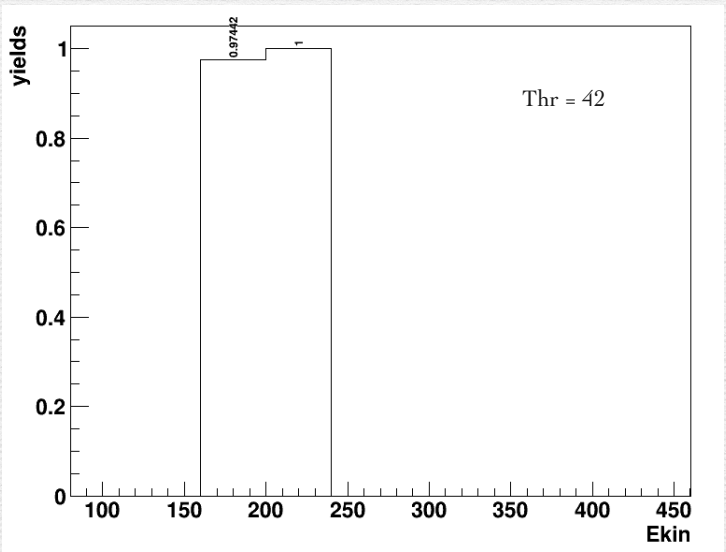


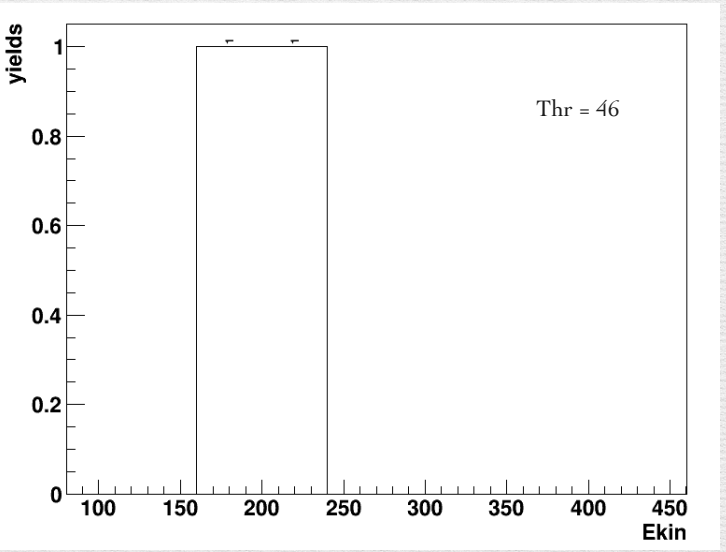


Ratio in Ekin

- Efficiencies in angle and kinetic energy for each threshold: B

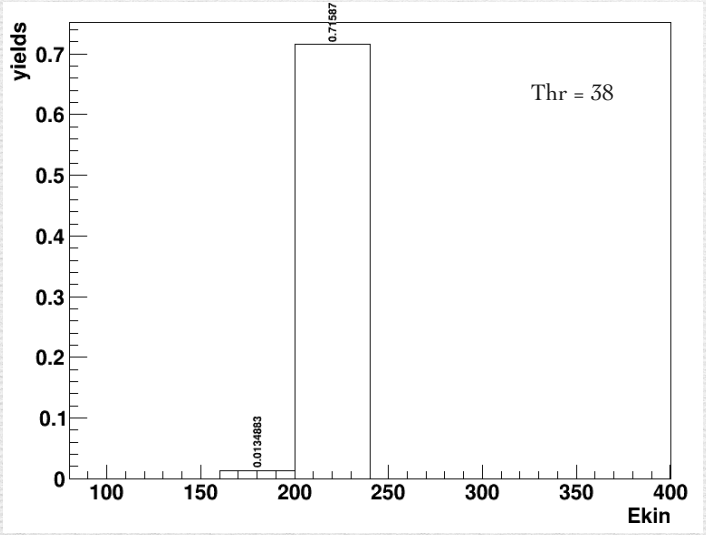


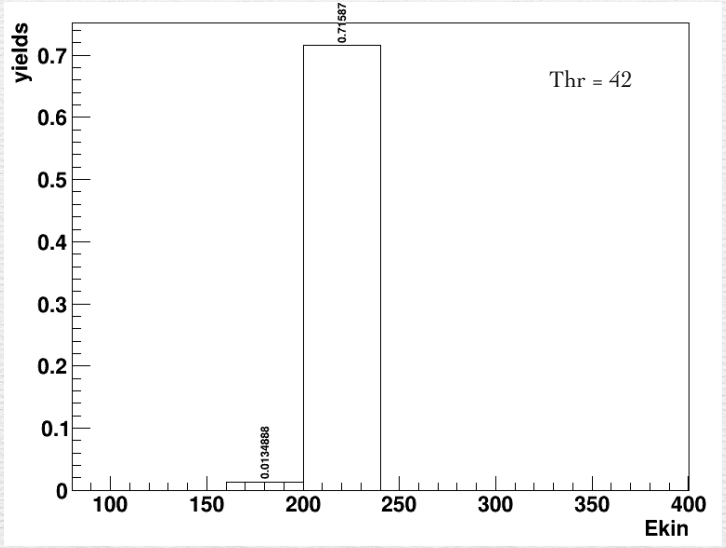


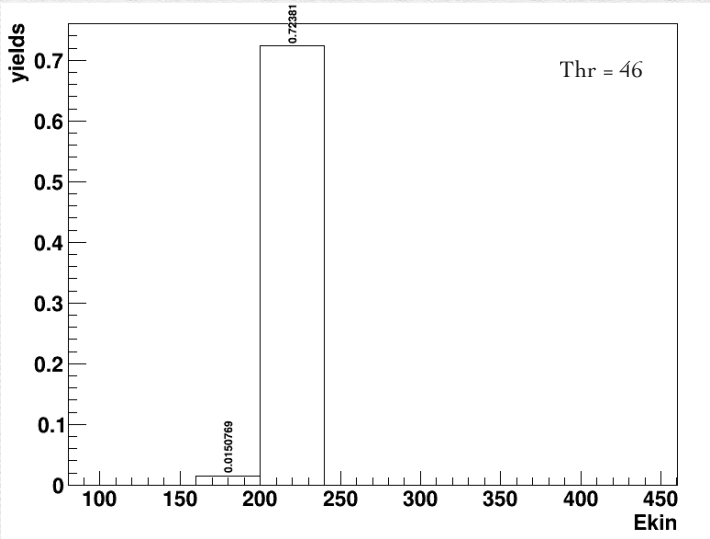


Ratio in Ekin

- Efficiencies in angle and kinetic energy for each threshold: C







Other steps to think about…

1. Scaling of cross section measurement

$$\sigma_{TW} = \frac{N_{TW}^{trigg}}{N_{prim}} \frac{Y_{TW}(Z)}{N_{TW}^{trigg}} \frac{1}{\epsilon_{trigg}} \cdot const$$

Scaling factor

Trigger efficiency

$$\sigma_{MB} = \frac{Y_{MB}(Z)}{N_{TW}^{trigg}} \cdot const$$

2. Studies of C fragmentation in this two channels using the Calorimeter and try different trigger implementations (e.g. with another hit somewhere on the TW) :

$$^{12}C -> B + p$$

$$^{12}C -> ^{11}C + n$$

3. Check the correlation between charge and signal amplitude for safe threshold application

SPARE SLIDES

TW Trigger OR

- Using the distributions we have calculated the fragmentation percentage for each fragment using a minimum bias trigger and using the TW trigger, for each threshold:

MB	
H	0.04604
He	0.028705
Li	0.003831
Be	0.001895
B	0.004068
C	0.915454
Total Fragments	0.087442

$$\frac{N(Z)}{N_{tot}}\Big|_{MB}$$

$$\frac{N(Z)}{N_{tot}}\Big|_{TW}$$

Threshold: 38	
H	0.477890
He	0.297905
Li	0.039757
Be	0.019664
B	0.03224
C	0.13254
Total Fragments	0.867247

Threshold: 42	
H	0.473782
He	0.295344
Li	0.039416
Be	0.019495
B	0.040556
C	0.131407
Total Fragments	0.866458

Threshold: 46	
H	0.466091
He	0.290550
Li	0.038776
Be	0.019179
B	0.041166
C	0.144237
Total Fragments	0.853515

TW Trigger OR Ztrue

- Using the distributions we have calculated the fragmentation percentage for each fragment using a minimum bias trigger and using the TW trigger, for each threshold:

MB	
H	0.026388
He	0.019016
Li	0.001892
Be	0.001112
B	0.002696
C	0.948895
Total Fragments	0.053098

$$\frac{N(Z)}{N_{tot}}\Big|_{MB}$$

$$\frac{N(Z)}{N_{tot}}\Big|_{TW}$$

Threshold: 38	
H	0.412271
He	0.297097
Li	0.029553
Be	0.017371
B	0.037336
C	0.206374
Total Fragments	0.81350

Threshold: 42	
H	0.41039
He	0.295742
Li	0.02941
Be	0.017291
B	0.041674
C	0.205485
Total Fragments	0.814303

Threshold: 46	
H	0.399400
He	0.287822
Li	0.028630
Be	0.016828
B	0.040810
C	0.226510
Total Fragments	0.792773