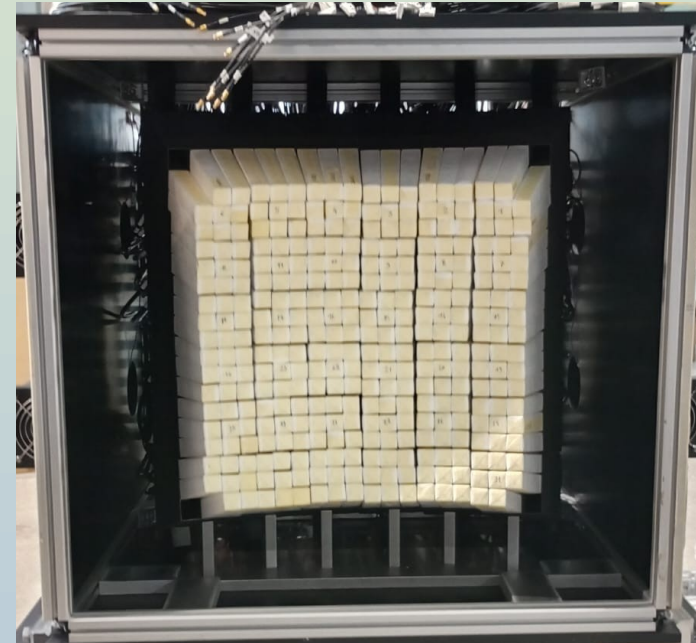
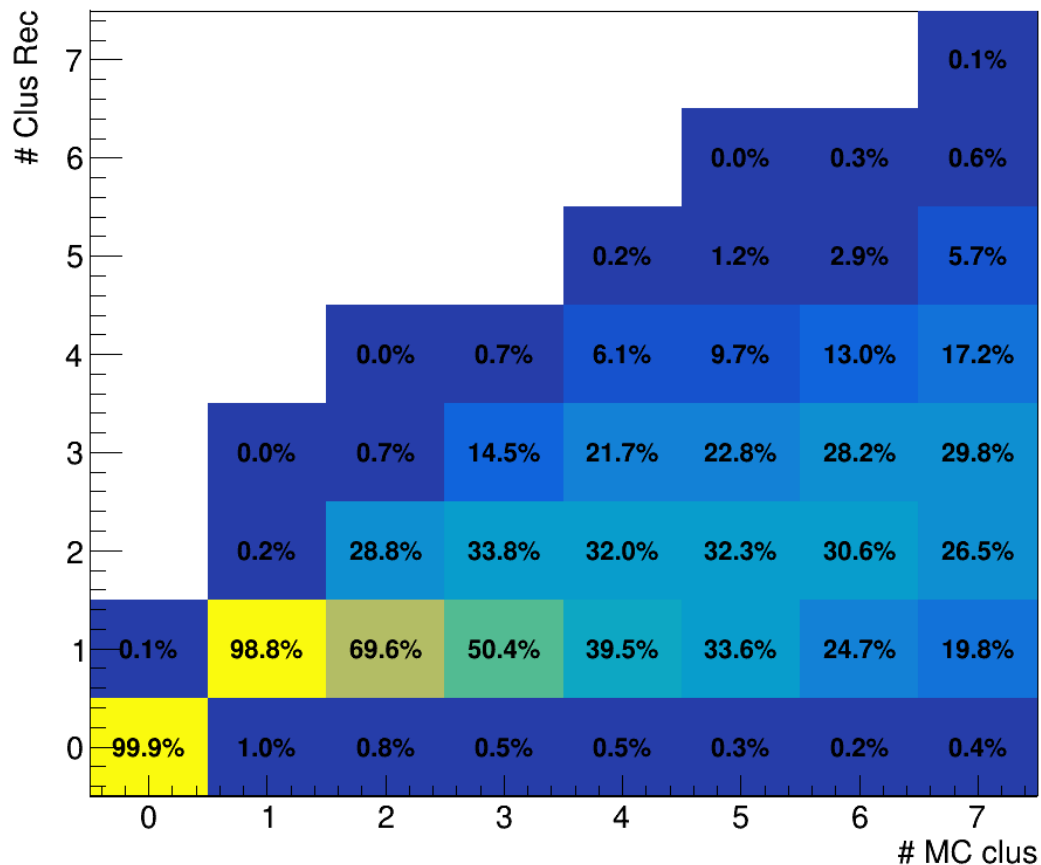


Towards cross-sections @ CNAO 2024

B. Spadavecchia on behalf of the
FOOT Turin group



Pile-up effect on clustering (MC analysis) - recap



A track impinging on CALO is called “first-impinging” if it crosses AIR → AIR_CALO → CALO, in **this** order.

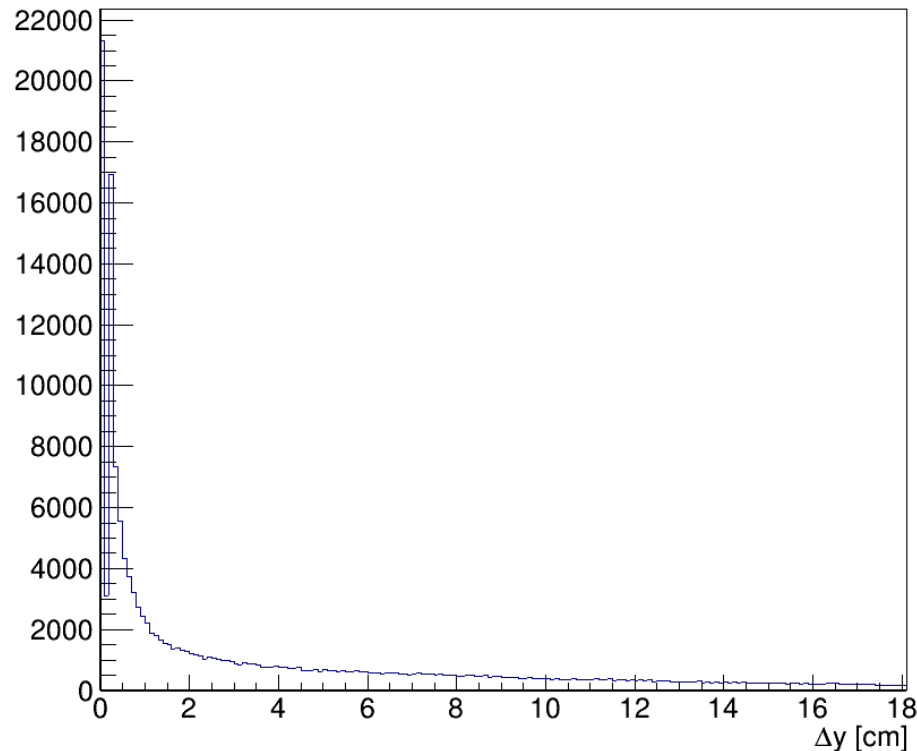
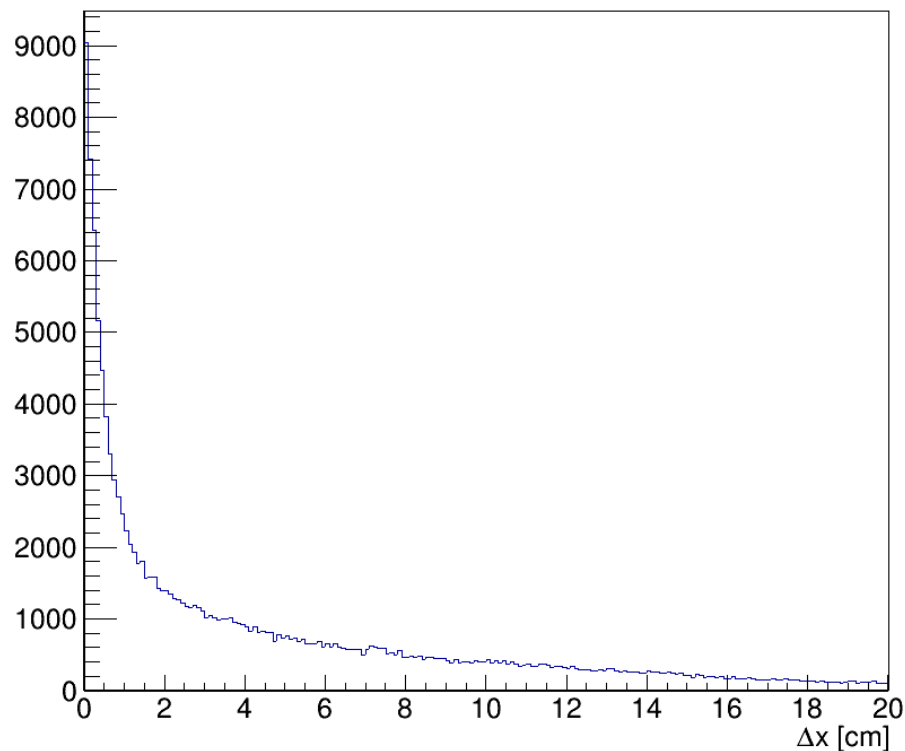
First-impinging tracks on the CALO → MC clus.

The larger the number of MC clusters, the higher the probability they are underestimated.

In $\approx 2\%$ of cases, a cluster does not correspond to any “first-impinging” track; in 1% of cases, the fragment they are associated to is reflected by the CALO.

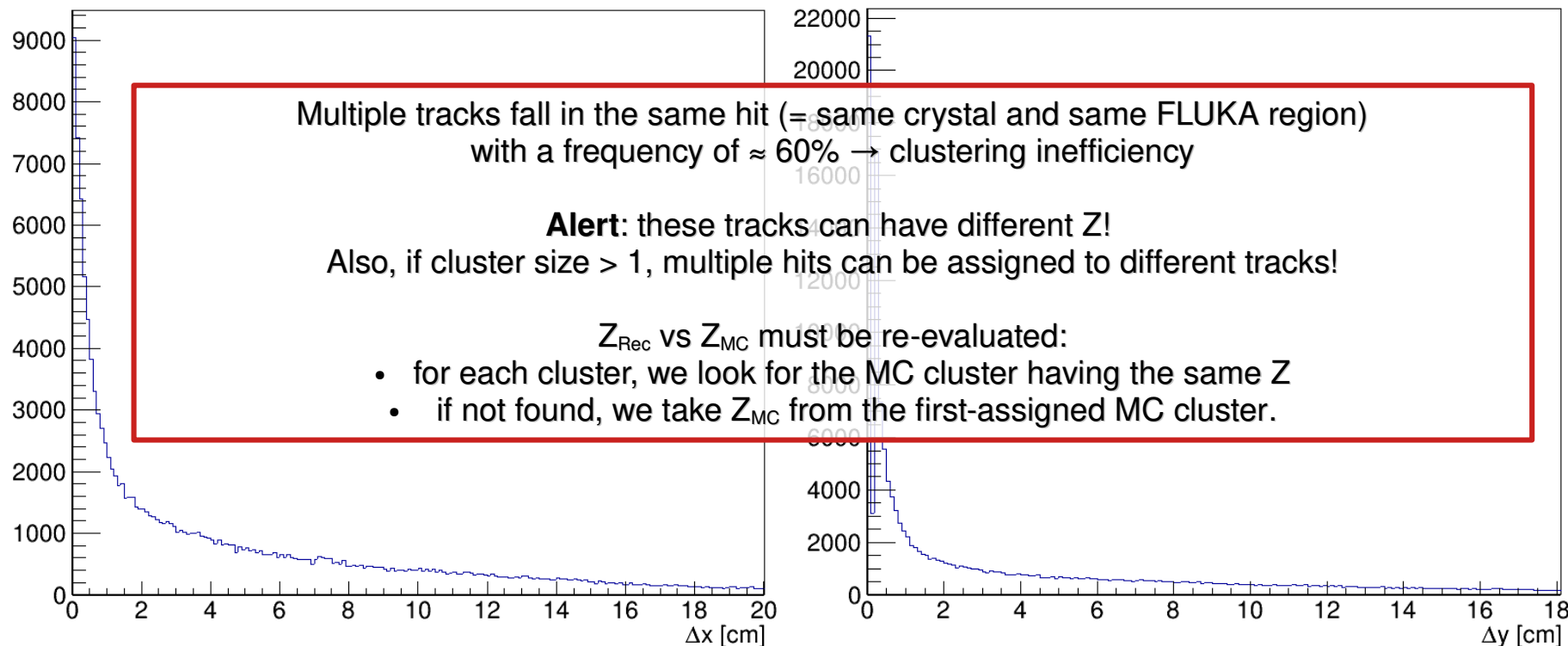
Pile-up effect on clustering (MC analysis)

What happens when $\text{ClusRec} > \text{ClusMC}$? For each possible pair of “first-impinging” tracks, I tried to plot their mutual distance in order to see how likely it is for them to fall in the same hit ($|x|$ or $|y| < 2.1$ cm).



Pile-up effect on clustering (MC analysis)

What happens when $\text{ClusRec} > \text{ClusMC}$? For each possible pair of “first-impinging” tracks, I tried to plot their mutual distance in order to see how likely it is for them to fall in the same hit ($|x|$ or $|y| < 2.1$ cm).



Intrinsic Z misidentification (MC analysis)

CA/ZrecVsZMC normalized (col)



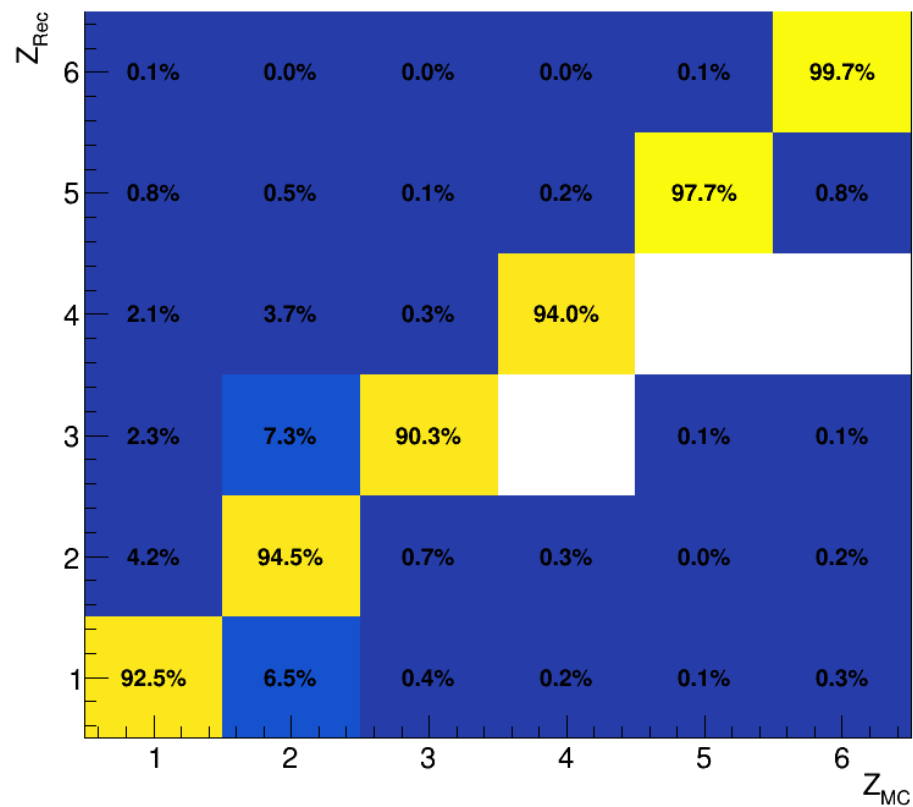
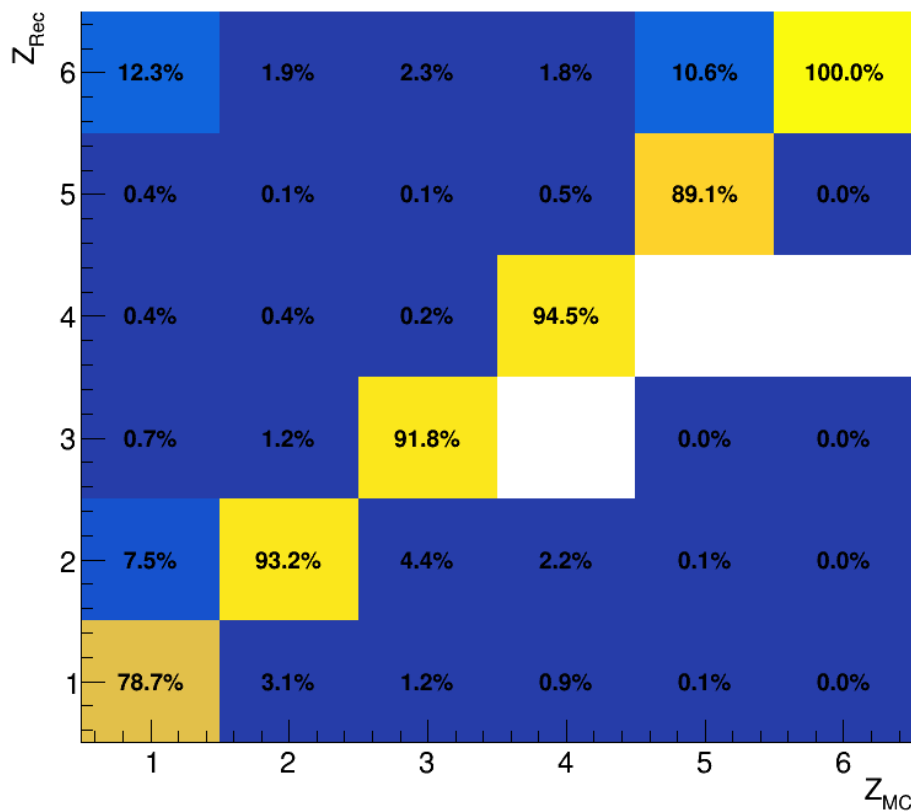
Out of diagonal, $P(Z_{rec} \neq Z_{MC} | Z_{MC}) \rightarrow$ statistics loss

CA/ZrecVsZMC normalized (row)



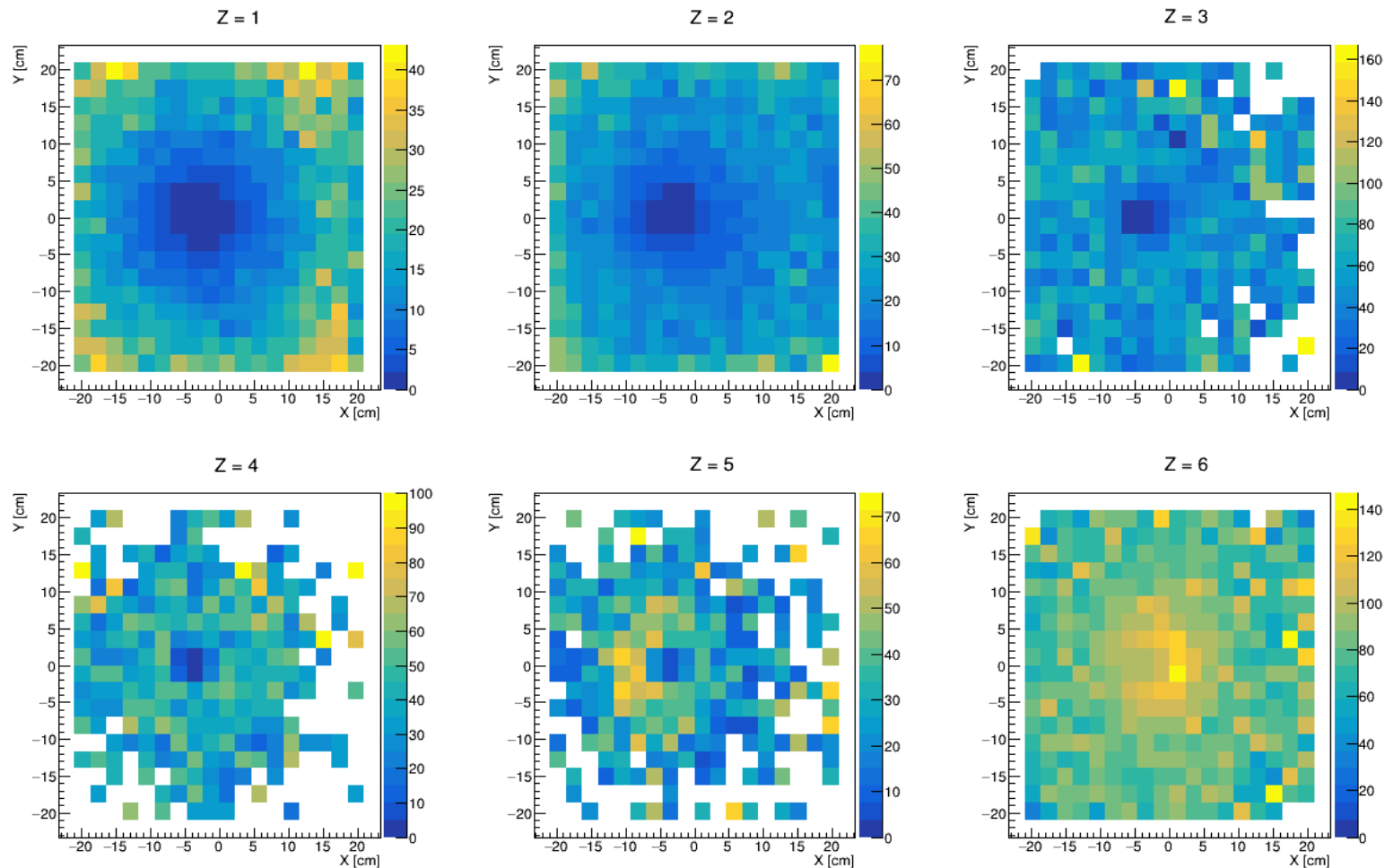
On diagonal, $P(Z_{MC} = Z_{rec} | Z_{rec}) \rightarrow$ “true positives”

Intrinsic Z misidentification (MC analysis)

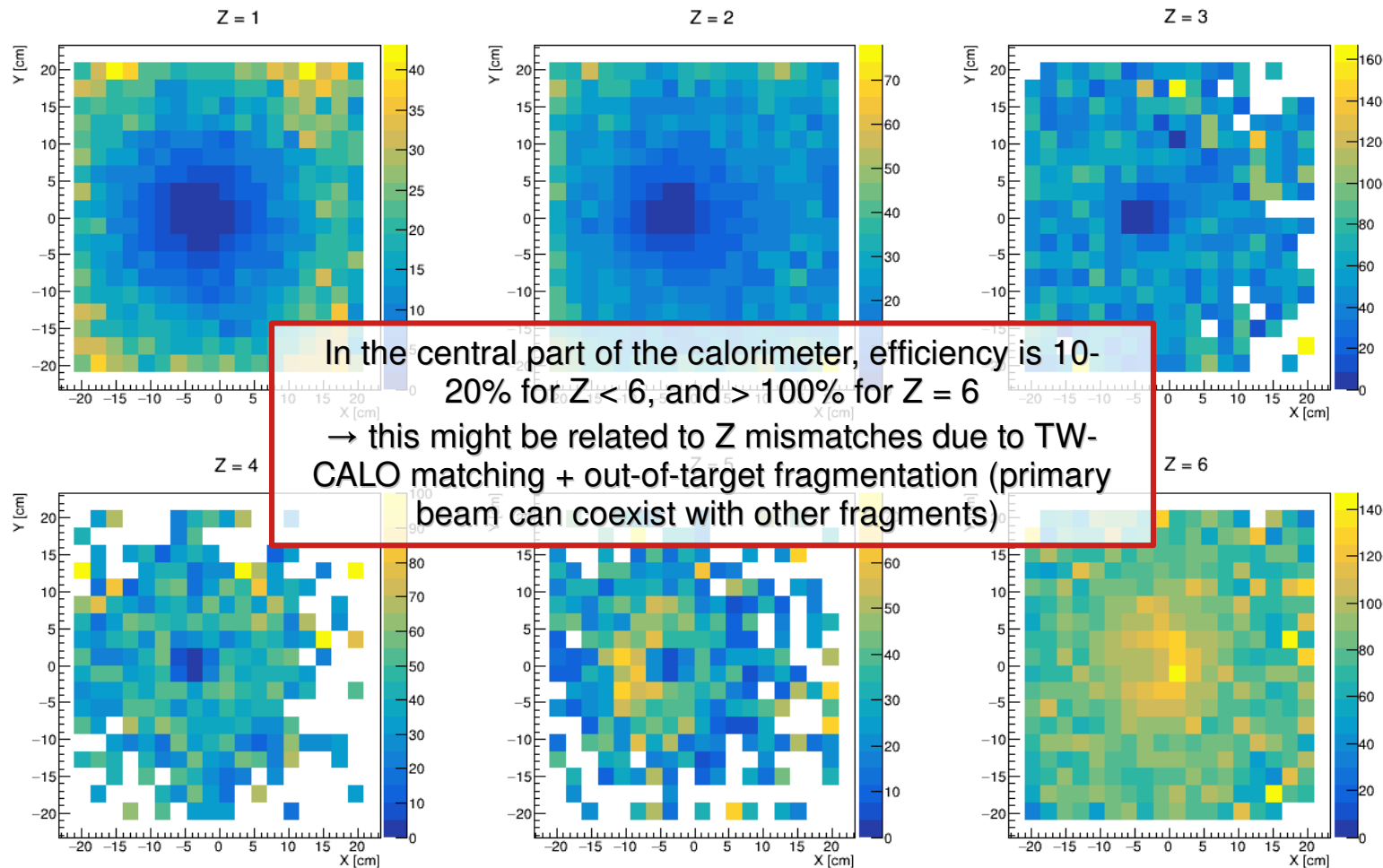


When $ClusMC = ClusRec$ there is a drastical improvement in Z identification.

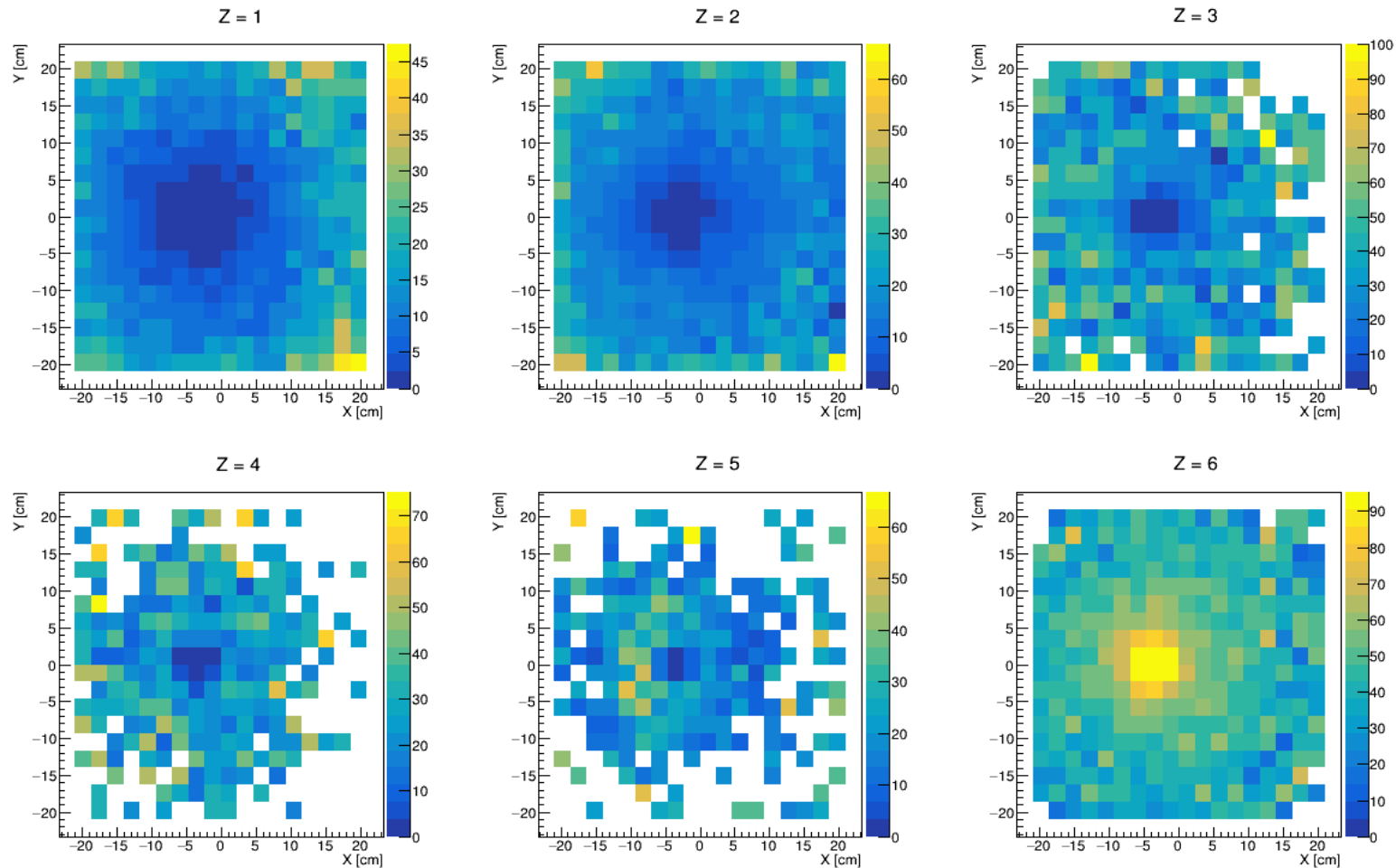
Fraction of identified Z wrt position (%)



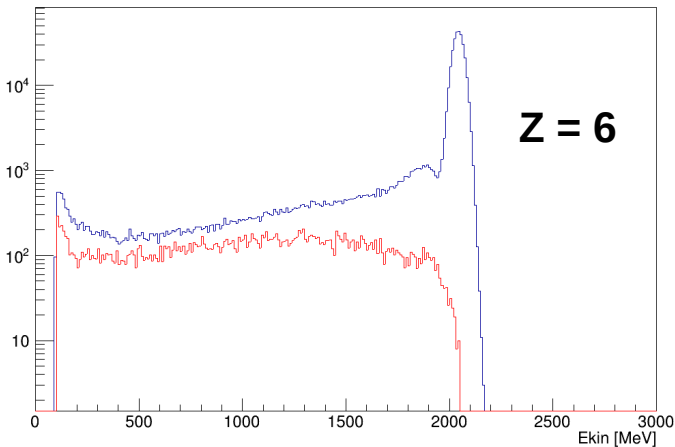
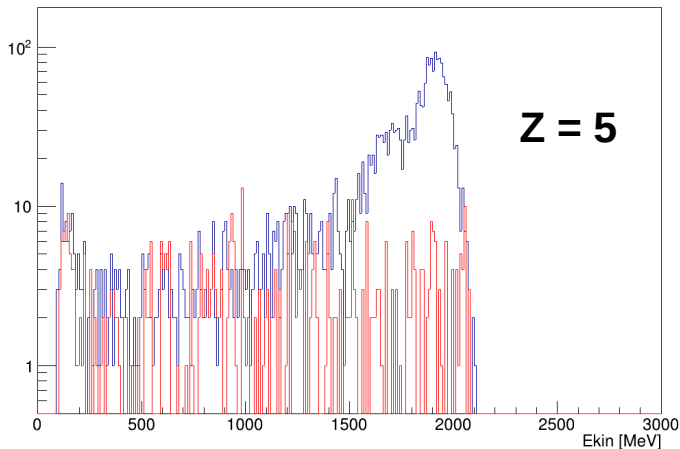
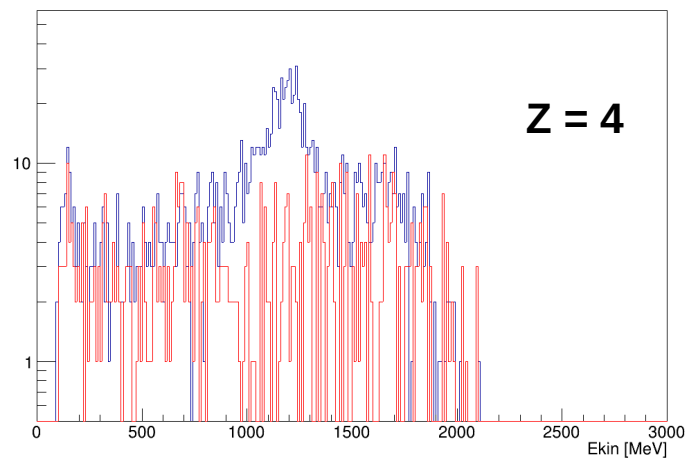
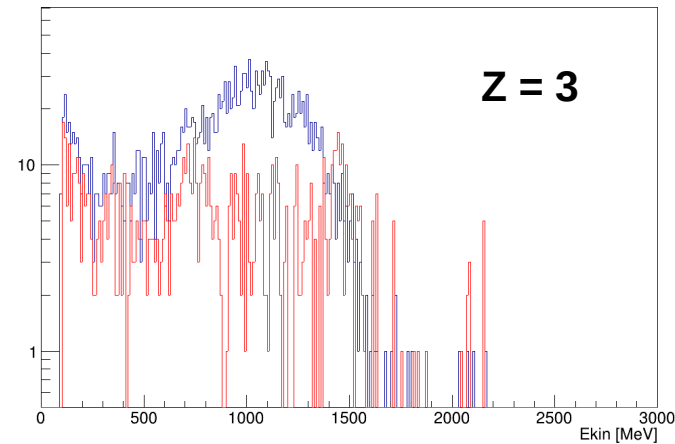
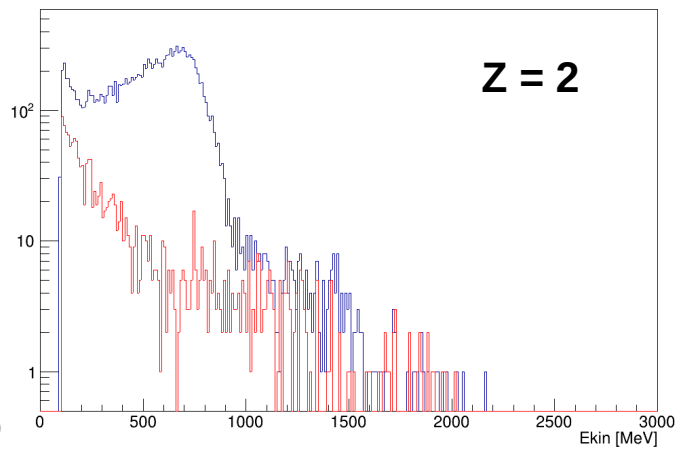
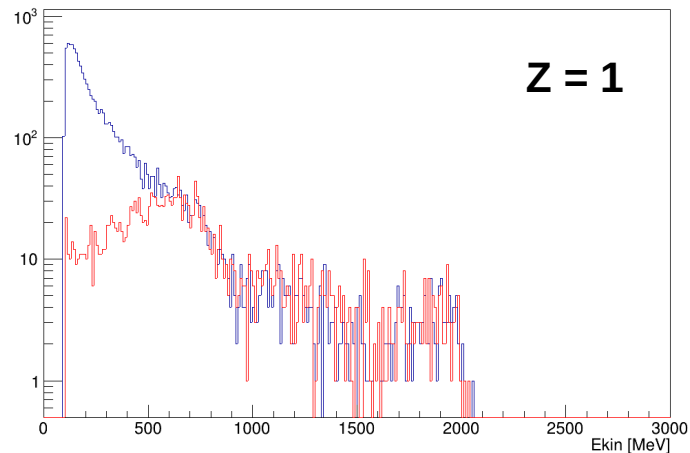
Fraction of identified Z wrt position (%)



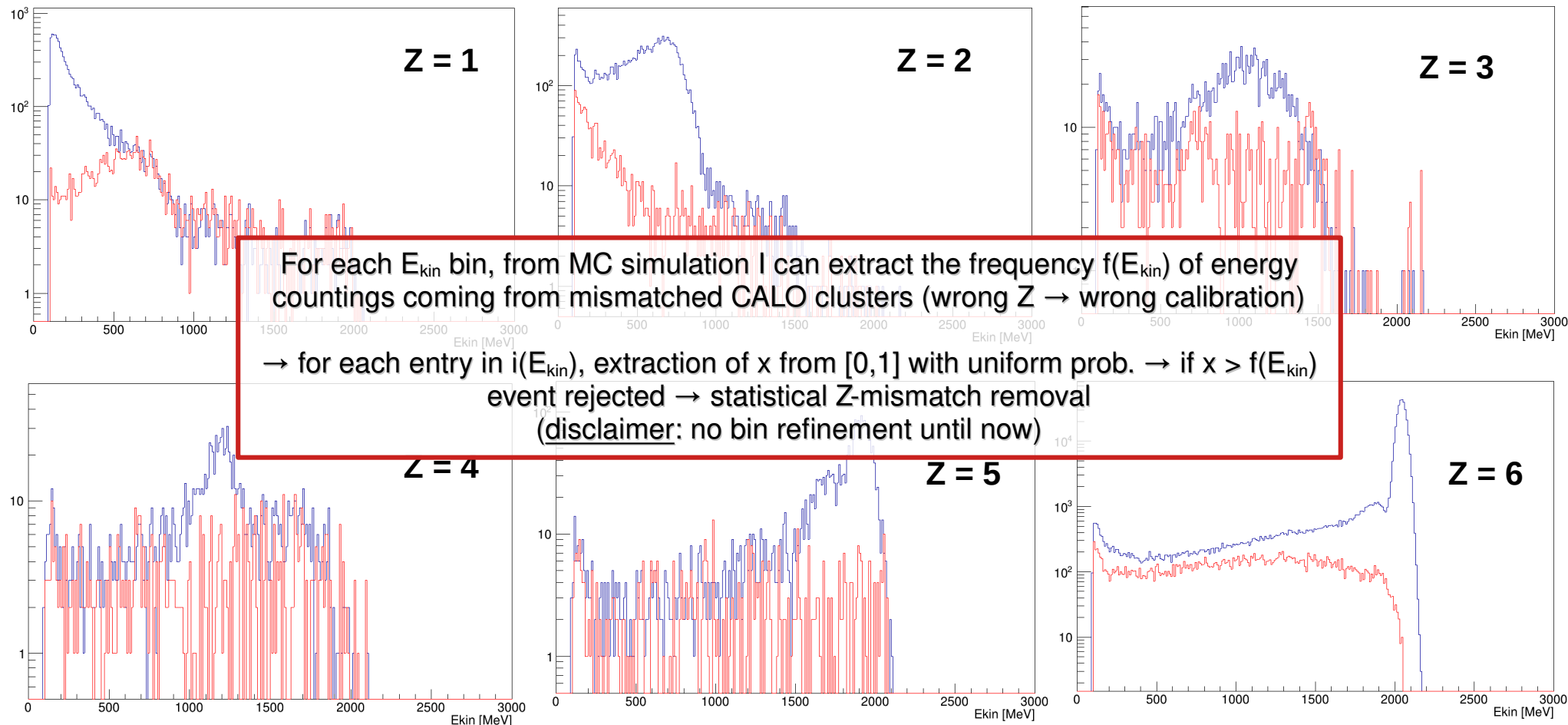
In-target fraction wrt position and Z (%)



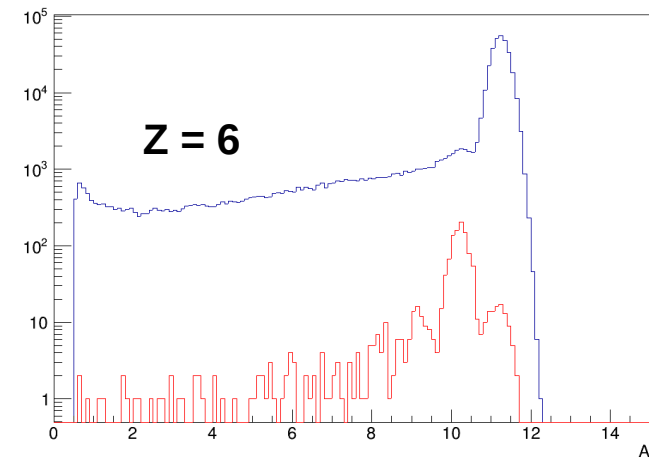
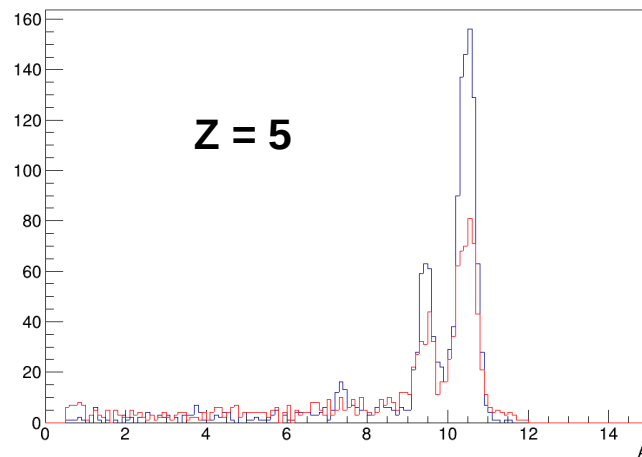
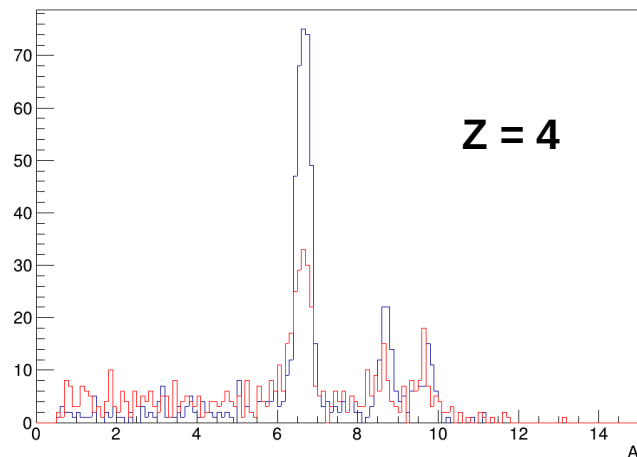
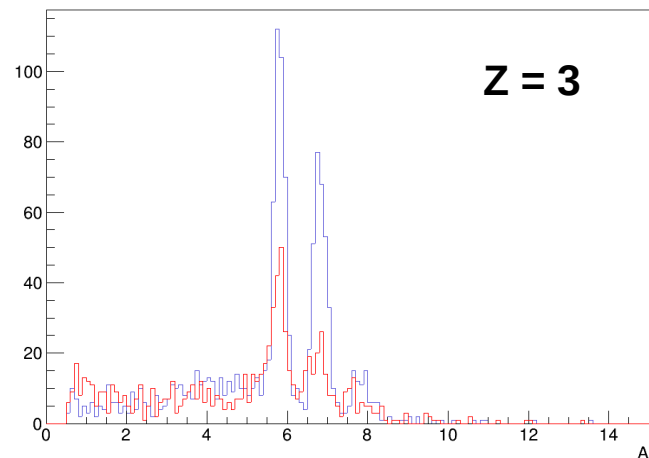
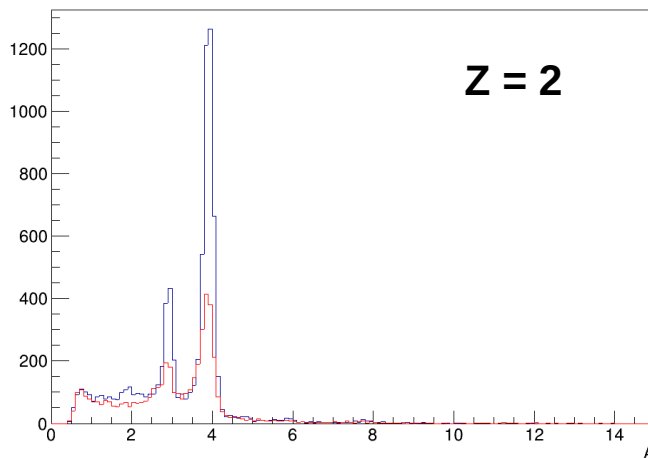
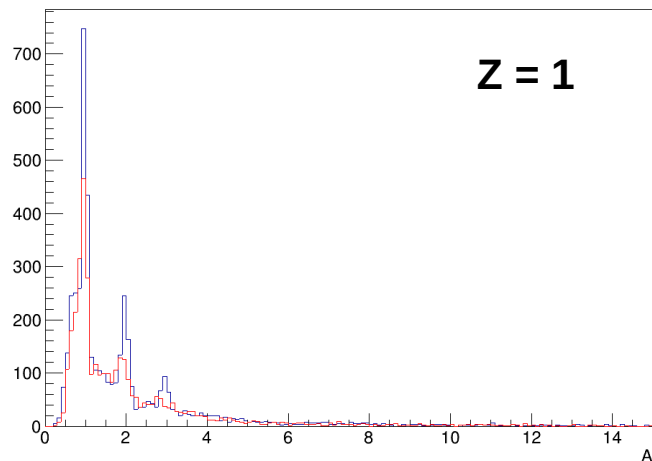
E_{kin} distributions: **Z mis-id** vs **all** (MC simulation)



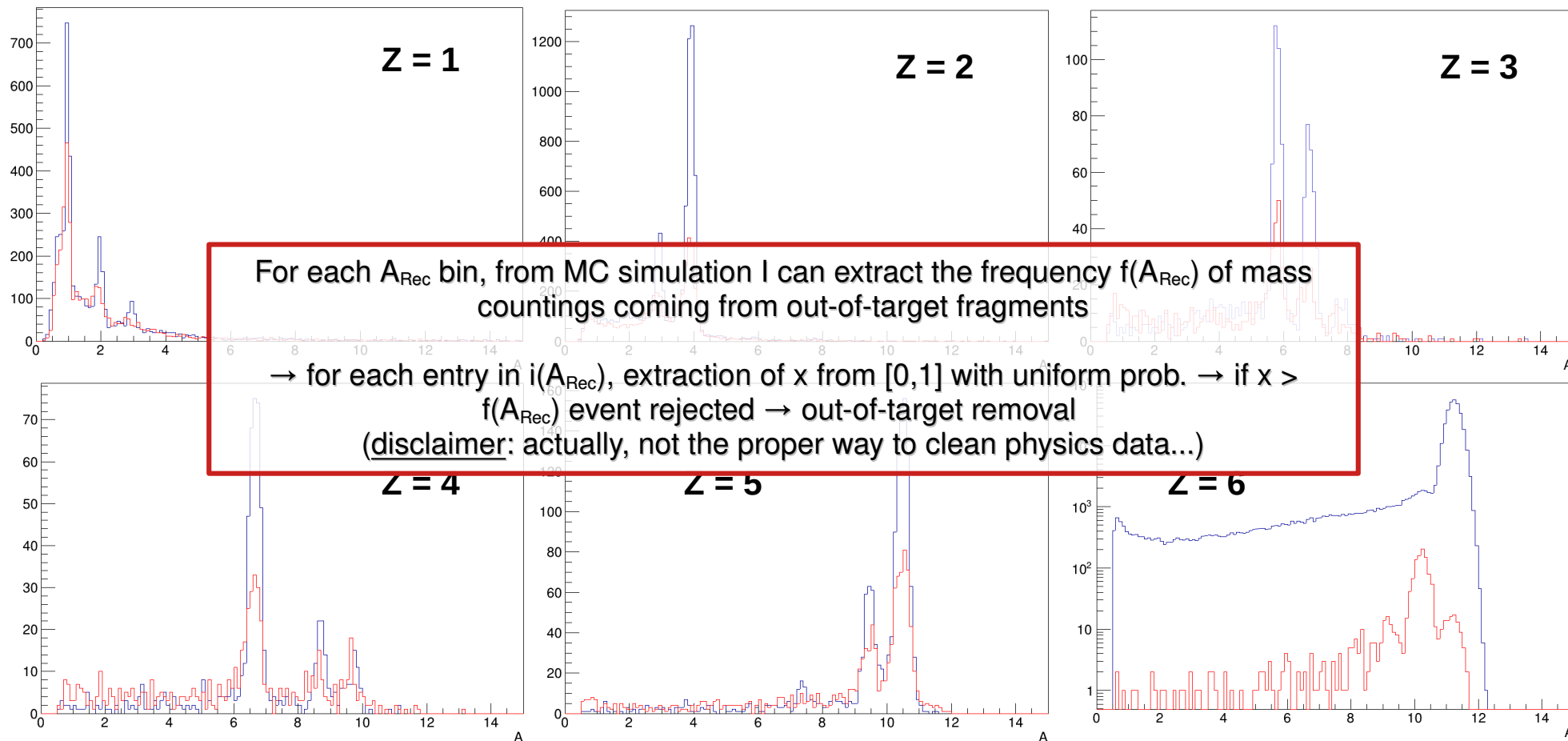
E_{kin} distributions: **Z mis-id** vs **all** (MC simulation)



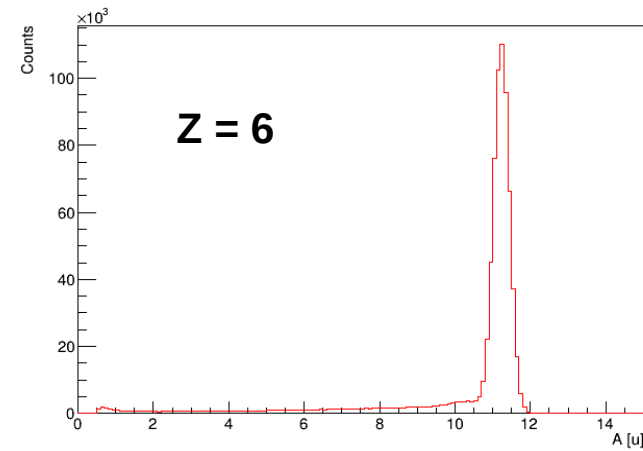
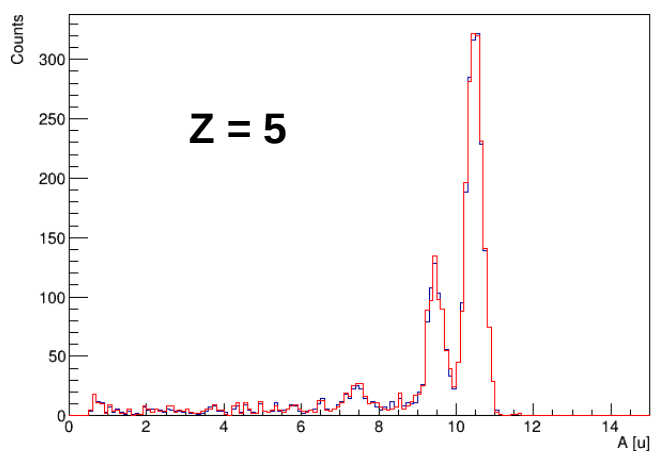
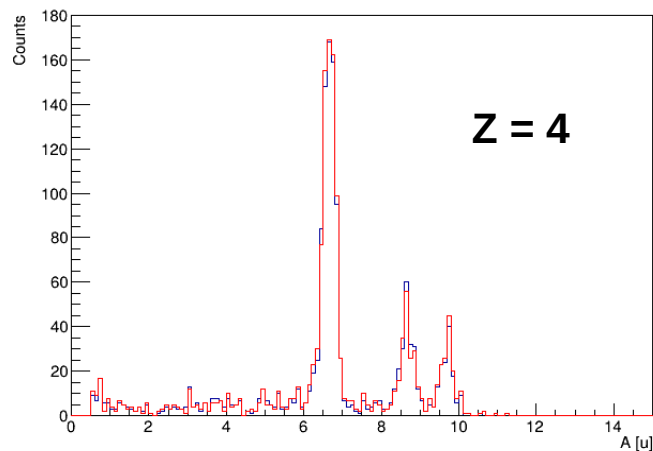
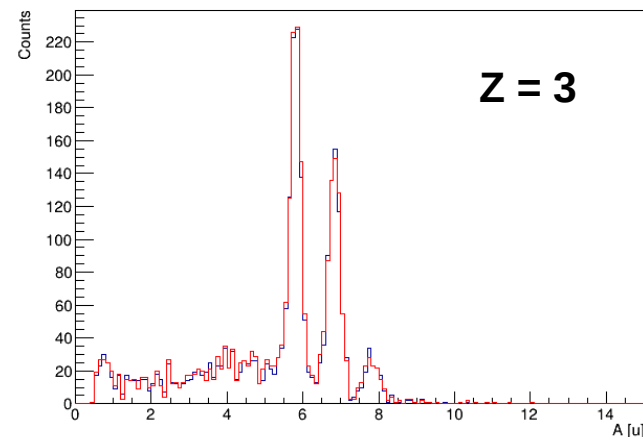
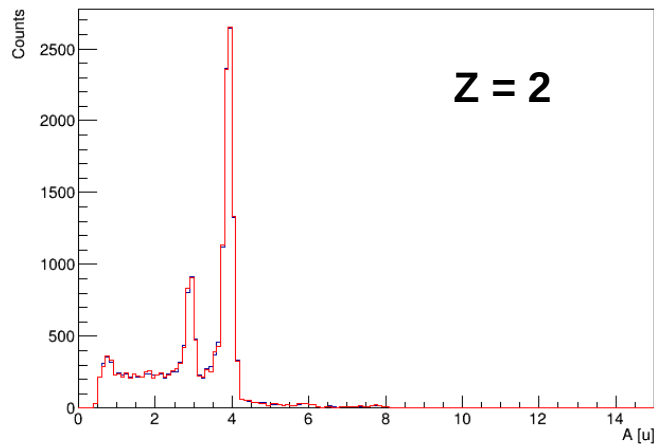
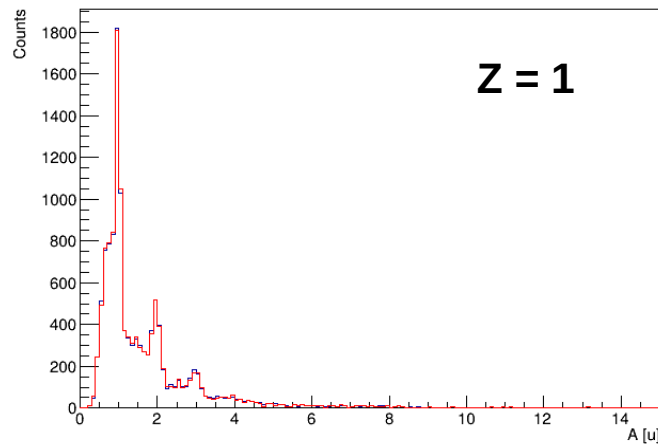
Out-of-target vs in-target fragmentation (MC simulation)



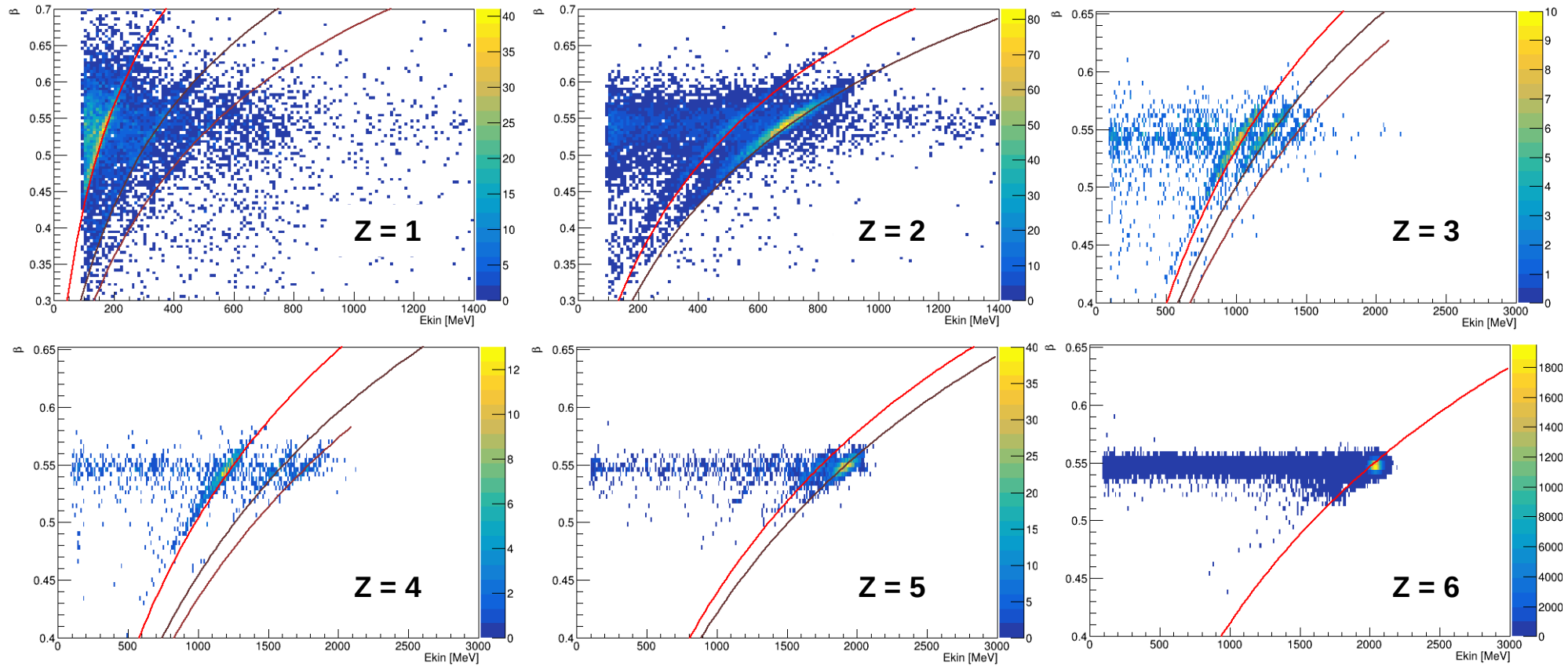
Out-of-target vs in-target fragmentation (MC simulation)



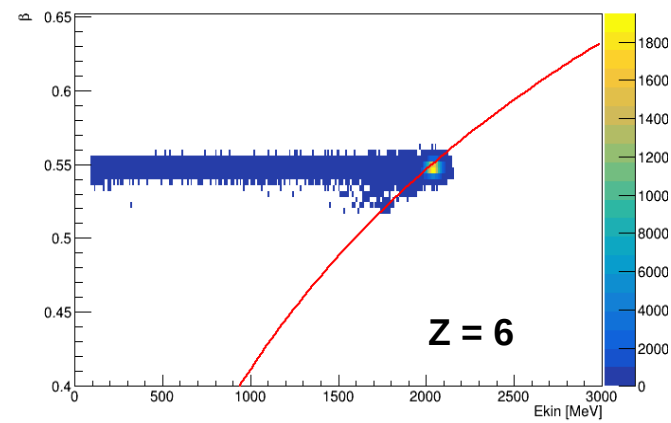
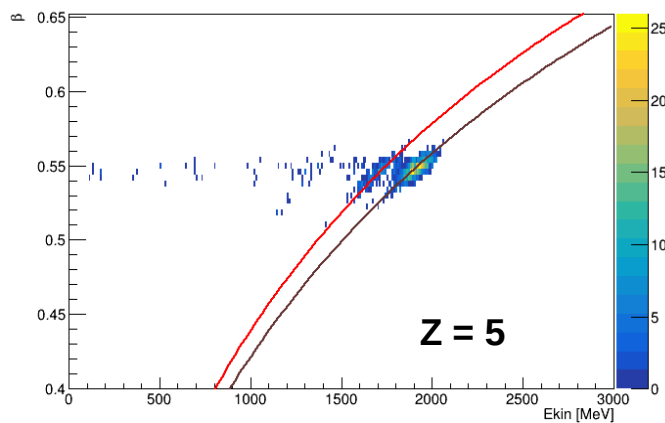
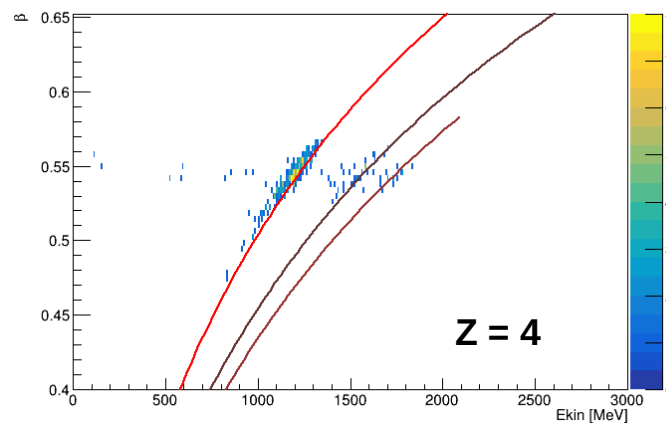
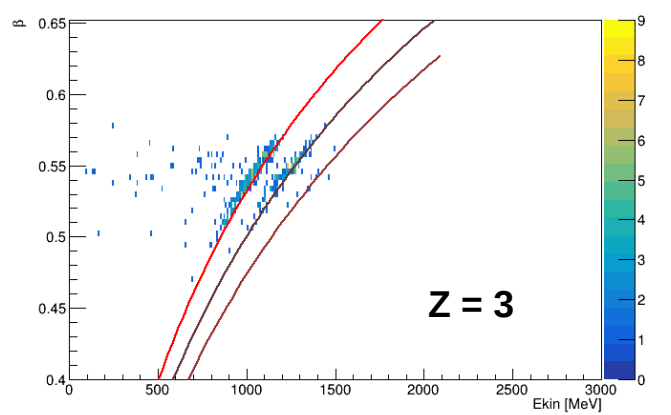
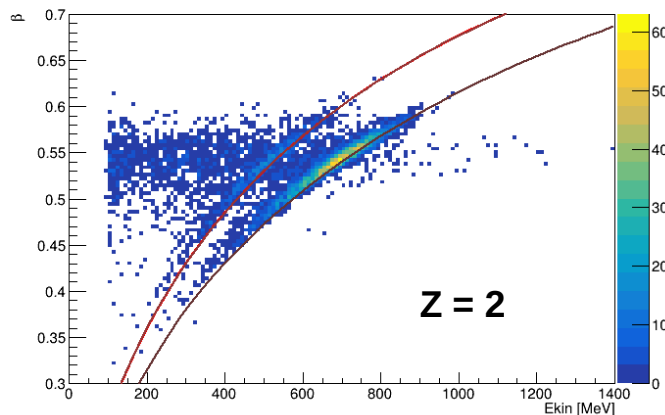
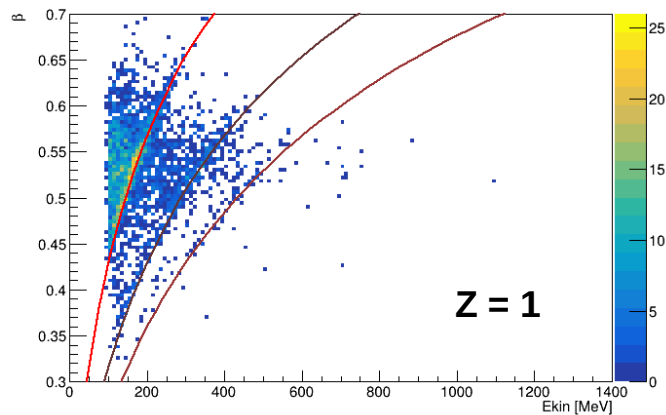
Direct vs **statistical** subtraction of out-of-target bkg



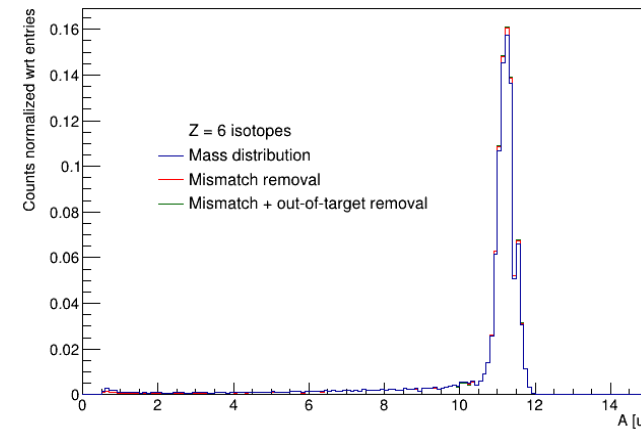
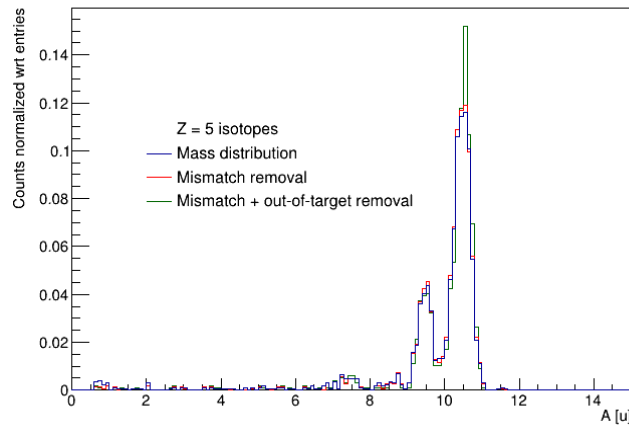
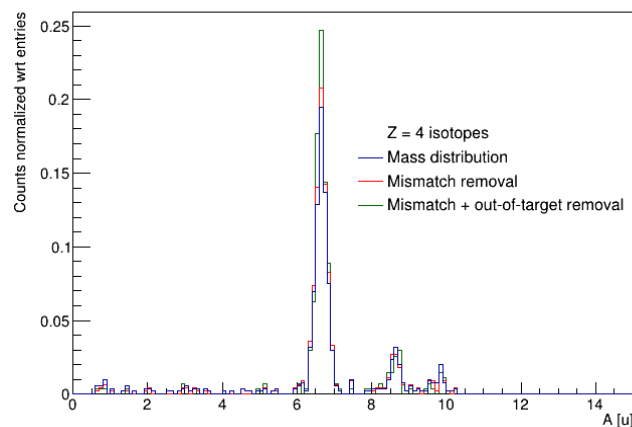
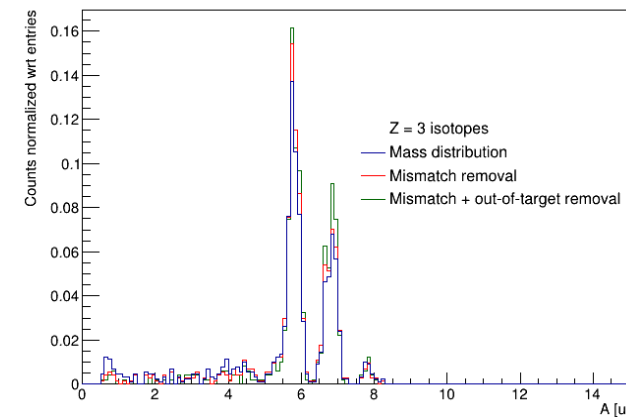
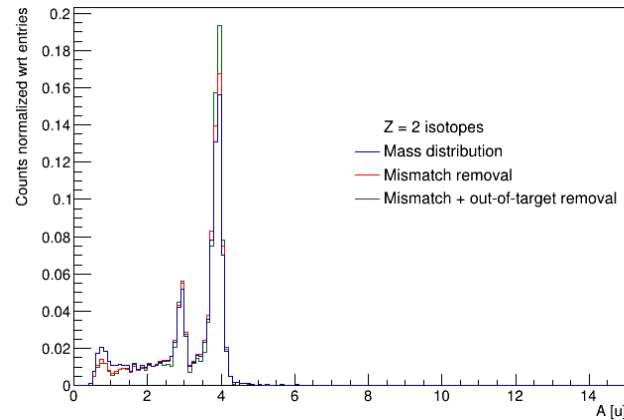
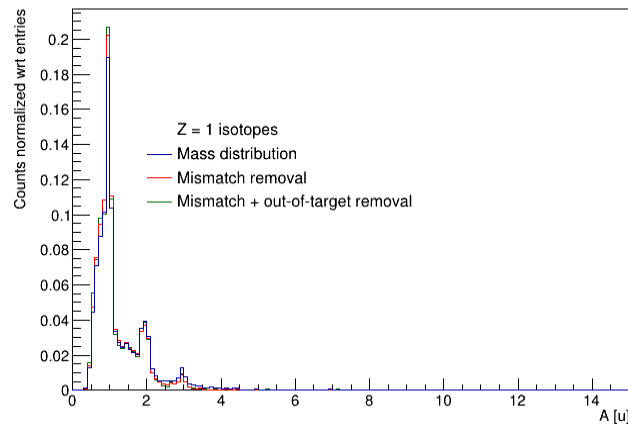
β vs E_{kin} distributions with A_{nom} correction - MC



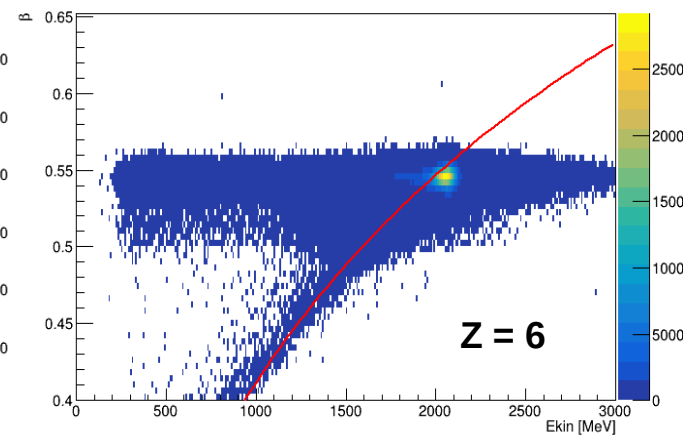
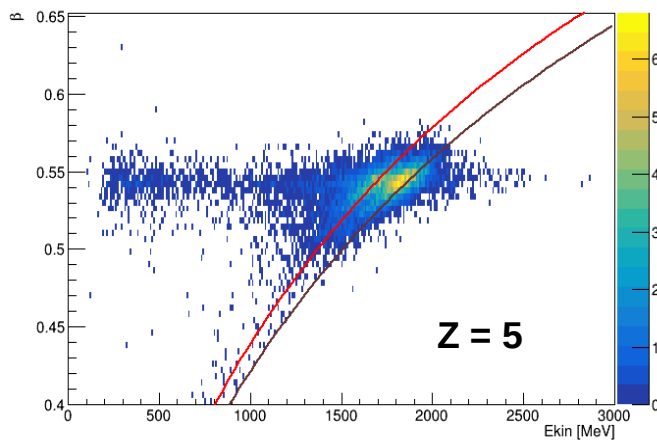
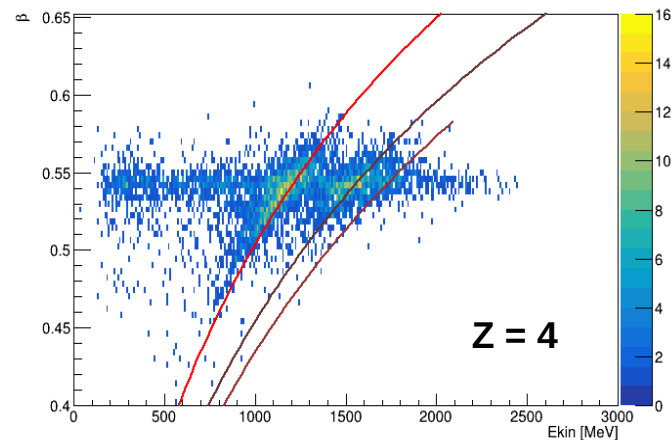
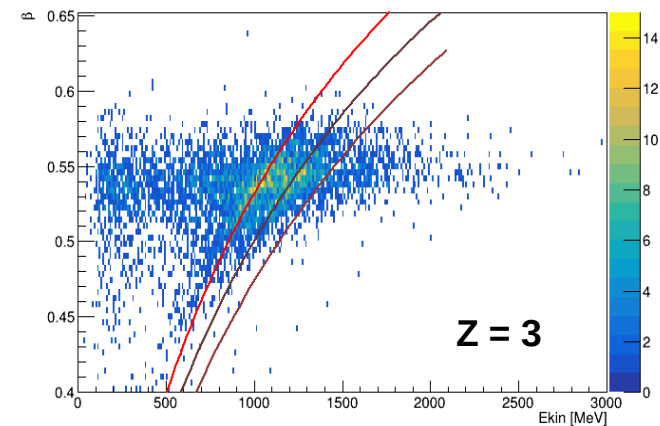
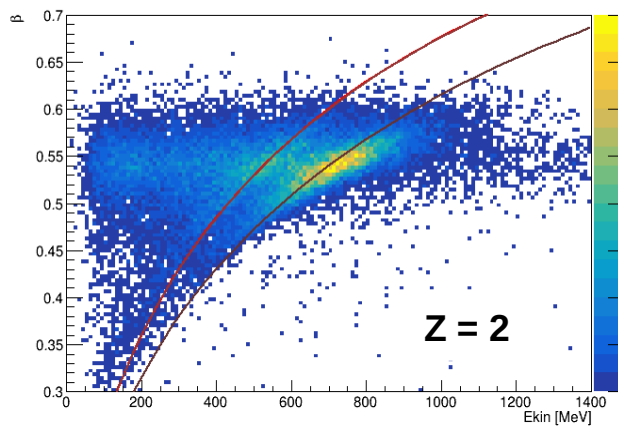
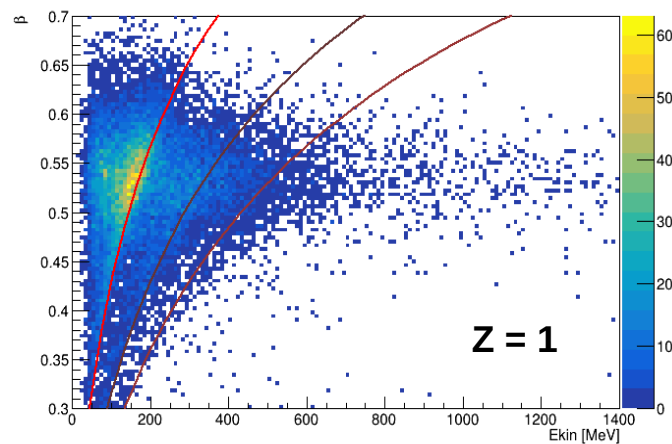
Out-of-target + Z-mismatch removal (β vs E_{kin}) - MC



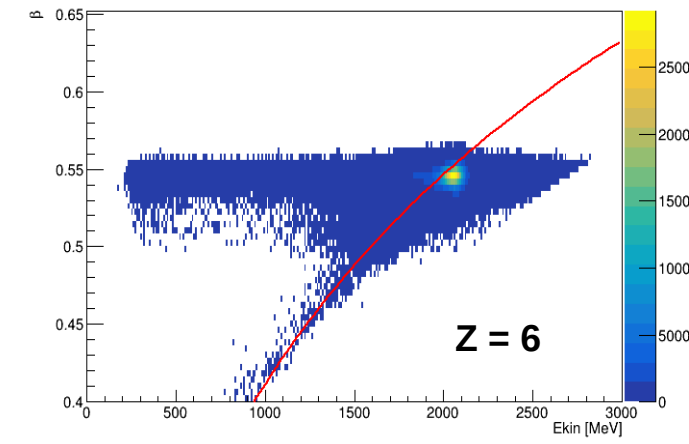
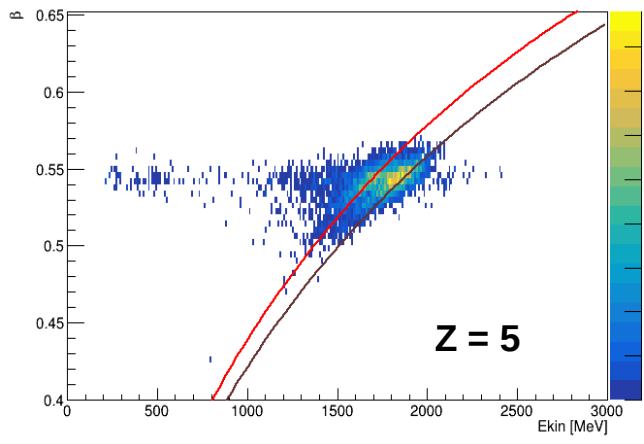
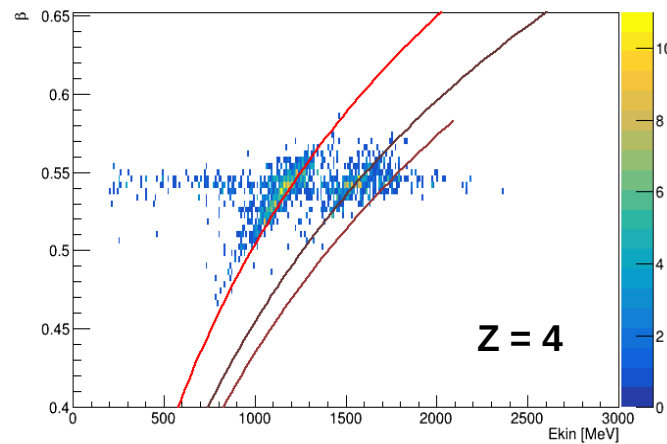
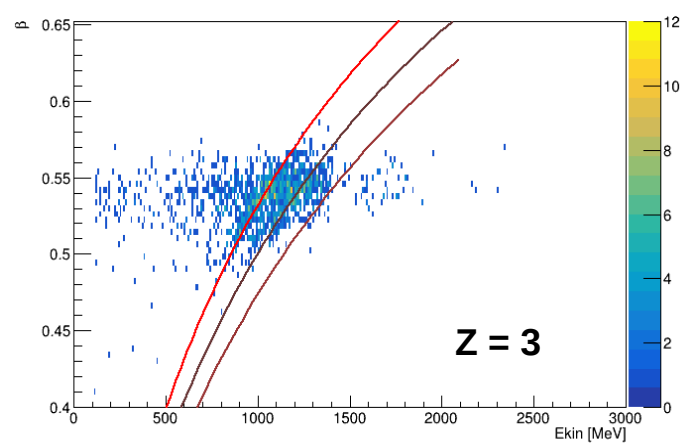
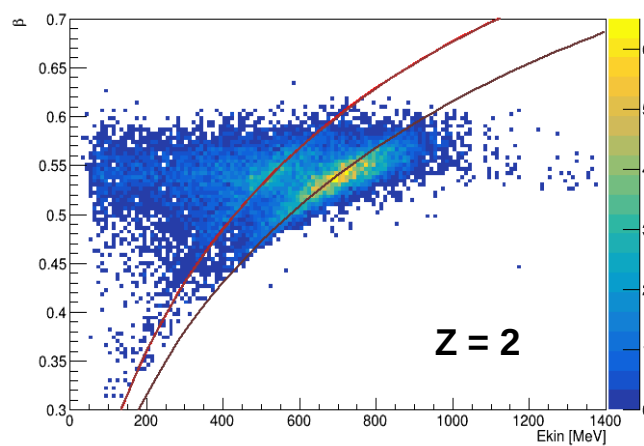
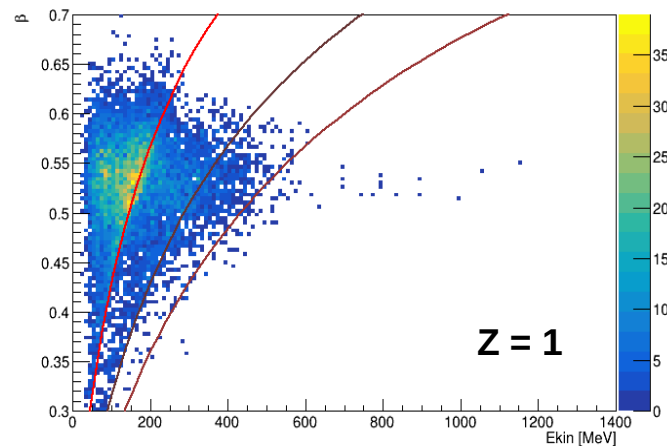
Out-of-target + Z-mismatch removal in MC



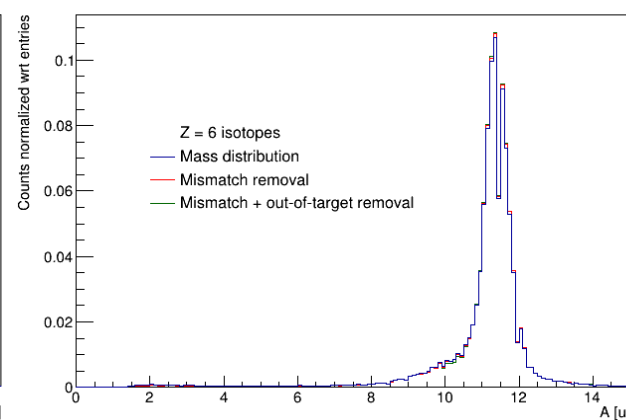
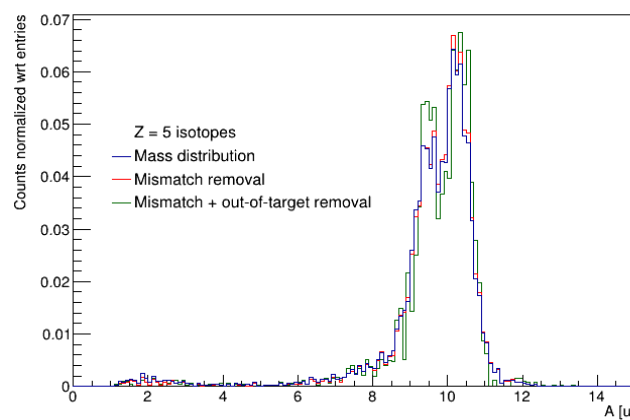
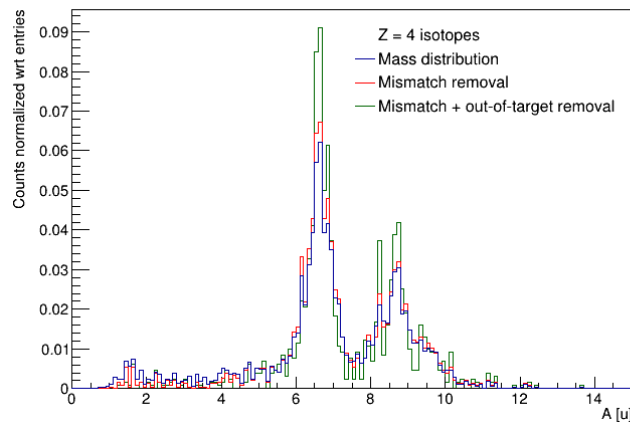
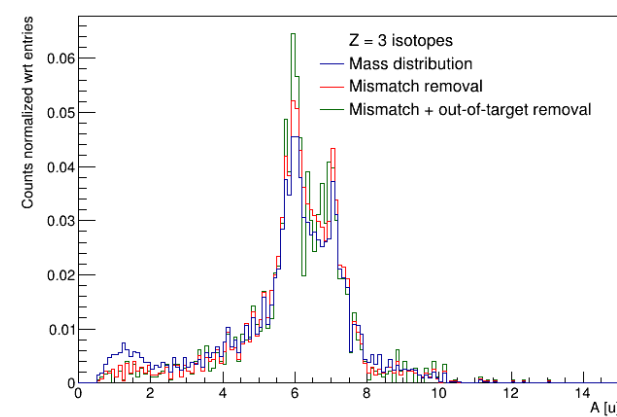
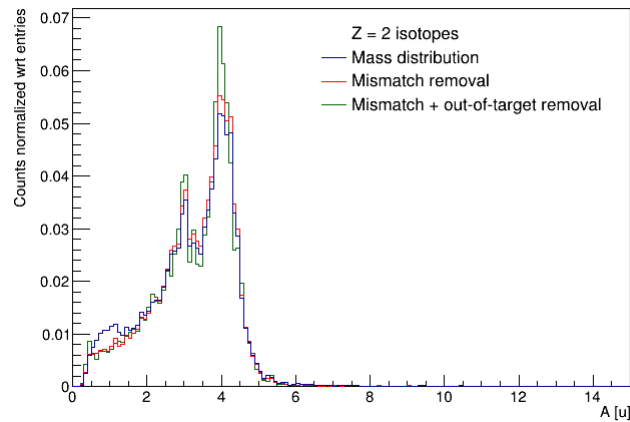
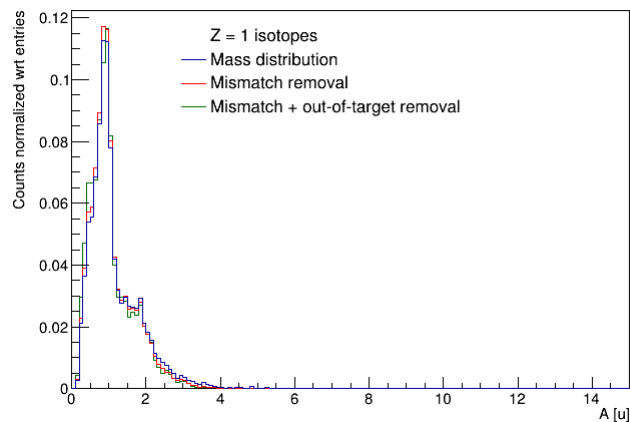
β vs E_{kin} distributions with A_{nom} correction - data



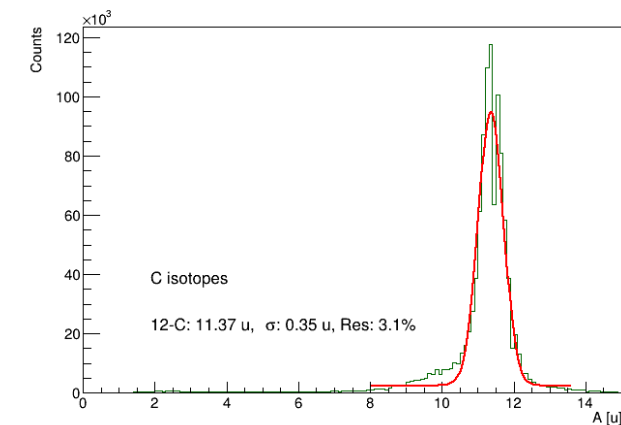
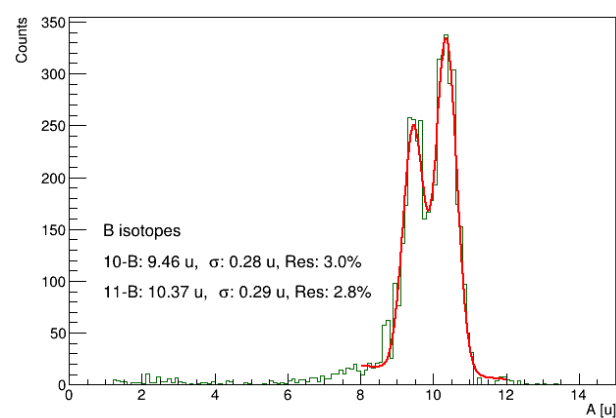
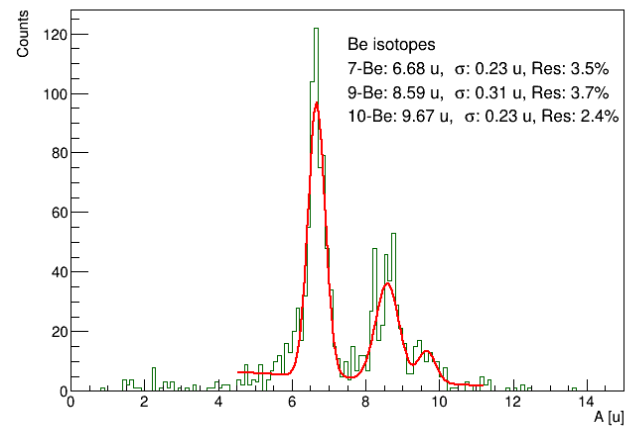
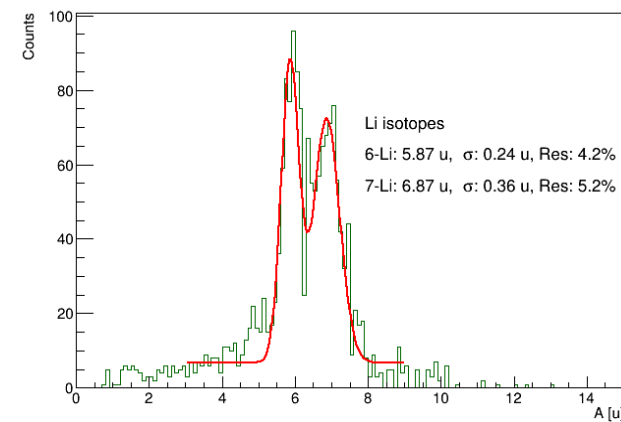
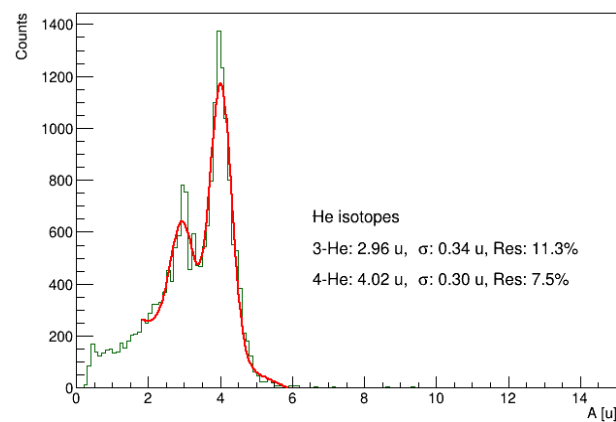
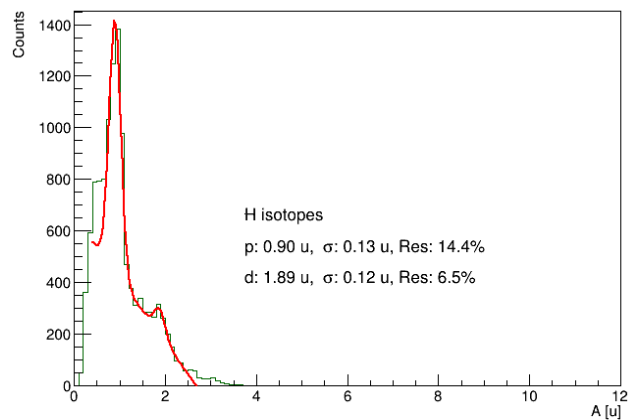
Out-of-target + Z-mismatch removal (β vs E_{kin}) - data



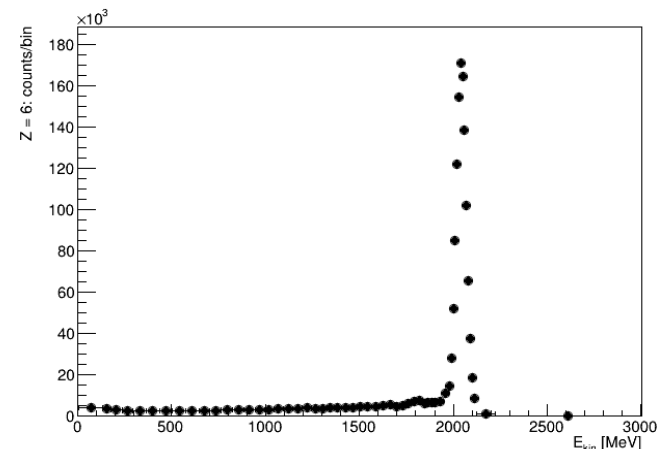
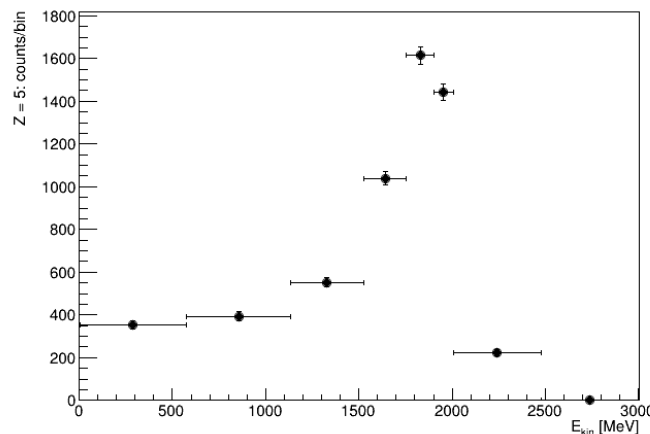
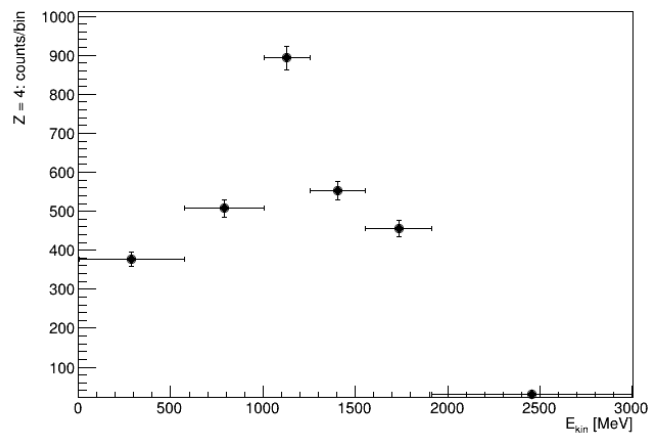
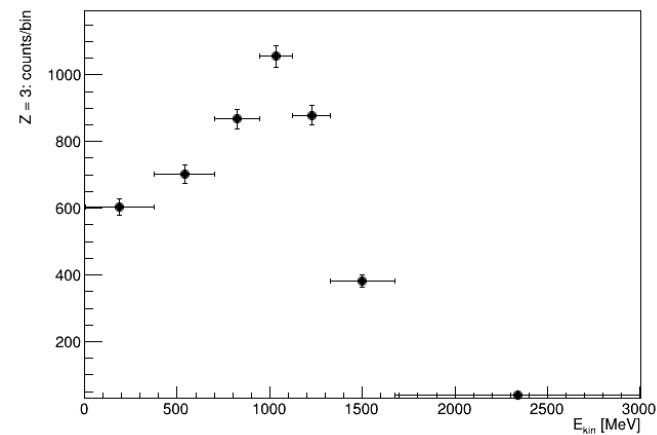
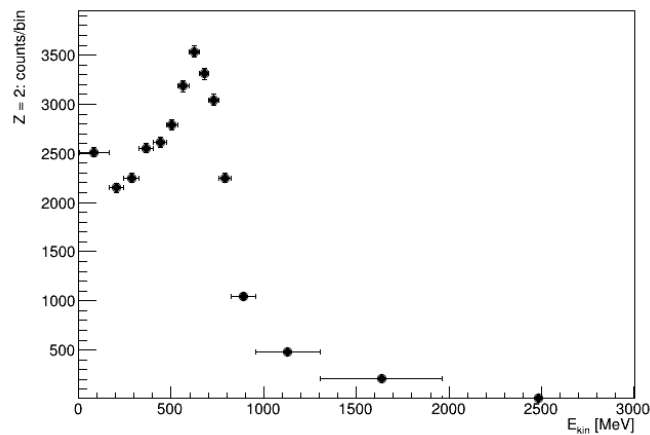
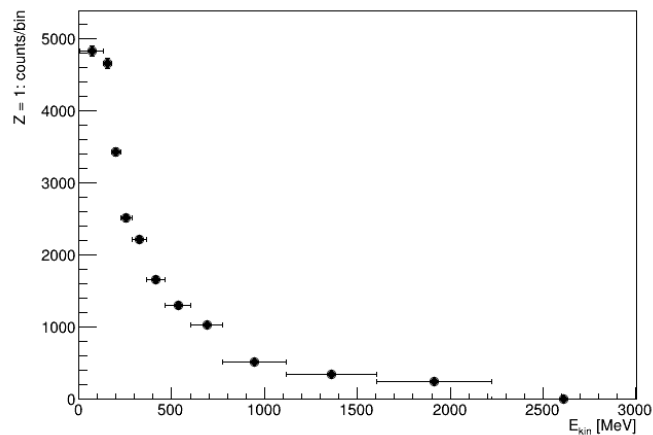
Out-of-target + Z-mismatch removal in data



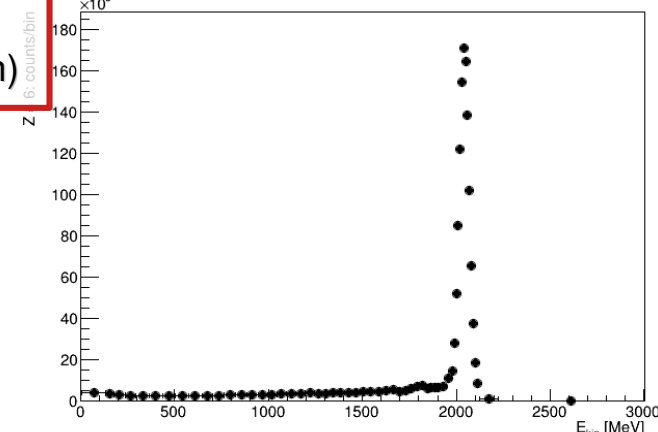
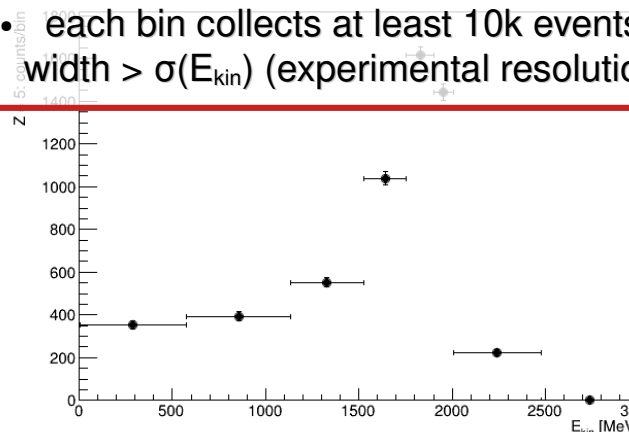
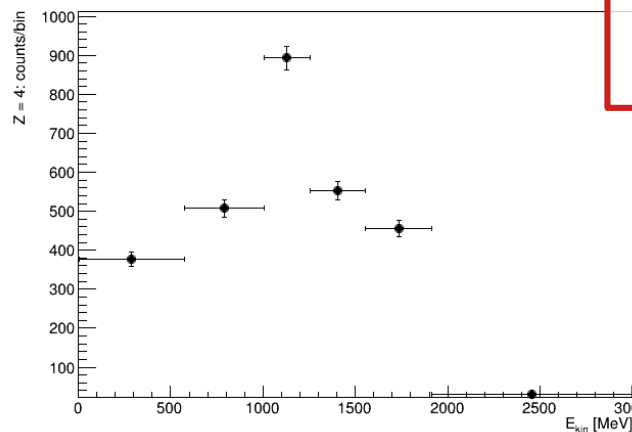
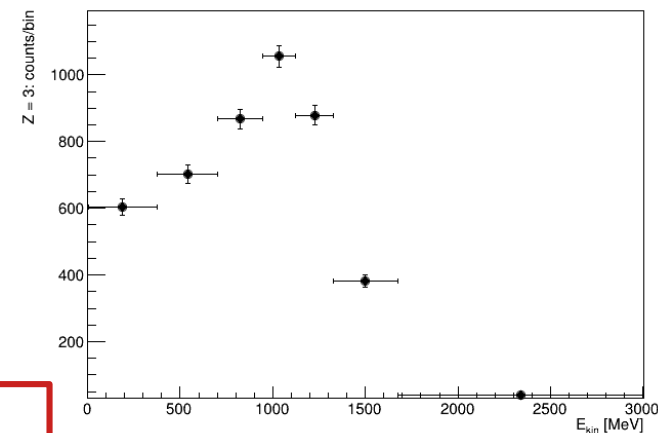
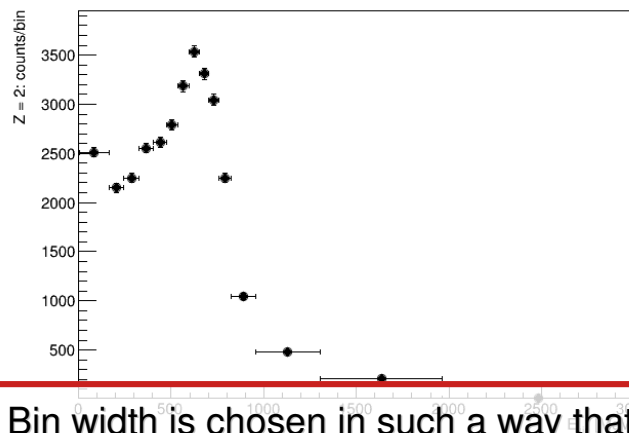
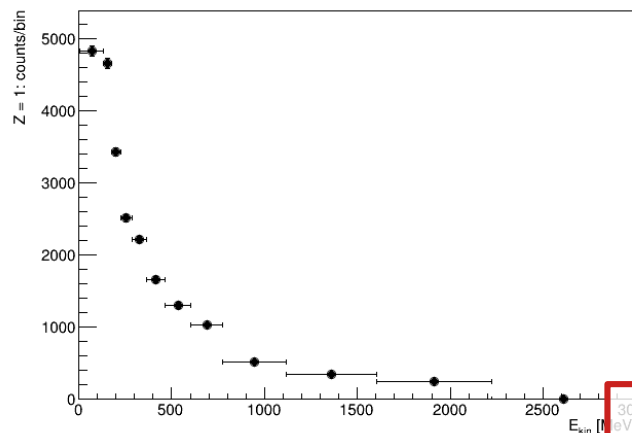
“Clean” mass peaks + linear background in data



Counts vs E_{kin} (MC reconstruction, 1M events)



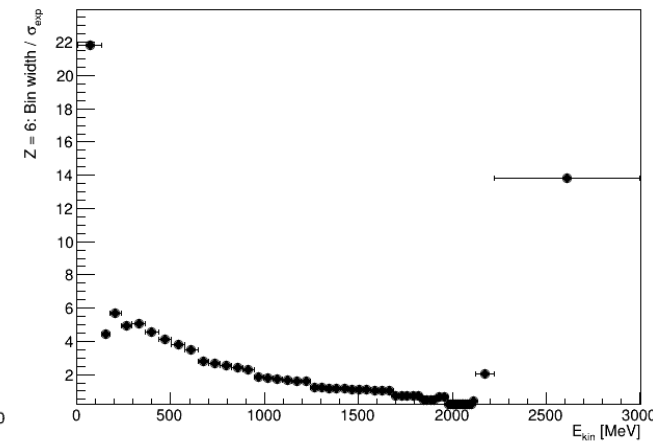
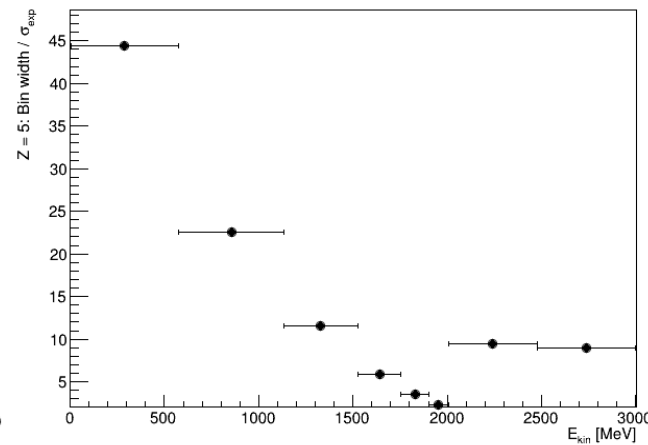
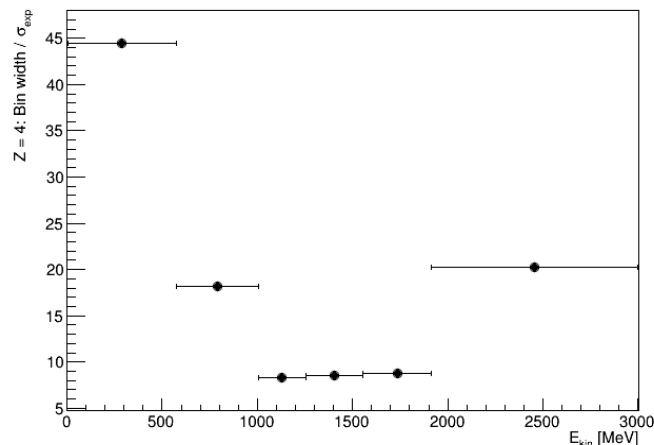
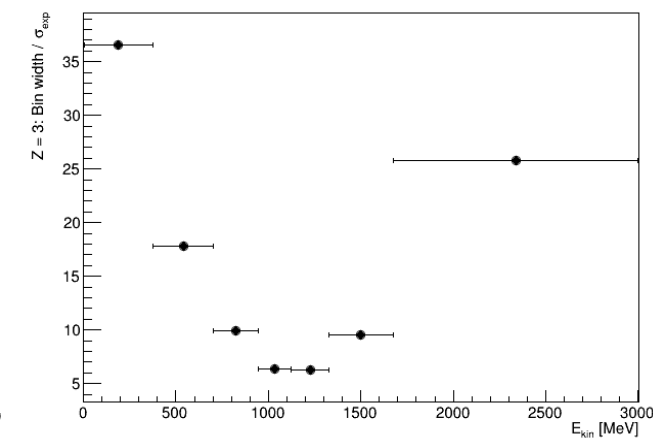
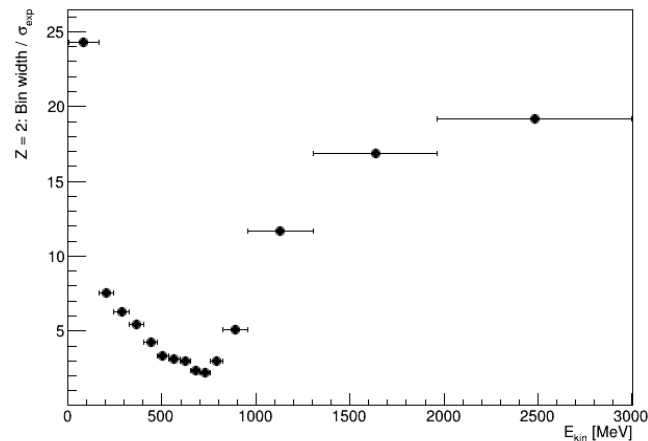
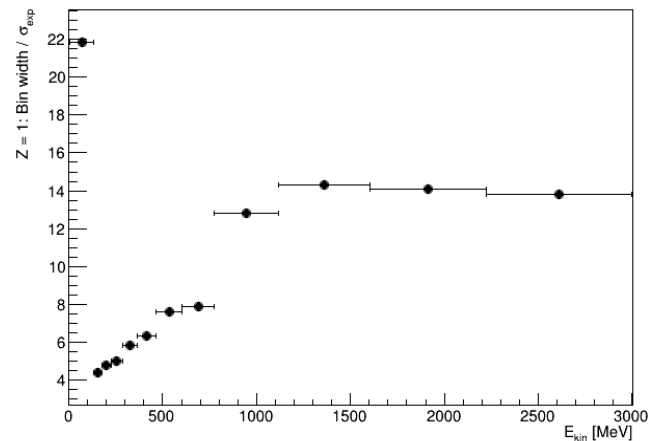
Counts vs E_{kin} (MC reconstruction, 1M events)



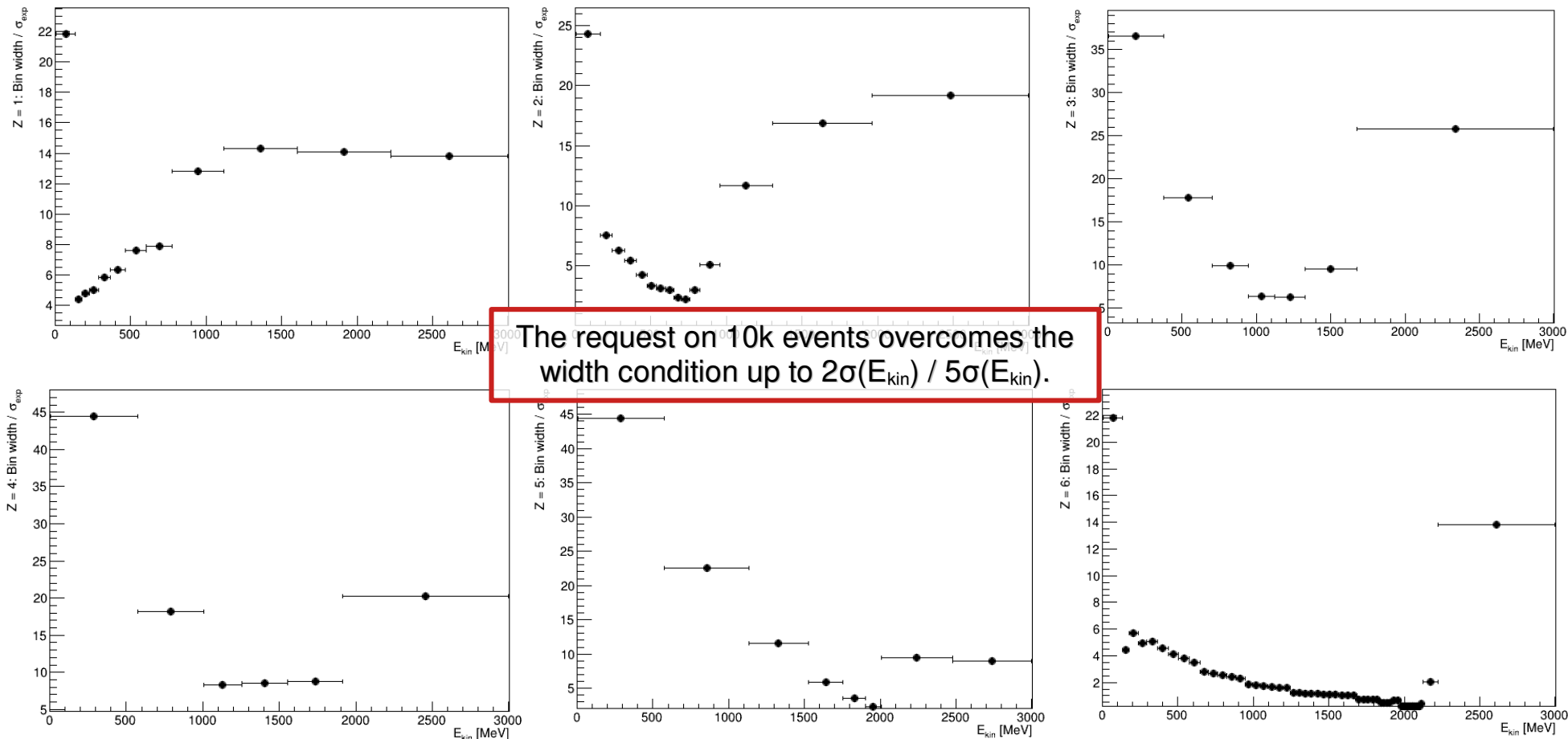
Bin width is chosen in such a way that:

- each bin collects at least 10k events;
- width $> \sigma(E_{\text{kin}})$ (experimental resolution)

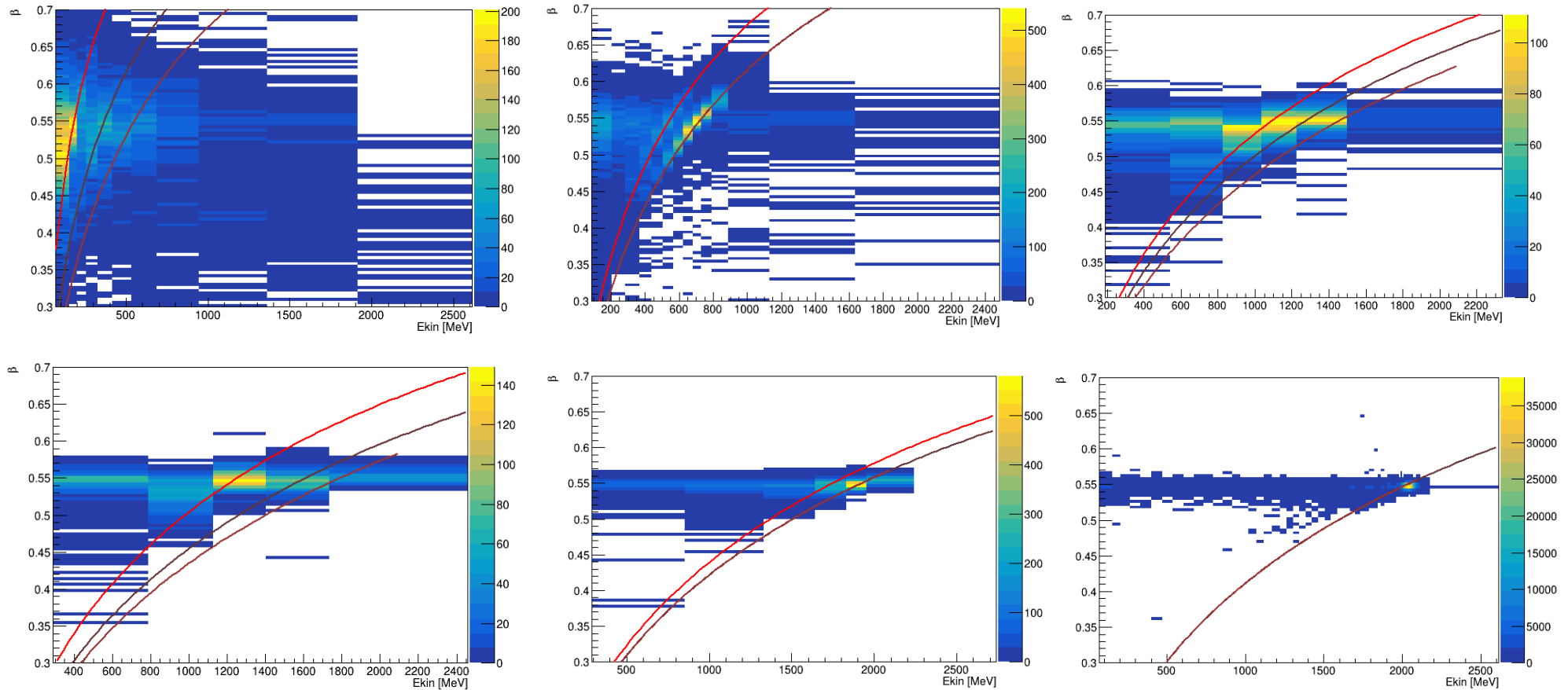
Bin width / σ_{exp} (MC analysis, 1M events)



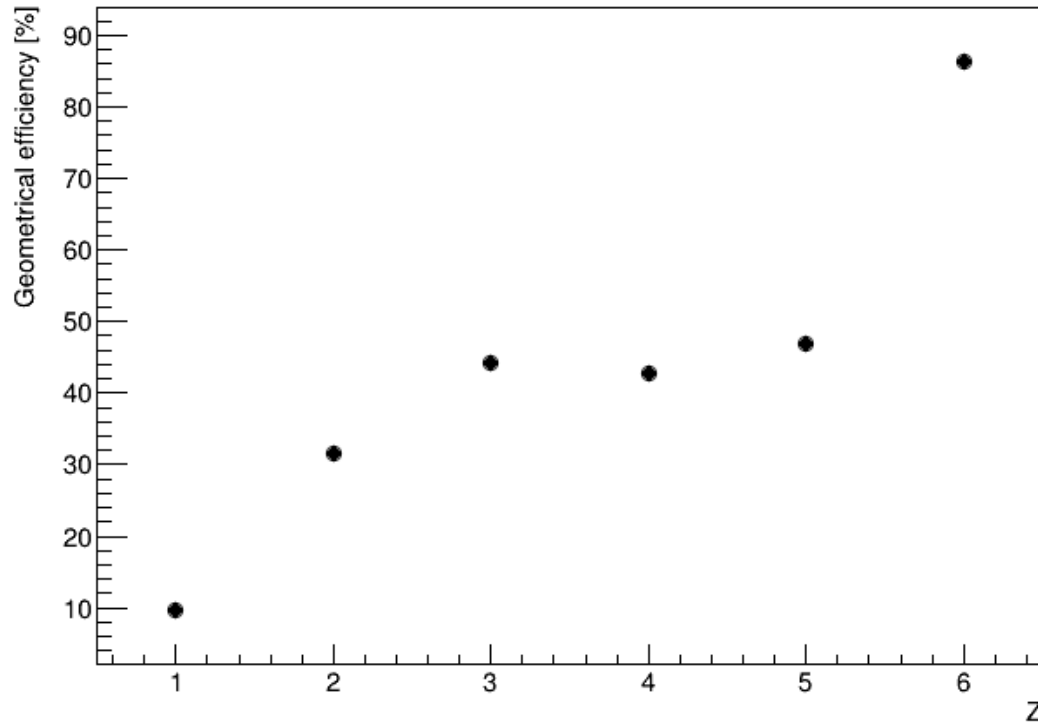
Bin width / σ_{exp} (MC analysis, 1M events)



β vs E_{kin} distributions with E_{kin} rebinning – MC reco



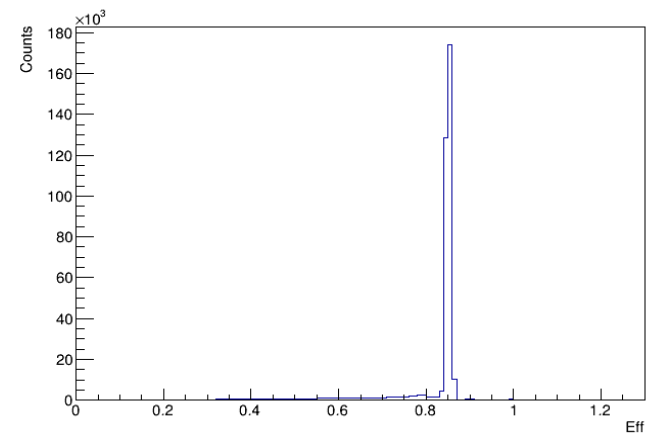
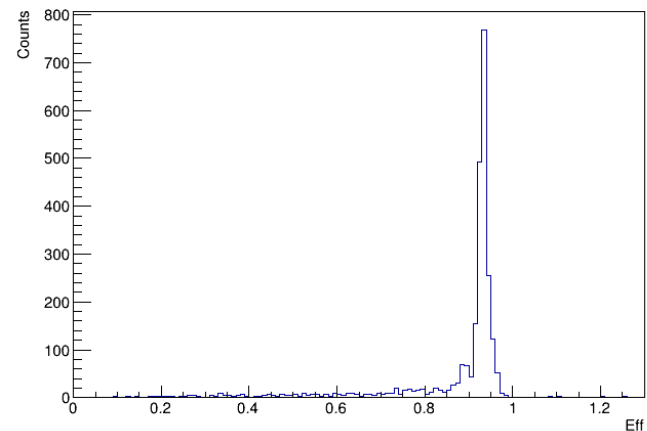
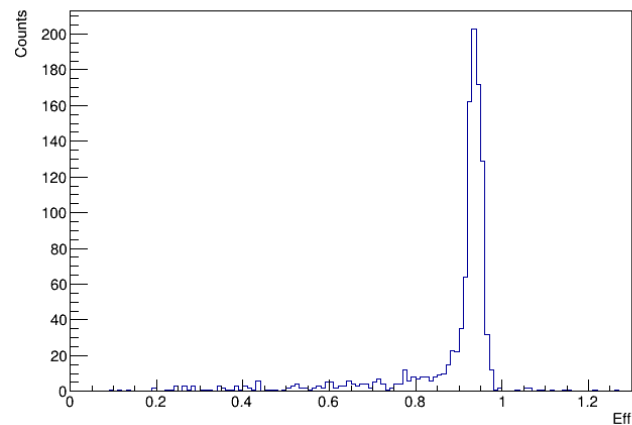
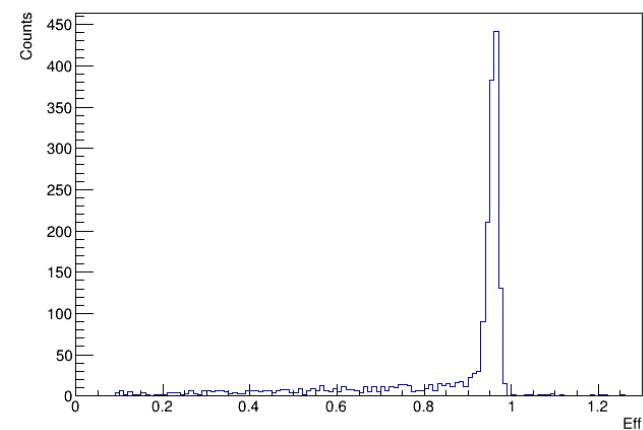
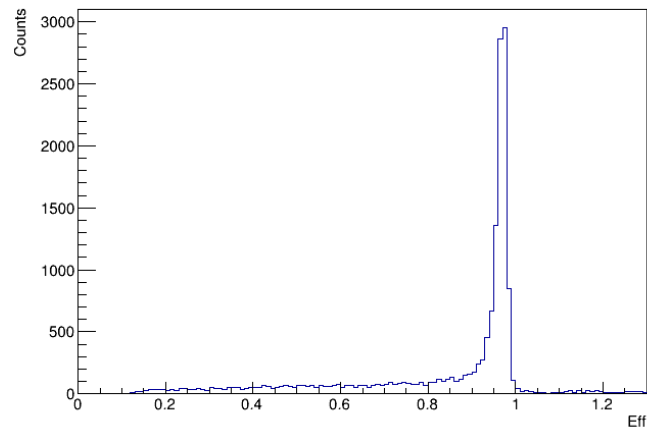
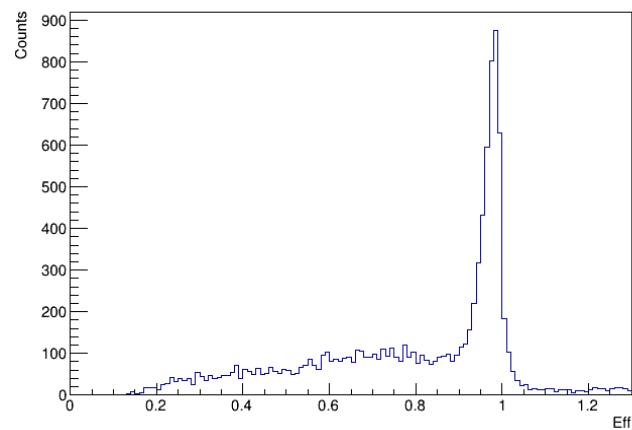
Geometrical acceptance wrt to Z



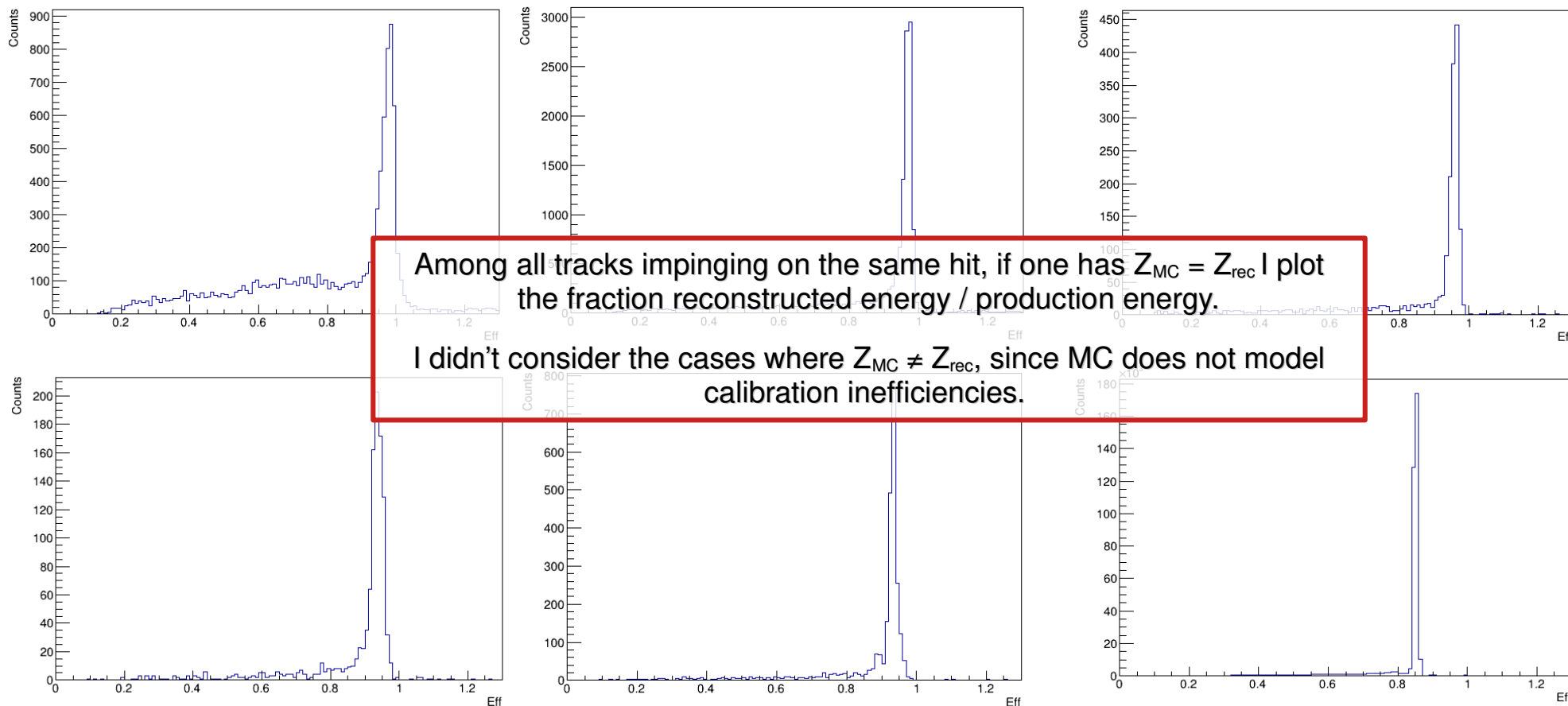
Ratio between tracks impinging on the CALO and overall tracks produced in target + beam.

Efficiency for $Z = 1$ is of $\approx 10\%$, while it's among 30-50% for other Z , aside from C.

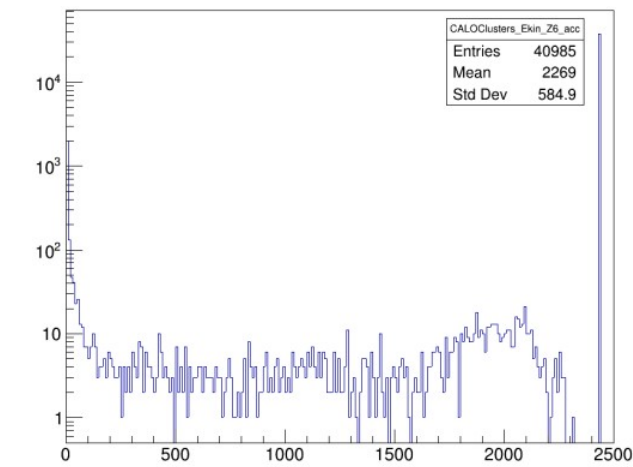
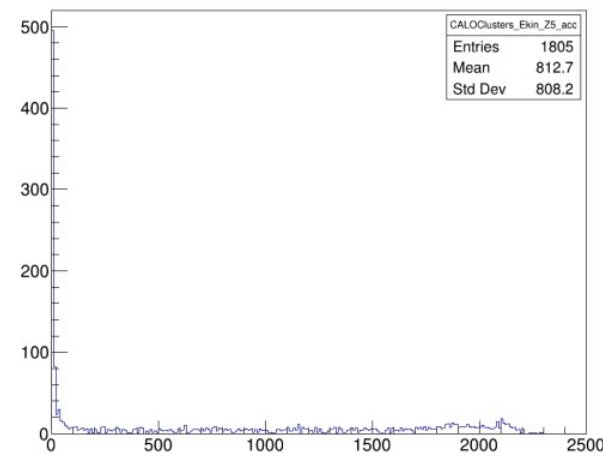
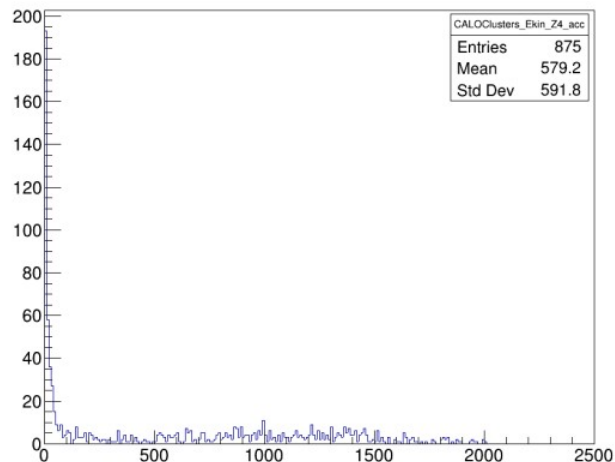
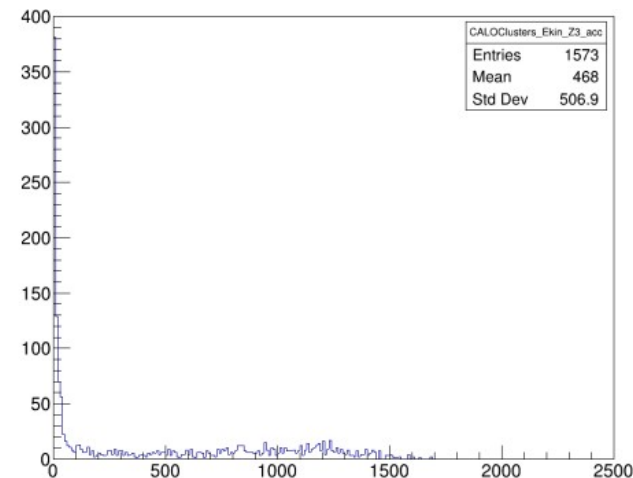
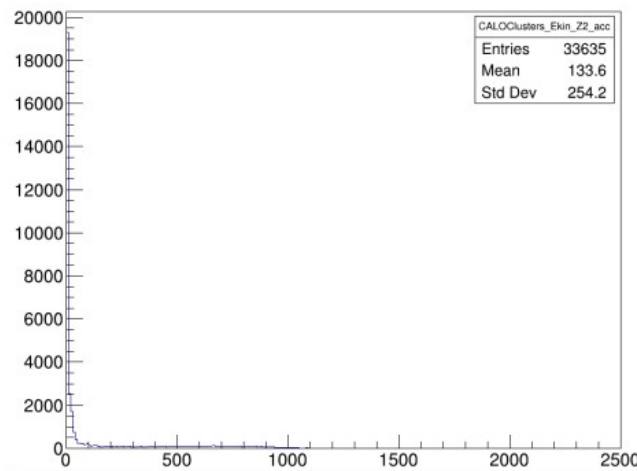
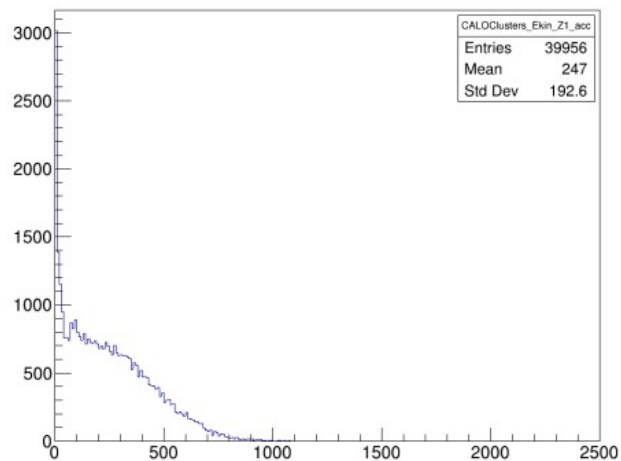
Fraction of in-production energy reconstructed wrt Z



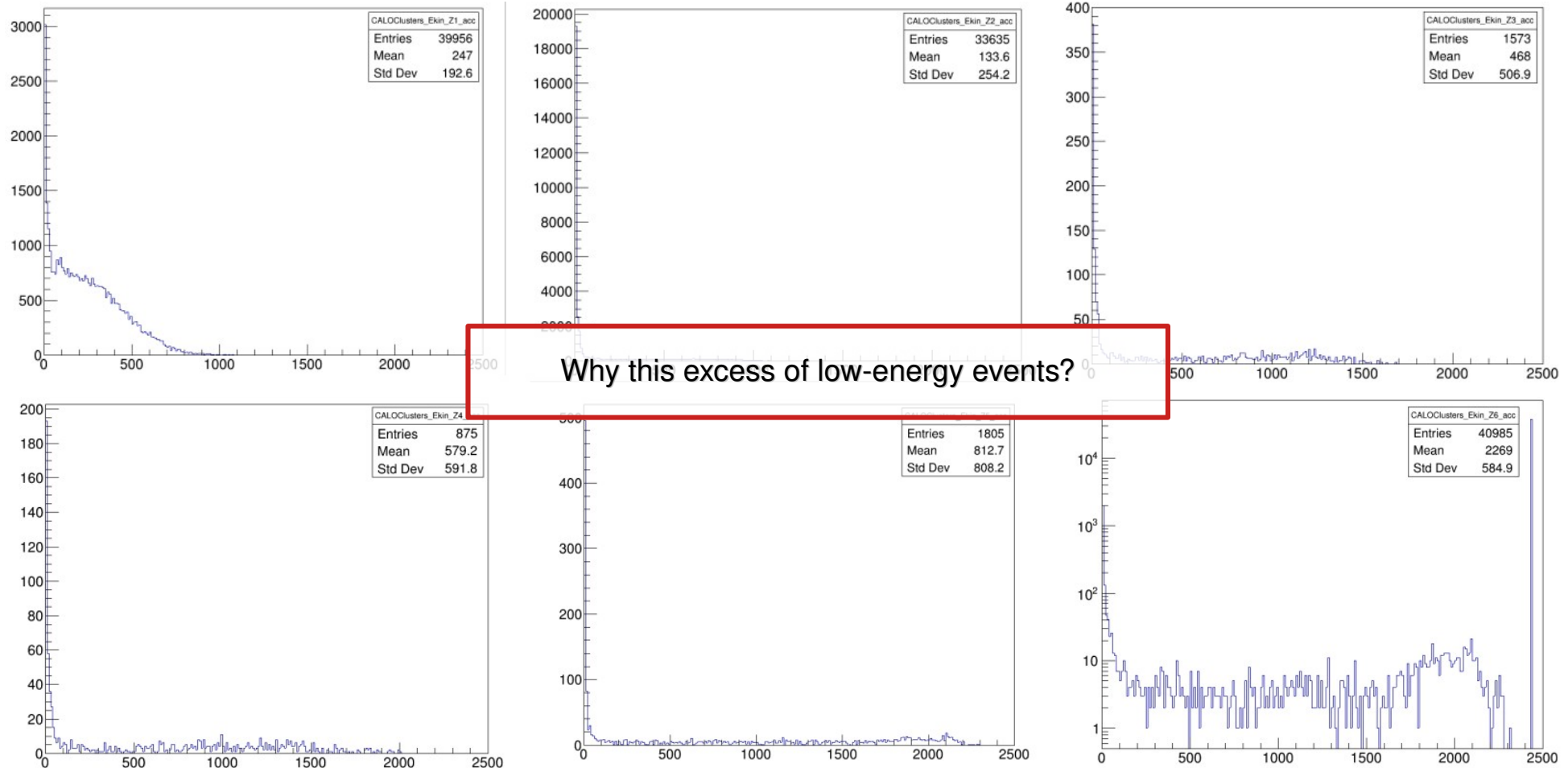
Fraction of in-production energy reconstructed wrt Z



In-production energy for all impinging fragments



In-production energy for all impinging fragments



- The E_{kin} binning is being refined to allow isotope separation and, in general, cross sections optimization

(At least) five efficiencies to consider:

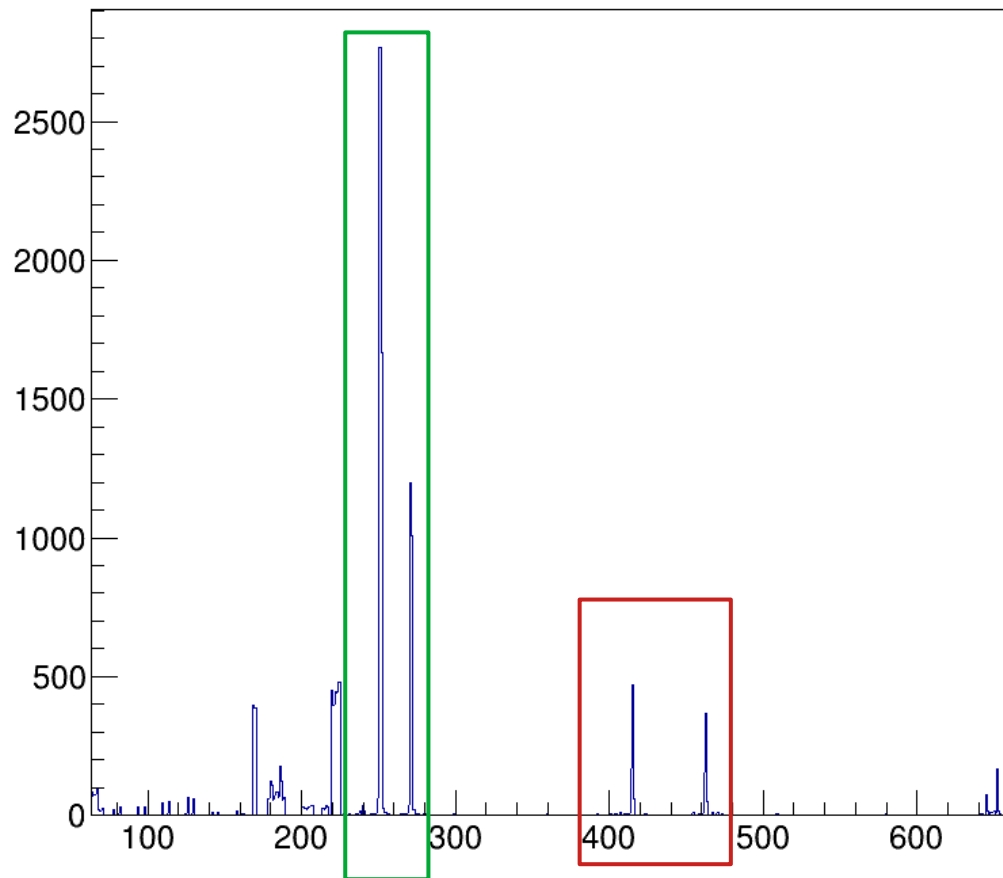
- TW-crossing / production
 - TW-Reco / TW-crossing
 - CALO-crossing / TW-crossing
 - CALO-Reco / CALO-crossing
 - CALO-TW matching
-
- Events with C + other (out-of-target) fragments must be removed, to see if consistent improvement in resolution is achieved
-
- What is the most efficient background removal?



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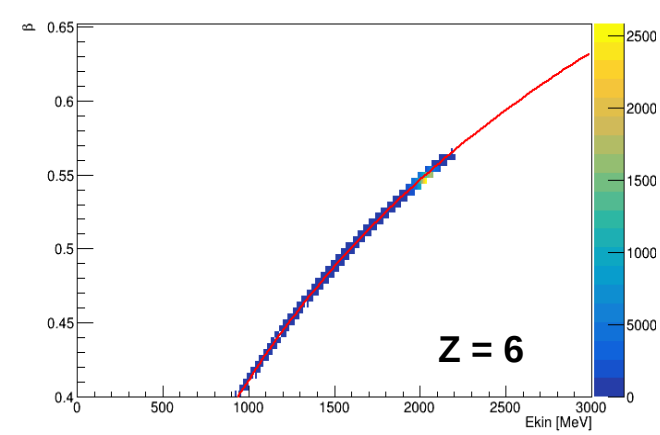
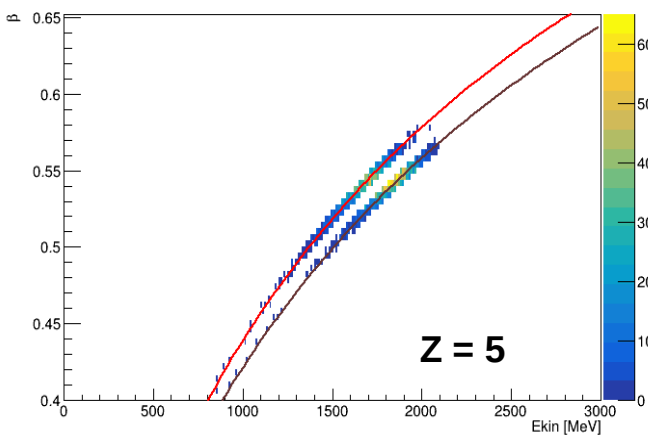
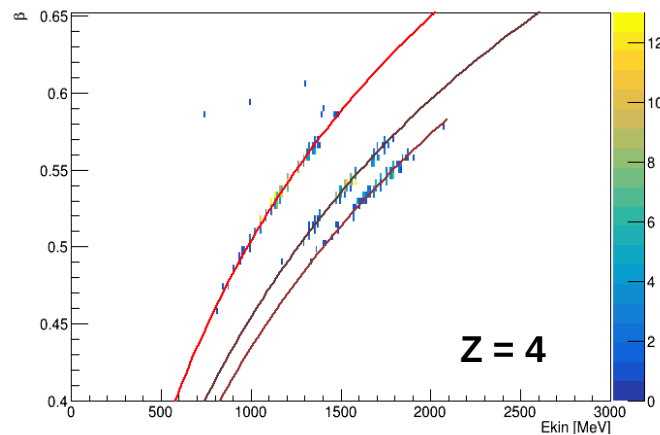
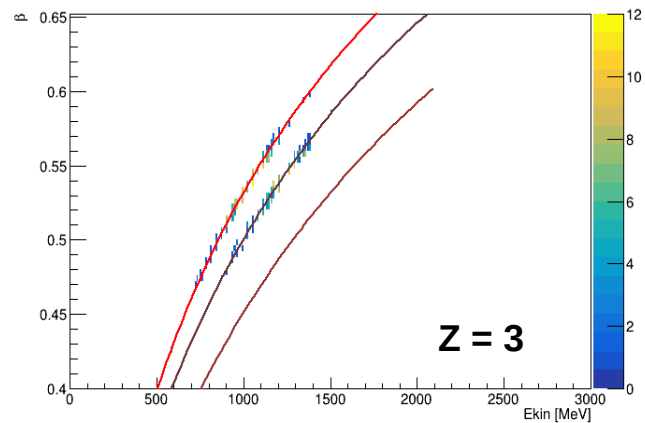
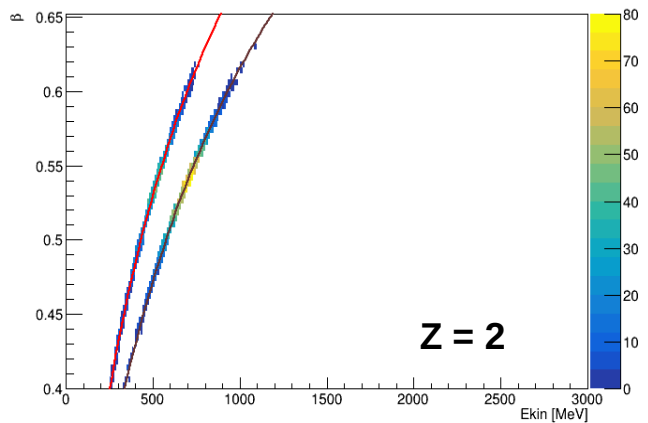
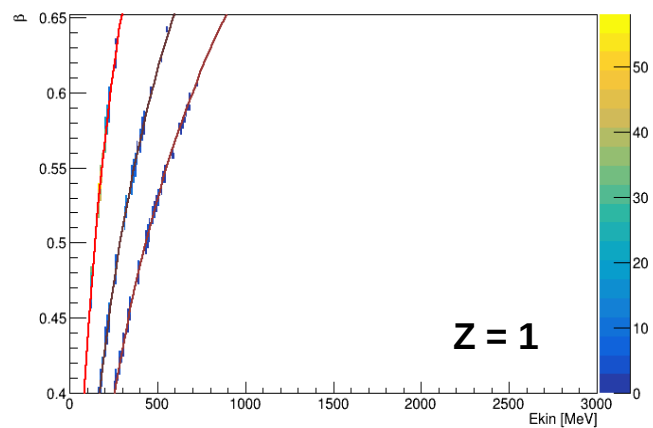


Out-of-target vs in-target fragmentation (MC simulation)

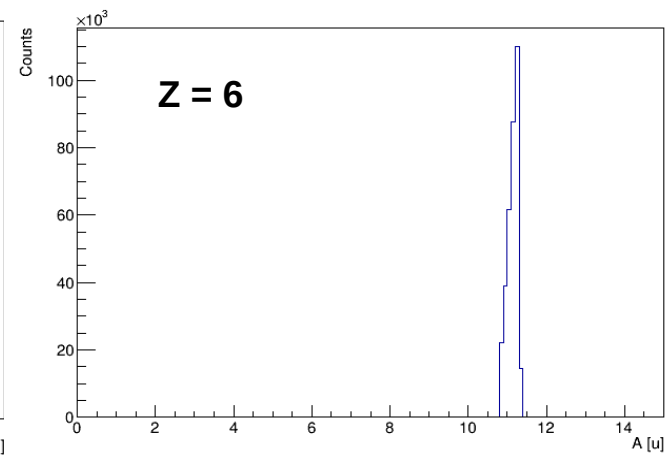
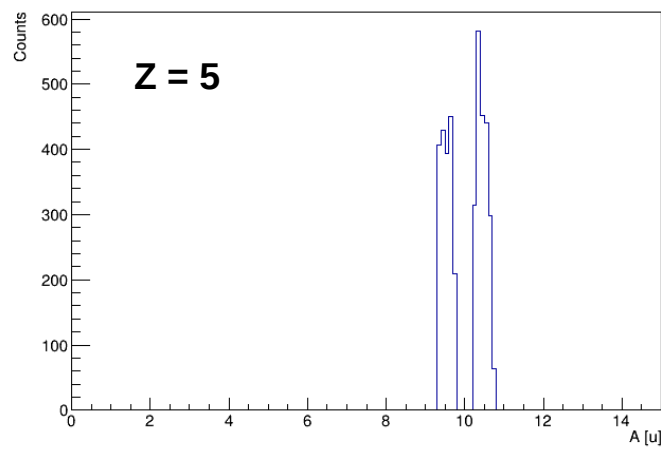
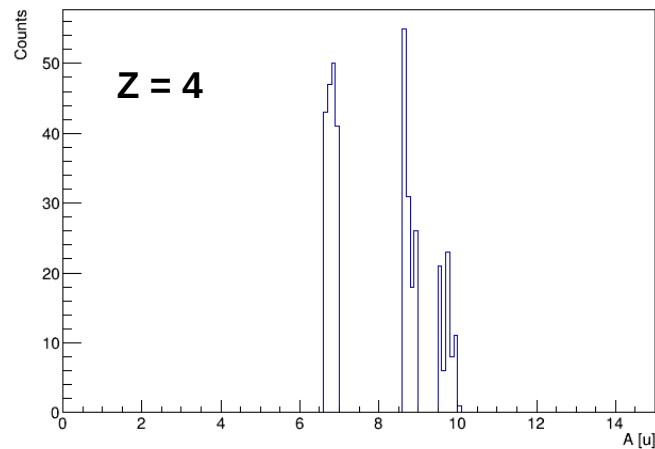
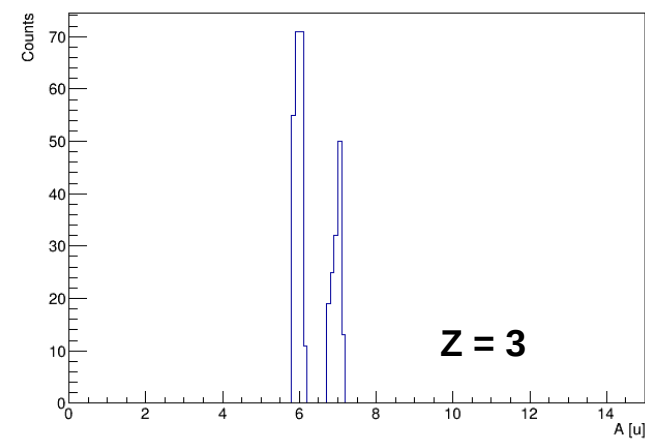
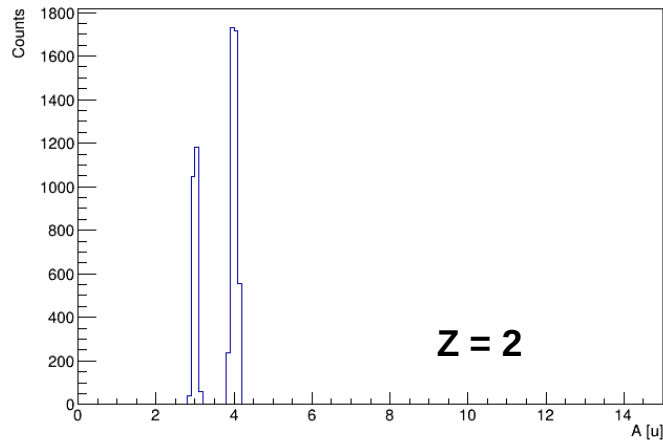
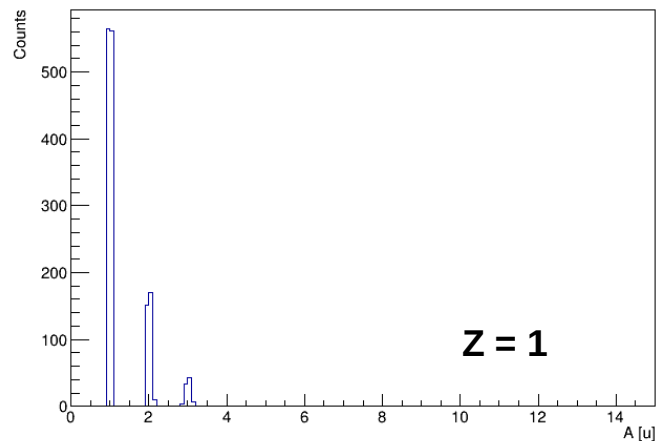


Most of “out-of-target” fragments come from the **TW center** or the **CALO center**.

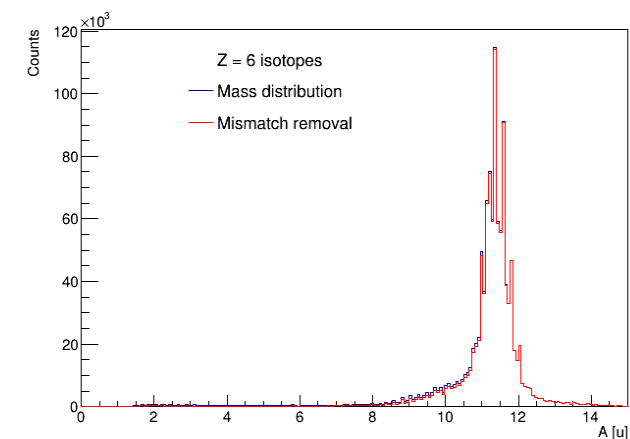
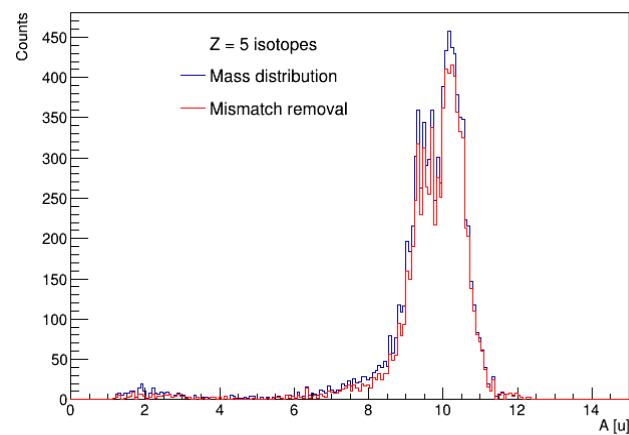
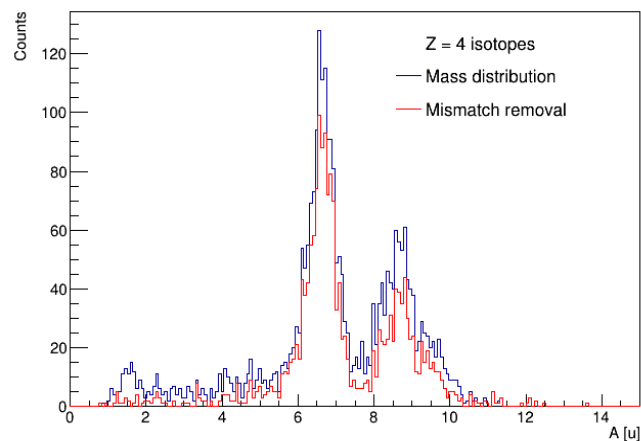
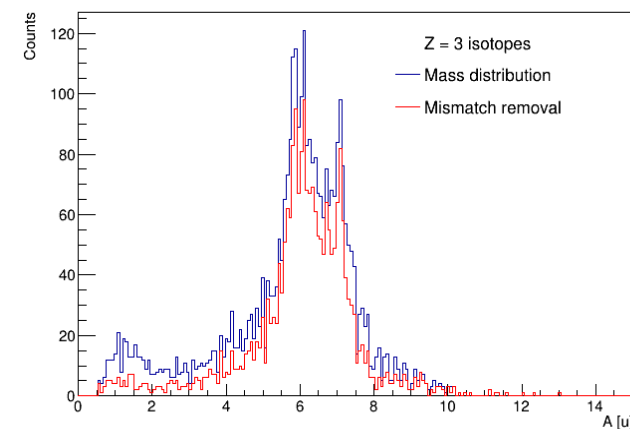
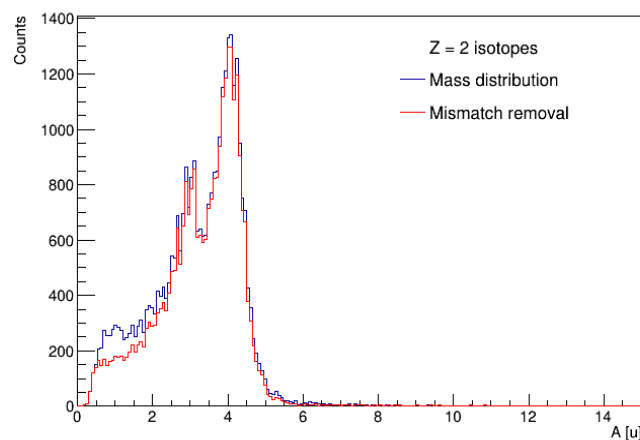
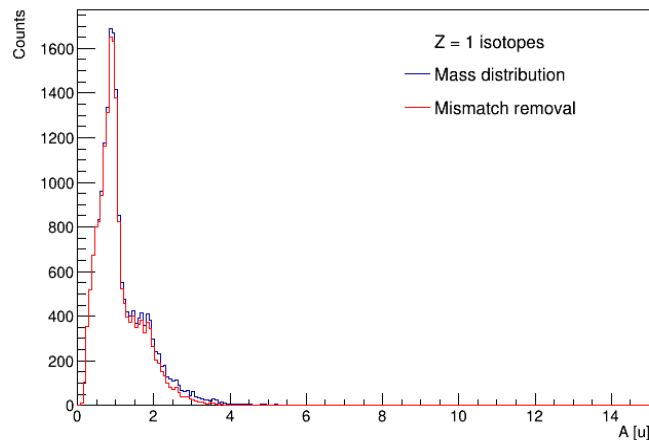
Beta vs E_{kin} - cut @ $2\sigma_{\text{res}}$ from nominal curves



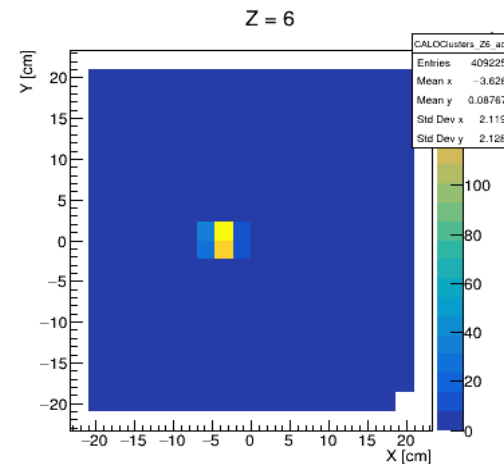
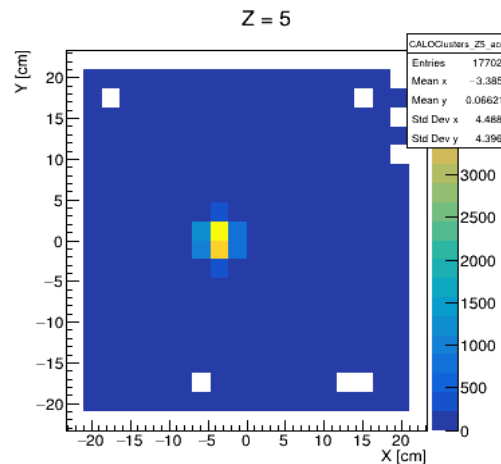
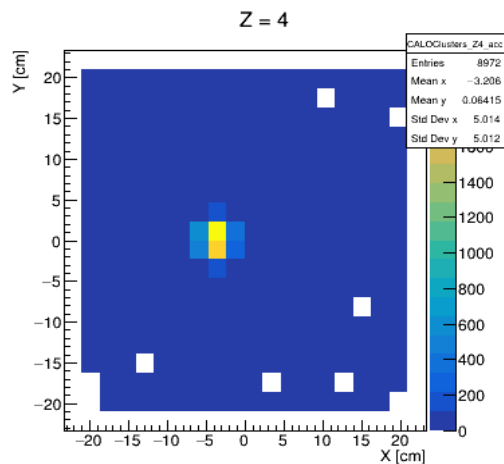
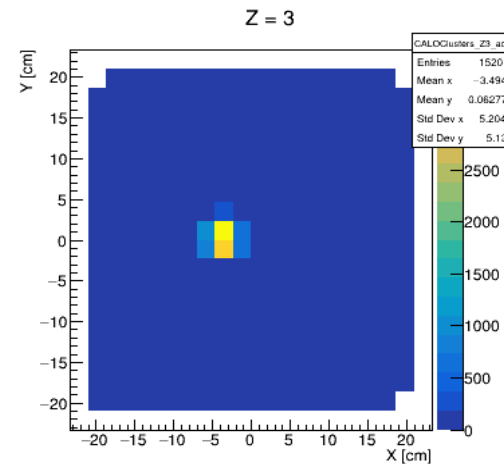
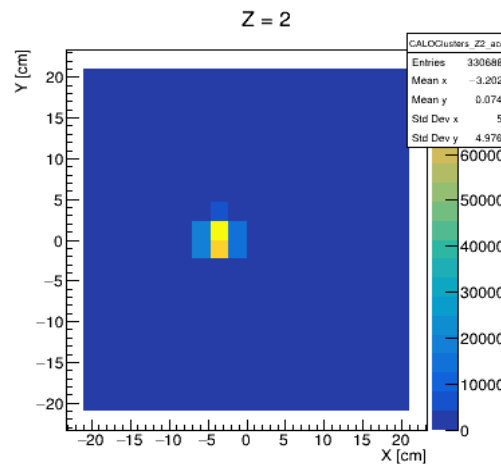
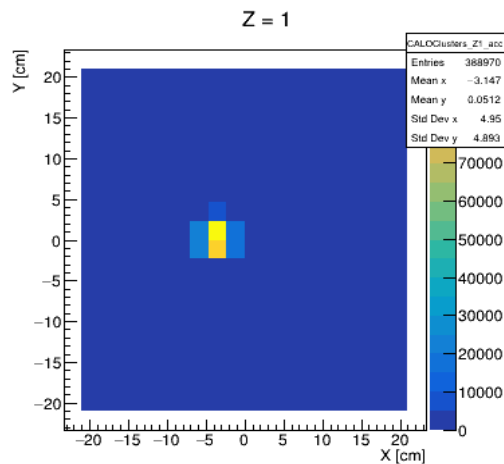
Beta vs E_{kin} - cut @ $2\sigma_{\text{res}}$ from nominal curves



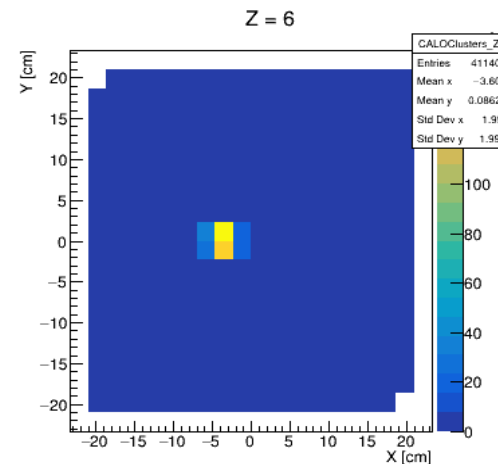
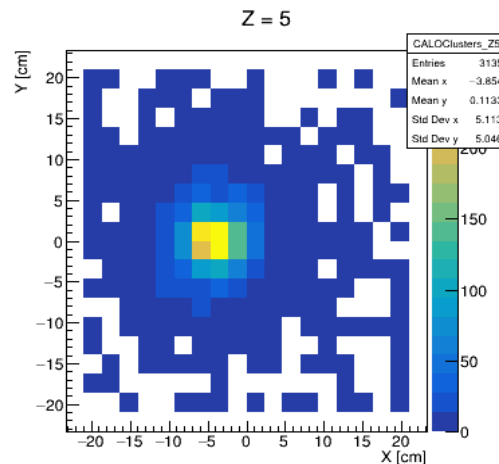
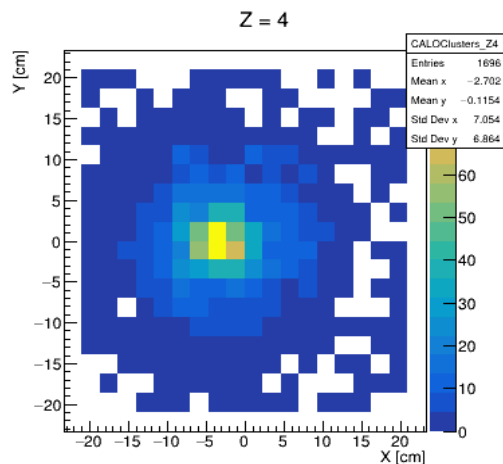
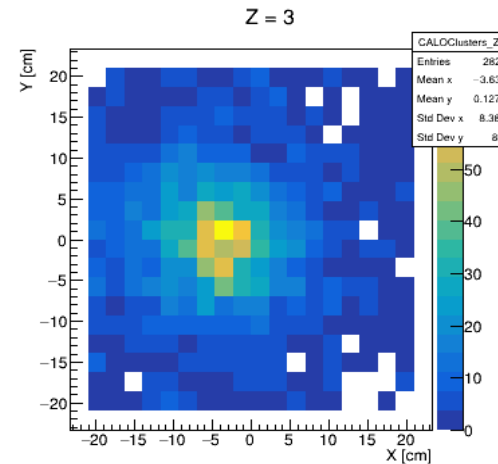
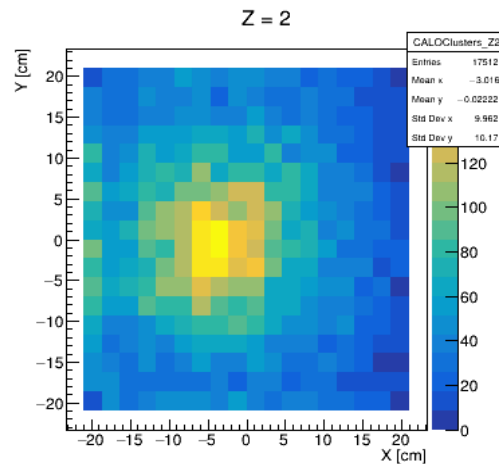
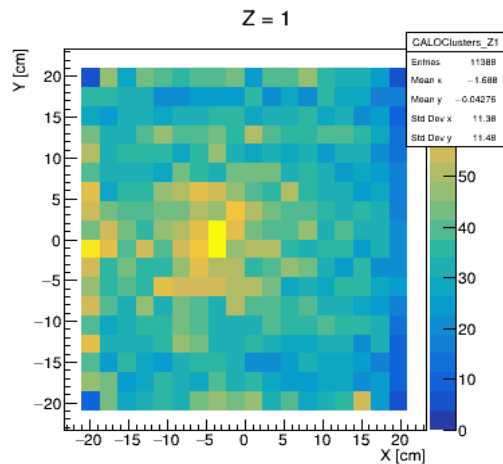
Statistical Z-mismatch removal in data



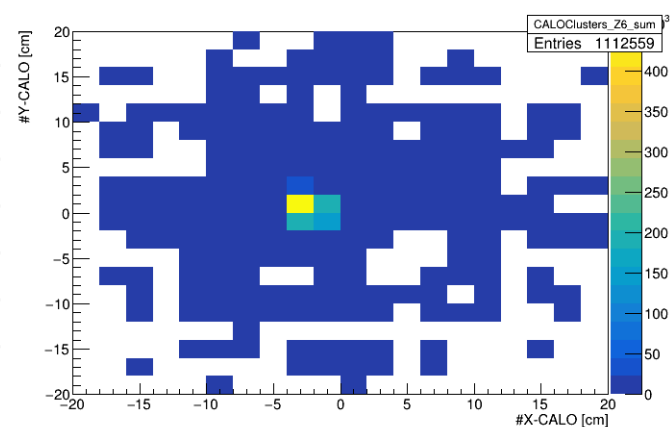
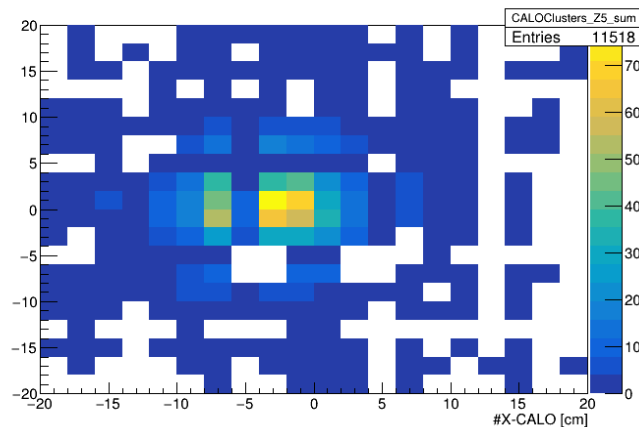
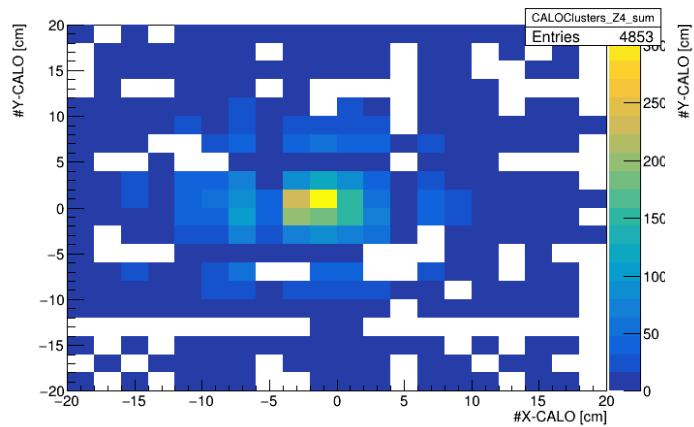
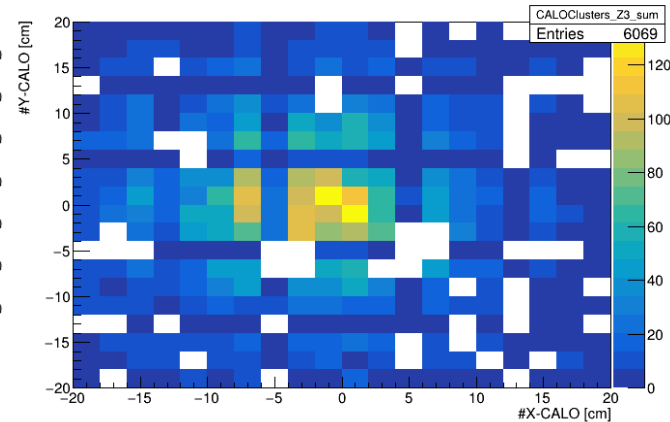
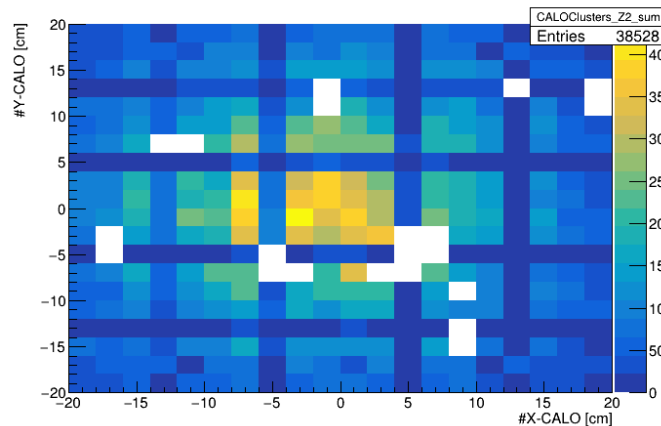
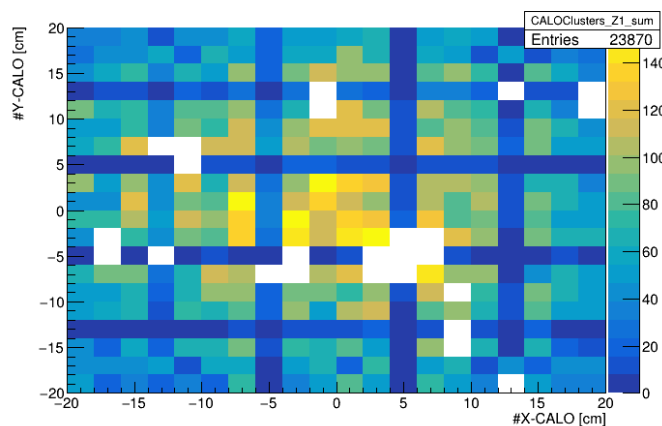
Impinging Z wrt position - MC



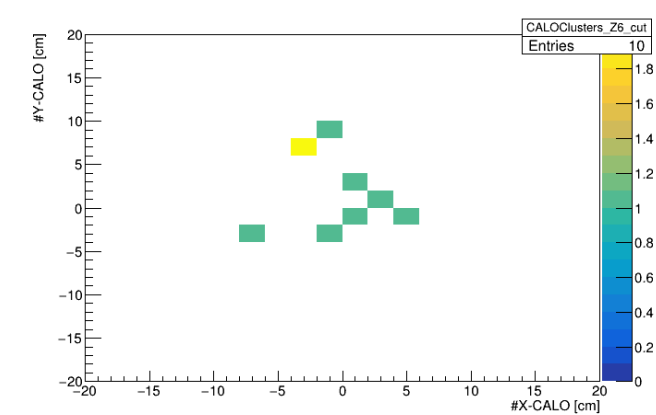
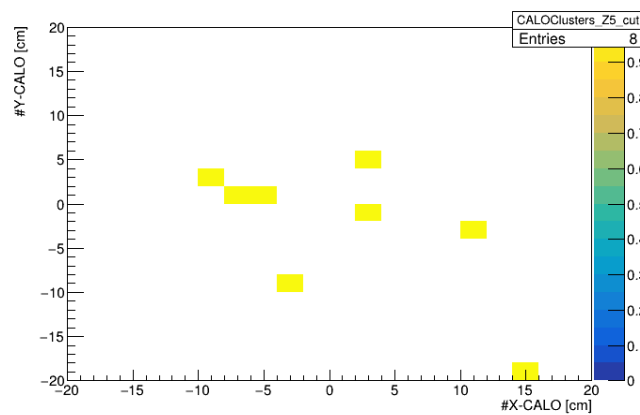
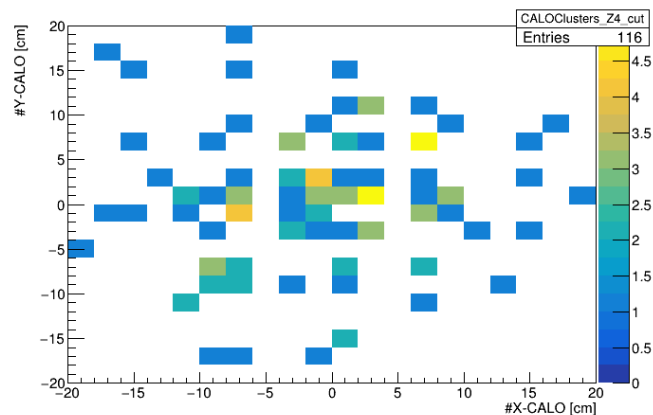
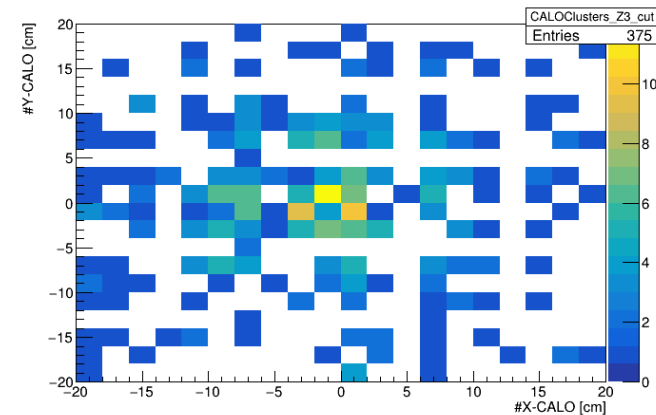
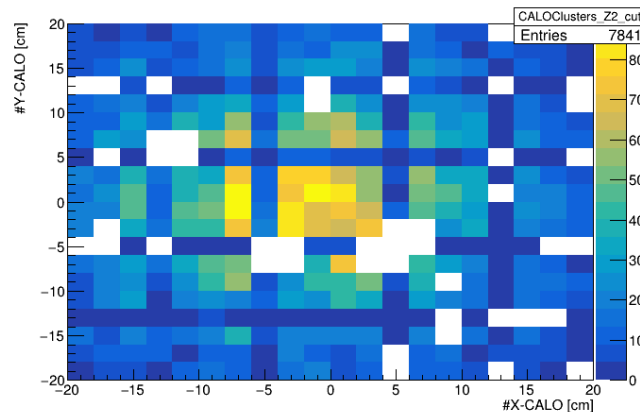
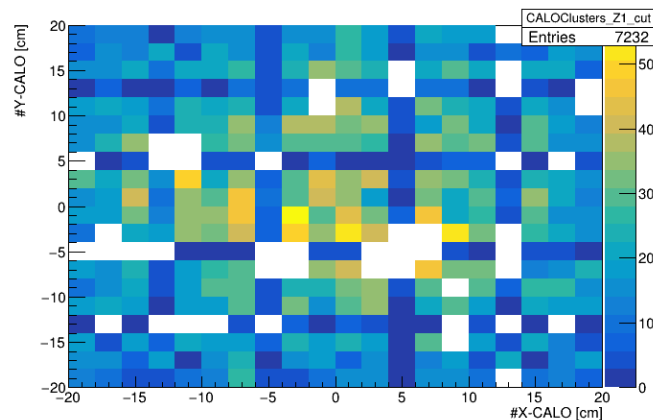
Identified Z wrt position - MC



Cluster distribution (over 1.5M events) - data



Events with > 2 clusters (over 1.5M events) – data



Clusters with size > 2 (over 1.5M events) - data

