GSI2021 analysis without tracking

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Cross section measurement

With available data **total integrated** and angle differential cross section are achievable (no kinetic energy)

$$\Delta\sigma(Z) = \int_{\beta_{\min}}^{\beta_{\max}} \int_{0}^{\theta_{\max}} \left(\frac{\partial^2 \sigma}{\partial\theta \partial\beta} \right) \mathrm{d}\theta \mathrm{d}\beta = \frac{Y(Z)}{N_{\mathrm{prim}} \cdot N_{\mathrm{TG}} \cdot \varepsilon(Z)}$$

Align FOOT detectors and estimate angular acceptance

Extract fragment yields from TW

Calculate MC efficiencies for fragments

Evaluate the beta range from data and put in MC for efficiency calculations

Cross section measurement

With available data total integrated and **angle differential** cross section are achievable (no kinetic energy)

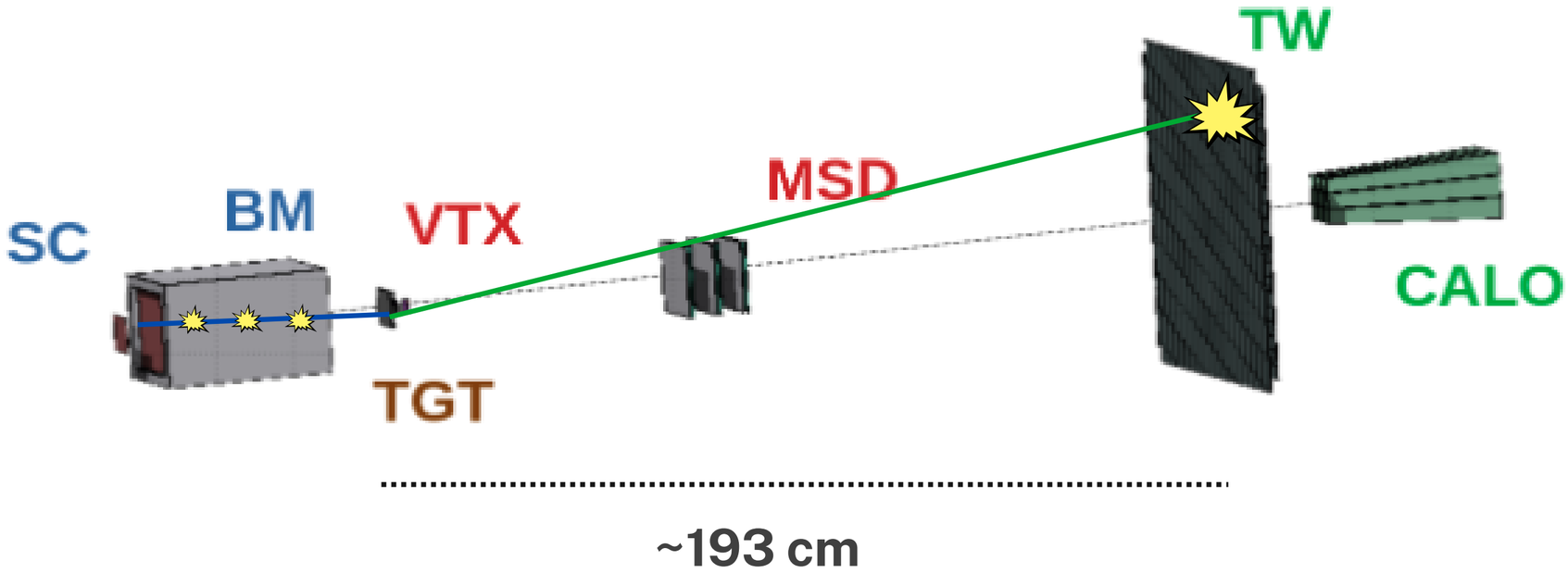
$$\frac{\mathrm{d}\sigma}{\mathrm{d}\theta}(Z) = \frac{Y(Z,\theta)}{N_{\mathrm{prim}} \cdot N_{\mathrm{TG}} \cdot \Delta\theta \cdot \varepsilon(Z,\theta)}$$

Align FOOT detectors and estimate **angular acceptance**

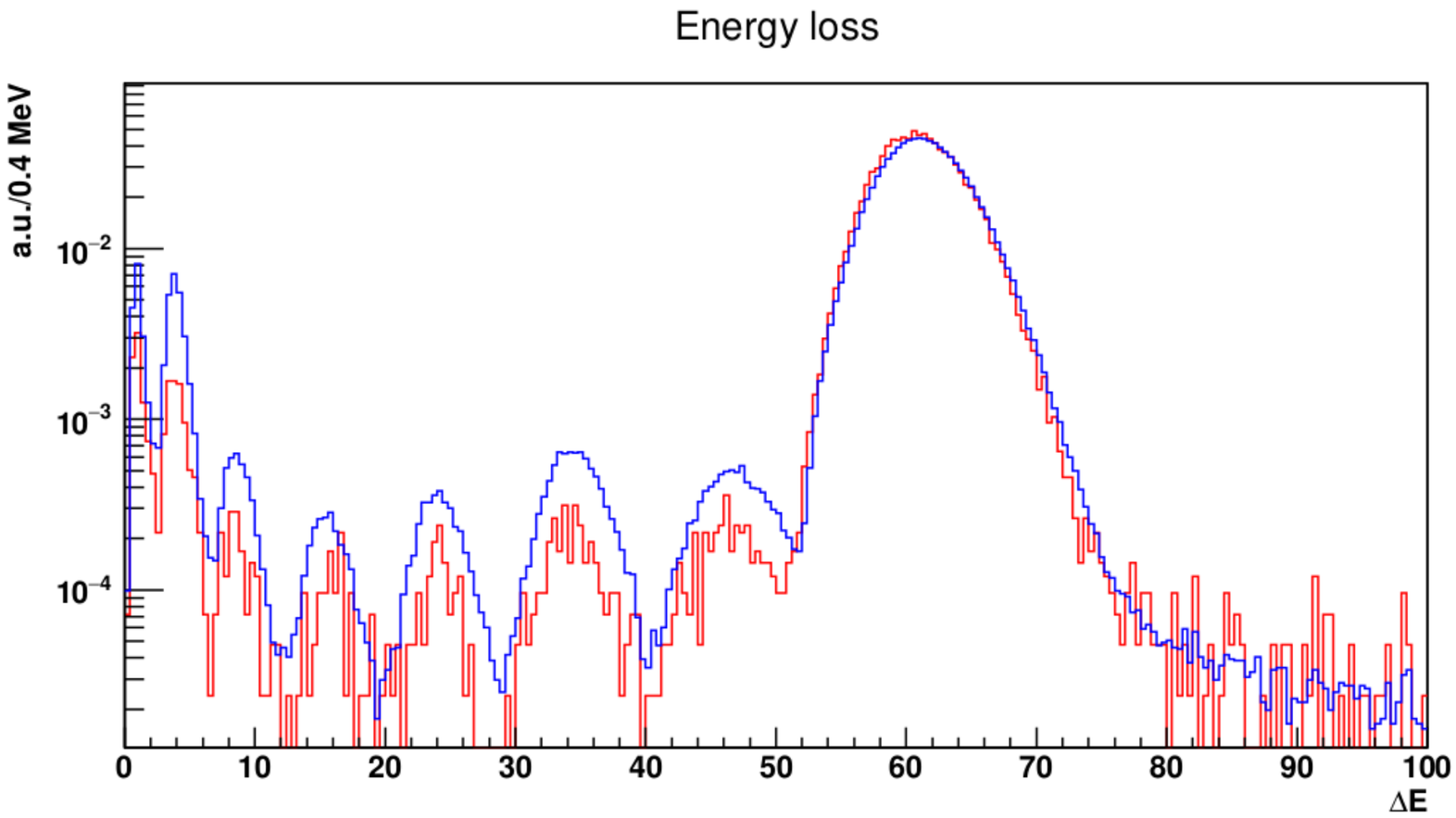
Extract fragment yields from TW

Calculate MC efficiencies for fragments

Angle measurement

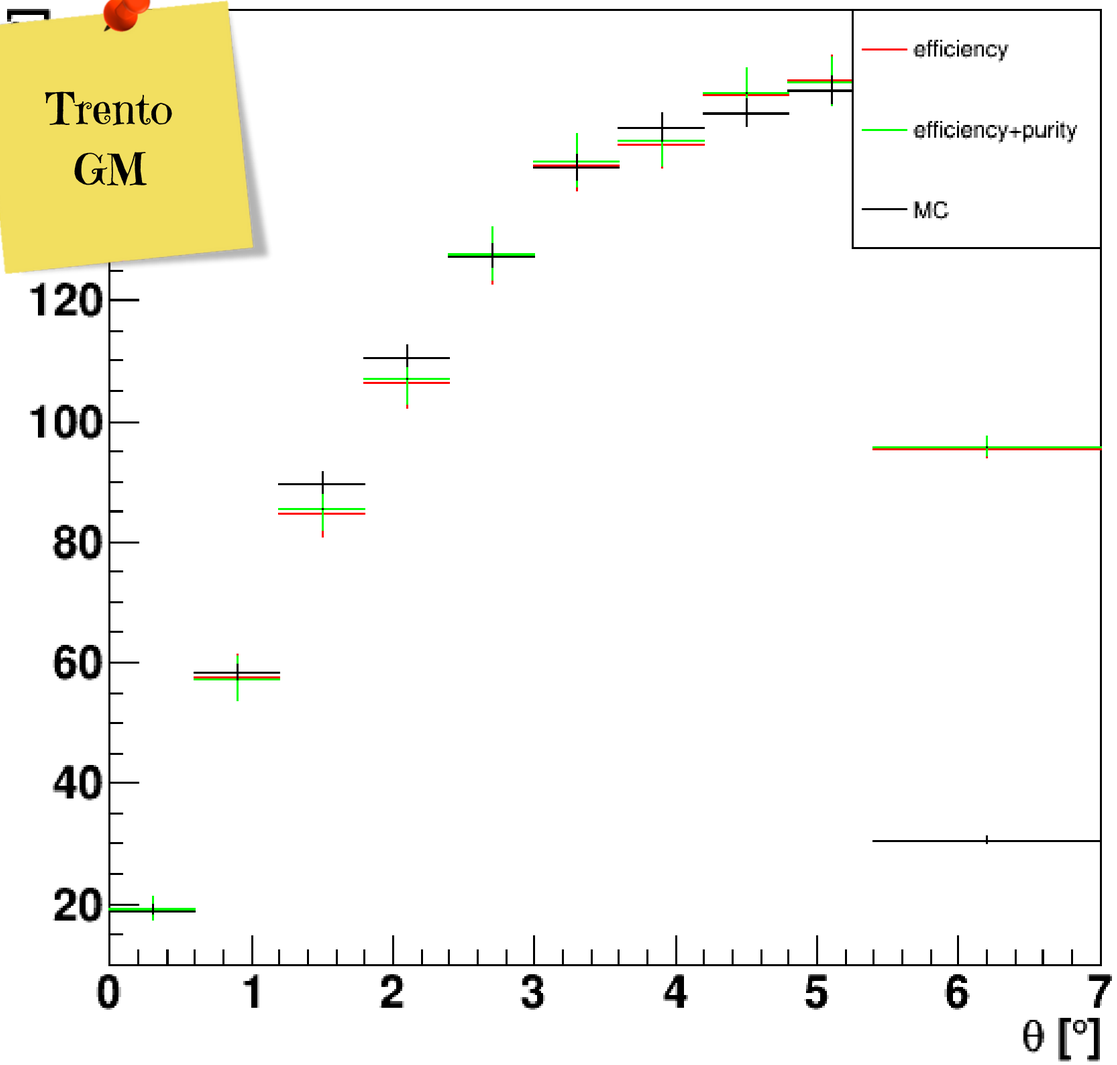


Why background subtraction?

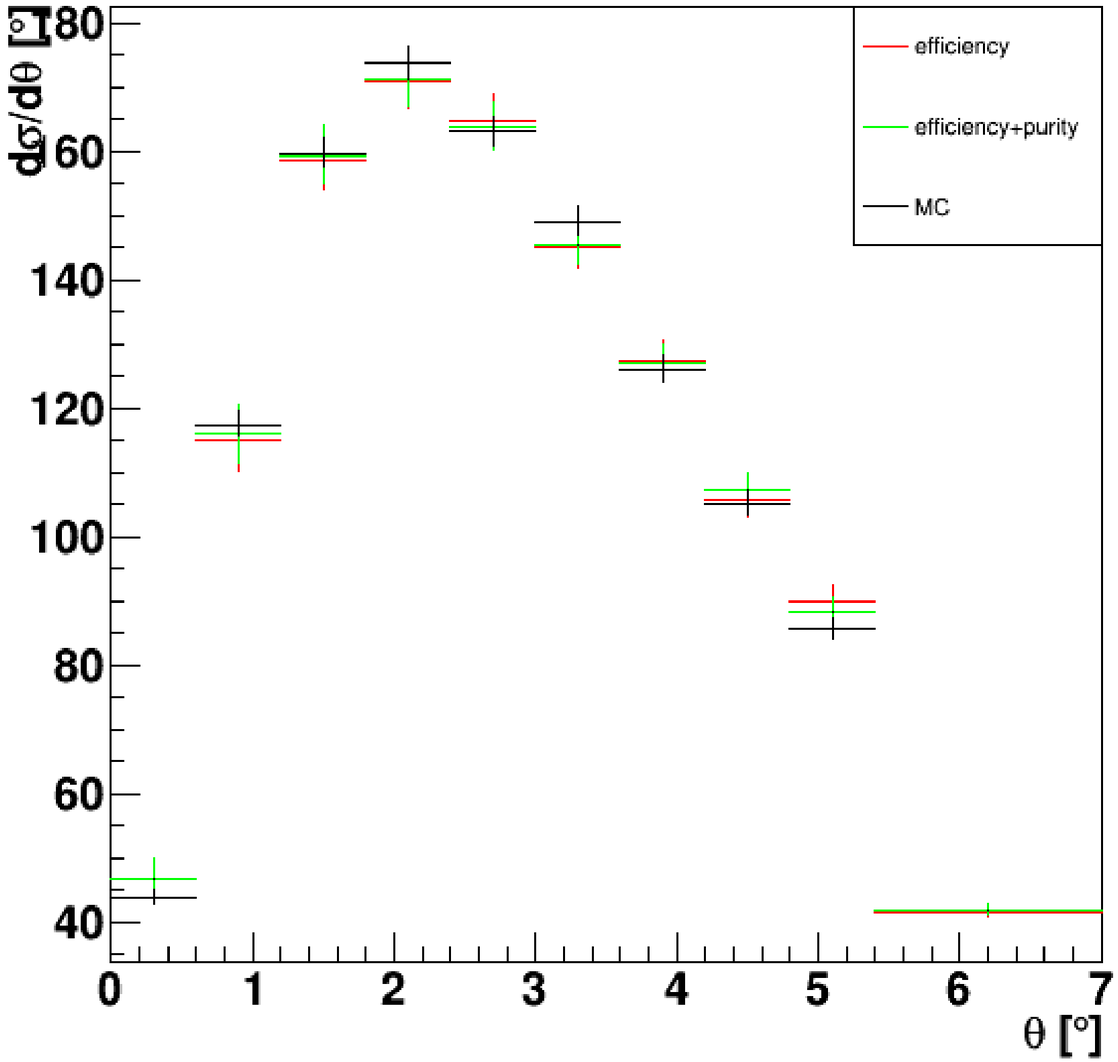


Trento
GM

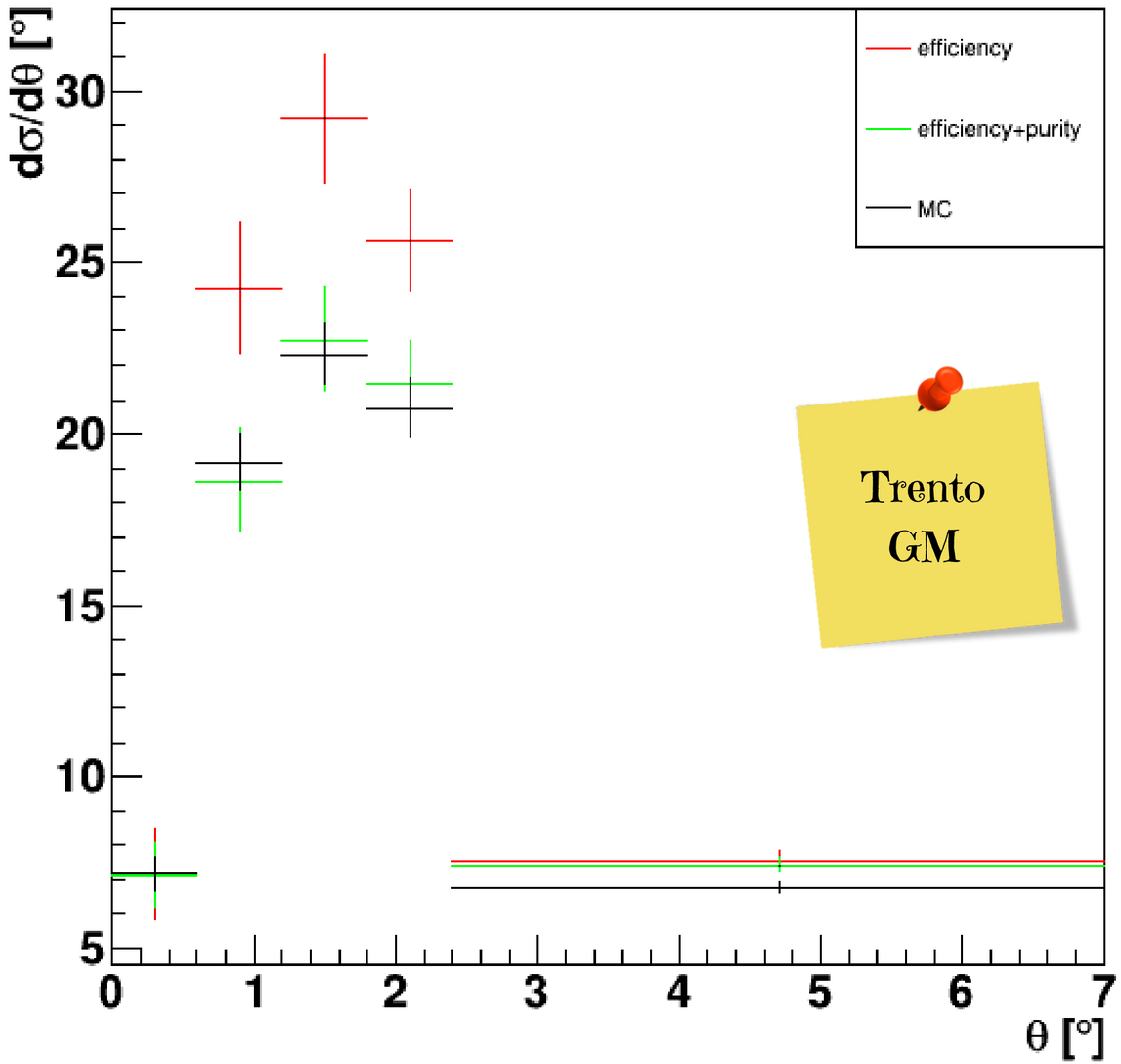
Angular cross section Z1



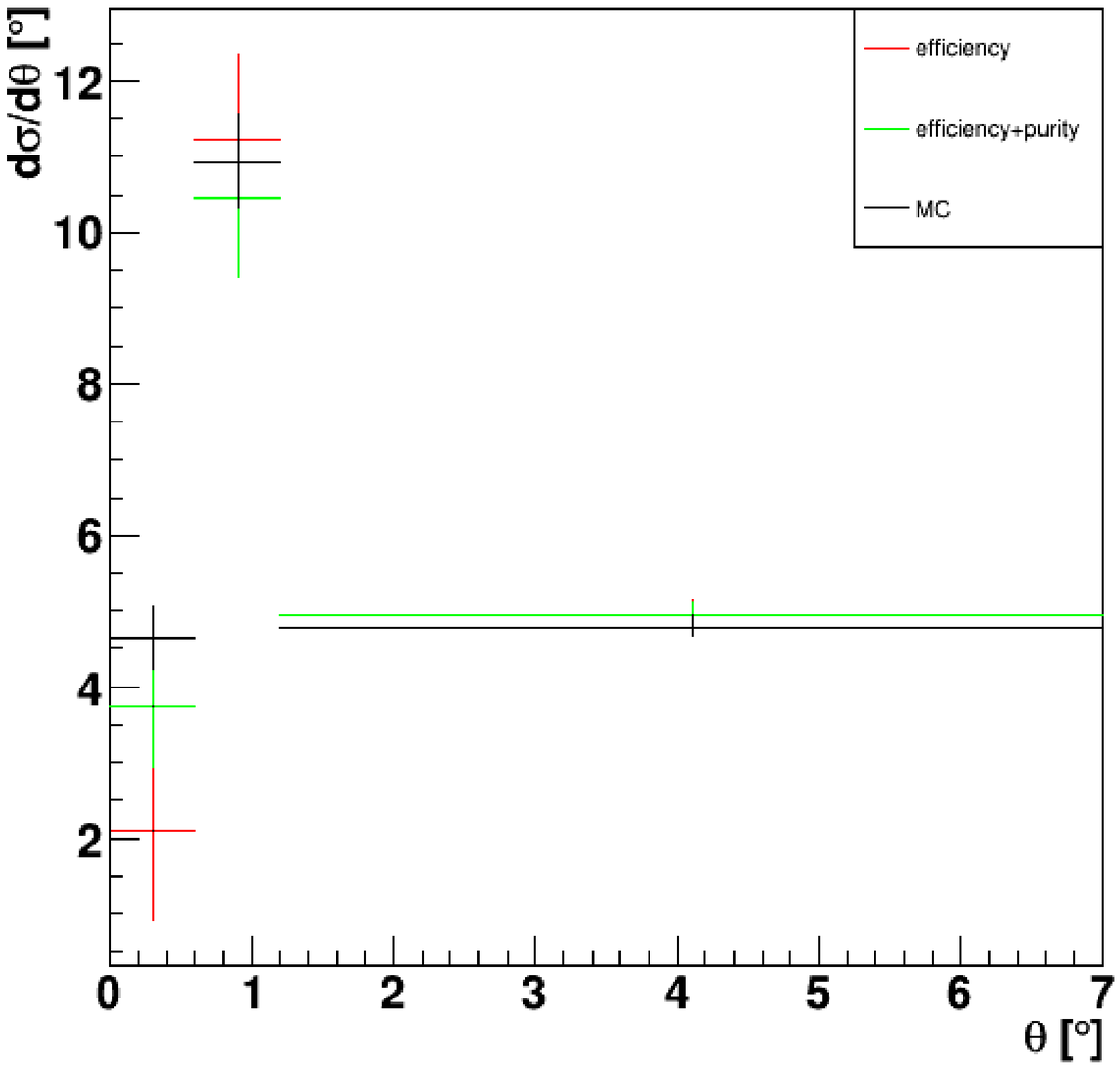
Angular cross section Z2



Angular cross section Z3

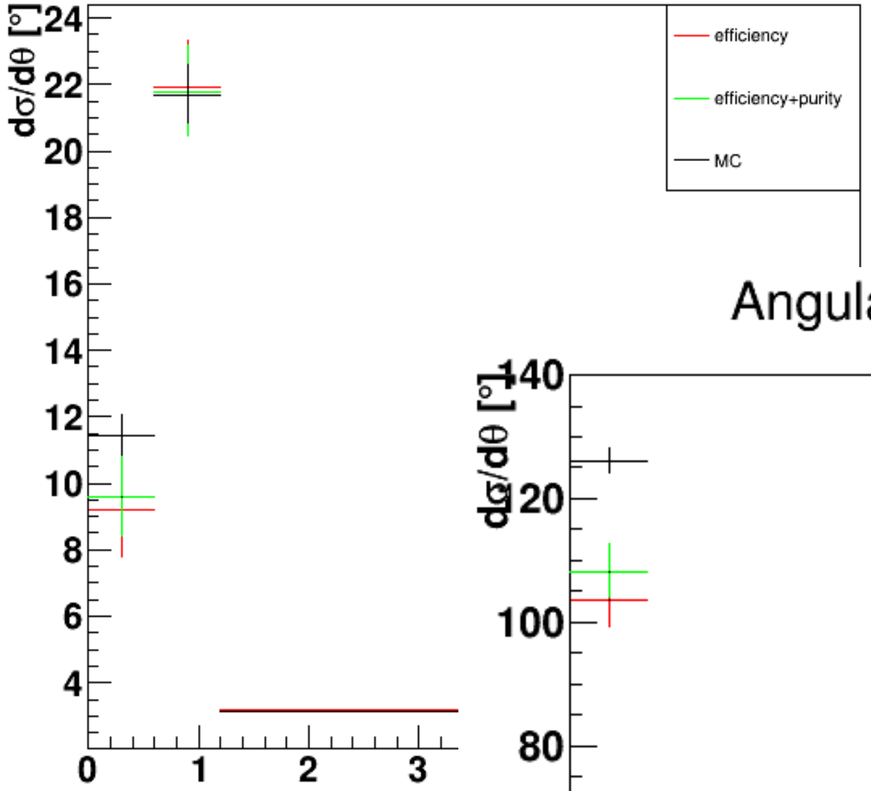


Angular cross section Z4

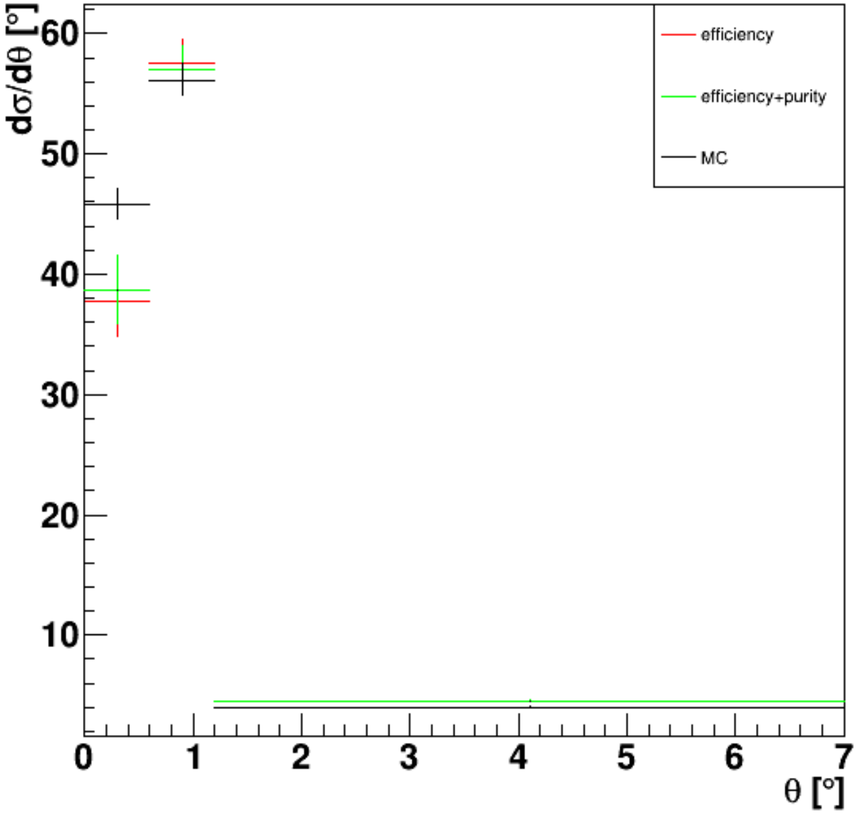


Trento
GM

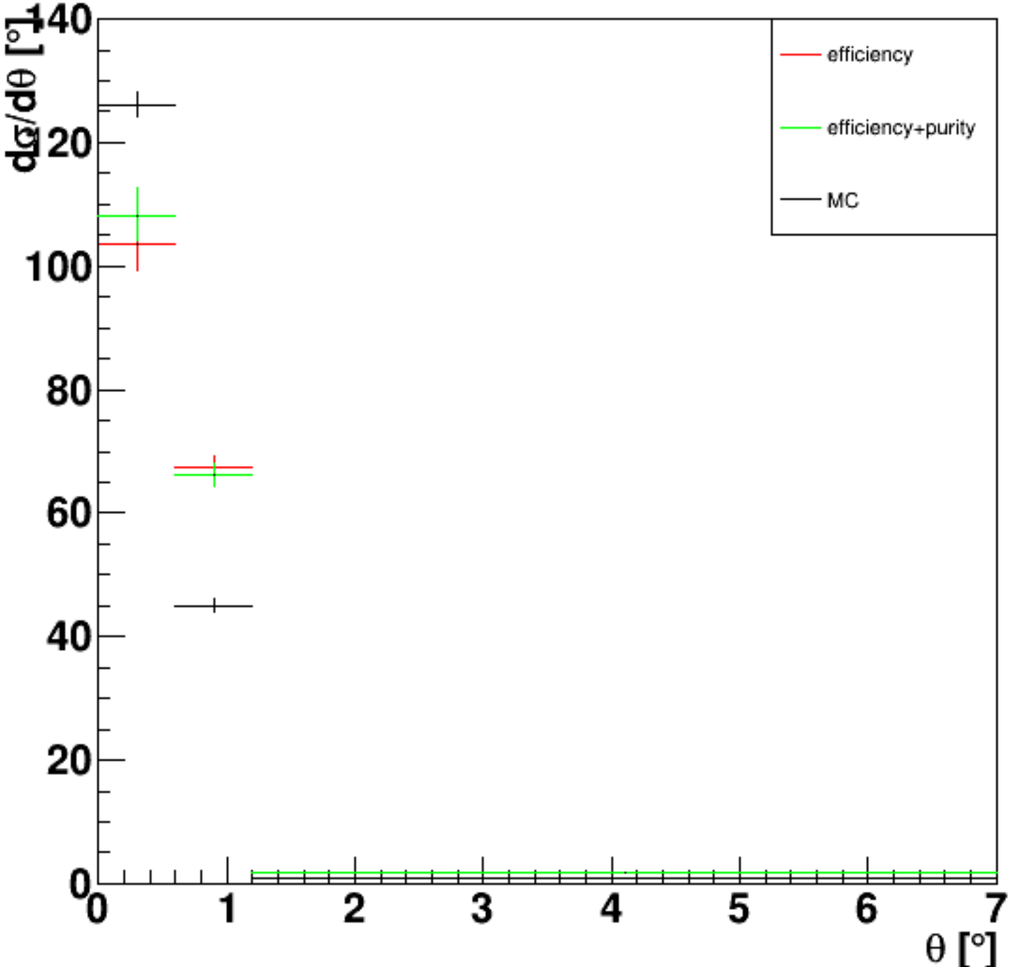
Angular cross section Z5

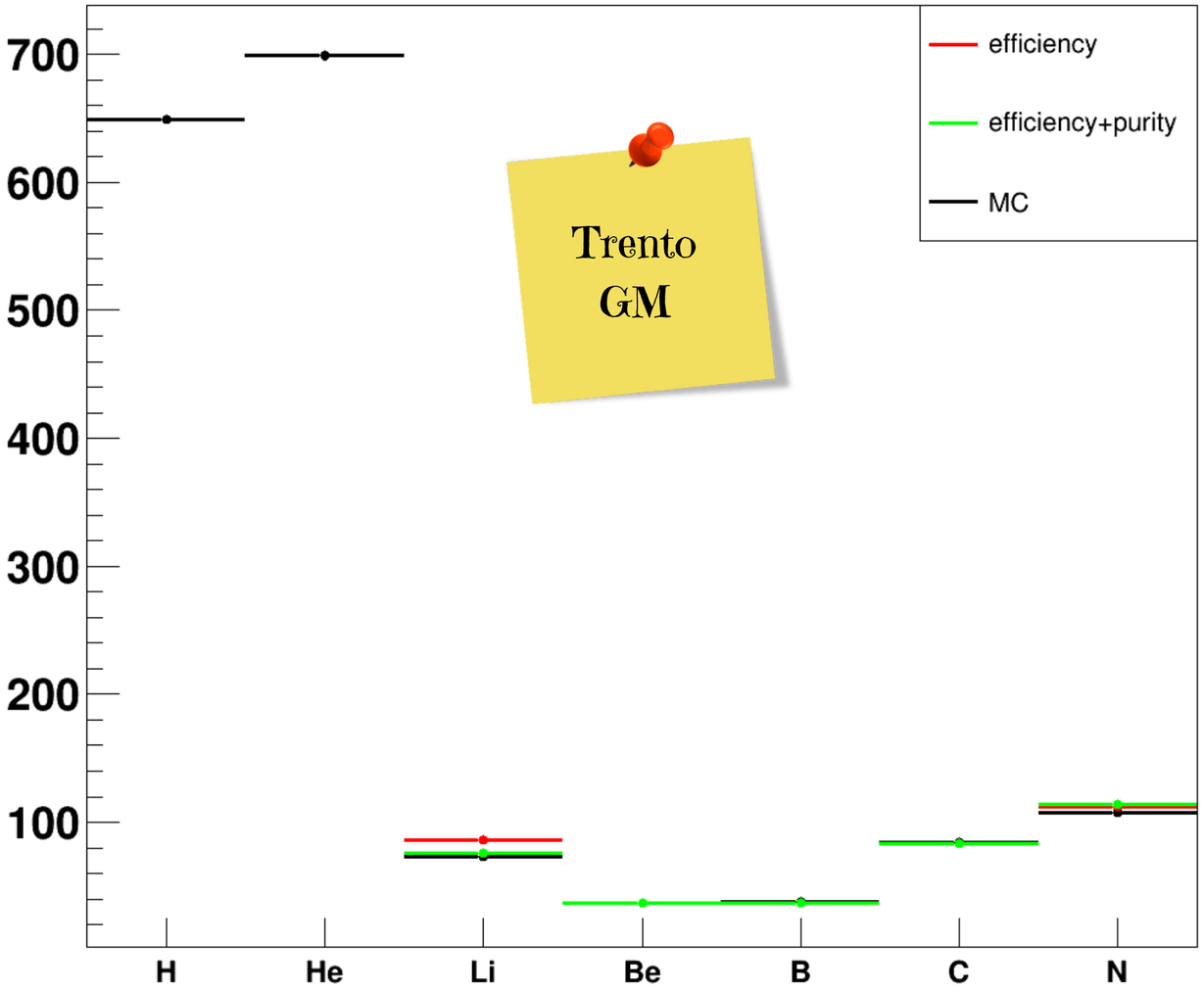


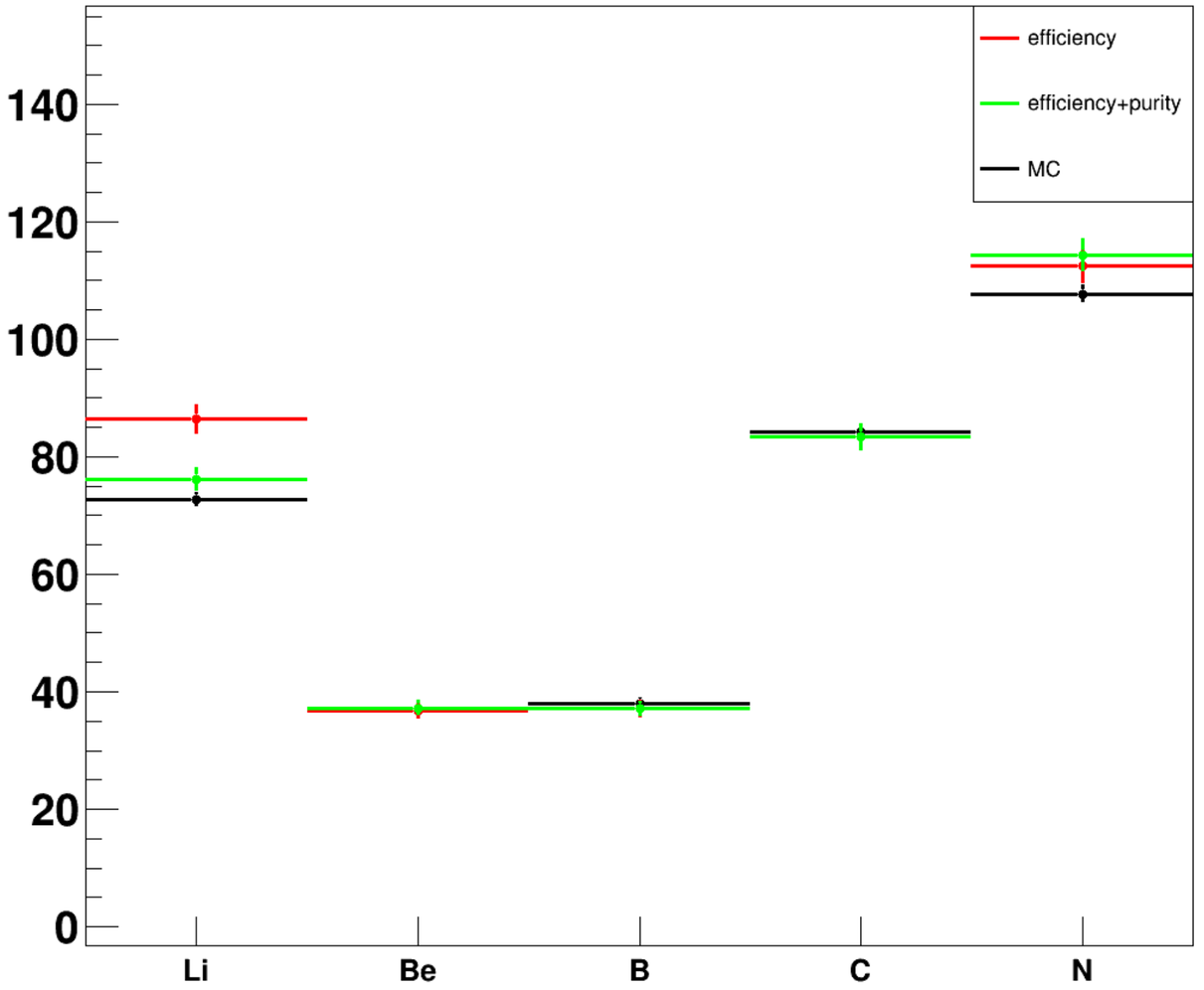
Angular cross section Z6



Angular cross section Z7




700
600
500
400
300
200
100
H
He
Li
Be
B
C
N
efficiency
efficiency+purity
MC
Trento
GM


140
120
100
80
60
40
20
0
Li
Be
B
C
N
efficiency
efficiency+purity
MC

Some comments…

Purity correction goes always in the “right” direction

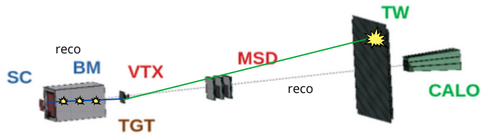
Huge contribution in Li (and Be) cross section as expected

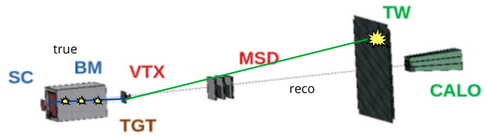
Difference in C and N to be understood

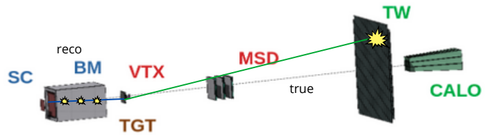
Angle unfolding procedure will have an impact

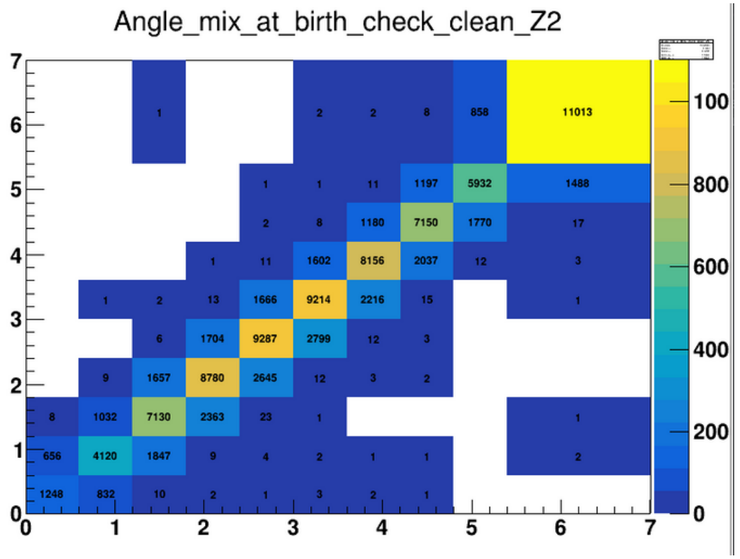
Why these differences?

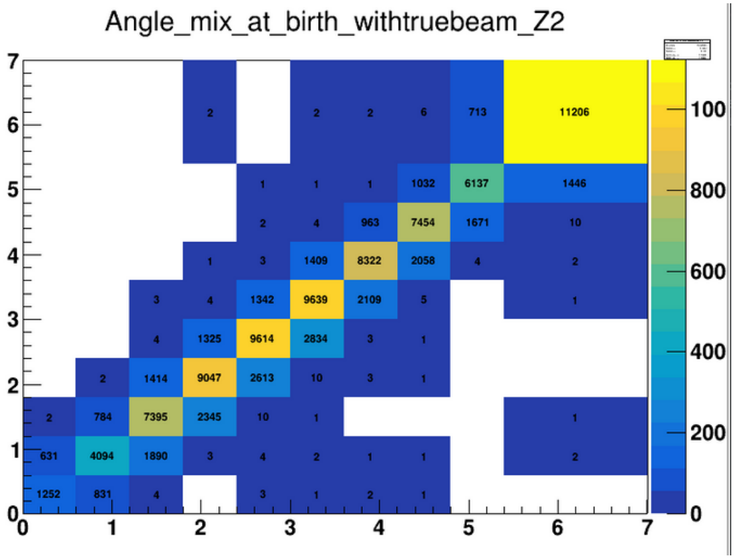
Angle mixing with this method is not negligible...

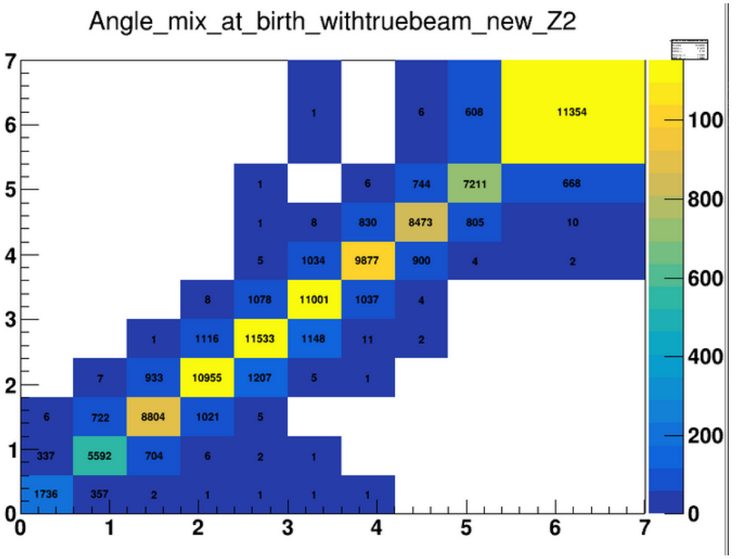






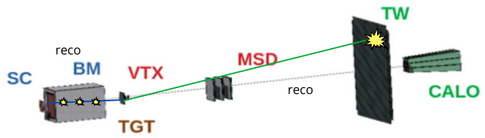


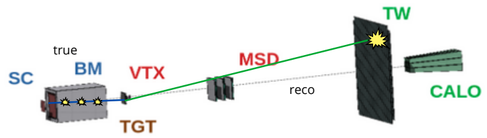


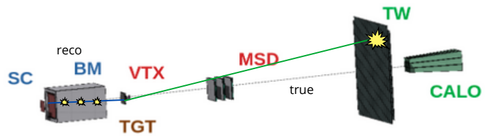


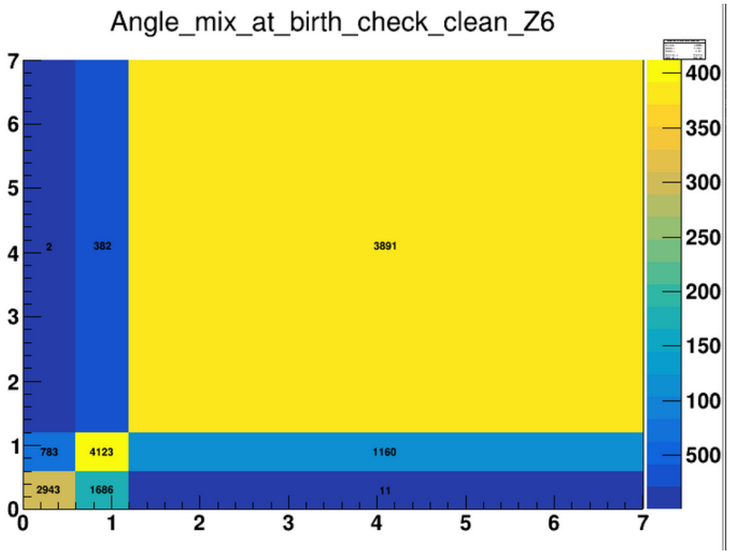
Why these differences?

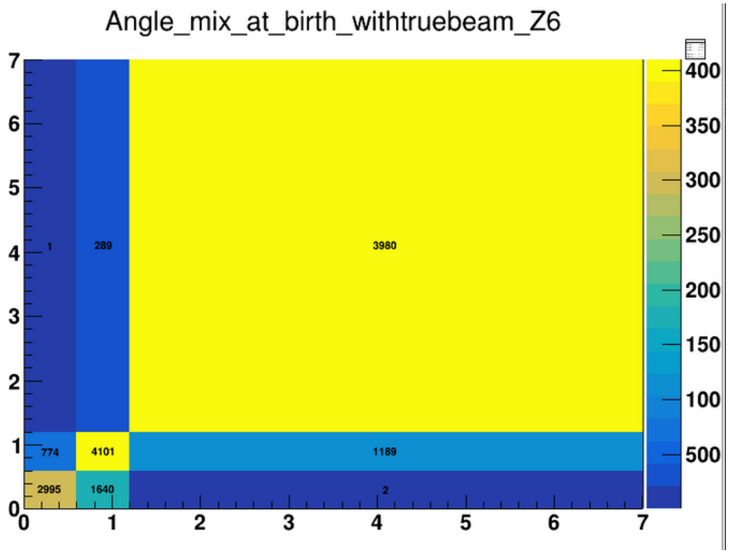
Angle mixing with this method is not negligible...

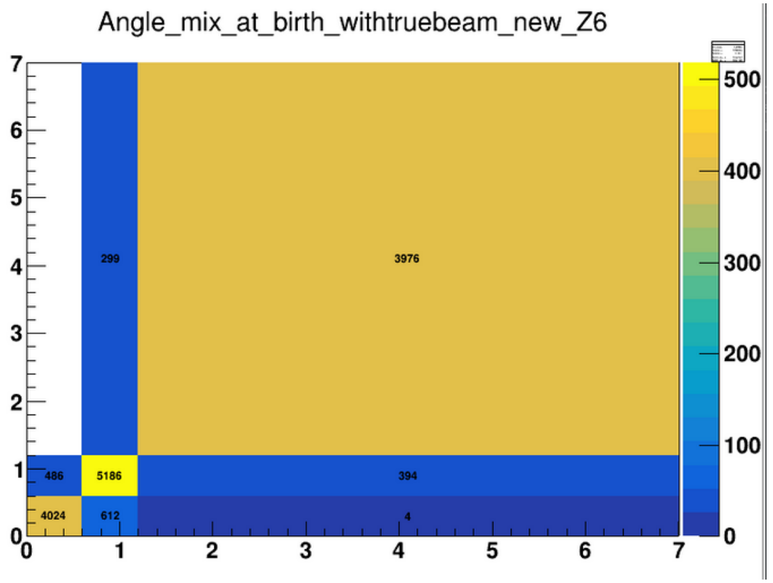












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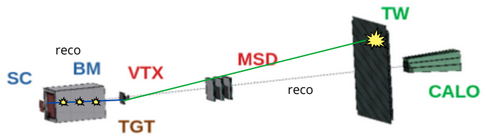
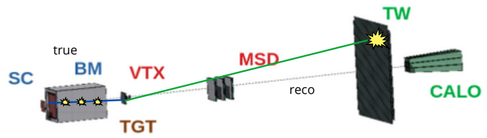
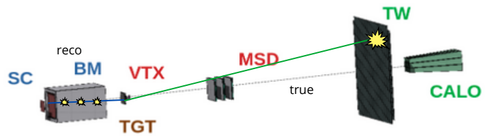
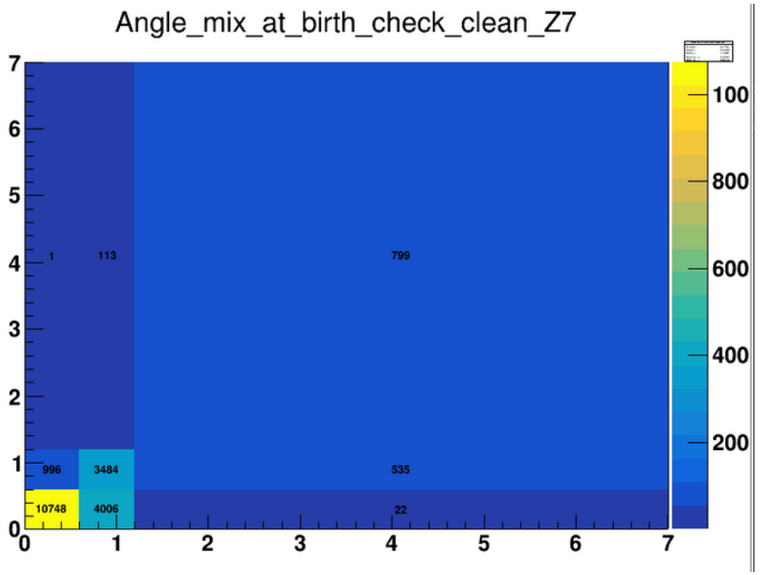
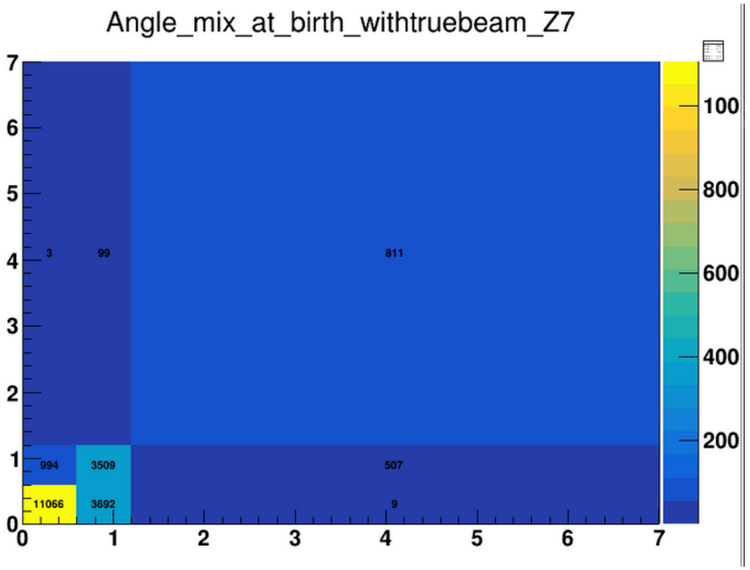
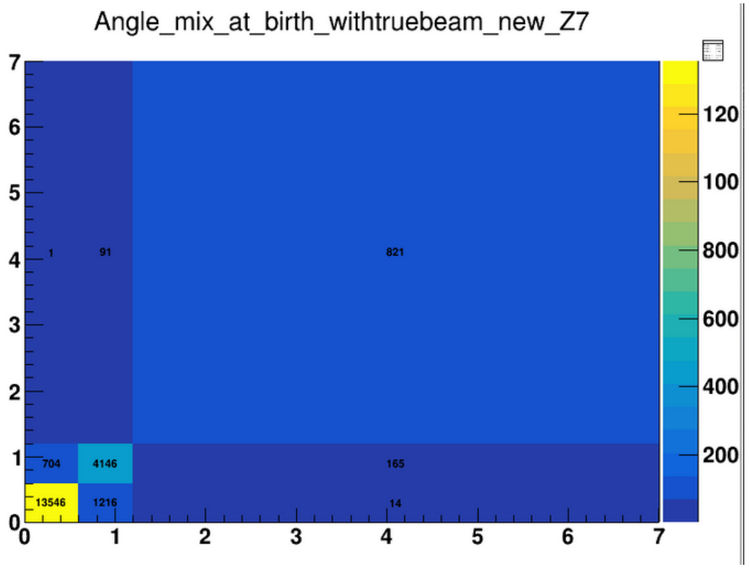






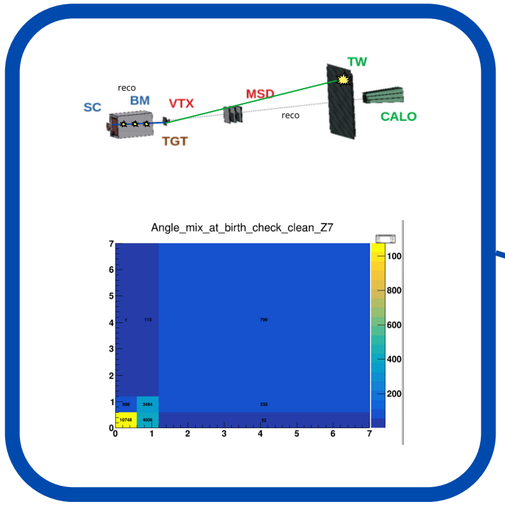


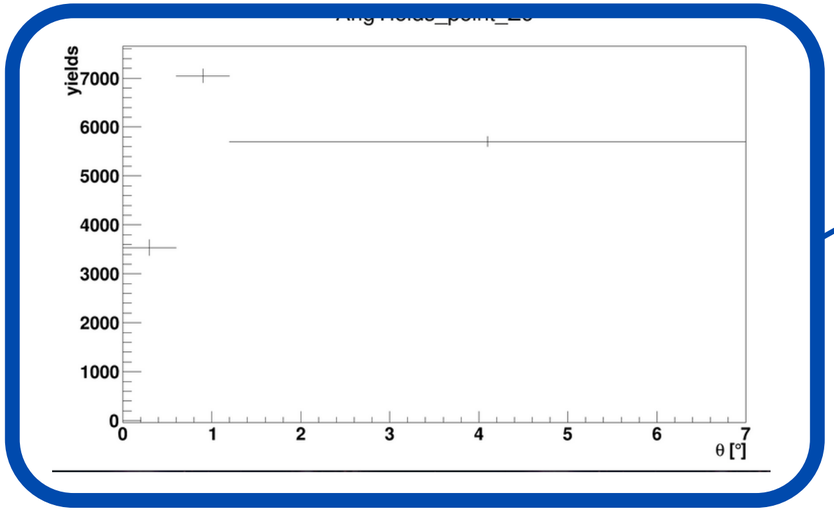


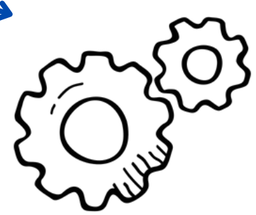


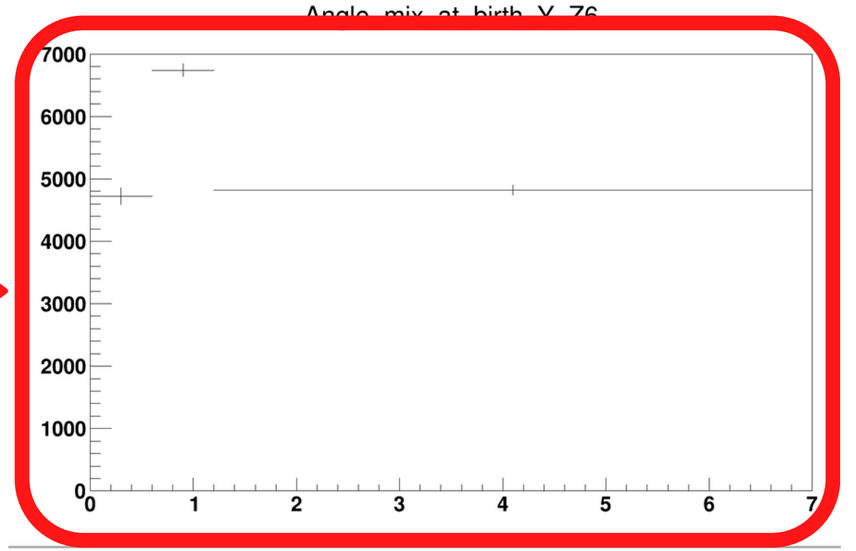
Angular unfolding

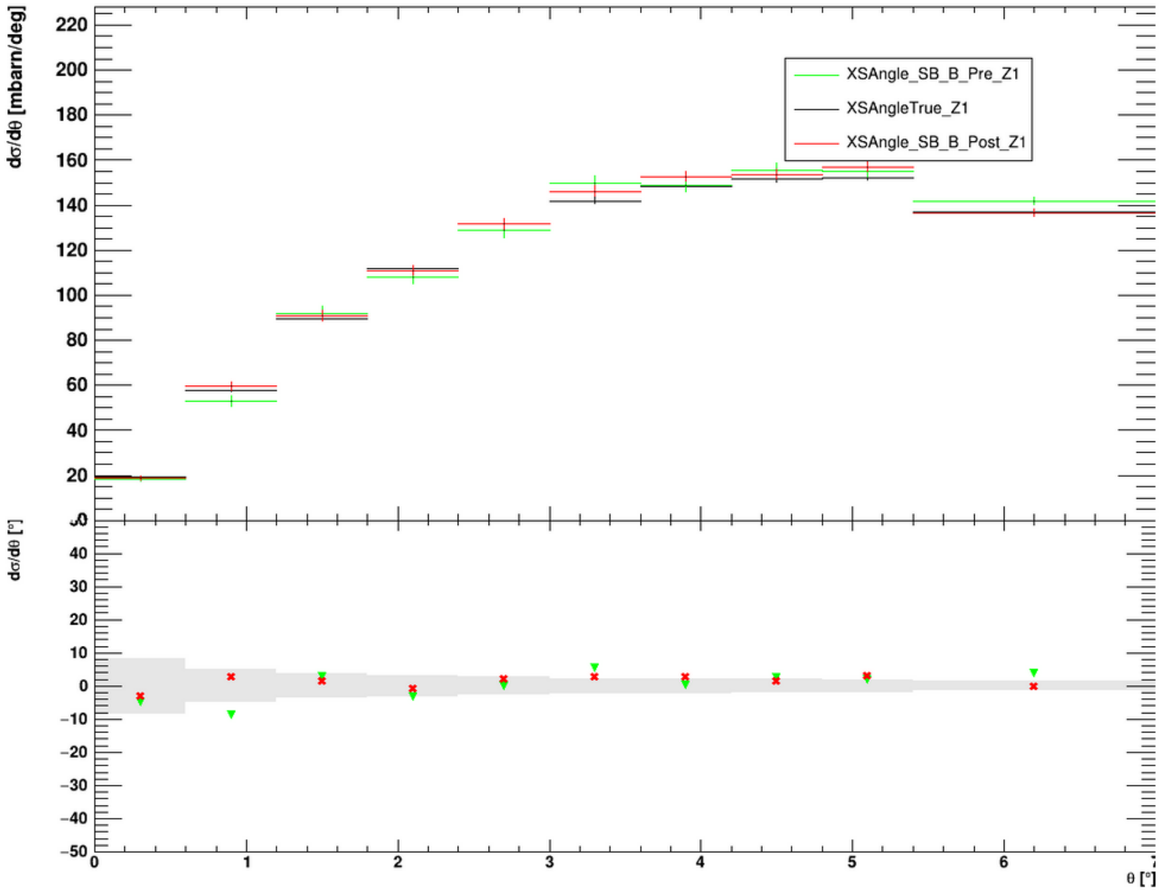
Several unfolding routines implemented (TUnfold, TUnfoldSVD, RooUnfold package)

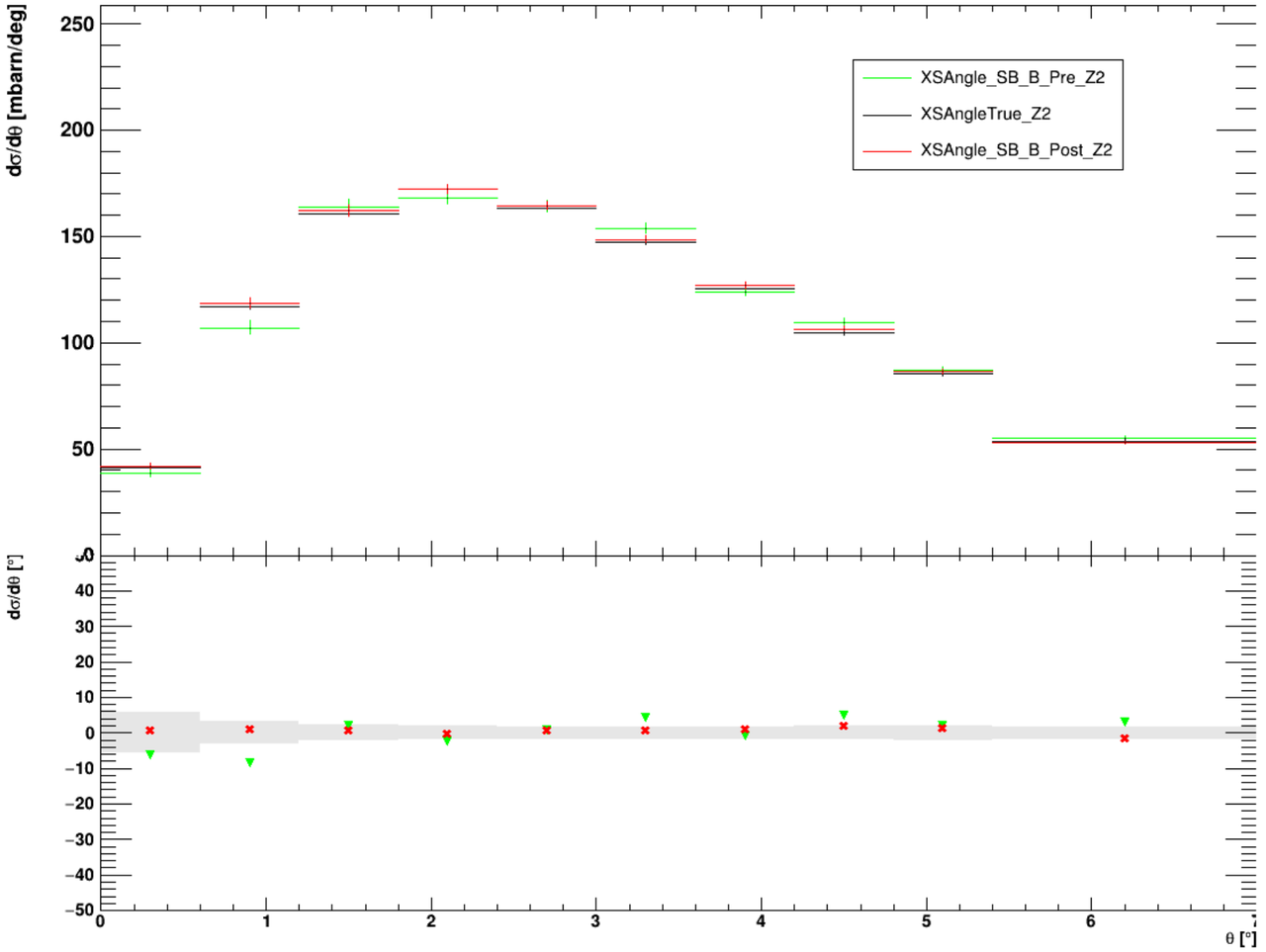


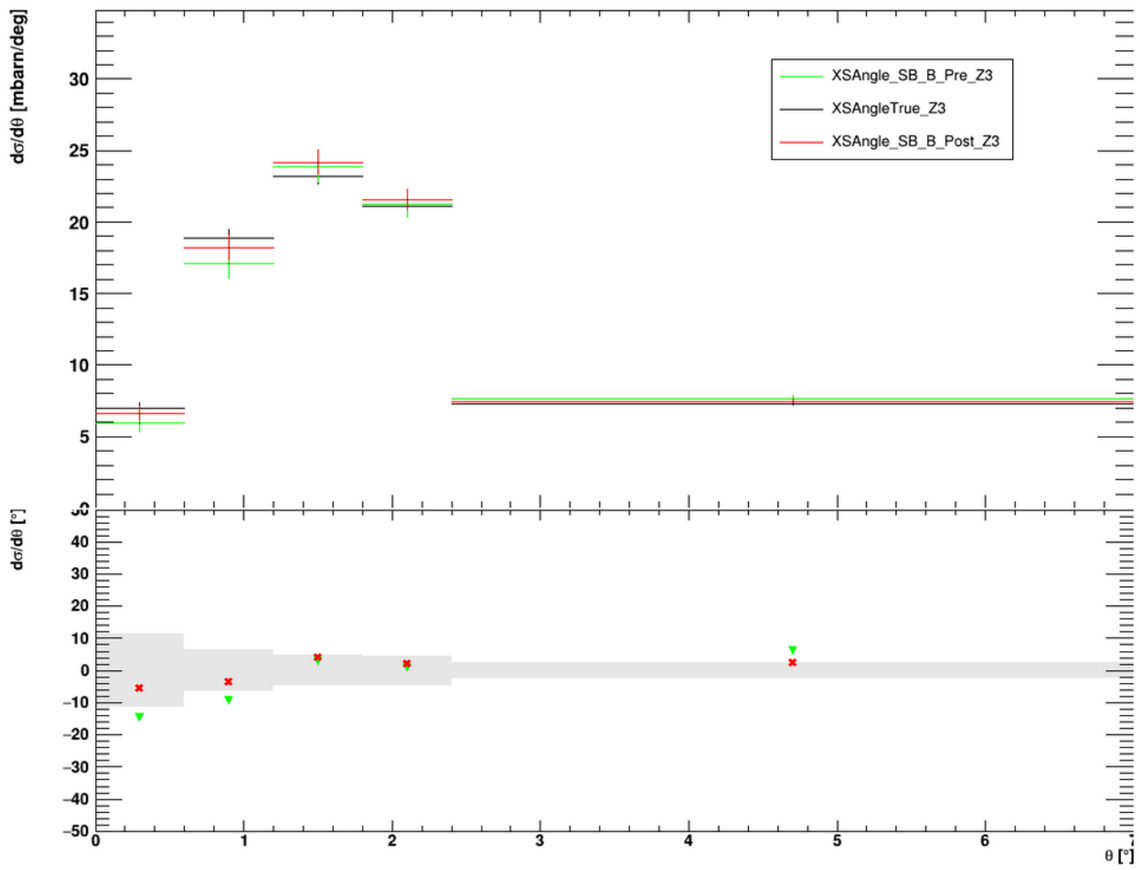


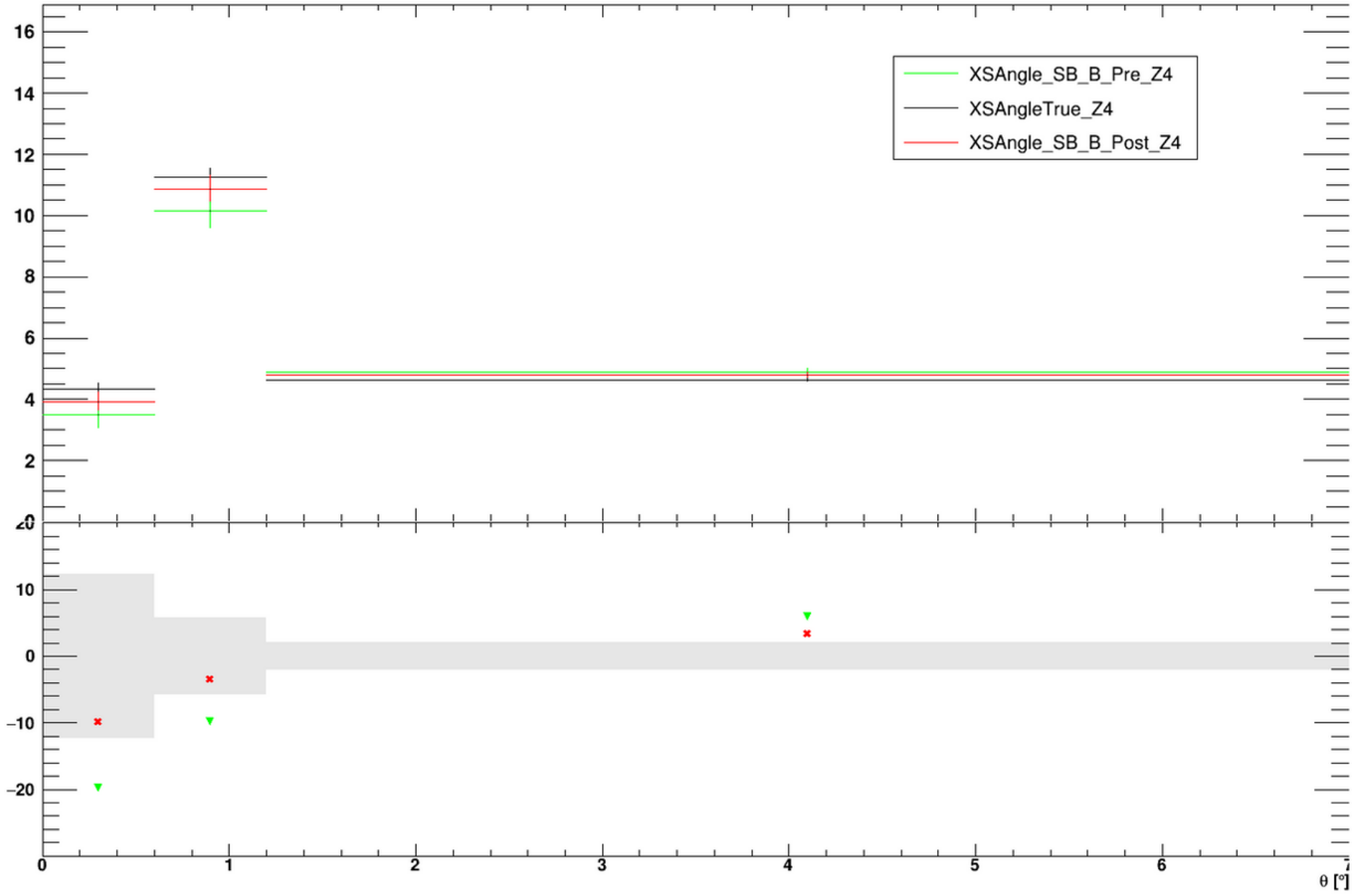


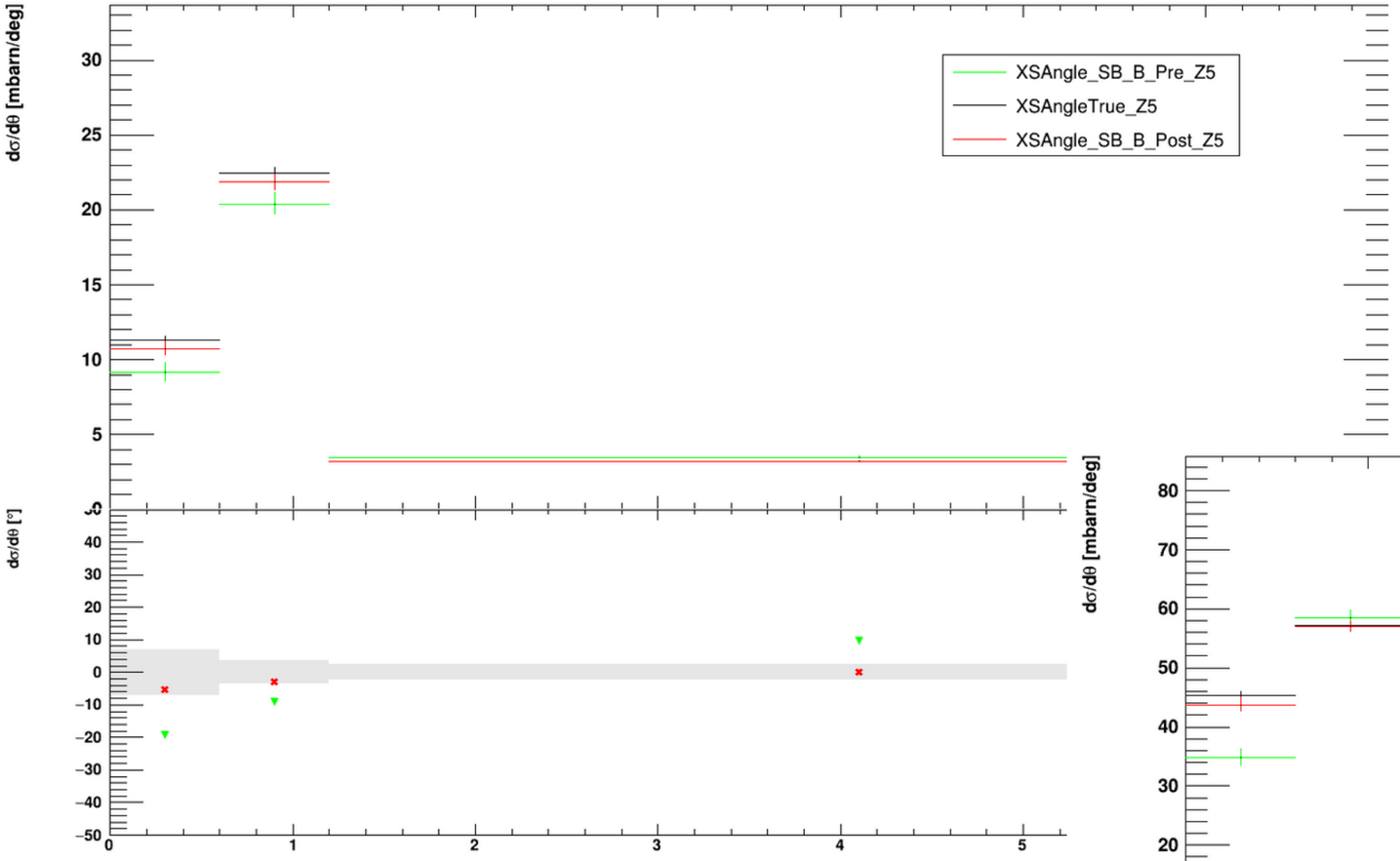


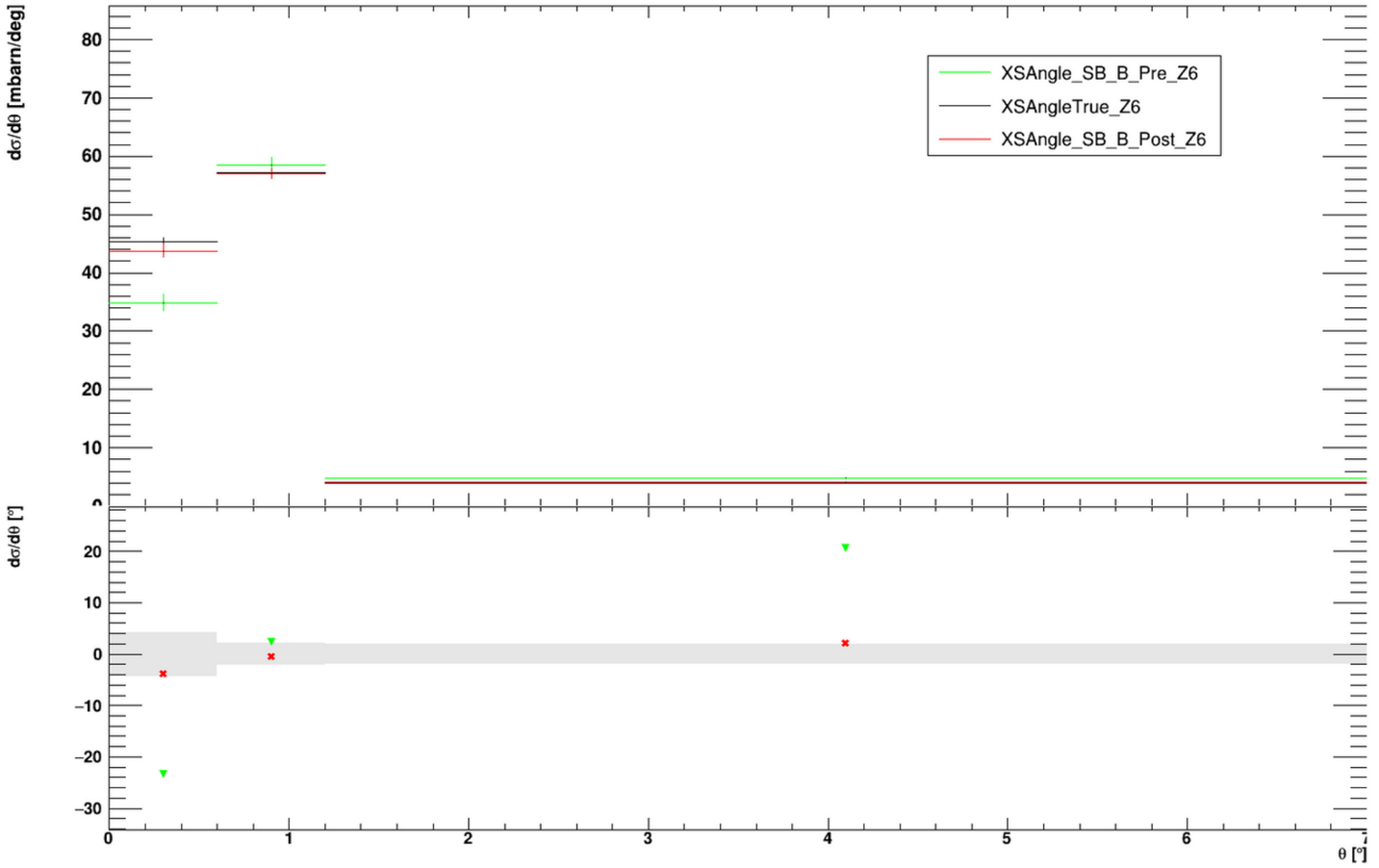

dσ/dθ [mbarn/deg]
XSAngle_SB_B_Pre_Z1
XSAngleTrue_Z1
XSAngle_SB_B_Post_Z1
dσ/dθ [°]
θ [°]

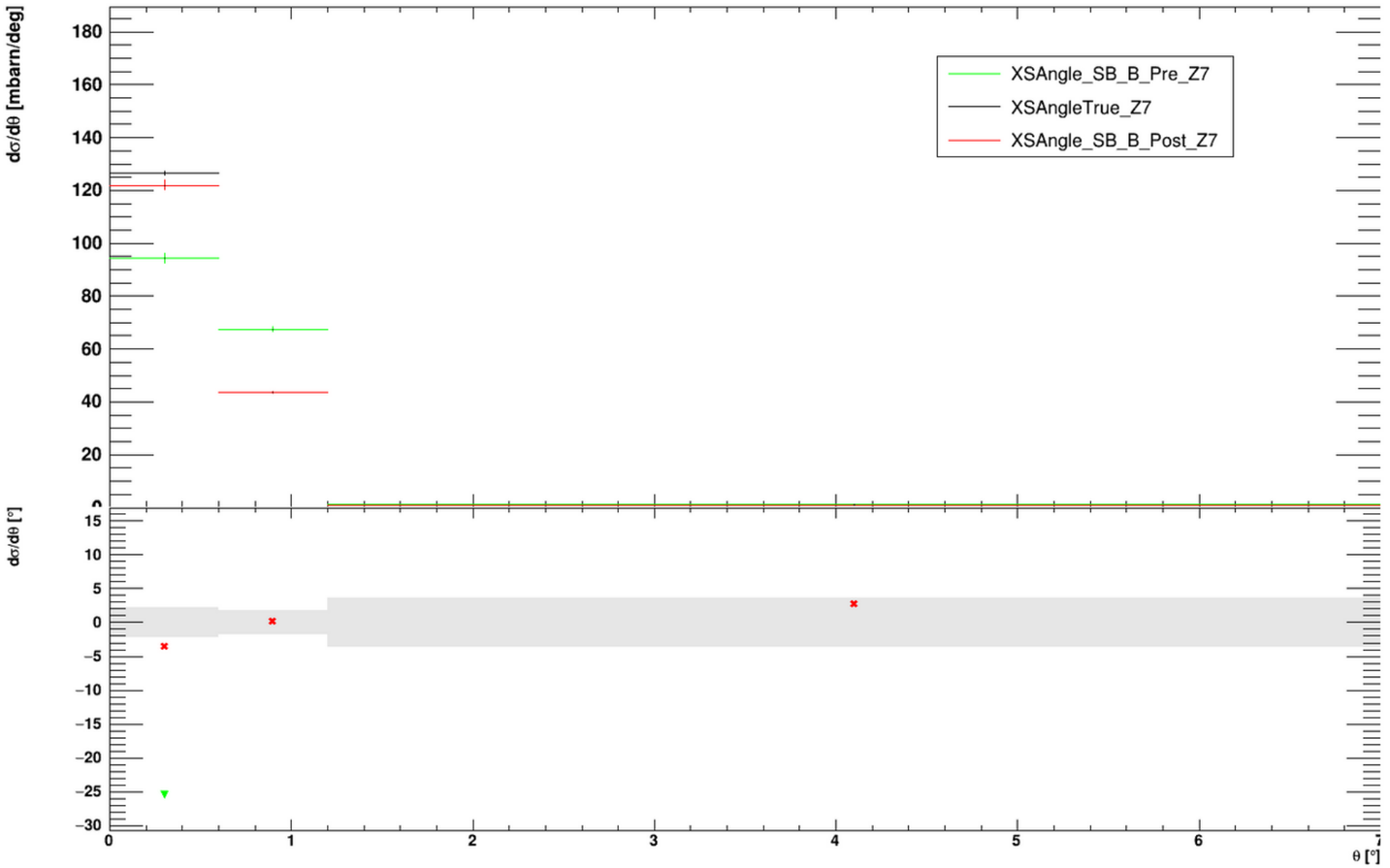

dσ/dθ [mbarn/deg]
XSAngle_SB_B_Pre_Z2
XSAngleTrue_Z2
XSAngle_SB_B_Post_Z2
dσ/dθ [°]
θ [°]

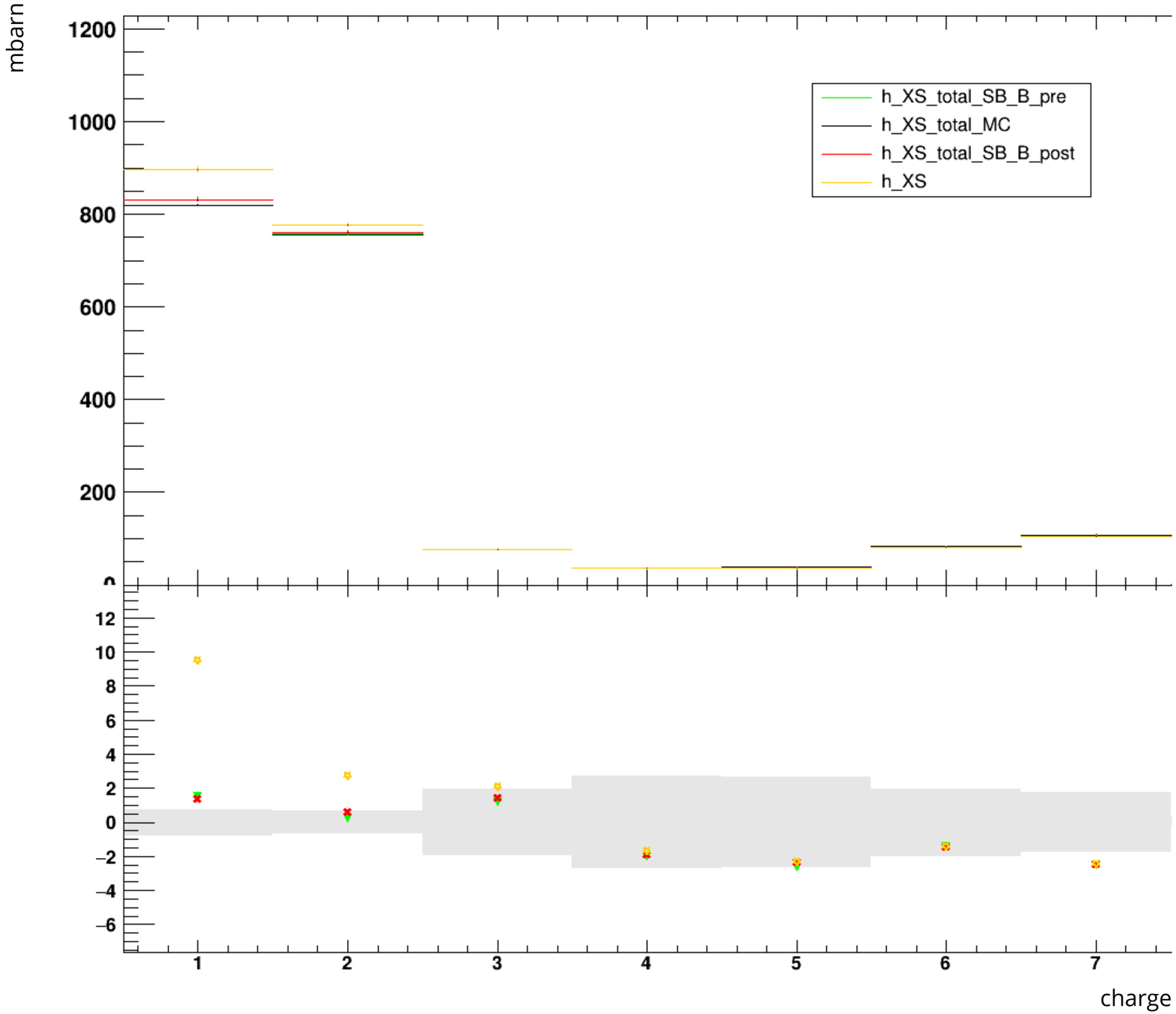

dσ/dθ [mbarn/deg]
XSAngle_SB_B_Pre_Z3
XSAngleTrue_Z3
XSAngle_SB_B_Post_Z3
dσ/dθ [°]
θ [°]


XSAngle_SB_B_Pre_Z4
XSAngleTrue_Z4
XSAngle_SB_B_Post_Z4
θ [°]


dσ/dθ [mbarn/deg]
XSAngle_SB_B_Pre_Z5
XSAngleTrue_Z5
XSAngle_SB_B_Post_Z5
dσ/dθ [°]


dσ/dθ [mbarn/deg]
XSAngle_SB_B_Pre_Z6
XSAngleTrue_Z6
XSAngle_SB_B_Post_Z6
dσ/dθ [°]
θ [°]


dσ/dθ [mbarn/deg]
180
160
140
120
100
80
60
40
20
0
XSAngle_SB_B_Pre_Z7
XSAngleTrue_Z7
XSAngle_SB_B_Post_Z7
dσ/dθ [°]
15
10
5
0
−5
−10
−15
−20
−25
−30
0
1
2
3
4
5
6
7
θ [°]


mbarn
1200
1000
800
600
400
200
0
h_XS_total_SB_B_pre
h_XS_total_MC
h_XS_total_SB_B_post
h_XS
12
10
8
6
4
2
0
−2
−4
−6
1
2
3
4
5
6
7
charge

New analysis flow

Evaluate **efficiencies** and **purities**

Repeat for with and w/o target samples

Apply reconstruction cuts (SC, BM)

Normalize yields and **subtract** background

Apply efficiency and **purity** for fragmentation in target

Unfolding

Calculate angular **cross sections**

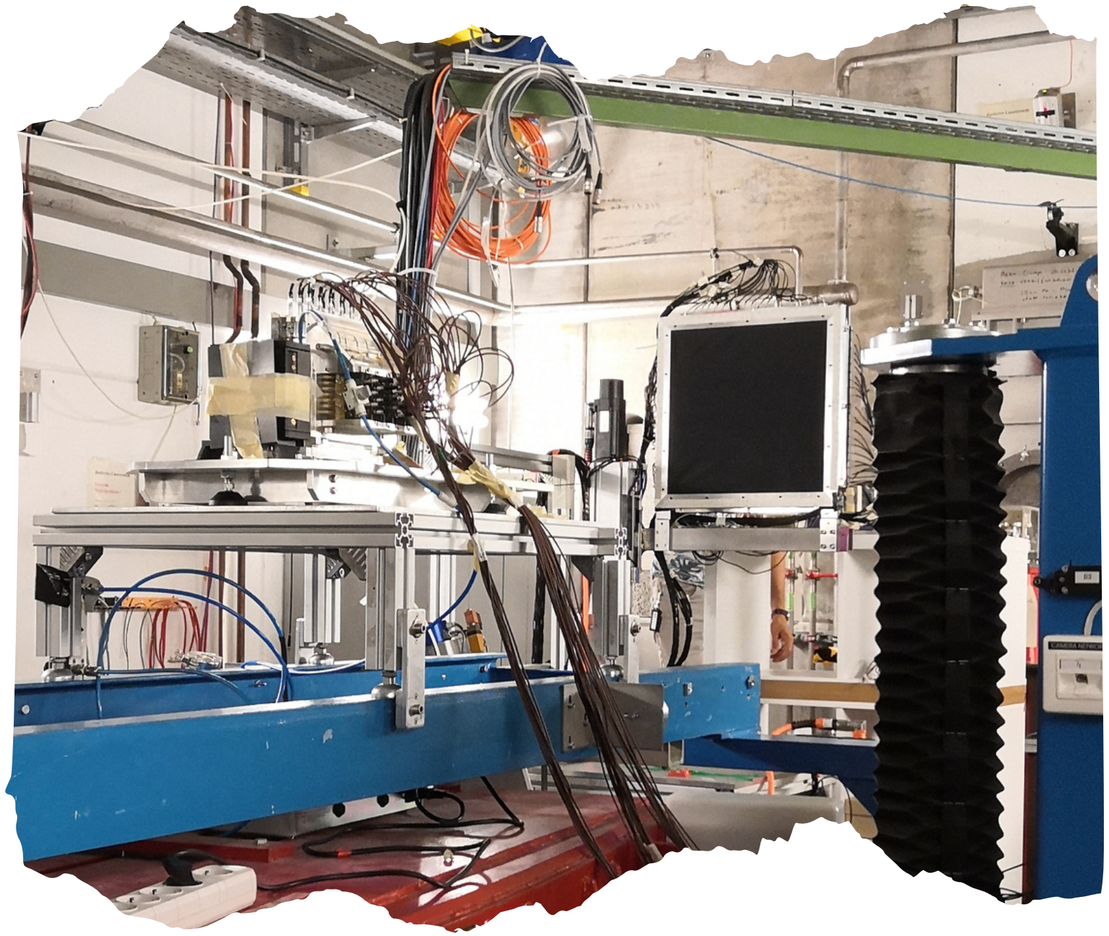
Compare with MC

Next steps

Run on data with the same steps of MC analysis

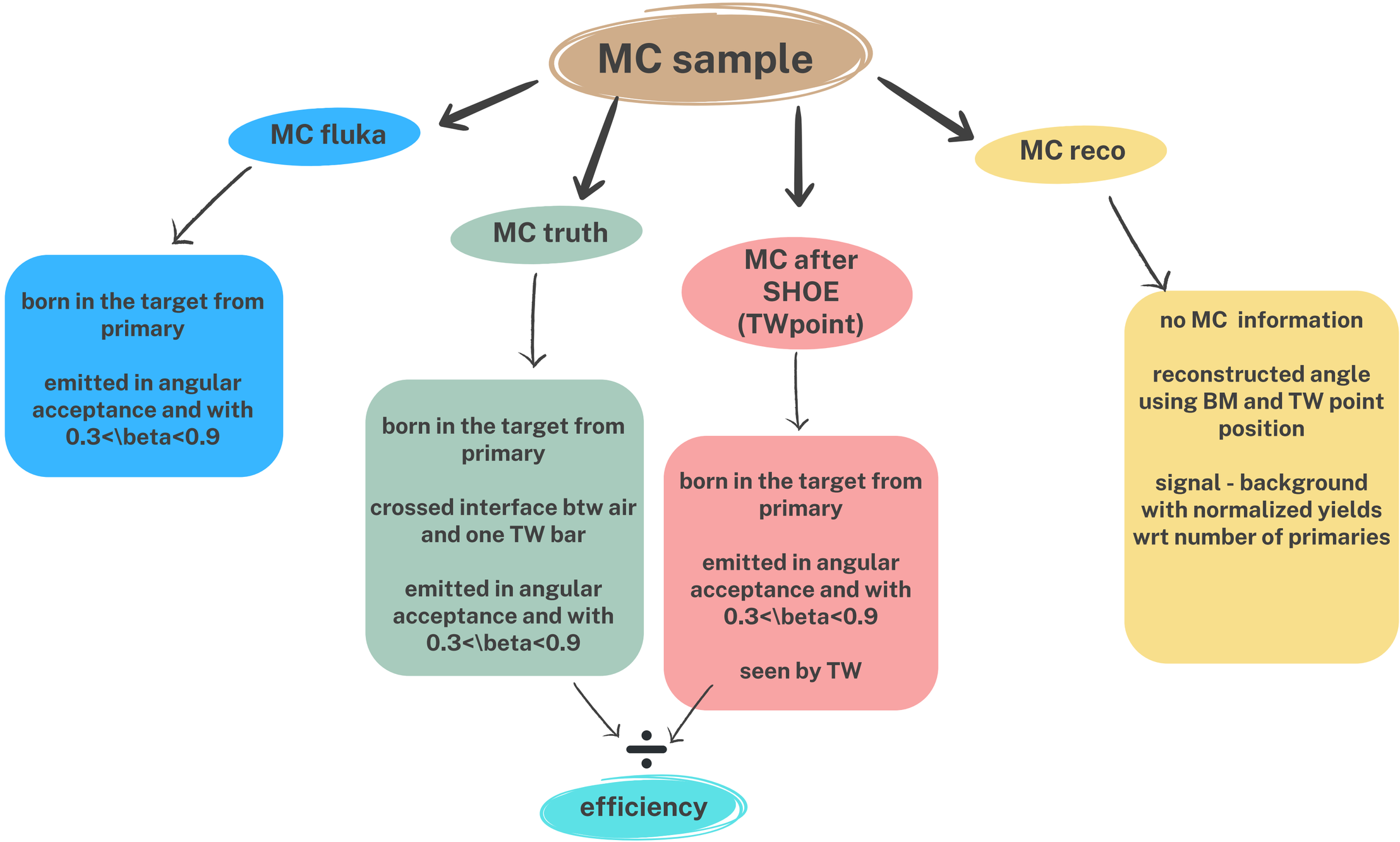
400 MeV/u ^{16}O beam on 5mm Carbon target

Run	Trigger type	Target	Events
4305	MB	C	162102
4306	MB	C	577096
4307	MB	C	513370
4308	Frag + MB	C	510169
4309	Frag + MB	C	531812
4310	Frag + MB	C	1012099
4313	MB	no	57133



Next update soon!

Thanks for listening!


MC sample
MC fluka
MC truth
MC after SHOE (TWpoint)
MC reco
born in the target from primary
emitted in angular acceptance and with 0.3<\beta<0.9
born in the target from primary
crossed interface btw air and one TW bar
emitted in angular acceptance and with 0.3<\beta<0.9
born in the target from primary
emitted in angular acceptance and with 0.3<\beta<0.9
seen by TW
no MC information
reconstructed angle using BM and TW point position
signal - background with normalized yields wrt number of primaries
÷
efficiency