Some considerations about statistics needed @ CNAO2023

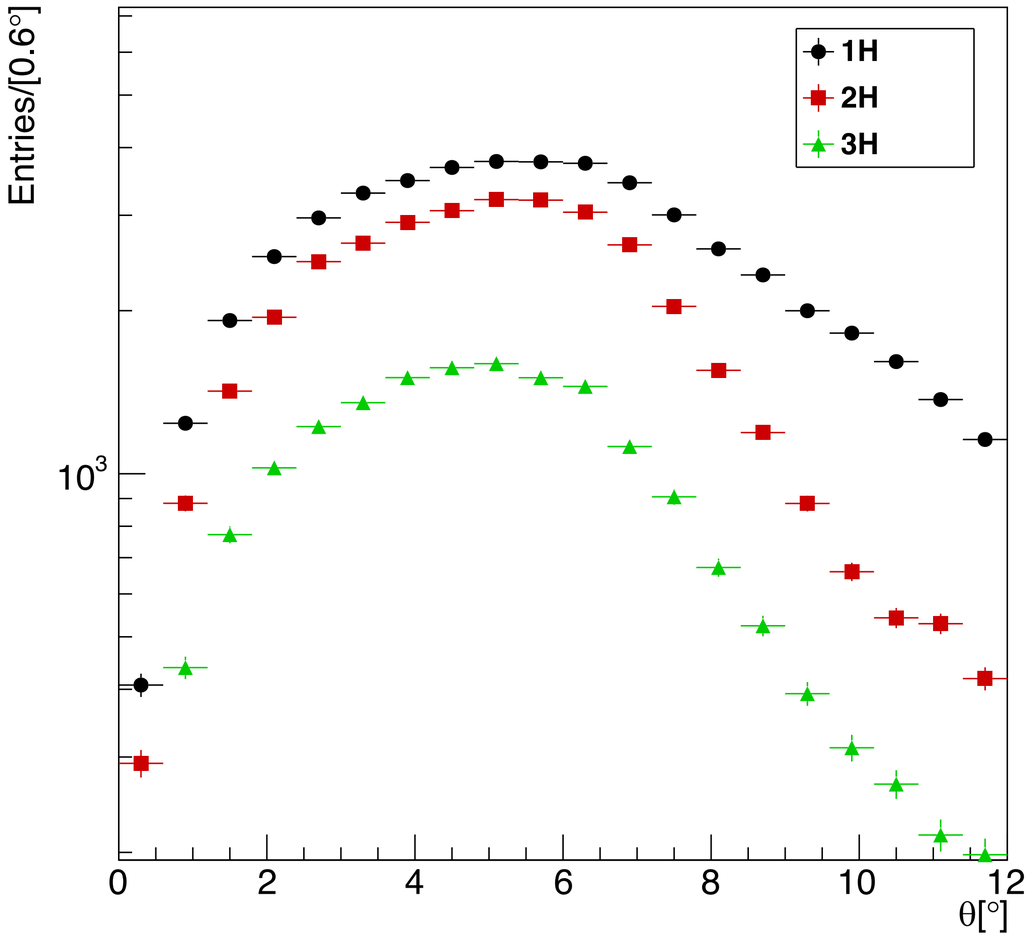
Analysis and reconstruction meeting

Marco Toppi – 06/10/2023

MC tracks selection @ ”CNAO2023” (12C_200_2023v2)

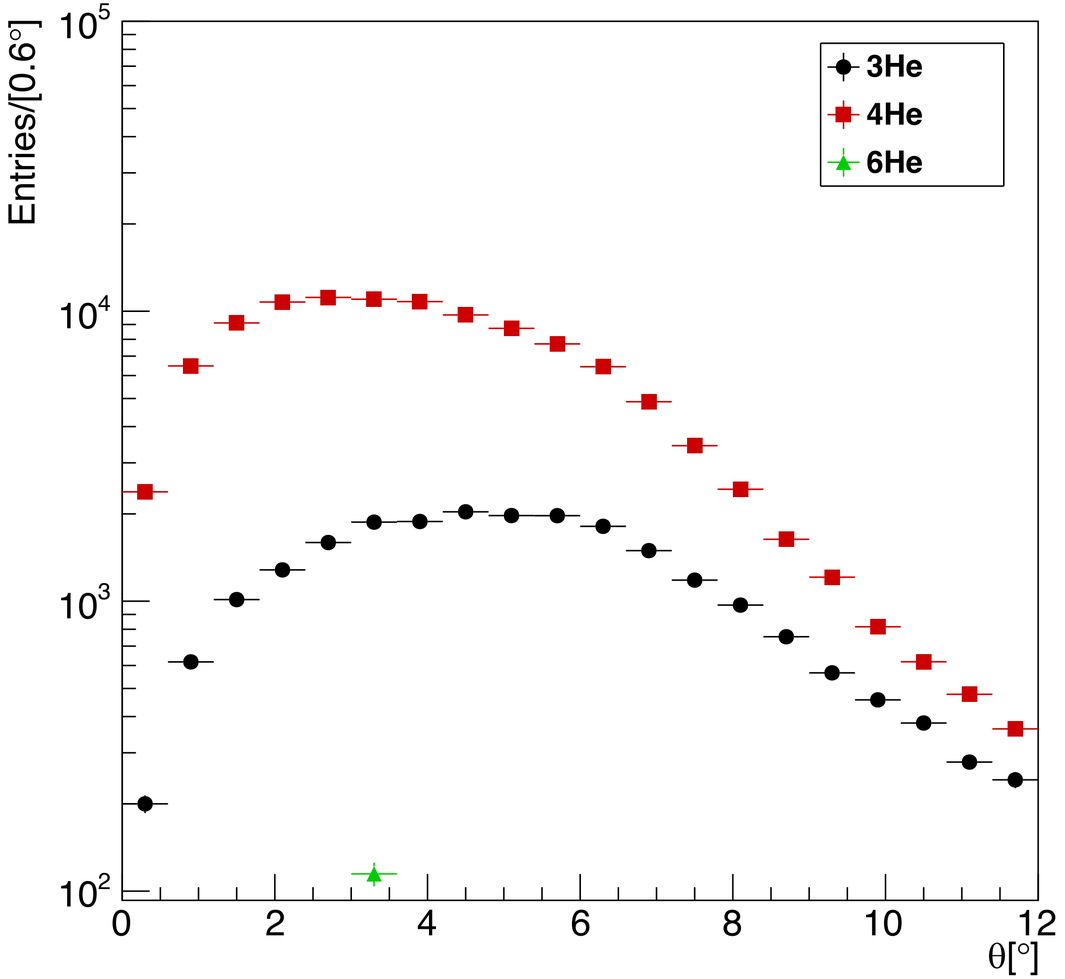
- Campaign MC:12C_200_2023v2 with 5M events
- Selected only tracks crossing the TW from the front with Ekin/u>50 MeV/u at production
- MC truth for isotopes identification (Z+A)
- Theta distribution at production in TG (no BM direction subtraction)
- Applied a flat 60% efficiency (see Yun) cut over all the Z and isotopes (looking already studied simulations efficiency grow up from protons~60% to Nitrogen>90%, without any cut on global tracks)
- Study done only for C target (not C2H4), and only for theta bin (not Ekin)

Yields for Z=1, Nprim=5M

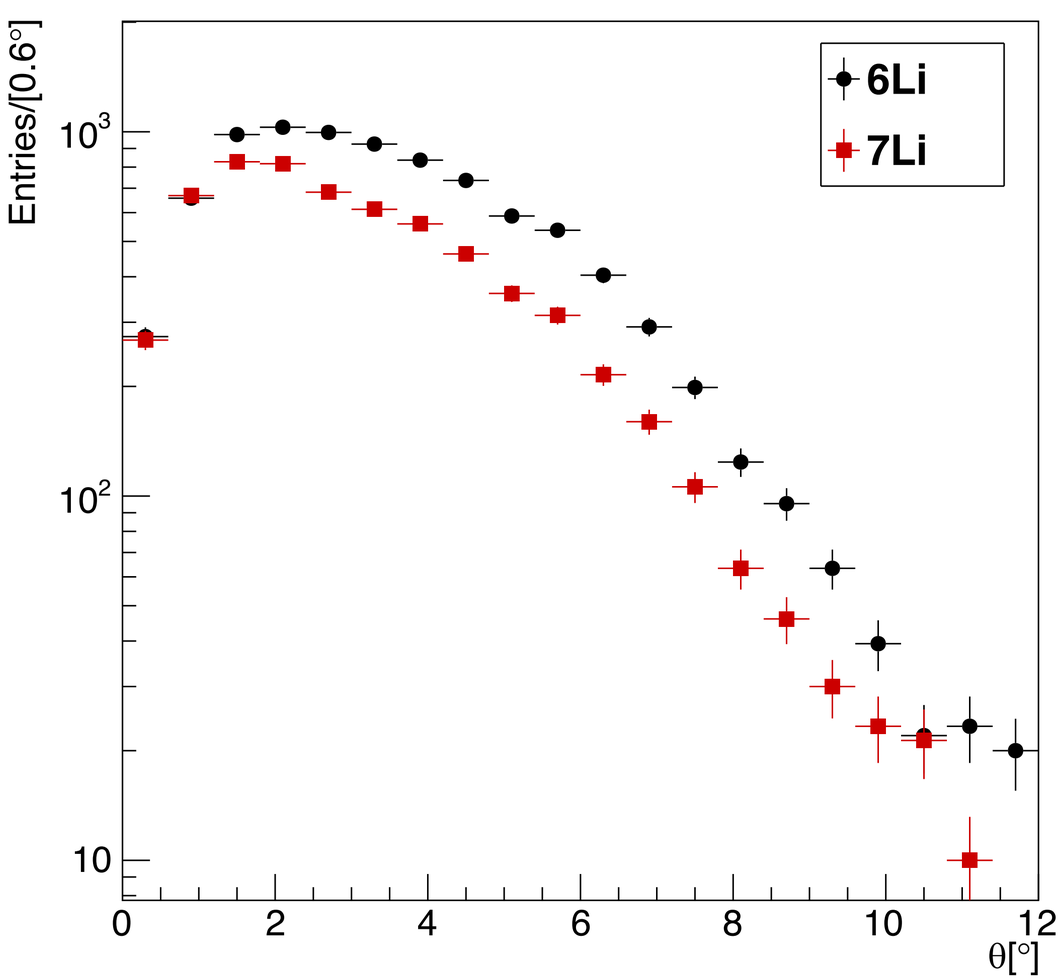


MC tracks selection @ ”CNAO2023” (12C_200_2023v2)

Yields for Z=2, Nprim=5M

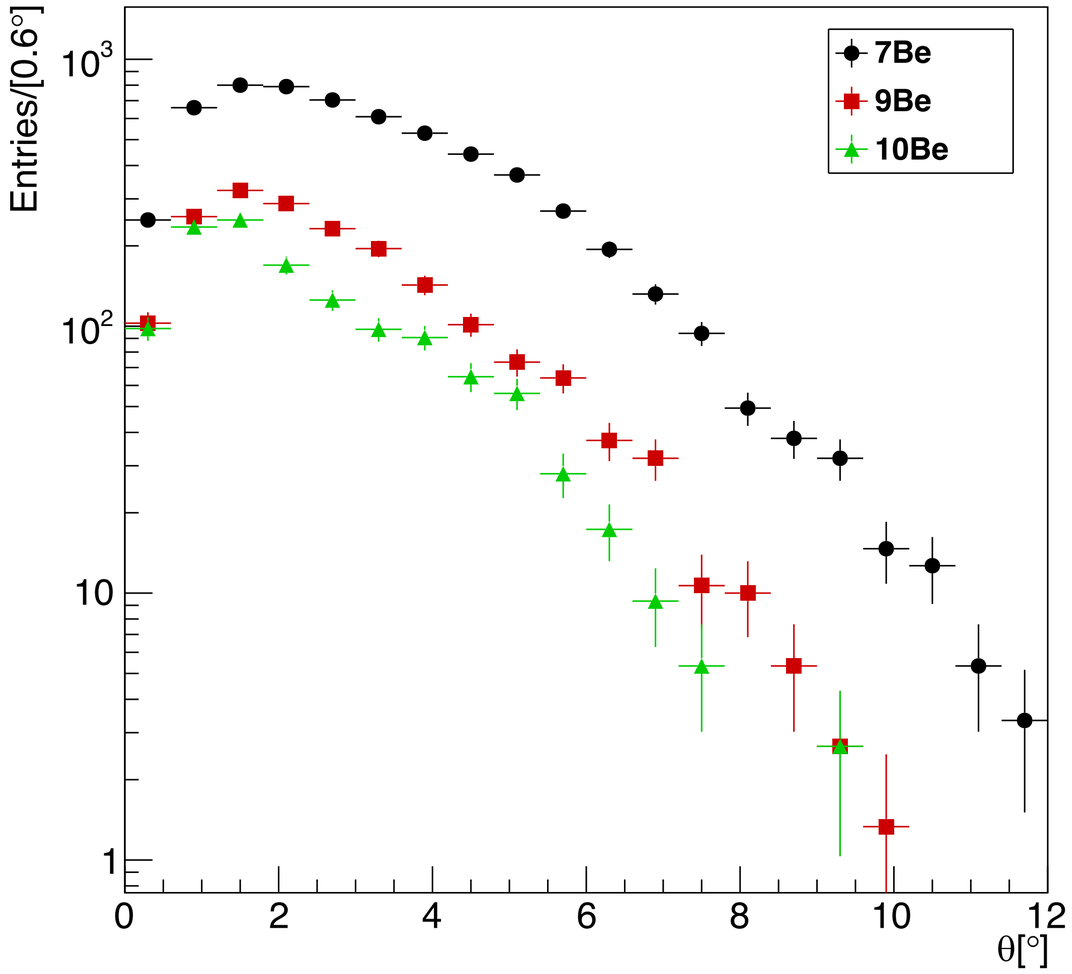


Yields for Z=3, Nprim=5M

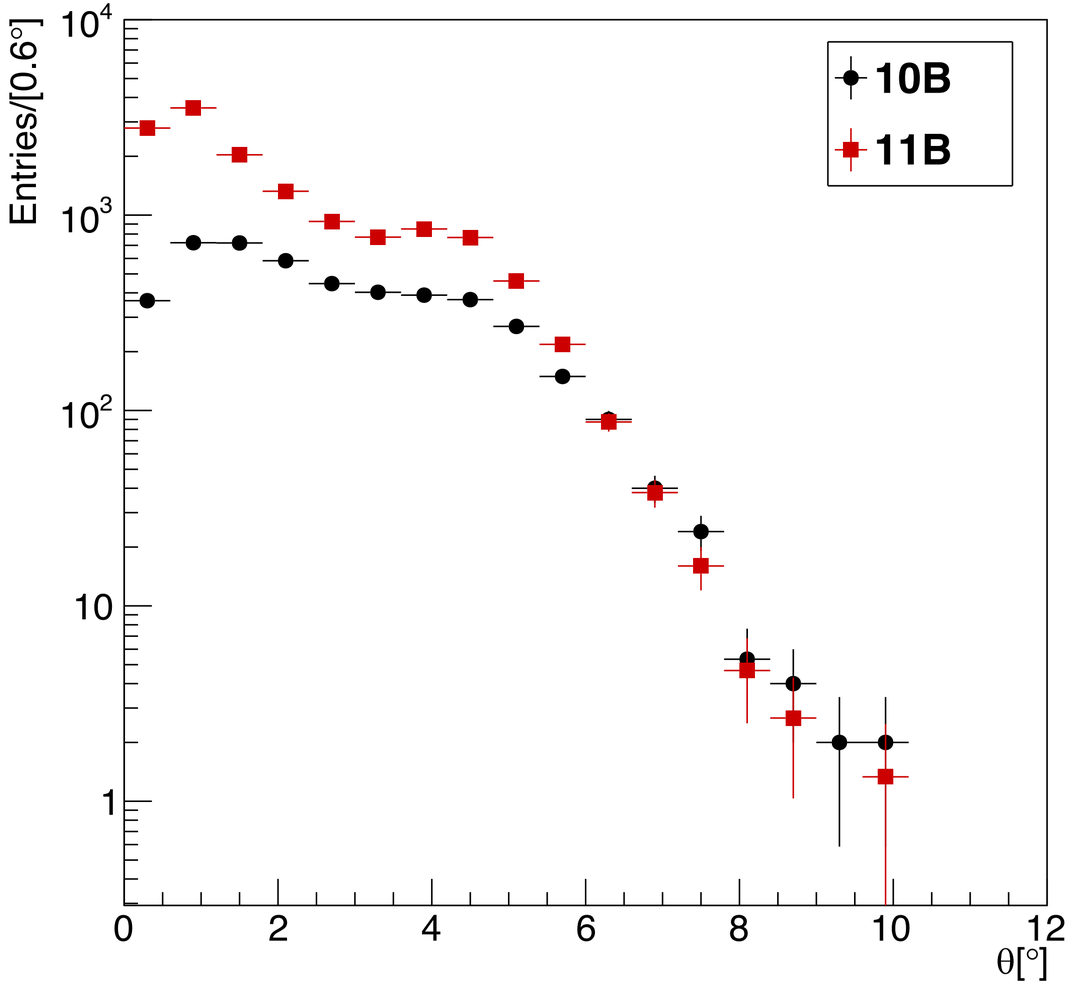


MC tracks selection @ ”CNAO2023” (12C_200_2023v2)

Yields for Z=4, Nprim=5M

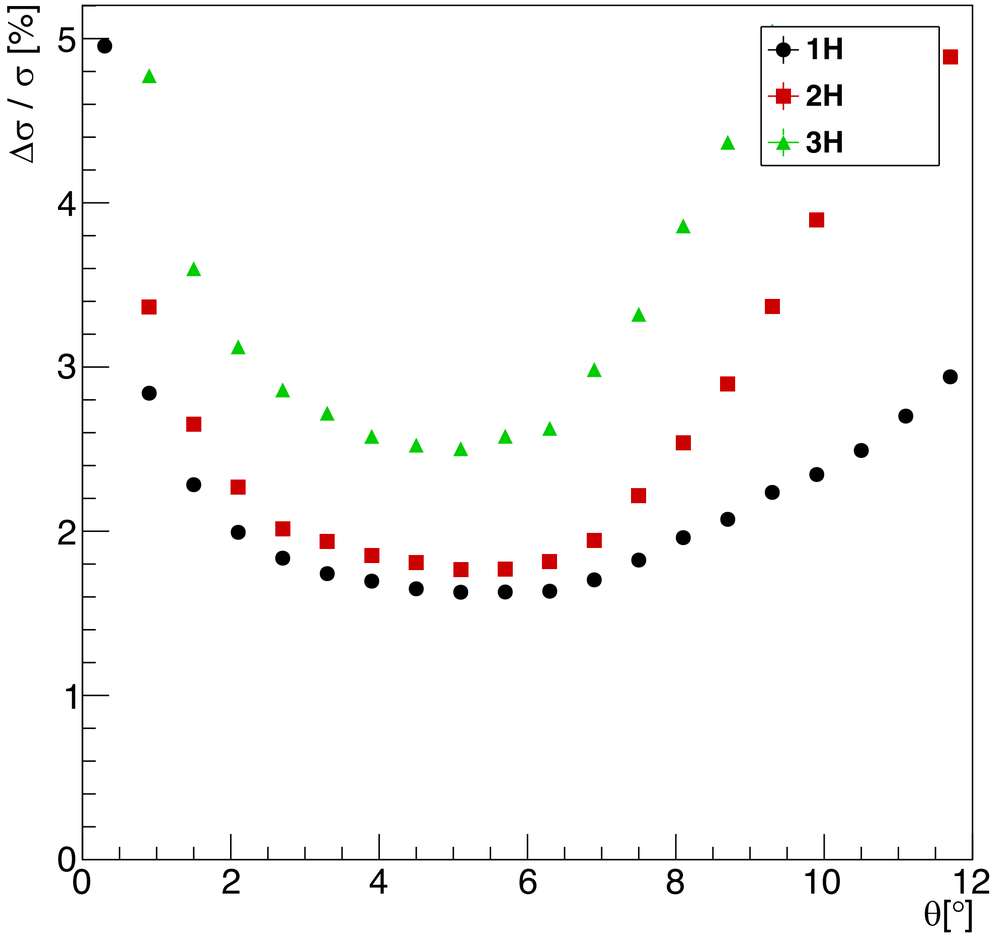


Yields for Z=5, Nprim=5M

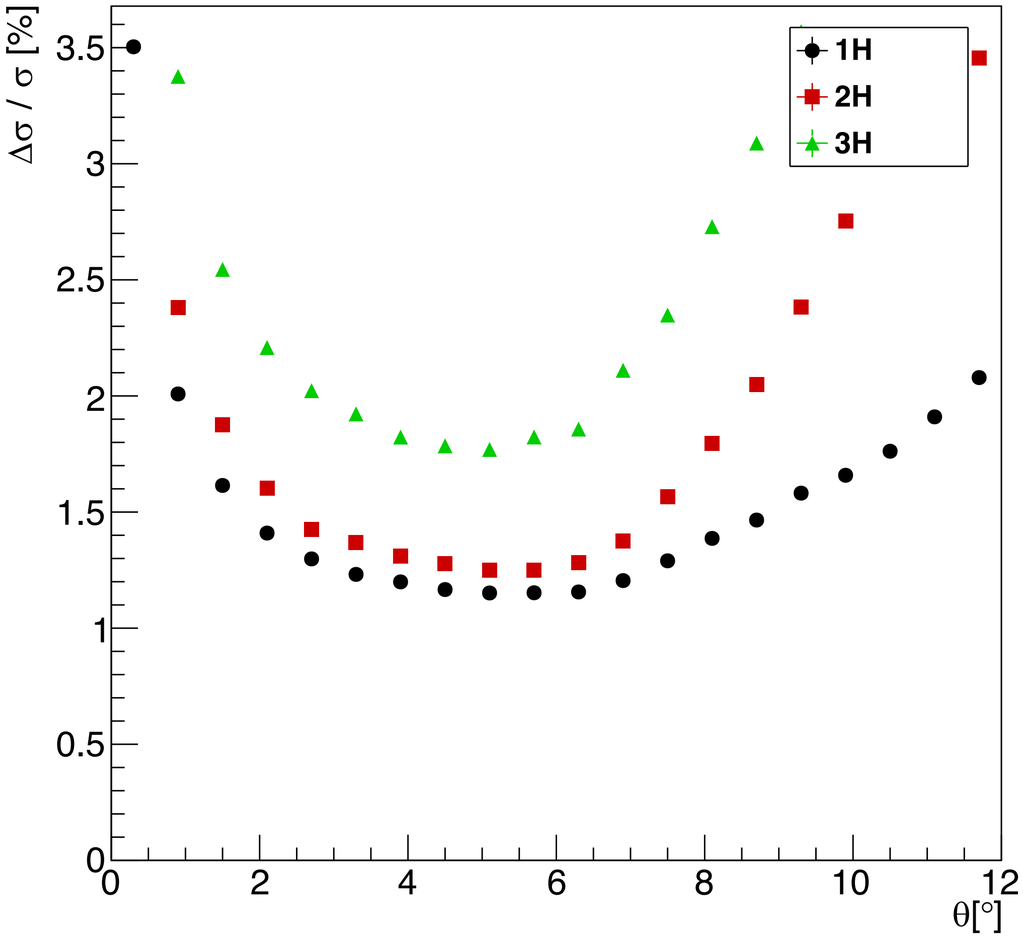


Cross section relative errors (taking into account only yields contribution to the error) – Z = 1

XS relative errors for Z=1, Nprim=5M

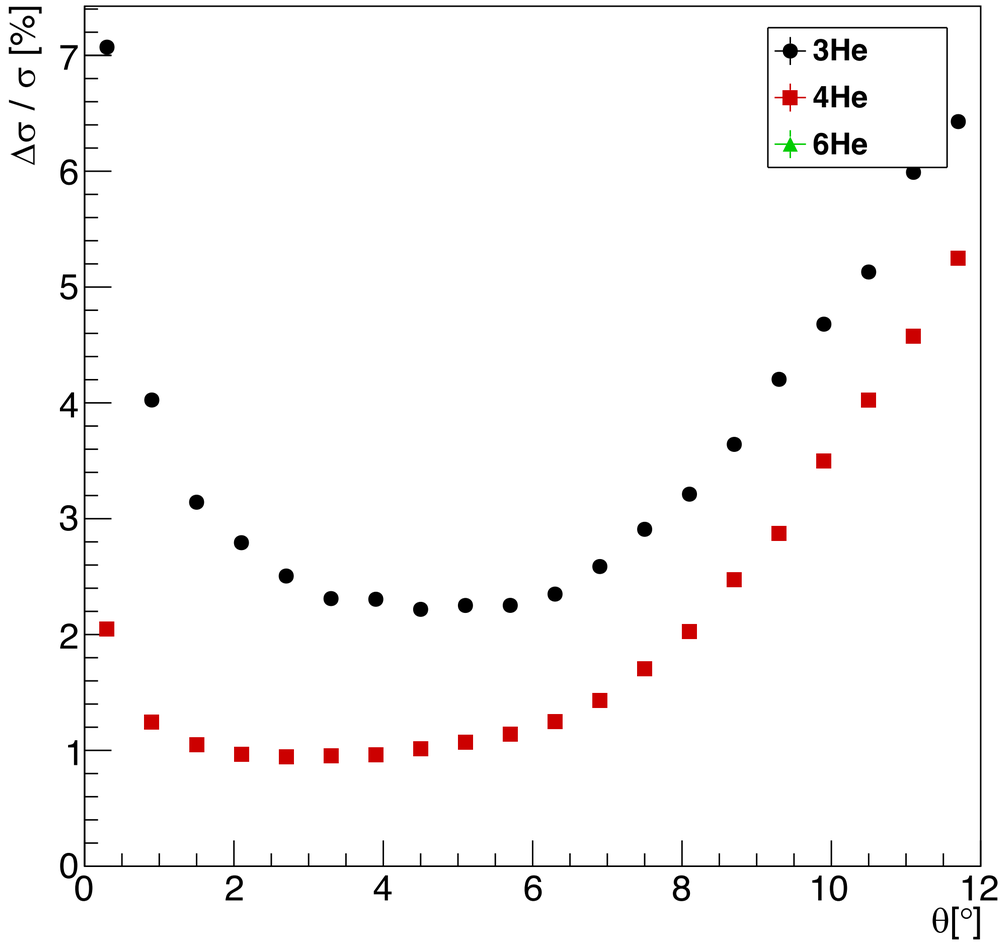


XS relative errors for Z=1, Nprim=10M

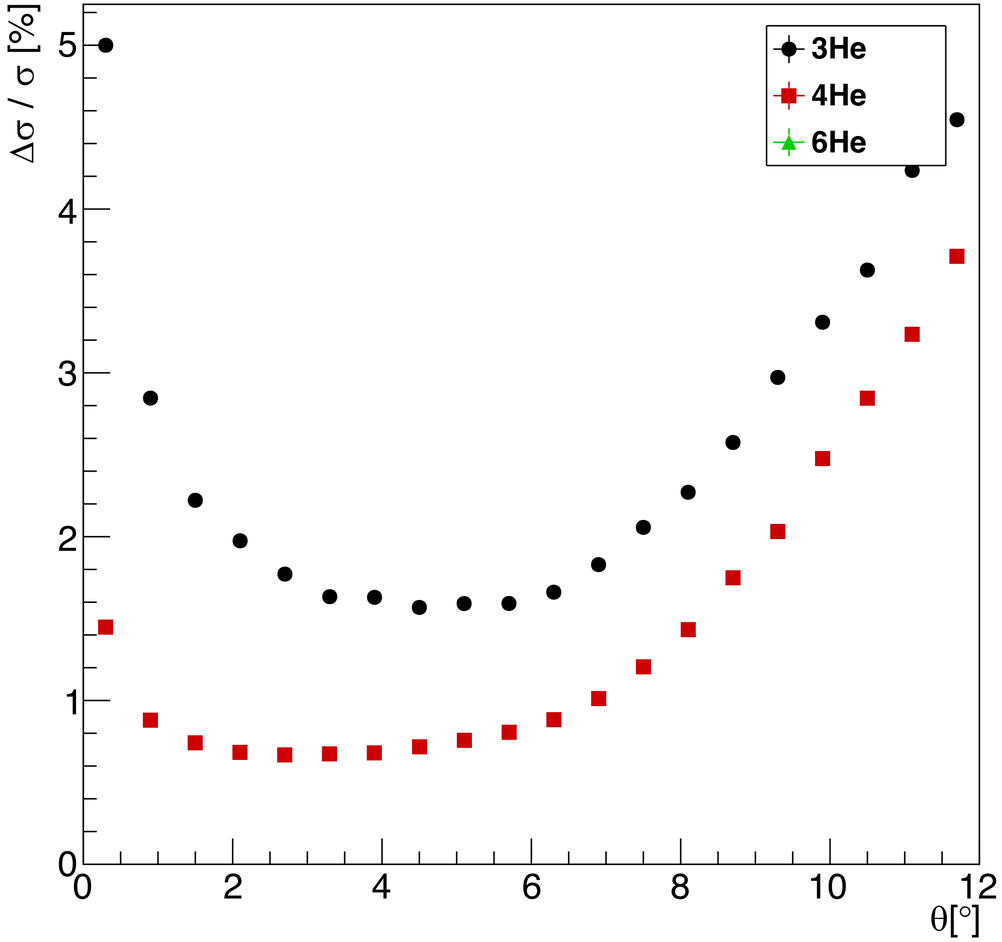


Cross section relative errors (taking into account only yields contribution to the error) – Z = 2

XS relative errors for Z=2, Nprim=5M

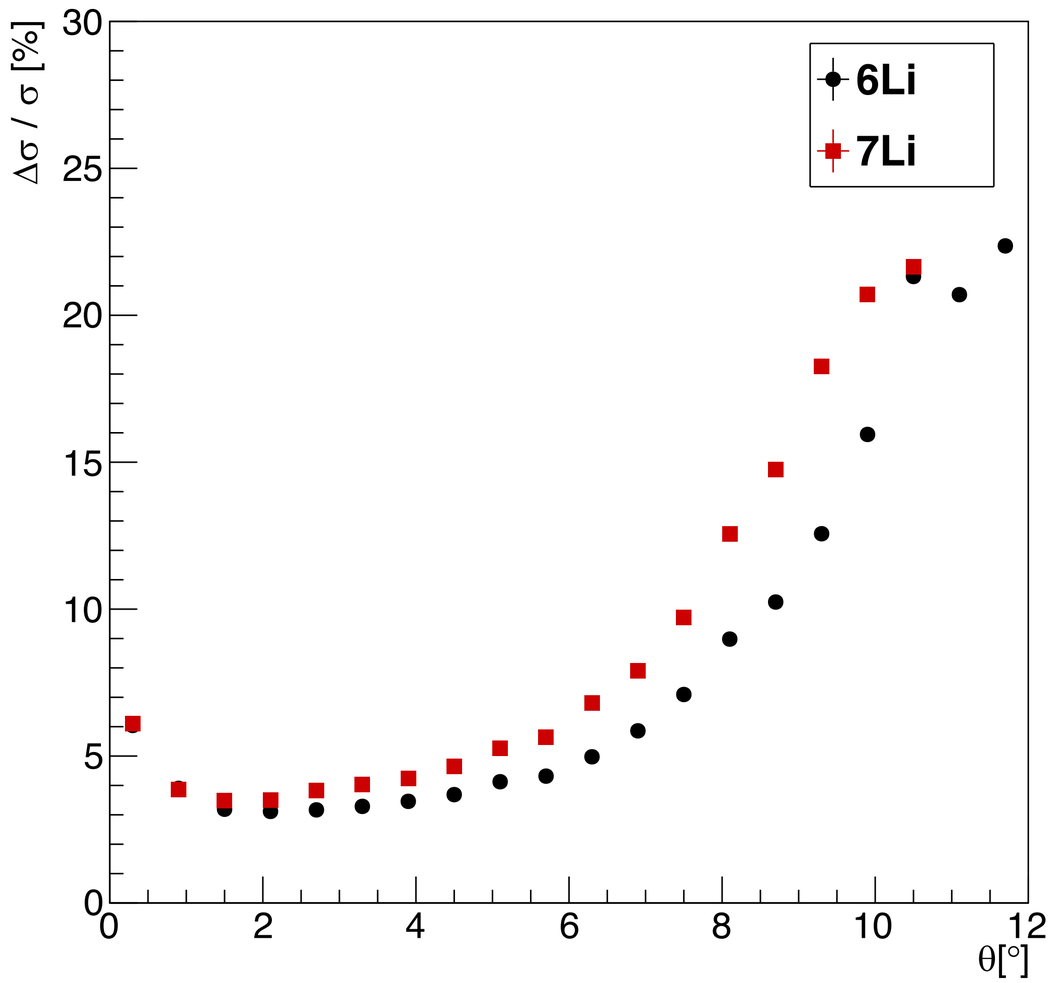


XS relative errors for Z=2, Nprim=10M

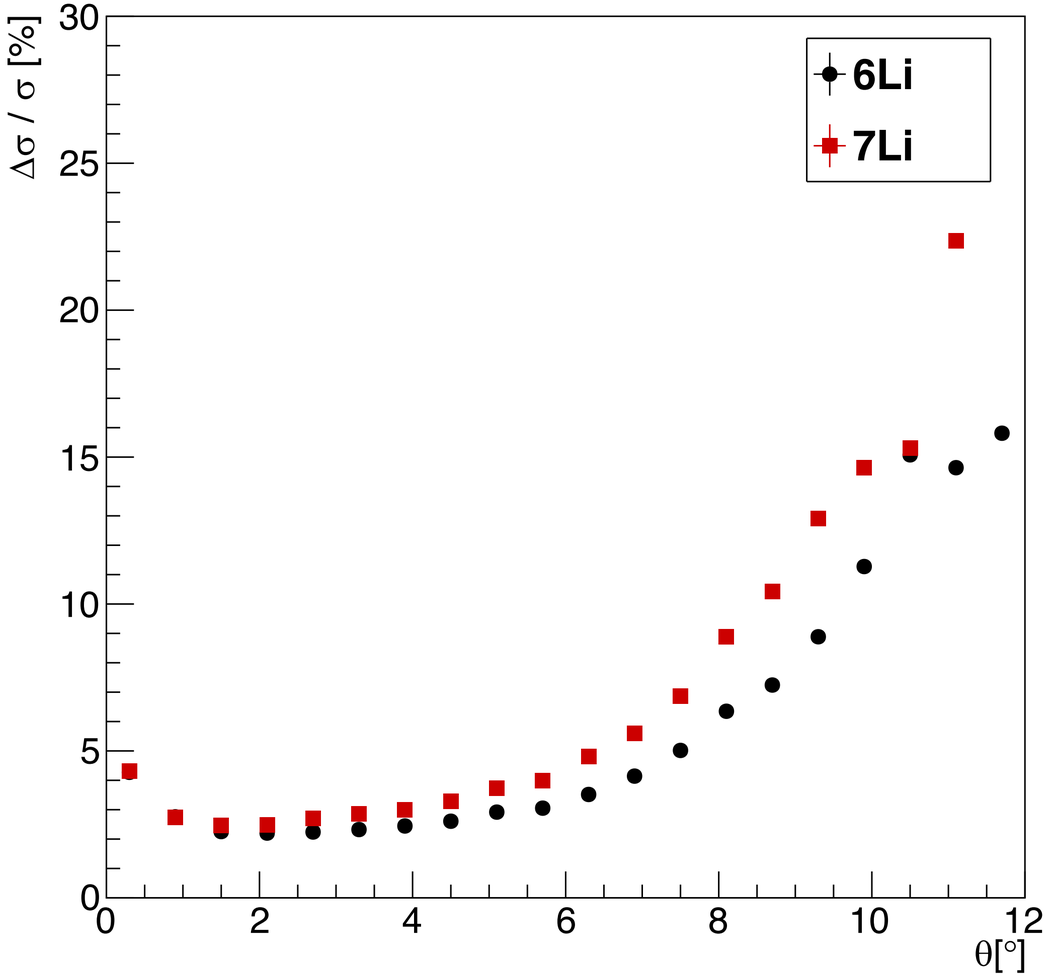


Cross section relative errors (taking into account only yields contribution to the error) – Z = 3

XS relative errors for Z=3, Nprim=5M

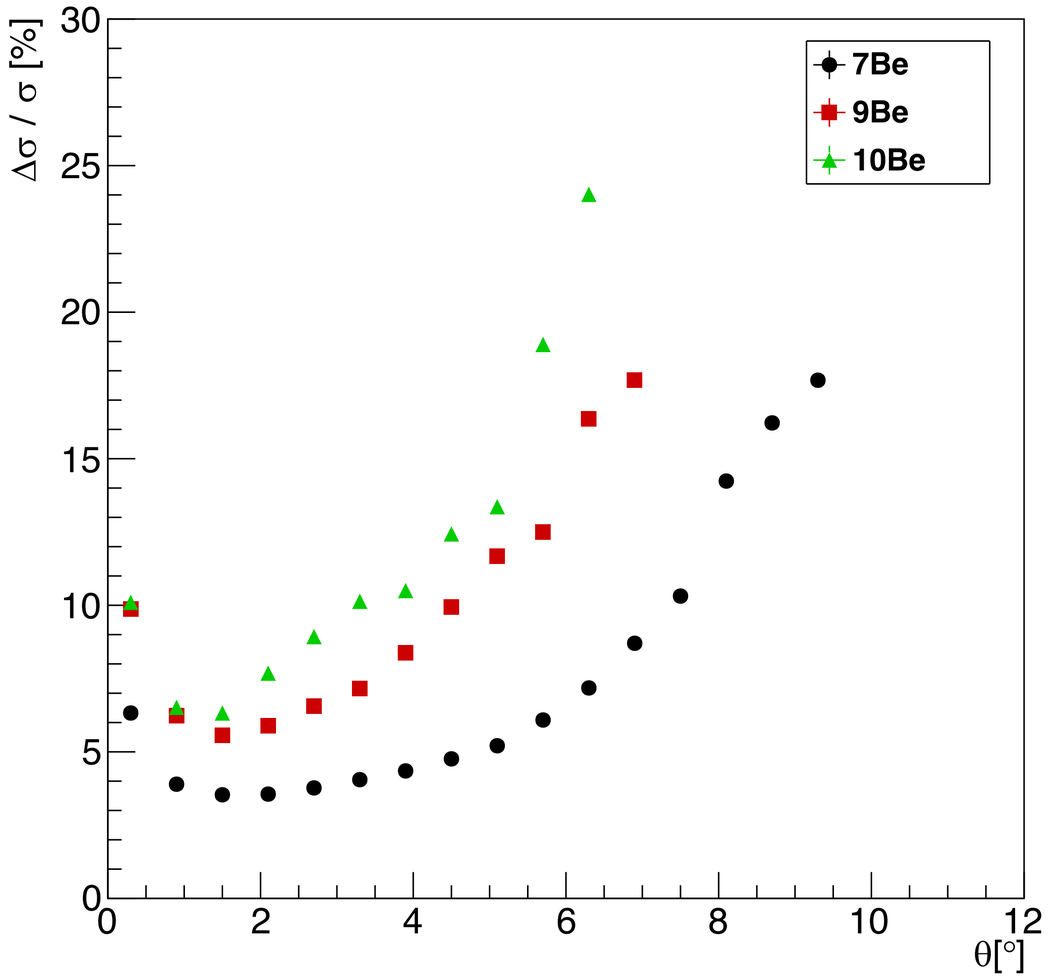


XS relative errors for Z=3, Nprim=10M

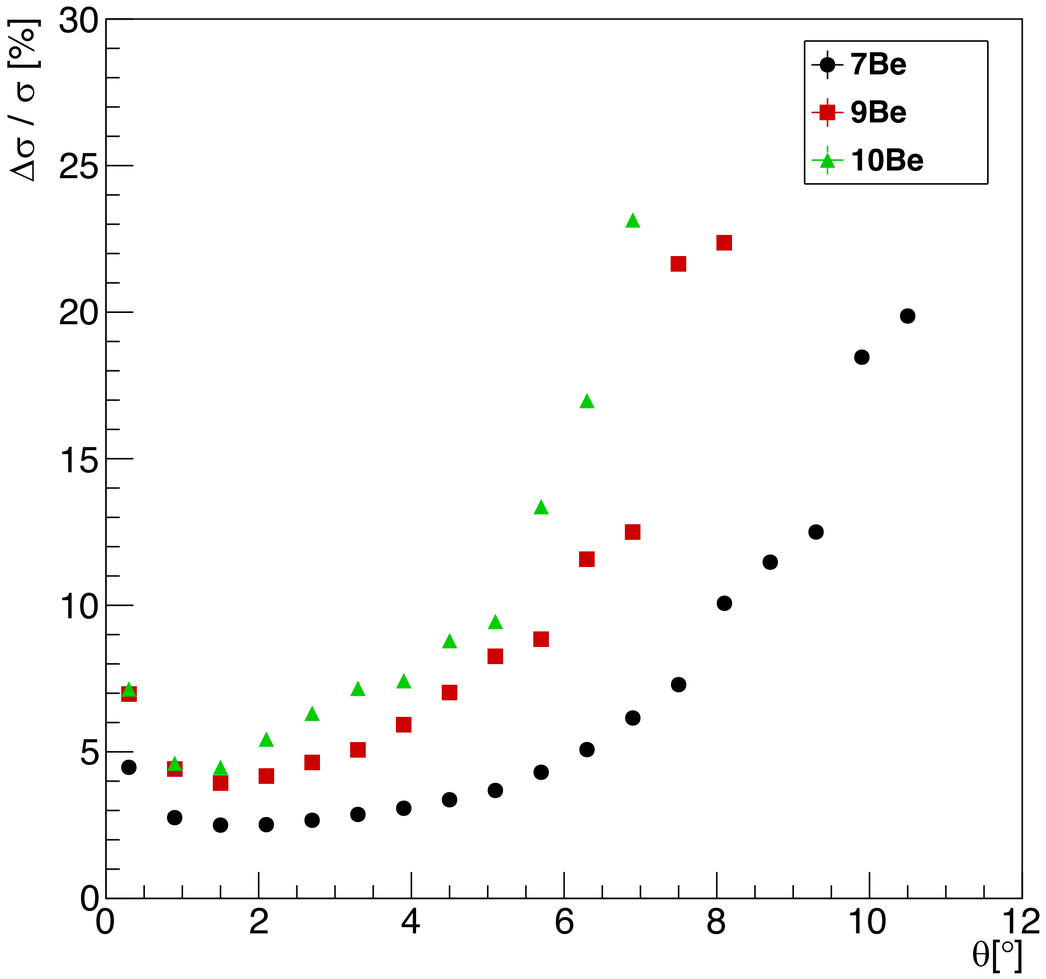


Cross section relative errors (taking into account only yields contribution to the error) – Z = 4

XS relative errors for Z=4, Nprim=5M

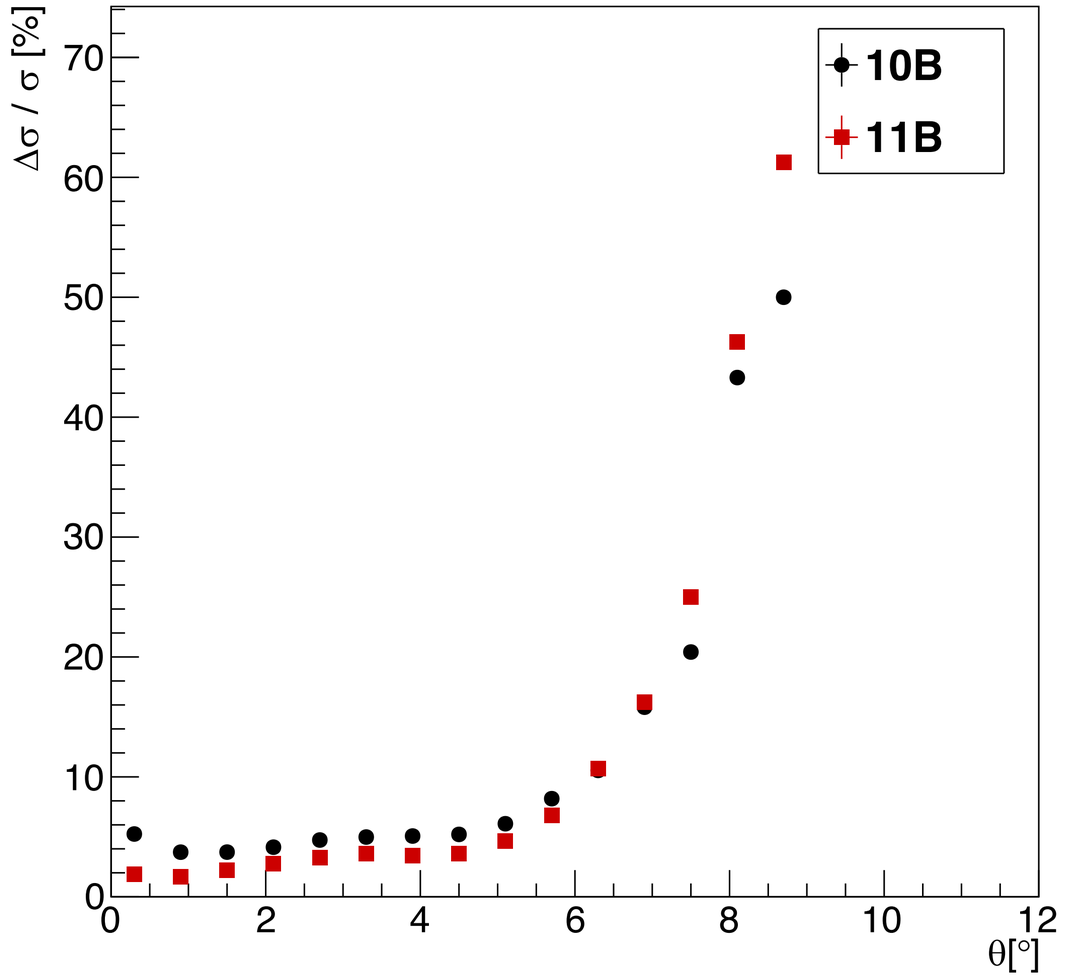


XS relative errors for Z=4, Nprim=10M

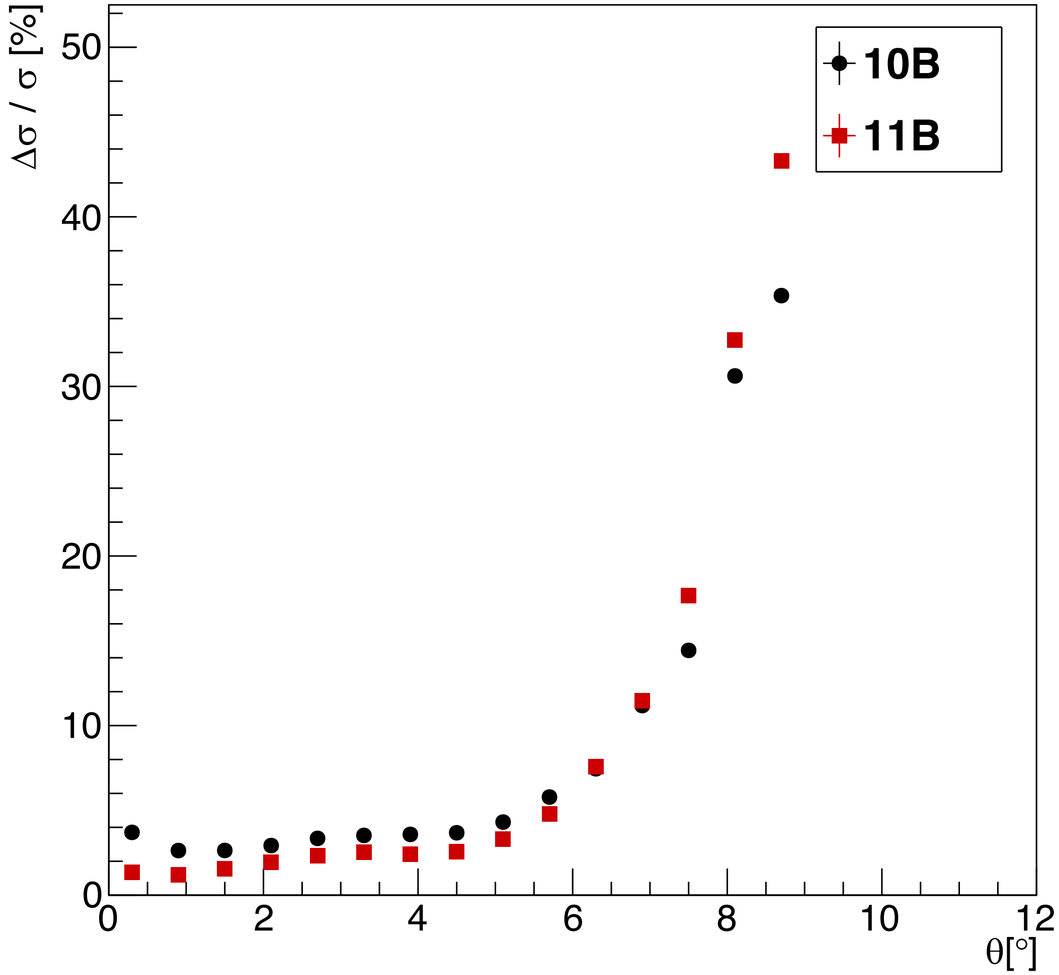


Cross section relative errors (taking into account only yields contribution to the error) – Z = 5

XS relative errors for Z=5, Nprim=5M



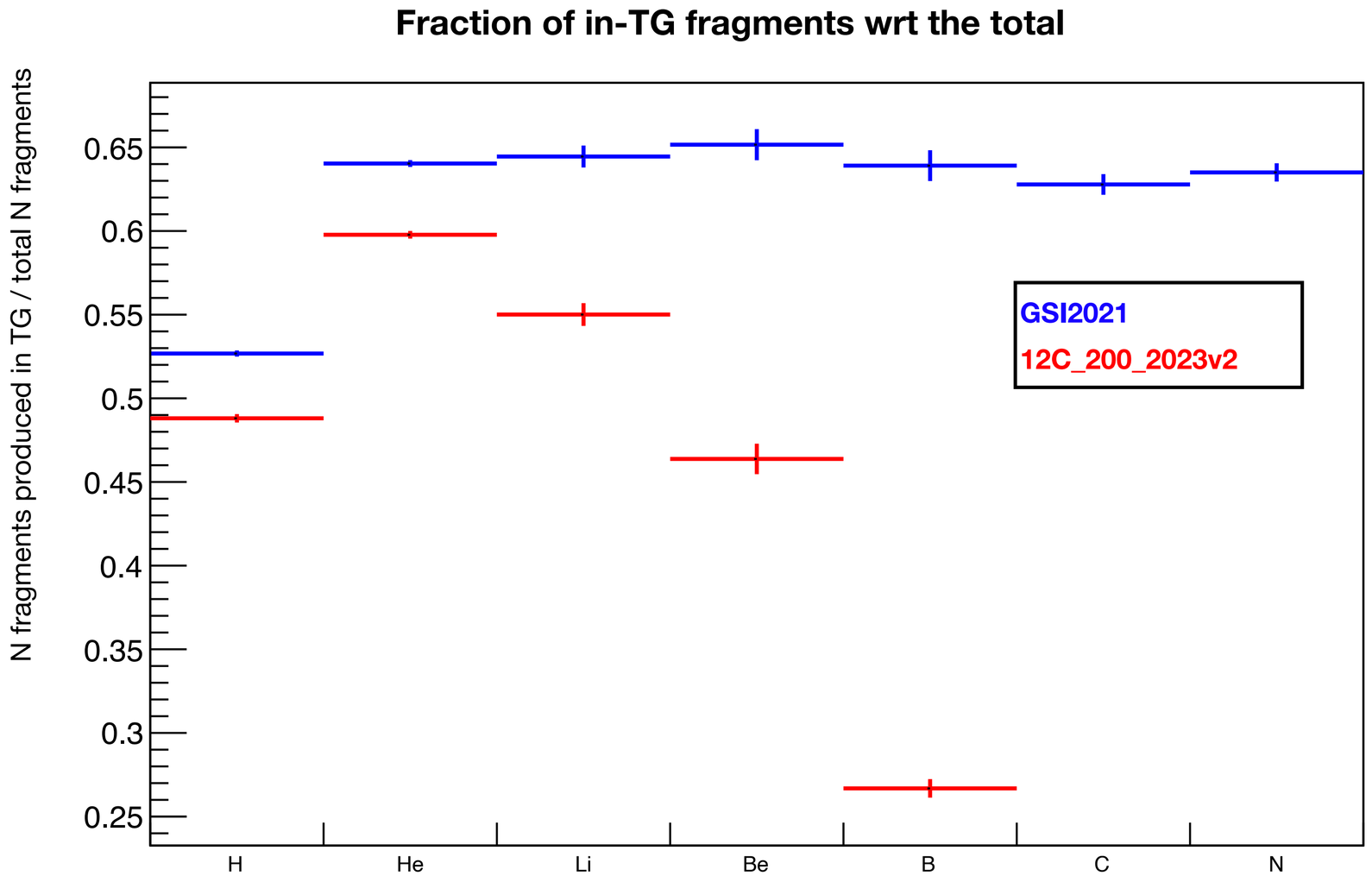
XS relative errors for Z=5, Nprim=10M



GSI2021 vs ”CNAO2023” (12C_200_2023v2)

- Fraction of fragments produced in the TG wrt the total N fragments per Z→ [N MC true trks at TW crossing produced in TG (Z) / N MC true trks at TW crossing (Z)]
- GSI2021_MC and 12C_200_2023v2 with 1M events run
- Selected only tracks crossing the TW from the front with 50MeV/u<Ekin/u<1 GeV/

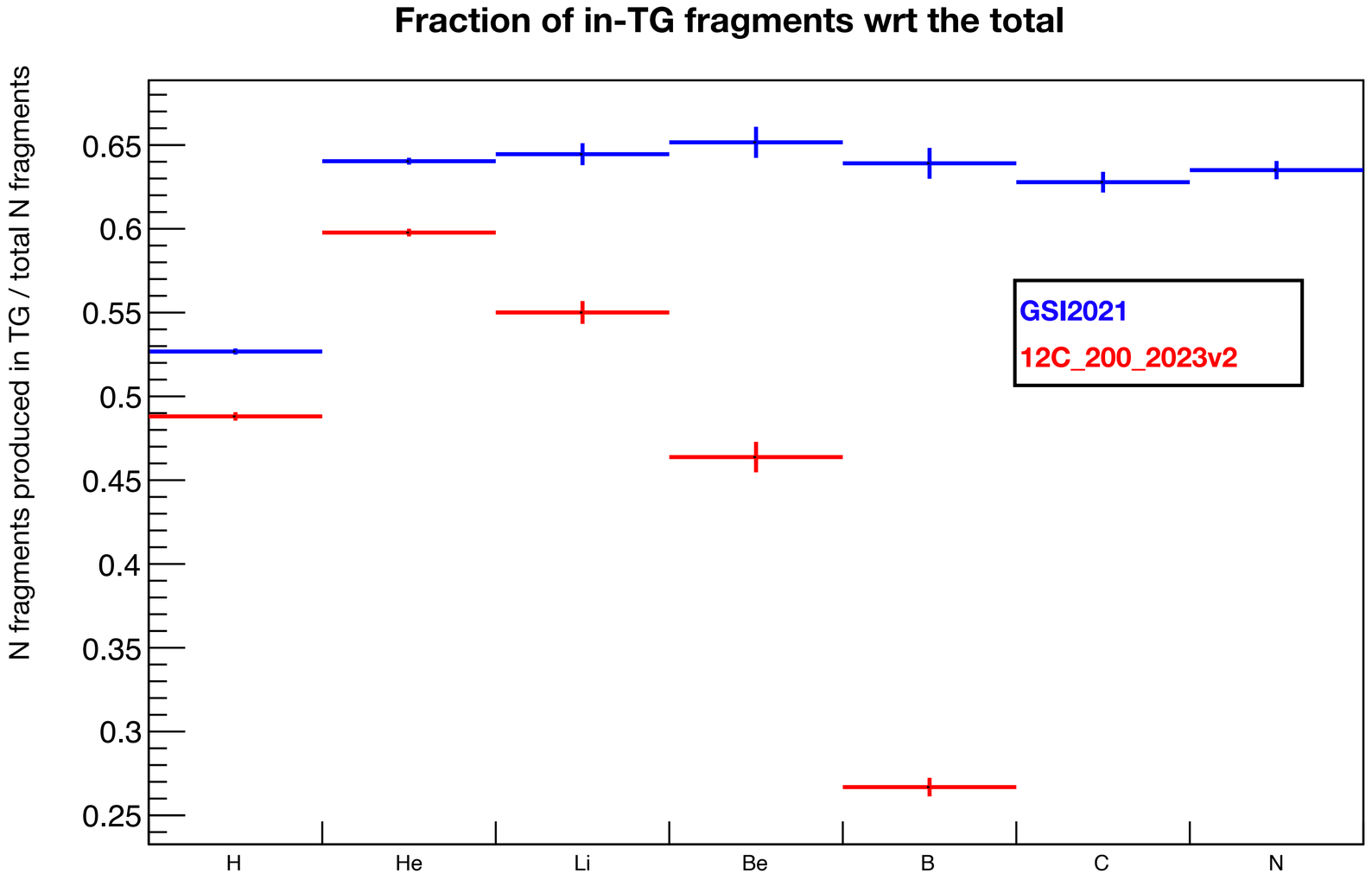
(*) At GSI2019 total fragmentation out of target was ~ 25% (done with reconstructed TW points)--> reasonable, less material budget on the beam line (neither MSD nor CALO



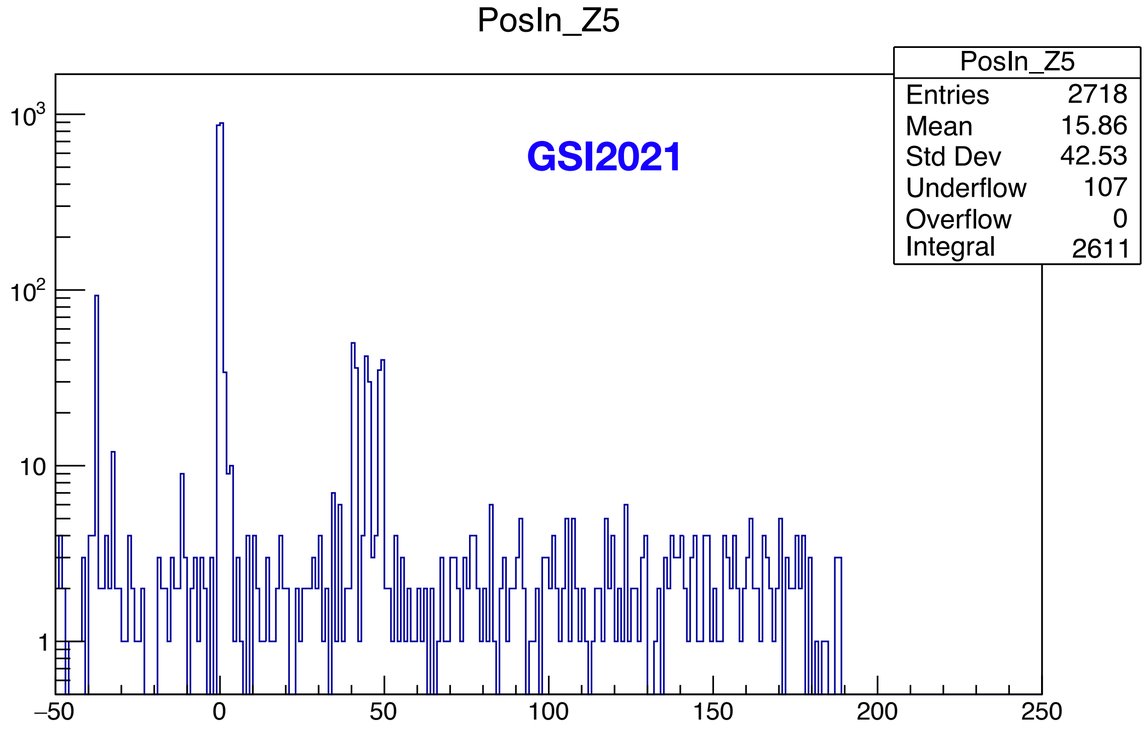
GSI2021 vs ”CNAO2023” (12C_200_2023v2)

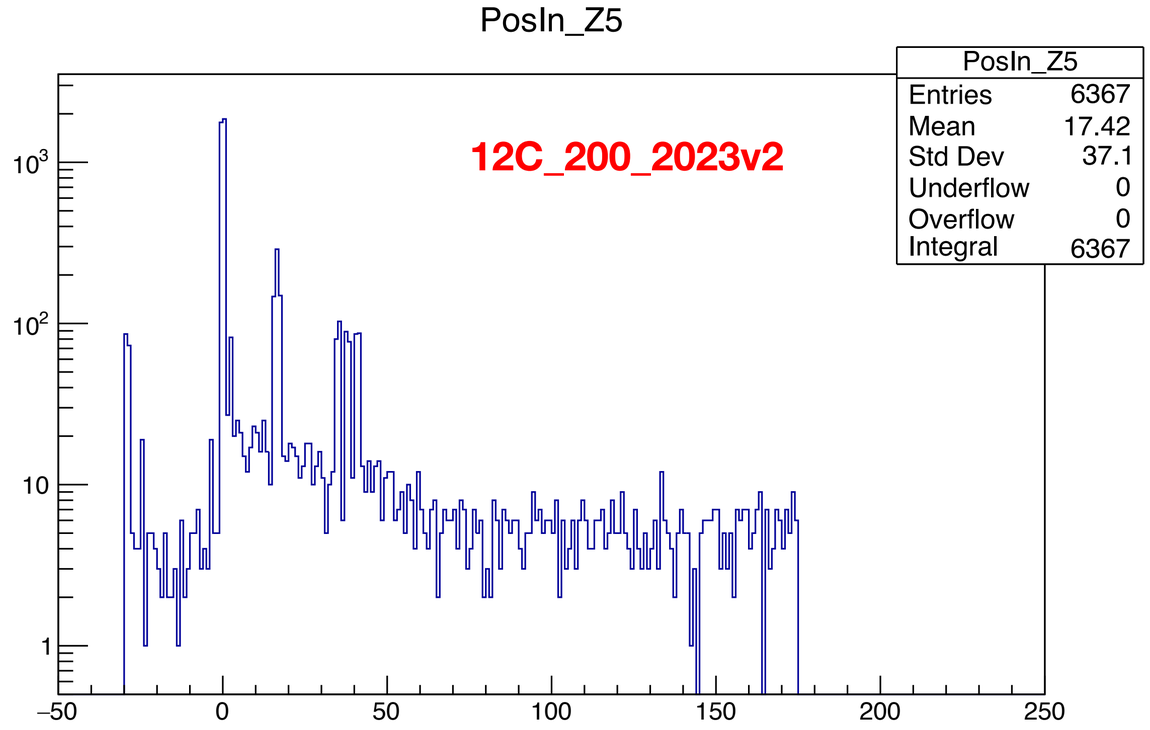
- This plot brings two further questions:
- 1- Are we still able to reject background with global tracking + Z rec in MSD and VTX? (I guess yes…)
- 2- If this is true the efficiency when we will ask for good track will go further down? (a factor 2 for B)

(*) At GSI2019 total fragmentation out of target was ~ 25% (done with reconstructed TW points)--> reasonable, less material budget on the beam line (neither MSD nor CALO



GSI2021 vs ”CNAO2023” (12C_200_2023v2)





1. It is clear that the fragmentation out of target in CNAO2023 is more than at GSI (full setup)
2. From Yun presentation fragmentation before TG more than the one after @GSI. To be checked

Some considerations about available acquisition time

- Hypothesis:
- DAQ rate 200Hz with MB and 100 Hz with fragmentation trigger (from previous data takings);
- Let's suppose we are able to set thresholds for veto in fragmentation trigger in order to reject ~50% of the primaries events (that it wouod be a good choice in order to keep pile-up under control in VTX and IT)
- Let's suppose that in MB trigger 90% of the events are from primaries
- Consequences:
- In 1h of MB trigger we can acquire $200x3600=7.2x10^5$ events (of which ~10% of fragmentation: $7.2x10^4$). In order to have 10^7 events and get the relative errors we have seen in XS (only stat (no syst) and only yields from MC (no fit), so NOT conservative) we need 14 h [only one target!!!]
- In 1h of frag trigger we can collect $100x3600=36x10^4$ events (of which 50% of fragmentation this time: $18x10^4$). So in this condition we gain with frag trigger 18/7.2~2.5 the fragmentation statistics we collect with MB in 1h

Some considerations about available acquisition time

- We need to find the right compromise between MB and frag trigger to acquire I think 10M events per target (C and C2H4), reminding the XS precision FOOT want to reach and reminding that the value show are underestimate (efficiencies could be less, no syst included, no fit procedure for yield extraction)

- From studies of Aafke, Giuseppe and Silvia 1 cm C2H4 target should provide similar statistics at the same acquisition time. Can we produce a MC simulation to check the same distribution.

- Clearly if we acquire less stat we can play with the bin width.

- For inverse kinematic the relative error will propagate in finding the C+H XS from subtraction procedure. With the estimated needed acquisition time we saturate the available time but I think it is fine for inverse kinematic because we want to prove we are able to do it and we can integrate the XS or use only few bins of Ekin

- From different studies (yun roberto giacomo) I think we could not need bkg acquisition. In this moment I don’t have idea how it could be usefule. Only one: extract background template for mass fitting. This could be checked wit a simulazion with a Air TG


come fai..SBAI