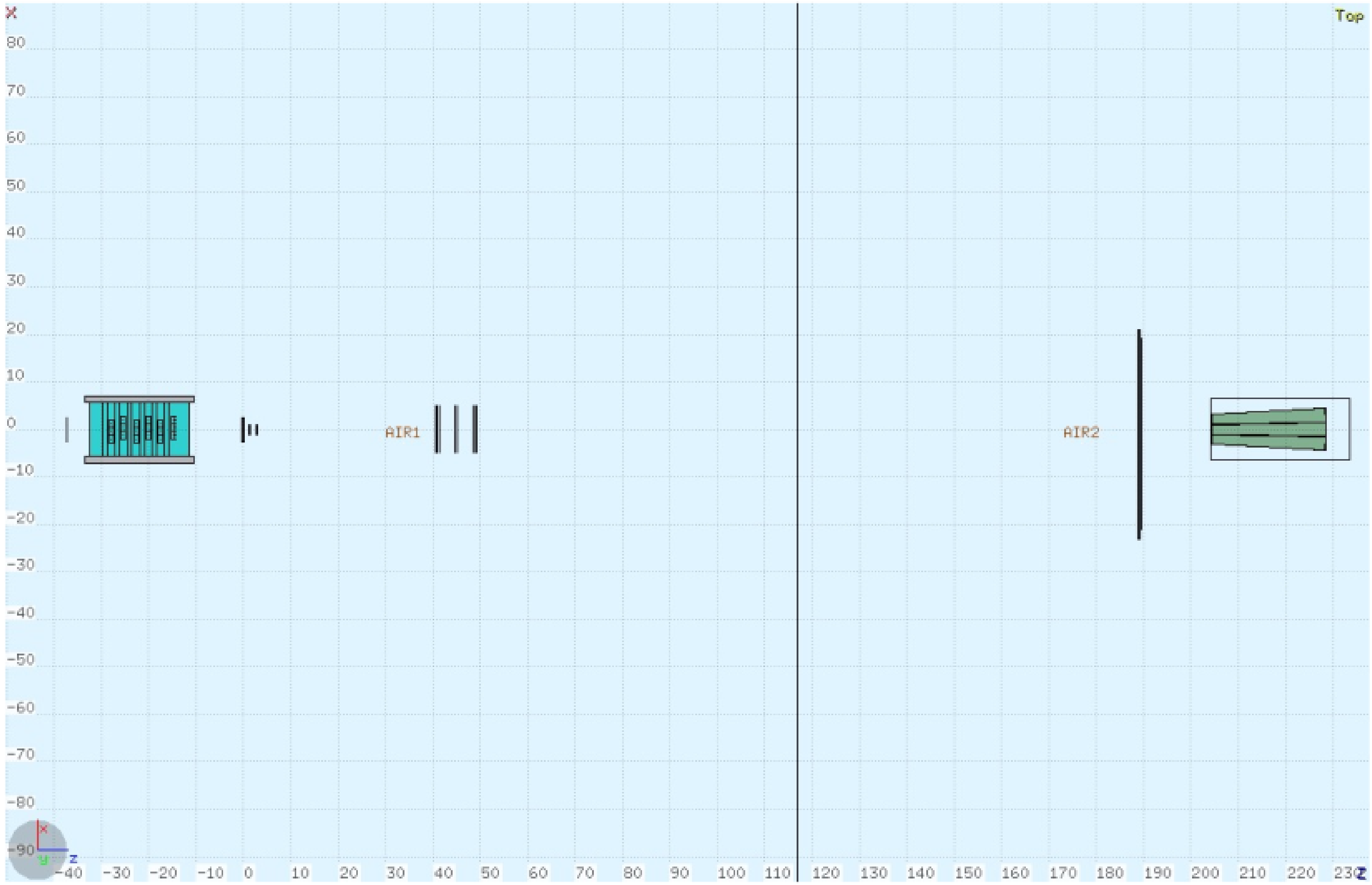
Update on the GSI2021 elemental cross sections

Riccardo Ridolfi

31 May 2023

MC simulation



Using just the **newgeom branch**, for the moment, the geometrical layout of GSI2021_MC campaign has been updated according to the survey performed in cave A (as from the document uploaded in the Elog)

We have considered for the moment the case with all detectors centered in the XY plane (400 MeV/u runs)

Gaussian beam with σ_x = 2.3 mm
σ_y = 1.5 mm

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)

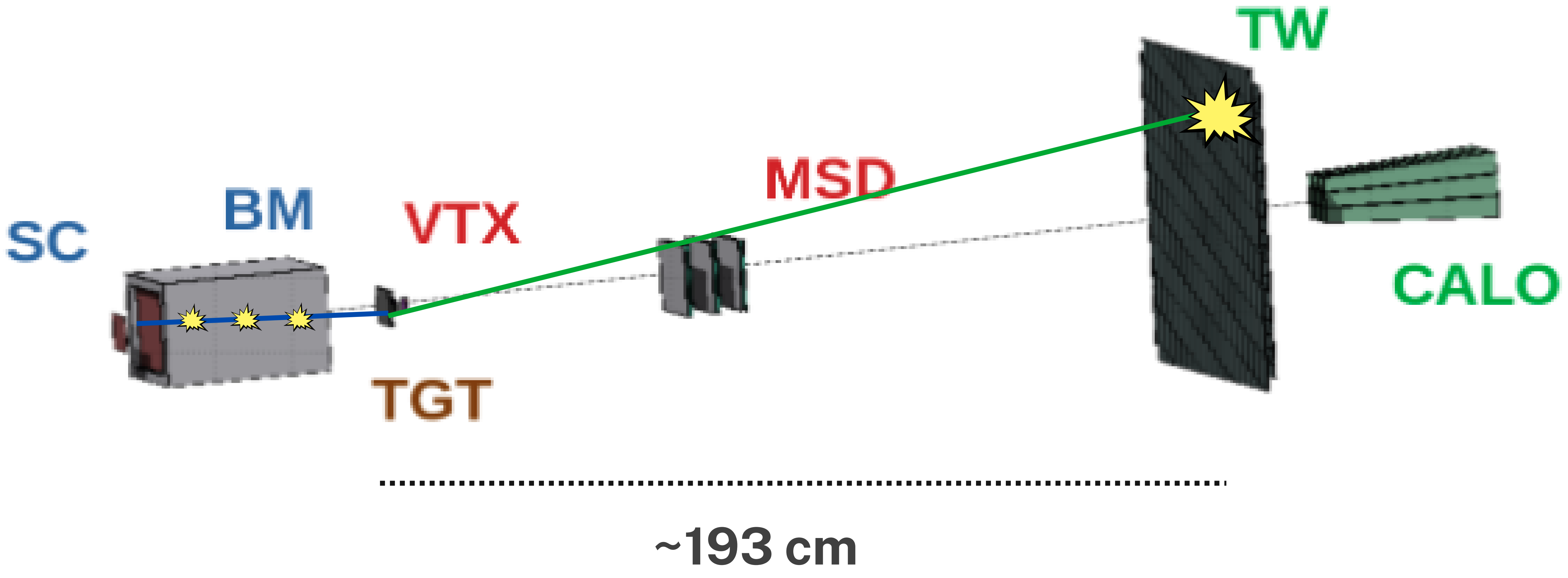
$$\frac{\mathrm{d}\sigma}{\mathrm{d}\theta}(Z) = \frac{Y(Z,\theta)}{N_{\mathrm{prim}} \cdot N_{\mathrm{TG}} \cdot \Delta\theta \cdot \varepsilon(Z,\theta)}$$

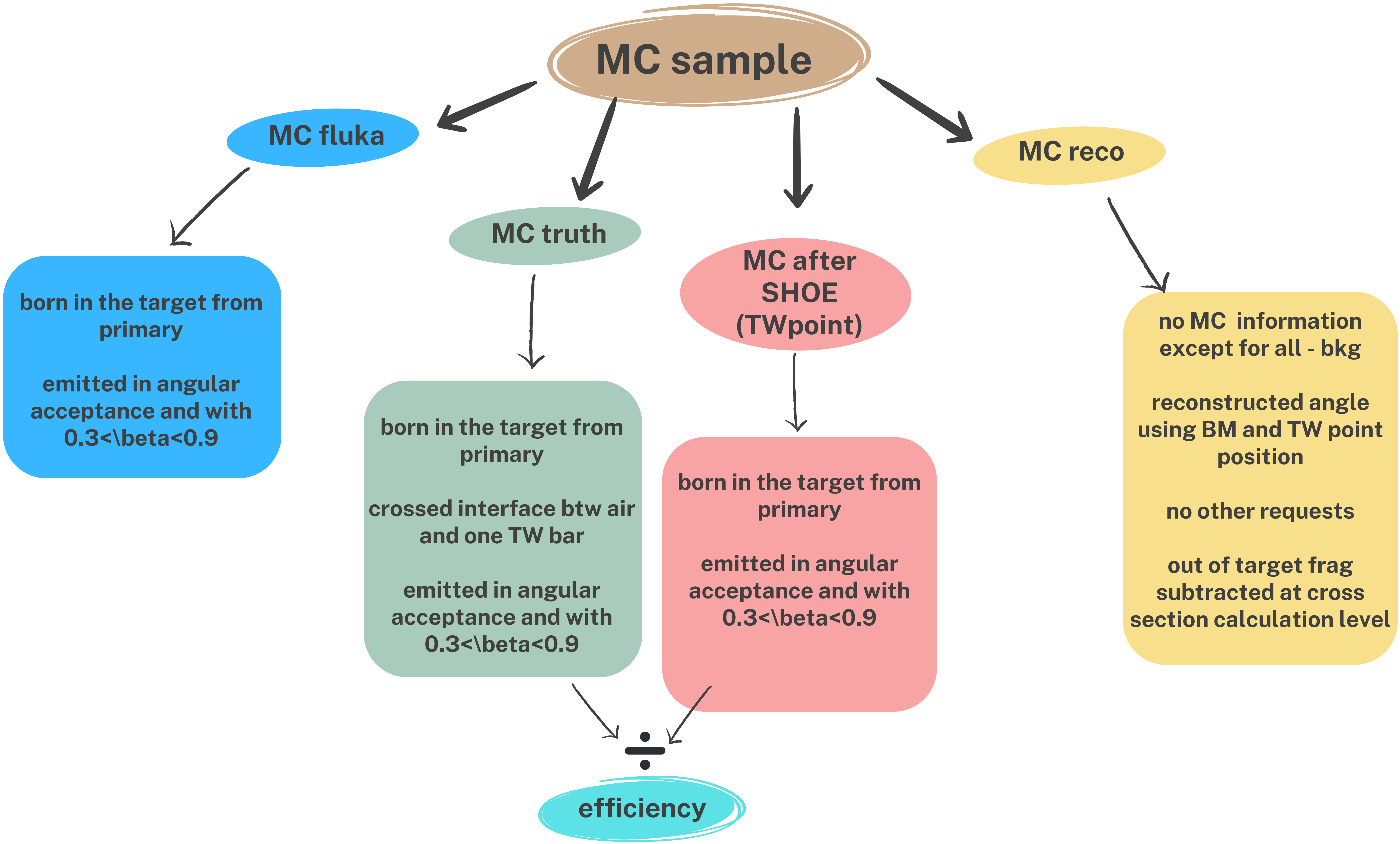
Align FOOT detectors and estimate **angular acceptance**

Extract fragment yields from TW

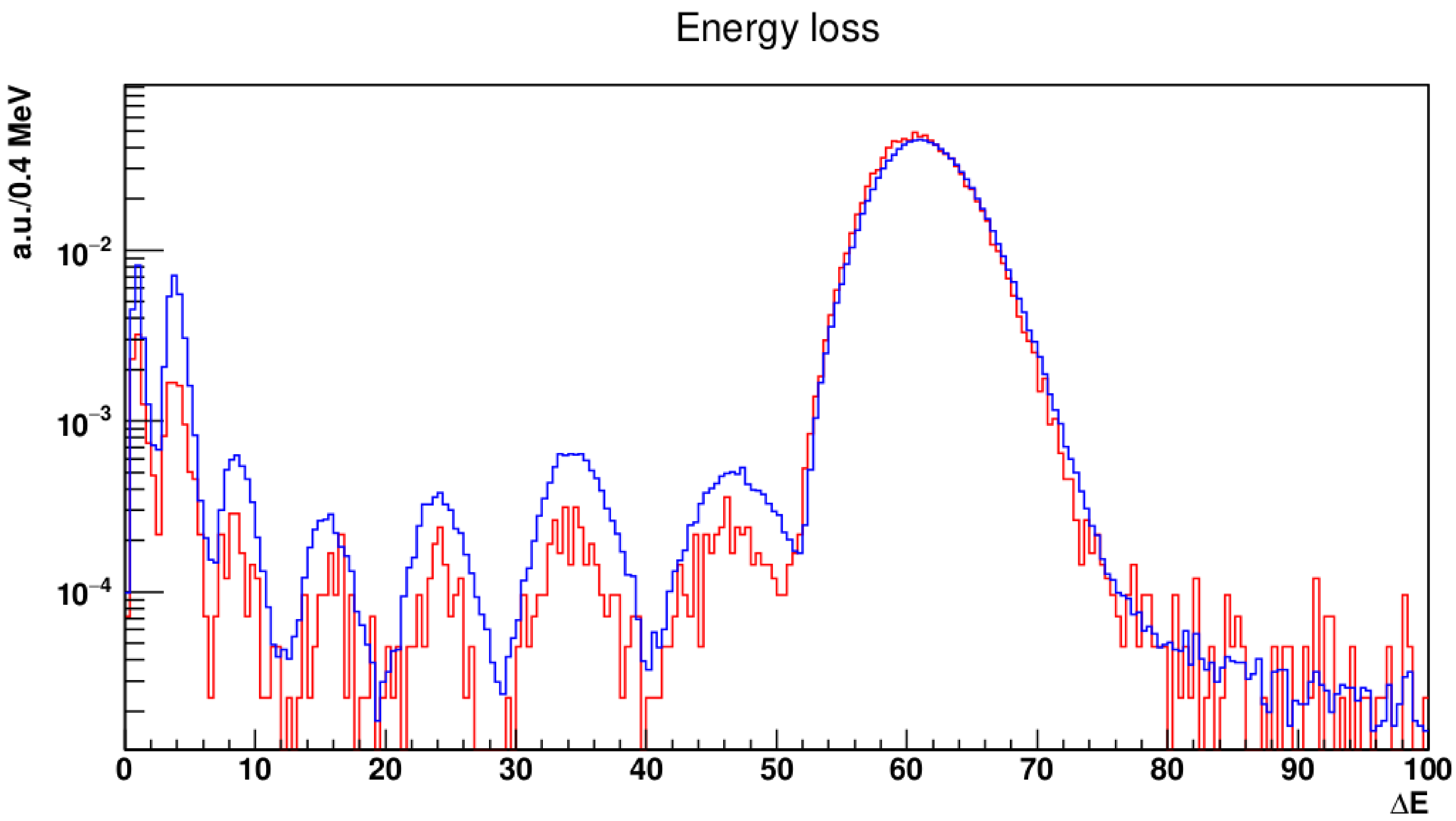
Calculate MC efficiencies for fragments

Angle measurement



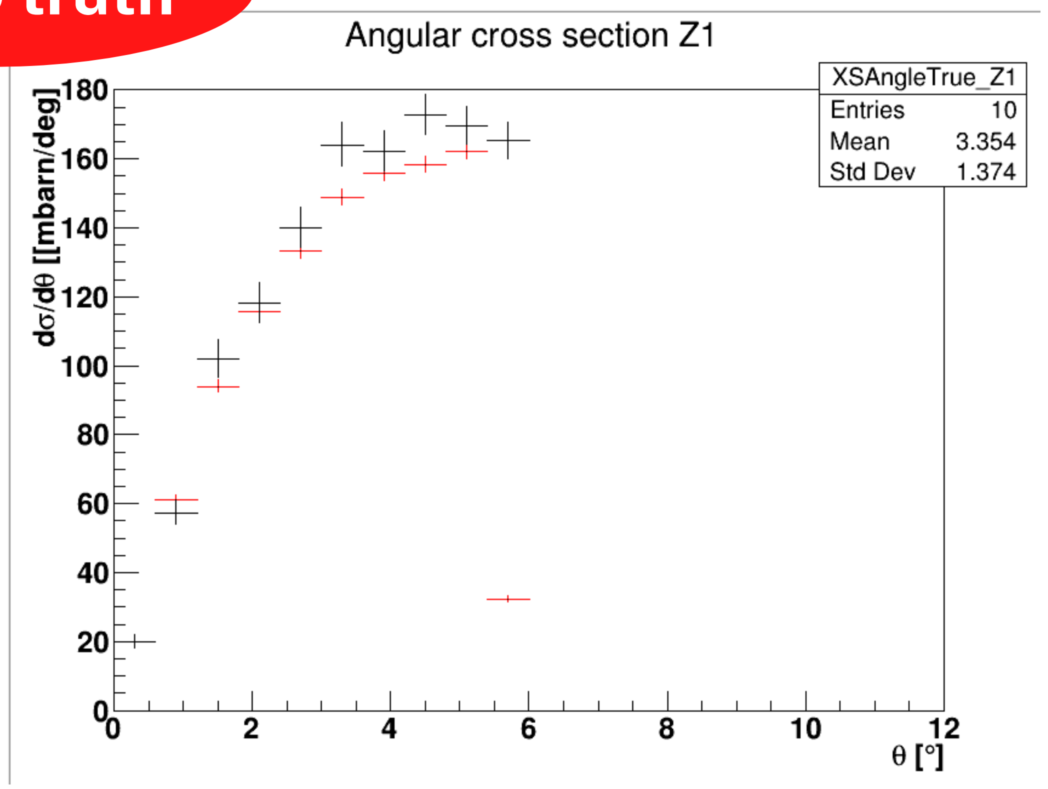

MC sample
MC fluka
MC truth
MC after SHOE (TWpoint)
MC reco
born in the target from primary
emitted in angular acceptance and with 0.3<\beta<0.9
born in the target from primary
crossed interface btw air and one TW bar
emitted in angular acceptance and with 0.3<\beta<0.9
born in the target from primary
emitted in angular acceptance and with 0.3<\beta<0.9
no MC information except for all - bkg
reconstructed angle using BM and TW point position
no other requests
out of target frag subtracted at cross section calculation level
÷
efficiency

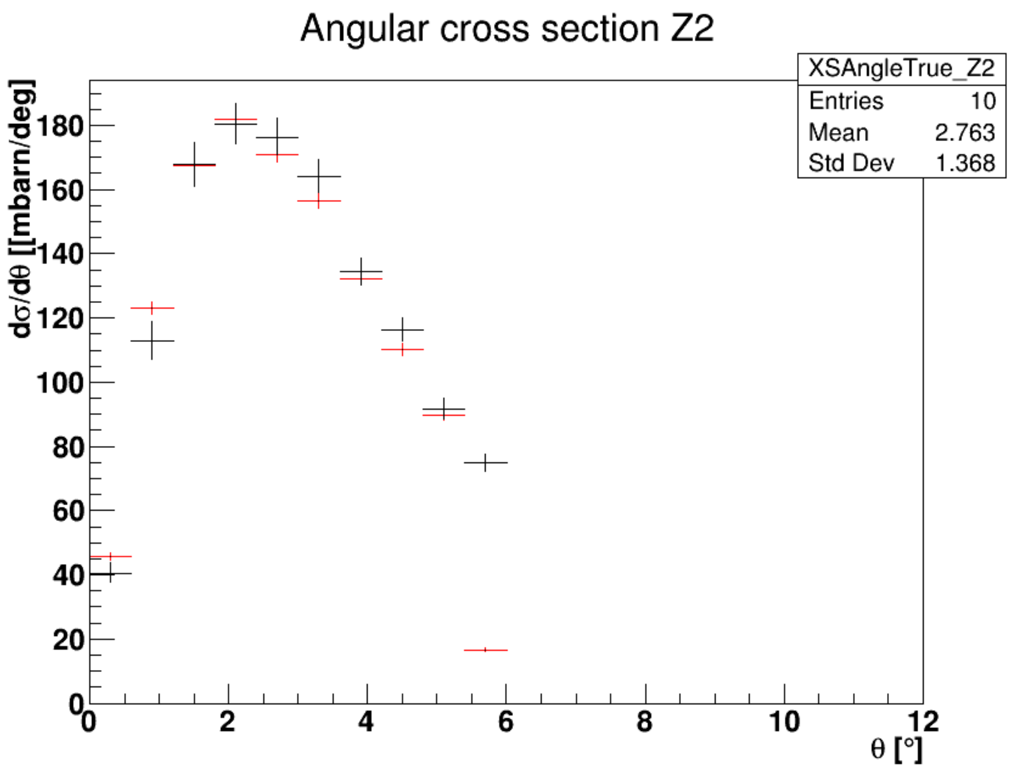
Why background subtraction?

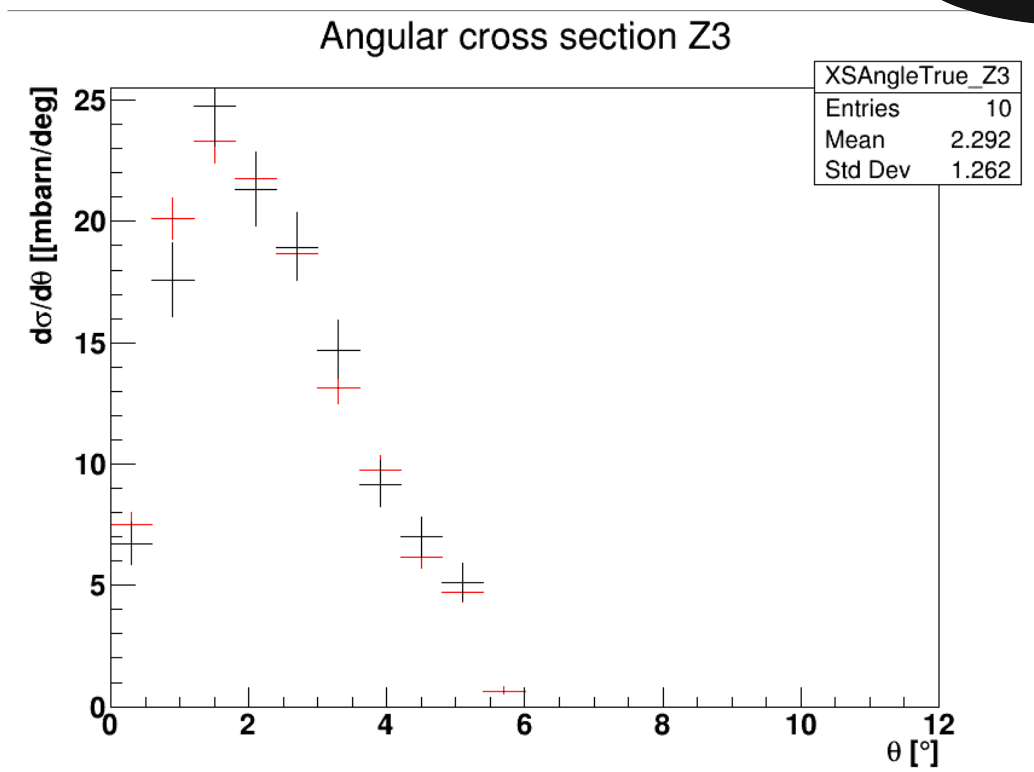


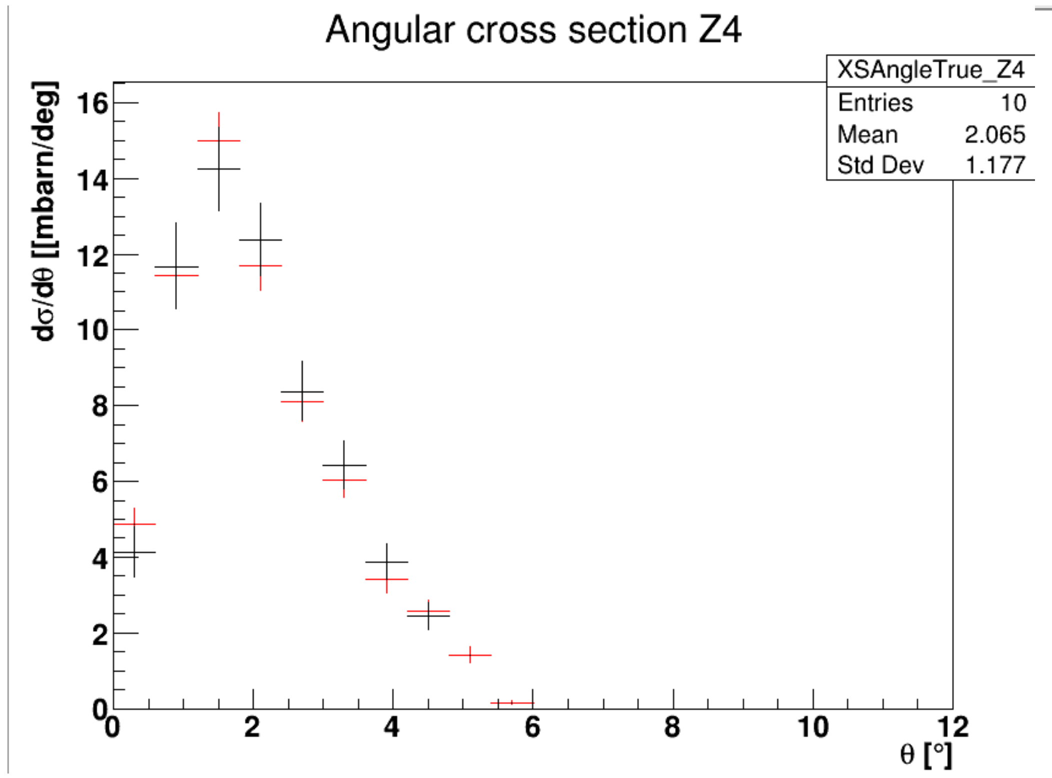
MC truth

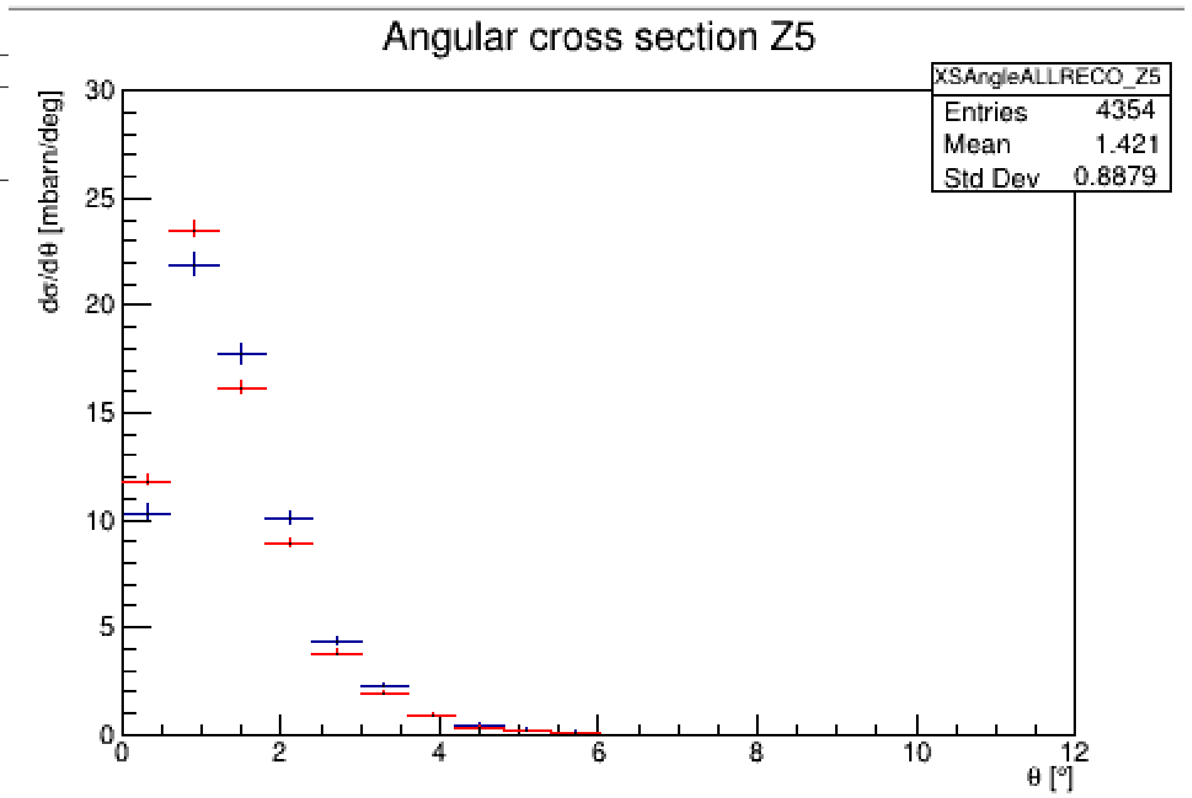
MC reco

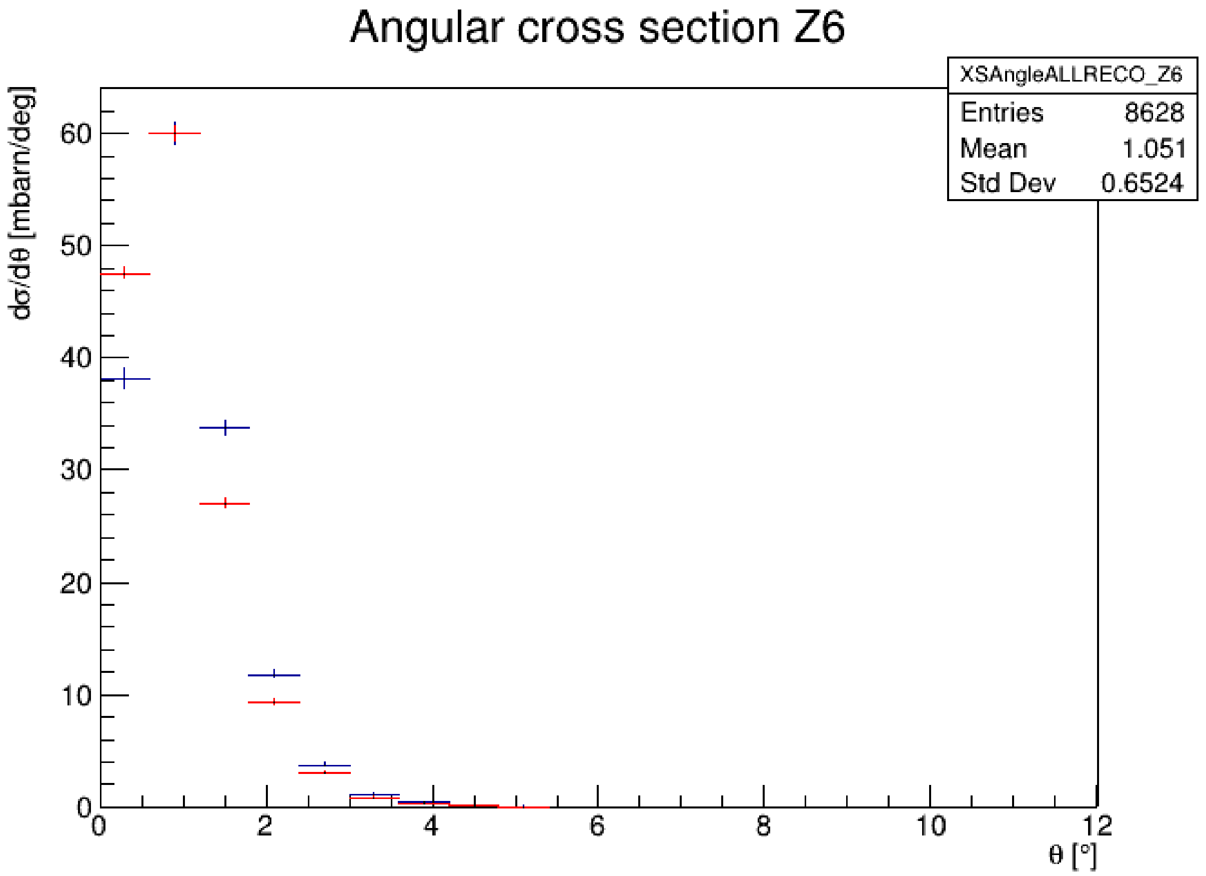


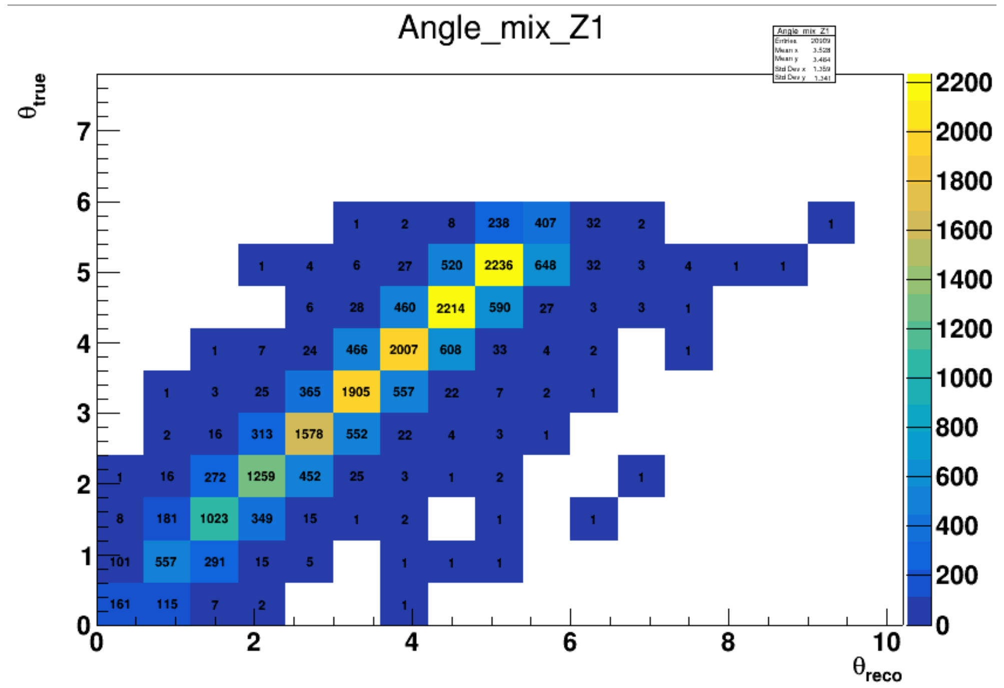


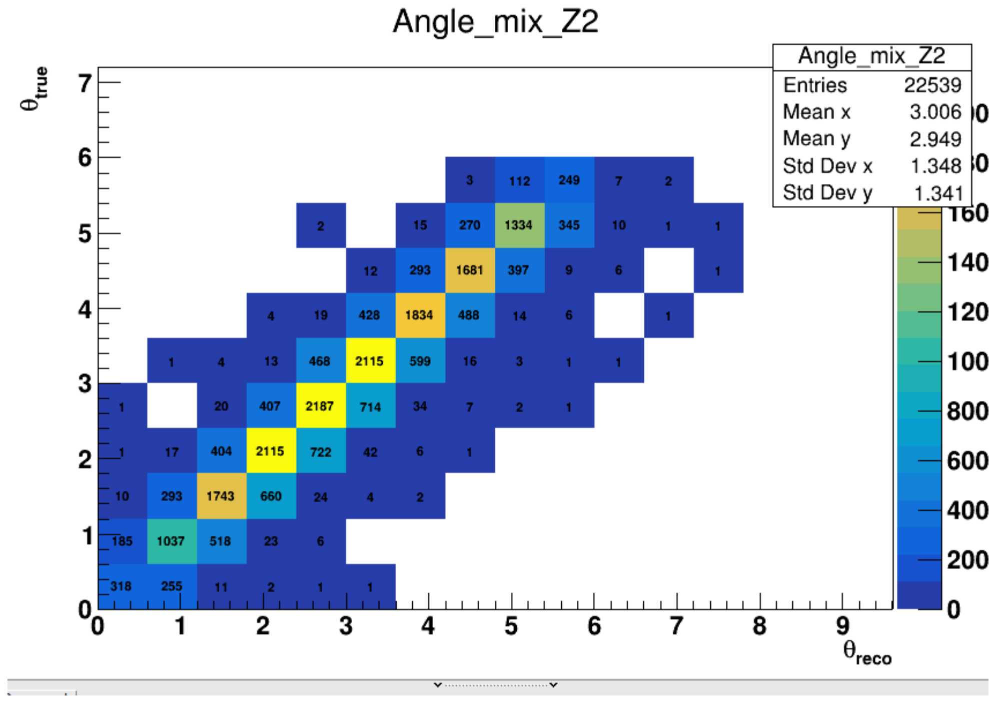


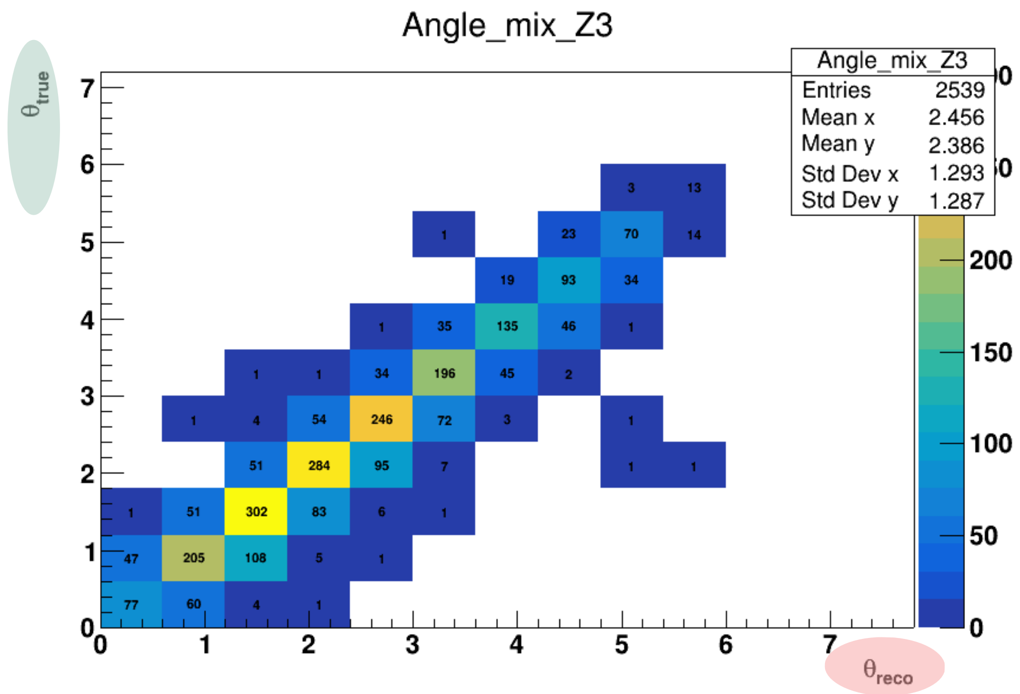












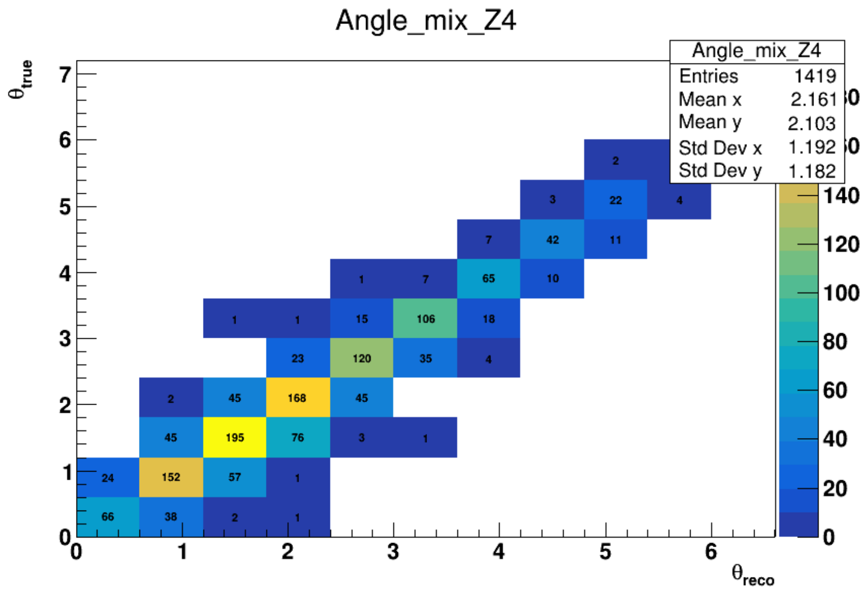
if present

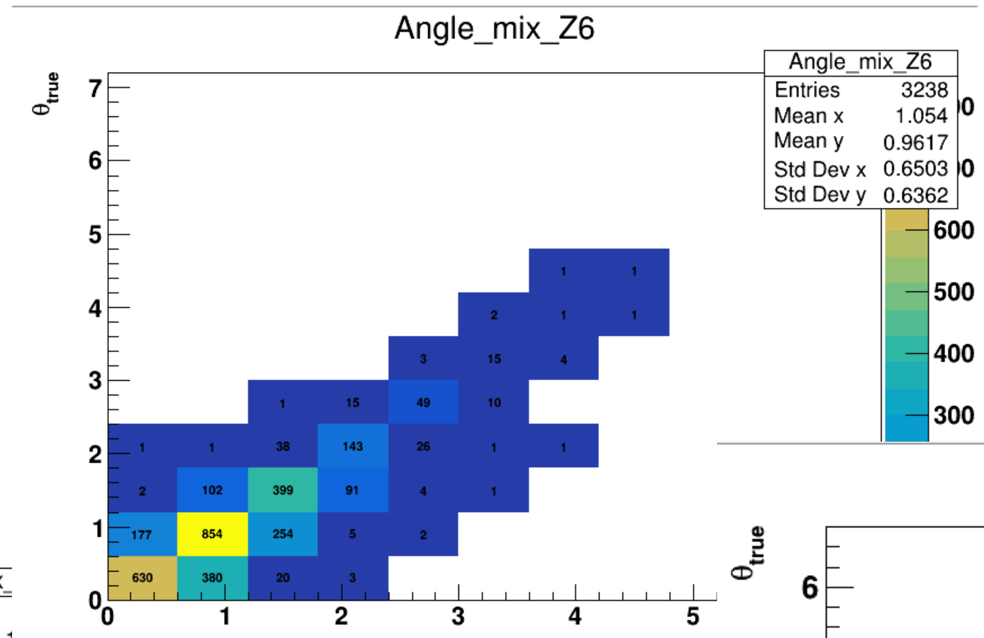
MC after SHOE (TWpoint)

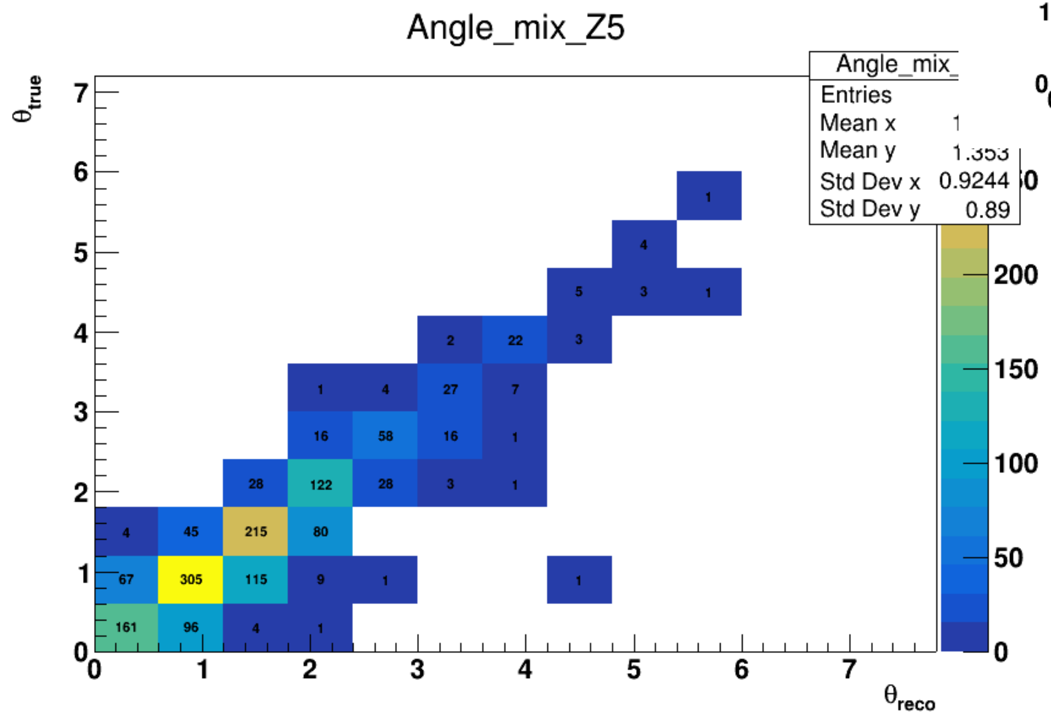
take its reco angle

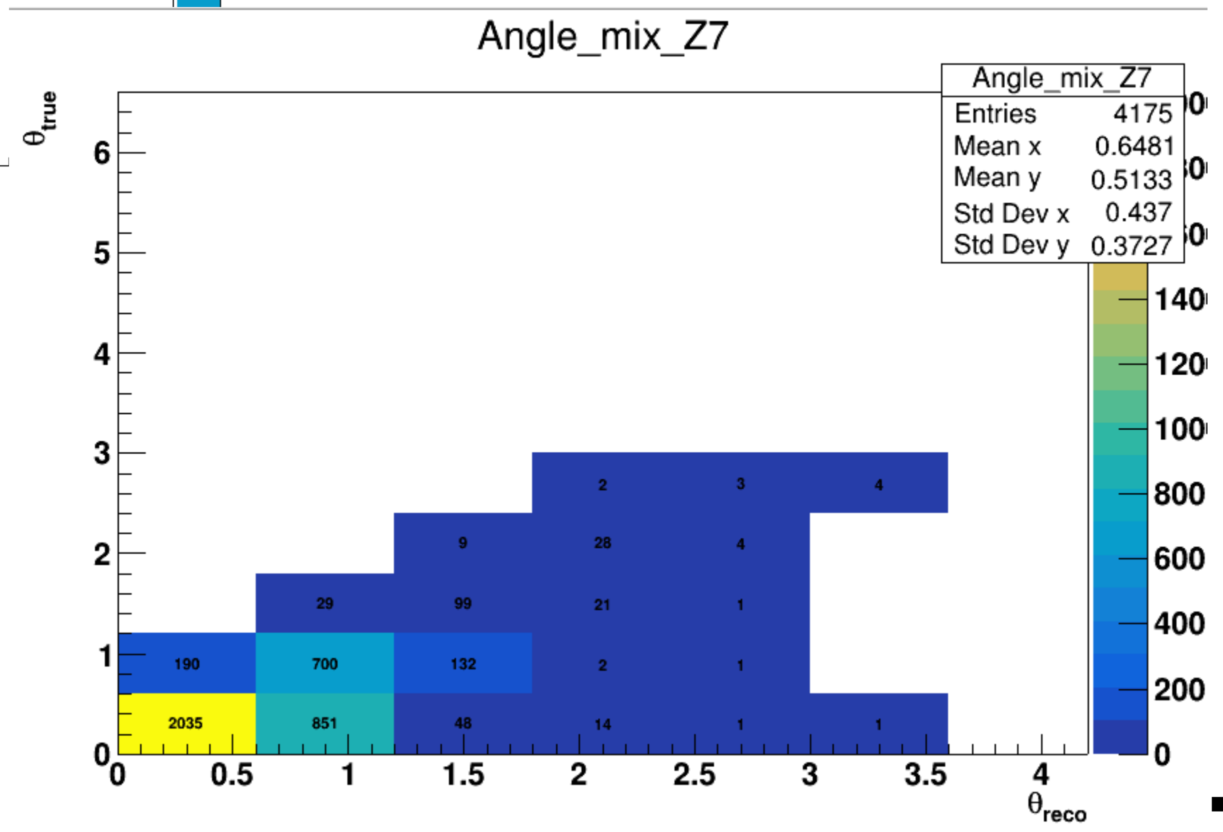
then

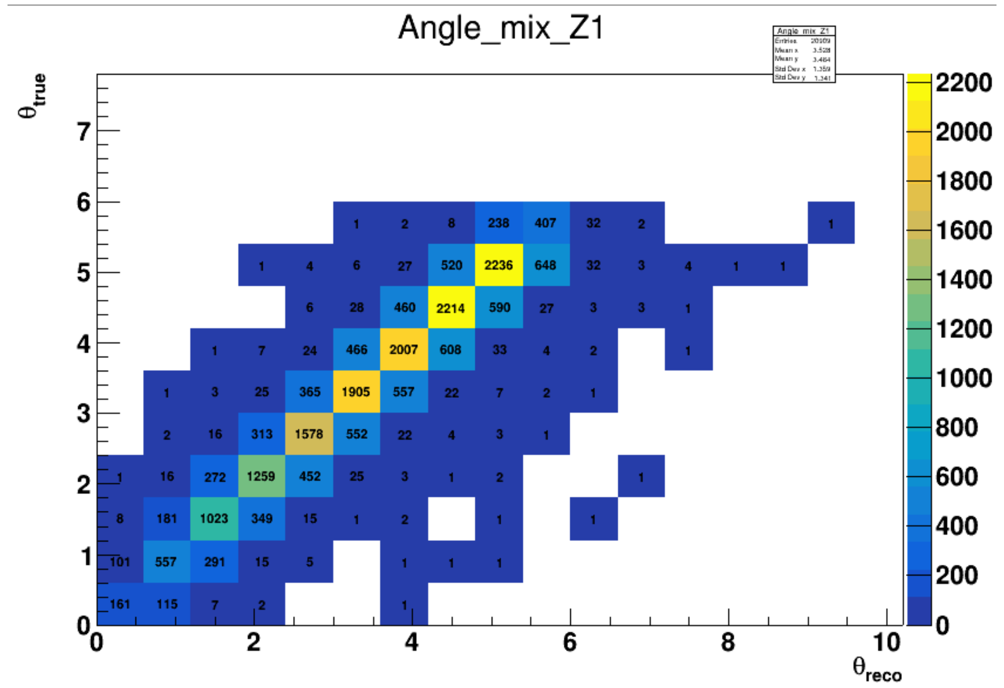
MC truth

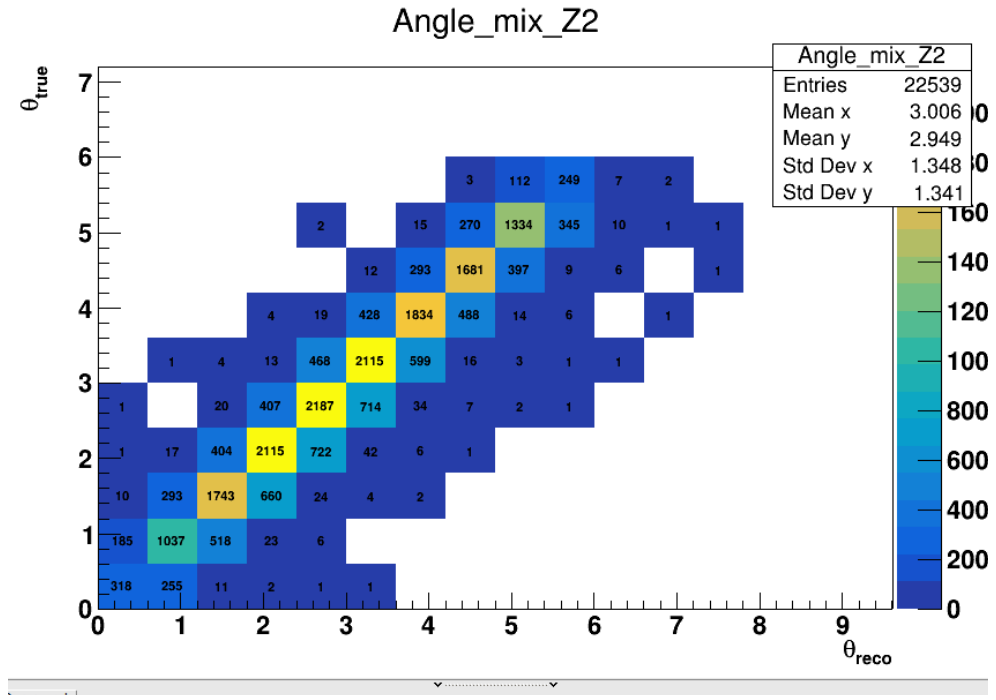


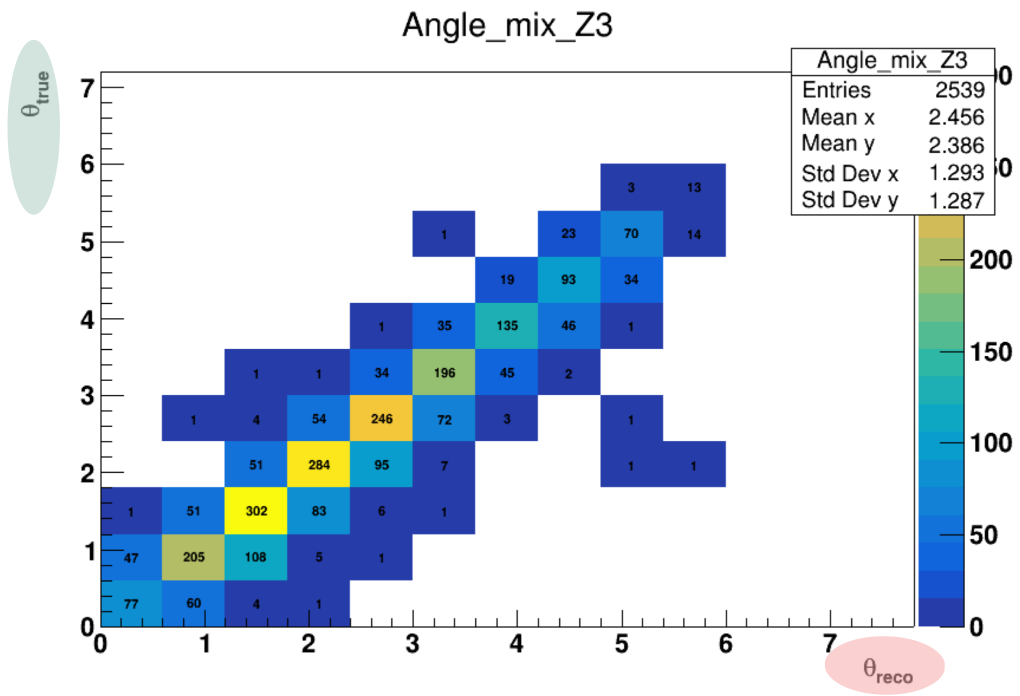












if present

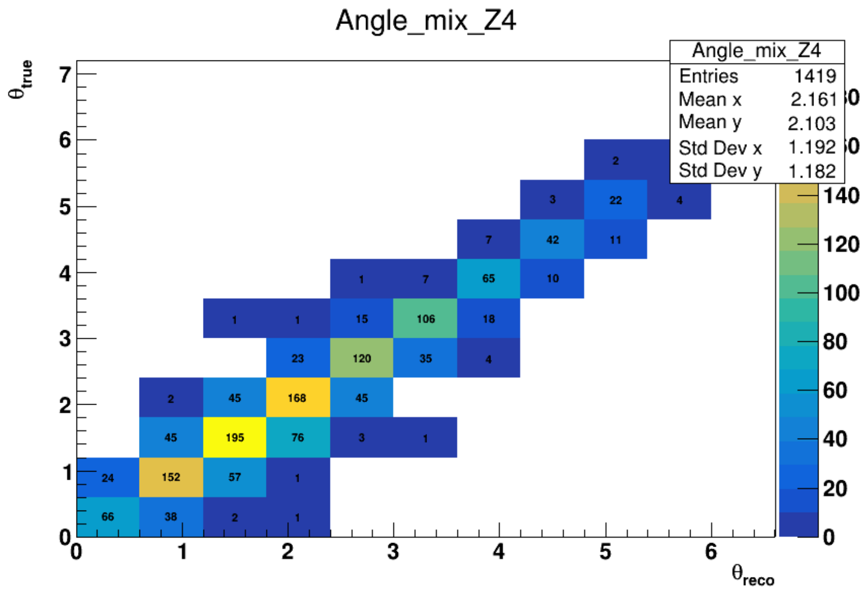
MC after SHOE (TWpoint)

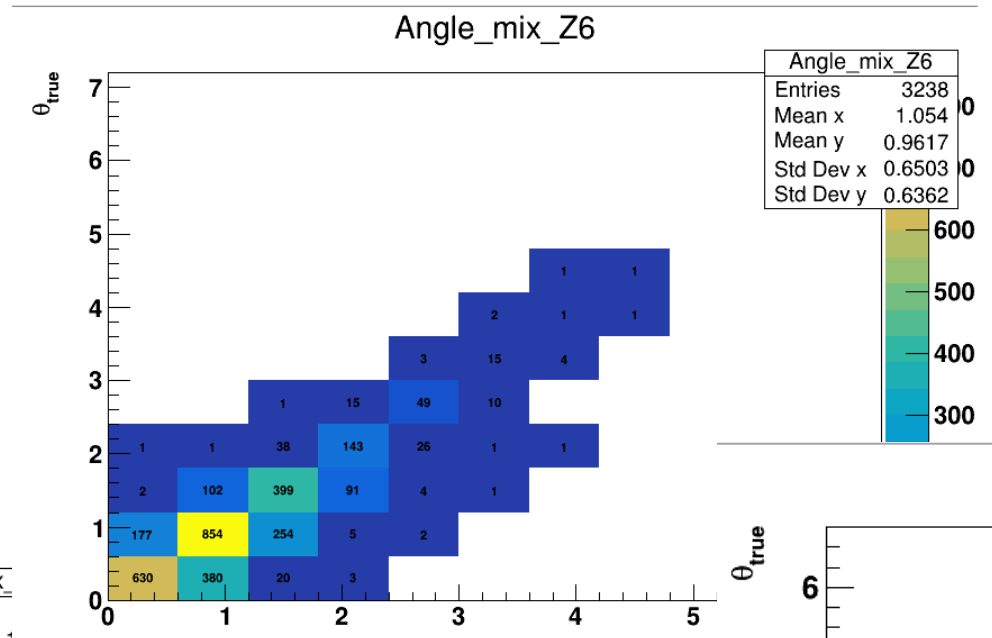
take its reco angle

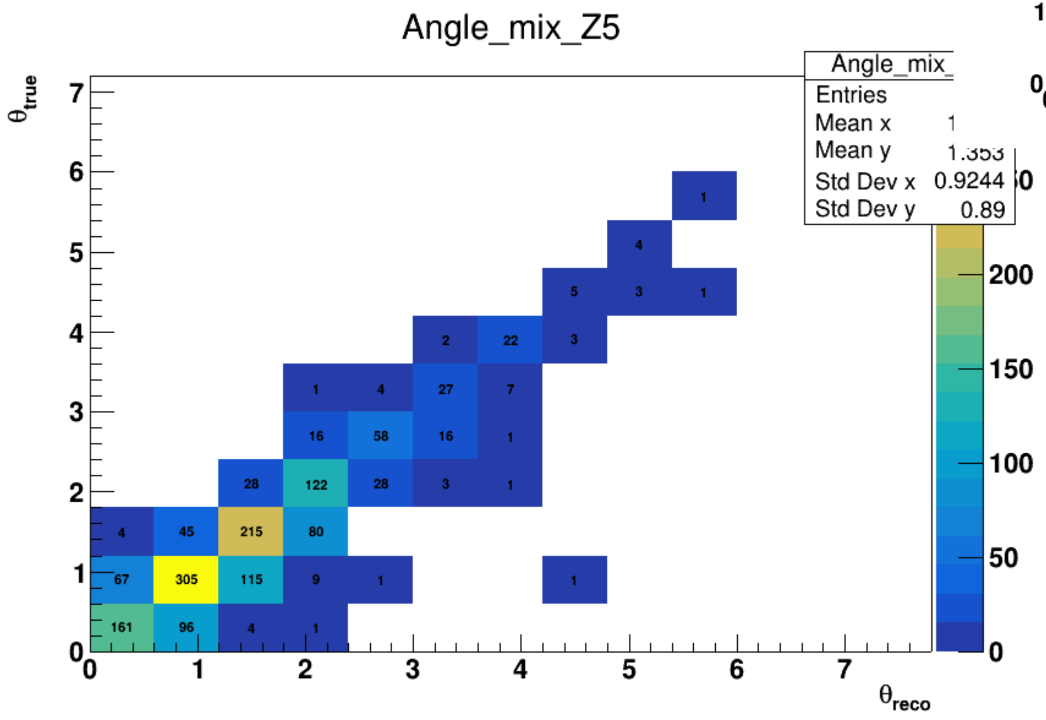
then

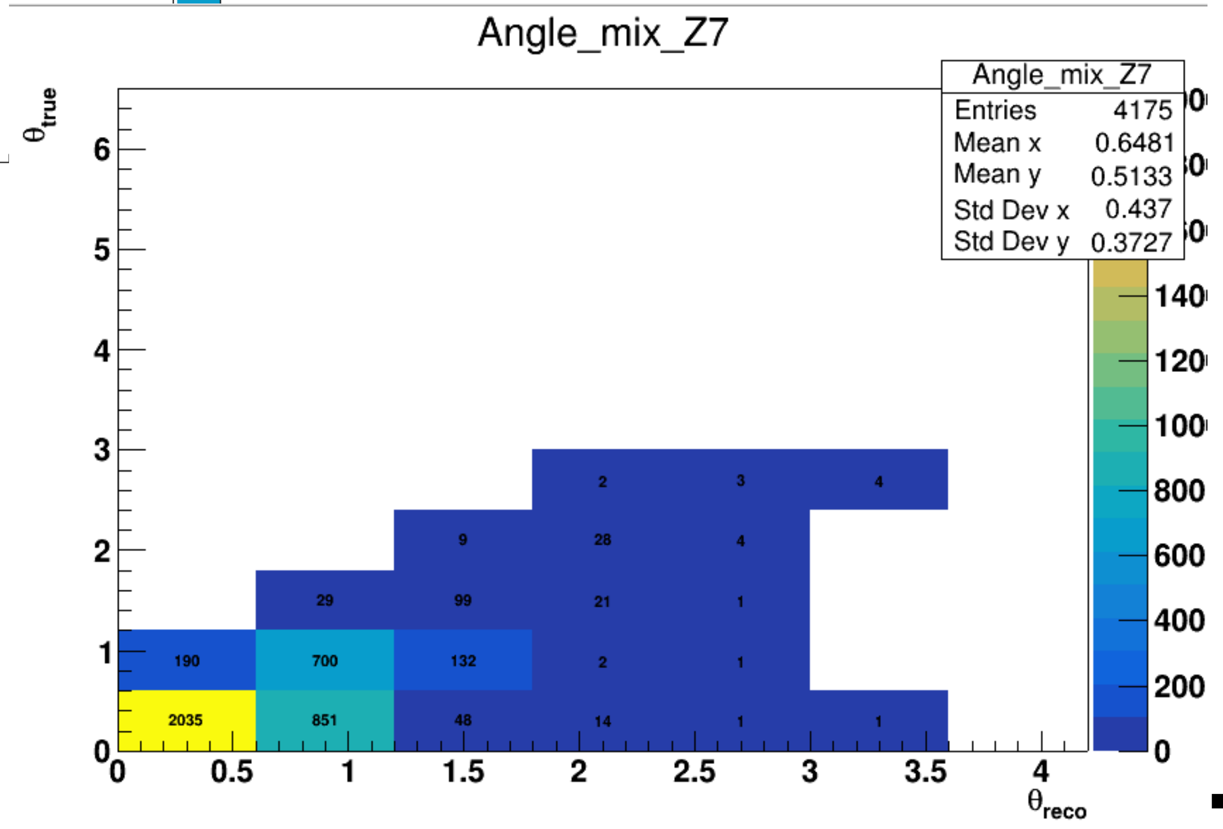
MC truth

unfolding is needed!









DESY 12-129
September 2012

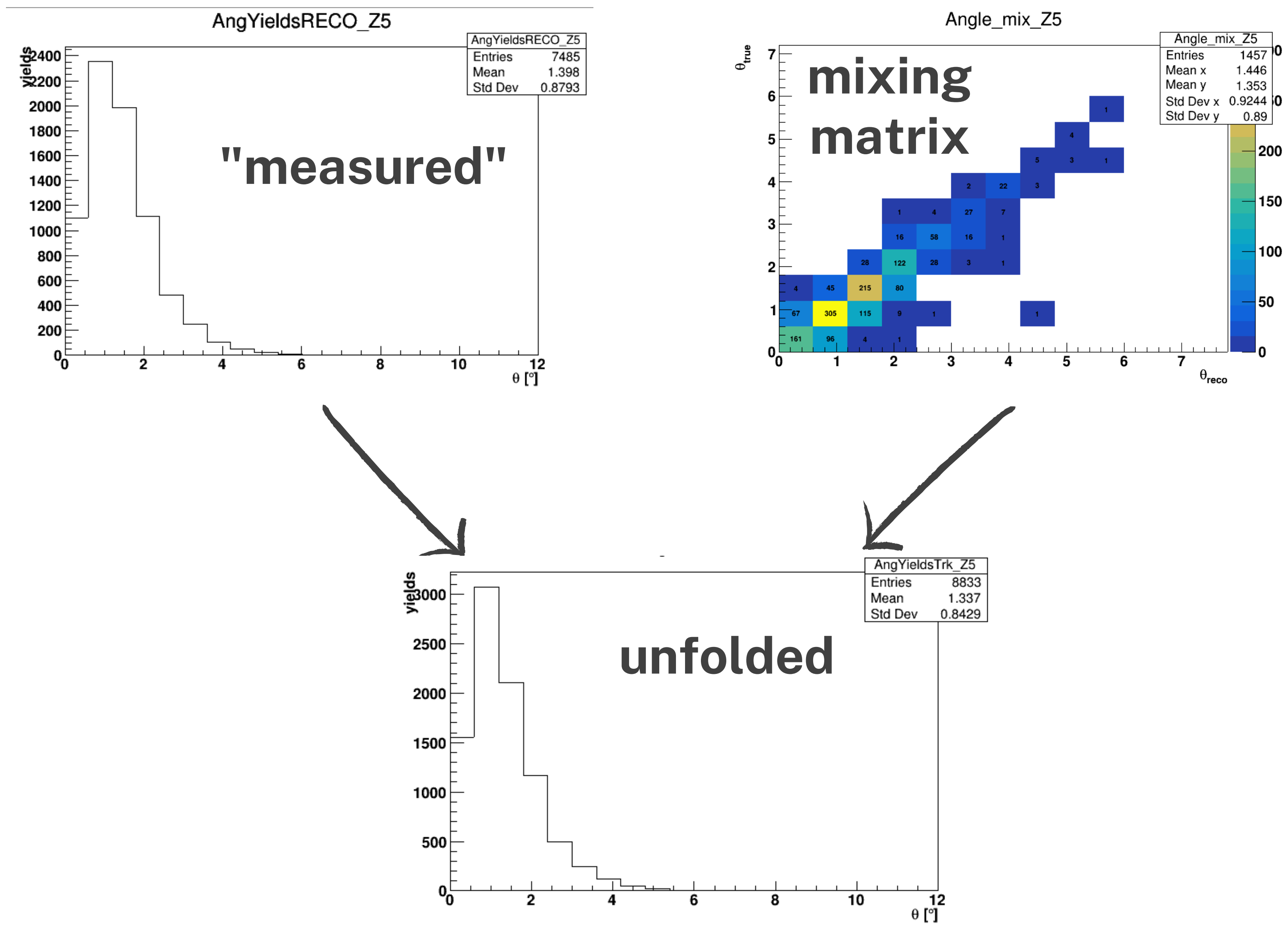
ISSN 0418-9833

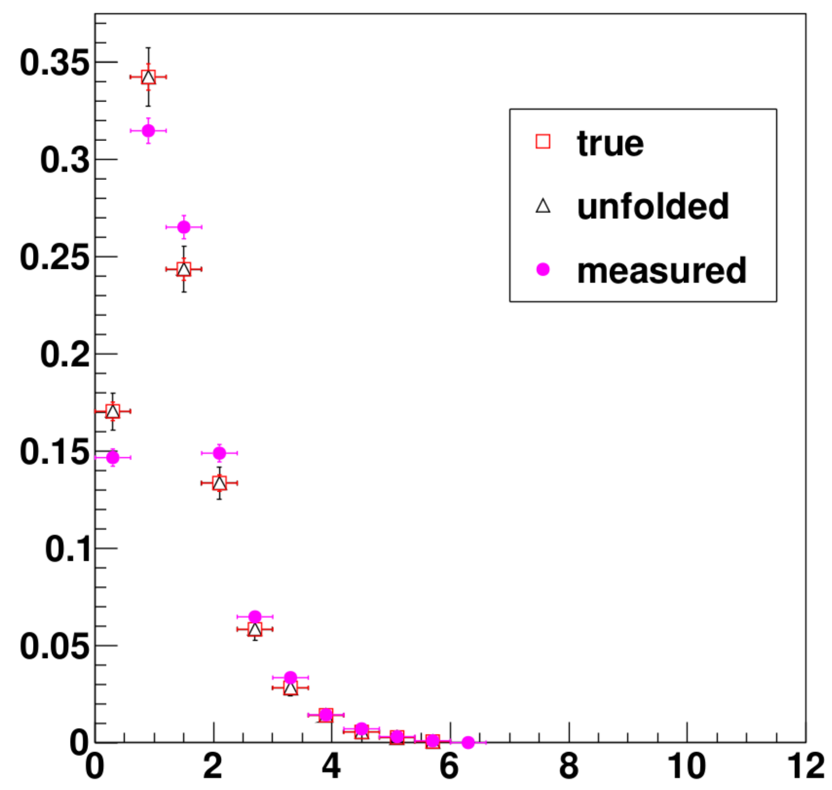
TUnfold, an algorithm for correcting migration effects in high energy physics

Stefan Schmitt, DESY, Notkestraße 85, 22607 Hamburg
email: sschmitt@mail.desy.de

Abstract

TUnfold is a tool for correcting migration and background effects in high energy physics for multi-dimensional distributions. It is based on a least square fit with Tikhonov regularisation and an optional area constraint. For determining the strength of the regularisation parameter, the L-curve method and scans of global correlation coefficients are implemented. The algorithm supports background subtraction and the propagation of statistical and systematic uncertainties, in particular those originating from limited knowledge of the response matrix. The program is interfaced to the ROOT analysis framework.

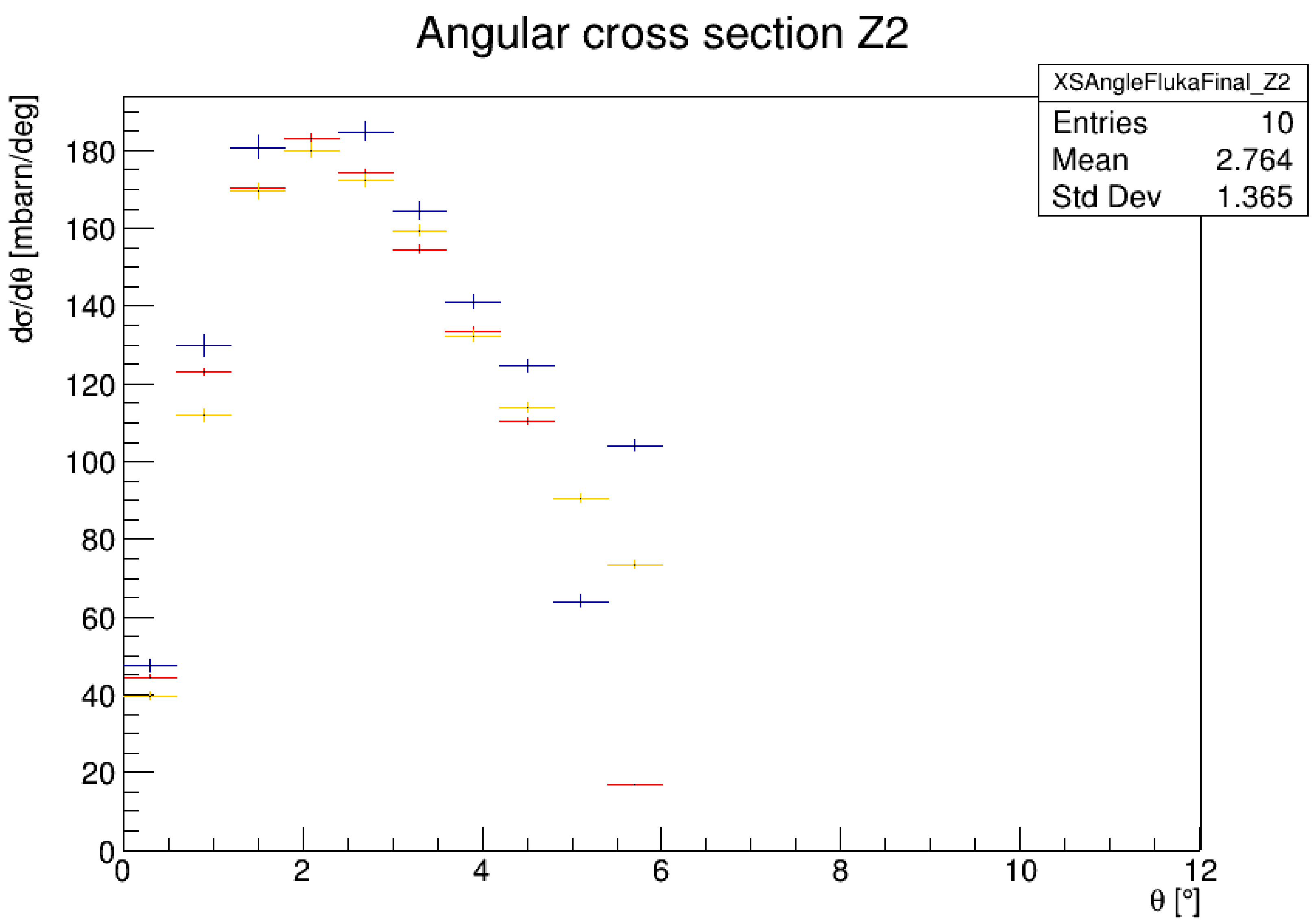


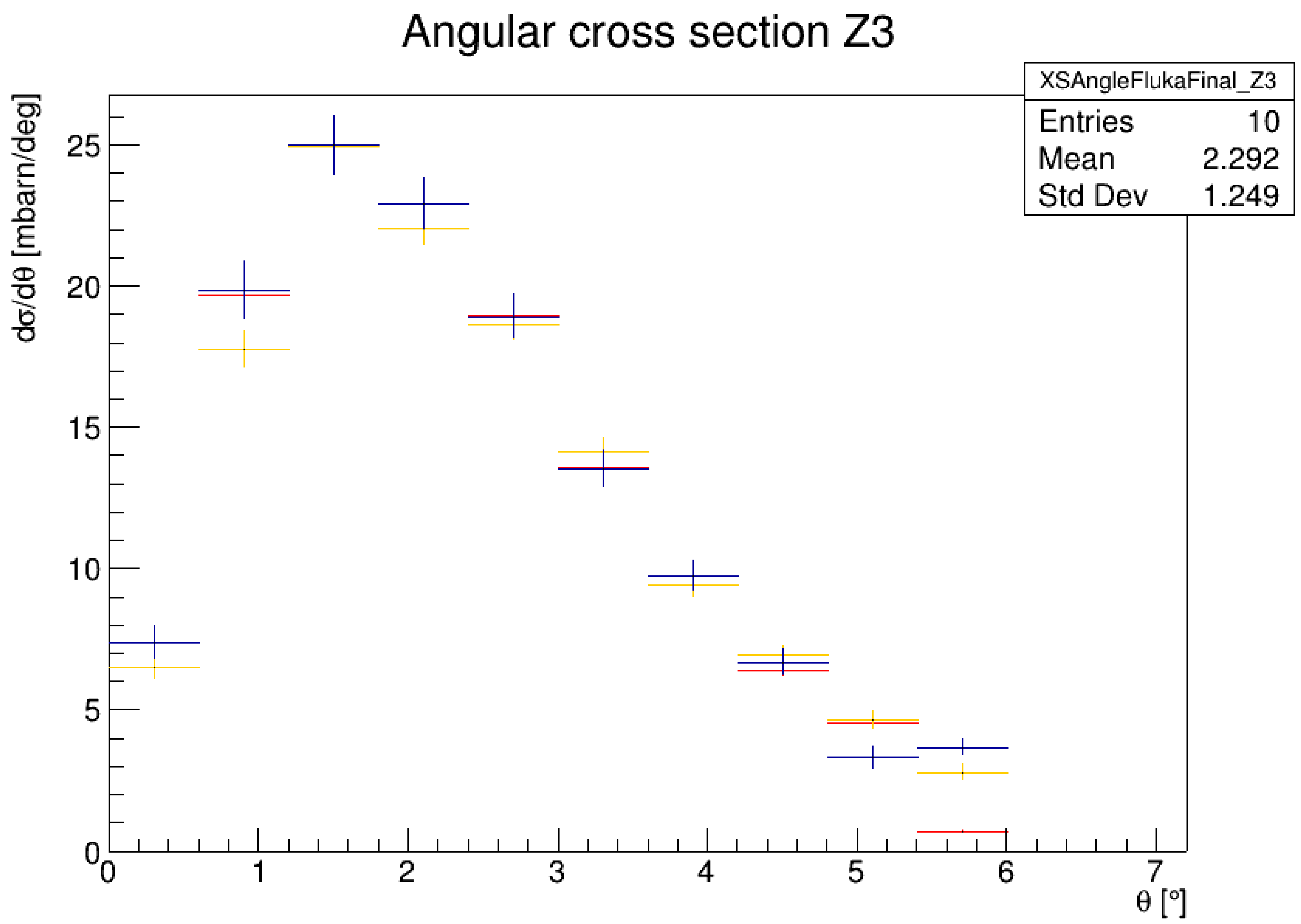


MC reco before unfolding

MC fluka

MC reco after unfolding

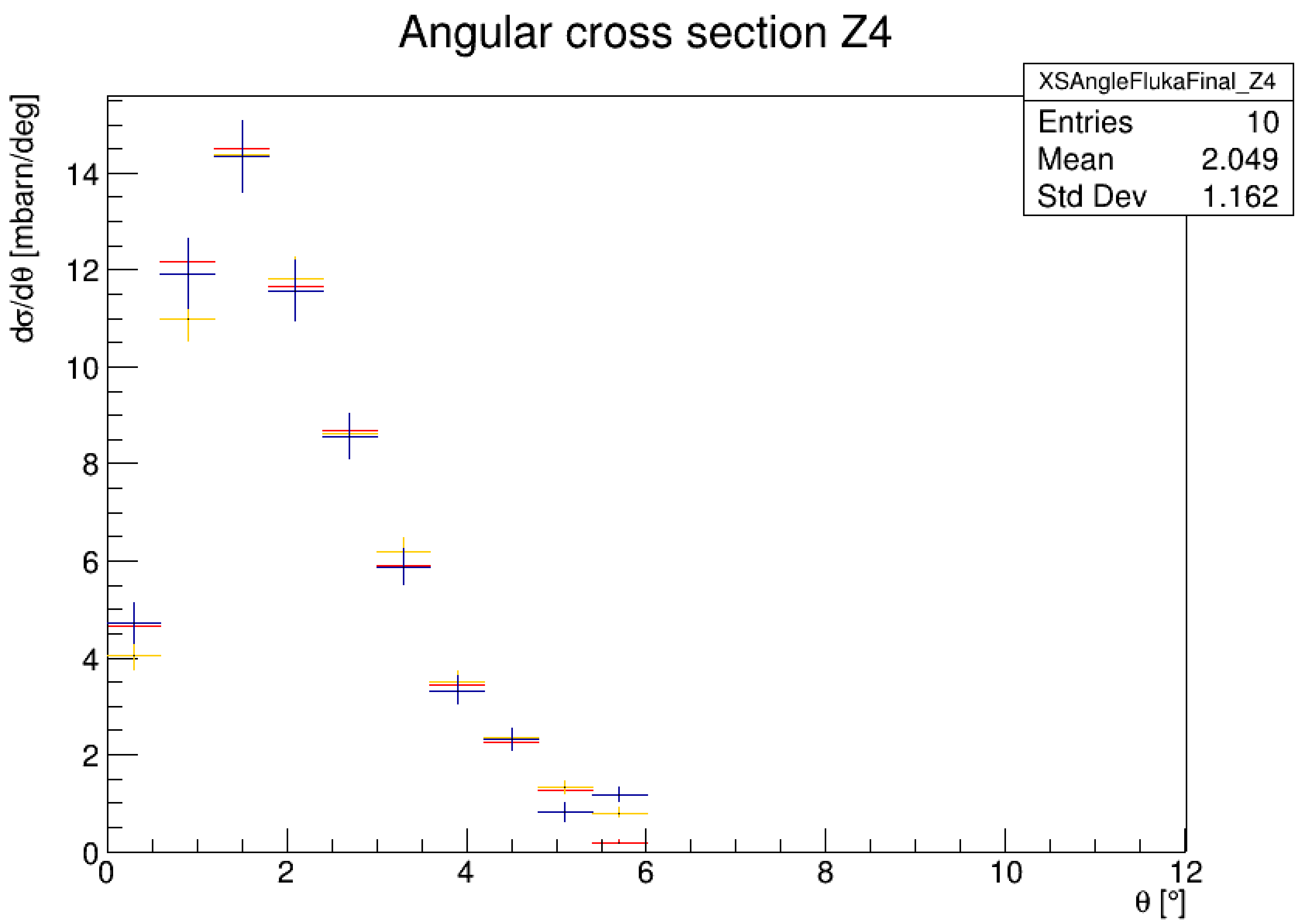


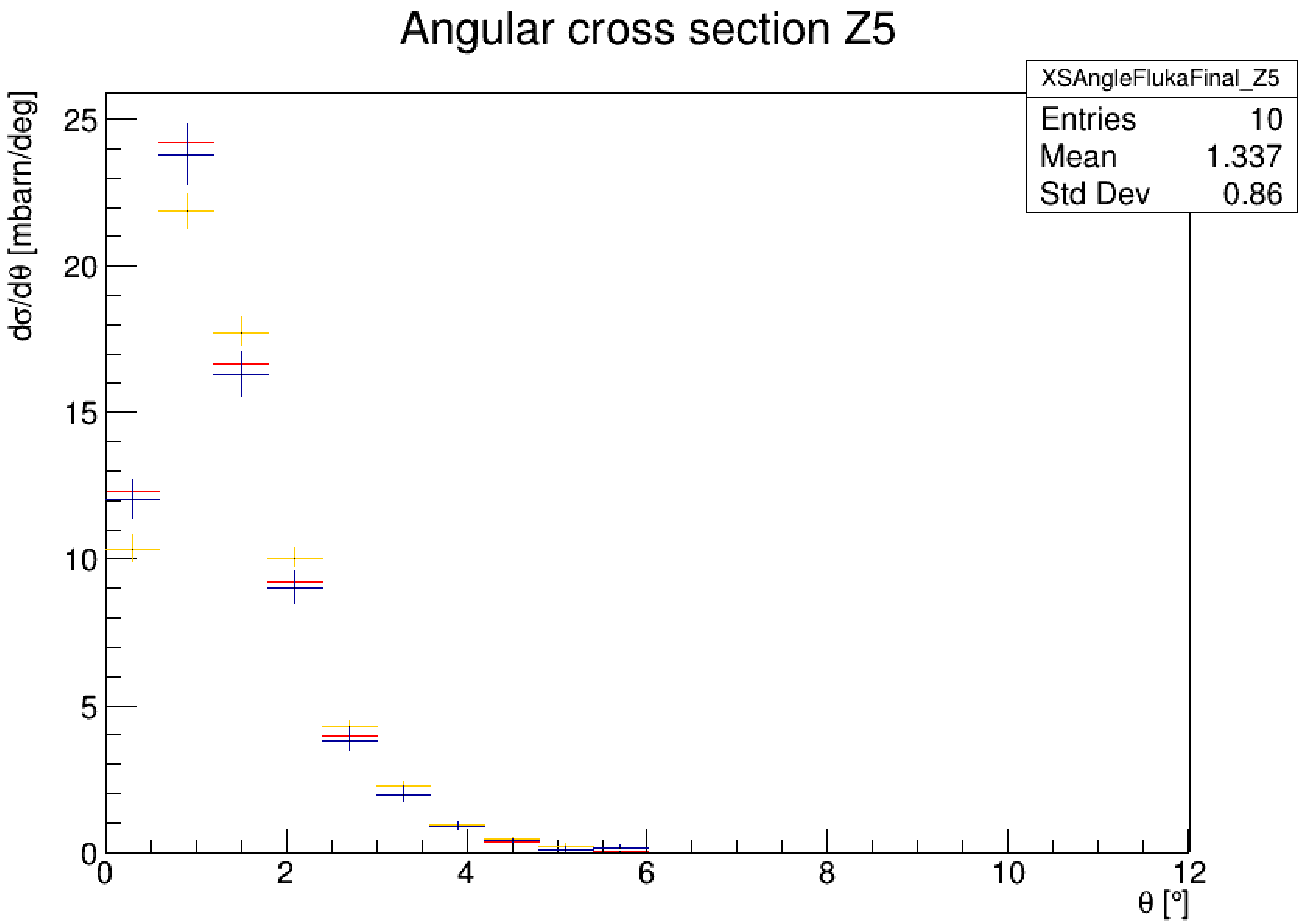


MC reco before unfolding

MC fluka

MC reco after unfolding

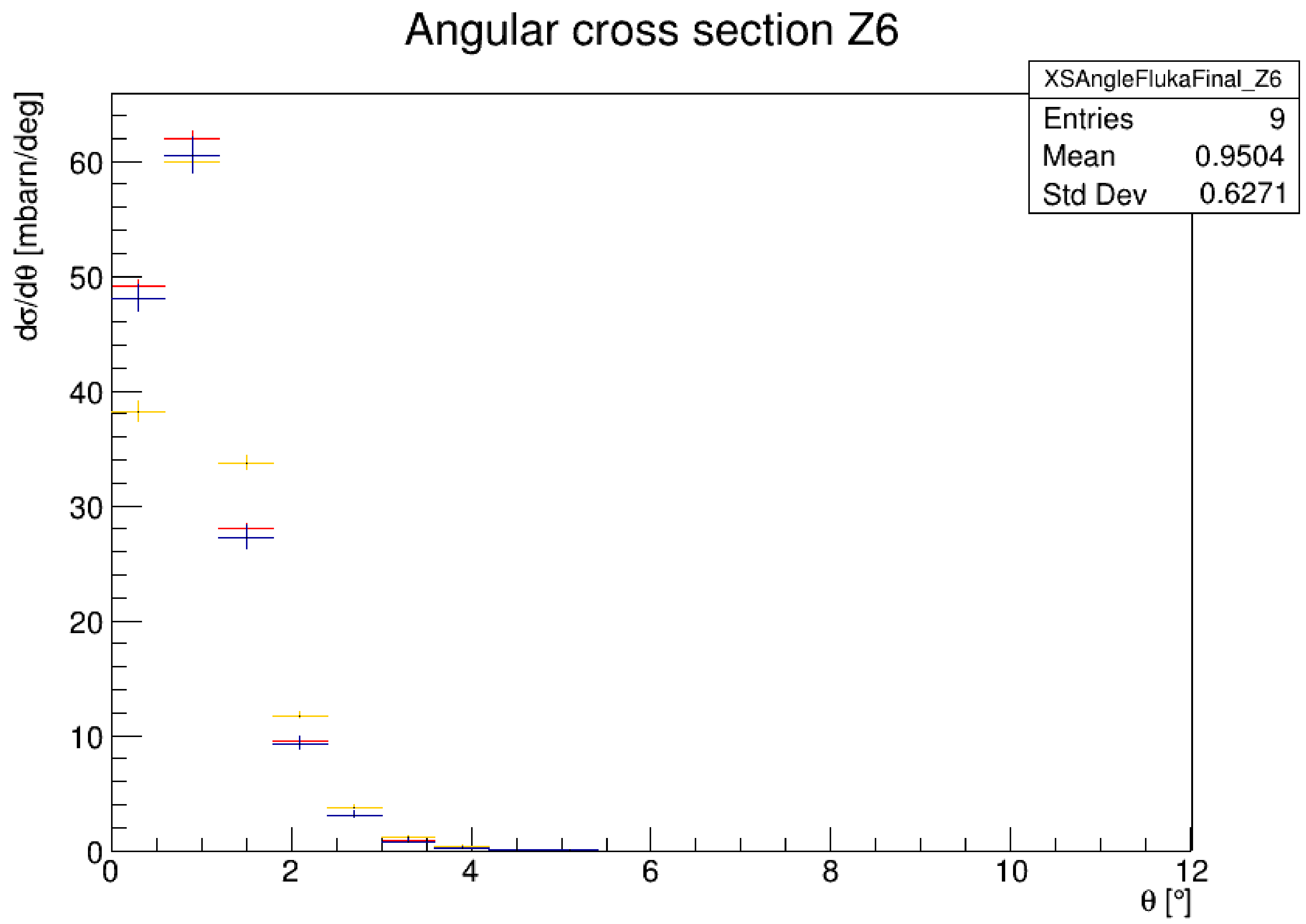


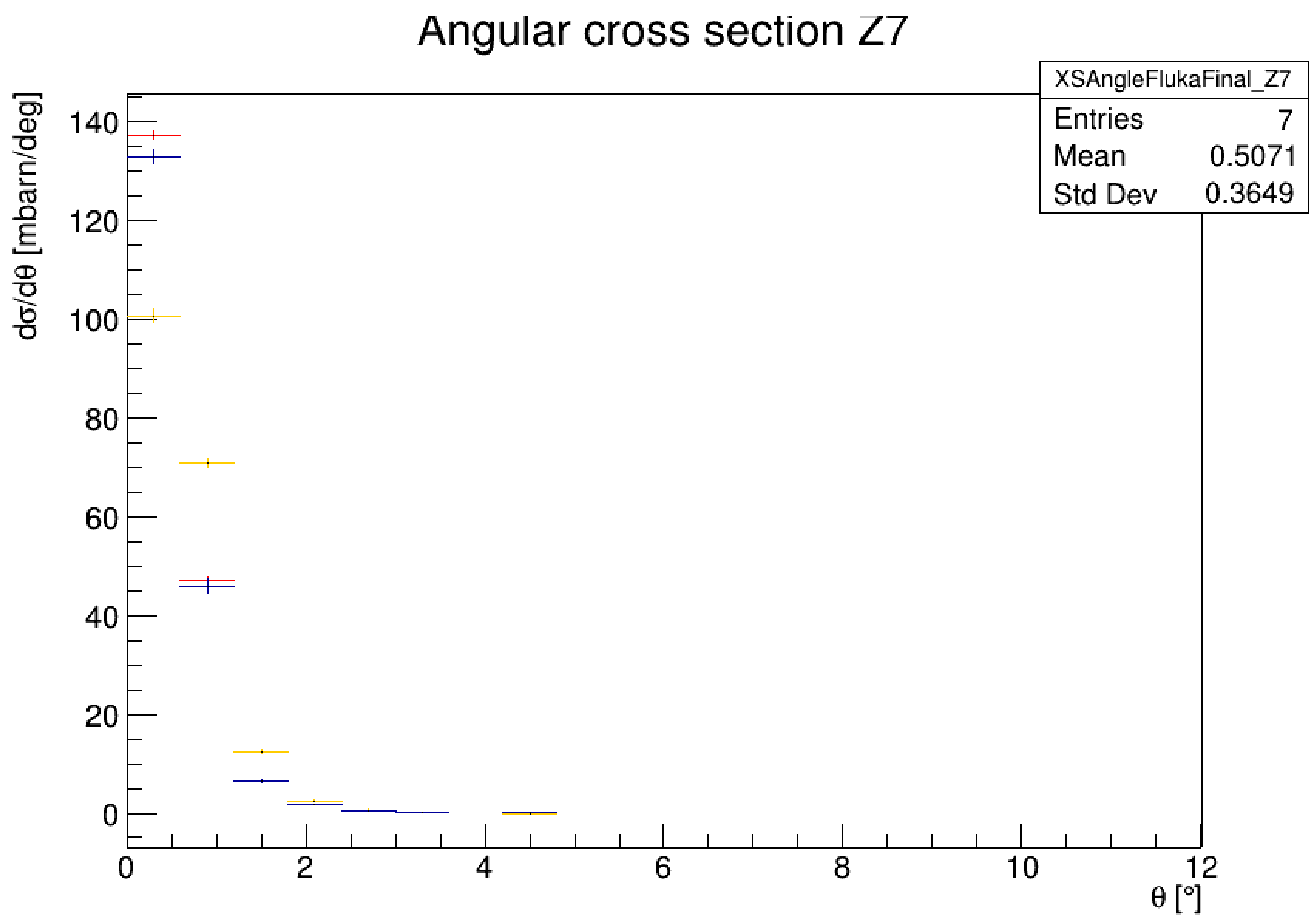


MC reco before unfolding

MC fluka

MC reco after unfolding





The background subtraction strategy (+ unfolding) seems to behave well also with angle differential cross sections!

$$\Delta\sigma(Z) = \frac{1}{N_{\mathrm{TG}} \cdot \varepsilon(Z)} \left(\frac{Y^{\mathrm{sig}}(Z)}{N^{\mathrm{sig}}_{\mathrm{prim}}(Z)} - \frac{Y^{\mathrm{bkg}}(Z)}{N^{\mathrm{bkg}}_{\mathrm{prim}}(Z)} \right)$$

frontiers | Frontiers in Physics

TYPE Original Research
PUBLISHED 02 November 2022
DOI 10.3389/fphy.2022.979229

OPEN ACCESS

EDITED BY
Giuseppe Mandaglio,
University of Messina, Italy

REVIEWED BY
Antonio Trifirò,
University of Messina, Italy
Marzio De Napoli,
National Institute of Nuclear Physics of Catania, Italy

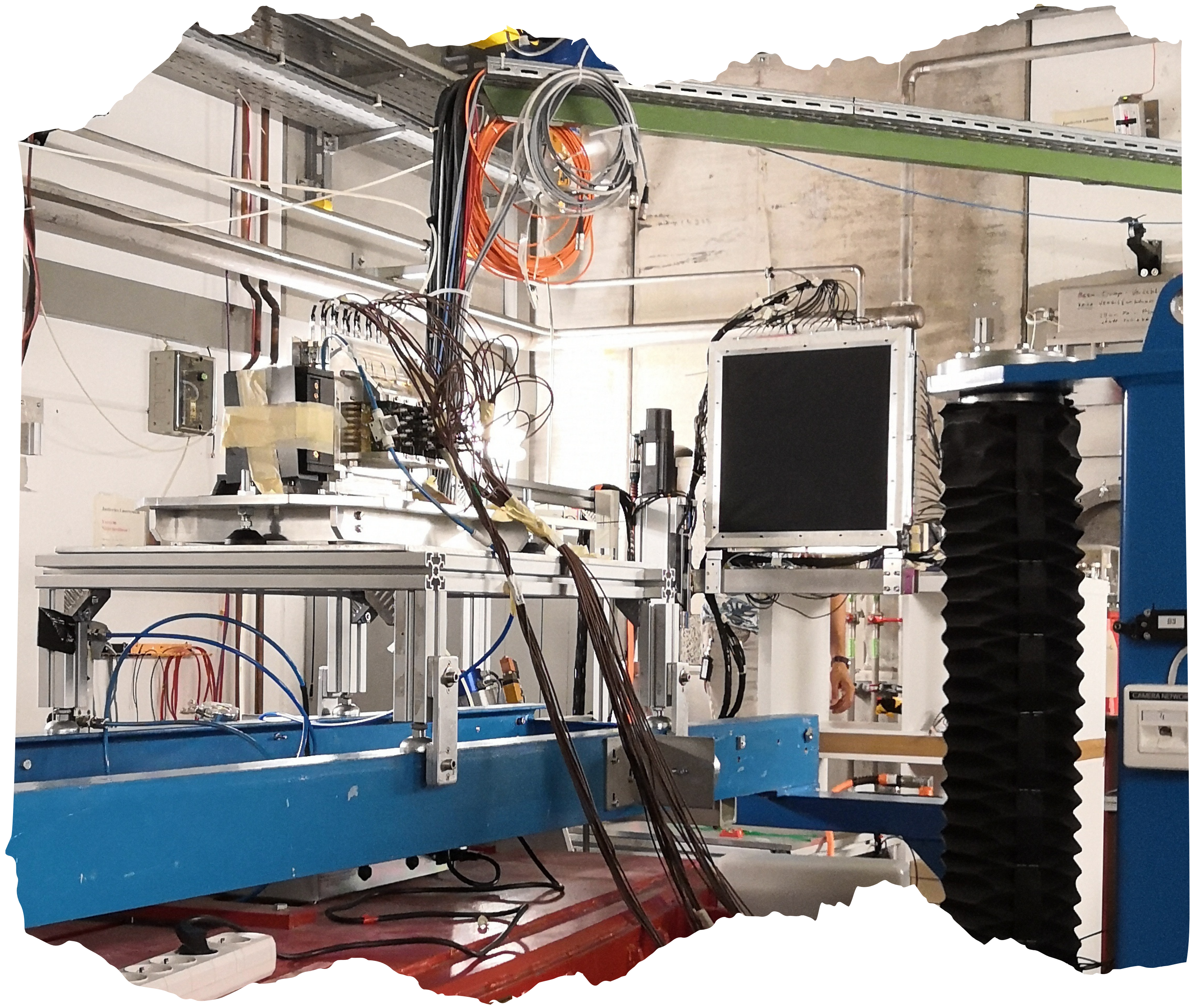
*CORRESPONDENCE
A. De Gregorio,
Angelica.Degregorio@uniroma1.it

Elemental fragmentation cross sections for a ^{16}O beam of 400 MeV/u kinetic energy interacting with a graphite target using the FOOT ΔE-TOF detectors

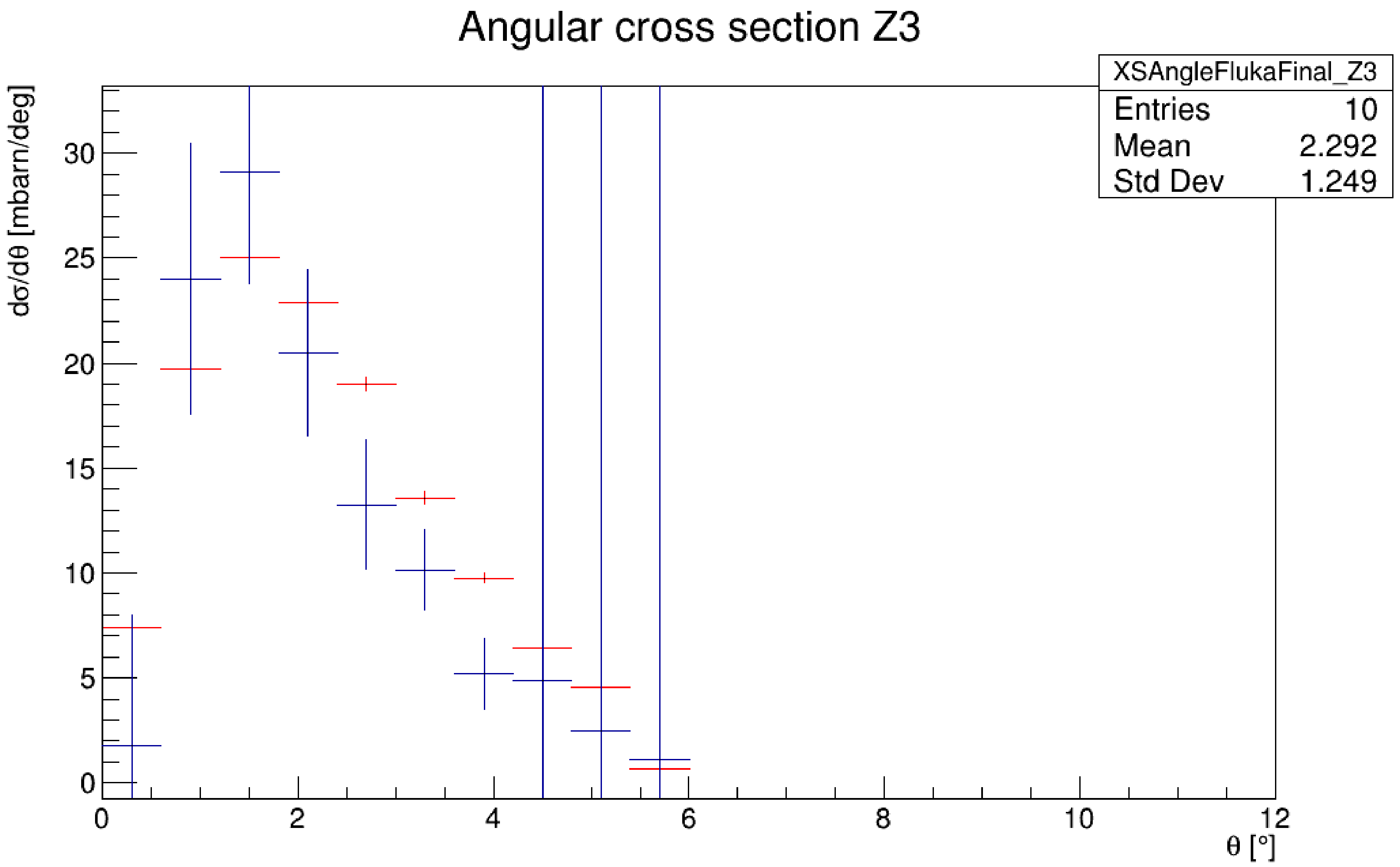
Let's look at the data!

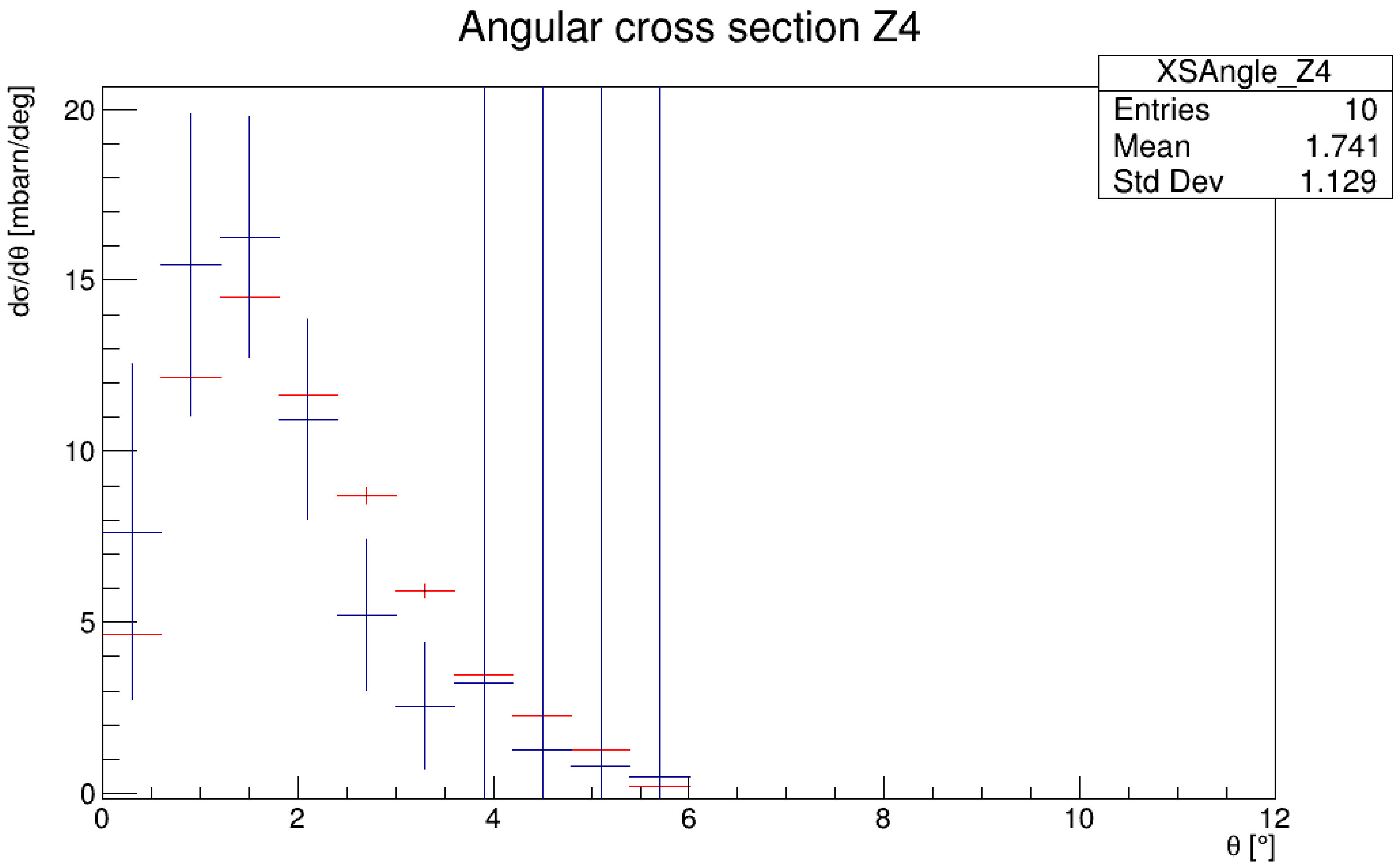
400 MeV/u ^{16}O beam on 5mm Carbon target

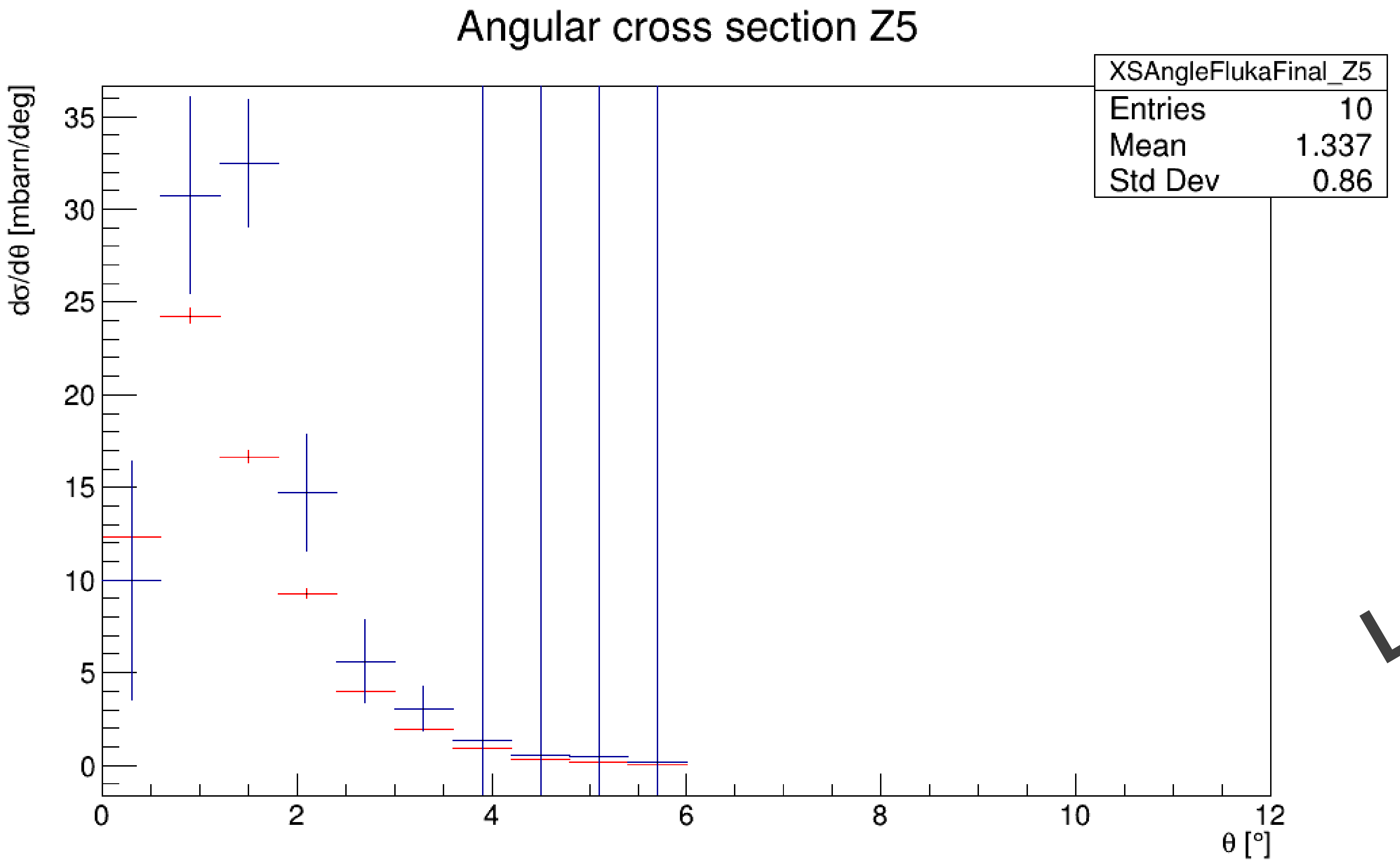
Run	Trigger type	Target	Events
4305	MB	C	162102
4306	MB	C	577096
4307	MB	C	513370
4308	Frag + MB	C	510169
4309	Frag + MB	C	531812
4310	Frag + MB	C	1012099
4313	MB	no	57133



Let's look at the data (preliminary)!

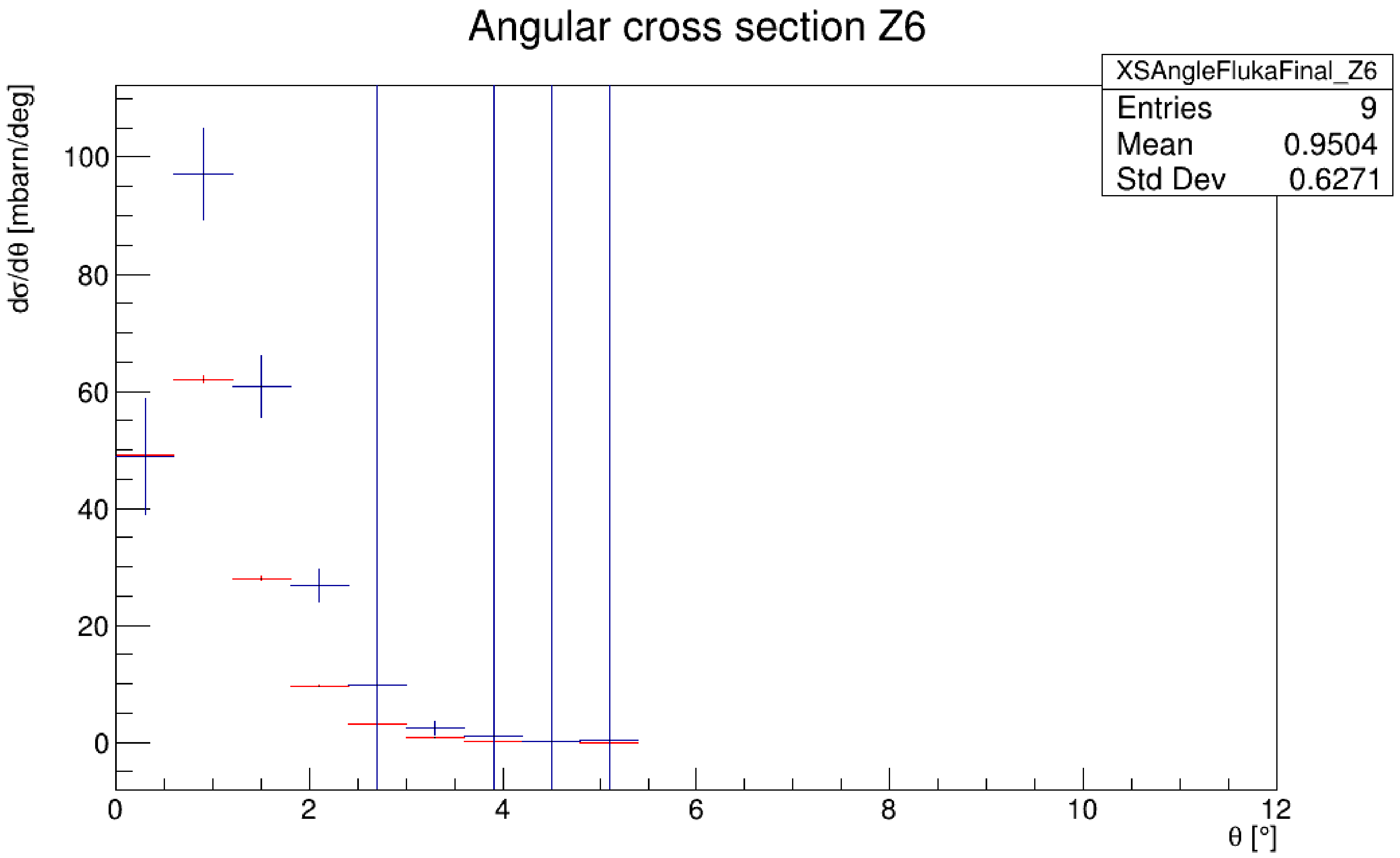


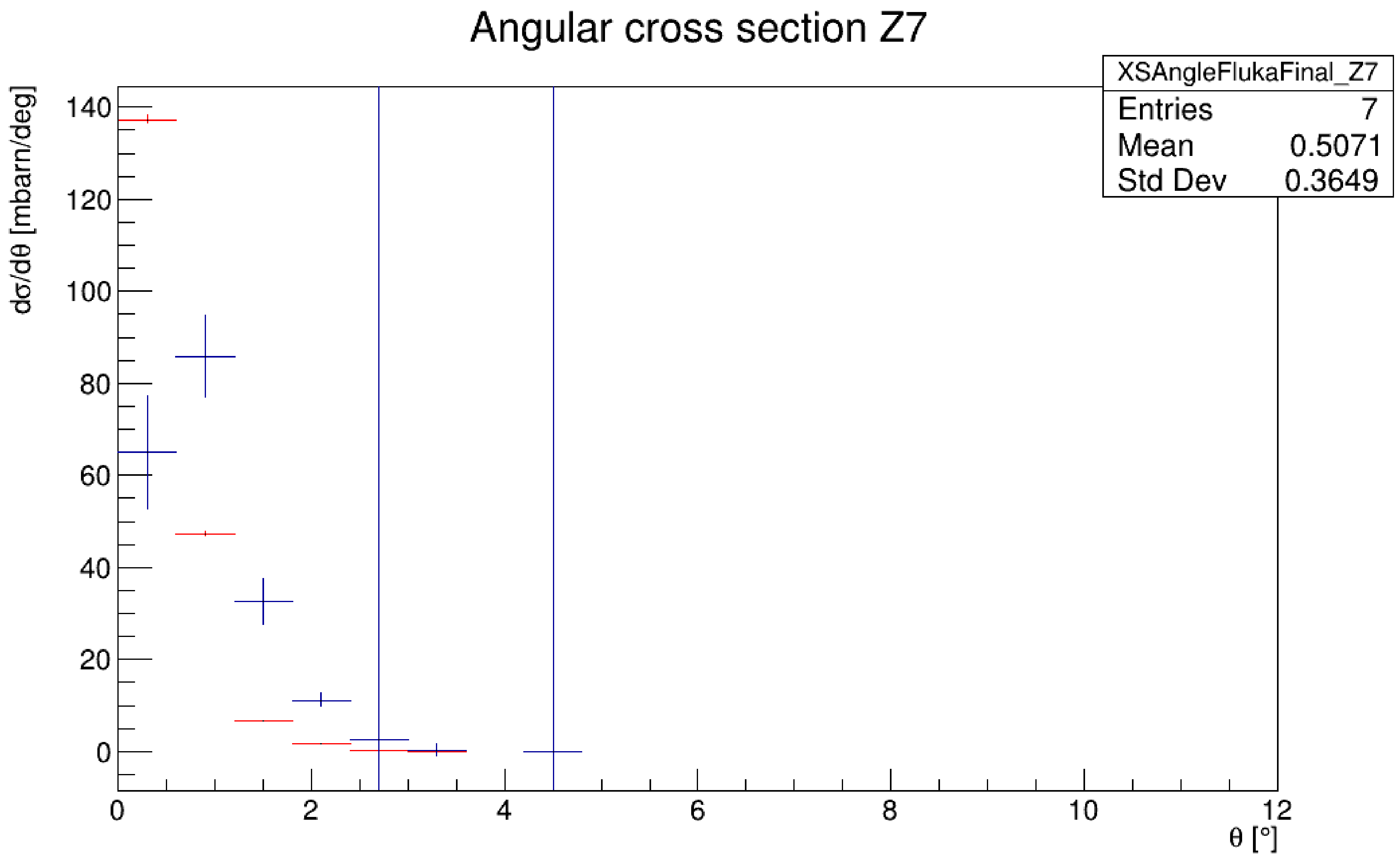




Look at values not at error bars

Let's look at the data (preliminary)!

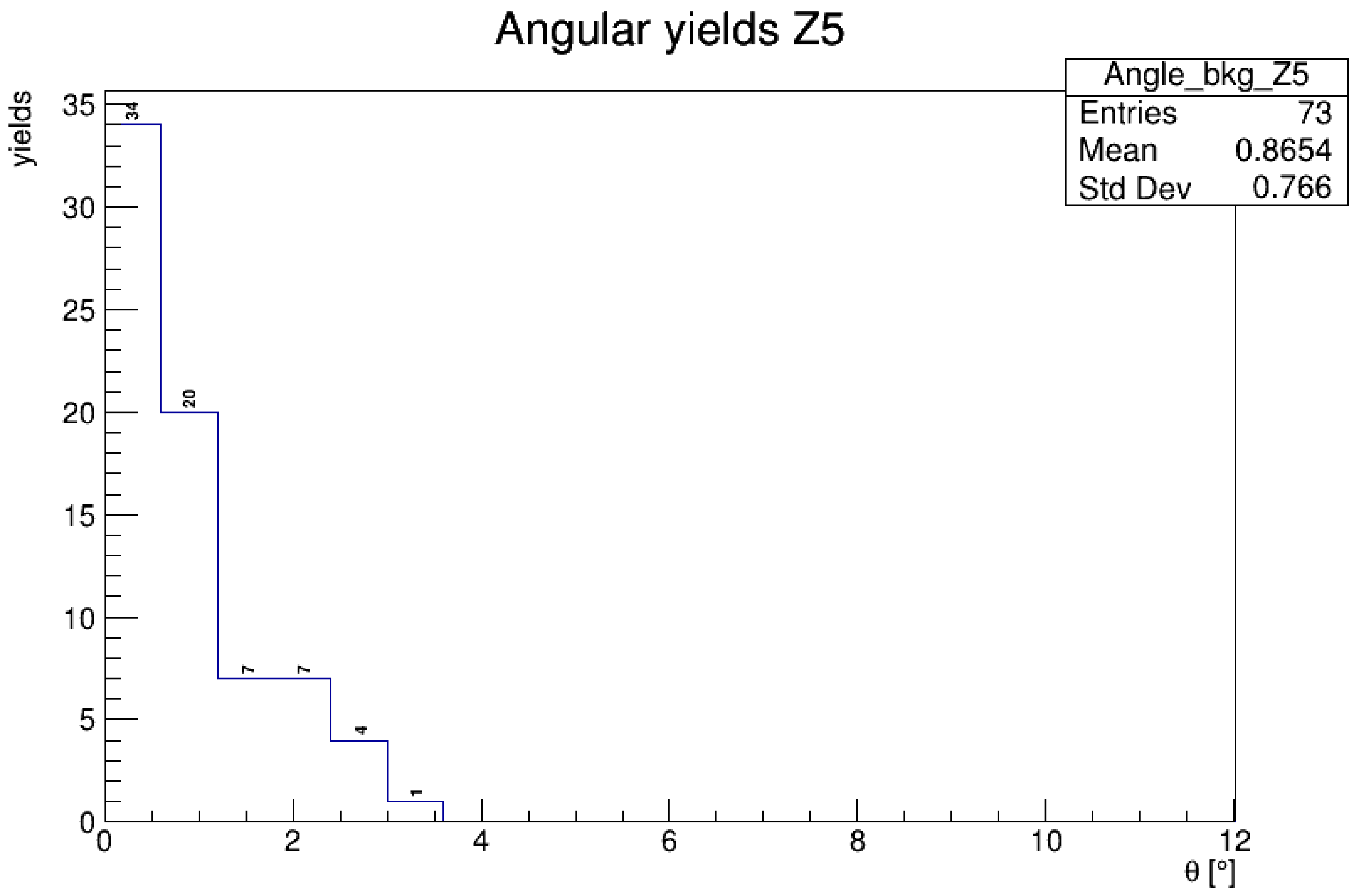


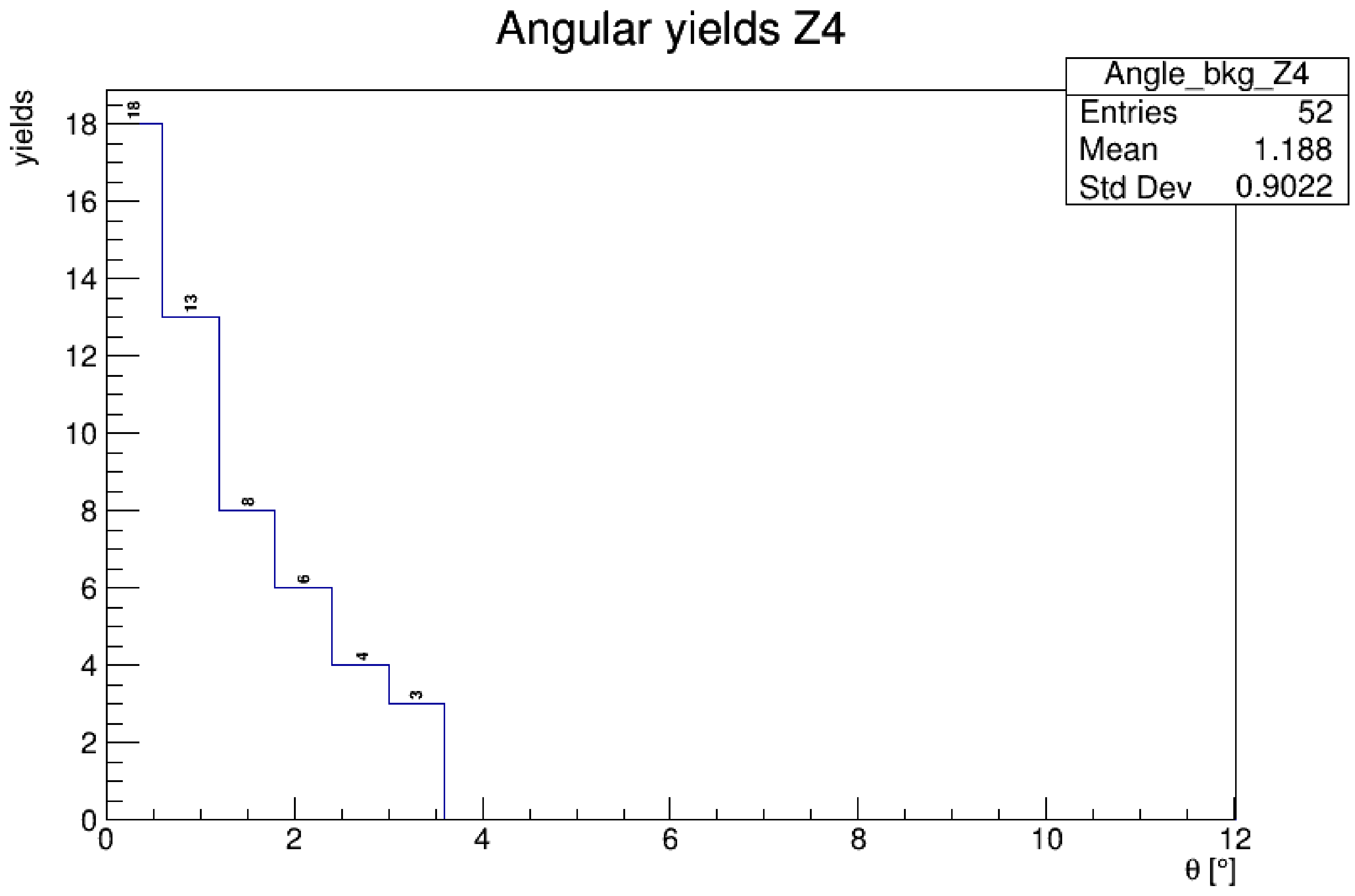


Look at values not at error bars

Very few background sample for 400 MeV/u Oxygen...

11	Carbon target	MargaritaMajorit	400	Carbon 5 mm	1,252,568		VTX in data
12	Carbon target &	Fragmentation	400	Carbon 5 mm	2,054,080		VTX in data
20	Alignment	MargaritaMajorit	400	no target	57,133		VTX in data





Conclusions

Background subtraction strategy seems to work also for angle differential cross sections

Very few statistics for background, real impact to final results to be understood soon

Possible strategy to enlarge background sample (GSI2019, MC validation)

Checks on detector alignment in data to be performed