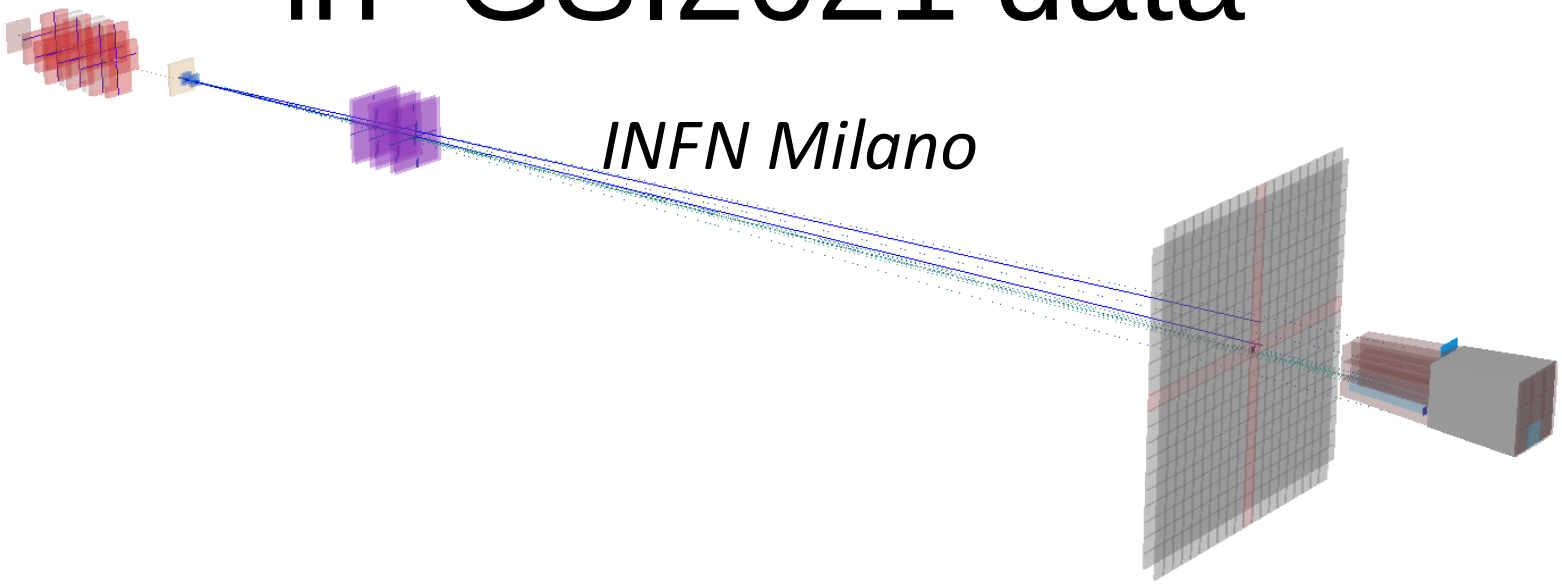
Very preliminary!

First attempt to track multiple α events in GSI2021 data

INFN Milano



Introduction

- At the Collaboration meeting in Naples, I reported the 1st MC study of multi-α tracking for the GSI2021 data concerning ^{16}O fragmentation at 400 MeV/u, C target (GSI21PS_MC campaign), in view of the possibility of using global track reconstruction on real GS2021 experimental data:

https://agenda.infn.it/event/40055/contributions/233767/attachments/122536/179388/GBatt_AlphaGSI21.pdf

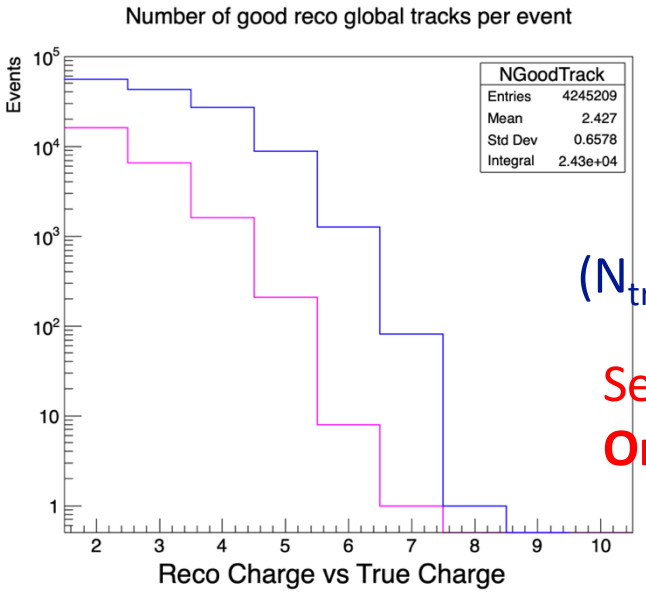
- The GenFit reconstruction was used, implementing Event and Track selection cuts defined during the discussions in the Physics and Analysis group

- Here I report about the 1st (overdue…) attempt to perform this reconstruction and analysis on the real data

- Goal: start data analysis for α -clustering with the electronic spectrometer beginning from the simplest case (no magnet) for ^{16}O fragmentation (more interesting that ^{12}C)

Summary of main results from 2024 MC study

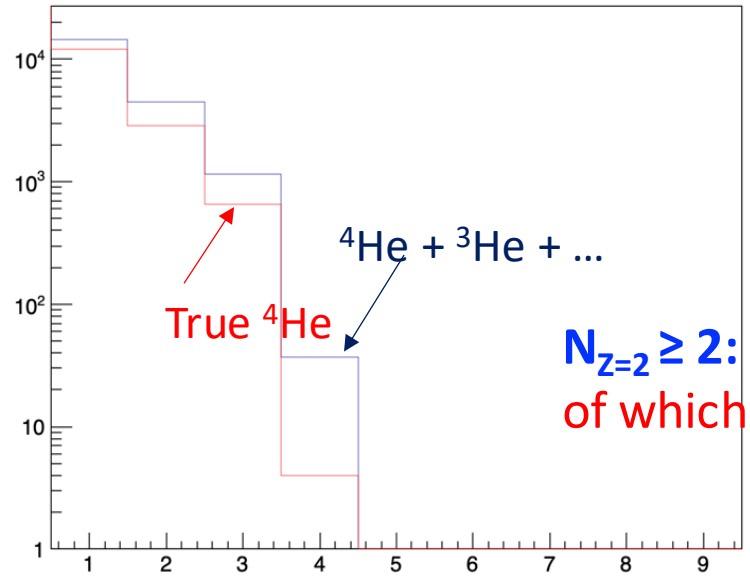
5 10^6 primary events



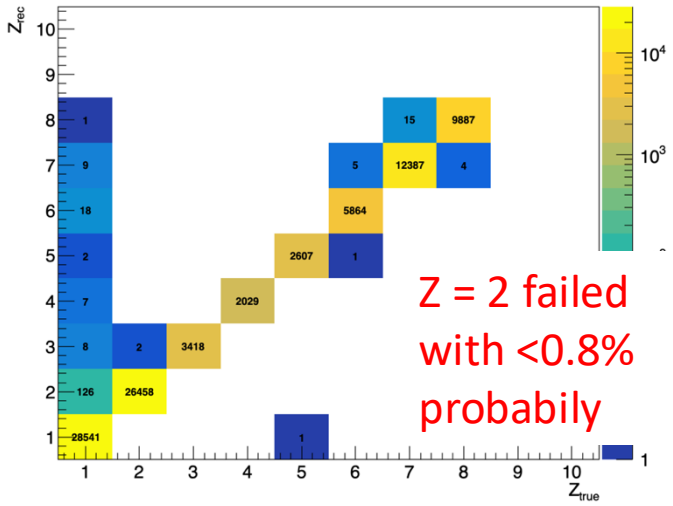
After event and track selection:

True Events (N_{track}>1 at TW): 135 715

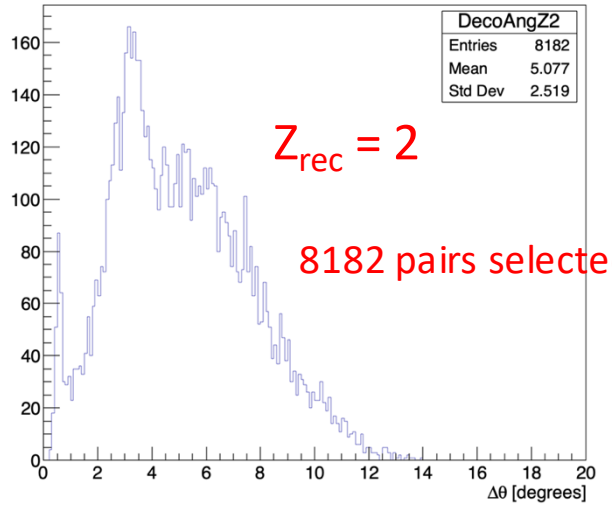
Selected Events(N_{track}>1)
Only 24 299 events left!



$N_{Z=2}$ ≥ 2: 5685 event
of which 3542 are true ^{4}He



Z = 2 failed with <0.8% probabily



Z_{rec} = 2

8182 pairs selected

GSI2021 Run selection at 400 MeV/u

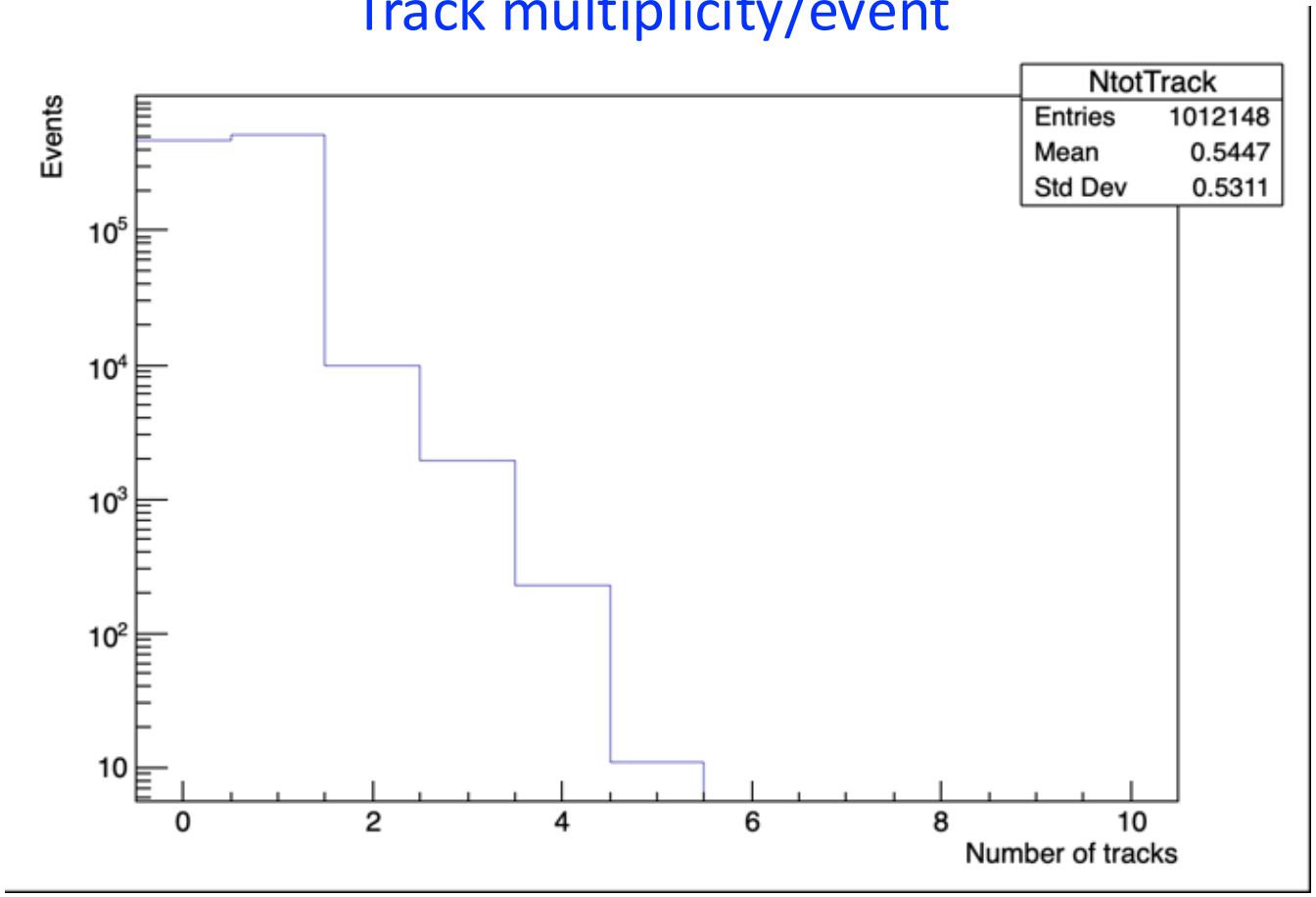
Run	Trigger type	n. events
4305	Min. bias	162110
4306	Min. bias	577120
4307	Min. bias	513365
4308	Fragm.	513391
4309	Fragm.	531838
4310	Fragm.	1012148
	Total:	3309972

Let's start looking at run 4310

1) GenFit Reconstruction

- N measure in global tracking: 5

Track multiplicity/event



This campaign is known to have a very high pileup

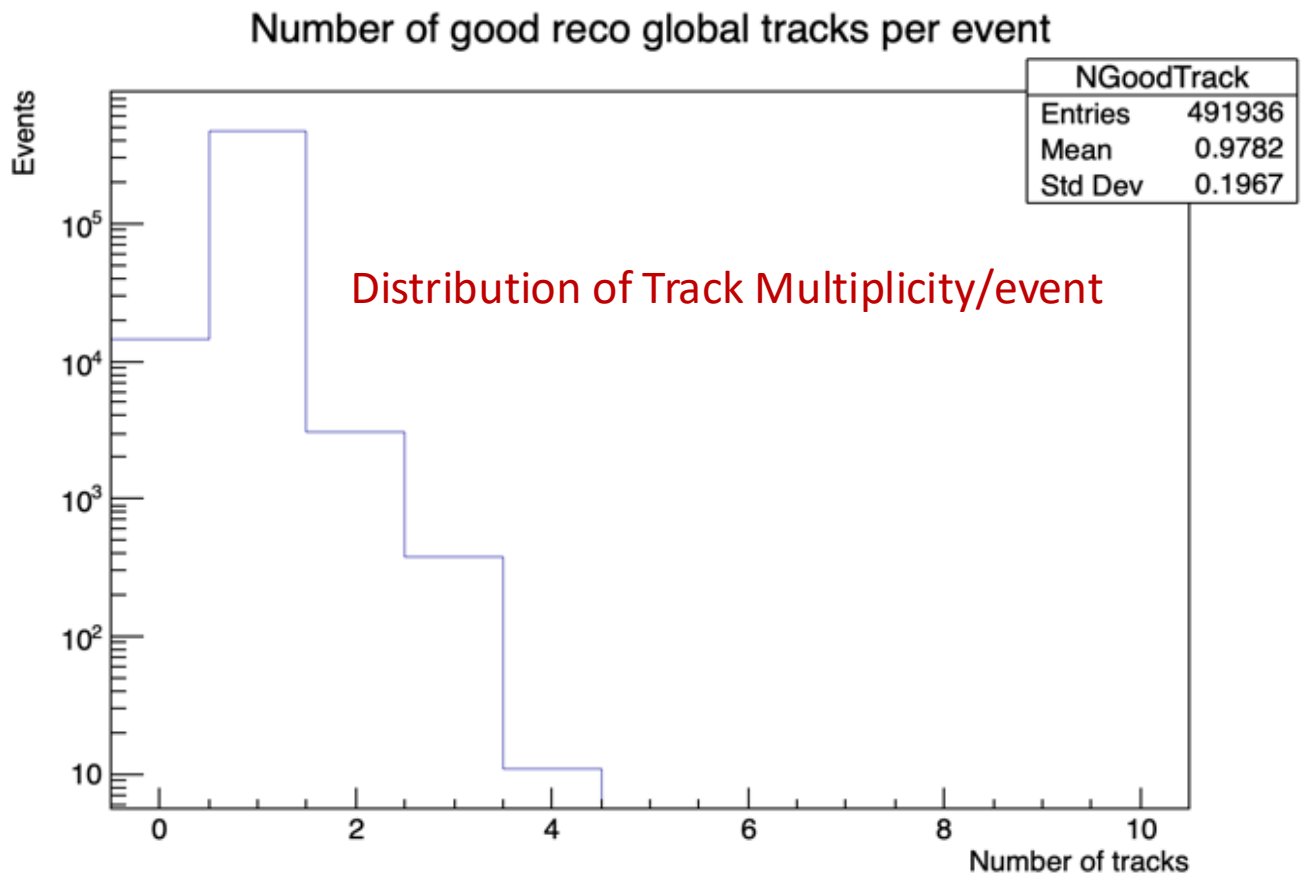
469329 events with 0 reconstructed tracks

516524 1 track event
9957 2 track event
1931 3 track event
230 4 track event
11 5 track event

In 1 track events there are mainly non interacted primaries

1) GenFit Reconstruction – 2

- Introducing minimal selections



Criteria for event selection:

1 BM track

+

No. of reconstructed tracks =
No. of TW points in the event

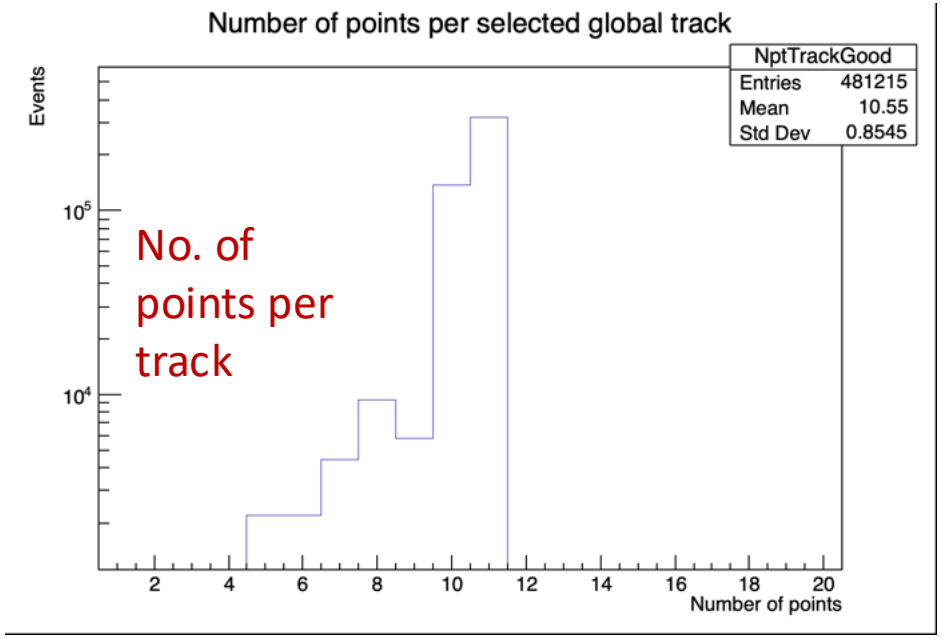
491836 events remain

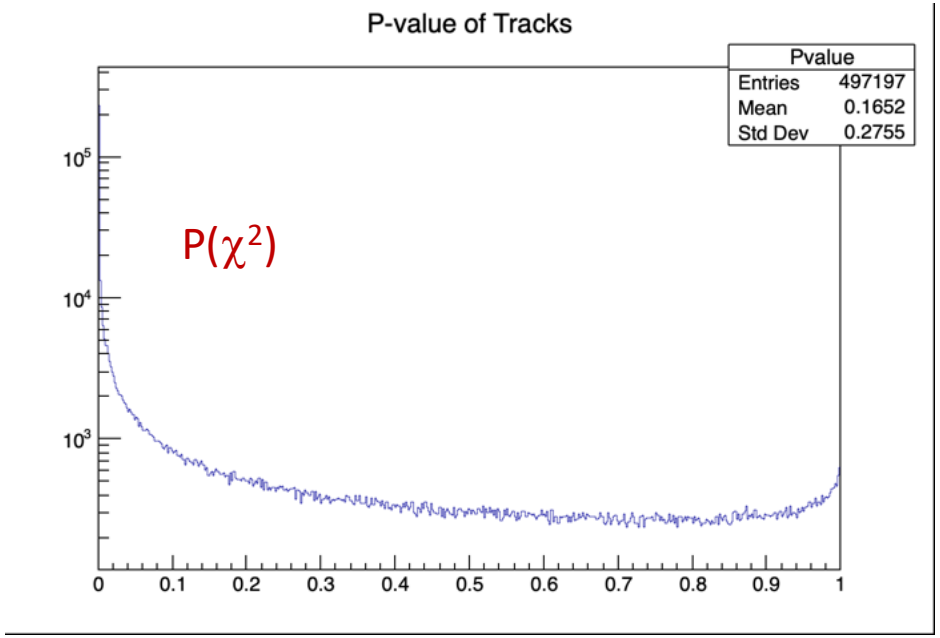
criterium for track selection:

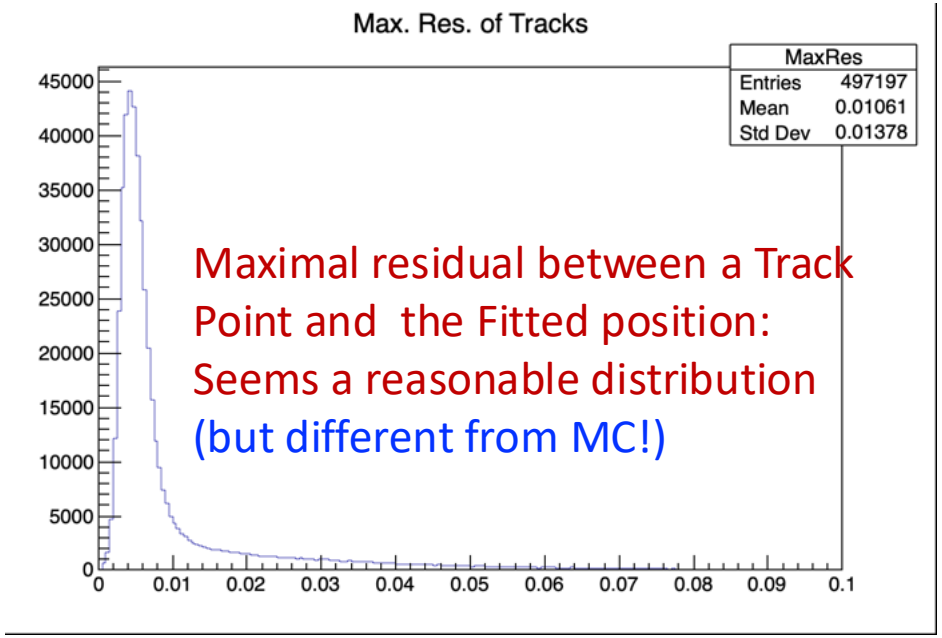
1 TW point/track

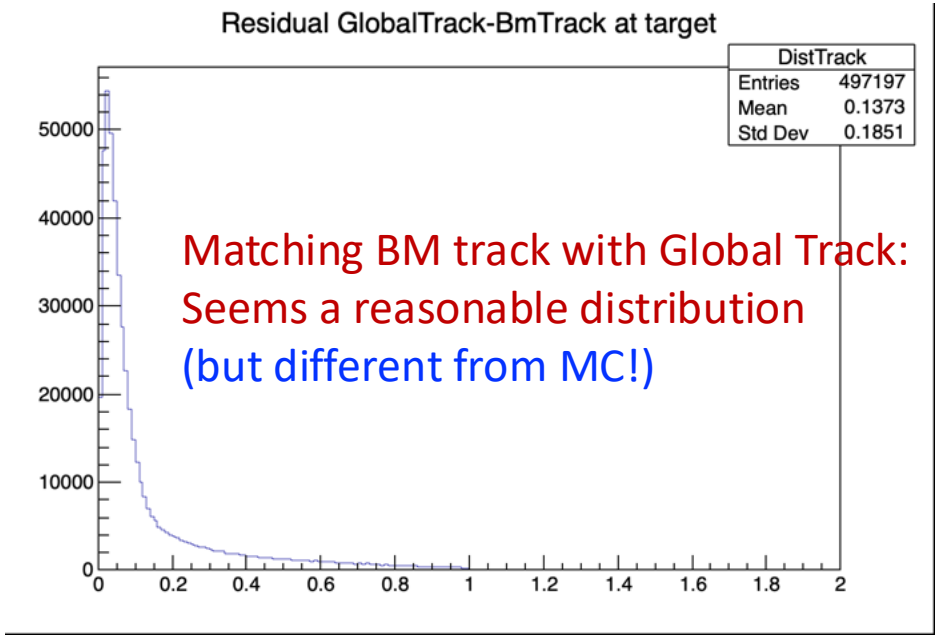
14583 events with 0 reconstructed tracks

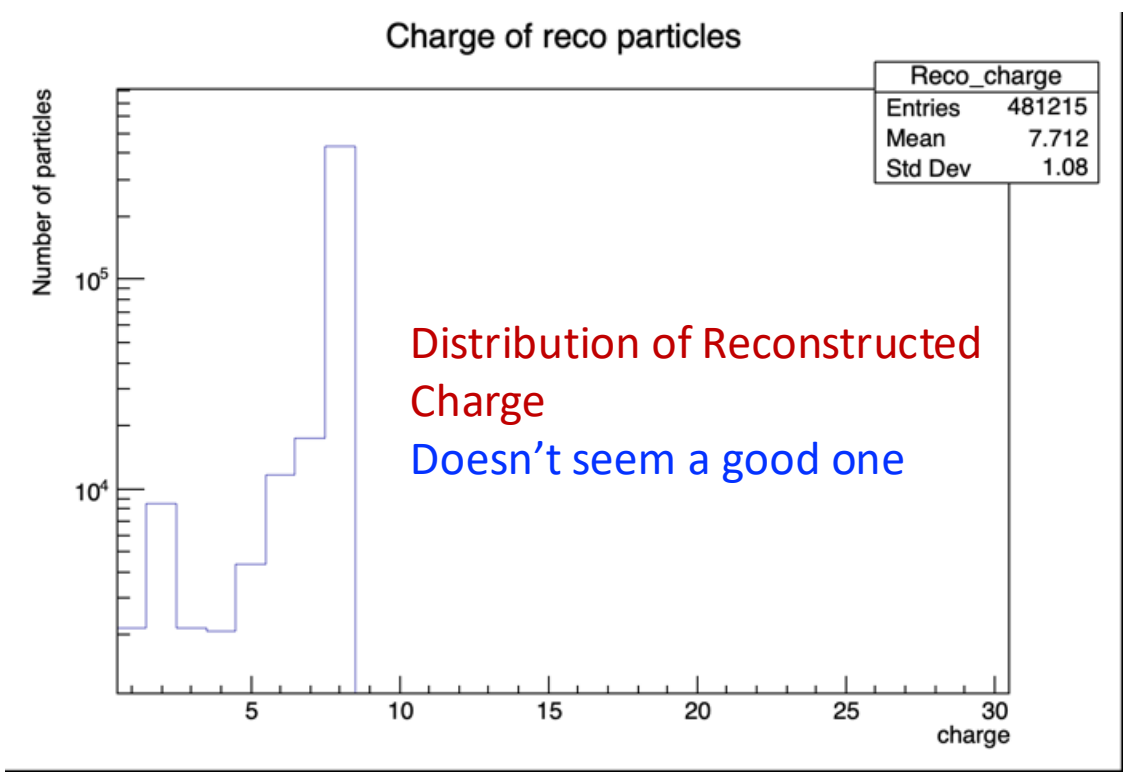
473895	1 track event
3065	2 track event
382	3 track event
11	4 track event
0	≥5 track event

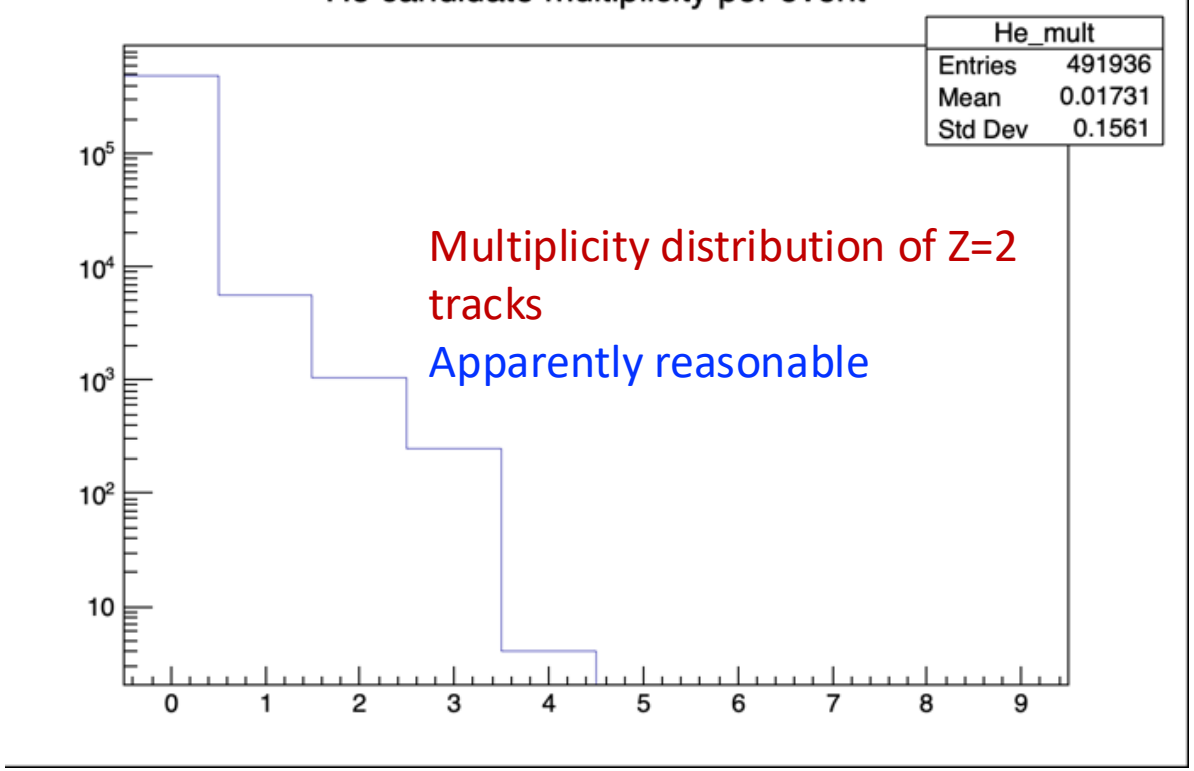

Number of points per selected global track
NptTrackGood
Entries 481215
Mean 10.55
Std Dev 0.8545
Events
Number of points
No. of points per track

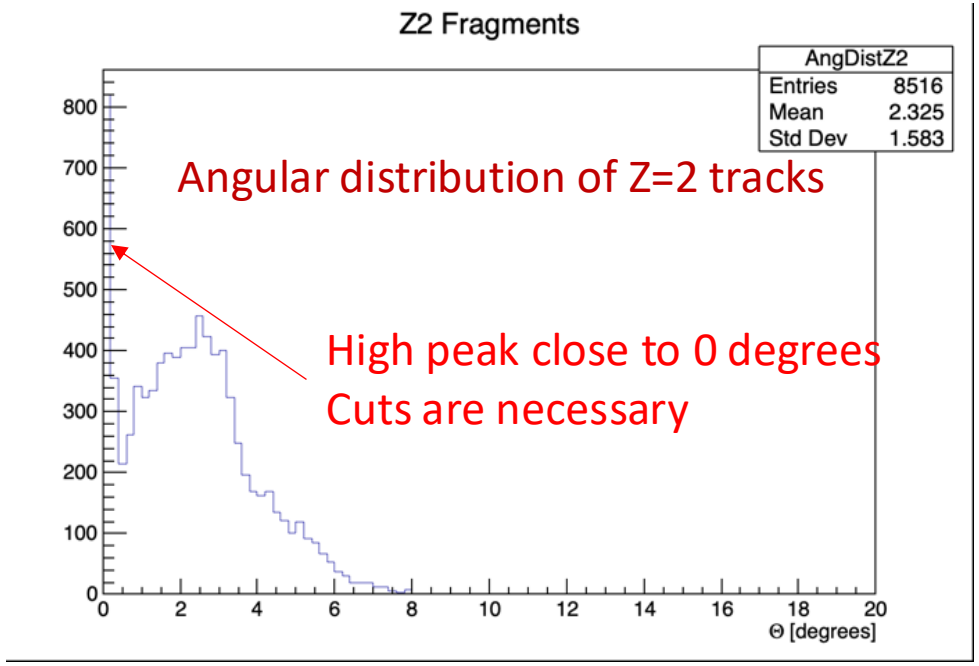

P-value of Tracks
Pvalue
Entries 497197
Mean 0.1652
Std Dev 0.2755
P(χ²)


Max. Res. of Tracks
MaxRes
Entries 497197
Mean 0.01061
Std Dev 0.01378
Maximal residual between a Track Point and the Fitted position:
Seems a reasonable distribution
(but different from MC!)


Residual GlobalTrack-BmTrack at target
DistTrack
Entries 497197
Mean 0.1373
Std Dev 0.1851
Matching BM track with Global Track:
Seems a reasonable distribution
(but different from MC!)

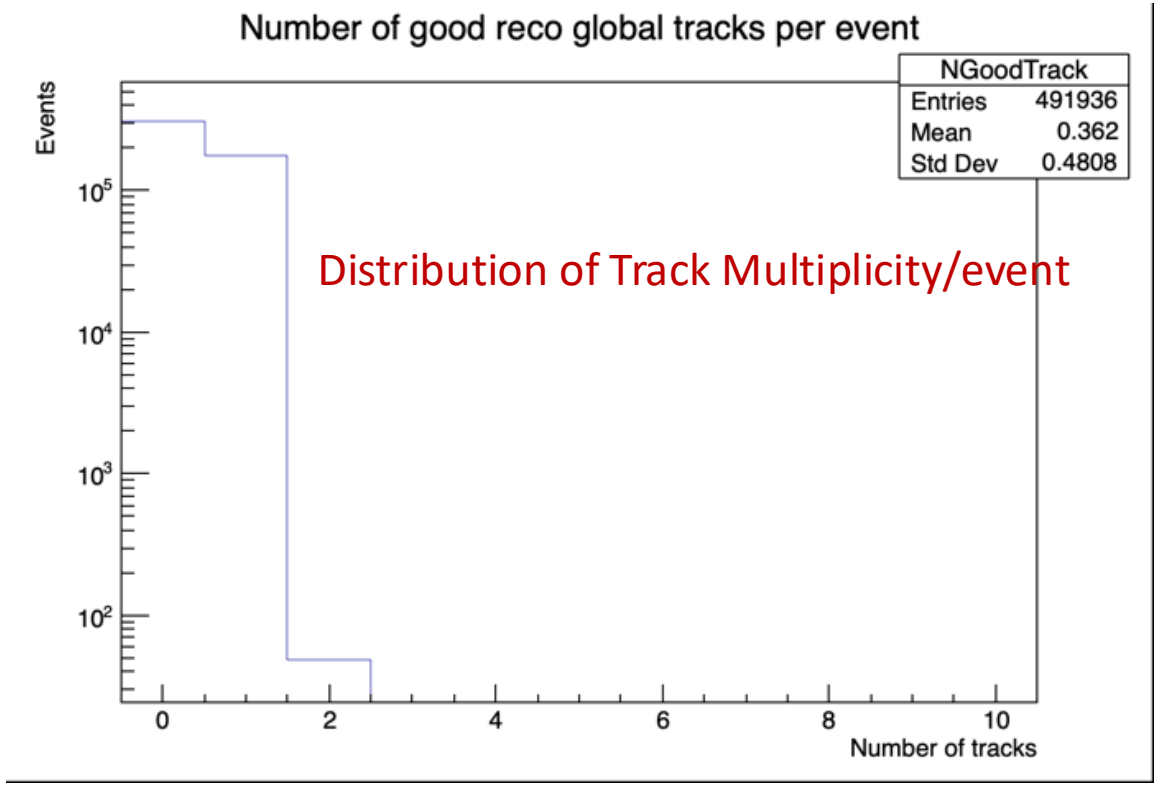

Charge of reco particles
Reco_charge
Entries 481215
Mean 7.712
Std Dev 1.08
Number of particles
charge
Distribution of Reconstructed Charge
Doesn't seem a good one


He_mult
Entries 491936
Mean 0.01731
Std Dev 0.1561
Multiplicity distribution of Z=2 tracks
Apparently reasonable


Z2 Fragments
AngDistZ2
Entries 8516
Mean 2.325
Std Dev 1.583
Angular distribution of Z=2 tracks
High peak close to 0 degrees
Cuts are necessary
Θ [degrees]

Attempting standard (loose) quality cuts

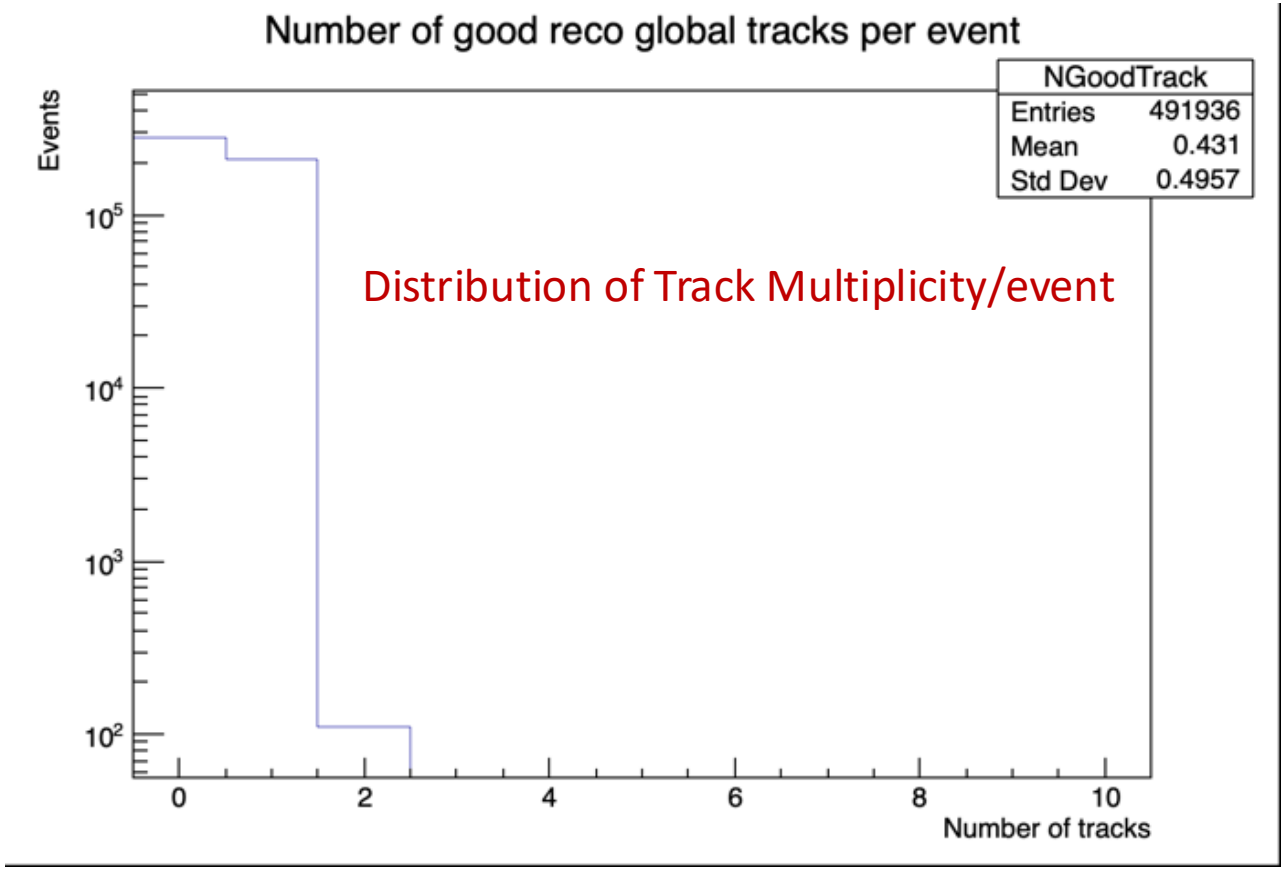
- $P(\chi^2) > 0.02$
- Match BM track – Global track: d< 0.15 cm



Events with Ntracks>1 are killed!

Attempting standard (loose) quality cuts - 2

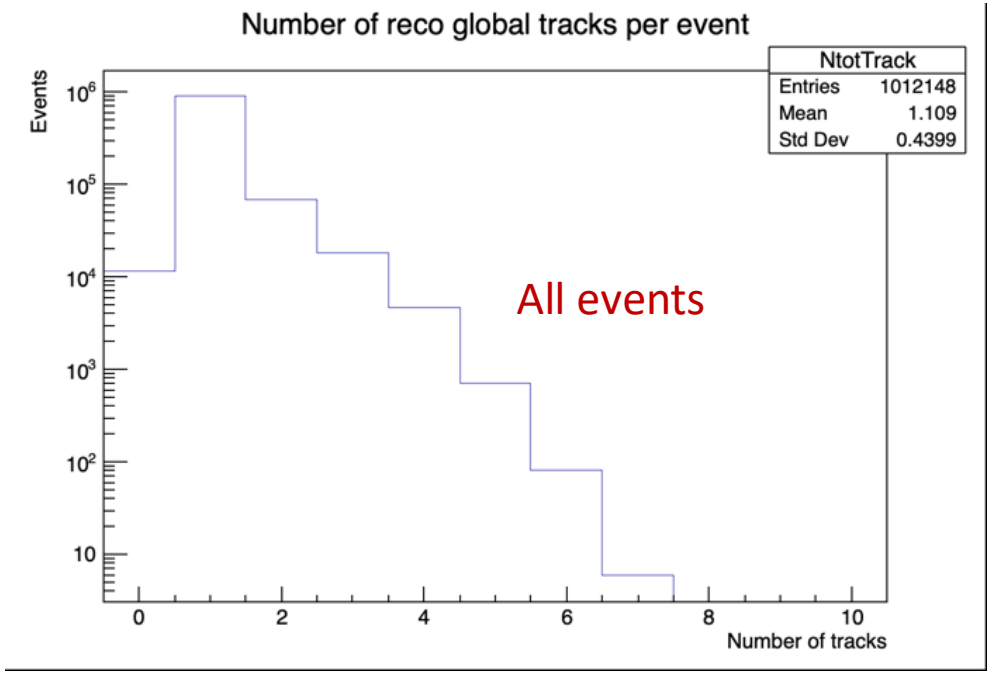
- Leaving only $P(\chi^2) > 0.02$

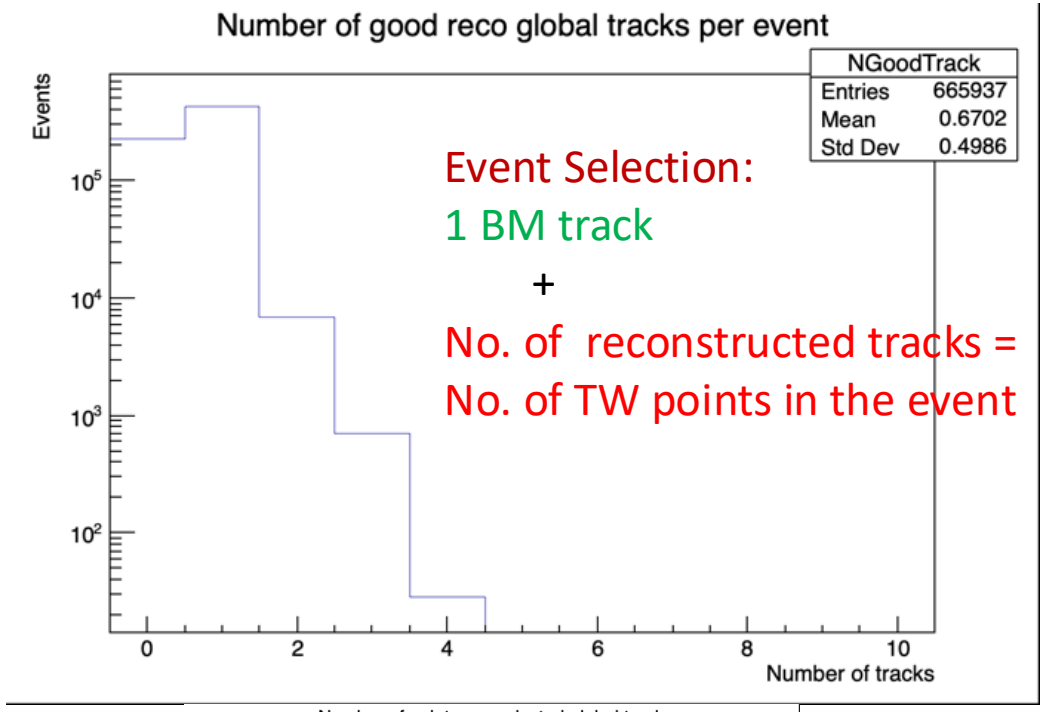


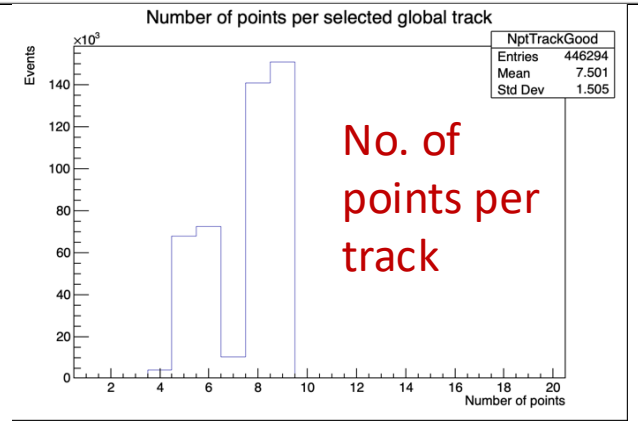
Events with Ntracks>1 are killed!

Another attempt: Straight Line Reconstruction

Track multiplicity/event





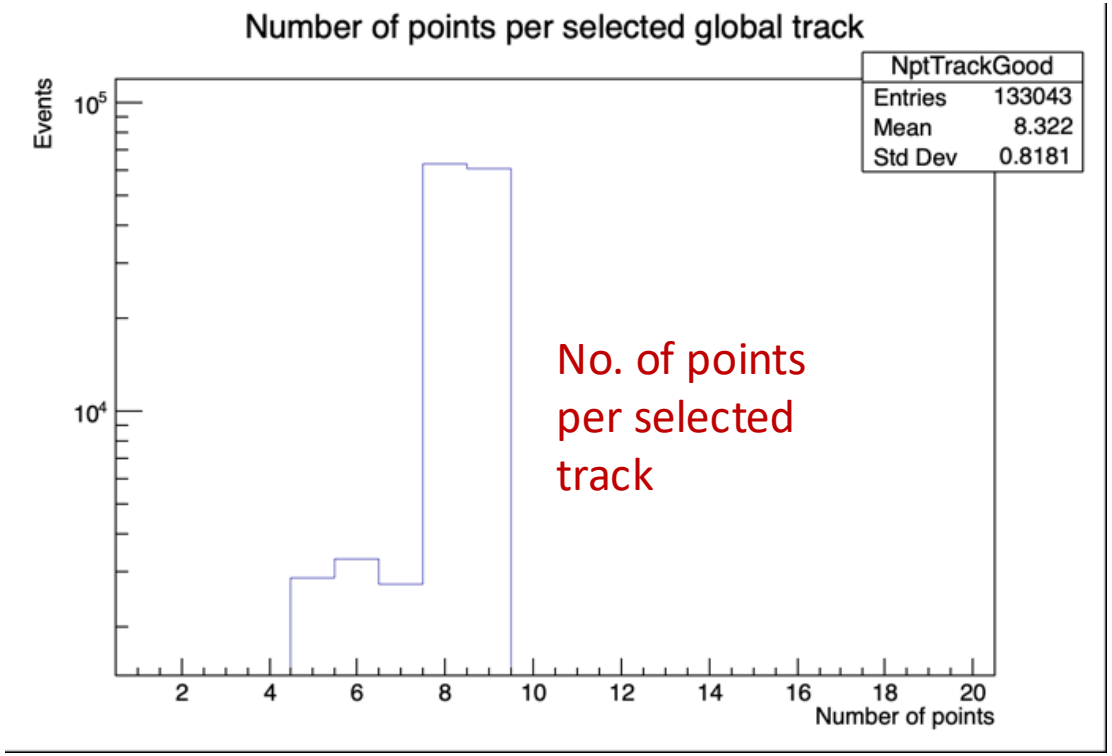


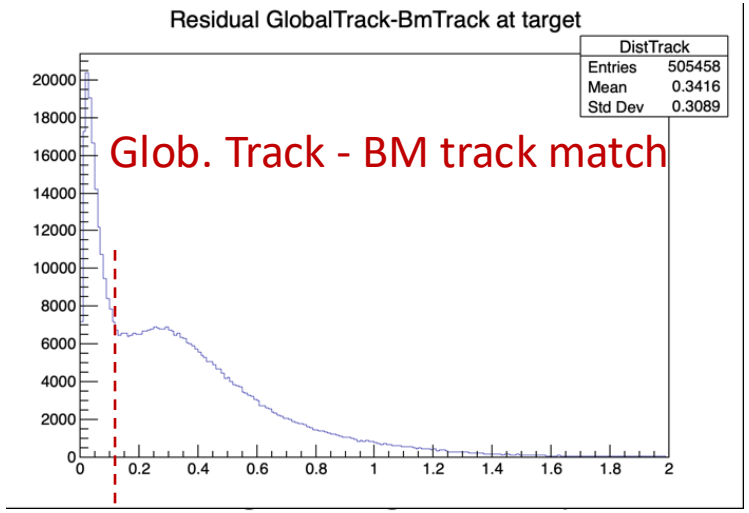
Attempt of Track Selection Cuts

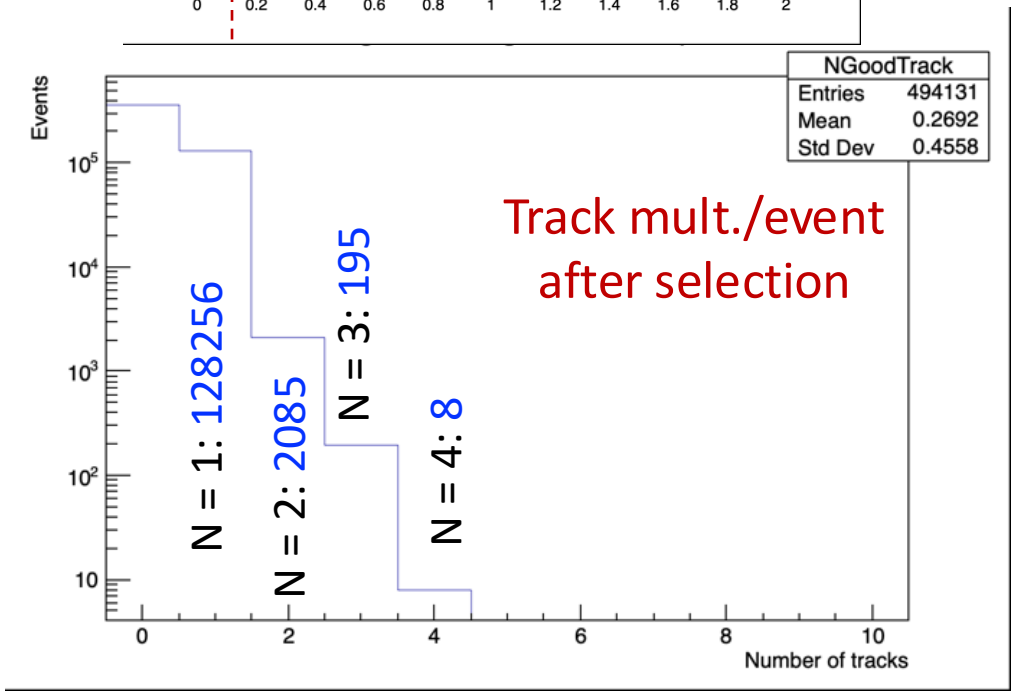
nPoints/Track >= 5 && nPtVTX>=3

TW point required

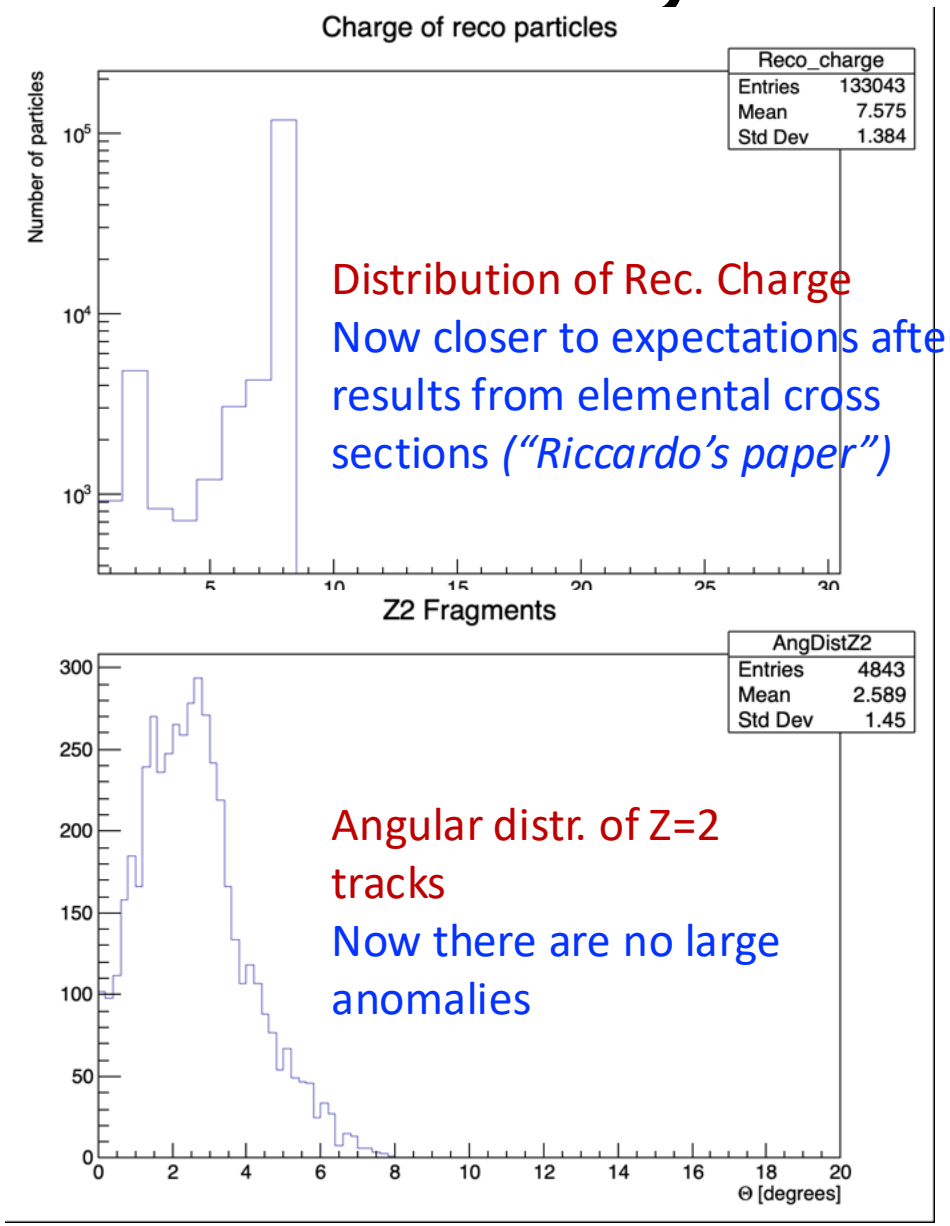
Glob. Track - BM track match < 0.12

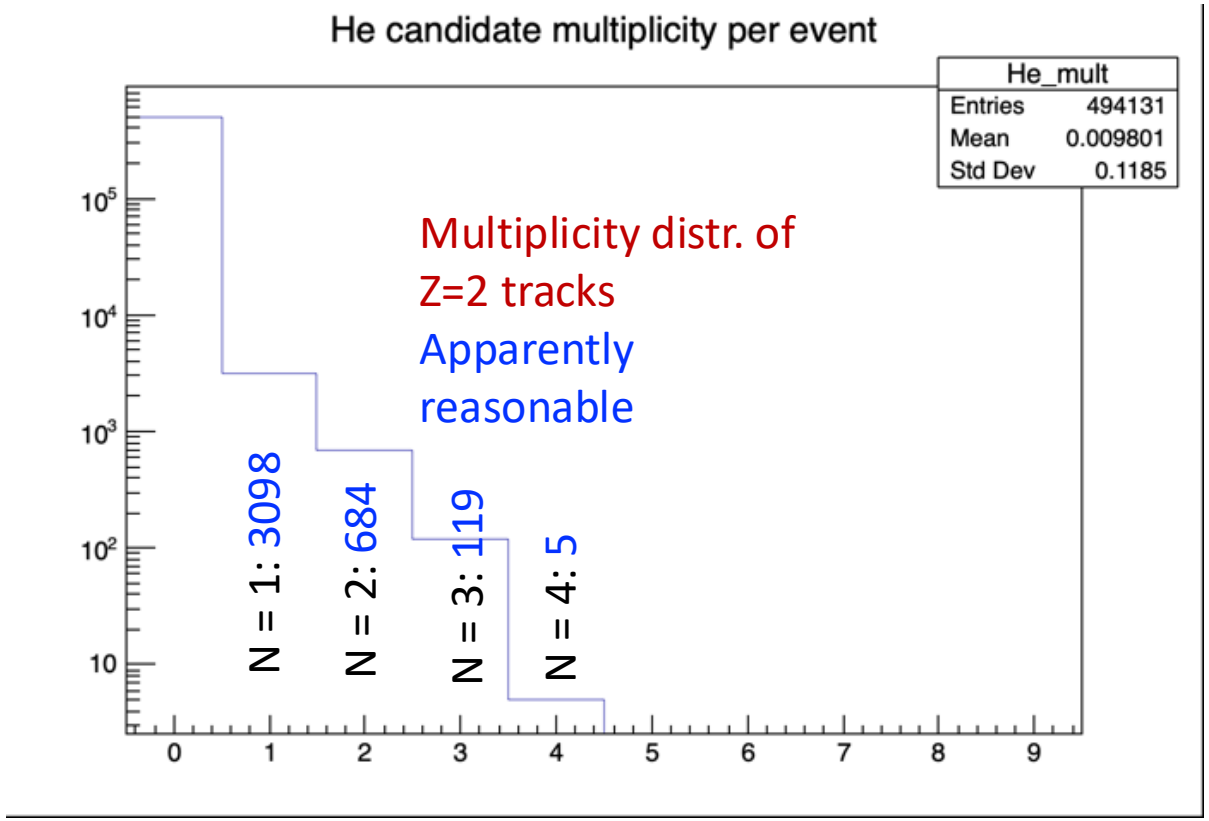




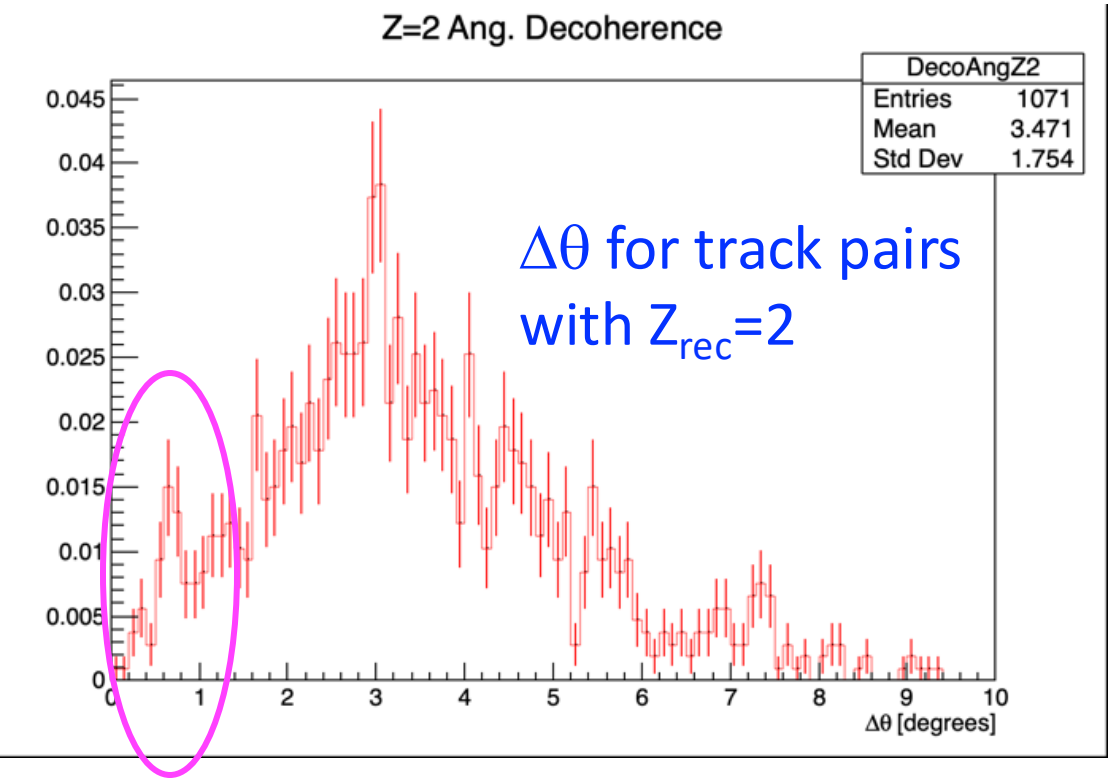


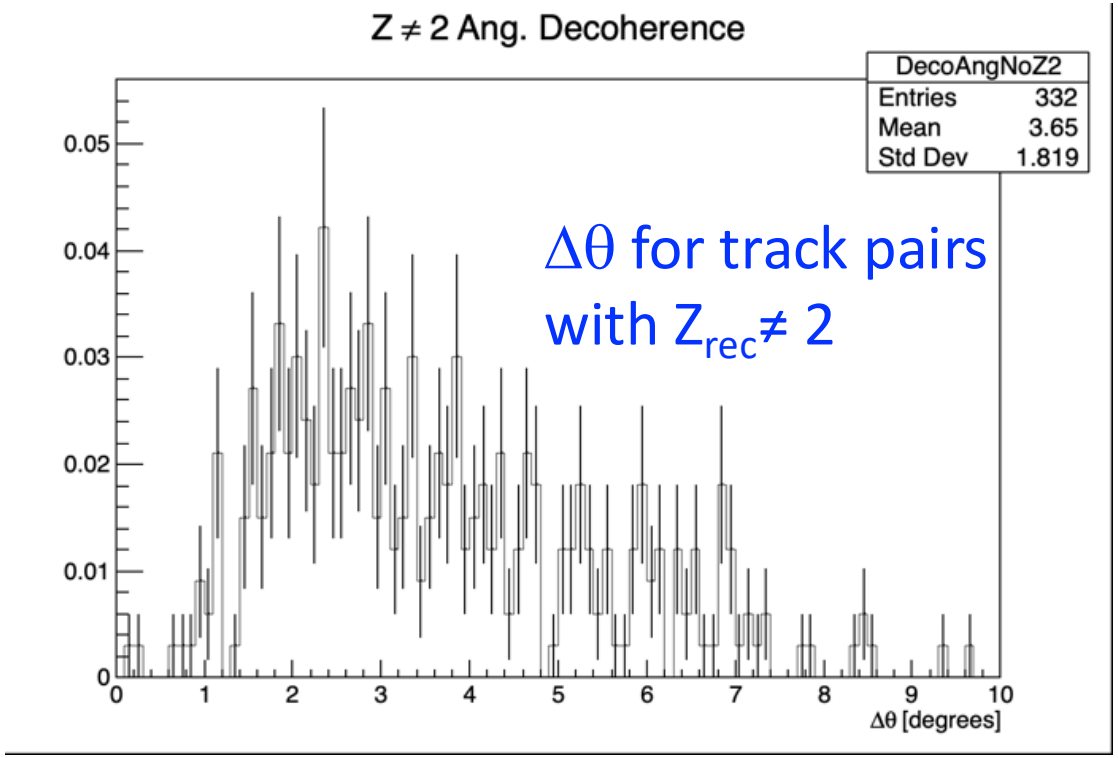
Preliminary Results





Preliminary Results:
angular separation of Z=2 tracks and search for ^{8}Be peak

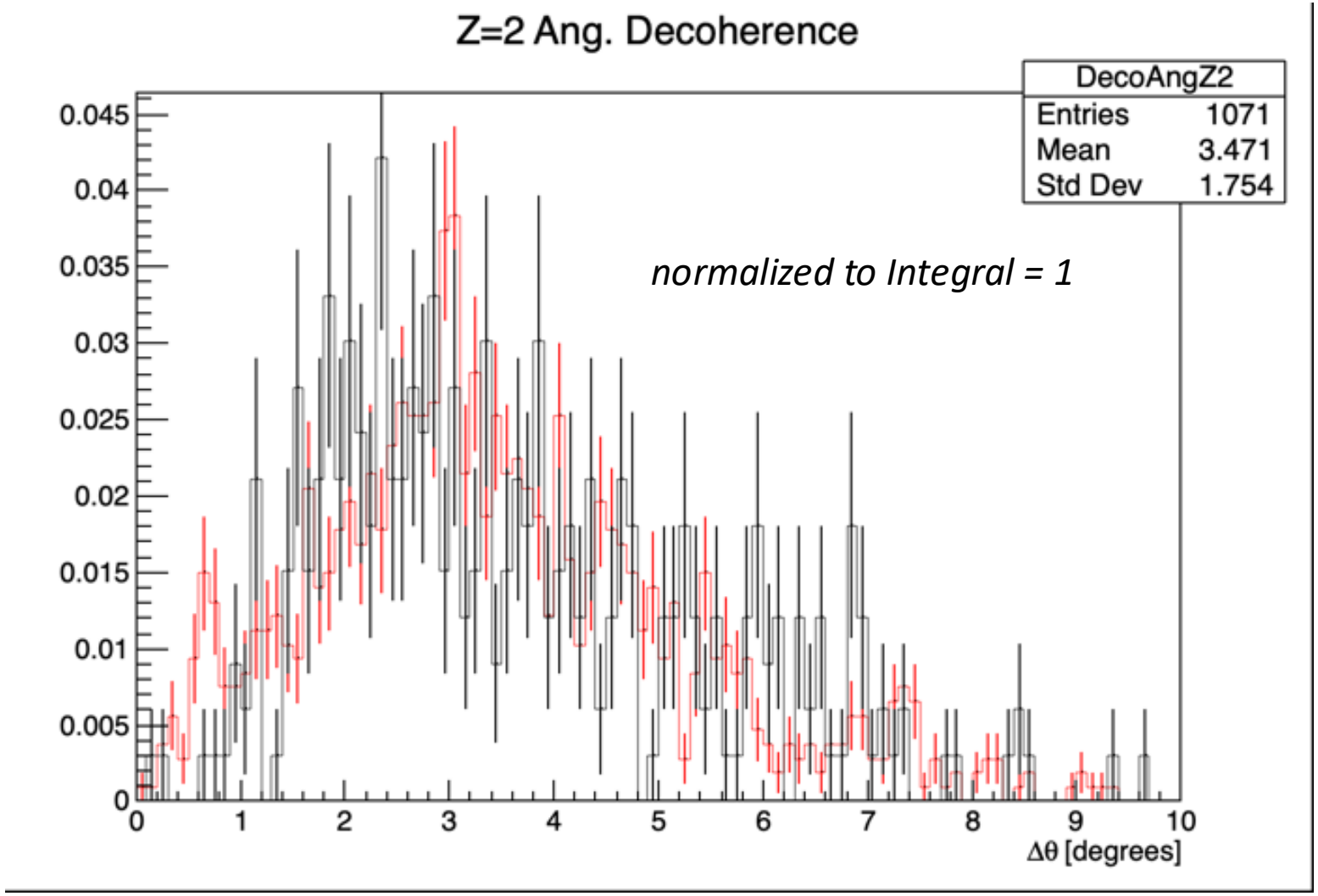




Both normalized to Integral = 1

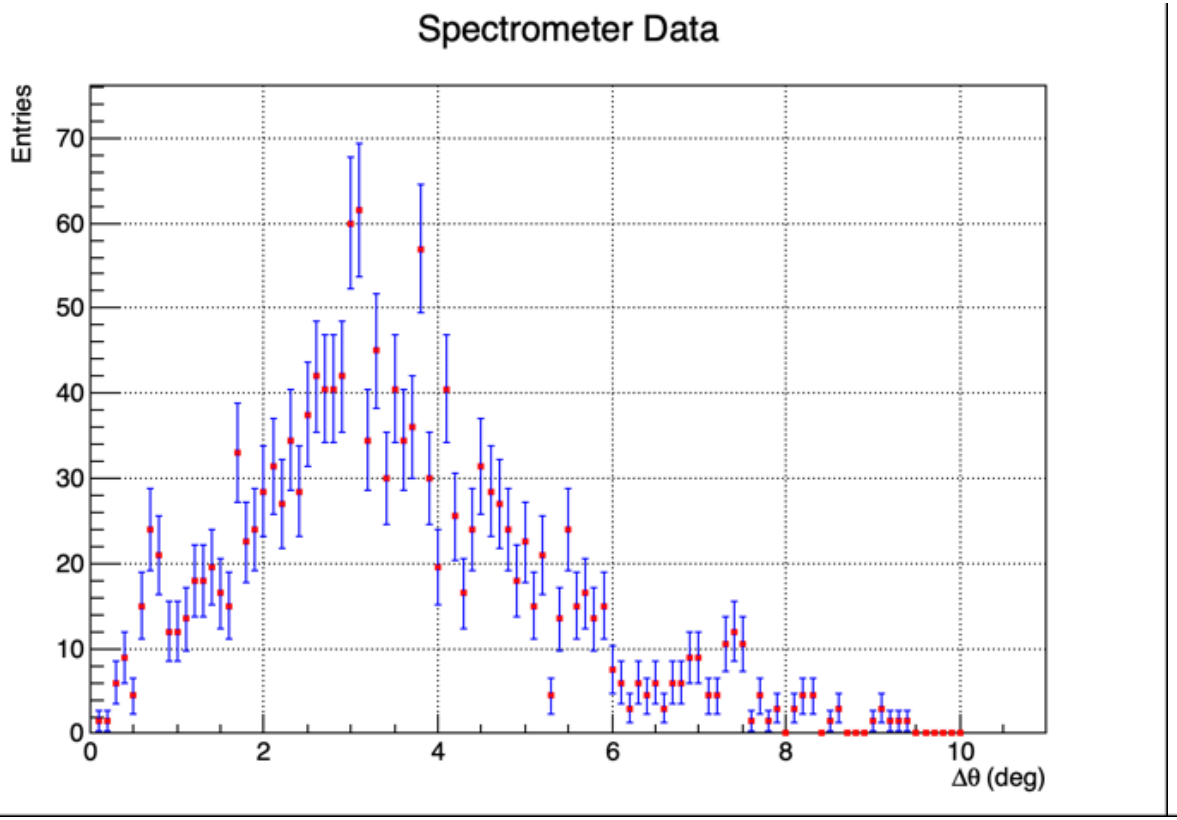
Very preliminary, still a single run

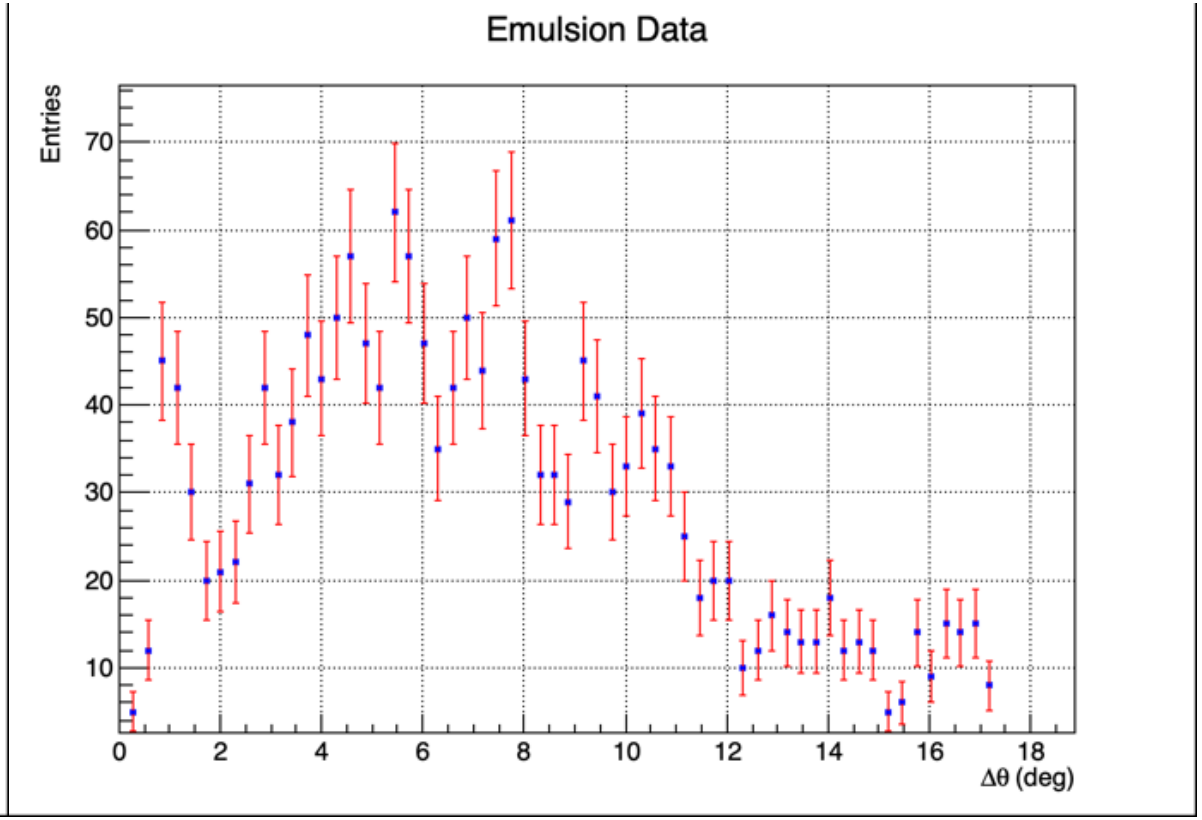
Preliminary Results:
angular separation of Z=2 tracks and search for ^{8}Be peak



Very preliminary, still a single run

Comparison to Emulsion Data at 200 MeV/u





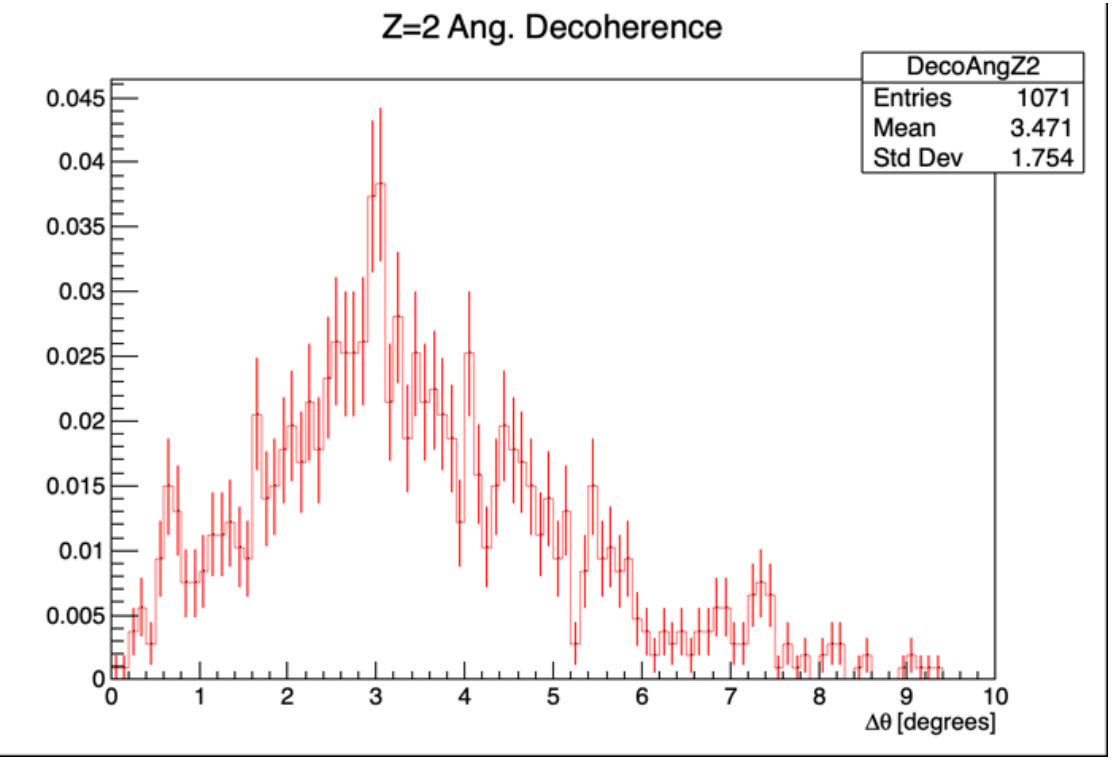
2 possible comments:

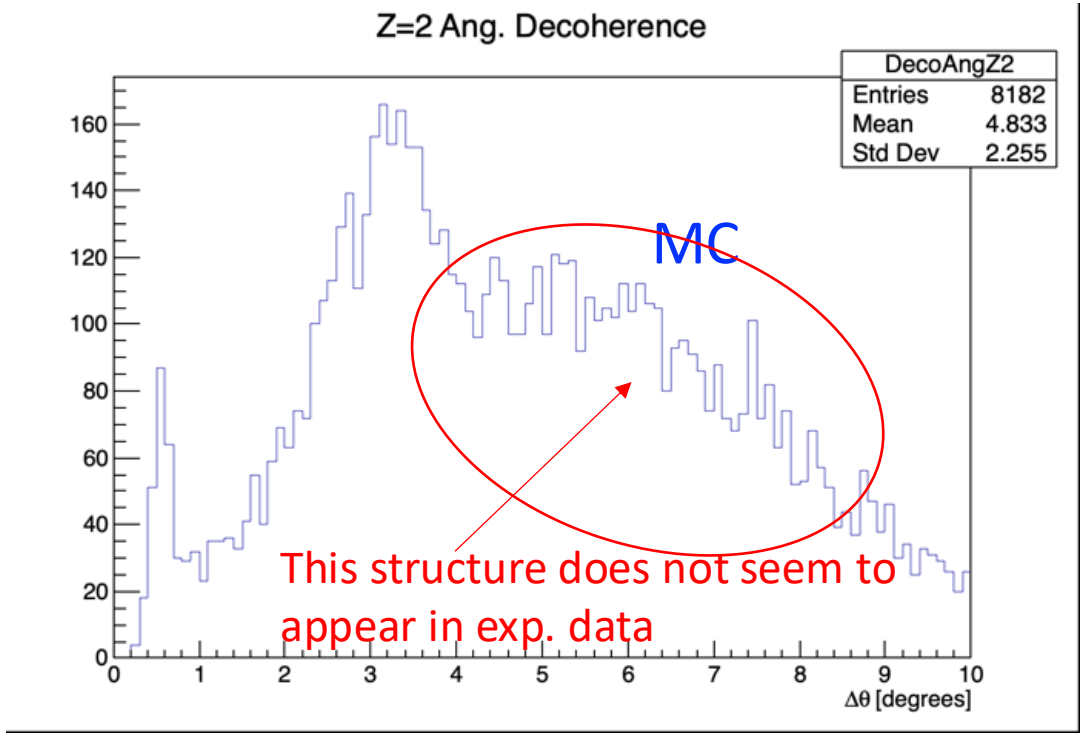
a) at 200 MeV/u you indeed expect a wider angular separation

b) in the electronic setup, small angular separations are penalized: superposition on the same TW bar

Remind: very preliminary!

Comparison with 2024 MC reconstructed with GenFit





Something concerning physics?

➔ Too early to say something…

Conclusions and to-do list

- Apparently, there are problems in using GenFit in GSI2021 data
- Surely, all cuts previously defined at MC level have to be changed
- Problems probably arise from the significant pileup
- Straight Line Reconstruction seems to work better
- Not easy to evaluate the contamination in Z reconstruction, at this time. MSD could be very helpful in this situation
- Results are however encouraging: a comparison with emulsion analysis at 200 MeV/u could be possible

To be done:

- Re-define all cuts previously defined at MC level
- Use Straight Line Reconstruction also for MC data, so to allow comparison with exp. Data *(so far work was based on GenFit)*
- Analyze all selected runs of the campaign
- Think about efficiency definition and evaluation: totally a different job with respect to inclusive cross section measurements

We hope to have more refined results for the next Collaboration Meeting