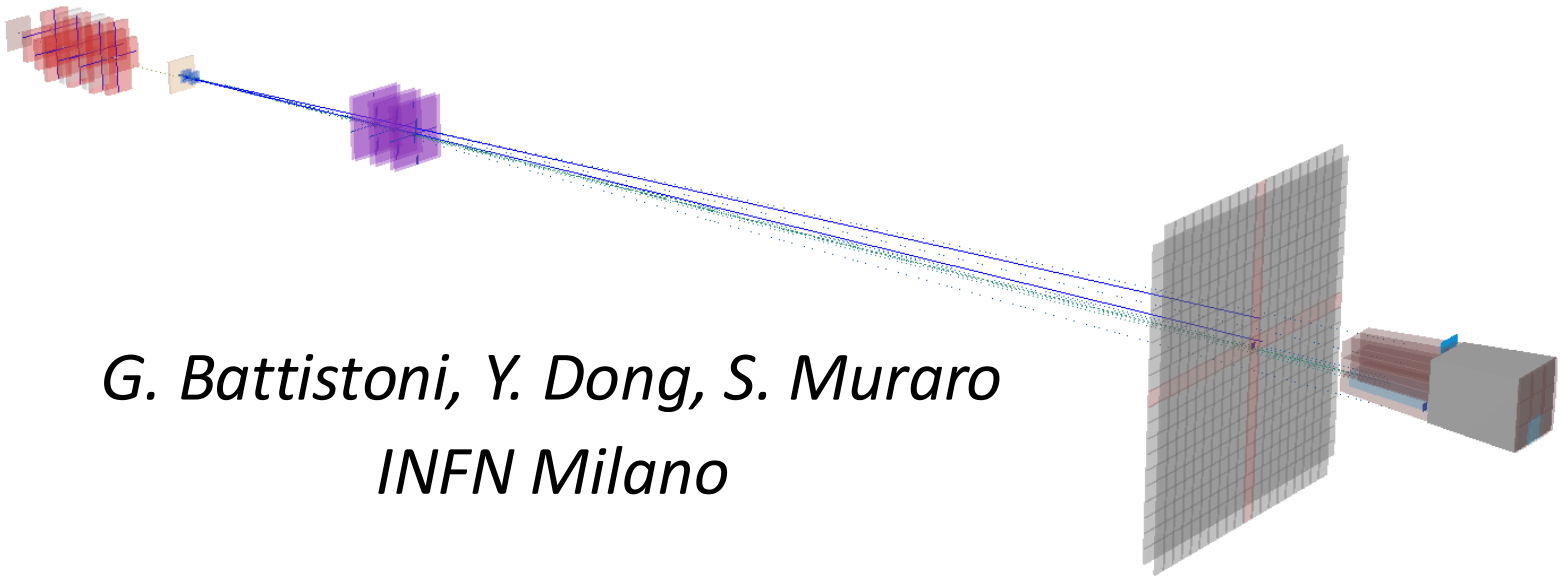
An attempt of including MSD-based Z-id in GSI2021 data reconstruction



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Introduction

- At the last Collaboration meeting in Riccione, we reported the attempt of multi-α tracking of GSI2021 (^{16}O fragmentation at 400 MeV/u, C target) using straight line reconstruction requiring only VTX + TW

https://agenda.infn.it/event/45978/contributions/265009/attachments/135935/203931/GB_AlphaGSI21exp.pdf

- Here we present the attempt of including MSD and make use of their energy loss response to improved Z-id

Summary from collaboration meeting - 1

Data reconstruction:

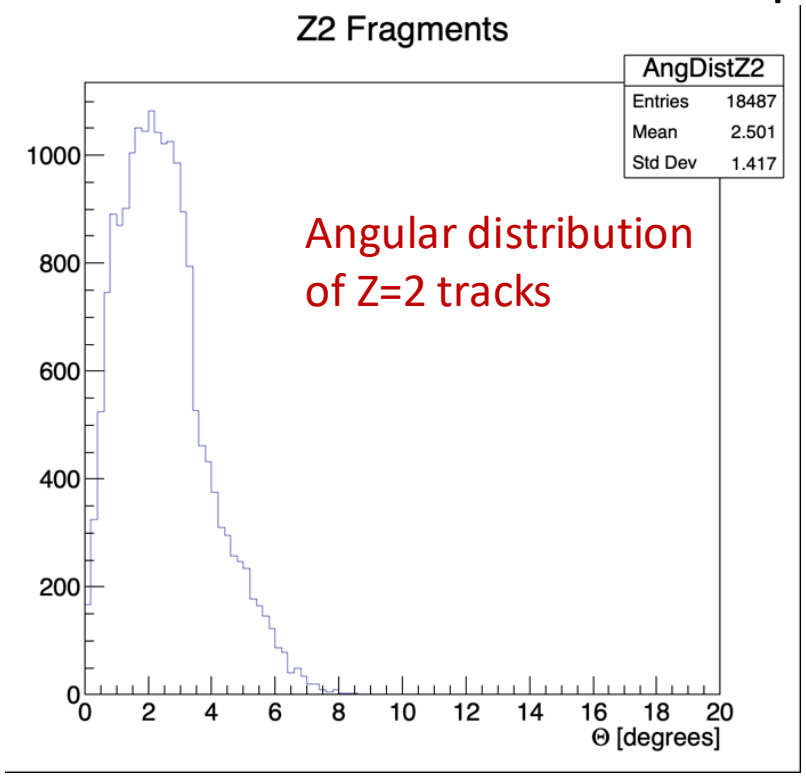
- Straight Line Reconstruction. Options:
  - EnableBMVTmatch yes
  - MSD no
  - Minimum 4 points
- No sensible results obtained with GenFit (higher multiplicity events too much penalized)

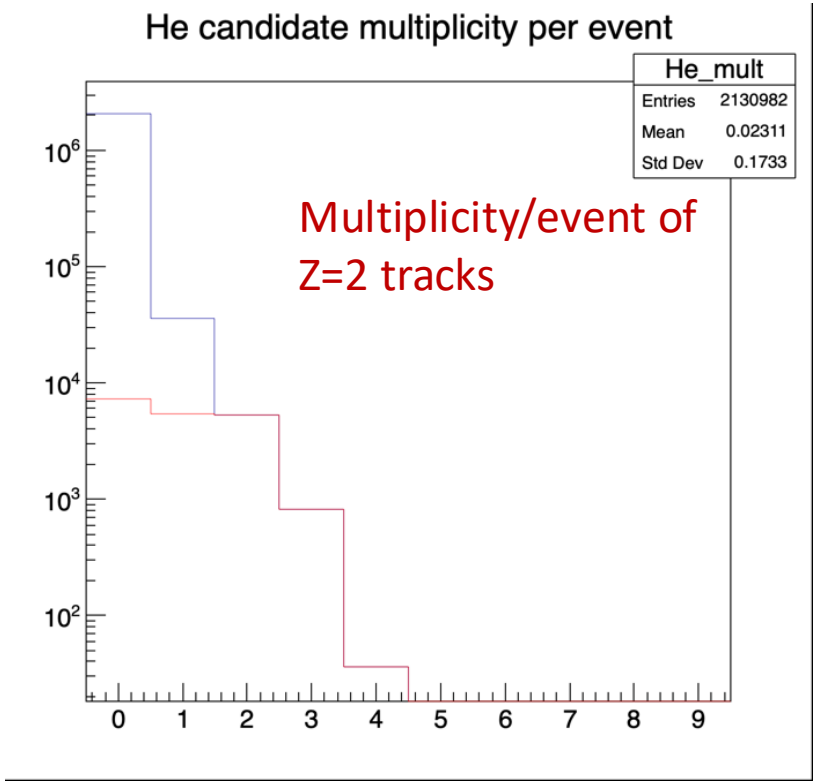
Event and track selection:

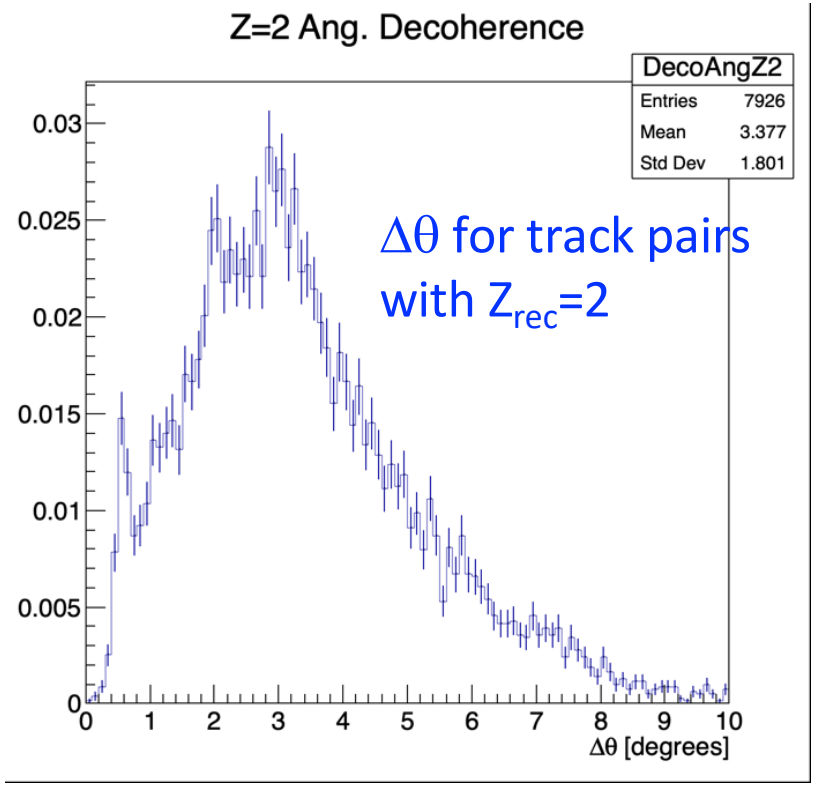
- Pile-up rejection (only 1 pulse in Start Counter Acq. time window)
- Selection on x-y position of primary beam at z=0
- Track acceptance criteria: 1 TW point
- 1 BM track $\otimes$ ≥2 accepted tracks/event
- For each accepted track: selection on the matching between BM track and Global Track on the x-y plane at z=0.

Summary from collaboration meeting - 2

Exp. Data: all selected runs







Final statistics:

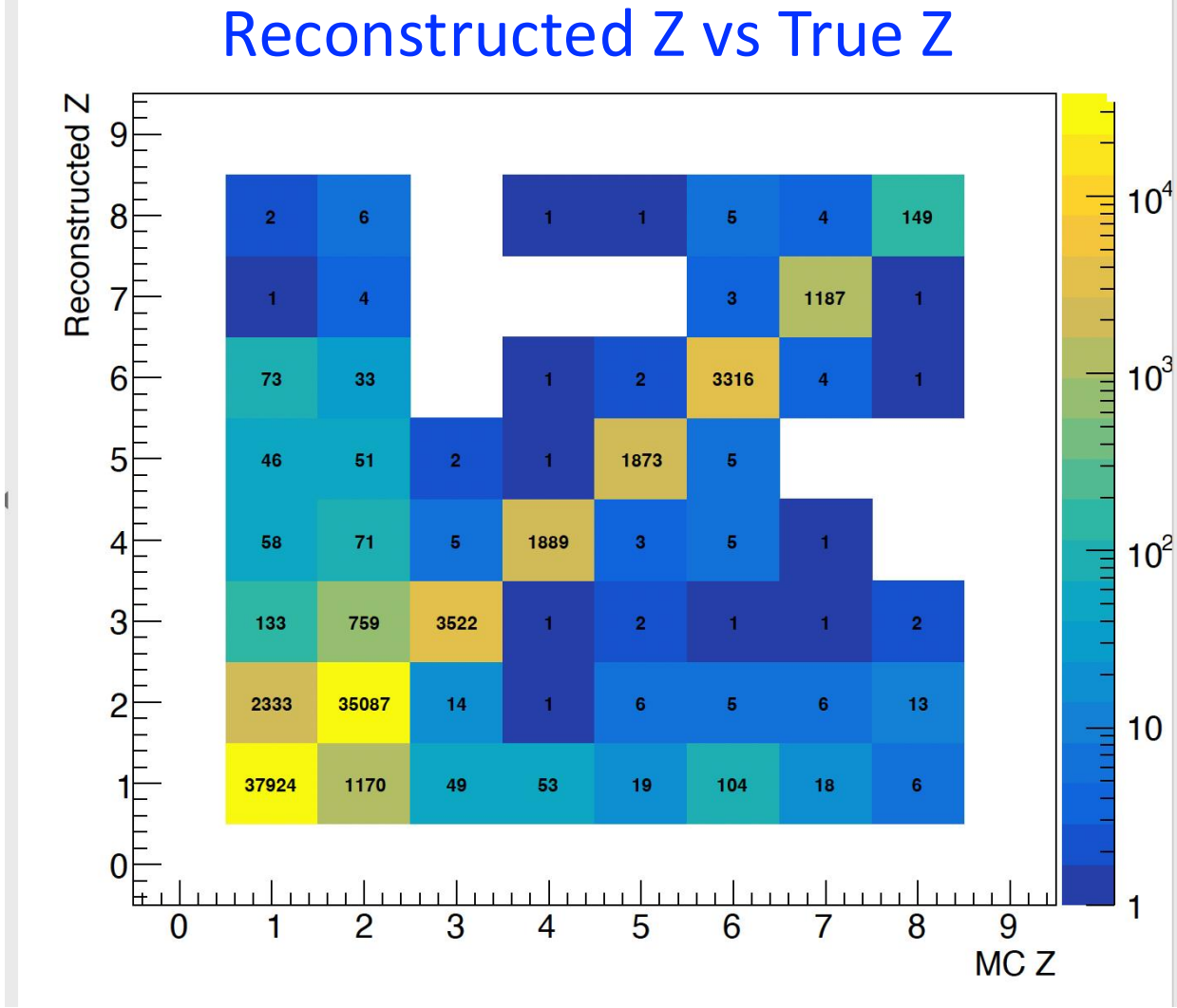
Processed Events: 3306798 Rejected Events: 1175816 (35.6%) Events with 0 Tracks: 745337 (22.5%)

Total no. of Global Tracks: 2521223 (1.82 track/event)

Tracks with 1 TW point: 2105796 (83.5%) Tracks accepted after matching with BM target: 1401234 (66.5%)

Remaining tracks after $N_{track} \geq 2$ selection: 29644 (1.2%), of which Z=2 Tracks: 18487 (62.3% of accept. tracks)

Summary from collaboration meeting - 3: comparison with reconstructed MC



This matrix is essentially diagonal, but the sample of Z=2 tracks has a contamination of Z=1 of the order of ~6.5%

It is unclear if we can trust this prediction: at present we are not including in MC the inefficiency of VT for Z=1 particles

Summary from collaboration meeting - 4: conclusions

- There are still a lot of uncertainties that cannot be simply solved without additional information. For instance, the reliability of Z reconstruction and the amount of Z=1 contamination
- MSD had to be taken away from reconstruction, for the time being. They could be very helpful in this situation

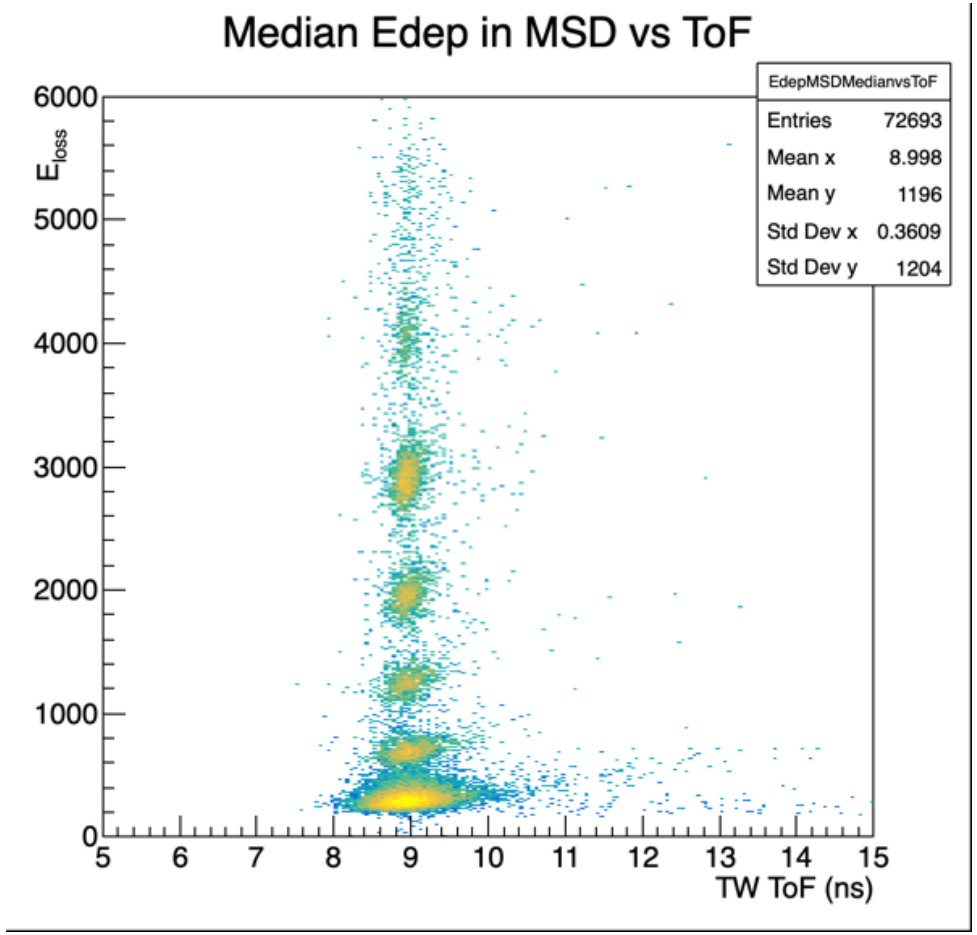
- For this reason, we have tried to have a new reconstruction, now including MSD
- To this purpose, Y.D. reviewed and corrected Straight Line Reconstruction, in order to fix some bugs and to make it behave consistently with GenFit reconstruction in terms of MSD points and Get methods
- Reconstruction was performed using the same requirements for event and track selection. The only difference was to set back MSD in FootGlobal.par. The minimum no. of points/tracks of 4 was maintained

Energy loss in MSD and Z-id

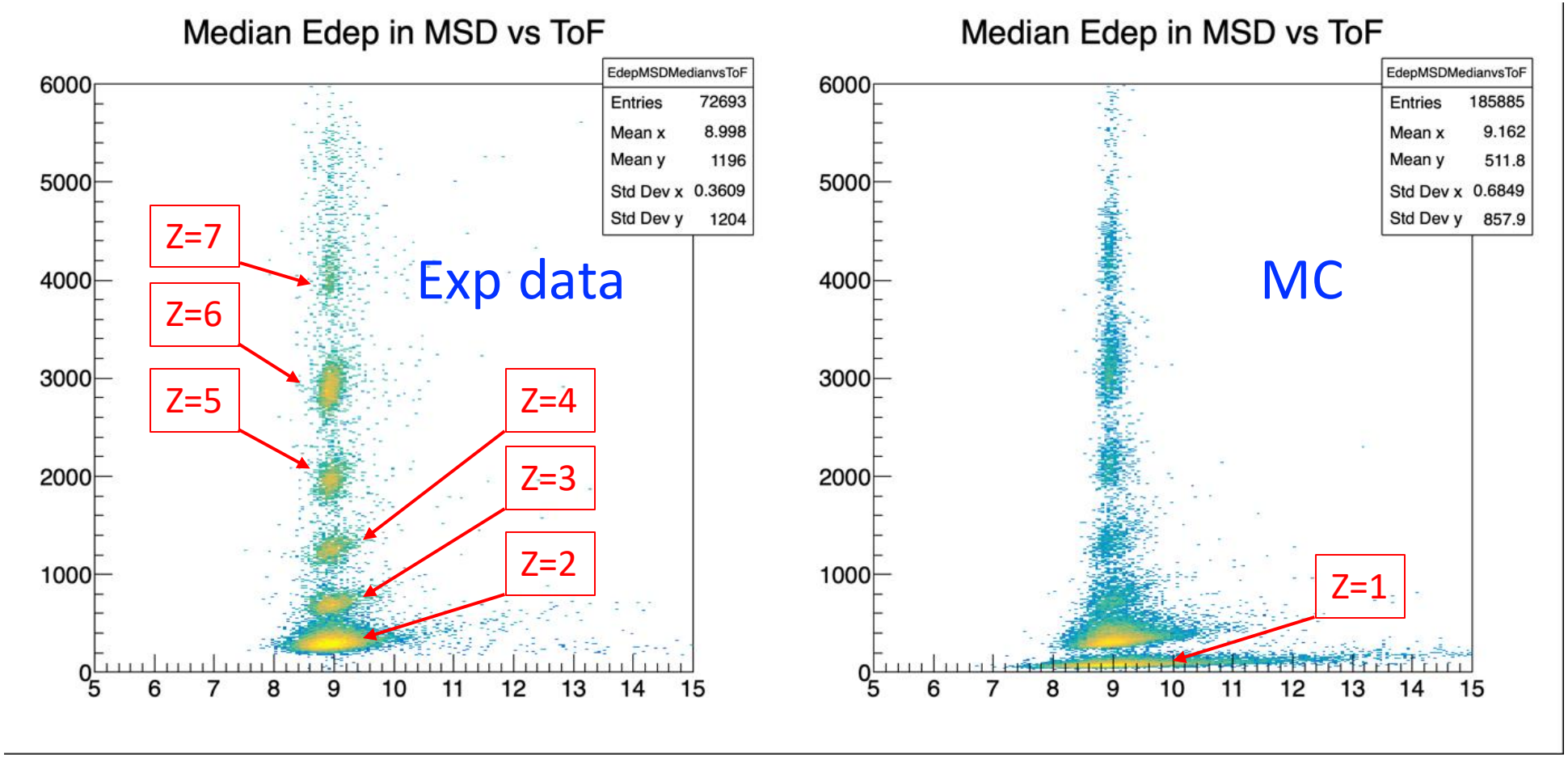
Following what was presented at the Napoli Coll. Meeting by R. Zarrella, we have used energy loss in MSD to identify Z

As a preliminary attempt we consider the median Energy loss in MSD, here plotted as a function of ToF measured by TW

The different Z are immediately separable

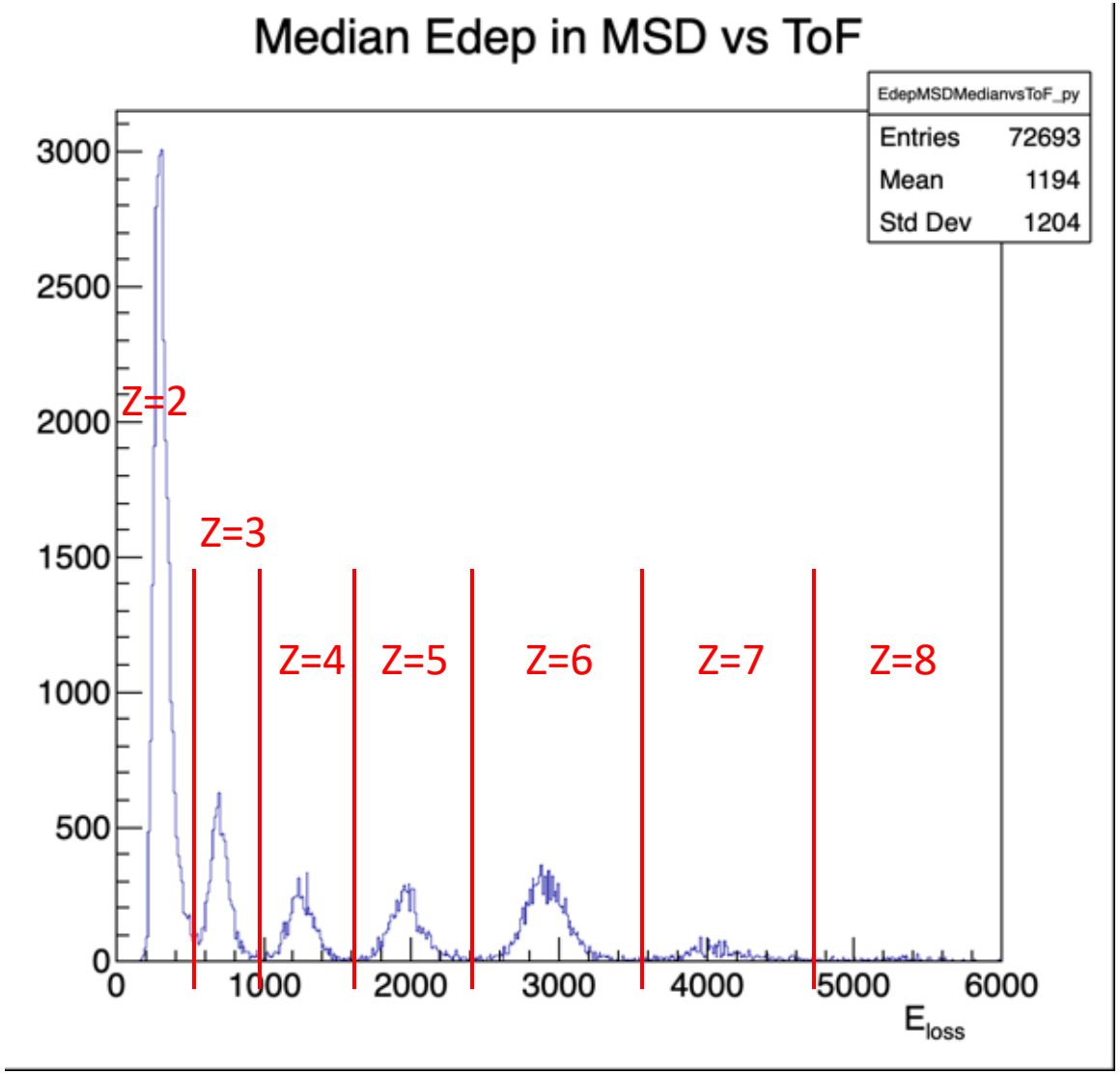


Comparison with MC (same reconstruction and selection)



Z=1 in exp. data are completely cut out. A threshold effect?

Rough (preliminary!) Z selection in MSD

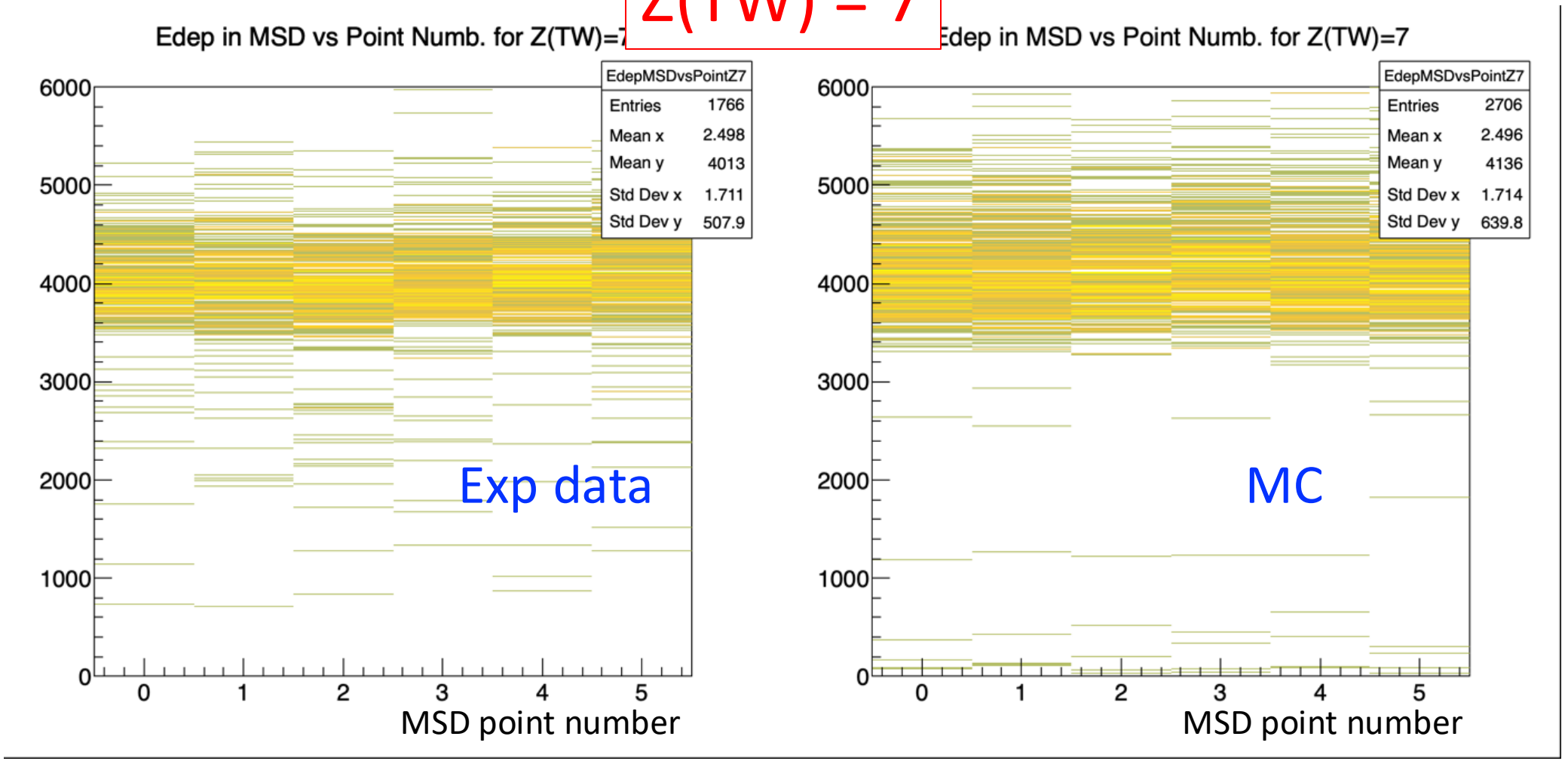


Curve lines in the 2-dim plot would be of course a cleaner way to do the job…

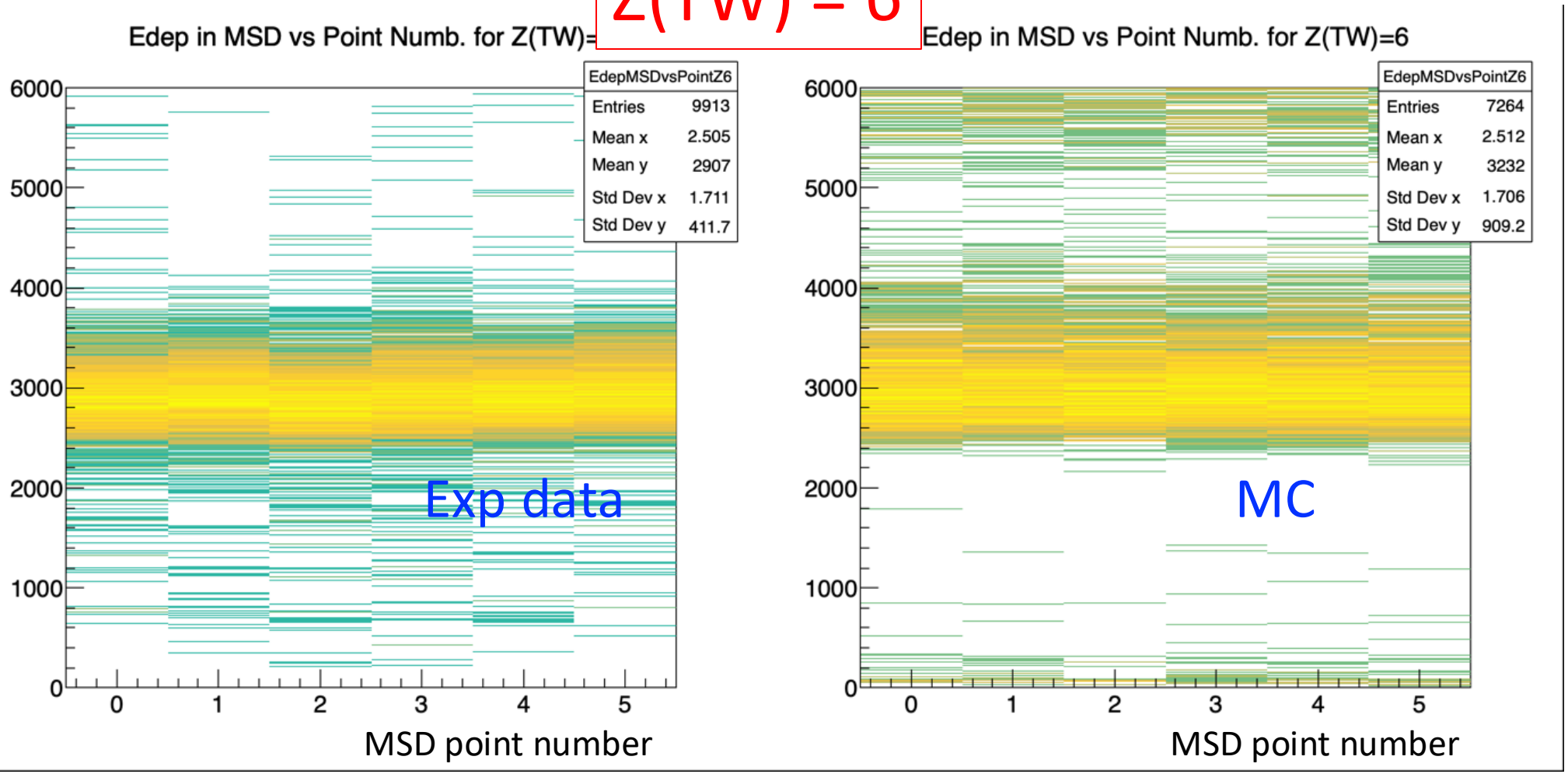
E_{loss} vs point number in MSD

Select Z using TW point and look at MSD

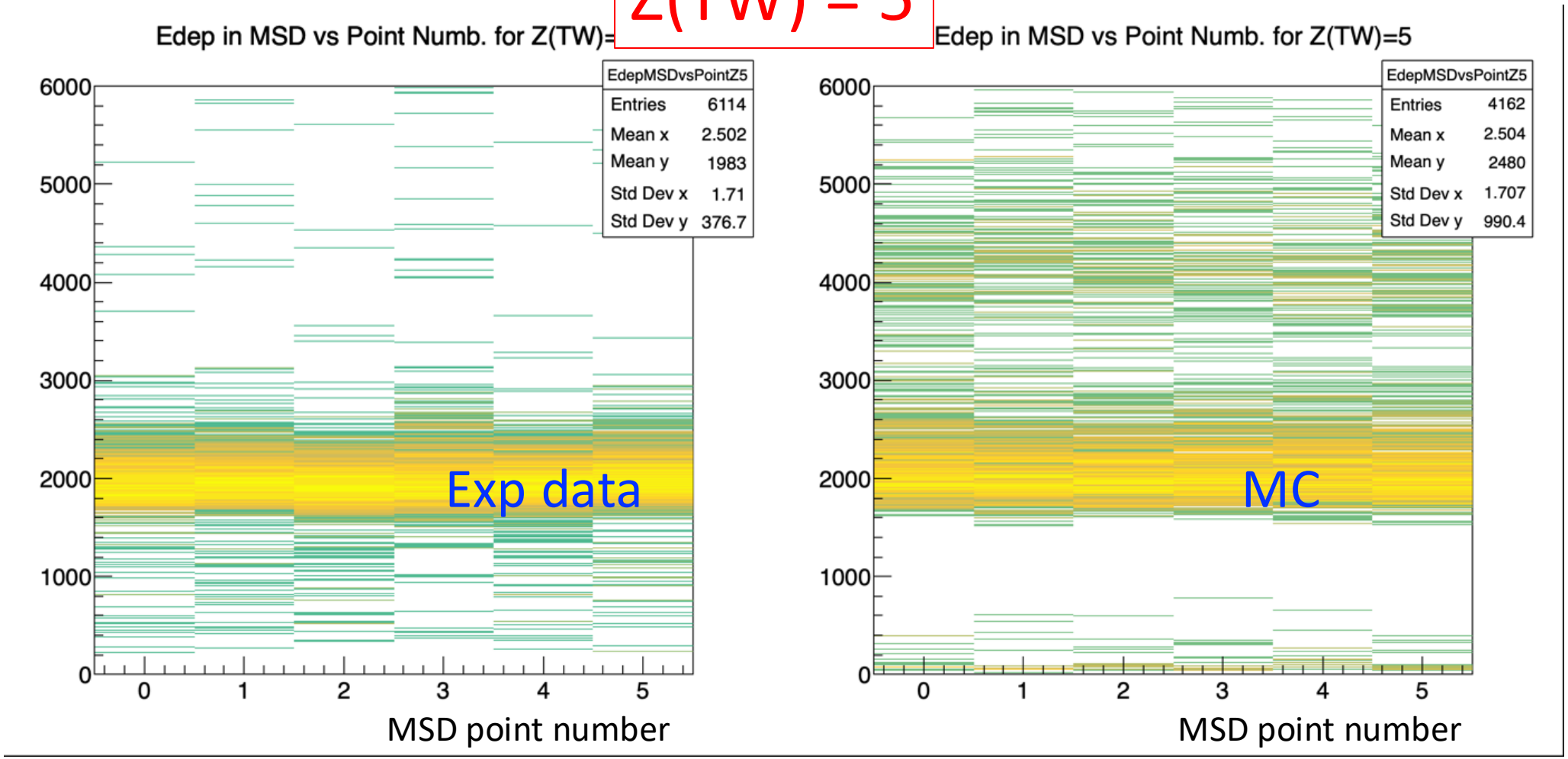
Z(TW) = 7



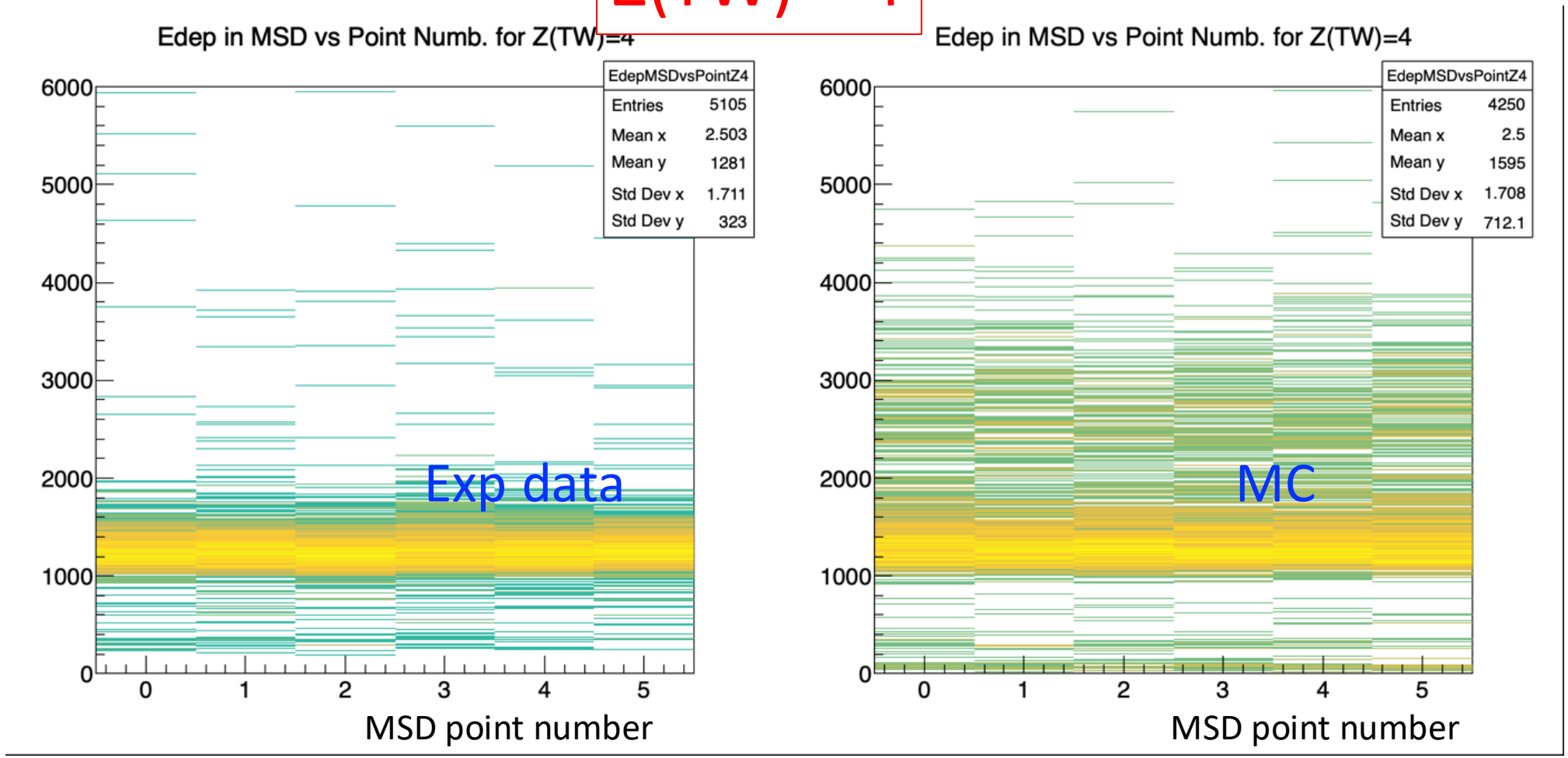
Z(TW) = 6


Edep in MSD vs Point Numb. for Z(TW)=
EdepMSDvsPointZ6
Entries 9913
Mean x 2.505
Mean y 2907
Std Dev x 1.711
Std Dev y 411.7
Exp data
MSD point number
Edep in MSD vs Point Numb. for Z(TW)=6
EdepMSDvsPointZ6
Entries 7264
Mean x 2.512
Mean y 3232
Std Dev x 1.706
Std Dev y 909.2
MC
MSD point number

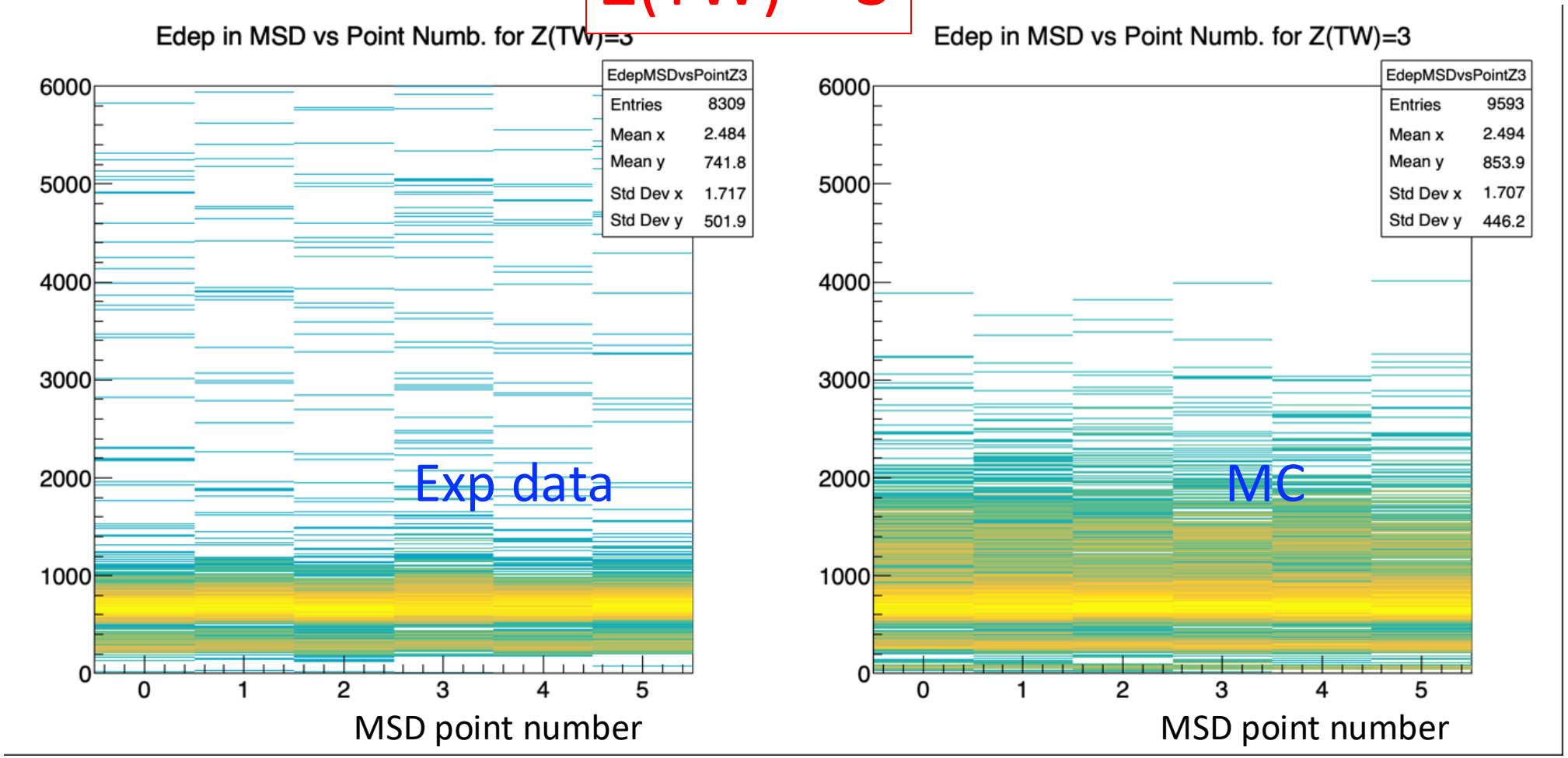
Z(TW) = 5


Edep in MSD vs Point Numb. for Z(TW)=
EdepMSDvsPointZ5
Entries 6114
Mean x 2.502
Mean y 1983
Std Dev x 1.71
Std Dev y 376.7
Exp data
MSD point number
Edep in MSD vs Point Numb. for Z(TW)=5
EdepMSDvsPointZ5
Entries 4162
Mean x 2.504
Mean y 2480
Std Dev x 1.707
Std Dev y 990.4
MC
MSD point number

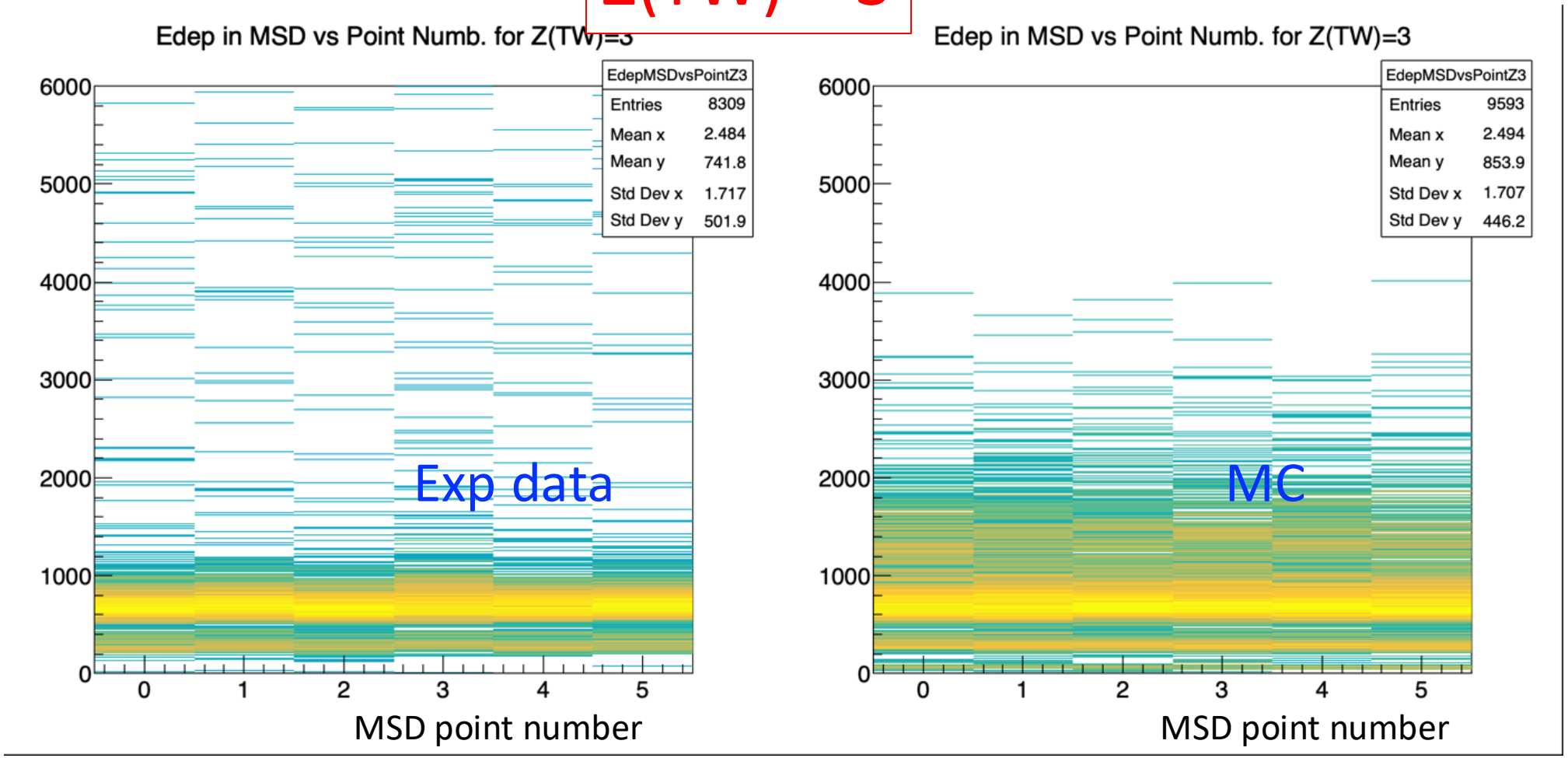
Z(TW) = 4


Edep in MSD vs Point Numb. for Z(TW)=4
EdepMSDvsPointZ4
Entries 5105
Mean x 2.503
Mean y 1281
Std Dev x 1.711
Std Dev y 323
Exp data
MSD point number
Edep in MSD vs Point Numb. for Z(TW)=4
EdepMSDvsPointZ4
Entries 4250
Mean x 2.5
Mean y 1595
Std Dev x 1.708
Std Dev y 712.1
MC
MSD point number

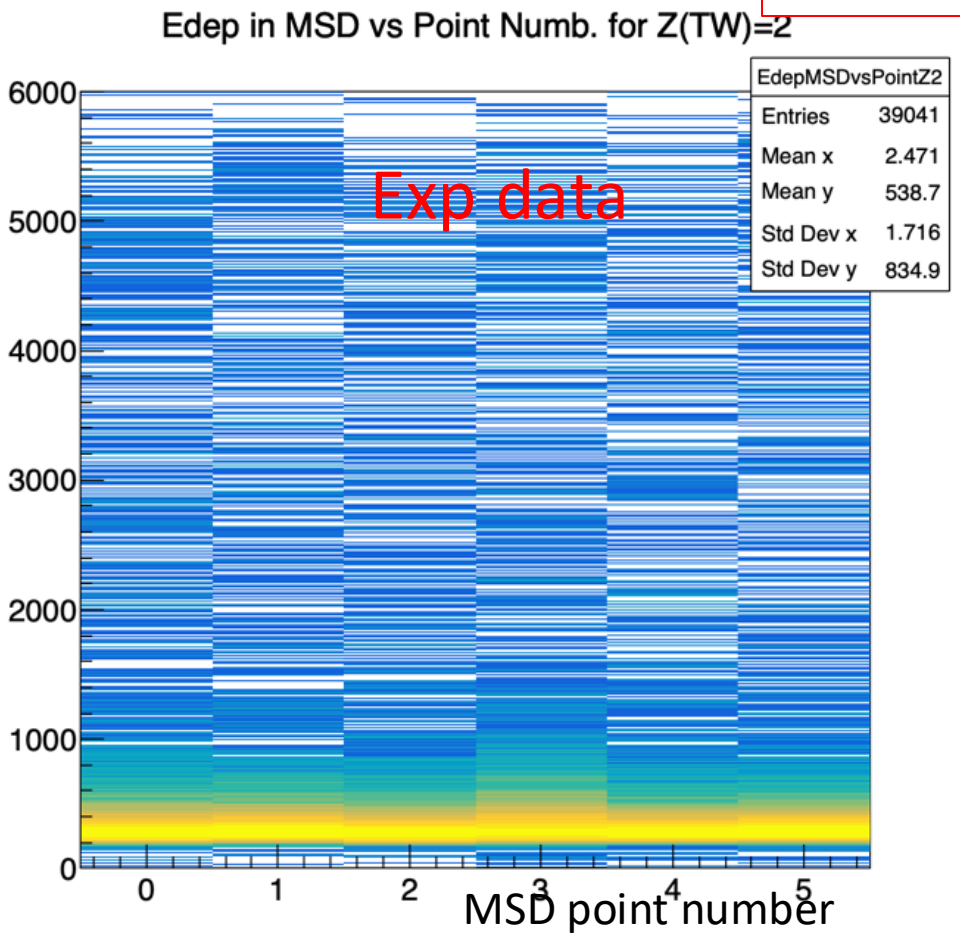
Z(TW) = 3

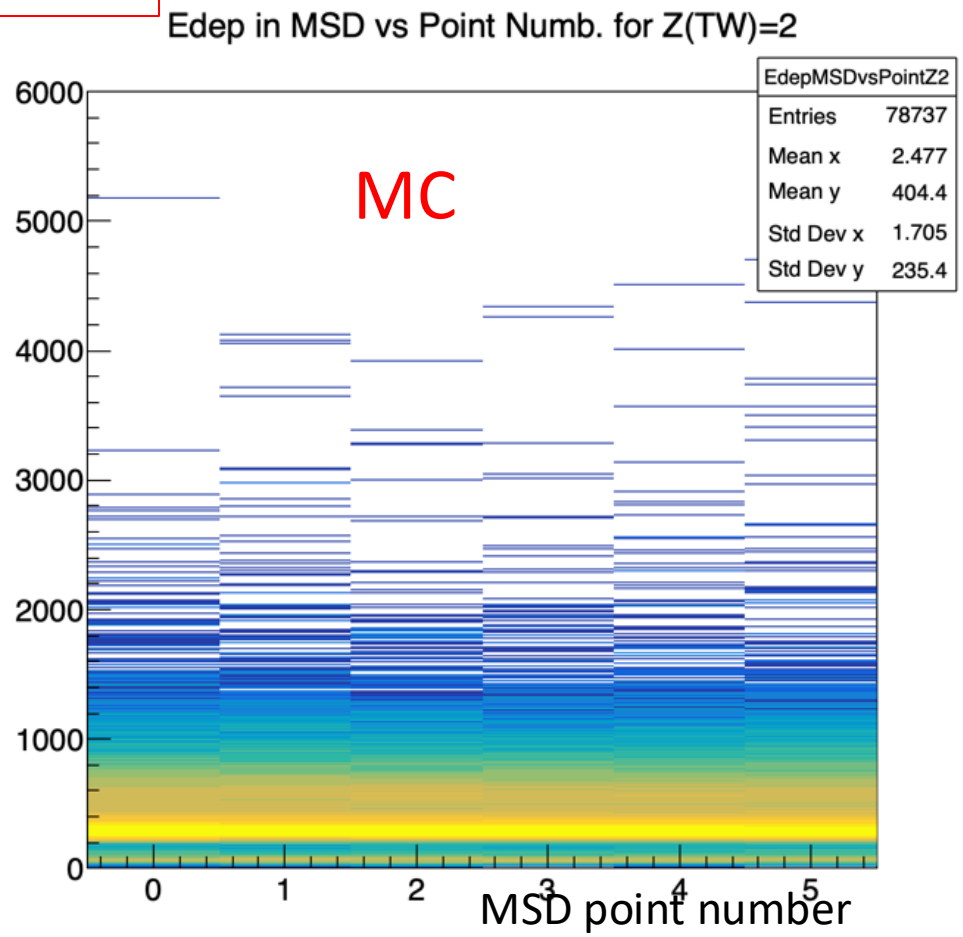

Edep in MSD vs Point Numb. for Z(TW)=3
EdepMSDvsPointZ3
Entries 8309
Mean x 2.484
Mean y 741.8
Std Dev x 1.717
Std Dev y 501.9
Exp data
MSD point number
Edep in MSD vs Point Numb. for Z(TW)=3
EdepMSDvsPointZ3
Entries 9593
Mean x 2.494
Mean y 853.9
Std Dev x 1.707
Std Dev y 446.2
MC
MSD point number

Z(TW) = 3

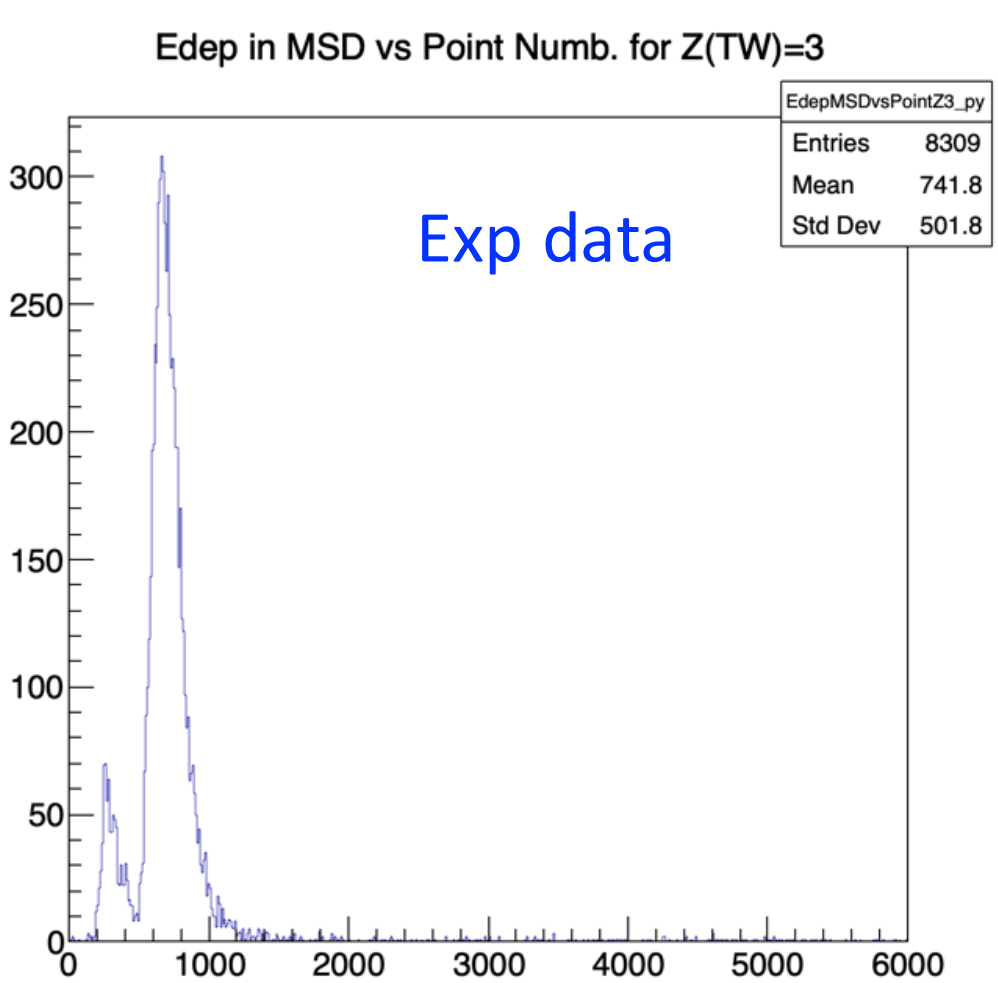

Edep in MSD vs Point Numb. for Z(TW)=3
EdepMSDvsPointZ3
Entries 8309
Mean x 2.484
Mean y 741.8
Std Dev x 1.717
Std Dev y 501.9
Exp data
MSD point number
Edep in MSD vs Point Numb. for Z(TW)=3
EdepMSDvsPointZ3
Entries 9593
Mean x 2.494
Mean y 853.9
Std Dev x 1.707
Std Dev y 446.2
MC
MSD point number

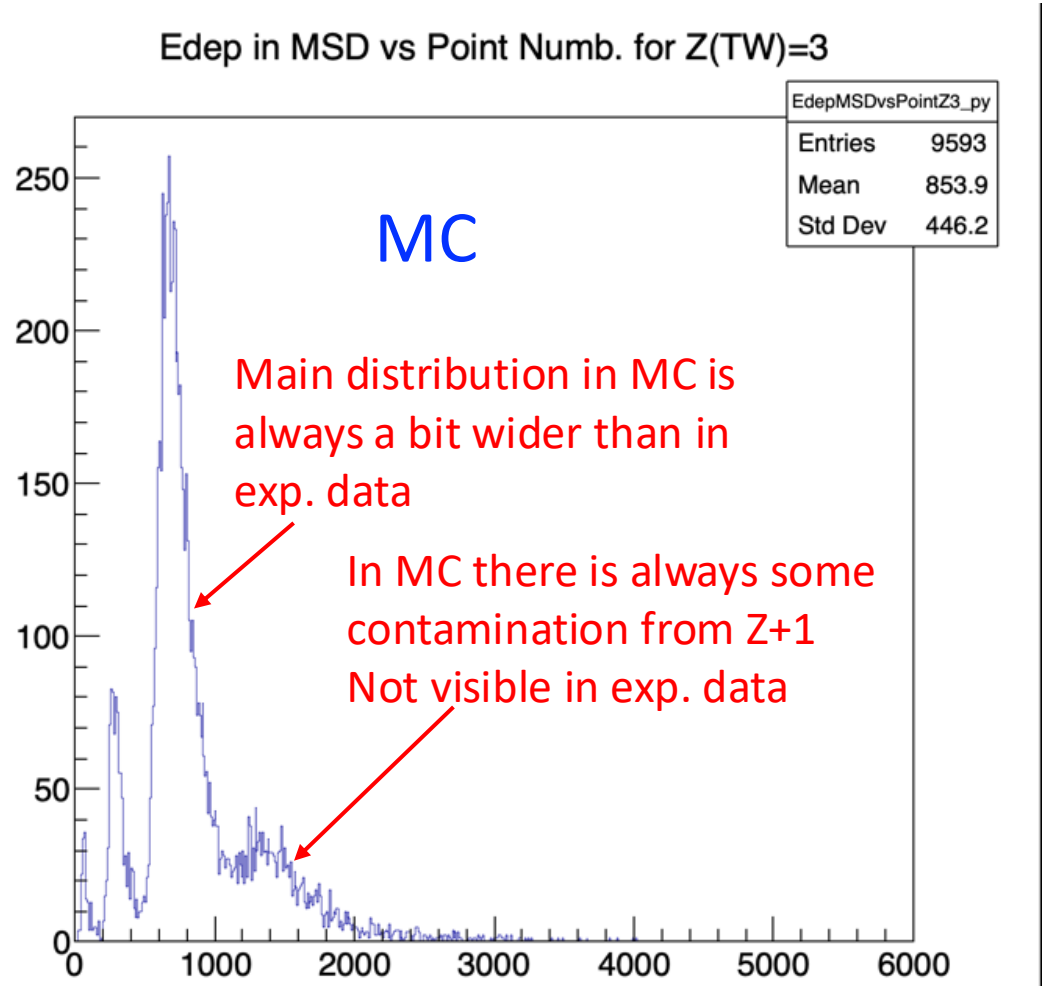
Z(TW) = 2


Edep in MSD vs Point Numb. for Z(TW)=2
EdepMSDvsPointZ2
Entries 39041
Mean x 2.471
Mean y 538.7
Std Dev x 1.716
Std Dev y 834.9
Exp data
6000
5000
4000
3000
2000
1000
0
0 1 2 3 4 5
MSD point number

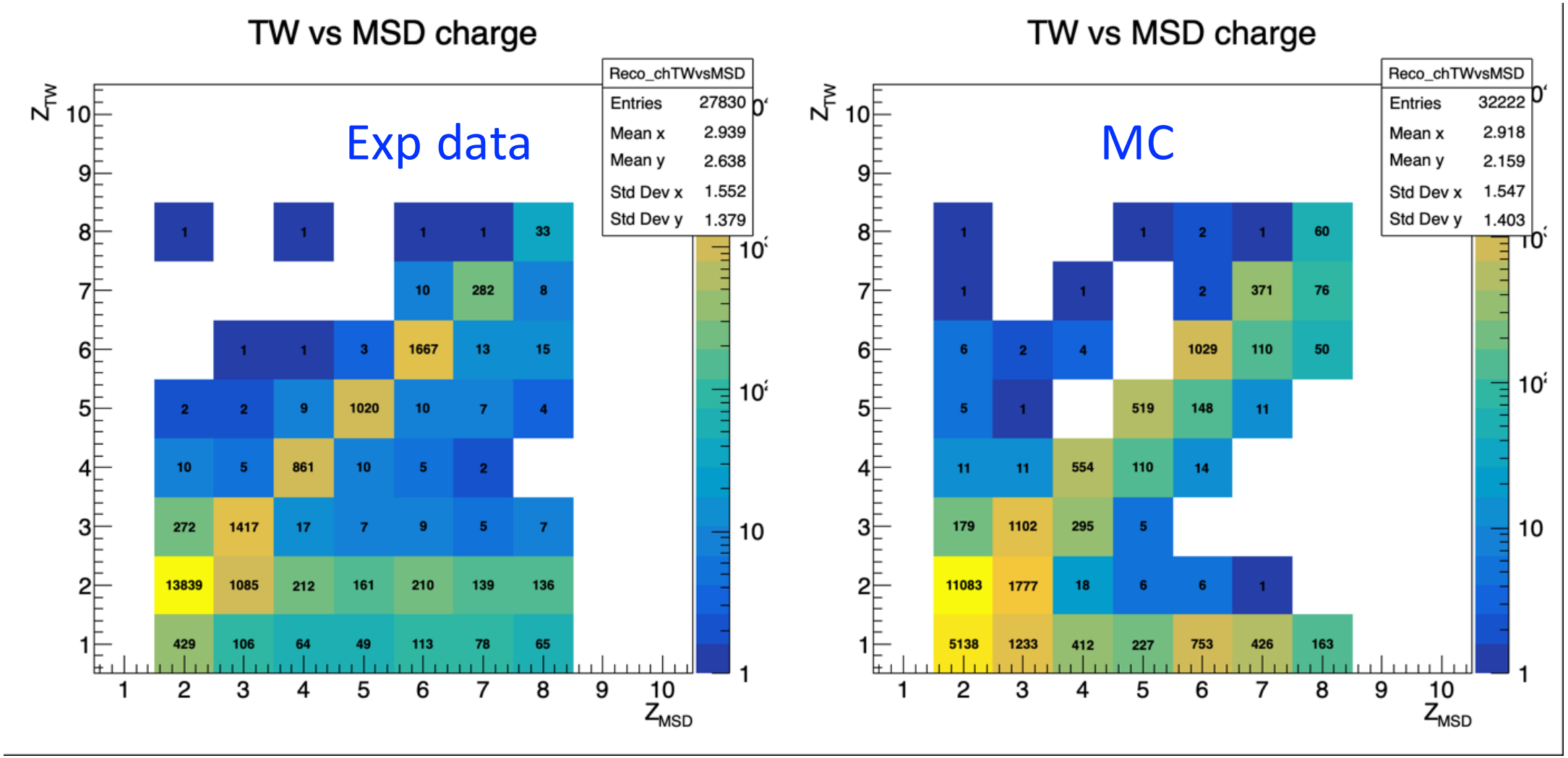

Edep in MSD vs Point Numb. for Z(TW)=2
EdepMSDvsPointZ2
Entries 78737
Mean x 2.477
Mean y 404.4
Std Dev x 1.705
Std Dev y 235.4
MC
6000
5000
4000
3000
2000
1000
0
0 1 2 3 4 5
MSD point number

One case (Z_{TW}=3) seen in projection

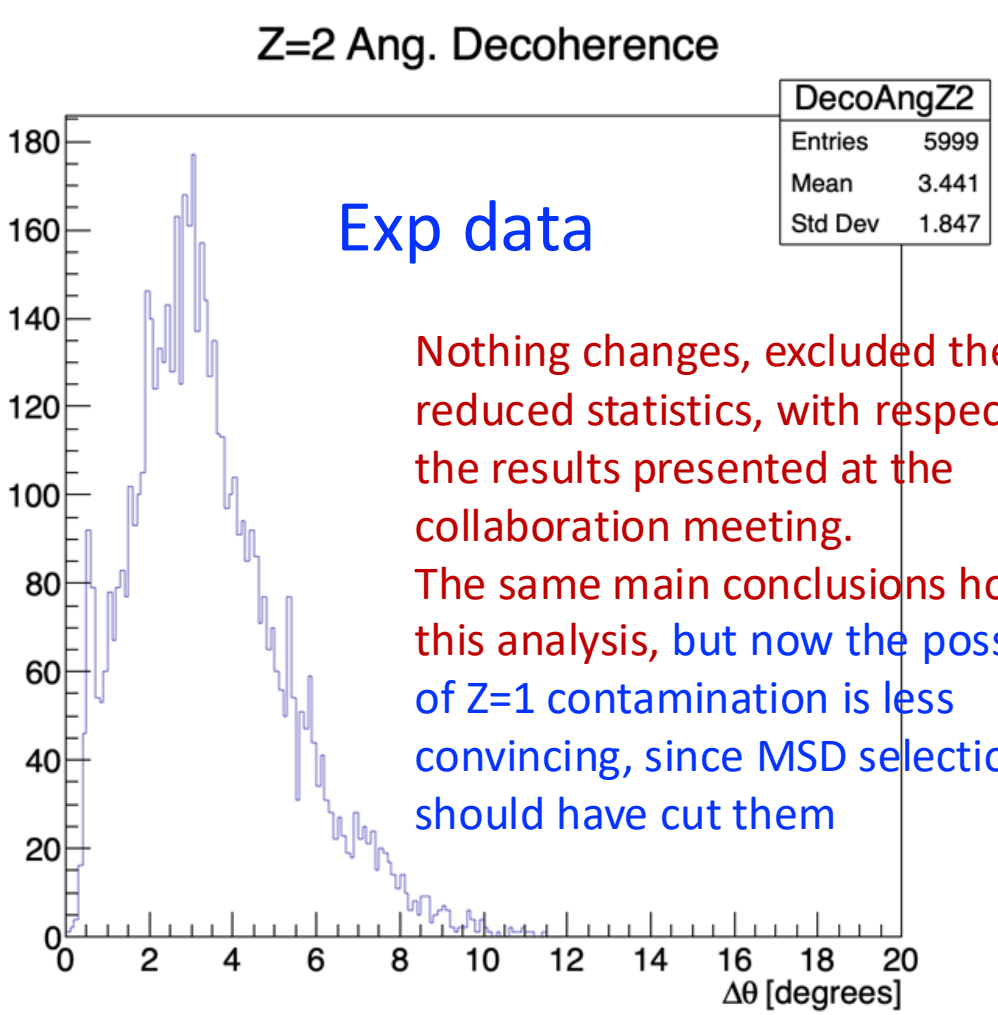




Z_{TW} vs Z_{MSD}

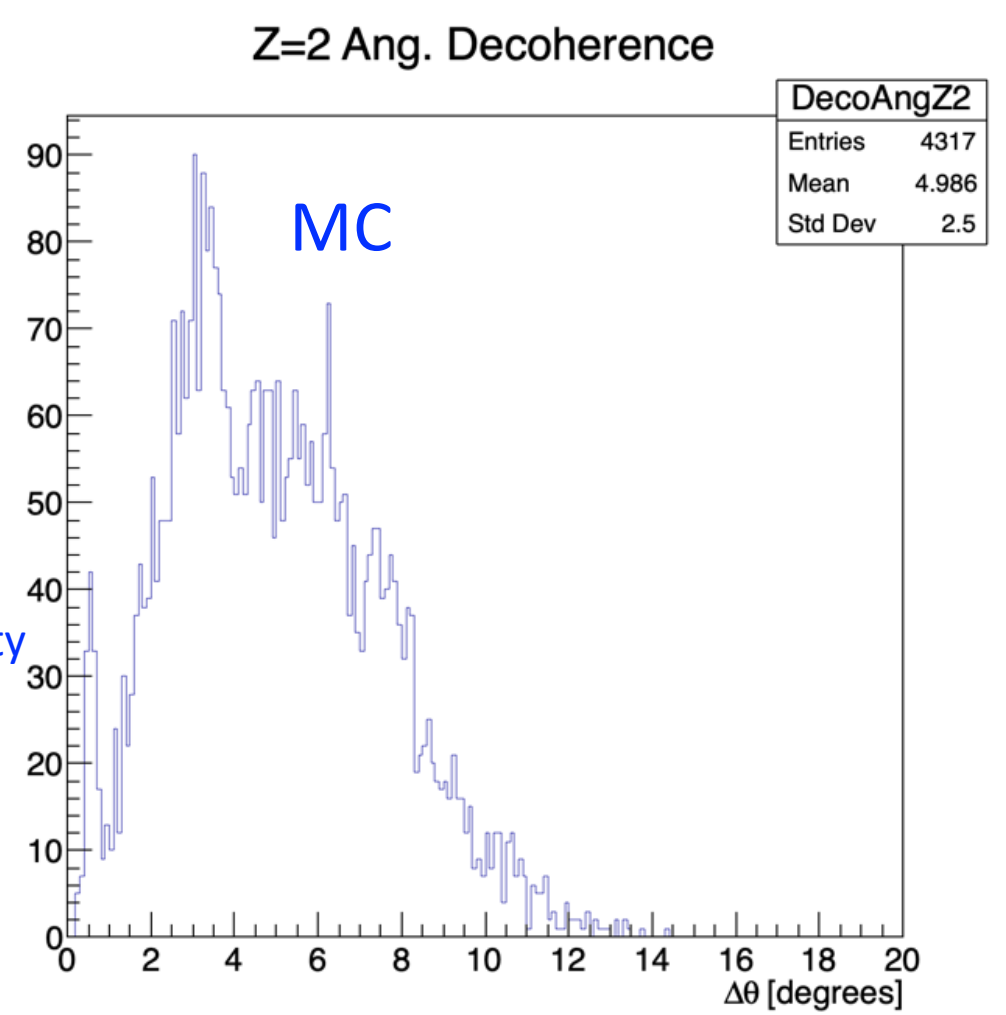

TW vs MSD charge
Exp data
Reco_chTWvsMSD
Entries 27830
Mean x 2.939
Mean y 2.638
Std Dev x 1.552
Std Dev y 1.379
Z_{TW}
Z_{MSD}
TW vs MSD charge
MC
Reco_chTWvsMSD
Entries 32222
Mean x 2.918
Mean y 2.159
Std Dev x 1.547
Std Dev y 1.403
Z_{TW}
Z_{MSD}

Attempt to select $Z_{TW} = Z_{MSD} = 2$ for $\Delta\theta$ analysis



Nothing changes, excluded the reduced statistics, with respect to the results presented at the collaboration meeting.

The same main conclusions hold in this analysis, but now the possibility of Z=1 contamination is less convincing, since MSD selection should have cut them



Some preliminary conclusion

- As far as GSI2021 data are concerned, the energy loss in MSD seems already to be working as additional Z-id tool, even if pedestals etc are not yet fixed
- Z=1 is not visible in MSD exp data
- There are strong similarities between MC and exp. data as far as average values are concerned
- However, there are instead important difference: MC seems dirtier than data, except than the Z=2 case, where is the opposite
- All this is of course, still preliminary. Many things are yet to be understood