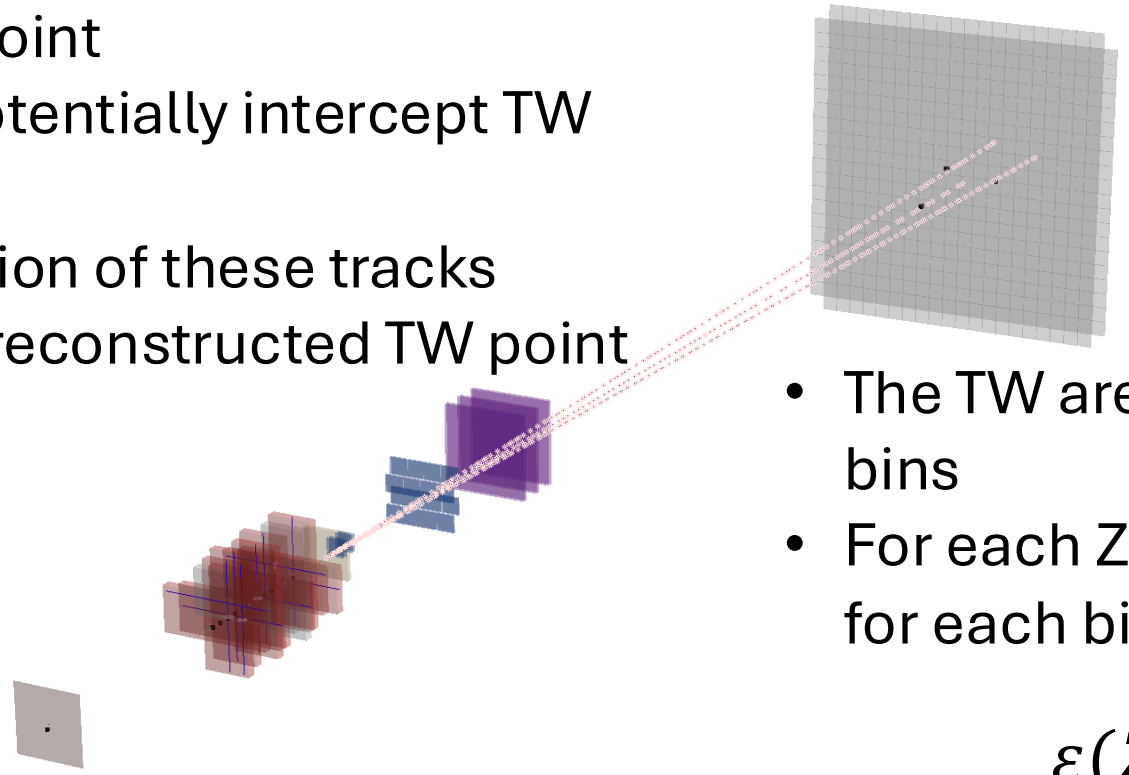
A preliminary evaluation of TW efficiency as a function of Z and x-y position

G.B.

Basic idea

- Select global tracks for which it is possible to identify the charge Z using MSD only, without any requirement on the existence of TW point
- Verify that they potentially intercept TW
  N_{in}
- Measure the fraction of these tracks which has also a reconstructed TW point
  N_{inTWp}



- The TW area is divided in 2x2 cm^2 x-y bins
- For each Z_{id}(MSD) obtain the efficiency for each bin

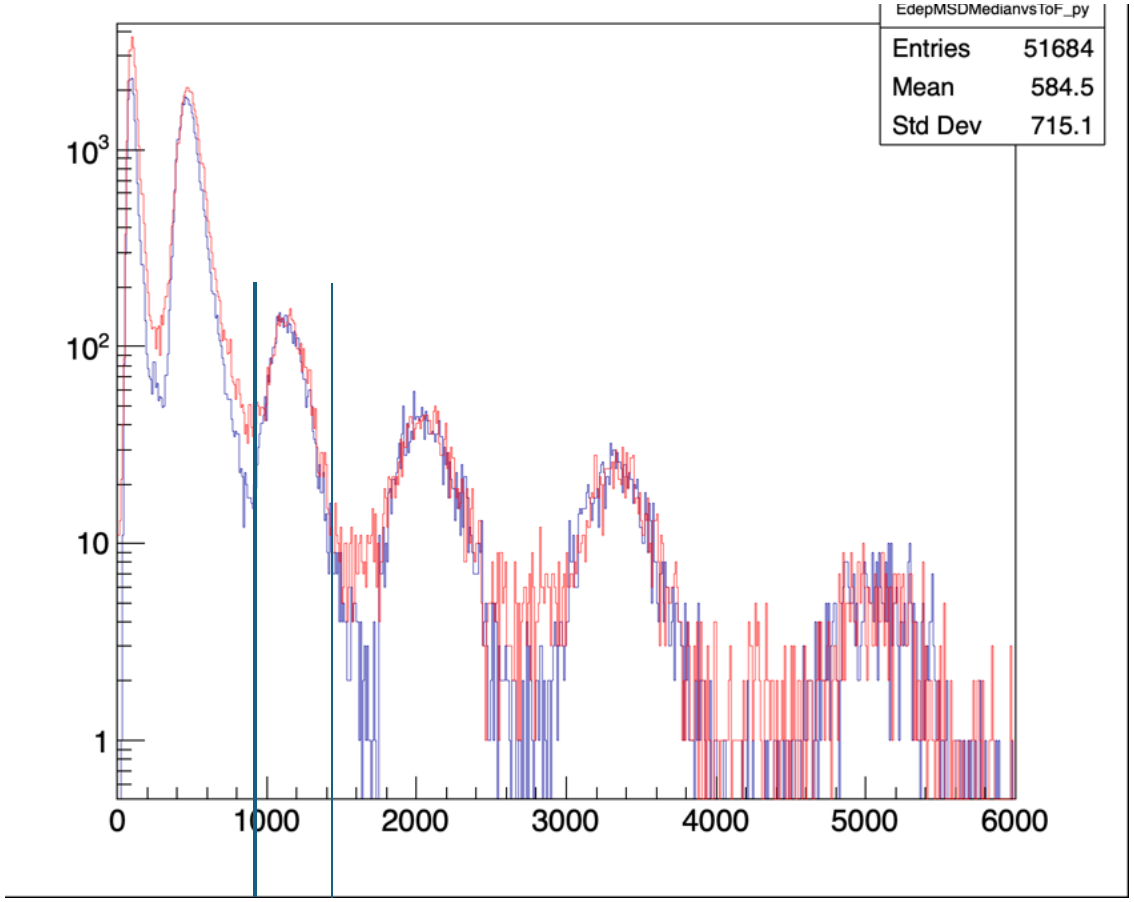
$$\varepsilon(Z, xy) = \frac{N_{inTWp}(Z, xy)}{N_{in}(Z, xy)}$$

Data Selection

- Data CNAO2025 Sept. (no B-field): **2134224** events processed
- Shoe **cnao2025datataking** branch, GentFit reconstruction
- Event Selection:
  - ✓No Pile-up in Start Counter
  - ✓1 BM track
  - ✓1 VT vertex matched with BM track
  - ✓z coordinate of matched vertex in range within target
  - ✓≥ 2 Global Tracks with >2 VT points + ≥2 MSD points (no requirement on TW point)
- Comparison with CNAO25SEP_MC simulated data

Exp. Data Zid using MSD only

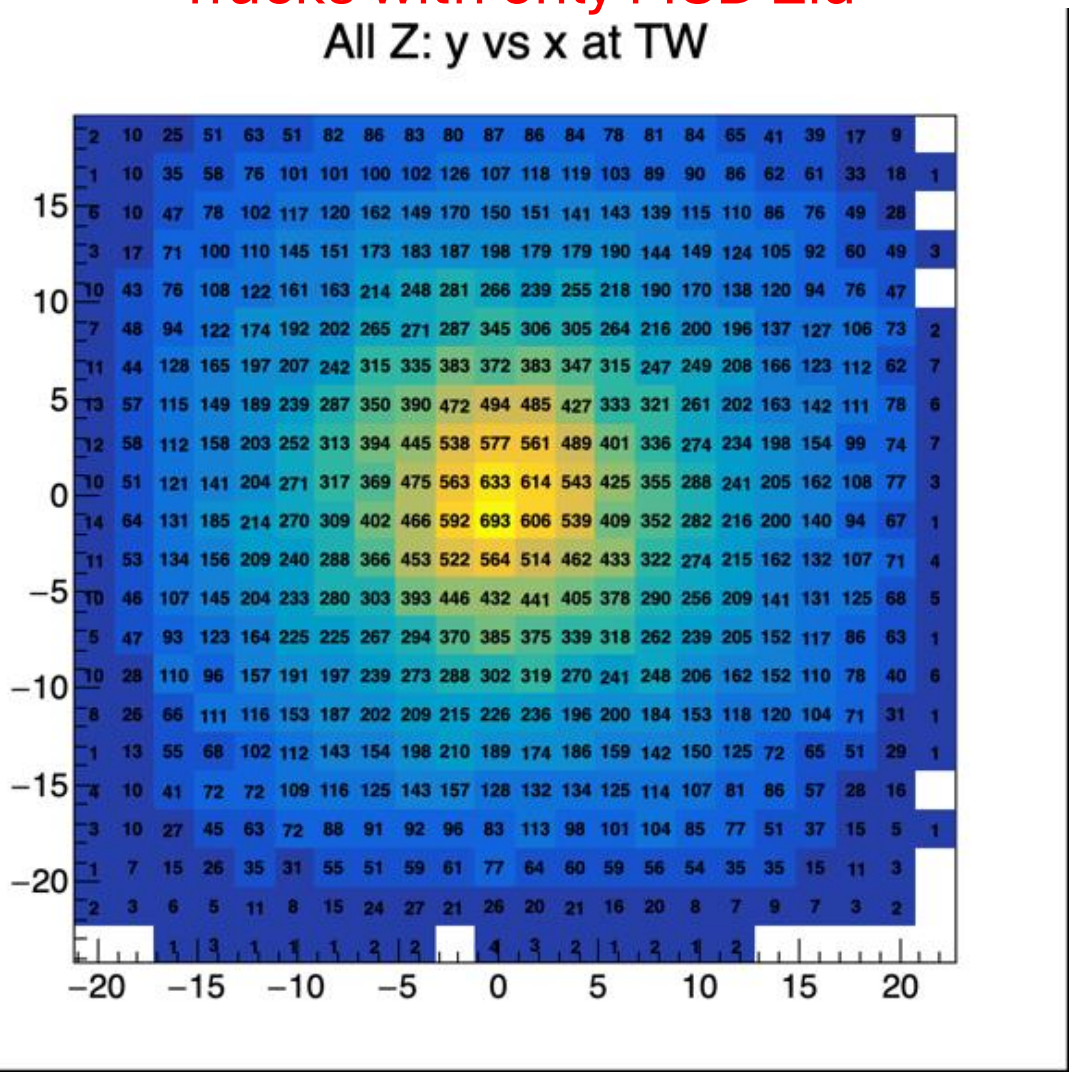
Edep(MSD) = average of Edep in the different sensors



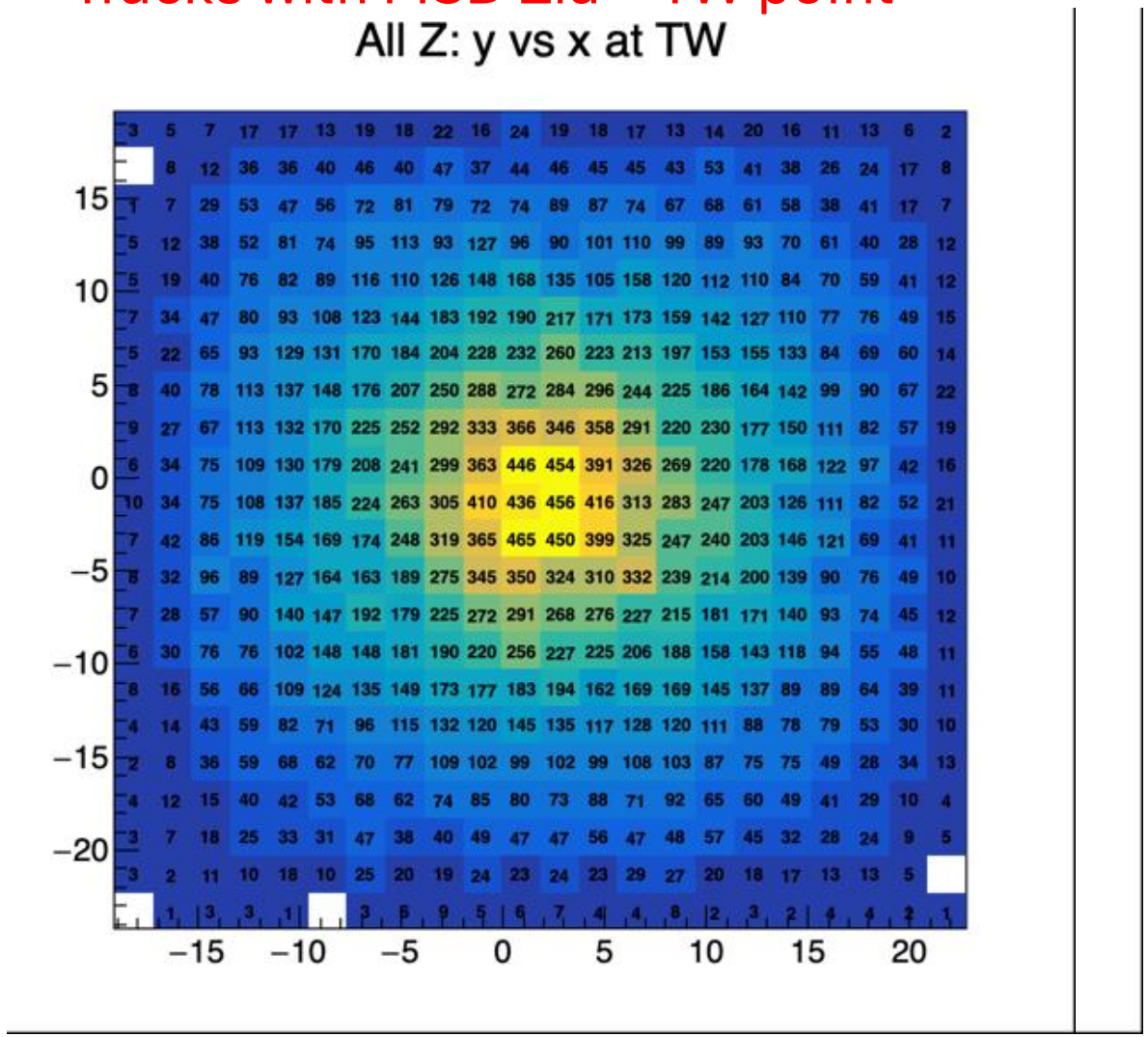

```
if (EdepMSDmed<=30.) {
  ChMSD = 0;
} else if (EdepMSDmed>30. && EdepMSDmed<230.) {
  ChMSD = 1;
} else if (EdepMSDmed>330. && EdepMSDmed<750.) {
  ChMSD = 2;
} else if (EdepMSDmed>990. && EdepMSDmed<1400.) {
  ChMSD = 3;
} else if (EdepMSDmed>1750. && EdepMSDmed<2500.) {
  ChMSD = 4;
} else if (EdepMSDmed>3000. && EdepMSDmed<4000.) {
  ChMSD = 5;
} else if (EdepMSDmed>4500) {
  ChMSD = 6;
}
```

Exp. Data all Z

Tracks with only MSD Zid

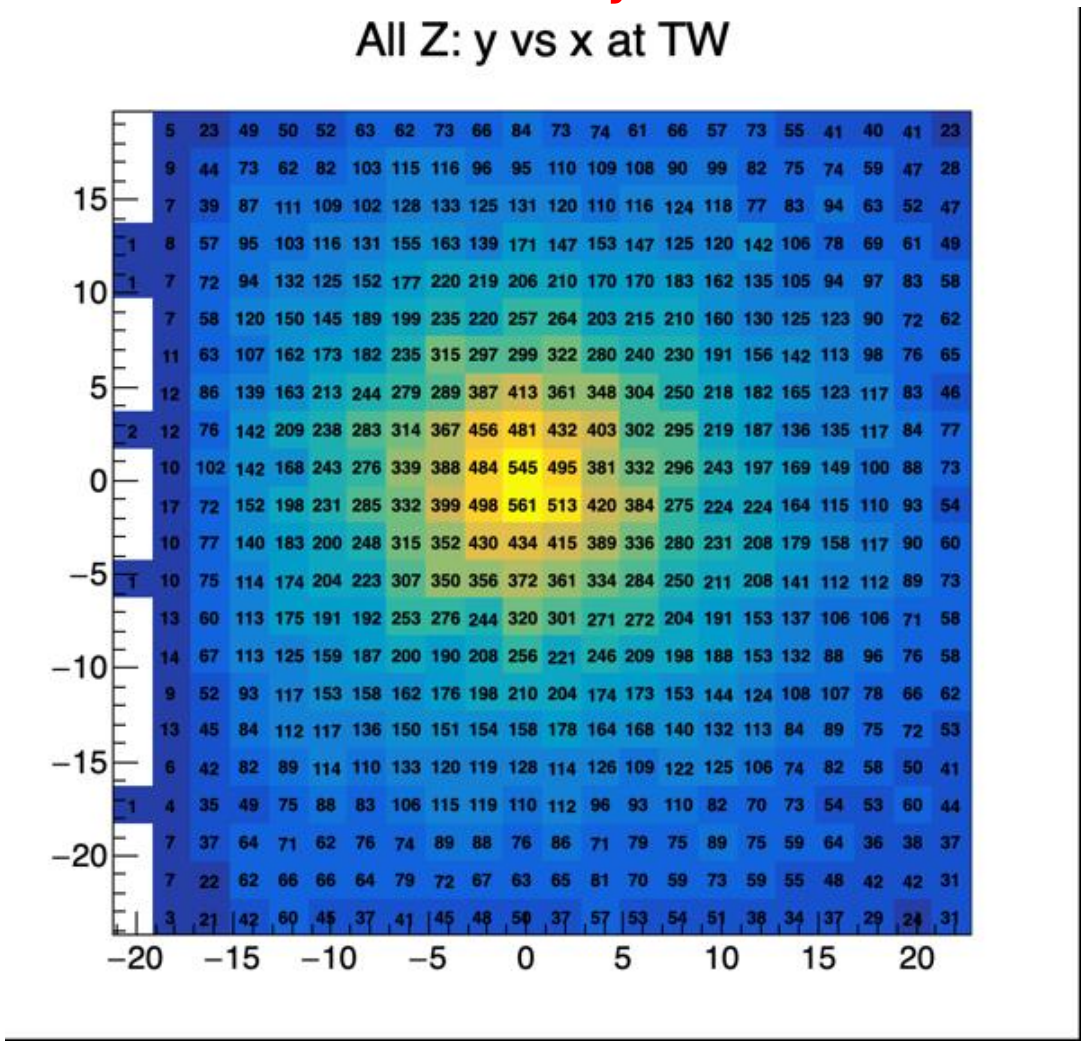


Tracks with MSD Zid + TW point

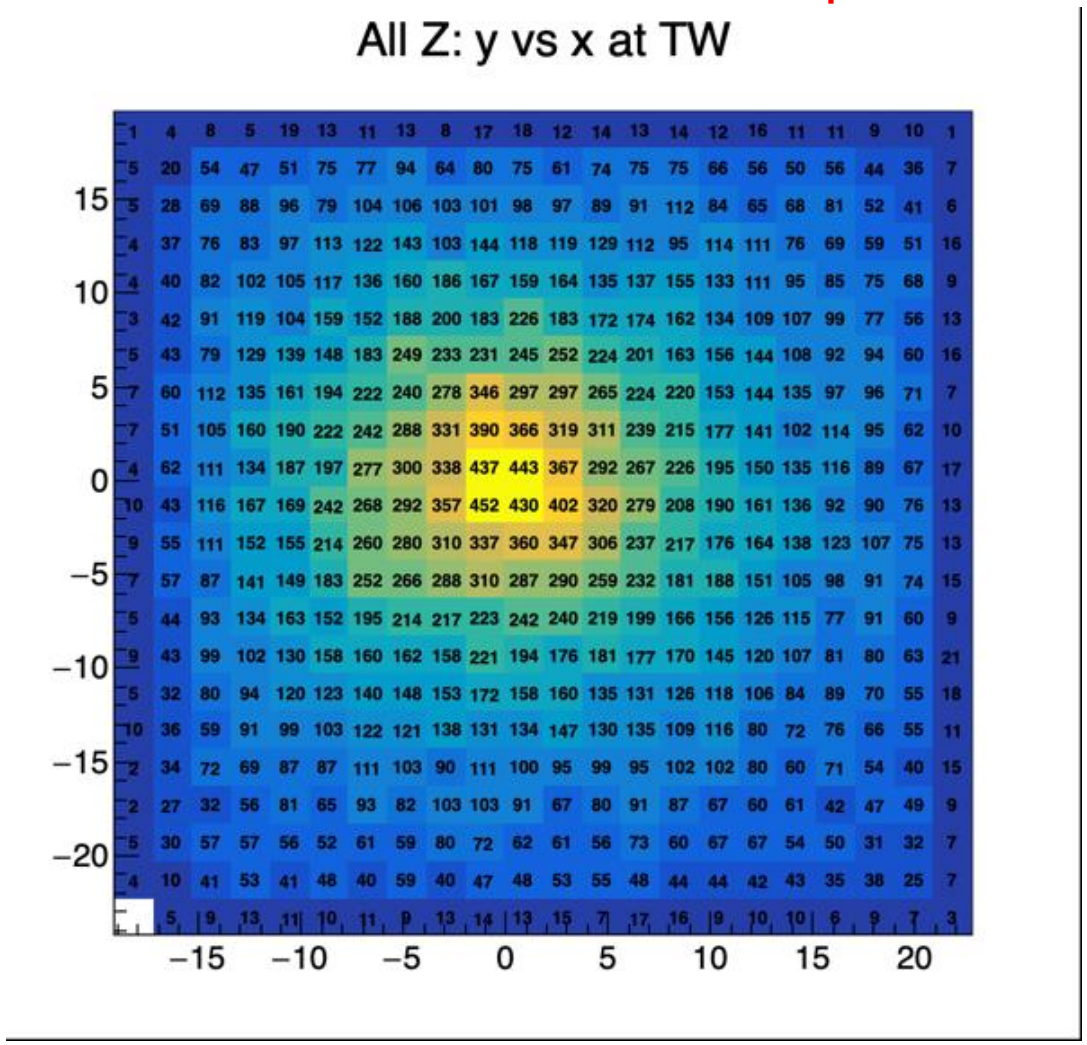


MC all Z

Tracks with only MSD Zid

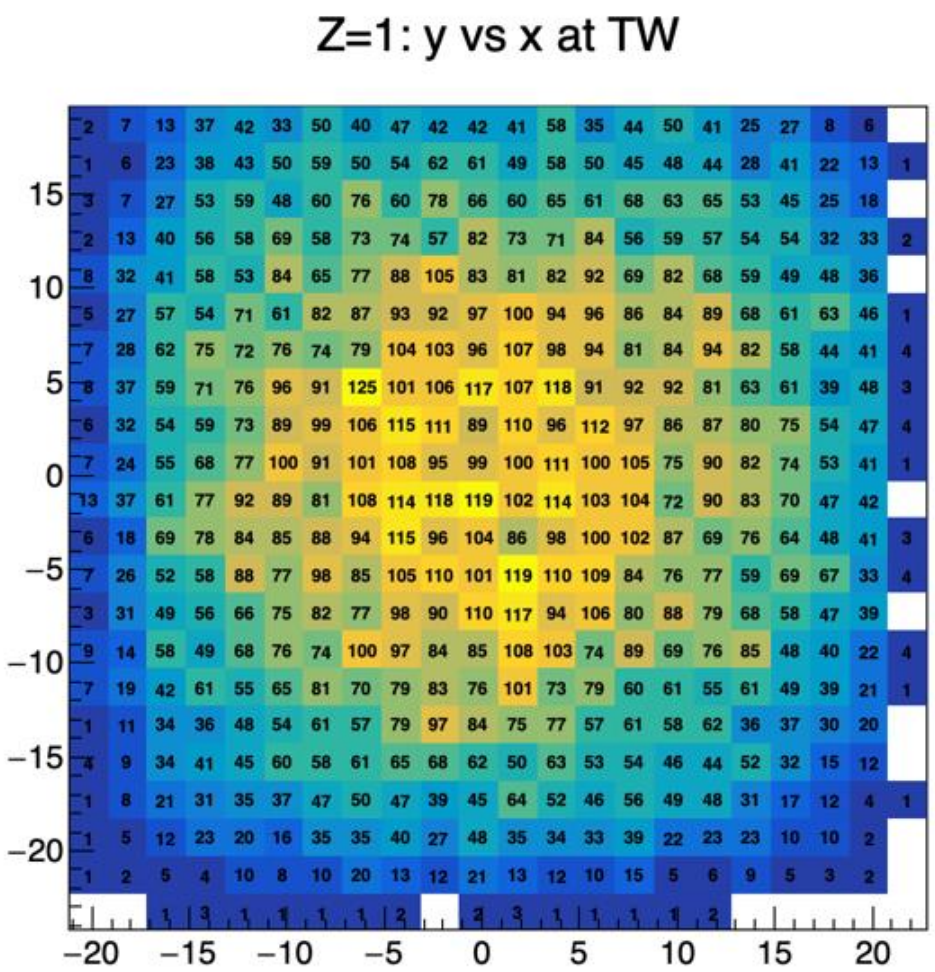


Tracks with MSD Zid + TW point

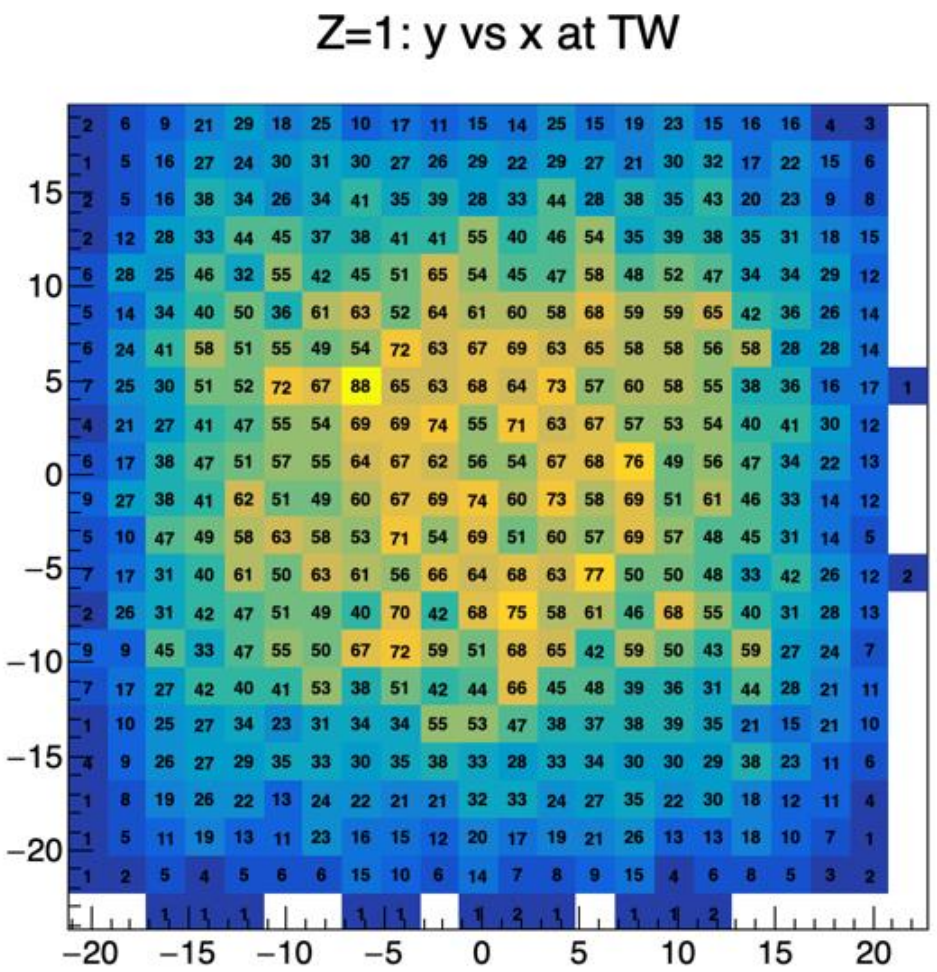


Exp data Z=1

Tracks with only MSD Zid



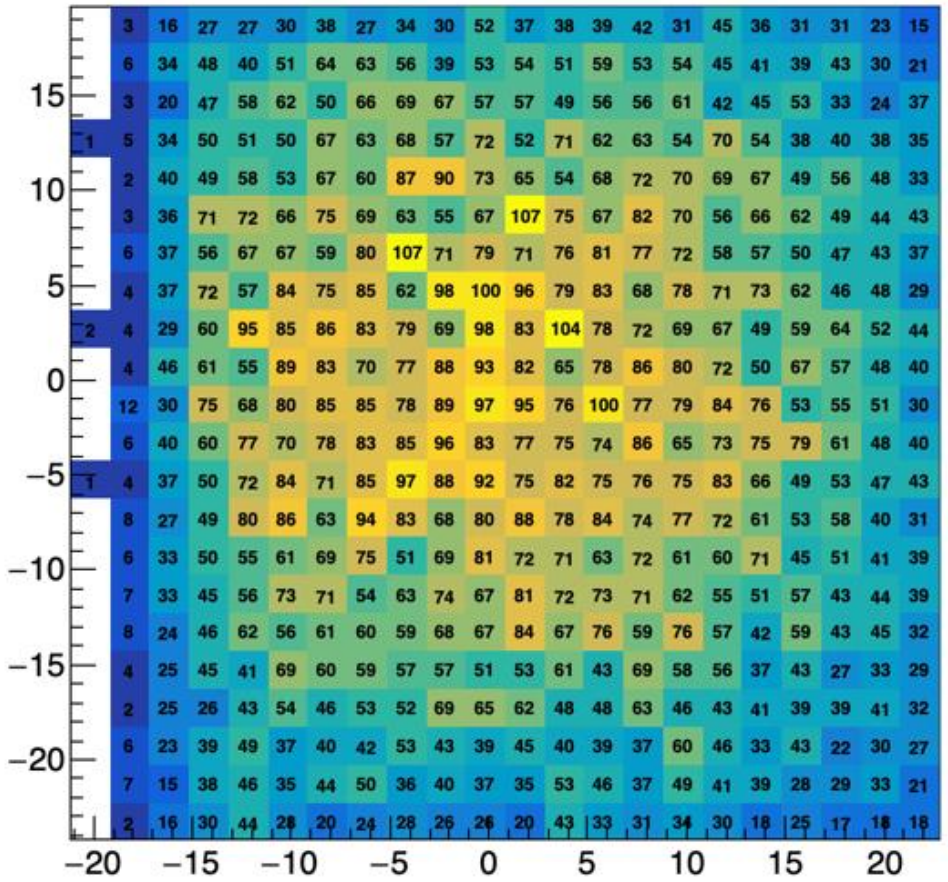
Tracks with MSD Zid + TW point



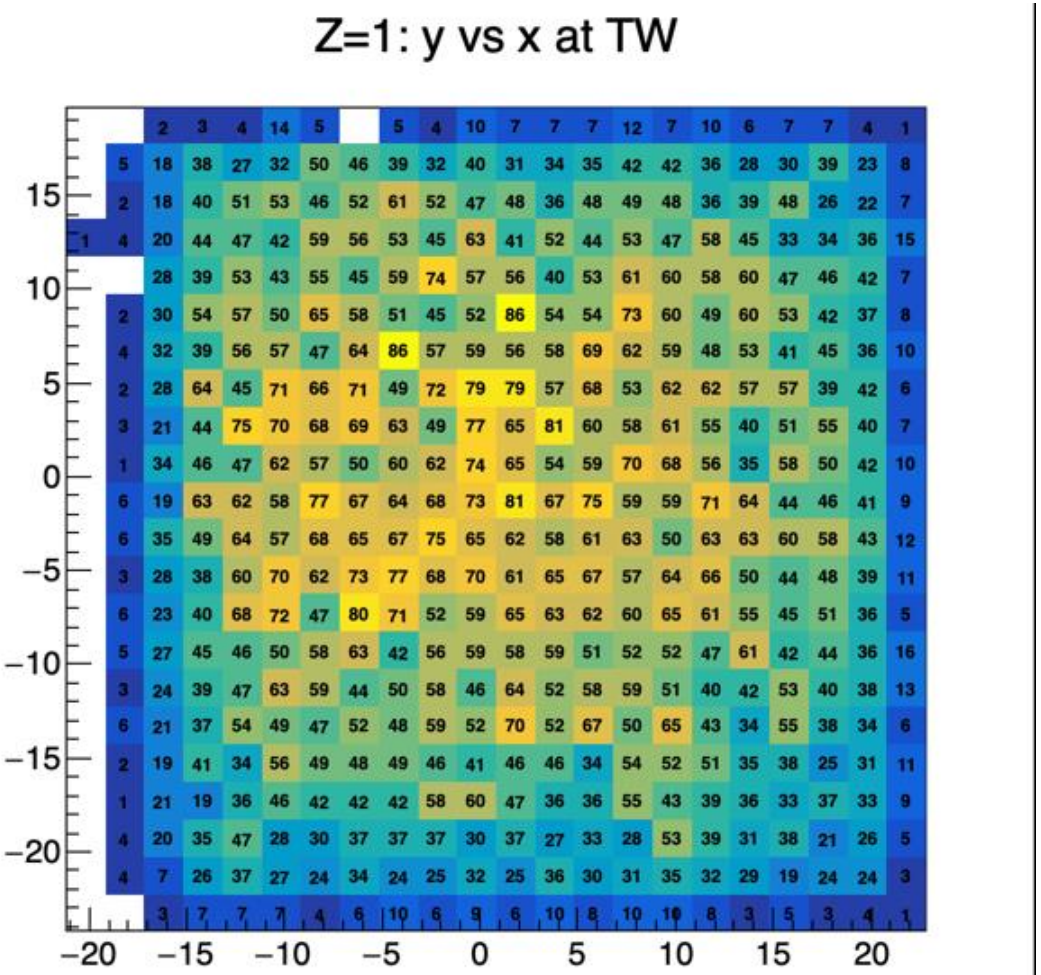
Notice: in this analysis there was no request for Z(MSD) = Z(TW)

MC Z=1

Tracks with only MSD Zid

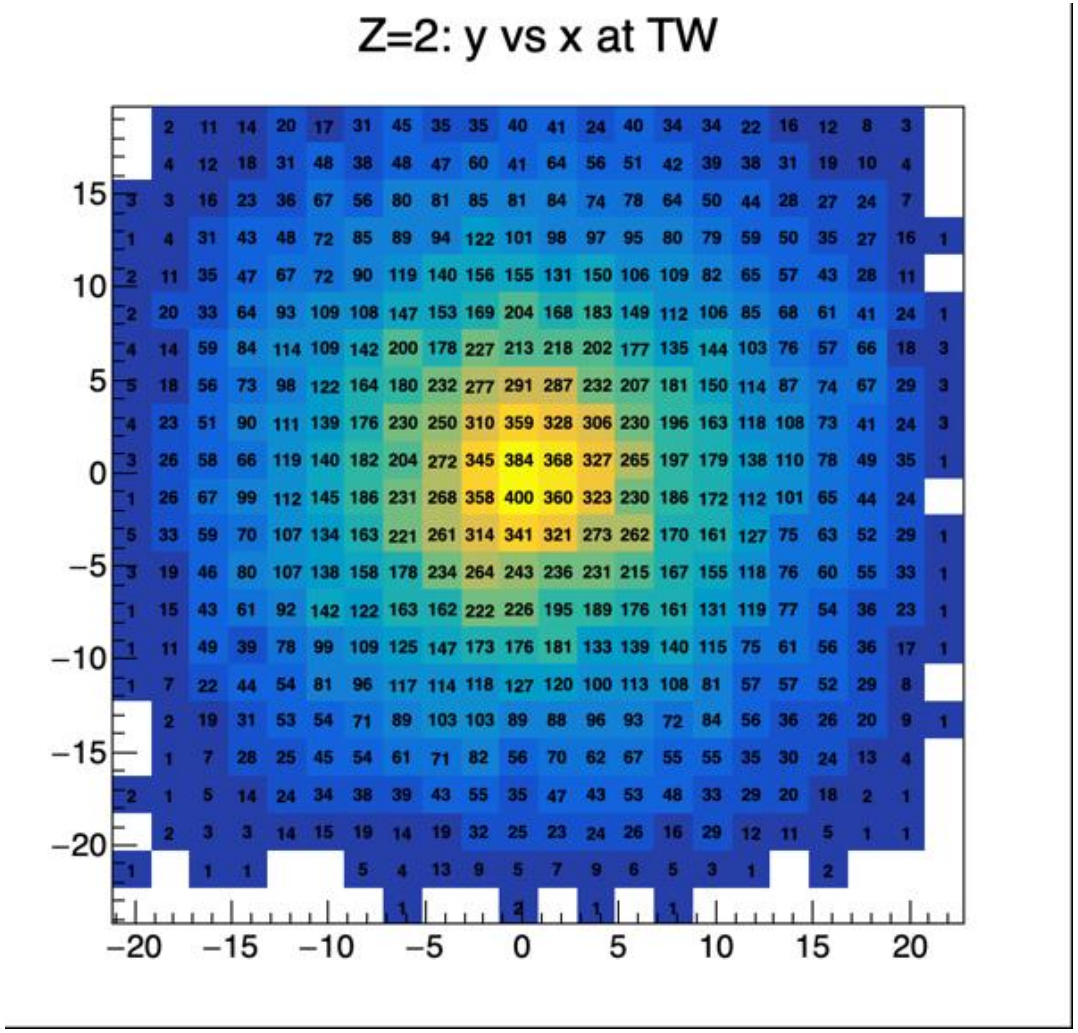


Tracks with MSD Zid + TW point

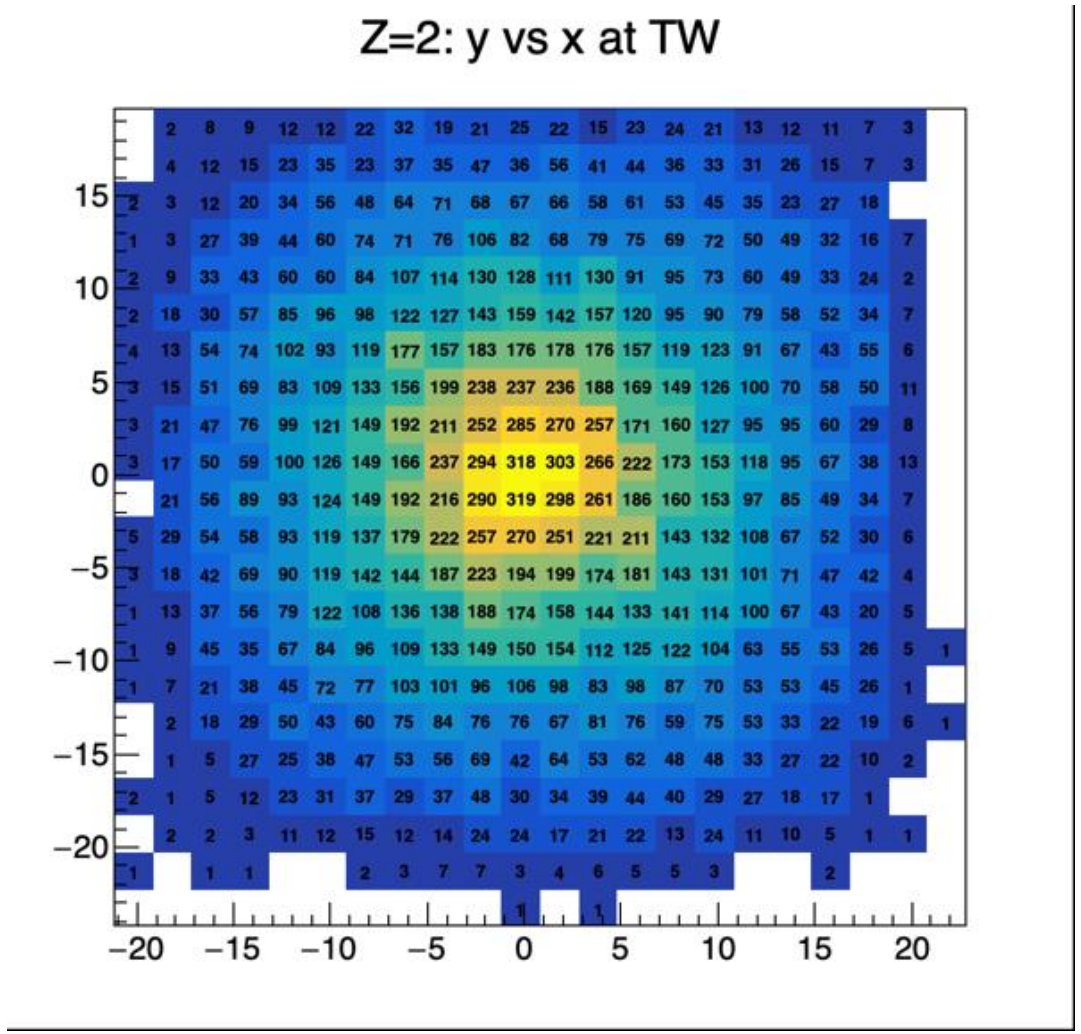


Exp data Z=2

Tracks with only MSD Zid

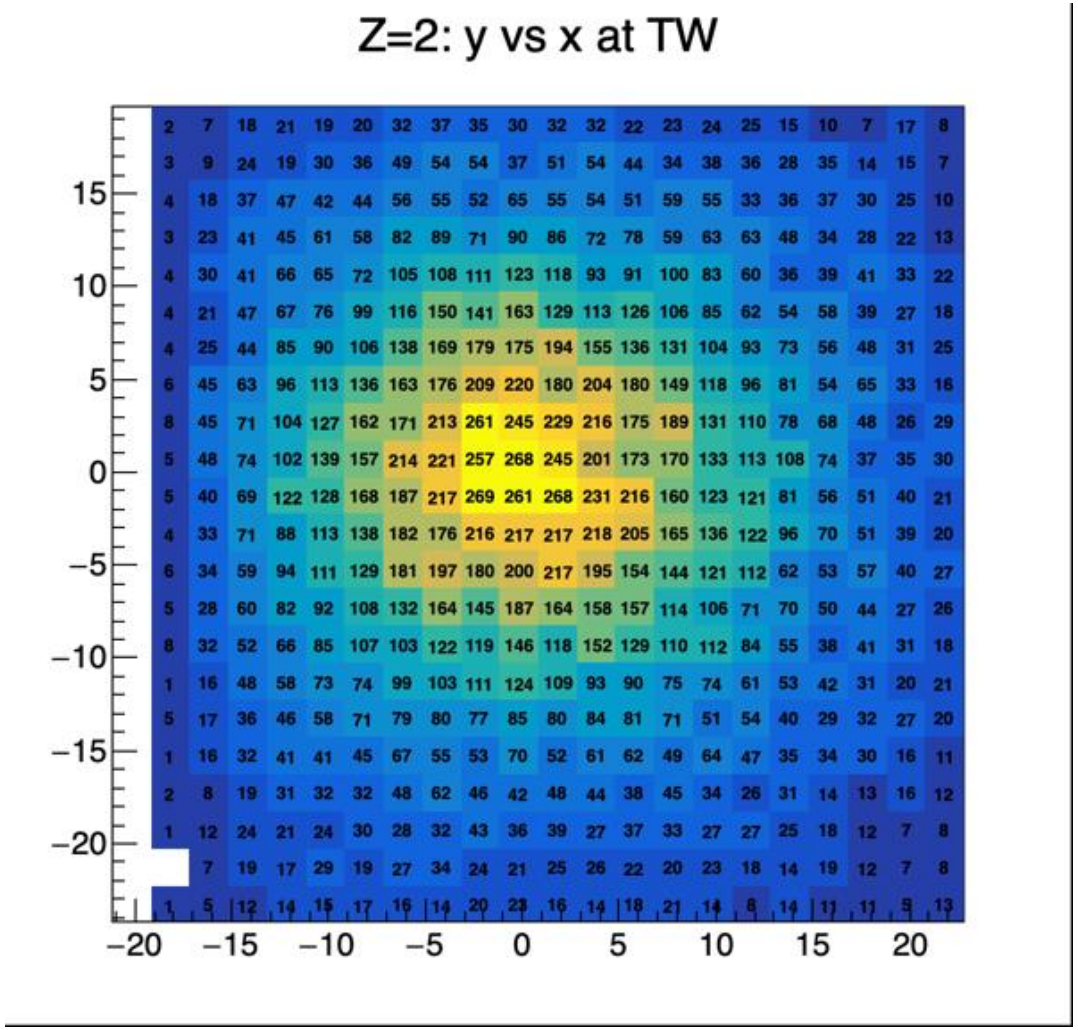


Tracks with MSD Zid + TW point

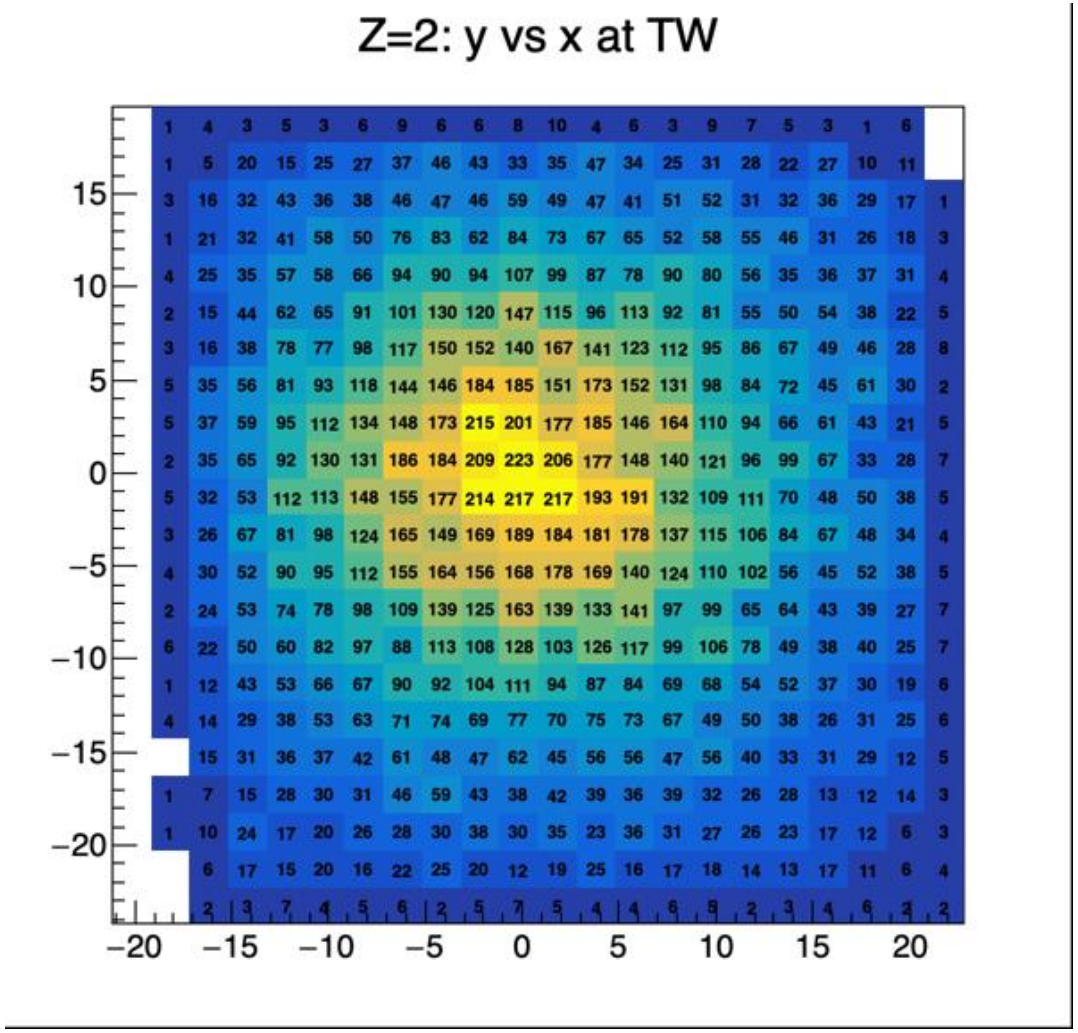


MC Z=2

Tracks with only MSD Zid

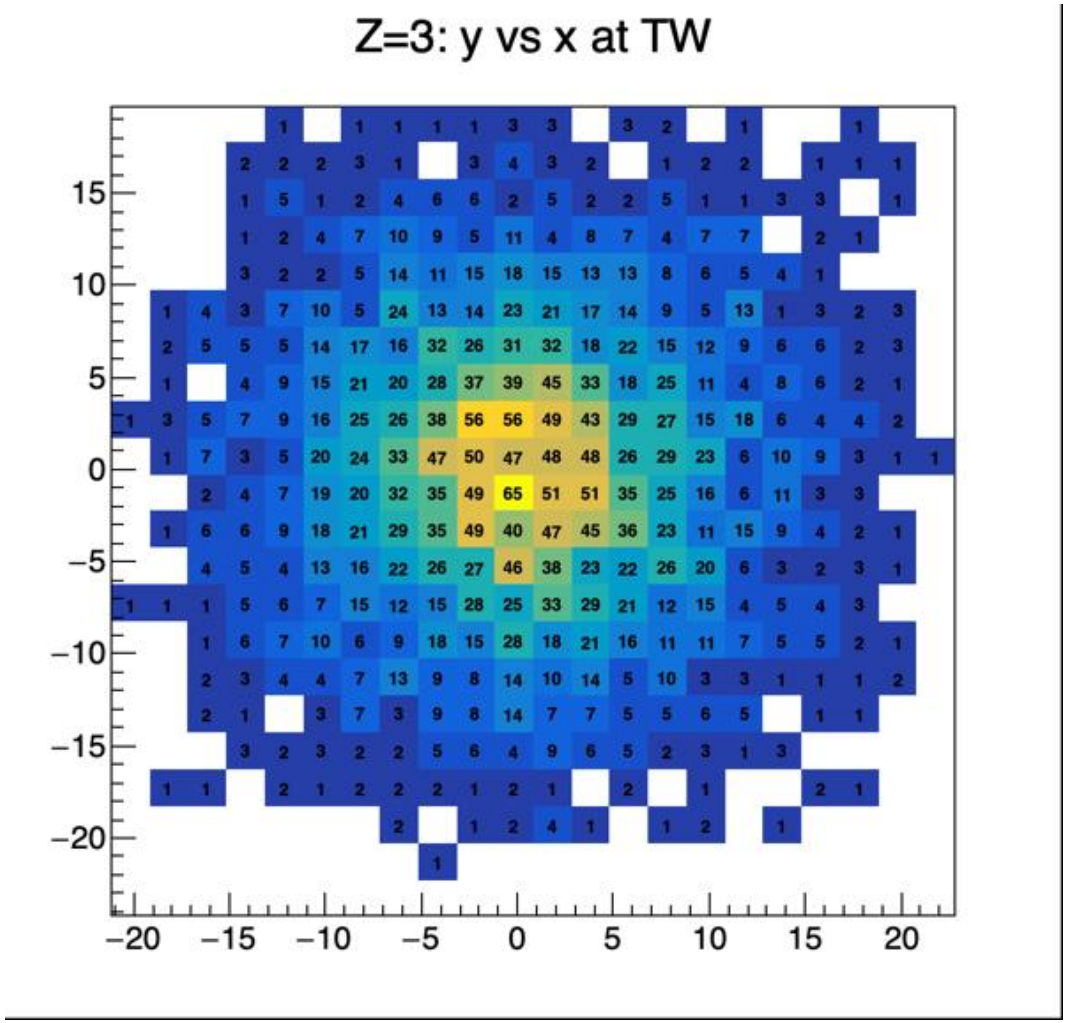


Tracks with MSD Zid + TW point

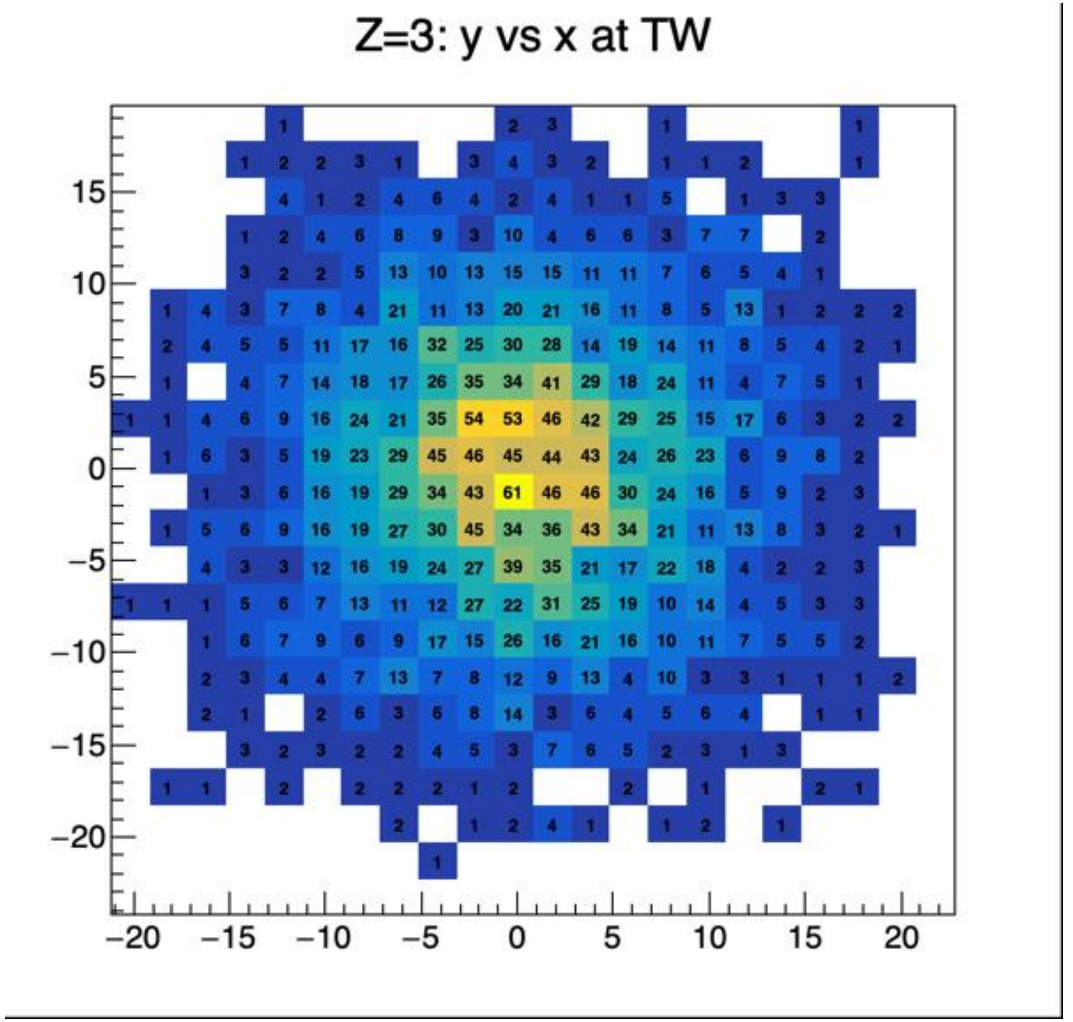


Exp data Z=3

Tracks with only MSD Zid

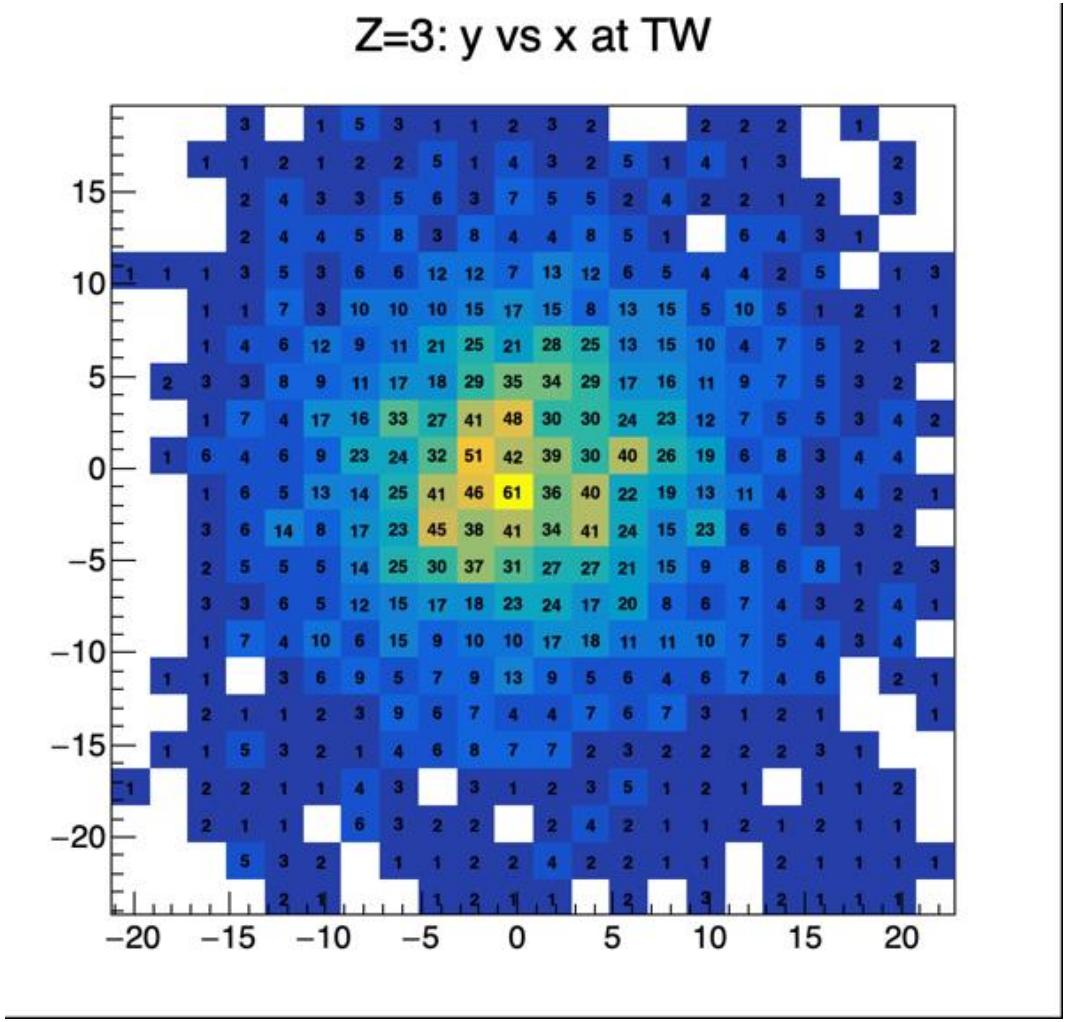


Tracks with MSD Zid + TW point

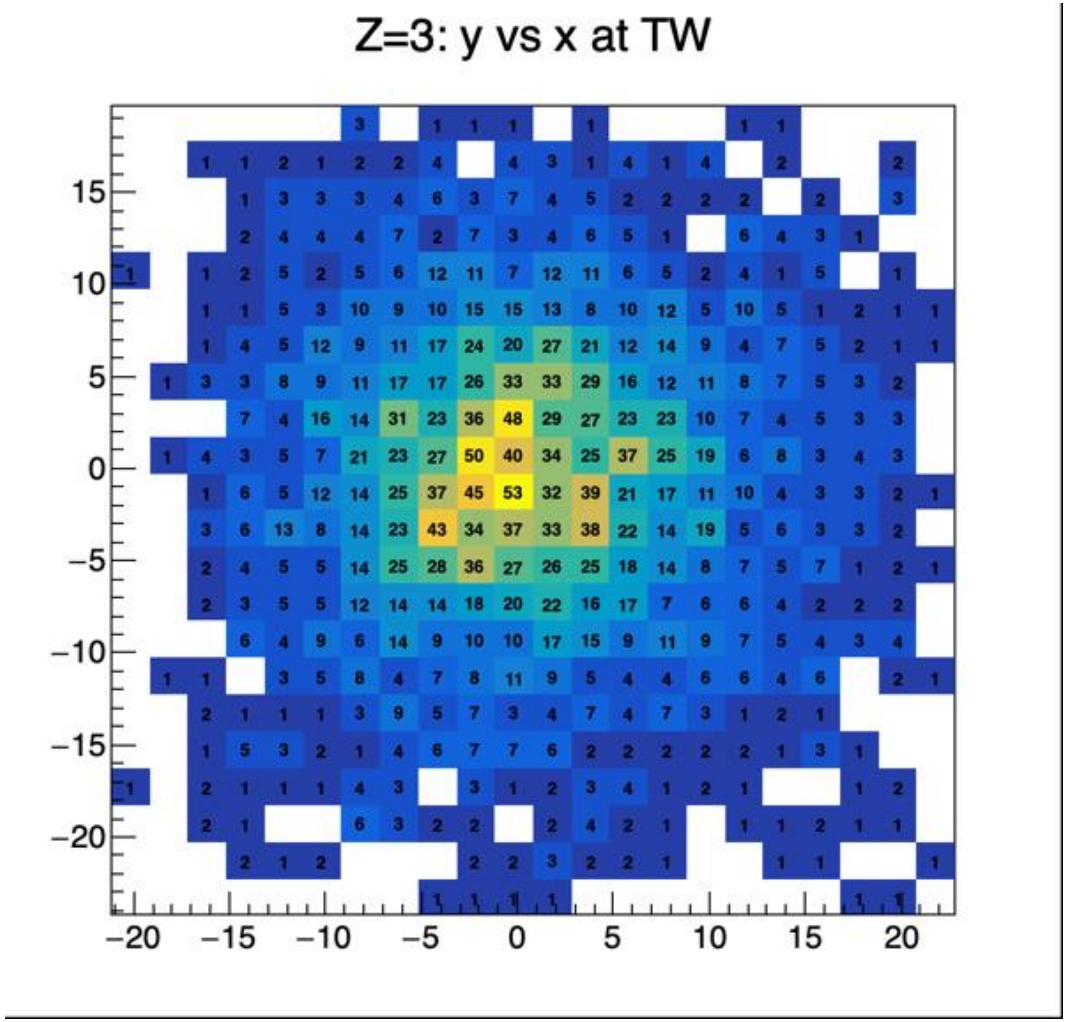


MC Z=3

Tracks with only MSD Zid

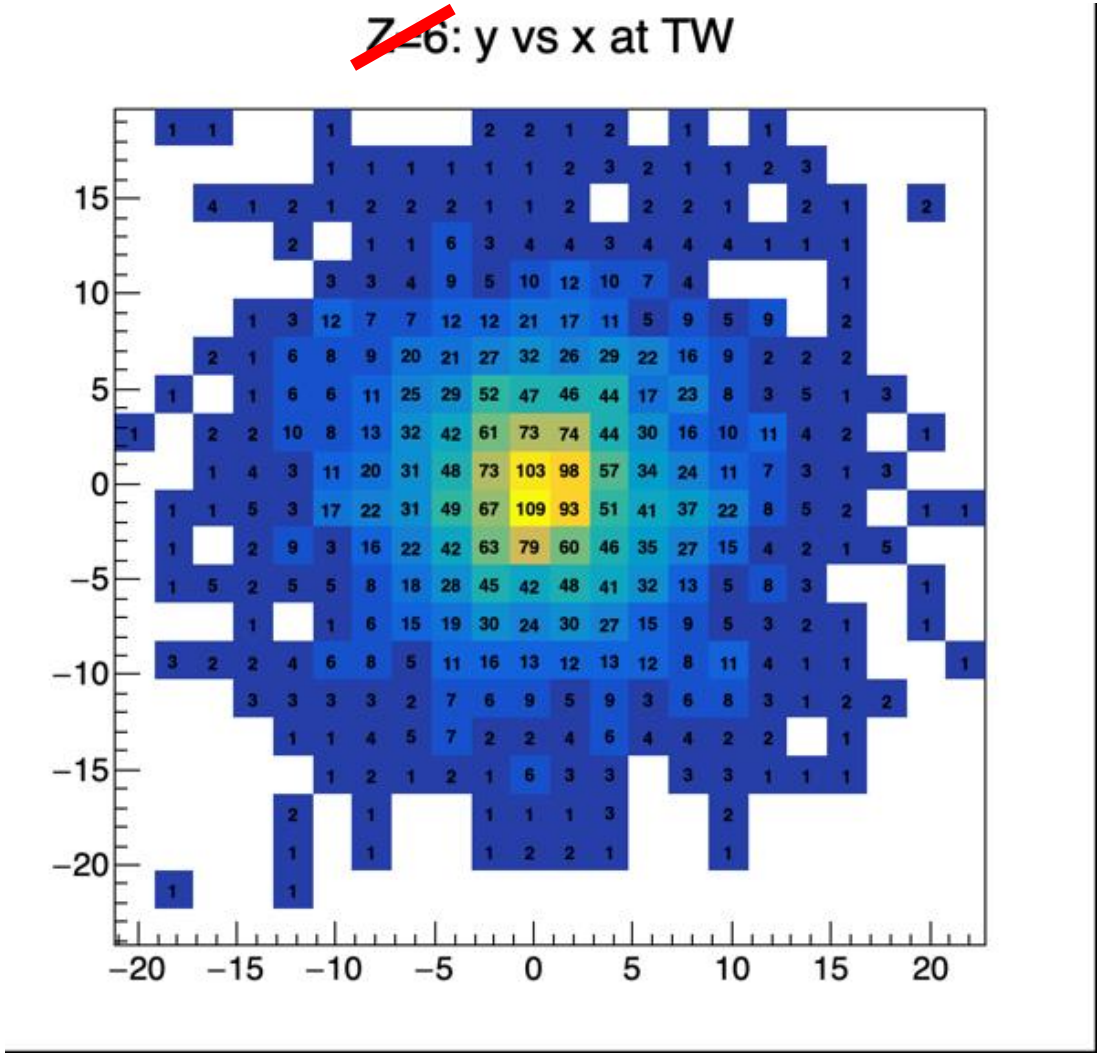


Tracks with MSD Zid + TW point

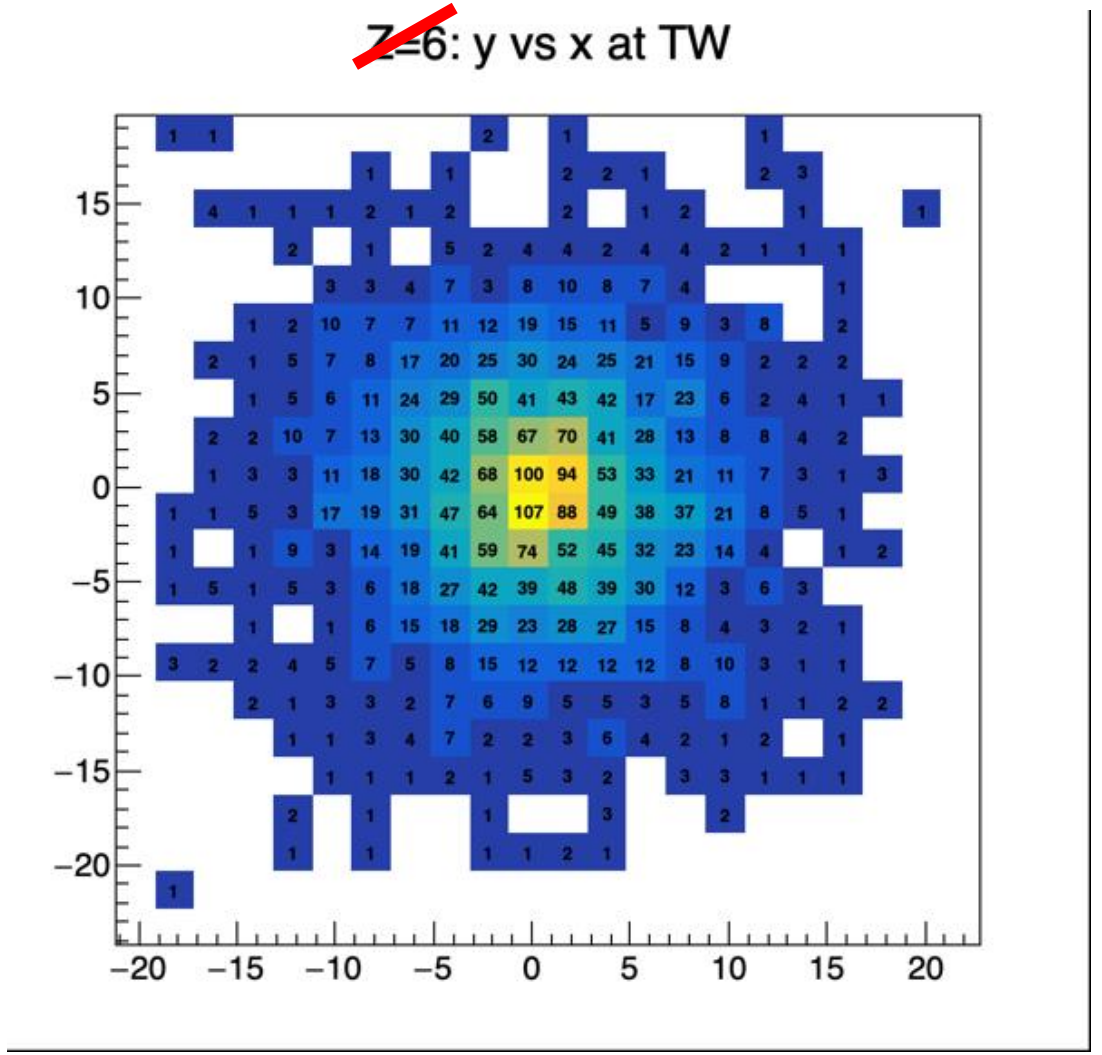


Exp. data Z= 4+5+6

Tracks with only MSD Zid

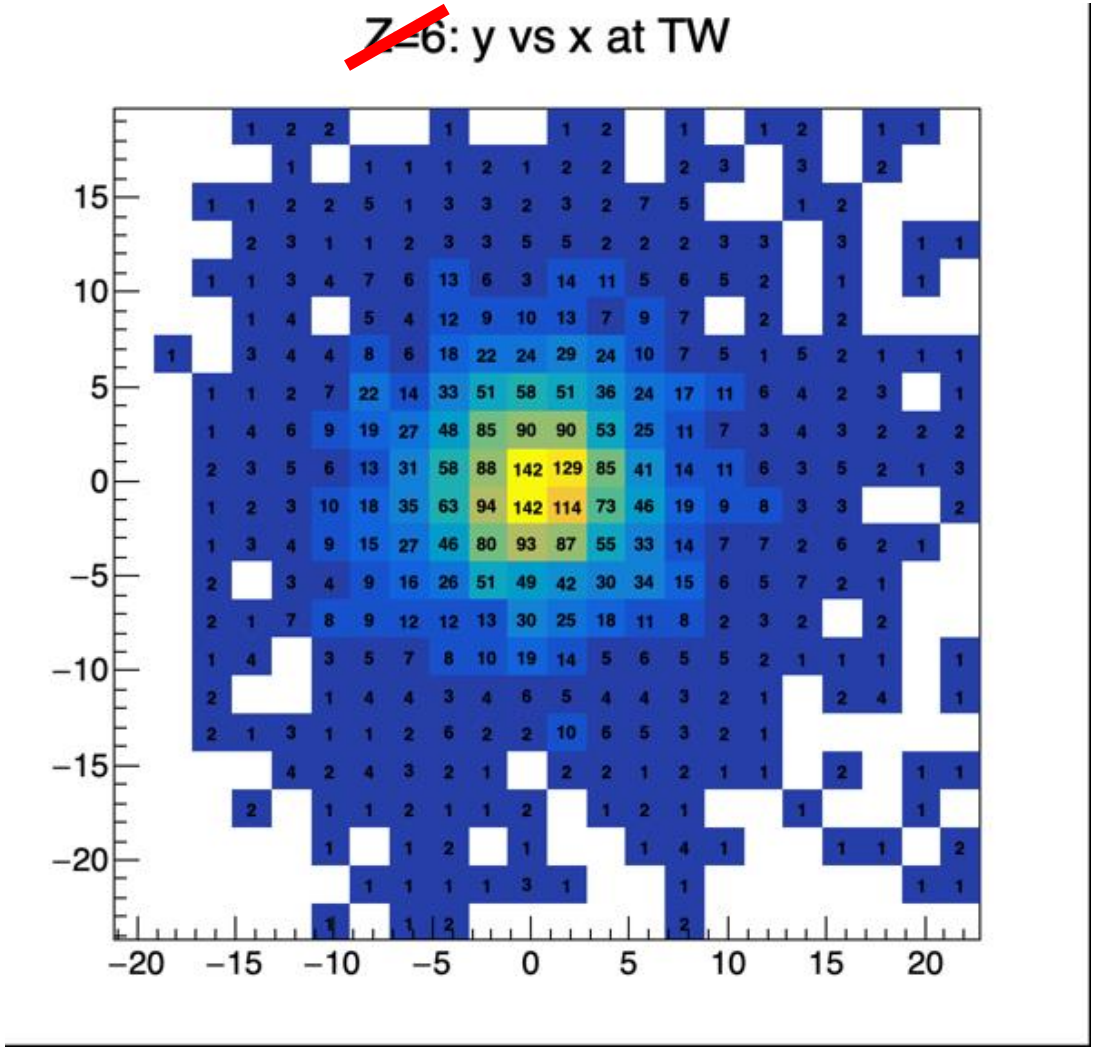


Tracks with MSD Zid + TW point

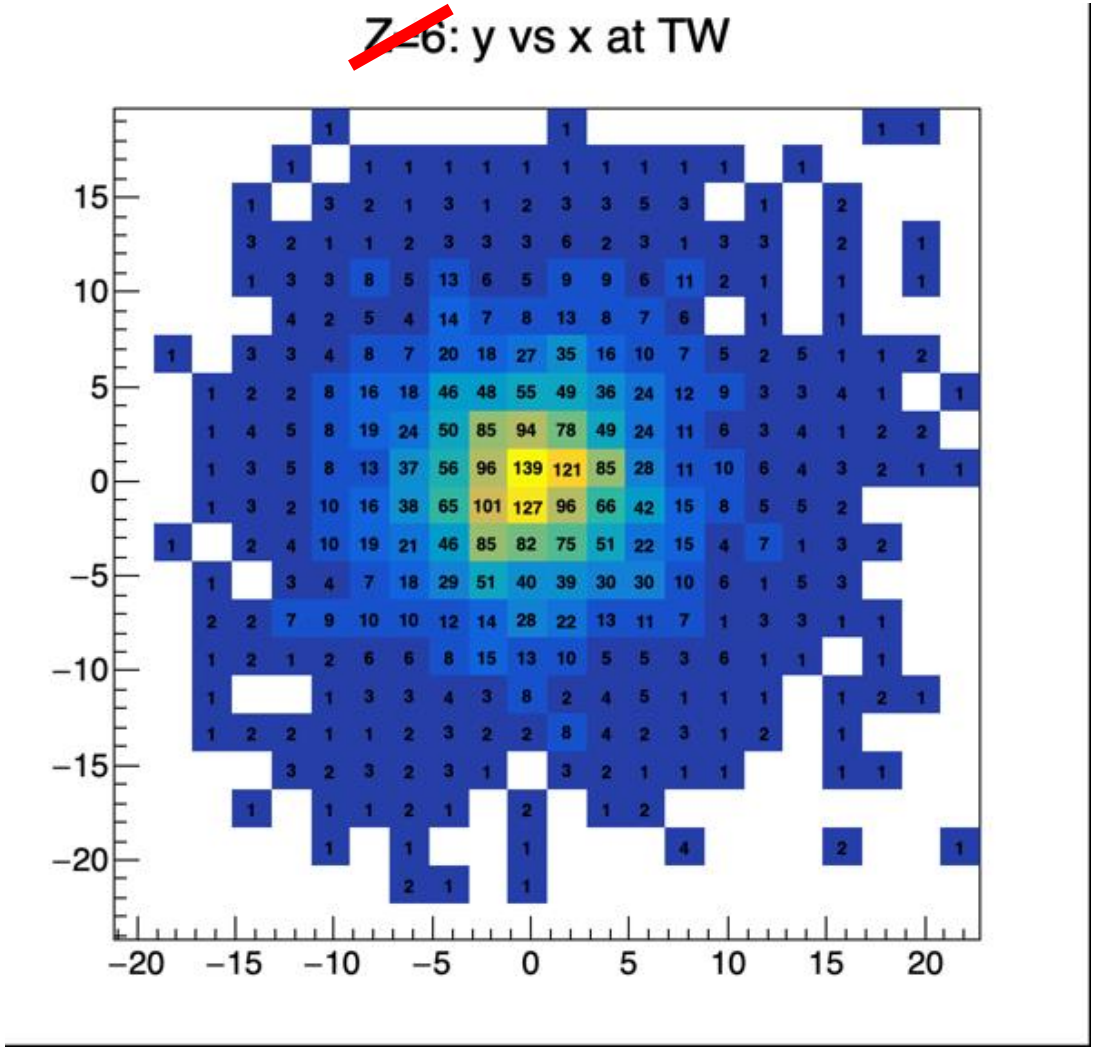


MC Z= 4+5+6

Tracks with only MSD Zid



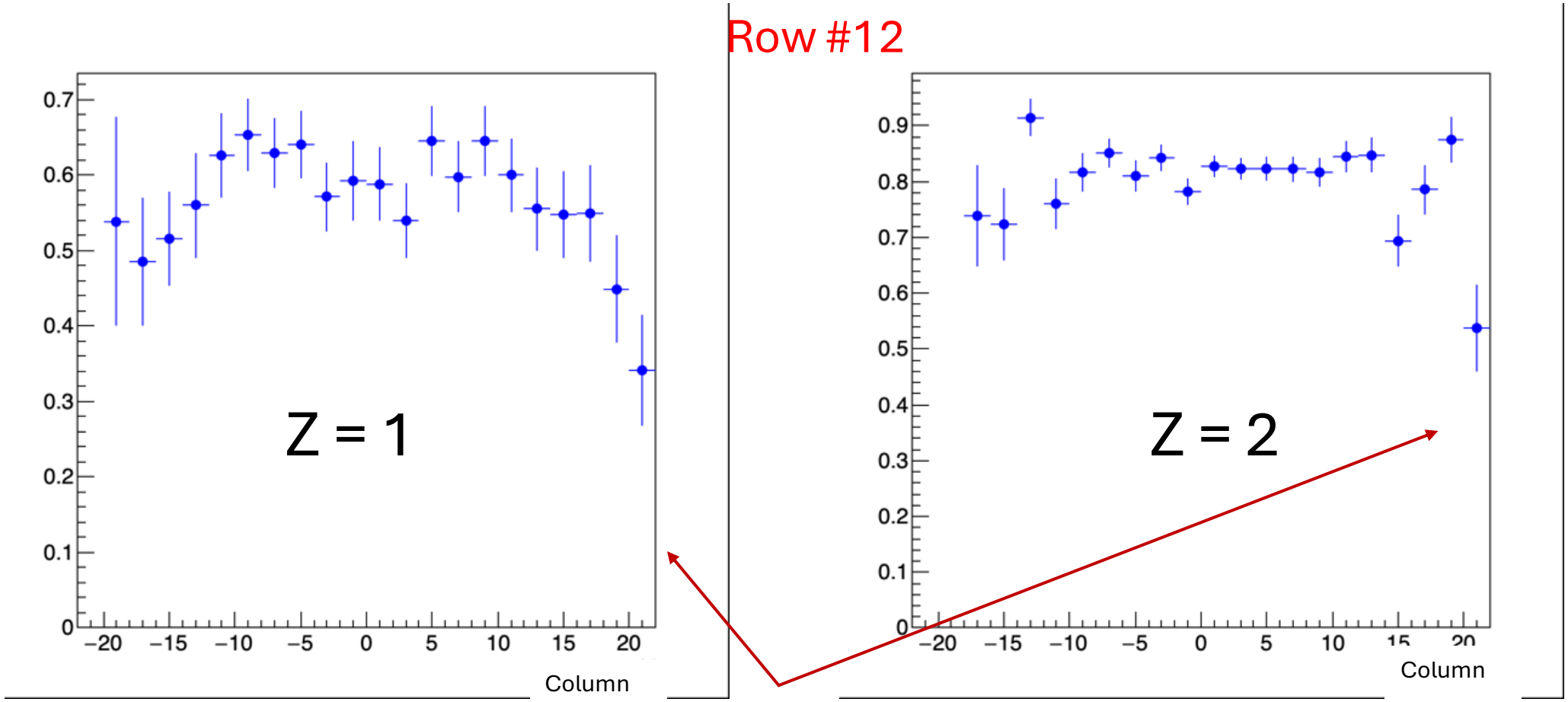
Tracks with MSD Zid + TW point



Exp. Data: Efficiency for different Z

We limit ourselves to a central row, inspecting efficiency as a function of column

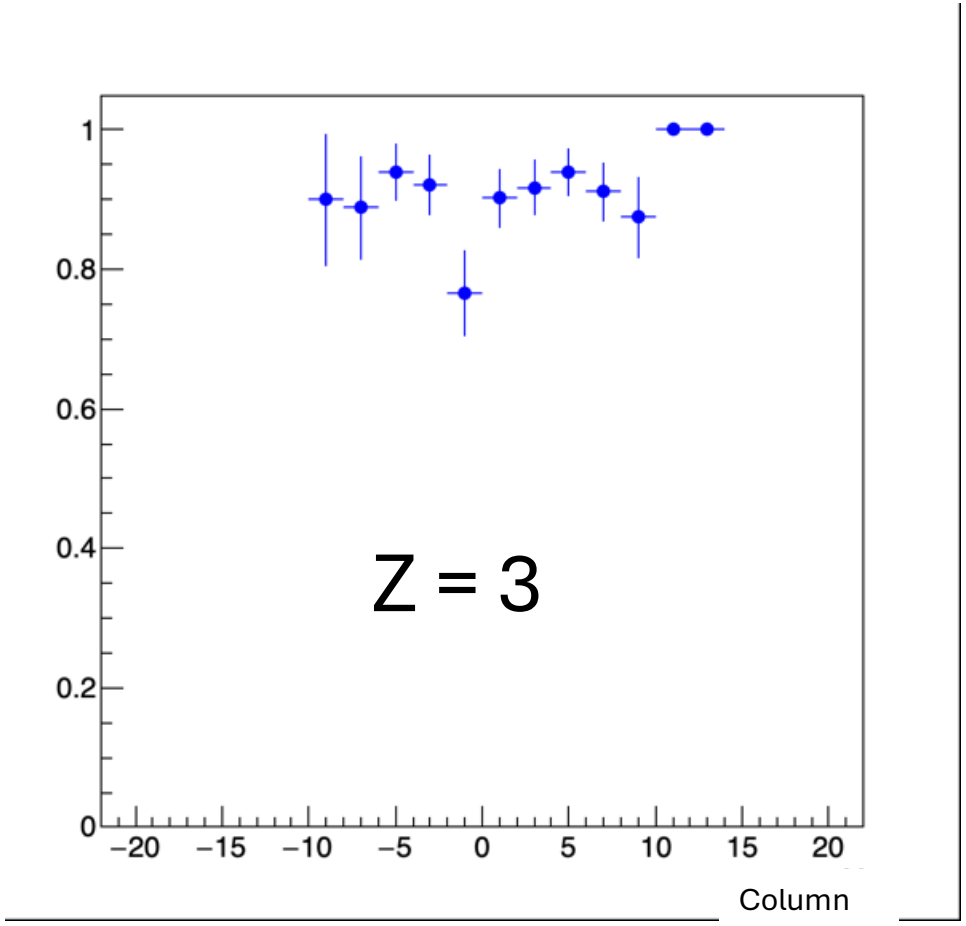
Row #12

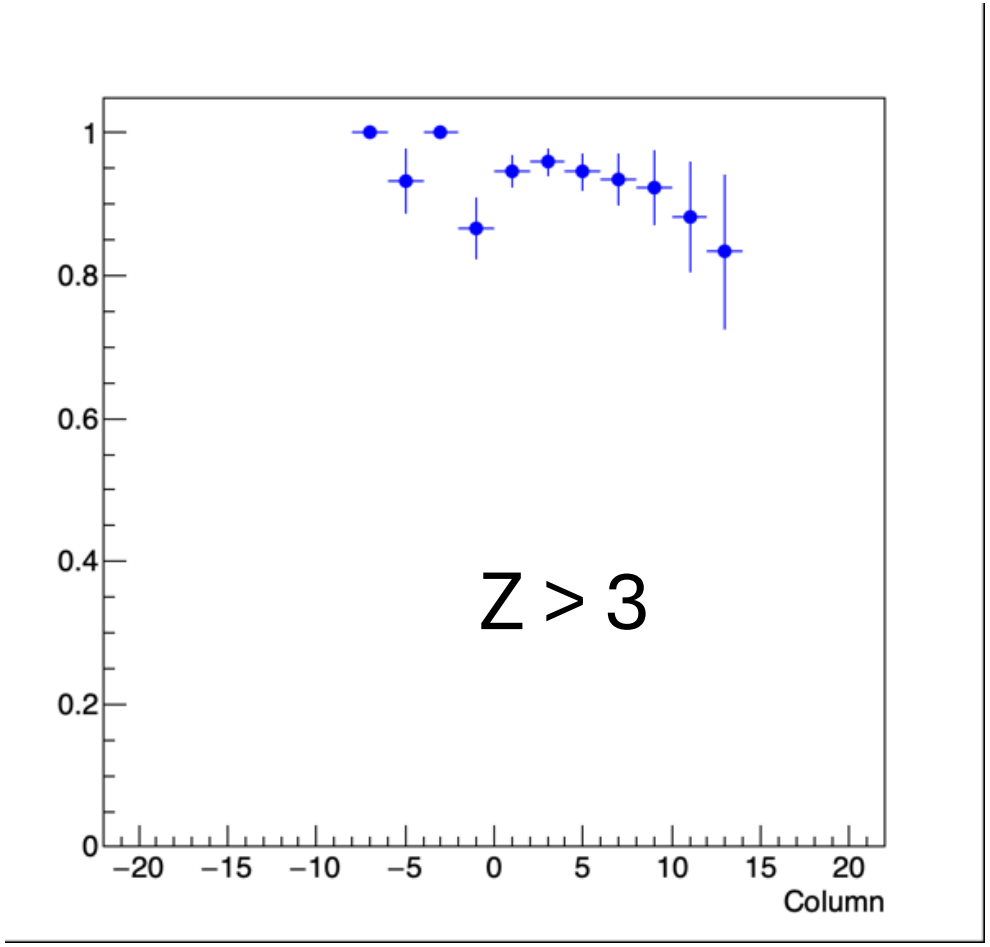


The first and last column in these histograms could be affected by border effects in the geometrical acceptance

Exp. Data: Efficiency for different Z

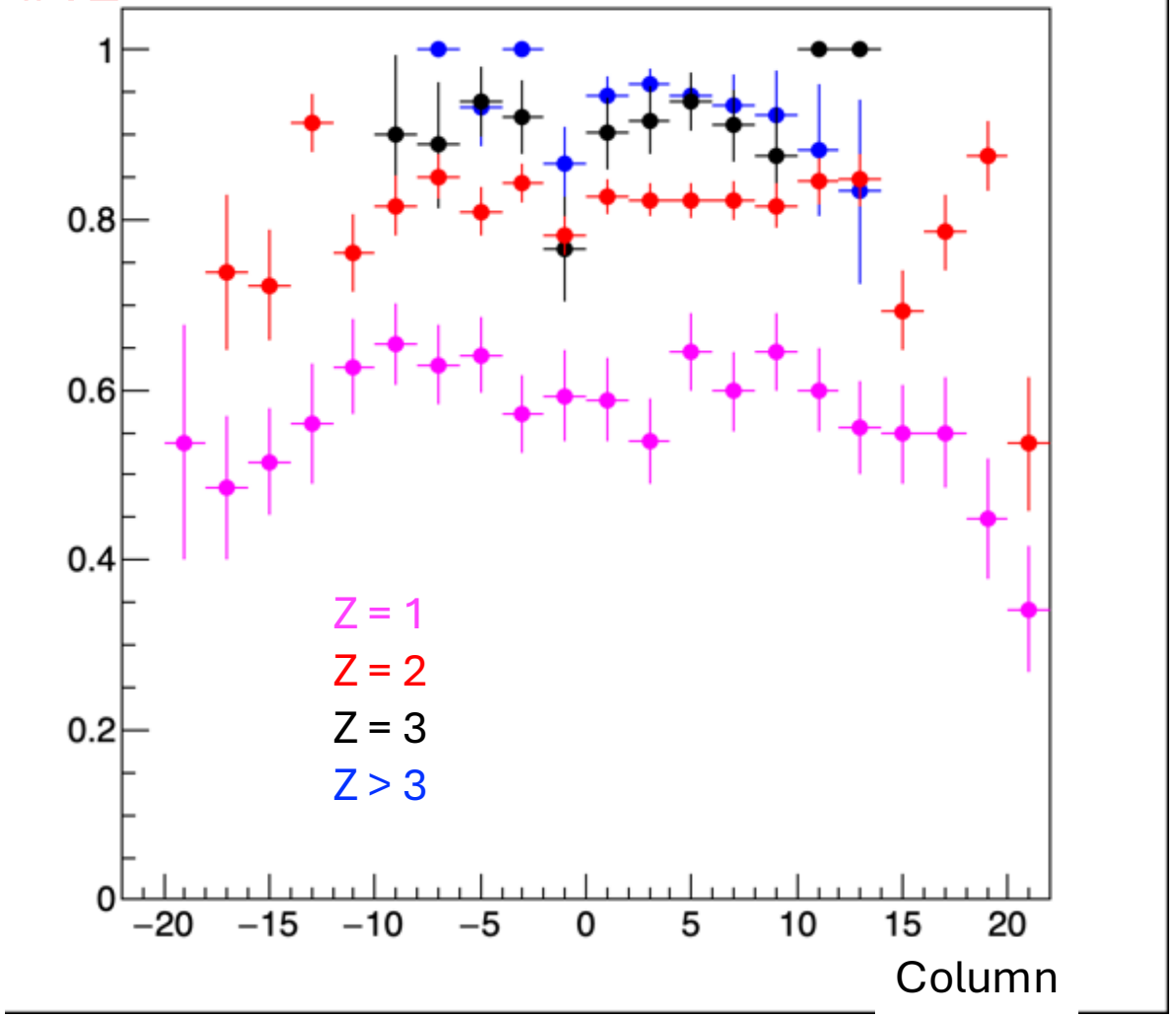
Row #12





Exp. Data: Efficiency for different Z

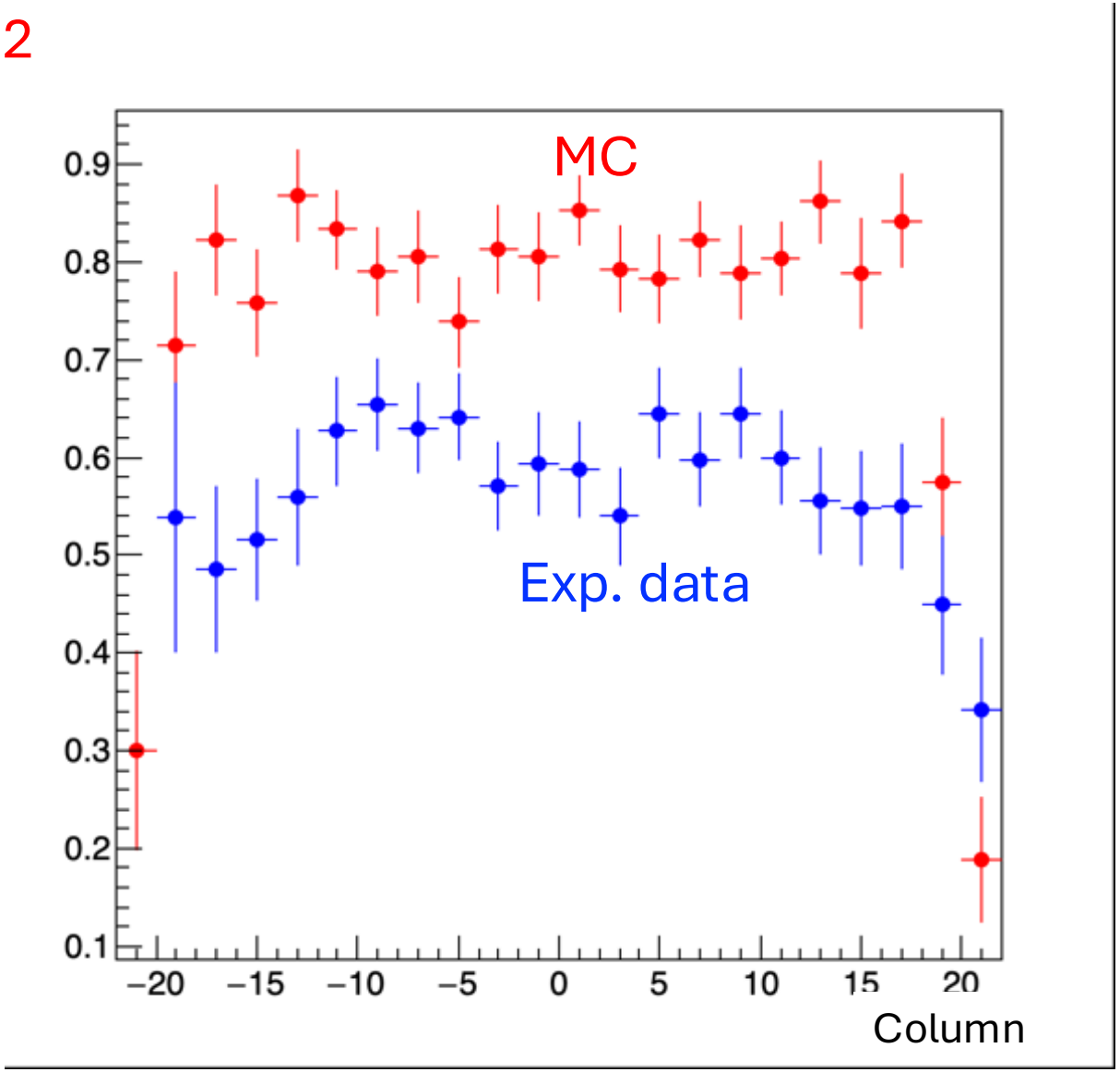
Row #12



In the case of Z=1 there is some evidence of increasing inefficiency for tracks close to the extreme positions in scintillator bars

MC and Exp Data Efficiency Z=1

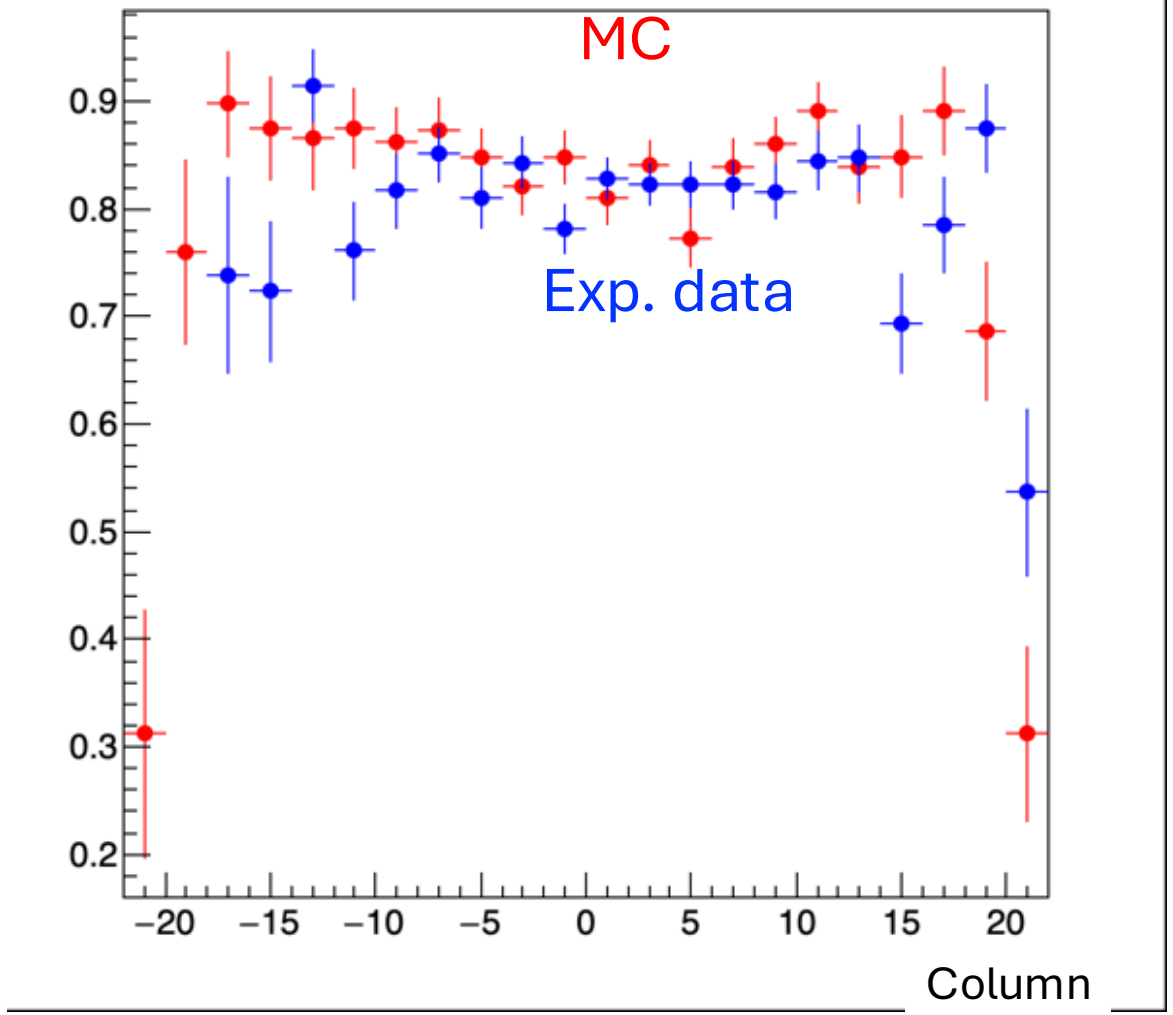
Row #12



As expected, in the case of MC Z=1 tracks there is no evidence of position-dependent inefficiency

MC and Exp Data Efficiency Z=2

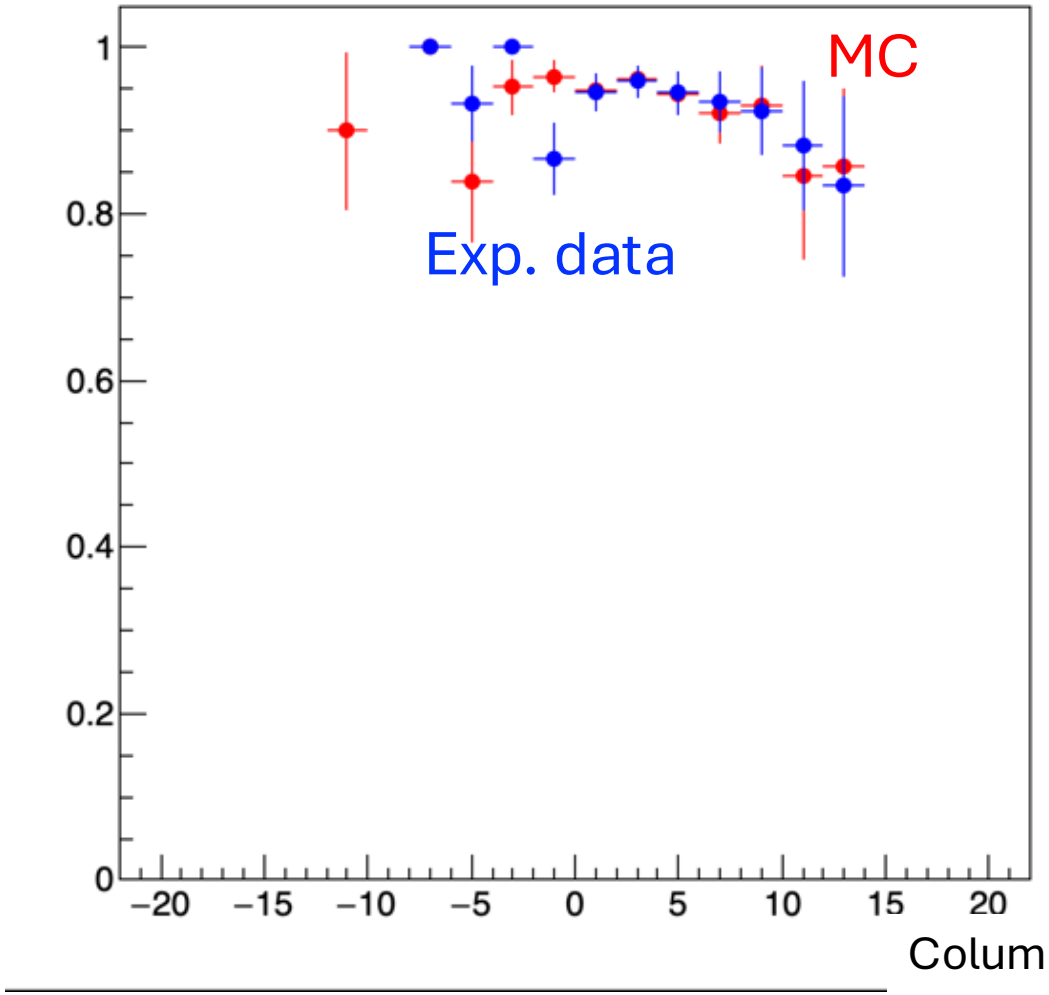
Row #12



As expected, in the case of Z>1 tracks there is a good compatibility between data and MC

MC and Exp Data Efficiency Z>3

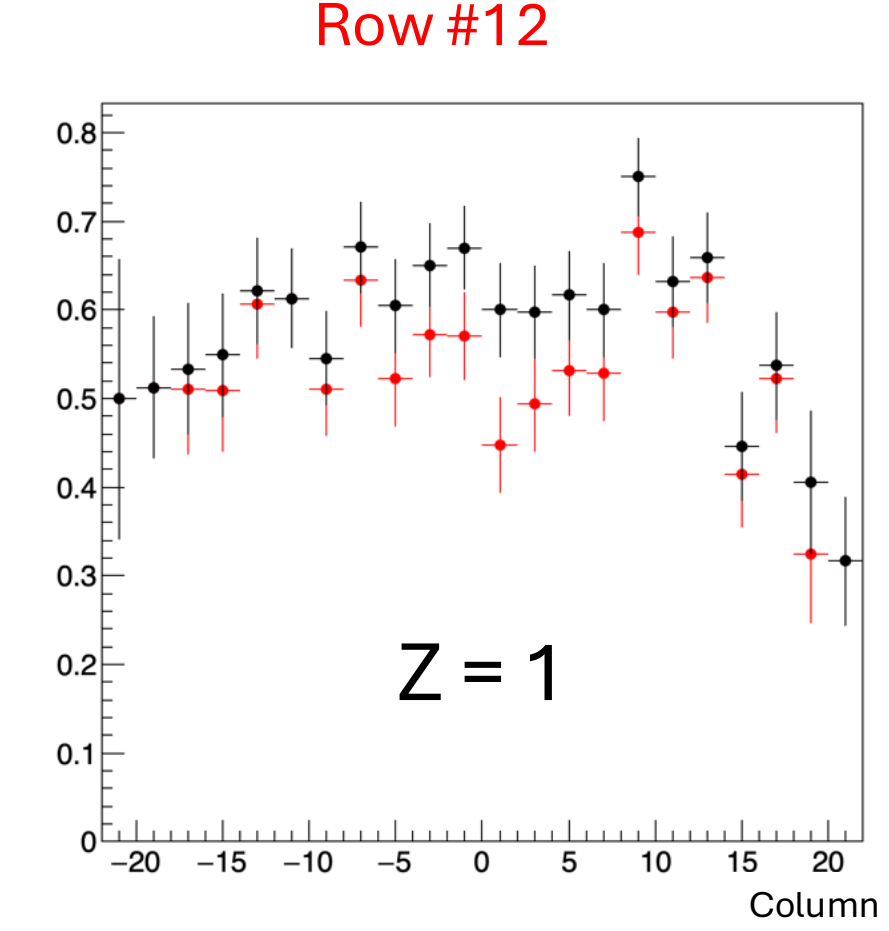
Row #12

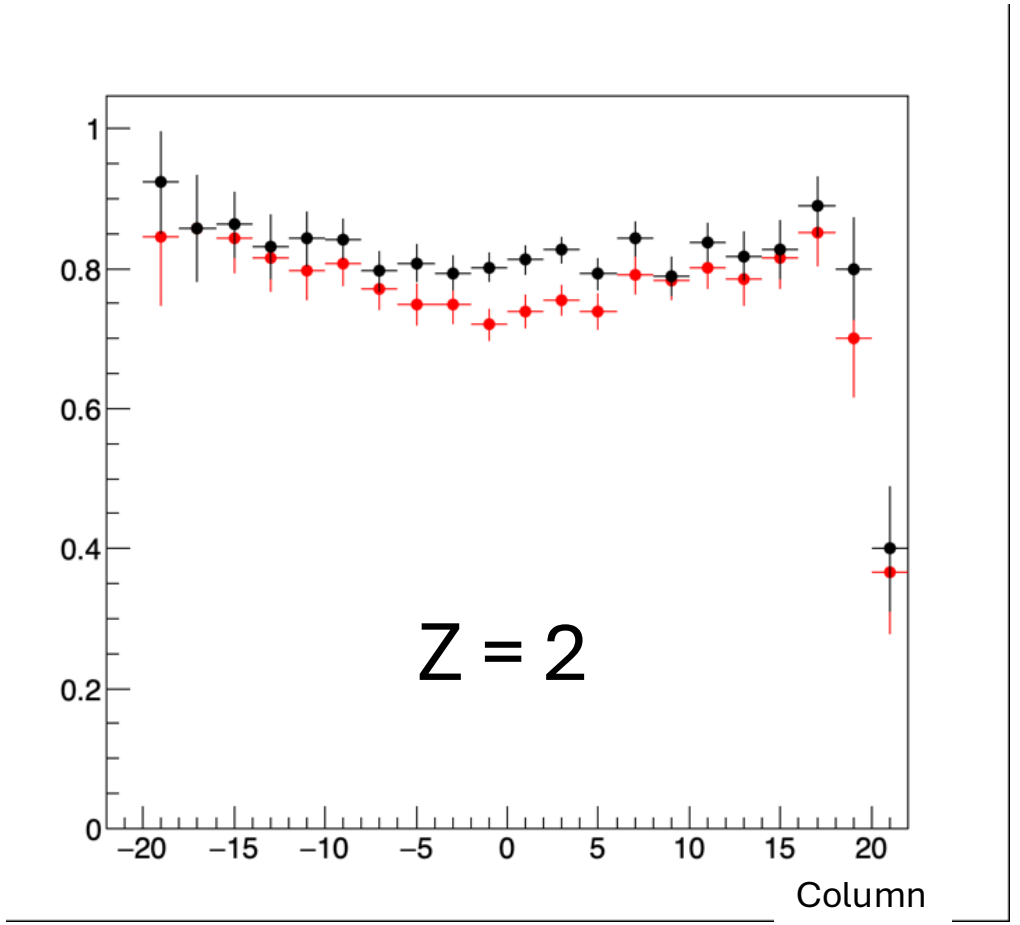


As expected, in the case of Z>1 tracks there is a good compatibility between data and MC

Exp. Data: Efficiency with 2 different methods

Row #12





1 TW point any Z_{id}(TW)

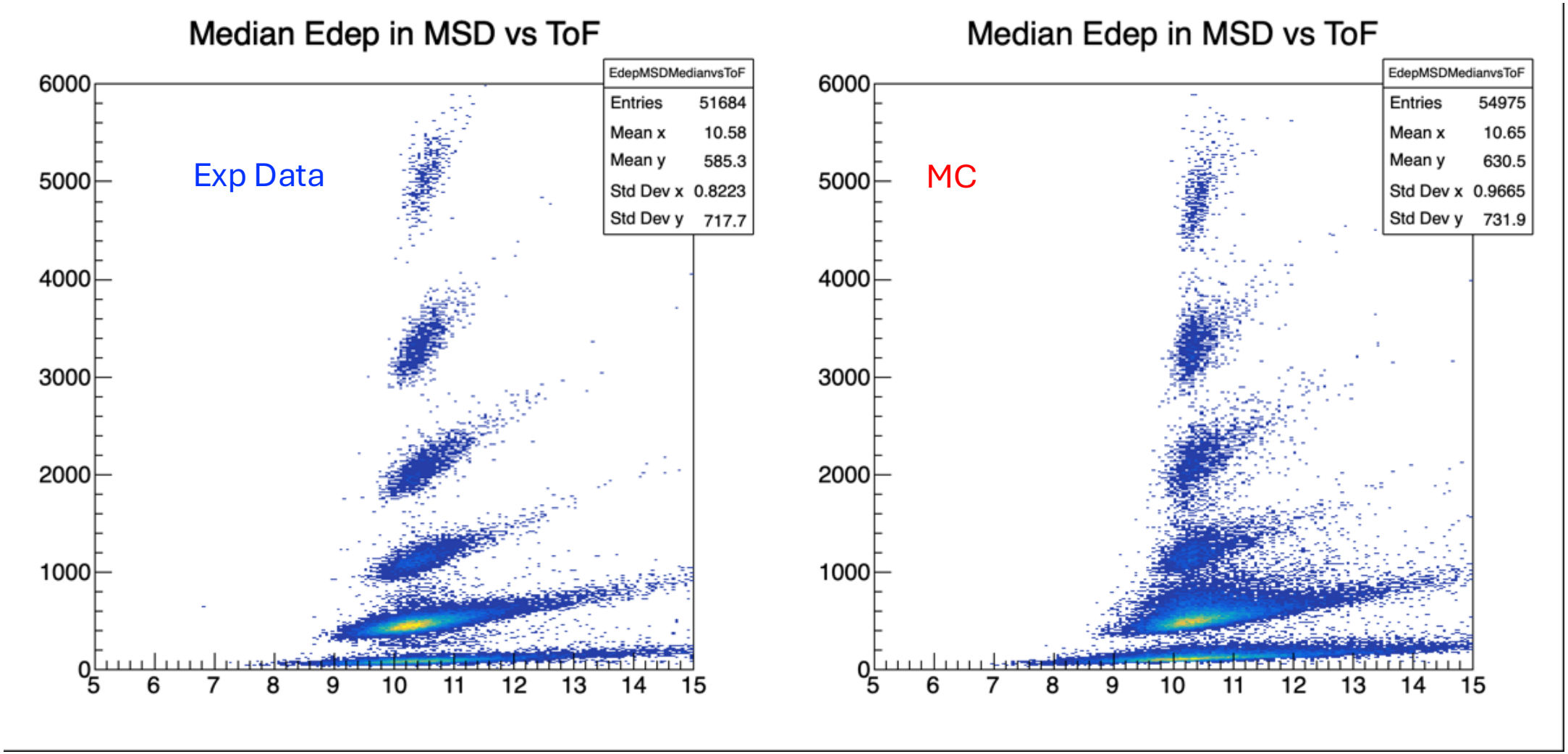
1 TW point with Z_{id}(TW) = Z_{id}(MSD)

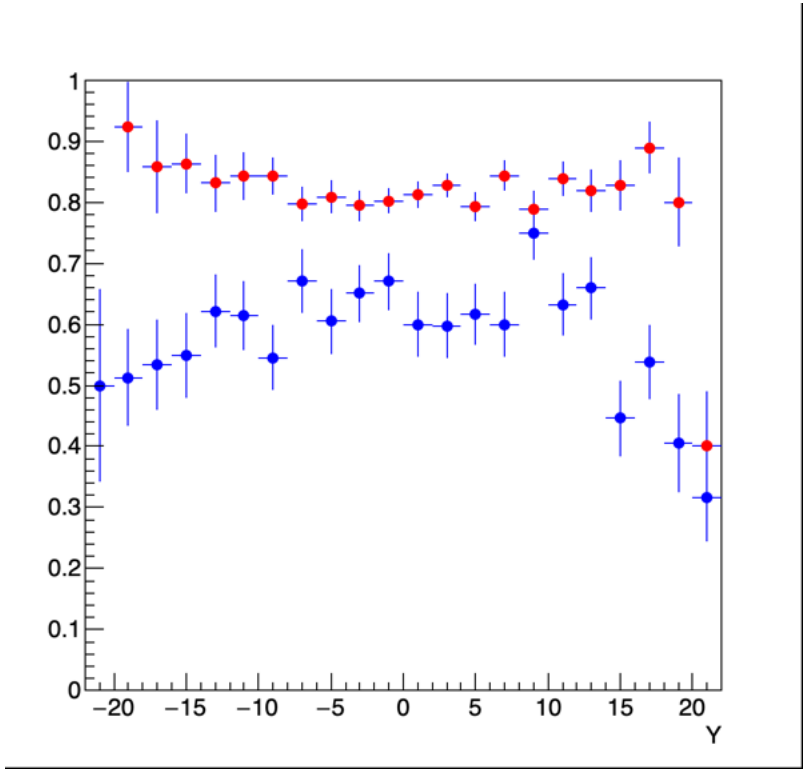
Some (preliminary) conclusions

- Making using of a sample of events in a campaign without magnetic field (=no curvature) considering global tracks (GenFit) where charge-id is given by MSD, and assuming a straight-line extrapolation to the the TW, it is possible to measure the probability of having a TW point in a track as a function of Z.
- For Z>1 MC and exp. data exhibit a similar TW efficiency, close to 90%
- This confirms that the level of inefficiency in these conditions is given only by reconstruction. It is probably due to the rejection of TW points when there are multiple hits in the same bar
- Instead, for Z=1, there is an evident increase of the inefficiency of the detector, as already expected
- Efficiency for Z=1 turns out to be ~60% in the central part of the detector
- There are strong hints that such efficiency has a further drop when the TW point position approaches the extremity of scintillator bars
- A larger statistics would be necessary
- This was a first attempt: the whole procedure should be carefully checked.

Backup

Full Z_{id} using MSD E_{dep} vs ToF

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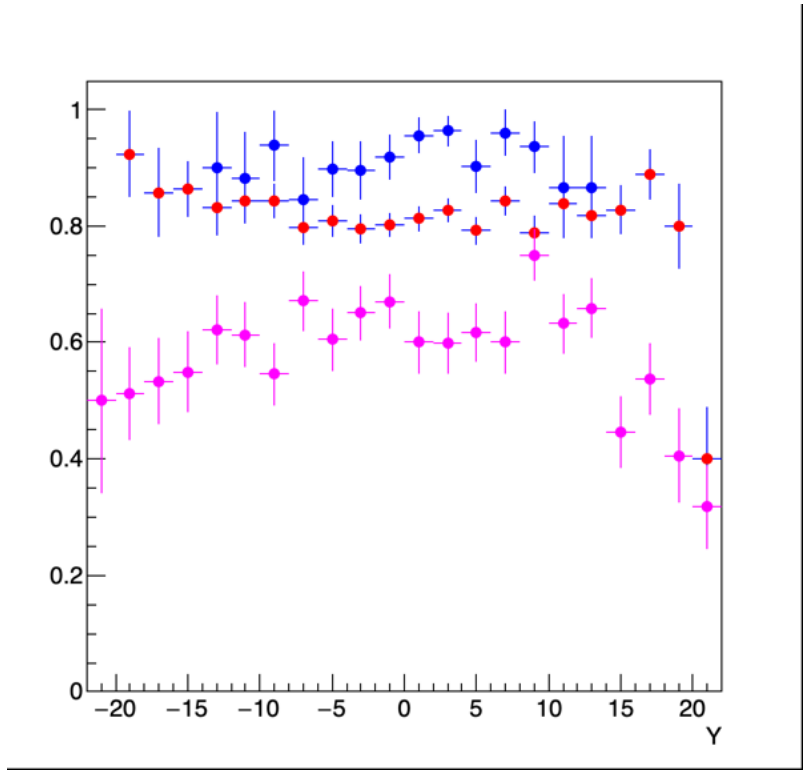
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
−20
−15
−10
−5
0
5
10
15
20
Y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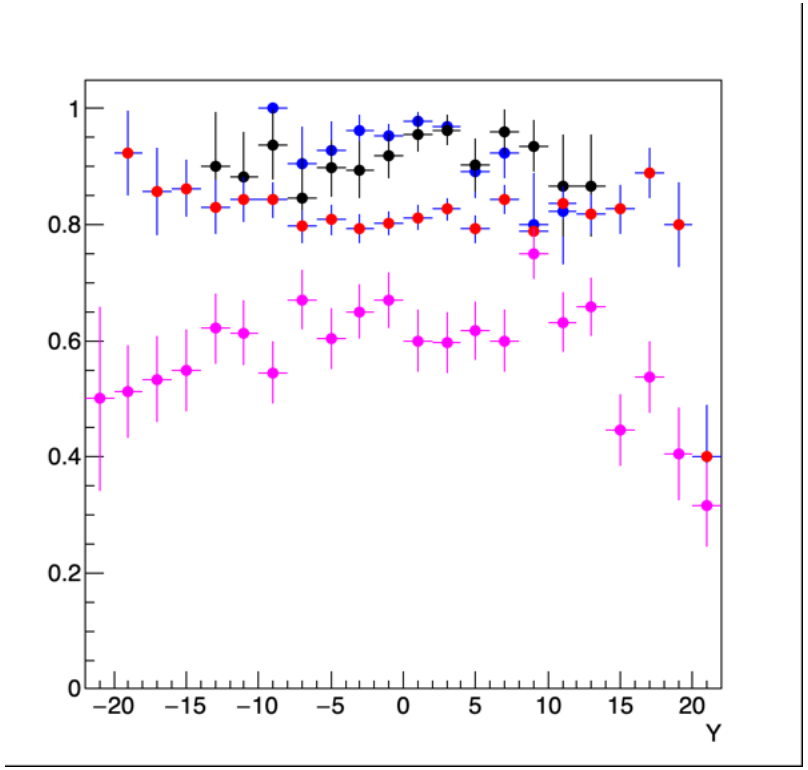
0.6
0.4
0.2
0
−20
−15
−10
−5
0
5
10
15
20
Y


1
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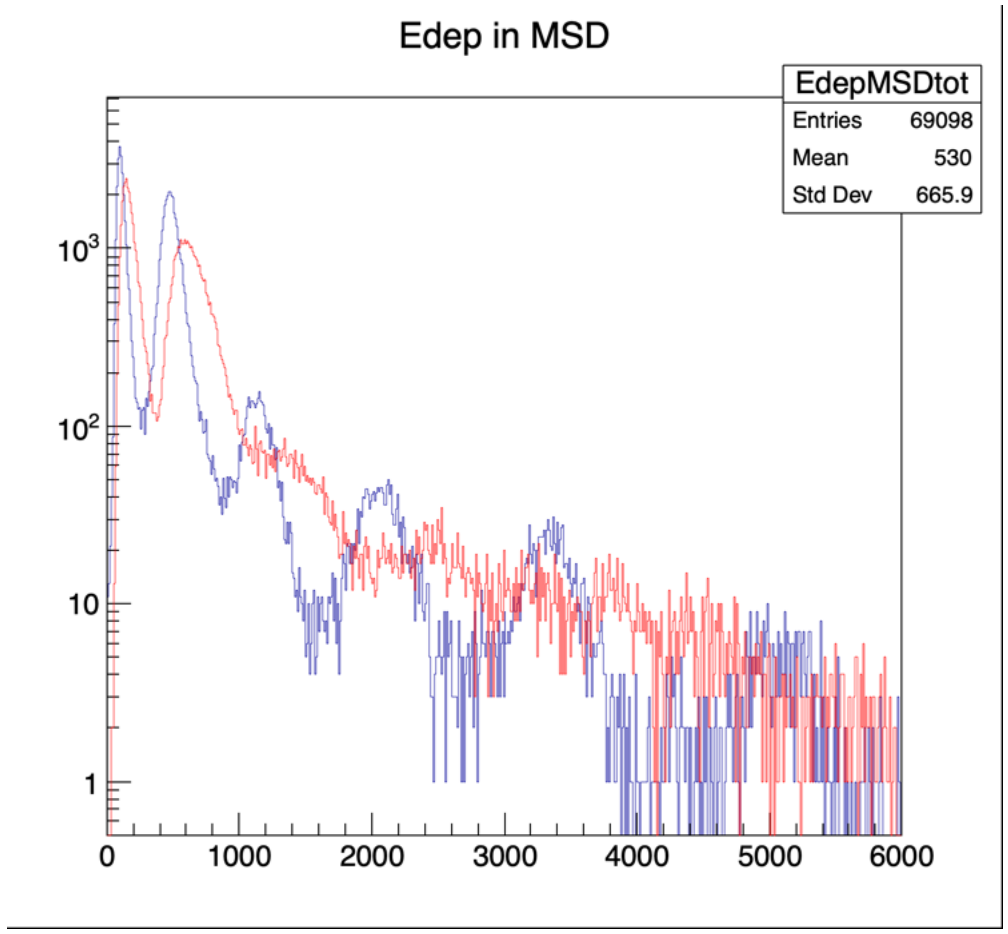
0.6
0.4
0.2
0
−20
−15
−10
−5
0
5
10
15
20
Y


Edep in MSD
EdepMSDtot
Entries 69098
Mean 530
Std Dev 665.9
10^3
10^2
10
1
0
1000
2000
3000
4000
5000
6000