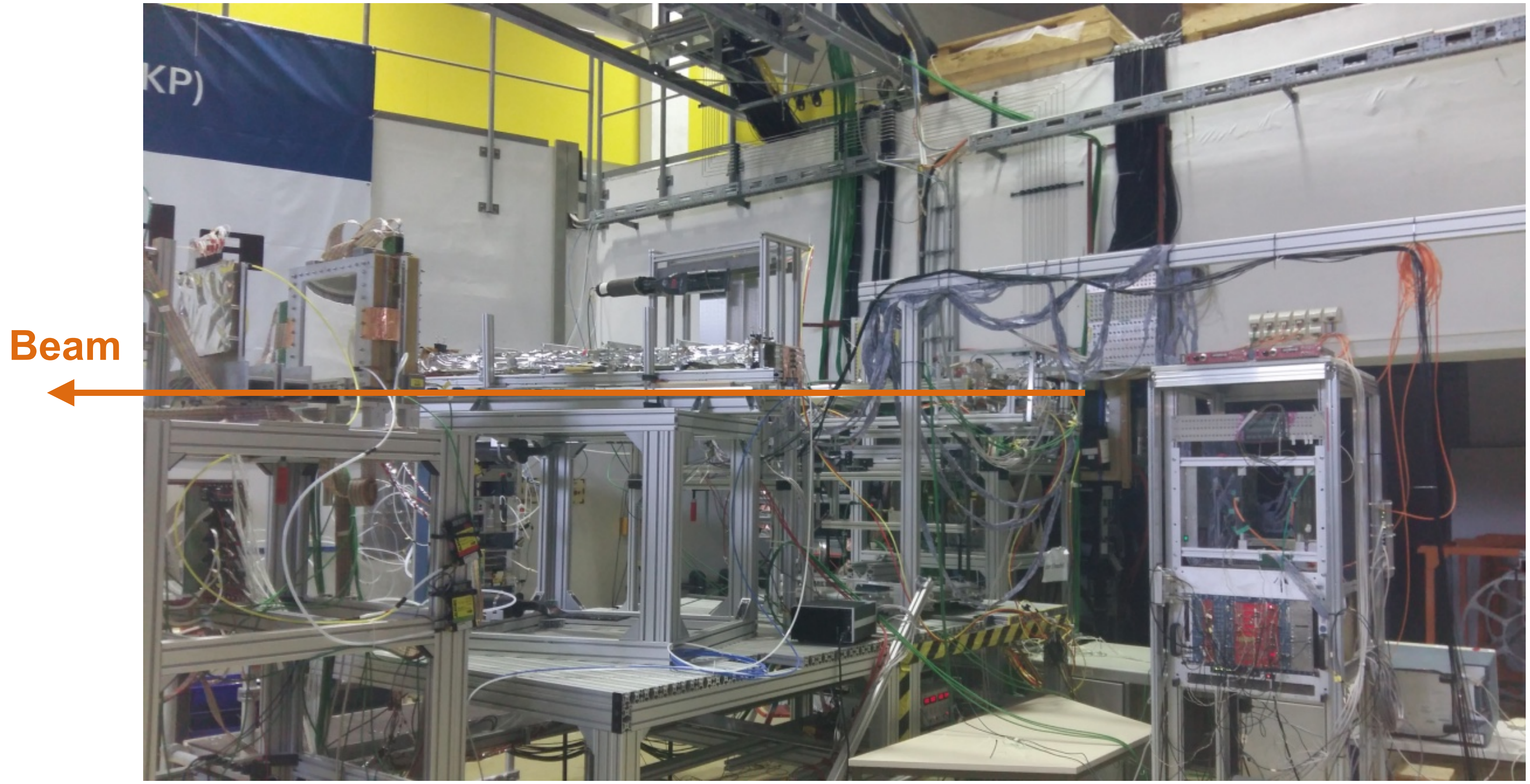
rijksuniversiteit groningen
kvi - center for advanced radiation technology
JÜLICH FORSCHUNGSZENTRUM

Analysis methods and results for the ASIC readout

Alexandros Apostolou
KVI-CART and FZJ

Outline

- General information
- Analysis steps
- Results
- Summary



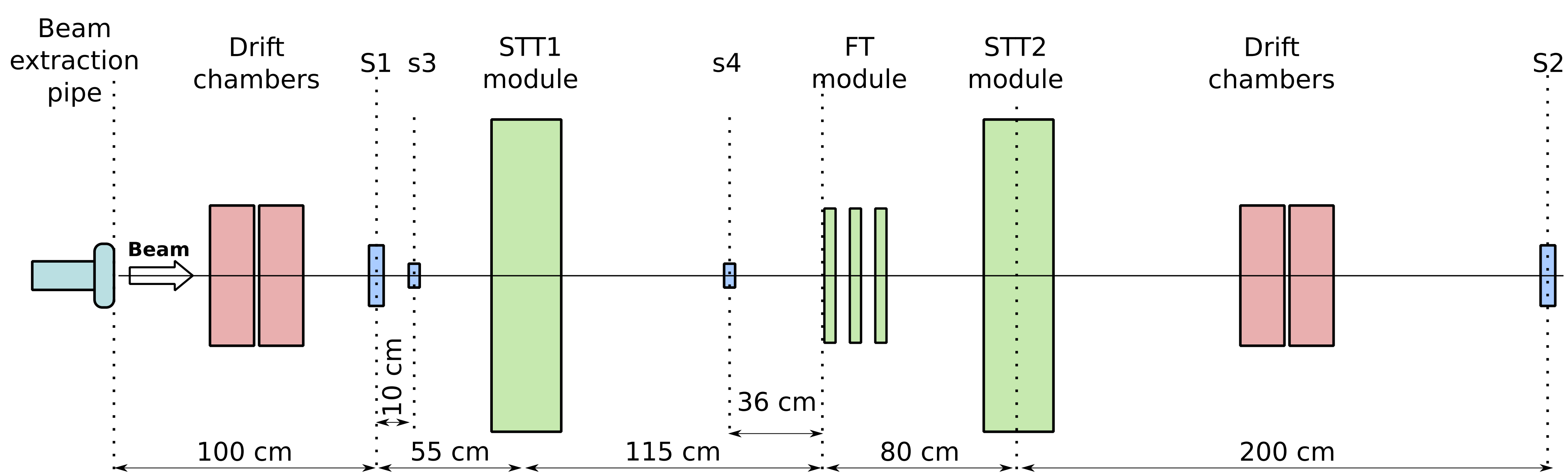
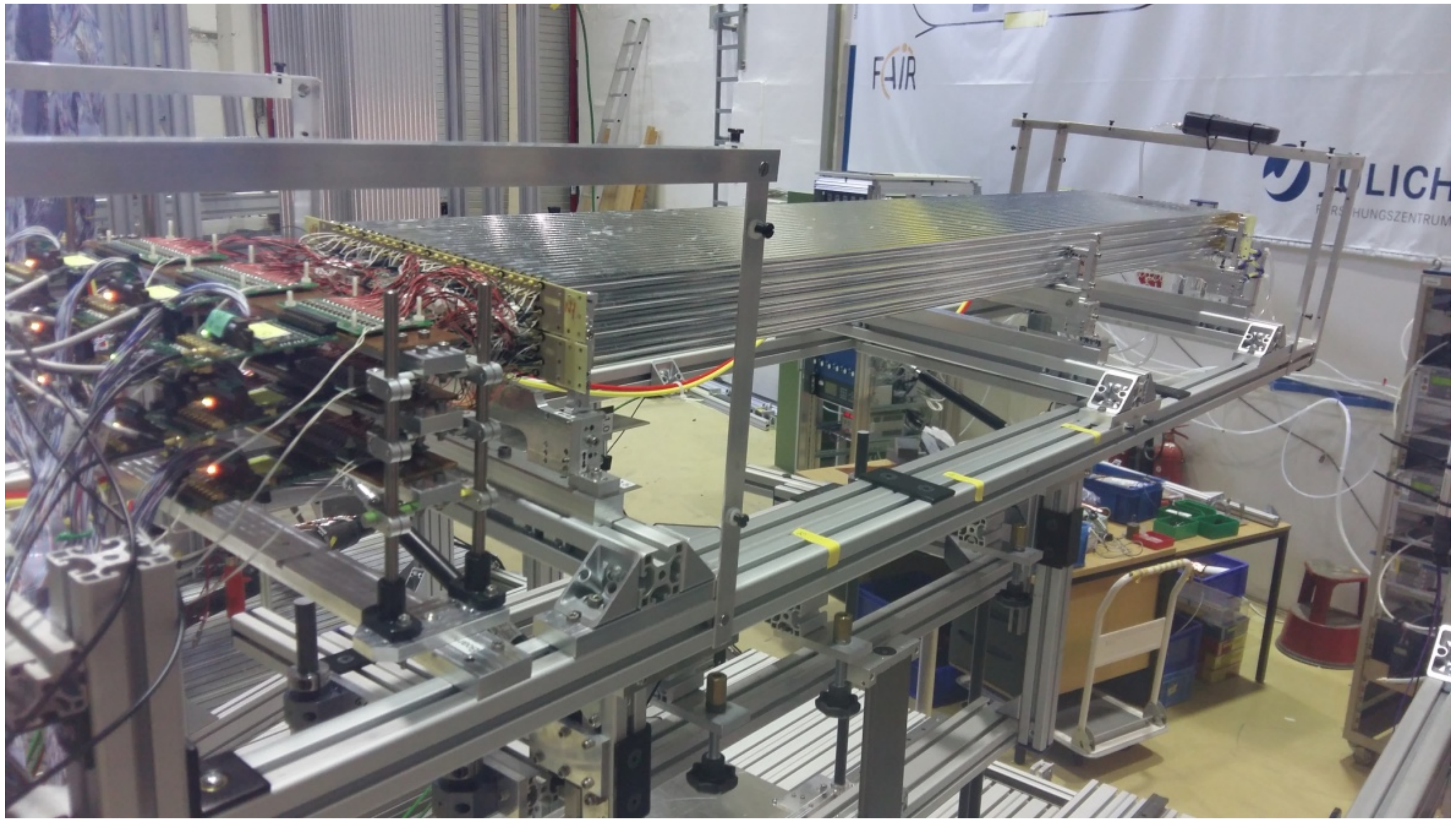


Figure by Pawel Strzempek (JU)



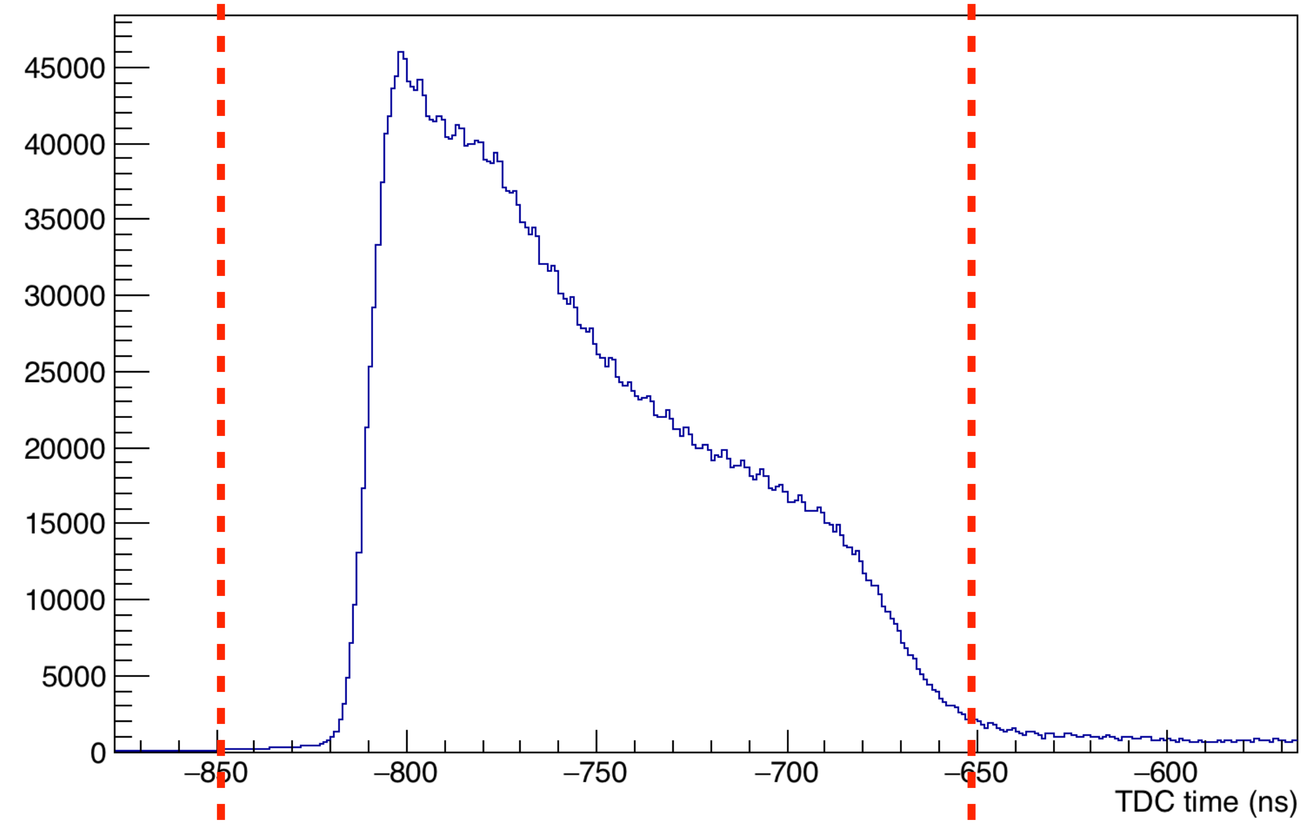
STT-ASIC readout
144 channels
6 layers x 24 tubes

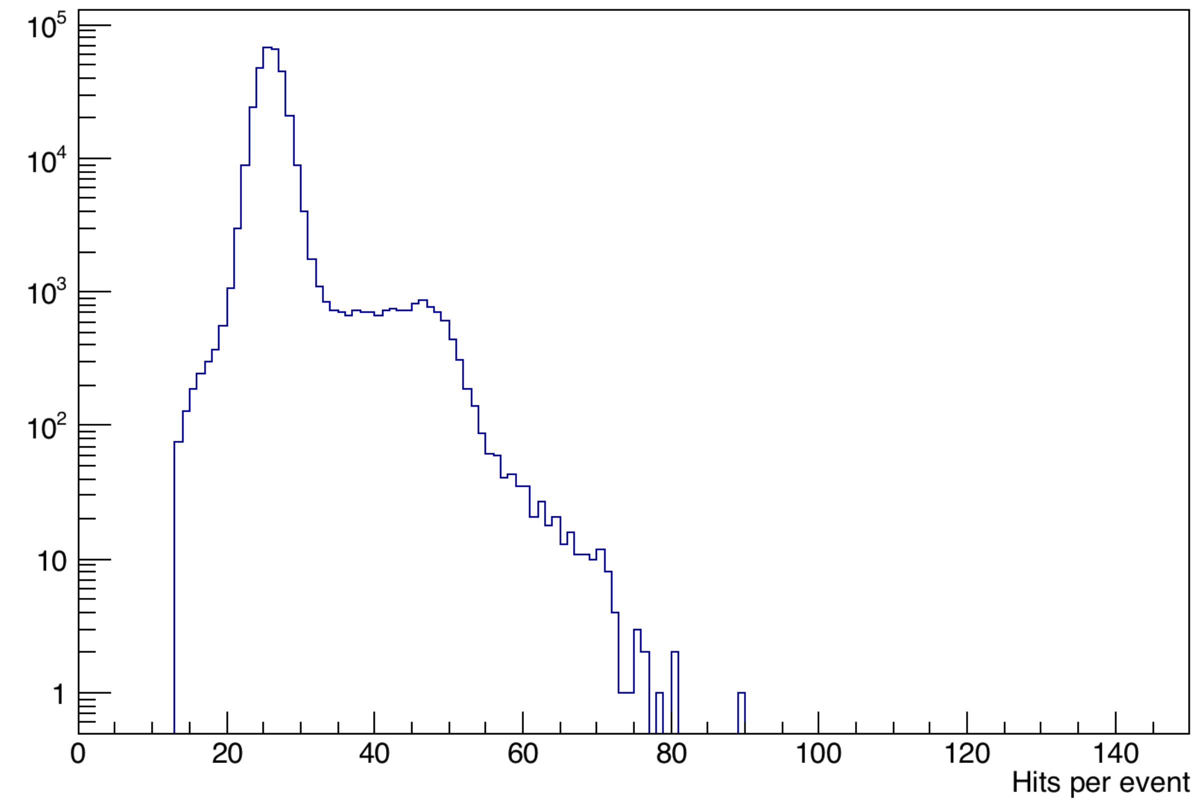
Beam time April 2016
Particles: Protons
Momentum: 0.55, 0.75, 1.0, 2.95 GeV/c

Beam time December 2016
Particles: Deuterons
Momentum: 0.65, 0.75, 1.5 GeV/c

Plots are from both particle species and various momenta
Same settings: voltage is 1800 V, threshold is 20mV, gain is 1, peak time is 35 ns

First check is time distribution from raw data

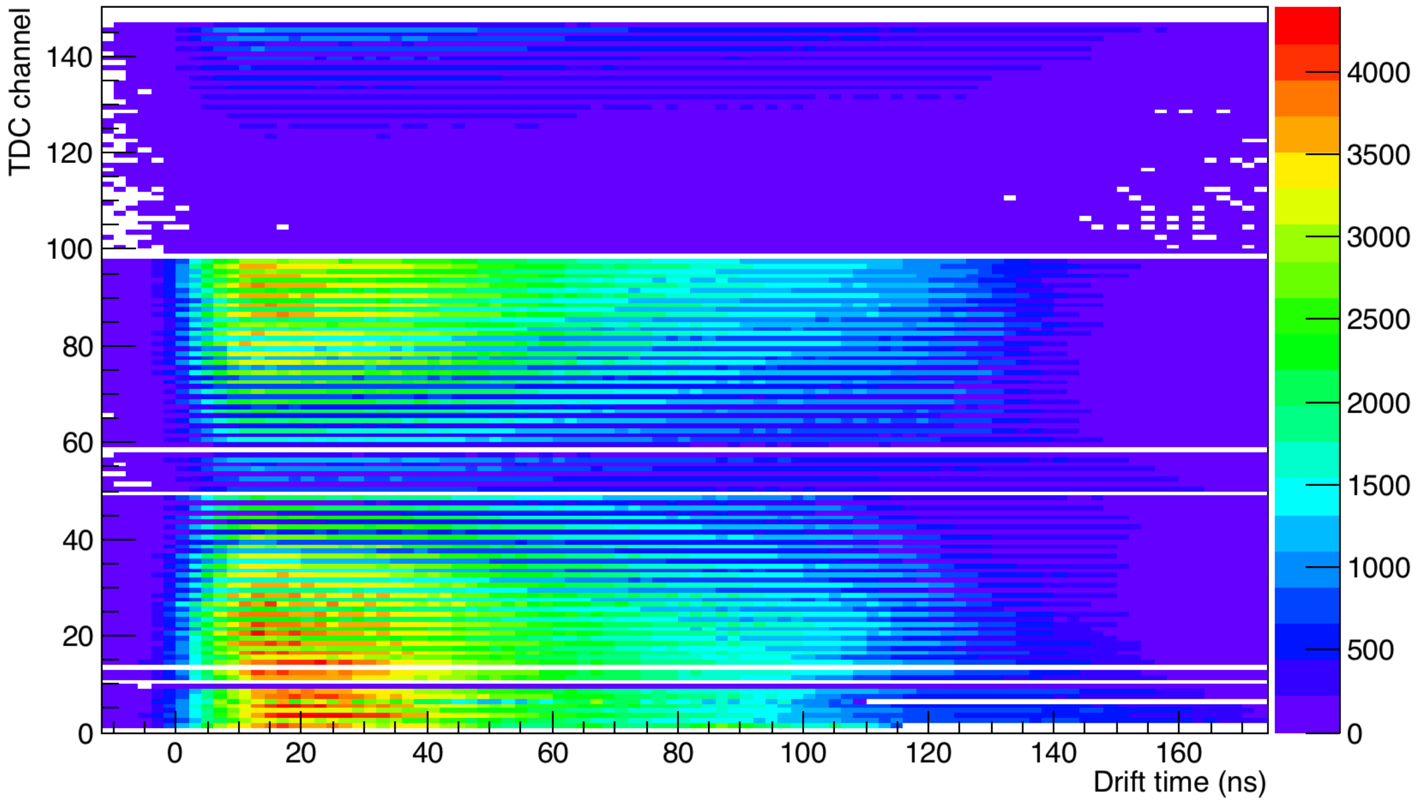


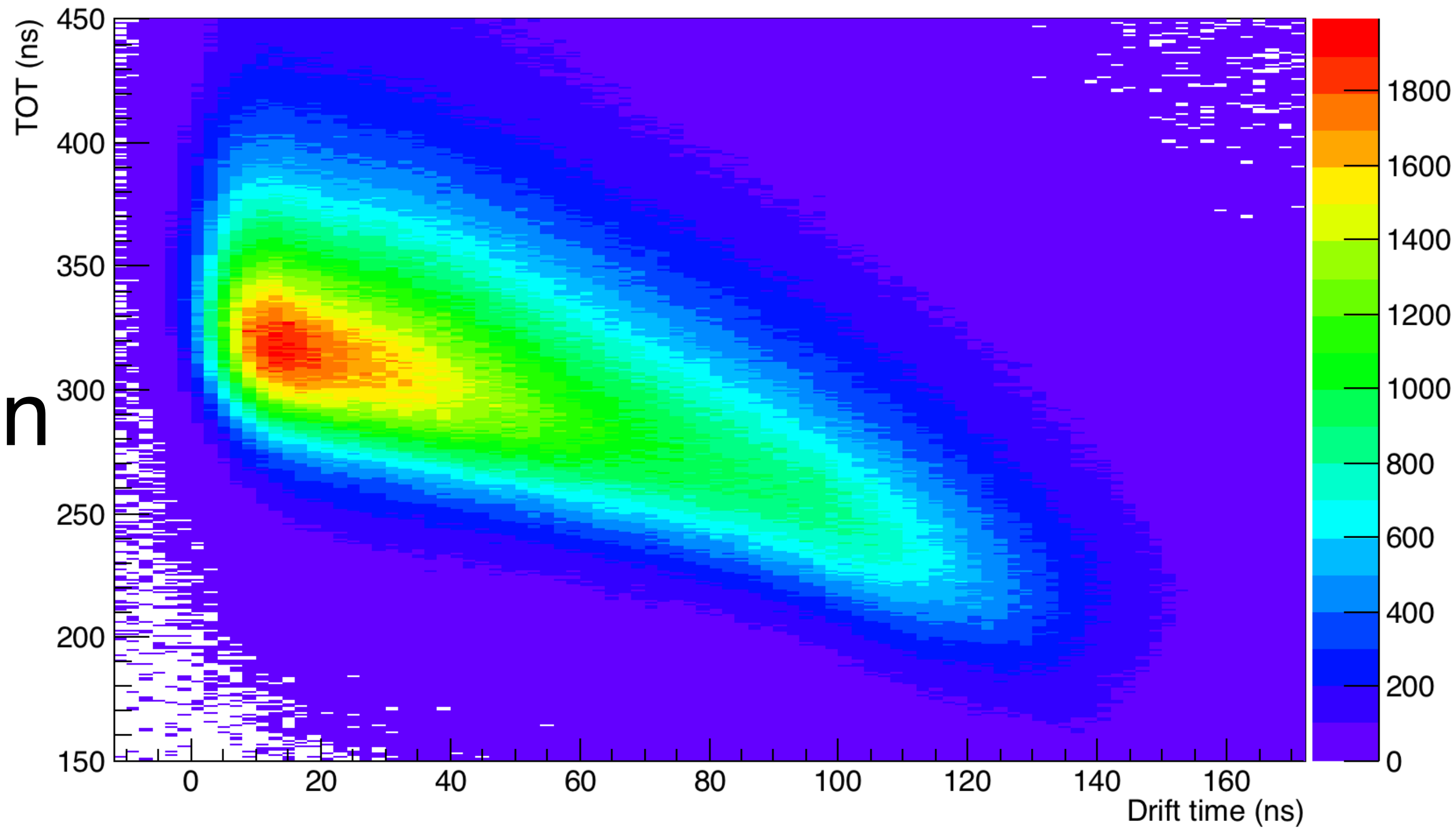


<u>Requirement: At least 12 hits per event (50% of total)</u>

80-90 % of the events in the raw data is used
(1 GeV/c proton data : 65-70%)

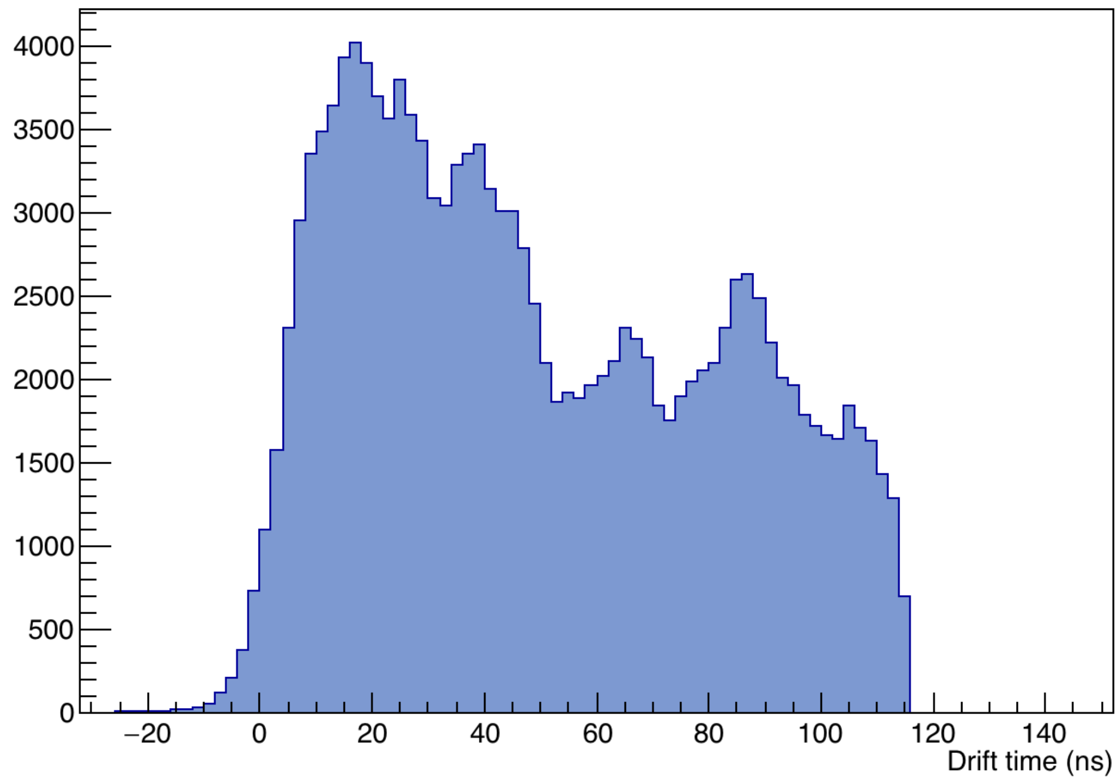
Next step —> calibration

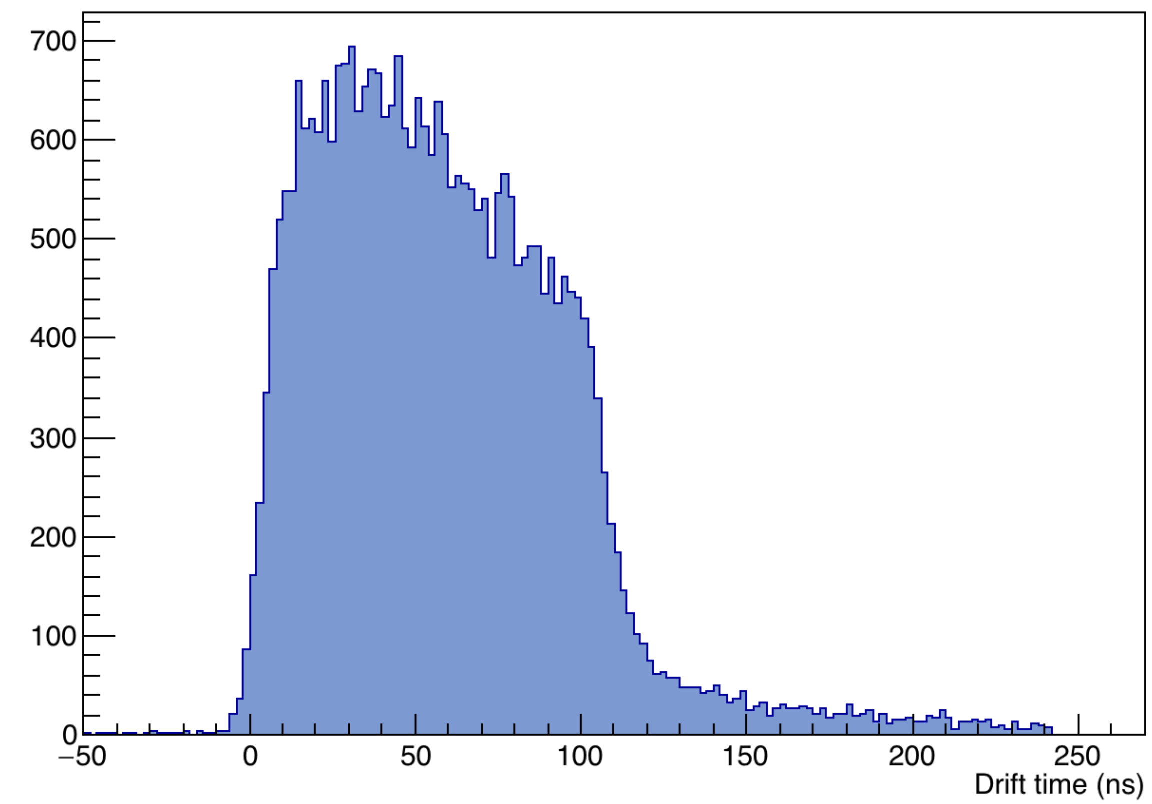


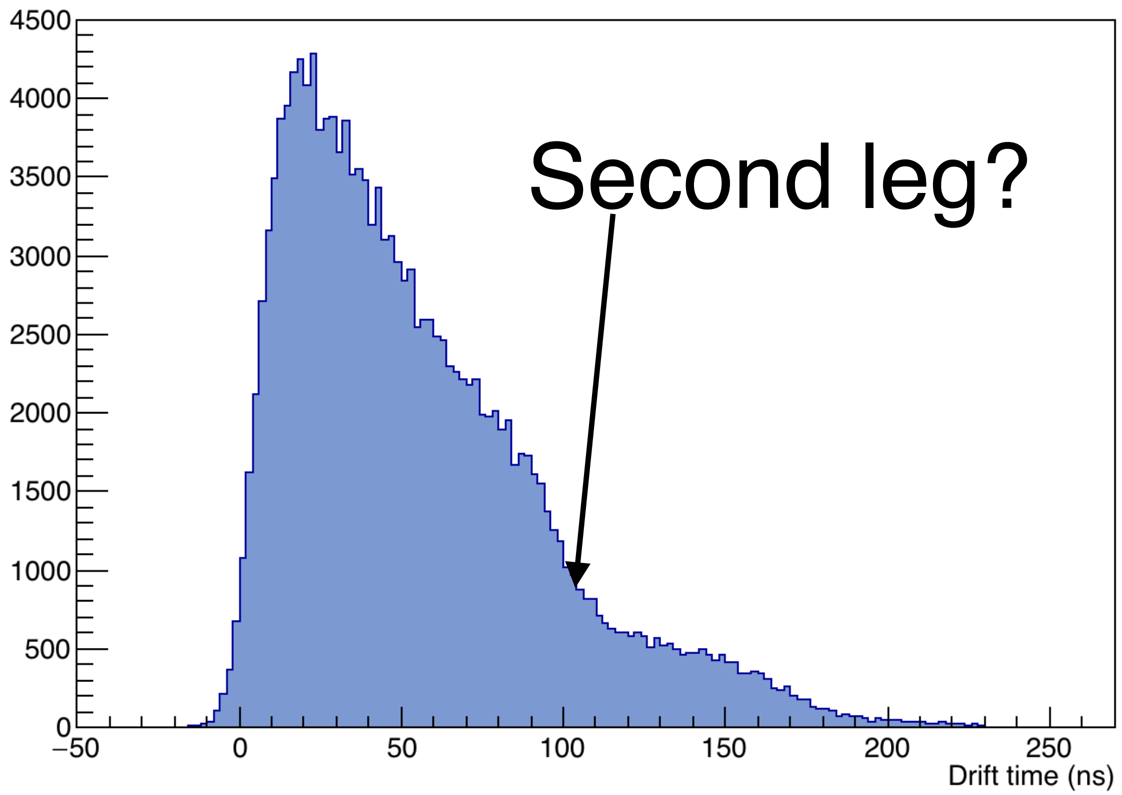


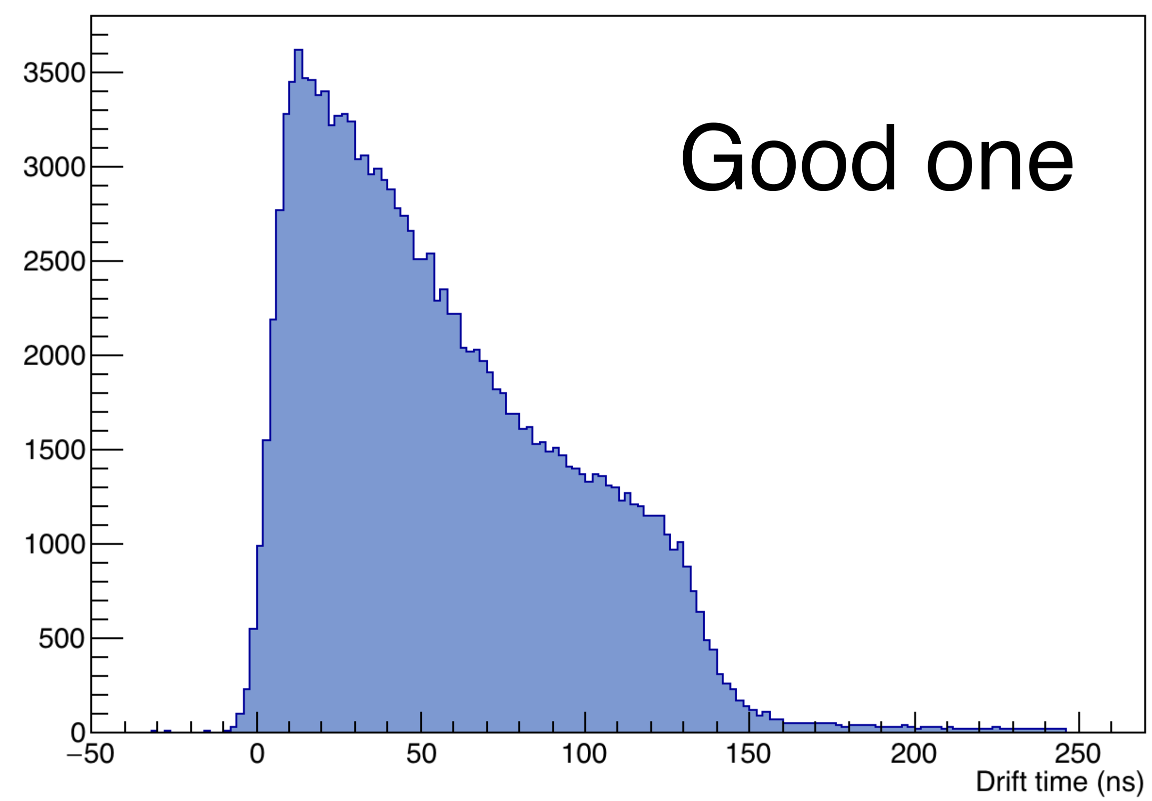
Both look reasonable and clean

BUT there are channels with strange time distributions

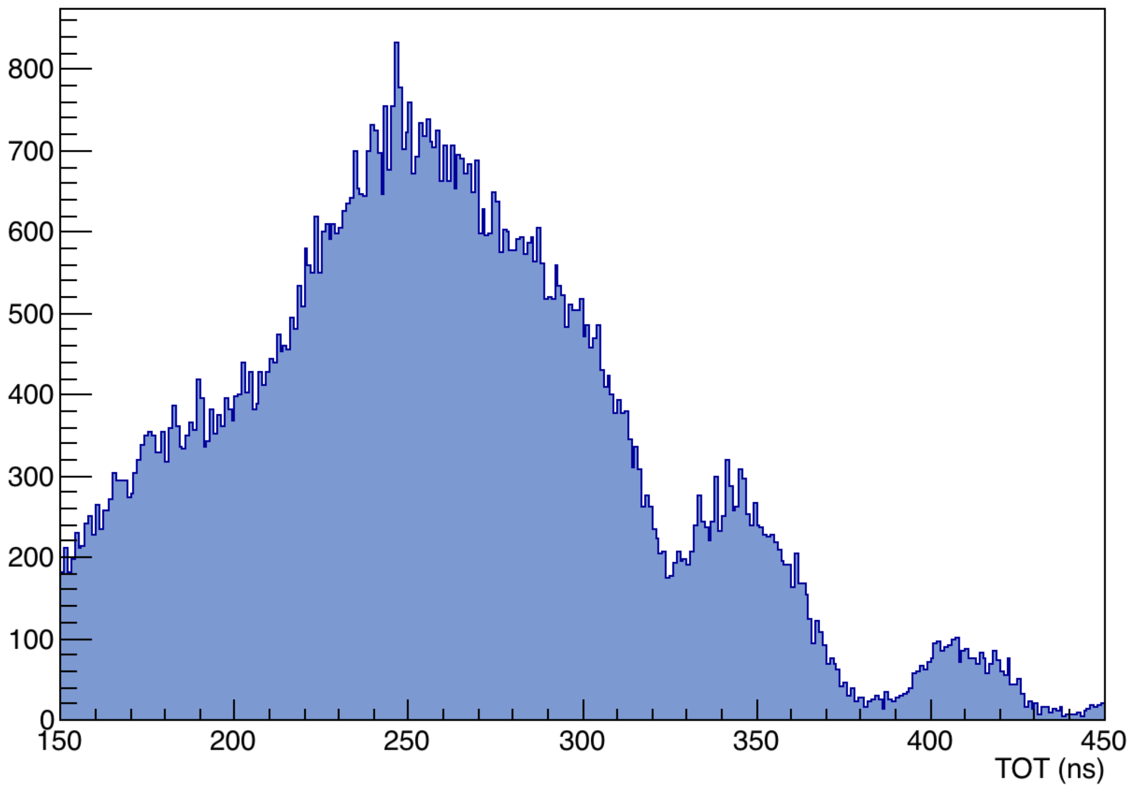


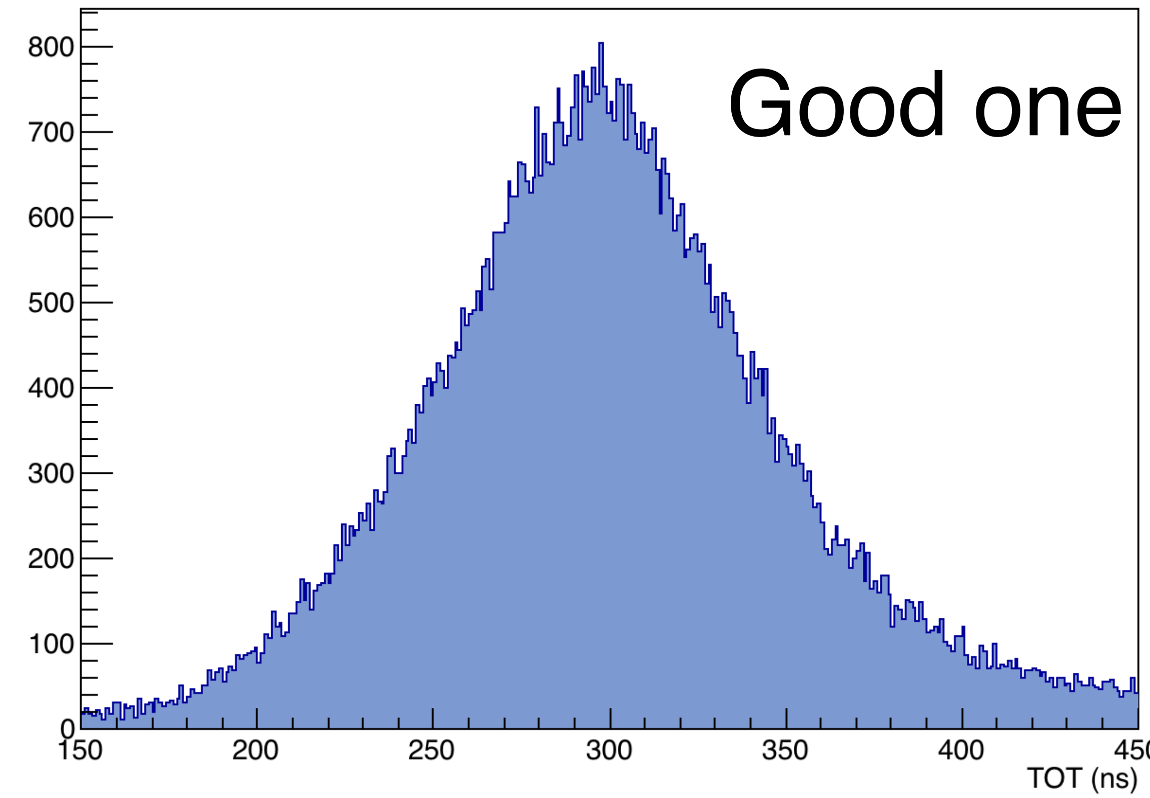






AND at the same time strange TOTs (not always)





<u>"Clean up"</u>

24 channels excluded in April data (1/6 of total)

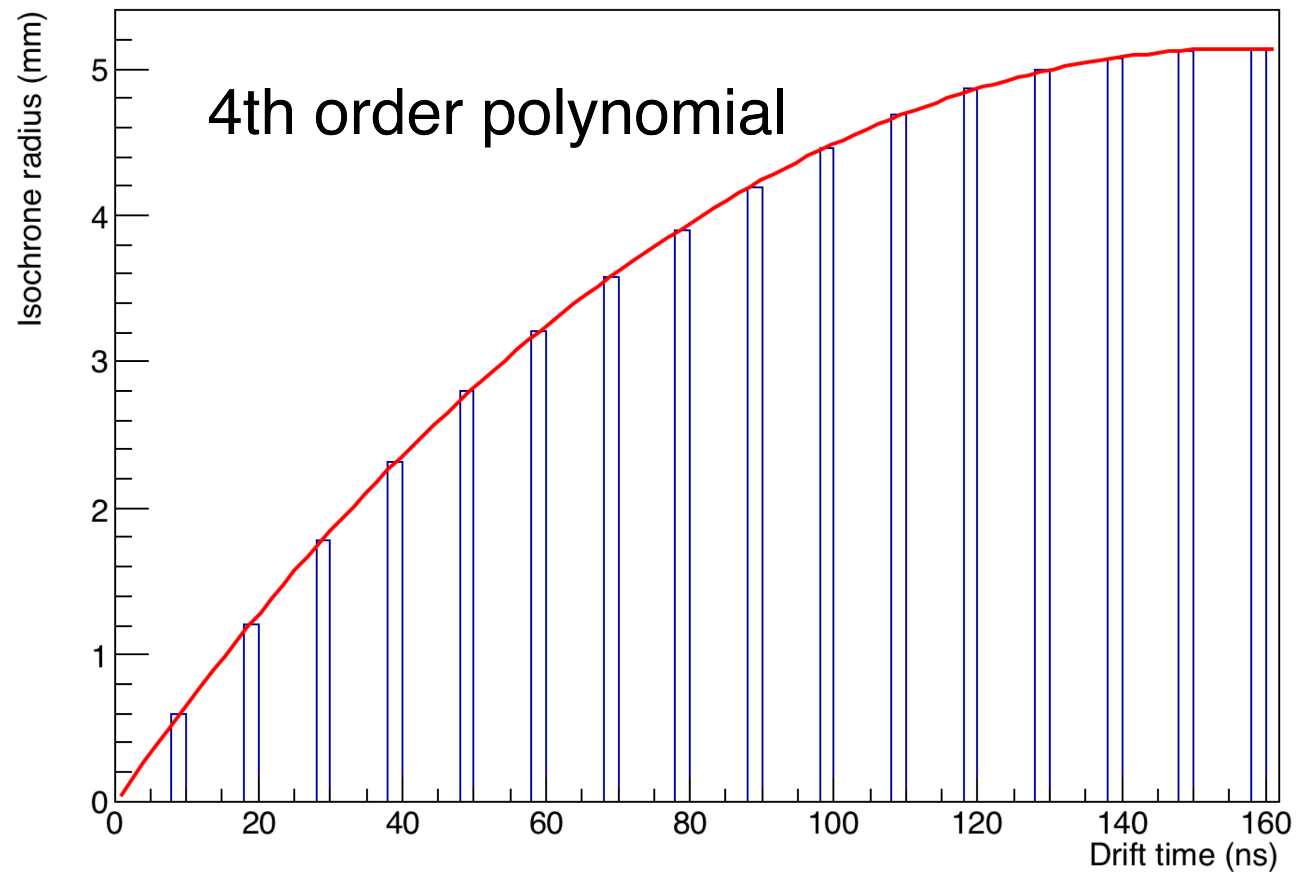
16 channels excluded in December data (1/9 of total)(???)

Only drift times between 0 and 160 ns

Requirement: At least 12 hits per event (50% of total)

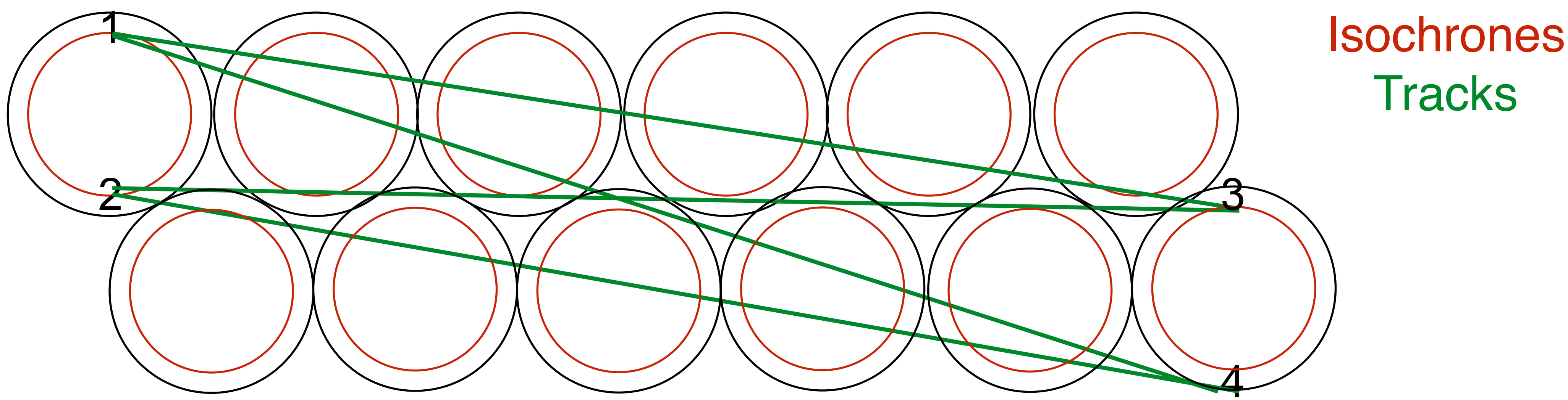
75-85 % of the calibrated events is used

(no "clean up" : ~90%)

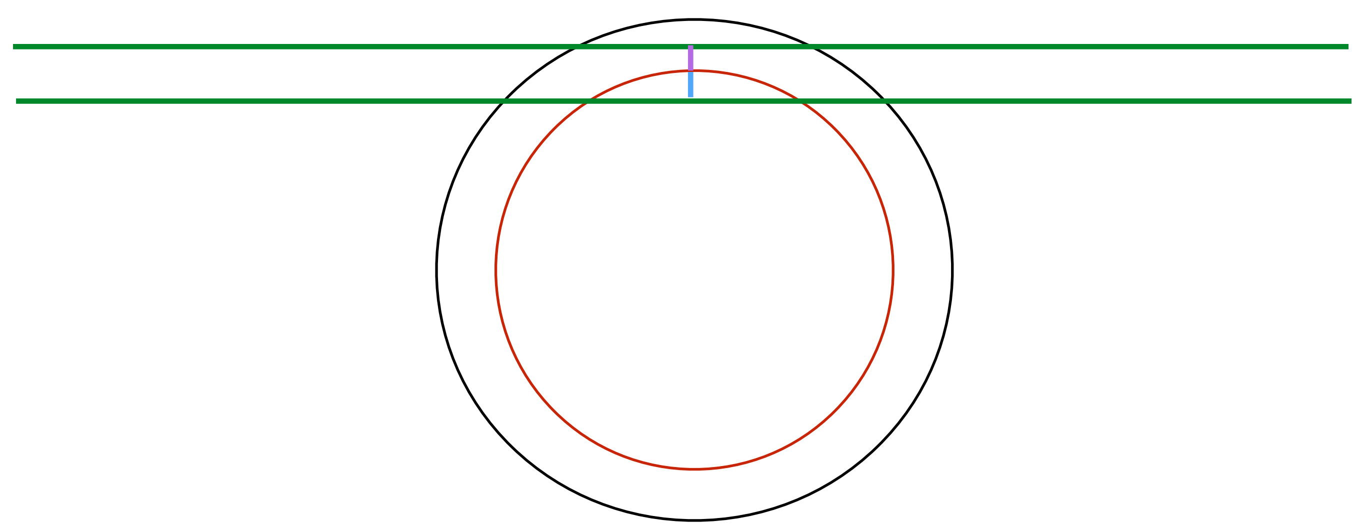


$$r(t_i) = (R_{tube} - R_{wire})\frac{\sum_i N_i}{N_{tot}} + R_{min}$$

Next step —> tracking



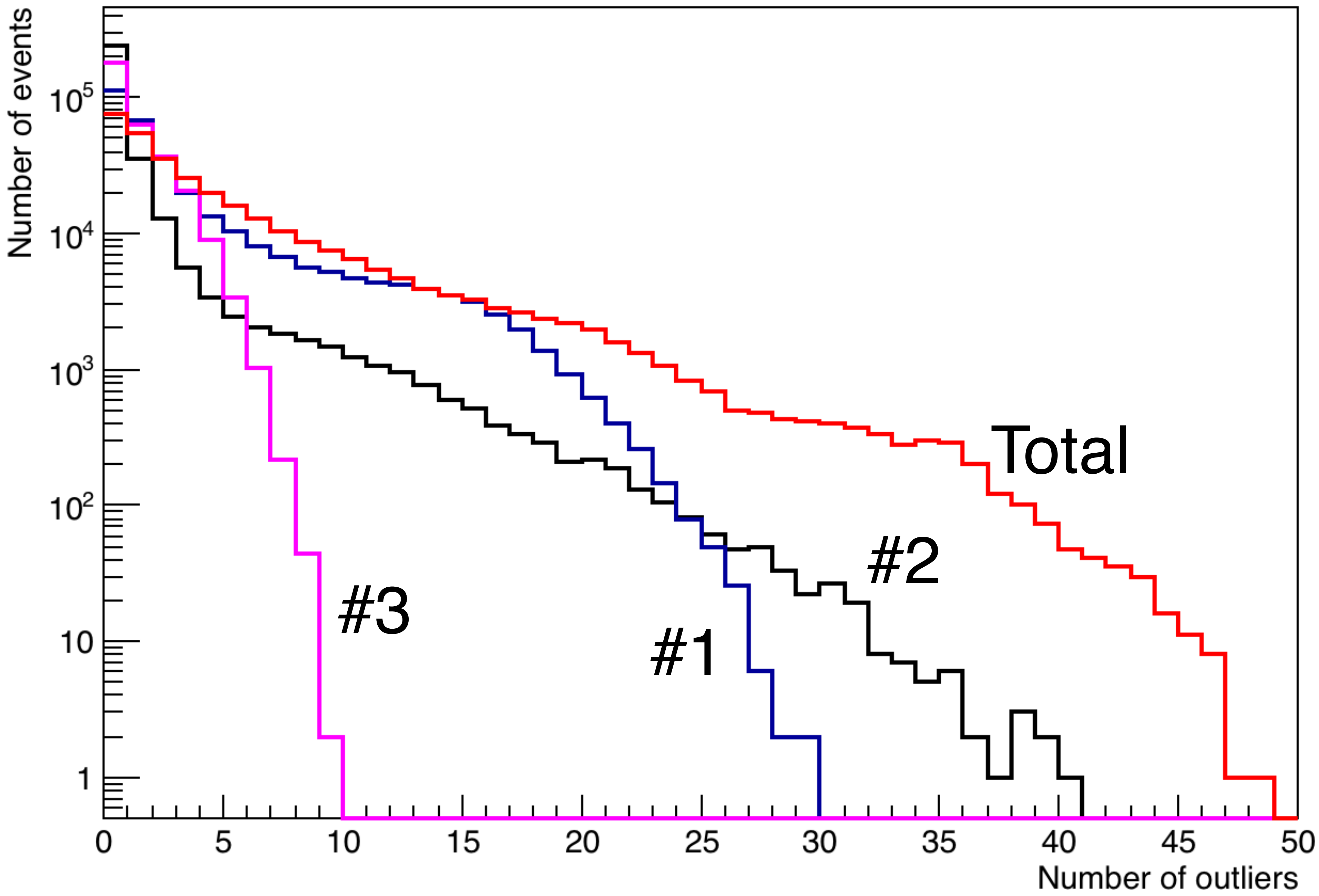
4 candidate tracks
Selection of best track (pre track)
Apply minimization to the pre track (Minuit function)

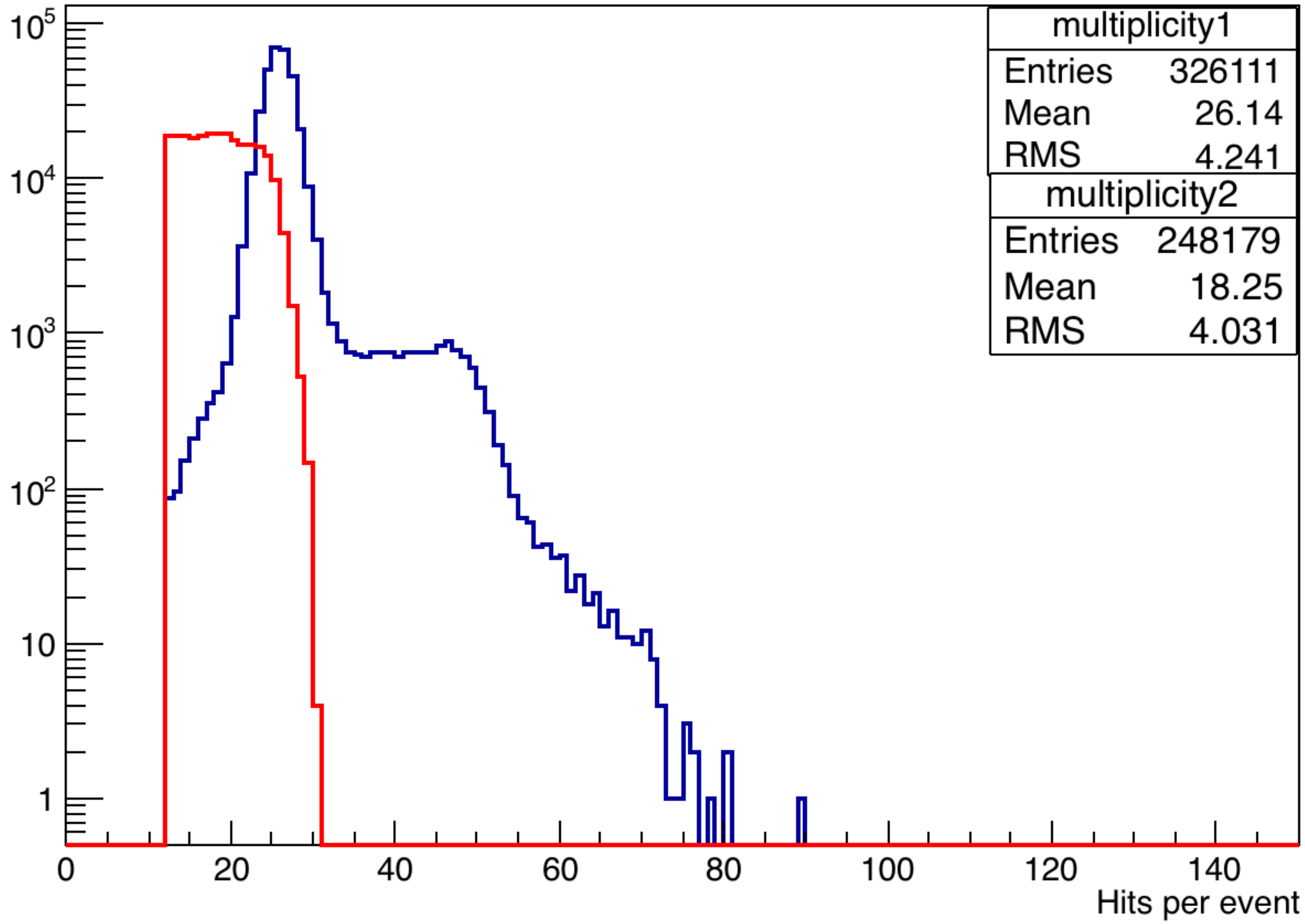


Steps and cuts for tracking

- Calculation of isochrones based on the parameters of the fit
- If isochrone is between -200μm and 0, set 250μm
- Determination of the pre track
- Outliers #1: Distance between track and wire > 6mm, skip hit
- Apply minimization
- Outliers #2: Residual > 0.6mm, skip hit
- Apply minimization
- Outliers #3: Residual > 2.5 sigma of the isochrone error, skip hit
- Apply minimization
- Requirement: At least 12 hits per event (50% of total)
- Final track

Outliers

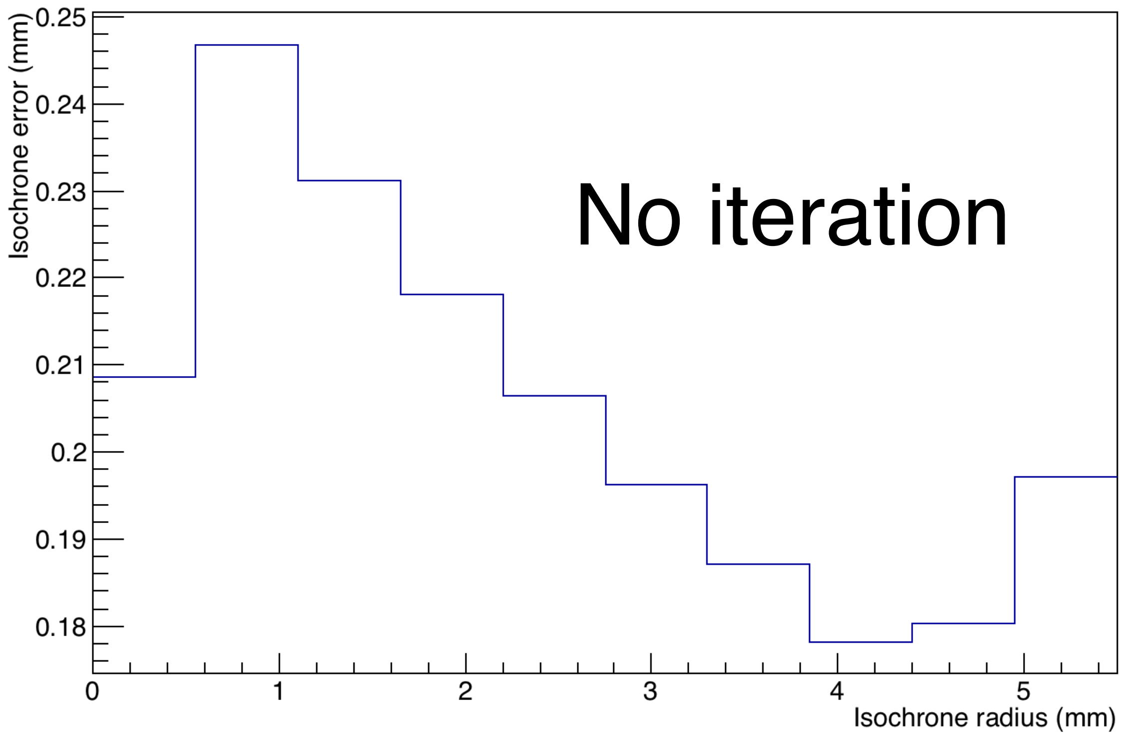

Number of events
10^5
10^4
10^3
10^2
10
1
0
5
10
15
20
25
30
35
40
45
50
Number of outliers
Total
#2
#3
#1

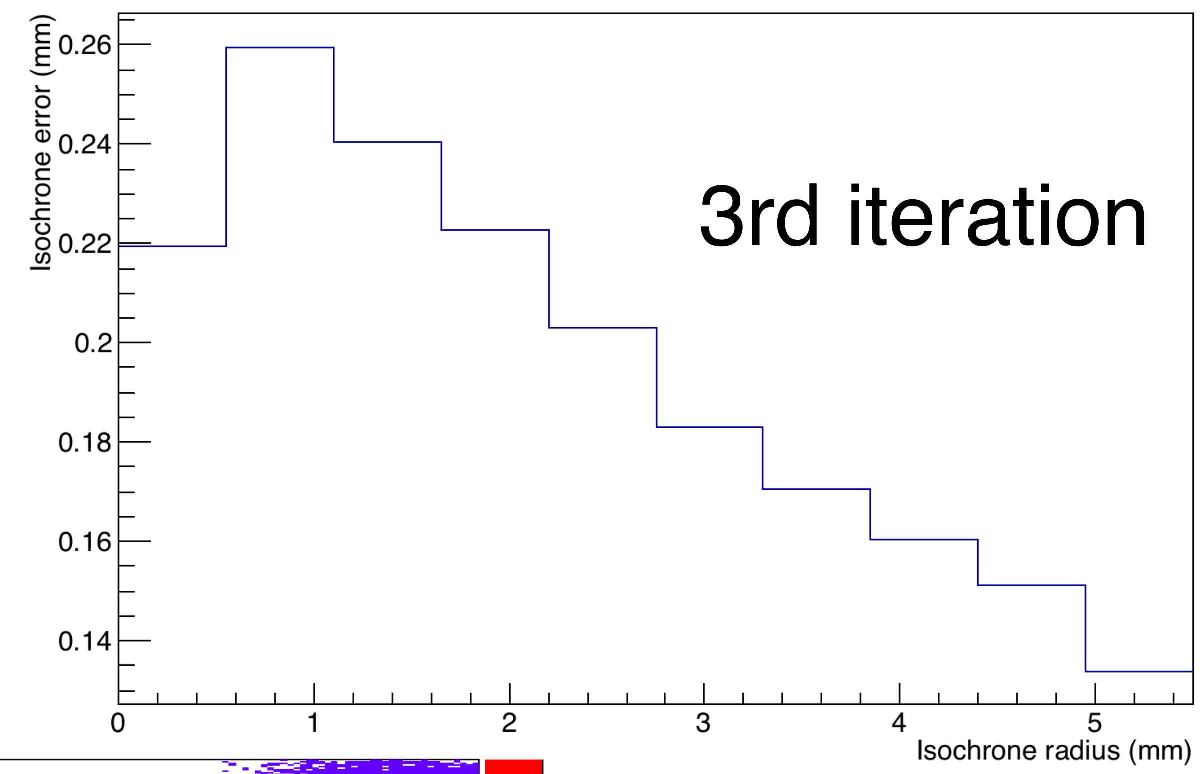


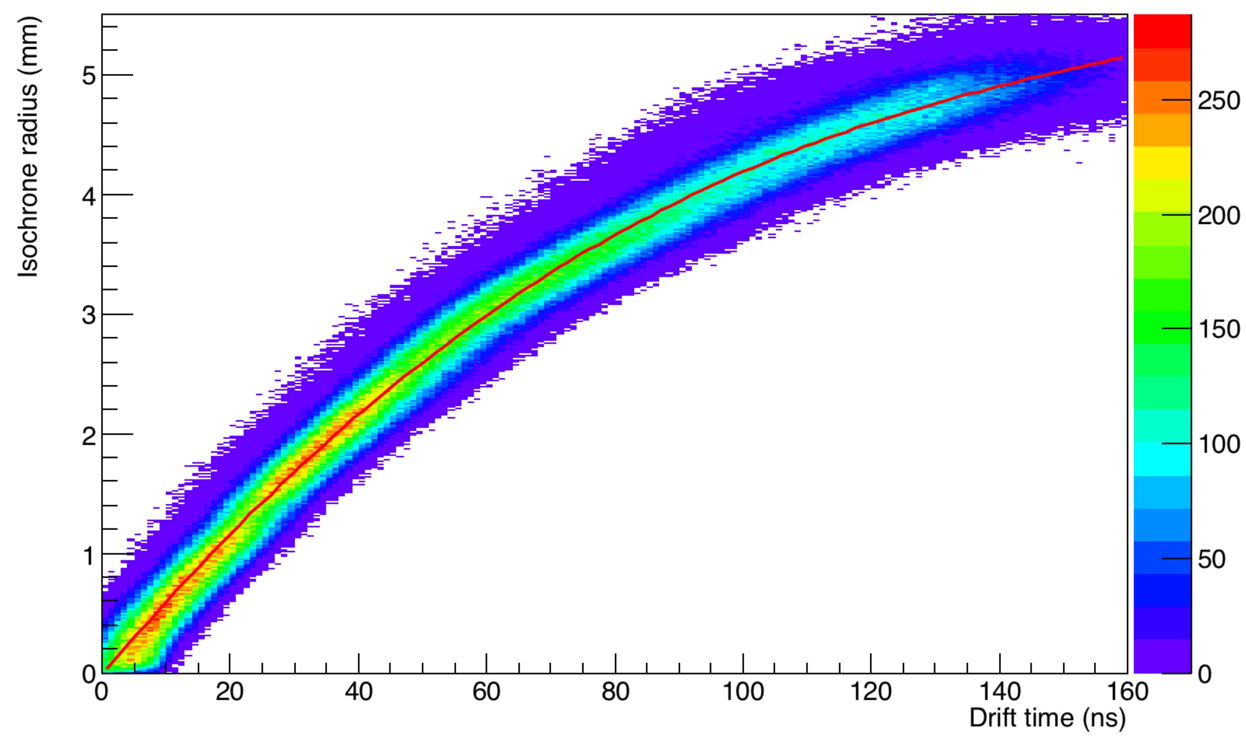
75-85 % of the events used for final tracking

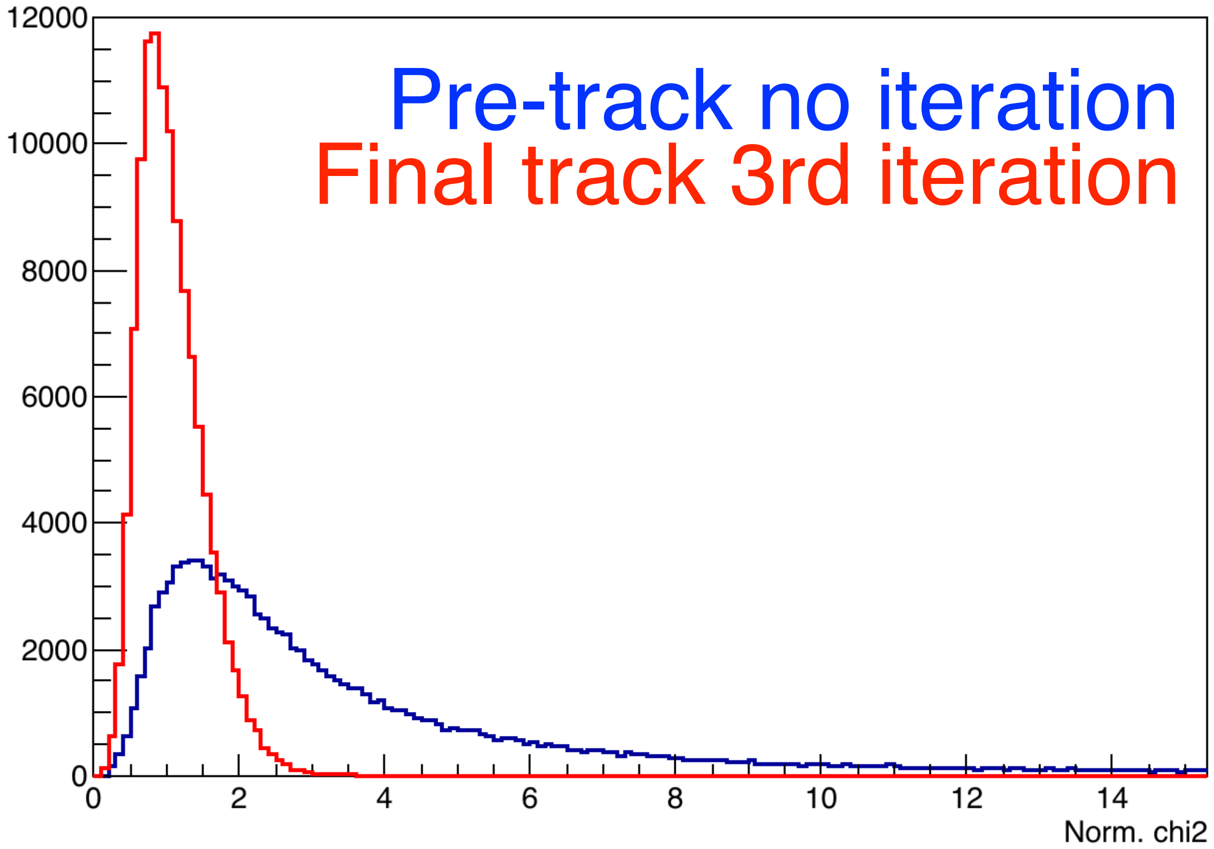
Iteration procedure

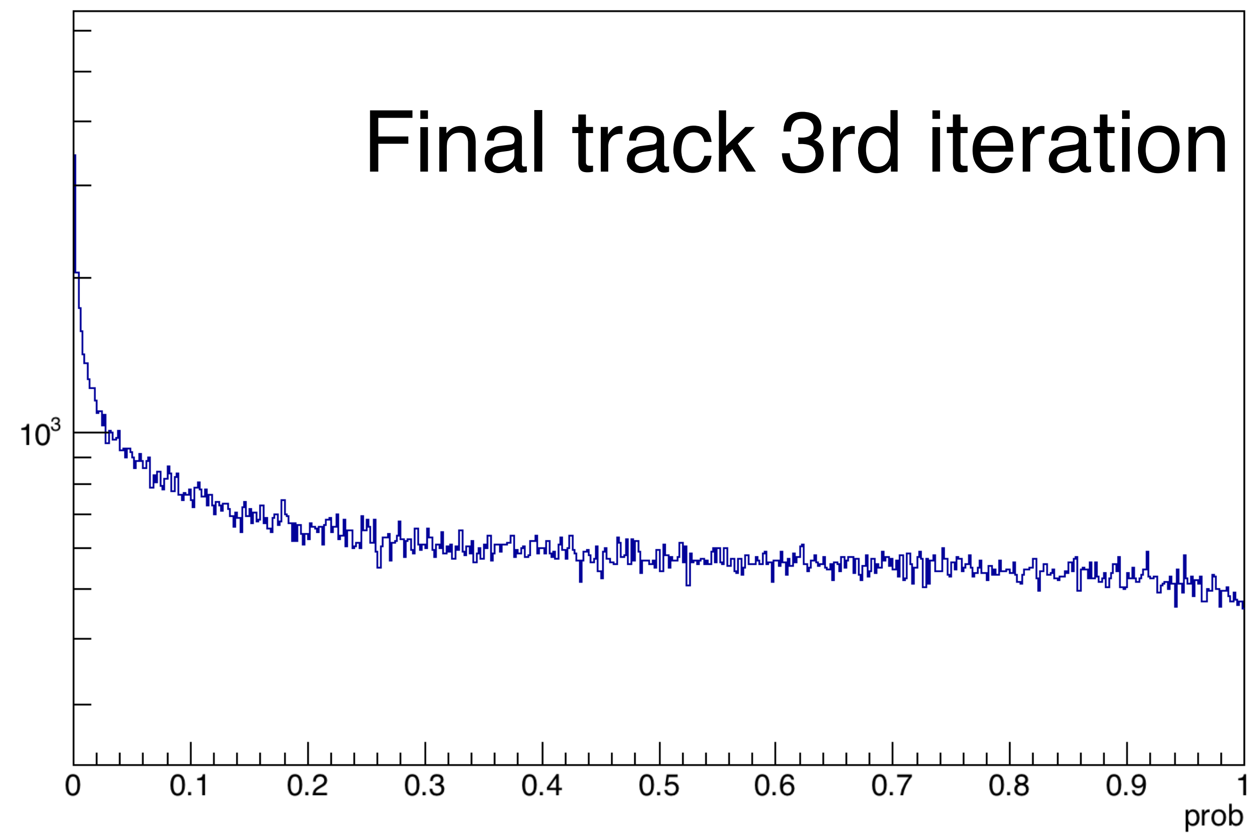
Recalculation of isochrones and isochrone error based on data



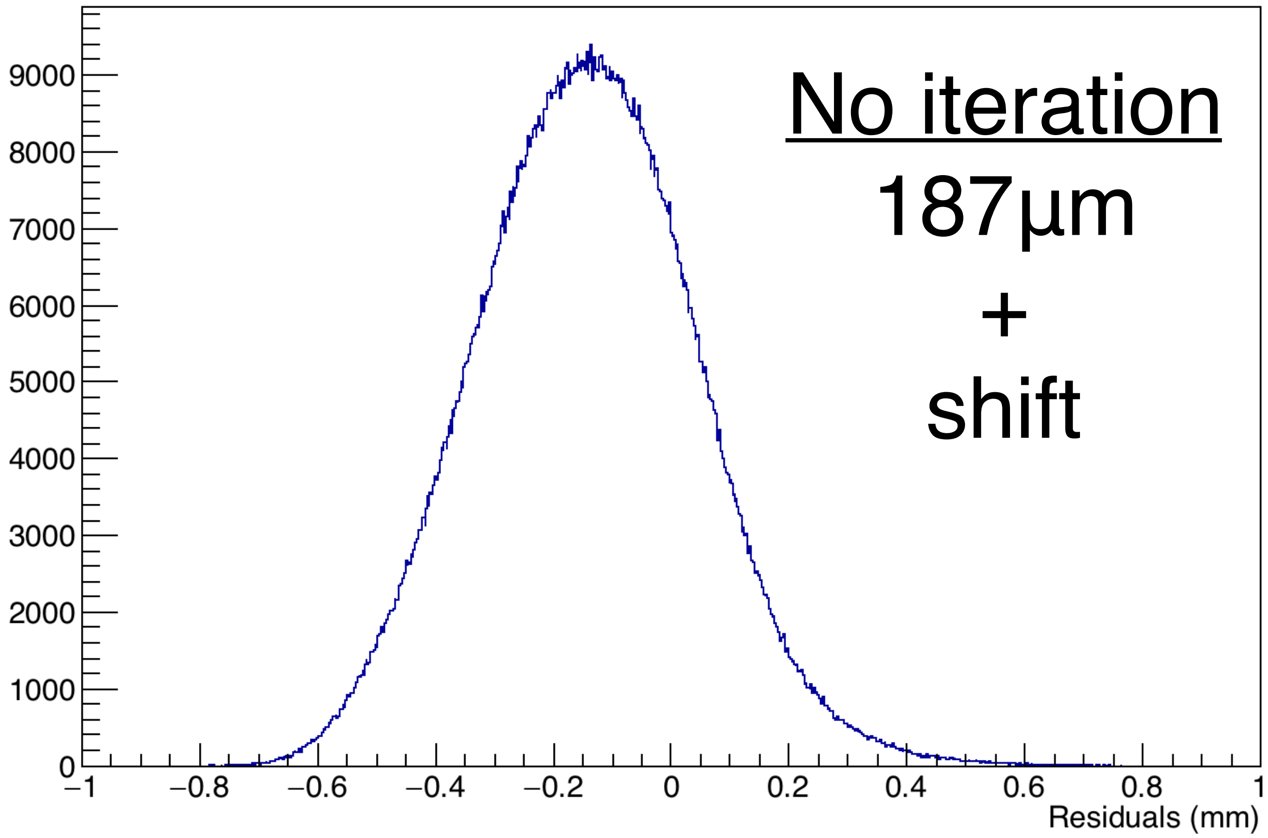


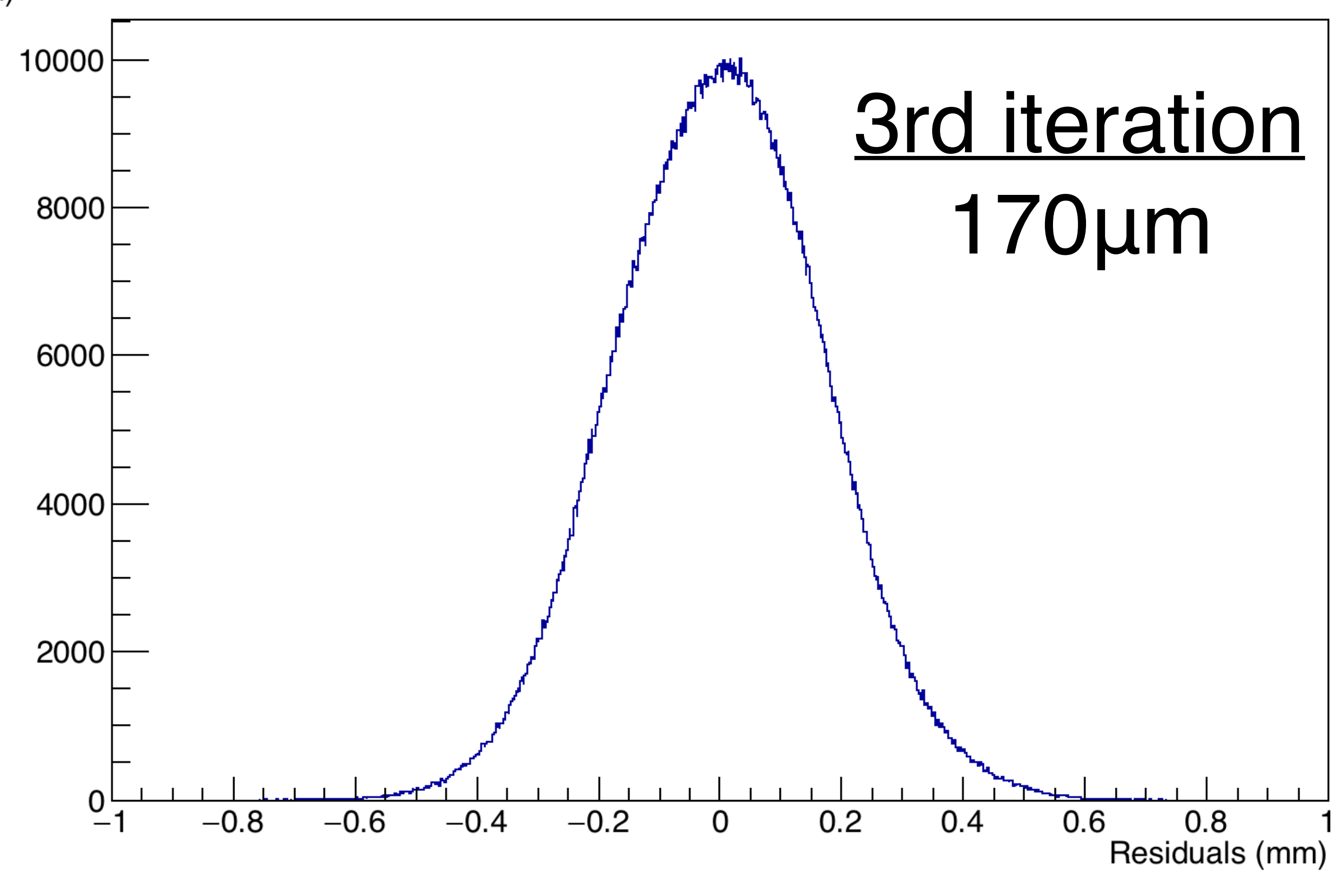




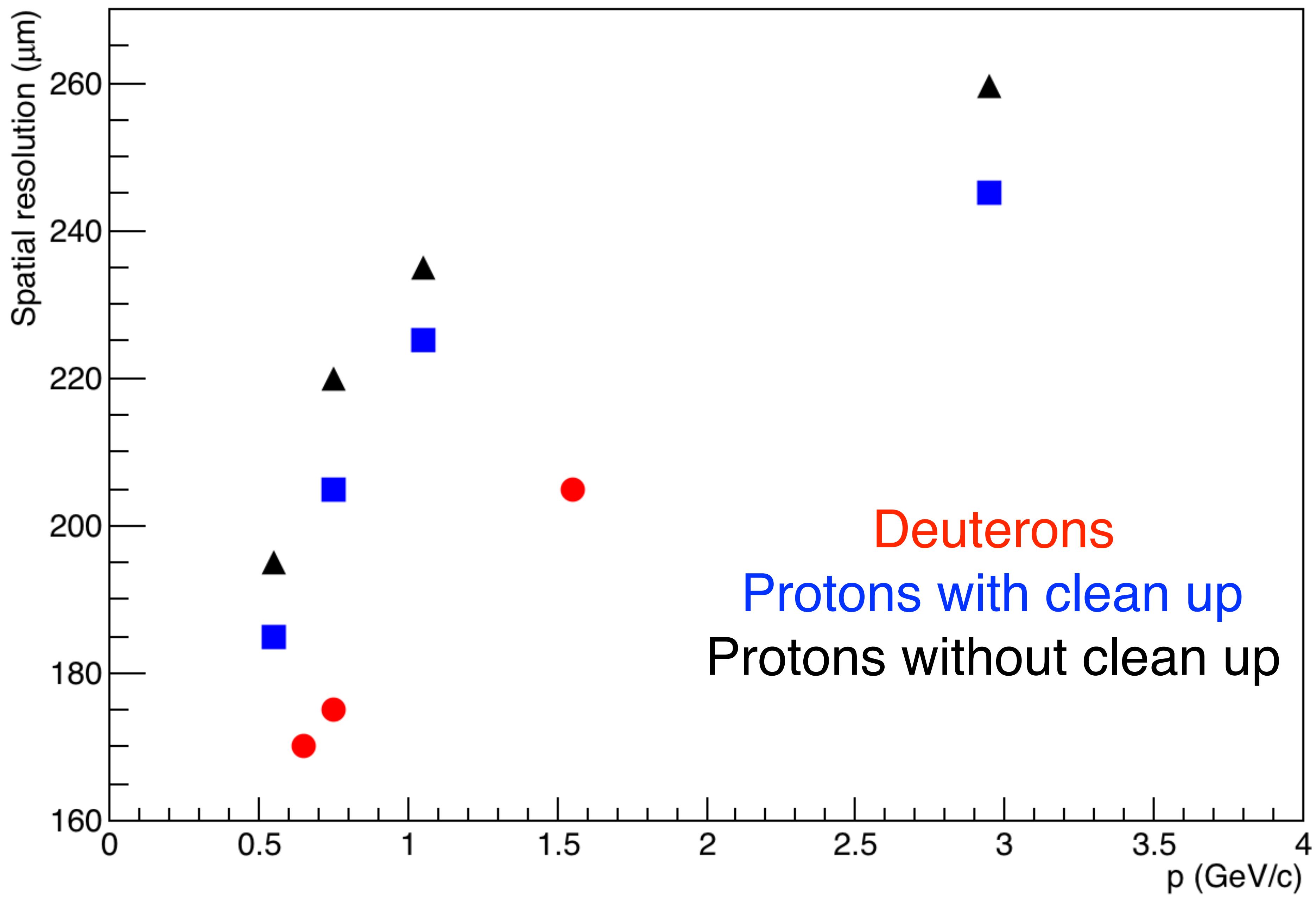


Alexandros Apostolou


No iteration
187µm
+
shift
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
Residuals (mm)

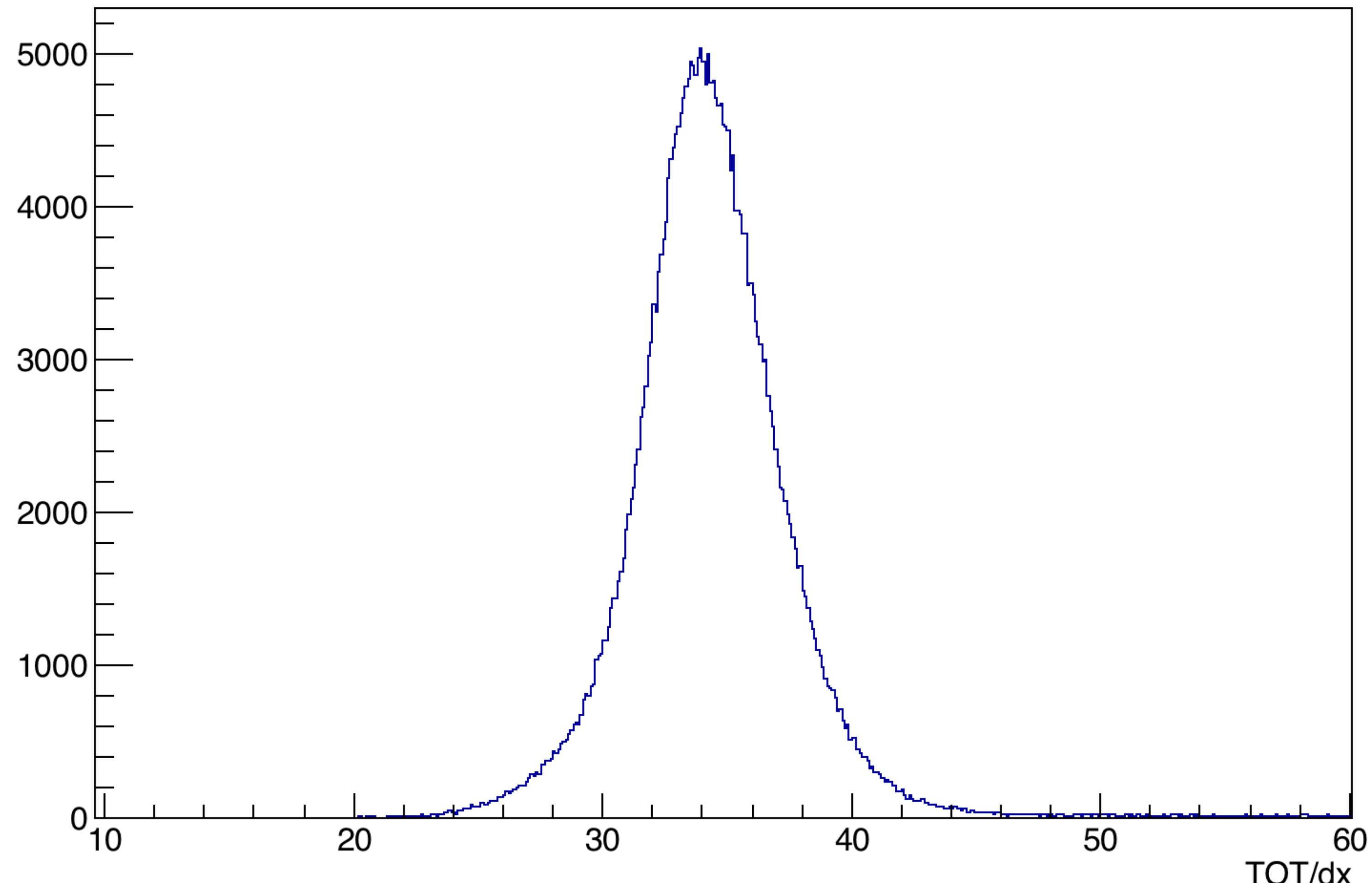

3rd iteration
170µm
0
2000
4000
6000
8000
10000
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
Residuals (mm)

Summary of spatial resolution



TOT/dx : information from 3rd iteration

ΣTOT/Σdx



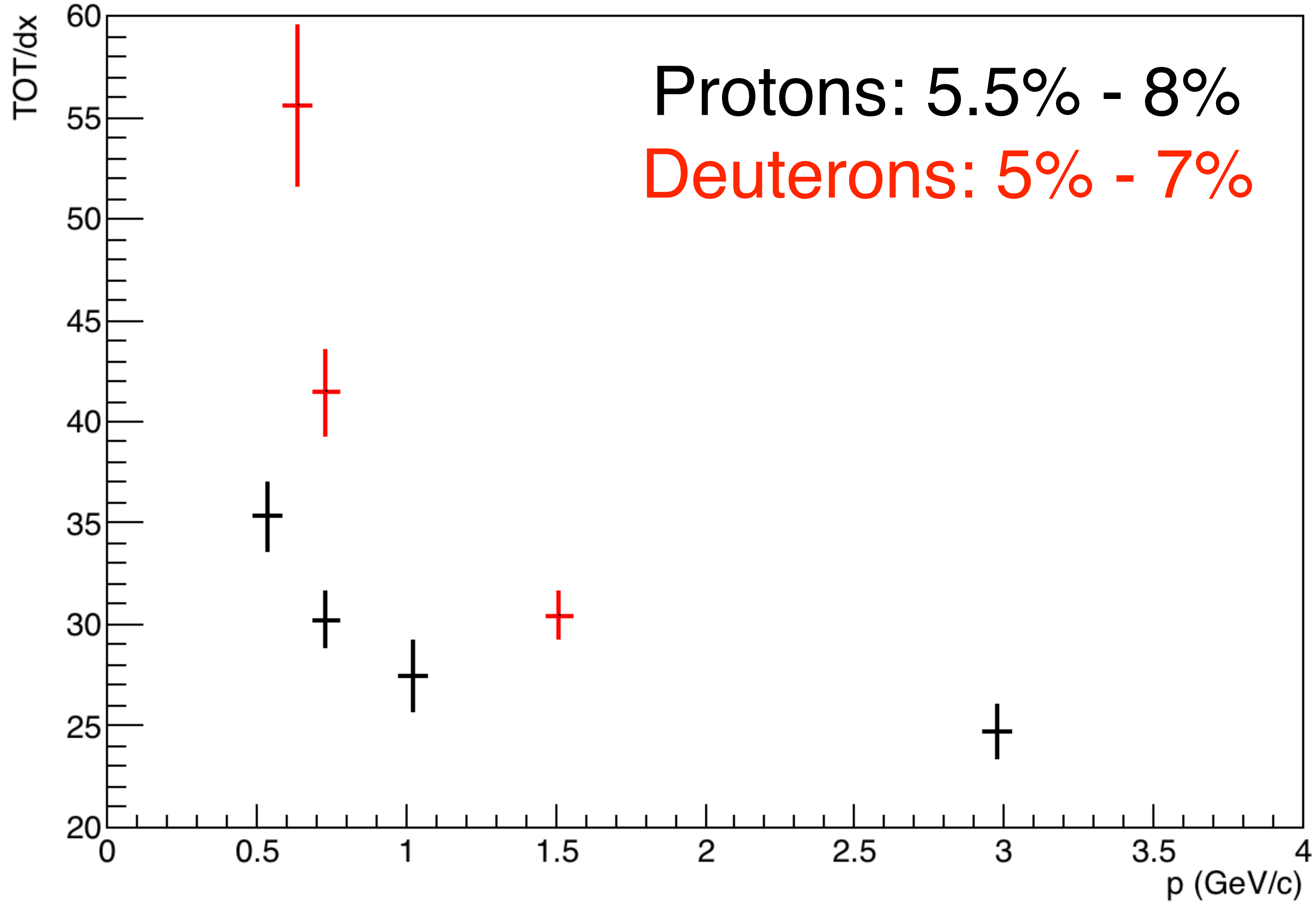
Truncation per hit

Combinations of 10%,20%,30% for right and left side

Use of FWHM/2.355 and divide by the mean

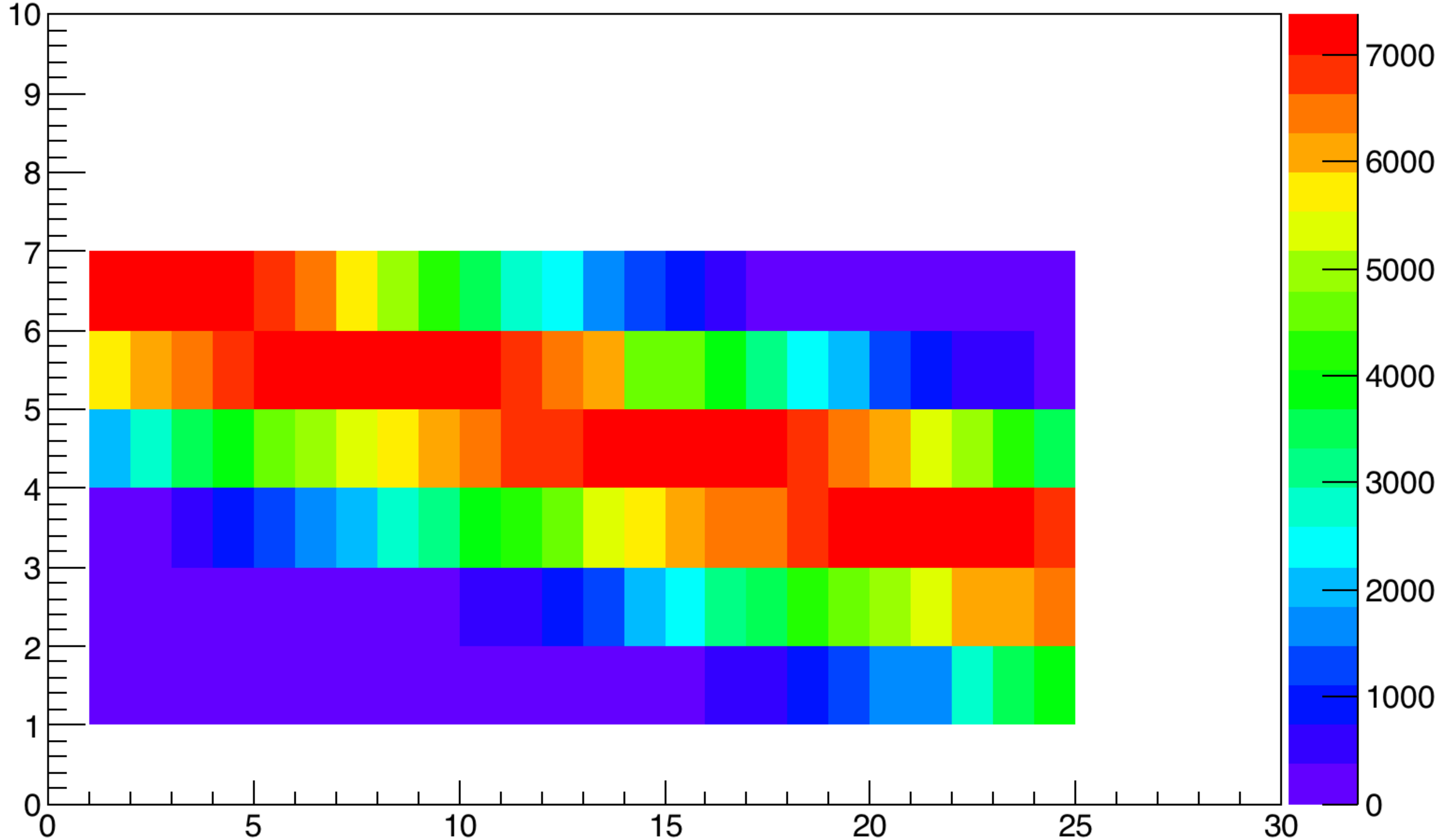
Resolution (30% truncation on the right part)

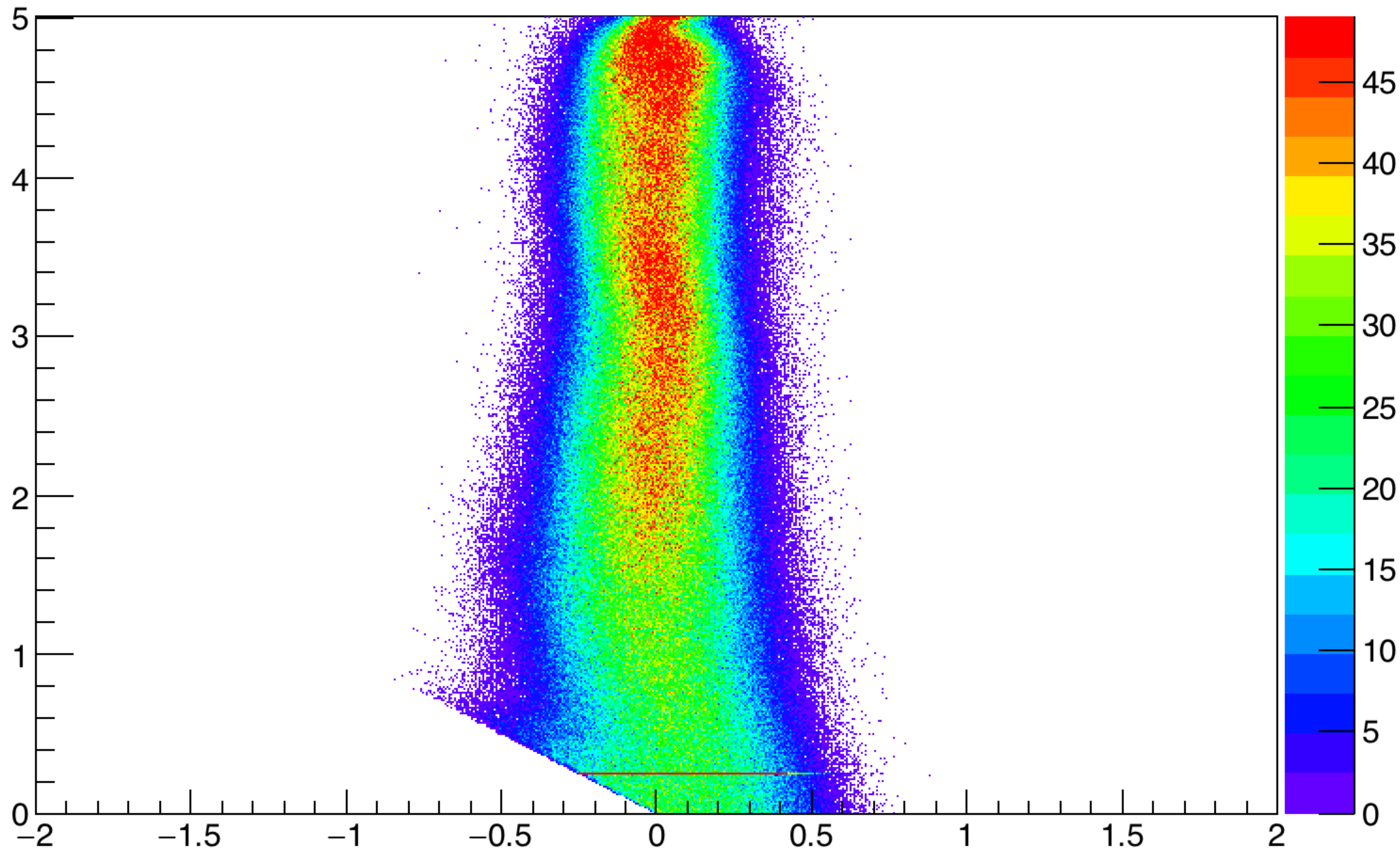
Summary of TOT/dx



Conclusions

Some problems with prototype (proton test)
Software analysis methods are working


10
9
8
7
6
5
4
3
2
1
0
0
5
10
15
20
25
30
7000
6000
5000
4000
3000
2000
1000
0


5
4
3
2
1
0
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2
45
40
35
30
25
20
15
10
5
0