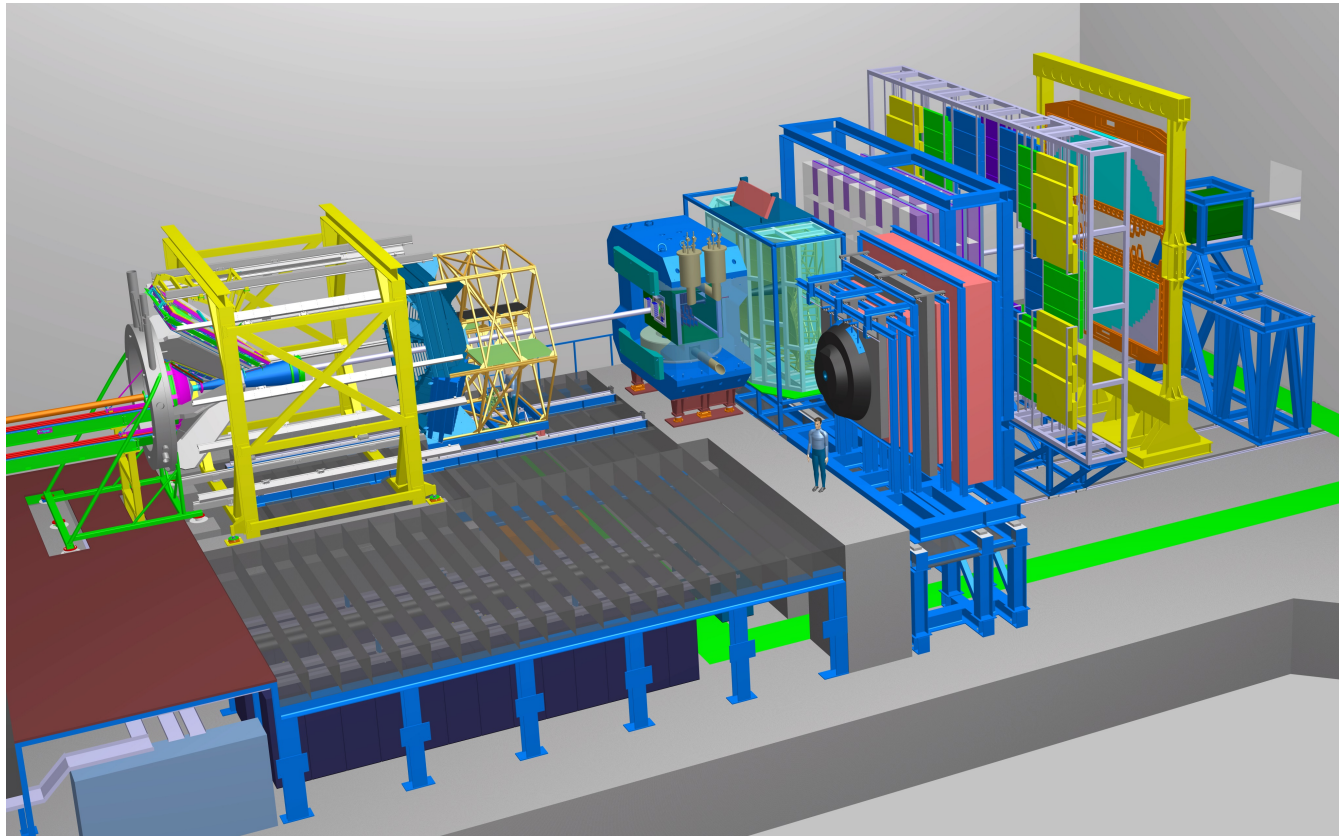


Time based reconstruction in CBM ToF

T. Ablyazimov^{1,2}, V. Friese¹

1. GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

2. IIT, The Joint Institute for Nuclear Research, Dubna, Russia

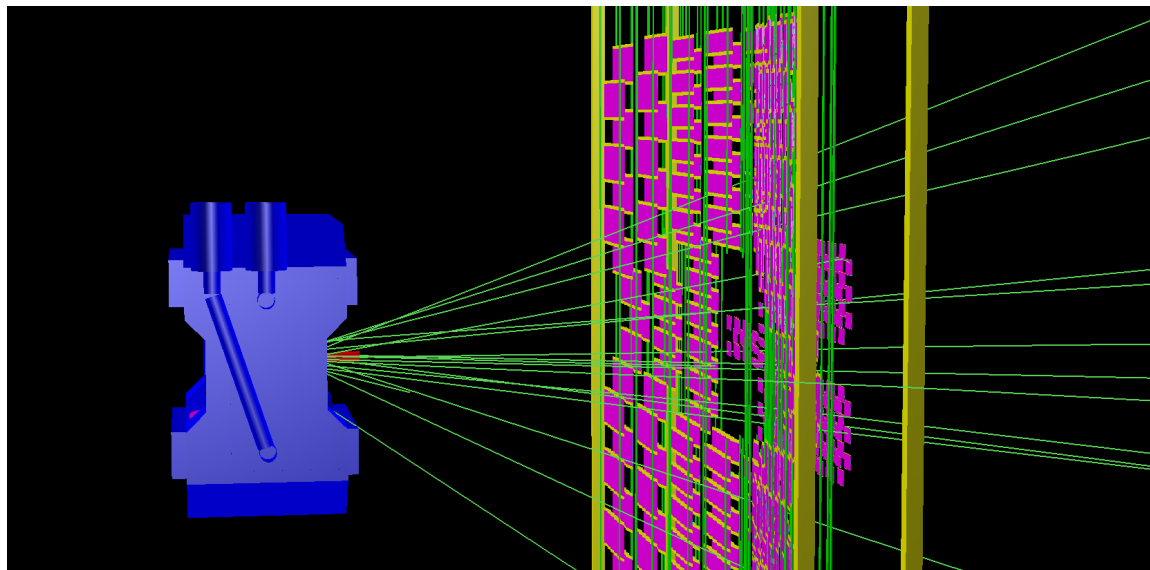


CBM experiment

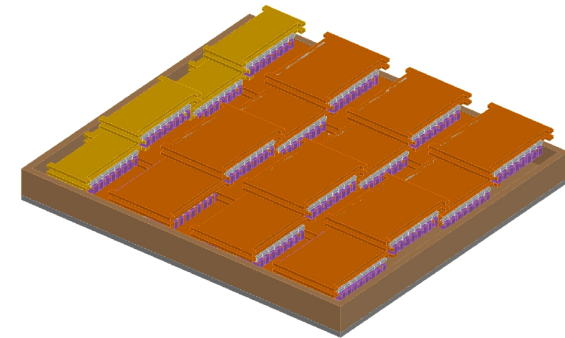
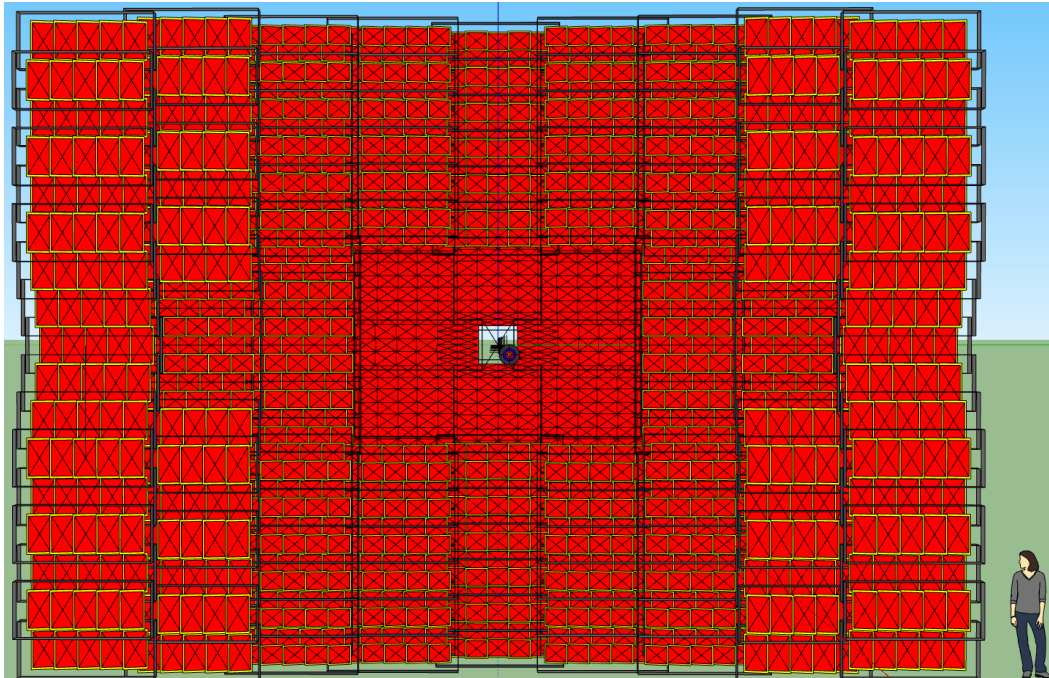
- CBM – Compressed Baryonic Matter
- Future heavy ion experiment at FAIR
- Up to 10 AGeV Au+Au collisions
- Up to 10^7 collisions/s
- Continuous data stream
- No hardware trigger
- Taking to account time of measurements is needed

Joining ToF information in the event reconstruction

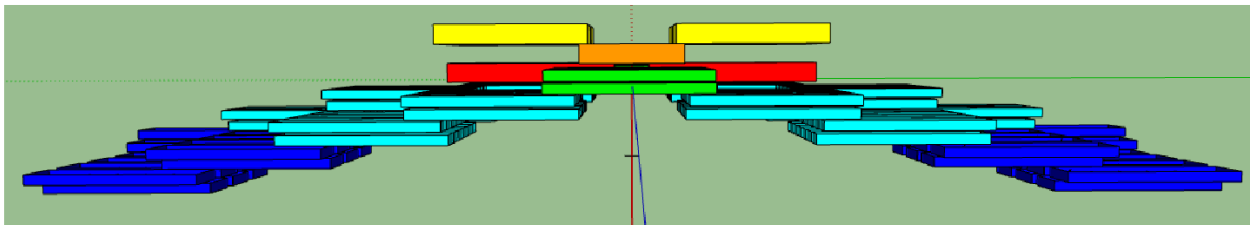
- Have STS time based track reconstructor
- Particle identification
- Event builder
- Joining ToF information → enable PID and improve event building



ToF detector



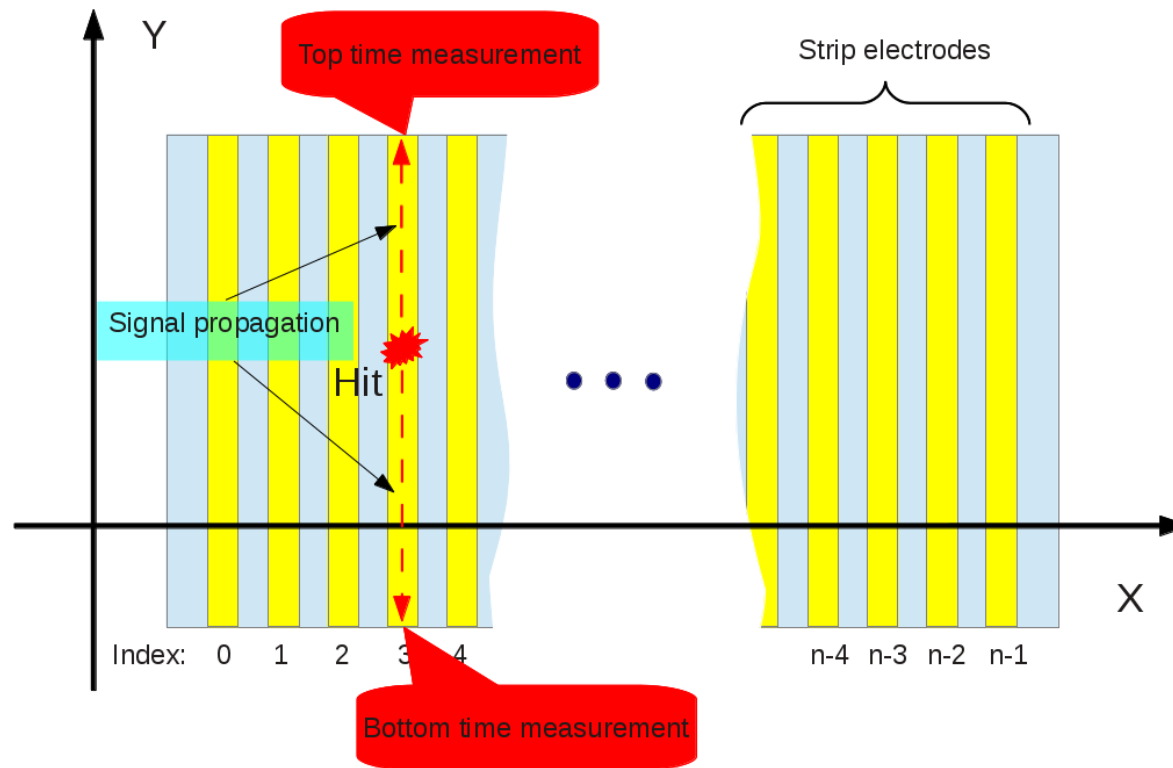
- Number of modules: 226
- Number of MRPC: 1376
- Number of channels: 53184



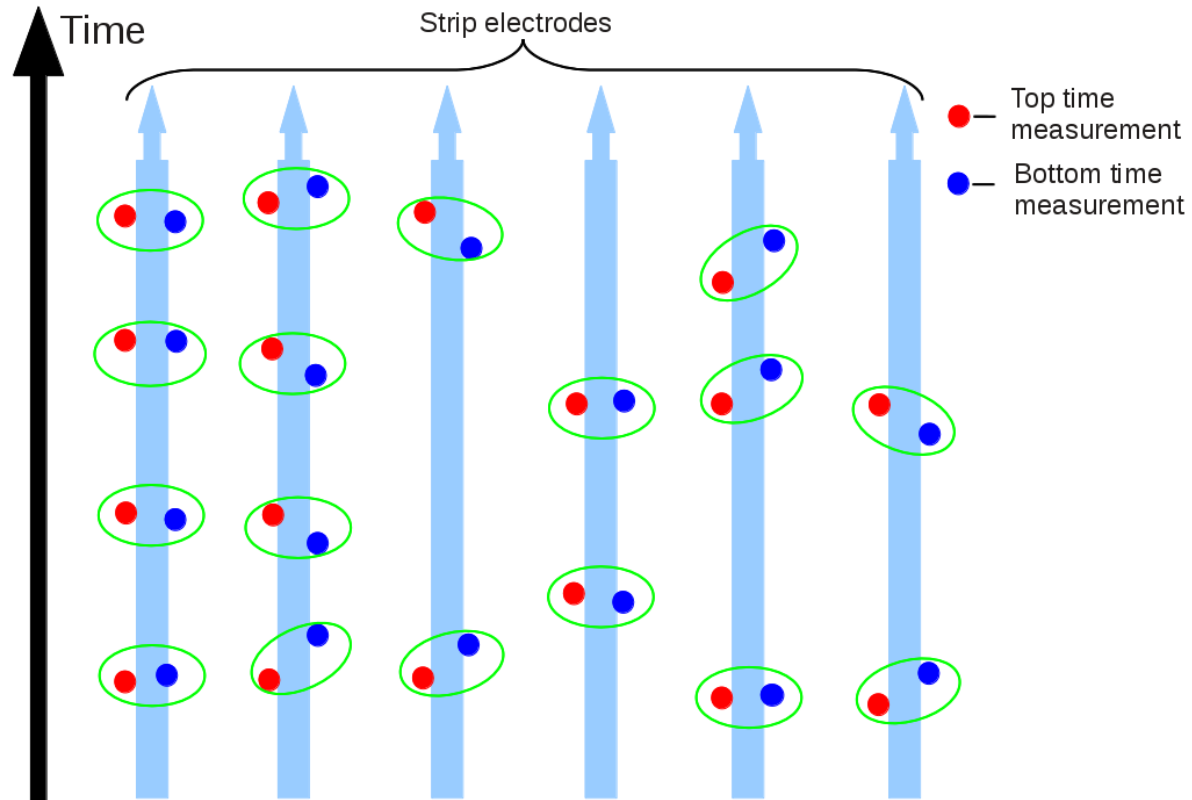
Two algorithms

- Reconstruction of ToF hits (cluster finding)
- Assigning ToF hits to reconstructed tracks

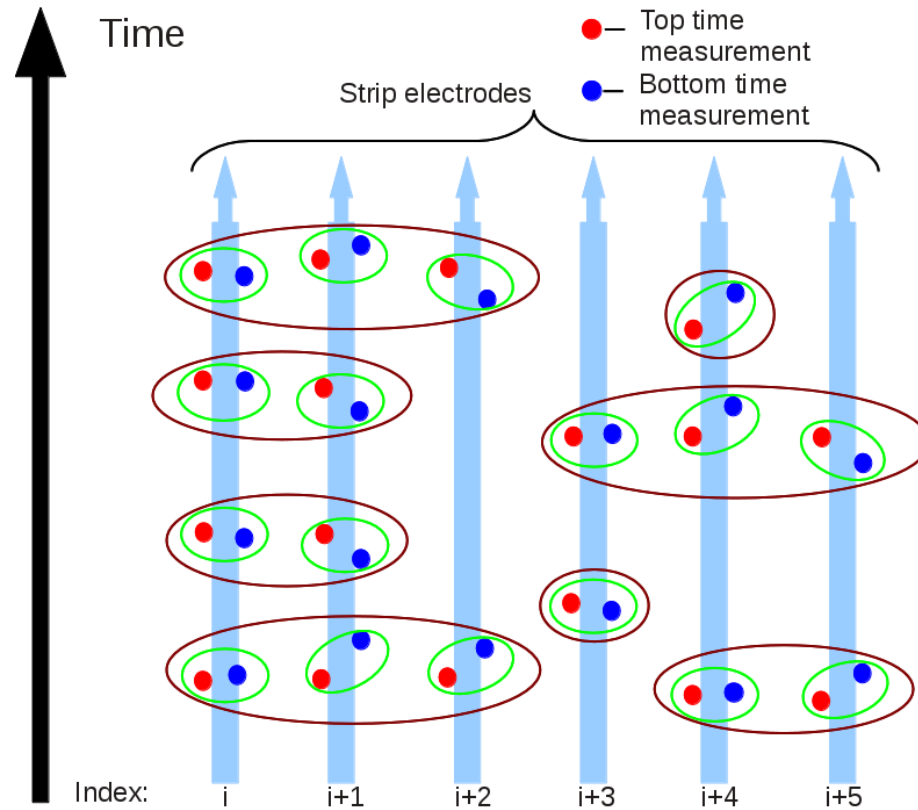
Algorithm 1: time based clustering MRPC scheme



Clustering: 1. measurements pairing



Clustering: 2. (results) built hits



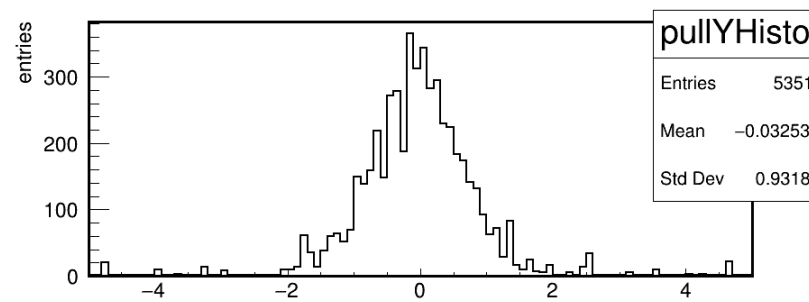
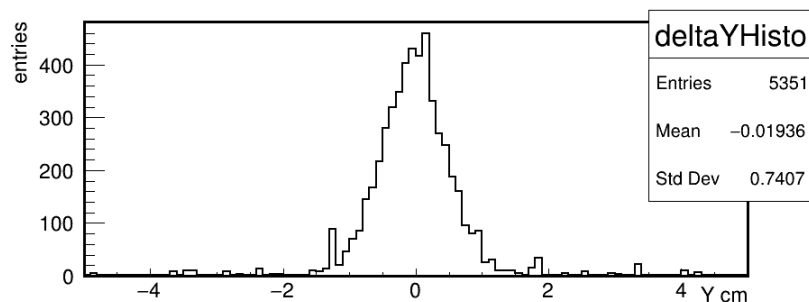
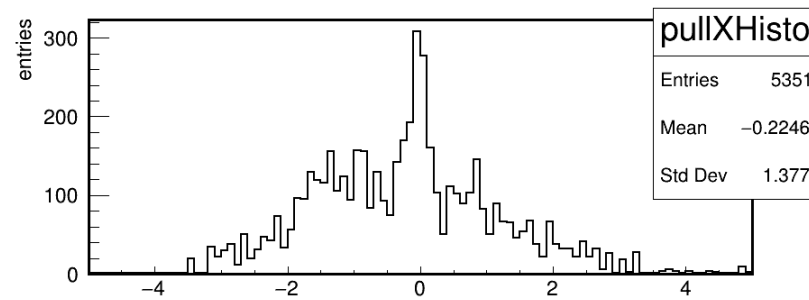
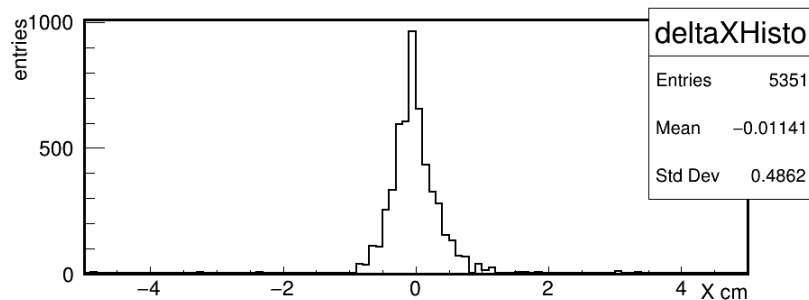
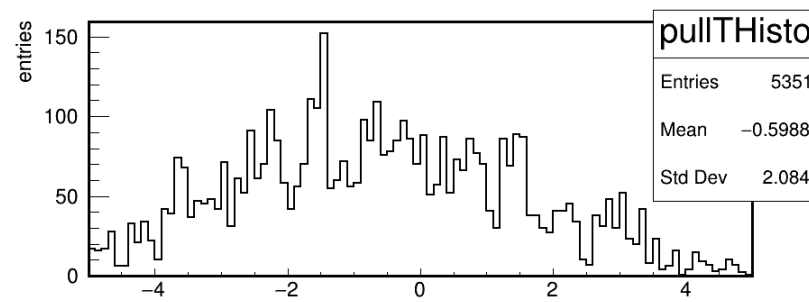
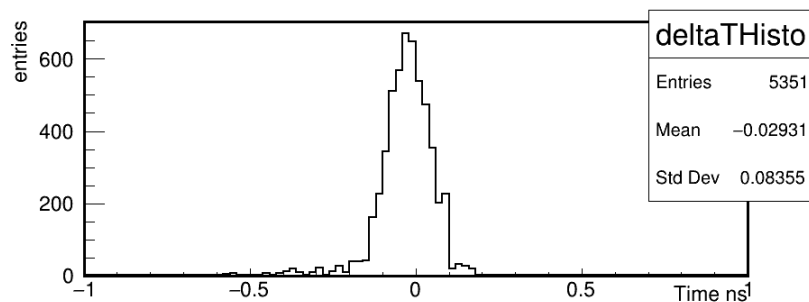
Clustering results

- Efficiency: 97.15%
- Runtime: 4 ms/event

$$Efficiency = \frac{N_{hit}}{N_{all}}$$

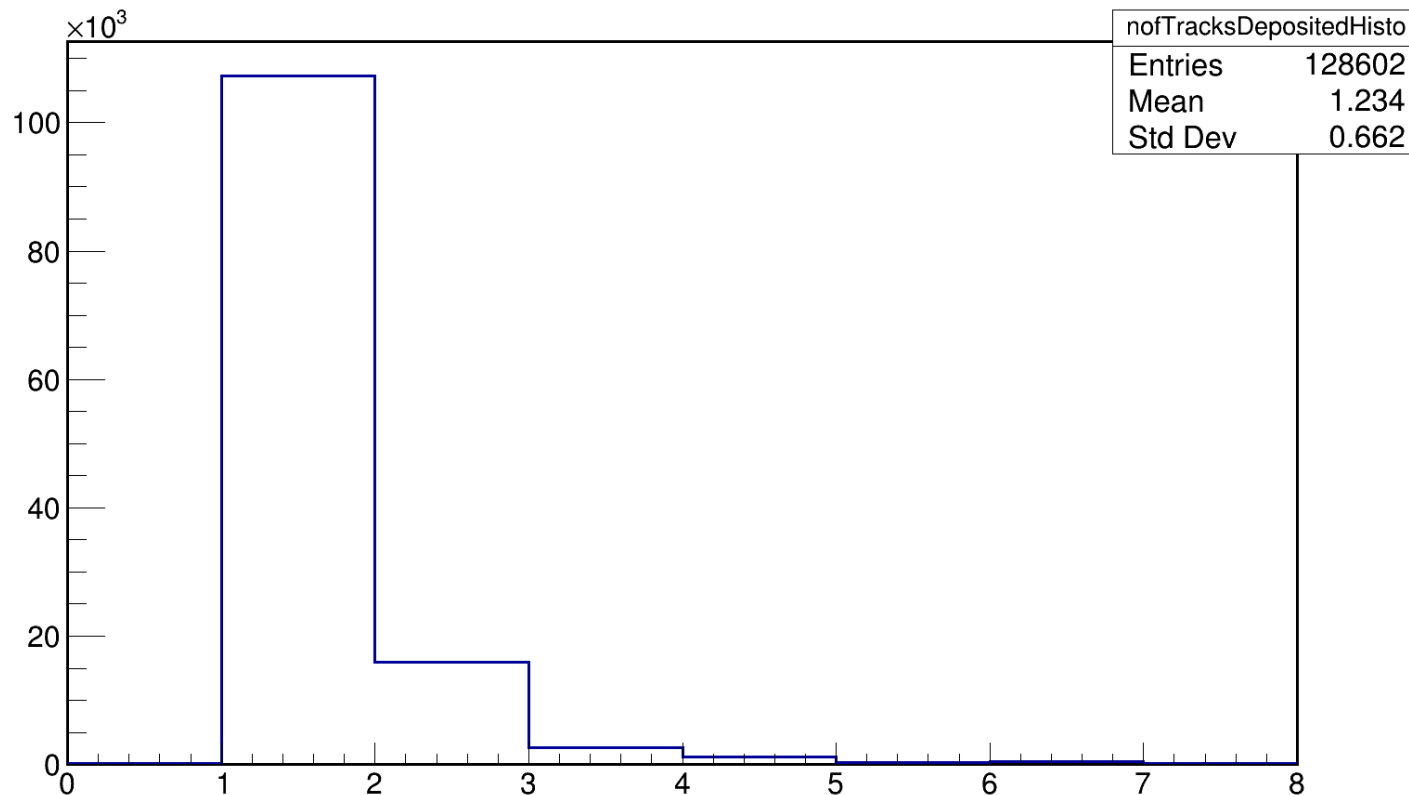
- N_{all} – the number of all MC tracks, having MC points in ToF
- N_{hit} – those tracks from N_{all} , for which a hit is generated
- The efficiency has been measured for minimum bias [Au+Au@10AGeV](#) collisions on a Intel(R) Xeon(R) CPU E5-1607 v3 @ 3.10GHz machine

Residuals and pulls



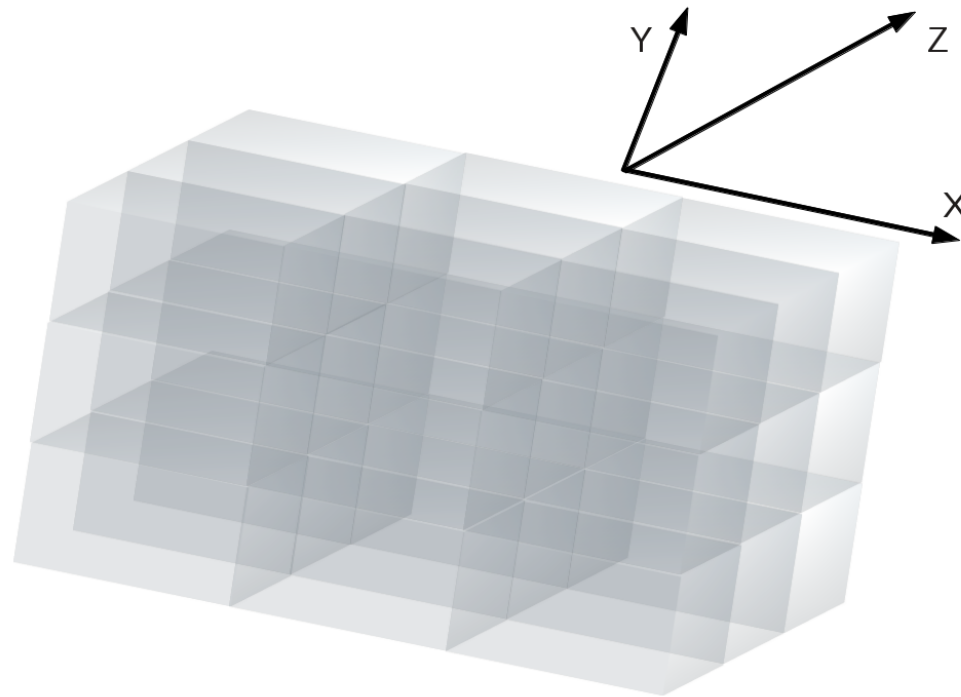
Number of tracks contributing to a cluster

83.44 % – 'pure clusters' – clusters for which only one particle contributed

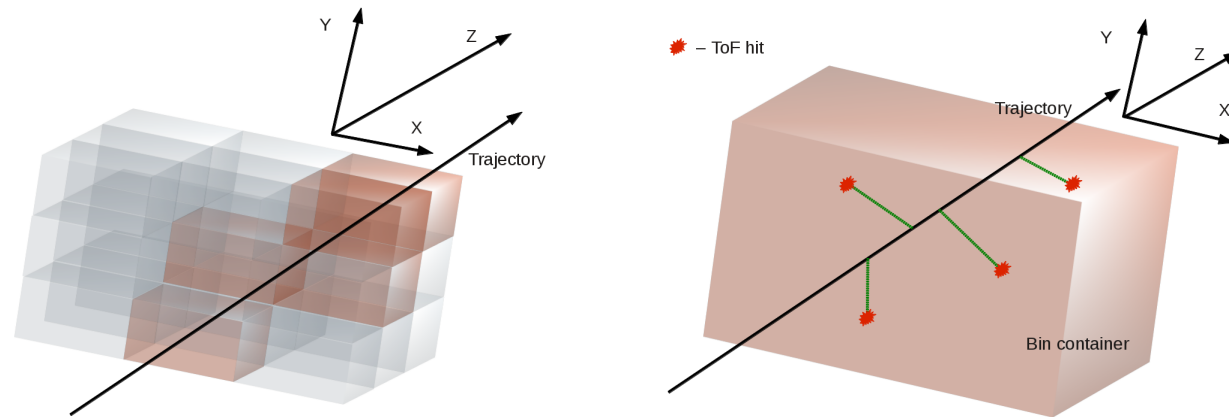


Algorithm2: ToF binning

- XYZT cuboid: XYZ cuboid, covering ToF x time slice
- XYZT ToF cuboid is subdivided to the smaller 4D cuboids, storing hits



Algorithm 2: ToF hit to track assignment



- Extrapolate an STS track to the beginning of the ToF area with the Kalman filter extrapolation procedure
- Linearly extrapolate further through the ToF and calculate cuboids, which this line intersects
- Nearest hit with respect to space and time coordinates is assigned to track
- The same hit can be assigned to several tracks

Hit search and assignment results

- Assigning efficiency (correctly assigned tracks): 93%
- Tracks with wrongly assigned ToF hits: 3%
- Tracks for which ToF hits were not assigned: 4%
- Procedure runtime: 14 ms

$$Efficiency = \frac{N_{ca}}{N_{all}}$$

- N_{all} – the number of the 'reference' tracks, which are defined as MC tracks, matched with a reconstructed STS track and produced a hit in ToF
- N_{ca} – the number of reference tracks for which a correct hit was assigned
- Tested for minimum bias [Au+Au@10AGeV](#) events at Intel(R) Xeon(R) CPU E5-1607 v3 @ 3.10GHz machine.

Conclusion

- Possibility to reconstruct space and time information on particles crossed the ToF wall has been proved
- Possibility to attach the ToF information to reconstructed tracks has been proven as well