

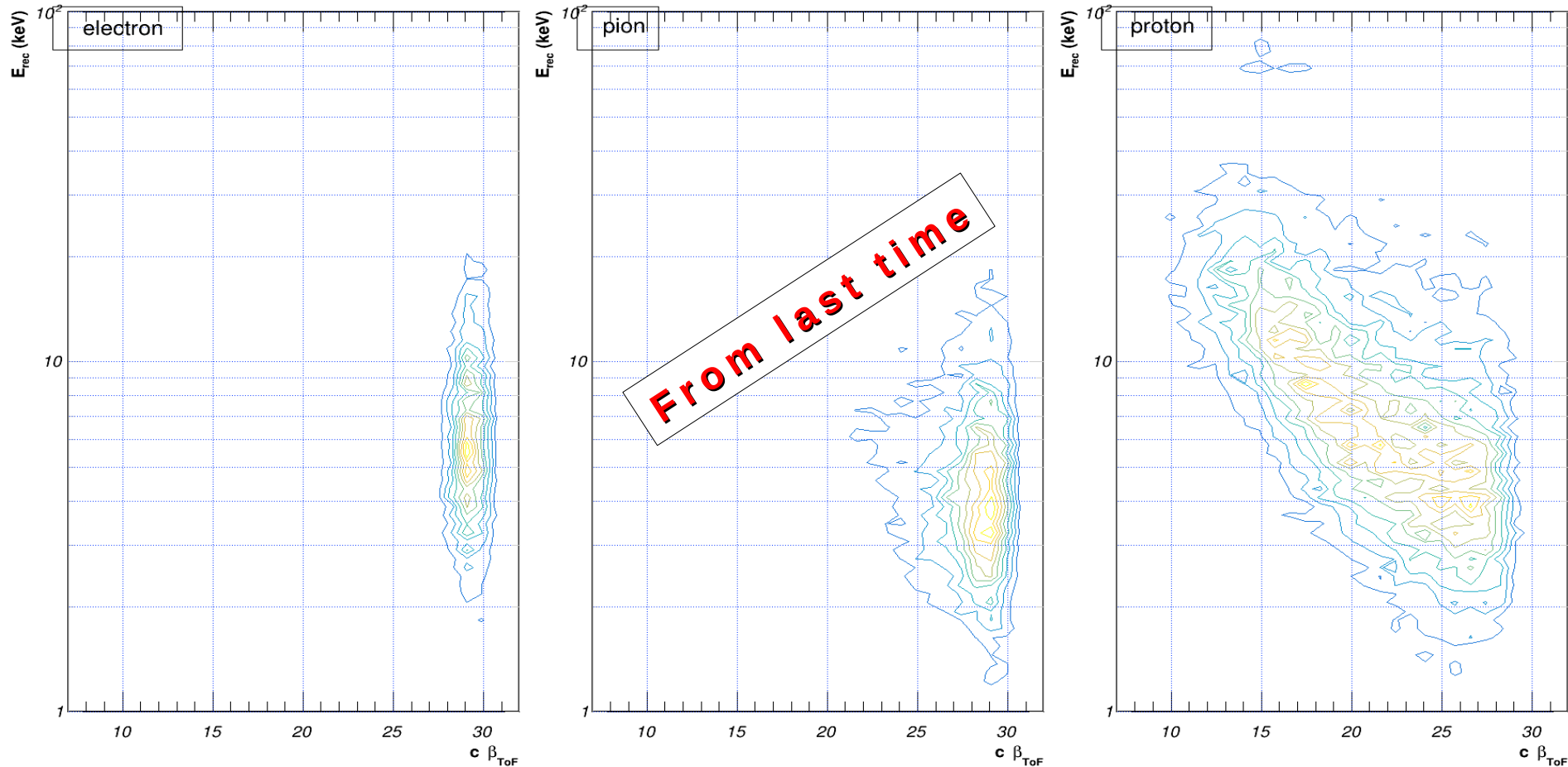
TRD - ToF @ mCBM PID

Alex Bercuci

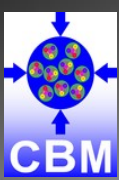
*mCBM Data Analysis Meeting
29th August 2023*

Based on L1 global tracks

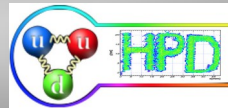
→ select TRD ToF hits (reconstructed MC)



Some collaboration with NH & al would be very welcomed (**Thx Yue Hang**)



Overview of the measurements set and some surprises along the way



TSA files

- using first 360 files of run 2391
- approx 58 x 360 ~ 21k TS (unpacked)
- less than 13k TS after reco/L1 (crash in L1 see below)
- total of 7.7M tracks (nSTS>=2, nTRD2D==1, nTRD1D>=1, nToF>=1)

=====

GlobalFindTracksEvents: Run summary

Time slices : 58
 Hits / TS : 595340.36
 Tracks / TS : 29048.76
 Hits per track : 20.4945
 Time per TS : 311137 ms
 Events processed : 886913
 Hits / event : 38.9325
 Tracks / event : 1.89965
 Time per event : 20.3469 ms

=====

- Total Run Time: 22742.9 s -----

[0.000119 s/ev 0.000030 %]	0B "FairTaskList"
[4.322269 s/ev 1.102285 %]	427M " BuildRawEvents"
[6.856875 s/ev 1.748672 %]	336M " RecoSts"
[3.912504 s/ev 0.997785 %]	105M " TrdClusterFinder"
[6.804508 s/ev 1.735317 %]	163M " TrdHitProducer"
[3.278647 s/ev 0.836136 %]	162M " TOF Event Clusterizer"
[55.727390 s/ev 14.211856 %]	89M " TOF Track Finder"
[0.000025 s/ev 0.000006 %]	0B " CbmTrackingDetectorInterfaceInit"
[0.000020 s/ev 0.000005 %]	0B " CbmStsTrackingInterface"
[0.000018 s/ev 0.000004 %]	0B " CbmTrdTrackingInterface"
[0.000016 s/ev 0.000004 %]	0B " CbmToFTrackingInterface"
[0.000020 s/ev 0.000005 %]	0B " KF"
[0.000016 s/ev 0.000004 %]	0B " L1"
[311.216581 s/ev 79.367889 %]	262M " GlobalFindTracksEvents"

L1 trk selection

- STS component :
 "nsts==2&&uSts[0]==0&&uSts[1]==1&&lSts[1]==1"
- TRD component :
 "eTrd[0]>0&&(eTrd[1]>0||eTrd[2]>0)"

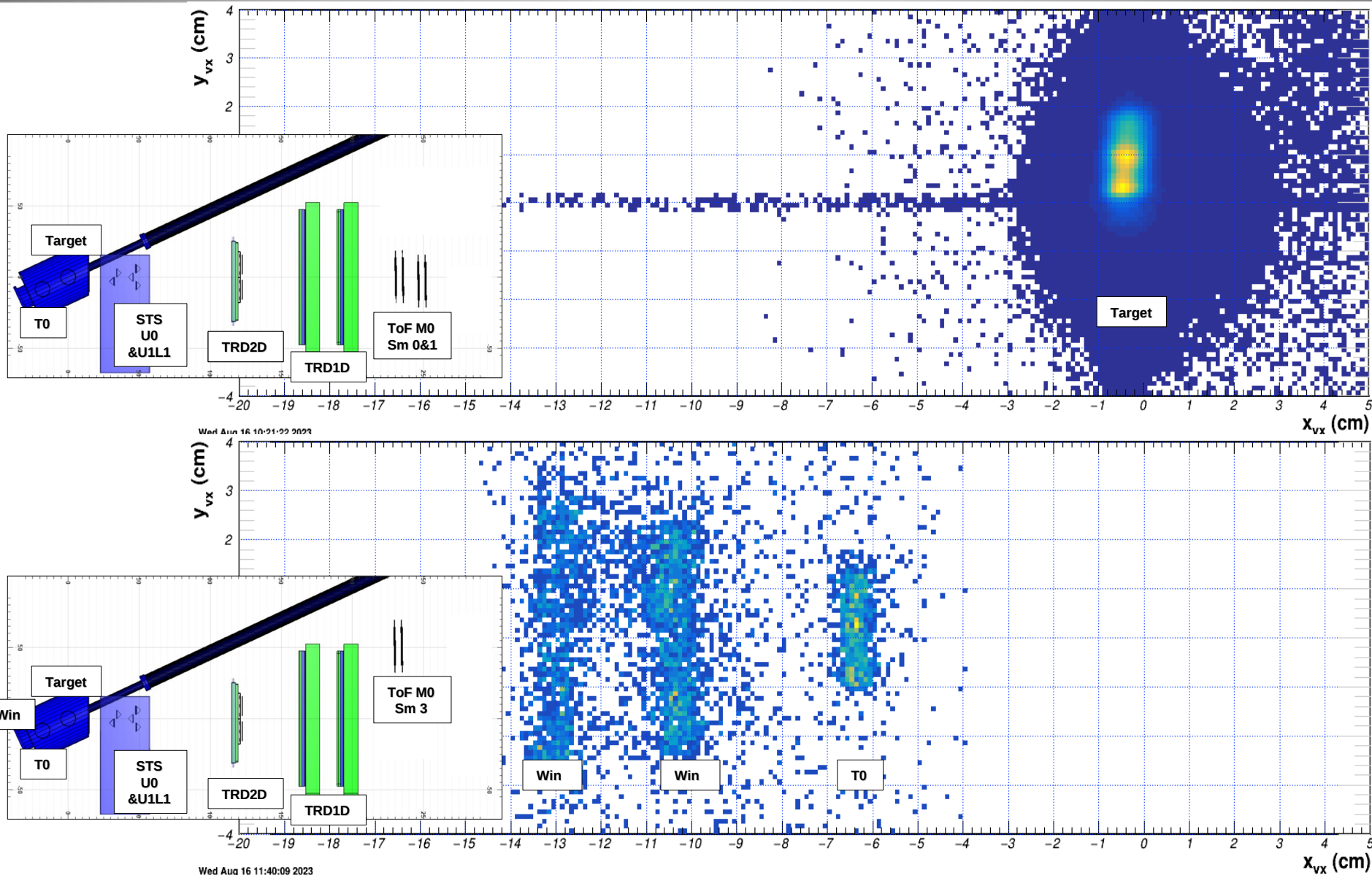
Memory management :

If memory would be allocated in sufficient amount from the start we would win some time !

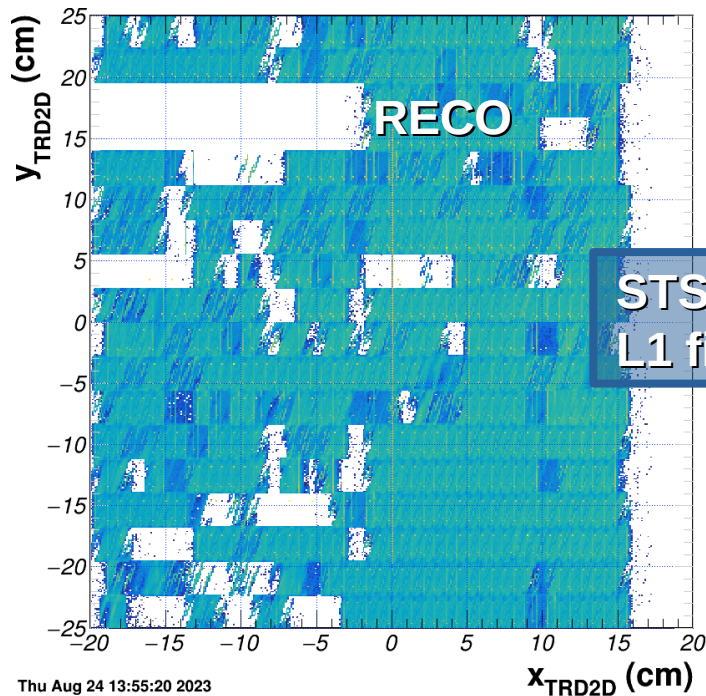
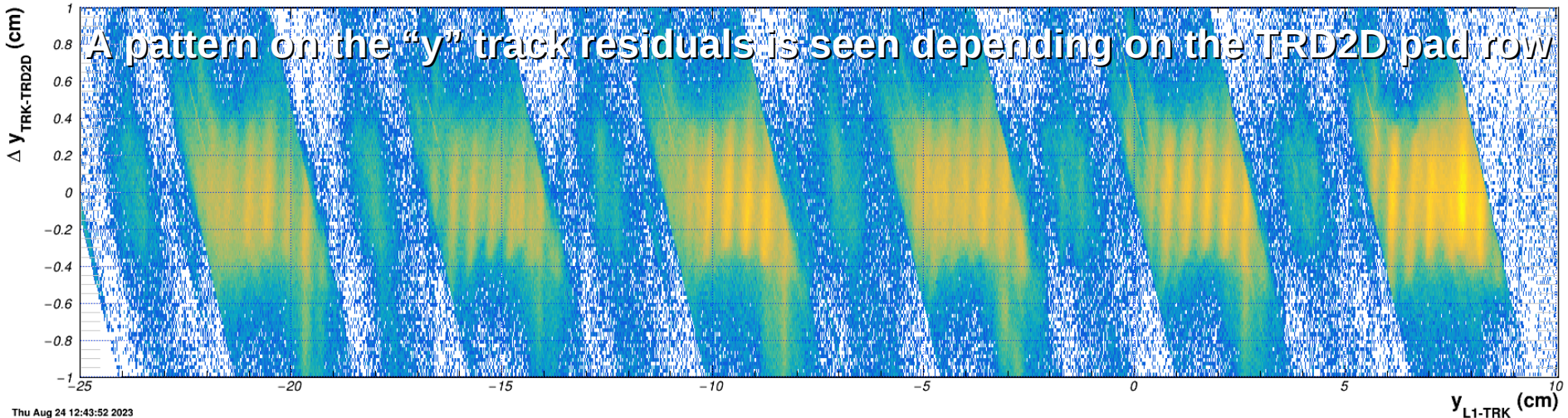
L1 error message :

root.exe:
 myDir/cbmroot/reco/L1/L1Algo/L1Algo.h:587:
 static unsigned int L1Algo::PackTripletId(unsigned int, unsigned int, unsigned int):
 Assertion `iTriplet < L1Constants::size::kMaxNtriplets' failed.

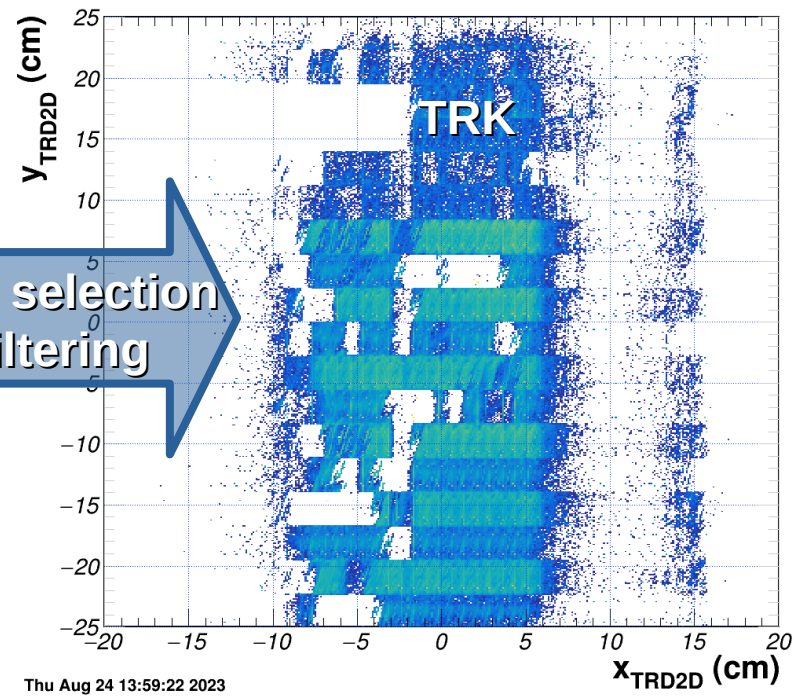
Track vertex according to ToF Sm selection



TRD2D [non-]performance



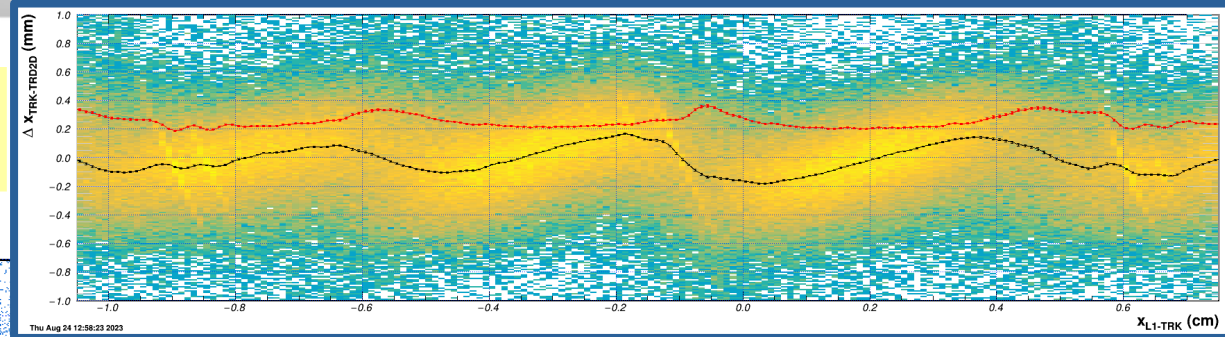
STS selection
L1 filtering



TRD2D [non-]performance

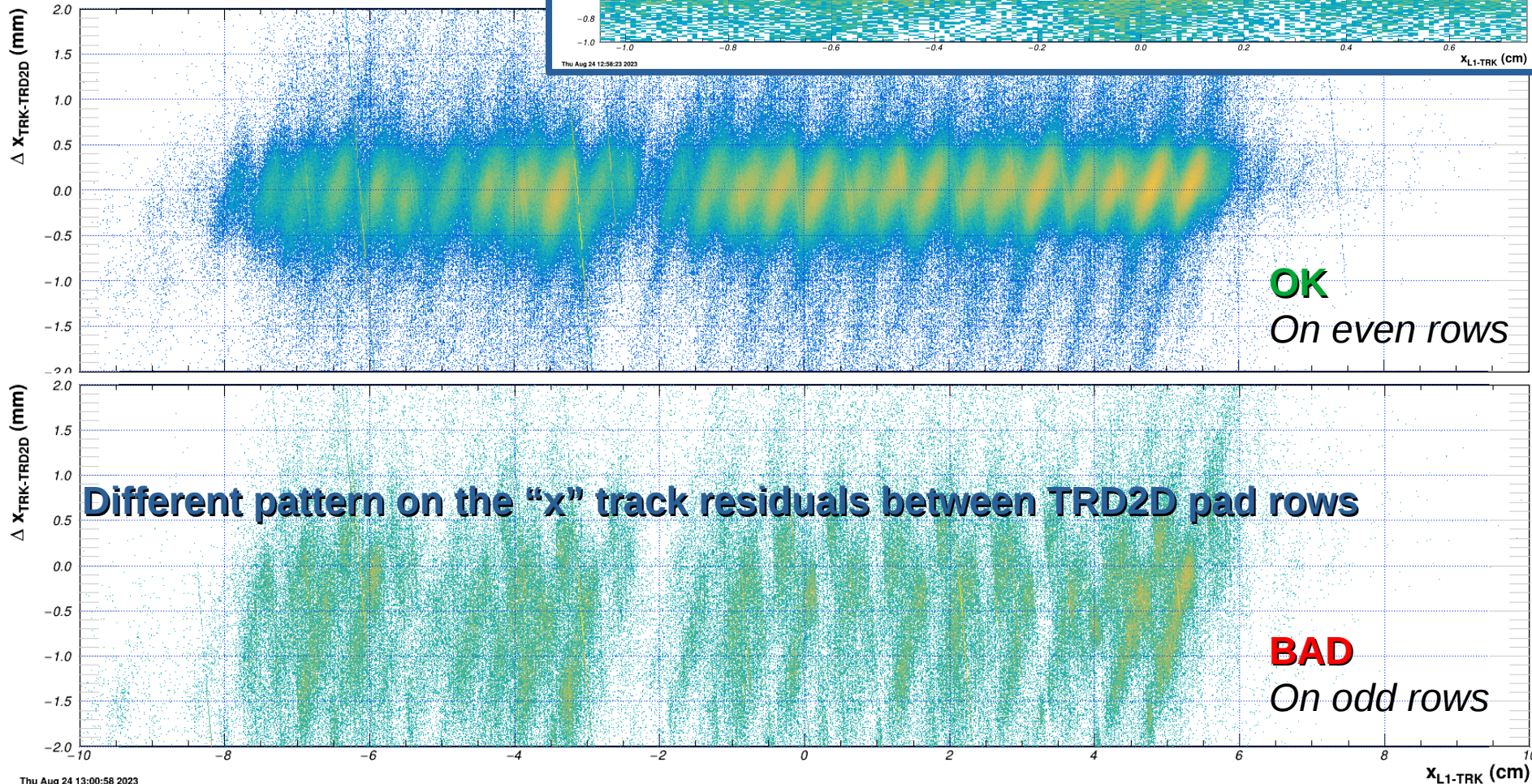
TRD2D x resolution < 200 μm

- systematic effects from detector structure
- results are optimized only wrt alignment



OK

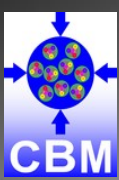
On even rows



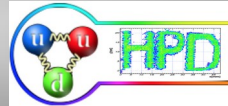
Different pattern on the "x" track residuals between TRD2D pad rows

BAD

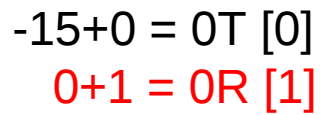
On odd rows



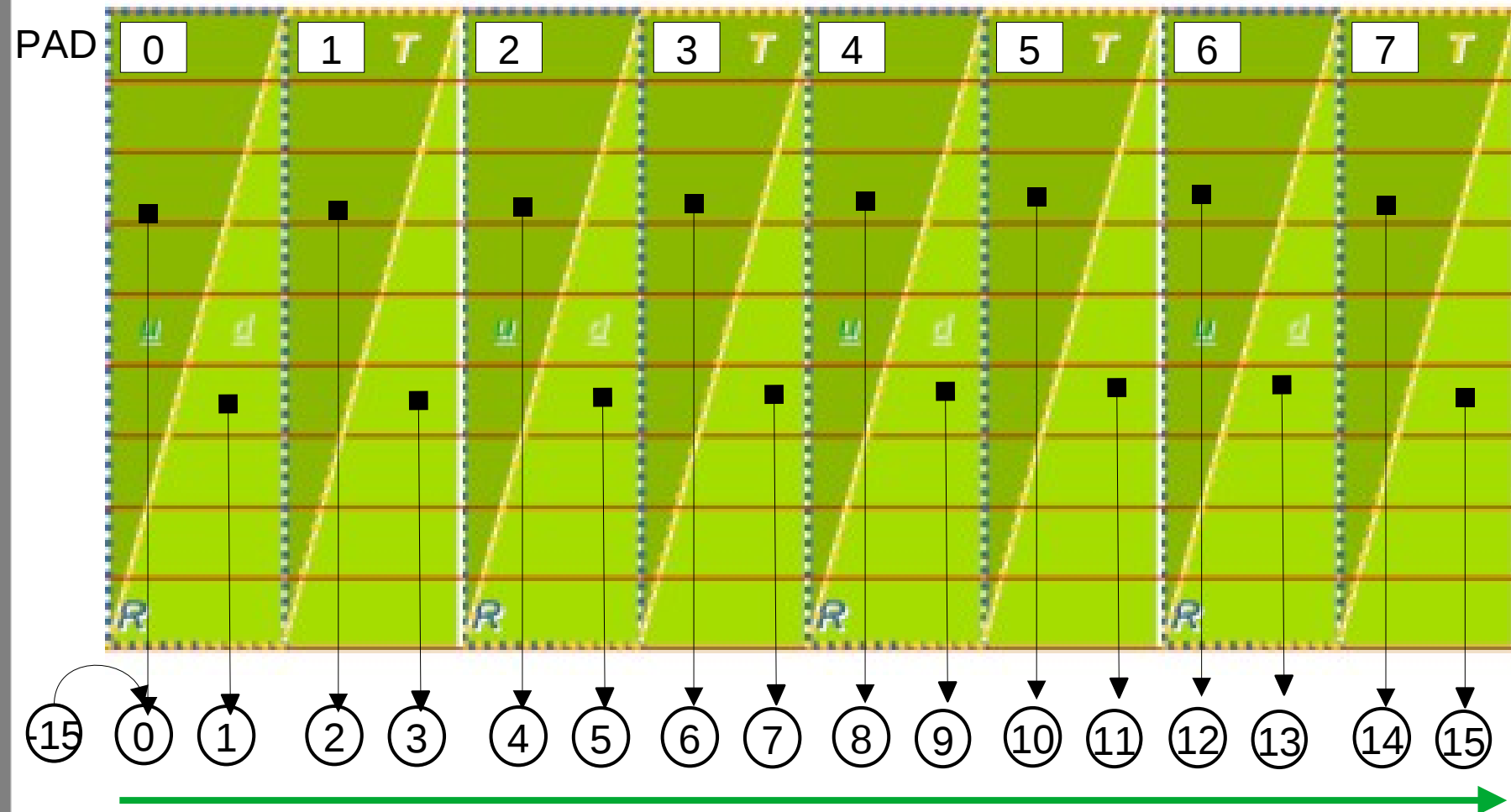
Pad → FASP → Channel

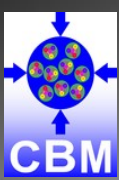


```
// installed map for the 2022 setup (06.05.2022)
const int nfeb = 18;
Int_t asicMap [] = {
    -1, -1, -1, -1, -1, -1, -1, -1, // [ 0]
    -1, -1, 2, 1, 0, 8, 7, 6, -1, // [ 1] <- CROB 3 (0xffc2 / crob13)
    -1, -1, 3, 4, 5, 9, 10, 11, -1, // [ 2]
    -1, -1, 14, 13, 12, 20, 19, 18, -1, // [ 3] <-
    -1, -1, 15, 16, 17, 21, 22, 23, -1, // [ 4]
    -1, -1, 26, 25, 24, 32, 31, 30, -1, // [ 5] <-
    -1, -1, 27, 28, 29, 33, 34, 35, -1, // [ 6]
    -1, -1, 38, 37, 36, 44, 43, 42, -1, // [ 7] <- CROB 2 (0xffc5 / crob32)
    -1, -1, 39, 40, 41, 45, 46, 47, -1, // [ 8]
    -1, -1, 50, 49, 48, 56, 55, 54, -1, // [ 9] <-
    -1, -1, 51, 52, 53, 57, 58, 59, -1, // [10]
    -1, -1, 62, 61, 60, 68, 67, 66, -1, // [11] <-
    -1, -1, 63, 64, 65, 69, 70, 71, -1, // [12]
    -1, -1, 86, 85, 84, 92, 91, 90, -1, // [13] <- CROB 1 (0xffc1 / crob28)
    -1, -1, 87, 88, 89, 93, 94, 95, -1, // [14]
    -1, -1, 98, 97, 96, 104, 103, 102, -1, // [15] <-
    -1, -1, 99, 100, 101, 105, 106, 107, -1, // [16]
    -1, -1, 74, 73, 72, 80, 79, 78, -1, // [17] <-
    -1, -1, 75, 76, 77, 81, 82, 83, -1, // [18]
    -1, -1, -1, -1, -1, -1, -1, -1, -1 // [19]
};
```

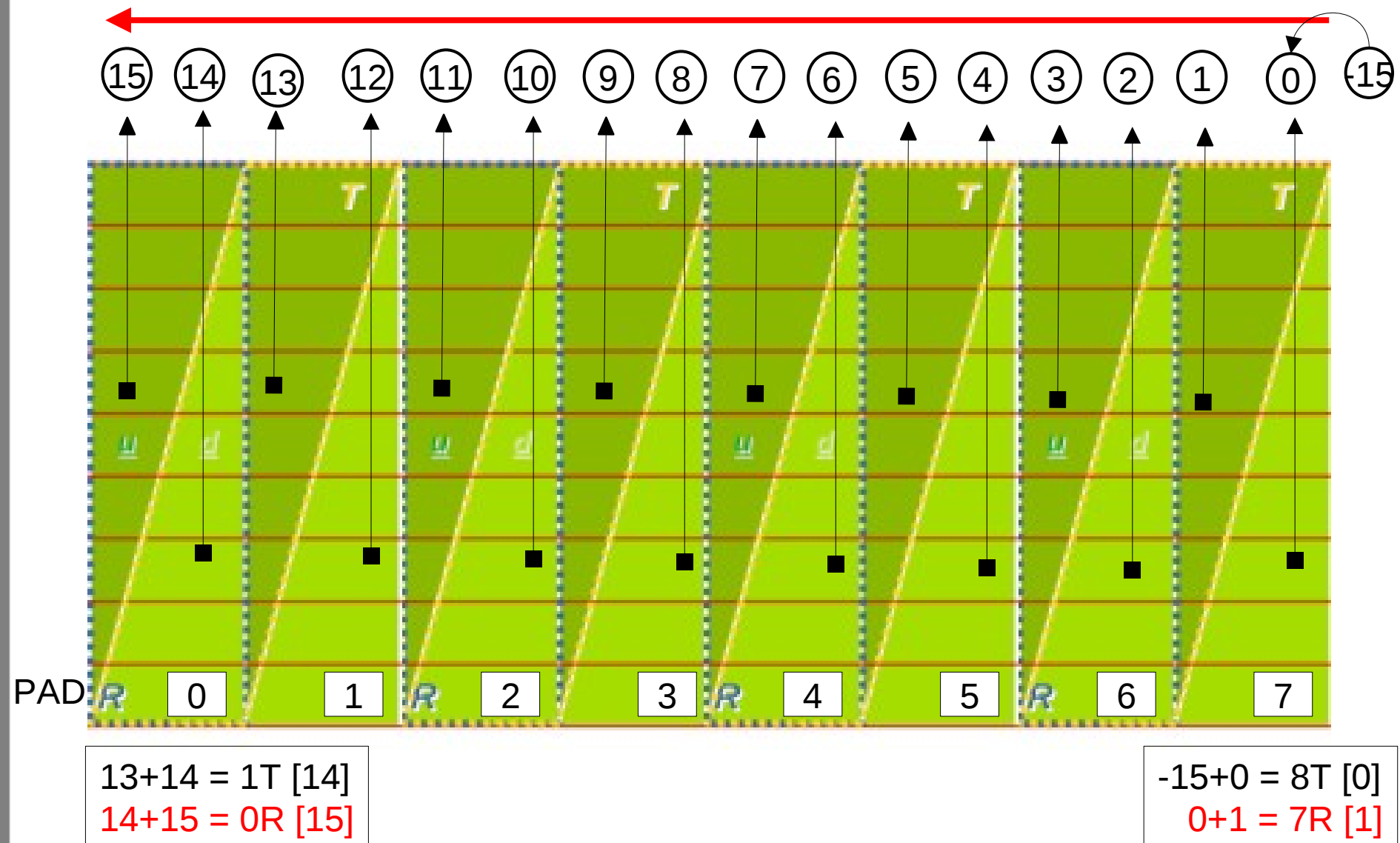
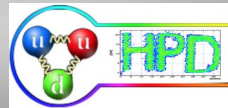


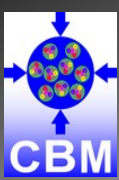
13+14 = 7T [14]
14+15 = 7R [15]



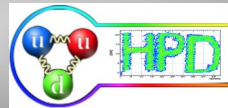


Pad to FASP “decreasing” mapping





TRD2D fix

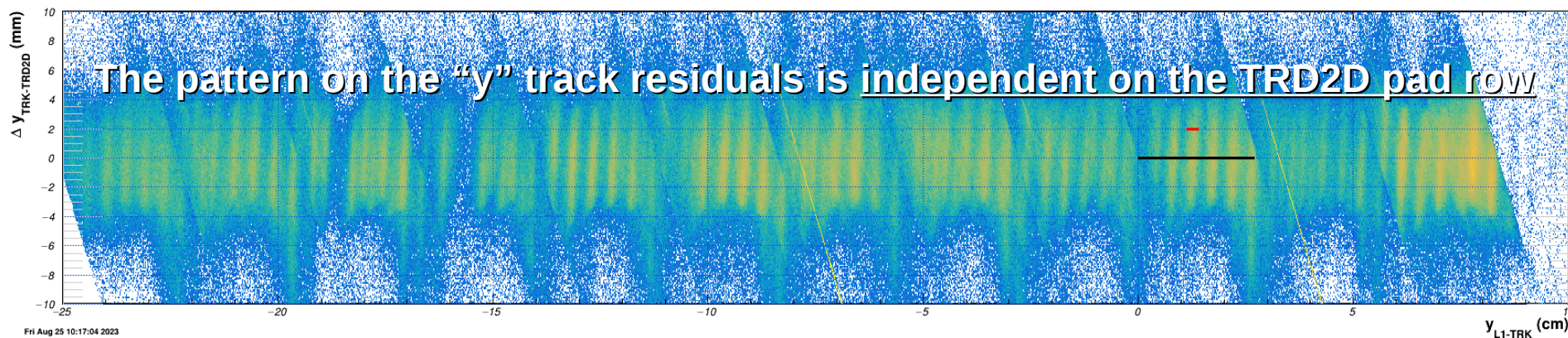
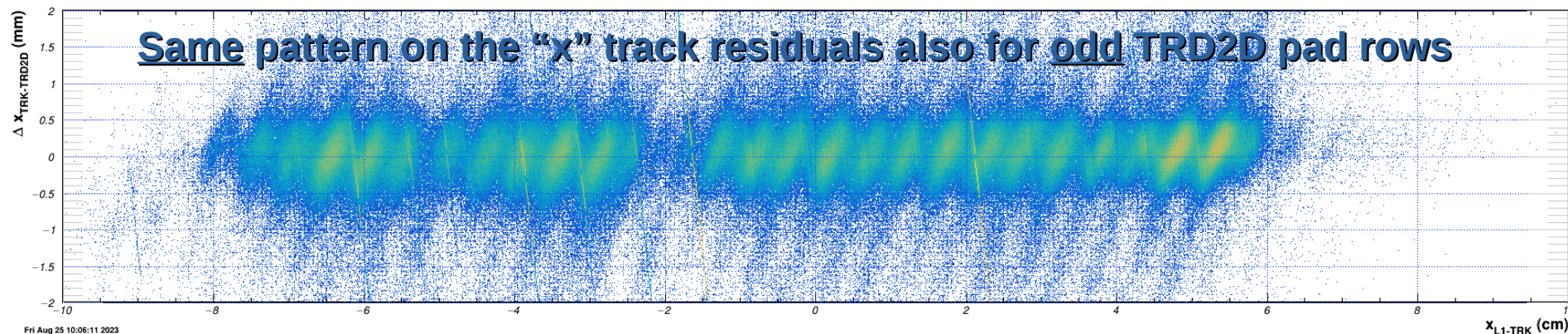


→ trks ($n_{STS} \geq 2$, $n_{TRD2D} = 1$, $n_{TRD1D} \geq 1$, $n_{ToF} \geq 1$)
7.7M tracks → 9.0M tracks

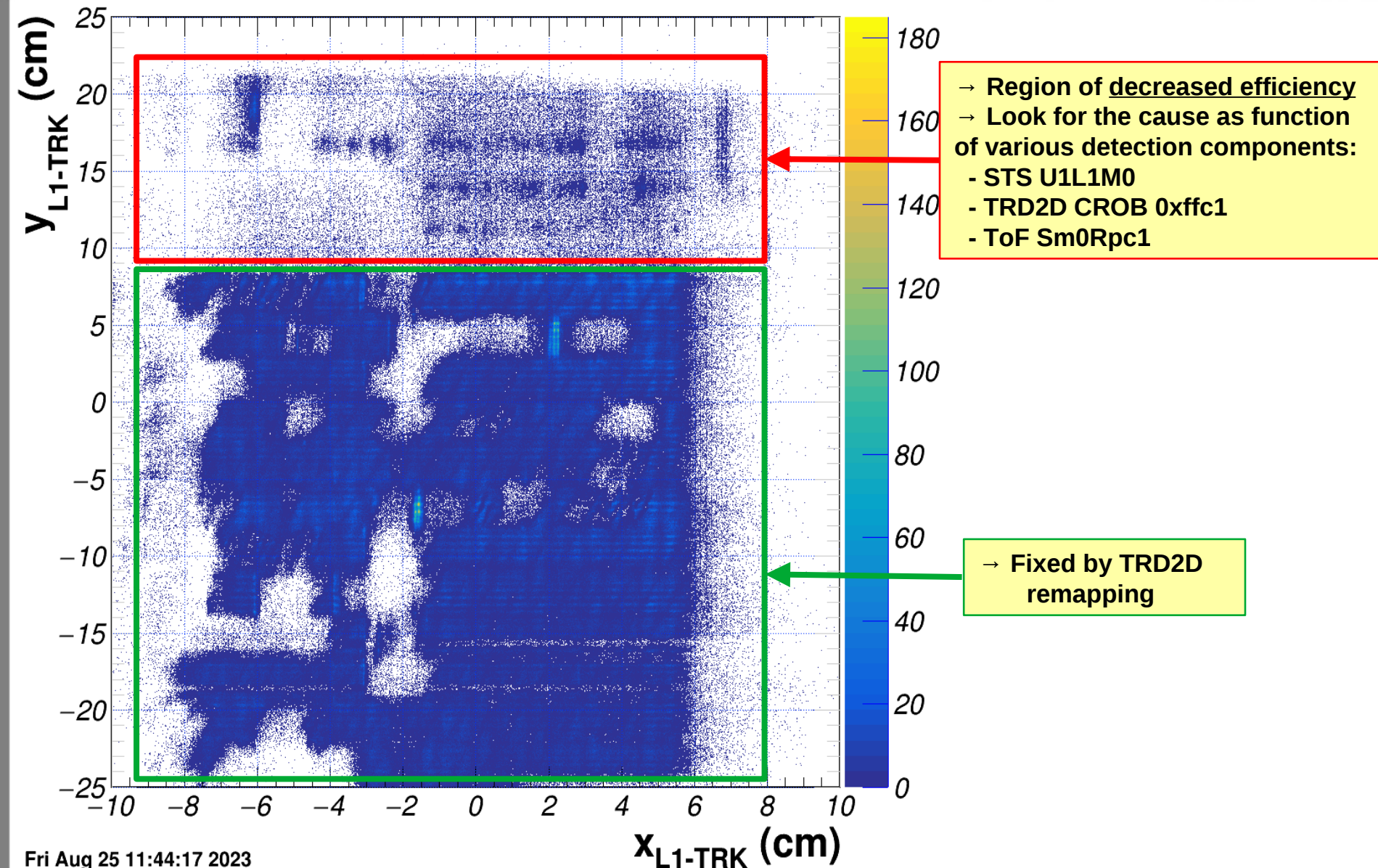
MR : parameters → https://git.cbm.gsi.de/CbmSoft/cbmroot_parameter/-/merge_requests/138

MR : CbmRoot → https://git.cbm.gsi.de/computing/cbmroot/-/merge_requests/1304

Redmine : <https://redmine.cbm.gsi.de/issues/2850>

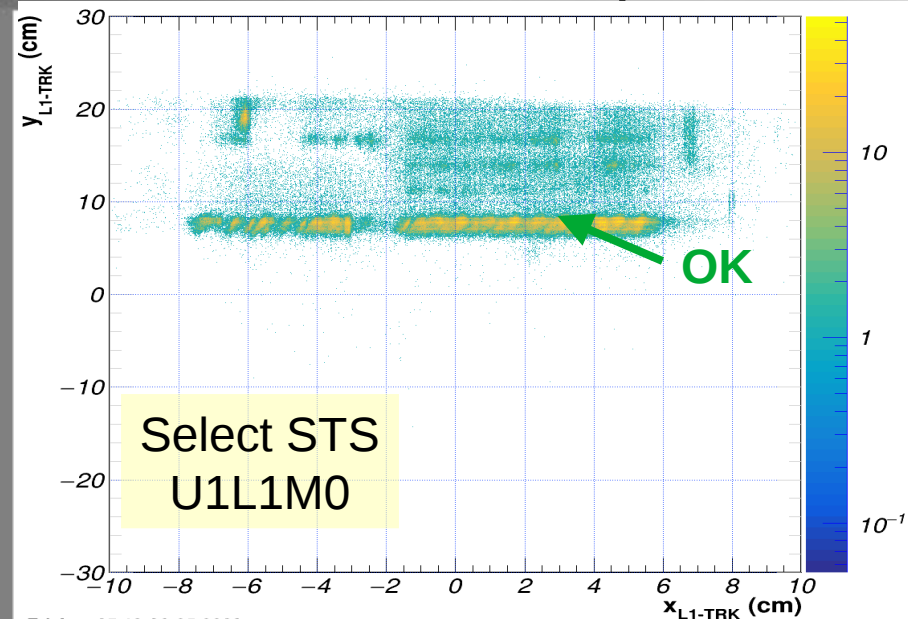
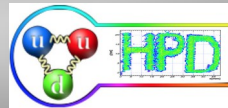


STILL ...

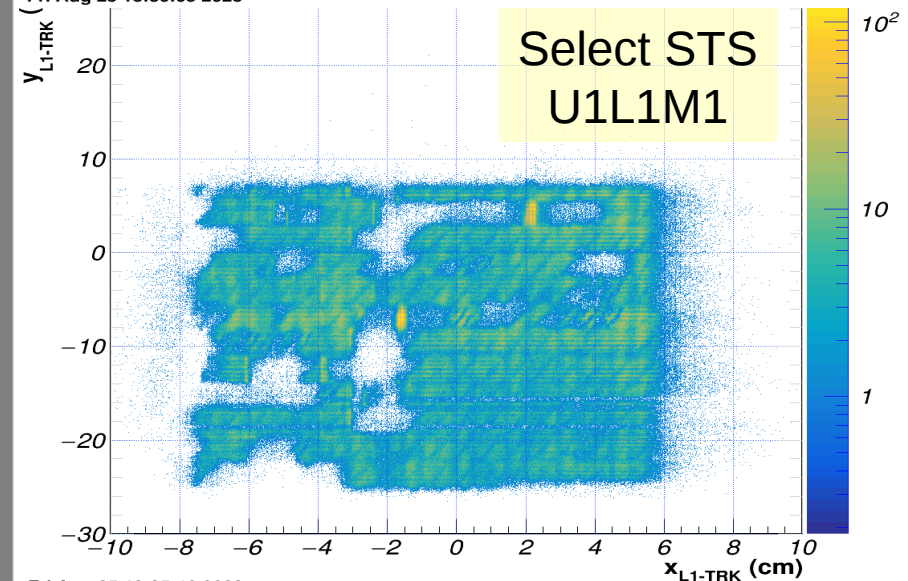




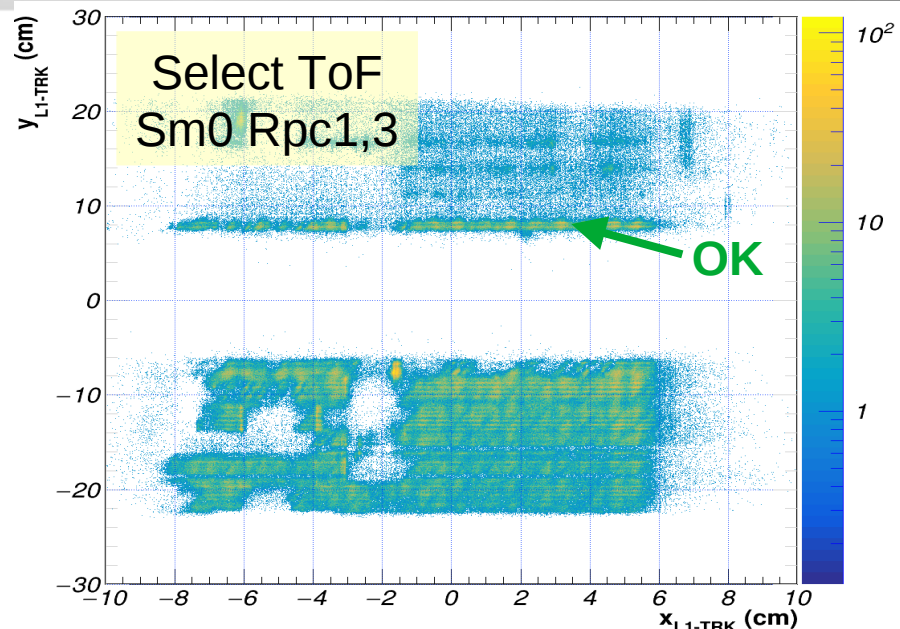
Exploring correlation with other mCbm components



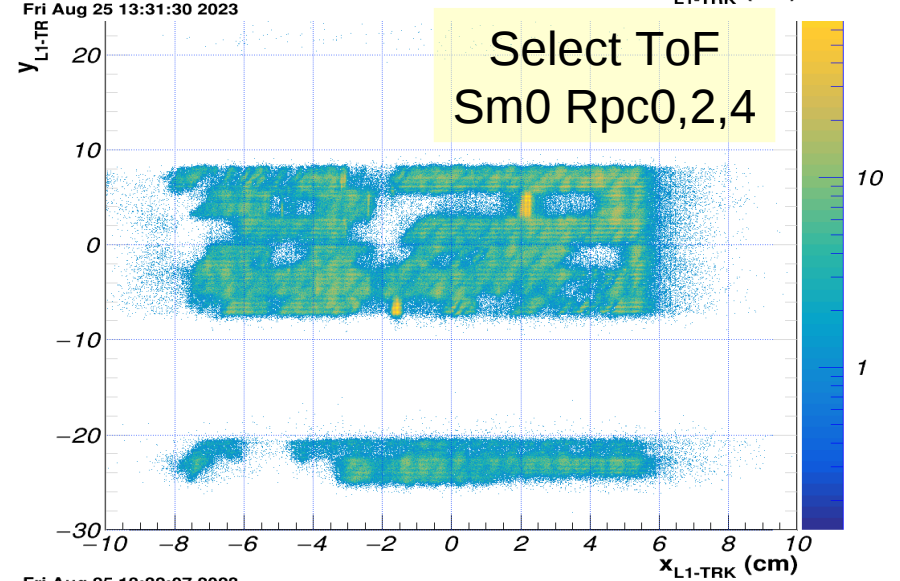
Fri Aug 25 13:36:05 2023



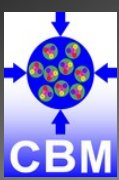
Fri Aug 25 13:35:19 2023



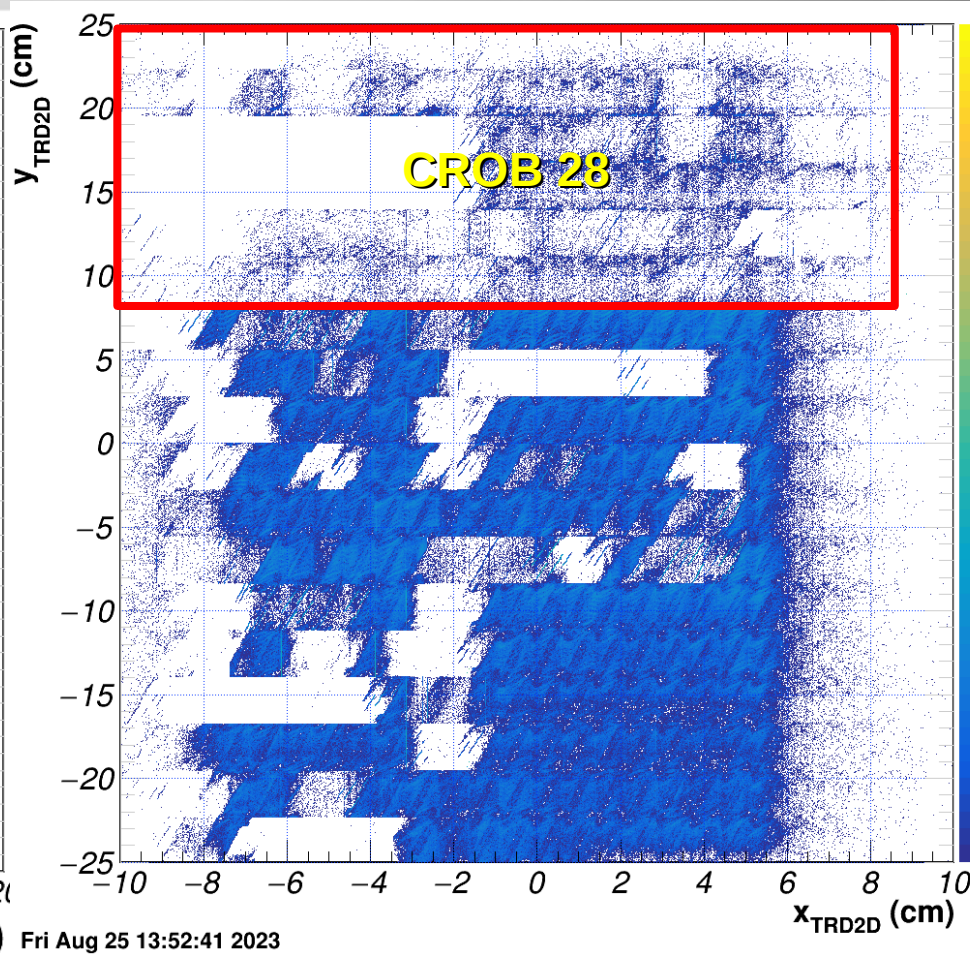
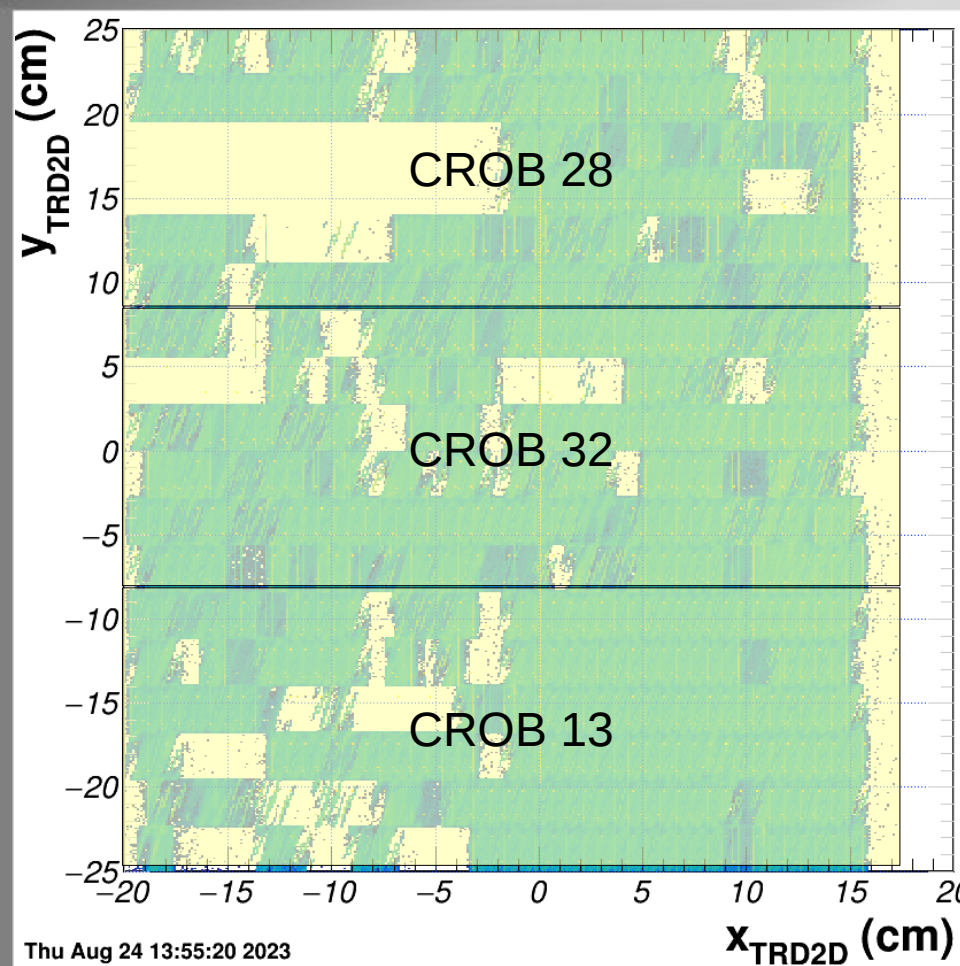
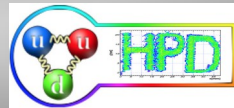
Fri Aug 25 13:31:30 2023

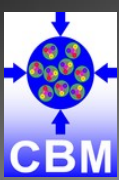


Fri Aug 25 13:32:07 2023

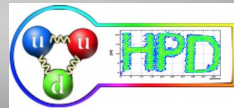


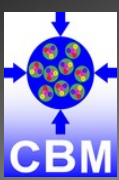
TRD2D CROB



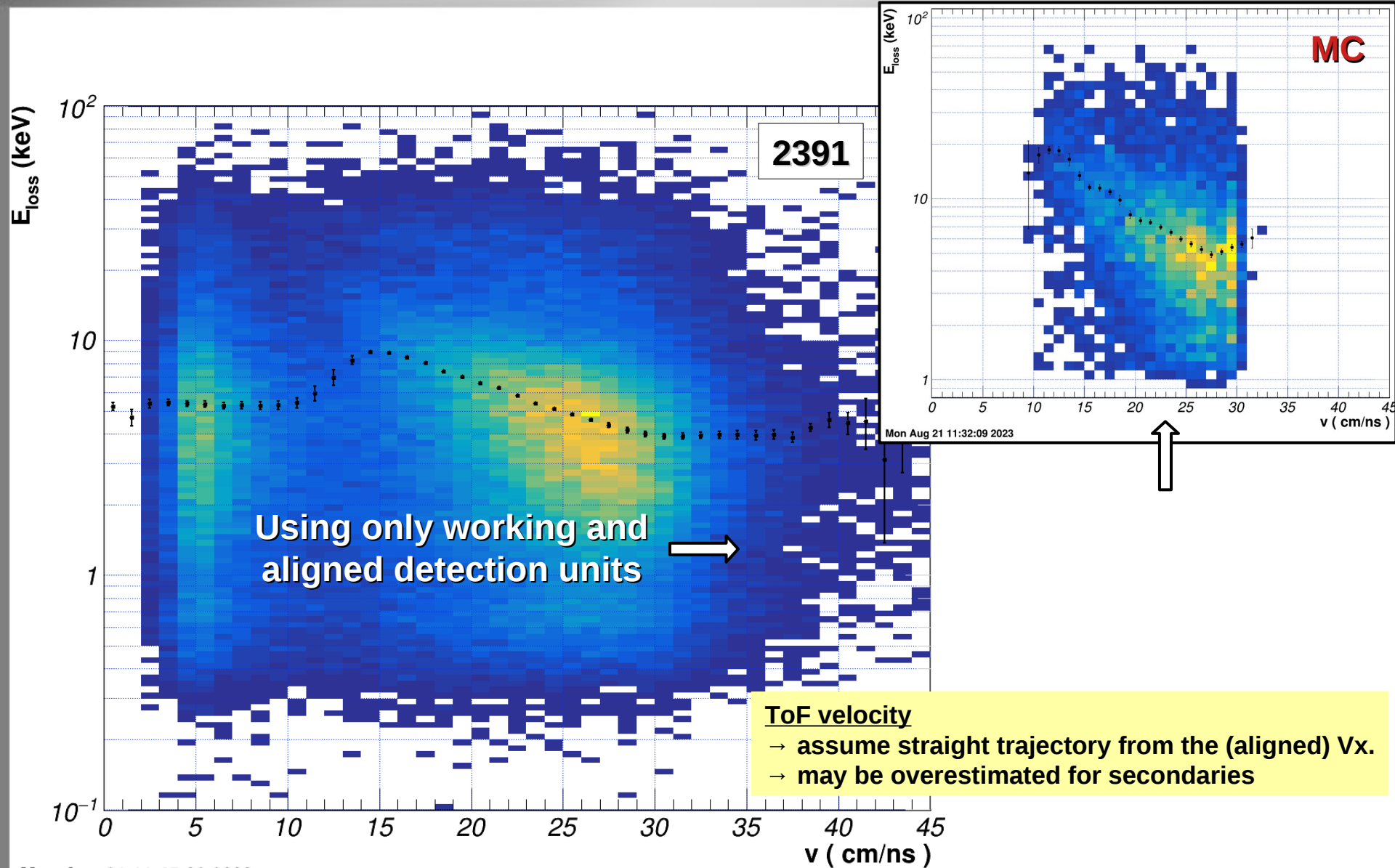
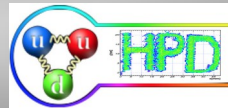


ToF time





TRD2D – ToF correlation (reconstructed 2391)

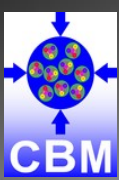


Mon Aug 21 11:45:09 2023

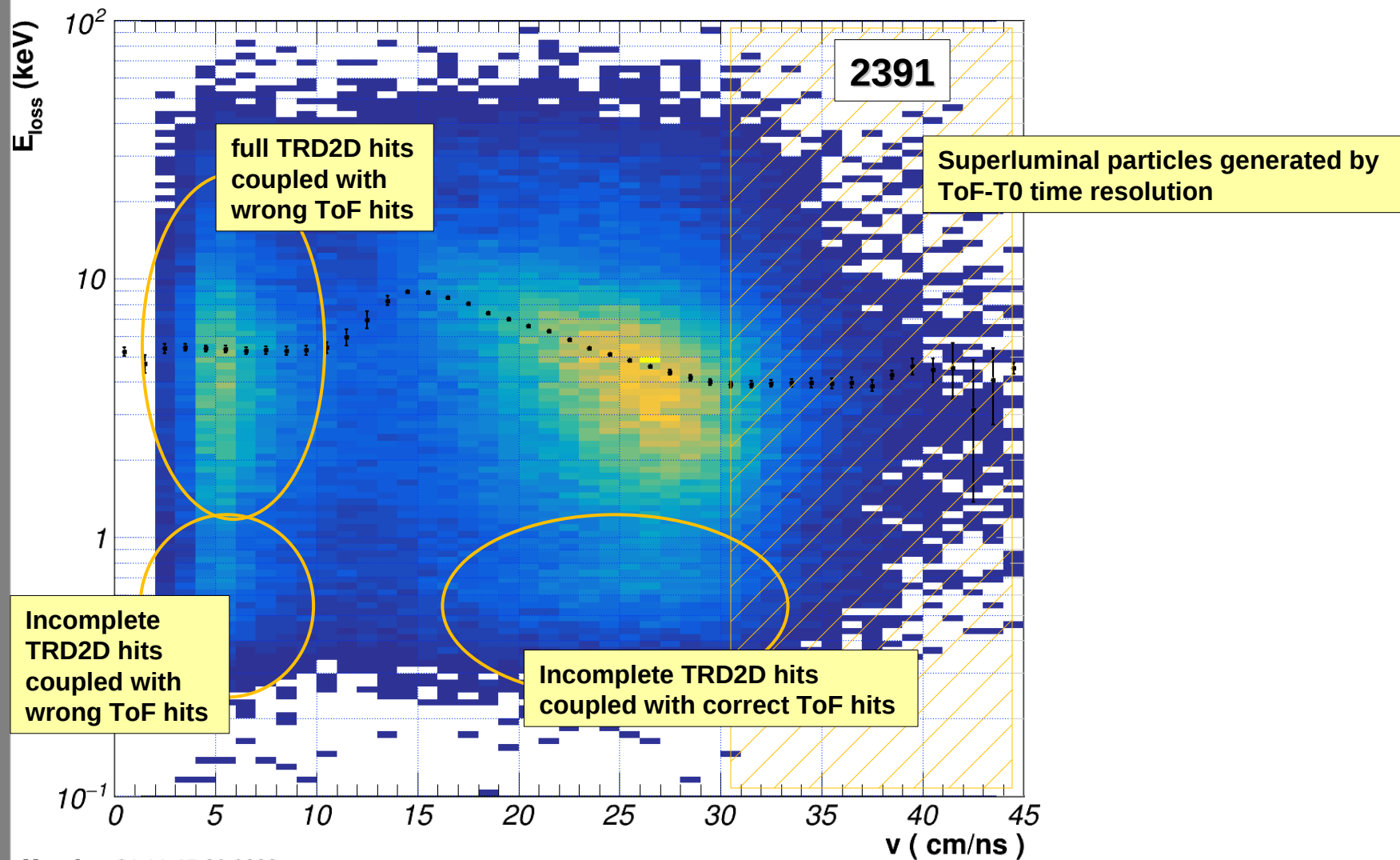
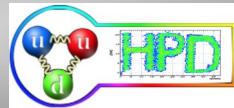
29/08/23

TRD - ToF PID

15



TRD2D – ToF Sm0 (L1 tracked 2391)



Mon Aug 21 11:45:09 2023

29/08/23

TRD - ToF PID

16

$$v = \frac{L(x_{ToF}, y_{ToF}, z_{ToF}, x_{target}, y_{target}, z_{target} | Align, DAQ(ToF))}{t_{ToF} - (t_{T0} - t_{Th}) + \delta t(ToF, T0) | DAQ(ToF), DAQ(T0)}$$

$$x_{ToF} = f(\delta t_{ToF}^{strip})$$

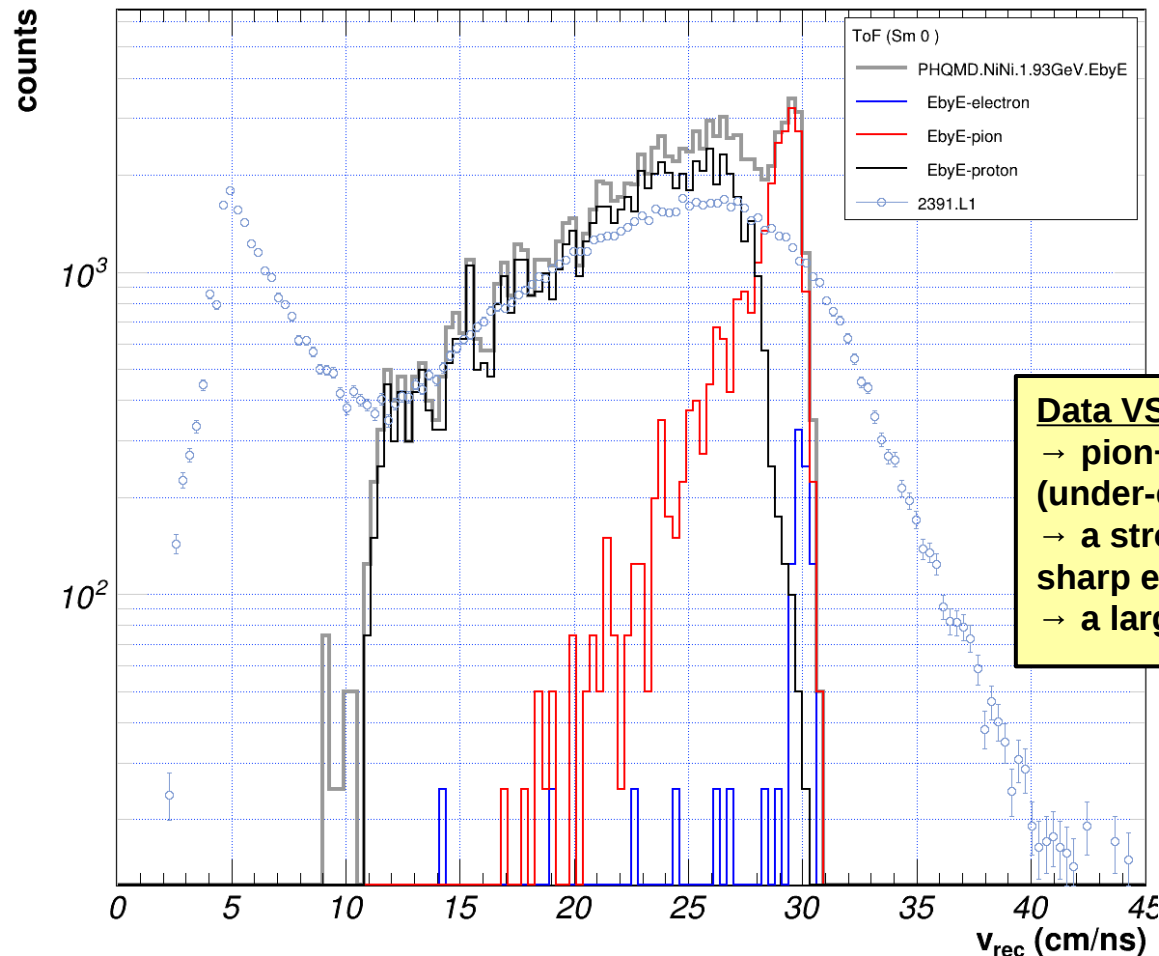
$$y_{ToF}, z_{ToF} = f(Align)$$

$$x_{target} = 0.67 \text{ cm}(Align)$$

$$y_{target} = 0. \text{ cm}(Align)$$

$$z_{target} = 1.50 \text{ cm}(Align)$$

$$t_{Th} + \delta t(ToF, T0) = 29 \text{ ns}$$



Data VS MC lessons (identical selection)

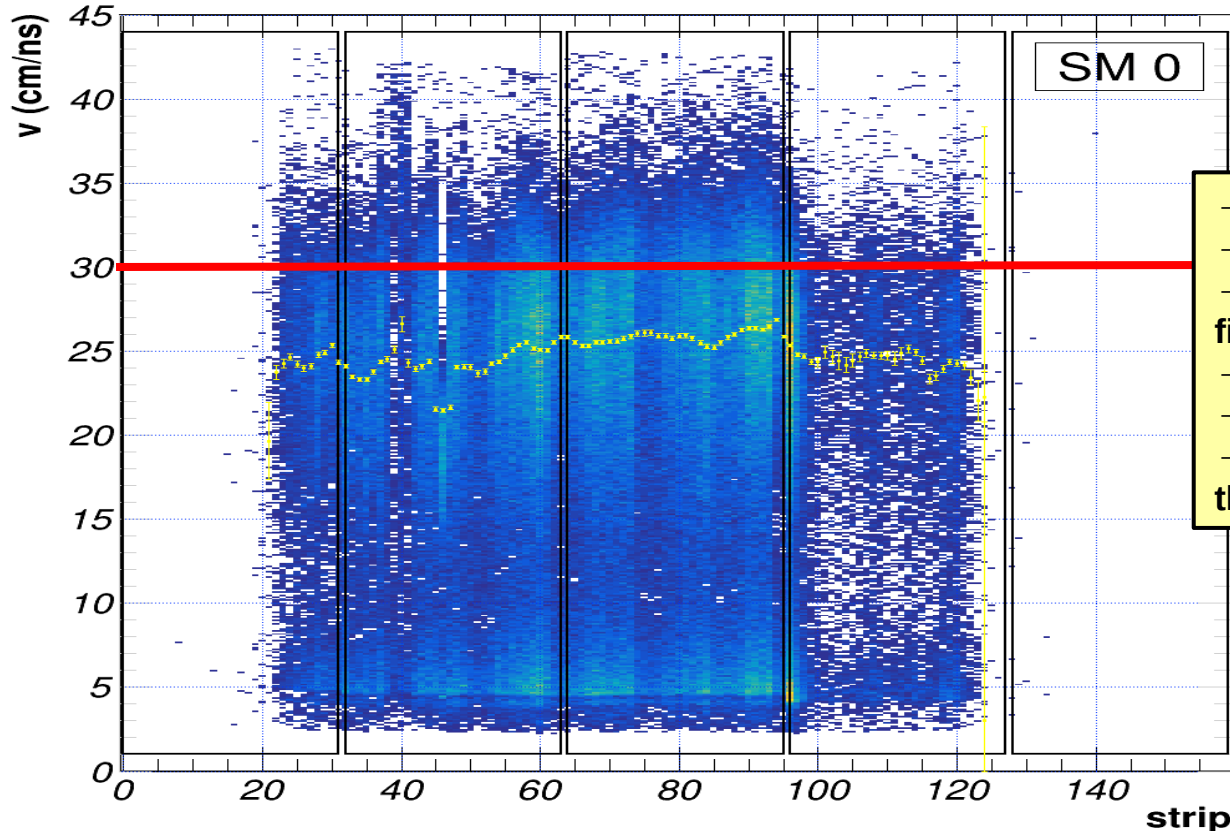
- pion+electron component totally missing (under-estimated or smeared by resolution)
- a strong component below 10 cm/ns with a sharp edge at 5 cm/ns (inter event pile-ups ?)
- a large superluminal component above 40 cm/ns

ToF calibration

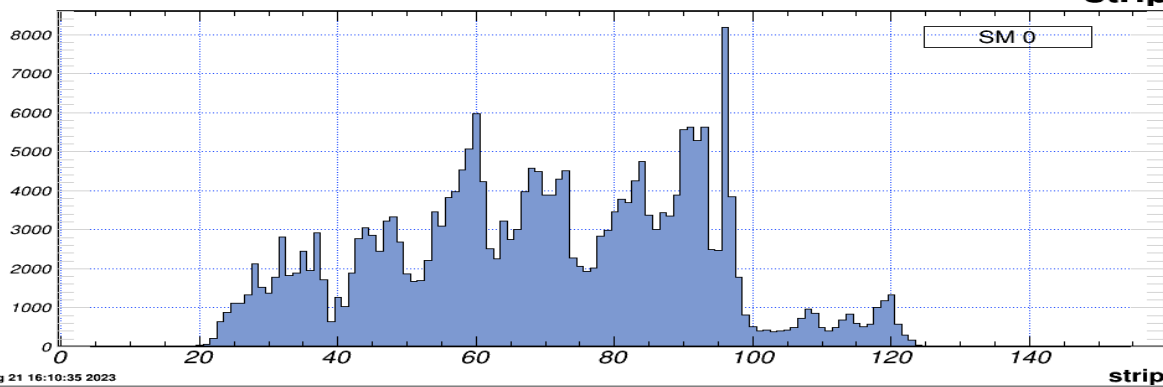
```

→ cCalId = "2391.5.000";
→ iCalSet = 22002500;
→ Int_t calMode = 93;
   Int_t calSel   = 1;
   Int_t calSm    = 0;
   Int_t RefSel   = 0;
   Double_t dDeadtime = 50.;
   Int_t iSel2    = 500;
   Bool_t bOut    = kFALSE;
  
```

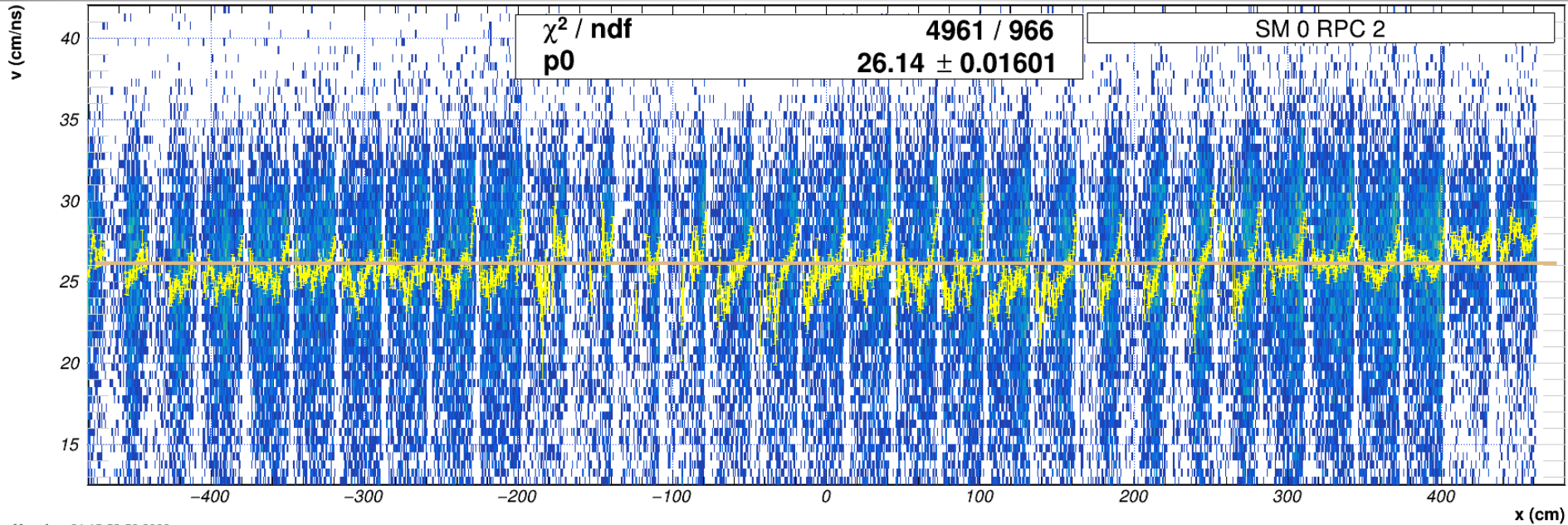
ToF Sm0 strip-strip variation



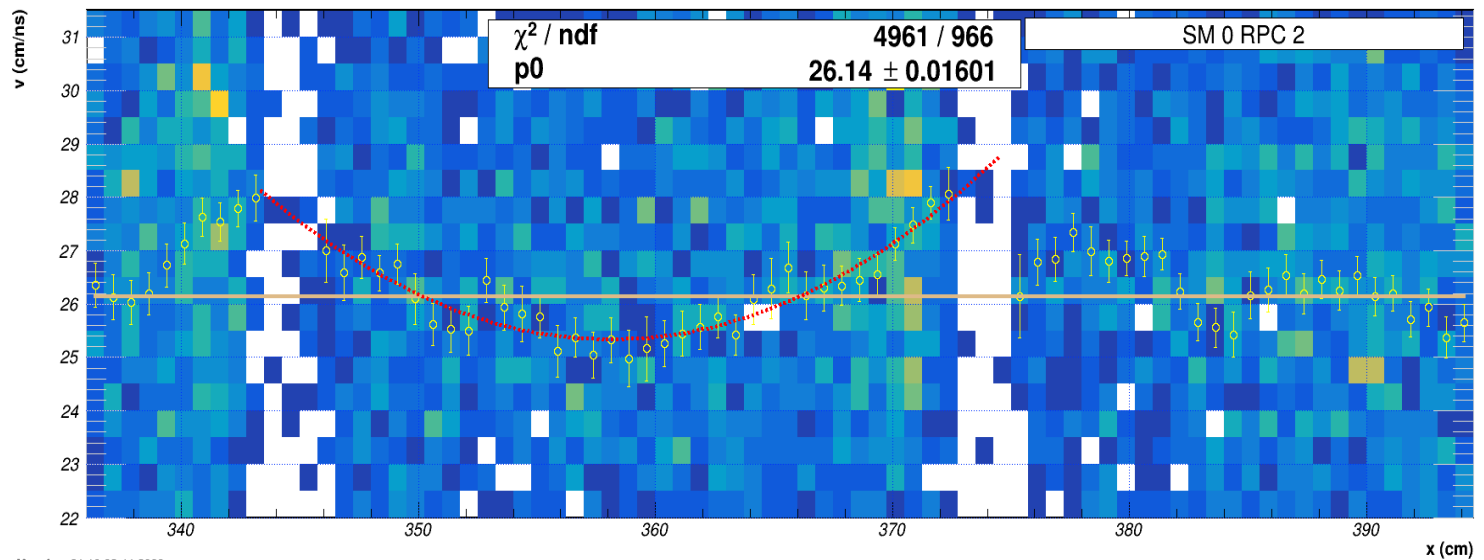
- $\text{strip} = \text{iRpc} * 32 + \text{iStrip}$
- strip selected on yToF coordinate
- yellow curve : the mean of a Gauss fit (MPV velocity)
- red line : speed of light
- component $v < 15 \text{ cm/ns}$ neglected
- non-uniform yield distribution over the strips.



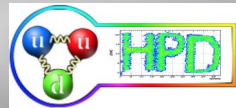
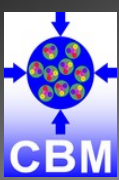
ToF Sm0 strip-x variation



Mon Aug 21 15:58:53 2023



Mon Aug 21 16:02:11 2023



BACKUP

Based on L1 global tracks

- select TRD ToF hits (reconstructed MC)
- from TRD hits select MC tracks
- select TRD & ToF points (true MC)

