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# How to access low $p_T$ values using TRD-2D

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***CBM PWG-COM meeting***
***Remote meeting***
***9 Apr 2021***

# TRD TDR Addendum – the scope

**TRD Module type definition and position on the TRD station according to TRD TDR**

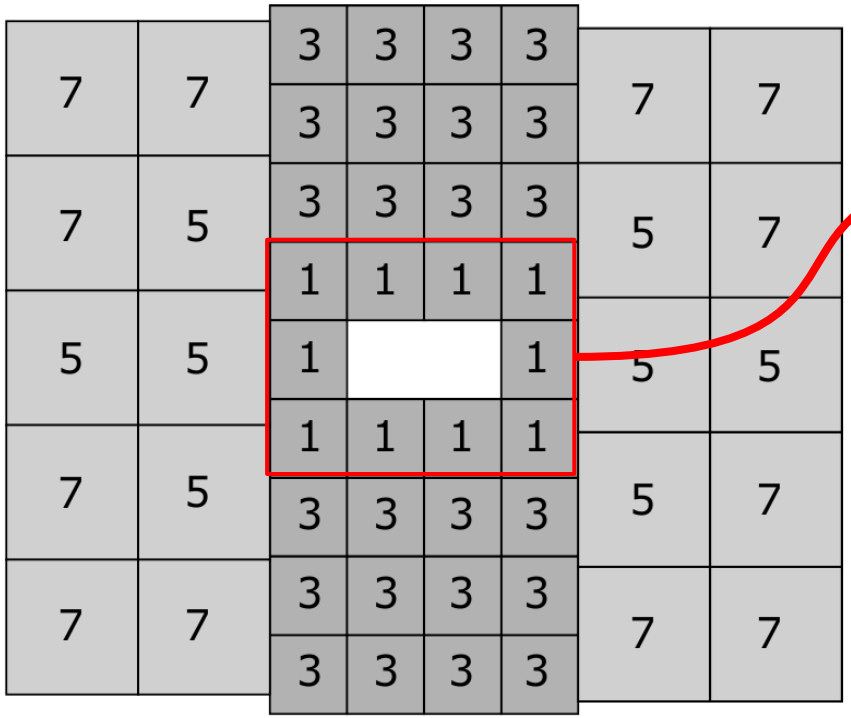
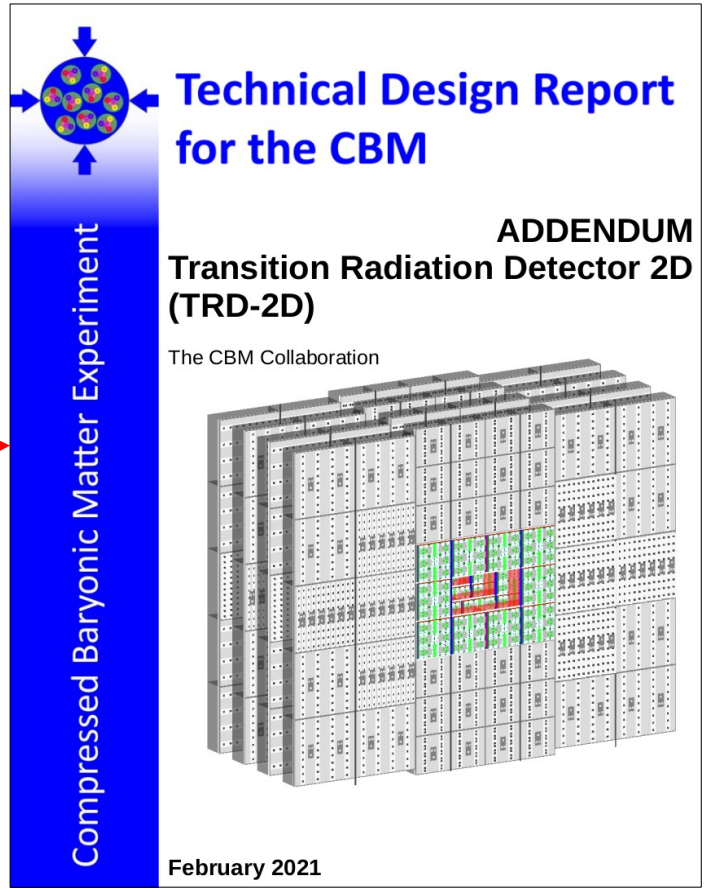
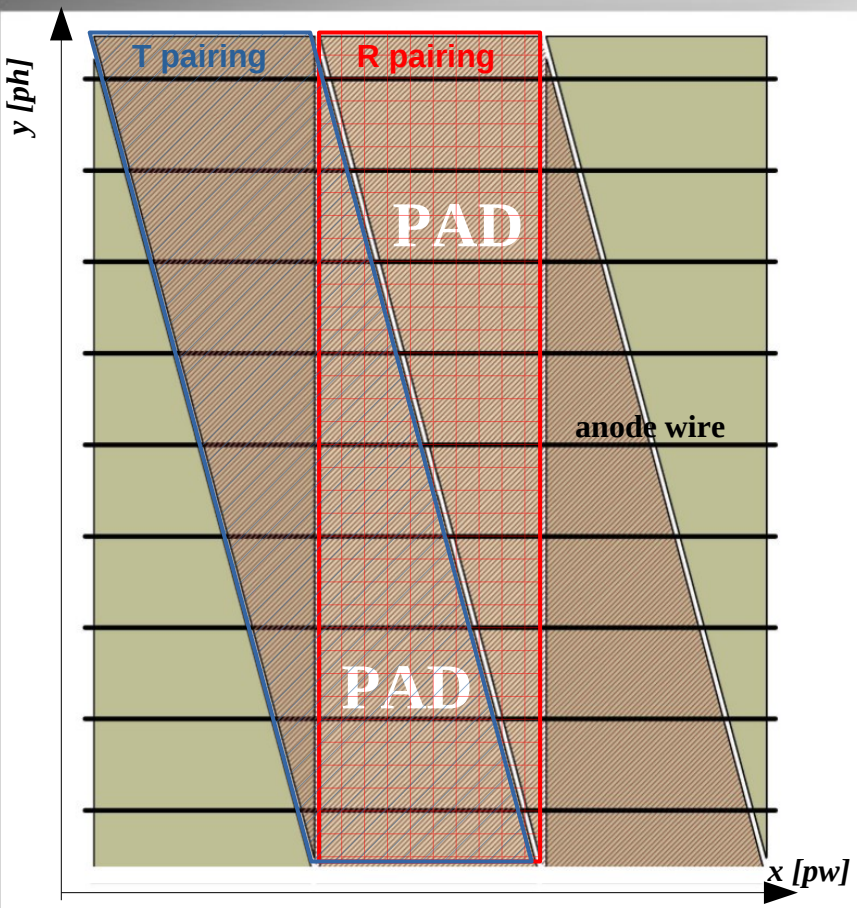



Figure 8.2: The arrangement of the different module types in one TRD layer. A layer can be separated into three vertical segments, two outer ones (shown in light gray) consisting of large modules, and a center one (shown in dark gray) containing only small modules.

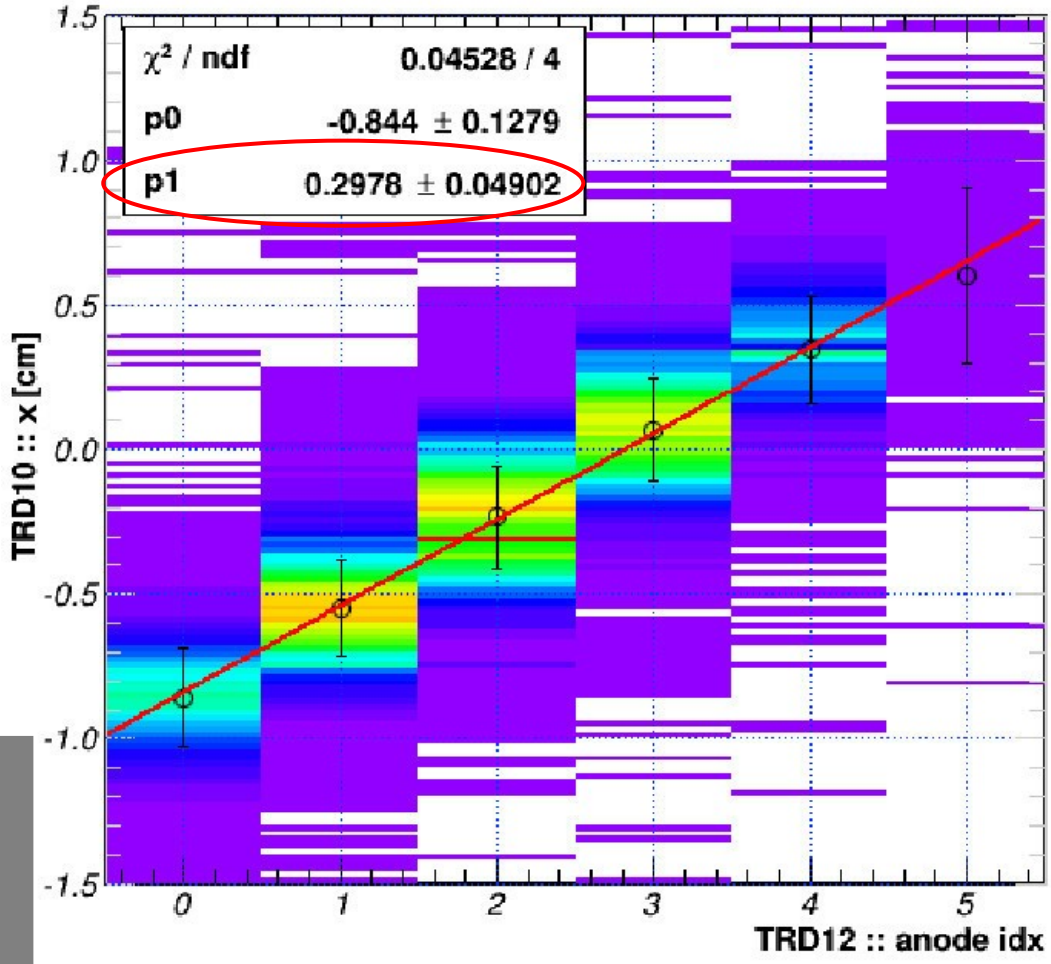


# The read-out principle of TRD-2D

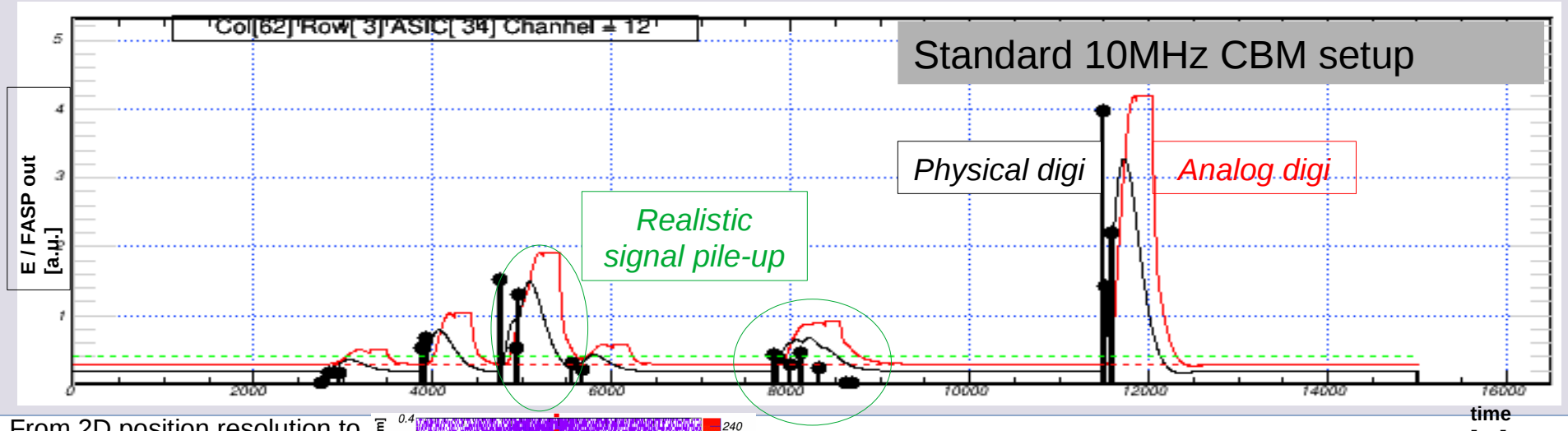



→ *The pad-plane is split in right triangular PADs*
→ *The read-out is organized based on overlapping R-pairs/T-pairs*
→ *For a cluster of charges one pad is read-out twice with the final outcome of identification of the anode where the charge was amplified;*

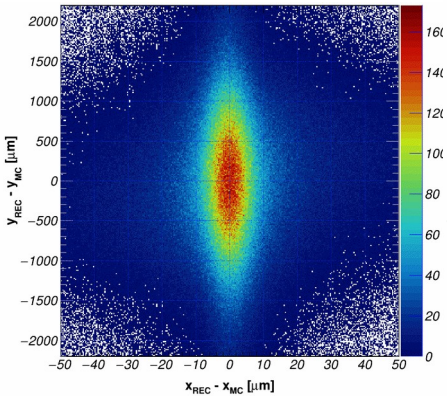
→ *First experimental proof the the anode wire identification method works by using a setup similar to TRD-TDR*



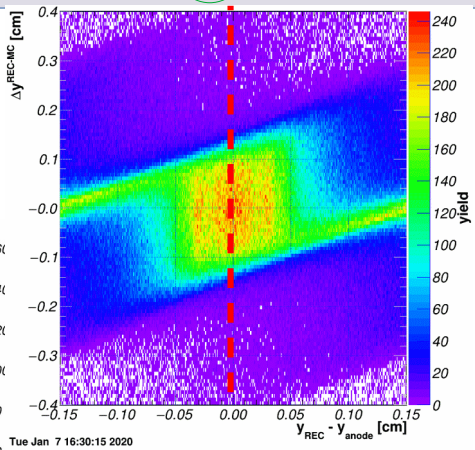
# CbmRoot integration : Digitization → Reconstruction → Tracking → *Physics*

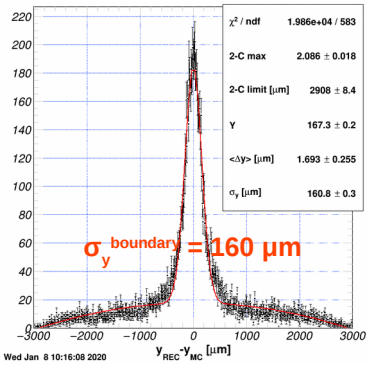


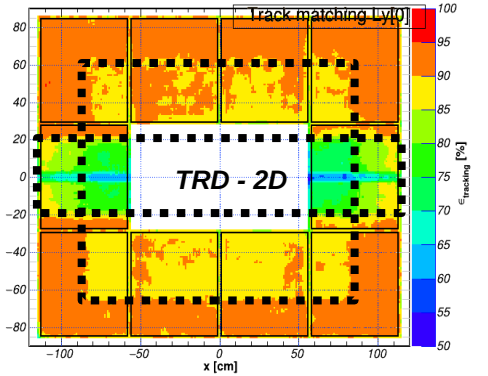

From 2D position resolution to tracking efficiency in SIS100 set-up EbyE simulations.

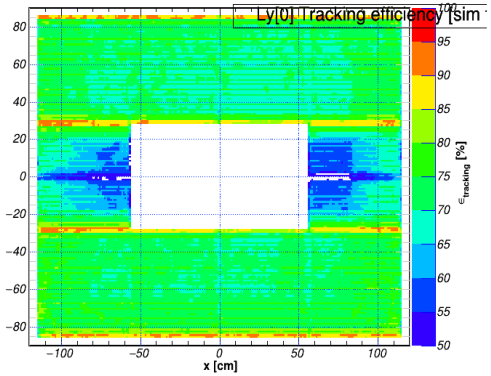


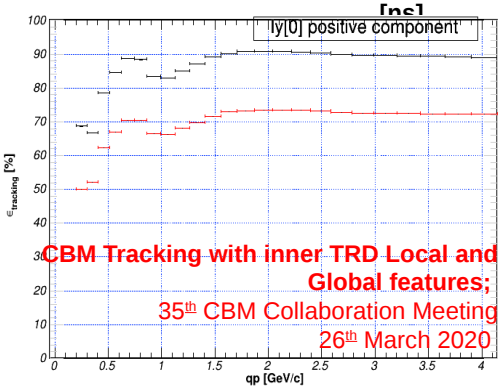

Differential y resolution over the amplification cell with emphasis on the best resolution of $\sigma_y$=160μm.



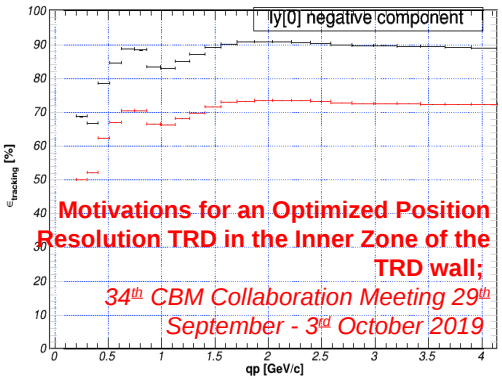



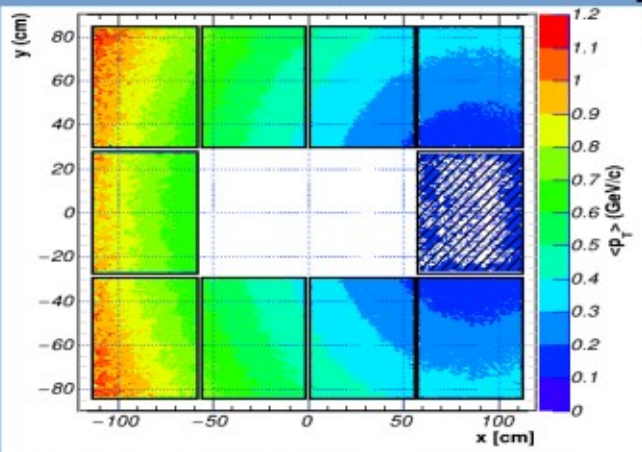

**CBM Tracking with inner TRD Local and Global features;**
35th CBM Collaboration Meeting
26th March 2020



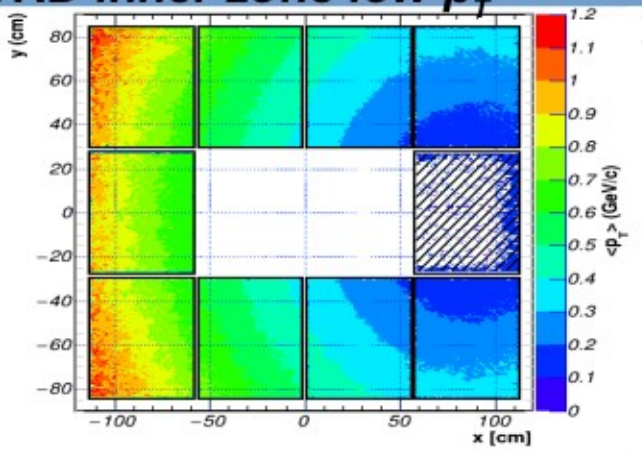

**Motivations for an Optimized Position Resolution TRD in the Inner Zone of the TRD wall;**
*34th CBM Collaboration Meeting 29th September - 3rd October 2019*

# TRD-2D tracking motivation

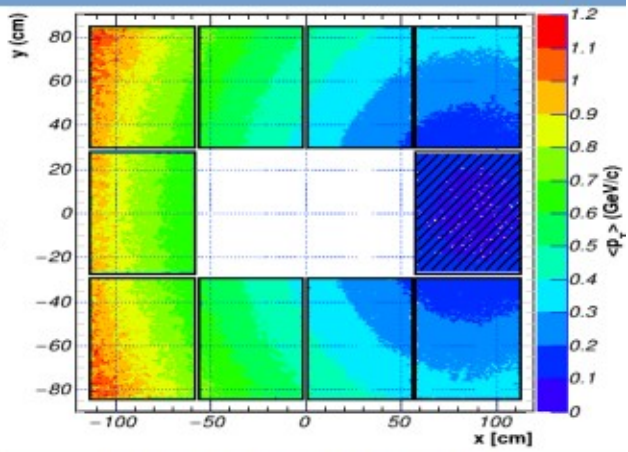
## TRD inner zone low $p_T$




p & $K^+$ with $|y_{CM}|<0.25$, propagated from STS seeds to last TRD station. Hatched area is a projection of the STS blind spot.




... tracks which attach TRD hits. The hatched area shows a low efficiency !

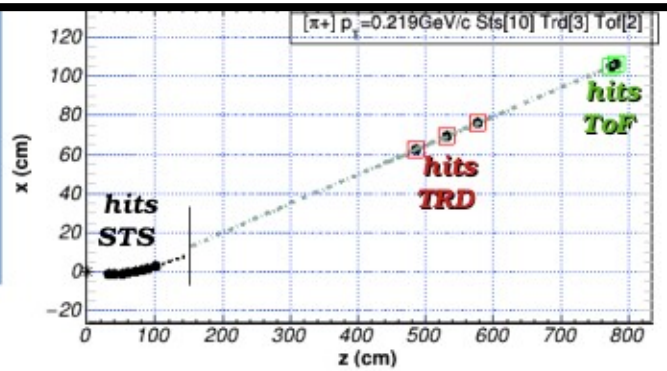


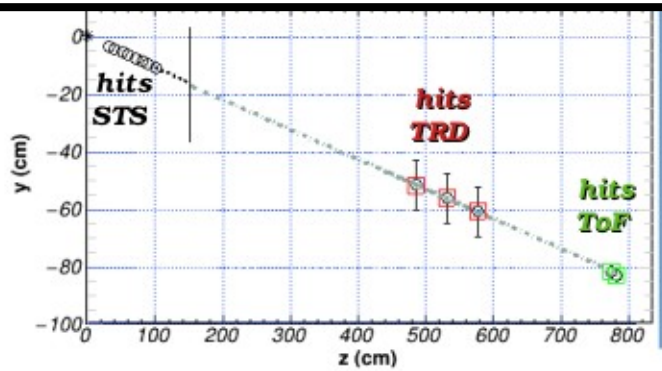

... tracks which IDEALLY can be reconstructed starting from TRD-2D seeding

***THE EFFECT EXEMPLIFIED HERE FOR PROTONS CAN BE REPRODUCED FOR EACH CHARGED PARTICLE WITH PROPER B FIELD SETTINGS***

**TRD-2D seeding:**

- can be done with at least 2 hits
- x-y resolution independent of missing station !



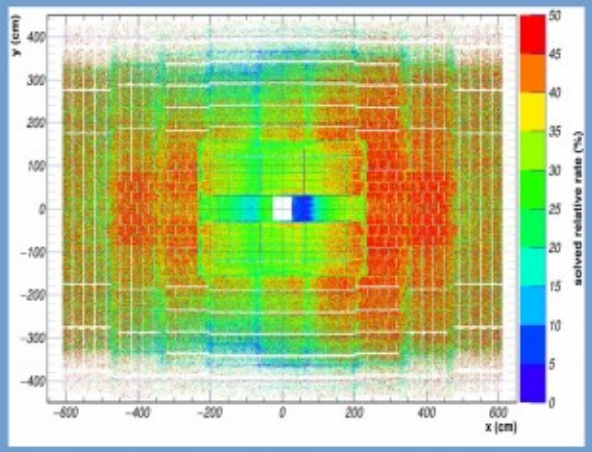

**TRD-2D seeding:**

- can seed STS residual hits
- can extend/complement STS seeding for ToF hit attachment (see next slide)

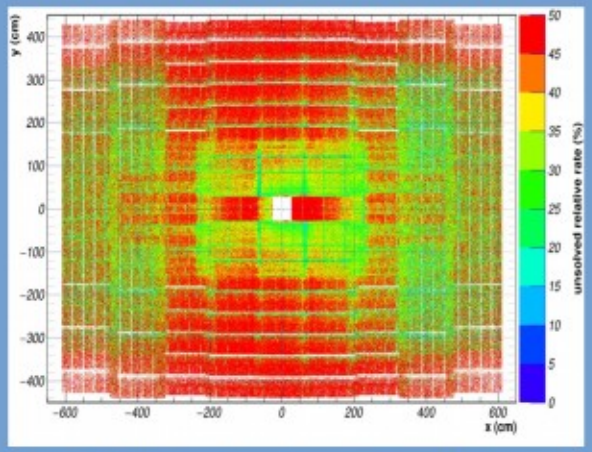
***Once a TRD seed is produced we need also few (2) sparse STS hits to estimate $p_T$***

# Effect on downstream detectors

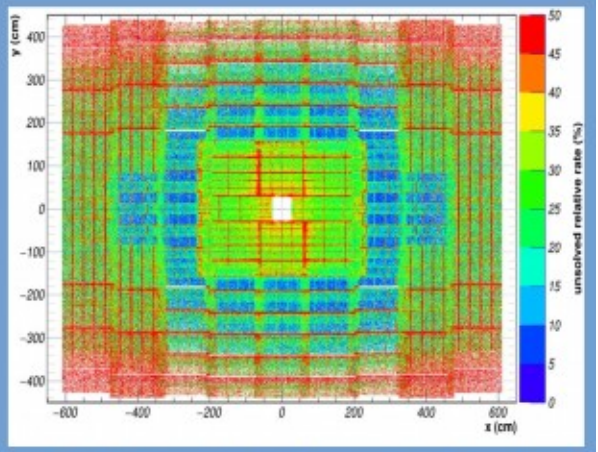
## ToF hits classification




ToF hits IDEALLY solved by STS seeding … 32%

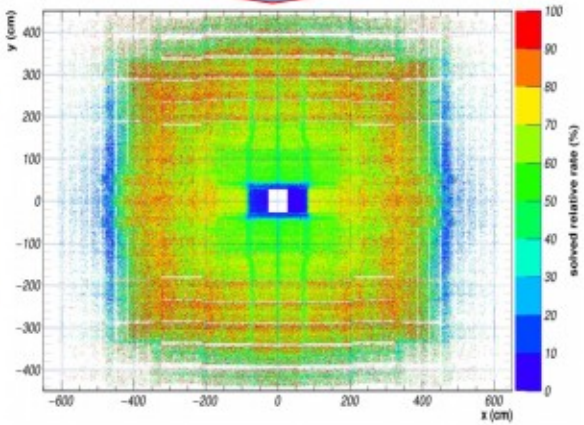



ToF hits produced by INCIDENT particles on the wall but no STS seeding info … 38%




ToF hits produced in or after the wall … 30%

Solved by TRD-2D seeding



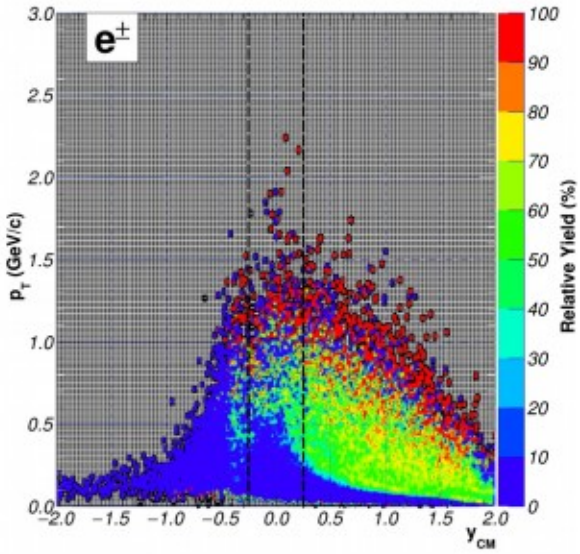

TRD-2D seeding:

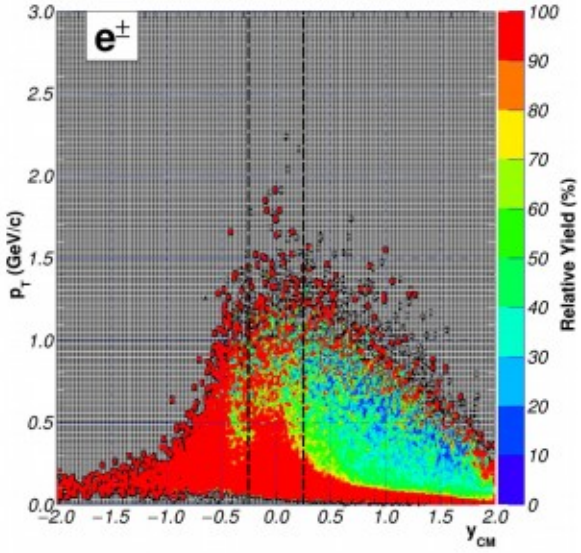
- can recover 55% of STS not-trackable ToF hits

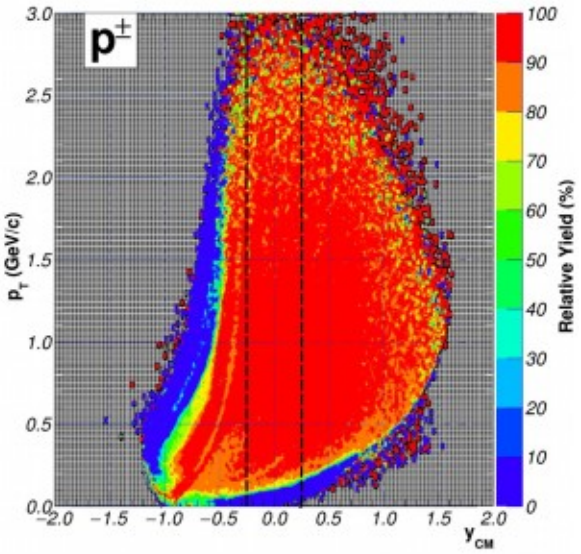
TRD-2D seeding:

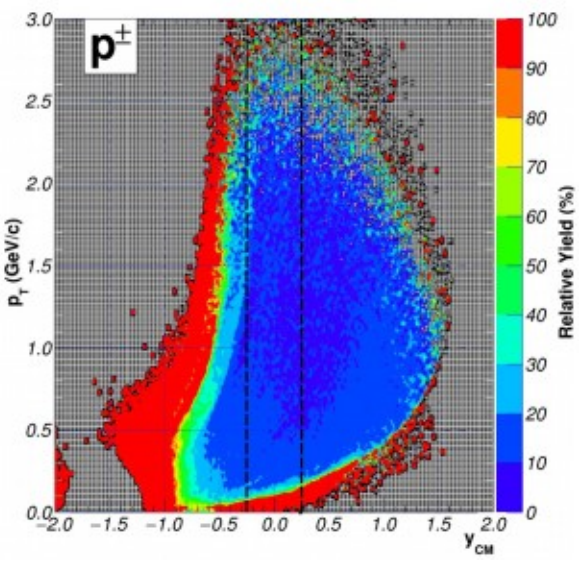
- can sharpen x-y roads for ToF hits attachment wrt STS seeds

# Expansion of the kinematic phase space TRD-2D vs trackable (*




***STS track seeding***

***Realized STS tracks wrt ideally possible seeds propagated to first TRD station***

*10 AGeV Au-Au central collisions*

*SIS100 electron setup*

**Trackable (ideally) track : 4 MC hits in STS**
**Ideal SA TRD seed : 2 MC hits in TRD and 4 MC hits in STS**
**Realized STS track : STS seed propagated to the active volume of TRD**

***TRD-2D track seeding***

***Ideal stand-alone TRD seeds in the first TRD station wrt to STS seeds out of all possible***

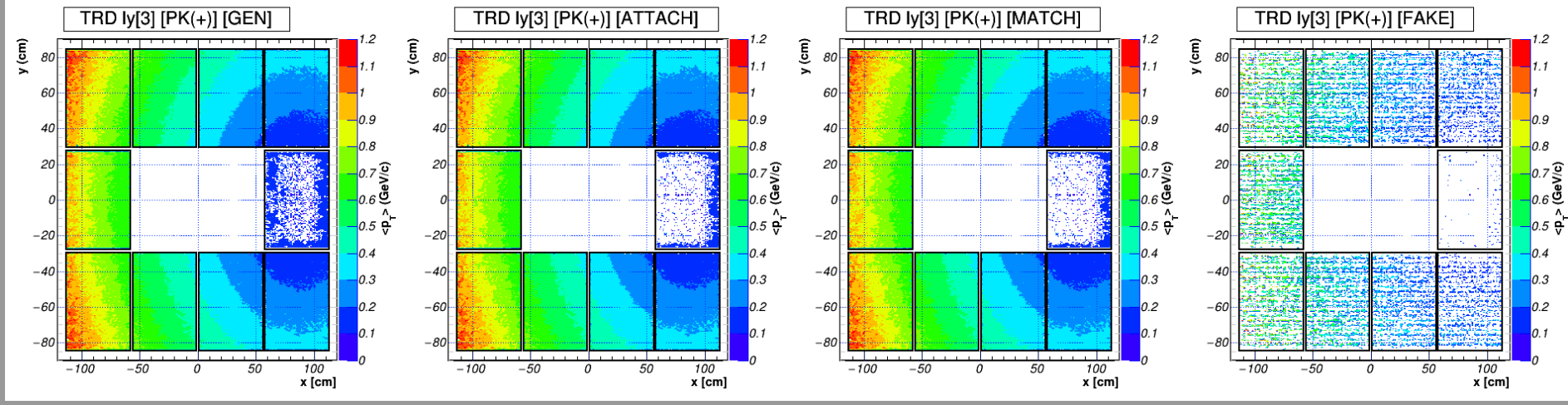
# Conclusions

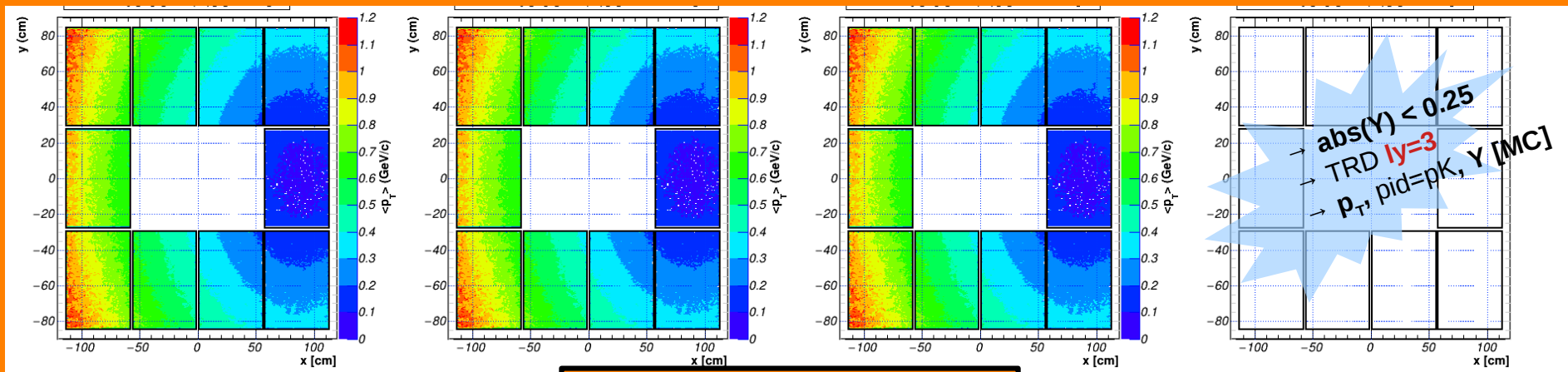
- The low $p_T$ (<200 MeV/c) activity at mid rapidity is taking place in the blind spot of the STS.
- TRD active zone is complementary to it (as function of B field, rapidity, PID)
- TRD-2D is an efficient device to recover this missing area.
- Additionally
  - background reduction can be achieved for downstream systems
  - Improved performance for TRD observables (energy time, position) can be achieved by the 2D technique.

# BACKUP

# <$p_T$> (x,y | pid, chg, Y)

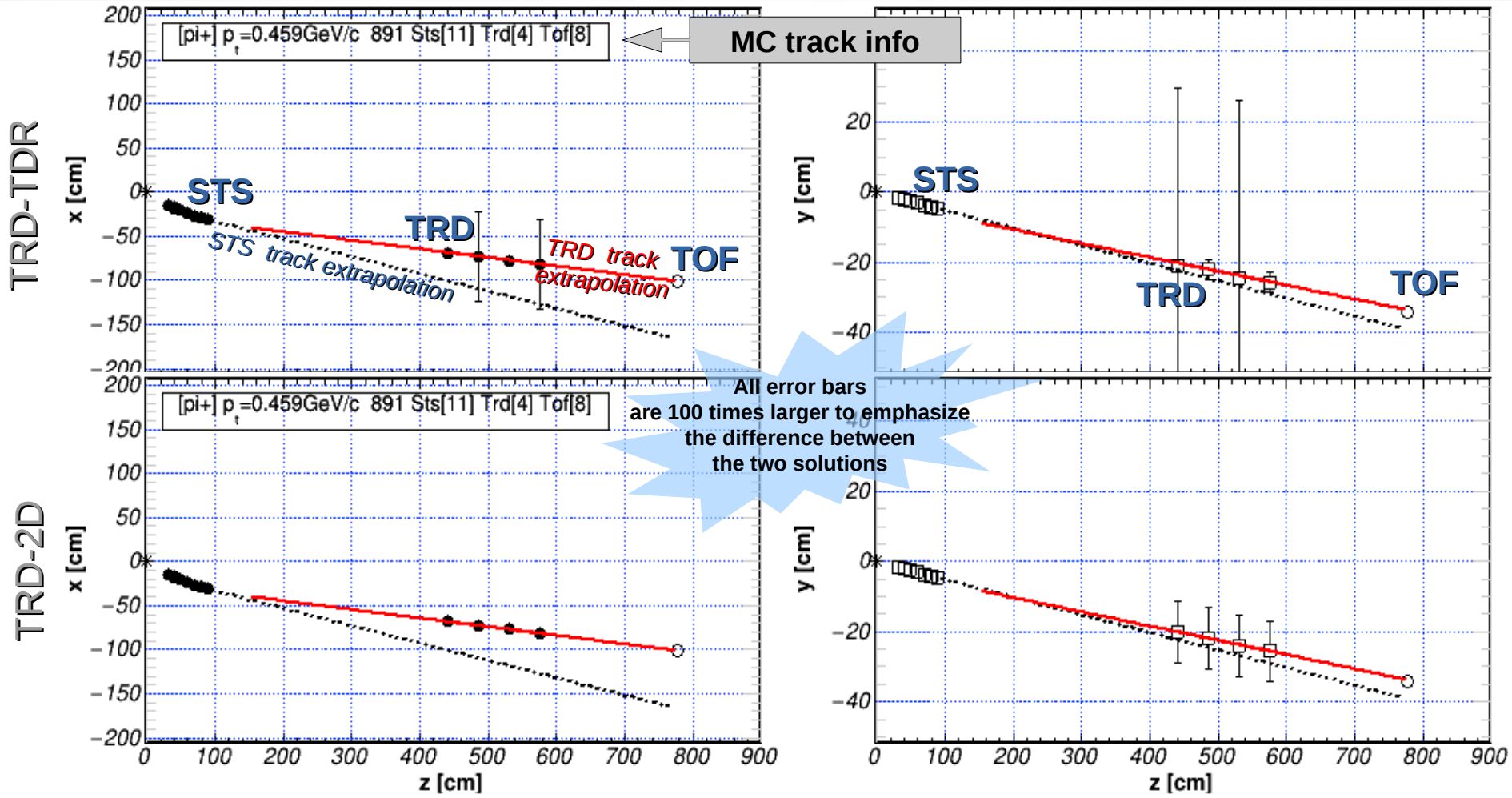
Default RECO




Standalone recoverable

# Standalone/complementary TRD tracking




**TRD track extrapolation** : linear fit of ideally reconstructed TRD hit extrapolated to STS and ToF (z of MC point)

→ see next slide for ideal reconstructed TRD hit definition