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mCBM High Intensity Features

A study of various yields

Alex Bercuci

mCBM Data Analysis Meeting

25th April 2023

Motivation

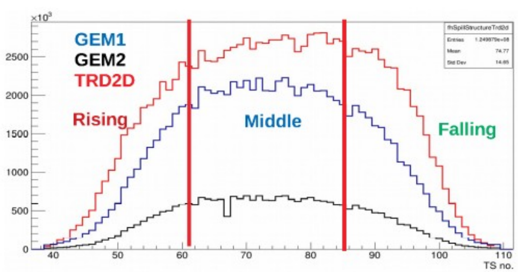
Results of high Intensity mCBM, June 2022 data

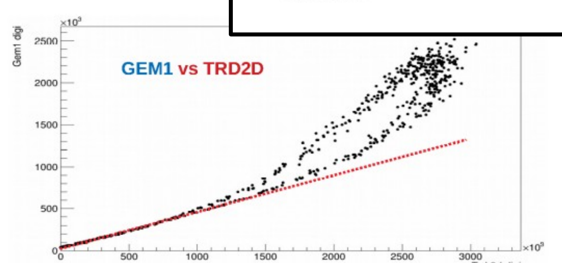
Date: 21.02.2023

Highest Intensity Run
Run: **2570**
Gem1 HV= 4800V (I = 1492 uA)
Gem2 HV= 4412V (I = 1491 uA)
Target= Thick Nickel (4mm)
Beam Intensity= **2.5x10⁸/Spill**
Time= 21:54:27
Date: 19th June, 2022

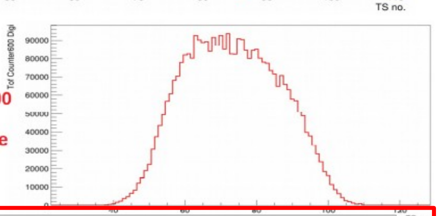
Chandrasekhar Ghosh
(On behalf of MuCh team)

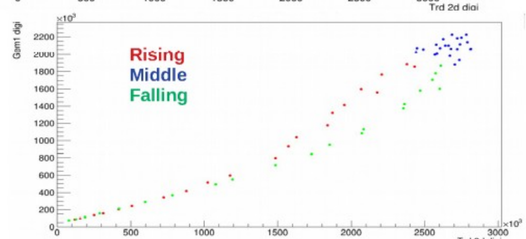
Run:2570 (I= 2.5x10⁸, 4mm Nickel), GEM1 HV=4800V: GEM1





TOF_Counter600 Spill for beam profile reference





Conclusions:
1.Beam profile of TRD2D shows saturation w.r.t TOF-600
2. Digi corelation show saturation of TRD2D w.r.t GEM1

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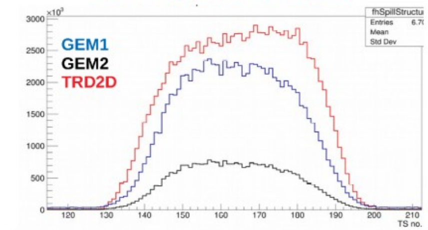
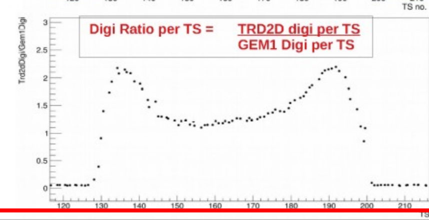
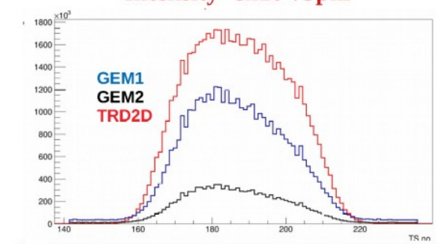
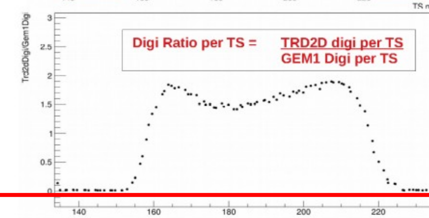
Run:2570
Intensity=2.5x10⁸ /Spill





Run:2561
Intensity=8x10⁷ /Spill





TRD shows less rise in digis as compared to GEM1
And the ratio dip is significant.

TRD shows more linear ratio as compared to highest Intensity run and ratio dip is less significant.

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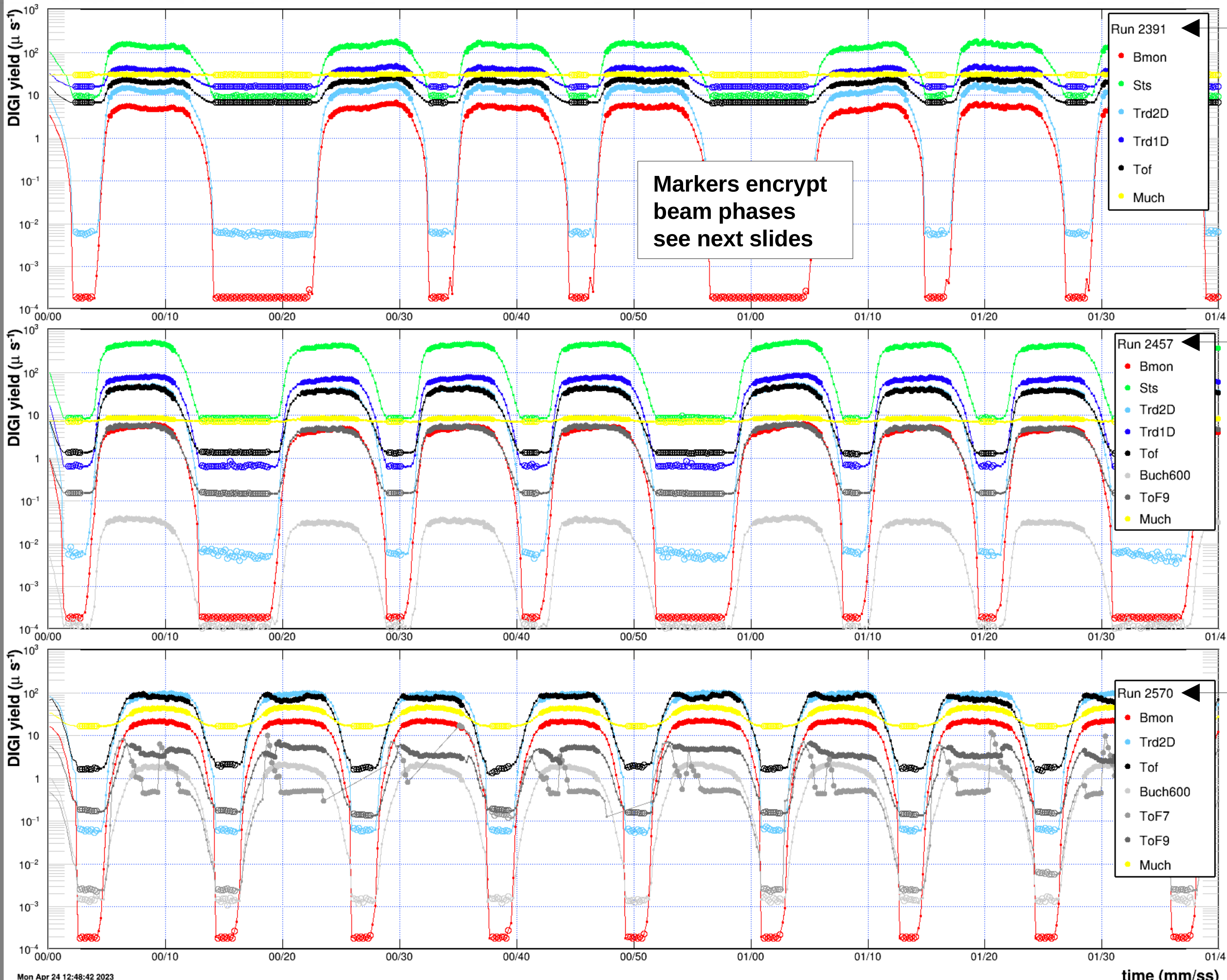
Thank you

Collab Meeting 10th March 2023
https://indico.gsi.de/event/16428/sessions/7939/attachments/43102/60378/20230310-41th-CBM-Week-OC-Summary-CSturm-v13.pptx

Technical Board on 21st Feb 2023
https://indico.gsi.de/event/17016/contributions/69928/attachments/42724/59681/TB210223_MuChHighRateDataAnalysis.pdf

mCBM Analysis Meeting 21st Feb 2023
https://indico.gsi.de/event/16943/contributions/69690/attachments/42738/59709/210223_MuChHighRateDataAnalysis.pdf

Analysis outline



Nickel setup

Low Intensity run
Full reconstruction
L1 Tracking & Align

Gold setup

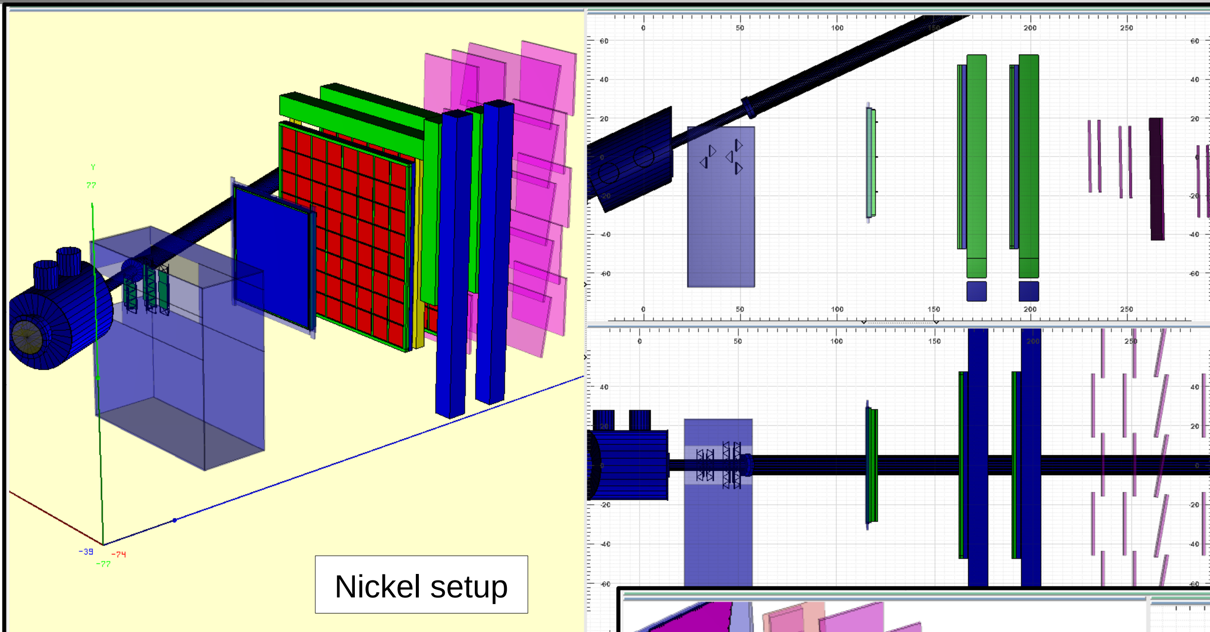
High Intensity run
Digi unpacking

Gold setup

High Intensity run
Digi unpacking

Same as in MUCH example

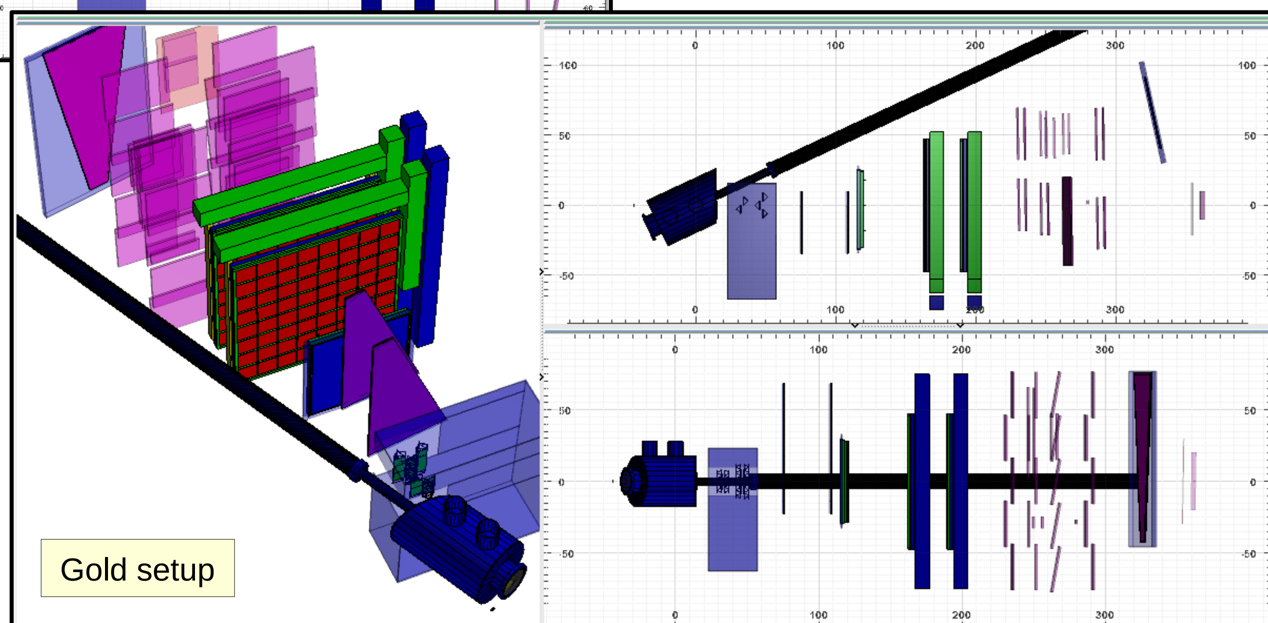
Geo setups



Nickel setup

Detectors participating in all runs and setups under investigation

→ Bmon (no change)
→ TRD2D (no change)
→ ToF (tracking setup)



Gold setup

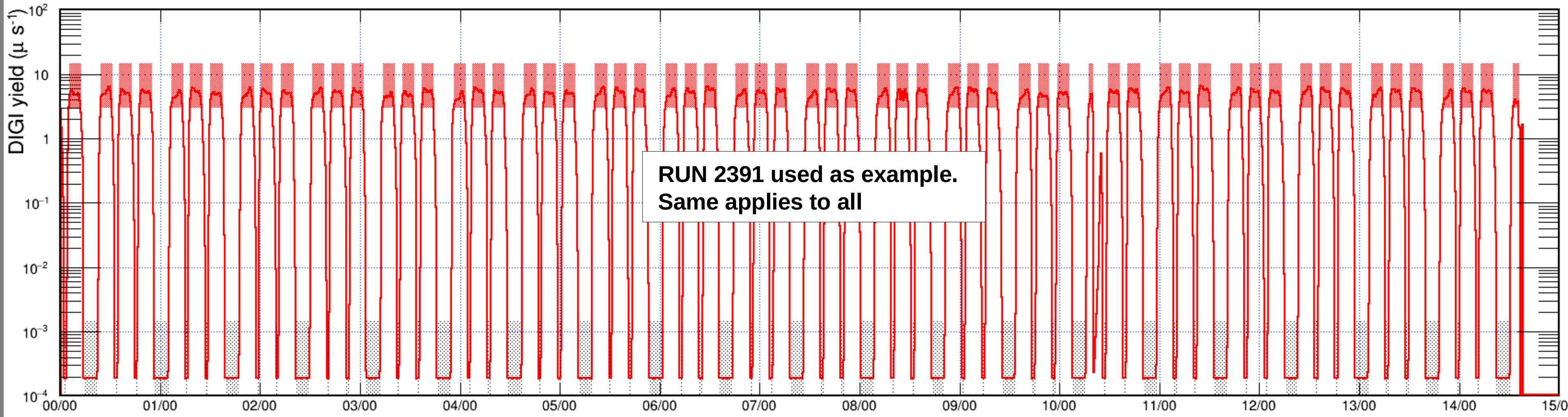
Beam phases

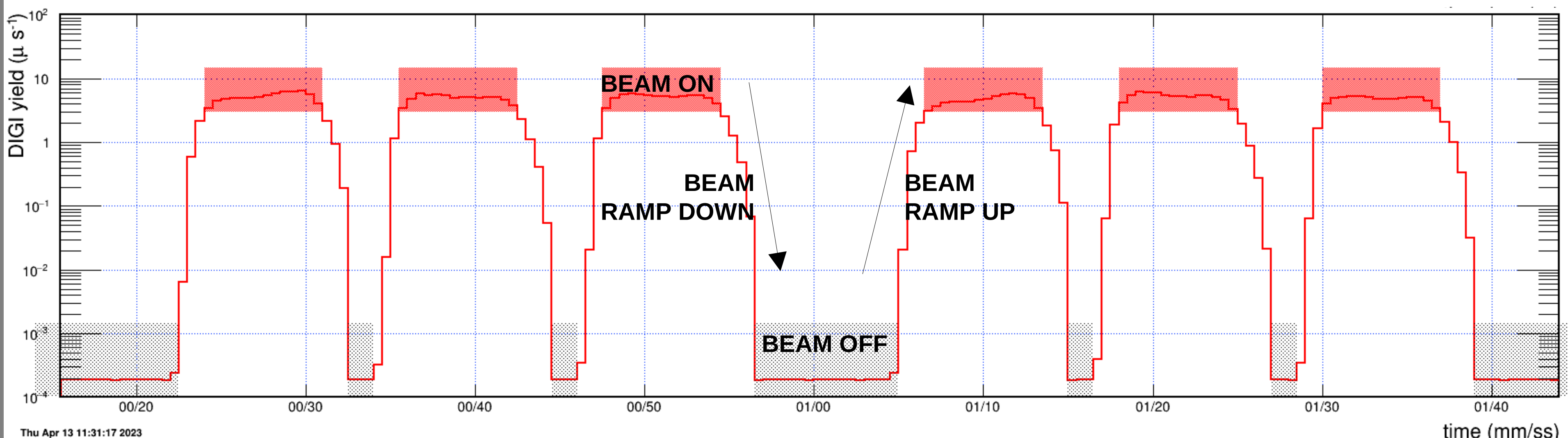
The Bmon detector is best suited for defining the beam profile ! Additionally

→ Less influenced by deltas

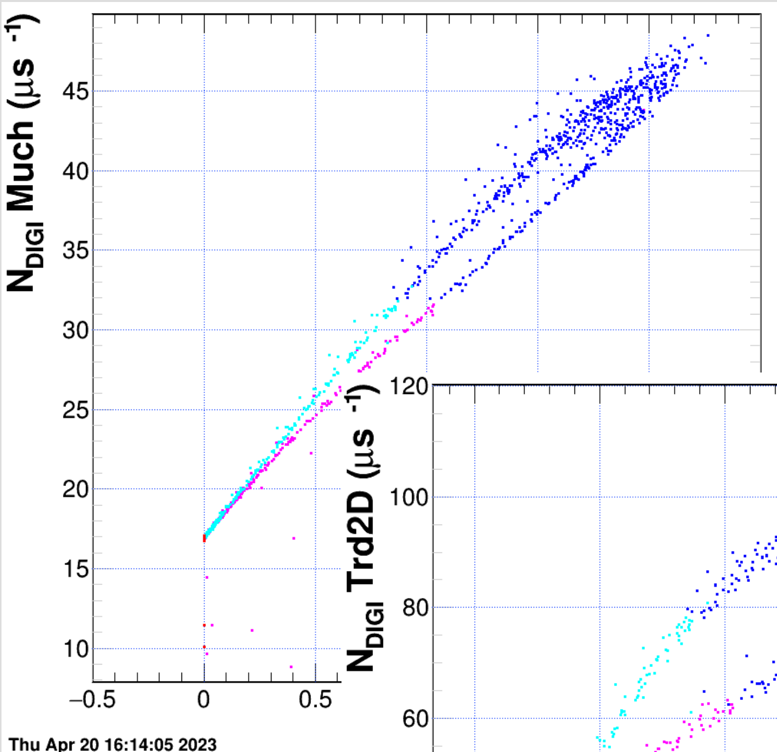
→ The best S/N ratio (beam ON/OFF)

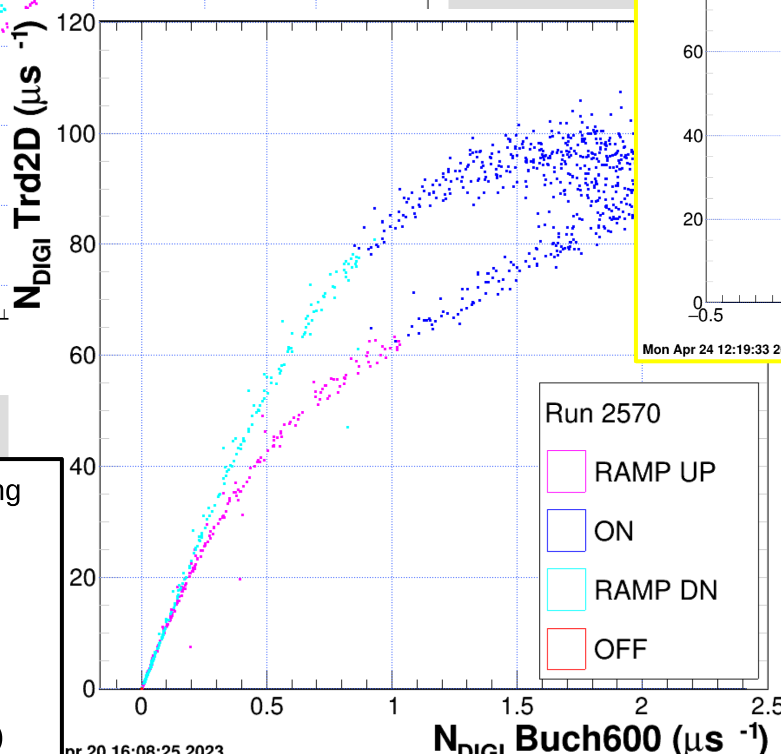
→ Always available and heavily used in event and track definition

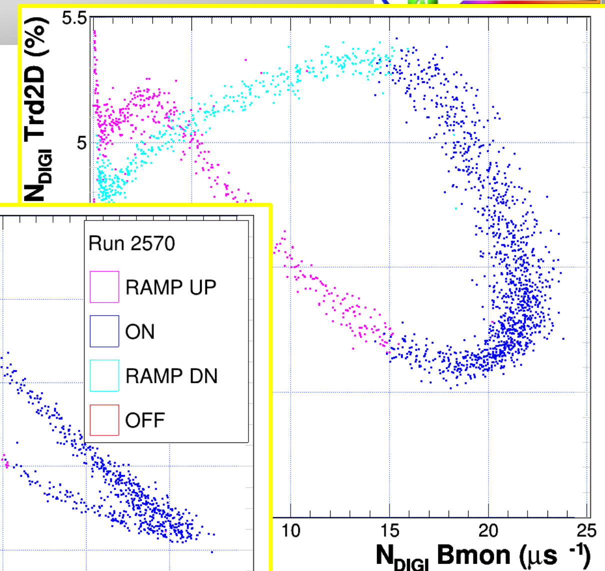


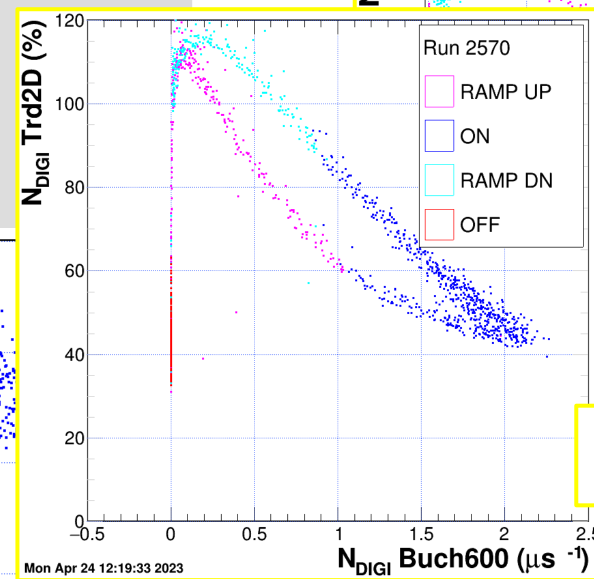


Reproducing the “hysteresis” dependency observed previously

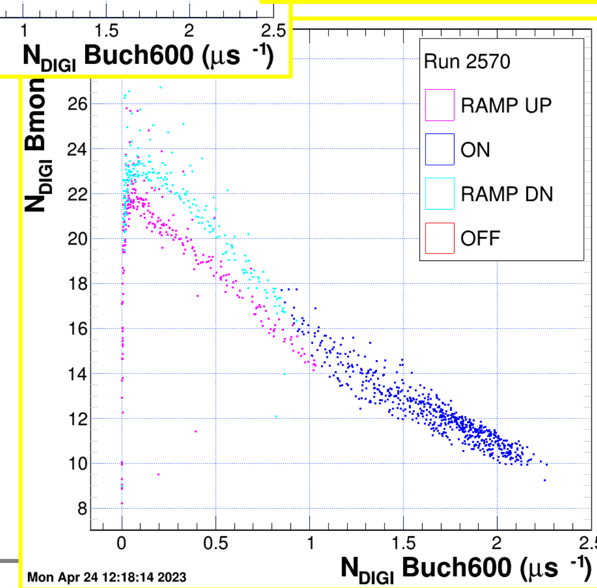






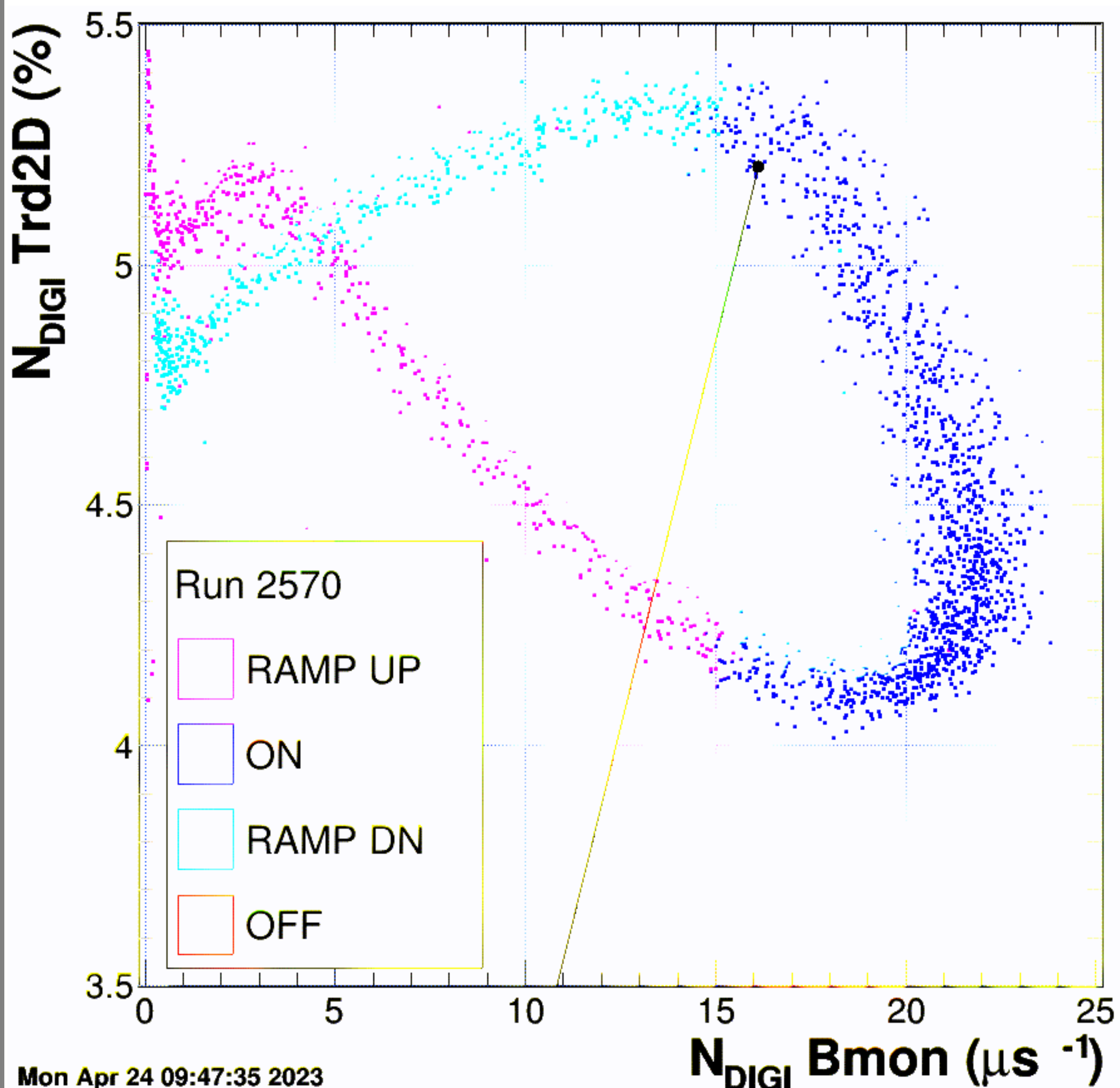


New plots confirming the feature



→ Similar plots reproducing the feature.
→ A better control of systematics by:
1. time dependence in natural units
2. beam analysis on reference detector (Bmon)
3. Use of a large statistics of beam spills.

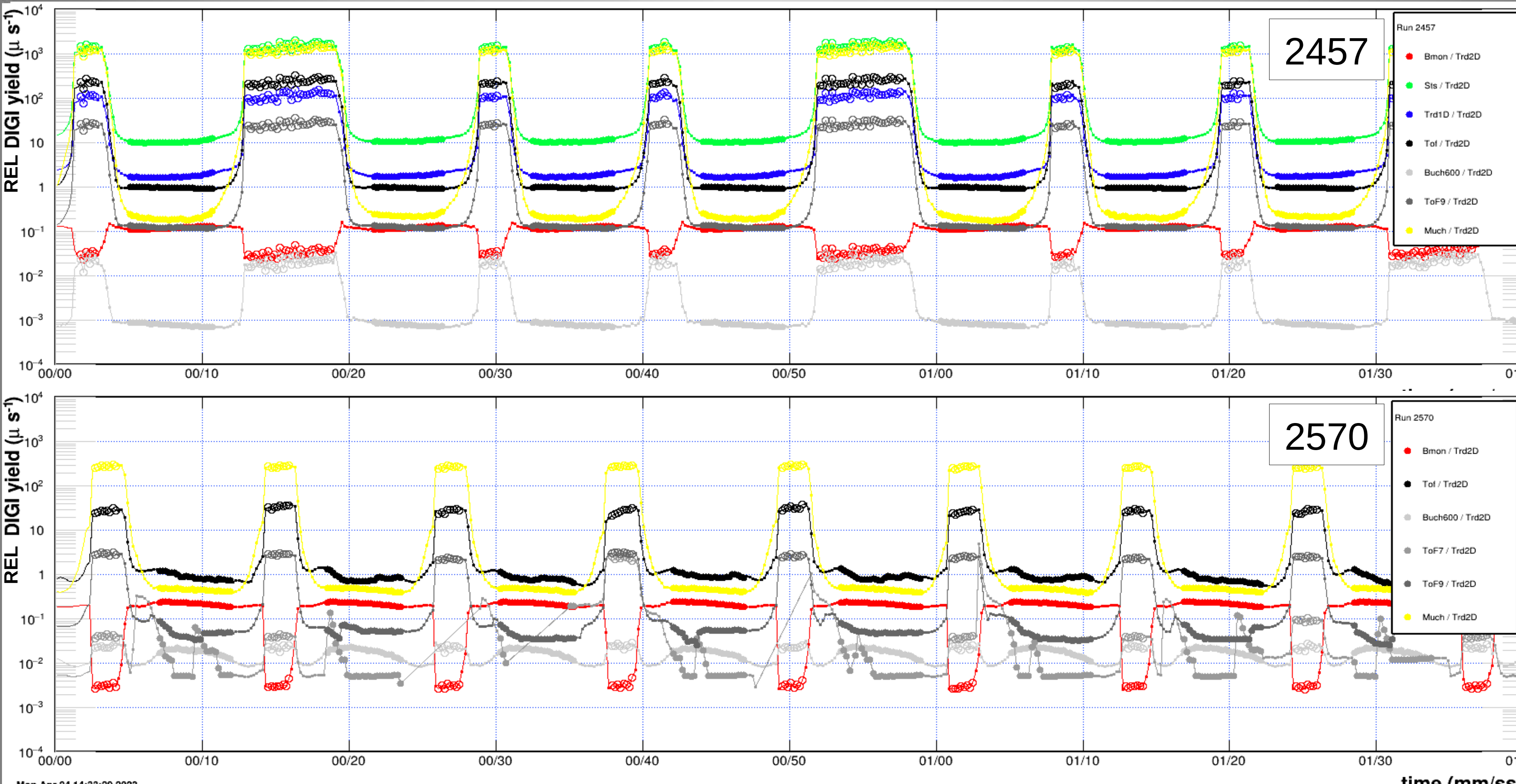
Fact 1



Time dependent “hysteresis”

→ The system(in this case TRD2D+Bmon) evolve on a “path” in this phase space.
→ The path is traversed in phase with beam
→ Ramp DOWN is very similar with Ramp UP phase from detector point of view (point dispersion) which DENY detector related effects (e.g. space charge).

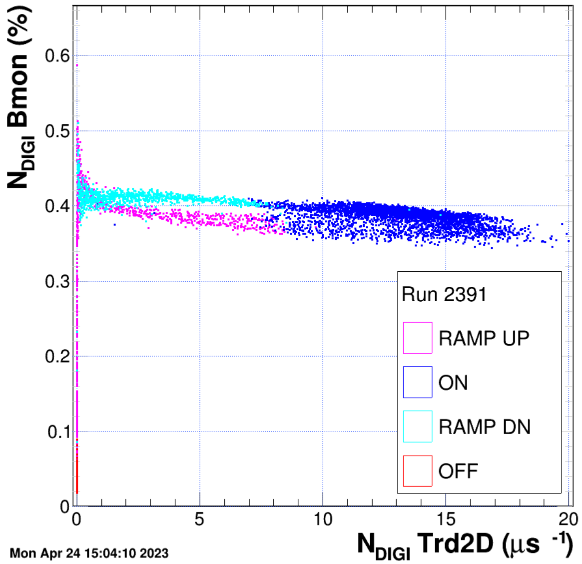
Fact 2

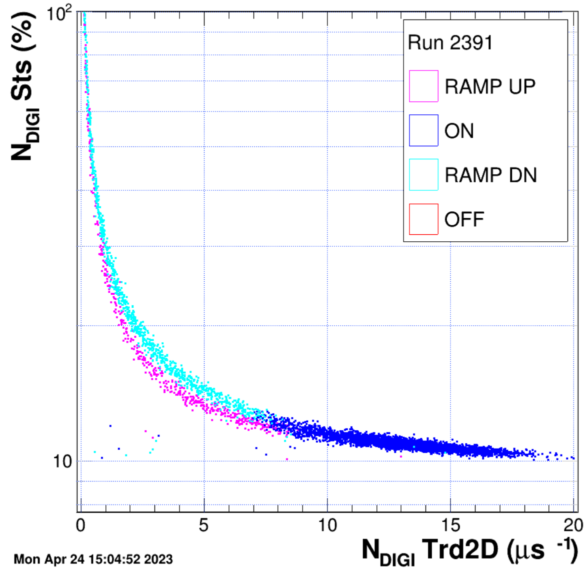


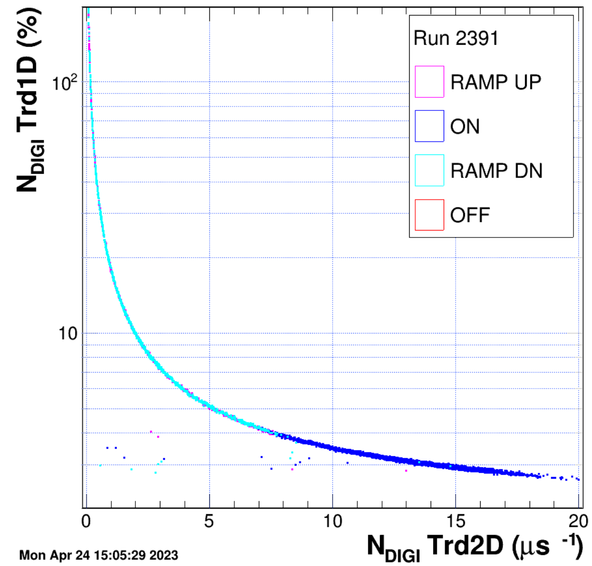
Relative switch ON/OFF of detector yields

→ The pattern of relative digi yields with beam switch ON/OFF repeats identically for each spill (no effects from spill to spill).
→ The pattern depends on compared detectors
→ The approx constant relative yield not connected with beam intensity/phase.

Fact 3

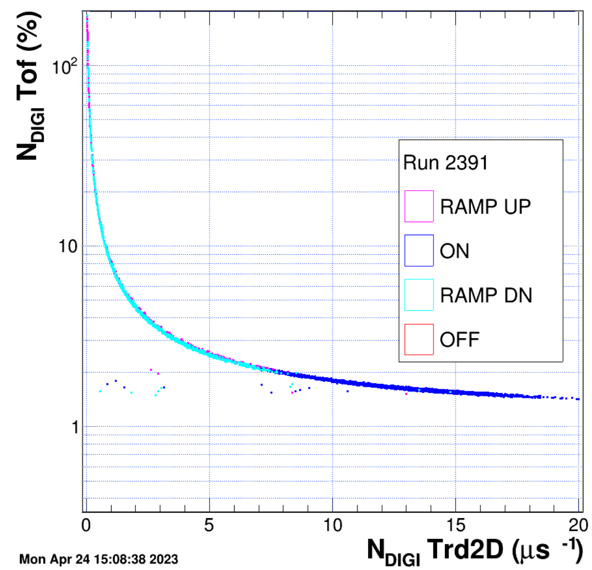




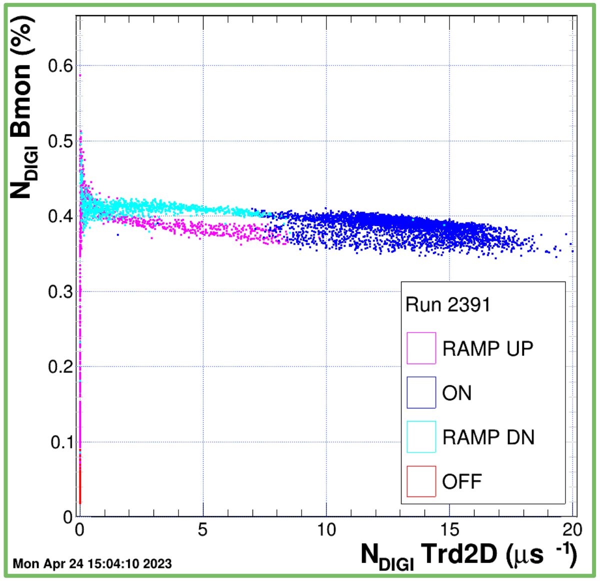


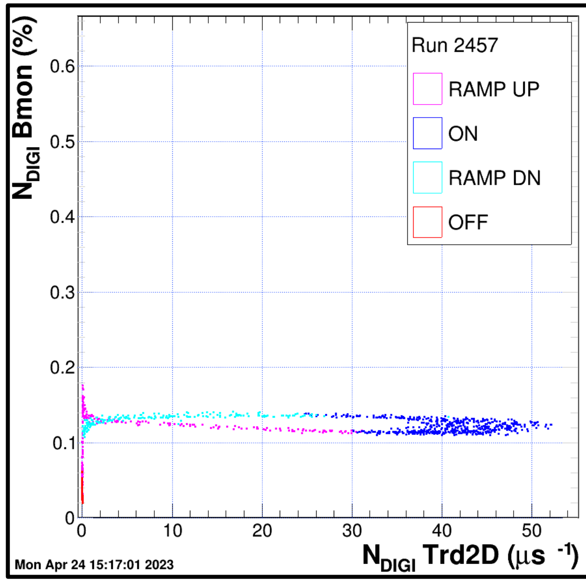
Detector “hysteresis” in low intensity runs (2391)

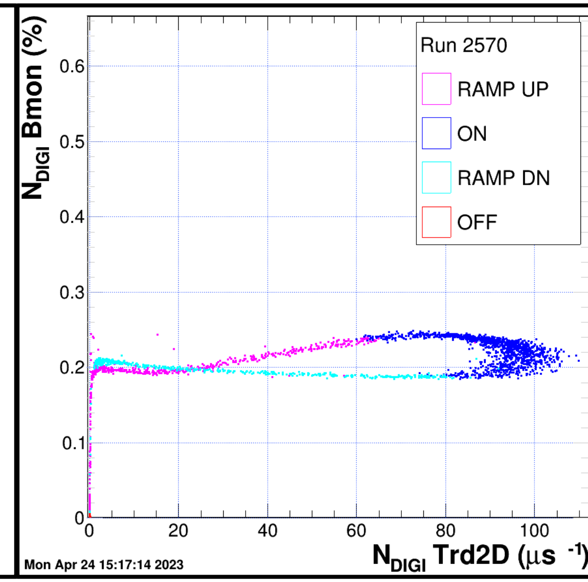
→ BEAM ON/OFF visible .
→ May depend on distance to the target ?!



Fact 3



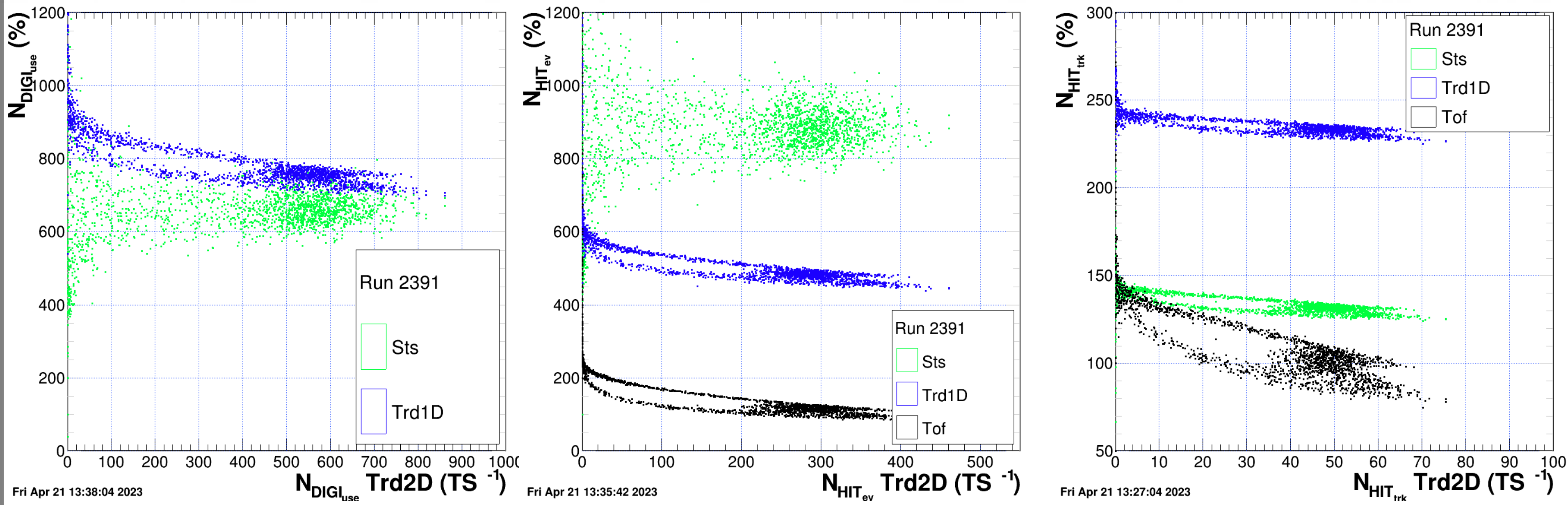




Detector “hysteresis” as function of beam intensity and target

→ The split in the system trajectory happens at various detector yields.
→ The general “shape” of the trajectory always visible
→ In general RAMP DN is less noisy than RAMP UP ?!

Fact 4



Detector “hysteresis” as function of reconstruction “filtering” (Time Slice view)

→ ***Clusters*** split TRD1D.
→ ***Reco hits*** split also ToF
→ ***Trk hits*** split also STS

1. The more one is able to filter the noisy data the more one see the “hysteresis” effect.
2. Independent systems traverse the “hysteresis” path synchronously.

Conclusions

1. The observation of “hysteresis” curves in the yield ratio of different systems @ mCBM first observed by the MUCH team is confirmed.
2. More specific a similar curve is observed for all beam intensities and all detector systems. Mostly visible at digi levels for those systems which are intrinsically noise free (e.g. Bmon, Trd2D, Buch600).
3. The more data are filtered (clusters, hits, tracks) of noise, the curve is clearly visible for all systems.

→ It appears that detector “hysteresis” is a practical method to define beam quality (focus) and eventually to select regions of data taking with constant beam quality.

→ It might be of great importance to study such effects in simulations and quantify their influence on physics estimates.

→ On a longer term we might impose quality requirements on beam focus and time profile

Thank You