Bundesministerium
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MVD - DAQ Status

mMVD in May-2025 Beam Time

Benedikt Gutsche for the MVD team

Outline

mMVD Hardware

Cave Installation & Synchronization

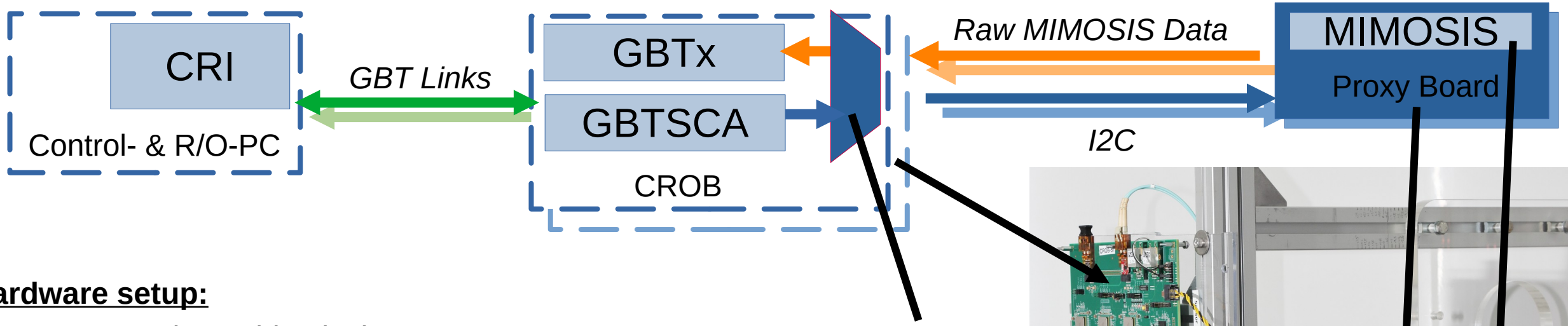
Beam Time Observations

Results

Status and Outlook

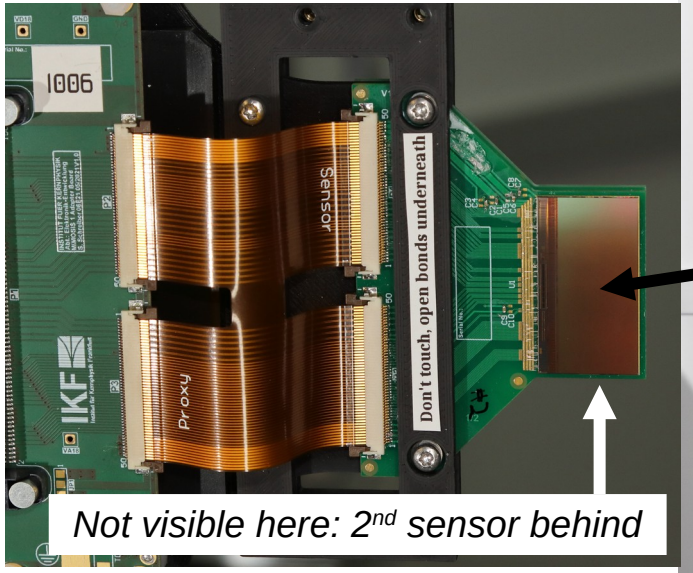
Summary

Reminder: mMVD Hardware



Hardware setup:

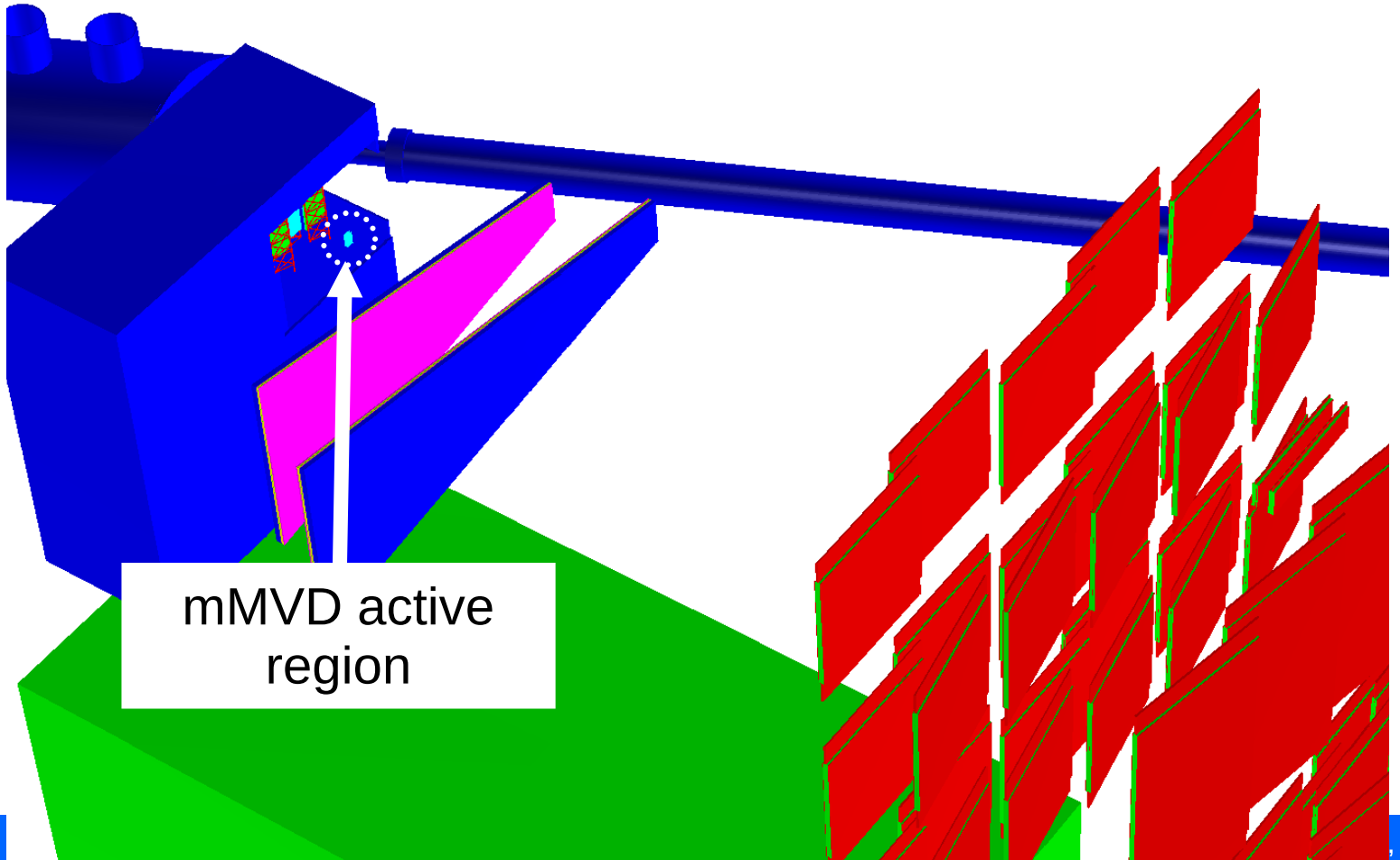
- 1 CRI to readout 2 identical setups
- Each setup: 1 MIMOSIS, 1 PROXY board, 1 CROB, 1 Adapter-board
- 2 Sensors back-to-back
  → measure correlation,redundancy
- All boards are electrically isolated from the Flex-link structure, and therefore isolated from the rest of mCBM.

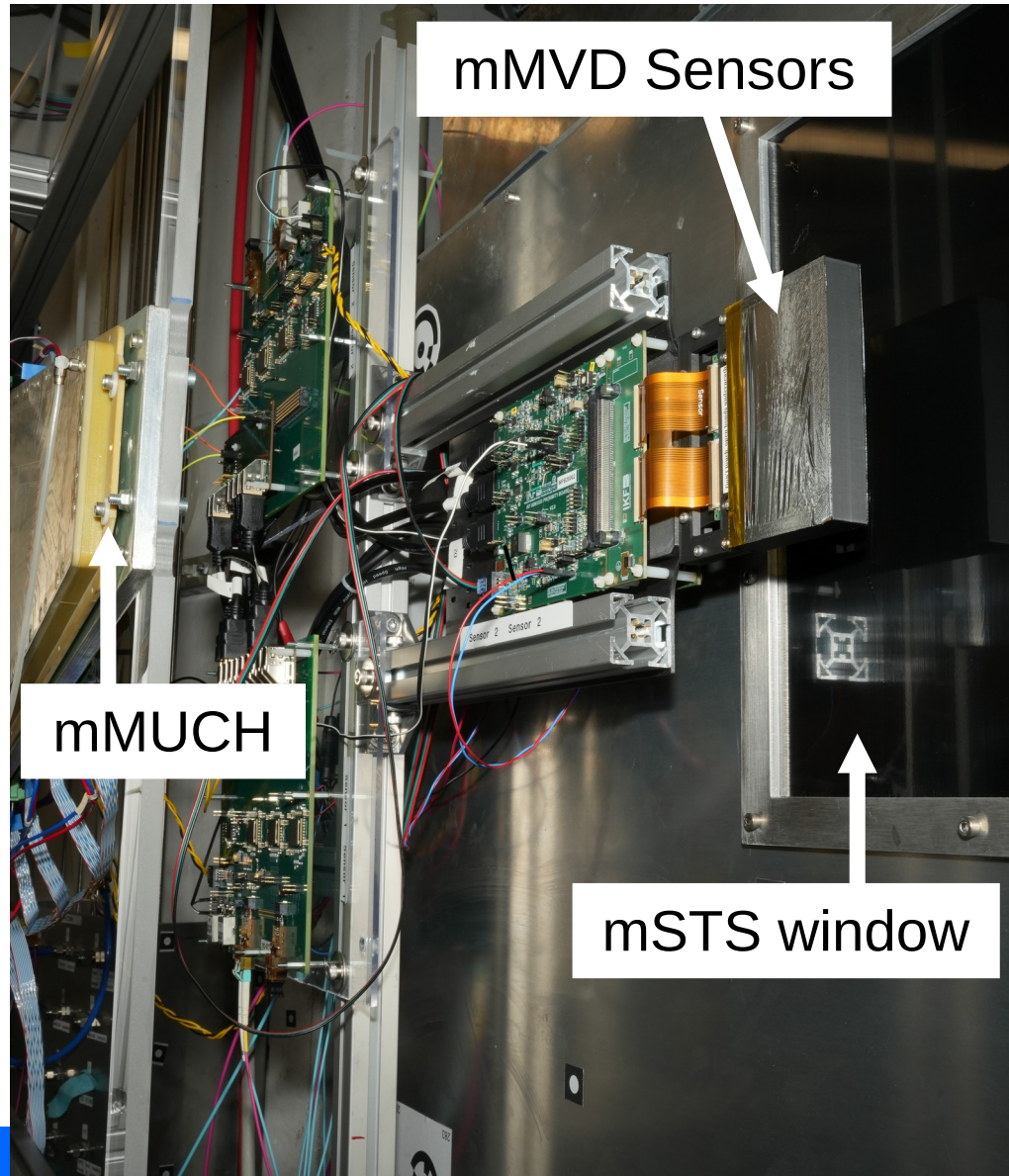


mMVD in the Cave

Cave positioning:

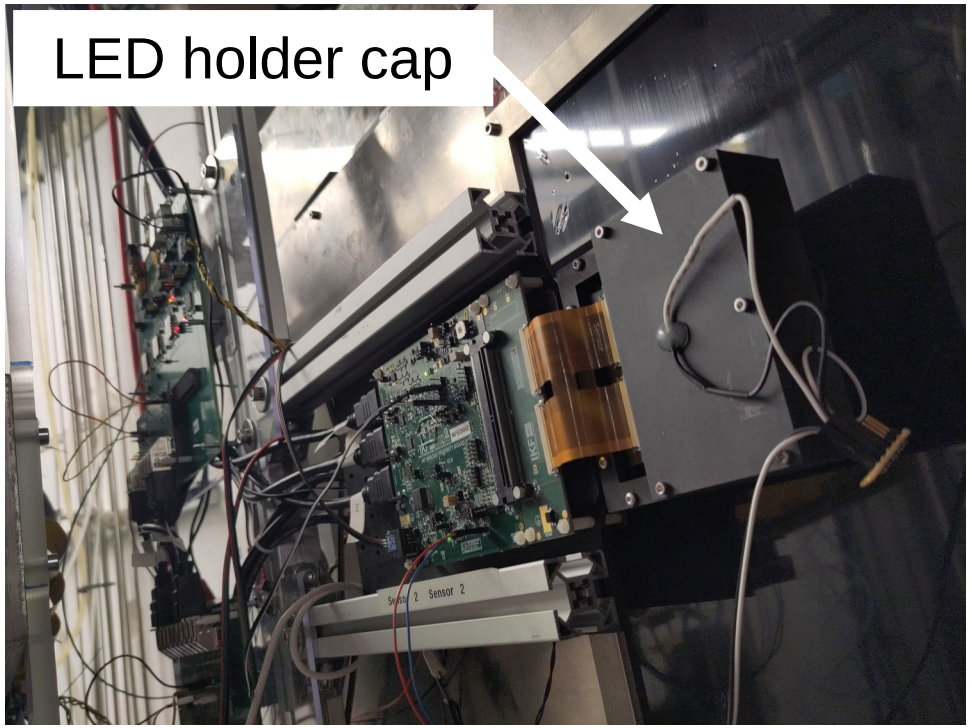
- mMVD Sensors between mSTS and mMUCH
- Positioned behind a mSTS ladder
- Allows for mMVD-mSTS correlation studies

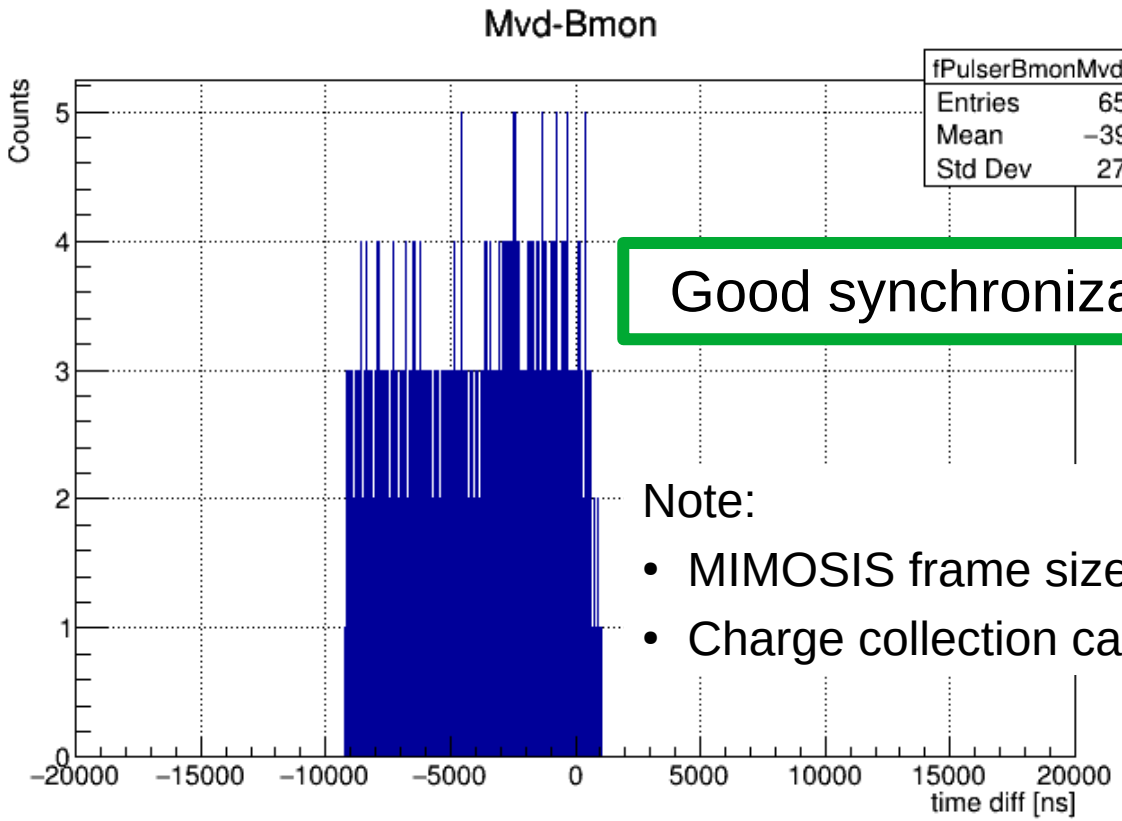




Synchronization

- Sensor-to-sensor synchronization already tested in the lab
- mMVD-to-mCBM synchronization tested in cave
- Pulses converted to light via LEDs in front of both sensors
- Compare pulses of one sensor with BMON



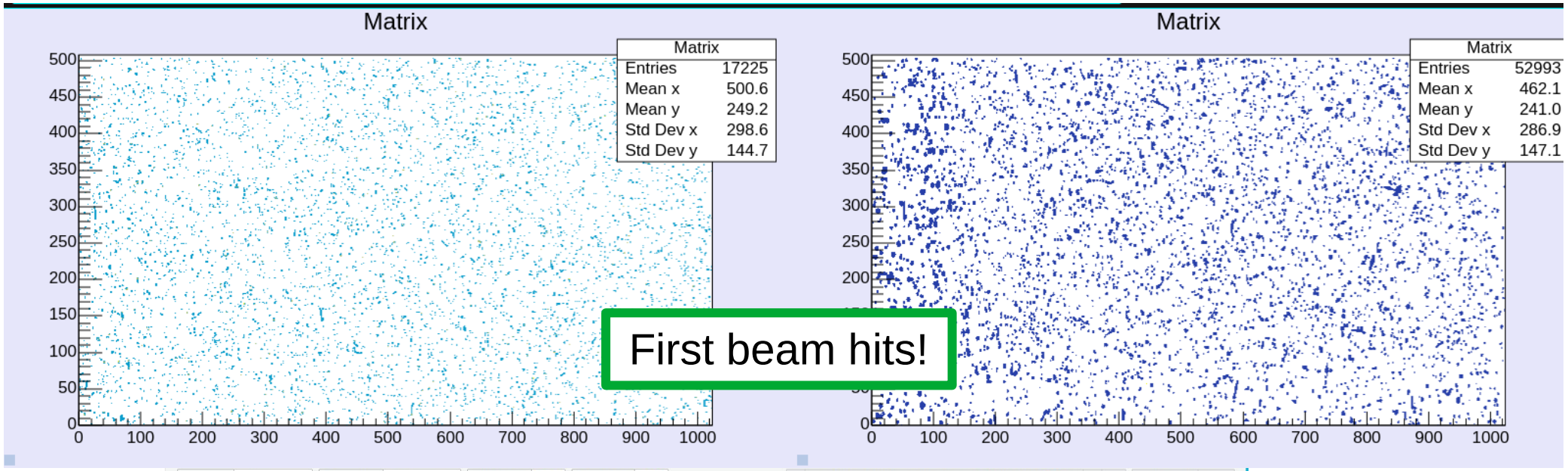


Good synchronization!

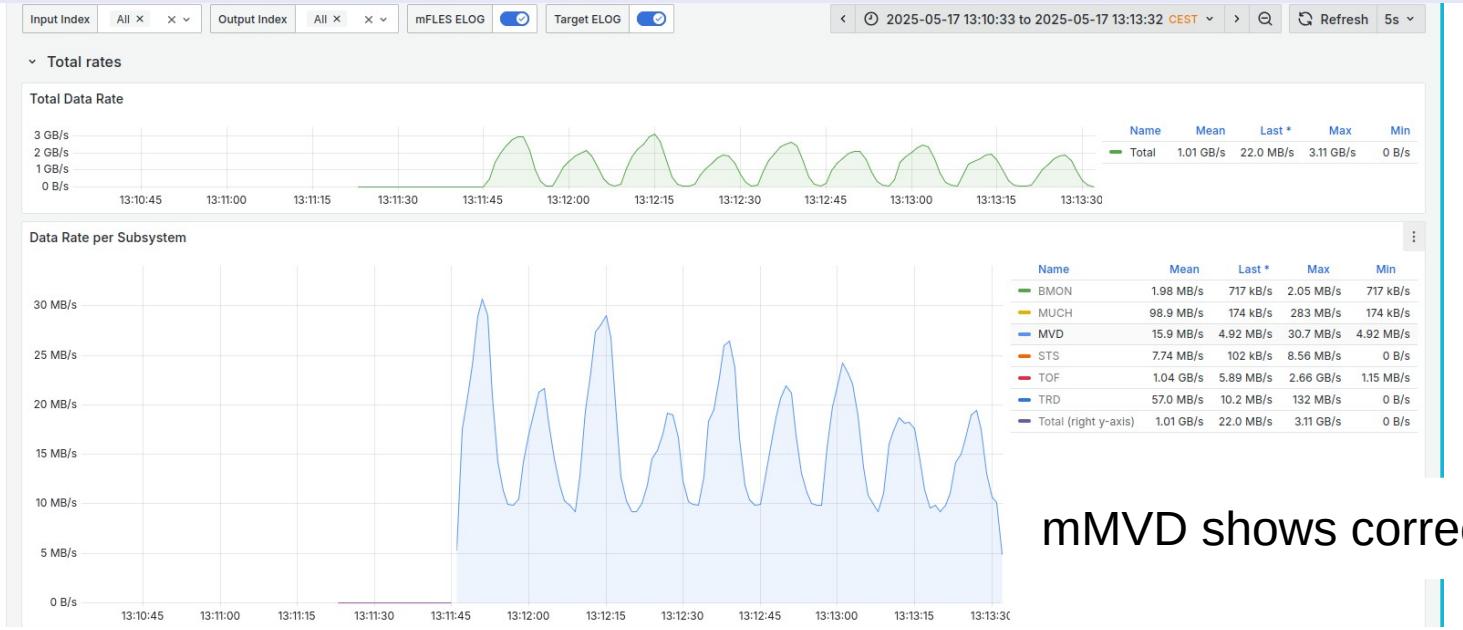
Note:

- MIMOSIS frame size = 5 µs
- Charge collection can take up to 2 frames

Beam Time Observations



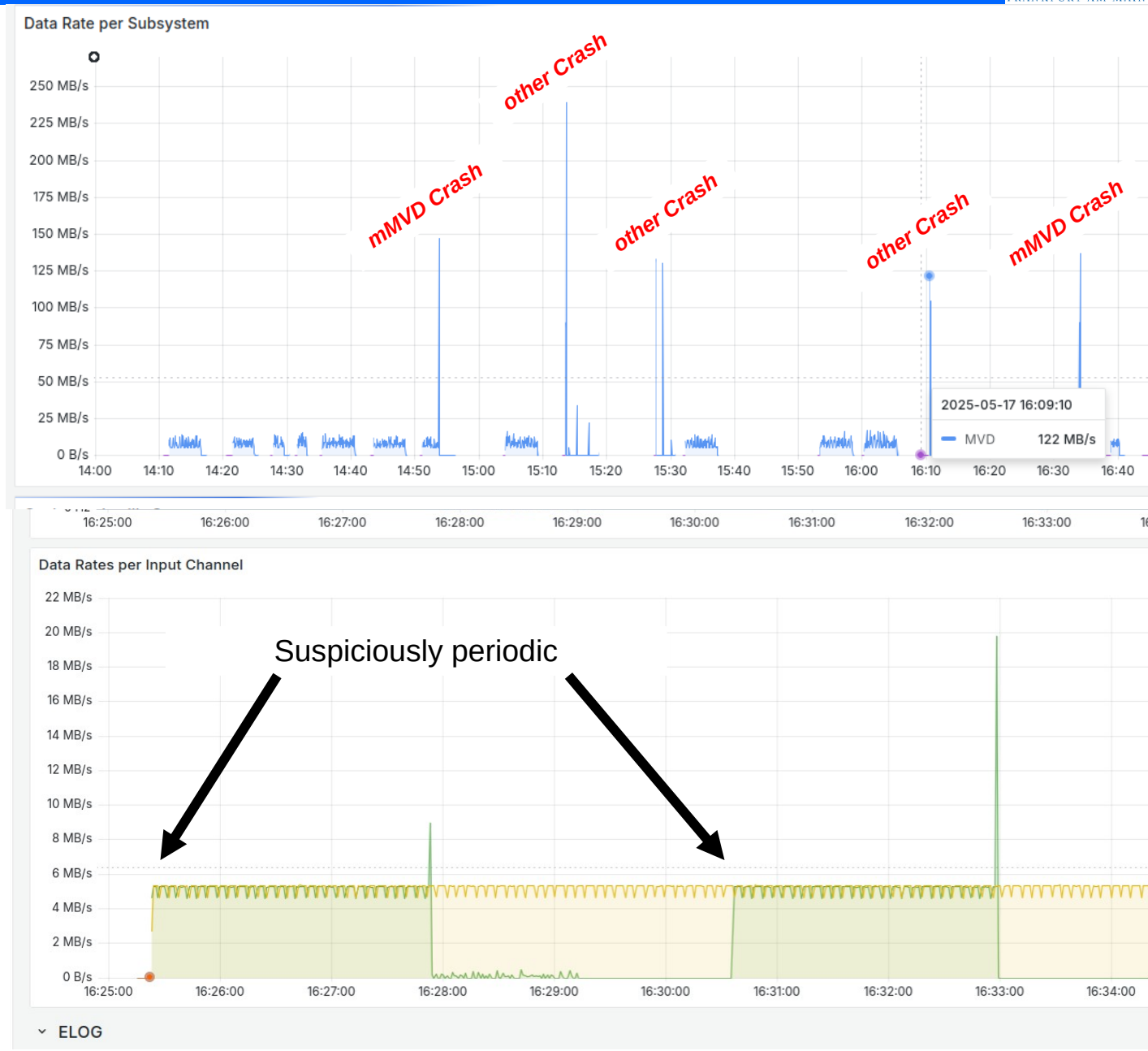
First beam hits!



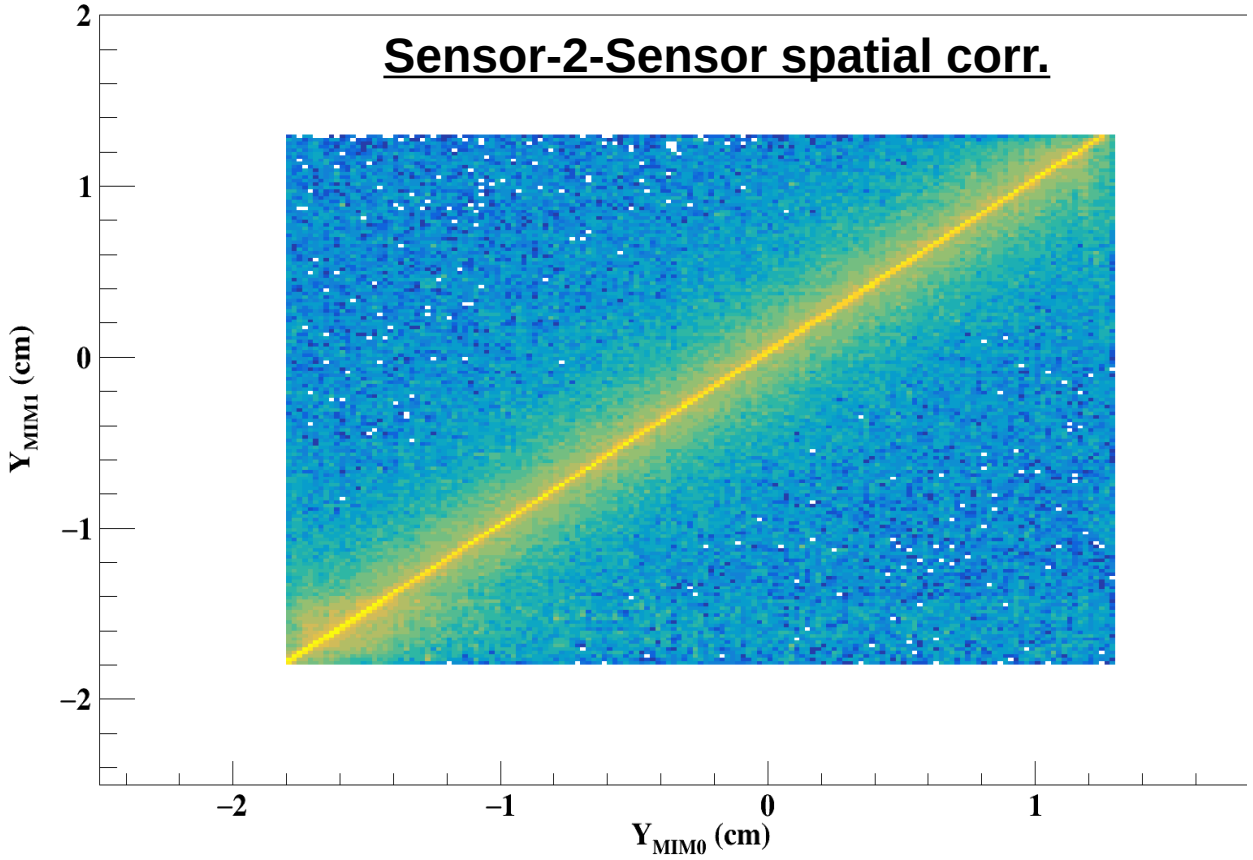
mMVD shows correct beam structure

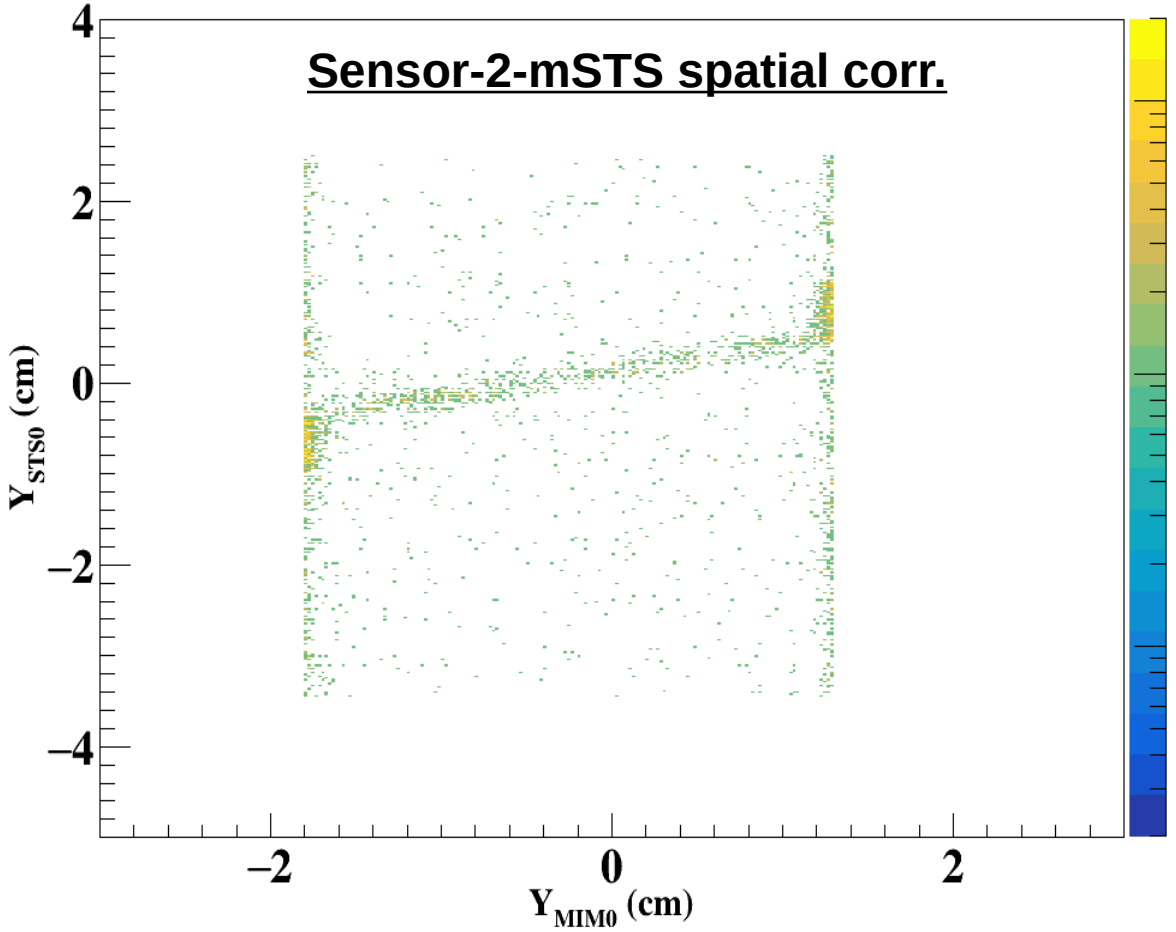
Beam Time Observations

- Occasional crashes were observed on Sensor #1
- Already visible during the pulsing runs
- Most likely an erroneous sensor
- Not a show stopper, most of the time the sensor worked
- Exact problem not understood yet, my guess: bit flip in the frame counter
- A future firmware could handle such a case better



Results – Spatial Correlations

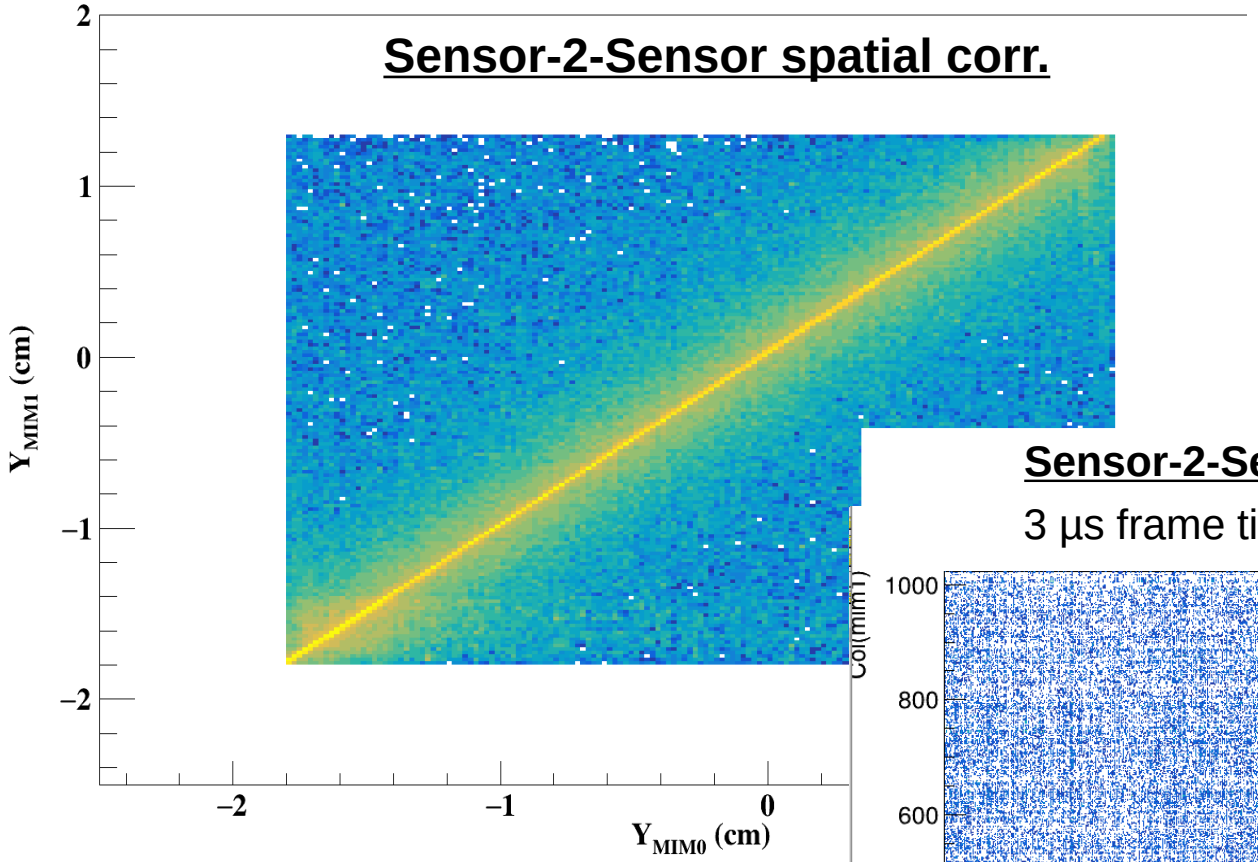




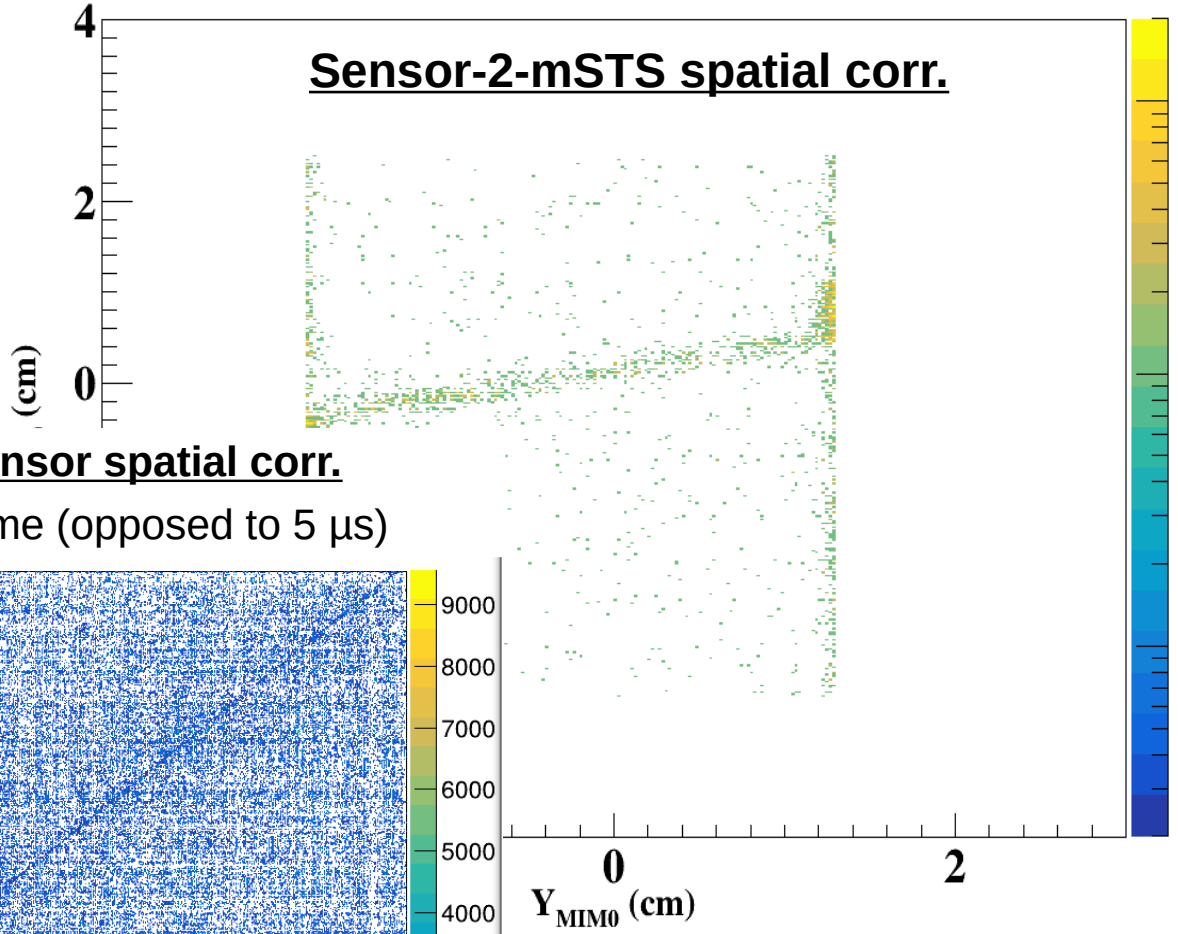
* Readout & Hitfinder params for mSTS from Feb ‘25 run used

Results – Spatial Correlations

Sensor-2-Sensor spatial corr.

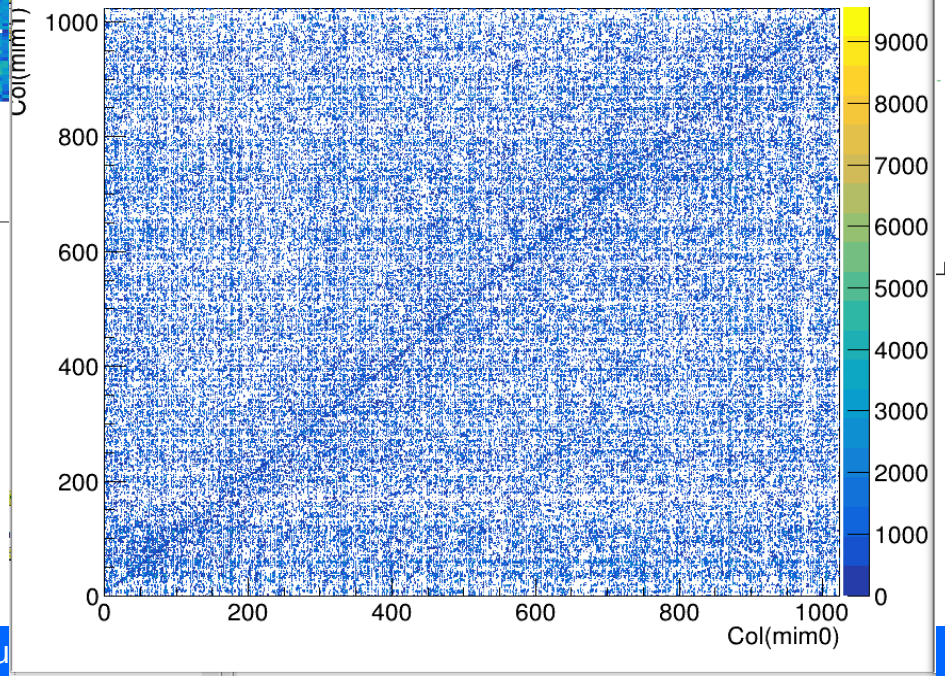


Sensor-2-mSTS spatial corr.



Sensor-2-Sensor spatial corr.

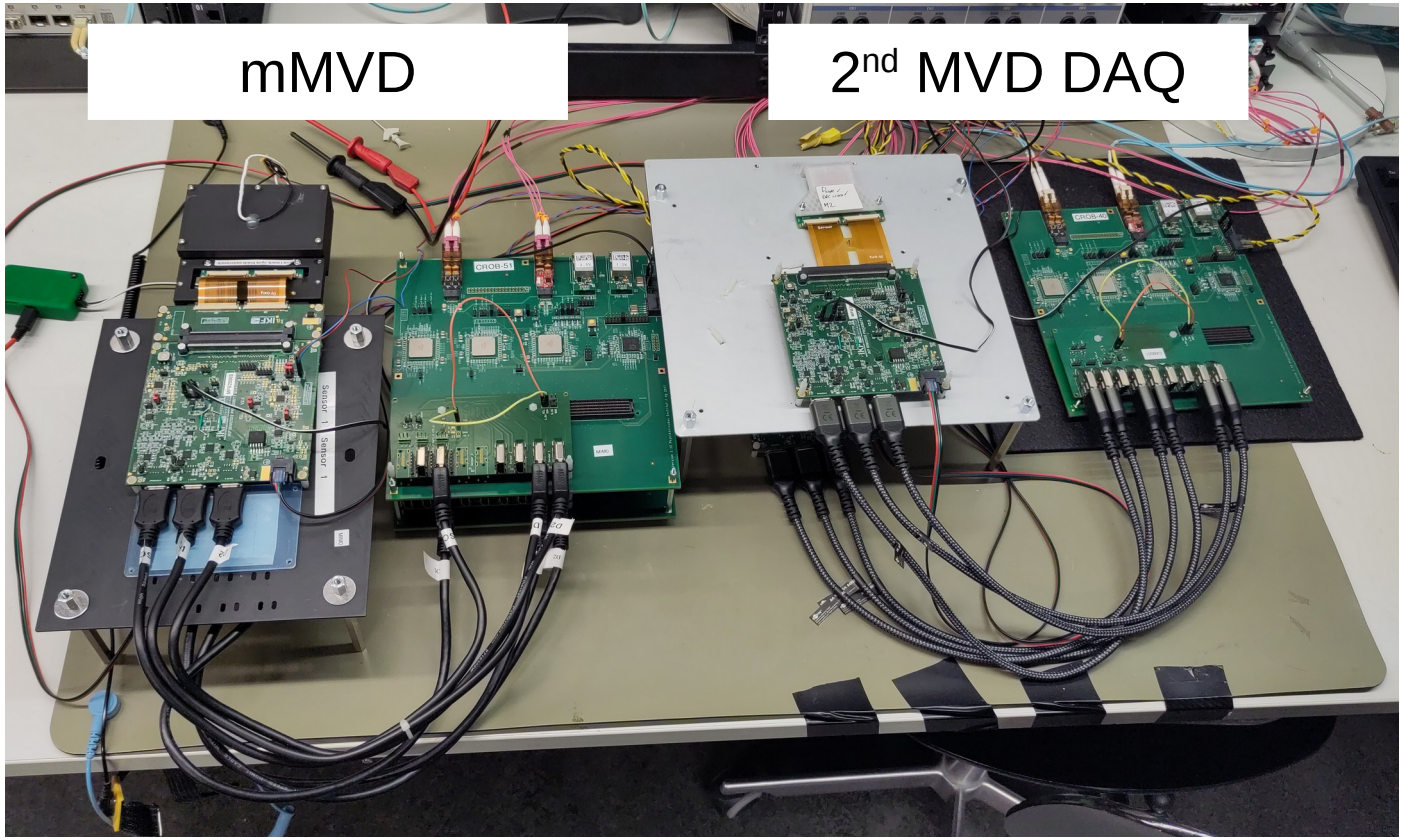
3 µs frame time (opposed to 5 µs)

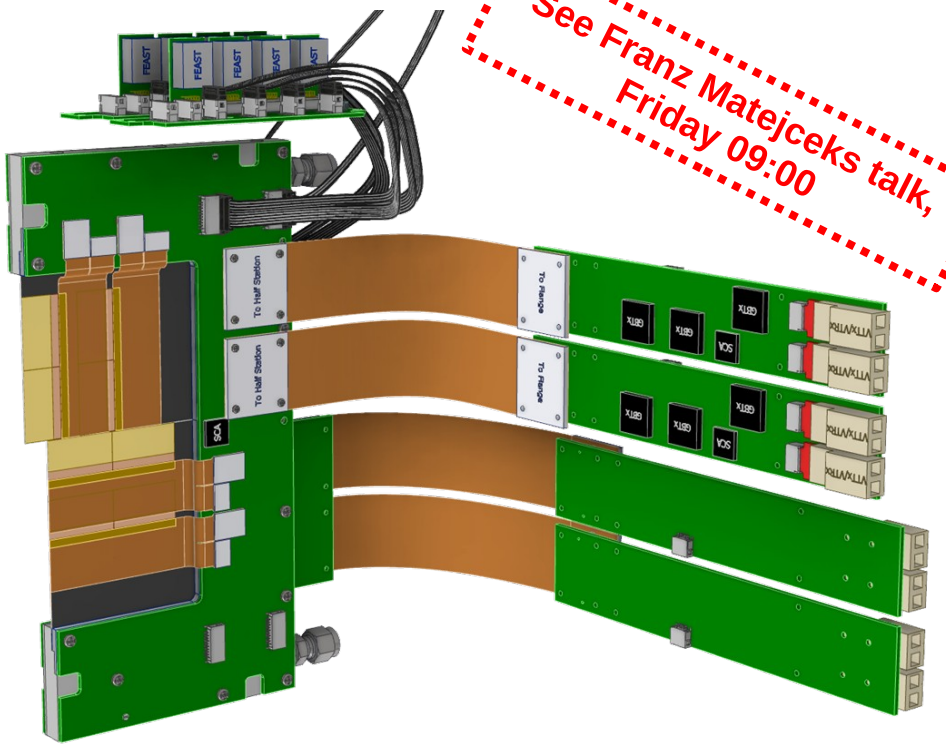


* Readout & Hitfinder params for mSTS from Feb ‘25 run used

Status and Outlook

- mMVD taken back to the lab where it will be useful for other tests
  → but is ready to be brought back to mCBM at any time if necessary
- 2nd setup to continue firmware development:
  - Multiple sensors readout by one CROB
  - Inner µSlice-Format
  - New way to synchronize sensors necessary
- Front-end board for (real) MVD under development



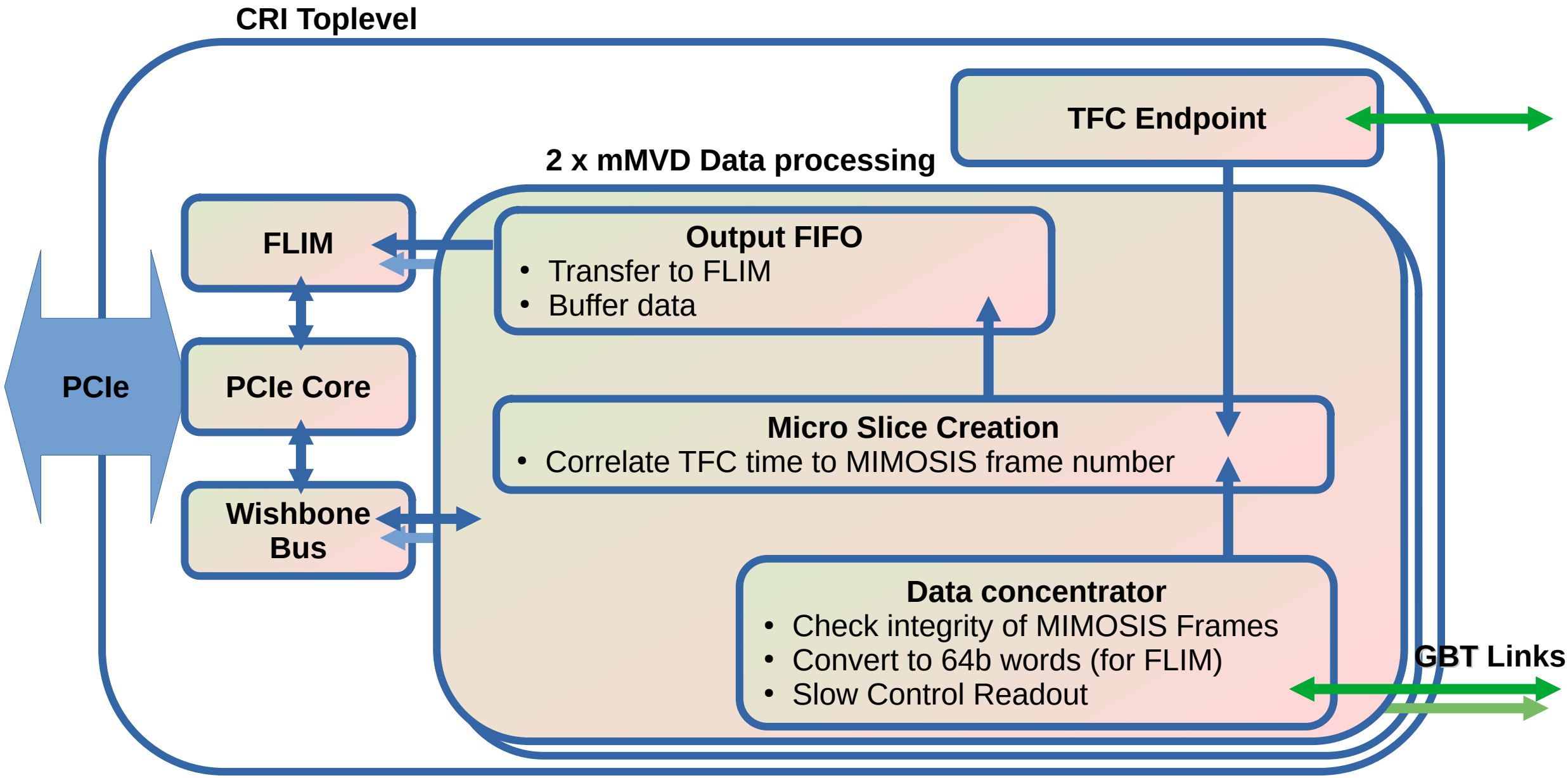


Summary

- mMVD successfully integrated in mCBM
- Synchronization with other detectors
- Spatial correlation with mSTS validates mMVD
- Validated mMVD Read-out, compatible to CBM (first time demonstrated)
- Reduction 5 → 3 µs frame time tested, seems to work
- Important lessons for ongoing development learned
- Firmware and Hardware developments is in the next phase

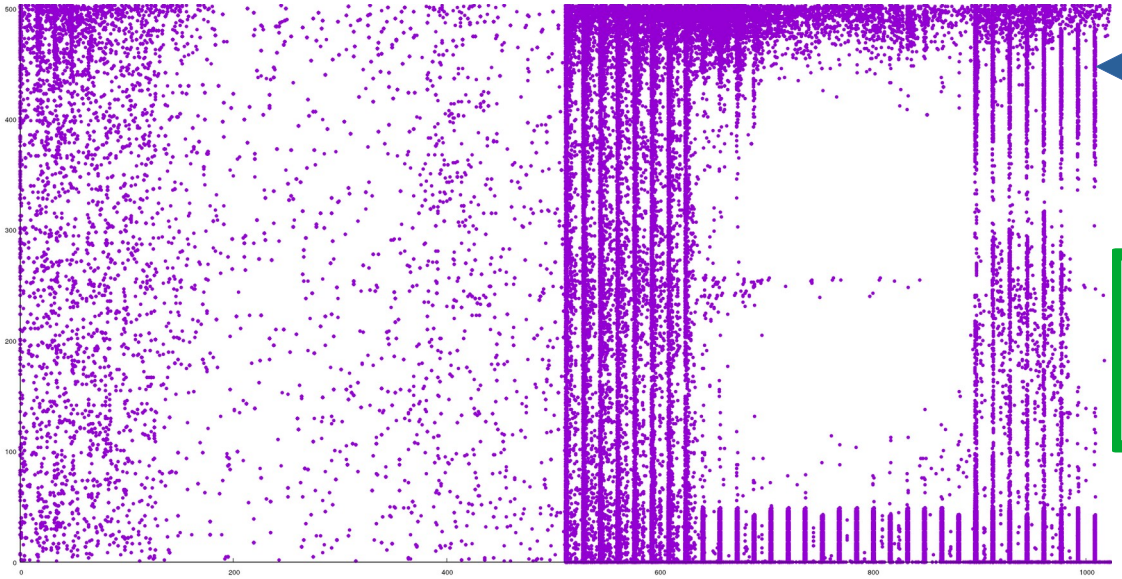
Thank you for your attention!
Questions?

BACKUP – mMVD CRI design

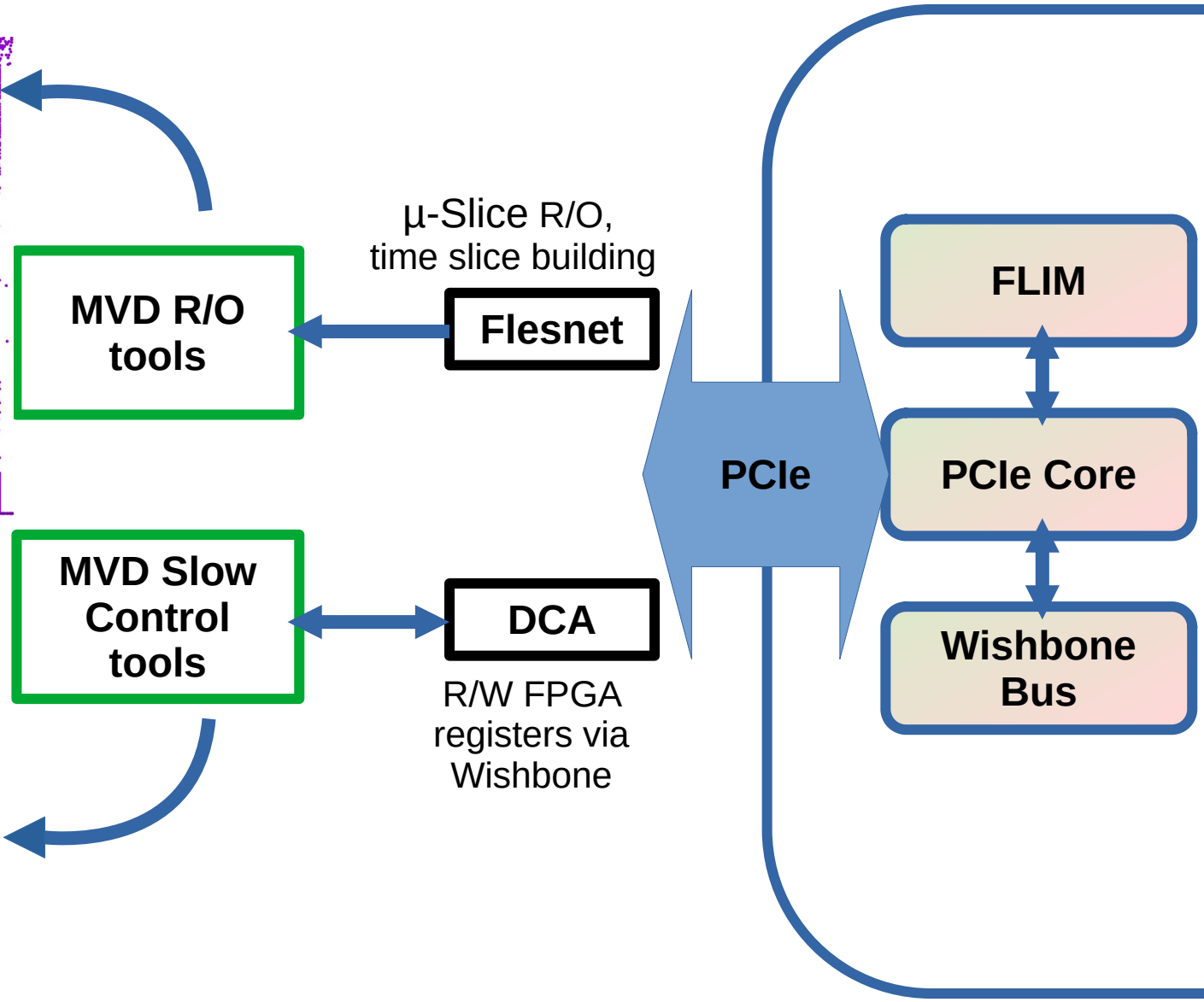


BACKUP – mMVD Software

Sensor Matrix
MIMOSIS1



- Start DAQ
- Reset sensors and state machines
- Some Statistics during operation (Frame counter, frame length, valid checksum counter, buffer fill level, …)



BACKUP – mMVD Micro Slice Building

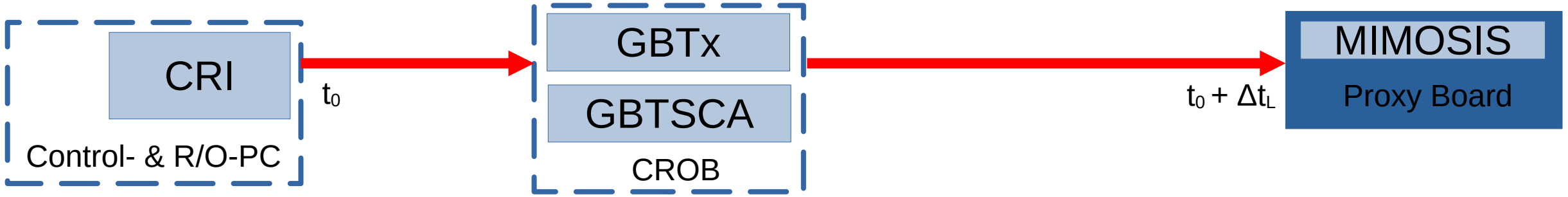
Background knowledge:

→ Sensor starts pixel readout upon a start signal, f*rame start*

→ *frame end* after 5 µs

→ Frame gets a *frame number* and is outputted

→ When you know the start time you know the hit time



- Send Start signal to sensor at TFC time t_0
- Sensor starts sending frames at $t_S = t_0 + \Delta t_L$, Δt_L = Latency
- Frames get packed into µ-Slices together with the start time

Example with µ-Slice size 1 µs:

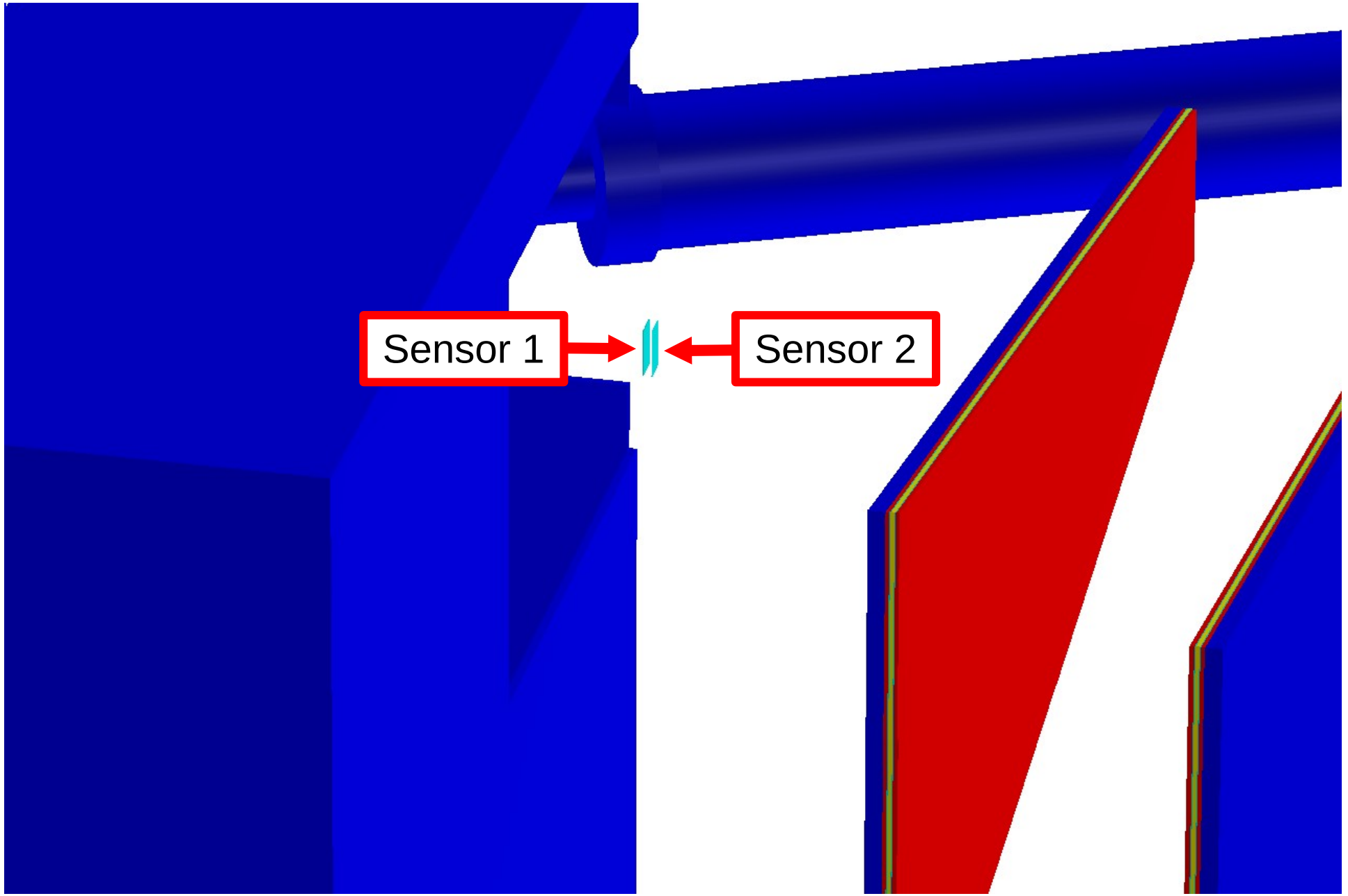
µS-Ind. = t_i	µS-Ind. = t_{i+1}	µS-Ind. = t_{i+2}	µS-Ind. = t_{i+3}	µS-Ind. = t_{i+4}	µS-Ind. = t_{i+5}
Start time t_S	Empty	Empty	Empty	Empty	Start time t_S
Sensor Data Frame # n					Sensor Data Frame # n+1

BACKUP – mMVD Repositories

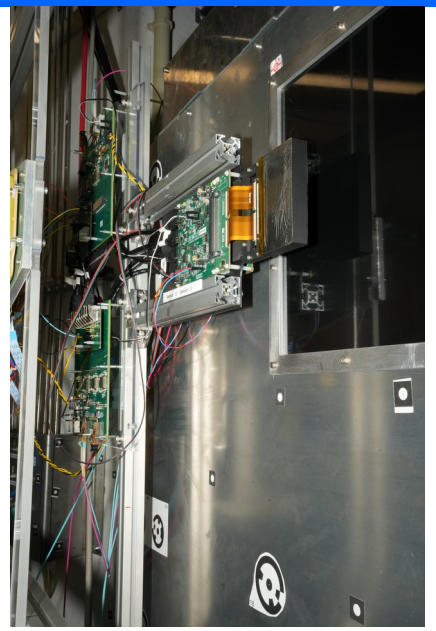
- CRI-MVD repository:
  https://git.cbm.gsi.de/daq/fpga-firmware/cri/mvd-firmware/cri-mvd
  → Custom CRI MVD Fork

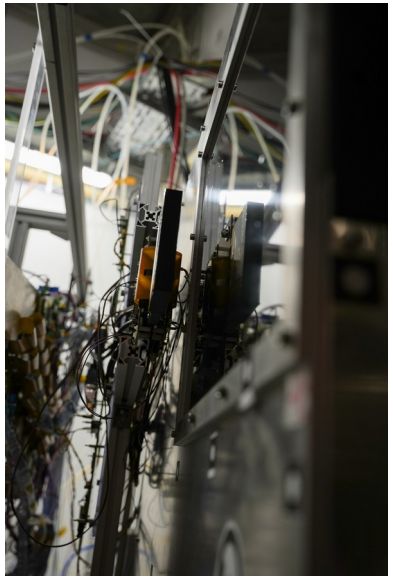
- MIMOSIS / MVD specific python tools:
  https://git.cbm.gsi.de/daq/fpga-firmware/cri/mvd-firmware/cri-mvd-tools
  → based on python-cri
  → Startup procedure, make sensor running
  → R/O data FIFO via slow control
  → Offline data analysis

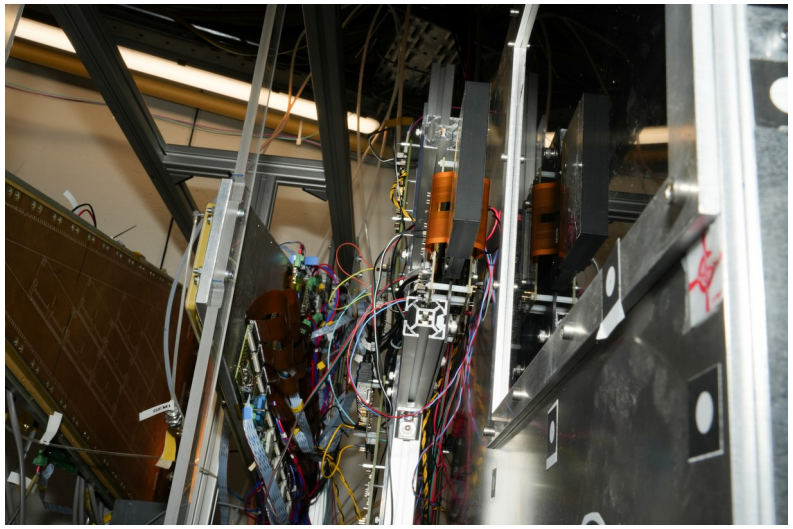
BACKUP – mMVD Geometry

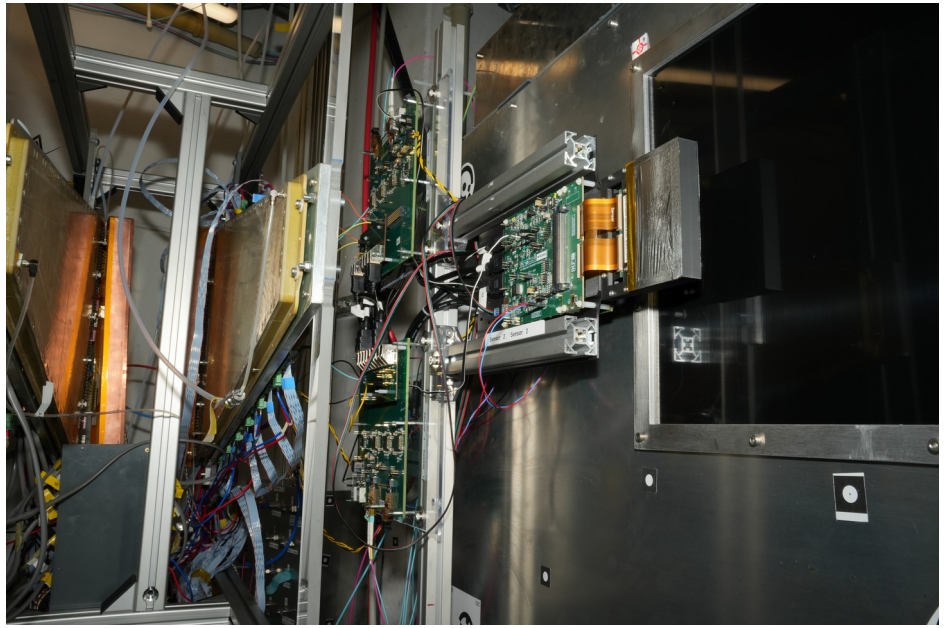


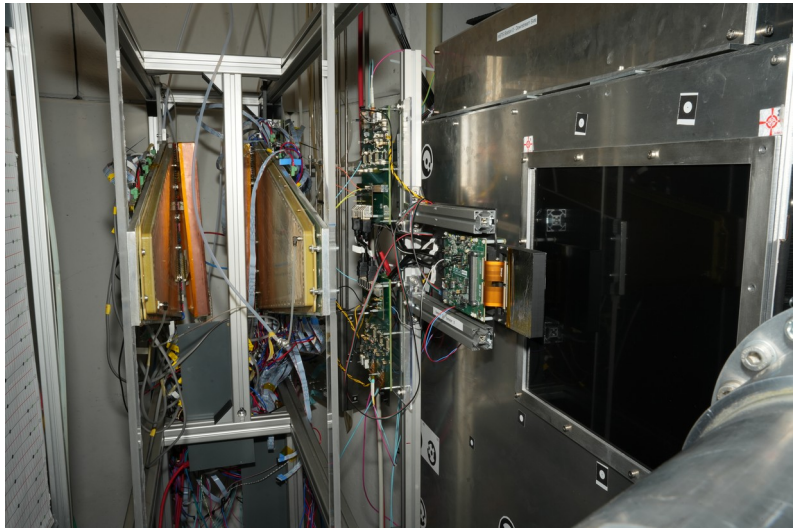
BACKUP – More Pictures mMVD

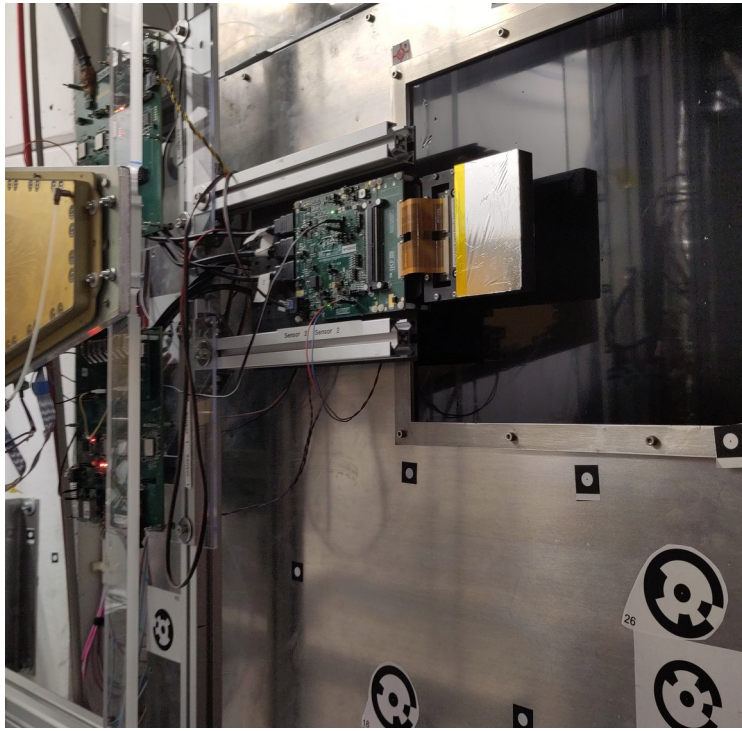




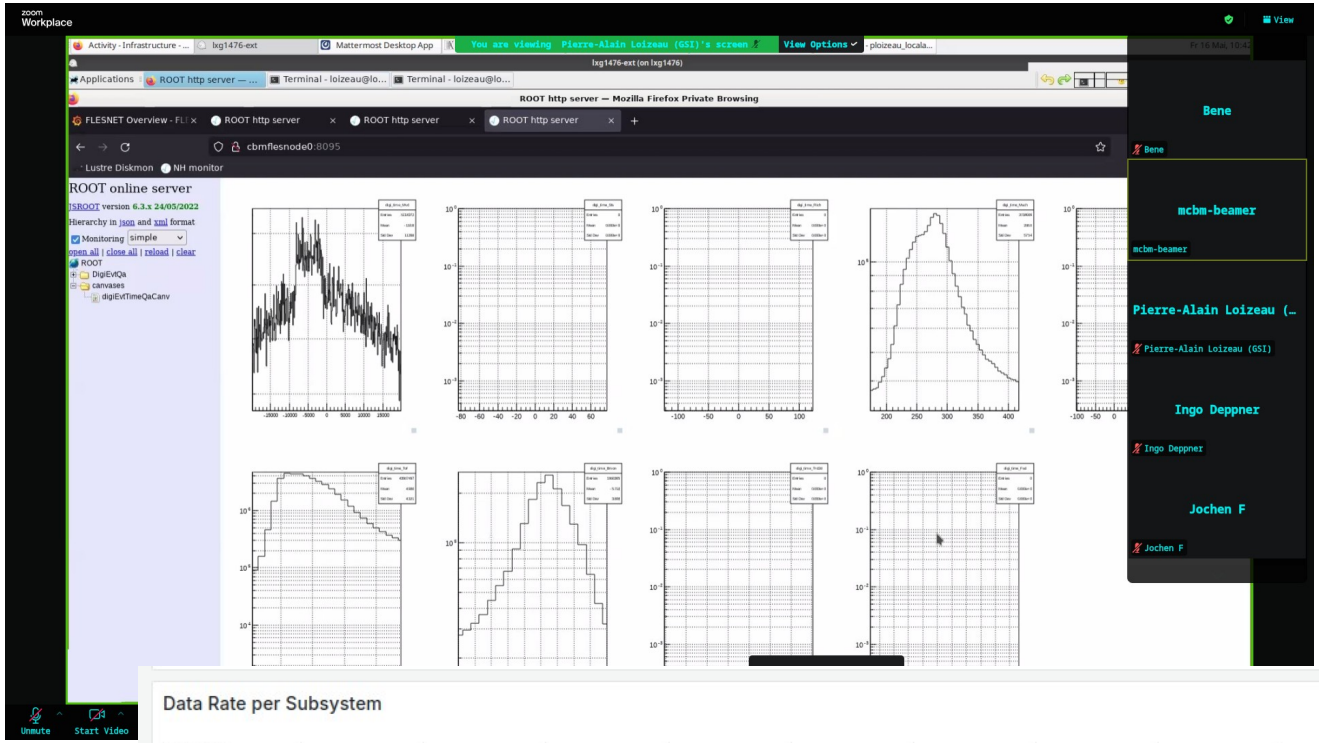


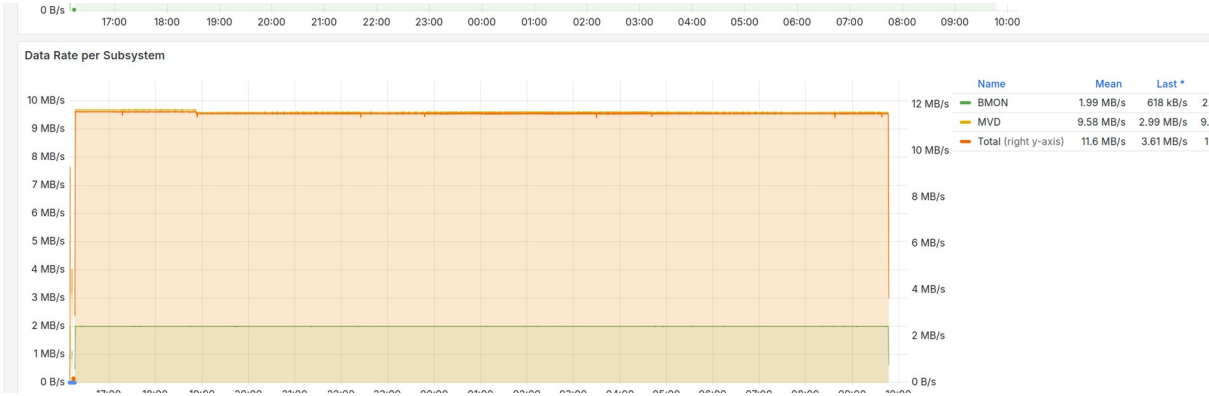


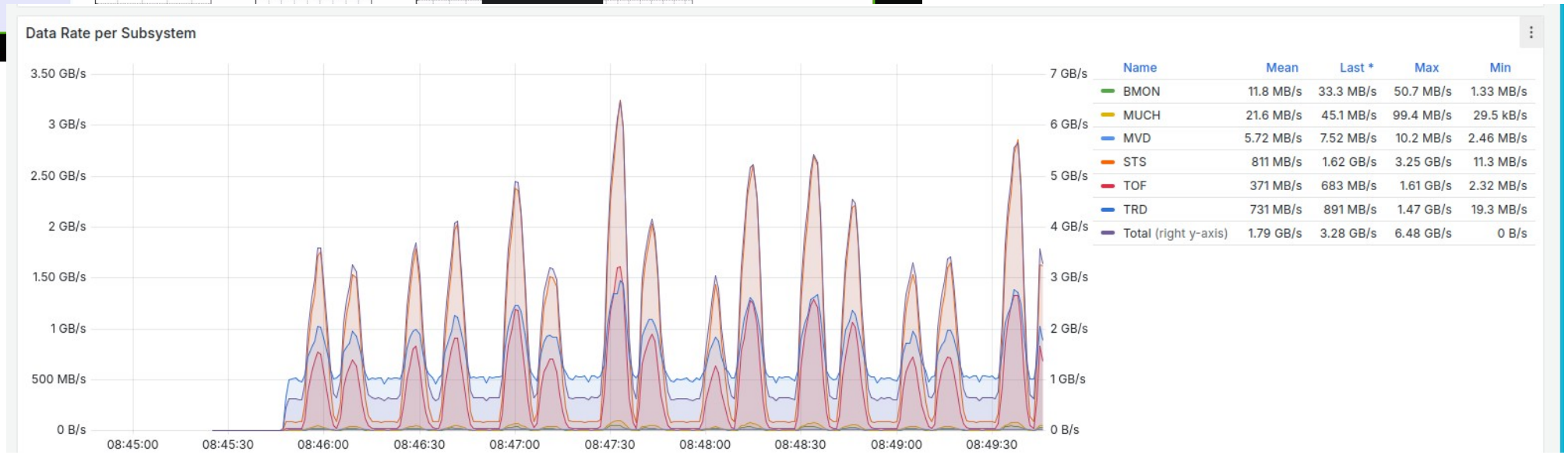




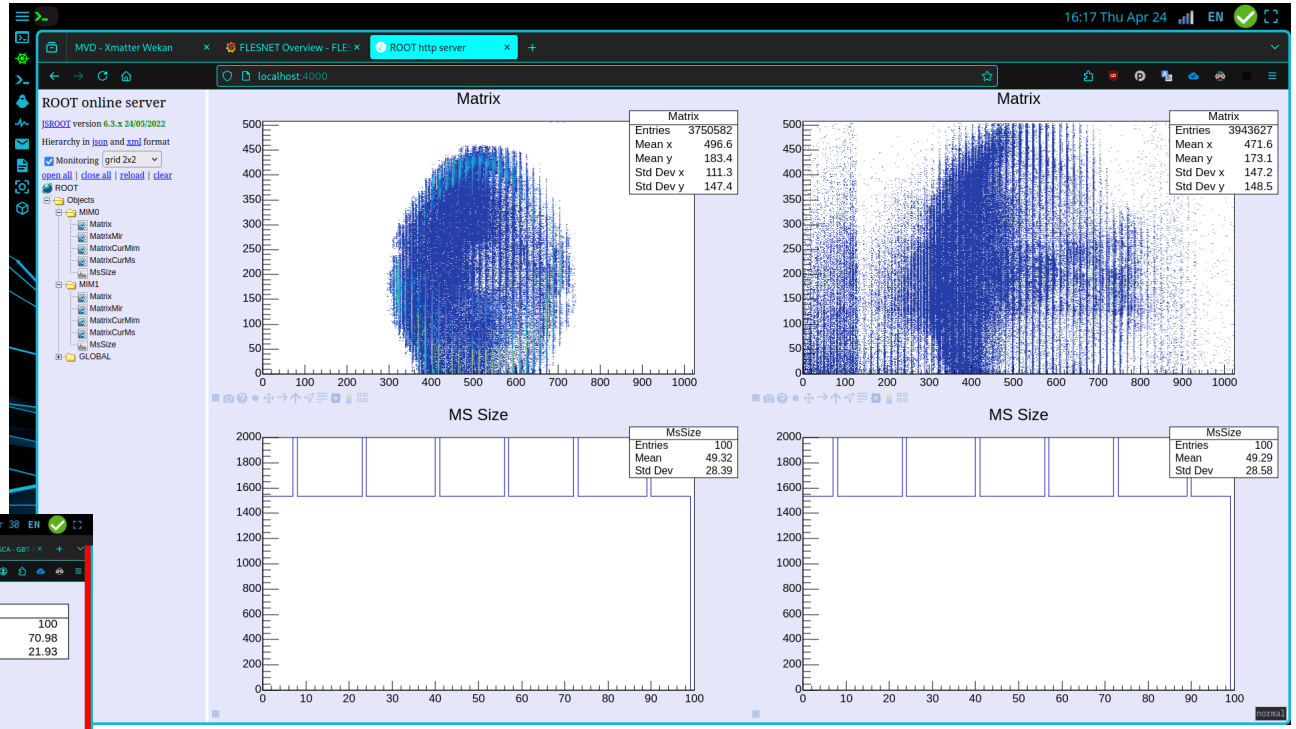
BACKUP – More Pictures Beam time

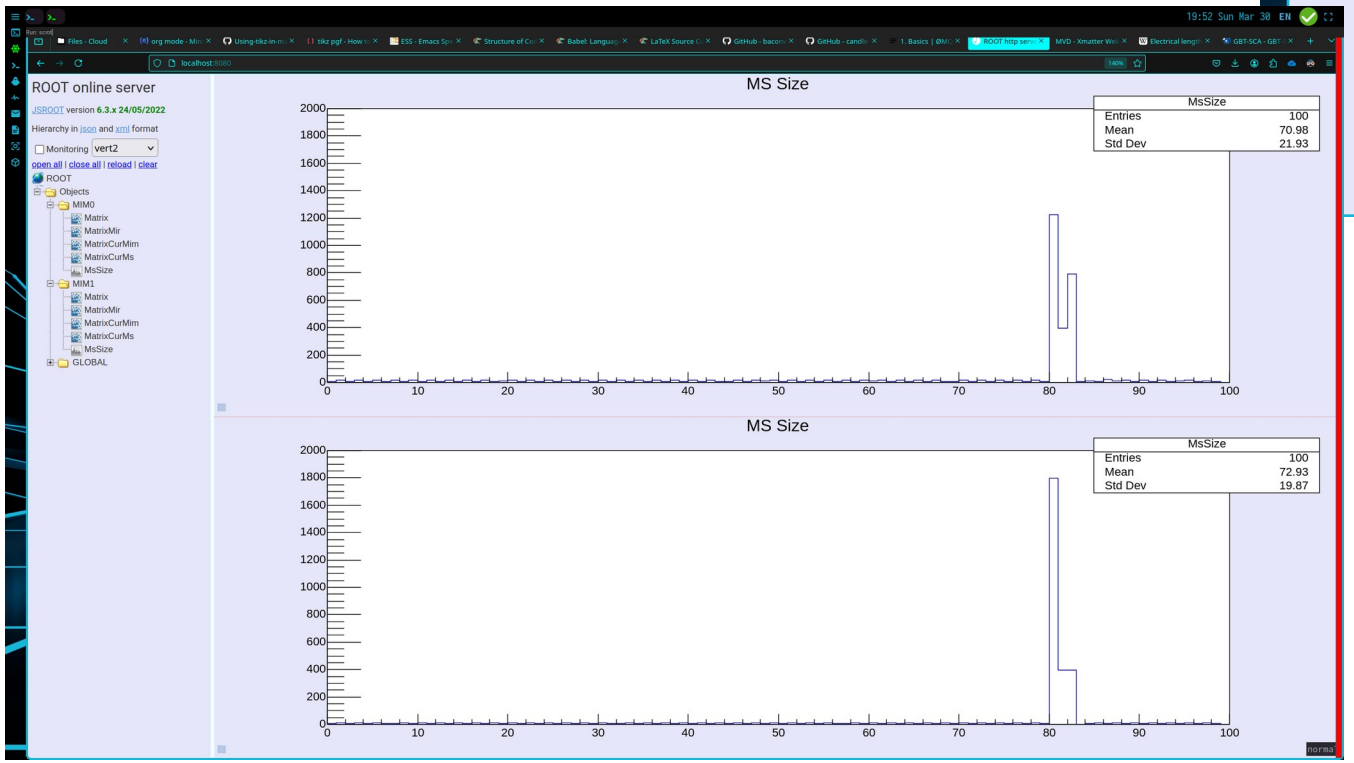






BACKUP – More Pictures Sync





BACKUP – Stand alone R/O Setup for Lab Testing

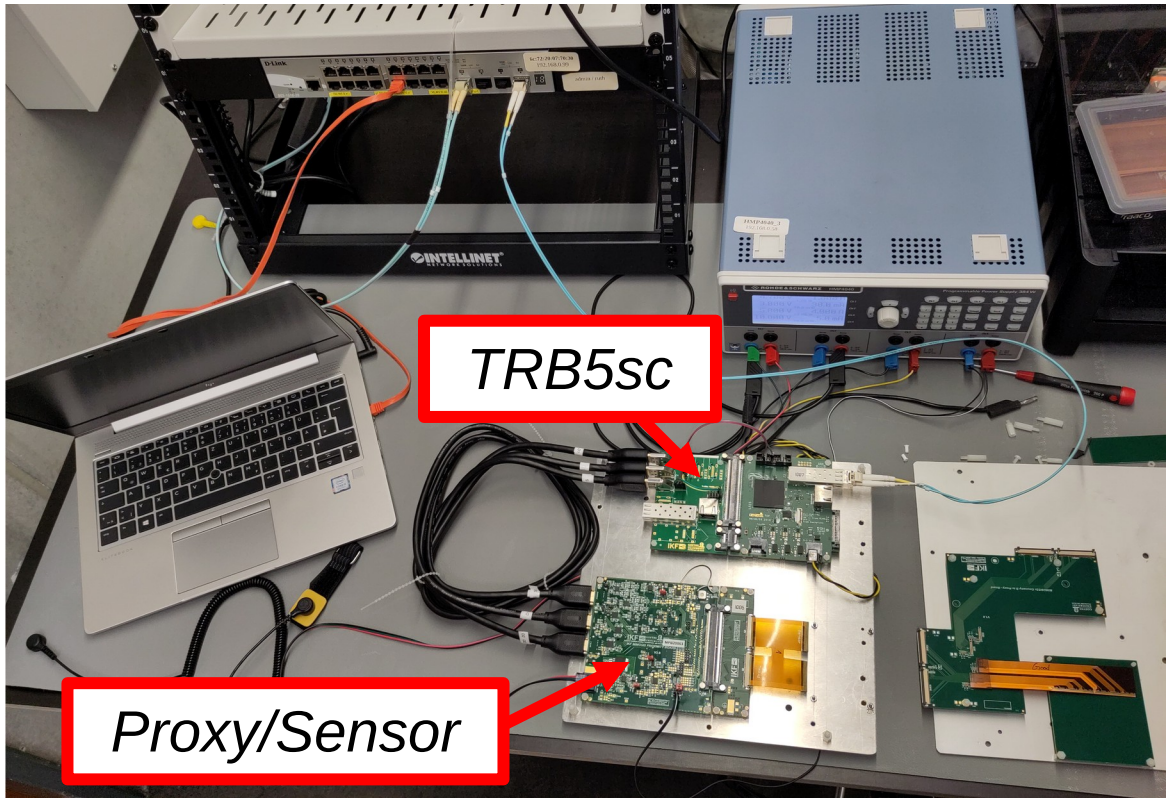
Lab Setup:

- TRBnet based sensor R/O for sensor test experiments
- Recent update reduces necessary hardware to one FPGA board

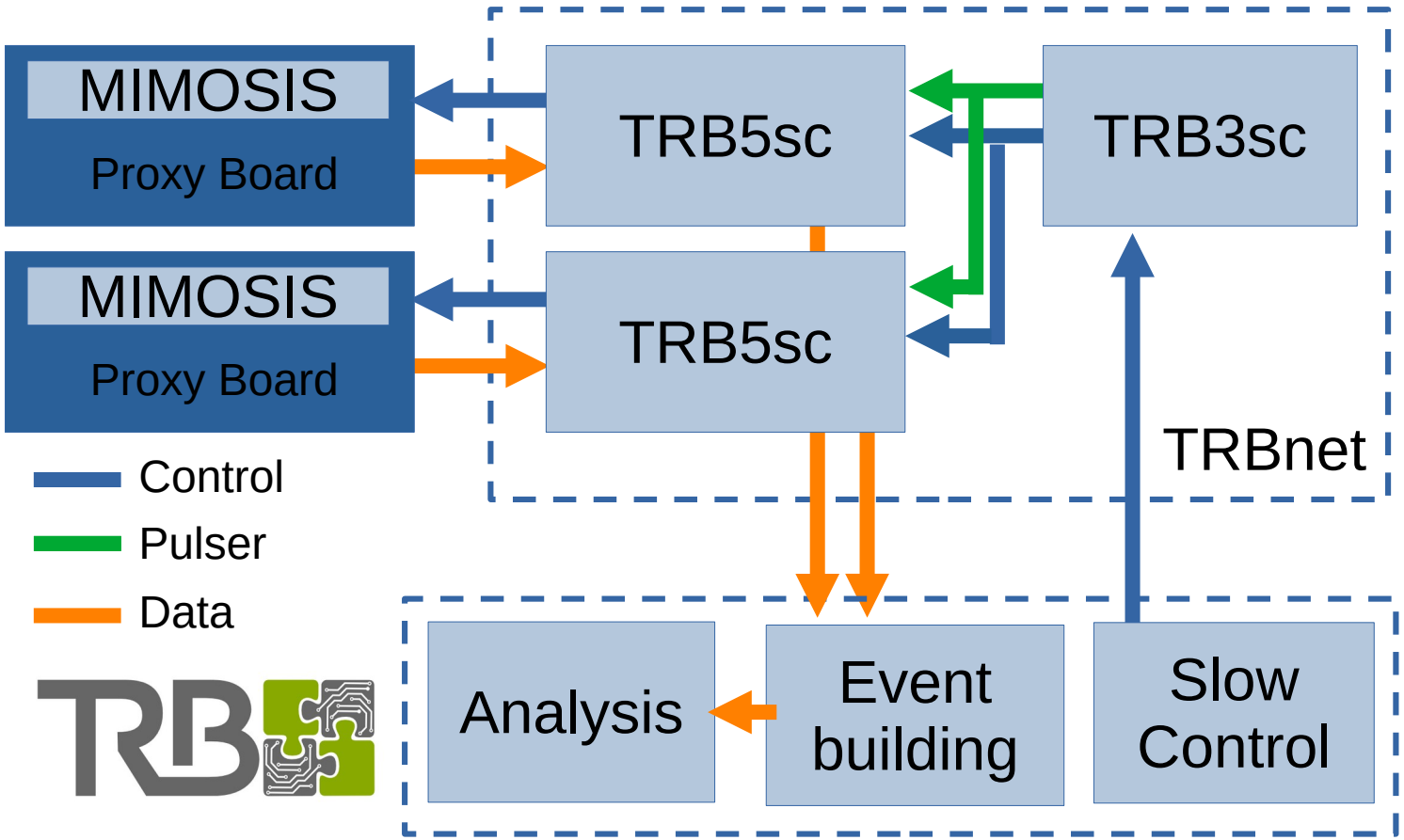
Control
Data

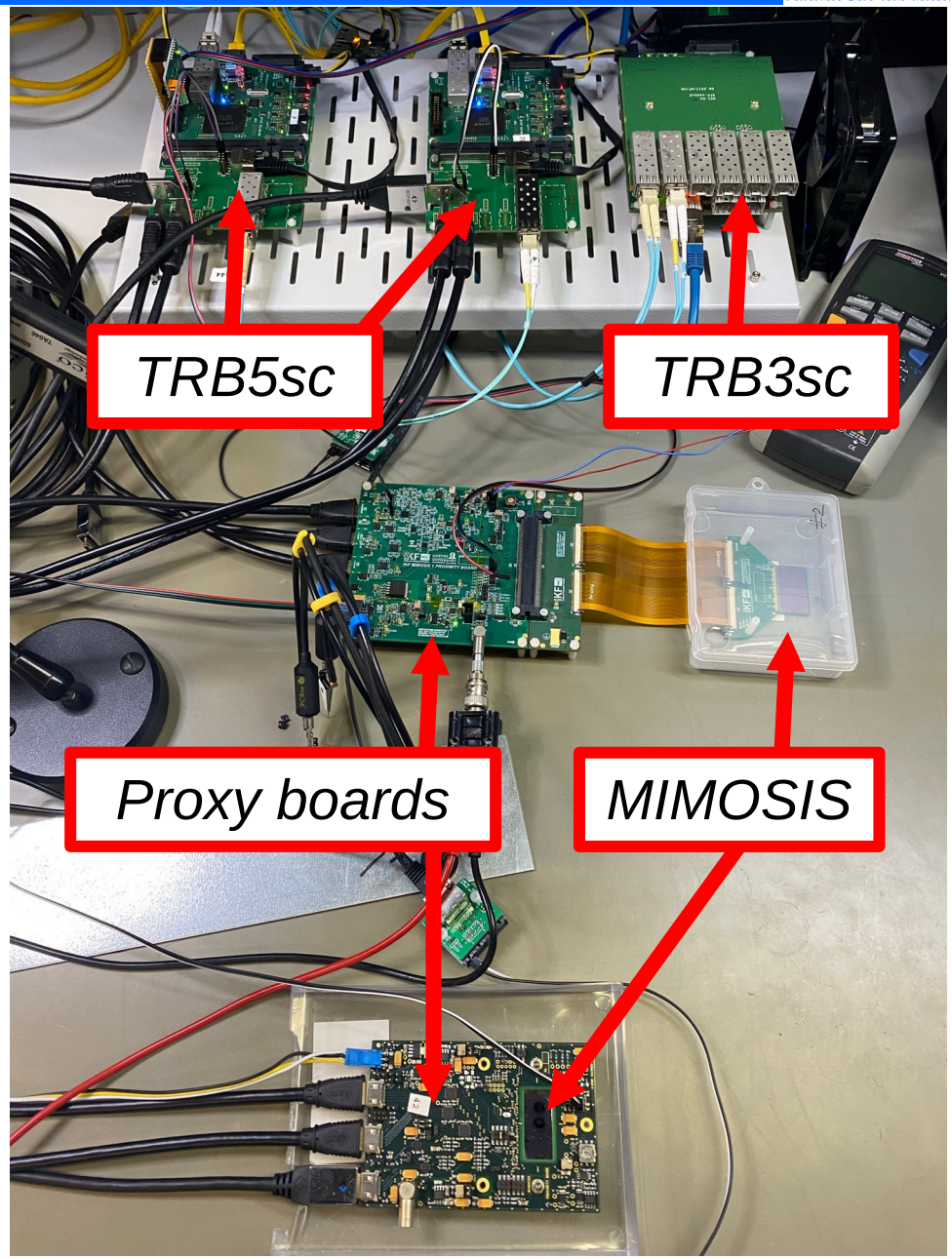
- Easy to setup, very portable
- Cost efficient
- R/O of single sensors for test beams and probe station

Finalized single-sensor R/O setup ready for mass-testing and MIMOSIS-QA



BACKUP – R/O Setup for Lab Testing





Synchronized setup used for double sensor R/O