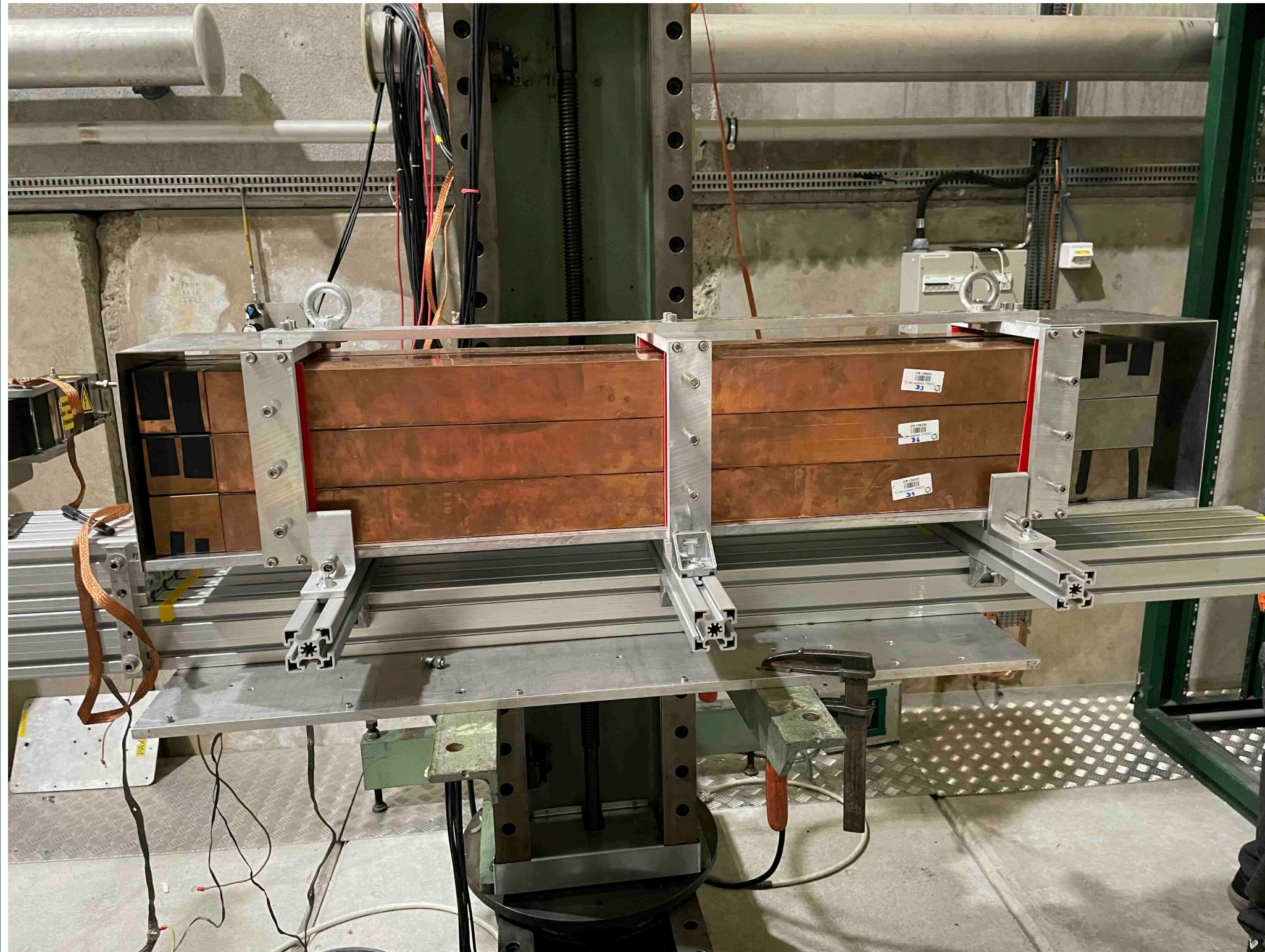# H2GCROC update (Focal-H testbeam)

What we learned for next one...

Norbert Novitzky
(ORNL)
With Miklos Czeller, Gabor Nagy and
Shihai Jia

FoCal-H prototype 3

Capillary tube design:
- Cu tube with scintillating fiber inside
- Tubes are stacked together, reducing air gaps as much as they can
- End scintillators are just attached to 6x6 mm^2 SiPM's
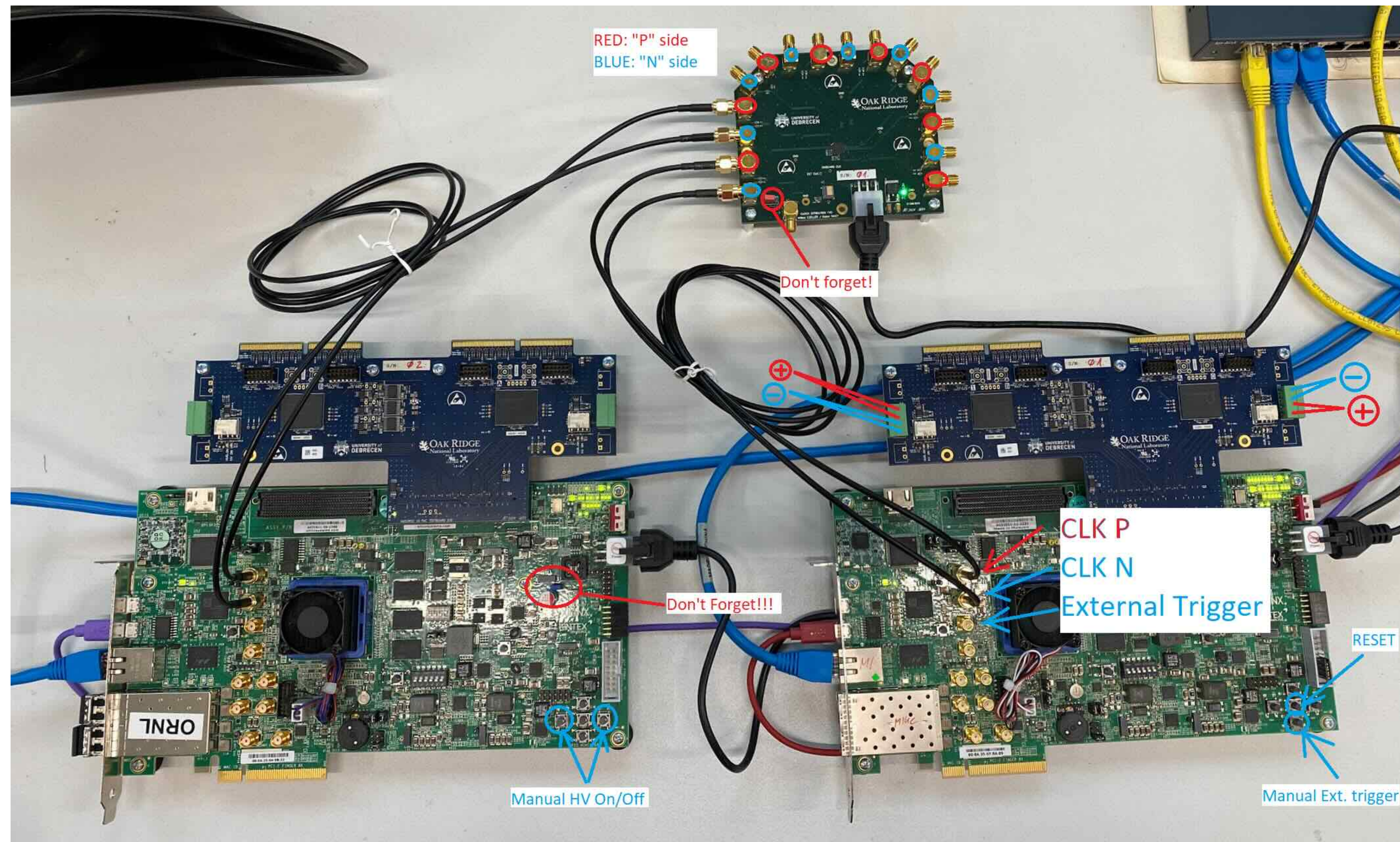- Fully tested with CAEN already

3x3 modules in testbeam:
- Inside module is 7x7 channels
- Outside modules are 5x5 channels
- Altogether is 249 channels (4 H2GCROCs can cover it)

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Readout setup

2 KCU's needed, each connected with 2 H2GCROC protoboard2.0:
- Common clock for the KCU's are provided with an LVDS external clock board

Communication with the KCU is via UDP:
- Usually 40-byte commands in set formats
- Data is coming in 40-byte format also, sectioned in the firmware by the FPGA

Slow control:
- I2C setup for each H2GCROC
- HV On/Off
- DAQ setups:
  - Set external trigger on/off
  - Generator, set events
  - Prepulse for calibration
  - Delays adjustment, debug data, etc.

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Schedule

FoCal-H Testbeam schedule:

	Day shift 7am-3pm	Evening shift 3pm-11pm	Night shift 11pm-7am
22nd Wed	Installation	7pm first beam	**H2GCROC**
23rd Thur			
24th Fri		**CAEN**	
25 Sat			
26 Sun			
27 Mon		**H2GCROC**	
28 Tue			
29 Wed	Removal		

**Purpose for first night was to try if we can get reasonable data**

Here we just took data with different energies, check the different responses.
Check always for KCU A, KCU B, then KCU A+B runs
Very inefficient data taking, but just trying to debug

More smooth data taking, TOA/ TOT were also 'calibrated'

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Two day running

	Run description
Run000-006	Technical runs
Run007—015	Hadron energy scan (each 100k events) 350, 325, 300, 250, 200, 150, 120, 100, 80, 60 GeV
Run016—022 + Run052	Electron energy scan (each 100k) 40, 60, 80, 100, 120, 150, 180, 200 GeV
PhaseScan00-15	Phase scan (internal delay of 25/16 ns) See the full SiPM response
Run025—029, Run038—042	Position scan, hadron beam 250 GeV 10 runs moving the reference by x/y±6.5cm
Run030—033	Voltage scan, hadron 250 GeV Internal DAC voltage for all channels -1V, -2V, -3V, 0V
Run034—037	Voltage scan, hadron 250 GeV External voltage (on PS) 55V, 54V, 53V, 56V
Run043—Run053	Position scan, electron beam 100 GeV 10 runs moving the reference by x/y±6.5cm

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Some very very early results (almost online monitoring)
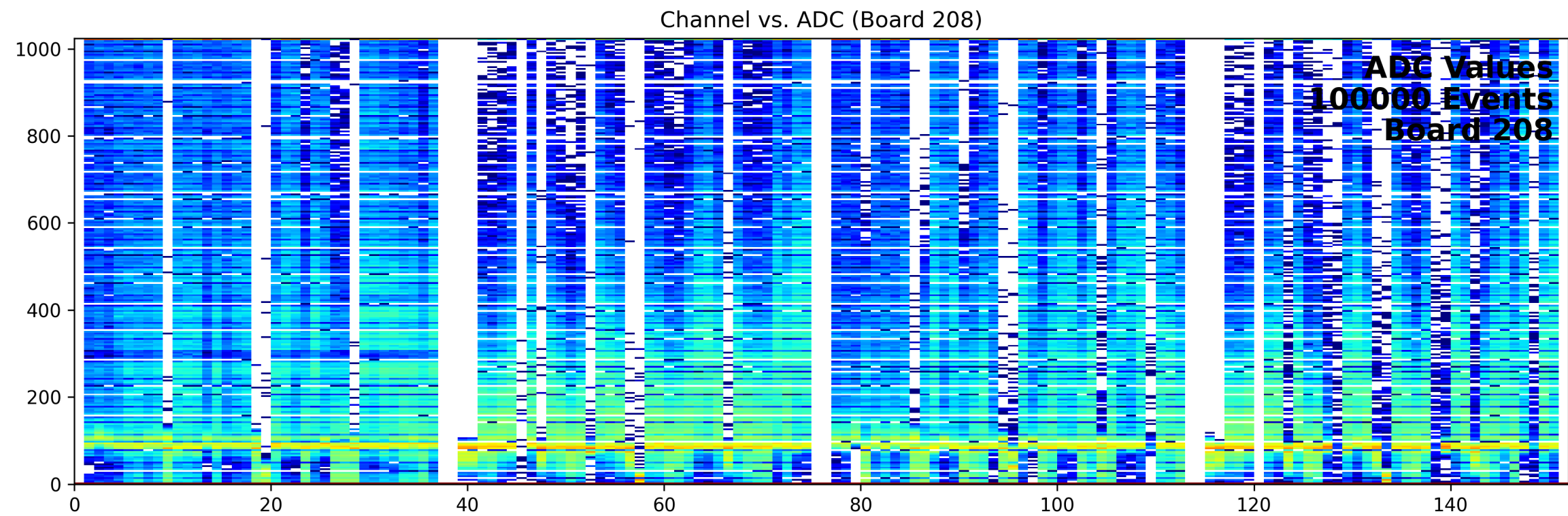
One run of 150 GeV hadrons, TOT and TOA are responding, some channels are cut, but it is mostly in the software (need better reconstruction)
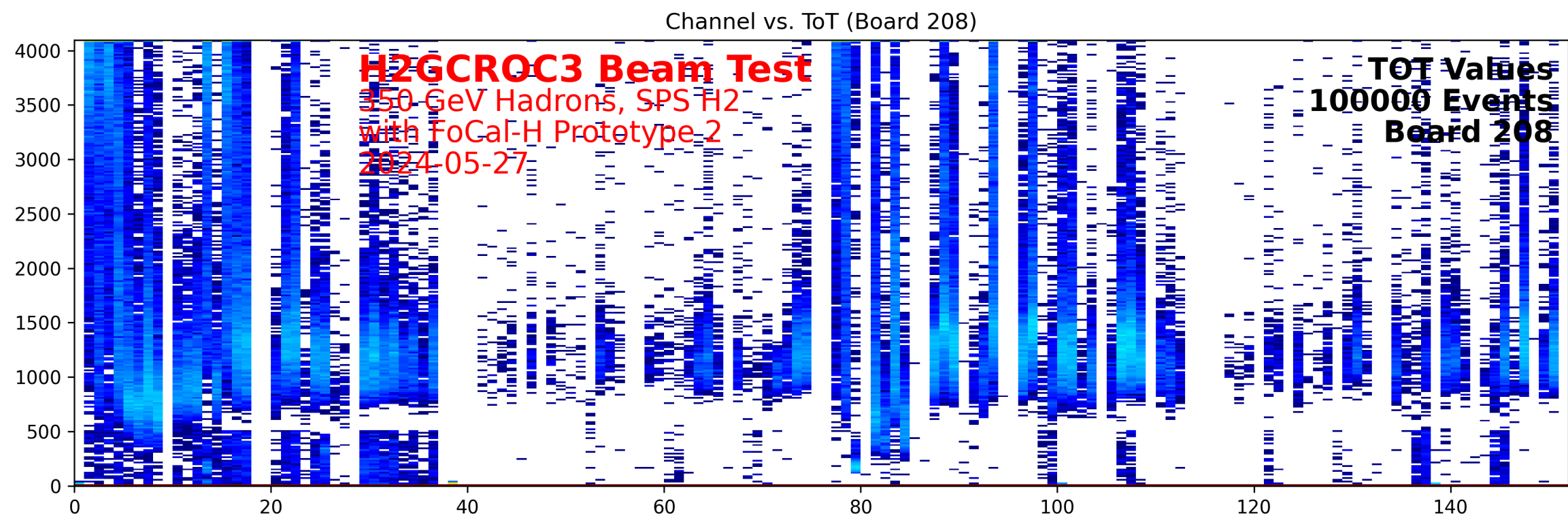
One channel example on the phase scan (sum of 16 runs), ADC only. Overall makes sense, there is a dip in 150-200ns (could be TOT dip, pile up, etc)

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Some problems

Channel vs. ADC

Channel vs. ToT

Channel vs. ToA
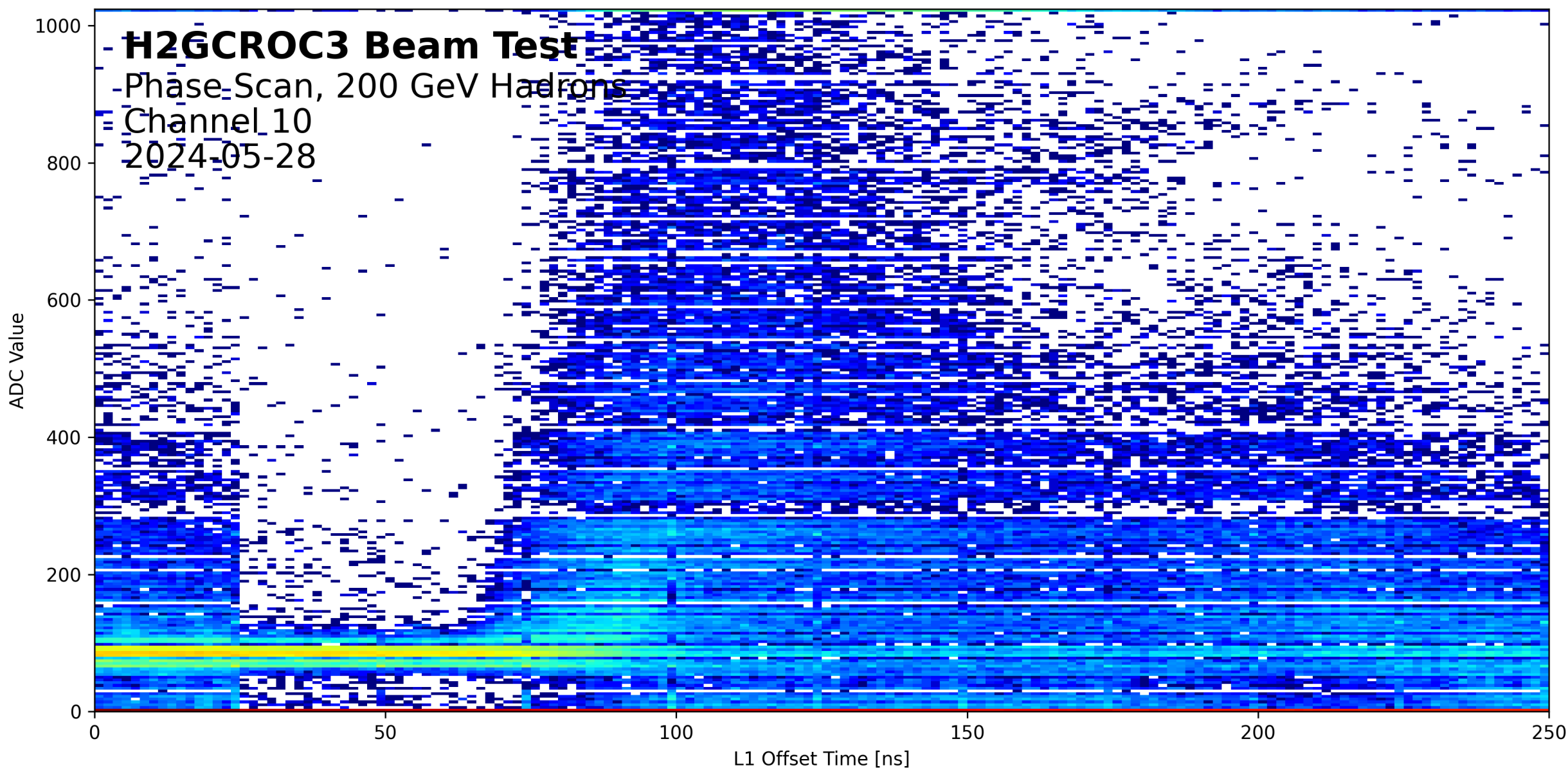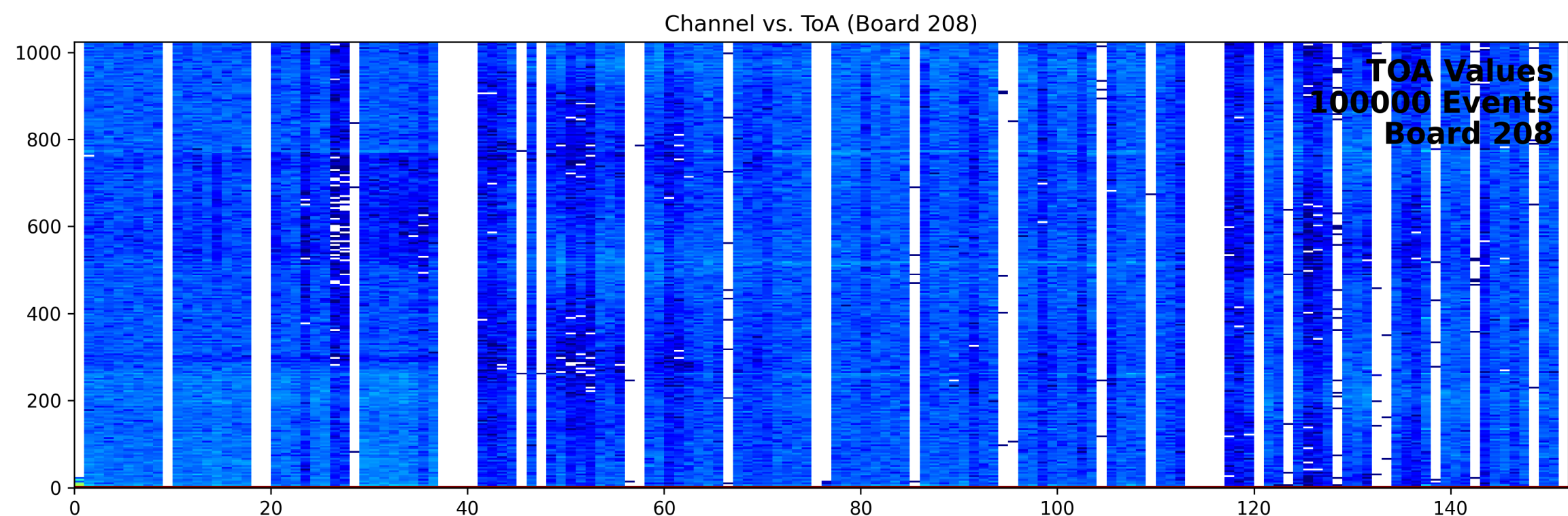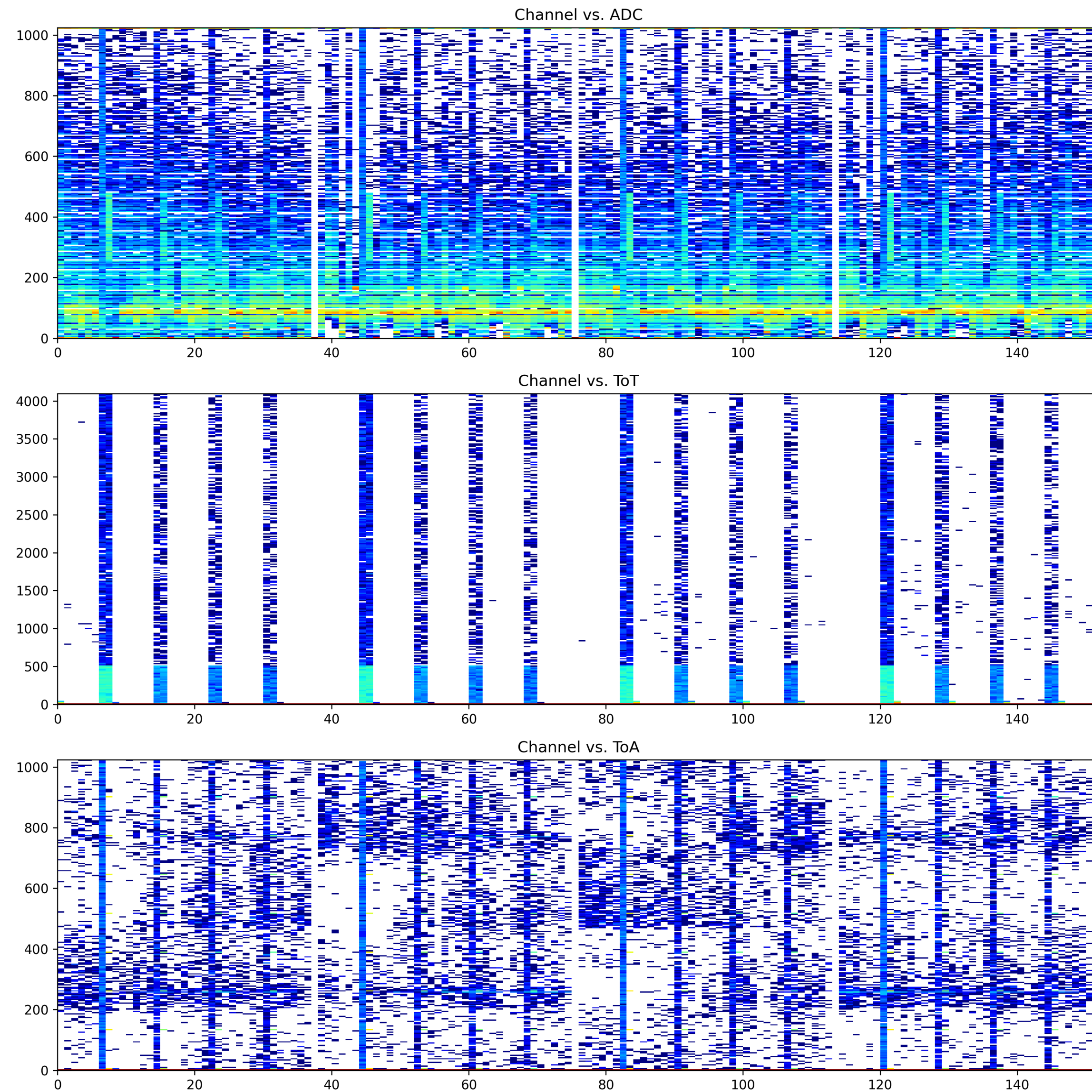
Without the cut, there are strips:
Looks like a counter to me, probably the header is recognized as the 17th channel for example
Need to check the reconstruction code…

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LFHCal – cosmics seen
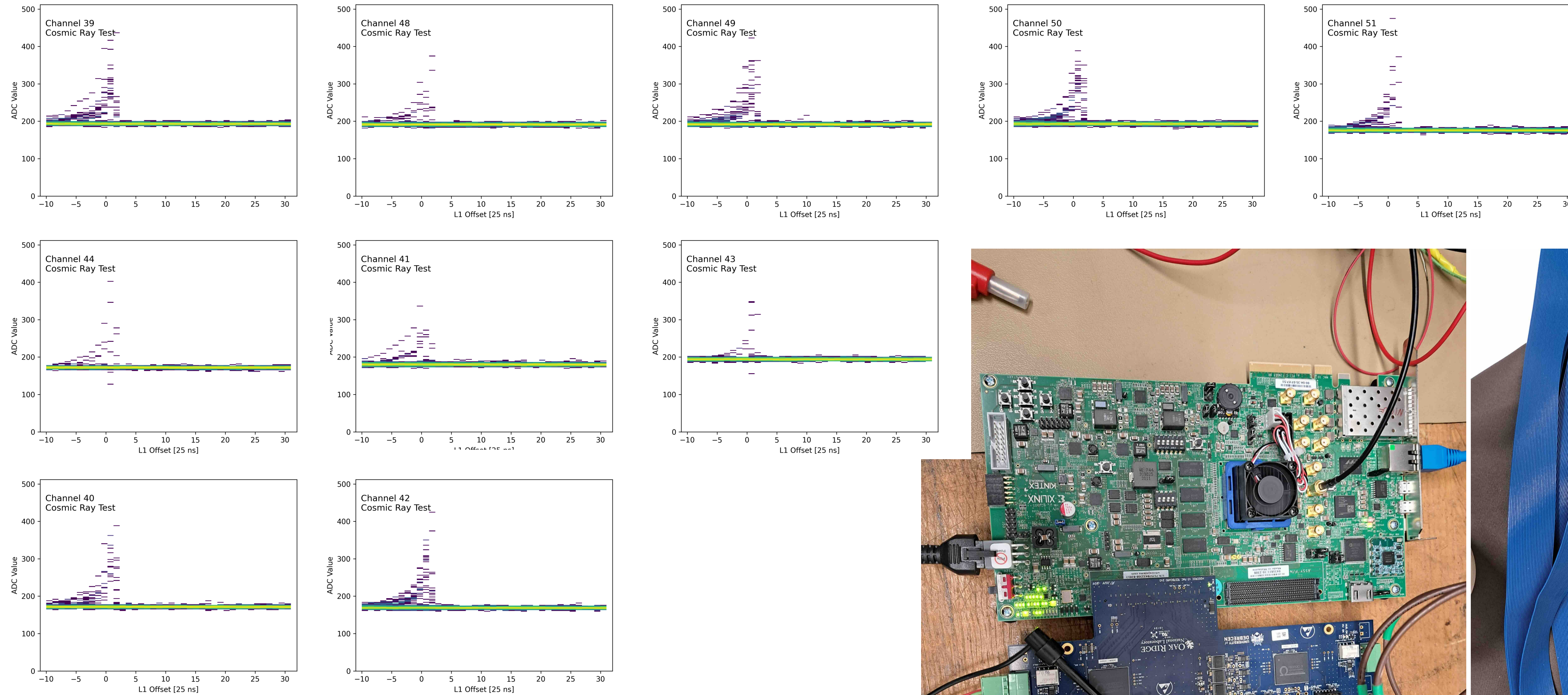
14 channels sees at least 1 hit, 10 channels shown:
- Limited scintillator trigger (10x10cm)
- 2 layers could be attached only
- MIP seems 2x higher? than previous measurement
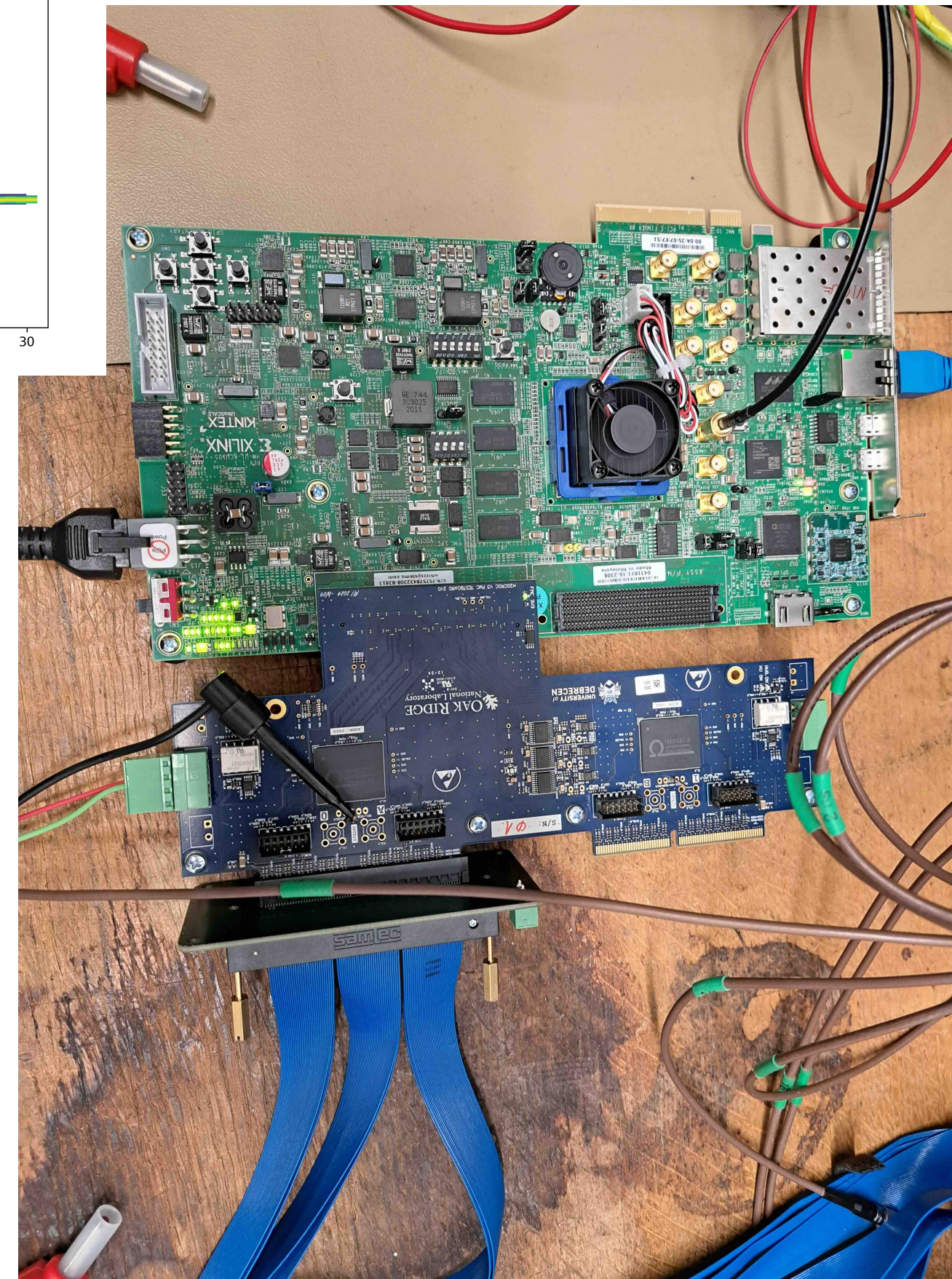
LFHCal testbeam
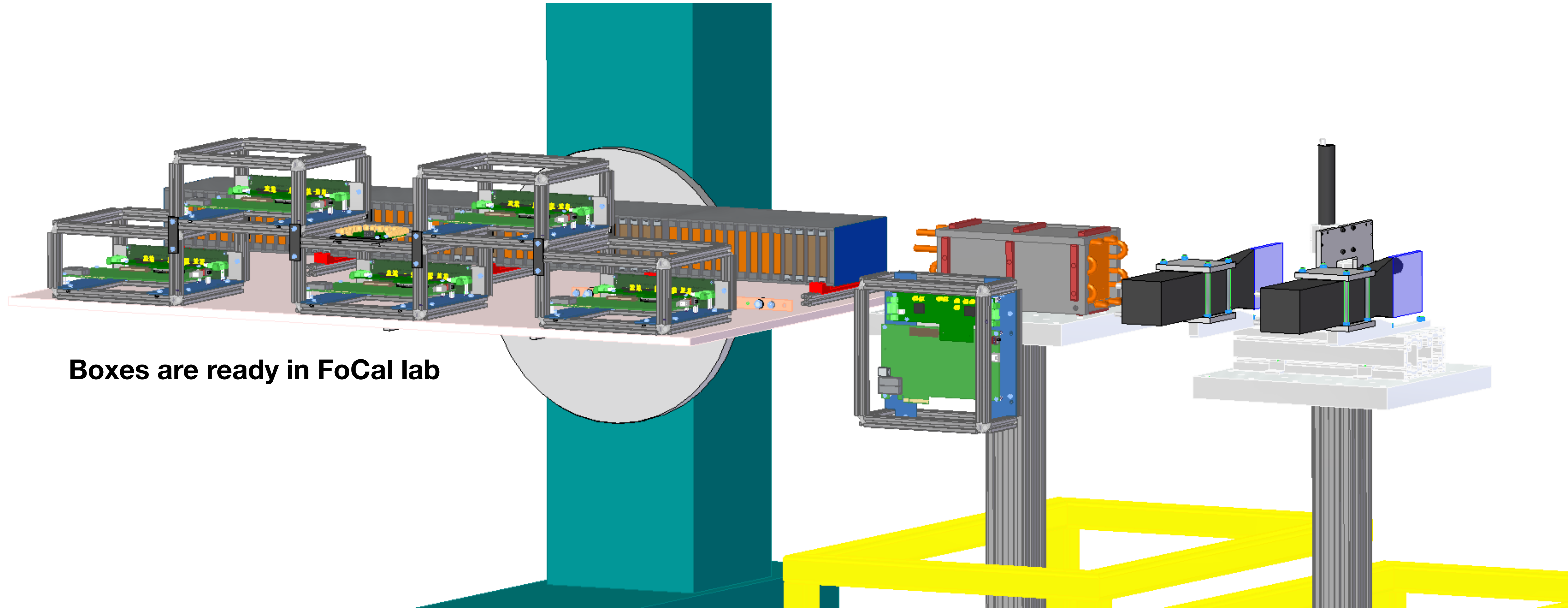
Boxes are ready in FoCal lab

Need 5 KCU's: ORNL, FoCal lab, KU, Miki, CTP group CERN. Need at least 1 more for spare.

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A0 Asic ID, 00 - FPGA (KCU) ID, 24 half chip ID, 00 - line (0..4)

FPGA timestamp

Header
CM0
CH0
Calib0
CH17
CH5
CH35
CRC32
CH0 on other side (half ID 25) = channel 36

10

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Backup

Next steps toward the final FoCal-H design

The H2GCROC is designed to interface with the input of the LpGBT ASIC

PS

CRU/KCU/FELIX, any FPGA

2.5V, 1.2V

2x1.28 Gbps

I2C

FastC, Clock

2x1.28 Gbps

I2C

FastC, Clock
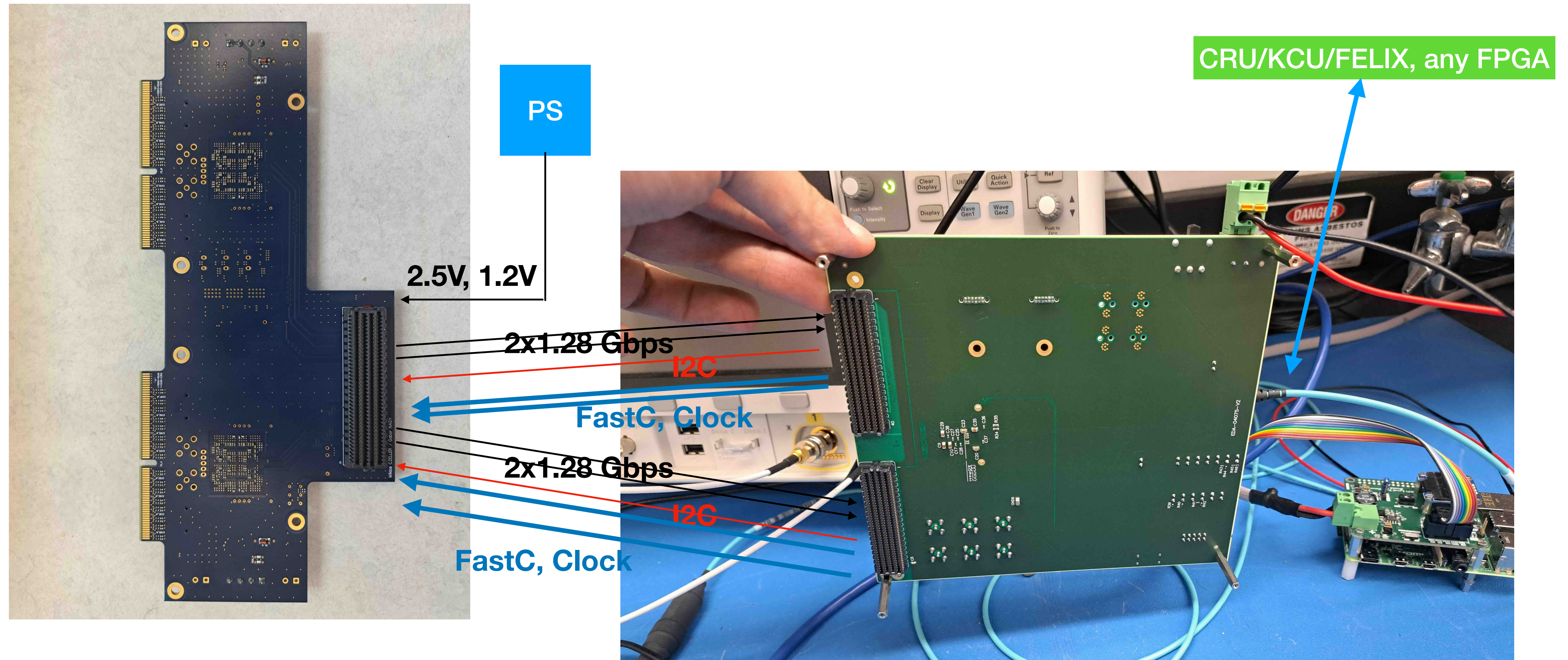
All of this in the middle is a quite passive board

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FoCal-H final