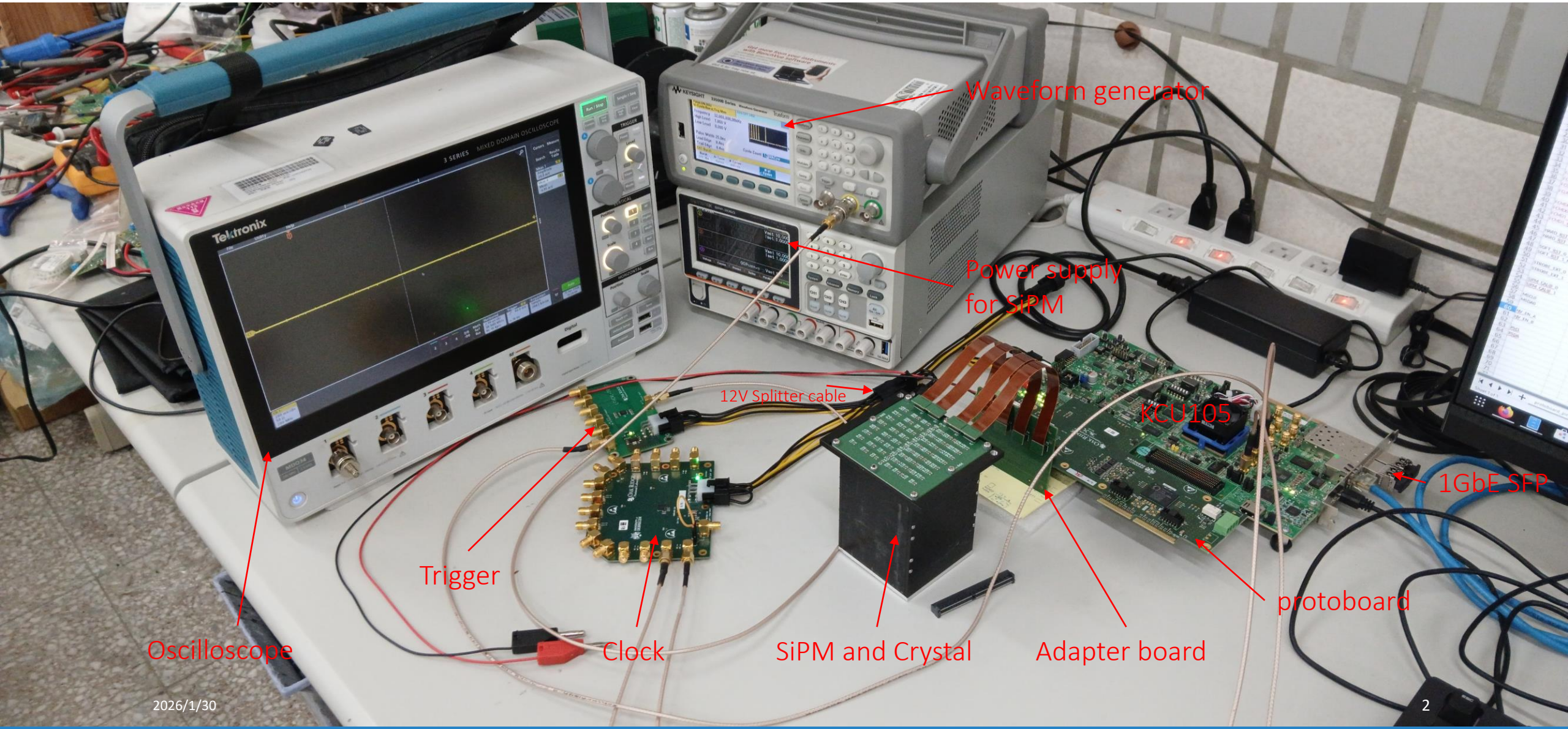
Prepare to use H2GCROC for beam testing

2025-2026

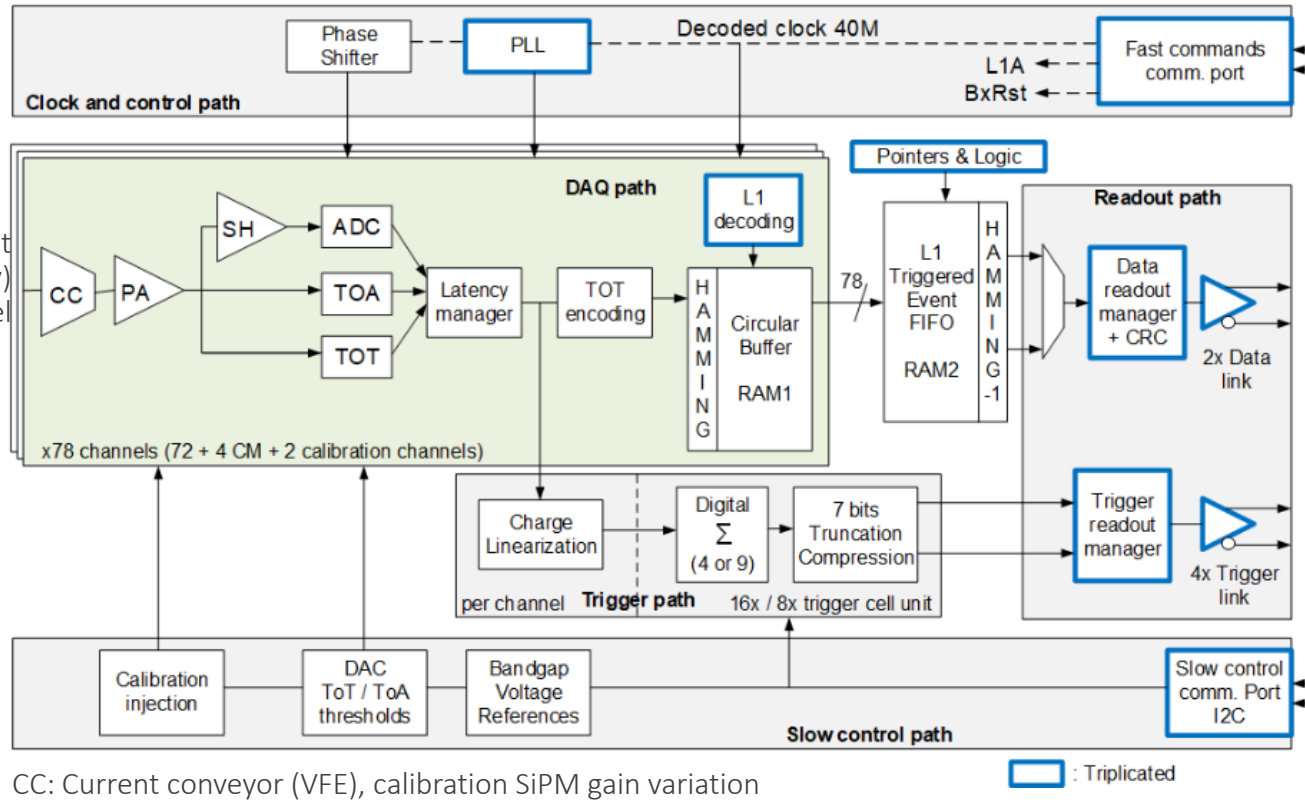
Current environment



Architectural

1 H2GCROC3b: architectural overview

The overall block diagram is described as per below.



320MHz Clock input
Command link (L1A is trigger input)

72 channels of analog signals input
4 CM (only connect to ADC internally)
2 Calibration channel

Two lane for data output:
Speed 1.28Gbps
Charge info, Time info…

Four lane for trigger generation
1.28Gbps x4

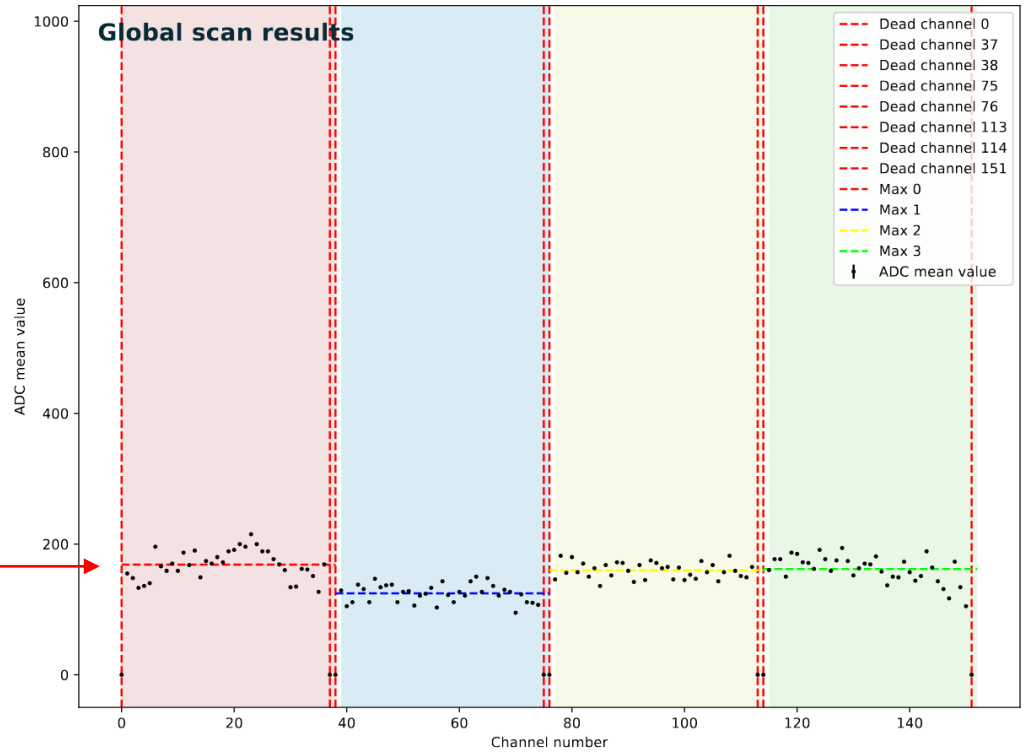
I2C interface read/write 7900 parameters

CC: Current conveyor (VFE), calibration SiPM gain variation
PA: Preamplifier
TOT: Time Over Threshold, dedicated discriminator and TDC (50ps), 12 bit
TOA: Time Of Arrival, dedicated discriminator and TDC (24ps), 12 bit
SH: Shaper
ADC: 10bit 40MHz SARADC

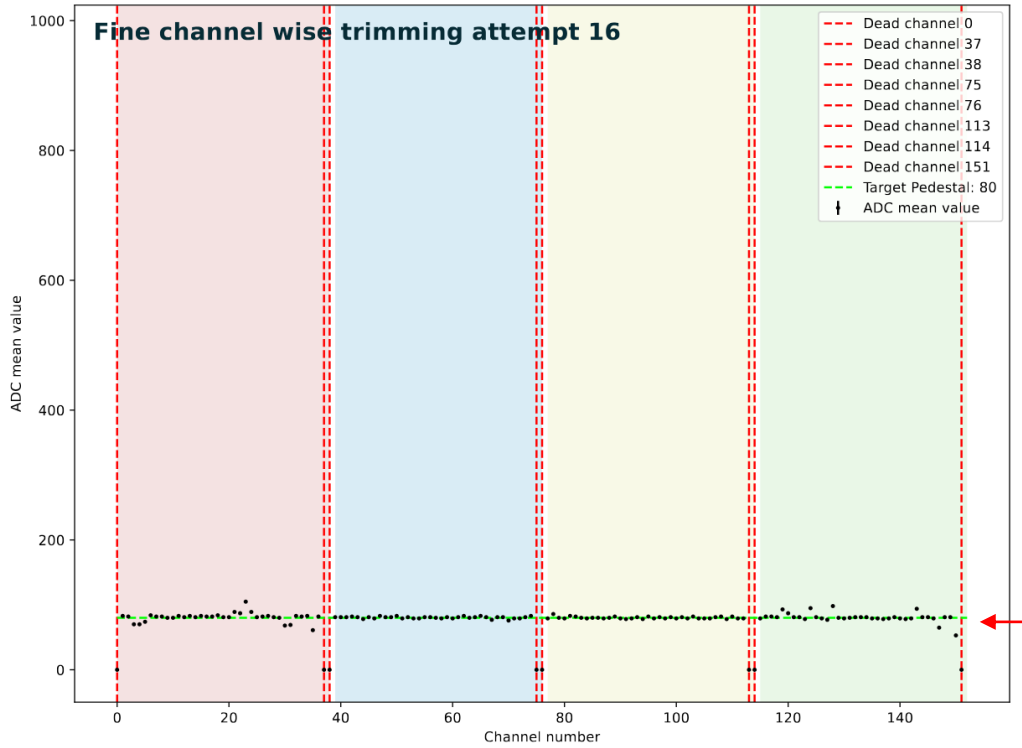
H2GCalib_3B – ADC pedestal calibration

- This program try to get the best pedestal value, it start from config “default_2024Aug_config.json”
- python 005_PedestalCalib.py

avg



Before calibration ADC pedestal



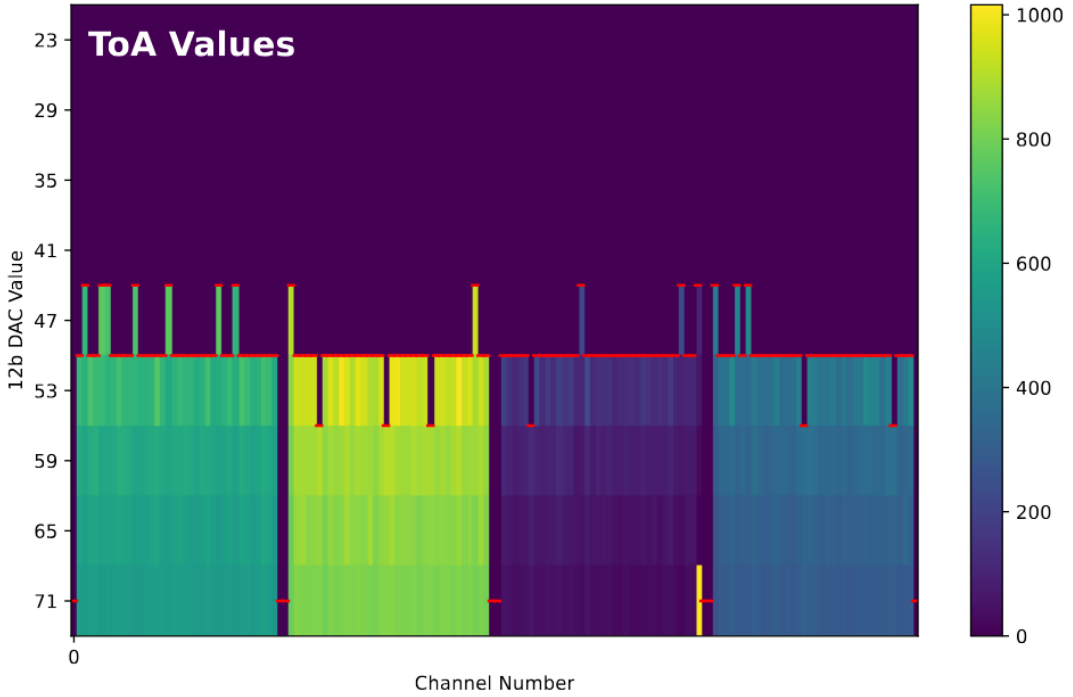
target

After calibration ADC pedestal

H2GCalib_3B – ToA Calibration

- python 006_ToACalib.py -t 50 -i dump/005_PedestalCalib_data_20250625_135655/config_pede_a0_20250625_135817.json,dump/005_PedestalCalib_data_20250625_135655/config_pede_a1_20250625_135817.json

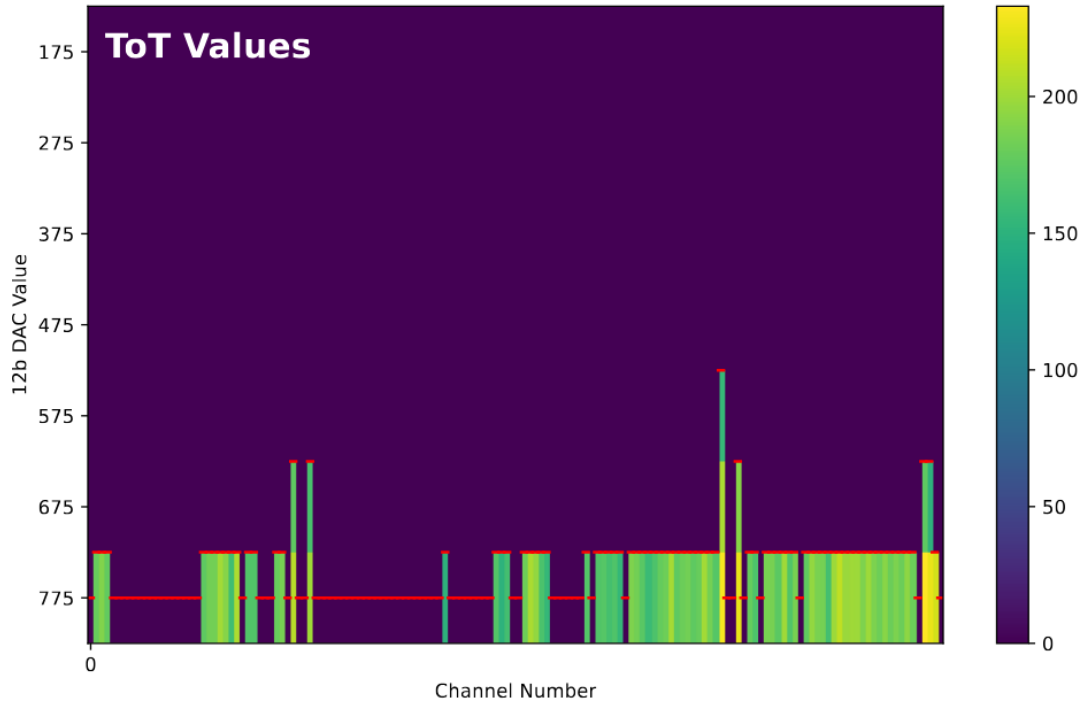
Before calibration ToA



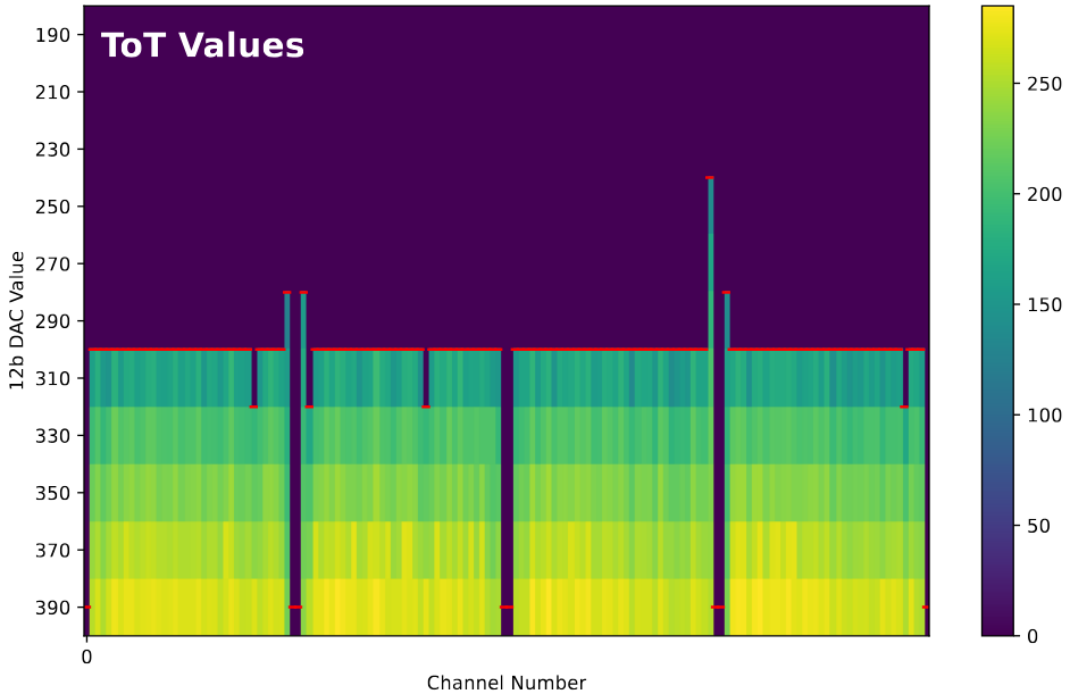
After calibration ToA

H2GCalib_3B – ToT Calibration

- python 010_ToTCalib.py -t 300 -i dump/006_ToACalib_data_20250625_143708/config_toa_a0_20250625_151028.json,dump/006_ToACalib_data_20250625_143708/config_toa_a1_20250625_151028.json



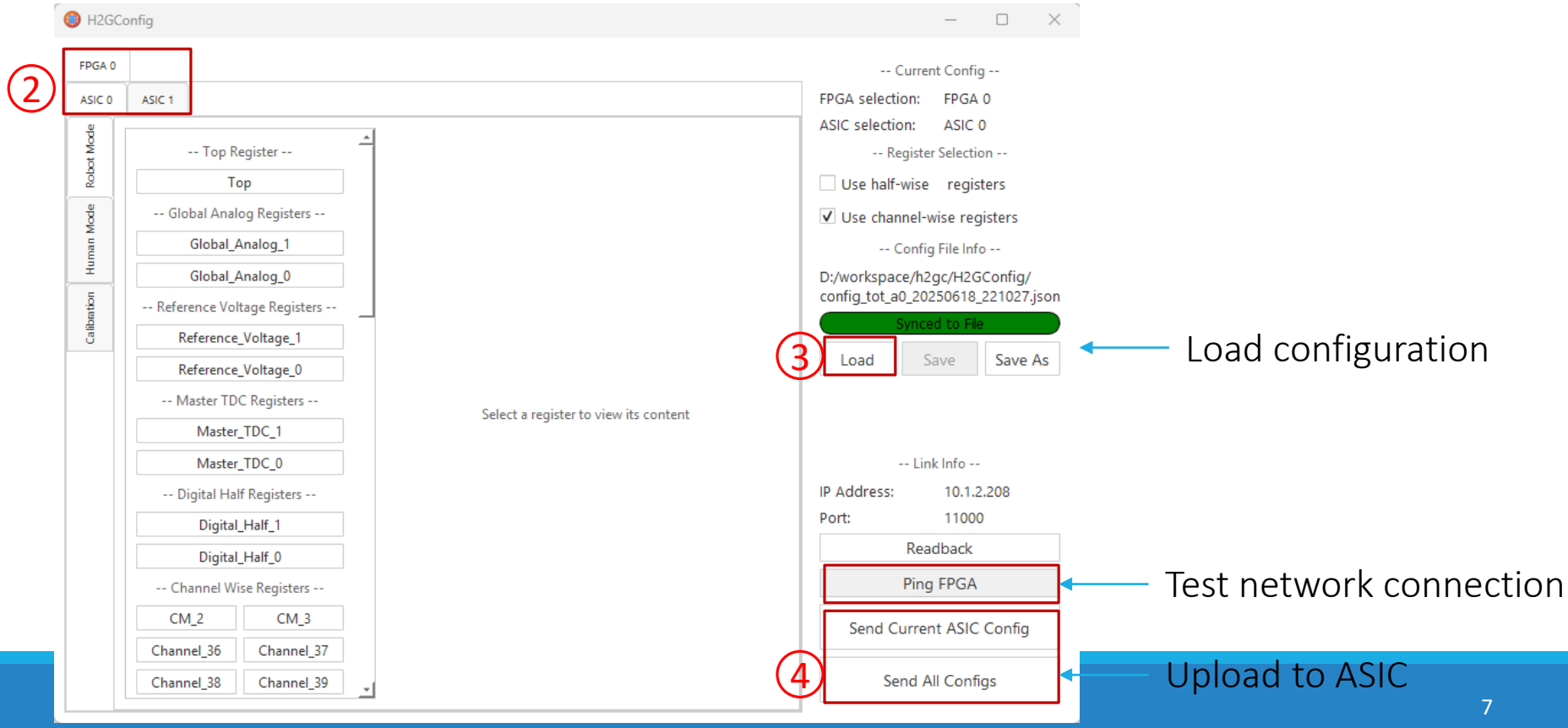
Before calibration ToT



After calibration ToT

Operation Procedure - Config

- H2GConfig
  - The GUI can read the configuration file and display it graphically. It allow you to modify register bit by bit
  - It can upload configuration to the ASIC
  - There is also a Ping FPGA button for you to test the ethernet connection



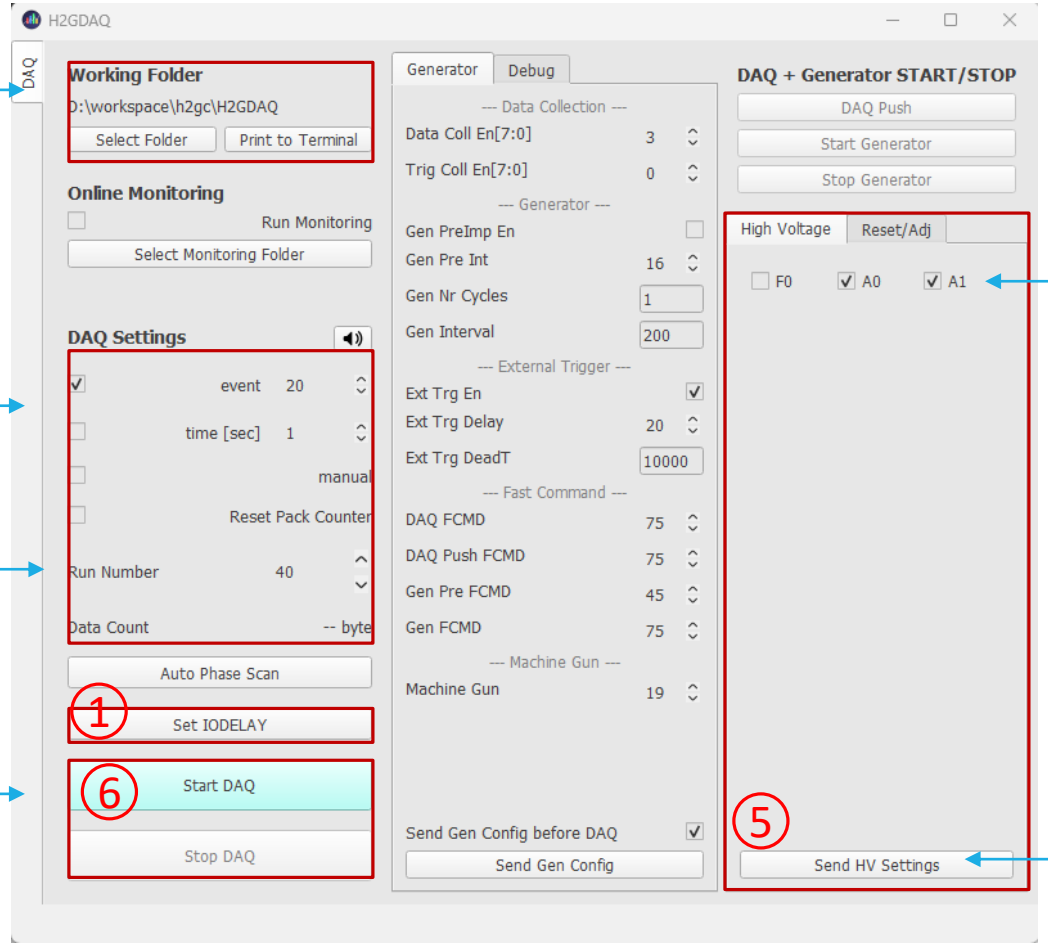
Operation Procedure - DAQ

Directory to store data

DAQ stop condition: By event count, by time or manual

Output Run040.h2g

Start/Stop DAQ button



high voltage relay setting

A0 = ASIC 0 only

A1 = ASIC1 only

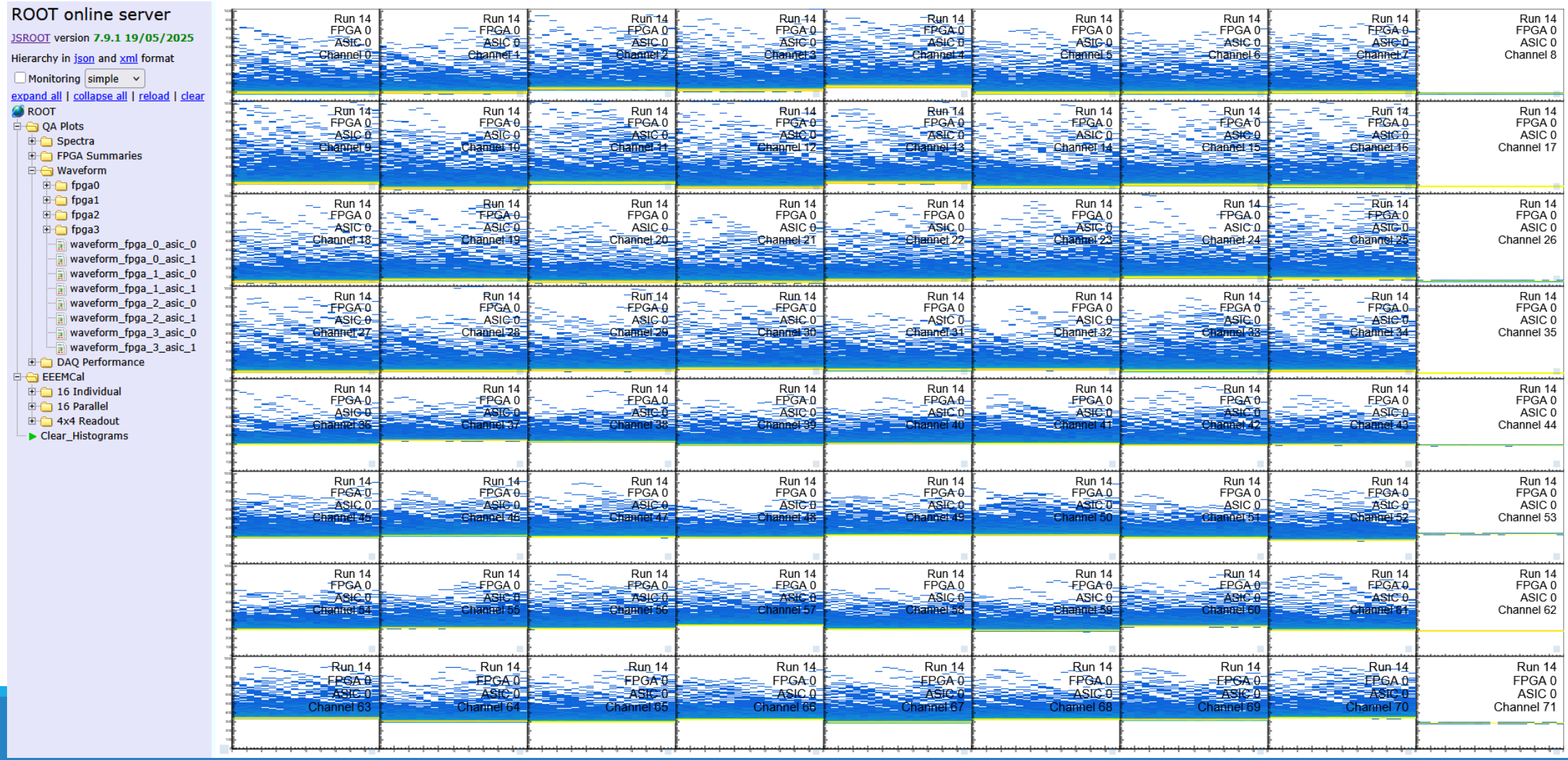
F0 = ASIC0 and ASIC1 both

Send command to turn On/Off the relay base on the settings above. You also need to turn on your power supply

Operation Procedure - online_monitoring

- Apply 28V

```
$ cd ~/workspace/h2g_online_monitoring; make
$ export DATA_DIRECTORY=~/workspace/H2GDAQ; export MONITORING_PORT=12345
$ root -q -b -x -l RunMonitoring.c\(RunNumber\)
```

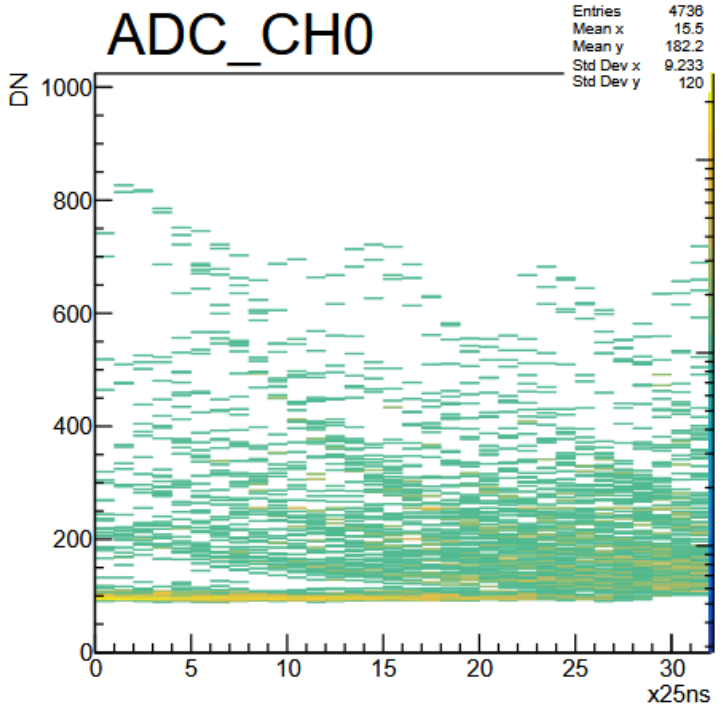


Operation Procedure - decode

- Convert raw data to root file for future analysis.

```
$ ./build/h2g_run -r 14 -d 0 -n 1
$ root
Tfile f("Run014.root")
root [1] events->Print()
******************************************************************************
*Tree    :events    : Events                                                  *
*Entries :    98258 : Total =      7360953537 bytes  File  Size =  492028194 *
*        :          : Tree compression factor =  14.96                       *
******************************************************************************
*Br    0 :event_number : event_number/i                                       *
*Entries :    98258 : Total  Size=     395183 bytes  File Size  =     138994 *
*Baskets :       18 : Basket Size=      51200 bytes  Compression=   2.84     *
*.............................................................................*
*Br    1 :timestamps : timestamps[1]/i                                        *
*Entries :    98258 : Total  Size=     395145 bytes  File Size  =     114179 *
*Baskets :       18 : Basket Size=      51200 bytes  Compression=   3.45     *
*.............................................................................*
*Br    2 :num_samples : num_samples/i                                         *
*Entries :    98258 : Total  Size=     395161 bytes  File Size  =       4019 *
*Baskets :       18 : Basket Size=      51200 bytes  Compression=  98.15     *
*.............................................................................*
*Br    3 :adc       : adc[144][32]/i                                          *
*Entries :    98258 : Total  Size= 1811620311 bytes  File Size  =  408563585 *
*Baskets :     5745 : Basket Size=    7088128 bytes  Compression=   4.43     *
*.............................................................................*
*Br    4 :toa       : toa[144][32]/i                                          *
*Entries :    98258 : Total  Size= 1811620311 bytes  File Size  =   22647543 *
*Baskets :     5745 : Basket Size=    7088128 bytes  Compression=  79.99     *
*.............................................................................*
*Br    5 :tot       : tot[144][32]/i                                          *
*Entries :    98258 : Total  Size= 1811620311 bytes  File Size  =    8514786 *
*Baskets :     5745 : Basket Size=    7088128 bytes  Compression= 212.75     *
*.............................................................................*
*Br    6 :hamming   : hamming[144][32]/i                                      *
*Entries :    98258 : Total  Size= 1811643307 bytes  File Size  =    8529147 *
*Baskets :     5745 : Basket Size=    7089664 bytes  Compression= 212.39     *
*.............................................................................*
*Br    7 :hit_max   : hit_max[144]/i                                          *
*Entries :    98258 : Total  Size=   56630819 bytes  File Size  =   21343750 *
*Baskets :      353 : Basket Size=     221184 bytes  Compression=   2.65     *
*.............................................................................*
*Br    8 :hit_pedestal : hit_pedestal[144]/i                                  *
*Entries :    98258 : Total  Size=   56632604 bytes  File Size  =   22016214 *
*Baskets :      353 : Basket Size=     221696 bytes  Compression=   2.57     *
*.............................................................................*
```

ADC waveform
x-axis: time
y-axis: amplitude



Status

- ✓Test under FPGA firmware V4.11 - V4.12
- ✓Set up the testing environment and prepare the software and hardware in parallel.
- ✓Tested ASIC calibration, apply high voltage to SiPM and run data acquisition.
- ✓Studied the DAQ program, data format. Decode and plotting the waveform has been tested.
- Next studies:
  - internal trigger, LED injection, SiPM calibration, gain...
  - ASIC parameters...

Q/A

- WWW