LAMPS Neutron Detector Array Status & DAQ software plan

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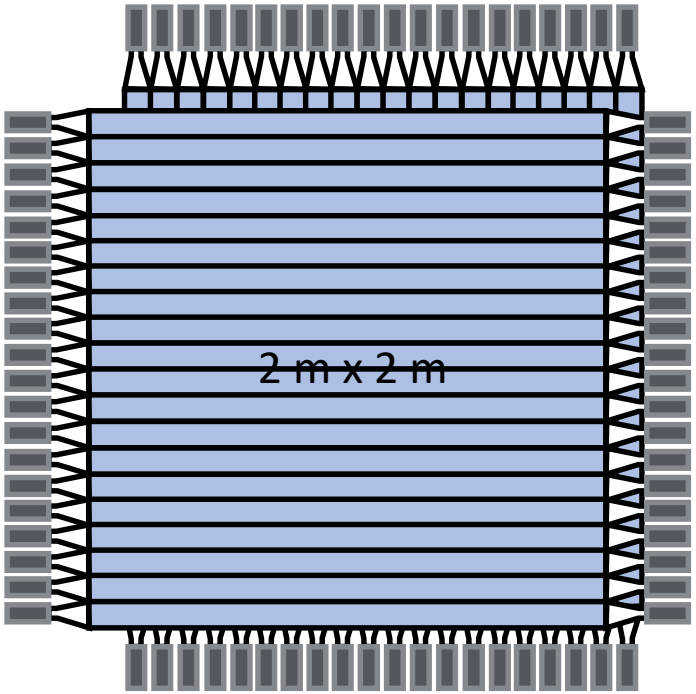
LAMPS Neutron Detector Array

- 4 layer
- 160 x BC408 (100 mm x 100 mm x 2000 mm) + 2 H7195 Scintillation detector
- Measure neutron TOF with < 200 ps timing resolution with 2 m x 2 m detection area

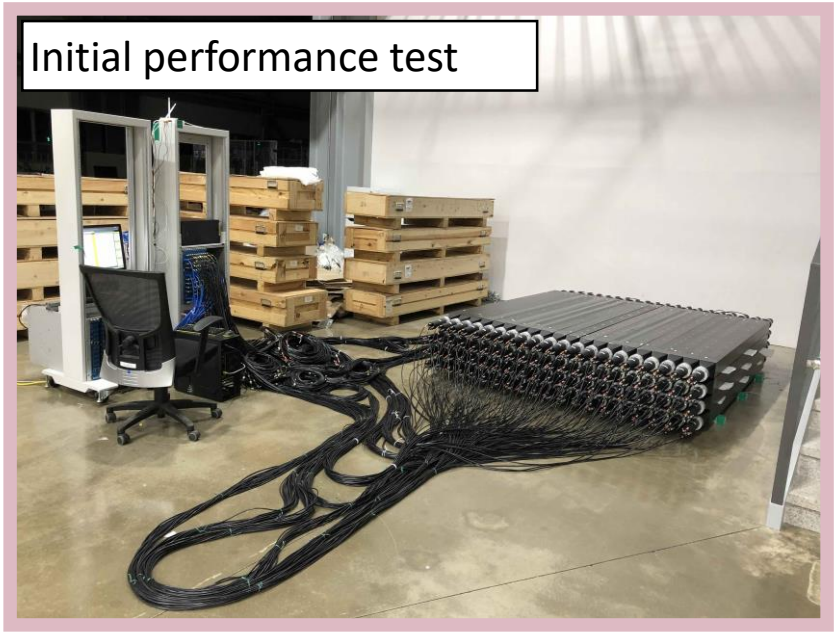


Setup for cosmic ray measurement

Detector sorting

Detector Installation(1)

Initial performance test

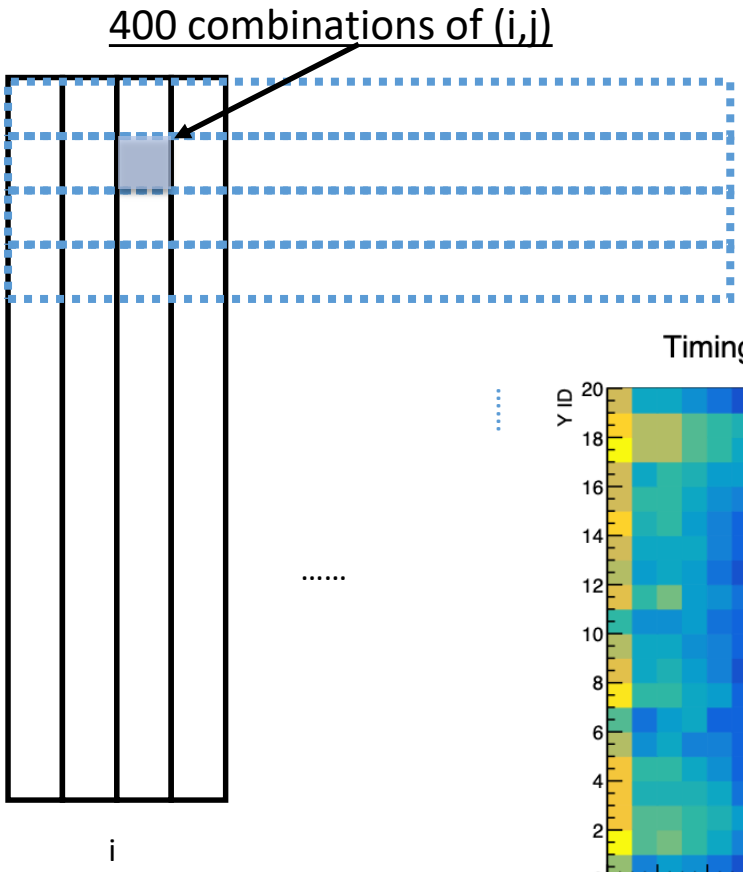


Detector Installation(2)

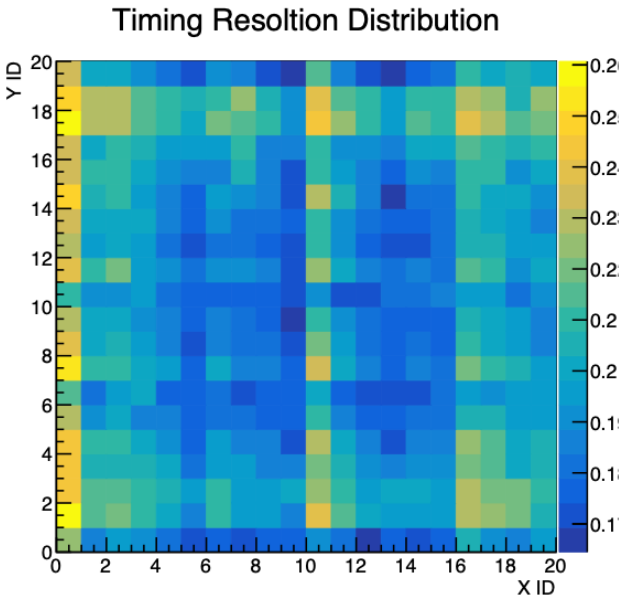
Construction complete

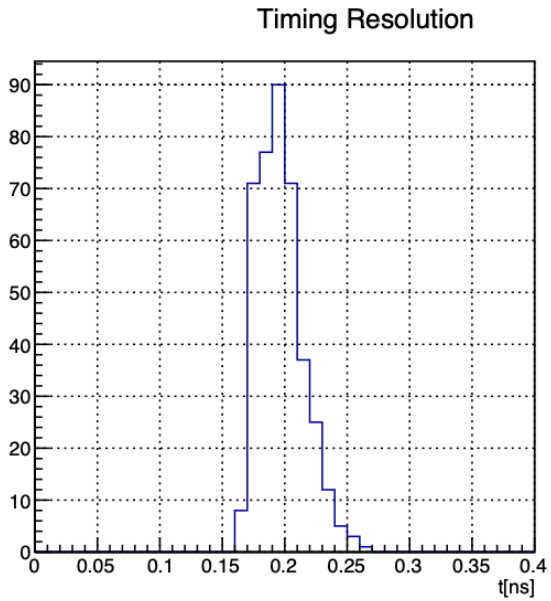
Timing resolution

Only two plane -> Difficult to derive timing resolution



Sigma of (T_i - T_j) distribution

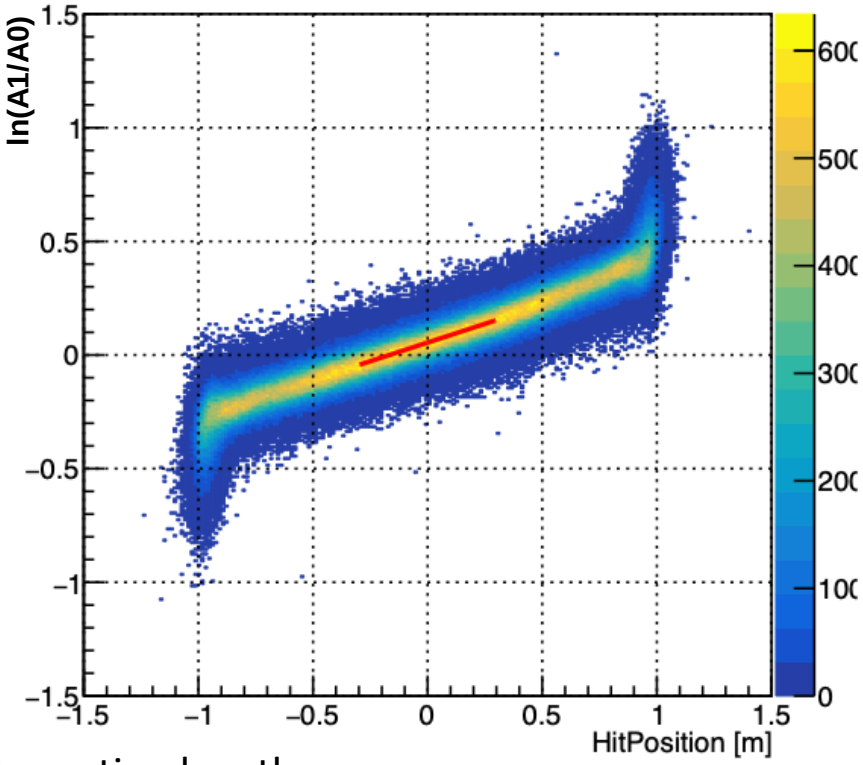


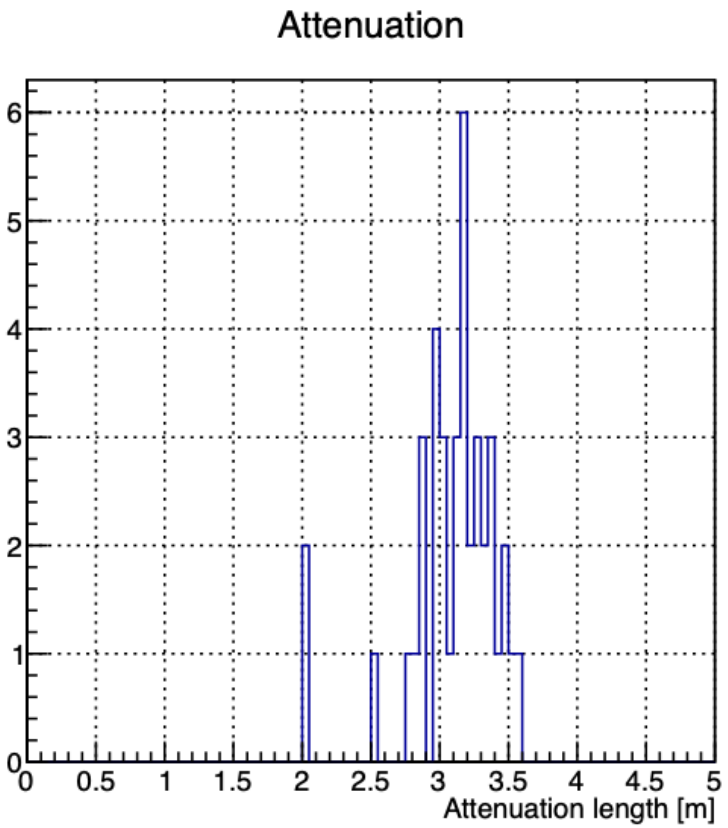


Mean value : 197ps -> ~140 ps

Detector Performance - Attenuation length

Signal attenuation





Attenuation length
Average : ~3.1 m
Minimum : 2 m
Threshold=200 cnt, Cosmic Peak=1000
=> Dynamic Range : 5.6 ~ 50 MeV

	Prev (1 module)	Current (40 module)
t res.	139 ps	140 ps (197 ps)
pos res.	23 mm	-
Attenuation length	3.3 m	3.1 m

Requirements for Neutron detector array DAQ system & Software

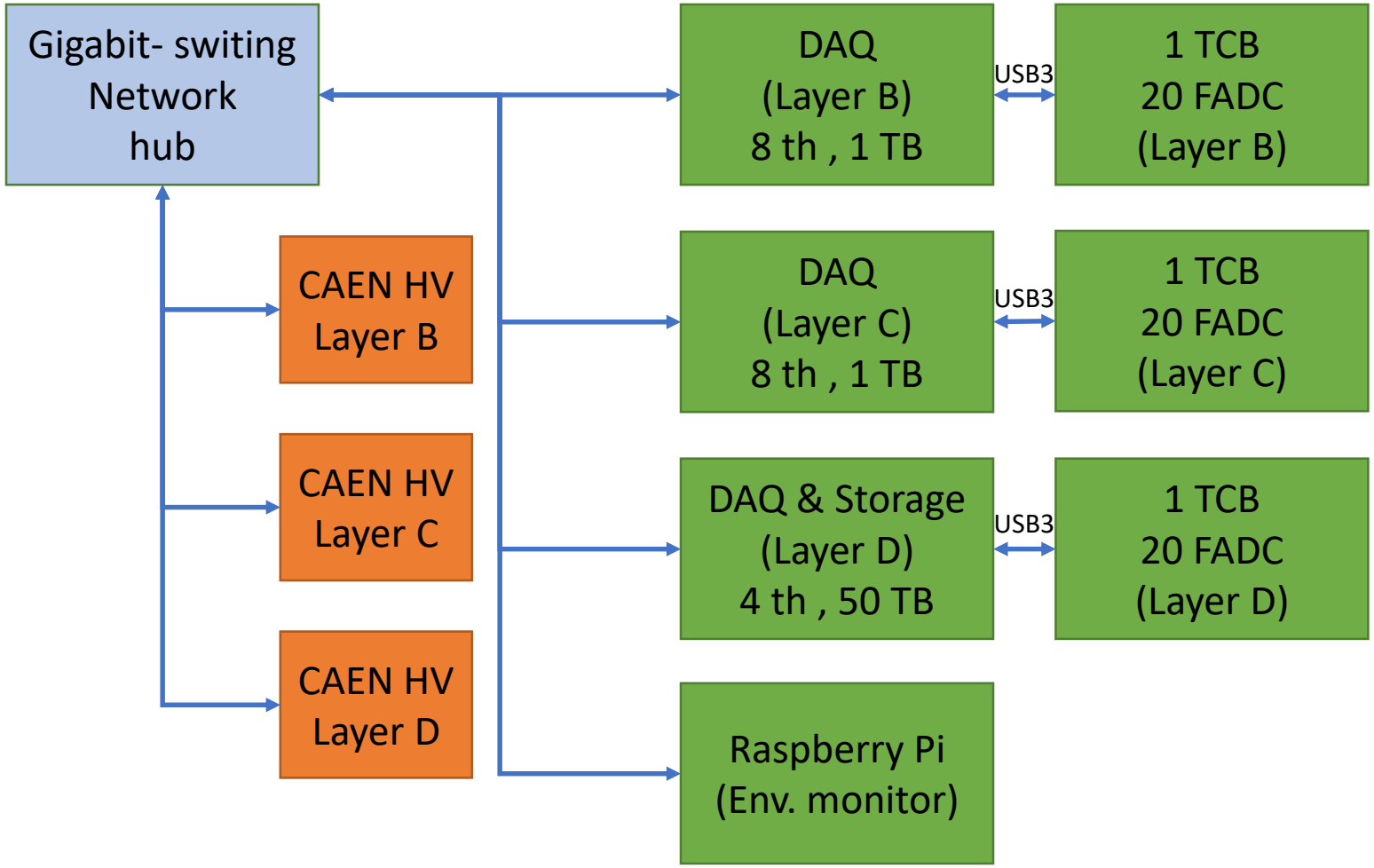
- DAQ
  - DAQ should run under network (multiple machines for DAQ) : Socket programming
  - Only one USB3 device handled by single process : Multi-process
  - Run many process simultaneously & Control them via network
  - TCB & FADC upgrade
  - LTE

- Calibration & gain (HV) adjustment
  - Make automated calibration & HV adjustment program (180 module – 360 PMTs)
  - Make criteria for gain adjustment

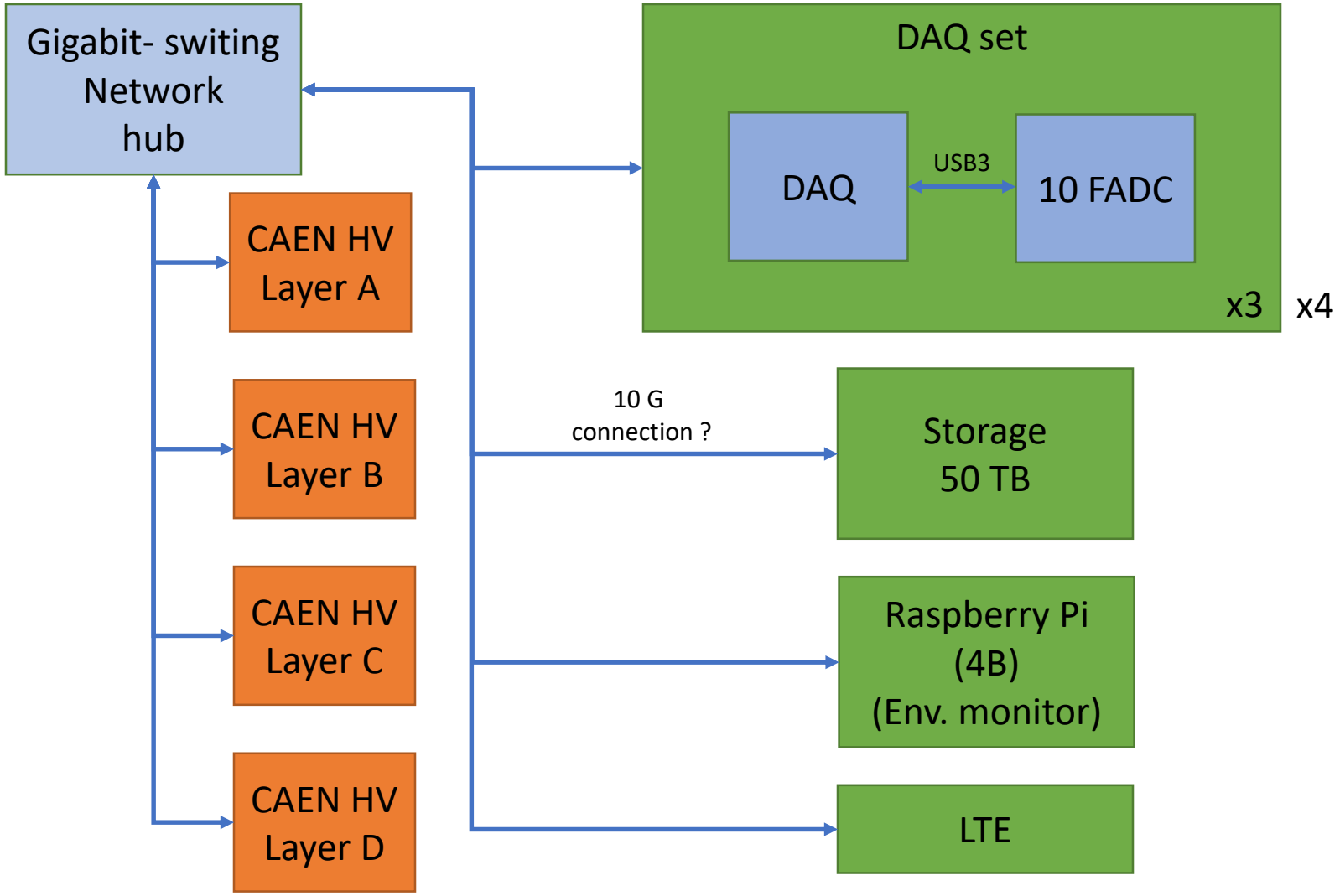
- Environment monitoring
  - Searching good tools for displaying choronological data

- Data base for RUN data

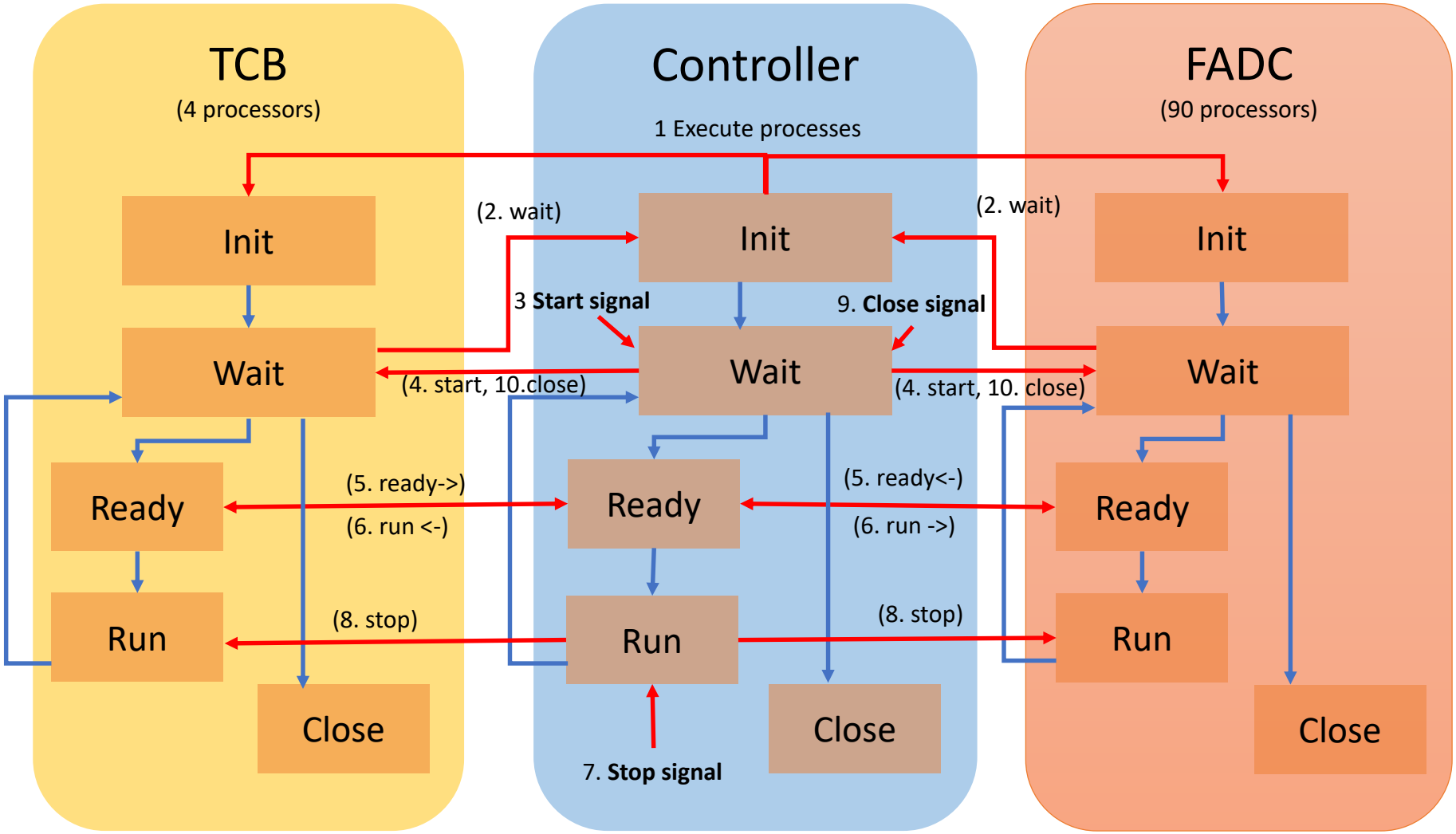
Current setup – Network connection



Future setup (Full setup)



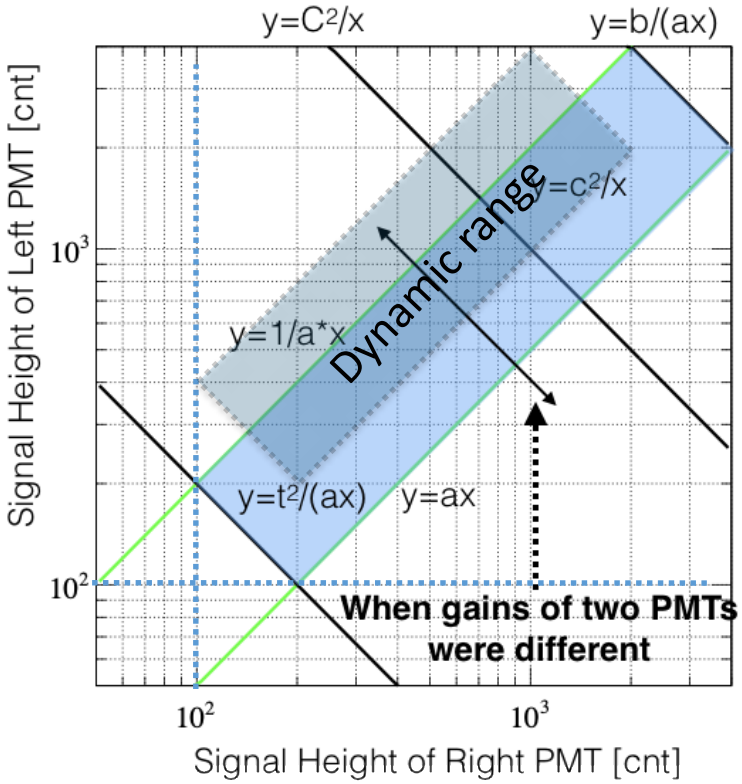
DAQ diagram



(TCB & FADC sends their own status to the controller by 5 secs)

Gain alignment

Dynamic range of scintillator

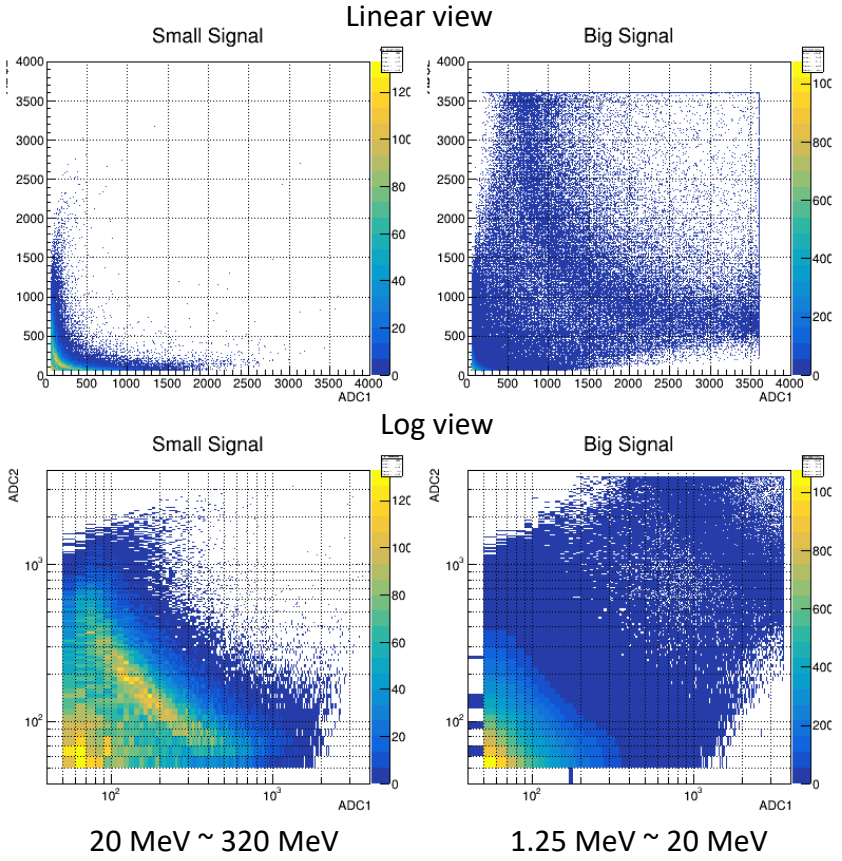


C : Cosmic ray MIP

t : threshold (count)

a : attenuation for 2 m

Sample Distributions



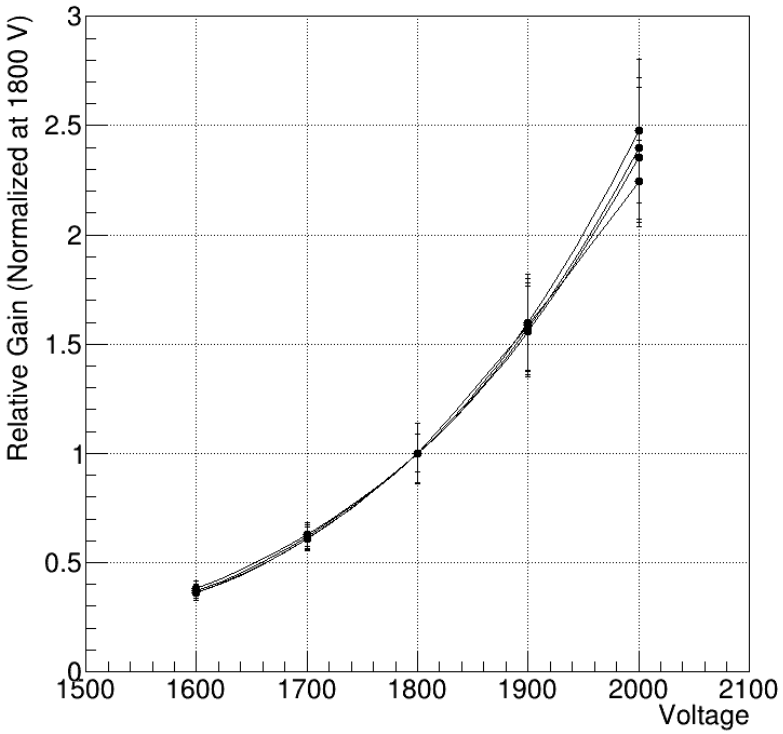
20 MeV ~ 320 MeV

1.25 MeV ~ 20 MeV

HV & Gain adjustment

$$V = e^{\frac{1}{8.56} \times \ln(Gain/a)}$$

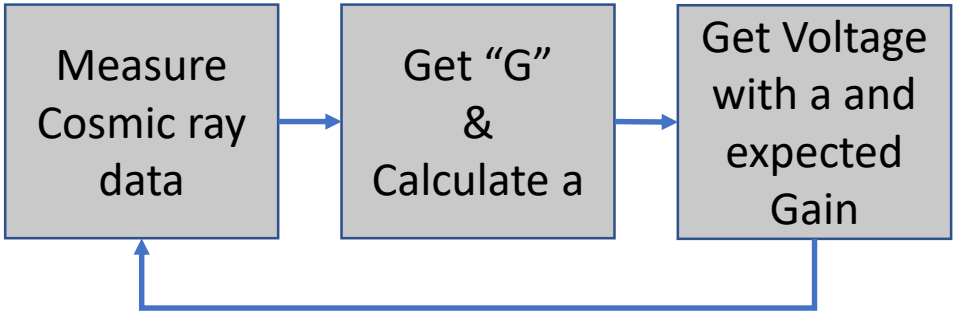
PMT HV Gain curve (H7195)



$$G(V) = a\ (V/1000)^{8.56}$$

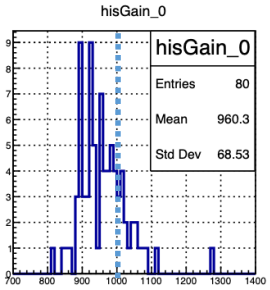
Dynode stages : 12

Collection Efficient : 0.71

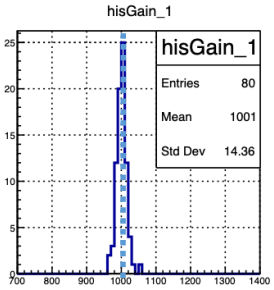


Make script for auto HV adjustment

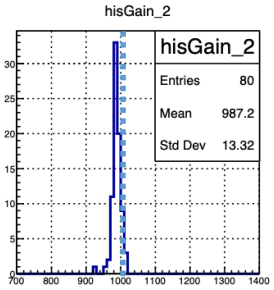
Initial Gain Dist.



Adjust 1 times



Adjust 2 times



All gains were aligned with ~2% by two times of HV adjustments

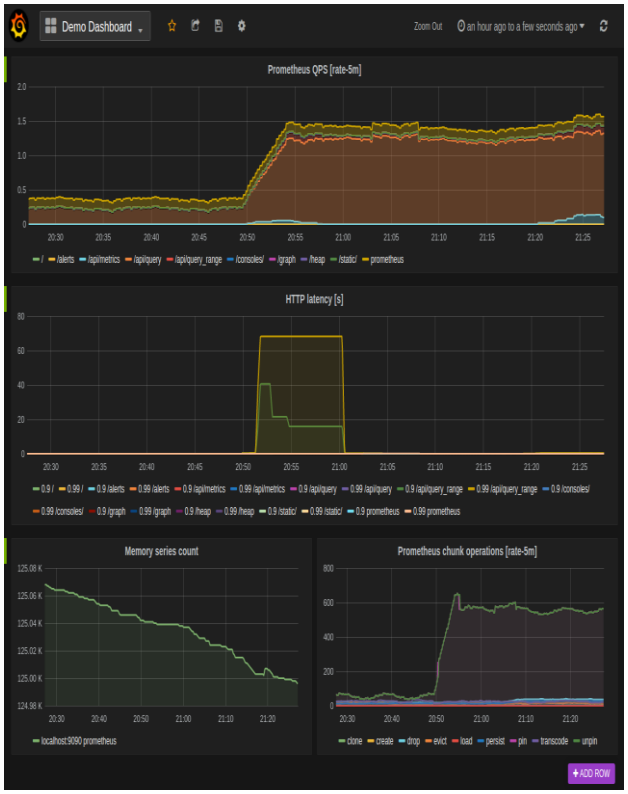
Each measurement took 1~2 hr (3~6 hr total)

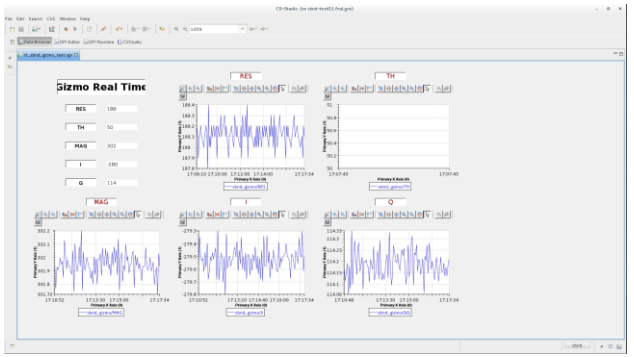
HV control

- CAEN HV control library
  - Can control All types of CAEN HV supplies.
  - Connected via LAN to SY5257 (Current HV supply system)
  - Run HV control command in command line ->Automation!
- CAEN GECO2020
  - GUI program for HV control
- WEB : CAEN HV supply embedded

Chronological data monitoring and Run info data base

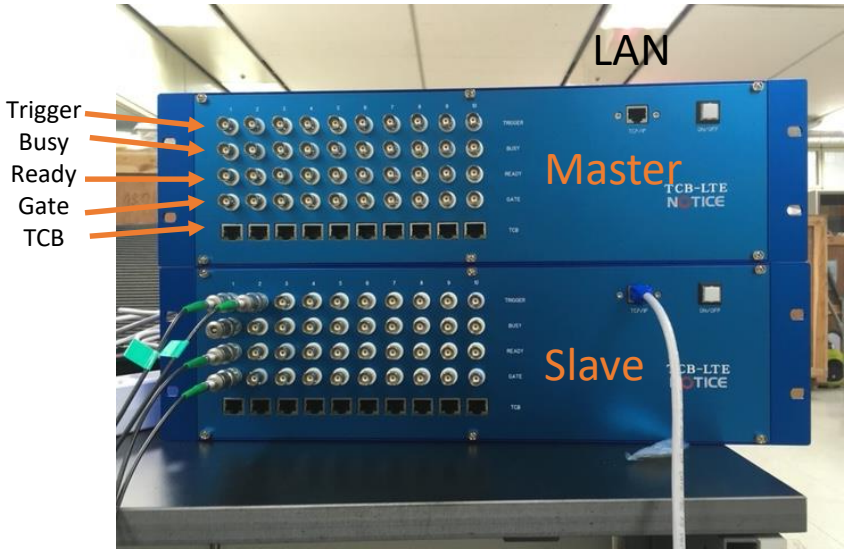
- Many chronological data to monitor
  - Trigger rate
  - Data size & free storage size
  - HV & current
  - Environment data
    - temperature
    - humidity
    - vacuum
    - Gas flow
    - Beam intensity?
- Prometheous + Grafana : Under test.
- EPICS?
- RUN info data base with Run number, Trigger type, Start time, End time, etc..





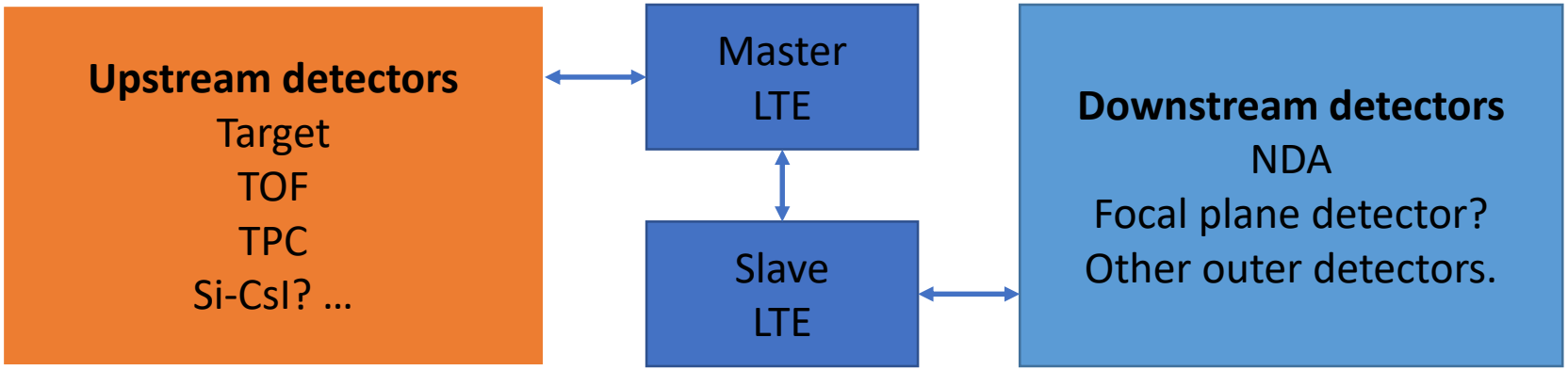
Trigger System

LTE module



Concept

- LTE has its own processor (PC).
- All trigger information from connected detectors will be recorded.
- All time stamp of detector DAQs synchronize with Master's clock.
- Handle VETO signal.
- Trigger decision
- …



TCB & FADC Firmware upgrade plan for LTE

- FADC
  - Buffer full readout (buffer size >= 16k) -> Ontime readout / buffer full readout selectable
- TCB
  - Trigger logic upgrade
  - Time sync : No time sync (own clock) -> Sync time with LTE
  - Handle VETO signal
- RUN mode
  - Self Trigger mode : Check hit pattern (4 ch set) -> Record data (Ordinary one)
  - External Trigger mode : Send trigger sigal via UTP port (RJ45) or LEMO input -> Record data (Upgraded one)
  - Mixed mode : Check hit pattern in TCB (Self trigger mode) -> Send Trig info to LTE -> Trigger decision in LTE -> Send back & distributes trigger signal to all TCB - > Record data (New one)

Summary

- Neutron detector array was build.
- DAQ system & Programs are preparing now.
  - New version of DAQ program was developed.
  - TCB & FADC firmware will be upgraded for final version.
  - New Trigger controller (LTE) is under development.
  - Monitoring system is testing.