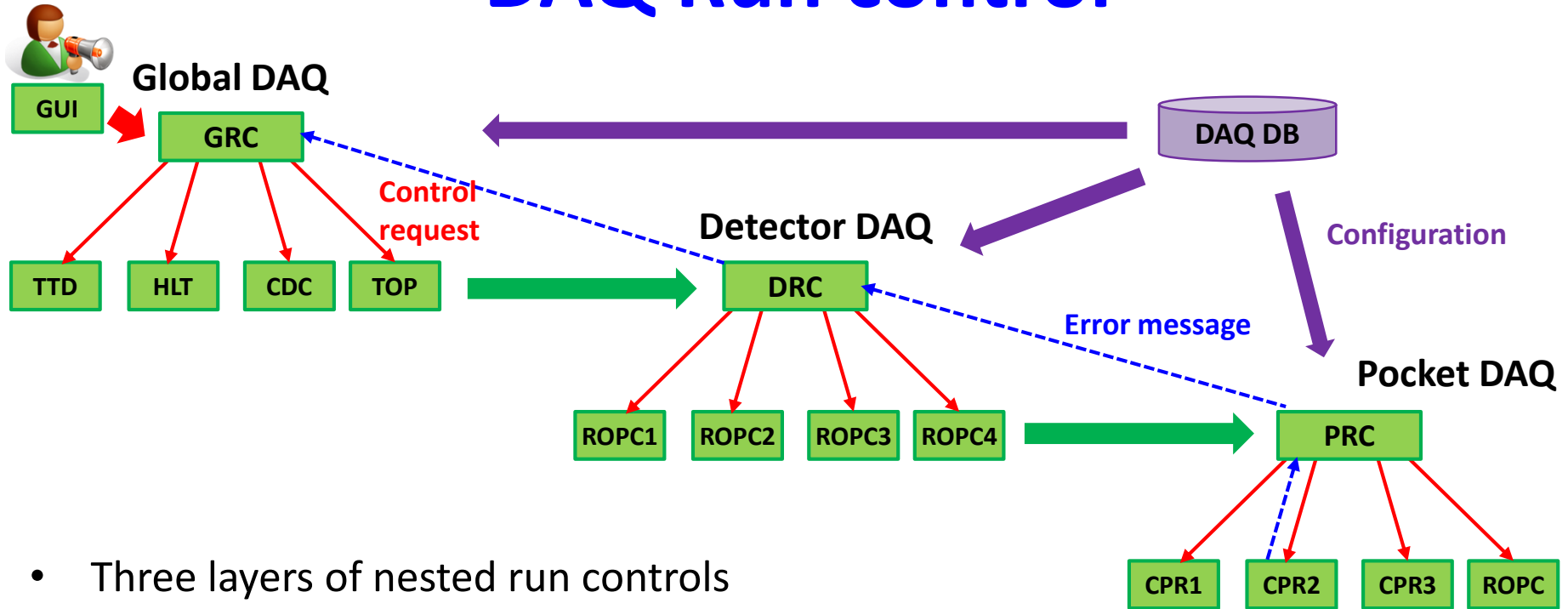


# Run control

Tomoyuki Konno

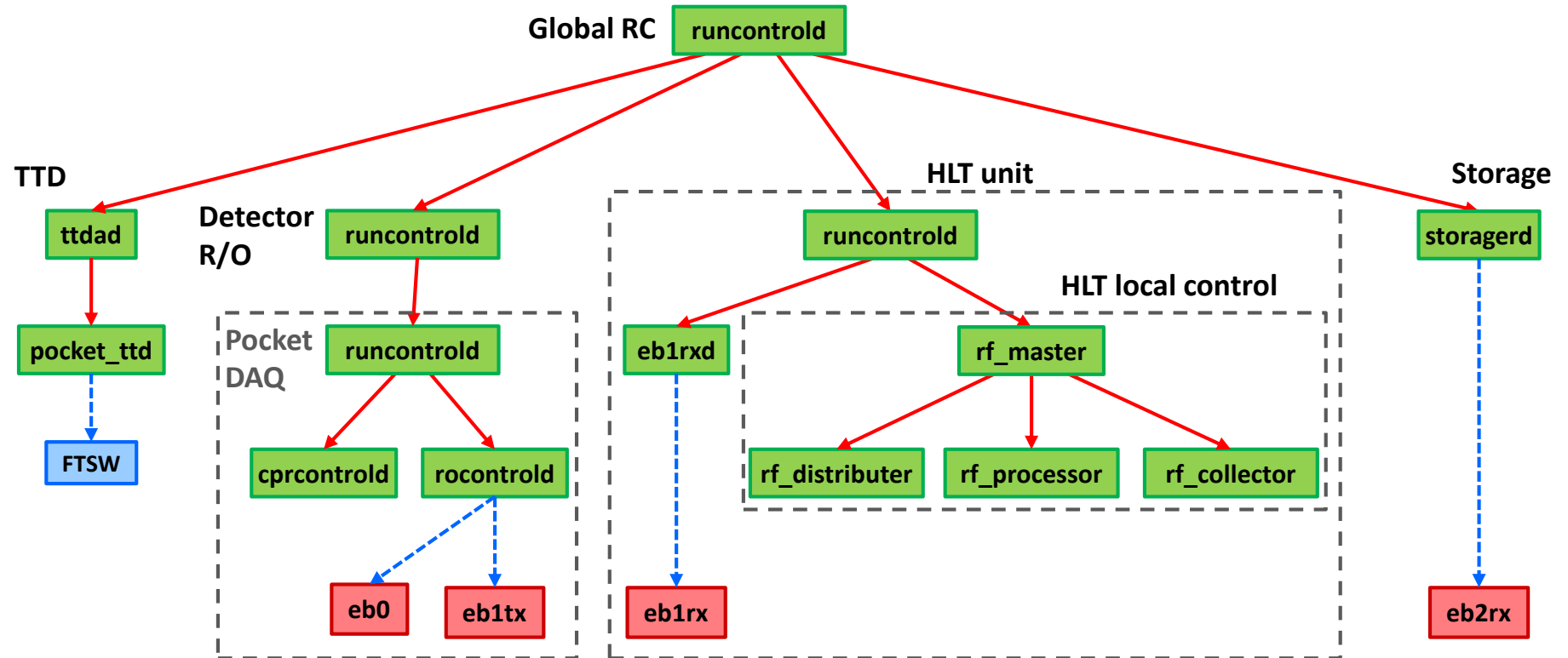
TRG/DAQ workshop 2016,  
Budker Institute of Nuclear Physics, Novosibirsk

# DAQ Run control



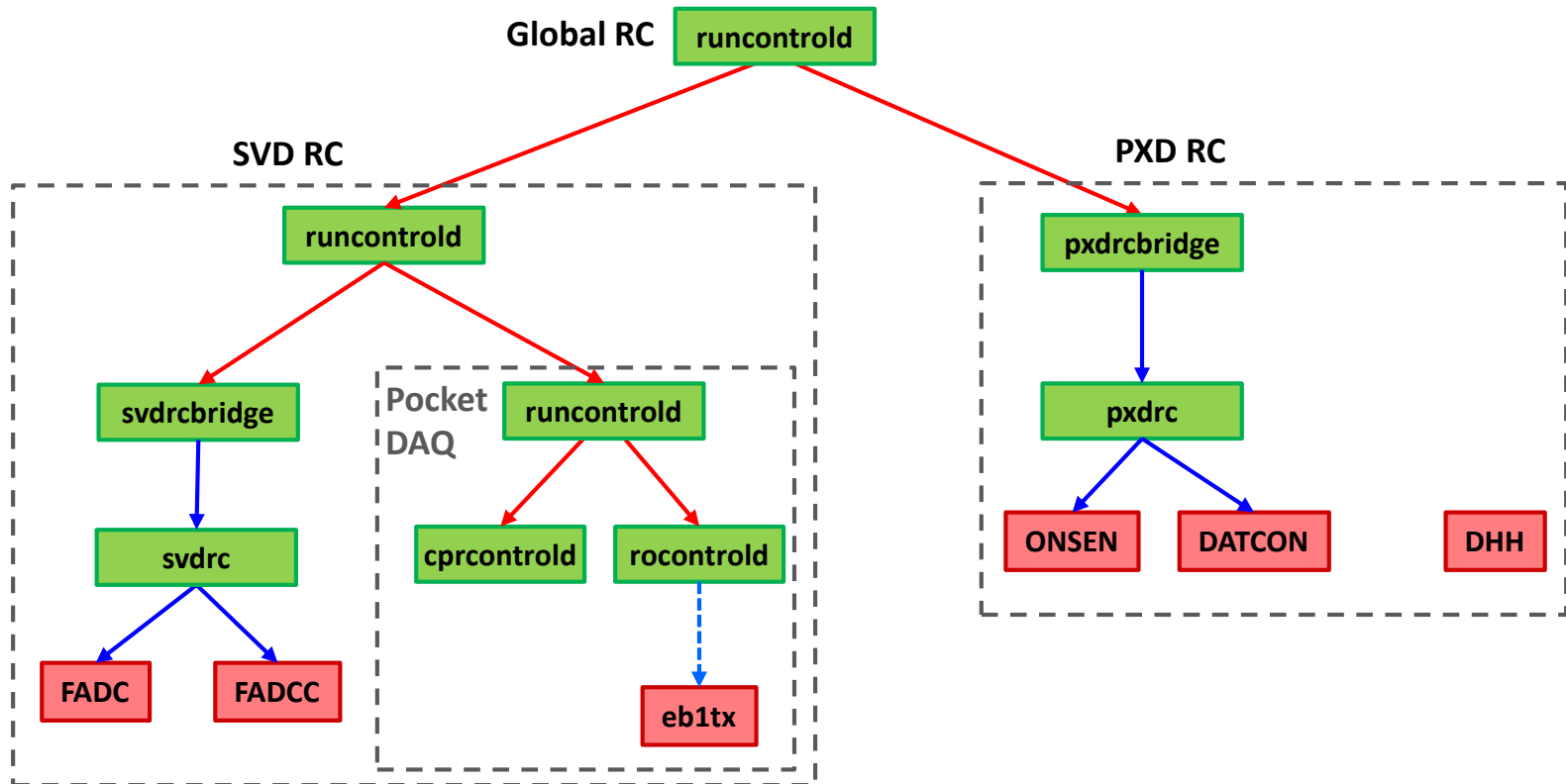
- Three layers of nested run controls
  - Global DAQ : Full system of the Belle II DAQ for physics run
  - Detector DAQ : Detector local DAQ setup for calibration or test
  - Pocket DAQ : COPPER and RO PC for HSLB readout
 => Each layer of run control is controllable from GUI (by detector experts)
- Run control is a distributor of control request
  - Run configuration is provided from DAQ DB
  - Error messages are transferred in opposite direction

# Control tree to DAQ components



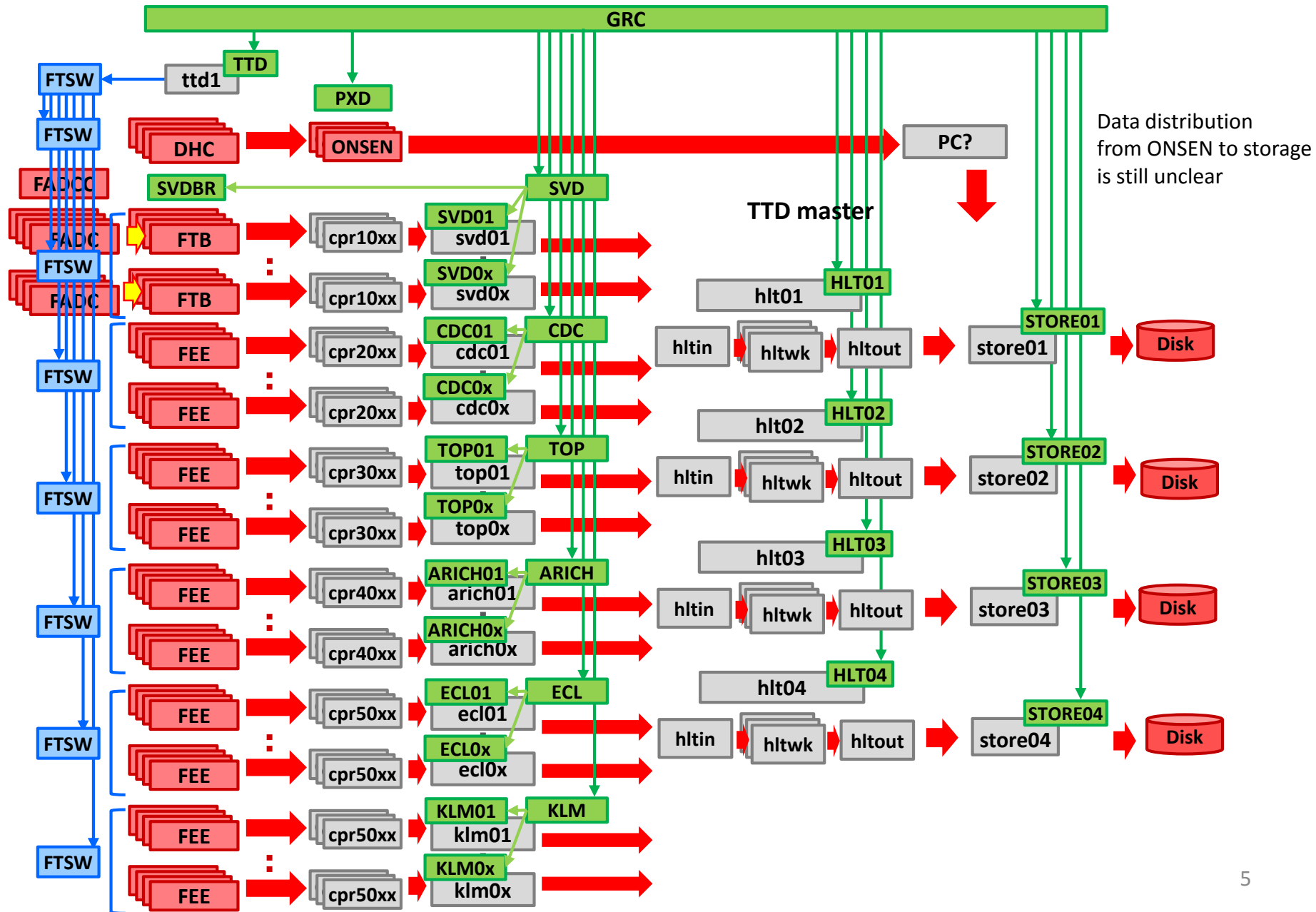
- Three layers of nested run controls
- HLT unit also has runcontrol to merge eb1rx and HLT local control
- eb0 + eb1tx, eb1rx and eb2rx : under control of rocontrol, eb1rx and storagerd

# Control tree to SVD / PXD subsystems



- pxdrcbridge and svdrcbridge are EPICS-NSM bridges
  - pxdrc : a core of PXD local run control
    - DHH (sensor also) is out of run control but in power supply control
  - svdrc : a core of SVD local run control

# Global run control tree



# Operation status

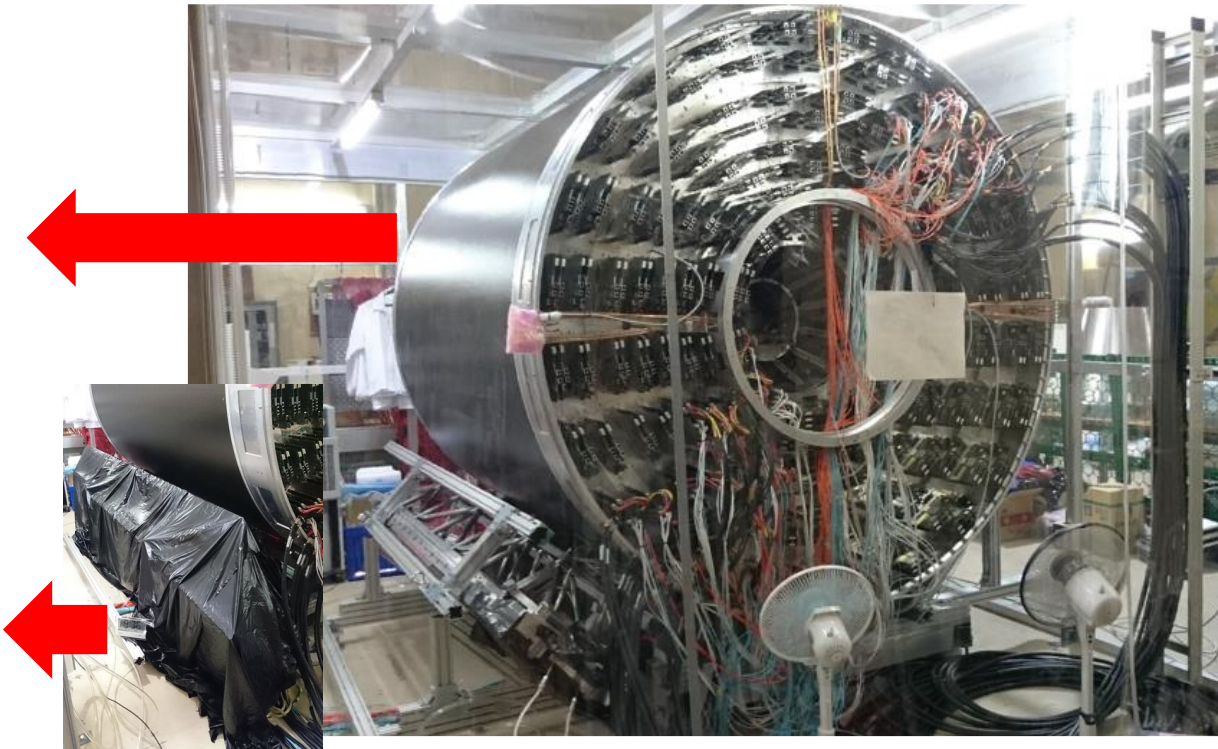
# Operation of Belle II DAQ system

Belle II DAQ is now used everywhere for Cosmic Ray Test (CRT) and beam test

- CRT operation for installed detectors
  - ECL : The first success of **Global DAQ**
  - TOP : **Global DAQ** or Pocket DAQ for firmware development
  - KLM : Pocket DAQ for FEE development and detector test
- CRT near to the Belle II detector in Tsukuba hole
  - CDC + TOP : **Full global DAQ with multiple detectors**
  - AIRCH : Pocket DAQ with **slow control GUI**
    - **Local run** for threshold measurement with LEDs
- VXD (= PXD + SVD) **beam test at DESY** : Copy of full global DAQ
  - 2014 Jan. : Establishment of RoI feed back scheme
  - 2016 Apr. : Slow control and analysis software
  - 2016 Nov. : Scheduled to test final design of VXD readout

# Cosmic ray test : CDC + TOP

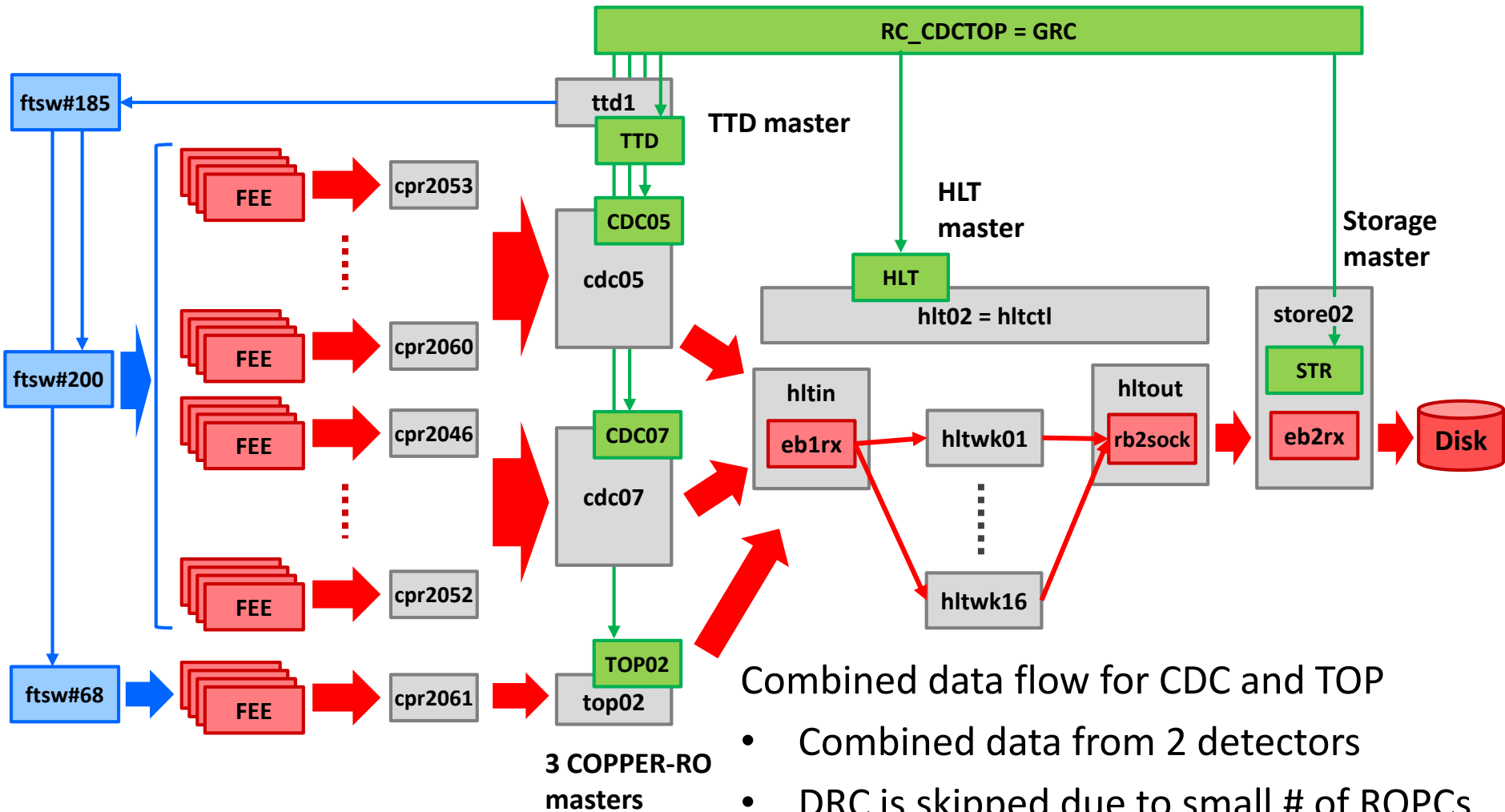
Ehut



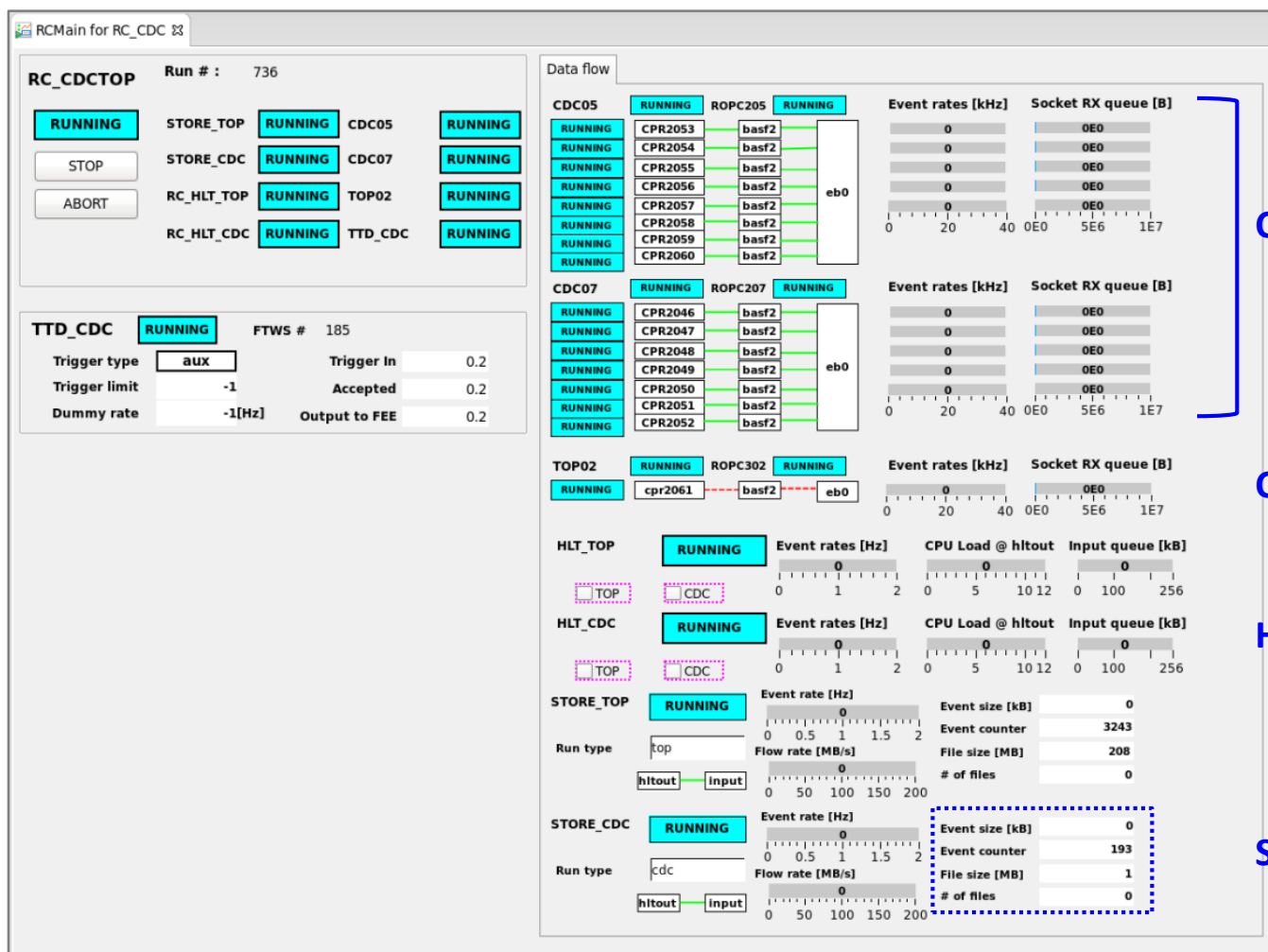
- Placed at clean tent in Tsukuba BF4 (close to Ehut and detector)
- CDC itself is very stable and collecting cosmic ray for more than 10 months
- A TOP module is installed to work synchronously with CDC
  - Many of firmware developments has been proceeded



# CRT for CDC+TOP



# RC GUI for CDC+TOP



- Two data flows in a control GUI working in a VNC screen
  - Bad GUI with patchworks => need to be improved (not yet!)

# How to operate DAQ

1. Set TTD condition on ttd1:

\$ ttaddr -200 -g; FTSW#200 (cdc05 and cdc07) as daughter

\$ ttaddr -68 -g; FTSW#68 (top02) as daughter

\$ ttaddr -185 -l ; FTSW#185 as master

2. Open VNC session

– Make a ssh tunneling:

\$ ssh -L 5905:b2shift1.daqnet.kek.jp:5905 -f -N <youraccount>@bdaq.local.kek.jp

– Open VNC viewer and access to localhost:5"

=> You will find the control GUI in the screen

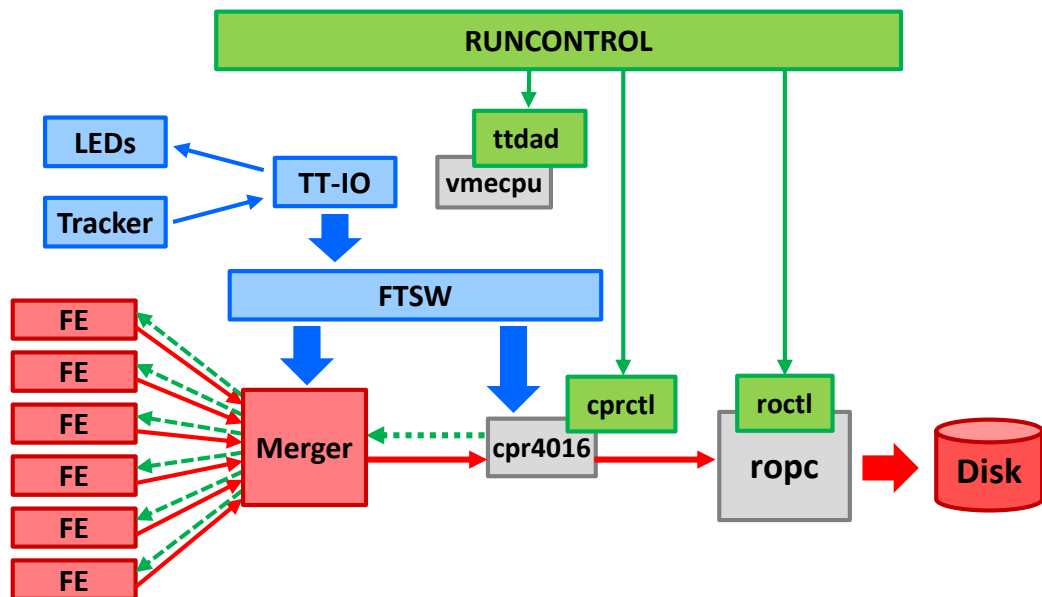
3. Push LOAD button to make all components **READY**

– Push START button to make all **RUNNING**

=> Check if Event counter in STORE\_TOP increases

4. Push ABORT button to stop DAQ and make all **NOTREADY**

# ARICH cosmic ray test

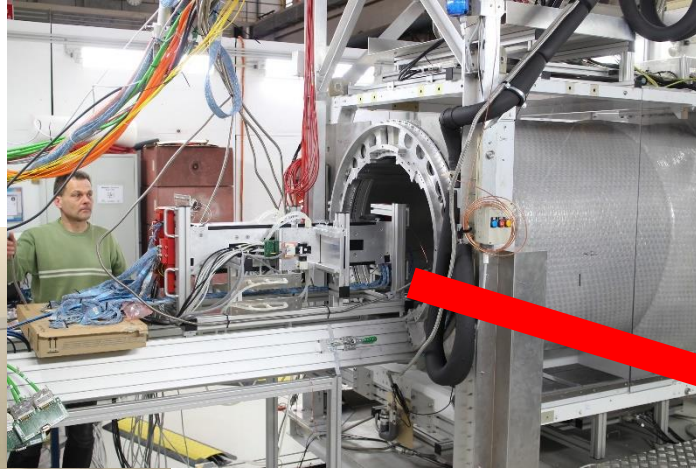


- ARICH structure partially assembled at B4
- PocketDAQ with control GUI
  - Only single Merger-HSLB for now  
=> 6 HAPDs on structure are online
- External trigger from TT-IO board
  - LED trigger for threshold scan
  - Cosmic test for ring image study

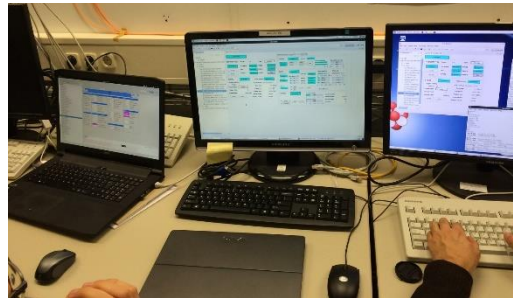
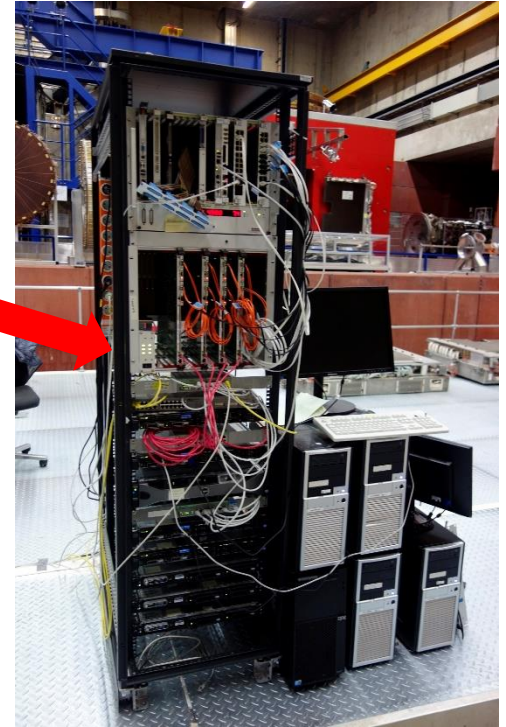


# Belle II VXD beam test (April 2016, DESY)

VXD  
@beam line



DAQ pre-setup @hall west

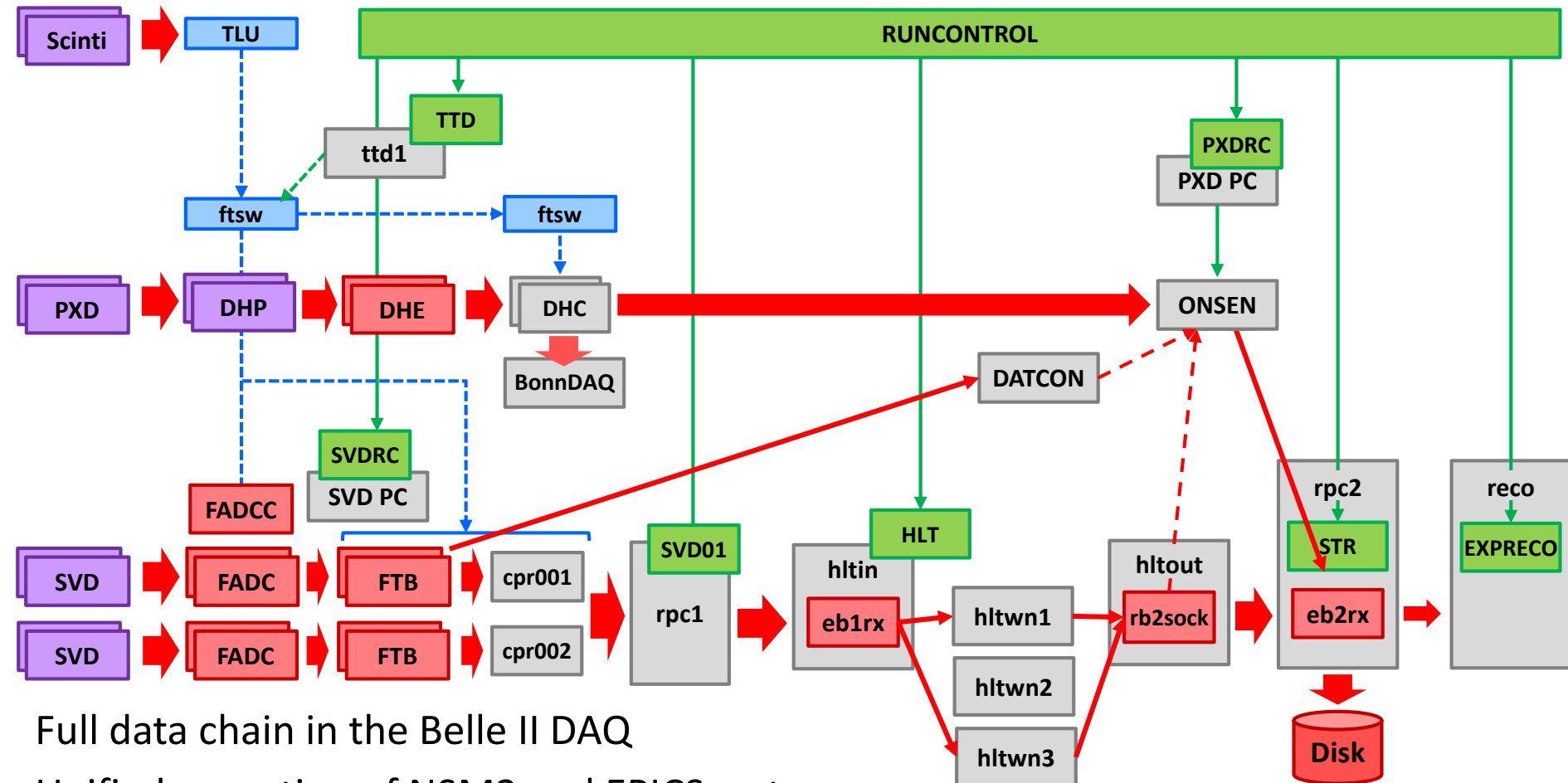


- A beam test for the Belle II VXD at DESY electron test beam facility at April 2016
  - Combined test for VXD(SVD+PXD), DAQ and offline software
- High rate test of RoI feedback in the real beam up to a few kHz
- Demonstration of the full global slow control scheme
- DAQ stability when repeating start and stop runs



# DAQ setup at VXD BT

- - - - - Trigger timing  
 - - - - - Data  
 - - - - - Slow control



Full data chain in the Belle II DAQ

Unified operation of NSM2 and EPICS systems

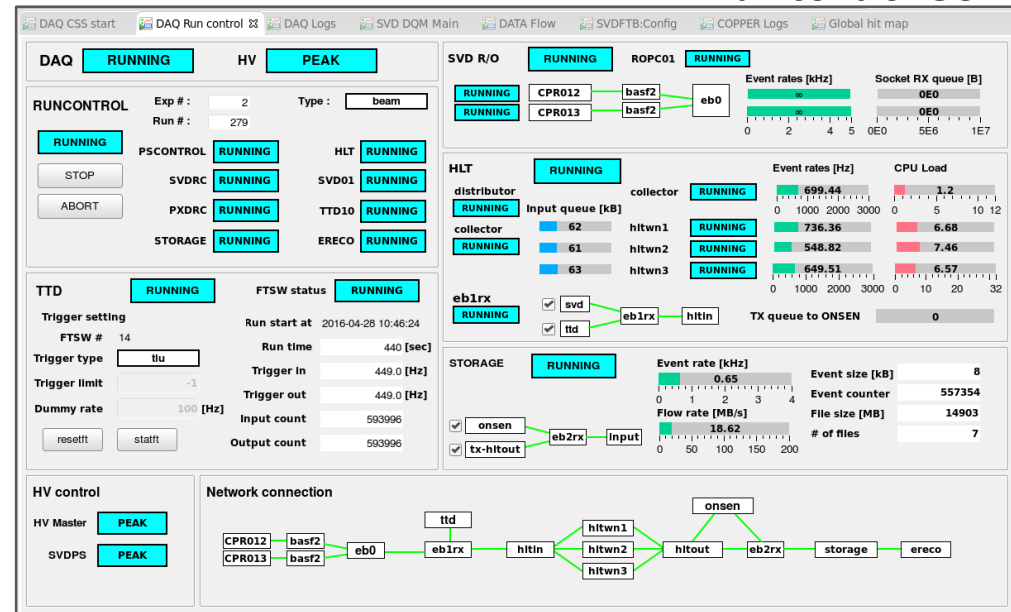
- SVD RC : FADC + FADCC and PS
- PXD RC : ONSEN + DATCON

# Run control /config. GUIs

## Run control GUI

- Run start / stop
- Operation of sub systems
  - Trigger settings
- Flow monitor at each point
  - Network connection
  - Event rate
  - Data in queues

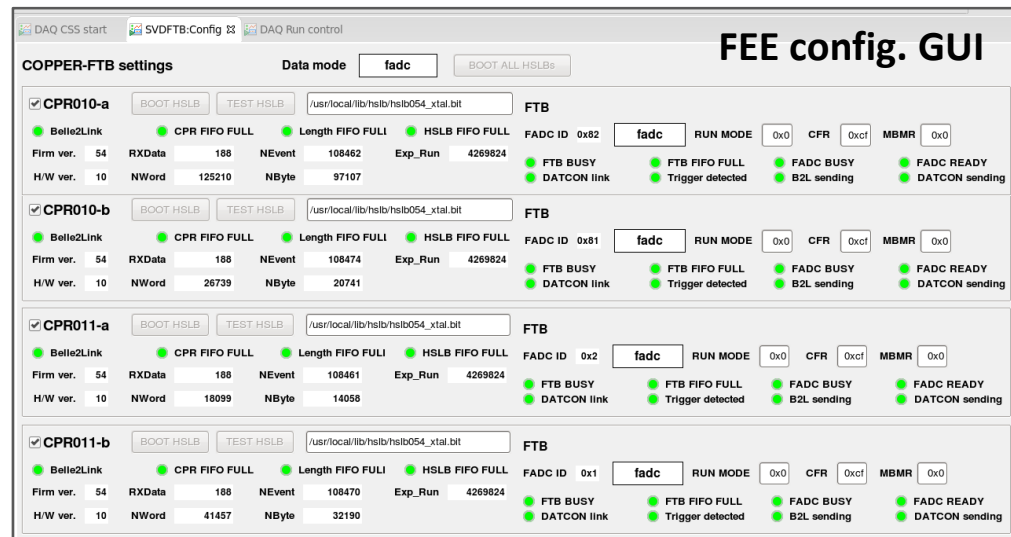
## Run control GUI



## SVD FEE Config. GUI

- HSLB setting
- Operation of SVD FTB via COPPER-HSLB
  - Monitoring SVD FEE status

## FEE config. GUI



# Operation crews and problems

Some CRT run controls are taken over to non DAQ experts

- CDC : Nanae-san => Very stable and
- TOP (+CDC) : Maeda-san, Alessandro
- ARICH : Luka, Yonenaga-san => for both threshold scan and cosmic

=> **Tanks to their efforts and feedbacks**

But we failed to take over the control in the last VXD beam test yet

- Complex procedure of recovering
  - ONSSEN required amount of typing until very last of the beam time  
=> Cold restart can be done by a button
- Error investigation was complicated because
  - Event mixing could not be detected online (Yamada-san checked by hand)  
=> PXD Unpacker will check data format and make error flags
  - HLT logs were difficult to see and could not provided to GUI  
=> Logs are now easier to see and provided to GUI

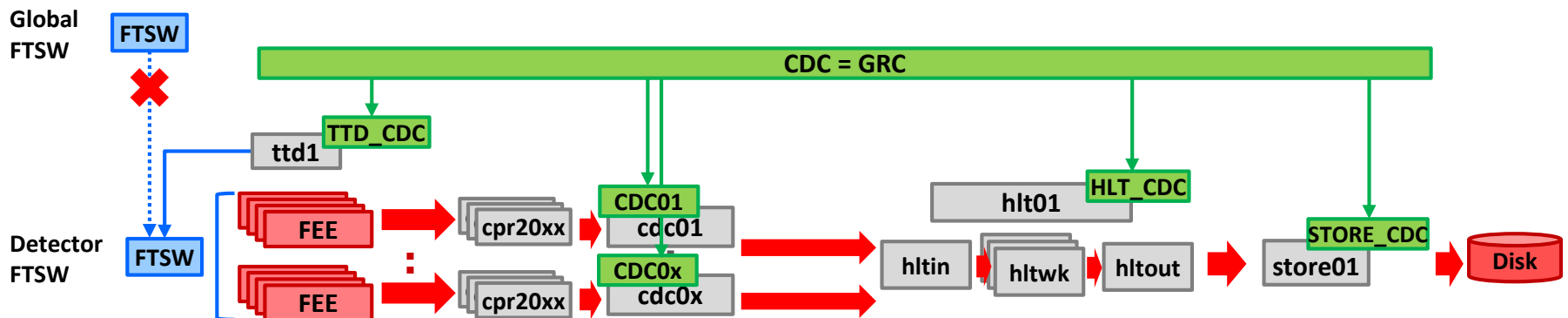
=> **Operation will be done by non-expert at the next beam test**



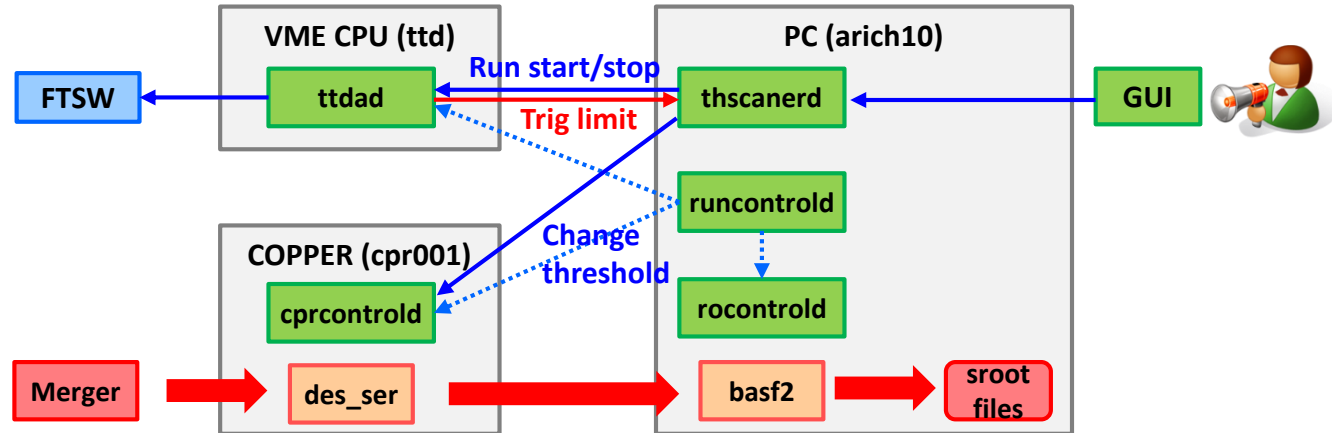
**Local run**

# Local run control

- PXD : BonnDAQ without ONSEN
  - SVD : Dedicated readout to Flash ADC without COPPER
- => I do not care them in detail!
- Others : Partial copy of the global DAQ (=PocketDAQ + a HLT unit)
    - Current CDC-CRT control is exactly the local run control
  - Special handling for threshold scan in ARICH :
    - $O(100)$  cycles of changing FEE config. and taking data
- =>  $O(100)$  runs in a measurement
- **Similar case is possible in other detectors?**



# Local run for ARICH (current)



- thscanerd : control slow control components from threshold scan  
=> Repeating trigger start/stop with changing threshold
  - Reads trigger output count until maximum of # triggers
  - Write threshold values via COPPER-HSLB
  - Send trigger start / stop instead of run control master
- Run controller master is not used during threshold scan

# Control GUI

RCMain for RC\_CDC merger.opi

**Run control**

ARICH10 Run #: 1442

READY ROPC410 READY

START CPR4001 READY

ABORT TTD READY

**Trigger info.**

TTD READY FTWS # 28

Trigger type pulse Trigger In 17250.0

Trigger limit 1000 Accepted 0.0

Dummy rate 1000[Hz] Output to FEE 0.0

**Booting FEBs**

Boot FEE Load FEE

off READY

100 5

1000 0

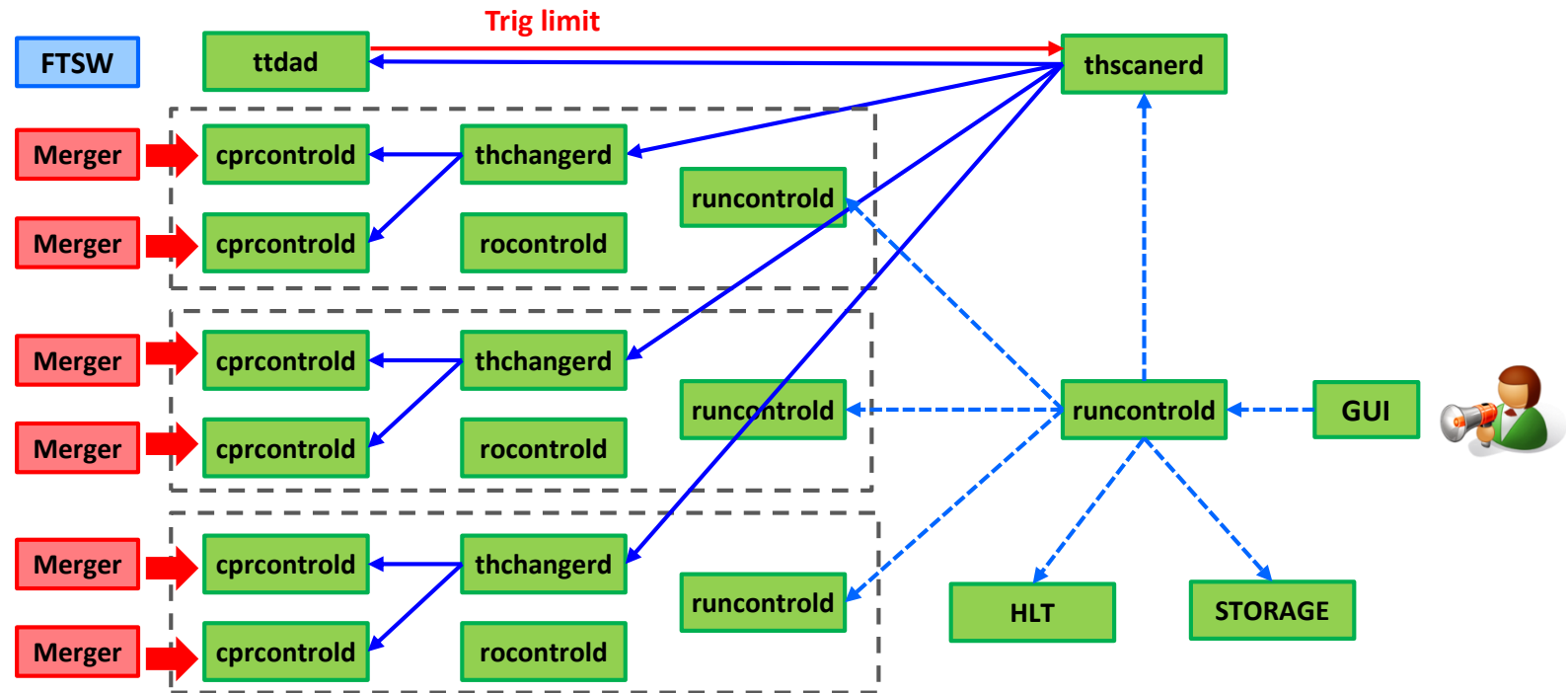
dth 0.004

th0 -0.300

**Threshold scan**

- Setting for threshold scan is editable from GUI
  - # of events per run
  - Difference of threshold value (dth)
  - Initial threshold value (th0)
- Trigger source is also switchable (pulse, aux=LED)

## Local run for ARICH (full system)



- thchangerd is a part of thscanerd before to change threshold values
- thscanerd handle only run start / stop
  - Collect information if configuration of FEE is finished
- Run control master is used to make all R/Os ready before scan

# Experiment and run numbers

- We still do not have practical rule for experiment and run numbers
  - Current idea (in my mind) for global run:
    - Experiment #: monotonically increase by physical period of operation
    - Run #: monotonically increase run-by-run (unique in a experiment#)
  - How about local run?
    - Experiment # should relay on only physical period same as global run
    - Run # should be also unique in a experiment#?
- => Several local run with different detectors go in parallel might cause mixture of run numbers among detectors
- Proposal: text information to identify global / local and which detector
    - Run label: global / pxd / svd / cdc /... / pxd\_svd ...
    - Run number should be unique in a pair of experiment # and run label

Run# is unique  
in a exp#

| Exp # | Run# | Run label |
|-------|------|-----------|
| 1     | 1    | ARICH     |
| 1     | 2    | ARICH     |
| 1     | 3    | CDC       |
| 1     | 4    | ARICH     |

Run# is unique  
in a exp# and  
run type

| Exp # | Run# | Run label |
|-------|------|-----------|
| 1     | 1    | ARICH     |
| 1     | 2    | ARICH     |
| 1     | 1    | CDC       |
| 1     | 3    | ARICH     |

# Summary

- Run control is now in operation for CRT and VXD beam test
  - CRTs for CDC and TOP are done by non-DAQ experts
  - Non-expert runs is a goal in the next VXD beam test
- Local run control is based on PocketDAQ+HLT unit
- A scheme for threshold scan in ARICH has been developed
  - Repeats cycles of changing parameters and taking data
- Rule for Experiment and run # is discussed