Implementation of EPICS configuration of Voltage controls for Hall D detectors

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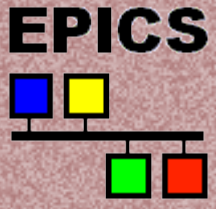
Overview

- Introduction
  - EPICS
  - Hardware (CAEN SY1527, WIENER MPOD)
  - Available driver softwares
- Problem statement and solution
  - Mapping of detector channels into hardware ones
  - DB scheme
  - Start-up configuration example
  - Archiving, Alarm configuration and other external hooks
  - GUI-es and monitoring histograms
- Further development
  - Synchronizing from SQL DB

Introduction: EPICS

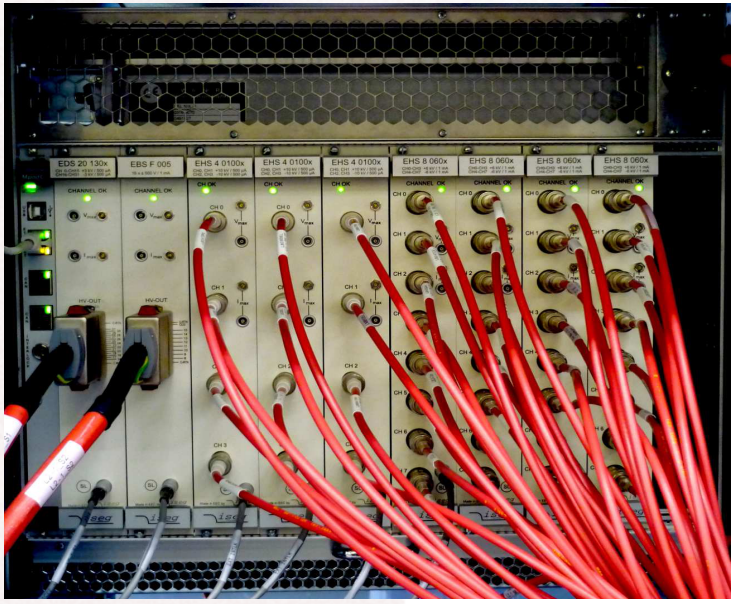
Experimental Physics and Industrial Control System

- EPICS is a set of software tools and applications which provide a software infrastructure for use in building **distributed control systems** to operate devices such as Particle Accelerators, Large Experiments and major Telescopes.
- EPICS uses **Client/Server and Publish/Subscribe techniques** to communicate between the various computers. Most servers (called **Input/Output Controllers or IOC**s) perform real-world I/O and local control tasks, and publish this information to clients using the **Channel Access (CA) network protocol**.
- It is **free, open source,** has a **large user/developer bases**, **clients-server communication is via PV names**, no single point of failure due to DNS server or fixed IP addresses, flexibility scale-ability



Introduction: Hardware

- CAEN SY1527
- Up to 16 slots for boards,distributors and branch controllers
- 6 fans arranged on two rows
- Up to 3 power supply units



- WIENER MPOD
- Up to 10 slots for boards
- A special slot for controller
- Up to 600W HV power

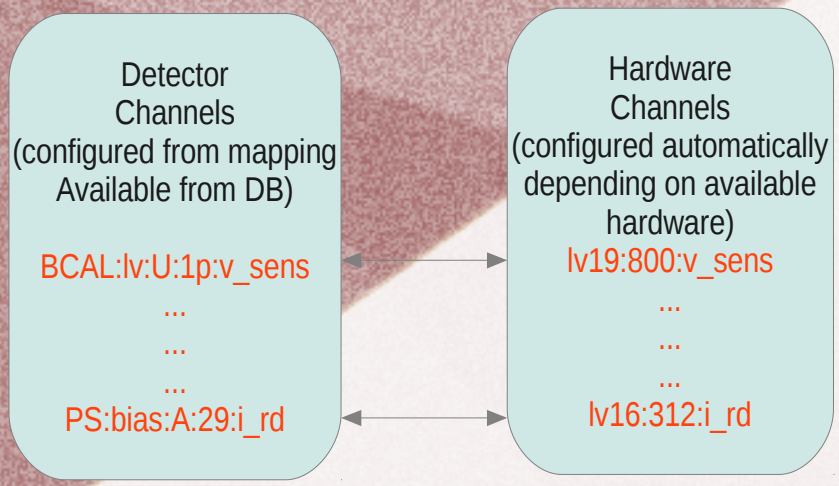
Introduction: Available software present

- Modified Ru's EPICS driver for CAEN SY1527 type of mainframes
- SNMP EPICS driver and WIENER MPOD specific EPICS driver with Benni's modifications

- Both drivers allow an automatic recognition of boards
- Both are allowing automatic configuration of EPICS PV-es

Requirements

- Easy modification and maintainability of:
  - Hardware reconfigurations reflected in the IOC
  - IOC configurations
  - GUI-es
  - Alarms
- Alarm system
- Archiving of channels
- Save/Restore of configuration settings (demanded voltages for example)



Mapping of detector channels into hardware

- The problem is to decide which way to name PV-es
  - Detector wise:

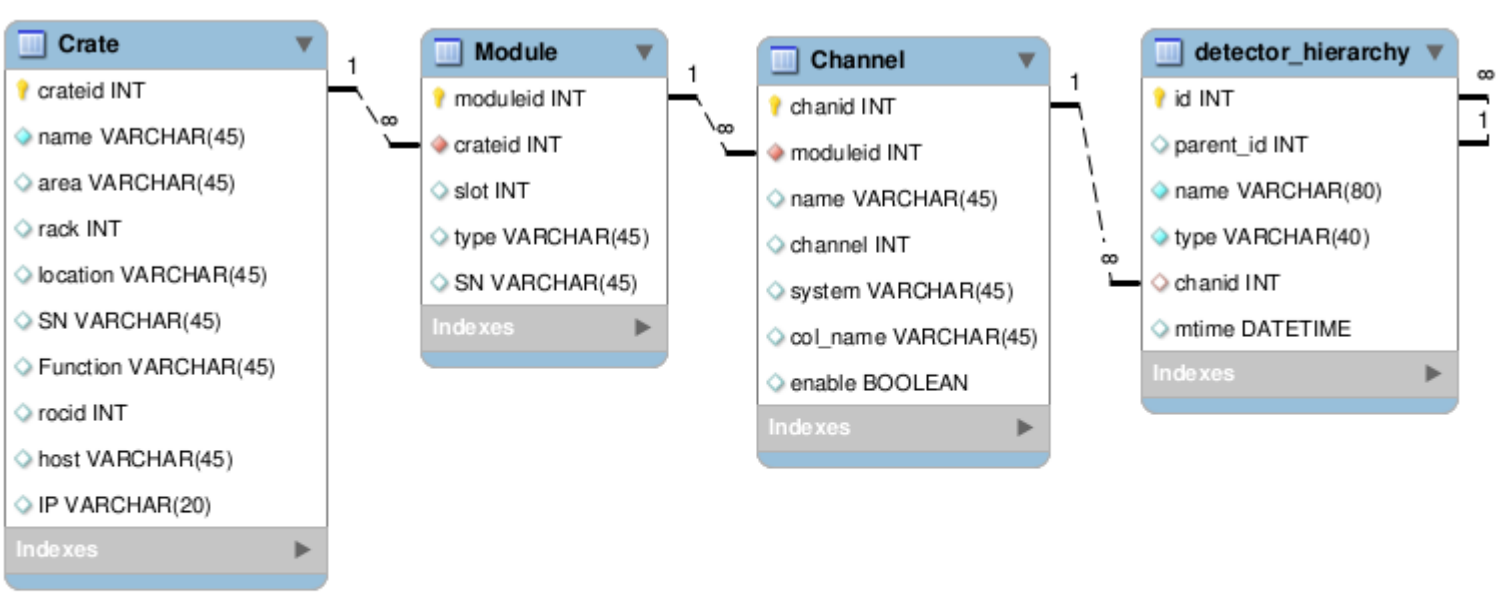
DETECTOR:TYPE:SUBDETECTOR1:SUBSUBDETECTOR1:...:PARAMTER

  - Hardware wise:

CRATE:SLOT:CHANNEL:PARAMTER

- Solution was to have both sets and where Detector PV-es are mapping into Hardware ones
  - For example BCAL:bias:U:48:4:v_sens
  - Corresponds to lv19:515:v_sens
- It is possible to find corresponding HW channel (is accessible via INP or OUT fields)

Data Base



- Using Crate, Module, Channel tables from Translation Tables developed by D. Lawrence (currently SQLite3 DB) from Spreadsheets maintained by F. Barbosa
- Extended the 'Crate' table with 'host' column
- Extended the 'Channel' table with 'enable' column
- Extended with 'Detector_Hierarchy' table
- Mapping in the run-time EPICS IOC DB would be continuously synchronized from SQL DB

Problem & Solution: Start-up configuration example

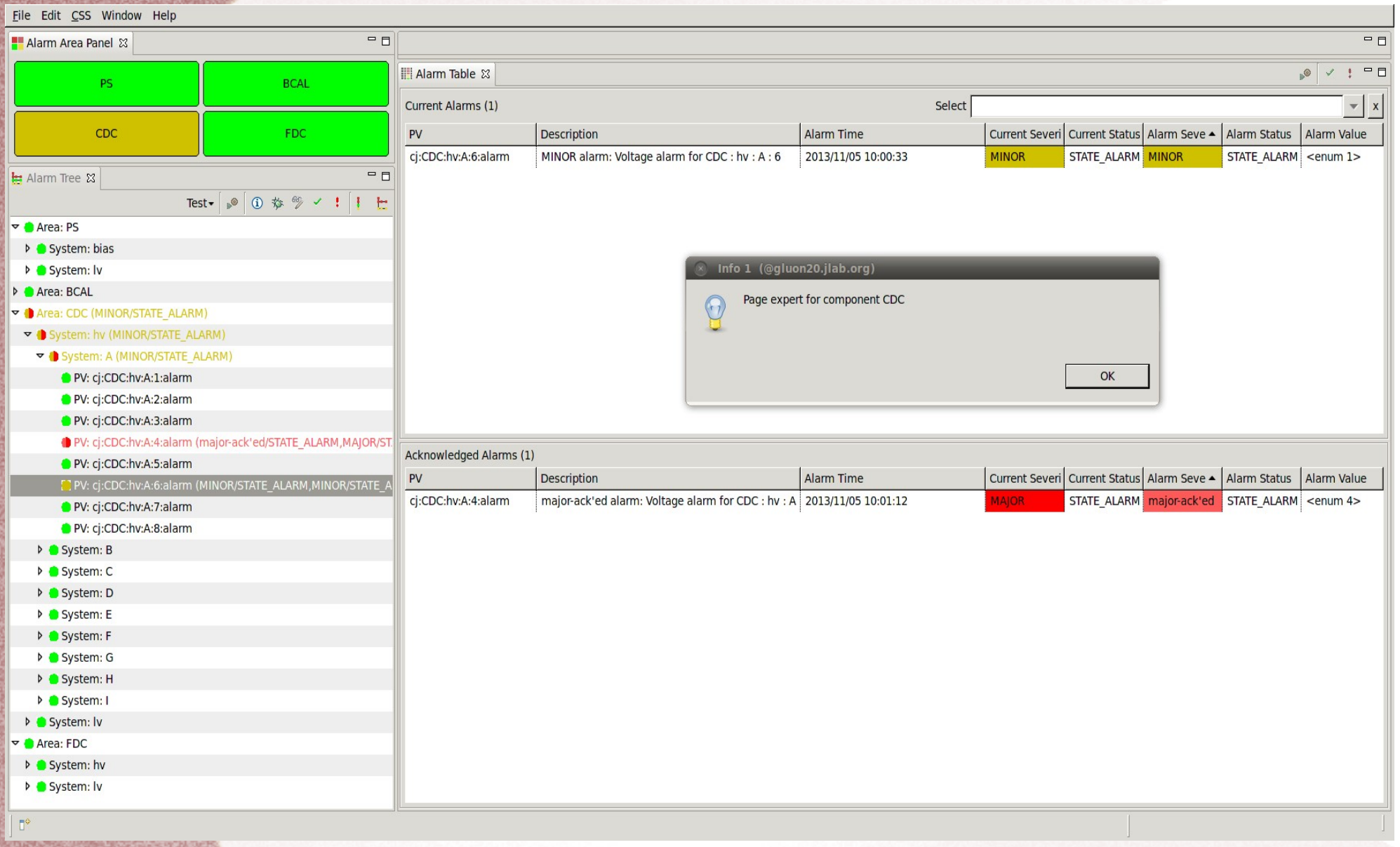
```
#!../../bin/linux-x86/hvCaen
< envPaths
epicsEnvSet("MIB","WIENER-CRATE-MIB::")
epicsEnvSet("WO", "WIENER-CRATE-MIB::output")
cd ${TOP}
dbLoadDatabase "dbd/hvCaen.dbd"
hvCaen_registerRecordDeviceDriver pdbbase
epicsEnvSet("PREFIX","test_")
detUsePrefix ${PREFIX}
detConfigureCrate "BCAL","sqlite:///home/nerses/controls/epics/app/hvCaenApp/src/tt.db"
detDbLoadRecords
dbLoadRecords "db/DetWF.db" "DET=BCAL:bias,PREFIX=${PREFIX},SUFFIX=i_rd,NELM=384"
dbLoadRecords "db/DetWF.db" "DET=BCAL:bias,PREFIX=${PREFIX},SUFFIX=v_sens,NELM=384"
dbLoadRecords "db/DetWF.db" "DET=BCAL:lv,PREFIX=${PREFIX},SUFFIX=i_rd,NELM=48"
dbLoadRecords "db/DetWF.db" "DET=BCAL:lv,PREFIX=${PREFIX},SUFFIX=v_sens,NELM=48"

cd ${TOP}/iocBoot/${IOC}
iocInit
```

Archiving, Alarming, Backup & Restore

- The Archiving of mapping will be done by automatically archiving **INP** or **OUT** fields of detector channel EPICS records
  - New values would be archived on change of mapping
  - Will archive even temporary or accidental changes
- For Alarming of each channel a dedicated PV will have an alarm state
  - MySQL DB for alarms would be generated from the same DB used for mapping detector-hardware Pves.
  - Will have customized values of alarm states calculated depending on hardware type and possible states
- For Backup & Restore we will use MyA based save/restore system developed by accelerator control group.

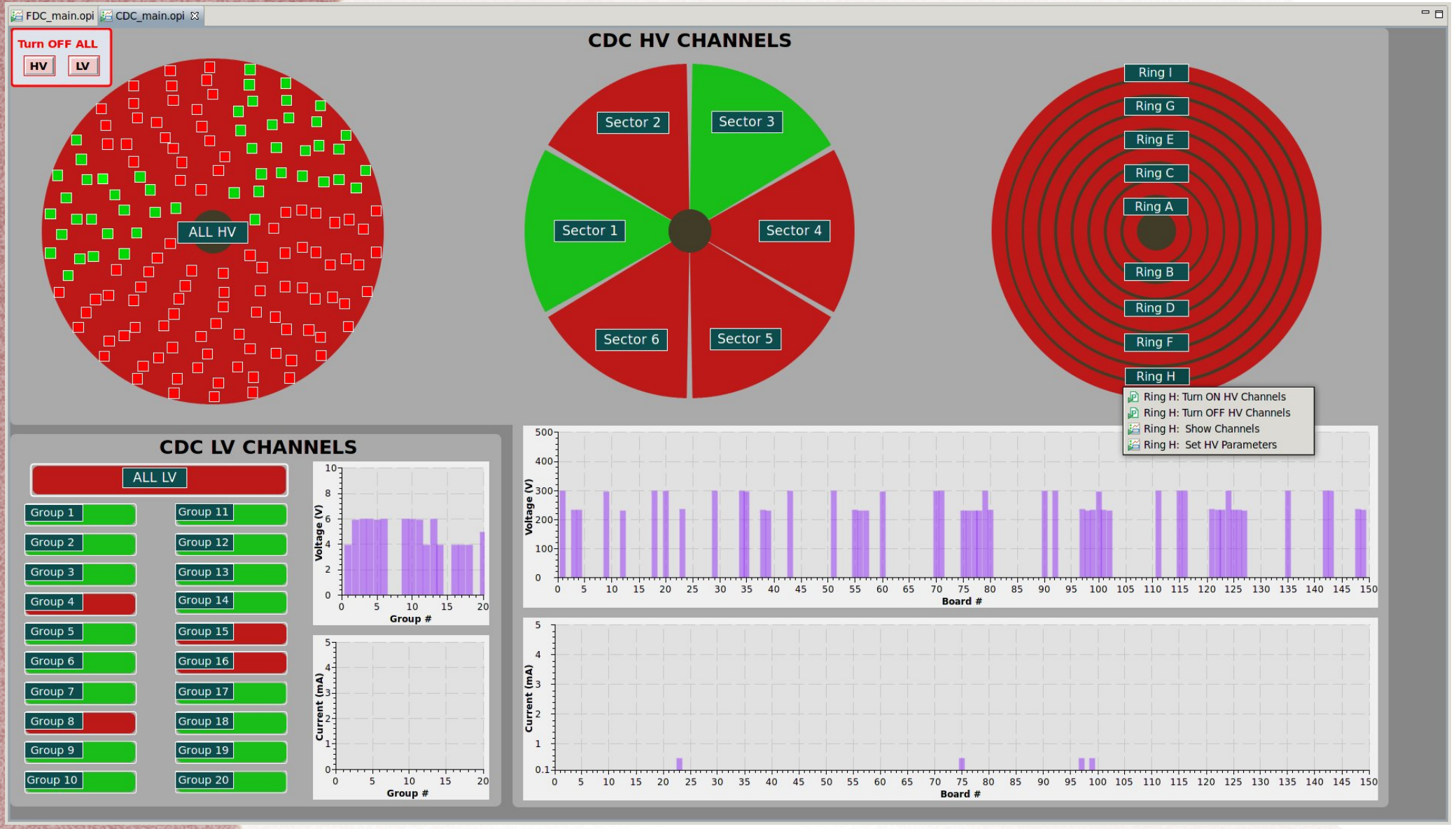
Alarming (Hovanes Egiyan)



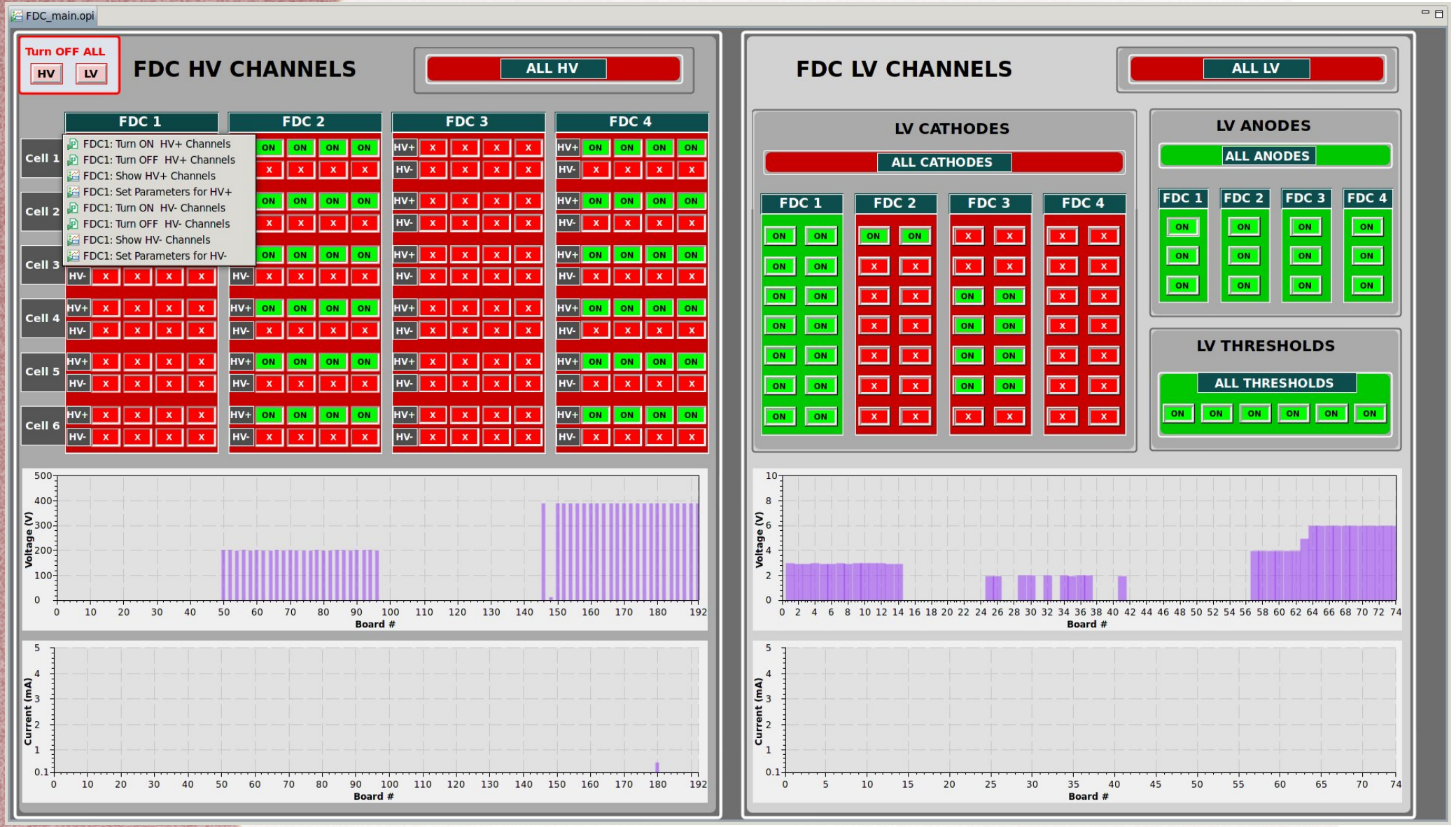
GUI (Vanik Kakoyan)

- GUI-es are made with CSS
- CSS allows use of JavaScript and Python scripts
- Dynamically generated content
- Parallel processing using threads
- Currently GUI-es available for CDC, FDC, PS (contribution from I. Tolstukhin) and BCAL
- Other features...

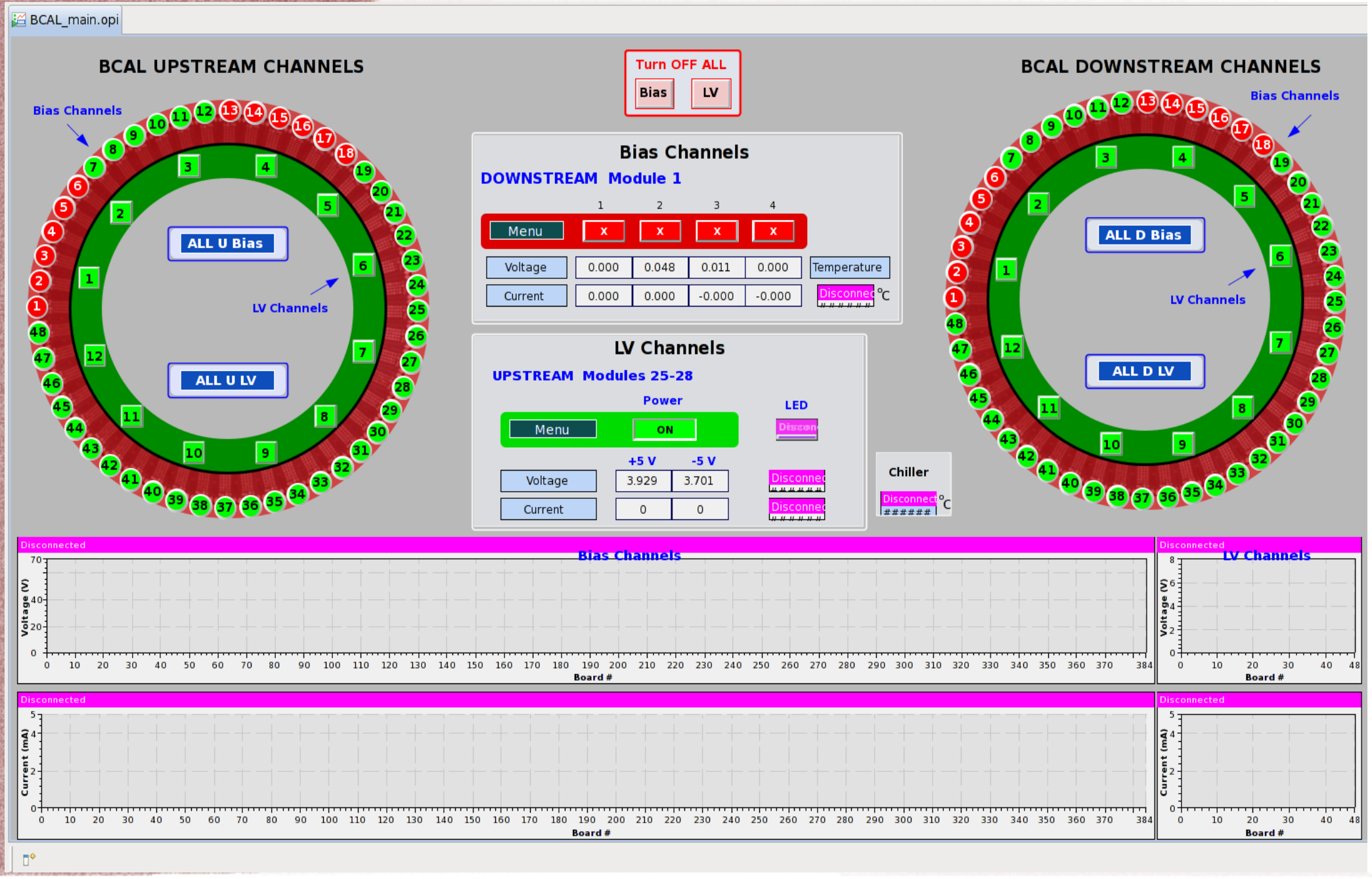
CDC GUI


FDC_main.opi
CDC_main.opi
Turn OFF ALL
HV
LV
CDC HV CHANNELS
ALL HV
Sector 1
Sector 2
Sector 3
Sector 4
Sector 5
Sector 6
Ring I
Ring G
Ring E
Ring C
Ring A
Ring B
Ring D
Ring F
Ring H
Ring H: Turn ON HV Channels
Ring H: Turn OFF HV Channels
Ring H: Show Channels
Ring H: Set HV Parameters
CDC LV CHANNELS
ALL LV
Group 1
Group 2
Group 3
Group 4
Group 5
Group 6
Group 7
Group 8
Group 9
Group 10
Group 11
Group 12
Group 13
Group 14
Group 15
Group 16
Group 17
Group 18
Group 19
Group 20
Voltage (V)
Group #
Current (mA)
Group #
Voltage (V)
Board #
Current (mA)
Board #

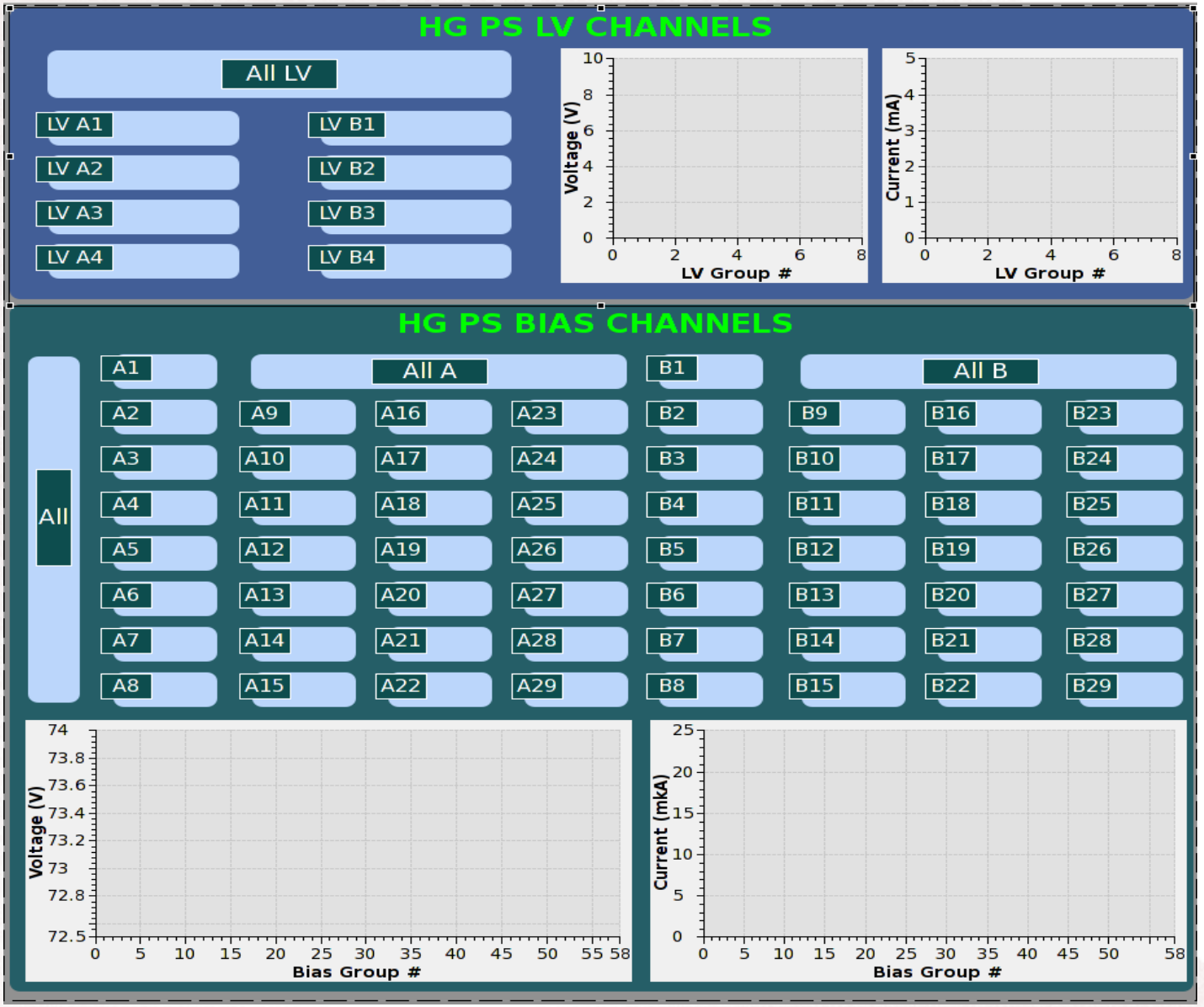
FDC GUI


FDC_main.opi
Turn OFF ALL
HV
LV
FDC HV CHANNELS
ALL HV
FDC 1
FDC 2
FDC 3
FDC 4
Cell 1
Cell 2
Cell 3
Cell 4
Cell 5
Cell 6
FDC1: Turn ON HV+ Channels
FDC1: Turn OFF HV+ Channels
FDC1: Show HV+ Channels
FDC1: Set Parameters for HV+
FDC1: Turn ON HV- Channels
FDC1: Turn OFF HV- Channels
FDC1: Show HV- Channels
FDC1: Set Parameters for HV-
Voltage (V)
Board #
Current (mA)
Board #
FDC LV CHANNELS
ALL LV
LV CATHODES
ALL CATHODES
LV ANODES
ALL ANODES
LV THRESHOLDS
ALL THRESHOLDS
Voltage (V)
Board #
Current (mA)
Board #

BCAL GUI


BCAL_main.opi
BCAL UPSTREAM CHANNELS
Bias Channels
ALL U Bias
LV Channels
ALL U LV
Turn OFF ALL
Bias
LV
Bias Channels
DOWNSTREAM Module 1
1 2 3 4
Menu x x x x
Voltage 0.000 0.048 0.011 0.000 Temperature
Current 0.000 0.000 -0.000 -0.000 Disconnec ℃
LV Channels
UPSTREAM Modules 25-28
Power
LED
Menu ON
+5 V -5 V
Voltage 3.929 3.701
Current 0 0
Chiller
Disconnect ℃
BCAL DOWNSTREAM CHANNELS
Bias Channels
ALL D Bias
LV Channels
ALL D LV
Disconnected
Bias Channels
Voltage (V)
Board #
Disconnected
LV Channels
Voltage (V)
Board #
Disconnected
Current (mA)
Board #
Disconnected
Current (mA)
Board #

PS GUI (Ivan Tolstukhin)



Voltage Parameters GUI

CDCHV_Channels.opi

Ring H **CDC HV Channels**

Channel Name	Crate Slot Channel #	Measured Voltage	Voltage Setpoint	Voltage Setpoint Readback	HV ON/OFF	Channel Status	Measured Current	Trip Current Setpoint	Trip Current Readback	Trip Timeout Setpoint	Trip Timeout Readback	Max Voltage Setpoint	Max Voltage Readback	Ramp Up Rate Setpoint	Ramp Up Rate Readback	Ramp Down Rate Setpoint	Ramp Down Rate Readback
H:1	kyzhv39:0:1	299.50	0	300.00		On	0.00	0	300	0	10	0	3,500	0	100	0	100
H:2	kyzhv39:0:1	300.00	0	300.00		On	0.00	0	300	0	10	0	3,500	0	100	0	100
H:3	kyzhv39:1:1	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:4	kyzhv39:1:1	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:5	kyzhv39:1:1	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:6	kyzhv39:1:2	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:7	kyzhv39:2:1	235.50	0	237.00		On	0.50	0	6	0	300	0	2,399	0	100	0	100
H:8	kyzhv39:2:1	234.00	0	237.00		On	0.50	0	2	0	300	0	2,399	0	100	0	100
H:9	kyzhv39:2:1	232.50	0	237.00		On	0.00	0	2	0	300	0	2,399	0	100	0	100
H:10	kyzhv39:2:2	233.00	0	237.00		On	0.00	0	2	0	300	0	2,399	0	100	0	100
H:11	kyzhv39:2:2	233.00	0	237.00		On	0.50	0	2	0	300	0	3,500	0	100	0	100
H:12	kyzhv60:0:1	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:13	kyzhv60:0:2	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:14	kyzhv60:0:2	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:15	kyzhv60:0:2	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:16	kyzhv60:1:1	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:17	kyzhv60:1:1	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:18	kyzhv60:1:2	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:19	kyzhv60:1:2	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:20	kyzhv60:2:1	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:21	kyzhv60:2:1	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:22	kyzhv60:2:1	0.00	0	0.00		Off	0.00	0	0	0	0	0	0	0	0	0	0
H:23	kyzhv39:0:1	300.50	0	300.00		On	0.00	0	300	0	10	0	3,500	0	100	0	100
H:24	kyzhv39:0:1	300.50	0	300.00		On	0.00	0	300	0	10	0	3,500	0	100	0	100

TODO

- Slow communication of MPOD driver on the gluon machines (is normal on curlyjoe RHEL5.10)
- For CAEN HV boards read out of hardware maximum Voltage settings
- Fix the channels sequence in the histograms
- Documentation
- Other detectors (FCAL, Tagger, ...)
- Other hardware (Indiana University Cockroft-Walton Bases) and tagger microscope bias control boards.

Summary

- A lot of progress was achieved to implement this scheme. But we are flexible to accommodate some adjustments in the future like implementation of special requirements for a particular detectors.
- Much progress was achieved with DB, monitoring, histograms, GUI-es, Alarms
- A lot of things should be done. Some of major things are:
  - Alarm configuration
  - Hooking with archiver
  - Backup/restore
  - Fixing slow speed with MPOD
  - Other sources of information on the detector-hardware mapping