Status of KLM Slow Control System

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Overview of this talk

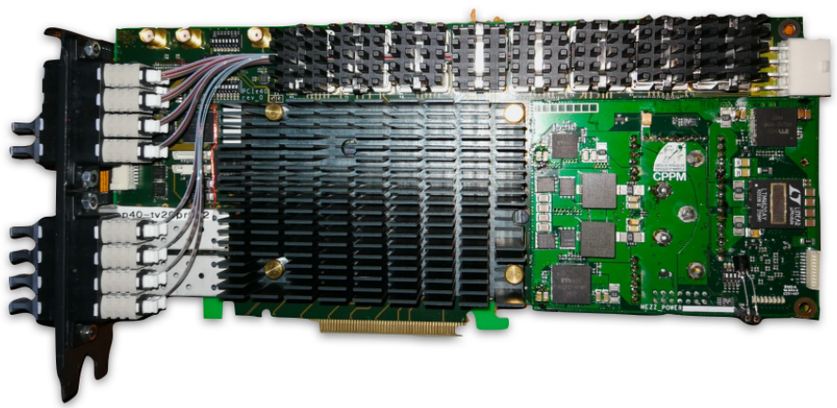
- PCIe40 based readout system
- KLM Run Control GUI
- BB2 efficiency loss
- KLM activities related to the DCS group
- RPC Gas Flow Monitoring
- Interlock system for HV
- HV CAEN mainframe firmware ~~upgrade~~ update
- Improvements of KLM HV control GUI
- OS upgrade for KLM shifter and HV control PCs

PCIe40 upgrade

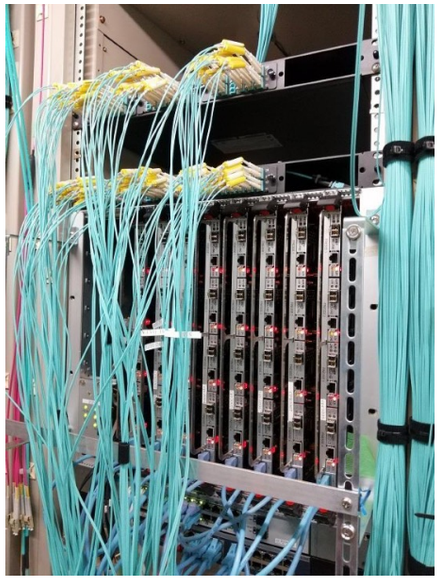
- KLM is running smoothly with the new PCIe40 based readout system.

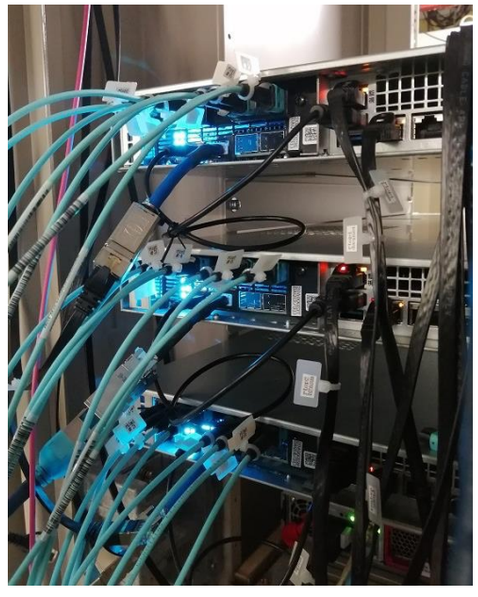
Each COPPER board could serve 4 Belle2links, whereas, each PCIe40 board can serve up to 48 belle2links.

COPPER based readout



PCIe40 based readout

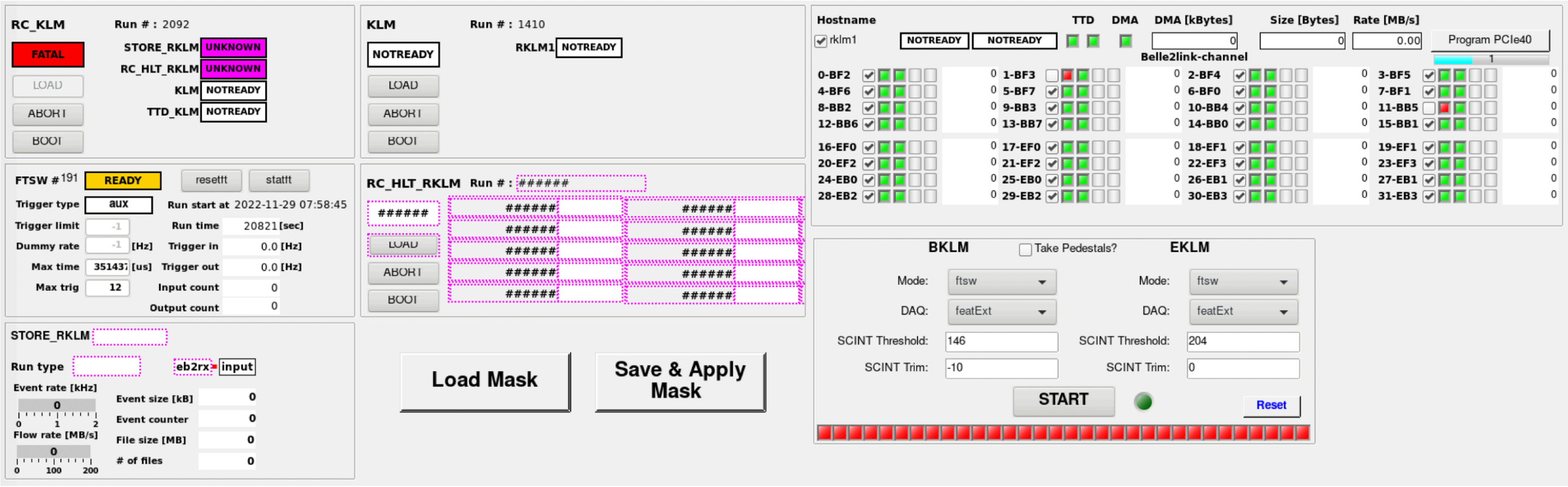




- No major readout related issue during the last data taking period.

- Eliminates complicated debugging process for COPPER based readout.
  - PCIe40 firmware reprogramming and driver reload can be done directly from GUI.

New KLM RunControl GUI for PCIe40 based readout



Config. DB interface for the TTD system

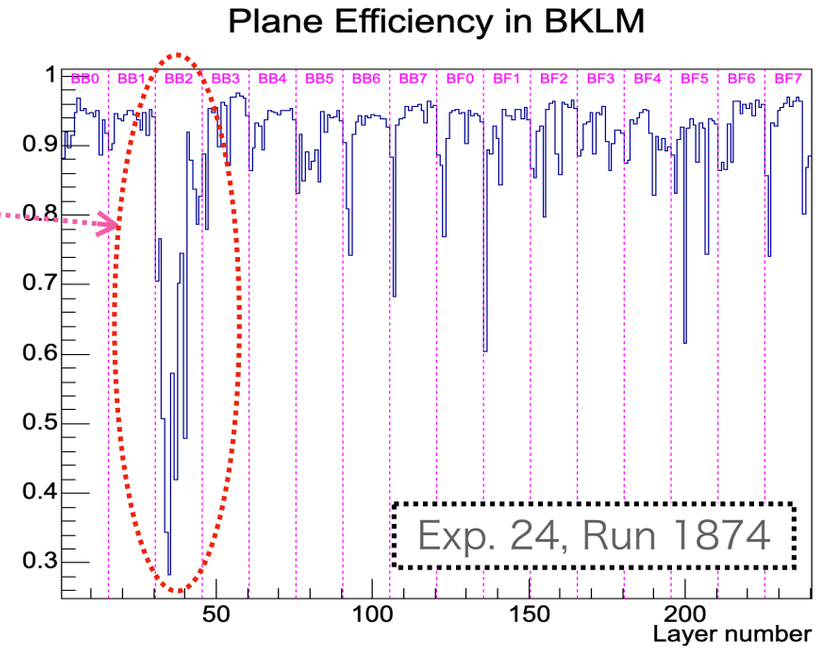
Previously, one had to run ttaddr commands to exclude a FEE from the TTD side.

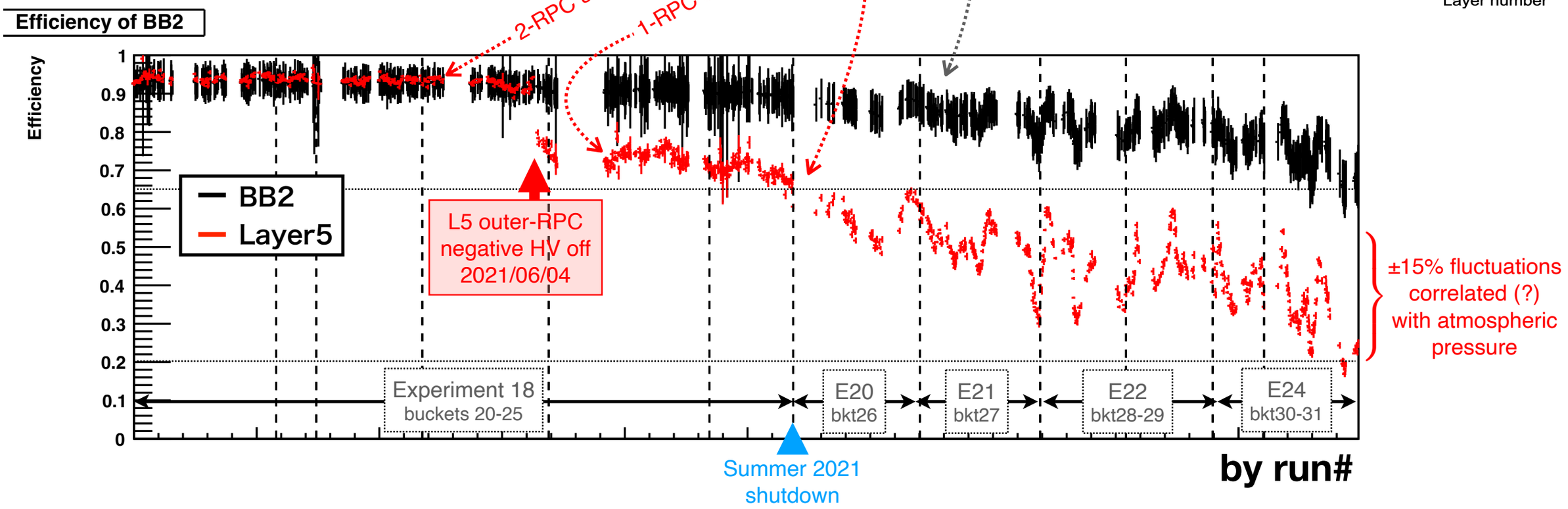
A new functionality has been added to the new PCIe40 based RunControl GUI based on *maskdb* to easily include/exclude subsystem FEEs.

Now the Save/Load FEE Masking buttons automatically creates/loads *maskdb* entries and applies it.

BB2 efficiency loss

- In April 2022, newly implemented efficiency plots in DQM showed low efficiency in most BB2 RPC layers
- From off-line calibration-data efficiency measurements, this trend had started near end of Expt 18 (~June 2021) – particularly noticable for BB2 RPC layer 5
- Almost certainly due to water-vapour contamination via diffusion into input-line polyethylene tubing interior (seen in 1999 before start of Belle operation, cured by switch to copper tubing + months-long drying out)





- Polyethylene RPC-inlet tubing for BB2 was only partially replaced with copper due to access difficulty around solenoid's liquid-helium chimney – only this sector still has long poly tubing

[Courtesy: Leo Piilonen's talk at BPAC, October 2022]

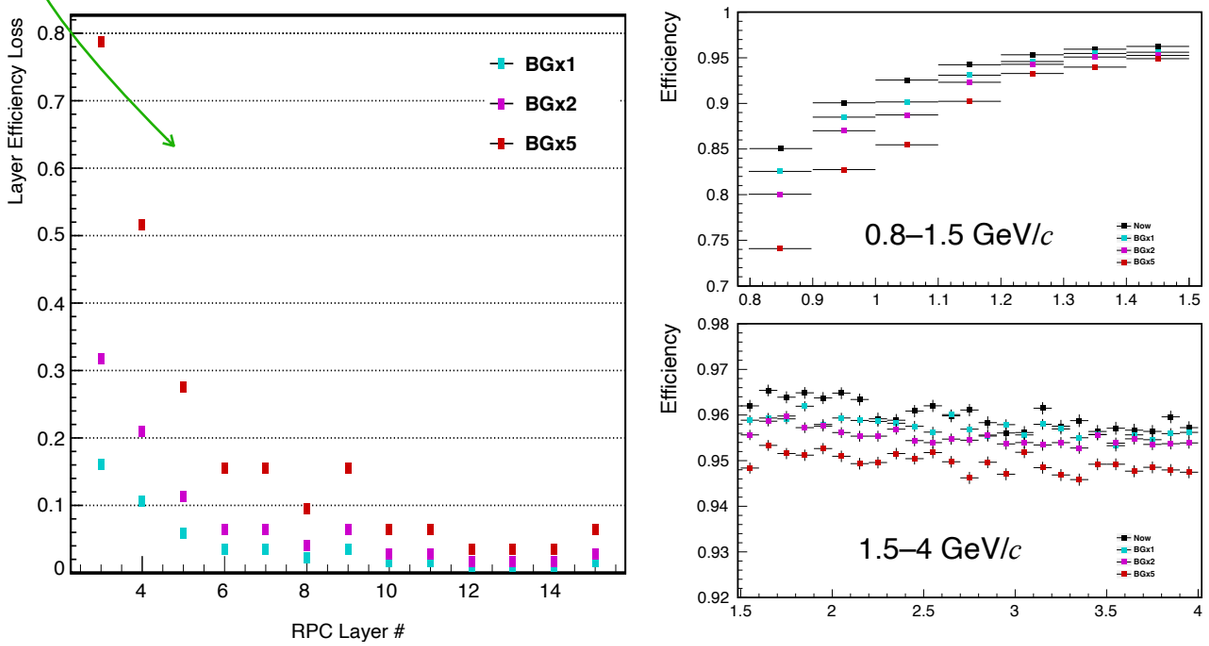
BB2 efficiency loss remediation

Status: 1. Dry out the BB2 RPC's

2. Measure efficiencies and hit rates

3. Estimate physics impact of lower BB2 efficiency

- *From November:* Simulate single-track muons in BB2 with range of RPC detection efficiencies to assess impact on muon-identification performance
  - similar to the study done for KLM Upgrade Proposal, where MUID performance was evaluated under very high background conditions in RPCs (up to 5× expected background at 8×10^{35} cm^{-2} s^{-1} luminosity)
- Determine acceptable threshold of efficiency recovery via drying *but no other active intervention (e.g., NH_3 flush)*



[Courtesy: Leo Piilonen's talk at BPAC, October 2022]

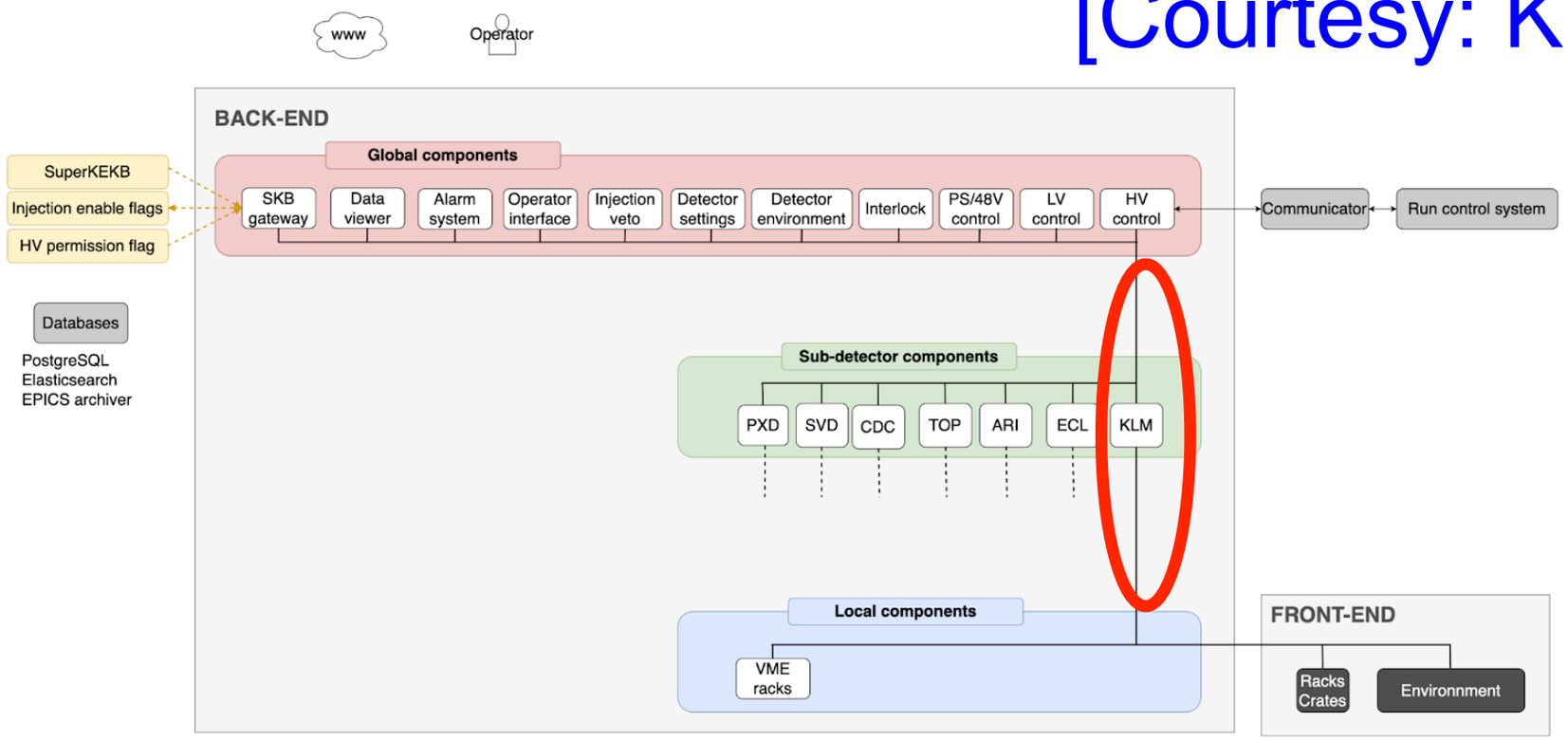
Ongoing: 1. Improvements data quality monitoring and alerts.

2. Establish/operate RPC test stand

3. RPC gas bubbler monitoring system used in Belle era

Detector Control system (DCS) architecture

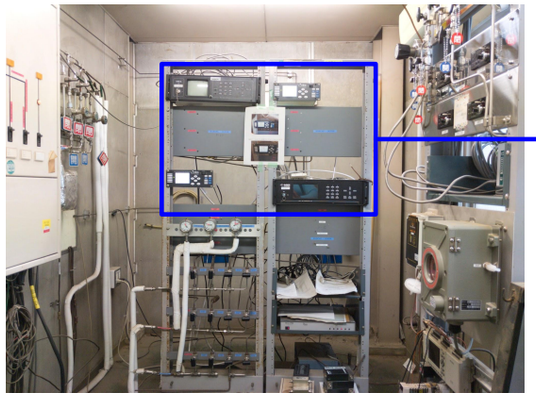
[Courtesy: Kunigo-san]



Target of the detector control system

- High voltage control
- Low voltage control
- Power supply
- SKB gateway
- Interlock
- Detector environment (Gas, heating, chiller, etc)
- Detector setting parameters (V-threshold, masking, etc)
- + Operator interfaces (with interfaces to the databases)

RPC Gas Flow Monitoring system



RPC Gasflow Monitor

Overall Status OK

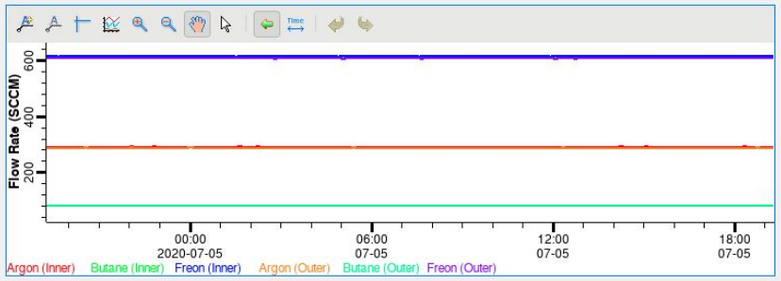
Last Updated 2020-07-05 19:10:01

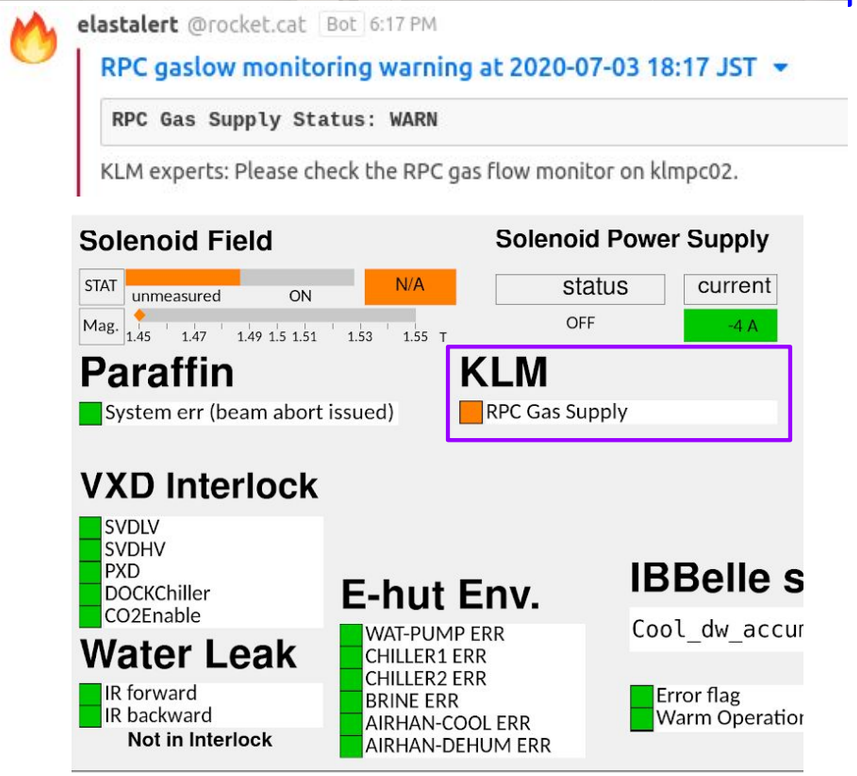
	Inner RPCs		Outer RPCs	
	Set Value	Monitored Value	Set Value	Monitored Value
Argon	300.0	290.1	300.0	285.7
Butane	80.0	78.5	80.0	78.3
Freon	620.0	614.0	620.0	607.5

All gasflow rates are in standard cubic centemeter per minute (SCCM).
The values are updated once in every 5 minutes.

OK : The monitored value is within 5% of set value.
WARN : The monitored value is within 5% - 10% of the set value.
ERROR : The monitored value is more than 10% away from the set value.

DISCONNECTED : Communication with the gas mixing station is broken for more than 15 minutes.





RPC Gas Flow Monitoring system

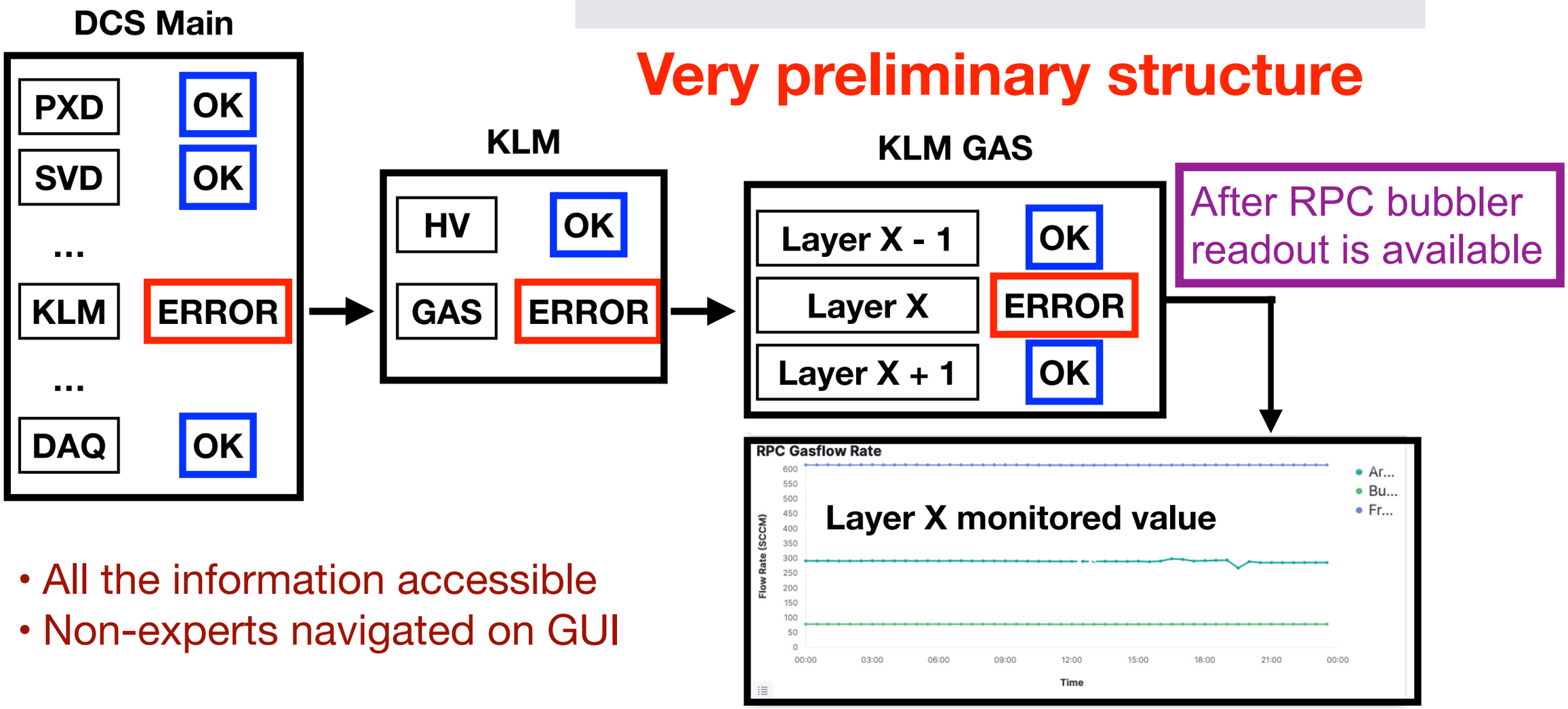
[Courtesy: Kunigo-san]

Chat tool is not a proper interface for alarm handling

Graphical user interface via CSS opi

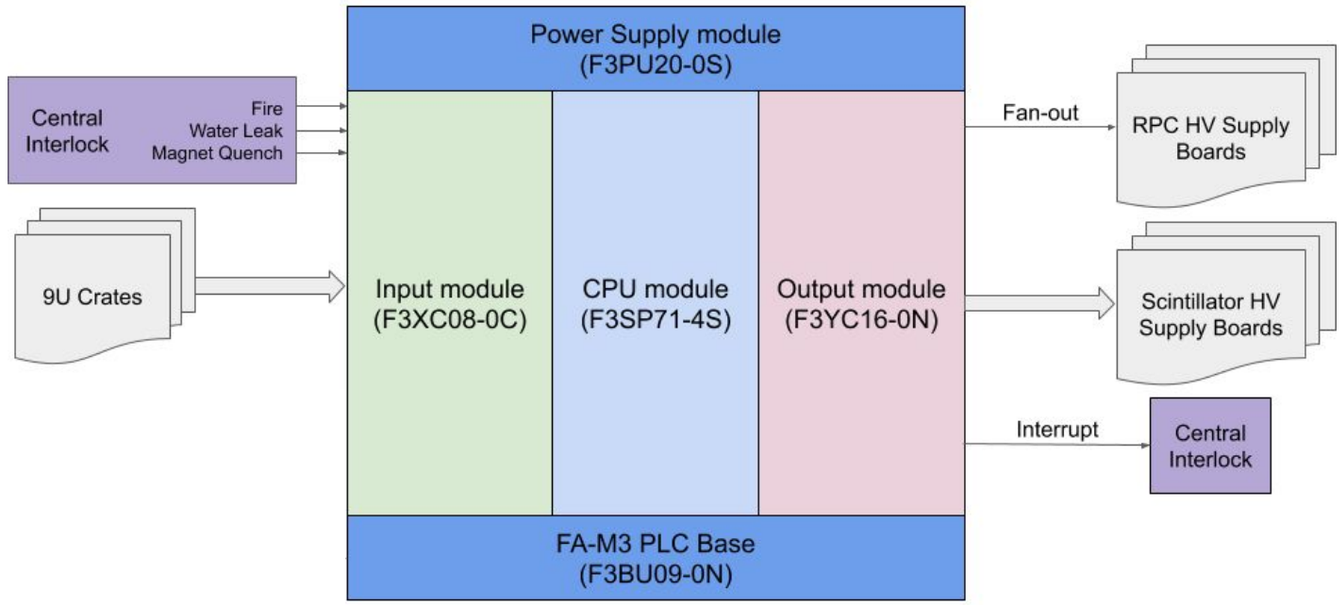
Activated alarms	Activated at
KLM gas flow Layer X	2022-11-01T09:00:00 JST

Very preliminary structure

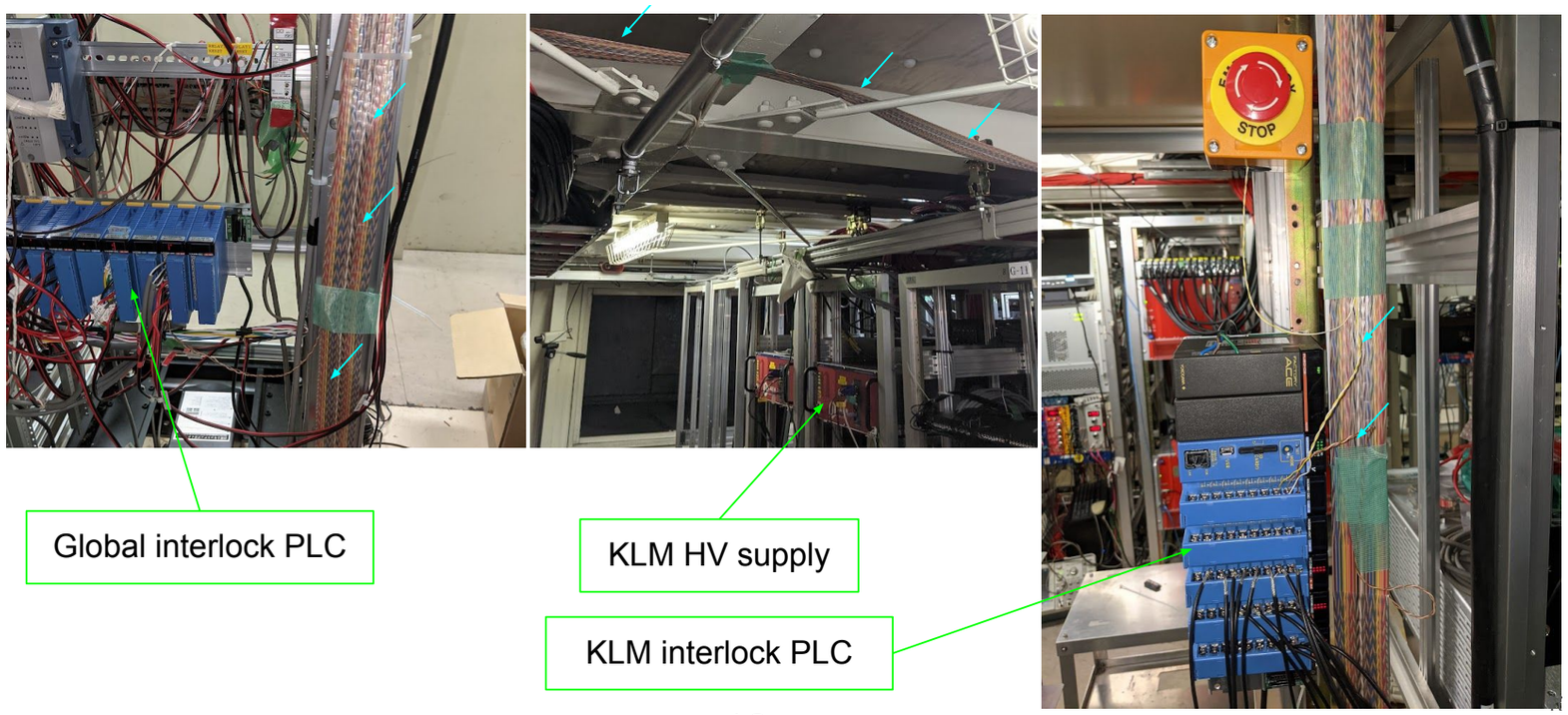


- All the information accessible
- Non-experts navigated on GUI

Interlock for HV power supply



- Receives signals from the global interlock.
- Automatically turns off the HV supply in the event of massive earthquake, fire, water leak or QCS quench.

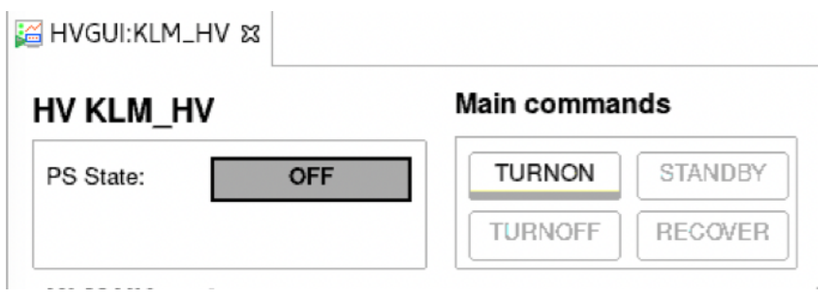


KLM CAEN mainframe firmware

There are 5 CAEN mainframes (3 for scintillators and 2 for RPC). Two of them are shown below:

CAEN HV mainframes

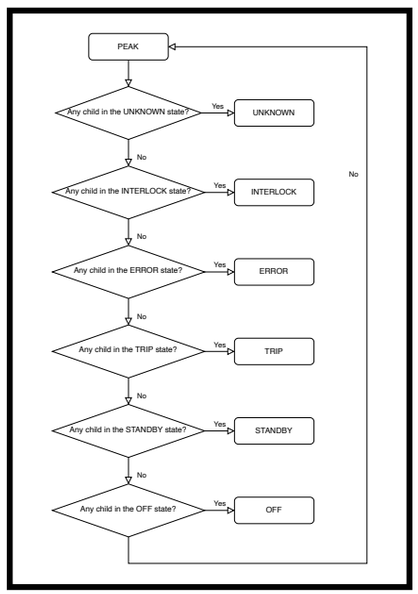
- Firmware of the KLM HV mainframes didn't work with CAEN library > v5.56 version
  - Two separate versions of CAEN library needed to be maintained in the daq_slc repository
  - **It was a log-standing request from DAQ/slow control group to make KLM HV work with the newer CAEN library, so that we can get rid of the older version.**
  - We recently tested in detail and found that the two older RPC mainframes needed configuration "type" update to work with the newer (v5.85) CAEN library version deployed in daq_slc.
- This solves the long standing incompatibility issue
- KLM HV mainframes firmware upgrade not needed after this update. Single CAEN library version can be used for KLM in daq_slc.



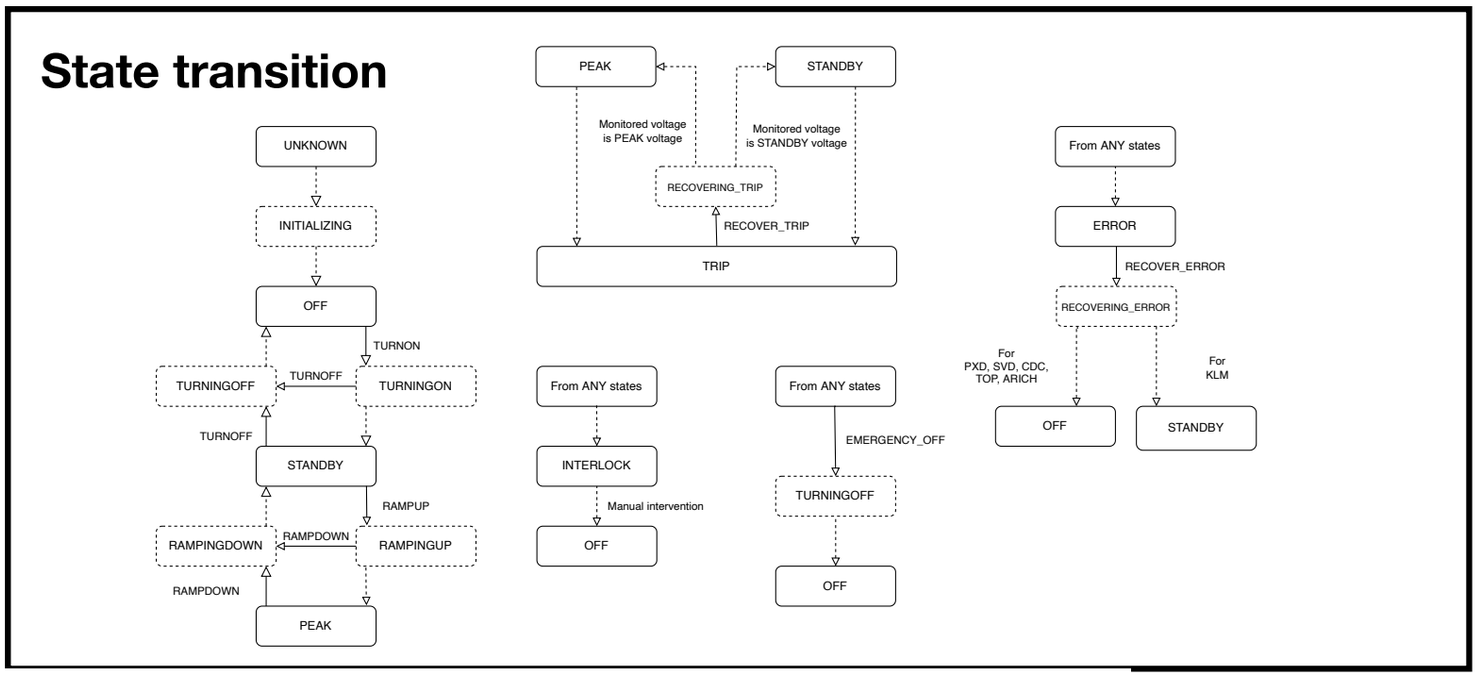
DCS related KLM HV status

[Courtesy: Kunigo-san]

State rule



State transition



- HV transition test for KLM in DCS : successfully completed
- Redefinition of HV state in DCS
  - Now, the same function is called in both transitions from PEAK and STANDBY to OFF. However, some sub detectors require proceeding with them differently. So, another function called "Emergency OFF" will be implemented for direct transition from PEAK to OFF, instead of TURN OFF. We also need to implement that function.
  - Recover and Reset functions also need modification. After TRIP and calling RECOVER or RESET functions, the final state should be the state before tripping. Currently, KLM HV always goes to STANDBY. We must modify the implementation.

Improvements of KLM HV control GUI

Belle II KLM / BIIKLM-165 https://agira.desy.de/browse/BIIKLM-165

Displaying Extra Information in KLM HV GUI

Description

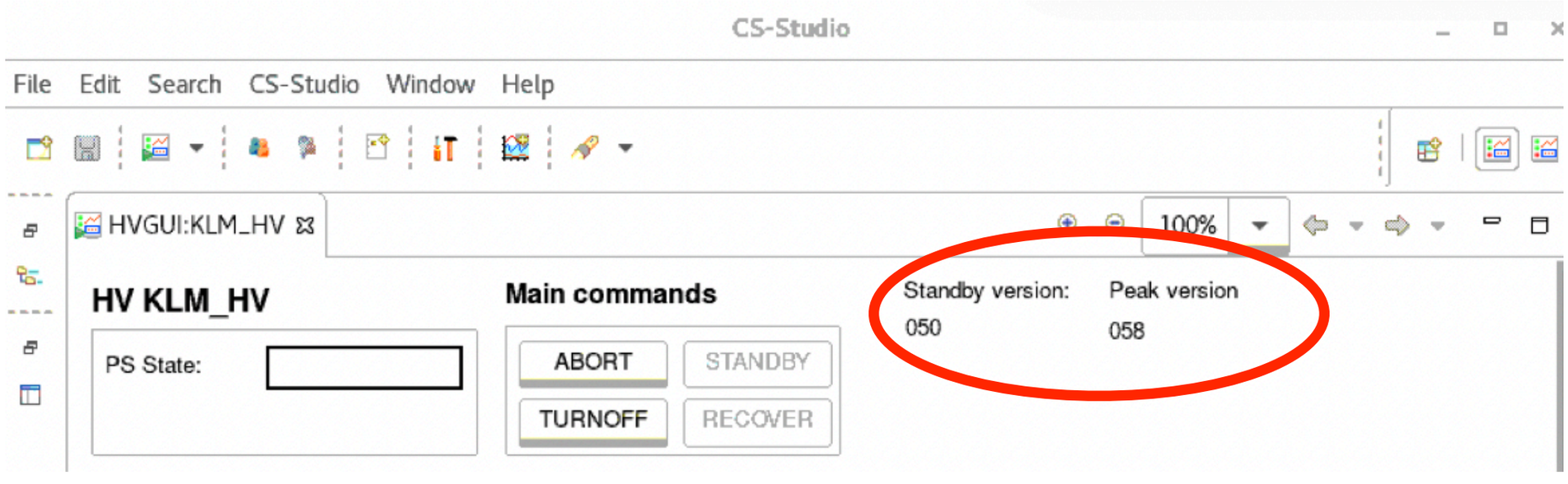
This ticket is as per request from Dmitri Liventsev. The proposal is to show some important information relevant to the KLM shifter in the KLM HV GUI, for example -

- Versions of peak and standby config being used.
- klmhvd daemon uptime
- GUI uptime
- nsm2socket and nsm2cad versions being used
- Status of nsm2cad and nsm2socket processes, etc.

Displaying this information in the GUI should help in faster debugging of HV issues.

The purpose of this ticket is to collect suggestions and comments regarding what should be the most important things to display in the GUI.

First task completed : https://stash.desy.de/projects/B2DAQ/repos/daq_slc/pull-requests/538/overview



OS upgrade for KLM shifter and HV control PCs

- CentOS 7 will be supported only till June 30, 2024. After that, **there won't be any supported operating system that can run our HV control PCs.**
- The newly purchased HV control PC doesn't run on CentOS 7. This made us to set up a very complicated system where a virtual machine (klmhv03) runs CentOS 7 on top of the CentOS 8 host (klmhv01) and the KLM HV related processes runs inside that virtual machine (klmhv03).
  - Fragile setup, quite time-consuming if we need to set it up again.
  - Needs to be replaced with some simpler setup.

The current status of KLM shifter PCs and HV control PCs are as follows:

Computer	**Current OS**	**Remarks**
Primary shifter PC (klmpc03)	CentOS 8	Already reached EOL on December 31, 2021.
Backup shifter PC (klmpc02)	CentOS 7	Will reach EOL on June 30, 2024.
Primary HV control PC (klmhv03 on klmhv01)	CentOS 7 (guest) + CentOS 8 (host)	Host has already reached EOL and guest will reach EOL on June 30, 2024.
Backup HV control PC (klmhv02)*	CentOS 6	Reached its EOL on November 30, 2020.

All these machines are planned to be upgraded to Rocky Linux 8 or 9 during LS1.

Summary

- Status of PCIe40 based readout: operating smoothly.
- New Run Control GUI for KLM with save/apply FEE masking feature.
- BB2 efficiency loss understood due to water vapor contamination.
- Current status of remidiation includes study of impact on physics analysis.
- Monitoring RPC gas bubblers output, as used to be done in Belle era.
- Interlock system for HV power supply.
- HV mainframe firmware upgrade not needed after configuration update.
- KLM activities related to the DCS group ongoing to re-define the global HV states using inputs from all subsystems.
- Improvements of KLM HV control GUI ongoing.
- OS upgrade for KLM shifter and HV control PCs planned during LS1.