Ring Imaging Cherenkov Counter Operation and Safety

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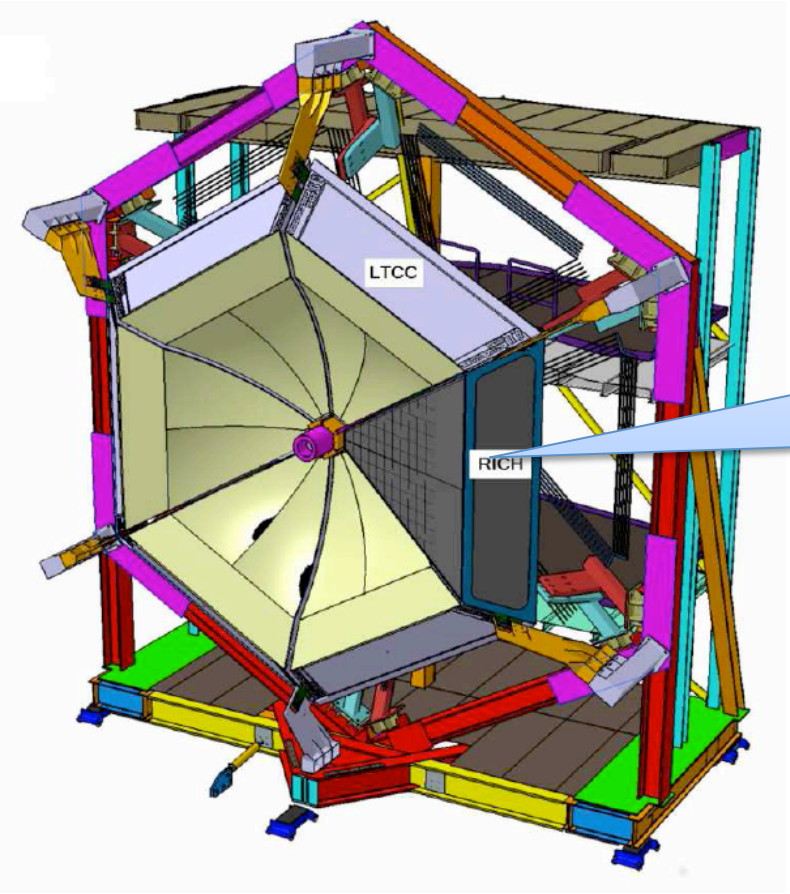
May 31,2016

Plan

- RICH components
- Hazard analysis
- Operation manual

Ring Imaging Cherenkov Counter



Designed to replace one sector LTCC

RICH Components

- Aerogel radiator.

  Non-toxic, non-flammable light material
- Mirror system.

  Reduce the photo detector area to $1m^2$
- Photo detector.

  391 Hamamatsu Multianode Photomultipliers

  (MAPMTs). Each MAPMT has 64 pixels. Total number of channels – 25024
- Front-end electronics.

  Adapter board, ASIC board, FPGA board. Located inside the detector box. In total RICH has 138 tiles of front-end.

RICH Components (continues)

- High voltage system.

  HV <=1100 V. The divider current 225 μA. The power consumption 100 W in total.
- Low voltage system.

  +5V. The power consumption 110 W in total.
- Cooling system.

  Designed to remove the heat generated by HV and LV circuits from the detector box.
- The Nitrogen system.

  Preserves the aerogel optical performance.

Hazards

- Electrical shock from touching exposed wires if the enclosure is opened with HV on
- Damage to the MAPMTs if the enclosure is opened with HV on
- Heat buildup inside the RICH enclosure if cooling system is not running may cause damages to the equipment
- The high pressure of the air in the cooling system

Mitigations

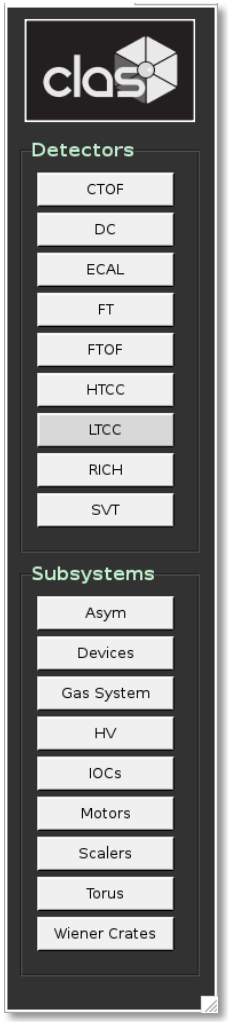
Potential hazards	Proposed mitigations
Electrical shock from touching exposed wires and damage to the MAPMTs	Hardware enclosure door **interlock** will turn OFF HV and LV systems and will prevents to switch ON HV and LV if the door is opened.
Heat buildup inside the RICH enclosure	• Hardware cooling system **interlock** will turn OFF HV and LV systems and will prevents to switch ON HV and LV if the cooling system is OFF. • Temperature **interlock** will switch off HV and LV systems
The high pressure of the air in the cooling system	The gas system is designed and will be certified by Jlab engineers (under development)

RICH Operation

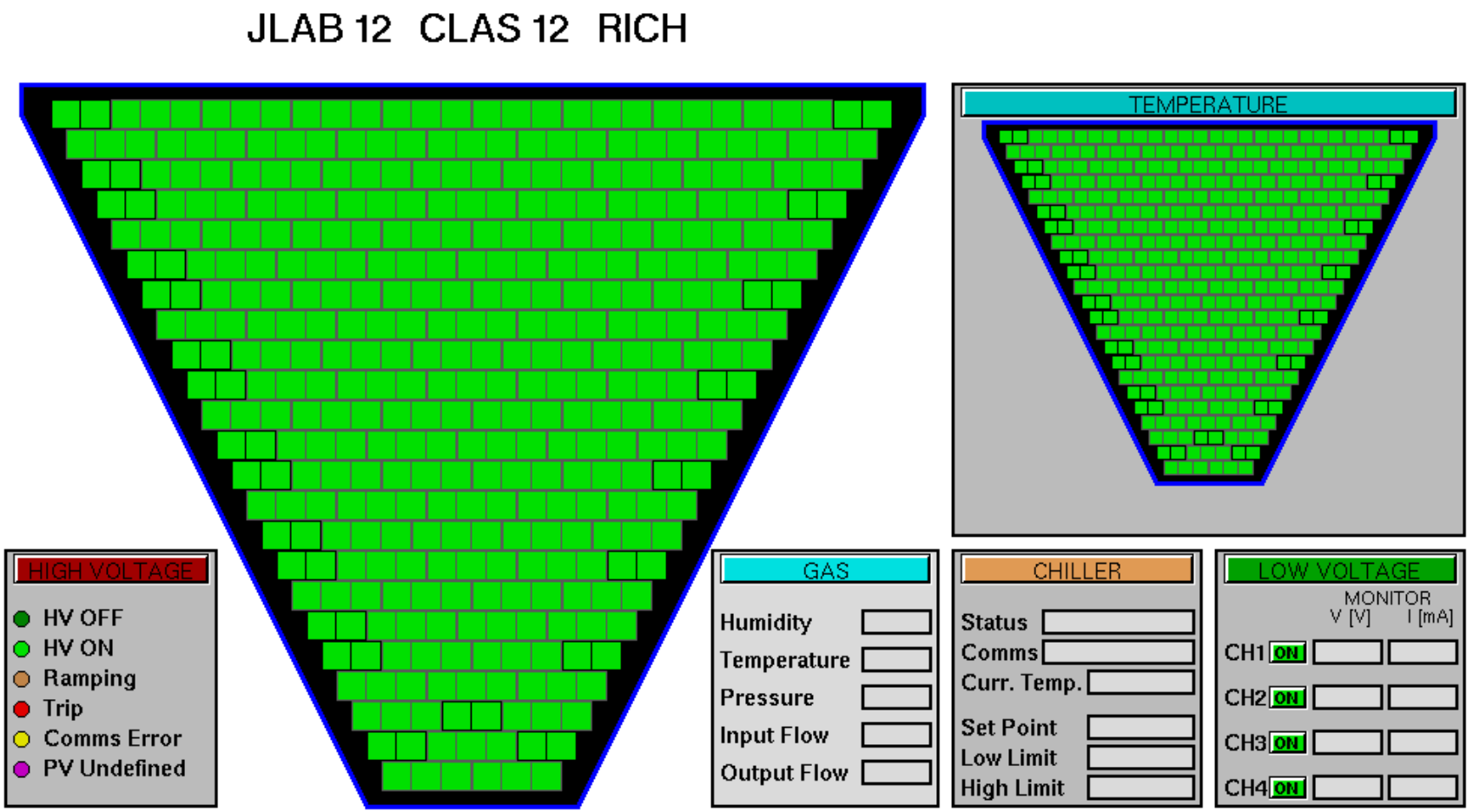
- Shift Instructions
- HV and LV system
- Cooling system
- Temperature control
- Detector control
- Strip charts

Shift recourses

- RICH control will be accessible through the main CLAS-EPICS window
- The main RICH EPICS window will include combined HV, LV, Temperature, Gas system, Cooling systems and detector control



Main RICH Control Menu



View of the EPICS HV control window

Channel Name	Group#				Measured V	Demand V	Input V	Measured I	Status
ECAL_TOP_01	1	Ena		Dis	389.000	389.000	389.000	1.600	1.000
ECAL_TOP_02	1	Ena		Dis	382.703	382.700	382.000	0.000	1.000
ECAL_TOP_03	1	Ena		Dis	378.595	378.600	378.000	0.000	1.000
ECAL_TOP_04	1	Ena		Dis	381.998	382.000	382.000	54.225	1.000
ECAL_TOP_05	1	Ena		Dis	386.694	386.700	386.000	0.000	1.000
ECAL_TOP_06	1	Ena		Dis	383.587	383.600	383.000	1.325	1.000
ECAL_TOP_07	1	Ena		Dis	403.192	403.200	403.000	56.225	1.000
ECAL_TOP_08	1	Ena		Dis	380.890	380.900	380.000	0.325	1.000
ECAL_TOP_09	1	Ena		Dis	387.394	387.400	387.000	23.675	1.000
ECAL_TOP_10	1	Ena		Dis	392.890	392.900	392.000	0.000	1.000
ECAL_TOP_11	1	Ena		Dis	394.889	394.900	394.000	31.625	1.000
ECAL_TOP_12	1	Ena		Dis	384.290	384.300	384.000	0.000	1.000

LV GUIs

DC and HTCC voltage control is shown as an example. RICH is under design for a moment.

Expert

DC Low Voltage

		Measured		Setpoint	
Channel	Status	Voltage	Current	Voltage	Current
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00
S5 R1	ON	7.00	18.25	7.00	20.00

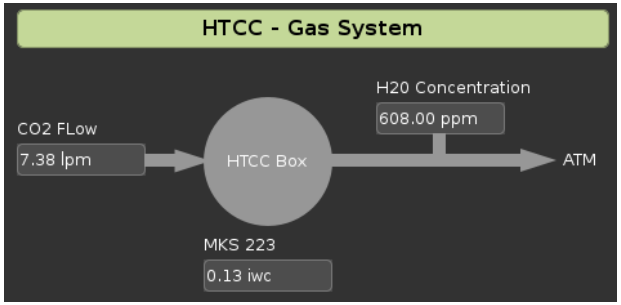
HTCC Compensation Coil Voltages

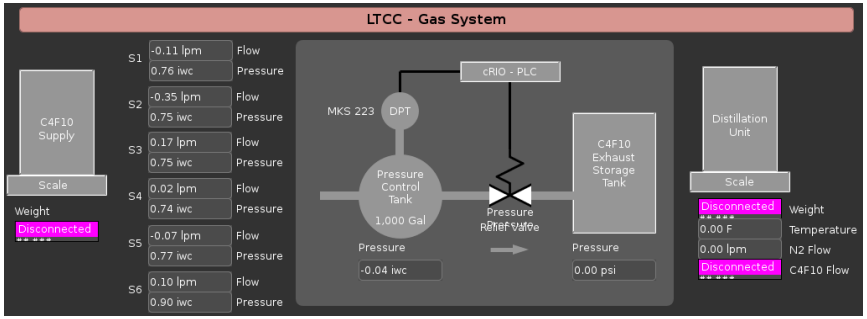
Channel	Status	Pw Set		Imon	Iset	V In	V Out	T Shunt	T Sink
htcclv1	OFF	ON	OFF	0.0	0	12.0	0.0	31.9 C	35.2 C
htcclv1	OFF	ON	OFF	0.0	0	12.0	0.0	31.9 C	35.2 C
htcclv1	OFF	ON	OFF	0.0	0	12.0	0.0	31.9 C	35.2 C
htcclv1	OFF	ON	OFF	0.0	0	12.0	0.0	31.9 C	35.2 C
htcclv1	OFF	ON	OFF	0.0	0	12.0	0.0	31.9 C	35.2 C
htcclv1	OFF	ON	OFF	0.0	0	12.0	0.0	31.9 C	35.2 C
htcclv1	OFF	ON	OFF	0.0	0	12.0	0.0	31.9 C	35.2 C
htcclv1	OFF	ON	OFF	0.0	0	12.0	0.0	31.9 C	35.2 C

Nitrogen Gas System

LTCC and HTCC gas control systems are shown as an example.
RICH gas control is under development

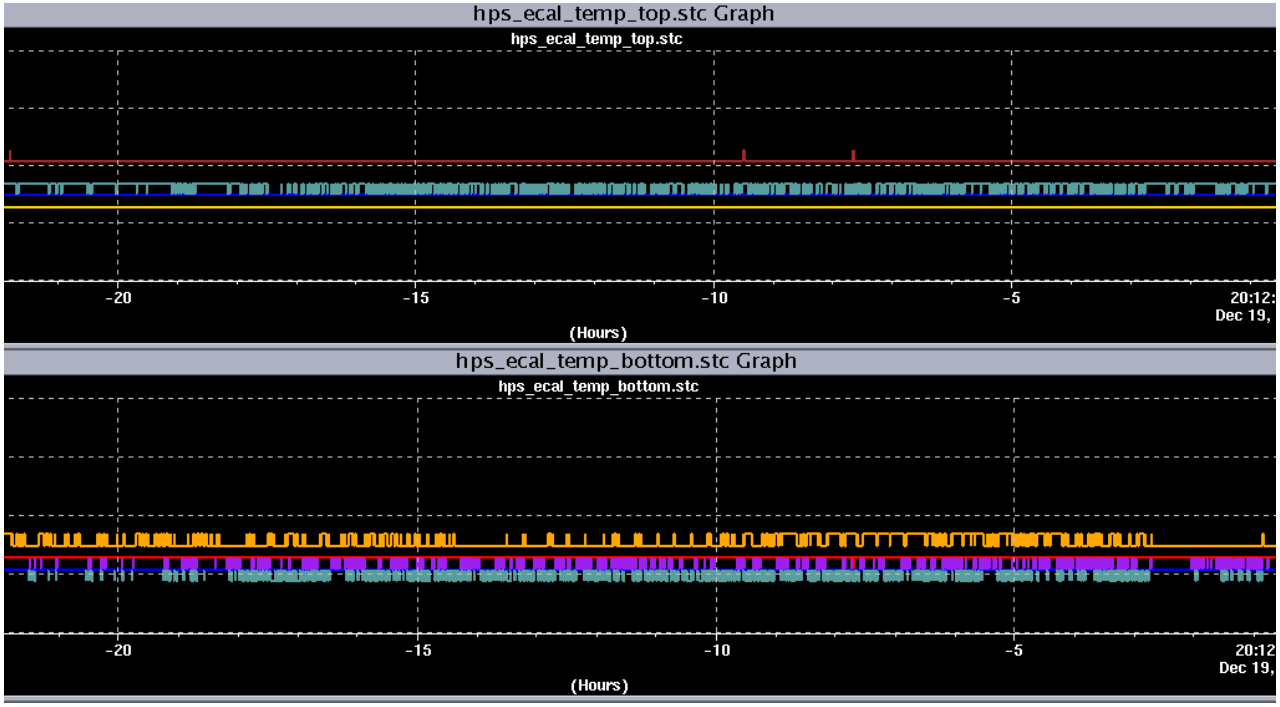
We plan to refresh the full RICH volume, close to 5000 liters, in about one day.



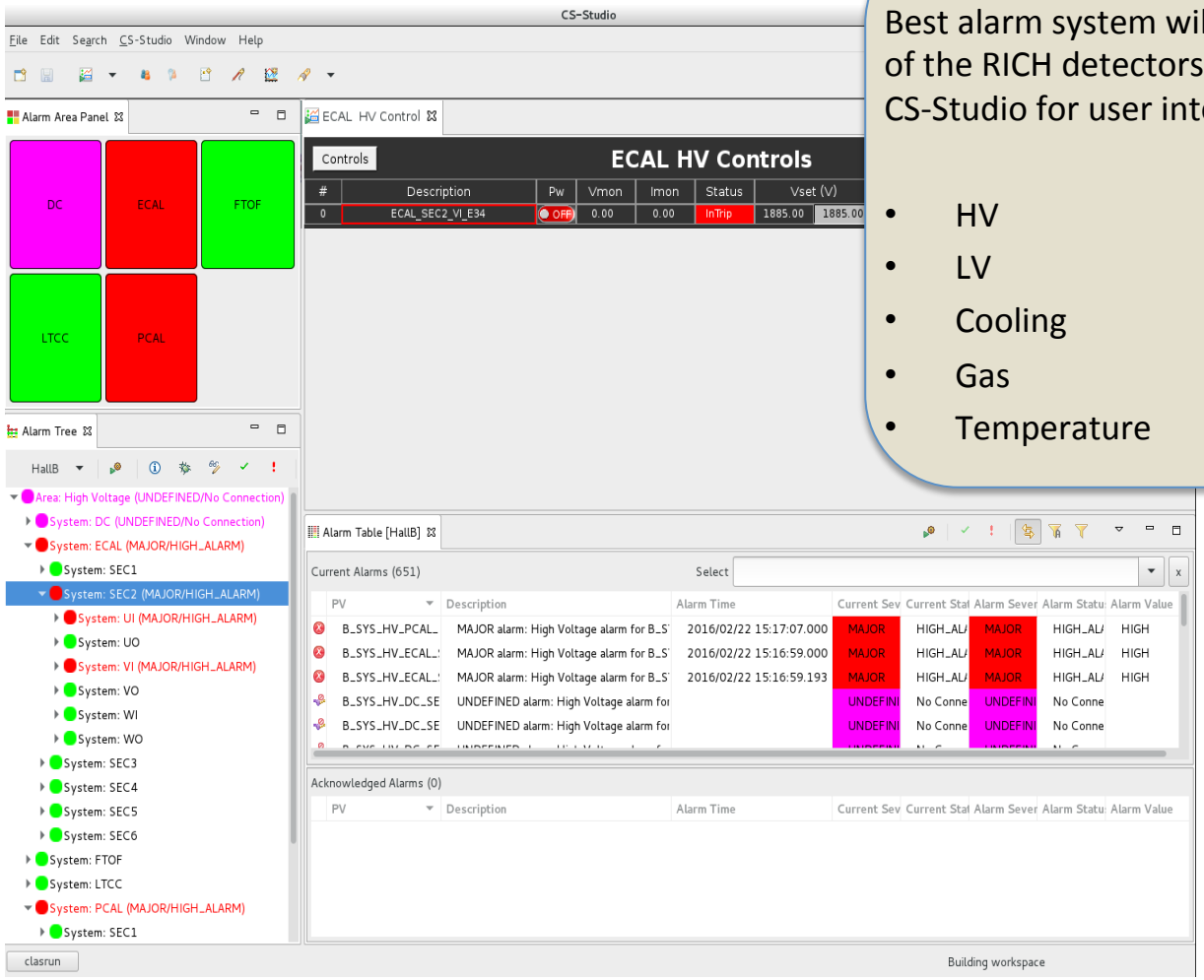


Temperature control

Temperature sensors will be placed in the RICH enclosure and should be monitored through RICH's main EPICS screen and the strip charts shown below.



BEAST Alarm System



Best alarm system will monitor all critical parameters of the RICH detectors. Audible/Visible alarms built into CS-Studio for user interaction

- HV
- LV
- Cooling
- Gas
- Temperature

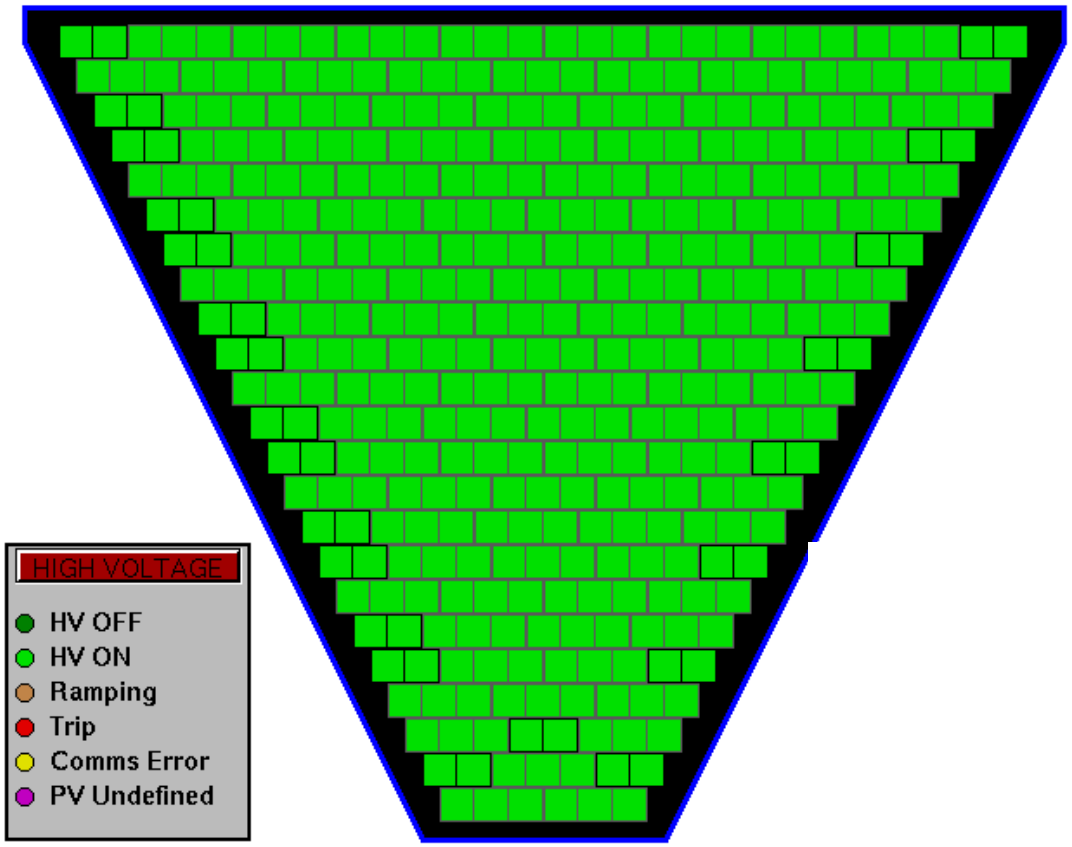
Scalers

- Rates seen by the RICH detectors will be available every pixel.
- The averaged over all PMT's pixels will be available as well
- The more complicated analysis will include the event display and Cherenkov ring reconstruction

Conclusion

- The hazards were identified for the operation of the RICH detector
- The proposed mitigations will make the operation of the detector safe
- The detector control will be based on the CLAS12 EPICS system
- The RICH will use GUI developed for other detectors that are in a very good shape
- The detector control program are under the development

RICH HV Control Panel



Work Planning, Control, and Authorization Procedure)

Author:	Valery Kubarovsky	Date:	May 26, 2016	Task #: If applicable	

Complete all information. Use as many sheets as necessary

Task Title:	Operation of RICH			**Task Location:**	Hall-B
Division:	Physics	**Department:**	Hall-B	**Frequency of use:**	Daily
Lead Worker:	Valery Kubarovsky				
Mitigation already in place: Standard Protecting Measures Work Control Documents	Standard Hall-B protective measures and appropriate personal training including but not limited to RICH ESAD and RICH manual.				

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
1	Operation of RICH High Voltage for PMTs. Potential hazards: • Electrical shock from touching exposed wires. • Rapid heat buildup inside the RICH enclosure if cooling system is not running may cause damages to the equipment.	L	L	1	• Hardware enclosure door interlock • Hardware cooling system interlock • Temperature interlock • Personal training, setting boundaries around equipment. • Use Lock/Tag/try procedures	• All maintenance and repair work inside HYCAL enclosure is done by trained personal with HV off, power supplies power cords unplugged and LTT devices applied. • Interlock disables HV when enclosure is open. • Interlock disables HV if the cooling system is not running.	Negligible