PRad-II/X17 Collaboration Meeting

Status and Plans for DAQ and Online Monitoring

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03/03/2025

This work is supported in part by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357.

Current Status of the PRad-II DAQ System

- HyCal DAQ
  - Cosmic test for single module finished
  - Planned cosmic test for multiple modules
  - Planned FADC electronics test in hall (Chris's talk)

- GEM DAQ (Xinzhan's talk)
  - 1 MPD – 3 APVs
  - Test setup at UVA demonstrates 25 kHz

- Planned Integration
  - HyCal + GEM
  - Zero suppression for GEM needed due to bandwidth limit for data transferring

PRad-II/X17 Triggers

- Pulsar/internal triggers
  - Internal triggers
  - Random pulsar (from alpha source in the LMS system)
  - Fixed-frequency pulsar (from function generator that drives the LMS system)
- Physics triggers
  - Total energy sum
    - [x] MeV (need calibration)
  - Cluster triggers
    - Number of clusters [x]
    - Energy threshold for each cluster [y] MeV (need calibration)
    - Energy sum of the clusters [z] MeV
  - Scintillator veto

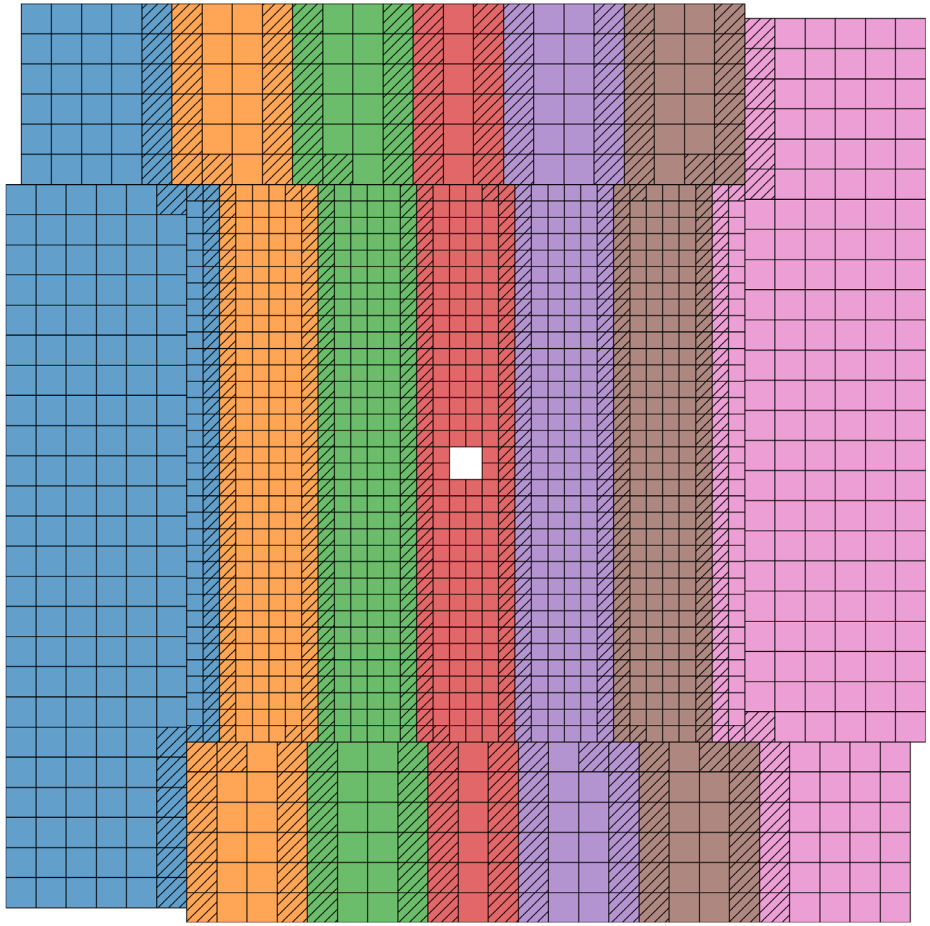
Segment of HyCal DAQ

Crate No.	No. of Ch.			No. of FADCs			Optical Links	
	All	PbWO4	LG	All	PbWO4	LG	To Left	To Right
1	242	68	174	16	5	11	0	49
2	252	204	48	16	13	3	49	49
3	252	204	48	16	13	3	47	47
4	236	200	36	16	13	3	47	47
5	252	204	48	16	13	3	47	47
6	252	204	48	16	13	3	49	49
7	242	68	174	16	5	11	49	0
Total: 7	1728	1152	576	112				

In total: **7 crates** and **112 FADC** modules

- ✓ <= 16 FADC modules per crate
- ✓ <= 16 channels per FADC module
- ✓ <= 64 channels to link between adjacent crates
- ✓ Single type of modules in each FADC

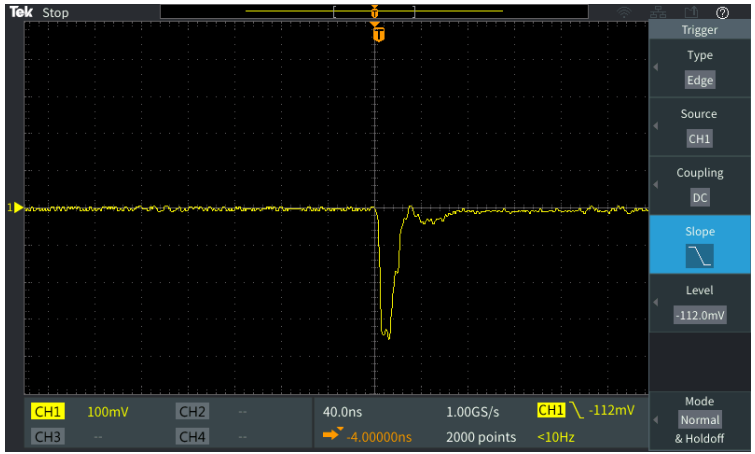
Detailed DAQ assignment (crate, slot, channel) can be found at https://github.com/JeffersonLab/prad2_daq



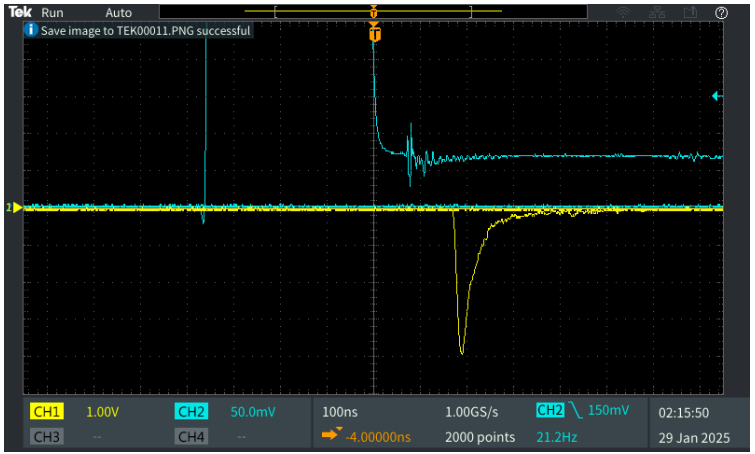
Cosmic Test with FADC - Oscilloscope

- Thanks to ESB testing team: Erik, Buddhiman, Aruni, Eugene, Sergey
- Recent test with crystal module W445

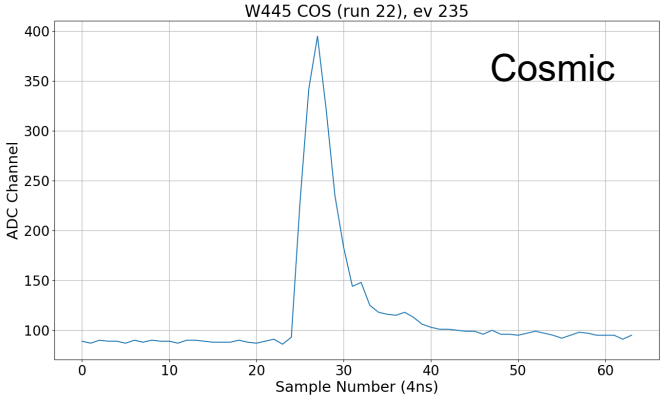
Cosmic, y-scale: 100 mV

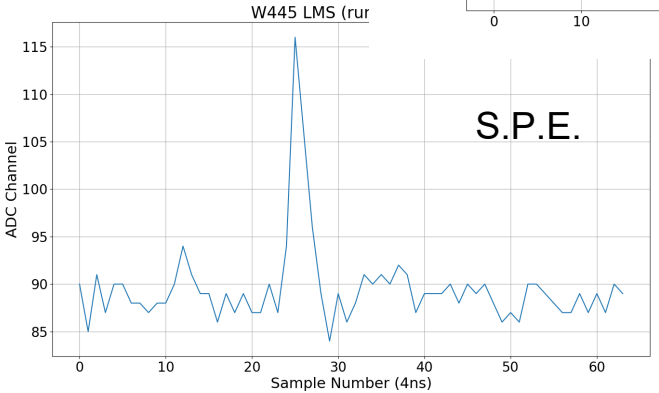


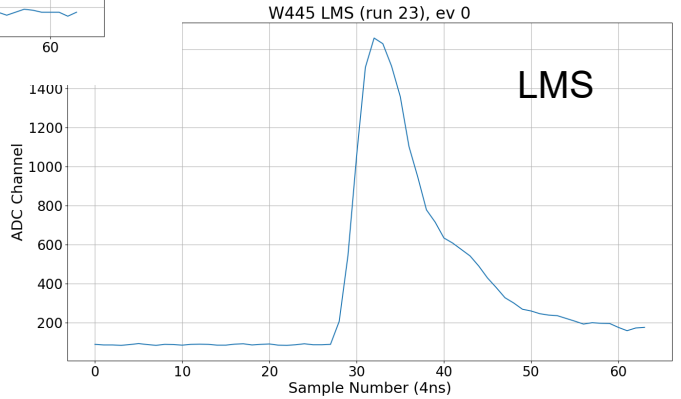
LMS, y-scale: 1 V



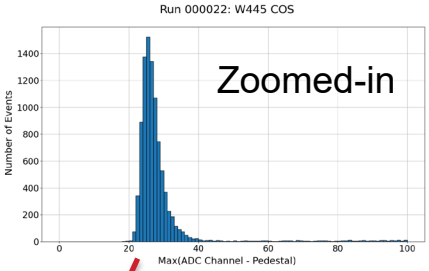
Cosmic Test with FADC - Waveforms

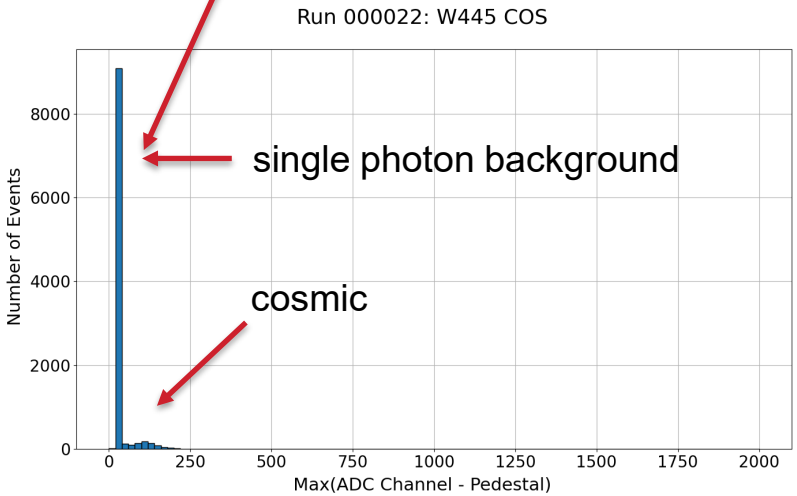


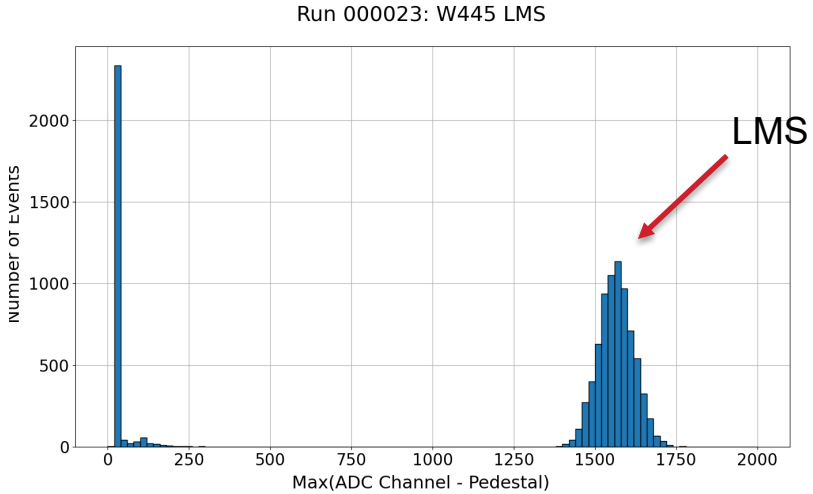




Cosmic Test with FADC – Peak height

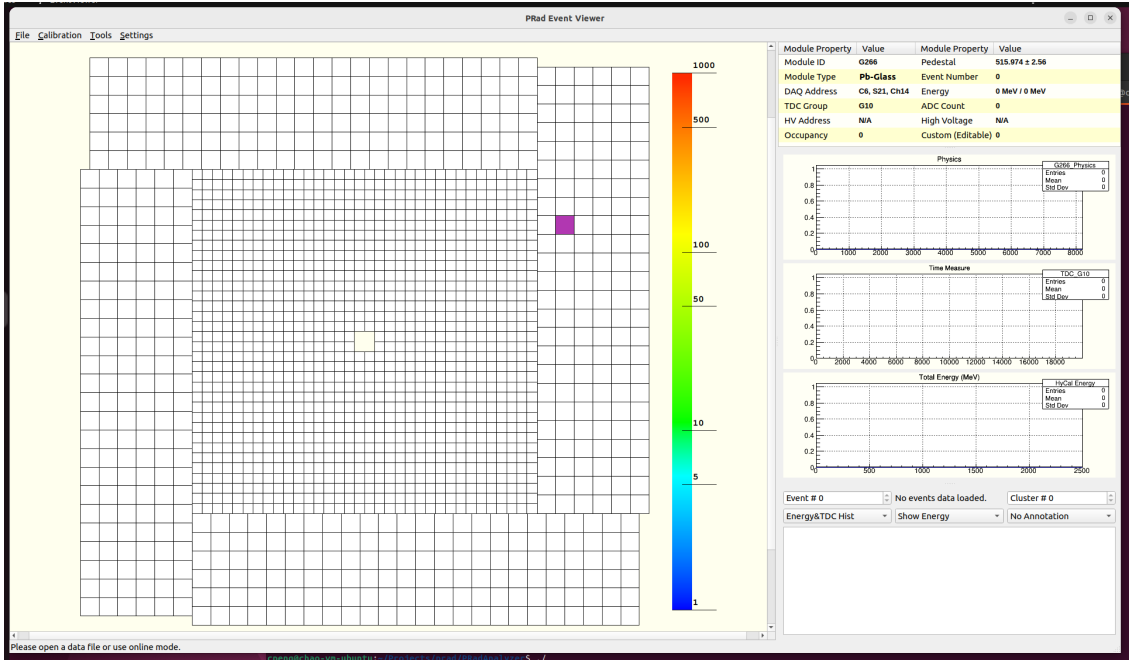






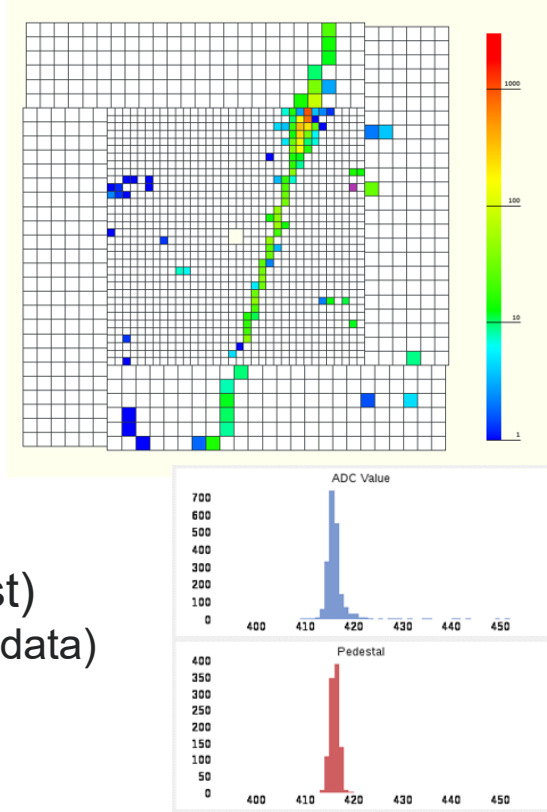
PRad Software and Online Monitoring

- PRadAnalyzer
  https://github.com/JeffersonLab/PRadAnalyzer
- Event Reconstruction
  - Clustering for both HyCal and GEM
  - Non-linearity correction
  - Energy-leakage correction
  - Detector location and rotation correction
- Online monitoring
  - Read data from CODA ET
  - Read scalers info injected into the data stream
  - High-voltage control and monitoring



Online-monitoring Experimental Data

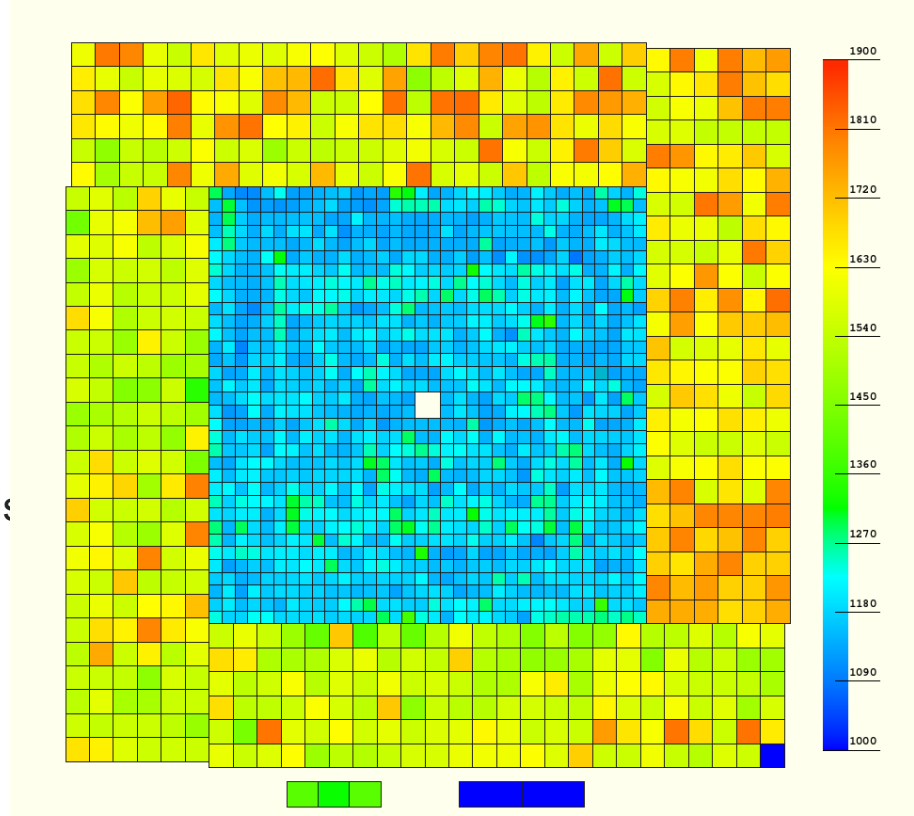
- Event visualization in the GUI
  - Energy deposit on modules
  - Occupancy of the whole HyCal
  - Pedestal mean and sigma
- Histograms
  - Energy sum spectrum (crystal, LG, and all)
  - ADC spectrum for each channel
  - TDC spectrum for each TDC group
- **Planned work** (need a fully running DAQ to test)
  - Update viewer/histograms for FADC (waveform data)
  - Add more physics-related histograms
  - May modernize the GUI



Online-monitoring the Detector

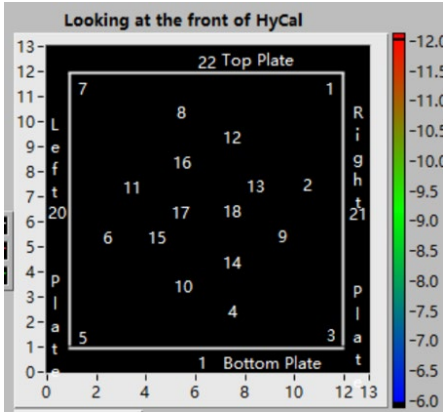
- Existing monitoring
  - High-voltage
  - EPICS channels values

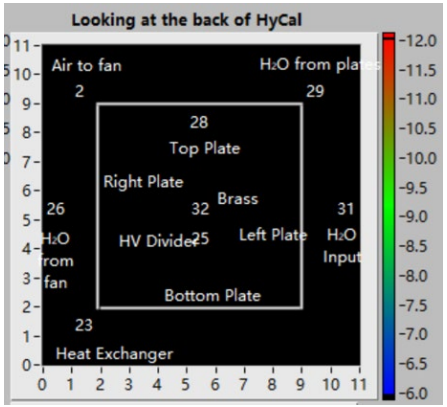
- **Need to implement**
  - HyCal temperature monitoring
  - Visualizations for EPICS channels
    - HyCal temperature
    - Target status
    - Scalers



Online Monitoring Development

- HyCal temperature monitoring
  - Need convert LabVIEW to EPICS
  - Ongoing GUI development (Yuan, Chao)
- Target pressure/temperature/flow monitoring
  - Adding EPICS channels (Anil)
  - Ongoing GUI development (Yuan, Chao)
- Scalers
  - Able to read scalers from EPICS events
  - Ongoing GUI development (Yuan, Chao)

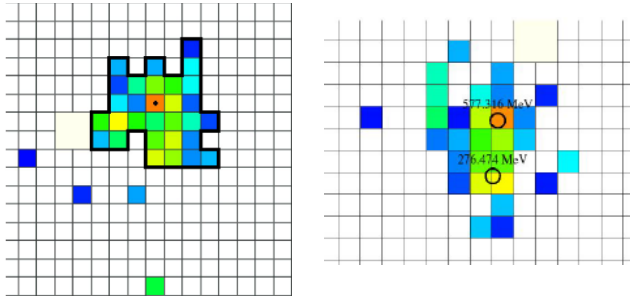


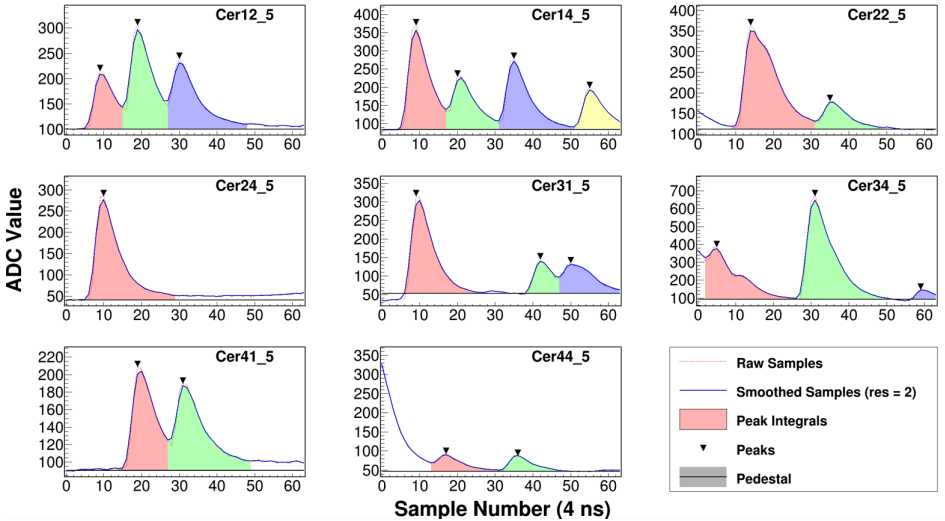


Data Analysis Framework

- PRadAnalyzer is also used for cooking data
  - Decode the evio file written by the DAQ system
  - Reconstruct raw detector outputs to hit information
  - Clustering for HyCal and GEM
  - Event matching
- **Planned updates**
  - Decoding FADC data
  - Waveform analysis
    - Pedestal fitting
    - Separate peaks
    - Timing, integral
  - Ready as standalone code
    - Need to be integrated

Clustering for HyCal





Summary

- DAQ development is on track
  - Currently no showstopper
  - Most of the tests are expected to be done before ERR
    - HyCal and GEM DAQ electronics tests
    - Multi-module cosmic test with HyCal

- Online monitoring is available
  - Ongoing work on implementing monitoring GUI (with EPICS readout)
    - HyCal temperature, target status, scalers
  - Data model to be finalized after building the DAQ