

HCal Status Update

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September 14th 2020

Jefferson Lab

Completed:

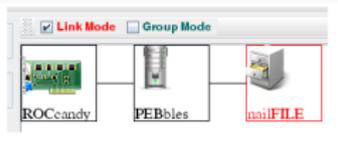
- All DAQ electronics tested and working.
 - Except summing modules require testing.
- Operational decoder and readout lists (CODA 2→CODA 3).
- Full database implemented.
- Available Triggers:
 - Cosmic trigger.
 - LED pulser trigger.
- Flags file to configure ROCs (switch between triggers, set windows, prescales, etc).
 - Standardize across subsystems? GUI?
- Event display available.
- Simple cluster finding algorithm implemented (max energy module).
 - More advanced algorithm under development. (e.g. associates regions of BB with regions of HCal.)

To-do:

- PMT QE calibration requires more LED data (test lab).
- Calibrate NPE to ADC signal (test lab).
- Calibrate HV to ADC signal (test lab).
- Test summing module trigger (test lab).
- Implement online monitoring software (maybe mimic Hall C).
 - fADC250 scaler mode. GUI exists (ask Steve Wood?).
- Determine alarm handler information.
 - HV alarms etc.
- Setup HCal in the hall.
 - Reestablish DAQ.
 - Synchronize timings.

Coda 3 Upgrade

- In the process of upgrading DAQ to CODA 3. (Thanks, Bryan!)
 - New CODA configuration written.
 - DAQ readout lists almost updated.
 - About to install final VXS crate. (Thanks, Alex!)
- Need to test CODA 3 on cosmic data as final test.



ROC:

Name	<input type="text" value="ROCcandy"/>	Type	<input type="text" value="ROC"/>
Priority	<input type="text" value="1,210"/> <input checked="" type="checkbox"/> Master Roc	ID	<input type="text" value="0"/>
ROL1	<input type="text" value="/home/daq/rol/vme_list.so"/>	User String	<input type="text" value="userstring"/>
ROL2	<input type="text" value="/home/daq/rol/event_list.so"/>	User String	<input type="text" value="userstring"/>
User Config	<input type="text" value="undefined"/> (optional)		
Description (optional)	<input type="text" value="undefined"/>		
Process		<input type="checkbox"/> RunData	<input checked="" type="checkbox"/> tsCheck
<input type="button" value="Open"/> <input type="button" value="New..."/>		<input type="checkbox"/> Sparsify	<input type="text" value="2"/> tsSlop
<input type="button" value="Ok"/> <input type="button" value="Apply to All"/> <input type="button" value="Clear"/> <input type="button" value="Cancel"/>			

Completed:

- All front-end electronics, cables, patch panels etc. installed and operational.

To-do:

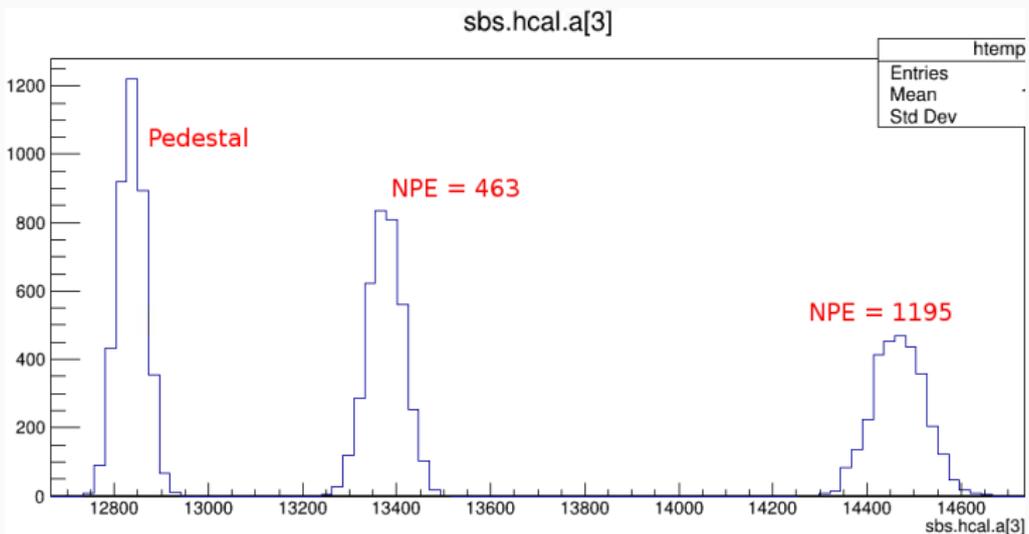
- Need to finish greasing PMTs.
 - Calibrations can't be finalized until this is completed.
 - Requires test lab access.
 - Unless we have a volunteer who can access the test lab, Scott will do this when authorized to enter.
 - Hopefully granted access when JLab enters SAD.
- Assemble 4 remaining pulser boxes (CMU).
- Fabricate remaining 3 shims that go between the 4 subassemblies. Other 20 installed already (JLab).
- Move to Hall A and revive the DAQ system.
- Install dry air supply for PMTs in the hall.

LED Calibration Procedure

1. Illuminate PMTs with internal LED fiber optics and take a data run at a nominal voltage setting.
 - Calculate the number of photoelectrons (NPE) observed by PMTs.

$$NPE = \left(\frac{\langle ADC \rangle}{\sqrt{RMS^2 - RMS_{pedestal}^2}} \right)^2 \quad (1)$$

- Calibrates NPE to ADC value.



LED Calibration Procedure Cont.

2. Take a cosmic run at the same voltage as the LED run.
 - Use NPE to ADC calibration to estimate the NPE observed from cosmic rays.
 - Note: Not an absolute calibration. Cosmics don't perfectly obey Poisson statistics.
 - Compare results with estimates from simulation.
 - G4SBS predicts ≈ 5.5 PE per MeV deposited.
 - G4SBS predicts 13-14 MeV for average cosmic event.
3. Use NPE to ADC calibration along with G4SBS simulations to predict ADC signals from hadrons.

LED Calibration Procedure Cont.

4. Use LEDs to perform voltage scans.
 - LEDs much quicker than cosmics.
 - Gives calibration of HV to ADC.
5. Use the NPE to ADC calibration along with the HV to ADC calibration to predict safe voltage setting ranges for the PMTs during experiments.
 - Benchmarked such that 99.5% of hadron signals do not saturate the DAQ. See https://hallaweb.jlab.org/wiki/images/4/4f/HCal_Energy_Deposition.pdf for energy deposition study.
 - Energy deposition study based on G4SBS simulations of G_M^n and signal tracing through the electronics.
- June-July 2018 JLab cosmic tests (Vanessa Brio, Catania):
 - Cosmic tests with 4x4 block of PMT modules.
 - Two runs measured 56 and 70 PE detected.
 - Average G4SBS cosmic 72-77 PE.
 - PMTs not greased yet (can improve PE collection up to 30%).

Current Status Summary

- DAQ operational and detector fully assembled.
- Cosmics/calibrations will resume when test lab access is restored.
- To do: <https://docs.google.com/document/d/1S--0K01QL0gP-EP-2nf8LSBLx6Y6d6TAFrWK1UkRxBE/>
- Grease remaining PMTs.
- Calibrate relative PMT QEs.
- Calibrate PMTs with LED pulser/cosmics.
- Voltage scans.
- Simulation cosmics vs. real.
- Finish CODA 3 upgrade.
- Online monitoring.
- Analysis scripts.
- Assemble remaining pulser boxes.
- Fabricate shims.
- Move to Hall A.
- Install dry air supply.
- Personnel:
 - 2 postdocs: Scott Barcus and Juan Carlos Cornejo.
 - 1 student: Vanessa Brio.
 - Brian Quinn and Bogdan Wojtsekhowski.
 - New collaborators: Jim Napolitano, Donald Jones, and Kent Paschke.

Acknowledgments

Thanks to [Gregg Franklin](#) for his many dedicated years designing and overseeing the construction of HCal. Thanks to [Università di Catania](#) for their major financial contributions. Many other people and institutions were involved in making HCal possible, including, but not limited to:

- Thanks to the many students who have worked on HCal including [Alexis Ortega](#), [So Young Jeon](#), [Jorge Peña](#), [Carly Wever](#), and [Dimitrii Nikolaev](#).
- Thanks to [Alexandre Camsonne](#) for helping us get the DAQ working and finding all the modules for us.
- Thanks to [Chuck Long](#) for all his help fixing and acquiring things.
- Thanks to [Bryan Moffit](#) for DAQ help.
- Thanks also to [Brian Quinn](#) and [Bogdan Wojtsekhowski](#).
- Thanks to [Vanessa Brio](#), [Cattia Petta](#), and [Vincenzo Bellini](#) for their cosmic commissioning efforts.

Questions?