Jefferson Lab

Commissioning, Calibration, and Interfaces

Oct 17th 13

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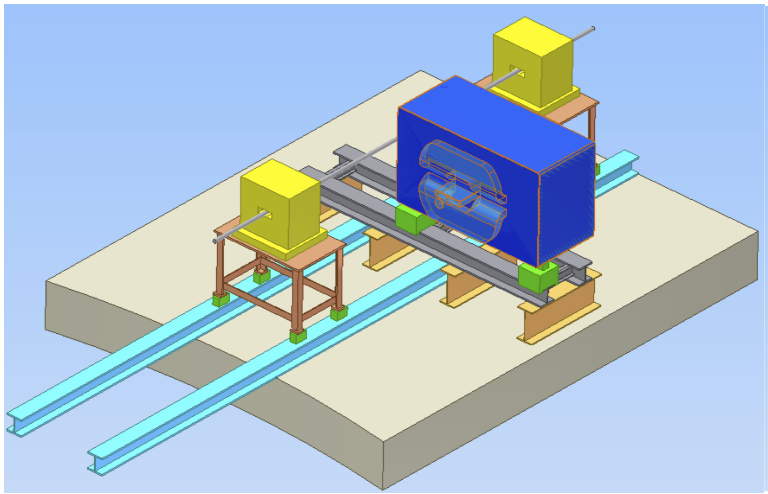
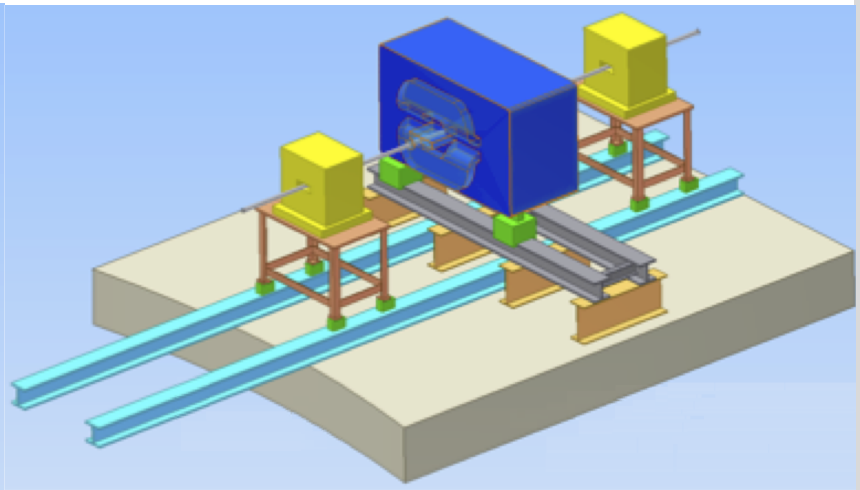
Procedure and agenda for installation

	12/13	01/14	02/14	03/14	04/14	05/14	06/14	07/14	08/14	09/14
Crystal refurbishment	→	→	→							
ECal assembly			→	→	→	→	→			
Test and calibration							→	→	→	
Installation									→	→

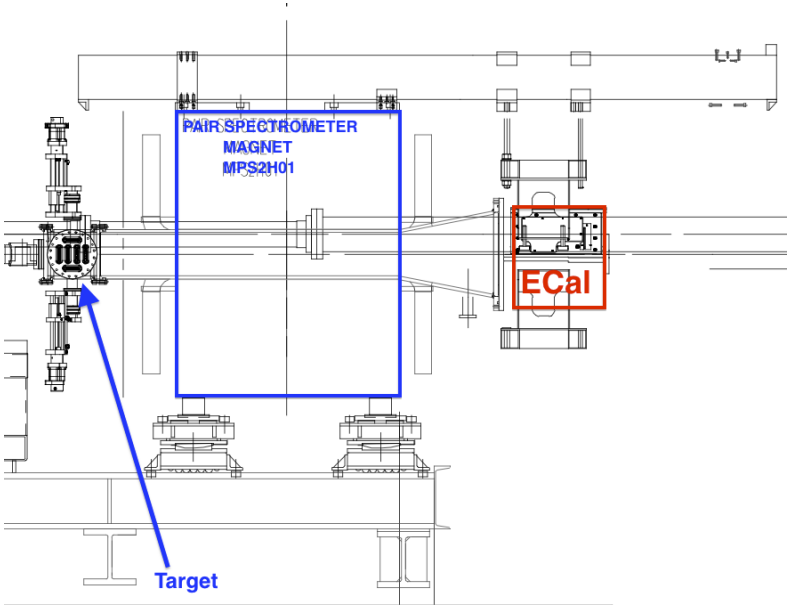
- Schedule for ECal construction allows it to be ready by end of Aug 2014
- Beamline and SVT installed and commissionned by the beginning of Sep 14
- Installation is planned for Sep 2014



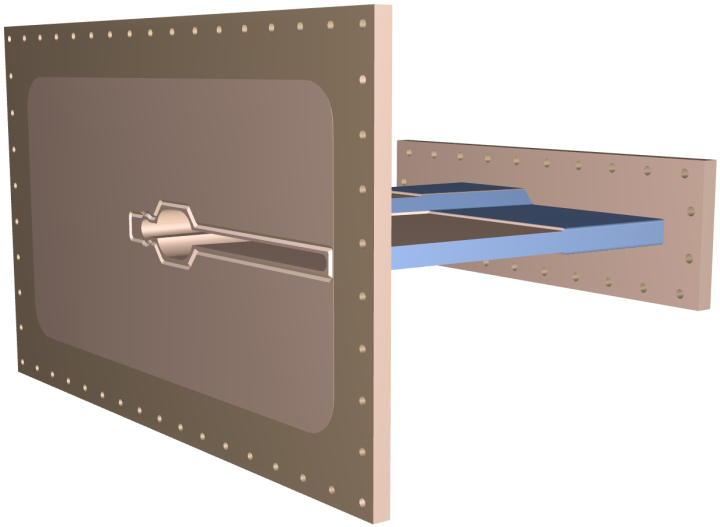


Procedure and agenda for installation

Side view :



Vacuum chamber :



- SVT installed and aligned
- ECal vacuum chamber
- Vacuum system pumped down and SVT cooled
- Check SVT operation
- ECal weight supported by PS magnet
- Mounting system adjustable horizontally and vertically

Commissioning and Calibration

Commissioning and Calibration of the ECal complementary steps

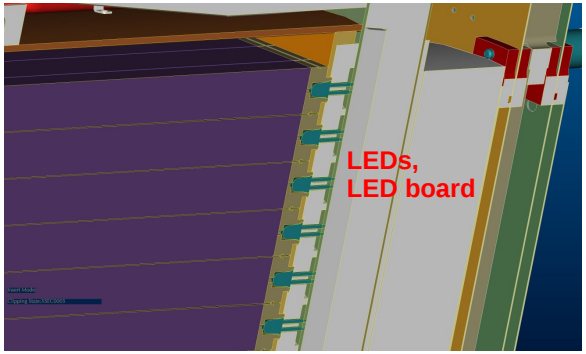
- LED monitoring system
- MIP from cosmic muons
- Track-based calibration using the SVT, not covered in this talk
- Neutral pion invariant mass reconstruction

ECal calibration must be reasonably known early on, as a first set of calibration constant enters into the trigger logic.

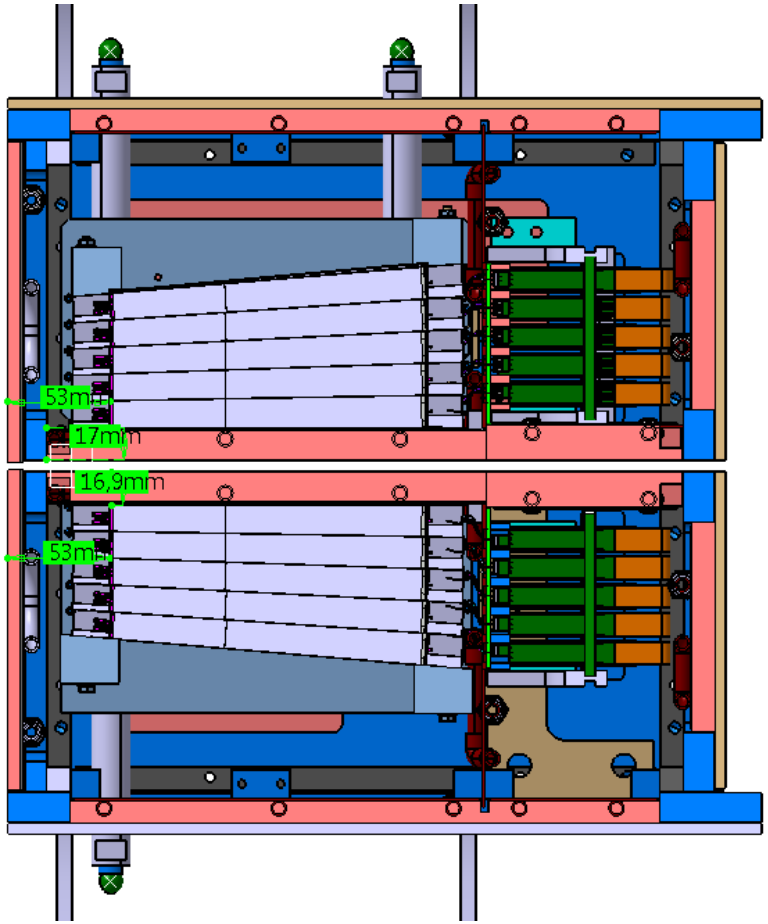
The final ECal calibration can improve the e^+e^- invariant mass resolution, thus extending the reach.

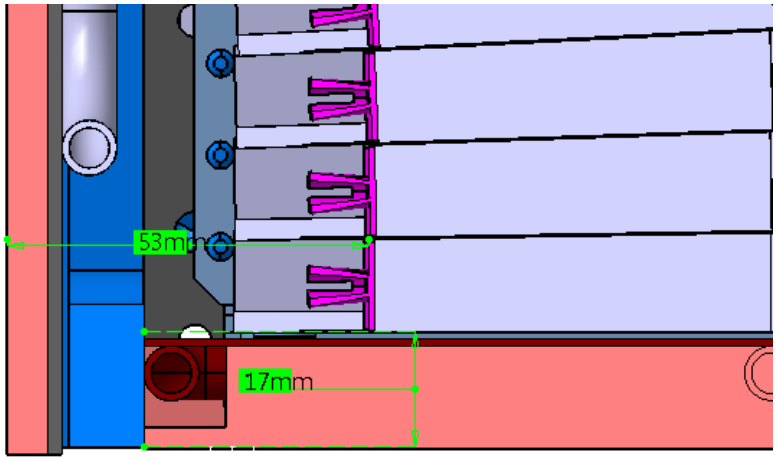
Commissioning and Calibration

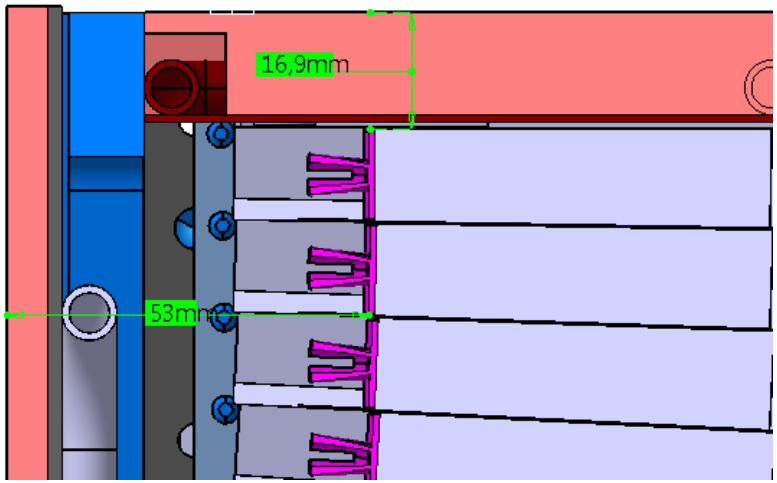
LED monitoring system



- Existing CLAS12 Forward Tagger design
- Each LED pulsed by a dedicated fast driver
- Controller is EPICS compliant



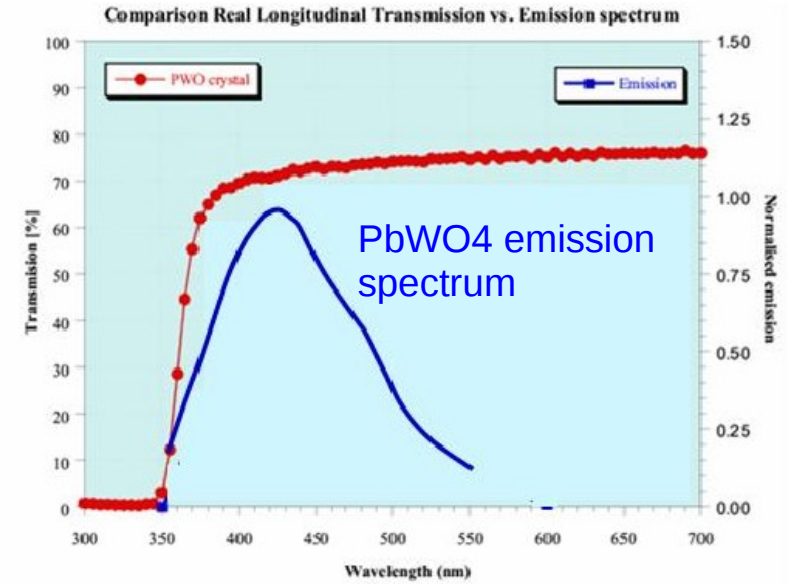


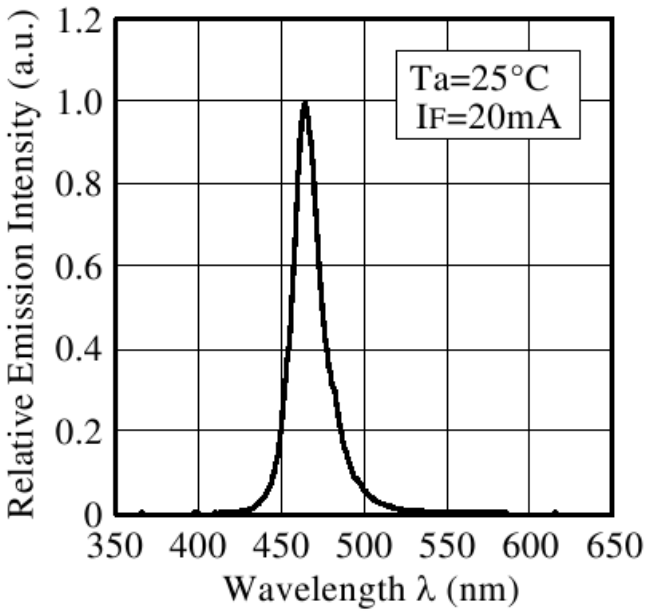


Commissioning and Calibration

LED monitoring system

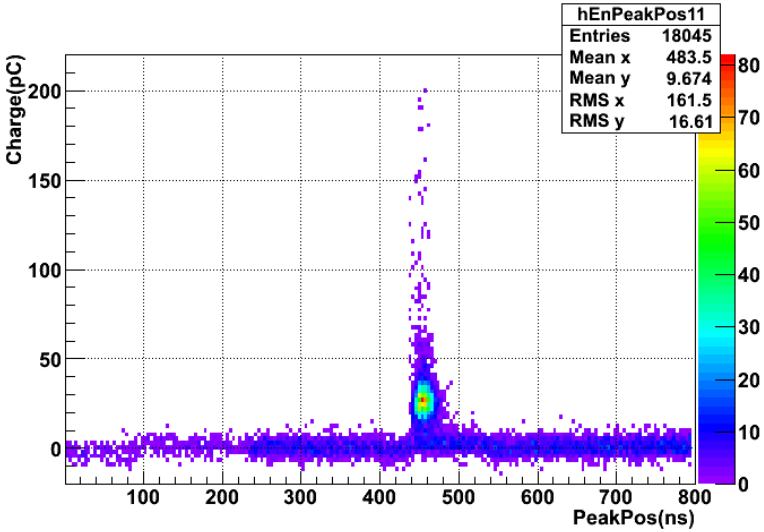
- LED board mounted inside the thermal enclosure on the front side
- Critical for cabling test and general debugging during commissioning
- Gain matching, linearity, timing synchronization
- Bicolor LED :
  - Blue for transmission/radiation damage only
  - Red is less sensitive to radiation damage, APD gain monitoring
- With an estimate of nphe/MeV, and using photostatistics, can provide a first estimate of absolute calibration

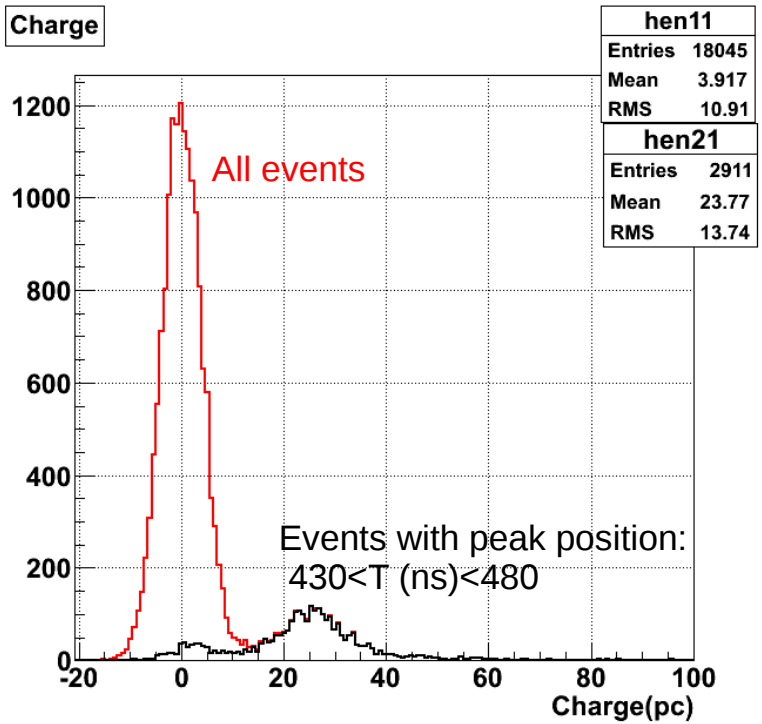




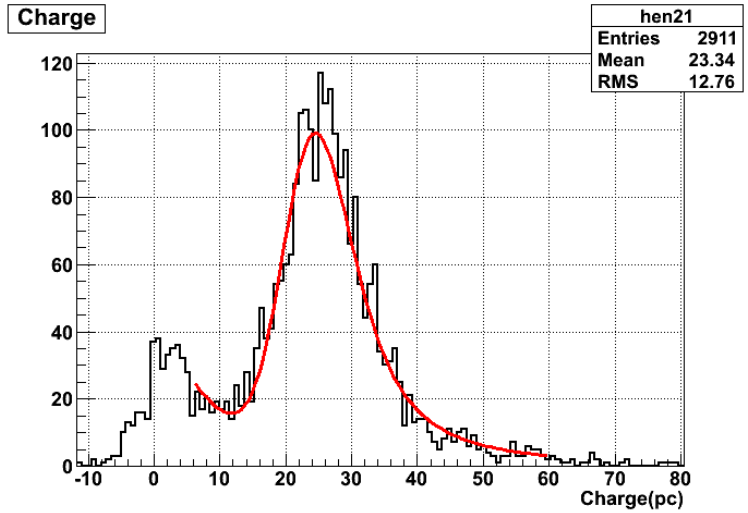
Commissioning and Calibration

Cosmic muon calibration



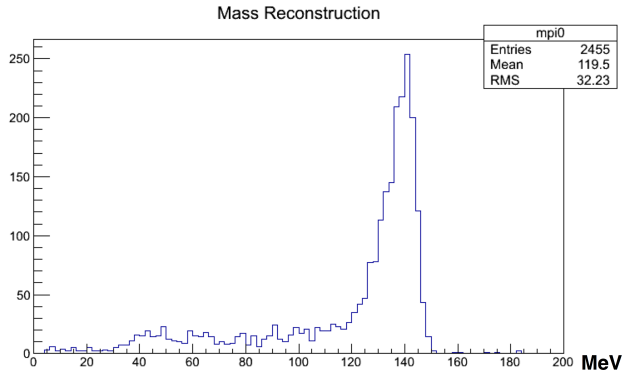


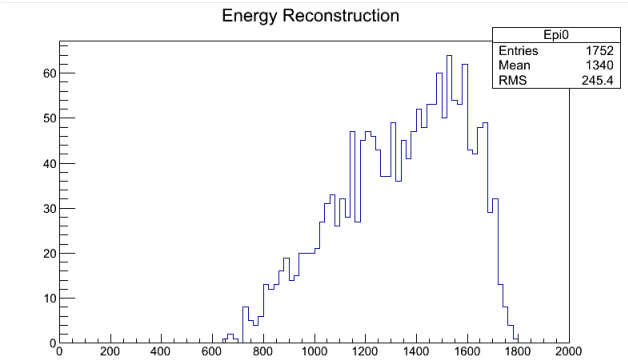
- Trigger by external coincident counters
- Possibility of self trigger with pattern recognition
- About 15 MeV deposition, results with 10x10 APDs at 18 °C
- Deposited charge versus time
- Integrated charge shows separated peak after time cut
- Fit the MIP peak position with Landau $\otimes$ Gaus + exponential
- Peak position 23.1 $\pm$ 0.2 pC



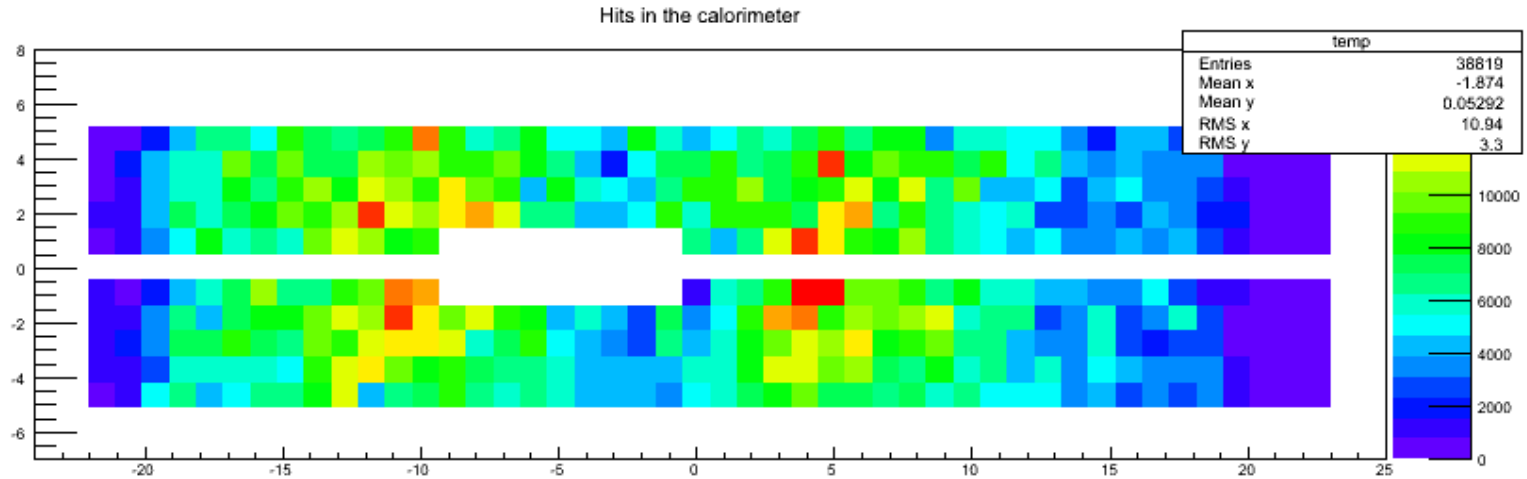
Commissioning and Calibration

Neutral pion invariant mass

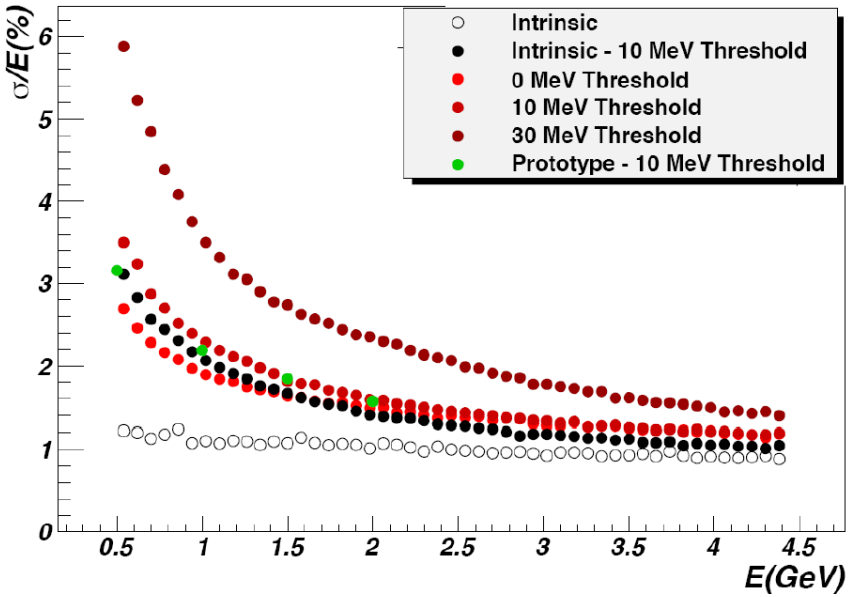




- Generated energy flat between 0.3 and 1.7 GeV (2.2 GeV run)
- Standard target position
- Simulations without background
- SVT veto ?



ECal calibration performances



CLAS12 Forward tracker simulated energy resolution
ECal should be very similar

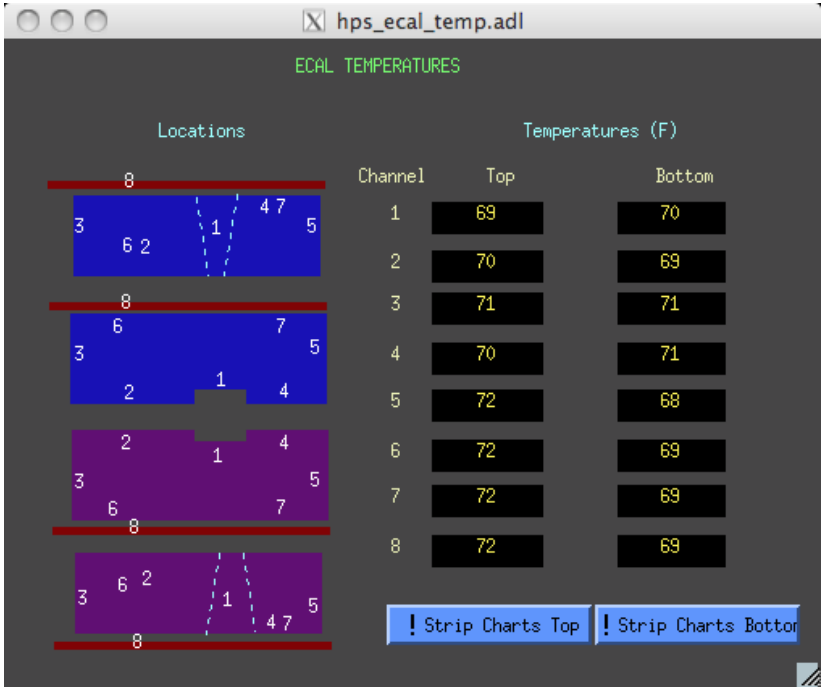
E_{beam} (GeV)	B (T)	$\delta p/p$ (%)	$\delta\theta, \phi$ (mrad)	$\delta m^2_{A'}/m^2_{A'}$ (%)
1.1	0.25	7.7	2.7	11.6
2.2	0.5	4.4	1.4	6.9-9.9
6.6	1.5	2.5	0.8	3.8-4.8

$$\delta m^2_{A'} \approx m^2_{A'} \sqrt{2\left(\frac{\delta p}{p}\right)^2 + 2(\delta\theta)^2}$$

Slow control/Interface

Using Experimental Physics and Industrial Control System (EPICS) standard at JLab

- High voltage
  CAEN modules in SY1257 chassis
  IOC and GUIs flexible enough to accomodate readily grouping changes
- Low voltage
  Currently no external control/monitoring
- Temperature
  Omega thermocouples and RS-485 readout modules
  No remote control/monitoring of the chiller
- Scalers
  Existing ROOT interface with FADC readout
- Vacuum in the ECal chamber



Summary

- Check one layer of crystal APD connection before installing next layer
- Bicolor LED monitoring for gain matching, linearity, timing
  - blue : transmission/radiation damage
  - red : APD gain monitoring
- New APDs will allow for cosmic muon calibration point
- Full instrumentation and test with LED and cosmic muons in the lab
- ECal installation ready in Sept 2014
- Luminosity scan for trigger dead-time
- Photon pair invariant mass π^0 calibration
- Can potentially contribute to HPS "bump hunt" reach
- Most slow control already exist
- EPICS IOC and GUI flexibility for later changes