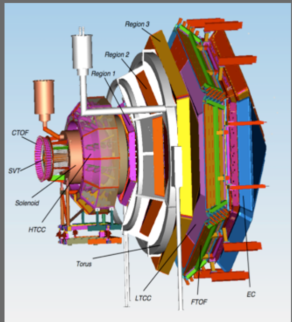
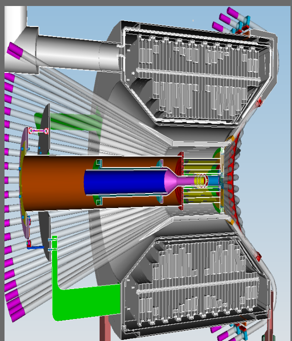
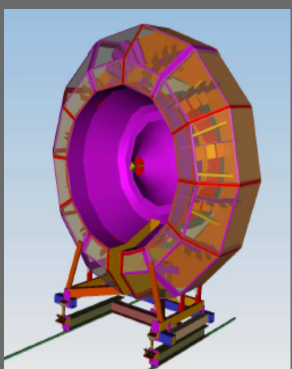
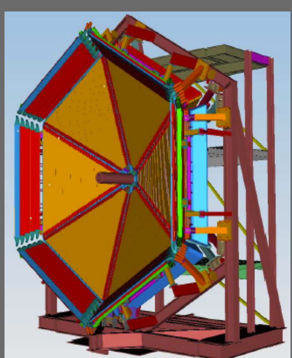


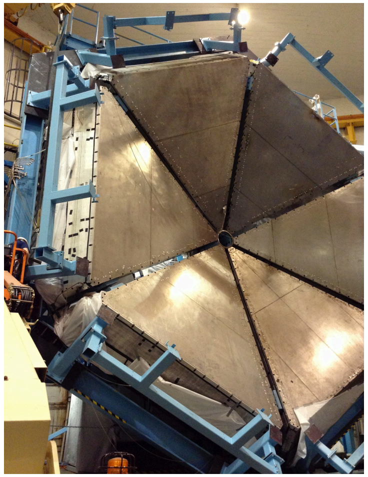
CLAS12 CalCom Status Update

CLAS Collaboration Meeting

February 24, 2016

Outline

- Detector commissioning and calibration:
  - Status update and upcoming work for CLAS12 subsystems (EC-PCAL, FTOF, LTCC/HTCC, DC, SVT, MM, CTOF, CND, FT)
  - Calibration suites development
- Commissioning with Beam Plan
  - Rate estimates
  - Simulation studies
  - Work plan



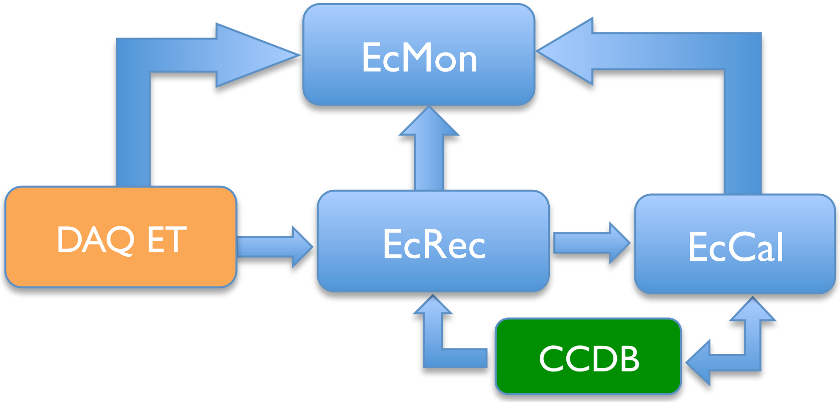
EC Software Suite

Contributors
Gagik Gavalian (JLAB)
Nicholas Compton (Ohio U)
Taya Chetry (Ohio U)
Cole Smith (UVA)

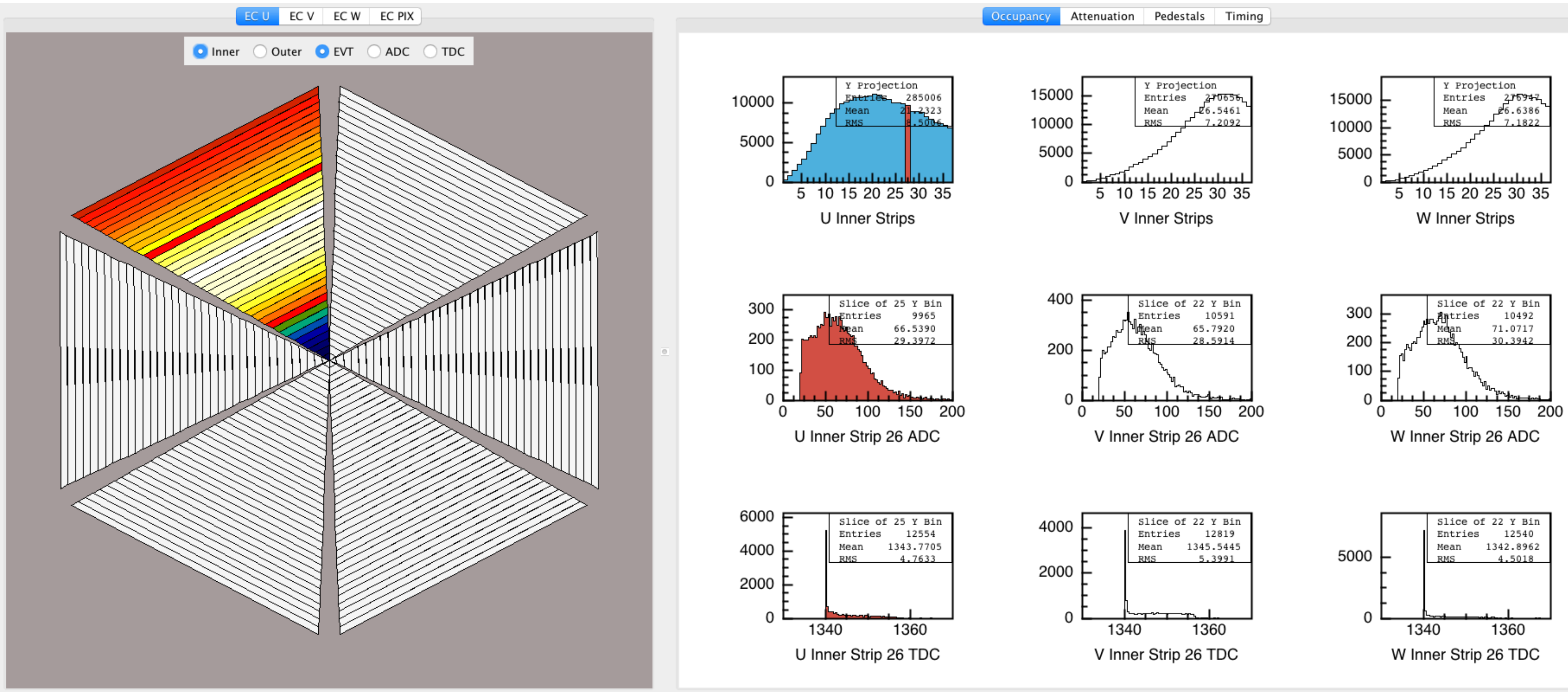
EcMon: Monitors raw, calibrated and reconstructed data in real-time with detector map navigation, strip-charts, histograms. Single-event, rate and accumulation modes

EcCal: Performs calibration procedures and displays intermediate results (PMT gains, attenuation lengths, timing offsets and other constants)

EcRec: Offline/online energy cluster reconstruction package. Will also be used to select suitable calibration events for **EcCal**



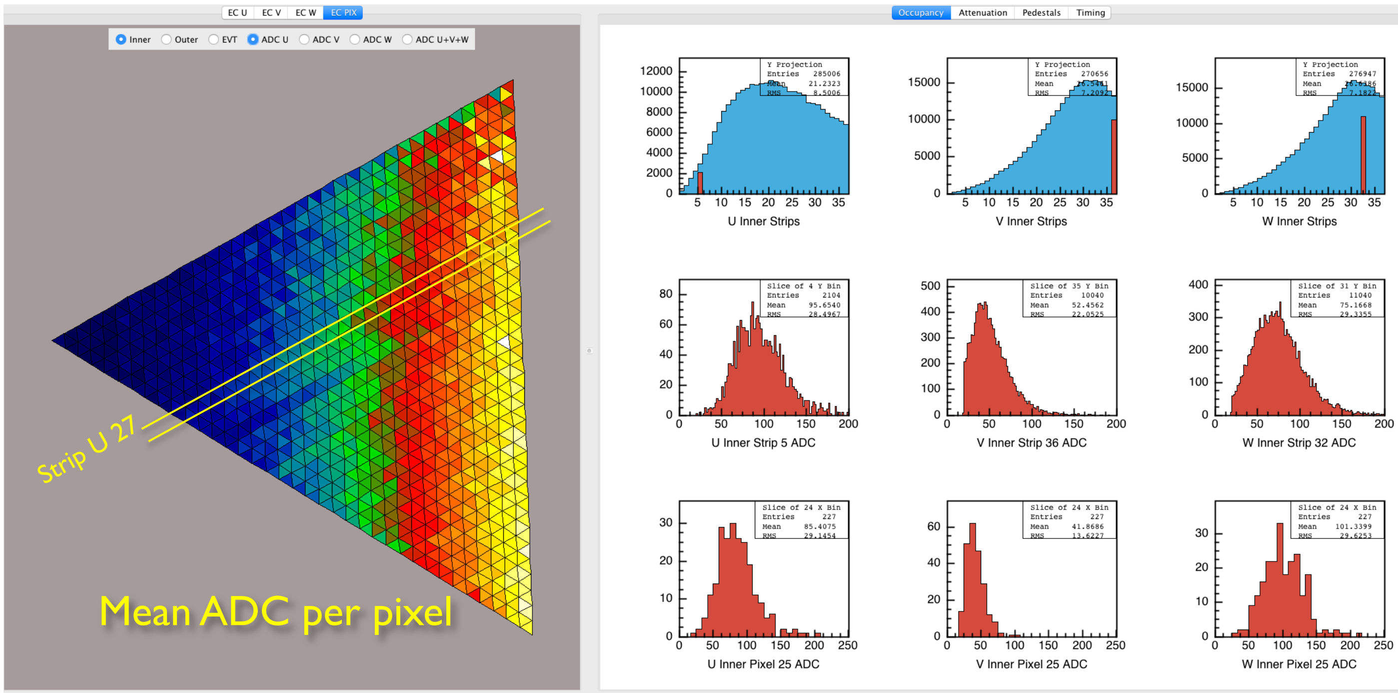
EC Monitoring (EcMon)



Detector panel (left) allows navigation at the strip level (ECU, ECV, ECW) or pixel level (EC PIX).
Detector elements color-coded with events (EVT) or mean ADC, TDC values.

Monitoring panel (right) uses tabs to group monitored items (occupancy, calibration, pedestals, etc.)
At strip level all raw data are shown. At pixel level only events with single pixel hits are shown.

EC Monitoring (EcMon)



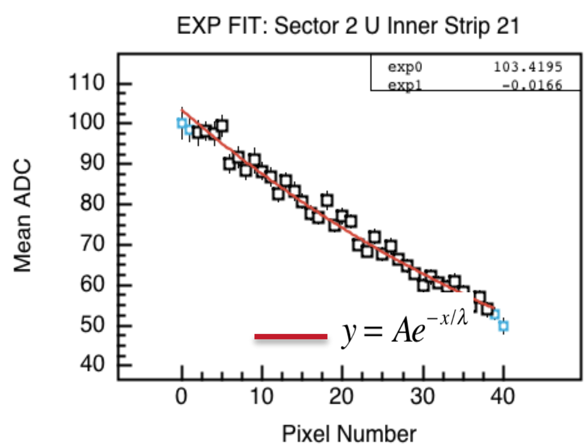
Detector navigation maps are collections of pixel and strip objects which map to the histogram data

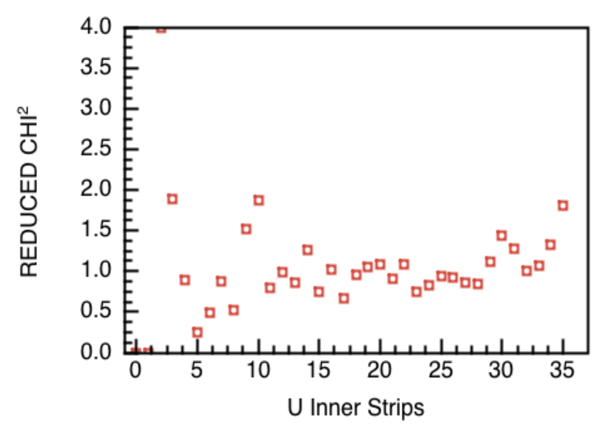
Each strip object contains only the pixels relevant for calibration of that strip

Each pixel object contains energy loss distribution of MIP muons

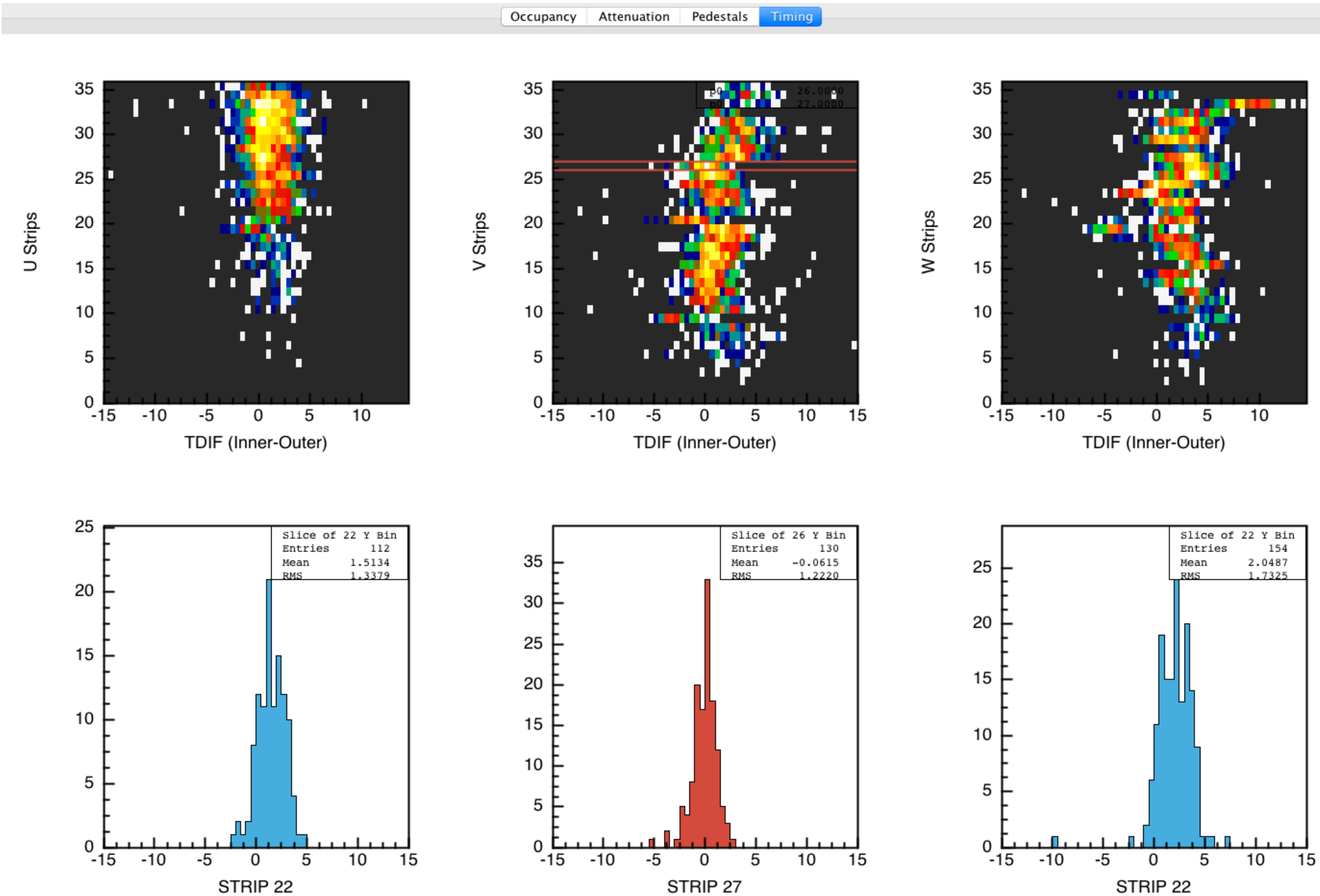
Calibrations performed as data accumulate. Results shown in real-time

Allows timely evaluation of cuts, systematics issues, and convergence of fits



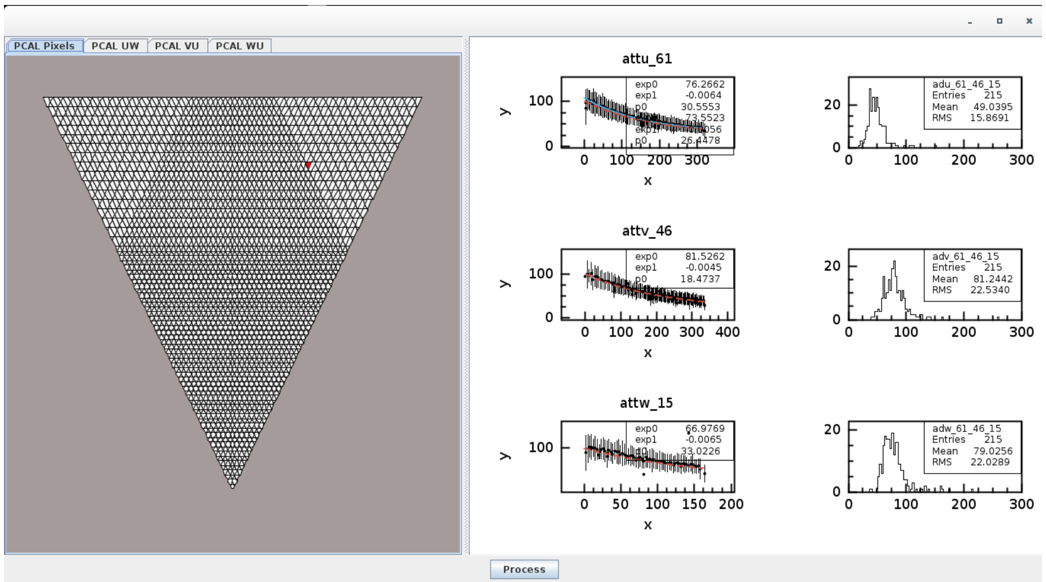


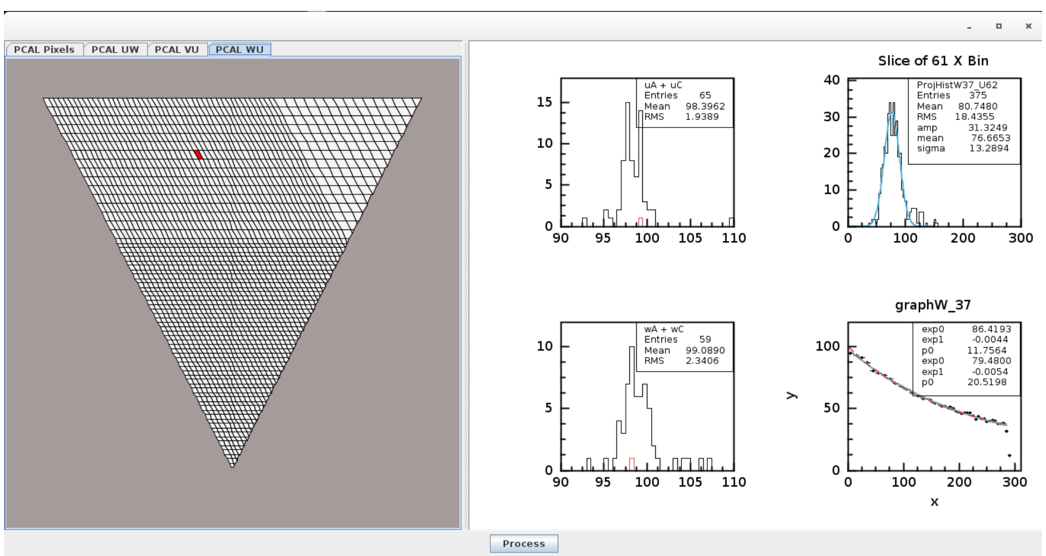
EcMon: TDC Monitoring



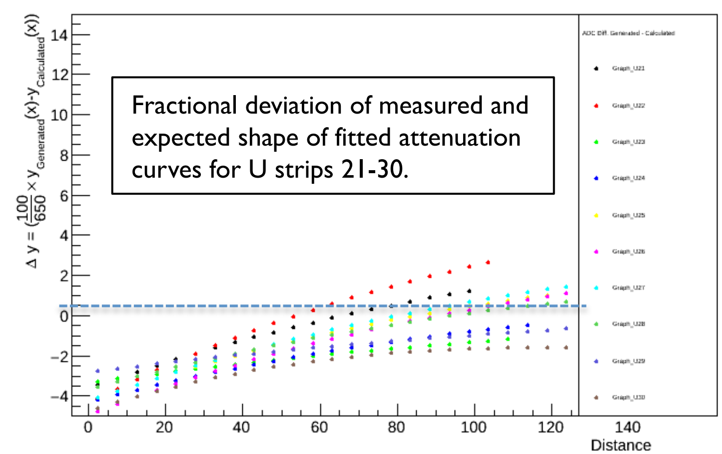
Time difference between EC Inner, Outer strips can be used to monitor quality of time calibration, changes in offsets, noise, etc. FADC Mode 7 timing shown here.

PCAL Calibration





- PCAL calibration GUI under development by Ohio University group
- PCAL pixel geometry complicated by aperiodic overlap of U,V,W strips
- JAVA classes to describe overlapping strip objects developed by Nick Compton
- Systematics of fitting algorithms using 2-strip and 3-strip pixels are being studied by Taya Chetry using GEMC simulations
- Baseline CCDB calibration constants will be derived from pre-installation test setup cosmic runs taken in 2012-2013
- Forward carriage data will be used to evaluate changes during last 4-5 years



Progress and Near-Term Goals

Progress

CCDB tables

- /test/fc: FADC parameters (pedestals, NSA, NSB, TET) used by EventDecoder, PeakFitter.
- /calibration/ec: ECAL and PCAL tables reorganized into single table.
- /calibration/ec/attenuation: Run 1=no attenuation, Run 2-10=376 cm, Run 11-inf = measured.

EcMon

- Added real-time monitoring of gain/attenuation calibration, pedestals and timing.
- Decoding of Mode 7 FADC pulse integral and high-resolution timing.

EcCal

- Development of utility and draw Java classes for PCAL strips, pixels (Nick Compton).
- Studies on systematics of 3-parameter attenuation fits to PCAL cosmic data (Taya Chetry).

Mid-Term Goals (2-3 monts)

EcMon

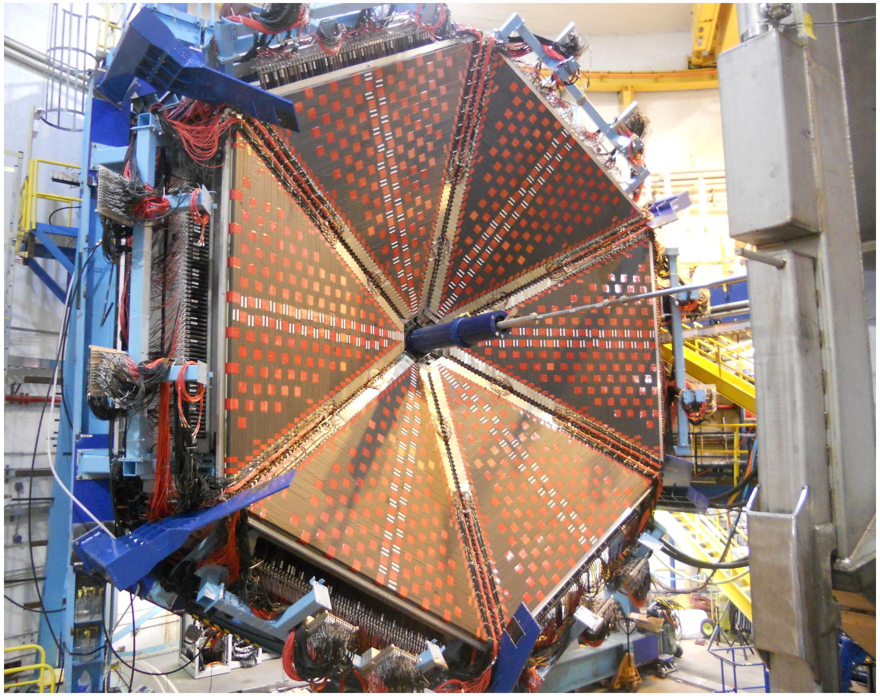
- Incorporate strip-chart, update and single-event modes.
- Import EPICS HV and scaler data into displays.
- Detector status plots which incorporate various data sources.

EcCal

- Implement timing calibration and ECAL/PCAL relative alignment procedures.
- Current plan is to develop EcCal as plug-in for EcMon.
- Could also run under CLARA as stand-alone service.
- ECAL and PCAL calibration algorithms may be merged within this package.

Demonstrate complete MIP-based calibration cycle (HV adjustment and CCDB table entry) for both ECAL (likely first) and PCAL by mid-Spring 2016.

FTOF Calibration Update



Calibration Runs:

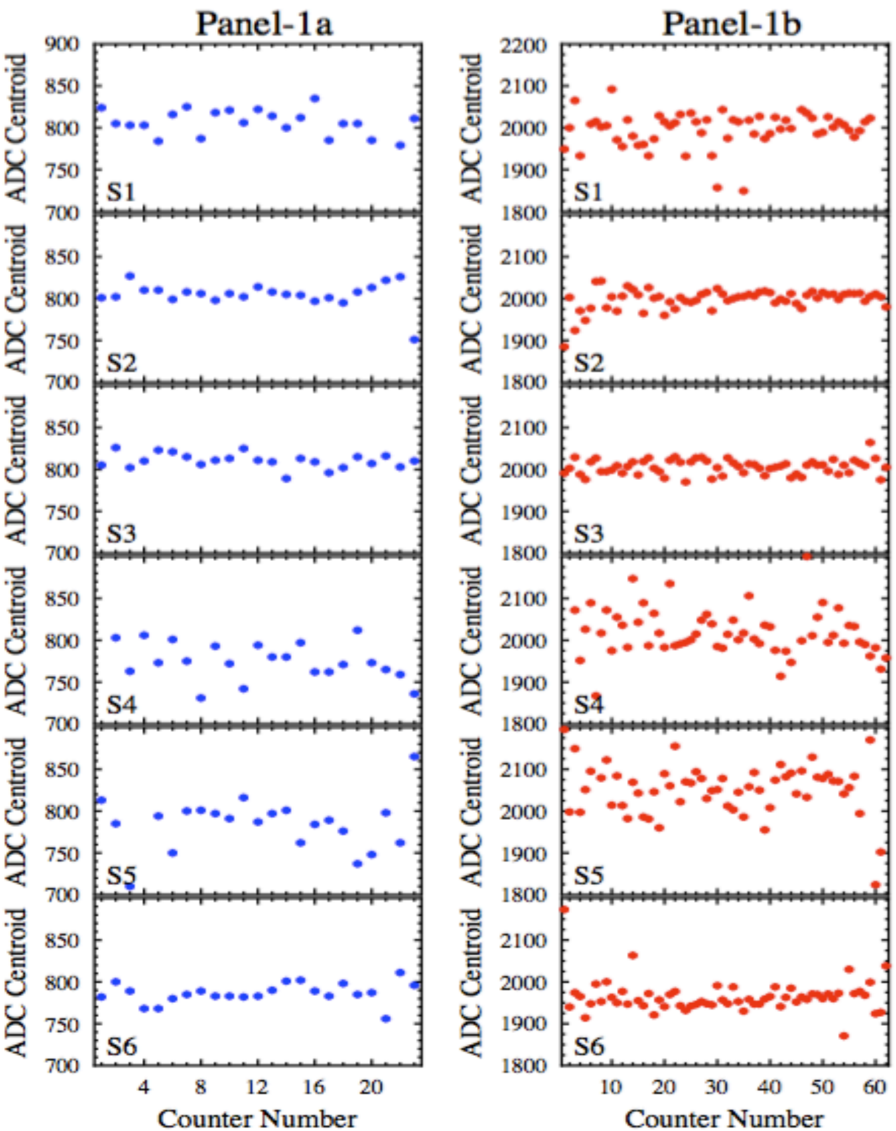
- *Check signal connectivity*
- *Check signal inverters (panel-1b)*
- *Complete HV gain matching*
- *Check for swapped cables*
- *Check counter functionality*
- *Test DAQ and electronics*
- *Collect data for calibration suite development*

Recent/Current Work:

- *Completed final functionality checks after torus spit removal and LTCC support install*
- *Check functionality after LTCC installation*
- *Preparing for FTOF panel-2 installation in Feb. 2016*

Known Problems: *- S4b #7R (high PMT current)* *- S5a #4L (bad dynode)* *- S6a #21L (bad voltage divider)* *- S6b #54L (high PMT current)*

FTOF Calibration Update



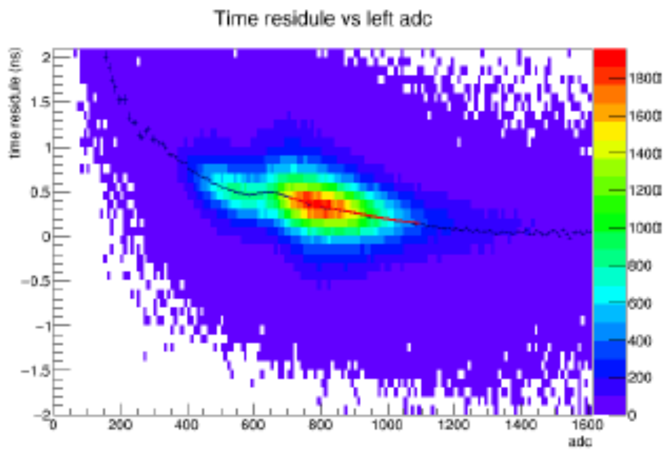
- FTOF gain calibrations complete; monitoring system long-term stability
  - *studies using legacy code*
- Using cosmic ray data to develop FTOF calibration suite
  - *code development in progress by H. Lu (Iowa) & L. Clark (Glasgow)*
  - *Studies with GEMC data getting underway*
- Gearing up for PCAL/EC/FTOF1a+1b geometry matching and FTOF efficiency measurements using cosmic rays
  - *work completed in 2014 for S5*
- Finishing analysis of FTOF survey data to build into FTOF geometry
- Development of Forward Carriage monitoring GUI is progress

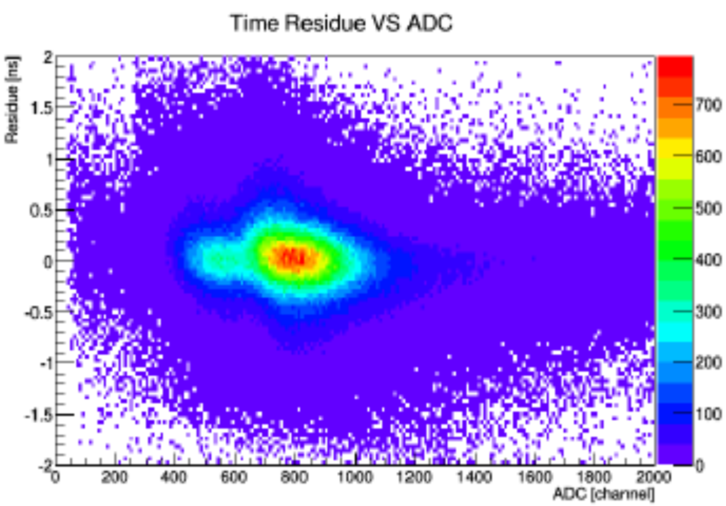
FTOF time-walk correction

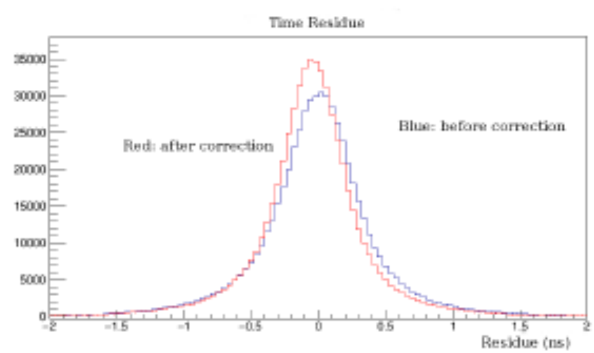
Algorithm development

Haiyun Lu (Iowa U.)

- Formula: $\Delta t = t_0 - \frac{\lambda_0}{adc^{\lambda_1}}$
- Right: example of fit
- Bottom Left: residue after correction VS ADC
- Bottom right: comparison before and after correction







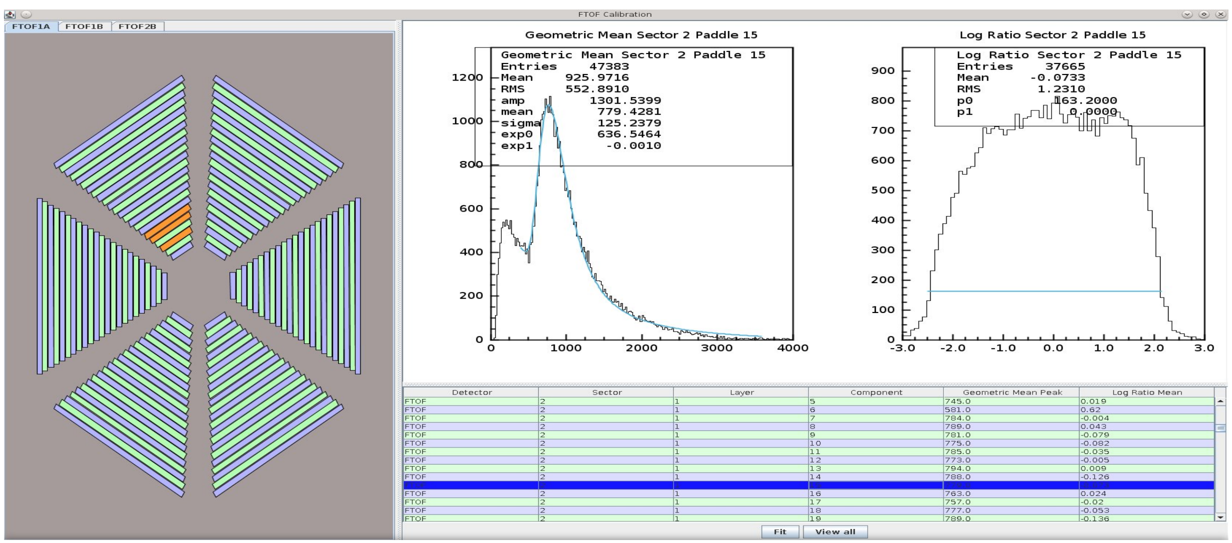
FTOF Calibration Suite

Work in progress:

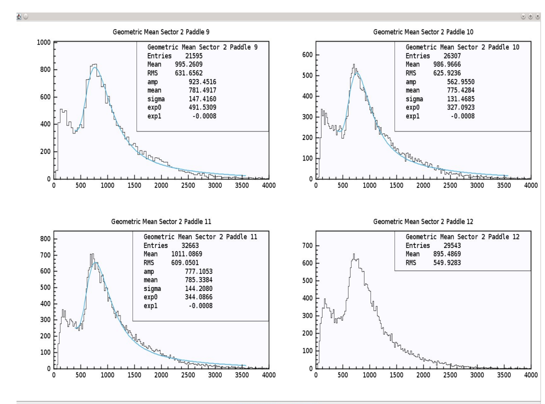
- Development of calibration software using standardised calibration code and common tools. Features include:
  - Use of common code GUI tools including calibration constants table, book canvas
  - Detector GUI to highlight paddles with calibration issues
  - Refitting panel to adjust fit parameters for individual paddles
- High voltage calibration testing with forward carriage cosmic data from Jan 16
  - evio events processed in raw or integrated format

Work planned:

- High voltage adjustments to achieve desired channel for MIP
- Conversion of remaining calibration algorithms to COATJAVA framework
- Full functionality within GUI for each calibration area
  - Summary graphs of calibration values
  - Output file of calibration constants for transfer to calibration database



Louise Clark (University of Glasgow)



FTOF Software and Documentation

- Calibration procedures in development:
  - Haiyun Lu (ROOT/C++) and Louise Clark (Integrated Java version)
  - Daniel Carman and Gagik Gavalian providing orchestration and oversight
  - Code designed to complete gain matching calibration (for online HV adjustments)
  - Code designed to complete timing calibration (offline calibration)
    - *Time-walk correction*
    - *Left-right adjustment*
    - *Energy loss*
    - *Attenuation length*
    - *Effective velocity*
    - *RF parameters*
    - *Counter-to-counter delays*
  - Work plan includes development of tutorials for training
  - Software tested on FTOF cosmic data, CLAS g14 data, and will include testing using MC data
- Documentation for FTOF:
  - Geometry document
  - Calibration constants document
  - Monte Carlo simulation baseline
- Calibration software on track to be ready (in beta version) by end of May 2016

DC12: Calibration Status

M. Mestayer and K. Adhikari

DC Calibration Categories:

- **Translation Tables** – …WELL UNDERWAY…
  - associate each wire with its electronics; STB → DCRB; CAEN → HVTB, etc.
- **Geometry** –
  - ideal wire positions … DONE…
  - misalignment … Procedure established…
- **Time Delays** – … Procedure established…
  - cable delays … Automated method established
  - signal velocity along wire
  - time difference between DCRB and FTOF
- **Status Tables** –
  - keep time history of HV, lv, wire status …GUI's, Maps built…
- **Drift Velocity** –
  - determine time as a function of (DOCA,θ_{local},**B**) … Parameterization done

New since last meeting

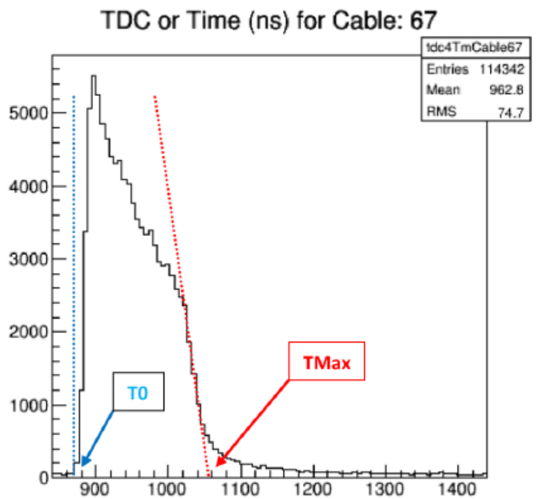
DC12: Calibration

M. Mestayer and K. Adhikari

Fitting Time Distributions

Fit leading and trailing edges of time distribution to a sigmoid function to obtain:

- **T0** (start time)
- **Tmax** (maximum drift time)

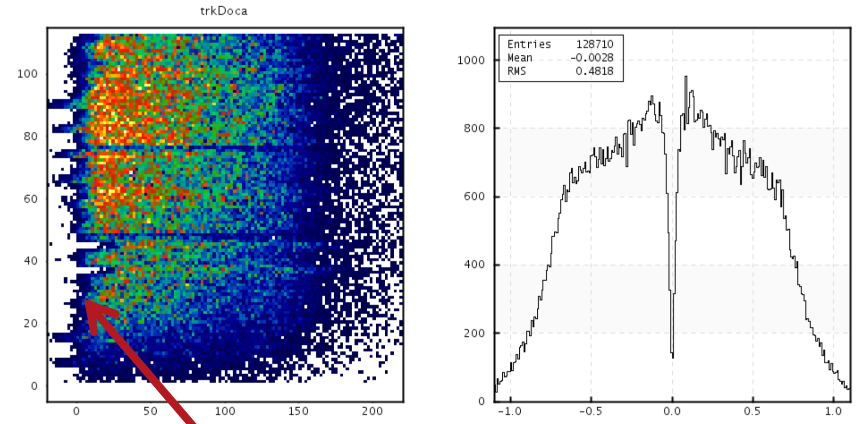


Knowledge of TMax can be useful in monitoring the DC condition and performance. For example, if the gas density changes, TMax will change.

Fit function:

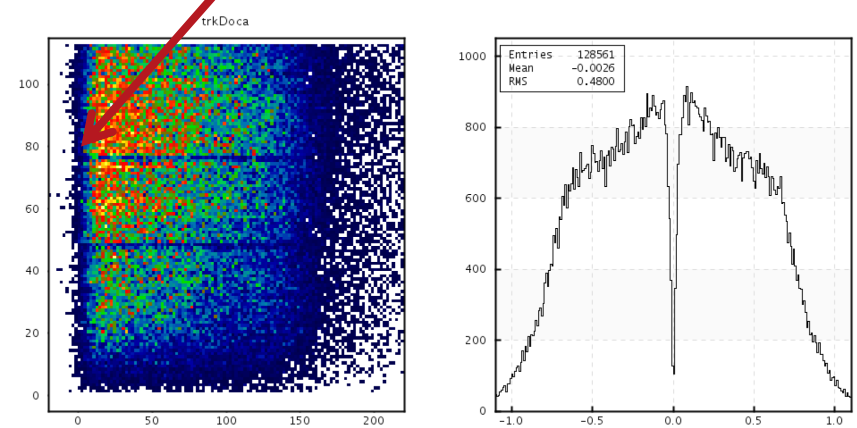
$$f(t) = (1 - sigmoid) \times exponential + constant$$

$$f(t) = (1 - \frac{1}{1 + e^{A-Bt}}) \times e^{C-Dt} + E$$



Improved T0 Corrections

Before and **After** automated **T0- fitting**

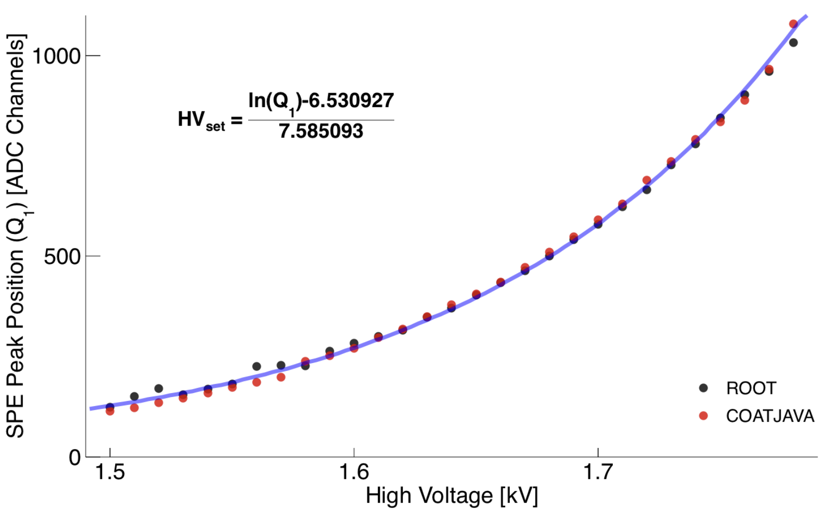


HTCC Calibration

Y. Sharabian, N. Markov, W. Phelps

Updated EVIO reader and fitting in Java:

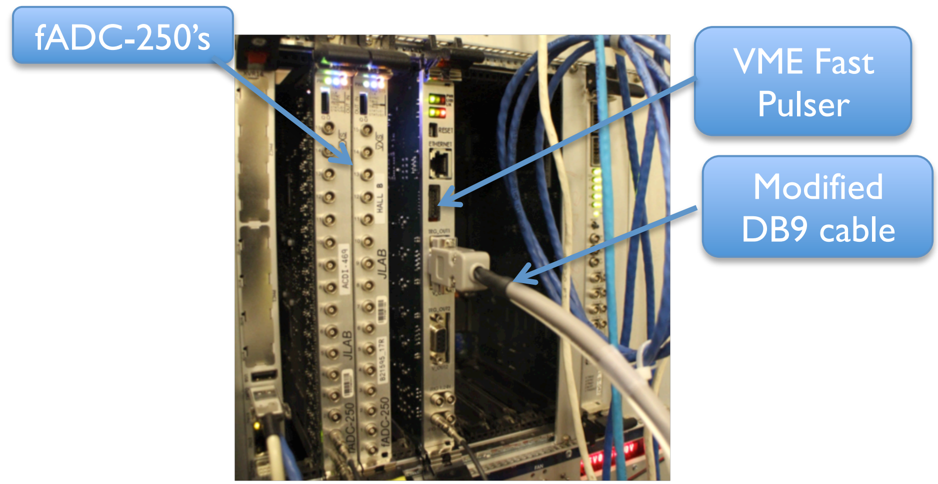
- Multithreaded
- Optimized code
- 2 minutes per fit on a single core



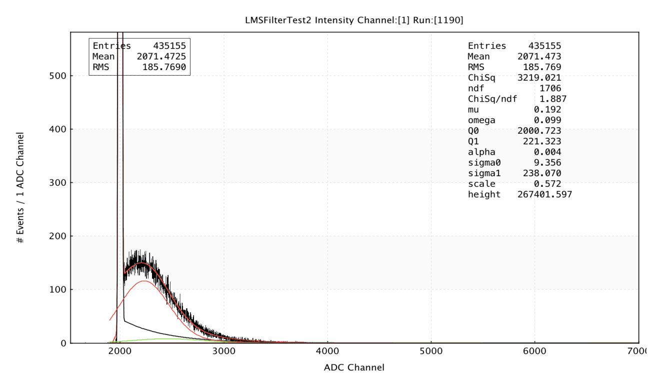
- Fits are consistent between ROOT and COATJAVA packages
- Similar calibration curve will be created for each of the 48 PMTs for the purpose of gain matching

New production hardware

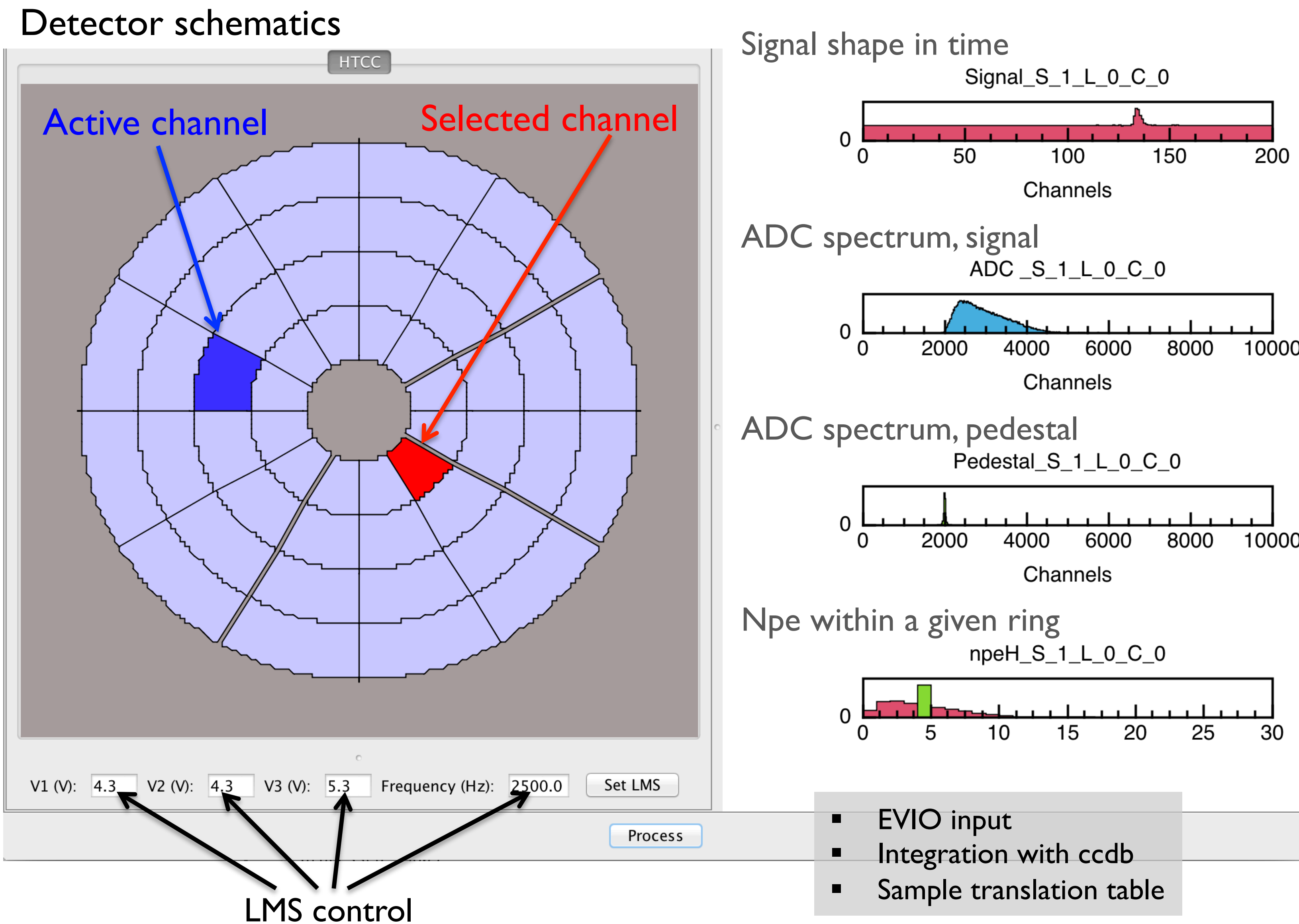
- VME fast pulser board
- Patch panel
- DB9 cable with noise reduction



Fit with new hardware and software



HTCC Calibration Suite

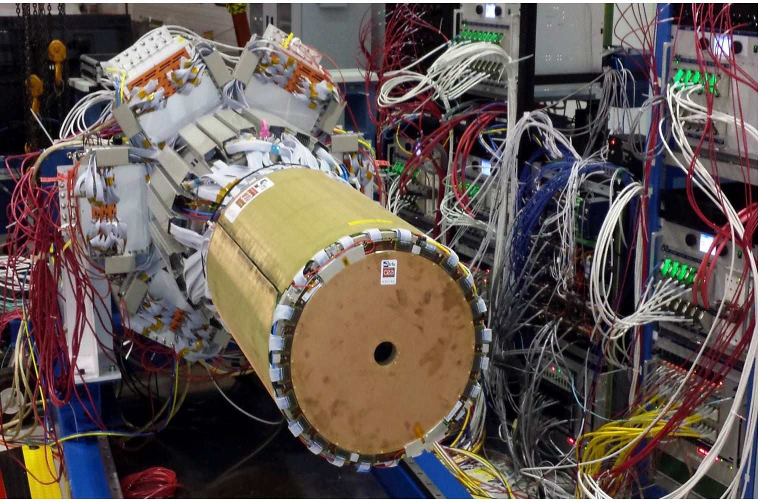


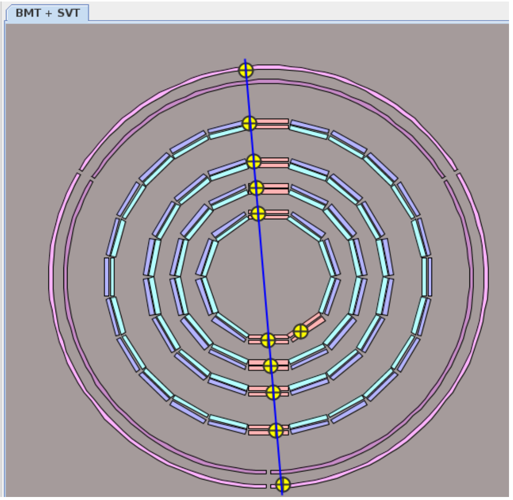
- EVIO input
- Integration with ccdb
- Sample translation table

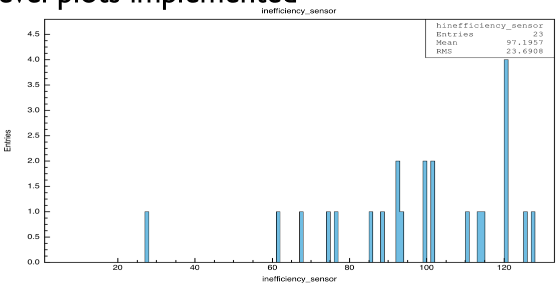
SVT Commissioning Status

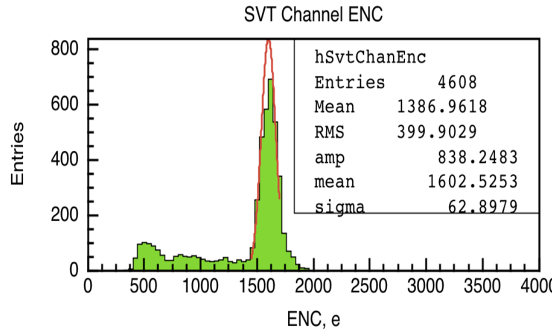
Y. Gotra

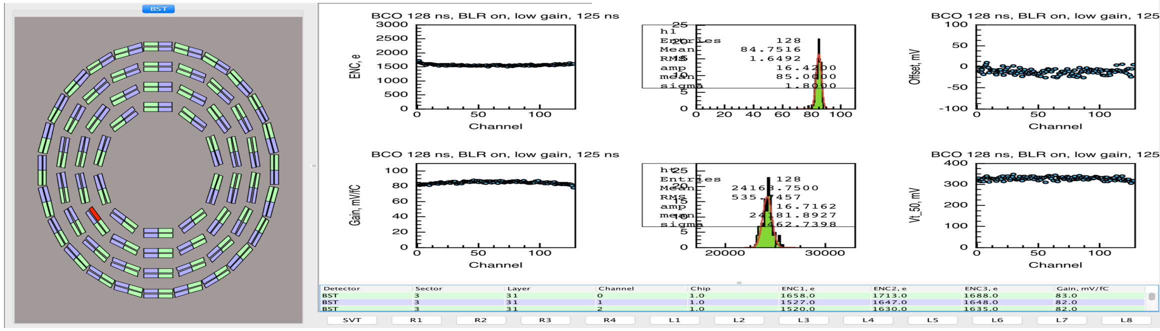
- SVT is integrated with Micromegas tracker (December 2015)
- Both systems calibrated, no extra noise observed
- DAQ synchronized, SVT is providing master trigger to the MVT
- Central tracker commissioning in progress, taking cosmic data 24/7
- Online cosmic track reconstruction monitoring of SVT and MVT using ET implemented
- Tracker alignment sample: 100 M SVT tracks and 20 M SVT/MVT tracks collected
- Mechanical survey data analysis complete
- Noise performance monitored by periodic SVT calibration scans (20 min per scan) and logged
- SVT long term stability is monitored since integration (August 2015)
- Sensor temperature 12-14C with coolant at 6C
- Nitrogen purging remote control and monitoring system installed and tested
- CoatJava based calibration suite developed (5 min to analyze a calibration scan)
- Channel, Chip, Sector, Layer, Region and Detector level plots implemented
- Tuning of fit parameters done
- Bad channel mapping done
- SVT calibration data table defined











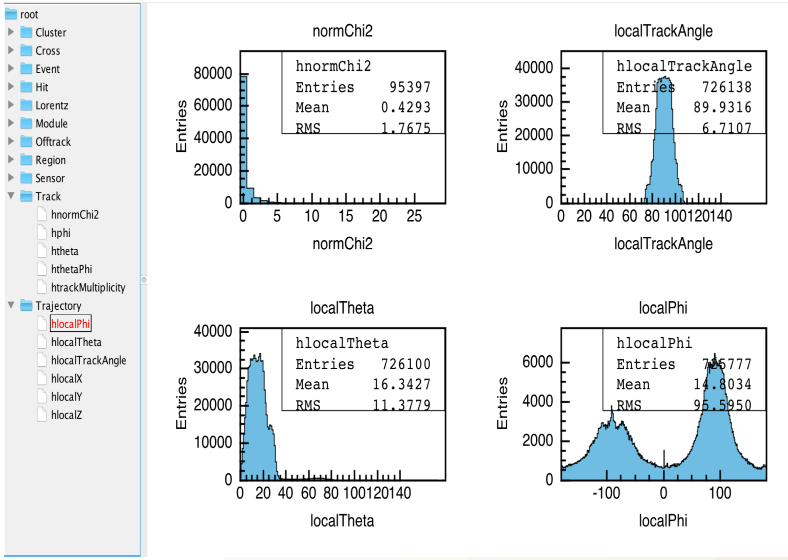
SVT: progress and plans

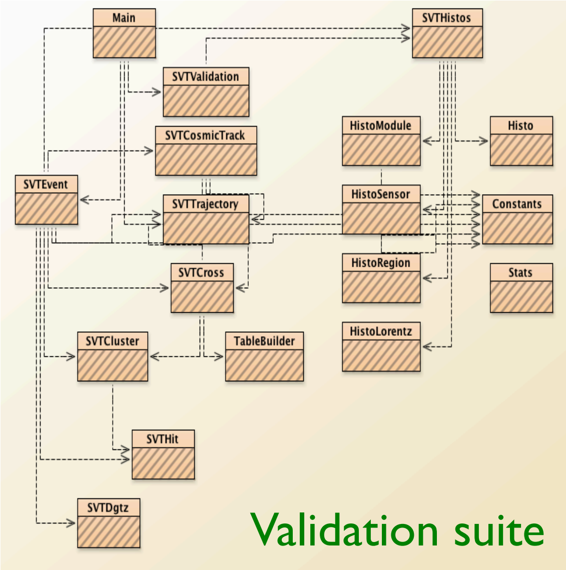
Work in progress

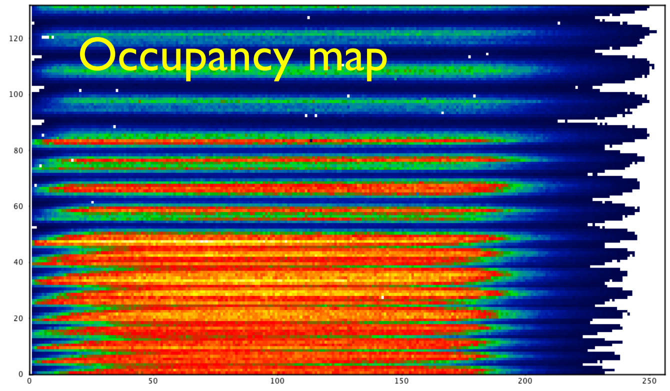
- Development of the data validation and monitoring suite
- Validation of local and track reconstruction
- Monte Carlo tuning on the cosmic data
- SVT alignment using Monte Carlo and cosmic data

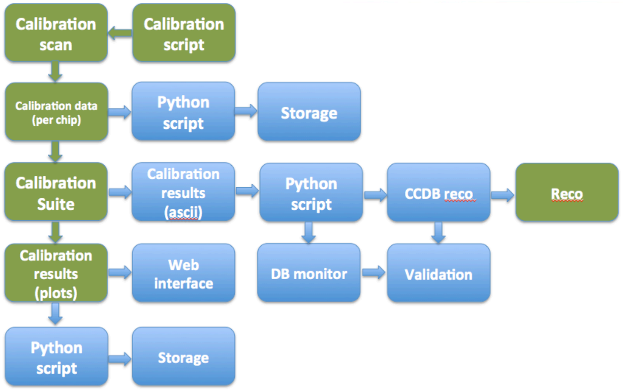
Path forward

- Monitoring web interface
- Trigger studies
- Analysis suite for MYA DB
- Profiling, benchmarking and batch processing
- Calibration history monitoring
- Documentation

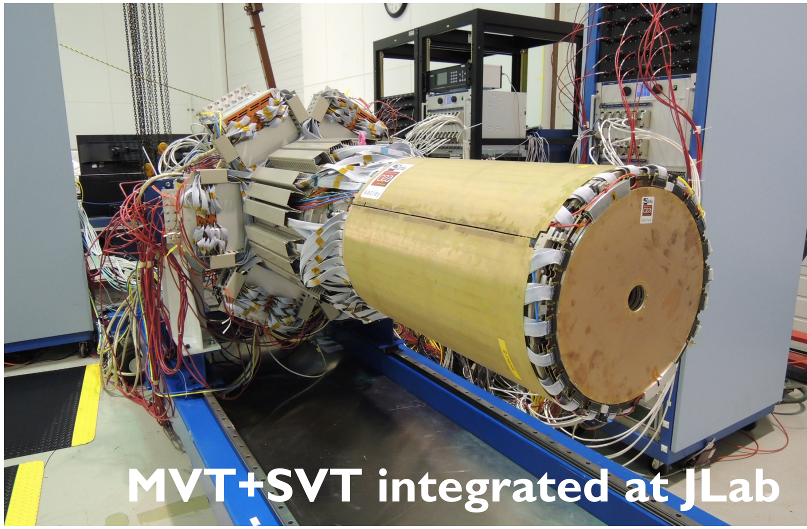






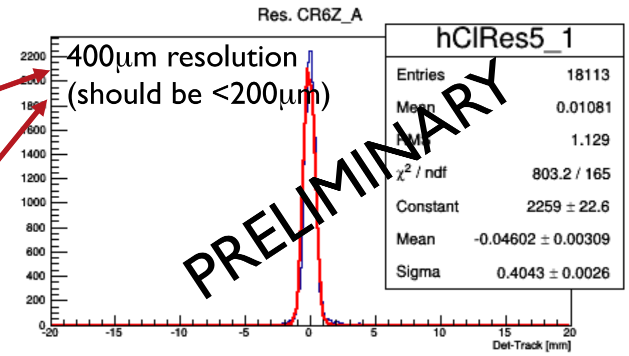


MVT Commissioning



Since October 2015:

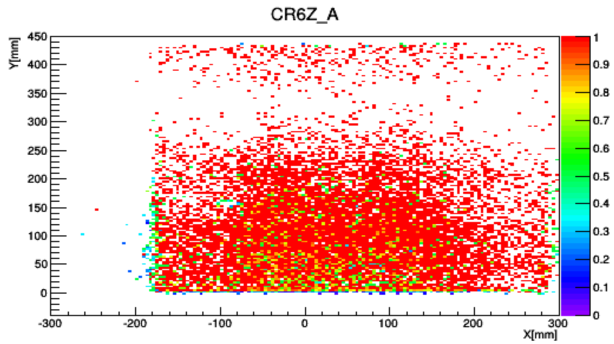
- 2-layer barrel + 3-layer forward sent to Jlab
- Geometry information given to Veronique
- Complete checkout of the system at Jlab (detectors, lv, hv, gas, electronics, etc)
- Integration in CODA-based DAQ
- Integration with the 4-layer SVT (went flawlessly)
- Full surveys during installation
- Recorded S/N ratios (>40 !)
- Started using reconstruction package + monitoring system (Java)
- Had to develop alternate code (C++/ROOT-based) in order to proceed with cosmics analysis
- Fully analyzed barrel cosmic runs using Veronique's tracking (v1)

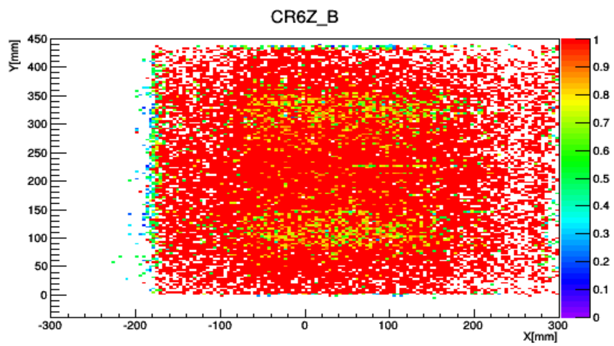


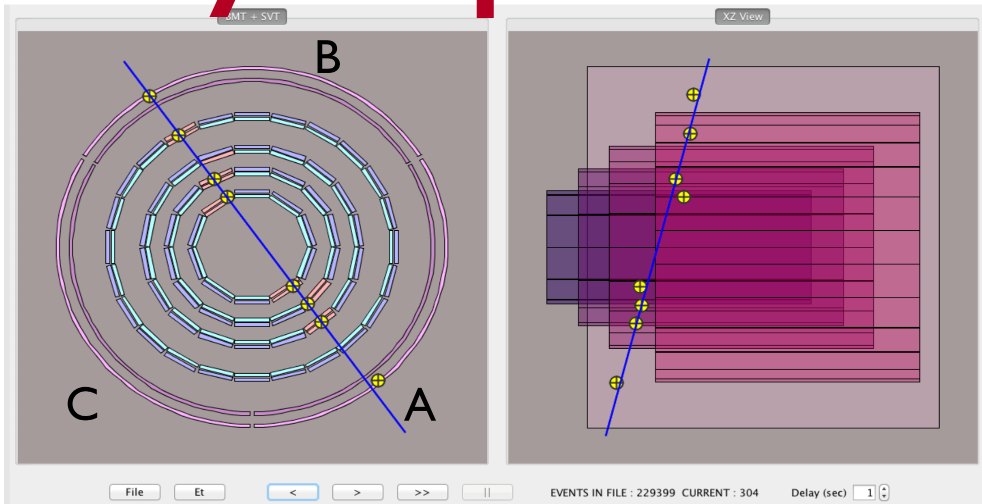
Next:

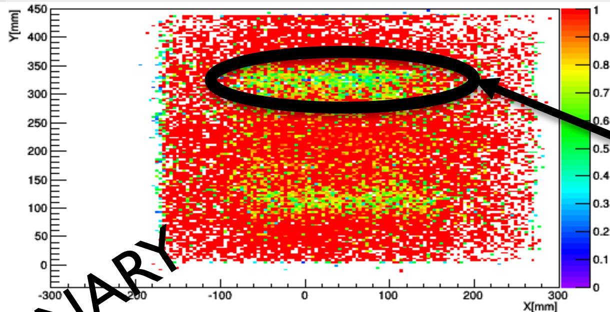
- Need to solve some issues with tracking
- Use MVT in tracking (right now, only SVT, MVT as « check »)
- So far, using maximum sample as only information (mode 7)
  → need to implement full waveform analysis to optimize reconstruction and use timing information
- Analysis of forward detector (only barrel so far)
- Implement/optimize geometry (survey + cosmics data)
- Implement various databases

MVT: efficiency maps

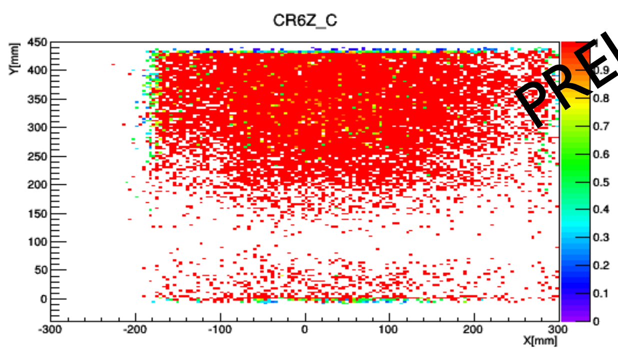


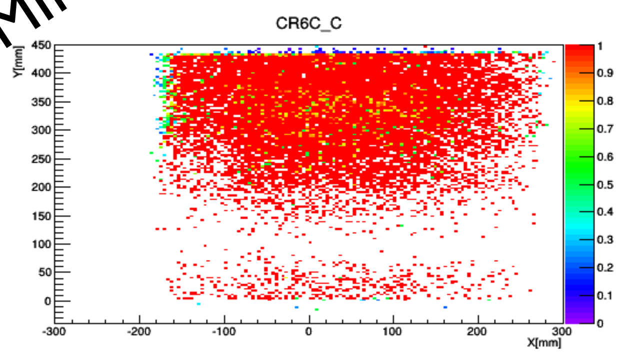






Issues with tracking (shallow tracks?)



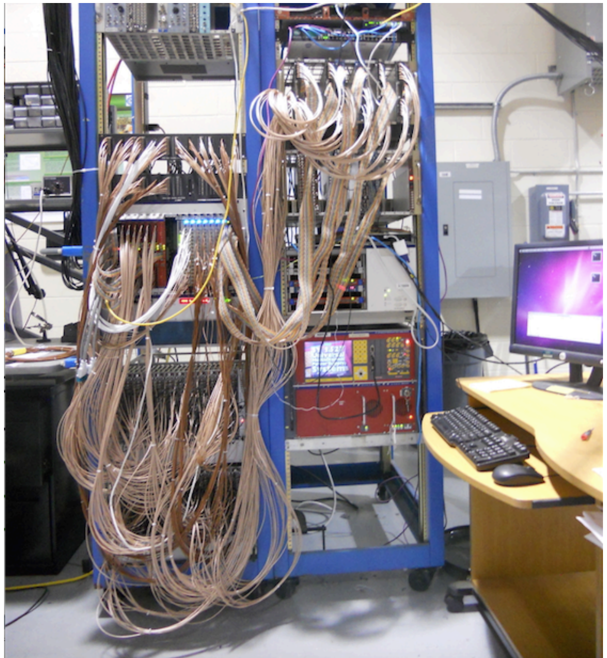


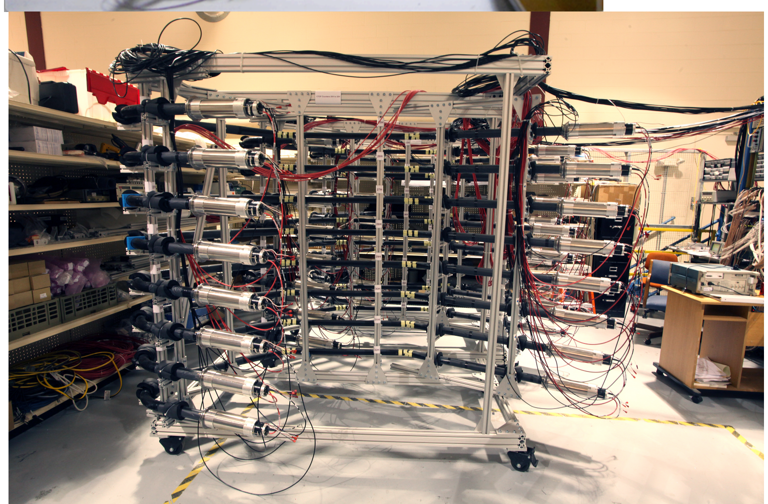
PRELIMINARY

Run 232 :
1 018 619 Entries
HVmesh 500V (rather low)
HVdrift 400V

CR6Z_A : 0.88
CR6Z_B : 0.94
CR6Z_C : 0.88
CR6C_A : 0.82
CR6C_B : 0.87
CR6C_C : 0.87

CTOF Cosmic Ray Studies



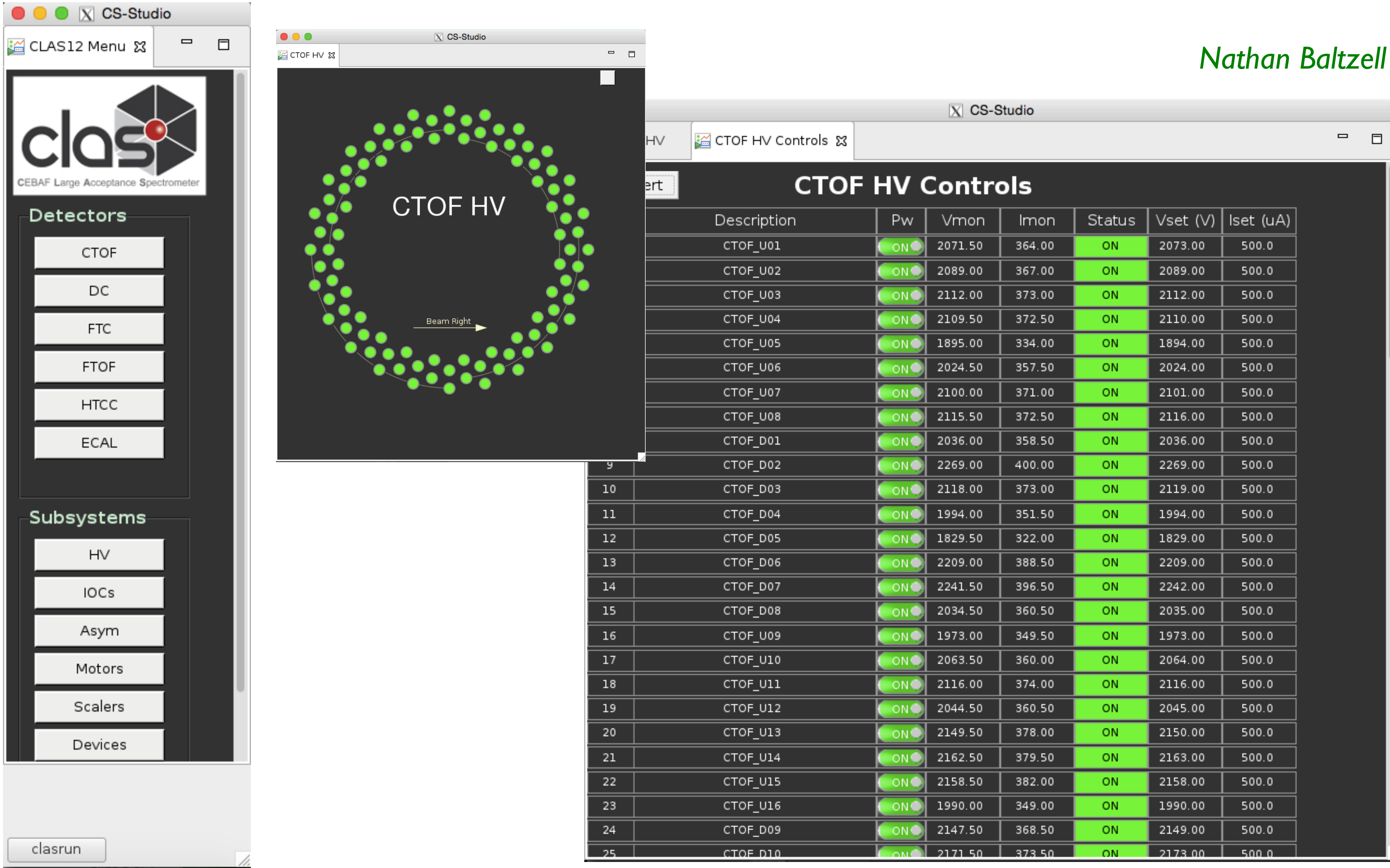


Detailed characterization of counters in progress:

- Counter HV gain matching complete
- Slow controls system developed
- Measurements completed for:
  - *counter resolution*
    - *σ = 70 → 75 ps*
    - *limited by counter alignment*
  - *attenuation length*
  - *number of photoelectrons*
  - *Discriminators - CFD vs. LED*
  - *Time walk corrections*
- Light Monitoring System operation to be developed this spring after part delivery
- Documentation well underway

CTOF Slow Controls

Nathan Baltzell



#	Description	Pw	Vmon	Imon	Status	Vset (V)	Iset (uA)
	CTOF_U01	ON	2071.50	364.00	ON	2073.00	500.0
	CTOF_U02	ON	2089.00	367.00	ON	2089.00	500.0
	CTOF_U03	ON	2112.00	373.00	ON	2112.00	500.0
	CTOF_U04	ON	2109.50	372.50	ON	2110.00	500.0
	CTOF_U05	ON	1895.00	334.00	ON	1894.00	500.0
	CTOF_U06	ON	2024.50	357.50	ON	2024.00	500.0
	CTOF_U07	ON	2100.00	371.00	ON	2101.00	500.0
	CTOF_U08	ON	2115.50	372.50	ON	2116.00	500.0
	CTOF_D01	ON	2036.00	358.50	ON	2036.00	500.0
9	CTOF_D02	ON	2269.00	400.00	ON	2269.00	500.0
10	CTOF_D03	ON	2118.00	373.00	ON	2119.00	500.0
11	CTOF_D04	ON	1994.00	351.50	ON	1994.00	500.0
12	CTOF_D05	ON	1829.50	322.00	ON	1829.00	500.0
13	CTOF_D06	ON	2209.00	388.50	ON	2209.00	500.0
14	CTOF_D07	ON	2241.50	396.50	ON	2242.00	500.0
15	CTOF_D08	ON	2034.50	360.50	ON	2035.00	500.0
16	CTOF_U09	ON	1973.00	349.50	ON	1973.00	500.0
17	CTOF_U10	ON	2063.50	360.00	ON	2064.00	500.0
18	CTOF_U11	ON	2116.00	374.00	ON	2116.00	500.0
19	CTOF_U12	ON	2044.50	360.50	ON	2045.00	500.0
20	CTOF_U13	ON	2149.50	378.00	ON	2150.00	500.0
21	CTOF_U14	ON	2162.50	379.50	ON	2163.00	500.0
22	CTOF_U15	ON	2158.50	382.00	ON	2158.00	500.0
23	CTOF_U16	ON	1990.00	349.00	ON	1990.00	500.0
24	CTOF_D09	ON	2147.50	368.50	ON	2149.00	500.0
25	CTOF_D10	ON	2171.50	373.50	ON	2173.00	500.0

CTOF Calibration Suite

Development of CTOF calibration suite:

- Development by A. Ni (KNU) in Oct. 2015 followed development of FTOF suite by L. Clark (Glasgow)

- Using common tools developed by G. Gavalian:
  - code developed to read EVIO data from cosmic ray test stand
  - wrote rudimentary code to digitize the ADC and TDC data
  - implemented translation table
  - plotted histograms for HV gain matching

- Further development on hold due to limited manpower
  - unless new manpower is found, plan for L. Clark to develop CTOF timing calibration code when FTOF work is completed
    - *no new algorithms – main work is to develop GUI interface*

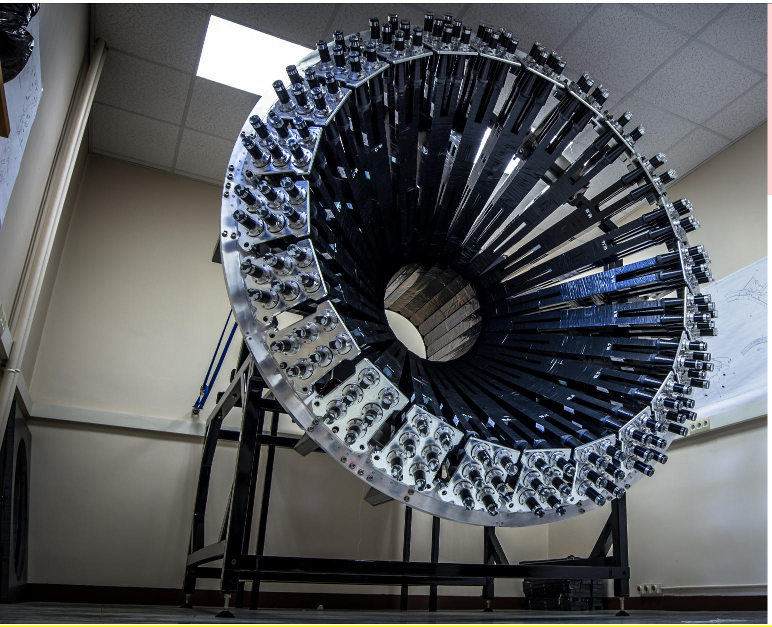
CTOF Software and Documentation

- Calibration procedures in development:
  - Andrey Ni and Louise Clark (Integrated Java version)
  - Daniel Carman and Gagik Gavalian providing orchestration and oversight
  - Code designed to complete gain matching calibration (for online HV adjustments)
  - Code designed to complete timing calibration (offline calibration)
    - *Left-right adjustment*
    - *Energy loss*
    - *Attenuation length*
    - *Effective velocity*
    - *RF parameters*
    - *Counter-to-counter delays*
  - Work plan includes development of tutorials for training
  - Software tested on CTOF cosmic data and will include testing using MC data
- Documentation for CTOF:
  - Geometry document
  - Calibration constants document
  - Monte Carlo simulation baseline
- Calibration software goal to be ready (in beta version) by end of May 2016

Central Neutron Detector

Main physics goal: detect the recoiling neutron in nDVCS → The CND must ensure:

- good neutron/photon separation for $0.2<p_n<1$ GeV/c → ~150 ps time resolution
- momentum resolution dp/p < 10%
- no stringent requirements for angular resolutions



CND design: scintillator barrel - 3 radial layers, 48 bars per layer coupled two-by-two downstream by a "u-turn" lightguide, 144 PMTs upstream

Recent achievements:

- CONSTRUCTION COMPLETED
- Detector at JLab (ESB building) since 6/2015
- HV calibrations of PMTs completed
- Cosmic data analysis: s_t ~150 ps for all blocks
- Assembly in mechanical structure done
- Development of calibration and reconstruction software ongoing

Plan for 2016:

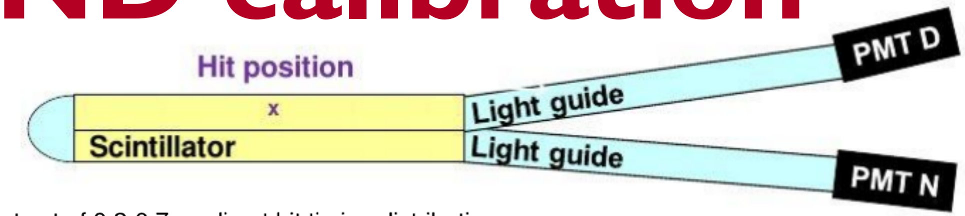
- March-April: **Cosmic rays tests at JLab** (ESR building), to check time resolution and characterize the block using CLAS12 electronics
- June: **readyness review**
- December: **installation** in the CD?

Photos of the CND:
https://www.flickr.com/x/t/0095009/photos/117533494@N07/

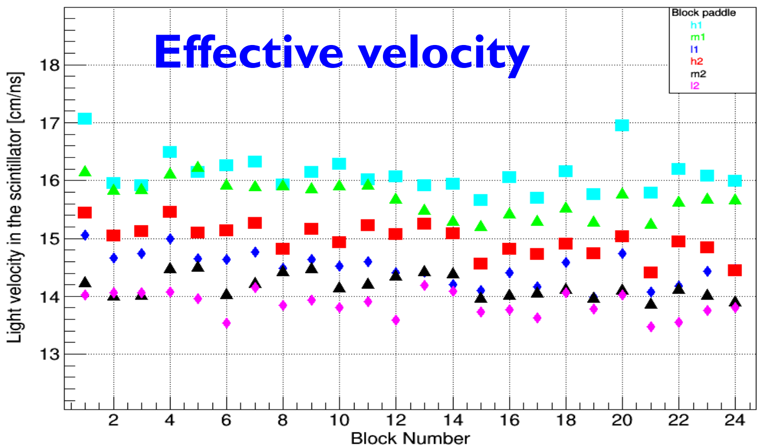
IPN ORSAY

CND calibration

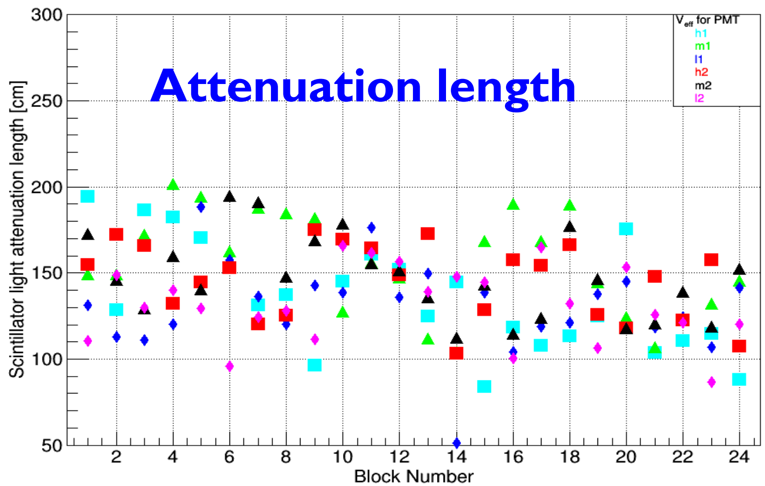
Giulia Hull, IPN

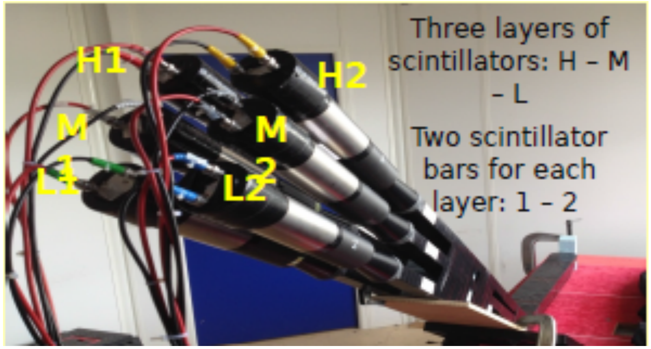


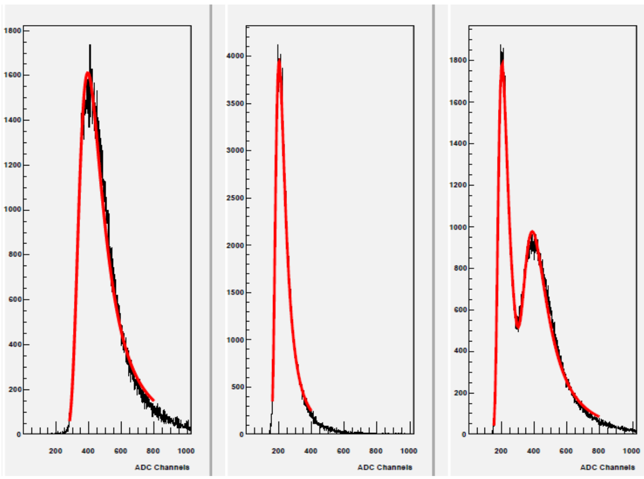
Top-hat cut of 0.2-0.7 on direct hit timing distribution



Light attenuation length for direct hits in scintillators

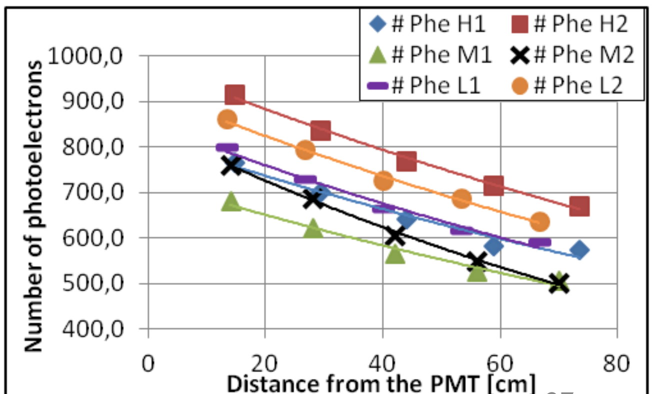




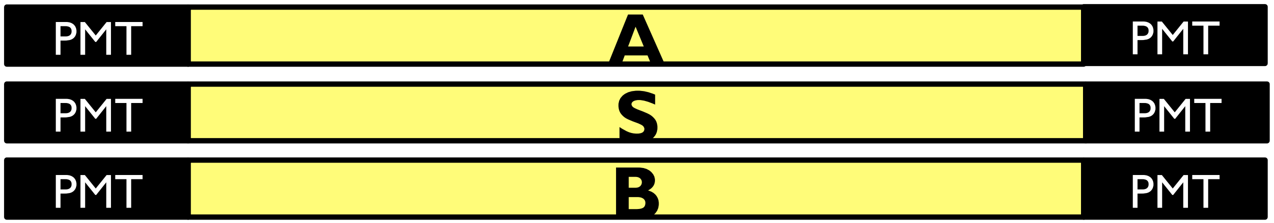


- One week per block of **cosmic data taking** (Orsay, right after assembly) to characterize the blocks (same 6 PMTs used for all blocks)
- Orsay data are being used to **optimize calibration algorithms** and **codes**

Gavin Murdoch, Daria Sokhan (Glasgow)



CND: time resolution



E.S. Smith et al. NIM A 432 (1999) 265-298
Measurement of time resolution with cosmic rays (following the method described by *R.T. Giles et al. NIM A 252 (1986) 41-52)*

$$T_{ref} = (T_{AL}+T_{AR} - T_{BL} - T_{BR})/2$$

Halftime difference between A and B

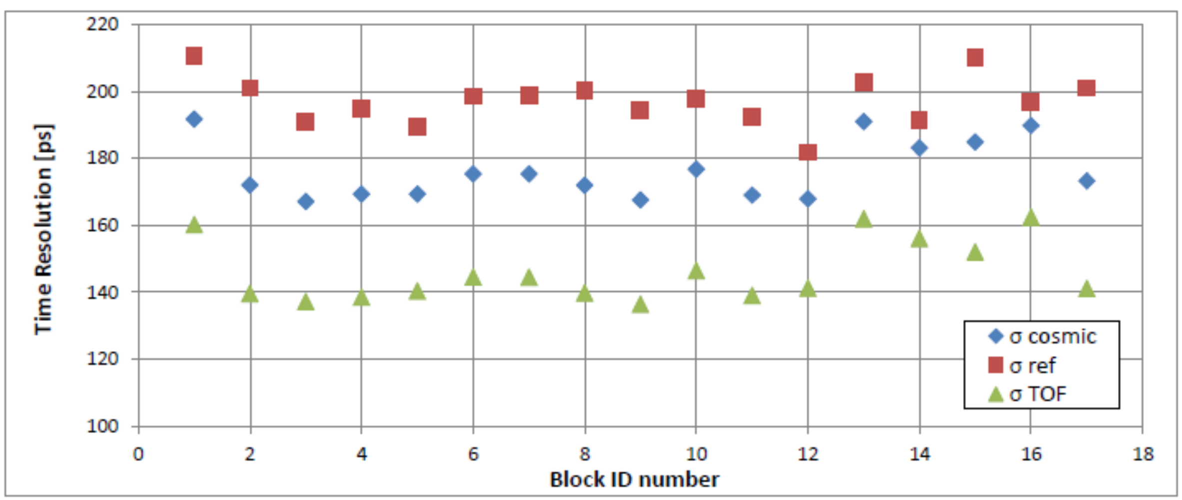
$$T_S = (T_{SL}+T_{SR})/2$$

Time measured by S

$$T_{cosmic} = (T_{AL}+T_{AR} + T_{BL} + T_{BR})/4 - T_S$$

$$\sigma_S = \sqrt{\sigma^2{}_{cosmic} - (\sigma_{ref}/2)^2}$$

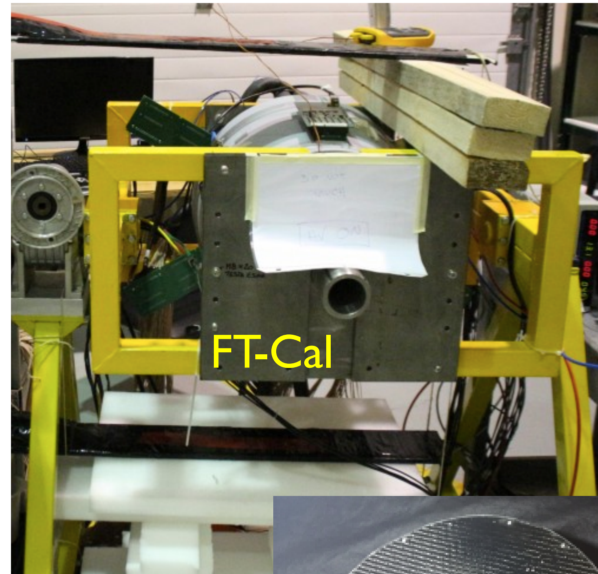
Tests planned from next week to mid-April here at JLab

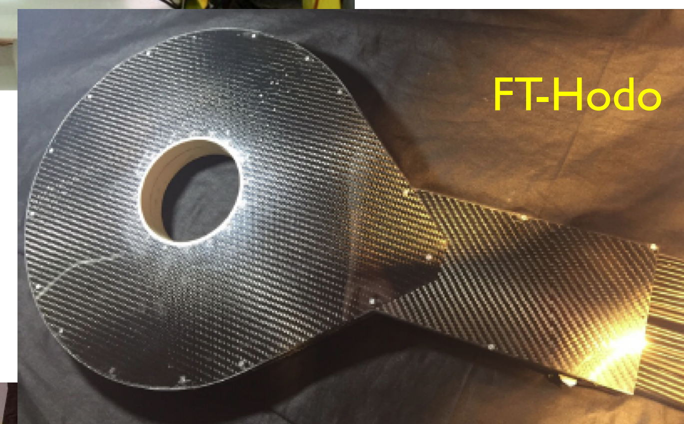


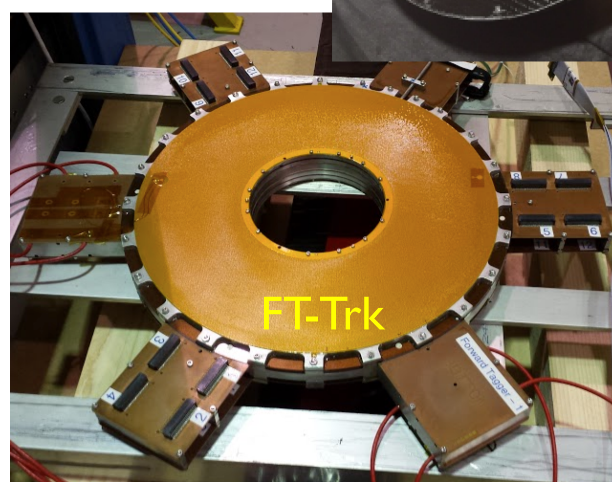
FT Status

Coordination: INFN-Genova
Contributors: CEA, INFN-Ge, INFN-Roma2, U. Edinburg, U. Glasgow, JLab, James Madison U., Norfolk State U., Ohio U.

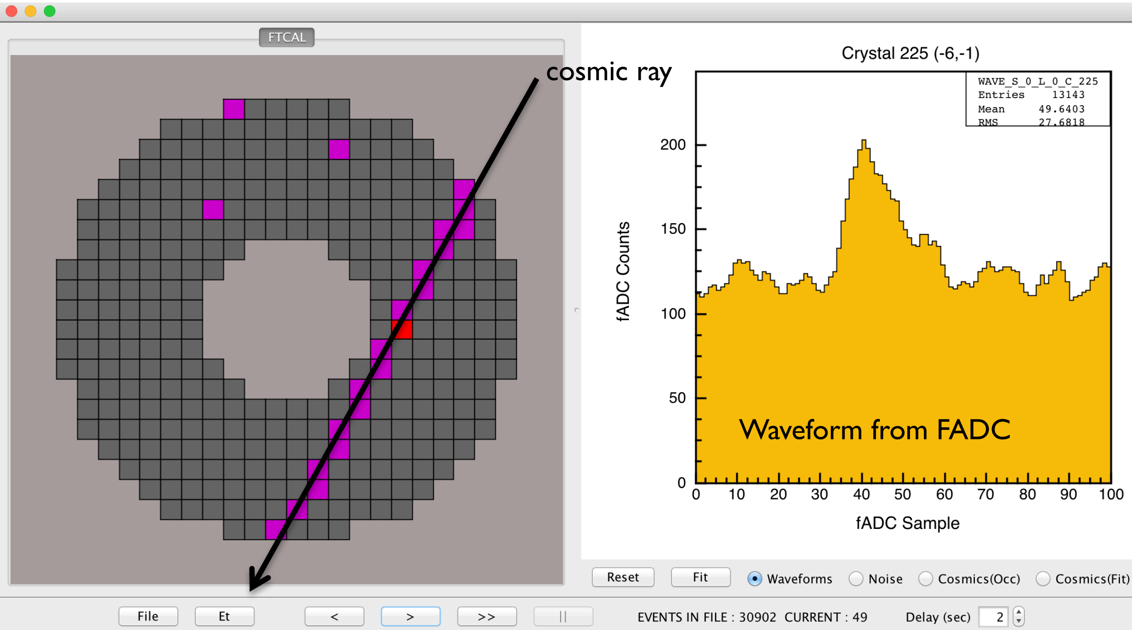
- FT-Cal:
  - Assembled and tested in Genova with light source and cosmics
  - Transferred to Jlab in Nov. 2015 and re-assembled in the EEL building in December
  - Commissioning in progress
- FT-Hodo:
  - Assembled and tested in Edinburgh
  - Transferred to Jlab in Jan. 2016
  - Commissioning in progress
- FT-Trk:
  - First detector built and tested in Saclay and Jlab
  - Second detector presently being built, ready in June







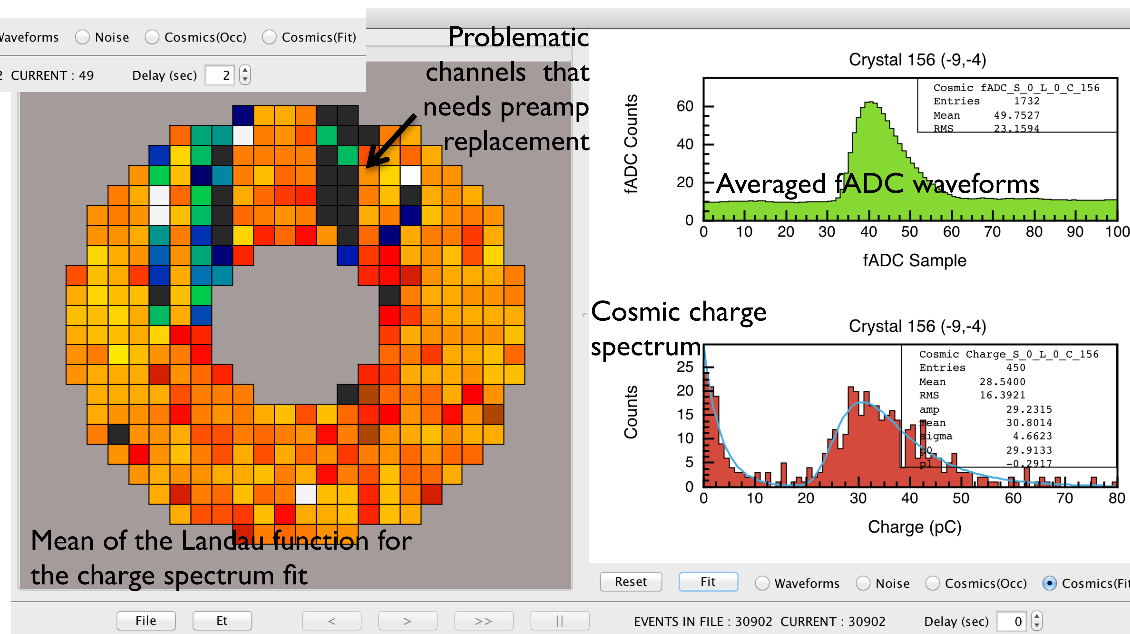
FT-Cal Calibration with Cosmics



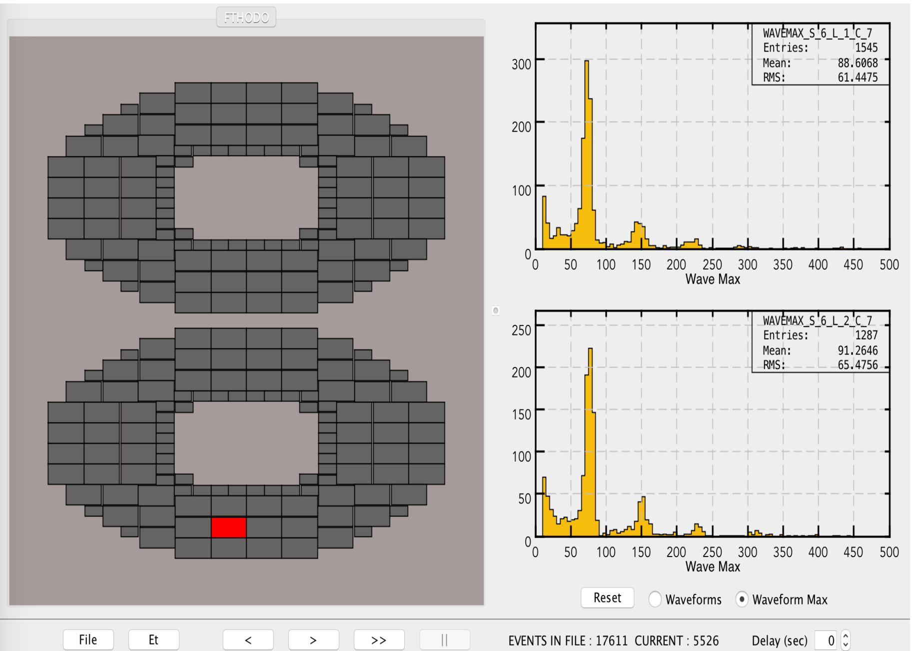
Developed based on template provided by the software group and on common tools:

- Presently used for FT-Cal checkout and commissioning with cosmic rays
- Read from file and ET ring
- Shows single events and accumulated spectra

- Development work being continued by Shloka Chandavar and Harkirat Mann
- Will be extended for analysis of LED induced signals

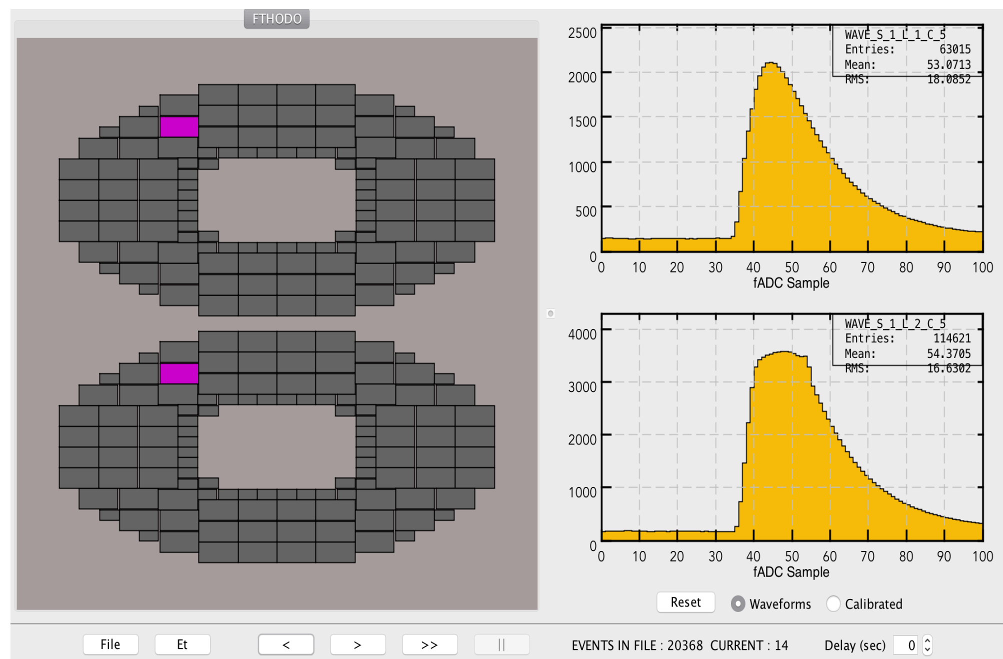


FT-Hodo Commissioning



Inherited from FT-Cal Monitoring code

- Used for checkout along with FT-Cal
- Read from file and ET ring
- Shows single events and accumulated signal: noise spectra shown here (peak minus baseline)
- Gain match channels and calibrate to photoelectron signals



Future Work

- Calibrate to charge spectra from cosmics Landau – match hits in two layers
- Ultimately validate a live calibration method
- Combined monitoring option with FT-Cal
- Gary Smith, Lorenzo Zana, Nick Zachariou, Ivana Stankovic

Calibration Schedule

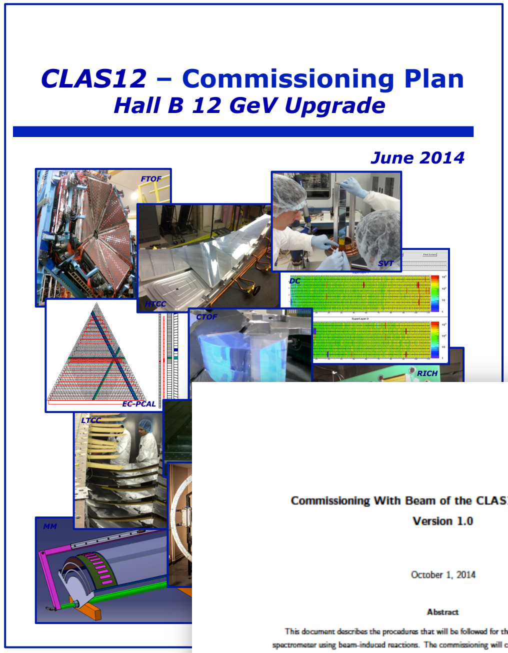
Calibration development schedule:

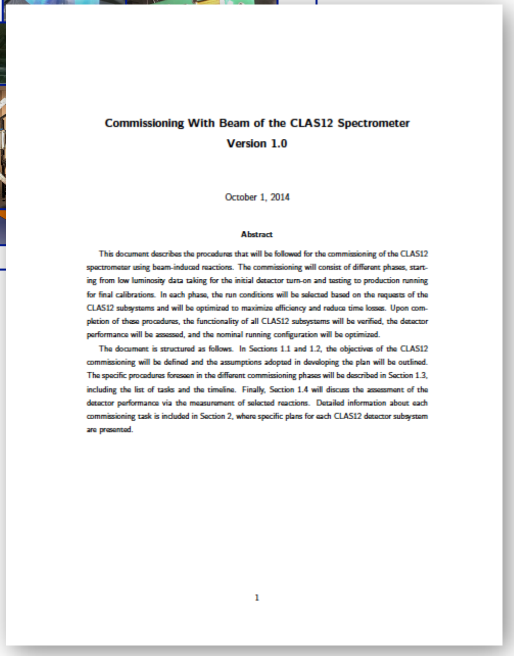
- https://userweb.jlab.org/~devita/clas12_commissioning/calibration%20schedules/
- Built based on input of CLAS12 detector groups
- Used to track progresses, identify critical tasks, …
- Updated regularly on monthly basis
- On track to have first version of calibration suites by Summer

Detector	Category	SubCategory	Activity ID	Actvity Name	Start date	Finish date	Resources (FTE)	Names	Status (% completion)	Comments
EC-Pcal	CCDB	Calibration/ec tables	ec_pcal_1	EC-Pcal table definition (document)	in progress	29-Feb-16		C. Smith	90	Need to revise document
			ec_pcal_2	EC-Pcal table creation	Done			J. Goetz, C.Smith (revised)	100	Some additional tables likely
			ec_pcal_3	EC-Pcal fill tables w nominal values	Done			C. Smith	100	
	Calibration Algorithm and Suite Development	EC calibration suite	ec_pcal_4	EC-Pcal algorithm development	in progress	30-Apr-16		C. Smith, N. Compton, T. Chetry	80	Timing and alignment pending.
			ec_pcal_5	EC-Pcal c++ suite development	Done			N. Compton	100	
			ec_pcal_6	EC-Pcal c++ suite tests (PCAL cosmics)	Done			N. Compton	100	
			ec_pcal_7	EC-Pcal java suite development	in progress	30-Apr-16		C. Smith, N. Compton, T. Chetry	70	Code consolidation, utility classes
			ec_pcal_8	EC-Pcal java suite tests (cosmics)	in progress	30-Apr-16		C. Smith	70	Ongoing until commissioning.
			ec_pcal_9	EC-Pcal java suite tests (GEMC)	in progress	30-Apr-16		C. Smith, N. Compton, T. Chetry	80	Mostly PCAL work.
			ec_pcal_10	EC-Pcal java suite documentation	1-May-16	31-Jul-16		C. Smith, N. Compton, T. Chetry	10	Mostly GitHub wikis
			ec_pcal_11	EC-Pcal java suite tutorials	1-May-16	31-Aug-16		C. Smith, N. Compton, T. Chetry	10	Mostly GitHub wikis
		EC cosmic calibration	ec_pcal_12	EC-Pcal algorithm development	Done			C. Smith	100	Calibration with cosmic muons
			ec_pcal_13	EC-Pcal FORTRAN, PAW tool implementation	Done			C. Smith	100	
	Monitoring	EC Monitoring	ec_pcal_14	EC-Pcal observables definition	in progress	31-Mar-16		C. Smith	70	HV, scalers and physics data pending.
			ec_pcal_15	EC-Pcal java tool implementation	in progress	30-Apr-16		C. Smith, G. Gavalian	70	Code consolidation, utility classes
			ec_pcal_16	EC-Pcal documentation	in progress	31-Jul-16		C. Smith, G. Gavalian	10	Mostly GitHub wikis
(last update 2/15/16)			ec_pcal_17	EC-Pcal slow controls	in progress	31-Jul-16		C. Smith, N. Baltzell, K. Livingston		
FTOF	CCDB	FTOF tables	ftof_1	FTOF table definition (document)	in progress	15-Feb-16		D.S. Carman, H. Lu	50	on schedule
			ftof_2	FTOF table creation	in progress	15-Feb-16		B. McKinnon	50	on schedule
			ftof_3	FTOF fill tables w nominal values	in progress	29-Feb-16		B. McKinnon, D.S. Carman, C. Smi	50	on schedule
	Calibration Algorithm and Suite Development	FTOF calibration suite	ftof_4	FTOF algorithm development	in progress	29-Apr-16		D.S. Carman, H. Lu, L. Clark	30	on schedule
			ftof_5	FTOF c++ suite development	in progress	31-Mar-16		H. Lu, D.S. Carman	50	on schedule
			ftof_6	FTOF c++ suite tests (cosmics)	in progress	31-Mar-16		H. Lu	30	on schedule
			ftof_7	FTOF c++ suite tests (g14 data)	in progress	31-May-16		L. Clark, G. Gavalian, D.S. Carman	30	on schedule
			ftof_8	FTOF java suite development	in progress	15-Apr-16		L. Clark, G. Gavalian	30	on schedule
			ftof_9	FTOF Java suite tests (cosmics)		1-May-16		L. Clark, G. Gavalian, M. Ungaro	0	
			ftof_10	FTOF java suite tests (GEMC)	1-Mar-16	31-Jul-16		L. Clark, H. Lu, D.S. Carman	0	
			ftof_11	FTOF java suite documentation	1-Jun-16	31-Aug-16		L. Clark, D.S. Carman	0	
			ftof_12	FTOF Java suite tutorials	done			D.S. Carman	100	
		FTOF cosmic ray calibration	ftof_13	FTOF algorithm development	done			D.S. Carman	100	
			ftof_14	FTOF FORTRAN, PAW tool implementation						
	Monitoring	FTOF monitoring	ftof_15	FTOF observables definition	26-Feb-16	31-May-16		D.S. Carman	0	
			ftof_16	FTOF java tool implementation	in progress	31-May-16		G. Gavalian	20	on schedule
			ftof_17	FTOF documentation	1-Jun-16	30-Sep-16		D.S. Carman, G. Gavalian	0	
(last update 2/15/16)			ftof_18	FTOF slow controls	in progress	01-Jun-16		N. Baltzell, K. Livingston	60	on schedule
LTCC	CCDB	LTCC tables	ltcc_1	LTCC table definition (document)	in progress	15-Feb-16		M. Ungaro	50	
			ltcc_2	LTCC table creation	in progress	1-Mar-16		M. Ungaro	20	
	Calibration Algorithm and Suite Development	LTCC calibration suite	ltcc_3	LTCC geometry in simulation	in progress	15-Apr-16		M. Ungaro	50	
			ltcc_4	LTCC digitization in simulation	in progress	15-Apr-16		M. Ungaro	10	
			ltcc_5	LTCC algorithm development	in progress	15-May-16		M. Ungaro	50	
			ltcc_6	LTCC java suite development	15-Jun-16	15-Aug-16		M. Ungaro, G. Gavalian	0	
			ltcc_7	LTCC Java suite tests	15-Aug-16	15-Sep-16		M. Ungaro, G. Gavalian	0	
			ltcc_8	LTCC java suite documentation	15-Jun-16	15-Sep-16		M. Ungaro	0	
			ltcc_9	LTCC java suite tutorials	15-Aug-16	15-Sep-16		M. Ungaro	0	

Commissioning with Beam

- Revision of initial Commissioning with Beam (CWB) plan started
- Commissioning With Beam:
  - 15 calendars days with full CLAS12 detector
  - Establishing beam
  - Detector checkout with particles from beam interaction
  - Initial calibrations
  - Proof of detector functionality
- Jan. 15 CWB review outcomes:
  - 15 days CWB period at pass 3 (6 GeV) to possibly exploit photon tagger and past CLAS experience at same energy
  - Main focus on achievement of Key Performance Parameters (KPP) to reach 12 GeV project milestones
  - Commissioning at 11 GeV to follow during engineering run





Commissioning With Beam of the CLAS12 Spectrometer
Version 1.0

October 1, 2014

Abstract

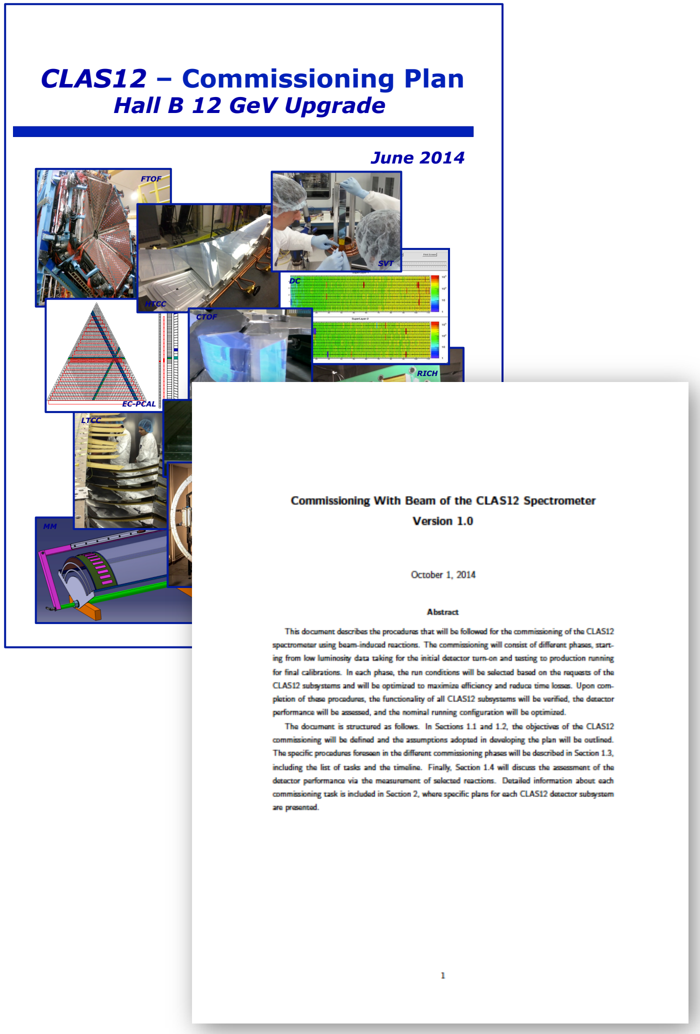
This document describes the procedures that will be followed for the commissioning of the CLAS12 spectrometer using beam-induced reactions. The commissioning will consist of different phases, starting from low luminosity data taking for the initial detector turn-on and testing to production running for final calibrations. In each phase, the run conditions will be selected based on the requests of the CLAS12 subsystems and will be optimized to maximize efficiency and reduce time losses. Upon completion of these procedures, the functionality of all CLAS12 subsystems will be verified, the detector performance will be assessed, and the nominal running configuration will be optimized.

The document is structured as follows. In Sections 1.1 and 1.2, the objectives of the CLAS12 commissioning will be defined and the assumptions adopted in developing the plan will be outlined. The specific procedures foreseen in the different commissioning phases will be described in Section 1.3, including the list of tasks and the timeline. Finally, Section 1.4 will discuss the assessment of the detector performance via the measurement of selected reactions. Detailed information about each commissioning task is included in Section 2, where specific plans for each CLAS12 detector subsystem are presented.

1

CWB - Workplan

- Focus CWB plan on achievement of KPP
- Revision:
  1. Restrict CWB running condition to 6.X GeV and few nA (>2 nA)
  2. Optimize target configuration
  3. Determine expected backgrounds in all detector systems for different CWB phases
  4. Provide quantitative information on electron and hadron rates and background
  5. Address beamline commissioning
  6. Address trigger and DAQ commissioning
  7. Discuss how the specific KPP will be achieved providing supporting documentation
     - Work on present version of KPP, even if not yet confirmed
     - For each parameter define what we must, should, and could do



CLAS12 – Commissioning Plan
Hall B 12 GeV Upgrade

June 2014

Commissioning With Beam of the CLAS12 Spectrometer
Version 1.0

October 1, 2014

Abstract

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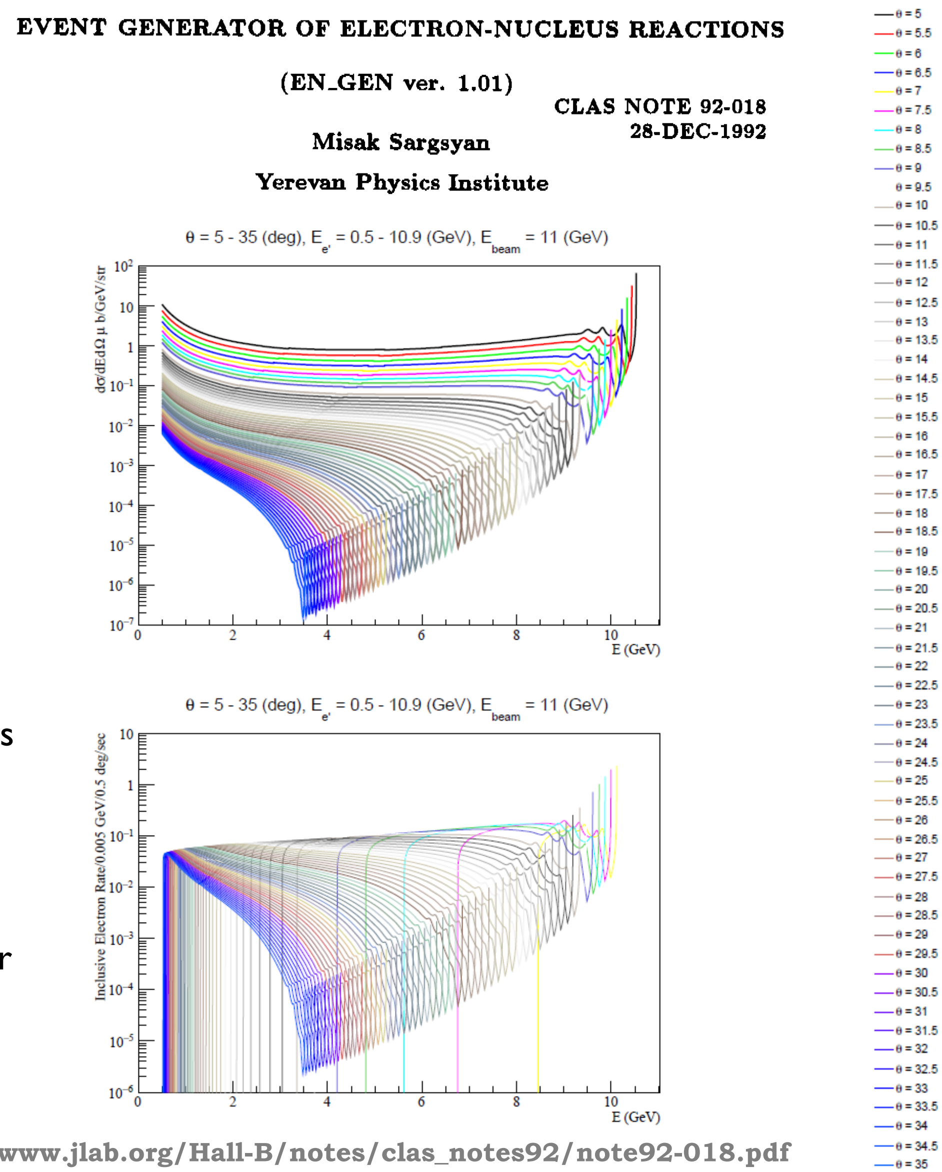
1

Inclusive electron rates

for CLAS12 commissioning and calibration

During the commissioning phase, physical processes will be used to test CLAS12 performances or to calibrate subsystems

- A realistic estimation of the rates is essential to allocate the number of days for each step
- Inclusive electron rates will be important to estimate the expected *trigger rate*
- Many proposal have projections based on the *fastMC* – now that the reconstruction framework is starting to be ready for physics study these estimations have to be updated, so to include a realistic CLAS12 acceptance and efficiency
- Hadron production channels are also important for subsystem calibrations



Work by S. Pisano

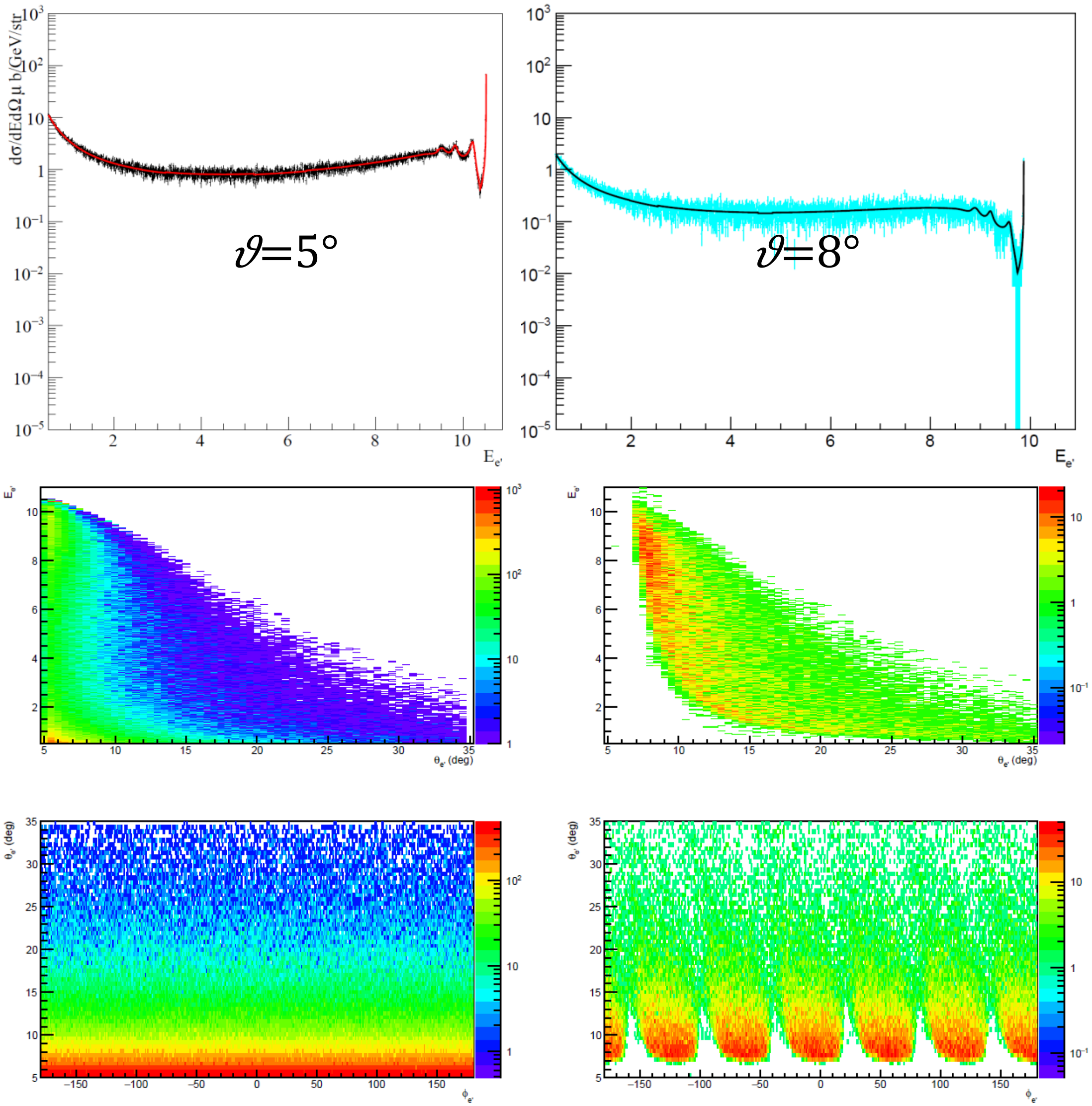
*https://www.jlab.org/Hall-B/notes/clas_notes92/note92-018.pdf

Building an inclusive generator

Distributions of cross-sections in a given configuration are used to generated events in the LUND format

- Generated according to the cross-section
- Generated uniformly in the selected energy and theta bin
- Lund files are then given as input to the whole simulation/reconstruction chain: **gemc + reconstruction software (version 1.0)**
- Realistic rates in CLAS12 can be estimated
- Different configurations can be explored (e.g., magnetic field current etc)

- Total (reconstructed) electron rates at 10^{35} cm^{-2}s^{-1} luminosity, high torus field: ~1.5 kHz



Work by S. Pisano

Extension to hadron rates

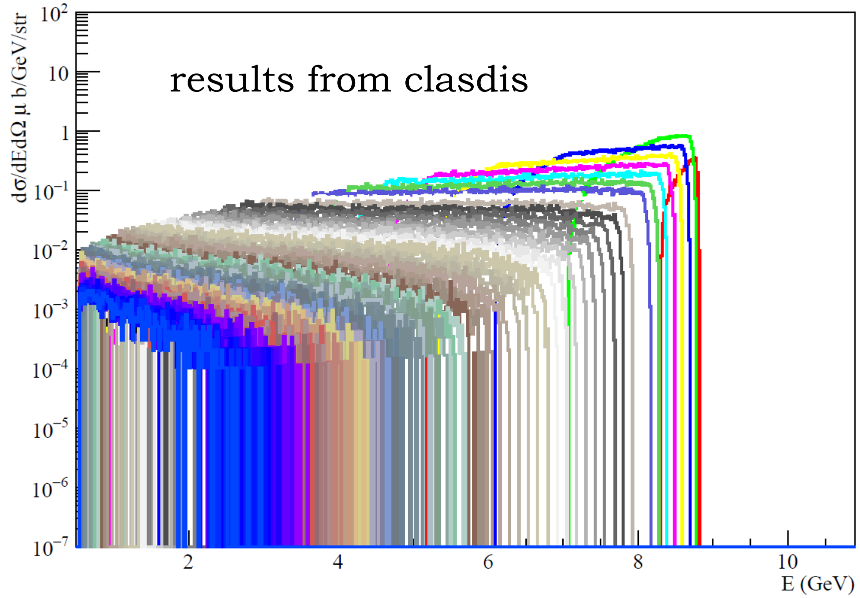
and comparison to clasDIS

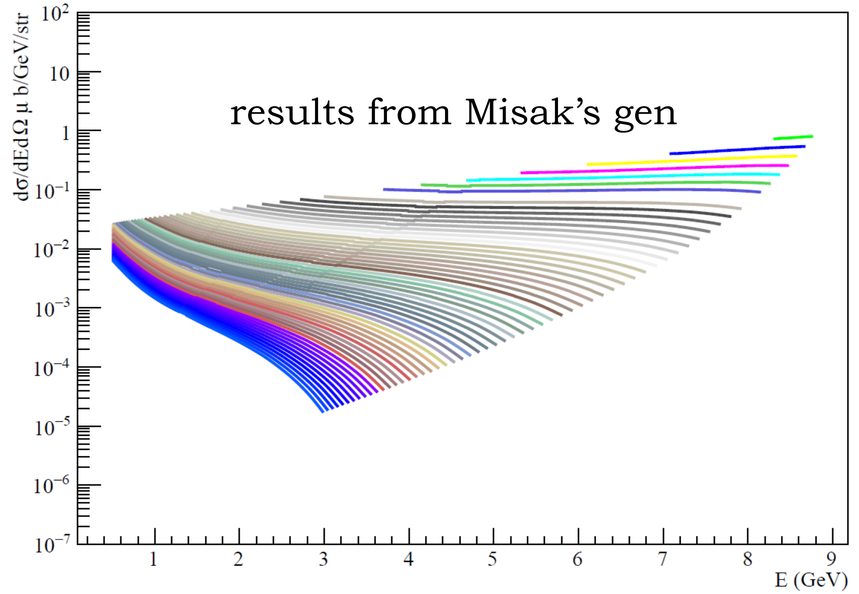
Being hadrons needed for some detector calibrations, a semi-inclusive generator will be essential **clasdis** (valid in the deep-inelastic regime)

In order to test the consistency among the two generators, a common kinematics is identified through the cuts

Distributions of the cross-section in this regime are compared

Integrated rad cross-section is 0.066 consistent estimation from the two generators





Work by S. Pisano

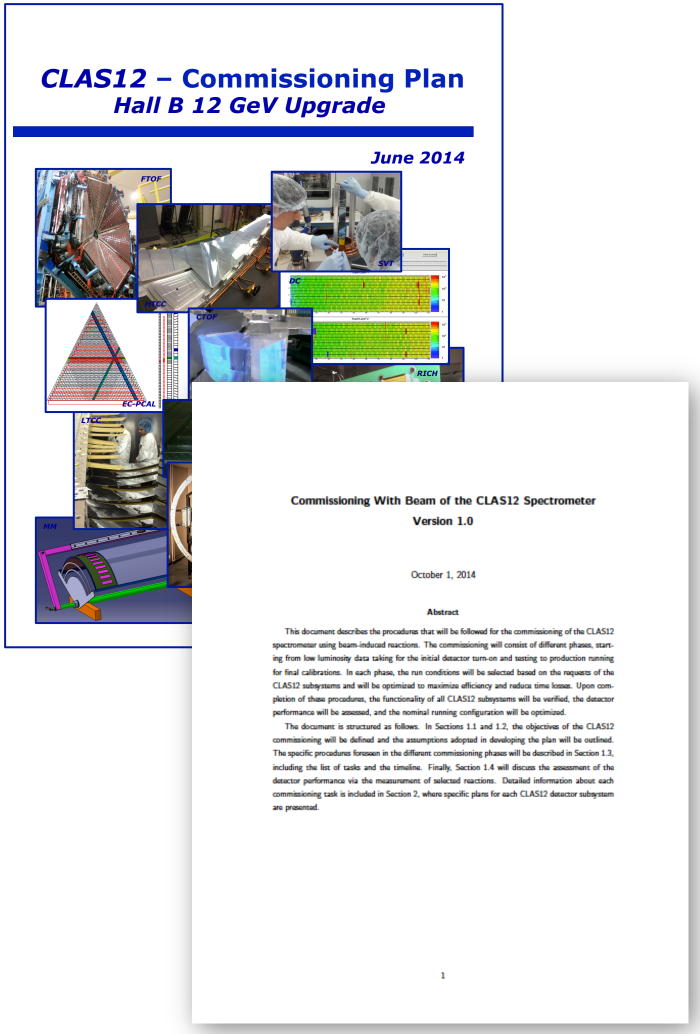
Latest version of KPP
(from DOE Oct. 2015 review)

Detector operational: events recorded with a > 2 nA electron beam at > 6 GeV beam energy (3 pass)

1. Detector running for ~one shift recording data from all subsystems.
2. Screenshots of beam status screens and accelerator Elog entries demonstrating the electron beam current and energy
3. Plots showing relative timing (coincidence) of calorimeters, time-of-flight and Cerenkov counters
4. Event displays showing correlations of particle hits in Forward Detectors
5. Event display showing correlations of particles detected in FD and hits in CTOF of central detector (CD)
6. Plots of particle trajectories showing target position
7. Particle identification plots using signals from calorimetry detectors

KPP – Simulation studies

- Should have dedicated simulation studies addressing the individual KPP
  - include beam background
  - use realistic geometry including (some) detector misalignment
  - “non-calibrated” detector response
- KPP-2,4,5: Event display snapshots:
  - simulate hadronic reactions
- KPP-3: Timing correlation:
  - relative timing of HTCC, FTOF, EC-PCal
  - what can we expect before full timing calibrations?
- KPP-6: Tracking and vertex distribution:
  - show vertex distribution from tracking
  - will hit-based level be enough?
- KPP-7: Particle id from calorimeters:
  - electrons (E_{rec} vs p)
  - pi0


CLAS12 – Commissioning Plan
Hall B 12 GeV Upgrade
June 2014

Commissioning With Beam of the CLAS12 Spectrometer
Version 1.0

October 1, 2014

Abstract

This document describes the procedures that will be followed for the commissioning of the CLAS12 spectrometer using beam-induced reactions. The commissioning will consist of different phases, starting from low luminosity data taking for the initial detector turn-on and testing to production running for final calibrations. In each phase, the run conditions will be selected based on the requests of the CLAS12 subsystems and will be optimized to maximize efficiency and reduce time losses. Upon completion of these procedures, the functionality of all CLAS12 subsystems will be verified, the detector performance will be assessed, and the nominal running configuration will be optimized.

The document is structured as follows. In Sections 1.1 and 1.2, the objectives of the CLAS12 commissioning will be defined and the assumptions adopted in developing the plan will be outlined. The specific procedures foreseen in the different commissioning phases will be described in Section 1.3, including the list of tasks and the timeline. Finally, Section 1.4 will discuss the assessment of the detector performance via the measurement of selected reactions. Detailed information about each commissioning task is included in Section 2, where specific plans for each CLAS12 detector subsystem are presented.

1

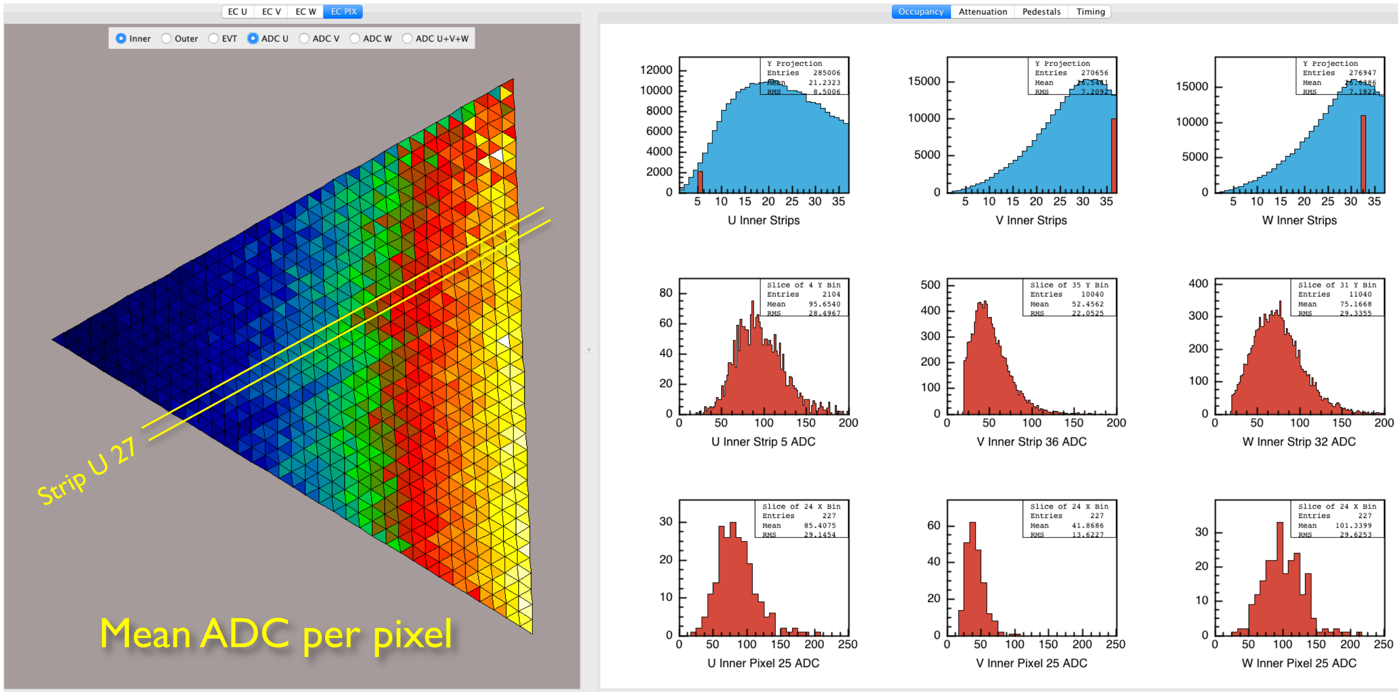
Summary

- Detector commissioning and calibration
  - Continuous progresses for all systems systems
  - Calibration suite under development for all CLAS12 sub-detectors
  - Close collaboration with software group
  - Intense use of common tools
  - Advanced stage for forward carriage detectors and SVT
  - Important progresses for all systems including non-baseline equipment
  - Aiming at first version of calibration suites by Summer

- Commissioning With Beam (CWB)
  - In progress:
    - Revision of CWB plan
    - Evaluation of particle rates at 11 and 6 GeV
    - Simulation of detector backgrounds
  - Focus of next months:
    - Simulation studies for KPP achievement

backup

EC Monitoring (EcMon)



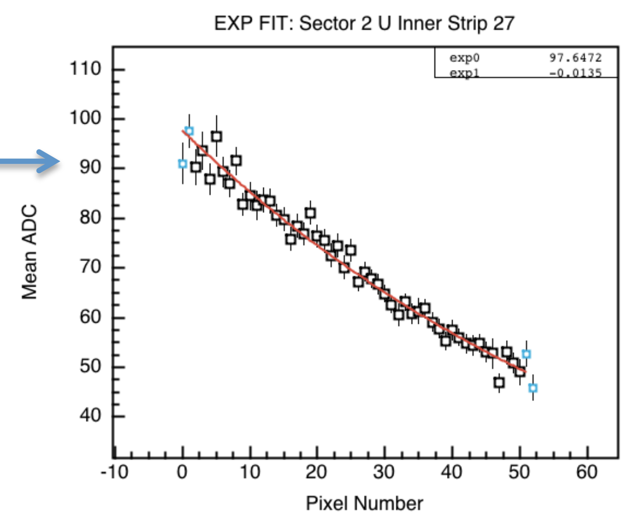
Detector navigation maps are collections of pixel and strip objects which map to the histogram data

Each strip object contains only the pixels relevant for calibration of that strip

Each pixel object contains energy loss distribution of MIP muons

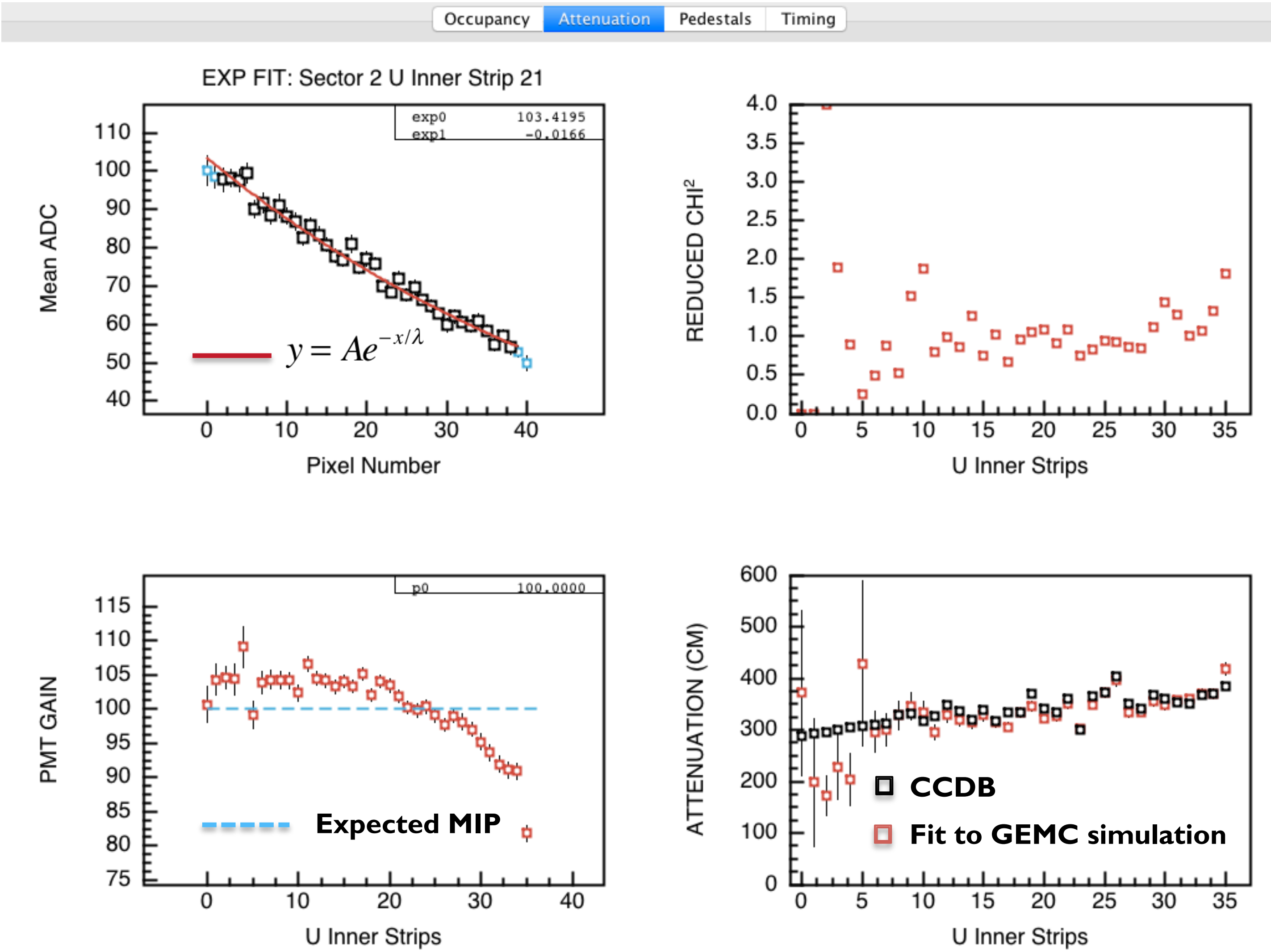
```
public class CalibrationData {

    DetectorDescriptor desc = new DetectorDescriptor();

    private List<GraphErrors>  rawgraphs  = new ArrayList<GraphErrors>();
    private List<GraphErrors>  fitgraphs  = new ArrayList<GraphErrors>();
    private List<F1D>          functions  = new ArrayList<F1D>();
    private List<Double>            chi2  = new ArrayList<Double>();
```

Adapted from Youri Gotra / SVT suite



CalibrationData object created for each strip:
1. Pixels stored in rawgraphs.
2. Exponential fit to pixels stored in fitgraphs.
3. Fitting function and fitted parameters stored in functions.

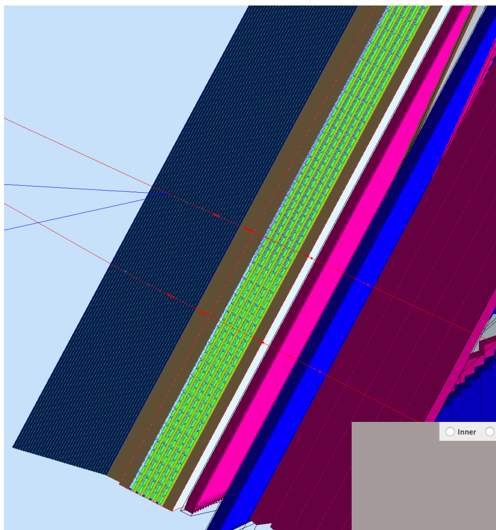
EcMon: Calibration Monitoring

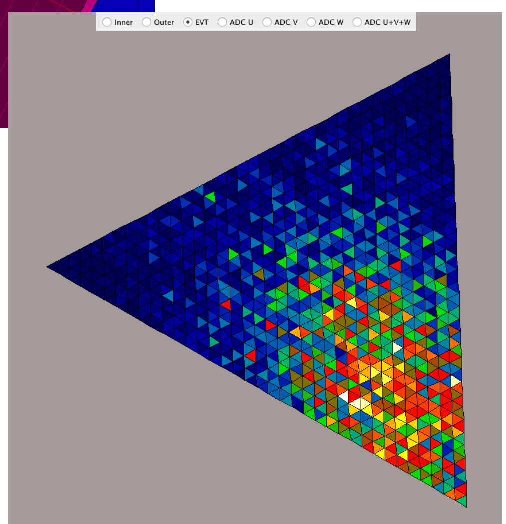


Calibrations performed as data accumulate. Results shown in real-time.
Allows timely evaluation of cuts, systematics issues, and convergence of fits.

Calibration Validation using GEMC

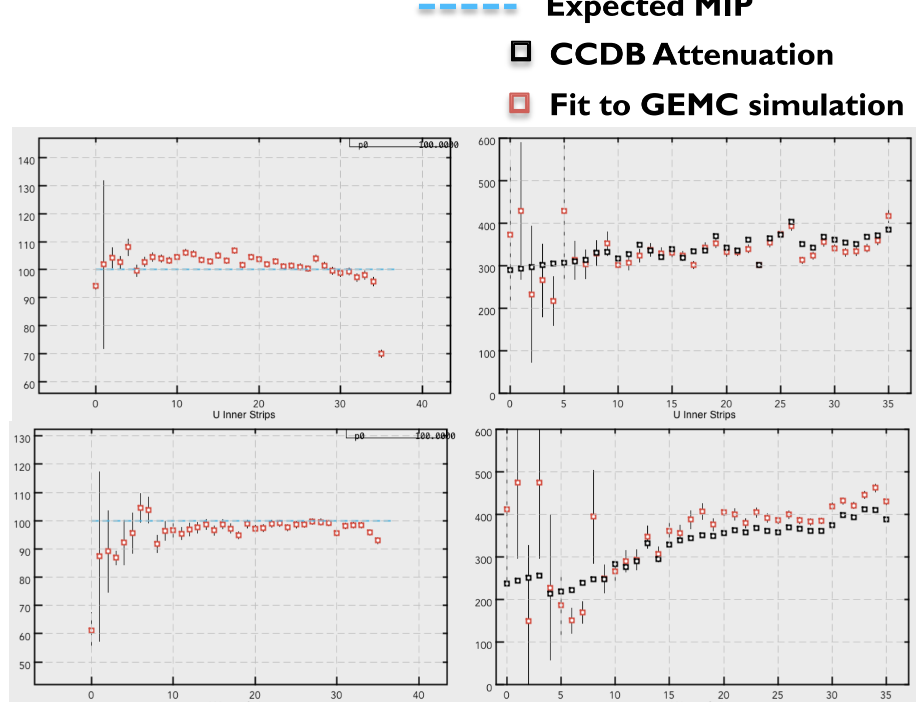
Minimum ionizing muons used to simulate cosmic data and test monitoring and calibration suites





EcMon display of pixel hits from GEMC data

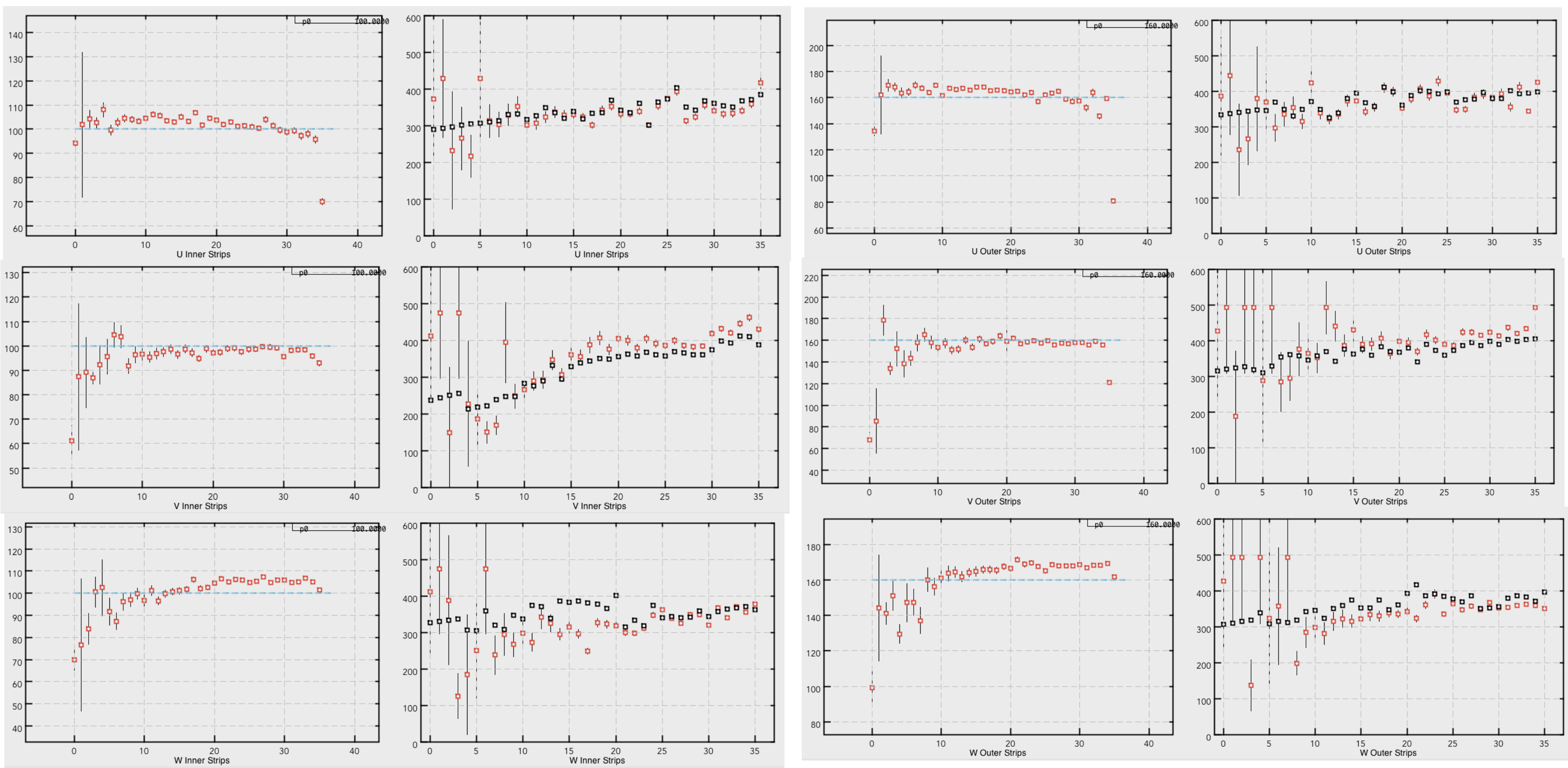
- Fits to simulations used to study assumptions, cuts and thresholds which underlie energy calibration based on MIP cosmic-muons
- GEMC now uses realistic cosmic-muon generator. Effect of knock-on electrons and multiple scattering can be studied
- Fits to GEMC data also used to validate attenuation extraction.



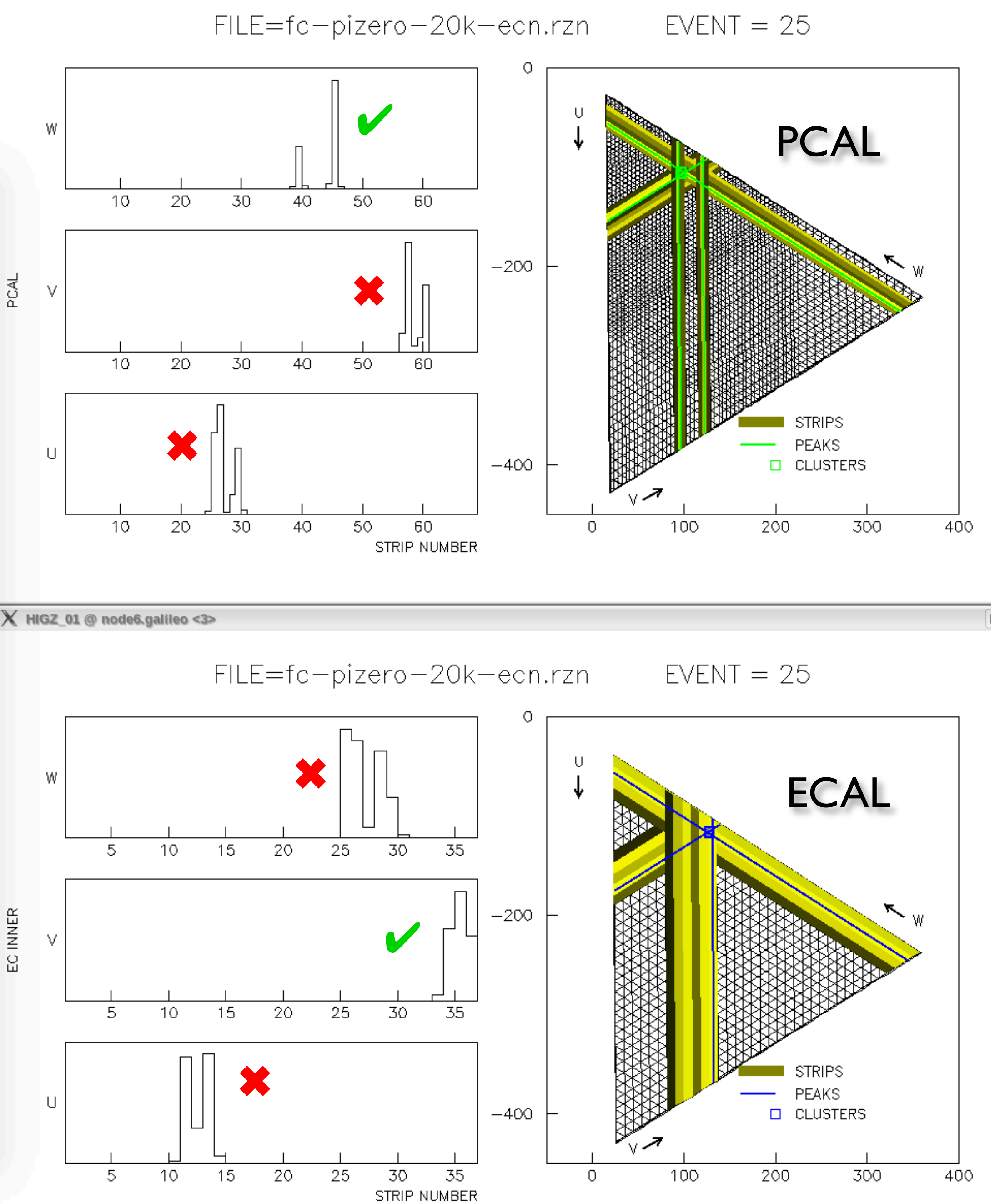
Validiation of Calibration Algorithm

- Fits to simulations used to study assumptions, cuts and thresholds which underlie energy calibration based on MIP cosmic-muons.
- GEMC now uses realistic cosmic-muon generator. Effect of knock-on electrons and multiple scattering can be studied.
- Fits to GEMC data also used to validate attenuation extraction.

Expected MIP
CCDB Attenuation
Fit to GEMC simulation



EC Reconstruction



EcRec upgrade:

1. Calibration constants from CCDB (done).
2. Attenuation correction (done).
3. Iteration of reconstruction (in progress).
4. Indexing to allow identification of strips in clusters, peaks (for iteration, calibration) (done).
5. Configuration parameters: thresholds, peak/cluster/iteration options, etc. (in progress).
6. Two-cluster identification with shared energy in peaks (for pi-zeros) (in progress).

Validation of reconstruction

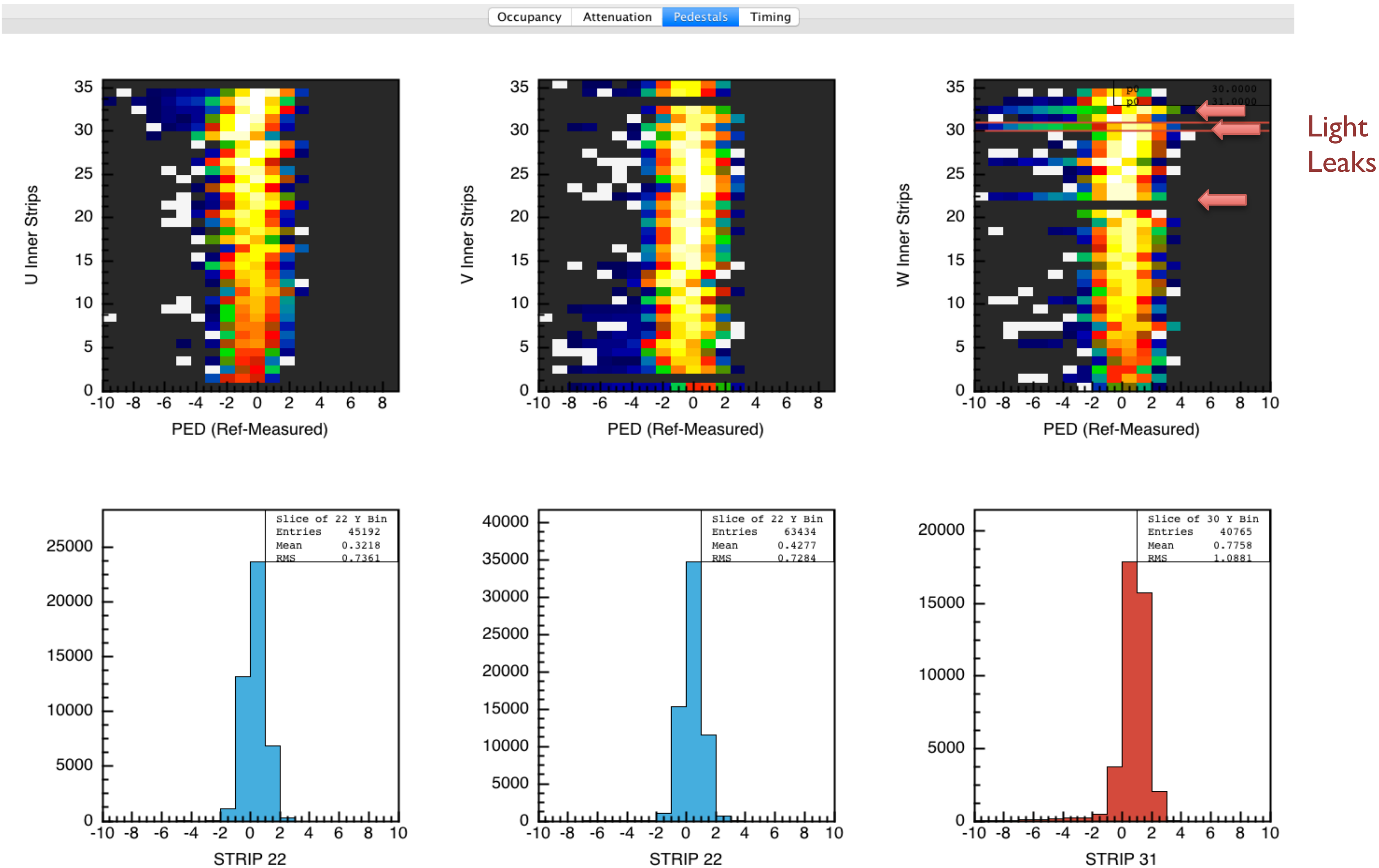
Peaks are defined as groups of adjacent strips, but two peaks with shared energy are missed.

Simple solution for shared-energy peaks is to raise threshold. Better solution is 2^{nd} pass over peak objects to find double peaks.

Still must decide how to apportion energy to each peak, which requires information from other views. Also peaks can belong to 2 clusters.

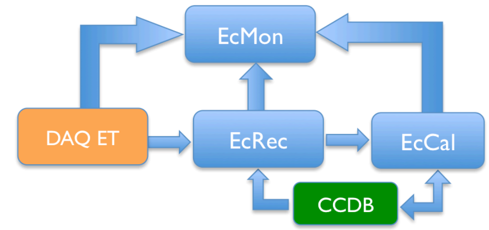
Plan: Implement CLAS6 era algorithm in Java with rigorous testing using GEMC simulations.

EcMon: Noise Monitoring



FADC Mode 7 provides event-by-event pedestals. Used to monitor luminosity related noise levels, light leaks, etc. by comparing to reference pedestals measured under normal conditions.

Near-term Goals (2-3 months)



EcRec

- Finish upgrade and begin study of pi-zero reconstruction.
- Add methods to provide pixel cut data for energy calibration.

EcMon

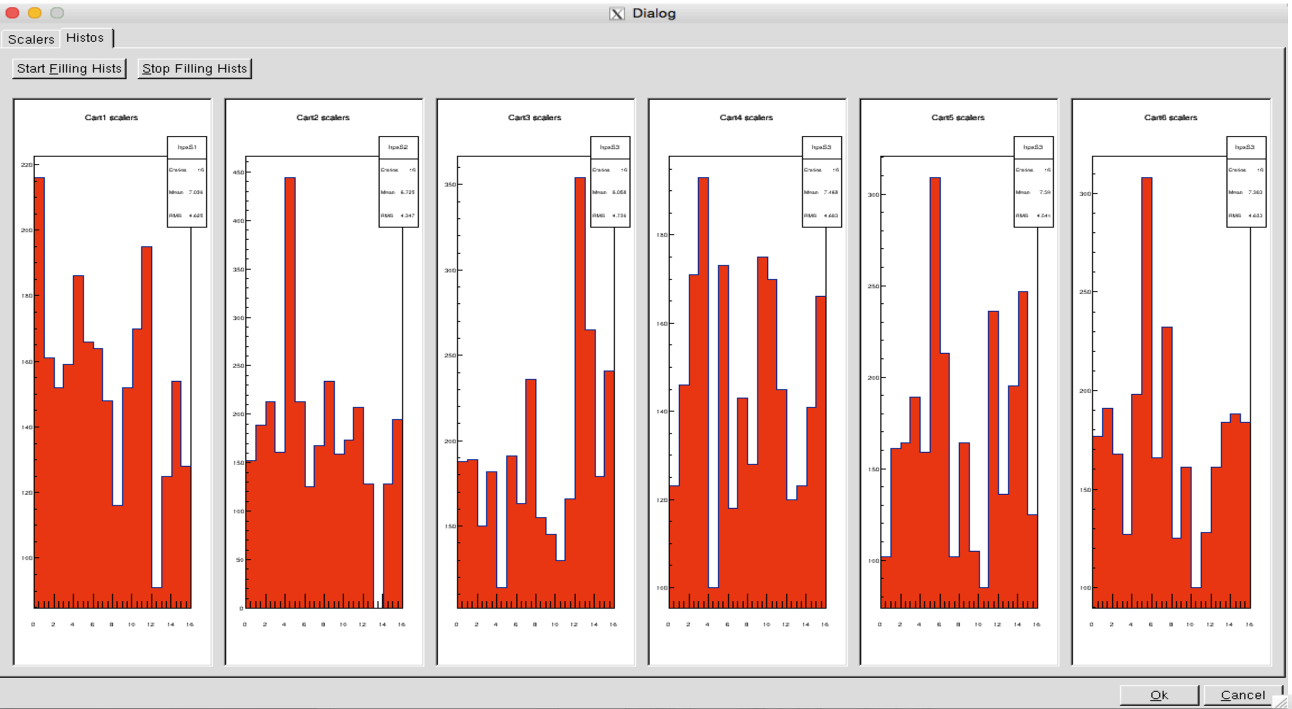
- Incorporate strip-chart, update and single-event modes.
- Import EPICS HV and scaler data into displays.
- Detector status plots which incorporate various data sources.

EcCal

- Implement timing calibration and ECAL/PCAL relative alignment procedures.
- Current plan is to develop EcCal as plug-in for EcMon.
- Could also run under CLARA as stand-alone service.
- ECAL and PCAL calibration algorithms may be merged within this package.

Demonstrate complete MIP-based calibration cycle (HV adjustment and CCDB table entry) for both ECAL (likely first) and PCAL by mid-Spring 2016.

CTOF Monitoring



Trigger scalers

Scalers | Histos

Scalers

D01 ->	218	U01 ->	171	D02 ->	151	U02 ->	161	D03 ->	154	U03 ->	118	D04 ->	161
U04 ->	180	D05 ->	123	U05 ->	156	D06 ->	144	U06 ->	162	D07 ->	125	U07 ->	144
D08 ->	136	U08 ->	136	D09 ->	148	U09 ->	185	D10 ->	206	U10 ->	162	D11 ->	441
U11 ->	211	D12 ->	182	U12 ->	223	D13 ->	223	U13 ->	140	D14 ->	143	U14 ->	172
D15 ->	130	U15 ->	0	D16 ->	120	U16 ->	180	D17 ->	177	U17 ->	190	D18 ->	135
U18 ->	184	D19 ->	159	U19 ->	242	D20 ->	146	U20 ->	198	D21 ->	161	U21 ->	151
D22 ->	179	U22 ->	203	D23 ->	400	U23 ->	263	D24 ->	164	U24 ->	231	D25 ->	144
U25 ->	208	D26 ->	135	U26 ->	161	D27 ->	94	U27 ->	138	D28 ->	131	U28 ->	162
D29 ->	128	U29 ->	159	D30 ->	174	U30 ->	161	D31 ->	138	U31 ->	140	D32 ->	122
U32 ->	148	D33 ->	123	U33 ->	180	D34 ->	143	U34 ->	184	D35 ->	171	U35 ->	322
D36 ->	226	U36 ->	115	D37 ->	131	U37 ->	102	D38 ->	86	U38 ->	218	D39 ->	136
U39 ->	171	D40 ->	273	U40 ->	162	D41 ->	154	U41 ->	211	D42 ->	187	U42 ->	149
D43 ->	188	U43 ->	291	D44 ->	158	U44 ->	180	D45 ->	117	U45 ->	171	D46 ->	143
U46 ->	182	D47 ->	143	U47 ->	159	D48 ->	174	U48 ->	156	UNUSED ->	0	UNUSED ->	0

tools now under development