Jefferson Lab

INFN



# ECal Software; Set up, Monitoring and Calibration

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HPS Software Review SLAC, USA, January 27<sup>th</sup>, 2014





# Outline

- Introduction
- Software Tasks, Assignments and Schedule
- Monitoring
- Calibration
- Recent Progress
- Summary and Outlook



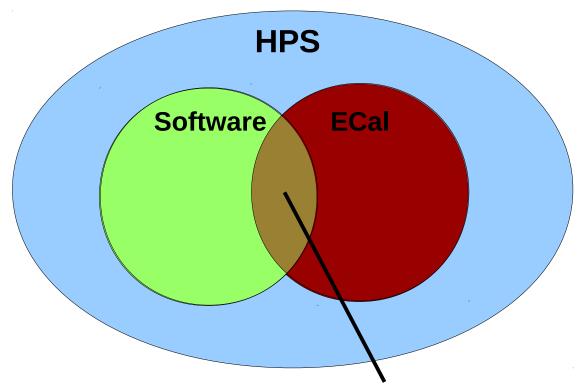
### Introduction

- Significant recent efforts in the organisation of the ECal software project
- Aided by a moderate influx of new collaborators in the final months of 2013
- An ECal software co-ordinator was recently appointed (me), as part of efforts towards the ECal group taking on responsibility for the simulation and reconstruction toolchain
- From these steps, the plan is to have all necessary components in place and tested in time for installation



# Scope

• What do we mean by ECal software?



"ECal software" covers software activities relating to the simulation, reconstruction, monitoring, calibration and triggering of the HPS ECal



## **ECal Software Tasks**

- Step 0 identify tasks coming under the remit of ECal software
- List not exhaustive, shown here for guidance
  - Simulation
    - GEANT4 geometry updates
    - Digitization and electronic noise
    - Production of data for the group
    - Maximum energy in a crystal
  - Reconstruction
    - Testing cluster algorithms
    - Evaluate sampling fraction
    - Cluster position corrections, for electron, photon and positron
    - Cluster timing
    - Cluster pattern
    - Matching with tracking
    - Verify clustering algorithms
    - Study different clustering algorithms



# ECal Software Tasks (cont.)

- Monitoring
  - Light monitoring system and software
  - Occupancy and rates
- Calibration
  - Track based calibration
  - $\pi^0$  reconstruction
  - Cosmic triggering and calibration
  - Single electron scattering
  - Position corrections
- Trigger Studies
  - Understanding trigger algorithms at board and crate level
  - Rates of physical noise
  - Algorithm optimization
- Online Software
  - Trigger monitoring
  - ECal data quality check



# **ECal Software Tasks**

- Step 1 Task assignments
- Final assignments in progress
  - Simulation
    - GEANT4 geometry updates Daria Sokhan (Glasgow)
    - Digitization and electronic noise Gabriel Charles (IPN Orsay)
    - Production of data for the group Gabriel Charles (IPN Orsay)
    - Maximum energy in a crystal
  - Reconstruction
    - Testing cluster algorithms Kyle McCarty (UNH)
    - Evaluate sampling fraction Stuart Fegan (INFN Ge)
    - Cluster position corrections, for electron, photon and positron
    - Cluster timing
    - Cluster pattern
    - Matching with tracking
    - Verify clustering algorithms Kyle McCarty (UNH)
    - Study different clustering algorithms Holly Vance



# ECal Software Tasks (cont.)

- Monitoring
  - Light monitoring system and software Andrea Celentano (INFN Ge)
  - Occupancy and rates Andrea Celentano (INFN Ge)
- Calibration
  - Track based calibration (INFN Ro2)
  - $\pi^0$  reconstruction Gabriel Charles (IPN Orsay)
  - Cosmic triggering and calibration Holly Vance
  - Single electron scattering (INFN Ro2)
  - Position corrections
- Trigger Studies K. McCarty & G. Charles
  - Understanding trigger algorithms at board and crate level
  - Rates of physical noise
  - Algorithm optimization
- Online Software
  - Trigger monitoring Kyle McCarty (UNH)
  - ECal data quality check



# Schedule

- Several tasks already well under way, or completed
- More details available in the software schedule

.⇒ Activiti	es											
# Info	Title	Assigned Resources	% Comp Given		decess Expecte		Q4 / 2013		Q2 / 2014	Q3 / 2014	Q4 / 2014	
132	▼Calorimeter	Sho Uemura; Andrea	Planned	Status	Start 11/4/1	07 08 09 10 Calorimeter		1 02 03 04	05 06	07 08 09	9 10 11	
133	► Low Level Monitors	Andrea Celentano; 🔻		<del>ر</del> ب	12/2/1		fonitors 5.13 months	,	A.C.; K.L.			
143	► Signal Level Monitoring	Stuart Fegan	0%	<b>F</b>	2/3/14	Dow Deter.	Signal Level Monitorir					
145	▼Low Level Calibrations	Stuart Fegan; Sho Uer			2/3/14	Low Level Calibrations	-					
		2 .		*		Gains and Thresholds	•	5.F.;	0.11			
147	►Gains and Thresholds	Stuart Fegan; Sho Uer		· · · · · · · · · · · · · · · · · · ·	11/4/1			5.F.;	510.			
154	▼Reconstruction	Stuart Fegan; Kyle Mc		*	11/11/	Reconstructio	•		-			
155	►Clustering	Stuart Fegan; Kyle Mc		1	11/11/	Clusterir	-		S.F.; K.	M.; H.V.		
172	▼High Level Calibrations	Allesandro Rizzo; Gab	5%	1	1/13/1		h Level Calibrations 🧡					
173	►Cosmic Calibration	Holly Vance	20%	1	1/13/1			.64 months ?	H.V.			
178 🕘	►Track based Energy Calibr	Stuart Fegan; Luca Co	0%		4/28/1		Track	based Energy Calibration	1.5m S.F.; L	.c.		
184 🞱	▶ Pi0 Energy Calibration	Gabriel Charles	0%		4/1/14		Pi0 E	Energy Calibration 2.75 m	winths ? G.C	<b>.</b>		
191 🕲	► Single Electron Scattering	Stuart Fegan; Allesan(	0%		2/17/1		Single Electron Scatt	ering 2.47 months	S.F.; A.R.			
197	▷Position Corrections	Stuart Fegan	0% 2w?	158	3/3/14		Position Co	prrections 1m? S.F.				
199	► High Level Monitoring	Stuart Fegan; Kyle Mc	0%		6/3/14			High Level Mo	nitoring 2.47 mon	ths S.F.; K.	М.; М.Н.	
208	►Trigger Reconstruction	Sho Uemura; Gabriel	5%	1	11/4/1	Trigger Reconstruction	8.11 months ?		s.u	J.; G.C.; K.M.; M.H.		
217	⊳ECAL Low Level & Signal Monitors R	Milestones	0%	133;	134; 1 4/23/14		ECAL Low Level &	Signal Monitors Ready 📈	м.			
219	⊳ECAL High Level Monitors Ready	Milestones	0%	199; 3	200; 2 8/11/14			ECAL F	High Level Monitors R	eady 🔸 M.		
221	⊳ECAL High Level Calibrations Ready	Milestones	0%	172	6/16/14			ECAL High Level Calibrati	ions Ready 🔸 🕹	۹		
223	⊳ECAL Calibration & Monitoring Read	Milestones	0%	217; 3	219 8/11/14			ECAL Calib	ration & Monitoring R	eady 🔸 M.		
225	⊳ECAL Reconstruction Ready	Milestones	0%	155; 3	208 6/18/14			ECAL Reconstruc	tion Ready 🙀 1	4		
227	⊳Tracker Ready	Milestones	0%	96; 13	30; 21 8/11/14				Tracker R	.eady 🔸 M.		
229	⊳Calorimeter Ready	Milestones	0%	223; 3	225 8/11/14				Calorimeter R	.eady 🔥 M.		
231	⊳Ready for Data	Milestones	0%	219; 3	221; 2 8/11/14				Ready for	Data 🔥 M.		
233	▼Studies	Gabriel Charles; Kyle	0%		2/10/1		Stud	lies 🖕	-	•		
234	►Trigger Studies	Gabriel Charles; Kyle	0%		2/10/1		Trigger Stud	lies 3.28 months ?	G.C.; K.M.			
244	► Monitoring Apps	Jeremy McCormick; N	46%	*	11/4/1	Monitoring Apps	7.36 months		J.M.; M.J	H.; K.M.		
<	-				<>							



# Monitoring

# Light monitoring system

# Motivations for a light monitoring system in the HPS ECal

### 1) During debugging, it is critical to switch on/off channels independently for debugging.

- Test the correct functionality of all APDs / amplifiers.
- · Check all the electronic channels.
- Verify correct cabling.
- The system provides a fast pre-equalization during in-lab commissioning, both for energy and timing, before real calibration with physics is performed.

#### 2) During operations, the system can measure fluctuations in the ECAL components.

- PbWO<sub>4</sub> crystals are radiation-sensitive, light transmission lowers resulting in effective LY loss.
- Such a process is non-uniform in the ECal, due to the different irradiation in each crystal.
- Crystals response needs to be monitored continuously and, if necessary, re-equalized.
- Possible APDs gain variation during time needs to be under control.

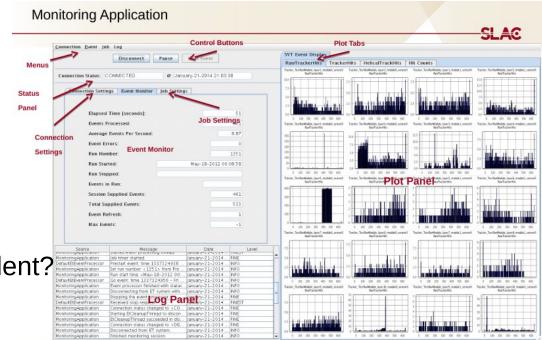
### 3) The system can be used for crystals annealing, to recover the radiation damage

A. Celentano, talk last week at HPS collaboration meeting



# Monitoring

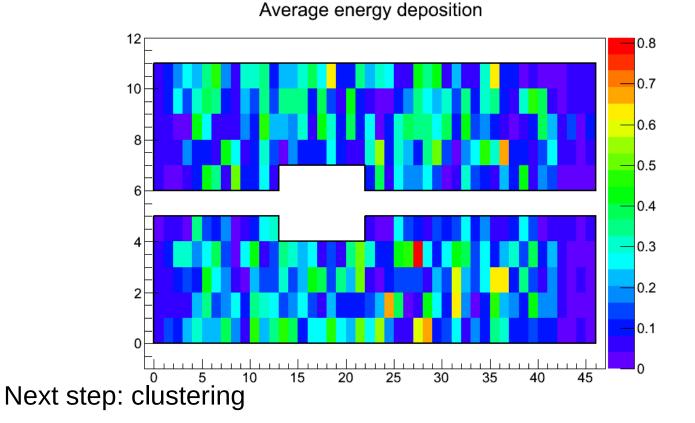
- LED system forms part of the low level monitoring, and will provide pre-calibration equalisation of ECal channels
- Mostly complete, save final EPICS integration and user front-end
- Higher level monitoring is separate to this, and covers quality of cluster data, monitoring of energy resolution, and trigger monitoring
- Monitoring application should be a useful start to these tasks
- Event display;
  - wired/JAS3?
  - Something independent?





# Calibration

- Step zero of calibration process, production of sample data, already in place
- Basic tools available for handling this data





# Software Workshop

- Several collaborators involved in ECal software are attending the software workshop this week
- An ideal opportunity to push ECal software forward, and disseminate knowledge on HPS software back to our respective groups
- This will be particularly useful for those of us in Europe where the time difference with experts here can be frustrating.



# **Summary and Outlook**

- The attention of the ECal group is now turning to ensuring that the required software will be ready and available in time for experimental running
- The management framework is in place for effective communication between the ECal software project and the wider HPS software and ECal groups
- Tasks and scheduling are coming together, with a few tasks remaining to be assigned to willing collaborators
- Ready to push on and redouble our efforts for the challenges ahead