



Jefferson Lab



# ECal Software; Set up, Monitoring and Calibration

Stuart Fegan  
INFN Genova

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## Outline

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

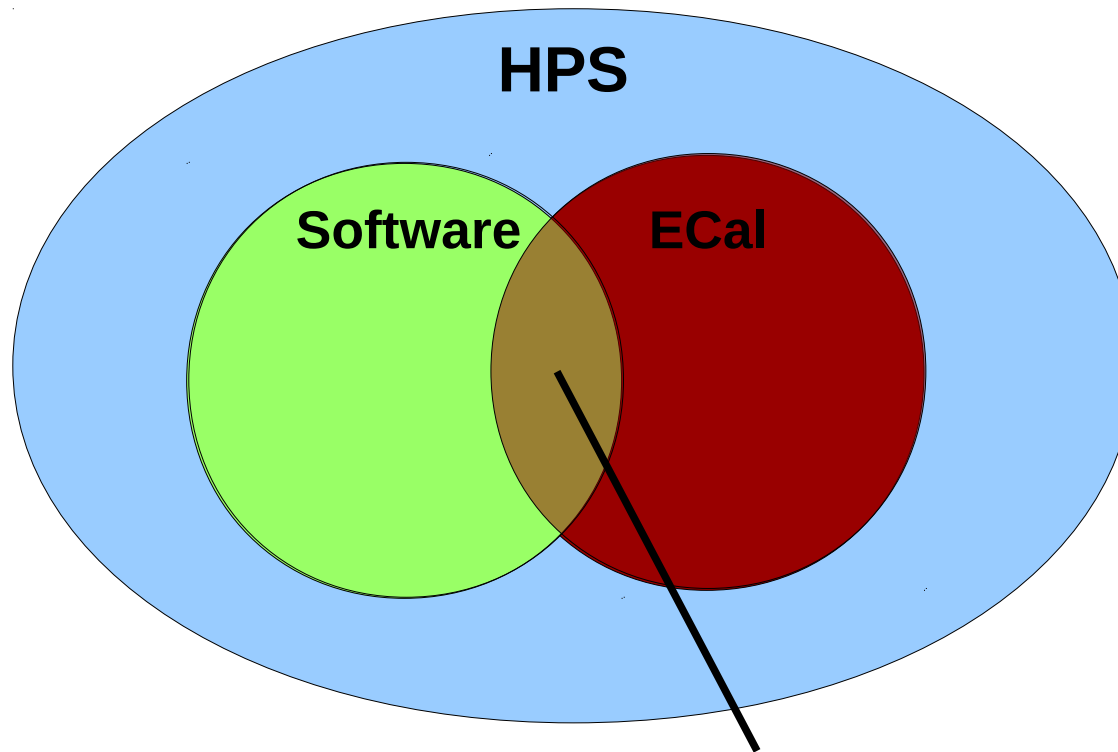


## Introduction

- 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.)

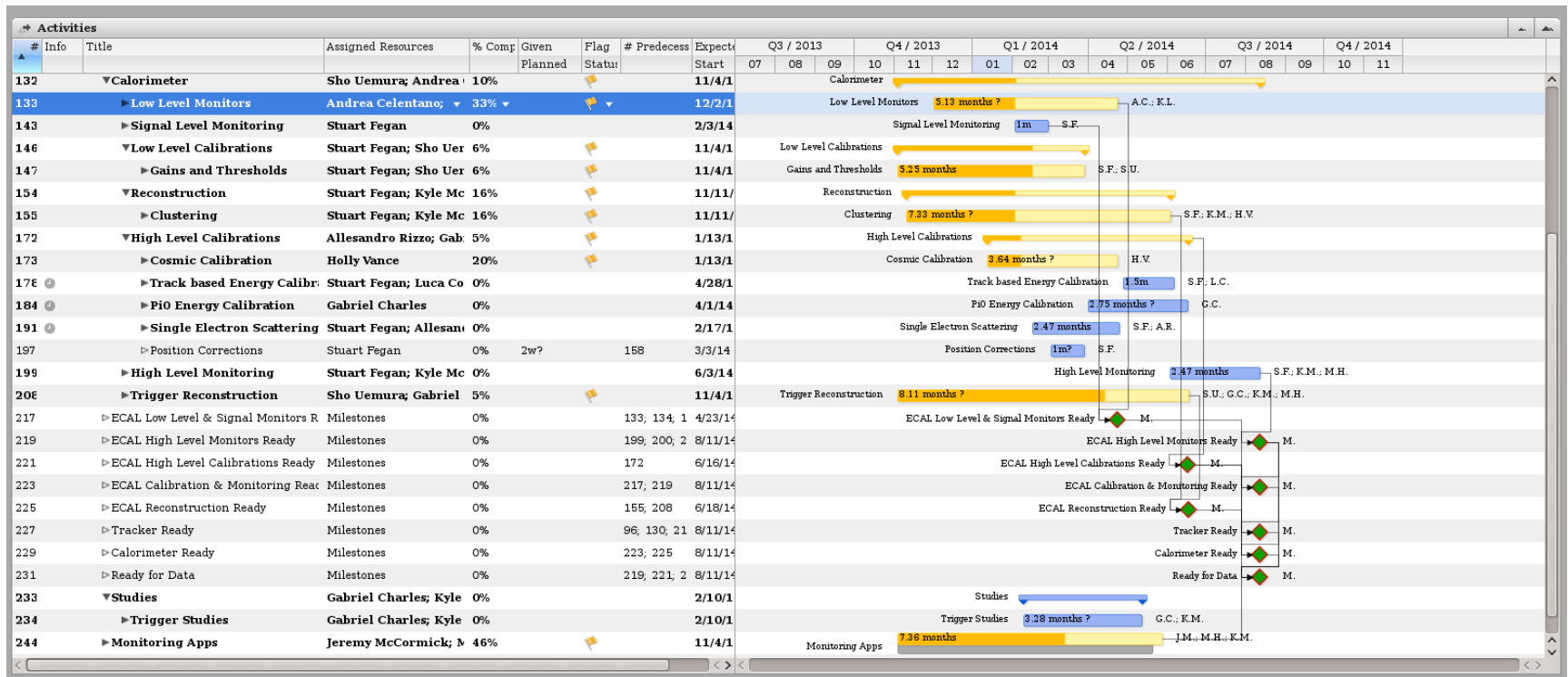
- Monitoring
  - Light monitoring system and software – Andrea Celentano (INFN Ge)
  - Occupancy and rates – Andrea Celentano (INFN Ge)
- Calibration
  - Track based calibration – (INFN Ro2)
  - $\pi^0$  reconstruction – Gabriel Charles (IPN Orsay)
  - Cosmic triggering and calibration – Holly Vance
  - 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





## 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.**

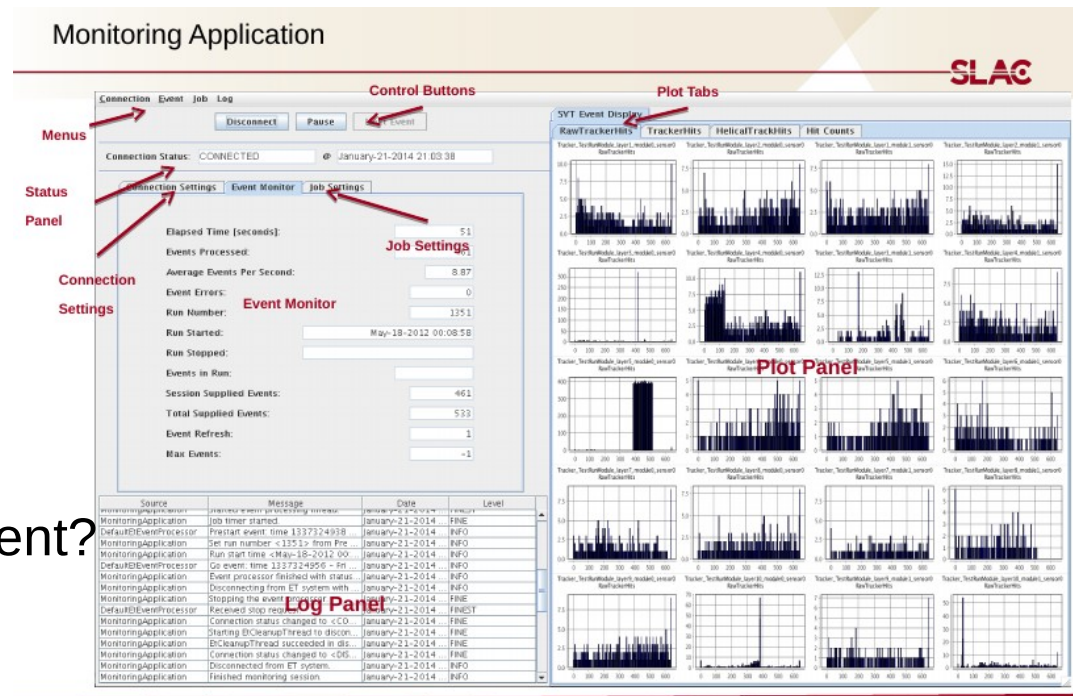
- $\text{PbWO}_4$  crystals are radiation-sensitive, light transmission lowers resulting in effective LY loss.
- Such a process is non-uniform in the ECal, due to the different irradiation in each crystal.
- Crystals response needs to be monitored continuously and, if necessary, re-equalized.
- Possible 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

- Next step: clustering



## 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