九州大学
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UCL

Data acquisition in ILD

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1. Introduction and general remarks
2. DAQ work in CALICE
3. Common DAQ work in AIDA-2020

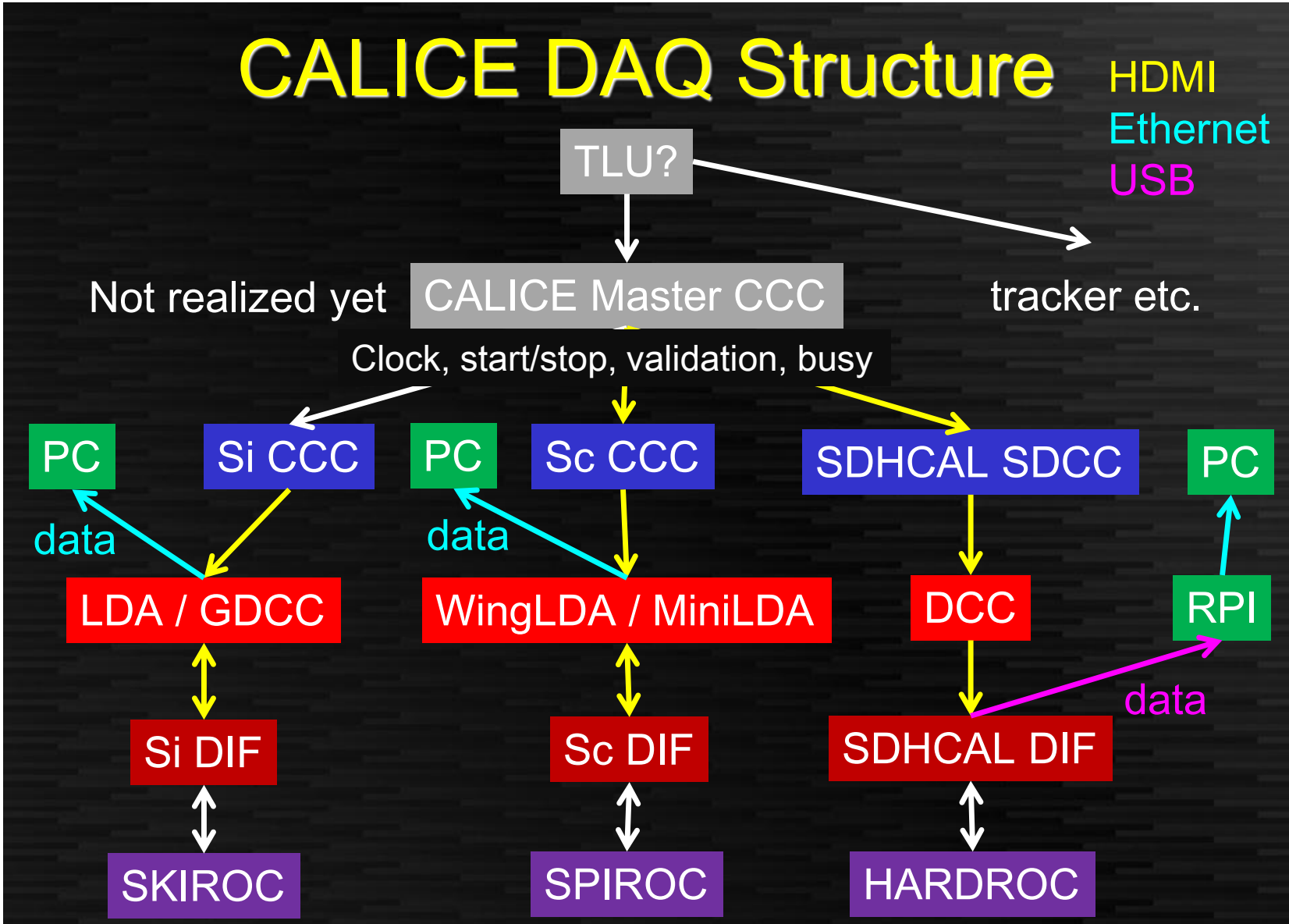
ILD meeting, Santander — 4 June 2016

Introduction and general remarks

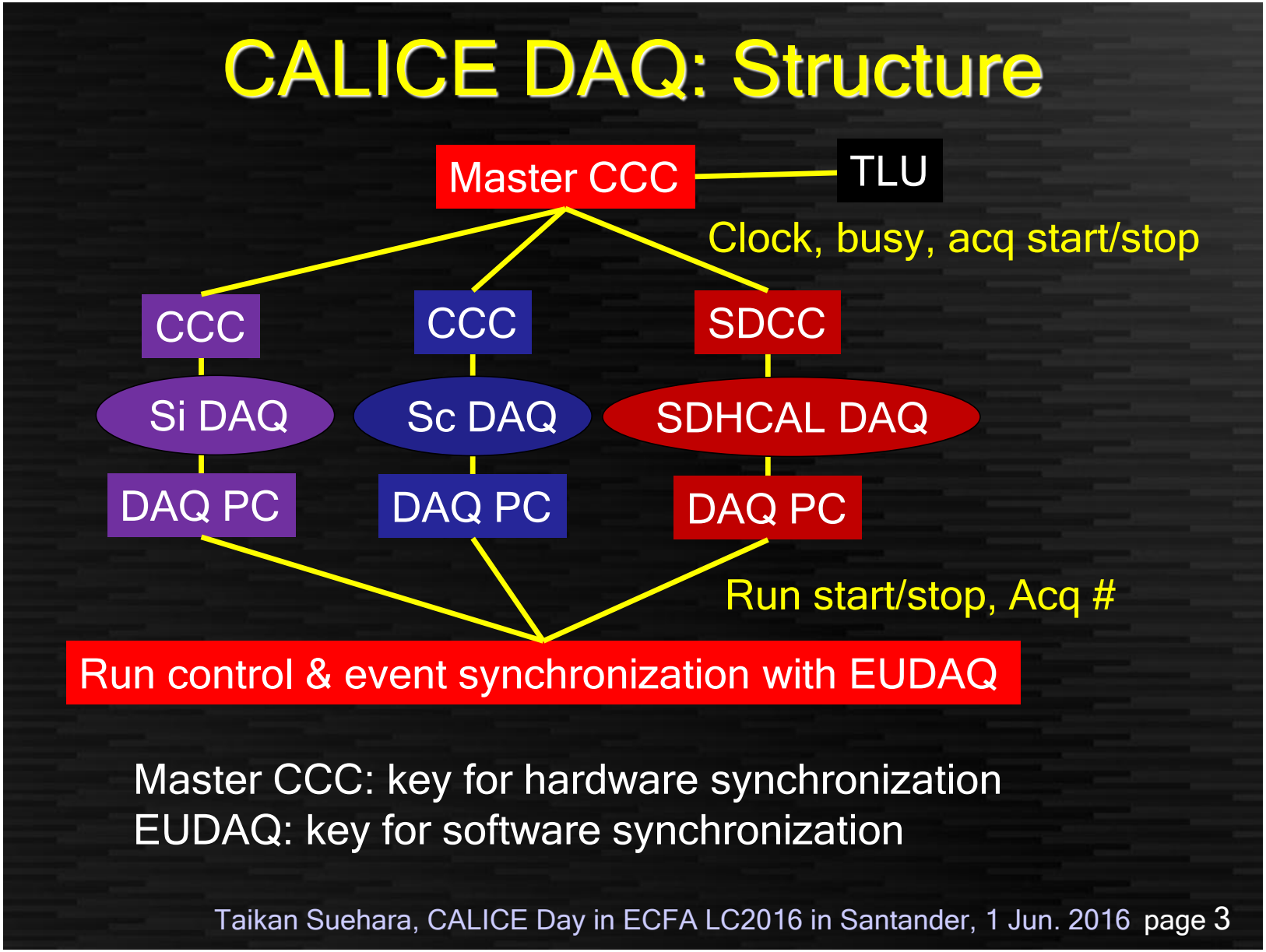
- We are not designing a prototype DAQ system for a Linear Collider detector.
- Priority is to ease running of detectors in a beam test (a service).
- Should allow more physics and technical understanding to be extracted. Understand performance of detector and / or validation of reconstruction algorithms for individual and multiple detectors.
- Clear links with other parts of the collaboration on software, calorimetry and, indeed, all detectors under development.
- In principle (ideally) we should be as inclusive as possible, developing solutions which are useable by all and providing common frameworks and tools.
- As a by-product, learning about a future Linear Collider DAQ and some of its challenges.
- Will discuss here the common solutions being worked on; provide some information to and receive feedback from detector groups.

CALICE structure

Individual DAQ hardware and software for each calorimeter based on UK design.



CALICE DAQ structure



CALICE DAQ

A CALICE task force, led by Taikan, aims to unify the various DAQ systems and have a common approach, where possible, and with minimum of effort.

- Common clock and acquisition cycle.
- Synchronised data taking and event matching.
- Common run control.
- Interface to upper control (TLU).

All for use in combined beam tests.

- Recent AHCAL beam test with beam interface (BIF).
- SiW ECAL and SDHCAL beam test coming up.

AIDA-2020 WP5 Tasks and their responsibles

- Task 5.1 Scientific coordination, **D. Cussans, M. Wing**
  - Coordination, reporting, organising, links with other WPs.
  - **UCL, Bristol.**
- Task 5.2 Interface, synchronisation and control of multiple-detector systems, **D. Cussans**
  - Principal task for definitions, specifications and hardware, TLU, CCC, etc.
  - **Bristol**, UCL.
- Task 5.3 Development of central DAQ software and run control system, **M. Wing**
  - Principal software task. EUDAQ as starting point.
  - **DESY, UCL**, Bristol, Prague, Sussex.
- Task 5.4 Development of data quality and slow control monitoring, **F. Salvatore**
  - See the task name !
  - **Prague, DESY, Sussex**, UCL.
- Task 5.5 Event model for combined DAQ, **A. Irles**
  - Concept of an event for online data, match to LCIO.
  - **DESY**, UCL.

AIDA-2020 Task 5.1: coordination

Have reasonably frequent, open meetings.

Communication via e-mail list which anyone can join, not just AIDA-2020 WP5 partners.

Need to communicate and have links with other work-packages and all detectors in the LC community.

Set up a wiki page for collecting and sharing information within group and with detector groups.

`http://flcwiki.desy.de/AIDA2020WP5`

AIDA-2020 Task 5.2: Interface, synchronisation and control of mulitple-detector systems

Principal task for definitions, specifications and hardware, all to be able to run multiple different detectors together.

Design of new TLU complete and schematic capture ready to start. To be reviewed/ checked by ATLAS.

Firmware modifications ongoing: move from Spartan-6 based carrier board to Artix-7 board and IPBus ported to Artix-7.

New features:

- Extra HDMI connector that can accept a clock.
- Change from mini-HDMI connector to full-size HDMI (or Display Port) and strain-relieving locking.
- Break strict FMC physical compliance.
- Use jitter-reducing clock generator for clock rather than internal FPGA allowing more flexibility.

Hardware designs, firmware and documentation on CERN-supported Open Hardware site:

http://www.ohwr.org/projects/fmc-mtlu/wiki

AIDA-2020 Task 5.3: Central DAQ and run control

Independent standalone (detector) DAQs.

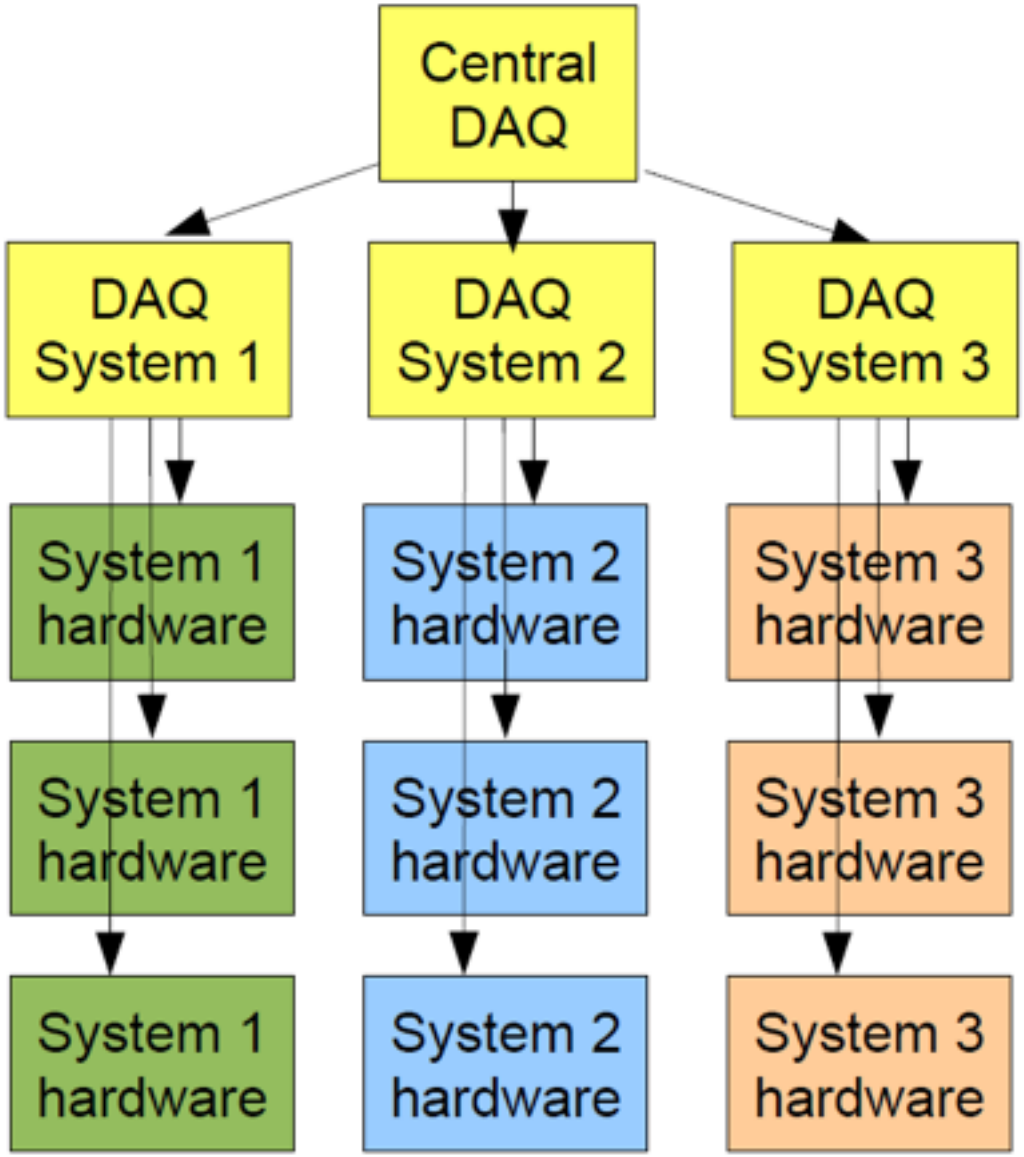
EUDAQ as central, high-level DAQ

- Lightweight modular and portable framework.
- Originally developed for (EUDET) pixel telescope and used in many beam tests.

EUDAQ1 has a stable release and used for many years.

EUDAQ2 under development and hope for release soon. Scalability and applicability to multi-detector setups.

Work started (ideas) on event builder within EUDAQ2.



K. Krueger

AIDA-2020 Task 5.4: Monitoring

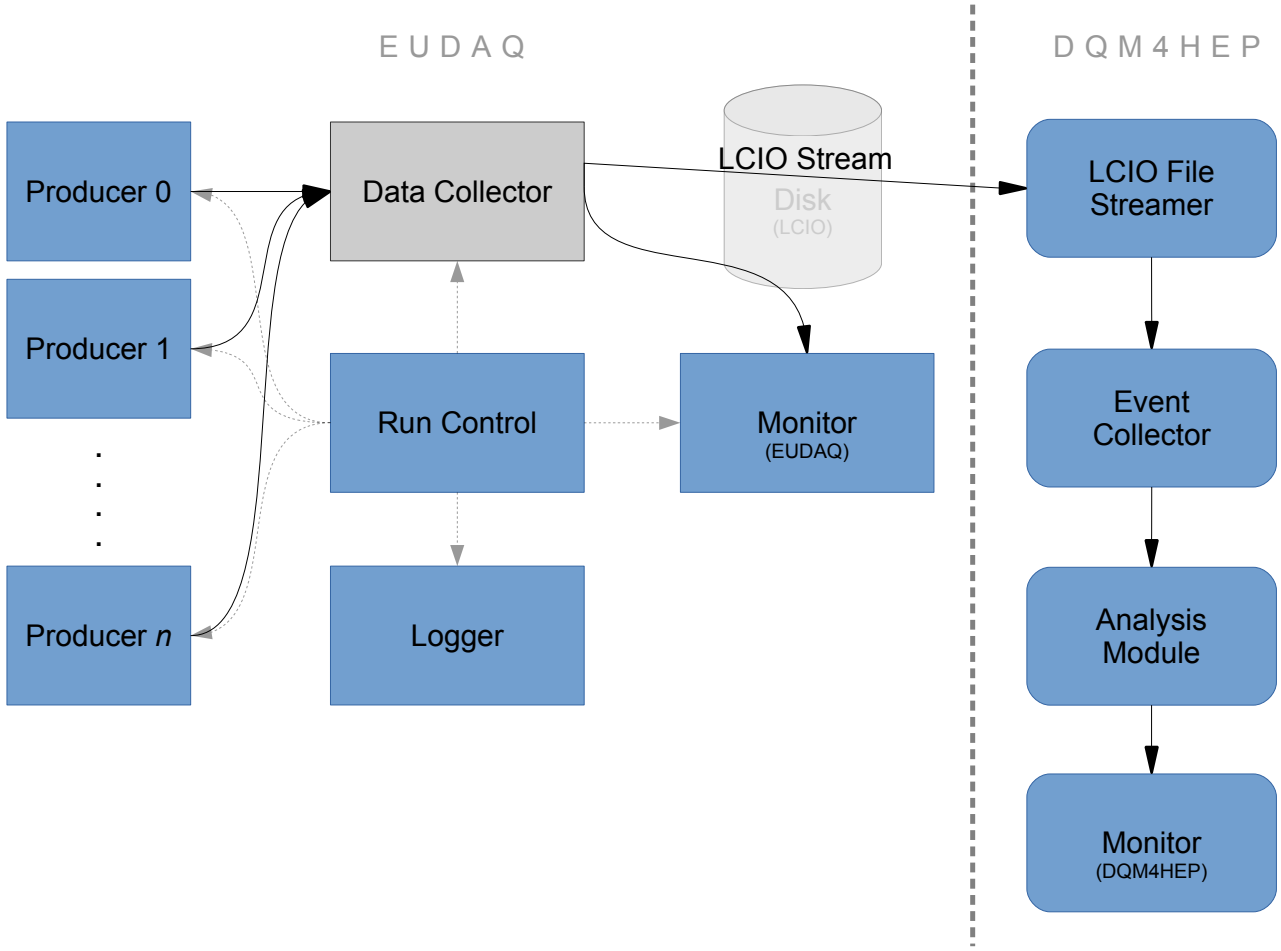
Using DQM4HEP, developed for SDHCAL beam tests by R. Eté (IPNL, Lyon) and A. Pingault (UGent): https://github.com/DQM4HEP

Generic data structures compatible with any input data type.

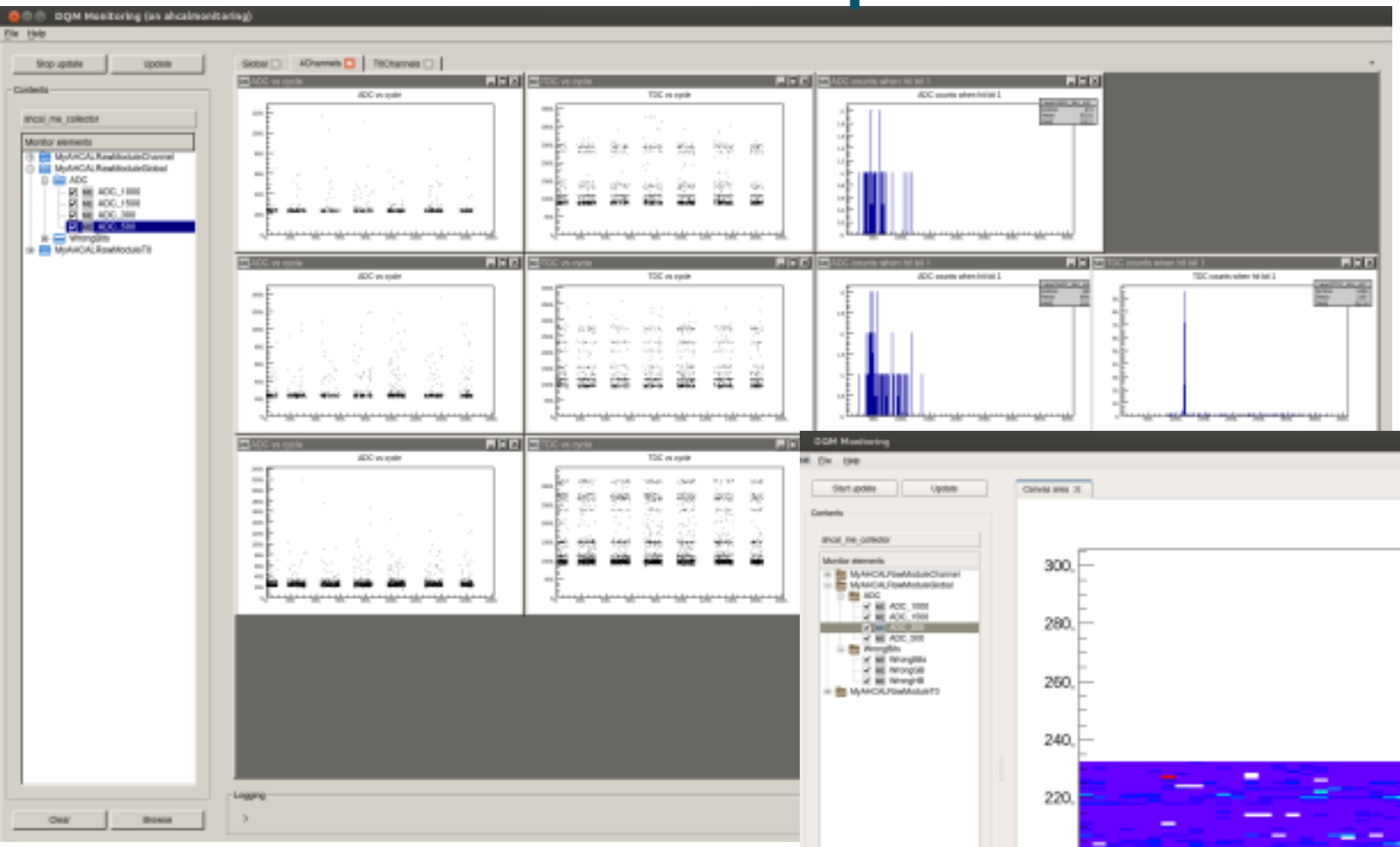
Interfaced with EUDAQ.

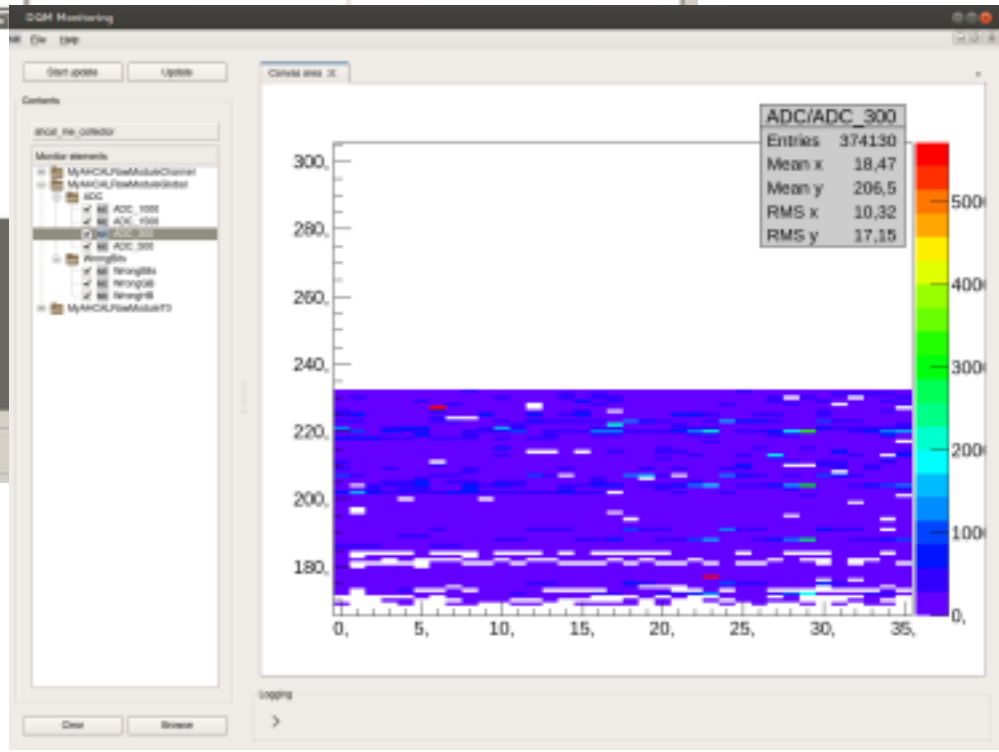
System set up at DESY and used in AHCAL beam test.

Participating in June SiECAL / SDHCAL beam test.



AIDA-2020 Task5.4: Example distributions





Monitoring system successfully worked in AHCAL beam test.

AIDA-2020 Task 5.5: Event model

To define an event model for online data, from different detectors with very different signals and properties.

Based on Linear Collider Input Output (LCIO) framework.

Lots of information gathering on current systems and their data (format).

First proposal for EUDAQ raw data format

Information and proposals collected at:

`http://flcwiki.desy.de/AIDA2020WP5_Task55_EventModelforCombinedDAQ`

First AIDA-2020 deliverable: interface document

Discussions have been ongoing throughout first year and during the various meetings.

Document will list requirements, recommendations, suggestions and observations, giving a hierarchy of importance in order to be able to interface to common DAQ.

Some important issues:

- Specifying a common clock, where detectors may use different values;
- Different states in the final state machine;
- Providing a common time stamp or trigger stamp in order to define an event;
- How to interface between EUDAQ and non-EUDAQ detector DAQ;
- How to interface to the common monitoring framework.
- …

Aim to have first draft in next couple of weeks (D. Cussans writing) and discuss at Annual Meeting and iterate.

The document will help to fix many aspects, but will also iterate during the time of the project and this needs to be managed.

Summary

Has been good progress recently on unifying DAQ work for Linear Collider beam tests.

Taikan is leading the task force in CALICE and Matthew is leading the work-package in AIDA-2020 project.

We will need to work closely with everyone to ensure we can make a common DAQ a success.

This will help us get better physics and technical understanding of the detectors.

Back-up

Project management – deliverables

List of deliverables

Deliverable Number [14]	Deliverable Title	Lead beneficiary	Type [15]	Dissemination level [16]	Due Date (in months) [17]
D5.1	Interface definition	30 - UCL	Report	Public	15
D5.2	Trigger Logic Unit ready	31 - UNIBRIS	Demonstrator	Public	30
D5.3	Data acquisition software	30 - UCL	Report	Public	30
D5.4	Data acquisition hardware	31 - UNIBRIS	Demonstrator	Public	30
D5.5	Online event data model	9 - DESY	Report	Public	30
D5.6	Common DAQ system used in combined beam tests	30 - UCL	Report	Public	45

First deliverable (and milestone)

- D5.1 Definition of interface standards for the common DAQ system which will describe how the detector DAQ system connects to the common DAQ. (Task 5.2)
- D5.2 The TLU hardware, including interface to CCC, will be ready, along with first versions of firmware and software for testing and integration with detector systems. (Task 5.2)
- D5.3 A software, including EUDAQ interfaces, run control, data monitoring and slow control will be available for common detector test-beams. (Tasks 5.3, 5.4)
- D5.4 As well as the TLU and software, the computing infrastructure, principally PCs, disks and networking, will be ready. (Tasks 5.2, 5.3)
- D5.5 Definition of the online event data model, i.e. the concept of an event for detector systems having very different integration times, compatible with the offline software and in coordination with WP3. (Task 5.5)
- D5.6 The DAQ system will be in use in common test-beam campaigns and the final description of the implementation and performance results will be presented in a report. (Tasks 5.1, 5.2, 5.3, 5.4, 5.5)

Project management – milestones

Number	Definition	Beneficiary	Month	Verification
MS25	Definition of detector interface standards with common DAQ (Definition of interface standards for the common DAQ system which will describe how the detector DAQ system connects to the common DAQ, Task 5.2)	UCL	15	Report to StCom
MS43	Trigger logic unit (TLU) design ready (This will include the design of the interface to the CCC as well as firmware block diagrams and implementation plan,Task 5.2)	Bristol	21	Report to StCom
MS46	EUDAQ interfaces to other DAQs available (EUDAQ interfaces to other DAQs available for integrating different software and hence different detector systems into the central common system, Task 5.3)	DESY	24	Test running results
MS47	Online event data model available (Definition of the online event data model, i.e. the concept of an event for detector systems having very different integration times, compatible with the offline software and in coordination with WP3,Task 5.5)	DESY	24	Test running results
MS62	Development of run control ready (Development of run control ready, incorporating controls for data taking, the ability to send and receive configuration data and receive status messages, Task 5.3)	UCL	27	Test running results
MS66	TLU hardware, firmware and software ready for tests beams (The hardware, along with the interface to the CCC, as well as the firmware and software will be ready for integration by detector systems, Task 5.2)	Bristol	30	Test running results
MS67	Data quality monitoring tools ready (Data quality monitoring tools ready, comparing quantities as soon as possible after data taking but as accurate as possible as offline to expected distributions, Task 5.4)	UCL	30	Test running results
MS68	Slow control system ready (Slow control system ready to monitor environmental conditions from the various detector systems, providing a synchronised picture of the conditions, Task 5.4)	Prague	30	Test running results
MS80	Common DAQ system ready for combined test beams (Tasks 5.1, 5.2, 5.3, 5.4, 5.5)	UCL	36	Test running results