DQM4HEP
Status and prospects.

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DESY

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AIDA 2020

UNIVERSITY OF SUSSEX

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Summary

- Introduction
- Framework presentation
- Experiments running with DQM4HEP
- EUDAQ / DQM4HEP interface
- Current status
- Ongoing and future work

Introduction

DQM systems in HEP domain :

- Evaluate data quality and alert users of anomalies
  - Are the distribution what we expect ?
  - Comparison between runs or old/new software version
  - Quick feedback from hundred of plots is challenging
- Provide online and offline analysis
  - Automated data quality tests, possibly with reference histograms
  - Distributed system for online analysis (data collectors)
  - Dedicated visualization interface (Qt, Web)
- Already developed for most of HEP experiments (i.e AMORE or CMSSW)

But ... Based on experiment specific event format

- Not re-usable by other experiments
- Duplicated software
- Ad-hoc solution for test-beam setup monitoring

Development of a generic DQM software for any HEP experiment : **DQM4HEP**

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Software overview

Key points :

- Standalone plugin system
  - Plugin = C++ class in a shared library
  - Load shared library at runtime and hook plugin class
- **Generic event data model/format**. User needs to define :
  - Event model
  - Conversion Model $\leftrightarrow$ Binary

More general features :

- Online analysis (API)
- Distributed system (TCP/IP)
- Data collectors : event and histogram collector servers
- Quality test tools : interface + quality test templates
- Visualization interface (histograms and quality tests)

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Quality test API

Monitor element

- Wrap a ROOT TObject
- Optionally hold a ROOT TObject as reference

Quality test

- Implement the logic to test a monitor element
- Output a quality report (quality flag, success, etc)

One monitor element can be tested with many QTests, e.g :

- Kolmogorov test using a reference histogram
- Mean of histogram within an expected value

One QTest can be attached to many monitor elements, e.g :

- Test different histograms with the same gaussian distribution

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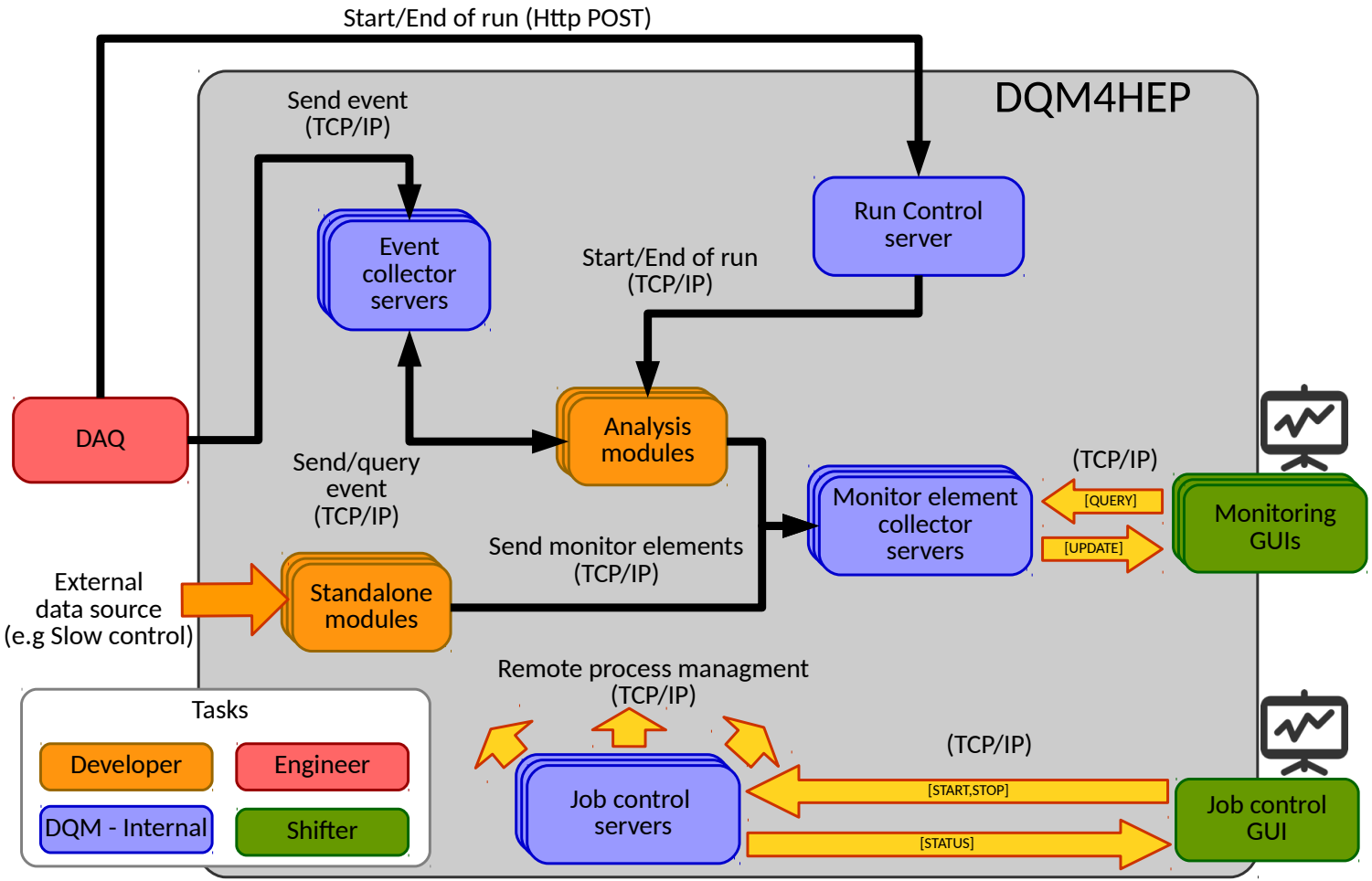
Online architecture



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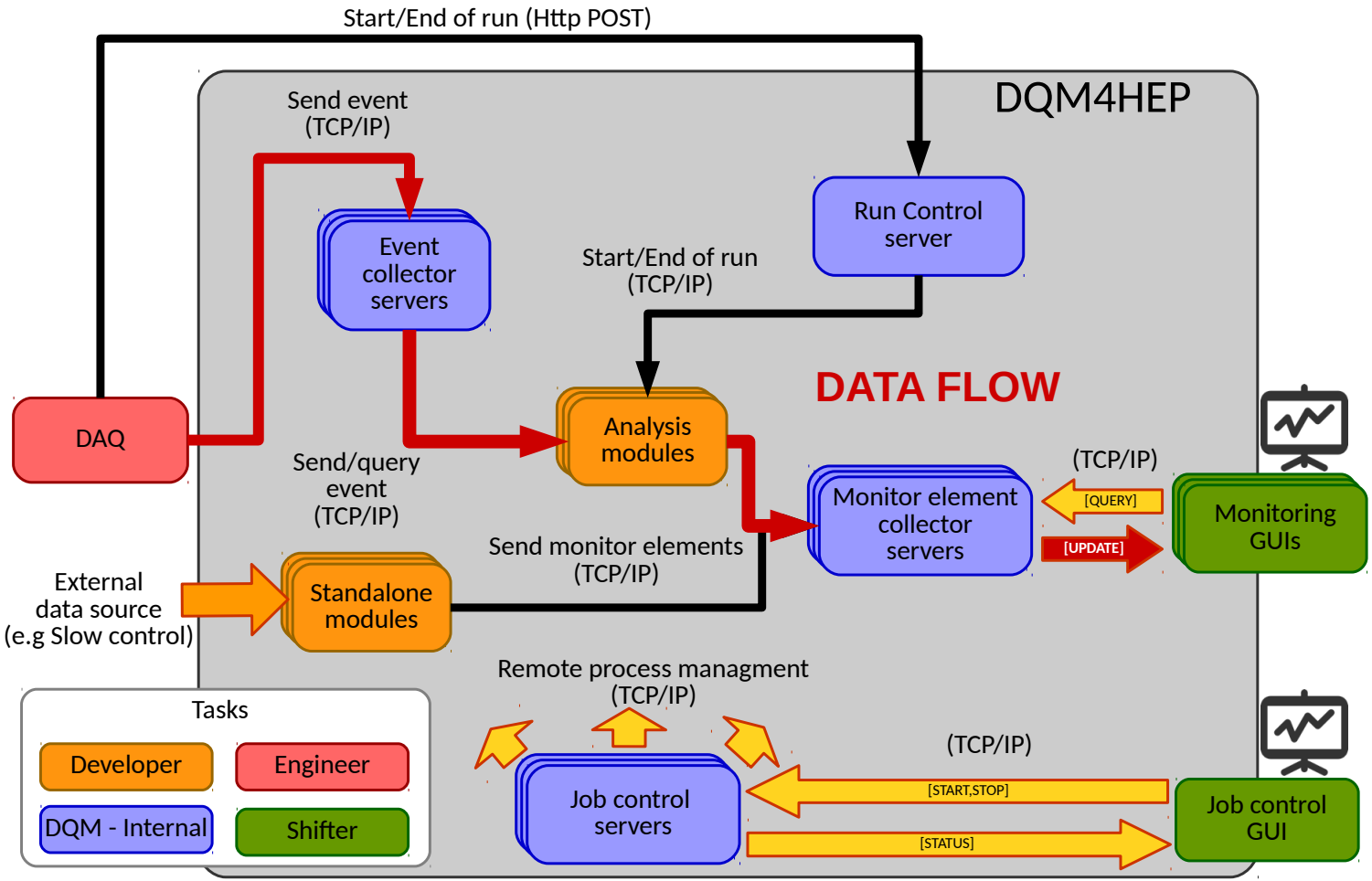
Online architecture



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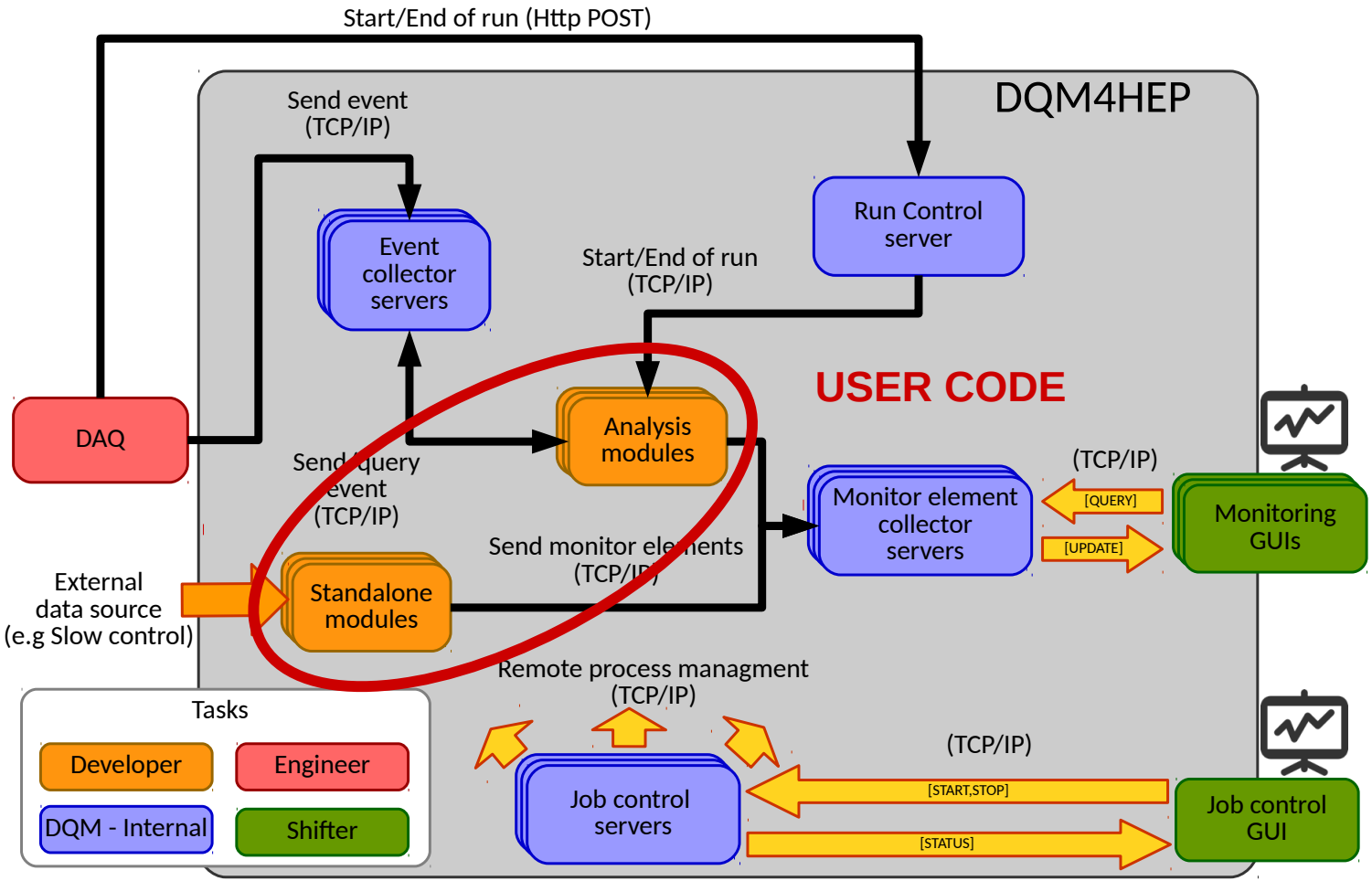
Online architecture



Analysis module

- **Receive and process event (e.g from DAQ)**
- Book and fill histograms
- Process quality tests
- Send histogram and QReports to collectors with cycle structure
  - Every N events/seconds
  - User can reset histogram if needed at end of cycle

Standalone module

- **Receive and process data from external source (e.g slow control)**
- Book and fill histograms
- Process quality tests
- Send histogram and QReports to collectors every N seconds

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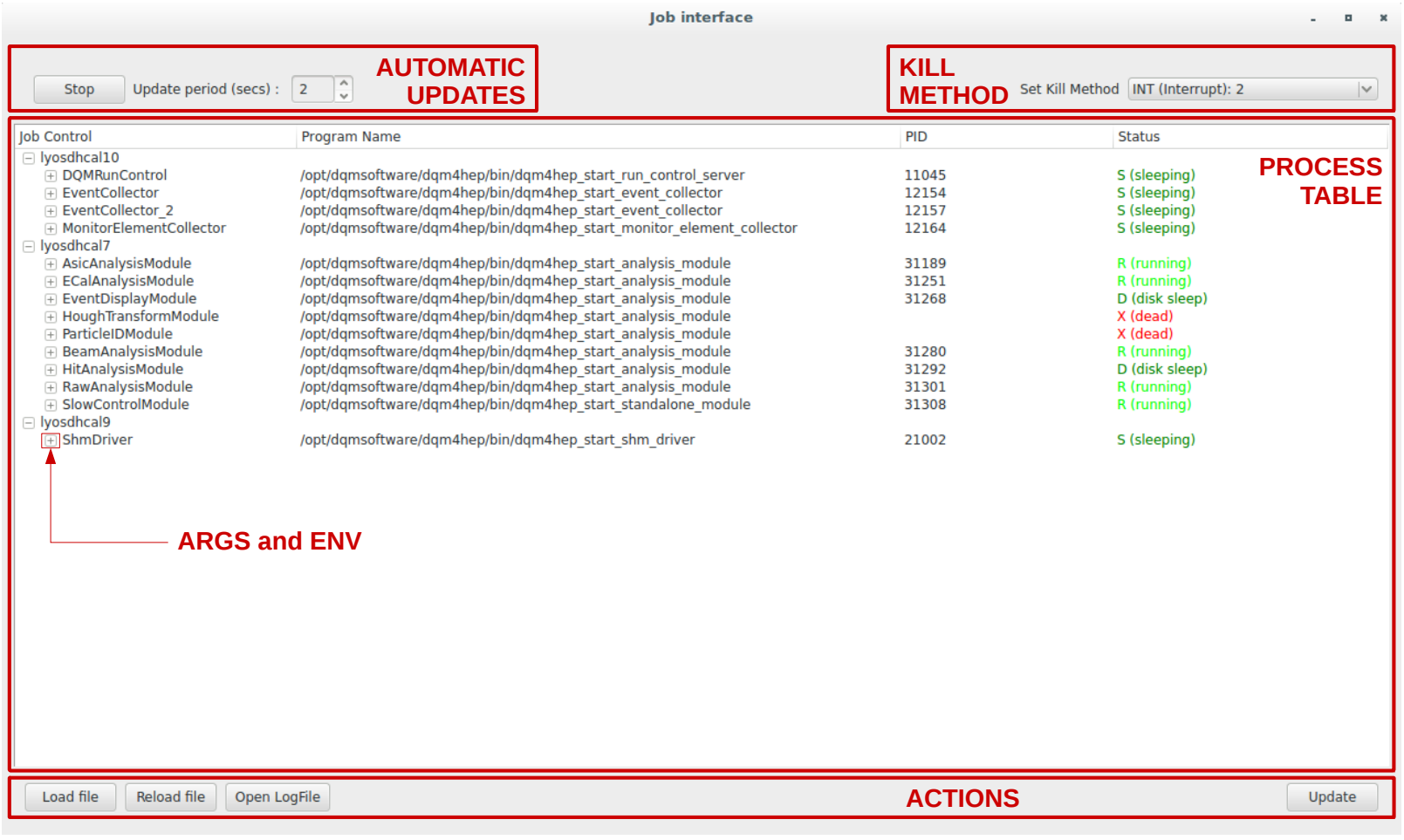
Job control interface (Qt Gui)



Start/stop/manage many processes on many hosts

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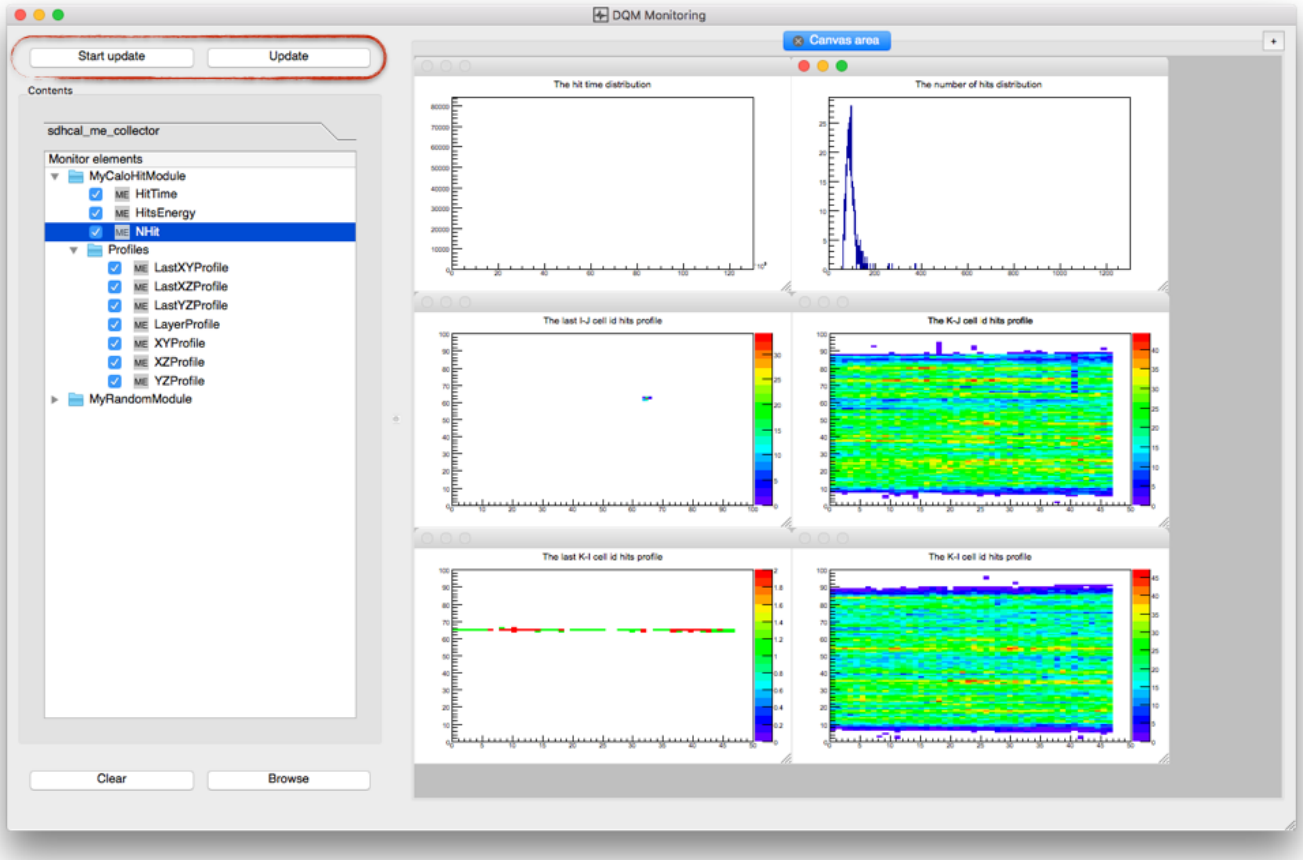
Online monitoring interface (Qt Gui)



- Histograms organized in tree structure
- Plot many histograms at the same time
- Receive real time updates
- Browse histograms on collectors

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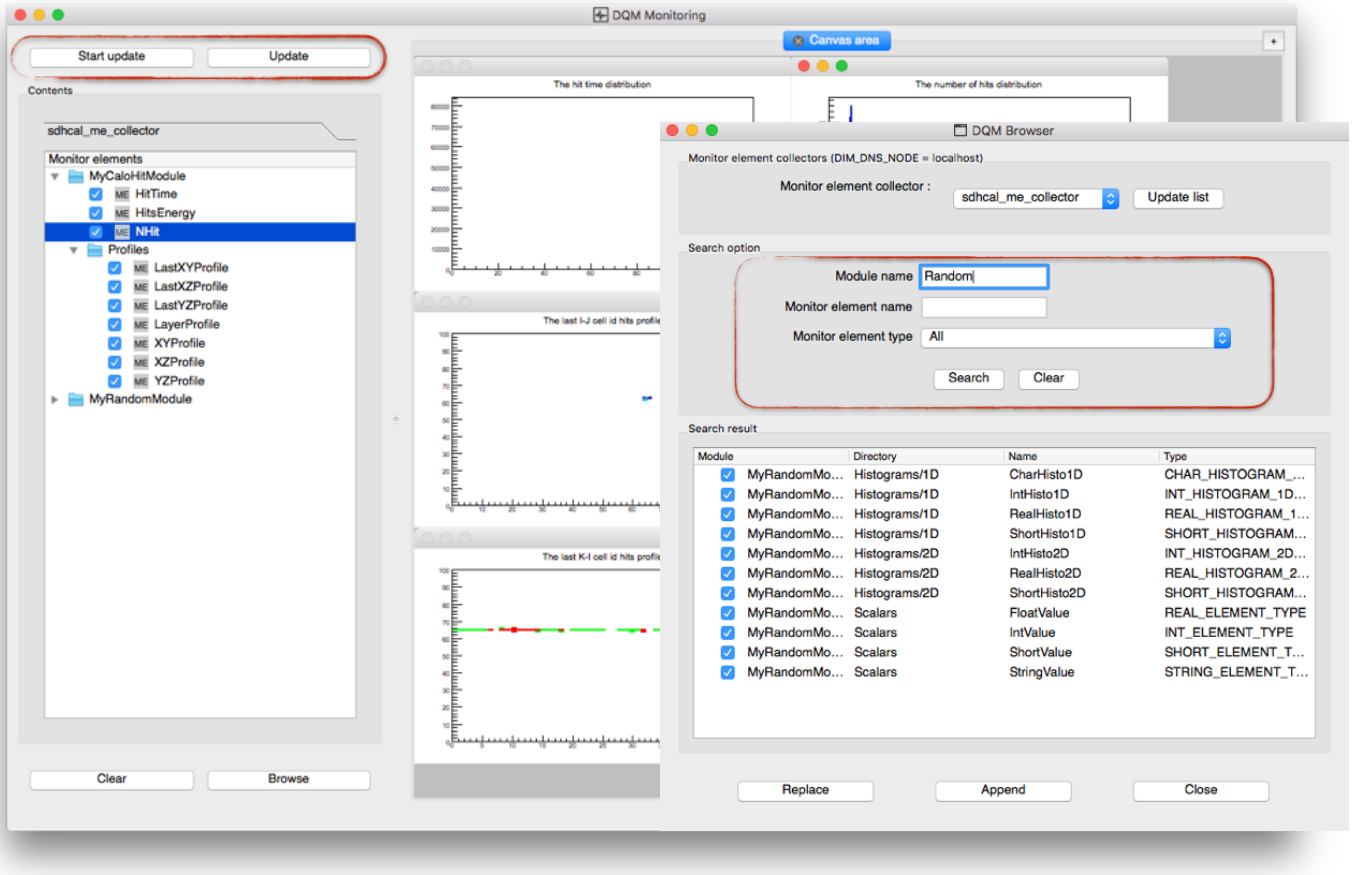
Online monitoring interface (Qt Gui)



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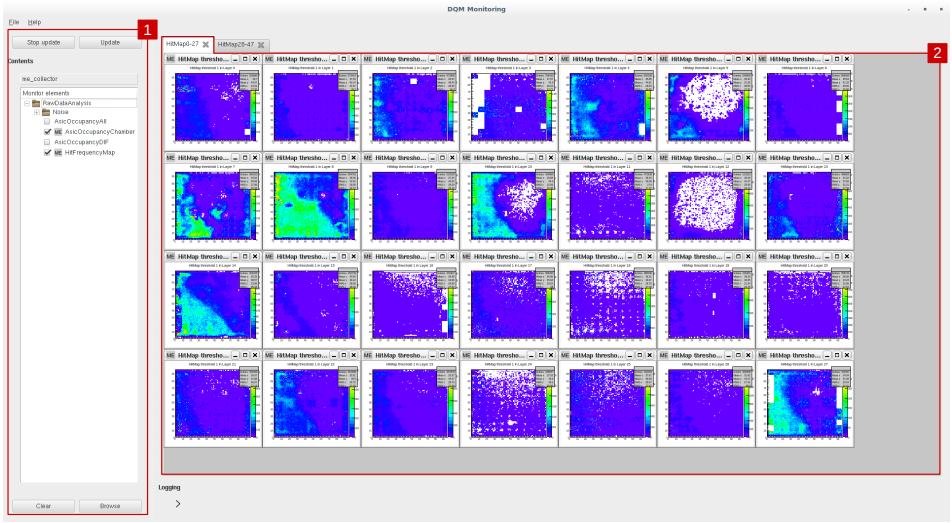
Detectors using DQM4HEP

DQM4HEP used by different detectors in the CALICE collaboration.

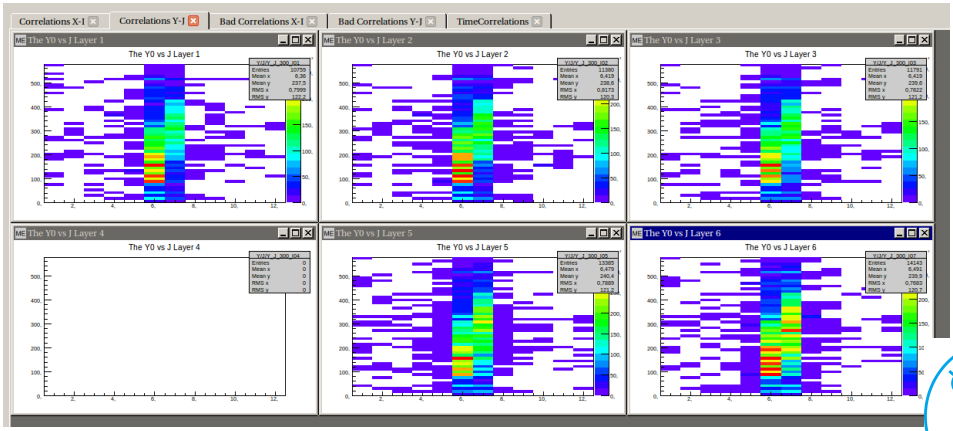
SDHCal online monitoring

- Hit maps
- Electronics rate
- Slow control : I, HV, LW, T, P
- GRPC efficiency, multiplicity



AHCal online monitoring

- Hit maps
- Correlation with Telescope hits
- Electronics rate



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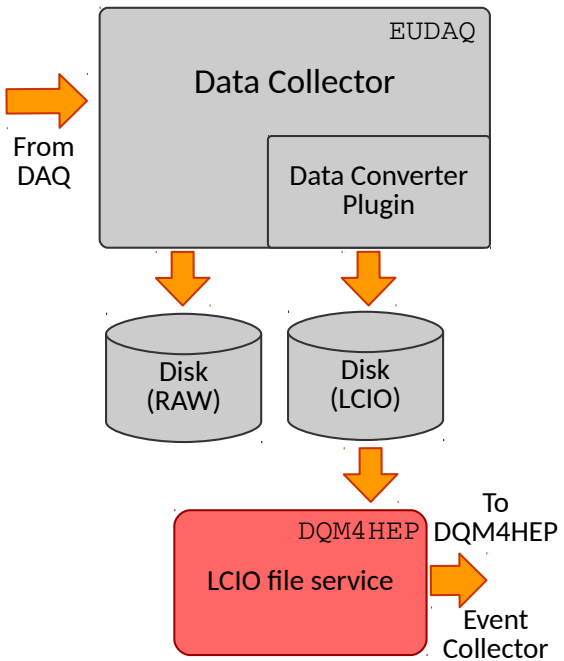
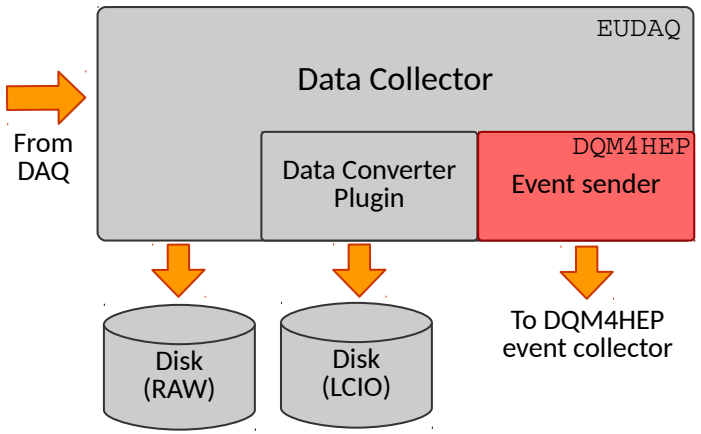
AIDA2020 and EUDAQ binding

DQM4HEP adopted as monitoring framework by AIDA2020 WP5 :

> *Task 5.4 Development of data quality and slow control monitoring*

Binding between the EUDAQ framework and DQM4HEP is ongoing.





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Ongoing work on framework

ILD collaboration entering in a new MC production process.

Need for automatic data quality checks for simulated/reconstructed quantities.

Ongoing work to separate the main package (DQMCore) into two different software

dqm4hep-core

- MonitorElement (ROOT)
- Quality test
- Event interface
- Streaming (xdrstream)
- Plugin management
- DB tools (MySQL)
- Logging (spdlog)

dqm4hep-online

- Modules (User classes, Online API)
- Event collector (server and client)
- Monitor element collector (server and client)
- Run control (server, client and external interface)

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Ongoing work on framework

Current effort to provide an important set of quality test templates in core library

Users can also implement their own quality test(s)

- **Kolmogorov test (hist + ref)**
- Mean withing range
- Mean 90 within range
- No data after limit
- No data before limit
- **Fit function and check χ^2**
- Likelihood fit
- Fraction of data after limit exceed
- Fraction of data before limit exceed
- RMS lower than
- RMS 90 lower than
- RMS greater than
- RMS 90 greater than
- Mean lower than
- Mean 90 lower than
- Mean greater than
- Mean 90 greater than
- RMS within range
- RMS 90 within range
- **Fit function and check parameters within range**
- Distance between two values

Incoming work : **possibility to test any object in ROOT files using these quality tests**

Conclusion

- Development of a new **generic framework** for data quality monitoring
- Used during test-beam by different detectors and **combination of sub-detectors**
- Current implementation works for online setup

Perspectives

- Refactoring of the framework to make it working for **offline data quality monitoring**
- Development of a EUDAQ binding for online data taking
- Development of quality test templates

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URLs and contact

GitHub collaboration

`https://github.com/dqm4hep`

Installation package (`v04-03-00`)

`https://github.com/dqm4hep/dqm4hep`

Slack channel (Announcements, issues, management)

`https://dqm4hep.slack.com`

Contact us !

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