# ATLAS online data quality monitoring

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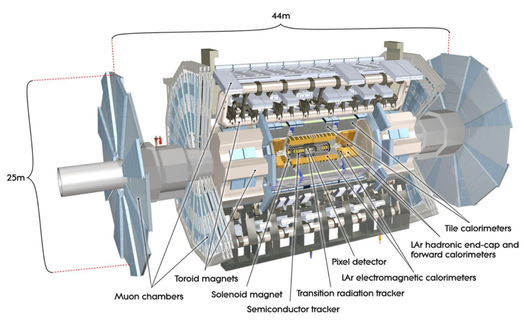
## ATLAS Data Acquisition system



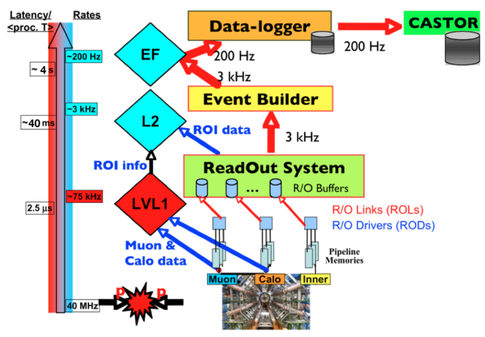

### The ATLAS detector

The ATLAS experiment is one of the generic detectors designed and built to record the output of the proton-proton collisions provided by the Large Hadron Colider at CERN, Geneva.

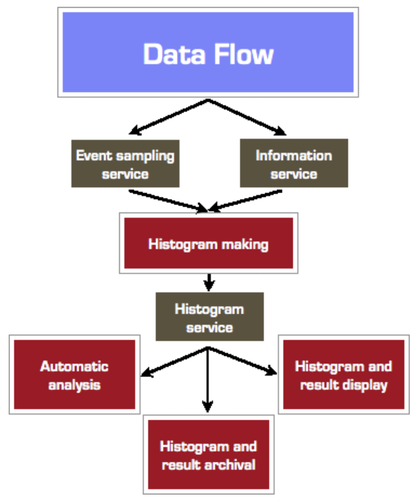
### The Data Acquisition system

Data acquisition is based on a three-level trigger architecture. The goal is to achieve a final rate of 200Hz, from the 40MHz proton-proton collision rate.

**Data Flow** is responsible for collecting data fragments, serving them to trigger processors and sending them to mass storage. Online data quality monitoring analyzes data from all subsystems at all stages of Data Flow




## Monitoring infrastructure




A subset of the Data Acquisition system is devoted to monitor the performance of each element of the Data Flow and Trigger chains and the quality of the data being recorded.

### Monitoring main features

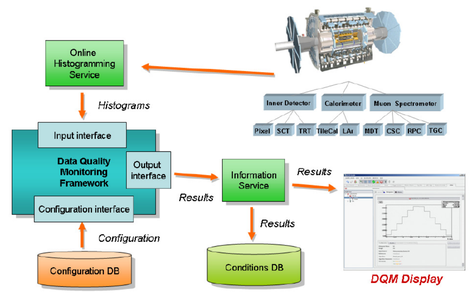
Many monitoring applications run online in order to satisfy the large diversity of monitoring needs:

- access data at all levels of DataFlow and Trigger and **produce online histograms**
- analyze **operational conditions** of the different hardware elements
- perform **automatic checks** on the histograms and operational data made available by other applications
- **archive** all the data and results produced online
- provide **easy and fast visualization**, locally and remotely, of all the information made available for shifters and experts.

### Resources

Monitoring uses about 32 dedicated machines. The different processes access data and operational conditions at all stages of Data Flow and trigger, analyze them and provide results.

## Data Quality Monitoring Framework




The Data Quality Monitoring Framework (DQMF) is a data driven distributed and scalable framework to monitor data quality both online and offline.

### Main features of the framework

- reading the configuration information from the data base
- finding and get all the available input histograms every time they are updated
- executing predefined tests, as specified in the configuration
- producing results and making them available
- and writing to the DB

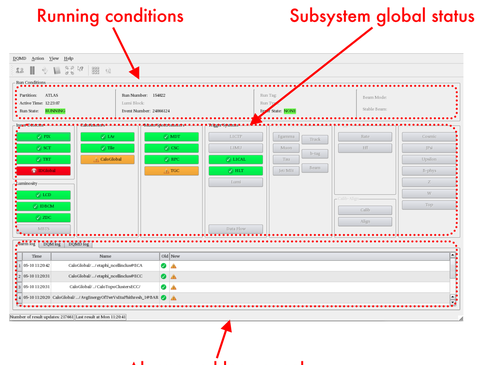
### DQTree

Single data quality (DQ) tests are handled by **DQParameters**. Each DQParameter specifies what input histogram(s) to use, what algorithm (**DQAlgorithm**) to apply and the thresholds to classify the result (**DQResult**) as good or bad.
DQParameters are grouped in **DQRegions**. DQRegions also have DQResults associated. The mechanism to combine the results of the subparameters is specified in the configuration. DQRegions can be grouped in mother DQRegions, thus creating a DQ tree.

### DQAgent

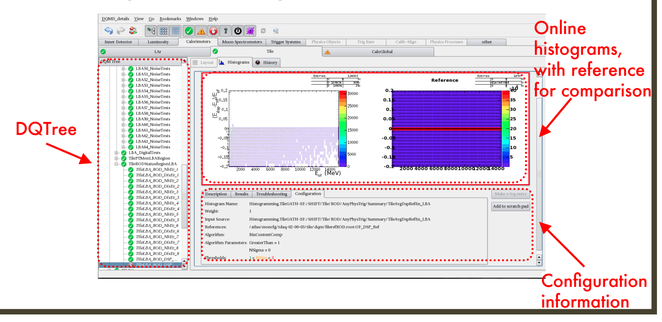
DQ agents are the applications at the core of the framework. These run the actual algorithms online. Input and output mechanisms are implemented as plug-ins, thus providing a large degree of flexibility. The checks, thresholds and parameters are loaded from the configuration data base.

## Data Quality Monitoring Display

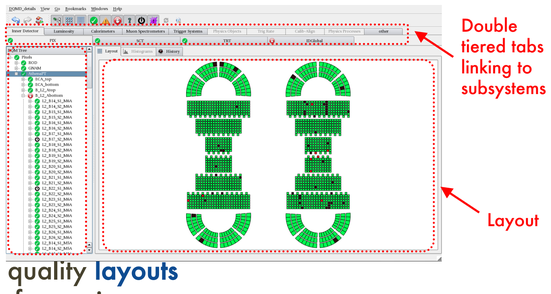



A new result is produced every time a histogram is **updated**. The configuration specifies the input histogram location, the checks and thresholds to be applied. The results, together with the configuration, description and the result timeline are displayed in the **detailed panel**.If results bring new histograms attached, these are also displayed in a separate tab.

The Data Quality Monitoring Display (DQMD) is an application for **easy visualization** of data quality status of each subsystem.
The main panel provides an **overview** and **Alarms** and **Logs** tabs have been added for enhanced control or errors.
There is one button per subsystem. Clicking on them brings up a detailed panel with the relevant subsystem data quality tree, histograms and results.
Clicking on Alarm or Log entries also brings up a detailed panel with further information

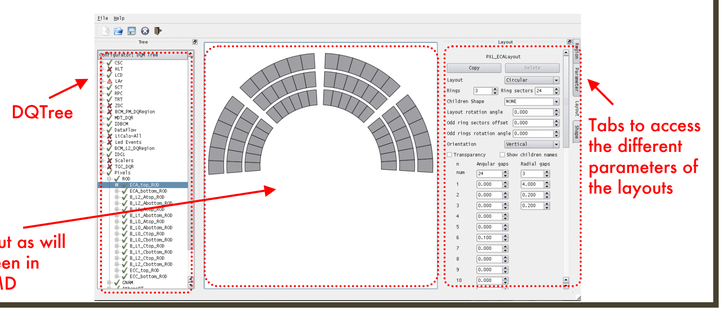



## Data Quality Monitoring Configurator




Data quality **layouts** allow for easier understanding of the status of the subsystems and faster navigation to problematic regions. Layouts are defined and **configured** together with the tree structure and the automatic test parameters. Clicking on each part of the layout brings the appropriate subtree or result

The Data Quality Monitoring Configurator (DQMC) is an easy-to-use **graphical interface to generate the layouts** and link to the data quality tree. This application reads from and writes to standard configuration **database**. For each DQRegion of the tree on the right panel, the layout is shown in the central part of the display. The controls on the right tabs allow for changing the setting




## Current status and conclusions

- So far, the framework handles
  - **20** DQAgents
  - more than **75000** DQParameters
  - organized in more than **15000** DQRegions
  - more than **150000** new results per minute
- These figures correspond only for the **DQ framework**. Event sampling, information extraction and histogram generation and publishing use other processes and resources
- The feedback provided by system experts and shifters has resulted on many upgrades, specially in visualization tools
  - **DQMC** used by most systems to generate layouts
  - **DQMD** always used in most desks in the ATLAS control room to ensure good data quality taking and chase down any issues that might arise

- The Data Quality Monitoring Framework has been successfully **commissioned**, proving to be able to meet the stringent ATLAS requirements
- The framework together with the applications provided have proven very useful to ensure **good data quality**
- This same framework is reused **offline** to assess DQ and set offline DQ flags. The good runs lists for the first physics results were generated using this offline DQ assessment
- DQMF is actively being used to ensure good data taking with collisions runs at 7TeV. It won't discover new physics,
  - but makes sure we are taking and analyzing good data to make our first discoveries

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