



A software framework for Data Quality Monitoring in ATLAS

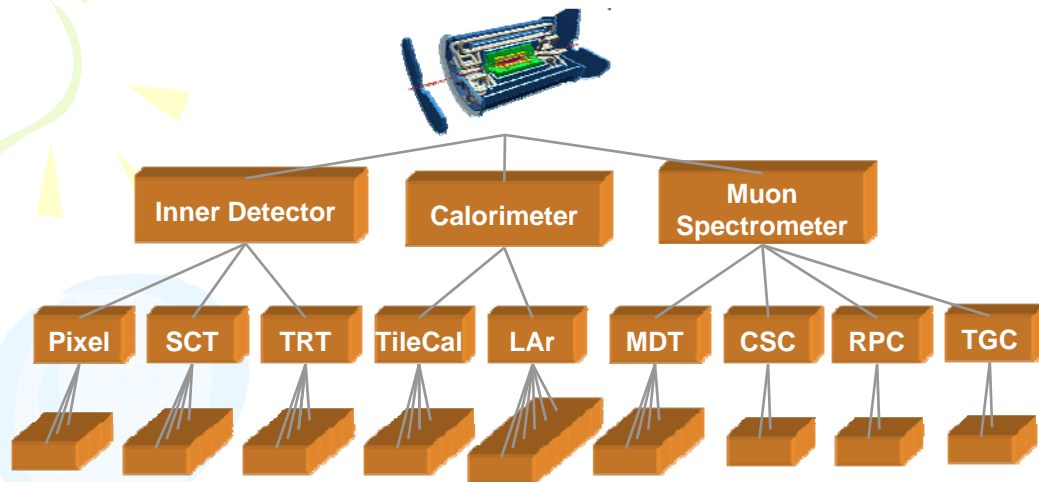
S.Kolos, A.Corso-Radu *University of California, Irvine*,
M.Hauschild *CERN*,
B.Kehoe, H.Hadavand *Southern Methodist University*



Outline

- The ATLAS Data Quality challenge
- Data Quality Framework
 - Design & Implementation
 - Experience during ATLAS commissioning
- Conclusion

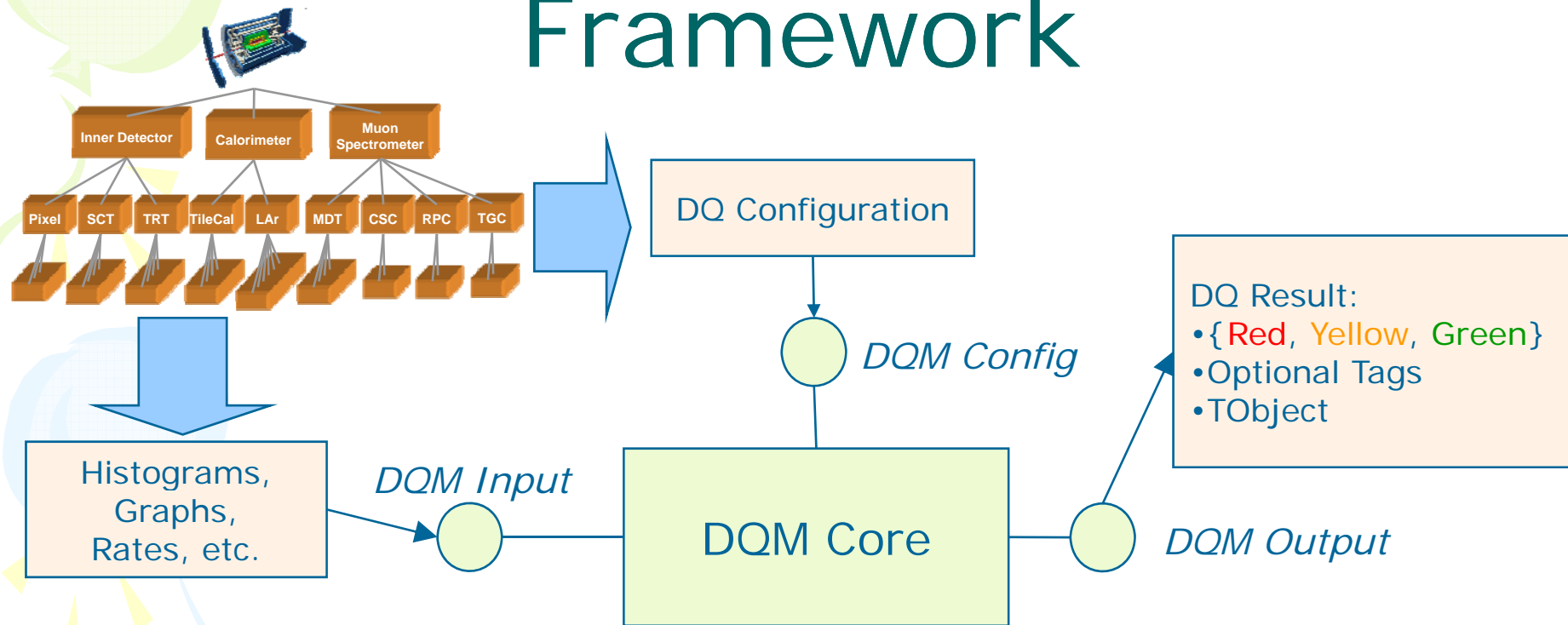
ATLAS DQ Challenge



- The Data Quality Challenge:
 - Fast and reliable detection of DQ problems during data taking and reconstruction

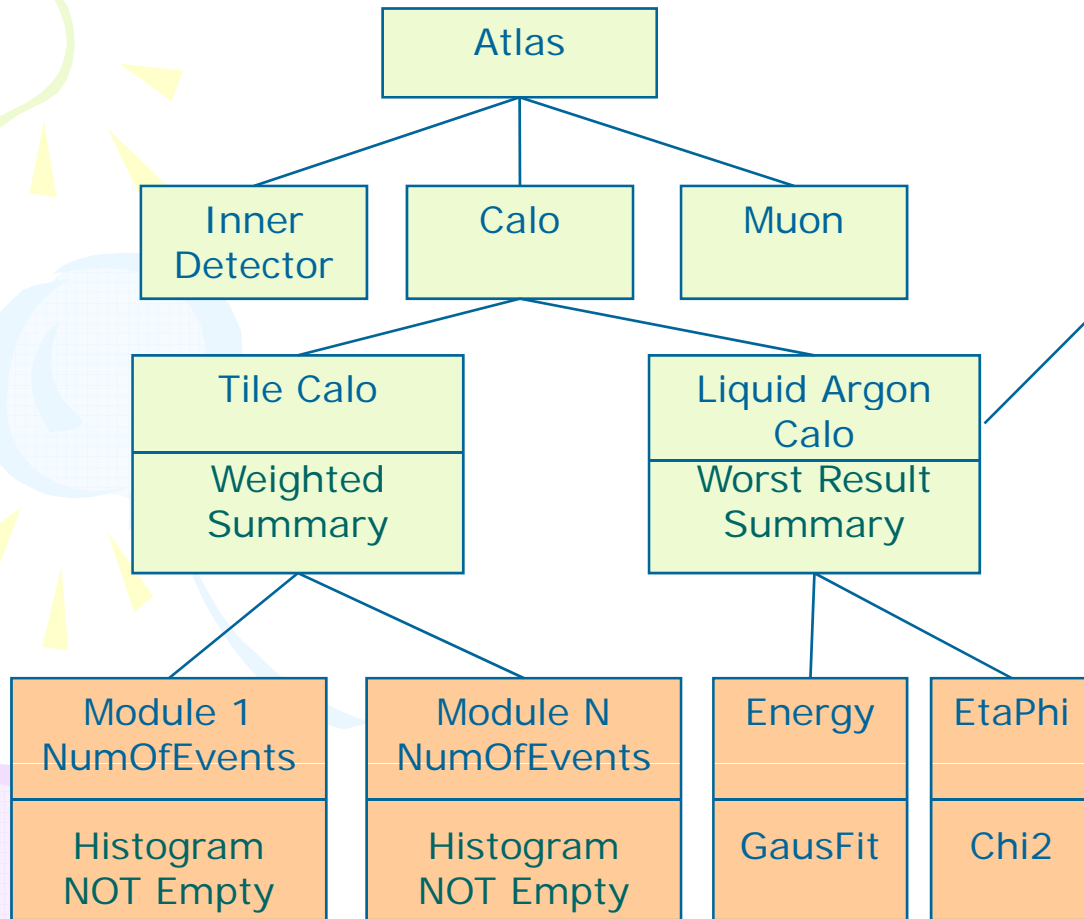
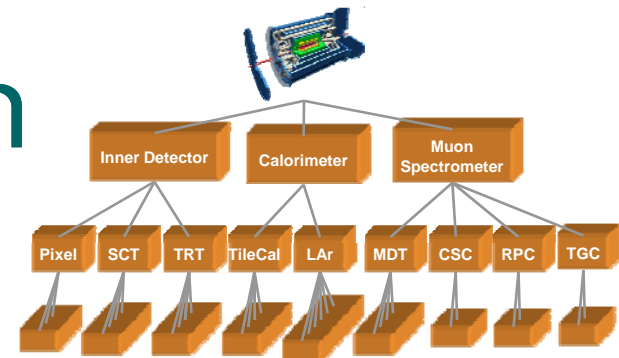
- 3 main detectors
- 10 sub-detectors + LVL1 Trigger
- 33 sub-systems
- Each sub-system can be used independently
- 140M channels
- Bunch crossing rate 40MHz
- 3 Trigger levels reducing rate by 10^5

The Model of Data Quality Framework



- DQM Core:
 - Read DQ Configuration
 - Algorithm execution is data-driven:
 - Execute DQ algorithms as soon as input data becomes available
 - Produce DQ Result

DQ Configuration



DQ Region:

- Produces summary result for given sub-system
- It is based on the children results

DQ Parameter:

- Produces DQ result for a given quantity
- Analyses input data with specific algorithm



DQ Algorithm

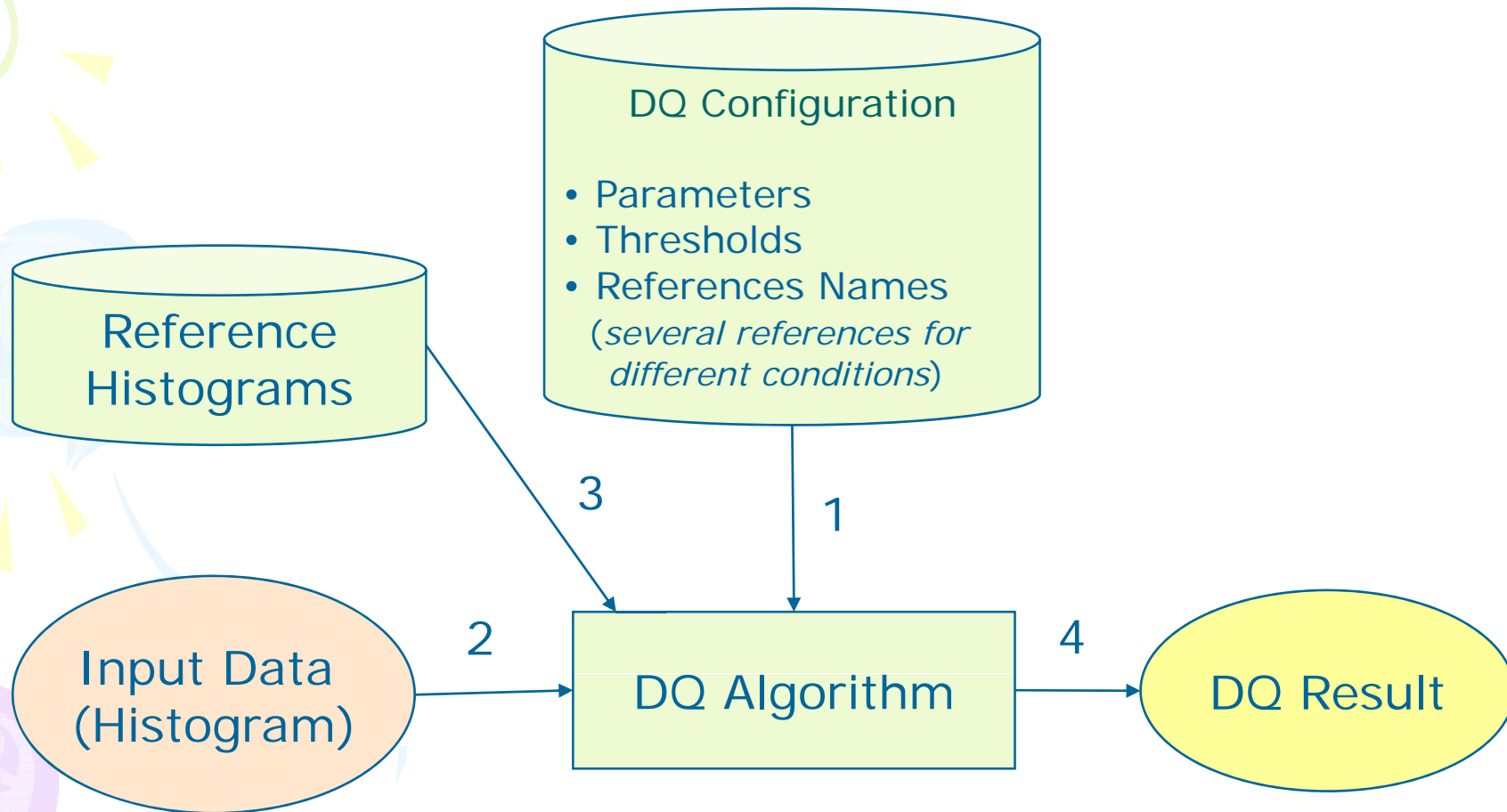
- C++ function which analyses histogram and produce the DQ Result for the corresponding DQ Parameter
- Special type of DQ Algorithms is SummaryMaker:
 - Produces DQ Result for a DQ Region
 - This result is based on the DQ Results of the Region's children
- Custom algorithms can be easily plugged in by:
 - Inheriting from the Algorithm base class
 - Implementing two abstract methods: clone and execute



Data Quality Algorithms

- DQMF provides shared algorithms repository:
 - contains a set of predefined algorithms:
 - Reference Histogram comparison
 - *Chi2, Kolmogorov, Bin comparison (using ROOT)*
 - Fits:
 - *Gaus, Landau, Pol1 (using ROOT)*
 - Bin Threshold:
 - *<, >, <=< >=*
 - Basic Histogram checks
 - *All_Bins_Filled, Histogram_Not_Empty, No_UnderFlows, No_OverFlows*
 - Basic Stat Checks
 - *CheckHisto_Mean, CheckHisto_RMS*
 - Etc.
 - Contains 2 summary makers:
 - Worst result
 - Weighted result
- Repository is filled up by ATLAS sub-system experts:
 - Share experience between sub-systems
 - Avoid duplication of work

DQ Algorithm Data Flow



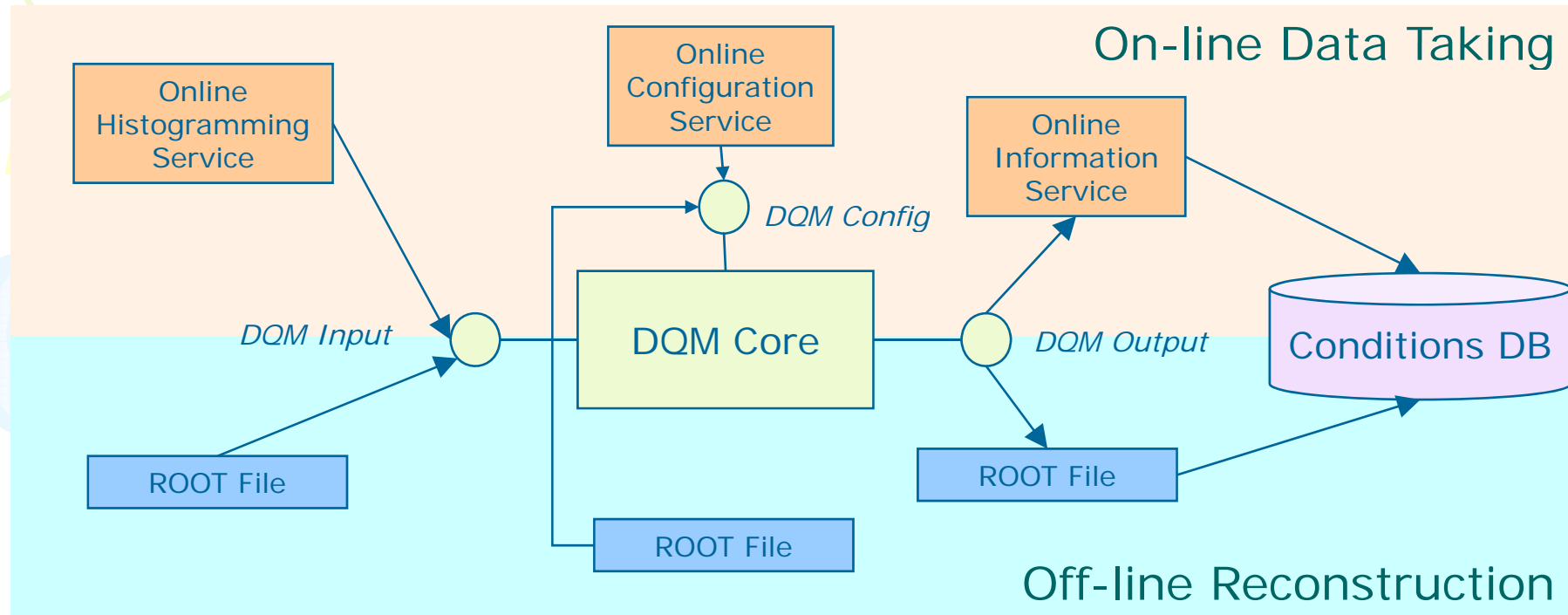


DQM Workbench

- DQMF provides set of Root macros which can be used to run DQ Algorithms in Root shell:
 - For algorithms development and debugging
 - For preparing configuration

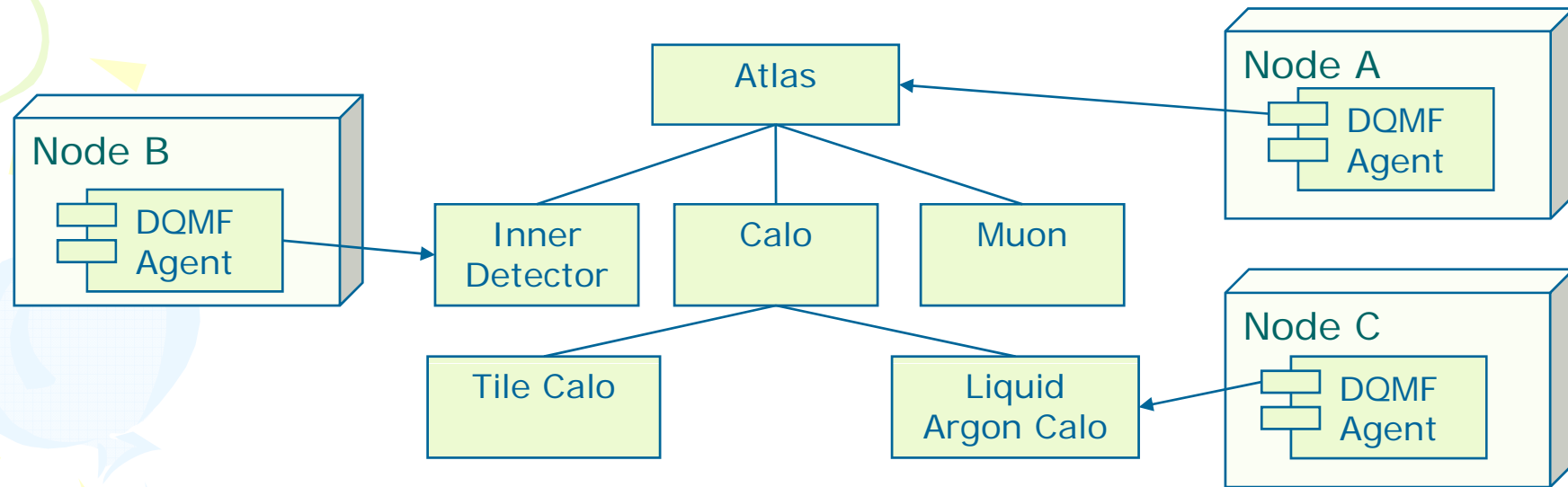
```
root [0] .x Workbench.C
root [1] .x TestBinContentCompAlgorithm.C
Number of bins 2 Sigma away from reference is 16
Green threshold: 33 bin(s); Red threshold : 1 bin(s)
Result 2
```

On-line vs. Off-line



- DQMF is used for DQ assessment during the online data taking as well as during the off-line reconstruction

On-line DQMF Scalability



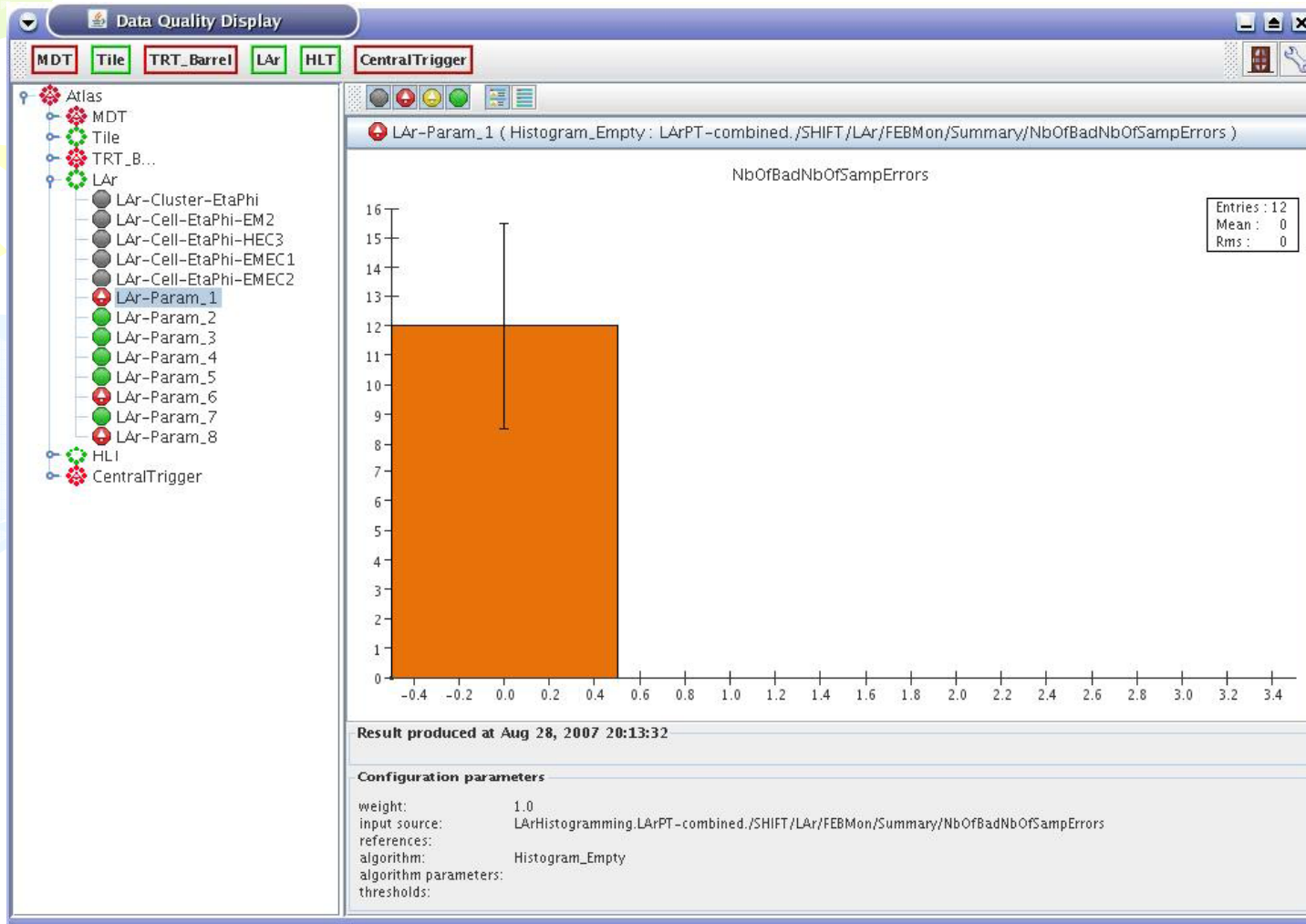
- Online environment implies high performance requirements for the DQ Assessment
- The DQMF functionality is provided by a process called DQMF Agent
 - Any DQRegion can be processed by individual DQMF Agent on a separate node



DQMF at the ATLAS Commissioning

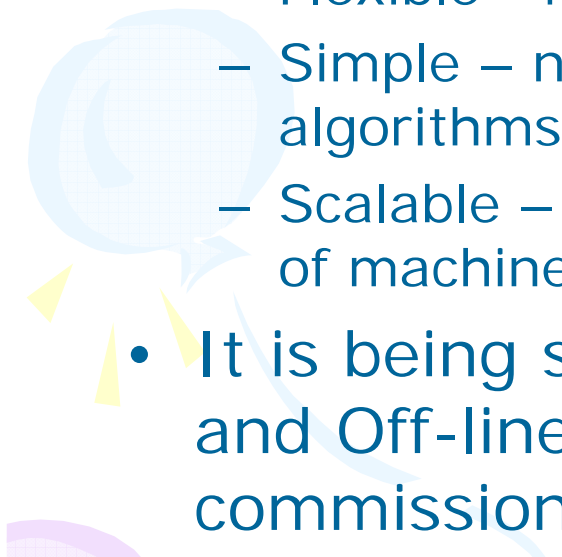

- Online DQMF configuration for the last Commissioning run includes ~2000 histograms:
 - Signals distributions, energy distributions, noise distributions, Trigger rate, etc.
 - This configuration has been handled by a single DQMF agent process
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Online DQMF Display (1/2)





Summary & Conclusion

- DQMF is framework for DQ analysis which is:
 - Efficient – implemented in C++ using ROOT
 - Flexible - fully configurable via simple interface
 - Simple – no code development is necessary if standard algorithms can be used
 - Scalable – can be naturally distributed over any number of machines
 - It is being successfully used now in both On-line and Off-line environments for the ATLAS commissioning
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Backup

September 2007

CHEP 07 Conference

16

Software development process

At this stage the scope of the framework has been extended to the Off-line reconstruction

Design has been influenced by the feedback to the Requirements document

- The standard software development model has been found extremely useful

