The ATLAS RPC Data Quality Offline

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The ATLAS Data Quality Framework

ATLAS is a particle physics experiment at the Large Hadron Collider (LHC) at CERN. The LHC is running since March 2010 with proton beam, with center-of-mass energy of 7 TeV. The detector is composed of more than 140 million electronic channels, distributed in several subdetector each one with a very specific task. Data Quality Monitoring is an important and integral part of the data taking process for HEP experiments. It is performed throughout the data acquisition (DAQ) and the offline processing of data. Assessment of the quality of incoming data is made with continuous monitoring and is archived for retrieval at the physics analysis stage. In the ATLAS experiment a framework for automatic data quality assessments and a visualization tool for easy identification of problems has been developed. A distributed Data Quality Monitoring Framework (DQMF) has been built and is being used to monitor the quality of the data as well as operational conditions of hardware and software elements of the detector, trigger, and data acquisition systems. The Data Quality algorithm (DQA) identifies problems automatically as they occur and produce alarms for the shifter. The framework allows to check and archive the quality of the data as well as to re-assess it at a later stage. A web display for the Offline Monitor has been developed, the display enables quick and efficient resolution identification of problems by displaying the Data Quality status using colored flags[1].

The RPC DAQ Histograms and Algorithms

The RPC offline monitoring[3] provides histograms to the Data Quality procedure which for each run flags the detector status and trigger as "good" or "bad" for data analysis. The RPC Data Quality web display is organized in two separates block `'RPCBA'` and `'RPCBC'`, according to Side A and Side C as the DAQ partitions[5]. Each block contain histograms related to cluster size, efficiency, trigger coverage, detector dtability, noise and timing. These plots, together with the applied Data Quality algorithms, are able to define the overall status of the RPC detector.

The plot of Figure 1 show one of this histogram with his related DQA algorithms; it is a two-dimensional map of trigger hits generated by ATLAS LVL1 low pt trigger coincidence. Each bins represent one RPC trigger tower following the Muon Spectometer[2] geometry, on the x axis there is the RPC Eta station number along an ATLAS geometrical sector ranging from 0 to 7 for Side A and from -1 to -7 for Side C. On the y axis is plotted the geometrical sector number ranging from 1 to 16, but with 32 total bins in order to have separate counts for different sector logic inside the a geometrical sector.
Similar plots are realized with the hits generated by high pt LVL1 trigger coincidence. The choice of a binning which is equal to the segmentation of the trigger towers allow an easy identification of noisy or inefficient towers. The data quality flag is set GREEN if the number of station with trigger hits are above 95% of the total and set RED if below 90% of the total. where a station is counted if there are at least 300 trigger hits. A similar map and algorithm exist for trigger hits generated by high pt coincidence.

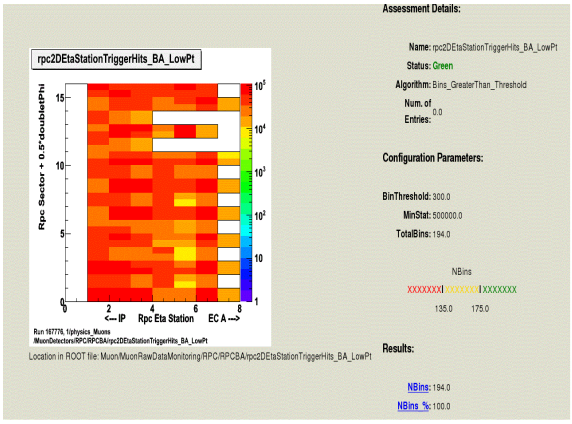

Figure 1. DQMF web display for RPC bidimensional trigger maps with his DQA algorithms.

Results of algorithms applied on each histogram are collected and summed using the *Worst Case Algorithm*. With this techinque the final flags of the RPC partition result equal to the worst result of each histograms, an example is given if Figure 2, were as an effect of a "yellow flag" data quality result on a single histograms all the RPC partition is declared "yellow". Apparently this might seem a very restrictive for the quality certification of detector, but this actually makes it possible to immediately identify any single issue.

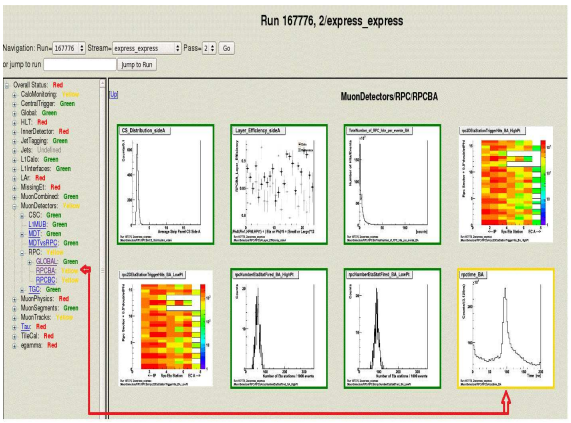

Figure 2. DQMF web display results for RPC partition, the end result ("yellow flag") is due to the presence of a single histogram whose data quality algorithm produced a "yellow flag" result.

In order to produce meaningful Data Quality Assessment for different run conditions (Cosmic runs, Proton-Proton collision runs and Lead-Lead runs), different configurations of web display have been set up each with an appropriate selection of algorithms and histograms. Right web display configuration is automatically selected by the DQMF following the associated run tag defined by the DAQ system, that identifies the type of data container acquired.

Use of the Data Quality Flags

The partition flags coming from the DQMF Offline are stored in a Database (COOL DB), together with the results of Online and the ones generated by the Detector Control System (DCS) and all together are used as the main source of the final detector flags. The definition of the final flags, that identify the state of the detector during data taking, is to demanded to the Offline Muon Shifter who daily review, for each run, the results of the various Data Quality sources and fill a dedicate COOL DB folder. The contents of this COOL folder is finally used for the definition of Good Runs Lists (GRL) i.e. the lists which collect all runs or run fractions which are declared usable for each of the physical analysis. The RPC Offline Data Quality were setup during the ATLAS commissioning phase and worked smoothly during the whole ATLAS 2010 data taking.

REFERENCES

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