The ATLAS RPC Offline Monitoring

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The ATLAS Muon Spectrometer [1] uses Resistive Plate Chambers (RPC) detectors [2] in the barrel region to trigger on muons and to identify the bunch-crossing. The system is made of 1116 RPC units, which span different sizes and configurations covering a total surface of about 4000 m^2.
The RPC detector and its first level trigger electronics are designed to detect and select high momentum muons and provide the bunch crossing identification, measuring the longitudinal (η-view) and the azimuthal coordinates (ϕ-view) with a spatial resolution of 8-10 mm. The RPCs are organized in several modules and their dimensions have been chosen to match those of the corresponding tracking precision chambers (MDT), to whom they are mechanically integrated. The so-called Middle Stations, at a radial distance of about 7 m from the interaction point contain two doublets of RPCs separated by $\sim$ 0.7 m, called Confirm and Pivot doublets, while the so-called Outer Stations contain one doublet only, at 10 m radial distance. From the trigger point of view, the barrel system is segmented in 64 sectors, in the ϕ projection 32 sectors per half-barrel. Each physical chamber in the Pivot plane defines two trigger regions in the $\eta - \phi$ plane, called PADs, belonging logically to two trigger sectors, 396 PADs are installed in the whole ATLAS Barrel Muon Spectrometer. The trigger signal is generated inside the so called Coincidence Matrix (CMA) board, each PAD hosts 8 CMA.

The Monitoring Package

A software package to debug and monitor the RPC detector[3], has been developed within the ATLAS software framework (ATHENA)[4]. The data are read-out by the ATLAS detector (Front-End) and filtered by three levels of online triggers: level 1 (LVL1), level 2 (LVL2) and Event Filter (EF) [5]. The recorded events are stored into different streams depending on the purpose (calibrations, physics or monitoring) and trigger hypothesis (muons, calorimetric clusters, minimum bias, and so on ...) .

The RPC Monitoring offline software is executed in the online environment, sampling events from the Sub-Farm Inputs (SFIs). This allows prompt reconstruction and monitoring of data as it is read out of the detector. The data is then written out to file by the Sub-Farm Outputs (SFOs) and read in by CERN Tier-0 computer farm, where the first pass of full reconstruction and monitoring is performed.
The code was developed using C++ objet oriented framework and it is configurable via Python script. Inside the Monitoring offline package, four algorithms have been developed, each focusing on specific monitoring task. The first three focus the monitoring on the RPC the response as trigger detector, the last one monitor RPC performance with RPC standalone tracks.

The four algorithms are higly configurable and driven by python files named *joboptions*. In these joboptions, the algorithms are called and added to the Athena top sequence with several parameters (properties) that can be easily changed, if it is necessary, without changing (and re-compile) the C++ algorithm code. However, in the C++ code the default value of each parameter can be over-written by the value in the joboptions file, if it exists. Furthermore, the algorithms are meant to be modular (some analysis can be switched on/off by setting appropriate flags) and scalable (we can reduce the granularity of histograms to reduce memory consuming).

Several plots, are not activated at Tier-0, due to the large computing memory consumption, nevertheless, they can be produced by expert if the overview plots spot particular problems. This allows to save mantainace, development and debugging time. In order to reduce the number of histograms during the commissioning phase, where the RPC coverage was limited to a part of the apparatus, and during normal runs, when single data file have no more than several thousands of events, the booking is done only when the very first hit belonging to that plots appear in the event (*automatic plot booking*). To understand at glance the RPC coverage and simplify the data quality automatic checks, most of these histograms are booked exactly with the correct range (*automatic axis range*). A hole in these histograms corresponds to a hole in the detector coverage.

The Monitoring Output

The RPC monitoing histograms are grouped in different sub-folders according application purposes (*Expert Plots, Shifter Plots, Data Quality Plots etc ..*), detector granularity (*Overview Plots, Sector Plots, Chambers Plots, etc.. *) and Monitoring subject (*RPC Detector Monitoring ReadOut, LVL1 Monitoring ReadOut, RPCvs-MDT Correlations and RPC performance with StandAlone Tracks*).
Example of these plots are shown in Figs 1, 2 and Fig 3.

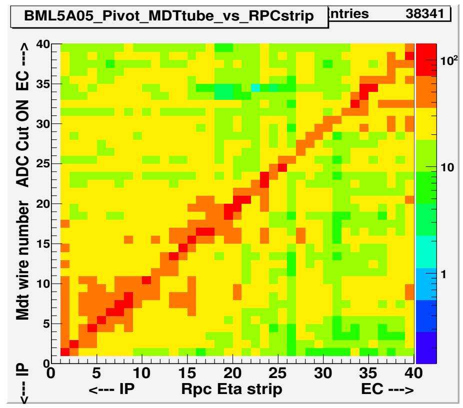

Figure 2. MDT tube vs RPC eta strip for one RPC readout panel inside a station.

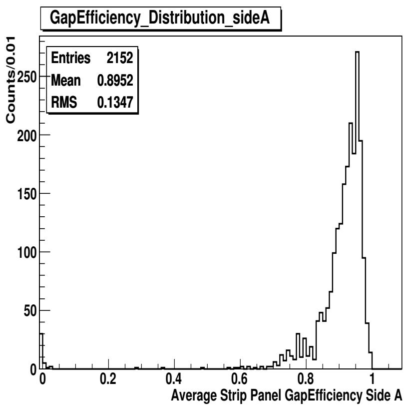

Figure 1. Distribution of the RPC gas volume efficiency for one of Muon Spectrometer Sides.

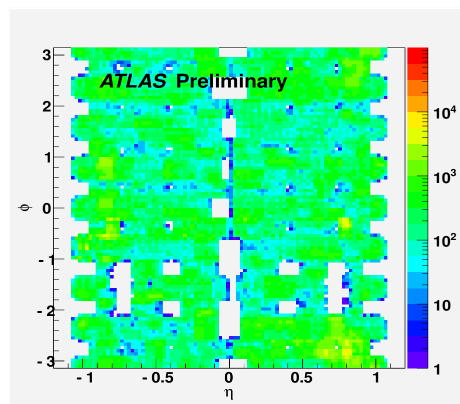

Figure 3. RPC readout η a and ϕ view coincidence of RPC trigger hits. The data are from run 167776 and physics_Muons stream.

Calibration Constant from Monitoring Results

Inside the Monitoring framework a tool able to extract characterizing quantity such as Efficiency, Cluster Size, Noise, Dead Strips, for each single readout panel has been inserted. The output of this tool is a portable SQLite Data Base, which has the same structure (for the RPC) of the more ATLAS general DataBase called Cool DB. The SQLite DB can be copied to CoolDB by the detector expert, the content of which is directly usable by the official analysis code ATHENA. The RPC calibration costant extracted from the data collected in 2010 runs were already inserted in the CoolDB and used for the 2010 Montecarlo production.

REFERENCES

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