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Conference Report

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Offline Data Quality Monitoring for the RPC of the CMS Detector

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Abstract

Data Quality Monitoring is an important activity that guarantees the proper operation of the detectors in high energy experiments. Besides of the online environment for data quality monitoring there is an offline environment which main goal is the reconstruction and validation of the calibration results, software releases and simulated data. The offline monitoring system of the Resistive Plate Chambers at the Muon Detector of the CMS consists on the data analysis of each run in order to verify that all the subsystems are working correctly, at an efficiency greater than 95pct. This work presents the latest upgrade done to the offline monitoring software based on the restyling of the efficiency code for the 2016 data taking that is about to start. This update allows to do the general analysis in less time in a more complete way and makes the code more flexible to do specific analysis.

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Offline Data Quality Monitoring for the RPC of the CMS Detector

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Abstract. Data Quality Monitoring (DQM) is an important activity that guarantees the proper operation of the detectors in high energy experiments. Besides of the online environment for data quality monitoring there is an offline environment which main goal is the reconstruction and validation of the calibration results, software releases and simulated data. The offline monitoring system of the Resistive Plate Chambers at the Muon Detector of the CMS consists on the data analysis of each run in order to verify that all the subsystems are working correctly, at an efficiency greater than 95%. This work presents the latest upgrade done to the offline monitoring software based on the restyling of the efficiency code for the 2016 data taking that is about to start. This update allows to do the general analysis in less time in a more complete way and makes the code more flexible to do specific analysis.

1. Introduction

The primary goal of the CMS Data Quality Monitoring (DQM) system is to guarantee high quality physics data. Its functions are monitoring the detector and trigger performance, debugging hardware and certifying recorded data[1]. For this system there is an *online environment* and an *offline environment*.

The **offline environment** accumulates monitoring data from several workflows [2], [3]

- Tier-0 prompt reconstruction,
- Tier-1s re-reconstruction,
- Validation of the alignment and calibration results, the software releases and all the simulated data.

Offline monitoring is unique and formally divided in two steps:

- (i) **Data analysis.** It analyzes the RAW (RPC Monitor) or RECO or FEVT (Express) data. It produces a ROOT file with the result of the analysis.
- (ii) **Efficiency calculation.** Histograms and monitoring information are extracted and merged to yield full statistics. Efficiencies are calculated, summary plots are produced and quality tests are performed.

There are several parameters that the Resistive Plate Chamber (RPC) DQM group monitors, including occupancy, multiplicity, cluster size, synchronization, noise and detection efficiency[1].

2. RPC Efficiency: Code Restyling

The latest modifications to the efficiency offline monitoring code were mainly done to improve the summary of the efficiency as a last step in the generation of the plots. The old code produced output files in different formats (ROOT, TXT, folders with PNG, etc). The functionality of the code is preserved. The first step of the analysis is unmodified and the second one has been upgraded. Currently, the code preserves its functionality but now it is shorter and updated with one new module and with some additional macros. The output files are only in ROOT format allowing to the user an easy browsing through the plots and the information needed. The efficiency calculation is done in less time.

3. Results

In this conference was presented part of the results of the analyzed runs up to May 4th, 2016. The first stable collision runs analyzed with $B = 0$ T and a duration greater than 30 minutes were 271336, 271646, and the Cosmic Runs Analyzed At Full Tesla (CRAFT) with a duration greater than 40 minutes were 272133, 272134, 272137, 272138, 272139, 272143, 272148. The following efficiency maps show the performance of each subdetector allowing to monitor the operation of chambers (endcap) or *sectors* (barrel) [4] during the taking of collision data and cosmic data.

3.1. Collision runs

In this case, it is observed that the most majority of the subsystems are above 95% of efficiency.

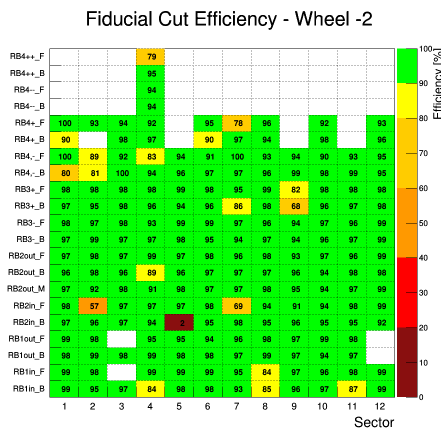


Figure 1. Efficiency map for the wheel -2 of the barrel.

3.2. Cosmic runs

The ideal performance of each subdetector must be above 95%. However, it can be seen that for the barrel there is an important quantity of chambers that are not working at the required efficiency, but this results are extrapolated of the data. These results are a consequence of the way the cosmic rays go across the detector, and therefore, they do not cross the endcap completely.

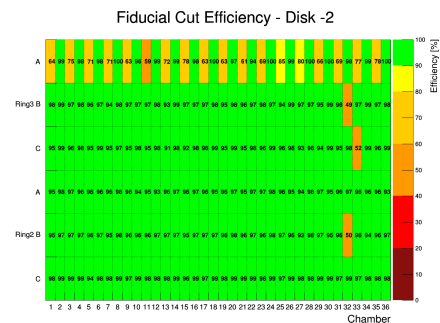


Figure 2. Efficiency map for the disk -2 of the endcap.

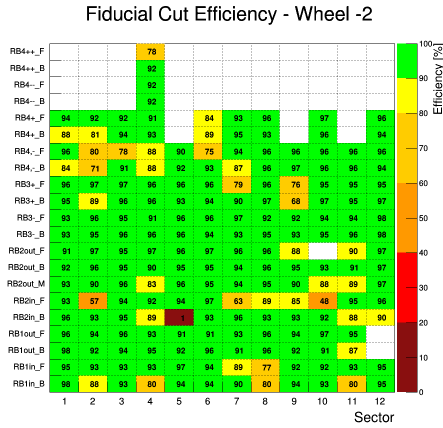


Figure 3. Efficiency map for the wheel -2 of the barrel.

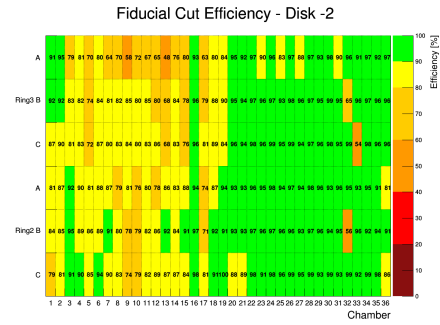


Figure 4. Efficiency map for the disk -2 of the endcap.

4. Conclusion

The most recent implementatio to the RPC offline analysis code has been focused on the efficiency plots, making the management of all the information easier and stored in an unique format ROOT file. After this upgrade, the second step of the offline analysis takes only few minutes to be completed, saving time and concentrating the monitoring information in a more complete way.

References

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- [2] Cimmino A, Paolucci P and Lomidze D (CMS) 2010
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- [4] 2014 URL <https://cds.cern.ch/record/1667879>