Offline Data Quality Monitoring for the RPC of the CMS Detector

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Outline

Data Quality Monitoring at CMS

- The primary goal of the CMS Data Quality Monitoring (DQM) system is to guarantee high quality physics data.
- Its functions are:
  - Monitor the detector and trigger performance
  - Monitor hardware status
  - Certify recorded data
- There is an online environment and an offline environment.

RPC DQM System: Offline environment

- Step 1: Data analysis: It analizes the RAW (RPC Monitor) or RECO or FEVT (Express) data. It produces a ROOT file with the results of the analysis.
- Step 2: Efficiency calculation: Efficiency is calculated for each roll. At this step other monitoring plots are generated. Summary plots of wheel/barrel and disk/endcap efficiencies; 2D efficiency histograms (roll vs sector) for barrel and endcap, etc.

RPC DQM System: Monitored Parameters

There are several parameters that the Resistive Plate Chamber (RPC) DQM group monitors, including:

- Occupancy
- Multiplicity
- Cluster size
- Synchronization
- Noise
- Detection efficiency

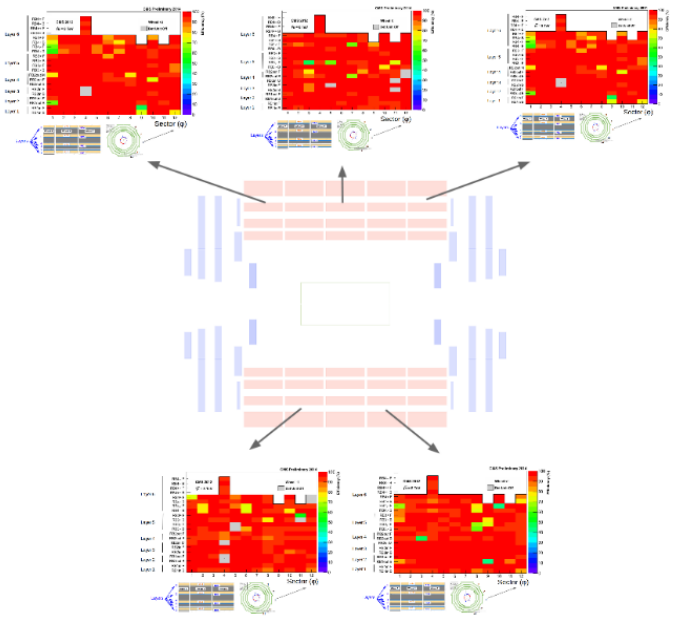
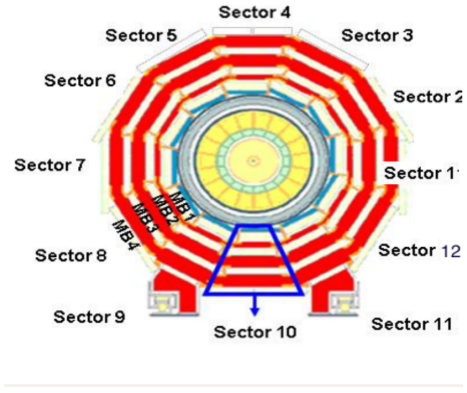
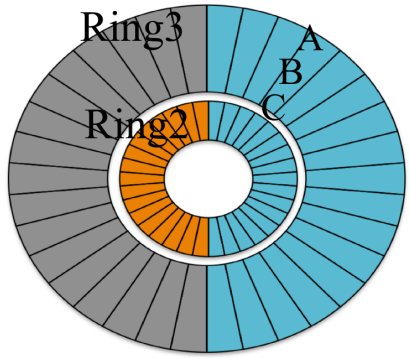


Figure : Efficiency maps: Barrel





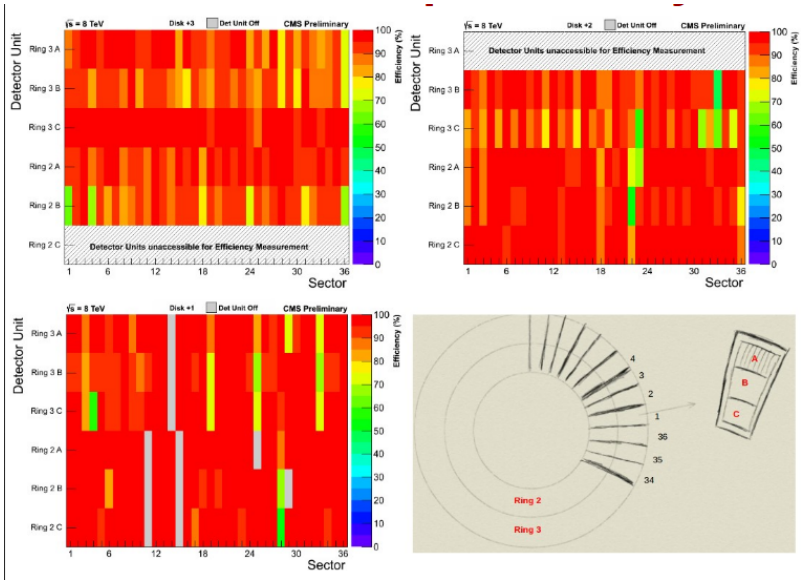


Figure : Efficiency maps: Endcap

Recent implementations to the Efficiency Code

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 functionality of the code is preserved.
- The old code produced output files in different formats (ROOT, TXT, folders with PNG, etc).
- The first step of the analysis is unmodified and the second one was upgraded.
- The code is shorter but updated with one new module and with some additional macros. The output files are only in ROOT format. The efficiency calculation is done in less time.

Example of analyzed runs

The analyzed runs (up to May 4, 2016):

- First stable collision runs (B = 0 T): Duration > 30 min,
  - **ExpressPhysics**: 271195, 271196, 271214.
  - **RPCMonitor**: **271336**, **271646**.
- First stable collisions (B = 3.8 T): 272011, 272012, 272022.
- Cosmic runs at full tesla (CRAFT): Duration > 40 min: **272133**, **272134**, **272137**, **272138**, **272139**, **272143**, **272148**, 272150.

RPCMonitor 271336 and 271646

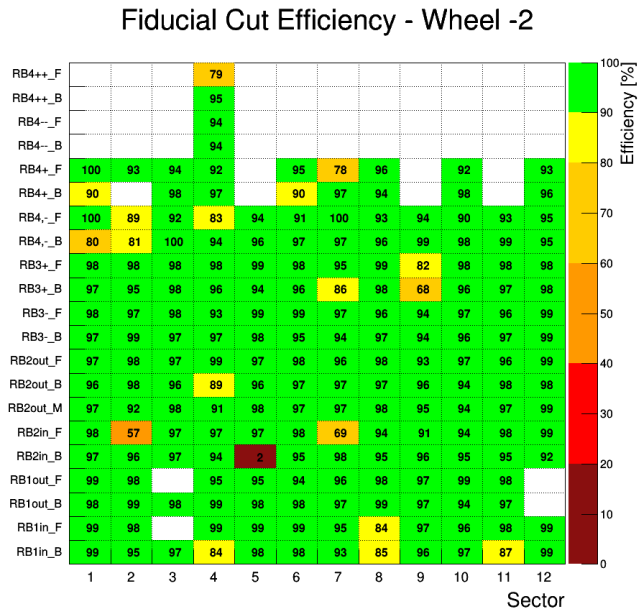


Figure : Barrel

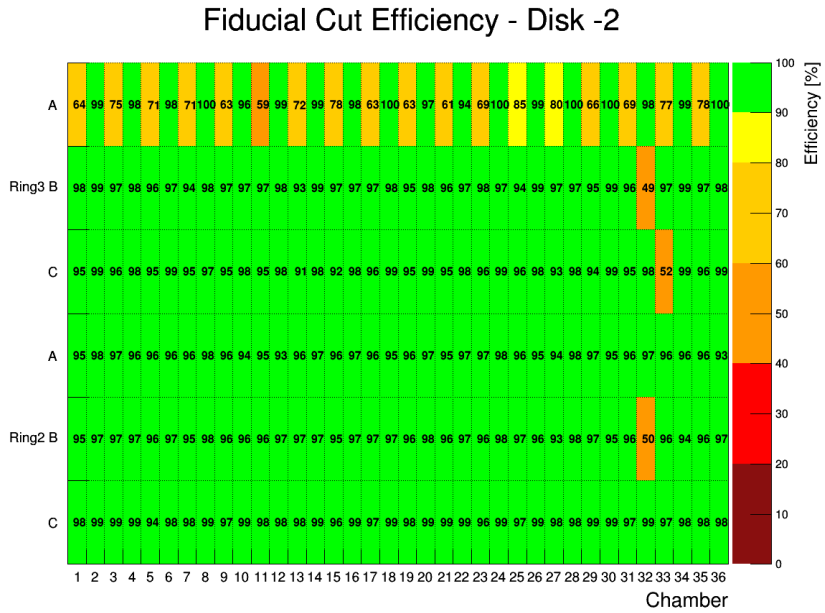


Figure : Endcap

CRAFT 272133 to 272148

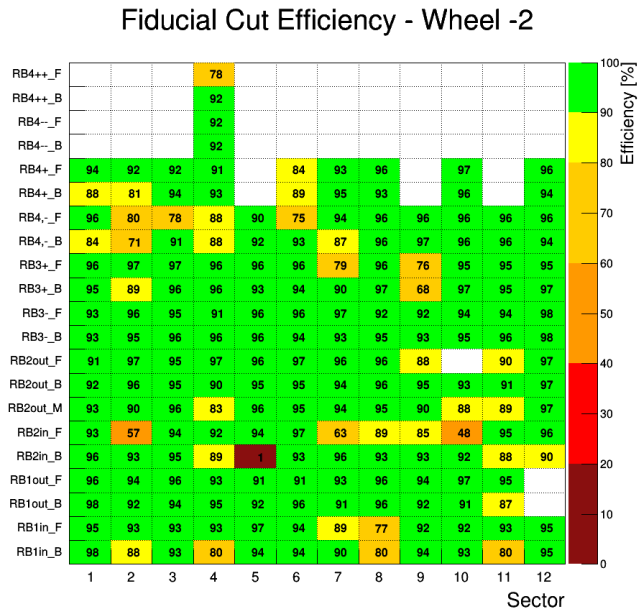


Figure : Barrel

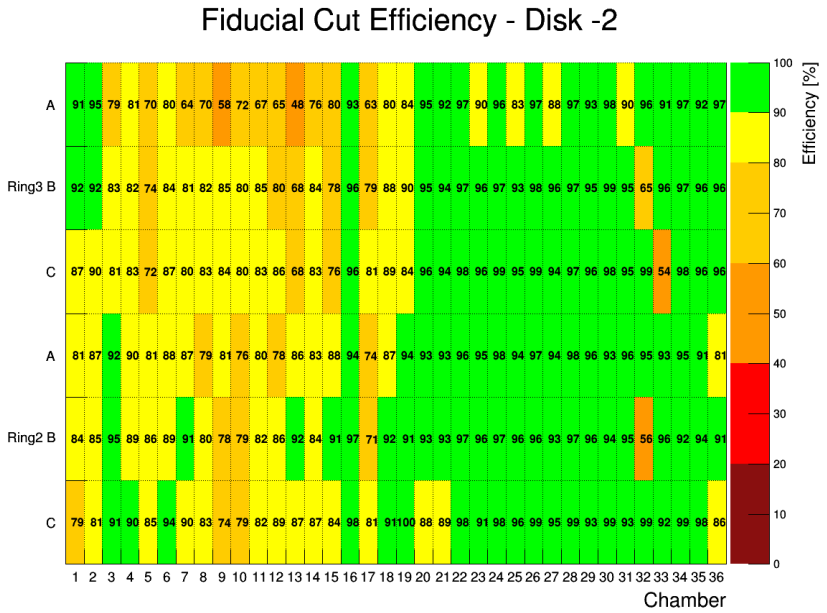


Figure : Endcap

Summary

- The most recent implementation to the RPC offline analysis code has been focused on the Efficiency plots.
- It is much easier to manage all the information stored in ROOT files.
- The second step takes few minutes to be completed and the third one takes almost one minute, saving time.

References I


A. Cimmino, "Data quality monitoring and performance studies of the resistive plate chamber detector at the CMS experiment at LHC"


CMS Collaboration, "Resistive Plate Chambers commissioning and performance results for 2011-2013," CMS-DP-2014-003, 2014. http://cds.cern.ch/record/1667879.


A. Cimmino *et al.* [CMS Collaboration], "Data Quality Monitoring for the CMS Resistive Plate Chamber Detector," CMS-NOTE-2010-013, CERN-CMS-NOTE-2010-013.

References II


S. Chatrchyan *et al.* [CMS Collaboration], "Performance Study of the CMS Barrel Resistive Plate Chambers with Cosmic Rays," JINST **5**, T03017 (2010) doi:10.1088/1748-0221/5/03/T03017 [arXiv:0911.4045 [physics.ins-det]].