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Automating the CMS ECAL calibration workflows for optimal performance in LHC Run 3

Many physics analyses using the CMS detector at the LHC require accurate, high resolution electron and photon energy measurements. The CMS electromagnetic calorimeter (ECAL) is a fundamental component of these analyses. The excellent resolution of ECAL was of central importance to the discovery of the Higgs boson in 2012, and is being used for increasingly precise measurements of Higgs boson properties, as well as Standard Model measurements, and searches for new physics that contain electromagnetic particles and jets in the final state.

Maintaining the optimal ECAL performance during LHC operation relies on the precise calibration of its energy and timing response. This is achieved via dedicated calibration workflows, using physics events, and a dedicated laser monitoring system. With the increased luminosity delivered during LHC Run 3 (2022+), detector aging effects have increased, requiring more frequent calibrations. To reduce the time needed for this task, a new system has been developed to automatically execute the calibration workflows. This new development is intended both to improve the quality of the reconstructed data (by facilitating more frequent updates) and to reduce the time and workload needed to provide the optimal calibrations for physics analyses, the latter of which were previously obtained at the end of each data-taking year.

The new system is based on industry standard tools (Openshift, Jenkins, Influxdb, and Grafana) for workflow automation and monitoring. The system architecture was previously presented during ACAT 2022. In this presentation we focus on recent developments and improvements, and the operational experience gained with this system during Run 3. Particular focus will be given to the improved performance obtained during the 2024 run, where the automated system was expanded to encompass the full range of energy calibration, signal pulse template, timing and detector alignment workflows.

Significance

References

https://cms.cern.ch/iCMS/jsp/db_notes/showNoteDetails.jsp?noteID=CMS%20CR-2023/021

Experiment context, if any

CMS experiment

Author: CMS COLLABORATION

Presenter: CMS COLLABORATION

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