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Achieving the optimal calibration and performance of the CMS Electromagnetic Calorimeter in LHC Runs 2 and 3

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Many physics analyses using the Compact Muon Solenoid (CMS) detector at the LHC require accurate, high resolution electron and photon energy measurements. Excellent energy resolution is crucial for studies of Higgs boson decays with electromagnetic particles in the final state, as well as searches for very high mass resonances decaying to energetic photons or electrons. The CMS electromagnetic calorimeter (ECAL) is a fundamental component of these analyses, and its energy resolution is crucial for the Higgs boson mass measurement. It also provides a measurement of the electromagnetic component of jets, and contributes to the measurement of calorimeter energy sums, both of which are important for a wide range of CMS physics analyses.

The energy and timing response of the ECAL has been precisely calibrated exploiting the full Run 2 (2015-18) dataset, and has been used for the legacy reprocessing of these data. A dedicated calibration of each detector channel has been performed. This talk will summarize the calibration techniques, the improved ECAL performance that has been achieved, and will describe how this impacts on the sensitivity of the Higgs mass measurement in the H->ZZ->4l and H->gg channels.

The calibration plans that are being developed to maintain the optimum ECAL performance during LHC Run 3 (2022-25) will also be discussed, and results from the first year of operation in 2022 will be shown. A new system has been developed to automatically execute the calibration workflows during data taking in Run 3. This new development aims to reduce the time needed to provide the best possible performance for physics analyses by one order of magnitude, and the status, plans, and operational experience with this system will be described.

Primary author: GOERLACH, Ulrich (IPHC-CNRS Strasbourg)

Presenter: Dr DIMOVA , Tatyana (CERN / Budker Institute)

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