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ECAL trigger performance in Run 2 and improvements for Run 3

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The CMS Electromagnetic Calorimeter (ECAL) is a high resolution crystal calorimeter operating at the CERN LHC. It is responsible for the identification and precise reconstruction of electrons and photons in CMS, which were crucial in the discovery and subsequent characterization of the Higgs boson. It also contributes to the reconstruction of tau leptons, jets, and calorimeter energy sums, which are are vital components of many CMS Physics analyses.

The ECAL trigger system employs fast digital signal processing algorithms to precisely measure the energy and timing information of ECAL energy deposits recorded during LHC collisions. These trigger primitives are transmitted to the Level-1 trigger system at the LHC collision rate of 40 MHz. These energy deposits are then combined with information from other CMS sub-detectors to determine whether the event should trigger the readout of the data from CMS to permanent storage.

This presentation will summarize the ECAL trigger performance achieved during LHC Run 2 (2015-2018). It will describe the methods that are used to provide frequent calibrations of the ECAL trigger primitives during LHC operation. These are needed to account for radiation-induced changes in crystal and photodetector response and to maintain stable trigger rates and efficiencies up to |eta|=3.0. They also minimize the spurious triggering on direct signals in the photodetectors used in the barrel region (|eta|<1.48). Both of these effects have increased relative to LHC Run 1 (2009-2012), due to the higher luminosities experienced in Run 2.

Further improvements in the energy and time reconstruction of the CMS ECAL trigger primitives are being explored for LHC Run 3 (2021-23), using additional features implemented in the on-detector readout. These are particularly focused on improving the performance at the highest instantaneous luminosities (which will reach or exceed 2x10ˆ34 cm-2 s-1 in Run 3) and in the most forward regions of the calorimeter (|eta|>2.5), where the effects of detector aging will be the greatest. The main features of these improved algorithms will be described and preliminary estimates of the expected performance gains will be presented

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