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Performance of the CMS precision electromagnetic calorimeter at the LHC Run II and prospects for high-luminosity LHC

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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. Particularly important are decays of the Higgs boson resulting in electromagnetic particles in the final state, as well as searches for very high mass resonances decaying to energetic photons or electrons. Following the excellent performance achieved during LHC Run I at center of mass energies of 7 and 8 TeV, the CMS electromagnetic calorimeter (ECAL) is operating at the LHC with proton-proton collisions at 13 TeV center-of-mass energy. The instantaneous luminosity delivered by the LHC during Run II has achieved unprecedented levels. The average number of concurrent proton-proton collisions per bunch-crossing (pileup) has reached up to 40 interactions in 2016 and may increase further in 2017. These high pileup levels necessitate a retuning of the ECAL readout and trigger thresholds and reconstruction algorithms, to maintain the best possible performance in these more challenging conditions. The energy response of the detector must be precisely calibrated and monitored to achieve and maintain the excellent performance obtained in Run I in terms of energy scale and resolution. A dedicated calibration of each detector readout channel is performed with physics events exploiting electrons from W and Z boson decays, photons from pi0/eta decays and the azimuthally symmetric energy distribution of minimum bias events. This talk describes the new reconstruction algorithms and calibration strategies that were implemented to maintain the excellent performance of the CMS ECAL throughout Run II. We will show performance results from the 2015-2016 data taking periods and provide an outlook on the expected Run II performance in the years to come. Finally, we review the design and R&D studies for the CMS ECAL crystal calorimeter upgrade for the HL-LHC era, which will include new readout and trigger electronics, and we also present first test beam studies.

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