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# Simulation of the CMS electromagnetic calorimeter response at the energy and intensity frontier

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The harsh radiation environment in which detectors will have to operate during the High Luminosity phase of The electromagnetic calorimeter (ECAL) of the CMS experiment at the LHC is a homogeneous calorimeter made of 75848 lead tungstate (PbWO_4) scintillating crystals, designed for high precision electron and photon energy measurements in hadron collisions at the TeV scale. The detailed simulation of the calorimeter response is crucial for physics analyses involving electrons, photons, jets or missing energy. The detector simulation has been tuned during the first LHC run, including a detailed description of the upstream material. The increase of centre of mass energy, bunch crossing rate and instantaneous luminosity in the second run has resulted in updated and improved data readout settings and reconstruction techniques. Furthermore ageing effects due to radiation, in particular noise increases in the photodetectors and crystal transparency losses, have caused a change of the calorimeter response. All of these effects have been taken into account in order to improve the simulation of the calorimeter response and to ensure that it describes the data well over time, notwithstanding the evolving conditions. In 2024 the ECAL will undergo an upgrade to cope with the high luminosity phase of the LHC (HL-LHC). The temperature of the calorimeter will be lowered to mitigate the ageing effects, the front-end electronics will be replaced with a faster version and the data will be read out in streaming mode towards the off-detector electronics. The fast PbWO 4 response time will be exploited to measure the timing of high-energy showers with high precision. A detailed simulation description of the crystal response is fundamental for the design of the detector electronics and to predict the performance for the energy and timing measurements. The techniques employed in tuning the simulation of the detector response for the present running conditions and for the upgrade will be presented.

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