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Upgrade of the CMS electromagnetic calorimeter barrel readout electronics for the High-Luminosity LHC

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The CMS electromagnetic calorimeter (ECAL) is a homogeneous calorimeter made of about 75000 lead tungstate scintillating crystals. In view of the high-luminosity phase of the LHC, the ECAL readout electronics must be upgraded to cope with the more stringent requirements in terms of trigger latency and rate, as well as the harsh radiation environment and the extreme level of pile-up events, with up to 200 simultaneous proton-proton collisions. The new electronics will transmit the data in streaming mode from the front-end electronics to the off-detector electronics, where the trigger primitives will be formed in powerful FPGAs. The front-end electronics will feature two new radiation-hard chips: a dual gain trans-impedance amplifier (TIA) and a sampling ADC with lossless data compression. The TIA choice allows the preservation of the fast pulse shape of the lead tungstate coupled to avalanche photodiodes (APD), and it is more resistant to the noise increase due to the radiation-induced APD leakage current. An important characteristic of the new design will be the capability to provide precision timing measurements, of the order of 30 ps, for photons and electrons above 50 GeV. The excellent time resolution will improve the overall CMS physics performance by mitigating the high pile-up effects. First characterization results of the TIA chip will be shown, and studies of energy and timing resolution performed in beam tests with the electronic prototypes will be presented.

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