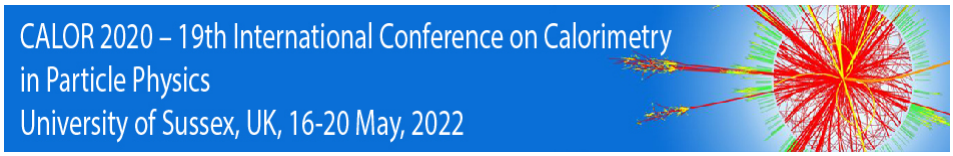

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Upgrade of the CMS Barrel Electromagnetic Calorimeter for LHC Phase 2

The High Luminosity upgrade of the LHC (HL-LHC) at CERN will provide unprecedented instantaneous and integrated luminosities of around 5 x 10^34 /cm2 /s and 3000/fb, respectively, from 2027 onwards. During this period, an average of 140 to 200 collisions per bunch-crossing (pileup) is expected, posing a challenge to the capability of the Compact Muon Solenoid (CMS) detector to maintain. In order to cope with the extreme pileup conditions, harsh environment, and increased data rates, CMS is undergoing a significant Phase II upgrade program.

In the barrel region of the CMS electromagnetic calorimeter (ECAL), the lead tungstate crystals and avalanche photodiodes (APDs) will keep performing well and will therefore be maintained, while the entire readout and trigger electronics will be replaced. A dual gain trans-impedance amplifier and an ASIC providing two 160 MHz ADC channels, gain selection, and data compression will be installed. The noise increase in the APDs, due to radiation-induced dark current, will be contained by reducing the ECAL operating temperature from 18 deg C to around 9 deg C.

We review the design and R&D studies for the CMS ECAL barrel crystal calorimeter upgrade and present the results of test beam studies performed in the CERN SPS H4 beam line. We present test beam results of the new readout and trigger electronics, which must be upgraded due to the increased trigger and latency requirements at the HL-LHC. In addition, particle detectors with a timing resolution of around 30 ps can significantly improve event reconstruction at high luminosity hadron colliders. The CMS ECAL barrel upgrade will achieve a timing resolution of around 30 ps for high energy photons and electrons. The benefits of precision timing for the ECAL event reconstruction at HL-LHC will be discussed in this presentation. Simulation and test beam studies carried out for the timing upgrade of the CMS ECAL barrel will also be presented, and the prospects for a full implementation of this option will be discussed.

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