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The CMS Level-1 Trigger for LHC Run II (12' + 3')

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The Compact Muon Solenoid (CMS) experiment has implemented a sophisticated two-level online selection system that achieves a rejection factor of nearly 10e5. During Run II, the LHC will increase its centre-of-mass energy up to 13 TeV and progressively reach an instantaneous luminosity of 2e34cm-2s-1. In order to guarantee a successful and ambitious physics programme under this intense environment, the CMS Trigger and Data acquisition (DAQ) system has been upgraded. The upgraded CMS L1 trigger is designed to improve the performance at high luminosity and large number of simultaneous inelastic collisions per crossing (pile-up). During the technical stop at the beginning of 2016, all the electronic boards of the CMS L1 trigger have been replaced, tested, and commissioned with data. The L1 calorimeter trigger hardware and architecture have been redesigned to maintain the current thresholds for electrons and photons in these more challenging conditions. This design benefits from recent microTCA technology, allowing sophisticated algorithms to be deployed, better exploiting the calorimeter granularity and opening the possibility of making correlations between different parts of the detector. The new Level-1 Calorimeter Trigger uses a novel Time Multiplexed Trigger which allows the L1 trigger a global view of the entire event with higher granularity. Smarter, more complex, and innovative algorithms are now the core of the first decision layer of CMS: the upgraded trigger system implements pattern recognition and MVA (Boosted Decision Tree) regression techniques in the trigger boards for p_T assignment, pile up subtraction, and isolation requirements for muons, electrons, and taus. In addition, the new global trigger is capable of evaluating complex selection algorithms such as those involving the invariant mass of trigger primitives. All the above is drastically reducing the trigger rate and improving the trigger efficiency for a wide variety of physics signals. In this presentation the upgraded CMS L1 trigger design and its performance are described. The impact of the improved selection criteria on benchmark physics channels such as Higgs and Supersymmetry will be presented as well in this talk.

Presenter: TAPPER, Alex (Imperial College Sci., Tech. & Med. (GB))

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