

## The CMS Level-1 Calorimeter Trigger Upgrade for LHC Run II

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An upgrade of the CMS Level-1 calorimeter trigger has been completed, fully commissioned and was used by CMS to collect data starting with the 2016 run. The new trigger has been designed to improve performance at high luminosity and large number of simultaneous inelastic collisions per crossing (pile-up). For this purpose it uses a novel design, the Time Multiplexed (TM) design, which enables all the data from an event to be processed by a single trigger processor at full granularity over several bunch crossings. The TM design is a modular design based on the uTCA standard. The trigger processors are instrumented with Xilinx Virtex-7 690 FPGAs and 10 Gbps optical links. The TM architecture is flexible and the number of trigger processors can be expanded according to the physics needs of CMS. Intelligent, sophisticated 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 processors for momentum assignment, pile up subtraction, and isolation requirements for electrons, and tau leptons. The resolution of the jet pseudo-rapidity and azimuthal angle have dramatically improved, allowing the implementation of di-jet mass triggers. The performance of the TM design and latency measurements are presented, alongside algorithm performance measured using the 2016 data and a summary of the running experience from 2016.

**Primary author:** THEA, Alessandro (R)

**Presenter:** THEA, Alessandro (R)

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