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40 MHz Level-1 Trigger Scouting for CMS

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The CMS experiment will be upgraded for operation at the High-Luminosity LHC to maintain and extend its optimal physics performance under extreme pileup conditions. Upgrades will include an entirely new tracking system, supplemented by a track trigger processor capable of providing tracks at Level-1, as well as a high-granularity calorimeter in the endcap region. New front-end and back-end electronics will also provide the level-1 trigger with high-resolution information from the barrel calorimeter and the muon systems. The upgraded Level-1 processors, based on powerful FPGAs, will be able to carry out sophisticated feature searches with resolutions often similar to the offline ones, while keeping pileup effects under control. In this paper, we discuss the feasibility of a system capturing Level-1 intermediate data at the beam-crossing rate of 40 MHz and carrying out online analyses based on these limited-resolution data. This 40 MHz scouting system would provide fast and virtually unlimited statistics for detector diagnostics, alternative luminosity measurements and, in some cases, calibrations, and it has the potential to enable the study of otherwise inaccessible signatures, either too common to fit in the L1 accept budget, or with requirements which are orthogonal to “mainstream” physics, such as long-lived particles. We discuss the requirements and possible architecture of a Phase-2 40 MHz scouting system, as well as some of the physics potential, and results from a demonstrator operated at the end of Run-2 using the Global Muon Trigger data from CMS. Plans for further demonstrators envisaged for Run 3 are also discussed.

Consider for promotion

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