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Standalone framework for the emulation of HGCAL firmware trigger primitives in the CMS online trigger system

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The fast-approaching High Luminosity LHC phase introduces significant challenges and opportunities for CMS. One of its major detector upgrades, the High Granularity Calorimeter (HGCAL), brings fine segmentation to the endcap regions. It requires a fast online trigger system (12.5 us latency) to extract interesting information from the ~100Tb of data produced every second by its custom read-out chips. A fraction of that time is devoted to the generation of trigger primitives (TPs) in the firmware. TPs represent the building blocks of the physical quantities used to decide whether an event is worth further inspection.

The emulation of the reconstruction of TPs, so far available through the official CMS software in C++, has been ported to a standalone Python framework, and has been fully validated. The emulation can now be run locally, which is ideally suited for fast testing, parameter optimization and exploration and development of new algorithms. In parallel, we have implemented a simplified version of the full geometry of HGCAL, used to debug the official C++ geometry and to create event displays to validate, inspect and illustrate the reconstruction. The framework is being currently used by a small team, and is expected to become the basis of the remaining optimisation studies on TPs' reconstruction.

In this talk we cover the framework's structure, conceived to be modular and fast, targeting datasets with high pile-up. We will briefly cover some reconstruction algorithms available in the emulator, as well as the two- and three-dimensional interactive event displays being used. We conclude by discussing different ways to share interactive visualizations, including the deployment of a simple web application using CERN's Platform-as-a-Service.

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