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Novel reconstruction algorithms for an imaging calorimeter for HL-LHC

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To face the increase of radiation levels and to maintain the high physics performance during the HL-LHC, an upgrade of the Compact Muon Solenoid (CMS) experiment will replace the existing forward calorimeters with a new high granularity sampling calorimeter (HGCAL). The current design of HGCAL uses silicon sensors as active material in the highest radiation regions and plastic scintillator tiles in the regions of lower dose/fluence. Particle shower reconstruction in high-granularity calorimeters in high-density environments, such as HL-LHC, is a very interesting challenge. A typical event at the HL-LHC consists of about 140-200 superimposed collisions where many showers tend to overlap. Due to the extreme combinatorial complexity, conventional algorithms are expected to fail the requirements on memory and CPU time consumption. A novel reconstruction approach is being developed to fully exploit the granularity and other significant features of the detector, such as precision timing. The main purpose of the new iterative reconstruction framework called TICL (The Iterative CLustering) is to process hits that are built in the detector and return particle properties and probabilities. The framework is fully modular, allowing the user to test and validate different components and it is designed such that new algorithms or techniques (e.g. Machine Learning) can be plugged on top easily. In view of the expected pressure on the computing capacity in the HL-LHC era, the algorithms and their data structured are also being designed with heterogeneous computing and parallelisation in mind. Preliminary results show that significant speed-up can be obtained running the clustering algorithm on GPUs. This talk will describe the approaches being considered and show the latest developments and results.

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