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k4Clue: Empowering Future Collider Experiments with CLUE

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CLUE is a fast and innovative density-based clustering algorithm to group digitized energy deposits (hits) left by a particle traversing the active sensors of a high-granularity calorimeter in clusters with a well-defined seed hit. It was developed in the context of the new high granularity sampling calorimeter (HGCAL) which will be installed in the forward region of the Compact Muon Solenoid (CMS) experiment as part of its HL-LHC upgrade. Its outstanding performance in terms of high efficiency and excellent computing timing has been proven in the context of the CMS Phase-2 upgrade using both simulated and test beam data.

Initially, CLUE was developed in a standalone repository to allow performance benchmarking with respect to its CPU and GPU implementations, demonstrating the power of algorithmic parallelization in the coming era of heterogeneous computing. In recent years, CLUE's capabilities outside CMS and, more specifically, at experiments at future colliders, were tested by adapting it to run in the Turnkey Software Stack (key4hep) framework. The new package, k4Clue, is now fully integrated into the Gaudi software framework and it now supports EDM4hep data format for inputs and outputs.

This contribution will start from CLUE's state-of-the-art in the CMS software reconstruction context, to then move to describe the enhancements needed for the algorithm to run on several detector geometries and for both the barrel and the forward region of the detector. The preliminary performance will also be presented for several types of high-granularity calorimeters proposed at linear and circular e^+e^- colliders.

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