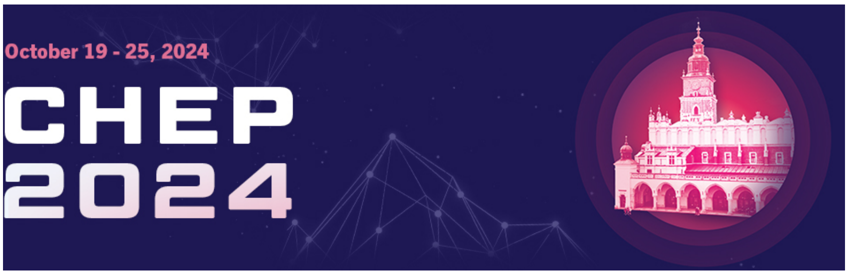

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The CMS Phase-2 High Granularity Calorimeter Endcap Event Reconstruction with the TICL Framework

Tuesday 22 October 2024 13:30 (18 minutes)

The imminent high-luminosity era of the LHC will pose unprecedented challenges to the CMS detector. To meet these challenges, the CMS detector will undergo several upgrades, including replacing the current endcap calorimeters with a novel High-Granularity Calorimeter (HGCAL). A dedicated reconstruction framework, The Iterative Clustering (TICL), is being developed within the CMS Software (CMSSW). This new framework is designed to fully exploit the high spatial resolution and precise timing information provided by HGCAL, as well as the information from other subdetectors (e.g., Tracker and Mip-Timing-Detector). Its reconstruction capabilities aim to provide the final global event interpretation while mitigating the effects of the dense pile-up environment. The TICL framework, crafted with heterogeneous computing in mind, is a unique solution to the computing challenges of the HL-LHC phase. Data structures and algorithms have been developed for massively parallel architectures using the Alpaka performance portability library. The framework reconstructs particle candidates starting from the hundreds of thousands of energy deposits left in the calorimeter. Dedicated clustering algorithms have been developed to retain the physics information while reducing the problem complexity by order of magnitudes. Pattern recognition algorithms aim to reconstruct particle showers in the 3-dimensional space, striving for high efficiency and cluster purity, keeping the pile-up contamination as low as possible. The high-purity requirements, together with detector inhomogeneity, lead to fragmented 3D clusters. An additional linking step is available to recover the fragmentation. In this step, several algorithms are adopted to target different types of particle shower reconstruction. A SuperClustering linking plugin has been developed for electron and photon reconstruction, while a geometrical linking is used to target the hadron reconstruction. The final charged candidates are built by linking Tracks with the HGCAL 3D clusters, exploiting timing information from both HGCAL and MTD. This presentation will introduce the TICL framework. Its physics and computational performance will be highlighted, showcasing the approach adopted to face the challenges of HL-LHC.

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