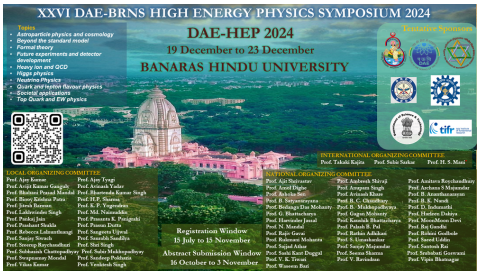

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Challenges and novel reconstruction techniques for the CMS High Granularity Calorimeter for HL-LHC

The high-luminosity era of the LHC will pose unprecedented challenges to the detectors. To meet these challenges, the CMS detector will undergo several upgrades, including the replacement of the current endcap calorimeters with a novel High-Granularity Calorimeter (HGCAL). Developing a reconstruction sequence that fully exploits the granularity to achieve optimal electromagnetic and hadron identification, as well as a good energy resolution, in the presence of pileup, is a challenging problem. To cope with this task and to make optimal use of this innovative detector, novel algorithms are being devised within a dedicated modular reconstruction framework, The Iterative Clustering (TICL), within CMS Software (CMSSW). This new framework, crafted with heterogeneous computing in mind, is designed to fully exploit the high spatial resolution and precise timing information provided by HGCAL along with information from other subdetectors such as Tracker and Mip-Timing-Detector. Dedicated 2D and 3D pattern recognition algorithms have been developed to retain the physics information while significantly reducing the problem complexity. These algorithms aim to reconstruct single particle showers in 3D and link multiple showers originating from the same particle (e.g bremsstrahlung, hadrons), maximizing efficiency and object purity, while minimizing contamination from pile-up. Advanced machine learning algorithms are also employed in key areas of the reconstruction chain. This presentation will introduce the TICL framework, highlight its physics and computational performance, include validations with test beam data, and showcase the approach being adopted to address the challenges of HL-LHC.

Field of contribution

Experiment

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