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Optimal use of Charge Information for the HL-LHC Pixel Detector Readout

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The pixel detectors for the High Luminosity upgrades of the ATLAS and CMS detectors will preserve digitized charge information in spite of extremely high hit rates. Both circuit physical size and output bandwidth will limit the number of bits to which charge can be digitized and stored. We therefore study the effect of the number of bits used for digitization and storage on single and multi-particle cluster resolution, efficiency, classification, and particle identification. We show how performance degrades as fewer bits are used to digitize and to store charge. We find that with limited charge information (4 bits), one can achieve near optimal performance on a variety of tasks.

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