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Simulation study of pixel detector charge digitization[1] FUYUE WANG, BENJAMIN NACHMAN, MAURICE SCIVERES, Lawrence Berkeley National Laboratory, LAWRENCE BERKELEY NATIONAL LABORATORY TEAM — Reconstruction of tracks from nearly overlapping particles, called Tracking in Dense Environments (TIDE), is an increasingly important component of many physics analyses at the Large Hadron Collider as signatures involving highly boosted jets are investigated. TIDE makes use of the charge distribution inside a pixel cluster to resolve tracks that share one of more of their pixel detector hits. In practice, the pixel charge is discretized using the Time-over-Threshold (ToT) technique. More charge information is better for discrimination, but more challenging for designing and operating the detector. A model of the silicon pixels has been developed in order to study the impact of the precision of the digitized charge distribution on distinguishing multi-particle clusters. The output of the GEANT4-based simulation is used to train neutral networks that predict the multiplicity and location of particles depositing energy inside one cluster of pixels. By studying the multi-particle cluster identification efficiency and position resolution, we quantify the trade-off between the number of ToT bits and low-level tracking inputs. As both ATLAS and CMS are designing upgraded detectors, this work provides guidance for the pixel module designs to meet TIDE needs.

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