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Machine-Learned Particle Flow for the Compact Linear Collider (CLIC)

Efficient and accurate algorithms are necessary to reconstruct particles in the highly granular detectors anticipated at future proton-proton, electron-positron, and muon colliders. We study scalable machine-learning models for event reconstruction in electron-positron collisions based on a full detector simulation. Particle-flow reconstruction can be formulated as a supervised learning task using tracks and calorimeter clusters. We compare a graph neural network and kernel-based transformer and demonstrate that we can avoid quadratic operations while achieving realistic reconstruction. We show that hyperparameter tuning significantly improves the performance of the models. The best graph neural network model shows improvement in the jet transverse momentum resolution by up to 50% compared to the rule-based algorithm. The resulting model is portable across Nvidia, AMD, and Habana hardware. Accurate and fast machine-learning-based reconstruction can significantly improve future measurements at colliders.

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