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Optimal transport solutions for pileup mitigation at hadron colliders

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Hadronic jets and missing transverse energy are key experimental probes when searching for new physics or performing standard model precision measurements in collision events at the LHC. In this work, we propose a graph neural network algorithm for obtaining a global event description that demonstrates greatly improved resolution in the aforementioned objects obtained with a fast simulation of the CMS detector and reconstruction. This is achieved through a novel approach employing metrics inspired by optimal transport problems as the cost function of the neural network. By learning the difference between two particle collections, one containing only the event from the hard scattering and one containing additional products from secondary proton collisions, our network is able to reject contributions from pileup more effectively than other algorithms, which translates into a better resolution for observables related to jets or missing transverse energy. The implementation of such an algorithm would lead to a quasi-global improvement for analyses performed on proton collision data and would become crucial in the high-pileup scenario expected at the High Luminosity LHC.

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