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Meta-Learning Quantum Jet Properties with Quantum Generative Models

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Quantum Generative Models are emerging as a promising tool for modelling complex physical phenomena. In this work, we explore the application of Quantum Boltzmann Machines and Quantum Generative Adversarial Networks to the intricate task of jet substructure modelling in high-energy physics. Specifically, we use these quantum frameworks to model the kinematics and corrections of the leading hadrons within a jet, focusing on accurately capturing quantum correlations. The aim is to evaluate whether quantum computing can reproduce the complex correlations observed in jets, which are challenging to simulate with classical methods. Our approach leverages a quantum-enhanced generative model to generate features that encapsulate the underlying quantum nature of jet evolution, incorporating quantum interference effects between hadrons. By studying this novel application of quantum generative models, we analyse their ability to outperform classical models in capturing such complex structures. We also investigate the impact of barren plateaus in training deep quantum circuits and propose strategies to mitigate their effects. Our empirical results provide insight into the potential of quantum computing in jet physics, paving the way for future applications in quantum-assisted substructure modelling.

Track

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