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Machine Learning for Parton-Level Studies of Quantum Entanglement Using pp→ττ

Quantum entanglement is a hallmark feature of quantum mechanics, manifesting as correlations between subsystems that cannot be fully described without one another, regardless of spatial separation. While entanglement has been observed in processes such as $pp \to t\bar{t}$ and thoroughly analyzed in Higgs decay channels ($H \to VV$) at the Large Hadron Collider (LHC), it remains comparatively underexplored in the $pp \to \tau\tau$ system. In this study, we adapt OmniLearn, a foundational model for solving all jet physics tasks, to reconstruct the neutrino information in the final state of $pp \to \tau\tau$ system, which is an essential step toward probing quantum entanglement in this channel. Good neutrino reconstruction has reached now, which is the key to the following steps in the reconstruction level study.

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