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VBF vs. GGF Higgs with Full-Event Deep Learning: Towards a Decay-Agnostic Tagger

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We study the benefits of jet- and event-level deep learning methods in distinguishing vector boson fusion (VBF) from gluon-gluon fusion (GGF) Higgs production at the LHC. We show that a variety of classifiers (CNNs, attention-based networks) trained on the complete low-level inputs of the full event achieve significant performance gains over shallow machine learning methods (BDTs) trained on jet kinematics and jet shapes, and we elucidate the reasons for these performance gains. Finally, we take initial steps towards the possibility of a VBF vs. GGF tagger that is agnostic to the Higgs decay mode, by demonstrating that the performance of our event-level CNN does not change when the Higgs decay products are removed. These results highlight the potentially powerful benefits of event-level deep learning at the LHC.

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