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Mass Sensitivity Study of Boosted b-jet Reconstruction with Muon-in-Jet Corrections and Regressed Models

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The Higgs self-coupling, as related to the shape of the Higgs potential, is central to several fundamental questions, such as the dynamics of the early universe, its expansion and cooling, and the origin of baryon asymmetry. By analyzing di-higgs events that occur during proton-proton collisions in the ATLAS experiment, observed bounds have been placed on this self-coupling value, but remain insufficient to probe BSM modifications to the Higgs potential relevant for scenarios of early-universe dynamics. To improve these bounds, sensitivity at every step in the calculation must be improved, including sensitivity of reconstructed jet kinematics. For the di-higgs analysis isolating boosted 4b final states, improvements have been introduced for large radius b-jet reconstruction, including reintroducing energy from muons and muon neutrinos that had not been considered previously, and implementing machine learning regression models to reconstruct jet variables. This project quantifies these improvements considering sensitivity of reconstructed jet mass. The mass sensitivity can be improved by as much as 30% when comparing baseline reconstructed values to ones found with ML regression techniques for transverse momentum above 0.6 TeV. Techniques and limitations will be discussed.

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