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Reconstruction of boosted and resolved multi-Higgs-boson final states with symmetry-preserving attention

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The production of multiple Higgs bosons at the CERN LHC provides a direct way to measure the trilinear and quartic Higgs self-interaction strengths as well as potential access to beyond the standard model effects that can enhance production at large transverse momentum T. The largest event fraction arises from the fully hadronic final state in which every Higgs boson decays to a bottom quark-antiquark pair (), which introduces a combinatorial challenge known as the \emph{jet assignment problem}: assigning jets to sets representing Higgs boson candidates. Symmetry-preserving attention networks (SPA-Nets) have been been introduced to address this challenge for a given event topology. However, the complexity of this challenge increases when simultaneously considering both → reconstruction possibilities, i.e., two "resolved" small-radius jets each containing a cascade initiated by a quark or one "boosted" large-radius jet containing a merged cascade initiated by a pair. The latter improves reconstruction efficiency at large T. In this work, we introduce a generalization to the SPA-Net approach to simultaneously consider both boosted and resolved reconstruction possibilities and unambiguously interpret an event as "fully resolved," "fully boosted," or in between. We report the performance of baseline methods, the original SPA-Net approach, and our generalized version on nonresonant production at the LHC.

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