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Probing a HN through vector boson fusion and machine learning techniques

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We propose a novel strategy to probe heavy neutrinos with non-universal fermion couplings at the Large Hadron Collider (LHC) using vector boson fusion (VBF) processes. Focusing on proton-proton collisions at $\sqrt{s} = 13\,\mathrm{TeV}$, we investigate final states characterized by a muon, missing energy, and two forward/backward jets, originating from a virtual heavy neutrino. Unlike resonant production channels, the VBF process maintains sensitivity at higher masses due to reduced kinematic suppression. We simulate both signal and Standard Model background events and apply gradient-boosted decision trees (BDTs) to optimize event classification. Our results, assuming $3000\,\mathrm{fb}^{-1}$ of integrated luminosity, demonstrate that heavy neutrino masses in the range of 250-5000 GeV can be probed with a mixing parameter sensitivity of approximately 0.1. This approach enhances the discovery potential for heavy neutrinos and provides a complementary pathway to existing search strategies.

Mini Symposia (Invited Talks Only)

Plenary (Invited talks only)

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