

Diphoton jet signals from light fermiophobic Higgs boson at the HL-LHC

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In this study, we explore the signatures of a light fermiophobic Higgs boson within the type-I two-Higgs-doublet model at the HL-LHC. Our parameter scan identifies a mass range between 1 and 10 GeV, challenging to detect due to soft decay products. We propose a discovery channel with the final state consisting of four photons, one lepton, and missing transverse momentum. However, the merger of photons into a single jet intensifies QCD backgrounds. To address this, we devise a strategy to identify diphoton jets. Our simulations across 18 benchmark points show signal significances exceeding 5 sigma at 3/ab integrated luminosity, enabling accurate mass reconstructions for the fermiophobic Higgs boson and the charged Higgs boson. Additionally, machine learning techniques boost significance in scenarios with heavy charged Higgs bosons.

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