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Impact of quark flavor violating SUSY on h(125) decays at future lepton colliders

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We study the CP-even neutral Higgs boson decays h -> c \bar{c}, b \bar{b}, b \bar{s}, \gamma \gamma, g g in the Minimal Supersymmetric Standard Model (MSSM) with general quark flavor violation (QFV) due to squark generation mixings, identifying the h as the Higgs boson with a mass of 125 GeV. We compute the widths of the h decays to c \bar c, b \bar b, b \bar s (s \bar b) at full one-loop level. For the h decays to \gamma \gamma and g g we compute the widths at NLO QCD level. For the first time, we perform a systematic MSSM parameter scan for these widths respecting all the relevant theoretical and experimental constraints, such as those from B-meson data, and the 125 GeV Higgs boson data from recent LHC experiments, as well as the limits on Supersymmetric (SUSY) particle masses from the LHC experiments. We also take into account the expected SUSY particle mass limits from the future HL-LHC experiment. In strong contrast to the usual studies in the MSSM with Minimal Flavor Violation (MFV), we find that the deviations of these MSSM decay widths from the Standard Model (SM) values can be quite sizable and that there are significant correlations among these deviations. Furthermore, we point out that the experimental measurement uncertainties as well as the MSSM prediction uncertainties tend to cancel out significantly in the width ratios, making the measurement of these width ratios a very sensitive probe of virtual SUSY loop effects in these h decays at future lepton colliders. All of these sizable deviations in the h decays are mainly due to large scharm-stop mixing and large sstrange-sbottom mixing. Such sizable deviations from the SM can be observed at high signal significance in future lepton colliders such as ILC, CLIC, CEPC, FCC-ee and muon collider even after the failure of SUSY particle discovery at the HL-LHC. In case the deviation pattern shown here is really observed at the lepton colliders, then it would strongly suggest the discovery of QFV SUSY (the MSSM with general QFV). References: Phys. Rev. D 91 (2015) 015007; JHEP 1606 (2016) 143; IJMP A34 (2019) 1950120; PoS(ICHEP2022) 536; PoS(EPS-HEP2023) 487. In collaboration with: H. Eberl and E. Ginina (HEPHY Vienna)

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