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New Physics Models Facing Lepton Flavor Violating Higgs Decays

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We speculate about the possible interpretations of the recently observed excess in the h to tau mu decay. We derive a robust lower bound on the Higgs boson coupling strength to a tau and a muon, even in presence of the most general new physics affecting other Higgs properties. Then we reevaluate complementary indirect constraints coming from low energy observables as well as from theoretical considerations. In particular, the tentative signal should lead to tau to mu gamma at rates which could be observed at Belle II. In turn we show that, barring fine-tuned cancellations, the effect can only be accommodated within models with an extended scalar sector. These general conclusions are demonstrated using a number of explicit new physics models. Finally we show how, given the h to tau mu signal, the current and future searches for mu to e gamma and mu to e nuclear conversions unambiguously constrain the allowed rates for h to tau e.

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