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Detecting Heavy Higgs Bosons from Natural SUSY at a 100 TeV Hadron Collider

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Supersymmetric models with radiatively-driven naturalness (RNS) enjoy low electroweak fine-tuning whilst respecting LHC search limits on gluinos and top squarks and allowing for $m_h \simeq 125$ GeV. While the heavier Higgs bosons H, A may have TeV-scale masses, the SUSY conserving μ parameter must lie in the few hundred GeV range. Thus, in natural SUSY models there should occur large heavy Higgs boson branching fractions to electroweakinos, with Higgs boson decays to higgsino plus gaugino dominating when they are kinematically accessible. These SUSY decays can open up new avenues for discovery.

We investigate the prospects of discovering heavy neutral Higgs bosons H and A decaying into light plus heavy chargino pairs which can yield a four isolated lepton plus missing transverse energy signature at the LHC and at a future 100~TeV pp collider. We find that discovery of heavy Higgs decay to electroweakinos via its 4ℓ decay mode is very difficult at HL-LHC. For FCC-hh or SPPC, we study the H, $A \to$ SUSY reaction along with dominant physics backgrounds from the Standard Model and devise suitable selection requirements to extract a clean signal for FCC-hh or SPPC with $\sqrt{s} = 100$ TeV, assuming an integrated luminosity of 15 ab^{-1}. We find that while a conventional cut-and-count analysis yields a signal statistical significance greater than 5σ for $m_{A,H} \sim 1.1 - 1.65$ TeV, a boosted-decision-tree analysis allows for heavy Higgs signal discovery at FCC-hh or SPPC for $m_{A,H} \sim 1 - 2$ TeV.

Collaboration / Activity

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