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Winos from natural SUSY at the high luminosity LHC

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In natural supersymmetric models defined by no worse than a part in thirty electroweak fine-tuning, winos and binos are generically expected to be much heavier than higgsinos. Moreover, the splitting between the higgsinos is expected to be small, so that the visible decay products of the heavier higgsinos are soft, rendering the higgsinos quasi-invisible at the LHC. Within the natural SUSY framework, heavy electroweak gauginos decay to W, Z or h bosons plus higgsinos in the ratio $\sim 2:1:1$, respectively. This is in sharp contrast to models with a bino-like lightest superpartner and very heavy higgsinos, where the charged (neutral) wino essentially always decays to a W (h) boson and an invisible bino. Wino pair production at the LHC, in natural SUSY, thus leads to VV, Vh and $hh+\not{E}_T$ final states ($V=W,Z$) where, for TeV scale winos, the vector bosons and h daughters are considerably boosted. We identify eight different channels arising from the leptonic and hadronic decays of the vector bosons and the decay $h\to b\bar{b}$, each of which offers an avenue for wino discovery at the high luminosity LHC (HL-LHC). By combining the signal in all eight channels we find, assuming $\sqrt{s}=14$ TeV and an integrated luminosity of 3000 fb^{-1}, that the discovery reach for winos extends to $m(wino)\sim 1.1$~TeV, while the 95\% CL exclusion range extends to a wino mass of almost 1.4~TeV. We also identify "higgsino specific channels" which could serve to provide 3σ evidence that winos lighter than 1.2~TeV decay to light higgsinos rather than to a bino-like LSP, should a wino signal appear at the HL-LHC.

Mini Symposia (Invited Talks Only)

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