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Hiding Missing Energy in Missing Energy

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Searches for supersymmetry (SUSY) often rely on a combination of hard physics objects (jets, leptons) along with large missing transverse energy to separate New Physics from Standard Model hard processes. We consider a class of "double-invisible" SUSY scenarios: where squarks, stops and sbottoms have a three-body decay into {\em two} (rather than one) invisible final-state particles. This occurs naturally when the LSP carries an additional conserved quantum number under which other superpartners are not charged. In these topologies, the available energy is diluted into invisible particles, reducing the {\em observed} missing energy and visible energy. This can lead to sizable changes in the sensitivity of existing searches, dramatically changing the qualitative constraints on superpartners. % In particular, our studies would indicate that, for a massless LSP, unflavored squarks have limits reduced from 840
gev to ~ 520
gev, sbottoms from 650
gev to 500
gev and stops from 650
gev to 560
gev. In particular, for $m_{\rm LSP}$
$gtrsim 160$
gev, we find no robust constraints from the LHC at any squark mass for any generation, while for lighter LSPs we find significant reductions in constraints. If confirmed by a full reanalysis from the collaborations, such scenarios allow for the possibility of significantly more natural SUSY models. While not realized in the MSSM, such phenomenology occurs naturally in models with mixed sneutrinos, Dirac gauginos and NMSSM-like models.

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