

Higgs boson decays into light sparticles, being electroweakinos or staus.

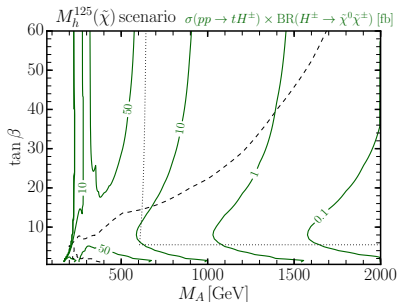
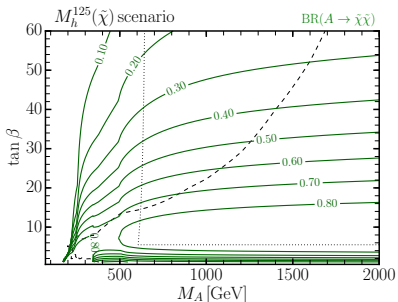
Early prospects were worked out by CMS some 15-20 years ago, see e.g.:
[\[10.1140/epjcd/s2004-02-003-9; hep-ph/0112046; hep-ph/0112045; hep-ph/0105081; CMS TDR\]](#)

Recently theorists advocated such channels again, see e.g.:
[\[Craig et al., 1504.04630; Barman et al. 1607.00676; Bahl et al.; 1808.07542; Gori Liu Shakya, 1811.11918\]](#)

The production through Higgs bosons can be the dominant production mode of $\tilde{\chi}_i \tilde{\chi}_j$ or $\tilde{\tau} \tilde{\tau}$, larger than direct production. The resonant Higgs boson(s) yield(s) specific kinematics, not necessarily well captured by the existing searches.

Example: ✓ $M_h^{125}(\tilde{\chi})$ scenario: [\[1808.07542\]](#)

$M_1 = 160$ GeV, $M_2 = \mu = 180$ GeV, Decay modes $H/A/H^\pm \rightarrow \tilde{\chi}_i \tilde{\chi}_j$:



How do electroweakinos decay in the $M_h^{125}(\tilde{\chi})$ scenario? [T. Stefaniak]

Example point $\tan \beta = 10$ and $m_A = 1$ TeV, where we get the dominant decays

$\text{BR}(H/A \rightarrow \tilde{\chi}_1^\pm \tilde{\chi}_1^\mp \rightarrow WW \tilde{\chi}_1^0 \tilde{\chi}_1^0) \approx 19\%/26\%$ for H/A and

$\text{BR}(H/A \rightarrow \tilde{\chi}_1^\pm \tilde{\chi}_2^\mp) \approx 30\%/17\%$

with subsequent decay

$\rightarrow WW \tilde{\chi}_1^0 \tilde{\chi}_1^0$ with 43%

$\rightarrow WWZ \tilde{\chi}_1^0 \tilde{\chi}_1^0$ with 51% through an intermediate $\tilde{\chi}_1^\pm$

$\rightarrow WWW \tilde{\chi}_1^0 \tilde{\chi}_1^0$ with 6% through intermediate $\tilde{\chi}_2^0$ and $\tilde{\chi}_1^\pm$.

In this scenario W and Z are off-shell because of the compressed spectrum and the corresponding leptons are soft. \rightarrow [Multilepton searches with \$E_T\$](#) .

[Gori Liu Shakya, 1811.11918] discuss and check the sensitivity of benchmark scenarios, which set $m_{\tilde{\chi}_3^0} = m_{\tilde{\chi}_2^0} = m_{\tilde{\chi}_1^0} + 100$ GeV, such that the dominant decay chain is $H/A \rightarrow Z \tilde{\chi}_1^0 \tilde{\chi}_1^0$. \rightarrow [Mono- \$Z\$ searches](#).

Existing searches can be optimised, though they have a dependence on the various mass splittings.

Comment by Sven: Collaborations should explore the $M_1 - M_2 - \mu(-\tan \beta)$ parameter space for fixed m_A and $\tan \beta$.