The ABC of RPV: classification of R-parity violating signatures at the LHC

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Introduction.

- Even if supersymmetry is a well-motivated extension of the Standard Model, no evidence of it has been found so far. Several bounds have been set to SUSY particles at the LHC.
- Are existing bounds on SUSY models robust, or are there still signatures not covered by existing searches, allowing LHC-scale SUSY to be hiding?
- Most of SUSY searches are focused on R-parity conserving SUSY, are they able to cover the parameter space of the R-parity violating SUSY landscape?
- Our aim:
  Classification of all potential RPV SUSY signatures at the LHC and its analysis using the current coverage of the LHC to address this question.

How to address this question.

(R-Parity violating terms)

$$W = W_{\text{MSSM}} + W_{\text{LNV}} + W_{\text{BNV}}$$

$$W_{\text{LNV}} = \frac{1}{2}\lambda^{ijk} L_i L_j \bar{E}_k + \lambda'^{ijk} L_i Q_j \bar{D}_k + \kappa^i H_u L_i\,, \qquad W_{\text{BNV}} = \frac{1}{2}\lambda''^{ijk} \bar{U}_i \bar{D}_j \bar{D}_k$$

We will assume (relatively) small couplings:

$$\sqrt{\frac{(\beta\gamma)\, 10^{-12}\,\text{GeV}}{m_{\text{LSP}}}} \lesssim \lambda \ll g\,, \qquad \mathcal{O}\left(10^{-7}\right) \lesssim \lambda \ll \mathcal{O}\left(10^{-1}\right)$$

In this range we make sure that the sparticle decays are prompt and also that their production is MSSM-like (no single-production)

How to address this question.

$$W = W_{\rm MSSM} + W_{\rm LNV} + W_{\rm BNV}$$

$$W_{\rm LNV} = \boxed{\frac{1}{2}\lambda^{ijk} L_i L_j \bar{E}_k} + \boxed{\lambda'^{ijk} L_i Q_j \bar{D}_k} + \kappa^i H_u L_i \,, \qquad W_{\rm BNV} = \boxed{\frac{1}{2}\lambda''^{ijk} \bar{U}_i \bar{D}_j \bar{D}_k}$$

This operators allow for 45 different RPV trilinear couplings, the total number of possibilities is inmense!

We assume one RPV trilinear coupling at a time.

In order to have the most general coverage we allow for arbitrary LSP and mass spectra. However, for the sake of simplicity we assume mass degeneracy between components of the same doublets and 1st and 2nd generation.

Our approach.

We wish to create a minimal set of signatures that provides complete coverage for the spaces of RPV-MSSM models irrespective of how frequently an individual signature may arise.

We will tie to the LHC search program discussing current experimental coverage and we will try to identify possible gaps.

To help with this process we have created the RPV Python library abc-rpv[1]

This library tells you the resulting signatures of a given RPV coupling and operator and also it gives you the operators and couplings for a chosen specific signature.

[1]abc-rpv Python library is available at: https://github.com/kys-sheng/abc-rpv.git

Our approach.

As R parity is not a symmetry anymore, the Lightest Supersymmetric Particle is allowed to decay into SM particles.

For a given operator and coupling, we study the production of sparticles that decay into the LSP.

The final decay of the LSP will define the potential signature of such an operator and coupling, allowing us to identify the best searches.

$$\text{RPV signature} = \begin{pmatrix} \tilde g \tilde g \\ \tilde g\tilde q, \tilde g \tilde u \dots \\ \tilde q\tilde q, \tilde q_3\tilde q_3, \tilde q\tilde u \dots \\ \tilde\ell\tilde\ell, \tilde\tau_L\tilde\tau_L, \tilde\ell\tilde\nu \dots \\ \tilde H\tilde H \\ \tilde W\tilde W \\ \tilde B\tilde B \end{pmatrix}_{\substack{\text{Production}\\ \text{Channels}}} \otimes \begin{pmatrix} \tilde B \\ \tilde H \\ \tilde W \\ \tilde\ell(\tilde\nu) \\ \tilde\tau_L(\tilde\nu_\tau) \\ \tilde e \\ \tilde\tau_R \\ \tilde q \\ \tilde u \\ \tilde d \\ \tilde q_3 \\ \tilde t \\ \tilde b \\ \tilde g \end{pmatrix}_{\substack{\text{Possible}\\ \text{LSPs}}} \otimes \begin{pmatrix} L_1L_2\bar E_1 \\ \dots \\ L_1Q_1\bar D_1 \\ \dots \\ \bar U_3\bar D_2\bar D_3 \end{pmatrix}_{\substack{\text{LSP}\\ \text{Decay}}}$$

LLE couplings.

LSP	LLE	LL$_3$E
$\tilde{\ell}\,(\tilde{\nu})$	$3\ell + E_T^{\text{miss}}/4\ell$	$2\ell + \tau + E_T^{\text{miss}}/2\ell + 2\tau$
$\tilde{e}$	$2\ell + E_T^{\text{miss}}$	$2\ell + E_T^{\text{miss}}/\ell + \tau + E_T^{\text{miss}}$
$\tilde{\tau}_L\,(\tilde{\nu}_\tau)$	$4\ell + 2\tau + E_T^{\text{miss}}/4\ell + \tau + E_T^{\text{miss}}$	$3\ell + E_T^{\text{miss}}/4\ell$
$\tilde{\tau}_R$	$4\ell + 2\tau + E_T^{\text{miss}}$	$4\ell + 2\tau + E_T^{\text{miss}}/3\ell + 3\tau + E_T^{\text{miss}}$
$\tilde{g}$	$4\ell + 4j + E_T^{\text{miss}}$	$4\ell + 4j + E_T^{\text{miss}}/3\ell + \tau + 4j + E_T^{\text{miss}}$
$\tilde{q},\ \tilde{u},\ \tilde{d}$	$4\ell + 2j_l + E_T^{\text{miss}}$	$4\ell + 2j_l + E_T^{\text{miss}}/3\ell + \tau + 2j_l + E_T^{\text{miss}}$
$\tilde{t}_L(\tilde{b}_L)$	$4\ell + 2j_3 + E_T^{\text{miss}}$	$4\ell + 2j_3 + E_T^{\text{miss}}/3\ell + \tau + 2j_3 + E_T^{\text{miss}}$
$\tilde{t}_R$	$4\ell + 2t + E_T^{\text{miss}}$	$4\ell + 2t + E_T^{\text{miss}}/3\ell + \tau + 2t + E_T^{\text{miss}}$
$\tilde{b}_R$	$4\ell + 2b + E_T^{\text{miss}}$	$4\ell + 2b + E_T^{\text{miss}}/3\ell + \tau + 2b + E_T^{\text{miss}}$
$\tilde{B},\ \tilde{W},\ \tilde{H}$	$4\ell + E_T^{\text{miss}}$	$4\ell + E_T^{\text{miss}}/3\ell + \tau + E_T^{\text{miss}}$

Searches covering LLE signatures:

1. $2L + E_T^{\text{miss}}$
2. $3L + E_T^{\text{miss}}$
3. $4L$
4. $4L + (0-4)j + E_T^{\text{miss}}$
5. $5L + E_T^{\text{miss}}$
6. $6L + E_T^{\text{miss}}$

If we take the LLE operator we can study the multiple decays of each LSP that lead to their experimental signatures. For the LLE case we find 6 possible signatures that are covered by LHC searches.

LLE couplings.

- We assume only one non-zero RPV coupling at a time.
- We assume all mass eigenstates aligned with the gauge eigenstates, except for the neutral Higgsinos that are maximally mixed.
- We take the signatures from our RPV dictionary that are covered by ATLAS and CMS searches.
- Simulations are performed using MadGraph5_aMC@NLO linked to PYTHIA 8.2 (We let MadGraph to compute the 2-body decays while higher orders are set by hand)
- The events are then passed through CheckMATE2 that contains ATLAS and CMS searches.

LLE couplings. Gluino LSP

LSP	Production	Coupling	LSP Decay		Label
$\tilde{g}$	Direct	λ_{121}	$2e + 2j_l + \nu_\mu$	$e + \mu + 2j_l + \nu_e$	$D_{\tilde{g}}^{e\mu e}$
	Direct	λ_{121}	$2e + 2b + \nu_\mu$	$e + \mu + 2b + \nu_e$	$D_{\tilde{g}}^{e\mu e-b}$
	Direct	λ_{121}	$2e + 2t + \nu_\mu$	$e + \mu + 2t + \nu_e$	$D_{\tilde{g}}^{e\mu e-t}$
	Direct	λ_{122}	$2\mu + 2j_l + \nu_e$	$e + \mu + 2j_l + \nu_\mu$	$D_{\tilde{g}}^{e\mu\mu}$
	Direct	λ_{311}	$2e + 2j_l + \nu_\tau$	$e + \tau + 2j_l + \nu_e$	$D_{\tilde{g}}^{\tau ee}$
	Direct	λ_{313}	$2\tau + 2j_l + \nu_e$	$e + \tau + 2j_l + \nu_\tau$	$D_{\tilde{g}}^{\tau e\tau}$

We consider the gluino to be the LSP. Only direct production of gluinos is considered since the cross section is higher than any other channel.
(Other sparticles are decoupled)

LLE couplings. Squark LSP

LSP	Production	Coupling	LSP Decay		Label
$\tilde{q}/\tilde{u}/\tilde{d}$	Direct	λ_{121}	$2e + j_l + \nu_\mu$	$e + \mu + j_l + \nu_e$	$\mathrm{D}_{\tilde{q}}^{e\mu e}$
	$\tilde{g}$				$\mathrm{I}_{\tilde{g}\to\tilde{q}}^{e\mu e}$
	Direct	λ_{313}	$2\tau + j_l + \nu_e$	$e + \tau + j_l + \nu_\tau$	$\mathrm{D}_{\tilde{q}}^{\tau e\tau}$
	$\tilde{g}$				$\mathrm{I}_{\tilde{g}\to\tilde{q}}^{\tau e\tau}$
$\tilde{q}_3/\tilde{t}/\tilde{b}$	Direct	λ_{121}	$2e + j_3 + \nu_\mu$	$e + \mu + j_3 + \nu_e$	$\mathrm{D}_{\tilde{q}_3}^{e\mu e}$
	$\tilde{g}$				$\mathrm{I}_{\tilde{g}\to\tilde{q}_3}^{e\mu e}$
	Direct	λ_{313}	$2\tau + j_3 + \nu_e$	$e + \tau + j_3 + \nu_\tau$	$\mathrm{D}_{\tilde{q}_3}^{\tau e\tau}$
	$\tilde{g}$				$\mathrm{I}_{\tilde{g}\to\tilde{q}_3}^{\tau e\tau}$

Direct and indirect (via gluinos) productions are considered. The RPV couplings chosen are those that produce the maximum and minimun of light leptons in the final state.
(Other sparticles are decoupled)

LLE couplings. Electroweakino LSP

LSP	Production	Coupling	LSP Decay		Label
$\tilde{W}$	Direct	λ_{121}	$2e+\nu_\mu/2e+\mu$	$e+\mu+\nu_e/e+\nu_e+\nu_\mu$	$\mathrm{D}^{e\mu e}_{\tilde{W}}$
	$\tilde{g}$				$\mathrm{I}^{e\mu e}_{\tilde{g}\to\tilde{W}}$
	$\tilde{q}/\tilde{u}/\tilde{d}$				$\mathrm{I}^{e\mu e}_{\tilde{q}\to\tilde{W}}$
	Direct	λ_{313}	$2\tau+\nu_e/e+2\tau$	$e+\tau+\nu_\tau/\tau+\nu_e+\nu_\tau$	$\mathrm{D}^{\tau e\tau}_{\tilde{W}}$
	$\tilde{g}$				$\mathrm{I}^{\tau e\tau}_{\tilde{g}\to\tilde{W}}$
	$\tilde{q}/\tilde{u}/\tilde{d}$				$\mathrm{I}^{\tau e\tau}_{\tilde{q}\to\tilde{W}}$

Direct and indirect productions are considered. For indirect production through squarks we focus on the light-flavour squarks.

(Other sparticles are decoupled)

LLE couplings. Electroweakino LSP

LSP	Production	Coupling	LSP Decay		Label
$\tilde{H}$	Direct	λ_{121}	$2e + V + \nu_\mu$	$e + \mu + V + \nu_e$	$D^{e\mu e}_{\tilde{H}}$
	$\tilde{g}$				$I^{e\mu e}_{\tilde{g}\to\tilde{H}}$
	$\tilde{q}_3/\tilde{t}/\tilde{b}$				$I^{e\mu e}_{\tilde{q}_3\to\tilde{H}}$
	Direct	λ_{313}	$2\tau + V + \nu_e$	$e + \tau + V + \nu_\tau$	$D^{\tau e\tau}_{\tilde{H}}$
	$\tilde{g}$				$I^{\tau e\tau}_{\tilde{g}\to\tilde{H}}$
	$\tilde{q}_3/\tilde{t}/\tilde{b}$				$I^{\tau e\tau}_{\tilde{q}_3\to\tilde{H}}$

Direct and indirect productions are considered. For the indirect production we only include gluinos and heavy-flavour squarks since the coupling to light-flavours is suppressed.
(Other sparticles are decoupled)

LLE couplings. Electroweakino LSP

LSP	Production	Coupling	LSP Decay		Label
$\tilde{B}$	$\tilde{g}$	λ_{121}	$2e+\nu_\mu$	$e+\mu+\nu_e$	$\mathrm{I}^{e\mu e}_{\tilde{g}\to\tilde{B}}$
	$\tilde{q}/\tilde{u}/\tilde{d}$				$\mathrm{I}^{e\mu e}_{\tilde{q}\to\tilde{B}}$
	$\tilde{q}_3/\tilde{t}/\tilde{b}$				$\mathrm{I}^{e\mu e}_{\tilde{q}_3\to\tilde{B}}$
	$\tilde{\ell}/\tilde{\nu}/\tilde{e}$				$\mathrm{I}^{e\mu e}_{\tilde{\ell}\to\tilde{B}}$
	$\tilde{\tau}_L/\tilde{\nu}_\tau/\tilde{\tau}_R$				$\mathrm{I}^{e\mu e}_{\tilde{\tau}\to\tilde{B}}$
	$\tilde{W}$				$\mathrm{I}^{e\mu e}_{\tilde{W}\to\tilde{B}}$
	$\tilde{H}$				$\mathrm{I}^{e\mu e}_{\tilde{H}\to\tilde{B}}$

LSP	Production	Coupling	LSP Decay		Label
$\tilde{B}$	$\tilde{g}$	λ_{313}	$2\tau+\nu_e$	$e+\tau+\nu_\tau$	$\mathrm{I}^{\tau e\tau}_{\tilde{g}\to\tilde{B}}$
	$\tilde{q}/\tilde{u}/\tilde{d}$				$\mathrm{I}^{\tau e\tau}_{\tilde{q}\to\tilde{B}}$
	$\tilde{q}_3/\tilde{t}/\tilde{b}$				$\mathrm{I}^{\tau e\tau}_{\tilde{q}_3\to\tilde{B}}$
	$\tilde{\ell}/\tilde{\nu}/\tilde{e}$				$\mathrm{I}^{\tau e\tau}_{\tilde{\ell}\to\tilde{B}}$
	$\tilde{\tau}_L/\tilde{\nu}_\tau/\tilde{\tau}_R$				$\mathrm{I}^{\tau e\tau}_{\tilde{\tau}\to\tilde{B}}$
	$\tilde{W}$				$\mathrm{I}^{\tau e\tau}_{\tilde{W}\to\tilde{B}}$
	$\tilde{H}$				$\mathrm{I}^{\tau e\tau}_{\tilde{H}\to\tilde{B}}$

Only indirect production is considered for binos. Direct production is not relevant due to the small cross section.

(Other sparticles are decoupled)

LLE couplings. Slepton LSP

LSP	Production	Coupling	LSP Decay		Label
	Direct				$\mathrm{D}_{\tilde{\ell}}^{e\mu e}$
			$2e/e+\mu$	$e+\nu_e/e+\nu_\mu$	
	$\tilde{g}$	λ_{121}			$\mathrm{I}_{\tilde{g}\to\tilde{\ell}}^{e\mu e}$
			$\mu+\nu_e$	$*$	
	$\tilde{W}$				$\mathrm{I}_{\tilde{W}\to\tilde{\ell}}^{e\mu e}$
	Direct				$\mathrm{D}_{\tilde{\ell}}^{\tau e\tau}$
$\tilde{\ell}/\tilde{\nu}/\tilde{e}$					
	$\tilde{g}$	λ_{313}	$2\tau/\tau+\nu_\tau$	$*$	$\mathrm{I}_{\tilde{g}\to\tilde{\ell}}^{\tau e\tau}$
	$\tilde{W}$				$\mathrm{I}_{\tilde{W}\to\tilde{\ell}}^{\tau e\tau}$
	Direct	λ_{122}	$2\mu/e+\mu/e+\nu_\mu$	$\mu+\nu_e/\mu+\nu_\mu/*$	$\mathrm{D}_{\tilde{\ell}}^{e\mu\mu}$
	Direct	λ_{311}	$e+\tau/e+\nu_\tau$	$\tau+\nu_e/*$	$\mathrm{D}_{\tilde{\ell}}^{\tau ee}$

LSP	Production	Coupling	LSP Decay		Label
	Direct				$\mathrm{D}_{\tilde{\tau}}^{e\mu e}$
			$2e+\tau+\nu_\mu$	$2e+\nu_\mu+\nu_\tau$	
	$\tilde{g}$	λ_{121}			$\mathrm{I}_{\tilde{g}\to\tilde{\tau}}^{e\mu e}$
			$e+\mu+\tau+\nu_e$	$e+\mu+\nu_e+\nu_\tau$	
	$\tilde{W}$				$\mathrm{I}_{\tilde{W}\to\tilde{\tau}}^{e\mu e}$
	Direct				$\mathrm{D}_{\tilde{\tau}}^{\tau e\tau}$
$\tilde{\tau}_L/\tilde{\nu}_\tau/\tilde{\tau}_R$					
	$\tilde{g}$	λ_{313}	$e+\tau/e+\nu_\tau$	$\tau+\nu_e$	$\mathrm{I}_{\tilde{g}\to\tilde{\tau}}^{\tau e\tau}$
	$\tilde{W}$				$\mathrm{I}_{\tilde{W}\to\tilde{\tau}}^{\tau e\tau}$
	Direct	λ_{122}	$2\mu+\tau+\nu_e/e+\mu+\tau+\nu_\mu$	$2\mu+\nu_e+\nu_\tau/e+\mu+\nu_\mu+\nu_\tau$	$\mathrm{D}_{\tilde{\tau}}^{e\mu\mu}$
	Direct	λ_{311}	$2e/e+\nu_e$	$2e+\tau+\nu_\tau/e+2\tau+\nu_e$	$\mathrm{D}_{\tilde{\tau}}^{\tau ee}$

For the indirect production we only considered gluino and Higgsino parents.

As sleptons couple directly to the LLE operator we have included other non-zero RPV couplings.

(Other sparticles are decoupled)

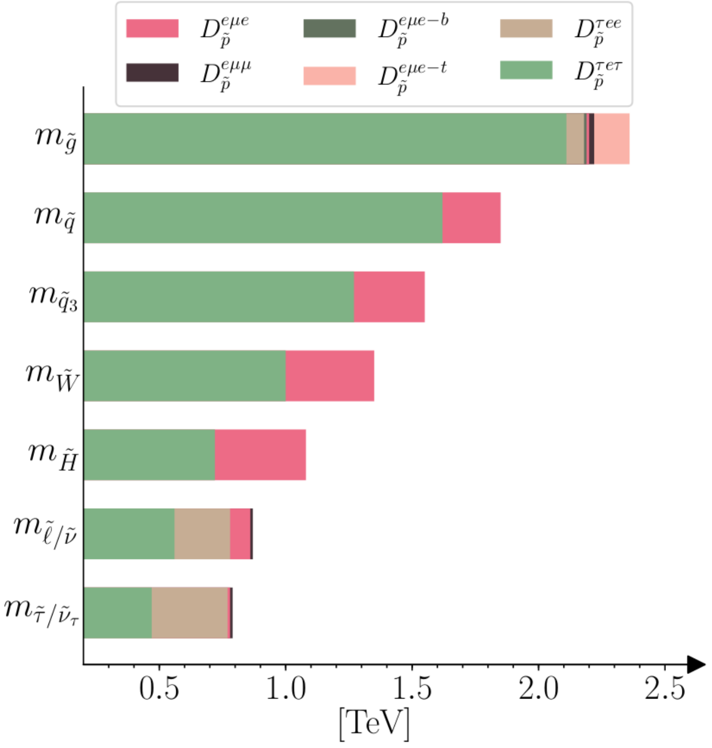
LLE couplings. Results

We stress one important detail: even if we use simple scenarios as benchmarks with other sparticles decoupled, we expect our results to be more general since the characteristic signature from the LSP decay is independent from the spectrum details.

The relevant ATLAS and CMS searches are:

Reference and search region	Representative cuts	Most sensitive for
CMS-ewk-4ℓ [44] SR **G05**	$\geq 4\ell$, $0b$, $E_T^{\rm miss}$	$D^{e\mu e}_{\tilde g}$, $D^{e\mu\mu}_{\tilde g}$, $D^{e\mu e}_{\tilde q,\tilde W,\tilde H}$, $D^{\tau ee}_{\tilde \ell}$, $D^{e\mu e}_{\tilde \tau}$, $D^{e\mu\mu}_{\tilde \tau}$
ATLAS-gluino-SS/3ℓ [23] SR **Rpv2L**	$\geq 2\ell$, $\geq 6j$	$D^{e\mu e}_{\tilde g}$, $D^{e\mu\mu}_{\tilde g}$, $D^{e\mu e-b}_{\tilde g}$, $D^{e\mu e-t}_{\tilde g}$, $D^{\tau ee}_{\tilde g}$, $D^{e\mu e}_{\tilde q_3}$
ATLAS-RPV-1ℓ/SS [55] SR **SS-6j100-0b**	$\geq 2\ell$, $\geq 6j$, $0b$	$D^{\tau ee}_{\tilde g}$, $D^{\tau e\tau}_{\tilde g}$, $D^{\tau e\tau}_{\tilde q}$
ATLAS-gluino-SS/3ℓ-1b [139] SR **Rpc3L1bH**	$\geq 3\ell$, $\geq 4j$, $\geq 1b$, $E_T^{\rm miss}$	$D^{e\mu e}_{\tilde q_3}$, $D^{\tau e\tau}_{\tilde q_3}$
CMS-ewk-2τ2ℓ [44] SR **K03**	2ℓ, 2τ, $E_T^{\rm miss}$	$D^{\tau e\tau}_{\tilde W}$, $D^{\tau e\tau}_{\tilde H}$
CMS-ewk-3ℓ [44] SR **A44**	3ℓ, $E_T^{\rm miss}$	$D^{e\mu e}_{\tilde \ell}$, $D^{e\mu\mu}_{\tilde \ell}$, $D^{\tau ee}_{\tilde \tau}$
CMS-ewk-1τ3ℓ [44] SR **I04**	3ℓ, 1τ, $E_T^{\rm miss}$	$D^{\tau e\tau}_{\tilde \ell}$
CMS-ewk-2τ1ℓ [44] SR **F12**	1ℓ, 2τ, $E_T^{\rm miss}$	$D^{\tau e\tau}_{\tilde \tau}$

LLE couplings. Results for direct production.

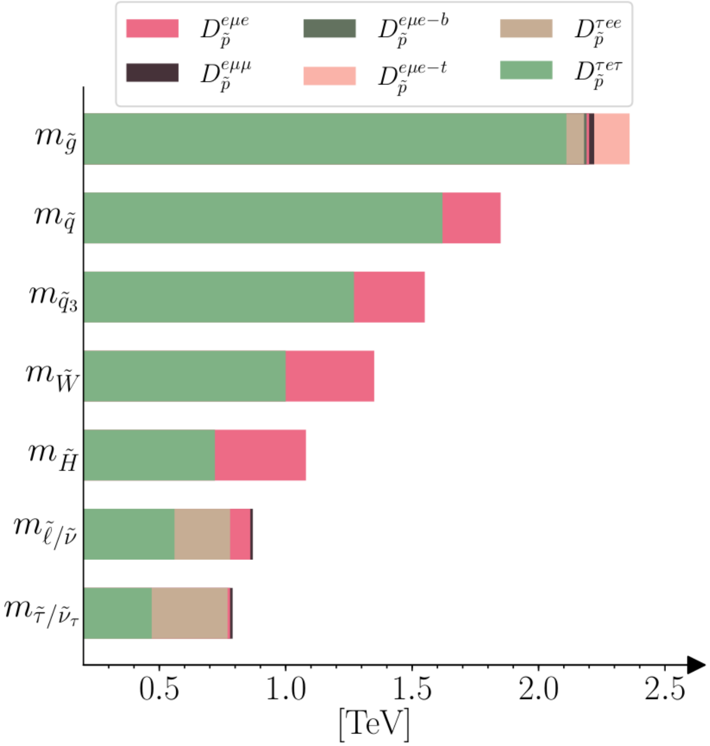


The gluino scenarios show the most constrained scenario ~2.4 TeV

The squarks and electroweakinos despite having similar signatures as the gluino are less constrained due to the lower production cross section.

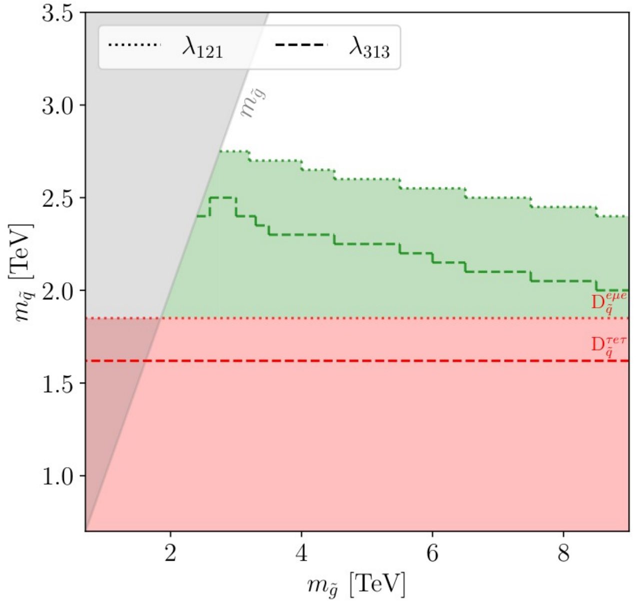
Sleptons present a bigger gap depending on the coupling. The searches involving tau leptons are less sensitive than the ones with light leptons.

LLE couplings. Results for direct production.

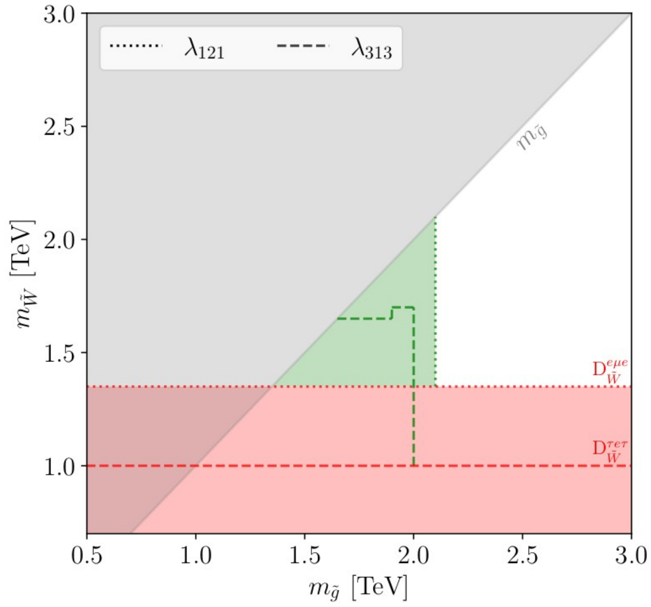


Reference and search region	Representative cuts	Most sensitive for
CMS-ewk-4ℓ [44] SR **G05**	$\geq 4\ell$, $0b$, E_T^{miss}	$D_{\tilde{g}}^{e\mu e}$, $D_{\tilde{g}}^{e\mu\mu}$, $D_{\tilde{q},\tilde{W},\tilde{H}}^{e\mu e}$, $D_{\tilde{\ell}}^{\tau ee}$, $D_{\tilde{\tau}}^{e\mu e}$, $D_{\tilde{\tau}}^{e\mu\mu}$
ATLAS-gluino-SS/3ℓ [23] SR **Rpv2L**	$\geq 2\ell$, $\geq 6j$	$D_{\tilde{g}}^{e\mu e}$, $D_{\tilde{g}}^{e\mu\mu}$, $D_{\tilde{g}}^{e\mu e-b}$, $D_{\tilde{g}}^{e\mu e-t}$, $D_{\tilde{g}}^{\tau ee}$, $D_{\tilde{q}_3}^{e\mu e}$
ATLAS-RPV-1ℓ/SS [55] SR **SS-6j100-0b**	$\geq 2\ell$, $\geq 6j$, $0b$	$D_{\tilde{g}}^{\tau ee}$, $D_{\tilde{g}}^{\tau e\tau}$, $D_{\tilde{q}}^{\tau e\tau}$
ATLAS-gluino-SS/3ℓ-1b [139] SR **Rpc3L1bH**	$\geq 3\ell$, $\geq 4j$, $\geq 1b$, E_T^{miss}	$D_{\tilde{q}_3}^{e\mu e}$, $D_{\tilde{q}_3}^{\tau e\tau}$
CMS-ewk-2τ2ℓ [44] SR **K03**	2ℓ, 2τ, E_T^{miss}	$D_{\tilde{W}}^{\tau e\tau}$, $D_{\tilde{H}}^{\tau e\tau}$
CMS-ewk-3ℓ [44] SR **A44**	3ℓ, E_T^{miss}	$D_{\tilde{\ell}}^{e\mu e}$, $D_{\tilde{\ell}}^{e\mu\mu}$, $D_{\tilde{\tau}}^{\tau ee}$
CMS-ewk-1τ3ℓ [44] SR **I04**	3ℓ, 1τ, E_T^{miss}	$D_{\tilde{\ell}}^{\tau e\tau}$
CMS-ewk-2τ1ℓ [44] SR **F12**	1ℓ, 2τ, E_T^{miss}	$D_{\tilde{\tau}}^{\tau e\tau}$

LLE couplings. Results for indirect production.

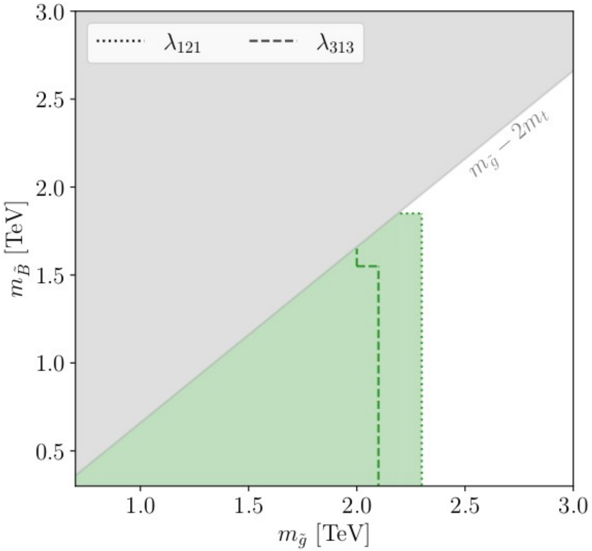


Squark LSP with gluino production

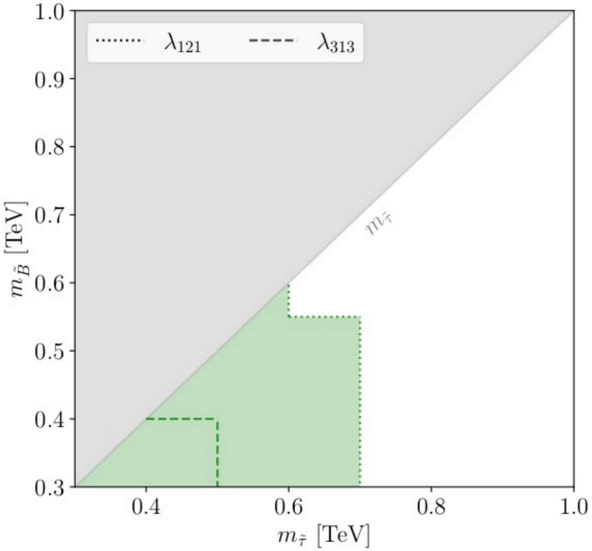


Wino LSP with gluino production

LLE couplings. Results for indirect production.

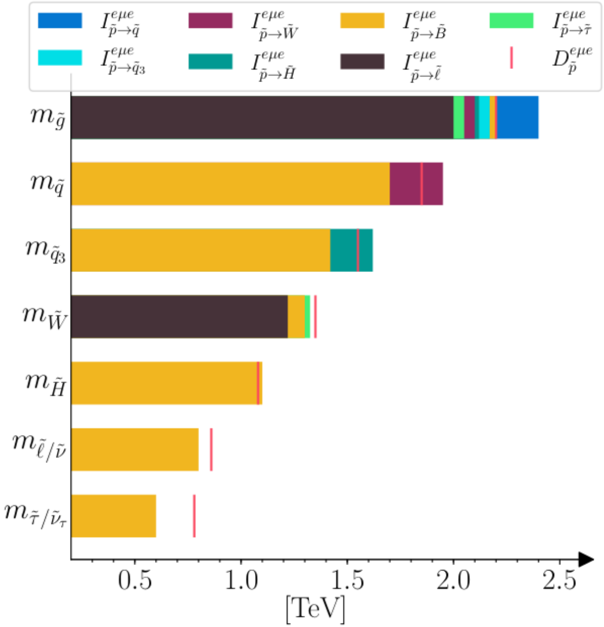


Bino LSP with gluino production

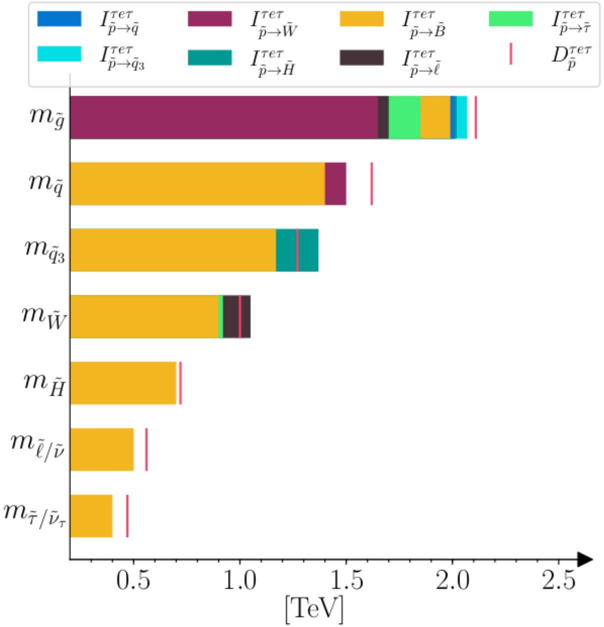


Bino LSP with stau production

LLE couplings. Summary of results.



(a) λ_{121}.



(b) λ_{313}.

Conclusions.

- We have systematically analyzed the RPV-MSSM and classified the possible signatures at the LHC.

- We have compiled a minimal set of experimental searches that provides complete coverage for RPV.

- We developed the abc-rpv dictionary that provides experimental signatures to RPV operators.

- Making use of this tool we have analyzed the current coverage of the RPV-MSSM at the LHC. We found that even though most RPV scenarios have not been searched for directly, the vast landscape of searches implemented by ATLAS and CMS provides full coverage.

- We find that strong exclusion limits comparable to the RPC-MSSM are obtained using only a few characteristic topologies to cover the most general RPV-MSSM scenario.

- The importance of joint collaborations between experimentalists and theorists :)

Thank you!