Searches for R-parity violating Supersymmetry with the ATLAS Experiment

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On behalf of the ATLAS Collaboration

ATLAS EXPERIMENT

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Université de Montréal

Introduction

- Supersymmetry (SUSY) is an extension of Standard Model (SM) that relates fermions and bosons
- Generic SUSY models, superpotential contains terms that violate leptonic and baryonic number

$$W_{\not{R}_p} = \frac{1}{2}\lambda_{ijk}L_iL_jE_k^c + \lambda'_{ijk}L_iQ_jD_k^c + \epsilon_i H_u L_i + \frac{1}{2}\boldsymbol{\lambda''_{ijk}}U_i^cD_j^cD_k^c$$

- R-parity ($R_p = (-1)^{3(B-L)+2S}$) conservation is often introduced to avoid rapid proton decay
- However, **R-parity violation (RPV) is still viable** with small λ_{RPV} and only *L or B* is violated at a time
- **RPV models are well motivated** and have weaker limits than RPC models
- Give rise to a wide variety of experimental signatures depending on the λ_{RPV} in consideration
    - RPV models do not often require large $E_{\mathrm{T}}^{\mathrm{miss}}$ like in RPC models

Latest RPV searches at ATLAS

- This talk highlights 4 recent searches using full Run 2 ATLAS data ($\mathrm{L} = 139\ \mathrm{fb}^{-1}$)

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RPV EW 3-leptons
Phys. Rev. D 103, (2021) 112003

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RPV 4-leptons
[JHEP 07 (2021) 167]

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Eur. Phys. J. C 81 (2021) 11

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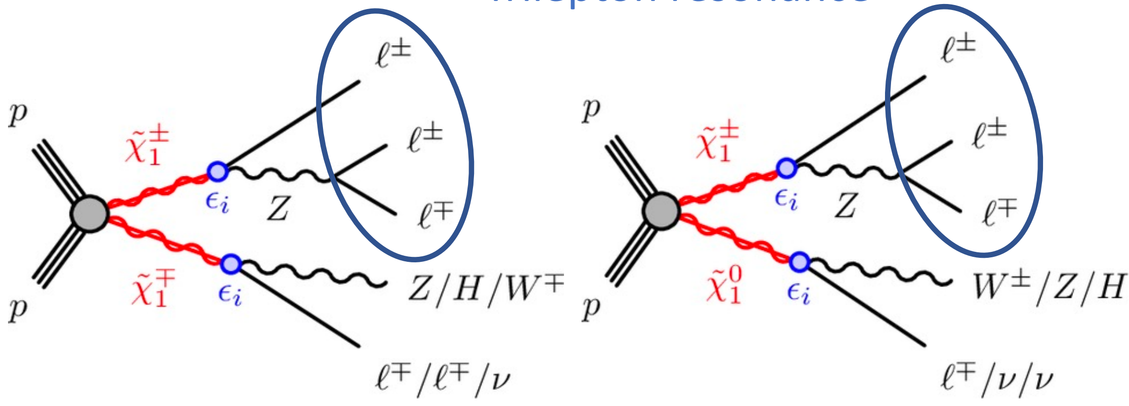
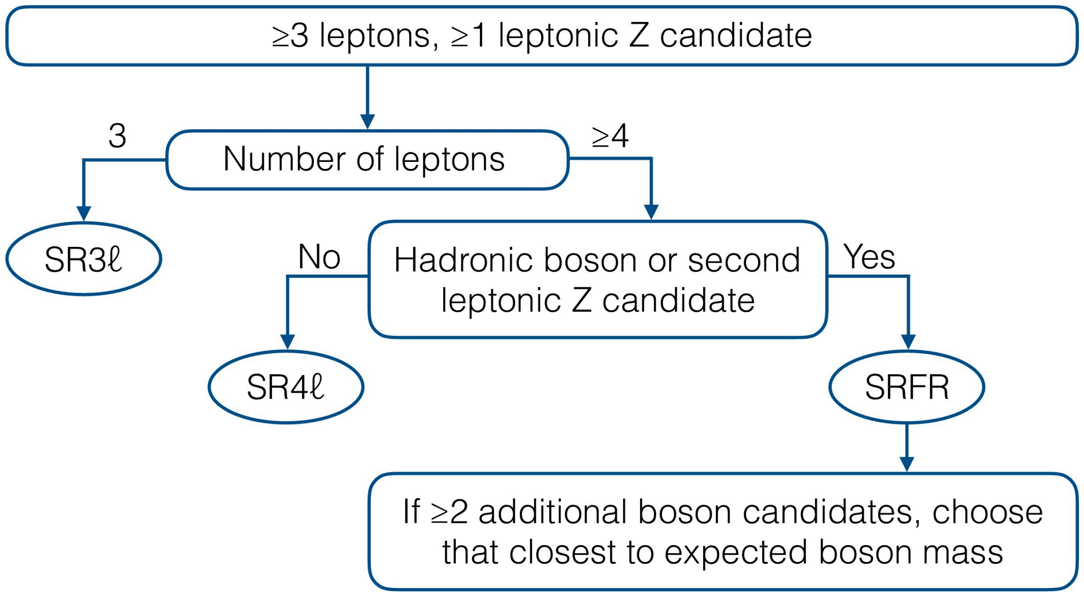
JHEP 07 (2021) 167

RPV multi-jet 1-lepton
Eur. Phys. J. C 81 (2021) 1023

- Inspired by MSSM that adds a gauged group $U(1)_{B-L}$ and includes right-handed neutrino supermultiplets
  - ***L* violation only**, *B* still conserved
- Targeting $\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{\mp}$ and $\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{0}$ production with at least one **decay of interest**: $\tilde{\chi}_1^{+} \longrightarrow Zl \longrightarrow lll$
- Wino-type chargino and neutralino are LSP
  - Nearly mass-degenerate
- Three SRs aims at different decays of 2nd $\tilde{\chi}_1^{\pm}/\tilde{\chi}_1^{0}$
  - SR3l : $N_l = 3$ and significant $E_{\mathrm{T}}^{\mathrm{miss}}$
  - SR4l : $N_l \geq 4$ and possible $E_{\mathrm{T}}^{\mathrm{miss}}$
  - SRFR: $N_l \geq 4$ and 2nd boson candidate (*Z*, *W*, Higgs)

Trilepton resonance





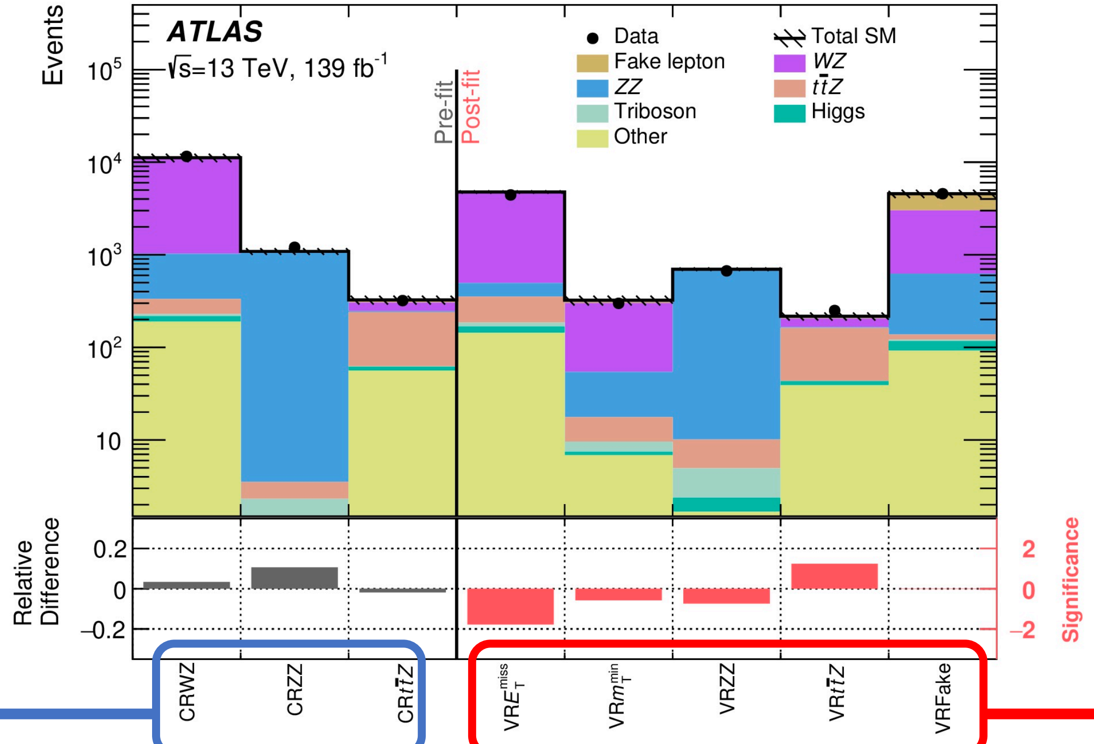
RPV EW 3-leptons

Phys. Rev. D 103, (2021) 112003

$\epsilon_i H_u L_i$

- **Main backgrounds**:
  - WZ, ZZ and $t\bar{t}Z$ estimated using MC, normalized to data in dedicated CRs
  - Processes with ≥ 1 *fake* lepton estimated with data-driven (*fake*-factor) method
  - Others SM processes estimated directly from MC

Data in agreement with post-fit background in all VRs



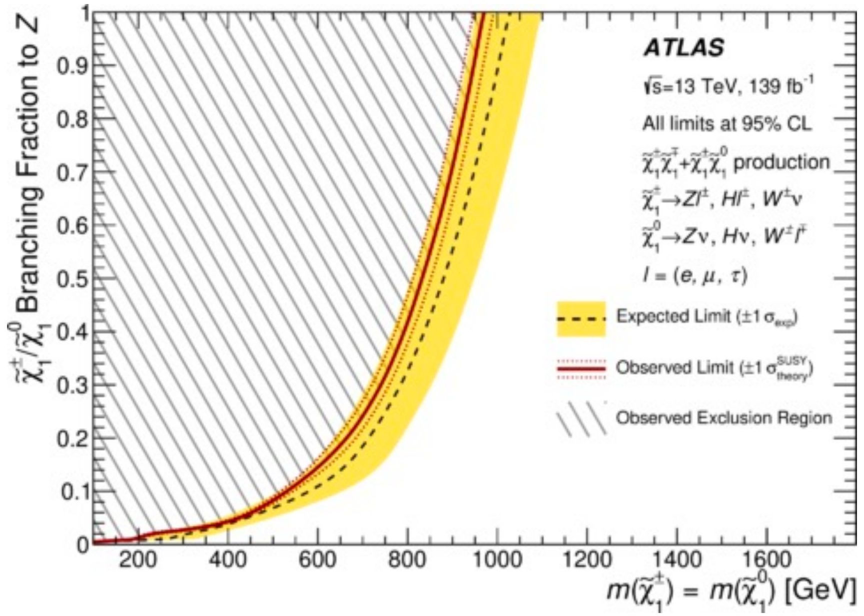
Control regions

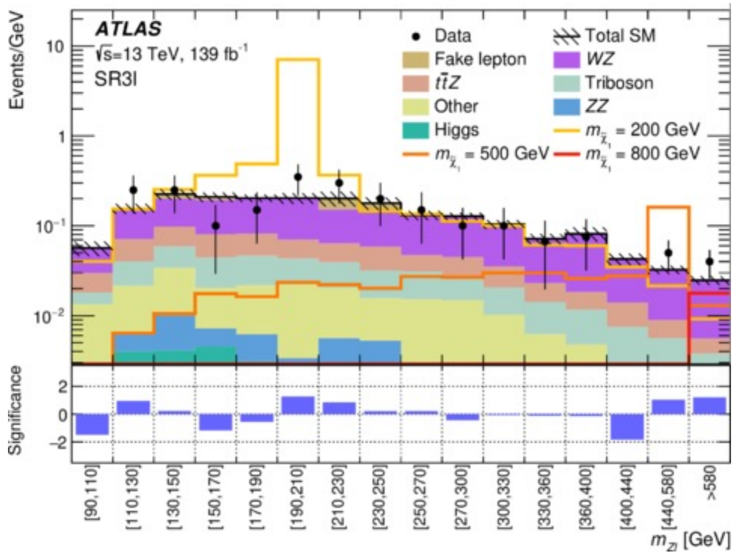
Validation regions

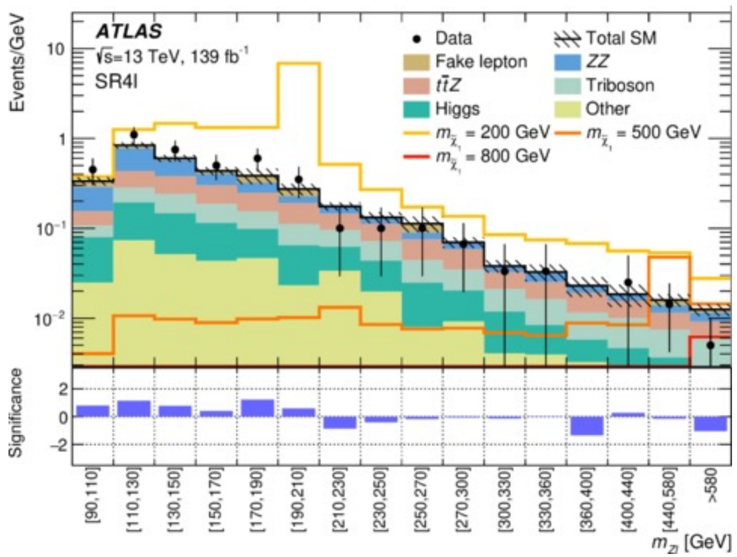
RPV EW 3-leptons

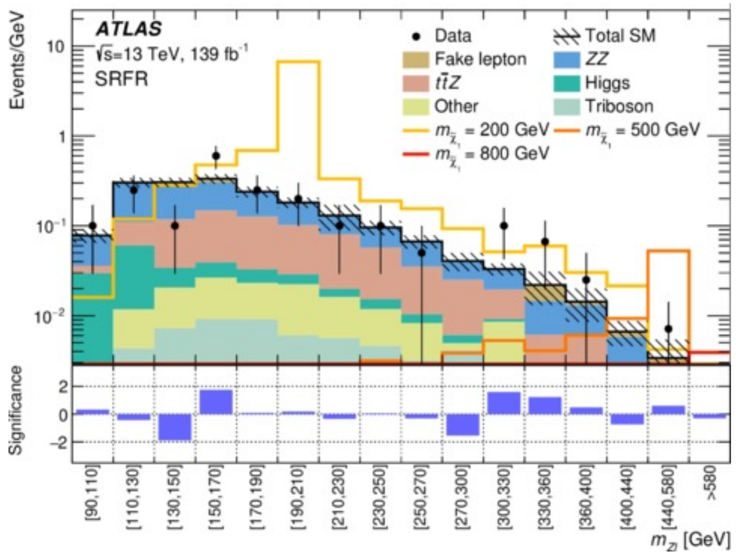
Phys. Rev. D 103, (2021) 112003 $\epsilon_i H_u L_i$

- **Good agreement between data and SM expectation** in m_{Zl} distribution in each SR
- Limits on $\tilde{\chi}_1^{\pm}/\tilde{\chi}_1^0$ masses is set depending on the branching ratios into a *Z*-boson and lepton flavor
  - For large BR to *Z*-boson , $\tilde{\chi}_1^{\pm}/\tilde{\chi}_1^0$ masses up to 975 GeV excluded in scenario with equal branching fraction to e, μ, τ









RPV 4-leptons

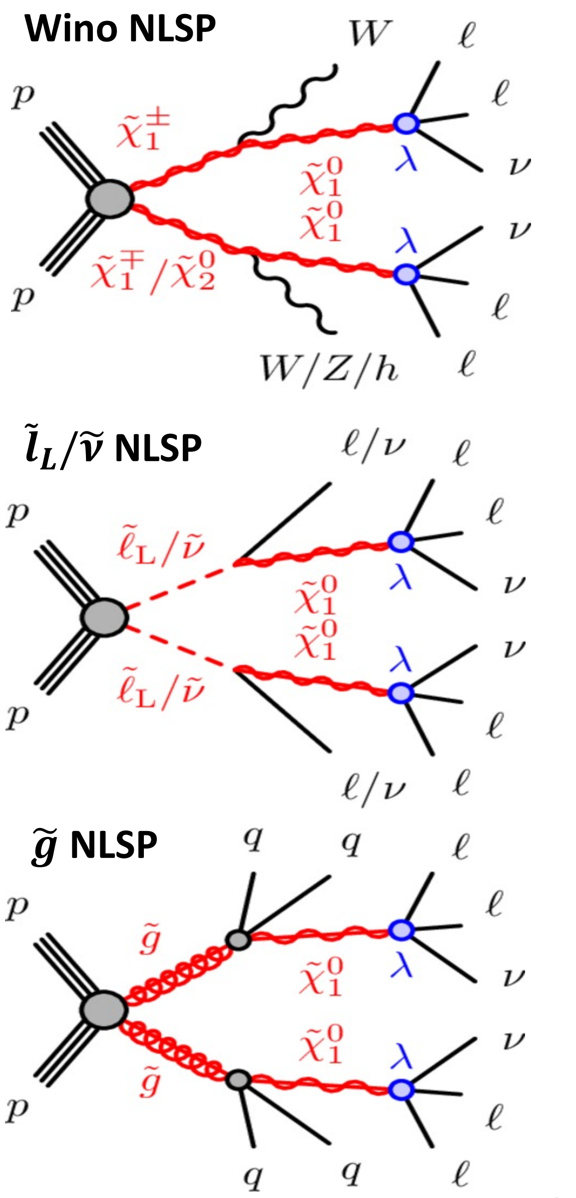
JHEP 07 (2021) 167

$$\frac{1}{2}\lambda_{ijk}L_iL_jE^c_k$$

- Consider 3 NLSP pair production possibilities with LSP decays into ≥ 4 lepton ($e,\ \mu,\ \tau_{\text{had}}$) final state
  - Results probe λ_{12k} and λ_{i33} $(i, k \in 1, 2)$ for RPV couplings
- Three event categories based on e/μ and τ_{had} multiplicity requirement
  - *4L0T*: $N_{e/\mu} \geq 4$ and $N_{\tau_{\text{had}}} \geq 0$
  - *3L1T*: $N_{e/\mu} = 3$ and $N_{\tau_{\text{had}}} = 1$
  - *2L2T*: $N_{e/\mu} = 2$ and $N_{\tau_{\text{had}}} \geq 2$
- A general region 5*L0T* with $N_{e/\mu} \geq 5$ also considered
- Further requirements on *Z* veto, presence of *b*-tagged jets, and m_{eff} are applied to define 10 SRs for RPV scenarios

$$m_{\text{eff}} = E_{\text{T}}^{\text{miss}} + \sum_{e,\mu,\tau_{\text{had}},\text{jets}} p_{\text{T}}$$

- Main backgrounds:
  - **Irreducible**: *ZZ* and $t\bar{t}Z$ shape exacted from MC, normalization derived from data
  - **Reducible:** ≥ 1 fake/non-prompt lepton, data-driven estimation (*fake*-factor)

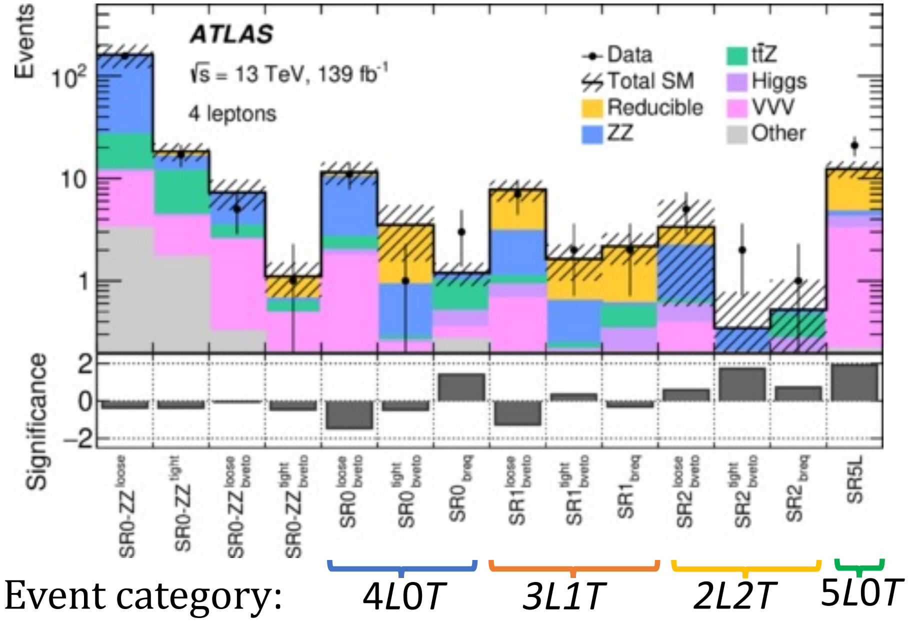


RPV 4-leptons

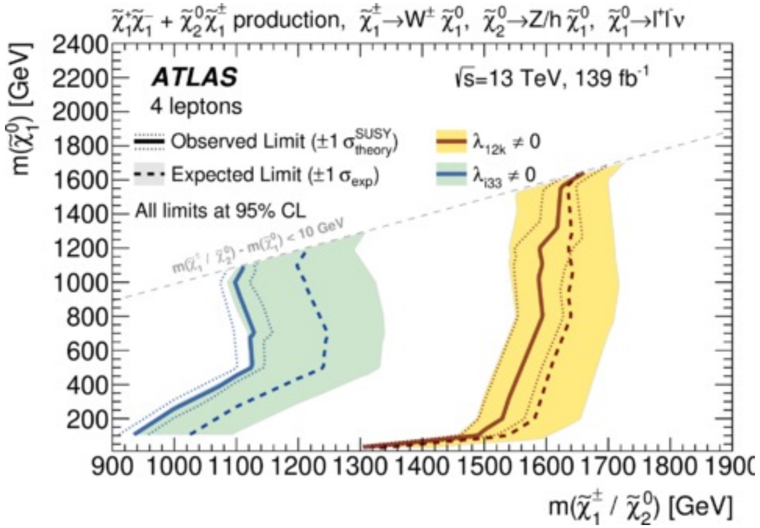
JHEP 07 (2021) 167

$$\frac{1}{2}\lambda_{ijk} L_i L_j E^c_k$$

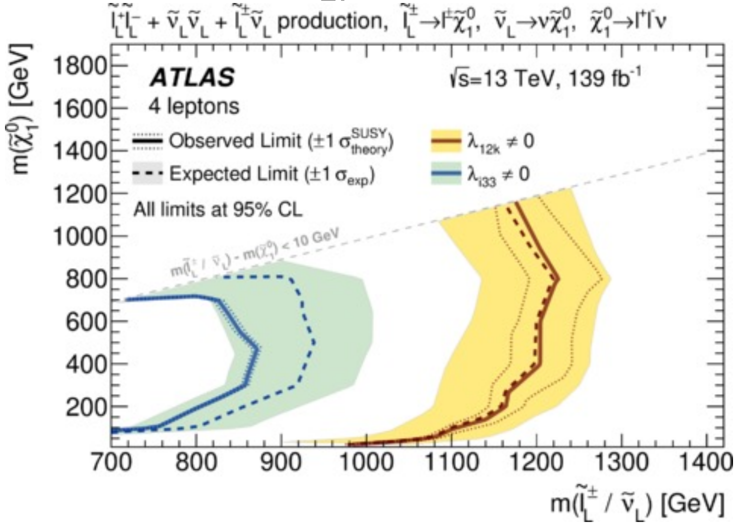
- **Observations in agreement with SM expectations**
  - Highest local significance of 1.9σ in SR5L
  - SR5L yields: $N_{\rm obs}^{SR5L} = 21$, and $N_{\rm SM}^{SR5L} = 12.4 \pm 2.3$
- $\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$, $\tilde{l}_L/\tilde{\nu}$, and $\tilde{g}$ masses up to 1.6 TeV, 1.2 TeV, and 2.5 TeV are, respectively, excluded
  - Improve previous limits in similar models by 100-350 GeV



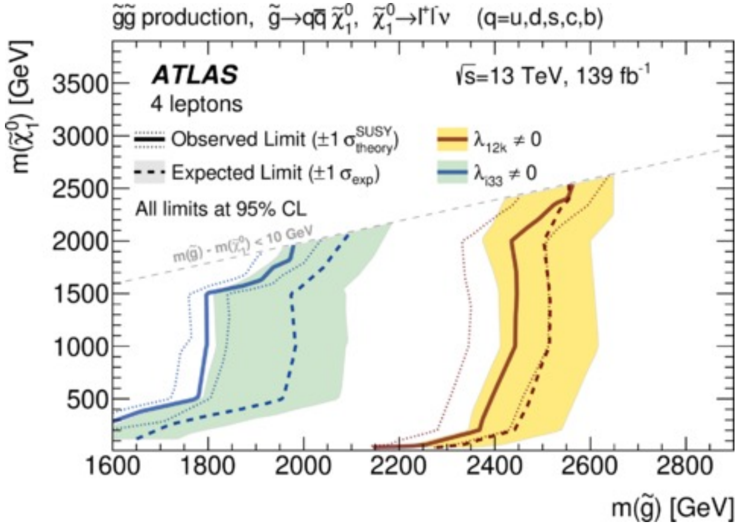
Wino NLSP



$\tilde{l}_L/\tilde{\nu}$ NLSP



$\tilde{g}$ NLSP



RPV multi-b-jet

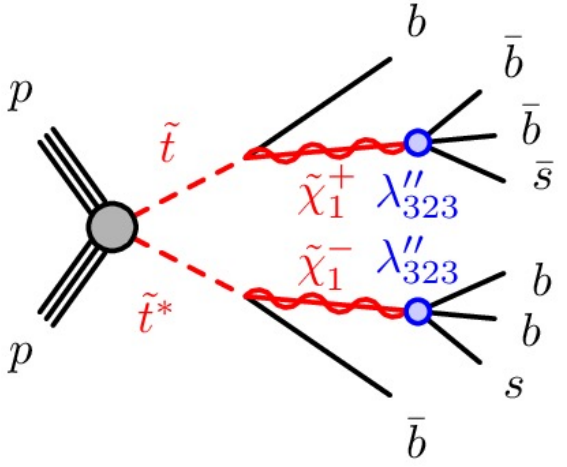
Eur. Phys. J. C 81 (2021) 11

$$\frac{1}{2}\lambda''_{ijk}U_i^cD_j^cD_k^c$$

- Search for top-squark pair production in multi-b-jet final states
  - ≥ 4 jets with $p_{\mathrm{T}} \geq 120$ (140) GeV, extra jets have $p_{\mathrm{T}} \geq 25$ GeV
- **Analysis strategy** is based on **counting events** in different jet number (N_j) and b-tagged jet number (N_b)
- Events selection for SR: $N_j \geq 6$, $N_b \geq 4$, reconstructed lepton vetoed
- **Dominant backgrounds**: multi-jet (data-driven $\mathrm{TRF_{MJ}}$) and $t\bar{t} + X$ (MC)
  - $\mathrm{TRF_{MJ}}$ based on probability of b-tagging extra jet produced in multijet event

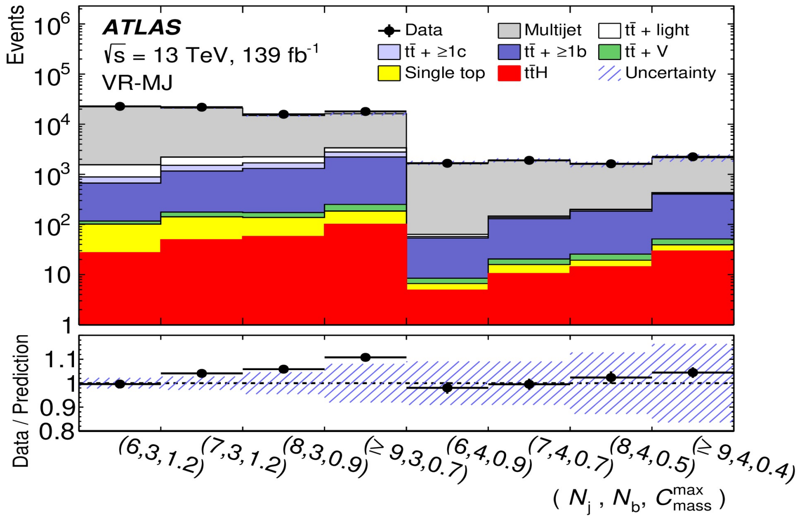
Saturate BR in

$m_{\tilde{t}} - m_{\tilde{\chi}_1^\pm} < m_{top}$



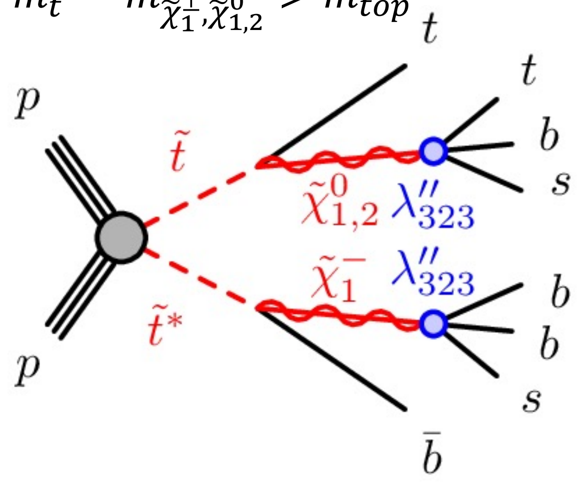
Analysis Regions		N_b 3	4	≥ 5
N_j	6	VR-MJ $C_{\mathrm{mass}}^{\mathrm{max}} = 1.2$	$\mathrm{SR}_{\tilde{t}}$ VR-MJ $C_{\mathrm{mass}}^{\mathrm{max}} = 0.9$	$\mathrm{SR}_{\tilde{t}}$
	7	VR-MJ $C_{\mathrm{mass}}^{\mathrm{max}} = 1.2$	$\mathrm{SR}_{\tilde{t}}$ VR-MJ $C_{\mathrm{mass}}^{\mathrm{max}} = 0.7$	$\mathrm{SR}_{\tilde{t}}$
	8	VR-MJ $C_{\mathrm{mass}}^{\mathrm{max}} = 0.9$	$\mathrm{SR}_{\tilde{t}}$ VR-MJ $C_{\mathrm{mass}}^{\mathrm{max}} = 0.5$	$\mathrm{SR}_{\tilde{t}}$, $\mathrm{SR_{discovery}}$
	≥ 9	VR-MJ $C_{\mathrm{mass}}^{\mathrm{max}} = 0.7$	$\mathrm{SR}_{\tilde{t}}$ VR-MJ $C_{\mathrm{mass}}^{\mathrm{max}} = 0.4$	$\mathrm{SR}_{\tilde{t}}$, $\mathrm{SR_{discovery}}$

VR-MJ: $\mathrm{TRF_{MJ}}$ validation regions



Significant in

$m_{\tilde{t}} - m_{\tilde{\chi}_1^\pm,\tilde{\chi}_{1,2}^0} > m_{top}$

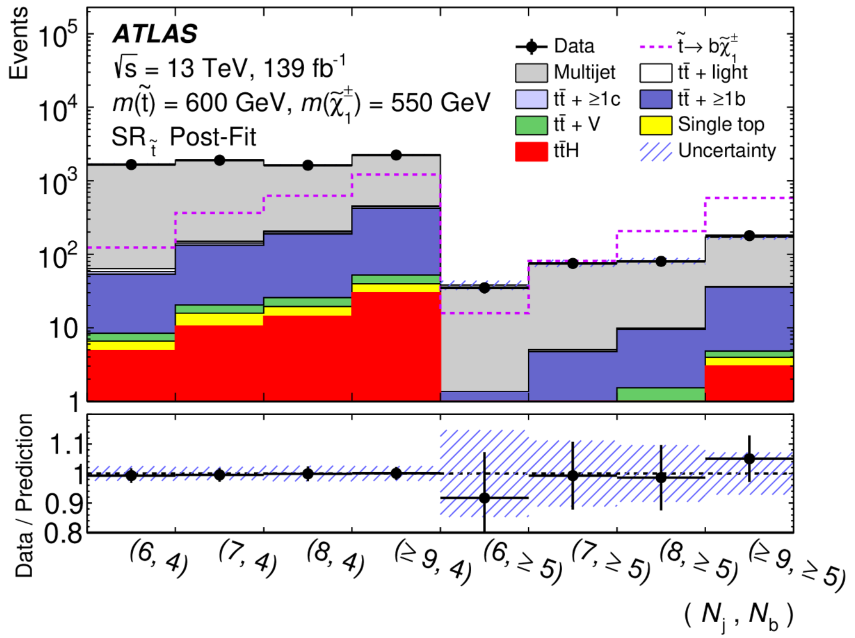


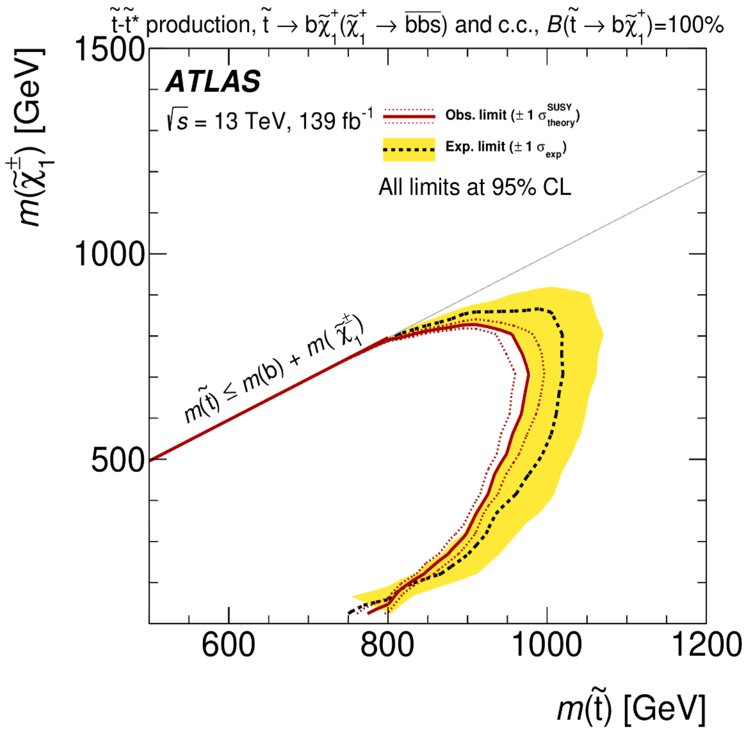
RPV multi-*b*-jet

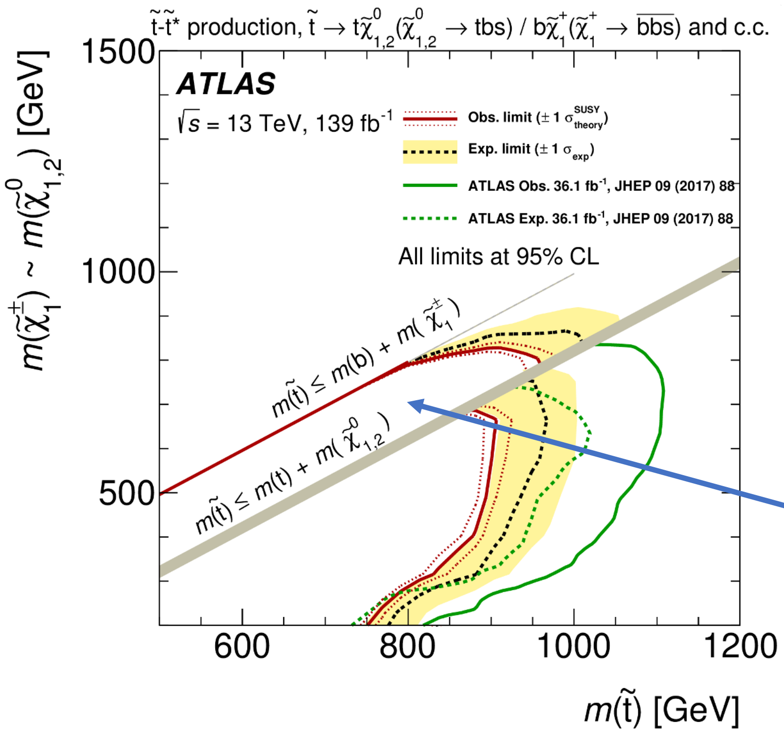
$$\frac{1}{2}\lambda''_{ijk}U_i^c D_j^c D_k^c$$

- Events with $N_j \geq 6, N_b \geq 4$ are input for multi-bin fit
- **No significant excess over the SM expectation observed**
- Exclusion of top-squark masses reaches 950 GeV

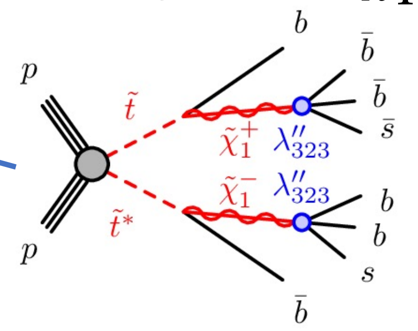
Hypothesis testing based on Profile Likelihood







First limits on top-squarks decay exclusively into $b + \tilde{\chi}_1^{\pm}$

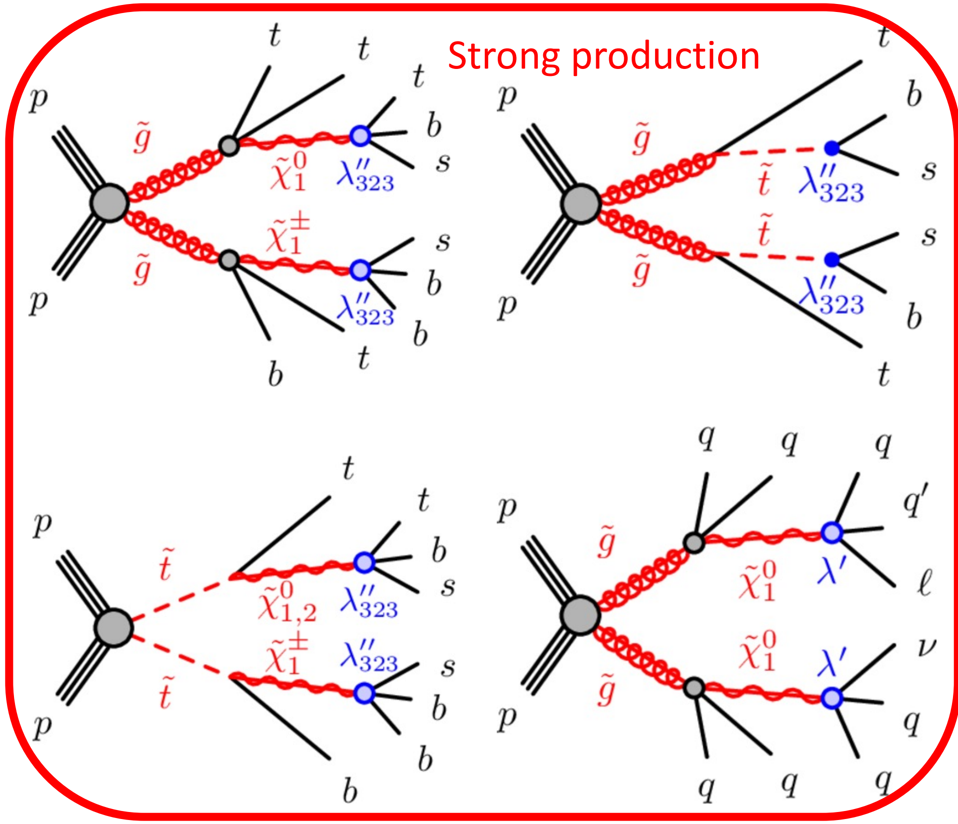


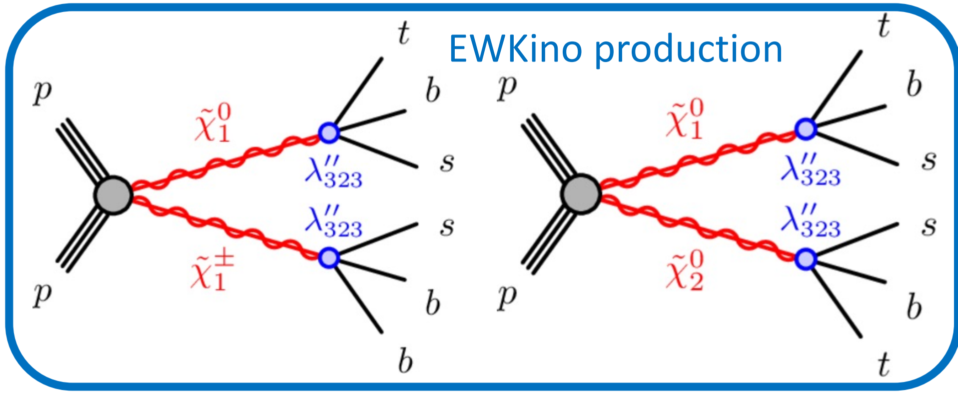
RPV multi-jet 1-lepton

Eur. Phys. J. C 81 (2021) 1023

$$\lambda'_{ijk} L_i Q_j D^c_k + \frac{1}{2}\lambda''_{ijk} U^c_i D^c_j D^c_k$$

- Search for RPV signals in final states with ≥ 1 lepton, ≥ 8 to 15 jets, some of which are b-tagged, no $E_{\mathrm{T}}^{\mathrm{miss}}$ required
  - 3 production modes: gluinos, top-squark, electroweakinos
- Events are split into two disjoint categories: $1l$ and $2l^{sc}$ and further categorized based on jet and b-jet multiplicity
- **Two analysis strategies** depending on production type
  - **Jet counting**: 5 jet-p_{T} thresholds of 20, 40, 60, 80, 100 GeV corresponding to highest jet multiplicity considered
  - **EWK analysis**: NN discriminant ($1l$ only) introduced to separate higgsino signal from $t\bar{t}$ background
- Multi-bin fit to two-dimensional space of jet and b-jet multiplicity is performed to constrain SUSY parameters





RPV multi-jet 1-lepton

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$$\lambda'_{ijk} L_i Q_j D^c_k + \frac{1}{2}\lambda''_{ijk} U^c_i D^c_j D^c_k$$

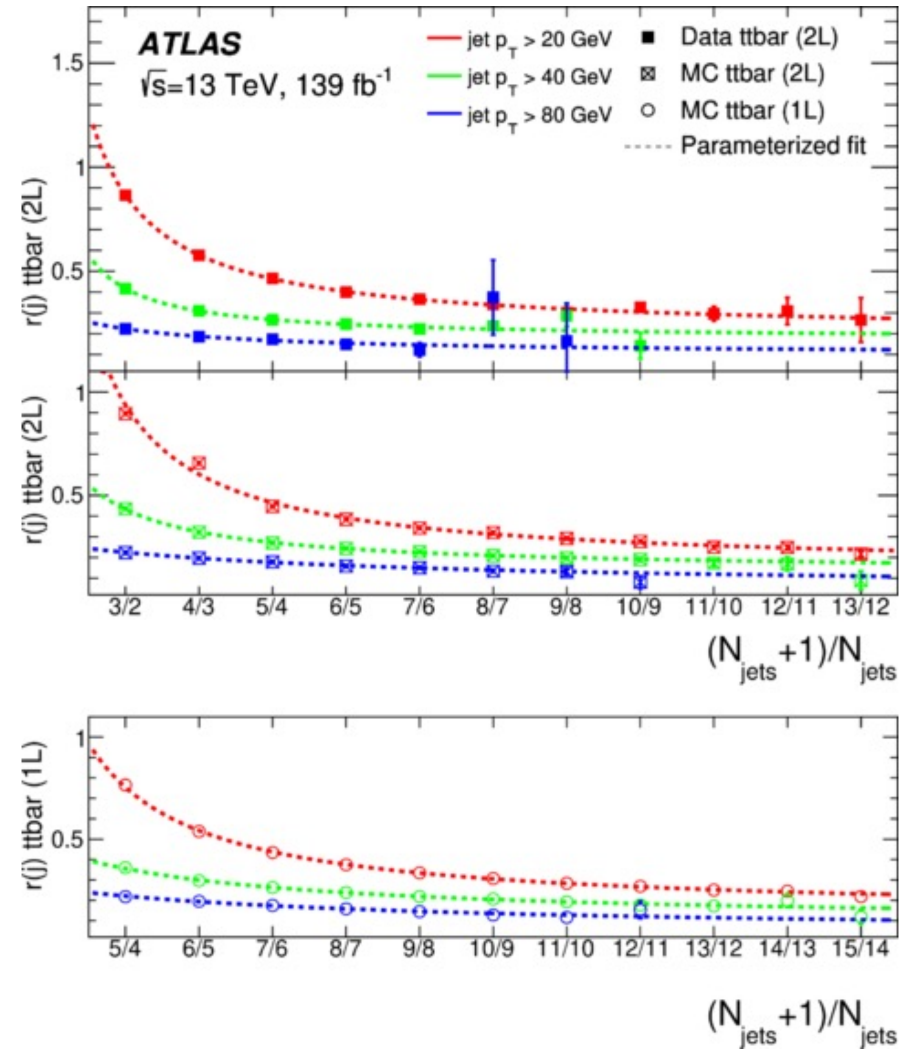
- **Main backgrounds**: W/Z + jets, $t\bar{t}$ + jets, VV, $t\bar{t}W$
  - Suffer from large uncertainties at high jet multiplicity
  - Data-driven approach: extrapolate background estimation from moderate to high jet multiplicity
- **Evolution of background events** for process X parameterized:

$$r^X(j) \equiv N^X_{j+1}/N^X_j = c^X_0 + c^X_1/(j + c^X_2),$$

- c^X_i are process-dependent constants and extracted from data
- **Background yields** of process X in j-th jet slice formulated as

$$N^X_j = N^X_4 \prod_{j'=4}^{j'=j-1} r^X(j')$$

- Similar approach for b-jet multiplicity prediction of process X



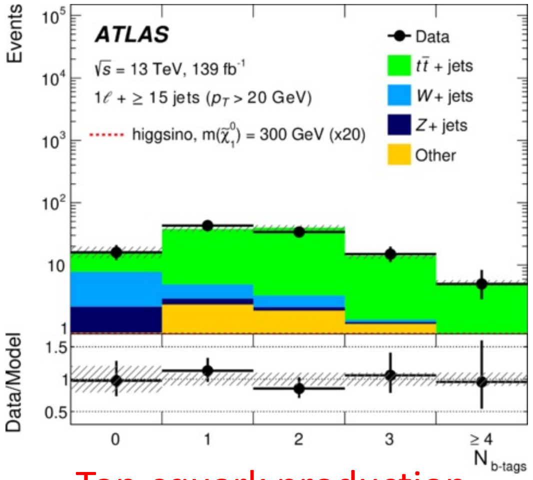
RPV multi-jet 1-lepton

Eur. Phys. J. C 81 (2021) 1023

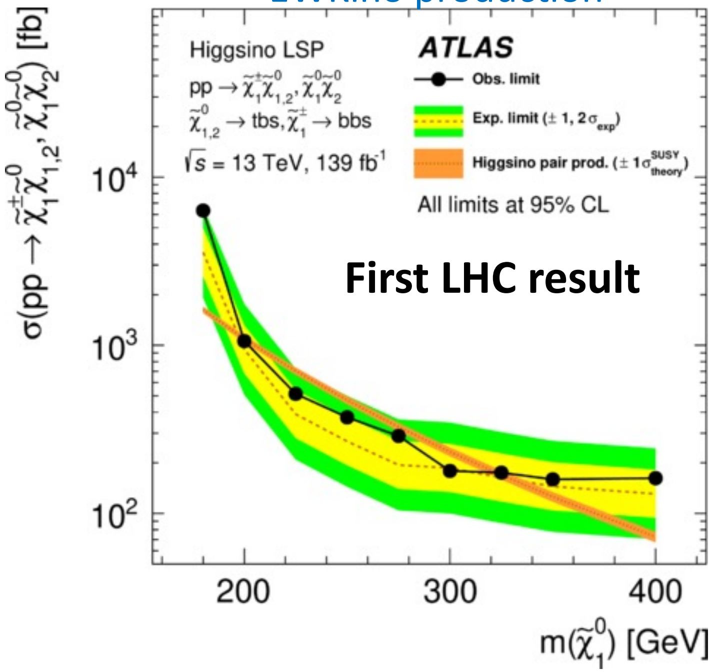
$$\lambda'_{ijk} L_i Q_j D^c_k + \frac{1}{2}\lambda''_{ijk} U^c_i D^c_j D^c_k$$

- **No observed significant excess over the SM expectation**
- Higgsino masses between 200 and 320 GeV excluded
- Exclusion of gluino and top-squark masses up to 2.38 TeV and 1.36 TeV
- Sensitive to SM $t\bar{t}t\bar{t}$ production: $\mu_{t\bar{t}t\bar{t}} = 2.0^{+0.9}_{-0.7}$

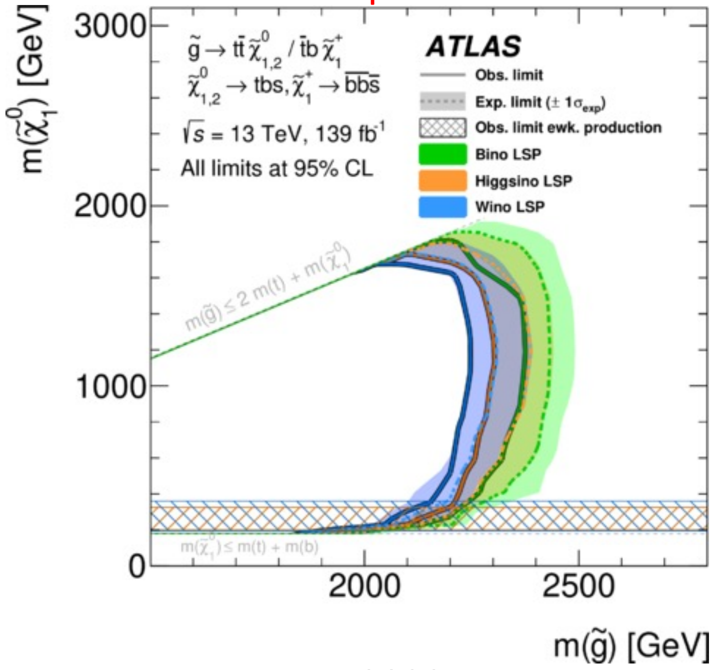
EWK, $1l$, ≥15 jets, ($p_T \geq 20$ GeV)



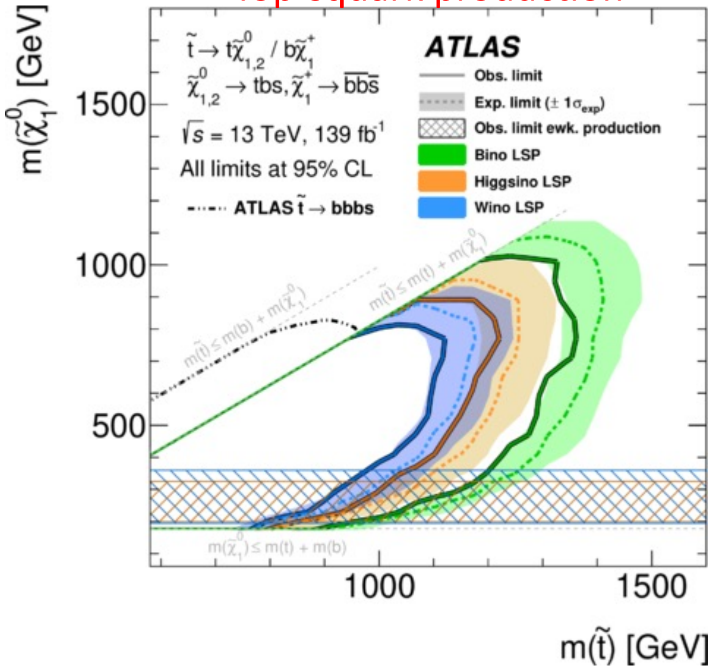
EWKino production



Gluino production



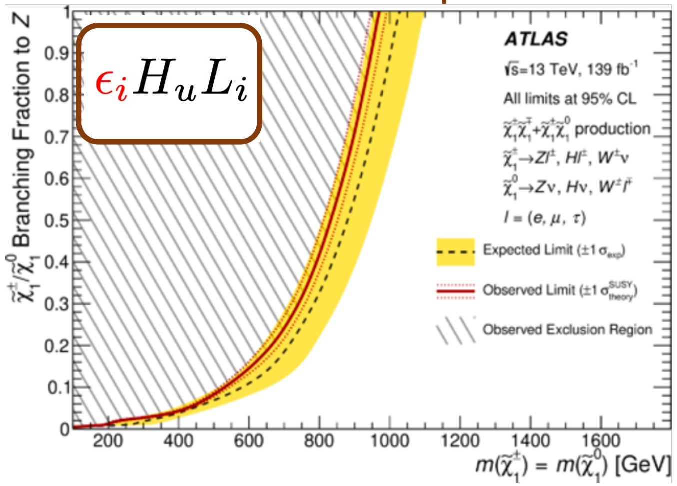
Top-squark production



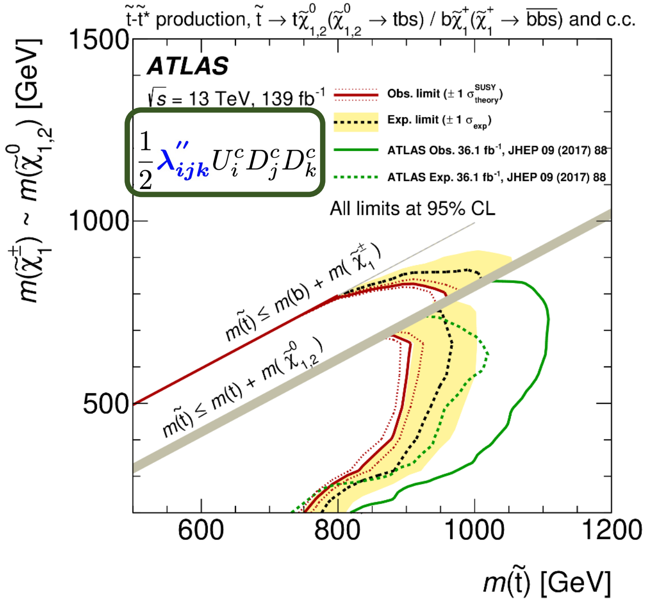
Conclusions

- ATLAS searches for SUSY RPV cover a wide range of scenarios
  - No significant excess beyond SM expectations observed yet
- Many ATLAS RPV searches not covered can be found in
  - [ATLAS SUSY RPV Public Results]
- Run-3 LHC is coming with lots more data to study → Stay tuned!

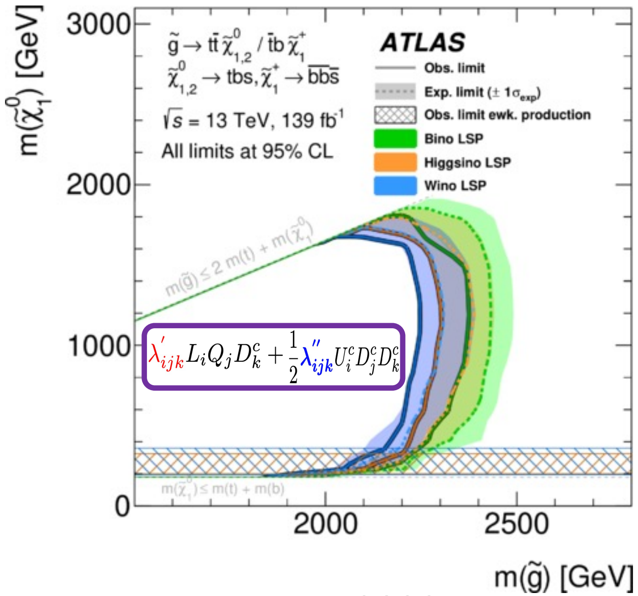
RPV EW 3-leptons



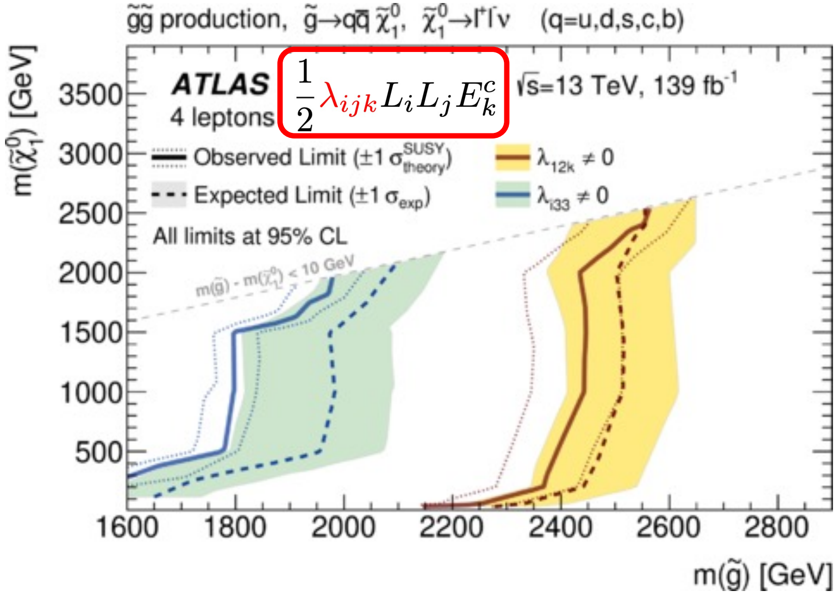
RPV multi-*b*-jet



RPV multi-jet 1-lepton



RPV 4-leptons



THANK YOU

ATLAS SUSY searches

[ATL-PHYS-PUB-2021-019]

ATLAS SUSY Searches* - 95% CL Lower Limits
June 2021

ATLAS Preliminary
$\sqrt{s}$ = 13 TeV

	Model	Signature			$\int \mathcal{L}\, dt$ [fb^{-1}]	Mass limit		Reference
Inclusive Searches	$\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}_1^0$	0 e,μ	2-6 jets	E_T^{miss}	139	$\tilde{q}$ [1×, 8× Degen.] 1.0 1.85	m($\tilde{\chi}_1^0$)<400 GeV	2010.14293
		mono-jet	1-3 jets	E_T^{miss}	36.1	$\tilde{q}$ [8× Degen.] 0.9	m($\tilde{q}$)-m($\tilde{\chi}_1^0$)=5 GeV	2102.10874
	$\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}\tilde{\chi}_1^0$	0 e,μ	2-6 jets	E_T^{miss}	139	$\tilde{g}$ 2.3	m($\tilde{\chi}_1^0$)=0 GeV	2010.14293
						$\tilde{g}$ Forbidden 1.15-1.95	m($\tilde{\chi}_1^0$)=1000 GeV	2010.14293
	$\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}W\tilde{\chi}_1^0$	1 e,μ	2-6 jets		139	$\tilde{g}$ 2.2	m($\tilde{\chi}_1^0$)<600 GeV	2101.01629
	$\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}(\ell\ell)\tilde{\chi}_1^0$	$ee,\mu\mu$	2 jets	E_T^{miss}	36.1	$\tilde{g}$ 1.2	m($\tilde{g}$)-m($\tilde{\chi}_1^0$)=50 GeV	1805.11381
	$\tilde{g}\tilde{g}, \tilde{g}\to qqWZ\tilde{\chi}_1^0$	0 e,μ	7-11 jets	E_T^{miss}	139	$\tilde{g}$ 1.97	m($\tilde{\chi}_1^0$) <600 GeV	2008.06032
		SS e,μ	6 jets		139	$\tilde{g}$ 1.15	m($\tilde{g}$)-m($\tilde{\chi}_1^0$)=200 GeV	1909.08457
	$\tilde{g}\tilde{g}, \tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0-1 e,μ	3 b	E_T^{miss}	79.8	$\tilde{g}$ 2.25	m($\tilde{\chi}_1^0$)<200 GeV	ATLAS-CONF-2018-041
		SS e,μ	6 jets		139	$\tilde{g}$ 1.25	m($\tilde{g}$)-m($\tilde{\chi}_1^0$)=300 GeV	1909.08457
3rd gen. squarks direct production	$\tilde{b}_1\tilde{b}_1$	0 e,μ	2 b	E_T^{miss}	139	$\tilde{b}_1$ 1.255	m($\tilde{\chi}_1^0$)<400 GeV	2101.12527
						$\tilde{b}_1$ 0.68	10 GeV<Δm($\tilde{b}_1,\tilde{\chi}_1^0$)<20 GeV	2101.12527
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to b\tilde{\chi}_2^0 \to bh\tilde{\chi}_1^0$	0 e,μ	6 b	E_T^{miss}	139	$\tilde{b}_1$ Forbidden 0.23-1.35	Δm($\tilde{\chi}_2^0,\tilde{\chi}_1^0$)=130 GeV, m($\tilde{\chi}_1^0$)=100 GeV	1908.03122
		2 τ	2 b	E_T^{miss}	139	$\tilde{b}_1$ 0.13-0.85	Δm($\tilde{\chi}_2^0,\tilde{\chi}_1^0$)=130 GeV, m($\tilde{\chi}_1^0$)=0 GeV	ATLAS-CONF-2020-031
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to t\tilde{\chi}_1^0$	0-1 e,μ	≥ 1 jet	E_T^{miss}	139	$\tilde{t}_1$ 1.25	m($\tilde{\chi}_1^0$)=1 GeV	2004.14060,2012.03799
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to Wb\tilde{\chi}_1^0$	1 e,μ	3 jets/1 b	E_T^{miss}	139	$\tilde{t}_1$ Forbidden 0.65	m($\tilde{\chi}_1^0$)=500 GeV	2012.03799
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to\tilde{\tau}_1 b\nu, \tilde{\tau}_1\to\tau\tilde{G}$	1-2 τ	2 jets/1 b	E_T^{miss}	139	$\tilde{t}_1$ Forbidden 1.4	m($\tilde{\tau}_1$)=800 GeV	ATLAS-CONF-2021-008
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to c\tilde{\chi}_1^0$ / $\tilde{c}\tilde{c}, \tilde{c}\to c\tilde{\chi}_1^0$	0 e,μ	2 c	E_T^{miss}	36.1	$\tilde{c}$ 0.85	m($\tilde{\chi}_1^0$)=0 GeV	1805.01649
		0 e,μ	mono-jet	E_T^{miss}	139	$\tilde{t}_1$ 0.55	m($\tilde{t}_1,\tilde{c}$)-m($\tilde{\chi}_1^0$)=5 GeV	2102.10874
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to t\tilde{\chi}_2^0, \tilde{\chi}_2^0\to Z/h\tilde{\chi}_1^0$	1-2 e,μ	1-4 b	E_T^{miss}	139	$\tilde{t}_1$ 0.067-1.18	m($\tilde{\chi}_2^0$)=500 GeV	2006.05880
	$\tilde{t}_2\tilde{t}_2, \tilde{t}_2\to\tilde{t}_1 + Z$	3 e,μ	1 b	E_T^{miss}	139	$\tilde{t}_2$ Forbidden 0.86	m($\tilde{\chi}_1^0$)=360 GeV, m($\tilde{t}_1$)-m($\tilde{\chi}_1^0$)= 40 GeV	2006.05880
EW direct	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0$ via WZ	Multiple ℓ/jets		E_T^{miss}	139	$\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$ 0.96	m($\tilde{\chi}_1^0$)=0, wino-bino	2106.01676, ATLAS-CONF-2021-022
		$ee,\mu\mu$	≥ 1 jet	E_T^{miss}	139	$\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$ 0.205	m($\tilde{\chi}_1^{\pm}$)-m($\tilde{\chi}_1^0$)=5 GeV, wino-bino	1911.12606
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{\mp}$ via WW	2 e,μ		E_T^{miss}	139	$\tilde{\chi}_1^{\pm}$ 0.42	m($\tilde{\chi}_1^0$)=0, wino-bino	1908.08215
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0$ via Wh	Multiple ℓ/jets		E_T^{miss}	139	$\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$ Forbidden 1.06	m($\tilde{\chi}_1^0$)=70 GeV, wino-bino	2004.10894, ATLAS-CONF-2021-022
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{\mp}$ via $\tilde{\ell}_L/\tilde{\nu}$	2 e,μ		E_T^{miss}	139	$\tilde{\chi}_1^{\pm}$ 1.0	m($\tilde{\ell},\tilde{\nu}$)=0.5(m($\tilde{\chi}_1^{\pm}$)+m($\tilde{\chi}_1^0$))	1908.08215
	$\tilde{\tau}\tilde{\tau}, \tilde{\tau}\to\tau\tilde{\chi}_1^0$	2 τ		E_T^{miss}	139	$\tilde{\tau}$ [$\tilde{\tau}_L, \tilde{\tau}_{R,L}$] 0.16-0.3 0.12-0.39	m($\tilde{\chi}_1^0$)=0	1911.06660
	$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}, \tilde{\ell}\to\ell\tilde{\chi}_1^0$	2 e,μ	0 jets	E_T^{miss}	139	$\tilde{\ell}$ 0.7	m($\tilde{\chi}_1^0$)=0	1908.08215
		$ee,\mu\mu$	≥ 1 jet	E_T^{miss}	139	$\tilde{\ell}$ 0.256	m($\tilde{\ell}$)-m($\tilde{\chi}_1^0$)=10 GeV	1911.12606
	$\tilde{H}\tilde{H}, \tilde{H}\to h\tilde{G}/Z\tilde{G}$	0 e,μ	≥ 3 b	E_T^{miss}	36.1	$\tilde{H}$ 0.13-0.23 0.29-0.88	BR($\tilde{\chi}_1^0\to h\tilde{G}$)=1	1806.04030
		4 e,μ	0 jets	E_T^{miss}	139	$\tilde{H}$ 0.55	BR($\tilde{\chi}_1^0\to Z\tilde{G}$)=1	2103.11684
		0 e,μ	≥ 2 large jets	E_T^{miss}	139	$\tilde{H}$ 0.45-0.93	BR($\tilde{\chi}_1^0\to Z\tilde{G}$)=1	ATLAS-CONF-2021-022
Long-lived particles	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^{\pm}$	Disapp. trk	1 jet	E_T^{miss}	139	$\tilde{\chi}_1^{\pm}$ 0.66	Pure Wino	ATLAS-CONF-2021-015
						$\tilde{\chi}_1^{\pm}$ 0.21	Pure higgsino	ATLAS-CONF-2021-015
	Stable $\tilde{g}$ R-hadron		Multiple		36.1	$\tilde{g}$ 2.0		1902.01636,1808.04095
	Metastable $\tilde{g}$ R-hadron, $\tilde{g}\to qq\tilde{\chi}_1^0$		Multiple		36.1	$\tilde{g}$ [$\tau(\tilde{g})$ =10 ns, 0.2 ns] 2.05 2.4	m($\tilde{\chi}_1^0$)=100 GeV	1710.04901,1808.04095
	$\tilde{\ell}\tilde{\ell}, \tilde{\ell}\to\ell\tilde{G}$	Displ. lep		E_T^{miss}	139	$\tilde{e},\tilde{\mu}$ 0.7	$\tau(\tilde{\ell})$ = 0.1 ns	2011.07812
						$\tilde{\tau}$ 0.34	$\tau(\tilde{\ell})$ = 0.1 ns	2011.07812
RPV	$\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{\mp}/\tilde{\chi}_1^0, \tilde{\chi}_1^{\pm}\to Z\ell\to\ell\ell\ell$	3 e,μ			139	$\tilde{\chi}_1^{\mp}/\tilde{\chi}_1^0$ [BR($Z\tau$)=1, BR(Ze)=1] 0.625 1.05	Pure Wino	2011.10543
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{\mp}/\tilde{\chi}_2^0 \to WW/Z\ell\ell\ell\ell\nu\nu$	4 e,μ	0 jets	E_T^{miss}	139	$\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$ [$\lambda_{i33}\neq 0, \lambda_{12k}\neq 0$] 0.95 1.55	m($\tilde{\chi}_1^0$)=200 GeV	2103.11684
	$\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}_1^0, \tilde{\chi}_1^0\to qqq$		4-5 large jets		36.1	$\tilde{g}$ [m($\tilde{\chi}_1^0$)=200 GeV, 1100 GeV] 1.3 1.9	Large λ''_{112}	1804.03568
	$\tilde{t}\tilde{t}, \tilde{t}\to t\tilde{\chi}_1^0, \tilde{\chi}_1^0\to tbs$		Multiple		36.1	$\tilde{t}$ [λ''_{323}=2e-4, 1e-2] 0.55 1.05	m($\tilde{\chi}_1^0$)=200 GeV, bino-like	ATLAS-CONF-2018-003
	$\tilde{t}\tilde{t}, \tilde{t}\to b\tilde{\chi}_1^{\pm}, \tilde{\chi}_1^{\pm}\to bbs$		≥ 4b		139	$\tilde{t}$ Forbidden 0.95	m($\tilde{\chi}_1^{\pm}$)=500 GeV	2010.01015
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to bs$		2 jets + 2 b		36.7	$\tilde{t}_1$ [qq, bs] 0.42 0.61		1710.07171
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to q\ell$	2 e,μ	2 b		36.1	$\tilde{t}_1$ 0.4-1.45	BR($\tilde{t}_1\to be/b\mu$)>20%	1710.05544
		1 μ	DV		136	$\tilde{t}_1$ [1e-10< λ'_{23k} <1e-8, 3e-10< λ'_{23k} <3e-9] 1.0 1.6	BR($\tilde{t}_1\to q\mu$)=100%, cosθ_t=1	2003.11956
	$\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0/\tilde{\chi}_1^0, \tilde{\chi}_{1,2}^0\to tbs, \tilde{\chi}_1^{+}\to bbs$	1-2 e,μ	≥6 jets		139	$\tilde{\chi}_1^0$ 0.2-0.32	Pure higgsino	ATLAS-CONF-2021-007

Mass scale [TeV] (axis: 10^{-1}, 1)

RPV EW 3-leptons
RPV 4-leptons
RPV multi-b-jet

*Only a selection of the available mass limits on new states or phenomena is shown. Many of the limits are based on simplified models, c.f. refs. for the assumptions made.