Search for SUSY with two same-sign leptons or three leptons and jets at $\sqrt{s}$ = 13 TeV with the ATLAS Detector

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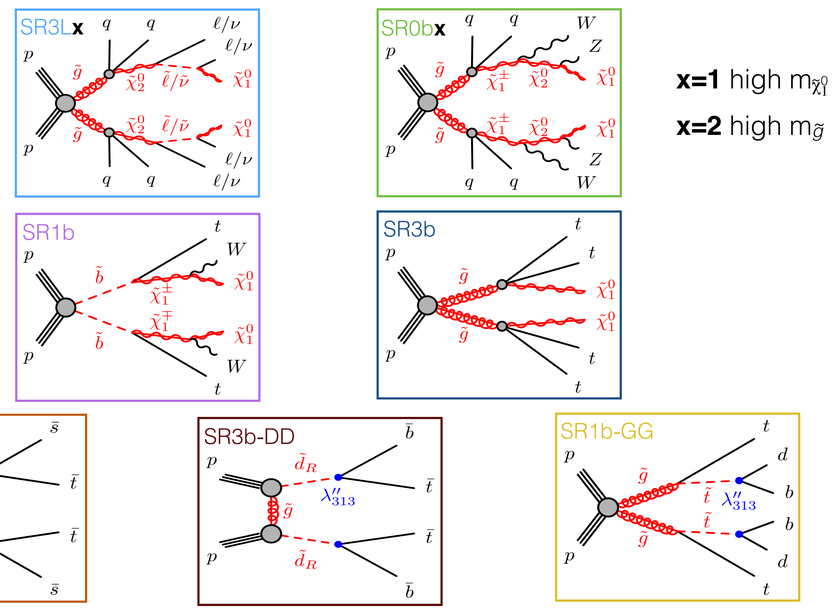
1 Introduction

Supersymmetry (SUSY) is a well motivated extension of the Standard Model (SM) that postulates the existence of a super-partner for each SM particle. A search for strongly produced SUSY particles decaying to a pair of two isolated **same-sign leptons** (**SS**) or **three leptons** (**3L**) has been carried out in 13.2 fb^{-1} of 13 TeV data collected by the ATLAS experiment. The analysis benefits from a low SM background and uses looser kinematic requirements compared to other beyond the SM searches (BSM) which increases its sensitivity to scenarios with small mass differences between the SUSY particles, or in which R-parity is not conserved. The results are interpreted in the context of **R-parity conserving** (**RPC**) or **R-parity violating** (**RPV**) simplified signal models.

2 Signal regions

The signal regions (SR) were optimized on SUSY signal scenarios, using the number of (b-tagged) jets, missing transverse momentum (E_T^{miss}), and $m_{eff} = E_T^{miss} + \Sigma\, p_T$ (jets and leptons)



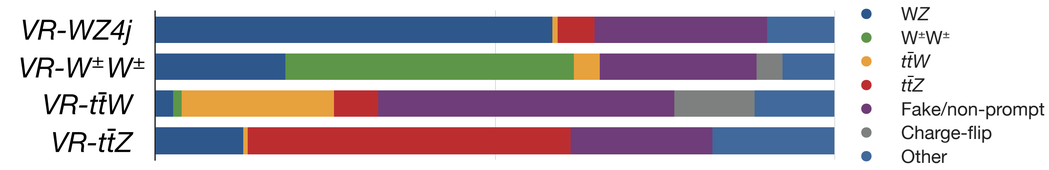
Signal region	N_{lept}^{signal}	N_{b-jets}^{20}	N_{jets}	$p_{T,jets}$ [GeV]	E_T^{miss} [GeV]	m_{eff} [GeV]	Other
SR3L1	≥3	=0	≥4	40	>150	-	-
SR3L2	≥3	=0	≥4	40	>200	>1500	-
SR0b1	≥2	=0	≥6	25	>150	>500	-
SR0b2	≥2	=0	≥6	40	>150	>900	-
SR1b	≥2	≥1	≥6	25	>200	>650	-
SR3b	≥2	≥3	≥6	25	>150	>600	-
SR1b-DD	≥2	≥1	≥4	50	-	>1200	≥ 2 negatively-charged leptons
SR3b-DD	≥2	≥3	≥4	50	-	>1000	≥ 2 negatively-charged leptons
SR1b-GG	≥2	≥1	≥6	50	-	>1800	-

3 Background estimation

Two main background sources:

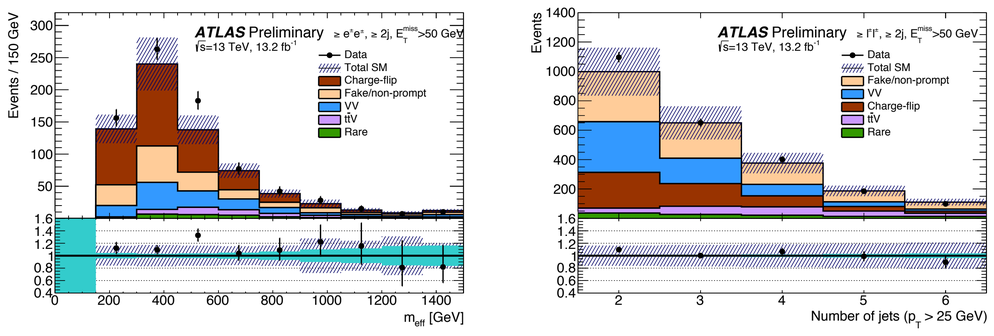
Irreducible Prompt SS or 3L sources estimated with pure MC
- Signal regions without b-jets dominated by dibosons
- Signal regions with b-jets dominated by $t\bar{t}V$ (V=W,Z)

Dedicated validation regions (VR) with enhanced contributions from dibosons and $t\bar{t}V$ are defined to verify the predictions.



	VR-WZ	VR-$W^{\pm}W^{\pm}$	VR-$t\bar{t}W$	VR-$t\bar{t}Z$
Observed	124	32	81	121
Total SM	132 ± 26	26.0 ± 3.7	76 ± 19	139 ± 23

Reducible Fake or non-prompt (FNP) leptons and mis-measured electron charge (charge-flip) estimated using data-driven methods
- FNP leptons mainly from hadron decays estimated by the matrix-method: relies on probabilities that loosely identified real or fake leptons pass tight isolation cuts
- Charge-flip mainly from $t\bar{t}$: use charge-flip rates measured in a $Z/\gamma^* \rightarrow ee$ data sample to re-weight data events in VRs or SRs but with an opposite sign lepton pair requirement.

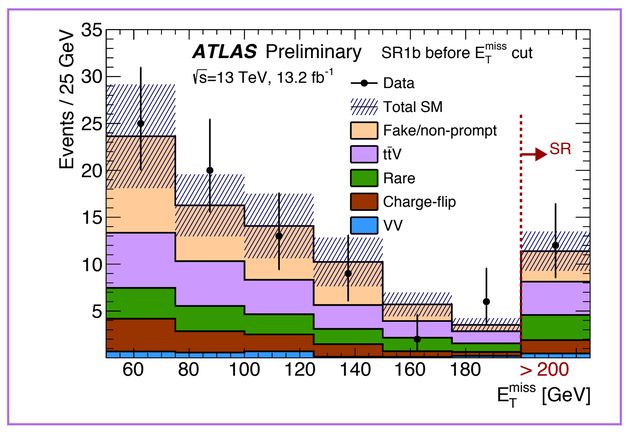


Good overall agreement between data and expected background.

4 Results

The expected contributions from the SM backgrounds and the observed number of events in the SRs are shown below:

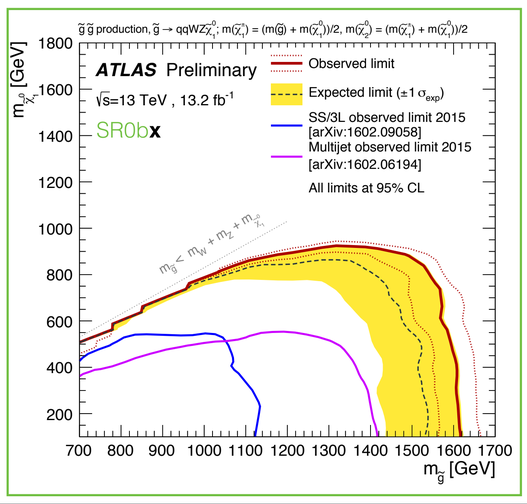
	Observed	Total SM
SR3L1	6	6.1 ± 2.2
SR3L2	2	1.2 ± 0.5
SR0b1	5	8.8 ± 2.9
SR0b2	0	1.6 ± 0.8
SR1b	12	11.4 ± 2.8
SR3b	2	1.6 ± 0.6
SR1b-GG	2	1.7 ± 0.5
SR1b-DD	12	12.0 ± 2.7
SR3b-DD	4	1.9 ± 0.8

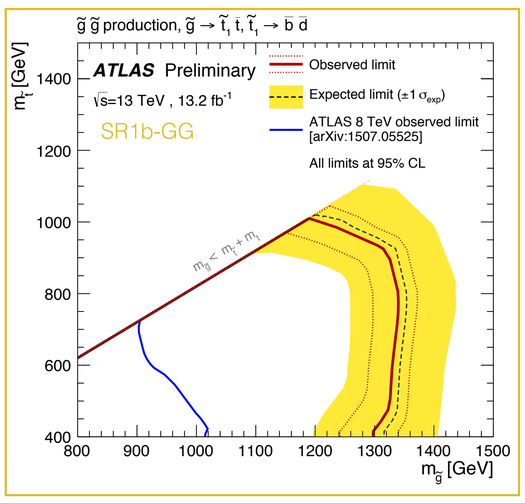


In the absence of any significant deviations from the SM predictions, the frequentist CL_s approach is used to set 95% confidence intervals.

Exclusion limits on 8 simplified models

$\tilde{g}\tilde{g}$ models: $m_{\tilde{g}} < 1.3$ - 1.7 TeV for $m_{\tilde{\chi}_1^0} < 0.85$ - 1.1 TeV
$\tilde{b}_1\tilde{b}_1^*$ model: $m_{\tilde{b}_1} < 690$ GeV for a light $\tilde{\chi}_1^0$
RPV models: $m_{\tilde{d}_R} < 700$ GeV
are **excluded** at 95% confidence level





5 Conclusion

With no significant excess over the SM expectation observed, results are interpreted using SUSY simplified models featuring RPC and RPV scenarios. The analysis improves the sensitivity to BSM processes with respect to previous analyses.

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