Search for pair production of squarks or gluinos with two same-sign or three leptons final states at $\sqrt{s}$=13 TeV with the ATLAS detector

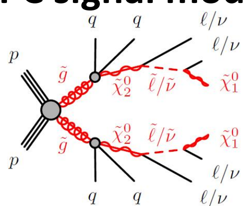
Introduction

This poster presents recent up-to-date results of the search for squarks or gluinos with two same-sign or three leptons final state using run2 data of ATLAS detector.

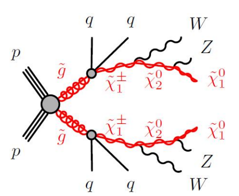
- Squarks and gluinos have significantly larger production cross sections (strong production) than weak gauginos and sleptons.
- Two same-sign or three leptons final state have low SM backgrounds thus it allows the use of relatively loose kinematic requirements to increase sensitivity to compressed scenarios.

This search is sensitive to a wide variety of models.

RPC signal models



GG 2-step via sleptons



GG 2-step via WZ bosons

Event selection

- Bad event cleaning: Jet Cleaning, Bad Muon Veto, Primary Vertex
- Trigger strategy: Di-lepton triggers for MET<250 GeV, MET triggers for MET>250 GeV
- Pre-selection: at least two signal leptons
- Signal regions definition:

SRs for RPC GG 2-step via sleptons

RpcGGslep1	RpcGGslep2	RpcGGslep3
$N_{lept}^{signal} \geq 3$, $N_{jets}^{40GeV} \geq 4$, $N_{b-jets}^{20GeV} == 0$, veto $81 < m_{SFOS} < 101$ GeV		
$E_T^{miss}/\sum p_T^j \geq 0.4$	$E_T^{miss}/\sum p_T^j \geq 0.3$	-
$E_T^{miss}/\sum p_T^{lep} \geq 1.4$	$\Delta\phi(\ell 1\ell 2, E_T^{miss}) > 0.7$	-
$p_T^{\ell 2} \geq 30$ GeV	$p_T^{\ell 2} \geq 70$ GeV	$\sum p_T^j \geq 1200$ GeV
-	$E_T^{miss} \geq 150$ GeV	$E_T^{miss} \geq 100$ GeV

SRs for RPC GG 2-step via WZ

SR	N_{lept}^{signal} (N_{lept}^{base})	N_{b-jets}^{20GeV}	n_{jets}	Jet Pt threshold	E_T^{miss}	m_{eff}	$\Delta\phi(\ell 1\ell 2, E_T^{miss})$	Sig(E_T^{miss})	$m_{eff}/\sum p_T^{lep}$
RpcGGwz1	>=2 (-)	=0	>=6	40 GeV	>150 GeV	>2100 GeV	-	-	-
RpcGGwz2	>=2 (-)	=0	>=6	40 GeV	>190 GeV	>1300 GeV	>0.8	-	-
RpcGGwz3	>=2 (>= 3)	=0	>=6	25 GeV	>200 GeV	-	>0.2	>6	>8

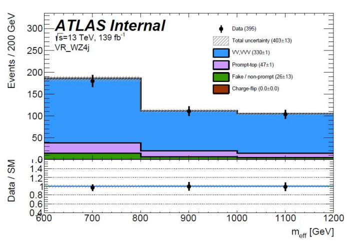
Background estimation

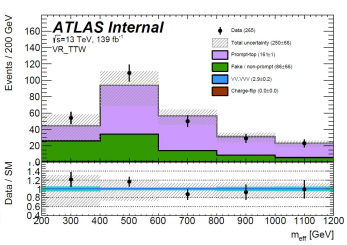
- Irreducible background
  --WZ+jets: estimated from MC, corrected via data in CR
  --Others: estimated directly from MC
- Reducible (or detector) background:
  --TTbarSgTop, V+jet: data-driven method
  --Charge-flip: data-driven method

- **WZ+jets CR is defined to obtain a normalization factor to correct the mis-modelling.**
- **VRs are defined to verify the theoretical predictions of the event yields of these processes in the signal regions.**

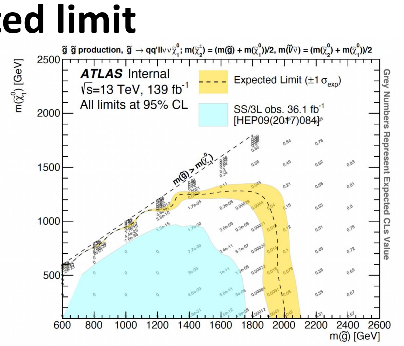
	N_{lept}^{signal} (N_{lept}^{base})	N_{b-jets}^{20GeV}	N_{jets}	jet p_T [GeV]	m_{eff} [GeV]	E_T^{miss} [GeV]	Other cuts	Purity
VRWZ4j	==3 (==3)	==0	≥4	> 25	600 GeV < m_{eff} < 1.5 TeV	30 < E_T^{miss} < 250 GeV	$E_T^{miss}/m_{eff} < 0.2$, $81 < m_{SFOS} < 101$ GeV	80%
VRWZ6j	==3 (==3)	==0	≥6	> 25	400 GeV < m_{eff} < 1.5 TeV	30 < E_T^{miss} < 250 GeV	$E_T^{miss}/m_{eff} < 0.15$, $81 < m_{SFOS} < 101$ GeV	68%
VRTTV	≥2 (≥2) ≥1 SS pair	≥1	≥3	> 40	600 GeV < m_{eff} < 1.5 TeV	30 < E_T^{miss} < 250 GeV	$p_T > 30$ GeV for the $\ell_{1,2}$ SS leptons, $\Delta R(\ell 1, j) > 1.1$, $\sum p_T^{b-j}/\sum p_T^j > 0.4$, $E_T^{miss}/m_{eff} > 0.1$	54%
VRTTW	==2 (==2) only $\mu\mu$ pairs	≥2	≥2	> 25	m_{eff} < 1.5 TeV	30 < E_T^{miss} < 250 GeV	$p_T > 40$ (25) GeV for ℓ_1 (ℓ_2)	43%
VRTTW3j	==2 (==2) only $e\mu$ pairs	≥2	≥3	> 25	m_{eff} < 1.5 TeV	30 < E_T^{miss} < 250 GeV	$p_T > 25$ GeV for $\ell_{1,2}$	30%

	N_{lept}^{signal} (N_{lept}^{base})	N_{b-jets}^{20GeV}	N_{jets}^{25GeV}	Other cuts	Purity
CRWZ2j	==3 (==3)	==0	== 2 or == 3	$30 < E_T^{miss} < 150$ GeV, $m_{eff} < 1.5$ TeV, $\sum p_T^{lep} > 130$ GeV, $81 < m_{SFOS} < 101$ GeV, $p_T > 15$ GeV for $\ell_{1,2}$ forming the SS pair	> 85%

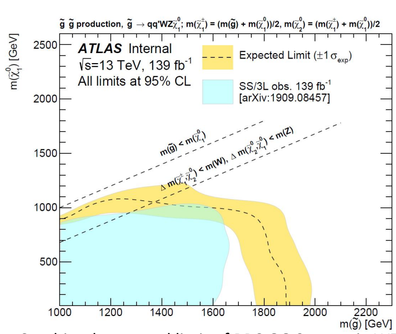




Expected limit



Combined expected limit of GG 2-step via sleptons



Combined expected limit of RPC GG 2-step via WZ

Conclusion

- Expected limit of gluino mass reach to 2000 GeV in GG 2-step via sleptons signal model for a massless lightest neutralino.
- Expected limit of gluino mass reach to 1900 GeV in GG 2-step via WZ signal model for a massless lightest neutralino.

Shiyi Liang (Institute of High Energy Physics, Chinese Academy of Sciences)