



Search for Gluinos in Events with One Isolated Lepton, Jets and Large Missing Transverse Momentum at $\sqrt{s}=13$ TeV with the ATLAS Detector

ICHEP 2016, Aug 3-10, Chicago

Benchmark signal: simplified SUSY model of *gluino* pair production

Only three free parameters: $m_{\tilde{g}}, m_{\tilde{\chi}_1^\pm}$ and m_{LSP}

Two different scenarios considered in this search:

- m_{LSP} fixed to 60 GeV
- $m_{\tilde{\chi}_1^\pm}$ fixed to $(m_{\tilde{g}} + m_{\text{LSP}})/2$ GeV

Lepton p_T used to exploit different SUSY mass spectra:

hard-lepton channel

lepton $p_T > 35$ GeV

large gluino-LSP mass splittings

soft-lepton channel

lepton $p_T < 35$ GeV

compressed SUSY mass spectra

1 lepton (e/μ) + jets + missing transverse momentum

Muons:

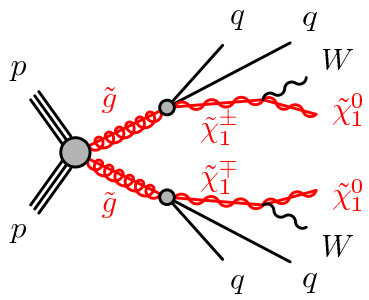
$p_T > 6$ GeV, $|\eta| < 2.5$
Track Quality
Small Impact Param.
Isolation

Electrons:

$p_T > 7$ GeV, $|\eta| < 2.5$
Track & Calo Quality
Small Impact Param.
Isolation

Jets:

$p_T > 30$ GeV, $|\eta| < 2.8$
anti- k_T $R=0.4$
Pileup Suppression
(77% eff. b-tagging)

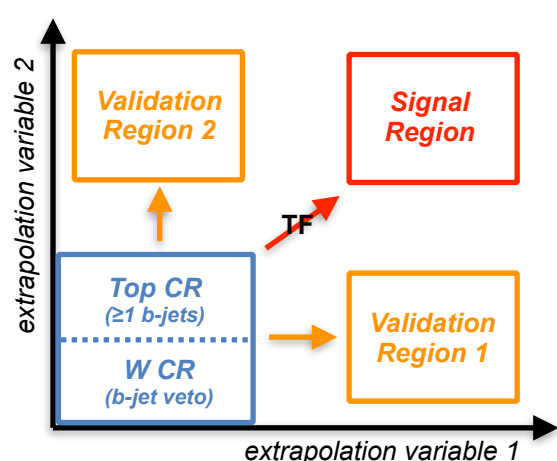


Analysis Strategy

The analysis is based on **14.8 fb⁻¹** of ATLAS data at $\sqrt{s}=13$ TeV:

- selecting events using **missing transverse momentum triggers**;
- requiring **exactly one lepton** (e/μ) in the final state.

Define **Signal Regions (SR)** to enhance a possible SUSY signal in the data over the Standard Model backgrounds. Main discriminating variables: **transverse mass** (m_T), “**effective**” **mass** (m_{eff}), **missing transverse momentum** (E_T^{miss}) and **aplanarity** (Aplanarity).



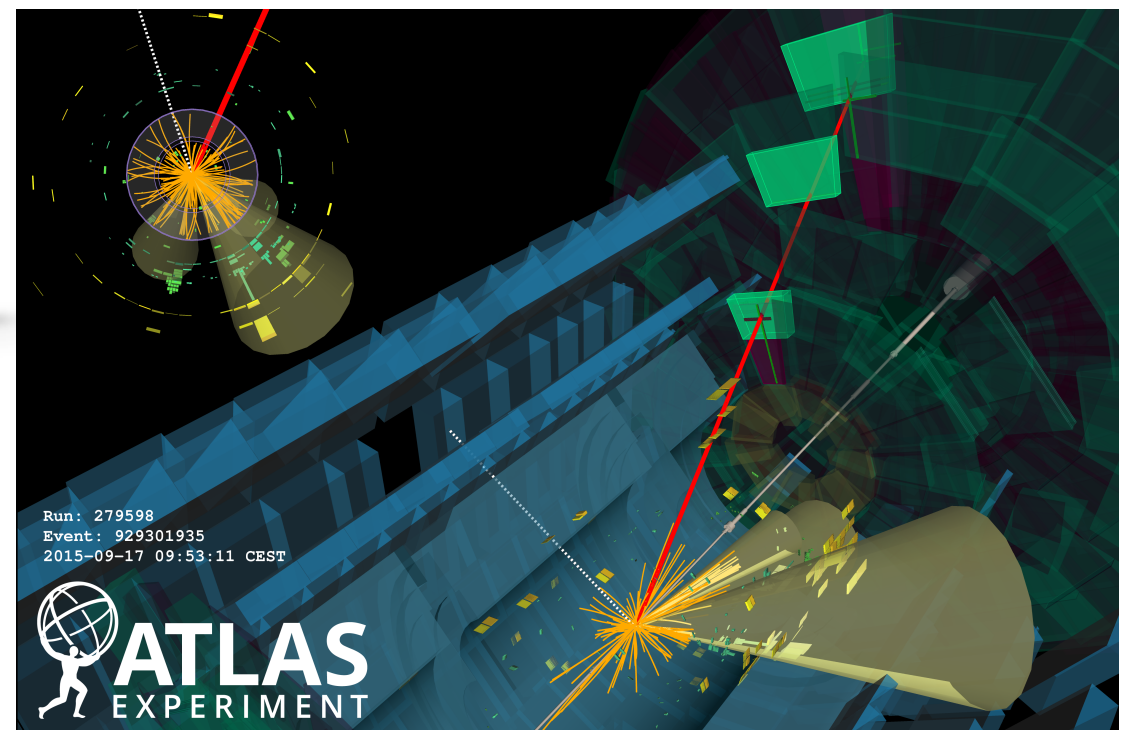
Main backgrounds: $t\bar{t}$, W+jets

- normalization fitted simultaneously to data in specific **Control Regions (CR)**
- extrapolated to SR using MC-based Transfer Factors (TF)

Minor backgrounds: single top, diboson, Z+jets and $t\bar{t}V$

- estimated entirely using MC simulation

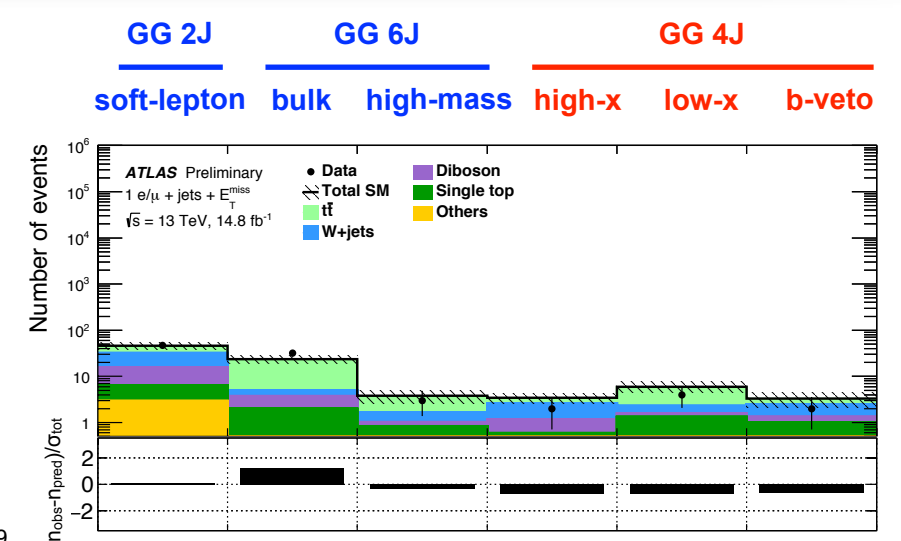
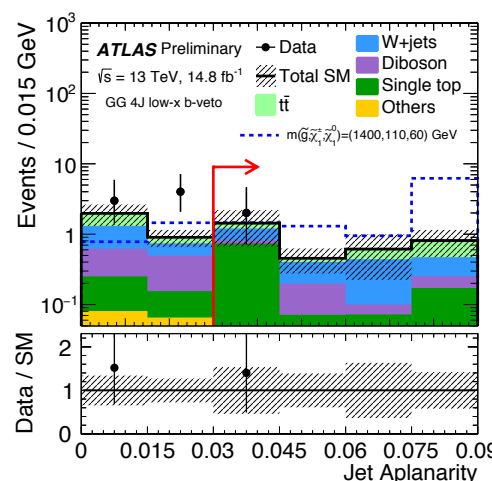
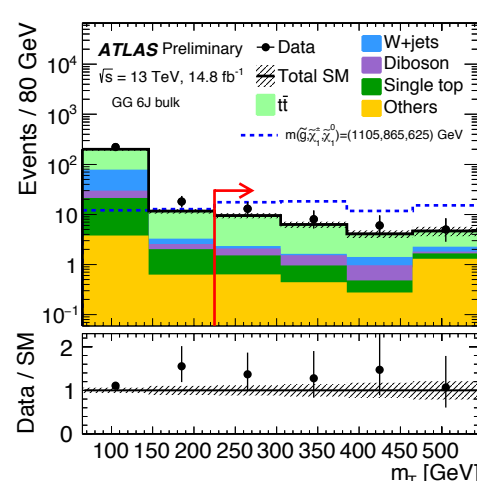
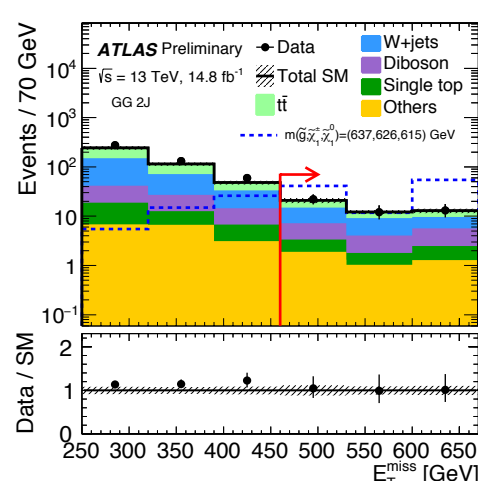
The **final observable** is the absolute number of events observed in each signal region.



SR	GG 2J	GG 6J bulk	GG 6J high-mass	GG 4J low-x	GG 4J low-x b-veto	GG 4J high-x
p_T^l (GeV)	[7(6), 35] for $e(\mu)$	> 35	> 35	> 7(6) for $e(\mu)$	> 7(6) for $e(\mu)$	> 35
N_{jet}	≥ 2	≥ 6	≥ 6	≥ 4	≥ 4	≥ 4
p_T^{jet1} (GeV)	> 200	> 125	> 125	> 100	> 100	> 400
$p_T^{\text{jet2,3}}$ (GeV)	> 30/-	> 30	> 30	> 100	> 100	> 30
p_T^{jet4} (GeV)	-	> 30	> 30	> 100	> 100	[30, 100]
$p_T^{\text{jet5,6}}$ (GeV)	-	> 30	> 30	-	-	-
$N_{b\text{-jet}}$	-	-	-	-	= 0	-
m_T (GeV)	> 100	> 225	> 225	> 125	> 125	> 475
E_T^{miss} (GeV)	> 460	> 250	> 250	> 250	> 250	> 250
m_{eff} (GeV)	-	> 1000	> 2000	> 2000	> 2000	> 1600
$E_T^{\text{miss}}/m_{\text{eff}}^{\text{inc}}$	> 0.35	> 0.2	> 0.1	-	-	> 0.3
Jet aplanarity	-	> 0.04	> 0.04	> 0.06	> 0.03	-

Results

The observed data agree with the Standard Model background prediction in the signal regions. The largest deviation is a 1.1 standard deviation excess in a channel requiring a high- p_T lepton and six jets.



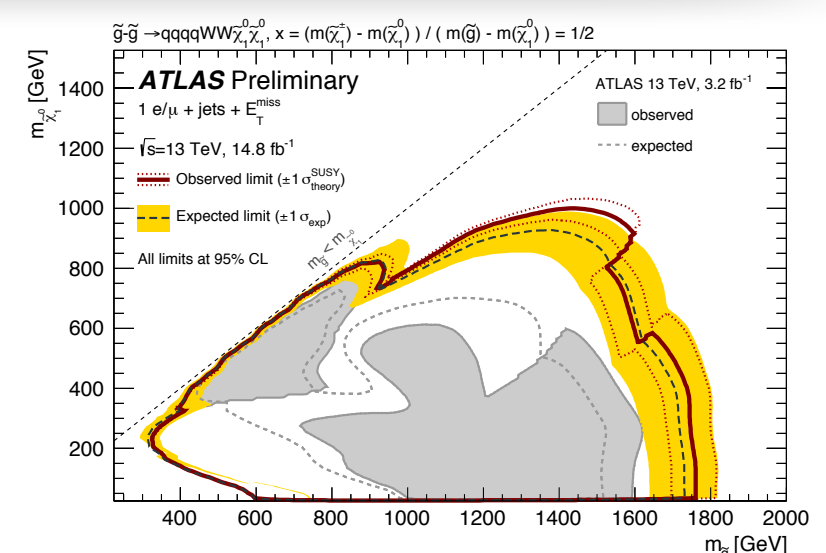
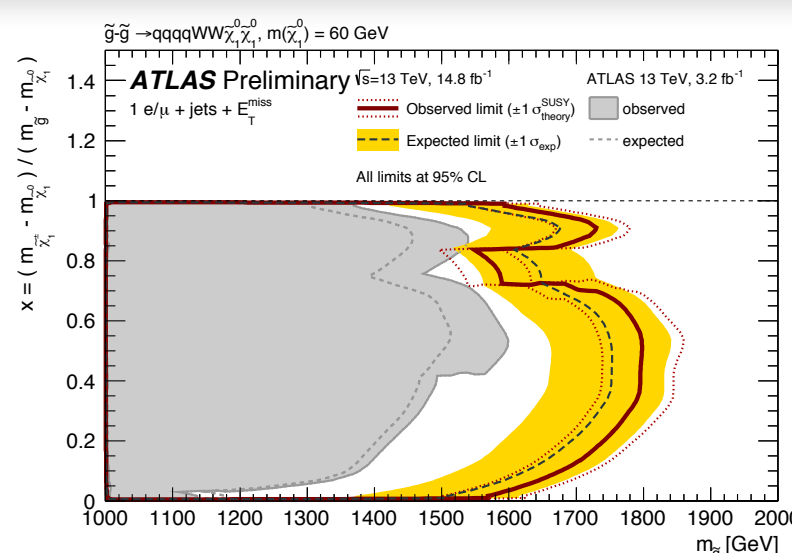
Statistical Interpretation

Observed and expected events in each SR

Region (GG)	2J	6J bulk	6J high-mass	4J low-x	4J low-x b-veto	4J high-x
Observed events	47	32	3	4	2	2
Fitted background events	46 ± 7	24 ± 5	3.8 ± 1.2	6.0 ± 1.6	3.3 ± 1.2	3.4 ± 0.9
Fitted $t\bar{t}$ events	12.4 ± 3.5	17 ± 5	2.0 ± 0.9	3.4 ± 1.6	0.8 ± 0.4	0.7 ± 0.4
Fitted W+jets events	16.7 ± 3.2	1.2 ± 0.5	0.6 ± 0.4	0.7 ± 0.4	1.2 ± 0.7	1.4 ± 0.4
Fitted Z+jets events	2.9 ± 1.7	0.04 ^{+0.07} _{-0.04}	0.11 ± 0.09	0.11 ± 0.08	0.030 ± 0.030	0.040 ± 0.030
Fitted single top events	3.4 ± 2.8	2.0 ± 1.6	0.7 ± 0.6	1.2 ± 1.0	1.0 ± 0.9	0.6 ± 0.5
Fitted diboson events	9 ± 5	1.8 ± 1.5	0.20 ^{+0.33} _{-0.20}	0.21 ^{+0.32} _{-0.21}	0.31 ^{+0.33} _{-0.31}	0.6 ± 0.6
Fitted $t\bar{t}+V$ events	1.27 ± 0.12	1.72 ± 0.32	0.18 ± 0.06	0.27 ± 0.05	0.04 ± 0.010	0.18 ± 0.04

Model-independent upper limits and discovery p-values

Region	$\langle \epsilon \sigma \rangle_{\text{obs}}^{95}$ [fb]	S_{obs}^{95}	S_{exp}^{95}	CL_B	$p(s=0)$
GG 2J	1.44	21.3	20.2 ^{+6.8} _{-5.1}	0.56	0.41
GG 6J bulk	1.49	22.1	14.7 ^{+6.3} _{-4.2}	0.89	0.11
GG 6J high-mass	0.35	5.1	5.5 ^{+2.2} _{-1.4}	0.40	0.90
GG 4J high-x	0.28	4.2	5.2 ^{+2.2} _{-1.2}	0.26	0.77
GG 4J low-x	0.37	5.5	6.6 ^{+2.7} _{-1.7}	0.28	0.83



Combined exclusion limits (95% CL) in the two gluino simplified models using for each model point the signal region with the best expected sensitivity. The exclusion limits by previous ATLAS analyses are shown as the grey area.