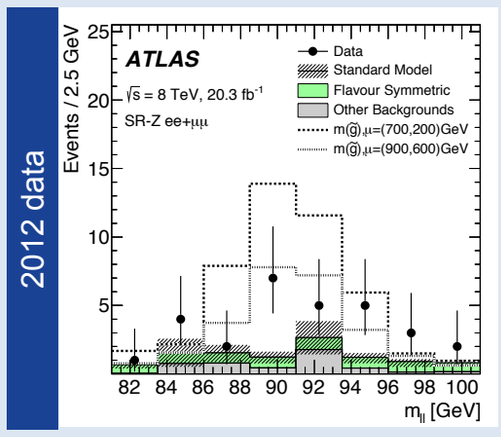
ICHEP POSTER SESSION - AUGUST 8, 2016

SEARCH FOR SUSY PARTICLE DECAYS TO Z+JETS+E_T^{miss} AT ATLAS

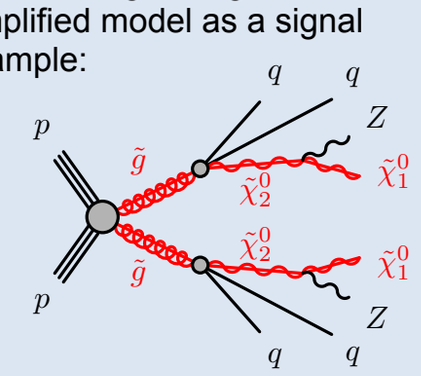
introduction



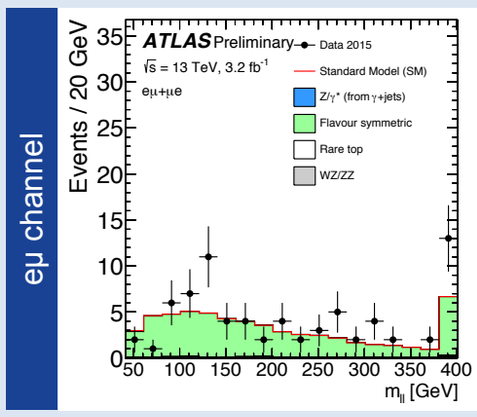
In Run 1, the Z+E_T^{miss} SUSY search saw a 3σ excess searching for events with

- opposite sign/same flavor leptons with an invariant mass from 81-101 GeV
- ≥2 jets
- H_T (the scalar sum of jet and lepton p_T) > 600 GeV
- E_T^{miss} > 225 GeV
- $\Delta\phi(E_T^{miss}, jet_{1,2})$ > 0.4

Our goal is to investigate this excess with the 3.2 fb^{-1} of 13 TeV data collected so far, so we keep the same signal region. We use a simplified model as a signal example:



standard model backgrounds

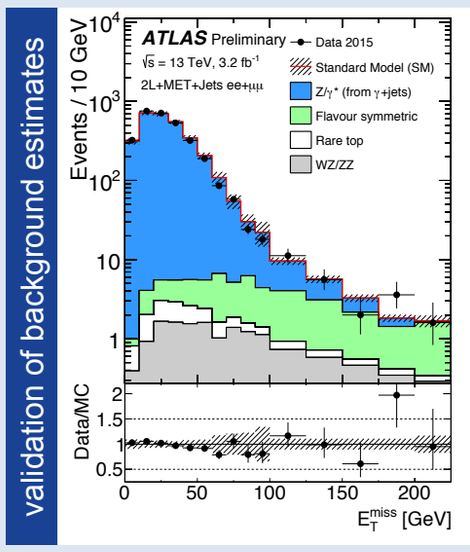


The dominant background is from **flavor symmetric processes**:

- ttbar, WW, Wt, Z→ττ

Assume a 2:1:1 ratio in eμ:ee:μμ

- use eμ data to predict ee/μμ
- apply corrections for triggers and efficiencies
- widen the invariant mass range and correct with MC for better statistics



Cross checked with a sideband fit.

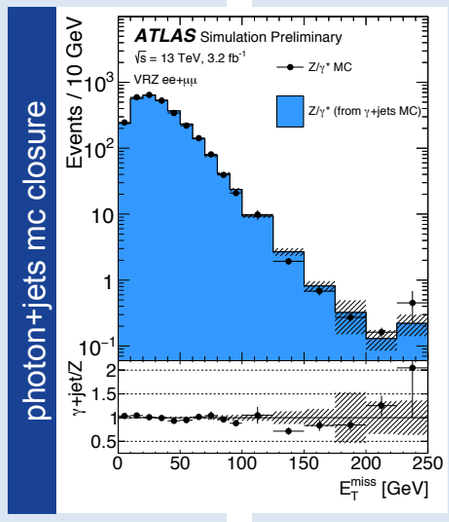
Region	Flavour-symmetry	Sideband fit
SRZ	5.1 ± 2.0	6.1 ± 1.7
VRS	18.9 ± 4.8	20.5 ± 5.6

Region	E_T^{miss} [GeV]	H_T [GeV]	n_{jets}	$m_{\ell\ell}$ [GeV]	SF/DF	$\Delta\phi(jet_{12}, p_T^{miss})$	$m_T(\ell_3, E_T^{miss})$ [GeV]	$n_{b\text{-jets}}$
Signal regions								
SRZ	> 225	> 600	≥ 2	$81 < m_{\ell\ell} < 101$	SF	> 0.4	-	-
Control regions								
Z normalisation	< 60	> 600	≥ 2	$81 < m_{\ell\ell} < 101$	SF	> 0.4	-	-
CR-FS	> 225	> 600	≥ 2	$61 < m_{\ell\ell} < 121$	DF	> 0.4	-	-
CRT	> 225	> 600	≥ 2	$m_{\ell\ell} \notin [81, 101]$	SF	> 0.4	-	-
Validation regions								
VRZ	< 225	> 600	≥ 2	$81 < m_{\ell\ell} < 101$	SF	> 0.4	-	-
VRT	100–200	> 600	≥ 2	$m_{\ell\ell} \notin [81, 101]$	SF	> 0.4	-	-
VRS	100–200	> 600	≥ 2	$81 < m_{\ell\ell} < 101$	SF	> 0.4	-	-
VR-FS	100–200	> 600	≥ 2	$61 < m_{\ell\ell} < 121$	DF	> 0.4	-	-
VR-WZ	100–200	-	-	-	3ℓ	-	< 100	0
VR-ZZ	< 100	-	-	-	4ℓ	-	-	0
VR-3L	60–100	> 200	≥ 2	$81 < m_{\ell\ell} < 101$	3ℓ	> 0.4	-	-

Z+jets background small at high E_T^{miss}, and with our cut on $\Delta\phi(E_T^{miss}, jet_{1,2})$. It peaks in our signal region, so it's still a very important background.

Model using photon + jets events

- correct for kinematic differences
- reweight photon p_T to match Zs
- smear photons to match resolutions of e and μ pairs
- normalize photon distribution after an H_T cut



Additional backgrounds taken from MC.

- dibosons make up largest fraction
- also use ttV, ttVV
- validation regions determine diboson agreement between data and MC
- VR-WZ has 90% purity
- VR-ZZ has >99% purity

We see excellent agreement between our predictions and data in all validation regions.

	VRS	VR-WZ	VR-ZZ	VR-3L
Observed events	56	89	20	7
Total expected background events	52.6 ± 9.1	87 ± 10	15.5 ± 3.4	6.5 ± 1.6
Flavour symmetric ($t\bar{t}$, Wt, WW and $Z \to \tau\tau$) events	18.9 ± 4.8	1.3 ± 0.4	0	0.3 ± 0.2
WZ/ZZ events	7.5 ± 1.7	82 ± 10	15.5 ± 3.4	4.9 ± 1.6
$Z/\gamma^* + \text{jets}$ events	24.8 ± 7.6	2.7 ± 2.8	0	0.2 ± 0.2
Rare top events	1.4 ± 0.2	0.9 ± 0.4	0.04 ± 0.02	1.0 ± 0.1

uncertainties

For flavor symmetric backgrounds:

- dominant uncertainties from statistical error
- others from MC closure, m_{ll} extrapolation, efficiency correction factors

Z+jets background:

- difference from reweighting in multiple variables (H_T, E_T, number of jets)
- other uncertainties from MC closure and statistics

Backgrounds taken from MC:

- theoretical uncertainties from scale, pdf, and cross section
- experimental uncertainties are included, but are negligible

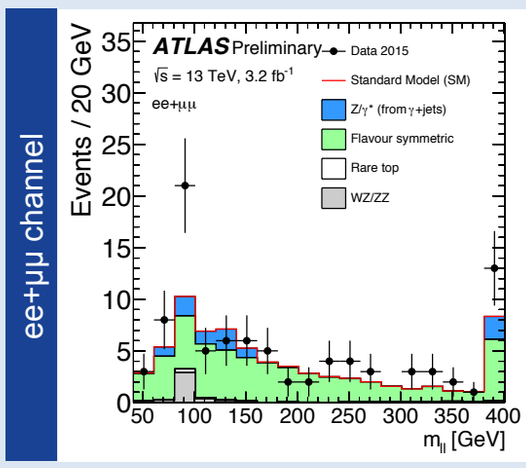
Source	Relative systematic uncertainty [%]
	SRZ
Total systematic uncertainty	22
Flavour symmetry (statistical)	14
Flavour symmetry (systematic)	12
$Z/\gamma^* + \text{jets}$ (systematic)	7.8
WZ generator uncertainty	7.6
$Z/\gamma^* + \text{jets}$ (statistical)	2.2

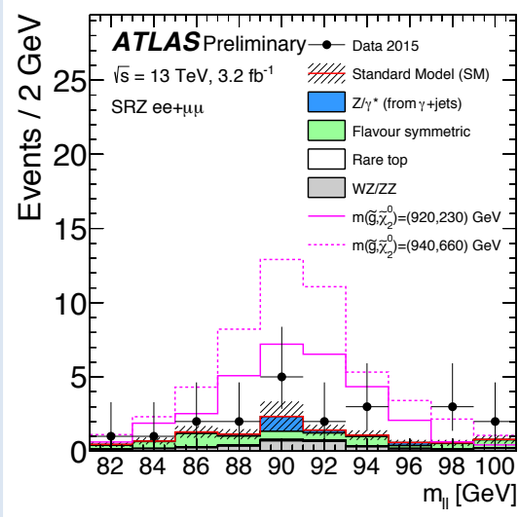
results

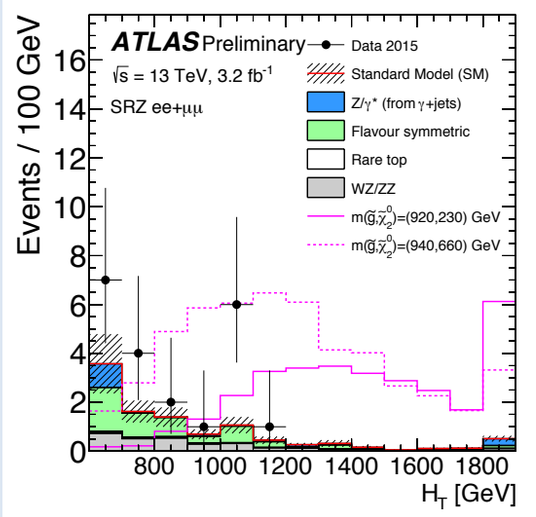
Observed events	21
Total expected background events	10.3 ± 2.3
Flavour symmetric ($t\bar{t}$, Wt, WW and $Z \to \tau\tau$) events	5.1 ± 2.0
WZ/ZZ events	2.9 ± 0.8
$Z/\gamma^* + \text{jets}$ events	1.9 ± 0.8
Rare top events	0.4 ± 0.1
p-value	0.013
Significance	2.2
Observed (Expected) S^{95}	$20.0\ (10.2^{+4.4}_{-3.0})$

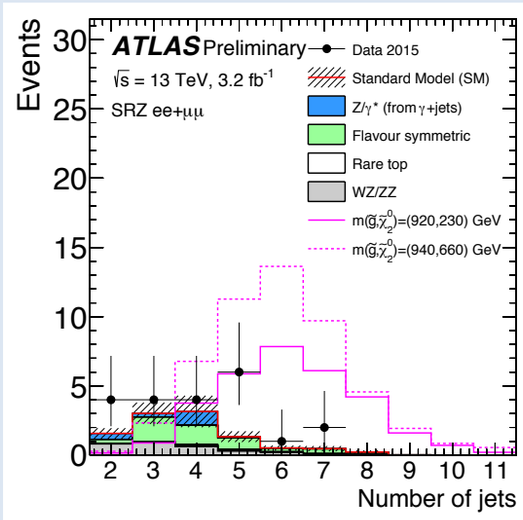
We observe 10 ee and 11 μμ events, and exclude gluino masses up to 1.1 TeV.

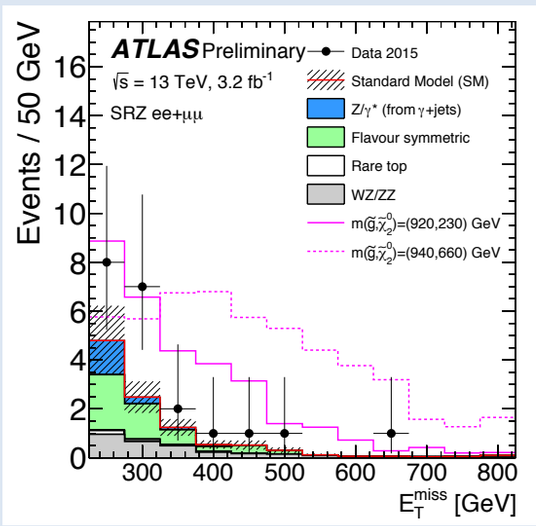
See excess on-Z, but little evidence for shape differences with respect to background in SR distributions.











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,2015 CONF Note: ATLAS-CONF-2015-082, 8 TeV Paper: arXiv:1503.03290v2