PROCEEDINGS OF SCIENCE

Search for gluino and squark production in final states with an isolated lepton, jets and missing transverse momentum with the ATLAS detector in 20 fb^{-1} of $\sqrt{s}$=8 TeV pp collisions

Jeanette Miriam LORENZ*
on behalf of the ATLAS Collaboration
Ludwig-Maximilians-Univ. Muenchen
E-mail: Jeanette.Lorenz@physik.uni-muenchen.de

We present the latest results from searches for squarks and gluinos in final states with one isolated lepton, jets and missing transverse momentum ($E_{\mathrm{T}}^{\mathrm{miss}}$), using the full 2012 dataset of 20.3 fb^{-1} taken at $\sqrt{s}$ = 8 TeV pp collisions by the ATLAS detector [1] at the LHC. Using optimized signal regions, we exclude gluino masses up to 1.18 TeV and squark masses up to 700 GeV in various simplified models.

The European Physical Society Conference on High Energy Physics
18-24 July, 2013
Stockholm, Sweden

*Speaker.

PoS(EPS-HEP 2013)049

1. Signal regions

Assuming the existence of supersymmetry (SUSY) at LHC energies, squarks and gluinos may be produced copiously. They will decay into final states with jets, possibly leptons (produced in chargino, neutralino or slepton decays) and the lightest supersymmetric particle (LSP). Concentrating on R-parity conserving SUSY models, the LSP (in this analysis the $\tilde{\chi}_1^0$) will escape the detector and thus generate a significant amount of missing transverse energy ($E_{\mathrm{T}}^{\mathrm{miss}}$). The analysis presented here [2] was optimized for models with gluino or squark pair production and final states including an isolated lepton (electron or muon) with transverse momentum $p_{\mathrm{T}} > 25$ GeV. Squarks (gluinos) typically decay into one (two) quark(s) and a neutralino or a chargino, which subsequently decay into final states with W/Z-bosons or neutrinos/leptons and the LSP. Consequently, this analysis uses three different sets of signal regions (SR), one requiring at least three jets and targeting squark pair production, another one requiring at least five jets focusing on gluino pair production and the last one requiring at least six jets (optimized for gluino pair production and long decay chains). Further cuts applied to separate signal from background are summarized in table 1. The main discriminating variables are the transverse mass,$m_{\mathrm{T}} = \sqrt{2 \cdot E_{\mathrm{T}}^{\mathrm{miss}} \cdot p_{\mathrm{T}} \, (1 - \cos\Delta\phi(\vec{E}_{\mathrm{T}}^{\mathrm{miss}}, \vec{p}_{\mathrm{T}}))}$, $E_{\mathrm{T}}^{\mathrm{miss}}$ and the effective mass, $m_{\mathrm{eff}} = \sum p_{\mathrm{T}}^{\mathrm{jet}} + p_{\mathrm{T}}^{\mathrm{lepton}} + E_{\mathrm{T}}^{\mathrm{miss}}$.

	inclusive (binned) hard single-lepton		
	3-jet	**5-jet**	**6-jet**
N_ℓ	1 (electron or muon)		
p_{T}^{ℓ}(GeV)	> 25		
$p_{\mathrm{T}}^{\mathrm{add.}\ \ell}$ (GeV)	< 10		
N_{jet}	≥ 3	≥ 5	≥ 6
$p_{\mathrm{T}}^{\mathrm{jet}}$(GeV)	$> 80, 80, 30$	$> 80, 50, 40, 40, 40$	$> 80, 50, 40, 40, 40, 40$
$p_{\mathrm{T}}^{\mathrm{add.\ jets}}$(GeV)	$-$ (< 40)	$-$ (< 40)	$-$
$E_{\mathrm{T}}^{\mathrm{miss}}$ (GeV)	>500 (300)	>300	>350 (250)
m_{T} (GeV)	> 150	> 200 (150)	> 150
$E_{\mathrm{T}}^{\mathrm{miss}}/m_{\mathrm{eff}}^{\mathrm{excl}}$	> 0.3	$-$	$-$
$m_{\mathrm{eff}}^{\mathrm{incl}}$ (GeV)	> 1400 (800)		> 600
binning	$-$ (in $m_{\mathrm{eff}}^{\mathrm{incl}}$, four bins in [800,1600] GeV)		$-$ (in $E_{\mathrm{T}}^{\mathrm{miss}}$, three bins in [250,550] GeV)

Table 1: The signal regions can be categorized in three sets according to their jet multiplicity as described in the text. The inclusive signal regions are used to derive model independent limits, whereas the binned signal regions are used to place limits in specific models.

2. Background estimates

The dominant backgrounds in the signal regions are W+jets and $t\bar{t}$ production. These two backgrounds are estimated via a semi-data-driven method: Each background is first isolated in a dedicated control region (CR), defined by relaxing cuts on $E_{\mathrm{T}}^{\mathrm{miss}}$, m_{T} and m_{eff} and requiring a b-tagged jet (veto on b-tagged jets) for the $t\bar{t}$ (W+jets) CR. The Monte Carlo (MC) prediction is then normalized to data in all control regions simultaneously by using a fit based on a profile log-likelihood method. The background estimates in the signal region are obtained by using transfer factors (CR $\rightarrow$ SR) taken from MC. The QCD multi-jet background is estimated by a matrix

PoS(EPS-HEP 2013)049

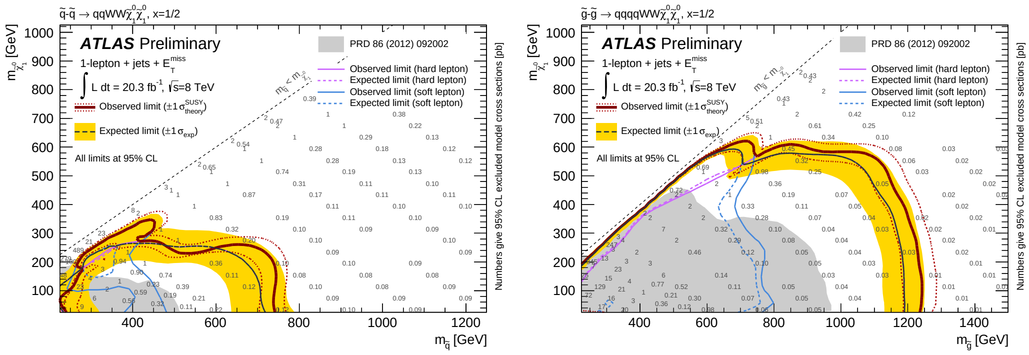

Figure 1: The results are interpreted in a variety of models, including two simplified models with squark (left) and gluino pair production (right) decaying via an intermediate chargino [2]. The limits are a combination of the analysis presented here and a similar analysis requiring a soft lepton with $6(\mu)/10(e) < p_T < 25$ GeV. In this combination always the analysis providing the best expected limit is chosen.

method, which makes use of a control sample with relaxed isolation criteria on the selected lepton. Further smaller backgrounds are directly taken from MC.

3. Results and interpretation

In none of the signal regions any significant excess with respect to the Standard Model expectation is observed. Model independent upper limits on the visible cross-section (i.e. the cross section evaluated inside a given signal region) are evaluated in the inclusive signal regions. The limits obtained range from 0.38 fb (signal region requiring three jets and one muon) to 0.15 fb (signal region requiring six jets and one muon). Based on the binned signal regions, limits are placed on a variety of models. The sensitivity of the analysis is considerably enhanced by binning the signal regions, as each of these bins can be considered as a separate (and orthogonal) signal region that constrains the signal contribution. The considered models include simplified models in which the gluinos or the squarks decay via one or two intermediate steps into the LSP. Figure 1 shows the interpretation in one step simplified models as a function of the gluino (squark) and LSP masses. In these cases, the mass of the $\tilde{\chi}_1^{\pm}$ appearing in the decay chain is given by $x = \frac{m(\tilde{\chi}_1^{\pm})-m(\tilde{\chi}_1^0)}{m(\tilde{g})-m(\tilde{\chi}_1^0)} = \frac{1}{2}$. For low LSP masses, gluino masses up to 1.18 TeV are excluded in this model. Gluino masses up to 700 GeV are excluded for all LSP masses where the mass difference between the gluino and the LSP is greater than 25 GeV. The limits on the squark mass are considerably lower than those on the gluino mass, due to smaller production cross sections. However, the squark mass limit still extends up to 700 GeV for a low mass LSP. In more complicated simplified models with two intermediate steps, similar limits are obtained, as detailed in [2].

References

[1] ATLAS Collaboration, *The ATLAS Experiment at the CERN Large Hadron Collider*, 2008 *JINST* 3 S08003.

[2] ATLAS Collaboration, *Search for squarks and gluinos in events with isolated leptons, jets and missing transverse momentum at $\sqrt{s}$=8 TeV with the ATLAS detector*, ATLAS-CONF-2013-062, `http://cdsweb.cern.ch/record/1557779`.