Search for Supersymmetry in events with large missing transverse momentum, at least one b-jet candidate and at least one electron or muon in 7 TeV pp collisions with the ATLAS detector

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1 Introduction

Supersymmetry (SUSY) is a well motivated theory for physics beyond the standard model, which solves the hierarchy problem and provides a dark matter candidate if R-parity is conserved (lightest SUSY particle, LSP). Leptons and multiple jets can be produced in cascade decays of SUSY particles, at the end of which the LSP leads to high missing transverse momentum (E_T^{miss}). The production of third generation squarks is favoured in many scenarios, which serves as motivation for the b-jet search channel. The data sample used consists of an integrated luminosity of 35 pb^{-1} recorded in 2010 by the ATLAS experiment at the LHC. For a detailed account of this analysis the reader is referred to [1] and references therein.

2 Event Selection

For the presented analysis jets with $p_T > 20$ GeV and b-jets with $p_T > 30$ GeV were considered. The latter were tagged using the signed decay length significance such that a 50% tagging efficiency was achieved on a top pair production Monte Carlo sample. For the leptons a p_T threshold of 20 GeV was applied, as well as a fiducial cut in pseudo rapidity ($|\eta| < 2.47$ for electrons and $|\eta| < 2.4$ for muons). The triggers were chosen such that they were fully efficient for 20 GeV leptons. To remove misidentified jets and non-collision events a set of quality requirements was applied.

At least one muon or electron, at least two jets (with p_T >60, 30 GeV) as well as $E_T^{miss} > 80$ GeV and $m_T > 100$ GeV[1] were required. In the final stage of the selection at least one b-tagged jet and $m_{\text{eff}} > 500$ GeV was required, where m_{eff} is defined as $m_{\text{eff}} = \sum_{i\leq 4}({p_T}^{jet})_i + E_T^{miss} + \sum_i {p_T}^{lep}$.

[1] m_T is defined as $m_T = \sqrt{2p_T^{lep}E_T^{miss} - 2\vec{\mathbf{p}}_{\mathrm{T}} \cdot \vec{\mathbf{E}}_{\mathrm{T}}^{\mathrm{miss}}}$

3 Background Estimation

The main backgrounds considered were QCD multijet, W, Z, single top and top pair production, the latter being the dominant background (∼95%). To estimate the multijet QCD background a data-driven matrix method was applied. For the other backgrounds a data-driven method relying on the low correlation between m_T and m_{eff} was used. The background estimations were validated using Monte Carlo simulations (MC).

4 Results and Interpretation

After the final selection 9 events were measured, whereas the background estimations yielded 14.7 ± 3.7. No significant deviation from the SM is observed.

This result was interpreted in terms of production of light stop either direct or gluino-mediated. The stop was assumed to decay with 100% branching ratio to $b+\tilde{\chi}_1^{\pm}$. The masses of $\tilde{\chi}_1^0$ and $\tilde{\chi}_1^{\pm}$ were fixed to 60 and 120 GeV respectively. All other SUSY particles were assumed to be heavy (> 1 TeV). The results were also interpreted in the framework of mSUGRA with A_0=500 GeV, $\tan\beta = 40$, sgn(μ)=+1. Figure 1 shows both the limits in the gluino-stop mass plane and the mSUGRA plane.

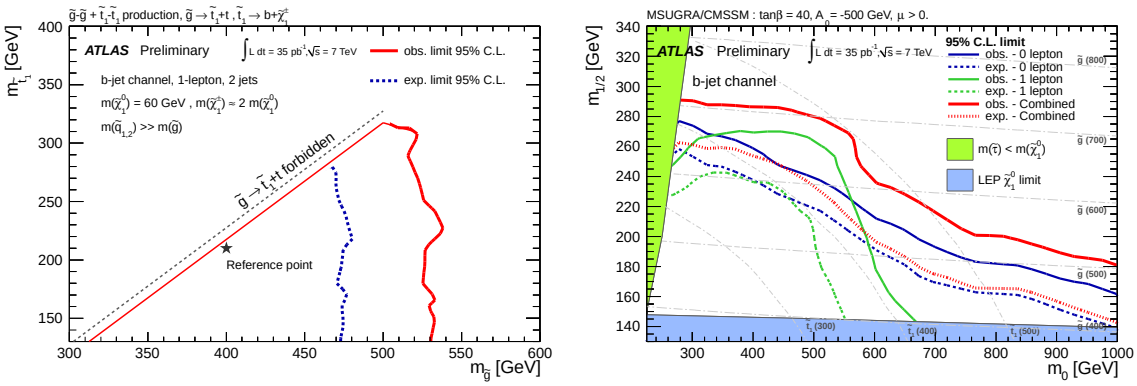

Figure 1: Limits in the gluino-stop mass plane (left). Limits in mSUGRA m_0-$m_{1/2}$-plane (right) with parameters: A_0=500 GeV, $\tan\beta = 40$, sgn(μ)=+1.

References

[1] ATLAS Collaboration, arXiv:1103.4344 (hep-ex).