Search for Supersymmetric particles using final states with one lepton, jets and missing transverse momentum with ATLAS detector

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Supersymmetry (SUSY) is one of the promising theories which propose a solution to the hierarchy problem of the Standard Model (SM) and a natural candidate for dark matter. We search for a SUSY signature in the final state with one isolated lepton, multijets, and large missing transverse momentum (E_T^{miss}). The full dataset (4.7 fb^{-1}) recorded by the ATLAS [1] detector at $\sqrt{s}$ =7 TeV in 2011 is used in the analysis.

As a pre-selection, exactly one isolated electron (muon) with p_T >25 (20) GeV, transverse mass[1] m_T >100 GeV, and E_T^{miss} >250 GeV are required. Events with additional leptons are vetoed. To cover both squark-pair production and gluino-pair production, two signal regions (3-jet SR and 4-jet SR) are defined after the pre-selection. The 4-jet SR has at least four jets with $p_T > 80$ GeV and E_T^{miss}/m_{eff} >0.2 and m_{eff} >800 GeV, where m_{eff} is the scalar sum of the transverse momenta of the lepton, E_T^{miss} and jets. The 3-jet SR is required to have a leading jet with p_T >100 GeV, at least two additional jets with p_T >25 GeV, E_T^{miss}/m_{eff} >0.3 and $m_{eff} > 1200$ GeV; Events in which the second, third and fourth jets have $E_T >$ 80 GeV are removed from the 3-jet SR as these events are in the 4-jet sample.

Further improvement in sensitivity is achieved by splitting the SRs into bins in m_{eff}, thereby the shape differences of signal and backgrounds are taken into account.

The dominant backgrounds in both of the SRs are W+jets and $t\bar{t}$, which are estimated by Monte Carlo simulation. They are normalized in two dedicated Control Regions (CRs), where the following kinematic selections are applied to enhance the components: $m_T = 40 - 80$ GeV, $E_T^{miss} = 30 - 120$ GeV, $m_{eff} > 400$ GeV, and at least three jets with p_T >25 GeV are required, where the leading jet should have $p_T > 80$ GeV. W+jets and $t\bar{t}$ components are then separated by the existence of b-jet in the leading 3jets. If there is at least 1 b-tagged jet, the event is classified into $t\bar{t}$ CR, and if there is no b-tagged jet, then the event goes to W+jets CR.

The dominant uncertainty in the SR prediction comes from the shape variation caused by the energy scale uncertainty of jets. Multijets background is estimated in a data-driven way.

[1] $m_T = \sqrt{2\, p_T^{lep}\, E_T^{miss}\, (1 - \cos\Delta\Phi(lep, E_T^{miss}))}$

As shown in Figure 1, three events are observed in 3jet-SR, where the SM predicts 5.7±4.0 events, while six events are found in 4jet-SR, which is consistent with our expectation of 8.3±3.1. Since no significant excess is observed in both of the SRs, 95% CL exclusion limit is calculated in the MSUGRA/CMSSM model (Figure 2). Squark mass has been excluded up to 1.2 TeV.

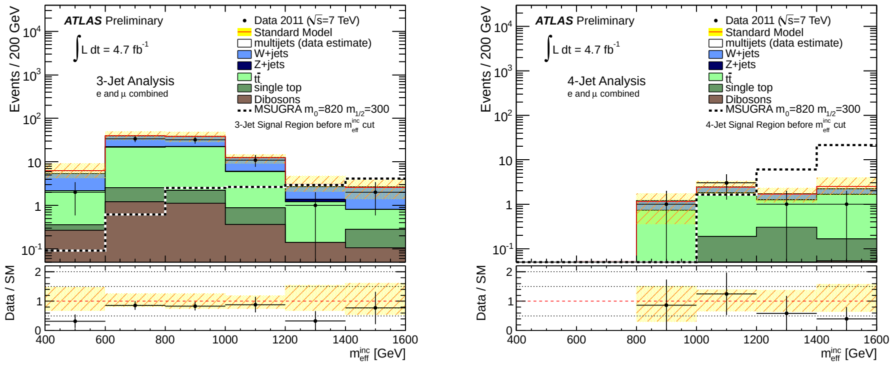

Figure 1: m_{eff} distributions in 3jet-SR(left) and 4jet-SR(right) [2].

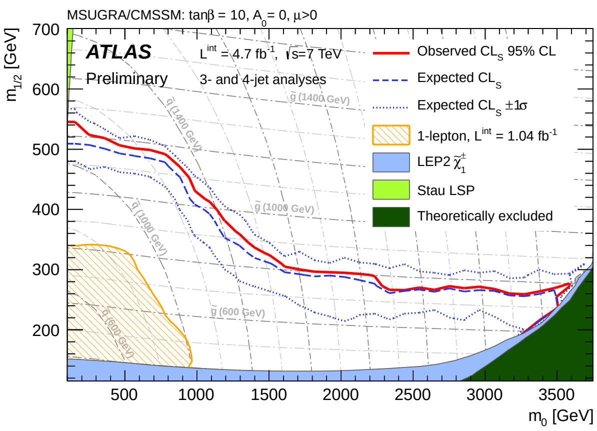

Figure 2: Expected and observed 95% CL exclusion limits [2].

References

[1] ATLAS Collaboration, 2008, *JINST* **3** S08003.

[2] ATLAS Collaboration, ATLAS-CONF-2012-041. This result has been published in combination with 2-lepton and soft-lepton results : arXiv:1208.4688v1