

Search for chargino neutralino production in final states with a W boson and Higgs boson

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Summary. — Supersymmetry (SUSY) is an extension of the Standard Model (SM), and its searches are a central part of ATLAS physics program. In this proceeding, the most recent result in searches of chargino ($\tilde{\chi}_1^\pm$) and neutralino ($\tilde{\chi}_2^0$) production where $\tilde{\chi}_1^\pm$ decays in a W boson and the lightest and stable SUSY particle ($\tilde{\chi}_1^0$), while $\tilde{\chi}_2^0$ decays in the lightest SUSY particle and a SM Higgs boson is reported. The search was based on the analysis of 36.1 fb^{-1} pp collision data recorded by the ATLAS experiment at $\sqrt{s} = 13 \text{ TeV}$. Fully hadronic, semileptonic, diphoton, and multilepton (electrons, muons) final states with missing transverse momentum are considered in this search. Higgs bosons in the final state are identified by either two jets originating from bottom quarks ($h \rightarrow bb^-$), two photons ($h \rightarrow \gamma\gamma$), or leptons from the decay modes $h \rightarrow WW$, $h \rightarrow ZZ$ or $h \rightarrow \tau\tau$. As no SUSY signal was observed, the confidence level limits on charginos and neutralinos masses in the context of simplified SUSY models are reported.

1. – Introduction

Supersymmetry (SUSY) is one of the extensions of Standard Model (SM) and it could solve both hierarchy and dark matter problems. Since no SUSY signal was observed up to now, the searches for electroweakinos, which are fermions obtained by the mixing of the partners of Higgs and gauge bosons, are motivated by the expected lower production cross-section with respect to coloured particles. Electroweakinos are represented as mass eigenstates by $\tilde{\chi}_{i=1,2,3,4}^0$ (neutralino) for neutral particles and $\tilde{\chi}_{i=1,2}^\pm$ (chargino) for charged particles. In this proceeding, the most recent search using 36.1 fb^{-1} of proton-proton collision data provided by the Large Hadron Collider at $\sqrt{s} = 13 \text{ TeV}$ and collected by the ATLAS detector in 2015 and 2016 for electroweakinos pair production decaying to a W and Higgs with Lightest SUSY Particles (LSP) [1] is reported.

2. – Analysis strategy

In this analysis, four distinct signal channels are probed. The channels are categorized by decay mode of W and Higgs; $hW \rightarrow bbqq$ ($0lbb$), $hW \rightarrow bbl\nu$ ($1lbb$), $hW \rightarrow \gamma\gamma\nu$ ($1l\gamma\gamma$) and Higgs decaying to leptons (multilepton). The main SM backgrounds are

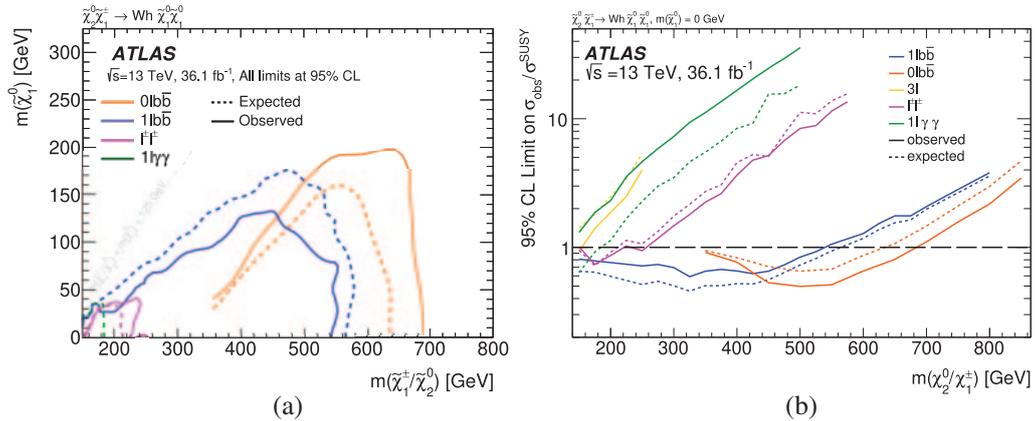


Fig. 1. – Expected and observed exclusion contours for each analysis described in the text are shown. (a) Exclusion contours in the plane of $m(\tilde{\chi}_1^0)$ and $m(\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0)$. For $1l\gamma\gamma$, only expected exclusion is shown since observed exclusion does not appear due to observed excess. (b) 95% CL limits on cross-section as a function of $m(\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0)$ assuming massless LSP.

estimated using background-only fit, independently for each channel, while sub-dominant SM backgrounds are evaluated using MC simulation. The fit is performed on observed events in control regions designed to be enriched for specific background contributions while minimizing the signal contamination. Expected yields are compared with observed events in signal regions. The results reported in this proceeding are the first ones obtained in those final states using $\sqrt{s} = 13$ TeV data collected with the new IBL pixel layer which improved light-flavor jet rejection. $0l b \bar{b}$ channel is probed for the first time in this analysis.

3. – Results

Good agreement with SM expectations is observed in all the channels except for $1l\gamma\gamma$ channel. In $1l\gamma\gamma$ channel, mild excesses are observed, and those are interpreted as discovery p_0 values. All evaluated p_0 values are within 2σ . The observed numbers are also interpreted as 95% confidence-level exclusion limits, as shown in fig. 1. These searches exclude models with masses of $\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$ in the context of massless LSP model, while the previous limit on the same model was 250 GeV [2].

4. – Conclusions

Search for electroweakino pair production decaying to a W boson and Higgs boson with lightest SUSY particles (LSP) using 36.1 fb^{-1} of proton-proton collision data provided by the Large Hadron Collider at $\sqrt{s} = 13$ TeV and collected by the ATLAS detector in 2015 and 2016 is overviewed. Observed data show good consistency with SM expectations, and were then interpreted as 95% CL exclusion limits. The limits reach up to 680 GeV in $m(\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0)$ for models with massless LSP.

REFERENCES

- [1] ATLAS COLLABORATION, *Phys. Rev. D*, **100** (2019) 012006.
- [2] ATLAS COLLABORATION, *Eur. Phys. J. C*, **75** (2015) 5.