SUSY Searches at ATLAS in Multilepton Final States with Jets and Missing Transverse Energy

Basil Schneider
Universität Bern: Laboratorium für Hochenergiephysik
CH-3012 Bern, SWITZERLAND
on behalf of the ATLAS Collaboration

Supersymmetry (SUSY) events with multilepton final states have an excellent potential to be effectively separated from the overwhelming hadron-rich standard model (SM) background typical to high-energy hardron-hadron collisions. The analysis presented here is mainly a summary of an ATLAS CONF note [1].

Most of the SM background is suppressed by selecting final states with three or more isolated leptons (electrons or muons), two or more jets and a missing transverse energy of at least 50 GeV. A requirement of two or more jets and a moderate missing transverse energy cuts away most of the background events and hence improves the signal to background ratio, as can be seen in Figure 1.

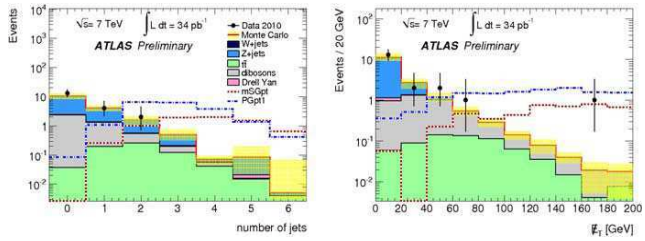

Figure 1: Distribution of number of jets (left) and missing transverse energy (right) [1]. The datapoints correspond to events with at least 3 leptons but before other cuts.

The leptons are selected by requiring a transverse momentum of at least 20 GeV for the two leading leptons and 20 GeV (10 GeV) if the third lepton is an electron (muon). To reject Drell-Yan background, leptons of the same flavour but with opposite signs are rejected if they have an invariant mass of less than 20 GeV. To reject Z background, events with same flavour opposite sign lepton pairs are also rejected if the invariant mass is within 5 GeV of the Z mass.

This event selection has been shown to be effective over a range of different SUSY scenarios. For the collected data, the total number of SM background events expected

is $0.109 \pm 0.023^{+0.036}_{-0.025}$. Virtually all the SM background comes from $t\bar{t}$ events, with less than 0.01 Z events contributing.

No events in the observed data passed all cuts in the multilepton event selection. The expected number of signal events is dependent on the supersymmetric scenario in question and its parameters. We set upper limits on the production cross-section for different SUSY scenarios. The exclusion plots for a slice in the parameter space of the minimal supergravity model (mSUGRA) and PhenoGrid 2 (an MSSM-based model) can be seen in Figure 2. Limits comparable to those obtained by LEP [2] and the Tevatron [3] are reproduced but using a much smaller integrated luminosity.

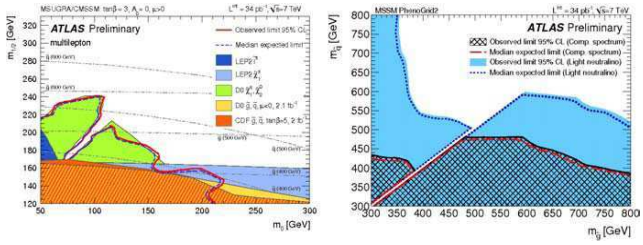

Figure 2: Exclusion plot for the mSUGRA and the PhenoGrid 2 model [1].

The data used in this analysis was recorded by ATLAS [4] in 2010 from LHC collisions at a centre-of-mass energy of 7 TeV. The integrated luminosity corresponds to $(34 \pm 3.7)\,\mathrm{pb}^{-1}$ [5].

References

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[4] ATLAS Collaboration, JINST **3** (2008) S08003.

[5] ATLAS Collaboration, Eur. Phys. J. **C71** (2011) 1630. [arXiv:1101.2185].