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

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On behalf of ATLAS SUSY 1-lepton group

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Introduction

- Supersymmetry (SUSY) proposes...
  - a natural candidate for dark matter
  - a solution to the hierarchy problem of SM.

- We searched SUSY indications in 1-lepton channel with 5fb\(^{-1}\) data recorded in ALTAS at √s = 7TeV.

- Focus on a colored SUSY particles production, where the lepton is mainly emitted from W or top in the decay chain.
Event selection (1/2)

Baseline selections
◆ == 1 electron ($p_T \geq 25\text{GeV}$) or == 1 muon ($p_T \geq 20\text{GeV}$)
◆ Veto on 2\textup{nd} lepton: $p_T < 10\text{GeV}$
◆ $m_T \geq 100\text{GeV}$
◆ $E_T^{\text{miss}} \geq 250\text{GeV}$

Two signal regions (SR) are defined.

Event selection is optimized to cover the general SUSY topologies:
◆ Heavy particles production $\Rightarrow$ 3jet SR
◆ Multi-jet topology $\Rightarrow$ 4jet SR
Event selection (2/2)

- Benchmark points are chosen from MSUGRA/CMMS grid.

3Jet SR
- Large $m_{\text{eff}}$, less number of jets.
  - $p_T^{\text{Jet}} \geq 100, 25, 25 \text{ GeV}$
  - $(4^{\text{th}} \text{ Jet veto}: p_T^{\text{Jet}4} < 80\text{GeV})$
  - $m_{\text{eff}} > 1200 \text{ GeV}, E_T^{\text{miss}}/m_{\text{eff}} > 0.3$

4Jet SR
- Smaller $m_{\text{eff}}$, many number of jets.
  - $p_T^{\text{Jet}} \geq 80, 80, 80, 80 \text{ GeV}$
  - $m_{\text{eff}} > 800 \text{ GeV}, E_T^{\text{miss}}/m_{\text{eff}} > 0.2$

\[
m_T = \sqrt{2 \cdot p_T^{\text{lep}} \cdot E_T^{\text{miss} \left(1 - \cos \Delta \phi (p_T^{\text{lep}}, E_T^{\text{miss}})\right)}}
\]
\[
m_{\text{eff}} = p_T^{\text{lep}} + E_T^{\text{miss}} + \sum_{p_T^{\text{jet}} > 25\text{GeV}} p_T^{\text{jet}}
\]
Background estimation

- Dominant backgrounds are W+jets and ttbar.
- Both are estimated by Monte Carlo (MC), normalized in Control Regions (CR).

**W+jets CR**
- b-jet veto, $40\text{GeV} < m_T < 80\text{GeV}$,
- $30\text{GeV} < E_T^{\text{miss}} < 120\text{GeV}$, $m_{\text{eff}} > 400\text{GeV}$

**ttbar CR**
- b-jet requirement, $40\text{GeV} < m_T < 80\text{GeV}$,
- $30\text{GeV} < E_T^{\text{miss}} < 120\text{GeV}$, $m_{\text{eff}} > 400\text{GeV}$

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Results

- Observed events are consistent with SM expectation in both SRs.

<table>
<thead>
<tr>
<th>Signal Region</th>
<th>SM expectation</th>
<th>Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>3Jet SR</td>
<td>$5.7 \pm 4.0$</td>
<td>3</td>
</tr>
<tr>
<td>4Jet SR</td>
<td>$8.3 \pm 3.1$</td>
<td>6</td>
</tr>
</tbody>
</table>

Syst.+Stat. uncertainties are combined.

- ... And no surprise in $m_{\text{eff}}$ distributions.

$m_{\text{eff}}$ in 3Jet SR

$m_{\text{eff}}$ in 4Jet SR
Define binned likelihoods in both SRs and combine them into one. (The two SRs are exclusive.)

Set a limit on MSUGRA/CMSSM $m_0$-$m_{1/2}$ plain.

- Excluded
  - $\sim 1.2$ TeV (for squark mass)
  - $\sim 0.8$ TeV (for gluino mass)
And finally..

Thank you very much for all the analyzers in SUSY 1-lepton group, who worked very hard on this analysis all day and night.