Search for squarks and gluinos

with the ATLAS detector in final states with jets and missing transverse momentum using 20.3 fb⁻¹ of √s = 8 TeV proton-proton collision data

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### What are we trying to find?

- Squarks and gluinos are SUSY partners of quarks and gluons
- The partners of the neutral and charged SM gauge and Higgs bosons are respectively the neutralinos ($\tilde{\chi}^0$) and chargeless $\tilde{g}$

We assume:

- R-parity conservation:
  - therefore squarks and gluinos must be produced in pairs ($qq$, $gg$)
- the neutralino ($\tilde{\chi}^0$) is the LSP
- Strong production is the dominant mode for the production of SUSY sparticles at the LHC
- This search is looking in final states containing 2 to 6 jets and large $E_T$, with an leptons

### Interpretations

- Simplified models,
- mSUGRA/CMSSM

- The main results of this analysis are relevant for constraining any RSM physics that predicts production of jets in association with $E_T$.

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### Background estimation

<table>
<thead>
<tr>
<th>CR</th>
<th>SR background</th>
<th>CR process</th>
<th>CR selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR1</td>
<td>$Z(\to \nu\nu)$+jets</td>
<td>$\gamma$+jets</td>
<td>Isolated photon</td>
</tr>
<tr>
<td>CRQ</td>
<td>Multi-jets</td>
<td>Multi-jets</td>
<td>SR with reversed requirements on (1 $\Delta m(E_T)$, $E_T^{miss}$(h),m(T)) and (2) $E_T^{miss}$(m(N)) or $E_T^{miss}$(f) $\sqrt{F_T}$</td>
</tr>
<tr>
<td>CRW</td>
<td>$W(\to \nu\nu)$+jets</td>
<td>$W(\to \nu\nu)$+jets</td>
<td>$30$ GeV &lt; $m(E_T)$, $E_T^{miss}$ &lt; 100 GeV, $t$-tag</td>
</tr>
<tr>
<td>CRT</td>
<td>$t\bar{t}$ and single-$t$</td>
<td>$t\bar{t}$ + b$gq$/$tq$</td>
<td>4 jets</td>
</tr>
</tbody>
</table>

Four main background estimated in dedicated control regions and extrapolated to signal region

- Orthogonal to SR, but similar
- Each SR has 4 CR each one enriched with one of the 4 main backgrounds
- Z+jets, W+jets, ttbar rely on MC simulation except for the normalization which is extrapolated from data

### Results

- Number of events
  - Data 2012 / 2013

### Interactions

- The results of exclusion fits in all the SI are used to compute limits in several slices of the SUSY parameter space
- The combined limits were achieved choosing the best expected signal region per model point
- Limits are shown for:
  - mSUGRA model: squarks and gluinos of equal mass are excluded for masses below 1650 GeV
  - Simplified models: in which only direct production of gluino pairs, gluino squark pairs or light-flavour squark pairs are considered
- All other superscripts, except for the neutralino LSP $\tilde{\chi}^0$, are decoupled thereby forcing each light-flavour squark or gluino to decay directly to one or more quarks and $\tilde{g}$
- Direct squark pair production limits are shown for 1 degenerate squark, as well as for 1 nondegenerate squark (A lines lower limit)
- When the $\tilde{\chi}^0$ mass is defined as the squark mass is 1600 GeV, and the limit on the squark mass is 900 GeV