\[ b \rightarrow b\tilde{\chi}_1^0 \]

**Tevatron Searches: Sbottom**

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V. M. Abazov et al. [D0 Collaboration], 1005.2222

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S. Su
FIG. 2: Exclusion plane at 95% C.L. as a function of sbottom angle and neutralino masses. The observed and expected upper limits from this analysis are compared to previous results from LEP \cite{29} experiments at CERN with squark mixing and from CDF and D0 experiments at the Tevatron in Run II \cite{4} \cite{5}.

\[ \bar{b} \rightarrow b \tilde{\chi}_1^0 \]

CDF

\[ M_{\tilde{b}_1} < M_{\tilde{\chi}_1^0} + M_b \]

Observed Limit (95% C.L.)

Expected Limit (95% C.L.)

CDF (2650 pb\(^{-1}\))

D0 (310 pb\(^{-1}\))

CDF (295 pb\(^{-1}\))

\[ m_{\bar{b}} > 230 \text{ GeV} \ (95\% \text{ C.L.}) \]

T. Aaltonen et al. [CDF Collaboration], 1005.3600
CDF, Run II, 2.5 fb⁻¹, gluino pair production, \( \tilde{g} \rightarrow \tilde{b}\tilde{b}, \tilde{b} \rightarrow b\tilde{\chi}_1^0 \)

two or more jets, large MET, 2b-tagging

T. Aaltonen et al. [CDF Collaboration], PRL 102, 221801 (2009).

CDF Run II (2.5 fb⁻¹)

\[ m(\tilde{g}) \text{ [GeV/c}^2\text{]} \]

Cross Section [pb]

\[ \sigma(p\bar{p} \rightarrow \tilde{g}\tilde{g}) \text{ at } \sqrt{s}=1.96 \text{ GeV} \]

PROSPINO NLO (CTEQ6M)

\[ m(\tilde{g}) \text{ [GeV/c}^2\text{]} = 500 \text{ GeV/c}^2 \]

95% CL limit (m[\tilde{b}] = 250 GeV/c²)

95% CL limit (m[\tilde{b}] = 300 GeV/c²)

Expected limit

$\tilde{g} \rightarrow \tilde{b}\tilde{b} (100\% \text{ BR})$  
$\tilde{b} \rightarrow b\tilde{\chi}_1^0 (100\% \text{ BR})$

D0 Run II 310 pb⁻¹  
Sbottom Pair Production Excluded Region

CDF Run II 156 pb⁻¹  
Excluded Region

Gluino Mass [GeV/c²]

CDF Run I excluded

95% CL limit

$g \rightarrow b\bar{b}$ kinematically forbidden

$\tilde{g} \rightarrow \tilde{b}b (100\% \text{ BR})$

$\tilde{b} \rightarrow b\tilde{\chi}_1^0 (100\% \text{ BR})$

$\tilde{g}(95\% \text{ CL limit}) = 250 \text{ GeV/c}^2$

$\tilde{g}(95\% \text{ CL limit}) = 300 \text{ GeV/c}^2$

Expected limit

$\tilde{g}(95\% \text{ CL limit}) = 400 \text{ GeV/c}^2$

$\tilde{g}(95\% \text{ CL limit}) = 500 \text{ GeV/c}^2$

\[ m(\tilde{g}) = 60 \text{ GeV/c}^2 \]

\[ m(\tilde{\chi}_1^0) = 500 \text{ GeV/c}^2 \]
CDF, Run II, 2.7 fb⁻¹, stop pair production, \( \tilde{t}_1 \rightarrow b \tilde{\chi}_1^\pm \rightarrow b \tilde{\chi}_1^0 l\bar{\nu} \), \( m_{\tilde{s}_t} > 150 - 185 \text{ GeV} \)

\[ \begin{array}{c}
\text{CDF Run II Preliminary (2.7 fb⁻¹)} \\
M(\tilde{\chi}_1^0) = 105.8 \text{ GeV/c}^2 \\
\text{BR}(\tilde{t}_1 \rightarrow \tilde{\chi}_1^0 b) = 1 \\
\text{BR}(\tilde{t}_1 \rightarrow \tilde{\chi}_1^0 l\bar{\nu}) = 1.0 \\
\text{BR}(\tilde{t}_1 \rightarrow \tilde{\chi}_1^0 l\bar{\nu}) = 0.50 \\
\text{BR}(\tilde{t}_1 \rightarrow \tilde{\chi}_1^0 l\bar{\nu}) = 0.25 \\
\end{array} \]

\[ \begin{array}{c}
\text{CDF Run II Preliminary (2.7 fb⁻¹)} \\
M(\tilde{\chi}_1^0) = 125.8 \text{ GeV/c}^2 \\
\text{BR}(\tilde{t}_1 \rightarrow \tilde{\chi}_1^0 b) = 1 \\
\text{BR}(\tilde{t}_1 \rightarrow \tilde{\chi}_1^0 l\bar{\nu}) = 1.0 \\
\text{BR}(\tilde{t}_1 \rightarrow \tilde{\chi}_1^0 l\bar{\nu}) = 0.50 \\
\text{BR}(\tilde{t}_1 \rightarrow \tilde{\chi}_1^0 l\bar{\nu}) = 0.25 \\
\end{array} \]

0 lepton, 3 jets (1b)

- Branching ratios
- Small m_{gluino}-msb, msb - m_{\chi^0_1}
might lose 2 b jets

Extra cuts
- 2-3 jets
- other f=met/Meff: larger for 2j
- other MET, Meff values
- loose \Delta \Phi_{min}
- transverse sphericity S_T
**ATLAS searches with b-tag**

**1 lepton, 2 j (1b)**

Small mgluino-mst, mst - mχ₁⁺, mχ₁⁻ - mχ₁⁰ might lose lepton, also suffer from small Br(l)

- Fully hadronic channel with b-tag
  - more jets (≥ 5, 6)
  - ΔΦmin
  - other values for MET, Meff

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**Table 2: Summary of the expected and observed event yields.**

<table>
<thead>
<tr>
<th>System</th>
<th>Expected</th>
<th>Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>g→b+χ₀</td>
<td>200 pb</td>
<td>150 pb</td>
</tr>
<tr>
<td>g→b+χ⁺</td>
<td>150 pb</td>
<td>100 pb</td>
</tr>
<tr>
<td>g→b+χ⁻,χ₀</td>
<td>100 pb</td>
<td>70 pb</td>
</tr>
</tbody>
</table>

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**References:**

- ATLAS Reference point
- NLO Prospino
- CDF, D0
- MET, Meff

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**Notes:**

1. **Cross section [pb]**
2. **m[χ₀]** = 60 GeV, m[χ⁺] = 2 m[χ₀]
3. m[χ⁺,χ⁻,χ₀] >> m[χ]
4. m[χ] = 210 GeV
5. m[χ] = 180 GeV
6. ∫L dt = 35 pb⁻¹, √s = 7 TeV
7. S. Su
8. 6
ATLAS searches with b-tag

MSUGRA/CMSSM : tan$\beta = 40$, $A_0 = 0$, $\mu > 0$.

$\int L dt = 35$ pb$^{-1}$, $\sqrt{s} = 7$ TeV

95% C.L. limit
- obs. - 0 lepton
- exp. - 0 lepton
- obs. - 1 lepton
- exp. - 1 lepton
- obs. - Combined
- exp. - Combined

ATLAS

b-jet channel

$\tilde{g}$ (400)
$\tilde{g}$ (500)
$\tilde{g}$ (600)
$\tilde{g}$ (700)
$\tilde{g}$ (800)

$\tilde{\chi}_1^0$ (400)
$\tilde{\chi}_1^0$ (500)
$\tilde{\chi}_1^0$ (600)
$\tilde{\chi}_1^0$ (700)

m$_{\tilde{g}}$ [GeV]

m$_0$ [GeV]