Gluino Mass Reconstruction in the Focus Point Region at the LHC

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1) Characteristics for analysis in the Focus Point region.

2) Using these characteristics to reconstruct the gluino mass.

3) Reconstructing the top mass

4) Future Work

5) Summary
Characterizing by SUSY Masses

$\sigma_{\text{total}} = 3148 \text{ fb}$

$m_{1/2} = 314 \text{ GeV}$

$m_0 = 3550 \text{ GeV}$

$tan \beta = 10$

$A_0 = 0$

$\mu > 0$

ISAJET 7.75

$m_{1/2}=314, m_0=3550, \tan \beta=10, m_{top}=175$

(Focus Point 3)
Particles in the Detector

1) [Jet] = fragmentation of gluon or light quark ($u, d, s, c$)
2) [$b$-jet] = fragmentation of a bottom quark
3) [Lepton] = electron ($e$) or muon ($\mu$)
4) [$P_T$] = transverse momentum, perpendicular to the beam axis
5) [$E_T^{\text{miss}}$] = missing transverse energy or magnitude of momentum unbalance seen in a detector due to undetected particles like neutrinos and dark matter particles
Characterizing by Particles

\[ N(l) \geq 2 \ (P_T > 10 \text{ GeV}) \text{ w/o } \& \text{ with } E_T^{\text{miss}} > 180 \text{ GeV} \]

So, we want to look for events with at least \(2l+2j+E_T^{\text{miss}} > 180\) GeV.
Catching a Gluino

\( \tilde{g} \to t \bar{t} \tilde{\chi}_2^0 \to (W^+ b)(W^- \bar{b})(\ell^+ \ell^- \tilde{\chi}_1^0) \)

1) For a near full reconstruction of the gluino mass, we need to reconstruct the top quark.

2) For a full reconstruction of the top quark, we need to identify the \( W \) boson.

3) Thus, we attempt to explore the \( W \to jj \) decay.
Combinatorial Dijet Mass $M(jj)$

$\Delta R(j,j)$ is essentially a measure of the angular difference between the two jets.

- $p_T(j) > 15$ GeV
- $p_T(j) > 30$ GeV
- $p_T(j) > 50$ GeV

$0.4 < \Delta R(j,j) < 1.5$ cut, helpful!!!
This means that, as we change $p_T(j)$, events with $W$ decays into di-jets are not cut.
Cleaning up $M(jjbj)$

Now, using the $W$ mass window, we can look for a $b$-jet!

Using the $b$-jet analysis, the $M(jjbj)$ system gives us the $M(\text{top})$!
Catching Top Inclusively

\[ \tilde{g} \rightarrow t \bar{t} \tilde{\chi}^0_2 \rightarrow (W^+ b)(W^- \bar{b})(\ell^+ \ell^- \tilde{\chi}^0_1) \]

1) \( N(\ell) > 2 \)
   - \( p_T(\ell) > 10 \) GeV
   - \(|\eta| < 2.5 \) (LHC limit)

2) \( E_T^{\text{miss}} > 180 \) GeV

3) Selection of \( W \rightarrow jj \)
   - \( p_T(j) > 15 \) GeV
   - \( 0.4 < \Delta R(j,j) < 1.5 \)
   - \( 70 < M(jj) < 90 \) GeV

4) Selection of \( t \rightarrow Wb \)
   - \( p_T(b) > 20 \) GeV
   - \( 0.5 < \Delta R(jj, b) < 1.5 \)

\[ N \sim 300 \text{ events (300 fb}^{-1}) \]
\[ M = 177.6 \pm 1.1 \text{ GeV} \]
Catching 2 Tops?

\[ \tilde{g} \rightarrow t \bar{t} \tilde{\chi}_2^0 \rightarrow (W^+ b)(W^- \bar{b})(\ell^+ \ell^- \tilde{\chi}_1^0) \]

We want to be able to reconstruct another top mass so that we can then reconstruct the gluino mass.

This is currently in progress...
\[ \tilde{g} \rightarrow t \bar{t} \tilde{\chi}_2^0 \rightarrow (W^+ b)(W^- \bar{b})(\ell^+\ell^- \tilde{\chi}_1^0) \]

1) For the first time, we are able to construct $W$ and top in its “all-hadronic” decay modes in the Focus Point region of the LHC.

2) For the gluino mass measurement, we need to reconstruct two top quarks, along with the neutralino mass.

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