Searches for New Physics in Top Events at the Tevatron

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Recontres de Moriond
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Search for nMSSM $H^+ @ CDF$

Motivation

- Search for $t \rightarrow H^+ b$, where $H^+ \rightarrow W^+ A$
- If $m_A < 2m_b$, $A \rightarrow \tau^+ \tau^-$ will dominate
- No strong limits on $A$ in this scenario
- c.f. arXiv:0807.2135

Selection

- Start with standard $tt$ lepton+jets selection...
- $\geq 3$ jets, 1 $b$–tag, $H_T > 250$GeV
- Search for isolated track with $3 \leq p_T \leq 20$ GeV
- Dominant background from Underlying Event

arXiv:0905.3381
Search for nMSSM $H^+$ @ CDF

Underlying Event Modeling

- Many samples have identical UE $\rho_T$ spectra
- Jet–triggered data is used to model the UE $\rho_T$ spectrum
- This model is tested by measuring the $Z/\gamma^*$ cross–section
- Excellent agreement found with previous measurements
Search for nMSSM $H^+ @ CDF$

Results

- The data are consistent with the UE model
- But, no indication of signal
- Limits on $BR(t \to H^+ b)$ vs. $m_{H^+}$ are set for several values of $m_A$
Search for MSSM $H^+$ @ DØ

Results

- For large $\tan(\beta)$, $BR(H^+ \rightarrow \tau^+ \nu_\tau) \sim 1$

- Neural Net analysis to separate $t\bar{t} \rightarrow W^+ bW^- \bar{b}$ from $W+$jets

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Search for $H^+ @ \text{DØ}$

Results

- Limits on branching–ratio, $m_{H^+}$ vs. $\tan(\beta)$

![Graph showing limits on branching–ratio, $m_{H^+}$ vs. $\tan(\beta)$]
Search for $\tilde{t} \rightarrow c\tilde{\chi}^0$ in $E_T + \text{jets} @ \text{CDF}$

A search for light $\tilde{t}$

- We consider $m_{\tilde{t}} \sim 150$ GeV
- $\tilde{t} \rightarrow c\tilde{\chi}^0$ dominant
- Signature: two charm jets + $E_T$
- The Tevatron is a great place to test such a scenario

$p\bar{p} \rightarrow \tilde{t}_1 \bar{\tilde{t}}_1$ at $\sqrt{s}=1.96$ GeV

$\mu_R = \mu_F = M(\tilde{t}_1)$

Cross Section [pb]

- PROSPINO NLO (CTEQ8M)
- PROSPINO LO (CTEQ6L1)
Search for $\tilde{t} \rightarrow c\tilde{\chi}_0^0$ in $E_T^{\text{miss}} + \text{jets} @ \text{CDF}$

- To isolate this signal, a flavor separator was developed
- A Neural Network is trained to distinguish charm from light jets and bottom

- Backgrounds are controlled and are reduced using cuts and a NN trained to reject QCD
Search for $\tilde{t} \rightarrow c\tilde{\chi}^0_1$ in $E_T + \text{jets}$

- No signal observed
Search for $t\bar{t}H$ @ DØ

- Simultaneous estimation of $t\bar{t}$ and $t\bar{t}H$ cross-sections

- $\sigma_{t\bar{t}} = 8.36^{+1.08}_{-0.98} (\text{stat} + \text{syst}) \pm 0.51 (\text{lumi}) \text{ pb}$

- Limits also set in context of heavy color-octet production of $t'\bar{t}'$

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DØ Run II Preliminary (1fb$^{-1}$)

- Expected limit 95% CL
- Observed limit 95% CL
- $m_t = M_{G'}/2=400 \text{ GeV}$
- $m_t = M_{G'}/2=450 \text{ GeV}$
- $m_t = M_{G'}/2=500 \text{ GeV}$
- Standard Model

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DØ Run II Preliminary (1fb$^{-1}$)

- $m_t = M_{G'}/2$
- $r = 0.4$, $s_L = 0.2$

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Excluded region @ 95% CL

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Expected limit @ 95% CL

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Standard Model

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Search for resonant $t\bar{t}$ production in the all–hadronic channel @ CDF

- Multijet background modeled using data.
- Event selection by Neural Net
Search for resonant $t\bar{t}$ production in lepton+jets @ DØ

- Reconstruction simplified, robust
- 95 CL limit on top-color-assisted technicolor $Z'$:
  $$m_{Z'} > 820 \text{ GeV} \text{ for } \Gamma_{Z'} = 0.012M_{Z'}$$
Search for $t' @ CDF$

- Search for $t' \rightarrow Wq$ in lepton+jet events
- $t'$ mass reconstructed using kinematic fit
- Fit to estimate signal cross-section in multidimensional space: $H_T, M_{rec}, N_{jet}$
Search for $t' \@ CDF$

- No statistically significant excess, it’s really less than 2 sigma
- Events with high $M_{reco}$ appear to be clean lepton+jet events
Event Displays of high–$M_{\text{reco}}$ events

CDF Run II Preliminary
Run: 194323  Ht: 856.7 GeV
Event: 9830702  Mreco: 449.7 GeV

CDF Run II Preliminary
Run: 192306  Ht: 635.2 GeV
Event: 405574  Mreco: 521.9 GeV
Thank You