

Non-SUSY Searches at Tevatron

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for the CDF and D0 Collaborations

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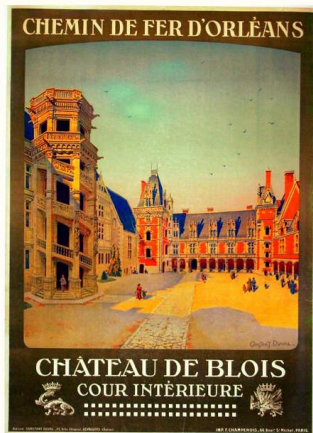
The XXIII Rencontres de Blois

Chateau de Blois, May 29 - June 3, 2011

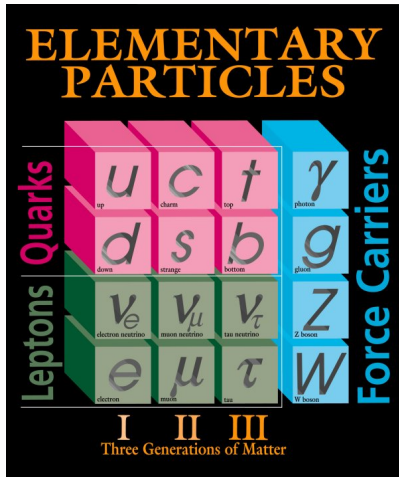


Outline

- Introduction
- Fourth Generation Quarks
- Signature based searches
- Extra Dimensions
 - Randall-Sundrum Gravitons
 - Universal Extra Dimensions
- Conclusions



Physics Beyond the Standard Model



Enormously successful at predicting a wide range of phenomena

But, it can't be the whole story:

Matter-Antimatter Asymmetry?

Dark Energy?

Dark Matter?

Why three generations?

Final States at Tevatron

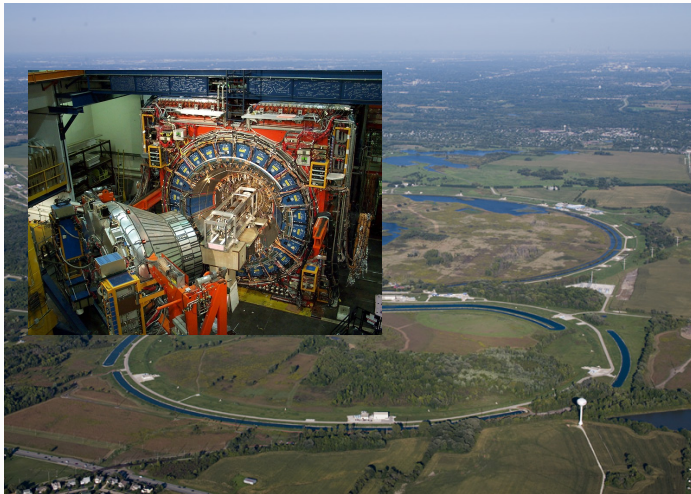
Tevatron

Proton-antiproton collisions at **1.96** TeV center of mass energy.



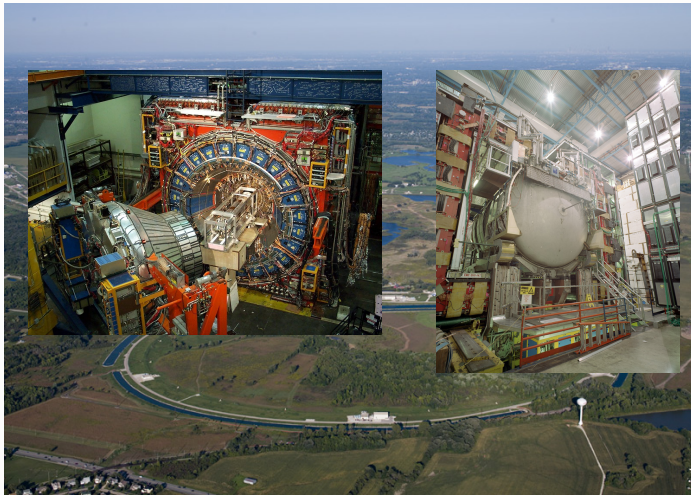
Tevatron

Proton-antiproton collisions at 1.96 TeV center of mass energy.



Tevatron

Proton-antiproton collisions at **1.96** TeV center of mass energy.



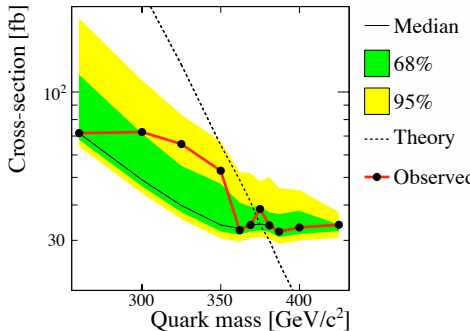
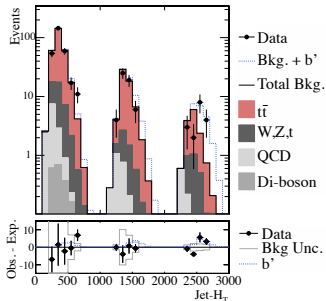


Fourth Generation Quarks: b'

Current limits constrain $M_{b'} > M_t + M_W \Rightarrow$ search for heavy b'

- Assuming $b' \rightarrow Wt$
- Final state: leptons + \cancel{E}_T + jets
- Key variables in the analysis:
 - Number of jets
 - $H_T = \sum_{l, jets, \cancel{E}_T} E_T$

arXiv:1101.5728 (submitted to PRL)

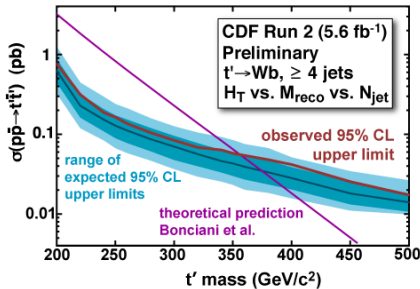
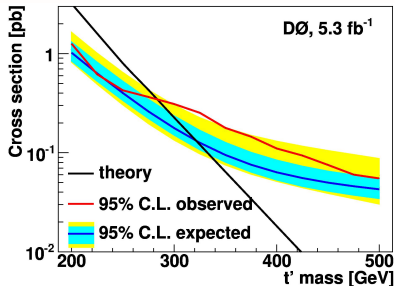
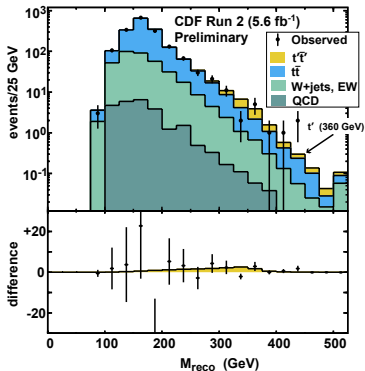


b' excluded below $372 \text{ GeV}/c^2$

Fourth Generation Quarks: t'



- Assuming $t' \rightarrow Wb$
- Final state: $l + \cancel{E}_T + \text{jets}$
- At least 4 jets (1 b-tag)



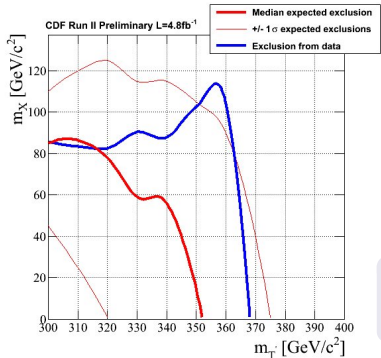
t' excluded below 358 GeV/c²

Exotic T' - Dark Matter Search

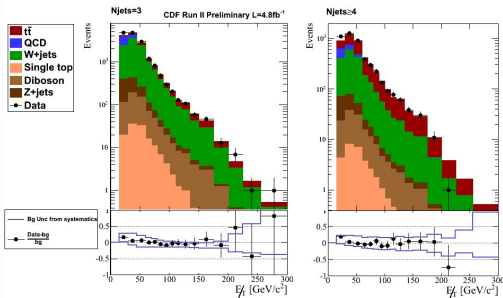


Assuming $T' \rightarrow tX$ with suppressed $T' \rightarrow Wb$

- Final state: $l + \cancel{E}_T +$ at least 4 jets
- Looking for an excess with large \cancel{E}_T



PRL 106, 191801 (2011)



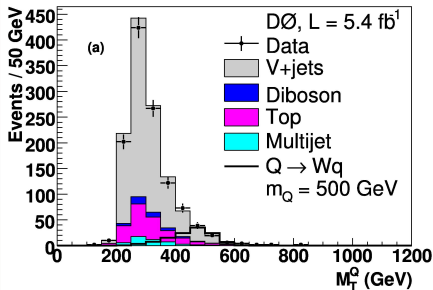
T' excluded below 360 GeV/c^2 for M_X below 100 GeV/c^2



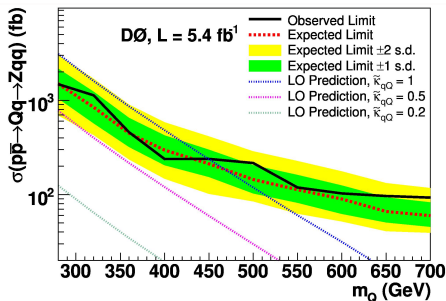
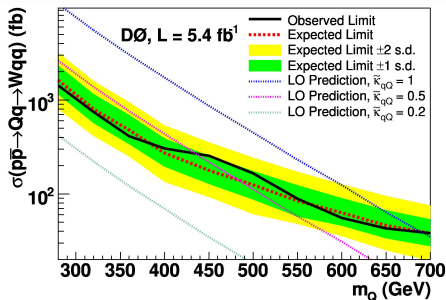
Vector-like Quarks

RH and LH components transform identically

- Search for decays into: Wq and Zq
- Looking for: $1l+2j+\cancel{E}_T$ or $2l+2j$



PRL 106, 081801 (2011)

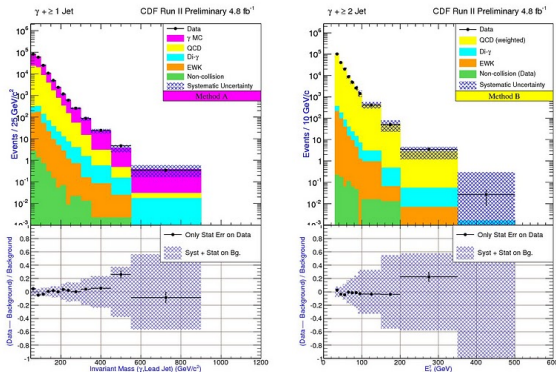




CDF public note 10355

Model independent search, looking for deviations from SM prediction

- Search for events with 1 γ , 1 or 2 jets, and \cancel{E}_T
- Also selection without \cancel{E}_T



Good agreement with the Standard Model

Search for $\gamma + \text{lepton} + \text{bjets} + \cancel{E}_T$

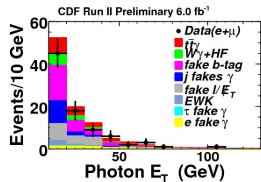
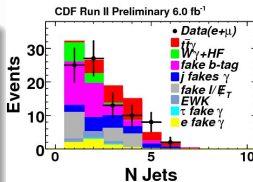
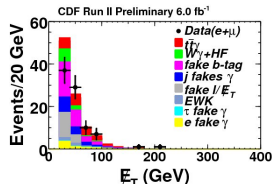
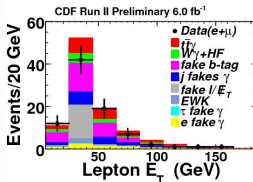


- Requiring:

- $E_T^l > 20 \text{ GeV}$
- $E_T^\gamma > 10 \text{ GeV}$
- $\cancel{E}_T > 20 \text{ GeV}$
- $E_T^{bjet} > 20 \text{ GeV}$

- Good agreement with SM predictions

CDF public note 10270



$$\sigma(\bar{t}t\gamma)$$

Use the search to perform a Xsection measurement on one of the main backgrounds: $\geq 3\text{jets}$ and $H_T > 200 \text{ GeV}$

$$\sigma(\bar{t}t\gamma) = 0.18 \pm 0.07 \pm 0.04 \text{ pb}$$

Search for lepton jets + \cancel{E}_T - Dark Photon

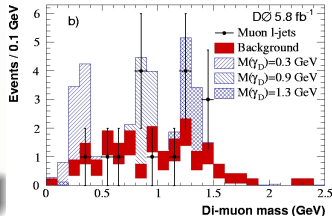
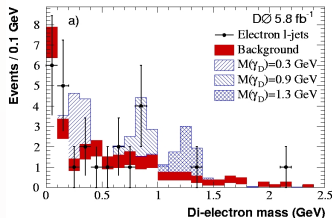
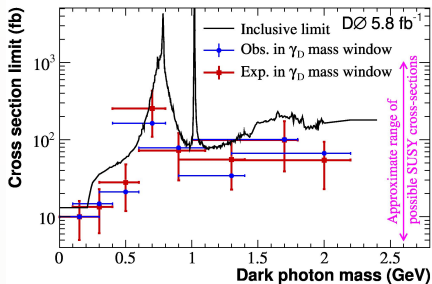
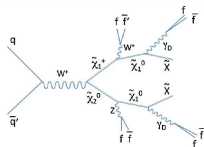


Lightest neutralino decays into dark photon

γ_D and LSP in the hidden sector $\tilde{\chi}$

Signature:

- Light $\gamma_D \Rightarrow$ collimated lepton pair
- LSP escapes detection $\Rightarrow \cancel{E}_T$



PRL 105, 211802 (2010)

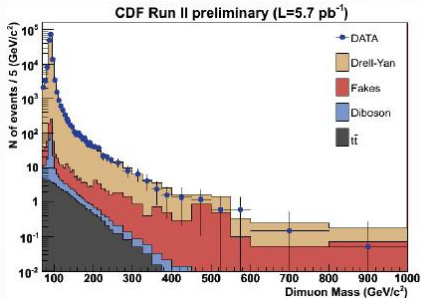
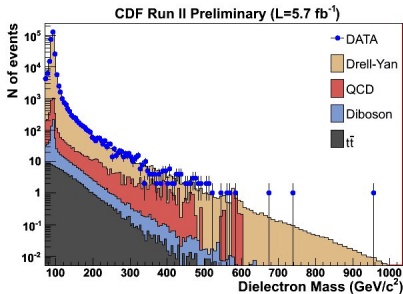
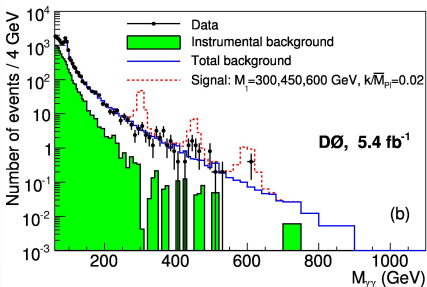
Randall-Sundrum Gravitons - I



Search for RS Gravitons in di-lepton and di-photon decays.

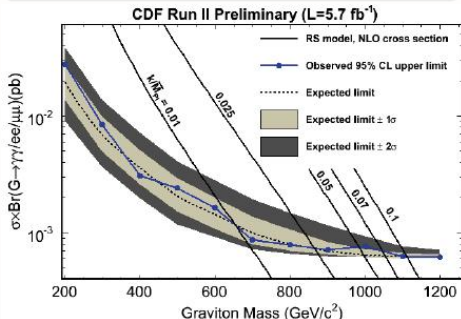
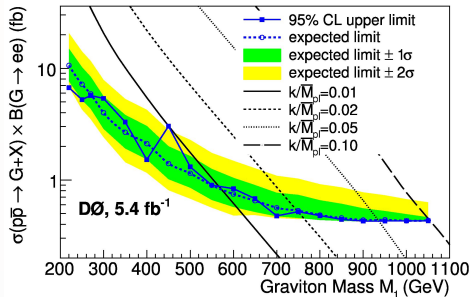
Looking for a bump in the di-lepton and di-photon mass distribution.

Di-electron event with 960 GeV mass observed!!



PRL 104, 241802 (2010)

ee, $\mu\mu$, and $\gamma\gamma$ limit: arXiv 1103.4650

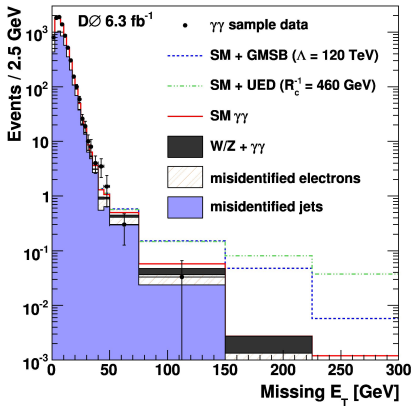
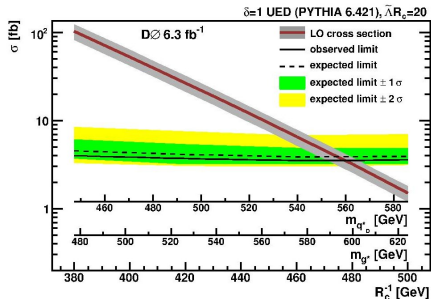


Exclude RS Graviton below
1050 GeV for $k/M_{pl} = 0.1$

Exclude RS Graviton below
1111 GeV for $k/M_{pl} = 0.1$

- Assume a single compactified extra dimension
- Produce pairs of Kaluza-Klein photons, which decay to a photon and a graviton
- Final state: two $\gamma + \cancel{E}_T$

PRL 105, 221802 (2010)



Summary

- Tevatron will run till September 2011
 - $\sim 12 \text{ fb}^{-1}$ delivered
 - $\sim 10 \text{ fb}^{-1}$ recorded
- **No evidence of BSM Physics** in up to 6 fb^{-1} of data
- The LHC already producing more sensitive results in some signatures, but the Exotics program at Tevatron is continuously producing new results (and improving limits)
- Still room for surprises!!! Stay tuned

**Tevatron is still a place to find new physics,
new data not analyzed yet !!!**

More information:

<http://www-cdf.fnal.gov/physics/exotic/exotic.html>

<http://www-d0.fnal.gov/Run2Physics/WWW/results.htm>

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