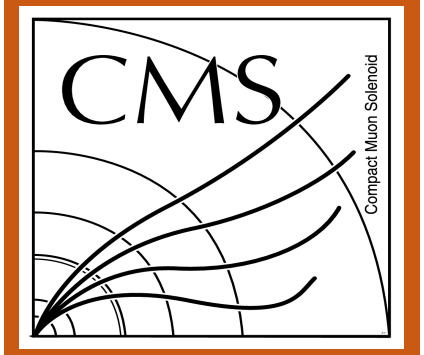

Search For Vector-Like b' Pair Production with Multilepton Final States

USLUO 2013

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Introduction

- A search for b', a vector-like partner of the b quark
- Pair production of vector-like partner quarks are produced mainly through gluon-gluon fusion

- The decay modes of b' are to a tW, bZ, or bH
  - Multilepton signatures:
    - 2 b-jets guaranteed for all modes
    - 3 or 4 leptons, 2 same-sign leptons, 2 opposite-sign leptons
    - Sensitive variable: $S_T \sim 2M_{b'}$ = sum p_T of all objects in the event

- General analysis idea: multichannel counting experiment
  - use exclusive bins instead of cuts

Analysis Strategy
Bin in Exclusive Multilepton Channels

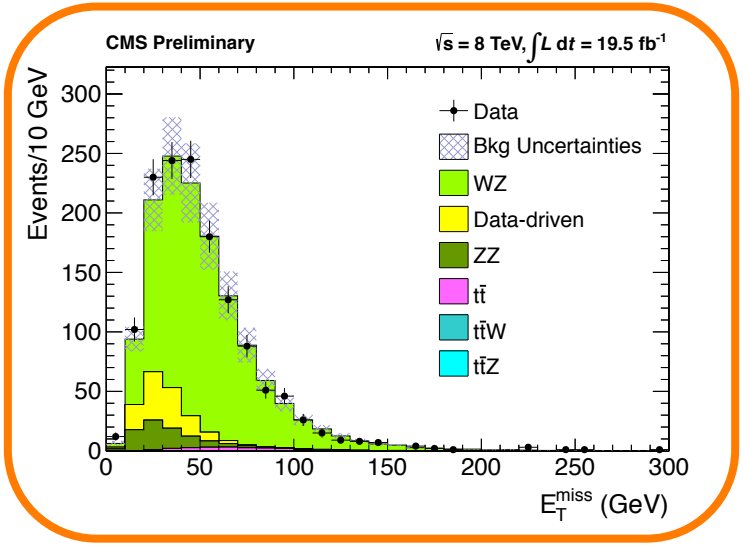
- Number of leptons: 3 and ≥ 4 leptons e, μ, hadronic τ
  - e, μ : p_T > 10 GeV , and $|\eta|$ < 2.4
  - Hadronic τ: p_T > 20 GeV, and $|\eta|$ < 2.5
  - Jet: p_T > 30 GeV, and $|\eta|$ < 2.5

- Number of opposite-sign same-flavor (OSSF) pairs
- For events with an OSSF pair, bin in dilepton mass:
  - *On Z, above Z,* or *below Z* window (75-105 GeV)
  - Reject events with J/ψ, *Upsilon, Y* meson* (M(l+l-) < 12 GeV)

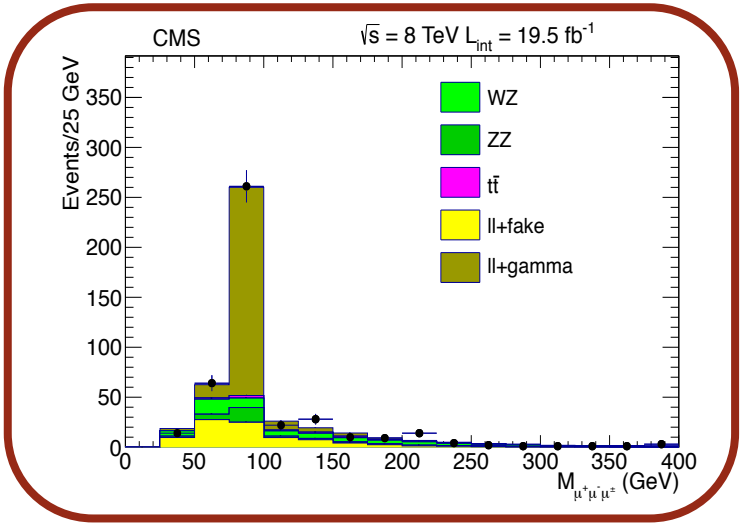
- 0 or ≥ 1 b-jets (CSV medium working point)
- 0 or ≥1hadronic taus
- S_T bins: 0-0.3, 0.3-0.6, 0.6-1, 1-1.5, 1.5-2, and > 2TeV

Background Predictions

- Monte Carlo predictions cover sources of backgrounds such as
  - ttbar and irreducible backgrounds: WZ+jets, ZZ+jets
  - MC corrected to match efficiency measurements
  - We scale WZ to match data in the 3lepton+MET control region

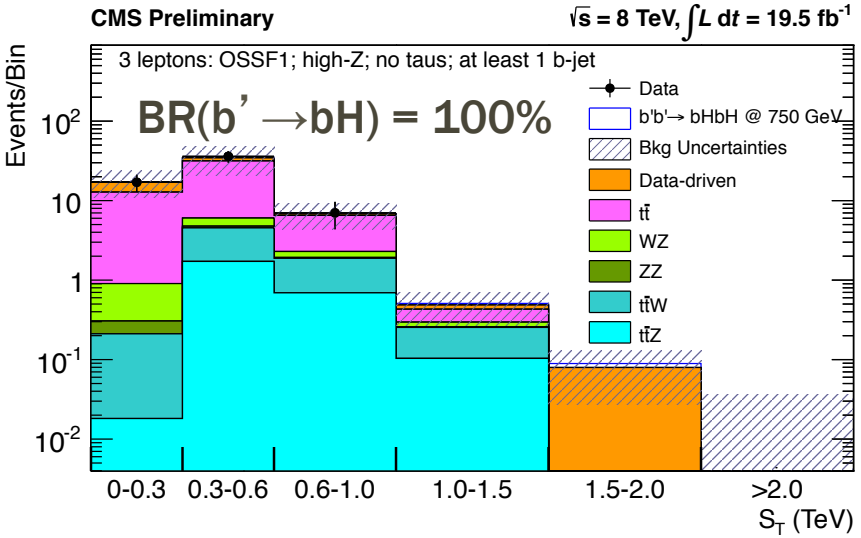


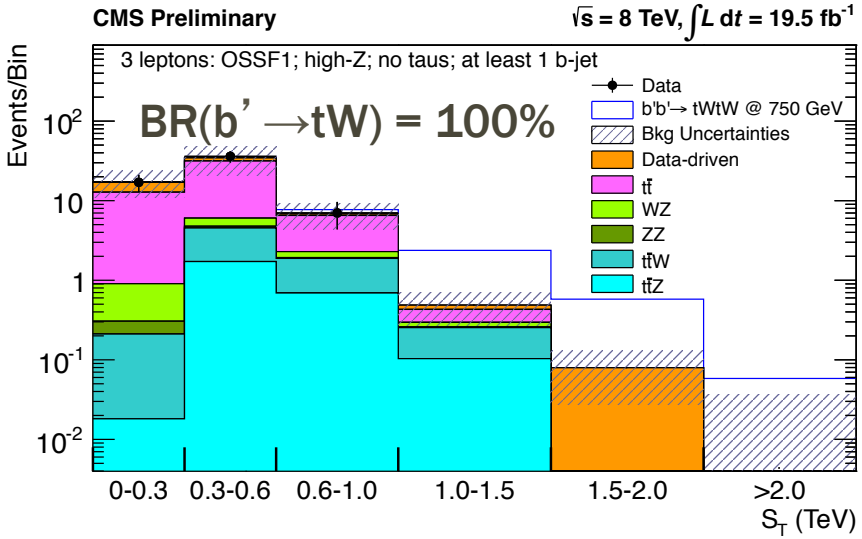
- Data-driven methods cover other sources of backgrounds such as
  - Z+jets, WW+jets, W+jets, and QCD
  - Z+ γ Asymmetric Conversion $\gamma \rightarrow e$ +e- or $\gamma \rightarrow \mu + \mu$ - (off-shell photon)

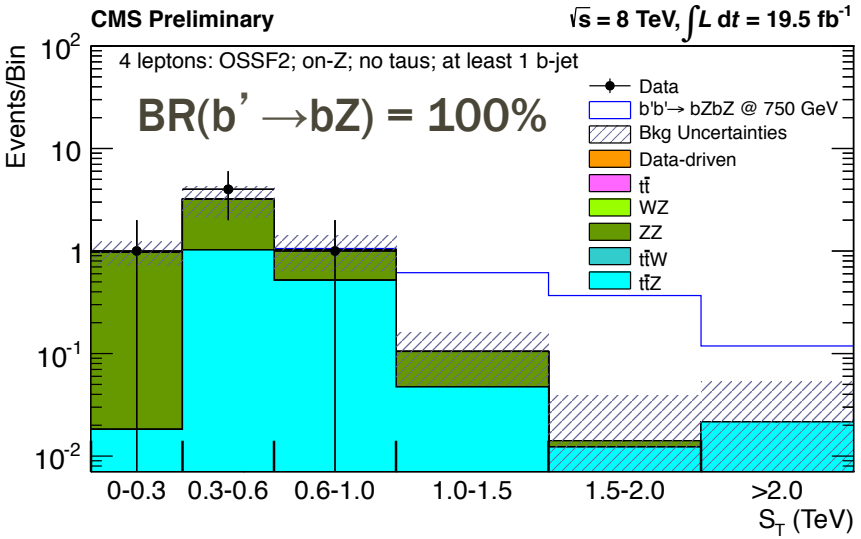


S_T Distributions
For 3 and 4 Lepton Events

- S_T Distribution for b' @ 750GeV
- Channel sensitive to tW and bH
  - 3 Leptons, 1OSSF pairs, high-Z, 0 taus, and at least 1 b-jet
- Channel sensitive to bZ
  - 4 Leptons, 2 OSSF pairs on-Z, 0 taus, and at least 1 b-jet

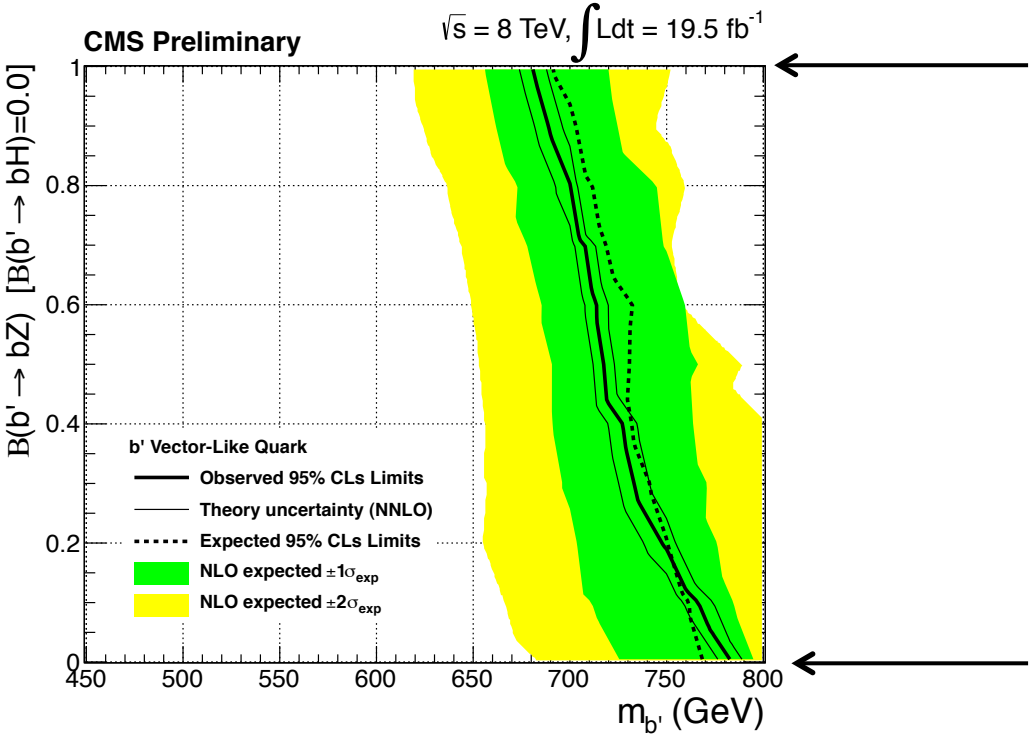




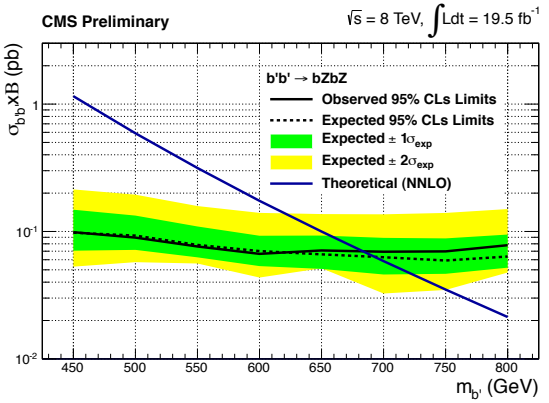


Interpretation in b' Models

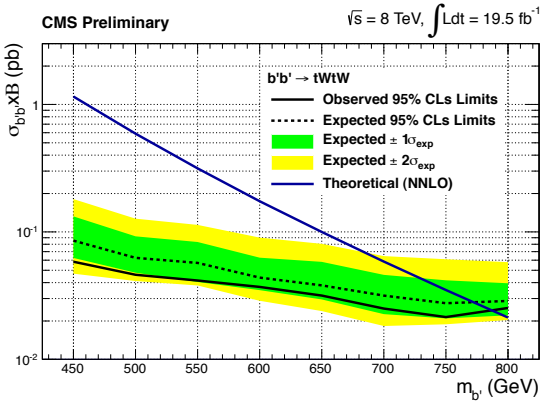
- We assume BR(b'→bH) is zero
- Limits vary from ~685 to ~790 GeV for the b' mass as the branching ratio is varied



b'b'→bZbZ

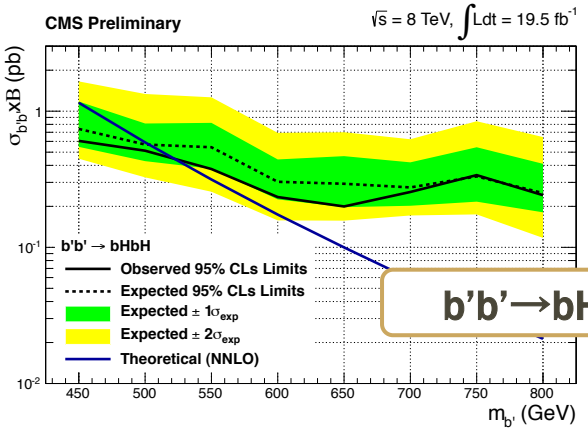


b'b'→ tWtW



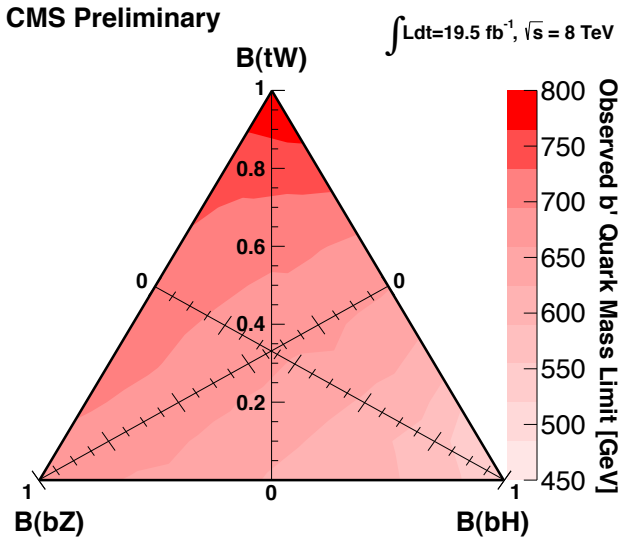
Triangle Exclusion Limit Plots

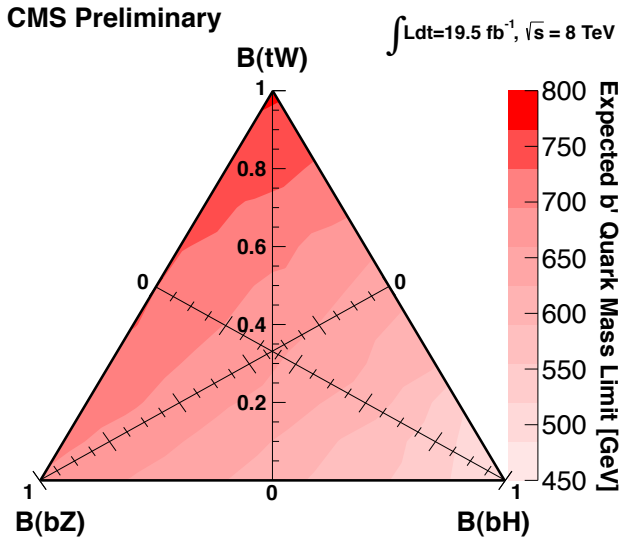
- For BR(b'→bH) = 100% the observed limit is 525 GeV



- Expected an observed limit results with varying BR of tW, bZ, and bH

- Points in the triangle correspond to a particular set of BR





Conclusions

- Presented a search for ≥ 3 leptons events with 19.5 fb^{-1} collision data at 8 TeV
  - Binned in S_T, number of $M(l^+l^-)$ pair, number of hadronic taus and b-jets
- Interpreted results in the context of a vector-like quark b' model
- Limits were placed on the b' mass as a function of its branching ratios
- Analysis was just approved yesterday