

HLT Optimization for a Heavy B Quark

Sylvia Lewin

July 7, 2011

+ CMS

Looking for:

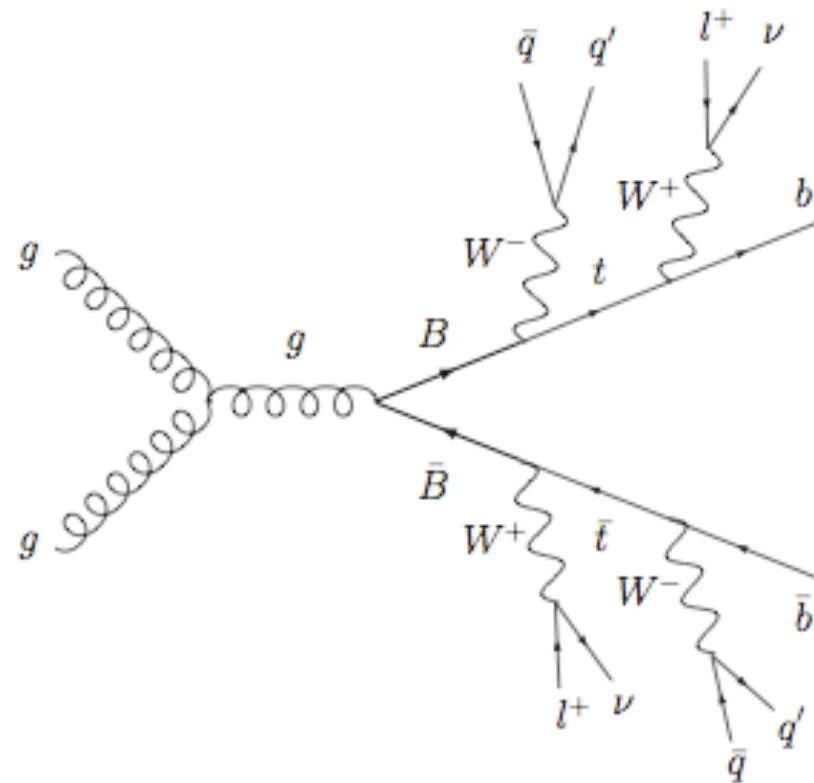
- The Higgs
- Supersymmetry
- Technicolor
- ...anything else we can find!

+ The HLT

- ~40 terabytes of data per second: too much to store
- L1 (level 1) trigger reduces rate to ~50 gigabytes
 - keeps “interesting” events, e.g. those with high energy particles or unexpected combinations of particles
- HLT (high level trigger) reduces rate to ~100 megabytes per second
 - quickly reconstructs events, does not keep “standard” events
 - optimized using Monte Carlo simulations

+ The Heavy B

- charge: $-1/3$
- mass: 400 GeV – 1 TeV
(testing 400 GeV, 500 GeV)
- partner of the $T_{5/3}$



+ Sources of background:

- $t\bar{t}W^{\pm+}$
- $t\bar{t}W^+W^-$
- $W^{\pm}W^+W^-$
- $W^{\pm}W^{\pm}$
- $t\bar{t} + \text{jets}$
- $W + \text{jets}$
- $Z + \text{jets}$
- QCD multijets

+ Background: Feynman diagrams

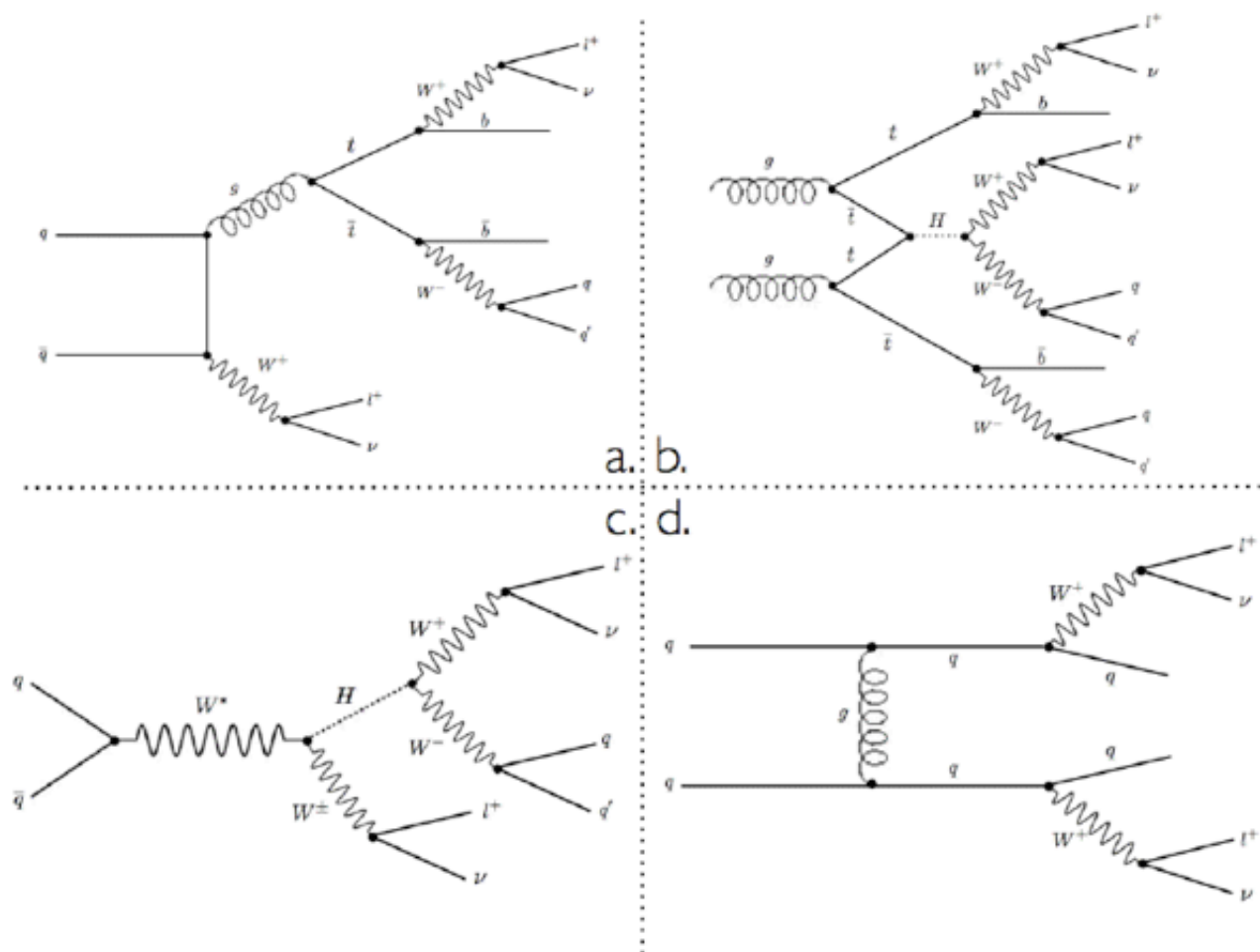


Figure 4: Feynman diagrams for a. $t\bar{t}W^\pm$, b. $t\bar{t}W^+W^-$, c. $W^\pm W^+W^-$, and d. $W^\pm W^\pm$.

+ Tasks completed

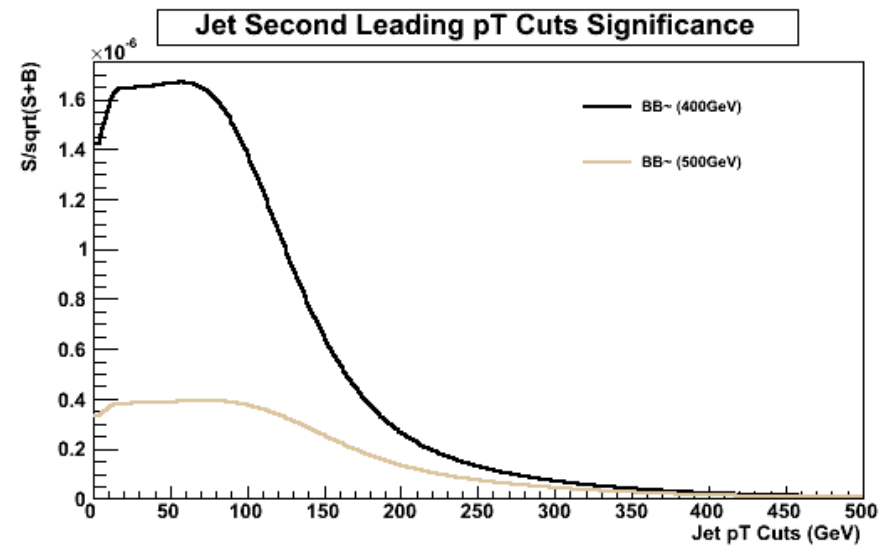
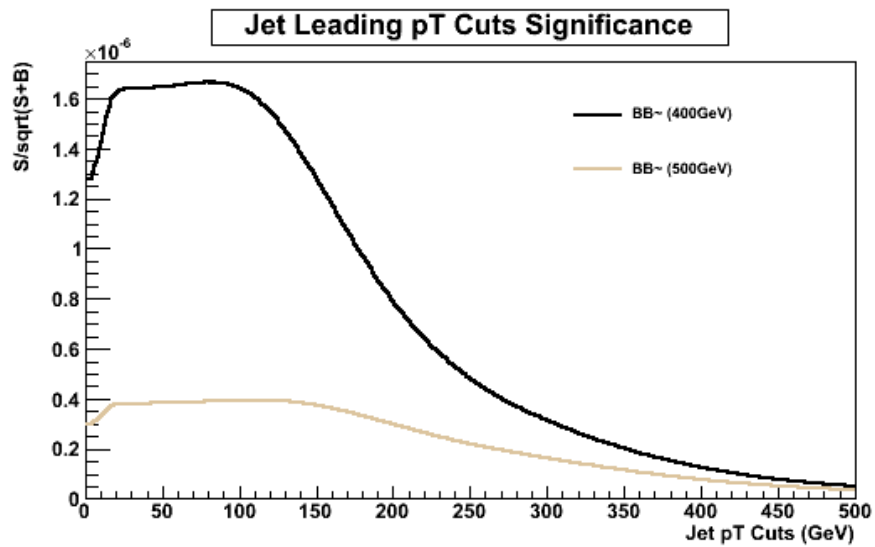
- Signal and background generation
 - Analysis:
 - Efficiency plots for cuts on transverse momentum
 - Jet leading p_T
 - Jet second leading p_T
 - Lepton leading p_T
 - Lepton second leading p_T
- ($E = S / \sqrt{S+B}$)

+ Results

Most efficient cuts:

- Jet leading p_T : 80 GeV

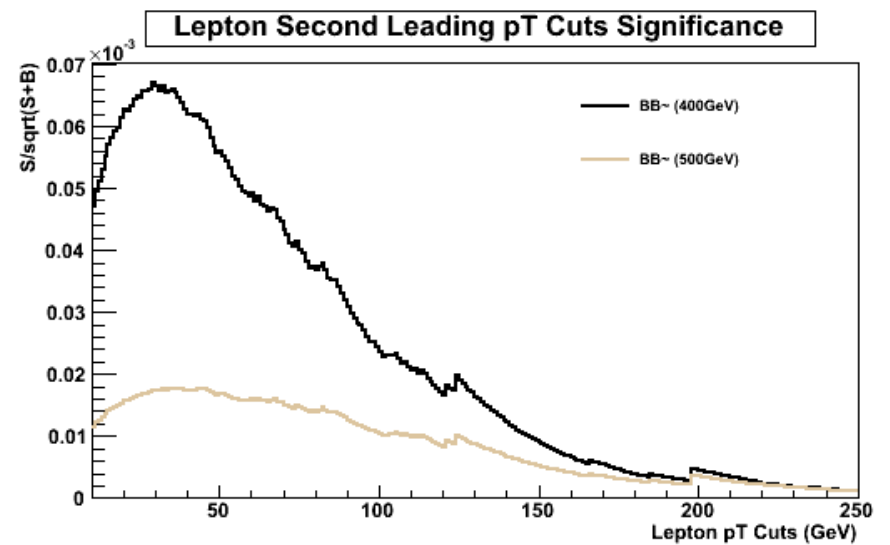
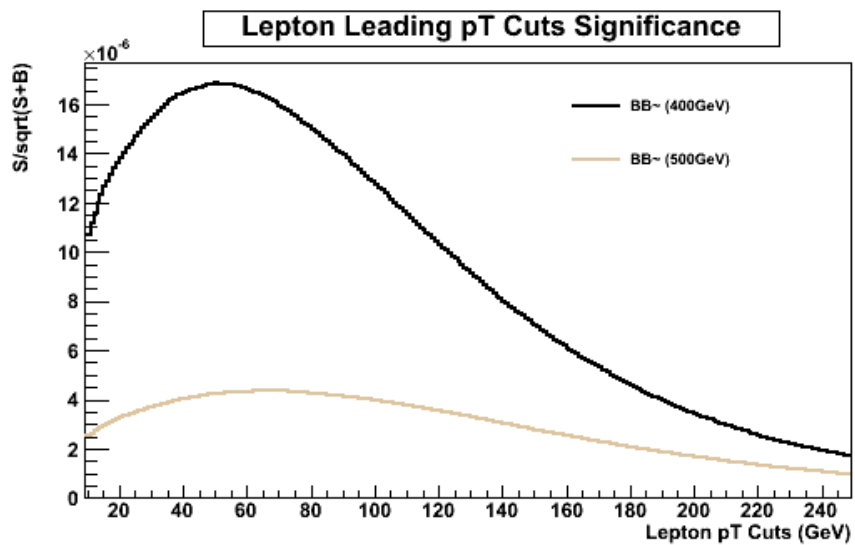
- Jet second leading p_T : 57 GeV



+ Results (cont.'d)

Most efficient cuts:

- Lepton leading p_T : 50 GeV
- Lepton second leading p_T : 29 GeV



+ Work for the future

- Monte Carlo simulations:
 - Optimization for lepton isolation
 - Apply all optimized cuts
 - Determine expected # of particles from signal, background at current luminosity
 - Determine luminosity required to either discover or exclude heavy B at these masses
- Data:
 - Apply cuts on # jets, p_T , isolation
 - Search for events matching heavy B signature
 - Attempt to either discover or exclude heavy B with mass of 400/500 GeV

+ Sources

- CERN. (2011). *CMS – Detector (Triggering)*. Retrieved from <http://cms.web.cern.ch/cms/Detector/DataAcquisition/Triggering.html>
- Cheung, E. (May 17, 2011). *Searching for Heavy Top Quark Partners Using the CMS Detector*.
- The CMS Collaboration. (July 21, 2009). *Search for Exotic Partners of the Top Quark with the CMS Experiment*.

+ Things I've learned:

- It is depressing to offer food to someone with a nut allergy
- Gathering more than 4 of us in the lobby is guaranteed to take at least half an hour
- Performance art in Lausanne may involve a lack of pants
- Some vending machines sell candy, some sell cigarettes, and some sell pregnancy tests
- ...I should bring my camera along more often 😊