

Measurement of the top quark mass in single top events using tracks only

Elizabeth Drueke

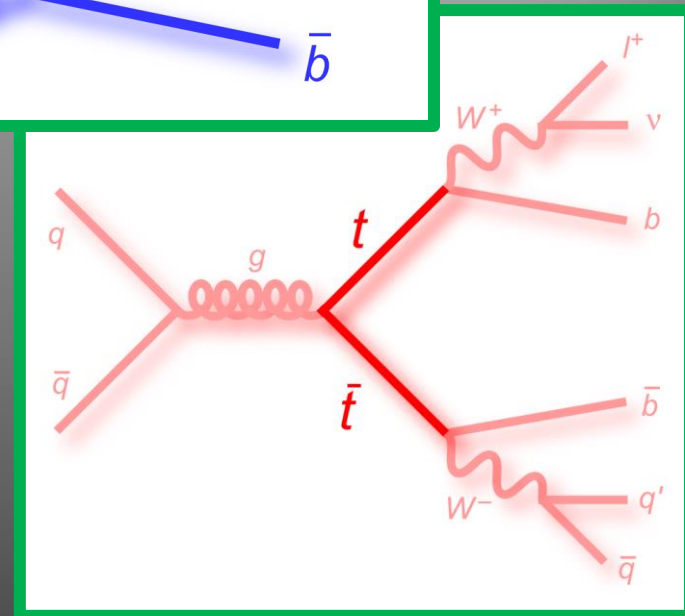
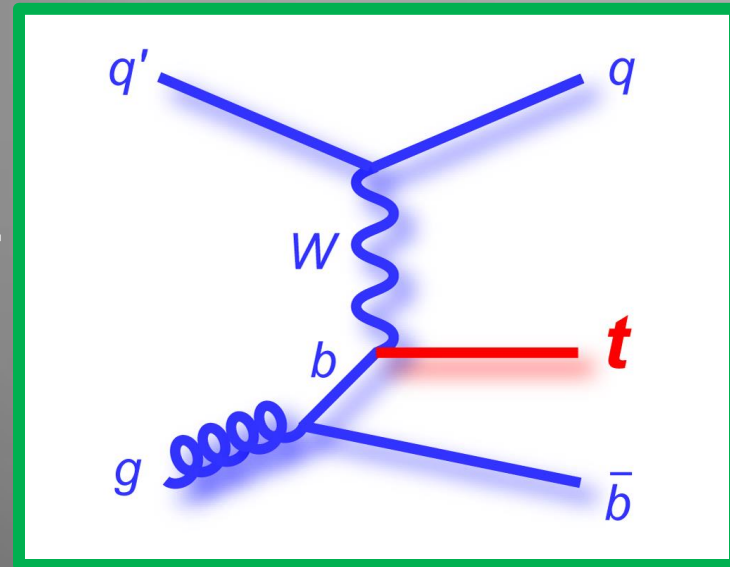
Martijn Mulders, Benjamin Stieger, and Pedro Silva

CERN Summer Student Programme 2015



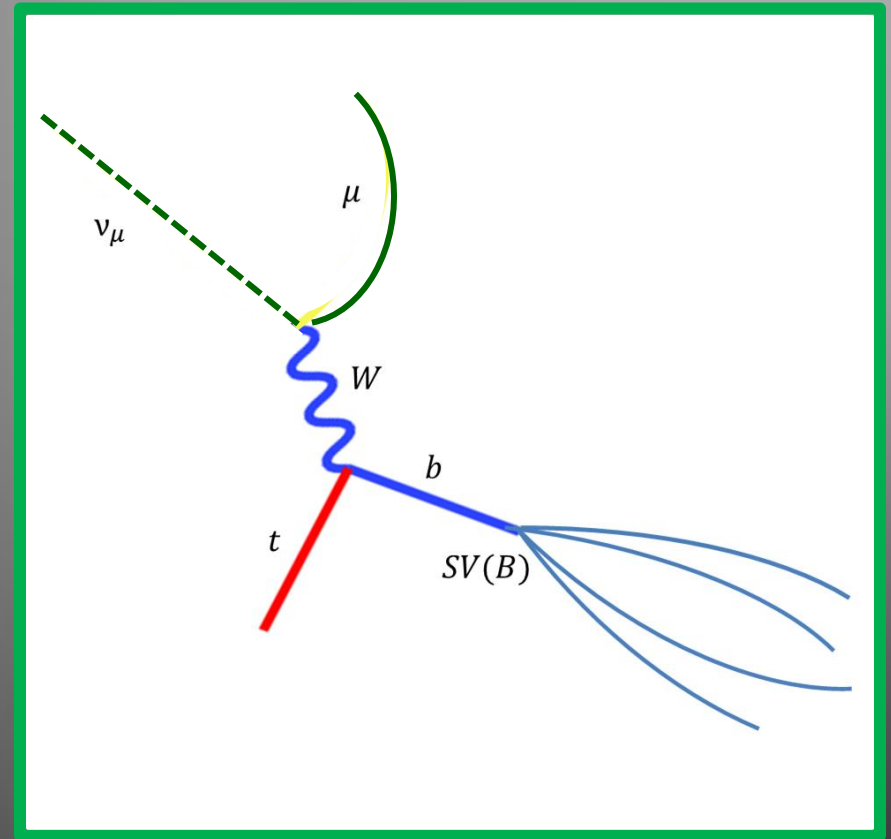
Why use Single Top for extracting the top quark mass?

- ▶ Two methods of top quark production: top pair ($t\bar{t}$) and single top (electroweak).
- ▶ Single top: b -jet must hadronize in a distinct way when compared with $t\bar{t}$.
 - Color Reconnection



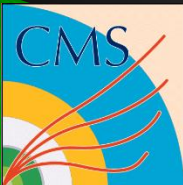
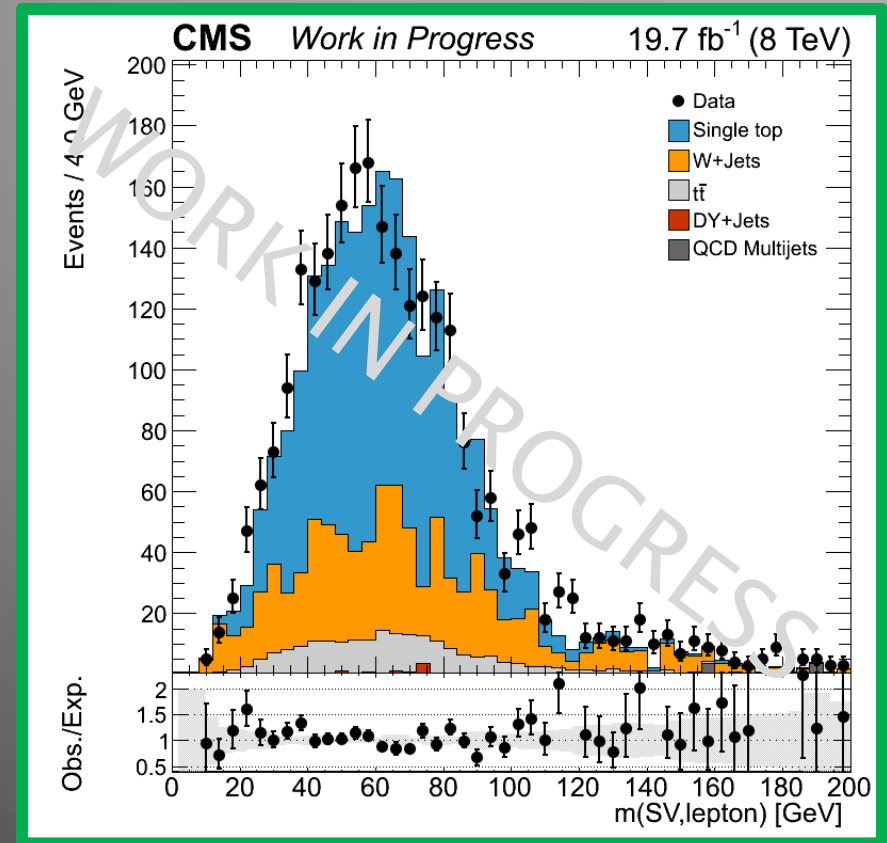
Using Tracks Only

- ▶ Reconstruct secondary vertex from tracks coming from B hadron.
- ▶ Combine invariant mass of lepton with that of secondary vertex to calculate a Lorentz-invariant observable (SVL).
- ▶ Calculate this observable for many top masses with MC and compare it with data to extract mass of the top quark.



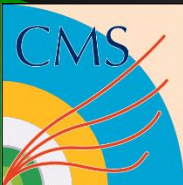
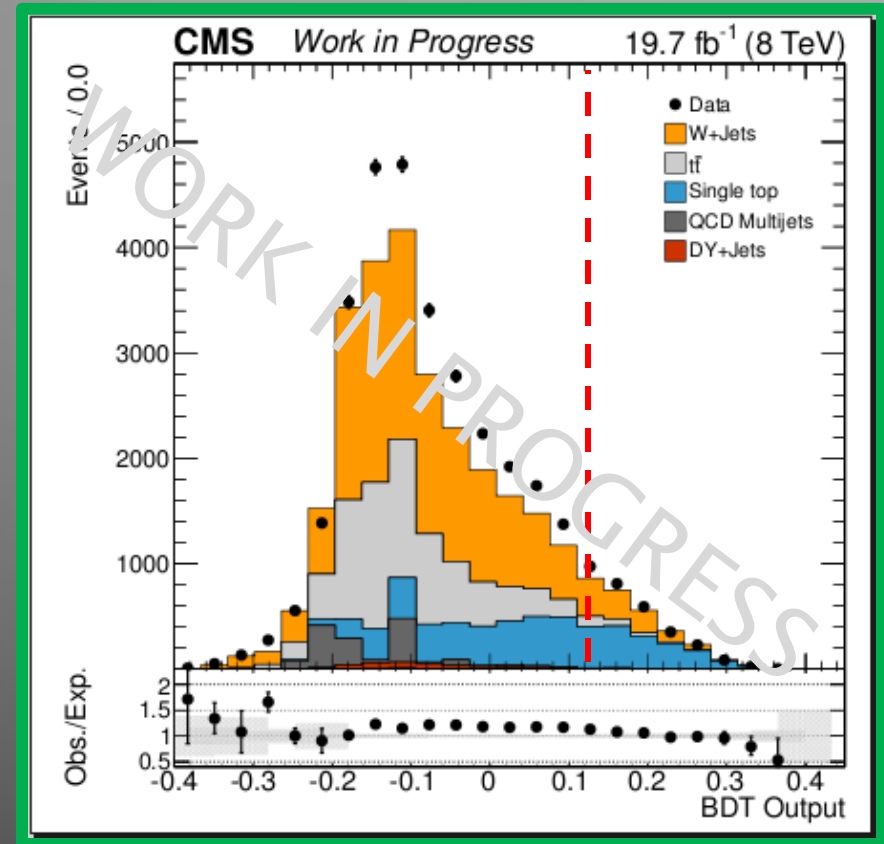
Selection

- ▶ 1 electron or muon
- ▶ 1 forward jet with
 - $p_t \geq 40 \text{ GeV}$
- ▶ 2 total jets with
 - $p_t \geq 40 \text{ GeV}$
- ▶ 1 Secondary Vertex
- ▶ At least 1 b-tagged jet
- ▶ $M_T \geq 50 \text{ GeV}$
- ▶ $MET \geq 45 \text{ GeV}$ if lepton is an electron



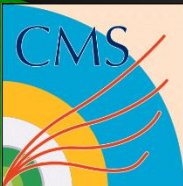
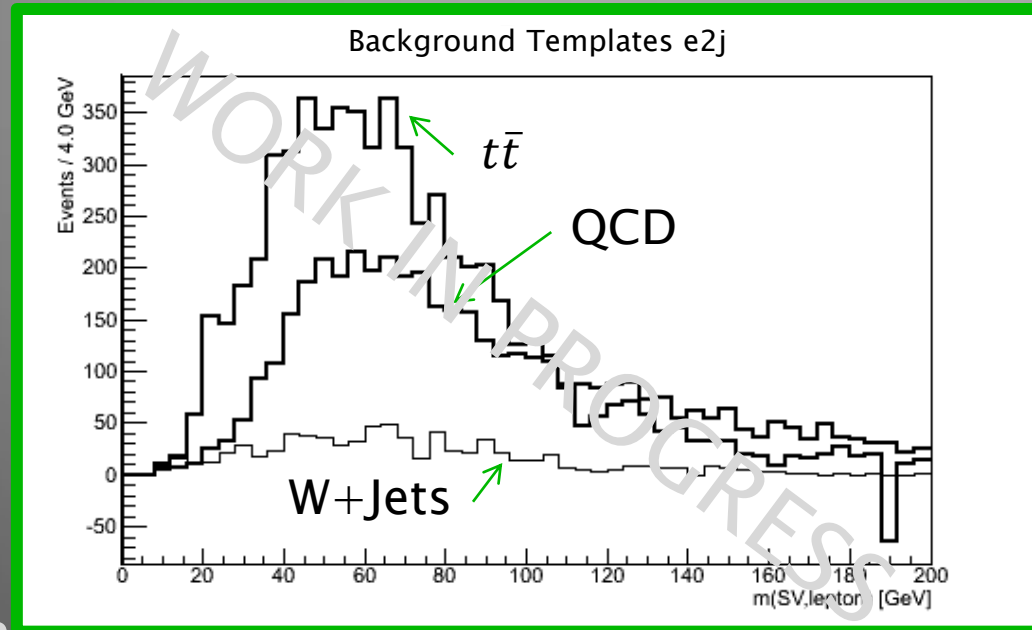
Using a Boosted Decision Tree

- ▶ Main backgrounds:
 - W +Jets
 - $t\bar{t}$
- ▶ Selection optimized for signal/ $t\bar{t}$
- ▶ Main variables used by BDT:
 - η of forward jet
 - $\Delta\eta$ of forward jet and other jet



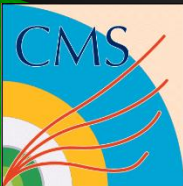
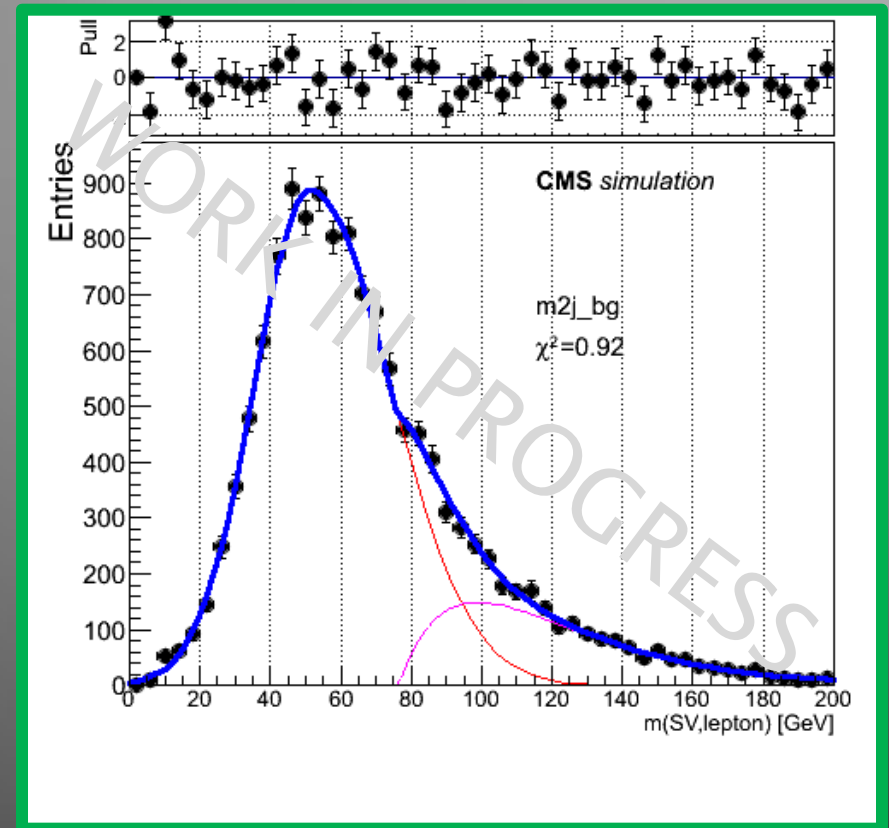
Background Modeling

- ▶ $t\bar{t}$
 - 3 jet region with $-0.05 \leq BDT \leq 0.11$
- ▶ W+Jets
 - Region with $-0.05 \leq BDT \leq 0.11$
- ▶ QCD
 - Inverted lepton isolation region with $-0.05 \leq BDT \leq 0.11$



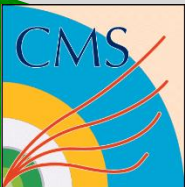
Template Fit

- ▶ Run the analysis over multiple masses using Monte Carlo.
- ▶ Create a template fit for SVL to be used on the data dependent on m_t
- ▶ Parameterize shape of observable as a function of m_t



Other Aspects of the Analysis

- ▶ Calibrate measurement with pseudo-experiments
- ▶ Evaluate systematic uncertainties
- ▶ Analyze differences in top and anti-top production as a possible probe of CPT invariance



Thank you!

»» Questions?

