Measurement of $t\bar{t}$ cross section in the lepton+jets channel at $\sqrt{s} = 13$ TeV with the ATLAS detector

Jessica Sydnor, Harris Kagan, Shaun Roe, Suyog Shrestha, and Nicola Venturi

University of Michigan CERN-REU Student Project
ATLAS Top Quark Group

• Studies top quark production at LHC and precision measurements of its properties

• Top quark is biggest background for physics beyond the Standard Model searches

• Cross section is an important property used for overall modeling of the top quark

http://cdn.arstechnica.net/Science/March10/Atlas_detector.jpg
BCM Sub-Detector

• ATLAS Diamond Beam Conditions Monitor

• Monitors collision/background rate:
  • Abort Beam if losses are large
  • Provide bunch-by-bunch luminosity measurement

• Provides uncertainty in luminosity to all ATLAS measurements
  • Cross section and luminosity are related by:
    • $N = L \times \sigma_{t\bar{t}}$
BCM/LUCID Ratio Plots Before and After Using Scale Factors

Ratio of BCM and LUCID for Single Bunch Train at Varying Mu

Altered BCM/LUCID for Single Bunch Train at Varying Mu
BCM/LUCID Ratio for First and Second Bunch Train

Altered BCM/LUCID for Single Bunch Train at Varying Mu

First full bunch train

Second full bunch train
Log Likelihood of $t\bar{t}$

Vertical line at $\log(L_{t\bar{t}}) = -48$. A cut of $\log(L_{t\bar{t}}) > -48$ is used to select more pure $t\bar{t}$ events. This cut is the same as the 8 TeV W helicity paper: *Eur. Phys. J. C* (2017) 77:264 DOI 10.1140/epjc/s10052-017-4819-4
Discrepancy Between Transfer Functions for Transverse Momentum of Leading b-jet

There is about a 10% difference in the $p_T$ range of ~ 20-100 GeV.
Summary and Outlook

• Compared BCM and LUCID
  • Discrepancy is dependent on $\mu$ and BCID
  • Obtained correction factors for data collected in 2016

• Compared 8 TeV and 13 TeV transfer functions
  • Noticed ~10% difference in kinematic variables
  • 13 TeV transfer functions result in better mass resolution

• Possible Future Work:
  • Refine correction factors for 2016 data and extend to multiple year data
  • Determine whether the 13 TeV parameters result in smaller signal to background ratio
  • Compare transfer functions with Dihiggs hypothesis
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Questions?
Backup
Derivation & Object Selection

- HIGG5D2 Derivation
- Moriond 2017 CP recommendations
- ntuple production code based on CxAOD Framework
- Single lepton trigger

### Lepton

Tight (Medium) Likelihood $e$ ($\mu$)

- $p_T > 27$ GeV, $|\eta| < 2.5$ (2.4) $e$ ($\mu$),
- FixedCutTightTrackOnly Isolation

### Jets

AntiKt4EMTopo Jets

Quality criteria – pass JVT and jet cleaning

- **b-**jet: $p_T > 20$ GeV, $|\eta| < 2.5$, MV2c10 @ 85% WP
- **Non-**b jet: $p_T > 20$ GeV, $|\eta| < 2.5$, non-b tagged

### MET

Loose Leptons, JVT-passed jets and TrackSoftTerm used for MET calculation.

Overlap Removal between $e$ & $\mu$

Shrinking Cone lep-jet OR
Pre-Selection Requirements

- Single lepton trigger
- Primary vertex with at least 2 tracks
- At least four jets
  - With at least two b-tagged
- Each jet must have $p_T > 20\, \text{GeV}$ and $|\eta| < 2.5$
- One trigger-matched lepton

- Pre-selection requirements and other details used to derive 13 TeV transfer functions can be found here: [https://tinyurl.com/y7lhmutl](https://tinyurl.com/y7lhmutl)
Kinematic distribution of mass of hadronically decaying W boson
A shift to the left can be seen clearly after a double gaussian fit as been applied to the 8TeV and 13TeV results separately. The mean of $m_{whad}$ with 8TeV parameters is ~81, while with 13TeV parameters it is ~77; however, the resolution is about 2GeV better for 13 parameters.