Study of WZ + Heavy Flavor Production in the Fully Leptonic Channel

Aaron Webb
University of Texas at Austin

Abstract

A measurement of WZ produced with an associated heavy flavor jet is performed using 140 fb^{-1} of proton-proton collision data at $\sqrt{s} = 13$ TeV from the ATLAS experiment at the LHC. The measurement is performed in the fully leptonic decay mode, $WZ \to l\nu ll$. Events are separated into inclusive 1-jet and 2-jet categories, and regions formed based on pseudo-continuous b-tag spectrum of the associated jets are fit to data.

Introduction

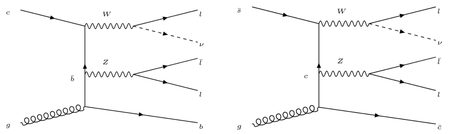
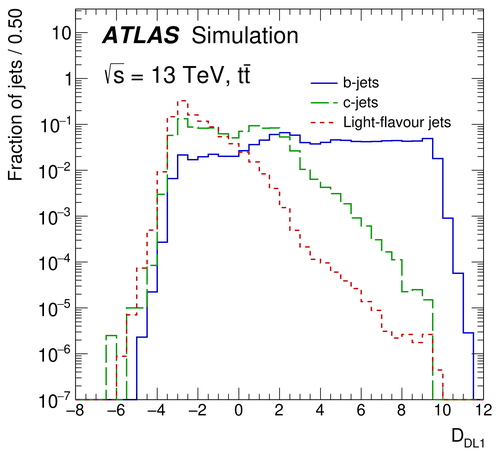


Figure 1: $WZ + b$ and $WZ + c$ production

- Because of the QCD processes involved, WZ + heavy flavor is a difficult process to simulate accurately
- Many major analyses include WZ + b as a background, motivating an accurate measurement of this process
- The continuous b-tagging spectrum of the jets is used to separate out WZ + b from WZ + light, forming regions which are fit to data.
- Currently blinded to data, showing MC only Asimov fits



Event Selection

- Exactly three, tight, isolated leptons with $p_T > 20$ GeV, $|\eta| < 2.47$
- $M_{l^+l^-}$ of a pair of oppositely charged, same flavor leptons within 10 GeV of 91.2 GeV
- Require 1-2 jets, with $p_T > 25$ GeV, $|\eta| < 2.5$
- $E^T_{miss} > 20$ GeV

tZ BDT

- Primary background in the high b-tag region is tZ, introduces large uncertainty
- Lepton, jet kinematics, and reconstructed top mass are used as inputs to a BDT to distinguish WZ from tZ events
- Output score is used to form a tZ CR

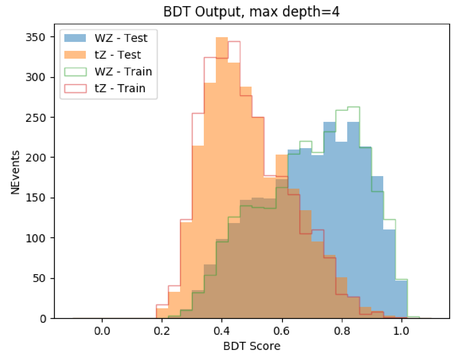


Figure 3: Output of the BDT for WZ and tZ events

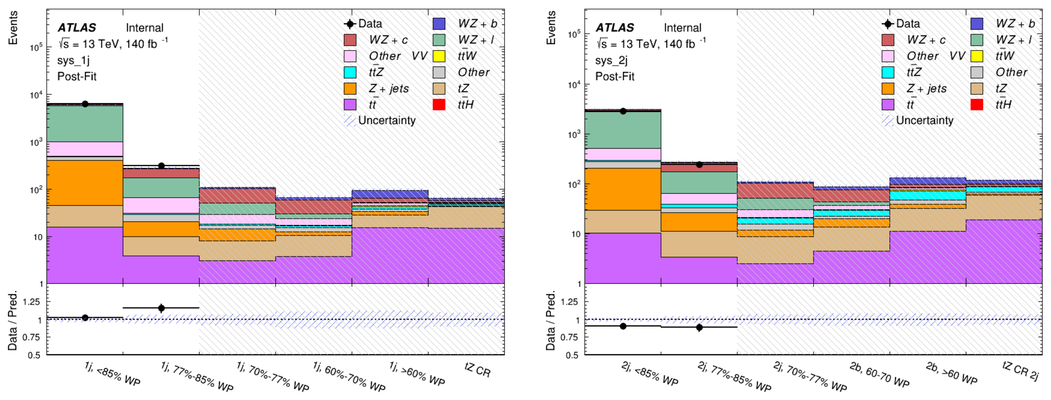
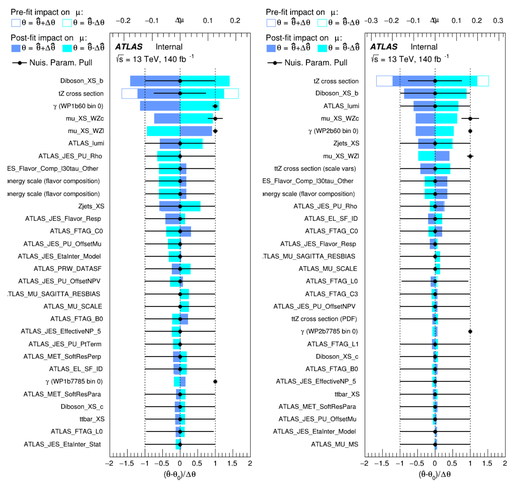


Figure 4: Summary of the fit regions for (left) 1-jet events and (right) 2-jet events.

Fit Procedure

- MC predictions are fit to the full Run-2 dataset, 140 fb^{-1} of $\sqrt{s} = 13$ TeV data
- Truth jets are binned based on the b-jet efficiency working points of the DL1r algorithm - 85%, 77%, 70% and 60%
- Events meeting the highest working point are further separated into a signal like region and a tZ CR based on an MVA
- The WZ events are separated by truth flavor into three templates, which are fit to data

Results



Flavor	Prefit/Postfit Yield
Truth b Jets	1.18±0.14
Truth c Jets	2.21±0.31
Truth light Jets	0.88±0.06

Figure 5: Ratio of pre-fit and post-fit yields of each jet flavor

Covariance Matrix:

Flavor	B-Jets	Charm-Jets	Light-Jets
B-Jets	1	0.37	-0.19
Charm-Jets	0.37	1	-0.76
Light-Jets	-0.19	-0.76	1

Figure 6: Matrix showing the covariance between the templates in the fit

- Good agreement is acheived between post-fit results and data.
- While a large shift in the charm jet contribution is observed, this is strongly correctly with the light jet contribution, as shown in figure **??**.
- The best fit result shifts the b-jet contribution by around 20%, suggesting that WZ+b can be predicted with greater accuracy.

Future Work