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

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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

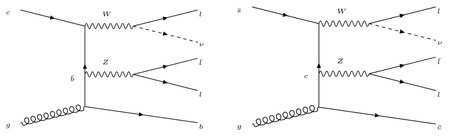

Figure 1: $WZ + b$ and $WZ + c$ production

- Many major analyses include WZ + b as a background, motivating a measurement of this process, which is difficult to simulate accurately
- 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
- Draft of a note can be found here:

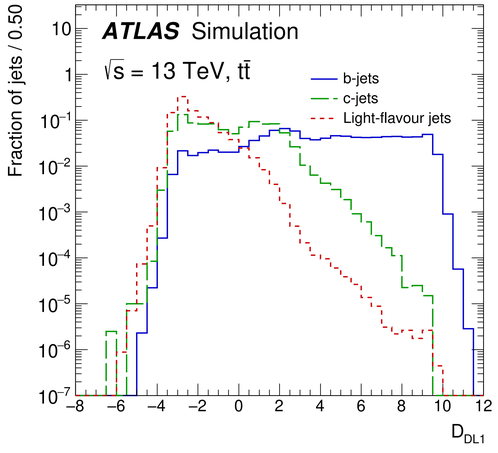

Figure 2: Distribution of DL1r score for b, charm, and

Event Preselection

- 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
- Data/MC Yields after preselection has been applied are shown in figure **??**

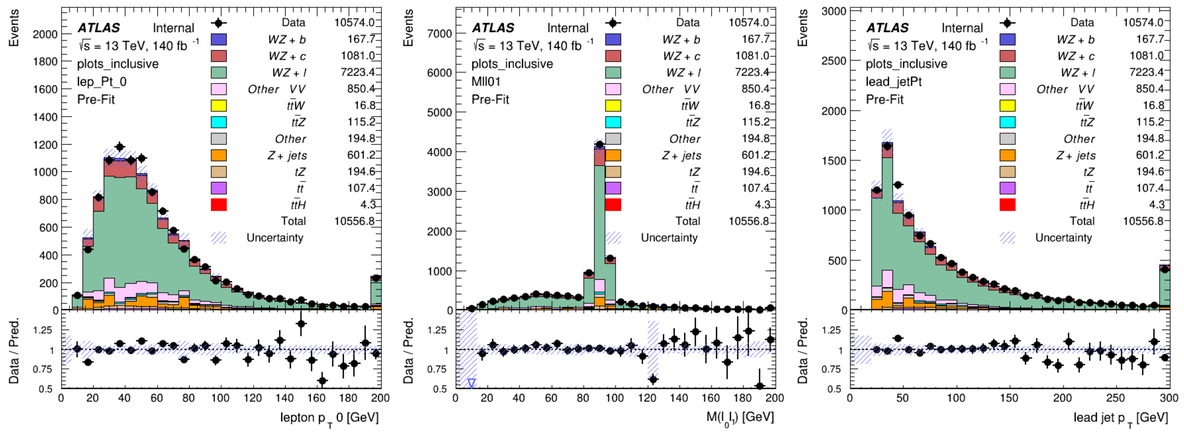

Figure 3: Distribution of (left) the p_T of the opposite sign lepton, (center) the invariant mass of a lepton pair, and (right) the p_T of the leading jet.

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

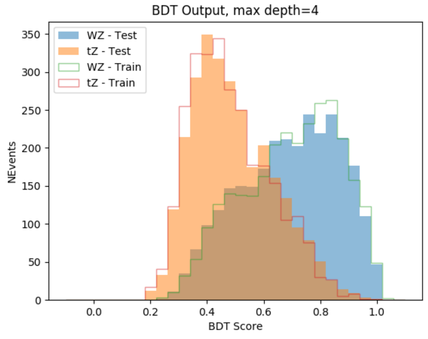

Figure 4: Output of the BDT for WZ and tZ events

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

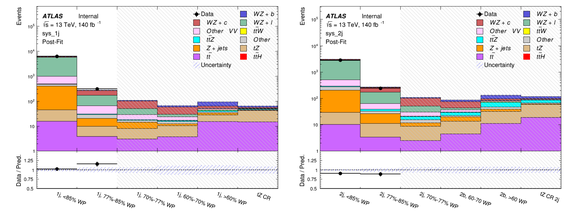

Figure 5: Summary of the fit regions for (left) 1-jet events and (right) 2-jet events.

1-jet Asimov Fit Results: $\mu_{WZ+b} = 1.00^{+0.54}_{-0.49}$, $\mu_{WZ+c} = 1.00 \pm 0.21$, $\mu_{WZ+l} = 1.00 \pm 0.06$

2-jet Asimov Fit Results: $\mu_{WZ+b} = 1.00^{+0.51}_{-0.48}$, $\mu_{WZ+c} = 1.00 \pm 0.24$, $\mu_{WZ+l} = 1.00 \pm 0.09$

$\mu = \sigma_{observed}/\sigma_{SM} \pm stat \pm sys$

- 170 systematic uncertainties are considered in the fit, either as norm factors, shape variations, or both
- The impact of these systematics on the measured value of WZ+b is shown in figure **??**

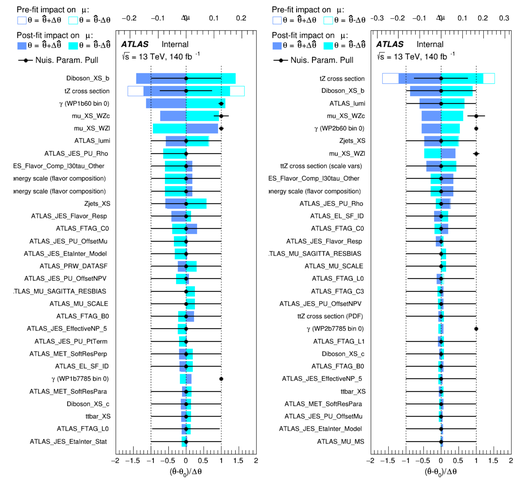

Figure 6:

Conclusions