ATLAS Note
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AtlasTitle: WZ + Heavy Flavor Production in pp collisions at $\sqrt{s}$ = 13 TeV

The ATLAS Collaboration

WZ + heavy-flavor production is measured using 36.1 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, $WZ \to l\nu ll$. The cross-section is measured to be X ± X ± X

Contents

1 Introduction

The production of WZ in association with a heavy flavor jet represents an important test of the Standard Model. While measurements have been made of WZ production, WZ + heavy flavor remains poorly understood. This is in part because the QCD processes involved in the production of WZ + b-jet make it difficult to simulate accurately, introducing a large uncertainty for analyses that include it as a background. This includes any analysis with leptons and b-jets in the final state, such as $t\bar{t}H$, $t\bar{t}W$, and $t\bar{t}Z$. Motivated by its relevance to the $t\bar{t}H$ multilepton analysis, we perform a study of the fully leptonic decay mode of this channel.

The pseudo-continuous b-tagging spectrum of each event in a diboson enriched region is fit to data in order make a more accurate estimate of the contribution of WZ + heavy-flavor. The full 2015 + 2016 dataset collected by the ATLAS detector, representing 36.1 fb^{-1} of data from pp collisions at $\sqrt{s} = 13$ TeV, is used for this study.

2 Data Samples and Event Selection

The study uses a sample of proton-proton collision data collected by the ATLAS detector in 2015 and 2016 at $\sqrt{s} = 13$ TeV. It represents an integrated luminosity of 36.1 fb^{-1}.

Several different generators were used to produce Monte Carlo simulations of the signal and background processes. For all samples, the response of the ATLAS detector is simulated using Geant4. The diboson samples are simulated using Sherpa 2.2.1 [**sherpa**]. Specific information about the Monte Carlo samples being used can be found in table 1 of [**ttH_paper**] .

Selected events are required to include exactly three reconstructed light leptons, which have a total charge of ±1. As the opposite sign lepton is found to be prompt 97% of the time [**ttH_paper**], it is required to be loose, while the same sign leptons must be very tight. All leptons are required to be isolated, and pass a non-prompt BDT selection described in [**ttH_paper**]. The opposite sign lepton is required to have $p_T > 10$ GeV, while the same sign leptons are required to have $p_T > 20$ GeV to reduce the contribution of non-prompt leptons. The leptons must all fall within $|\eta| < 2.5$.

The invariant mass of at least one pair of opposite sign, same flavor leptons is required to fall within 10 GeV of the Z mass. Events where one of the opposite sign pairs have an invariant mass less than 12 GeV are rejected in order to suppress low mass resonances. Further, events where the trilepton mass falls within 5 GeV of the Z mass are rejected to remove Z events that include conversions.

An additional requirement is placed on the transverse mass of the W candidate, $m(E_T^{miss} + l_{other}) > 30$ GeV, where EE_T^{miss} is the missing transverse energy, and l_{other} is the lepton not included in he Z-candidate.

Events are requied to have one or two reconstructed jets. Events with more than two jets are rejected in order to reduce the contribution of background such as $t\bar{t}Z$ and $t\bar{t}W$, which tend to have higher jet multiplicity. Jets are required to have $p_T > 25$ GeV, and must be within $|\eta| < 2.47$.

Diboson	tZ	Triboson	Z	Other
1914.47 ± 18.09	54.93 ± 0.80	24.99 ± 1.44	22.68 ± 0.31	26.1 ± 1.18

MC bkg total	Data	Data/MC (data stat, mc stat)
2043.17 ± 21.82	2078	1.02 ± 0.02 ± 0.01

Table 1: Data and MC yields in the signal region

The event yields for both data and Monte Carlo are summarized in table 1, which shows good agreement between data and Monte Carlo, and demonstrates that this signal region consists primarily of diboson events.