$\mathbf{W\gamma}$ at $\sqrt{s}$ =8 TeV.

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Abstract

We present a study of Wγ production in proton-proton collisions at $\sqrt{s} = 8$ TeV.

Contents

1 Introduction

The Standard Model (SM) has been proved to be an accurate description of production of elementary particles observed so far. The interaction of W bosons with photons is particularly important as a important test of self coupling of these bosons as predicted by non-Abelian gauge group of electroweak sector. Precise measurements of diboson properties and cross sections are a crucial step towards understanding the production of major backgrounds of Higgs boson searches at LHC.

In this analysis note we report the analysis of inclusive $W\gamma + X$ processes using leptonic decays of $W \to \ell\nu$ where $\ell = e, \mu$. The $W\gamma$ productions at tree level can be represented by Feynman diagrams in Figs. 1 and **??** as three processes: initial state radiation (ISR) where a photon is produced from one of the incoming partons, final state radiation (FSR) where a photon is radiated off one of the charged leptons from the W boson decay, and finally when a photon is produced in $s-$channel via TGC $WW\gamma$ for $W\gamma$ production. The last process is allowed only for $W\gamma$g production in the SM, as there are no neutral TGC in the SM.

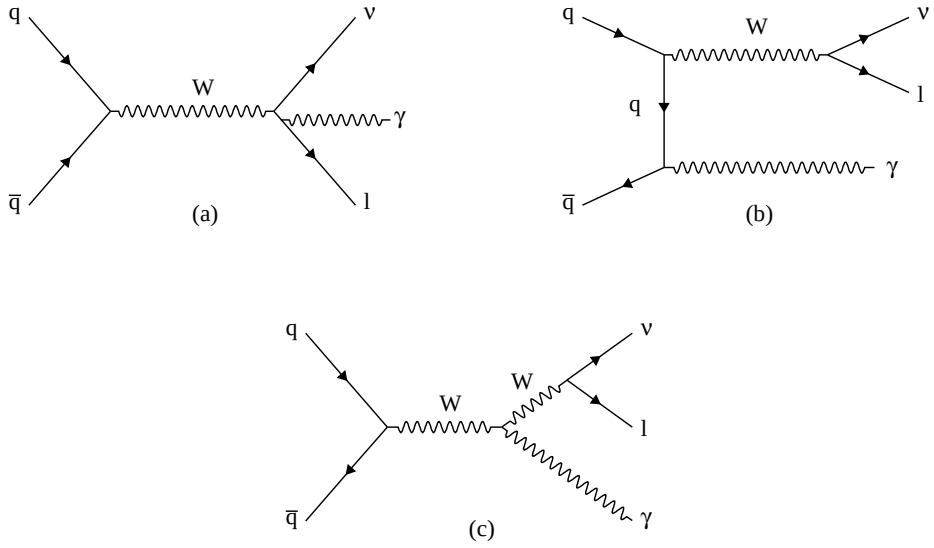

Figure 1: Feynman diagrams of the Wγ production via final (a) and initial (b) state radiation and via WWγ trilinear gauge coupling (c).

2 Data and Monte Carlo samples

2.1 Data sample

The data sample we use in this analysis was recorded by the CMS experiment in 2012. The data is collected by single electron ($p_T > 27$GeV) triggers 1. Only certified runs and luminosity sections are considered, which means that good functioning of all CMS sub-detectors is required. The selection of the validated run and luminosity sections are obtained from the following official JSON file:

- Cert_190456−208686_8TeV_22Jan2013ReReco_Collisions12_JSON.txt

The total statistics analyzed correspond to an integrated luminosity of 19.6 fb^{-1}.

The dataset used for the analysis and the corresponding run ranges are listed in Table 2. All samples have been processed using a `CMSSW_5_3_2` release version.

Dataset	Trigger name	Description
SingleElectron	HLT_Ele27_WP80*	$p_T > 27\ GeV$

Table 1: Analysis triggers for data sample.

Dataset name	Run range
/SingleElectron/Run2012A-22Jan2013-v1/AOD	190456-193621
/SingleElectron/Run2012B-22Jan2013-v1/AOD	193833-196531
/SingleElectron/Run2012C-22Jan2013-v1/AOD	198022-203746
/SingleElectron/Run2012D-22Jan2013-v1/AOD	203777-208686

Table 2: Summary of data samples used and run ranges of applicability.

2.2 Monte Carlo samples

All MC samples considered in this analysis come from the official "Summer12_53X". Events from all samples were reconstructed making use of a `CMSSW_5_3_X` release version. The simulated samples are reweighted to represent the distribution of the number of pp interactions per bunch crossing (pile-up), as measured in the data.

Information on Monte Carlo samples used for the analyses is given in Table 3 for signals and backgrounds. The corresponding leading order (LO) and next-to-leading order (NLO) cross sections are also listed in this Table.

Table 3: Summary of Monte Carlo background samples used.

Process (Fall11)	σ, pb	Dataset Name (AODSIM data tier)
$W\gamma \to l\nu\gamma$	553.92 (NLO)	`/WGToLNuG_TuneZ2star_8TeV-madgraph-tauola`
$W \to l\nu + jets$	36257.2 (NNLO)	`/WJetsToLNu_TuneZ2Star_8TeV-madgraph-tarball`
$Z \to ll + jets$	3503.71	`/DYJetsToLL_M-50_TuneZ2Star_8TeV-madgraph-tarball`
$t\bar{t} + jets + 1l$	99.44 (NNLO)	`/TTJets_SemiLeptMGDecays_8TeV-madgraph`
$t\bar{t} + jets + 2l$	23.83	`/TTJets_FullLeptMGDecays_8TeV-madgraph`
$t\bar{t} + \gamma$	1.444	`/TTGJets_8TeV-madgraph`
$Z\gamma \to ee\gamma$	159.120	`/ZGToLLG_8TeV-madgraph`

3 Object selection

In this Section we document the electron, and photon identification and isolation criteria, MET criteria, and provide the results of comparing Monte Carlo simulation with data.

3.1 Electron selection

In $W\gamma$ analysis we consider electrons with $p_T > 30$ GeV and passing the Medium-identification and isolation optimized by EGamma-POG for 2012 analyses. We summarize electron identification and isolation requirements in Table **??**.

The ECAL fiducial region is defined in terms of barrel and endcap sections with pseudorapidity ranges of $|\eta| < 1.4442$ and $1.566 < |\eta| < 2.5$, respectively. An electron is considered to be within this ECAL acceptance if its associated SuperCluster (SC) is within the ECAL acceptance. Data/MC scale factors are applied.

3.2 Photon selection

Photon candidates are reconstructed as SuperClusters with $E_T > 15$ GeV in the fiducial volume of the ECAL detector: barrel (EB) with $|\eta| < 1.4442$ and endcap (EE) with $1.566 < |\eta| < 2.5$. To reduce copious background objects from jets misidentified as photons we apply the Medium identification and isolation selections as recommended by EGamma-POG. Data/MC scale factors are applied.

3.3 MET

no selection yet