Measurement of Z→μμ cross section in pp collisions at $\sqrt{s} = 13\text{TeV}$

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Abstract

I. INTRODUCTION

Z boson is a particle which mediate the weak interaction. The production of Z bosons in pp collisions is mainly via the weak Drell-Yan process. Z boson immediately decays into lepton-antilepton pairs. Cross section of $Z \rightarrow \mu\bar{\mu}$ can be measured by reconstructing muon data from the CMS detector.

Theoretical predictions are available at next-to-next-leading order (NNLO) in perturbative quantum chromodynamics (QCD). Precise measurements of $Z \rightarrow \mu\bar{\mu}$ cross section provide tests of perturbative QCD and validate the theoretical predictions of higher-order corrections. Monte Carlo simulation method is used for theoretical prediction.

II. THE CMS DETECTOR

The Compact Muon Solenoid (CMS) detector is a multi-purpose apparatus due to operate at the Large Hadron Collider (LHC) at CERN. CMS contains a silicon pixel and strip tracker, an electromagnetic calorimeter (ECAL), a hadron calorimeter (HCAL), superconducting solenoid, and a muon detector. The solenoid provides 3.8T magnetic field and this bends muon trajectory oppositely inside and outside. Muons are detected from silicon pixel and strip tracker, and muon detector.

A right-handed coordinate system is used with the origin at the nominal interaction point, the x-axis pointing to the center of the LHC ring, the y-axis pointing up (perpendicular to the LHC plane), and the z-axis along the anticlockwise-beam direction. The polar angle θ is measured from the positive z-axis and the azimuthal angle φ is measured in the xy-plane. The pseudorapidity is given by $\eta = -\ln\tan(\theta/2)$.

Z boson candidates are required to have reconstructed dimuon mass between 60 and 120GeV. Muons are triggered by $p_T < 15GeV$ and $|\eta| < 2.1$. Muons are reconstructed from seed tracks in the muon detector with silicon pixel and strip tracker.

III. ANALYSIS

[Data/MC description]

The muon data samples are from Run2015C to Run2015D and luminosity $L = 569.017\ \text{pb}^{-1}$. Muons are selected online by a single-muon trigger.

Monte Carlo (MC) simulated samples are used to calculate acceptance efficiencies. Total number of MC events are 4.527×10^{11}.

[Muon id, event selection]

For muon identification, following selection cut are applied. Muon candidates must be reconstructed as a global muon and particle flow muon. χ^2 over number of degree of freedom of global muon track fit is less than 10. At least one muon chamber hit is included in global muon track fit. Muon segments should be at least two muon stations. Tracker track has transverse impact parameter $d_{xy} < 2mm$ with respect to the beam axis, and has longitudinal distance with respect to the primary vertex is $d_z < 5mm$. At least one pixel hits and 6 tracker layers hits are required. Track isolation value $\Sigma_{\text{tracks}} p_T/pT$ is less than 0.10.

[Acceptance and efficiency calculation]

The acceptance is defined as the fraction of simulated Z signal events with $p_T^{gen} > 20\text{GeV}$ and $|\eta^{\text{gen}}| < 2.1$, and $60 < m_{inv} < 120\text{GeV}$ divided by the total number of signal events in the same mass range.

[acceptance calculation]

The efficiency is the fraction of events selected.

[efficiency calculation]…

IV. RESULT

[How to calculate cross section]

Cross section $\sigma = \frac{N}{A\epsilon L}$ where N is number of events $60 < m_{inv} < 120$, A is Acceptance, ϵ is efficiency and L is luminosity.

V. CONCLUSIONS

Reference