Measurement of $H \to b\bar{b}$ in Associated Production with the CMS Detector

by

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Abstract

We measured $VH \to b\bar{b}$ with the CMS Detector.

Thesis Supervisor: Christoph M. E. Paus
Title: Professor of Physics

Acknowledgments

Thanks.

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3.1 Associated Production at the LHC

The LHC is a hadron collider.

Quark interactions can lead to Vector boson production, since the protons are at high energy.

Virtual vector bosons can radiate a Higgs.

This happens along with additional event stuff, caused by breaking apart the protons and pileup.

3.2 Observables of Associated Production

We can count charged leptons or infer neutrinos to tag vector bosons.

We are interested in Higgs to $b\bar{b}$.

3.3 Detector Requirements

We need to identify interesting particles, be able to reconstruct missing transverse momentum, and remove pileup.

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In order to effectively measure Higgs production, we need to be able to accurately estimate other events that end up in our selection.

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We use different generators.

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$t\bar{t}$

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Section 3.6.1 describes how detector responses are linked to possible physical particles. We want to remove false positives, so here are some tighter requirements for counting for event selection.

Once we have our objects defined, we can count them.

5.1.1 Muons

Muons can show up in weakly decaying jets, so we're only interested in isolated ones here.

5.1.2 Electrons

Electrons do the same thing as muons, but messier because the ECAL isn't as clean as the muon chambers.

5.1.3 Jets

Jets are messier still.

Pileup removal is a big deal here.

5.1.4 MET

MET is corrected.

5.1.5 Undesirable Particles

There are certain particles that we do not want present. We make very loose selections for those and veto on them.

Photons

Tau Leptons

5.2 Removal of QCD

We have some cuts across the board on our objects in order to remove events that are just QCD.

5.3 Categories of Vector Boson Decay

Now that we are ready to count, we can count leptons in order to characterise potential vector bosons.

5.3.1 0 Leptons

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[1] The CMS Collaboration. Observation of higgs boson decay to bottom quarks. *Physical Review Letters*, 121(12), Sep 2018.