

NORTHWESTERN UNIVERSITY

The Search for the Higgs Boson Decaying into a Z Boson and a Photon

A DISSERTATION

SUBMITTED TO THE GRADUATE SCHOOL  
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

for the degree

DOCTOR OF PHILOSOPHY

Field of Physics and Astronomy

By

James Bueghly

EVANSTON, ILLINOIS

December 2019

© Copyright by James Bueghly 2019

All Rights Reserved

# ABSTRACT

The Search for the Higgs Boson Decaying into a Z Boson and a Photon

James Bueghly

Since its discovery in 2012 at the Large Hadron Collider (LHC), efforts have been made to measure and characterize the properties of the Higgs boson. Among these efforts have been searches for rare decays of the Higgs predicted by the Standard Model (SM) of particle physics. One such decay is the process  $H \rightarrow Z\gamma$ , which is predicted by the SM to have a branching fraction of XX. An observation of this decay mode at a rate deviating from the SM prediction would provide indirect evidence of new physics beyond the SM. Previous searches for  $H \rightarrow Z\gamma$  were carried out using proton-proton collision data from Run 1 of the LHC. Run 1 exclusion limits on the process were placed at roughly ten times the SM expectation by the Compact Muon Solenoid (CMS) experiment.

This thesis describes the search for  $H \rightarrow Z\gamma$  in the  $\ell\ell\gamma$  final state with the CMS detector using LHC Run 2 proton-proton collision data. The process is not observed, and exclusion limits are placed on the production cross section times branching fraction at XX times the SM expectation.

## Acknowledgements

Text for acknowledgments.

## Table of Contents

ABSTRACT	3
Acknowledgements	4
Table of Contents	5
List of Tables	6
List of Figures	7
Chapter 1. Introduction	8
Chapter 2. Results and Interpretation	9
References	10

## List of Tables

## List of Figures

## CHAPTER 1

### **Introduction**

introductory text



## CHAPTER 2

# Results and Interpretation

results text

## References

- [1] A bibliographic item. A bibliographic item. A bibliographic item. A bibliographic item.
- [2] Another bibliographic item.
- [3] Yet another bibliographic item.