

NORTHWESTERN UNIVERSITY

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

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## ABSTRACT

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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.

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## CHAPTER 1

### **Introduction**

introductory text



## CHAPTER 2

### Theory

#### 2.1. The Standard Model

#### 2.2. Electroweak Theory

#### 2.3. Spontaneous Symmetry Breaking (Higgs Mechanism)

#### 2.4. Higgs Production

#### 2.5. Higgs Decay

#### 2.6. Physics Beyond the Standard Model

## CHAPTER 3

**Results and Interpretation**

results text

## References

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