A Collider Search for Dark Matter Produced in Association with a Higgs Boson with the CMS Detector at the 13 TeV LHC

By

DUSTIN RAY BURNS

B.S. Physics (Georgia Institute of Technology) 2011 B.S. Applied Mathematics (Georgia Institute of Technology) 2011 M.S. Physics (University of California, Davis) 2012

DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Physics

in the

OFFICE OF GRADUATE STUDIES

of the

University of California

Davis

Approved:

Chair Michael Mulhearn, Chair

Robin Erbacher

Albert De Roeck

Committee in Charge

2017

Copyright © 2017 by

Dustin Ray Burns

All rights reserved.

To someone very important ... a nice dedication.

Contents

| | List | of Figu | ires | iv |
|-----------------|---------------------------------------|---------|---------------------------|----|
| | List | of Tab | les | V |
| | Abs | tract . | | V |
| | Ack | nowledg | gments | vi |
| 1 | Motivation and theoretical background | | | |
| | 1.1 | The S | tandard Model | 1 |
| | | 1.1.1 | Symmetries of nature | 1 |
| | | 1.1.2 | Particle content | 1 |
| 1.2 Dark matter | | Dark | matter | 1 |
| | | 1.2.1 | Observational evidence | 1 |
| | | 1.2.2 | Beyond the Standard Model | 1 |

LIST OF FIGURES

LIST OF TABLES

Abstract

A Collider Search for Dark Matter Produced in Association with a Higgs Boson with the CMS Detector at the 13 TeV LHC

The abstract submitted as part of your dissertation, in the introductory pages, does not have a word limit. It should follow the same format as the rest of your dissertation (1.5 inch left margin, double-spaced, consecutive page numbering, etc.).

ACKNOWLEDGMENTS

Acknowledgements to those who helped you get to this point. They should be listed by chapter when appropriate.

Chapter 1

Motivation and theoretical background

- 1.1 The Standard Model
- 1.1.1 Symmetries of nature
- 1.1.2 Particle content
- 1.2 Dark matter
- 1.2.1 Observational evidence
- 1.2.2 Beyond the Standard Model

[?]

A Collider Search for Dark Matter Produced in Association with a Higgs Boson with the CMS Detector at the 13 TeV LHC

Abstract

The abstract that is submitted to UMI must be formatted as shown in the example here. The body of the abstract cannot exceed 350 words. It should be in typewritten form, double-spaced, and on bond paper. It is important to write an abstract that gives a clear description of the content and major divisions of the dissertation, since UMI will publish the abstract exactly as submitted. Students completing their requirements under Plan A should provide extra copies of the typed summary for use by the dissertation committee during the examination.

The abstract that is submitted to UMI must be formatted as shown in the example here. The body of the abstract cannot exceed 350 words. It should be in typewritten form, double-spaced, and on bond paper. It is important to write an abstract that gives a clear description of the content and major divisions of the dissertation, since UMI will publish the abstract exactly as submitted. Students completing their requirements under Plan A should provide extra copies of the typed summary for use by the dissertation committee during the examination.

The abstract that is submitted to UMI must be formatted as shown in the example here. The body of the abstract cannot exceed 350 words. It should be in typewritten form, double-spaced, and on bond paper. It is important to write an abstract that gives a clear description of the content and major divisions of the dissertation, since UMI will publish the abstract exactly as submitted. Students completing their requirements under Plan A should provide extra copies of the typed summary for use by the dissertation committee during the examination.

The abstract that is submitted to UMI must be formatted as shown in the example here. The body of the abstract cannot exceed 350 words. It should be in typewritten

form, double-spaced, and on bond paper. It is important to write an abstract that gives a clear description of the content and major divisions of the dissertation, since UMI will publish the abstract exactly as submitted. Students completing their requirements under Plan A should provide extra copies of the typed summary for use by the dissertation committee during the examination.