University of California
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Search for new physics with final states containing a same-sign dilepton pair at a center-of-mass energy of 13 TeV with the CMS detector

A dissertation submitted in partial satisfaction
of the requirements for the degree

Doctor of Philosophy
in
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by

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March 2019

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Curriculum Vitæ

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Education

2019	Ph.D. in Physics (Expected), University of California, Santa Barbara.
2017	M.A. in Physics, University of California, Santa Barbara.
2014	B.Sc. in Physics, Texas A&M University, College Station, TX.

Publications

- B. Hashemi, N. Amin, K. Datta, D. Olivito, and M. Pierini, *LHC analysis-specific datasets with Generative Adversarial Networks* [arXiv:1901.0528]
- CMS Collaboration, *Search for standard model production of four top quarks in final states with same-sign and multiple leptons in proton-proton collisions at* $\sqrt{s} =$ 13 TeV [PAS TOP-18-003]
- CMS Collaboration, *Search for physics beyond the standard model in events with two same-sign leptons or at least three leptons and jets in proton-proton collisions at* $\sqrt{s} = 13$ TeV [PAS SUS-19-008]
- CMS Collaboration, *Search for standard model production of four top quarks with same-sign and multilepton final states in proton-proton col- lisions at* $\sqrt{s} = 13$ TeV, *Eur. Phys. J.* **C78** (2018) [arXiv:1710.1061]
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Abstract

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David McAlister Barry

Two related searches for Standard Model and beyond the Standard Model physics with a final state containing a pair of same-charged leptons and jets are performed using a sample of $\sqrt{s} = 13$ TeV data corresponding to an integrated luminosity of 137 fb^{-1}, collected by the CMS detector between 2016 and 2018. The first inclusive search observes no excess above the Standard Model and thus places constraints on R-parity violating and R-parity conserving supersymmetric models with pair production of gluinos and squarks. Gluino masses are excluded up to 2.1 TeV, while top and bottom squarks are excluded up to 0.9 TeV. The second search measures the cross-section of the production of four top quarks within the Standard Model using both cut-based and multivariate approaches. The observed (expected) significance of the multivariate approach is 2.6 (2.7) standard deviations, with a measured cross-section of $12.6^{+5.8}_{-5.2}$ fb, consistent with the Standard Model prediction of $12.0^{+2.2}_{-2.5}$ fb. These results are translated into constraints on the Yukawa coupling of the top quark, as well as constraints on heavy scalar or pseudoscalar production in a type II 2HDM scenario.

Contents

Chapter 1

Introduction

1.1 Info

Some facts

- Standard model missing some stuff
- LHC smashes protons together very fast
- CMS detector is very big
- Analyze CMS data to find stuff beyond the standard model (e.g., SUZY)
- Did not find anything

The results presented in this thesis correspond to the published results in Refs. [1, 2, 3, 4]

Appendix A

Appendix Title

A.1 Section Title

Feed me later, please

Bibliography

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