SEARCH FOR CHARGINOS, NEUTRALINOS AND SLEPTONS IN OPPOSITE-SIGN DI-LEPTON FINAL STATES AT CENTER-OF-MASS ENERGY OF 13 TEV WITH THE CMS DETECTOR.

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Abstract of Dissertation
Doctor of Philosophy

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This document presents two searches for physics beyond the Standard Model (SM), each using $35.9\mathrm{fb}^{-1}$ of proton–proton collision data collected with the CMS detector at a center-of-mass energy of 13 TeV, at the CERN Large Hadron Collider (LHC). The two searches for new phenomena is targeting electroweak production of Supersymmetric (SUSY) particles, so called Charginos, Neutralinos and sleptons, in a production mode that results in two leptons of opposite-sign and same-flavor, large missing transverse momentum, $\mathrm{p_T^{miss}}$.

The document contains a summary of the theoretical framework that make up the SM and SUSY, along with a comprehensive description of the CMS experiment at the LHC accelerator complex. The two searches presented in this thesis both target the production of electroweak SUSY particles, but are divided into two types, according to the production mode. The search for Charginos and Neutralinos result in final states where two or more jets resulting from hadronization are produced, while the search for the direct production of sleptons is chrarcterized by the fact that no hadronization is expected, and thus results in a final state without any jets. The search strategies thus differ slightly, and the two strategies are presented, along with a description of the SM background processes that govern these final states.

Since no excess of collision data is observed with respect to the predicted SM backgrounds in neither of the searches, a statistical interpretation of the results yielding

upper limits in the production cross sections on the SUSY particles, is performed. These limits greatly extend the limits set using 8 TeV collision data during the LHC Run 1.

Concluding remarks commenting on the current absence of evidence for physics beyond the SM (BSM) are given, and an outlook highlighting the unprecedented instantaneous luminosity expected at the LHC, and the window of opportunity for searches for BSM physics that it presents.

CHAPTER 1
INTRODUCTION

The Standard Model (SM) of particle physics is an extremely successful theory shown to correctly predict the behavior of the particles and forces which make up the most basic constituents of all known matter. After the prediction of the existence of a spin-0 boson with ability to explain how all particles acquire mass in the 60's, and the subsequent discovery of the Higgs boson in 2012 by the ATLAS and CMS experiments, the SM is established as the most precise theory to explain matter. But in order for the SM to be a complete theory, it needs to be able to explain some interesting features. Among these features, is why the lightest particle, the neutrino, and the heaviest particle, the top quark, span 3 orders of magnitude in mass. And further, the SM is not able to explain the origin of dark matter. In order to account for these phenomena, possible theoretical extensions of the SM are proposed, of which Supersymmetry is by far the theory that has attracted most popularity. The popularity In particular, the SM predicts that the massive particles of the theory acquire their mass by interacting with a scalar particle called the Higgs boson [**? ? ? ?**]. On July 4, 2012 two collaborations at the Large Hadron Collider (LHC), the A Toroidal LHC Apparatus (ATLAS) and Compact Muon Solenoid (CMS), announced the discovery of a new boson at 125 GeV with properties similar to the Standard Model Higgs [**? ? ?**]. This discovery was fueled by the investigation into the Higgs decays to the vector bosons ZZ and $\gamma\gamma$.