A search for sparticles in zero lepton final states

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ABSTRACT

A search for sparticles in zero lepton final states

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Acknowledgements

Dedication

Chapter 1

Introduction

Particle physics is a remarkably successful field of scientific inquiry. The ability to precisely predict the properties of a exceedingly wide range of physical phenomenom, such as the description of the cosmic microwave background (cite planck) anomalous magnetic moment of the muon (cite paper on this), and the measurement of the number of weakly-interacting neutrino flavors is truly amazing.

The theory that has allowed this range of predictions is the Standard Model of particle physics (SM) as developed by Gell-Mann, This quantum field theory (QFT) contains a tiny number of particles, whose interactions describe phenomenom up to at least the TeV scale. These particles are manifestations of the fields of the Standard Model, after application of the Higgs Mechanism. The particle content of the SM consists only of the six quarks, six leptons, the four gauge bosons, and the scalar Higgs boson.

guy and guy., cite

Despite its impressive range of described phenomenom, the Standard Model has some theoretical and experimental deficiencies. The SM contains 26 free parameters. [1]While this is not upsetting, if the number of free parameters could be understood in terms of a more fundamental theory, this would be more theoretically pleasing. The major theoretical concern of the Standard Model, as it pertains to this thesis, is the "hierachy problem".The light mass of the Higgs boson (125 GeV) should be quadratically dependent on the scale of UV physics, due to the quantum corrections from high-energy physics processes. The most perplexing experimental issue is the existence of "dark matter", which interacts very weakly with those particles of the

cite hierachy problem

cite dark matter research

Standard Model, which has been shown by cosmological data. There is no particle in the SM which can act as a candidate for dark matter.

check or add some, maybe cited

cite

Both of these major issues, as well as numerous others , can be solved by the introduction of "supersymmetry".In supersymmetric theories, all particles have a so-called "superpartners", or sparticles, differing from the particle by 1/2 in spin. These theories solve the hierachy problem, since the corrections induced from the superpartners exactly cancel those induced by the SM particles. In addition, these theories are usually constructed assuming $R-$parity, which can be thought of as the "charge" of supersymmetry, with SM particles having $R = 1$ and sparticles having $R = -1$. In collider experiments, since the incoming SM particles have total $R = 1$, the resulting sparticles are produced in pairs. This is produces a rich phenomenology, which is often characterized by large missing transverse energy ($E_{\mathrm{T}}^{\mathrm{miss}}$), which provides significant discrimination against SM backgrounds.

cite many searches

Despite the power of searches for supersymmetry where $E_{\mathrm{T}}^{\mathrm{miss}}$ is a primary discriminating variable, there has been significant interest in the use of other variables to discriminate against SM backgrounds. These include searches based on the variables $\alpha something$, $M_{T,2}$, and the razor variables (M_R, R^2). In this thesis, we will present the first search for supersymmetry using the novel Recursive Jigsaw Reconstruction (RJR) technique. RJR can be considered the conceptual successor of the razor variables. We impose a particular final state "decay tree" on an event, which roughly corresponds to a simplified Feynmann diagram. This allows understanding of internal decay structure, as well as additional rejection of SM backgrounds.

7 fb^{-1}

This thesis details a search for the superpartners of the gluon and squark, the gluino and squark, in final states with zero leptons, with of data using the AT-

[1] This is the Standard Model corrected to include neutrino masses. These parameters are the fermion masses (6 leptons, 6 quarks), CKM and PMNS mixing angles (8 angles, 2 CP-violating phases), W/Z/Higgs masses (3) , the Higgs field expectation value, and the couplings of the strong, weak, and electromagnetic forces (3 α_{force}) .

LAS detector. This thesis is organized as follows. The theoretical motivation of the Standard Model and supersymmetry are described in Chapters 2 and 3. The Large Hadron Collider and the ATLAS detector are presented in Chapters 4 and 5. Chapter 5 provides a detailed description of Recursive Jigsaw Reconstruction, as well as a description of the variables used for the particular search presented in this thesis. Chapter 6 presents the details of the analysis, including the dataset, object reconstruction, and selections used by the analysis. In Chapter 7, the final results are presented; since there is no evidence of a supersymmetric signal in the analysis, we present the final exclusion curves in simplified supersymmetric models.

Chapter 2

The Standard Model

Here you can write some introductory remarks about your chapter. I like to give each sentence its own line.

When you need a new paragraph, just skip an extra line.

2.1 Quantum Field Theory

2.2 Symmetries

2.3 The Standard Model

Overview

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Fermions

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Bosons

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2.4 Electroweak Symmetry breaking

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2.5 Deficiencies of the Standard Model

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Chapter 3

Supersymmetry

Here you can write some introductory remarks about your chapter. I like to give each sentence its own line.

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3.1 Motivation

Only Additional allowed Lorentz invariant symmetry

Dark Matter

Cancellation of quadratic divergences in corrections to the Higgs Mass

3.2 Supersymmetry

3.3 Additional particle content

3.4 Phenomenology

R parity Consequences for sq/gl decays

Chapter 4

The Large Hadron Collider

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4.1 Magnets

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Chapter 5

The ATLAS detector

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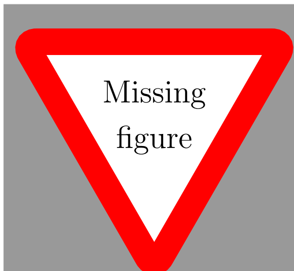

Overall ATLAS schematic

5.1 Inner Detector

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Pixel Detector

Missing figure

Pixel detector schematic

Insertable B-Layer

Qualification task, so add a bit more.

Missing figure

IBL ROD/BOC schematic

Semiconductor Tracker

Missing figure

SCT schematic

Transition Radiation Tracker

Missing figure

TRT schematic

5.2 Calorimeter

Missing figure

Calo schematic

Electromagnetic Calorimeter

Hadronic Calorimeter

5.3 Muon Spectrometer

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MS schematic

Chapter 6

The Recursive Jigsaw Technique

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6.1 Razor variables

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6.2 SuperRazor variables

6.3 The Recursive Jigsaw Technique

6.4 Variables used in the search for zero lepton SUSY

Chapter 7

Title of Chapter 1

Chapter 8

Title of Chapter 1

Here you can write some introductory remarks about your chapter. I like to give each sentence its own line.

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8.1 Object reconstruction

Photons, Muons, and Electrons

Jets

Missing transverse momentum

Probably longer, show some plots from the PUB note that we worked on

8.2 Signal regions

Gluino signal regions

Squark signal regions

Compressed signal regions

8.3 Background estimation

Z vv

W ev

ttbar

Chapter 9

Title of Chapter 1

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9.1 Statistical Analysis

maybe to be moved to an appendix

9.2 Signal Region distributions

9.3 Pull Plots

9.4 Systematic Uncertainties

9.5 Exclusion plots

Conclusion

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9.6 New Section

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