

ABSTRACT

SEARCH FOR CHARGED HIGGS BOSONS IN THE $\tau + \ell$ FINAL STATE WITH 36.1 fb⁻¹ OF pp COLLISION DATA AT $\sqrt{s} = 13$ WITH THE ATLAS EXPERIMENT

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This dissertation uses 139 fb⁻¹ of pp collision data collected at a center of mass energy of $\sqrt{s} = 13$ by the ATLAS detector to search for charged Higgs bosons decaying to a tau lepton and a neutrino ($H^\pm \rightarrow \tau^\pm \nu_\tau$) in association with a leptonically decaying top quark. No significant excess was found, therefore limits are set at the 95% confidence level on the charged Higgs production cross section times the branching fraction into the $\tau^\pm \nu_\tau$ ranging from XX pb to XX fb. These limits are interpreted in the hMSSM benchmark scenario as an exclusion at 95% confidence on $\tan\beta$ as a function of m_{H^\pm} . In this scenario, for $\tan\beta = 60$, the H^\pm mass range up to XXXX GeV is excluded, with all values of $\tan\beta$ excluded for $m_{H^\pm} \leq XXX \text{ GeV}$.

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EXPERIMENT**

BY

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DEDICATION

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CHAPTER 1

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1.1.1 Particles

1.1.1.1 Fermions

1.1.1.2 Bosons

1.1.2 Interactions

1.1.2.1 Electromagnetic Interaction

1.1.2.2 Weak Interaction

1.1.2.3 Strong Interaction

1.1.3 The Higgs Mechanism

1.2 Supersymmetry

1.2.1 MSMM Particles

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2.2.1.1 Pixel

2.2.1.2 Semiconductor Tracker

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3.3 Calorimeters

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3.6.2 Tau

3.7 $E_{\text{T}}^{\text{miss}}$

CHAPTER 4

SEARCH FOR CHARGED HIGGS BOSONS

4.1 Signature and Event Selection

NEEDS TO BE DONE

4.1.1 Object Definitions

NEEDS TO BE DONE

4.1.2 Event Selections

NEEDS TO BE DONE

4.2 Datasets

NEEDS TO BE DONE

4.2.1 Signal Modeling

NEEDS TO BE DONE

4.3 Background Modeling

NEEDS TO BE DONE

4.4 Analysis Strategy

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4.4.1 Multivariate Analysis Techniques

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4.4.2 Training

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4.4.3 Feature Selection

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4.4.4 Hyperparameter Optimization

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4.5 Systematic Uncertainties

NEEDS TO BE DONE

4.6 Results

CHAPTER 5
CONCLUSION

Appendices

