# Search for Neutrino Transients Using IceCube and DeepCore

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by

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# Search for Neutrino Transients Using IceCube and DeepCore

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# PREFACE

This dissertation is based on data acquired with the IceCube Neutrino Observatory whose maintenance and operation is the result of an immense international collaborative effort. The bulk of the work pertaining to experimental hardware, data acquisition, reconstruction algorithms, systematics, and simulation presented in this document can be attributed to many IceCube collaborators. However, the refinement of the event selection and subsequent analysis of the data are the original work of the author.

# ACKNOWLEDGEMENTS

I want to thank my fellow graduate student office mates whose constant distractions helped me retain my sanity.

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# SUMMARY

Observations indicate that there is a correlation between long duration gamma-ray bursts (GRBs) and core-collapse supernovae (SNe). The leading model for GRB production assumes that relativistic jets are generated by the core-collapse within the progenitor star. Charged particles undergo Fermi-acceleration within internal shocks of these jets and subsequently give rise to gamma ray emission once the jets breach the surrounding stellar envelope. Very few SNe result in the occurrence of GRBs, however, but it has been suggested that a significant fraction of core-collapse SNe manage to produce mildly relativistic jets. These jets are insufficiently energetic to break through the envelope and are effectively 'choked' resulting in a lack of observed gamma ray emission. In both the failed and successful GRB scenario, neutrino production can occur if protons are accelerated in the internal shocks of these jets. These neutrinos may be detectable by the IceCube neutrino observatory and its low energy extension DeepCore. A dedicated search for temporal and spatial clustering of neutrino events during the 2012 data season aims to reveal the presence of any 'choked' GRB events within 20 Mpc.

# CHAPTER I

# INTRODUCTION

The expansion of traditional optical astronomy into wavelengths unobservable to the human eye revealed a myriad of phenomena previously unknown to science. Using wavebands of light spanning several orders of magnitude allows for the discovery of completely new astronomical sources. Additionally, it allows for the study of completely different physical processes within and around source objects. For all the vast advances in our understanding of the universe the opening up of the electromagnetic spectrum has brought us, though, it relies entirely upon the physical properties of its messenger particle, the photon.

# CHAPTER II

# DETECTOR

The IceCube Neutrino Observatory is located at the geographical South Pole deep within the glacial ice of the Antarctic ice sheet. This site allows for the use of the Amundsen-Scott South Pole station as a staging ground and logistics hub for the construction and continued operation of the detector.

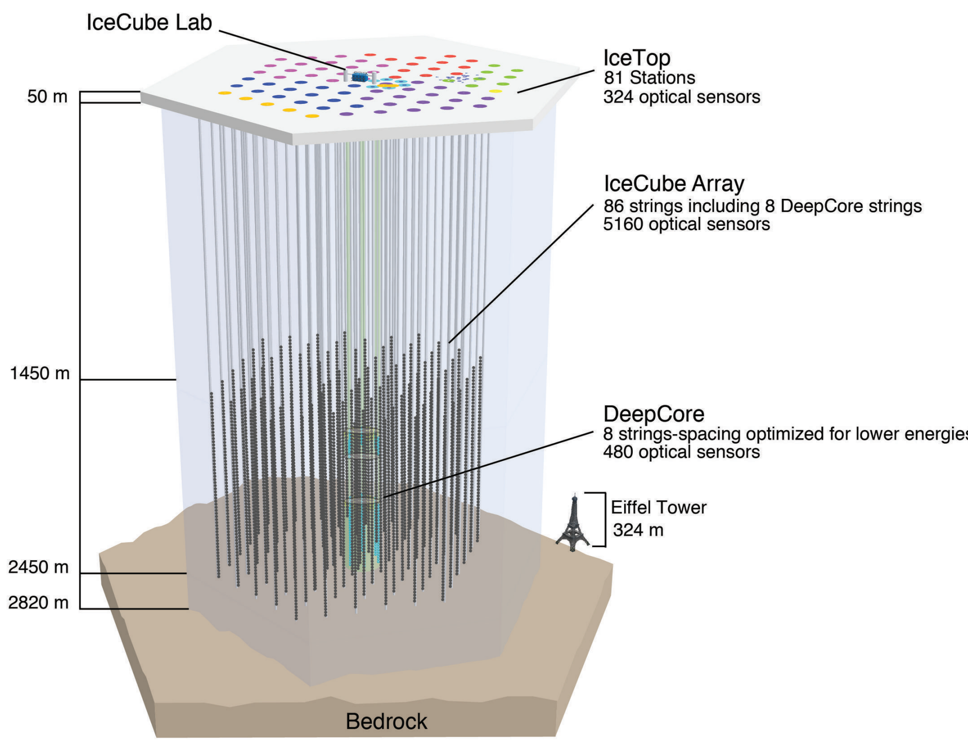


**Figure 1:** Diagram of the IceCube Neutrino Observatory.

# CHAPTER III

# PREVIOUS POINT SOURCE SEARCHES

# CHAPTER IV

# DATA ACQUISITION

Blah blah blah [1].

# CHAPTER V

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## APPENDIX PLACEHOLDER

Ancillary material should be put in appendices, which appear just before the bibliography.

# REFERENCES

[1] The IceCube Collaboration, "The IceCube Data Acquisition System: Signal Capture, Digitization, and Timestamping," *ArXiv e-prints*, Oct. 2008.

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# VITA