A Search for Sterile Neutrinos at the NOνA Far Detector

A DISSERTATION PRESENTED
BY
GARETH KAFKA
TO
THE DEPARTMENT OF PHYSICS

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN THE SUBJECT OF
PHYSICS

HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS

MAY 2016

Thesis advisor: Professor Gary Feldman Gareth Kafka

A Search for Sterile Neutrinos at the NOνA Far Detector

Abstract

We measured things. And searched for other things. Here is what we found, please let me graduate.

Contents

List of Figures

List of Tables

This is the dedication.

Acknowledgments

These people were cool.

1

A Brief History of Neutrinos

1.1 Introduction

The neutrino was first postulated by Wolfgang Pauli as a possible explanation for the continuous spectrum of electrons emitted from nuclear β decay[1]. This decay was originally thought to be the emission of an electron from an atom, resulting in a different nucleus, via the process,

$$N \to N' + e \tag{1.1}$$

where N and N' are the parent and daughter nuclei, respectively.

Three years later,

2

Theory of Neutrino Oscillations

3

The NOνA Experiment

4

Experiment Simulation

5

Event Reconstruction

6

Neutral Current Event Selection

7

Neutral Current Disappearance Analysis

8

Analysis Results and Systematic Errors

9

Conclusions and Future Improvements

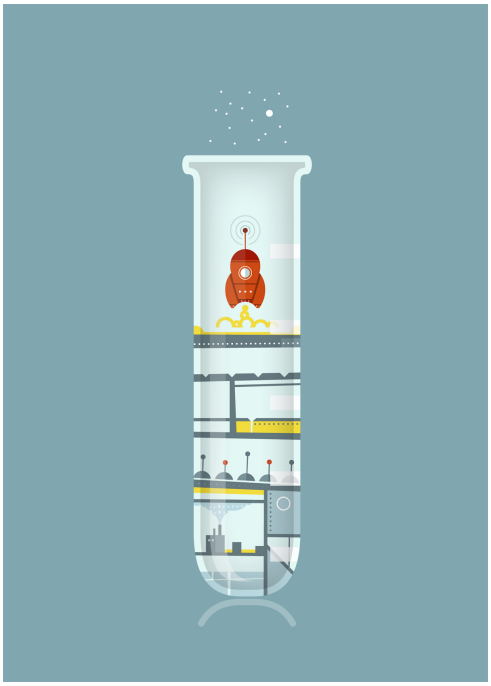
9.1 Conclusions

The results of this analysis are consistent with no sterile neutrinos.

9.2 Future Improvements

References

[1] Pauli, W. (1930). Letter to a physicists' gathering at tubingen.



This thesis was typeset using LaTeX, originally developed by Leslie Lamport and based on Donald Knuth's TeX. The body text is set in 11 point Egenolff-Berner Garamond, a revival of Claude Garamont's humanist typeface. The above illustration, *Science Experiment 02*, was created by Ben Schlitter and released under CC BY-NC-ND 3.0. A template that can be used to format a PhD dissertation with this look & feel has been released under the permissive AGPL license, and can be found online at github.com/asm-products/Dissertate or from its lead author, Jordan Suchow, at suchow@post.harvard.edu.