SLAC-R-801

# A Search for B Meson Decay to a Muon, a Neutrino, and a Photon

M. G. Greene

Stanford Linear Accelerator Center
Stanford University
Stanford, CA 94309

SLAC-Report-801

Prepared for the Department of Energy
under contract number DE-AC02-76SF00515

Printed in the United States of America. Available from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

# A Search for B Meson Decay to a Muon, a Neutrino, and a Photon

A Dissertation

Presented to the Faculty of the Graduate School

of

Yale University

in Candidacy for the Degree of

Doctor of Philosophy

by

Michael G. Greene

Dissertation Director: Homer Alfred Neal, Jr. II

May 2004

## Abstract

**A Search for B Meson Decay to a Muon, a Neutrino, and a Photon**

**Michael G. Greene**

**2004**

This thesis describes a search for the rare decay $B^+ \to \mu^+ \nu_\mu \gamma$, performed at the Stanford Linear Accelerator Center. The *BABAR* detector is used to analyze 81.65 $\text{fb}^{-1}$ of data, with $(88.6 \pm 0.6) \times 10^6$ charged $B$ meson decays, from the PEP-II $e^+e^-$ collider running at the $\Upsilon(4S)$ resonance. The background estimate for the analysis is three events, and three signal candidates are observed. An upper limit on the branching fraction is set at $\mathcal{B}(B^+ \to \mu^+ \nu_\mu \gamma) < 1.8 \times 10^{-5}$, at the 90% confidence level.

# Acknowledgements

I would like to thank the faculty of the Graduate School of Yale University for granting me the opportunity to return to Yale in order to complete my Ph.D., after a 20-year hiatus.

I wish to thank my thesis advisor, Homer Neal, for allowing me to join the effort in the search for $B^+ \to \mu^+ \nu_\mu \gamma$. I thoroughly enjoyed the many thought-provoking discussions that we had, regarding every aspect of the analysis.

I am grateful to the members of my dissertation committee, Homer Neal, Charles Baltay, Michael Zeller, Witold Skiba, Daniel McKinsey, and Lawrence Gibbons, for their careful reading of the manuscript, and for their insightful comments and suggestions.

I received invaluable help with this project from many members of the *BABAR* Collaboration, and I would particularly like to thank Steven Robertson, Thomas Moore, Steve Sekula, Mousumi Datta, David Cote-Ahern, Sylvie Brunet, Gregory Dubois-Felsmann, Edward Chen, Paul Jackson, and Joerg Stelzer.

I would like to express my gratitude to Sébastien Descotes-Genon for an illuminating conversation concerning the paper he co-authored with C. T. Sachrajda, that is central to this thesis. I hope that there are not too many inac-

curacies in my description of their work.

I'd especially like to thank Charles Baltay. Charlie's lucid approach to complex physics problems is unsurpassed; no less extraordinary is the kindness and concern for my success that he showed me on every occasion.

Finally, I'd like to thank my family: Dad, Doris, Robin, Steve, Justin, Sara, Max, Meryl, Jon, Barie, Tracy, Scott, and Kilgore. Without their love, support, encouragement, entreaties, and threats, this work would never have been completed.

# Contents

# List of Figures

# List of Tables