UNIVERSITY OF CALIFORNIA
RIVERSIDE

MEASUREMENT OF THE LONGTIDUDIANL SINGLE SPIN ASYMMETRY, A_L, FOR POLARIZED PROTON-PROTON COLLISIONS IN THE $W \to \mu$ DECAY CHANNEL

A Dissertation submitted in partial satisfaction
of the requirements for the degree of

Doctor of Philosophy

in

Physics

by

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August 2016

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Acknowledgments

In no particular order now, but say something nice about each person.

Advisors and Mentors

Ken Barish, Richard Hollis, K. Oleg Eyser, Ralf Seidl, Francesca Giordano, Joe Seele, Josh Perry, Martin Leitgab, Chris Pinkenburg, Martin Purschke, Collaborators, Sangwha Park, Daniel Jumper, Abraham Meles, Chong Kim,

Friends and Family

Bob Beaumier, Marian Beaumier, Joe Beaumier, David Beaumier, Emily Vance, Jackie Hubbard, Alexander Anderson-Natalie, Corey Kownacki, Chris Heidt, Pat Odenthal, Behnam Darvish Sarvestani, Oleg Martynov,

Some say that it takes a village to raise a child. The same can be said of raising a graduate student up to earning a PhD. This thesis is dedicated to the multitude who have helped me become the man I am today, and to students who struggle, and their mentors who do not give up on them.

ABSTRACT OF THE DISSERTATION

MEASUREMENT OF THE LONGTIDUDIANL SINGLE SPIN ASYMMETRY, A_L, FOR POLARIZED PROTON-PROTON COLLISIONS IN THE $W \to \mu$ DECAY CHANNEL

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Professor Kenneth Barish , Chairperson

This thesis discusses the process of extracting information about the spin structure of protons, specifically, spin contributions from the sea of quarks and antiquarks, which are kinematically distinct from the 'valence quarks'. We have known since the 'proton-spin crisis' **REFERENCE NEEDED** of the 1990s that proton spin does not entirely reside in the valence quarks, so the thurst of experimental efforts since then have been designed to determine both how to probe the proton spin structure, and how to validate models for proton spin structure. Here, I discuss one particular approach to understanding the sea-quark spin contribution, which utilizes the production of real W-bosons, and the W coupling with polarized spin structure in the proton sea, as produced from polarized protons collisions. Only one of the colliding protons is longitudinally spin polarized, in this analysis, and they are collided at an energy of $500GeV$. The expermental observable used is referred to as "A_L" which is expressed mathematically as a ratio of sums and differences of various helicity combinations of singly polarized interactions between two protons, i.e. $p + p^{\Rightarrow} :\to W \to \mu + \nu$. Once A_L has been experimentally measured, it can then be used to determine appropriate polarizations of proton sea-quarks, within a given uncertainty, if we write the cross-sections used in the calculation of A_L in terms of polarized parton distribution functions. Finally, this thesis will also include a discussion of my work experimentally determining the absolute luminosity of collisions at RHIC, which is needed as a normalization on any cross section used in the analysis. In particular, studying the cross section of the W interaction can help to validate our models for assigning a signal-to-background ratio to the $W \to \mu$ events.

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