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A Study of Small Angle Radiative Bhabha Scattering and Measurement of the Luminosity at SLD [*]

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A STUDY OF SMALL ANGLE RADIATIVE BHABHA SCATTERING AND MEASUREMENT OF THE LUMINOSITY AT SLD

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

By
Sharon Leigh White
December, 1995

To the Graduate Council:

I am submitting herewith a dissertation written by Sharon Leigh White entitled "A Study of Small Angle Radiative Bhabha Scattering and Measurement of the Luminosity at SLD". I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy with a major in Physics.

William M. Bugg, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor
and Dean of The Graduate School

This dissertation is dedicated to my parents, Perry and Marguerite White.

Acknowledgements

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Abstract

Small angle Bhabha scattering ($e^+e^- \rightarrow e^+e^-$) is used to measure the luminosity for the 1993 run of the SLD experiment. SLD operates at the Stanford Linear Collider at Stanford Linear Accelerator Center where electrons and positrons are collided at center of mass energy on the Z^0 resonance. A silicon tungsten luminosity monitor is used to record the Bhabha events and a description of this device and its performance is presented. The luminosity is measured using two different methods to correct for small displacements in the luminosity monitor and the results are:

$$\mathcal{L} = 1726.5 \pm 5.1_{stat} \pm 3.9_{sys} \pm 4.6_{MC} \text{ nbarn}^{-1}$$

$$\mathcal{L} = 1718.5 \pm 5.0_{stat} \pm 2.2_{sys} \pm 5.5_{MC} \text{ nbarn}^{-1}$$

Measurement of the integrated luminosity is essential for the determination of the cross section for all final states in the experiment.

Radiative Bhabha events are studied using two types of radiative events; those with a photon visible in the luminosity monitor, and events with an undetected photon radiated down the beampipe, i.e. less than 28 mrad. The measured cross sections for these types of events in the acceptance region of the luminosity monitor are compared with Monte Carlo predictions from the BHLUMI 2.01 Monte Carlo. These cross sections are $\sigma_{sep\ photon} = 0.644 \pm 0.019_{stat} \pm 0.013_{sys} \pm 0.003_{lum}$ nbarn for the events with an identifiable photon in the luminosity monitor, and $\sigma_{beampipe} = 7.45 \pm 0.22_{sys} \pm 0.07_{stat} \pm 0.03_{lum}$ nbarn for events with a photon down the beampipe. Characteristics of the radiative events including photon energy distribution and acollinearity distributions are compared with the BHLUMI predictions.

Contents

List of Tables

List of Figures