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A Measurement of the Left-Right Cross Section Asymmetry in Z^0 Production with Polarized e^+e^- Collisions*

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A MEASUREMENT OF THE LEFT-RIGHT CROSS SECTION ASYMMETRY IN Z° PRODUCTION WITH POLARIZED $e^{+}e^{-}$ COLLISIONS

by

HWANBAE PARK

A DISSERTATION

Presented to the Department of Physics
and the Graduate School of the University of Oregon
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"A Measurement of the Left-Right Cross Section Asymmetry in Z° Production with Polarized $e^{+}e^{-}$ Collisions," a dissertation prepared by Hwanbae Park in partial fulfillment of the requirements for the Doctor of Philosophy degree in the Department of Physics. This dissertation has been approved and accepted by:

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Approved: ______________________________

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The Stanford Linear Collider at SLAC is an $e^{+}e^{-}$ collider running at $\sqrt{s} \approx M_Z$ and has provided an electron beam with longitudinal polarization at the SLC interaction point. The 1992 polarized run data were taken with the SLD detector. We present here the measurement of the left-right cross section asymmetry (A_{LR}) for the 1992 run.

The polarized run began in May and ended in September of 1992 at a mean center-of-mass energy of 91.56 GeV. Tower hit information of the liquid argon calorimeter and endcap warm iron calorimeter pads were used for selecting hadronic Z^0 or tau pair events. The SLD detector collected about 11,000 events during this run.

The magnitude of the longitudinal polarization of the electron beam was continuously measured by a polarimeter based on Compton scattering, and was monitored by a polarimeter based on Moller scattering. The luminosity-weighted average longitudinal polarization during the 1992 run was measured as 22.4 $\pm$ 0.6 (syst.)%.

From these data, the value of A_{LR} has been measured to be 0.102 $\pm$

0.044 (stat.) ± 0.003 (syst.), corresponding to an effective electroweak mixing angle ($\sin^2\theta_w^{\rm eff}$) of 0.2375 ± 0.0056 (stat.) ± 0.0004 (syst.). The error is dominated by the statistical error. This value of $\sin^2\theta_w^{\rm eff}$ is in good agreement with existing measurements from other experiments. Studies of improvements in A_{LR} event selection for future high-statistics runs are also discussed.

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[1] K. Abe, *et. al.,* Phys. Rev. Lett. **71** (1993) 2528.

[2] K. Abe, *et. al.,* Phys. Rev. Lett. **70** (1993) 2515.

[3] S. Berridge, *et. al.,* IEEE Nuc. Sci. **39** (1992) 1242.

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