Electroweak Coupling Measurements from Polarized Bhabha Scattering at the Z0 Resonance

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ELECTROWEAK COUPLING MEASUREMENTS FROM POLARIZED
BHABHA SCATTERING AT THE Z" RESONANCE

by

KEVIN T. PITTS

A DISSERTATION
Presented to the Department of Physics
and the Graduate School of the University of Oregon
in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy

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The cross section for Bhabha scattering (e^+e^- → e^+e^-) with polarized electrons at the center of mass energy of the Z^0 resonance has been measured with the SLD experiment at the Stanford Linear Accelerator Center during the 1992 and 1993 runs. The electroweak couplings of the electron are extracted.

At small angles the measurement is done in the SLD Silicon/Tungsten Luminosity Monitor (LMSAT). A detailed description of the design, construction, commissioning, and operation of the LMSAT is provided. The integrated luminosity for 1992 is measured to be \( \mathcal{L} = 120.86 \pm 2.56 \text{ (stat)} \pm 1.23 \text{ (sys) nb}^{-1} \). The luminosity asymmetry for polarized beams is measured to be \( A_{\ell p}(\ell^+\ell^-) = 1.7 \pm 6.4 \times 10^{-4} \).

The large angle polarized Bhabha scattering reveals the effective electron vector and axial vector couplings to the Z^0 through the measurement of the Z^0 → e^+e^- partial width, \( \Gamma_{e^+e^-} \), and the parity violation parameter, \( A_\ell \). From the combined 1992
and 1993 data the effective electron vector and axial vector couplings are measured to be $\bar{g}_V^e = -0.0495 \pm 0.0096 \pm 0.0030$, and $\bar{g}_A^e = -0.4977 \pm 0.0035 \pm 0.0064$ respectively. The effective weak mixing angle is measured to be $\sin^2 \theta_W^{eff} = 0.2251 \pm 0.0019 \pm 0.0015$. These results are compared with other experiments.
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