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Measurement of the Tau Lepton Polarization and its Forward-Backward Asymmetry from Z^0 Decays

The OPAL Collaboration

Abstract

We report on a measurement of the tau lepton polarization and its forward-backward asymmetry at the Z^0 resonance using the OPAL detector. This measurement is based on analyses of the $\tau \rightarrow e\bar{\nu}_e\nu_\tau$, $\tau \rightarrow \mu\bar{\nu}_\mu\nu_\tau$, $\tau \rightarrow \pi(K)\nu_\tau$ and $\tau \rightarrow \rho\nu_\tau$ decays from a sample of 30663 $e^+e^- \rightarrow \tau^+\tau^-$ events collected during the years 1990 to 1992. Assuming that the tau lepton decays according to V−A theory, we measure the average τ polarization to be $\langle P_\tau \rangle = (-14.9 \pm 1.9 \pm 1.3)\%$ and the τ polarization forward-backward asymmetry to be $A_{pol}^{FB} = (-8.9 \pm 2.2 \pm 0.9)\%$, where the first error is statistical and the second systematic. These results are consistent with the hypothesis of lepton universality. When combined under the assumption of universality, our results can be interpreted as a measurement of $\sin^2\theta_{\mathrm{eff}}^{\mathrm{lept}} = 0.2321 \pm 0.0023$ within the context of the Standard Model.

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