Measurement of the Michel Parameters and the average τ Neutrino Helicity from τ Decays in $e^+e^- \to \tau^+\tau^-$

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Abstract

The Michel parameters ρ, η, ξ and $\xi\delta$, the chirality parameter ξ_h and the τ polarization $\mathcal{P}_\tau$ are measured using 32000 τ pair decays. Their values are extracted from the energy spectra of leptons and hadrons in $\tau^- \to l^-\bar{\nu}_l\nu_\tau$ and $\tau^- \to \pi^-\nu_\tau$ decays, the energy and decay angular distributions in $\tau^- \to \rho^-\nu_\tau$ decays, and the correlations in the energy spectra and angular distributions of the decay products.

Assuming universality in leptonic and semileptonic τ decays, the results are $\rho = 0.794 \pm 0.039 \pm 0.031$, $\eta = 0.25 \pm 0.17 \pm 0.11$, $\xi = 0.94 \pm 0.21 \pm 0.07$ and $\xi\delta = 0.81 \pm 0.14 \pm 0.06$, the chirality parameter is $\xi_h = -0.970 \pm 0.053 \pm 0.011$, and the τ polarization $\mathcal{P}_\tau = -0.154 \pm 0.018 \pm 0.012$. The values for all Michel parameters are in agreement with a V$-$A structure of the weak charged current interaction in τ lepton decays. The measurement of the chirality parameter ξ_h agrees with only left handed τ neutrinos in semileptonic τ decays. The value for the τ polarization $\mathcal{P}_\tau$ obtained in this analysis is in agreement with the result of our previous τ polarization measurement.