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Probing Charged Current B-anomalies via a U (1)μ−τ Extension of the Standard Model

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The lepton flavor universality ratios $R(D)$ and $R(D^*)$, defined as $R_{D^{(*)}} \equiv \mathcal{B}(\bar{B} \to D^{(*)}\tau^-\bar{\nu}_\tau)/\mathcal{B}(\bar{B} \to D^{(*)}\ell^-\bar{\nu}_\ell)$ where$(\ell = e, \mu)$, are measured in semi-leptonic B decays and serve as sensitive probes of new physics beyond the Standard Model (SM). Recent experimental averages, $R(D) = 0.342 \pm 0.026$ and $R(D^*) = 0.287 \pm 0.012$, show a combined deviation of 3.2σ from SM predictions, indicating the possibility of new physics in semi-leptonic B meson decays. We base our attention on the Charge Current(CC) process $b \to c\tau^-\bar{\nu_\tau}$, where we explore this process using a well-motivated extension of the SM, featuring a $U(1)_{\mu-\tau}$ gauge symmetry. The model introduces new vector-like quark doublets (Q'_a) and a singlet scalar (χ), both charged under $U(1)_{\mu-\tau}$ and odd under Z_2 symmetry. The corresponding Wilson coefficients are derived and a χ^2-fit is performed with the current experimental data to constrain the model parameters.

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