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Exploring $b \to c\tau\nu$ mediated baryonic decay modes in SMEFT framework

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Motivated by the interplay between the LEFT and SMEFT operators at the electroweak scale, we study the interrelation among the transitions $b \to c\ell\nu_\ell$, $b \to s\nu_\ell\nu_\ell$ and $b \to s\ell\ell$ ($\ell = e, \mu, \tau$). We explore this correlation within the context of six - SMEFT operators: $\mathcal{Q}^{(3)}_{\ell q}$, $\mathcal{Q}_{\ell e d q}$, $\mathcal{Q}^{(1)}_{\ell e q u}$, $\mathcal{Q}^{(3)}_{\ell e q u}$, $\mathcal{Q}^{(3)}_{\phi q}$ and $\mathcal{Q}^{(1)}_{\ell q}$.
We constrain the new physics parameter space through a comprehensive global fit incorporating the observables: R_D, R_{D^*}, $P_\tau(D)$, $P_\tau(D^*)$, $F_L(D^*)$, $\mathcal{B}(B_0 \to K^*\nu\nu)$, $\mathcal{B}(B \to K^+\nu\nu)$, $\mathcal{B}(B \to K^+\tau^+\tau^-)$ and $\mathcal{B}(B_s \to \tau^+\tau^-)$. We then investigate the sensitivity of new physics in the semileptonic decay modes of b-baryons, specifically $\Xi_b \to \Xi_c\tau^-\bar{\nu}_\tau$ and $\Sigma_b \to \Sigma_c^{(*)}\tau^-\bar{\nu}_\tau$. We also provide the predictions of several observables such as the branching ratio, forward-backward asymmetry, longitudinal polarisation asymmetry, convexity parameter, and the lepton flavor non-universality observable of $\Xi_b \to \Xi_c\tau^-\bar{\nu}_\tau$ and $\Sigma_b \to \Sigma_c^{(*)}\tau^-\bar{\nu}_\tau$ processes.

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