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Semi- and di-tauonic B decays and LFUV at future e^+e^- colliders

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$b \to s\tau^+\tau^-$ measurements are highly motivated for addressing lepton-flavor-universality (LFU)-violating puzzles such as $R_{K^{(*)}}$ anomalies. The anomalies of $R_{D^{(*)}}$ and $R_{J/\psi}$ further strengthen their necessity and importance, given that the LFU-violating hints from both involve the third-generation leptons directly. Z factories at the future e^-e^+ colliders stand at a great position to conduct such measurements because of their relatively high production rates and reconstruction efficiencies for B mesons at the Z pole. To fully explore this potential, we pursue a dedicated sensitivity study in four $b \to s\tau^+\tau^-$ benchmark channels, namely $B^0 \to K^{*0}\tau^+\tau^-$, $B_s \to \phi\tau^+\tau^-$, $B^+ \to K^+\tau^+\tau^-$ and $B_s \to \tau^+\tau^-$, at the future Z factories. We develop a fully tracker-based scheme for reconstructing the signal B mesons and introduce a semi-quantitative method for estimating their major backgrounds. The simulations indicate that branching ratios of the first three channels can be measured with a precision $\sim \mathcal{O}(10^{-7} - 10^{-6})$ and that of $B_s \to \tau^+\tau^-$ with a precision $\sim \mathcal{O}(10^{-5})$ at Tera-Z. The impacts of luminosity and tracker resolution on the expected sensitivities are explored. The interpretations of these results in effective field theory are also presented.

What is your topic?

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