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Searching for effects beyond SMEFT in flavour physics

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Effective field theory (EFT) offers a powerful framework for indirect searches of physics beyond the Standard Model (BSM). Standard Model Effective Field Theory (SMEFT) is one of the most common EFT approaches for such searches. In SMEFT, the $SU(2)_L \times U(1)_Y$ electroweak (EW) symmetry of the Standard Model is linearly realized. However, it is possible that more general EFTs, such as the Higgs Effective Field Theory (HEFT), where the EW symmetry is non-linearly realized, are needed to describe experimental data. Identifying the most suitable EFT description above the EW scale would be critical in order to understand the nature of Higgs and the mode of realization of EW symmetry. In this work, we study the possibility of flavour physics observables in distinguishing between SMEFT and HEFT effects. We explore the effects of scalar and vector new-physics operators that contribute to the charged current process $b \to c\tau\nu_\tau$. The angular distribution of $\Lambda_b \to \Lambda_c(\to \Lambda\pi)\tau\bar{\nu}_\tau$ decay is sensitive to the 6-dimensional effective operators $O_V^{LR} = (\bar{\tau}\gamma^\mu P_L \nu_\tau)(\bar{c}\gamma_\mu P_R b)$, which is present in HEFT but suppressed in SMEFT. We identify the angular observables that can have significant contribution from O_V^{LR}, and hence would be useful for pointing out not only BSM physics but also physics beyond SMEFT. We further find that constraining the branching ratio of $B_c \to \tau\bar{\nu}_\tau$ would be crucial in performing this task.

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