

L to l' l+ l- LFV decays in the SM with massive neutrinos

Abstract

We revisit the computations of X. Y. Pham ($\tau \rightarrow 3\mu$, Eur.Phys.J. C8 (1999) 513-516) and S. T. Petcov ($\mu \rightarrow 3e$, Sov.J.Nucl.Phys. 25 (1977) 340, Erratum in 698) of L to l' l+ l- LFV decays in the SM with massive neutrinos. Pham obtained an unexpectedly large $\tau \rightarrow 3\mu$ branching ratio ($\sim 1E-14$) as a result of a seeming IR divergence (a logarithmic term in neutrino masses, without its coefficient being also proportional to these masses, as it should be to cure its IR behavior) in his result. We show that this comes from an incorrect expansion along his computation and correct it, yielding a result at the level of $1E-50$ for the contribution of the dominating diagram. This is in basic agreement with the estimations in the classical paper by Petcov. However, we question the usual approximation of neglecting external momenta and masses in the loop computations, both for the dominating Z-penguins and W-box contributions, and discuss the accuracy of our predictions. Our result ensures that (even for $\tau \rightarrow 3\mu$) any signal at Belle-II (or forthcoming facilities) of these modes would be a new physics manifestation.

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