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Predictions on the second-class current decays $\tau^- \to \pi^-\eta(')\nu_\tau$

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Collaboration

Abstract content

We analyze the second-class current decays $\tau^- \to \pi^-\eta(')\nu_\tau$ in the framework of Chiral Perturbation Theory with Resonances. Taking into account $\pi^0 - \eta - \eta'$ mixing, the $\pi - \eta(')$ vector form factor is extracted, in a model-independent way, using existing data on the $\pi - \pi_0$ one. For the participant scalar form factor, we have considered different parameterizations ordered according to their increasing fulfillment of analyticity and unitarity constraints. We start with a Breit-Wigner parameterization dominated by the $a_0(980)$ scalar resonance and after we include its excited state, the $a_0(1450)$. We follow by an elastic dispersion relation representation through the Omnes integral. Then, we illustrate a method to derive a closed-form expression for the $\pi - \eta$, $\pi - \eta'$ (and $K - K^0$) scalar form factors in a coupled-channels treatment. Finally, predictions for the branching ratios and spectra are discussed emphasizing the error analysis. An interesting result of this study is that both $\tau^- \to \pi^-\eta(')\nu_\tau$ decay channels are promising for the soon discovery of second-class currents at Belle-II. We also predict the relevant observables for the partner $\eta(')_{l3}$ decays, which are extremely suppressed in the Standard Model.

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