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The $\tau^- \to \eta^{(\prime)} \pi^- \nu_\tau \gamma$ decays as backgrounds in the search for second class currents

Abstract

Observation of $\tau^- \to \eta^{(\prime)} \pi^- \nu_{\tau}$ decays at Belle-II would indicate either a manifestation of isospin symmetry breaking or genuine second class currents (SCC) effects. The corresponding radiative $\tau^- \to \eta^{(\prime)} \pi^- \nu_{\tau} \gamma$ decay channels are not suppressed by *G*-parity considerations and may represent a serious background in searches of SCC in the former. We compute the observables associated to these radiative decays using Resonance Chiral Lagrangians and conclude that vetoing photons with $E_{\gamma} > 100$ MeV should get rid of this background in the Belle-II environment searching for the $\tau^- \to \eta \pi^- \nu_{\tau}$ channel. Similar considerations hold inconclusive for decays involving the η' given the theory uncertainties in the prediction of the $\tau^- \to \eta' \pi^- \nu_{\tau}$ branching ratio. Still, additional kinematics-based cuts should be able to suppress this background in the η' case to a negligible level.

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