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Non-standard interactions and the $\tau \to (K\pi)\nu\tau$ decays

Content

We analyze the $\tau \to (K\pi)\nu\tau$ decays within an effective field theory description of heavy new physics (NP) modifying the SM left-handed weak charged current and include refined SM input for the participant meson form factors exploiting chiral symmetry, dispersion relations and (lattice) data. We include the leading dimension six operators and work at linear order in the effective couplings. Within this setting we (i) follow the derivation in Phys. Rev. Lett. 120, 141803 where it was proved unambiguously that it is impossible to understand the BABAR anomaly in the CP asymmetry measurement within this framework. We allow for reasonable variations of the hadronic input involved and study the associated uncertainty. (ii) We first show that the anomalous bump present in the published Belle data for the $K_S\pi$ invariant mass distribution close to threshold cannot be due to heavy NP. (iii) We first bind the heavy NP effective couplings using $\tau \to (K\pi)\nu\tau$ decays and show that they are competitive with those found in hyperon semileptonic decays [but clearly not with those obtained in kaon (semi)leptonic decays for NP scalar currents]. We put forward that the comparison of the considered tau decays with (semi)leptonic kaon and hyperon decays provides meaningful tests of lepton universality for (NP) tensor interactions. We also compare the SM predictions with the possible deviations caused by NP in a couple of Dalitz plot distributions, in the forward-backward asymmetry and in the dimeson invariant mass distribution, and we discuss the most interesting measurements to be performed at Belle-II using these decay data.

Summary

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