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Subleading contributions in rare semileptonic $B^+ \to \pi^+\ell^+\ell^-$ decay (17+3)

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In the Standard Model (SM), the $b \to s$ and $b \to d$ flavor-changing neutral currents (FCNC) are induced by loop effects. Rare semileptonic B-meson decays originated by these currents are standard channels for testing the SM precisely and searching for possible physics beyond the Standard Model. Differential branching fractions of semileptonic B-decays and angular distributions in some of them are experimentally measured by the LHCb, ATLAS and CMS collaborations at the LHC as well as by BaBar and Belle at the B-factories. We also anticipate significantly improved results from the ongoing Belle-II experiment.
Here, we consider the rare $B^\pm \to \pi^\pm\ell^+\ell^-$ decay, where $\ell = e, \mu, \tau$ is a charged lepton, and present its dilepton invariant-mass spectrum and decay rate based on the effective electroweak Hamiltonian approach for the $b \to d\ell^+\ell^-$ transitions in the SM, taking into account also the weak annihilation diagrams. We present theoretical predictions for total and partial branching fractions for $B^+ \to \pi^+\tau^+\tau^-$ in dependence on the parameterization type for the $B \to \pi$ form factors. Our prediction for the total branching fraction of $B^+ \to \pi^+\mu^+\mu^-$ agrees with the LHCb result (Aaij R. et al.,LHCb Collab., JHEP 10 (2015) 34) within the experimental and theoretical uncertainties. Moreover, accounting for the weak annihilation contributions allows us to obtain a better agreement with the experimental data on the distribution in the dimuon invariant mass squared q^2 in the entire kinematically allowed region and, in particular, in its lowest q^2-part. The importance of the long-distance contributions from the light vector mesons on the dilepton invariant-mass spectrum is also discussed. These results are potentially useful in testing the lepton flavor universality in the FCNC $B \to \pi\ell^+\ell^-$ decays.

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