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Impact of weak annihilation contribution on rare semileptonic $B^+ \to \pi^+\ell^+\ell^-$ decay

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In the Standard Model, the flavor-changing neutral currents of the $b \to s$ and $b \to d$ transitions appear as vacuum effects, at the one-loop level. Rare semileptonic decays of B-mesons, originating by these currents, are extremely useful tools for testing the Standard Model and searching for a possible physics beyond the Standard Model. Differential branching fractions of semileptonic B-decays and angular distributions in some of them are experimentally measured by LHCb, ATLAS and CMS collaborations at LHC as well as by BaBar and Belle at B-factories. Here, we consider the rare $B^+ \to P\ell^+\ell^-$ decay, where P is a pseudoscalar meson and $\ell = e, \mu$ is a charged lepton. For example, we present results on the dilepton invariant-mass spectrum and decay rate for $B^+ \to \pi^+\ell^+\ell^-$ based on the effective Hamiltonian approach for the $b \to d\ell^+\ell^-$ transitions in two cases — with taking into account weak annihilation diagrams and without this contribution. Our prediction for total branching fraction of $B^+ \to \pi^+\mu^+\mu^-$ is in a good agreement with the LHCb result (Aaij R. et al.. LHCb Collab,. JHEP. 10 (2015) 34) within experimental uncertainties. Moreover, accounting weak annihilation contributions allow us to obtain a better agreement with the experimental data on the distribution in the muon-pair invariant mass squared q^2 in the entire kinematically allowed region and, in particular, in its lowest q^2-part. This differs from the previous analysis, where the low-q^2 experimental peak was obtained through the long-distance contributions from light vector mesons.

Primary author(s) : Ms. PARNOVA, Irina (P.G.Demidov Yaroslavl State University)

Co-author(s) : Dr. PARKHOMENKO, Alexander (P.G. Demidov Yaroslavl State University)

Presenter(s) : Ms. PARNOVA, Irina (P.G.Demidov Yaroslavl State University)

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