Contribution ID : **30** Type : **Oral presentation**

Dilepton invariant mass spectrum and the decay rate in $B^{\pm} \to \pi^{\pm}\mu^{+}\mu^{-}$

Saturday, 5 July 2014 15:30 (15)

We present a precise calculation of the dilepton invariant-mass spectrum and the decay rate for B±⟶π±ℓ+ℓ− (ℓ±=e±,μ±) in the Standard Model (SM) based on the effective Hamiltonian approach for the b⟶dℓ+ℓ− transitions. With the Wilson coefficients already known in the next-to-next-to-leading logarithmic (NNLL) accuracy, the remaining theoretical uncertainty in the short-distance contribution resides in the form factors f+(q2), f0(q2) and fT(q2). Of these, f+(q2) is well measured in the charged-current semileptonic decays B⟶πℓνℓ and we use the B-factory data to parametrize it. The corresponding form factors for the B⟶K transitions have been calculated in the Lattice-QCD approach for large-q2 and extrapolated to the entire q2-region using the so-called z-expansion. Using an SU(3)F-breaking Ansatz, we calculate the B⟶π tensor form factor, which is consistent with the recently reported lattice B⟶π analysis obtained at large q2. The prediction for the total branching fraction B(B±⟶π±μ+μ−)=(1.88+0.32−0.21)×10−8 is in good agreement with the experimental value obtained by the LHCb collaboration. In the low q2-region, the Heavy-Quark Symmetry (HQS) relates the three form factors with each other. Accounting for the leading-order symmetry-breaking effects, and using data from the charged-current process B⟶πℓνℓ to determine f+(q2), we calculate the dilepton invariant-mass distribution in the low q2-region in the B±⟶π±ℓ+ℓ− decay. This provides a model-independent and precise calculation of the partial branching ratio for this decay.

Summary

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Session Classification : Flavour Physics

Track Classification : Flavour Physics