Abstract

We demonstrate a method for calculating the neutral B-meson decay constants and mixing matrix elements in unquenched lattice QCD with domain-wall light quarks and static b-quarks. Our computation is performed on the "2+1" flavor gauge configurations generated by the RBC and UKQCD Collaborations with a lattice spacing of $a \approx 0.11$ fm ($a^{-1} = 1.729$ GeV) and a lattice spatial volume of approximately $(1.8 \text{ fm})^3$. We simulate at three different light sea quark masses with pion masses down to approximately 430 MeV, and extrapolate to the physical quark masses using a phenomenologically-motivated fit function based on next-to-leading order heavy-light meson $SU(2)$ chiral perturbation theory. For the b-quarks, we use an improved formulation of the Eichten-Hill action with static link-smearing to increase the signal-to-noise ratio. We also improve the heavy-light axial current used to compute the B-meson decay constant to $\mathcal{O}(\alpha_s pa)$ using one-loop lattice perturbation theory. We present initial results for the $SU(3)$-breaking ratios f_{B_s}/f_{B_d} and $\xi = f_{B_s}\sqrt{B_{B_s}}/f_{B_d}\sqrt{B_{B_d}}$, thereby demonstrating the viability of the method. For the ratio of decay constants, we find $f_{B_s}/f_{B_d} = 1.15(12)$ and for the ratio of mixing matrix elements, we find $\xi = 1.13(12)$, where in both cases the errors reflect the combined statistical and systematic uncertainties, including an estimate of the size of neglected $\mathcal{O}(1/m_b)$ effects.

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