Abstract

I study the non-leptonic tree induced $B_d \to J/\Psi K_s$ and penguin induced $B_d \to \Phi K_s$ decay modes, of the neutral $B_d$ mesons reviewing the current experimental measurements for the four $CP$ violation observables $C(B_d \to J/\Psi K_s)$, $S(B_d \to J/\Psi K_s)$, $C(B_d \to \Phi K_s)$, $S(B_d \to \Phi K_s)$, and analyzing the effects of the BSS mechanism on their decay amplitudes in both the Standard Model and the general LR model.

I perform three Standard Model calculations of the $B_d \to \Phi K_s$ decay amplitude using the Effective Hamiltonian approach, and employing the Operator Product Expansion (OPE) technique, in the leading order (LO) and next to leading order (NLO). These calculations are based on works done by Nam, Fleischer and Ali et al. respectively.

My SM calculations have shown that QCD corrections to the Standard Model give only a small shift from the naive calculations of $S(\Phi K_s)$. The corrected Standard Model is consistent with the current experimental value for that observable.

I use the LO $A(B_d \to J/\Psi K_s)_{I}$ and $A(B_d \to J/\Psi K_s)_{II}$ amplitudes calculated by Nam and calculate the corresponding $B_d \to \Phi K_s$ amplitude in the general LR model of types I and II using the effective Hamiltonian approach, first in the LO (based on Nam’s work) and then in the NLO (where I extended the Ali, Lü and Kramer SM amplitude). Using these amplitude calculations together with those of $(q/p)_{(Bd)}$ for the neutral $B_d - \overline{B}_d$ mixing, I numerically calculate the observables $C(B_d \to J/\Psi K_s), S(B_d \to J/\Psi K_s), C(B_d \to \Phi K_s), S(B_d \to \Phi K_s)$. In the general LR model there are six parameters, and some choices of the parameters are excluded by the experimental observations.

My LR calculations have shown that for type II, for the Nam based $B_d \to J/\Psi K_s$ calculation and for both the Nam based and the Ali and Lü based $B_d \to \Phi K_s$ calculations, $S$ constrains the parameter space more than $C$ does. Between the two decays, one finds that $S(B_d \to J/\Psi K_s)$ restricts the parameter space more significantly than $S(B_d \to \Phi K_s)$. For type I, and for the Nam based $B_d \to J/\Psi K_s$ calculation, $S(B_d \to J/\Psi K_s)$ constrains the parameter space more than $C(B_d \to J/\Psi K_s)$ does. To the contrary, for both the Nam based and the Ali and Lü based $B_d \to \Phi K_s$ calculations, $C(B_d \to \Phi K_s)$ constrains the parameter space more than $S(B_d \to \Phi K_s)$ does.

I set lower bounds on the mass of the right-handed boson $M(W_2)$

In the general LR model there are contributions to the $CP$ violating parameters from the mixing of $W_L$ and $W_R$ and also from the $CP$ violating phases in the analogue of the CKM matrix for right handed quarks. If the vector boson mixing is large enough, a compensating $CP$ violation from the RH CKM matrix is required to reduce the $CP$ violation to the observed levels. In these cases I find an upper bound on the mass of $W_2$. 

iii