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Optimized Observables in non-leptonic decays

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We study the penguin-mediated $\bar{B}_{d(s)} \to K^{(*)0}\bar{K}^{(*)0}$ and $\bar{B}_{d(s)} \to \bar{K}^{*0}(K^{*0})\phi$ transitions. We propose optimised observables $L_{K^{(*)}\bar{K}^{(*)}}$, $L_{K^*\phi}$ from the ratio of longitudinal branching ratios of these decays, with limited hadronic uncertainties and enhanced sensitivity to New Physics. $L_{K^{(*)}\bar{K}^{(*)}}$ deviates at the 2.4σ (2.6σ) level while $L_{K^*\phi}$ exhibits a deviation at the $1.48\,\sigma$ level between its experimental value and its SM determination within QCD factorisation. These results can be accommodated together, if New Physics is assumed to affect either the QCD penguin operator Q_4 or the chromomagnetic dipole operator Q_{8g} for both $b \to d$ and $b \to s$ transitions. The allowed range for the Wilson coefficients $C_{4s,8gs}$ is narrower compared to $C_{4d,8gd}$ since the $b \to s$ transition $\bar{B}_d \to \bar{K}^{*0}\phi$ is in better agreement with the SM. If we add the measured branching ratio for the $\bar{B}_d \to \bar{K}^0\phi$ to our analysis, the simultaneous explanation of all the experimental data for the $K^{(*)}\bar{K}^{(*)}$ and the $K^*(\bar{K}^{(*)})\phi$ channels in terms of New Physics in $C_{4d,s}$ or $C_{8gd,s}$ operators only becomes very constrained. This set of observables can be explained more easily if we assume New Physics either in (C_{4f}, C_{6f}) or (C_{6f}, C_{8gf}) in both $f = d, s$. This should provide a strong incentive for the LHCb experiment to perform a measurement of the branching ratios of $\bar{B}_d \to \bar{K}^{(*)0}\phi$ and an improved measurement for the branching ratio of $\bar{B}_s \to K^{*0}\phi$

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