

Supplemental material

The $B^+ \rightarrow J/\psi\pi^+$ and $B^+ \rightarrow J/\psi K^+$ decay amplitudes can be expressed in the following forms,

$$A(B^+ \rightarrow J/\psi\pi^+) = -\lambda\mathcal{A}(1 + ae^{i\theta}e^{i\gamma}), \quad (1)$$

and

$$A(B^+ \rightarrow J/\psi K^+) = (1 - \lambda^2/2)\mathcal{A}'(1 + \epsilon a'e^{i\theta'}e^{i\gamma}), \quad (2)$$

where $\lambda = V_{us}$, $\epsilon = \lambda^2/(1 - \lambda^2)$, $\mathcal{A}^{(\prime)}$ is the hadronic matrix element for the tree topology, and $a^{(\prime)}$ and $\theta^{(\prime)}$ are the relative size and strong-phase difference between the penguin and tree contributions, respectively. The weak phase difference is given by the CKM angle $\gamma = \phi_3 \equiv \arg[-(V_{ud}V_{ub}^*)/(V_{cd}V_{cb}^*)]$. Assuming SU(3) flavor symmetry, it follows that

$$a = a', \quad \theta = \theta'. \quad (3)$$

Using the value for the ratio of hadronic matrix elements $\mathcal{A}'/\mathcal{A} = 1.32 \pm 0.07$ from Ref. [?] and the recent LHCb combination result of the angle $\gamma = (64.6 \pm 2.8)^\circ$ [?], the two-dimensional 68% confidence-level contours determined from χ^2 tests using the $\Delta\mathcal{A}^{CP}$ and $\mathcal{R}_{\pi/K}$ measurements are shown in Fig. S1. It can be seen that the $\Delta\mathcal{A}^{CP}$ measurement provides a strong constraint on the imaginary part of $ae^{i\theta}$. A complete study that takes into account the effects of SU(3) flavor-symmetry breaking is needed when using this constraint in the determination of the phase 2β in $B^0 \rightarrow J/\psi K^0$ decays.

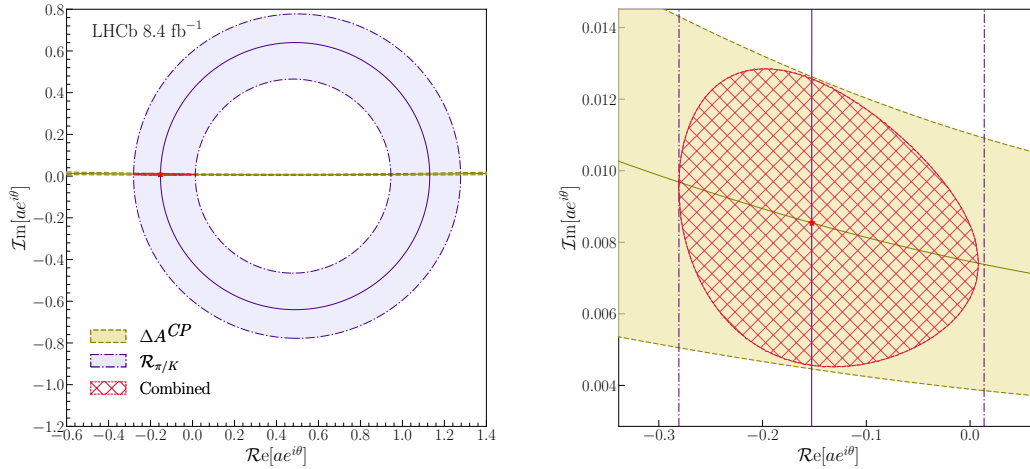


Figure S1: The 68% confidence-level contours in the complex plane of $ae^{i\theta}$, derived from the $\Delta\mathcal{A}^{CP}$ measurement, the $\mathcal{R}_{\pi/K}$ measurement and their combination. The solid lines correspond to the central values of the measurements. The right figure shows a zoomed-in view of the intersecting region in the left one.