

B-CP anomalies, “4th generation” and the LHC

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Although the CKM-paradigm works to an accuracy of $\sim 20\%$, there are by now several indications that suggest the need for beyond the Standard Model CP-odd phase(s). The value of $\sin 2\beta$ measured via the goldplated (tree) mode, $B \rightarrow \psi K_s$ is smaller than the value deduced by using improved lattice matrix elements. The value of $\sin 2\beta$ measured via ‘penguin-dominated’(loop) decays tends to be even smaller still. There is also a rather large difference between the direct CP asymmetries in $B \rightarrow K - \pi +$ and $B - \rightarrow K - \pi 0$ that is rather difficult to understand. More recently, CDF and D0 are finding about a 2.2σ signal in CP asymmetry in the corresponding gold-plated mode $B_s \rightarrow \psi\phi$. If true, this would be consistent with the indications of new CP-phase in penguin $b \rightarrow s$ transitions seen at B-factories. A brief discussion of some of the BSM scenarios that could be the underlying cause of these deviations is given. In particular, we emphasize that the data are quite suggestive of a fourth family with $m' t$ in the range of 400–600 GeV as perhaps the simplest BSM candidate which ‘naturally’ explains the data. This picture leads to significant repercussions for the LHC which will be explored.

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