Phenomenology of CP Violation in a Flavor Blind MSSM

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The only source of CP violation within the Standard Model (SM) quark sector is the phase of the Cabibbo-Kobayashi-Maskawa (CKM) matrix and in the last years, the two B factories have confirmed the SM CKM picture of flavor and CP violation up to an accuracy of the $(10-20)\%$ level. Still, a closer look at several CP violating observables indicates that the CKM phase might not be sufficient to describe simultaneously CP violation in K, B_d and B_s decays. In particular:

i) The values for $\sin 2\beta$ as extracted from the time dependent CP asymmetries in the loop induced decays $B \to (\phi, \eta')K_S$ are considerably lower than the one obtained in the "golden" tree level mode $B \to \psi K_S$. This could be a hint for the presence of new phases in the above mentioned loop decays.

ii) Within the SM, CP violation in the $B_d - \overline{B}_d$ system appears insufficient to describe the measured amount of CP violation in the neutral Kaon system, ϵ_K, if the $\Delta M_d/\Delta M_s$ constraint is taken into account [1,2].

In order to address these problems and tensions one has to go beyond the SM and introduce new CP violating phases. In [3] we analyze the low energy implications of a *Flavor Blind* supersymmetric scenario, where the CKM matrix is still the only source of flavor violation but new CP violating and flavor conserving phases are present in the soft sector. We find that the best probes of this rather restricted scenario are

i) flavor conserving observables like the electric dipole moments (EDMs) of the electron (d_e) and the neutron (d_n) and

ii) flavor changing and CP violating processes in B systems, like the direct CP asymmetry in the decay $b \to s\gamma$, i.e. $A_{CP}(b \to s\gamma)$ and the time dependent CP asymmetries in $B \to \phi(\eta')K_S$, i.e. $S_{\phi(\eta')K_S}$.

The non-standard values for $S_{\phi(\eta')K_S}$ can find a natural explanation within our scenario and as shown in Fig. 1 this would unambiguously imply

i) positive and often large (non-standard) values for $A_{CP}(b \to s\gamma)$ and

ii) a lower bound for the electron and neutron EDMs at the level of $d_{e,n} \gtrsim 10^{-28}\, e\,\mathrm{cm}$.

Moreover, we predict positive New Physics contributions to ϵ_K which could be welcomed in view of the recently lowered Standard Model value for ϵ_K [2].

We point out that a correlated study of these CP violating low energy observables allows to rule out or to confirm the framework of the Flavor Blind MSSM, and can give an answer to the question whether new sources of flavor violation beyond the CKM are required to describe low energy CP violation within Supersymmetry.

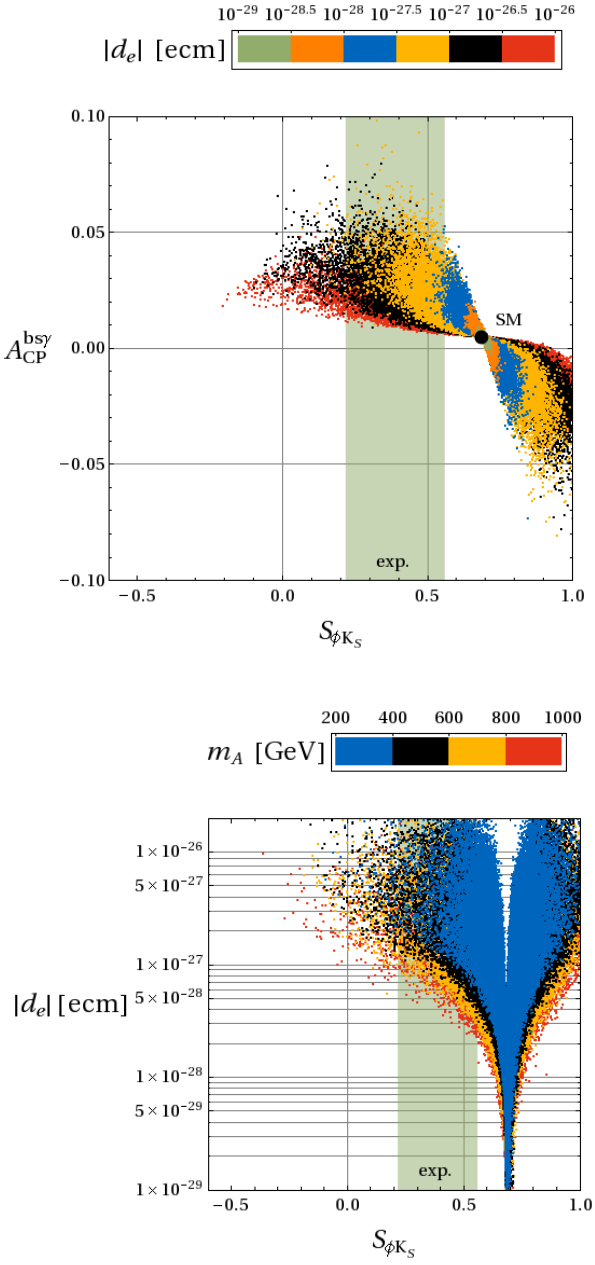

Fig. 1: Upper: Direct CP asymmetry in $b \to s\gamma$, $A_{CP}(b \to s\gamma)$ against the time dependent CP asymmetry in $B \to \phi K_S$, $S_{\phi K_S}$. Here and also in the lower plot the shaded green area corresponds to the current experimental bound on $S_{\phi K_S}$ at the 68% C.L.. The colored bands correspond to different obtained values for the electron EDM d_e. Lower: Electron EDM (d_e) against $S_{\phi K_S}$. The colored bands correspond to different values for the pseudoscalar Higgs mass m_A.

References

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