SM with four generations: Selected implications for rare B and K decays

Amarjit Soni,[1] Ashutosh Kumar Alok,[2] Anjan

Giri,[3] Rukmani Mohanta,[4] and Soumitra Nandi[5]

[1]*Physics Department, Brookhaven National Laboratory, Upton, NY 11973, USA*

[2]*Physique des Particules, Université de Montréal,*

C.P. 6128, succ. centre-ville, Montréal, QC, Canada H3C 3J7

[3]*Physics Department, IIT Hyderabad, Andhra Pradesh-502205, India*

[4]*School of Physics, University of Hyderabad, Hyderabad - 500046, India*

[5]*Dipartimento di Fisica Teorica, Univ. di Torino and INFN,*

Sezione di Torino, I-10125 Torino, Italy

We extend our recent work and study implications of the Standard Model with four generations (SM4) for rare B and K decays. We again take seriously the several 2-3 σ anomalies seen in B, B_s decays and interpret them in the context of this simple extension of the SM. SM4 is also of course of considerable interest for its potential relevance to dynamical electroweak symmetry breaking and to baryogenesis. Using experimental information from processes such as $B \to X_s \gamma$, B_d and B_s mixings, indirect CP-violation from $K_L \to \pi\pi$ etc along with oblique corrections, we constrain the relevant parameter space of the SM4, and find $m_{t'}$ of about 400-600 GeV with a mixing angle $|V_{t'b}^* V_{t's}|$ in the range of about (0.05 to 1.4)$\times 10^{-2}$ and with an appreciable CP-odd associated phase, are favored by the current data. Given the unique role of the CP asymmetry in $B_s \to \psi\phi$ due to its gold-plated nature, correlation of that with many other interesting observables, including the semileptonic asymmetry (A_{SL}) are studied in SM4. We also identify several processes, such as $B \to X_s \nu\bar{\nu}$, $K_L \to \pi^0 \nu\bar{\nu}$ etc, that are significantly different in SM4 from the SM. Experimentally the very distinctive process $B_s \to \mu^+\mu^-$ is also discussed; the branching ratio can be larger or smaller than in SM, $(3.2 \to 4.2) \times 10^{-9}$, by a factor of $\mathcal{O}(3)$.