invariant (formally) under the flavor group $SU(3)^3_q$ [23]. Invariance under CP may or may not be imposed in addition.

According to this criterion one should in principle consider operators with arbitrary powers of the (dimensionless) Yukawa fields. However, a strong simplification arises by the observation that all the eigenvalues of the Yukawa matrices are small, but for the top one (and possibly the bottom one, see later), and that the off-diagonal elements of the CKM matrix are very suppressed. Working in the basis in Eq. (2.10), and neglecting the ratio of light quark masses over the top mass, we have

$$\left[Y^u (Y^u)^\dagger\right]^n_{i\neq j} \approx y_t^{2n} V^*_{ti} V_{tj} \ . \tag{4.2}$$

As a consequence, including high powers of the the Yukawa matrices amounts only to a redefinition of the overall factor in (4.2) and the the leading $\Delta F = 2$ and $\Delta F = 1$ FCNC amplitudes get exactly the same CKM suppression as in the SM:

$$\mathcal{A}(d^i \to d^j)_{\rm MFV} = (V^*_{ti} V_{tj})\ \mathcal{A}^{(\Delta F=1)}_{\rm SM} \left[1 + a_1 \frac{16\pi^2 M_W^2}{\Lambda^2}\right] \ , \tag{4.3}$$

$$\mathcal{A}(M_{ij} - \overline{M}_{ij})_{\rm MFV} = (V^*_{ti} V_{tj})^2 \mathcal{A}^{(\Delta F=2)}_{\rm SM} \left[1 + a_2 \frac{16\pi^2 M_W^2}{\Lambda^2}\right] \ , \tag{4.4}$$

where the $\mathcal{A}^{(i)}_{\rm SM}$ are the SM loop amplitudes and the a_i are $\mathcal{O}(1)$ real parameters. The a_i depend on the specific operator considered but are flavor independent. This implies the same relative correction in $s \to d$, $b \to d$, and $b \to s$ transitions of the same type.

Within the MFV framework, several of the constraints used to determine the CKM matrix (and in particular the unitarity triangle) are not affected by NP [26]. In this framework, NP effects are negligible not only in tree-level processes but also in a few clean observables sensitive to loop effects, such as the time-dependent CPV asymmetry in $B_d \to \psi K_{L,S}$. Indeed the structure of the basic flavor-changing coupling in Eq. (4.4) implies that the weak CPV phase of B_d–$\overline{B}_d$ mixing is $\arg[(V_{td} V^*_{tb})^2]$, exactly as in the SM. This construction provides a natural (a posteriori) justification of why no NP effects have been observed in the quark sector: by construction, most of the clean observables measured at B factories are insensitive to NP effects in the MFV framework.

In Table II we report a few representative examples of the bounds on the higher-dimensional operators in the MFV framework. For simplicity, only leading spurion dependence is shown on the left-handed column. The built-in CKM suppression leads to bounds on the effective scale

to define the minimal sources of flavour symmetry breaking if we want to keep track of non-vanishing neutrino masses [24, 25].