at the LO QCD corrections can be found from Eq. (62). Since $Q_{1,2}$ mix with the QCD and EW penguin operators, i.e. Q_{3-10}, we basically need the 10×10 ADM matrix for the operators Q_{1-10}. Since the mixture of $Q_{1,2}$ and Q_{3-10} is dominated by the QCD penguin operators, we adopt the 6×6 ADM for the new physics effects, and the ADM is given as [54]:

$$\hat{\gamma}^{(0)}_{QCD} = \begin{pmatrix} \frac{6}{N_c} & 6 & 0 & 0 & 0 & 0 \\ 6 & \frac{-6}{N_c} & \frac{-2}{3N_c} & \frac{2}{3} & \frac{-2}{3N_c} & \frac{2}{3} \\ 0 & 0 & \frac{-22}{3N_c} & \frac{22}{3} & \frac{-4}{3N_c} & \frac{4}{3} \\ 0 & 0 & 6-\frac{2f}{3N_c} & \frac{-6}{N_c}+\frac{2f}{3} & \frac{-2f}{3N_c} & \frac{2f}{N_c} \\ 0 & 0 & 0 & 0 & \frac{6}{N_c} & -6 \\ 0 & 0 & \frac{-2f}{3N_c} & \frac{2f}{3} & \frac{-3f}{3N_c} & \frac{-6(-1+N_c^2)}{N_c}+\frac{2f}{3} \end{pmatrix}, \tag{63}$$

with f being the number of flavors. If we take the operators Q_{1-6} as a basis, from Eq. (24), the corresponding Wilson coefficients can form a vector and be expressed as $C_T = (1,-1,0,0,0,0)\zeta^{LL}_{21}$ and $C'_T = (1,-1,0,0,0,0)\zeta^{RR}_{21}$ at the m_{H_3} scale. Using RG evolution with ADM in Eq. (63) [54], the Wilson coefficients at the m_c scale can be obtained as:

$$C_T(m_c) \approx (2.0,\, -2.0,\, 0,\, 0,\, 0,\, 0)\zeta^{LL}_{21}\,, \tag{64}$$

where we have ignored the effects that are less than or around ± 0.1, and $C'_T(m_c)$ can be obtained from $C_T(m_c)$ using ζ^{RR}_{21} instead of ζ^{LL}_{21}.

Similarly, we can apply the same approach to the $Q^{(\prime)SLL,u}_{1-4}$ operators. From the Hamiltonian in Eq. (24), the Wilson coefficients at the $\mu = m_{H_3}$ scale can be formed as $C^{SLL,u} = (4,\, 4,\, 1,\, 1)\zeta^{LR}_{21}$ and $C'^{SLL,u} = (4,\, 4,\, 1,\, 1)\zeta^{RL}_{21}$. Using the ADM in Eq. (62), the Wilson coefficients at $\mu = m_c$ can then be obtained as:

$$C^{SLL,u}(m_c) = (-5.44,\, 1.33,\, 2.41,\, 0.09)\zeta^{LR}_{21}\,. \tag{65}$$

We can obtain $C'^{SLL,u}(m_c)$ from $C^{SLL,u}(m_c)$ using ζ^{RL}_{21} instead of ζ^{LR}_{21}.

Following Eqs. (24) and (54) and using the introduced matrix elements, the $Re(\epsilon'/\epsilon)$ from the tree-level diquark contributions can be formulated as: