Weak decays of stable open-bottom tetraquark by SU(3) symmetry analysis

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Abstract The exotic state $X(5568)$ which was observed by D0 Collaboration is very likely to be a tetraquark state with four different valence quark flavors, though the existence was not confirmed by other collaborations. The possibility of such state still generates lots of interests in theory. In the paper, we will study the properties of the state under the SU(3) flavor symmetry. The four quark states with a heavy bottom quark and three light quarks(anti-quark) can form $\bar{3}$, 6 and $\bar{15}$ representations. The weak decays can be dominant and should be discussed carefully while these states are stable against the strong and electromagnetic interactions. Therefore we will study the multi-body semileptonic and nonleptonic weak decays systematically. With the help of SU(3) flavor symmetry, we can give the Hamiltonian in the hadronic level, then obtain the parameterized irreducible amplitudes and the relations of different channels. At the end of the article, we collect some Cabibbo allowed two-body and three-body weak decay channels which can be used to reconstruct X_{b6} states at the branching fraction up to be 10^{-5} .

1 Introduction

The naive quark model in which the hadron is composed of a quark-antiquark pair or triquarks has achieved lots of successes over the past 50 years. Quantum chromodynamics (QCD) theory also allows the existence of the exotic states such as tetraquarks, pentaquarks, moleculars and baryonium. Such exotic states attract wide interests in both experiments and theories (see the recent reviews in [1–7]). Current experimental data strongly indicated the pos-

sibility of the existence of hidden heavy flavor tetraquarks and pentaquarks. The discovery of $X(3872)$ in $B^\pm \rightarrow K^\pm X(X(3872) \rightarrow J/\psi \pi^+ \pi^-)$ at Belle [8] fired the first shot in the studies of the hidden charm tetraquarks. The hidden bottom tetraquarks $Z_b^\pm(10610, 10650)$ were first observed in $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-(n = 1, 2, 3)$ and $e^+e^- \rightarrow h_b(nP)\pi^+\pi^-(n = 1, 2)$ at Belle [9]. Two P_c states discovered in $\Lambda_b^0 \rightarrow J/\psi K^- p$ at LHCb in 2015 could be treated as the candidates of the hidden charm pentaquarks [10].

Quite unexpectedly, the D0 Collaboration reported the signal for the tetraquark $X(5568)$ with four different flavors in the decay $X(5568) \rightarrow B_s^0 \pi^\pm$ in 2016 [11]. However, efforts by LHCb [12], CMS [13], CDF [14] and ATLAS [15] Collaborations to confirm the state provide no supporting evidence for its existence in the identical channel. Recently, the D0 Collaboration have reconfirmed the existence of $X(5568)$ via the semileptonic decays of B_s [16]. If the observation of $X(5568)$ is true, it would be the first discovery of tetraquark states with four different valence quark flavors. The theoretical papers have appeared to study the properties of the open-flavor tetraquark state [17–29].

The studies on stable open-flavor tetraquarks or pentaquarks are of even higher interests in literatures, especially on the doubly heavy flavor tetraquarks [30–40]. Theoretical calculations on the masses of $bb\bar{q}_1\bar{q}_2$ with $q_i = u, d$ or s always imply these states are stable against strong decays. However, the productions of such doubly heavy-flavor tetraquark states are too rare in experiments, especially at the current stage [30, 31]. To search for stable open-flavor tetraquarks, one of the present authors proposed the possible tetraquark composed of $bs\bar{u}\bar{d}$ in Ref. [27], which is supported by the quark delocalization color screening model [29]. Such stable tetraquark state has a unique advantage in the exper-

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imental searches. It has a lifetime as large as ordinary B mesons, so that it decays at a secondary vertex at the proton-proton colliders which rejects most of the backgrounds from the preliminary vertex. Besides, its production is much larger than the bb -tetraquarks. Therefore the searches of such stable singly heavy-flavor tetraquarks would be more promising.

To hunting for the possible stable open-bottom tetraquarks, a systematical analysis of decay modes is helpful. A successful example is the discovery of the Ξ_{cc}^{++} via the final state of $\Lambda_c^+ K^- \pi^+ \pi^+$ [41], which was first pointed out as the most favorable mode in [42]. Although the theoretical calculation of such multi-body decay modes has to deal with the nonperturbative strongly-coupled gauge dynamics, some dynamics-screening approaches always reduce the difficulties. In this paper, we will adopt the light quark SU(3) flavor symmetry to deal with the weak decays of the open-bottom tetraquarks. SU(3) flavor symmetry analysis has been applied into the studies of B meson and heavy baryon decays [43–63] and it provides a general insight for different decay modes.

The open-bottom four quark multiplets $Qq_i\bar{q}_j\bar{q}_k$ can form a $\bar{3}$, 6 or $\bar{15}$ representation in the SU(3) flavor symmetry. It will be seen in the next section that the fifteen-fold states are the excited tetraquark states which can hadronic decay into the sextet states, and the anti-triplet can usually electromagnetic decay into B meson. Therefore we will study the possible weak decays of sextet states (denoted as X_{b6}) on the main body of the paper. If the X_{b6} multiplets can be stable against the strong and electromagnetic decays, the weak decay analysis of such states will be the key tool for searching these exotic states in experiment. By constructing the weak decay Hamiltonian in hadronic level and parameterizing the amplitudes into some irreducible parts, we will give the weak decay amplitude expressions for the X_{b6} states and obtain the relations among different decay channels.

The paper is organized as followed. We give the multiplets of the open-bottom tetraquarks and the related hadrons in the SU(3) flavor symmetry in Sect. 2. We will discuss the energy thresholds of sextet open-bottom tetraquarks, and list the possible masses from corresponding literatures in Sect. 3. From Sect. 4 to Sect. 5, we mainly study the semi-leptonic and non-leptonic weak decays of the X_{b6} states. In Sect. 6, we will select some possible golden channels which may be performed in future experiments. We summarize and conclude in the end.

2 Particle multiplets

In the SU(3) flavor symmetry, the open-bottom tetraquark ($bq_i\bar{q}_j\bar{q}_k$, $q_x = u, d, s$)¹ can form $\bar{3}$, 6 and $\bar{15}$ by the

¹ Throughout the paper, the charge conjugation is assumed and one can get the corresponding properties for $\bar{b}\bar{q}_i q_j q_k$ under the charge conjugation.

decomposition of $3 \otimes \bar{3} \otimes \bar{3} = \bar{3} \oplus \bar{3} \oplus 6 \oplus \bar{15}$. The sextet tetraquark state can be expressed as $(X_{b6})_{[jk]}^i = \epsilon_{\alpha jk} (X_{b6})^{(\alpha i)} = \epsilon^{i\alpha\beta} (X_{b6})_{[\alpha\beta], [jk]}$ (antisymmetric tensor $\epsilon_{123} = -1$ and $\epsilon^{123} = 1$). While the $\bar{15}$ states usually strong decay into the sextets and we will not consider them here. On the other hand, the $\bar{3}$ tetraquarks have a quark-antiquark pair and can electromagnetic decay into B meson, we will only focus on the sextet tetraquark states. The traceless sextet $(X_{b6})_{jk}^i$ satisfies the condition that the flavor components are antisymmetric under the exchange of j and k [24], which can be written explicitly

$$\begin{aligned} (X_{b6})_{[2,3]}^1 &= \frac{1}{\sqrt{2}} X_{u\bar{d}\bar{s}}, \quad (X_{b6})_{[3,1]}^2 = \frac{1}{\sqrt{2}} X_{d\bar{s}\bar{u}}, \\ (X_{b6})_{[1,2]}^3 &= \frac{1}{\sqrt{2}} X_{s\bar{u}\bar{d}}, \\ (X_{b6})_{[1,2]}^1 &= (X_{b6})_{[2,3]}^3 = \frac{1}{2} Y_{(u\bar{u}, s\bar{s})\bar{d}}, \\ (X_{b6})_{[3,1]}^1 &= (X_{b6})_{[2,3]}^2 = \frac{1}{2} Y_{(u\bar{u}, d\bar{d})\bar{s}}, \\ (X_{b6})_{[1,2]}^2 &= (X_{b6})_{[3,1]}^3 = \frac{1}{2} Y_{(d\bar{d}, s\bar{s})\bar{u}}. \end{aligned} \quad (1)$$

The light pseudo-scalars form an octet plus a singlet, and the octet mesons can be written as

$$M_8 = \begin{pmatrix} \frac{\pi^0}{\sqrt{2}} + \frac{\eta}{\sqrt{6}} & \pi^+ & K^+ \\ \pi^- & -\frac{\pi^0}{\sqrt{2}} + \frac{\eta}{\sqrt{6}} & K^0 \\ K^- & \bar{K}^0 & -2\frac{\eta}{\sqrt{6}} \end{pmatrix}. \quad (2)$$

For the bottom mesons, they form two triplets with $B_i = (B^-, \bar{B}^0, \bar{B}_s^0)$ and $\bar{B}^i = (B^+, B^0, B_s^0)$. For the charm mesons, two similar triplets are given as $D_i = (D^0, D^+, D_s^+)$ and $\bar{D}^i = (\bar{D}^0, D^-, D_s^-)$.

For the baryon states, the light anti-baryons form an octet and an anti-decuplet representation. The octet can be written as

$$\bar{T}_8 = \begin{pmatrix} \frac{1}{\sqrt{2}} \bar{\Sigma}^0 + \frac{1}{\sqrt{6}} \bar{\Lambda}^0 & \bar{\Sigma}^+ & \bar{\Xi}^+ \\ \bar{\Sigma}^- & -\frac{1}{\sqrt{2}} \bar{\Sigma}^0 + \frac{1}{\sqrt{6}} \bar{\Lambda}^0 & \bar{\Xi}^0 \\ \bar{p} & \bar{n} & -\sqrt{\frac{2}{3}} \bar{\Lambda}^0 \end{pmatrix}, \quad (3)$$

while the light anti-decuplet become

$$\begin{aligned} (T_{10})^{111} &= \bar{\Delta}^{--}, \quad (T_{10})^{112} = (T_{10})^{121} = (T_{10})^{211} \\ &= \frac{1}{\sqrt{3}} \bar{\Delta}^-, \\ (T_{10})^{222} &= \bar{\Delta}^+, \quad (T_{10})^{122} = (T_{10})^{212} = (T_{10})^{221} \\ &= \frac{1}{\sqrt{3}} \bar{\Delta}^0, \\ (T_{10})^{113} &= (T_{10})^{131} = (T_{10})^{311} = \frac{1}{\sqrt{3}} \bar{\Sigma}'^-, \end{aligned}$$

$$\begin{aligned}
 (T_{10})^{223} &= (T_{10})^{232} = (T_{10})^{322} = \frac{1}{\sqrt{3}} \bar{\Sigma}^{\prime+}, \\
 (T_{10})^{123} &= (T_{10})^{132} = (T_{10})^{213} = (T_{10})^{231} \\
 &= (T_{10})^{312} = (T_{10})^{321} = \frac{1}{\sqrt{6}} \bar{\Sigma}^0, \\
 (T_{10})^{133} &= (T_{10})^{313} = (T_{10})^{331} = \frac{1}{\sqrt{3}} \bar{\Xi}^0, \quad (T_{10})^{233} \\
 &= (T_{10})^{323} = (T_{10})^{332} = \frac{1}{\sqrt{3}} \bar{\Xi}^{\prime+}, \\
 (T_{10})^{333} &= \bar{\Omega}^+.
 \end{aligned} \tag{4}$$

For the anti-charmed anti-baryons, they form a triplet and an anti-sextet

$$\begin{aligned}
 T_{\bar{c}3} &= \begin{pmatrix} 0 & \bar{\Lambda}_{\bar{c}}^- & \bar{\Xi}_{\bar{c}}^- \\ -\bar{\Lambda}_{\bar{c}}^- & 0 & \bar{\Xi}_{\bar{c}}^0 \\ -\bar{\Xi}_{\bar{c}}^- & -\bar{\Xi}_{\bar{c}}^0 & 0 \end{pmatrix}, \\
 T_{\bar{c}6} &= \begin{pmatrix} \bar{\Sigma}_{\bar{c}}^{--} & \frac{1}{\sqrt{2}} \bar{\Sigma}_{\bar{c}}^- & \frac{1}{\sqrt{2}} \bar{\Xi}_{\bar{c}}^{\prime-} \\ \frac{1}{\sqrt{2}} \bar{\Sigma}_{\bar{c}}^- & \bar{\Sigma}_{\bar{c}}^0 & \frac{1}{\sqrt{2}} \bar{\Xi}_{\bar{c}}^0 \\ \frac{1}{\sqrt{2}} \bar{\Xi}_{\bar{c}}^{\prime-} & \frac{1}{\sqrt{2}} \bar{\Xi}_{\bar{c}}^0 & \bar{\Omega}_{\bar{c}}^0 \end{pmatrix}.
 \end{aligned} \tag{5}$$

It is easily to get the components for the singly charmed baryons which form an anti-triplet $T_{\bar{c}3}$ and a sextet $T_{\bar{c}6}$. Their explicit expressions can be found in Refs. [40,55,57,59].

3 Strong decay thresholds for the X_{b6} tetraquarks

In this section, we will look at the strong and electromagnetic decay thresholds for the X_{b6} tetraquarks. One should note that the states of $X_{s\bar{u}\bar{d}}$, $X_{u\bar{d}\bar{s}}$ and $X_{d\bar{s}\bar{u}}$ are purely open flavor states and can not electromagnetic decay into B meson. For the other three states of $Y_{(u\bar{u},d\bar{d})\bar{s}}$, $Y_{(u\bar{u},s\bar{s})\bar{d}}$ and $Y_{(d\bar{d},s\bar{s})\bar{u}}$, even though they have a quark-antiquark pair, they will not electromagnetic decay into B meson because of the antisymmetric quark structure for X_{b6} . The X_{b6} tetraquarks may have different spin-parities, and the ground states of the X_{b6} states will have the spin-parity with $J^P = 0^+$. Higher excited X_{b6} states will strong decay into the ground states. Thus we only focus on the $j^P = 0^+$ X_{b6} ground states.

The BK mass threshold at 5.77 GeV will influence the decay properties if the mass of $X_{s\bar{u}\bar{d}}$ state is higher than 5.77 GeV. The $B_s\pi$ mass threshold at 5.51 GeV will influence the decay properties if the masses of $X_{u\bar{d}\bar{s}}$, $X_{d\bar{s}\bar{u}}$ and $Y_{(u\bar{u},d\bar{d})\bar{s}}$ states are higher than 5.51 GeV. While for the $Y_{(u\bar{u},s\bar{s})\bar{d}}$ and $Y_{(d\bar{d},s\bar{s})\bar{u}}$ states, their strong decay threshold lies in the $B\pi$ mass at 5.41 GeV. Therefore, it can be assigned a stable tetraquark against strong decays only if the mass is below the strong decay threshold. The stable tetraquark has to decay

Table 1 The masses (in GeV) of the lowest-lying open bottom X_{b6} tetraquarks with $J^P = 0^+$ were predicted by different models such as diquark-antidiquark model [22,27], simple constituent quark model [27], QCD sum rules [18,26], quark delocalization color screening model [29]. The predictions for the masses of the $Y_{(u\bar{u},d\bar{d})\bar{s}}$, $Y_{(u\bar{u},s\bar{s})\bar{d}}$ and $Y_{(d\bar{d},s\bar{s})\bar{u}}$ states are missing

$X_{u\bar{d}\bar{s}}$	$X_{d\bar{s}\bar{u}}$	$X_{s\bar{u}\bar{d}}$
5.708 [22]	5.708 [22]	5.637 (Mod-I) [27]
5.59 ± 0.18 [26]	5.86 ± 0.20 [26]	6.119 (Mod-II) [27]
	5.58 ± 0.14 [18]	5.701 [29]

weakly, but most of weak decay channels can be tested in the future experiment inversely.

In literatures, there are lots of theoretical predictions for these open-bottom tetraquarks. Using the diquark-antidiquark model, the mass of $X_{s\bar{u}\bar{d}}$ state was predicted at 5.637 GeV in Ref. [27] by one of the present authors, while the states of $X_{u\bar{d}\bar{s}}$ and $X_{d\bar{s}\bar{u}}$ were predicted with the mass at 5.7 GeV in Ref. [22] by another one of the present authors and the collaborator. Using the simple constituent quark model, the mass of $X_{s\bar{u}\bar{d}}$ state was predicted at 6.119 GeV [27].

The masses of the lowest-lying open-flavor bottom tetraquarks have been explored in recent articles, so we listed them in Table 1.

From the predictions of the mass spectra of X_{b6} states, one can see some predictions support the existence of the X_{b6} states blow the strong decay thresholds. The processes of weak decays are dominant once the stable tetraquarks are confirmed. It is very useful to study the weak decays by the SU(3) symmetry analysis without any assumptions of factorization or dynamic information. The semi-leptonic and nonleptonic decay amplitudes have been parameterized in terms of SU(3) irreducible representations. For completeness, the weak two body and three body decays of open bottom tetraquarks will be studied in the following.

4 Semi-leptonic decays

4.1 $b \rightarrow q\ell\bar{\nu}_\ell$: semi-leptonic decays into mesons

In the following, we will focus on the bottom quark decays. For the b quark decay, the electro-weak Hamiltonian can be expressed as

$$\mathcal{H}_{eff} = \frac{G_F}{\sqrt{2}} [V_{q'b}\bar{q}'\gamma^\mu(1-\gamma_5)b\bar{\ell}\gamma_\mu(1-\gamma_5)\nu_\ell] + h.c., \tag{6}$$

with $q' = u, c$. Therein the $b \rightarrow c$ transition forms a singlet in SU(3) flavor symmetry, while the $b \rightarrow u$ transition becomes a SU(3) triplet H'_3 with $(H'_3)^1 = -(H'_3)_{23} =$

Fig. 1 Feynman diagrams for semileptonic decays of open-flavor bottom tetraquarks. **a** Represents the semileptonic decays into one meson. In **b, c**, the final states include two mesons. **d, e** Denote the processes including baryonic states. The suppressed annihilation topologies are panels (**a, c, e**)

Table 2 Amplitudes for open bottom tetraquark X_{b6} semi-leptonic decays into a light meson

Channel	Amplitude ($/V_{ub}$)	Channel	Amplitude ($/V_{ub}$)
$X_{d\bar{s}\bar{u}}^- \rightarrow K^0 l^- \bar{\nu}$	$-\frac{a_1}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \bar{K}^0 l^- \bar{\nu}$	$\frac{a_1}{\sqrt{2}}$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \pi^+ l^- \bar{\nu}$	$\frac{a_1}{2}$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow K^+ l^- \bar{\nu}$	$-\frac{1}{2}a_1$
$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \pi^0 l^- \bar{\nu}$	$-\frac{a_1}{2\sqrt{2}}$	$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \eta l^- \bar{\nu}$	$\frac{1}{2}\sqrt{\frac{3}{2}}a_1$

$(H'_3)_{32} = 1$ and $(H'_3)^{2,3} = \epsilon^{(2,3)ij}(H'_3)_{ij} = 0$, ($i, j = 1, 2, 3$).

Firstly, the effective Hamiltonian for X_{b6} decays to a light meson and $\ell\bar{\nu}_\ell$ in hadron level can be easily written as

$$\mathcal{H}_{eff} = a_1(X_{b6})_{[jk]}^i (H'_3)^j M_i^k \bar{\ell}\nu_\ell, \quad (7)$$

where and in the following the coefficient a_i represents the nonperturbative parameters. The related Feynman diagram is plotted in Fig. 1a. Expanding the above hamiltonian, one can obtain the effective amplitudes for different decay channels, which are given in Table 2. From it one can see that all amplitudes of six different decay channels are proportional to a_1 . Therefore, we can derive the decay width relations for different channels when ignoring the small effects of phase space. For the tetraquark semi-leptonic decays into a light meson, the relations for different decay widths are

$$\begin{aligned} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow K^0 l^- \bar{\nu}) &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \bar{K}^0 l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \pi^+ l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow K^+ l^- \bar{\nu}) \end{aligned}$$

$$\begin{aligned} &= 4\Gamma(Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \pi^0 l^- \bar{\nu}) \\ &= \frac{4}{3}\Gamma(Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \eta l^- \bar{\nu}). \end{aligned}$$

The effective Hamiltonian for X_{b6} semileptonic decays into two mesons can also be constructed as

$$\begin{aligned} \mathcal{H}_{eff} &= a_2(X_{b6})^{[ij]}(H'_3)_{[il]}M_j^k M_k^l \bar{\ell}\nu_\ell \\ &+ a_3(X_{b6})_{[jk]}^i M_i^j (\bar{D})^k \bar{\ell}\nu_\ell. \end{aligned} \quad (8)$$

The corresponding Feynman diagrams are given in Fig. 1b, c. The full term $a_2(X_{b6})^{[ij]}(H'_3)_{[il]}M_j^k M_k^l \bar{\ell}\nu_\ell + a'_2(X_{b6})^{[ij]}(H'_3)_{[il]}M_i^k M_k^l \bar{\ell}\nu_\ell$ can be expressed as two new terms $a_2(2(X_{b6})_{[kl]}^i (H'_3)^j M_i^k M_j^l - 4(X_{b6})_{[jl]}^i (H'_3)^j M_i^k M_k^l) \bar{\ell}\nu_\ell$ which are related to Fig. 1c, b respectively. It should be mentioned that the process of $X_{u\bar{d}\bar{s}} \rightarrow \pi^+ K^+ \ell^- \bar{\nu}$ is trivial because of the exchangeable antisymmetric antiquarks $\bar{d}$ and $\bar{s}$ in the initial state. One can obtain the decay amplitudes from the effective Hamiltonian. The results for a light meson plus a charmed meson in final states are given in Table 3, while the ones for two light mesons in final states are given in Table 4.

Table 3 Amplitudes for open bottom tetraquark X_{b6} semi-leptonic decays into a charmed meson and a light meson

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ D_s^+ l^- \bar{\nu}$	$\frac{a_3}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow K^+ D^+ l^- \bar{\nu}$	$-\frac{a_3}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- D_s^+ l^- \bar{\nu}$	$-\frac{a_3}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow K^0 D^0 l^- \bar{\nu}$	$\frac{a_3}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \bar{K}^0 D^0 l^- \bar{\nu}$	$-\frac{a_3}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow K^- D^+ l^- \bar{\nu}$	$\frac{a_3}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ D^0 l^- \bar{\nu}$	$-\frac{a_3}{2}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 D^+ l^- \bar{\nu}$	$\frac{a_3}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{K}^0 D_s^+ l^- \bar{\nu}$	$\frac{a_3}{2}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \eta D^+ l^- \bar{\nu}$	$\frac{1}{2}\sqrt{\frac{3}{2}}a_3$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 D_s^+ l^- \bar{\nu}$	$-\frac{a_3}{\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^+ D^0 l^- \bar{\nu}$	$\frac{a_3}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 D^+ l^- \bar{\nu}$	$-\frac{a_3}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 D^0 l^- \bar{\nu}$	$\frac{a_3}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- D^+ l^- \bar{\nu}$	$\frac{a_3}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^- D_s^+ l^- \bar{\nu}$	$-\frac{a_3}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \eta D^0 l^- \bar{\nu}$	$-\frac{1}{2}\sqrt{\frac{3}{2}}a_3$		

Table 4 Amplitudes for open bottom tetraquark X_{b6} semi-leptonic decays into two light mesons

Channel	Amplitude ($/V_{ub}$)	Channel	Amplitude ($/V_{ub}$)
$X_{d\bar{s}\bar{u}}^- \rightarrow K^+ \pi^- l^- \bar{\nu}$	$-\frac{a_2}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow K^0 \pi^0 l^- \bar{\nu}$	$\frac{a_2}{2}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \eta K^0 l^- \bar{\nu}$	$\frac{a_2}{2\sqrt{3}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \bar{K}^0 \pi^0 l^- \bar{\nu}$	$-\frac{a_2}{2}$
$X_{s\bar{u}\bar{d}}^- \rightarrow K^- \pi^+ l^- \bar{\nu}$	$\frac{a_2}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \eta \bar{K}^0 l^- \bar{\nu}$	$-\frac{a_2}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{K}^0 K^+ l^- \bar{\nu}$	$\frac{a_2}{2}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \eta \pi^+ l^- \bar{\nu}$	$\frac{a_2}{\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^+ \pi^0 l^- \bar{\nu}$	$-\frac{a_2}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \pi^+ l^- \bar{\nu}$	$-\frac{a_2}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \eta K^+ l^- \bar{\nu}$	$\frac{a_2}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^+ \pi^- l^- \bar{\nu}$	$\frac{a_2}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 \pi^0 l^- \bar{\nu}$	$\frac{a_2}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^- K^+ l^- \bar{\nu}$	$-\frac{a_2}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \eta \pi^0 l^- \bar{\nu}$	$-\frac{a_2}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \eta \eta l^- \bar{\nu}$	$-\frac{a_2}{2}$

For the semi-leptonic decays into a charmed meson and a light meson, one has the relations as

$$\begin{aligned}
 \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ D_s^+ l^- \bar{\nu}) &= \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow K^+ D^+ l^- \bar{\nu}) \\
 &= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- D_s^+ l^- \bar{\nu}) \\
 &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \bar{K}^0 D^0 l^- \bar{\nu}) = \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow K^- D^+ l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ D^0 l^- \bar{\nu}) \\
 &= 4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 D^+ l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{K}^0 D_s^+ l^- \bar{\nu}) \\
 &= \frac{4}{3}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \eta D^+ l^- \bar{\nu}) \\
 &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 D_s^+ l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^+ D^0 l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 D^+ l^- \bar{\nu}) \\
 &= 4\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 D^0 l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- D^+ l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^- D_s^+ l^- \bar{\nu})
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{4}{3}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \eta D^0 l^- \bar{\nu}) \\
 &= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow K^0 D^0 l^- \bar{\nu}).
 \end{aligned}$$

For the semi-leptonic decays into two light mesons, one has

$$\begin{aligned}
 \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow K^+ \pi^- l^- \bar{\nu}) &= 2\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow K^0 \pi^0 l^- \bar{\nu}) \\
 &= 6\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \eta K^0 l^- \bar{\nu}) \\
 &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow K^- \pi^+ l^- \bar{\nu}) = 6\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \eta \bar{K}^0 l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ \eta l^- \bar{\nu}) \\
 &= 4\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^+ \pi^0 l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \pi^+ l^- \bar{\nu}) \\
 &= 12\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \eta K^+ l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^+ \pi^- l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 \pi^0 l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^- K^+ l^- \bar{\nu}) \\
 &= 6\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \eta \pi^0 l^- \bar{\nu}) \\
 &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \eta \eta l^- \bar{\nu})
 \end{aligned}$$

$$\begin{aligned}
&= 2\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \bar{K}^0 \pi^0 l^- \bar{\nu}) \\
&= 3\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow K^+ \bar{K}^0 l^- \bar{\nu}).
\end{aligned}$$

4.2 $b \rightarrow q\ell\bar{\nu}_\ell$: semileptonic decays into a light baryon plus a light anti-baryon

The X_{b6} tetraquark can also decay into a light baryon which is from an octet or anti-decuplet plus a light anti-baryon. Thus there are four different combinations for final states. The irreducible Hamiltonian can be constructed as follows

$$\begin{aligned}
\mathcal{H}_{eff} = & b_1(X_{b6})_{[jk]}^i(H_3)^j(T_8)_l^k(\bar{T}_8)_i^l\bar{\ell}\nu_\ell \\
& + b_2(X_{b6})_{[jk]}^i(H_3)^j(T_8)_l^i(\bar{T}_8)_i^k\bar{\ell}\nu_\ell \\
& + b_3(X_{b6})_{[jk]}^i(H_3)^l(T_8)_l^j(\bar{T}_8)_i^k\bar{\ell}\nu_\ell \\
& + b_4(X_{b6})_{[jk]}^i(H_3)^l(T_8)_i^j(\bar{T}_8)_l^k\bar{\ell}\nu_\ell \\
& + c_1(X_{b6})_{[ij],[kl]}(H_3)^i(T_8)_m^k(\bar{T}_{10})^{(jlm)}\bar{\ell}\nu_\ell \\
& - d_1(X_{b6})^{(ij)}(H_3)^k(T_{10})_{(ijl)}(\bar{T}_8)_k^l\bar{\ell}\nu_\ell \\
& - d_2(X_{b6})^{(ij)}(H_3)^k(T_{10})_{(ikl)}(\bar{T}_8)_j^l\bar{\ell}\nu_\ell \\
& + f_1(X_{b6})_{[jk]}^i(H_3)^j(T_{10})_{(ilm)}(\bar{T}_{10})^{(klm)}\bar{\ell}\nu_\ell. \quad (9)
\end{aligned}$$

The four kinds of amplitudes are given in Tables 5 and 6. We labelled the different final states as class I for an octet anti-baryon plus an octet baryon, class II for an octet anti-baryon plus a decuplet baryon, class III for an anti-decuplet anti-baryon plus an octet baryon, and class IV for an anti-decuplet anti-baryon plus a decuplet baryon. The decay amplitudes of $X_{u\bar{d}\bar{s}}^-$ in Class IV disappear. In topology level, the corresponding Feynman diagrams are shown in Fig. 1d, e. For class I, the corresponding results for the decay widths become

$$\begin{aligned}
\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow p\bar{\Sigma}^- l^- \bar{\nu}) &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^+ \bar{p} l^- \bar{\nu}) \\
&= 2\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^0 \bar{n} l^- \bar{\nu}) = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow p\bar{p} l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^+ \bar{\Sigma}^- l^- \bar{\nu}), \quad \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow p\bar{\Sigma}^+ l^- \bar{\nu}) \\
&= \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Xi}^+ l^- \bar{\nu}), \\
\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow n\bar{\Sigma}^0 l^- \bar{\nu}) &= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Xi}^+ l^- \bar{\nu}) \\
&= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow n\bar{\Sigma}^+ l^- \bar{\nu}), \\
\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Sigma}^+ l^- \bar{\nu}) &= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}^+ l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}^+ l^- \bar{\nu}) \\
&= 2\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Sigma}^0 l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Sigma}^+ l^- \bar{\nu}), \\
\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Sigma}^0 l^- \bar{\nu}) & \\
&= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Sigma}^+ l^- \bar{\nu}), \\
\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow p\bar{n} l^- \bar{\nu}) &
\end{aligned}$$

$$\begin{aligned}
&= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^0 \bar{\Xi}^0 l^- \bar{\nu}) \\
&= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^+ \bar{\Xi}^0 l^- \bar{\nu}), \\
\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Xi}^+ l^- \bar{\nu}) & \\
&= \frac{1}{2}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda^0 \bar{\Xi}^0 l^- \bar{\nu}), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Lambda}^0 l^- \bar{\nu}) \\
&= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Sigma}^0 l^- \bar{\nu}), \\
\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}^0 l^- \bar{\nu}) & \\
&= \frac{1}{2}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Sigma}^+ l^- \bar{\nu}), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow n\bar{n} l^- \bar{\nu}) \\
&= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^0 \bar{\Xi}^0 l^- \bar{\nu}), \\
\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Lambda}^0 l^- \bar{\nu}) & \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Lambda}^0 l^- \bar{\nu}), \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow p\bar{\Lambda}^0 l^- \bar{\nu}) \\
&= \frac{1}{2}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow n\bar{\Lambda}^0 l^- \bar{\nu}).
\end{aligned}$$

The relations for class II are

$$\begin{aligned}
2\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda^0 \bar{\Xi}^0 l^- \bar{\nu}) &= 6\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^0 \bar{\Xi}^0 l^- \bar{\nu}) \\
&= 3\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}^+ l^- \bar{\nu}) \\
&= 6\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow n\bar{\Sigma}^0 l^- \bar{\nu}) = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi^- \bar{\Omega}^+ l^- \bar{\nu}) \\
&= 3\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^+ \bar{\Delta}^- l^- \bar{\nu}) \\
&= \frac{3}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^0 \bar{\Delta}^0 l^- \bar{\nu}) = \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^- \bar{\Delta}^+ l^- \bar{\nu}) \\
&= 3\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Sigma}^+ l^- \bar{\nu}) \\
&= 6\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Sigma}^0 l^- \bar{\nu}) \\
&= 4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Sigma}^+ l^- \bar{\nu}) \\
&= 12\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Sigma}^0 l^- \bar{\nu}) \\
&= 12\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Sigma}^+ l^- \bar{\nu}) \\
&= 6\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow p\bar{\Delta}^0 l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow n\bar{\Delta}^+ l^- \bar{\nu}) \\
&= 6\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Xi}^+ l^- \bar{\nu}) \\
&= 4\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Xi}^+ l^- \bar{\nu}) \\
&= 6\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^+ \bar{\Xi}^0 l^- \bar{\nu}) \\
&= 12\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^0 \bar{\Xi}^+ l^- \bar{\nu}) \\
&= 12\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow p\bar{\Sigma}^0 l^- \bar{\nu}) \\
&= 6\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow n\bar{\Sigma}^+ l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi^0 \bar{\Omega}^+ l^- \bar{\nu}) \\
&= 8\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}^0 l^- \bar{\nu})
\end{aligned}$$

Table 5 Amplitudes for open bottom tetraquark X_{b6} semi-leptonic decays into a light baryon octet plus a light anti-baryon octet for class I, a light baryon octet and an anti-baryon anti-decuplet for class II

Channel	Amplitude ($/V_{ub}$)	Channel	Amplitude ($/V_{ub}$)
Class I			
$X_{ud\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{(b_3+b_4)}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow p \bar{\Sigma}^+ l^- \bar{\nu}$	$-\frac{(b_3+b_4)}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda^0 \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{(2b_1-b_2-b_3)}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^0 \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{1}{2}(b_2-b_3)$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}^+ l^- \bar{\nu}$	$-\frac{(b_2+b_4)}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow p \bar{\Sigma}^- l^- \bar{\nu}$	$-\frac{(b_1-b_3)}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Lambda}^0 l^- \bar{\nu}$	$-\frac{(b_1-2b_2-b_4)}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{1}{2}(b_1+b_4)$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Lambda^0 \bar{n} l^- \bar{\nu}$	$\frac{(b_1-2b_2+b_3)}{2\sqrt{3}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^+ \bar{p} l^- \bar{\nu}$	$\frac{(b_1-b_3)}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^0 \bar{n} l^- \bar{\nu}$	$-\frac{1}{2}(b_1-b_3)$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{(b_2+b_4)}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Lambda}^0 l^- \bar{\nu}$	$-\frac{(2b_1-b_2+b_4)}{2\sqrt{3}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{1}{2}(b_2+b_4)$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{\sqrt{6}}{12}(b_1+b_2+b_3+3b_4)$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Lambda}^0 l^- \bar{\nu}$	$\frac{(b_1+b_2-3b_3-b_4)}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{(b_1-b_2-b_3-b_4)}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Sigma}^+ l^- \bar{\nu}$	$-\frac{(b_1-b_2-b_3-b_4)}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow p \bar{n} l^- \bar{\nu}$	$\frac{1}{2}(b_2-b_3)$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{1}{2}(b_1+b_4)$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{(2b_1-b_2-b_3)}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^+ \bar{\Xi}^0 l^- \bar{\nu}$	$-\frac{1}{2}(b_2-b_3)$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^0 \bar{\Xi}^+ l^- \bar{\nu}$	$-\frac{(b_2+b_3+2b_4)}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow p \bar{\Lambda}^0 l^- \bar{\nu}$	$-\frac{(b_1-2b_2-b_4)}{2\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow p \bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{(b_1-2b_3-b_4)}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow n \bar{\Sigma}^+ l^- \bar{\nu}$	$-\frac{1}{2}(b_1+b_4)$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Lambda}^0 l^- \bar{\nu}$	$-\frac{1}{4}(b_1+b_2-b_3+b_4)$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{(b_1+b_2+b_3+3b_4)}{4\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^+ \bar{\Sigma}^- l^- \bar{\nu}$	$\frac{1}{2}(b_1-b_3)$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Lambda}^0 l^- \bar{\nu}$	$-\frac{(b_1+b_2-3b_3-b_4)}{4\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{1}{4}(b_1+b_2-b_3+b_4)$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{1}{2}(b_2+b_4)$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow p \bar{p} l^- \bar{\nu}$	$-\frac{1}{2}(b_1-b_3)$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow n \bar{n} l^- \bar{\nu}$	$-\frac{1}{2}(b_1-b_2)$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}^+ l^- \bar{\nu}$	$-\frac{1}{2}(b_2+b_4)$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^0 \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{1}{2}(b_1-b_2)$
Class II			
$X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda^0 \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{c_1}{2}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^0 \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{c_1}{\sqrt{6}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow p \bar{\Sigma}^- l^- \bar{\nu}$	$-\frac{c_1}{\sqrt{6}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{c_1}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi^- \bar{\Omega}^+ l^- \bar{\nu}$	$\frac{c_1}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^+ \bar{\Delta}^- l^- \bar{\nu}$	$-\frac{c_1}{\sqrt{6}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^0 \bar{\Delta}^0 l^- \bar{\nu}$	$\frac{c_1}{\sqrt{3}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^- \bar{\Delta}^+ l^- \bar{\nu}$	$\frac{c_1}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{c_1}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{c_1}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{6}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Sigma}^+ l^- \bar{\nu}$	$-\frac{c_1}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow p \bar{\Delta}^0 l^- \bar{\nu}$	$-\frac{c_1}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow n \bar{\Delta}^+ l^- \bar{\nu}$	$-\frac{1}{2}c_1$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Xi}^+ l^- \bar{\nu}$	$-\frac{c_1}{2\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^+ \bar{\Xi}^0 l^- \bar{\nu}$	$-\frac{c_1}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^0 \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow p \bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow n \bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi^0 \bar{\Omega}^+ l^- \bar{\nu}$	$-\frac{1}{2}c_1$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{1}{4}c_1$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^+ \bar{\Sigma}^- l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{1}{4}\sqrt{3}c_1$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Sigma}^+ l^- \bar{\nu}$	$-\frac{c_1}{\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow p \bar{\Delta}^- l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow n \bar{\Delta}^0 l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}^+ l^- \bar{\nu}$	$-\frac{c_1}{\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^0 \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{3}}$		

Table 6 Amplitudes for open bottom tetraquark X_{b6} semi-leptonic decays into a light baryon decuplet and an anti-baryon octet for class III, a light baryon decuplet and an anti-baryon anti-decuplet for class IV

Channel	Amplitude ($/V_{ub}$)	Channel	Amplitude ($/V_{ub}$)
Class III			
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++}\bar{\Lambda}^0 l^- \bar{\nu}$	$\frac{(d_1+d_2)}{2\sqrt{3}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++}\bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{1}{2}(d_1+d_2)$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^+\bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{(d_1+d_2)}{\sqrt{6}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^+\bar{\Xi}^+ l^- \bar{\nu}$	$\frac{(d_1+d_2)}{\sqrt{6}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^+\bar{\Sigma}^- l^- \bar{\nu}$	$\frac{d_2}{\sqrt{6}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0\bar{\Lambda}^0 l^- \bar{\nu}$	$\frac{1}{6}(d_1+d_2)$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0\bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{(d_1-d_2)}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^-\bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{d_1}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^0\bar{\Xi}^0 l^- \bar{\nu}$	$\frac{d_2}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^-\bar{\Xi}^+ l^- \bar{\nu}$	$\frac{d_1}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^+\bar{p} l^- \bar{\nu}$	$\frac{d_2}{\sqrt{6}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^0\bar{n} l^- \bar{\nu}$	$\frac{d_2}{2\sqrt{3}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0\bar{\Lambda}^0 l^- \bar{\nu}$	$\frac{1}{6}(d_1-2d_2)$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0\bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{d_1}{2\sqrt{3}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^-\bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{d_1}{\sqrt{6}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^-\bar{\Xi}^+ l^- \bar{\nu}$	$\frac{d_1}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^{++}\bar{p} l^- \bar{\nu}$	$\frac{d_2}{2}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^+\bar{n} l^- \bar{\nu}$	$\frac{d_2}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+\bar{\Lambda}^0 l^- \bar{\nu}$	$\frac{(2d_1-d_2)}{6\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+\bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{(2d_1+d_2)}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0\bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{(2d_1+d_2)}{2\sqrt{6}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^0\bar{\Xi}^+ l^- \bar{\nu}$	$\frac{(2d_1+d_2)}{2\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^{++}\bar{\Sigma}^- l^- \bar{\nu}$	$\frac{d_2}{2}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+\bar{\Lambda}^0 l^- \bar{\nu}$	$\frac{(d_1+d_2)}{3\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+\bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{d_1}{\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0\bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{(2d_1+d_2)}{2\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^+\bar{\Xi}^0 l^- \bar{\nu}$	$\frac{d_2}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^0\bar{\Xi}^+ l^- \bar{\nu}$	$\frac{(2d_1+d_2)}{2\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^+\bar{p} l^- \bar{\nu}$	$\frac{d_2}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^0\bar{n} l^- \bar{\nu}$	$\frac{d_2}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^+\bar{\Sigma}^- l^- \bar{\nu}$	$\frac{d_2}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^0\bar{\Lambda}^0 l^- \bar{\nu}$	$\frac{1}{12}(2d_1-d_2)$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^0\bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{(2d_1-d_2)}{4\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^-\bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{d_1}{\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^0\bar{\Xi}^0 l^- \bar{\nu}$	$\frac{d_2}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^-\bar{\Xi}^+ l^- \bar{\nu}$	$\frac{d_1}{\sqrt{3}}$
Class IV			
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^+\bar{\Sigma}'^- l^- \bar{\nu}$	$-\frac{f_1}{3\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0\bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{1}{3}f_1$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^-\bar{\Sigma}'^+ l^- \bar{\nu}$	$-\frac{f_1}{\sqrt{6}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^0\bar{\Xi}^0 l^- \bar{\nu}$	$-\frac{1}{3}f_1$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^-\bar{\Xi}'^+ l^- \bar{\nu}$	$-\frac{1}{3}\sqrt{2}f_1$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi'^-\bar{\Omega}^+ l^- \bar{\nu}$	$-\frac{f_1}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^+\bar{\Delta}^- l^- \bar{\nu}$	$\frac{f_1}{3\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^0\bar{\Delta}^0 l^- \bar{\nu}$	$\frac{f_1}{3}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^-\bar{\Delta}^+ l^- \bar{\nu}$	$\frac{f_1}{\sqrt{6}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0\bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{f_1}{3}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^-\bar{\Sigma}'^+ l^- \bar{\nu}$	$\frac{1}{3}\sqrt{2}f_1$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^-\bar{\Xi}'^+ l^- \bar{\nu}$	$\frac{f_1}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^{++}\bar{\Delta}^- l^- \bar{\nu}$	$\frac{f_1}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^+\bar{\Delta}^0 l^- \bar{\nu}$	$\frac{f_1}{3}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^0\bar{\Delta}^+ l^- \bar{\nu}$	$\frac{f_1}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+\bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{f_1}{3\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0\bar{\Sigma}'^+ l^- \bar{\nu}$	$\frac{f_1}{3\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^0\bar{\Xi}'^+ l^- \bar{\nu}$	$\frac{f_1}{6}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^{++}\bar{\Sigma}'^- l^- \bar{\nu}$	$-\frac{f_1}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+\bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{f_1}{3\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0\bar{\Sigma}'^+ l^- \bar{\nu}$	$-\frac{1}{6}f_1$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^+\bar{\Xi}^0 l^- \bar{\nu}$	$-\frac{1}{3}f_1$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^0\bar{\Xi}'^+ l^- \bar{\nu}$	$-\frac{f_1}{3\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi'^0\bar{\Omega}^+ l^- \bar{\nu}$	$-\frac{f_1}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^+\bar{\Delta}^- l^- \bar{\nu}$	$\frac{f_1}{6}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^0\bar{\Delta}^0 l^- \bar{\nu}$	$\frac{f_1}{3}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^-\bar{\Delta}^+ l^- \bar{\nu}$	$\frac{f_1}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^+\bar{\Sigma}'^- l^- \bar{\nu}$	$-\frac{1}{6}f_1$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^-\bar{\Sigma}'^+ l^- \bar{\nu}$	$\frac{f_1}{6}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^0\bar{\Xi}^0 l^- \bar{\nu}$	$-\frac{1}{3}f_1$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^-\bar{\Xi}'^+ l^- \bar{\nu}$	$-\frac{1}{6}f_1$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega^-\bar{\Omega}^+ l^- \bar{\nu}$	$-\frac{1}{2}f_1$

$$\begin{aligned}
&= 6\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^+ \bar{\Sigma}'^- l^- \bar{\nu}) \\
&= \frac{8}{3}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Sigma}'^0 l^- \bar{\nu}) \\
&= \frac{3}{2}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Sigma}'^+ l^- \bar{\nu}) \\
&= 6\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow p \bar{\Delta}^- l^- \bar{\nu}) \\
&= 6\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow n \bar{\Delta}^0 l^- \bar{\nu}) \\
&= \frac{3}{2}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}'^+ l^- \bar{\nu}) \\
&= 6\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^0 \bar{\Xi}'^0 l^- \bar{\nu}) \\
&= 3\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow p \bar{\Sigma}'^- l^- \bar{\nu}).
\end{aligned}$$

For class III, the relations are

$$\begin{aligned}
\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++} \bar{\Lambda}^0 l^- \bar{\nu}) &= \frac{1}{3}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++} \bar{\Sigma}^0 l^- \bar{\nu}) \\
&= \frac{1}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^+ \bar{\Sigma}^+ l^- \bar{\nu}) \\
&= \frac{1}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^+ \bar{\Xi}^+ l^- \bar{\nu}) = 3\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0 \bar{\Lambda}^0 l^- \bar{\nu}) \\
&= \frac{3}{2}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Lambda}^0 l^- \bar{\nu}), \\
\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^+ \bar{\Sigma}^- l^- \bar{\nu}) &= 2\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Xi}^0 l^- \bar{\nu}) \\
&= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^+ \bar{p} l^- \bar{\nu}) \\
&= 2\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^0 \bar{n} l^- \bar{\nu}) \\
&= \frac{2}{3}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^{++} \bar{p} l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^+ \bar{n} l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^+ \bar{\Xi}^0 l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^+ \bar{p} l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^0 \bar{n} l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^0 \bar{\Xi}^0 l^- \bar{\nu}) \\
&= \frac{2}{3}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^{++} \bar{\Sigma}^- l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^+ \bar{\Sigma}^- l^- \bar{\nu}), \\
\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^- \bar{\Sigma}^+ l^- \bar{\nu}) &= 3\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^- \bar{\Xi}^+ l^- \bar{\nu}) \\
&= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^- \bar{\Xi}^+ l^- \bar{\nu}) \\
&= \frac{3}{2}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^- \bar{\Xi}^+ l^- \bar{\nu}) \\
&= 6\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0 \bar{\Sigma}^0 l^- \bar{\nu}) \\
&= 3\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^- \bar{\Sigma}^+ l^- \bar{\nu}) \\
&= \frac{3}{2}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^- \bar{\Sigma}^+ l^- \bar{\nu}) \\
&= 3\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Sigma}^0 l^- \bar{\nu}),
\end{aligned}$$

$$\begin{aligned}
\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+ \bar{\Lambda}^0 l^- \bar{\nu}) &= \frac{2}{3}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Sigma}^0 l^- \bar{\nu}) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Lambda}^0 l^- \bar{\nu}), \\
\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+ \bar{\Sigma}^0 l^- \bar{\nu}) &= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0 \bar{\Sigma}^+ l^- \bar{\nu}) \\
&= \frac{1}{2}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^0 \bar{\Xi}^+ l^- \bar{\nu}) \\
&= \frac{1}{2}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0 \bar{\Sigma}^+ l^- \bar{\nu}) \\
&= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^0 \bar{\Xi}^+ l^- \bar{\nu}).
\end{aligned}$$

For class IV, the relations become

$$\begin{aligned}
\frac{9}{2}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^+ \bar{\Sigma}'^- l^- \bar{\nu}) &= \frac{9}{4}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0 \bar{\Sigma}'^0 l^- \bar{\nu}) \\
&= \frac{3}{2}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^- \bar{\Sigma}'^+ l^- \bar{\nu}) = \frac{9}{4}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Xi}'^0 l^- \bar{\nu}) \\
&= \frac{9}{8}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^- \bar{\Xi}'^+ l^- \bar{\nu}) = \frac{3}{2}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi'^- \bar{\Omega}^+ l^- \bar{\nu}) \\
&= \frac{9}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^+ \bar{\Delta}^- l^- \bar{\nu}) = \frac{9}{4}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^0 \bar{\Delta}^0 l^- \bar{\nu}) \\
&= \frac{3}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^- \bar{\Delta}^+ l^- \bar{\nu}) = \frac{9}{4}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0 \bar{\Sigma}'^0 l^- \bar{\nu}) \\
&= \frac{9}{8}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^- \bar{\Sigma}'^+ l^- \bar{\nu}) = \frac{3}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^- \bar{\Xi}'^+ l^- \bar{\nu}) \\
&= 3\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^{++} \bar{\Delta}^- l^- \bar{\nu}) = \frac{9}{4}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^+ \bar{\Delta}^0 l^- \bar{\nu}) \\
&= 3\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^0 \bar{\Delta}^+ l^- \bar{\nu}) = \frac{9}{2}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+ \bar{\Sigma}'^0 l^- \bar{\nu}) \\
&= \frac{9}{2}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0 \bar{\Sigma}'^+ l^- \bar{\nu}) = 9\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^0 \bar{\Xi}'^+ l^- \bar{\nu}) \\
&= 3\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^{++} \bar{\Sigma}'^- l^- \bar{\nu}) = \frac{9}{2}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Sigma}'^0 l^- \bar{\nu}) \\
&= 9\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0 \bar{\Sigma}'^+ l^- \bar{\nu}) = \frac{9}{4}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^+ \bar{\Xi}'^0 l^- \bar{\nu}) \\
&= \frac{9}{2}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^0 \bar{\Xi}'^+ l^- \bar{\nu}) = 3\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi'^0 \bar{\Omega}^+ l^- \bar{\nu}) \\
&= 9\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^+ \bar{\Delta}^- l^- \bar{\nu}) = \frac{9}{4}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^0 \bar{\Delta}^0 l^- \bar{\nu}) \\
&= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^- \bar{\Delta}^+ l^- \bar{\nu}) = 9\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^+ \bar{\Sigma}'^- l^- \bar{\nu}) \\
&= 9\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^- \bar{\Sigma}'^+ l^- \bar{\nu}) = \frac{9}{4}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^0 \bar{\Xi}'^0 l^- \bar{\nu}) \\
&= 9\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^- \bar{\Xi}'^+ l^- \bar{\nu}) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega^- \bar{\Omega}^+ l^- \bar{\nu}).
\end{aligned}$$

4.3 $b \rightarrow c\ell\bar{\nu}_\ell$: semi-leptonic decays into a charmed baryon plus a light anti-baryon

$b \rightarrow c\ell\bar{\nu}_\ell$ transition belongs to the SU(3) flavor singlet. X_{b6} can decay into a light anti-baryon and a charmed anti-triplet or sextet baryon. According to the symmetry of indexes, the processes with the final states of light anti-decuplet anti-baryon are not allowed. Therefore the effective Hamiltonian is written as

$$\mathcal{H}_{eff} = -b_1(X_{b6})^{[ij]}(T_{c\bar{3}})_{[il]}(\bar{T}_8)_j^l \bar{\ell}\nu_\ell$$

$$-c_1(X_{b6})^{[ij]}(T_{c6})_{[il]}(\bar{T}_8)_j\bar{\ell}\nu_\ell. \quad (10)$$

The amplitudes for different channels are given in Table 7 for a charmed anti-triplet baryon plus an octet anti-baryon and a charmed sextet baryon plus an octet anti-baryon. We plotted the Feynman diagram in Fig. 1d.

The relations of decay widths for class I are

$$\begin{aligned} \Gamma(X_{ud\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Sigma}^+ l^- \bar{\nu}) &= \Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Sigma}^+ l^- \bar{\nu}) \\ &= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda_c^+ \bar{\Sigma}^- l^- \bar{\nu}) \\ &= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^0 l^- \bar{\nu}) \\ &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^+ \bar{p} l^- \bar{\nu}) = \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{n} l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda_c^+ \bar{n} l^- \bar{\nu}) \\ &= \frac{4}{3}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Lambda}^0 l^- \bar{\nu}) \\ &= 4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^0 l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^+ l^- \bar{\nu}) \\ &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Sigma}^0 l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^0 l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^+ l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda_c^+ \bar{p} l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^+ \bar{\Sigma}^- l^- \bar{\nu}) \\ &= \frac{4}{3}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Lambda}^0 l^- \bar{\nu}) \\ &= 4\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^0 l^- \bar{\nu}). \end{aligned}$$

The relations of decay widths for class II are

$$\begin{aligned} 3\Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Lambda}^0 l^- \bar{\nu}) &= \Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Sigma}^0 l^- \bar{\nu}) \\ &= \Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Sigma}^+ l^- \bar{\nu}) = \Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi_c'^+ \bar{\Sigma}^+ l^- \bar{\nu}) \\ &= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^+ \bar{\Sigma}^- l^- \bar{\nu}) = 3\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Lambda}^0 l^- \bar{\nu}) \\ &= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Sigma}^0 l^- \bar{\nu}) = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c'^0 \bar{\Sigma}^0 l^- \bar{\nu}) \\ &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c'^+ \bar{p} l^- \bar{\nu}) = \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c'^0 \bar{n} l^- \bar{\nu}) \\ &= \frac{3}{4}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c^0 \bar{\Lambda}^0 l^- \bar{\nu}) = \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^{++} \bar{p} l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^+ \bar{n} l^- \bar{\nu}) = 12\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Lambda}^0 l^- \bar{\nu}) \\ &= 4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^0 l^- \bar{\nu}) = 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^+ l^- \bar{\nu}) \\ &= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Sigma}^+ l^- \bar{\nu}) = \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^{++} \bar{\Sigma}^- l^- \bar{\nu}) \\ &= 3\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Lambda}^0 l^- \bar{\nu}) = \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Sigma}^+ l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^0 l^- \bar{\nu}) = 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^+ l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^+ \bar{p} l^- \bar{\nu}) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^0 \bar{n} l^- \bar{\nu}) \\ &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c'^+ \bar{\Sigma}^- l^- \bar{\nu}) = 12\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c'^0 \bar{\Lambda}^0 l^- \bar{\nu}) \\ &= 4\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c'^0 \bar{\Sigma}^0 l^- \bar{\nu}) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega_c^0 \bar{\Sigma}^0 l^- \bar{\nu}). \end{aligned}$$

5 Non-leptonic X_{b6} decays

In quark-level transitions, the bottom quark non-leptonic weak decays can be divided into four different kinds

$$b \rightarrow c\bar{c}d/s, \quad b \rightarrow c\bar{u}d/s, \quad b \rightarrow u\bar{c}d/s, \quad b \rightarrow q_1\bar{q}_2q_3, \quad (11)$$

where $q_{1,2,3}$ represent the light quark. For these four kinds of transitions, the weak effective Hamiltonian $\mathcal{H}_{eff}$ are given separately

$$\begin{aligned} \mathcal{H}_{eff} &= \frac{G_F}{\sqrt{2}} V_{cb} V_{cq}^* [C_1 O_1^{\bar{c}c} + C_2 O_2^{\bar{c}c}] + \text{h.c.}, \\ \mathcal{H}_{eff} &= \frac{G_F}{\sqrt{2}} V_{cb} V_{uq}^* [C_1 O_1^{\bar{c}u} + C_2 O_2^{\bar{c}u}] + \text{h.c.}, \\ \mathcal{H}_{eff} &= \frac{G_F}{\sqrt{2}} V_{ub} V_{cq}^* [C_1 O_1^{\bar{u}c} + C_2 O_2^{\bar{u}c}] + \text{h.c.}, \\ \mathcal{H}_{eff} &= \frac{G_F}{\sqrt{2}} \left\{ V_{ub} V_{uq}^* [C_1 O_1^{\bar{u}u} + C_2 O_2^{\bar{u}u}] \right. \\ &\quad \left. - V_{tb} V_{tq}^* \left[\sum_{i=3}^{10} C_i O_i \right] \right\} + \text{h.c.} \end{aligned} \quad (12)$$

where O_i is the four-quark effective operators and C_i is the Wilson short-distance coefficient. O_1, O_2 are tree level operators while $O_3 - O_{10}$ are called as penguin operators. In hadron level, it is easily to discuss the X_{b6} non-leptonic decay modes when writing down the effective Hamiltonian using the SU(3) flavor symmetry.

5.1 $b \rightarrow c\bar{c}d/s$ transition

5.1.1 Two-body decays into mesons

The $b \rightarrow c\bar{c}d/s$ transition leads to form a SU(3) triplet operator. For X_{b6} decays to two mesons, the effective Hamiltonian is constructed as

$$\mathcal{H}_{eff} = a_1 (X_{b6})_{[jk]}^i (H_3)^j M_i^k J/\psi + a_2 (X_{b6})_{[jk]}^i (H_3)^j (\bar{D})^k D_i, \quad (13)$$

where $(H_3)_2 = -(H_3)^{13} = (H_3)^{31} = V_{cd}^*$ and $(H_3)_3 = (H_3)^{12} = -(H_3)^{21} = V_{cs}^*$. The amplitudes for the decays to the J/ψ plus a light meson are given in Table 8. The amplitudes for the decays to the charmed meson plus an anti-charmed meson are given in Table 9. The corresponding Feynman diagrams are given in Fig. 2a, b, which are denoted as the W-exchange processes.

The relations for decay widths are given as respectively

$$\begin{aligned} \Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^+ J/\psi) &= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- J/\psi) \\ &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{K}^0 J/\psi) \\ &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 J/\psi) \end{aligned}$$

Table 7 Amplitudes for open bottom tetraquark X_{b6} semi-leptonic decays into a charmed baryon anti-triplet and an anti-baryon octet for class I, a charmed baryon sextet and an anti-baryon octet for class II

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
Class I			
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{b_1}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{b_1}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda_c^+ \bar{\Sigma}^- l^- \bar{\nu}$	$-\frac{b_1}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{b_1}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^+ \bar{p} l^- \bar{\nu}$	$-\frac{b_1}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{n} l^- \bar{\nu}$	$-\frac{b_1}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda_c^+ \bar{n} l^- \bar{\nu}$	$\frac{b_1}{2}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Lambda}^0 l^- \bar{\nu}$	$-\frac{1}{2}\sqrt{\frac{3}{2}}b_1$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{b_1}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^+ l^- \bar{\nu}$	$-\frac{b_1}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Xi}^0 l^- \bar{\nu}$	$-\frac{b_1}{\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{b_1}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{b_1}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda_c^+ \bar{p} l^- \bar{\nu}$	$-\frac{b_1}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^+ \bar{\Sigma}^- l^- \bar{\nu}$	$-\frac{b_1}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Lambda}^0 l^- \bar{\nu}$	$-\frac{1}{2}\sqrt{\frac{3}{2}}b_1$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{b_1}{2\sqrt{2}}$		
Class II			
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Lambda}^0 l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{3}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{c_1}{2}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{c_1}{2}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c'^+ \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{c_1}{2}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^+ \bar{\Sigma}^- l^- \bar{\nu}$	$\frac{c_1}{2}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Lambda}^0 l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{c_1}{2}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c'^0 \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{c_1}{2}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c'^+ \bar{p} l^- \bar{\nu}$	$\frac{c_1}{2}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c'^0 \bar{n} l^- \bar{\nu}$	$\frac{c_1}{2}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c^0 \bar{\Lambda}^0 l^- \bar{\nu}$	$-\frac{c_1}{\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^{++} \bar{p} l^- \bar{\nu}$	$\frac{c_1}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^+ \bar{n} l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c'^+ \bar{\Lambda}^0 l^- \bar{\nu}$	$-\frac{c_1}{4\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c'^+ \bar{\Sigma}^0 l^- \bar{\nu}$	$\frac{c_1}{4}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c'^0 \bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{c_1}{2}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^{++} \bar{\Sigma}^- l^- \bar{\nu}$	$\frac{c_1}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Lambda}^0 l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Sigma}^+ l^- \bar{\nu}$	$\frac{c_1}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c'^+ \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c'^0 \bar{\Xi}^+ l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^+ \bar{p} l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^0 \bar{n} l^- \bar{\nu}$	$\frac{c_1}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c'^+ \bar{\Sigma}^- l^- \bar{\nu}$	$\frac{c_1}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c'^0 \bar{\Lambda}^0 l^- \bar{\nu}$	$-\frac{c_1}{4\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c'^0 \bar{\Sigma}^0 l^- \bar{\nu}$	$-\frac{c_1}{4}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega_c^0 \bar{\Xi}^0 l^- \bar{\nu}$	$\frac{c_1}{2}$

Table 8 Open bottom tetraquark X_{b6} decays into J/ψ and a light meson

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ J/\psi$	$-\frac{a_1 V_{cs}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow K^+ J/\psi$	$\frac{a_1 V_{cd}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- J/\psi$	$\frac{a_1 V_{cs}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow K^- J/\psi$	$-\frac{a_1 V_{cd}^*}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 J/\psi$	$-\frac{a_1 V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{K}^0 J/\psi$	$-\frac{1}{2}a_1 V_{cs}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \eta J/\psi$	$-\frac{1}{2}\sqrt{\frac{3}{2}}a_1 V_{cd}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 J/\psi$	$\frac{a_1 V_{cs}^*}{\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 J/\psi$	$\frac{1}{2}a_1 V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- J/\psi$	$-\frac{1}{2}a_1 V_{cd}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^- J/\psi$	$\frac{1}{2}a_1 V_{cs}^*$		

Table 9 Open bottom tetraquark X_{b6} decays into a charmed meson and an anti-charmed meson

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
$X_{u\bar{d}\bar{s}}^+ \rightarrow D^+\bar{D}^0$	$-\frac{a_2 V_{cs}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+\bar{D}^0$	$\frac{a_2 V_{cd}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^0 D^-$	$\frac{a_2 V_{cs}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D^0 D_s^-$	$-\frac{a_2 V_{cd}^*}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0\bar{D}^0$	$-\frac{1}{2}a_2 V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ D_s^-$	$-\frac{1}{2}a_2 V_{cs}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+ D_s^-$	$\frac{1}{2}a_2 V_{cd}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0\bar{D}^0$	$\frac{1}{2}a_2 V_{cs}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ D^-$	$-\frac{1}{2}a_2 V_{cs}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ D^-$	$\frac{1}{2}a_2 V_{cd}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 D^-$	$-\frac{1}{2}a_2 V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 D_s^-$	$\frac{1}{2}a_2 V_{cs}^*$

Fig. 2 Feynman diagrams for nonleptonic decays of open-flavor bottom tetraquark. **a, b** Represent the decays into two mesons in the final states. In **e–j**, the final states include three mesons. **c, d** Denote the process of baryonic states

$$\begin{aligned}
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^- J/\psi), \\
\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow K^+ J/\psi) &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow K^- J/\psi) \\
&= \frac{4}{3}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \eta J/\psi) \\
&= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 J/\psi) \\
&= 4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 J/\psi) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- J/\psi), \\
\frac{\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ J/\psi)}{\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow K^+ J/\psi)} &= \frac{|V_{cs}|^2}{|V_{cd}|^2}, \\
&= \frac{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ D^-)}{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ D^-)} \\
&= \frac{2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 D_s^-)}{2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 D^-)} \\
&= \frac{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0\bar{D}^0)}{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0\bar{D}^0)} = \frac{|V_{cs}|^2}{|V_{cd}|^2}.
\end{aligned}$$

and

$$\begin{aligned}
&\frac{\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+\bar{D}^0)}{\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+\bar{D}^0)} \\
&= \frac{\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^0 D^-)}{\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^0 D_s^-)} = \frac{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ D_s^-)}{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+ D_s^-)}
\end{aligned}$$

5.1.2 Two-body decays into a charmed baryon and an anti-charmed anti-baryon

The transition $b \rightarrow c\bar{c}d/s$ can also produce a charmed baryon and an anti-charmed anti-baryon. Charmed baryons can be an anti-triplet or a sextet, while the anti-charmed anti-baryons can form the triplet or anti-sextet baryons. The effective Hamiltonian in hadron level is constructed as

$$\mathcal{H}_{eff} = b_1(X_{b6})^{[ij]}(H_3)_{[ik]}(T_{c\bar{3}})_{[jl]}(T_{\bar{c}3})^{[kl]}$$

$$\begin{aligned}
& + c_1 (X_{b6})_{[jk]}^i (H_3)^j (T_{c6})_{[il]} (T_{\bar{c}3})^{[kl]} \\
& + c_2 (X_{b6})_{[jk]}^i (H_3)^j (T_{c6})_{[il]} (T_{\bar{c}3})^{[jk]} \\
& + d_1 (X_{b6})_{[jk]}^i (H_3)^j (T_{\bar{c}3})_{[il]} (T_{\bar{c}6})^{[kl]} \\
& + f_1 (X_{b6})_{[jk]}^i (H_3)^j (T_{c6})_{[il]} (T_{\bar{c}6})^{[kl]}. \quad (14)
\end{aligned}$$

We listed the decay amplitudes in Tables 10 and 11, which represent anti-triplet charmed baryon plus the triplet anti-charmed anti-baryon, sextet charmed baryon plus the triplet anti-charmed anti-baryon, anti-triplet charmed baryon plus the anti-sextet anti-charmed anti-baryon, sextet charmed baryon plus the anti-sextet anti-charmed anti-baryon, respectively. The corresponding topologies are given in Fig. 2c, d.

The relations of decay widths for class I are

$$\begin{aligned}
\frac{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Xi}_c^0)}{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}_c^0)} &= \frac{\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Lambda}_c^-)}{\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-)} \\
&= \frac{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda_c^+ \bar{\Lambda}_c^-)}{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Lambda}_c^-)} \\
&= \frac{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0)}{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^-)} \\
&= \frac{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Xi}_c^-)}{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0)} \\
&= \frac{2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-)}{2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Lambda}_c^-)} = \frac{|V_{cd}|^2}{|V_{cs}|^2}.
\end{aligned}$$

The relations of decay widths for class II are

$$\begin{aligned}
\frac{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Xi}_c^0)}{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}_c^0)} &= \frac{\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Lambda}_c^-)}{\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-)} \\
&= \frac{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^+ \bar{\Lambda}_c^-)}{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0)} = \frac{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0)}{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^-)} \\
&= \frac{\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Lambda}_c^-)}{\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Xi}_c^0)} = \frac{\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Xi}_c^-)}{\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega_c^0 \bar{\Xi}_c^-)} \\
&= \frac{|V_{cd}|^2}{|V_{cs}|^2}, \\
\frac{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Xi}_c^-)}{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Lambda}_c^-)} &= \frac{\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c^0 \bar{\Xi}_c^-)}{\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Lambda}_c^-)} \\
&= \frac{\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^-)}{\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Lambda}_c^-)} = \frac{|V_{cd}|^2}{|V_{cs}|^2}, \\
\frac{\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Xi}_c^-)}{\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Lambda}_c^-)} &= \frac{\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-)}{\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Lambda}_c^-)}
\end{aligned}$$

$$= \frac{|V_{cd}|^2}{|V_{cs}|^2},$$

$$\frac{\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Xi}_c^-)}{\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c^0 \bar{\Lambda}_c^-)} = \frac{|V_{cd}|^2}{|V_{cs}|^2}.$$

For class III, the relations of decay widths are

$$\begin{aligned}
\frac{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Omega}_c^0)}{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Xi}_c^0)} &= \frac{\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^+ \bar{\Sigma}_c^-)}{\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda_c^+ \bar{\Sigma}_c^-)} \\
&= \frac{\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^-)}{\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Xi}_c^-)} = \frac{2\Gamma(X_{ud\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Xi}_c^0)}{2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^+ \bar{\Sigma}_c^-)} \\
&= \frac{2\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-)}{2\Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}_c^0)} = \frac{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Omega}_c^0)}{2\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-)} \\
&= \frac{2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda_c^+ \bar{\Sigma}_c^-)}{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}_c^-)} = \frac{4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda_c^+ \bar{\Xi}_c^-)}{4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}_c^-)} \\
&= \frac{4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0)}{4\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^-)} = \frac{4\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Xi}_c^-)}{4\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0)} \\
&= \frac{4\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-)}{4\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}_c^-)} = \frac{|V_{cd}|^2}{|V_{cs}|^2}.
\end{aligned}$$

For class IV, the relations of decay widths are

$$\begin{aligned}
\frac{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Sigma}_c^-)}{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Xi}_c^-)} &= \frac{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Xi}_c^0)}{\Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}_c^0)} \\
&= \frac{\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^+ \bar{\Sigma}_c^-)}{\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^+ \bar{\Sigma}_c^-)} = \frac{\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Sigma}_c^-)}{\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c^0 \bar{\Xi}_c^-)} \\
&= \frac{\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^{++} \bar{\Sigma}_c^-)}{\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^{++} \bar{\Xi}_c^-)} = \frac{\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Xi}_c^-)}{\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Omega}_c^0)} \\
&= \frac{2\Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}_c^0)}{2\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-)} = \frac{2\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-)}{2\Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Xi}_c^0)} \\
&= \frac{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0)}{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Xi}_c^-)} = \frac{2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Xi}_c^-)}{2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Omega}_c^0)} \\
&= \frac{2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^+ \bar{\Sigma}_c^-)}{2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^+ \bar{\Xi}_c^-)} = \frac{2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega_c^0 \bar{\Xi}_c^-)}{2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Xi}_c^-)} \\
&= \frac{4\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-)}{4\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^-)} = \frac{4\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^-)}{4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0)} \\
&= \frac{|V_{cs}|^2}{|V_{cd}|^2}.
\end{aligned}$$

Table 10 Open bottom tetraquark X_{b6} decays into a charmed baryon anti-triplet and an anti-charmed anti-baryon triplet for class I, a charmed baryon sextet and an anti-charmed anti-baryon triplet for class II

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
Class I			
$X_{ud\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Xi}_c^0$	$-\frac{b_1 V_{cd}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}_c^0$	$-\frac{b_1 V_{cs}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-$	$\frac{b_1 V_{cs}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Lambda}_c^-$	$\frac{b_1 V_{cd}^*}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda_c^+ \bar{\Lambda}_c^-$	$-\frac{1}{2} b_1 V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Lambda}_c^-$	$-\frac{1}{2} b_1 V_{cs}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0$	$\frac{1}{2} b_1 V_{cd}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Xi}_c^-$	$\frac{1}{2} b_1 V_{cd}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^-$	$\frac{1}{2} b_1 V_{cs}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0$	$-\frac{1}{2} b_1 V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Lambda}_c^-$	$-\frac{1}{2} b_1 V_{cs}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-$	$-\frac{1}{2} b_1 V_{cd}^*$
Class II			
$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Lambda}_c^-$	$\frac{c_1 V_{cs}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Xi}_c^-$	$-\frac{c_1 V_{cd}^*}{\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Xi}_c^0$	$-\frac{1}{2} (c_1 - 2c_2) V_{cd}^*$	$X_{ud\bar{s}}^+ \rightarrow \Xi_c^{'+} \bar{\Xi}_c^0$	$-\frac{1}{2} (c_1 - 2c_2) V_{cs}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Lambda}_c^-$	$\frac{c_1 V_{cs}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Xi}_c^-$	$-\sqrt{2} c_2 V_{cd}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-$	$\frac{1}{2} (c_1 - 2c_2) V_{cs}^*$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Lambda}_c^-$	$-\frac{1}{2} (c_1 - 2c_2) V_{cd}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c^0 \bar{\Lambda}_c^-$	$\sqrt{2} c_2 V_{cs}^*$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c^0 \bar{\Xi}_c^-$	$-\frac{c_1 V_{cd}^*}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^+ \bar{\Lambda}_c^-$	$-\frac{(c_1 - 2c_2) V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^{'+} \bar{\Lambda}_c^-$	$\frac{(c_1 + 2c_2) V_{cs}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^{'+} \bar{\Xi}_c^-$	$-\frac{c_1 V_{cd}^*}{\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0$	$-\frac{(c_1 - 2c_2) V_{cd}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Xi}_c^-$	$-\frac{1}{2} (c_1 - 2c_2) V_{cs}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Lambda}_c^-$	$\frac{c_1 V_{cs}^*}{\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Xi}_c^-$	$-\frac{(c_1 + 2c_2) V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Xi}_c^0$	$-\frac{1}{2} (c_1 - 2c_2) V_{cd}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^{'+} \bar{\Xi}_c^-$	$\frac{(c_1 - 2c_2) V_{cs}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0$	$-\frac{(c_1 - 2c_2) V_{cs}^*}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Lambda}_c^-$	$-\frac{1}{2} (c_1 - 2c_2) V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Lambda}_c^-$	$\frac{(c_1 + 2c_2) V_{cs}^*}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^-$	$-\frac{(c_1 + 2c_2) V_{cd}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega_c^0 \bar{\Xi}_c^-$	$\frac{1}{2} (c_1 - 2c_2) V_{cs}^*$

5.1.3 Three-body decays into mesons

The $b \rightarrow c\bar{c}d/s$ transition can also lead to three-body meson decays in which the effective Hamiltonian in hadron level is

$$\begin{aligned}
 \mathcal{H}_{eff} = & a_1 (X_{b6})^{[ij]} (H_3)_{[il]} M_j^k M_l^j J/\psi \\
 & + a_2 (X_{b6})_{[jk]}^i (H_3)^j M_i^k D_l (\bar{D})^l \\
 & + a_3 (X_{b6})_{[jk]}^i (H_3)^j M_i^l D_l (\bar{D})^k \\
 & + a_4 (X_{b6})_{[jk]}^i (H_3)^l M_i^j D_l (\bar{D})^k \\
 & + a_5 (X_{b6})_{[jk]}^i (H_3)^j M_l^k D_i (\bar{D})^l \\
 & + a_6 (X_{b6})_{[jk]}^i (H_3)^l M_l^j D_i (\bar{D})^k. \quad (15)
 \end{aligned}$$

The Feynman diagrams are shown in Fig. 2e–j. It should be noted that the diagram in Fig. 2e can lead to the process $X_{s\bar{u}\bar{d}} \rightarrow \bar{K}^0 K^- J/\psi$. However, the total amplitude of the process vanishes for the antisymmetric lower indexes in X_{b6} . The decay amplitudes of X_{b6} decays to J/ψ and two light mesons are given in Table 12, while the amplitudes of X_{b6}

decays to an anti-charmed meson plus a charmed meson and a light meson are given in Table 13. From them, we obtain the results for these decay widths

$$\begin{aligned}
 \Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^+ K^0 J/\psi) &= 2\Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^0 K^+ J/\psi) \\
 &= 6\Gamma(X_{ud\bar{s}}^+ \rightarrow K^+ \eta J/\psi) = 2\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \pi^0 K^- J/\psi) \\
 &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \pi^- \bar{K}^0 J/\psi) = 6\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow K^- \eta J/\psi) \\
 &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ \pi^- J/\psi) = \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \pi^0 J/\psi) \\
 &= 6\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \eta J/\psi) = 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow K^0 \bar{K}^0 J/\psi) \\
 &= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \eta \eta J/\psi) = 4\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 K^0 J/\psi) \\
 &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^- K^+ J/\psi) = 12\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \eta J/\psi) \\
 &= 3\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- \eta J/\psi) = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^0 K^- J/\psi), \\
 \frac{3}{2}\Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^+ \eta J/\psi) &= \Gamma(X_{ud\bar{s}}^+ \rightarrow K^+ \bar{K}^0 J/\psi) \\
 &= \frac{3}{2}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- \eta J/\psi) = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow K^0 K^- J/\psi) \\
 &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ K^- J/\psi) = 4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \bar{K}^0 J/\psi)
 \end{aligned}$$

Table 11 Open bottom tetraquark X_b decays into a charmed baryon anti-triplet and an anti-charmed anti-baryon anti-sextet for class III, a charmed baryon sextet and an anti-charmed anti-baryon anti-sextet for class IV

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
Class III			
$X_{ud\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Sigma}_c^0$	$-\frac{d_1 V_{cs}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Xi}_c^0$	$\frac{1}{2} d_1 V_{cd}^*$
$X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}_c^0$	$-\frac{1}{2} d_1 V_{cs}^*$	$X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Omega}_c^0$	$\frac{d_1 V_{cd}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda_c^+ \bar{\Sigma}_c^{\prime-}$	$-\frac{d_1 V_{cs}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^{\prime-}$	$\frac{1}{2} d_1 V_{cs}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^+ \bar{\Sigma}_c^{\prime-}$	$\frac{d_1 V_{cd}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Sigma}_c^{\prime-}$	$\frac{1}{2} d_1 V_{cd}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda_c^+ \bar{\Sigma}_c^{\prime-}$	$-\frac{d_1 V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}_c^{\prime-}$	$\frac{d_1 V_{cs}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^{\prime-}$	$-\frac{d_1 V_{cd}^*}{\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}_c^0$	$\frac{1}{2} d_1 V_{cs}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0$	$-\frac{d_1 V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Sigma}_c^{\prime-}$	$\frac{d_1 V_{cs}^*}{\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Xi}_c^{\prime-}$	$-\frac{d_1 V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^{\prime-}$	$\frac{d_1 V_{cs}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0$	$-\frac{d_1 V_{cs}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Omega}_c^0$	$\frac{1}{2} d_1 V_{cd}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda_c^+ \bar{\Sigma}_c^{\prime-}$	$\frac{1}{2} d_1 V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^+ \bar{\Sigma}_c^{\prime-}$	$-\frac{1}{2} d_1 V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}_c^{\prime-}$	$-\frac{d_1 V_{cs}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^{\prime-}$	$-\frac{d_1 V_{cd}^*}{2\sqrt{2}}$
Class IV			
$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Sigma}_c^{\prime-}$	$-\frac{1}{2} f_1 V_{cs}^*$	$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Xi}_c^{\prime-}$	$\frac{1}{2} f_1 V_{cd}^*$
$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Sigma}_c^0$	$-\frac{1}{2} f_1 V_{cs}^*$	$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Xi}_c^0$	$\frac{f_1 V_{cd}^*}{2\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}_c^0$	$-\frac{f_1 V_{cs}^*}{2\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Omega}_c^0$	$\frac{1}{2} f_1 V_{cd}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^+ \bar{\Sigma}_c^{\prime-}$	$\frac{1}{2} f_1 V_{cs}^*$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Sigma}_c^{\prime-}$	$\frac{1}{2} f_1 V_{cs}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^{\prime-}$	$\frac{f_1 V_{cs}^*}{2\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^+ \bar{\Sigma}_c^{\prime-}$	$-\frac{1}{2} f_1 V_{cd}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Sigma}_c^{\prime-}$	$-\frac{f_1 V_{cd}^*}{2\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c^0 \bar{\Xi}_c^{\prime-}$	$-\frac{1}{2} f_1 V_{cd}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^{++} \bar{\Sigma}_c^{\prime-}$	$-\frac{1}{2} f_1 V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^+ \bar{\Sigma}_c^{\prime-}$	$-\frac{1}{4} f_1 V_{cd}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}_c^{\prime-}$	$-\frac{1}{4} f_1 V_{cs}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}_c^0$	$-\frac{f_1 V_{cs}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0$	$\frac{1}{4} f_1 V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Xi}_c^0$	$-\frac{f_1 V_{cs}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Omega}_c^0$	$\frac{1}{2} f_1 V_{cd}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^{++} \bar{\Sigma}_c^{\prime-}$	$\frac{1}{2} f_1 V_{cs}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Xi}_c^{\prime-}$	$\frac{1}{4} f_1 V_{cd}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Sigma}_c^0$	$-\frac{1}{2} f_1 V_{cs}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Xi}_c^0$	$\frac{f_1 V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Xi}_c^{\prime-}$	$\frac{1}{4} f_1 V_{cs}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}_c^0$	$-\frac{1}{4} f_1 V_{cs}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Omega}_c^0$	$\frac{f_1 V_{cd}^*}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^+ \bar{\Sigma}_c^{\prime-}$	$-\frac{f_1 V_{cd}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Sigma}_c^{\prime-}$	$-\frac{f_1 V_{cs}^*}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^+ \bar{\Sigma}_c^{\prime-}$	$\frac{f_1 V_{cs}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}_c^{\prime-}$	$\frac{1}{4} f_1 V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Xi}_c^{\prime-}$	$-\frac{1}{4} f_1 V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega_c^0 \bar{\Xi}_c^{\prime-}$	$\frac{f_1 V_{cs}^*}{2\sqrt{2}}$

$$\begin{aligned}
&= 12\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{K}^0 \eta J/\psi) = \frac{3}{2}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 \eta J/\psi) \\
&= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^+ K^- J/\psi) = 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \bar{K}^0 J/\psi) \\
&= 4\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 K^- J/\psi) = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- \bar{K}^0 J/\psi) \\
&= 12\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^- \eta J/\psi),
\end{aligned}$$

and

$$\begin{aligned}
&\Gamma(X_{ud\bar{s}}^+ \rightarrow D^+ \pi^0 \bar{D}^0) = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^0 \pi^0 D^-) \\
&= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 \pi^+ D^-) = \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ \pi^- \bar{D}^0), \\
&\Gamma(X_{ud\bar{s}}^+ \rightarrow D_s^+ \bar{K}^0 \bar{D}^0) = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D_s^+ K^- D^-) \\
&= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \bar{K}^0 D^-) = 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ K^- \bar{D}^0), \\
&\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^0 \pi^- \bar{D}^0) = \Gamma(X_{ud\bar{s}}^+ \rightarrow D^+ \pi^+ D^-)
\end{aligned}$$

Table 12 Open bottom tetraquark X_{b6} decays into a J/ψ and two light mesons

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ K^0 J/\psi$	$\frac{a_1 V_{cd}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ \eta J/\psi$	$-\frac{a_1 V_{cs}^*}{\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^0 K^+ J/\psi$	$\frac{1}{2} a_1 V_{cd}^*$	$X_{u\bar{d}\bar{s}}^+ \rightarrow K^+ \bar{K}^0 J/\psi$	$-\frac{a_1 V_{cs}^*}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow K^+ \eta J/\psi$	$-\frac{a_1 V_{cd}^*}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- \eta J/\psi$	$\frac{a_1 V_{cs}^*}{\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow K^0 K^- J/\psi$	$\frac{a_1 V_{cs}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^0 K^- J/\psi$	$-\frac{1}{2} a_1 V_{cd}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^- \bar{K}^0 J/\psi$	$-\frac{a_1 V_{cd}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow K^- \eta J/\psi$	$\frac{a_1 V_{cd}^*}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ \pi^- J/\psi$	$-\frac{1}{2} a_1 V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ K^- J/\psi$	$-\frac{1}{2} a_1 V_{cs}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \pi^0 J/\psi$	$-\frac{1}{2} a_1 V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \bar{K}^0 J/\psi$	$\frac{a_1 V_{cs}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \eta J/\psi$	$-\frac{a_1 V_{cd}^*}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow K^0 \bar{K}^0 J/\psi$	$\frac{1}{2} a_1 V_{cd}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{K}^0 \eta J/\psi$	$\frac{a_1 V_{cs}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \eta \eta J/\psi$	$\frac{1}{2} a_1 V_{cd}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 K^0 J/\psi$	$-\frac{a_1 V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 \eta J/\psi$	$\frac{a_1 V_{cs}^*}{\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^- K^+ J/\psi$	$\frac{1}{2} a_1 V_{cd}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^+ K^- J/\psi$	$\frac{1}{2} a_1 V_{cs}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \bar{K}^0 J/\psi$	$-\frac{1}{2} a_1 V_{cs}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \eta J/\psi$	$-\frac{a_1 V_{cd}^*}{2\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 K^- J/\psi$	$\frac{a_1 V_{cs}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- \bar{K}^0 J/\psi$	$\frac{1}{2} a_1 V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- \eta J/\psi$	$-\frac{a_1 V_{cd}^*}{\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^0 K^- J/\psi$	$-\frac{1}{2} a_1 V_{cd}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^- \eta J/\psi$	$-\frac{a_1 V_{cs}^*}{2\sqrt{6}}$		

$$\begin{aligned}
&= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ \bar{K}^0 D^-) = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 K^- \bar{D}^0), \\
&\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^0 K^- \bar{D}^0) = \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ K^+ D_s^-) \\
&= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ K^0 D_s^-) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \pi^- \bar{D}^0), \\
&\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ K^0 \bar{D}^0) = 2\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^0 \pi^0 D_s^-) \\
&= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^+ \pi^- D_s^-) \\
&= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ K^0 D_s^-) = 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ \pi^- \bar{D}^0), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 K^0 \bar{D}^0) = 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+ \pi^0 D_s^-) \\
&= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^+ \pi^- D_s^-), \\
&\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ \eta \bar{D}^0) = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^0 \eta D^-) \\
&= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ \eta D^-) = 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 \eta \bar{D}^0), \\
&\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^0 \pi^+ \bar{D}^0) = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^+ \pi^- D^-), \\
&\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^0 K^+ \bar{D}^0) = \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D_s^+ K^- D_s^-), \\
&\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \pi^0 \bar{D}^0) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 K^0 D_s^-), \\
&\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \eta \bar{D}^0) = 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \eta D^-), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 \bar{K}^0 \bar{D}^0) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^+ K^- D^-), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ K^- \bar{D}^0) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \bar{K}^0 D^-), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+ K^- \bar{D}^0) = \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 K^+ D_s^-), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 \pi^0 \bar{D}^0) = \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ \pi^0 D^-),
\end{aligned}$$

$$\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \pi^- \bar{D}^0) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 K^0 D_s^-),$$

5.2 $b \rightarrow c\bar{u}d/s$ transition

5.2.1 Decays into a charmed meson and a light meson

The $\bar{c}b\bar{q}u$ transition can form an octet operator by SU(3) symmetry, in which nonzero entry is $(H_8)_1^2 = V_{ud}^*$ for the $b \rightarrow c\bar{u}d$ or $b\bar{d} \rightarrow c\bar{u}$ transition, while $(H_8)_1^3 = V_{us}^*$ for the $b \rightarrow c\bar{u}s$ or $b\bar{s} \rightarrow c\bar{u}$ transition. The effective Hamiltonian is then written as

$$\begin{aligned}
\mathcal{H}_{eff} = & a_3 (X_{b6})_{[jk]}^i (H_8)_i^j M_l^k (\bar{D})^l \\
& + a_4 (X_{b6})_{[jk]}^i (H_8)_i^l M_l^j (\bar{D})^k \\
& + a_5 (X_{b6})_{[jk]}^i (H_8)_i^j M_l^k (\bar{D})^l \\
& + a_6 (X_{b6})_{[jk]}^i (H_8)_i^l M_l^j (\bar{D})^k
\end{aligned} \quad (16)$$

The decays amplitudes are given in Table 14, and the relations among different decay widths become

$$\begin{aligned}
&\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ \pi^0) \\
&= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ \pi^-), \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \pi^0) \\
&= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \pi^-), \\
&\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \bar{K}^0)
\end{aligned}$$

Table 13 Open bottom tetraquark X_{b6} decays into a charmed meson, an anti-charmed meson and a light meson

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
$X_{u\bar{d}\bar{s}}^+ \rightarrow D^0 \pi^+ \bar{D}^0$	$-\frac{(a_2+a_5)V_{cs}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D^0 K^+ \bar{D}^0$	$\frac{(a_2+a_5)V_{cd}^*}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ \pi^+ D^-$	$-\frac{(a_2+a_3)V_{cs}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ \pi^0 \bar{D}^0$	$\frac{1}{2}(a_5 - a_3)V_{cs}^*$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ K^+ D^-$	$\frac{(a_2-a_4)V_{cd}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ K^+ D_s^-$	$-\frac{(a_3+a_4)V_{cs}^*}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ K^0 \bar{D}^0$	$\frac{(a_5-a_6)V_{cd}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ \eta \bar{D}^0$	$-\frac{(a_3+a_5-2a_6)V_{cs}^*}{2\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \pi^+ D^-$	$\frac{(a_3+a_4)V_{cd}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \pi^+ D_s^-$	$\frac{(a_4-a_2)V_{cs}^*}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \pi^0 \bar{D}^0$	$\frac{1}{2}(a_3 - a_6)V_{cd}^*$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ K^+ D_s^-$	$\frac{a_2 V_{cd}^*}{\sqrt{2}} + \frac{a_3 V_{cd}^*}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \bar{K}^0 \bar{D}^0$	$\frac{(a_6-a_5)V_{cs}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \eta \bar{D}^0$	$\frac{(a_3-2a_5+a_6)V_{cd}^*}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^0 \pi^0 D^-$	$\frac{1}{2}(a_5 - a_3)V_{cs}^*$	$X_{d\bar{s}\bar{u}}^- \rightarrow D^0 \pi^- \bar{D}^0$	$\frac{(a_2+a_3)V_{cs}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^0 K^0 D^-$	$\frac{(a_4+a_6)V_{cd}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D^0 K^0 D_s^-$	$\frac{(a_3+a_4)V_{cs}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^0 \eta D^-$	$\frac{(a_3+a_5-2a_6)V_{cs}^*}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D^+ \pi^- D^-$	$\frac{(a_2+a_5)V_{cs}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D_s^+ \pi^- D^-$	$-\frac{(a_4+a_6)V_{cd}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D_s^+ \pi^- D_s^-$	$\frac{(a_2-a_4)V_{cs}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D_s^+ K^- D^-$	$\frac{(a_5-a_6)V_{cs}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D^0 \pi^0 D_s^-$	$\frac{1}{2}(a_6 - a_5)V_{cd}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow D^0 \bar{K}^0 D^-$	$-\frac{(a_3+a_4)V_{cd}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D^0 \bar{K}^0 D_s^-$	$-\frac{(a_4+a_6)V_{cs}^*}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow D^0 K^- \bar{D}^0$	$-\frac{a_2 V_{cd}^*}{\sqrt{2}} - \frac{a_3 V_{cd}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D^0 \eta D_s^-$	$\frac{(2a_3-a_5-a_6)V_{cd}^*}{2\sqrt{3}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow D^+ \pi^- D_s^-$	$\frac{(a_6-a_5)V_{cd}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D^+ K^- D^-$	$\frac{(a_4-a_2)V_{cd}^*}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow D^+ K^- D_s^-$	$\frac{(a_4+a_6)V_{cs}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^+ K^- D_s^-$	$-\frac{(a_2+a_5)V_{cd}^*}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 \pi^+ D^-$	$-\frac{1}{2}(a_3 + a_4)V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 \pi^+ D_s^-$	$-\frac{1}{2}(a_4 + a_5)V_{cs}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 \pi^0 \bar{D}^0$	$-\frac{(a_2+a_3+a_5-a_6)V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 K^+ D_s^-$	$\frac{1}{2}(a_5 - a_3)V_{cd}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 \bar{K}^0 \bar{D}^0$	$-\frac{1}{2}(a_2 + a_6)V_{cs}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 \eta \bar{D}^0$	$-\frac{(3a_2+a_3+a_5+a_6)V_{cd}^*}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ \pi^0 D^-$	$\frac{(a_4-a_2)V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ \pi^0 D_s^-$	$\frac{(a_4+a_5)V_{cs}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ \pi^- \bar{D}^0$	$\frac{1}{2}(a_6 - a_5)V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ K^0 D_s^-$	$\frac{1}{2}(a_5 - a_6)V_{cd}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ \bar{K}^0 D^-$	$-\frac{1}{2}(a_2 + a_3)V_{cs}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ K^- \bar{D}^0$	$\frac{1}{2}(a_6 - a_3)V_{cs}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ \eta D^-$	$\frac{1}{2}\sqrt{\frac{3}{2}}(a_4 - a_2)V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ \eta D_s^-$	$\frac{(2a_3+3a_4-a_5+2a_6)V_{cs}^*}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+ \pi^0 D^-$	$-\frac{(a_2+a_6)V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+ \bar{K}^0 D^-$	$\frac{1}{2}(a_3 + a_4)V_{cd}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+ \bar{K}^0 D_s^-$	$\frac{1}{2}(-a_2 + a_4 - a_5 + a_6)V_{cs}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+ K^- \bar{D}^0$	$\frac{1}{2}(a_3 - a_5)V_{cd}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+ \eta D_s^-$	$\frac{(-3a_2-2a_3-2a_5+a_6)V_{cd}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 \pi^+ D^-$	$\frac{1}{2}(a_3 - a_5)V_{cs}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 \pi^0 \bar{D}^0$	$\frac{(2a_2+a_3+a_5)V_{cs}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 K^+ D^-$	$\frac{1}{2}(a_4 + a_5)V_{cd}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 K^+ D_s^-$	$\frac{1}{2}(a_3 + a_4)V_{cs}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 K^0 \bar{D}^0$	$\frac{1}{2}(a_2 + a_6)V_{cd}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 \eta \bar{D}^0$	$\frac{(a_3+a_5-2a_6)V_{cs}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ \pi^0 D^-$	$\frac{(2a_2+a_3+a_5)V_{cs}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ \pi^- \bar{D}^0$	$\frac{1}{2}(a_5 - a_3)V_{cs}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ K^0 D^-$	$\frac{1}{2}(a_2 - a_4 + a_5 - a_6)V_{cd}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ K^0 D_s^-$	$-\frac{1}{2}(a_3 + a_4)V_{cs}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ \eta D^-$	$-\frac{(a_3+a_5-2a_6)V_{cs}^*}{2\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \pi^0 D^-$	$-\frac{(a_3+2a_4+a_6)V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \pi^0 D_s^-$	$\frac{(a_2-a_4)V_{cs}^*}{\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \pi^- \bar{D}^0$	$\frac{1}{2}(a_3 - a_6)V_{cd}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ K^0 D_s^-$	$\frac{1}{2}(a_2 + a_3)V_{cd}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \bar{K}^0 D^-$	$\frac{1}{2}(a_6 - a_5)V_{cs}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ K^- \bar{D}^0$	$\frac{1}{2}(a_5 - a_6)V_{cs}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \eta D^-$	$\frac{(a_3-2a_5+a_6)V_{cd}^*}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \pi^0 D^-$	$\frac{(a_3+a_4-a_5+a_6)V_{cd}^*}{2\sqrt{2}}$

Table 13 continued

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \pi^0 D_s^-$	$\frac{(a_4+a_5)V_{cs}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \pi^- \bar{D}^0$	$-\frac{1}{2}(a_2+a_3)V_{cd}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 K^0 D_s^-$	$\frac{1}{2}(a_6-a_3)V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \bar{K}^0 D^-$	$\frac{1}{2}(a_3-a_6)V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 K^- \bar{D}^0$	$\frac{1}{2}(a_2+a_3)V_{cs}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \eta D^-$	$-\frac{(a_3+3a_4+a_5+a_6)V_{cd}^*}{2\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \eta D_s^-$	$\frac{(-2a_3-3a_4+a_5-2a_6)V_{cs}^*}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^+ \pi^- D^-$	$\frac{1}{2}(-a_2+a_4-a_5+a_6)V_{cd}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^+ \pi^- D_s^-$	$\frac{1}{2}(a_4+a_5)V_{cs}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^+ K^- D^-$	$\frac{1}{2}(a_2+a_6)V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^+ \pi^- D_s^-$	$-\frac{1}{2}(a_2+a_6)V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^+ K^- D^-$	$-\frac{1}{2}(a_4+a_5)V_{cd}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^+ K^- D_s^-$	$\frac{1}{2}(a_2-a_4+a_5-a_6)V_{cs}^*$		

Table 14 Open bottom tetraquark X_{b6} decays into a charmed meson and a light meson

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
$X_{u\bar{d}\bar{s}}^+ \rightarrow D^0 \pi^+$	$-\frac{(a_3+a_5)V_{us}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D^0 K^+$	$\frac{(a_3+a_5)V_{ud}^*}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ \pi^0$	$\frac{1}{2}(a_3-a_6)V_{us}^*$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ K^0$	$\frac{(a_3-a_4)V_{ud}^*}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ \eta$	$-\frac{(a_3-2a_4+a_6)V_{us}^*}{2\sqrt{3}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \pi^0$	$\frac{1}{2}(a_6-a_4)V_{ud}^*$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \bar{K}^0$	$\frac{(a_4-a_3)V_{us}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+ \eta$	$\frac{(-2a_3+a_4+a_6)V_{ud}^*}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^0 \pi^-$	$\frac{(a_5+a_6)V_{us}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D^0 K^-$	$-\frac{(a_5+a_6)V_{ud}^*}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 \pi^0$	$-\frac{(a_3-a_4+a_5+a_6)V_{ud}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 \bar{K}^0$	$-\frac{1}{2}(a_4+a_5)V_{us}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0 \eta$	$-\frac{(a_3+a_4+3a_5+a_6)V_{ud}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ \pi^-$	$\frac{1}{2}(a_4-a_3)V_{us}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ K^-$	$\frac{1}{2}(a_4-a_6)V_{us}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+ K^-$	$\frac{1}{2}(a_6-a_3)V_{ud}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 \pi^0$	$\frac{(a_3+2a_5+a_6)V_{us}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 K^0$	$\frac{1}{2}(a_4+a_5)V_{us}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 \eta$	$\frac{(a_3-2a_4+a_6)V_{us}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+ \pi^-$	$\frac{1}{2}(a_3-a_6)V_{us}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \pi^-$	$\frac{1}{2}(a_6-a_4)V_{ud}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ K^-$	$\frac{1}{2}(a_3-a_4)V_{us}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \pi^-$	$-\frac{1}{2}(a_5+a_6)V_{ud}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 K^-$	$\frac{1}{2}(a_5+a_6)V_{us}^*$

$$\begin{aligned}
&= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ K^-), \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^0 \pi^-) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 K^-), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+ \pi^-) \\
&= \frac{1}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ K^0), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \pi^-) \\
&= \frac{1}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^0 K^-), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0 \eta) \\
&= \frac{1}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+ \eta).
\end{aligned}$$

5.2.2 Two-body decays into a charmed baryon and an anti-baryon

Concerning the two-body decays into a charmed baryon and an anti-baryon, the efficient Hamiltonian which includes four different kinds of combinations in final states can be written

as

$$\begin{aligned}
\mathcal{H}_{eff} = & -b_1(X_{b6})^{[ij]}(H_8)_i^k(T_{c\bar{3}})_{[jl]}(\bar{T}_8)_k^l \\
& -b_2(X_{b6})^{[ij]}(H_8)_i^k(T_{c\bar{3}})_{[kl]}(\bar{T}_8)_j^l \\
& -b_3(X_{b6})^{[ij]}(H_8)_i^k(T_{c\bar{3}})_{[ik]}(\bar{T}_8)_j^l \\
& -c_1(X_{b6})^{[ij]}(H_8)_i^k(T_{c6})_{[jl]}(\bar{T}_8)_k^l \\
& -c_2(X_{b6})^{[ij]}(H_8)_i^k(T_{c6})_{[kl]}(\bar{T}_8)_j^l \\
& -c_3(X_{b6})^{[ij]}(H_8)_i^k(T_{c6})_{[ij]}(\bar{T}_8)_k^l \\
& -c_4(X_{b6})^{[ij]}(H_8)_i^k(T_{c6})_{[ik]}(\bar{T}_8)_j^l \\
& +d_1(X_{b6})_{[jk]}^i(H_8)_i^j(T_{c\bar{3}})_{[im]}(\bar{T}_{10})^{[klm]} \\
& +f_1(X_{b6})_{[jk]}^i(H_8)_i^j(T_{c6})_{[lm]}(\bar{T}_{10})^{[klm]} \\
& +f_2(X_{b6})_{[jk]}^i(H_8)_i^j(T_{c6})_{[im]}(\bar{T}_{10})^{[klm]}. \quad (17)
\end{aligned}$$

The related decay amplitudes are given in Tables 15 and 16, which are for anti-triplet charmed baryon plus octet anti-baryon (class I), sextet charmed baryon plus octet anti-baryon class II, anti-triplet charmed baryon plus anti-decuplet anti-

Table 15 Open bottom tetraquark X_{b6} decays into a light anti-baryon octet and a charmed baryon anti-triplet for class I, a light anti-baryon octet and a charmed baryon sextet for class II

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
Class I			
$X_{ud\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Lambda}^0$	$\frac{(b_1 - b_2 + b_3) V_{ud}^*}{2\sqrt{3}}$	$X_{ud\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Sigma}^0$	$-\frac{1}{2} (b_1 + b_2 - b_3) V_{ud}^*$
$X_{ud\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{n}$	$\frac{b_1 V_{us}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Lambda}^0$	$-\frac{(2b_1 + b_2 - b_3) V_{us}^*}{2\sqrt{3}}$
$X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Sigma}^0$	$\frac{1}{2} (b_3 - b_2) V_{us}^*$	$X_{ud\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}^0$	$\frac{b_1 V_{ud}^*}{\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow \Xi_c^0 \bar{\Sigma}^+$	$-\frac{b_2 V_{us}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow \Xi_c^0 \bar{\Xi}^+$	$\frac{b_2 V_{ud}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^-$	$\frac{b_3 V_{us}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{p}$	$-\frac{b_3 V_{ud}^*}{\sqrt{2}}$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Lambda_c^+ \bar{p}$	$\frac{1}{2} (b_3 - b_2) V_{ud}^*$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^-$	$-\frac{1}{2} b_1 V_{ud}^*$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{p}$	$-\frac{1}{2} (b_1 + b_2 - b_3) V_{us}^*$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Lambda}^0$	$-\frac{(b_1 + 2b_2 + b_3) V_{ud}^*}{2\sqrt{6}}$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^0$	$\frac{(b_1 - b_3) V_{ud}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{n}$	$-\frac{1}{2} (b_1 + b_2) V_{us}^*$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Sigma}^-$	$-\frac{1}{2} (b_1 + b_2 - b_3) V_{ud}^*$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{p}$	$-\frac{1}{2} b_1 V_{us}^*$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^-$	$\frac{1}{2} (b_3 - b_2) V_{us}^*$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Lambda}^0$	$-\frac{(2b_1 + b_2 - b_3) V_{us}^*}{2\sqrt{6}}$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^0$	$\frac{(b_2 + b_3) V_{us}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}^0$	$\frac{1}{2} (b_1 + b_2) V_{ud}^*$
$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^-$	$-\frac{1}{2} b_3 V_{ud}^*$	$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{p}$	$\frac{1}{2} b_3 V_{us}^*$
Class II			
$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Sigma}^-$	$\frac{(c_1 + c_3) V_{ud}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{p}$	$\frac{(c_1 + c_3) V_{us}^*}{\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Lambda}^0$	$\frac{(c_1 + c_2 + c_4) V_{ud}^*}{2\sqrt{6}}$	$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Sigma}^0$	$\frac{(-c_1 + c_2 + c_4) V_{ud}^*}{2\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{n}$	$\frac{1}{2} c_1 V_{us}^*$	$X_{ud\bar{s}}^+ \rightarrow \Sigma_c^0 \bar{\Sigma}^+$	$\frac{c_2 V_{ud}^*}{\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow \Xi_c'^+ \bar{\Lambda}^0$	$\frac{(-2c_1 + c_2 + c_4) V_{us}^*}{2\sqrt{6}}$	$X_{ud\bar{s}}^+ \rightarrow \Xi_c'^+ \bar{\Sigma}^0$	$\frac{(c_2 + c_4) V_{us}^*}{2\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow \Xi_c'^+ \bar{\Xi}^0$	$\frac{1}{2} c_1 V_{ud}^*$	$X_{ud\bar{s}}^+ \rightarrow \Xi_c'^0 \bar{\Sigma}^+$	$\frac{1}{2} c_2 V_{us}^*$
$X_{ud\bar{s}}^+ \rightarrow \Xi_c'^0 \bar{\Xi}^+$	$\frac{1}{2} c_2 V_{ud}^*$	$X_{ud\bar{s}}^+ \rightarrow \Omega_c'^+ \bar{\Xi}^+$	$\frac{c_2 V_{us}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Sigma}^-$	$\frac{(c_3 + c_4) V_{ud}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{p}$	$\frac{c_3 V_{us}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c'^0 \bar{\Sigma}^-$	$\frac{1}{2} c_4 V_{us}^*$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c'^0 \bar{p}$	$\frac{1}{2} c_4 V_{ud}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c'^0 \bar{\Sigma}^-$	$\frac{c_3 V_{ud}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c'^0 \bar{p}$	$\frac{(c_3 + c_4) V_{us}^*}{\sqrt{2}}$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^+ \bar{p}$	$\frac{(c_2 + c_4) V_{ud}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^0 \bar{n}$	$\frac{1}{2} c_2 V_{ud}^*$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi_c'^+ \bar{\Sigma}^-$	$\frac{(c_1 + 2c_3) V_{ud}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi_c'^+ \bar{p}$	$\frac{(c_1 + c_2 + 2c_3 + c_4) V_{us}^*}{2\sqrt{2}}$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi_c'^0 \bar{\Lambda}^0$	$\frac{(c_1 - 2c_2 + c_4) V_{ud}^*}{4\sqrt{3}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi_c'^0 \bar{\Sigma}^0$	$\frac{1}{4} (c_4 - c_1) V_{ud}^*$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi_c'^0 \bar{n}$	$\frac{(c_1 + c_2) V_{us}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Omega_c'^0 \bar{\Lambda}^0$	$\frac{(-2c_1 - 2c_2 + c_4) V_{us}^*}{2\sqrt{6}}$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Omega_c'^0 \bar{\Sigma}^0$	$\frac{c_4 V_{us}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Omega_c'^0 \bar{\Xi}^0$	$\frac{1}{2} c_1 V_{ud}^*$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Sigma}^-$	$\frac{(c_1 + c_2 + 2c_3 + c_4) V_{ud}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{p}$	$\frac{(c_1 + 2c_3) V_{us}^*}{2\sqrt{2}}$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Lambda}^0$	$\frac{(c_1 + c_2 + c_4) V_{ud}^*}{2\sqrt{6}}$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Sigma}^0$	$-\frac{(c_1 + c_2 - c_4) V_{ud}^*}{2\sqrt{2}}$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{n}$	$\frac{1}{2} c_1 V_{us}^*$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Xi_c'^+ \bar{\Sigma}^-$	$\frac{(c_2 + c_4) V_{us}^*}{2\sqrt{2}}$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Xi_c'^0 \bar{\Lambda}^0$	$\frac{(-2c_1 + c_2 + c_4) V_{us}^*}{4\sqrt{3}}$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Xi_c'^0 \bar{\Sigma}^0$	$\frac{1}{4} (c_4 - c_2) V_{us}^*$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Xi_c'^0 \bar{\Xi}^0$	$\frac{(c_1 + c_2) V_{ud}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Omega_c'^0 \bar{\Xi}^0$	$\frac{1}{2} c_2 V_{us}^*$
$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^0 \bar{p}$	$\frac{1}{2} c_4 V_{ud}^*$	$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Xi_c'^0 \bar{\Sigma}^-$	$\frac{(2c_3 + c_4) V_{ud}^*}{2\sqrt{2}}$
$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Xi_c'^0 \bar{p}$	$\frac{(2c_3 + c_4) V_{us}^*}{2\sqrt{2}}$	$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Omega_c'^0 \bar{\Sigma}^-$	$\frac{1}{2} c_4 V_{us}^*$

Table 16 Open bottom tetraquark X_{b6} decays into a light anti-baryon anti-decuplet and a charmed baryon anti-triplet for class III, a light anti-baryon anti-decuplet and a charmed baryon sextet for class IV

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
Class III			
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Delta}^0$	$-\frac{d_1 V_{us}^*}{\sqrt{6}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Sigma}^0$	$\frac{d_1 V_{ud}^*}{2\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Sigma}^0$	$-\frac{d_1 V_{us}^*}{2\sqrt{3}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}^0$	$\frac{d_1 V_{ud}^*}{\sqrt{6}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda_c^+ \bar{\Delta}^{--}$	$-\frac{d_1 V_{us}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^{'-}$	$\frac{d_1 V_{us}^*}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^+ \bar{\Delta}^{--}$	$\frac{d_1 V_{ud}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Delta}^{--}$	$\frac{d_1 V_{ud}^*}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda_c^+ \bar{\Delta}^{--}$	$-\frac{d_1 V_{ud}^*}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Delta}^{--}$	$\frac{d_1 V_{us}^*}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^{'-}$	$-\frac{d_1 V_{ud}^*}{\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Delta}^0$	$\frac{d_1 V_{us}^*}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^0$	$-\frac{d_1 V_{ud}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Delta}^{--}$	$\frac{d_1 V_{us}^*}{\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Sigma}^{'-}$	$-\frac{d_1 V_{ud}^*}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^{'-}$	$\frac{d_1 V_{us}^*}{2\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^0$	$-\frac{d_1 V_{us}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}^0$	$\frac{d_1 V_{ud}^*}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda_c^+ \bar{\Delta}^{--}$	$\frac{1}{2} d_1 V_{ud}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^+ \bar{\Delta}^{--}$	$-\frac{1}{2} d_1 V_{us}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Delta}^{--}$	$-\frac{d_1 V_{us}^*}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^{'-}$	$-\frac{d_1 V_{ud}^*}{2\sqrt{3}}$
Class IV			
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Delta}^{--}$	$-\frac{(f_1+f_2)V_{us}^*}{\sqrt{6}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Sigma}^{'-}$	$\frac{(f_1+f_2)V_{ud}^*}{\sqrt{6}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Delta}^0$	$-\frac{(2f_1+f_2)V_{us}^*}{2\sqrt{3}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Sigma}^0$	$\frac{(2f_1+f_2)V_{ud}^*}{2\sqrt{6}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^0 \bar{\Delta}^+$	$-\frac{f_1 V_{us}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^0 \bar{\Sigma}^{' +}$	$\frac{f_1 V_{ud}^*}{\sqrt{6}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^{' +} \bar{\Sigma}^0$	$-\frac{(2f_1+f_2)V_{us}^*}{2\sqrt{6}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^{' +} \bar{\Xi}^0$	$\frac{(2f_1+f_2)V_{ud}^*}{2\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^{' 0} \bar{\Sigma}^{' +}$	$-\frac{f_1 V_{us}^*}{\sqrt{3}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^{' 0} \bar{\Xi}^{' +}$	$\frac{f_1 V_{ud}^*}{\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Omega_c^0 \bar{\Xi}^{' +}$	$-\frac{f_1 V_{us}^*}{\sqrt{6}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Omega_c^0 \bar{\Omega}^+$	$\frac{f_1 V_{ud}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^+ \bar{\Delta}^{--}$	$\frac{1}{2} f_2 V_{us}^*$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Delta}^{--}$	$\frac{f_2 V_{us}^*}{\sqrt{6}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^{' 0} \bar{\Sigma}^{' -}$	$\frac{f_2 V_{us}^*}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^{' +} \bar{\Delta}^{--}$	$-\frac{1}{2} f_2 V_{ud}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^{' 0} \bar{\Delta}^{--}$	$-\frac{f_2 V_{ud}^*}{2\sqrt{3}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c^0 \bar{\Sigma}^{' -}$	$-\frac{f_2 V_{us}^*}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^{++} \bar{\Delta}^{--}$	$-\frac{1}{2} (f_1 + f_2) V_{ud}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^+ \bar{\Delta}^{--}$	$-\frac{(2f_1+f_2)V_{ud}^*}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^0 \bar{\Delta}^0$	$-\frac{f_1 V_{us}^*}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^{' +} \bar{\Delta}^{--}$	$-\frac{f_2 V_{us}^*}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^{' +} \bar{\Sigma}^{' -}$	$-\frac{f_1 V_{ud}^*}{\sqrt{6}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^{' 0} \bar{\Delta}^0$	$-\frac{f_2 V_{us}^*}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^{' 0} \bar{\Sigma}^0$	$\frac{(f_2-2f_1)V_{ud}^*}{4\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Sigma}^0$	$-\frac{f_2 V_{us}^*}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Xi}^0$	$\frac{(f_2-f_1)V_{ud}^*}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^{++} \bar{\Delta}^{--}$	$\frac{1}{2} (f_1 + f_2) V_{us}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Delta}^{--}$	$\frac{f_1 V_{us}^*}{\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Sigma}^{' -}$	$\frac{f_2 V_{ud}^*}{2\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Delta}^0$	$\frac{(f_1-f_2)V_{us}^*}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Sigma}^0$	$\frac{f_2 V_{ud}^*}{2\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^{' +} \bar{\Sigma}^{' -}$	$\frac{(2f_1+f_2)V_{us}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^{' 0} \bar{\Sigma}^0$	$\frac{(2f_1-f_2)V_{us}^*}{4\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^{' 0} \bar{\Xi}^0$	$\frac{f_2 V_{ud}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Omega_c^0 \bar{\Xi}^0$	$\frac{f_1 V_{us}^*}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^+ \bar{\Delta}^{--}$	$-\frac{f_2 V_{ud}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Delta}^{--}$	$-\frac{f_2 V_{ud}^*}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^{' +} \bar{\Delta}^{--}$	$\frac{f_2 V_{us}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^{' 0} \bar{\Delta}^{--}$	$\frac{f_2 V_{us}^*}{2\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^{' 0} \bar{\Sigma}^{' -}$	$-\frac{f_2 V_{ud}^*}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega_c^0 \bar{\Sigma}^{' -}$	$\frac{f_2 V_{us}^*}{2\sqrt{3}}$

baryon class III, sextet charmed baryon plus anti-decuplet anti-baryon class IV, respectively. The relations of decay widths for class I are given as

$$\begin{aligned}
 & \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^-) \\
 &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{p}), \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^-) \\
 &= \frac{1}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}^0), \\
 & \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Sigma}^-) \\
 &= \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Sigma}^0), \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{p}) \\
 &= \frac{1}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{n}), \\
 & \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^-) \\
 &= \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Sigma}^0), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^-) \\
 &= \frac{1}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{p}), \\
 & \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Lambda}^0) \\
 &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Lambda}^0).
 \end{aligned}$$

The relations of decay widths for class II are

$$\begin{aligned}
 & \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^0 \bar{\Sigma}^+) = 2\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^0 \bar{\Xi}^+) \\
 &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^0 \bar{n}), \\
 & \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^0 \bar{\Sigma}^+) = \frac{1}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Omega_c^0 \bar{\Xi}^+) \\
 &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Omega_c^0 \bar{\Xi}^0), \\
 & \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^-) = 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Sigma}^0) \\
 &= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega_c^0 \bar{\Sigma}^-), \\
 & \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^-) \\
 &= \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Sigma}^0), \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Lambda}^0) \\
 &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Lambda}^0), \\
 & \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{n}) \\
 &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{n}), \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Lambda}^0) \\
 &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Lambda}^0), \\
 & \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}^0) \\
 &= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Xi}^0), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^0 \bar{p}) \\
 &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{p}).
 \end{aligned}$$

The relations of decay widths for class III become

$$\begin{aligned}
 & 3\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Delta}^0) = 6\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Sigma}^0) \\
 &= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda_c^+ \bar{\Delta}^{--}) = 3\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^{'-})
 \end{aligned}$$

$$\begin{aligned}
 &= 6\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Delta}^-) = 6\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Delta}^0) \\
 &= \frac{3}{2}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Delta}^-) = 6\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^{'-}) \\
 &= 12\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^{'0}) = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^+ \bar{\Delta}^{--}) \\
 &= 6\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Delta}^-), \\
 & 6\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda_c^+ \bar{\Sigma}^{'0}) = 3\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}^{'0}) \\
 &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^+ \bar{\Delta}^{--}) = 3\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Delta}^-) \\
 &= 6\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda_c^+ \bar{\Delta}^-) = \frac{3}{2}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^{'-}) \\
 &= 12\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^{'0}) = 6\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda_c^+ \bar{\Sigma}^{'-}) \\
 &= 6\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Xi}^{'0}) = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda_c^+ \bar{\Delta}^{--}) \\
 &= 6\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^{'-}).
 \end{aligned}$$

The relations of decay widths for class IV become

$$\begin{aligned}
 & \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^0 \bar{\Delta}^+) = \frac{3}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^0 \bar{\Sigma}^{'+}) \\
 &= 3\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Omega_c^0 \bar{\Xi}^{'+}) = 3\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Delta}^-) \\
 &= 6\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Omega_c^0 \bar{\Xi}^{'0}), \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^+ \bar{\Delta}^{--}) \\
 &= \frac{3}{2}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Delta}^-) = 3\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^{'-}) \\
 &= 6\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Delta}^-) = 6\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^0 \bar{\Delta}^0) \\
 &= 6\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega_c^0 \bar{\Sigma}^{'0}) = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^+ \bar{\Delta}^{--}) \\
 &= 6\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Delta}^-) \\
 &= 3\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega_c^0 \bar{\Sigma}^{'-}), 2\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^0 \bar{\Sigma}^{'+}) \\
 &= \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^0 \bar{\Xi}^{'+}) \\
 &= 4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^0 \bar{\Delta}^0) = 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^{'-}) \\
 &= \frac{2}{3}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Omega_c^0 \bar{\Omega}^+), \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^+ \bar{\Delta}^{--}) \\
 &= 3\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi_c^0 \bar{\Delta}^-) = \frac{3}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega_c^0 \bar{\Sigma}^{'-}) \\
 &= 6\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^+ \bar{\Sigma}^{'-}) = 6\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^0 \bar{\Sigma}^{'0}) \\
 &= 6\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^0 \bar{\Sigma}^{'0}) = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^+ \bar{\Delta}^{--}) \\
 &= 3\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma_c^0 \bar{\Delta}^-) = 6\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^0 \bar{\Sigma}^{'-}), \\
 & \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Delta}^0) = 2\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Sigma}^{'0}) \\
 &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi_c^+ \bar{\Sigma}^{'-}), 2\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^+ \bar{\Sigma}^{'0}) \\
 &= \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi_c^+ \bar{\Xi}^{'0}) \\
 &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^+ \bar{\Delta}^-), \frac{3}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^{++} \bar{\Delta}^-) \\
 &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma_c^{++} \bar{\Delta}^{--}),
 \end{aligned}$$

$$\frac{3}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma_c^{++}\bar{\Sigma}'^-) = \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma_c^{++}\bar{\Delta}^{--}).$$

5.2.3 Three-body decays into mesons

For the X_{b6} decays into three mesons, one constructs the effective Hamiltonian as follows

$$\begin{aligned} \mathcal{H}_{eff} = & a_8(X_{b6})_{[jk]}^i (H_8)_i^j (\bar{D})^k M_m^l M_l^m \\ & + a_9(X_{b6})_{[jk]}^i (H_8)_i^j (\bar{D})^l M_m^k M_l^m \\ & + a_{10}(X_{b6})_{[jk]}^i (H_8)_i^l (\bar{D})^j M_m^k M_l^m \\ & + a_{11}(X_{b6})_{[jk]}^i (H_8)_i^l (\bar{D})^m M_l^j M_m^k \\ & + a_{12}(X_{b6})_{[jk]}^i (H_8)_m^j (\bar{D})^k M_l^i M_l^m \\ & + a_{13}(X_{b6})_{[jk]}^i (H_8)_m^l (\bar{D})^j M_i^j M_l^k \\ & + a_{14}(X_{b6})_{[jk]}^i (H_8)_m^l (\bar{D})^m M_i^j M_l^k \\ & + a_{15}(X_{b6})_{[jk]}^i (H_8)_m^l (\bar{D})^j M_i^m M_l^k. \end{aligned} \quad (18)$$

The decay amplitudes are given in Table 17. The relations of different decay widths become

$$\begin{aligned} \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^0\pi^+K^0) &= 6\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^0K^+\eta) \\ &= 2\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^0\pi^0K^+), \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+\pi^0K^0) \\ &= 3\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+K^0\eta) \\ &= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+K^0K^-), \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+\pi^0\bar{K}^0) \\ &= 3\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+\bar{K}^0\eta) \\ &= 6\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+K^-\eta) \\ &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+\pi^-\bar{K}^0), \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^0K^+\bar{K}^0) \\ &= \frac{3}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^0\pi^+\eta), \\ \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^0\pi^-K^0) &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^+\pi^-K^-) \\ &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^+\pi^-K^-) \\ &= \frac{1}{2}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D_s^+\pi^-\pi^-) \\ &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+\pi^-K^0) \\ &= 4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^+\pi^0\pi^-) \\ &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+\pi^0\pi^-) \\ &= 4\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0\pi^0\pi^-) \\ &= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^+\pi^-\pi^-), \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+K^0K^-) \\ &= \frac{3}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+\pi^0\eta) \\ &= \frac{3}{2}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+\pi^-\eta), \\ \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D_s^+\pi^-K^-) & \end{aligned}$$

$$\begin{aligned} &= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^0\bar{K}^0K^-) \\ &= \frac{1}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^+K^-K^-) \\ &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+\bar{K}^0K^-) \\ &= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^+K^-K^-) \\ &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^+\pi^-K^-), \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^0\pi^0K^-) \\ &= 3\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^0K^-\eta) \\ &= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0K^0K^-), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0\pi^0K^-) \\ &= \frac{1}{4}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^0K^0K^-), \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0K^+K^-) \\ &= \frac{1}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^+K^+K^-), \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+\pi^0\pi^0) \\ &= \frac{1}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+\pi^+\pi^-), \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0\pi^+\pi^-) \\ &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0\pi^0\pi^0), \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0\pi^0\bar{K}^0) \\ &= 3\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^0\bar{K}^0\eta), \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+\pi^0K^-) \\ &= 3\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^+K^-\eta), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0\pi^-\bar{K}^0) \\ &= \frac{3}{4}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^0\pi^-\eta), \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^+\pi^0\eta) \\ &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^+\pi^-\eta), \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0\pi^0K^0) \\ &= 3\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^0K^0\eta). \end{aligned}$$

5.3 $b \rightarrow u\bar{c}d/s$ transition

5.3.1 Two-body decays into mesons

The $(\bar{u}b)(\bar{q}c)$ transition can lead to an anti-symmetric $\bar{\mathbf{3}}$ and a symmetric $\mathbf{6}$ tensor representations. The anti-symmetric tensor H_3'' and the symmetric tensor H_6 have the nonzero components $(H_3'')^{13} = -(H_3'')^{31} = V_{cs}^*$, $(H_6)^{13} = (H_6)^{31} = V_{cs}^*$, for the $b \rightarrow u\bar{c}s$ or $b\bar{s} \rightarrow u\bar{c}$ transition. When interchanging 2 $\leftrightarrow$ 3 in the subscripts and replacing V_{cs} by V_{cd} at the same time, one gets the nonzero components for the $b \rightarrow u\bar{c}d$ transition. The effective Hamiltonian for X_{b6} produce two mesons by $b \rightarrow u\bar{c}d/s$ transition is

$$\begin{aligned} \mathcal{H}_{eff} = & a_7(X_{b6})_{[jk]}^i (H_3'')^{[jk]} M_i^l D_l \\ & + a_8(X_{b6})_{[jk]}^i (H_3'')^{[jl]} M_i^k D_l \\ & + a_9(X_{b6})_{[jk]}^i (H_3'')^{[jl]} M_i^k D_i \\ & + a_{10}(X_{b6})_{[jk]}^i (H_6)^{\{jl\}} M_i^k D_l \\ & + a_{11}(X_{b6})_{[jk]}^i (H_6)^{\{jl\}} M_i^k D_i. \end{aligned} \quad (19)$$

Decay amplitudes for different channels are shown in Table 18, which leads to the following relations

$$\begin{aligned} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \bar{D}^0\pi^-) &= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0K^-), \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^-\pi^+) \end{aligned}$$

Table 17 Open bottom tetraquark X_{b6} decays into a charmed meson and two light meson

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
$X_{ud\bar{s}}^+ \rightarrow D^0 \pi^+ K^0$	$\frac{(a_9 - a_{11} + a_{14}) V_{ud}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow D^0 \pi^+ \eta$	$-\frac{(a_9 - a_{11} + a_{14}) V_{us}^*}{\sqrt{3}}$
$X_{ud\bar{s}}^+ \rightarrow D^0 \pi^0 K^+$	$\frac{(a_9 - a_{11} + a_{14}) V_{ud}^*}{2}$	$X_{ud\bar{s}}^+ \rightarrow D^0 K^+ \bar{K}^0$	$-\frac{(a_9 - a_{11} + a_{14}) V_{us}^*}{\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow D^0 K^+ \eta$	$-\frac{(a_9 - a_{11} + a_{14}) V_{ud}^*}{2\sqrt{3}}$	$X_{ud\bar{s}}^+ \rightarrow D^+ \pi^+ \pi^-$	$-\frac{(2a_8 + a_9 + a_{12}) V_{us}^*}{\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow D^+ \pi^0 \pi^0$	$-\frac{(2a_8 + a_9 + a_{12}) V_{us}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow D^+ \pi^0 K^0$	$-\frac{(a_9 + a_{10} - a_{15}) V_{ud}^*}{2}$
$X_{ud\bar{s}}^+ \rightarrow D^+ \pi^0 \eta$	$\frac{(a_9 - a_{11} - a_{12} - a_{15}) V_{us}^*}{\sqrt{6}}$	$X_{ud\bar{s}}^+ \rightarrow D^+ \pi^- K^+$	$\frac{(a_9 + a_{10} + a_{13}) V_{ud}^*}{\sqrt{6}}$
$X_{ud\bar{s}}^+ \rightarrow D^+ K^+ K^-$	$\frac{(-2a_8 + a_{10} - a_{12} + a_{13}) V_{us}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow D^+ K^0 \bar{K}^0$	$\frac{(-2a_8 - a_9 + a_{10} + a_{11}) V_{us}^*}{\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow D^+ K^0 \eta$	$-\frac{(a_9 + a_{10} - a_{15}) V_{ud}^*}{2\sqrt{3}}$	$X_{ud\bar{s}}^+ \rightarrow D^+ \eta \eta$	$-\frac{(6a_8 + a_9 - 4a_{10} - 2a_{11} + a_{12} + 2a_{15}) V_{us}^*}{3\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow D_s^+ \pi^+ \pi^-$	$\frac{(2a_8 - a_{10} + a_{12} - a_{13}) V_{ud}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow D_s^+ \pi^+ K^-$	$-\frac{(a_9 + a_{10} + a_{13}) V_{us}^*}{\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow D_s^+ \pi^0 \pi^0$	$\frac{(2a_8 - a_{10} + a_{12} + a_{15}) V_{ud}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow D_s^+ \pi^0 \bar{K}^0$	$\frac{(a_9 + a_{10} - a_{15}) V_{us}^*}{2}$
$X_{ud\bar{s}}^+ \rightarrow D_s^+ \pi^0 \eta$	$\frac{(a_{10} + a_{11} + a_{12}) V_{ud}^*}{\sqrt{6}}$	$X_{ud\bar{s}}^+ \rightarrow D_s^+ K^+ K^-$	$\frac{(2a_8 + a_9 + a_{12}) V_{ud}^*}{\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow D_s^+ K^0 \bar{K}^0$	$\frac{(2a_8 + a_9 - a_{10} - a_{11}) V_{ud}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow D_s^+ \bar{K}^0 \eta$	$\frac{(a_9 + a_{10} - a_{15}) V_{us}^*}{2\sqrt{3}}$
$X_{ud\bar{s}}^+ \rightarrow D_s^+ \eta \eta$	$\frac{(6a_8 + 4a_9 - a_{10} - 2a_{11} + a_{12} - a_{15}) V_{ud}^*}{3\sqrt{2}}$	$X_{d\bar{s}u}^- \rightarrow D^0 \pi^- K^0$	$-\frac{(a_{13} + a_{15}) V_{ud}^*}{\sqrt{2}}$
$X_{d\bar{s}u}^- \rightarrow D^0 \pi^- \eta$	$\frac{(a_{12} + a_{14} + a_{15}) V_{us}^*}{\sqrt{3}}$	$X_{d\bar{s}u}^- \rightarrow D^0 K^0 K^-$	$\frac{(a_{12} - a_{13} + a_{14}) V_{us}^*}{\sqrt{2}}$
$X_{d\bar{s}u}^- \rightarrow D_s^+ \pi^- \pi^-$	$\sqrt{2} (a_{13} + a_{15}) V_{ud}^*$	$X_{d\bar{s}u}^- \rightarrow D_s^+ \pi^- K^-$	$\frac{(a_{13} + a_{15}) V_{us}^*}{\sqrt{2}}$
$X_{s\bar{u}d}^- \rightarrow D^0 \pi^0 K^-$	$-\frac{(a_{12} + a_{14} + a_{15}) V_{ud}^*}{2}$	$X_{s\bar{u}d}^- \rightarrow D^0 \pi^- \bar{K}^0$	$-\frac{(a_{12} - a_{13} + a_{14}) V_{ud}^*}{\sqrt{2}}$
$X_{s\bar{u}d}^- \rightarrow D^0 \bar{K}^0 K^-$	$\frac{(a_{13} + a_{15}) V_{us}^*}{\sqrt{2}}$	$X_{s\bar{u}d}^- \rightarrow D^0 K^- \eta$	$\frac{(a_{12} + a_{14} + a_{15}) V_{ud}^*}{2\sqrt{3}}$
$X_{s\bar{u}d}^- \rightarrow D^+ \pi^- K^-$	$-\frac{(a_{13} + a_{15}) V_{ud}^*}{\sqrt{2}}$	$X_{s\bar{u}d}^- \rightarrow D^+ K^- K^-$	$-\sqrt{2} (a_{13} + a_{15}) V_{us}^*$
$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^0 \pi^+ \pi^-$	$-\frac{(2a_8 + a_9 - a_{10} - a_{11} + a_{12} - a_{13} + a_{14}) V_{ud}^*}{2}$	$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^0 \pi^+ K^-$	$\frac{(a_{10} + a_{11} + a_{13} - a_{14}) V_{us}^*}{2}$
$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^0 \pi^0 \pi^0$	$-\frac{(2a_8 + a_9 - a_{10} - a_{11} + a_{12} + a_{14} + a_{15}) V_{ud}^*}{2}$	$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^0 \pi^0 \bar{K}^0$	$\frac{(-a_{10} - a_{11} + a_{14} + a_{15}) V_{us}^*}{2\sqrt{2}}$
$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^0 \pi^0 \eta$	$-\frac{(a_9 + a_{10} + a_{12} + a_{14}) V_{ud}^*}{2\sqrt{3}}$	$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^0 K^+ K^-$	$-\frac{(2a_8 + a_9 + a_{12}) V_{ud}^*}{2}$
$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^0 K^0 \bar{K}^0$	$\frac{(-2a_8 + a_{10} + a_{14}) V_{ud}^*}{2}$	$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^0 \bar{K}^0 \eta$	$\frac{(-a_{10} - a_{11} + a_{14} + a_{15}) V_{us}^*}{2\sqrt{6}}$
$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^0 \eta \eta$	$-\frac{(6a_8 + a_9 - a_{10} + a_{11} + a_{12} - 3a_{14} - a_{15}) V_{ud}^*}{6}$	$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^+ \pi^0 \pi^-$	$-\frac{(a_{13} + a_{15}) V_{ud}^*}{2\sqrt{2}}$
$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^+ \pi^0 K^-$	$-\frac{(a_{10} + a_{11} + a_{12} + a_{13} + a_{15}) V_{us}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^+ \pi^- \bar{K}^0$	$-\frac{(a_{10} + a_{11} + a_{12}) V_{us}^*}{2}$
$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^+ \pi^- \eta$	$-\frac{(2a_9 + 2a_{10} + 3a_{13} + a_{15}) V_{ud}^*}{2\sqrt{6}}$	$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^+ K^0 K^-$	$-\frac{(a_9 + a_{10} - a_{15}) V_{ud}^*}{2}$
$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D^+ K^- \eta$	$\frac{(a_{10} + a_{11} + a_{12} - 3a_{13} - 3a_{15}) V_{us}^*}{2\sqrt{6}}$	$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D_s^+ \pi^0 K^-$	$\frac{(-a_9 + a_{11} + a_{12} + a_{15}) V_{ud}^*}{2\sqrt{2}}$
$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D_s^+ \pi^- \bar{K}^0$	$\frac{1}{2} (-a_9 + a_{11} + a_{12} - a_{13}) V_{ud}^*$	$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D_s^+ \bar{K}^0 K^-$	$-\frac{(a_{13} + a_{15}) V_{us}^*}{2}$
$Y_{(u\bar{u}, s\bar{s})d}^0 \rightarrow D_s^+ K^- \eta$	$\frac{(a_9 - a_{11} - a_{12} - a_{15}) V_{ud}^*}{2\sqrt{6}}$	$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^0 \pi^+ \pi^-$	$\frac{(2a_8 + a_9 + a_{12}) V_{us}^*}{2}$
$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^0 \pi^0 \pi^0$	$\frac{(2a_8 + a_9 + a_{12}) V_{us}^*}{2}$	$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^0 \pi^0 K^0$	$\frac{(a_{10} + a_{11} - a_{14} - a_{15}) V_{ud}^*}{2\sqrt{2}}$
$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^0 \pi^0 \eta$	$\frac{(a_9 - a_{11} + a_{12} + 2a_{14} + a_{15}) V_{us}^*}{2\sqrt{3}}$	$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^0 \pi^- K^+$	$-\frac{(a_{10} + a_{11} + a_{13} - a_{14}) V_{ud}^*}{2}$
$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^0 K^+ K^-$	$\frac{(2a_8 + a_9 - a_{10} - a_{11} + a_{12} - a_{13} + a_{14}) V_{us}^*}{2}$	$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^0 K^0 \bar{K}^0$	$\frac{(2a_8 - a_{10} - a_{14}) V_{us}^*}{2}$
$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^0 K^0 \eta$	$\frac{(a_{10} + a_{11} - a_{14} - a_{15}) V_{ud}^*}{2\sqrt{6}}$	$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^0 \eta \eta$	$\frac{(6a_8 + a_9 - 4a_{10} - 2a_{11} + a_{12} + 2a_{15}) V_{us}^*}{6}$
$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^+ \pi^- K^0$	$\frac{(a_{13} + a_{15}) V_{ud}^*}{2}$	$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^+ \pi^- \eta$	$\frac{(a_9 - a_{11} - a_{12} - a_{15}) V_{us}^*}{\sqrt{6}}$
$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D^+ K^0 K^-$	$\frac{(a_9 - a_{11} - a_{12} + a_{13}) V_{us}^*}{2}$	$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D_s^+ \pi^0 \pi^-$	$\frac{(a_{13} + a_{15}) V_{ud}^*}{\sqrt{2}}$
$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D_s^+ \pi^0 K^-$	$\frac{(a_9 + a_{10} + 2a_{13} + a_{15}) V_{us}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, d\bar{d})s}^0 \rightarrow D_s^+ \pi^- \bar{K}^0$	$\frac{1}{2} (a_9 + a_{10} - a_{15}) V_{us}^*$

Table 17 continued

Channel	Amplitude ($/V_{cb}$)	Channel	Amplitude ($/V_{cb}$)
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ \pi^- \eta$	$\frac{(a_{10}+a_{11}+a_{12})V_{ud}^*}{\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ K^0 K^-$	$\frac{(a_{10}+a_{11}+a_{12})V_{ud}^*}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^+ K^- \eta$	$-\frac{(a_9+a_{10}-a_{15})V_{us}^*}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \pi^0 \pi^-$	$-\frac{(a_{13}+a_{15})V_{ud}^*}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \pi^0 K^-$	$\frac{(a_{12}-a_{13}+a_{14})V_{us}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \pi^- \bar{K}^0$	$\frac{1}{2}(a_{12}+a_{14}+a_{15})V_{us}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 \pi^- \eta$	$\frac{(-2a_{12}+3a_{13}-2a_{14}+a_{15})V_{ud}^*}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 K^0 K^-$	$-\frac{(a_{12}+a_{14}+a_{15})V_{ud}^*}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^0 K^- \eta$	$-\frac{(a_{12}-3a_{13}+a_{14}-2a_{15})V_{us}^*}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^+ \pi^- \pi^-$	$-(a_{13}+a_{15})V_{us}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^+ \pi^- K^-$	$-\frac{(a_{13}+a_{15})V_{us}^*}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^+ \pi^- K^-$	$\frac{(a_{13}+a_{15})V_{ud}^*}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^+ K^- K^-$	$(a_{13}+a_{15})V_{us}^*$		

Table 18 Open bottom tetraquark X_{b6} decays into a anti-charmed meson and a light meson

Channel	Amplitude ($/V_{ub}$)	Channel	Amplitude ($/V_{ub}$)
$X_{u\bar{d}\bar{s}}^+ \rightarrow \bar{D}^0 \pi^+$	$\frac{(a_8+a_9-a_{10}-a_{11})V_{cs}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \bar{D}^0 K^+$	$\frac{(-a_8-a_9+a_{10}+a_{11})V_{cd}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \bar{D}^0 \pi^-$	$\frac{(-2a_7-a_8+a_{10})V_{cs}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D^- \pi^0$	$\frac{1}{2}(2a_7-a_9+a_{11})V_{cs}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^- K^0$	$-\frac{(a_8+a_9+a_{10}+a_{11})V_{cd}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D^- \eta$	$\frac{(-2a_7+a_9+3a_{11})V_{cs}^*}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D_s^- K^0$	$-\frac{(2a_7+a_8+a_{10})V_{cs}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \bar{D}^0 K^-$	$\frac{(2a_7+a_8-a_{10})V_{cd}^*}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow D^- \bar{K}^0$	$\frac{(2a_7+a_8+a_{10})V_{cd}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- \pi^0$	$-a_{11}V_{cd}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- \bar{K}^0$	$\frac{(a_8+a_9+a_{10}+a_{11})V_{cs}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- \eta$	$\frac{(a_9-2a_7)V_{cd}^*}{\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \pi^0$	$\frac{(2a_7+a_8-a_{10}-2a_{11})V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \bar{K}^0$	$\frac{1}{2}(a_8+a_9-a_{10}+a_{11})V_{cs}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \eta$	$\frac{(2a_7+3a_8+2a_9-3a_{10})V_{cd}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^- \pi^+$	$\frac{1}{2}(2a_7+a_8+a_{10})V_{cd}^*$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^- \pi^+$	$\frac{1}{2}(a_8+a_9+a_{10}-a_{11})V_{cs}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^- K^+$	$\frac{1}{2}(2a_7-a_9+a_{11})V_{cd}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \pi^0$	$-\frac{(2a_7+2a_8+a_9-2a_{10}-a_{11})V_{cs}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 K^0$	$-\frac{1}{2}(a_8+a_9-a_{10}+a_{11})V_{cd}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \eta$	$\frac{(-2a_7+a_9+3a_{11})V_{cs}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- \pi^+$	$-\frac{1}{2}(2a_7-a_9+a_{11})V_{cs}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- K^+$	$-\frac{1}{2}(a_8+a_9+a_{10}-a_{11})V_{cd}^*$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^- K^+$	$-\frac{1}{2}(2a_7+a_8+a_{10})V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0 \pi^-$	$\frac{1}{2}(2a_7+a_8-a_{10})V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0 K^-$	$-\frac{1}{2}(2a_7+a_8-a_{10})V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- \pi^0$	$-\frac{(2a_7+a_8+a_{10}+2a_{11})V_{cd}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- \bar{K}^0$	$\frac{1}{2}(-2a_7+a_9+a_{11})V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- \eta$	$\frac{(2a_7+3a_8+2a_9+3a_{10})V_{cd}^*}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \pi^0$	$-\frac{(a_8+a_9+a_{10}-a_{11})V_{cs}^*}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- K^0$	$\frac{1}{2}(2a_7-a_9-a_{11})V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \eta$	$\frac{(4a_7+3a_8+a_9+3a_{10}+3a_{11})V_{cs}^*}{2\sqrt{6}}$

$$\begin{aligned}
&= \frac{1}{2} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^- \bar{K}^0), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^- \pi^+) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \pi^0), \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- \pi^+) \\
&= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^- \pi^0), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^- K^+) \\
&= \frac{1}{2} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D_s^- K^0), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0 \pi^-) \\
&= \frac{1}{2} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \bar{D}^0 K^-),
\end{aligned}$$

$$\begin{aligned}
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \eta) \\
&= \frac{1}{2} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^- \eta).
\end{aligned}$$

5.3.2 Two-body decays into a baryon and an anti-baryon

The $b \rightarrow u\bar{c}d/s$ transition can lead to the decays into an anti-charmed anti-baryon plus a light baryon. The effective Hamiltonian in hadron level is then written as

$$\mathcal{H}_{eff} = b_1(T_{b6})_{[ij],[kl]}(H_3'')^{[ij]}(T_8)_m^k(T_{\bar{c}3})^{[lm]}$$

$$\begin{aligned}
& + b_2(T_{b6})_{[ij],[kl]}(H_3'')^{[im]}(T_8)_m^j(T_{\bar{c}3})^{[kl]} \\
& + b_3(T_{b6})_{[ij],[kl]}(H_6'')^{[ik]}(T_8)_m^j(T_{\bar{c}3})^{[lm]} \\
& + b_4(T_{b6})_{[ij],[kl]}(H_6'')^{[im]}(T_8)_m^j(T_{\bar{c}3})^{[kl]} \\
& + c_1(T_{b6})_{[ij],[kl]}(H_3'')^{[ij]}(T_8)_m^k(T_{\bar{c}6})^{[lm]} \\
& + c_2(T_{b6})_{[ij],[kl]}(H_3'')^{[im]}(T_8)_m^k(T_{\bar{c}6})^{[jl]} \\
& + c_3(T_{b6})_{[ij],[kl]}(H_6'')^{[ik]}(T_8)_m^j(T_{\bar{c}6})^{[lm]} \\
& + c_4(T_{b6})_{[ij],[kl]}(H_6'')^{[im]}(T_8)_m^k(T_{\bar{c}6})^{[jl]} \\
& + d_1(T_{b6})_{[ijk]}^i(H_3'')^{[jl]}(T_{10})_{\{ilm\}}(T_{\bar{c}3})^{[km]} \\
& + d_2(T_{b6})_{[ijk]}^i(H_6'')^{[jl]}(T_{10})_{\{ilm\}}(T_{\bar{c}3})^{[km]} \\
& + d_3(T_{b6})_{[ijk]}^i(H_6'')^{[lm]}(T_{10})_{\{ilm\}}(T_{\bar{c}3})^{[jk]} \\
& + f_1(T_{b6})_{[ijk]}^i(H_3'')^{[jk]}(T_{10})_{\{ilm\}}(T_{\bar{c}6})^{[lm]} \\
& + f_2(T_{b6})_{[ijk]}^i(H_3'')^{[jl]}(T_{10})_{\{ilm\}}(T_{\bar{c}6})^{[km]} \\
& + f_3(T_{b6})_{[ijk]}^i(H_6'')^{[jl]}(T_{10})_{\{ilm\}}(T_{\bar{c}6})^{[km]}. \quad (20)
\end{aligned}$$

The related decay amplitudes for different channels are given in Tables 19 and 20. Therein class I corresponds with the processes with octet baryon plus triplet anti-baryon, class II corresponds with the processes with octet baryon plus anti-sextet anti-baryon, class III corresponds with the processes with decuplet baryon plus triplet anti-baryon, class IV corresponds with the processes with decuplet baryon plus anti-sextet anti-baryon. The relation of decay widths for class I are given as:

$$\begin{aligned}
& \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda^0 \bar{\Xi}_c^-) \\
& = 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Xi}_c^0), \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}_c^0) \\
& = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}_c^0), \\
& \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Lambda}_c^-) \\
& = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Lambda}_c^-), \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Xi}_c^-) \\
& = \frac{1}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Xi}_c^-), \\
& \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^+ \bar{\Xi}_c^-) \\
& = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^0 \bar{\Xi}_c^-), \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow p \bar{\Lambda}_c^-) \\
& = \frac{1}{2}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Lambda}_c^-), \\
& \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}_c^0) \\
& = \frac{1}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Xi}_c^0).
\end{aligned}$$

The relations of decay widths for class II are given as

$$\begin{aligned}
& \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow p \bar{\Sigma}_c^0) \\
& = 2\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Xi}_c^0), \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow p \bar{\Xi}_c^0) \\
& = \frac{1}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Omega}_c^0),
\end{aligned}$$

$$\begin{aligned}
& \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda^0 \bar{\Xi}_c^{\prime -}) \\
& = 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Xi}_c^0), \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Sigma}_c^-) \\
& = \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow n \bar{\Sigma}_c^0), \\
& \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Xi}_c^0) \\
& = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Omega}_c^0), \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Sigma}_c^-) \\
& = \frac{1}{2}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Sigma}_c^0), \\
& \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Xi}_c^{\prime -}) \\
& = \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Omega}_c^0), \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Sigma}_c^-) \\
& = \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Sigma}_c^0), \\
& \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}_c^-) \\
& = \frac{1}{2}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Sigma}_c^0), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Sigma}_c^0) \\
& = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}_c^0), \\
& \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi^- \bar{\Omega}_c^0) \\
& = 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi^0 \bar{\Omega}_c^0), \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^+ \bar{\Sigma}_c^-) \\
& = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow p \bar{\Sigma}_c^-), \\
& \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^- \bar{\Sigma}_c^0) \\
& = 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow n \bar{\Sigma}_c^0), \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^+ \bar{\Xi}_c^{\prime -}) \\
& = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^0 \bar{\Xi}_c^{\prime -}), \\
& \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^+ \bar{\Sigma}_c^-) \\
& = \frac{1}{2}\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow p \bar{\Sigma}_c^-).
\end{aligned}$$

The relations of decay widths for class III are given as

$$\begin{aligned}
& \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^{\prime +} \bar{\Lambda}_c^-) \\
& = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^{\prime 0} \bar{\Lambda}_c^-), \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Xi}_c^-) \\
& = 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^{\prime 0} \bar{\Xi}_c^-), \\
& \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0 \bar{\Xi}_c^0) \\
& = 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^{\prime 0} \bar{\Xi}_c^0), \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^{\prime 0} \bar{\Xi}_c^0) \\
& = \frac{1}{2}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^{\prime 0} \bar{\Xi}_c^0), \\
& \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++} \bar{\Lambda}_c^-) \\
& = 3\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0 \bar{\Lambda}_c^-) \\
& = \frac{3}{2}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Lambda}_c^-), \\
& \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++} \bar{\Xi}_c^-) \\
& = 3\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^{\prime 0} \bar{\Xi}_c^-)
\end{aligned}$$

Table 19 Open bottom tetraquark X_{b6} decays into a anti-charmed anti-baryon triplet and a light baryon octet for class I, a anti-charmed anti-baryon anti-sextet and a light baryon octet for class II

Channel	Amplitude ($/V_{ub}$)	Channel	Amplitude ($/V_{ub}$)
Class I			
$X_{ud\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Xi}_c^0$	$\sqrt{2} (b_2 - b_4) V_{cs}^*$	$X_{ud\bar{s}}^+ \rightarrow p \bar{\Xi}_c^0$	$\sqrt{2} (b_4 - b_2) V_{cd}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda^0 \bar{\Xi}_c^-$	$\frac{(2b_1 - 2b_2 + 3b_3 - 6b_4) V_{cs}^*}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^0 \bar{\Xi}_c^-$	$\frac{1}{2} (-2b_1 + 2b_2 + b_3 - 2b_4) V_{cs}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}_c^0$	$\frac{(b_3 - 2b_1) V_{cs}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Lambda}_c^-$	$-\frac{(2b_1 + b_3) V_{cs}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Xi}_c^-$	$\sqrt{2} (b_2 + b_4) V_{cd}^*$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Lambda^0 \bar{\Lambda}_c^-$	$\frac{2(b_2 - b_1) V_{cd}^*}{\sqrt{3}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^0 \bar{\Lambda}_c^-$	$(b_3 - 2b_4) V_{cd}^*$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Xi}_c^0$	$\frac{(2b_1 - b_3) V_{cd}^*}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Lambda}_c^-$	$\sqrt{2} (b_2 + b_4) V_{cs}^*$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Xi}_c^-$	$-\frac{(2b_1 + b_3) V_{cd}^*}{\sqrt{2}}$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Xi}_c^0$	$\frac{(2b_1 + 4b_2 - 3b_3) V_{cd}^*}{2\sqrt{6}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Lambda}_c^-$	$(b_2 + b_3 - b_4) V_{cs}^*$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Xi}_c^-$	$-\frac{1}{2} (2b_1 + b_3) V_{cd}^*$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Xi}_c^0$	$\frac{(2b_1 + b_3 - 4b_4) V_{cd}^*}{2\sqrt{2}}$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow p \bar{\Lambda}_c^-$	$\frac{1}{2} (2b_1 - 2b_2 - b_3 + 2b_4) V_{cd}^*$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Xi}_c^0$	$(b_2 - b_3 + b_4) V_{cs}^*$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Xi}_c^0$	$\frac{(-2b_1 + 2b_2 - 3b_3 + 6b_4) V_{cs}^*}{2\sqrt{6}}$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Sigma^+ \bar{\Xi}_c^-$	$\frac{1}{2} (2b_1 - 2b_2 - b_3 + 2b_4) V_{cs}^*$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Sigma^0 \bar{\Xi}_c^0$	$\frac{(-2b_1 - 2b_2 + b_3 + 2b_4) V_{cs}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow p \bar{\Lambda}_c^-$	$-\frac{1}{2} (2b_1 + b_3) V_{cs}^*$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow p \bar{\Xi}_c^-$	$(b_2 + b_3 - b_4) V_{cd}^*$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow n \bar{\Xi}_c^0$	$-(b_2 - b_3 + b_4) V_{cd}^*$
$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Lambda}_c^-$	$\frac{(2b_1 + b_2 + 3b_4) V_{cs}^*}{\sqrt{6}}$	$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Xi}_c^-$	$-\frac{(2b_1 + 4b_2 + 3b_3) V_{cd}^*}{2\sqrt{6}}$
$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Lambda}_c^-$	$-\frac{(b_2 + b_3 - b_4) V_{cs}^*}{\sqrt{2}}$	$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Xi}_c^-$	$\frac{(2b_1 - b_3 + 4b_4) V_{cd}^*}{2\sqrt{2}}$
$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}_c^0$	$\frac{1}{2} (2b_1 - b_3) V_{cd}^*$	$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow n \bar{\Lambda}_c^-$	$\frac{1}{2} (2b_1 - 2b_2 + b_3 - 2b_4) V_{cd}^*$
$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}_c^0$	$\frac{1}{2} (b_3 - 2b_1) V_{cs}^*$	$Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Xi^0 \bar{\Xi}_c^-$	$\frac{1}{2} (2b_1 - 2b_2 + b_3 - 2b_4) V_{cs}^*$
Class II			
$X_{ud\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Xi}_c^0$	$\frac{1}{2} (c_2 - c_4) V_{cs}^*$	$X_{ud\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Omega}_c^0$	$\frac{(c_4 - c_2) V_{cd}^*}{\sqrt{2}}$
$X_{ud\bar{s}}^+ \rightarrow p \bar{\Sigma}_c^0$	$\frac{(c_4 - c_2) V_{cs}^*}{\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow p \bar{\Xi}_c^0$	$\frac{1}{2} (c_2 - c_4) V_{cd}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda^0 \bar{\Xi}_c^-$	$\frac{(6c_1 + 3c_2 + c_3 + c_4) V_{cs}^*}{2\sqrt{6}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^0 \bar{\Xi}_c^-$	$\frac{(2c_1 + c_2 - c_3 - c_4) V_{cs}^*}{2\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}_c^0$	$\frac{1}{2} (2c_1 - c_3) V_{cs}^*$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Omega}_c^0$	$\frac{(c_2 + c_4) V_{cd}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow p \bar{\Sigma}_c^-$	$-\frac{(2c_1 + c_2 + c_3 - c_4) V_{cs}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Sigma}_c^-$	$-\frac{1}{2} (2c_1 + c_3) V_{cs}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Xi}_c^-$	$-\frac{1}{2} (c_2 + c_4) V_{cd}^*$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi^- \bar{\Omega}_c^0$	$\frac{(2c_1 + c_2 - c_3 + c_4) V_{cs}^*}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Lambda^0 \bar{\Sigma}_c^-$	$-\frac{(c_3 + c_4) V_{cd}^*}{\sqrt{6}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^+ \bar{\Sigma}_c^-$	$-\frac{(2c_1 + c_2 + c_3 - c_4) V_{cd}^*}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^0 \bar{\Sigma}_c^-$	$\frac{(2c_1 + c_2) V_{cd}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^- \bar{\Sigma}_c^0$	$\frac{(2c_1 + c_2 - c_3 + c_4) V_{cd}^*}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Sigma}_c^0$	$\frac{(c_2 + c_4) V_{cs}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Xi}_c^0$	$\frac{1}{2} (2c_1 - c_3) V_{cd}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Sigma}_c^-$	$-\frac{1}{2} (c_2 + c_4) V_{cs}^*$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Xi}_c^-$	$-\frac{1}{2} (2c_1 + c_3) V_{cd}^*$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Sigma}_c^0$	$\frac{(3c_2 - 2c_3 + c_4) V_{cs}^*}{2\sqrt{6}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Xi}_c^0$	$\frac{(6c_1 - c_3 + 2c_4) V_{cd}^*}{4\sqrt{3}}$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Sigma}_c^-$	$-\frac{(c_2 + 2c_3 - c_4) V_{cs}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Xi}_c^-$	$\frac{(2c_1 + 2c_2 + c_3 - 2c_4) V_{cd}^*}{2\sqrt{2}}$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Sigma}_c^0$	$\frac{(c_2 + 2c_3 - c_4) V_{cs}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Xi}_c^0$	$-\frac{1}{4} (2c_1 + 2c_2 + c_3) V_{cd}^*$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow p \bar{\Sigma}_c^-$	$\frac{(-2c_1 - c_2 + c_3 + c_4) V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow n \bar{\Sigma}_c^0$	$-\frac{1}{2} (2c_1 + c_2 - c_3 + c_4) V_{cd}^*$
$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Xi}_c^0$	$\frac{(c_2 - 2c_3 + c_4) V_{cs}^*}{2\sqrt{2}}$	$Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Omega}_c^0$	$\frac{1}{2} (2c_1 + c_3) V_{cd}^*$
$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Xi}_c^0$	$-\frac{(6c_1 + 3c_2 + c_3 + c_4) V_{cs}^*}{4\sqrt{3}}$	$Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Omega}_c^0$	$\frac{(2c_3 - c_4) V_{cd}^*}{\sqrt{6}}$

Table 19 continued

Channel	Amplitude ($/V_{ub}$)	Channel	Amplitude ($/V_{ub}$)
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma^+ \bar{\Xi}_c'^-$	$\frac{(-2c_1 - c_2 + c_3 + c_4)V_{cs}^*}{2\sqrt{2}}$	$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma^0 \bar{\Xi}_c'^0$	$\frac{1}{4}(2c_1 - c_2 - c_3 + c_4)V_{cs}^*$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma^0 \bar{\Omega}_c^0$	$\frac{c_2 V_{cd}^*}{\sqrt{2}}$	$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow p \bar{\Sigma}_c^-$	$\frac{(2c_1 + 2c_2 + c_3 - 2c_4)V_{cs}^*}{2\sqrt{2}}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow p \bar{\Xi}_c'^-$	$-\frac{(c_2 + 2c_3 - c_4)V_{cd}^*}{2\sqrt{2}}$	$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow n \bar{\Sigma}_c^0$	$\frac{1}{2}(2c_1 + c_3)V_{cs}^*$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow n \bar{\Xi}_c'^0$	$\frac{(c_2 - 2c_3 + c_4)V_{cd}^*}{2\sqrt{2}}$	$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Xi^0 \bar{\Omega}_c^0$	$-\frac{1}{2}(2c_1 + c_2 - c_3 + c_4)V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}_c^-$	$-\frac{(3c_2 - 2c_3 + c_4)V_{cs}^*}{4\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Xi}_c'^-$	$-\frac{(6c_1 + c_3 - 2c_4)V_{cd}^*}{4\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^+ \bar{\Sigma}_c^-$	$\frac{1}{2}(2c_1 + c_2 + c_3 - c_4)V_{cs}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Sigma}_c^-$	$-\frac{1}{4}(4c_1 + c_2 - c_4)V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Xi}_c'^-$	$\frac{1}{4}(-2c_1 - 2c_2 + c_3)V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}_c'^0$	$\frac{1}{2}(c_3 - 2c_1)V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}_c'^0$	$\frac{(-2c_1 - 2c_2 + c_3 - 2c_4)V_{cd}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow p \bar{\Sigma}_c^-$	$\frac{1}{2}(2c_1 + c_2 + c_3 - c_4)V_{cd}^*$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow n \bar{\Sigma}_c^-$	$\frac{(2c_1 + c_2 + c_3 + c_4)V_{cd}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}_c'^0$	$\frac{(-2c_1 - 2c_2 + c_3 - 2c_4)V_{cs}^*}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Omega}_c^0$	$\frac{1}{2}(c_3 - 2c_1)V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^0 \bar{\Xi}_c'^-$	$\frac{(2c_1 + c_2 + c_3 + c_4)V_{cs}^*}{2\sqrt{2}}$

Table 20 Open bottom tetraquark X_{b6} decays into an anti-charmed anti-baryon triplet and a light baryon decuplet for class III, an anti-charmed anti-baryon anti-sextet and a light baryon decuplet for class IV

Channel	Amplitude ($/V_{ub}$)	Channel	Amplitude ($/V_{ub}$)
Class III			
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++} \bar{\Lambda}_c^-$	$\frac{(d_2 - d_1)V_{cs}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++} \bar{\Xi}_c^-$	$\frac{(d_1 - d_2)V_{cd}^*}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^+ \bar{\Xi}_c^0$	$\frac{(d_1 - d_2 + 4d_3)V_{cd}^*}{\sqrt{6}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^+ \bar{\Xi}_c^0$	$\frac{(d_1 - d_2 + 4d_3)V_{cs}^*}{\sqrt{6}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0 \bar{\Lambda}_c^-$	$\frac{(d_2 - d_1)V_{cs}^*}{\sqrt{6}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0 \bar{\Xi}_c^-$	$\frac{(d_1 + d_2 - 4d_3)V_{cd}^*}{\sqrt{6}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^- \bar{\Xi}_c^0$	$\frac{(d_1 + d_2)V_{cd}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Xi}_c^-$	$\frac{(d_2 - 2d_3)V_{cs}^*}{\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^- \bar{\Xi}_c^0$	$\frac{(d_1 + d_2)V_{cs}^*}{\sqrt{6}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^0 \bar{\Lambda}_c^-$	$-\frac{(d_2 - 2d_3)V_{cd}^*}{\sqrt{3}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0 \bar{\Lambda}_c^-$	$-\frac{(d_1 + d_2 - 4d_3)V_{cs}^*}{\sqrt{6}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0 \bar{\Xi}_c^-$	$\frac{(d_1 - d_2)V_{cd}^*}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^- \bar{\Xi}_c^0$	$\frac{(d_1 + d_2)V_{cd}^*}{\sqrt{6}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^- \bar{\Xi}_c^0$	$\frac{(d_1 + d_2)V_{cs}^*}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^+ \bar{\Lambda}_c^-$	$-\frac{(d_2 - 2d_3)V_{cd}^*}{\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+ \bar{\Lambda}_c^-$	$-\frac{(d_1 - 2d_3)V_{cs}^*}{\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+ \bar{\Xi}_c^-$	$\frac{(d_1 - d_2)V_{cd}^*}{\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0 \bar{\Xi}_c^0$	$\frac{(d_1 + 2d_3)V_{cd}^*}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^0 \bar{\Xi}_c^0$	$\frac{(d_1 + 2d_3)V_{cs}^*}{\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Lambda}_c^-$	$\frac{(d_2 - d_1)V_{cs}^*}{\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Xi}_c^-$	$\frac{(d_1 - 2d_3)V_{cd}^*}{\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0 \bar{\Xi}_c^0$	$\frac{(d_1 + 2d_3)V_{cd}^*}{\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^+ \bar{\Xi}_c^-$	$\frac{(d_2 - 2d_3)V_{cs}^*}{\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^0 \bar{\Xi}_c^0$	$\frac{(d_1 + 2d_3)V_{cs}^*}{\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^0 \bar{\Lambda}_c^-$	$-\frac{(d_2 - 2d_3)V_{cd}^*}{\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Lambda}_c^-$	$-\frac{(d_1 - 2d_3)V_{cs}^*}{\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Xi}_c^-$	$\frac{(d_1 - 2d_3)V_{cd}^*}{\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^- \bar{\Xi}_c^0$	$\frac{(d_1 + d_2)V_{cd}^*}{\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^0 \bar{\Xi}_c^-$	$\frac{(d_2 - 2d_3)V_{cs}^*}{\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^- \bar{\Xi}_c^0$	$\frac{(d_1 + d_2)V_{cs}^*}{\sqrt{3}}$
Class IV			
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++} \bar{\Sigma}_c^-$	$\frac{1}{2}(f_2 - f_3)V_{cs}^*$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++} \bar{\Xi}_c'^-$	$\frac{1}{2}(f_3 - f_2)V_{cd}^*$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^+ \bar{\Sigma}_c^0$	$\frac{(f_2 - f_3)V_{cs}^*}{\sqrt{6}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^+ \bar{\Xi}_c'^0$	$\frac{(f_3 - f_2)V_{cd}^*}{2\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^+ \bar{\Xi}_c'^0$	$\frac{(f_2 - f_3)V_{cs}^*}{2\sqrt{3}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^+ \bar{\Omega}_c^0$	$\frac{(f_3 - f_2)V_{cd}^*}{\sqrt{6}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^+ \bar{\Sigma}_c^-$	$\frac{(-2f_1 - f_2 + f_3)V_{cs}^*}{\sqrt{6}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0 \bar{\Sigma}_c^-$	$-\frac{(4f_1 + f_2 - f_3)V_{cs}^*}{2\sqrt{3}}$

Table 20 continued

Channel	Amplitude ($/V_{ub}$)	Channel	Amplitude ($/V_{ub}$)
$X_{d\bar{s}u}^- \rightarrow \Delta^0 \bar{\Xi}_c^{'-}$	$-\frac{(f_2+f_3)V_{cd}^*}{2\sqrt{3}}$	$X_{d\bar{s}u}^- \rightarrow \Delta^- \bar{\Sigma}_c^0$	$-\sqrt{2}f_1 V_{cs}^*$
$X_{d\bar{s}u}^- \rightarrow \Delta^- \bar{\Xi}_c^0$	$-\frac{1}{2}(f_2+f_3)V_{cd}^*$	$X_{d\bar{s}u}^- \rightarrow \Sigma^0 \bar{\Xi}_c^{'-}$	$-\frac{(2f_1+f_2)V_{cs}^*}{\sqrt{6}}$
$X_{d\bar{s}u}^- \rightarrow \Sigma^{'-} \bar{\Xi}_c^0$	$-\frac{(4f_1+f_2+f_3)V_{cs}^*}{2\sqrt{3}}$	$X_{d\bar{s}u}^- \rightarrow \Sigma^{'-} \bar{\Omega}_c^0$	$-\frac{(f_2+f_3)V_{cd}^*}{\sqrt{6}}$
$X_{d\bar{s}u}^- \rightarrow \Xi^{'-} \bar{\Omega}_c^0$	$-\frac{(2f_1+f_2+f_3)V_{cs}^*}{\sqrt{6}}$	$X_{s\bar{u}d}^- \rightarrow \Sigma^{'+} \bar{\Xi}_c^{'-}$	$\frac{(2f_1+f_2-f_3)V_{cd}^*}{\sqrt{6}}$
$X_{s\bar{u}d}^- \rightarrow \Sigma^0 \bar{\Sigma}_c^-$	$\frac{(2f_1+f_2)V_{cd}^*}{\sqrt{6}}$	$X_{s\bar{u}d}^- \rightarrow \Sigma^{'-} \bar{\Sigma}_c^0$	$\frac{(2f_1+f_2+f_3)V_{cd}^*}{\sqrt{6}}$
$X_{s\bar{u}d}^- \rightarrow \Xi^0 \bar{\Sigma}_c^-$	$\frac{(f_2+f_3)V_{cs}^*}{2\sqrt{3}}$	$X_{s\bar{u}d}^- \rightarrow \Xi^0 \bar{\Xi}_c^{'-}$	$\frac{(4f_1+f_2-f_3)V_{cd}^*}{2\sqrt{3}}$
$X_{s\bar{u}d}^- \rightarrow \Xi^{'-} \bar{\Sigma}_c^0$	$\frac{(f_2+f_3)V_{cs}^*}{\sqrt{6}}$	$X_{s\bar{u}d}^- \rightarrow \Xi^{'-} \bar{\Xi}_c^0$	$\frac{(4f_1+f_2+f_3)V_{cd}^*}{2\sqrt{3}}$
$X_{s\bar{u}d}^- \rightarrow \Omega^- \bar{\Xi}_c^0$	$\frac{1}{2}(f_2+f_3)V_{cs}^*$	$X_{s\bar{u}d}^- \rightarrow \Omega^- \bar{\Omega}_c^0$	$\sqrt{2}f_1 V_{cd}^*$
$Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Delta^{++} \bar{\Sigma}_c^{'-}$	$\frac{1}{2}(2f_1+f_2-f_3)V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Delta^+ \bar{\Sigma}_c^-$	$\frac{(2f_1+f_2)V_{cd}^*}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Delta^0 \bar{\Sigma}_c^0$	$\frac{(2f_1+f_2+f_3)V_{cd}^*}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Sigma^{'+} \bar{\Sigma}_c^-$	$\frac{f_2 V_{cs}^*}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Sigma^{'+} \bar{\Xi}_c^{'-}$	$\sqrt{\frac{2}{3}}f_1 V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Sigma^0 \bar{\Sigma}_c^0$	$\frac{f_2 V_{cs}^*}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Sigma^0 \bar{\Xi}_c^0$	$\frac{(2f_1+f_3)V_{cd}^*}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Xi^0 \bar{\Xi}_c^0$	$\frac{f_2 V_{cs}^*}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Xi^0 \bar{\Omega}_c^0$	$\frac{(2f_1-f_2+f_3)V_{cd}^*}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})s}^0 \rightarrow \Delta^{++} \bar{\Sigma}_c^{'-}$	$-\frac{1}{2}(2f_1+f_2-f_3)V_{cs}^*$
$Y_{(u\bar{u},d\bar{d})s}^0 \rightarrow \Delta^+ \bar{\Sigma}_c^-$	$-\sqrt{\frac{2}{3}}f_1 V_{cs}^*$	$Y_{(u\bar{u},d\bar{d})s}^0 \rightarrow \Delta^+ \bar{\Xi}_c^{'-}$	$-\frac{f_2 V_{cd}^*}{\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})s}^0 \rightarrow \Delta^0 \bar{\Sigma}_c^0$	$-\frac{(2f_1-f_2+f_3)V_{cs}^*}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})s}^0 \rightarrow \Delta^0 \bar{\Xi}_c^0$	$-\frac{f_2 V_{cd}^*}{\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})s}^0 \rightarrow \Sigma^{'+} \bar{\Xi}_c^{'-}$	$-\frac{(2f_1+f_2)V_{cs}^*}{\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})s}^0 \rightarrow \Sigma^0 \bar{\Xi}_c^0$	$-\frac{(2f_1+f_3)V_{cs}^*}{2\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})s}^0 \rightarrow \Sigma^0 \bar{\Omega}_c^0$	$-\frac{f_2 V_{cd}^*}{\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})s}^0 \rightarrow \Xi^0 \bar{\Omega}_c^0$	$-\frac{(2f_1+f_2+f_3)V_{cs}^*}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Delta^+ \bar{\Sigma}_c^{'-}$	$\frac{(2f_1+f_2-f_3)V_{cd}^*}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Delta^0 \bar{\Sigma}_c^-$	$\frac{(2f_1+f_2)V_{cd}^*}{\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Delta^- \bar{\Sigma}_c^0$	$\frac{1}{2}(2f_1+f_2+f_3)V_{cd}^*$	$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Sigma^{'+} \bar{\Sigma}_c^{'-}$	$-\frac{(2f_1+f_2-f_3)V_{cs}^*}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Sigma^0 \bar{\Sigma}_c^-$	$\frac{(f_3-2f_1)V_{cs}^*}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Sigma^0 \bar{\Xi}_c^{'-}$	$\frac{(2f_1-f_3)V_{cd}^*}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Sigma^{'-} \bar{\Sigma}_c^0$	$\frac{(-2f_1+f_2+f_3)V_{cs}^*}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Sigma^{'-} \bar{\Xi}_c^0$	$\sqrt{\frac{2}{3}}f_1 V_{cd}^*$
$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Xi^0 \bar{\Xi}_c^{'-}$	$-\frac{(2f_1+f_2)V_{cs}^*}{\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Xi^{'-} \bar{\Xi}_c^0$	$-\sqrt{\frac{2}{3}}f_1 V_{cs}^*$
$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Xi^{'-} \bar{\Omega}_c^0$	$\frac{(2f_1-f_2-f_3)V_{cd}^*}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Omega^- \bar{\Omega}_c^0$	$-\frac{1}{2}(2f_1+f_2+f_3)V_{cs}^*$

$$= \frac{3}{2}\Gamma(Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Sigma^{'+} \bar{\Xi}_c^{'-}),$$

$$\Gamma(X_{d\bar{s}u}^- \rightarrow \Delta^- \bar{\Xi}_c^0)$$

$$= 3\Gamma(X_{s\bar{u}d}^- \rightarrow \Xi^{'-} \bar{\Xi}_c^0)$$

$$= \frac{3}{2}\Gamma(Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Sigma^{'-} \bar{\Xi}_c^0),$$

$$\Gamma(X_{d\bar{s}u}^- \rightarrow \Sigma^0 \bar{\Xi}_c^-)$$

$$= \Gamma(Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Xi^0 \bar{\Xi}_c^-)$$

$$= \Gamma(Y_{(u\bar{u},d\bar{d})s}^0 \rightarrow \Sigma^{'+} \bar{\Xi}_c^-),$$

$$\Gamma(X_{d\bar{s}u}^- \rightarrow \Sigma^{'-} \bar{\Xi}_c^0)$$

$$= \frac{1}{3}\Gamma(X_{s\bar{u}d}^- \rightarrow \Omega^- \bar{\Xi}_c^0)$$

$$= \frac{1}{2}\Gamma(Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Xi^{'-} \bar{\Xi}_c^0),$$

$$\Gamma(Y_{(u\bar{u},s\bar{s})d}^0 \rightarrow \Delta^+ \bar{\Lambda}_c^-)$$

$$= \Gamma(X_{s\bar{u}d}^- \rightarrow \Sigma^0 \bar{\Lambda}_c^-)$$

$$= \Gamma(Y_{(d\bar{d},s\bar{s})u}^- \rightarrow \Delta^0 \bar{\Lambda}_c^-).$$

The relations of decay widths for class IV are given as:

$$\Gamma(X_{u\bar{d}s}^+ \rightarrow \Delta^{++} \bar{\Sigma}_c^-) = \frac{3}{2}\Gamma(X_{u\bar{d}s}^+ \rightarrow \Delta^+ \bar{\Sigma}_c^0)$$

$$= 3\Gamma(X_{u\bar{d}s}^+ \rightarrow \Sigma^{'+} \bar{\Xi}_c^0),$$

$$\Gamma(X_{u\bar{d}s}^+ \rightarrow \Delta^{++} \bar{\Xi}_c^{'-}) = 3\Gamma(X_{u\bar{d}s}^+ \rightarrow \Delta^+ \bar{\Xi}_c^0)$$

$$\begin{aligned}
&= \frac{3}{2} \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^+ \bar{\Omega}_c^0), \\
&\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0 \bar{\Xi}_c^0) = \frac{1}{3} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^- \bar{\Xi}_c^0) \\
&= \frac{1}{2} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^- \bar{\Omega}_c^0), \\
&\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^- \bar{\Sigma}_c^0) = 3 \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^- \bar{\Xi}_c^0) \\
&= 3 \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Sigma}_c^0), \\
&\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0 \bar{\Sigma}_c^0) = \frac{1}{2} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^- \bar{\Sigma}_c^0) \\
&= \frac{1}{3} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^- \bar{\Xi}_c^0), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+ \bar{\Sigma}_c^0) \\
&= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0 \bar{\Sigma}_c^0) \\
&= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^0 \bar{\Xi}_c^0), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+ \bar{\Xi}_c^0) = \frac{1}{3} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^- \bar{\Omega}_c^0) \\
&= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^- \bar{\Xi}_c^0), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Xi}_c^0) = \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0 \bar{\Xi}_c^0) \\
&= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^0 \bar{\Omega}_c^0), \\
&\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^+ \bar{\Sigma}_c^0) = 2 \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^+ \bar{\Sigma}_c^0) \\
&= \frac{2}{3} \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^{++} \bar{\Sigma}_c^0), \\
&\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Xi}_c^0) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^0 \bar{\Xi}_c^0) \\
&= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^+ \bar{\Xi}_c^0), \\
&\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi'^- \bar{\Omega}_c^0) = \frac{2}{3} \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega^- \bar{\Omega}_c^0) \\
&= 2 \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi'^0 \bar{\Omega}_c^0), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^{++} \bar{\Sigma}_c^0) = \frac{3}{2} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^+ \bar{\Sigma}_c^0) \\
&= 3 \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^+ \bar{\Sigma}_c^0), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^+ \bar{\Sigma}_c^0) = \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^0 \bar{\Sigma}_c^0) \\
&= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^0 \bar{\Sigma}_c^0), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^0 \bar{\Sigma}_c^0) = \frac{1}{2} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^- \bar{\Sigma}_c^0) \\
&= \frac{1}{3} \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^- \bar{\Sigma}_c^0).
\end{aligned}$$

$$\begin{aligned}
&+ b_2(X_{b6})_{[jk]}^i (H_3'')^{[jl]} D_i M_m^k M_l^m \\
&+ b_3(X_{b6})_{[jk]}^i (H_3'')^{[lm]} D_i M_l^j M_m^k \\
&+ b_4(X_{b6})_{[jk]}^i (H_3'')^{[jk]} D_m M_i^l M_l^m \\
&+ b_5(X_{b6})_{[jk]}^i (H_3'')^{[jl]} D_m M_l^k M_l^m \\
&+ b_6(X_{b6})_{[jk]}^i (H_3'')^{[jl]} D_l M_i^m M_m^k \\
&+ b_7(X_{b6})_{[jk]}^i (H_3'')^{[jl]} D_m M_l^k M_l^m \\
&+ b_8(X_{b6})_{[jk]}^i (H_6'')^{[jl]} D_i M_m^k M_l^m \\
&+ b_9(X_{b6})_{[jk]}^i (H_6'')^{[jl]} D_m M_i^k M_l^m \\
&+ b_{10}(X_{b6})_{[jk]}^i (H_6'')^{[jl]} D_l M_i^m M_m^k \\
&+ b_{11}(X_{b6})_{[jk]}^i (H_6'')^{[jl]} D_m M_i^m M_l^k. \quad (21)
\end{aligned}$$

The related amplitudes for different channels are presented in Tables 21 and 22, from which one obtain relations for decay widths

$$\begin{aligned}
&\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D^- \bar{K}^0 \bar{K}^0) = 2 \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \bar{D}^0 \bar{K}^0 K^-), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \pi^0 \bar{K}^0) = 2 \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \eta \bar{K}^0), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^- \pi^+ \pi^0) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0 \pi^0 \pi^-), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \pi^0 K^0) = \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 K^0 \eta), \\
&\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \bar{D}^0 \pi^+ \pi^0) = \frac{1}{2} \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^- \pi^+ K^+), \\
&\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^- \pi^0 \pi^0) = \frac{1}{2} \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \pi^+ \pi^-), \\
&\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- \pi^0 \pi^0) = \frac{1}{2} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- \pi^+ \pi^-), \\
&\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- \pi^0 \bar{K}^0) = \frac{1}{2} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- \pi^+ K^-), \\
&\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \pi^0 \pi^0) = \frac{1}{2} \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \pi^+ \pi^-), \\
&\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^- \pi^+ K^+) = \frac{1}{2} \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^- K^+ K^+), \\
&\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \bar{D}^0 \pi^- K^0) = \frac{1}{2} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D_s^- K^0 K^0), \\
&\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^- \pi^+ \eta) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \pi^0 \eta), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- \pi^+ \eta) = 2 \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^- \pi^0 \eta), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^- \pi^+ K^0) = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D_s^- \pi^0 K^0), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^- K^+ \eta) = \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D_s^- K^0 \eta), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \eta \eta) = \frac{1}{2} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow D^- \eta \eta), \\
&\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- \pi^0 K^+) = 3 \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- K^+ \eta), \\
&\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \bar{D}^0 \pi^0 \pi^-) = \frac{1}{4} \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D^- \pi^+ \pi^+) \\
&= \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \bar{D}^0 \pi^0 \pi^+) = \frac{1}{2} \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^- K^+ \pi^+)
\end{aligned}$$

5.3.3 Three-body decays into mesons

For X_{b6} decays into three meson modes, the hadron-level effective Hamiltonian can be constructed as

$$\mathcal{H}_{eff} = b_1(X_{b6})_{[jk]}^i (H_3'')^{[jk]} D_i M_m^l M_l^m$$

$$= \frac{1}{2} \Gamma(Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow D^- \pi^0 \pi^+),$$

5.4 Charmless $b \rightarrow q_1 \bar{q}_2 q_3$ transition

5.4.1 Two-body decays into mesons

The charmless tree operator of $(\bar{q}_1 b)(\bar{q}_2 q_3)$ can lead to a triple H_3 , a sextet H_6 with antisymmetric upper indices, and a traceless H_{15} with symmetric upper indices. The penguin operators behave as the triplet H_3 . The nonzero components of the irreducible tensor for the $\Delta S = 0(b \rightarrow d)$ transition are

$$\begin{aligned} (H_3)^2 &= (H_3)_{31} = -(H_3)_{13} = 1, \quad (H_6)^{12} \\ &= -(H_6)^{21} = (H_6)^{23} = -(H_6)^{32} = 1, \\ 2(H_{15})_1^{12} &= 2(H_{15})_1^{21} = -3(H_{15})_2^{22} \\ &= -6(H_{15})_3^{23} = -6(H_{15})_3^{32} = 6. \end{aligned} \quad (22)$$

For the $\Delta S = 1(b \rightarrow s)$ transition, the nonzero entries can be obtained from Eq. (22) by the exchange $2 \leftrightarrow 3$. The effective Hamiltonian for X_{b6} decays into two mesons in the charmless transition is

$$\begin{aligned} \mathcal{H}_{eff} &= b_1(X_{b6})^{[ij]}(H_3)_{[il]}M_j^k M_l^l \\ &\quad - b_2(X_{b6})^{[ij]}(H_6)_{[ij]}M_l^k M_l^l \\ &\quad - b_3(X_{b6})^{[ij]}(H_6)_{[il]}M_j^k M_l^l \\ &\quad - b_4(X_{b6})^{[ij]}(H_6)_{[kl]}M_i^k M_j^l \\ &\quad + b_5(X_{b6})_{[jk]}^i(H_{15})_i^{[jl]}M_m^k M_l^m \\ &\quad + b_6(X_{b6})_{[jk]}^i(H_{15})_m^{[jl]}M_i^k M_l^m \\ &\quad + b_7(X_{b6})_{[jk]}^i(H_{15})_m^{[jl]}M_i^m M_l^k. \end{aligned} \quad (23)$$

The related decay amplitudes are given in Table 23 for the $b \rightarrow d$ transition and Table 24 for the $b \rightarrow s$ transition. The relations of decay widths become

$$\Gamma(Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \pi^0 K^0) = 3\Gamma(Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \eta K^0),$$

and

$$\begin{aligned} \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ \pi^0) &= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- \pi^0), \quad \Gamma(Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \bar{K}^0) \\ &= 3\Gamma(Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \eta \bar{K}^0). \end{aligned}$$

5.4.2 Two-body decays into a baryon and an anti-baryon

To construct the hadron-level effective Hamiltonian, one need contain all possible combinations for final states.

$$\begin{aligned} \mathcal{H}_{eff} &= b_1(X_{b6})_{[jk]}^i(H_3)^j(T_8)_l^k(\bar{T}_8)_i^l \\ &\quad + b_2(X_{b6})_{[jk]}^i(H_3)^j(T_8)_i^l(\bar{T}_8)_l^k \\ &\quad + b_3(X_{b6})_{[jk]}^i(H_3)^l(T_8)_l^j(\bar{T}_8)_i^k \\ &\quad + b_4(X_{b6})_{[jk]}^i(H_3)^l(T_8)_i^j(\bar{T}_8)_l^k \end{aligned}$$

$$\begin{aligned} &- b_5(X_{b6})^{[ij]}(H_6)_{[ij]}(T_8)_l^k(\bar{T}_8)_k^l \\ &- b_6(X_{b6})^{[ij]}(H_6)_{[il]}(T_8)_j^k(\bar{T}_8)_k^l \\ &- b_7(X_{b6})^{[ij]}(H_6)_{[ik]}(T_8)_l^k(\bar{T}_8)_j^l \\ &- b_8(X_{b6})^{[ij]}(H_6)_{[kl]}(T_8)_i^k(\bar{T}_8)_j^l \\ &+ b_9(X_{b6})_{[jk]}^i(H_{15})_i^{[jl]}(T_8)_m^k(\bar{T}_8)_l^m \\ &+ b_{10}(X_{b6})_{[jk]}^i(H_{15})_i^{[jl]}(T_8)_l^m(\bar{T}_8)_m^k \\ &+ b_{11}(X_{b6})_{[jk]}^i(H_{15})_i^{[lm]}(T_8)_l^j(\bar{T}_8)_m^k \\ &+ b_{12}(X_{b6})_{[jk]}^i(H_{15})_l^{[jm]}(T_8)_i^k(\bar{T}_8)_m^l \\ &+ b_{13}(X_{b6})_{[jk]}^i(H_{15})_l^{[jm]}(T_8)_i^l(\bar{T}_8)_m^k \\ &+ b_{14}(X_{b6})_{[jk]}^i(H_{15})_l^{[jm]}(T_8)_m^k(\bar{T}_8)_i^l \\ &+ b_{15}(X_{b6})_{[jk]}^i(H_{15})_l^{[jm]}(T_8)_l^m(\bar{T}_8)_i^k \\ &- c_1(X_{b6})^{[ij]}(H_3)^k(T_{10})_{[ij]l}(\bar{T}_8)_k^l \\ &- c_2(X_{b6})^{[ij]}(H_3)^k(T_{10})_{[ik]l}(\bar{T}_8)_j^l \\ &- c_3(X_{b6})^{[ij]}(H_6)_{[i]l}^{[kl]}(T_{10})_{[m]jk}(\bar{T}_8)_l^m \\ &- c_4(X_{b6})^{[ij]}(H_6)_{[m]l}^{[kl]}(T_{10})_{[ijk]}(\bar{T}_8)_l^m \\ &- c_5(X_{b6})^{[ij]}(H_{15})_i^{[kl]}(T_{10})_{[m]jk}(\bar{T}_8)_l^m \\ &- c_6(X_{b6})^{[ij]}(H_{15})_i^{[kl]}(T_{10})_{[mkl]}(\bar{T}_8)_j^m \\ &- c_7(X_{b6})^{[ij]}(H_{15})_m^{[kl]}(T_{10})_{[ijk]}(\bar{T}_8)_l^m \\ &- c_8(X_{b6})^{[ij]}(H_{15})_m^{[kl]}(T_{10})_{[ikl]}(\bar{T}_8)_j^m \\ &+ d_1(X_{b6})_{[ij],[kl]}(H_6)_{[i]l}^{[j]k}(T_8)_o^k(\bar{T}_{10})^{[lmo]} \\ &+ d_2(X_{b6})_{[ij],[kl]}(H_6)_{[m]l}^{[io]}(T_8)_o^k(\bar{T}_{10})^{[jlm]} \\ &+ d_3(X_{b6})_{[ij],[kl]}(H_{15})_m^{[ik]}(T_8)_o^j(\bar{T}_{10})^{[lmo]} \\ &+ d_4(X_{b6})_{[ij],[kl]}(H_{15})_m^{[ik]}(T_8)_o^m(\bar{T}_{10})^{[jlo]} \\ &+ d_5(X_{b6})_{[ij],[kl]}(H_{15})_m^{[io]}(T_8)_o^k(\bar{T}_{10})^{[jlm]} \\ &+ f_1(X_{b6})_{[jk]}^i(H_3)^j(T_{10})_{[ilm]}(\bar{T}_{10})^{[klm]} \\ &- f_2(X_{b6})^{[ij]}(H_6)_{[ij]}(T_{10})_{[klm]}(\bar{T}_{10})^{[klm]} \\ &- f_3(X_{b6})^{[ij]}(H_6)_{[ik]}(T_{10})_{[jlm]}(\bar{T}_{10})^{[klm]} \\ &- f_4(X_{b6})^{[ij]}(H_6)_{[kl]}(T_{10})_{[ijm]}(\bar{T}_{10})^{[klm]} \\ &+ f_5(X_{b6})_{[jk]}^i(H_{15})_i^{[jl]}(T_{10})_{[lmo]}(\bar{T}_{10})^{[kmo]} \\ &+ f_6(X_{b6})_{[jk]}^i(H_{15})_l^{[jm]}(T_{10})_{[imo]}(\bar{T}_{10})^{[klo]}. \end{aligned} \quad (24)$$

In this case, the decay amplitudes are given in Tables 25, 26 and 27 for the $b \rightarrow d$ transition, Tables 28, 29 and 30 for the $b \rightarrow s$ transition. For $b \rightarrow d$ transition, the relations of decay widths for Class II are

$$\begin{aligned} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^0 \bar{p}) &= \frac{1}{2} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^- \bar{n}) \\ &= \frac{1}{3} \Gamma(Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Delta^- \bar{n}) = \Gamma(Y_{(d\bar{d}, s\bar{s})\bar{u}}^- \rightarrow \Delta^0 \bar{p}), \\ \Gamma(Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^- \bar{\Sigma}^+) &= \Gamma(Y_{(u\bar{u}, s\bar{s})\bar{d}}^0 \rightarrow \Xi'^- \bar{\Xi}^+) = \Gamma(Y_{(u\bar{u}, d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^- \bar{\Xi}^+) \end{aligned}$$

Table 21 Open bottom tetraquark X_{b6} decays into an anti-charmed meson and two light meson

Channel	Amplitude ($/V_{ub}$)	Channel	Amplitude ($/V_{ub}$)
$X_{u\bar{d}\bar{s}}^+ \rightarrow \bar{D}^0 \pi^+ \pi^0$	$\frac{(b_5+b_7-b_9-b_{11})V_{cs}^*}{2}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \bar{D}^0 \pi^+ K^0$	$\frac{\sqrt{2}(-b_2+2b_3-b_6+b_8+b_{10})V_{cd}^*}{2}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \bar{D}^0 \pi^+ \eta$	$\frac{(2b_2-4b_3+b_5+2b_6+b_7)V_{cs}^*}{2\sqrt{3}} + \frac{(-2b_8-b_9-2b_{10}-b_{11})V_{cs}^*}{2\sqrt{3}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \bar{D}^0 \pi^0 K^+$	$\frac{(-b_2+2b_3-b_5-b_6)V_{cd}^*}{2} + \frac{(-b_7+b_8+b_9+b_{10}+b_{11})V_{cd}^*}{2}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \bar{D}^0 K^+ \bar{K}^0$	$\frac{\sqrt{2}(b_2-2b_3+b_6-b_8-b_{10})V_{cs}^*}{2}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \bar{D}^0 K^+ \eta$	$\frac{\sqrt{3}(b_2-2b_3-b_5+b_6-b_7)V_{cd}^*}{6} + \frac{\sqrt{3}(-b_8+b_9-b_{10}+b_{11})V_{cd}^*}{6}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D^-\pi^+\pi^+$	$\sqrt{2}(b_5+b_7-b_9-b_{11})V_{cs}^*$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D^-\pi^+ K^+$	$\frac{(-b_5-b_7+b_9+b_{11})V_{cd}^*}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^-\pi^+ K^+$	$\frac{(b_5+b_7-b_9-b_{11})V_{cs}^*}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow D_s^- K^+ K^+$	$\sqrt{2}(-b_5-b_7+b_9+b_{11})V_{cd}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow \bar{D}^0 \pi^0 \pi^-$	$\frac{(-b_5-b_7+b_9+b_{11})V_{cs}^*}{2}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \bar{D}^0 \pi^- K^0$	$-\frac{(b_5+b_7+b_9+b_{11})V_{cd}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \bar{D}^0 \pi^- \eta$	$\frac{(-4b_4-b_5-2b_6+b_7)V_{cs}^*}{2\sqrt{3}} + \frac{(+b_9+2b_{10}+3b_{11})V_{cs}^*}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \bar{D}^0 K^0 K^-$	$-\frac{(2b_4+b_5+b_6+b_9-b_{10})V_{cs}^*}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^-\pi^+\pi^-$	$-\frac{(4b_1+b_2+2b_4+b_5-b_8-b_9)V_{cs}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D^-\pi^0 \pi^0$	$\frac{\sqrt{2}(-4b_1-b_2-2b_4+b_7+b_8-b_{11})V_{cs}^*}{2}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^-\pi^0 K^0$	$\frac{(b_2-2b_3+b_5+b_6+b_7)V_{cd}^*}{2} + \frac{(b_8+b_9+b_{10}+b_{11})V_{cd}^*}{2}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D^-\pi^0 \eta$	$-\frac{(b_2-2b_3-2b_4+b_7-b_8+b_{11})V_{cs}^*}{\sqrt{6}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^-\pi^- K^+$	$\frac{(-b_2+2b_3-b_6-b_8-b_{10})V_{cd}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D^- K^+ K^-$	$\sqrt{2}(-2b_1-b_2+b_3)V_{cs}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^- K^0 \bar{K}^0$	$-\frac{(4b_1+b_2+2b_4+b_5+b_8+b_9)V_{cs}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D^- K^0 \eta$	$\frac{(b_2-2b_3-b_5+b_6-b_7)V_{cd}^*}{2\sqrt{3}} + \frac{(b_8-b_9+b_{10}-b_{11})V_{cd}^*}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D^-\eta\eta$	$\frac{\sqrt{2}(-12b_1-5b_2+4b_3)V_{cs}^*}{6} + \frac{\sqrt{2}(-2b_4+b_7-3b_8+3b_{11})V_{cs}^*}{6}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D_s^-\pi^0 K^0$	$\frac{(2b_4+b_6-b_7+b_{10}+b_{11})V_{cs}^*}{2}$
$X_{d\bar{s}\bar{u}}^- \rightarrow D_s^-\pi^- K^+$	$-\frac{(2b_4+b_5+b_6-b_9+b_{10})V_{cs}^*}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow D_s^- K^0 K^0$	$-\sqrt{2}(b_5+b_7+b_9+b_{11})V_{cd}^*$
$X_{d\bar{s}\bar{u}}^- \rightarrow D_s^- K^0 \eta$	$\frac{(2b_4+2b_5+b_6+b_7)V_{cs}^*}{2\sqrt{3}} + \frac{(2b_9+b_{10}+3b_{11})V_{cs}^*}{2\sqrt{3}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \bar{D}^0 \pi^0 K^-$	$\frac{(2b_4+b_5+b_6-b_9-b_{10}-2b_{11})V_{cd}^*}{2}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \bar{D}^0 \pi^- \bar{K}^0$	$\frac{(2b_4+b_5+b_6+b_9-b_{10})V_{cd}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \bar{D}^0 \bar{K}^0 K^-$	$\frac{(b_5+b_7+b_9+b_{11})V_{cs}^*}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \bar{D}^0 K^- \eta$	$\frac{(-2b_4+b_5-b_6+2b_7-b_9+b_{10})V_{cd}^*}{2\sqrt{3}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D^-\pi^+ K^-$	$\frac{(2b_4+b_5+b_6-b_9+b_{10})V_{cd}^*}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow D^-\pi^0 \bar{K}^0$	$-\frac{(2b_4+b_5+b_6+b_9+b_{10}+2b_{11})V_{cd}^*}{2}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D^-\bar{K}^0 \bar{K}^0$	$\sqrt{2}(b_5+b_7+b_9+b_{11})V_{cs}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow D^-\bar{K}^0 \eta$	$\frac{\sqrt{3}(-2b_4+b_5-b_6+2b_7+b_9-b_{10})V_{cd}^*}{6}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^-\pi^+\pi^-$	$\sqrt{2}(2b_1+b_2-b_3)V_{cd}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^-\pi^+ K^-$	$\frac{(b_2-2b_3+b_6+b_8+b_{10})V_{cs}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^-\pi^0 \pi^0$	$\sqrt{2}(2b_1+b_2-b_3)V_{cd}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^-\pi^0 \bar{K}^0$	$-\frac{(b_2-2b_3+b_6+b_8+b_{10})V_{cs}^*}{2}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^-\pi^0 \eta$	$\sqrt{\frac{2}{3}}(b_{11}-b_8)V_{cd}^*$
$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- K^+ K^-$	$\frac{(4b_1+b_2+2b_4+b_5-b_8-b_9)V_{cd}^*}{\sqrt{2}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- K^0 \bar{K}^0$	$\frac{(4b_1+b_2+2b_4+b_5+b_8+b_9)V_{cd}^*}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- \bar{K}^0 \eta$	$\frac{\sqrt{3}(-b_2+2b_3-2b_5-b_6-2b_7)V_{cs}^*}{6} + \frac{\sqrt{3}(-b_8-2b_9-b_{10}-2b_{11})V_{cs}^*}{6}$	$X_{s\bar{u}\bar{d}}^- \rightarrow D_s^- \eta\eta$	$\frac{\sqrt{2}(6b_1+b_2+b_3+4b_4-2b_7)V_{cd}^*}{3}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$	$\frac{(4b_1+2b_2-2b_3+2b_4)V_{cd}^*}{2} + \frac{(b_5+b_6+b_9-b_{10})V_{cd}^*}{2}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \pi^+ K^-$	$\frac{(b_2-2b_3+b_5+b_6+b_7)V_{cs}^*}{2} + \frac{(b_8+b_9-b_{10}-b_{11})V_{cs}^*}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \pi^0 \pi^0$	$\frac{(4b_1+2b_2-2b_3+2b_4+b_5)V_{cd}^*}{2} + \frac{(b_6-b_9-b_{10}-2b_{11})V_{cd}^*}{2}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \pi^0 \bar{K}^0$	$\frac{(-b_2+2b_3+b_5-b_6+b_7)V_{cs}^*}{2\sqrt{2}} - \frac{(b_8-b_9+b_{10}+b_{11})V_{cs}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \pi^0 \eta$	$\frac{\sqrt{3}(2b_4+2b_5+b_6+b_7)V_{cd}^*}{6} - \frac{\sqrt{3}(2b_8-2b_9-b_{10}-b_{11})V_{cd}^*}{6}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 K^+ K^-$	$\frac{(4b_1+b_2+2b_4-b_7-b_8+b_{11})V_{cd}^*}{2}$

Table 21 continued

Channel	Amplitude ($/ V_{ub}$)	Channel	Amplitude ($/ V_{ub}$)
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 K^0 \bar{K}^0$	$\frac{1}{2} (4b_1 + b_2 - b_6 + b_8 + b_{10}) V_{cd}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \bar{K}^0 \eta$	$\frac{\sqrt{6}(-b_2+2b_3+b_5-b_6+b_7)V_{cs}^*}{12} + \frac{\sqrt{6}(-b_8-b_9+b_{10}+b_{11})V_{cs}^*}{12}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{D}^0 \eta \eta$	$\frac{(12b_1+2b_2+2b_3+2b_4)V_{cd}^*}{6} + \frac{(3b_5-3b_6+2b_7-3b_9+3b_{10})V_{cd}^*}{6}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^- \pi^+ \pi^0$	$-\frac{(b_9+b_{11})V_{cd}^*}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^- \pi^+ \bar{K}^0$	$(b_5 + b_7) V_{cs}^*$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^- \pi^+ \eta$	$\frac{(2b_4+2b_5+b_6+b_7-b_9+b_{10})V_{cd}^*}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D^- K^+ \bar{K}^0$	$\frac{(2b_4+b_6-b_7+b_{10}+b_{11})V_{cd}^*}{2}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^- \pi^+ K^0$	$\frac{(-b_2+2b_3+2b_4+b_5+b_8+b_9)V_{cd}^*}{2}$

Table 22 Open bottom tetraquark X_{b6} decays into an anti-charmed meson and two light mesons

Channel	Amplitude ($/ V_{ub}$)	Channel	Amplitude ($/ V_{ub}$)
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^- \pi^+ \eta$	$\frac{\sqrt{6}(b_2-2b_3-b_5+b_6-b_7)V_{cs}^*}{6} + \frac{\sqrt{6}(-b_8-b_9+b_{10}+b_{11})V_{cs}^*}{6}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^- \pi^0 K^+$	$\frac{(-b_2+2b_3+2b_4+b_5)V_{cd}^*}{2\sqrt{2}} + \frac{(b_8-b_9-2b_{11})V_{cd}^*}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^- K^+ \bar{K}^0$	$\frac{(b_2-2b_3+b_5+b_6+b_7-b_8-b_9+b_{10}+b_{11})V_{cs}^*}{2}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow D_s^- K^+ \eta$	$\frac{\sqrt{6}(b_2-2b_3-2b_4+3b_5)V_{cd}^*}{12} + \frac{\sqrt{6}(4b_7-b_8-3b_9-2b_{11})V_{cd}^*}{12}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$	$-\frac{(4b_1+b_2+2b_4-b_7-b_8+b_{11})V_{cs}^*}{2}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \pi^0 \pi^0$	$-\frac{(4b_1+b_2+2b_4+2b_5)V_{cs}^*}{2} - \frac{(b_7-b_8-2b_9-b_{11})V_{cs}^*}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \pi^0 K^0$	$\frac{(b_2-2b_3-b_5+b_6-b_7)V_{cd}^*}{2\sqrt{2}} + \frac{(b_8+b_9-b_{10}-b_{11})V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \pi^0 \eta$	$\frac{\sqrt{3}(-b_2+2b_3-2b_4-b_5-2b_6)V_{cs}^*}{6} + \frac{\sqrt{3}(b_8+b_9+2b_{10}+2b_{11})V_{cs}^*}{6}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \pi^- K^+$	$-\frac{(b_2-2b_3+b_5+b_6+b_7)V_{cd}^*}{2} - \frac{(b_8+b_9-b_{10}-b_{11})V_{cd}^*}{2}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 K^+ K^-$	$-\frac{(4b_1+2b_2-2b_3+2b_4)V_{cs}^*}{2} - \frac{(b_5+b_6+b_9-b_{10})V_{cs}^*}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 K^0 \bar{K}^0$	$-\frac{(4b_1+b_2-b_6+b_8+b_{10})V_{cs}^*}{2}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 K^0 \eta$	$\frac{\sqrt{6}(b_2-2b_3-b_5+b_6-b_7)V_{cd}^*}{12} + \frac{\sqrt{6}(b_8+b_9-b_{10}-b_{11})V_{cd}^*}{12}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \bar{D}^0 \eta \eta$	$\frac{(-12b_1-5b_2+4b_3)V_{cs}^*}{6} + \frac{(-2b_4+b_7-3b_8+3b_{11})V_{cs}^*}{6}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- \pi^+ \pi^0$	$\frac{(-b_5-b_7+b_9+b_{11})V_{cs}^*}{\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- \pi^+ K^0$	$-\frac{(b_2-2b_3+b_5+b_6+b_7-b_8-b_9+b_{10}+b_{11})V_{cd}^*}{2}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- \pi^+ \eta$	$\frac{\sqrt{6}(b_2-2b_3-2b_4)V_{cs}^*}{6} + \frac{\sqrt{6}(b_7-b_8+b_{11})V_{cs}^*}{6}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- \pi^0 K^+$	$\frac{(-b_2+2b_3+b_5-b_6+b_7)V_{cd}^*}{2\sqrt{2}} + \frac{(b_8+b_9-b_{10}-b_{11})V_{cd}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- K^+ \bar{K}^0$	$\frac{(b_2-2b_3-2b_4-b_5-b_8-b_9)V_{cs}^*}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D^- K^+ \eta$	$\frac{(b_2-2b_3-b_5+b_6-b_7)V_{cd}^*}{2\sqrt{6}} - \frac{(b_8-b_9+b_{10}+b_{11})V_{cd}^*}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^- \pi^+ K^0$	$-\frac{(2b_4+b_6-b_7+b_{10}+b_{11})V_{cs}^*}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^- \pi^0 K^+$	$-\frac{(2b_4+2b_5+b_6+b_7)V_{cs}^*}{2\sqrt{2}} - \frac{(-2b_9+b_{10}-b_{11})V_{cs}^*}{2\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^- K^+ K^0$	$-(b_5 + b_7) V_{cd}^*$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow D_s^- K^+ \eta$	$\frac{\sqrt{6}(2b_4+2b_5+b_6+b_7)V_{cs}^*}{12} + \frac{\sqrt{6}(2b_9+b_{10}+3b_{11})V_{cs}^*}{12}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0 \pi^0 \pi^-$	$-\frac{(b_9+b_{11})V_{cd}^*}{\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0 \pi^0 K^-$	$-\frac{(2b_4+2b_5+b_6+b_7-b_{10}-b_{11})V_{cs}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0 \pi^- \bar{K}^0$	$\frac{(-2b_4-b_6+b_7+b_{10}+b_{11})V_{cs}^*}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0 \pi^- \eta$	$\frac{\sqrt{6}(2b_4+2b_5+b_6+b_7-b_{10}-b_{11})V_{cd}^*}{6}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0 K^0 K^-$	$\frac{(2b_4+b_6-b_7-b_{10}-b_{11})V_{cd}^*}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \bar{D}^0 K^- \eta$	$\frac{\sqrt{6}(2b_4+2b_5+b_6+b_7)V_{cs}^*}{12} + \frac{\sqrt{6}(4b_9-b_{10}+3b_{11})V_{cs}^*}{12}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- \pi^+ \pi^-$	$\frac{(4b_1+2b_2-2b_3+2b_4)V_{cd}^*}{2} + \frac{(b_5+b_6-b_9+b_{10})V_{cd}^*}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- \pi^+ K^-$	$\frac{(b_2-2b_3-2b_4-b_5+b_8+b_9)V_{cs}^*}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- \pi^0 \pi^0$	$\frac{(4b_1+2b_2-2b_3+2b_4+b_5)V_{cd}^*}{2} + \frac{(b_6+b_9+b_{10}+2b_{11})V_{cd}^*}{2}$

Table 22 continued

Channel	Amplitude ($/ V_{ub}$)	Channel	Amplitude ($/ V_{ub}$)
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- \pi^0 \bar{K}^0$	$\frac{\sqrt{2}(-b_2+2b_3+2b_4-b_5-2b_7-b_8-b_9)V_{cs}^*}{4}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- \pi^0 \eta$	$-\frac{(2b_4+2b_5+b_6+b_7)V_{cd}^*}{2\sqrt{3}} - \frac{(2b_8+2b_9+b_{10}+b_{11})V_{cd}^*}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- K^+ K^-$	$\frac{(4b_1+b_2-b_6-b_8-b_{10})V_{cd}^*}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- K^0 \bar{K}^0$	$\frac{(4b_1+b_2+2b_4-b_7+b_8-b_{11})V_{cd}^*}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- \bar{K}^0 \eta$	$\frac{(-b_2+2b_3+2b_4+3b_5)V_{cs}^*}{2\sqrt{6}} + \frac{(2b_7-b_8+3b_9+4b_{11})V_{cs}^*}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D^- \eta \eta$	$\frac{(12b_1+2b_2+2b_3+2b_4+3b_5)V_{cd}^*}{6} + \frac{(-3b_6+2b_7+3b_9-3b_{10})V_{cd}^*}{6}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \pi^+ \pi^-$	$\frac{(-4b_1-b_2+b_6+b_8+b_{10})V_{cs}^*}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \pi^0 \pi^0$	$\frac{(-4b_1-b_2+b_6+b_8+b_{10})V_{cs}^*}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \pi^0 K^0$	$\frac{(b_2-2b_3-2b_4-b_5+b_8-b_9-2b_{11})V_{cd}^*}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \pi^0 \eta$	$\frac{\sqrt{3}(-b_2+2b_3+b_5-b_6+b_7)V_{cs}^*}{6} + \frac{\sqrt{3}(b_8+b_9-b_{10}-b_{11})V_{cs}^*}{6}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \pi^- K^+$	$-\frac{(b_2-2b_3-2b_4-b_5+b_8+b_9)V_{cd}^*}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- K^+ K^-$	$-\frac{(4b_1+2b_2-2b_3+2b_4)V_{cs}^*}{2} - \frac{(b_5+b_6-b_9+b_{10})V_{cs}^*}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- K^0 \bar{K}^0$	$\frac{(-4b_1-b_2-2b_4+b_7-b_8+b_{11})V_{cs}^*}{2}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- K^0 \eta$	$\frac{(b_2-2b_3-2b_4+3b_5)V_{cd}^*}{2\sqrt{6}} + \frac{(4b_7+b_8+3b_9+2b_{11})V_{cd}^*}{2\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow D_s^- \eta \eta$	$-\frac{(12b_1+5b_2-4b_3+8b_4)V_{cs}^*}{6} - \frac{(6b_5+3b_6+2b_7+3b_8+6b_9+3b_{10}+6b_{11})V_{cs}^*}{6}$		

Table 23 Open bottom tetraquark X_{b6} decays into two light mesons induced by the charmless $b \rightarrow d$ transition

Channel	Amplitude	Channel	Amplitude
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ K^0$	$\frac{b_1+b_3+3b_5+b_6-2b_7}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^0 K^+$	$\frac{b_1+b_3+2b_4+3b_5+5b_6+2b_7}{2}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow K^+ \eta$	$-\frac{b_1+b_3-2b_4+3b_5-3b_6-6b_7}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- K^0$	$\sqrt{2}(b_4 - 2(b_6 + b_7))$
$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^0 K^-$	$\frac{-b_1+b_3+b_5-5b_6-6b_7}{2}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^- \bar{K}^0$	$\frac{-b_1+b_3+b_5+3b_6+2b_7}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow K^- \eta$	$\frac{b_1-b_3-4b_4-b_5-3b_6-2b_7}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ \pi^-$	$\frac{-b_1+4b_2+b_3+b_5+3b_6+2b_7}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \pi^0$	$\frac{-b_1+4b_2+b_3+b_5-5b_6-6b_7}{2}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \eta$	$-\frac{b_1-b_3+2b_4+7b_5+9b_6+2b_7}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow K^+ K^-$	$2b_2 + b_3 + b_4 - 2b_5 + 2b_7$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow K^0 \bar{K}^0$	$\frac{b_1+4b_2+b_3+3b_5+b_6-2b_7}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \eta \eta$	$\frac{3b_1+12b_2+5b_3-4b_4-3b_5-9b_6-6b_7}{6}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 K^0$	$-\frac{b_1+b_3-2b_4-5b_5-3b_6+2b_7}{2\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^- K^+$	$\frac{b_1+b_3+2b_4-5b_5-3b_6+2b_7}{2}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \eta$	$-\frac{b_1+b_3-2b_4-5b_5-3b_6+2b_7}{2\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 \pi^-$	$-2\sqrt{2}(b_6 + b_7)$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- \eta$	$\frac{-b_1+b_3-2b_4+b_5+3b_6+2b_7}{\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^0 K^-$	$\frac{-b_1+b_3+2b_4+b_5-b_6-2b_7}{2}$		

$$= \frac{1}{3} \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^- \bar{\Sigma}^+),$$

$$\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^+ \bar{p})$$

$$= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^0 \bar{n}), \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^0 \bar{\Sigma}^+)$$

$$= 2\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^0 \bar{\Xi}^+).$$

The relations of decay widths for Class III are

$$\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda^0 \bar{\Xi}^+)$$

$$= \frac{1}{2} \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi^0 \bar{\Omega}^+), 3\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^0 \bar{\Xi}^+)$$

$$= \frac{3}{2} \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow n \bar{\Sigma}^+),$$

$$\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^- \bar{\Sigma}^+)$$

$$= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^- \bar{\Xi}^+), \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^+ \bar{\Delta}^{--})$$

$$= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow p \bar{\Delta}^{--}),$$

$$\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow p \bar{\Sigma}'^0)$$

$$= \frac{1}{2} \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Xi}'^0), \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Sigma}'^-)$$

$$= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}'^0),$$

$$\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Sigma}'^0) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}'^0)$$

$$= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^- \bar{\Xi}'^+)$$

Table 24 Open bottom tetraquark X_{b6} decays into two light mesons induced by the charmless $b \rightarrow s$ transition

Channel	Amplitude	Channel	Amplitude
$X_{ud\bar{s}}^+ \rightarrow \pi^+ \pi^0$	$-b_4 - 2(b_6 + b_7)$	$X_{ud\bar{s}}^+ \rightarrow \pi^+ \eta$	$-\frac{b_1+b_3+b_4+3b_5+3b_6}{\sqrt{3}}$
$X_{ud\bar{s}}^+ \rightarrow K^+ \bar{K}^0$	$-\frac{b_1+b_3+3b_5+b_6-2b_7}{\sqrt{2}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^0 \pi^-$	$b_4 + 2(b_6 + b_7)$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- \eta$	$\frac{b_1-b_3-b_4-b_5+3b_6+4b_7}{\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow K^0 K^-$	$\frac{b_1-b_3-b_5-3b_6-2b_7}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \bar{K}^0 K^-$	$\sqrt{2}(2(b_6 + b_7) - b_4)$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ K^-$	$\frac{-b_1-b_3-2b_4+5b_5+3b_6-2b_7}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \bar{K}^0$	$\frac{b_1+b_3-2b_4-5b_5-3b_6+2b_7}{2\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{K}^0 \eta$	$\frac{b_1+b_3-2b_4-5b_5-3b_6+2b_7}{2\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^+ \pi^-$	$-2b_2 - b_3 - b_4 + 2b_5 - 2b_7$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 \pi^0$	$-2b_2 - \frac{b_3}{2} + \frac{b_4}{2} + 2b_5 + 4b_6 + 2b_7$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 \eta$	$\frac{b_1+b_5+3b_6+2b_7}{\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^+ K^-$	$\frac{b_1-4b_2-b_3-b_5-3b_6-2b_7}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \bar{K}^0$	$\frac{-b_1-4b_2-b_3-3b_5-b_6+2b_7}{2}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \eta \eta$	$2\left(-b_2 - \frac{b_3}{6} - \frac{b_4}{6} - b_5 + b_7\right)$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 K^-$	$\frac{b_1-b_3+2b_4-b_5+b_6+2b_7}{2\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- \bar{K}^0$	$\frac{b_1-b_3-2b_4-b_5+b_6+2b_7}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^- \eta$	$\frac{-b_1+b_3-2b_4+b_5+15b_6+14b_7}{2\sqrt{6}}$		

$$\begin{aligned}
&= \frac{1}{3} \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi^- \bar{\Omega}^+) \\
&= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^- \bar{\Xi}^+).
\end{aligned}$$

The relations of decay widths for Class *IV* in $b \rightarrow d$ transition are given as:

$$\begin{aligned}
\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0 \bar{\Sigma}^-) &= \frac{2}{3} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^- \bar{\Sigma}^0) \\
&= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^- \bar{\Xi}^0), \\
\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^- \bar{\Sigma}^+) &= \frac{3}{4} \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^- \bar{\Xi}^+) \\
&= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi'^- \bar{\Omega}^+), \\
\Gamma(X_{ud\bar{s}}^+ \rightarrow \Delta^0 \bar{\Sigma}^+) &= \frac{1}{2} \Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma'^0 \bar{\Xi}^+) \\
&= \frac{1}{3} \Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi'^0 \bar{\Omega}^+), \\
\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0 \bar{\Sigma}^0) &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^0 \bar{\Xi}^0), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^- \bar{\Sigma}^0) \\
&= \frac{1}{3} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^- \bar{\Xi}^0), \\
\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^+ \bar{\Delta}^{--}) &= \frac{1}{2} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^+ \bar{\Delta}^{--}), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^0 \bar{\Delta}^-) \\
&= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^0 \bar{\Delta}^-), \\
\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^- \bar{\Delta}^0) &= \frac{3}{2} \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^- \bar{\Delta}^0), \Gamma(X_{ud\bar{s}}^+ \rightarrow \Delta^+ \bar{\Sigma}^0) \\
&= \frac{1}{2} \Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma'^+ \bar{\Xi}^0).
\end{aligned}$$

For $b \rightarrow s$ transition, the relations of decay widths for Class *II* are

$$\begin{aligned}
\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Sigma}^-) &= \frac{1}{2} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi'^- \bar{\Xi}^0) \\
&= \frac{1}{3} \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega^- \bar{\Xi}^0) = \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^0 \bar{\Sigma}^-), \\
\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^- \bar{\Sigma}^+) &= \frac{1}{3} \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega^- \bar{\Xi}^+) \\
&= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi'^- \bar{\Xi}^+) = \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^- \bar{\Sigma}^+), \\
\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^+ \bar{\Sigma}^-) &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi'^0 \bar{\Xi}^0), \Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma'^0 \bar{\Sigma}^+) \\
&= \frac{1}{2} \Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi'^0 \bar{\Xi}^+).
\end{aligned}$$

The relations of decay widths for Class *III* are given as

$$\begin{aligned}
\Gamma(X_{ud\bar{s}}^+ \rightarrow \Lambda^0 \bar{\Sigma}^+) &= \frac{3}{2} \Gamma(X_{ud\bar{s}}^+ \rightarrow \Xi'^0 \bar{\Xi}^+) \\
&= 3 \Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma'^0 \bar{\Sigma}^+) = \frac{1}{2} \Gamma(X_{ud\bar{s}}^+ \rightarrow n \bar{\Delta}^+), \\
\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^- \bar{\Delta}^+) &= 3 \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^- \bar{\Sigma}^+) \\
&= 3 \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^- \bar{\Sigma}^+) = 3 \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi^- \bar{\Xi}^+) \\
&= 3 \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi^- \bar{\Xi}^+), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^+ \bar{\Delta}^{--}) \\
&= \frac{1}{2} \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow p \bar{\Delta}^{--}), \\
\Gamma(X_{ud\bar{s}}^+ \rightarrow p \bar{\Delta}^0) &= 2 \Gamma(X_{ud\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Sigma}^0), \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Delta}^-) \\
&= \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Delta}^0),
\end{aligned}$$

Table 25 Open bottom tetraquark X_{b6} decays into a light anti-baryon octet and a light baryon octet induced by the charmless $b \rightarrow d$ transition

Channel	Amplitude
Class I	
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda^0 \bar{\Xi}^+$	$\frac{-2b_1+b_2+b_3+b_6-2b_7+b_8-6b_9+3b_{10}+3b_{11}+3b_{13}+3b_{14}+3b_{15}}{2\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Xi}^0$	$\frac{b_2+b_4+b_6+3b_{10}+3b_{11}+b_{12}-2b_{13}}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^0 \bar{\Xi}^+$	$\frac{b_2-b_3+b_6+b_8+3b_{10}-3b_{11}+3b_{13}-b_{14}+5b_{15}}{2}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow p \bar{\Lambda}^0$	$\frac{b_1-2b_2-b_4-2b_6+b_7+b_8+3b_9-6b_{10}-3b_{11}+3b_{12}+3b_{13}+3b_{14}}{2\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow p \bar{\Sigma}^0$	$\frac{b_1+b_4+b_7+b_8+3b_9+3b_{11}+5b_{12}-b_{13}+3b_{14}}{2}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow n \bar{\Sigma}^+$	$\frac{b_1-b_3+b_7+3b_9-3b_{11}-2b_{14}+b_{15}}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}^0$	$-\frac{b_3+b_4-b_8-2b_{11}+b_{12}+3b_{13}+b_{14}+3b_{15}}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Sigma}^-$	$\frac{b_3+b_4+b_8-2b_{11}-3b_{12}-b_{13}-3b_{14}-b_{15}}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Lambda^0 \bar{p}$	$-\frac{b_1-2b_2+b_3+2b_6-b_7+2b_8-b_9+2b_{10}-b_{11}+2b_{13}+3b_{15}}{2\sqrt{3}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^0 \bar{p}$	$\frac{-b_1+b_3+b_7+b_9-b_{11}-6b_{14}-5b_{15}}{2}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^- \bar{n}$	$\frac{-b_1+b_3+b_7+b_9-b_{11}+2b_{14}+3b_{15}}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Lambda}^0$	$\frac{2b_1-b_2+b_4+b_6-2b_7-2b_8-2b_9+b_{10}-b_{11}-3b_{12}-2b_{14}}{2\sqrt{3}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Sigma}^0$	$\frac{-b_2-b_4+b_6+b_{10}+b_{11}-5b_{12}-6b_{13}}{2}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Sigma}^-$	$\frac{-b_2-b_4+b_6+b_{10}+b_{11}+3b_{12}+2b_{13}}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Lambda}^0$	$\frac{3b_1+3b_2-3b_3+3b_4+12b_5+5b_6+5b_7-4b_8-3b_9-3b_{10}-9b_{12}-6b_{13}-6b_{14}-9b_{15}}{12}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Sigma}^0$	$\frac{\sqrt{3}(-b_1-b_2-b_3-3b_4+b_6+b_7-2b_8-7b_9-7b_{10}-4b_{11}-15b_{12}-4b_{13}-3b_{15})}{12}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Sigma}^-$	$\frac{-b_2-b_4+2b_5+b_6+4b_9-3b_{10}-3b_{11}+3b_{12}+2b_{13}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Lambda}^0$	$\frac{-b_1-b_2+3b_3+b_4+b_6+b_7-2b_8-7b_9-7b_{10}+4b_{11}-3b_{12}-4b_{14}-15b_{15}}{4\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Sigma}^0$	$\frac{-b_1-b_2+b_3-b_4+4b_5+b_6+b_7+b_9+b_{10}-5b_{12}-6b_{13}-6b_{14}-5b_{15}}{4}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^- \bar{\Sigma}^+$	$\frac{-b_1+b_3+2b_5+b_7-3b_9+4b_{10}+3b_{11}+2b_{14}+3b_{15}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow p \bar{p}$	$\frac{b_1-b_2+2b_5+b_6+b_7+b_8-b_9-3b_{10}+b_{13}+3b_{14}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow n \bar{n}$	$\frac{b_1-b_3+2b_5+b_7-b_9+4b_{10}+b_{11}-2b_{14}+b_{15}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^- \bar{\Xi}^+$	$\frac{-b_1+b_2+2b_5+b_6+b_7+b_8-3b_9-b_{10}+3b_{13}+b_{14}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Xi}^0$	$\frac{b_2+b_4+2b_5+b_6+4b_9-b_{10}-b_{11}+b_{12}-2b_{13}}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Xi}^0$	$\frac{\sqrt{6}(-2b_1+b_2+b_3+b_6-2b_7+b_8+10b_9-5b_{10}-5b_{11}-5b_{13}+3b_{14}+3b_{15})}{12}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^0 \bar{\Xi}^0$	$-\frac{b_2+b_3+2b_4+b_6-b_8-5b_{10}+b_{11}+2b_{12}+b_{13}+b_{14}-5b_{15}}{2\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^- \bar{\Xi}^+$	$\frac{b_2-b_3+b_6+b_8-5b_{10}-3b_{11}+3b_{13}-b_{14}-3b_{15}}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow p \bar{\Sigma}^-$	$\frac{b_1+b_4+b_7+b_8-5b_9+3b_{11}-3b_{12}-b_{13}+3b_{14}}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow n \bar{\Lambda}^0$	$\frac{\sqrt{6}(b_1-2b_2-b_4-2b_6+b_7+b_8-5b_9+10b_{10}+5b_{11}+3b_{12}+3b_{13}-5b_{14})}{12}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow n \bar{\Sigma}^0$	$-\frac{b_1-2b_3-b_4+b_7-b_8-5b_9-b_{11}-5b_{12}+b_{13}+b_{14}+2b_{15}}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}^-$	$\frac{\sqrt{6}(-b_1-b_2-b_3-3b_4+b_6+b_7-2b_8+b_9+b_{10}+4b_{11}+9b_{12}+4b_{13}-3b_{15})}{12}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Sigma}^-$	$\frac{-b_1+b_2+b_3+b_4-b_6+b_7+b_9-b_{10}-2b_{11}-3b_{12}-2b_{13}-6b_{14}-5b_{15}}{2\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Lambda}^0$	$\frac{\sqrt{6}(-b_1-b_2+3b_3+b_4+b_6+b_7-2b_8+b_9+b_{10}-4b_{11}-3b_{12}+4b_{14}+9b_{15})}{12}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Sigma}^0$	$\frac{b_1-b_2-b_3-b_4+b_6-b_7-b_9+b_{10}+2b_{11}-5b_{12}-6b_{13}-2b_{14}-3b_{15}}{2\sqrt{2}}$

Table 25 continued

Channel	Amplitude
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow n\bar{p}$	$\frac{-b_2+b_3+b_6+b_8+b_{10}-b_{11}+b_{13}-3b_{14}-b_{15}}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^-\bar{\Xi}^0$	$\frac{-b_1-b_4+b_7+b_8+b_9+b_{11}-b_{12}-3b_{13}+b_{14}}{2}$

Table 26 Open bottom tetraquark X_{b6} decays into a light anti-baryon octet and a light baryon decuplet induced by the charmless $b \rightarrow d$ transition

Channel	Amplitude	Channel	Amplitude
Class II			
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++}\bar{\Sigma}^-$	$\frac{c_1+c_3+c_4+3c_5+3c_7}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^+\bar{\Lambda}^0$	$\frac{c_1+c_2-3c_4+6c_5+6c_6+3c_7}{6}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^+\bar{\Sigma}^0$	$-\frac{c_1-c_2+2c_3+c_4-6c_6-5c_7}{2\sqrt{3}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^0\bar{\Sigma}^+$	$\frac{c_2-c_3+3c_5+6c_6}{\sqrt{6}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^+\bar{\Xi}^0$	$\frac{c_1+c_3-c_4+3c_5-c_7}{\sqrt{6}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^0\bar{\Xi}^+$	$\frac{c_2-c_3+3c_5+6c_6}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0\bar{\Sigma}^-$	$\frac{c_1+c_2+c_4-2c_5-2c_6+3c_7}{\sqrt{6}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^-\bar{\Lambda}^0$	$\frac{c_1+c_2-3c_4-2c_5-2c_6+3c_7}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^-\bar{\Sigma}^0$	$-\frac{c_1-c_2-c_4+2c_5+2c_6+5c_7}{2}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^-\bar{\Xi}^0$	$\frac{c_1+c_2-c_4-2c_5-2c_6-c_7}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^0\bar{p}$	$\frac{c_2+c_3-c_5-2c_6}{2\sqrt{3}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^-\bar{n}$	$\frac{c_2+c_3-c_5-2c_6}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0\bar{\Sigma}^-$	$\frac{c_1-c_3+c_4-c_5+3c_7}{\sqrt{6}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^-\bar{\Lambda}^0$	$\frac{c_1-2c_2-3c_3-3c_4+c_5+4c_6+3c_7}{6}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^-\bar{\Sigma}^0$	$-\frac{c_1+c_3-c_4+c_5+5c_7}{2\sqrt{3}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^-\bar{\Xi}^0$	$\frac{c_1-c_3-c_4-c_5-c_7}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^+\bar{p}$	$\frac{c_2+c_3-c_5+6c_6}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^0\bar{n}$	$\frac{c_2+c_3-c_5+6c_6}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+\bar{\Sigma}^-$	$\frac{c_1+c_4+c_5+3c_7}{\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0\bar{\Lambda}^0$	$\frac{2c_1-c_2-3c_3-6c_4+7c_5-14c_6+6c_7}{12}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0\bar{\Sigma}^0$	$-\frac{2c_1+c_2-c_3-2c_4+c_5-2c_6+10c_7}{4\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^-\bar{\Sigma}^+$	$\frac{c_2-c_3+3c_5-2c_6}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^0\bar{\Xi}^0$	$\frac{c_1-c_4+c_5-c_7}{\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^-\bar{\Xi}^+$	$\frac{c_2-c_3+3c_5-2c_6}{2\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+\bar{\Sigma}^-$	$\frac{2c_1+c_2+c_3+2c_4+c_5+6c_6+6c_7}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0\bar{\Lambda}^0$	$\frac{c_1+c_2-3c_4+2c_5+2c_6+3c_7}{3\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0\bar{\Sigma}^0$	$-\frac{c_1+c_3+c_4-c_5+4c_6-5c_7}{\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^-\bar{\Sigma}^+$	$\frac{c_2-c_3+3c_5-2c_6}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^0\bar{\Xi}^0$	$\frac{2c_1+c_2+c_3-2c_4+c_5+6c_6-2c_7}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^-\bar{\Xi}^+$	$\frac{c_2-c_3+3c_5-2c_6}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^0\bar{p}$	$\frac{c_2+c_3-c_5-2c_6}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^-\bar{n}$	$\frac{c_2+c_3-c_5-2c_6}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^0\bar{\Sigma}^-$	$\frac{2c_1+c_2-c_3+2c_4-3c_5-2c_6+6c_7}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^-\bar{\Lambda}^0$	$\frac{2c_1-c_2-3c_3-6c_4-c_5+2c_6+6c_7}{6\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^-\bar{\Sigma}^0$	$-\frac{2c_1-c_2+c_3-2c_4+3c_5+2c_6+10c_7}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^-\bar{\Xi}^0$	$\frac{2c_1+c_2-c_3-2c_4-3c_5-2c_6-2c_7}{2\sqrt{3}}$

$$\begin{aligned}
& \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0\bar{\Delta}^-) \\
&= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0\bar{\Delta}^0), \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^-\bar{\Delta}^0) \\
&= \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^-\bar{\Sigma}^0).
\end{aligned}$$

The relations of decay widths for Class IV become

$$\begin{aligned}
& \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^0\bar{\Delta}^+) = \frac{3}{2}\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^0\bar{\Sigma}^+) \\
&= 3\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi'^0\bar{\Xi}^+), \\
& \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0\bar{\Delta}^-) = \Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^-\bar{\Delta}^0) \\
&= \frac{2}{3}\Gamma(X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^-\bar{\Sigma}^0), \\
& \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^-\bar{\Delta}^+) = \frac{3}{4}\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^-\bar{\Sigma}^+)
\end{aligned}$$

$$\begin{aligned}
&= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega^-\bar{\Xi}^+), \\
& \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^+\bar{\Delta}^0) \\
&= 2\Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^+\bar{\Sigma}^0), \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^+\bar{\Delta}^{--}) \\
&= 2\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^+\bar{\Delta}^{--}), \\
& \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^0\bar{\Sigma}^{'-}) \\
&= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^0\bar{\Sigma}^{'-}), \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Xi'^-\bar{\Xi}^0) \\
&= \frac{2}{3}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega^-\bar{\Xi}^0), \\
& \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^-\bar{\Delta}^0) \\
&= 3\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^-\bar{\Sigma}^0), \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0\bar{\Delta}^0) \\
&= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^0\bar{\Sigma}^0),
\end{aligned}$$

Table 27 Open bottom tetraquark X_{b6} decays into a light anti-baryon anti-decuplet plus a light baryon octet for class III and a light anti-baryon anti-decuplet plus a light baryon decuplet for class IV induced by the charmless $b \rightarrow d$ transition

Channel	Amplitude	Channel	Amplitude
Class III			
$X_{ud\bar{s}}^+ \rightarrow \Lambda^0 \bar{\Xi}'^+$	$\frac{2d_1+d_2+d_3-2d_4-d_5}{2}$	$X_{ud\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Xi}^0$	$\frac{2d_1-d_2+d_3-2d_4+3d_5}{\sqrt{6}}$
$X_{ud\bar{s}}^+ \rightarrow \Sigma^0 \bar{\Xi}'^+$	$-\frac{2d_1+d_2+d_3-2d_4-d_5}{2\sqrt{3}}$	$X_{ud\bar{s}}^+ \rightarrow p \bar{\Sigma}^0$	$-\frac{2d_1-d_2+d_3-2d_4+3d_5}{2\sqrt{3}}$
$X_{ud\bar{s}}^+ \rightarrow n \bar{\Sigma}'^+$	$-\frac{2d_1+d_2+d_3-2d_4-d_5}{\sqrt{6}}$	$X_{ud\bar{s}}^+ \rightarrow \Xi^0 \bar{\Omega}^+$	$\frac{2d_1+d_2+d_3-2d_4-d_5}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Xi}^0$	$\sqrt{\frac{2}{3}}(d_2+2d_5)$	$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Sigma}'^-$	$-\sqrt{\frac{2}{3}}(d_2+2d_5)$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Lambda^0 \bar{\Delta}^-$	$-\frac{4(d_3+d_4+d_5)}{3}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^+ \bar{\Delta}^{--}$	$-\frac{2d_1+d_2+3d_3+2d_4-3d_5}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^0 \bar{\Delta}^-$	$\frac{2d_1+d_2-d_3-2d_4+d_5}{\sqrt{3}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma^- \bar{\Delta}^0$	$\frac{2d_1+d_2-5d_3-6d_4+5d_5}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Sigma}^0$	$\frac{2d_1-d_2-5d_3-6d_4+d_5}{2\sqrt{3}}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Sigma}'^-$	$-\frac{2d_1-d_2+3d_3+2d_4+d_5}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Sigma}^0$	$\frac{6d_1-3d_2-7d_3+14d_4+11d_5}{12}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Sigma}'^-$	$\frac{d_2+d_3+2d_4-3d_5}{\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Sigma}^0$	$\frac{2d_1-d_2-d_3+2d_4-3d_5}{4\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^- \bar{\Sigma}'^+$	$\frac{2d_1+d_2+d_3+6d_4-d_5}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow p \bar{\Delta}^-$	$-\frac{2d_1+d_2-5d_3+2d_4-3d_5}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow n \bar{\Delta}^0$	$-\frac{2d_1+d_2-5d_3+2d_4+5d_5}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^- \bar{\Xi}^0$	$\frac{2d_1+d_2+d_3+6d_4-d_5}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Xi}^0$	$-\frac{d_2+d_3+2d_4+d_5}{\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Xi}^0$	$-\frac{6d_1+3d_2-13d_3+2d_4+5d_5}{6\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^0 \bar{\Xi}^0$	$-\frac{2d_1-3d_2+d_3+6d_4-d_5}{2\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^- \bar{\Xi}^0$	$-\frac{2d_1+d_2+d_3+6d_4-d_5}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow p \bar{\Sigma}'^-$	$\frac{2d_1-d_2-7d_3-2d_4+3d_5}{2\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow n \bar{\Sigma}^0$	$\frac{2d_1+3d_2-7d_3-2d_4+3d_5}{2\sqrt{6}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi^- \bar{\Omega}^+$	$-\frac{2d_1-d_2-d_3-6d_4+d_5}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}'^-$	$-\frac{6d_1-3d_2+d_3-2d_4-5d_5}{6\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Sigma}'^-$	$-\frac{2d_1+3d_2-5d_3-6d_4+d_5}{2\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Sigma}^0$	$-\frac{2d_1+3d_2-5d_3-6d_4+9d_5}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow p \bar{\Delta}^{--}$	$\frac{2d_1+d_2+3d_3+2d_4-3d_5}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow n \bar{\Delta}^-$	$\frac{2d_1+d_2+3d_3+2d_4+5d_5}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}^0$	$-\frac{2d_1+d_2+5d_3+6d_4-d_5}{2\sqrt{3}}$
Class IV			
$X_{ud\bar{s}}^+ \rightarrow \Delta^{++} \bar{\Sigma}'^-$	$\frac{f_1+f_3+2f_4+3f_5+3f_6}{\sqrt{6}}$	$X_{ud\bar{s}}^+ \rightarrow \Delta^+ \bar{\Sigma}^0$	$\frac{f_1+f_3+f_4+3f_5+f_6}{3}$
$X_{ud\bar{s}}^+ \rightarrow \Delta^0 \bar{\Sigma}'^+$	$\frac{f_1+f_3+3f_5-f_6}{3\sqrt{2}}$	$X_{ud\bar{s}}^+ \rightarrow \Sigma'^+ \bar{\Xi}^0$	$\frac{\sqrt{2}(f_1+f_3+f_4+3f_5+f_6)}{3}$
$X_{ud\bar{s}}^+ \rightarrow \Sigma'^0 \bar{\Xi}'^+$	$\frac{f_1+f_3+3f_5-f_6}{3}$	$X_{ud\bar{s}}^+ \rightarrow \Xi'^0 \bar{\Omega}^+$	$\frac{f_1+f_3+3f_5-f_6}{\sqrt{6}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0 \bar{\Sigma}'^-$	$\frac{\sqrt{2}(f_4-2f_6)}{3}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^- \bar{\Sigma}^0$	$\frac{f_4-2f_6}{\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^- \bar{\Xi}^0$	$\frac{\sqrt{2}(f_4-2f_6)}{3}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^+ \bar{\Delta}^{--}$	$-\frac{f_1+f_3+f_5-3f_6}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^0 \bar{\Delta}^-$	$\frac{(-f_1+f_3+f_5+f_6)}{3}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Sigma'^- \bar{\Delta}^0$	$-\frac{f_1+f_3+f_5+5f_6}{3\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0 \bar{\Sigma}'^-$	$\frac{\sqrt{2}(-f_1+f_3+f_4+f_5-f_6)}{3}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^- \bar{\Sigma}^0$	$\frac{(-f_1+f_3+f_4+f_5+3f_6)}{3}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^- \bar{\Xi}^0$	$-\frac{f_1+f_3+2f_4+f_5+f_6}{\sqrt{6}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^{++} \bar{\Delta}^{--}$	$-\frac{f_1+2f_2+f_3+3f_5-3f_6}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^+ \bar{\Delta}^-$	$-\frac{f_1+3f_2+f_3-f_5+f_6}{3}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^0 \bar{\Delta}^0$	$-\frac{f_1+6f_2+f_3+5f_5+5f_6}{6}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Delta^- \bar{\Delta}^+$	f_2+2f_5	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+ \bar{\Sigma}'^-$	$-\frac{f_1+6f_2+3f_3+4f_4-7f_5+f_6}{6}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0 \bar{\Sigma}^0$	$\frac{3f_2+f_3+f_4+2f_6}{3}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^- \bar{\Sigma}'^+$	$\frac{f_1+6f_2+f_3+7f_5-f_6}{6}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^0 \bar{\Xi}^0$	$\frac{f_1+6f_2+3f_3+4f_4-5f_5+3f_6}{6}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^- \bar{\Xi}'^+$	$\frac{f_1+3f_2+f_3+f_5-f_6}{3}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega^- \bar{\Omega}^+$	$\frac{f_1+2f_2+f_3-f_5-f_6}{2}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Sigma}'^-$	$\frac{f_1+f_3+4f_4-5f_5-f_6}{6}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0 \bar{\Sigma}^0$	$\frac{f_1+f_3+2f_4-5f_5-f_6}{3\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^- \bar{\Sigma}'^+$	$\frac{f_1+f_3-5f_5-f_6}{2\sqrt{3}}$

Table 27 continued

Channel	Amplitude	Channel	Amplitude
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^0 \bar{\Xi}^{\prime 0}$	$\frac{f_1+f_3+2f_4-5f_5-f_6}{3\sqrt{2}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^- \bar{\Xi}^{\prime +}$	$\frac{f_1+f_3-5f_5-f_6}{3}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi'^- \bar{\Omega}^+$	$\frac{f_1+f_3-5f_5-f_6}{2\sqrt{3}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^+ \bar{\Delta}^{--}$	$\frac{-f_1+f_3+f_5-3f_6}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^0 \bar{\Delta}^-$	$\frac{-f_1+f_3+f_5+f_6}{3}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Delta^- \bar{\Delta}^0$	$\frac{-f_1+f_3+f_5+5f_6}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Sigma}'^-$	$\frac{-f_1+f_3+2f_4+f_5-3f_6}{3\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^- \bar{\Sigma}'^0$	$\frac{-f_1+f_3+2f_4+f_5+f_6}{3\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^- \bar{\Xi}'^0$	$\frac{-f_1+f_3+4f_4+f_5-3f_6}{6}$		

Table 28 Open bottom tetraquark X_{b6} decays into a light anti-baryon octet and a light baryon octet induced by the charmless $b \rightarrow s$ transition

Channel	Amplitude
Class I	
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda^0 \bar{\Sigma}^+$	$\frac{\sqrt{3}(-b_1-b_2+2b_3-b_6-b_7-b_8-3b_9-3b_{10}+6b_{11}-3b_{13}+3b_{14}-6b_{15})}{6}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Lambda}^0$	$-\frac{b_1+b_2+2b_4+b_6+b_7+b_8+3b_9+3b_{10}+6b_{11}+6b_{12}-3b_{13}+3b_{14}}{2\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Sigma}^0$	$\frac{-b_1+b_2+b_6-b_7-b_8-3b_9+3b_{10}-4b_{12}-b_{13}-3b_{14}}{2}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^0 \bar{\Sigma}^+$	$\frac{b_1-b_2-b_6+b_7-b_8+3b_9-3b_{10}-3b_{13}-b_{14}-4b_{15}}{2}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow p \bar{n}$	$-\frac{b_2+b_4+b_6+3b_{10}+3b_{11}+b_{12}-2b_{13}}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi^0 \bar{\Xi}^+$	$-\frac{b_1-b_3+b_7+3b_9-3b_{11}-2b_{14}+b_{15}}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}^-$	$\frac{b_1+b_2-2b_3-b_6-b_7-b_8-b_9-b_{10}+2b_{11}-b_{13}+9b_{14}+6b_{15}}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^0 \bar{\Sigma}^-$	$\frac{b_1-b_2+b_6-b_7+b_8-b_9+b_{10}+b_{13}+3b_{14}+4b_{15}}{2}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Lambda}^0$	$\frac{b_1+b_2+2b_4-b_6-b_7-b_8-b_9-b_{10}-2b_{11}+6b_{12}+9b_{13}-b_{14}}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Sigma}^0$	$\frac{-b_1+b_2-b_6+b_7+b_8+b_9-b_{10}+4b_{12}+3b_{13}+b_{14}}{2}$
$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{p}$	$\frac{b_2+b_4-b_6-b_{10}-b_{11}-3b_{12}-2b_{13}}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}^0$	$\frac{b_1-b_3-b_7-b_9+b_{11}-2b_{14}-3b_{15}}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{n}$	$\frac{b_3+b_4-b_8-2b_{11}+b_{12}+3b_{13}+b_{14}+3b_{15}}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{p}$	$\frac{-b_3-b_4-b_8+2b_{11}+3b_{12}+b_{13}+3b_{14}+b_{15}}{\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{n}$	$\frac{\sqrt{6}(-b_1+2b_2+2b_3+3b_4+2b_6-b_7-b_8+5b_9-10b_{10}-b_{11}+3b_{12}-b_{13}+3b_{14}-6b_{15})}{12}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{p}$	$\frac{-b_1-b_4-b_7-b_8+5b_9-3b_{11}+3b_{12}+b_{13}-3b_{14}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{n}$	$\frac{b_1+b_4+b_7-b_8-5b_9+3b_{11}+b_{12}+3b_{13}-b_{14}-4b_{15}}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^- \bar{\Sigma}^+$	$\frac{-b_2+b_3-b_6-b_8+5b_{10}+3b_{11}-3b_{13}+b_{14}+3b_{15}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Lambda}^0$	$\frac{2b_1-b_2-3b_3-2b_4-b_6+2b_7-b_8-10b_9+5b_{10}+b_{11}-6b_{12}+3b_{13}-b_{14}+3b_{15}}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Sigma}^0$	$\frac{b_2-b_3+b_6-b_8-5b_{10}-3b_{11}-4b_{12}-b_{13}+3b_{14}+b_{15}}{2\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Lambda}^0$	$-b_5 - \frac{b_6}{6} - \frac{b_7}{6} - \frac{b_8}{6} - b_9 - b_{10} + b_{13} + b_{14}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Sigma}^0$	$\frac{b_1+b_2-2b_3+b_9+b_{10}-2b_{11}+b_{13}+3b_{14}+6b_{15}}{2\sqrt{3}}$

Table 28 continued

Channel	Amplitude
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma^+ \bar{\Sigma}^-$	$\frac{-b_1+b_2-2b_5-b_6-b_7-b_8+b_9+3b_{10}-b_{13}-3b_{14}}{2}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma^0 \bar{\Lambda}^0$	$\frac{b_1+b_2+2b_4+b_9+b_{10}+2b_{11}+6b_{12}+3b_{13}+b_{14}}{2\sqrt{3}}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma^0 \bar{\Sigma}^0$	$-b_5 - \frac{b_6}{2} - \frac{b_7}{2} + \frac{b_8}{2} + b_9 + b_{10} + 2b_{12} + b_{13} + b_{14} + 2b_{15}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma^- \bar{\Sigma}^+$	$\frac{b_1-b_2-2b_5-b_6-b_7-b_8+3b_9+b_{10}-3b_{13}-b_{14}}{2}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow p \bar{p}$	$\frac{b_2+b_4-2b_5-b_6-4b_9+3b_{10}+3b_{11}-2b_{12}-2b_{13}}{2}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow n \bar{n}$	$\frac{-b_2-b_4-2b_5-b_6-4b_9+b_{10}+b_{11}-b_{12}+2b_{13}}{2}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Xi^- \bar{\Xi}^+$	$\frac{b_1-b_3-2b_5-b_7+3b_9-4b_{10}-3b_{11}-2b_{14}-3b_{15}}{2}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Xi^0 \bar{\Xi}^0$	$\frac{-b_1+b_3-2b_5-b_7+b_9-4b_{10}-b_{11}+2b_{14}-b_{15}}{2}$
$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Lambda^0 \bar{p}$	$\frac{b_1-2b_2-2b_3-3b_4+2b_6-b_7-b_8-b_9+2b_{10}+5b_{11}+9b_{12}+5b_{13}+9b_{14}+6b_{15}}{2\sqrt{6}}$
$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Sigma^0 \bar{p}$	$\frac{b_1+b_4-b_7+b_8-b_9-b_{11}-3b_{12}-b_{13}+3b_{14}+4b_{15}}{2\sqrt{2}}$
$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Sigma^- \bar{n}$	$\frac{b_1+b_4-b_7-b_8-b_9-b_{11}+b_{12}+3b_{13}-b_{14}}{2}$
$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Xi^- \bar{\Lambda}^0$	$\frac{-2b_1+b_2+3b_3+2b_4-b_6+2b_7-b_8+2b_9-b_{10}-5b_{11}+6b_{12}+9b_{13}+5b_{14}+9b_{15}}{2\sqrt{6}}$
$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Xi^- \bar{\Sigma}^0$	$\frac{b_2-b_3-b_6+b_8-b_{10}+b_{11}+4b_{12}+3b_{13}-b_{14}-3b_{15}}{2\sqrt{2}}$
$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Xi^0 \bar{\Sigma}^-$	$\frac{b_2-b_3-b_6-b_8-b_{10}+b_{11}-b_{13}+3b_{14}+b_{15}}{2}$

Table 29 Open bottom tetraquark X_{b6} decays into a light anti-baryon octet and a light baryon decuplet induced by the charmless $b \rightarrow s$ transition

Channel	Amplitude	Channel	Amplitude
Class II			
$X^+_{u\bar{d}\bar{s}} \rightarrow \Delta^{++} \bar{p}$	$\frac{c_1+c_3+c_4+3c_5+3c_7}{\sqrt{2}}$	$X^+_{u\bar{d}\bar{s}} \rightarrow \Delta^+ \bar{n}$	$\frac{c_1+c_3-c_4+3c_5-c_7}{\sqrt{6}}$
$X^+_{u\bar{d}\bar{s}} \rightarrow \Sigma'^+ \bar{\Lambda}^0$	$\frac{-2c_1+c_2-3c_3-3c_5+6c_6+6c_7}{6}$	$X^+_{u\bar{d}\bar{s}} \rightarrow \Sigma'^+ \bar{\Sigma}^0$	$\frac{c_2-c_3-2c_4+3c_5+6c_6+4c_7}{2\sqrt{3}}$
$X^+_{u\bar{d}\bar{s}} \rightarrow \Sigma'^0 \bar{\Sigma}^+$	$\frac{c_2-c_3+3c_5+6c_6}{2\sqrt{3}}$	$X^+_{u\bar{d}\bar{s}} \rightarrow \Xi'^0 \bar{\Xi}^+$	$\frac{c_2-c_3+3c_5+6c_6}{\sqrt{6}}$
$X^-_{d\bar{s}\bar{u}} \rightarrow \Delta^0 \bar{p}$	$\frac{c_1-c_3+c_4-c_5+3c_7}{\sqrt{6}}$	$X^-_{d\bar{s}\bar{u}} \rightarrow \Delta^- \bar{n}$	$\frac{c_1-c_3-c_4-c_5-c_7}{\sqrt{2}}$
$X^-_{d\bar{s}\bar{u}} \rightarrow \Sigma'^0 \bar{\Sigma}^-$	$\frac{c_2+c_3-c_5-2c_6}{2\sqrt{3}}$	$X^-_{d\bar{s}\bar{u}} \rightarrow \Sigma'^- \bar{\Lambda}^0$	$\frac{-2c_1+c_2+3c_3+c_5-2c_6+6c_7}{6}$
$X^-_{d\bar{s}\bar{u}} \rightarrow \Sigma'^- \bar{\Sigma}^0$	$\frac{-c_2+c_3+2c_4-c_5-2c_6-4c_7}{2\sqrt{3}}$	$X^-_{d\bar{s}\bar{u}} \rightarrow \Xi'^- \bar{\Xi}^0$	$\frac{c_2+c_3-c_5-2c_6}{\sqrt{6}}$
$X^-_{s\bar{u}\bar{d}} \rightarrow \Xi'^0 \bar{p}$	$\frac{c_1+c_2+c_4-2c_5-2c_6+3c_7}{\sqrt{6}}$	$X^-_{s\bar{u}\bar{d}} \rightarrow \Xi'^- \bar{n}$	$\frac{c_1+c_2-c_4-2c_5-2c_6-c_7}{\sqrt{6}}$
$X^-_{s\bar{u}\bar{d}} \rightarrow \Omega^- \bar{\Lambda}^0$	$\frac{-c_1+c_2-2c_5-2c_6-3c_7}{\sqrt{3}}$	$X^-_{s\bar{u}\bar{d}} \rightarrow \Omega^- \bar{\Sigma}^0$	$2c_7 - c_4$
$Y^0_{(u\bar{u},s\bar{s})\bar{d}} \rightarrow \Sigma'^+ \bar{p}$	$\frac{2c_1+c_2+c_3+2c_4+c_5+6c_6+6c_7}{2\sqrt{3}}$	$Y^0_{(u\bar{u},s\bar{s})\bar{d}} \rightarrow \Sigma'^0 \bar{n}$	$\frac{2c_1+c_2+c_3-2c_4+c_5+6c_6-2c_7}{2\sqrt{6}}$
$Y^0_{(u\bar{u},s\bar{s})\bar{d}} \rightarrow \Xi'^0 \bar{\Lambda}^0$	$\frac{-4c_1+c_2+3c_3-c_5+14c_6-12c_7}{6\sqrt{2}}$	$Y^0_{(u\bar{u},s\bar{s})\bar{d}} \rightarrow \Xi'^0 \bar{\Sigma}^0$	$\frac{c_2-c_3-4c_4+3c_5-2c_6+8c_7}{2\sqrt{6}}$
$Y^0_{(u\bar{u},s\bar{s})\bar{d}} \rightarrow \Xi'^- \bar{\Sigma}^+$	$\frac{c_2-c_3+3c_5-2c_6}{2\sqrt{3}}$	$Y^0_{(u\bar{u},s\bar{s})\bar{d}} \rightarrow \Omega^- \bar{\Xi}^+$	$\frac{c_2-c_3+3c_5-2c_6}{2}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Delta^+ \bar{p}$	$\frac{c_1+c_4+c_5+3c_7}{\sqrt{3}}$	$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Delta^0 \bar{n}$	$\frac{c_1-c_4+c_5-c_7}{\sqrt{3}}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma'^+ \bar{\Sigma}^-$	$\frac{c_2+c_3-c_5+6c_6}{2\sqrt{3}}$	$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma'^0 \bar{\Lambda}^0$	$\frac{-2c_1+c_2-c_5+2c_6+6c_7}{6}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma'^0 \bar{\Sigma}^0$	$\frac{-c_3+2c_4-2c_5+4c_6-4c_7}{2\sqrt{3}}$	$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Sigma'^- \bar{\Sigma}^+$	$\frac{c_2-c_3+3c_5-2c_6}{2\sqrt{3}}$
$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Xi'^0 \bar{\Xi}^0$	$\frac{c_2+c_3-c_5+6c_6}{2\sqrt{3}}$	$Y^0_{(u\bar{u},d\bar{d})\bar{s}} \rightarrow \Xi'^- \bar{\Xi}^+$	$\frac{c_2-c_3+3c_5-2c_6}{2\sqrt{3}}$
$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Sigma'^0 \bar{p}$	$\frac{2c_1+c_2-c_3+2c_4-3c_5-2c_6+6c_7}{2\sqrt{6}}$	$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Sigma'^- \bar{n}$	$\frac{2c_1+c_2-c_3-2c_4-3c_5-2c_6-2c_7}{2\sqrt{3}}$
$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Xi'^0 \bar{\Sigma}^-$	$\frac{c_2+c_3-c_5-2c_6}{2\sqrt{3}}$	$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Xi'^- \bar{\Lambda}^0$	$\frac{-4c_1-c_2+3c_3+5c_5+2c_6+12c_7}{6\sqrt{2}}$
$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Xi'^- \bar{\Sigma}^0$	$\frac{-c_2+c_3+4c_4-c_5-2c_6-8c_7}{2\sqrt{6}}$	$Y^-_{(d\bar{d},s\bar{s})\bar{u}} \rightarrow \Omega^- \bar{\Xi}^0$	$\frac{c_2+c_3-c_5-2c_6}{2}$

Table 30 Open bottom tetraquark X_{b6} decays into a light anti-baryon anti-decuplet plus a light baryon octet for class III and a light anti-baryon anti-decuplet and a light baryon decuplet for class IV induced by the charmless $b \rightarrow s$ transition

Channel	Amplitude	Channel	Amplitude
Class III			
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Lambda^0 \bar{\Sigma}'^{+}$	$-\frac{2d_1-d_2-d_3+2d_4+d_5}{2}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^+ \bar{\Sigma}'^0$	$-\frac{2d_1-d_2+d_3-2d_4+3d_5}{2\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma^0 \bar{\Sigma}'^{+}$	$\frac{2d_1+d_2+d_3-2d_4-d_5}{2\sqrt{3}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow p \bar{\Delta}^0$	$\frac{2d_1-d_2+d_3-2d_4+3d_5}{\sqrt{6}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow n \bar{\Delta}^{+}$	$\frac{2d_1+d_2+d_3-2d_4-d_5}{\sqrt{2}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi^0 \bar{\Xi}'^{+}$	$-\frac{2d_1+d_2+d_3-2d_4-d_5}{\sqrt{6}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}'^{-}$	$\frac{6d_1+3d_2+d_3-2d_4+7d_5}{6}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^0 \bar{\Sigma}'^{-}$	$\frac{2d_1+d_2-5d_3-6d_4-3d_5}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma^- \bar{\Sigma}'^0$	$\frac{2d_1-d_2-5d_3-6d_4+d_5}{2\sqrt{3}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow p \bar{\Delta}^{--}$	$-\frac{2d_1+d_2+3d_3+2d_4-3d_5}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow n \bar{\Delta}^{-}$	$-\frac{2d_1-d_2+3d_3+2d_4+d_5}{\sqrt{6}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}'^0$	$\frac{2d_1+d_2-5d_3-6d_4+5d_5}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^- \bar{\Delta}^0$	$\sqrt{\frac{2}{3}}(d_2+2d_5)$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi^0 \bar{\Delta}^{-}$	$-\sqrt{\frac{2}{3}}(d_2+2d_5)$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Lambda^0 \bar{\Delta}^0$	$\frac{3d_2-4d_3-4d_4+2d_5}{3\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^+ \bar{\Delta}^{--}$	$\frac{2d_1-d_2-7d_3-2d_4+3d_5}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^0 \bar{\Delta}^0$	$-\frac{2d_1-3d_3+2d_4+d_5}{\sqrt{6}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma^- \bar{\Delta}^{+}$	$-\frac{2d_1-d_2-d_3-6d_4+d_5}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^- \bar{\Sigma}'^{+}$	$-\frac{2d_1+d_2+d_3+6d_4-d_5}{2\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi^0 \bar{\Sigma}'^0$	$\frac{2d_1+3d_2-7d_3-2d_4+3d_5}{2\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Lambda^0 \bar{\Sigma}'^0$	$\frac{d_3-2d_4-5d_5}{6}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^+ \bar{\Sigma}'^{-}$	$-\frac{2d_1+d_2-5d_3+2d_4-3d_5}{2\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^0 \bar{\Sigma}'^0$	$\frac{2d_1-d_2-2d_3+4d_4+2d_5}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma^- \bar{\Sigma}'^{+}$	$\frac{2d_1+d_2+d_3+6d_4-d_5}{2\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow p \bar{\Delta}^{-}$	$\frac{d_2+d_3+2d_4-3d_5}{\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow n \bar{\Delta}^0$	$-\frac{d_2+d_3+2d_4+d_5}{\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi^- \bar{\Xi}'^{+}$	$\frac{2d_1+d_2+d_3+6d_4-d_5}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi^0 \bar{\Xi}'^0$	$-\frac{2d_1+d_2-5d_3+2d_4+5d_5}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Delta}^{-}$	$\frac{-3d_2+4d_3+4d_4-2d_5}{3\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^+ \bar{\Delta}^{--}$	$\frac{2d_1+d_2+3d_3+2d_4-3d_5}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Delta}^{-}$	$-\frac{2d_1+d_3+2d_4+d_5}{\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Delta}^0$	$-\frac{2d_1+d_2+5d_3+6d_4-d_5}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Sigma}'^0$	$-\frac{2d_1+3d_2-5d_3-6d_4+9d_5}{2\sqrt{6}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^0 \bar{\Sigma}'^{-}$	$\frac{2d_1+d_2+3d_3+2d_4+5d_5}{2\sqrt{3}}$
Class IV			
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^{++} \bar{\Delta}^{-}$	$-\frac{f_1+f_3+2f_4+3f_5+3f_6}{\sqrt{6}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^+ \bar{\Delta}^0$	$-\frac{\sqrt{2}(f_1+f_3+f_4+3f_5+f_6)}{3}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Delta^0 \bar{\Delta}^{+}$	$-\frac{f_1+f_3+3f_5-f_6}{\sqrt{6}}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^+ \bar{\Sigma}'^0$	$-\frac{f_1-f_3-f_4-3f_5-f_6}{3}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \Sigma'^0 \bar{\Sigma}'^{+}$	$-\frac{f_1-f_3-3f_5+f_6}{3}$	$X_{u\bar{d}\bar{s}}^+ \rightarrow \Xi'^0 \bar{\Xi}'^{+}$	$-\frac{f_1+f_3+3f_5-f_6}{3\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^+ \bar{\Delta}^{--}$	$\frac{f_1-f_3-f_5+3f_6}{\sqrt{6}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^0 \bar{\Delta}^{-}$	$\frac{\sqrt{2}(f_1-f_3-f_4-f_5+f_6)}{3}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Delta^- \bar{\Delta}^0$	$\frac{f_1-f_3-2f_4-f_5-f_6}{\sqrt{6}}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^0 \bar{\Sigma}'^{-}$	$\frac{f_1-f_3-f_5-f_6}{3}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \Sigma'^- \bar{\Sigma}'^0$	$\frac{f_1-f_3-f_4-f_5-3f_6}{3}$	$X_{d\bar{s}\bar{u}}^- \rightarrow \Xi'^- \bar{\Xi}'^0$	$\frac{f_1-f_3-f_5-5f_6}{3\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^0 \bar{\Delta}^{-}$	$-\frac{\sqrt{2}(f_4-2f_6)}{3}$	$X_{s\bar{u}\bar{d}}^- \rightarrow \Xi'^- \bar{\Delta}^0$	$-\frac{\sqrt{2}(f_4-2f_6)}{3}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \Omega^- \bar{\Sigma}'^0$	$-\frac{f_4-2f_6}{\sqrt{3}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^+ \bar{\Delta}^{--}$	$-\frac{f_1-f_3-4f_4+5f_5+f_6}{6}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^0 \bar{\Delta}^0$	$-\frac{f_1+f_3+2f_4-5f_5-f_6}{3\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Sigma'^- \bar{\Delta}^{+}$	$-\frac{f_1+f_3-5f_5-f_6}{2\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^0 \bar{\Sigma}'^{+}$	$-\frac{f_1+f_3+2f_4-5f_5-f_6}{3\sqrt{2}}$	$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Xi'^- \bar{\Sigma}'^{+}$	$-\frac{f_1-f_3+5f_5+f_6}{3}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \Omega^- \bar{\Xi}'^{+}$	$-\frac{f_1+f_3-5f_5-f_6}{2\sqrt{3}}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^{++} \bar{\Delta}^{--}$	$\frac{f_1-2f_2-f_3+3f_5+3f_6}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^+ \bar{\Delta}^{-}$	$\frac{f_1-6f_2-3f_3-4f_4+7f_5-f_6}{6}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^0 \bar{\Delta}^0$	$-\frac{f_1-6f_2-3f_3-4f_4+5f_5-3f_6}{6}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Delta^- \bar{\Delta}^{+}$	$-\frac{f_1-2f_2-f_3+f_5+f_6}{2}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^+ \bar{\Sigma}'^{-}$	$\frac{f_1-3f_2-f_3+f_5-f_6}{3}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^0 \bar{\Sigma}'^0$	$-\frac{3f_2-f_3-f_4-2f_6}{3}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Sigma'^- \bar{\Sigma}'^{+}$	$-\frac{f_1-3f_2-f_3-f_5+f_6}{3}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi'^0 \bar{\Xi}'^0$	$\frac{f_1-6f_2-f_3-5f_5-5f_6}{6}$	$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Xi'^- \bar{\Xi}'^{+}$	$-\frac{f_1-6f_2-f_3-7f_5+f_6}{6}$

Table 30 continued

Channel	Amplitude	Channel	Amplitude
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \Omega^-\bar{\Omega}^+$	$-f_2 - 2f_5$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^+\bar{\Delta}^{--}$	$\frac{f_1-f_3-f_5+3f_6}{2\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^0\bar{\Delta}^-$	$\frac{f_1-f_3-2f_4-f_5+3f_6}{3\sqrt{2}}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma'^-\bar{\Delta}^0$	$\frac{f_1-f_3-4f_4-f_5+3f_6}{6}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^0\bar{\Sigma}'^-$	$\frac{f_1-f_3-f_5-f_6}{3}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi'^-\bar{\Sigma}'^0$	$\frac{f_1-f_3-2f_4-f_5-f_6}{3\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega^-\bar{\Xi}'^0$	$\frac{f_1-f_3-f_5-5f_6}{2\sqrt{3}}$		

5.4.3 Three-body decays into mesons

The effective hadron-level Hamiltonian for X_{b6} decays into three light mesons is written as

$$\begin{aligned}
 \mathcal{H}_{eff} = & c_1(X_{b6})_{[jk]}^i(H_3)^j M_i^k M_m^l M_l^m \\
 & + c_2(X_{b6})_{[jk]}^i(H_3)^j M_i^k M_m^l M_l^m \\
 & + c_3(X_{b6})_{[jk]}^i(H_3)^l M_i^j M_m^k M_l^m \\
 & + c_4(X_{b6})_{[jk]}^i(H_3)^l M_i^j M_l^k M_m^m \\
 & - c_5(X_{b6})^{\{ij\}}(H_6)_{\{ij\}} M_l^k M_m^l M_k^m \\
 & - c_6(X_{b6})^{\{ij\}}(H_6)_{\{ik\}} M_j^k M_l^m M_l^m \\
 & - c_7(X_{b6})^{\{ij\}}(H_6)_{\{il\}} M_j^k M_l^m M_k^m \\
 & - c_8(X_{b6})^{\{ij\}}(H_6)_{\{lm\}} M_i^k M_j^l M_k^m \\
 & + c_9(X_{b6})_{[jk]}^i(H_{15})_i^{\{jl\}} M_l^k M_o^m M_m^o \\
 & + c_{10}(X_{b6})_{[jk]}^i(H_{15})_i^{\{jl\}} M_o^k M_l^m M_m^o \\
 & + c_{11}(X_{b6})_{[jk]}^i(H_{15})_i^{\{lm\}} M_o^j M_l^k M_m^o \\
 & + c_{12}(X_{b6})_{[jk]}^i(H_{15})_o^{\{jl\}} M_i^k M_l^m M_m^o \\
 & + c_{13}(X_{b6})_{[jk]}^i(H_{15})_o^{\{jl\}} M_i^m M_l^k M_m^o \\
 & + c_{14}(X_{b6})_{[jk]}^i(H_{15})_m^{\{jl\}} M_i^m M_o^k M_l^o \\
 & + c_{15}(X_{b6})_{[jk]}^i(H_{15})_o^{\{lm\}} M_i^j M_l^k M_m^o. \quad (25)
 \end{aligned}$$

The decay amplitudes are given in Tables 31 and 32 for the $b \rightarrow d$ transition, and Tables 33 and 34 for the $b \rightarrow s$ transition. The corresponding relations of decay widths are

$$\begin{aligned}
 2\Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^+\pi^0 K^0) &= 6\Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^+ K^0 \eta) \\
 &= 3\Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^0 K^+ \eta) = 2\Gamma(X_{d\bar{s}u}^- \rightarrow \pi^0 \pi^- K^0) \\
 &= \frac{1}{2}\Gamma(X_{d\bar{s}u}^- \rightarrow \pi^- \pi^- K^+) = \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 \pi^- K^+) \\
 &= \frac{3}{2}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^- K^+ \eta), \\
 \frac{1}{3}\Gamma(X_{d\bar{s}u}^- \rightarrow K^0 K^0 K^-) &= 2\Gamma(X_{s\bar{u}d}^- \rightarrow \pi^0 K^- \eta) \\
 &= \Gamma(X_{s\bar{u}d}^- \rightarrow \pi^- \bar{K}^0 \eta), \\
 \Gamma(X_{s\bar{u}d}^- \rightarrow \pi^+ \pi^- K^-) &= 2\Gamma(X_{s\bar{u}d}^- \rightarrow \pi^0 \pi^0 K^-) \\
 &= 4\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ \pi^0 \pi^-) = 8\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \pi^0 \pi^0)
 \end{aligned}$$

$$\begin{aligned}
 &= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^+ \pi^- \pi^-) \\
 &= 4\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 \pi^0 \pi^-), \\
 \Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^0 \pi^0 K^+) &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^+ \pi^- K^0), \Gamma(X_{ud\bar{s}}^+ \rightarrow K^+ K^0 \bar{K}^0) \\
 &= \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 K^0 \bar{K}^0), \\
 \Gamma(X_{ud\bar{s}}^+ \rightarrow K^+ \eta \eta) &= 2\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \eta \eta), \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ \pi^- \eta) \\
 &= 2\Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \pi^0 \eta), \\
 \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \eta \eta) &= \frac{1}{2}\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- \eta \eta), \frac{3}{2}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 K^0 \eta) \\
 &= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 K^0 K^-), \\
 \Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^+ \pi^- K^+) &= \frac{1}{2}\Gamma(X_{ud\bar{s}}^+ \rightarrow K^+ K^+ K^-), \frac{1}{2}\Gamma(X_{s\bar{u}d}^- \rightarrow K^+ K^- K^-) \\
 &= \Gamma(X_{s\bar{u}d}^- \rightarrow K^0 \bar{K}^0 K^-).
 \end{aligned}$$

and

$$\begin{aligned}
 \Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^+ \pi^+ \pi^-) &= 4\Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^+ \pi^0 \pi^0) \\
 &= 2\Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^+ K^+ K^-), \\
 \frac{3}{4}\Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^+ \pi^0 \eta) &= \frac{3}{4}\Gamma(X_{d\bar{s}u}^- \rightarrow \pi^0 \pi^- \eta) \\
 &= \frac{3}{2}\Gamma(X_{s\bar{u}d}^- \rightarrow \bar{K}^0 K^- \eta) = \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ \pi^0 K^-) \\
 &= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 \pi^- \bar{K}^0), \Gamma(X_{ud\bar{s}}^+ \rightarrow \pi^0 K^+ \bar{K}^0) \\
 &= 3\Gamma(X_{ud\bar{s}}^+ \rightarrow K^+ \bar{K}^0 \eta) = \frac{1}{4}\Gamma(X_{s\bar{u}d}^- \rightarrow \pi^+ K^- K^-), \\
 \Gamma(X_{d\bar{s}u}^- \rightarrow \pi^0 K^0 K^-) &= 3\Gamma(X_{d\bar{s}u}^- \rightarrow K^0 K^- \eta) \\
 &= \frac{1}{4}\Gamma(X_{s\bar{u}d}^- \rightarrow \pi^- \bar{K}^0 \bar{K}^0), \\
 \frac{1}{3}\Gamma(X_{s\bar{u}d}^- \rightarrow \pi^0 \bar{K}^0 K^-) &= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \bar{K}^0 \eta) \\
 &= \Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 K^- \eta),
 \end{aligned}$$

Table 31 Open bottom tetraquark X_{b6} decays into three light mesons induced by the charmless $b \rightarrow d$ transition (part I)

Channel	Amplitude
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+\pi^0K^0$	$\frac{1}{2}(-c_3 - c_4 + c_8 - c_{12} - c_{13} - c_{14} - c_{15})$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+\pi^-K^+$	$\frac{2c_1+c_2+2c_6+c_7+c_8-2c_9-c_{10}-c_{13}+c_{14}}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+K^0\eta$	$-\frac{c_3+c_4-c_8+c_{12}+c_{13}+c_{14}+c_{15}}{2\sqrt{3}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^0\pi^0K^+$	$\frac{2c_1+c_2-c_3-c_4+2c_6+c_7+2c_8-2c_9-c_{10}-c_{12}-2c_{13}-c_{15}}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^0K^+\eta$	$\frac{\sqrt{6}(c_3+c_4+c_8-c_{12}-c_{13}-c_{14}-c_{15})}{6}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow K^+K^+K^-$	$\sqrt{2}(2c_1 + c_2 + 2c_6 + c_7 + c_8 - 2c_9 - c_{10} - c_{13} + c_{14})$
$X_{u\bar{d}\bar{s}}^+ \rightarrow K^+K^0\bar{K}^0$	$\frac{\sqrt{2}(2c_1+c_2-c_3-c_4+2c_6+c_7-2c_9-c_{10}+c_{12}+2c_{14}+c_{15})}{2}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow K^+\eta\eta$	$\frac{6c_1+3c_2-c_3-c_4+6c_6+3c_7-6c_9-3c_{10}+3c_{12}+6c_{14}+3c_{15}}{3\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^0\pi^-K^0$	$\frac{c_3+c_4-c_8+c_{12}+c_{13}+c_{14}+c_{15}}{2}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^-\pi^-K^+$	$-\sqrt{2}(c_3 + c_4 - c_8 + c_{12} + c_{13} + c_{14} + c_{15})$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^-K^0\eta$	$\frac{3c_3+3c_4+c_8-c_{12}-c_{13}-c_{14}-c_{15}}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow K^0K^0K^-$	$\sqrt{2}(c_3 + c_4 + c_8 - c_{12} - c_{13} - c_{14} - c_{15})$
$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^+\pi^-K^-$	$\frac{-2c_1-c_2+c_3+c_4+2c_6+c_7-2c_9-c_{10}+c_{12}+2c_{14}+c_{15}}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^0\pi^0K^-$	$\frac{-2c_1-c_2+c_3+c_4+2c_6+c_7-2c_9-c_{10}+c_{12}+2c_{14}+c_{15}}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^0K^-\eta$	$-\frac{c_3-c_4-c_8+c_{12}+c_{13}+c_{14}+c_{15}}{\sqrt{6}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^-\bar{K}^0\eta$	$-\frac{c_3-c_4-c_8+c_{12}+c_{13}+c_{14}+c_{15}}{\sqrt{3}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow K^+K^-K^-$	$\sqrt{2}(-2c_1 - c_2 + 2c_6 + c_7 + c_8 - 2c_9 - c_{10} - c_{13} + c_{14})$
$X_{s\bar{u}\bar{d}}^- \rightarrow K^0\bar{K}^0K^-$	$\frac{-2c_1-c_2+2c_6+c_7+c_8-2c_9-c_{10}-c_{13}+c_{14}}{\sqrt{2}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow K^-\eta\eta$	$\frac{-6c_1-3c_2+c_3+c_4+6c_6+3c_7+6c_8-6c_9-3c_{10}-3c_{12}-6c_{13}-3c_{15}}{3\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+\pi^0\pi^-$	$\frac{-2c_1-c_2+c_3+c_4+2c_6+c_7-2c_9-c_{10}+c_{12}+2c_{14}+c_{15}}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+\pi^-\eta$	$\frac{\sqrt{6}(-6c_1-3c_2+c_3+c_4+12c_5-2c_6+3c_7-2c_8+2c_9+9c_{10}+4c_{11}+5c_{12}+2c_{13}+5c_{15})}{12}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+K^0K^-$	$-\frac{c_3-c_4+6c_5+2c_7+c_8+4c_{10}+2c_{11}+c_{12}-c_{13}-c_{14}+c_{15}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0\pi^0\pi^0$	$\frac{3(-2c_1-c_2+c_3+c_4+2c_6+c_7-2c_9-c_{10}+c_{12}+2c_{14}+c_{15})}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0\pi^0\eta$	$\frac{\sqrt{6}(-6c_1-3c_2+c_3+c_4+12c_5-2c_6+3c_7-2c_8+2c_9+9c_{10}+4c_{11}+5c_{12}+2c_{13}+5c_{15})}{12}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0K^+K^-$	$-\frac{2c_1+c_2-6c_5-2c_6-3c_7-3c_8+2c_9-3c_{10}-2c_{11}+3c_{13}+c_{14}}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0K^0\bar{K}^0$	$-\frac{2c_1+c_2+6c_5-2c_6+c_7-c_8+2c_9+5c_{10}+2c_{11}+2c_{12}+c_{13}-c_{14}+2c_{15}}{2\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0\eta\eta$	$\frac{-6c_1-3c_2-5c_3-5c_4+6c_6+3c_7-6c_9-3c_{10}+3c_{12}+6c_{14}+3c_{15}}{6\sqrt{2}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^-K^+\bar{K}^0$	$\frac{c_3+c_4+6c_5+2c_7+c_8+4c_{10}+2c_{11}+c_{12}-c_{13}-c_{14}+c_{15}}{12}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow K^+K^-\eta$	$-\frac{6c_1+3c_2+6c_5+2c_6+3c_7+3c_8-2c_9+3c_{10}+2c_{11}-3c_{13}-c_{14}}{2\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow K^0\bar{K}^0\eta$	$\frac{\sqrt{6}(-6c_1-3c_2+2c_3+2c_4-6c_5-2c_6-3c_7+2c_8+2c_9-3c_{10}-2c_{11}-4c_{12}-c_{13}-3c_{14}-4c_{15})}{12}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \eta\eta\eta$	$\frac{\sqrt{6}(-18c_1-9c_2+3c_3+3c_4-12c_5-6c_6-7c_7+2c_8+6c_9-5c_{10}-4c_{11}-9c_{12}-2c_{13}-8c_{14}-9c_{15})}{12}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^+\pi^-K^0$	$\frac{2c_1+c_2-c_3-c_4+2c_6+c_7+2c_8-2c_9-c_{10}-c_{12}-2c_{13}-c_{15}}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0\pi^0K^0$	$\frac{2c_1+c_2+c_3+c_4+2c_6+c_7-2c_9-c_{10}+c_{12}+2c_{14}+c_{15}}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0\pi^-K^+$	$-\frac{c_3+c_4-c_8+c_{12}+c_{13}+c_{14}+c_{15}}{\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0K^0\eta$	$\frac{c_3+c_4}{\sqrt{3}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^-K^+\eta$	$\frac{\sqrt{6}(c_3+c_4+c_8-c_{12}-c_{13}-c_{14}-c_{15})}{6}$

Table 32 Open bottom tetraquark X_{b6} decays into three light mesons induced by the charmless $b \rightarrow d$ transition (part II)

Channel	Amplitude
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^+ K^0 K^-$	$\frac{2c_1+c_2+c_3+c_4+2c_6+c_7+2c_8-2c_9-c_{10}-c_{12}-2c_{13}-c_{15}}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 K^0 \bar{K}^0$	$2c_1 + c_2 - c_3 - c_4 + 2c_6 + c_7 - 2c_9 - c_{10} + c_{12} + 2c_{14} + c_{15}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \eta \eta$	$\frac{6c_1+3c_2-c_3-c_4+6c_6+3c_7-6c_9-3c_{10}+3c_{12}+6c_{14}+3c_{15}}{6}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^+ \pi^- \pi^-$	$-2c_1 - c_2 + c_3 + c_4 + 2c_6 + c_7 - 2c_9 - c_{10} + c_{12} + 2c_{14} + c_{15}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 \pi^0 \pi^-$	$\frac{-2c_1-c_2+c_3+c_4+2c_6+c_7-2c_9-c_{10}+c_{12}+2c_{14}+c_{15}}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 K^0 K^-$	$\frac{c_3+c_4}{\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- K^+ K^-$	$\frac{-2c_1-c_2-c_3-c_4+2c_6+c_7+2c_8-2c_9-c_{10}-c_{12}-2c_{13}-c_{15}}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- K^0 \bar{K}^0$	$\frac{-2c_1-c_2+c_3+c_4+2c_6+c_7+2c_8-2c_9-c_{10}-c_{12}-2c_{13}-c_{15}}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- \eta \eta$	$\frac{-6c_1-3c_2-5c_3-5c_4+6c_6+3c_7-6c_9-3c_{10}+3c_{12}+6c_{14}+3c_{15}}{6}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^0 K^- \eta$	$-\frac{c_3+c_4+2c_8-2c_{12}-2c_{13}-2c_{14}-2c_{15}}{\sqrt{6}}$

Table 33 Open bottom tetraquark X_{b6} decays into three light mesons induced by the charmless $b \rightarrow s$ transition (part I)

Channel	Amplitude
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ \pi^+ \pi^-$	$\sqrt{2}(-2c_1 - c_2 - 2c_6 - c_7 - c_8 + 2c_9 + c_{10} + c_{13} - c_{14})$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ \pi^0 \pi^0$	$\frac{-2c_1-c_2-2c_6-c_7-c_8+2c_9+c_{10}+c_{13}-c_{14}}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ \pi^0 \eta$	$\sqrt{\frac{2}{3}}(-c_8 + c_{12} + c_{13} + c_{14} + c_{15})$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ K^+ K^-$	$\frac{-2c_1-c_2-2c_6-c_7-c_8+2c_9+c_{10}+c_{13}-c_{14}}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ K^0 \bar{K}^0$	$\frac{-2c_1-c_2+c_3+c_4-2c_6-c_7+2c_9+c_{10}-c_{12}-2c_{14}-c_{15}}{\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ \eta \eta$	$\frac{-6c_1-3c_2+4c_3+4c_4-6c_6-3c_7-3c_8+6c_9+3c_{10}+3c_{13}-3c_{14}}{3\sqrt{2}}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^0 K^+ \bar{K}^0$	$\frac{c_3+c_4-c_8+c_{12}+c_{13}+c_{14}+c_{15}}{2}$
$X_{u\bar{d}\bar{s}}^+ \rightarrow K^+ \bar{K}^0 \eta$	$\frac{c_3+c_4-c_8+c_{12}+c_{13}+c_{14}+c_{15}}{2\sqrt{3}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^+ \pi^- \pi^-$	$\sqrt{2}(2c_1 + c_2 - 2c_6 - c_7 - c_8 + 2c_9 + c_{10} + c_{13} - c_{14})$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^0 \pi^0 \pi^-$	$\frac{2c_1+c_2-2c_6-c_7-c_8+2c_9+c_{10}+c_{13}-c_{14}}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^0 \pi^- \eta$	$\sqrt{\frac{2}{3}}(c_8 - c_{12} - c_{13} - c_{14} - c_{15})$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^0 K^0 K^-$	$\frac{c_3+c_4-c_8-c_{12}-c_{13}-c_{14}-c_{15}}{2}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- K^+ K^-$	$\frac{2c_1+c_2-c_3-c_4-2c_6-c_7+2c_9+c_{10}-c_{12}-2c_{14}-c_{15}}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- K^0 \bar{K}^0$	$\frac{2c_1+c_2-2c_6-c_7-c_8+2c_9+c_{10}+c_{13}-c_{14}}{\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- \eta \eta$	$\frac{6c_1+3c_2-4c_3-4c_4-6c_6-3c_7-3c_8+6c_9+3c_{10}+3c_{13}-3c_{14}}{3\sqrt{2}}$
$X_{d\bar{s}\bar{u}}^- \rightarrow K^0 K^- \eta$	$\frac{-c_3-c_4-c_8+c_{12}+c_{13}+c_{14}+c_{15}}{2\sqrt{3}}$
$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^+ K^- K^-$	$\sqrt{2}(c_3 + c_4 - c_8 + c_{12} + c_{13} + c_{14} + c_{15})$
$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^0 \bar{K}^0 K^-$	$-c_3 - c_4$
$X_{s\bar{u}\bar{d}}^- \rightarrow \pi^- \bar{K}^0 \bar{K}^0$	$\sqrt{2}(-c_3 - c_4 - c_8 + c_{12} + c_{13} + c_{14} + c_{15})$
$X_{s\bar{u}\bar{d}}^- \rightarrow \bar{K}^0 K^- \eta$	$\frac{c_8-c_{12}-c_{13}-c_{14}-c_{15}}{\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ \pi^0 K^-$	$\frac{-c_8+c_{12}+c_{13}+c_{14}+c_{15}}{\sqrt{2}}$

$$\begin{aligned}
& \Gamma(X_{u\bar{d}\bar{s}}^+ \rightarrow \pi^+ K^0 \bar{K}^0) \\
&= \Gamma(Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow K^0 \bar{K}^0 \bar{K}^0), \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \pi^+ \pi^- \pi^-) \\
&= 4\Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \pi^0 \pi^0 \pi^-),
\end{aligned}$$

$$\begin{aligned}
& \Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^+ \pi^0 \pi^-) \\
&= \frac{2}{3}\Gamma(Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 \pi^0 \pi^0), \Gamma(X_{d\bar{s}\bar{u}}^- \rightarrow \pi^- K^+ K^-) \\
&= 6\Gamma(Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^+ K^- K^-).
\end{aligned}$$

Table 34 Open bottom tetraquark X_{b6} decays into three light mesons induced by the charmless $b \rightarrow s$ transition (part II)

Channel	Amplitude
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ \pi^- \bar{K}^0$	$\frac{-2c_1 - c_2 - c_3 - c_4 - 2c_6 - c_7 - 2c_8 + 2c_9 + c_{10} + c_{12} + 2c_{13} + c_{15}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^+ K^- \eta$	$\frac{2c_3 + 2c_4 - c_8 + c_{12} + c_{13} + c_{14} + c_{15}}{\sqrt{6}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \pi^0 \bar{K}^0$	$\frac{-2c_1 - c_2 - c_3 - c_4 - 2c_6 - c_7 + 2c_9 + c_{10} - c_{12} - 2c_{14} - c_{15}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \pi^0 \bar{K}^0 \eta$	$-\frac{c_3 + c_4}{\sqrt{3}}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow K^+ \bar{K}^0 K^-$	$\frac{-2c_1 - c_2 + c_3 + c_4 - 2c_6 - c_7 - 2c_8 + 2c_9 + c_{10} + c_{12} + 2c_{13} + c_{15}}{2}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow K^0 \bar{K}^0 \bar{K}^0$	$-2c_1 - c_2 + c_3 + c_4 - 2c_6 - c_7 + 2c_9 + c_{10} - c_{12} - 2c_{14} - c_{15}$
$Y_{(u\bar{u},s\bar{s})\bar{d}}^0 \rightarrow \bar{K}^0 \eta \eta$	$\frac{-6c_1 - 3c_2 + c_3 + c_4 - 6c_6 - 3c_7 + 6c_9 + 3c_{10} - 3c_{12} - 6c_{14} - 3c_{15}}{6}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^+ \pi^0 \pi^-$	$\frac{2c_1 + c_2}{\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^+ \pi^- \eta$	$\frac{-6c_5 - 2c_6 - 3c_7 - 3c_8 + 2c_9 - 3c_{10} - 2c_{11} + 3c_{13} + c_{14}}{\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^+ K^0 K^-$	$\frac{-c_3 - c_4 - 6c_5 - 2c_7 - c_8 - 4c_{10} - 2c_{11} - c_{12} + c_{13} + c_{14} - c_{15}}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 \pi^0 \pi^0$	$\frac{3(2c_1 + c_2)}{\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 \pi^0 \eta$	$\frac{-6c_5 - 2c_6 - 3c_7 + c_8 + 2c_9 - 3c_{10} - 2c_{11} - 4c_{12} - c_{13} - 3c_{14} - 4c_{15}}{\sqrt{6}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 K^+ K^-$	$\frac{4c_1 + 2c_2 - c_3 - c_4 - 6c_5 - 2c_7 + c_8 - 4c_{10} - 2c_{11} - 3c_{12} - c_{13} - c_{14} - 3c_{15}}{2\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 K^0 \bar{K}^0$	$\frac{4c_1 + 2c_2 - c_3 - c_4 + 6c_5 + 2c_7 - c_8 + 4c_{10} + 2c_{11} + 3c_{12} + c_{13} + c_{14} + 3c_{15}}{2\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^0 \eta \eta$	$\frac{6c_1 + 3c_2 - 4(c_3 + c_4)}{3\sqrt{2}}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \pi^- K^+ \bar{K}^0$	$\frac{c_3 + c_4 - 6c_5 - 2c_7 - c_8 - 4c_{10} - 2c_{11} - c_{12} + c_{13} + c_{14} - c_{15}}{2}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^+ K^- \eta$	$\frac{\sqrt{6}(-c_3 - c_4 + 6c_5 - 4c_6 - c_8 + 4c_9 + 4c_{10} + 2c_{11} + c_{12} + c_{13} - 3c_{14} + c_{15})}{12}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow K^0 \bar{K}^0 \eta$	$\frac{\sqrt{6}(c_3 + c_4 + 6c_5 - 4c_6 - c_8 + 4c_9 + 6c_{10} + 2c_{11} + c_{12} + c_{13} - 3c_{14} + c_{15})}{12}$
$Y_{(u\bar{u},d\bar{d})\bar{s}}^0 \rightarrow \eta \eta \eta$	$\frac{\sqrt{6}(6c_5 - 6c_6 - c_7 - c_8 + 6c_9 + 7c_{10} + 2c_{11} + c_{13} - 5c_{14})}{6}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^+ \pi^- K^-$	$\frac{2c_1 + c_2 + c_3 + c_4 - 2c_6 - c_7 - 2c_8 + 2c_9 + c_{10} + c_{12} + 2c_{13} + c_{15}}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 \pi^0 K^-$	$\frac{2c_1 + c_2 + c_3 + c_4 - 2c_6 - c_7 + 2c_9 + c_{10} - c_{12} - 2c_{14} - c_{15}}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 \pi^- \bar{K}^0$	$\frac{c_8 - c_{12} - c_{13} - c_{14} - c_{15}}{\sqrt{2}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^0 K^- \eta$	$-\frac{c_3 + c_4}{\sqrt{3}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \pi^- \bar{K}^0 \eta$	$\frac{-2c_3 - 2c_4 - c_8 + c_{12} + c_{13} + c_{14} + c_{15}}{\sqrt{6}}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^+ K^- K^-$	$2c_1 + c_2 - c_3 - c_4 - 2c_6 - c_7 + 2c_9 + c_{10} - c_{12} - 2c_{14} - c_{15}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^0 \bar{K}^0 K^-$	$\frac{2c_1 + c_2 - c_3 - c_4 - 2c_6 - c_7 - 2c_8 + 2c_9 + c_{10} + c_{12} + 2c_{13} + c_{15}}{2}$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow K^- \eta \eta$	$\frac{6c_1 + 3c_2 - c_3 - c_4 - 6c_6 - 3c_7 + 6c_9 + 3c_{10} - 3c_{12} - 6c_{14} - 3c_{15}}{6}$

6 Golden X_{b6} decay channels

The golden decay channels will have a large branching ratios and also have relatively clear final products, which are very helpful to hunting for the stable X_{b6} states [42]. In this section, we will list the golden channels of X_{b6} decays. Under the SU(3) flavor analysis, the conclusions will not be changed when one hadron is replaced by the excited state with the same quark structure. For instance one may replace the pseudoscalar $\bar{K}^0$ by the vector $\bar{K}^{*0}$ which decays into $K^- \pi^+$. Considering some neutral mesons and baryons are very difficult to reconstruct at large hadron colliders,

the channels including the $\pi^0, \eta, \rho^0, \omega$ and $n, \bar{n}$ are not employed.

To reconstruct the X_{b6} via the decays into mesons, we collect the golden channels in Table 35, while we collect the golden channels for the X_{b6} via the decays into baryons in Table 36. The golden channels to search for X_{b6} are chosen by Cabibbo-allowed tree-emission decays of $b \rightarrow c\bar{c}s$ or $b \rightarrow c\bar{u}d$. Under the heavy quark symmetry limit, the branching fractions of the tree emitted X_{b6} decays would be at the same order as those of B meson decays. Considering $Br(B^- \rightarrow D^0 D_s^-) = 9 \times 10^{-3}$, $Br(B^- \rightarrow D^0 \pi^-) = 5 \times 10^{-3}$ and $Br(B^- \rightarrow J/\Psi K^-) = 1 \times 10^{-3}$ [64], it can be

Table 35 Cabibbo allowed X_{b6} decays, in which $\bar{K}^0$ can be replaced by the vector meson $\bar{K}^{*0}$

Two body decays

$X_{ud\bar{s}}^+ \rightarrow \pi^+ J/\psi$	$X_{ud\bar{s}}^+ \rightarrow D^+ \bar{D}^0$	$X_{ud\bar{s}}^+ \rightarrow D^0 K^+$	$X_{ud\bar{s}}^+ \rightarrow D^+ K^0$
$X_{ud\bar{s}}^+ \rightarrow \bar{D}^0 \pi^+$			
$X_{d\bar{s}u}^- \rightarrow \pi^- J/\psi$	$X_{d\bar{s}u}^- \rightarrow D^0 D^-$	$X_{d\bar{s}u}^- \rightarrow \bar{D}^0 \pi^-$	$X_{d\bar{s}u}^- \rightarrow D_s^- K^0$
$X_{s\bar{u}d}^- \rightarrow D^0 K^-$	$X_{s\bar{u}d}^- \rightarrow D_s^- \bar{K}^0$		
$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow \bar{K}^0 J/\psi$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^+ D_s^-$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^+ \pi^-$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D_s^+ K^-$
$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow \bar{D}^0 \bar{K}^0$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D_s^- \pi^+$		
$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^+ D^-$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^0 \bar{D}^0$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^0 K^0$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D_s^+ \pi^-$
$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^- \pi^+$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D_s^- K^+$		
$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow K^- J/\psi$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D^0 D_s^-$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow \bar{D}^0 K^-$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D^- \bar{K}^0$

Three body decays

$X_{ud\bar{s}}^+ \rightarrow D^0 \pi^+ \bar{D}^0$	$X_{ud\bar{s}}^+ \rightarrow D^+ \pi^+ D^-$	$X_{ud\bar{s}}^+ \rightarrow D_s^+ \pi^+ D_s^-$	$X_{ud\bar{s}}^+ \rightarrow D^+ K^+ D_s^-$
$X_{ud\bar{s}}^+ \rightarrow D_s^+ \bar{K}^0 \bar{D}^0$	$X_{ud\bar{s}}^+ \rightarrow D^0 \pi^+ K^0$	$X_{ud\bar{s}}^+ \rightarrow D^+ \pi^- K^0$	$X_{ud\bar{s}}^+ \rightarrow D_s^+ \pi^+ \pi^-$
$X_{ud\bar{s}}^+ \rightarrow D_s^+ K^+ K^-$	$X_{ud\bar{s}}^+ \rightarrow D_s^+ K^0 \bar{K}^0$	$X_{ud\bar{s}}^+ \rightarrow \bar{D}^0 K^+ \bar{K}^0$	$X_{ud\bar{s}}^+ \rightarrow D^- \pi^+ \pi^+$
$X_{ud\bar{s}}^+ \rightarrow D_s^- \pi^+ K^+$	$X_{ud\bar{s}}^+ \rightarrow K^+ \bar{K}^0 J/\psi$	$X_{ud\bar{s}}^+ \rightarrow \pi^+ D_s^+ l^- \bar{\nu}$	$X_{ud\bar{s}}^+ \rightarrow K^+ D^+ l^- \bar{\nu}$
$X_{d\bar{s}u}^- \rightarrow D_s^+ \pi^- D_s^-$	$X_{d\bar{s}u}^- \rightarrow D^0 \pi^- \bar{D}^0$	$X_{d\bar{s}u}^- \rightarrow D^0 K^0 D_s^-$	$X_{d\bar{s}u}^- \rightarrow D^+ \pi^- D^-$
$X_{d\bar{s}u}^- \rightarrow D_s^+ K^- D^-$	$X_{d\bar{s}u}^- \rightarrow D^0 \pi^- K^0$	$X_{d\bar{s}u}^- \rightarrow D_s^+ \pi^- \pi^-$	$X_{d\bar{s}u}^- \rightarrow \bar{D}^0 K^0 K^-$
$X_{d\bar{s}u}^- \rightarrow D^- \pi^+ \pi^-$	$X_{d\bar{s}u}^- \rightarrow D^- K^+ K^-$	$X_{d\bar{s}u}^- \rightarrow D_s^- \pi^- K^+$	$X_{d\bar{s}u}^- \rightarrow D^- K^0 \bar{K}^0$
$X_{d\bar{s}u}^- \rightarrow K^0 K^- J/\psi$	$X_{d\bar{s}u}^- \rightarrow \pi^- D_s^+ l^- \bar{\nu}$	$X_{d\bar{s}u}^- \rightarrow K^0 D^0 l^- \bar{\nu}$	
$X_{s\bar{u}d}^- \rightarrow D^0 \bar{K}^0 D_s^-$	$X_{s\bar{u}d}^- \rightarrow D^+ K^- D_s^-$	$X_{s\bar{u}d}^- \rightarrow D^0 \pi^- \bar{K}^0$	$X_{s\bar{u}d}^- \rightarrow D^+ \pi^- K^-$
$X_{s\bar{u}d}^- \rightarrow \bar{D}^0 \bar{K}^0 K^-$	$X_{s\bar{u}d}^- \rightarrow D^- \bar{K}^0 \bar{K}^0$	$X_{s\bar{u}d}^- \rightarrow D_s^- \pi^+ K^-$	$X_{s\bar{u}d}^- \rightarrow K^- \bar{K}^0 J/\psi$
$X_{s\bar{u}d}^- \rightarrow K^- D^+ l^- \bar{\nu}$	$X_{s\bar{u}d}^- \rightarrow \bar{K}^0 D^0 l^- \bar{\nu}$		
$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^0 \bar{K}^0 \bar{D}^0$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D_s^+ \bar{K}^0 D_s^-$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^+ \bar{K}^0 D^-$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^+ K^- \bar{D}^0$
$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^0 \pi^+ D_s^-$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^0 \pi^+ \pi^-$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^0 K^+ K^-$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^0 K^0 \bar{K}^0$
$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^+ K^0 K^-$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D_s^+ \pi^- \bar{K}^0$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow \bar{D}^0 \pi^+ K^-$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D^- \pi^+ \bar{K}^0$
$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow D_s^- K^+ \bar{K}^0$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow K^- \pi^+ J/\psi$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow \pi^+ D^0 l^- \bar{\nu}$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow \pi^0 D^+ l^- \bar{\nu}$
$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow \bar{K}^0 D_s^+ l^- \bar{\nu}$	$Y_{\{u\bar{u},s\bar{s}\}d}^0 \rightarrow \eta D^+ l^- \bar{\nu}$		
$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^0 \pi^+ D^-$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^0 K^+ D_s^-$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^+ \pi^- \bar{D}^0$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^+ K^0 D_s^-$
$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D_s^+ \bar{K}^0 D^-$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D_s^+ K^- \bar{D}^0$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^0 \pi^- K^+$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^+ \pi^- K^0$
$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D_s^+ K^0 K^-$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow \bar{D}^0 K^+ K^-$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow \bar{D}^0 K^0 \bar{K}^0$
$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D^- K^+ \bar{K}^0$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow D_s^- \pi^+ K^0$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow K^+ K^- J/\psi$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow K^0 \bar{K}^0 J/\psi$
$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow \pi^0 D_s^+ l^- \bar{\nu}$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow K^+ D^0 l^- \bar{\nu}$	$Y_{\{u\bar{u},d\bar{d}\}s}^0 \rightarrow K^0 D^+ l^- \bar{\nu}$	
$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D^+ \pi^- D_s^-$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D^0 \bar{K}^0 D^-$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D^0 K^- \bar{D}^0$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D^+ K^- D^-$
$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D_s^+ K^- D_s^-$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D^0 K^0 K^-$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D^+ \pi^- \pi^-$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D_s^+ \pi^- K^-$
$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow \bar{D}^0 \pi^- \bar{K}^0$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D^- \pi^+ K^-$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D_s^- \pi^+ \pi^-$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D_s^- K^+ K^-$
$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow D_s^- K^0 \bar{K}^0$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow K^0 K^- J/\psi$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow \pi^0 D^0 l^- \bar{\nu}$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow \pi^- D^+ l^- \bar{\nu}$
$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow K^- D_s^+ l^- \bar{\nu}$	$Y_{\{d\bar{d},s\bar{s}\}u}^- \rightarrow \eta D^0 l^- \bar{\nu}$		

Table 36 Cabibbo allowed X_{b6} decays in which $\bar{K}^0$ can be replaced by the vector meson $\bar{K}^{*0}$

Two body decays

[illegible]

Table 36 continued

$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi_c^{\prime 0} \bar{\Sigma}^{\prime -}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Lambda}_c^-$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Lambda}_c^-$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^0 \bar{\Xi}_c^-$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Lambda^0 \bar{\Sigma}_c^-$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^+ \bar{\Sigma}_c^-$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Sigma}_c^-$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^- \bar{\Sigma}_c^0$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^- \bar{\Xi}_c^0$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^0 \bar{\Xi}_c^-$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^0 \bar{\Lambda}_c^-$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^{\prime 0} \bar{\Xi}_c^-$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^{\prime -} \bar{\Xi}_c^0$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^{\prime +} \bar{\Sigma}_c^-$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^{\prime 0} \bar{\Sigma}_c^-$
$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Sigma^{\prime -} \bar{\Sigma}_c^0$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^{\prime 0} \bar{\Xi}_c^{\prime -}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Xi^{\prime -} \bar{\Xi}_c^{\prime 0}$	$Y_{(d\bar{d},s\bar{s})\bar{u}}^- \rightarrow \Omega^- \bar{\Omega}_c^0$	

expected that the branching fractions of the selected golden channels of X_{b6} are at the order of 10^{-3} . The final states usually include charmed mesons or charmed baryons, which have to be reconstructed by further final particles in experiments, for example, $J/\Psi \rightarrow \mu^+ \mu^-$ with a branching fraction of 6%, $D^+ \rightarrow K^- \pi^+ \pi^+$ with branching fraction of 9%, $D^0 \rightarrow K^- \pi^+$ and $K^- \pi^+ \pi^+ \pi^-$ with branching fractions of 4% and 8% respectively, $D_s^+ \rightarrow K^+ K^- \pi^+$ with branching fraction of 5%, and $\Lambda_c^+ \rightarrow p K^- \pi^+$ with branching fraction of 6%. Therefore, the total branching fractions of golden channels of X_{b6} tetraquark decaying into final detected particles would be around 10^{-5} . Such an order of branching fraction is large enough to be detected at the current experiments. For instance, the LHCb has measured $B^- \rightarrow J/\Psi K^-$ and $D^0 \pi^-$, with the total branching fractions of order of 10^{-5} as discussed above, and found the signal events of 2×10^5 and 3×10^5 respectively using the data sample of 3.0 fb^{-1} [65]. Therefore, the X_{b6} tetraquarks can be observed with high possibility if they exists as stable states.

7 Conclusions

We studied the weak decay properties of open-bottom tetraquark X_{b6} states under the SU(3) flavor symmetry. The states with the quark component $Qq_i \bar{q}_j \bar{q}_k$ can form $\bar{3}$, 6 and $\bar{15}$ representations by the decomposition of $3 \otimes \bar{3} \otimes \bar{3} = \bar{3} \oplus \bar{3} \oplus 6 \oplus \bar{15}$. But only the sextet X_{b6} states may be stable. We focused on semi-leptonic and non-leptonic weak decays of the ground states of sextet representations whose masses are below the thresholds of strong and electromagnetic decays. Their decay amplitudes were discussed by constructing the relevant Hamiltonian at the hadronic level and parameterizing the interactions into some constants ($a_i, b_j, \dots$). It is easily to obtain the relations of different channels when we ignore the small effect of phase space. We have given the Cabibbo allowed two-body and three-body decay channels, which shall play an important role to hunting for the stable open-bottom tetraquark X_{b6} states.

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References

1. H.X. Chen, W. Chen, X. Liu, S.L. Zhu, Phys. Rep. **639**, 1 (2016). <https://doi.org/10.1016/j.physrep.2016.05.004>. arXiv:1601.02092 [hep-ph]
2. S. L. Olsen, Front. Phys. (Beijing) **10**, no. 2, 121 (2015). <https://doi.org/10.1007/S11467-014-0449-6>. arXiv:1411.7738 [hep-ex]
3. N. Brambilla et al., Eur. Phys. J. C **71**, 1534 (2011). <https://doi.org/10.1140/epjc/s10052-010-1534-9>. arXiv:1010.5827 [hep-ph]
4. A. Ali, J.S. Lange, S. Stone, Prog. Part. Nucl. Phys. **97**, 123 (2017). <https://doi.org/10.1016/j.pnpnp.2017.08.003>. arXiv:1706.00610 [hep-ph]
5. A. Esposito, A. Pilloni, A.D. Polosa, Phys. Rept. **668**, 1 (2016). <https://doi.org/10.1016/j.physrep.2016.11.002>. arXiv:1611.07920 [hep-ph]
6. R.F. Lebed, R.E. Mitchell, E.S. Swanson, Prog. Part. Nucl. Phys. **93**, 143 (2017). <https://doi.org/10.1016/j.pnpnp.2016.11.003>. arXiv:1610.04528 [hep-ph]
7. F.K. Guo, C. Hanhart, U.G. Meissner, Q. Wang, Q. Zhao, B.S. Zou, Rev. Mod. Phys. **90**(1), 015004 (2018). <https://doi.org/10.1103/RevModPhys.90.015004>. arXiv:1705.00141 [hep-ph]
8. S. K. Choi et al. [Belle Collaboration], Phys. Rev. Lett. **91**, 262001 (2003)
9. A. Bondar et al. [Belle Collaboration], Phys. Rev. Lett. **108**, 122001 (2012). <https://doi.org/10.1103/PhysRevLett.108.122001>. arXiv:1110.2251 [hep-ex]
10. R. Aaij et al. [LHCb Collaboration], Phys. Rev. Lett. **115**, 072001 (2015). <https://doi.org/10.1103/PhysRevLett.115.072001>. arXiv:1507.03414 [hep-ex]
11. V. M. Abazov et al. [D0 Collaboration], Phys. Rev. Lett. **117**, no. 2, 022003 (2016). <https://doi.org/10.1103/PhysRevLett.117.022003>. arXiv:1602.07588 [hep-ex]

12. R. Aaij *et al.* [LHCb Collaboration], Phys. Rev. Lett. **117**, no. 15, 152003 (2016) Addendum: [Phys. Rev. Lett. **118**, no. 10, 109904 (2017)]. <https://doi.org/10.1103/PhysRevLett.118.109904>. arXiv:1608.00435 [hep-ex]
13. A. M. Sirunyan *et al.* [CMS Collaboration], Phys. Rev. Lett. **120**, no. 20, 202005 (2018). <https://doi.org/10.1103/PhysRevLett.120.202005>. arXiv:1712.06144 [hep-ex]
14. T. Aaltonen *et al.* [CDF Collaboration], Phys. Rev. Lett. **120**, no. 20, 202006 (2018). <https://doi.org/10.1103/PhysRevLett.120.202006>. arXiv:1712.09620 [hep-ex]
15. M. Aaboud *et al.* [ATLAS Collaboration], Phys. Rev. Lett. **120**, no. 20, 202007 (2018). <https://doi.org/10.1103/PhysRevLett.120.202007>. arXiv:1802.01840 [hep-ex]
16. V. M. Abazov *et al.* [D0 Collaboration], Phys. Rev. D **97**, no. 9, 092004 (2018). <https://doi.org/10.1103/PhysRevD.97.092004>. arXiv:1712.10176 [hep-ex]
17. A. Ali, L. Maiani, A.D. Polosa, V. Riquer, Phys. Rev. D **94**(3), 034036 (2016). <https://doi.org/10.1103/PhysRevD.94.034036>. arXiv:1604.01731 [hep-ph]
18. S.S. Agaev, K. Azizi, H. Sundu, Phys. Rev. D **93**(7), 074024 (2016). <https://doi.org/10.1103/PhysRevD.93.074024>. arXiv:1602.08642 [hep-ph]
19. W. Chen, H.X. Chen, X. Liu, T.G. Steele, S.L. Zhu, Phys. Rev. Lett. **117**(2), 022002 (2016). <https://doi.org/10.1103/PhysRevLett.117.022002>. arXiv:1602.08916 [hep-ph]
20. Z.G. Wang, Eur. Phys. J. C **76**(5), 279 (2016). <https://doi.org/10.1140/epjc/s10052-016-4133-6>. arXiv:1603.02498 [hep-ph]
21. F.K. Guo, U.G. Meisner, B.S. Zou, Commun. Theor. Phys **65**(5), 593 (2016). <https://doi.org/10.1088/0253-6102/65/5/593>. arXiv:1603.06316 [hep-ph]
22. W. Wang, R. Zhu, Chin. Phys. C **40**(9), 093101 (2016). <https://doi.org/10.1088/1674-1137/40/9/093101>. arXiv:1602.08806 [hep-ph]
23. T.J. Burns, E.S. Swanson, Phys. Lett. B **760**, 627 (2016). <https://doi.org/10.1016/j.physletb.2016.07.049>. arXiv:1603.04366 [hep-ph]
24. X.G. He, P. Ko, Phys. Lett. B **761**, 92 (2016). <https://doi.org/10.1016/j.physletb.2016.08.005>. arXiv:1603.02915 [hep-ph]
25. L. Tang, C.F. Qiao, Eur. Phys. J. C **76**(10), 558 (2016). <https://doi.org/10.1140/epjc/s10052-016-4436-7>. arXiv:1603.04761 [hep-ph]
26. W. Chen, H.X. Chen, X. Liu, T.G. Steele, S.L. Zhu, Phys. Rev. D **95**(11), 114005 (2017). <https://doi.org/10.1103/PhysRevD.95.114005>. arXiv:1705.10088 [hep-ph]
27. F.S. Yu, arXiv:1709.02571 [hep-ph]
28. X. Chen, J. Ping, Phys. Rev. D **98**(5), 054022 (2018). <https://doi.org/10.1103/PhysRevD.98.054022>. arXiv:1807.10505 [hep-ph]
29. H. Huang, J. Ping, arXiv:1902.05778 [hep-ph]
30. A. Ali, Q. Qin, W. Wang, Phys. Lett. B **785**, 605 (2018). <https://doi.org/10.1016/j.physletb.2018.09.018>. arXiv:1806.09288 [hep-ph]
31. A. Ali, A.Y. Parkhomenko, Q. Qin, W. Wang, Phys. Lett. B **782**, 412 (2018). <https://doi.org/10.1016/j.physletb.2018.05.055>. arXiv:1805.02535 [hep-ph]
32. X. Yan, B. Zhong, R. Zhu, Int. J. Mod. Phys. A **33**(16), 1850096 (2018). <https://doi.org/10.1142/S0217751X18500963>. arXiv:1804.06761 [hep-ph]
33. D. Ebert, R.N. Faustov, V.O. Galkin, W. Lucha, Phys. Rev. D **76**, 114015 (2007). <https://doi.org/10.1103/PhysRevD.76.114015>. arXiv:0706.3853 [hep-ph]
34. M. Karliner, J.L. Rosner, Phys. Rev. Lett. **119**(20), 202001 (2017). <https://doi.org/10.1103/PhysRevLett.119.202001>. arXiv:1707.07666 [hep-ph]
35. E.J. Eichten, C. Quigg, Phys. Rev. Lett. **119**(20), 202002 (2017). <https://doi.org/10.1103/PhysRevLett.119.202002>. arXiv:1707.09575 [hep-ph]
36. A. Francis, R.J. Hudspith, R. Lewis, K. Maltman, Phys. Rev. Lett. **118**(14), 142001 (2017). <https://doi.org/10.1103/PhysRevLett.118.142001>. arXiv:1607.05214 [hep-lat]
37. P. Bicudo, J. Scheunert, M. Wagner, Phys. Rev. D **95**(3), 034502 (2017). <https://doi.org/10.1103/PhysRevD.95.034502>. arXiv:1612.02758 [hep-lat]
38. T. Mehen, Phys. Rev. D **96**(9), 094028 (2017). <https://doi.org/10.1103/PhysRevD.96.094028>. arXiv:1708.05020 [hep-ph]
39. L. Maiani, A.D. Polosa, V. Riquer, Phys. Lett. B **778**, 247 (2018). <https://doi.org/10.1016/j.physletb.2018.01.039>. arXiv:1712.05296 [hep-ph]
40. Y. Xing, R. Zhu, Phys. Rev. D **98**(5), 053005 (2018). <https://doi.org/10.1103/PhysRevD.98.053005>. arXiv:1806.01659 [hep-ph]
41. R. Aaij *et al.* [LHCb Collaboration], Phys. Rev. Lett. **119**, no. 11, 112001 (2017). <https://doi.org/10.1103/PhysRevLett.119.112001>. arXiv:1707.01621 [hep-ex]
42. F.S. Yu, H.Y. Jiang, R.H. Li, C.D. L.W. Wang, Z.X. Zhao, Chin. Phys. C **42**(5), 051001 (2018). <https://doi.org/10.1088/1674-1137/42/5/051001>. arXiv:1703.09086 [hep-ph]
43. M. J. Savage, M. B. Wise, Phys. Rev. D **39**, 3346 (1989) Erratum: [Phys. Rev. D **40**, 3127 (1989)]. <https://doi.org/10.1103/PhysRevD.39.3346>, <https://doi.org/10.1103/PhysRevD.40.3127>
44. M. Gronau, O.F. Hernandez, D. London, J.L. Rosner, Phys. Rev. D **52**, 6356 (1995). <https://doi.org/10.1103/PhysRevD.52.6356>. arXiv:hep-ph/9504326
45. X.G. He, Eur. Phys. J. C **9**, 443 (1999). <https://doi.org/10.1007/s100529900064>. arXiv:hep-ph/9810397
46. X.G. He, Y.K. Hsiao, J.Q. Shi, Y.L. Wu, Y.F. Zhou, Phys. Rev. D **64**, 034002 (2001). <https://doi.org/10.1103/PhysRevD.64.034002>. arXiv:hep-ph/0011337
47. C.W. Chiang, M. Gronau, J.L. Rosner, D.A. Suprun, Phys. Rev. D **70**, 034020 (2004). <https://doi.org/10.1103/PhysRevD.70.034020>. arXiv:hep-ph/0404073
48. Y. Li, C.D. Lu, W. Wang, Phys. Rev. D **77**, 054001 (2008). <https://doi.org/10.1103/PhysRevD.77.054001>. arXiv:0711.0497 [hep-ph]
49. W. Wang, C.D. Lu, Phys. Rev. D **82**, 034016 (2010). <https://doi.org/10.1103/PhysRevD.82.034016>. arXiv:0910.0613 [hep-ph]
50. H.Y. Cheng, S. Oh, JHEP **1109**, 024 (2011). [https://doi.org/10.1007/JHEP09\(2011\)024](https://doi.org/10.1007/JHEP09(2011)024). arXiv:1104.4144 [hep-ph]
51. Y.K. Hsiao, C.F. Chang, X.G. He, Phys. Rev. D **93**(11), 114002 (2016). <https://doi.org/10.1103/PhysRevD.93.114002>. arXiv:1512.09223 [hep-ph]
52. C.D. L.W. Wang, F.S. Yu, Phys. Rev. D **93**(5), 056008 (2016). <https://doi.org/10.1103/PhysRevD.93.056008>. arXiv:1601.04241 [hep-ph]
53. X.G. He, W. Wang, R.L. Zhu, J. Phys. G **44**(1), 014003 (2017). <https://doi.org/10.1088/0954-3899/44/1/014003>, <https://doi.org/10.1088/0022-3727/44/27/274003>. arXiv:1606.00097 [hep-ph]
54. W. Wang, F.S. Yu, Z.X. Zhao, Eur. Phys. J. C **77**(11), 781 (2017). <https://doi.org/10.1140/epjc/s10052-017-5360-1>. arXiv:1707.02834 [hep-ph]
55. W. Wang, Z.P. Xing, J. Xu, Eur. Phys. J. C **77**(11), 800 (2017). <https://doi.org/10.1140/epjc/s10052-017-5363-y>. arXiv:1707.06570 [hep-ph]
56. X.H. Hu, Y.L. Shen, W. Wang, Z.X. Zhao, Chin. Phys. C **42**(12), 123102 (2018). <https://doi.org/10.1088/1674-1137/42/12/123102>. arXiv:1711.10289 [hep-ph]
57. Y.J. Shi, W. Wang, Y. Xing, J. Xu, Eur. Phys. J. C **78**(1), 56 (2018). <https://doi.org/10.1140/epjc/s10052-018-5532-7>. arXiv:1712.03830 [hep-ph]
58. R. Zhu, X.L. Han, Y. Ma, Z.J. Xiao, Eur. Phys. J. C **78**, 740 (2018). <https://doi.org/10.1140/epjc/s10052-018-6214-1>. arXiv:1806.06388 [hep-ph]
59. W. Wang, J. Xu, Phys. Rev. D **97**(9), 093007 (2018). <https://doi.org/10.1103/PhysRevD.97.093007>. arXiv:1803.01476 [hep-ph]

60. X.G. He, W. Wang, Chin. Phys. C **42**(10), 103108 (2018). <https://doi.org/10.1088/1674-1137/42/10/103108>. [arXiv:1803.04227](https://arxiv.org/abs/1803.04227) [hep-ph]
61. D. Wang, P.F. Guo, W.H. Long, F.S. Yu, JHEP **1803**, 066 (2018). [https://doi.org/10.1007/JHEP03\(2018\)066](https://doi.org/10.1007/JHEP03(2018)066). [arXiv:1709.09873](https://arxiv.org/abs/1709.09873) [hep-ph]
62. C.Q. Geng, Y.K. Hsiao, C.W. Liu, T.H. Tsai, JHEP **1711**, 147 (2017). [https://doi.org/10.1007/JHEP11\(2017\)147](https://doi.org/10.1007/JHEP11(2017)147). [arXiv:1709.00808](https://arxiv.org/abs/1709.00808) [hep-ph]
63. C.Q. Geng, Y.K. Hsiao, C.W. Liu, T.H. Tsai. [arXiv:1810.01079](https://arxiv.org/abs/1810.01079) [hep-ph]
64. M. Tanabashi *et al.* [Particle Data Group], Phys. Rev. D **98**, no. 3, 030001 (2018). <https://doi.org/10.1103/PhysRevD.98.030001>
65. R. Aaij *et al.* [LHCb Collaboration], Phys. Rev. D **95**, no. 5, 052005 (2017). <https://doi.org/10.1103/PhysRevD.95.052005>. [arXiv:1701.05501](https://arxiv.org/abs/1701.05501) [hep-ex]