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Fragmentation fractions of two-body b-baryon decays

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ABSTRACT

We study the fragmentation fractions ($f_{\mathbf{B}_b}$) of the b-quark to b-baryons ($\mathbf{B}_b$). By the assumption of $f_{\Lambda_b}/(f_u+f_d)=0.25\pm0.15$ in accordance with the measurements by LEP, CDF and LHCb Collaborations, we estimate that $f_{\Lambda_b}=0.175\pm0.106$ and $f_{\Xi_b^{-,0}}=0.019\pm0.013$. From these fragmentation fractions, we derive $\mathcal{B}(\Lambda_b\to J/\psi\Lambda)=(3.3\pm2.1)\times10^{-4}$, $\mathcal{B}(\Xi_b^-\to J/\psi\Xi^-)=(5.3\pm3.9)\times10^{-4}$ and $\mathcal{B}(\Omega_b^-\to J/\psi\Omega^-)>1.9\times10^{-5}$. The predictions of $\mathcal{B}(\Lambda_b\to J/\psi\Lambda)$ and $\mathcal{B}(\Xi_b^-\to J/\psi\Xi^-)$ clearly enable us to test the theoretical models, such as the QCD factorization approach in the b-baryon decays.

1. Introduction

The LHCb Collaboration has recently published the measurements of the b-baryon ($\mathbf{B}_b$) decays [1–3], such as the charmful Λ_b decays of $\Lambda_b\to\Lambda_c^+(K^-,\pi^-)$, $\Lambda_b\to\Lambda_c^+(D^-,D_s^-)$, $\Lambda_b\to D^0p(K^-,\pi^-)$, and $\Lambda_b\to J/\psi p(K^-,\pi^-)$, which are important and interesting results. For example, while the $p\pi$ mass distribution in $\Lambda_b\to J/\psi p\pi^-$ [2] suggests the existence of the higher-wave baryon, such as $N(1520)$ or $N(1535)$, a peaking data point in the Dp mass distribution in $\Lambda_b\to D^0p(K^-,\pi^-)$ [3] hints at the resonant $\Sigma_c(2880)$ state. On the other hand, it is typical to have the partial observations for the decay branching ratios, given by [4]

$$\begin{aligned}
&\mathcal{B}(\Lambda_b\to J/\psi\Lambda)f_{\Lambda_b}=(5.8\pm0.8)\times10^{-5},\\
&\mathcal{B}(\Xi_b^-\to J/\psi\Xi^-)f_{\Xi_b^-}=(1.02^{+0.26}_{-0.21})\times10^{-5},\\
&\mathcal{B}(\Omega_b^-\to J/\psi\Omega^-)f_{\Omega_b^-}=(2.9^{+1.1}_{-0.8})\times10^{-6},
\end{aligned}\tag{1}$$

where $f_{\mathbf{B}_b}$ are the fragmentation fractions of the b quark to b-baryons $\mathbf{B}_b=\Lambda_b$, Ξ_b^- and Ω_b^-. The partial observations in Eq. (1) along with the measurements of the Ξ_b^0 decays [3–5] are due to the fact that $f_{\Lambda_b,\Xi_b^{-,0},\Omega_b^-}$ are not well determined. In the assumption of $f_{\Lambda_b}\simeq f_{baryon}$ with $f_{baryon}\equiv\mathbf{B}(b\to\text{all } b\text{-baryons})$, it is often adopted that $f_{\Lambda_b}=0.1$ [6,7].[1] However, according to the recent observations of the relatively less decays associated with $\Xi_b^{-,0}$ and Ω_b^- [8], $f_{\Lambda_b}\simeq f_{baryon}$ is no longer true. As a result, it is urgent to improve the value of f_{Λ_b} and obtain the less known ones of $f_{\Xi_b^{-,0}}$.

Although it is possible to estimate f_{Λ_b} by the ratio of $f_{\Lambda_b}/(f_u+f_d)$ with $f_{u,d,s}\equiv\mathcal{B}(b\to B^-,\bar B^0,\bar B_s^0)$, different measurements on $f_{\Lambda_b}/(f_u+f_d)$ are not in good agreement, given by

$$\begin{aligned}
&f_{\Lambda_b}/(f_u+f_d)=0.281\pm0.012(\text{stat})^{+0.058}_{-0.056}(\text{sys})^{+0.128}_{-0.087}(\text{Br})\ [9],\\
&f_{\Lambda_b}/(f_u+f_d)=0.125\pm0.020\ [4],
\end{aligned}\tag{2}$$

with the uncertainty related to Br due to the uncertainties on the measured branching ratios, where the first relation given by the CDF Collaboration [9] is obviously twice larger than the world averaged value of the second one [4], dominated by the LEP measurements on Z decays. Moreover, since the recent measurements by the LHCb Collaboration also indicate this inconsistency [10–12], it is clear that the values of f_{Λ_b} and $f_{\Xi_b^{0,-}}$ cannot be experimentally determined yet. In this paper, we will demonstrate the possible range for $f_{\Lambda_b}/(f_u+f_d)$ in accordance with the measurements by LEP, CDF and LHCb Collaborations and give the theoretical estimations of f_{Λ_b} and $f_{\Xi_b^{0,-}}$, which allow us to extract $\mathcal{B}(\Lambda_b\to J/\psi\Lambda)$, $\mathcal{B}(\Xi_b^-\to J/\psi\Xi^-)$, and $\mathcal{B}(\Omega_b^-\to J/\psi\Omega^-)$ from the data in Eq. (1).

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[1] $f_{baryon}\sim0.1$ was also taken in the previous versions of the PDG.

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Consequently, we are able to test the theoretical approach based on the factorization ansatz, which have been used to calculate the two-body $\mathbf{B}_b$ decays [7,13–19].

2. Estimations of f_{Λ_b} and $f_{\Xi_b^{-,0}}$

Experimentally, in terms of the specific cases of the charmful $\Lambda_b \to \Lambda_c^+\pi^-$ and $\bar{B}^0 \to D^+\pi^-$ decays or the semileptonic $\Lambda_b \to \Lambda_c^+\mu^-\bar{\nu}X$ and $\bar{B} \to D\mu^-\bar{\nu}X$ decays detected with the bins of p_T and η, where p_T is the transverse momentum and $\eta = -\ln(\tan\theta/2)$ is the pseudorapidity defined by the polar angle θ with respect to the beam direction [9–11], the ratio of $f_{\Lambda_b}/(f_u + f_d)$ can be related to p_T and η. This explains the inconsistency between the results from CDF and LEP with $p_T = 15$ and 45 GeV, respectively. While f_s/f_u is measured with slightly dependences on p_T and η [20], $f_{\Lambda_b}/(f_u + f_d)$ is fitted as the linear form in Ref. [10] with $p_T = 0$–14 GeV and the exponential form in Refs. [11,12] with $p_T = 0$–50 GeV, respectively, for the certain range of η.

2.1. The present status of $f_{\Lambda_b}/(f_u + f_d)$

With the semileptonic $\Lambda_b \to \Lambda_c^+\mu^-\bar{\nu}X$ and $\bar{B} \to D\mu^-\bar{\nu}X$ decays, the LHCb Collaboration has shown the dependence of $f_{\Lambda_b}/(f_u + f_d)$ on p_T in the range of $p_T = 0$–14 GeV to be the linear form, given by [11]

$$f_{\Lambda_b}/(f_u + f_d) = \big(0.404 \pm 0.017(\text{stat}) \pm 0.027(\text{syst}) \pm 0.105(\text{Br})\big) \big(1 - [0.031 \pm 0.004(\text{stat}) \pm 0.003(\text{syst})]p_T\big)\,, \tag{3}$$

where Br arises from the absolute scale uncertainty due to the poorly known branching ratio of $\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)$. By averaging $f_{\Lambda_b}/(f_u + f_d)$ with $p_T = 0$–14 GeV, we obtain

$$\bar{f}_{\Lambda_b} = (0.316 \pm 0.087)(f_u + f_d)\,, \tag{4}$$

which agrees with the first relation in Eq. (2) given by the CDF Collaboration with $p_T \simeq 15$ GeV. On the other hand, with the charmful $\Lambda_b \to \Lambda_c^+\pi^-$ and $\bar{B}^0 \to D^+\pi^-$ decays, another analysis by the LHCb Collaboration presents the exponential dependence of f_{Λ_b}/f_d on p_T [11,12]:

$$f_{\Lambda_b}/f_d = (0.151 \pm 0.030) + \exp\{-(0.57 \pm 0.11) - (0.095 \pm 0.016)p_T\}\,, \tag{5}$$

with the wider range of $p_T = 0$–50 GeV. By averaging the value in Eq. (5) with $p_T = 0$–50 GeV, we find

$$\bar{f}_{\Lambda_b} = (0.269 \pm 0.040)f_d = (0.135 \pm 0.020)(f_u + f_d)\,, \tag{6}$$

with $f_u = f_d$ due to the isospin symmetry, where the error has combined the uncertainties in Eq. (5). It is interesting to note that, as the relation in Eq. (5) with $p_T = 0$–50 GeV overlaps $p_T \simeq 45$ GeV for the second relation from LEP in Eq. (2), its value of $\bar{f}_{\Lambda_b} = (0.135 \pm 0.020)(f_u + f_d)$ is close to the LEP result of $f_{\Lambda_b} = (0.125 \pm 0.020)(f_u + f_d)$. Apart form the values in Eqs. (4) and (6), the reanalyzed results by CDF and LHCb Collaborations give $f_{\Lambda_b}/(f_u + f_d)$ to be 0.212 ± 0.058 and 0.223 ± 0.022 with the averaged $p_T \simeq 13$ and 7 GeV, respectively [12]. We hence make the assumption of

$$R_{\Lambda_b} \equiv f_{\Lambda_b}/(f_u + f_d) = 0.25 \pm 0.15\,, \tag{7}$$

to cover the possible range in accordance with the measurements from the three Collaborations of LEP, CDF and LHCb, which will be used to estimate the values of f_{Λ_b} and $f_{\Xi_b^{0,-}}$ in the following.

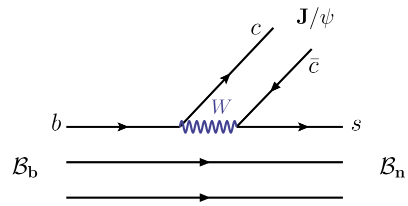

Fig. 1. The $\mathbf{B}_b \to \mathbf{B}_n J/\psi$ decays via the internal W-boson emission diagram.

2.2. Theoretical determination of $f_{\Xi_b^-}/f_{\Lambda_b}$

In principle, when the ratios of $f_{\Lambda_b}/(f_u + f_d)$ and $f_{\Xi_b^{0,-}}/f_{\Lambda_b}$ are both known, by adding the relations of [4,20]

$$f_u + f_d + f_s + f_{baryon} = 1\,,$$
$$f_{baryon} \simeq f_{\Lambda_b} + f_{\Xi_b^-} + f_{\Xi_b^0}\,,$$
$$f_s = (0.256 \pm 0.020)f_d\,, \tag{8}$$

and $f_u = f_d$ as well as $f_{\Xi_b^-} = f_{\Xi_b^0}$ due to the isospin symmetry, we can derive the values of f_u, f_d, f_s, f_{Λ_b}, $f_{\Xi_b^-}$ and $f_{\Xi_b^0}$. For $f_{\Xi_b^-}/f_{\Lambda_b}$, it was once given that

$$f_{\Xi_b^-}/f_{\Lambda_b} \simeq f_s/f_u \text{ [8,21]}\,,$$
$$f_{\Xi_b^0}/f_{\Lambda_b} \simeq 0.2 \text{ [22]}\,, \tag{9}$$

where the first relation from Refs. [8,21] requires the assumption of $R_1 \equiv \mathcal{B}(\Xi_b^- \to J/\psi\,\Xi^-)/\,\mathcal{B}(\Lambda_b \to J/\psi\,\Lambda) \simeq 1$ [11], while the second one from Ref. [22] uses $R_2 \equiv \mathcal{B}(\Xi_b^0 \to \Xi_c^+\pi^-)/\mathcal{B}(\Lambda_b \to \Lambda_c^+\pi^-) \simeq 1$ along with $R_3 \equiv \mathcal{B}(\Xi_c^+ \to pK^-\pi^+)/\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+) \simeq 0.1$ from the naive Cabibbo factors. However, we note that the theoretical calculations provide us with more understanding of b-baryon decays, such as the difference between the $\Lambda_b \to \Lambda$ and $\Xi_b^- \to \Xi^-$ transitions, based on the $SU(3)$ flavor and $SU(2)$ spin symmetries. As a result, the assumption of $R_1 = R_2 \simeq 1$ might be too naive. Since the theoretical approach with the factorization ansatz well explains $\mathcal{B}(\Lambda_b \to p\pi^-)$ and $\mathcal{B}(\Lambda_b \to pK^-)$, and particularly the ratio of $\mathcal{B}(\Lambda_b \to p\pi^-)/\mathcal{B}(\Lambda_b \to pK^-) \sim 0.84$ [23], it can be reliable to determine $f_{\Xi_b^-}/f_{\Lambda_b}$.

Theoretically, we use the factorization approach to calculate the two-body b-baryon decay, such that the amplitude corresponds to the decaying process of the $\mathbf{B}_b \to \mathbf{B}_n$ transition with the recoiled meson. Explicitly, as shown in Fig. 1, where the W-boson emission is internal, the amplitude via the quark-level $b \to c\bar{c}s$ transition can be factorized as

$$\mathcal{A}(\mathbf{B}_b \to \mathbf{B}_n J/\psi) = \frac{G_F}{\sqrt{2}} V_{cb}V_{cs}^* a_2 \,\langle J/\psi|\bar{c}\gamma^\mu(1-\gamma_5)c|0\rangle\langle\mathbf{B}_n|\bar{s}\gamma_\mu(1-\gamma_5)b|\mathbf{B}_b\rangle\,, \tag{10}$$

for $\Lambda_b \to \Lambda J/\psi$ or $\Xi_b^- \to \Xi^- J/\psi$, where the parameter a_2 is given by [24,25]

$$a_2 = c_2^{eff} + \frac{c_1^{eff}}{N_c}\,, \tag{11}$$

with the effective Wilson coefficients $(c_1^{eff}, c_2^{eff}) = (1.168, -0.365)$. Note that the color number N_c originally being equal to 3 in the naive factorization, which gives $a_2 = 0.024$ in Eq. (11), should be taken as a floating number from $2 \to \infty$ to account for the non-factorizable effects in the generalized factorization. The matrix element for the J/ψ production is given by $\langle J/\psi|\bar{c}\gamma_\mu c|0\rangle =$

$m_{J/\psi} f_{J/\psi} \varepsilon^*_\mu$ with $m_{J/\psi}$, $f_{J/\psi}$, and ε^*_μ as the mass, decay constant, and polarization vector, respectively. The matrix elements of the $\mathbf{B}_b \to \mathbf{B}_n$ baryon transition in Eq. (10) have the general forms:

$$\langle \mathbf{B}_n|\bar{q}\gamma_\mu b|\mathbf{B}_b\rangle = \bar{u}_{\mathbf{B}_n}[f_1\gamma_\mu + \frac{f_2}{m_{\mathbf{B}_b}} i\sigma_{\mu\nu}q^\nu + \frac{f_3}{m_{\mathbf{B}_b}} q_\mu]u_{\mathbf{B}_b}\,,$$
$$\langle \mathbf{B}_n|\bar{q}\gamma_\mu\gamma_5 b|\mathbf{B}_b\rangle = \bar{u}_{\mathbf{B}_n}[g_1\gamma_\mu + \frac{g_2}{m_{\mathbf{B}_b}} i\sigma_{\mu\nu}q^\nu + \frac{g_3}{m_{\mathbf{B}_b}} q_\mu]\gamma_5 u_{\mathbf{B}_b}\,, \tag{12}$$

where f_j (g_j) $(j = 1, 2, 3)$ are the form factors, with $f_{2,3} = 0$ and $g_{2,3} = 0$ due to the helicity conservation, as derived in Refs. [7,14,26]. It is interesting to note that, as the helicity-flip terms, the theoretical calculations from the loop contributions to $f_{2,3}$ $(g_{2,3})$ indeed result in the values to be one order of magnitude smaller than that to $f_1(g_1)$, which can be safely neglected. In the double-pole momentum dependences, one has that [23]

$$F(q^2) = \frac{F(0)}{(1 - q^2/m^2_{\mathbf{B}_b})^2} \quad (F = f_1\,,\ g_1). \tag{13}$$

We are able to relate different $\mathbf{B}_b \to \mathbf{B}_n$ transition form factors based on $SU(3)$ flavor and $SU(2)$ spin symmetries, which have been used to connect the space-like $\mathbf{B}_n \to \mathbf{B}'_n$ transition form factors in the neutron decays [27], and the time-like $0 \to \mathbf{B}_n\bar{\mathbf{B}}'_n$ baryonic as well as $B \to \mathbf{B}_n\bar{\mathbf{B}}'_n$ transition form factors in the baryonic B decays [28–32]. As a result, we obtain $(f_1(0), g_1(0)) = (C, C)$, $(-\sqrt{2/3}C, -\sqrt{2/3}C)$, and $(0, 0)$ with C a constant for $\langle p|\bar{u}\gamma_\mu(\gamma_5)b|\Lambda_b\rangle$, $\langle \Lambda|\bar{s}\gamma_\mu(\gamma_5)b|\Lambda_b\rangle$, and $\langle \Sigma^0|\bar{s}\gamma_\mu(\gamma_5)b|\Lambda_b\rangle$, which are the same as those in Ref. [26] based on the heavy-quark and large-energy symmetries for the $\Lambda_b \to (p, \Lambda, \Sigma^0)$ transitions, respectively. In addition, we have $f_1(0) = g_1(0) = C$ for $\langle \Xi^-|\bar{s}\gamma_\mu(\gamma_5)b|\Xi_b^-\rangle$. To obtain the branching ratio for the two-body decays, the equation is given by [4]

$$\mathcal{B}(\mathbf{B}_b \to J/\psi\mathbf{B}_n) = \frac{\Gamma(\mathbf{B}_b \to J/\psi\mathbf{B}_n)\tau_{\mathbf{B}_b}}{6.582 \times 10^{-25}}\,, \tag{14}$$

with $\tau_{\mathbf{B}_b}$ the life time, where

$$\Gamma(\mathbf{B}_b \to J/\psi\mathbf{B}_n) = \frac{|\vec{P}_{J/\psi}|}{8\pi m^2_{\mathbf{B}_b}}|\mathcal{A}(\mathbf{B}_b \to J/\psi\mathbf{B}_n)|^2\,, \tag{15}$$

with $|\vec{P}_{J/\psi}| = |\vec{P}_{\mathbf{B}_n}| = \{[m^2_{\mathbf{B}_b} - (m_{J/\psi} + m_{\mathbf{B}_n})^2][m^2_{\mathbf{B}_b} - (m_{J/\psi} - m_{\mathbf{B}_n})^2]\}^{1/2}/(2m_{\mathbf{B}_b})$. As a result, we obtain

$$\frac{\mathcal{B}(\Xi_b^- \to J/\psi\,\Xi^-)}{\mathcal{B}(\Lambda_b \to J/\psi\,\Lambda)} = \frac{\tau_{\Xi_b^-}}{\tau_{\Lambda_b}}\frac{C^2}{(-\sqrt{2/3}C)^2} = 1.63 \pm 0.04\,, \tag{16}$$

with $\tau_{\Xi_b^-}/\tau_{\Lambda_b} = 1.089 \pm 0.026 \pm 0.011$ [33]. We note that, theoretically, $R_1 = 1.63$ apparently deviates by 63% from $R_1 = 1$ in the simple assumption. To determine $f_{\Xi_b^-}/f_{\Lambda_b}$, we relate Eq. (16) to (1) to give

$$f_{\Xi_b^-} = (0.108 \pm 0.034) f_{\Lambda_b}\,, \tag{17}$$

which is different from the numbers in Eq. (9).

2.3. Determinations of $f_{\Xi_b^{-,0}}$ and f_{Λ_b}

According to Eqs. (4), (7), (8) and (17), we derive the values of f_u, f_d, f_s, f_{Λ_b}, $f_{\Xi_b^-}$ and $f_{\Xi_b^0}$ in Table 1, which agree with the data in the PDG [4]. Note that $f_{\Omega_b^-} < 0.108$ is from the error in f_{baryon}. In addition, $f_{baryon} = 0.213 \pm 0.108$, which overlaps 0.089 ± 0.015 from Z-decays [4] and 0.237 ± 0.067 from Tevatron [4], is due to the assumption of $R_{\Lambda_b} = 0.25 \pm 0.15$ in Eq. (7) to cover the possible range from the data. Similarly, $f_{\Lambda_b} = 0.175 \pm 0.106$ overlaps $f_{\Lambda_b} = 0.07$ from the LEP measurements [34], while $f_{\Xi_b^-} = f_{\Xi_b^0} = 0.019 \pm 0.013$ is consistent with $f_{\Xi_b^-} = 0.011 \pm 0.005$ from the measurement [35]. We hence convert the data in Eq. (1) to be

Table 1
Results of f_i ($i = u,\ d,\ s$, baryon, Λ_b, $\Xi_b^{-,0}$, and Ω_b^-), compared with those from Z-decays and Tevatron in PDG [4].

	Our result	Z-decays [4]	Tevatron [4]
$f_u = f_d$	0.349 ± 0.037	0.404 ± 0.009	0.330 ± 0.030
f_s	0.089 ± 0.018	0.103 ± 0.009	0.103 ± 0.012
f_{baryon}	0.213 ± 0.108	0.089 ± 0.015	0.237 ± 0.067
f_{Λ_b}	0.175 ± 0.106	–	–
$f_{\Xi_b^-} = f_{\Xi_b^0}$	0.019 ± 0.013	–	–
$f_{\Omega_b^-}$	< 0.108	–	–

$$\mathcal{B}(\Lambda_b \to J/\psi\,\Lambda) = (3.3 \pm 2.1) \times 10^{-4}\,,$$
$$\mathcal{B}(\Xi_b^- \to J/\psi\,\Xi^-) = (5.3 \pm 3.9) \times 10^{-4}\,,$$
$$\mathcal{B}(\Omega_b^- \to J/\psi\,\Omega^-) > 1.9 \times 10^{-5}\,, \tag{18}$$

with $\mathcal{B}(\Xi_b^- \to J/\psi\,\Xi^-) \simeq 1.6\mathcal{B}(\Lambda_b \to J/\psi\,\Lambda)$ to be in accordance with Eq. (16). With the use of $f_{\Xi_b^{0,-}}$, we can also estimate the $\Xi_b^{0,-}$ decays [4,5], given by

$$\mathcal{B}(\Xi_b^- \to \Xi^-\ell^-\bar{\nu}_\ell X) = (2.1 \pm 1.5) \times 10^{-2}\,,$$
$$\mathcal{B}(\Xi_b^0 \to \bar{K}^0 p\pi^-) = (1.1 \pm 1.5) \times 10^{-5}\,,$$
$$\mathcal{B}(\Xi_b^0 \to \bar{K}^0 pK^-) = (1.1 \pm 1.1) \times 10^{-5}\,,$$
$$\mathcal{B}(\Xi_b^0 \to D^0 pK^-) = (9.5 \pm 9.4) \times 10^{-5}\,,$$
$$\mathcal{B}(\Xi_b^0 \to \Lambda_c^+ K^-) = (4.2 \pm 4.7) \times 10^{-5}\,. \tag{19}$$

2.4. Test of the non-factorizable effects

To numerically test the non-factorizable effects, the CKM matrix elements in the Wolfenstein parameterization are taken as $(V_{cb}, V_{cs}) = (A\lambda^2, 1 - \lambda^2/2)$ with $(\lambda,\ A) = (0.225,\ 0.814)$ [4], while $f_{J/\psi} = 418 \pm 9$ MeV [36]. The constant value of C in Ref. [23] is fitted to be $C = 0.136 \pm 0.009$ to explain the branching ratios and predict the CP violating asymmetries of $\Lambda_b \to p(K^-, \pi^-)$, which is also consistent with the value of 0.14 ± 0.03 in the light-cone sum rules [26] and those in Refs. [7,14].

To explain the branching ratios of $\Lambda_b \to J/\psi\,\Lambda$ and $\Xi_b^- \to J/\psi\,\Xi^-$ in Eq. (18), the floating color number N_c is evaluated to be

$$N_c = 2.15 \pm 0.17\,, \tag{20}$$

which corresponds to $a_2 = 0.18 \pm 0.04$, in comparison with $a_2 = 0.024$ for $N_c = 3$. Note that since $N_c = 2.15$ in Eq. (20) is not far from 3, we conclude that the non-factorizable effects are controllable. As a result, the theoretical approach based on the factorization ansatz is demonstrated to be reliable to explain the two-body $\mathbf{B}_b$ decays.

3. Conclusions

In sum, we made the assumption of $R_{\Lambda_b} = f_{\Lambda_b}/(f_u + f_d) = 0.25 \pm 0.15$, which is in accordance with the measurements by LEP, CDF and LHCb Collaborations. We have estimated that $f_{\Lambda_b} = 0.175 \pm 0.106$ and $f_{\Xi_b^{-,0}} = 0.019 \pm 0.013$, which can be used to extract the branching ratios of the anti-triplet b-baryon decays.

Explicitly, we have found $\mathcal{B}(\Lambda_b \to J/\psi\Lambda) = (3.3 \pm 2.1) \times 10^{-4}$, $\mathcal{B}(\Xi_b^- \to J/\psi\Xi^-) = (5.3 \pm 3.9) \times 10^{-4}$ and $\mathcal{B}(\Omega_b^- \to J/\psi\Omega^-) > 1.9 \times 10^{-5}$. We have also demonstrated that the predictions of $\mathcal{B}(\Lambda_b \to J/\psi\Lambda)$ and $\mathcal{B}(\Xi_b^- \to J/\psi\Xi^-)$ would help us to test the theoretical models, such as the factorization approach.

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