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Baryon Resonance in $\chi_{c0}\to B\bar{B}MM$ Decays*

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Abstract The exclusive decays of χ_{c0} into multi-body $B\bar{B}MM$(B:baryon, M:meson) are investigated based on the $SU(3)$ symmetry. The transitional amplitudes of $\chi_{c0}\to B\bar{B}\to B\bar{B}MM$ are given in terms of the isospin coupling constant. Based on these amplitudes, it is found that N^* resonances make a relatively large contribution to the $\chi_{c0}\to N\bar{N}\pi\pi$, which might serve as a channel to study N^* resonance in data analysis.

Key words decays of χ_{c0}, baryon resonance

1 Introduction

Decays of the P-wave charmonia have continuously attracted interest of both the theoretical and experimental experts[1—7]. The earliest theoretical treatment on the exclusive charmonium decays into light hadrons was carried out by Lepage and Brodsky in the framework of perturbative QCD[2]. They predicted the angular distribution and the decay widths based on the assumption that the mass of light quark and gluon can be neglected. The theoretical analysis predicted that the decays $\chi_{c0}\to B\bar{B}$(B:baryon) are forbidden by the "helicity selection rule"[3]. However, the experimental values for these kinds of exclusive decays do not vanish within the experimental error, for example, the branching ratios for $\chi_{c0}\to p\bar{p}$, $\Lambda\bar{\Lambda}$ are at the order 10^{-4}[4].

Nowadays, there is a renewed interest in studying the P-wave charmonium decay mechanism, not only due to the theoretical inconsistence mentioned above, but also due to the recent progress in experimental measurements on χ_{cJ} exclusive decays from BES collaboration[5, 6]. It seems that some calculations of the two-body exclusive decay widths deviate obviously from the measured values, for example, the theory based on the color octet mechanism[7] predicted that $\Gamma(\chi_{c1}\to\Lambda\bar{\Lambda})/\Gamma(\chi_{c1}\to p\bar{p})=0.6$, which is smaller than the experimental value of 3.6 ± 1.4 by about 2σ. To understand the P-wave charmonium decay mechanism, the comparison between the theoretical predication and experimental values are expected. In this work, the exclusive decays of χ_{c0} into baryon antibaryon plus two mesons $B\bar{B}MM$ are investigated based on $SU(3)$ symmetry. The results serves as a reference for the experimental experts to investigate the 4-charged particle decays of the χ_{c0}.

2 $SU(3)$ constraints

We focus on the investigation of the contribution from the excited baryon in the multi-body decays of the χ_{c0} to $B\bar{B}MM$. The decays are assumed via the chain $\chi_{c0}\to B^*\bar{B}^*\to B\bar{B}MM$, where B^* is the intermediate state, an excited octet sector baryon or decuple sector baryon. The relative decay strengths to different final states may be got from the Clebsch-Gordan(CG) coefficients.

We start with $SU(4)$ group representations, mesons are assigned to the adjoint representation $\underline{15}$, and the $J^P=\frac{1}{2}^+$ baryons are assigned to the repre-

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sentation $\underline{20}'$. The $J^P=\frac{3}{2}^+$ isobars are placed in $\underline{20}$, which contains a decuplet with the C-quantum number C=0. The CG coefficients are available from[8]. For $\chi_{c0}\to B^*\bar{B}^*$ decays they are expressed by:

$$\chi_{cJ}\ \to\ (B_8^*\bar{B}_8^*, B_{10}^*\bar{B}_{10}^*, B_{10}^*\bar{B}_8^*, B_8^*\bar{B}_{10}^*)= \\ (-1/\sqrt{2}, \sqrt{5/14}, 0, 0), \qquad (1)$$

where B_8^* and B_{10}^* denote excited octet sector baryons and decuple sector baryons, respectively.

The $SU(3)$ CG coefficients for decays $B_8^*\bar{B}_8^*\to B_8\bar{B}_8MM$ are expressed by:

$$\begin{pmatrix} N^*\bar{N}^* \\ \Sigma^*\bar{\Sigma}^* \\ \Lambda^*\bar{\Lambda}^* \\ \Xi^*\bar{\Xi}^* \end{pmatrix} \to \begin{pmatrix} N\bar{N}\pi\pi\ N\bar{N}\eta\eta\ \Sigma\bar{\Sigma}K\bar{K}\ \Lambda\bar{\Lambda}K\bar{K} \\ N\bar{N}K\bar{K}\quad \Sigma\bar{\Sigma}\pi\pi\quad \Lambda\bar{\Lambda}\pi\pi \\ N\bar{N}K\bar{K}\quad \Sigma\bar{\Sigma}\pi\pi\quad \Lambda\bar{\Lambda}\eta\eta \\ \Sigma\bar{\Sigma}K\bar{K}\quad \Lambda\bar{\Lambda}K\bar{K}\quad \Xi\bar{\Xi}\pi\pi \end{pmatrix} =$$

$$\frac{1}{20}\begin{pmatrix} 9\ \ 1\ \ 9\ \ 1 \\ 6\ \ 0\ \ 4 \\ 2\ \ 12\ \ 4 \\ 9\ \ 1\ \ 9 \end{pmatrix}_{B_8\bar{B}_8} \quad \text{and} \quad \frac{1}{12}\begin{pmatrix} 3\ \ 3\ \ 3\ \ 3 \\ 2\ \ 8\ \ 0 \\ 6\ \ 0\ \ 0 \\ 3\ \ 3\ \ 3 \end{pmatrix}_{B_8'\bar{B}_8'}, \qquad (2)$$

where the two parts correspond to the contributions from the two baryonic $SU(3)$ representations $\underline{8}$ and $\underline{8}'$, and $K^T=(K^+,K^0)$, $\pi^T=(\pi^+,\pi^0,\pi^-)$, $\bar{K}^T=(\bar{K}^0,-K^-)$, $N^T=(p,n)$, $\Sigma^T=(\Sigma^+,\Sigma^0,\Sigma^-)$ and $\Xi^T=(\Xi^0,\Xi^-)$.

The CG coefficients for decays $B_8^*\bar{B}_8^*\to B_{10}\bar{B}_{10}MM$ are expressed by:

$$\begin{pmatrix} N^*\bar{N}^* \\ \Sigma^*\bar{\Sigma}^* \\ \Lambda^*\bar{\Lambda}^* \\ \Xi^*\bar{\Xi}^* \end{pmatrix} \to \begin{pmatrix} \Delta\bar{\Delta}\pi\pi \\ \Sigma\bar{\Sigma}\pi\pi \\ \Sigma\bar{\Sigma}\pi\pi \\ \Xi\bar{\Xi}\pi\pi \end{pmatrix} = \frac{1}{15}\begin{pmatrix} 12 \\ 2 \\ 9 \\ 3 \end{pmatrix}. \qquad (3)$$

The CG coefficients for decays $B_{10}^*\bar{B}_{10}^*\to B_8\bar{B}_8MM$ are expressed by:

$$\begin{pmatrix} \Delta^*\bar{\Delta}^* \\ \Sigma^*\bar{\Sigma}^* \\ \Xi^*\bar{\Xi}^* \end{pmatrix} \to \begin{pmatrix} N\bar{N}\pi\pi\quad \Sigma\bar{\Sigma}K\bar{K} \\ N\bar{N}K\bar{K}\ \ \Sigma\bar{\Sigma}\pi\pi\ \ \Lambda\bar{\Lambda}\pi\pi \\ \Sigma\bar{\Sigma}K\bar{K}\ \ \Lambda\bar{\Lambda}K\bar{K}\ \ \Xi\bar{\Xi}\pi\pi \end{pmatrix} = \frac{1}{12}\begin{pmatrix} 6\ \ 6 \\ 2\ \ 2\ \ 3 \\ 3\ \ 3\ \ 3 \end{pmatrix}, \qquad (4)$$

and the CG coefficients for decays $B_{10}^*\bar{B}_{10}^*\to B_{10}\bar{B}_{10}MM$ are expressed by:

$$\begin{pmatrix} \Delta^*\bar{\Delta}^* \\ \Sigma^*\bar{\Sigma}^* \\ \Xi^*\bar{\Xi}^* \end{pmatrix} \to \begin{pmatrix} \Delta\bar{\Delta}\pi\pi \\ \Sigma\bar{\Sigma}\pi\pi \\ \Xi\bar{\Xi}\pi\pi \end{pmatrix} = \frac{1}{24}\begin{pmatrix} 15 \\ 8 \\ 3 \end{pmatrix}. \qquad (5)$$

The Yukawa coupling strength can be expressed in terms of the CG coefficients as listed above. For example, if we assume an interaction Lagrangian of the type

$$L_{\rm int}=g_0B^+BM$$

for $\chi_{c0}\to B\bar{B}$ decays, one gets the strength $-1/\sqrt{2}g_0$ and $\sqrt{5/14}g_0$ for χ_{c0} decays into $\bar{B}_8B_8$ and $\bar{B}_{10}B_{10}$, respectively. Table 1 summarizes the isospin coupling constants involved.

Table 1. Isospin coupling constants, where g_1 and g_1' are constants for $B_8\to B_8M$ decays, and g_2, g_3 and g_4 are constants for $B_8\to B_{10}M, B_{10}\to B_8M$ and $B_{10}\to B_{10}M$ decays, respectively.

channels	$\chi_{c0}\to B_8\bar{B}_8$: $-\frac{1}{\sqrt{2}}g_0$		$\chi_{c0}\to B_{10}\bar{B}_{10}$: $\sqrt{\frac{5}{14}}g_0$	
	$B_8^*\bar{B}_8^*\to B_8\bar{B}_8MM$	$B_8^*\bar{B}_8^*\to B_{10}\bar{B}_{10}MM$	$B_{10}^*\bar{B}_{10}^*\to B_8\bar{B}_8MM$	$B_{10}^*\bar{B}_{10}^*\to B_{10}\bar{B}_{10}MM$
$N\bar{N}\to N\bar{N}\pi\pi$	$\frac{9}{20}g_1^2+\frac{3}{12}g_1'^2$		$\bar{\Delta}\Delta\to\bar{N}N\pi\pi$: $\frac{6}{12}g_3^2$	
$\Sigma\bar{\Sigma}\to N\bar{N}K\bar{K}$	$\frac{6}{20}g_1^2+\frac{2}{12}g_1'^2$		$\frac{2}{12}g_3^2$	
$\Lambda\bar{\Lambda}\to N\bar{N}K\bar{K}$	$\frac{2}{20}g_1^2+\frac{6}{12}g_1'^2$			
$N\bar{N}\to N\bar{N}\eta\eta$	$\frac{1}{20}g_1^2+\frac{3}{12}g_1'^2$			
$\Sigma\bar{\Sigma}\to\Lambda\bar{\Lambda}\pi\pi$	$\frac{4}{20}g_1^2$		$\frac{3}{12}g_3^2$	
$N\bar{N}\to\Lambda\bar{\Lambda}K\bar{K}$	$\frac{1}{20}g_1^2+\frac{3}{12}g_1'^2$			
$\Xi\bar{\Xi}\to\Lambda\bar{\Lambda}K\bar{K}$	$\frac{1}{20}g_1^2+\frac{3}{12}g_1'^2$		$\frac{3}{12}g_3^2$	
$\Lambda\bar{\Lambda}\to\Lambda\bar{\Lambda}\eta\eta$	$\frac{4}{20}g_1^2$			
$\Sigma\bar{\Sigma}\to\Sigma\bar{\Sigma}\pi\pi$	$\frac{8}{12}g_1'^2$	$\frac{2}{15}g_2^2$	$\frac{2}{12}g_3^2$	$\frac{8}{24}g_4^2$
$\Lambda\bar{\Lambda}\to\Sigma\bar{\Sigma}\pi\pi$	$\frac{12}{20}g_1^2$	$\frac{9}{15}g_2^2$		
$\Xi\bar{\Xi}\to\Sigma\bar{\Sigma}K\bar{K}$	$\frac{9}{20}g_1^2+\frac{3}{12}g_1'^2$		$\frac{3}{12}g_3^2$	
$\Xi\bar{\Xi}\to\Xi\bar{\Xi}\pi\pi$	$\frac{9}{20}g_1^2+\frac{3}{12}g_1'^2$	$\frac{3}{15}g_2^2$	$\frac{3}{12}g_3^2$	$\frac{3}{24}g_4^2$

3 Baryon resonance contribution

The baryonic resonances are described with the non-relativistic Breit-Wigner, i.e.

$$BW=\frac{\sqrt{\Gamma Br}}{\sqrt{s}-M+\mathrm{i}\Gamma/2},\tag{6}$$

where Γ and M are the resonance decay width and mass, and $\sqrt{s}$ is the invariant mass of decayed particles. For a specific decay mode, the coupling strength of the mother particle with the decayed particle is absorbed in the branching ratio Br. Then the transitional amplitude can be constructed in terms of isospin constants as follows:

For $\chi_{c0}\to N\bar{N}\pi\pi$:

$$M=-\frac{1}{\sqrt{2}}g_0\times\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{N_i}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{N_i}+\mathrm{i}\Gamma_i/2)}\times\left(\frac{9}{20}g_1^2+\frac{3}{12}g_1'^2\right)+\sqrt{\frac{5}{14}}g_0\times\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Delta_i}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Delta_i}+\mathrm{i}\Gamma_i/2)}\frac{6}{12}g_3^2,\tag{7}$$

where the sum runs over baryon resonances over their production thresholds.

For $\chi_{c0}\to N\bar{N}K\bar{K}$:

$$M=-\frac{1}{\sqrt{2}}g_0\left\{\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Sigma_{8i}}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Sigma_i}+\mathrm{i}\Gamma_i/2)}\left(\frac{6}{20}g_1^2+\frac{2}{12}g_1'^2\right)+\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Lambda_{8i}}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Lambda_i}+\mathrm{i}\Gamma_i/2)}\left(\frac{2}{20}g_1^2+\frac{6}{12}g_1'^2\right)\right\}+\sqrt{\frac{5}{14}}g_0\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Sigma_{10i}}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Sigma_{10i}}+\mathrm{i}\Gamma_i/2)}\frac{2}{12}g_3^2,\tag{8}$$

where the Σ_{8i} and Σ_{10i} denote the sum running over the octet and decuplet Σ resonances, respectively.

For $\chi_{c0}\to N\bar{N}\eta\eta$:

$$M=-\frac{1}{\sqrt{2}}g_0\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{N_i}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{N_i}+\mathrm{i}\Gamma_i/2)}\left(\frac{1}{20}g_1^2+\frac{3}{12}g_1'^2\right).\tag{9}$$

For $\chi_{c0}\to\Lambda\bar{\Lambda}\pi\pi$:

$$M=-\frac{1}{\sqrt{2}}g_0\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Sigma_{8i}}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Sigma_{8i}}+\mathrm{i}\Gamma_i/2)}\frac{4}{20}g_1^2+\sqrt{\frac{5}{14}}g_0\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Sigma_{10i}}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Sigma_{10i}}+\mathrm{i}\Gamma_i/2)}\frac{6}{12}g_3^2.\tag{10}$$

For $\chi_{c0}\to\Lambda\bar{\Lambda}\bar{K}K$:

$$M=-\frac{1}{\sqrt{2}}g_0\left\{\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{N_i}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{N_i}+\mathrm{i}\Gamma_i/2)}+\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Xi_{8i}}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Xi_{8i}}+\mathrm{i}\Gamma_i/2)}\right\}\times\left(\frac{1}{20}g_1^2+\frac{3}{12}g_1'^2\right)+\sqrt{\frac{5}{14}}g_0\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Xi_{10i}}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Xi_{10i}}+\mathrm{i}\Gamma_i/2)}\frac{3}{12}g_3^2.\tag{11}$$

For $\chi_{c0}\to\Lambda\bar{\Lambda}\eta\eta$:

$$M=-\frac{1}{\sqrt{2}}g_0\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Lambda_i}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Lambda_i}+\mathrm{i}\Gamma_i/2)}\frac{4}{20}g_1^2.\tag{12}$$

For $\chi_{c0}\to\Sigma_8\bar{\Sigma}_8\pi\pi$:

$$M=-\frac{1}{\sqrt{2}}g_0\left\{\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Sigma_{8i}}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Sigma_{8i}}+\mathrm{i}\Gamma_i/2)}\frac{8}{12}g_1'^2+\sum_i\frac{\Gamma_iBr_i}{(\sqrt{s_1}-M_{\Lambda_i}+\mathrm{i}\Gamma_i/2)(\sqrt{s_2}-M_{\Lambda_i}+\mathrm{i}\Gamma_i/2)}\frac{12}{20}g_1^2\right\}+$$

$$\sqrt{\frac{5}{14}}g_0\sum_i\frac{\varGamma_iBr_i}{(\sqrt{s_1}-M_{\Sigma_{10i}}+\mathrm{i}\varGamma_i/2)(\sqrt{s_2}-M_{\Sigma_{10i}}+\mathrm{i}\varGamma_i/2)}\frac{2}{12}g_3^2. \tag{13}$$

For $\chi_{c0}\to\Sigma_{10}\bar{\Sigma}_{10}\pi\pi$:

$$\begin{aligned}M=&-\frac{1}{\sqrt{2}}g_0\left\{\sum_i\frac{\varGamma_iBr_i}{(\sqrt{s_1}-M_{\Sigma_{8i}}+\mathrm{i}\varGamma_i/2)(\sqrt{s_2}-M_{\Sigma_{8i}}+\mathrm{i}\varGamma_i/2)}\frac{2}{15}g_2^{\prime 2}+\right.\\&\left.\sum_i\frac{\varGamma_iBr_i}{(\sqrt{s_1}-M_{\Lambda_i}+\mathrm{i}\varGamma_i/2)(\sqrt{s_2}-M_{\Lambda_i}+\mathrm{i}\varGamma_i/2)}\frac{9}{15}g_2^2\right\}+\\&\sqrt{\frac{5}{14}}g_0\sum_i\frac{\varGamma_iBr_i}{(\sqrt{s_1}-M_{\Sigma_{10i}}+\mathrm{i}\varGamma_i/2)(\sqrt{s_2}-M_{\Sigma_{10i}}+\mathrm{i}\varGamma_i/2)}\frac{8}{24}g_4^2.\end{aligned} \tag{14}$$

For $\chi_{c0}\to\Sigma\bar{\Sigma}\mathrm{K}\bar{\mathrm{K}}$:

$$\begin{aligned}M=&-\frac{1}{\sqrt{2}}g_0\sum_i\frac{\varGamma_iBr_i}{(\sqrt{s_1}-M_{\Xi_{8i}}+\mathrm{i}\varGamma_i/2)(\sqrt{s_2}-M_{\Xi_{8i}}+\mathrm{i}\varGamma_i/2)}\left(\frac{9}{20}g_1^2+\frac{3}{12}g_1^{\prime 2}\right)+\\&\sqrt{\frac{5}{14}}g_0\sum_i\frac{\varGamma_iBr_i}{(\sqrt{s_1}-M_{\Xi_{10i}}+\mathrm{i}\varGamma_i/2)(\sqrt{s_2}-M_{\Xi_{10i}}+\mathrm{i}\varGamma_i/2)}\frac{3}{12}g_3^2.\end{aligned} \tag{15}$$

For $\chi_{c0}\to\Xi_8\bar{\Xi}_8\pi\pi$:

$$\begin{aligned}M=&-\frac{1}{\sqrt{2}}g_0\sum_i\frac{\varGamma_iBr_i}{(\sqrt{s_1}-M_{\Xi_{8i}}+\mathrm{i}\varGamma_i/2)(\sqrt{s_2}-M_{\Xi_{8i}}+\mathrm{i}\varGamma_i/2)}\left(\frac{9}{20}g_1^2+\frac{3}{12}g_1^{\prime 2}\right)+\\&\sqrt{\frac{5}{14}}g_0\sum_i\frac{\varGamma_iBr_i}{(\sqrt{s_1}-M_{\Xi_{10i}}+\mathrm{i}\varGamma_i/2)(\sqrt{s_2}-M_{\Xi_{10i}}+\mathrm{i}\varGamma_i/2)}\frac{3}{12}g_3^2.\end{aligned} \tag{16}$$

For $\chi_{c0}\to\Xi_{10}\bar{\Xi}_{10}\pi\pi$:

$$\begin{aligned}M=&-\frac{1}{\sqrt{2}}g_0\sum_i\frac{\varGamma_iBr_i}{(\sqrt{s_1}-M_{\Xi_{8i}}+\mathrm{i}\varGamma_i/2)(\sqrt{s_2}-M_{\Xi_{8i}}+\mathrm{i}\varGamma_i/2)}\frac{3}{15}g_2^2+\\&\sqrt{\frac{5}{14}}g_0\sum_i\frac{\varGamma_iBr_i}{(\sqrt{s_1}-M_{\Xi_{10i}}+\mathrm{i}\varGamma_i/2)(\sqrt{s_2}-M_{\Xi_{10i}}+\mathrm{i}\varGamma_i/2)}\frac{3}{24}g_4^2.\end{aligned} \tag{17}$$

The partial decay width for $\chi_{c0}\to\mathrm{B\bar{B}MM}$ can be expressed by:

$$\mathrm{d}\varGamma=\frac{(2\pi)^4}{2M_{\chi_{c0}}}|M|^2\mathrm{d}\phi_4, \tag{18}$$

where $\mathrm{d}\phi_4$ is an element of standard 4-body phase space.

4 Summary and discussion

We mainly focus on the investigation of the baryonic contributions to $\chi_{c0}\to\mathrm{B\bar{B}MM}$ decays with the $SU(3)$ constraints. It should be pointed out that the experimental results on these decays include not only the contribution of intermediate baryonic resonances, but also the contributions from other decay mechanisms, for instance, $\chi_{c0}\to\mathrm{B\bar{B}V}\to\mathrm{B\bar{B}MM}$(V:vector meson). Under the $SU(3)$ symmetry and the flavor singlet assumption, the decay rate among the isobar multiplet is loosely constrained. For example, the ratio $\varGamma(\chi_{c0}\to\mathrm{p\bar{p}}\pi^+\pi^-)/\varGamma(\chi_{c0}\to\mathrm{p\bar{n}}\pi^+\pi^0)=2$ is easily got from the isospin CG coefficients $\langle\mathrm{p\bar{p}}\pi^+\pi^-|\mathrm{N\bar{N}}\rangle=-2/3$ and $\langle\mathrm{p\bar{n}}\pi^+\pi^0|\mathrm{N\bar{N}}\rangle=-\sqrt{2}/3$. Taking symmetric constraints into consideration, for example, the chiral symmetry, one finds that the decay $\chi_{c0}\to\mathrm{n\bar{p}}\pi^+\pi^0$ is highly suppressed[1)]. Based on the well known baryon resonances, one finds that N^* and Δ resonances make a large contribution to the decay $\chi_{c0}\to\mathrm{B\bar{B}}\to\mathrm{N\bar{N}}\pi\pi$. For an illumination of this point, we make a numerical evaluation of the decay rates with the following well established baryon resonances:

Octet members: N(1440), N(1535), N(1520), N(1650), N(1680), N(1700), N(1675), N(1710),

1) For example, with the q-order chiral Lagrangian $L^{(1)}=\frac{g}{4f^2}\mathrm{Tr}(\bar{B}[[\phi,\partial_0\phi],B])$, the amplitude of $\chi_{c0}\to\mathrm{n\bar{p}}\pi^+\pi^0$ is proportional to $E_\mathrm{p}-E_\mathrm{n}$, where, E_p and E_n are the proton and nucleon energy

N(1720), Σ(1660), Σ(1670), Λ(1600), Λ(1670), Λ(1690);

Decuplet members: Δ(1232), Δ(1620), Δ(1700), Σ(1385), Ξ(1530).

Inputting the PDG values of the above resonances with a naive assumption $g_0 = g_1 = g_1' = g_3 = 1$, one gets $\Gamma(p\bar{p}\pi^+\pi^-) : \Gamma(p\bar{p}K^+K^-) : \Gamma(p\bar{p}\eta\eta) : \Gamma(\Lambda\bar{\Lambda}\pi^+\pi^-) : \Gamma(\Lambda\bar{\Lambda}K^+K^-) : \Gamma(\Lambda\bar{\Lambda}\eta\eta) : \Gamma(\Sigma^+\bar{\Sigma}^-\pi^+\pi^-) : \Gamma(\Sigma^+\bar{\Sigma}^-K^+K^-) : \Gamma(\Xi^-\bar{\Xi}^-\pi^+\pi^-) = 1 : 2.0\times10^{-3} : 1.6\times10^{-3} : 4.2\times10^{-4} : 1.1\times10^{-4} : 1.8\times10^{-5} : 1.3\times10^{-2} : 2.3\times10^{-8} : 7.5\times10^{-3}$. This result shows that the baryonic contribution to the decays of hyperon pair production is much smaller than that to $N\bar{N}\pi\pi$ decays.

To summarize, the contributions of baryonic resonances in $\chi_{c0} \to B\bar{B}MM$ decays are investigated based on the $SU(3)$ symmetry constraints. The transitional amplitudes are given in terms of the isospin constants.

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$\chi_{c0} \to B\bar{B}MM$ 衰变中的重子共振态*

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摘要　基于$SU(3)$对称性研究了χ_{c0}的遍举多体衰变$\chi_{c0} \to B\bar{B}MM$(B: 重子, M: 介子), 通过同位旋耦合常数构造了$\chi_{c0} \to B\bar{B} \to B\bar{B}MM$衰变的跃迁振幅. 基于这些跃迁振幅, 发现N*共振态对$\chi_{c0} \to B\bar{B}\pi\pi$的贡献相对较大, 这个衰变道可以在实验上用来研究N*共振态.

关键词　χ_{c0}衰变　重子共振态

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