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**Exclusive production of heavy meson pairs
in e^+e^- annihilation**

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Abstract

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A constituent quark model is used to calculate the exclusive pair production of $B_{u,s,c}^{(*)}$ and $D_{u,s}^{(*)}$ mesons in e^+e^- annihilation. It allows one to illuminate the meaning of the $1/m_{b,c}$ corrections to the leading order of effective heavy quark theory.

Аннотация

В.В.Киселев. Эксклюзивное образование пар тяжелых мезонов в e^+e^- аннигиляции.: Препринт ИФВЭ 93-75. – Протвино, 1993. – 13 с., 2 рис., библиогр.: 11.

Для расчета эксклюзивного парного образования $B_{u,s,c}^{(*)}$ и $D_{u,s}^{(*)}$ мезонов в e^+e^- аннигиляции используется модель конститuentных кварков. Показана роль $1/m_{b,c}$ поправок к оценкам ведущего порядка эффективной теории тяжелых кварков.

Introduction

In Ref.[1] the effective heavy quark theory (EHQT) [2] was used to predict cross sections for pair production of $B^{(*)}\bar{B}^{(*)}$ meson in e^+e^- annihilation by means of a scale transformation of respective cross sections of $D^{(*)}\bar{D}^{(*)}$ mesons. A ratio of the cross sections $\sigma(B\bar{B}) : \sigma(B^*\bar{B}) : \sigma(B^*\bar{B}^*)$ was calculated too. In the limit $m_{b,c} \rightarrow \infty$ one found

$$\frac{\sigma_{e^+e^- \rightarrow B\bar{B}}(s_B)}{\sigma_{e^+e^- \rightarrow D\bar{D}}(s_D)} = \left(\frac{e_b m_D}{e_c m_B}\right)^2 \left(\frac{\alpha_S(m_B)}{\alpha_S(m_D)}\right)^{2a_L}, \quad (1)$$

where s is total energy squared, $s_B/m_B^2 = s_D/m_D^2$, α_S is "running" QCD coupling constant, $e_{b,c}$ are electric charges of quarks.

$$\begin{aligned} a_L(y) &= \frac{8}{33 - 2n_f} [-yr(y) - 1], \\ r(y) &= \frac{1}{\sqrt{y^2 - 1}} \ln[-y + \sqrt{y^2 - 1}]. \end{aligned} \quad (2)$$

y is the four-velocity product for the heavy quarks inside D and $\bar{D}$ mesons

$$y = \frac{s}{2m_D^2} - 1. \quad (3)$$

For the ratio of the $B\bar{B}$, $B^*\bar{B}$ and $B^*\bar{B}^*$ meson yields one got

$$(1 + h) : \frac{s}{2m_B^2} : 3(1 + \frac{s}{3m_B^2} + h), \quad (4)$$

where α_S - correction is equal to

$$h = -\frac{2\alpha_S}{3\pi} \sqrt{1 - 4m_B^2/s} \ln\left(\frac{s}{2m_B^2} - 1 + \frac{s}{2m_B^2} \sqrt{1 - 4m_B^2/s}\right). \quad (5)$$

Note, in the leading order of EHQT [2] the B and B^* masses coincide with each other. Analogous relations were considered in Ref.[3] without account of the QCD correction h (see Eq.(5)).¹

Thus, calculations of the exclusive production cross sections for the heavy meson pairs were done in the framework of EHQT leading order. Therefore, one must consider $1/m_{heavy}$ corrections to find the accuracy of the leading approximation and to compare practically some predictions of the theory with experimental data.

To clarify the role of $1/m_{heavy}$ corrections, one might, first of all, do rather complex and bulky straightforward calculations in the framework of the $1/m_{heavy}$ expansion in EHQT [4]. In an other way, one may calculate the production cross sections in a model, which does not assume a low value of Λ_{QCD}/m_{heavy} , and then one may draw a conclusion on the correction role, comparing model results with the leading order EHQT results.

Appropriate models are the QCD sum rules [5] and phenomenological constituent quark models [6,7,8]. In the present paper we use a constituent quark model [8] to calculate the cross sections for the exclusive production of the $B_{u,s,c}^{(*)}$ and $D_{u,s}^{(*)}$ mesons in e^+e^- annihilation. The obtained expressions for the $B^{(*)}$ and $D^{(*)}$ cross sections are used to analyze $1/m_{b,c}$ corrections. The formulae for the $B^{(*)}_{s,c}$ and $D_s^{(*)}$ mesons may be considered as predictions for experimental search for those mesons in e^+e^- annihilation near the threshold, where the $B_{s,c}^{(*)}$ and $D_s^{(*)}$ meson pair yields are rather sizable

$$\begin{aligned} \frac{\sigma(B_s^{(*)}\bar{B}_s^{(*)})}{\sigma(bb)} &\simeq 0.4\%, \\ \frac{\sigma(B_c^{(*)}\bar{B}_c^{(*)})}{\sigma(bb)} &\simeq 0.02\%, \\ \frac{\sigma(D_s^{(*)}\bar{D}_s^{(*)})}{\sigma(c\bar{c})} &\simeq 0.4\%. \end{aligned} \quad (6)$$

¹In the following we will not consider a contribution by Υ - resonances ($\Upsilon(4S)$, $\Upsilon(5S)$...) into the exclusive production of $B^{(*)}\bar{B}^{(*)}$ mesons, like it was done in Refs.[1,3].

1. Constituent Quark Model

1.1. Basic Points of Model

In the present paper we use the constituent quark model [8], which contains quark masses and leptonic constants as the only parameters.

For $(Q\bar{q})$ meson mass one has

$$M = m_Q + m_q . \quad (7)$$

four-momenta of the quarks entering meson are equal to

$$\begin{aligned} k_Q &= \frac{m_Q}{M} P + q , \\ k_q &= \frac{m_q}{M} P - q , \end{aligned} \quad (8)$$

where P is meson momentum.

Quark propagator has the form

$$S(k) = (k_\mu \gamma^\mu + m) D(k) , \quad (9)$$

where

$$D^{-1}(k) = k^2 - m^2 . \quad (10)$$

For nonrelativistic constituent quarks, an imaginary part of $D(k)$ contributes, so that

$$\text{Im } D(k) = \frac{\pi M}{m} \delta(Pk) . \quad (11)$$

Then a quark - meson vertex may be represented as

$$L_{q\bar{q}M} = \bar{q}(k_q) \Gamma Q(k_Q) D^{-1}(k_q) D^{-1}(k_Q) \chi(P; q) , \quad (12)$$

where $q(k)$, $Q(k)$ are quark spinors, Γ is spinor matrix, which is equal to

$$\Gamma = \gamma_5 , \quad (13)$$

for pseudoscalar mesons, and it is equal to

$$\Gamma = \epsilon_\mu \gamma^\mu , \quad (14)$$

for vector mesons with the polarization vector ϵ .

For nonrelativistic constituent quarks, the form factor has the form

$$\chi(P; q) = 2\pi \delta(Pq) \phi(q^2), \quad (15)$$

where typical q^2 -dependence is like as

$$\phi(q^2) = \frac{M}{m_q m_Q} \frac{\sqrt{6}}{f} \exp(q^2/\omega^2) \quad (16)$$

for the lightest state, so that

$$f = 2\sqrt{\frac{3}{M}} \left(\frac{\omega^2}{2\pi}\right)^{3/4}, \quad (17)$$

Eqs. (7)-(17) define the model of the meson, composed by the constituent quarks *off mass shell*, so that this model differs significantly from ISGW [6] and WSB [7] models, where the meson is a superposition of free quarks. Note, however, when the wave packet is rather narrow ($\omega \ll m$), the difference between two types of the constituent quark models (the on and off shell quarks) becomes not significant, because the quark virtuality is not essential in that case.

1.2. Amplitudes and Cross Sections

Diagrams for the exclusive production of the heavy meson pairs in e^+e^- annihilation are shown on Fig.1.

Figure 1.

Matrix elements for the pair production of the pseudoscalar P and vector V mesons have the form

$$T_{PP} = \frac{128\pi^2 \alpha_S (4m_q^2) \alpha_{em}}{9s^3} f_P^2 \frac{M^3}{m_q^3} e_Q$$

$$\left(1 - \frac{e_q}{e_Q} \frac{m_q^3}{m_Q^3} \frac{\alpha_S(4m_Q^2)}{\alpha_S(4m_q^2)} \frac{m_Q s - 2m_q M^2}{m_q s - 2m_Q M^2}\right) \left(\frac{m_q s}{2M} - m_Q M\right) l_\mu k^\mu, \quad (18)$$

$$T_{PV} = \frac{128\pi^2 \alpha_S(4m_q^2) \alpha_{em}}{9s^3} f_P f_V \frac{M^4}{m_q^3} e_Q$$

$$\left(1 - \frac{e_q}{e_Q} \frac{m_q^3}{m_Q^3} \frac{\alpha_S(4m_Q^2)}{\alpha_S(4m_q^2)}\right) \epsilon_{\mu\nu\alpha\beta} l^\mu \epsilon^\nu p^\alpha k^\beta, \quad (19)$$

$$T_{VV} = \frac{128\pi^2 \alpha_S(4m_q^2) \alpha_{em}}{9s^3} f_V^2 \frac{M^5}{m_q^3} e_Q$$

$$\left(1 - \frac{e_q}{e_Q} \frac{m_q^3}{m_Q^3} \frac{\alpha_S(4m_Q^2)}{\alpha_S(4m_q^2)}\right) l_\mu (\epsilon_1^\mu (\epsilon_2 p) - \epsilon_2^\mu (\epsilon_1 p) - (\epsilon_1 \epsilon_2) k^\mu a), \quad (20)$$

respectively, so that l_μ is vector current of leptons and

$$a = \frac{m_Q}{M} \frac{1 - \frac{e_q}{e_Q} \frac{m_q^4}{m_Q^4} \frac{\alpha_S(4m_Q^2)}{\alpha_S(4m_q^2)}}{1 - \frac{e_q}{e_Q} \frac{m_q^3}{m_Q^3} \frac{\alpha_S(4m_Q^2)}{\alpha_S(4m_q^2)}}. \quad (21)$$

After simple algebraic calculations one gets for the differential cross sections $d\sigma/d\cos\theta$ the following expressions

$$\frac{d\sigma_{PP}}{d\cos\theta} = \frac{\pi^3 \alpha_S^2(4m_q^2) \alpha_{em}^2}{3^6 4m_q^6} \frac{m_Q^2}{M^2} f_P^4 (1-v^2)^3 v^3 (1-\cos^2\theta) \times$$

$$\left(3e_Q \left(\frac{m_q}{m_Q} - \frac{1-v^2}{2}\right) - 3e_q \left(1 - (1-v^2) \frac{m_q}{2m_Q}\right) \frac{m_q^3 \alpha_S(4m_Q^2)}{m_Q^3 \alpha_S(4m_q^2)}\right)^2 \quad (22)$$

$$\frac{d\sigma_{PV}}{d\cos\theta} = \frac{\pi^3 \alpha_S^2(4m_q^2) \alpha_{em}^2}{3^6 16m_q^6} f_P^2 f_V^2 (1-v^2)^4 v^3 \left(3e_Q - 3e_q \frac{m_q^3 \alpha_S(4m_Q^2)}{m_Q^3 \alpha_S(4m_q^2)}\right)^2, \quad (23)$$

$$\frac{d\sigma_{VV}}{d\cos\theta} = \frac{\pi^3 \alpha_S^2(4m_q^2) \alpha_{em}^2}{3^6 8m_q^6} f_V^4 (1-v^2)^3 v^3 \left(3e_Q - 3e_q \frac{m_q^3 \alpha_S(4m_Q^2)}{m_Q^3 \alpha_S(4m_q^2)}\right)^2 \times$$

$$[2(1-v^2) + (1-\cos^2\theta) \times$$

$$\{(1+v^2)(1-a)^2 + \frac{a^2}{2}(1-v^2)(1-3v^2)\}], \quad (24)$$

where θ is the angle between the lepton and meson, $v = \sqrt{1 - 4M^2/s}$. In Eq.(23) for $d\sigma_{PV}/d\cos\theta$ we have neglected the difference between masses of the vector and pseudoscalar states.

The total cross sections for the exclusive production of the heavy meson pairs in e^+e^- annihilation are equal to

$$\begin{aligned}
\sigma(e^+e^- \rightarrow (Q\bar{q})_P(\bar{Q}q)_P) &= \frac{\pi^3 \alpha_S^2 (4m_q^2) \alpha_{em}^2}{3^7 4m_q^6} \frac{m_Q^2}{M^2} f_P^4 (1-v^2)^3 v^3 \times \\
&\left(3e_Q \left(\frac{2m_q}{m_Q} - 1 + v^2 \right) - 3e_q \left(2 - (1-v^2) \frac{m_q}{m_Q} \right) \frac{m_q^3 \alpha_S (4m_Q^2)}{m_Q^3 \alpha_S (4m_q^2)} \right)^2, \quad (25) \\
\sigma(e^+e^- \rightarrow (Q\bar{q})_P(\bar{Q}q)_V) &= \frac{\pi^3 \alpha_S^2 (4m_q^2) \alpha_{em}^2}{3^7 2m_q^6} f_P^2 f_V^2 (1-v^2)^4 v^3 \times \\
&\left(3e_Q - 3e_q \frac{m_q^3 \alpha_S (4m_Q^2)}{m_Q^3 \alpha_S (4m_q^2)} \right)^2, \\
\sigma(e^+e^- \rightarrow (Q\bar{q})_V(\bar{Q}q)_V) &= \frac{\pi^3 \alpha_S^2 (4m_q^2) \alpha_{em}^2}{3^7 2m_q^6} f_V^4 (1-v^2)^3 v^3 \times \\
&\left(3e_Q - 3e_q \frac{m_q^3 \alpha_S (4m_Q^2)}{m_Q^3 \alpha_S (4m_q^2)} \right)^2 [3(1-v^2) + (1+v^2)(1-a)^2 + \\
&\frac{a^2}{2}(1-v^2)(1-3v^2)]. \quad (26)
\end{aligned}$$

Those formulae may be considered as precise expressions for the $B_c^{(*)+} B_c^{(*)-}$ production, but applying to the estimate of the exclusive production of $B_s^{(*)} \bar{B}_s^{(*)}$ and $D_s^{(*)} \bar{D}_s^{(*)}$, one must take into account a low uncertainty due to both light quark mass and α_S value.

2. Infinitely Heavy Quark Limit

In the leading order of EHQT one must take $m_Q \rightarrow \infty$. Then one has

$$\sigma(e^+e^- \rightarrow (Q\bar{q})_P(\bar{Q}q)_P) = \frac{\pi^3 \alpha_S^2 (4m_q^2) \alpha_{em}^2}{3^5 4m_q^6} f_P^4 e_Q^2 (1-v^2)^5 v^3, \quad (27)$$

$$\sigma(e^+e^- \rightarrow (Q\bar{q})_P(\bar{Q}q)_V) = \frac{\pi^3 \alpha_S^2 (4m_q^2) \alpha_{em}^2}{3^5 2m_q^6} f_P^2 f_V^2 e_Q^2 (1-v^2)^4 v^3, \quad (28)$$

$$\sigma(e^+e^- \rightarrow (Q\bar{q})_V(\bar{Q}q)_V) = \frac{\pi^3 \alpha_S^2 (4m_q^2) \alpha_{em}^2}{3^5 4m_q^6} f_V^4 e_Q^2 (1-v^2)^4 v^3 (7-3v^2). \quad (29)$$

The yield ratio for the pseudoscalar and vector mesons near the threshold are equal to

$$\sigma_{PP} : \sigma_{PV} : \sigma_{VV} = 1 : 2 \frac{f_V^2}{f_P^2} : 7 \frac{f_V^4}{f_P^4}, \quad (30)$$

which are in a good agreement with the EHQT results of Refs.[1,3] and results of a potential model [9] without taking into account kinematical corrections due to both the mass difference of the vector and pseudoscalar states and $f_P \neq f_V$.

At the same velocities of the B and D mesons ($s_B/m_B^2 = s_D/m_D^2$), one has

$$\frac{\sigma(e^+e^- \rightarrow B\bar{B})}{\sigma(e^+e^- \rightarrow D\bar{D})} = \left(\frac{f_B}{f_D}\right)^4 \left(\frac{e_b}{e_c}\right)^2, \quad (31)$$

where the B and D mesons are to be in the same spin states. Then using scaling law in the leading order of EHQT [2]

$$f^2 M = \text{const}, \quad (32)$$

one gets, that

$$\frac{\sigma(e^+e^- \rightarrow B\bar{B})}{\sigma(e^+e^- \rightarrow D\bar{D})} = \left(\frac{m_D}{m_B}\right)^2 \left(\frac{e_b}{e_c}\right)^2. \quad (33)$$

In Eq.(33) one does not take into account α_s corrections to the vector current of the heavy quark, i.e. the corrections in the effective theory. Without the factor

$$\left(\frac{\alpha_S(m_B^2)}{\alpha_S(m_D^2)}\right)^{2a_L}, \quad (34)$$

corresponding to the corrections, the results in both the present paper and the leading order of EHQT without α_s corrections, coincide fully. We do not consider here corrections to the scaling law (32).

Thus, the considered model of the meson, composed by the nonrelativistic constituent quarks, leads to the result expected from EHQT, when one calculates the exclusive production cross sections for the heavy meson pairs in the limit $m_Q \rightarrow \infty$, so that uncertainties, caused by the choice of the constituent mass of the light quark, are cancelled in the cross section ratios.

Let's consider the value of the $1/m_Q$ corrections.

Note, first of all, that the corrections, caused by the electromagnetic interaction of the light quarks, are very low and appear as factors in the process

amplitudes

$$r = 1 - \frac{e_q m_q^3 \alpha_S(4m_Q^2)}{e_Q m_Q^3 \alpha_S(4m_q^2)} \quad (35)$$

Such corrections have the most significance in production of the vector and pseudoscalar mesons $e^+e^- \rightarrow (Q\bar{q})_P(\bar{Q}q)_V$, if one doesn't take into account the mass difference of the states.

One gets instead of Eq.(31) in the first order over m_q/m_Q , that

$$\frac{\sigma(e^+e^- \rightarrow B\bar{B})}{\sigma(e^+e^- \rightarrow D\bar{D})} = \left(\frac{f_B}{f_D}\right)^4 \left(\frac{e_b}{e_c}\right)^2 \left(\frac{1 - 2m_q/m_b - v^2}{1 - 2m_q/m_c - v^2}\right)^2, \quad (36)$$

$$\frac{\sigma(e^+e^- \rightarrow B^*\bar{B}^*)}{\sigma(e^+e^- \rightarrow D^*\bar{D}^*)} = \left(\frac{f_{B^*}}{f_{D^*}}\right)^4 \left(\frac{e_b}{e_c}\right)^2 \left(\frac{7 - 3v^2 - (1 - 3v^2)2m_q/m_B^*}{7 - v^2 - (1 - 3v^2)2m_q/m_D^*}\right). \quad (37)$$

Thus, near the threshold ($v^2 \ll m_q/m_Q$) the factors from the phenomenological account of the m_q/m_Q - correction, may be rather large

$$\begin{aligned} K(B\bar{B}/D\bar{D}) &= \left(\frac{1 - 2m_q/m_b}{1 - 2m_q/m_c}\right)^2, \\ K(B^*\bar{B}^*/D^*\bar{D}^*) &= \left(\frac{1 - 2m_q/7m_b}{1 - 2m_q/7m_c}\right). \end{aligned} \quad (38)$$

Supposing

$$\begin{aligned} m_c &= 1.55 \text{ GeV}, \\ m_b &= 4.9 \text{ GeV}, \\ m_q &= 0.33 \text{ GeV}, \end{aligned} \quad (39)$$

one gets

$$\begin{aligned} K(B\bar{B}/D\bar{D}) &\simeq 2.2, \\ K(B^*\bar{B}^*/D^*\bar{D}^*) &\simeq 1.05. \end{aligned} \quad (40)$$

Therefore, in the present model the m_q/m_Q - corrections are essential near the threshold for the pair production of the pseudoscalar states.

For the threshold yields of the mesons one has

$$\sigma_{PP} : \sigma_{PV} : \sigma_{VV} = (1 - 2m_q/m_Q)^2 : 2 \frac{f_V^2}{f_P^2} : \frac{f_V^4}{f_P^4} (7 - 2m_q/m_Q). \quad (41)$$

Note, Eqs.(38), (41) contain a rather sizable uncertainty, as the constituent quark masses inside the B and D mesons may be varied in the broad region

$$\begin{aligned} m_c &= 1.5 \div 1.8 \text{ GeV} , \\ m_b &= 4.9 \div 5.2 \text{ GeV} , \\ m_q &= 0.25 \div 0.35 \text{ GeV} . \end{aligned} \tag{42}$$

In accordance with Eq.(7) at $m_Q \approx M(Q\bar{q})$ the constituent mass of the light quark must be low and not essential in Eq.(41).

Note, that in present paper we do not consider corrections like ω^2/M^2 .

3. Numerical Estimates

The cross section ratios of the exclusive pair production of the heavy mesons to the respective heavy quark cross sections in e^+e^- annihilation

$$\sigma(e^+e^- \rightarrow Q\bar{Q}) = \frac{4\pi\alpha_{em}^2 e_Q^2}{s} \sqrt{1 - 4m_Q^2/s} (1 + 2m_Q^2/s) , \tag{43}$$

at

$$\begin{aligned} m_c &= 1.55 \text{ GeV} , \\ m_b &= 4.9 \text{ GeV} , \\ m_{u,d} &= 0.33 \text{ GeV} , \\ m_s &= 0.45 \text{ GeV} , \\ \Lambda_{QCD} &= 0.2 \text{ GeV} \end{aligned} \tag{44}$$

are shown on Fig.2.

Summing over the vector and pseudoscalar states, one may expect at the maximum values of R , that

$$\frac{\sigma(D^{(*)}\bar{D}^{(*)})}{\sigma(c\bar{c})} \simeq \frac{\sigma(B^{(*)}\bar{B}^{(*)})}{\sigma(b\bar{b})} \simeq 0.014 , \tag{45}$$

$$\frac{\sigma(D_s^{(*)}\bar{D}_s^{(*)})}{\sigma(c\bar{c})} \simeq \frac{\sigma(B_s^{(*)}\bar{B}_s^{(*)})}{\sigma(b\bar{b})} \simeq 0.0037 \tag{46}$$

$$\frac{\sigma(B_c^{(*)+}\bar{B}_c^{(*)-})}{\sigma(b\bar{b})} \simeq 0.0002 . \tag{47}$$

Figure 2.

If one supposes, that the probability to glue quarks Q and $\bar{q}$ into the meson ($Q\bar{q}$) is of the order of $\alpha_S(4m_q^2)/\pi$, then the suppression factors of the q quark sea will be equal to

$$\begin{aligned}\lambda_{u,d} &\approx 0.4, \\ \lambda_s &\approx 0.17, \\ \lambda_c &\approx 0.03,\end{aligned}\tag{48}$$

in accordance with Eq.(47).

Summing, one gets

$$\lambda_u + \lambda_d + \lambda_s + \lambda_c \approx 1.\tag{49}$$

We have chosen leptonic constants as in Table 1. Those values do not contradict the estimates of both of the QCD sum rules and potential models.

Table 1. Leptonic Decay Constants of the Heavy Mesons [10,11].

q	f_{D_q}	$f_{D_q^*}$	f_{B_q}	$f_{B_q^*}$
u,d	170	230	95	135
s	220	290	130	170
c	—	—	570	570

The quantities in Eq.(48) have admissible phenomenological values. For example, the beauty mesons and baryons are produced with 80% probability through b quark fragmentation, and the beauty-strange states with 20%.

Moreover, one has

$$\frac{\lambda_s}{\lambda_{u,d}} \approx 0.43 . \quad (50)$$

Note, that the exclusive channel of the heavy quark fragmentation into the mesons is a small fraction ($1 \div 2\%$) of the total number of events, which are generally saturated by multiparticle events (jets).

4. Discussion and Conclusion

In the present paper we have considered the exclusive pair production of the $B_{u,s,c}^{(*)}$ and $D_{u,s}^{(*)}$ mesons in e^+e^- annihilation with no account of possible resonances in the final states in the framework of the phenomenological model of the mesons, composed by the constituent quarks.

In the limit of infinitely heavy quarks, the results of the model agree with the consideration done in the leading order of EHQT. We have also shown that from the phenomenological point of view the corrections like m_{light}/m_{heavy} may be large for the pair production of the pseudoscalar states. For the D mesons, the corrections may be about 50%. However, an uncertainty of the correction values is rather large because of a broad spread of the mass parameters $m_{u,d}$.

The accuracy for the model predictions increases for the total cross sections of the D_s and $B_{s,c}$ mesons.

As for the consideration of the resonant region near the thresholds, like the $D\bar{D}$ production from the $\psi(3770)$ decays or the $B\bar{B}$ production from the $\Upsilon(4S)$ decays, the calculated cross sections for the exclusive production of the heavy meson pairs may lead, using sum rules, to estimations of the meson contributions into the leptonic decays of $\psi(3770)$ and $\Upsilon(4S)$, and to determination of coupling constants of the D mesons to $\psi(3770)$ and the B mesons to $\Upsilon(4S)$. The last estimations are of specific additional interests and will be made elsewhere.

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