INTERFERENCE OF SOFT END-POINT AND MASS CORRECTIONS IN THE VERTEX FUNCTION $F_{\eta' g^* g^*}(Q^2, \omega, \eta)$

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Recently, in order to explain the large branching ratio $B_r(B \to \eta' + X_s)$, a mechanism that employs the two-gluon content of the η'-meson was suggested. In accordance with this approach [1], the dominant fraction of the $B \to \eta' + X_s$ decay rate appears as the result of the transition $g^* \to g\eta'$ of a virtual gluon from the standard model penguin diagram $b \to sg^*$. To explain the same ratio a gluon fusion mechanism was proposed [2], as well. The vertex function (VF) $F_{\eta' g^* g^*}(q_1^2, q_2^2, m_{\eta'}^2)$ is the main ingredient of these mechanisms and require further detailed investigations.

The VF $F_{\eta' g^* g^*}(Q^2, \omega, \eta)$ was analyzed in Refs.[3,4], where soft end-point and mass corrections were calculated, respectively. The joint treatment of these effects has been performed recently in Ref.[5]. In this short report we present main results of this work.

The VF is the sum of the quark and gluon components defined in terms of the invariant amplitudes of the process $\eta'(P) \to g^*(q_1) + g^*(q_2)$

$$M^{q(g)} = -iF^{q(g)}_{\eta' g^* g^*}(Q^2, \omega, \eta)\delta_{ab}\varepsilon^{\mu\nu\rho\sigma}\varepsilon_\mu^{a*}\varepsilon_\nu^{b*}q_{1\rho}q_{2\sigma}. \tag{1}$$

Here ε_μ^a, ε_ν^b and q_1, q_2 are the polarization vectors and 4-momenta of the virtual gluons. The vertex function depends on the total gluon virtuality Q^2, the asymmetry parameter ω, and η'-meson scaled mass η

$$Q^2 = Q_1^2 + Q_2^2, \ \ \omega = (Q_1^2 - Q_2^2)/Q^2, \ \ \eta = m_{\eta'}^2/Q^2. \tag{2}$$

In Eq. (2) $Q_1^2 = -q_1^2 \geq 0$, $Q_2^2 = -q_2^2 \geq 0$ (we consider space-like momentum transfers), and the parameter ω varies in the region $-1 \leq \omega \leq 1$.

The quark and gluon components of the η'-meson distribution amplitudes are given by the expressions

$$\phi^q(x, \mu_F^2) = 6Cx\bar{x}\left\{1 + \sum_{n=2,4..}^{\infty}\left[B_n^q\left(\mu_F^2\right) + \rho_n^g B_n^g\left(\mu_F^2\right)\right]C_n^{3/2}(2x-1)\right\}, \tag{3}$$

and

$$\phi^g(x, \mu_F^2) = Cx\bar{x}\left\{\sum_{n=2,4..}^{\infty}\left[\rho_n^q B_n^q\left(\mu_F^2\right) + B_n^g\left(\mu_F^2\right)\right]C_{n-1}^{5/2}(2x-1)\right\}. \tag{4}$$

To compute end-point corrections to VF the symmetrized running coupling (RC) method is used [3], that implies the replacements

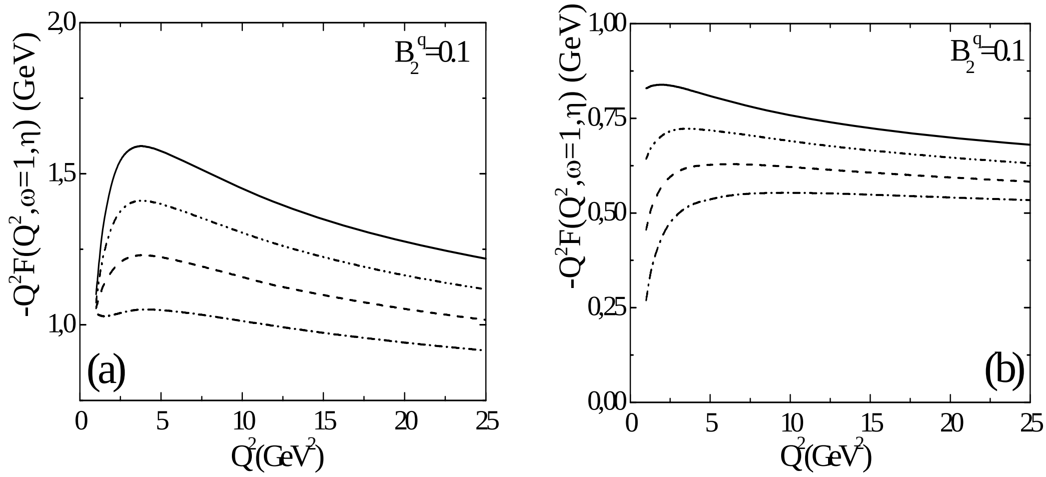
$$\alpha_s(Q^2 x),\ \alpha_s(Q^2\bar{x}) \to [\alpha_s(Q^2 x) + \alpha_s(Q^2\bar{x})]/2 .$$

In the context of the RC method one expresses the QCD coupling $\alpha_s(Q^2 x)$ as

$$\alpha_s(Q^2 x) = \frac{4\pi}{\beta_0}\int_0^\infty du \exp[-ut]R(u,t)x^{-u},$$

where $R(u,t)$ is a function of u and $t = \ln(Q^2 / \Lambda^2)$

$$R(u,t) = 1 - \frac{2\beta_1}{\beta_0^2} u\left(1 - \gamma_E - \ln t - \ln u\right).$$



Some results of the numerical computations are shown in the figures: here the vertex function computed at $\omega = \pm 1$ using the RC method (a) and standard perturbative QCD (pQCD) (b) is depicted. In the figures the correspondence between plotted curves and parameter B_2^g at the normalization scale $\mu_0^2 = 1\,GeV^2$ is: $B_2^g = 0$ for the solid lines; $B_2^g = 2$ for the dot-dot-dashed curves; $B_2^g = 4$ for the dashed lines, and $B_2^g = 6$ for the dot-dashed lines.

Performed studies prove that the η'-meson mass effects considerably change predictions of Ref. [3]: they suppress the absolute values of the quark and gluon components of VF, and modify their behavior as functions of the asymmetry parameter ω. This modification, in the case of the gluon component, has not only quantitative, but also qualitative character. Thus, at $\omega = 0$ the gluon component of VF vanishes identically. As a result, mass effects change the dependence of the full VF on Q^2 and ω.

The presented numerical analysis shows that power corrections considerably enhance the standard pQCD predictions for the VF in the explored region $1 \le Q^2 \le 25\ GeV^2$, though other sources, may give rise to power corrections. As an important consistency check, in Ref.[5] we have proved, that the results obtained within the RC method in asymptotic limit $Q^2 \to \infty$ reproduce pQCD predictions for the vertex function.

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