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Radiative decays of h_c to the light mesons $\eta^{(\prime)}$: A perturbative QCD calculation

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We study the radiative decays $h_c \to \gamma\eta^{(\prime)}$ in the framework of perturbative QCD and evaluate analytically the one-loop integrals with the light quark masses kept. Interestingly, the branching ratios $\mathcal{B}(h_c \to \gamma\eta^{(\prime)})$ are insensitive to both the light quark masses and the shapes of $\eta^{(\prime)}$ distribution amplitudes. And it is noticed that the contribution of the gluonic content of $\eta^{(\prime)}$ is almost equal to that of the quark-antiquark content of $\eta^{(\prime)}$ in the radiative decays $h_c \to \gamma\eta^{(\prime)}$. By employing the ratio $R_{h_c} = \mathcal{B}(h_c \to \gamma\eta)/\mathcal{B}(h_c \to \gamma\eta')$, we extract the mixing angle $\phi = 33.8^\circ \pm 2.5^\circ$, which is in clear disagreement with the Feldmann-Kroll-Stech result $\phi = 39.0^\circ \pm 1.6^\circ$ extracted from the ratio $R_{J/\psi}$ with nonperturbative matrix elements $\langle 0 \mid G^a_{\mu\nu}\tilde{G}^{a,\mu\nu} \mid \eta^{(\prime)}\rangle$, but in consistent with $\phi = 33.5^\circ \pm 0.9^\circ$ extracted from the asymptotic limit of the $\gamma^*\gamma - \eta'$ transition form factor and $\phi = 33.9^\circ \pm 0.6^\circ$ extracted from $R_{J/\psi}$ in perturbative QCD. We also briefly discuss possible reasons for the difference in the determinations of the mixing angle.

Publications

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