

Light-front quark model analysis of the $P(\pi^0, \eta, \eta')$ to $\gamma^* \gamma$ transition form factors

In the present work, we investigated the $P \rightarrow \gamma^* \gamma$ ($P = \pi, \eta, \eta'$) transition form factors (TFF) in the light-front quark model (LFQM) based on the QCD motivated effective LF Hamiltonian.

In the previous work, we discussed the link between the chiral symmetry of QCD and the numerical results of the LFQM, analyzing both the two-point and three-point functions of a pseudo scalar meson from the perspective of the vacuum fluctuation consistent with the chiral symmetry of QCD. In this work, we start from the covariant Bethe-Salpeter (BS) model used in the previous works to pin down the zero mode for the $P \rightarrow \gamma^* \gamma$ TFFs and find that the meson-photon TFF is immune to the zero mode. We confirm the self-consistent correspondence relation between the covariant BS model and the LFQM that allow the substitution of the radial and spin-orbit wave functions of the exactly solvable model by the more phenomenologically accessible model wave functions that can be provided by the LFQM analysis of meson mass spectra. Furthermore, we show not only timelike but also spacelike TFF using the analytic continuation method of changing $Q^2 \rightarrow -Q^2$ in the form factor.

The η - η' mixing scheme is analyzed to obtain the optimum values of the $\eta(\eta')$ - γ TFFs and compared with the current available experimental data. The present work rejuvenates our earlier analysis of the $P \rightarrow \gamma^* \gamma$ process solely based on the standard LF approach of the LFQM, in which we have shown a good agreement with the low- and intermediate Q^2 data ($0 < Q^2 < 10 \text{ GeV}^2$) measured decades ago from the CELLO and CLEO Collaborations.

Primary author: Dr RYU, Hui-Young (Department of physics, Pusan National University)

Co-authors: Prof. JI, Chueng-Ryong (Department of physics, North Carolina State University); Prof. CHOI, Ho-Meoyng (Department of physics, Teachers College, Kyungpook National University)

Presenter: Dr RYU, Hui-Young (Department of physics, Pusan National University)