

Implications of η' Coupling In The Chiral Constituent Quark Model

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Using the latest data pertaining to $\bar{u} - \bar{d}$ asymmetry and the spin polarization functions, detailed implications of the possible values of the coupling strength of the singlet Goldstone boson η' have been investigated in the χ CQM with configuration mixing. Using Δu , Δ_3 , $\bar{u} - \bar{d}$ and \bar{u}/\bar{d} , the possible ranges of the coupling parameters a , $\alpha^2 a$, $\beta^2 a$ and $\zeta^2 a$, representing respectively the probabilities of fluctuations to pions, K , η and η' , are shown to be $0.10 < a < 0.14$, $0.2 < \alpha < 0.5$, $0.2 < \beta < 0.7$ and $0.10 < |\zeta| < 0.70$. To further constrain the coupling strength of η' , detailed fits have been obtained for spin polarization functions, quark distribution functions and baryon octet magnetic moments corresponding to the following sets of parameters: $a = 0.1$, $\alpha = 0.4$, $\beta = 0.7$, $|\zeta| = 0.65$ (Case I); $a = 0.1$, $\alpha = 0.4$, $\beta = 0.6$, $|\zeta| = 0.70$ (Case II); $a = 0.14$, $\alpha = 0.4$, $\beta = 0.2$, $\zeta = 0$ (Case III) and $a = 0.13$, $\alpha = \beta = 0.45$, $|\zeta| = 0.10$ (Case IV). Case I represents the calculations where a is fixed to be 0.1, in accordance with earlier calculations, whereas other parameters are treated free and the Case IV represents our best fit. The fits clearly establish that a small non-zero value of the coupling of η' is preferred over the higher values of η' as well as when $\zeta = 0$, the latter implying the absence of η' from the dynamics of χ CQM. Our best fit achieves an overall excellent fit to the data, in particular the fit for Δu , Δd , Δ_8 as well as the magnetic moments μ_n , μ_{Σ^-} , μ_{Σ^+} and μ_{Ξ^-} is almost perfect, the μ_{Ξ^-} being a difficult case for most of the similar calculations. The implications of η' on the gluon polarization have also been investigated.