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Dynamically Running Mass of Light Quark and QCD Vacuum Condensates

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Abstract: Based on Dyson-Schwinger equations (DSEs) in ``rainbow'' approximation, the dynamically running mass of light quark and QCD vacuum condensate are investigated. The structure of non-local quark vacuum condensate, the values of local vacuum condensate of quarks and quark-gluon mixture, and dynamical transition of quark mass from current quark to constituent quark are illustrated. At the same time, according to the knowledge and experience learned from an extensive study of the solutions of DSEs, a parameterized form of confining quark propagator is suggested for a practical use. The new parameterized form of quark propagator is analytic everywhere in the finite complex p^2-plane and has no Lehmann representation. The predictions for p^2-dependence of effective quark masses, $M_f(p^2)$, defined by the self-energy functions $A_f(p^2)$ and $B_f(p^2)$, both from the numerical solutions of DSEs and from its parameterized form, are shown dynamically. Our conclusion is that all numerical results are consistent with empirical values used in QCD sum rules and lattice QCD calculations. For a qualitative study, the parameterized form is a sufficiently good approximation to confining quark propagator.

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