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Dynamical Running Mass of Quark in the Dyson-Schwinger Equation Approach

MA Wei-Xing,[1,2,3] SHEN Peng-Nian,[1,2] and ZHOU Li-Juan[3]

[1] Institute of High Energy Physics, the Chinese Academy of Sciences, Beijing 100039, China
[2] Institute of Theoretical Physics, the Chinese Academy of Sciences, Beijing 100080, China
[3] Department of Information and Computing Science, Guangxi University of Technology, Liuzhou 545006, China
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Abstract: Based on the Dyson-Schwinger equations of QCD in the ``rainbow" approximation, the fully dressed quark propagator $S_f(p)$ is investigated, and then an algebraic parametrization form of the propagator is obtained as a solution of the equations. The dressed quark amplitudes A_f and B_f built up the fully dressed quark propagator and the dynamical running masses M_f defined by A_f and B_f for light quarks u, d and s are calculated, respectively. Using the predicted running masses M_f, quark condensates $\langle 0|\bar{q}(0)q(0)|0\rangle = -(0.255\ \mathrm{GeV})^3$ for u, d quarks, and $\langle 0|\bar{s}s|0\rangle = 0.8\ \langle 0|\bar{q}(0)q(0)|0\rangle$ for s quark, and experimental pion decay constant $f_\pi = 0.093$ GeV, the masses of Goldstone bosons K, π, and η are also evaluated. The numerical results show that the masses of quarks are dependent on their momentum p^2. The fully dressed quark amplitudes A_f and B_f have correct behaviors which can be used for many purposes in our future researches on nonperturbative QCD.

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Key words: Dyson-Schwinger equations, quark propagator, quark mass, the masses of Goldstone bosons

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