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Asymptotic freedom of gluons in Hamiltonian dynamics

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Asymptotic freedom of gluons in QCD is obtained in the leading terms of their renormalized Hamiltonian in the Fock space. We calculate the three-gluon interaction term in the front-form Hamiltonian for gluons using the renormalization group procedure for effective particles (RGPEP). The resulting three-gluon vertex is a function of the scale parameter, s, that has an interpretation of the size of effective gluons. The corresponding Hamiltonian running coupling constant, g_λ, depending on the associated momentum scale $\lambda = 1/s$, is calculated in the series expansion in powers of $g_0 = g_0$ up to the terms of third order, assuming some small value for g_0 at some large λ_0. The third-order QCD solution of the RGPEP equation to be discussed, provides an explicit example of how asymptotic freedom of gluons is exhibited in the scale-dependence of Hamiltonians as operators in the Fock space.

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