Interpolating QCD between the instant and front forms of relativistic dynamics

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The two dimensional quantum chromodynamics (QCD) in the limit of infinite number of colors, known as the ’t Hooft model, was originally formulated in the Light Front Dynamics (LFD). The theory is exactly solvable, while still bearing some resemblance to the 4 dimensional real world QCD in aspects such as confinement and mass gap, as well as the spontaneous breaking of chiral symmetry. Similar work was done in 1978 by Bars and Green in the Instant Form Dynamics (IFD). The quark-antiquark bound state equation was derived and solved in each of the two forms, i.e., ’t Hooft equation and Bars-Green equations, respectively, and they give the same discrete meson mass spectrum independent of the quantization form. Introducing an interpolation angle parameter, $\delta$, we try to link the two distinct forms of dynamics, IFD and LFD, by letting the form rotate from the ordinary $\{t, z\}$ axes to the light front $\{x^+, x^-\}$ ones, as $\delta$ varies from 0 to $\pi/4$. We have found that the quark condensate is quantization angle independent. This indicates a non-trivial vacuum structure even in light-front form. We also unify the ’t Hooft and Bars-Green equations into one formula, and by numerically solving it we confirm the independence of the meson mass spectra on the interpolation angle $\delta$.

Early Consideration

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Yes

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