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Nonperturbative QCD Coupling and its β Function from Light-Front Holography

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Abstract

The light-front holographic mapping of classical gravity in anti-de Sitter space, modified by a positive-sign dilaton background, leads to a nonperturbative effective coupling $\alpha_s^{AdS}(Q^2)$. It agrees with hadron physics data extracted from different observables, such as the effective charge defined by the Bjorken sum rule, as well as with the predictions of models with built-in confinement and lattice simulations. It also displays a transition from perturbative to nonperturbative conformal regimes at a momentum scale ~ 1 GeV. The resulting β function appears to capture the essential characteristics of the full β function of QCD, thus giving further support to the application of the gauge/gravity duality to the confining dynamics of strongly coupled QCD. Commensurate scale relations relate observables to each other without scheme or scale ambiguity. In this paper we extrapolate these relations to the nonperturbative domain, thus extending the range of predictions based on $\alpha_s^{AdS}(Q^2)$.