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Non-perturbative renormalization of the average color charge and multi-point correlators of color charge from a non-Gaussian small-x action

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The McLerran-Venugopalan (MV) model is a Gaussian effective theory of color charge fluctuations at small-x in the limit of large valence charge density, i.e. a large nucleus made of uncorrelated color charges. In this work, we explore the effects of the first non-trivial (even C-parity) non-Gaussian correction on the color charge density to the MV model in SU(2) and SU(3) color groups in the non-perturbative regime. We also compare our results to existing perturbative ones on a lattice setup, where multi-point correlators of color charges can be computed for fixed configurations. We investigate three different choices for the renormalization of the couplings figuring in the non-Gaussian small-x action and find that one of them allows to control the deviations from the MV model as one approaches the continuum while the other two lead to a scenario where the small-x action evolves towards a critical theory dominated by strong non-Gaussian fluctuations regardless of the system size.

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