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Coupling scalar fields to the Curci-Ferrari model

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Content

The quantization of Yang–Mills (YM) theories via the functional integral requires a gauge-fixing procedure, which is typically carried out using the Faddeev–Popov (FP) method. Despite its great success at high energies due to the asymptotic freedom property of YM theories, the usual perturbation theory, which uses the FP action as a starting point, does not provide accurate results at low energies. In fact, the FP method itself is called into question in the infrared regime due to the existence of so-called Gribov copies, which compromise its hypotheses. The Curci–Ferrari model is obtained by adding a phenomenologically motivated mass term for the gluons after gauge fixing. The origin of this mass parameter is related to the effects of Gribov copies in the infrared. One can define a renormalization scheme within this model so as to perform trustworthy perturbative calculations at any energy scale, producing results in agreement with lattice simulations. In this work, we couple scalar fields in the adjoint representation to the CF model and compute the one-loop two-point correlation functions for gluons, ghosts, and scalars. We then compare these analytical results with lattice simulation data to assess whether the predictions of the CF framework remain consistent in this scenario.

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