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A first survey of the ghost-gluon vertex in the Gribov-Zwanziger framework

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In order to have a proper definition of a quantum nonabelian gauge theory, such as QCD, one needs to have a well-defined generating functional. In the perturbative regime at high energies, this can be achieved through the well-known Faddeev-Popov quantization procedure. For energy scales in which the coupling of the strong force becomes sufficiently high, the perturbative approach may display some inconsistencies. One such problem is the so-called Gribov problem: in a gauge fixed theory, the ghost fields acquire a pole at finite (euclidean) momentum. Equivalently, the determinant of the Faddeev-Popov operator vanishes and the generating functional of the theory becomes void. In order to correct this problem (at least partially), Gribov suggested to restrict the functional integration of gauge fields to a subset of the field space, which is now called the Gribov region.

As this restriction of the gauge fields to the Gribov region is taken into account, it turns out that the resulting gauge field propagators display a nontrivial infrared behavior, being very close to the ones observed in lattice gauge field theory simulations. In this work, we explore for the first time a higher correlation function in the presence of the Gribov horizon: the ghost-anti-ghost-gluon interaction vertex, at one-loop level. Our analytical results (within the so-called Refined Gribov Zwanziger theory) are fairly compatible with lattice YM simulations, as well as with solutions from the Schwinger-Dyson equations. This is an indication that the RGZ framework can provide a reasonable description in the infrared not only of gauge field propagators, but also of higher correlation functions, such as interaction vertices.

Summary

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