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Inverse problem approach for non-perturbative QCD: mathematical foundation

We propose a novel theoretical framework, the inverse problem approach, to calculate the non-perturbative QCD quantities. Using the dispersion relation of quantum field theory, it solves the unknown low-energy non-perturbative quantities by the inverse problem, with the known high-energy perturbative calculations as inputs. We prove that the inverse problem of dispersion relation is ill-posed, with the solutions being unique but unstable. Based on the state-of-the-art mathematics of the inverse problem, regularization methods must be used to get the stable approximate solutions which converges to the true values of solutions as the uncertainties of inputs being close to zero. We have tested some toy models to vividly show the main features of the inverse problem approach. It can be found that this approach does not have any artificial assumptions and can systematically improve the precision of the solution。

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