Complete Renormalization Group Improvement- Avoiding Factorization and Renormalization Scale Dependence in QCD Predictions

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Abstract

For moments of leptoproduction structure functions we presented that all dependence on the renormalization and factorization scales disappears provided that all the ultraviolet logarithms involving the physical energy scale Q are completely resummed. The approach is closely related to Grunberg's method of Effective Charges

Proceeding

The problem of renormalization scheme dependence in QCD perturbation theory remains on obstacle to making precise tests of the theory.We pointed out that the renormalization scale dependence of dimensionless physical QCD observables, depending on a single energy scale Q, can be avoided provided that all ultraviolet logarithms which build the physical energy dependence

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on Q are resummed. This was termed complete Renormalization Group (RG)-improvement. It was stressed that standard RG-improvement, as customarily applied with a Q-dependent scale $\mu = xQ$, omits an infinite subset of these logarithms. One should rather keep μ independent of Q, and then carefully resum to all-orders the RG-predictable ultraviolet logarithms.In this way all μ-dependence cancels between the renormalized coupling and the logarithms of μ contained in the coefficients,and the correct physical Q-dependence is built. At next-to-leading order (NLO) the result is identical to the Effective Charge approach of Grunberg. We wish to extend this argument to processes involving factorization of operator matrix elements and coefficient functions, where a factorization scale M arises in addition to the renormalization scale μ. We shall use the prototypical factorization problem of moments of leptoproduction structure functions as a specific example. We shall identify the logarithms of μ,M , and Q which occur, and show explicitly that on resumming all the ultraviolet logarithms the μ and M dependence disappears.

In the talk was presented,given some basic definitions for the moments of structure functions then considered the dependence of the perturbative coefficients on the parameters which label the renormalization and factorization procedure. Finally dealed with the complete RG-improvement of the structure function moments and identified and resumed the physical ultraviolet logarithms.

References

[1] C.J.Maxwell and A.Mirjalili,hep-ph/0002204 Nucl.Phys.B577:209-220,2000