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Rapidity regulators for the CGC: F_L at NLO

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In recent years, numerous studies have aimed at improving the precision of the theoretical description of the nonlinear QCD regime of gluon saturation in high-energy collisions, in order to match the precision of the data coming from the LHC and the future EIC. In particular, NLO QCD corrections have been calculated for many high-energy processes sensitive to gluon saturation.

In most of such NLO calculations, the chosen regularization procedure is dimensional regularization for the transverse integrals complemented by a naive cut-off for the light-cone momentum kˆ+ integrals. Although convenient in that context, this regularization procedure has disadvantages. On the one hand, it does not allows us to disentangle soft and rapidity divergences, which are then both regulated by the cut-off. On the other hand, it complicates the comparison with results obtained in other regimes of QCD, for example in collinear or TMD factorizations, using other regularization schemes.

As an alternative, we discuss how to implement in these NLO gluon saturation calculations various new rapidity regulators proposed by the TMD or SCET communities. As a first application and consistency check, we revisit the calculation of the NLO corrections to the F_L DIS structure function at low x in the dipole factorization approach, now with these rapidity regulators together with dimensional regularization. When combining the results from all diagrams, we find as expected that the UV divergences are canceling each other, as well as the soft divergences. The only surviving divergence is the rapidity divergence associated with the Balitsky-Kovchegov evolution of the dipole operator. Among the finite NLO corrections to F_L, the only ones which are found to depend on the rapidity regularization scheme are associated with the scheme dependence concerning the choice of evolution variable for the BK equation.

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