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Small-x TMD factorization at NLO

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Two-particle azimuthal correlations provide valuable insights into the dynamics of gluon saturation in collider experiments. In the kinematic regime where the two particles are produced sufficiently forward in rapidity but back-to-back in the transverse plane, the differential cross-section computed in the Color Glass Condensate (CGC) EFT, admits a small-x Transverse Momentum Dependent (TMD) factorization. This so-called TMD-CGC correspondence was shown to hold at leading order (LO) in [1] where TMD operators are related to correlators of Wilson lines in the CGC. At next-to-leading order (NLO), one encounters two types of potentially large contributions: high-energy (small-x) logs and Sudakov (soft) logs, which must be jointly resummed in order to attain reliable theoretical predictions. Their simultaneous resummation was proposed in [2] based on TMD factorization arguments. However, a complete NLO calculation justifying this correspondence has been missing in the literature. The subject of this talk is to elucidate this correspondence.

By examining the back-to-back limit of semi-inclusive dijet production in deep inelastic scattering (DIS) computed in the CGC EFT at NLO [3], we demonstrate that a kinematic constraint on the non-linear small-x evolution equation of the Weizsäcker Williams (WW) gluon distribution [4, 5] is essential for properly separating the phase space of small-x gluons and soft gluons. Remarkably, this kinematic constraint allows us to establish the first proof of small-x TMD factorization at NLO, as we show that all remaining NLO corrections can be fully factorized in terms of an NLO perturbative factor and the WW gluon distribution [6].

I will present preliminary results [6] for the differential cross-section of back-to-back dijets in DIS at small-x kinematics in the CGC EFT at NLO.

[1] F. Dominguez, C. Marquet, B-W. Xiao, and F. Yuan. Phys.Rev.D 83 (2011) 105005
[2] A. Mueller, B-W. Xiao, and F. Yuan. Phys.Rev.D 88 (2013) 11, 114010
[3] P. Caucal, F. Salazar and R. Venugopalan, JHEP 11 (2021) 222
[4] P. Caucal, F. Salazar, B. Schenke and R. Venugopalan. JHEP 11 (2022) 169
[5] P. Taels, T. Altinoluk, G. Beuf, C. Marquet. JHEP 10 (2022) 184
[6] P. Caucal, F. Salazar, T. Stebel, B. Schenke and R. Venugopalan (arXiv: 2304.03304).

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