Contribution ID: **65** Type: **not specified**

Weizsäcker-Williams TMD factorization at NLO for back-to-back inclusive dijets in DIS at small x

Tuesday, May 23, 2023 11:25 AM (20 minutes)

The "tomography"of the proton and heavy nuclei, which refers to the three-dimensional imaging of elementary quarks and gluons in these QCD bound states, is one the primary goal of the future Electron-Ion Collider (EIC). Gluon tomography is mathematically encoded into the gluon Weizšacker-Williams (WW) transverse momentum dependent (TMD) distribution which, in light cone gauge, represents the light cone quantized number distribution of gluons as function of their transverse momenta in a proton or nucleus at small $x_{\rm Bj}$. A "golden process" to extract the gluon WW distribution is the inclusive production of a pair of back-to-back jets, or back-to-back hadrons, in deep inelastic electron-proton or electron-nucleus scattering (DIS).

In this talk, I will show that for dijets with relative transverse momenta $P_\perp$ and transverse momentum imbalance $q_\perp$, to leading power in $q_\perp/P_\perp$, the cross-section for longitudinally and transversely polarized virtual photons to NLO can be fully factorized into a product of a perturbative hard factor and the non-perturbative Weizsäcker-Williams TMD. This factorization formula is valid to all orders in $Q_s/q_\perp$ for $q_\perp, Q_s \ll P_\perp$, where Q_s is the CGC saturation scale. The hard factor and the soft factor, which resums Sudakov double and single logs in $P_\perp/q_\perp$, are given by remarkably compact analytic expressions while the WW TMD satisfies a kinematically constrained JIMWLK renormalization group evolution in rapidity.

I will finally present results of a numerical study that explores the relative importance of gluon saturation, Sudakov effects and genuine $\mathcal{O}(\alpha_s)$ corrections on the inclusive back-to-back dijet cross-section in DIS at small $x_{\rm Bj}$.

Refs:
[1] Caucal, Salazar, Schenke, Venugopalan, JHEP 11 (2022) 169, arXiv:2208.13872.
[1] Caucal, Salazar, Schenke, Stebel, Venugopalan, to appear.

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Session Classification: TMDs