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Signatures of gluon saturation in future DIS experiments

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Discovering experimental signatures of gluon saturation is one of the major physics motivations behind the future nuclear-DIS facilities such as the Electron-Ion Collider. Probably the simplest observable to look for saturation effects is the inclusive structure function measurement, where the Bjorken-x dependence can be predicted from the Color Glass Condensate framework by solving the Balitsky-Kovchegov (BK) small-x evolution equation which includes non-linear saturation effects. On the other hand, in collinear factorization based approaches the DGLAP evolution can predict the virtuality (Q^2) dependence. As both the BK and DLGAP equations require non-perturbative initial conditions, distinguishing genuine BK and DGLAP effects must be done carefully.

We quantify in [1] the differences between the BK and DGLAP evolutions in proton and nuclear DIS structure functions in EIC and LHeC kinematics, and assess the capabilities of the future facilities in distinguishing between the DGLAP and BK dynamics, taking into the fact that there is uncertainty related to the non-perturbative initial condition. By reweighting PDFs to pseudodata generated with BK evolution we construct DGLAP evolved structure functions F_2 and F_L which agree with the corresponding BK-evolved structure functions on a $Q_s^2(x)$ line in the (x, Q^2) plane. By studying the deviations outside the $Q_s^2(x)$ line we can determine how fast DGLAP evolution differs from BK evolution.

For proton targets we find that the F_2 structure function needs to be measured at a few percent accuracy in order to distinguish the DGLAP and BK evolutions. For F_L the differences are larger, up to $10\ \%$ in EIC kinematics and $40\ \%$ at the LHeC/FCC-he. With heavy nuclei, we also find significant deviation up to $10\ \%$ in case of F_2 structure function. As with proton targets, F_L is much more sensitive observable to gluon saturation, with differences to BK evolved predictions being up to $20\ \%$ in EIC kinematics and $60\ \%$ at the LHeC/FCC-he.

References:
[1] N. Armesto, T. Lappi, H. Mäntysaari, H. Paukkunen, M. Tevio, in preparation

Submitted on behalf of a Collaboration?

No

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