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# Quark and Gluon helicity evolution at small x: Revised and updated

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We revisit the problem of small Bjorken-$x$ evolution of the gluon and flavor-singlet quark helicity distributions in the shock wave (s-channel) formalism. Earlier works on the subject in the same framework resulted in an evolution equation for the gluon field-strength $F^{12}$ and quark "axial current"$\bar{\psi}\gamma^+\gamma^5\psi$ operators in the double-logarithmic approximation summing powers of $\alpha_s \log^2(1/x)$. In this work, we observe that an important mixing of the above operators with another gluon operator, $\overleftarrow{D}^i D^i$, was missing in the previous works. This operator has the physical meaning of sub-eikonal (covariant) phase: its contribution to helicity evolution is shown to be proportional to another sub-eikonal operator, $D^i - overleftarrow{D}^i$, which is related to the Jaffe-Manohar polarized gluon distribution. In this work, we include this new operator into small-$x$ helicity evolution, and construct novel evolution equations mixing all three operators ($D^i - overleftarrow{D}^i$, $F^{12}$, $\bar{\psi}\gamma^+\gamma^5\psi$), generalizing previous results. We also construct closed double-logarithmic evolution equations in the large-$N_c$ and large-$N_c$&$N_f$ limits, with $N_c$ and $N_f$ the numbers of quark colors and flavors, respectively. Solving the large-$N_c$ equation numerically we obtain the small-$x$ asymptotic of the quark and gluon helicity distributions $\Delta\Sigma$ and $\Delta G$, along with the $g_1$ structure function, which are in complete agreement with earlier works by Bartels, Ermolaev, and Ryskin.

## Submitted on behalf of a Collaboration?

No

## Participate in poster competition?

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