Evolution equation for the structure function $g_2(x, Q^2)$ [1]

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Abstract:

In spite of the significant progress that has been achieved, understanding of the scale dependence of $g_2(x, Q^2)$ still poses an outstanding theoretical problem. The difficulty is due to the well-known fact that the structure function $g_2(x, Q^2)$ presents by itself only one special projection of a more general three-particle quark-antiquark-gluon correlation function in the nucleon that depends, generally, on two variables - the momentum fractions carried by partons.

We perform an extensive study of the scale dependence of flavor-singlet contributions to the structure function $g_2(x, Q^2)$ in polarized deep-inelastic scattering. We find that the mixing between quark-antiquark-gluon and three-gluon twist-3 operators only involves the three-gluon operator with the lowest anomalous dimension and is weak in other cases. This means, effectively, that only those three-gluon operators with the lowest anomalous dimension for each moment are important, and allows to formulate a simple two-component parton-like description of $g_2(x, Q^2)$ in analogy with the conventional description of twist-2 parton distributions. The similar simplification was observed earlier for the nonsinglet distributions, although the reason is in our case different.

In physical terms, the constructed approximation corresponds to the introduction of quark and gluon transverse spin parton distributions which are identified with the particular components of quark-antiquark-gluon and three-gluon parton correlation functions that possess the lowest anomalous dimension. We will find that, first, the structure function $g_2(x, Q^2)$ is dominated by contributions of these two distributions at large scales, and, second, the 'leakage' of transverse spin to genuine three-particle degrees of freedom at lower scales is small due to the specific pattern of the QCD evolution. We would like to emphasize that importance of this result is not so much in the possibility to calculate the scale dependence, but in the identification of important transverse spin degrees of freedom that are preserved by QCD interactions.

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[1] The talk is based on the work V. M. Braun, G. P. Korchemsky and A. N. Manashov, Nucl. Phys. B **603** (2001) 69 [hep-ph/0102313].

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