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Transverse-spin gluon distribution function

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We define the novel polarized PDF, the transverse-spin gluon distribution function $G_T(x)$, as the nucleon matrix element of the gauge-invariant bilocal light-cone operator in QCD, and discuss their properties. $G_T(x)$ is the gluonic analogue of the transverse-spin quark distribution function $g_T(x)$ that contributes to the transverse-spin structure function $g_2(x, Q^2)$ in the DIS of a longitudinally-polarized lepton off a transversely-polarized nucleon target. These distributions, $g_T(x)$ and $G_T(x)$, are relevant to the "angular momentum sum rule"for the transversely-polarized nucleon, because the integral of $g_T(x)$ ($G_T(x)$) over x gives the quark-spin (gluon-spin) contribution arising in the partonic decomposition of the transverse nucleon spin. We show that the transverse-spin gluon distribution function $G_T(x)$ can be expressed as the sum of the two types of gluonic light-cone correlators: one is the correlator of the chromoelectric fields and the other is the correlator of the chromomagnetic fields; both of these correlators are of twist-three and correspond to the helicity flip by one unit (i.e., correlator between the chromoelectric (chromomagnetic) field carrying the helicity zero and the chromoelectric (chromomagnetic) field carrying the helicity +1 or -1), similarly as the helicity-flip nature of the transverse-spin quark distribution $g_T(x)$. We note that the former (chromoelectric) correlator coincides with the twist-three gluon distribution $G_3(x)$ introduced by X. Ji in Phys. Lett. B289 (1992) 137, but the relevance of the latter (chromomagnetic) correlator has not been noticed so far. The classification of the collinear PDFs is now completed up to twist-three with this chromomagnetic correlator. We derive the moment sum rules for $G_T(x)$ and the corresponding operator product expansion, revealing that $G_T(x)$ receives the three-gluon correlation effects. This work is based on our paper JHEP1302 (2013) 003 and the recent new results.

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