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Factorization and gauge invariance of the twist-3 cross-section for single spin asymmetry

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We present a consistent framework for the twist-3 calculation for the single transverse spin asymmetry (SSA). We prove that the consistent use of the Ward identity for color gauge invariance is crutial to obtain the factorization property and the gauge invariance of the twist-3 single-spin-dependent cross section. This proof had been missed in the previous literature. As an application, we present a complete twist-3 cross section formula for SSA for semi-inclusive deep inelastic scattering in terms of the complete set of the twist-3 quark-gluon distributions which include all kinds of pole (soft-gluon-pole, soft-fermion-pole and hard-pole) contributions. We will also make a comment on the connection between the twist-3 approach and the Sivers function approach to SSA. The detail is reported in our recent paper Nucl.Phys.B763:198-227,2007 [HEP-PH 0610314].

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