Single Transverse Spin Asymmetry for Semi-Inclusive Deep Inelastic Scattering

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We discuss the single transverse spin asymmetry (SSA) for the large p_T pion production in semi-inclusive deep inelastic scattering. We first derive the cross section formula for SSA in the framework of the collinear factorization. In this framework, SSA is a twist-3 observable, and the quark-gluon correlation functions in the hadrons play an essential role for its description. The SSA is a naively "T-odd" observable and it occurs as an interference between the amplitudes which have different phases. The phases are given as pole contributions in the partonic hard cross sections, which are classified as soft-gluon-pole (SGP), hard-pole (HP) and soft-fermion-pole (SFP) contributions. Our cross section formula includes all these contributions. We emphasize that these pole contributions to the hard cross section satisfy a particular consistency condition which is crucial to obtain the gauge invariant cross section in terms of the complete set of the twist-3 correlation functions. In the literature of the twist-3 calculations for SSA, proof for this relation was missing. We also discuss the characteristic azimuthal dependence of the SSA in comparison with the Sivers and Collins asymmetries, and present a simple estimate of the asymmetries, using a model for the nonperturbative functions.