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Exact Relations for Twist-3 Gluon Distribution and Fragmentation Functions from Operator Identities

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We perform a systematic study on the twist-3 gluon distribution and fragmentation functions which appear in the collinear twist-3 factorization for hard inclusive processes. Three types of twist-3 distribution and fragmentation functions, i.e., intrinsic, kinematical and dynamical ones, which are necessary to describe all kinds of twist-3 cross sections, are related to each other by the operator identities based on the QCD equation of motion and the Lorentz invariance properties of the correlation functions. We derive the exact relations for all twist-3 gluonic distribution and fragmentation functions for a spin-1/2 hadron. Those relations allow one to express intrinsic and kinematical twist-3 gluon functions in terms of the twist-2 and dynamical twist-3 functions, which provides a basis for the renormalization of intrinsic and kinematical twist-3 functions. In addition, those model independent relations are crucial to guarantee gauge invariance and frame independence properties of the twist-3 cross sections.

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