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Transverse Momentum Dependent Factorization and Evolution for Spin Physics

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Abstract : After 1988 Electron muon Collaboration (EMC) announcement of measurement of spin dependent structure function, it has been found that it has become a need to understand spin structure of a hadron. In the study of three-dimensional spin structure of a proton, we need to understand the foundation of quantum field theory in terms of electro-weak and strong theories using rigorous mathematical theories and models. In the process of understanding the inner dynamical stricture of proton we need understand the mathematical formalism in perturbative quantum chromodynamics (pQCD). In QCD processes like proton-proton collision at high energy we calculate cross section using conventional collinear factorization schemes. In this calculations, parton distribution functions (PDFs) and fragmentation function are used which provide the information about probability density of finding quarks and gluons (partons) inside the proton and probability density of finding final hadronic state from initial partons. In transverse momentum dependent (TMD) PDFs and FFs, collectively called as TMDs, take an account for intrinsic transverse motion of partons. The TMD factorization in the calculation of cross sections provide a scheme of hadronic and partonic states in the given QCD process. In this study we review Transverse Momentum Dependent (TMD) factorization scheme using Collins-Soper-Sterman (CSS) Formalism. CSS formalism considers the transverse momentum dependence of the partons, in this formalism the cross section is written as a Fourier transform over a transverse position variable which has physical interpretation as impact parameter. Along with this we compare this formalism with improved CSS formalism. In this work we study the TMD evolution schemes and their comparison with other schemes. This would provide description in the process of measurement of transverse single spin asymmetry (TSSA) in hadro-production and electro-production of J/psi meson at RHIC, LHC, ILC energy scales. This would surely help us to understand J/psi production mechanism which is an appropriate test of QCD.

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