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Transverse single spin asymmetry at two loops

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This talk is mostly based on our recent work [1] where we numerically compute transverse single spin asymmetry (SSA) in SIDIS based on a new mechanism suggested in [2]. In this mechanism, the phase required for the asymmetry is generated from higher order diagrams. Specifically in [2] it was demonstrated that with the $g_T(x)$ quark distribution for the transversely polarized proton, a non-zero STSA appears first at two-loops. In our work, we also included an analogous gluon-initiated contribution arising from the $G_{3T}(x)$ distribution. In our framework, both $g_T(x)$ and $G_{3T}(x)$ were considered in the Wilczek-Wandzura (WW) approximation, i.e., as integrals of the quark and gluon helicity distributions respectively. Hence these contributions to the asymmetry can be evaluated unambiguously without inputs from unknown parameters such as dynamical twist-3 distributions. Overall, we are using a collinear framework appropriate for high p_T hadron production, so our results serve as predictions for the planned Electron Ion Collider (EIC). We find that the asymmetry associated with the $\sin(\phi_h - \phi_S)$, $\sin(\phi_S)$ and $\sin(2\phi_h - \phi_S)$ harmonics can reach up to 1-2$\%$ at the EIC. Further I will also discuss our recent calculations [3] which extend this mechanism to hadron and direct photon production in forward pp collisions and present numerical estimates for them. We find that while the SSA for forward hadron production production is rather small, the asymmetry for direct photon production can reach upto 1% in the very forward regions at small values of p_T (1-2 GeV). In general our results for SIDIS and pp collisions should be understood as parts of the respective NLO computations that would be indispensable for a quantitative assessment of SSA.

[1] S. Benić, Y. Hatta, A. K, H-n. Li, Phys. Rev. D 104 (2021), 094027

[2] S. Benić, Y. Hatta, H-n. Li, D.-J. Yang, Phys. Rev. D 100 (2019) 9, 094027

[3] S. Benić, Y. Hatta, A. K, H-n. Li, in preparation

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