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On the odderon mechanism for transverse single spin asymmetry in the Wilczek-Wandzura approximation

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The recent PHENIX [1] and STAR [2] data on the nuclear dependence of the transverse single spin asymmetry calls for a careful investigation into potential theoretical mechanisms that would explain this data in a quantitative way. To that end we investigate the transverse single spin asymmetry in forward $p^\uparrow p$ and $p^\uparrow A$ collisions from the odderon mechanism suggested by Kovchegov and Sievert in [3]. We first identify the relevant collinear parton distribution function (PDF) of the transversely polarized proton $p^\uparrow$ as the intrinsic twist-3 $g_T(x)$ distribution by confirming fully the results in [3] where they are obtained on a partonic level. We further argue that the complete polarized cross section in the collinear twist-3 framework must in general contain also contributions from the kinematical and the dynamical twist-3 PDFs, in addition to the the intrinsic twist-3 PDF. By restricting to the Wandzura-Wilczek (WW) approximation, where the dynamical twist-3 PDFs are dropped, we find, quite surprisingly, that the polarized cross section for inclusive hadron production is exactly zero at the next-to-leading order in the strong coupling [4]. Finally, we outline several opportunities for the odderon mechanism that either rely on going beyond the WW approximation or to the next-to-next-to leading order in α_s.

[1] PHENIX, Phys. Rev. Lett. 123 (2019) 122001
[2] STAR, Phys. Rev. D 103 (2021) 7, 072005
[3] Kovchegov, Sievert, Phys. Rev. D 86 (2012) 034028
[4] SB, Kaushik, Vivoda, in preparation

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