Hyperon polarization from unpolarized pp and ep collisions

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It has been a well known experimental fact that hyperons produced in unpolarized pp collision is polarized transversely to the collision plane. Recently, HERMES group has also reported the transverse polarization of Λ and $\bar{\Lambda}$. Parton model gives rise no such polarization and the origin of the polarization is ascribed to the quark-gluon correlation (twist-3 effect) in the hadrons not included in the twist-2 parton distribution. QCD analysis for the asymmetry is crucial for the ongoing RHIC-SPIN, HERMES and COMPASS experiments.

In this contribution, we will present an analysis for the above hyperon polarization in the framework of the collinear factorization. According to the generalized QCD factorization theorem, the polarized cross section for $pp \to Y_\perp^\uparrow X$ consists of two kinds of twist-3 cross sections,

$$\text{(A)} \qquad E_a(x_1, x_2) \otimes q_b(x') \otimes \delta\widehat{q}_{c\to Y}(z) \otimes \hat{\sigma}^1_{ab\to c}, \tag{1}$$

$$\text{(B)} \qquad q_a(x) \otimes q_b(x') \otimes \widehat{G}_{c\to Y}(z_1, z_2) \otimes \hat{\sigma}^2_{ab\to c}, \tag{2}$$

and the one for $ep \to Y_\perp^\uparrow X$ likewise receives two contributions,

$$\text{(A}') \qquad E_a(x_1, x_2) \otimes \delta\widehat{q}_{a\to Y}(z) \otimes \hat{\sigma}, \tag{3}$$

$$\text{(B}') \qquad q_a(x) \otimes \widehat{G}_{a\to Y}(z_1, z_2) \otimes \hat{\sigma}'. \tag{4}$$

Here the functions with two variables (momentum fractions) $E_a(x_1, x_2)$, $\widehat{G}_{c\to Y}(z_1, z_2)$ are twist-3 quantities: E_a is the unpolarized distribution functions in the nucleon and $\widehat{G}_{c\to Y}$ is the polarized fragmentation function for Y. a, b and c stand for the parton's species. Other functions are twist-2; $q_b(x)$ the unpolarized distribution and $\delta\widehat{q}_{c\to Y}$ the transversity fragmentation function. $\hat{\sigma}^1_{ab\to c}$ *etc* represents the partonic cross section which yields large transverse momentum of the hyperon. Note that (A) and (A') contain two chiral-odd functions which should appear in a pair to give nonzero cross section.

The analyses of (A) contribution has been provided in [1] and it has been shown that with a moderate model assumption (A) gives rise to a large polarization of Λ at large x_F. Here we extend the analysis to the (B) term (for a preliminary study, see [2]) and the $ep \to Y_\perp^\uparrow X$ case so that we can have more thorough understanding on the hadron structure and the origin of the polarization.

References

[1] Y. Kanazawa and Y. Koike, Phys. Rev. **D64** (2001) 034019.
[2] Y. Koike, hep-ph/0106260, Proceedings of DIS2001. (Bologna, Italy, April, 2001.)