Transverse Asymmetry in Vector Meson Leptoproduction at Small x

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Abstract

Double spin asymmetries for longitudinally polarized leptons and transversely polarized target in vector meson leptoproduction at HERMES energy is discussed. The two-gluon coupling with the proton at small x has been used in the form

$$V^{\alpha\alpha'}_{pgg}(p,t,x_P,..) = (\gamma^\alpha p^{\alpha'} + \gamma^{\alpha'} p^\alpha) B(t,x_P,..) + iH(t,x_P,..)(p^\alpha \sigma^{\alpha'\rho}\Delta_\rho + p^{\alpha'}\sigma^{\alpha\rho}\Delta_\rho). \quad (1)$$

The distribution $B(t,..)$ in (1) determines the spin-non-flip contributions. The term $H(t,..)$ leads to the transverse spin-flip in the coupling (1). This model for the gluon distribution has been used to study transverse spin effects in vector meson leptoproduction at small $x_P \sim (Q^2+m_V^2)/W^2$.

The double-spin asymmetry has been found in the form

$$A_{LT} \sim \frac{(\vec{Q}\vec{S}_T)}{4m} \frac{y x_P |t|}{(1+(1+y)^2)m_V^2 + 2(1-y)Q^2} \frac{\bar{B}\bar{H}}{\bar{B}^2 + |t|/m^2\bar{H}^2}. \quad (2)$$

Here $\bar{B}$ and $\bar{H}$ are the integrated gluon distributions which are directly connected to the corresponding SPDs $\mathcal{F}^g$ and $\mathcal{K}^g$, m is the proton mass and $\vec{S}_T$ is a transverse target polarization. As a result this asymmetry can be approximated as

$$A_{LT} \sim C_g \frac{\mathcal{K}^g_\zeta(\zeta)}{\mathcal{F}^g_\zeta(\zeta)} \text{ with } \zeta = x_P.$$

Simple estimations shows that the coefficient $C_g(J/\Psi)$ at HERMES energy for $y = 0.5, |t| = 1\text{GeV}^2, Q^2 = 5\text{GeV}^2$ is quite small and of about 0.007. It is found that this simple model predicts weak mass dependence of the gluon contribution to the asymmetry. For the same kinematical variables $C(\phi) \sim C(\rho) \sim 0.008$. Some model estimations gives the value of about .1 for the ratio $\mathcal{K}^g_\zeta(\zeta)/\mathcal{F}^g_\zeta(\zeta)$. Thus the expected value for the longitudinal–transverse asymmetry of vector meson production at HERMES is smaller than .1%.