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**TWIST-2 POLARIZED FRAGMENTATION
FUNCTION IN THE OPEN CHARM
PRODUCTION IN DIS**

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Abstract

Arestov Yu.I. Twist-2 Polarized Fragmentation Function in the Open Charm Production in DIS : IHEP Preprint 2001-3. – Protvino, 2001. – p. 3, figs. 4.

To extract the polarized fragmentation function G_1 , the transmitted polarization parameter D_{LL} has been considered in the semi-inclusive leptonproduction process $e_{\uparrow}^- + p \rightarrow e^- + \Lambda_{c\uparrow}^+ + X$ with both longitudinally polarized electron and charmed lambda. The polarization transfer \hat{d}_{LL} for the lepton-gluon subprocess $e_{\uparrow}^- + g \rightarrow e^- + Q_{\uparrow}\bar{Q}$ was carefully studied, and it appeared to be sizable. The quantitative estimates of \hat{d}_{LL} were made at the gluon momentum fraction $x_g = 0.2$.

Аннотация

Арестов Ю.И. Поляризованная функция фрагментации твиста-2 в образовании открытого чарма в DIS.: Препринт ИФВЭ 2001-3. – Протвино, 2001. – 3 с., 4 рис.

Для определения поляризованной функции фрагментации G_1 твиста-2 рассматривается параметр переданной поляризации D_{LL} в полукклюзивном процессе $e_{\uparrow}^- + p \rightarrow e^- + \Lambda_{c\uparrow}^+ + X$ с поляризованными электронами и Λ^+ . Детально изучена передача поляризации от e_{\uparrow}^- к тяжелому кварку в лептон-глюонном подпроцессе $e_{\uparrow}^- + g \rightarrow e^- + Q_{\uparrow}\bar{Q}$, где она оказывается значительной. Сделаны количественные оценки \hat{d}_{LL} при импульсе глюона $x_g = 0.2$.

The polarized charmed lambda production is considered in SIDIS reaction

$$e_{\uparrow}^- + p \rightarrow e^- + \Lambda_c^+ + X \quad (1)$$

with the longitudinally polarized lepton beam shown in fig. 1 in the LO approximation. The polarization transmission parameter D_{LL} is defined as

$$D_{LL} = \frac{\sigma_{++} + \sigma_{--} - \sigma_{+-} - \sigma_{-+}}{\sigma_{++} + \sigma_{--} + \sigma_{+-} + \sigma_{-+}}, \quad (2)$$

where the subscripts $\{++\}$ etc. relate to the helicity states of the lepton and Λ_c^+ .

In the absence of the initial polarization, Λ_c^+ may be polarized only transversely to the production plane. A longitudinal component of the Λ_c^+ polarization vector may arise due to the longitudinal lepton polarization in the initial state.

The polarization transmission coefficient which can be measured experimentally relates to the fragmentation function $G_1(z, \mu^2)$ (FF) through the following expression:

$$D_{LL} \sim G(x_g) \cdot \hat{d}_{LL} \cdot G_1, \quad (3)$$

where $G(x_g)$ is the gluon distribution in the (unpolarized) proton and \hat{d}_{LL} is the polarization transmission coefficient in the heavy quark pair production in the lepton-gluon scattering

$$e_{\uparrow}^- + g \rightarrow e^- + Q_{\uparrow} \bar{Q}. \quad (4)$$

In order to plan measurements of the unknown FF G_1 , it would be instructive to know the range of the values of \hat{d}_{LL} in subprocess (4). The matrix element of reaction (4) incorporates the contributions of u -channel ($Q\bar{Q}$ configuration in Fig. 1), t -channel with the permuted Q 's and the interference term. Below these contributions are referred to as wu , tt and tu terms.

As is seen from Fig. 2, the d_{LL} properties may be quite different depending on t or u -channel that is on the $Q\bar{Q}$ configuration in the diagram. The azimuthal angle ϕ counts from the lepton scattering plane. The total

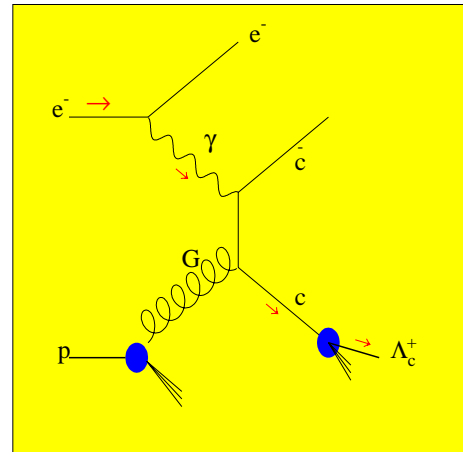


Fig. 1. The SIDIS reaction (1).

ϕ -dependence integrated over p_T exhibits a remarkable behaviour with a deep minimum at $\phi = 180^\circ$ and a positive maximum at $\phi = 0^\circ$ (360°). The maximum of the absolute value of d_{LL} may reach 0.3.

Apart from p_T dependence it can be interesting to track down the \hat{d}_{LL} dependence on E_Q , the quark energy, and on $\cos(Q, q)$, the cosine of the scattering angle in respect to the virtual photon direction. In Fig. 3 the corresponding two- and one-dimensional plots are shown in two regions: $\phi = 0 \pm 30^\circ$ and $\phi = 180 \pm 30^\circ$.

Finally, Fig. 4 presents the quark energy E_Q dependence of the polarization coefficient \hat{d}_{LL} integrated in separate hemispheres in respect to the virtual photon momentum. It is seen that at the reasonable values of the quark energy, the coefficient \hat{d}_{LL} appears to be sizable.

From the above consideration, it follows that the model expectations for the fragmentation function G_1 (see (3)) may be quite reasonable because the underlying subprocess exhibits the large values of \hat{d}_{LL} in some regions of the phase space.

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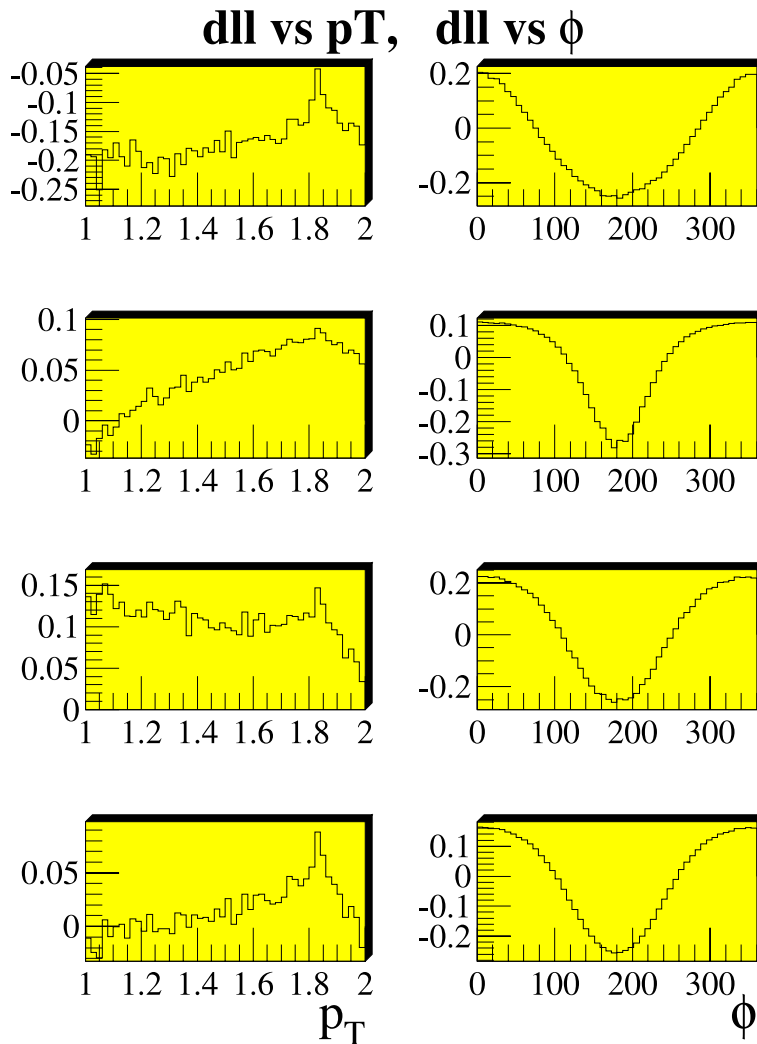


Fig. 2. \hat{d}_{LL} versus p_T and ϕ for (from up to down) tt , uu , tu and total terms.

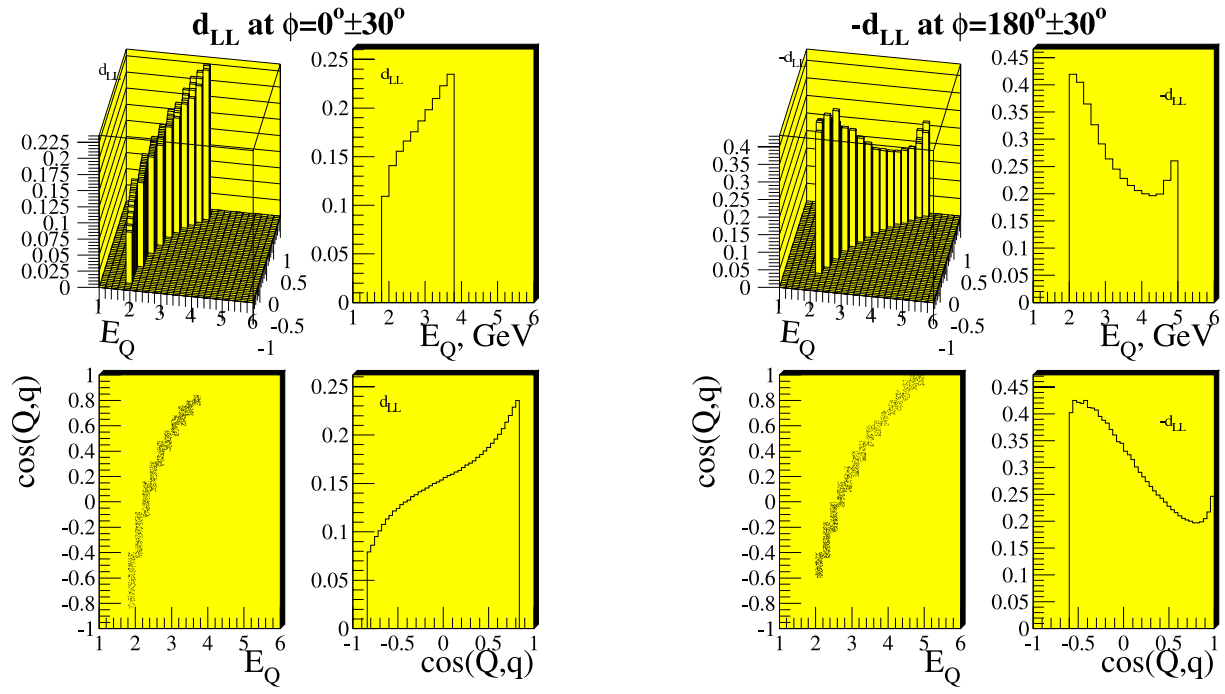


Fig. 3. \hat{d}_{LL} dependence on the quark energy E_Q and (Q,q) angle (see the text).

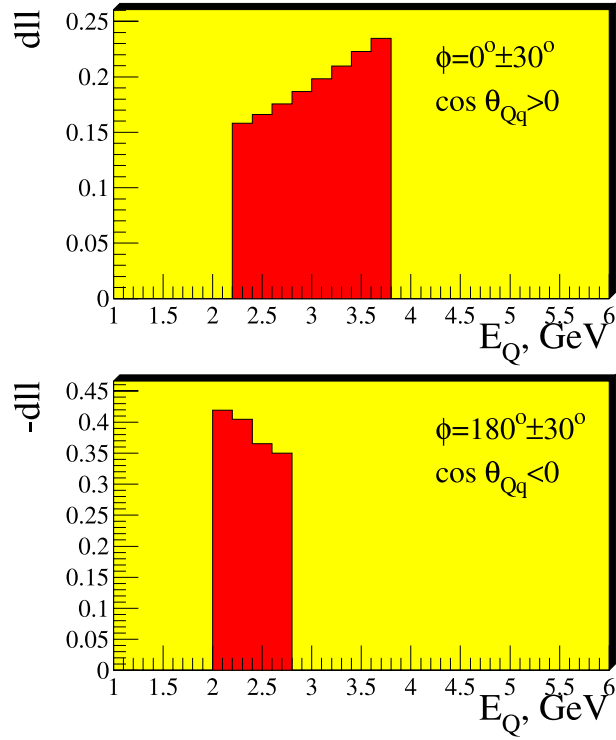


Fig. 4. The quark energy dependence of \hat{d}_{LL} in the forward and backward hemispheres.

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