Fragmentation of polarized deuterons into high momentum mesons as source of spin information of deuteron core structure

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Spin effect study at fragmentation of polarized 9 GeV deuterons into high momentum pions $\vec{d}A \to \pi(\theta)X$ was performed at the first time at Dubna polarized deuteron facility. Main attention was paid to the behaviour of spin observables at π-meson production with momenta close to kinematic limit when pions are produced on strongly correlated nucleon pair (cumulative production [1]), i.e. in the region of deuteron core. Dominating of D-state in the deuteron core region was supposed to cause notable spin effects in this reaction.

The simplest approach to explain a pion production off deuteron is the direct production mechanism (DPM) when the pion is produced at interaction of one of the nucleons in the deuteron with probe nucleon $NN \to NN\pi$. In terms quality the behavior of T_{20} in $dp \to \pi X$ reaction should be similar with $dp \to pX$ (well studied deuteron breakup) because it is defined by asymmetry of nucleon momentum distribution in D-state and by assumption that in both reactions the probe nucleon interacts with a quasi-free nucleon in the deuteron. However, the DPM-mechanism disregards meson exchange currents (MEC) which contribution is considerable in deuteron core region as it was supported by measurements of A- and B-deuteron formfactors at high Q^2 in ed-scattering [2].

The measurements of tensor A_{yy} and vector A_y analyzing powers in the reaction $\vec{d} + A \to \pi(\theta) + X$ were carried out with 9 GeV polarized deuterons slowly extracted from Dubna 10 Gev accelerator [3]. At fixed deuteron momentum p_d=9 GeV/c the pion momentum p_π was varied to cover the kinematic region which corresponds to internal momenta k in the deuteron from 0 to 0.5 GeV/c. The 0°-data show that $A_{yy}(0°)$, contrary to IA-predictions and A_{yy}-behaviour in $dp \to pX$, has the negative sign and increases with rise of p_π without any peculiarity near $k \simeq 0.3$ where D-state effects are maximum in deuteron breakup $dA \to pX$. The measurements at θ_π=135 and 180 mrad were performed as well. The sign of A_{yy} in the cumulative region ($p_\pi > 3$ GeV/c) is negative at all angles of $\pi^\pm$ emission. As the pion transverse momentum increases to 0.8 GeV/c the tensor analyzing power rises to $A_{yy} = -0.4$.

Thus, the large D-state effects were observed at fragmentation of tensor polarized deuterons into cumulative pions. It cannot be explained with the hypothesis of DPM-mechanism. Obviously, a meson component in deuteron core region should be takes into consideration. The new data of spin-dependent observables can be used for a profounder study of structure of meson exchange and quark exchange currents at short range NN-interactions.

References

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