ANALYZING POWERS A_{yy} AND A_y IN THE $A(d,p)X$ AND $A(d,d)X$ REACTIONS AT LARGE P_T

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The tensor and vector analyzing powers A_{yy} and A_y in deuteron inclusive breakup and deuteron inelastic scattering on carbon have been measured at a 9 GeV/c and 85 mr of the detected angle using polarized beam of the Synchrophasotron of the Laboratory for High Energies of JINR. The data are in definite contradiction with the predictions based on the standard nucleon-nucleon potentials.

The data on the tensor analyzing power T_{20} in deuteron inclusive breakup with the emission of the proton at a zero angle [1,2,3] have shown that the traditional picture of the deuteron as a bound state of a neutron and a proton fails for short distances between them. Neither account of mechanisms in addition to relativistic impulse approximation, nor including of additional components in the deuteron wave function (DWF) due to relativistic effects allow the T_{20} data be described at internal nucleon momenta ≥ 600 MeV/c. The T_{20} data in deuteron inelastic scattering [4] also demonstrate the unexpected behavior at large 4-momenta, t.

A failure of attempts to describe the polarization observables for these both reactions at 0^o in the framework of the traditional approaches can be considered as an indication of the manifestation of the non-nucleon degrees of freedom in the deuteron. An enlargement of the kinematic region to measure these observables is very desirable for a closer examination of this problem.

The experiment has been performed using a tensorially polarized deuteron beam of the Synchrophasotron of the Laboratory for High Energies of JINR. A slowly extracted 9 GeV/c deuteron beam with a typical intensity of $\sim 2 \cdot 10^9$ $\vec{d}$/spill was directed onto a carbon target. The data were taken at a 85 mrad of the emission angle and 6 values of secondary particle momentum between 4.5 and 7.0 GeV/c. The polar angle acceptance of the setup was $\Delta\theta \approx \pm 8$ mr. The momentum acceptance depending on momentum varied between $\Delta p/p \approx \pm 0.02$ and ± 0.03. The time-of-flight (TOF) information with a base line of $\sim$ 28 m was used in an off-line analysis for particle identification. The TOF resolution was better than 0.2 ns (1σ). The residual background was completely eliminated by the requirement that particles are detected at least in two prompt TOF windows.

Fig.1 shows the A_{yy} data from the present experiment along with the T_{20} data obtained at a zero transverse momentum of the proton on carbon target [1,2,3] plotted versus momentum of proton in the rest frame of the deuteron, q, (at a zero angle, $T_{20} = -\sqrt{2}A_{yy}$). The values of A_{yy} are positive for all data at large momenta q. These values are incompatible with the predictions[5] using DWFs from any reasonable nucleon-nucleon potential. On the other hand, attempts to take account of the non-nucleon degrees of freedom in the deuteron seems to be successful. An asymptotic positive value of $A_{yy} \sim 0.2$ for deuteron breakup at 0^o was obtained in the framework of the QCD motivated approach[7].

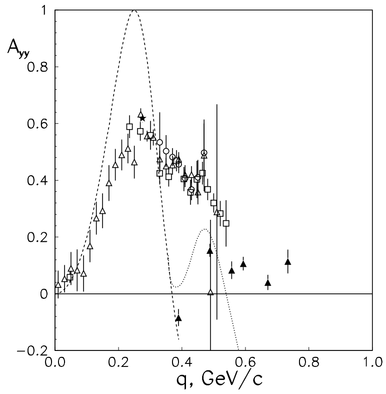

Figure 1: A_{yy} data for deuteron inclusive breakup from present experiment (filled triangles) as compared with the data obtained at 0^o on carbon target (ref.[1,2,3]) versus proton momentum in the rest frame of the deuteron q. The dashed and dotted lines are the results of calculations [5] using Paris DWF [6] for 0 and 85 mr proton emission angles, respectively.

Such a behavior of A_{yy} in the $^{12}C(d,p)X$ reaction at 0^o was obtained in the calculations taking into account multiple scattering and the Pauli principle at the constituent quark level[8].

In Fig.2 the A_{yy} and A_y data for deuteron inelastic scattering are presented versus the mass of undetected system. At low masses both observables are positive, while at $M_X \sim$ 2.2 GeV/c^2 they are consistent with a zero. The sign of A_{yy} at low M_X coincides with the sign of A_{yy} data obtained at a zero angle [4].

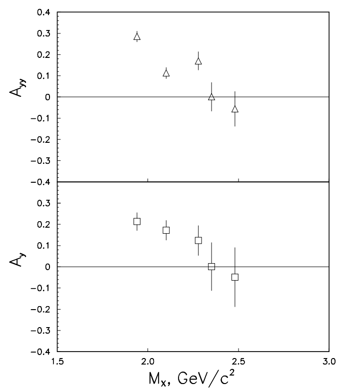

Figure 2: A_{yy} and A_y data in deuteron inelastic scattering versus missing mass M_X.

To conclude the results on the tensor and vector analyzing powers, A_{yy} and A_y, in deuteron inclusive breakup and deuteron inelastic scattering on carbon at large transverse momenta of the secondary particles have been obtained. The range of measurements corresponds to transverse momenta p_T between 390 and 600 MeV/c.

We observe that A_{yy} for deuteron inclusive breakup remains positive up to the largest momenta of the proton. Such a behavior of A_{yy} definitely contradicts the predictions of the relativistic hard scattering model [5] using conventional DWFs and may be caused by the manifestation of the non-nucleonic degrees of freedom in the deuteron. The observed non-zero value of the vector analyzing power A_y in deuteron inclusive breakup can be interpreted as an important role of the spin-dependent part of the nucleon-nucleon amplitude.

The data on A_{yy} and A_y in the $A(d,p)X$ reaction could provide new information on the spin structure of the deuteron and barionic excitation.

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