ОБЪЕДИНЕННЫЙ
ИНСТИТУТ
ЯДЕРНЫХ
ИССЛЕДОВАНИЙ
ДУБНА

E1-94-155

L.S.Azhgirey, S.V.Afanasyev, E.V.Chernykh, A.P.Kobushkin[1], V.P.Ladygin, S.Nedev, L.Penchev[2], C.F.Perdrisat[3], N.M.Piskunov, V.Punjabi[4], I.M.Sitnik, G.D.Stoletov, E.A.Strokovsky, A.I.Syamtomov[1], S.A.Zaporozhets

NEW DATA ON T_{20} IN INCLUSIVE DEUTERON BREAKUP AT 9 GeV/c ON PROTONS AND CORRELATION BETWEEN POLARIZATION OBSERVABLES

Submitted to «Few Body XIV Conference», May, 1994, USA

[1]ITP, 252130, Metrologicheskaya 14, Kiev, Ukraine
[2]INRNP, 1184, bul. Lenin 72, Sofia, Bulgaria
[3]The College of William and Mary, Williamsburg, VA 23185 USA
[4]Norfolk State University, Norfolk, VA 23504 USA

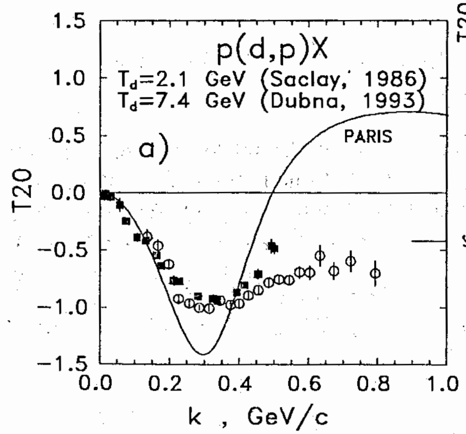
1994

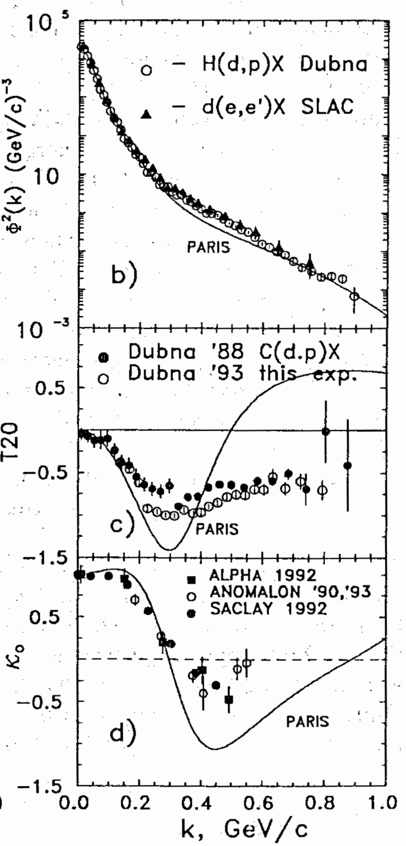
Experiments probing the deuteron structure at short distances with smooth transition to the intermediate and large distances provide a basis for crucial tests of the modern QCD-motivated theory of strong interactions. Such data are particularily important when the internal momentum is too large to allow separate identities for the nucleons in the deuteron. The very notion of the wave function is not defined in this region at all. Progress has been achieved[1, 2] especially in the measurement of cross section data and polarization observables for the inclusive deuteron breakup $A(d,p)X$ for beam momenta up to $9\,GeV/c$ (Fig. 1). The main results are as follows: (1) the empirical momentum density (EMD) of the nucleon in the deuteron is almost independent of the deuteron energy, of the target and of the type of the inclusive breakup reaction (see Fig.1b and refs.[1, 2]). (2) Polarization observables are also largely independent of the target and initial energy up to $9\,GeV/c$, as follows from comparison of our new data with data of ref.[2] (Fig.1a,c,d). (3) Impulse Approximation (IA) predictions are in agreement with all data sets *only for* $k \leq 150\,MeV/c$; a drastic disagreement is seen beyond this region. More complicated models, taking into account various additional contributions to the reaction mechanism, or "relativization effects", result in a partial success for a given observable, but not for the whole set of observables (Fig. 1,2 and ref.[3]; see also references therein).

1. New preliminary data on T_{20} in $p(d,p)X$ reaction at 0^o and discussion.

We present here new preliminary data on the tensor analyzing power T_{20} of the breakup reaction $p(d,p)X$ at 0^o obtained up to $k \sim 0.8\,GeV/c$ (Fig. 1a, open circles). The experiment was done using the ALPHA setup at the Dubna synchrophasotron; the "up" and "down" polarized deuterons were produced by the source POLARIS; the polarization modes were changed "burst-after-burst". The tensor beam polarization was measured using a 2-arm polarimeter[4]: $\mid \rho_{20}^{up} \mid + \mid \rho_{20}^{down} \mid = 0.914 \pm 0.012$. We used digital TOF-trigger[5] in the large k-region to select proton-fragments from a large background of inelastically scattered deuterons; as a by-product data on T_{20} for deep inelastic $p(d,d')X$ reaction were taken. The new breakup T_{20} data are close to the carbon data from ref.[2] apart from minor deviation around $k = 0.3\,GeV/c$ (Fig.1c); they agree well with data at lower energies (Fig.1a) far from the kinematical limit. There is no tendency to cross zero, a possibility not excluded by the previous carbon data at $9\,GeV/c$ which had big error bars. The interpretation of these data is normally based on two main assumptions: **(I)** the laboratory momentum $\vec{p}_{fr}$ (or $\vec{q}_{fr}$ in the deuteron rest frame) of the detected fragment proton is in one-to-one correspondence with the relative momentum of the deuteron constituents $\vec{q}$, which is the argument of the DWF in the Schroedinger equation in momentum space. This assumption justifies treating the argument of the DWF *as an observable.* **(II)** The spin state of the detected proton remains unchanged in the reaction. Authors of ref.[3] argued that it is the assumption **(II)** *together* with the commonly accepted S– and D–compo-

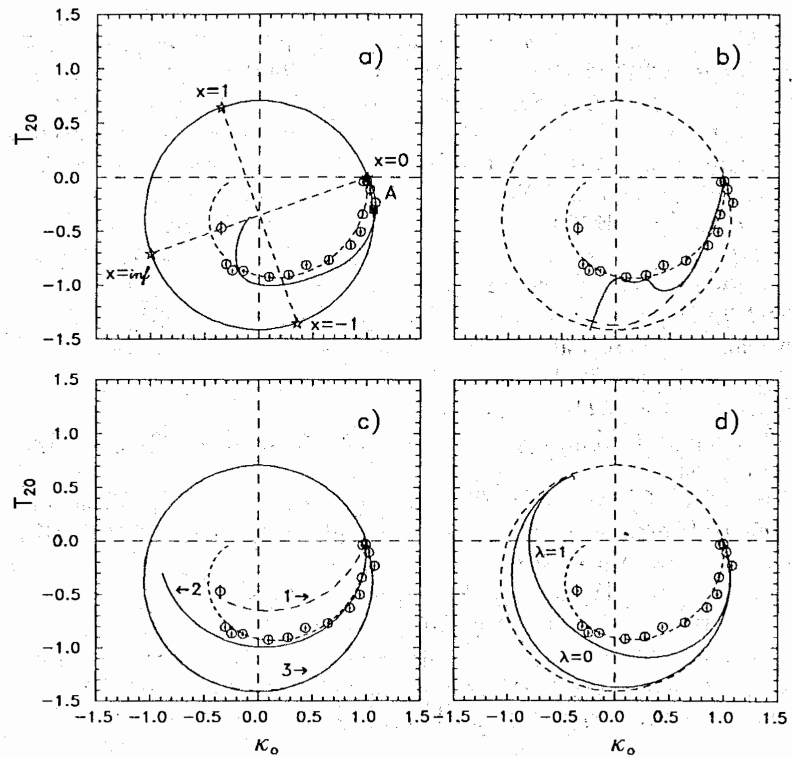
Fig.1 Observables measured for the deuteron breakup on protons and carbon. (a) T_{20} data for $p(d,p)X$ reaction versus the light cone variable k. Open circles: preliminary data from this experiment; solid squares: Saclay data from refs.[2]. QCD-motivated asympotic value of T_{20}: short solid line. (b) The EMD extracted from data[1, 6]. (c) All bulk of T_{20} data from refs.[2] and this experiment. (d) κ_0 data taken from refs.[2]. Solid lines: IA calculations based on Paris DWF.





nent structure of the DWF which results in a remarkable data-to-data relation between T_{20} and the ratio of the proton-fragment polarization to the polarization of the vectorially polarized incident deuteron (κ_0); this relation is the equation of a circle in the κ_0-T_{20} plane. The advantages of this representation are[3]: **(i)** the circle is independent on the particular form of the $S + D$ DWF, **(ii)** the specific momentum variable needs not to be defined explicitly.

Fig. 2 (a) κ_0-T_{20} plot with the circle[3]. Data points are from ref.[1] (Saclay exp.); short-dashed line: their fitted trajectory. The QCD-motivated asymptotic point: full square; the solid curve: calculations from ref.[7]. The stars mark the points where the ratio $x = D/S$ is equal to 0, $\pm\infty$, +1 and −1. **(b)** The same with calculations from ref.[8] with DWF based on Bonn $N-N$ potential. Solid line: full calculation, dashed line: calculation with only single scattering graphs (in both cases the complete elastic NN amplitude were used). **(c)** κ_0-T_{20} plot with trajectories calculated by Tokarev[9] for incident deuteron kinetic energies 2.1 GeV (1), 4.45 GeV (2) and $\sim 2\cdot 10^4\,GeV$ (3). **(d)** The same κ_0-T_{20} plot with trajectories calculated including the P-wave admixture as explained in ref.[3]. Parameter λ was introduced in ref.[10]: pseudovector ($\lambda = 0$) and pseudoscalar ($\lambda = 1$) πNN coupling.



The experimental data plotted on the κ_0-T_{20} plane (Fig. 2) deviate from the circle, indicating that either the DWF has additional components, (N^*N P-wave [3]), or that complicated spin dependent graphs modify the spin state of the detected proton.

2. Acknowledgments

We are grateful to the LHE staff for providing good conditions for the experiment, L.N. Strunov, A.A.Nomofilov and V.I.Sharov for measurements of the polarization of the primary deuteron beam, I.R.Boyko, L.V.Budkin, M.A.Ignatenko, N.S.Moroz, Z.P.Motina and members of SPHERE and DISK collaborations for their help during the experiment, M.P.Rekalo for his interest to the topics considered in the paper.

The research described in this publication was supported in part by grant N^o 93-02-3961 of the Russian Foundation for Fundamental Researches, by grant RFU 000 from the International Science Foundation, by grant PHY-91-11942 from the US National Science Foundation and grant DE-FG05-89ER40525 from the US Department of Energy.

References

1. V.G.Ableev et al, *Pis'ma ZhETF* **37** (1983) 196; *ibid* **45** (1987) 467; *Nucl. Phys.* **A393** (1983) 491, **A411** 541(E); *JINR Rapid Comm* **1[52]-92** (1992) 10; *Few Body Systems* **8** (1990) 137; C.F. Perdrisat et al, *Phys. Rew. Lett.* **59** (1987) 2840; V. Punjabi et al, *Phys. Rev.* **C39** (1989) 608.
2. V.Punjabi et al, *Phys. Rev.* **C39** (1989) 608; V.G.Ableev et al, *Pis'ma ZhETF* **47** (1988) 558; *JINR Rapid Comm* **4[43]-90** (1990) 5; E. Cheung et al, *Phys. Lett.* **B284** (1992) 210; I.Atanasov et al, talk presented at 10^{th} *Int. Symp. on High Energy Spin Physics, Nov. 9-14 1992, Nagoya*; T.Dzikowsky et al, in:*Proc. Int. Workshop "Dubna – Deuteron-91"*, JINR **E2-92-25** (1992) 181; A.A.Nomofilov et al, JINR **E1-93-405** (1993).
3. B.Kuehn, C.F.Perdrisat, E.A.Strokovsky, talk presented at *Int. Symp. Dubna – Deuteron-93, September 14-18 1993, Dubna.*
4. V.G.Ableev et al, *NIM*, **A306** (1991) 73.
5. V.P.Ladygin, P.K.Manyakov, N.M.Piskunov, *JINR Rapid Comm.*, **2[59]-93** (1993) 56.
6. I.Sick, D.Day, J.S.McCarthy, *Phys. Rev. Lett.* **45** (1980) 871; P.Bosted at al, *ibid* **49** (1982) 1380; D. Day et al, *ibid* **43** (1979) 1143; J.S.McCarthy et al, *Phys. Rev.* **C13** (1976) 712.
7. G.I.Lykasov, M.G.Dolidze, *Z. Phys.* **A336** (1990) 339.
8. C.F. Perdrisat, V.Punjabi, *Phys. Rev.* **C42** (1990) 608.
9. M.V.Tokarev, private comm.; see also review M.A.Braun, M.V.Tokarev, *Physics of Elementary Particles and Atomic Nuclei*, **22** (1991) 1237.
10. W.Buck, F.Gross, *Phys. Lett.* **63B** (1976) 286.

Received by Publishing Department
on April 28, 1994.