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E1-94-156

MEASUREMENTS OF T_{20} IN BACKWARD ELASTIC *dp* SCATTERING AT DEUTERON MOMENTA 3.5—6 GeV/c

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

1994

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1. Introduction

Direct reconstruction of the deuteron wave function (DWF) based on its relation with measured quantities within the Impulse Approximation (IA) framework is possible for the reaction of the deuteron electrodisintegration $ed \to enp$, and also for reactions with nuclear probe such as $A(d,p)X$ at zero angle and $p(d,p)d$ (at 180° in the center of mass).

The comparison of the momentum distributions of the fragments extracted in this way from experiments with electromagnetic and nuclear probes[1-3] has revealed their similarity even in a region where appreciable deviation from the IA calculations take place. This circumstance gave a strong motivation to develop a program of investigations of polarization observables in reactions with nuclear probes, which would allow to reconstruct the DWF components. The measurement of T_{20} in dp backward elastic scattering was one of the first experiments with a polarized deuteron beam at SATURNE-2[4].

Here we present results of measurements of this observable which were performed at the JINR synhrophasotron mainly in the range of energies unreachable at SATURNE. The investigation was carried out by the Dubna-Saclay-Virginia collaboration, which was organized to study polarization phenomena in the elastic backward dp scattering both at Saclay and at Dubna.

2. Experiment

The tensor polarized beam of intensity 10^9 deuterons/beam spill incidented on a 30 cm liquid hydrogen target. The beam polarization states were changed in a bunch-after-bunch mode during data taking; the beam polarization was $\rho_{20}^{+} = 0.49 \pm 0.03$ and $\rho_{20}^{-} = -0.52 \pm 0.04$.

The recoil protons emitted in lab. in forward direction at 0 ± 15 mrad were detected after the beam-line in the magnetic spectrometer ALPHA. The corresponding angular acceptance in the center of mass system increased from $(180 \pm 2.4)^o$ at the lowest energy to $(180 \pm 3.0)^o$ at the highest energy of the primary beam. The backward scattered deuterons were not detected; in this case one needs to have high momentum resolution to reject non-elastic events. In this experiment $\frac{\Delta p}{p} = 0.3\%$ was achieved; it corresponds to

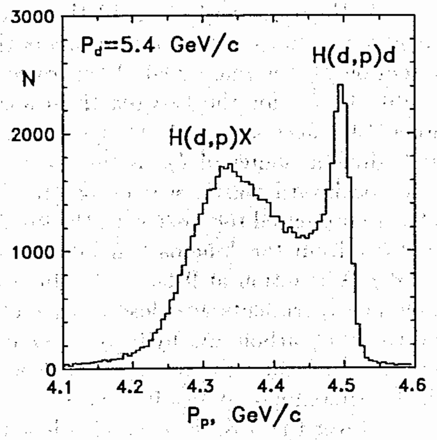

Fig.1 Forward proton momentum distribution in vicinity of backward elastic peak.

a missing mass resolution of 4 MeV for the lowest energy and 8 MeV for the highest.

The separation of elastic events from the background (mainly deuteron breakup reaction in the region of the kinematical limit) is illustrated in Fig.1. It was also necessary to separate protons from inelastically scattered deuterons with the same momentum from the reaction p(d,d')X [5]. This contamination contribute up to 3000 deuterons per 1 proton at the highest energy. To reject such events at the trigger level, a digital TOF-trigger[6] was tuned to make rather soft rejection.

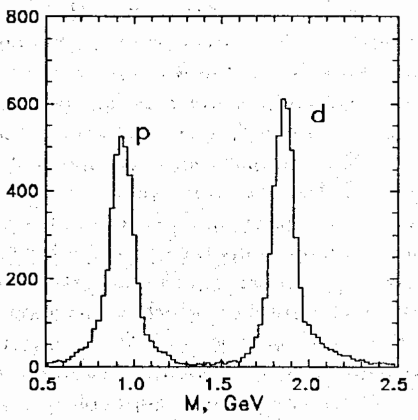

Fig.2 Mass distribution (deuterons are suppressed partly by the TOF-trigger).

The final separation of protons from deuterons was done using measured values of particle momenta and their times of flight. The mass separation achieved is illustrated in Fig. 2.

3. Results

In the framework of the IA the expression T_{20} is identical for $p(d,p)d$ and $p(d,p)X$ reactions (when one considers the deuteron as S- and D-component system only); the main goal of this experiment was to establish whether this equality of T_{20} for the two reactions holds true in reality. The rather large momentum acceptance of the spectrometer (see Fig.1) allowed us to follow the regime of change of T_{20} as the breakup process approaches its kinematical limit: backward elastic scattering. In Fig.3 the backward elastic scattering data are presented together with the breakup data from this experiment taken far away from the kinematical limit at each energy, and with the data for $^{12}C(d,p)X$ reaction at 9 GeV/c[7]. One can see that breakup data from these different experiments are close to each other in spite of the different energies and targets (carbon and hydrogen). One can see also an important difference between T_{20} values for breakup reaction and for backward elastic scattering which is maximum at $k = 0.65$ GeV/c.

Never-the-less, the general k-dependence of T_{20} in both reactions demonstrate the same important disagreements with expectations based on IA-like approaches: T_{20} does not achieve expected value of minimum $(-\sqrt{2})$ in vicinity of $k = 0.3$ GeV/c[8] and in contradiction with the predictions have a tendency to remain negative at higher values of k.

The new measurements of dp bacward elastic scattering were undertook in Dubna this year. The data analysis now in progress. But it is possible to say already now that T_{20} remains negative up to $k = 0.85$ GeV/c.

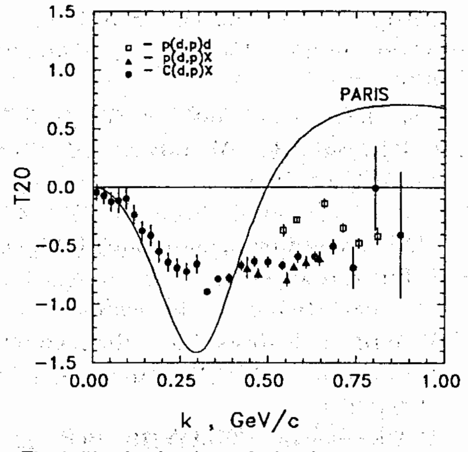

Fig.3 T_{20} for backward elastic scattering and for breakup reaction far from the elastic peak (this experiment) and for the $^{12}C(d,p)X$ reaction[7].

To explain revealed effects one can consider the additional to IA mechanisms, different for the discussed reactions. It is possible also remaining in the framework of the IA to assume more than two-component DWF. For example, two P-wave in the DWF emerges when the deuteron is considered in relativistic approach[9], or N^*N projections of the 6-quark DWF[10] are essential. It is important to stress that if the DWF has a P-wave component then the identity between the IA expressions for T_{20} for the discussed two reactions disappears[12].

The relativistic model of the deuteron assuming more than two arguments of the DWF[11] must be considered also. A more detailed analysis of these hypotheses in the light of the new data needs to be done.

This work has been supported in part by the Russian Foundation for Fundamental Research under grant No. 93-02-3961, and by the US National Science Foundation (C.F.P.: grant PHY91-11942) and US Dept. of Energy (V.P.: grant DE-FG05-8940525).

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**Received by Publishing Department
on April 28, 1994.**