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1. The Experiment

In this paper we report preliminary results of a study of the deuteron-pion systems in the $dp \to dp\pi^+\pi^-$ and $dp \to dn\pi^+$ reactions.

The data were obtained in a ~ 0.6 event/μb exposure of the JINR hydrogen bubble chamber to a 3.3 *GeV/c* deuteron beam.

A sample of 134 4-C fit events of the reaction

$$dp \to dp\pi^+\pi^- \qquad (1)$$

was selected out of 2054 four-prong events. All of them belonging to reaction (1) were unambiguous.

We found 197 unambiguous events for the reaction

$$dp \to d\pi^+ n \ . \qquad (2)$$

The ionization criterion enabled protons and deuterons up to the 1.7 *GeV/c* momentum to be separated.

For convenience in comparison with other experiments all the quantities in the text below are presented in the deuteron rest system.

2. The $dp \to dp\pi^+\pi^-$ *Reaction*

The cross section of $276 \pm 24 \mu b$ was obtained for the reaction (1). The available data on the $dp \to dp\pi^+\pi^-$ reaction for different energies are listed in Table 1. The

Table I

P_{beam} (GeV/c)	(μb) $pd \to dp\pi^+\pi^-$	Γ (MeV)	M (MeV)	Reference
1.665	276 ± 24	13 ± 6	2151 ± 5	this paper
1.69	–	≳ 20	2161 ± 2	/13/, counter exp.
1.825	310 ± 30	50 ± 10	2130 ± 10	/1/
2.11	340 ± 30	50 ± 10	2145 ± 10	/1/

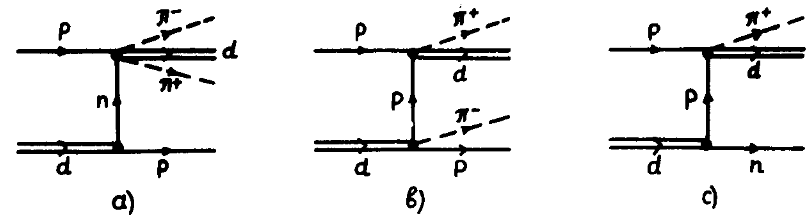

Fig. 1. Diagrams involving baryon exchange.

four-momentum transfer t_{dd} distribution from the initial to the final state deuteron is flat enough and implies no significant contribution of the coherent pion production on the deuteron. Figure 1 shows the possible diagrams with baryon exchange which can lead to the observed t_{dd} distribution.

In fig. 2 (a) and (b) the deuteron momentum is plotted versus the nucleon momentum for the reactions (1) and (2), respectively. Further we are concerned with the events lying below the diagonal line for which the deuteron momentum is bigger than the proton one. We call them events with fast deuteron.

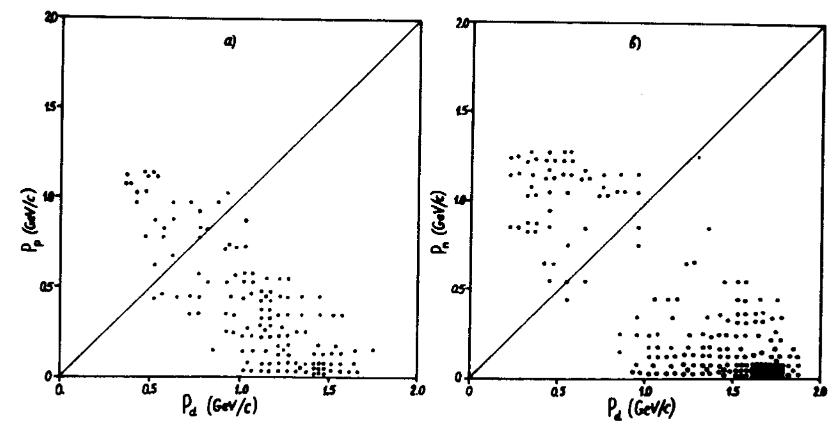

Fig. 2. The deuteron momentum distribution versus the nucleon momentum in the deuteron rest system: (a). reaction (1); (b). reaction (2).

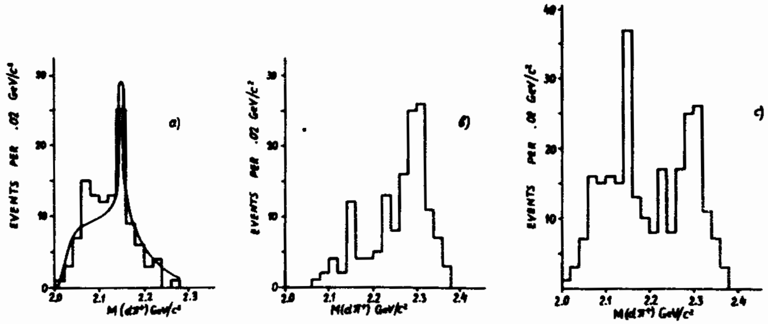

Fig. 3. The $d\pi^+$ *effective mass distribution: (a). reaction (1); (b). reaction (2); (c). summary distribution. The curve represents the fitted combination of the Breit-Wigner and phase space distributions.*

In fig. 3 (a) we show the $(d\pi^+)$ effective mass distribution for fast deuteron events. A significant peak is observed at 2.151 ± 0.005 *GeV* with a remarkable Γ value of 13 ± 6 *MeV*.

3. *The* $dp \to d\pi^+ n$ *Reaction*

The t_{dd} distribution for unambiguous events from the reaction (2) is similar to that observed for the reaction (1). The $d\pi^+$ effective mass distribution for fast deuteron events shows (fig. 3b) an enhancement at $M_{d\pi^+}$ = 2.294 ± ±0.005 *GeV* with a width of 47 ± 13 *MeV*. A signal at 2.15 *GeV* is also present but of weaker significance than in the reaction (1).

An enhancement in the $d\pi^+$ system near 2.3 *GeV* has been recently observed in the $pd \to dn\pi^+$ reaction for slightly higher energy [9]. For comparison table II shows the peak parameters and the total nucleon-nucleon c.m.s. energies for ref. [9] and for our experiment. It is seen that for both cases the peak position is close to the total nucleon-nucleon c.m.s. energy. The neutron momentum distribution (fig. 4b) follows fairly well the prediction of the deuteron wave function. These two facts imply that

Table II

P_{beam} (GeV/c)	M (MeV)	Γ (MeV)	total c.m.s. energy (MeV)	Reference
1.665	2294 ± 5	47 ± 13	2312	this paper
1.825	2375 ± 10	75 ± 15	2370	/9/

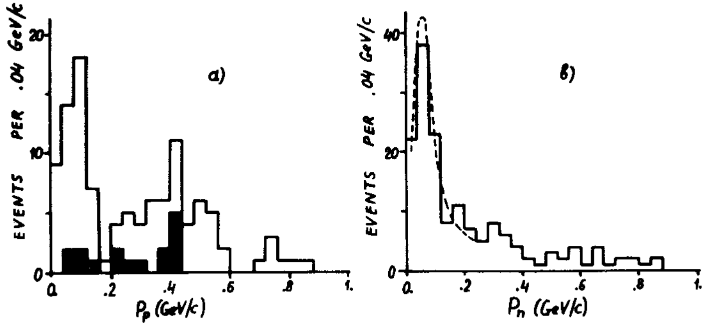

Fig. 4. The final nucleon momentum distributions in the deuteron rest system: (a). proton momentum distribution for reaction (1); (b). neutron momentum distribution for reaction (2). The curve represents the spectaror momentum distribution for the $dp \to ppn$ *reaction normalized in the 0 - 200 MeV/c interval.*

the observed enhancement cannot be considered as a resonance but as a kinematic effect. The peak width is probably due to the Fermi motion of the nucleon in the deutron.

4. Discussion of the $d\pi^+(2.15)$ Enhancement

Some authors of production experiments [2–4,8,11] have reported on $d\pi^+$ enhancement for the 2.2 *GeV* effective mass with a width from 100 to 200 *MeV* for various incoming particles, incident momenta, and final states. The bump at 2.2 *GeV* has been also seen in formation experiments [6,7].

Several mechanisms were proposed to explain the effect [10–12]; in each of them there occured the intermediate Δ production leading to the width of the enhancement comparable to that of the Δ and close to that observed in experiment.

The only direct observation was reported [1] on $d\pi^+$ enhancement with a much smaller width of (50 ± 10) *MeV*. An indication of the existence of a peak in

the $d\pi^+$ system with a width of about 20 *MeV* was also presented in ref. [13] (see table I).

It is unlikely that the narrow peak at 2.51 ± 0.005 *GeV* observed in our experiment, can be ascribed to various processes involving the intermediate Δ production due to a very narrow width of the peak. However, a connection is possible between the observed signal and the predicted $\Delta\Delta$ bound state discussed recently in the literature [14–18].

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