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# INDICATION OF DIBARYON RESONANCE PRODUCTION IN PROCESSES OF RELATIVISTIC DEUTERON FRAGMENTATION

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Proton momentum spectra for reaction

$$d + A \longrightarrow p + X \qquad (1)$$

have been measured in detail at the Dubna synchrophasotron. The incident deuteron momentum was 8.9 GeV/c. The protons emitted at an angle of $\theta < 0.4^\circ$ were registered and identified by threshold Cherenkov counters. The experimental set-up description and a table of the experimental data for the C target are presented elsewhere/1/. The measured invariant cross sections of the proton yield for reaction (1) on the C and $CH_2$ targets are presented in fig.1.

The relativistic deuteron wave function of the hybrid model/2/

$$\psi_d = \psi_{np} + \beta\, \psi_{6q}$$

was used for the experimental data description. The Paris potential (PARIS) and the oscillator quark model were chosen for the calculation of a two-nucleon wave function $\psi_{np}$ /3/ and a six-quark wave function $\psi_{6q}$, respectively.

The hybrid model has three free parameters: the RMS radius of the 6q-system, $r_{6q}$, the value of 6q-admixture in the deuteron, $\beta^2$, and a relative phase of np and 6q components of the deuteron wave function, $\kappa$. These parameters were found by fitting the calculation (see formula (2.10) in ref./4/) to the data in the region of the momentum spectra from 5.0 to 7.5 GeV/c (110 to 500 MeV/c in the deuteron rest frame). The lower momentum region was used for the absolute normalization of experimental data. The fitted parameters are given in the table. As is seen from the table, the approximation of the cross sections on both targets gives consistent results. The value of 6q-admixtures agrees with the estimates obtained in other papers (see, e.g.,/5/). The experimental data are well described by the model with the obtained parameters over the whole measured region except for the narrow band (A) from 290 to 390 MeV/c (in the table values of $\chi^2$ are given for experimental points lying outside this band). One can see from fig.2 that the difference of the experimental data and the calculations in this region has a bump which can be explained by the production of dibaryon resonance in the reaction

$$d + N \longrightarrow d^* + N, \quad d^* \longrightarrow p + N \qquad (2)$$

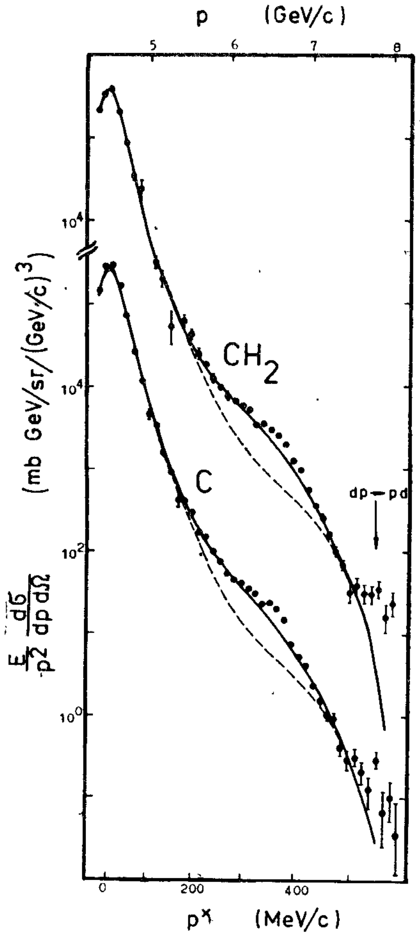


Fig.1. Invariant cross sections of the proton yield for reaction (1) on the C and $CH_2$ targets as a function of proton momentum in the deuteron rest frame (lower horizontal scale) or as a function of proton laboratory momentum (upper horizontal scale). Solid lines - the result of the calculations within the framework of the model[4] with the parameters presented in the table, dashed lines - the calculations without taking into account the 6q-component of the deuteron wave function.

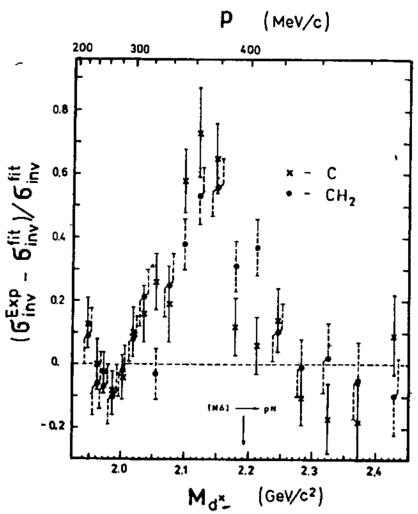


Fig.2. Difference of the experimental cross sections and calculations for reaction (1) on the C and $CH_2$ targets as a function of proton momentum in the deuteron rest frame (upper horizontal scale). The lower horizontal scale corresponds to the mass of the d* system produced at a zero angle.



or by other imitating reactions. For example, one could attempt to explain the enhancement in the region (A) by the contribution from the triangular diagram with $\Delta$-isobar in the intermediate state.

Table

The hybrid model parameters

| Target | $\beta^2$ | $r_{6q}$ (fm) | $\kappa$ | $\chi^2$/degree of freedom |
|---|---|---|---|---|
| $CH_2$ | $(5.4\pm0.6)\%$ | $0.99\pm0.04$ | $95°\pm7°$ | 1.6 |
| C | $(4.3\pm0.4)\%$ | $0.95\pm0.05$ | $82°\pm6°$ | 1.9 |

To clarify the nature of this bump, a combined analysis of the data from the C and $CH_2$ targets has been made. The excess of the experimental cross section over the calculation can be expressed as

$$R = \sum_i (\sigma^i_{exp} - \sigma^i_{fit}) / \sum_i \sigma^i_{fit}.$$

The ratio of these values for the $CH_2$ and C targets is

$$R(CH_2)/R(C) = 1.00 \pm 0.07, \qquad (3)$$

i.e., the process which gives an anomalous behaviour in the spectra in the region (A) is insensitive to the nucleon composition of a target. At the same time the value of ratio (3) must be different from 1 for the processes with nonzero isospin exchange. For example, for the process with intermediate $\Delta$-isobar the ratio (3) must be equal to 1.22 if the effective number of nucleons in carbon equals to 4. So, the $\Delta$-origin of the observed bump is unprobable.

If the observed bump is interpreted as a contribution from process (2), the result (3) suggests that the d*-resonance has a zero isospin. The Monte-Carlo simulation of diffractive production mechanism of the reaction (2) gives a bump position and its half width that agrees with experimental ones if the values of the resonance mass and width are $M = 2.14$ GeV/c$^2$ and $\Gamma$ = = 80 MeV/c$^2$, respectively.

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Аблеев В.Г. и др. E1-82-777
Указание на рождение дибарионного резонанса
в процессах фрагментации релятивистского дейтрона

Приводятся результаты измерений фрагментации дейтронов с импульсом 8,9 ГэВ/с на C и $CH_2$ мишенях. Импульсный спектр протонов, вылетающих под углом $\theta < 0{,}4°$, исследован в области 4 ГэВ/с $<p<$ 8 ГэВ/с. Для описания экспериментальных данных использована модель с гибридной волновой функцией дейтрона $\psi_d = \psi_{np} + \beta\psi_{6q}$. Обнаружена особенность в импульсных спектрах протонов при $p \sim 6{,}6$ ГэВ/с. Она интерпретируется как проявление дибарионного резонанса с изоспином I = 0, массой и шириной $M \simeq 2{,}14$ ГэВ/с$^2$, $\Gamma \simeq 80$ МэВ/с$^2$.

Работа выполнена в Лаборатории высоких энергий ОИЯИ.

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Ableev V.G. et al. E1-82-777
Indication of Dibaryon Resonance Production
in Processes of Relativistic Deuteron Fragmentation

Proton momentum spectra from d–C and d–$CH_2$ fragmentation reactions at 8.9 GeV/c are measured at an angle of $\theta < 0.4°$ in the region of 4 to 8 GeV/c. Results are described by a hybrid model of deuteron wave function $\psi_d = \psi_{np} + \beta\,\psi_{6q}$. Enhancements observed in the spectra at $p \sim 6.6$ GeV/c are interpreted as an evidence for a dibaryon resonance with isospin I = 0, mass and width $M \simeq 2.14$ GeV/c$^2$, $\Gamma \simeq 80$ MeV/c$^2$, respectively.

The investigation has been performed at the Laboratory of High Energies, JINR.

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