TEST OF CHARGE SYMMETRY IN ($\pi^{\pm}$d)-ELASTIC SCATTERING AT T_π = 417 MeV ENERGY

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A considerable number of experimental and theoretical investigations has been devoted lately to the comparison of observables in charge symmetry processes. The (πd) — system is quite convenient for the experimental test of charge symmetry. The first precise measurements of (π^-d) — and (π^+d) total cross sections have been carried out at SIN [1]. Then, in experiments of CERN [2], LAMPF [3], TRIUMF [4] the charge asymmetry parameter

$$A(T_\pi, \Theta^*) = \frac{d\sigma/d\Omega^-(\Theta^*) - d\sigma/d\Omega^+(\Theta^*)}{d\sigma/d\Omega^-(\Theta^*) + d\sigma/d\Omega^+(\Theta^*)}$$

has been measured. These measurements have been performed in the energy region of T_π = 143 — — 256 MeV, and at T_π = 65 MeV, that is at energies in the region of the Δ_{33} — isobar or below.

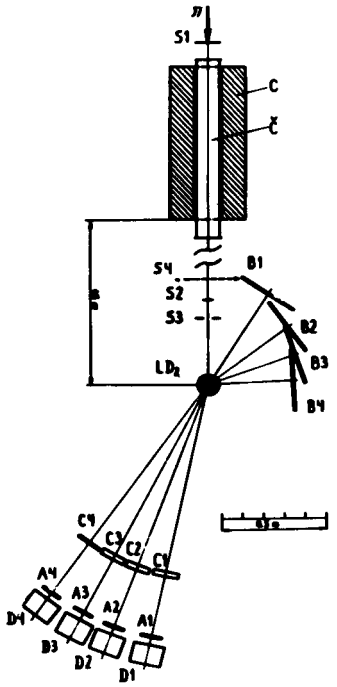

Fig. 1. Experimental set-up

The deviation of $A(T_\pi, \Theta^*)$ from zero (which persistently remains after the estimations of electromagnetic interaction) in the Δ_{33} — region was explained by the authors [3, 4] when variating, within small bounds, the masses and widths of the charge components of the isobar. This explanation for the behavior of $A(T_\pi, \Theta^*)$ at T_π= 65 MeV was impossible [2, 5]. In view of the above mentioned it is interesting to investigate this problem at energies well beyond Δ_{33} — isobar.

The charge asymmetry parameter $A(T_\pi, \Theta^*)$ at T_π = 417 MeV for scattering angles Θ^* = 106°; 122°; 137° and 154° has been measured at the pion channel of the LNPI synchrocyclotron. A number of scintillation spectrometers and a helium-cooling liquid deuterium target have been created for this experiment. The experimental set-up is shown in fig 1. The secondary particle beam has been formed by a pion channel of the LNPI. To decrease the contamination of protons and heavier particles in the beam we have used the plexiglas degrader 8 cm wide, placed in the midplane of the pion channel; the momentum collimator was placed at a short distance downstream. The momentum acceptance $\Delta P/P$ due to this collimator was $\cong$0.03 (FWHM). The protons remaining in the π^+-beam were reduced by the time of flight criterion between the monitor counters S1 and S2 (on a base of 2 m). The resulting proton contamination in the beam monitor count was $\cong$0.5%. One and the same momentum collimator and degrader have been used for both π^+-mesons and π^--ones to provide identical experimental conditions. The data were collected in sequences of 14 alternating cycles of (π^-d)- and (π^+d)-elastic scattering to reduce possible systematic errors. The equality of

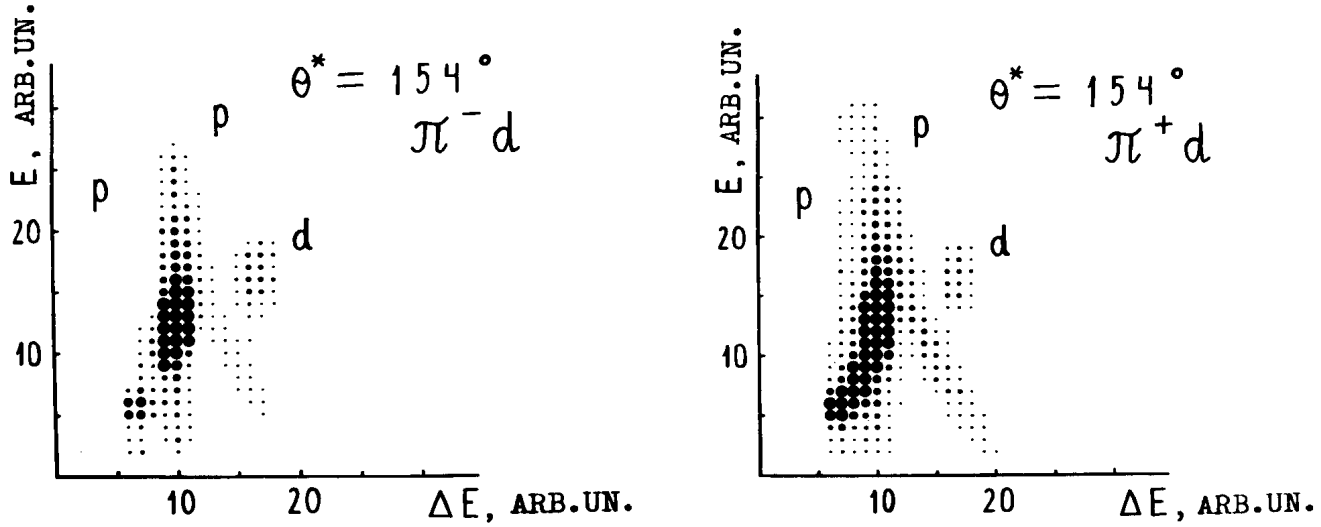

Fig. 2. Scatterplots for the angle $\Theta^* = 154$ deg. Area of each circle is proportional to number of events. Number of deuteron events$\cong$1000 for each of scatterplot

the mean incident beam energies of π^-- and π^+-mesons was within $\pm 0.2\%$. The contamination of electrons (positrons) in the beam was rejected using a gas Cherenkov counter (CO_2). The profiles of π^- - and π^+-beams, hitting the target, have bean controlled periodically using a special profile device S4.

The main criterions which have been used to select the $\pi d \to \pi d$ events were:

1. The coincidence of pulses from detectors A_i, B_i, C_i and D_i which were placed at angles corresponding to the kinematics of πd-elastic scattering.

2. The values of energy losses ΔE and energy E of particles, where $\Delta E = dE/dX \cdot \Delta X$ corresponded to the pulse height in plastic scintillators C_i, and E to the pulse height in NaI crystals D_i.

A scatterplot for scattering angle $\Theta^* = 154°$ is shown in fig 2 in two dimentional histograms of ΔE vs E. It is seen that the use of two main criterions (5 criterions have been used in the experiment) allows to separate the deuterons from the quasielastic proton in the reaction $\pi p(n) \to \pi p(n)$ on deuteron.

Similar scatterplots have been measured at each scattering angle. The treatment of these histograms permits to calculate a number of events of (π^-d)- and (π^+d)-elastic scattering. The data which have been obtained in the above mentioned way are being analyzed.

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