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 because many systematical errors are canceled due to identity of the experimental set-ups for the measurements of both $\pi^- d$ and $\pi^+ d$-elastic scattering. In experiments of CERN [1], LAMPF [2], TRIUMF [3] the charge asymmetry parameter

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

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.

The deviations of $A(T_\pi,\Theta^*)$ from zero (which remain after the estimations of electromagnetic interaction) in the Δ_{33}-region were explained by the authors [2,3] when variating the masses and widths of the charge components of the isobar. On the other hand this explanation for the behaviour of $A(T_\pi, \Theta^*)$ at T_π =65 *MeV* was impossible [1,4]. In view of the above mentioned it is interesting to investigate this problem at the energies well beyond Δ_{33}-isobar.

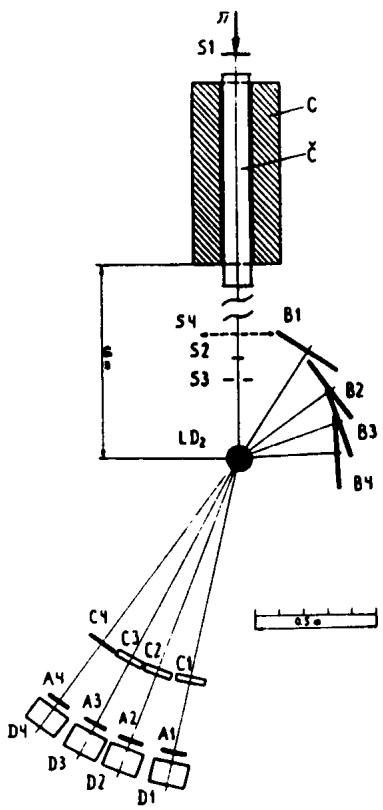

Fig.1.

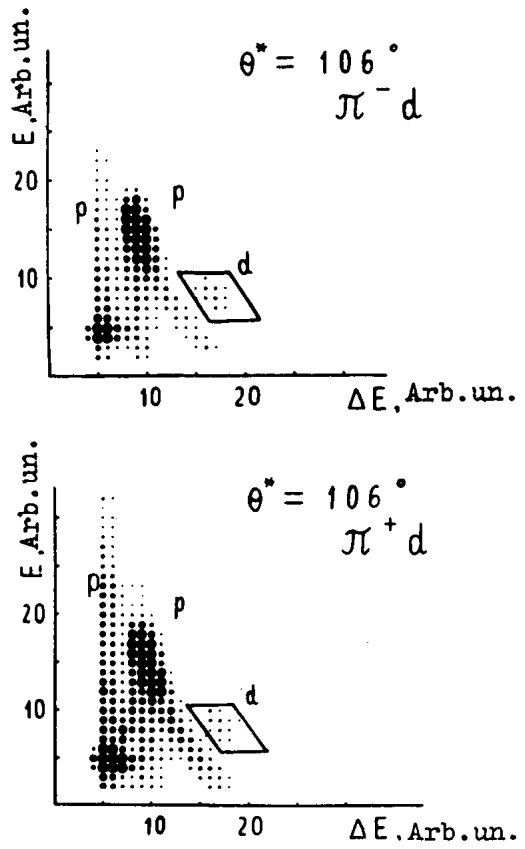

Fig.2.

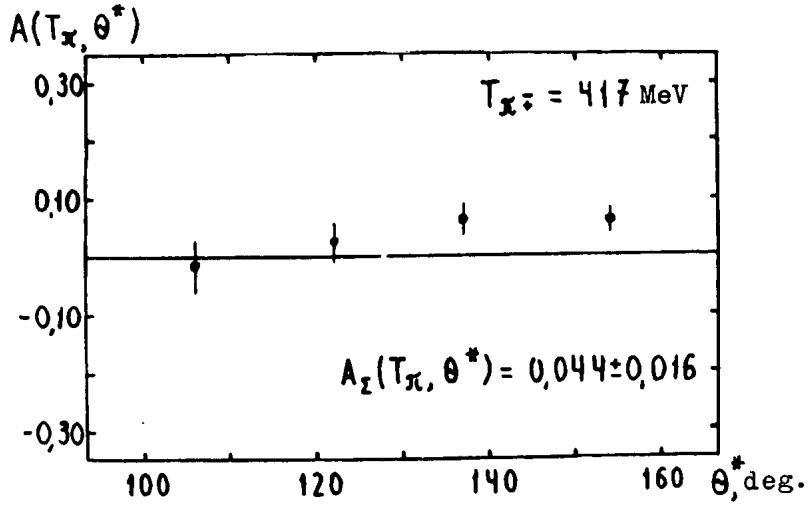

Fig.3.

The charge asymmetry parameter $A(T_\pi, \Theta^*)$ at $T_\pi = 417$ *MeV* for scattering angles $\Theta = 106^0; 122^0; 137^0$ and 154^0 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 built for this experiment. The experimental set-up is shown in fig.1. The $\pi^-(\pi^+)$-momentum acceptance was $\Delta p/p \approx 0.03$ (FWHM). The data were collected in sequences of 14 alternating runs of $\pi^- d$ and $\pi^+ d$-elastic scattering to reduce possible systematic errors. The equality of the mean incident beam momenta of π^- and π^+ -mesons was within $^{+0.4}_{-0.2}\%$.

The electrons (positrons) contamination in the beam was rejected using a gas Cherenkov counter (CO_2). The profiles of π^- and π^+ beams hitting the target have been controlled periodically using a special profile device S4.

The two main criteria which have been used to select the $\pi d \to \pi d$ events were (in total five criteria have been used in the experiment):

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

2. The values of the energy losses ΔE and the energies E of the particles (where $\Delta E = dE/dx \cdot \Delta x$ corresponded to the pulses in the plastic scintillators C_i and E corresponded to the pulses in NaI crystals D_i).

A scatterplots for the scattering angle $\Theta^* = 106^0$ are shown in fig.2 in two-dimensional histogram of ΔE vs E. Similar scatterplots have been measured at each scattering angle. The treatment has allowed to calculate a number of events of $\pi^- d$ and $\pi^+ d$ elastic scattering.

Revealed by this way the charge asymmetry parameter $A(T_\pi, \Theta^*)$ is shown in fig.3 [5].

Statistical errors of $A(T_\pi, \Theta^*)$ are between 2.4% and 4.6% depending on the scattering angle and 1.6% for the integral asymmetry parameter $A_\Sigma(T_\pi, \Theta^*)$ [5]. Systematic errors are from 1.5 to 2.7%. The radiation corrections have been calculated with Borie's method [6] and taken into account in our results.

References

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