MEASUREMENT OF SPIN ROTATION PARAMETERS *R* AND *A* IN πp ELASTIC SCATTERING IN REGION OF LOW-LYING PION-NUCLEON RESONANCES

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Lately the study of πp scattering has made a qualitatively new step. On the one hand, extensive experimental investigations were continued at all the meson factories (PSI, LAMPF, TRIUMF) and at the accelerators of LNPI, ITEP, KEK; as a result new precise and systematic experimental data were obtained. Spectrim of πN resonances can be extracted from these data using procedure of a phase-shift analysis. On the other hand, efforts of theoreticians have led to development of many different quark models describing spectrum of πN resonances and predicting their parameters. Comparison of the theoretically calculated

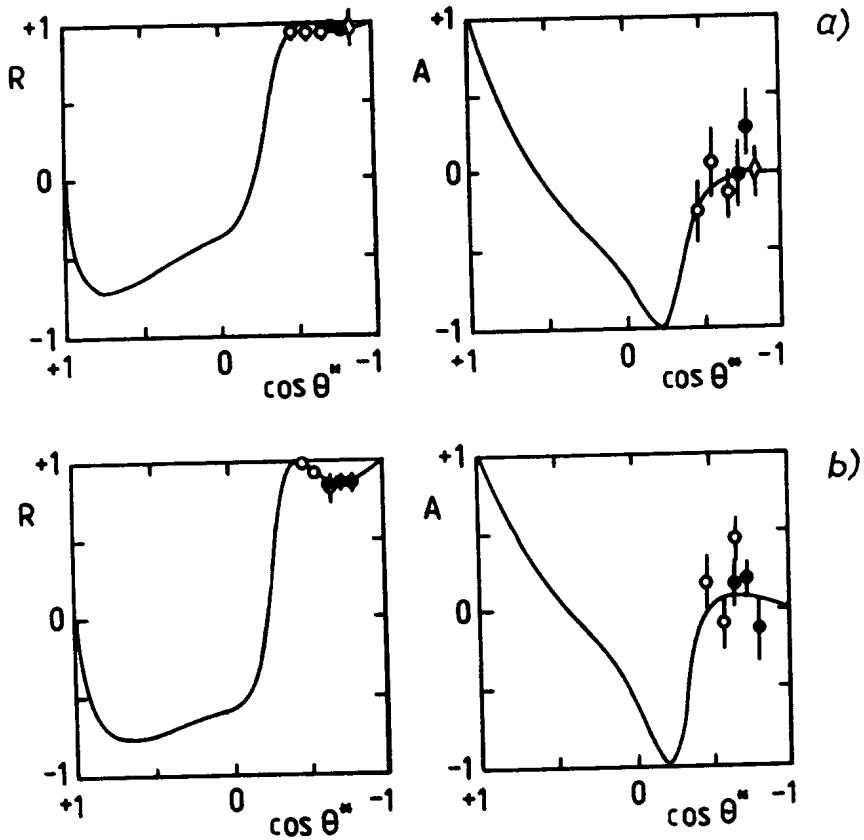

Fig.1. Spin rotation parameters in $\pi^- p$ elastic scattering at energies 530 MeV (*a*) and 560 *MeV* (*b*) measured at angles $\alpha_1 = -35^0$ (•) and $\alpha_2 = 10^0$ (o). Shown by curves are results of the LNPI phase-shift analysis. Results of LAMPF measurements (◊) performed at the energy 530 MeV for one scattering angle $\cos\Theta^* = -0.84$ are also presented

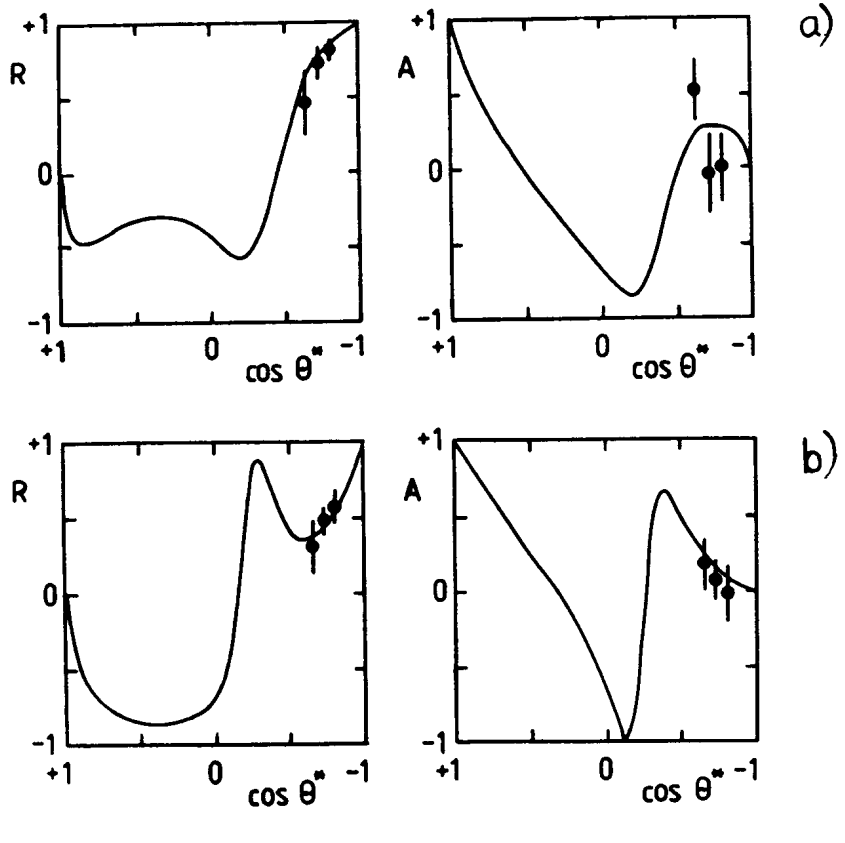

Fig.2. Spin rotation parameters in $\pi^- p$ elastic scattering at the energies 450 *MeV* (*a*) and 600 *MeV* (*b*) measured at angle $\alpha = -35^0$. Shown by curves are results of LNPI phase-shift analyses

spectrum (and parameters) of πN resonances with the one extracted from experimental data will allow, in principle, to choose the most reliable theoretical model.

One of the most important experiments is a measurement of the spin rotation parameters R and A. Such experiment provides physicists with an information which they can not obtain, in principle, from the measurements of any other observables. Only after performing the spin rotation parameters measurement an unambiguous determination of the scattering amplitude and characteristics of the πN resonances is possible.

The main parts of the experimental set-up are a polarized proton target inside a pair of superconducting Helmholtz coils with horizontal orientation of polarization vector and a proton polarimeter on the base of multigap optical spark chambers with carbon electrodes; a special television measuring system is developed for information readout from these chambers. Measuring an asymmetry of the secondary scattering of the recoil protons on the carbon nuclei allows to determine both the spin rotation parameters and the parameter P. The up-down asymmetry ε_V is proportional to a linear combination of the spin rotation parameters R and A

$$\varepsilon_V = P_c P_i (A \cos\alpha + R \sin\alpha) \qquad (1)$$

(where P_i is the value of the target polarization, α is the angle between the vector of the target polarization and the momentum of incident pions), while the left-right asymmetry is proportional to the parameter P

$$\varepsilon_H = P_c P. \qquad (2)$$

In the above relations P_c is the analyzing power of proton-carbon scattering.

Measurements were performed at the energies 450, 530, 560, 600 MeV for $\pi^- p$ scattering to the backward hemisphere: $\cos\Theta^* = -0.4\text{-}0.9$. The construction of the Helmholtz coils restricted the angular range available for emitting the scattered pions and the recoil protons, so for obtaining data in the above mentioned angular range it is necessary to make two independent measurements for two different orientations of the Helmholtz coils with respect to the direction of the incident beam (i.e. for different values of angle α - see formula (1)). Corresponding values of the angle α were $\alpha_1 = -35^\circ$ and $\alpha_2 = 10^\circ$. Some of the obtained results [1,2] are presented in figs.1—2 in comparison with data of the new LNPI phase-shift analysis [3]. When performing this analysis the experimental data obtained in LNPI (including the last results on the spin rotation parameters) were used as a data-base. The procedure of the analysis was the same as described earlier in our paper [4]. Inspection of figs.1-2 shows that the new phase-shift analysis desribes the experimental spin rotation data quite well.

It was shown in the LNPI phase-shift analysis that there exists charge splitting in P_{33}-amplitude of πN scattering in the range of invariant masses $\sqrt{s} = (1.2-1.5)\ GeV/c^2$. The partial πN amplitudes obtained in this analysis can be used as a good base for comparison with different theoretical models describing πN scattering.

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