Measurement of the polarization parameter P in elastic π^+p scattering at 335, 370, and 410 MeV

V. S. Bekrenev, Yu. A. Beloglazov, V. G. Gaditskiĭ, A. I. Kovalev, S. P. Kruglov, A. A. Kulbardis, I. V. Lopatin, A. N. Prokof'ev, V. V. Sumachev, V. Yu. Trautman, É. P. Fedorova-Koval', E. A. Filimonov, and A. V. Shvedchikov

B. P. Konstantinov Institute of Nuclear Physics, Academy of Sciences of the USSR

(Submitted 28 December 1981)

Pis'ma Zh. Eksp. Teor. Fiz. **35**, No. 3, 121–123 (5 February 1982)

The polarization parameter P has been measured in the elastic π^+p scattering at 335, 370, and 410 MeV for the angles $\cos\theta^* < 0$. The absolute error of the measurements is $\Delta P \approx \pm 0.05$. The obtained results are in good agreement with the predictions of the phase analysis.

PACS numbers: 13.75.Gx

Reliable results of a measurement of the polarization parameter P in elastic π^+p scattering are currently available in the region of low-lying πN resonances. These data were obtained at the Swiss Institute of Nuclear Research ($E_\pi < 300$ MeV),[1-3] at the Leningrad Institute of Nuclear Physics (400 MeV $< E_\pi <$ 600 MeV),[4,5] and at the Rutherford Laboratory ($E_\pi > 600$ MeV).[6] The absence of published experimental data in the energy range 300–400 MeV complicates the determination of the energy dependence of the parameter P and the phase analysis of the entire region. The polarization parameter was therefore measured in elastic π^+p scattering at 335, 370, and 410 MeV as part of the overall program of experiments on pion-nucleon interactions in the Leningrad Institute of Nuclear Physics. Since it was shown in the preceding experiment[5] that a scattering into the back hemisphere produces the strongest change in the parameter P with energy, we have concentrated our efforts on measurements in the range of angles $\cos\theta^* < 0$.

The experiment was carried out on the π-meson channel of the synchrocyclotron of the Leningrad Institute of Nuclear Physics, using a polarized proton target[7] made from a double lanthanum-magnesium nitrate. Five stacks of spark chambers, each 0.5×0.5-m^2 in dimension and each stack having four spark chambers, were used as recording equipment.[8]

The results of the experiment are illustrated in Fig. 1, in which only the statistical errors are shown. The additional systematic error associated with the inaccurate determination of the polarization of the target is within the limits of ±3%, according to our estimates. At 335 and 370 MeV the statistical errors are $\Delta P \cong \pm 0.05$, consistent with the accuracy of measurements carried out in the SIN meson factory.[1-3] The results of an experiment carried out earlier at 410 MeV by the method of double scattering are also shown. A good agreement of the data of the two experiments confirms that there are no significant unaccounted systematic errors in them. The curves in the figure represent the angular dependences of the parameter P, which have been calculated on the basis of the last two phase analyses.[10,11] We see that

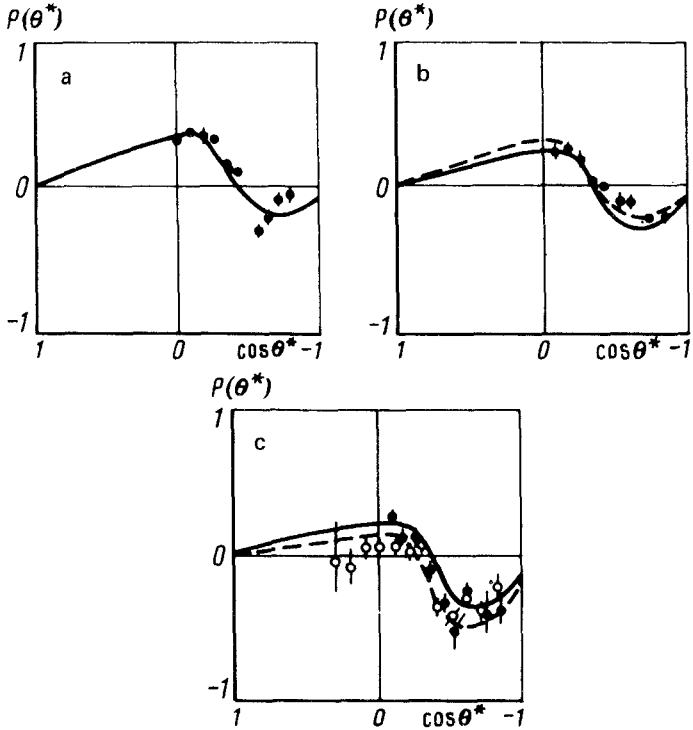

FIG. 1. The results of measurements of the polarization parameter P in π^+p scattering at energies (a) 335 MeV, (b) 370 MeV, and (c) 410 MeV. The open circles represent the data of Ref. 9 for 410 MeV. The solid curve represents the predictions of the phase analysis of KN-78 (Ref. 10) and the dashed curve denotes the phase analysis of CMU-LBL (Ref. 11).

there are no significant discrepancies between the experimental data and the predictions of these analyses in the energy range of 300 to 400 MeV.

The results of measurements of the polarization parameter P in elastic π^+p scattering carried out by us, together with the results of Refs. 1-6, form a continuous set of overlapping experimental data in the region of low-lying πN resonances.

1. C. Amsler *et al.*, Phys. Lett. **57B**, 289 (1975).
2. C. Amsler *et al.*, Lett. Nuovo Cim. **15**, 209 (1975).
3. L. Dubal *et al.*, Helv. Phys. Acta **50**, 815 (1977).
4. V. S. Bekrenev *et al.*, Yad. Fiz. **24**, 91 (1976) [Sov. J. Nucl. Phys. **24**, 45 (1976)].
5. V. S. Bekrenev *et al.*, Pis'ma Zh. Eksp. Teor. Fiz. **34**, 152 (1981) [JETP Lett. **34**, 145 (1981)].
6. J. P. Martin *et al.*, Nucl. Phys. **B89**, 253 (1975).
7. A. I. Kovalev *et al.*, Preprint LIYaF-168, 1975.
8. V. S. Bekrenev *et al.*, Preprint LIYaF-401, 1978.
9. P. Bareyre *et al.*, Phys. Rev. Lett. **14**, 198 (1965).
10. G. Höhler *et al.*, Handbook of Pion-Nucleon Scattering, Physics Data No. 12-1, Karlsruhe, 1979.
11. R. E. Cutkosky *et al.*, Phys. Rev. **D20**, 2804 (1979).

Translated by S. J. Amoretty
Edited by Robert T. Beyer