MEASUREMENTS OF SPIN ROTATION PARAMETER A IN PION–PROTON ELASTIC SCATTERING AT 1.62 GeV/c*

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(Received June 2, 2000)

New experimental data on the spin rotation parameters R and A in $\pi^{\pm}p$ elastic scattering at 1.62 GeV/c is presented. The measurements were performed at ITEP accelerator by ITEP-PNPI collaboration. The experimental setup includes polarized proton target and carbon polarimeter based on the multiwire spark chambers. The data obtained confirms our understanding of Barrelet ambiguities of partial wave analysis based on the information about A and R parameters at 1.43 GeV/c.

PACS numbers: 13.75.Gx, 13.85.Dz, 13.88.+e

Both the experimental and the theoretical baryon spectroscopy is under steady progress in recent years. Partial wave analysis (PWA) is one of the most powerful instruments in the baryon spectroscopy. But it is still not free from ambiguities caused by the incomplete experimental database. Especially poor is the knowledge on spin rotation parameters A and R in the region of incident particle momenta above 0.75 GeV/c. Predictions of these parameters made by different PWA contradict with each other in a number of kinematic regions. The single measurement in this region fulfilled by the ITEP-PNPI collaboration [1] supports PWA of Ref. [2] and contradicts to PWA of Ref. [3, 4].

The apparatus is shown in Fig. 1. Its basic elements are: *(i)* polarized proton target in superconductive solenoid (P); *(ii)* carbon filter (C); *(iii)* four sets of multiwire magnetostrictive spark chambers (MSC1–MSC6, MSC7–MSC12, MSC13–MSC16, MSC17–MSC21) and *(iv)* a number of scintillation

* Presented at the Meson 2000, Sixth International Workshop on Production, Properties and Interaction of Mesons, Cracow, Poland, May 19–23, 2000.

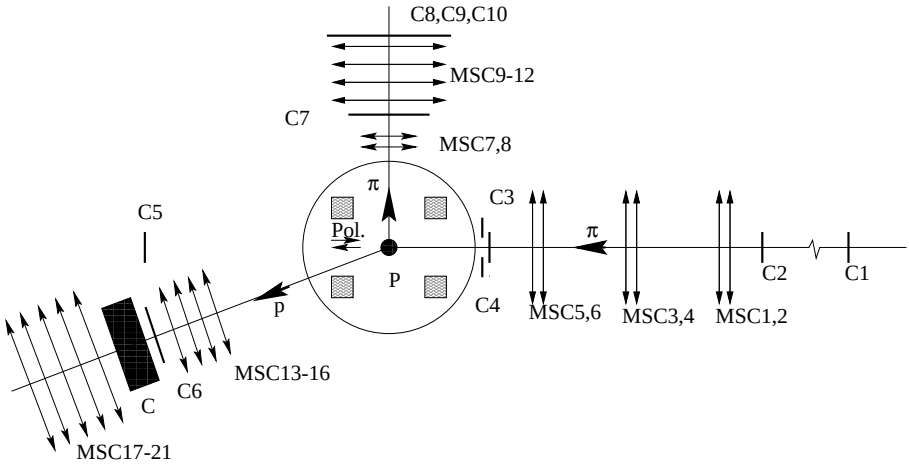


Fig. 1. The experimental layout (not to scale)

counters (C1-C10) to provide the trigger and to identify the positive pions in the beam by the time of flight. The two sets of chambers with the 36.5 g/cm^2 thick carbon filter in between form the polarimeter which analyzing power was measured beforehand at the ITEP accelerator [5].

This paper presents the results of two runs at the ITEP accelerator. During the first run 1.4×10^6 triggers with π^+ beam were obtained while the second one gave 6.5×10^5 triggers from π^- beam.

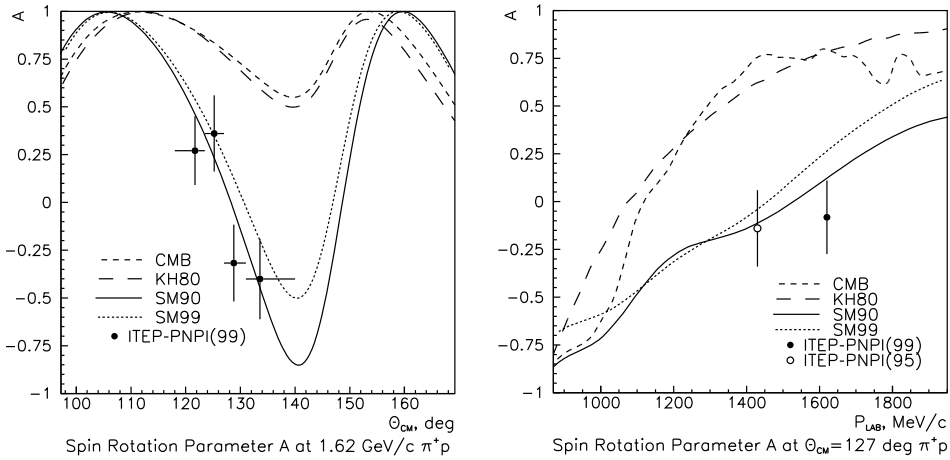
The processing of the data was performed in several steps: *(i)* Events of the elastic πp scattering on the polarized target were selected by coplanarity and pion-proton angular correlation. *(ii)* Single track events with polar angle of the second scattering $> 3^\circ$ were selected in the polarimeter. The average analyzing power for selected events is 0.191. After this selection 16686 events of elastic $\pi^+ p$ scattering and 4708 events of $\pi^- p$ scattering were left for further processing. *(iii)* The method of maximum likelihood was used to get the polarization parameters from the data. The probability density was built only as a function of parameters A and P, while the parameter R was calculated from the equation: $P^2 + A^2 + R^2 = 1$.

The results of the experiment are given in the Table I. Only statistical errors are given. All the systematic errors are negligible compared to the statistical errors. New results for the parameter A are shown in Fig. 2(a), (b) as functions of center-mass scattering angle and beam momentum correspondingly. Our data for $\pi^+ p$ scattering does not contradict to the predictions given by the analysis of Ref. [2] and is in strong disagreement with the predictions of Ref. [3,4]. This remains true in a wide momentum range as seen from Fig. 2(b).

TABLE I

Results of the experiment

$\theta_{\rm cm}$ (degr.) range	mean	P	A	$\lvert R\rvert$
		π^+p elastic scattering		
118–123.5	121.7	0.24 ± 0.12	0.27 ± 0.18	0.93 ± 0.06
123.5–127	125.2	0.30 ± 0.12	0.36 ± 0.20	0.88 ± 0.09
127–131	128.8	0.40 ± 0.13	-0.32 ± 0.20	0.86 ± 0.10
131–140	133.6	0.29 ± 0.13	-0.40 ± 0.21	0.87 ± 0.11
		π^-p elastic scattering		
118–124.8	122.3	-0.11 ± 0.19	0.88 ± 0.28	0.46 ± 0.54
124.8–129.4	127.0	0.03 ± 0.19	0.56 ± 0.28	0.83 ± 0.19
129.4–140	132.8	0.19 ± 0.20	0.51 ± 0.29	0.84 ± 0.18



(a) (b)

Fig. 2. Results of this work (full dots) compared to the data from [1] (open dots) and predictions of selected PWA [2–4].

This work was partially supported by the Russian Fund for Basic Research grant 99-02-16635 and Russian State Scientific Technical Program "Fundamental Nuclear Physics".

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