ANALYSIS OF THE SPIN ROTATION PARAMETERS A and R MEASUREMENTS IN THE REGION OF THE FIRST AND SECOND MAXIMA OF THE PION-PROTON ELASTIC SCATTERING CROSS SECTION

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The results of the spin rotation parameter A and R measurements are discussed for the backward angle scattering in the pion beam energy range $T_\pi = 450$–1300 MeV. The pion momenta regions for the additional A and R parameters measurements are under discussion.

1 Experimental data in the region $T_\pi \geq$450 MeV.

From the PNPI measurements [1] it is established that in the beam energy region $T_{\pi^-} = 450$–600 MeV the sign of the parameter R^- is positive and $|R^-| \geq 0.5$. In this momenta region the sign of the parameter A^- is positive too and $|A^-| \leq 0.3$. As a result the partial-wave analysis (PWA) ambiguities due to the absence of A and R experimental data in this region are removed. The experimental data are accumulated in the table 1. In the region around $T_{\pi^+} =$ 1300 MeV (around the maximum in the π^+p elastic scattering cross section) near the pion scattering angle $\Theta_{\pi p}(cm) \simeq 130^\circ$ the sign of the parameter A^+ is negative and $|A^+| \simeq 0,5$. In this region $|R^-| \geq 0.5$. The experimental data [2] are accumulated in the table 2. New experimental data for A^+ do not confirm the predictions of the PWA's CMB [3] and KA84 [4]. This result is very important since all characteristics of the πN resonances presented in the Tables of the Particle Data Group are based just on the PWA's CMB and KA84. This leads to the conclusion that these Tables need to be revised. It is extremely important to continue the A and R parameters measurements to answer the question which PWA give a correct result for πN amplitude, but it

Table 1: Experimental data bearing on the spin rotation parameters in $\pi^- p$ elastic scattering from PNPI.

Energy (MeV)	$\cos\Theta_(cm)$	A^-	R^-
450	-0.56	0.77±0.16	0.01±0.38
	-0.65	0.85±0.11	-0.04±0.33
	-0.63	0.47±0.22	0.53±0.20
	-0.72	0.73±0.11	-0.03±0.26
	-0.80	0.82±0.07	0.01±0.23
530	-0.46	0.94±0.06	-0.26±0.21
	-0.56	0.93±0.05	0.06±0.27
	-0.66	0.94±0.05	-0.14±0.24
	-0.72	0.98±0.02	-0.03±0.20
	-0.79	0.95±0.07	0.29±0.24
560	-0.47	0.98±0.03	0.17±0.18
	-0.56	0.93±0.04	-0.09±0.16
	-0.65	0.82±0.09	0.45±0.14
	-0.64	0.86±0.05	0.16±0.14
	-0.72	0.87±0.04	0.19±0.12
	-0.79	0.86±0.06	-0.13±0.20
600	-0.47	0.44±0.27	0.51±0.20
	-0.56	0.61±0.12	0.25±0.15
	-0.66	0.50±0.13	0.31±0.13
	-0.65	0.32±0.17	0.18±0.17
	-0.72	0.48±0.09	0.07±0.13
	-0.79	0.58±0.11	-0.02±0.19

is carefully to estimate the pion momenta regions where such experiments are really necessary.

2 The suspicious upon twofold PWA ambiguities regions.

The comparing of the PWA predictions in wide pion momenta region is convenient to realize by using of the Barrelet zero trajectories method [5]. At fixed energy the transversity amplitudes $F(\pm)$ are usualy considered either as functions of $z = cos\theta$ or as functions of a variable ω , which is connected with z by a conformal mapping $\omega = e^{i\theta} = z \pm \sqrt{z^2 - 1}$ [5].

Transversity amplitudes have the advantage that their modulus can be determined from $d\sigma/d\omega$ and P data alone $\mid F(\pm) \mid^2 = d\sigma/d\omega \times (1 \pm P)$. This equation shows that the zeros of the amplitude can be derived from the zeros of $d\sigma/d\omega$ and P data but, unfortunately, there is a 2^{2N} fold ambiguity because for each pair of zeros z_i and z_i^* (or ω_i and $1/\omega_i^*$) one has the choice whether z_i or z_i^* belongs to the amplitude F.

Table 2: Experimental data bearing on the spin rotation parameters in $\pi^+ p$ elastic scattering from PNPI-ITEP collaboration.

Energy (MeV)	$\cos\Theta_(cm)$	A^+	$\|R^+\|$
1300	-0.604	-0.14±0.20	0.84±0.07
	-0.675	-0.58±0.20	0.67±0.19

Table 3: The suspicious upon twofold PWA ambiguities regions.

Pion momenta (MeV/c)	$\Theta_\pi(cm)$(deg.)
950–1000	80–100
850–900	150–170
≃1900	65–80
≃1900	45–65
≃1900	140–160

The positions of the zeros of $F(\pm)$ depend on the incident pion beam momenta. When a zero trajectory crosses the unit cicle [5], ω and $1/\omega_i^*$ are equal. At this point, an alternate zero trajectory (with $\omega \to 1/\omega_i^*$) can emerge. This allows one to locate problems of the unknown PWA ambiguities simply by looking at the zero trajectories on the ω - planes which are near the physical region. Such trajectories are constructed by us for PWA's KA84 [4], CMB [3] and SM90 [6] respectively in the 0.20-2.00 GeV/c pion beam momenta range. The suspicionous regions are accumulated in the table 3.

In the latter regions the parameters A and R in the $\pi^\pm p \to \pi^\pm p$ elastic scattering must be measured.

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