INFLUENCE OF THE SPIN ROTATION PARAMETERS MEASUREMENTS ON THE SPECTRUM AND PROPERTIES OF ISOBARS IN THE SECOND RESONANCE REGION

D.N. SVIRIDA for ITEP-PNPI Collaboration
Institute for Theoretical and Experimental Physics,
B. Cheremushkinskaya 25, Moscow 117259, Russia
E-Mail: SVIRIDA@VITEP5.ITEP.RU

Recent experimental data on spin rotation parameters in pion- proton elastic interaction at pion incident momentum 1.43 GeV/c is in good agreement with VPI group phase shift analyses and strongly contradict to the older CMB and KH80 solutions. This could be attributed to the discrete ambiguity of the Barrelet type. The suggested method of making corrections to existing partial wave solutions is based on the Barrelet conjugation of the complex roots of the transverse amplitudes. This allows to select the right branch of a solution taking into account the obtained values of spin rotation parameters and leaving intact its representation of differential crossection and asymmetry. The correction does not affect much the 4-star resonance parameters, while the resonances with lower rating manifest the essential decrease of elasticity and changes in widths. The signal for the $*D_{33}(1940)$, seen only in CMB solution, disappears. General agreement of partial waves behaviour from different phase shift analyses is better after correction.

The choice of the kinematic region for the experiment on spin rotation parameters measurement [1] was influenced by the existence of the degenerated resonance structure near $\sqrt{s} = 1.9\ GeV$, which includes 7 resonances with $I = 3/2$, and the contradiction between predictions of various PWA's on the parameter A in the angular region $120^o < \theta_{cm} < 140^o$ (fig. 1,2).

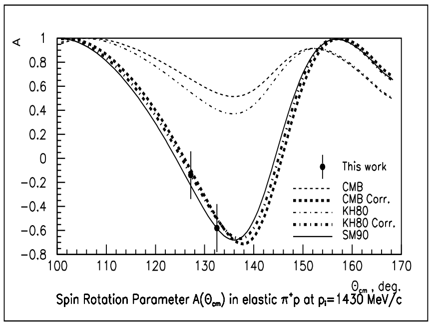

Fig. 1: Spin rotation parameter A in elastic π^+p process at 1.43 GeV/c.

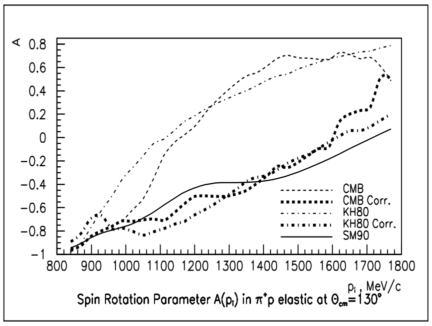

Fig. 2: Spin rotation parameter A in elastic π^+p process at $\theta_{cm} = 130^o$.

The baryonic spectra in this region from the results of various PWAs is shown in the following table.

Resonance	Rating	**CMB**	**KH80**	**SM90**	**SM95**
$S_{31}(1900)$	***	1890(170)	1908(140)	-NO-	-NO-
$P_{31}(1910)$	****	1910(225)	1888(280)	1950(400)	2152(760)
$P_{33}(1920)$	***	1920(200)	1868(200)	-NO-	-NO-
$D_{33}(1940)$	*	1940(200)	-NO-	-NO-	-NO-
$D_{35}(1930)$	***	1940(320)	1901(195)	2018(400)	2056(590)
$F_{35}(1905)$	****	1910(400)	1905(260)	1794(230)	1850(294)
$F_{37}(1950)$	****	1950(340)	1913(224)	1884(240)	1921(232)

One can see that the $D_{33}(1940)$ resonance was only found in the CMB solution, while $S_{31}(1900)$ and $P_{33}(1920)$ were not found in SM90.

The experimental setup is shown in fig. 3. It's main elements are: longitudinally polarized target PT with proton spins parallel to the beam inside the superconductive solenoid, multi-plane carbon polarimeter CP and sets of magnetostrictive wire spark chambers for tracking of incident and scattered pions and the recoiled proton.

The component of the recoiled proton polarization in the scattering plane perpendicular to its momentum $P_t \cdot A$ (P_t - the target polarization) is analyzed via up-down asymmetry of the second scattering on carbon. Similarly the component normal to the scattering plane P is analyzed via left-right asymmetry. So we measured parameters A, P and $|R|$, since the spin rotation parameters and the normal polarization obey the equation: $A^2 + R^2 + P^2 = 1$.

The resulting values calculated from 5562 events selected from $5 \cdot 10^5$ raw recorded triggers are presented in the following table and in fig. 1:

$\cos\theta_{cm}$	θ_{cm}	Events	A	P	$\vert R\vert$
-0.604	127.2^o	2842	-0.14 ± 0.20	0.52 ± 0.10	0.84 ± 0.07
-0.675	132.5^o	2720	-0.58 ± 0.20	0.47 ± 0.11	0.67 ± 0.19

The data is in good agreement with predictions of the PWA SM90 and contradicts to that of KH80 and CMB.

An idea of making corrections for KH80 and CMB solutions aroused from thorough investigation of the transverse amplitude zero trajectories. An as-

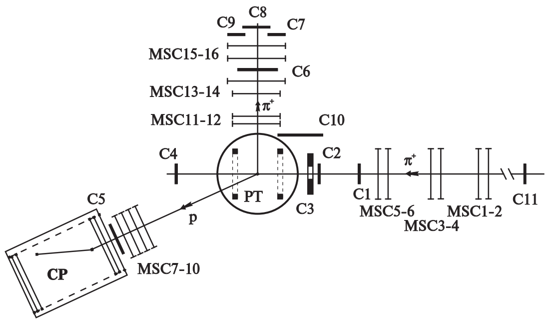

Figure 3: Setup layout for spin rotation parameters measurements.

sumption was made that the difference is caused by the ambiguous choice of the solution branch at $P_{in} = 1\ GeV/c$. It is known that in the absence of the data on spin rotation parameters single energy amplitudes of a PWA can only be determined with 2^{2N} ambiguity, corresponding to the so-called Barrelet conjugation of the transverse amplitude zeroes [2]. The differential crossection and the normal polarization are invariant to such transformations, while the spin rotation parameters and the amplitudes themselves are not. We applied the Barrelet conjugation to a particular zero of the amplitude in the angular range $120^o < \theta_{cm} < 140^o$ for KH80 and CMB analyses and thus achieved good agreement with SM90 predictions and our experimental data. The results of the correction are shown in fig. 1,2 in bold lines. One could see that the correction improves the agreement in a wide energy range.

Fig. 4,5 represent the Argand plots for some partial waves in the initial and corrected PWA solutions (see also [3]). One can see that the agreement between various PWAs is better after correction.

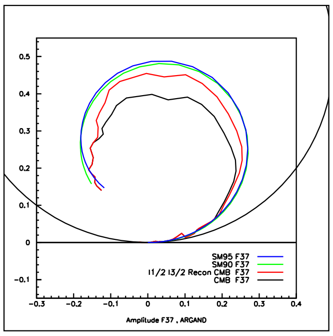

Fig. 4: Argand plot for $****F_{37}(1950)$.

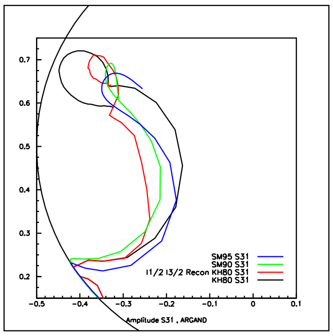

Fig. 5: Argand plot for $***S_{31}(1900)$.

There are small changes for the resonances with 4-star rating ($F_{35}(1905)$, $F_{37}(1950)$). The elasticity of the 3-star resonances ($S_{31}(1900)$, $P_{33}(1920)$) decreases essentially. The $D_{33}(1940)$ resonance disappears. It looks like that the rating of $S_{31}(1900)$ and $P_{33}(1920)$ is worth one star decreasing. It's interesting that the elasticity of $D_{35}(1930)$ resonance with negative parity remains large, while other well established resonances in the second region have positive parity according to the potential models.

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References

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