EVALUATION OF S-WAVE $\pi^+\pi^-$ PRODUCTION AMPLITUDES IN $\pi^- p_\uparrow \rightarrow \pi^+\pi^- n$ REACTION ON POLARIZED TARGET*

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A new analysis of the S-wave production amplitudes for the reaction $\pi^- p_\uparrow \rightarrow \pi^+\pi^- n$ on transversely polarized target was performed. The results can be of importance for the spectroscopy of scalar mesons and glueballs.

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We have performed a new analysis of the S-wave production amplitudes for the reaction $\pi^- p_\uparrow \rightarrow \pi^+\pi^- n$ on transversely polarized target [1]. This analysis is based on the results obtained twenty years ago by the CERN–Cracow–Munich collaboration in the $\pi^+\pi^-$ energy range from 610 MeV to 1590 MeV with 20 MeV data bins at 17.2 GeV/c π^- beam momentum [2]. Our aim was an energy independent separation of the S-wave pseudoscalar amplitude (called one pion-exchange) from the pseudovector amplitude (corresponding for example to a_1 meson exchange) using much weaker assumptions than in all previous analyses, which were not taking advantage of the polarized target data. Specifically we only assume that the dominant P, D and F waves are well described by the leading ρ, $f_2(1270)$ and $\rho_3(1690)$ resonances decaying to the $\pi^+\pi^-$ pairs and interfering with the S-wave. The main results are as follows:

1. The modulus of the amplitude g_B (see Fig. 1) corresponding to the a_1 exchange is substantially smaller than the modulus of the amplitude g_A related to the dominating π exchange. Nevertheless g_B cannot be completely neglected, especially at 1000 MeV and 1500 MeV. This puts in

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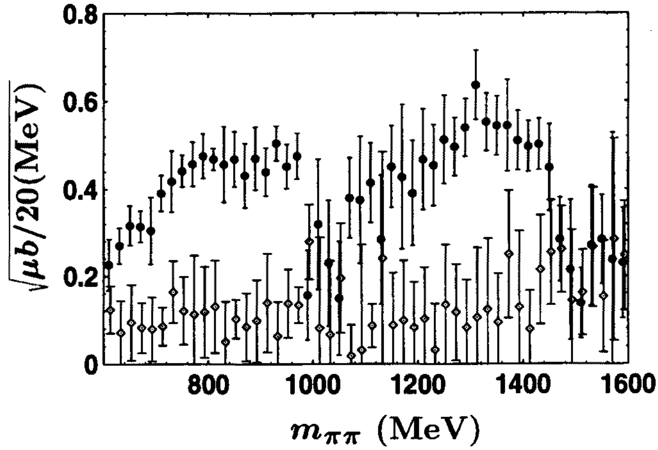

Fig. 1. The moduli of the pseudoscalar $\mid g_A \mid$ (full circles) and the pseudovector $\mid g_B \mid$ (diamonds) exchange amplitudes plotted as a function of the effective $\pi^+\pi^-$ mass for the solution "down–flat" .

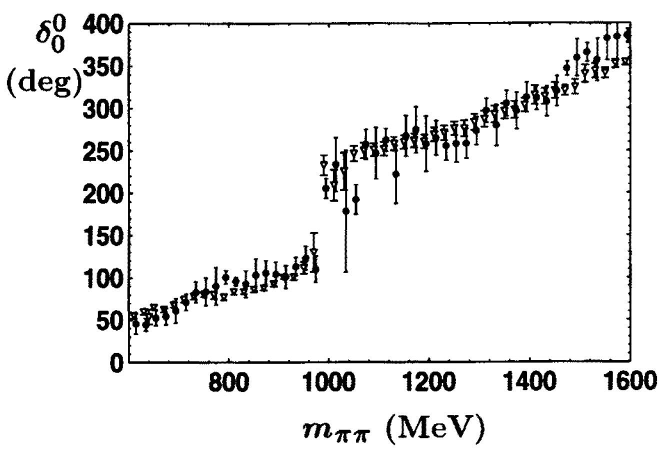

Fig. 2. The scalar–isoscalar $\pi^+\pi^-$ phase shifts δ_0^0 as a function of the effective $\pi^+\pi^-$ mass for the solution "down–flat" (full circles) and for unpolarized data (triangles).

serious doubt all the partial-wave analysis results which assumed absence of the a_1 exchange.

2. Separation of the π-exchange from the a_1-exchange allowed us to calculate in a weakly model dependent manner the isoscalar–scalar $\pi\pi$ phase shifts.

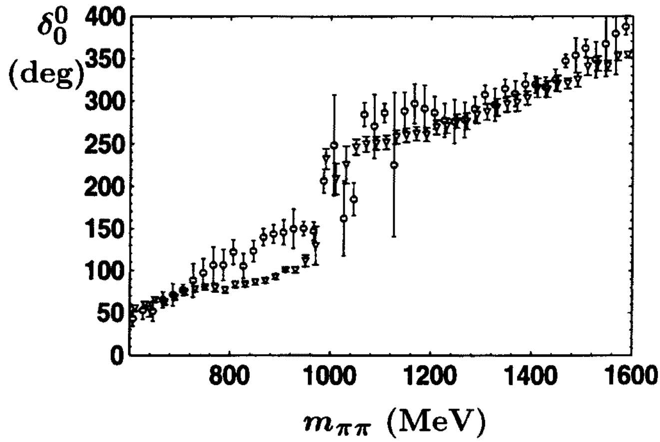

Fig. 3. Same as in Fig. 2 for the solution "up–flat" (open circles).

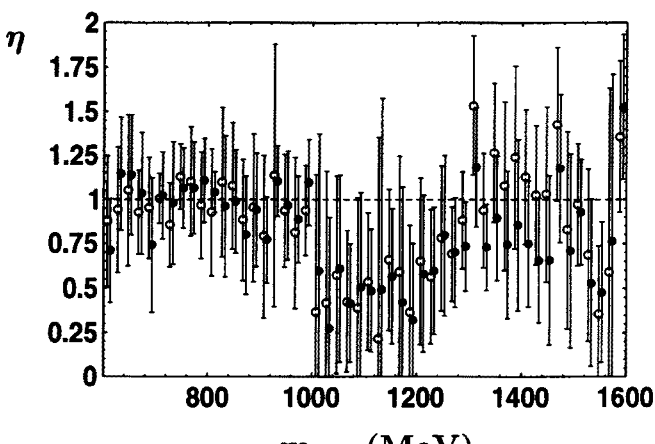

Fig. 4. The scalar–isoscalar $\pi^+\pi^-$ inelasticity coefficient η_0^0 versus the effective $\pi^+\pi^-$ mass for the solutions "down–flat" (full circles) and "up–flat" (open circles).

3.. We cannot exclude so-called "up" solution in addition to well known "down" solution (shown in Fig. 1) for the $\pi\pi$ scalar–isoscalar phase shifts in the energy range 610 MeV – 970 MeV. Both sets of amplitudes are acceptable if we choose solutions in which the S-wave phases increase slower with the effective $\pi\pi$ mass than the P-wave phases ("flat" solutions).
4. The I=0 S-wave $\pi\pi$ phase shifts are shown in Figs 2 and 3, respectively for the "down-flat" and "up-flat" solutions. The inelasticity coefficients are plotted in Fig. 4.

5. Above 1420 MeV both sets of phase shifts increase systematically faster with energy than in the experiment on unpolarized target. This fact may be related to the presence of a new scalar resonance $f_0(1500)$ whose existence has been recently postulated by the Crystal Barrel Group at CERN in their analysis of the proton–antiproton annihilation data.

These results can be of importance for the spectroscopy of scalar mesons and glueballs.

REFERENCES

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