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5.8 Measurement of Asymmetry in $\pi\vec{p}^{\uparrow}$ Elastic Scattering at (1.4-2.1) GeV/c

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The purpose of this work is to systematically study the elastic scattering asymmetry in the central angle region within (1.4-2.1) GeV/c. Within this energy region there are more than ten baryon resonances, the major part of which has not been conclusively established[1]. Since the basic method of identification and determination of baryon resonance quantum numbers is the partial-wave analysis (P.A.) of experimental data on differential cross sections and elastic scattering asymmetry, the confidence of the resonance systematics is directly associated with the accuracy of the data available. Meanwhile, the existing experimental data on elastic $\pi\vec{p}$ scattering asymmetry within (1.4-2.1) GeV/c is incomlete and even contradictory[2-4]. This leads to that the contemporary P.A. poorely agree with each other[5,6]. The authors of refs.[5,6] emphasized that the further progress of P.A. required an essential improvement of the data on $\pi\vec{p}$ elastic scattering asymmetry.

The experiment was performed on the π^- meson beam with the intensity $5\times10^5\,\pi^-$ per pulse and $\pm1\%$ momentum resolution. The set-up[7,8] is a two-arm magnetic spectrometer with spark wire chambers and a polarized proton target[9] as a base. The polarizing wide-apperture magnet of the target is used simultaneously as a spectrometric one which provides studying the reaction products in the wide range of solid angles. We used in the experiment a usual proton polarized target working at 0.5°K in a magnetic field of 25 kG. The material of the target is ethyleneglycol with doping agent paramagnetic complex HMBA - Cr^{V}, the dimensions - 21x28x60 mm . The mean polarization is 72%. The measurement of angles and of two-particle momenta in the spectrometer and their Cerenkov counter identification allows a good separation of elastic scattering events on free hydrogen. The quasi-elastic scattering background is 3.5-4.0%. The reaction of quasi-elastic scattering in used for normalization of the data.

The experimental results on the asymmetry obtained in this experiment are presented in Fig.1. The statistic errors including normalization errors are given. A systematic error within the data due to uncertainty in the normalization of polarization can be $\pm5\%$. The results demonstrate large polarization effects in the region of scattering central angles and their noticeable energy dependence. The general pattern of the data is featured by a minimum in the asymmetry angular distribution whose position is displaced from $\cos\theta=-0.1$ at 1.43 GeV/c to $\cos\theta=-0.3$ at 1.98 GeV/c. The functional character of the angular dependence varies also considerably with energy. Starting from 1.98 GeV/c one more asymmetry minimum is observed on the region of positive values of $\cos\theta$.

In principle, the general picture of the results of this experiment does not contradict the P.A. predictions[5]. However, there are some deviations from its predictions in the region (1.6-2.07) GeV/c.

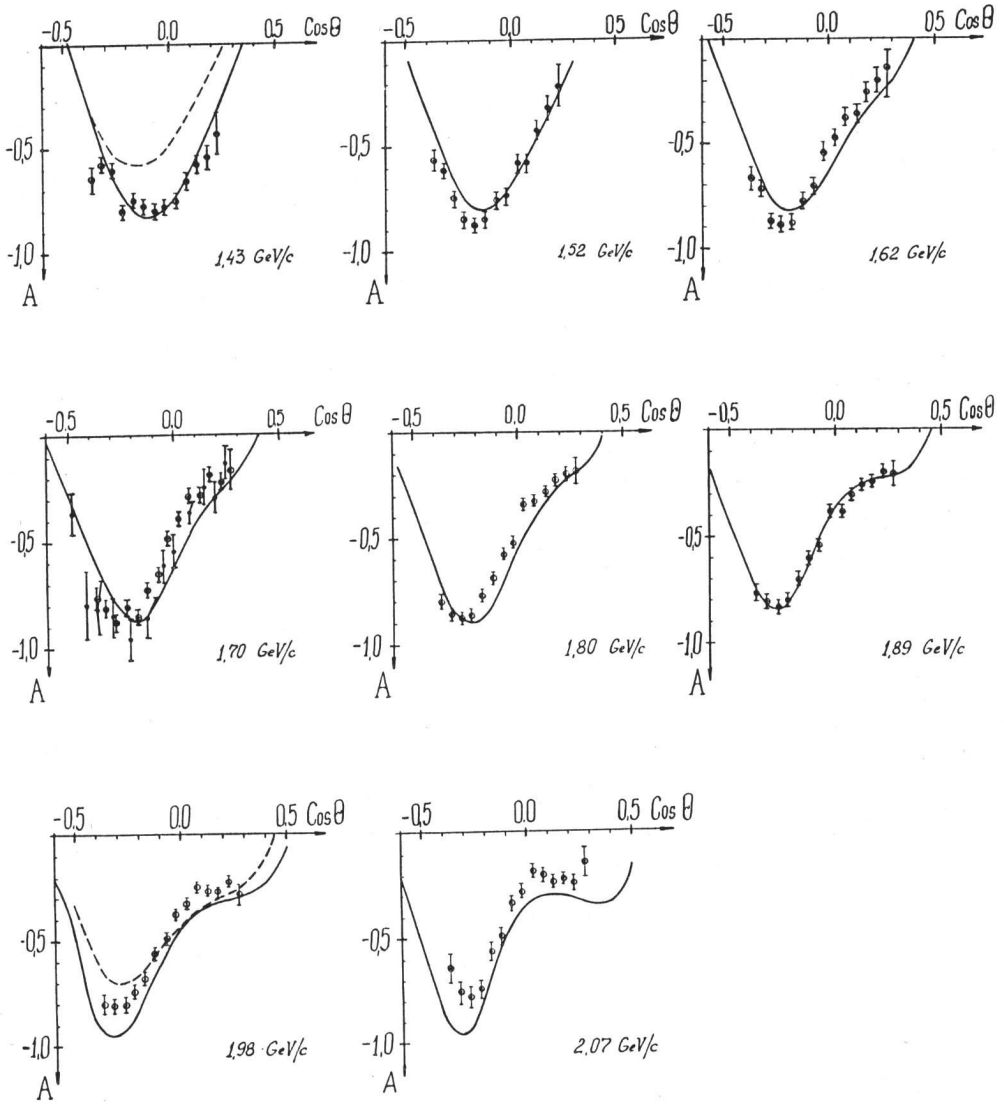

Fig.1. The elastic $\pi\bar{p}\uparrow$ scattering asymmetry as a function of $Cos\,\theta$ in the c.m.s. in this experiment (Φ); in experiment [2] at 1.73 GeV/c (I), (——) P.A. predictions [5], (— — —) P.A. predictions [6].

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