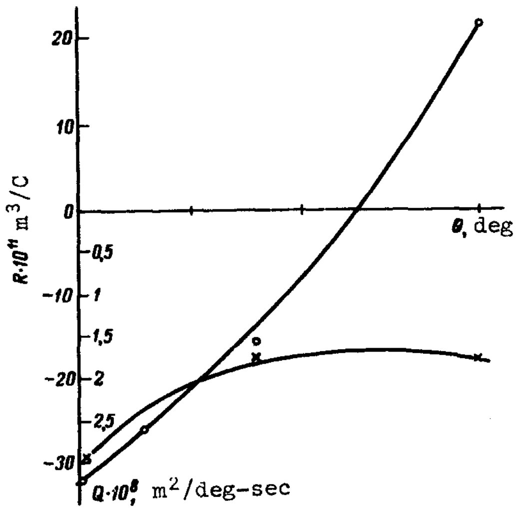

Ettingshousen emf's were measured by a potentiometer method using an FEOU-18 amplifier, and the voltage sensitivity of the setup was 2×10^{-9} V/mm. The magnetic field intensities was varied up to 16 kG.

The dependence of the Hall and Nernst-Ettingshausen constants R and Q on the angle θ between the magnetic field intensity vector $\vec{H}$ and the c-axis of the crystal is shown in the figure.

The table lists the values of $R_{\parallel}$ and $R_{\perp}$, and also $Q_{\parallel}$ and $Q_{\perp}$, i.e., the values of the Hall and Nernst-Ettingshausen constants for $\theta = 0°$ and $\theta = 90°$.

It is seen from the table and from the figure that the Hall effect in rhenium is strongly anisotropic. There is also a reversal of the sign of the Hall coefficient on going from one plane to another.

0	-32 ± 0.02	-3 ± 0.05
90	$+22 \pm 0.02$	-1.66 ± 0.05

Such an anisotropy of the Hall effect can be attributed to the anisotropy of the Fermi surface, which is electronic in the (0001) direction and of the hole type in the $(0\bar{1}01)$ direction, as shown in [4 - 6]. This agrees with our measurements, where $R_{\parallel} < 0$, indicating predominance of the electronic part, and $R_{\perp} > 0$, corresponding to the hole part of the Fermi surface.

[1] G. Ascherman and E. Justi, Z. Physik 43, 207 (1942).
[2] D.I. Volkov, T.M. Kozlova, V.N. Prudnikov, and E.V. Kozis, Zh. Eksp. Teor. Fiz. 55, 2103 (1968) [Sov. Phys.-JETP 28, 1113 (1969)].
[3] V.F. Nemchenko, S.N. L'vov, P.I. Mal'ko, and V.D. Deliev, Fiz. Met. Metallov. 33, 540 (1972).
[4] N.E. Alekseevskii, V.S. Egorov, and B.N. Kazak, Zh. Eksp. Teor. Fiz. 44, 1116 (1963) [Sov. Phys.-JETP 17, 752 (1963)].
[5] A.C. Thorsen and A.S. Joseph, Phys. Rev. 2078 (1963).
[6] L.F. Mattheiss. Phys. Rev. 151, 450 (1966).

LOW-ENERGY SPECTRUM OF ππ MASSES IN THE REACTION $\pi^- p \to \pi^+\pi^- n$ AT 400 MeV

M.M. Makarov, N.S. Gasilova, V.V. Nelyubin, V.V. Sarantsev, and L.N. Tkach
Leningrad Institute of Nuclear Physics, USSR Academy of Sciences

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The investigation of the low-energy ππ-mass spectrum in the reaction

$$\pi^- p \to \pi^+\pi^- n \tag{1}$$

was undertaken, first, to search for narrow resonances in the ππ system at low relative pion energies [1], and second to estimate the possibility of determining the pion-pion scattering length.

The experiment was performed with the synchrocyclotron of our Institute. Two emulsion stacks with a total volume exceeding 2 liters, made up of NIKFI-BR2 emulsions 600 μ thick, were bombarded with a beam of pions of momentum 550 MeV/c. The beam intensity was 2×10^5 particles per cm^2. The average beam energy, with allowance for the deceleration in the emulsion, was 400 MeV.

The kinematic region of the variables was chosen such as to enrich the region of low effective masses of the two pions. The search for events was based on the stopped π^+ mesons. The pions identification in the final state was absolute: the π^+ mesons were identified by the $\pi^+ \to \mu^+ + e^+$ decay and the π^- mesons by the stoppings (σ-stars) or by the relative ionization. We registered events with meson energies $E_{\pi^+} < 60$ MeV and $E_{\pi^-} < 130$ MeV, and with dip angles <35° relative to the emulsion plane. Taking into account the geometry of the chamber, the indicated angular and energy limitations make the kinematically investigated region of variables equal to 3% of the total. The energy of the π^- mesons was determined in 40% of the cases from the range ($\Delta E/E = 2\%$) and in 60% from the relative ionization ($\Delta E/E = 8 - 10\%$). The angle measurement accuracy was better than 1°. The resultant rms error of the effective two-pion mass was 2.7 MeV.

We found altogether 1307 events having two pions of opposite charge in the final state. They included 502 events with two prongs. The two-prong events, which occurred on free hydrogen, were separated from the events in the emulsion nuclei in accordance with the χ^2 criterion, inasmuch as the number of measured quantities for each event redetermined the three-particle kinematics. We have thus obtained 315 events pertaining to the re-

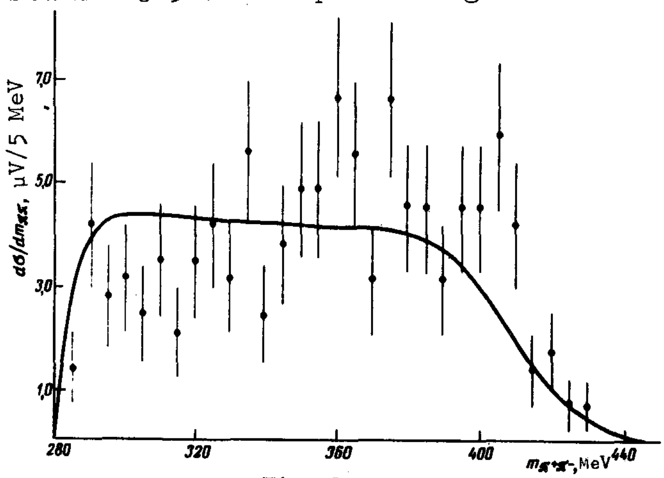

Fig. 1

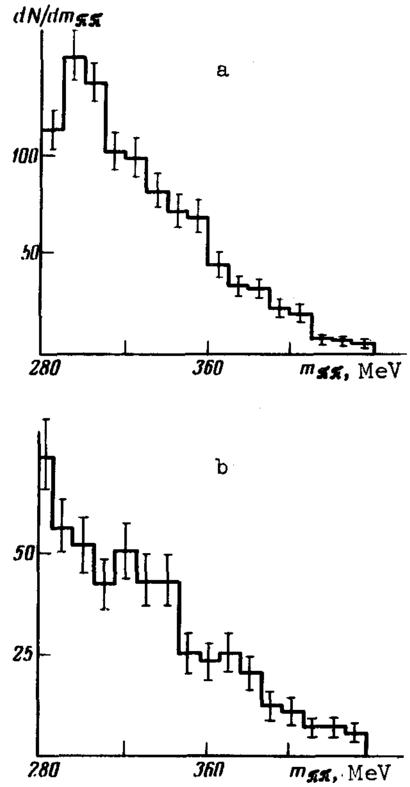

Fig. 2

Fig. 1. $m_{\pi\pi}$ distribution: curve - calculation by Monte Carlo method assuming a distribution of the cases over phase space.

Fig. 2. $m_{\pi\pi}$ distributions for the reaction (1) on nuclei: a - present experiment, b - results of [4].

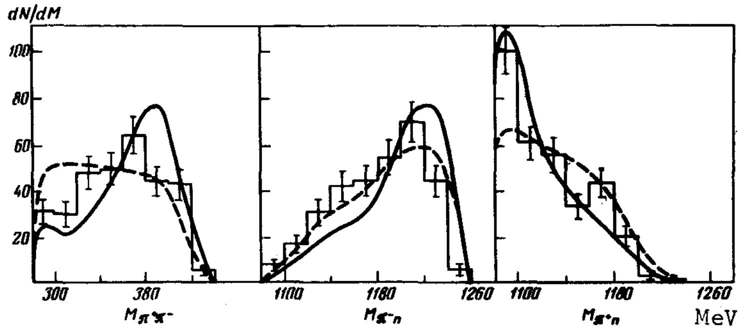

Fig. 3. Mass distribution of particle pairs. The curves were calculated by the Monte Carlo method: the dashed one from the phase space, and the solid one from the data of a partial-wave analysis [5]. Both curves are normalized to the experimental number of cases.

Figure 1 shows the distribution of 315 events with respect to the effective mass of the two pions. The absolute cross section was obtained with allowance for the efficiency of the search for the events. The figure shows also the phase-space curve calculated by the Monte Carlo method, with allowance for all the conditions of the experiment. The absolute value of the cross section for the phase space was obtained by starting from the total cross section of the reaction (1) and 400 MeV, which is equal to 2.8 mb. As seen from Fig. 1, in the region of the ABC anomaly (near 310 MeV) no rise above the phase-space curve is observed, in contrast to the nucleon-nucleon and nucleon-deuteron reactions [1]. The results remains unchanged if the phase curve is normalized to the total number of events. Thus, our experiment revealed no anomalies in the two-pion mass region from threshold to 340 MeV although, naturally, the usual comparison of the experimental spectra with the phase curve is not critical in this case, since neither the complete [2] nor the limited [3] $m_{\pi\pi}$ spectra are described by the phase curve.

Figure 2a shows the effective-mass distribution for the reaction (1) on nuclei. As seen from a comparison with Fig. 1, it differs from the corresponding distribution on hydrogen in that it has a maximum at small masses. Figure 2b shows the effective-mass distribution obtained in [4], where a xenon chamber was used; it coincides with the distribution for the events on nuclei in our experiment. The absence of a maximum at low energies in the two-pion mass spectrum on hydrogen indicates that the effect observed in [4] and by us is purely nuclear at the threshold mass of the two pions.

Figure 3 shows the mass distribution of the particle pairs for the reaction (1), and also the curves corresponding to the phase volume and to the previously performed [5] partial-wave analysis. It follows from Fig. 3 that in the chosen region of the kinematic variables the results of the partial-wave analysis differ from the experimentally obtained distributions. The reason may be that no account was taken in the partial-wave analysis of the triangle diagram corresponding to the rescattering of the pion from the decay of the (3, 3) isobar by the recoil pion. The final conclusion can be drawn after the completion of an experiment now under way at a lower beam energy, in which case the contribution of the triangle diagram is strongly altered by the fact that the logarithmic singularity changes its position relative to the physical region.

[1] J.H. Hall et al., Nucl. Phys. B12, 573 (1969); B. Maglic et al., Kiev Conference, 1970; J. Banaigs et al., Nucl. Phys. B28, 509 (1971); A. Abashian et al., Phys. Rev. 132, 2296 (1963).

[2] J. Kirz, J. Schwartz, and R. Tripp, Phys. Rev. 130, 2481 (1963).

[3] I.M. Blair, G. Torelli, and E. Zavattini, Nuovo Cimento 44, 671 (1966).

[4] G.S. Veselovskii et al., 12th Internat. Conf. on High-energy Physics, Atomizdat, Vol. 1, p. 67, 1966.

[5] M.M. Makarov et al., Yad. Fiz. 13, 891 (1971) [Sov. J. Nuc. Phys. 13, 510 (1971)].