THE REACTION $\pi^- p \to \pi^+ \pi^- n$ NEAR THE THRESHOLD

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The experiment was performed employing the emulsion chamber technique. Altogether 560 events corresponding to the reaction $\pi^- p \to \pi^+ \pi^- n$ (1) in the 200 – 300 MeV* energy interval were recorded, of which 373 events were in the 200 — 245 MeV interval. We studied the total cross sections, the angular distributions of the secondary particles, and the effective-mass spectra of the $\pi^\pm n^-$ and $\pi^+ \pi^-$ systems. The results of the total cross section measurements are given in Fig.1. Curve II with the error corridor was plotted on the basis of experimental points in the 210 – 317 MeV energy interval and corres-

*The threshold of reaction (1) is 172.4 MeV – Author's note.

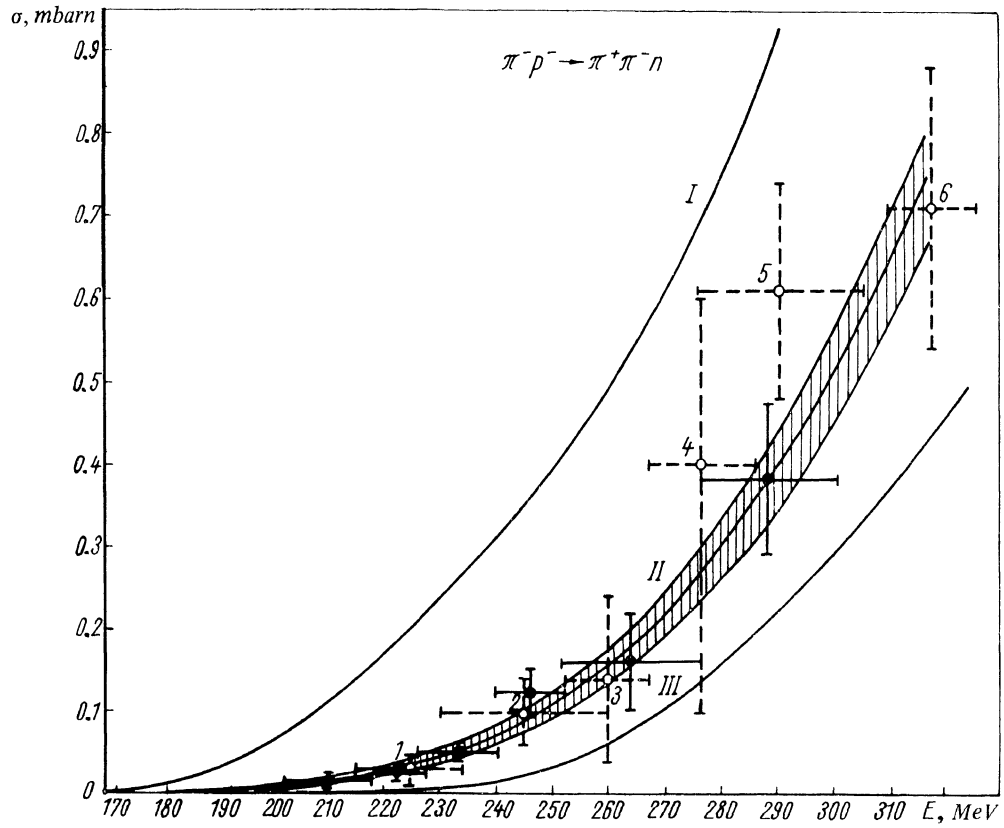

Fig.1. Total cross sections of the reaction $\pi^- p \to \pi^+ \pi^- n$:

• – the present work; ○ – the results of other studies. The numbers represent bibliographical references; curve I corresponds to Schnitzer's calculation, curve II is plotted on the basis of experimental points; curve III corresponds to the calculations of Kim Ze Pkhen and Tsellner.

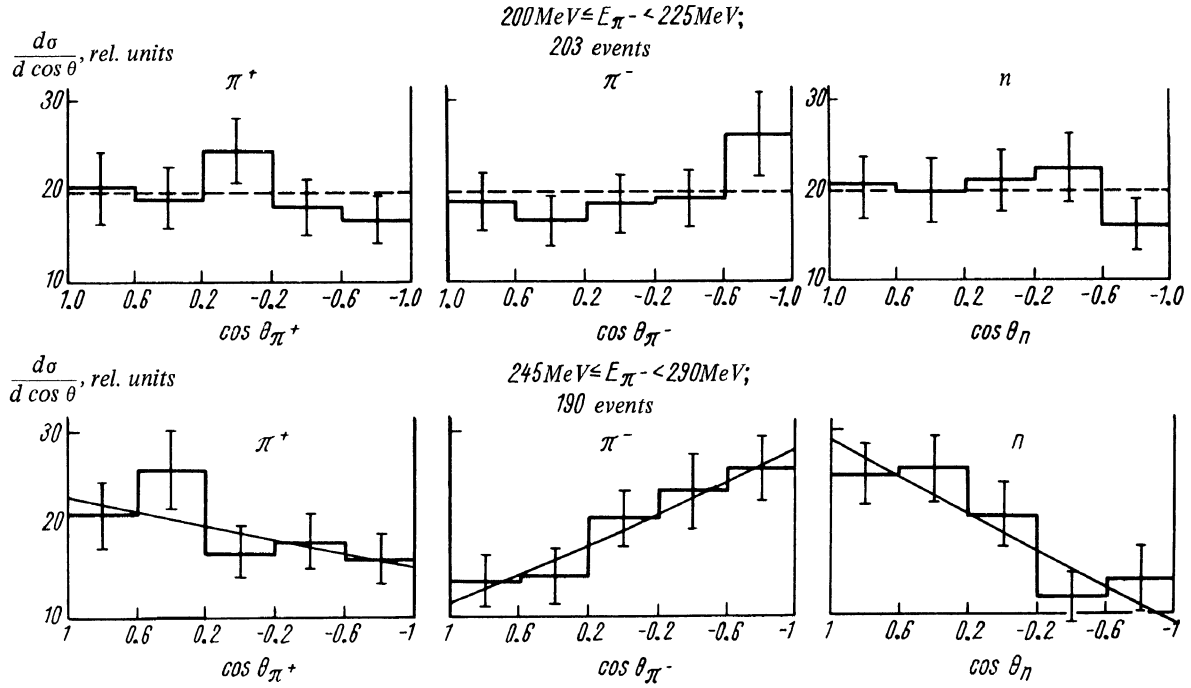

Fig.2. Angular distributions of secondary particles.

ponds to the empirical dependence $AT^2 + BT^3$, where T is the kinetic energy of the three particles in the center-of-mass system. Given here are the results of calculations carried out by Tsellner [6] according to the static model (curve III) and to the Schnitzer model [7] (curve I). As can be seen, the experimental data do not agree with these calculations.

The angular distributions of the secondary particles in the center-of-mass system for two energy intervals are given in Fig. 2. In the 200 – 225 MeV energy interval all the angular distributions are symmetric and isotropic. In the 245 – 290 MeV energy interval the angular distributions of π^+ are close to being isotropic, whereas the angular distributions of π^- and the neutrons are asymmetric and anisotropic: the neutrons fly mainly into the front hemisphere and the π^- mesons into the back hemisphere. According to Schnitzer's model, the π^- mesons should have a peak in the forward direction.

The effective-mass spectra for three energy intervals are given in Fig. 3. The spectra of the π^+n masses completely agree with the phase curve. However, the spectra of the $\pi^+\pi^-$ masses at all energies do not agree with the statistical distribution and are displaced toward high masses. This effect has been observed before [8]. It should be noted that no rises above the phase curve in the range of small $\pi\pi$ masses up to the 0 – 5 MeV interval are observed.

The experimental data in the 200 – 245 MeV range were analyzed from the point of view of the theory developed by Anisovich, Ansel'm, and Gribov [9] for the reactions

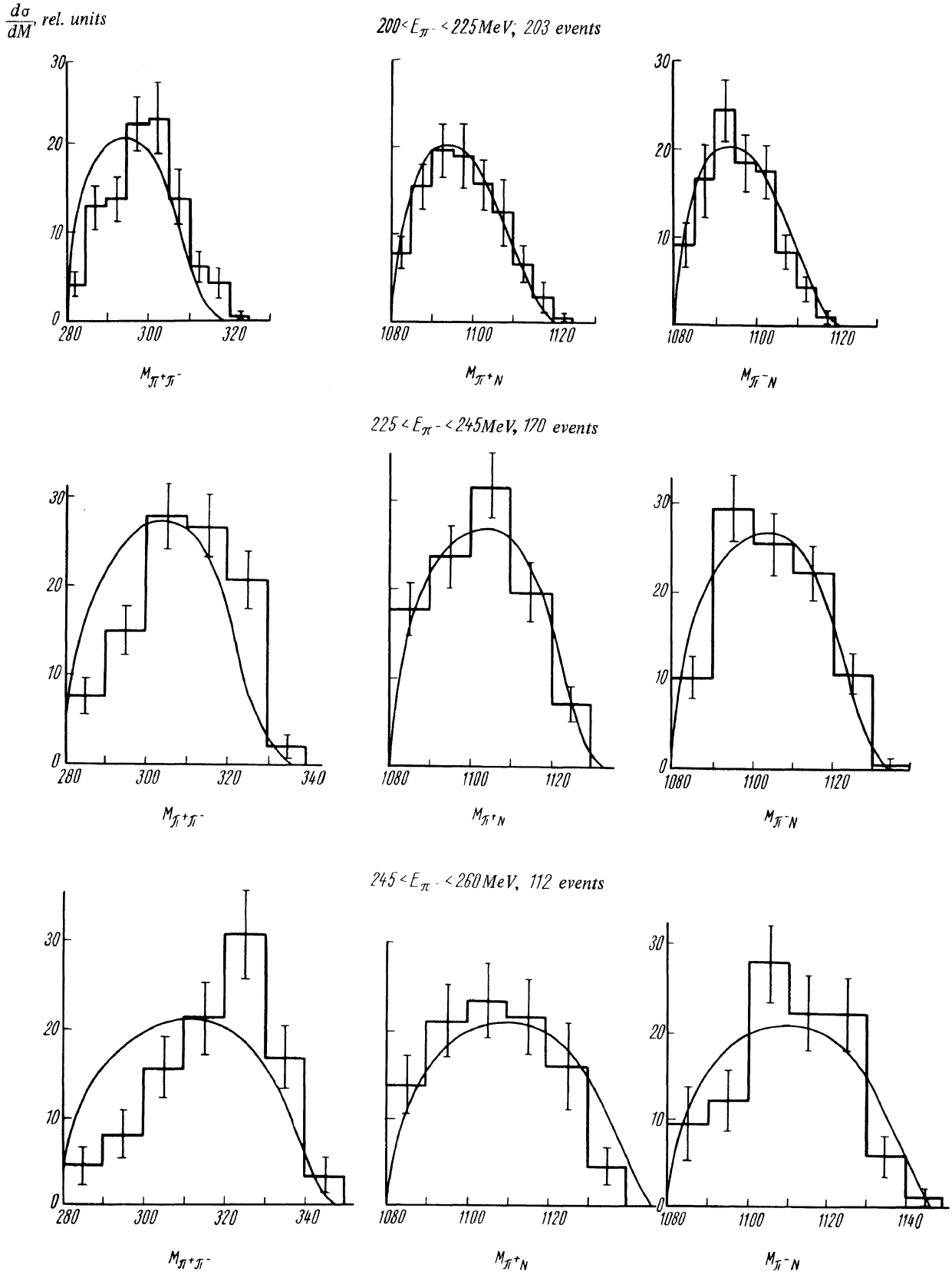

Fig.3. Effective-mass spectra of $\pi^{\pm}n$ and $\pi^+\pi^-$ systems.

$\pi N - \pi\pi N$ near the threshold. The study of the energy and angular distributions of the secondary particles in reaction (1) makes it possible to determine the difference in the $\pi\pi$-scattering lengths [10]. A preliminary analysis yielded for the difference $a_0 - a_2$ in the $\pi\pi$-scattering lengths a value of $0.25 \pm 0.05 \frac{\hbar}{\text{msec}}$. It should be noted, however, that since in the estimation of the scattering length difference only linear terms with respect to the relative momenta were allowed for, the results require further correction.

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