mentally observed mass difference of the K_1^0 and K_2^0 mesons that 1) either the leptonic weak interactions are cut off at energies of the order of a nucleon mass (for example, the weak interaction is mediated by a vector meson, whose mass is of the order of the nucleon mass†), 2) or the integral (close loop) over the leptons in the diagram is not quadratically divergent. In the latter case the leading divergence (of the order of $G^n\Lambda^{2n+2}$) should be absent not only from the diagram here considered, but from any diagram of this type in which the lepton loop can be made arbitrarily more complicated as a consequence of leptonic interactions. The existence of such a requirement (whose possibility has been indicated previously [2]) imposes definite limitations on the structure of the weak lepton-lepton interaction. A more detailed discussion of this question will be presented in a separate paper.

The author is greateful to L. B. Okun' for useful discussions.

*In the expression for the Hamiltonian we take into account only terms proportional to q_μ, the momentum of the K meson. The inclusion of terms proportional to the momentum of the pion does not affect our conclusions.

†In that case, in order to forbid the process $\mu \to e + \gamma$, it is necessary to have the muon and electron neutrinos not identical.

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THE ππ INTERACTION IN π⁻p COLLISIONS AT 7.2 BeV

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IN an investigation of multiple pion production in π^-p collisions at 7.2 BeV in a liquid hydrogen chamber in a magnetic field, we selected 675 double-pronged stars. An analysis of these events permitted us to isolate 196 elastic scattering events. [1] Among the 479 inelastic interaction events which remain, 142 cases were selected in which the positively charged particle is a proton. Events were selected when the proton range exceeds 0.4 cm, and if the proton did not remain inside the chamber, then events with proton momentum smaller than 1.5 BeV/c were selected. The protons were identified by their range and ionization (for slow protons) or by momentum and ionization.

The measurement of momenta and angles-of-flight of the protons allows us to plot the distribution (of events) with respect to the square of the total energy of the π mesons in their center-of-mass system for the reaction under consideration

$$\pi^- + p \to \dot{p} + \dot{\pi}^- + k\pi^0. \qquad (1)$$

The resulting distribution with respect to ω^2 (being in fact the distribution with respect to the effective masses of the system of outgoing π mesons) is shown in Fig. 1.

The same graph shows (in addition to the experimental histogram) the phase-volume curve normalized to the total number of events. Comparison of the resulting histogram and the phase-volume curve shows that a large number of events, clustered in a narrow maximum, are observed in the region $\omega^2 \sim 30$. The most probable explanation for the appearance of this maximum is the hypothesis that the reaction

$$\pi^- + p \to p + \rho^- \to p + \pi^- + \pi^0 \qquad (2)$$

takes place in a considerable number of events, where ρ^- is the ρ meson with mass ~750 BeV, [2] which has been previously observed in many investigations.

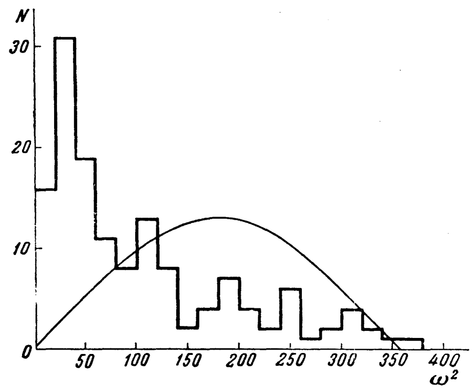

FIG. 1. Distribution of events in reaction (1) with respect to the square of the total energy of the secondary π mesons (ω in units $m_\pi c^2$).

Such an interpretation of the events appearing in the maximum of the distribution with respect to ω^2 is confirmed by the distribution with respect to the mass defect: events with $\omega^2 < 60$ are clustered for the most part near the value $M_X = m_\pi$.

The events selected for analysis correspond to small angles θ_ρ of emergence of the ρ^- meson in the c.m.s. ($1 - \cos\theta_\rho \leq 0.1$). For larger angles θ_ρ the momentum of the recoil protons must exceed 1.5 BeV/c. However, within the limits of these events, cases (in the region $\omega^2 < 60$) of small momentum transfer to the proton occur more frequently. This indicates that the angular distribution of the ρ^- mesons is sharply peaked in the forward direction. Of considerable interest is the angular distribution of the π^- mesons in the c.m.s. of the ρ^- meson. In the event that the ρ mesons are produced polarized or aligned, the shape of the resulting distribution determines the spin of the ρ meson. The resulting angular distribution for the π mesons in the c.m.s. of the ρ meson very closely corresponds to a distribution of the form $N(\theta^*) \sim a + b\cos^2\theta^*$ [see Fig. 2(a)], where $a \ll b$. Such a shape for the angular distribution indicates that the ρ mesons are produced strongly aligned and their spin equals 1. A similar result was obtained in [3].

The angular distribution of π mesons for $\omega^2 > 60$ (i.e., the region beyond the resonance) is very nearly isotropic [see Fig. 2(b)]. The substantial difference between the angular distributions of π^- mesons in the c.m.s. of the secondary π^- mesons for $\omega^2 < 60$ and $\omega^2 > 60$ is an important additional argument in favor of our hypothesis concerning the nature of the maximum in the region $\omega^2 \sim 30$.

An estimate of the cross section for the production of ρ^- mesons in collisions leads to a value ~ 1 mb.

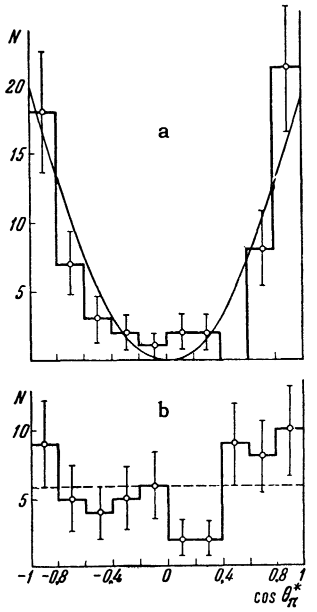

FIG. 2. The angular distribution of the π^- mesons in the c.m.s. of the ρ^- mesons: (a) for $\omega^2 < 60$ (63 cases), (b) for $\omega^2 > 60$ (58 cases).

Assuming that the pole diagram gives the major contribution to reaction (2), one can obtain a value for the scattering cross section. A calculation according to the Chew-Low formula, similar to one made earlier [2] for an initial momentum of 2.8 BeV/c, leads to a value for $\sigma_{\pi\pi}$ of the order of 300 ± 100 mb for $\omega^2 = 20$ to 30.

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