particles by deuterons as a whole will be equal to

$$\sigma = \sigma_d w_d(\lambda\!\!\!^-), \quad (1)$$

where σ_d is the total cross section of quasi-elastic scattering of particles on the deuteron (with account of the stripping reaction in the case of scattering of nucleons), while the quantity $w_d(\lambda\!\!\!^-)$ is the probability that the nucleons in the deuteron are found at distances less than $\lambda\!\!\!^-$, where $\lambda\!\!\!^-$ is the wavelength of the incident particle. In other words, $w_d(\lambda\!\!\!^-)$ is the relative probability of the process being studied. If we denote by $\psi_d(r)$ the wave function of the deuteron, then

$$w_d(\lambda\!\!\!^-) \approx 4\pi \int_0^{\lambda\!\!\!^-} \psi_d^2(r) r^2 dr \approx \frac{4\pi}{3} \psi_d^2(0) \lambda\!\!\!^{-3}. \quad (2)$$

The latter equality holds for sufficiently small $\lambda\!\!\!^-$. (For large $\lambda\!\!\!^-$, it is necessary to carry out numerical integration of the integral in (2). In the work of Blokhintsev, the integration is carried out up to R, where R is the radius of strong interaction of nucleons, $R \approx (0.3-0.4)\hbar/\mu c$. In the same expression for the relative probability $w_d(R)$ is shown to be independent of the momentum of the incident particle. At small separation distances, the wave function of the deuteron $\psi_d(r)$ contains in practice only the $^3S_1$ wave. Therefore,

$$\psi_d(0) = \lim_{r\to 0} (u(r)/r), \quad (3)$$

where $u(r)$ is a function of the $^3S_1$ state of the deuteron. Making use of the $u(r)$ computed by the Tamm-Dankoff method,[3] we find $\psi_d(0) \approx 0.7$. (in the system of units for which $\hbar = \mu_\pi = c = 1$) and

$$\omega_d(\lambda\!\!\!^-) \approx 4\pi\lambda\!\!\!^{-3}/3. \quad (4)$$

For energies of the incident protons of 675 Mev, $\lambda\!\!\!^- \approx 0.1$ and, consequently, $w_d(\lambda\!\!\!^-) \approx 2\times 10^{-3}$. The experimental value of this quantity[1,2] amounts to 7×10^{-3}.

Strictly speaking, in the computation of $w_d(\lambda\!\!\!^-)$, the mutual screening of the nucleons in the deuteron must be taken into account. This increases the relative probability $w_d(\lambda\!\!\!^-)$ somewhat.

From a comparison of the theoretical and experimental values of w_d, we come to the conclusion that the theory agrees qualitatively with experiment.

There is interest in the experimental investigation of the scattering of fast particles by deuterons and the comparison of the energy dependence of the relative elastic scattering probability of fast particles by deuterons with Eq. (2). It should be noted that the study of the scattering of fast pions by deuterons is preferential in this case in order to separate the stripping reaction, which exists concurrently with the elastic scattering of fast nucleons by deuterons.

In conclusion, I express my thanks to Academician I. E. Tamm for suggesting the topic.

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THE INTERACTION OF K-MESONS, PIONS, NUCLEONS AND HYPERONS

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A model was proposed in Refs. 1–3 for the description of the multiple production of strange particles. The structure of the "composite particle," formed in the collision of two fast particles, depends essentially on the assumption of a magnitude of the interaction of particles of different types. In the formulas of the statistical theory of multiple production, the interaction constants do not enter explicitly. "Strong" or "weak" interaction here is understood in the sense of the magnitude of the cross section obtained after establishment of statistical equilibrium between the produced particles. In our view, it is very probable that conclusions on "strong" or "weak" interaction of particles of different types which follow from a comparison of calculations (in terms of the statistical theory) with experiment over a wide range of energies give information on the relative magnitude of the interaction constants between these particles.* Since there are various opinions at the present time concerning the magnitude of the interaction of pions and K mesons with hyperons, and K mesons with nucleons, then even indirect information on these interactions is of great interest. We shall start out from the very well known experimental fact of the strong interaction of pions and nucleons ($g^2/4\pi\hbar c \gg 1$).

If we assume strong interaction of pions and K-mesons (or K mesons and nucleons), then the following possibilities exist for the choice of the space volumes for the "compound particle."

1. Statistical equilibrium between all the secondary particles is established in one and the same volume V_1.† In this case the fraction of created particles relative to the pions and nucleons exceeds that experimentally observed by us.

2. The statistical equilibrium of nucleons, pions and K-mesons is established in the same space volume V_1, but the equilibrium for hyperons is established in a smaller volume. In this case, the fraction of created strange particles is close to the experimental value;[6,7] however, the ratio of the number of K^- and K^+ mesons produced in nucleon-nucleon collisions at $E = 6.2$ Bev is $N^+/N^- \cong 3$. In the works of Chapp et al.,[4] values of N^+/N^- of $100 - 150$ were obtained for momenta of K-mesons of $p \sim 250 - 350$ Mev/c. Even taking the momentum distribution into account, it is difficult to harmonize these differences of two orders of magnitude.‡

3. The volume in which the equilibrium is established for K-mesons is larger than the corresponding volume for nucleons and pions. In this case, it is not possible to obtain experimental agreement either with the number of strange particles created or with the value of the ratio N^+/N^-.

Agreement can be produced between experiment and the results of the statistical theory of multiple particle production only if weak interaction is assumed between the K-mesons and the pions and nucleons. In this case, the statistical equilibrium for K-mesons is established in a smaller space volume than for pions and nucleons. The best agreement is found if, following Gell-Mann, we assume a symmetric interaction of the pions with nucleons and hyperons ($V = V_2$). Thus, the computed effective cross section σ_s of creation of strange particles in π^--nucleon collisions at 4.3 Bev is equal to 3 mb in this case.** The mean experimental value of this cross section is approximately equal to 2.2 mb.[6] If we assume that all the strange particles interact weakly with pions and nucleons ($V = V_3$), then $\sigma_s = 0.3$ mb. The divergence of the theoretical and experimental values in this case exceeds the experimental error.††

The ratio $N^+/N^- \approx 160$ for $V = V_2$ and $N^+/N^- \simeq 8$ for $V = V_3$, i.e., if we assume that all the strange particles interact weakly with the pions and nucleons, then the results of the calculation of N^+/N^- sharply contradicts experiment.

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*A detailed consideration of this question will be given at a later date.

†We use the same notation as in Refs. 1, 2.

‡Exact calculations with account of momentum distribution will be published later in Acta Physica Polonica.

**The calculations were carried out under the assumption that the number of created K^0 and $K+$ particles is approximately the same; $E = 5$ Bev. Taking the Fermi energy in the nucleus into account, this energy is close to the experimental energy of 4.3 Bev.

††The experimental error $\lesssim 50\%$; $\sigma_{tot} = (25 \pm 2.5)$ mb.

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*POLARIZATION OF MU-MESON IN COSMIC RAYS**

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THE recent discovery of nonconservation of parity in weak (decay) interactions leads, in particular, to an asymmetry of the decay of polarized μ-mesons. The measure of asymmetry should then be proportional to the degree of polarization. It can be concluded from the data of Lederman et al.[1]