ON THE THEORY OF SCATTERING OF PARTICLES BY NUCLEI

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Submitted to JETP editor October 24, 1957

J. Exptl. Theoret. Phys. (U.S.S.R.) 34, 251-253 (January, 1958)

THE scattering of particles by nuclei has been investigated using the degenerate Fermi gas as a model for nuclear matter.[1-3] This allows one to evaluate certain effects in scattering linked to the Pauli principle. Assuming that the differential cross section for particles colliding with free nucleons is isotropic, independent of energy and equal to $\sigma_0/4\pi$, it is possible to obtain the total collision cross section for particles against one of the nucleons of the nucleus in the form $\sigma = \sigma_0 F$, where the factor F is a function of two variables: $w = p_F/p$ and $\alpha = m/m_N$. Here, m and p denote the mass and momentum of the particle incident on the nucleus in the laboratory system, while m_N and p_F denote the mass of the nucleon and the momentum on the Fermi surface. The function $F(w, \alpha)$ has already been obtained for $\alpha \leq 1$. The case $\alpha = 1$ which corresponds to scattering of a nucleon against a nucleus has been considered in Refs. 1 and 2, and the case $\alpha < 1$ (meson scattering) in Ref. 3.

An investigation of the region $\alpha > 1$ permits one to construct the function over the whole $w - \alpha$ plane (more exactly, in the first quadrant). The final results are as follows: There are four regions in which F has various analytical forms; the regions are separated from one another by the curves $\alpha w = 1$ and $w = 1$ (see Fig. 1).

$$F = 1 - w^2(1 + 2\alpha)/5 \text{ in region I},$$

$$F = [\alpha^2 - 2 + 10w^2 - 20\alpha w^3 + 15\alpha^2 w^4 - 4\alpha^3 w^5] / 10w^3(1 - \alpha)^2 \text{ in region II},$$

$$F = (1 + \alpha)^2 / 10\alpha^2 w^3 \text{ in region III},$$

$$F = [1 - 10\alpha^2 w^2 + 10\alpha^2(1 + \alpha^2) w^3 - 15\alpha^4 w^4 + 2\alpha^2(3\alpha^2 - 1) w^5] / 10\alpha^2(\alpha - 1)^2 w^3 \text{ in region IV}.$$

Figures 2 and 3 show the curves $F(w)$ for values of α which correspond to π, K, N, Ξ, Σ. An analogous curve for Λ falls practically on the Σ curve. In Fig. 4, the abscissa is the energy $\epsilon = E/E_F$ (in units of $E_F \approx 25$ Mev).

The author is grateful to L. B. Okun' for valuable comments.

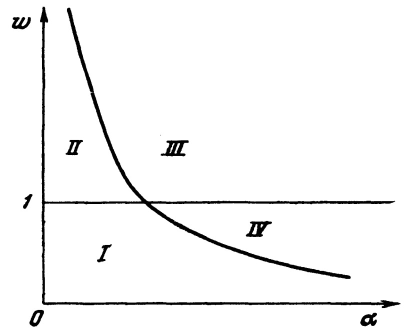

FIG. 1

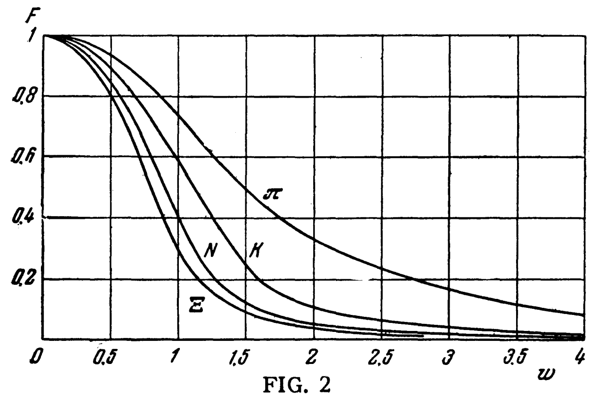

FIG. 2

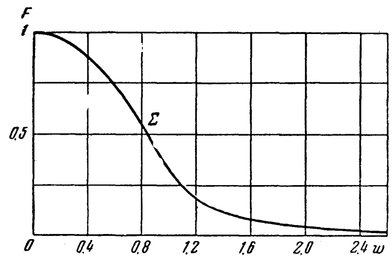

FIG. 3

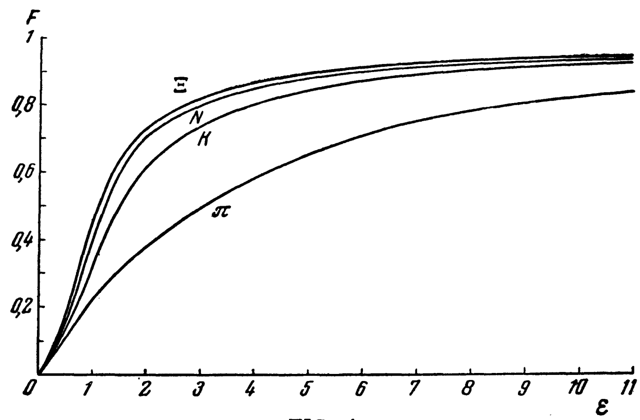

FIG. 4

[1] Hayakawa, Kawai, and Kikuchi, Progr. Theoret. Phys. 13, 415 (1955).

[2] M. L. Goldberger, Phys. Rev. 74, 1269 (1948).

[3] I. G. Ivanter and L. B. Okun', J. Exptl. Theoret. Phys. (U.S.S.R.) 32, 402 (1957), Soviet Phys. JETP 5, 340 (1957).

Translated by M. A. Melkanoff
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