p_1 is a proton from the accelerator, p_2 is a proton at rest, and p_3 and p_4 are also protons.

This process is followed by the decay of the ρ meson, but we do not record the decay products. The energies and momenta of the protons p_1, p_3, and p_4 must be measured with great accuracy. Let us form the expression

$$A = [(E_1 + Mc^2 - E_3 - E_4)^2 - c^2 (\mathbf{p}_1 - \mathbf{p}_3 - \mathbf{p}_4)^2].$$

For single production of ρ mesons we have $A = m_\rho^2 c^4$. In the case of an arbitrary process with production of two or more pions, we have a continuous spectrum of A values.

If it is observed in an experiment that there is a sufficiently narrow line (whose width must correspond to the accuracy of measurement of the magnitudes and directions of p_3 and p_4) in the distribution of A, the existence of a neutral meson with a strong nuclear interaction will have been demonstrated and its mass will have been determined.

I am grateful to V. B. Berestetskii and L. B. Okun' for their valuable advice.

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Translated by J. Heberle

INTERACTION OF A MEDIUM WITH A CURRENT INCIDENT ON IT

V. N. TSYTOVICH

Moscow State University

Submitted to JETP editor March 10, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **34**, 1646-1648 (June, 1958)

In the present note we analyze the interaction of a constant, straight current of strength I with a medium occupying the half-space $x \leq 0$ and described by arbitrary μ $\epsilon(\omega)$. The current is parallel to the dividing boundary and moves onto the medium with a velocity v which is perpendicular to the dividing boundary. Morozov[1] considered the interaction for the motion along a metal.

The force acting upon a unit current length is of the form

$$F_x = \frac{2I^2}{c^2\sqrt{1-\beta^2}} \int_0^\infty e^{-2kr} \frac{\zeta(-ikv)-\mu}{\zeta(-ikv)+\mu}\, dk, \tag{1}$$

$$r = -vt, \quad \zeta(-ikv) = \zeta(\omega)\big|_{\omega=-ikv};$$

$$\operatorname{Re}\zeta > 0, \quad \operatorname{Im}\zeta(-i\omega) = 0, \tag{2}$$

$$\zeta = \sqrt{1+\beta^2(\varepsilon(\omega)\mu - 1)}.$$

Expression (1) can be obtained, for instance, by applying the image method to the separate terms of a plane-wave expansion of the potential, taking it into account that the only singularities of the expressions under the integral sign are the poles ϵ and $1/\epsilon$ which lie in the upper half-plane of complex ω (see references 2 and 3; the time factor here is $e^{i\omega t}$).

For a dispersionless medium we get

$$F_x = -\frac{I^2}{c^2\sqrt{1-\beta^2}} \frac{\mu - \sqrt{1+(\varepsilon\mu-1)\beta^2}}{\mu + \sqrt{1+(\varepsilon\mu-1)\beta^2}} \frac{1}{r}. \tag{3}$$

For $\beta^2 > (\mu^2 - 1)/(\epsilon\mu - 1)$ the attraction changes into repulsion. For sufficiently small r, expression (3) is, of course, inapplicable since dispersion becomes important (from dimensional considerations, the order of magnitude of the excited frequencies is $\omega \sim v/r$).

If ζ is expanded in terms of $(\epsilon - 1)\beta^2$, and if we put $(\mu = 1,\ \beta^2 \ll 1)$

$$\varepsilon = 1 + \frac{4\pi ne^2}{m} \sum_k \frac{f_k}{\omega_k^2 - \omega^2 + i\gamma_k\omega}, \tag{4}$$

we find

$$F_x^k = \frac{\pi ne^2\beta}{mc^3 i\omega_k'} \{e^{-\alpha\eta_k + i\alpha}\, \mathrm{Ei}(-\alpha\eta_k - i\alpha) - e^{-\alpha\eta_k - i\alpha}\, \mathrm{Ei}(-\alpha\eta_k + i\alpha)\}, \tag{5}$$

where Ei is the exponential integral, and

$$F_x = \sum_k f_k F_x^k; \quad \omega_k' = \sqrt{\omega_k^2 - \gamma_k^2/4};$$

$$\eta_k = \gamma_k / 2\omega_k'; \quad \alpha = 2\omega_k' r / v. \tag{6}$$

For $r \gg v/\omega_k$, from (5), in particular, we get in accordance with (3)

$$F_x = \frac{\varepsilon(0) - 1}{4} \beta^2 \frac{I^2}{c^2} \frac{1}{r}, \tag{7}$$

and for $r \ll v/\omega_k$ we have

$$F_x^k = \pi^2 I^2 ne^2 \beta / mc^3 \omega_k'. \qquad (8)$$

If a current moves onto a plasma or a metal, such an expansion is impossible, since we must assume

$$\varepsilon = 1 - \omega_0^2/(\omega^2 - i\gamma\omega); \quad \gamma = \omega_0^2/4\pi\sigma;$$

$$\omega_0^2 = 4\pi ne^2/m; \quad \mu = 1, \qquad (9)$$

where σ is the electrical conductivity for $\omega = 0$. In that case it is necessary to evaluate expression (3) more accurately, retaining the radical under the integral sign. We shall give the results for particular cases. If $r \gg c/\omega_0$ and $\beta \gg (\gamma/\omega_0) \times (c/\omega_0 r)$, we have*

$$F_x = I^2/c^2 r \sqrt{1-\beta^2}. \qquad (10)$$

If the conditions $r \gg c/\omega_0$ and $\beta \ll (\gamma/\omega_0) \times (c/\omega_0 r')$ are satisfied, we get

$$F_x = \frac{2\pi I^2 \beta}{c^3 \sqrt{1-\beta^2}} \sigma \ln \frac{1.356\, c}{8\pi\sigma\beta r}. \qquad (11)$$

For $r \ll c/\omega_0$ and $\beta \geq \gamma/2\omega_0$ the evaluation of the integral (3) gives

$$F_x = \frac{I^2\omega_0}{3c^3\sqrt{1-\beta^2}} \{\eta^2 K(\sqrt{1-\eta^2/4})$$

$$+ 2(2-\eta^2) E(\sqrt{1-\eta^2/4}) + \eta(\eta^2-3)\}, \qquad (12)$$

where K and E are the complete elliptic integrals. In the particular case $\beta \gg \gamma/2\omega_0$, we expand (12) in powers of $\eta = \gamma/\omega_0\beta$,

$$F_x = (4I^2/3c^2\sqrt{1-\beta^2})\, \omega_0/c. \qquad (13)$$

If $r \ll c/\omega_0$ and $\beta \leq \gamma/2\omega_0$, we get the following result

$$F_x = \frac{2I^2\omega_0}{c^3\sqrt{1-\beta^2}} \Big\{-\frac{1}{6}\eta + \frac{2}{3\sqrt{|z_1|}} F(\varphi, k)$$

$$- \frac{1}{3}\frac{(2-\eta^2)|z_2|}{\sqrt{|z_1|}} \Big[\frac{\sqrt{k'^2 + |z_2|\, k'^{-2}}}{\sqrt{|z_2|(1+|z_2|)}} - k'^{-2} E(\varphi, k)\Big]\Big\}, \qquad (14)$$

where $E(\varphi, k)$ and $F(\varphi, k)$ are incomplete elliptic integrals, and

$$k^2 = (z_1 - z_2)/z_1; \; k'^2 = 1 - k^2;$$

$$\tan^2\varphi = 1/|z_2|; \quad \eta = \gamma/\omega_0\beta; \qquad (15)$$

$$z_1 = 1 - \frac{\eta^2}{2} - \frac{\eta^2}{2}\sqrt{1 - 4/\eta^2};$$

$$z_2 = 1 - \frac{\eta^2}{2} + \frac{\eta^2}{2}\sqrt{1 - 4/\eta^2}. \qquad (16)$$

The expansion of (14) for $\beta \ll \gamma/\omega_0$ gives

$$F_x = \frac{20\pi I^2\beta\sigma}{3c^3\sqrt{1-\beta^2}} \ln \frac{1.492\,\omega_0}{2\pi\sigma\beta}. \qquad (17)$$

I express my sincere gratitude to M. S. Rabinovich, M. L. Levin, and L. M. Kovrizhnyi for discussing the results of this paper.

*The second condition is in fact equivalent to $r \gg \delta$, where δ is the skin depth for a frequency v/r.

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Translated by D. ter Haar
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ENERGY DEPENDENCE OF THE REACTION CROSS SECTIONS FOR SLOW NEUTRONS

F. L. SHAPIRO

P. N. Lebedev Physics Institute, Academy of Sciences, U.S.S.R.

Submitted to JETP editor March 12, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **34**, 1648-1649 (June, 1958)

IT follows from very general assumptions that the reaction cross section for low-energy neutrons is proportional to $E^{-1/2}$ (cf., e.g., reference 1):

$$\sigma_r = (\sigma_r E^{1/2})_0 E^{-1/2}, \qquad (1)$$

where the index 0 denotes evaluation at the neutron energy $E = 0$. Expression (1) is essentially the first term in the series

$$\sigma_r = (\sigma_r E^{1/2})_0 (E^{-1/2} - \alpha + \gamma E^{1/2} + \cdots). \qquad (2)$$

The aim of the present paper is to show that the assumptions leading to the $1/v$ law also determine the quantity α in (2). The effective reaction cross section can be expressed through the logarithmic derivative of the wave function of the incoming particle at the nuclear boundary (f_0). In the notations of Blatt and Weisskopf[1] the reaction cross section for s neutrons incident on a nucleus with spin zero is equal to