this sense $\lambda \to 0$ means neglecting values of the order of magnitude of a/R.

For $R \ll \lambda_0$ (λ_0 is the order of magnitude of the wavelengths in the spectrum of the atom) U is the form of London's formula. In the other limiting case for $R \gg \lambda_0$ in the integrals with respect to p and ω, the regions $p \sim \omega \sim \lambda_0/R$ are important, and the main member in U will be

$$U = \frac{i}{16\pi^5} \alpha_1(0)\ \alpha_2\ (0)$$
$$\times \lim_{\lambda \to 0} \iint d\,\mathbf{p}'\,d\,\mathbf{p}'' e^{-i(\mathbf{p}'+\mathbf{p}'')\mathbf{R} - \lambda R(p'+p'')}$$
$$\times \int_{-\infty}^{\infty} \frac{d\omega}{(p'^2-\omega^2)(p''^2-\omega^2)} [3\omega^4 - \omega^2(p'^2+p''^2)$$
$$+ (\mathbf{p}'\mathbf{p}'')^2] = -\frac{23\alpha_1(0)\,\alpha_2(0)}{4\pi R^7},$$

which exactly coincides with the results obtained by Casimir and Polder.

I express my gratitude to L. P. Gorkov for taking part in the discussion of the above problem.

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239

The Energy Spectrum of γ-Quanta from Decaying π^0-Mesons

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(Submitted to JETP editor February 17, 1956)
J. Exptl. Theoret. Phys. (U.S.S.R.) **30**, 1150-1151 (June, 1956)

THE relationship which determines the energy spectrum of the γ-radiation $W(\epsilon_\gamma, \theta_N)$ observed in any coordinate system at some angle θ_N, as a function of the energy and angular distributions of neutral mesons $F(\epsilon_\pi, \theta)$ in the same coordinate system is

$$W(\varepsilon_\gamma, \theta_N) = \int_{\varepsilon_{min}}^{\infty} \frac{d\varepsilon_\pi}{\sqrt{\varepsilon_\pi^2 - 1}} \cdot \frac{1}{2\pi} \int_0^{2\pi} F(\varepsilon_\pi, \theta)\, d\varphi'. \tag{1}$$

Here ϵ_π and ϵ_γ are the total energy of the π^0-meson and the energy of the γ-quantum in units of the π^0-meson rest energy: $\epsilon_{min} = \epsilon_\gamma + 1/(4\epsilon_\gamma)$

$$\theta = \arccos(\sin\vartheta \cos\varphi' \sin\theta_N + \cos\vartheta\cos\theta_N);$$
$$\vartheta = \arccos\frac{\varepsilon_\pi - 1/2\varepsilon_\gamma}{\sqrt{\varepsilon_\pi^2 - 1}}.$$

For π^0-mesons whose angular distribution is proportional to $\cos^2\theta$ we obtain

$$W(\varepsilon_\gamma, \theta_N) = \frac{1}{2}(3\cos^2\theta_N - 1)\int_{\varepsilon_{min}}^{\infty} \frac{\cos^2\vartheta\, F(\varepsilon_\pi)\, d\varepsilon_\pi}{\sqrt{\varepsilon_\pi^2 - 1}} \tag{2}$$
$$+ \frac{1}{2}\sin^2\theta_N \int_{\varepsilon_{min}}^{\infty} \frac{F(\varepsilon_\pi)\, d\varepsilon_\pi}{\sqrt{\varepsilon_\pi^2 - 1}}.$$

From this it follows that the γ-spectrum recorded at angle $\theta_N^* = \arccos(1/\sqrt{3})$ is logarithmically symmetrical with respect to the energy $\epsilon_\gamma = 1/2$ just as in the case of isotropic distribution of π^0-mesons. This means that from the γ-spectrum at a given angle and for an angular distribution of mesons of the form $a + b\cos^2\theta$, it is possible to obtain directly the energy distribution of the mesons and their mass by the method described in Ref. 1. Angles which are characterized as noted above will hereinafter be called "isotropic".

Another characteristic of an "isotropic" angle is the dependence of the total gamma flux at a given angle on the ratio of the constants a and b in the angular distribution of the π^0-mesons.

By integrating (2) with respect to the energy we obtain the angular distribution of the γ-rays produced through the decay of π^0-mesons whose angular distribution is proportional to $\cos^2\theta$, in the form

$$W_\gamma(\theta_N) = \frac{1}{2}(3\cos^2\theta_N - 1) \tag{3}$$
$$\times \int_0^{\infty} d\varepsilon_\gamma \int_{\varepsilon_{min}}^{\infty} \frac{\cos^2\vartheta\, F(\varepsilon_\pi)\, d\varepsilon_\pi}{\sqrt{\varepsilon_\pi^2 - 1}} + \frac{1}{2}\sin^2\theta_N.$$

It follows that the gamma flux at angle $\theta_N^* = \arccos(1/\sqrt{3})$ remains unchanged in the transition from the $\cos^2\theta$ law of meson angular distribution to an isotropic distribution if only there is no change in the total number of mesons produced per unit time.

It also follows from (3) that when the angular distribution of π^0-mesons is $a + b\cos^2\theta$ the angular distribution of γ-rays must have the form $A + B \cos^2\theta$, where

$$A = a + \frac{b}{2}\left[1 - \int_0^\infty d\varepsilon_\gamma \int_\alpha^\infty \frac{\cos^2 \vartheta\, F(\varepsilon_\pi)\, d\varepsilon_\pi}{\sqrt{\varepsilon_\pi^2 - 1}}\right];$$

$$B = \frac{b}{2}\left[3 \int_0^\infty d\varepsilon_\gamma \int_{\varepsilon_{min}}^\infty \frac{\cos^2 \vartheta\, F(\varepsilon_\pi)\, d\varepsilon_\pi}{\sqrt{\varepsilon_\pi^2 - 1}} - 1\right].$$

The same conclusion was reached earlier in Ref. 2. Using this result and Rosenfeld's[3] suggestion regarding the existence of an "isotropic" angle θ_N^* for charged mesons we can also conclude that the gamma flux at angle θ_N^* is independent of the ratio of a and b in the angular distribution of π^0-mesons.

The above-mentioned properties of the gamma spectrum and flux for the "isotropic" angle are retained in the more general case when the angular and energy distributions of the π^0-mesons are of the form $a(\epsilon_\pi) + b(\epsilon_\pi) \cos^2\theta$. It should be noted that in this instance when the derivative of the measured gamma spectrum is multiplied by the gamma-ray energy we obtain the function $a(\epsilon_\pi) + 1/3\, b(\epsilon_\pi)$.

I take this opportunity to acknowledge my indebtedness to B. M. Pontecorvo for a discussion of the above results.

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237

On the Stability of the Phase Boundaries Between Normal and Superconducting States

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(Submitted to JETP editor March 2, 1956)
J. Exptl. Theoret. Phys. (U.S.S.R.) **30**, 1154-1155 (June, 1956)

NOT long ago, Beck's paper[1] appeared, in which the author, using London's equations for the magnetic field in a superconductor, found an instability in the boundary between the n- and s-phases as regards a periodic (along the surface) perturbation of the shape of the boundary. It is immediately clear from Eqs. (25) and (34) of Ref. 1 that the instability found by the author, at least as regards a perturbation with a period much greater than the penetration depth of the magnetic field in the superconductor, is explained by the well-known fact that London's equations lead to a negative surface energy on the boundary[2]. Since a negative surface tension contradicts experimental results for thin films, the analysis of the problem of stability should be based, not on London's equations, but on the theoretical calculations of Landau and Ginzburg[3], which give a positive value to the surface energy. In Landau and Ginzburg's theory, the problem of stability becomes the problem of a unique solution at infinity under corresponding boundary conditions. A strict analysis such as this can scarcely be performed by means of the non-linear equations of the theory. The only complete solution is for a perturbation with a period much greater than the penetration depth. In this case it can be made equal to zero, so that B = 0 in the superconducting phase. Also, in agreement with the theory of Landau and Ginzburg, we attribute a positive energy to the boundary between the n- and s-phases, which we write in the usual form, $(H_k^2/8\pi)\Delta$, where H_k is the critical field and Δ is a constant with the dimensions of length. The free energy change taking place with a variation in the shape of the boundary is written (for this case)

$$\delta F = \frac{H_k^2}{8\pi}\,\delta V_n + \Delta\frac{H_k^2}{8\pi}\,\delta S - \frac{1}{8\pi}\,\delta \int_{V_n} H^2 dV. \qquad (1)$$

The equilibrium of a plane boundary is studied in relation to an arbitrary (but not specifically oriented, as in Ref. 1) periodic perturbation. The stability of the boundary of arbitrary form is analyzed in the same way because any small part of the boundary can be thought of as a plane. The integral on the right side of Eq. (1) is easily transposed so that to calculate δF, correct to a second degree term over a small variation in the boundary δz, it is sufficient to know the magnetic field variation $\delta \mathbf{H}$ with an accuracy to a term of the first order of δz. By means of a simple transformation we can show that

$$-\frac{1}{8\pi}\,\delta \int_{V_n} H^2 dV = -\frac{H_0^2}{8\pi}\,\delta V_n + \frac{1}{8\pi}\int_S [\mathbf{A}_0 \delta \mathbf{H}]\, ds, \qquad (2)$$

where $\mathbf{A}_0$ is the vector potential of the unperturbed constant field $\mathbf{H}_0$; the integral on the right-hand side of Eq. (2) is taken over the surface of the perturbed boundary. In the derivation of Eq. (2) the vector potentials $\mathbf{A}$ and $\mathbf{A}_0$ are so normalized that