We found that in this case,

$$\chi'' = \frac{\chi_0}{2}\left\{\frac{\omega/\tau}{(\omega_0-\omega)^2+\tau^{-2}} + \frac{\omega/\tau}{(\omega_0+\omega)^2+\tau^{-2}}\right\};\ \chi''_z = \chi_0\frac{\omega/\tau}{\omega^2+\tau^{-2}} \quad (2)$$

(χ_0 = static susceptibility).

We note that the thermodynamic theory of Shaposhnikov evidently leads to the same formulas (see Ref. 4). If we consider that τ increases with increase in H_0,[3,5] then it is shown that the simple equations (2) provide both a qualitative and a quantitative description of the experimental results.

6. Considerations carried out above show that the magnetic double refraction of microwaves in paramagnetics ("the microwave effect of Cotton-Mouton") is closely connected with the paramagnetic absorption in perpendicular and parallel fields and, together with the paramagnetic resonance rotation,[6-9] enters into a series of phenomena which can now be united under the general title of "paramagnetic resonance."[10]

A more detailed explanation of the results obtained will be published separately.

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TOTAL CROSS SECTION OF STRIPPING AND DIFFRACTION DISINTEGRATION OF FAST DEUTERONS ON NONSPHERICAL NUCLEUS

V. S. POPOV

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LET us consider a nucleus having the form of an ellipsoid of rotation and one that is opaque for incident nucleons. The kinetic energy of the deuterons must be sufficiently large in order that the wavelength of the deuteron be many times smaller than the radius of the nucleus. We shall neglect the effect of the Coulomb field of the nucleus in this note.

With the help of a method developed by Akhiezer and Sitenko,[1] the following expression is obtained for the amplitude of elastic diffraction scattering of deuterons on a nucleus with a fixed orientation of its axis ω:

$$f(\varkappa,\omega) = 2\pi ik\left\{\frac{4p}{\varkappa'}\tan^{-1}\frac{\varkappa'}{2p}\,\Omega(\varkappa',\omega) - \frac{1}{b^2}\int dg\,\frac{2p}{|2g-\varkappa'|}\tan^{-1}\frac{|2g-\varkappa'|}{2p}\,\Omega(g,\omega)\,\Omega(\varkappa'-g,\omega)\right\}, \quad (1)$$

$$\Omega(\varkappa,\omega) = (b^2/2\pi)\,\xi(x)\,J_1(t)/t,$$

$$\cos\vartheta = x;\ t = \varkappa'\,[\xi^2(x)\cos^2(\varphi-\phi) + \sin^2(\varphi-\phi)]^{1/2};$$

$$\xi(x) = \left[\left(\frac{a}{b}\right)^2(1-x^2)+x^2\right]^{1/2}.$$

Here a, b = semiaxes of the ellipsoid, while a refers to the axis of rotation; $\omega = (\theta,\varphi)$ = angles defining the orientation of the nucleus in space; $J_1(t)$ is the Bessel function of order 1; κ = transverse momentum obtained by the deuteron upon scattering; $\kappa = k\theta$; (θ,φ) = direction of the momentum of the scattered deuteron; $\kappa' = \kappa b$; $p = b/R_d = 2\alpha b$.

Equation (1) is simplified when the radius of the nucleus is much larger than the radius of the deuteron and the scattering angles are small ($p \gg 1$, $p \gg \kappa'$). In particular, the forward scattering amplitudes are

$$f(0,\omega) = \frac{ika^2\xi}{2}\left[1 + \frac{1}{\pi p}\,E\left(\frac{\pi}{2},\frac{\sqrt{\xi^2-1}}{\xi}\right)\right], \quad (2)$$

where E is the complete elliptical integral. Averaging over the various orientations of the nucleus, we obtain the total cross section of all processes:

$$\sigma_t = \frac{4\pi}{k}\overline{\operatorname{Im} f(0,\omega)} = 2\pi b^2\left(1+\frac{\varepsilon}{6}-\frac{\varepsilon^2}{15}\right) + \pi bR_d\left(1+\frac{\varepsilon}{6}-\frac{\varepsilon^2}{40}\right) \quad (3)$$

(with accuracy up to terms $\sim\epsilon^3$); here $\epsilon = (a/b)^2 - 1$. Taking $p \gg 1$, we can neglect the curvature of the surface of the nucleus and use the probability of stripping and of diffraction break up, calculated per unit length of a screen in the form of an infinite half-plane (see Ref. 2). Upon multiplication by the length of the projection of the nucleus, and averaging over all its orientations, we obtain the total cross section of stripping and diffraction disintegration of the deuteron (with accuracy up to ϵ^3):

$$\sigma_p = \sigma_n = \frac{\pi}{2} bR_d \left(1 + \frac{\varepsilon}{6} - \frac{\varepsilon^2}{40}\right);$$
$$\sigma_d = \frac{\pi b R_d}{3}\left(2\ln 2 - \frac{1}{2}\right)\left(1 + \frac{\varepsilon}{6} - \frac{\varepsilon^2}{40}\right). \quad (4)$$

The following relation holds among σ_e, σ_d and σ_t: $\sigma_e + \sigma_d = \sigma_t/2$. This equality, which was established in Ref. 1 for a spherical nucleus, holds also in the case of a black, nonspherical nucleus. Therefore, we can determine the elastic diffraction scattering cross section:

$$\sigma_e = \pi b^2\left(1 + \frac{\varepsilon}{6} - \frac{\varepsilon^2}{15}\right) + \frac{2\pi}{3} bR_d (1 - \ln 2)\left(1 + \frac{\varepsilon}{6} - \frac{\varepsilon^2}{40}\right). \quad (5)$$

For a spherical nucleus, all the formulas reduce to the formula of Akhiezer and Sitenko[1] and of Glauber.[2]

In conclusion, I express my thanks to I. S. Shapiro for discussion of the results.

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CERENKOV RADIATION OF LONGITUDINALLY POLARIZED ELECTRONS

A. A. SOKOLOV and Iu. M. LOSKUTOV

Moscow State University

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THE discovery of parity non-conservation by Lee and Yang has aroused renewed interest in an investigation of longitudinal (circular) polarization since longitudinally polarized electrons are produced in β-decay.

In investigating the radiation associated with longitudinally polarized electrons, the Casimir formula cannot be used to calculate the matrix elements; instead, use must be made of Eq. (21.12) of Ref. 1 in which the spin state is explicitly taken into account, since the spin quantum number $s = \pm 1$ characterizes the eigenvalue of the operator $(\nabla\sigma)/i\sqrt{-\nabla^2}$. As has already been noted in Ref. 2 (and also in the detailed literature), this same formula can be used conveniently (with different mass values) in investigating the polarization properties of electrons produced in β-decay.

In the present work we extend the results[3] obtained in an investigation of the polarization properties of Cerenkov radiation to the case in which the electrons are longitudinally polarized.

Carrying out the summation indicated in Eq. (21.12) of Ref. 1 over the final spin states s' and fixing the initial value of the spin s we find that the Cerenkov radiation consists of three parts (in analyzing the polarization properties of the Cerenkov radiation, as in the earlier work,[3] we have used Eqs. (10), (11) and (12) of Ref. 4*):

$$W_{s\lambda} = \frac{e^2}{2c^2}\int_0^{\omega_{max}} \dot{w}_{s\lambda}(\omega)\,d\omega$$
$$= \frac{e^2}{2c^2}\int_0^{\omega_{max}} (w_{class}(\omega) + w_{quant}(\omega) + s\lambda w_{long}(\omega))\,d\omega.$$

Here $w_{class}(\omega) = \omega(1 - \cos^2\theta)$ is the classical component of the radiation (completely linearally polarized);

$$w_{quant}(\omega) = \hbar^2 (n^2\omega^3/2c^2p^2)(1 - n^{-2})$$

is the quantum contribution which is completely unpolarized;

$$w_{long}(\omega) = \hbar\frac{n\omega^2}{cp}\left(1 - \frac{1}{\beta n}\cos\theta\right)$$

characterizes the longitudinally polarized radiated photons (in accordance with conventional classical optics, for $\lambda = -1$ we have right-hand circular polarization while with $\lambda = +1$ we have left-hand circular polarization although the opposite convention would be more natural). It is of interest to note that this part of the radiation is not proportional to $\hbar^2$ (as w_{quant}), but rather to $\hbar$.

The degree of circular polarization is given by the following expression:

$$P = \frac{w_1(\omega) - w_{-1}(\omega)}{w_1(\omega) + w_{-1}(\omega)} \cong s\frac{\hbar n\omega}{cp}.$$

*The notation and a bibliography for this problem are given in Ref. 3.