effect, the difference lies in the presence or absence of acceleration of the radiating charge. A detailed comparison of Cerenkov radiation with the radiation from a charge moving with acceleration in a spatially-periodic force field (the macroscopic analog of the atomic field of a crystal lattice), which is directly applicable to the question considered here, was made in [6].

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FARADAY EFFECT ON "HOT" ELECTRONS IN SEMICONDUCTORS

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As is well known, heating of an electron gas in a semiconductor can exert a noticeable influence on different characteristics of the latter (electric conductivity, galvanomagnetic and thermomagnetic effects, etc.). In this paper we consider the influence of heating of an electron gas on the Faraday rotation of the plane of polarization of an electromagnetic wave passing through a semiconductor.

We shall characterize the degree of "heating" of the electron gas by means of an electron temperature T, which differs from the lattice temperature T_0. The possibility of such an approximation was confirmed in several papers (see, for example, [1]). Further, we shall assume that the magnetic field is weak and that the frequency of the electromagnetic wave is sufficiently low to neglect quantum effects. We consider a unipolar semiconductor, in which the carriers are characterized by an isotropic effective mass m* and the reciprocal momentum relaxation time depends on the carrier velocity like $\tau(v) \sim v^3$. Finally, we confine ourselves to the case of weak heating of the electron gas $\{[(T - T_0)/T_0] \ll 1\}$.

The standard solution of Maxwell's equations together with the kinetic equation yields for the Faraday angle (per unit length) the following expression:

$$\frac{\theta}{\ell} = \frac{\sqrt{\epsilon_0}\,\omega_L^2\omega_H}{2c}\left\langle \frac{\tau_0^2[1 + (\omega_H^2 - \omega^2)\tau_0^2]}{[1 + (\omega_H^2 - \omega^2)\tau_0^2]^2 + 4\omega^2\tau_0^2} \right\rangle - \frac{\sqrt{\epsilon_0}\,\omega_L^2\omega_H}{2c}\, S\, \frac{T - T_0}{T_0}\left\langle \frac{\tau_0^2\,\{[1 + \tau_0^2(\omega_H^2 - \omega^2)]^2 + 4\omega^2(\omega_H^2 - \omega^2)\tau_0^4\}}{\{[1 + \tau_0^2(\omega_H^2 - \omega^2)]^2 + 4\omega^2\tau_0^2\}^2} \right\rangle. \tag{1}$$

Here ω_L and ω_H are respectively the plasma and cyclotron frequencies, ω the frequency of the electromagnetic wave, and τ_0 the relaxation time τ when $T = T_0$. The symbol $\langle\ \rangle$ denotes the averaging customarily employed in the theory of kinetic phenomena. The second term in (1) is the sought change in the rotation of the plane of polarization of the wave due to the heating of the electron gas.

As is customary (see [2]), we can consider the "high-frequency" ($\omega\tau_0 \gg 1$) and "low-frequency" ($\omega\tau_0 \ll 1$) cases (the inequality $\omega_H\tau_0 < 1$ is implied). It is easy to see, however, that the high-frequency case is of little interest (factors $\omega^4\tau_0^4 \gg 1$) appear in the denominator of the second term of (1). The physical meaning lies in the fact that the dependence of the effect on the electron temperature is connected with the mechanism of the carrier scattering. In the high-frequency case, on the other hand, the carrier scattering becomes insignificant.

In the low-frequency case (infrared and millimeter regions of the spectrum), we obtain for the increment of the Faraday angle due to the heating of the electron gas

$$\frac{\Delta\theta}{\ell} = \frac{4\pi}{c^2}\,\frac{\sigma\mu_H H}{\sqrt{\epsilon_0}}\,(-S)\,\frac{T - T_0}{T_0} \tag{2}$$

where σ is the conductivity of the semiconductor and μ_H is the Hall mobility of the carriers. If σ, μ_H, and the magnetic field H are suitably chosen, a polarization-plane rotation on the order of one angular degree per centimeter can be obtained at quite small values of $(T - T_0)/T_0$ (for InSb, for example, when $(T - T_0/T_0 \gtrsim 10^{-4})$. This makes it possible, in principle, to measure small changes of the electron-gas temperature by determining the Faraday rotation.

The change in the electron temperature may be due to different causes. In particular, this may be due to heating by an external electric field E. In this case we obtain from the energy balance equation

$$\frac{T - T_0}{T_0} = \frac{2eE^2\tau_e\mu_d}{3\kappa T_0} \tag{3}$$

where μ_d is the drift mobility of the carriers and τ_e is the electron energy relaxation time, which can be determined from experiment [3]. The time τ_e is expecially large at low temperatures in semiconductors with low effective carrier mass (thus, τ_e in InSb at 4°K is of the order of 10^{-6} sec [4]. An estimate based on formulas (2) and (3) shows that a rotation $\Delta\theta/\ell$

of the plane of polarization of the order of one angular degree per centimeter can be obtained (under optimal conditions) in rather weak fields (in InSb at 4°K, for example, at $E \approx 10^{-4}$ V/cm). It is also seen from these formulas that in the considered region of weak external electric fields the polarization-plane rotation produced in an electromagnetic wave by this field is proportional to the square of the field intensity.

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TWO-PROTON RADIOACTIVITY OF NUCLEI HEAVIER THAN TIN

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In our earlier papers, devoted to a prediction of the existence and properties of a new type of spontaneous transmutation of 2p-radioactive elements [1 - 4], it was emphasized that this phenomenon is characteristic of neutron-deficient isotopes of light even elements up to tin ($Z < 50$), and gives way to α decay in heavier nuclei. Later on other workers [5] stated that the region of possible applicability of two-proton radioactivity is even more limited, to $Z < 38$. A more detailed analysis of the properties of neutron-defficient isotopes of elements heavier than tin leads, however, to the conclusion that a unique two-proton radioactivity should be quite abundant also in the region $Z = 50 - 82$, in which approximately half the total number (approximately 60) of 2p-radioactive nuclei of the even elements lie.

The unique feature of two-proton decay in the region $Z < 50$ is the fact that here all the 2p-active isotopes can decay also in the usual single-proton manner, with emission first of one (even) and only then of a second (odd) proton, with decay energy $Q_{p_{even}}$ and $Q_{p_{odd}} = Q_{p_{even}} + E_{pair}$ respectively in the first and second decay events.

However, frequently the direct two-proton decay, with energy $Q_{2p} = Q_{p_{even}} + Q_{p_{odd}} = 2Q_{p_{even}} + E_{pair}$, which exceeds in the cases in question the pairing energy E_{pair} for protons, is exponentially predominating over the p-decay (and α decay).

Comparing the expressions for the constants of the proton, biproton, and α decays in the presence of a Coulomb barrier only:

$$\lambda \approx 10^{22}\{\exp - \frac{2Ze^2\sqrt{m}}{\hbar}\frac{F}{\sqrt{Q}}[\arccos x^{1/2} - x^{1/2}(1 - x)^{1/2}]\}\sec^{-1}$$