The form of E_- is much simpler for p-type germanium ($p_0 >> n_0$):

$$E_- = \frac{kT}{ed} \frac{\Delta n(0) - \Delta n(d)}{p_{10}} \frac{\langle \tau_p \rangle}{\langle \tau_{p_1} \rangle} \frac{m_{p_1}}{m_t} \frac{x^3 \sin^2\theta \sin 3\Phi}{(\lambda_0^p)^2 + x^2(\lambda_1^p)^2} \frac{3\lambda_0^p \Phi_2 + \cos\theta \cdot \lambda_1^p \cdot \Phi_1}{[1 + \gamma(1 + x^2)]\Phi_1^2 + x^2 \Phi_1^2} \quad (2)$$

The results of the calculations by means of (2) are plotted in Figs. 1b and 2b.

An experimental verification of these results, undertaken by I. K. Kikoin and S. D. Lazarev [7], gave good agreement with the theoretical data.

The authors are grateful to Academician I. K. Kikoin and to S. D. Lazarev for supplying their experimental data prior to publication.

[1] I. K. Kikoin and S. D. Lazarev, JETP 39, 1471 (1960), Soviet Phys. JETP 12, 1022 (1961).
[2] I. K. Kikoin and S. D. Lazarev, J. Phys. Chem. Solids 26, 1965 (in press).
[3] I. K. Kikoin and S. D. Lazarev, FTT 7, No. 8 (1965), Soviet Phys. Solid State 7, in press (1966)
[4] Yu. Kagan and V. Sobakin, J. Phys. Chem. Solids 26, 1965 (in press).
[5] B. Lax, Revs. Mod. Phys. 30, 122 (1958).
[6] Bagguley, Stradling, and Whiting, Proc. Roy. Soc. A262, 340 (1961).
[7] I. K. Kikoin and S. D. Lazarev, this issue p. 47 (Russ. p. 75).

ANISOTROPY OF ODD PHOTOMAGNETIC EFFECT IN GERMANIUM IN STRONG EFFECTIVE MAGNETIC FIELDS

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It was shown in [1] that anisotropy of the odd photomagnetic effect is observed in germanium, besides the anisotropy of the even photomagnetic effect. A microscopic theory of the anisotropy of photomagnetic effect was developed by Kagan and Sobakin. According to this theory, at large values of the effective magnetic field, i.e., when $\omega\tau >> 1$ (ω = carrier cyclotron frequency, τ = relaxation time), a unique anomaly should be observed in the variation of the anisotropic component of the odd photomagnetic emf V_- with the angle θ between the direction of the magnetic field and the normal to the illuminated surface of the semiconductor. We define as normal the angular dependence $V_-(\theta)$ observed at low values of the effective magnetic field. To check on the consequences of the aforementioned theory [2] we measured the odd photomagnetic emf in n- and p-type germanium at T = 77°K and H = 25 kOe. The measurement procedure is described in [1]. Figure 1 shows the angular dependence of the odd anisotropic photomagnetic emf for n- and p-germanium at various values of the magnetic field. The [111] axis is perpendicular to the illuminated surface of the sample. The measurements were made at the extremal value of the anisotropic odd photomagnetic emf as a function of the angle of rotation of the sample about the normal to the illuminated surface, at T = 77°K.

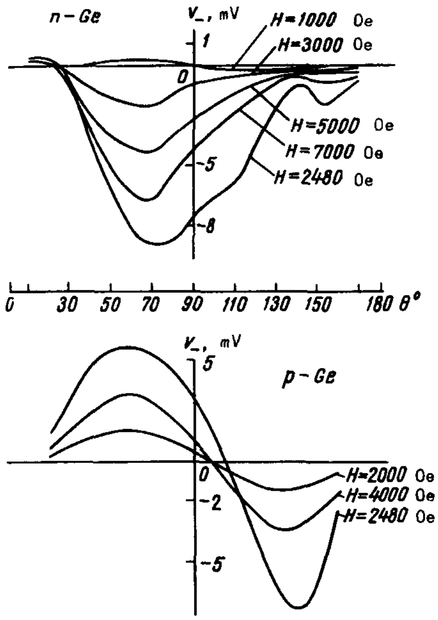

Fig. 1

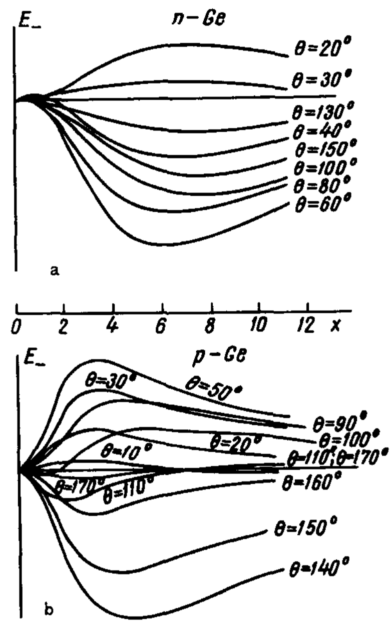

Fig. 2

Figure 2 shows the dependence of the odd anisotropic photomagnetic emf on the magnetic field intensity H at various values of the angle θ for n- and p-germanium.[1)]

We note that an appreciable difference is observed between the curves for n- and p-germanium in strong effective magnetic fields. A characteristic feature of Fig. 1 is the sharply pronounced asymmetry of the curve relative to changes in the angle θ. It is difficult to interpret this unusual character of the curves on the basis of elementary physical considerations. Nonetheless, the obtained experimental plots of $V_-(\theta)$ and $V_-(H)$ are in excellent agreement with the theory briefly outlined in this issue [3].

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[1] I. K. Kikoin and S. D. Lazarev, JETP 41, 1332 (1961), Soviet Phys. JETP 14, 947 (1962).

[2] Yu. Kagan and V. Sobakin, J. Phys. Chem. Solids 26, 1965 (in press).

[3] Yu. Kagan and V. Sobakin, this issue, p. 44 (Russ. p. 71).

1) The greater part of the measurements was made with the aid of an automatic two-coordinate plotter, and therefore no experimental points are shown on Figs. 1 and 2.