zinc crystals, under conditions when the dislocation-motion direction coincided with the direction of electrons injected with the aid of an accelerator, was observed directly in [2]. This condition is not always satisfied in the case of free electrons in a metal. According to estimates, the drift velocity of the electrons in our experiments, was $v = 9.7 \simeq 10$ cm/sec at 50 V on the terminals of our discharge device, and ~ 80 cm/sec at 400 V. According to [3], the velocity of the basal dislocations in zinc is $10^2 - 10^3$ cm/sec. Consequently, the drift velocity of the electron coincided at best case with that of the moving dislocations. It is possible that the interaction of the electrons with the elastic fields of the dislocations caused motion of some hindered dislocations, thus facilitating the work of the dislocation sources.

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FINE STRUCTURE OF CYCLOTRON RESONANCE LINES OF CADMIUM

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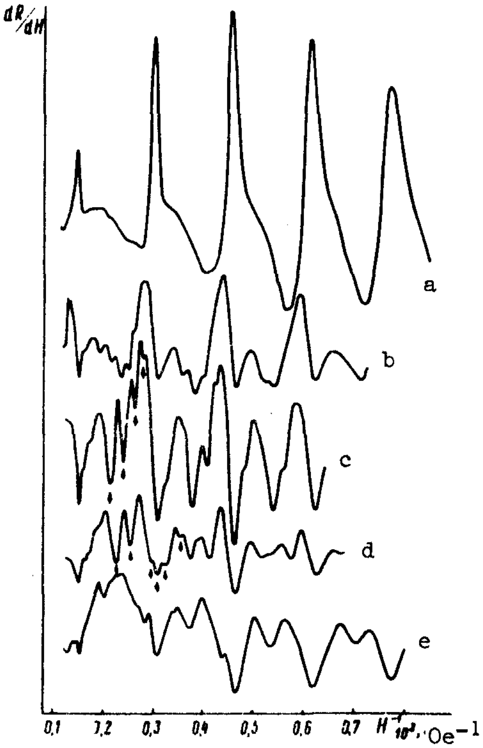
An investigation of the cyclotron resonance (CR) on the central section of the lenslike Fermi surface shows that the ordinary CR spectrum obtained at $\vec{H} \perp \vec{J}$ experiences significant changes when the magnetic field $\vec{H}$ is inclined to the surface of the sample. Even an inclination of several minutes of an angle produces on the weak-field side a broad rise that increases with further inclination of $\vec{H}$ (the amplitude of the main lines decreases), leads to a splitting of the resonance lines at $\phi \simeq 1.5 - 2°$, and to total inversion of the CR lines at $\phi \simeq 30°$. In this form, the CR is observed up to $\phi \simeq 30°$ with a strongly decreased amplitude. Another consequence of the inclination of H is the occurrence, at $\phi \gtrsim 1°$, of a series of small oscillations about each of several of the first main CR lines (see the figure). They are periodic in both H and H^{-1}. Their position relative to the magnetic field depends strongly on the angle of inclination, whereas rotation of $\vec{H}$ in the plane of the sample has practically no effect on them. These circumstances, and also the absence of oscillations in a parallel field, apparently make it impossible to attribute them to cyclotron resonance on the orbits of the "monster" with large mass [1]. At a sample thickness 2 mm and a mean free path $\ell \simeq 4.5 \times 10^{-3}$ cm, this structure can likewise not be attributed to excitation of the continuous-spectrum waves observed in [2]. The most probable explanation of the oscillations is excitation of the discrete-spectrum waves predicted in [3], which should lead to a fine structure of the CR lines just in an oblique field. Excitation of field spikes in a metal along a chain of trajectories can occur at either low frequencies ($\omega\tau \ll 1$) or high ones ($\omega\tau \gg 1$). At low frequencies it can be revealed only by the size effect of thin plates, and



Plots of cyclotron resonance at various inclinations of the magnetic field to the sample surface: a) $\phi = 0°$, b) $\phi = 1°20'$, c) $\phi = 2°$, d) $\phi = 3°30'$, e) $\phi = 7°$. The gain for plots d and e is three times larger than for plots a, b, and c. The experiment was performed at a frequency 3.6×10^{10} Hz and $T = 1.7°K$. The arrows denote the structure lines for which reduction results are listed in the table.

at high frequencies by the resonant variation of the impedance. The ordinary CR, due to the repeated return of the electrons to the skin layer, gives way in an oblique field to a resonant increase of the impedance, leading to inversion of the resonance lines. The penetration of the field into the metal along a chain of trajectories can be treated also as excitation of certain waves having a discrete spectrum. If the frequency of the external field does not coincide with any of the natural frequencies, as is the case, for example, at low frequencies, then the field spikes are nonresonant excitations of these waves. At high frequencies, resonance excitation of such waves is possible near the CR. If the distance between the neighboring discrete frequencies is small compared with the damping decrement, then the discrete character of the spectrum cannot manifest itself, i.e., the spectrum becomes practically continuous and a rather broad resonance line should appear. In the opposite case, the line has a fine structure, in which each line corresponds to excitation of one of the eigenfrequencies. Calculation shows [3] that for a quadratic dispersion law the dispersion and the damping of the waves near the CR can be described by the expressions

$$\mathrm{Re}\,\omega_{n,r} \approx n\Omega\left[1 + F\left(\frac{\Omega}{\Omega_p}\right)^2 \beta_r^{9/2} - E\left(\frac{\Omega_p}{\Omega}\right)^2 \beta_r^{-9/2}\right], \tag{1}$$

$$\mathrm{Im}\,\omega_{n,r} = \nu + \phi\Omega\,(2\pi\beta_r)^{1/2} \sin^2(kR - \beta_r), \tag{2}$$

where

$$F = \left(\frac{\phi c\,\Omega_p}{\omega_o V_F n}\right), \quad E = \frac{1}{4}\left(\frac{\omega_o V_F}{\Omega_p c}\right)^2, \quad \omega_o = \left(\frac{9}{2\pi}\right)^{1/4}\left(\frac{4\pi Ne^2}{m}\right)^{1/2},$$

$\Omega_p = \omega/n$ - cyclotron frequency of the n-th resonance, $\beta_r = \pi(r + 1/4)$ for even n, $\beta_r = \pi (r + 3/4)$ for odd n, r = 1, 2, 3, ..., ν - collision frequency, k - wave vector, R - radius of electron trajectory, and v_F is the Fermi velocity. Formula (1) is valid when $|\sigma_{xx}| << |\sigma_{yy}|$, leading to the following condition for the inclination angle ϕ:

$$2\frac{\nu}{\Omega} << \phi << \frac{1}{kR}. \quad (3)$$

If $|\sigma_{xx}| >> |\sigma_{yy}|$, which holds true when

$$\frac{n}{2(kR)^2}, \frac{\nu}{\Omega(kR)^{1/2}} << \phi << 2\frac{\nu}{\Omega}, \quad (4)$$

then the spectrum does not contain the third term of (1). In this experiment, the CR is observed on a lenslike Fermi surface (and not on a spherical one), which furthermore is not unique. However, the fact that the electrons can excite on it weakly damped field spikes is confirmed by the radio-frequency size effect. Since $\omega\tau \simeq 10$ (this value is estimated from the number of observable resonance lines); the condition (3) is not satisfied for any value of ϕ, and the conditions (4) always hold. Nonetheless, the presence of a fine structure on the resonance line, on the high-frequency field side, indicates that the formula determining the spectrum should contain a term due to the Hall conductivity σ_{xy}, i.e., the spectrum is still described by a formula such as (1). For convenience in the comparison with experiment, it is convenient to rewrite (1) in the form

$$F\beta^{9/2}X^4 + X^2 - X - E\beta^{-9/2} = 0,$$

where $X = \Omega/\Omega_p = H_p^{-1}/H_{st}^{-1}$ determines the positions of the fine-structure lines in the reciprocal magnetic field, H_p^{-1} is the position of the main resonance line in a parallel field,

$\phi_1 = 2°$, $F = 0.35 \cdot 10^{-8}$, $E = 7.7 \cdot 10^6$			$\phi_2 = 3°30'$, $F = 0.96 \cdot 10^{-8}$, $E = 7.7 \cdot 10^6$		
r	$X_{theor.}$	$X_{exp.}$	r	$X_{theor.}$	$X_{exp.}$
11	1.423	1.43	10	1,324	1,36
12	1.283	1.27	11	1,172	1,2
13	1.164	1.16	12	1,076	1,08
14	1.094	1.09	13	0.998	1,0
			14	0,924	0,95
			15	0,86	0,86

and H_{st}^{-1} is the position of the tructure line. By choosing the values of r, F, and E we can obtain the best agreement between the calculated and experimental values of X. The table lists these parameters and the corresponding values of X for two inclination angles and n = 2. As seen from the table, the agreement between the calculated and experimental values of X is quite good. The values obtained for r, E, and F are also reasonable. It follows from (1) that the product $FE = (\phi/2n)^2$ and the ratio of the coefficients F at different angles can be equal to $F_{\phi_1}/F_{\phi_2} = (\phi_1/\phi_2)^2$. Actually, however, $F_{\phi_1}/F_{\phi_2} = 2.7$ and $(\phi_1/\phi_2)^2 \simeq 3$, which is quite close, considering the inaccuracy with which $\phi = 0$ is determined, namely 10' - 15'. On the other hand the value of FE is 3.7×10^2 times larger than expected. This means that actually one of the coefficients (E or F) is larger than in formula (1). Starting from the value of F, we can determine the electron density. An estimate yields $N \sim 1.5 \times 10^{22}\ cm^{-3}$, which is in relatively good agreement with the $0.43 \times 10^{22}\ cm^{-3}$ obtained form the value of the lenslike Fermi surface. A similar estimate with the employed value of E yields a result which is patently exaggerated. This confirms the previously expressed idea that the obtained Hall conductivity $\sqrt{\sigma_{xy}}$ is for some reason much larger than follows from the theory. Thus, the observed oscillations are apparently due to resonant excitation in the metal of electromagnetic waves with a discrete spectrum near the CR.

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PLASMA HEATING BY AN ELECTRON BEAM PRODUCED IN A TURBULENT LINEAR DISCHARGE

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It was shown in [1, 2] that when conditions for electron runaway are created in a current-carrying plasma, a two-stream instability is excited and leads to an interruption of the current, to a concentration of the potential drop in a small section of the plasma column [2], and to the transport of the entire current by the beam of the accelerated electrons; practically the entire energy stored in the external circuit is then transferred, in the main, to the accelerated electrons.

It can therefore be assumed that one of the explanations of the strong plasma heating observed in investigations of a turbulent linear discharge [3 - 5] is the excitation of a beam of accelerated electrons in the linear discharge, and the subsequent collective interaction of this beam of accelerated electrons with the cold plasma [6].

To verify this assumption, experiments were performed on plasma heating in a magnetic mirror trap ("probkotron") by an electron beam generated by a linear discharge and passing through the anode. The experiments were performed with the "Aspa" setup [7]. The vacuum chamber (Fig. 1) consisted of two sections, glass (4) and metallic (3), and was located along the axis of a solenoid producing a quasistationary magnetic field H_0 of intensity up to 2500 Oe.

Two coils (5, 8) of the trap (R = 2.5) were placed over the glass chamber (spaced 75 cm apart). An electrode (cathode) 10 was located outside the trap, on the end face of the glass chamber, and a second reticular electrode (anode) 9 of the straight discharge was located 30 cm away from the cathode. A capacitor (0.2 μF) was connected to the electrodes 9 and 10. A turbulent linear discharge was excited in this circuit, with the grounded reticular electrode 9 serving as the anode during the first half-cycle. The parameters of the