As expected, the deduction that there is no S wave in the $\Sigma^+ \to n^+$ decay remains in force. On the other hand, the limitations on the amplitudes become less stringent. In place of the two equations (3) of [2], which relate the S-wave amplitudes of Λ^-, Ξ^-, Σ^-, and Ω^- decay, we have the triangle relations obtained in the SU(3) symmetry scheme[6]. The latter relation, which on satisfaction of the equality

$$(\Lambda \to p\pi^-)_S = \left(\sqrt{3}/2\right)(\Sigma^- \to n\pi^-)_S$$

goes over into the equality

$$(\Lambda \to p\pi^-)_S = \frac{1}{\sqrt{2}}(\Omega^- \to \Xi^{0*}\pi^-)_S$$

obtained in [2].

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1) Such a lucid picture implies, of course, a weak effective mutual influence between the quarks, which are in a bound state in a very deep potential well.

INVESTIGATION OF A MICROWAVE ELECTROMAGNETIC WAVE IN THE SKIN LAYER OF INDIUM

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The stationary distribution of a microwave electromagnetic field outside a conductor is usually determined experimentally by means of a test body. A similar method can also be used to investigate the electromagnetic field in the skin layer of a metal. In this case we can use as the test body some defined group of carriers in the metal.

It is known[1,2] that a slight inclination of a constant magnetic field H to the plane surface of the investigated single crystal of the metal changes the spectrum of the cyclotron resonances. This change is attributed in [2] to the Doppler shift of the frequency of cyclotron resoance with the carriers, which have a velocity component $v_H \| H$.

We represent an electromagnetic wave propagating along the inward normal z to the surface of the metal in the form

$$E(z,t) = E_0 \exp i(-z/\delta_i + iz/\delta_r + \omega t) \tag{1}$$

where the inductive skin depth δ_i characterizes the wave velocity, and the active skin depth δ_r its damping.

If the field H makes an angle θ with the surface of the metal, then the frequency ω of the carriers that move with velocity $v_H \sin\theta$ into the metal or to its surface is shifted by the Doppler effect by an amount $+v_H \sin\theta/\delta_i$ with - or + sign, respectively. This gives rise to a relative shift of the cyclotron peak by an amount

$$\delta H_n^{-1}/H_n^{-1} = \mp v_H \sin\theta/\omega\delta_i \tag{2}$$

where H_n is the field of the unperturbed cyclotron resonance of order n when $\theta = 0$.

The carriers belonging to the turning point of the Fermi surface, and with which cyclotron resonance is possible[3], move along H with Fermi velocity $v_F = v_H$, given by

$$v_F = P_c/\mu m_e \tag{3}$$

The effective mass $\mu = e/m_e c\omega\Delta H^{-1}$ is found from the period ΔH^{-1} of cyclotron resonance at $\theta = 0$, and P_c is the radius of the Fermi sphere, calculated in the free-electron model or measured in another experiment. This makes it possible to find δ_i with the aid of (2).

When θ increases, the carriers move farther and farther away from the surface of the metal within a time equal to the cyclotron period $T_n = 2\pi n/\omega$, and the cyclotron-resonance amplitude decreases. From its sharp decrease one determines the angle θ_0 at which the carriers travel through the depth of the skin layer, yielding

$$\delta_r = 2\pi n v_H \sin \theta_0/\omega . \tag{4}$$

This shows the possibility of determining δ_r.

The experiments were made with indium single crystals 17.8 mm in diameter and 1 mm thick[4], with a mirror-smooth flat surface of orientation $(0\bar{1}1)$. Cyclotron resonance was observed at 9.58 and 18.6 Gc/sec by the method of reference[5] at 1.5°K in a field up to 8 kOe parallel to the [111] axis and to the high-frequency currents in the sample.

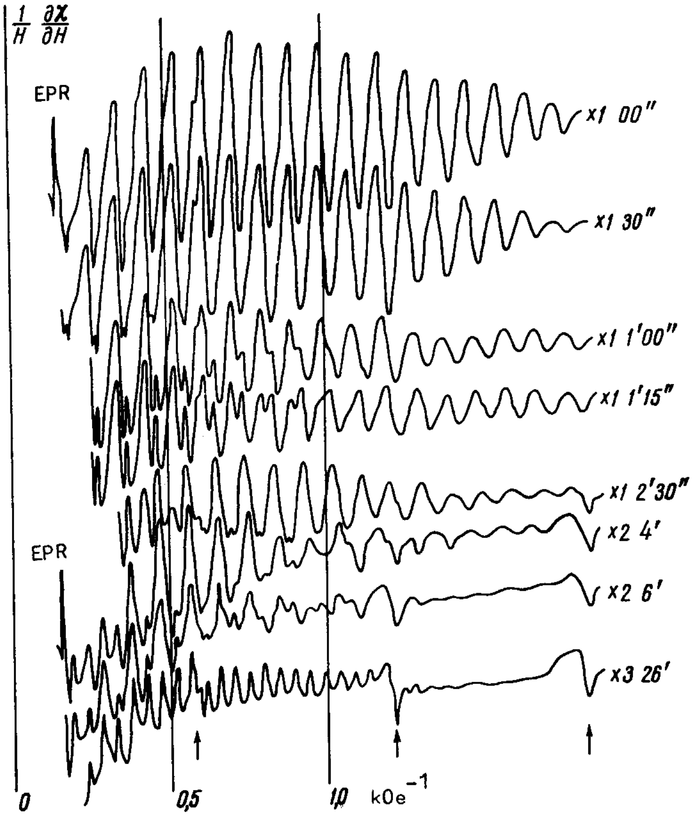

Fig. 1 Plots of the logarithmic derivative of the reactive part of the surface impedance of indium vs. the reciprocal of the magnetic field H^{-1} for different angles θ between the field and the sample surface. The lower arrows denote the cyclotron resonances on the electronic Fermi surface of the third zone[4]. On the right side the curves are marked with the amplification of the system and with the angle θ.

Figure 1 shows the recorded cyclotron-resonance spectra at the turning point of the hole Fermi surface of the second zone. At $\theta = 0$ one observes resonances up to order $n = 26$, corresponding to a mass $\mu = 1.605 \pm 0.005$. According to the free-electron model, $P_c = 1.1(h/a)$[4]. The measurements of P_c pulse based on the size effect[1)] yield $P_c = (1.25 \pm 0.005)(h/a)$, giving with the aid of formula (3) $v_F = (1.24 \pm 0.05) \times 10^8$ cm/sec.

When θ is small (Fig. 1) the cyclotron resonance splits into two peaks that are equidistant as functions of H^{-1}. The relative shift $\delta H_n^{-1}/H_n^{-1}$ of each resonance increases in proportion to θ, up to $\theta = 3 - 4'$ (Fig. 2). With further increase in θ, the splitting δH_n^{-1} stops increasing; the minima become broader, and the maxima become more peaked. At $\theta = 15 - 20'$ the spectrum assumes a form which remains the same up to $\theta = 1^\circ$, the maximum angle used in the experiments, viz., the replacement of the minima by new maxima doubles the number of peaks compared with $\theta = 0$. The doubling of the peaks is due to excitation of cyclotron resonance on the current sheets, observed earlier in aluminum and potassium [6].

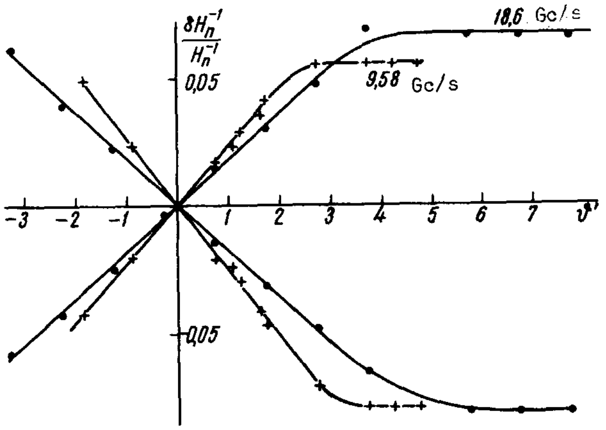

Fig. 2. Relative shift $\delta H_n^{-1}/H_n^{-1}$ of the peak of the cyclotron resonance of order $n = 5$ as a function of the angle θ. The points on the upper half of the plot correspond to the holes moving from the surface to the interior of the metal, and on the lower half to holes moving toward the surface.

Resonance with the current sheets with period $(1/2)\Delta H^{-1}$ occurs when the holes leave the skin layer after a time T_n. Thus, when $\theta > \theta_0$, this effect appears on the experimental plot like ordinary cyclotron resonance shifted by the Deppler effect (Fig. 1). Therefore the angle θ_0 is determined from Fig. 2 as the place where the plot of $\delta H^{-1}(\theta)$ changes direction; the values of δ_r obtained with the aid of (4) are listed in the table.

$\omega/2\pi$, Gc/s	δ_i 10^{-5} cm	δ_r 10^{-5}cm	δ_i/δ_r	Σ, ohm^{-1}	$v = \omega\delta_i$, 10^6 cm/sec
24.05 1)	-	-	-	31 1)	-
18.6	1.7 ± 0.1	3.9	0.44	48±3	2.0
9.58	2.4 ± 0.2	5.3	0.45	66±6	1.4
3.00 2)	1.65±0.02 2)	-	-	490±8 2)	-

1) Data of Ref. 9. 2) Data of Ref. 7.

We note that the angle θ_0 is different for holes moving in opposite directions, since cyclotron resonances of the same order occur for these holes in different magnetic fields. The table lists the values of δ_i calculated with the aid of (2) for $\theta < 4'$, and also the value of δ_i measured at 3 Gc/sec using the transition of indium into the superconducting state.

We note the following results of our experiments: 1) The width of the cyclotron-resonance peaks remains practically the same when the peaks split. 2) The relative shift $\delta H_n^{-1}/H_n^{-1}$ is independent of n when θ is small. 3) The ratio $\delta_i/\delta_r = X/R = 0.44$ is practically one-quarter the value given by the theory of the anomalous skin effect[8]. On the basis of these facts, the character of the wave in the skin layer of indium can be represented, within experimental accuracy, by formula (1).

Taking (1) into account, the surface impedance takes the form

$$Z = R + iX = \frac{4\pi\omega}{c^2}\,\delta_i\,\frac{1 + i\delta_i/\delta_r}{1 + (\delta_i/\delta_r)^2} \qquad (5)$$

The surface conductance $\Sigma = R^{-1}$ of indium, calculated with the aid of (5), is listed in the table, together with results of measurements made with high-frequency currents parallel to the [111] axis at 3 Gc/sec[7] and measurements on polycrystalline indium at 24 Gc/sec[9]. We see that our results agree with [9].

According to theory[8], $\Sigma \propto \omega^{-2/3}$. However, if we recalculate the value of Σ(3 Gc) to 18.6 Gc/s, we obtain a quantity three times as large as the Σ(18.6 Gc) obtained in this work. The values of δ_i(3 Gc) and δ_i(18.6 Gc) listed in the table are practically equal, whereas according to [8] they should differ by a factor of ~1.8, in accord with the $\delta_i \propto \omega^{-1/3}$ law. From our results, assuming a power-law relation $\delta_i \propto \omega^X$, we should get $X = -0.5 \pm 0.15$.

The disparity between our data and the theory of anomalous skin effect [8] is not unexpected, since that theory pertains to a metal in zero magnetic field. An analysis of the surface impedance of a metal in a magnetic field parallel to its surface is given in [10]. However, formulas suitable for a direct comparison with the results of the experimental data have not yet been obtained.

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IONIZATION OF THE XENON ATOM BY THE ELECTRIC FIELD OF RUBY LASER EMISSION

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The ionization of the xenon atom by the electric field of a light wave with $\lambda = 6943$ Å was observed experimentally. The ionization potential of xenon is $I = 12.13$ eV, so that its ionization necessitates the absorption of seven quanta with $h\nu = 1.78$ eV. The ionization effect has a typical threshold character. The threshold value of the electric field for xenon is $E_{thr} = 8.0 \times 10^6 - 1.5 \times 10^7$ V/cm. No ionization of helium is observed at this electric field intensity.

The electric field was produced by focusing the radiation of a Q-switched ruby laser[1]. The intensity and spatial distribution of the electric field were measured by a photometric method (see the figure). The emission of the laser 1 was aimed with the aid of mirror 2 onto objective 3. The ions produced at the focus 4 were drawn out by a uniform electric field 5 of intensity ~ 10 V/cm to the collector 6. Part of the laser radiation, transmitted through the mirror 2 and attenuated by neutral filters 7, was incident on objective 8, identical with objective 3 and located at the same distance from the laser. The spatial distribution of the illumination in various sections of the focusing region was photographed on an enlarged scale by means of micro-objective 9 and photographic film 10.