$[(d\sigma_{dd}/d\Omega)/(d\sigma/d\Omega)]_{\theta=0°}$, where $d\sigma_{dd}/d\Omega$ is the cross section for the process $\gamma + d \rightarrow d + \pi^0$. In the impulse approximation we have for this ratio

$$\left[\frac{d\sigma_{dd}}{d\Omega} \Big/ \frac{d\sigma}{d\Omega}\right]_{\theta=0°} = \frac{8}{3}\left|\frac{V}{V+S}\right|^2 I^2, \qquad (3)$$

where V and S stand for the isovector and isoscalar parts of the photoproduction amplitude, and $I^2 \approx 1$ is the deuteron formfactor. In the region $q \approx q_0$, where $|V + S|$ is small, $d\sigma_{dd}/d\Omega$ depends critically on the value of S, and a study of this ratio may provide information on both S-wave photoproduction of π^0 mesons on neutrons and on the $\pi\pi$ interaction, since the latter is connected to the two-pion intermediate state which contributes only to S. In this way the study of the indicated singularity may give rise to valuable information about the parameters of pion physics at low energies.

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NEW TYPE OF QUANTUM OSCILLATIONS IN THE ULTRASONIC ABSORPTION COEFFICIENT OF ZINC

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A great deal of attention has recently been directed to the study of the electron structure of metals by ultrasonic means. In the case in which $\kappa l \gg 1$ (κ is the wave vector of the sound, l is the mean free path length of the electrons) oscillations in the absorption coefficient α were observed in a comparatively weak magnetic field perpendicular to the vector $\boldsymbol{\kappa}$. These oscillations are due to the coincidence of the cyclotron radius of the electron orbit with an integral number of sound wavelengths.[1,2] The theory of this phenomenon has been considered by V. L. Gurevich[3] and Kaner,[4] who gave the connection between the absorption coefficient and the energy spectrum of the conduction electrons. The quantum oscillations of the absorption coefficient in the perpendicular field were observed experimentally in bismuth and zinc.[5,6] Gurevich, Skobov, and Firsov,[7] predicted the existence of a new quantum effect—gigantic oscillations of the absorption coefficient. The predicted oscillations arise in a non-perpendicular field (in particular, in a longitudinal one) if the following conditions are satisfied:

$$\zeta \gg \hbar\Omega \gg kT, \qquad \varkappa l = \sqrt{\zeta/kT}$$

(ζ is the chemical potential and Ω the cyclotron frequency of the electrons). Both conditions are satisfied at helium temperatures. The frequency of the ultrasound is 100—200 Mc/sec and higher for sufficiently pure metals with only slightly occupied electron bands.

With the aim of observing this phenomenon, we set up experiments in a longitudinal magnetic field ($\mathbf{H} \parallel \boldsymbol{\kappa}$) of intensity up to 35 koe. Single crystals of zinc prepared by zone refining were used. The purity of the samples is characterized by a residual resistance $R_{4.2}/R_{300} = 3 \times 10^{-5}$.

The dependence of $\alpha - \alpha_0$ on the reciprocal of the magnetic field is shown in Fig. 1 (α and α_0 are the absorption coefficients in the field and in the absence of a field, respectively). The wave vector $\boldsymbol{\kappa}$ and the vector **H** were directed along the $[10\bar{1}0]$ axis of the crystal; the frequency of the ultrasound was 220 Mc/sec. The absorption coefficient increases markedly with increase in the magnetic field intensity, and in a field $H \sim 10$ koe oscillations appear, the amplitude of which increases rapidly. The period of the oscillations in the inverse field is $\Delta H^{-1} = (0.204 \pm .005) \times 10^{-5}$

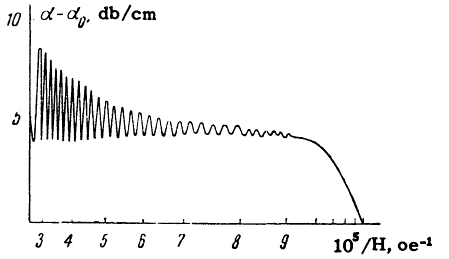

FIG. 1

oe^{-1} and is identical, for this orientation, with the period of the de Haas–van Alphen oscillations of the magnetic susceptibility, measured by Verkin and Dmitrenko[8] (the so-called fine structure of the effect), with accuracy to within the experimental error.

The same dependence for the vectors κ and **H** directed along [11$\bar{2}$0] is shown in Fig. 2. The distinctive feature of this curve is the decrease in the coefficient α in comparison with α_0 in the weak field, and its increase in the stronger field, although $\alpha - \alpha_0$ remains negative over the whole range of variation of H. For this orientation, the oscillations of α are beats between two components having neighboring periods $\Delta H^{-1} = (0.16 \pm 0.005) \times 10^{-5}\ oe^{-1}$. These periods differ somewhat more from the period of oscillation of the magnetic susceptibility for the [11$\bar{2}$0] direction.

The study of the amplitude of the gigantic oscillations was carried out by us at 1.9—4.2°K. The amplitude of the oscillations increases with decrease in temperature.

Evidently, just as in the case of the de Haas–van Alphen oscillations, it is possible to determine the effective mass of the carriers by the temperature dependence of the amplitude; however, a theoretical analysis is still necessary here. The difference is observed between the periods of oscillation of the magnetic susceptibility and of the gigantic ultrasonic absorption is due to the difference in the cross section areas of the Fermi surface on which the oscillations are realized.

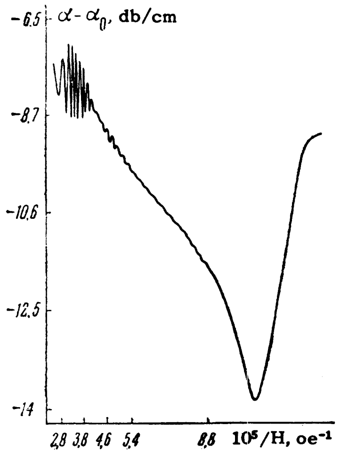

FIG. 2

The de Haas–van Alphen effect is determined, as is well known, by the extreme cross sections of the Fermi surface, while gigantic oscillations are realized on that cross section $P_z = P_z^0$, which guarantees the equality $v_z = w$[7] (w is the ultrasonic velocity and v is the Fermi velocity of the electrons).

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HEXAGONAL ANISOTROPY IN $MnCO_3$ *AND* $CoCO_3$

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DZYALOSHINSKII has shown[1] that the thermodynamic potential of rhombohedral antiferromagnetic crystals showing weak ferromagnetism contains, among others, a term $K_3 \sin^2 3\varphi$, where φ is an angle taken in the (111) plane. This term is responsible for the hexagonal anisotropy occurring