Notice should be taken of the anomalously large values of the effects from the 4f electron, which exceeds the usual ones [4, 5] by a factor 10 - 20. The theoretical and experimental quantities are in good agreement, and the characteristic form of the curve offers evidence in favor of the verified potential. The agreement is particularly accurate for the Waber's relativistic solution, which pertain directly to the experimentally investigated europium.

It should also be noted that the $\Delta E = \phi(E)$ relation can serve as a sui generis "facsimile" of the 4f electron, by which it is possible to identify experimentally events in which this electron takes part.1)

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ABSORPTION OF ULTRASOUND BY TIN IN THE INTERMEDIATE STATE

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Andreev has shown in a theoretical paper [1] that the absorption of high-frequency ultasound in a pure superconductor in the intermediate state, under condition when the normal-layer thickness a_n becomes comparable with the wavelength of sound, is described by the expression

$$\alpha/\alpha_n = \eta\Phi(2a_n/\lambda)$$

where α and α_n are the sound absorption coefficients in the intermediate and in the normal states, respectively, η is the concentration of the normal phase, and $\Phi(x)$ is a function that ranges from zero at $x = 0$ to unity when $x \to \infty$. Thus, it follows from this formula that the sound absorption should be smaller than η is $a_n \sim \lambda$. This behavior of the sound absorption coefficient is closely linked with the peculiar law governing the reflection of excitations incident on the interface between the normal and superconducting phases [2].

Measurements of α/α_n when the form of the function $\Phi(x)$ is known may serve as an indirect method of determining a_n and the period $d = a_n/\eta$ of the layered structure, in the

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1) A plot of $\Delta E = \phi(E)$ for d-electrons is shown in Fig. 2. The "facsimiles" of the s- and p-electrons in the region of the $K_{\alpha 1,2}$ and $K_{\beta 1,3}$ lines change the form of the horizontal lines located a height +80 and +100 meV. On the $K_{\beta 2,4}$ line, however, they become strongly bent, with the curve for the s-electron going downward (becoming negative), while that of the p-electron goes upward. We hope to discuss this in one of our future papers.

interior of the sample, in contrast with the direct methods [3, 4], which make it possible to investigate a_n only on the surface of the superconductors.

We report here the results of experiments on the absorption of sound by tin in the intermediate state. The sample was a cylinder 6 mm in diameter and 12 mm long, and its axis was close to the [110] direction and coincided with the sound propagation direction. The initial material was tin with a resistance ratio $R(300^\circ K)/R(4.2^\circ K) = (4 - 5) \times 10^4$. The sample was placed in a transverse magnetic field produced by a solenoid.

The measurements were made at frequencies 10, 30, 70, and 110 MHz. The converters used were X-cut quartz plates with fundamental frequency 10 MHz. The measurement temperature was low enough (1.5°K) to be able to neglect the contribution made to the absorption by the normal excitations in the superconducting regions.

The measurement results are shown in Fig. 1. The start of the penetration of the field into the sample was registered at $H = 0.58H_c$, which coincides with the results of magnetic investigations [5] performed for a sample having the same geometry. It also follows from the cited paper [5] that η is a linear function of the field, with the exception of small regions near $H = 0.58H_c$ and $H = H_c$. As to the $\alpha/\alpha_n = f(H/H_c)$ curves, they illustrate to a lesser degree the qualitative agreement between the experimental data and the theoretical predictions. Indeed, at a fixed H/H_c, meaning at a specified concentration η of the normal phase, α/α_n decreases with decreasing sound frequency, and duplicates the behavior of the function $\Phi(2a_n/\lambda)$.

Figure 2 shows the dependence of a_n on $\eta = 2.38H/H_c - 1.38$, a quantity calculated from the values of α/α_n for ultrasound frequencies 110, 70, and 30 MHz on the basis of the formula given above for α/α_n. We see that the data for 110 and 70 MHz almost coincide, but those for 30 MHz differ from them. The data obtained for 10 MHz differ even more. This fact can be explained qualitatively as follows: The theoretical expression for α/α_n was obtained in the limit of large $q\ell$ ($q = 2\pi/\lambda$, ℓ - electron mean free path). In the case of not too large $q\ell$, the angular dimensions, f the effective interaction zone, determined by the factor $q\ell^{-1}$ [6], already become such that practically all the electrons that take part in the absorption begin to feel the boundary of the normal layer. Further decrease of the frequency should not lead in this case to a strong change of α/α_n. Therefore, in the case of not too large $q\ell$, the

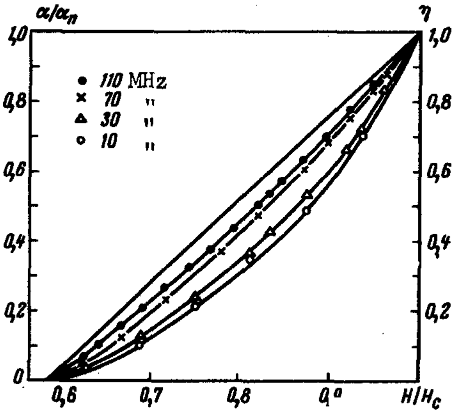

Fig. 1

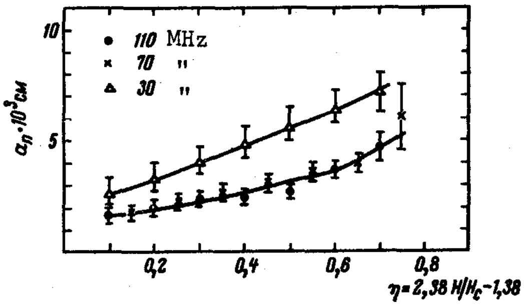

Fig. 2

form of the function $\Phi(x)$ will differ from the form indicated in [1], and this leads to the observed discrepancy between the values of a_n obtained at various frequencies. This reasoning is confirmed by the fact that in more contaminated samples the deviations of the curves from the value of η is much smaller and the saturation state is reached at higher frequencies.

Since the values of a_n obtained from the data at 70 and 110 MHz coincide, it can be concluded that these values are close to the true thickness of the normal layers in the interior of the sample at the given sample geometry. It should be noted that the obtained values of a_n are smaller on the average by a factor of four than those obtained by calculations for a plane-parallel plate, and they change less than predicted by the theory in the region $0.1 < \eta < 0.8$.

It was impossible to observe the oscillations of the sound-absorption coefficient in these experiments probably because the thickness of the normal layers was small compared with the Larmor radius of the electrons at $H = H_c$.

In conclusion, we are grateful to V. P. Galaiko for interesting discussions and to V. F. Gorodinskii for help with the measurements.

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FINE STRUCTURE OF EXCITON BANDS AND BAND EXTREMA LOOP OF CdS AND CdSe CRYSTALS

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Rashba and Sheka [1] have shown theoretically that a so called band extrema loop can appear in wurtzite crystals without inversion centers because the expansion of $E(\vec{k})$ contains a term linear in the qusimomentum $\vec{k}$. This can cause splitting of the bands into individual components. We report here observation and measurement of such a splitting in the spectra of CdS and CdSe crystals.

A spectrograph with large dispersion (4 Å/mm) was used to obtain at T = 4.2°K the absorption spectra of thin ($d \sim 0.15\ \mu$) single-crystal CdS films and the reflection spectra of bulky CdS and CdSe single crystals. Unlike the earlier measurements [2], in our case the single crystals were not secured through an optical contact to transparent substrate, a practice that inevitably leads at low temperatures to stresses of the sample and to a distortion of its spectrum, but were in a "free" state. The measurements were made in polarized light with the electric vector $\vec{E}$ of the wave parallel and perpendicular to the optical C axis of the crystal. Figure 1 shows the absorption spectra of the crystal at $\vec{E}$ perpendicular and parallel to C, covering the section of the exciton lines A and B, n = 1 and n = 2, connected with the transitions $\Gamma_9 - \Gamma_7$, respectively. It is seen from these spectra that the states n = 1 have a fine