expected distribution for the events of the reaction $\pi^- + p \to \Lambda^0 + K^0$.

From the 49 events having $|\delta| < 0.16$, we determined by the maximum-likelihood method the values of the magnetic moment μ_{Λ^0} and of the coefficient a. The likelihood function is written in the form

$$L(\mu, a) = \prod_i \left\{ \frac{1 + a\cos\theta_i(\mu)}{2} \right\},$$

where $\theta_i(\mu)$ is the c.m.s. angle of the Λ^0 hyperon between the direction of the emission of the π^- meson of the decay and the direction of the polarization vector at the instant of the decay, calculated under the assumption that the magnetic moment of the Λ^0 hyperon is equal to μ. It follows from Fig. 3 that

$$\mu_{\Lambda^0} = (-0.67^{+0.31}_{-0.37})\ \text{n.m.},\quad a = 0.55^{+0.23}_{-0.24}.$$

The indicated error corresponds to the decrease of the logarithm of the likelihood function by 0.5.

It should be noted that the presented preliminary results correspond to a reduction of a small fraction of the available irradiated material.

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TRANSITIONS OF ELECTRONS BETWEEN EXCITED STATES OF DONORS IN GERMANIUM

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The structure of excited states of shallow impurities in semiconductors is usually investigated by methods of long-wave infrared spectroscopy. The measurements are based either on the absorption of the radiation that effects the transitions of the electrons from the ground state of the impurity to the excited states [1], or on the change of the conductivity when such transitions are accompanied by a subsequent thermal emission of electrons into the conduction band [2]. Electron transitions between the states 1s - np of the donors in germanium were investigated in this manner. In the wavelength band 90 - 250 μ there were observed lines not narrower than 0.06 meV, which are connected

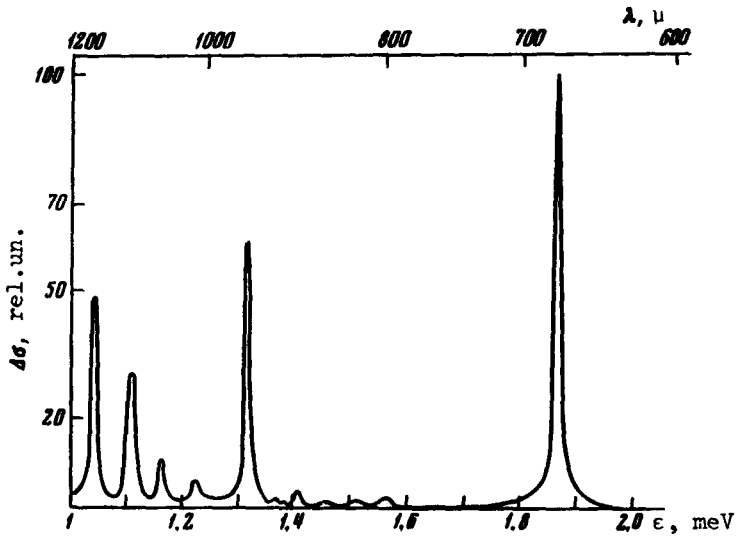

Fig. 1

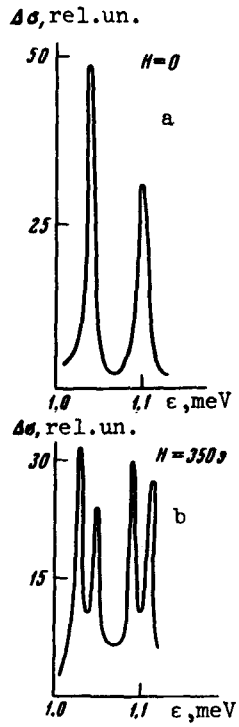

Fig. 2

with the lifetime of the electron in the excited state. The obtained energies of the p-states agreed well with the theoretical ones [3]. Zeeman splitting of some of the lines in magnetic fields H > 1 kOe was observed [4].

We investigated the photoconductivity of germanium in the wavelength band 500 - 1300 μ. The experiments were performed at T = 4.2 - 12°K on samples with donor concentrations 10^{12} - 10^{15} cm^{-3} with a degree of compensation not more than 20%, in magnetic fields up to 40 kOe. The radiation sources were backward-wave tubes (BWT) [5]. The radiation was fed through a quasi-optical channel to a Ge sample placed in the cavity of a superconducting solenoid; the amplitude-frequency characteristic of the BWT was stabilized with the aid of an electromechanical regulator of the microwave power level, the control signal of which was formed by a broad band n-InSb detector placed alongside the investigated sample. The use of a coherent radiation source of considerable power makes it possible to duplicate lines with $\Delta\lambda/\lambda \gtrsim 10^{-5}$ (the only limitation is the stability of the power supply of the BWT) and to realize high sensitivity (the power level on the sample, at a pulsation coefficient ∿1%, with tuning in the working frequency band, reaches 100 μW), something impossible to do by using ordinary monochromators in the long-wave part of the infrared band.

By way of an example, Fig. 1 shows a typical spectrum of the photoconductivity (Δσ is the change of the conductivity of the sample) at T = 7°K for a Ge sample with donor concentration $N_D = 2 \times 10^{13}$ cm^{-3} (Sb) and an acceptor concentration $N_A = 2 \times 10^{-12}$ cm^{-3}. The most intense lines correspond to energies 1.04, 1.11, 1.16, 1.23, 1.31, and 1.87 meV. In a magnetic field, some of the lines split. Figure 2 shows the following: a) the lines corresponding to the energies 1.04 and 1.11 meV in the absence of a magnetic field; b) the splitting of these lines at H = 350 Oe, when the magnetic field is directed along the crystallographic axis [100].

Let us note some features of the results.

1. The intense lines of the photoconductivity spectrum correspond to the same values of the energy for all the Ge(Sb) samples. The line width at $N_D \lesssim 2 \times 10^{13}$ cm^{-3} does not depend on the impurity concentration and ranges from

0.008 to 0.015 meV for different lines. When the impurity concentration increases to $N_D \approx 2 \times 10^{14}$ cm^{-3}, the individual lines double in width.

2. In a magnetic field $H \gtrsim 100$ Oe, all the intense lines of the spectrum, except for the line with energies 1.16 meV, split. The splitting depends on the orientation of H relative to the crystallographic axes and agrees well with the measurements of the Zeeman effect for donor impurities in Ge [4].

3. When the temperature increases from 4.2°K, the intensity of the lines ($\Delta\sigma$) first decreases and then at 9 - 10°K tends to saturation. The growth of the intensity is different for different lines and can reach 10^2 - 10^3 times.

The foregoing features of the experimental results allow us to state that the observed effect is photothermal ionization of the excited states of the shallow donors in Ge, namely, optical transitions of the electrons between excited states with subsequent thermal ionization leading to a change in the conductivity of the sample. The ground state of the impurity cannot take part in the electron transitions, since the radiation-quantum energy is smaller than the energy gap between the ground and first excited state of the impurity [1]. In addition, the absorption of the radiation by the sample in the entire investigated wavelength band is small [6], as was verified by us with the aid of an n-InSb detector placed behind the investigated sample.

We were able to identify two lines of Fig. 1: the sum of the transition energies 1.16 ± 0.005 and 1.87 ± 0.005 meV is 3.03 ± 0.01 meV, which corresponds to the transitions $2p_0 \rightarrow 2s$ and $2s \rightarrow 2p_{\pm 1}$, some of the energies of which $2p_0 - 2p_{\pm 1}$, agrees well with data of earlier measurements [1], namely 3.01 ± 0.04 meV. According to calculation [3], there is located between these p states a 2s level, the optical transition to which from the ground state is forbidden. An additional confirmation of the correctness of the identification of the indicated transitions are data on the Zeeman effect, namely, the line with energy 1.87 meV, unlike the line with 1.16 meV, splits in a magnetic field. This is evidence that the first transition is accompanied by a change of the magnetic quantum number by $\Delta m = \pm 1$, and for the second $\Delta m = 0$. Additional information is needed for the identification of the remaining lines of the spectrum.

Investigation of the transition of the electrons between the excited states at low population (at T = 7 - 9°K the number of carriers at states with ionization energy 5 - 2 meV is smaller by 3 - 5 orders of magnitude than at the ground level of the impurity) and the determination of a more complete spectrum of the excited states was made possible by the much higher sensitivity of the spectrometer with the BWT, compared with the previously employed spectrometers.

The observed lines have widths up to 0.008 meV, indicating apparently much longer lifetimes of the electrons in the excited states than heretofore assumed [6].

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