($d > d_0$) the effective conductivity tensor has the following components (the symbol eff is omitted; for σ_{xx} we write down an interpolation formula that matches the regions $\gamma \ll c$ and $\gamma \gg c$): $\sigma_{xx} = \sigma_{yy} \sim \sigma_0(\gamma^2 + c^2)$; $\sigma_{xy} = -\sigma_{yx} \sim \sigma_0\gamma$; $\sigma_{zz} \sim \sigma_0$, the remaining components are equal to zero. Inverting the tensor σ, we obtain for ρ_{xx}:

$$\rho_{xx} = \frac{\sigma_{yy}}{\sigma_{xx}\sigma_{yy} + \sigma_{xy}^2} \sim \sigma_0^{-1} \frac{\gamma^2 + c^2}{(\gamma^2 + c^2)^2 + \gamma^2}. \qquad (3)$$

A plot of this function is shown in Fig. 3. $\rho_{xx} \sim \sigma_0^{-1}$ when $c \ll \gamma \ll 1$, $\rho_{xx} \sim \sigma_0^{-1}c^2/\gamma^2$ when $c^2 \ll \gamma \ll c$, and $\rho_{xx} \sim \sigma_0^{-1}/c^2$ when $\gamma \lesssim c^2$. For a thin sample ($d < d_0$) we have $\sigma \sim \sigma_0\gamma^2$ in the entire region $\gamma \ll 1$, and $\rho_{xx} \sim \sigma_0^{-1}$. Thus, even in the region $\gamma \lesssim c$ the resistance increases sharply (by $(c/\gamma)^2$ times) when the sample thickness increases from $d < d_0$ to $d > d_0$. In conclusion we present approximate estimates. For $H \sim 10^5$ G and a free path $\sim 10^{-2}$ cm we have $\gamma \sim 10^{-2}$. If the crystallite dimension is $a \sim 3 \times 10^{-2}$ cm and $c \sim 3 \times 10^{-2}$, then the size effect will be observed at thicknesses $d_0 \sim a/c \sim 1$ cm. One can expect an increase of the resistance by a factor $(c/\gamma)^2 \sim 10$ times on going from $d < d_0$ to $d > d_0$.

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NUCLEAR MAGNETIC RESONANCE IN CERTAIN ORTHOFERRITES

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At the present time, signals of nuclear magnetic resonance on Fe^{57} nuclei in orthoferrites were observed only with the aid of a superregenerator in single-crystal yttrium orthoferrite grown by the hydrothermal method with spontaneous crystallization [1]. As to NMR in hyperfine fields on the nuclei Y^{89}, it follows from the literature that it has not been observed at all in any ferromagnetic and antiferromagnetic compound.

We present here a brief report of observation of NMR of Fe^{57} in $YFeO_3$, $TmFeO_3$, and $Y_{1-x}La_xFeO_3$, and also NMR of Y^{89} in $YFeO_3$ and $Y_{1-x}La_xFeO_3$.

The samples were polycrystalline yttrium and yttrium-lanthanum orthoferrite obtained by the usual ceramic technology, and single-crystal thulium orthoferrite grown by crucible-less zone melting with optical heating.

The search for the NMR signals was carried out with the aid of a semiautomatic spin-echo spectrometer with exciting-pulse durations $\tau_1 = 1$ μsec and $\tau_2 = 1$ μsec. To exclude the influence of the transverse and longitudinal relaxation, the interval between the pulses was chosen to be 50 μsec, and the repetition frequency was 29 GHz. The signals were registered with a stroboscopic integrator. All the measurements were carried out at 77°K.

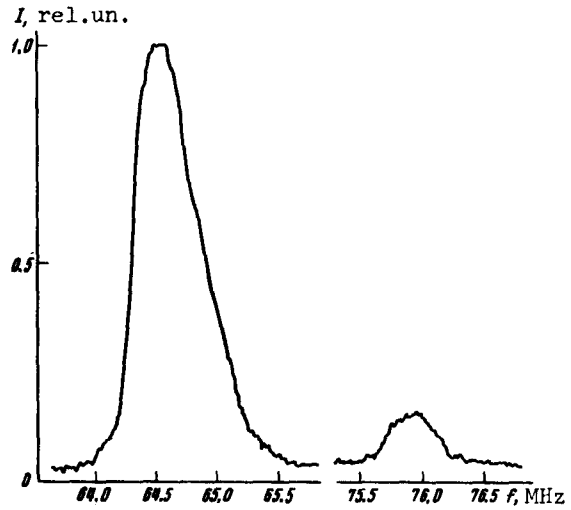

Fig. 1. NMR spectrum of yttrium orthoferrite.

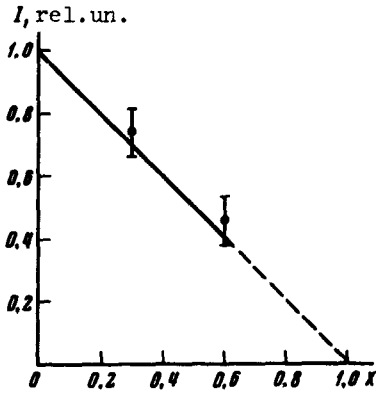

Fig. 2. Dependence of the ratio of the integral intensities of the signals at the frequencies 64.6 and 75.9 MHz on the degree of substitution of lanthanum for yttrium.

NMR on the nuclei Fe^{57} in yttrium orthoferrite was observed at the frequency 75.9 MHz, corresponding to a hyperfine field of 550.0 kOe at the nucleus. Unlike [1], where two closely lying lines 75.38 and 75.95 MHz were observed, we observed in this band only one line, the width of which overlapped the indicated band.

NMR on the Fe^{57} nuclei in thulium orthoferrite was observed at the frequency 75.8 MHz corresponding to a hyperfine field of 549.2 kOe at the nucleus. These results agree well with data obtained by the NGR method [2].

Attempts were made to observe the NMR signal on the Fe^{57} nuclei in lanthanum orthoferrite. They were, however, unsuccessful. When yttrium ions in the yttrium orthoferrite were replaced by lanthanum ions, the amplitude of the NMR signal decreased, and when more than the 70% of the yttrium was replaced it was practically impossible to observe the signal. When the yttrium was replaced by lanthanum, the frequency of the NMR of the Fe^{57} remained practically unchanged.

Even with 70% replacement, the shift of the resonant frequency did not exceed the measurement error (±0.05 MHz).

In addition to the indicated signal belonging to the Fe^{57} nuclei in the yttrium orthoferrite, there was observed at 64.6 MHz a signal whose integral intensity exceeded by more than one order of magnitude the integral intensity of the signal from the Fe^{57} nuclei (Fig. 1).

To determine the origin of this signal, the Mossbauer absorption spectra in $YFeO_3$ were plotted. The presence of one field of hyperfine interaction, corresponding to the Fe^{57} NMR frequency 75.9 MHz, was observed. Since in $YFeO_3$ there are only two sorts of magnetic nuclei Fe^{57} and Y^{89}, it can be assumed that the signal observed at 64.6 MHz belongs to the yttrium ions, corresponding to a field 307.6 kOe at the nucleus. The result of the calculation of the integral intensities of the signals at frequencies 64.6 and 75.9 MHz agreed in order of magnitude with the ratio of the natural content of the Y^{89} and Fe^{57} isotopes in the given compound.

Confirming that the signal at 64.6 MHz comes from the Y^{89} nuclei are the data shown in Fig. 2, which shows the dependence of the ratio of the integral

intensities of the signals at 64.6 and 75.9 MHz, normalized to the ratio of the intensities in pure yttrium orthoferrite when La ions are substituted for the Y ions. Since the relative number of magnetic Fe^{57} nuclei remains the same when lanthanum is substituted for yttrium, this ratio should decrease with decreasing number of Y ions, as follows from Fig. 2. In the case of 100% substitution of lanthanum for yttrium, no signal is observed at 75.9 MHz, as indicated above, nor at 64.6 MHz.

The reasons for the decrease of the signal from the Fe^{57} nuclei when the yttrium is replaced by lanthanum and for its complete vanishing in the case of 100% substitution are not yet clear.

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OPTICAL ORIENTATION OF FREE AND BOUND EXCITONS IN HEXAGONAL CRYSTALS

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It was shown recently [1 - 3] that interband transitions in semiconductors, produced by absorption of circularly polarized light, can cause optical orientation of the magnetic moments of the carriers relative to the direction of propagation of the exciting light. The application of the method of optical orientation to semiconductor optics is very useful and makes it possible in particular to determine such parameters as the lifetime and the spin-relaxation time of the free electrons [4], to investigate the features of spin relaxation of "hot" electrons [5 - 7], etc. So far, however, investigations of the optical orientation were carried out only on crystals with cubic symmetry. In these crystals, owing to the degeneracy of the valence band at the point $k = 0$, there occurs a strong spin relaxation of the holes [6] and it was therefore possible to observe only the orientation of the electrons. We report in this paper observation of optical orientation of electrons and holes bound into excitons in hexagonal crystals of cadmium selenide. Unlike in cubic crystals, we observed anisotropy of the optical orientation and the absence of depolarization in a transverse magnetic field.

Compared with cubic crystals, the anisotropic crystal field in hexagonal crystals leads to lifting of the degeneracy at the point $k = 0$ and to splitting of the upper valence band Γ_8 into two subbands Γ_9 and Γ_7 [8] (see Fig. 1). An examination of the selection rules shows that the optical orientation of the magnetic moments of the carriers in transitions from the upper valence subband Γ_9 to the conduction band can be realized only by excitation with circularly polarized light along the hexagonal axis C of the crystal. The degree of orientation of the carriers is $P = |(n_+ - n_-)/(n_+ + n_-)|$ (where n_+ and n_- are the numbers of the carriers with magnetic moments directed parallel and antiparallel to the propagation direction of the light) in such transitions will amount to $P = 1$. When excited light propagates perpendicular to the crystal axis, the transitions $\Gamma_9 - \Gamma_7$ are allowed only for linear polarization of the light with $E \perp C$, and absorption of the light will not lead to orientation of the moments of the carriers.