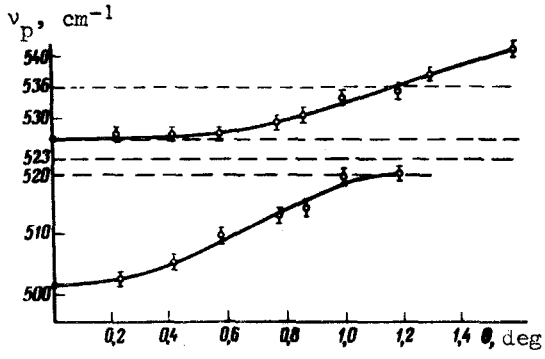

Fig. 2. Polariton frequency ν_p vs. θ in the region of the Fermi resonance.

exclude resonance between them [7]. Nor is the observed effect a resonance of the polariton with 536 cm^{-1}, as might be expected [8], since the center of the gap, 523 cm^{-1}, lies below the composite tone. In accord with the theory [3, 4], we assume that we have observed Fermi resonance of the polariton with the 523 cm^{-1} biphonon split from the composite tone 536 cm^{-1}. One can assume that the biphonon intensity is very low, and therefore it is not seen at $\theta = 90°$ and can be seen only as a result of the resonance. Thus, the Fermi resonance in $LiNbO_3$ offers indirect proof of the existence of a bound state (biphonon) in the crystal.

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EQUATORIAL KERR EFFECT IN IRON GARNETS

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We report here the results of the first measurements of the equatorial Kerr effect δ on single crystals of iron garnets of yttrium, europium, and terbium. We have observed that the change of the intensity of the reflected light upon reversal of the magnetic field reaches 5%, i.e., the equatorial Kerr effect in iron garnets greatly exceeds the maximum value of this effect in ferromagnetic d-metals. The most intense maxima on the δ curves have been identified with optical transitions in the tetrahedral Fe^{3+} ions. We have found that the rare-earth sublattice affects the intensity of the magneto-optical transitions in the Fe^{3+} ions.

We measured the change of the intensity of the p-component of linearly-polarized light upon reflection from a transversely-magnetized specimen (the magnetization vector was perpendicular to the plane of incidence of the light). The equatorial Kerr effect is then given by the formula $\delta = (I - I_0)/I_0$, where I_0 and I are the intensities of the light reflected from the demagnetized and magnetized specimen, respectively. The measurements were made at room

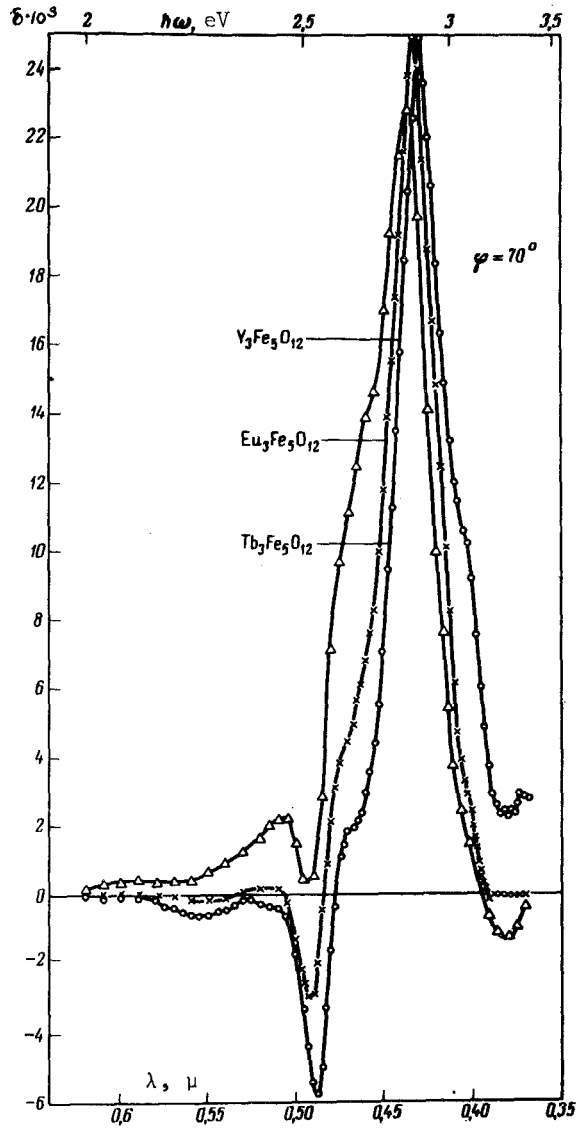

Fig. 1

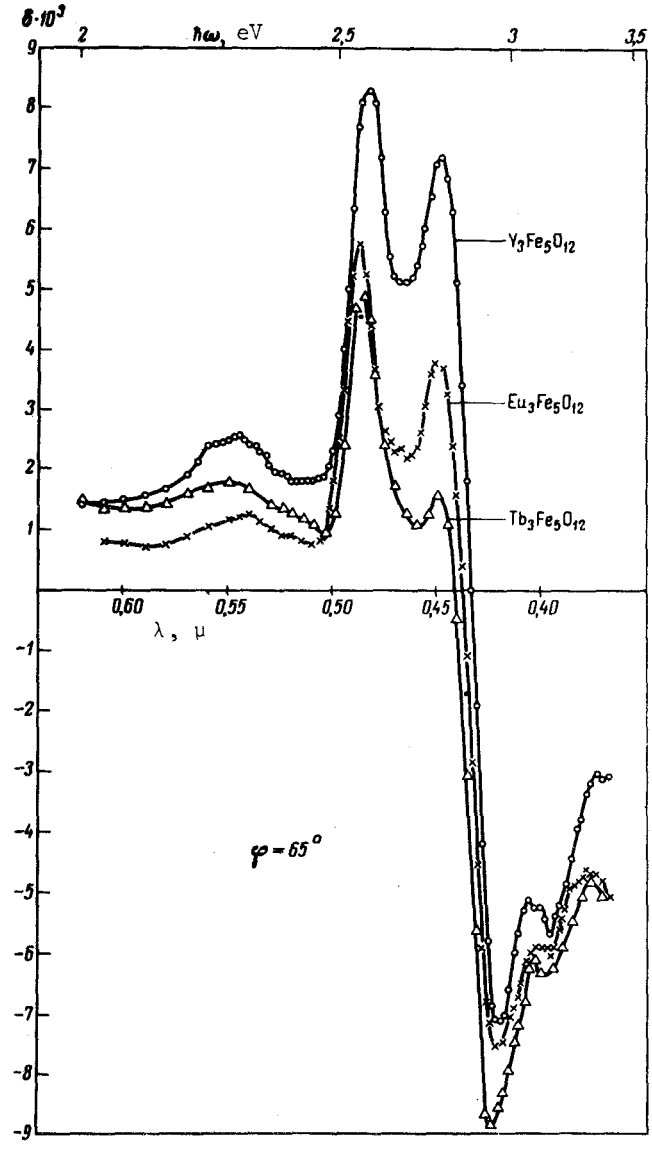

Fig. 2

temperature by a dynamic method with a setup similar to that described in [1]. The ratio of the registered signals on the s- and p-components of the linearly polarized light did not exceed 1% in the entire measurement range. The specimens were polished single-crystal plates cut in the [110] plane. The magnetization-reversal field H ≃ 5000 Oe was directed along the [110] axis.

Figures 1 and 2 show the frequency dependences of δ for iron garnets of yttrium, europium, and terbium at two light-incidence angles, $\phi = 70°$ and $\phi = 65°$. It is seen from Fig. 1 that the equatorial Kerr effect at $\hbar\omega = 2.85$ eV and $\phi = 70°$ reaches a value 0.025, which corresponds to a 5% change in the intensity of the reflected light when the field is reversed. We note that such a large effect is obtained in the angle interval 68.5 - 70.5° when the maximum is shifted by about 0.1 eV. Thus, the indicated maximal effect can be obtained on the intense 0.4358-μ mercury line without the use of a monochromator.

In addition, the effect can be further increased by using thin-layer nonmagnetic dielectric coatings.

The frequency dependence of $\delta(\omega)$ of the investigated iron garnets is characterized in the main by the presence of a strong positive maximum at $\hbar\omega = 2.85$ eV for $\phi = 70°$, and also of two positive maxima ($\hbar\omega = 2.55$ and 2.75 eV) and two negative maxima ($\hbar\omega = 2.95$ and 3.15 eV) for $\phi = 65°$. It can be assumed that this structure is due to the two lowest-energy transitions $t_1(\pi) \rightarrow e(\pi)$ (A) and $t_2(\pi_1\sigma) \rightarrow e(\pi)$ (B) in the tetrahedral FeO_4 complexes. These are two allowed electric-dipole transitions from the oxygen orbitals of the $2p(\pi, \sigma)$ type to the Fe^{3+} ion orbitals of the 3d(e) type [2]. The fact that the magneto-optical transitions in the region 2 - 3.4 eV are due mainly to the tetrahedral iron ions was established for europium garnets in [3] by replacing the tetrahedral Fe^{3+} ions with nonmagnetic Ga^{3+} ions, but the transitions for the iron garnets were not identified there. The δ curve for the yttrium garnet at $\phi = 65°$ (Fig. 2) can be represented in the 2.5 - 3.3 eV region as a superposition of two dispersion-type curves with natural frequencies 2.75 and 2.95 eV and half-widths of the order of 0.2 eV, and the δ curve for $\phi = 70°$ can be represented by a superposition of similar curves of the absorption type.

The last circumstance is apparently connected with the fact that according to our estimates the main contribution to δ at $\phi = 70°$ and in the 2 - 3.4 eV region is made by the absorption part of the nondiagonal component of the dielectric tensor. Thus, the indicated maximum of δ at $\phi = 70°$ and $\hbar\omega = 2.85$ eV is due to the maximum of the losses at the magneto-optical transitions A and B, and the values obtained for the natural frequencies of these transitions are 2.75 and 2.95 eV.

The δ curves for the terbium and europium garnets are in the main analogous to the corresponding curves for the yttrium garnet, but there are some significant differences. In the europium garnet, and particularly in the terbium garnet, the amplitudes of the 2.55 and 2.75 eV maxima are lower at $\phi = 65°$, and the shape of the positive 2.85-eV maximum at $\phi = 70°$ is altered. In the europium garnet the amplitude of the 2.55-eV negative peak at $\phi = 70°$ is lower, and in the terbium garnet this peak is shifted to the region of positive δ. The change observed in the $\delta(\omega)$ curves in the rare-earth terbium and europium garnet is apparently connected not directly with the optical transitions in the rare-earth Tb^{3+} and Eu^{3+} ions, but with the indirect influence of the rare earth sublattice on the character of the formation of the molecular orbitals in the FeO_4 complexes and on the intensity of the optical transition.

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INVESTIGATION OF THE METAL-DIELECTRIC TRANSITION IN Ge AND Si BY A MICROWAVE METHOD

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There are at present two points of view concerning the dielectric-metal transition in the exciton system in Ge and Si at low temperatures. A number of workers believe that the excitons condense into metallic drops already at a low exciton density, $n_e \sim 10^{12}$ cm^{-3}, and it is precisely the appearance of the drops