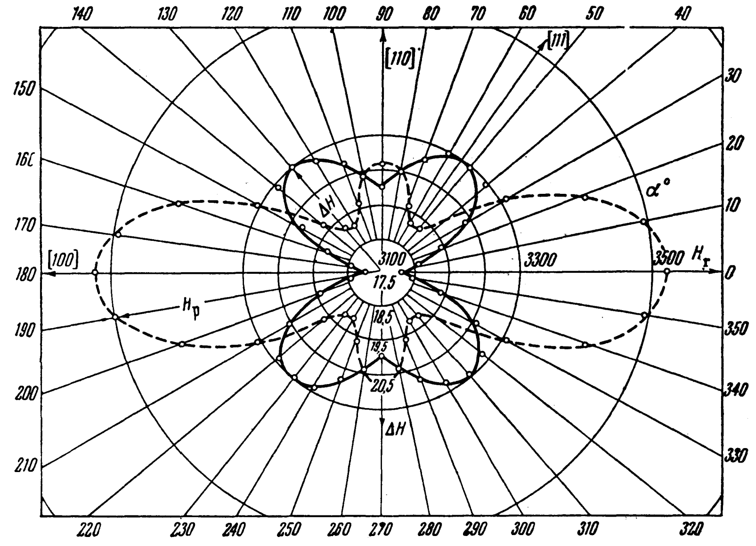

FIG. 1

tov.[5] It must be noted that in the interval from room temperature to +200° C the width of the resonance absorption line depends little on the temperature (see Fig. 2), whereas the constant of the magnetic crystallographic anisotropy, determined by the resonance method, is reduced by a factor of almost 20 in the same temperature interval.

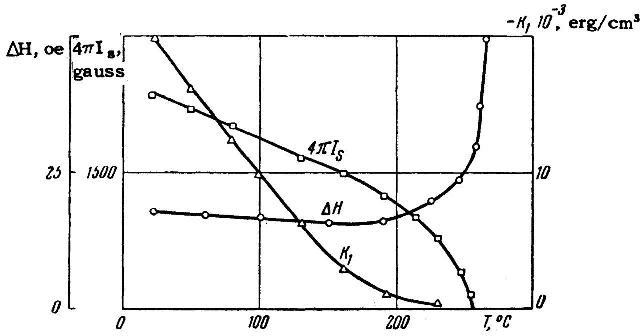

FIG. 2. Temperature dependence of the width ΔH of the line of ferromagnetic resonance absorption in the [100] direction, of the saturation magnetization $4\pi I_s$, and of the constant of magnetic anisotropy K_1, for the ferrite 6.9 MgO, 37.3 MnO, 55.9 Fe_2O_3.

The increase in ΔH in the region of the Curie point (Fig. 2) is apparently connected with the fluctuations of magnetization at the Curie point.

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ADDITIONAL ANOMALOUS LIGHT WAVES IN ANTHRACENE IN THE EXCITON ABSORPTION REGION

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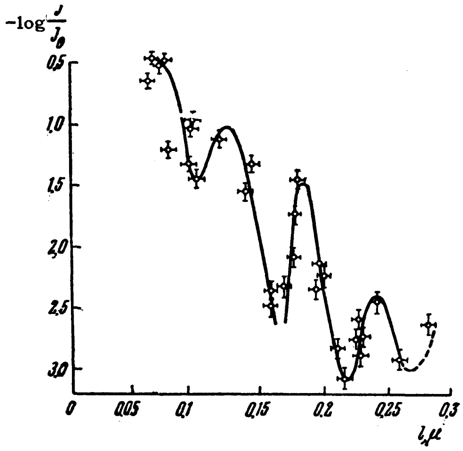
ONE of the authors[1-3] predicted theoretically the existence of additional anomalous light waves in crystals in the region of exciton absorption. In our earlier paper[4] we proposed a method of experimentally proving the existence of these waves. The method reduces to a measurement of the intensity of monochromatic light, passing through a plane-parallel slab of crystal as a function of the thickness of the slab. The existence of two waves in a crystal is manifest in the interference of these waves as they leave the crystal. This interference leads to distinctive intensity oscillations that depend on the thickness of the slab. It is necessary here to prevent the two waves connected with the usual double refraction from occuring in the slab. This is accomplished by so polarizing the incident light wave, that the electric vector is strictly parallel to the principal direction of polarization of the crystal. It is also necessary that the absorption of the light in the slab be so great, that the multiple reflection of the light from the surfaces of the slab can be neglected.

In an earlier paper[4] we processed previously obtained experimental data[5] on the absorption of light in slabs of anthracene of different thickness (at T = 20°K) within the intrinsic band absorption with a maximum at 25,200 cm^{-1}. The intensity of the transmitted light was indeed found to oscillate with the thickness in approximately the manner predicted by the theory of anomalous waves.

Taking into consideration the importance of the conclusions that must be drawn from experiments of this kind, we decided to repeat the measurements in anthracene more carefully. Thus, it was noted in reference 4 that the data used there on the optical density of the crystals were taken in arbitrary units. In the present work, however, absolute measurements were made of the intensity of light by photographic photometry (using an eight-step attenuator, the intensity reference of which was chosen at the frequency 24,720 cm^{-1}). The high-dispersion DFS-3 spectrograph was used. A three-lens system was used to illuminate the slit of the spectrograph.

Furthermore, the earlier measurements,[5] as was noted by I. V. Obreimov, in discussions with the authors, are of doubtful accuracy as regards the polarization of the light along the monoclinic crystal axis chosen for the investigation. Such an inaccuracy would produce in the crystal a second wave of usual double refraction. To dispel this doubt, we made our measurements with two parallel polarizers, located before (Glan prism) and after (spar) the crystal (only one polarizer was used in reference 5). The use of a second polarizer decreases the intensity of the second beam of ordinary double refraction at least by two orders of magnitude (compared with reference 5), i.e., it makes this beam negligible.

With the spar fixed and the crystal removed, the Glan prism was first rotated until one of the beams emerging from the spar was completely extinguished. Insertion of the approximately oriented crystal restored this beam, which was then again extinguished by slightly rotating the crystal. The monoclinic axis of the crystal was



thus set parallel to the vector of the electric field intensity of the light wave. The described adjustment was carried out in white light, since the direction of the investigated principal axis of crystal polarization (monoclinic axis) is independent of the frequency.

Finally, in the present investigation we studied 30 crystal thicknesses, i.e., we obtained twice as many points as in reference 4.

The diagram shows the experimentally obtained dependence of the optical density of the crystal on its thickness, for a frequency 25,108 cm^{-1}. The experimental points are plotted with their probable errors in the abscissas and ordinates. The measurements were made at T = 20°K (an estimate of the errors in the mounting of the crystals, in the measurement of their thickness, and in the method of cooling is given in reference 4). It seems to us that the figure indicates a considerably more pronounced oscillating character than in reference 4. It is important to emphasize the almost identical interval Δl between the extrema, something which is not at all inherent in a simple straggle of points. Actually, the abscissas of the maxima are: $l = \sim 0.072$, 0.128, 0.188, and 0.245 μ. The differences Δl are ~ 0.056, 0.060, and 0.057 μ. The minima are at $l = 0.105$, 0.168, and 0.233 μ. The corresponding differences are $\Delta l = 0.063$ and 0.055 μ. The average period of oscillation is 0.058 μ and the corresponding difference in the indices of refraction of the two interfering waves is 6.9.

We note that if we attempt to ascribe the observed oscillation, on the basis of the usual theory, to interference between beams that have passed once and three time, respectively, through the slab, it would be necessary to assume for the anthracene an index of refraction 3.45, whereas it actually exceeds 5 at the same frequency and temperature.[6] At the frequency investigated, the intensity of the thrice-passing beam is two or three orders of magnitude smaller than the intensity of the singly-passing beam, i.e., the former can be neglected.

The curve shown in the figure is similar in character to the theoretical curve, corresponding to the interference of two parallel polarized anomalous waves (see reference 4). Thus, our earlier qualitative conclusions are confirmed by the present more accurate results. The latter, it appears to us, represent a weighty experimental proof of the existence of additional anomalous waves in the anthracene crystal, as predicted by the theory.

It is quite desirable that similar investigations be carried out by others, both in anthracene and in other crystals. It is necessary to bear in mind here that, depending on the frequency, the difference in the indices of refraction of the two waves may prove to be considerably greater than in the case described above (see Figs. 1 and 2 of reference 2). Accordingly, the frequency of oscillation of the curve such as shown in the figure, will be much greater, and this will require a greater accuracy in the measurement of l. Otherwise the experimental points will be merely disordered.

The authors express their gratitude to A. F. Prikhot'ko for continuous interest in this work and for a discussion of the results, and also to S. V. Marisova for help with the measurements.

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INFLUENCE OF MAGNETIC FIELDS ON RESONANT ABSORPTION OF GAMMA RAYS

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THE discovery by Mössbauer[1] of the emission and resonance absorption of γ rays without loss of energy due to nuclear recoil opened the possibility of directly detecting the Zeeman splitting of excited nuclear states and of measuring their magnetic moments. This possibility was pointed out independently by several people,[2] in particular by one of the authors (A.I.A.).

To observe the Zeeman effect, we chose the γ transition in Sn^{119m} with an energy of 23.8 kev and a lifetime of 2.67×10^{-8} sec, i.e., with a level width of 2.5×10^{-8} ev.

However, in the mixture of isotopes of Sn there is a very strong source of x rays with an energy near to this (around 24 kev) in the form of In^{113} formed from Sn^{112} with a high cross section after neutron capture. For this reason we used a sample of tin enriched in the Sn^{118} isotope (96%) in which the impurity of Sn^{112} was less than 0.05%.

The apparatus for the measurements with a magnetic field consisted of an electromagnet with poles of pyramidal shape. The separation of the poles was 6 mm and the field could reach 20,000 gauss. The γ-ray source was 20×4 mm and 5 mg/cm^2 in thickness, and was fixed tight to one side of a Plexiglas plate 2 cm thick, while absorbers of natural tin of various thicknesses were attached to the other side of the plate. The absorption length of 23.8 kev γ rays due to the photoeffect in tin is 70 mg/cm^2, i.e., exceeds by far the resonance absorption lengths both in the source and in the absorber. The end of the plate holding the source was placed between the poles of the magnet. The source and absorber were immersed in liquid nitrogen. At the position of the absorber, there was a fringing magnetic field whose magnitude at high fields reached around 24% of the value of the magnetic field at the position of the source.

The experiment consisted in the following: Using a proportional counter filled with a mixture of krypton, argon and propane, we measured the intensity of the soft radiation from the source passing through the absorber after filtering by a plate of Plexiglas 2 cm thick and a palladium plate 60 mg/cm^2 thick for absorption of the x-ray