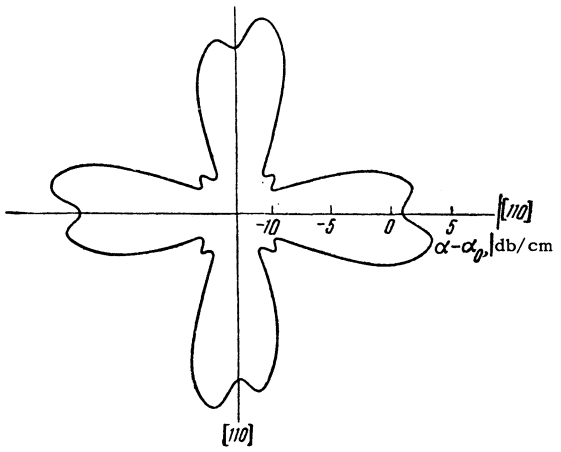

FIG. 4

absorption coefficient at a field of 7×10^3 oe for the field rotated in the (001) plane.

The absorption measured with the field $\mathbf{H} \parallel \mathbf{k}$ has singular points in the α(H) curve. In agreement with Gurevich's theory, the magnetic field at these points satisfies the relation $H_i = \text{const}/n$, where n is an integer.

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Translated by R. Berman
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FINE STRUCTURE IN THE PARAMAGNETIC RESONANCE SPECTRUM OF NATURAL SAPPHIRE

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WE have investigated the paramagnetic resonance spectrum of several natural sapphire single crystals at room temperature, in the range 9600 to 9200 Mcs.

The grey-blue color of sapphire is due to the Fe^{3+} and Ti^{3+} ions replacing Al^{3+} isomorphically in the corundum lattice.[1] The Ti^{3+} ions do not produce any effect because of the short spin-lattice relaxation time at room temperature. One can, therefore, assume that the effect is produced by the Fe^{3+} ions, and the analysis of the spectrum is made on this assumption.

Kornienko and Prokhorov[2] have recently examined the fine structure of the electron paramagnetic resonance spectrum of Fe^{3+} ions artificially introduced into the Al_2O_3 lattice. The interpretation of the spectrum observed was carried out using the following Hamiltonian:*

$$\mathcal{H} = g\beta \mathbf{HS} + DS_z^2 + \frac{F}{180}[35S_z^4 - 30S(S+1)S_z^2 + 25S_z^2] + \frac{a}{6}[S_\xi^4 + S_\eta^4 + S_\zeta^4], \quad (1)$$

where g is the spectroscopic splitting factor, β the Bohr magneton, S the spin operator, H the magnetic field strength, a the cubic field constant, and D and F the trigonal field constants. The coordinate system ξ, η, ζ is constructed on the cubic crystal field axes, and the z axis, directed along the trigonal axis, is also the (111) axis of the ξ, η, ζ system. The approximate energy levels were calculated by Kornienko and Prokhorov on the assumption that the last two terms in Eq. (1) can be treated as perturbations. This is not suitable for explaining the spectrum at a wavelength $\lambda \sim 3.2$ cm, as the second-order corrections can then be larger than the unperturbed values, and each term in Eq. (1) must be evaluated.

The required solution of Eq. (1) can be written in explicit form only for the case of a constant magnetic field directed along the trigonal symmetry axis of the electric field. The problem then becomes one of finding the roots of a sixth-order secular equation. Computations yield the follow-

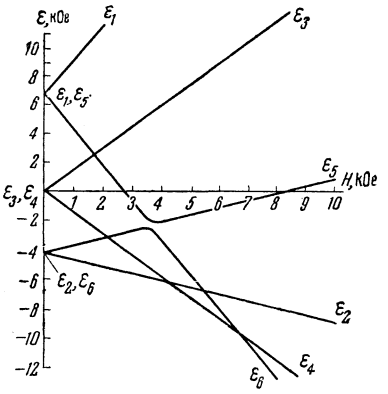

FIG. 1. Dependence of spin energy levels ε_i of Fe^{3+} atoms in sapphire on the magnetic field H, for $\mathbf{H} \parallel \mathbf{z}$.

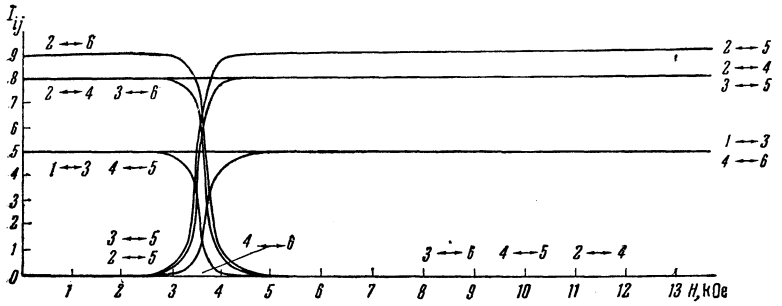

FIG. 2. Dependence of transition probabilities I_{ij} of magnetic dipole transitions on the magnetic field (**H** || z).

ing expressions for the energy levels:

$$\varepsilon_{1,2} = H - {}^3/_2(a-F) + D \pm {}^1/_6\sqrt{[9H+(a-F)+18D]^2+40a^2},$$

$$\varepsilon_{3,4} = \pm {}^3/_2 H, \quad \varepsilon_{5,6} = -H - {}^3/_2(a-F) + D \pm {}^1/_6\sqrt{[-9H+(a-F)+18D]^2+40a^2}. \quad (2)$$

The values of ϵ_i $(i = 1, \ldots, 6)$ are expressed in units of $g\beta$. The dependence of ϵ_i on H is shown graphically in Fig. 1.

We have calculated the relative transition probabilities I_{ij}, for magnetic dipole transitions between energy levels ϵ_i. The results are shown in Fig. 2. Transitions between other pairs of energy levels are forbidden.

A comparison of the spectrum observed with that calculated shows that the values of the constants in the Hamiltonian Eq. (1) for natural sapphire are, within the limits of experimental error, the same as those for Fe^{3+} ions artificially introduced into Al_2O_3, i.e.,

$$g = 2.003 \pm 0.001, \quad |D| = (1801 \pm 3)\ \text{Oe},$$
$$|a-F| = (357 \pm 2)\ \text{Oe}, \quad |a| = (280 \pm 20)\ \text{Oe}.$$

Finally we may note that Kornienko and Prokhorov[2] found a splitting of the atomic Fe^3 lines in Al_2O_3 for directions of the magnetic field other than parallel and perpendicular to the trigonal axis of the electric field. We found the same effect in natural sapphire crystals.

*Small constants, dependent on the spin quantum number S, are omitted.

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DECAY OF Te^{131} *($T_{1/2}$ = 30 HOURS)*

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INVESTIGATIONS of the decay of Te^{131} were reported in many papers.[1-3] The only decay scheme proposed in one of these papers[3] is based practically only on the energy balance of the observed beta and gamma transitions. In the present investigation we obtained a more accurate scheme for the lower levels of I^{131} excited in the decay of the 30-hour isomer Te^{131}, and obtained several new data on gamma transitions in this nucleus.

The investigation was carried out with a magnetic lens spectrometer and a scintillation coincidence spectrometer. The Te^{131} was obtained by irradiating metallic tellurium of high chemical purity with slow neutrons. After irradiation, the I^{131} that accumulated during the irradiation process was removed. Measurements of the gamma spectrum with a single-crystal scintillation spectrometer and with a beta spectrometer (using the secondary electrons) have shown that whereas the soft portion of the spectrum contains gamma radiation due to other isotopes of Te and to I^{131}, the gamma rays produced in the region $E_\gamma > 720$ kev belong only to Te^{131}.

We determined the relative intensities of the gamma transitions in this region. These are listed in Table I.