ment of a mirror behind the tube did not increase the superradiance intensity. The superradiance pulse duration did not exceed 20 nsec, and its power was somewhat lower than that for thallium [1]. The pulse repetition frequency was usually 10 - 15 Hz. When the repetition frequency was increased to 300 Hz, the superradiance power decreased noticeably. The spectrum of the discharge in TlI vapor was investigated with the STE-1 instrument in the 2500 - 6000 Å region. When the superradiance was present, the main lines represented in it were I II, Tl II, and Tl III. The spectrum of the discharge depends little on the type of buffer gas. When the temperature was increased above 410°C, the superradiance disappeared and strong Tl I lines appeared in the discharge spectrum.

The results, particularly the character of the discharge spectrum, indicate that under our conditions the superradiance was not due to direct excitation of the thallium atoms, but more likely the result of excitation of the TlI molecule. Consideration must be given to photodissociation by the radiation produced in the discharge itself as the possible inversion mechanism. The spectra of helium, neon, and argon have no strong lines in the region necessary for photodissociation (close to 2000 Å). A strong line in this region is present in the spectrum of I I, but under superradiance conditions the I I lines are very weak. It is not excluded that the photodissociation played a definite role when air was used as the buffer gas, since rather intense bands of the nitrogen-molecule emission are present in the required region of the spectrum.

Thus, the available experimental data, at least for inert buffer gases, agree best with the mechanism of dissociation of the TlI molecule by electrons with preferred population of the upper level of the 5350 Å line. For a detailed clarification of the mechanism of the observed superradiance, further experiments are necessary.

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HELICOIDAL ANTIPHASE SPIN ORDERING IN HEXAGONAL FERRITES WITH MAGNETOPLUMBITE STRUCTURE

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Submitted 9 January 1968
ZhETF Pis'ma 7, No. 6, 207-210 (20 March 1968)

We performed a neutron diffraction investigation of the ferrite $BaSc^{3+}_{1.8}Fe^{3+}_{10.2}O_{19}$(M) at 77°K and in magnetic fields up to 5000 Oe applied perpendicular to the scattering vector $\vec{\epsilon}$.

An earlier study of the magnetic properties of this compound has shown that, depending on the temperature, different orientations of the easy-magnetization axis are observed here [1]. Thus, in the temperature interval 125 - 355°K the easy-magnetization directions lie in

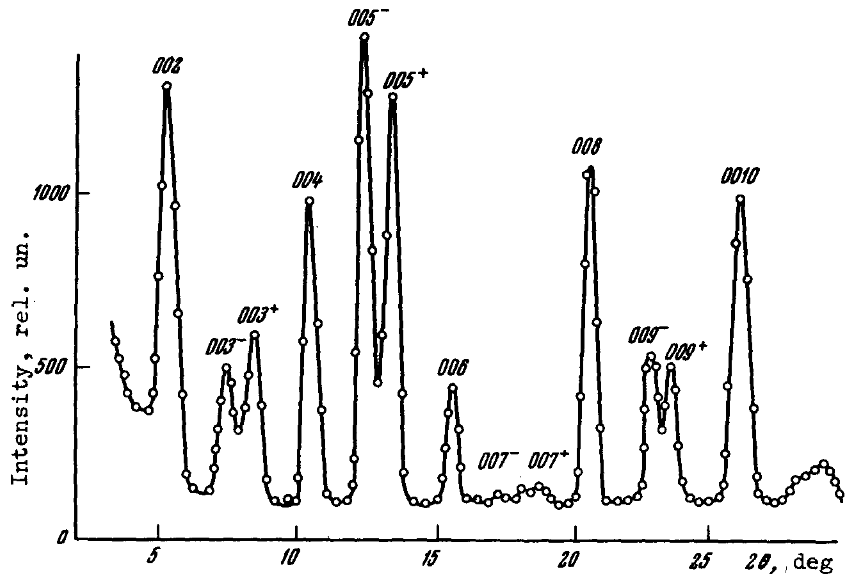

Fig. 1. Diffraction pattern of single-crystal ferrite $BaSc_{1.8}Fe_{10.2}O_{19}$ at 77°K. 00*l* reflections.

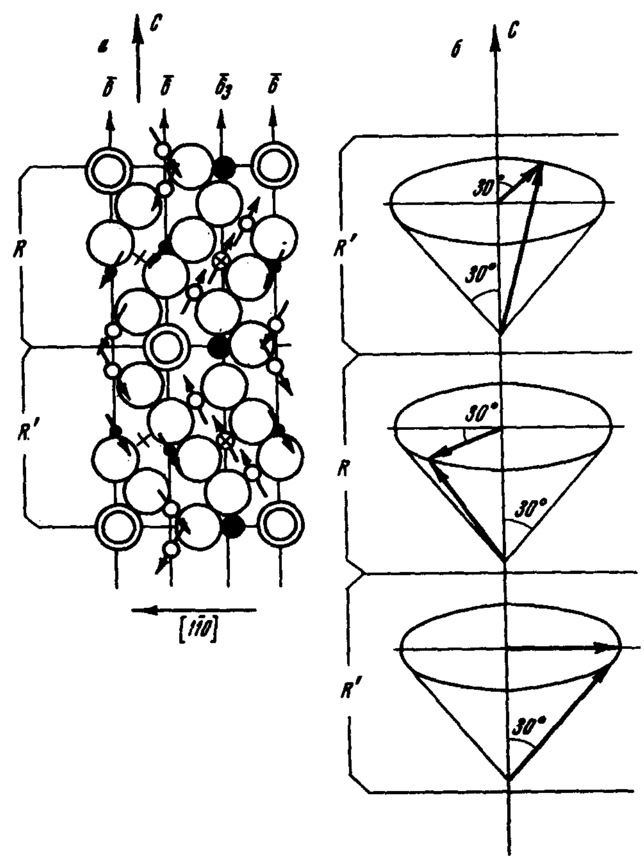

Fig. 2. Magnetic structure of ferrite $BaSc_{1.8}Fe_{10.2}O_{19}$(M) at 77°K. a - unit cell of investigated ferrite. The arrows show the ordering of the spin magnetic moments in accordance with [2]. ● - fivefold coordination, • - Fe, tetr., ∘ - ions in octahedral surrounding, ○ - O^{2-}, ◉ - Ba^{2+}; b - antiphase helical ordering of summary moments of the blocks R and R'. The components of the spin moments on the C axis and on a plane perpendicular to the latter determine respectively the spontaneous moment along the C axis and the antiphase helical structure.

the basal plane, and outside this interval they lie along the C axis. In addition, an anomalous variation of the magnetization curve was observed in [1] when the temperature was lowered to 77°K; this was explained on the basis of the different temperature variations of the magnetic moments of the ions in different crystallographic positions.

The neutron-diffraction pattern (reflections of the 00ℓ series) contains, besides the (ℓ - even) reflections that are allowed by the space group of the crystal ($P6_3/mmc$), also superstructure doublets of magnetic origin (Fig. 1). These reflections were assigned the indices $00\ell^{\pm}$ (ℓ - odd).

The existence of these doublets can be explained on the basis of the helicoidal ordering of the spin magnetic moments, and their symmetrical arrangement relative to the positions of the forbidden reflections with the ℓ-odd ones indicates apparently that the helix has an antiphase nature.

The helix extends along the C axis with a period ≈141 Å.

An analysis of the intensity of the diffraction reflections of $00\ell^{\pm}$ has shown that in this case we have an antiphase conical helix with a cone having a half-apex angle on the order of 30°.

At the same time, it is possible to separate in the unit cell of the investigated ferrite the blocks R and R' (Fig. 2), in each of which the spin ordering is collinear in accordance with the usual scheme [2].

However, the summary magnetic moments of the blocks R and R' form in the ferrite structure two helical sublattices, which are turned in exact antiphase, the wave vector of the helix being $2\pi/\tau$, where τ is the period of the helix.

When the magnetic field is applied perpendicular to $\vec{\tau}$, the intensity of the magnetic doublets decreases rapidly, i.e., the helical ordering is destroyed.

Simultaneously, there appears the "antiferromagnetic" reflection 005, which is forbidden by the space group of the crystal.

All the foregoing makes it possible to explain the anomalies of the magnetic properties from points of view that are different from those used in [1].

An analysis of the intensity of the magnetic diffraction from the investigated samples has shown that the most preferable locations of Sc are 4f ($z = 0.1889$) and 2b ($z = 0.25$).

The latter apparently leads to a redistribution of the energy of the exchange bonds on the boundary between the blocks R and R', as a result of which a noncollinear ordering of the described type takes place.

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