assumes an asymmetrical form. This is connected with the transition of part of the iron atoms into other electronic states, characterized by other values of the quadrupole splitting and isomer shifts. The figure shows the simplest resolution of the spectrum into two pairs of lines with quadrupole splitting.

The area under the line corresponding to the new states of the iron depends linearly on exp(-q/kT), as is seen from Fig. 2, and reaches ∿30% of the total area of the spectrum at 600°C.

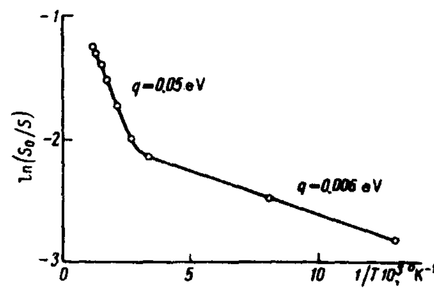

Fig. 2. Relative area of the additional Mossbauer-absorption line, produced upon increase of temperature, vs. T^{-1}.

The following is a probable interpretation of the obtained data. The appearance of a new line in the Mossbauer spectrum with increasing temperature is evidence of the production of new electronic states not belonging to the entire crystal, but localized near part of the atom during a time greatly exceeding the time of interaction of the γ quanta with the Fe^{57} nuclei. The fraction of the nuclei near which the state of the electrons is measured is relatively large (on the order of 30% at 600°C), making it necessary to connect the excited localized states with the main atoms of the matrix, rather than with the atoms of the possible small impurities. It is tempting to identify the observed localized states with small polarons of two types with characteristic production energies 0.006 and 0.05 eV. The value q = 0.05 eV turns out to coincide with the position of the sharp maximum in the IR absorption spectrum of β-$FeSi_2$ [5]; the temperature corresponding to the singular point on Fig. 2 coincides approximately with the temperature of the kink on the plot of ln σ- T^{-1} [2], and the ratio of the activation energies is the same in both cases.

If the observed local states are actually small polarons then, judging from the values of q and the values of the quadrupole spectrum, their radius is unusually small compared with the radius of the atom.

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RELAXATION AND NONCOLLINEARITY OF THE SPINS OF IRON IN THE FERRITE $Li_{0.5}Fe_{1.7}Al_{0.8}O_4$

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It was proposed in [1] that the spin configuration of the ferrite $Li_{0.5}Fe_{1.7}Al_{0.8}O_4$ is not collinear.

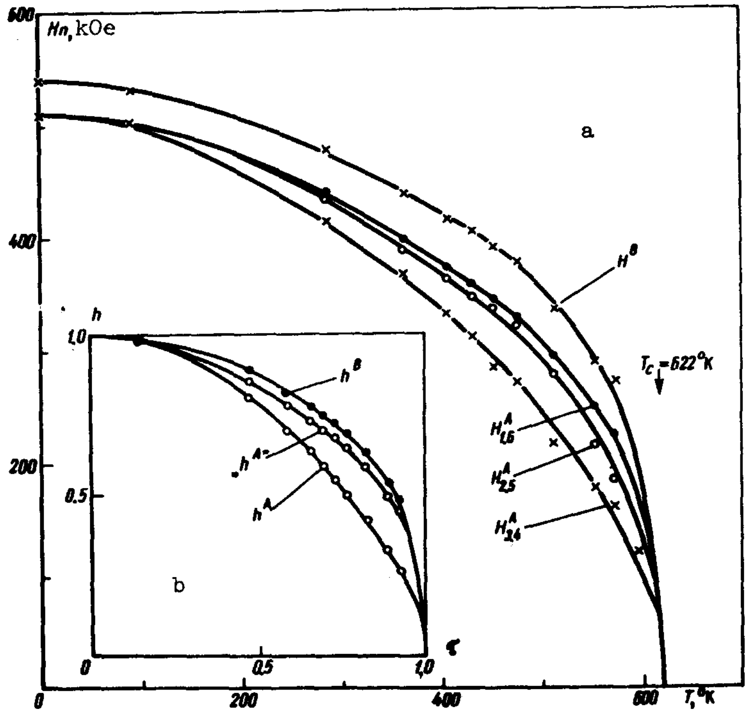

Fig. 1. a - Temperature dependence of the effective magnetic field at the iron nuclei in the A and B sublattices, obtained from the symmetrical components of the Zeeman sextet (these dependences coincide for the B places); b - reduced valuey of the magnetic field, corresponding to the case of very rapid spin relaxation.

To elucidate the character of the arrangement of the iron spins in this ferrite, we attempted to utilize the methodological capabilities of the Mossbauer effect. As is well known, in the case of sufficiently rapid spin relaxation, the magnitude of the hyperfine magnetic field at the location of the nucleus is proportional to the time-averaged projection of the atom spin [2]

$$H(T) = \text{const} < S_z >_T . \tag{1}$$

If the spin configuration is collinear, relation (1) makes it possible, in particular, to determine the temperature dependence of the ferrite sublattice magnetizations.

In this case, however, such an attempt encounters certain difficulties owing to the relaxation phenomena (first noted on samples of similar composition by the authors of [3]).

Figure 1a shows the results of the reduction of our data with the aid of a computer (by least squares). The computation program was compiled under the assumption that the relative intensities of the spectra of the A and B places are determined by the cation distribution (in accord with [4]) and the hyperfine structure components have Lorentz shapes.

The results of this reduction have made it possible to establish that the relaxation phenomenon take place only in the A sublattice (Fig. 1a).

Thus, whereas relation (1) holds true for the B sublattice, in the case of the A sublattice there can be no talk of proportionality between any of the obtained three values of the field $H^A(T)$ and the mean value of the spin projection $<S_z^A>$.

To find the ratio $h^A(\tau) = <S_z^A>_T/<S_z^A>_a$ we used the fact that Eq. (1) is satisfied only if $\Omega \gg \delta$, where Ω is the electron-spin relaxation frequency and δ is the frequency of the hyperfine structure [2]. The value of $h^A(\tau)$ is then obtained by extrapolating $H^A(\delta)/H^A_{T=0}$ to $\delta = 0$ for any of the chosen temperatures T.

This has made it possible to determine, besides the relation $h^B(\tau) = H^B(T)/H^B(0)$, also $h^A(\tau)$. Both are shown in Fig. 1b (where $\tau = T/T_c$).

In the case of the Neel model, the magnetic moment of the ferrite "molecule" can be written in the form

$$m_S(\tau) = m^B_{So} h^B(\tau) - m^A_{So} h^A(\tau) \quad (2)$$

Figure 1b shows the "$h^A(\tau)$" dependence obtained from (2) for known values of m_S, m^A_{So}, m^B_{So}, and h^B. The obvious disparity between this dependence and the actual $h^A(\tau)$ dependence shows that the Neel model cannot be used in our case.

It is easily seen that if the magnetic moments of the atoms in the sublattice are inclined at the same angle α to the direction of its resultant moment, then it is necessary to write in lieu of (2):

$$m_S(\tau) = m^B_{So} h^B(\tau) \cos \alpha^B_T - m^A_{So} h^A(\tau) \cos \alpha^A_T, \quad (3)$$

where m^A_{So} and m^B_{So} are the "nominal" moments corresponding to the cation distribution.

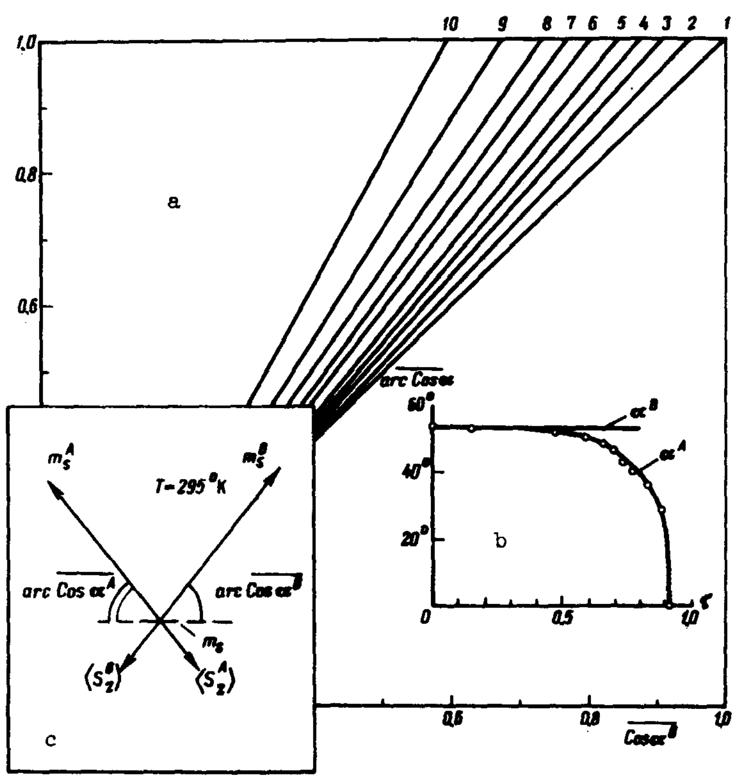

Fig. 2. a - The isotherms $m_S(\tau) = m^B_{So} h^B \cos \alpha^B - m^A_{So} h^A \cos \alpha^A$, which connect the values of the conical angles: 1 - 90°, 2 - 295°, 3 - 364°, 4 - 407°, 5 - 431°, 6 - 453°, 7 - 477°, 8 - 513°, 9 - 554°, 10 - 574°K; b - minimal values of the averaged angles, satisfying the isotherms a and obtained under the assumption that $\cos^{-1}\alpha^A(\tau)$ and $\cos^{-1}\alpha^B(\tau)$ are monotonic functions); c - schematic representation of the angle configurations at room temperature (according to b).

Relation (3) makes it possible to establish whether the spins are noncollinear in both sublattices or only in one. Equation (3) still does not make it possible to determine the values of the angles at a given temperature (Fig. 2a). It can be proposed, however, in accord with [5], that the angular configurations are unstable and vanish with increasing temperature, giving way to a collinear arrangement of the spins. The limitation $\cos \alpha_T \leq 1$ makes it then possible to estimate the minimum value of the angle α^B_{min}, which turns out to equal approximately 50°. This angle corresponds to $\alpha^A_{min}(\tau)$. If in fact $\alpha^B > 50°$, then the angles α^A are also larger.

On the other hand, the dependence of α^B on the temperature leads to a corresponding change of the $\alpha^A(\tau)$ curve. Figure 2b shows the minimal values of the angles at which it is still possible to satisfy Eq. (3).

We see that the experimental data can be explained only by assuming that the spins are noncollinear in both sublattices.

Since the neutron-diffraction data do not give regular angular configurations in samples of similar composition [6], the angles α^A and α^B should be taken to mean, generally speaking, $\cos^{-1} \alpha^A$ and $\cos \alpha^B$.

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GENERATION OF MAGNETOSONIC OSCILLATIONS IN THE TOKAMAK TO-1

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In connection with the prospects of using magnetosonic resonance [1] for additional heating of the plasma in the Tokamak, a study was made of the possibility of exciting natural oscillations of the plasma column using a high-frequency amplifier in a feedback loop via the plasma. Unlike the methods in which the source of oscillations is an independent generator with fixed frequency, this method makes it possible to introduce energy into the plasma with sufficiently broad tuning of the natural frequency.

Experiments on the generation of magnetosonic oscillations were carried out on the Tokamak TO-1 [2]. The plasma oscillations were excited by a loop inserted through a lateral stub in the liner and producing an HF magnetic-field component parallel to the column axis. The loop did not surround the plasma column and was located in the shadow of the diaphragm. The feedback was produced by a magnetic probe having the same polarization and placed in a diametrically opposite section of the liner.