Type of subspectrum	Experimental energy, MeV	Calculated energy, MeV
Most probable α_I	15.6	15 - 16
α_{II}	9.9	~10
α_{III}	9.0 8.3 7.6 7.1	7 - 8

and its occurrence may be attributed to the large probability of emission of α particles ($\varepsilon_\alpha < 0$) from the levels of cold nuclei with large angular momenta with subsequent transition of the levels of thermal excitation, or else to the existence of an intermediate mechanism [11]. These α particles are emitted with sharp anisotropy, and a ratio $\sigma(50°)/\sigma(100°) \simeq 15/1$. We have started investigations of the subbarrier regions of the α spectra in the reactions $Ne^{22} + Nb^{93}$ and $Ne^{22} + Au^{197}$. The measurements have shown, just as in the case of the reaction Ne^{22} + Ag considered here, the existence of α particles with low energies ($E_\alpha < V$) and with practically continuous spectrum up to energies ~3.5 MeV (the limiting energy of α-particle identification). Background experiments performed by us (without a target) and experiments on the α spectra in reactions of light nuclei ($Ne^{22} + C^{12}$, $Ne^{22} + Al^{27}$) have shown that the discussed low-energy sections of the α spectra are produced in reactions on heavy target nuclei, i.e., they represent an effect of subbarrier emission of α particles, the interpretation of which is possible within the framework of the notions indicated above.

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STRUCTURE OF DOMAIN WALL IN WEAK FERROMAGNETS

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Several years ago we called attention [1] to the fact that the magnetization vector $\vec{M}$ in uniaxial ferromagnets near the Curie point T_c should not rotate (as is the case far from T_c) but only change in magnitude. In a direction

perpendicular to the domain wall (along the y axis), the vector $\vec{M}$ varies as follows:

$$M_z = M_0 \operatorname{th} \frac{y}{y_0}, \quad M_x = M_y = 0. \tag{1}$$

Estimates show, however, that in ordinary ferromagnets the linear solution (1) corresponds to the minimum of the free energy only in a temperature interval on the order of 1 - 10° away from T_c. We wish to call attention in this paper to the fact that in weak ferromagnets (cf., e.g., [2 - 5]) the structure of the domain wall can be described by a solution of type (1) also at low temperatures, i.e., far from the Neel temperature T_N. Apparently, the most favorable conditions for the realization of the solution (1) occur in orthoferrites.

Let us consider that part of the free-energy density of orthoferrites, which depends on the sublattice magnetizations $\vec{M}_1$ and $\vec{M}_2$ (here $M_1 = M_2 = M_0$, cf. [5]):

$$F = \frac{1}{2} c\left(\frac{d\ell}{dy}\right)^2 + \frac{a}{2} m^2 - \frac{b_1}{2} \ell_x^2 - \frac{b_3}{2} \ell_z^2 + d_1 m_x \ell_z - d_3 m_z \ell_x,$$

$$m = \frac{M_1 + M_2}{2M_0}, \qquad \vec{\ell} = \frac{M_1 - M_2}{2M_0}. \tag{2}$$

When $b_1 > 0$ and $b_1 - b_3 > 0$ (this case is realized in most orthoferrites), we obtain from the condition of minimum of the energy (2) a homogeneous solution with a weak ferromagnetism inside the domains (account is taken of the fact that a >> b, d)

$$\ell_x = \pm 1, \quad m_z = \frac{d_3}{a} \ell_x, \quad \ell_y = \ell_z = m_x = m_y = 0. \tag{3}$$

It is seen from (3) that inside a 180° domain wall, when the sign of m_x reverses, the vector $\vec{\ell}$ should also reverse its direction by 180°. The equation for $\vec{\ell}(y)$ inside the wall is obtained from the condition of the minimum of the free energy; this equation must be solved with boundary conditions $\ell_x = \pm 1$ and $\ell_y = \ell_z = 0$ at $y = \pm\infty$. When $b_3 < 0$, the solution minimizing the free energy takes the form

$$\ell_x = \operatorname{th} \frac{y}{y_0}, \quad \ell_y = \frac{1}{\operatorname{ch} \frac{y}{y_0}}, \quad \ell_z = 0, \quad y_0 = \sqrt{\frac{c}{b_1}},$$

$$m_z = \frac{d_3}{a} \operatorname{th} \frac{y}{y_0}, \quad m_x = m_y = 0. \tag{4}$$

The surface energy of the wall for this solution is $\sigma = 2\sqrt{b_1 c}$. The solution (4) is a rotary one for the antiferromagnetism vector $\vec{\ell}$ (it rotates in the yx plane) and is a linear solution of type (1) for the magnetization vector m. We note that an indication of the possible appearance of a solution of just this type in orthoferrites, but without any calculations, is contained in the review [6].

When $b_3 < 0$ the minimum of the free energy yields a solution:

$$\ell_x = \mathrm{th}\frac{y}{y_0}, \quad \ell_z = \frac{1}{\mathrm{ch}\frac{y}{y_0}}, \quad \ell_y = 0, \quad y_0 = \sqrt{\frac{c}{(b_1 - b_3)}},$$

$$m_z = \frac{d_3}{a}\,\mathrm{th}\frac{y}{y_0}, \quad m_x = -\frac{d_1}{a}\frac{1}{\mathrm{ch}\frac{y}{y_0}}, \quad m_y = 0, \tag{5}$$

$$\sigma = 2\sqrt{(b_1 - b_3)c}\,.$$

In this case both $\vec{\ell}$ and $\vec{m}$ rotate through 180° in the zx plane, and when $d_1 \neq d_3$ the solution for $\vec{m}$ is elliptic. Only when $d_1 = d_3$ is the solution completely analogous to the usual rotary solution in ferromagnets far from T_c, and also in weak antiferromagnets of the type $MnCO_3$ and α-Fe_2O [7]. We note that if the crystal has the form of a parallelepiped and is broken up into domains, with walls perpendicular to the y axis and with magnetization inside the domains directed along the z axis, then, if the linear solutions (4) are realized, there is no stray field at all on the sample faces parallel to the yz plane. This feature makes it apparently possible to distinguish experimentally between the solution of type (4) and the rotary solution (5), for in the latter case there is a stray field with $H_x \sim M_x \neq 0$ on the faces parallel to the yz plane near the domain walls. The large width (≈0.5 mm) of the domains in orthoferrites, observed in [8], facilitates the observation of the stray fields on the faces parallel to the yz plane. The large dimensions of the domains along the y axis show also that the surface energy of the domain walls in the orthoferrites is large. This is obvious from the solutions (4) and (5), since the surface energy is determined by the parameters of the inhomogeneous exchange interaction and the strong anisotropy of the principal antiferromagnetic structure. The latter is understandable, since the antiferromagnetism vector $\vec{\ell}$ reverses its direction inside the domain wall. When $a \sim 10^6$ Oe and $b \sim 10^4$ Oe, we obtain $\sigma \sim 10$ erg/cm^2. This estimate greatly exceeds the magnitude of the surface energy of the wall for weak ferromagnets such as MnC_3 in which, owing to the weak anisotropy in the basal plane, only the rotary solution with $\sigma \sim 10^{-2} - 10^{-3}$ erg/cm^2 [7] is realized.

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