account the real $\Delta p/p$. The results of such a calculation are shown in Figs. 2b and 3b, where the solid curves are the momentum distributions obtained with allowance for the form factor, and the dashed ones are without this allowance. The theoretical curves of Figs. 3a and 3b are normalized, for the sake of clarity, to yield the same value of $d\sigma/d\Omega_d$ as the experimental spectrum. The figures demonstrate the good agreement between the experimental data and the solid curves, showing that the calculation of the form of the deuteron spectrum under the indicated assumptions is valid.

Using the expression for the differential cross section, we calculated on the basis of the experimental data the deuteron widths for both initial proton energies:

$$\theta^2 = 3{,}8 \pm 1{,}0 \text{ for } T_0 = 1260 \text{ MeV and}$$
$$\theta^2 = 2{,}7 \pm 0{,}7 \text{ for } T_0 = 730 \text{ MeV.}$$

The error in the determination of θ^2 contains, besides the statistical errors, also the inaccuracies in the determination of the absolute cross sections (∿20%) and the uncertainty resulting in the calculation of the spectrum (∿15%). The agreement between the reduced deuteron widths, at different values of the incoming proton energy within the limits of the experimental errors, confirms the validity of using the pole diagram for the process under consideration.

We note for comparison that $\theta^2 = 4.7 \pm 1.0$ for the O^{16} nucleus (this was obtained in [2] by reduction of the experimental data of [4]).

As indicated above, the excited levels of the final nucleus are not separated in the experiment. Nor are cases separated in which the final nucleus disintegrates. The obtained values must therefore be regarded as certain summary widths for the indicated transitions.

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MAGNETOCALORIC EFFECT IN RARE-EARTH IRON GARNETS

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We measured the magnetocaloric effect $\Delta T(H)$ in rare-earth iron garnets of Gd, Tb, Dy, Ho, Er, Yb, Tu, and also in yttrium iron garnet.

The ΔT effect is an energy characteristic, and its study can therefore yield added information concerning the magnetic structure and exchange interactions in rare-earth iron

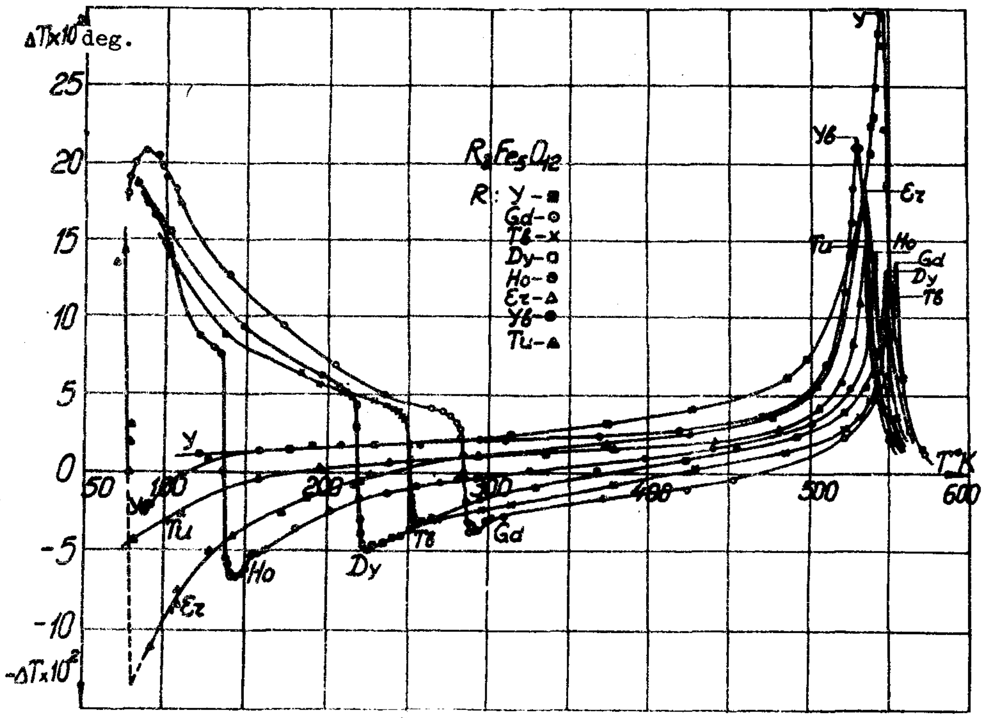

Fig. 1. Temperature dependence of the magnetocaloric effect measured in an external field of 16 kOe for Gd, Tb, Dy, Ho, Er, Yb, Tu, and Y iron garnets (on some curves, the experimental points near the Curie temperature are not indicated).

garnets. It should be noted that measurements of the ΔT effect in ferrites entails certain difficulties. The measurement procedure and conditions were indicated by us in [1].

The figure shows the ΔT(T) curves for the investigated ferrites in the interval from 78°K to the Curie point in a magnetic field of 16 kOe. We see that for rare-earth ferrites these curves have a rather complicated character compared with the curve for the yttrium ferrite. The curves are made complicated by the rare-earth ions.

1. In the region below the magnetic compensation point, the ΔT effect is positive. Since we used on our experiments fields much weaker than the critical fields at which the collinear arrangement of the magnetic moments of the rare-earth and iron sublattices is violated [2], the magnitude of the ΔT effect is determined mainly by the paraprocess of the rare earth ions.

Since the external field H and the effective exchange field H_{eff} applied by the iron ions on the rare-earth ions coincide in direction below θ_c, we have in this temperature region an ordinary paraprocess of the "ferromagnetic" type with the corresponding positive ΔT effect.

For the gadolinium iron garnet, as follows from the figure, a maximum positive ΔT effect is observed in the region of 90°K. This maximum occurs at the so-called "low-temperature point" θ_L, at which a sharp change takes place in the magnetic order of the rare-earth sublattice [3]. The ΔT effect corresponding to this point was calculated in [4] by the molecular-field method:

$$\Delta T = \frac{\nu \mu_B g_s S H_{eff}}{C_{VM} \mu_{co}} \chi H,$$

where C_{VM} is the specific heat, μ_{co} is the magnetic moment of the rare-earth sublattice, S and g_s are the spin and g-factor of the rare-earth ion, μ_B is the Bohr magneton, and χ is the susceptibility of the paraprocess. An estimate by means of this formula yields for $H = 10^4$ Oe a value $\Delta T \approx 7 \times 10^{-2}$ deg, which is in good agreement with our experimental data.

In the iron garnets of Tb, Dy, Ho, Er, Yb, and Tu, the "low-temperature points" lie at lower temperatures [5]. An analysis of the ΔT effect for these ferrites, particularly in the region of very low temperatures, is even more complicated, since the magnetization is affected not only by the spin of the rare-earth ion, but also by the orbital angular momentum, which in turn is strongly influenced by the electrostatic forces of the lattice.

2. At a temperature below the compensation point θ_c, the sign of the ΔT effect of rare-earth garnets becomes negative - a jump of the magnetocaloric effect is observed in the region of θ_c. We attribute the existence of a negative effect to the fact that a paraprocess of the "antiferromagnetic" type occurs in this temperature region, since H and H_{eff} have opposite directions when $T > \theta_c$. This magnetization mechanism leads to an increase of the entropy of the system of magnetic moments of the rare-earth sublattice, and consequently to a decrease of the entropy of the crystal lattice, i.e., to a lowering of its temperature.

It is seen from the figure that the lower the compensation point θ_c, the larger the maximum negative ΔT effect. Apparently, in Yb and Tu iron garnets, in which the θ_c point lies in the helium region, the negative ΔT effect will be much larger than in Ho and Er ferrites.

The increase of the jump of the ΔT effect in garnets with lower compensation points can be explained as follows: As is well known, the magnitude of the ΔT effect is determined by the quantity $d\sigma_s/dT$ or by the change of the magnetic part of the entropy ΔS_m. We have seen with Gd iron garnet as an example that $d\sigma_s/dT$ reaches a maximum in the region of the low-temperature point. Therefore, the closer θ_c is to the low-temperature point θ_L, the larger the jump of the ΔT effect. In Yb and Tu iron garnets the situation is most favorable for the points θ_L and θ_c to be close to each other .

3. In all the investigated garnets, a positive maximum of the magnetocaloric effect was observed in the region of the Curie temperature, with a value lower in the rare-earth garnets than in the yttrium garnet. This agrees with the measurements of the magnetic susceptibility [6] and with the conclusions of [7].

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SELF-FOCUSING OF ULTRASHORT LASER PULSES

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The self-focusing phenomenon has heretofore been investigated theoretically only for stationary [1-3] or nonstationary [4] boundary conditions. Such a formulation of the problem corresponds to the case when the duration of the laser pulse is sufficiently large, viz., the length of the light train determined by this duration should be much larger than the width of the nonlinear-medium layer through which the laser beam passes and in which its behavior is of interest to us. We consider in this paper the propagation, in a nonlinear medium, of "ultrashort" light pulses, with train lengths much shorter than (or of the order of) the width of the layer in which the self-focusing takes place. It is assumed here that the nonlinearity of the medium is due to the Kerr effect:

$$\epsilon = \epsilon_o + \frac{1}{2}\epsilon_2 |E|^2 \tag{1}$$

(ε is the dielectric constant, $|E|$ the amplitude of the electric-field oscillations). The electric field $\mathcal{E}(\vec{r}, t)$ is assumed scalar, for simplicity, i.e., satisfying the condition

$$\Delta \mathcal{E} - \frac{1}{c^2}\frac{\partial^2}{\partial t^2}(\epsilon \mathcal{E}) = 0. \tag{2}$$

Assuming

$$\mathcal{E} = \frac{1}{2} E(r, t)\, e^{i(kz - \omega t)} + \text{c.c.}, \quad (k = \frac{\omega}{c}\sqrt{\epsilon_o}) \tag{3}$$

we find an equation for the new unknown function E:

$$\Delta E + 2ik\frac{\partial E}{\partial z} + \left(\frac{\omega}{c}\right)^2 \epsilon' E + \frac{\epsilon_o + \epsilon'}{c^2}\left(2i\omega\frac{\partial E}{\partial t} - \frac{\partial^2 E}{\partial t^2}\right) + \frac{2}{c^2}\frac{\partial \epsilon'}{\partial t}\left(i\omega E - \frac{\partial E}{\partial t}\right) - \frac{1}{c^2}\frac{\partial^2 \epsilon'}{\partial t^2} E = 0, \tag{4}$$

where $\varepsilon' = (1/2)\,\varepsilon_2\,|E|^2$. We shall assume that the conditions

$$\Delta t_x \gg T, \quad \Delta z_x \gg \lambda, \quad \epsilon' \ll \epsilon_o, \tag{5}$$

are satisfied for all $\vec{r}$ and t; here Δt_x and Δz_x are the characteristic time and the characteristic length of variation of the field E as functions of t and z, respectively; $T = 2\pi/\omega$ is the period of the optical oscillation; $\lambda = 2\pi/k$ is the length of the light wave. Under conditions (5), some of the terms of (4) are negligibly small. Omitting these terms, we arrive at the following equation for E: