surface, $n(l)$ is the concentration on the unilluminated surface, σ_0 is the dark conductivity, and σ_I is the photoconductivity. The change in the sign of the PME emf can be explained by the fact that, after the light is switched off, the carrier concentration $n(l)$ becomes greater than $n(0)$ for some short time. This can happen if the surface recombination velocity for the illuminated surface is greater than for the unilluminated. In fact, experiments showed that with an inverse ratio of the surface recombination velocities, the PME emf does not change sign on switching off the light.

The fact that the change in sign of the PME emf on switching off the light is observed on specimens with equal surfaces can, it seems, be explained if it is assumed that there is a variation of surface recombination velocity with illuminating intensity which can, in the first approximation, be written as $S = S_0 + \alpha I$, where I is the illuminating intensity. In this way the results of the experiments on the effect of background illumination on the specimen can also be explained. Thus, for example, when the surface of the specimen not illuminated by the pulsed light is subjected to background illumination, the surface recombination velocities, which were previously different, become equal, and, as a consequence, the change of sign in the PME emf is not observed.

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THE MECHANISM OF PARAMAGNETIC SPIN-LATTICE RELAXATION IN IONIC CRYSTALS AT LOW TEMPERATURES

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RECENTLY, in order to eliminate the difficulties which beset the Kronig-Van Vleck theory [1,2] at low temperatures, it has been suggested that the most effective mechanism for paramagnetic spin-lattice relaxation consists of exchange pairs, [3,4] the existence and strong spin-phonon coupling of which has been demonstrated experimentally. [5,6] The hypothesis of relaxation by means of exchange pairs easily explains two basic experimental facts that clearly contradict the Kronig-Van Vleck theory: the strong dependence of the relaxation time T_1 on the concentration of paramagnetic particles C and the weak dependence of T_1 on the magnitude of the applied magnetic field H. The anomalous dependence of T_1 on the temperature T that is sometimes observed also receives a simple interpretation.

It seems to us that relaxation by means of exchange pairs is effective only in crystals with a sufficiently large concentration of paramagnetic particles and that the width of the resonance line is comparable to the least interval separating the resonance peaks of the individual particles from the peaks belonging to pairs. At smaller concentrations the spin-spin interactions are not able to provide a transfer of energy from the individual particles to the pairs, because their energy spectra are usually completely different. Actually, the existence of two different spin-lattice relaxation mechanisms, leading to different temperature dependence of T_1, has been established experimentally in ruby. [6,7] The anomalies of the temperature dependence are observed in crystals with concentrations of paramagnetic ions exceeding 0.2%.

Our calculations have shown that in crystals having a medium concentration of paramagnetic ions the most effective mechanism for relaxation turns out to be the following. Let S and S′ be the spins of the interacting particles and $J(r)$ the exchange integral, a function of the distance r between the particles. Because of indirect exchange the isotropic interaction $\mathcal{H} = J\mathbf{S}\cdot\mathbf{S}'$ is effective at rather large distances. Let 2D be the initial

splitting of the spin levels due to the crystalline field and let R be the distance at which J(R) = D. A small number of particles, for which r < R, form pairs. For an overwhelming number of particles r > R and in this case the exchange forces, while not altering the spectrum of the particles, should change the width of the resonance lines. This effect of the exchange forces was apparently observed long ago in ruby and in other crystals in which a concentration dependence of line width is observed but cannot be explained at C < 0.2% by dipole-dipole interactions.[8,9]

Spin-lattice relaxation due to exchange forces J < D will, firstly, depend strongly on the concentration C and, secondly, will be practically independent of the field H, since the matrix element of the interaction $\mathcal{H}$ is proportional to $D/g\beta H$. The probability of a relaxation transition of a particle from level i to level j can be calculated from the equation (see [10])

$$A_{ij} = \frac{8\pi^3}{3h^4}\frac{1}{\rho v^5}\sum_{r>R} r^2\left(\frac{\partial J}{\partial r}\right)^2 \times \sum_{k,l}\frac{E^3_{ik,jl}}{1-\exp\left(E_{ik,jl}/kT\right)}|\langle i,k|SS'|j,l\rangle|^2.$$

Here ρ is the density of the crystal, v is the speed of sound, and $E_{ik,jl}$ is the change in energy of the pair of particles in the transition $i,k \rightarrow j,l$. Detailed calculations were carried out for ruby. In order to obtain agreement between the calculated and measured values for the spin-lattice relaxation times for concentration C ~ 0.1%, it is necessary to take $J(\bar{r}) \approx 10^{-3}$ cm^{-1} ($\bar{r}$ = 27 Å, the mean separation between the particles). If it is recalled that at r ~ 6 Å the magnitude of J ~ 0.5 cm^{-1},[6] then our value for the exchange integral is acceptable, the more so since it does not contradict the data on the resonance line width. If for crystals oriented perpendicular to the magnetic field one numbers the spin levels of Cr^{3+} from the bottom upwards, then for the transitions 2—4, 1—2, 2—3, 3—4, the ratios of the relaxation times at 20.3°K are 10:6:8:4, according to measurements.[7] Our calculations give for these ratios 10:6:8.6:7.2.

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PRESSURE ON EVAPORATION OF MATTER IN A RADIATION BEAM

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RECENTLY the use of lasers has given high concentrations of light capable of causing intense evaporation even of heat-resistant materials. Equally well-known and widely used in practice are the heating and evaporation of materials by intense beams of charged particles (electronic and ionic cutting of metals, cathodic and anodic sputtering of electrodes, etc.). Strong energy fluxes concentrated over small areas (the attainable dimensions of a focus spot of a laser beam or an electron beam used in cutting amount to only several microns) are capable of producing such intense evaporation that in estimating the pressure on the surface it is necessary to allow for the strong recoil pressure during evaporation.

We shall estimate the recoil pressure for steady-state evaporation: $p \approx \alpha I v_f/\lambda$, where I is the energy density flux in the beam, v_f is the final velocity of vapor flow, $\lambda \approx \lambda_0 + \frac{1}{2}v_f^2$ is the specific