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1) We have in mind occupation numbers of both strongly interacting particles and leptons.

2) We can for example, in analogy with [5], estimate it in the following model: Φ_2 is the solution of the problem involving the behavior of many leptons in a potential well due to the self-consistent field. The dimensions of this well are governed by both strong and weak interactions, so that we can assume them to be $R \sim \hbar/m_\pi c$. The lepton interaction includes a short-range part, the radius of which is of the order of the length of the weak interaction $l \sim 10^{-17}$ cm, and the cross section is $\sigma_{lep} \sim 10^{-34}$ cm^2. These assumptions comprise a set of sufficient conditions for the development of instability and for the occurrence of time-irreversible processes. The relaxation time coincides in this case with τ_1 given in the text.

STEPWISE EXCITATION OF FLUORESCENCE OF $CaWO_4$ ACTIVATED WITH Er^{3+}

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Brown and Shand [1] reported that they obtained stepwise excitation of fluorescence of Er^{3+} in fluoride hosts. We observed an analogous effect in single-crystal $CaWO_4:Er^{3+}$. The crystals used in the experiment were grown by the Czochralski method, the concentration in the initial charge was 0.75%, and no special impurities were introduced to compensate for the excess charge. The samples were in the form of a parallelepiped measuring 17 x 4 x 7 mm. The exciting monochromatic beams were aimed on the crystals opposite to each other through the smaller faces. The radiation from the sample first passed through a filter absorbing the exciting light and was then registered with a FEU-27 photomultiplier.

The stepwise excitation of fluorescence at wavelengths near 543 nm was observed when the wavelength of one of the exciting beams was approximately 1.5 μ and corresponded to the region of infrared absorption of Er^{3+} in the $^4I_{15/2} \rightarrow {}^4I_{13/2}$ transition, while the wavelength of the second exciting beam corresponded to the 710 - 850 nm region. No fluorescence was excited by any of the beams separately, and the effect was observed only when the sample was simultaneously excited by both beams.

The scheme of the transitions responsible for the effect can be represented in the form shown in Fig. 1. Figures 2a and 2b show the dependence of the fluorescence intensity on the

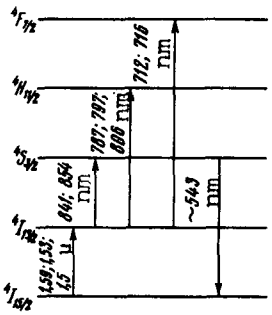

Fig. 1. Transition scheme of stepwise excitation of fluorescence of Er^{3+} in $CaWO_4$.

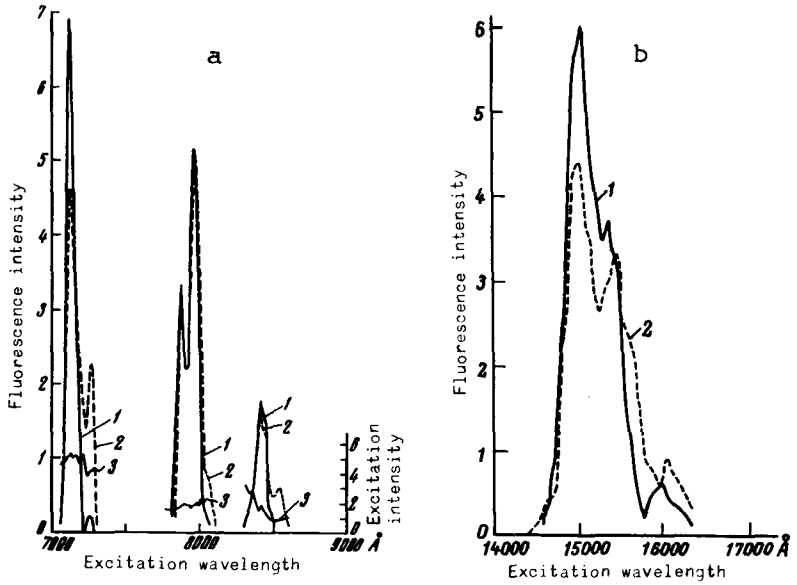

Fig. 2. Dependence of the fluorescence intensity on the excitation wavelength: 1 - at liquid-nitrogen temperature, 2 - at room temperature (3 - distribution of the excitation source power).

excitation wavelengths. In plotting these characteristics we varied the spectral composition of only one of the exciting beams, while the other contained all the wavelengths of the corresponding active band. For example, in the study of the dependence of the fluorescence on the wavelength of the red excitation, the infrared exciting beam contained all the wavelengths from 1.45 to 1.6 μ.

For a comparison of the efficiencies of the individual red bands, Fig. 2a shows the spectral distribution of the power in the exciting beam. The character of the influence of cooling on the form of the spectra of Fig. 2 enables us to advance definite assumptions concerning the origin of some of the peaks. In particular, it can be assumed that the peaks near 716, 806, and 854 nm are due to the Stark components of the $^4I_{13/2}$ state. When the temperature of the sample is lowered to that of liquid nitrogen, the populations of these components decrease rapidly, owing to the fast relaxation to the lower-lying components of the same state, thus explaining the weakening of these peaks and the intensification, at their expense, of the peaks corresponding to transitions from the lower levels of the $^4I_{13/2}$ states to the levels of the states $^4S_{3/2}$, $^4H_{11/2}$, and $^4F_{7/2}$. The effect of stepwise excitation of fluorescence can be used to transform light radiation of one frequency into light radiation of another frequency, for example to transfer a signal from the infrared region into the visible one (infrared "quantum counter" [2,3]).

We have estimated the conversion coefficient, taking the infrared exciting beam as the signal and the red one as the pump. At a pump power of several milliwatts in a 15 nm band near 795 nm, the conversion coefficient was of the order of 10^{-6} watts of visible radiation from the crystal per watt of incident infrared radiation. The conversion coefficient can be increased by raising the erbium concentration, by increasing the effective weight of the samples, and by

increasing the pump power. Using the fact that one of the pump bands (841 nm) is close to the emission band of gallium arsenide, we have tested a system in which the pumping was produced by such a semiconductor emitter. No appreciable improvement was obtained, however, first, because the radiation power was insufficient (~ 2 mW) and, second, because the 841 nm band corresponds to the transition $^4I_{13/2} \rightarrow {}^4S_{3/2}$, which is strongly L-forbidden ($\Delta L = 6$) and J-forbidden ($\Delta J = 10$), and is therefore of relatively low efficiency.

We have also observed in the $CaWO_4$ activated with Er^{3+} another scheme of stepwise transitions, differing from that of Fig. 1 in that the system goes over from the ground state, with absorption of ~ 980 nm radiation, into the $^4I_{11/2}$ state, the higher excited states remaining the same in this scheme.

The effect of stepwise excitation of fluorescence was obtained by us also in single crystals of $PbMoO_4$ activated with Er^{3+}, at a concentration 0.5%. The effect was observed at the same transitions and wavelengths as in $CaWO_4:Er^{3+}$.

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NEW ACOUSTIC RESONANCE IN AN OBLIQUE MAGNETIC FIELD

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References [1,2] report the observation of resonant oscillations of the absorption coefficient of sound in tin; these oscillations are connected with the drift of the electrons along the wave vector $\underset{\sim}{k}$. The experiments were carried out with orthogonal $\underset{\sim}{k}$ and $\underset{\sim}{H}$ [$\underset{\sim}{H}(0, 0, H_z)$ is the magnetic field vector], with the drift of the carriers along $\underset{\sim}{k}$ being ensured by the open Fermi surface. Later [3,4] an analogous resonance was investigated in cadmium and in zinc, where the Fermi surfaces likewise have open directions.

In the case of closed surfaces, the resonance connected with the carrier drift can be obtained on the non-extremal orbits of the electrons in a magnetic field which is inclined to $\underset{\sim}{k}$. Theoretically such an effect was considered in [5,6]. The resonance condition consists in the fact that when $\ell \gg \lambda$ the electron displacement during the time of one revolution in the magnetic field is equal to

$$s = n\lambda \qquad (1)$$

where $n = 1, 2, 3, \ldots$, λ - wavelength of sound, and ℓ - electron mean free path.

The oscillations are produced on the limiting trajectories (Fig. 1). The contribution to the absorption of sound is made by the electrons for which $\underset{\sim}{k} \cdot \underset{\sim}{v} = 0$ ($\underset{\sim}{v}$ is the electron velocity vector), and consequently the only orbits that can participate in the resonance are those having common points with the line $\underset{\sim}{k} \cdot \underset{\sim}{v} = 0$ on the Fermi surface. The state density of carriers