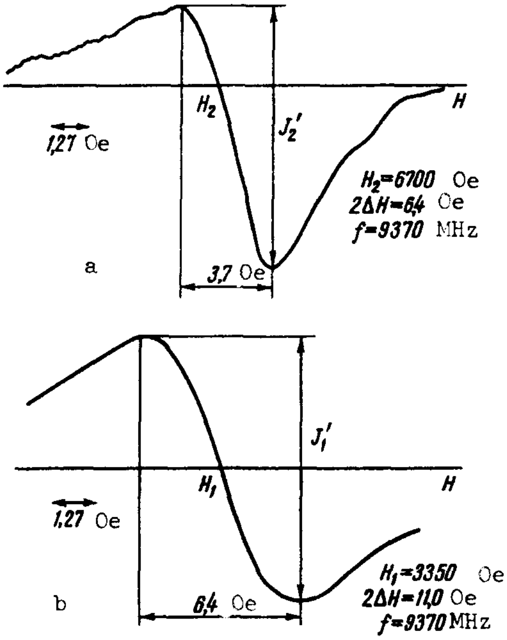
absorption line shape should coincide with the linear FMR line shape.



a - derivative of NFMR absorption line, b - derivative of linear FMR absorption line. Intensity ratio $I'_1/I'_2 = 10^6$.

The experimental observation of the NFMR was made with a standard radio spectroscope (RE 1301) at 9370 MHz. The use of a reflex resonator with Q = 500 and with a radiated power on the order of 15 W has made it possible to register, at the sensitivity limit of the spectrometer, the NFMR absorption line in a single-crystal sphere made of yttrium iron garnet. The sphere diameter was 3.3 mm. The derivative of the absorption line was recorded on the chart of the automatic plotter (Fig. 1a). The NFMR plotting was followed, under the same conditions (orientation and location of the ferrite sphere in the cavity), by a plotting of the derivative of the absorption line for the linear FMR (Fig. 1b). In this case, the high-frequency energy source was the klystron oscillator of the spectrometer, to prevent heating of the sample.

The NFMR and linear FMR absorption line widths are 6.4 and 11.0 Oe, respectively. The large experimentally obtained NFMR line width is due to distortion of the hf field in the cavity as a result of the strong microwave absorption in the ferrite.

We see therefore that NFMR can be used to study the FMR line shape of large-size samples. In addition, this phenomenon is of considerable interest from the point of view of the study of nonlinear interactions occurring in solids.

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LASER WITH FREQUENCY SCANNING DURING THE GENERATION PROCESS

V. I. Kravchenko, M. S. Soskin, and V. V. Tarabrov
Physics Institute, Ukrainian Academy of Sciences,
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We have observed the effect of frequency variation and the emission kinetics of a laser with a dispersive resonator, in which the maximum Q was displaced along the frequency scale during the course of the generation, within the limits of the luminescence spectrum of the active medium. For resonators with dispersive prisms [1,2], a controlled frequency variation (scanning) can be accomplished by rotation or angular vibration of the end reflector (Fig. 1), and for resonators with selector-interferometers operating in the transmission mode [3] it can be accomplished by rotating the selector. In the latter case repeated scanning with variable emission.

Thus, generation with variable emission frequency possesses a number of new useful properties. In fact, tuning of the dispersive resonator during the course of the laser operation leads to an ordering of the temporal and mode character of the generation. The possibility of controlling the kinetics and the spectrum of the generation makes it possible to investigate the spectral structures of the homogeneously and inhomogeneously broadened luminescence bands of condensed media activated with rare-earth ions. We note that for media having spectral inhomogeneities frequency scanning during the generation should increase the energy efficiency as a result of the sequential operation of active centers that do not participate in the generation in the usual "single-frequency" mode.

It is of fundamental interest to investigate the formation of the generation field in the resonator and the genesis of the mode composition of the radiation at those scanning speeds at which the time of resonator tuning, in a frequency interval corresponding to the distance between neighboring lines in the generation spectrum, becomes comparable with or smaller than the growth time of the stimulated-emission avalanche.

Lasers with frequency scanning during the course of generation can be used to investigate the dispersion relations between different effects of interaction between radiation and matter during one generation flash.

[1] V. L. Broude, N. F. Prokopyuk, M. S. Soskin, Byulleten' izobretenii i tovarnykh znakov (Bulletin of Inventions and Trade Marks), 15, 1964.

[2] V. L. Broude and M. S. Soskin, Kvantovaya elektronika (Quantum Electronics), Kiev, 1966, p. 123.

[3] E. Snitser, Appl. Optics 5, 121 (1966).

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* A decrease in the speed to 1 - 5 rps and a corresponding increase in pumping [4] should ensure a generation duration on the order of 500 μsec at a scanning range 500 cm^{-1}.

NATURE OF CONCENTRATION QUENCHING OF THE LUMINESCENCE OF Nd^{+++} IONS IN CRYSTALS

Yu. K. Voron'ko and V. V. Osiko
P. N. Lebedev Physics Institute, USSR Academy of Sciences
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We present in this communication prelminary results of an investigation of the nature of concentration quenching in crystals of fluorite (CaF_2) with Nd^{+++} added. It was shown earlier [1-3] that, besides isolated centers containing a single Nd^{+++} ion (L centers), there are produced in these crystals paired centers of two types (M and N), the concentration of which increases rapidly with increasing total Nd^{+++} concentration in the fluorite. It was shown that quenching in these crystals begins already at Nd^{+++} concentrations ∿ 0.5 wt. %.

In the present investigation we measured the relative quentum yield η and the radiative lifetimes τ_{rad} separately for single (L) and paired (M and N) Nd^{+++} centers as functions of speed is made possible by operating in different interference orders of the Fabry-Perot cavity.

The experiments were performed on a neodymium-glass laser (Fig. 1) using samples of KGSS-7 glass of 8 mm diameter and 80 and 120 mm long. The resonator was made up of a flat dielectric mirror 2 (R ∿ 99%) and a total-internal reflection prism 3 rotating at speeds from 20 to 300 rps. The direction of rotation corresponded to the increase of the frequency during the process of generation. The resonator dispersion was produced by two glass prisms 4 and amounted to 4 seconds of angle per cm^{-1}. The kinetics and generation spectra were investigated in the 9434 cm^{-1} band at different pump energies and scanning rates. Depending on the level of the initial overpopulation, which was determined by the delay of the start of generation relative to the ignition of the flash lamp, we observed either continuous generation (Fig. 2a) or regular oscillations (Fig. 2b). In the latter case, generation on the order of 40 μsec was obtained at a speed of 20 rps with the pump energy exceeding threshold by a factor of two and in a scanning range up to 300 cm^{-1}.

Fig.1. Laser with frequency scanning during generation: 1 - active medium, 2,3 - resonator reflectors, 4 - dispersive prism.

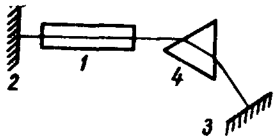

Figure 2c shows an oscillogram of the radiation from a laser operating in the mixed mode, when the intensity pulsations are observed against the background of a dc component. The corresponding spectrum is shown in Fig. 2d. The time scan shows that each band in the spectrum corresponds as a rule to a definite intensity burst. The interval between bands amounts on the average to 15 - 30 cm^{-1}, apparently determined by the homogeneous broadening of the Nd^{+++} ion in the glass. The band structure of the spectrum is due to the dips in the inverse population, within the limits of this value, caused by the stimulated

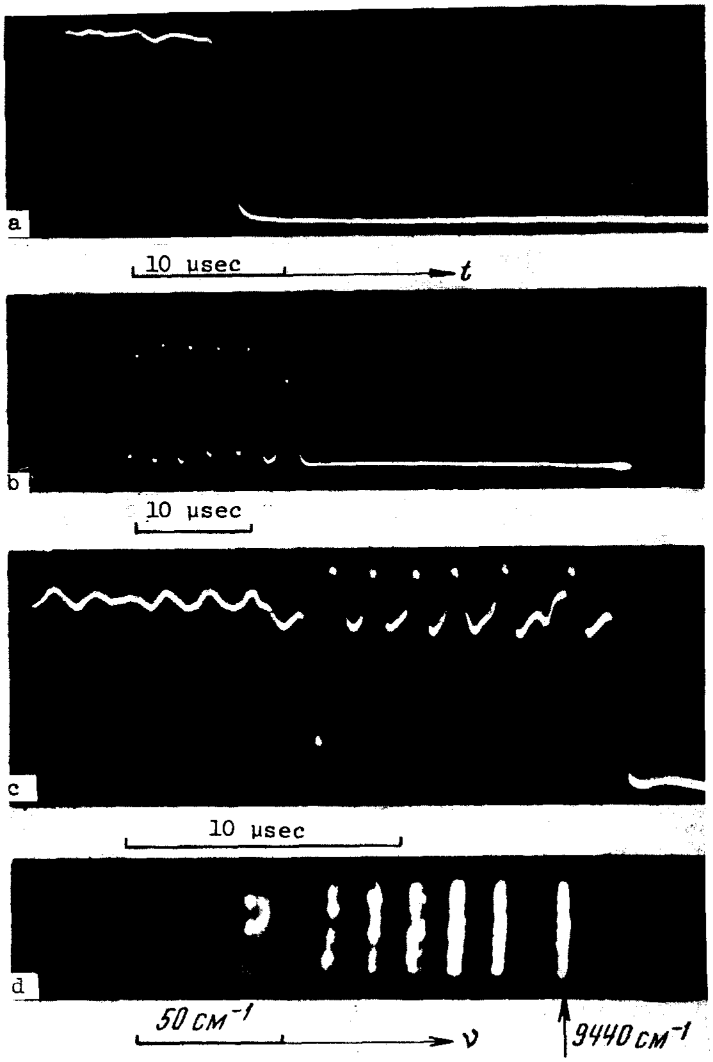

Fig.2. Oscillograms and spectrum of frequency-scanning Nd laser: a - quasi-cw mode; b - regular pulsation mode (added attenuator in front of receiver); c,d - emission oscillogram and corresponding spectrum. Prism 3 rotated at 20 rps.