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# SPECTRAL COMPOSITION OF GENERATION OF NEODYMIUM GLASS IN A DISPERSION RESONATOR

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Generation of the ruby $R_2$ line was previously attained in a dispersion resonator [1] by suppressing the usually observed $R_1$-line generation. As is well known [2], both lines in the luminescence spectrum of ruby are homogeneously broadened, and thermodynamic equilibrium is established between the $\bar{E}$ and $2\bar{A}$ levels, the transitions from which cause these lines.

We present here preliminary results on the spectral composition of the radiation and on the threshold parameters of a neodymium-glass laser, with an inhomogeneously broadened luminescence band in the 1.06 μ region.

A glass prism with angular dispersion ~1 sec/Å was used in the dispersion resonator. The reflection coefficients of the dielectric mirrors were constant within the limits of the luminescence band. Polished cylindrical glass rods with ~2% $Nd^{3+}$ ion concentration were used. The spectrum was registered by photographing the image from the screen of an electron-optical converter installed in the cassette part of an STE-1 spectrograph (dispersion 18 Å/mm).

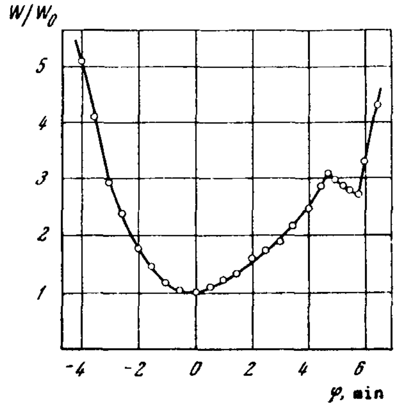

Fig. 1. Relative threshold pump energy $W/W_0$ vs. angle of inclination of mirror φ in a dispersion resonator.

At the generation threshold in an ordinary plane resonator, there appear near 9440 $cm^{-1}$ under our conditions emission lines whose number increases with increasing above-threshold pumping. At the maximum attainable pump energy, amounting to 6 times threshold, emission lines spaced more or less uniformly 3 - 5 $cm^{-1}$ apart were observed in the spectral interval from 9390 to 9470 $cm^{-1}$. Misalignment of the resonator had practically no effect on the position of the generation region in the spectrum. In the case of a dispersion resonator, with the mirrors inclined, a shift took place in the operating generation frequency. A plot of the threshold pump energy against the inclination of the end mirror is shown in Fig. 1. We note that the curve has a smaller slope at positive angles and a monotonic section in the 5 - 6' region (positive angles correspond to a shift towards lower frequencies).

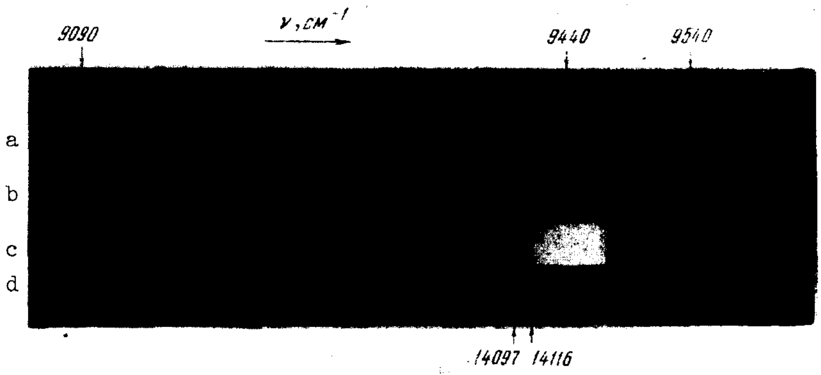

Fig. 2. Emission spectra of neodymium-glass laser:
a - dispersion resonator ($\varphi$ = -2'), b - dispersion resonator ($\varphi$ = +6'), c - ordinary resonator ($W/W_{thr}$ = 6), d - comparison spectrum (14116 and 14097 $cm^{-1}$ Hg lines). (a, b, c - second-order spectra in the STE-1 spectrograph; d - third-order spectrum).

Spectrograms (Fig. 2) were obtained for the emission of neodymium glass at different points of the threshold curve of Fig. 1. We consider the main result of the experiment to be the observation of emission lines at different inclinations of the end mirror in the range from 9090 to 9540 $cm^{-1}$, which is approximately five times larger than the entire region of generation in an ordinary resonator at maximum attainable pump energy.

It seems to us that the cause of so strong a shift of the generation spectrum in a dispersion resonator is the following. The individual $Nd^{3+}$ ion in the glass has near 1.06 μ several luminescence lines, occupying an interval of approximately 400 $cm^{-1}$ [3]. When thermodynamic equilibrium is established between the levels, the transitions from (or to) which cause these luminescence lines, generation is possible only at that line for which the threshold is minimal (in analogy with the circumstances under which generation takes place at the $R_1$ and $R_2$ lines in ruby). By introducing selective losses, the system with the dispersion resonator makes generation possible even at those luminescence lines which are not excited in an ordinary plane resonator.

The foregoing assumption agrees with the observed minimum of generation threshold for the 9170 $cm^{-1}$ frequency region, which coincides with the additional maximum in the luminescence band in glass due to the 9160 $cm^{-1}$ transition [3]. The foregoing explanation, however, cannot be checked conclusively until the nature of the broad luminescence band of the neodymium glasses is established, and its connection with the line spectrum of the $Nd^{3+}$ ion in crystal matrices is determined. It must also be recognized that generation at the non-overlapping luminescence bands of different centers contains many singularities which complicate the phenomenon [4].

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# DETERMINATION OF THE MIXING PARAMETER OF M1 AND E2 RADIATION FOR THE 0.341-MeV TRANSITION IN $Ti^{49}$

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As shown in [1,2], measurements of the angular correlation of two cascade $\gamma$ quanta, the first of which is mixed, can be used to check on the invariance of nuclear forces against the time-reversal operation.

Krupchitskii [3] proposed and calculated in detail an experiment which reduces the error in the determination of the part of the Hamiltonian which is odd with respect to the time-reversal operation. He proposes the use of the cascade transition $1/2^-(M1 + E2)3/2^-(E2)7/2^-$ in the $Ti^{49}$ nucleus. This cascade begins at the 1.719-MeV level, which is de-excited by a cascade transition through the 1.378-MeV level with emission of 0.341 and 1.378 $\gamma$ rays (Fig. 1). The second transition in this cascade is pure E2, while the first can be M1 or a mixture of

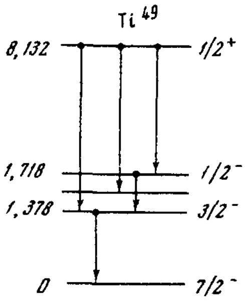

Fig. 1. Fragment of the level scheme of $Ti^{49}$.

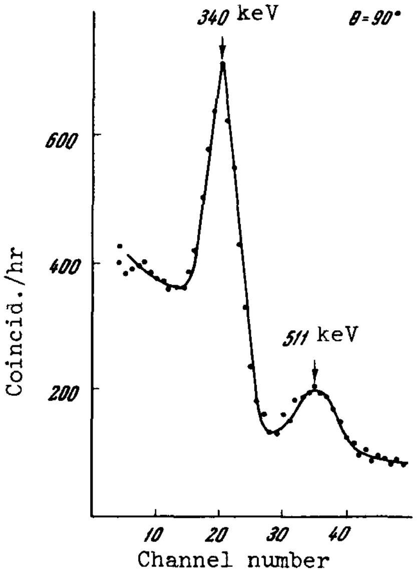

Fig. 2. Spectrum of coincidences with 1.378-MeV $\gamma$ rays.

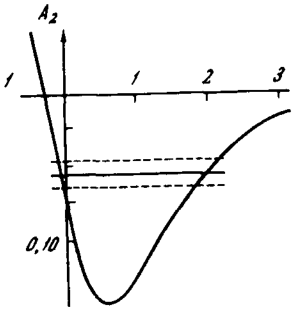

Fig. 3. Coefficient $A_2$ as a function of the multipole mixing parameter δ.