6. Electrons that move with velocities exceeding v_f and have an energy > 1 keV are generated in the fast mode simultaneously with the plasma.

The processes observed when the source operates in the fast mode are characteristic, judging from a number of the aforementioned features, of excitation of two-stream instability in a plasma. In particular, the strong electric fields observed in the experiments (item 5) can exist in the plasma as a result of this instability. Indeed, with decreasing C_0 the density of the generated plasma decreases and the collision frequency ν is accordingly reduced. For a given U_0 the ratio E_p/ν can be sufficient to excite and maintain two-stream instability during the entire plasma generation time. The value of E_p maintained in the plasma is relatively large, and this leads in the final analysis to acceleration of the plasma.

In the case of large C_0, with increasing current in the source the ratio E_p/ν decreases rapidly (compared with the plasma generation time) to a value below critical, and therefore the instabilities that set in during the start of the discharge are rapidly suppressed. The source will then operate in the slow mode.

In conclusion we note that the observed effect is in all probability not a property peculiar to the source employed. To obtain the fast mode it is important apparently to ensure, by some means, a sufficiently large value of E_p/ν in the plasma. In other sources this condition can be satisfied by reducing the quantity of gas admitted in to the source, by reducing the delay between the admission of the gas and the application of the voltage, etc.

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FEATURES OF THE TIME BEHAVIOR OF THE GENERATION IN A LASER WITH MOVING RUBY CRYSTAL

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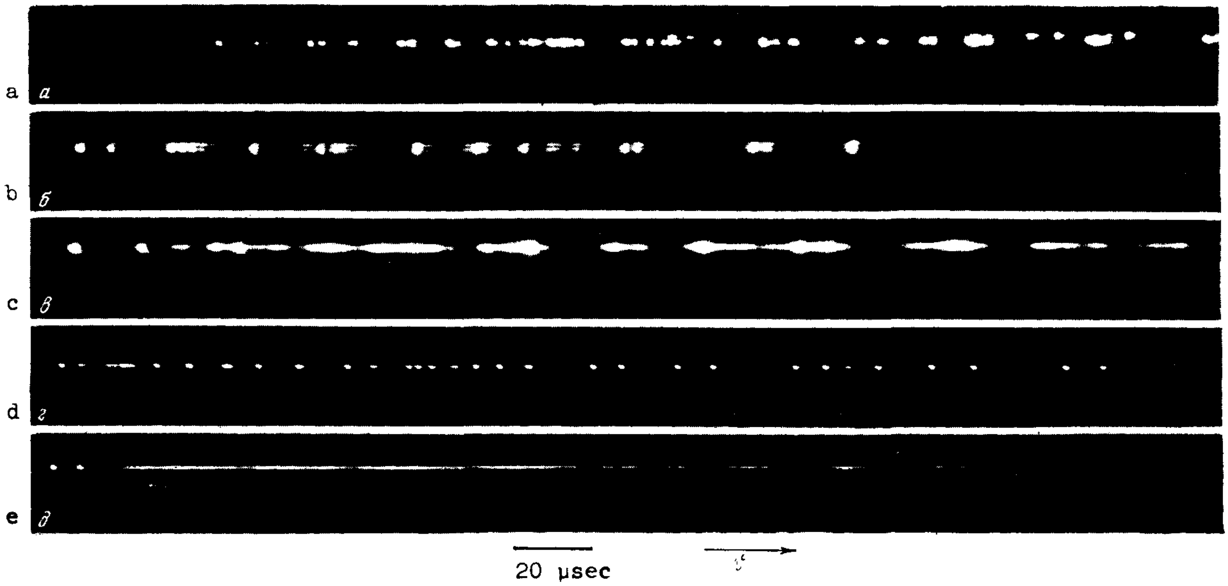
We have shown recently [1] that a laser with a ruby crystal moving along the axis of a planar resonator with speed $v \sim 30$ cm/sec radiates energy in a narrower spectral interval than a laser with stationary crystal, and that this increases the spectral density of the stimulated emission. This narrowing of the stimulated-emission spectrum is due to the decrease in the number of generating axial modes and is an experimental confirmation of the correctness of the theoretical premises of the model of Tang, Statz, and de Mars [2], which explains the nature of the mode makeup of solid-state lasers with homogeneously broadened luminescence line, corresponding to the working transition in the laser system.

On the other hand, the reduction in the number of competing axial modes that go into generation when the crystal moves has raised the hope of realizing continuous generation in a laser with moving crystal.

To investigate the influence of crystal motion on the time behavior of the laser generation mode, we used high-speed photography partially supplemented with oscillograms pertaining to the start of generation. All measurements were made at room temperature.



Time sweep of laser emission obtained with high-speed camera: a - stationary crystal, b - moving crystal (v ~ 40 cm/sec), c - moving crystal (v ~ 80 cm/sec), d - stationary crystal (with diaphragm of 1 mm dia), e - moving crystal (with diaphragm 1 mm dia, v ~ 80 cm/sec).

It was observed first that in a wide range of above-threshold pumping, even at speeds v ~ 40 cm/sec, a sharp increase takes place in the frequency of the lasing spikes, until they merge into continuous regions which are short compared with the generation duration (Figs. a, b). Further increase in the speed, at ~1.1 of threshold pump, resulted in a gradual expansion of the continuous regions. At speeds v ~ 80 cm/sec the generation becomes continuous in a number of cases practically from start to end (Fig. c), but the intensity oscillations still disclose traces of the spike regime.

The transformation of spike generation into continuous generation is greatly improved by introducing into the resonator a round diaphragm of 1 mm diameter, which increases the diffraction losses and prevents by the same token the generation by modes with high transverse indices (Figs. d, e). The level of the continuous generation then becomes approximately stationary. It should also be noted that the generation time exhibits a tendency to increase when the continuous regime sets in. In this communication we do not stop to discuss secondary features of the observed phenomenon.

Detailed investigations of the conditions necessary to ensure continuous generation in a laser with moving crystal should make it possible in the future, on the one hand, to formulate the principles of continuous operation of a solid-state laser with a moving crystal, and, on the other, explain the spike character of the generation of most contemporary solid-state lasers.

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LATTICE STABILITY IN THE PHONONLESS MECHANISM OF SUPERCONDUCTIVITY

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Following the paper by Little [1], several recent papers have considered the phononless superconductivity mechansims, particularly in three-dimensional systems [2,3].

The interaction that leads to superconductivity has in these papers, in final analysis, the standard form [4]

$$H_{\text{int}} = \frac{f}{2(2\pi)^3} \sum_{\vec{p}_1+\vec{p}_2=\vec{p}_3+\vec{p}_4} a^+_{\vec{p}_1\sigma_1} a^+_{\vec{p}_2\sigma_2} a_{\vec{p}_3\sigma_2} a_{\vec{p}_4\sigma_1} , \qquad (1)$$

where the effective interaction constant f is negative and the summation is confined to the region

$$(\epsilon(p_i) - \epsilon_F) < \Delta E.$$

ΔE depends on the concrete mechanism of the investigation and in the models under investigation [3] its order of magnitude is that of the width of the band of d-electrons in a transition metal or the excitation energy of the impurity atoms.

The superconducting transition temperature is given by the usual formula

$$T_c = 1.14 \, \Delta E \, e^{-1/\lambda}, \qquad (2)$$

where $\lambda = |f|mP_0/2\pi^2$ is the dimensionless constant of interaction (1) and P_0 is the Fermi momentum.

According to Geilikman's estimates $\Delta E \sim 0.1 - 1$ eV and $\lambda \sim 1$. In this case T_0 turns out to be of the order of $10^3 - 10^4$ °K, and this is the reason for the interest in these models.

In the usual superconductivity mechanism with a Froehlich electron-phonon interaction constant g (the corresponding dimensionless constant is $\zeta = g^2mP_0/2\pi^2$) there exists the natural limitation