on the periphery and increased towards the center of the "focus," where it reached 4 - 6 eV. The plasma density, estimated from the Stark effect, was ~(0.5 - 1.0) x 10^{18} cm^{-3} in the maximum contraction zone, giving a compression ratio ~100.

Using the measurements of T_e it is possible to estimate the polytropic exponent γ and then compare the experimentally obtained degrees of compression with those calculated from formula (1). The agreement is acceptable. Thus, our investigation has qualitatively confirmed the existence of a compression effect under the influence of an azimuthal field.

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[1] K. V. Brushlinskii, N. I. Gerlakh, and A. I. Morozov, Mekhanika zhidkostei i gaza (Mechanics of Liquids and Gases), No. 1, 1966.
[2] A. I. Morozov and L. S. Solov'ev, Zh. Tekh. Fiz. 34, No. 5 (1964) [Sov. Phys.-Tech. Phys. 9, No. 5 (1964)].
[3] A. I. Morozov, ibid. 37, No. 12 (1967) [12, No. 12 (1968)].
[4] K. V. Brushlinskii, N. I. Gerlakh, and A. I. Morozov, Paper at All-union Conference on Low-temperature Plasma Physics, Kiev, November 1966.
[5] K. V. Brushlinskii, N. I. Gerlakh, and A. I. Morozov, Dokl. Akad. Nauk SSSR (1968), in press [Sov. Phys.-Dokl. (1968), in press].
[6] P. E. Kovrov, A. I. Morozov, L. G. Tokarev, and G. Ya. Shchepkin, ibid. 172, 1305 (1967) [12, 155 (1967)]
[7] A. Ya. Kislov, P. E. Kovrov, A. I. Morozov, G. N. Tilinin, L. G. Tokarev, G. Ya. Shchepkin, A. K. Vinogradova, and Yu. P. Dontsov, Paper at Eighth International Conference on Ionization Phenomena in Gases, Vienna, August 1967.

* The content of the present note was reported at the Conference on Thermonuclear Fusion in Stockholm (August 1967).

** Electronic computer calculations of two-dimensional nonstationary axially-symmetrical flow of a plasma of finite conductivity, performed in 1966-1967, confirmed the conclusions of [3] (see [4,5]).

LASER WITH COMBINED ACTIVE MEDIUM

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Investigations of energy migration in active media with a variety of optical centers led to the development of a laser with combined active medium (CAM). We consider here briefly their parameters, using as an example a laser with a simple crystal $Y_3Al_5O_{12}:Nd^{3+}$ in conjunction with $CaF_2:YF_3:Nd^{3+}$ and LGS-6 glass. The laser with the CAM is characterized by low excitation thresholds E_{thr}, narrow emission lines (these characteristics are inherited from the simple crystals), and sufficiently high efficiency, obtained from the medium with the large number of optical centers. They also have controllable selective gain in a wide range of frequencies. Figure 1 shows the diagram of a laser with CAM, and Fig. 2 shows the energy levels of $Y_3Al_5O_{12}:Nd^{3+}$ and of LGS-6. The conditions for the onset of generation in such a laser are

$$\exp\{-2[(\alpha^1_{abs} - \alpha^1_{amp})\ell_1 + (\alpha^2_{abs} - \alpha^2_{amp})\ell_2]\}R_1/R_2 = 1$$

(α_{abs} and α_{amp} are the absorption and amplification coefficients of the media, l are the crystal lengths, and R the reflection coefficients of the mirrors). At first, stimulated emission is produced at a wavelength 10 641 Å, for in this case the effective gain α_{amp} is a maximum. With increasing excitation energy E_{exc}, the spectrum no longer reveals the characteristic stimulated emission of the glass (Fig. 3b), although its excitation threshold is low in the case of separate excitation (Fig. 3). Energy measurements show that in this laser the LGS-6 takes part in the stimulated emission. The produced stimulated-emission field at frequencies $h\nu_1$ and $h\nu_2$ (new line with λ = 10 614 Å, which is not present in the spectrum of the ordinary garnet laser) acts on the excited optical centers of the glass and stimulates their emission. We investigated lasers with CAM on the basis of more than 20 pairs and triads of substances, including the simple crystals $Y_3Al_5O_{12}$, CaF_2 and SrF_2, LaF_3 and CeF_3, $CaWO_4$ and YVO_4. The mixed systems tested were α-$NaCaYF_6$ and α-$NaCaCeF_6$, CaF_2:YF_3 and $2CaF_2$:$5YF_3$, CaF_2:CeF_3 and

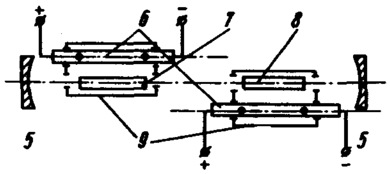


Fig. 1. Block diagram of laser with combined active medium (5 - spherical mirrors, 6 - excitation lamps, 7 - crystal of simple type, 8 - crystal of mixed type, 9 - illumination chamber).

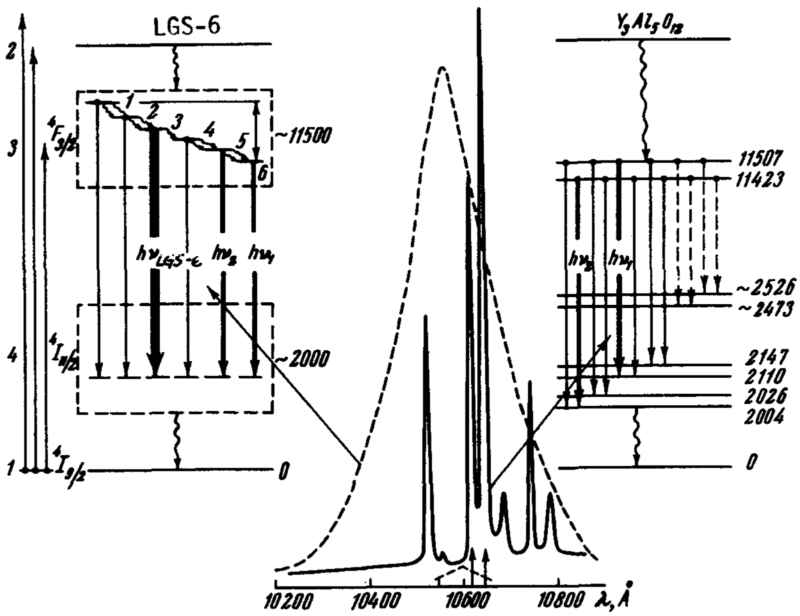
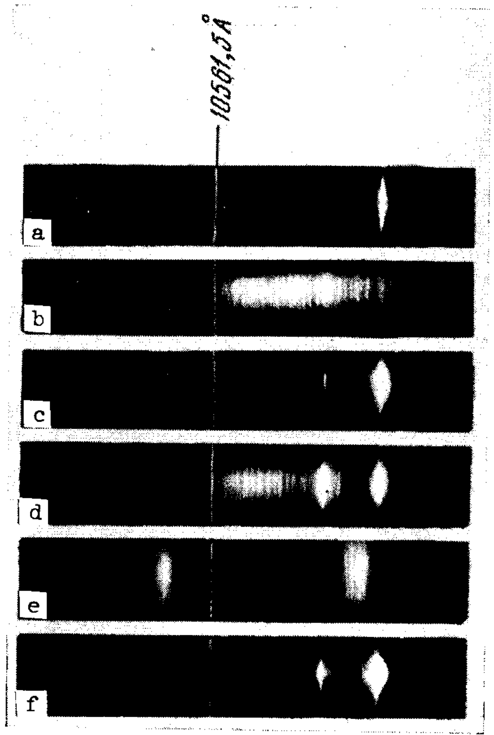


Fig. 2. Luminescence spectra of $Y_3Al_5O_{12}$:Nd^{3+} and of LGS-6 glass (dashed line) and arbitrary energy level schemes of the Nd^{3+} ion in the garnet and the glass. The level poistion is indicated in cm^{-1}. The thick arrows denote induced transitions and the wave ones nonradiative transitions.

Fig. 3. Emission spectra: a - of $Y_3Al_5O_{12}:Nd^{3+}$ crystal, E_{exc} = 150 J, E_{thr} = 10 J; b - of LGS-6 glass, E_{exc} = 300 J, E_{thr} = 30 J; c - of $Y_3Al_5O_{12}:Nd^{3+}$ + LGS-6, E_{exc} = 500 J; d - of $Y_3Al_5O_{12}:Nd^{3+}$ + LGS-6, E_{exc} = 1200 J; e - of $Ca_2:YF_3:Nd^{3+}$ crystal, E_{exc} = 100 J, E_{thr} = 23 J; f - of $Y_3Al_5O_{12}:Nd^{3+}$ + $CaF_2:YF_3:Nd^{3+}$, E_{exc} = 1000 J. All spectra were obtained from one lasing pulse. The arrow indicates the reference line.



$5NaF:9YF_3$, $BaF_2:LaF_3$ and $SrF_2:LaF_3$, $LaF_3:SrF_2$ and $LaNa(MoO_4)_2$, and also LGS and KGSS glasses activated with Nd^{3+} ions. In the laser with the CAM, the efficiency was higher than in the lasers using simple crystals, and the spectral brightness was higher and E_{thr} lower in lasers based on media of the latter type. The active media for lasers with CAM can be combinations of crystals with liquids, gases, and other substances.

METHOD OF OBTAINING A STABLE SYSTEM OF PLASMA VORTICES

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Considerable interest attaches to an investigation of methods of obtaining plasma formations that are stable in the atmosphere. There are apparently many physical processes that lead to their occurrence. In [1,2] we considered some of the possible methods, based on the electrodynamic deformation of the current lines into plasma vortices.

It was shown, in particular, that in the case of electrodynamic deformation of a current line, the shape of which is described by the equation

$$x = b^{-a^2y^2} \qquad (1)$$

there should be observed the formation of three plasma vortices. Owing to the magnetohydrodynamic interaction of the vortices and their interaction with the external medium, they should move to a stable-equilibrium position.