calculated and experimental variant. We are continuing work on allowance for the interactions (in particular, in the second perturbation-theory approximation), for a more accurate determination of the obtained constants.

In conclusion, the authors thank V. S. Zuev for useful advice during the work.

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HIGH-POWER SINGLE-MODE RUBY LASER

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The development of ruby laser generating one longitudinal and one transverse mode was already reported earlier [2], the maximum attained power being 2.7 MW. To obtain a higher power, we used a multi-element laser, consisting of several active rods with plane-parallel end surfaces. The rods are aligned in tandem in a spherical resonator, and the gaps between them are filled with nonlinear filters based on vanadium phthalocyanine dissolved in nitrobenzene. Such a generator is of interest from many points of view. For example, its threshold power is lower than for a solid rod having the same active-medium length and the same mirror reflection coefficients. Segmentation of the active rod makes it possible to install in the free gaps saturable filters that eliminate the coupling between the elements [2 - 4]. This makes it possible to eliminate certain undesirable effects, such as pre-generation and amplification of the spontaneous emission [2 - 5], which appear in long rods. The presence of a large number of reflecting surfaces and saturable filters has made it possible to obtain one axial mode with the pump up to 50% above threshold. Ruby crystals 120 mm long and with 0.05% chromium concentration, the first of 7 mm diameter and the second 8 mm, were placed in individual two-ellipsoid illuminators (briefly described in [1]) with two type IFP-2000 lamps. The radius of curvature of both mirrors was 2000 mm. Their power-reflection coefficients were 99.7 and 8% and the distance between mirrors was 1200 mm. The mirrors formed a convex cavity.

The cavity was Q-switched with the aid of a saturable nonlinear filter based on a solution of vanadium phthalocyanine in nitrobenzene, with initial transmission 30% at λ = 6943 Å. The filter was placed between the "dead-end" mirror and the end of the ruby rod. A similar filter with initial "transmission coefficient 50% was located in the free gap between the two rods. Besides its already mentioned function, this filter served also to sharpen the leading front of the amplified pulse [6]. The bank of K-41-I7 capacitors had a total rating of 1000

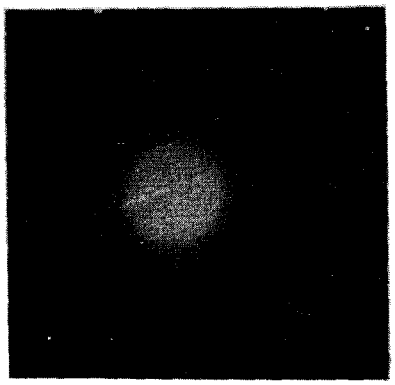

Fig. 1. Spectrogram of two-element ruby-laser emission

Fig. 2. Distribution of the field intensity in the far zone

μF. The maximum charging voltage of the bank was 4.5 kV. The bank was discharged through 75 μH inductance into four series-connected IFP-2000 lamps. The total generation threshold of both crystals was 3000 J (in terms of electric energy). With a pump-over-threshold ratio up to 50%, only frequencies separated by an interval $c/2\ell$ were observed. This is the interval between the modes of a cavity whose length equals that from the mirror to the reflecting (4%) surface of the decoupling filter. At sufficiently high pump energy, other non-equidistant frequencies are also excited. In our case $\Delta\nu$ amounted to 0.01 cm. The laser emission spectrum was investigated with the aid of Fabry-Perot interferometers with dispersion region 0.005 cm^{-1}. The spectrogram shown in Fig. 1 was recorded on photographic film with the aid of a "Tair-3" lens. When radiation of one longitudinal and one transverse mode is generated, a smooth monouplse with duration 10 nsec is observed on the oscilloscope screen. The form of the output pulse was registered on the S-1-14 oscilloscope with the aid of a coaxial photocell with resolution 0.3 nsec. The field distribution in the far zone is shown in Fig. 2. Figure 3 shows the laser emission directivity pattern, the width of which was 5.8×10^{-4} rad, which is of the same order as the diffraction divergence. The spatial coherence was investigated

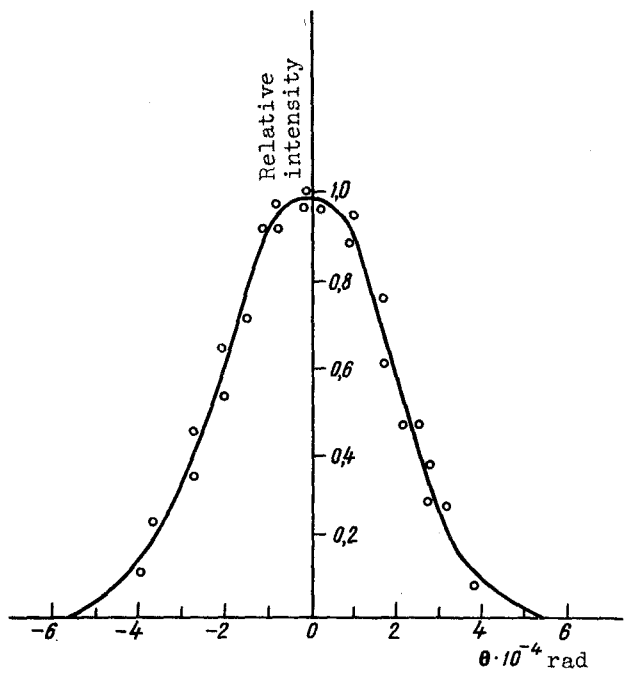

Fig. 3. Radiation directivity pattern

by a method described in [1]. The energy was measured by a calorimetric method and its largest value was 0.4 J at a pulse duration 10 nsec, corresponding to a peak power of 40 MW.

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DETERMINATION OF THE IONIC COMPOSITION OF AN ARC-DISCHARGE PLASMA IN CESIUM VAPOR

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One of the most important problems connected with the physical properties of the presently employed non-equilibrium ($T_e > T_a$) discharge plasma in cesium vapor is the nature of the ionization processes occurring in it [1]. In particularly, a highly debatable question now under discussion is the possible existence in such a plasma of molecular-associative ionization in accordance with any one of the schemes:

$$1)\ 2Cs^*_{6P} \rightarrow Cs^*_2 \rightarrow Cs^+_2 + e,$$
$$2)\ Cs^{**} + Cs \rightarrow Cs^*_2 \rightarrow Cs^+_2 + e$$

or

$$3)\ Cs^+ + 2Cs \rightarrow Cs^+_2 + Cs.$$

Here Cs^*_{6p} and Cs** are cesium atoms excited to the resonance level 6p with energy 1.4 eV and to higher levels with energy $\geq$ 3.2 eV. It is therefore necessary to determine by a direct experiment the role of this process which, unlike all other possible ones, leads to the formation of molecular cesium ions in the plasma. Incidentally, we note at the same time (i) the possibility, indicated in [2], of producing a current-free and obviously molecular-cesium plasma by irradiating its vapor with the resonance radiation of cesium, and (ii) the known possible presence of a noticeable amount of molecular ions in a plasma in inert gases.

To answer this important question, we used a direct method of mass-spectrometric analysis of the ion composition in an arc-discharge plasma in cesium vapor at different pressures p. To this end we constructed an integrally-sealed glass instrument consisting of two sections: 1) an arc-discharge tube provided with a probe for the determination of the density n_e and the temperature T_e of the electrons of the investigated plasma, and 2) a time-of-flight mass analyzer with an electron multiplier on the inside and an S1-17 oscilloscope at the output. Both sections were separated by a solid partition with a very narrow aperture, $\approx$ 0.1 mm, through which the ions were drawn from the plasma into the analyzer drift space. The ratio of the concentrations n_2 and n_1 of the molecular and atomic cesium ions in the plasma ($n_1 + n_2 = n_e$) should be characterized approximately by the ratio of the signal amplitudes at the output, $I_2/I_1 \approx n_2/n_1$, and their drift times should amount in our case to