present time these possibilities are subject only to technological rather than physical limitations.

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INCREASE OF RADIATION BRIGHTNESS IN A BRILLOUIN LASER

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One of the most important characteristics of radiation is its brightness B (W/cm^2sr). It can be increased by stimulated scattering in a resonator [1]. Stimulated Mandel'shtam-Brillouin scattering in a resonator (the Brillouin laser) was investigated by a number of authors, but there are still no reports of the increase of the brightness of such a system. We report here for the first time the increase of the brightness in a Brillouin laser[1)].

We investigated the generation of a carbon-disulfide[2)] Brillouin laser with transverse pumping (Fig. 1). The resonator was made up of two dielectric mirrors M_1 and M_2, spaced $\ell = 1.7$ m apart and having reflection coefficients $r_1 = 98\%$ and $r_2 = 80\%$. A rectangular diaphragm measuring 0.9×0.9 cm was placed in the resonator. The CS_2 filled a glass cell 24 cm long, 1 cm wide, and 2 cm high. The windows through which the generated radiation passed were placed at an angle 94° to the side walls and were made nonreflecting. A system of 17 glass total-internal-reflection prisms ensured multiple passage of the pump light perpendicular to the resonator axis. A thin layer of glycerine was located between the prisms and the cell. The exciting-radiation losses were determined mainly by the absorption in the glass and did not exceed 50%. The pumping was by means of a ruby laser, whose pulse entering the cell had a duration $T = 0.8$ μsec, an energy $E = 0.3$ J, a cross section $S = 0.9$ cm^2, a divergence $\phi = 4.5 \times 10^{-3}$ rad, and a spectral width $\Delta\nu = 40$ MHz.

The use of a pulse in the microsecond range was dictated by the fact that to increase the brightness it is necessary to develop a near-diffraction directivity pattern during the operating time of the Brillouin laser. To this end, the generated radiation must cover a path L determined from the condition $d/L \sim \lambda/d$, where d and λ are respectively the beam diameter and the generation wavelength. The time needed to traverse this path is $\tau \equiv L/c \sim d^2/c\lambda$. Substituting the numerical values, we obtain $\tau \sim 0.5$ μsec for d = 1 cm.

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1)For more details see [3].

2)In CS_2 the gain is $g \simeq 0.17$ cm/MW and the gain line width is $\delta\nu \simeq 40$ MHz. These values can be easily obtained for the case of transverse pumping from the results of [4].

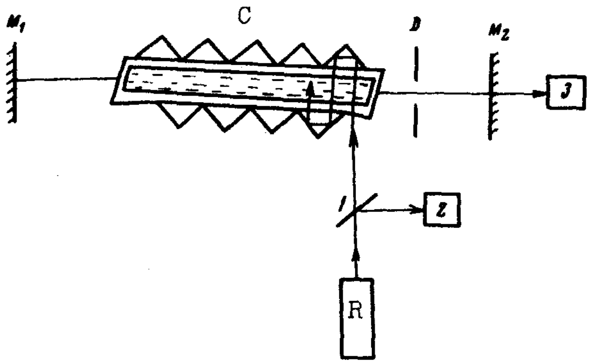

Fig. 1. Experimental setup: R - ruby laser, M_1, M_2 - resonator mirrors, D - diaphragm, C - cell with CS_2 (only some of the prisms are shown), 1 - semitransparent plate, 2 and 3 - systems for measuring the parameters of the pump and generation radiation.

We observed in the described setup generation of light with a divergence $\phi_g = 3 \times 10^{-4}$ rad at a beam cross section $S_g = 0.9 \times 0.5$ cm. The energy of the generated radiation was $E_g = 8 \times 10^{-3}$ J, and consequently the energy efficiency was 2%. Figures 2a and 2b show for comparison photographs of the distribution, in the far zone, of the pump and generation radiation, obtained by means of the procedure of [5]. Figure 2c shows a spectrogram of the radiation. The frequency difference between neighboring lines corresponds to 180° scattering in carbon disulfide. No stimulated Raman scattering generation was observed.

The ratio of the brightnesses of the transformed and excited radiation can be estimated from the formula

$$\frac{B_g}{B} = \frac{E_g}{E}\,\frac{S}{S_g}\,\frac{\phi^2}{\phi_g^2}\,\frac{T}{T_g}.$$

Substituting the numerical values and putting $T_g < T$, we find that $B_g/B > 0$.

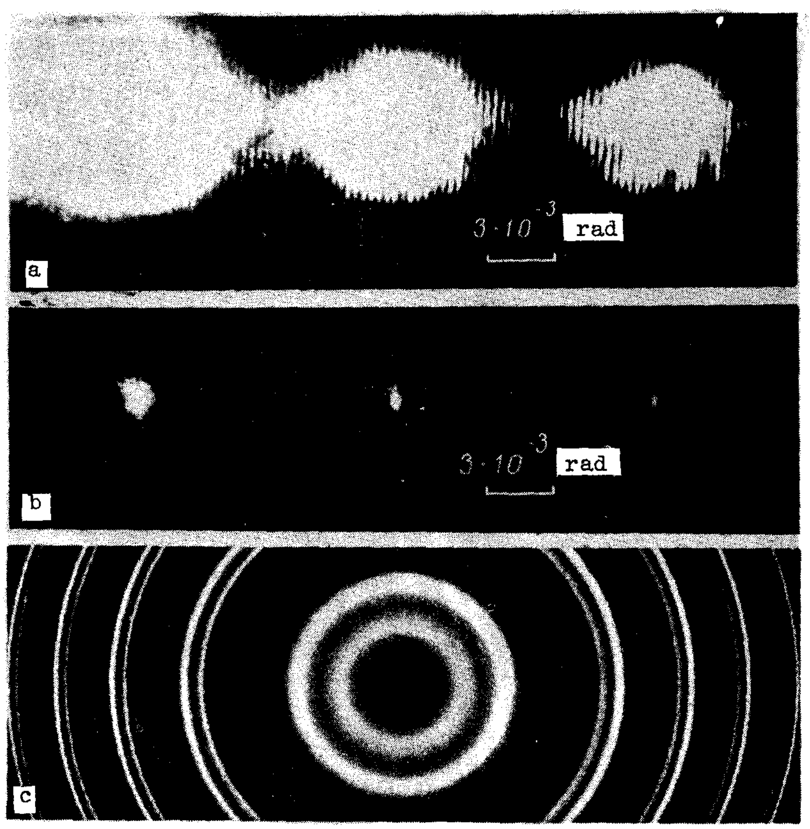

Fig. 2. a) Distribution of the pum pradiation in far zone. b) The same for the generation radiation. c) Sepctrogram of the generation radiation. The distance between the Fabry-Perot etalon mirrors is 0.5 cm.

We note that generation took place near threshold, and therefore one can hope for a still greater increase of the brightness if a more powerful pump source is used.

Thus, the results indicate that the use of a Brillouin laser offers promise of increasing the radiation brightness.

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E R R A T A

In the article by A.Z. Gryasuk et al., Vol. 12, No. 6, page 194, last line, "...we find that $B_g/B > 0$" should be replaced by "...we find that $B_b/B > 9$."