

ON ULTRASONIC OSCILLATIONS OF THE RADIATION INTENSITY OF “TRAVELING-MEDIUM” LASERS

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Fig. 1

Figure 1: Fig. 1

Abstract**Full Text**

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*PHYSICS***B. L. LIVSHITS, A. T. TURSUNOV****ON ULTRASONIC OSCILLATIONS OF THE RADIATION INTENSITY OF “TRAVELING-MEDIUM” LASERS***(Presented by Academician I. V. Obreimov, June 10, 1969)*

In “traveling-medium” lasers the active centers move relative to the spatially inhomogeneous electromagnetic field of the mode. Owing to this, the influence of inhomogeneities of the active medium, fluctuating in time, on the gain and loss coefficients is eliminated. This levels out the statistical, spiked character of the generation of solid-state lasers (1) and promotes the distinct manifestation of dynamic regularities, in particular modulation effects.

Analysis of experimental data on the time dependence of the radiation intensity has made it possible to identify yet another modulation effect

Fig. 1

in solid-state “traveling-medium” lasers, associated with the elastic properties of the active medium. Namely, it was found that, along with high-frequency kinematic modulation (megahertz) (2), relatively low-frequency modulation (tens of kilohertz) often occurs.

In Fig. 1*a*, *b* are shown oscillograms of the radiation intensity recorded with an SFR-2M high-speed photorecorder. Fig. 1*a* refers to a ruby “traveling-medium” laser, and Fig. 1*b* to a “traveling-medium” laser based on neodymium glass. In the case of ruby, the ultrasonic frequency of modulation of the laser radiation intensity is, as is seen from Fig. 1*a*, 40 kHz. The frequency of intensity modulation in Fig. 1*b* is 32 kHz. The observed oscillation frequencies are close to the corresponding frequencies of longitudinal elastic oscillations of the active media. Obviously, if the observed ultrasonic oscillations of the radiation intensity of “traveling-medium” lasers are associated with longitudinal elastic oscillations of the rods, accompanied by changes in the length of the latter, then their depth must depend on the character of the fastening of the ends of the laser

Figure 2

Figure 2: Figure 2

rods inside the illuminators. The experiment carried out by us in accordance with this, in which it was imple–

careful fastening of the ends of the rod was carried out, confirmed that the ultrasonic modulation of the radiation intensity of “traveling-medium” lasers is indeed caused by longitudinal oscillations of the solid active medium of the lasers.

Figure 1b shows the corresponding recording for a ruby laser carefully fastened at both ends. It is seen that the ultrasonic modulation becomes barely noticeable.

Fig. 2

Thus, it may be considered established that the cause of the modulation of the radiation intensity of “traveling-medium” lasers at ultrasonic frequency is the elastic oscillations of the laser rods associated with changes in their length.

The question of what the sources of these oscillations are—the “shaking” of the illuminators during the discharge of pulsed lamps, or elastic pulses arising in the rods because of their motion, or both simultaneously—is subject to further investigation. Here we wish only to demonstrate what the ultrasonic oscillations of the radiation intensity of “traveling-medium” lasers look like over the entire course of the generation process. Figure 2a shows an oscillogram of the radiation of a “traveling-medium” laser on neodymium glass. Being continuous in time, it is modulated by a sequence of damped wave trains of oscillations at ultrasonic frequency, which corresponds to insufficiently good fastening of the ends of the rod. The oscillogram shows that, along with the modulation frequency given above (see Fig. 1b), 32 kHz, modulation is also observed at a lower frequency, 3.4 kHz, which apparently is coupled with flexural oscillations of the glass rod. Improving the fastening leads to smoothing of these oscillations (Fig. 2b). The oscillation frequencies in the figures shown do not depend on pumping.

The mechanism as a result of which elastic oscillations of the rods give rise to the corresponding oscillations of the laser radiation intensity is undergoing further study.

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Note: Figure translations are in progress. See original paper for figures.

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