where the primed integral extends only over the region $\vartheta \geq \vartheta_0\ (x,y)$. If we assume for simplicity that the angle ψ is so small that $\sin\psi \ll 1$, then $p \geq \sin^{-1}\psi \gg 1$, from which follows

$$u(x,y,\ell) = -\frac{2iA\psi}{k}\exp[i(\omega t - \frac{k\ell}{\sin\psi}) + \frac{\alpha\ell}{\sin\psi}]$$

$$+ \frac{2iA\psi}{k}\exp[i(\omega t - \frac{k\ell}{\cos\vartheta_0(x,y)}) + \frac{\alpha\ell}{\cos\vartheta_0(x,y)}] \tag{4}$$

$$+ A\ell\int{}' \exp[i(\omega t - k\ell p) + \alpha\ell p]d\varphi dp.$$

We see from (4) that a plane anomalously slow sound wave, with an amplitude that can be quite large, arrives at the receiving plate. This wave, described by the first term of (4), is analogous to that considered in [1]. The two other terms constitute a complicated set of waves propagating along the z axis with velocities smaller than $s \cos\vartheta_m$ (ϑ_m is the minimum of all values of ϑ_0), and are connected with radiation from the boundaries of the plate.

Let the duration of the radiated elastic signal be much shorter than $s^{-1}\ell \sin^{-1}\psi$, and let the electric field be removed after a time $s^{-1}\ell \sin\psi$. Then the signals connected with the second and third terms of (4) will be much smaller than the anomalous wave, since after removal of the electric field there is strong absorption in all directions.

Thus, observation of an anomalous elastic wave in the presence of supersonic carrier drift can occur in principle also in the case when the front of the elastic wave is perpendicular to the direction of carrier motion. The anomalous signal can be quite large, while the usual ultrasonic waves cannot be amplified at all.

The author is grateful to Yu. L. Gazaryan, M. A. Isakovich, and I. A. Chaban for an interesting discussion.

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INTERACTION OF TRAVELING WAVES IN A RING LASER

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Submitted 23 November 1965
ZhETF Pis'ma 3, No. 1, 54-58, 1 January 1966

Investigation of the traveling-wave beats produced in a ring laser on a rotating platform makes it possible to study with great accuracy the spectral, statistical, and other characteristics of laser radiation [1,2]. The frequency splitting Δ of the traveling waves occurs, however, only at high rotation speeds v, exceeding a certain critical value v_{cr} (corresponding to $\Delta_{cr} = 2kv_{cr}/\pi$, where v is the linear velocity of the resonator mirrors and k is the wave vector). When $v < v_{cr}$, owing to the coupling of the traveling wave, mutual synchronization takes place and results in a single-frequency operating mode.

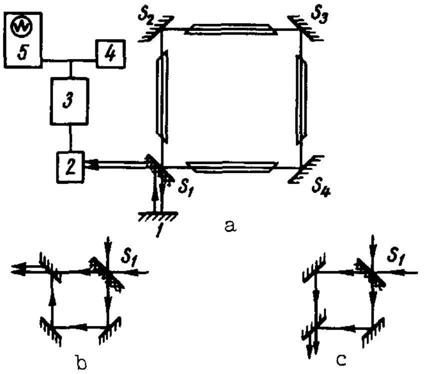

Fig. 1. a - Experimental setup: S_1, S_2, S_3, S_4 - mirrors of ring laser, 1 - plane mirror, S_1 - semitransparent mirror, 2 - photomixer, 3 - amplifier, 4 - spectrum analyzer, 5 - oscilloscope; b, c - different ways of extracting the radiation from the resonator.

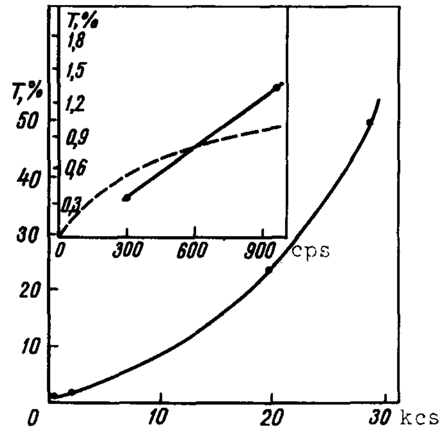

Fig. 2. Locking band vs. transmission of output mirror. The insert shows part of the experimental curve (solid line) and the theoretical curve (dashed) to an enlarged scale.

We have investigated the value of Δ_{cr} as a function of the parameters of the ring laser, and succeeded therefore in greatly reducing the locking band.

The experiment was performed with a He-Ne laser ($\lambda = 3.39\ \mu$) (Fig. 1a). The forward and backward beams $E_1(t)$ and $E_2(t)$ were extracted through the semitransparent mirror S_1 (Fig. 1a) and were aimed by mirror 1 on a photomixer. Measurements of the beat frequency Δ were made with a spectrum analyzer.

We investigated the dependence of the locking band Δ_{cr} on the transmission coefficient T of the output mirror S_1 (Fig. 1a). A decrease in the transmission leads to a radical change in the locking band (Fig. 2).

Experiments were made with the beam reflected from the outer mirror 1 (Fig. 1a) attenuated with the aid of a filter. As expected, attenuation of the signal lowers the locking band. To reduce the fraction of the energy entering the resonator upon reflection from the external mirrors, different optical schemes for feeding the forward and backward beams to the mixer were tried.

Figures 1b and 1c show variants of schemes for reducing the locking band to 300 cps (with the output mirror having a transmission T = 0.35%). We were able to obtain further reduction of the band by varying the Q of the resonator. To this end we replaced one of the "blind" mirrors of the resonator with a semitransparent one and kept the same transmission (T = 0.35%) for the output mirror. The locking band decreased from 300 to 50 cps for the same output power.

The magnitude of the locking band is determined by the following effects: reflection of energy from the different resonator elements, scattering by inhomogeneities of the medium, and nonlinear dependence of the polarization of the medium on the field.

An investigation of Maxwell's equations with account of polarization [3] leads to the following stability criterion for the single-frequency mode:

$$\Delta < \Delta_{cr} = (1/2)\ \frac{\nu}{k}\ \frac{\Gamma_1 + \Gamma_2}{L}\ D \tag{1}$$

Here L is the resonator length, Γ_i the relative power loss in transmission due to the reflection of the wave, and D a function of the resonator and medium parameters, decreasing with increasing field intensity E(z, t) and with increasing deviation of the resonator frequency ν_r from the center ν_l of the Doppler line. The latter is connected with the fact that when detuning $|\nu_r - \nu_l|$ exceeds the natural line width γ_{ab}, the radiation is produced in the traveling waves in fact by different atoms and the interaction of the fields via the medium becomes weaker. $D \cong 1$ when $\xi = |\nu_r - \nu_l|/\gamma_{ab} \gg 1$ and condition (1) coincides with the condition obtained in [4].

Figure 2 shows a plot of Δ_{cr} against the transmission coefficient of the output mirror (mirror S_1, Fig. 1a), calculated by means of formula (1). Allowance for the diffractive reflection from the mirrors and the Brewster windows changes the calculated curve by not more than 1 - 2 cps.

The theoretical and experimental curves coincide well when $0.6\% < T < 0.9\%$ and differ at large and small values of T. The former is due to the fact that (1) has been derived under the assumption that Γ_i is small, and the latter to the fact that polarization calculated in [3] does not take into account the spatial burnup of the inverse population and the resultant phase coupling between the traveling waves. Allowance for this coupling, in accord with [5], leads to a value

$$\Delta_{cr} \cong \frac{\nu}{Q}(\eta - 1), \tag{2}$$

where Q is the quality factor of the resonator and η the ratio of the pump intensity to its threshold value. Calculation of Δ_{cr} by means of formula (2) results in too large a Δ_{cr}, in contradiction to experiment. This difficulty still remains in the model with Doppler line broadening, when the motion of the molecules partially smooths out the inhomogeneity of the inverse population.

The way out of this contradiction lies in the fact that at small detunings in a ring laser, the stable mode is that with a single traveling wave, causing practically uniform burnup of the active medium. An increase in the detuning leads to the appearance of an oppositely traveling wave. The resultant small spatial modulation of the inverse population leads to a phase coupling between the oppositely moving waves. However, for a fixed field intensity, this coupling will be much weaker than that following from [5]. This in turn leads to a value Δ_{cr} much smaller than given by (2). The qualitative dependence of Δ_{cr} on the resonator Q then agrees with the experimental one, since the amplitude of the opposing traveling wave and the spatial modulation produced by it in the inverse population decrease with decreasing Q of the resonator.

The authors thank N. G. Basov for valuable advice and interest in the work, and V. V. Gromov for help with the experiments.

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ERRATA

In article by V. I. Nikolaev et al. "Magnetic Structure of the Compound FeGe", Vol. 2, No. 8, p. 236 (Russ. p. 375), line 11 from bottom reads: $\Delta = 3.33 + 0.01$ mm/sec, should read: $\Delta = 0.33 \pm 0.01$ mm/sec.

In article by V. A. Kirkinskii and A. P. Ryaposov, Vol. 2, No. 8, p. 227 and title page (translation only), the title should read 15,000 $\mathrm{kg/cm^2}$ and not 1500 $\mathrm{kg/cm^2}$.