VISCOSITY OF LIQUID pH_2 *AND* oH_2

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THE viscosity of solutions of pH_2 has been measured by the method of capillary viscosimetry [1] in the temperature range 14.5-20.4°K at concentrations of 25%, 50% and 99.8% pH_2. The viscosity was computed from these data under the assumption that the coefficients of viscosity are an additive quantity for these solutions. The data on the coefficients of viscosity are given in the Table.

T, °K	$10^6 \cdot \eta_{pH_2}$	$10^6 \cdot \eta_{oH_2}$	T, °K	$10^6 \cdot \eta_{pH_2}$	$10^6 \cdot \eta_{oH_2}$
15.0	204	215	18.0	149	156
16.0	182	191	19.0	138	142
17.0	164	172	20.0	129	132

For T = 15°K, the viscosity coefficient of pH_2 was smaller by ~4.5% than that of oH_2. The difference in the viscosity coefficients decreases upon increase in temperature. The densities of these solutions were obtained from data on the molar volumes of pH_2 and oH_2.[2]

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ON THE STATISTICS OF LASER EMISSION

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IT has been pointed out in a number of papers (cf. for example,[1,2]) that the coherent emission from lasers is not the same as the emission in a narrow frequency band from an extremely bright, small black body. The difference is in the statistics which describe the fluctuations of the radiation field. The characteristic property of light from a thermal source, which may be considered to be Gaussian white noise [3], is the fact that the amplitude (of the envelope) of the electric component of the light field is a Rayleigh random process. Hence measurements of the amplitude probability density provide information on the differences between laser light and Gaussian noise from thermal light sources1). The measurement procedure is the following.

Two light sources $E_1(t)$ and $E_2(t)$, at distinct frequencies f_1 and f_2, are incident on a photocathode which heterodynes the two signals. The beat signal $I(t)$ at frequency $\Delta f = f_1 - f_2$, has an amplitude $B(t)$ which is proportional to the product of amplitudes $A_1(t)$ and $A_2(t)$ of the incident light signals. This beat signal is applied to an amplitude analyzer which measures the amplitude distribution function $W(B)$. For two light beams with completely correlated amplitude fluctuations ($A_1(t) = cA_2(t)$) the amplitude distribution of the beat signal $W(B)$ is related to the amplitude distribution $w(A)$ of the incident light beams by the expression

$$W(B) = (B/c)^{-1/2} w[(B/c)^{1/2}]. \tag{1}$$

When the two Gaussian light beams (for which $w(A)$ is the Rayleigh distribution) are mixed we have

$$W(B) = \psi^{-1} \exp(-B/2c\psi), \qquad \psi = \overline{A_1^2}/2 \tag{2}$$

For the case of mixing two light beams with Gaussian amplitude fluctuations $A(t) = A_0(1 + \alpha(t))$ ($\overline{\alpha} = 0$, $\overline{\alpha^2} = \sigma$) we have

$$W(B) = (2\pi B\psi\sigma^2/c)^{-1/2} \exp\left[-\left(\sqrt{\frac{B}{2c\psi}} - 1\right)^2 \Big/ 2\sigma^2\right]. \tag{3}$$

The experimental set-up is shown in Fig. 1. To obtain two light beams with different frequencies but with correlated amplitude fluctuations we used

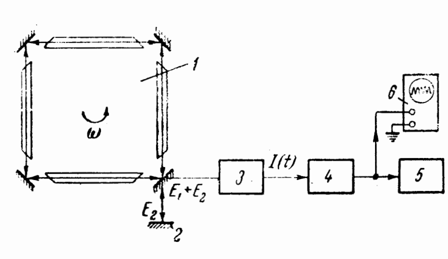

FIG. 1. Experimental set-up: 1) ring laser, 2) mirror, 3) photodetector, 4) amplifier, 5) amplitude analyzer, 6) oscilloscope.

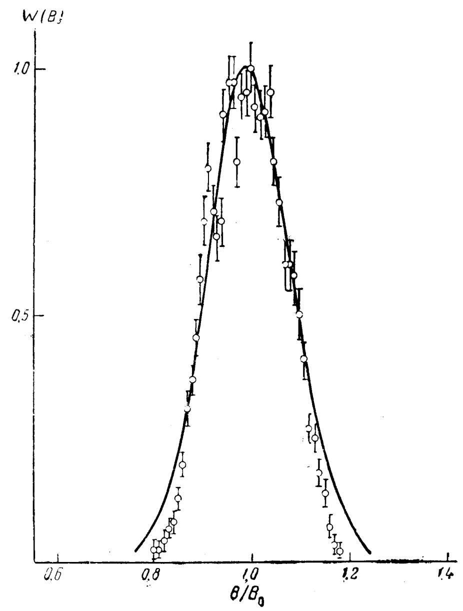

FIG. 2. Results of a measurement of the amplitude distribution for the beat signal between two laser fields. The solid line is a theoretical curve for light beams with correlated Gaussian amplitude fluctuations.

a rotating ring laser (1)[4] (containing a neon-helium mixture with partial pressures in the ratio 1 to 9, with an overall pressure of 1.6 mm Hg, operating at a wavelength of 3.39 μ, and having a side of length 0.5 m). The rotation rate was chosen so that the frequency difference between the two beams $\Delta f \cong 2kc$ was several times larger than the frequency separation at which locking occurs. The mirror (2) was rigidly attached to the massive base of the laser in order to eliminate instabilities in the direction of the reflected beam, which would lead to spurious fluctuations in the amplitude of the beat signal. The photodetector was a nitrogen-cooled InSb photoconductor. The laser was operated in the single mode regime by suitable choice of the pump power and by diaphragming the beam inside the cavity.

The results of one set of measurements are shown in Fig. 2. The abscissa is the ratio of the beat signal amplitude to the mean value B_0; the amplitude distribution is plotted as ordinate. Clearly these data cannot be approximated by the distribution (2), which corresponds to the mixing of two Gaussian light waves. However, distribution (3), corresponding to the heterodyning of two light beams with Gaussian amplitude fluctuations (with $\sigma = 4.2 \times 10^{-2}$) agrees satisfactorily with the experimental data (solid line).

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1)It is clear that measurements of the spectral density cannot give this information.

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THE CHANGE IN THE EMISSION CHARACTERISTICS OF A RUBY LASER CAUSED BY PHTHALOCYANINE SOLUTIONS IN THE LASER CAVITY

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MANY colored organic compounds change their absorption spectra under the influence of a sufficiently intense light pulse. Terenin and co-workers demonstrated this fact using the luminescent phthalocyanines; manganese, zinc, and the free-base phthalocyanine [1,2]. Recently this effect has been used for obtaining giant pulses in the output of a ruby laser [3]. An absorption cell with a solution of one of the phthalocyanines, placed inside the laser cavity, functions as a self-opening optical shutter. It was not indicated in [3] what type of phthalocyanine was used, nor were any properties of the resulting output described.

In the present work we have studied the effect of different concentrations of solutions of various phthalocyanines on the properties of the ruby laser.

The laser used had a cavity 800 mm long, employed a ruby rod 120 mm long, and 11 mm in