FORMATION OF AN ULTRASHORT LIGHT PULSE PROPAGATING IN A TWO-COMPONENT MEDIUM

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The change of shape and spectrum of a laser pulse propagating in a two-component medium consisting of the amplifying medium (ruby) and a nonlinear absorber with a short relaxation time (cryptocyanine) is investigated. The initial absorption in cryptocyanine considerably exceeded gain in ruby and the system was in a stable "blocked" state. A certain (threshold) intensity of the input signal renders absorption equal to gain and the signal propagates without attenuation. After five passes of a pulse with near threshold intensity the pulse length was found to decrease approximately 20 times (to 0.5 nsec) and the spectrum to broaden in the same ratio. The pulse narrowing was accompanied by the appearance of spikes in the envelope of the output pulse apparently due to fluctuations of the input pulse intensity. The experimental results are in agreement with the computations.

1. INTRODUCTION

LASERS with mode locking by a nonlinear absorber are widely used to generate picosecond light pulses[1]. The nonlinear absorber (organic dye solution) with a short relaxation time of the bleached state, T_1^b [1-4] plays the main role in the formation of ultrashort pulses by such a laser. The most recent measurements of the relaxation time of absorbers used for mode locking yield the value $T_1^b \approx 10^{-11}$ sec[5,6]. A low-inertia nonlinear absorber ensures the predominant development and narrowing of the most intense random spikes generated by the interference of a large number of non-locked modes. The development of the most intense spikes in multimode emission and the suppression of other less intense spikes, resulting from the passage of radiation through a two-component medium consisting of a nonlinear absorber and an amplifier in a resonator, can be considered as a process in which definite phase relations are being established among the fields of various modes. The shortening of the spike lengths can be regarded as a process in which the number of modes increases. Both processes are usually called mode locking. The model of pulse propagation in a two-component medium in a resonator allows us to perform a theoretical analysis of the formation of ultrashort optical pulses in all the stages of generation[4].

However, from the experimental point of view, the ultrashort pulse processes in a laser with a nonlinear absorber are not well known and have a number of obscure features. In particular, the causes of the observed instability of picosecond pulse generation are unclear, the nature of pulse evolution in a pulse train is not known, etc. The measurement of pulse parameters in the far forward edge of the pulse train, where according to[4] the ultrashort pulse is formed, are quite complex, requiring a highly sensitive apparatus with an extremely high time resolution. Therefore it was decided to study the shortening process of a nanosecond output pulse propagating in a two-component medium, i.e., in a traveling-wave mode[7]. Such an approach sharply decreases the equipment sensitivity and resolving power requirements.

Cryptocyanine was used as an absorber with a short relaxation time capable of producing ruby laser pulses of the order of 10^{-11} sec[8]. The power of the output pulse was within the cryptocyanine saturation range, i.e., amounted to several MW/cm^2. Each traversal of the pulse through the absorber shortened the pulse length and reduced its intensity. The attenuation of intensity was compensated for by gain in the ruby. The power of the spontaneous emission of the ruby was insufficient to bleach the cryptocyanine and thus the system as a whole was in a stable blocked state. Consequently only pulses with above-threshold intensity could propagate through the medium without damping.

We observed experimentally pulse narrowing by a factor of approximately 20 after five passes, and a corresponding broadening of the emission spectrum. The greatest narrowing was observed in pulses close to threshold intensity. Pulse narrowing was as a rule accompanied by the appearance of envelope spikes. This can be ascribed to the predominant development of fluctuation spikes present in the input pulse. The experimental results are in agreement with the computations.

2. EVOLUTION OF A PULSE PROPAGATING IN A TWO-COMPONENT MEDIUM

We consider incoherent interaction of an optical pulse with a two-component medium consisting of resonantly amplifying and resonantly absorbing particles. The incoherent interaction condition consists in the fact that the pulse length τ_p is much larger than the transverse relaxation times (damping time of the optical polarization of the medium) of the amplifying particles, T_2^a, and of the absorbing particles, T_2^b:

$$\tau_p \gg T_2^a, T_2^b. \quad (1)$$

Here and below the index a denotes amplifying particles and index b absorbing particles.

In contrast to[9-13], we consider the case where the relaxation time T_1^b of the bleached state is much shorter than the pulse length:

$$\tau_p \gg T_1^b. \tag{2}$$

In this case the difference in level populations of the absorbing particles is determined by the instantaneous intensity of the pulse

$$N_b = \frac{N_{b0}}{1 + 2\sigma_b T_1^b I}, \tag{3}$$

where σ_b is the cross section of radiative transition and N_{b0} is the initial population difference. Furthermore we consider that the pulse energy E_p is insufficient for gain saturation, i.e., $E_p \ll 1/2\sigma_a$. In this case gain does not depend on radiation intensity and pulse propagation is determined by a single equation:

$$\frac{\partial I}{\partial t} + c\frac{\partial I}{\partial x} = cI\left(\alpha_0 - \gamma - \frac{\varkappa_0}{1 + I/I_s}\right), \tag{4}$$

where $\alpha_0 = \sigma_a N_{a0}$ and $\kappa_0 = \sigma_b N_{b0}$ are initial gain and absorption coefficient per unit length, and $I_s = (2\sigma_b T_1^b)^{-1}$ is absorption saturation (in photons/cm^2·sec).

Figure 1 shows the effective gain $\alpha_{eff} = \alpha - \kappa_0/(1 + P)$ ($\alpha = \alpha_0 - \gamma$, $P = I/I_s$ is dimensionless power) as a function of the intensity. When $\alpha < \kappa_0$ for a weak signal the medium is absorbing, but it becomes amplifying at a certain threshold intensity

$$I_{th} = \frac{\varkappa_0 - \alpha}{\alpha} I_s$$

If the intensity of the initial pulse $I_0(t) < I_{th}$, the pulse attenuates as it propagates. When $I_0(t) > I_{th}$, the parts of the pulse that satisfy this condition are amplified and the remainder is attenuated. Obviously this process shortens the pulse length.

Equation (4) has an exact solution which is implicitly given by the expression[4]

$$\begin{aligned} &P^{-1}(\tau)\left[(\alpha - \varkappa_0 + \alpha P(\tau)\right]^{\varkappa_0/\alpha} \\ &= P_0^{-1}(\tau)\left[(\alpha - \varkappa_0) + \alpha P_0(\tau)\right]^{\varkappa_0/\alpha} e^{-(\alpha - \varkappa_0)x}, \end{aligned} \tag{5}$$

where $P_0(\tau)$ is the initial optical pulse and $\tau = y - x/c$.

The shortening of pulse length can be considered without solving (5). This can be readily accomplished for the case of a "smooth" initial pulse whose effective length can be determined from the following relationship

$$\tau_p^{-2} \approx -\frac{1}{P(\tau)}\frac{\partial^2 P(\tau)}{\partial \tau^2}\Big|_{\tau = \tau_m}, \tag{6}$$

where τ_m is the pulse maximum. By differentiating (5) twice at the point $\tau = \tau_m$ we find after transformations the relation between the pulse length and maximum power:

$$\tau_p = \tau_p^0\left(\frac{1 + P}{1 + P_0}\frac{\alpha - \varkappa_0 + \alpha P_0}{\alpha - \varkappa_0 + \alpha P}\right)^{1/2}, \tag{7}$$

where τ_p^0 is the initial pulse length, and $P_0 = P_0(\tau_m)$ and $P = P(\tau_m)$ denote the pulse intensity at the maximum.

When $\alpha > \kappa_0$ only the growth of intensity is possible. If the initial pulse power $P_0 \ll (\alpha - \kappa_0)/\alpha$, and the final $P \gg 1$, the pulse shortening during the entire development process is determined from (7) and equals

$$\tau_p/\tau_p^0 = [(\alpha - \varkappa_0)/\alpha]^{1/2}. \tag{8}$$

It follows from (8) that pulse narrowing can be significant if the condition of the medium is sufficiently close to critical ($\alpha = \kappa_0$), in which the initial absorption is exactly compensated by gain.

When $\alpha < \kappa_0$ pulses with $P > P_{th} = (\kappa_0 - \alpha)/\alpha$ are amplified and pulses with $P < P_{th}$ are damped out. The point $P = P_{th}$ (Fig. 1) is obviously unstable. We can express (7) in the form

$$\tau_p = \tau_p^0\left(\frac{1 + P}{1 + P_0}\frac{P_0 - P_{th}}{P - P_{th}}\right)^{1/2}. \tag{9}$$

If $P_0 < P_{th}$, then ultimately $P \to 0$ and pulse narrowing in the course of such a process is expressed by

$$\tau_p = \tau_p^0\left(\frac{1}{1 + P_0}\frac{P_{th} - P_0}{P_{th}}\right)^{1/2} \tag{10}$$

The shortening of pulse length is significant if P_0 is close enough to the threshold. If $P_0 > P_{th}$, then ultimately $P \to \infty$ and the pulse narrowing equals

$$\tau_p = \tau_p^0\left(\frac{P_0 - P_{th}}{1 + P_0}\right)^{1/2}, \tag{11}$$

i.e., it is also critically dependent on the proximity of the maximum intensity of the initial pulse to the threshold.

The case of $\alpha > \kappa_0$ is realized in a mode-locked laser by a nonlinear absorber. In such a case the formation of ultrashort pulse begins with the development of weak emission fluctuation. This problem is examined in detail in[4].

The case of $\alpha < \kappa_0$ is of interest because such a two-component medium is stable with respect to weak perturbations with $P < P_{th}$[1]. However even in this case the pulse can be shortened if its maximum intensity is close to P_{th}. This operating regime was considered in[7]. Furthermore, a stable two-component medium with power saturation of absorption essentially represents an amplitude discriminator of optical pulses. This property can be utilized for the detection and isolation of fluctuation spikes.

A two-component medium naturally possesses the above properties as long as condition (2) is valid. When $\tau_p \approx \tau_1^b$ the pulse narrowing rate falls and narrowing ceases altogether when $\tau_p \ll T_1^b$. This situation is investigated in[4].

Distributed two-component media with power saturation have not been created so far[2]. Therefore lasers with nonlinear absorption and our experiments described below use a two-component medium in the form of a succession of amplifying and absorbing layers. Given

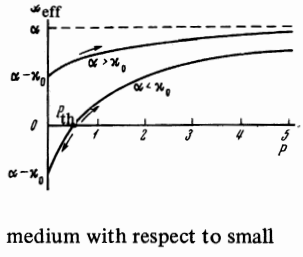

FIG. 1. Effective gain of a two-component medium as a function of emission power.

[1]The stability of a two-component medium with respect to small signals was considered in [10,11].

[2]We note that such a medium can be created by a method discussed in [14], by immersing an amplifying glass fiber with a propagating surface optical wave into an absorbing organic dye solution.

a sufficiently low optical density of each layer, the properties of such a medium are not different from those of a distributed medium. However it is practically more convenient to use optically dense layers. In particular this is the case in the experiments described below. Consequently some additional explanations are in order.

Pulse propagation in a single-component nonlinearly absorbing medium is described by (4) for $\alpha_0 = 0$. The general expression (7) leads to the following relation between the maximum intensities P_0 at the input and P at the output of the medium and pulse length τ_p^0 at the input and τ_p at the output of the medium:

$$\tau_p = \tau_p^0 \left(\frac{1+P}{1+P_0}\right)^{1/2}. \tag{12}$$

It follows from (12) that significant pulse narrowing can be obtained only by a substantial reduction of intensity from the value $P_0 \gg 1$ down to $P \ll 1$. For example, when the peak pulse power changes 10 times from the value $P_0 = 5$ to $P = 0.5$, the pulse narrows by a factor of 2[3]. The attenuation of intensity from P_0 to P occurs in the passage through an absorbing layer whose thickness x equals

$$x = \frac{1}{\varkappa_0}\left[\ln\frac{P_0}{P} + (P_0 - P)\right], \tag{13}$$

where it is assumed that $\gamma = 0$. The general expression for nonzero linear losses can be obtained from (5), setting $\alpha_0 = 0$. For example, to change the peak power from $P_0 = 5$ to $P = 0.5$ the initial optical density of the absorbing layer should amount to $x\varkappa_0 \approx 6.8$.

The narrowing rate of the pulse depends on the intensity and thus varies in the course of propagation. It is obvious from physical considerations that it is maximum in the region of greatest nonlinearity, i.e., when $P \approx 1$. This can be proved rigorously in the following manner. The length τ_p of a symmetric pulse at half height is determined by the expression $P(x, \pm\tau_p/2) = \frac{1}{2}P(x, 0)$, where $\tau = t - x/c$ and the pulse maximum lies at $T = 0$. Differentiating this relation, for example, at half the height on the leading edge $\tau_1 = -\tau_p/2$, and substituting the values of $\partial P/\partial x$ at the points $\tau = 0$ and $\tau = \tau_1$ according to (4) we can obtain the following expression characterizing the pulse narrowing rate:

$$\frac{d\tau_1}{dx} = -\frac{\varkappa_0}{2}\frac{P^2}{(1+P)(2+P)}\left|\frac{\partial P}{\partial \tau}\right|_{\tau=\tau_1} \tag{14}$$

For a Gaussian pulse $\partial P/\partial\tau|_{\tau=\tau_1} = 2\ln 2 \cdot P/\tau_p$.

Generally speaking, for bell-shaped pulses we can take $\partial P/\partial\tau|_{\tau=\tau_1} = P/\tau_p$. Considering that pulse narrowing occurs at the expense of compression of the leading and trailing edges, i.e., $d\tau_p/dx = d\tau_1/dx - d\tau_2/dx$, we finally obtain the following expression for the pulse narrowing rate in an absorbing medium:

$$W = \frac{d\tau_p}{dx} = -\tau_p\frac{\varkappa_0 P}{(1+P)(2+P)}. \tag{15}$$

It follows from (15) that the narrowing rate depends substantially on the pulse peak power. It is maximum for $P = \sqrt{2}$ and tends to zero in the limiting cases of $P \ll 1$ and $P \ll 1$. Hence it follows that the initial pulse peak power ahead of the layer should be several times unity and the final power should be several times less than unity. In such a case we can obtain a significant compression of the pulse. This also follows from expression (12).

The amplifying layer should compensate for the attenuation of intensity in the absorbing layer, i.e., it should have a gain of $K = P_0/P$. Since the attenuation P_0/P is much smaller than the attenuation of a weak signal in the absorbing layer such a multilayered two-component medium is on the whole stable with respect to weak input signals. On the other hand the point of threshold intensity is unstable for such a medium and the slightest deviation of peak intensity of the initial pulse from the threshold value results in a sharp rise or fall of the pulse. This circumstance determines the maximum number of layers that can be passed by a pulse maintaining its peak power within the maximum nonlinearity range, i.e., within $(0.5-5)I_s$. This number of layers reached five in our experiments.

As a rule the optical laser pulse has a more complex structure. In particular, if the width of the pulse spectrum $\Delta\nu$ is larger than the limiting width $\Delta\nu_p \approx 1/\tau_p$ determined by the finite pulse length (more precisely, for a gaussian pulse $\Delta\nu_p = 4\ln 2/\pi\tau_p$) then there are intensity fluctuations within the pulse that can be regarded as the result of random interference of radiation in many modes. If the emission consists of many purely axial modes, the average fluctuation amplitude has a maximum value $\delta I \approx \langle I\rangle$, where $\langle I\rangle$ is the intensity averaged over many fluctuations, i.e., it is the fluctuation envelope in the pulse. The mean duration of fluctuations $\tau_{fl} \approx 1/\Delta\nu$ and the mean fluctuation repetition frequency is of the order of $\Delta\nu$. Among the intensity fluctuations there are spikes with an amplitude several times exceeding the mean value $\langle I\rangle$. Their repetition frequency is evaluated in[18]. As a result the emission pulse of a multimode laser has a fairly complex structure.

If $\tau_{fl} \gg T_1^b$ each fluctuation spike will obviously be narrowed in the passage through the two-component medium. As long as $\tau_{fl} \gg T_1^b$ their narrowing is described by the above relations. The greatest narrowing have spikes with peak intensity close to I_{th}. Because of the predominant transmission of fluctuation spikes with the highest peak power and the damping out of spikes with intensity below I_{th}, fluctuations are subject to "gaps." The narrowing of fluctuation envelope occurs at $\tau_p \gg T_1^b$ independently of the narrowing of the fluctuations themselves.

3. EXPERIMENTAL INVESTIGATION

A. The setup and measurement method. The experimental setup is shown diagrammatically in Fig. 2.

The oscillator featured a ruby crystal with the active region 120 mm long and 12 mm in diameter. The end faces of the crystal were cut at the Brewster angle. A plane parallel plate was used as the output mirror and the mirrors were spaced 30 cm apart. A cell containing vanadium phthalocyanine solution in nitrobenzene served as the Q-switch. (A cryptocyanine solution was used when a narrow-spectrum pulse was needed).

[3] Pulse narrowing during passage through a saturable absorber was observed in [15-17].

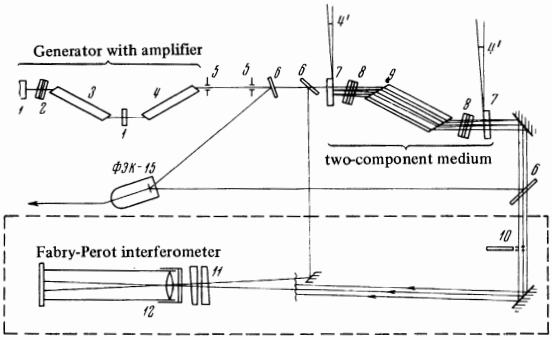

FIG. 2. Experimental setup. 1—oscillator mirrors; 2—Q-switch; 3, 4—ruby crystals of oscillator and amplifier; 5—diaphragm system; 6—beam splitters; 7—half-transparent mirrors; 8—cryptocyanine cells; 9—ruby crystal; 10—beam separating screen; 11—Fabry-Perot etalon; 12—Uf-84 camera.

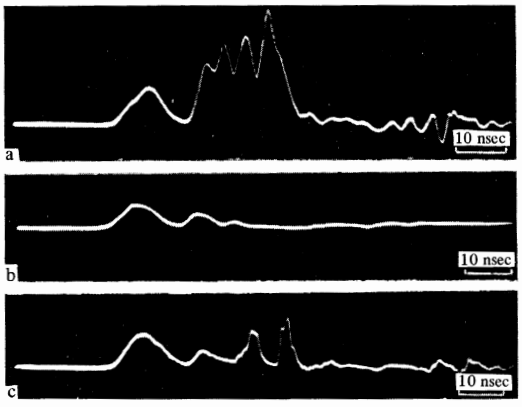

FIG. 3. Oscilloscopic traces of pulse shapes after consecutive traversals of the two-component medium. a—maximum intensity I of input pulse, $I > I_{th}$; b—$I < I_{th}$; c—$I = I_{th}$

The oscillator thus emitted pulses whose length was of the order of 8—10 nsec and spectral width was 1 cm^{-1}.

The oscillator was followed by an amplifier with a similar crystal. Gain variation was used to control the pulse output power. The usual operating power amounted to 1—10 MW/cm^2. A plane wave within diffraction limits was obtained by a system of two diaphragms 1 mm in diameter and 1 m apart placed behind the amplifier.

Two parallel mirrors (64% reflectivity, spaced 1.5 m apart) were used to pass the pulse many times through two cells with cryptocyanine solution and through the ruby crystal (length of active region of 240 mm and diameter of 18 mm) placed between the cells. Maximum gain K per pass through the ruby crystal was 10. The initial transmission of the cells was determined by the following considerations. On the one hand the initial transmission per pass of the cells should be low enough to effect a reduction of pulse length per pass; on the other hand the gain in the crystal should compensate for the reduction of intensity on passing through the absorbing cell, reflection from the half-transparent mirror, and reverse pass through the cell. In the absence of external radiation such a system remains in a stable "blocked" state since absorption per pass exceeds amplification at least by a factor of 4. The threshold power I_{th}, i.e., the power for which total losses are comparable with gain amounted to several MW/cm^2.

The emission passed through the output mirror entered an FÉK-15 coaxial photodiode having a resolution of about 2 nsec, and an I2-7 oscilloscope. A double transit time between the mirrors was 9 nsec allowing for a separate registration of pulses after the first, third, fifth, etc., pass. Furthermore, the input pulse was registered at the same time. Thus the same oscilloscopic trace showed the shape of the input pulse and its change due to consecutive traversal of the two-component medium.

B. Pulse shape variation. It was noted above that the process of pulse development in a two-component medium is unstable. The slightest deviation of the input pulse peak power from the threshold value causes either a sharp rise or damping of pulse intensity. In fact, according to experimental observation, a deviation of amplifier pump energy amounting to a few percent of the value for which the maximum pulse intensity coincides with threshold I_{th} causes a sharp rise or damping of the pulse train. The oscilloscopic traces in Figs. 3a and b show examples of the rising or falling pulse development.

Only in fairly rare cases were we successful in adjusting the maximum input pulse intensity to equal I_{th} with sufficient accuracy. In those cases we observed a train of pulses of approximately even intensity. An example of such a pulse development is given in the oscilloscopic trace in Fig. 3c. According to the above theory this is precisely the case of a significant pulse compression. Measurements of this trace show that compression per mass amounts to a factor of 1.8 which is in agreement with the computed value according to (12) and (13). Even after the third pass the pulse length becomes comparable to the time resolution of the recording system (~2 nsec). After the fifth pass the pulse length should amount to ~0.5 nsec. Of course such a length reduction occurs when the relaxation time of the bleached state of the cryptocyanine solution does not exceed this value; however the resolving power of our equipment did not permit us to clarify this point. To evaluate the final pulse length we performed an experiment in which pulse shortening was measured with reference to spectral broadening. The details of this experiment are described below.

The oscilloscope trace in Fig. 3 c shows that in addition to pulse compression the passage through a two-component medium is accompanied by sharp spikes in the envelope. This variation in pulse shape can be explained as follows. The spectrum width of the input pulse was 1 cm^{-1}, i.e., the pulse contained 10^2 axial modes. Random mode interference within the pulse can result in sufficiently short ($\sim 0.3 \times 10^{-10}$ sec) spikes whose amplitude is 4—5 times higher than the average value[18]. The instruments naturally are unable to distinguish these pulses and produce an envelope. The above results concerning pulse shortening refer to such an envelope. The two-component medium acts as an amplitude discriminator transmitting spikes with $I > I_{th}$ and suppressing the background between them. As a result only the most intense rare spikes remain. When their spacing becomes comparable to the resolving

time they begin to appear in the envelope. The spike spacing in the last pulse turns out equal to $2L/c$, where L is the optical length of the resonator of the input pulse generator.

A detailed investigation of pulse evolution obviously requires equipment with better resolving power.

C. Pulse spectrum. The pulse length after the third and following traversals was evaluated from the broadening of the pulse spectrum occurring during propagation. The assumed shortening by a factor of 20 after the fifth traversal should be accompanied by a corresponding spectral broadening. The spectral width of the initial pulse obtained with vanadium phthalocyanine Q-switch was too large (1 cm^{-1}) to observe such a broadening (because of the finite gain bandwidth of the ruby and probably because of the finite relaxation time of the bleached state of the nonlinear absorber). Therefore the phtalocyanine cell in the oscillator was replaced by a cryptocyanine cell. As we know one can obtain a sufficiently narrow spectrum in this case[19].

In our case the spectral width amounted to $(6 \pm 2) \times 10^{-3}$ cm^{-1}. The spectrum recording setup is shown in Fig. 2. A Fabry-Perot etalon with a dispersion region of 0.2 cm^{-1} and a resolution of 0.012 cm^{-1} (measured with a gas laser) served as the spectrum measuring instrument. The interference pattern was photographed with the UF-84 camera. The interferometer was illuminated so as to yield two separate spots in the pattern corresponding to the input pulse and a pulse obtained after a definite number of traversals of the two-component medium. The pulse shape variation was recorded simultaneously.

Figure 4 shows an interference pattern of the input pulse and of pulses obtained after the fifth traversal. The spectrum width of the pulse after the fifth traversal was ~0.1 cm^{-1}. We note that the radiation from the preceding passes was superimposed on the radiation after the fifth traversal because of light scattering in the ruby crystal, causing some narrowing of the spectrum. Spectral broadening by a factor of ~20 was observed. This means that pulse shortening occurred during all five traversals. At the same time the oscilloscopic tree of the pulse train was similar to that in Fig. 3 c. Consequently the maximum intensity of the input pulse in this case should be close to the threshold value and one could expect maximum pulse shortening by a factor of ~20.

In addition to the broadening of the spectrum we observed its shift. The interference pattern of Fig. 4 shows a shift of 0.04 cm^{-1}, thus amounting to approximately one-half of the broadening. This shift can be due to variation in the refraction index of the cryptocyanine in the anomalous dispersion region with saturated absorption. This effect was discussion in[20] for the case of nonlinearly amplifying medium.

FIG. 4. Interference patterns of input (left, shown by arrow) and output (right) pulses. Case of $I = I_{th}$.

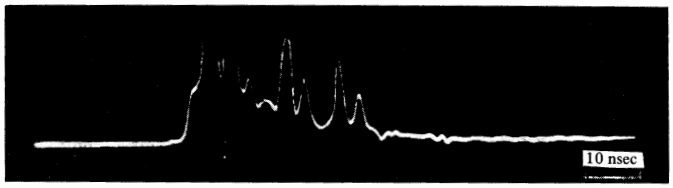

FIG. 5. Oscilloscopic trace of the evolution of a pulse shape of complex structure.

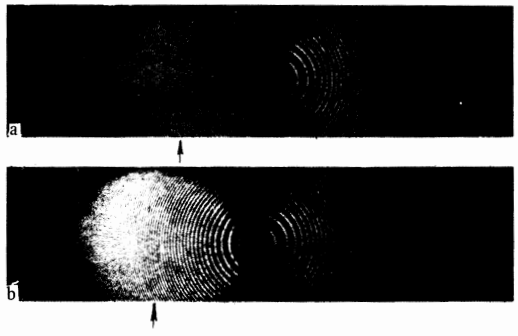

FIG. 6. Interference patterns of input (left, shown by arrow) and output (right) pulses. a—case of $I > I_{th}$; b—case of $I < I_{th}$.

In some cases the output pulse had a spectral width of 0.2 cm^{-1}. The input pulse had a somewhat greater spectral width in this case because of the excitation of several axial modes; this was clearly apparent in the beats in the input pulse trace (Fig. 5). We see that consecutive passes caused a sharpening and predominant development of the most intense spike.

When the development of the pulse train had an increasing or decreasing character, shown in Figs. 3 a and b, some narrowing was observed in place of the spectral broadening. The absence of broadening was obviously due to the fact that no pulse narrowing took place in these cases. The cause of narrowing and shifting of the spectrum (the shift occurred towards the short-wave region and amounted to 0.02 cm^{-1} in Fig. 6a, and to 0.03 cm^{-1} in Fig. 6b) is not sufficiently clear at this time.

4. CONCLUSION

In the present work we traced the process of formation of ultrashort optical pulses propagating in a two-component medium that was the basis of a mode-locking laser[1]. We observed experimentally pulse narrowing and spectral broadening by a factor of approximately 20. The actual two-component medium had a sharply defined intensity threshold. Pulse narrowing occurred when the peak pulse intensity approached the threshold intensity of the medium. Such a two-component medium acts as a pulse amplitude discriminator and transmits pulses whose intensity exceeds the threshold. If the input pulse has an internal fluctuational structure the traversal causes a predominant development of the most intense fluctuation spikes and suppression of weak spikes. Due to the change in amplitude distribution of spikes, fluctuations become rarer and thus can be directly observed. In continuation of this research we plan a more detailed study of

the passage of fluctuation spikes through a two-component medium. This is of interest for the investigation of multimode emission statistics and relaxation constants of a nonlinear absorber.

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