average power ~1.5 MW. Great difficulties are encountered here in producing (with the aid of a telescopic system) a long and very thin beam with a diameter on the order of a millimeter - too high powers are required for a larger diameter. It is, of course, possible to use a lens of sufficiently long focus; then the AW will cover a shorter distance - from the focus, where it is natural to produce the ignition, to that section of the conical light channel at which J drops below J_{min}.

An important factor is that the required average power is somewhat higher than the calculated value as a result of the spiked nature of the lasing, so that it is necessary to decrease to a minimum the off-duty cycle of the light beam. A harmful effect is exerted by the pauses during which the wave attenuates. In order for the AW to continue to move it is necessary that the plasma, which expands adiabatically and cools during the pause, retain its absorptivity, i.e., a temperature not lower than ~20 000°, at the instant when the spike begins. It turns out that the additional energy acquired during the time of the spike, when the power is accordingly larger than the mean value $\bar{J}$, is insufficient when $\bar{J} = J_{min}$. An estimate shows that for typical conditions (spike period ~1 μsec, spike duration ~1/3 of the period) and r = 0.1 cm the limiting average intensity is about double than in the case of a continuous light flux. The average AW velocity decreases somewhat. It is clear from the foregoing that in order to "ignite the detonation" it is necessary that a plasma with a temperature higher than approximately 25 000° overlap the light channel over a length on the order of one millimeter.

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* The radiative mechanism of maintaining the AW [4], which is effective at large values of J, is much inferior to the "detonation" mechanism considered here for small J.

** Estimates show that ionization, excitation, and the equalization of the electron and atomic temperatures are much faster, so that the use of formulas based on the assumed thermodynamic equilibrium in the gas is justified.

*** We note that this phenomenon has nothing in common with the "long spark" [6] produced as a result of gas breakdown by laser light over the entire length.

ELASTIC NONLINEARITY IN STIMULATED MANDEL'SHTAM-BRILLOUIN SCATTERING

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Stimulated Mandel'shtam-Brillouin scattering (SMBS) which is produced when a powerful laser light wave is focused, is accompanied by intensification of the particular sound wave from which this scattering takes place. The increase in the sound amplitude can cause elastic nonlinearity to play an important role in the behavior of the sound wave. Estimates presented in [1] have shown that under certain conditions the nonlinear effects can be appreciable. Let us obtain a criterion for elastic nonlinear effects in the case when there is amplification of the sound wave under the influence of a laser beam.

Let the displacement in the longitudinal sound wave from which the light is scattered be equal to

$$u = u_1 + u_2 \tag{1}$$

where u_1 is a solution, satisfying the synchronism conditions, of the system of Maxwell's equations and of the linearized (with respect to u) equations of elasticity theory under stationary conditions [2], and u_2 an increment which is quadratic in the sound amplitude, and is the solution of the second-approximation elastic equation [3]

$$\frac{\partial^2 u_2}{\partial t^2} - c_s^2 \frac{\partial^2 u_2}{\partial x^2} - \frac{\eta}{\rho_0} \frac{\partial^3 u_2}{\partial t \partial x^2} = \frac{\beta}{2\rho_0} \frac{\partial}{\partial x} \left(\frac{\partial u_1}{\partial x}\right)^2, \tag{2}$$

where c_s is the speed of sound, ρ_0 the density of the medium, η the viscosity, and β the nonlinear parameter of the medium [4].

If the sound wave is amplified in the SMBS, then we can assume approximately that

$$u_1 = u_0 e^{ax} \cos(\omega t - qx), \tag{3}$$

where ω and q are the frequency and the wave number of the sound wave.

Then the solution of (2) is

$$u_2 = \frac{u_0^2 q^2 \beta}{16 c_s^2 \rho_0 (a + 2\gamma)} (e^{2ax} - e^{-4\gamma x}) \cos 2(\omega t - qx), \tag{4}$$

where $\gamma = \eta\omega^2/2\rho_0 c_s^3$ is the coefficient of absorption of a sound wave of frequency ω. The second term of (4) rapidly attenuates as the sound propagates and can be discarded in comparison with the first. The growth of the second harmonic causes, at sufficiently large distances, violation of the condition $u_1 \gg u_2$ which was used in the derivation of (2) by successive approximations.

If the amplitudes of the first and second harmonics satisfy the equation $u_2 = (1/2)u_1$, then the sound wave has a sawtooth form, i.e., the sound wave is transformed into a periodic shock wave. This occurs at a distance

$$x_0 = \frac{1}{a} \ln \frac{8 c_s^4 (a + 4\gamma)}{n_0 \beta \omega^2}. \tag{5}$$

In other words, at distances $x \gtrsim x_0$ the elastic nonlinearity plays an essential role in the behavior of the sound wave. The parameter x_0 can be used as a measure of the nonlinear effects. If $x_0 < \tau c_s$, where τ is the duration of the light pulse, then the nonlinear effects have time to accumulate during the time of interaction of the sound wave with the light, and the elastic nonlinearity must be taken into account in the description of the SMBS.

The quantity x_0 is determined essentially by the gain α, i.e., in final analysis, by the intensity of the light wave. The remaining quantities are under the logarithm sign and therefore have little influence on x_0.

The quantity α can be estimated under certain simplifying assumptions. Thus, for example, if $\alpha \gg \gamma$ and if it is assumed that the electric field intensity E of the light wave from the laser remains constant, then we can obtain for α the expression

$$\alpha = \sqrt{\frac{q^2 a(\epsilon_0 + a)}{16\pi\epsilon_0 c_s^2 \rho_0}|E|^2}, \qquad (6)$$

where ϵ_0 is the dielectric constant and a the photoelastic constant of the material.

Let us estimate x_0 for the following values of the parameters characterizing the SMBS in quartz: sound-wave frequency $f = 2.7 \times 10^{10}$ sec^{-1} and electric field intensity at the focus $E = 10^5$ cgs esu. An estimate yields $\alpha = 3 \times 10^3$ cm^{-1}. Since $\gamma \simeq 300$ cm^{-1} in quartz at room temperature, the inequality $\gamma \ll \alpha$ is satisfied. Considering the amplification of the sound from the level of the thermal noise (an estimate yields for u_0 a value $u_0 \simeq 10^{-18}$ cm), we get $x_0 = 8 \times 10^{-3}$ cm. If the light pulse duration is $\tau = 30$ nsec, then the path covered by the sound during that time is more than double the value of x_0. Consequently, the nonlinear effects will play a significant role in the propagation of such a wave. Scattering of light by the second harmonic was observed in [4].

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E R R A T A

Article by I. A. Fomin, Vol. 6, No. 6

Page 197, line 3 from the bottom, reads: "This is essentially the temperature broadening due to transitions..." It should read: "This is essentially the temperature broadening and the broadening due to transitions..."

Article by A. I. Vainshtein, Vol. 6, No. 8 (p. 266)

In the term $M^{\pi}_{\mu\nu}$, corresponding to emission of a γ quantum by a pion at $k^2 \neq 0$, no account was taken of the pion electromagnetic form factor $F_\pi(k^2)$. Allowance for this factor changes the coefficient b, which becomes equal to

$$b = -\frac{3}{2}\frac{f}{m_\rho^2} + 2f\left.\frac{dF_\pi(k^2)}{dk^2}\right|_{k^2=0}$$

which agrees with the result obtained in the simultaneously performed investigation of T. Das, V. S. Mathur, and S. Okubo (Phys. Rev. Lett. 19, 859 (1967). In determining $dF_\pi(k^2)/dk^2$,