where P_{atm} is the gas pressure. For liquids $\beta \approx 10^{-3}$ deg^{-1}, and $\rho(\partial n/\partial \rho)$ is on the order of unity, therefore $\Delta n_{liq} \approx 10^{-3}\Delta T$. For example, a temperature rise $\Delta t \approx 30°$ will produce in a time $t \approx \lambda^2/\kappa$ a change in the refractive index $\Delta n_{liq} \approx 3 \times 10^{-2}$ or $\Delta n_g \approx 3 \times 10^{-5}$ for liquids and gases, respectively, which is sufficient to compensate for an incidence angle $\phi \lesssim \sqrt{\Delta n} \approx 10°$ for condensed media and $\phi \lesssim 5 \times 10^{-3} \approx 0.3°$ for gases at normal pressure, i.e., self-isolation will be produced only at small angles. The time required to produce the sonic change layer, $t \sim \ell/c_s \sim \lambda'/c_s \sim$ nsec can be quite small.

Similar effects can be observed on the boundary between an absorbing surface and a transparent solid.

Owing to the uneven heating and the surface roughness, a strong scattering of the refracted and of the reflected light should be observed.

The formation of refracting halos [1] (due to local heating of the medium and to sound waves) around small absorbing particles may be the cause of the anomalously large scattering of intense light in aerosols and hydrosols, which scatter light of low intensity weakly.

The foregoing effects may be useful to prevent excessive heating of surfaces by light, to guide high-power light fluxes, etc.

We did not touch upon self-isolation processes such as formation of a strongly absorbing layer on the surface (lamblack, soot, plasma), preventing further heating of the surface, since such processes call for much larger light flux densities.

[1] G. A. Askar'yan, Zh. Eksp. Teor. Fiz. 45, 810 (1963) [Sov. Phys.-JETP 18, 555 (1964)].

LASER BASED ON BORON TRICHLORIDE

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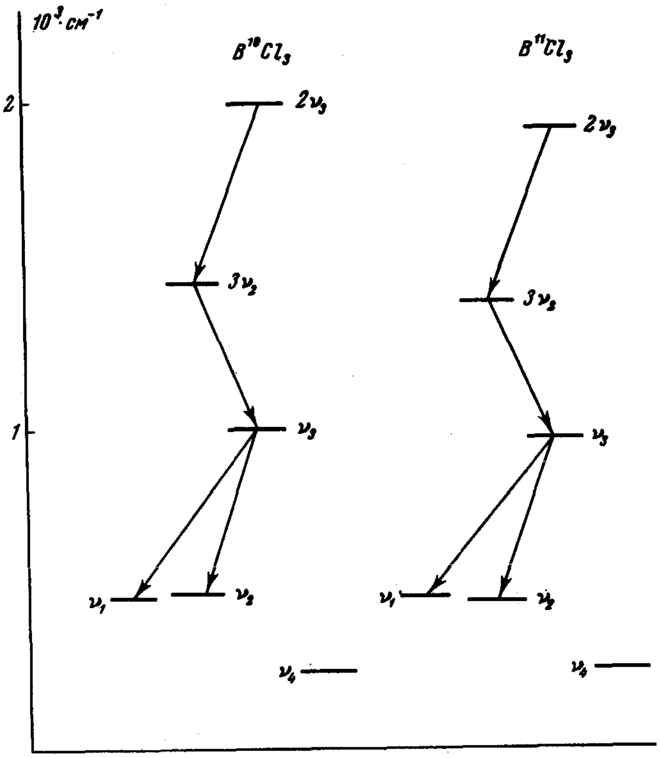
We report here the results of experiments aimed at obtaining generation in a gas laser based on boron trichloride (BCl_3).

Boron trichloride is a flat molecule with the boron atom located at the center of a regular triangle made up of the chlorine atoms. Such molecules can have four normal vibration modes (cf., e.g., the book by Herzberg [1]). Only the symmetrical valence vibration ν_1 is inactive in the ir spectrum. The fundamental frequencies and some of the harmonics of all these vibrations, listed by Scruby et al. [2], are shown in the figure for the molecules $B^{10}Cl_3$ and $B^{11}Cl_3$.

The frequencies ν_1 and ν_2 are very close to each other, so that the vibrations of these frequencies are strongly coupled as a result of the Fermi resonance. The levels ν_1 and ν_2 lie relatively low, and can therefore readily decay in a gas mixture as a result of collisions. The very low level ν_4 is strongly coupled to the ground state of the molecule.

The antisymmetrical vibration ν_3 corresponds to the 10-μ emission of the CO_2 laser. We have found earlier [3] that boron trichloride leads to a giant-pulse regime in a CO_2 laser. The ν_3 vibration is responsible for the saturating-filter effect. The results of [3] allow

Wavelength, μ	Relative intensity	Transition
18.3	0.5	$2\nu_3^{10} \rightarrow 3\nu_2^{10}$
18.8	0.3	$2\nu_3^{11} \rightarrow 3\nu_2^{11}$
19.1	0.4	$\nu_3^{10} \rightarrow \nu_1$
19.4	0.4	$\nu_3^{10} \rightarrow \nu_2^{10}$
20.2	1	$\nu_3^{11} \rightarrow \nu_2^{11}$
20.6	1	$\nu_3^{11} \rightarrow \nu_1$
22.4	0.2	$3\nu_2^{10} \rightarrow \nu_3^{10}$
23.0	0.4	$3\nu_2^{11} \rightarrow \nu_3^{11}$



us to assume that the decay of the ν_3 vibrations of the BCl_3 molecule exceeds 10^{-3} sec. This raises hopes for producing population inversion and lasing at the transitions between the vibrational levels of the BCl_3 molecule.

Lasing was attained by adding BCl_3 directly to the discharge tube of a CO_2 laser with a 30 W output. The CO_2-N_2-He gas mixture with a component ratio 1:3:7 was pumped through the discharge tube at pressure 7 Torr.

The generation at the BCl_3-laser frequencies was recorded with an IKS-21 spectrograph with a KBr prism.

It was observed that when very small amounts of BCl_3 are added in the discharge tube, the CO_2 laser goes over to a regime in which giant pulses of high intensity are produced. Increasing the BCl_3 content eliminates the giant pulses, but gives rise to relatively weak generation at wavelengths 13 and 14 μ, corresponding to the transition $\nu_3 \rightarrow \nu_4$ of the molecules $B^{10}Cl_3$ and $B^{11}Cl_3$. When the BCl_3 content is increased to a partial pressure less than 1 Torr, the generation at wavelengths 13 and 14 μ vanishes and relatively strong generation is produced in the 12-μ band. At the same time, the CO_2 lasing at 10.6 μ is produced. The intensity of the 12-μ generation is approximately 100 mW.

The generation occurs at several frequencies in the 12-μ band. The wavelengths of the observed generation, the relative intensities, and a tentative identification of the laser transitions are listed in the table. The laser transitions are designated by arrows in the figure.

The rotational structure of the generation spectrum could not be resolved fully. The constants of the rotational splitting of the vibrational spectrum of BCl_3 are not known accurately. Estimates based on the data of [1] for the BF_3 molecule, which is close to BCl_3, yield rotation splittings of 0.1 - 0.2 cm^{-1}.

We can propose the following generation mechanism for a gas laser with the CO_2-N_2-He-BCl_3 mixture. The ν_3 vibrations of the BCl_3 molecules are resonantly excited in the strong field of the 10-μ emission. This produces population inversion of the ν_3 level relative to the vibrational ν_1 and ν_2 levels. The $\nu_3 \rightarrow \nu_1$ and $\nu_3 \rightarrow \nu_2$ transitions are responsible for the most intense generation. In addition, the second harmonic of the antisymmetrical valence vibration, $2\nu_3$, is excited. It is not excluded that the population of the $2\nu_3$ level is further increased by resonant exchange of vibrational energy with the excited nitrogen. This additional excitation mechanism should be more effective for the $B^{10}Cl_3$ molecules, whose vibration frequency is closer to the vibration frequency of the excited nitrogen. Population inversion at the level $2\nu_3$ thus becomes possible relative to the level $3\nu_2$. The $3\nu_2$ level, in turn, experiences radiative decay in the $3\nu_2 \rightarrow \nu_3$ transitions.

The decay of the lower laser levels ν_1 and ν_2 to the ground state proceeds via collisions with the molecules of the other gases present in the discharge.

[1] G. Herzberg, Molecular Spectra and Molecular Structure, v. 2, Van Nostrand, 1950.
[2] R. E. Scruby, J. R. Lacher, and J. D. Park, J. Chem. Phys. 19, 386 (1951).
[3] N. V. Karlov, G. P. Kuz'min, Yu. P. Petrov, and A. M. Prokhorov, ZhETF Pis. Red. 7, 174 (1968) [JETP Lett 7, 134 (1968)].

EXPERIMENTS ON NEUTRON OBSERVATION BY FOCUSING POWERFUL LASER EMISSION ON THE SURFACE OF LITHIUM DEUTERIDE

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We report here the results of preliminary investigations aimed at obtaining thermonuclear temperatures in a dense plasma with the aid of powerful laser emission.

It was shown in 1962 [1] that when powerful laser emission is focused on the surface of a solid target containing deuterium, it is possible to obtain a dense plasma with a temperature high enough to produce thermonuclear reactions.

This called for a much higher laser power than was available at that time.

We investigated the possibility of increasing the output energy and power of lasers [2, 3]. The production of nanosecond light pulses of power higher than 10 GW entails damage to the active medium, thus greatly inhibiting experiments on plasma heating. It was observe that the damage threshold power increases when the pulse duration is decreased [2]. Using as the master generator a laser producing ultrashort pulses and having a nonlinear absorber [4], we succeeded in obtaining, after amplification, a light pulse of energy up to 20 J in a time that apparently did not exceed 10^{-11} sec.[1)]

The setup for neutron-observation experiments is shown in Fig. 1. The laser emission

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[1)] Separate experiments with the master generator have shown that the duration ranged from 10^{-11} to 10^{-12} sec. The procedure used to measure the pulse duration was described in [5].