$$\langle 0 \| M(E2) \| 2 \rangle \langle 0 \| M(E2) \| 2' \rangle \langle 2 \| M(E2) \| 2' \rangle$$

is positive. It follows from a comparison of P_α/P_C with its theoretical value that $Q_{2+} = -(0.53 \pm 0.17)$ b.

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OBTAINING A GIANT PULSE IN A SOLID-STATE LASER WITH THE AID OF ORGANIC SOLVENTS

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A giant pulse is generated, as is well known, in those cases when the loss in the resonator can be sharply reduced by the instant when the maximum population inversion of the active medium is reached. This can be attained, in particular, by placing a medium with nonlinear optical properties in the resonator. The most widely used are passive shutters based on the absorption-saturation effect [1, 2]. A number of workers have produced shutters based on stimulated Mandel'shtam-Brillouin scattered [3 - 5]. In principle, other nonlinear effects can also be used for this purpose.

In our experiment, the giant pulses were obtained with the aid of an organic solvent having no saturable absorption. A cell filled with this solvent was placed inside the misaligned laser resonator. A block diagram of the laser is shown in Fig. 1. The active element was a neodymium-glass rod measuring 130 × 10 mm. One of the resonator mirrors comprised a stack of three plane-parallel plates (M_1), and the other mirror was either a total-internal-reflection prism (M_2). The resonator length was 500 mm.

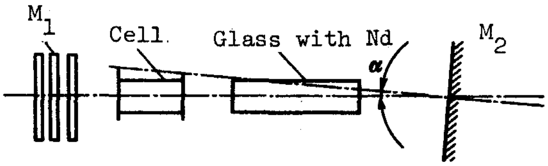

Fig. 1. Block diagram of experimental setup.

Insertion of a cell with acetone into the resonator has practically no influence on the threshold pump, but changes noticeably the generation kinetics. So long as the alignment is not disturbed, the presence of the solvent is manifest in a shortening of the spikes with simultaneous increase of the intensity and of the interval between them; this agrees with the results of [6]. The more M_2 is inclined, the more the spike amplitudes increase and the shorter their durations. It is easy to choose conditions such that only one giant pulse is emitted per flash. Figure 2 shows an oscillogram of a giant pulse with a half-power duration 10 - 15 nsec and energy of the order of 1 - 2 J. It corresponds to an inclination of the mirror M_2 by an angle $\alpha \approx 6 - 8'$ and a pump energy exceeding the threshold value (for the resonator before misalignment) by approximately four times. It should be noted that the effect is not very sensitive to the change of the resonator parameters.

The distribution of the field in the near zone is shown in Fig. 3. The spectrum of the giant pulse contains 3 - 6 components, the distance between which corresponds to the Stokes shift in stimulated Mandel'shtam-Brillouin

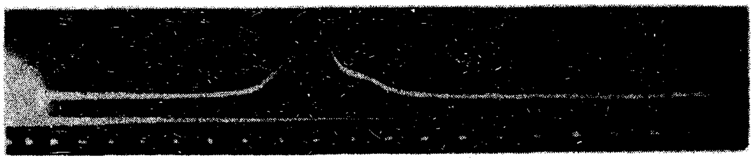

Fig. 2. Oscillogram of giant pulse. Distance between markers - 10 nsec.

scattering. It should be noted that besides the described generation regime, a giant pulse of lower power and greater duration can also be generated. In this case, the field distribution in the near zone has a deep spatial modulation, and the emission spectrum is broader than in the first case, and has no discrete structure.

An experimental verification of the possibility of using different solvents yielded the following results. A giant pulse was generated with bromobenzene, toluene, benzene, chloroform, acetone, and n-hexane, but not with ethyl alcohol or distilled water. The liquids of the first group corresponds to a larger Kerr constant [7] than those of the second, and consequently to lower self-focusing thresholds. This gives grounds for assuming that the Q-switching in the described experiment is due to the self-focusing effect. If the loss-modulation loss were to be connected only with the stimulated scattering (Mandel'shtam-Brillouin or temperature), then the giant-pulse regime would be obtained not only by inclining M_2, but also be increasing the transmission of M_1, but no such result was observed.

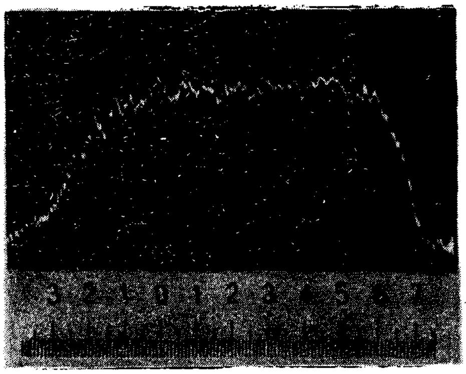

Fig. 3. Field distribution in the near zone, obtained by photometry of a film exposed to a giant pulse. Each major division is equal to 1 mm.

The loss modulation mechanism based on the self-focusing effect is quite obvious. If the resonator mirrors are inclined to each other, the diffraction loss in the resonator is large and high pumping is necessary to attain the generation threshold [8]. To reduce the loss it is necessary to localize the field in a region far from the resonator boundaries. This can be done by introducing into the resonator either a wedge that compensates for the mirror inclination or a sufficiently strong lens [9]. In our case, the role of the lens with a power-dependent focal length is played by the cell with the self-focusing liquid. The stimulated Mandel'shtam-Brillouin scattering produced in the solvent when the threshold power is reached serves as an additional mechanism for increasing the resonator Q.

The dependence of the generation kinetics on the misalignment angle of the mirrors was observed also in experiments with a ruby laser have no additional nonlinear elements [10]. By choosing the angle of inclination of the mirrors it is sometimes possible to obtain also giant pulses [11]. It is natural to assume that a mechanism connected with self-focusing comes into play here, too. Since, however, there were no additional nonlinear elements in the experiments of [10, 11], it can be assumed that their role was taken by the ruby itself.

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LINEWIDTH OF CYCLOTRON RESONANCE IN BISMUTH

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An investigation of cyclotron resonance (CR) in metals makes it possible to determine the relaxation time of the carriers from the width of the resonance line. We have investigated experimentally the CR in bismuth in the frequency range f = 10 - 76 GHz, and observed a dependence of τ on f.

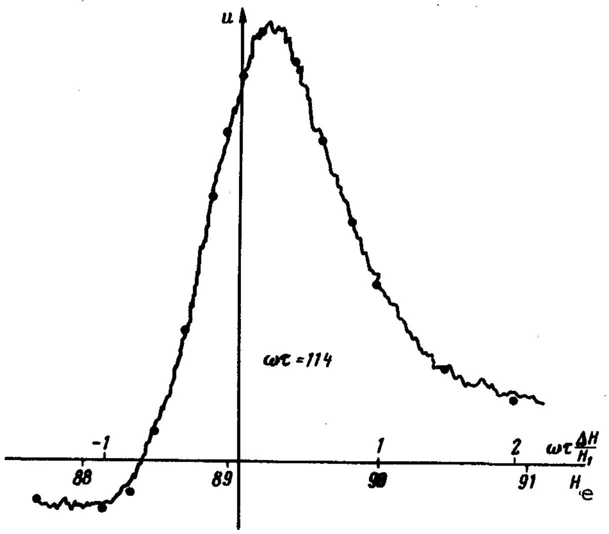

Fig. 1. Line of cyclotron resonance of first order in bismuth. H parallel to C_2, f = 26.4 GHz, T = 0.35°K. Solid line - experimental; points - calculation by formula (3).

The sample was single-crystal Bi whose normal was parallel to the trigonal axis C_3. It was grown from the melt in a dismountable quartz mold [2]. The sample served as the wall of a resonator. A strip resonator [2] was used at 10.22, 18.74, 26.4, and 37.1 GHz, and a cavity resonator with circular currents was used at 76.1 GHz. We measured the ac component of the signal power passing through the resonator and produced when the magnetic field is modulated at 12 Hz. The reflections from the elements of the microwave channel of approximate length $\sim 10\lambda$ made the system sensitive not only to changes of the resonator Q ($Q \simeq 10^3$), but also to changes of its natural frequency. The resultant signal was

$$U \backsim a\,\partial X/\partial H + b\,\partial x/\partial H. \tag{1}$$

The magnetic field H was produced by a system of Helmholtz coils. The field inside the sample was homogeneous within 0.1%. The earth's magnetic field was compensated for with three pairs of coils, accurate to ~ 0.01 Oe.

We measured the relaxation time of the electrons of minimal mass ($m^* = 0.0094m_0$) with $\vec{H}$ parallel to the binary axis C_2. If the angle between the magnetic field and the high-frequency current $\vec{J}$ was less than 30°, then the observed CR was due only to the electrons belonging to one ellipsoid of the Fermi surface, and small orientation errors did not change the CR linewidth. Measurements at 18.74 GHz have shown that if the angle between $\vec{H}$ and C_2 is <10', then the angle between $\vec{H}$ and $\vec{J}$ has no effect on the position, form, and width of the CR. The CR signal did not depend on the working section of the sample situated under the strip (measuring 6.7 × 2 mm) or on an inclination of ±30' of the magnetic field relative to the plane of the sample. Nor was the CR linewidth affected by repeated cooling and heating of the sample to room temperature.