only in crystalline quartz at $T = 80°K$ [4] and in Rochelle salt at $T \approx 300°K$ [5]. We were also able to record SMBS without damage to the samples photographically, with the aid of a Fabry-Perot interferometer (Fig. 2). The scattered-light frequency shifts $\Delta\nu = (0.825 \pm 0.025)$ cm^{-1} in fused quartz and $\Delta\nu = (0.975 \pm 0.025)$ cm^{-1} in crystalline quartz agree with those measured in [1,2]. The plot of the intensity of the reflected light against the power of the incident light, obtained for crystalline quartz, shows a rapid exponential growth near the SMBS threshold (Fig. 3).

The damage thresholds in fused and crystalline quartz differ greatly from sample to sample and even from point to point in the same sample, the damage and the SMBS thresholds being close to each other in a crystalline-quartz sample with large internal stresses. The SMBS thresholds hardly varied from sample to sample. The damage powers listed in the table for crystalline quartz correspond to points with maximum damage threshold in a sample without internal stresses.

In order to ascertain whether the damage to the fused or crystalline quartz is due to the action of the laser emission with SMBS, we estimated, using Kroll's theory [6], the hypersound power P_s generated during this scattering process. The estimates have shown that at laser-emission powers equal to the threshold for the volume damage of fused and crystalline quartz (see the table) P_s is equal to ~100 and ~1.5×10^4 W/cm^2 respectively.

For crystalline quartz, the value of P_s is close to the sound-power flux ~10^4 W/cm^2 at which the wave amplitude exceeds the ultimate strength of this material [6]. This shows that the SMBS can be responsible for the damage to crystalline quartz, although another damage mechanism is possible, particularly ionization.

As to fused quartz, we can conclude here quite definitely that its damage is not due to SMBS, since the quoted hypersound power $P_s = 100$ W/cm^2 is much lower than the value required to produce damage (the elastic-stress amplitude $\sigma \simeq 60$ kg/cm^2 corresponding to this power is much lower than the rupture stress $\sigma_{\text{rup}} \simeq 3 \times 10^4$ kg/cm^2 for fused quartz [7]).

In conclusion, the authors are grateful to N. N. Denisov for help with the work.

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INVESTIGATION OF STIMULATED MANDEL'SHTAM-BRILLOUIN SCATTERING THRESHOLDS FOR DIFFERENT MEDIA AT WAVELENGTHS 0.35, 0.69, and 1.06 μ

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We measured the stimulated Mandel'shtam-Brillouin scattering (SMBS) thresholds at an angle $\theta = 180°$ (backward scattering) in chlorobenzene, water, K-8 silicate glass, and crystalline quartz at wavelengths 0.35 μ (second harmonic of ruby laser, maximum energy $E_m = 0.07$ J at a pulse duration $\tau = 15$ nsec), 0.69 μ (ruby laser with saturable dye, $E_m = 0.7$ J, $\tau = 25$ nsec), and 1.06 μ (laser with KGSS-7 glass and saturable dye, $E_m = 0.5$ J, $\tau = 15$ nsec).

We developed and used in our investigation a simplified method of observing SMBS, consisting in the following:

The Q-switched laser emission (Fig. 1) was focused by lens 7 on the sample 8. Plate 5 diverted part of the back-scattered light to screen 6. The occurrence of back-scattered SMBS was revealed by the appearance of a small bright spot on the screen 6 (Fig. 2a). Simultaneous registration of the scattered light with the aid of a Fabry-Perot interferometer [2] and of the spot on the screen has shown that in all cases the threshold for the occurrence of the spot corresponded to the occurrence of the first SMBS Stokes component.

It is of interest to note that, owing to the divergence of the primary beam, the back-scattered light is convergent. A photograph of the beam at the minimum cross section is shown in Fig. 2b. The shape and structure of the spot on the screen 6 duplicate essentially the primary beam, and do not depend on the scattering medium and on the focal length of the lens 7 (in the range from 75 to 800 mm). In all cases, the aperture of the back-scattered light corresponded to the aperture of the primary beam and was independent of the diameter of the focusing lens, thus indicating that stimulated scattering in the backward direction took place. The reasons why there was no scattering in other directions call for further research. With the primary radiation power greatly in excess of threshold, the backward-scattered SMBS radiation power is more than 50% of the power of the exciting light for all the investigated samples.*

The table lists the threshold energies in the unfocused beam, obtained under standard experimental conditions (focusing with a 75 mm lens).

Comparison of the threshold power densities at different frequencies calls for allowance for the differences in the intensity distributions in the focus of the lens; this was

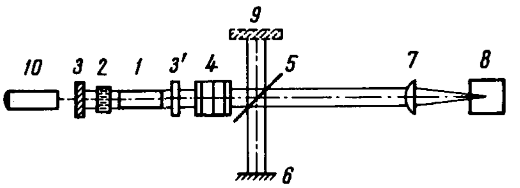

Fig. 1. Experimental setup: 1 - Active laser element (ruby or neodymium glass); 2 - cell with saturable dye; 3 - mirror with R = 1; 3' - semitransparent output mirror; 4 - attenuating filters and KDP crystal (for λ = 0.35 μ); 5 - semitransparent deflecting plane-parallel plate or wedge; 6 - screen; 7 - lens; 8 - investigated sample; 9 - mirror used only to obtain the Fabry-Perot interferometer patterns; 10 - He-Ne laser.

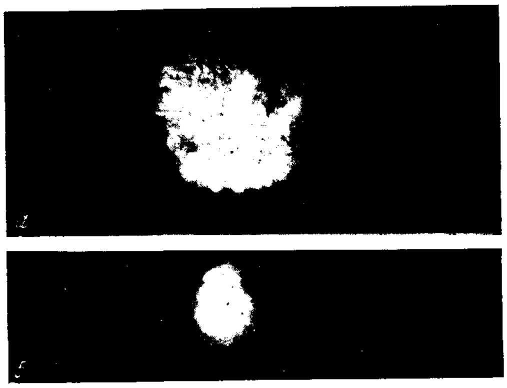

Fig. 2. a - Spot produced on screen upon occurrence of backward SMBS (magnification 4×). b - The same spot at minimum cross section (magnification 8×).

not done in our work. On the other hand, comparison of the thresholds at the same frequency for different substances is feasible. The accuracy with which the thresholds were determined at each frequency is 20 - 30% (approximately 50% for chlorobenzene).

Table

Threshold energies in unfocused beam for backward SMBS excited at the focus of a lens (f = 75 mm)

Medium	λ = 1.06 μ	λ = 0.69 μ	λ = 0.35 μ
Chlorobenzene	0.01 J	0.02 J	0.01 J
Water	0.07 J	0.10 J	0.10 J
K-8 glass	0.07 J	0.09 J	-
Single-crystal quartz (along z axis)	0.06 J	0.11 J	0.01 J

It should be noted that at all frequencies the SMBS for chlorobenzene is lower by approximately one order of magnitude than the SMBS threshold for water. This may be connected with the low self-focusing threshold in chlorobenzene [5,6]. The values of the threshold energies for each of these liquids are approximately the same at all frequencies. For K-8 glass the SMBS threshold for red and infrared light coincides approximately with the threshold of this effect for water, and no SMBS is observed in glass at 0.35 μ, possibly as a result of the appreciable absorption of the glass in this spectral region.

On the other hand, for quartz at 0.35 μ, the SMBS threshold is lower by almost one order of magnitude than at 1.06 and 0.69 μ, and becomes comparable with the threshold for chlorobenzene. At the same time, a change is observed in the character of the produced damage: At 0.69 and 1.06 μ the damage is in the form of a pointlike hit at the focus, accompanied by a cracking of the material; at 0.35 μ the damage is in the form of a chain of faults, starting at the focus and continuing for several millimeters beyond the focal region. The lowering of the threshold and the change in the character of the damage are apparently connected with self focusing. The SMBS effect was also observed by us at 0.35 μ in ruby crystals, for which filament-like damage connected with self focusing was observed earlier [7]. No SMBS was observed in ruby at other frequencies in our experiments. For quartz and K-8 glass, at all frequencies, the threshold of damage to the samples by laser radiation was approximately equal (within 20%) to the corresponding threshold of backward SMBS. This indicates that the stimulated scattering phenomenon can play a noticeable role in the damage produced in these materials [8,9].

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* Such an appreciable backward-scattering power was observed earlier only for carbon disulfide [1,3,4].

PLASMA CONTAINMENT IN A THREE-DIMENSIONAL TRAP FORMED BY A MICROWAVE QUASIPOTENTIAL

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The existence of an averaged quasipotential $\varphi = e^2E^2/4m\omega^2$, produced by an electromagnetic field of amplitude E and frequency ω [1], makes possible three-dimensional containment of a rarefied plasma ($\omega_L < \omega$) without the use of a constant magnetic field. We have attempted in the present investigation to contain a plasmoid by means of the forces of an averaged microwave potential. The experimental setup was as follows (see Fig. 1): a three-dimensional quasipotential trap was produced in a cylindrical resonator of 9 cm diameter and 12 cm length by exciting, with the aid of a decimeter-band microwave generator, an E_{011} mode in which the electric field is zero at the center. The plasma source was a spark gun 2, the plasma jet from which could pass through the center of the resonator. The plasma was generated by the gun in a time 0.2 - 0.5 μsec. In the experiment, the minimum height of the barrier trap was 700 eV, the resonator Q was 750, the microwave pulse duration was 7 - 9 μsec, the vacuum was 3×10^{-7} Torr, and the plasma-jet density at the center of the resonator was 5×10^9 particles/cm^3.

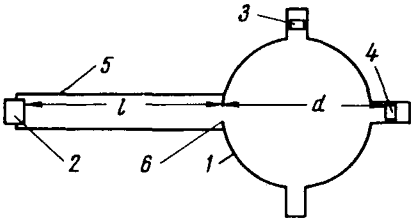

Fig. 1. Arrangement of spark chamber and probes: 1 - resonator; 2 - spark gun, 3,4 - plasma probes; 5 - transit tube; 6 - diaphragm of 0.6 cm diameter.

By delaying the switching of the microwave generator relative to the instant of gun operation, it is possible to investigate two possible modes. In the first, the plasma jet encounters in its path to the resonator an already-produced microwave barrier, T < 11 μsec (T - time between the instant of gun operation and the end of the microwave pulse). In the second, the microwave generator is turned on after the plasma has already entered the resonator, T > 11 μsec.

The oscillogram of probe 4 (Fig. 2d) shows that the plasma does not reach the probe during the time of the focusing microwave power pulse (Fig. 2e), but reaches the probe at a time t following the end of the microwave pulse. Theoretically, the plasma reaching the diaphragm 6 during the time of the microwave pulse cannot penetrate into the resonator, and