SPEED OF SOUND IN LIQUID NEON NEAR THE BOILING LINE

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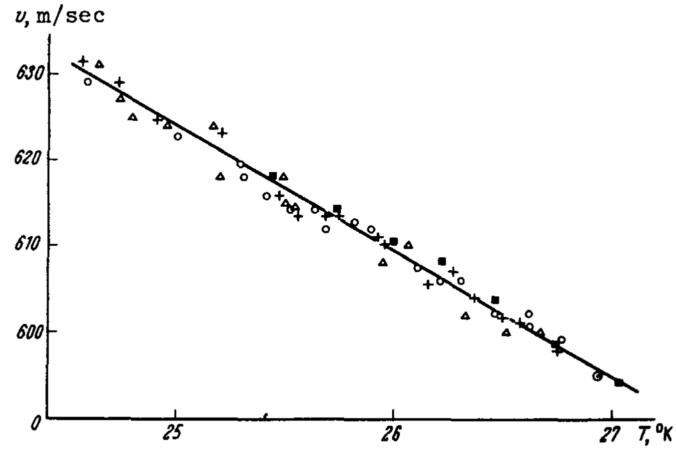
The speed of sound was measured in liquid helium at temperatures from 24.6 to 27°K and at pressures close to that of the saturated vapor. The measurements were made by the Debye-Sears method, using neon of purity better than 99.9%. The main impurities were nitrogen, helium, and hydrogen.

The ultrasound pickup employed was a barium titanate (piezolan) tablet of 12 mm diameter. The natural frequency of the pickup at room temperature was 2.4 MHz. During the measurements in the liquid neon, the frequency, determined with a precision frequency meter, was 2.695 MHz.



Temperature dependence of the speed of sound. o - measurement No. 1 (2.695 MHz); + - measurement No. 2 (2.695 MHz); ■ - measurement No. 3 (2.695 MHz); Δ - measurement No. 4 (8.376 MHz).

The light source was a 100-W high-pressure mercury lamp. The measurements were made with the 546-nm green line. The diffraction patterns were photographed on ORWO RS-2 film with exposures 1/25 and 1/50 sec. The shrinkage of the film after development was taken into account in the reduction of the diffraction patterns.

The temperature was measured with a Cu - $Au_{0.98}Co_{0.02}$ thermocouple. The cold junction was located near the optical axis of the cryostat, and the hot junction was fastened to the copper case of a lead resistance thermometer placed 15 mm above the optical axis.

The results are shown in the figure. The equation for the temperature dependence of the speed of sound, as determined by least squares, is

$$V = 989.0 - 14.602T. \qquad (1)$$

Here V is the speed of sound in m/sec and T is the temperature in °K.

The experimental points cluster about this line with small deviations, of which the largest is 0.38%, the rms deviation being 0.18%. The absolute values are preliminary, subject to slight changes when certain corrections are taken into account.

To prevent bubble formation in the liquids, the measurements were made at pressures 10 - 50 mm Hg higher than the saturated vapor pressure at the corresponding temperature. This gave fairly sharp diffraction patterns. Within the limits of the experimental accuracy, the measurement results were independent of the pressure in the indicated pressure range.

The measurements were made at 8.376 MHz. The results obtained at this frequency agreed, within the limits of measurement accuracy, with the results obtained at 2.695 MHz.

I am grateful to Professor Bewilogua for support during the work and for valuable discussions, and to H. Siegling for help with the measurements.

[1] P. Debye and F. W. Sears, Proc. Natl. Acad. Sci. 18, 409 and 414 (1932).

USE OF LASER TO MEASURE THE CROSS SECTION OF STIMULATED EMISSION OF MATTER

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The stimulated-emission cross section σ is one of the most important constants of active laser materials. In particular, knowledge of σ makes it possible to estimate the position of the investigated ion in the matrix. We describe below a new method of measuring σ, based on the change of intensity of the spontaneous luminescence of a medium under the influence of resonant laser radiation [1-3].

Let us examine the change of the population of the third (working) level in a four-level Q-switched laser during the lasing process. We can neglect the influence of the pump and of the spontaneous emission on the population of the metastable level during the time of the giant pulse. In this case the change of the inverted population is determined only by the field inside the cavity.

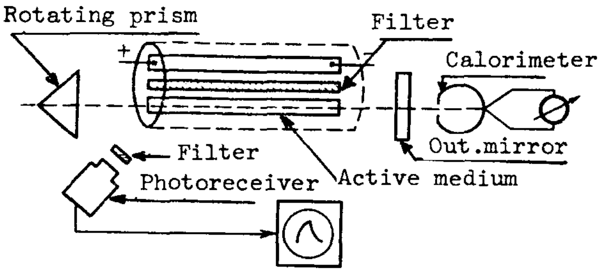

Fig. 1

Assuming that the population of the lower laser level is $N_2(t) \equiv 0$, we can write

$$\frac{dN_3}{dt} = -\sigma_{32} n(t) N_3, \qquad (1)$$

where N_3 is the population of the metastable level in the four-level system, σ_{32} is the stimulated-emission cross section, and $n(t)$ is the photon flux density in the active rod during the time of lasing.

We denote by t_1 and t_2 the instants when the giant pulse begins and ends. Solving