along the melting curve. It can also be assumed that this connection remains in force also far from the melting curve, i.e., in the region of metastable existence of one of the phases.

2. The wide range of validity of Simon's equation [13], which describes the melting curves of different substances, and the conclusion presented above, show that a universal connection can also exist between the entropies of the liquid and solid phases.

Table

Substance	cm^3/g	cm^3/g
Cu	$8.19\cdot10^{-5}$	$2.7\cdot10^{-2}$
NaCl	$29.4\cdot10^{-5}$	$9.2\cdot10^{-2}$
He^4	0.109	1.766

3. The first two conclusions can explain the existence of formulas relating the melting temperature of substances with the properties of one phase only (see Lindeman's equation [8]).

4. It follows from (5) that under infinite contraction the volume jump during melting tends to a finite value; this is one more argument against the possible existence of a critical point on the melting curve.

[1] E. A. Kraut and G. C. Kennedy, Phys. Rev. Lett. 16, 608 (1966).
[2] E. A. Kraut and G. C. Kennedy, Phys. Rev. 151, 668 (1966).
[3] J. J. Vilvary, Phys. Rev. Lett. 16, 1089 (1966).
[4] W. F. Libby, Phys. Rev. Lett. 17, 423 (1966).
[5] S. N. Vaidya and E. S. Raja Gopal, Phys. Rev. Lett. 17, 635 (1966).
[6] S. E. Babb Jr., Phys.Rev. Lett. 17, 1250 (1966).
[7] K. Mukherjee, Phys. Rev. Lett. 17, 1252 (1966).
[8] J. K. Roberts, Heat and Thermodynamics, Blackie, 1940.
[9] M. K. Zhokhovskii, in: Issledovaniya v oblasti izmerenii vysokikh davlenii i Trudy institutov komiteta (Research in High-pressure Measurements and Transactions of the Institutes of the Committee), Press of the Sate Committee on Standards and Measures, 1964, p. 69.
[10] R. L. Mills and E. R. Grilly, Phys. Rev. 99, 480 (1955).
[11] E. R. Grilly and R. L. Mills, Ann. of Physics 8, 1 (1959).
[12] S. B. Kormer, M. V. Sinitsyn, G. A. Kirillov, and V. D. Urlin, Zh. Eksp. Teor. Fiz. 48, 1033 (1965), Sov. Phys. JETP 21, 689 (1965).
[13] V. D. Urlin, ibid. 49, 485 (1965), transl. 22, 341 (1965).
[14] S. E. Babb Jr., Revs. Modern Phys. 35, 400 (1963).

THRESHOLD OF EXCITATION OF TRANSVERSE ELASTIC WAVES BY A LASER BEAM

A. L. Polyakova
Acoustics Institute

Submitted 7 June 1967
ZhETF Pis'ma 6, No. 4, 595-597 (15 August 1967)

When a high-intensity light wave produced by a laser propagates in a solid, interaction takes place between the light and elastic waves and can lead, under certain condition to growth of both longitudinal and transverse waves. Such a simultaneous excitation of longitudinal and transverse waves was revealed in [1] by stimulated Mandel'shtam-Brillouin scattering.

Let us consider a case in which a light wave with frequency ω_0, wave vector k_0, and electric-field amplitude E_0 is scattered simultaneously by a longitudinal and by a transverse wave. Then the wave vectors of both elastic waves are equal to $q = 2k_0$ (the Bragg condition), but their frequencies are different. In the case of an isotropic body, two waves are possible, with frequencies $\Omega_\ell = qv_\ell$ and $\Omega_t = qv_t$, where v_ℓ and v_t are the propagation velocities of the longitudinal and transverse elastic waves, respectively. The complete system of equations describing the elastic waves with the electric field of the light wave consists of Maxwell's equations and the equations of motion of the elastic medium with allowance for electrostriction [2,3]. The synchronism conditions for the two reflected light waves with frequencies ω_1 and ω_2 and wave vectors k_1 and k_2, which propagate in a direction opposite to that of the incident light and sound waves, are

$$\omega_1 = \omega_0 - \Omega_\ell, \qquad \omega_2 = \omega_0 - \Omega_t$$
$$k_1 = q - k_0, \qquad k_2 = q - k_0 + \Delta k, \tag{1}$$

where $\Delta k = qn[(v_\ell - v_t)/c]$ (c = velocity of light in vacuo, n = refractive index), Δk being a small quantity compared with q ($\Delta k \approx 10^{-5}q$).

Assuming conditions (1) to be satisfied and assuming the pump field amplitude E_0 to be constant in first approximation, and the amplitudes of the reflected light waves and elastic waves to vary slowly with the distance, we can obtain the conditions under which the elastic waves grow with increasing distance. Assuming the incident wave to be linearly polarized we find that the excitation thresholds of the longitudinal and transverse waves in an isotropic medium are given respectively by the relations

$$|E_0|_\ell^2 > \frac{2\pi (K + (4/3)\mu)\epsilon_0 a_\ell^2}{qk_1\alpha_2(\epsilon_0 + \alpha_2)}, \tag{2}$$

$$|E_0|_t^2 > \frac{8\pi\mu\epsilon_0 a_t^2}{qk_2\alpha_1(2\epsilon_0 - \alpha_1)}. \tag{3}$$

Here a_ℓ and a_t are the absorption coefficients of the longitudinal and transverse waves, K and μ are the moduli of hydrostatic ocmpression and shear, while α_1 and α_2 are the photoelastic constants for the isotropic body.

For quarts, in the case when an incident light wave polarized along the X axis propagates along the Z axis, the threshold for the longitudinal wave is equal to

$$|E_0|_\ell^2 > \frac{8\pi c_{33}\epsilon_0 a_\ell^2}{qk_1\alpha_{13}(\epsilon_0 + \alpha_{13})}, \tag{4}$$

for a transverse wave polarized along the X axis we have

$$|E_0|_{t_1}^2 > \frac{4\pi c_{44}\epsilon_0 a_{t_1}^2}{qk_2[2(\alpha_{44} - \epsilon_0)\alpha_{44} - 2\alpha_{14}^2}, \tag{5}$$

and for a transverse wave polarized along the Y axis

$$|E_0|_{t_2}^2 > \frac{4\pi c_{44}\epsilon_0 a_{t_2}^2}{qk_2\alpha_{14}}. \tag{6}$$

Here c_{33} and c_{44} are the components of the elastic-constant tensor, a_{14}, a_{13}, and a_{44} the components of the photoelastic-constant tensor, and ε_0 the dielectric constant of the unperturbed crystal.

To estimate the threshold sensitivity in the quartz, we shall assume that the absorption coefficients a_ℓ and a_t are of the same order of magnitude. This does not contradict the experimental data for hupersonic waves [4]. An estimate shows then that for a transverse wave polarized in the same direction as the incident light wave the thrshold intensity is of the same order as for a longitudinal wave. The threshold intensity for a transverse wave polarized in a perpendicular direction is larger by approximately one order of magnitude. Thus, the simultaneous excitation of longitudinal and transverse waves observed in [1] can be explained.

It should be noted at the same time that the growth increment of a longitudinal wave is usually larger than the increment of a transverse wave, and consequently the longitudinal wave is easier to excite. To excite a transverse wave it is necessary that the intensity of the incident light greatly exceed the threshold.

In conclusion, I am grateful to I. L. Fabelinskii for useful discussions.

[1] S. V. Krivokhizha, D. I. Mash, V. V. Morozov, V. S. Starunov, and I. L. Fabelinskii, ZhETF Pis. Red. 3, 378 (1966), JETP Lett. 3, 245 (1966).
[2] N.M. Kroll, J. Appl. Phys. 36, 34 (1965).
[3] C. F. Quate, C. D. W. Wilkinson, D. K. Winslow, Proc. IEEE 53, 1604 (1965).
[4] E. M. Ganapol'skii and A. N. Chernets, Zh. Eksp. Teor. Fiz. 51, 383 (1966), Sov. Phys. JETP 24, 255 (1967).

ERRATA

In JETP Letters V. 6, No. 4, p. 101, 5th line from top:

read "data for hypersonic waves [4]."