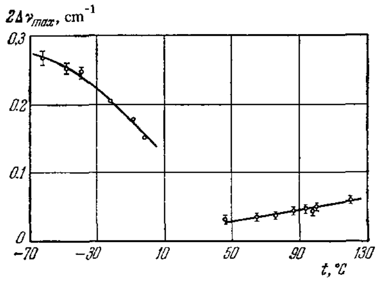

FIG. 1. Temperature dependence of $(2\Delta\nu_T) \approx (2\Delta\nu_{max})$ – the distance between the components of the fine structure of the Rayleigh-line wing in salol [7].

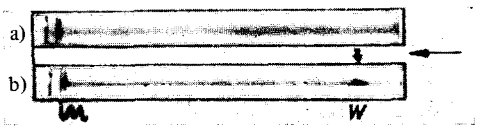

FIG. 2. Photograph of two-photon luminescence of the exciting radiation (8) and of the light scattered by nitrobenzene (b). W – maximum of two-photon luminescence, showing the existence of picosecond pulses in the stimulated scattering of light in the Rayleigh-line wing [11].

The performed experiment raises the question of a new theoretical investigation of this problem.

The authors observed and investigated four-photon interaction in stimulated scattering of the Rayleigh line; it is shown that such an interaction can cause the appearance of anti-Stokes and a large number of Stokes components of SMBS in liquids consisting of anisotropic molecules[9].

It has been previously proposed[10] that the back-scattered ($\vartheta = 180°$) StSW radiation contains ultrashort or picosecond radiation pulses of duration $t_S \leq 10^{-11}$ sec; these pulses were subsequently observed[11].

Ultrashort pulses in StSW were registered with the aid of a two-photon luminescence procedure. The scattered light passed through a vessel with a solution of rhodamine-6Zh in alcohol and was reflected backwards by a mirror. If the radiation contained short pulses, then the points of their encounter in the luminescent solution should reveal maxima of two-photon luminescence.

From the distance between these maxima it is possible to determine the time between two neighboring pulses, and from the widths of the maxima it is possible to determine the pulse duration. The StSW was excited with a giant ruby-laser pulse of power ~150–200 MW and duration 10^{-8} sec, focused inside a vessel with nitrobenzene.

Figure 2b shows the maximum of two-photon luminescence and demonstrates that the StSW radiation contained not less than two ultrashort pulses. Such pulses could be registered only if the spectrum of the scattered light revealed an intense Stokes StSW with total extent ~0.5–1.5 cm^{-1}.

The existence of the ultrashort StSW pulses explains[10,11] why the StSW spectrum usually reveals a band instead of the narrow line predicted by the stationary theory. The ultrashort StSW pulses can have a duration $t_S \sim \tau$, where τ is the anisotropy relaxation time, and consequently their spectral width is $(\Delta\Omega)_{max} \sim 1/\tau$.

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[1] V. S. Starunov, E. V. Tiganov, and I. L. Fabelinskiĭ, ZhETF Pis. Red. 5, 317 (1967) [JETP Lett. 5, 260 (1967)].

[2] D. I. Mash, V. V. Morozov, V. S. Starunov, and I. L. Fabelinskiĭ, ibid 2, 41 (1965) [2, 25 (1965)].

[3] D. I. Mash, V. S. Starunov, and I. L. Fabelinskiĭ, Zh. Eksp. Teor. Fiz. 47, 783 (1964) [Soviet Phys.-JETP 20, 523 (1965)].

[4] I. L. Fabelinskiĭ and V. S. Starunov, Appl. Optics 6, 1793 (1967).

[5] G. J. A. Stegeman and B. P. Stoicheff, Phys. Rev. Lett. 21, 202 (1968).

[6] I. L. Fabelinskiĭ, Molekulyarnoe rasseyanie sveta (Molecular Scattering of Light), Nauka, 1965 [Consultants Bureau, 1968].

[7] I. L. Fabelinskiĭ, L. M. Sabirov, V. S. Starunov, Phys. Lett. 29A, 414 (1969).

[8] L. M. Sabirov, V. S. Starunov, and I. L. Fabelinskiĭ, ZhETF Pis Red 8, 399 (1968) [JETP Lett. 8, 246 (1968)].

[9] Yu. I. Kyzylasov and V. S. Starunov, ibid 7, 160 (1968) [7, 123 (1968)].

[10] Yu. I. Kyzylasov, V. S. Starunov, and I. L. Fabelinskii, ibid 9, 383 (1969) [9, 227 (1969)].

[11] Yu. I. Kyzylasov and V. S. Starunov, ibid 9, 648 (1969) [9, 401 (1969)].

A. A. Berdyev, and N. B. Lezhnev. Acoustic Investigations of Liquids at Microwave Frequencies

The paper is a review of experiments performed in liquids at high and microwave frequencies, and also of the results obtained in the Laboratory of Molecular Acoustics of the Physicotechnical Institute of the Turkmenian Academy of Sciences.

In experimental investigations of the parameters of the liquids at microwave acoustic frequencies was carried out both by an optical method of investigating the fine structure of the line of Rayleigh scattering of lime, where incoherent radiation of phonons is used, and by direct methods in which the coherent sound is generated artificially. Whereas only a few years ago these experimental methods were separated by a frequency region extending over almost two orders of magnitude, this experimental gap has now been eliminated, owing to the efforts of Soviet and foreign scientists.

The theoretical concepts and the experimental facts show that the ultrasonic relaxation in liquids appears in a very wide range of frequencies. The acoustic apparatus developed by the authors for the frequency region 10^7–3×10^9 Hz, where new materials and methods of generating and receiving microwave acoustic frequencies are used, has made it possible to gain a greater insight in the mechanism of relaxation effects in a number of individual and viscous liquids, and also electrolyte solutions.

Recently, in connection with the development of radioelectronic and semiconductor techniques, new possibilities have appeared of obtaining microwave

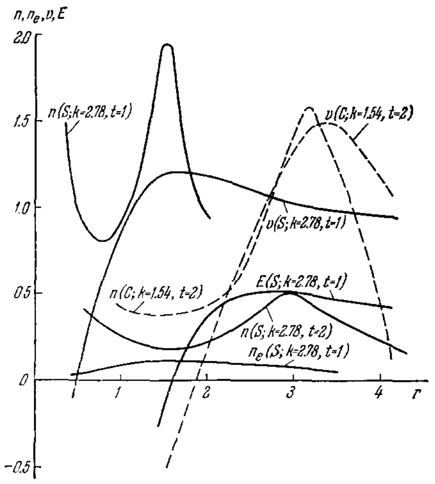

FIG. 1. Structure of pulse.

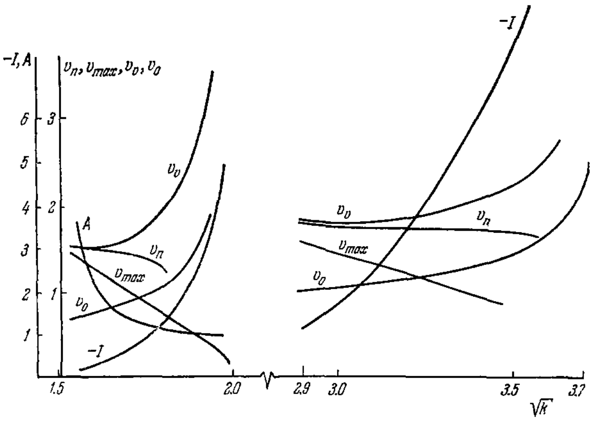

FIG. 2. Parameters of self-similar wave as functions of the initial density $\sqrt{k}$.

sound frequencies and to use them for the investigation of the liquid state. These promise an opportunity of a deeper study of the liquid state of matter by acoustic methods.

M. A. Gintsburg. Nonlinear Waves in Cosmic Plasma

In the first part of the paper the author described his work on acceleration of particles in nonlinear waves with a magnetic field in the vicinity of the earth and on the sun[1].

The second part is devoted to a solution of the problem of the expansion of a strongly inhomogeneous plasma. The initial density varies like C/r^2, where r is the distance from the axis, and the Debye radius can no longer be regarded as a characteristic dimension. If the ion density is $n = C/r^2$, and the electrons did not succeed yet in leaving the ions, $n_e = C_1/r^2$, but at the same time succeeded in acquiring a Boltzmann distribution, $n_e = e^{\varphi}$ ($T_e \gg T_i$), then an electric field $E = 2/r$ is automatically established in the plasma, and this blocks the electrons in a potential well and keeps them attached to the ions.

The time evolution of the plasma and of the field was investigated for three cases: spherical plasmoid (S), cylindrical column (C), and a plane layer (P). The main results are as follows: 1) a pulse of velocity, field, and density is produced, traveling with velocity v_v; $v_v > u_s$, where u_s is the velocity of the ion sound, to which all the velocities in Figs. 1 and 2 are normalized; 2) the effect of velocity inversion, which is now directed towards the center, takes place in the region behind the pulse. The absolute value of the velocity increases (ion-acceleration effects).

Figure 1 shows the structure of the pulse. The spherical pulse (S) is shown for two successive instants of time t = 1 and t = 2; we see how it spreads out. Figure 2 shows the dependence of the velocity of the characteristic points of the pulse on the initial density $\sqrt{k}$ (k—density at a distance of 1 cm from the axis, expressed in units of $\kappa T_e/4\pi e^2$, v_v—velocity of the maximum-velocity point, v_n—velocity of the maximum density, v_{max}—maximum ion velocity, v_0—velocity of the velocity-inversion point, A—pulse amplitude, −I—rate of change of the total number of particles.

The problem of stationary expansion ($\partial/\partial t \equiv 0$) of a plasma jet in a transverse direction, due to runaway of electrons, has also been solved. This runaway leads to a rotation of the velocity vector of the ions until it coincides with the radius vector at the observation point.

A numerical solution of the magnetohydrodynamic equations shows that oscillations of the particle velocities, fields, and density arise also in the expansion of a cold plasma (both in an initial magnetic field and in an initial electric field).

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[1] M. A. Gintzburg, Astron. zh. **45**, 610 (1960) Soviet Astronomy AJ **12**, 484 (1968); Kosm. issledovaniya (Cosmic Research) **4**, 296 (1966); J. Geophys. Res. **72**, 2749 (1967); Phys. Rev. Lett. **14**, 625 (1965) and **16**, 327 (1966).

A. Ya. Kipper. Certain Theoretical Questions in the Formation of Magnetic Fields of Stars and Nebulas

Nonstationary processes in outer space constitute the most interesting branch of astrophysics. In the case of nonstationary cosmic rays, a significant role is played by magnetic fields, which change the character of motion of the matter or give rise to various new phenomena.

The main problem of cosmic magnetic fields is their origin. It has been established by now that the initial presence of very weak fields suffices to give rise to strong fields. The motion of matter with high electric conductivity strengthens a weak field to almost any intensity. On the other hand, the initial weak field can arise in the presence of forces of non-electric origin. A number of rather likely hypotheses have been advanced in the literature concerning this question. It seems that the origin of cosmic magnetic fields is by now clear and requires no further consideration.

Nevertheless certain problems connected with the origin of cosmic magnetic fields have not yet been solved, such as the conditions under which a field is expected to appear, especially a strong one, the question whether the magnetic field of a star is an excep-