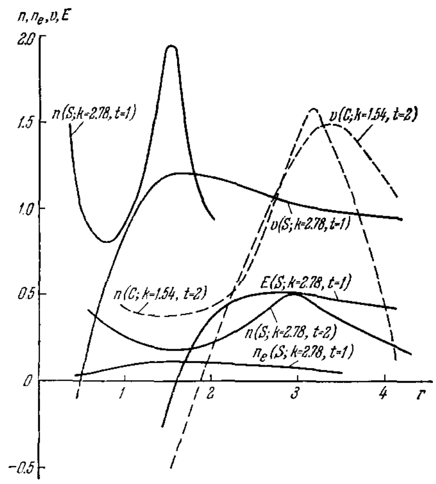

FIG. 1. Structure of pulse.

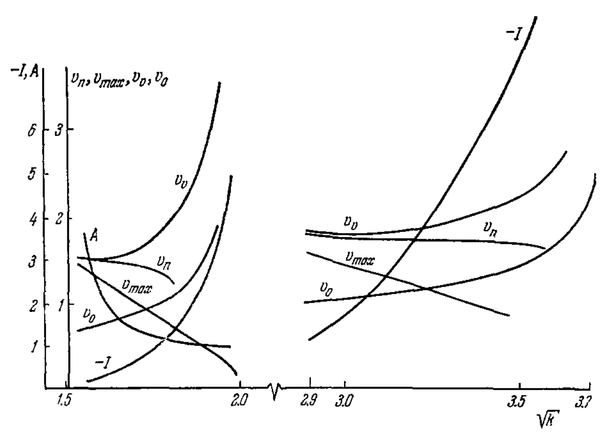

FIG. 2. Parameters of self-similar wave as functions of the initial density $\sqrt{k}$.

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).

[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-