It seemed of interest to investigate this possibility. We therefore used the setup illustrated in Fig. 1 to perform experiments on the electrodynamic deformation of the discharge channel obtained following an electric explosion of a copper wire of 0.07 mm diameter.

The developing processes were registered with the aid of a high-speed motion-picture camera (SFR-2M) using the IAB-451 Toepler setup. The wires were exploded by discharging a capacitor bank of 38.46 μF charged to 14 kV. The self-inductance coefficient of the discharge circuit was 6.9 μh and the maximum discharge current reached 36 kA. We registered in the experiments the oscillations of the current in the circuit and of the voltage directly across the discharge gap. An oscillatory discharge was observed.

It can be concluded from the experimental results that electrodynamic deformation of the discharge channel actually produces three vortices. As shown in the motion-picture frames (Fig. 2), the upper vortex, turning through some angle relative to the picture plane, shifts downwards. The two lateral vortices also change their position somewhat. A system of three vortices is produced and remains stable during the entire photography time (more than 1 msec).

Comparison of the motion picture with those of the explosion of straight wires bent in a different manner, and also with a series of motion pictures identical with those of Fig. 2, confirm the regularity of the observed phenomenon. It must be noted, however, that the process of vortex formation by this method is sensitive to the symmetry of the initial shape of the wire and to the magnitude of the discharge current.

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CHANGE OF CARRIER DENSITY IN ANTIMONY AND ARSENIC UNDER HYDROSTATIC COMPRESSION

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1. A new method was recently developed for the determination of the carrier density in semimetals. This method is convenient for the determination of the pressure dependence of the carrier density N(p) [1].

For compensated metals, whose Fermi surface is close to ellipsoidal, the following relation holds

$$\frac{2}{\pi e c}\int_0^\infty \sigma_{xx}(H)\,dH = N(q^{(+)} + q^{(-)}),$$

where $\sigma_{xx} = \rho_{xx}/(\rho_{xx}^2 + \rho_{xy}^2)$ is the conductivity in the basal plane of the crystal, ρ_{xx} and ρ_{xy} are the experimentally measured resistivity tensor component, $\vec{H}$ is the magnetic field, which is directed along the trigonal axis of the crystal, $N = N^{(+)} = N^{(-)}$ is the density of the holes or electrons, respectively, and $q^{(+)}$ and $q^{(-)}$ are certain dimensionless parameters (for the holes and electrons). An important factor is that these parameters depend only on the degree of anisotropy of the carrier-mobility tensor, and are quite stable against changes in

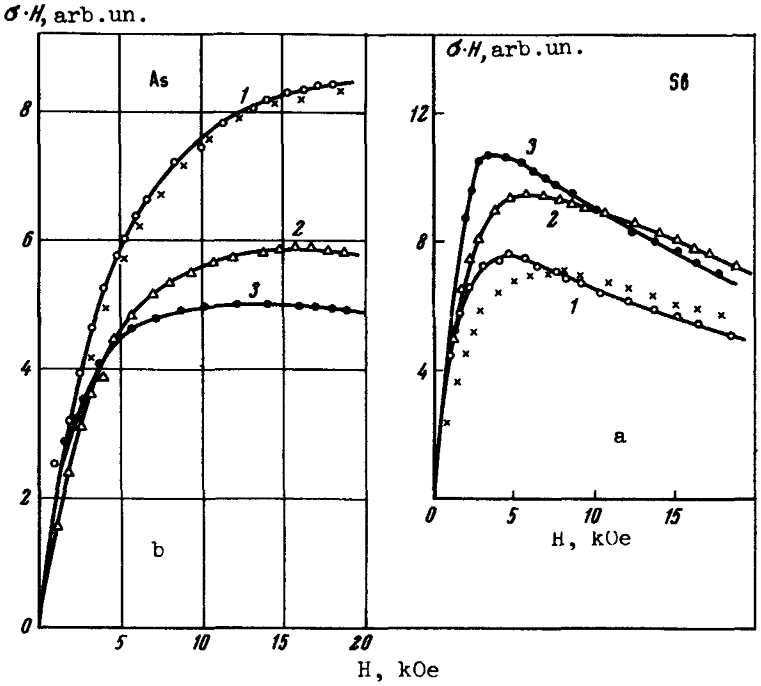

Fig. 1. Plot of $\{\sigma(H)H\}$ vs. H for Sb and As at pressures a - 3) p = 27.4 kbar, 2) p = 17.8 kbar, 1) p = 0 (o - 17.8 kbar pressure removed, × - 27.4 kbar pressure removed); b - 3) p = 29.3 kbar, 2) p = 24.8 kbar, 1) p = 0 (o - 29.3 kbar pressure removed, × - 24.8 kbar pressure removed).

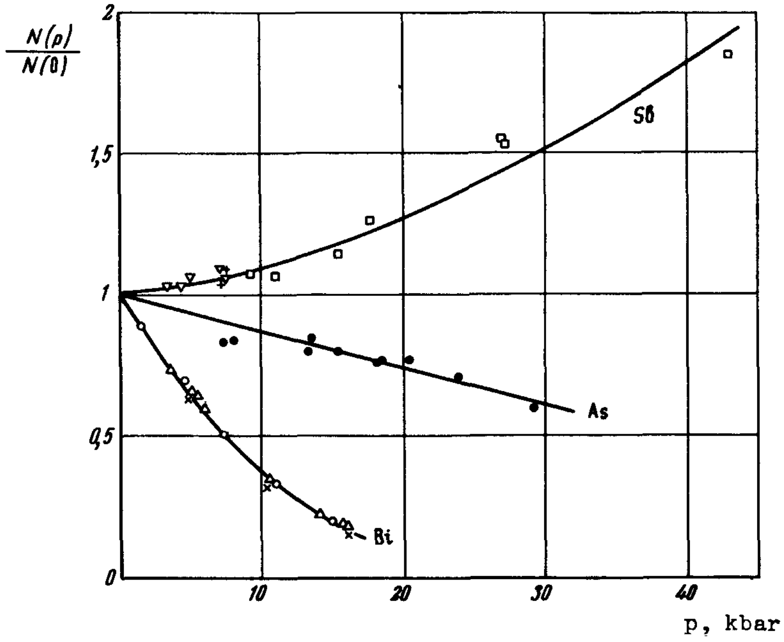

Fig. 2. Change in carrier density with pressure, N(p)/N(0), for Bi, Sb, and As: Sb - a) hydrostatic pressure, ∇ - calculated from $\int_0^\infty \sigma_{xx}(H)\,dH \sim N(p)$; + - calculated from $\{\sigma(H)H\}_{H=H_{extr}}$; b) quasihydrostatic pressure, □ - calculated from $\{\sigma(H)H\}_{H=H_{extr}}$; As) ● - quasihydrostatic pressure, calculated from $\{\sigma(H)H\}_{H=H_{extr}}$; Bi) Δ - calculated from $\int_0^\infty \sigma(H)\,dH \sim N(p)$ at hydrostatic and quasihydrostatic pressures, × - calculated from $\{\sigma(H)H_{H=H_{extr}}$; o - results of oscillatory measurements.

the carrier mobility. It thus becomes possible to eliminate the role of the mobilities, and the ratio of the areas under the $\sigma_{xx}(H)$ curves measured at different pressures will yield directly the pressure dependence of the carrier density $N(p)/N(0) = f(p)$. In those cases when the integral $\int_0^\infty \sigma_{xx}(H)dH$ cannot be determined with sufficient accuracy, it is possible to use an estimate based on the fact that the dependence of $\{\sigma(H)H\}$ on H should have a maximum at a certain value of the magnetic field H_{extr}, and the magnitude of this maximum is proportional to N [2].

A special investigation of the capability of the method of [1], carried out on Bi [2] and graphite [3], has shown that it yields good agreement with the results of a direct determination of the change of the volume of the Fermi surfaces under compression by oscillatory methods. It is also shown that the method is also suitable for polycrystals.

2. Since there are still no published experimental data on the character of the pressure dependence of the energy spectra of Sb and As, it was of interest to use the new method to determine N(p) of these metals. Since Bi, Sb, and As are usually regarded as a single group of semimetals with crystal-lattices of similar parameters and with a common genesis of the energy spectrum, it was natural to expect Sb and As to have the same pressure dependence of the carrier density. This point of view was confirmed also by the calculations of Falicov [4], who predicted for Sb (in analogy with Bi) a decrease in the overlap of the fifth and sixth bands with increasing pressure.

3. Measurements of $\int \sigma_{xx}(H)dH$ of Sb single crystals, made at pressures up to 8 kbar by the procedure proposed in [5], have shown that the carrier density in Sb increases with pressure, in contrast to the calculations of [4], the increase at p = 9 kbar being (7 ± 3)%. Owing to the smallness of the effect, special interest attaches to measurements at higher pressures. Pressures up to 43 kbar were obtained with the aid of the procedure described in [6], which makes it possible to obtain only quasihydrostatic pressure. Owing to the strong drop in the carrier mobility under non-hydrostatic compression, it is impossible to determine $\int \sigma(H)dH$ with sufficient accuracy ($R(H = 19\ \text{kbar})/R(H = 0) \approx 10$). Therefore, to estimate the change of the carrier density with pressure we used the dependence $\{\sigma(H)H\}$ on H. We observed an increase of the maximum of $\{\sigma(H)H\}_{H=H_{extr}}$ with pressure, thus indicating an increase of the carrier density under compression (Fig. 1a). At p = 43 kbar, the ratio is $N(p)/N(0) \approx 1.8$. In As, to the contrary, one observes in analogy with Bi a decrease in the carrier density with increasing pressure (a decrease in the value of $\{\sigma(H)H\}_{H=H_{extr}}$ with increasing pressure, see Fig. 1b). It is of interest to compare the measured values of N(p) of Sb and As with the similar relation for Bi (Fig. 2). We call attention to the fact that the change in the carrier density upon compression is similar for Bi and As and is dissimilar for Sb. It is also of interest to note that the pressure effect in Sb and As is anomalously large compared with Bi, since the carrier density in As and in Sb is larger by 7.3×10^2 and 1.85×10^2 respectively than in Bi.

Since Falicov's calculation of the change of the band overlap in Sb upon compression did not take into account the influence of the parameter u, which characterizes the displacement of the sublattices, it can be assumed that it is just the change of this parameter which is decisive in the case of Sb.

In conclusion, we are grateful to Yu. A. Pospelov for valuable discussions and to E. I. Skidan and N. A. Mikryukova for help with the measurements.

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PARA PROCESS IN YTTRIUM IRON GARNET IN A HIGH-FREQUENCY MAGNETIC FIELD IN THE VICINITY OF THE CURIE POINT

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Relaxation processes and corresponding relaxation energy losses should take place in ferro- and antiferromagnets near the Curie and Neel points, owing to the intense development of the spin fluctuations [1]. The action of an external magnetic field on the spin system (both constant and alternating), i.e., the para process, should change these losses [2]. These phenomena have not yet been observed experimentally in ferro- and antiferromagnets. Yet the development of methods for their measurement would afford an additional opportunity of investigating magnetic phase transitions.

The susceptibility of the para process in alternating magnetic fields should have near the Curie point the complex form $\chi_p = \chi'_p - i\chi''_p$. The imaginary part of the susceptibility χ'_p determines the para-process losses. According to [1], anomalies should be observed in the temperature dependence of this parameter near the Curie point.

The purpose of the present study was to observe experimentally the aforementioned phenomena in yttrium iron garnet in a high-frequency magnetic field. The ferrite single crystal had the form of an ellipsoid of revolution with axes 25, 8, and 8 mm. The choice of yttrium iron garnet was dictated by the fact that it has low eddy-current losses and a low magnetostriction and small internal friction in the vicinity of the Curie point, thereby ensuring a low level of interfering effects. Furthermore, this material has a relatively high magnetization, giving rise to a large para process near the Curie point.

The measurement coil containing the investigated sample was placed in a cylindrical quartz oven with bifilar winding, which was placed in turn in a dewar. The temperature stabilization (with allowance for the temperature gradient) was accurate to ±0.5°. A special winding produced in the investigated sample, along the [111] axis, a weak magnetic field of intensity $H_{\sim} = 10$ mOe, of frequency 3.174 MHz, and a constant magnetizing field of intensity