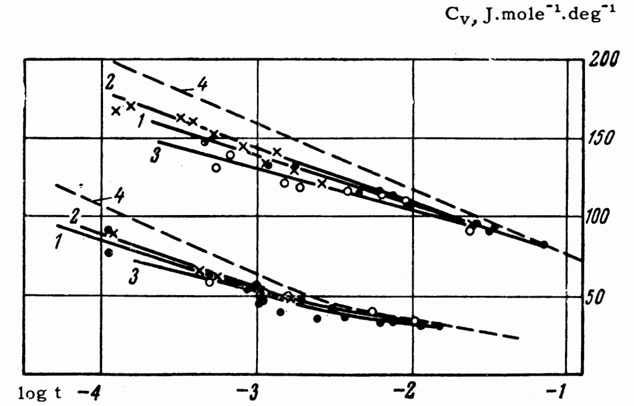

FIG. 2. Dependence of the specific heat of argon on log t at the densities: 1) 0.521 g/cm³ (o); 2) 0.530 g/cm³ (×); 3) 0.538 g/cm³ (o); 4) 0.533 g/cm³.

sults by Fisher,[3,5] we attempted to analyze the present results on the logarithmic scale (log C_V as a function of log t). Such an analysis showed that (at $T > T_c$) a power dependence (with an exponent $\frac{1}{4}$), as well as a semilogarithmic dependence, were equally compatible with the data within the limits of the scatter of the points. However, we are still of the opinion that the logarithmic dependence is more likely both because it fits the most reliable points and because we can retain the concept of a discontinuity, which seems important to us.

At present, we see no reason to review the propositions advanced in [4].

The authors are grateful to A. P. Golub', V. A. Popov, V. V. Shchekochikhin, and V. G. Gorbunov for their help in making the measurements.

[1] Bagatskiĭ, Voronel', and Gusak, JETP 43, 728 (1962), Soviet Phys. JETP 16, 517 (1963).

[2] Voronel', Chashkin, Simkin, and Popov, JETP 45, 828 (1963), Soviet Phys. JETP 18, 568 (1964).

[3] M. E. Fisher, Preprint, Rockefeller Institute, New York, 1964.

[4] Azbel', Voronel', and Giterman, JETP 46, 673 (1964), Soviet Phys. JETP 19, 457 (1964).

[5] M. E. Fisher, J. Math. Phys. (New York) 5, 944 (1964).

Translated by A. Tybulewicz
141

A POSSIBLE METHOD FOR STUDYING FERMI SURFACES

Yu. V. SHARVIN

Institute for Physics Problems, Academy of Sciences, U.S.S.R.

Submitted to JETP editor December 30, 1964

J. Exptl. Theoret. Phys. (U.S.S.R.) 48, 984-985 (March, 1965)

WITH measurements of the conductivity of metal samples in a magnetic field it is possible to observe various size effects if the electron free path is sufficiently large in comparison to the dimensions of the sample. We describe here an idea for an experiment which allows us to produce inside a metal single crystal something like a beta spectrograph with focusing of the electrons in a longitudinal magnetic field.

If there is an elliptic turning point on the Fermi surface for a given direction of the uniform magnetic field, then electrons located in the vicinity of this point of momentum space will be focused by the magnetic field, i.e., the electrons that have emerged from some point inside the metal collect again at a point which lies on the same line of force at a distance L from the first point. The distance L is related to the field strength H by

$$2\pi n\hbar / \sqrt{K} = eHL / c, \qquad (1)$$

where K is the Gaussian curvature of the Fermi surface at the turning point and n is an integer (if additional conditions are satisfied, focusing can also be realized on other parts of the Fermi surface; we do not discuss this here).

To observe the focusing effect it is proposed to measure the resistance of the sample between two contacts of very small size, which could be made, for example, by means of thin wires contacting the surface of the sample at two points on opposite sides of it. If the conditions for focusing are fulfilled for these points, there must be periodic minima in the dependence of the sample resistance on H.

One could also suggest another more practical and convenient arrangement of the experiment, in which the current is passed between the first microcontact and an auxiliary contact. Then the potential difference between the second microcontact and the other auxiliary contact will be extremal if the focusing conditions are fulfilled.

The magnitude of the effect can be estimated from the following simple considerations. We consider initially the value of the sample resistance in the absence of a magnetic field. The electric field differs from zero only in the immediate neighborhood of the contacts. Since the free path length noticeably exceeds the dimensions of this region, the resistance of the sample is determined only by electron acceleration near the contacts and does not depend on the free path just as, for example, in the case of the anomalous skin effect. In the absence of a magnetic field each of the contacts can be considered independently. In order to avoid unimportant complications connected with introducing a contact with a wire made of another metal, we regard the contact as a small area of diameter D in which there is contact between two half-spaces occupied by the single crystal studied and separated by a thin insulating diaphragm with a hole. In this form the problem resembles passage of a dilute gas through a hole. If the potential difference applied to the sample is V, the electrons going through the contact in either direction receive a speed increment equal to $\pm eV/p$ (where p is the Fermi momentum), from which a current $\sim (e^2V/p)D^2N$ arises (N is the electron density in cm^{-3}), i.e., the contact resistance is

$$R = p / e^2D^2N. \quad (2)$$

If the current is led into the sample through two microcontacts, the resistance of the sample in the absence of a magnetic field will equal the sum of the resistances of both contacts. If there is a magnetic field and the focusing condition is also fulfilled, part of the electrons accelerated in one contact already have this speed increment when they fall upon the other contact. As a result, the resistance of the sample decreases by a factor equal to the ratio of the solid angle in which focused electrons move to the whole angle in which electrons move from the contact. The values of these angles are determined by the required precision of focusing, i.e., by the dimensions of the contacts. A simple calculation shows that the relative decrease of the resistance due to focusing is $\sim (D/L)^{2/3}$, where L is the distance between the contacts.

From these estimates we find that for L = 0.05 cm, $D = 10^{-4}$ cm, and a measuring current of order 10 mA, the amplitude of the voltage peaks should be of order 10^{-7} V, which is fully measurable.

One of the basic difficulties of this experiment is the necessity of precise preliminary setting of the field direction. Such a setting could evidently be carried out using at first a field strong enough so that the resistance of the sample depends noticeably on the field direction and assumes a minimum value at the desired field direction.

Investigation of the effect described could give information on the curvature of the Fermi surface, and on the value of the free path and its temperature dependence. With a particular choice of parameters it is possible to impart to the electrons an energy large in comparison with kT and to study the dependence of the free path of the electrons on their energy.

I thank A. A. Abrikosov for useful discussions and P. L. Kapitza for interest in the work.

Translated by J. Shier
142

MAGNETIC MODEL OF THE UNIVERSE

Ya. B. ZEL'DOVICH

Submitted to JETP editor January 6, 1965

J. Exptl. Theoret. Phys. (U.S.S.R.) **48**, 986-988 (March, 1965)

IN the following we make the assumption that a primordial homogeneous magnetic field existed in the universe and we examine the features of the corresponding cosmological solution. Such a possibility has been cited by Hoyle,[1] but he considered it unsatisfactory and unpalatable, and contrasted it with the self-excited field in a steady-state theory with creation of matter.

The assumption of a primordial magnetic field has been the subject of a whole series of papers in which the difficulties due to the spontaneous origination of the galactic field have been pointed out.[1-3] Other works have considered the formation of the universe by condensation of a conducting gas within a magnetic field, in which case the structure of the galaxies and their radio-emanations are dependent on the orientation of the original inter-galactic field relative to the angular momentum of the gaseous cloud. A magnetic field which is homogeneous within the limits of a galaxy or of a cluster of galaxies has been considered in connection with the problem of quasars[8] and cosmic rays.[9]

In the present paper we take the next step in the direction of considering fields which are homogene-