Scientific session of the Division of General Physics and Astronomy of the Academy of Sciences of the USSR (25 September 1991)

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A scientific session of the Division of General Physics and Astronomy of the Academy of Sciences of the USSR was held on September 25, 1991 in the P. L. Kapitsa Institute of Physics Problems. The following reports were presented at the session.

90th Anniversary of the birth of L. V. Shubnikov

1. *N. E. Alekseevskiĭ.* Introduction to "Works of L. V. Shubnikov."

2. *V. N. Laukhin.* Shubnikov–de Haas effect in organic superconductors.

3. *R. V. Parfen'ev and M. L. Shubnikov.* Shubnikov–de Haas effect in semiconductors.

First five years of high-T_c superconductivity, news about M^2S-III

(Kinasawa, Japan, 22–26 July, 1991)

4. *L. V. Keldysh.* High-T_c Superconductivity-91 through the eyes of a dilettante.

5. *Reports by N. E. Alekseevskiĭ, S. V. Gaponov, Yu. V. Kopaev, F. A. Kuznetsov, S. M. Stishov, V. B. Timofeev, and I. F. Shchegolev.*

A brief summary of one report is given below.

R. V. Parfen'ev and M. L. Shubnikov. *Shubnikov–de Haas effect in semiconductors.*

In this report the status is described of investigations up to 1930 in the laboratory of Kamerlingh–Onnes in Leiden of low-temperature electric properties of bismuth, in which L. V. Shubnikov and de Haas discovered a new effect—oscillations of the electrical resistance of the metal in a strong magnetic field. Later the low-temperature oscillations of the magnetoresistance of bismuth and other metals formed the basis of the effect named after the two scientists—the quantum oscillations of kinetic coefficients. The Shubnikov–de Haas effect was developed in investigations of a number of metals as a method for studying the topology of the Fermi surface of charge carriers, since the period of the oscillations as a function of the inverse magnetic field is directly determined by the extremal cross section of the Fermi surface, perpendicular to the intensity vector of the magnetic field. The Shubnikov–de Haas discovery led to the development of an entire branch of physics of oscillations (in a magnetic field) of both kinetic and thermodynamic characteristics of metals, alloys, and degenerate semiconductors having different symmetry, composition and size and shape of the Fermi surfaces. The latter dependence is most interesting for semiconductors, in which the charge-carrier density and the spectrum can be altered by doping with differing impurities by creating a system of solid solutions.

In order to oserve the Shubnikov–de Haas effect the Fermi energy, the magnetic field, and the temperature must have optimal values. In the report these were discussed in detail for semiconductors. It should be noted that the study of the Shubnikov–de Haas oscillations in semiconductors became possible only after progress had been made in the technology of growing crystals with uniform impurity concentration and composition; this was noted already by L. V. Shubnikov in an investigation of the properties of bismuth, single crystals of which he grew with great care by the Obreimov–Shubnikov method.

In the report the results of investigations of the Shubnikov–de Haas effect in semiconductors with different filling of the conduction band, in multivalley semiconductors with different effective masses and carrier g-factors, and different number of filled energy extrema, as well as under the action of external factors, for example, hydrostatic and uniaxial pressure and lowering of the dimensionality of the system, were discussed. Special attention was devoted to the change in the electron interactions in a quantizing magnetic field in the semiconductor compounds and systems studied. The large amount of information provided by the Shubnikov–de Haas effect and the development, stimulated by it, of the quantum theory of transport phenomena in a magnetic field have led to the development of an experimental method of spectroscopy of semiconductors based on the Shubnikov–de Haas effect.

Translated by M. E. Alferieff

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