Physics – Uspekhi **42** (1) 45 – 47 (1999)

CONFERENCES AND SYMPOSIA PACS number: 01.10.Fv

Kourovka-98: the XXVII International Winter Workshop on Theoretical Physics

(Kyshtym, Chelyabinsk region, Russia, March 2 – 7, 1998)

The Ural Winter Workshop of theoretical physicists ('Kourovka') is the oldest school of physics in the Ural region, regularly holding since 1961. It was organized on the initiative of Academician S V Vonsovskiĭ who was its leader for more than three decades. In 1998 the workshop was held for the 27th time.

From the very beginning the workshop was a national (rather than regional) scientific event. It gained high authority among researchers working in the physics of condensed matter. The authority and wide popularity of the workshop was always ensured by the topicality and timeliness of the scientific program, its broad spectrum, membership of well-known researchers, and the democratic nature of the discussions.

The 'Kourovka' was by no means the specialized school within the precincts of which the narrow-minded problems were being discussed. For the past thirty seven years almost all the history of development and formation of the solid-state theory in the second half of the XX century was reflected in the scientific program of the school whose members were also the immediate originators of this theory. In the space of all these years the school topics followed the way of development for such branches as the electronic structure of condensed matter and related computation methods, various phase transitions and their attendant modifications of physical properties of solids, disordered systems and their properties, magnetism and superconductivity, multilayer structures, low-dimension systems and surface phenomena, kinetic and resonance phenomena in solids, nonlinear phenomena, dynamical chaos, and more. A high proportion of the 'Kourovka' topics was devoted to the discussion of adequate mathematical methods for setting up and solving the urgent problems in the theory of solids.

In different years the guest lists of Kourovka participants included such renowned scientists as A A Abrikosov, A M Afanas'ev, A F Andreev, V G Bar'yakhtar, V L Bonch-Bruevich, A S Borovik-Romanov, A A Chernov, I E Dzyaloshinskiĭ, Yu V Gulyaev, Yu M Kagan, M I Kaganov, M È Kaner, L V Keldysh, M S Khaĭkin, D A Kirzhnits, E I Kondorskiĭ, Yu V Kopaev, A M Kosevich, M A Krivoglaz, M A Leontovich, L A Maksimov, V P Silin, G A Smolenskiĭ, S M Stishov, R A Suris, N V Timofeev-Resovskiĭ, S V Tyablikov and many others. Not only theoreticians but also experimenters participated in the workshops. Recently the workshop became an international scientific event, and researchers from several countries took part in its sessions.

Uspekhi Fizicheskikh Nauk **169** (1) 49 – 51 (1999)
Translated by E Yankovsky; edited by A Radzig

Kourovka-98 was organized under the auspices of the Institute of Physics of Metals, Ural Branch of the Russian Academy of Sciences (the Organizing Committee was chaired by Prof. A P Tankeev) and Chelyabinsk State University (co-chairman Prof. V D Buchel'nikov). The workshop was held in the Southern Ural in a picturesque place on the coast of lake Sugomak near the town of Kyshtym (Chelyabinsk region) in the 'Dal'nyaya Dacha' rest house, with ideal conditions for productive work and leisure.

The main sponsors of the *Kourovka-98* were the Russian Foundation for Basic Research, the Administration of Chelyabinsk region, the Institute of Physics of Metals, UB RAS, and Chelyabinsk State University. The sponsor activity of the Presidium of the Ural Branch of the RAS, the International Centre for Fundamental Physics (Moscow) and the "Spektrum" Science and Technology Association (Ekaterinburg) would be also recognized.

The scientific program of the workshop included four topical problems of the physics of condensed matter: the electronic structure of metals and alloys, kinetic and dynamic effects, resonance and nonlinear phenomena, and phase transformations in inhomogeneous systems. The main goal of the workshop was to acquaint the participants with a wide range of basic ideas in all their aspects, the state-of-the-art research in these fields of solid-state physics, and the latest achievements in them. More than 180 researchers from CIS took part in the workshop, mainly from Russia (Chelyabinsk, Ekaterinburg, Izhevsk, Kazan', Krasnoyarsk, Moscow and Perm') and the Ukraine (Donetsk, Khar'kov and Kiev). Despite applications to participate in the workshop, no researchers from non-CIS countries took part.

The lecture part of the *Kourovka-98* program consisted of 17 lectures (11 plenary and 6 sectional). Verbal and displayed reports (a total of 116) were submitted in six sections: electronic structure, transport phenomena, spin dynamics and transformation of waves, magnetic resonance and relaxation, nonlinear dynamics and instabilities, and phase transitions. According to the workshop's program and within the framework of four display sections (electronic structure, transport phenomena, spin dynamics and transformation of waves, and phase transitions), round-table discussions of the reports presented at these sections were conducted. For the first time in the history of the Kourovka workshops, students and masters (a total of 16) from Chelyabinsk, Udmurt (Izhevsk), and Ural (Ekaterinburg) State Universities participated. Their reports were delivered in a special 'student' section.

A distinctive feature of this workshop was the participation of a large number of young researchers: the age of about one-third of the participants was no more than 33 years. It is very important that young researchers take part in such

workshops. Considerable financial support aimed at the participation of young researchers was provided by the Presidium of the Ural Branch of the Russian Academy of Sciences, which allocated special resources, and the Administration of the Chelyabinsk region.

Each problem mentioned in the program of the workshop was elaborated on in lectures delivered at plenary and sectional sessions. The following lectures were read on the problem of the electronic structure of metals and alloys: "Nonadiabatic effects in electron – phonon interactions", where a detailed review of the theoretical and experimental work in this field was given by E G Maksimov (P N Lebedev Physics Institute of the Russian Academy of Sciences, Moscow), and "On peculiarities of the density of states and kinetic properties near the Anderson transition point" by I M Suslov (P L Kapitza Institute for Physical Problems of the Russian Academy of Sciences, Moscow). The lecture by A S Moskvin (Ural State University, Ekaterinburg) on pseudo-Jahn – Teller centres and characteristics of magnetic resonance in copper oxides largely referred to the same problem. At present much attention is focused on the research done on the electronic structure and properties of organic metals which constitute a good model of a two-dimensional metal. The lecture by V G Peschanskiĭ (B I Verkin Institute of Low-Temperature Physics and Technology of the National Academy of Sciences of the Ukraine, Khar'kov) gave a review of the state-of-the-art theoretical and experimental studies in this area of fermiology.

As is known, the electronic structure also determines the kinetic properties of solids. Five lectures were devoted to this topic. The lecture by A B Granovskiĭ (M V Lomonosov Moscow State University), which dealt with the anomalous Hall effect in granular alloys, gave rise to considerable interest. Granovskiĭ made a complete analysis of the mechanisms of the anomalous Hall effect in granular metal–metal alloys with giant magnetoresistance and the nature of this effect in metal–insulator alloys. A lively discussion followed the lecture by É L Nagaev (Institute of High-Pressure Physics, RAS, Moscow), devoted to the nature of the giant magnetoresistance of the metal – insulator transition. The lecturer also gave a critical review of all the known mechanisms of this phenomenon. The same topic was elaborated on in the lecture by N G Bebenin (Institute of Physics of Metals, UB RAS, Ekaterinburg) who discussed in detail the mechanisms responsible for the conductivity in highly doped lanthanum manganites.

The influence of magnetic order on the de Haas – van Alphen effect in strongly correlated systems (systems with heavy fermions and systems with low current-carrier concentration) was discussed in detail in the lecture by V V Val'kov (L V Kirenskiĭ Physics Institute of the Siberian Branch of the Russian Academy of Sciences, Krasnoyarsk), which also drew much attention. The lecture by R N Gurzhi (B I Verkin Institute of Low-Temperature Physics and Technology, NAS of the Ukraine, Khar'kov) dealt with kinetic phenomena in a two-dimensional degenerate gas of colliding electrons. Gurzhi presented the results of investigations into the electron dynamics of a beam of electrons injected into a two-dimensional degenerate electron gas.

The problem of resonance and nonlinear phenomena was covered in three lectures. As is known, magnetic substances constitute an ideal system for studying nonlinear effects. All three lectures on nonlinear and dynamical phenomena dealt mainly with the spin dynamics of magnetic materials. The topic of A M Kosevich's lecture (B I Verkin Institute of Low-Temperature Physics and Technology, NAS of the Ukraine, Khar'kov) was Bloch oscillations of a magnetic soliton (analytical results and computer simulation) in an easy-axis ferromagnet. B N Filippov (Institute of Physics of Metals, UB RAS, Ekaterinburg), who reported on many of his results, lectured on studies of the nonlinear dynamics of domain walls (topological solitons) with internal degrees of freedom in magnetic films with a low Q-factor. His lecture raised extremely much interest: its topic was essentially the nonlinear dynamics of two-dimensional systems with a long-range interaction, for which analytical methods have to be more advanced, so that studies of such systems require well-developed numerical algorithms. All this was thoroughly discussed in the lecture. The starting point in describing spin dynamics in magnetic materials is the Landau – Lifshitz equation. Solutions of the linearized version of this equation serve as a basis for studying weakly nonlinear excitations. A method used to derive the linearized equations that describe the precession of individual spins in magnetic materials was proposed in the lecture by P E Zil'berman (Institute of Radio Engineering and Electronics of the Russian Academy of Sciences, Moscow). The starting point in this method is the quantum Liouville equations with an allowance made for thermal and spontaneous spin fluctuations.

The lecture by V V Ustinov (Institute of Physics of Metals, UB RAS, Ekaterinburg) was devoted to metallic superlattices with a controllable magnetic structure. The topic belongs both to the problem of kinetic phenomena and to the spin dynamics problem. The lecture was based entirely on the original findings obtained at the Institute of Physics of Metals, UB RAS where these materials have been synthesized and where their magnetic, electric, and kinetic properties are being thoroughly studied.

Three lectures that aroused unusual interest dealt with the topic of phase transitions. First, Academician B V Litvinov's lecture (Russian Federal Nuclear Centre "All-Russia Technical Physics Research Institute," Snezhinsk, Chelyabinsk region) was devoted to a field of materials science that is being intensively developed, namely, the use of explosives (and explosions) for the solution of selected problems of materials science. He discussed the results of studies of metallic materials synthesized in conditions of strong shock loading (or explosions), the phase diagrams of these materials, the properties of the materials synthesized in such a peculiar way, and the mathematics of processing the results.

The lecture by V G Shavrov (Institute of Radio Engineering and Electronics, RAS, Moscow) also dealt with original results obtained as a result of studying the shape-memory effect and the reverse plasticity of magnetically ordered intermetallic compounds. A complete analysis of the features of magnetic and structural phase transitions in such substances was carried out and the effect of a magnetic field on the temperature of martensite transformation was evaluated.

The effects of giant electromagnetic-acoustic transformation in ferromagnetic metals in the vicinity of magnetic phase transitions were examined in the lecture by V D Buchel'nikov (Chelyabinsk State University), which was also based on the results of original studies done in Moscow (Moscow State University and the Institute of Radio Engineering and Electronics, RAS), Izhevsk (Institute of Physics and Technology of the Ural Branch of the Russian Academy of Sciences), and Chelyabinsk (Chelyabinsk State University and South-Ural State University).

The lecture by A A Kokin (Institute of Physics and Technology of the Russian Academy of Sciences, Moscow) stood quite separately in the workshop's program. It was devoted to a basic problem, the transition from microelectronics to nanoelectronics and the fundamental physical limitations impeding the transition. Such lectures of problematic character, which do not hold for the main topic of the winter school, are a distinctive feature of Kourovka workshops.

Under the workshop's program, four sections of displayed reports were conducted. Round-table discussions took place in the evenings after the reports had been presented at the sections. The topics of these reports were extremely varied. As noted earlier, a wide range of subjects discussed is also a tradition of Kourovka workshops. It is impossible in this paper to give even a brief review of the reports displayed. We only note that to a great extent they reflect the tendencies that follow from the analysis of the above-cited lectures. This is especially true of the sections devoted to transport phenomena and spin dynamics. For example, at the section devoted to transport phenomena, the report by V V Marchenkov (Institute of Physics of Metals, UB RAS, Ekaterinburg) on the role of electron–dislocation scattering in the magnetoresistance of metallic crystals subjected to a strong magnetic field aroused considerable interest. Marchenkov discussed experiments which prove that dislocation walls in a metal may act as a sort of (fairly smooth) interface although the typical distances between dislocations are much larger than the characteristic electron wavelength. The report by V L Kobelev (Institute of Physics of Metals, UB RAS, Ekaterinburg) on non-Debye relaxation in fractal space resulted in a lively discussion about the limits of applicability of the concept of fractals in solid-state physics. In the section devoted to spin dynamics, a most lively discussion developed after N K Dan'shin (Donetsk Institute of Physics and Technology of the Ukrainian National Academy of Sciences, Donetsk) reported on the contribution of longitudinal oscillations of magnetization to resonance properties in the presence of spin-orientation phase transitions.

In addition to the four display sections there were four sections of verbal reports. The section of magnetic resonance and relaxation phenomena was mainly devoted to reports on nuclear magnetic resonance in high-temperature superconductors and magnetic materials. A lot of attention was focused on NMR research involving the magnetic structure and quantum fluctuations in quasi-one-dimensional antiferromagnets (P L Kapitza Institute for Physical Problems, RAS, Moscow; Institute of Spectroscopy, RAS, Troitsk; Institute of Physics of Metals, UB RAS, Ekaterinburg).The section devoted to nonlinear dynamics and instability examined the various features of the weakly nonlinear dynamics of magnetic substances. Here we note the report by V M Eleonskiĭ (State Research Institute of Physical Problems, Moscow) on vortex structures and symmetry patterns in nonlinear media. He reported on the results achieved in constructing weakly nonlinear two-dimensional wave lattices for a number of simple nonlinear-field models and discussed the symmetry problem of their patterns along with the possibility of replacing strictly periodic wave lattices by quasi-periodic ones. The 'student' section was also active, with the reports dealing with such topics as nonlinear physics, magnetic and superconducting properties of cuprates, and systems with giant magnetoresistance.

On the whole, the *Kourovka-98* workshop can be considered a success. The analysis of the lectures and the numerous reports suggests that, notwithstanding the critical financial situation of fundamental science in the CIS countries, some areas of the physics of condensed matter have retained their potential and are being actively developed. This is true of such hot topics as giant magnetoresistance, metallic superlattices, the physics of nanostructures, quantum fluctuations in quasi-one-dimensional antiferromagnets, and the fermiology of organic conductors as well as of traditional topics such as the electronic structure of metals and alloys, nonlinear problems of spin dynamics, magnetic resonance, various aspects of wave conversion, and phase transitions. The workshop demonstrated that in all these areas of physics the level of research done by Russian scientists is high and corresponds to international standards. Unfortunately, there is a high price to pay for this, because the scientific apparatus and devices are approaching the end of their service lives and are becoming more and more outdated. As for the problem of the new generation of scientists, the workshop showed that the influx of young scientists is getting stronger. Probably, this is the consequence of measures taken by the government to support young physicists that wish to follow a scientific career. The main goal now is to create all necessary conditions that will persuade the young scientists to follow this path of creative research.

The program of the workshop was fulfilled completely. The participants noted the high level of the lectures and reports, which made it possible to advance substantially in the understanding of a series of important problems of solid-state physics. The discussions were certainly fruitful, especially for the young contributors. It was decided that some of the *Kourovka-98* lectures will be published in one of the issues of the journal *Fizika Metallov i Metallovedenie*. An issue of the *Vestnik Chelyabinskogo Gosuniversiteta* will also be devoted to the proceedings of the workshop. The next *Kourovka* workshop is planned for the year 2000 and will cover the systems with strong electron–electron correlations.

V D Buchel'nikov, A P Tankeev, V G Shavrov