

PERSONALIA

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Evgenii Grigorievich Maksimov (on his 70th birthday)

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27 October 2008 is the 70th birthday of Professor Evgenii Grigorievich Maksimov — a corresponding member of the Russian Academy of Sciences, head of the Superconductivity Sector at the Theory Department of the Lebedev Physical Institute, Doctor of Physical and Mathematical Sciences.

E G Maksimov was born 27 October 1938 in the village of Aprelevka near Moscow. His father Grigorii Vasilievich Maksimov was killed on the frontline in 1943. His mother Anna Gavrilovna Kuleshova worked at the Aprelevka gramophone disc factory. In 1955, after finishing school with a gold medal, Maksimov entered the Physics Department of Lomonosov Moscow State University. He frequently refers to himself as a person who has often been lucky in his life. One such lucky event was his study at the MSU Physics Department when outstanding physicists of our time were teaching there: I K Kikoin, L D Landau, M A Leontovich, and many other prominent scientists. In particular, Maksimov's time at the University was unique in that Landau taught all parts of his course in theoretical physics, including quantum electrodynamics (the only such case in all of Landau's teaching). The lectures on theoretical physics by Landau were attended not only by students but also by the staff of the Physics Department and a number of research institutes of the Academy of Sciences.

It was by no means less lucky that in 1963 Maksimov started his postgraduate studies at the Theory Department, Lebedev Physical Institute; basically all of what Maksimov has been doing in science since then is associated with this Department. His scientific advisor David Abramovich Kirzhnitz taught Maksimov not only the basic elements of research work but also the ethics of unbiased and honest attitudes to ideas, others' as well as one's own. Soon after the beginning of his postgraduate studies, Maksimov took part in a research project, initiated by V L Ginzburg, on high-temperature superconductivity (HTSC), which is still the focus of his research interests.

Presently, Maksimov is one of the top experts in condensed-matter physics; he has authored more than 100 research papers and coauthored three collective monographs that are broadly recognized by the scientific community, both in this country and abroad. Maksimov's main achievements are in the field of superconductivity (including the various aspects of HTSC), the effects of electron – phonon coupling on the kinetic and thermodynamic properties of metals, and first-principle calculations of the properties of solids.

Maksimov has formulated a generalized approach to the theory of superconductivity based on dynamic ion scattering functions. This approach, applicable to disordered and

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strongly anharmonic crystals, allowed Maksimov to be the first to show that nonmagnetic impurities and other defects of a crystal lattice can significantly affect the critical temperature T_c by changing the lattice dynamics. He also demonstrated a strong dependence of the isotopic effect in superconductors on the anharmonicity. He was the first to clearly identify the role played in superconductors by low-frequency phonons, whose energy is below the superconducting transition temperature ($\omega < T_c$), by showing that although these phonons affect the value of T_c only weakly, they significantly alter the superconducting properties of the relevant systems in comparison with the predictions of the Bardeen – Cooper – Schrieffer model and, in particular, lead to a gapless spectrum of one-particle excitations at $T \neq 0$. This work acquired first-rate importance in view of the discovery of high-temperature superconductors, where the anharmonicity and the effects of low-frequency phonons are very strong. Recently, Maksimov and the group headed by him carried out detailed studies of systems with a strong electron – phonon coupling; they have shown that many features of the normal and superconducting states of high-temperature superconductors find their explanation within this approach.

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An important contribution has been made by Maksimov to the theory of high-temperature superconductivity. He and Kirzhnitz worked out a description of superconductivity in the language of the dielectric response functions. One of the main points of that work was to obtain a criterion for the efficiency of the HTSC mechanism due to the inevitable existence of negative values of the dielectric function. The very possibility of the inequality $\varepsilon(\mathbf{q}, 0) < 0$ to hold had been proved by Kirzhnitz; extending that result, Maksimov established the decisive role of the local field effects in ensuring the inequality $\varepsilon(\mathbf{q}, 0) < 0$ and indicated specific systems where it does hold. In the majority of superconducting metals, in particular, it was shown to hold due to the contribution of electron – phonon coupling.

Broad recognition was brought to Maksimov and the computational physics group that he created by their work on first-principle computations of the electronic, thermodynamic, and kinetic properties of solids without any fitting parameters. Within the band theory, in particular, they computed the electron spectra, Fermi surfaces, and optical and photoemission spectra of high-temperature superconductors. The results were in good agreement with the existing experimental data, which suggests that the relevant compounds are close (in the range of composition where they are superconducting, at least) to ordinary metals, which allows using the well-established tools of computational physics in evaluating their properties.

The work done in the sector headed by Maksimov at the Theory Department resulted in the creation of exact and efficient methods for microscopic calculation of lattice dynamics and the spectral density of the electron – phonon coupling. These methods were unprecedented at the time of their appearance and they have allowed evaluating the physical properties determined by the electron – phonon coupling for a large number of metals. The results showed excellent agreement with experimental data. It is worth noting that the mere numerical evaluation of a given physical quantity and comparison with experiment was not the ultimate goal of those works by Maksimov. The main emphasis was placed there on the use of computational tools to unveil the underlying physical mechanisms.

Maksimov has made a significant contribution to the theory of ion crystals and the theory of ferroelectricity. In the classic works by Ginzburg and others, the model of a 'soft' mode had been developed for the ferroelectric transition, based on the classical concepts of the structure of ion crystals. The soft mode theory and a number of its implications for the theory of ferroelectricity recently came under massive attack, mainly from experts in first-principle computations. These computations are based on the Bloch description of the periodic electron density, which essentially complicates identifying the individual ions in a crystal. The difficulty in individuating the ions, which is objectively inherent in the Bloch description, was declared inevitable by some authors, leading them to pronounce the entire classical theory of ion crystals erroneous. Maksimov has developed a powerful and efficient method of first-principle computations of the ion crystal properties based on representing the total density of a crystal as the sum of individual ion densities, which were in turn calculated with the full account of the effect exerted on them by the surrounding crystal. This approach was widely recognized by the international scientific community and is extensively used by many research groups. This computational method for ion crystals has been used, in particular, for elucidating the nature of ferroelectric transitions in perovskite crystals.

Maksimov and his collaborators have shown in their works that their method of first-principle calculations of ion crystals leads to lattice dynamics equations that formally coincide with those in the earlier, well-known phenomenological theory of a deformable and polarizable ion. Their approach allows finding the phenomenological parameters of the model without invoking any a priori hypotheses. This served as a justification of the classical soft mode model for the ferroelectric transition and allowed calculations for a large number of ion crystals exhibiting ferroelectric and other structural transitions.

Maksimov constantly gives much attention to bringing up the next generations of scientists. He has been the adviser of many graduate students and 12 PhD (Candidate of Science) theses. Two of his students have received the Doctor of Science degree.

Maksimov is a member of the Condensed Matter Physics Scientific Council at the Russian Academy of Sciences. For many years, he has been working on expert bodies of the Russian Foundation for Basic Research and on a number of Special scientific councils. He is an active member of the *Physics – Uspekhi* Editorial Board.

Whenever EG attends any conference or workshop, his presence cannot pass unnoticed. He is known for vivid and inventive presentations, inspired involvement in discussions, and piercing questions to the speakers. For several decades, Maksimov has most actively participated in the Kourovkas, winter schools for theoretical physicists in the Urals. He was among those who actually shaped and invigorated the scientific atmosphere and the spirit of these schools. Occasional instances of his absence are invariably regretted by the participants, who miss the drive of his personality and his poems.

We know Maksimov not only as a talented theoretical physicist but also as a colorful and vivacious personality with a broad outlook, extending far beyond scientific research.

On his birthday, Maksimov is full of new ideas and research prospects. We wish him good health and the fulfillment of all his projects.

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