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PERSONALIA

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Lev Petrovich Gor'kov (on his 80th birthday)

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The outstanding theoretical physicist Academician Lev Petrovich Gor'kov had his 80th birthday on 14 June 2009. L P Gor'kov was boen in Moscow. He was one of Lev Davidovich Landau's (1908 – 1968) disciples and grew as a scientist under his immediate influence. He belongs to the group of brilliant physicists known to the world as Landau's School.

In 1947, L P Gor'kov enrolled in the Physics and Technology Department of Moscow State University (MGU) and later, when this department was reorganized, transferred to the Engineering Physics Department of the Moscow Institute of Mechanics (currently the Moscow Engineering Physics Institute, MIFI in *Russ. abbr.*). In 1953, he defended his graduation project at the Institute for Physical Problems (IFP) and then enrolled in IFP postgraduate courses and began working at the Theoretical Department headed by L D Landau. In 1955, his first papers were published, in collaboration with I M Khalatnikov, in which they studied the quantum electrodynamics of particles with spin zero and unity. In 1956, L P Gor'kov submitted his CandSc thesis followed by its viva voce. He worked for nearly ten years at the Theoretical Department of IFP.

The year 1957, when the BCS theory of superconductivity was published, became decisive for the formation of the scientific interests of Lev Petrovich. The new theory of superconductivity attracted many theorists, but it was L P Gor'kov who succeeded in making the most important contribution to the theory: in 1958, only a few months after the publication of the BCS paper, he developed a powerful new method of describing superconductivity. It is a paper of only five pages, but judging by the importance of the results obtained, this work goes far beyond the boundaries of superconductivity theory and belongs to the class of the most significant achievements in the physics of condensed media. In fact, the entire superconductivity theory as it is today is based on the 'Gor'kov equations' derived in this paper.

L P Gor'kov's significant achievement in superconductivity theory was a series of papers published in 1959 and devoted to building a microscopic foundation of the Ginzburg–Landau phenomenological equations. Thanks to L P Gor'kov's work, this theory acquired general recognition as the simplest and universal technique for studying the electromagnetic properties of superconductors.

In 1958 – 1960, L P Gor'kov and A A Abrikosov developed a theory of superconducting alloys. They worked out a so-called 'cross' diagram technique especially efficient for this problem which made it possible to achieve considerable progress in the microscopic theory of metals. Using the example of superconductors with magnetic impurities,

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Lev Petrovich Gor'kov

L P Gor'kov (together with A A Abrikosov) predicted the phenomenon of gapless superconductivity. This discovery, which apparently flies in the face of the familiar Landau criterion, led to a more profound understanding of the phenomenon of superconductivity as an ordered coherent state for the existence of which the presence of a nonzero gap is not a necessary condition. The importance of such an interpretation of the nature of superconductivity became especially timely after the discovery of superfluid phases in helium-3 and the unusual superconductivity of high-temperature superconductors with d-type pairing.

While continuing in the 1960s to work on superconductivity, L P Gor'kov also worked on problems in solid state theory and quantum statistics. In 1961, Lev Petrovich submitted and defended his thesis for Doctorate of Physico-mathematical Sciences. In 1962, the famous 'green book' appeared, *Methods of Quantum Field Theory in Statistical Physics*, which L P Gor'kov co-authored with A A Abrikosov and I E Dzyaloshinskii, in which they presented the method of Feynman diagrams, as applied to quantum statistics, making it possible to efficiently investigate condensed state physics. This book went through several editions abroad and at last was reprinted in Russia. It became a must book on the

desktop of theoretical physicists the world over and was awarded the L D Landau Prize in 1989.

In 1966, L P Gor'kov won the Lenin Prize for his series of research works on the theory of superconducting alloys and in the same year was elected Corresponding Member of the USSR Academy of Sciences.

In 1963, L P Gor'kov moved to Chernogolovka where he headed the Theoretical Department of the Institute of Chemical Physics. In 1965, L P Gor'kov took active part in the creation of the Institute for Theoretical Physics of the USSR Academy of Sciences (ITP, now bearing the name of L D Landau), which gathered many of L D Landau's disciples. L P Gor'kov worked at ITP from the day it was founded. L P Gor'kov's role in the creation and evolution of ITP — this institute soon gained worldwide recognition and high standing in the community of scientists who have occupied key positions in theoretical physics — is invaluable. For a quarter of a century (1966 – 1991) L P Gor'kov headed the Moscow Institute of Physics and Technology (MFTI in *Russ. abbr.*) Chair of Problems of Theoretical Physics, anchored at ITP. Much has changed since that time, but each year this Chair invariably takes its pick of the best students of MFTI, who then go through the education system of the Landau Institute for Theoretical Physics of the Russian Academy of Sciences. A considerable proportion of ITP researchers, whether at junior or chief positions, have graduated from this chair. One also comes across graduates of this chair at many leading research centers the world over.

At the end of the 1960s and beginning of the 1970s L P Gor'kov worked on the problem of nonstationary and nonequilibrium superconductivity. The work he reported in collaboration with G M Eliashberg built the foundation of the theory of nonstationary phenomena in superconductors and provided the stimulus for numerous experimental studies in this field. Using the theory developed in these papers, they obtained a large number of specific results reflecting the behavior of superconductors in alternating fields: nonlinear phenomena, vortex dynamics, etc.

At the end of the 1970s L P Gor'kov began working on the theory of superconductors with the A15 alloy structure and the theory of organic (one-dimensional) conductors. He predicted the main features of the competition between structural instability, superconductivity, and the metallic state in organic metals, and developed the theory of localization in these compounds that allowed him to derive the frequency and temperature dependences of conductivity.

L P Gor'kov and G M Eliashberg became interested as early as the 1960s in the electrodynamics of small-sized particles. They showed that all three types of statistics of Wigner–Dyson levels are realized in such particles under different conditions. In 1979, L P Gor'kov, A I Larkin, and D E Khmel'nitskii developed a regular method for the calculation of quantum corrections to the conductivity of mesoscopic systems; this created the foundation for the weak localization theory. This work is especially important now in connection with advances in the physics of nanostructures.

In the mid-1980s L P Gor'kov began working on superconductors with 'heavy fermions', and once high-temperature superconductivity had been discovered, he vigorously joined in the research on this problem. Together with G E Volovik, he gave a general symmetry classification of possible types of superconducting pairing, which constitutes a most important tool in the diagnostics of superconducting phases in high-temperature superconductors and heavy-fermion superconductors.

In 1987, L P Gor'kov was elected Full Member of the USSR Academy of Sciences. In 1991, together with A A Abrikosov and V L Ginzburg, he won the John Bardeen Award for a series of papers on the theory of superconductivity.

In 1991, L P Gor'kov moved to the USA. First he worked at the State University of Illinois at Urbana-Champaign and then at the National High Magnetic Field Laboratory in Tallahassee (Florida). Lev Petrovich continues his active research activities. His recent papers on the physics of metals with heavy fermions, two-dimensional superconductivity, and the physics of multiband superconductors — which gained special popularity in view of the discovery of high-temperature superconductors based on iron compounds — have become widely known.

L P Gor'kov has a very wide range of interests in science. What we described above is far from an exhaustive description of all of L P Gor'kov's results. He also wrote important papers on hydrodynamics, the theory of semiconductors, and many other topics. Lev Petrovich's capacity for relentless hard work done with painstaking attention and profound responsibility in whatever work he carries out are staggering, especially in view of the heavy load of all sorts of responsibilities he carries. In the post-Soviet years which were so difficult for scientists in Russia, he organized and headed the program of cooperation between the U.S. National High Magnetic Field Laboratory and scientists from the former USSR; many scientists from Russia and CIS countries had a chance to do their experimental and theoretical studies on the premises of the laboratory.

In 2004, L P Gor'kov, together with S T Belyaev, received the Eugene Feenberg medal for their pioneering work on superfluidity and superconductivity. L P Gor'kov is Doctor Honoris Causa of the Universities of New York and Illinois. In 2005, L P Gor'kov was elected a member of the National Academy of Sciences of the USA.

Lev Petrovich is full of energy and creative plans. We wish him much health, every happiness, and further success.

A A Abrikosov, A F Andreev, G E Volovik,
V L Ginzburg, I E Dzyaloshinskii, S V Iordanskii,
N B Kopnin, L P Pitaevskii, V L Pokrovskii,
G B Teitel'baum, I M Khalatnikov, G M Eliashberg