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In memory of Anatolii Ivanovich Larkin

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Anatolii Ivanovich Larkin, one of the most original theoretical physicists of his generation, died on August 5, 2005. He will be remembered for making decisive contributions to almost all branches of the physics of condensed matter. Larkin died suddenly, full of new ideas and creative plans, leaving incomplete some promising new undertakings.

Anatolii Ivanovich Larkin was born on October 14, 1932 in Kolomna. The scientific career of this Full Member of the Russian Academy of Sciences, Head of the sector of the L.D. Landau Institute for Theoretical Physics, Professor of Moscow State University (MGU), Professor of Physics and member of the William I. Fine Theoretical Physics Institute (FTPI) of the School of Physics and Astronomy at the University of Minnesota (Minneapolis, USA), and recipient of prestigious international achievement recognition awards like the Hewlett Packard Europhysics Prize, the Humboldt Award, the Fritz London Prize in Low Temperature Physics, the Lars Onsager Prize in Statistical Physics, and the John Bardeen Prize for Superconductivity began more than half a century ago in Moscow. Having enrolled in the Moscow Institute of Engineering Physics (MIFI), he studied physics under brilliant teachers, among which were I E Tamm, M A Leontovich, I Ya Pomeranchuk, A B Migdal and some others.

His first research paper was written under A D Sakharov's supervision, after which he entered postgraduate courses and later was assigned a position at LIPAN (currently the Russian Research Centre 'Kurchatov Institute') in a group led by A B Migdal, which at the time included B T Geilikman, V M Galitskii, S T Belyaev, and V G Vaks. That was the epoch when theoretical physics had not yet split into many narrow branches; following the example of their teachers, young scientists worked successfully in various fields. In his first papers, Larkin applied the recently developed Green function technique to analyzing thermodynamics and losses of fast particles in plasmas. In another series of papers written together with Migdal he extended Landau's theory of Fermi liquid to the physics of atomic nuclei. At the beginning of the 1960s, his attention turned to the theory of superconductivity; it became his lifelong passion.

In 1964, Larkin and Yu N Ovchinnikov treated for the first time the formation of Cooper pairs with nonzero momentum; the importance of this result was to be properly appreciated only much later.

In 1966, Larkin transferred to the only just organized L.D. Landau Institute for Theoretical Physics. He devoted many years of his life to this institute. The ties did not break even after 1995, when he moved to a new job at the William I. Fine Theoretical Physics Institute (FTPI) at the University of Minnesota. Larkin worked there until his last days and was able to find there new friends, new students, and new coworkers.

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Anatolii Ivanovich Larkin
(14.10.1932 – 05.08.2005)

Larkin worked intensely and fruitfully on problems of nuclear physics, particle physics, and magnetic and disordered systems, and came teasingly close to solving the puzzle of phase transitions of the second order. However, he turned again and again to problems of the physics of superconductors. Larkin's contribution to the solution of these problems is truly monumental. To mention just the most outstanding among his achievements in this field of physics: the theory of superconducting fluctuations (jointly with L G Aslamazov), the theory of the Josephson effect in SNS contacts (jointly with Aslamazov and Ovchinnikov), the theory of weak pinning, the theory of collective creep, the quasiclassical theory of nonequilibrium phenomena in superconductors, the theory of macroscopic quantum tunneling (the last four works jointly with Ovchinnikov), and the theory of granulated superconductors (jointly with L B Ioffe, M A Skvortsov, and M V Feigel'man).

Larkin's contributions to physics are extremely diversified. He produced fundamental results not only in super-

conductivity theory but also in a number of other branches of theoretical physics. His joint paper with Vaks (1961) on soft pion physics was the first to propose the idea of spontaneous symmetry breaking as a mechanism for the generation of dynamic symmetry of elementary particles. In 1969, Larkin published, jointly with D E Khmel'nitskii, a paper on the theory of uniaxial ferroelectrics. This work pioneered the renormalization group method in the theory of condensed state. The renorm group technique is nowadays one of the main tools of theoretical physics. This paper played an important role in the development of the theory of critical phenomena. Larkin exerted significant influence on progress in the theory of one-dimensional systems. Publications written jointly with I E Dzyaloshinskii and later with K B Efetov were the first where fermion Green's functions and correlation functions were calculated. This was the corner stone of the current theory of one-dimensional electron systems. The application of the theory of weak pinning to charge density wave dynamics by Larkin and Efetov, as well as the calculation of the activation energy of the Fröhlich conductivity by Larkin and P A Li, constituted an important contribution to this field. Significant progress was achieved in the 1980s in understanding the physics of disordered conductors and Larkin became a recognized leader in the field. He and his coworkers (L P Gor'kov, Khmel'nitskii, Efetov, A G Aronov, B L Al'tshuler, S Hikami, and I Nagaoka) made important contributions to this area and built the foundation of such novel areas of research as weak localization, mesoscopics, and quantum chaos in electron systems.

The list of Larkin's scientific achievements could be greatly extended. From the mid-1980s till the very end of his life, he worked actively on the theory of high-temperature superconductivity (jointly with Ioffe), the theory of vortex states (jointly with J Blatter, V M Vinokur, V B Geshkenbein, and Feigel'man), the theory of fluctuations (jointly with A A Varlamov and V M Galitskii), the physics of nanostructures (jointly with L I Glazman and K A Matveev), and the theory of diffusion and chaos (jointly with I L Aleiner and S Tuan). Reading his latest publications, one can feel amazement not only at their depth and topicality, but also at the fact that his first publication appeared half a century ago. It is regretful that he wrote only a few review articles and only one monograph (jointly with Varlamov). It has just been issued but the publication of its Russian edition will, alas, be posthumous.

In Larkin's life, his achievements in science were inseparable from fostering young theorists. He never had a large flock of pupils at any one time but his talent as a teacher brought to theoretical physics many gifted persons of very different types of personality and talent, among which were Ovchinnikov, Aslamazov, Khmel'nitskii, Efetov, P B Wigman, V N Filev, Ioffe, Geshkenbein, Galitskii, Matveev, and Tuan.

Until his last days, Larkin remained a most desirable coauthor for many of his colleagues, whether well known or still very young. Anyone who had the luck of working together with him knew this incomparable feeling of mastering new knowledge. Larkin's human warmth, kindness, charm and expression of sheer joy in taking part in a joint act of creation attracted to him numerous people with different personalities and talents!

Anatolii Ivanovich Larkin died before he was able to bring to a close many of his undertakings and has left it to his students and coworkers to complete a dozen or so research projects that were launched on the basis of his ideas. No wonder that new papers with his surname among the authors will continue to appear long into the future.

A A Abrikosov, B L Al'tshuler, V G Vaks,
A A Varlamov, P B Wigman, L P Gor'kov,
L I Glazman, I E Dzyaloshinskii, K B Efetov,
L B Ioffe, Yu N Ovchinnikov, D E Khmel'nitskii