Il'ya Mikhaĭlovich Lifshitz (Obituary)

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Academician Il'ya Mikhaĭlovich Lifshitz, outstanding scientist, one of the world's greatest theoretical physicists, at the forefront of research into solid-state theory in the Soviet Union, died on 23 October 1982 at the age of 65.

All of Lifshitz's life was devoted to theoretical physics. He began his active creative activity very early. In 1941, four years after graduation from the university, he had already defended his doctoral dissertation, and worked without even a day's interruption to the very end. He spent several decades in Khar'kov, where he headed the theoretical division of the Physicotechnical Institute of the Ukrainian Academy of Sciences and the department of statistical physics and thermodynamics of the University. In 1969 he moved to Moscow to take charge of the theoretical division of the Institute of Physics Problems of the USSR Academy of Sciences. At the same time he organized a solid-state-theory division in the physics department of Moscow State University and was its head until his last days. He was active in the USSR Academy of Sciences (corresponding member since 1948, academician since 1970), but maintained his contact with the Ukrainian Academy (corresponding member since 1948, academician since 1967). He remained all these years the head of the school of theoretical physicists that he created in Khar'kov.

Il'ya Mikhailovich
Lifshitz
(1917-1982)

Lifshitz's name is closely associated with the period of burgeoning progress of solid state physics. His activity and that of his school were always in close contact with the experimenters. It can be stated without exaggeration that his work reshaped the quantum theory of solids.

One of the main problems of solid-state physics is the determination of the energy spectrum of a solid. We owe to him the idea of deducing the energy spectrum of a solid from experimental data, by starting with the concept of quasiparticles—bosons and fermions. He showed that Bose modes can be determined in principle from the temperature dependence of thermodynamic properties. The deduction of the Fermi branches of the spectra of metals (of the dispersion law of the conduction electrons) is much more complicated and called for research into subtle effects in a magnetic field. The most tangible recognition of a scientist's activity is the acceptance and development of his achievements and discoveries. The geometric language developed entirely by Lifshitz and his students is now used by all those engaged in metal physics. A unique spectroscopy of metals, using the properties of metals in strong magnetic fields, was created and is being actively developed.

Modern dynamic theory of solids is the theory of crystals that contain impurities, dislocations, and other irregularities. Lifshitz was the first to analyze the phonon and electron spectra of crystals with defects and, in particular, to discover local and quasilocal states. The mathematical formalism he developed remains to this day the basis of modern research in this field.

The interest in quantum crystals as comprising a "new" nontraditional aggregate state of matter is due to Lifshitz's basic results. He has shown that the defects and impurities in these bodies behave as free quasiparticles capable of motion at absolute zero temperature.

Lifshitz was always interested in the theory of phase transitions. He predicted the unique phase transitions of "order $2\frac{1}{2}$" due to the restructuring of the Fermi surface of a metal. He brought to light the most unusual kinetics of second-order phase transitions and the kinetics of the transition of a metal from the

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superconducting to the normal state under the influence of a magnetic field. He developed a theory of first-order quantum transitions at low temperatures.

Interest in the theory of phase transition led Lifshitz to the study of phase transitions in polymers. As usual, his turning to a new field was accompanied by creation of a fundamentally new approach, based on the profound physical idea that a polymer chain is a statistical system in partial equilibrium, with interaction in the bulk and with linear memory. Research into this topic, oriented towards biopolymer physics, is in the center of attention of specialists in polymer physics and biophysics. Biophysicists were attracted to his concrete results and to his deep understanding of the physical problems that underlie the functioning of live organisms.

This brief account is far from a complete summary of Lifshitz's activity. Although he is no longer with us the time has not yet come for a final summary. Physicists have not yet read his last book that has just been published, and the December issue of JETP contains his last article, on which he worked literally to his last day. His students are still trying to use his latest advice—everything is still too alive for a summary....

Looking back at the past years we can now understand how much courage was needed to initiate the research that brought Lifshitz deserved world fame: pioneering work on quantum mechanics of disordered systems at a time when theoreticians were afraid to "touch" this topic; study of the theory of galvanomagnetic effects of real anisotropic metals when the aggregate of the experimental data had the appearance of a boring "zoology"; and tackling the physics of biopolymers when biophysicists did not see the uniqueness of their general physical properties but considered concrete mechanisms of the action of each biopolymer.

Lifshitz had a splendid mastery of subtle mathematical methods. Never engaging in mathmatics for its own sake, he always found an appropriate mathematical formalism for solving truly difficult problems posed by theoretical physics. These findings enriched in turn the corresponding branches of mathematics. Having an amazing intuition, he easily grasped the most modern theoretical physics techniques and easily found his bearings in it. The breadth of his physical outlook struck everyone who communicated with him. From subtle mathematical models of phase transitions in disordered systems to technological problems of purification of metals—he was curious about everything "of interest" in condensed-state physics, and was able to find in it a "theoretical-physics kernel" and formulate the problem rigorously.

Lifshitz's breadth, his kindness and benevolence, his uncompromising rigor yet unoffending uprightness, and his accessibility (literal, not figurative) attracted many to him. In his study one could meet all kinds of people: a metallurgical engineer, a biologist, and of course a theoretical physicist. Listening to him talk, watching his complete immersion in the topic under discussion, and the liveliness of the discussion, it was impossible to believe that the subject is someone else's work, the search for a solution needed not by him but by one who sometimes was turning to him for the first time.

Lifshitz's merits were highly valued both in our country, and by the whole world. In 1952 he received the Mandel'shtam prize of the USSR Academy of Sciences; in 1962—the Simon prize of the British Physical Society, in 1967—the Lenin Prize, in 1982 the U. S. National Academy of Sciences elected him a Foreign Member. And yet complacency and self-importance were not for him. On the contrary, he never lost the sense of anxiety. He was keenly interested in the world, in its cares and its burdens. He worried about the fate of humanity and about the fate of individuals. Those who knew him were used to it: His first reaction to someone else's trouble was to respond, to ease, to help in all possible ways. And he did respond, ease, and help, expending effort and time. Many remained grateful to fate for bringing them together with Lifshitz.

Lifshitz was an amazingly gentle person. Even when tearing someone's work to pieces, he did so, afraid to humiliate the author, with utmost courtesy. This was a firm kindness, never turning into malice and viciousness. His likes, sympathies and antipathies were definite and clear cut. His assessments of scientific work were particularly clear cut, regardless of who the author was. He defended (and helped defend) work which he considered correct, and criticized the incorrect. His statements were not always liked, and not by all. But he could not utter something contrary to what he thought or remain silent when he deemed it necessary to speak up.

There was much of a child in Lifshitz—in the highest and most charming sense of this word. Friends and relatives called him by his childhood nickname Lyolya. He was childishly vulnerable. He felt all rudeness and injustice so acutely and strongly, that it left scars on his sick heart. We were forgetful of this and did not protect him.

I. M. Lifshitz was very greatly loved. And he deserved this love.

Translated by J. G. Adashko