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PERSONALIA

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In memory of Moisei Isaakovich Kaganov

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The brilliant scientist, professor, Doctor of Physical and Mathematical Sciences, and author of numerous reviews in *Uspekhi Fizicheskikh Nauk* (*UFN*) [*Physics–Uspekhi*] journal, Moisei Isaakovich Kaganov, passed away on August 31, 2019 at the age of 98. Moisei Isaakovich became famous for his brilliant work on the physics of metals and dielectrics and the physics of magnetic phenomena. His scientific style was characterized by a broad view of the subject under study, an original approach to problems, and an independent way of thinking. Moisei Isaakovich will also remain in our memory as a remarkable popularizer of science. In his popular scientific books and papers, he comprehensively presented contemporary scientific problems and achievements for a wide range of readers and, which is particularly important, infected many generations of the readers of the journal *Kvant* (Quantum) with his love of science and cognition of the world.

Moisei Isaakovich Kaganov (MIK) was born on June 4, 1921 in Kharkov. In 1939, he was admitted as a student to the Department of Physics at the Kharkov State University, but his studies did not last long. In December of the same year, MIK was conscripted into the army. He was in the war from beginning to end, serving till early 1946. In 1946, MIK returned to the university and, having done two diploma studies with his fellow student Viktor Moiseevich Tsukernik, graduated in 1949. This work and friendship between students were the beginning of their years-long fruitful collaboration in a whole number of fields, mainly in the theory of magnetic phenomena. The subject of one study about absorption of electromagnetic radiation by a spin wave system was proposed by Aleksandr Ilyich Akhiezer, and another one concerning the permittivity of a polycrystal was proposed by Ilya Mikhailovich Lifshitz. MIK considered I M Lifshitz to be his teacher. The cooperation with I M Lifshitz lasted many years and with time transformed into a strong friendship. Simultaneously, MIK worked a long time together with A I Akhiezer.

In October of 1949, MIK began working at the Ukrainian Institute of Physics and Technology (UIPT), where he remained till April 1970. In 1970, invited by P L Kapitza, he and I M Lifshitz left for Moscow for the Institute of Physical Problems (IPP, now Kapitza Institute), where he worked for 24 years until his retirement in 1994. Both in Kharkov and in Moscow, MIK combined his scientific work with teaching activity. He first taught at Kharkov State University and then became a professor at Lomonosov Moscow State University, where he delivered courses on the electron theory of metals and quantum solid-state theory, both very popular with students. After MIK retired in 1994, he went to Boston in the USA, where one of his daughters had settled.

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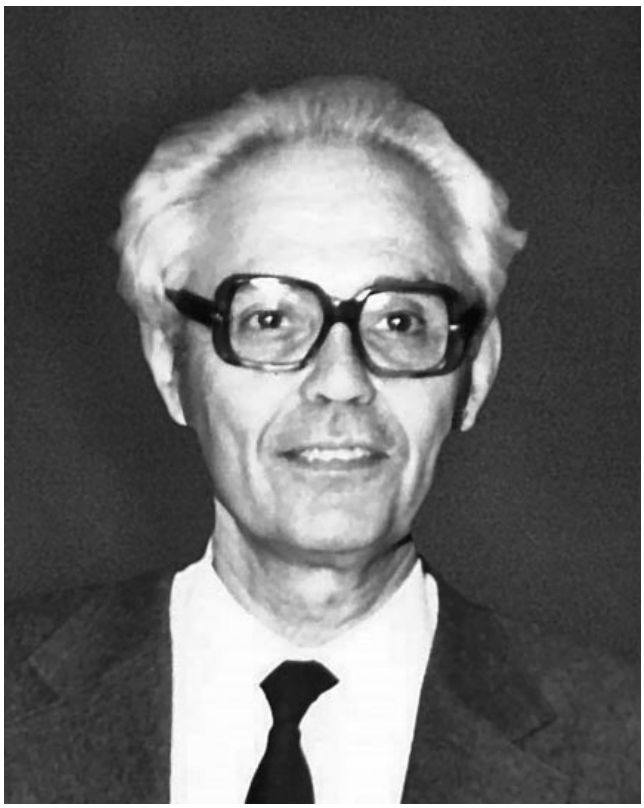
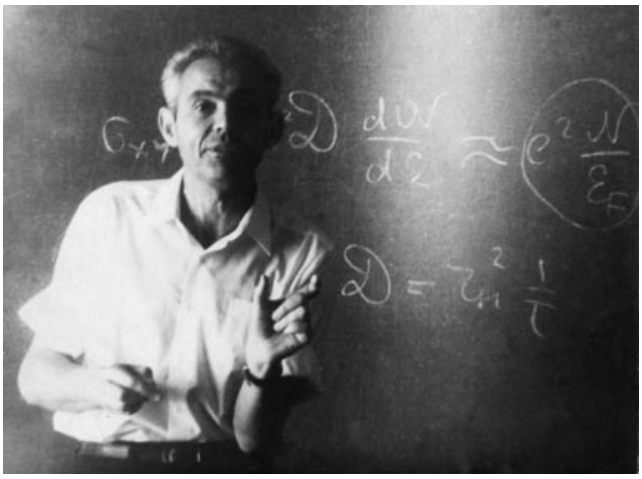


Moisei Isaakovich Kaganov
(04.06.1921 – 31.08.2019)

The range of MIK's scientific interests spanned from the problems of classical electrodynamics of continuum media to practical problems of the physics of metals. In the early 1950s, at the cryogenic laboratory of UIPT, experiments on solid-state physics were started, and MIK, together with I M Lifshitz, got involved in the electron theory of metals. This became a basic subject for MIK for many years. One of his first papers in this field that became widely known was "Kinetics of superconductivity destruction" (I M Lifshitz, M I Kaganov, *Dokl. Akad. Nauk SSSR*, 1953, v. 90, p. 579), in which the authors calculated the electromagnetic field distribution in a layer of normal metal emerging on a sample surface when superconductivity gets destroyed. In a normal metal layer, either a normal or an anomalous skin effect is realized, depending on the field oscillation frequency and the electron free path. According to MIK, he got to take part in that study as an expert on the anomalous skin effect.

MIK returned to the skin effect time and again. Together with M Ya Azbel', he formulated the theory of an anomalous skin effect in metals with an arbitrary electron spectrum (*Dokl. Akad. Nauk SSSR*, 1955, v. 102, p. 49). Together with V M Tsukernik, he solved the problem of the influence of thermoelectric forces on the skin effect in metals (*Zh. Eksp. Teor. Fiz.*, 1958, v. 35, p. 474 [*Sov. Phys. JETP*, 1959, v. 8,



Moisei Isaakovich Kaganov giving a talk. Mid-1960s.

p. 327]). This study was included in the *Electrodynamics of Continuous Media* by Landau and Lifshitz. In a paper (*Fiz. Met. Metalloved.*, 1959, v. 7, p. 288) on selective transparency of a ferromagnetic metal, MIK and his co-authors predicted that at a certain field frequency the skin penetration depth tends to infinity. Ten years later, this prediction was experimentally confirmed at IPP by B Heinrich and V F Meshcheryakov (*Pis'ma Zh. Eksp. Teor. Fiz.*, 1969, v. 9, p. 618 [*JETP Letters*, 1969, v. 9, p. 379]).

MIK's main achievement was undoubtedly the series of studies done together with I M Lifshitz that paved the way for the contemporary theory of conduction electrons in metals with an arbitrary dispersion law. The theory was formulated in three *UFN* reviews by I M Lifshitz and MIK: "Classical and quantum mechanics of electrons in metals" (*UFN*, 1959, v. 69, p. 419 [*Sov. Phys. Usp.*, 1960, v. 2, p. 831]), "Statistical mechanics and electron thermodynamics in metals" (*UFN*, 1962, v. 78, p. 411 [*Sov. Phys. Usp.*, 1963, v. 5, p. 878]), and "Kinetic properties of electrons in a metal" (*UFN*, 1965, v. 87, p. 389 [*Sov. Phys. Usp.*, 1966, v. 8, p. 805]). These three reviews laid the basis of the fundamental monograph *Electron Theory of Metals* written by MIK, I M Lifshitz, and M Ya Azbel'. At that same time, MIK and his students and colleagues were engaged in the problems of sound excitation in a metal by a guided electromagnetic wave. MIK's studies of the electron theory of metals were highly appreciated by both L D Landau and P L Kapitza; the latter rated especially highly the theory of galvanomagnetic effects (I M Lifshitz, M Ya Azbel', M I Kaganov, *Zh. Eksp. Teor. Fiz.*, 1956, v. 31, p. 63 [*Sov. Phys. JETP*, 1956, v. 3, p. 143]). MIK often communicated with Landau both at work and outside of work.

When MIK arrived in Moscow in 1970, he continued investigating problems of the electron theory of metals. In co-authorship with his students, MIK made a great contribution to the study of electron–phonon interactions in metals with an arbitrary dispersion law and of a system's behavior near a topological transition with the formation of a new Fermi surface. Together with IPP researchers, he actively analyzed the question of nonlinear generation of longitudinal ultrasound at the external field frequency. Simultaneously, MIK did several pioneering studies in magnetism. In particular, he was the first to consider the problem of surface magnetism occurring at temperatures higher than that in the sample volume (*Zh. Eksp. Teor. Fiz.*, 1972, v. 62, p. 1461 [*Sov. Phys. JETP*, 1972, v. 35, p. 631]).

MIK collaborated actively with foreign physicists, for the most part from Poland and Germany, and was on very friendly terms with most of them. For his scientific achievements and years-long collaboration with Polish physicists he was awarded an honorary degree of Doctor Honoris Causa of Wroclaw Polytechnical University.

MIK always had students and associated with many of them all his life, discussing not only current scientific events with them, but other things, too. MIK was a communicative, highly intelligent, and erudite man with a bright and unique individuality. In addition to physics, he took a keen interest in art and was on friendly terms with many 'lyrics'— D Samoilov, Yu Daniel', and many others. His judgments concerning science and literature were brilliant and nontrivial, and this attracted quite different people to him. Almost everybody who knew MIK called him simply Musik. This was what he called himself when he called somebody on the phone.

MIK spent much time popularizing achievements in solid-state physics. His first popular scientific paper was published in the journal *Nauka i Zhizn'* (Science and Life) in co-authorship with A S Kompaneyets. Together with I M Lifshitz, MIK wrote several popular scientific papers and the book *Quasiparticles. Ideas and principles of solid state quantum physics*. MIK is the author of the widely known book *Electrons, Phonons, Magnons* which was first issued in 1979 (it had been published before in the Polish language) and then was reissued many times in different languages. In 1982, together with V M Tsukernik, he published another book, *The Nature of Magnetism* which is still popular now. In 2005, when already a pensioner, MIK, together with G Ya Lyubarskii, published the book *Abstraction in Mathematics and Physics*. For several years, MIK was a member of the editorial board of the journal *Kvant* (Quantum) and contributed a great deal to this journal. In addition, he was an active member of the Educational Company Znanie and entered the Publishing Council of this company, the section in charge of publishing popular books on physics. For many years, MIK contributed to the physics desk of the Sovetskaya Entsiklopediya (Soviet Encyclopedia), for which he wrote articles, helped in selecting authors, and edited papers by his colleagues. When already in America (after his retirement), MIK wrote a review paper about a physical encyclopedia (*UFN*, 1999, v. 169, p. 1283 [*Phys. Usp.*, 1999, v. 42, p. 1177]). In 2016, at the age of 95, MIK was included on the short list of the Prosvetitel' (Enlightener) Prize for the book *Fizika glazami fizikov* (Physics as Physicists See It). It was a collection of papers MIK had written for the journal *Kvant*.

MIK was the author of the book *Landau School. What I Think of It*. There, he collected his essays about Landau's epoch and people of that epoch, and a large (over 700 pages) book of reminiscences, *A Long Life*. In both books, MIK's attention to the details and his genuine interest in the people whom he met in his life are amazing. MIK's ability to make friends with people quickly and for a long time, to sympathize with their problems, and to rejoice at their success was truly remarkable.

MIK lived a long life. In one of his last interviews, he formulated his attitude to the predetermination of science: "From my youth I had an enormous respect for science and boundless admiration of the scientific processes, in which a

clear and simple picture emerges of the world that surrounds us.'' There, he made, as he said, the main confession of his life: ''I am pleased with my fate.''

Moisei Isaakovich Kaganov left a brilliant legacy in science and no less in the hearts of those who witnessed his nobleness, generosity, absolute benevolence, and sincere pleasure with the success of other people. Everybody who knew him will keep the memory of this remarkable scientist and man forever.

M Ya Azbel', A F Andreev, B M Bolotovskii,
A Yu Grosberg, N M Kreines, L S Levitov,
L P Pitaevskii, V L Pokrovskii, E I Rashba,
A I Smirnov, D E Khmel'nitskii, A V Chubukov