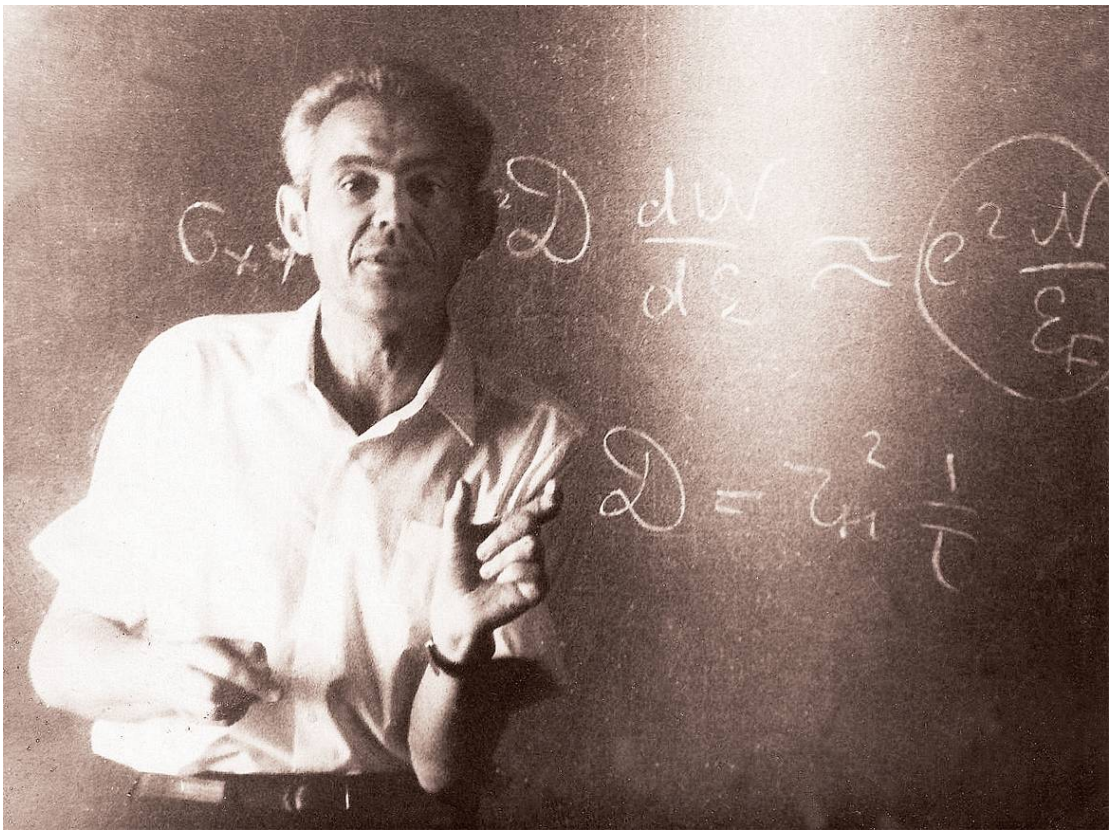
**IN MEMORY OF MOISEY ISAAKOVICH KAGANOV**
(1921 - 2019)



Professor Moisey Isaakovich Kaganov passed away at the age of 99 on August 31, 2019. He was a prominent theoretical physicist, a talented promoter of science, and an extraordinary personality.

Moisey Isaakovich was born on June 4, 1921. His mother, Dina Davydivna, was a professional pediatrician. His father, Isaak Yakovych Kaganov, a student of Academician O. Biletsky, was a famous philologist, working at Kharkiv University. Moisey Isaakovich spent his childhood in Kharkiv but later graduated from a high school in Kyiv, where his parents lived for a while after the capital of soviet Ukraine was moved from Kharkiv in 1934. During his school years Mussik – so he presented himself – was deeply impressed by the popular books on physics, and made a decision to become a scientist. After finishing school in 1939 he entered the Department of Physics and Mathematics at Kharkiv University. As he recalled, at that time everyone agreed that "the best physics in Ukraine was in Kharkiv". Mussik's student life, however, lasted only several months: he was drafted into the army as new draft rules were implemented towards the end of his freshman semester. Kaganov met the beginning of the Second World War as a coastal guard sailor near the city of Tuapse on Black Sea. After the war, decorated by the military Order of the Red Star, he succeeded in being demobilized by the end of 1945 (not an easy task at the time) and returned to continue his university studies. To make up for seven years of military service, Mussik skipped one year by going through early examinations, and graduated in 1949.

Towards the end of 1940's the Department of Physics at Kharkiv University was designated by the soviet government as the principal location for training young scientists to be employed in the USSR Atomic Project – an enterprise of highest priority. The program was operated by the classified research division of the Ukrainian Institute of Physics and Technology (UIPT) codenamed "Laboratory № 1". The heads of the two Theoretical Departments of Laboratory № 1, A.I. Akhiezer and I.M. Lifshitz, held professor positions and taught at the Department of Physics, where Moisey Isaakovich had a chance to meet them. After graduating from the University, he was employed in the Department headed by Ilya Mikhailovich Lifshitz, who became his teacher, and later a senior friend.

Moisey Isaakovich worked at UIPT from 1949 to 1970. His scientific activities focused on the quantum theory of solid state, applied to metals and magnetic systems at low temperatures. Together with I.M. Lifshitz and his students (M.Ya. Azbel, V.G. Peschanskii, E.A. Kaner) he authored a series of classic papers on the electronic theory of metals. This work laid the foundations of a new direction in the theory of solids, dubbed "fermiology". The results of fermiological studies were summarized in the book "Electronic Theory of Metals" by Lifshiz, Azbel, and Kaganov [1] published in 1971, as well as in review papers [2, 3]. For many years the "Electronic Theory of Metals" remained a reference book for solid-state physicists.

In the theory of magnetism Moisey Isaakovich worked together with A.I. Akhiezer, V.M. Tsukernik, V.G. Baryakhtar, and S.V. Peletminskii. It should be noted that in the late 1940's elementary excitations in magnets were understood in terms of the ideas of Felix Bloch and Holstein-Primakoff method. Nobody knew for sure how to deal with antiferromagnets, and eminent physicists, such as Lev Landau, suggested that one should first understand the material's ground states, which by itself was an intimidating task. The theory of spin waves developed with participation of Kaganov came as an essential step forward. It was presented in the review paper written by Moisey Isaakovich together with A.I. Akhiezer and V.G. Bar'jakhtar in 1960 [4]. Later this review became the basis for the famous "Spin Waves" volume [5]. Moisey Isaakovich did not co-author that book because he decided to concentrate on writing the "Electronic theory of metals". He used to say fondly that all his scientific and popular science publications were dedicated to the physics of three basic solid-state quasi-particles: the electrons, the phonons, and the magnons.

In line with the mainstream interests of Laboratory № 1, Moisey Isakovich participated in studies of radiation damage of metals by high-energy ions. For a long while those results were kept in classified reports, until eventually published as Refs. [6] and [7]. Calculations of ion bremsstrahlung were based on the model of sequential energy transfer: first to electrons, then to phonons, and finally to the crystal lattice deformations. Reference [6] for the first time ever considered the mechanism of electron-phonon interaction that cause radiation-induced changes in the heavy ion tracks. That paper is still used in the studies of nuclear reactor material damage. Reference [7] detailed the method of calculations performed in [6]. It is cited in the literature more than 450 times, an impressive number even nowadays, and formidable for the soviet literature of mid-twentieth century with its culture of spare citations.

From 1952 to 1970 Moisey Isaakovich was lecturing at the Department of Statistical Physics and Thermodynamics (currently the Department of Theoretical Physics) at Kharkiv University. For many years he delivered the courses on "Quantum theory of metals" and "Atomic and nuclear physics".

Historically, both theoretical departments at UIPT had strong connections with L.D. Landau and his group in Moscow. Kaganov used to report his results at Landau's seminar and established personal contact with him. In 1970 P.L. Kapitsa invited I.M. Lifshiz to the Institute of Physical Problems (IPP) as a new head of Theoretical Department and Landau's successor. Moisey Isaakovich moved to Moscow together with his teacher. There he took up the senior research fellow position at the Theoretical Department of IPP, and became a professor at Moscow University. Through his teaching at MU he recruited many talented young people and brought up several generations of students. In 1998 Wroclaw University of Technology (Poland) awarded him the title of Honorary Doctor for merits in his scientific and pedagogical contributions.

M.I. Kaganov's productive work at the Institute for Physical Problems continued until his retirement in 1994. The full list of his scientific papers (not including popular articles) has more than 230 positions. While working at IPP, M.I. did not sever his connections with Kharkiv physicists. He was frequently visiting the Institute for Low Temperature Physics and Engineering (ILTPE), Kharkiv University, and other physics centers. In his memoirs he fondly recalls being in possession of a permanent access card to the ILTPE building. M.I. regularly attended conferences on low-temperature metal physics organized by Donetsk Institute of Physics and Technol-

ogy in Stary Karavan. He also continued working as a member of editorial board of the ILTPE-based Low Temperature Physics journal.

M.I. Kaganov's popular science publications make a notable part of his scientific legacy. In his memoirs, he recalls how in middle school he had found, quite by chance, a striking popular book "Solar Matter" by M.P. Bronstein [8], which dramatically affected his future choices. This way M.I. learned very early about the importance of high-quality popular science literature. The best-known popular publication by M.I. Kaganov is "Electrons, phonons, and magnons" [9]. Another one is the "Nature of Magnetism" [10] written jointly with V.M. Tsukernik. These books can be found on the desks of many experimental physicists. After moving to the United States, Moisey Isaakovich published the "Abstraction in mathematics and physics" [11] together with G.Ya. Lubarsky.

In 1994 Moisey Isaakovich retired and moved to the United States to join his children. However, he could hardly be called a true retiree. He used to describe himself as "unemployed but productive", while continuing to take interest in science and his colleagues' work. Moisey Isakovich kept writing papers, reviews, and books on various fields of theoretical physics, as well as memoirs about physicists he knew throughout his long life.

The blessed memory of Moisey Isaakovich Kaganov will always remain in the hearts of his numerous colleagues and disciples.

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