

PERSONALIA

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In memory of Yurii Moiseevich Kagan

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The outstanding physicist and Academician of the Russian Academy of Sciences Yurii Moiseevich Kagan passed away on June 4, 2019.

Quite recently, on July 6, 2018, Yurii Moiseevich celebrated his 90th birthday. In this connection, the journal *Uspekhi Fizicheskikh Nauk* published a Personalia column (*Usp. Fiz. Nauk* **188** 799 [*Phys. Usp.* **61** 714 (2018)]) in which colleagues and friends heartily congratulated Yurii Moiseevich on this anniversary and recounted the main stages of his life and his most important achievements.

Yu M Kagan was born in Moscow in 1928. In the hard war years, young Yu M Kagan worked at a plant and attended an evening school for working youth. When he was 16, he entered the Moscow Aviation Institute. He has then transferred to the Engineering Physics Faculty of the Moscow Mechanical Institute and graduated from it in 1950 with honors. At the same time, he passed all the exams of the famous 'Theorminimum' of L D Landau, who invited him to the postgraduate course. However, he was sent to work on the USSR Atomic Project at the Ural Electrochemical Plant.

Here, Yu M Kagan developed the general theory of the separation of isotopic gas mixtures in porous media. He suggested the idea of replacing the medium by a heavy 'wall' gas.

In 1954, Yu M Kagan defended his Candidate of Sciences thesis. He delivered a classified special course at the Ural Polytechnical Institute (Sverdlovsk). In 1956, he was invited to Moscow, to the Institute of Atomic Energy (IAE). After that time, the scientific life of Yu M Kagan was connected with the Russian Research Center, 'Kurchatov Institute'. In 1959, he defended his thesis for the degree of Doctor of Sciences in Physics and Mathematics.

Here, Yu M Kagan formulated the kinetic theory of gases with rotational degrees of freedom. He constructed the theory of transport phenomena in external fields and explained the nature of kinetic coefficients variations in a magnetic field (the Sentfleben effect). The results were included in textbooks and initiated extensive studies. The terms 'Kagan vector' and 'Kagan polarization' appeared. The latter effect was observed 25 years later at the Leiden laboratory.

In the 1960s, Yu M Kagan began his research in the field of solid state physics. He developed the microscopic theory of nontransition metals and showed the decisive role of an electron liquid for their properties. The theory explained the nature of interion forces and predicted the appearance of singularities in the phonon spectrum. The results were confirmed experimentally.

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Yurii Moiseevich Kagan
(06.07.1928–04.06.2019)

For this series of works, Yu M Kagan, along with his pupil and co-author E G Brovman, was awarded the M V Lomonosov Prize of the USSR Academy of Sciences (1975).

Yu M Kagan's studies of metallic hydrogen are widely known. He proved the existence of a metastable phase and analyzed its crystalline structure and vibrational spectrum. He found the equation of state, estimated the pressure of the transition to the metallic phase, and showed that only anisotropic structures are quasi-stable and that with increasing pressure the tendency appeared to form a liquid phase. He estimated the temperature of the high-pressure superconducting transition.

A special place belongs to the studies of coherent phenomena in resonant interaction between nuclear radiation and crystals. In a series of studies carried out by Yu M Kagan and A M Afanasyev, the notion of collective excitation (a nuclear exciton) was introduced. The 'Kagan–

Academician Yurii Moiseevich Kagan (I V Kurchatov Institute of Atomic Energy) giving a talk at a working meeting, "The mechanisms of high-temperature superconductivity." Joint Institute of Nuclear Research (JINR), Dubna, 17 June 1988, photo by Yu A Tumanov.

Afanasyev effect' was predicted, i.e., the suppression of inelastic reaction channels when a strongly absorbing crystal becomes almost transparent. All the results were confirmed experimentally and investigated in detail. A series of studies on the theory of the Mössbauer effect is close to this field.

The prediction and experimental discovery of the suppression effect were honored with the State Prize of the USSR (1976).

Another topic — the study of low-temperature quantum phenomena in condensed media — was initiated by the classical paper of Yu M Kagan and I M Lifshitz. It was pointed out that the kinetics of a phase transition is realized through subbarrier tunneling of phase nuclei. The lifetime of the metastable phase at absolute zero then remains finite.

A large series of Yu M Kagan's studies was devoted to the theory of quantum diffusion of atomic particles in a solid. The self-localization effect was predicted for a low particle concentration. Another prediction stated that at a very low temperature the interaction with phonons leads to the coherent quantum diffusion, which removes localization.

These predictions were fully confirmed in the experimental investigation of the diffusion of ^{3}He atoms in a ^{4}He crystal matrix. This series of studies was honored by the Lenin Prize (1986). Yu M Kagan took an active part in the further analysis of quantum diffusion of particles in metals and superconductors.

Yu M Kagan paid much attention to the properties of imperfect crystals. He predicted the occurrence of quasilocal levels in the phonon spectrum of the defect crystals and related anomalies in the thermodynamic and kinetic properties. This also stimulated an extensive range of experimental studies.

In recent years, Yu M Kagan's interests were related to the problem of Bose condensation and superfluidity in macroscopic quantum systems formed by ultracold gases. A number of recognized pioneering results were obtained. For example, the problem of Bose condensation and long-range order formation in a classical gas was solved. The formation of a quasi-condensate was demonstrated for low-dimensional systems. The suppression of inelastic processes in the course of Bose condensate formation was predicted. The observation of this effect in an alkali metal gas at JILA (USA) was used as proof of condensate formation. Of great interest were studies devoted to the analysis of the superfluid state of atomic Fermi gas with attraction.

Working at the Kurchatov Institute, Yu M Kagan at the same time taught for over 40 years at the Moscow Engineering Physics Institute (MEPhI). When lecturing as a professor at the Theoretical Nuclear Physics Subh-faculty, he lectured a remarkable course on modern solid-state theory. He was frequently invited to give lectures at many famous universities and research centers around the world. Yu M Kagan trained a large number of students, who became candidates and doctors of science, and corresponding members of the Russian Academy of Sciences.

Every week (practically without fail) starting from the 1950s, Yurii Moiseevich Kagan regularly conducted seminars at which he, his colleagues, students, and co-authors, as well as invited specialists and famous scientists, gave talks. Many participants at the seminars — the Kagan seminars — considered it to be the school that alloved them to proudly consider themselves Yu M Kagan's pupils. Even those participants at the seminars who did not work much with Yurii Moiseevich (or formally did not work with him at all) think so. Yurii Moiseevich conducted these seminars almost to the last days of his life.

In 1970, Yu M Kagan was elected a corresponding member and in 1984 a full member of the USSR Academy of Sciences. He was given the title of Honorary Doctor of the Technical University of Münich (Germany, 1990) and Uppsala University (Sweden, 1996) and Honorary Professor of the University of Amsterdam (Netherlands, 1990). He was elected a member of the European Academy of Sciences (1995) and an honorary member of the Academy of Sciences of Hungary (1998). He was a member of the American Physical Society (1994). Yu M Kagan was twice invited by Harvard University to give the famous Morris Lab Lectures (1988, 1996). He was awarded the 1986 Lenin Prize and the 1976 State Prize, the Karpinsky Prize (Germany, 1994), the Humboldt Prize (Germany, 1994), the Triumph Prize (2006), the Demidov Prize (2009), and the I Ya Pomeranchuk Prize (2017). He was awarded the orders For Merits Before the Fatherland of the III and IV degrees, two orders of the Red Banner of Labor, and the orders of Friendship and Honor.

Yurii Moiseevich Kagan was one of the most prominent physicists of the USSR and Russia of the 20th–21st centuries who enriched science with fundamental achievements of prime importance. He made an invaluable contribution to the development of our civilization. The wonderful memory of Yu M Kagan as a remarkable person and scientist will always live in our hearts.

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