Yuriĭ Moiseevich Kagan (On his sixtieth birthday)

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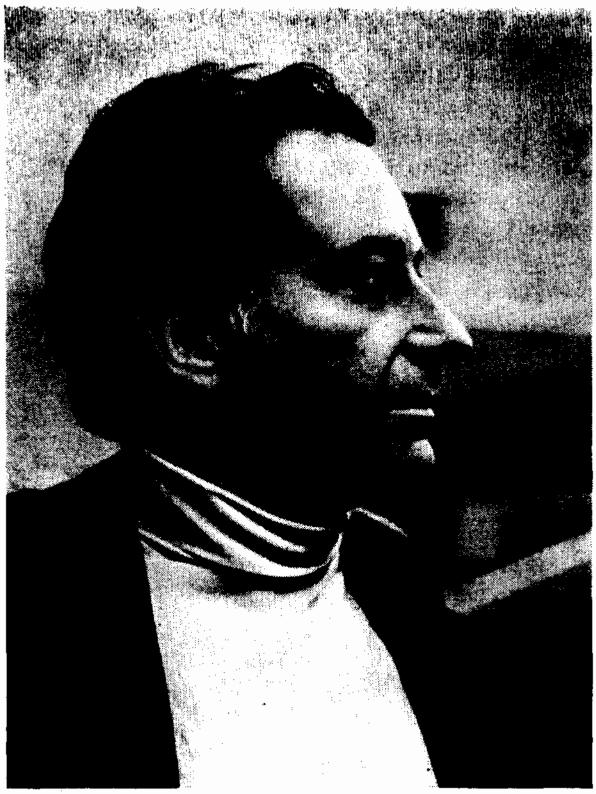
Academician Yuriĭ Moiseevich Kagan, one of the leading Soviet theoretical physicists of the post-war generation, celebrated his 60th birthday on July 6, 1988.



YURIĬ MOISEEVICH
KAGAN

Yu. M. Kagan was born in 1928 in Moscow. He started his career in the difficult post-war years. He worked in a factory and he attended a night school for working youth; but he was already a post-secondary student at 16. In 1950 he graduated from the Moscow Engineering-Physics Institute (MEPI). At that time the MEPI had an exceptionally strong faculty—I. E. Tamm, M. A. Leontovich, A. B. Migdal, and I. Ya. Pomeranchuk. Yuriĭ Kagan took the well-known Landau's theoretical minimum examination while still a student, and since then this scientific life was closely associated with Landau's school.

Yu. M. Kagan's scientific career started with research in molecular physics. Working on problems of great practical value, he carried out a series of studies on the kinetic theory of gases in the entire pressure range from the Knudsen regime up to the hydrodynamic regime. In 1956 Yu. M. Kagan was invited to the Institute of Atomic Energy. He continued his work in molecular physics by constructing a kinetic theory of gases with rotational degrees of freedom. The introduction of the angular momentum vector, together with the velocity vector, into the theory radically changed the entire structure of the classical kinetic theory of gases. Together with L. A. Maksimov he constructed a general theory of transport phenomena in external fields, enabling, in particular, explanation of the nature of the senftleben effects (change in the kinetic coefficients of an uncharged gas in a magnetic field), which was known since the 1930s. These papers formed the basis for a new direction in physical kinetics, and rapidly acquired a classical status; the new vector in the equations of gas dynamics, consisting of the velocity and angular moment vectors, was termed "Kagan's vector." It is interesting that the alignment of the angular moment predicted by the theory, in a gas flow in the presence of a temperature gradient was directly measured experimentally in the Leyden laboratory 25 years after the theoretical prediction.

Arriving at the Institute of Atomic Energy, Yu. M. Kagan entered what for him, was a new field—solid-state physics, in particular, the theory of interaction of radiation with crystals. He constructed a systematic theory of the Mössbauer effect for regular and extrinsic crystals, predicting in the process the existence of quasilocal levels in the phonon spectrum of crystals with defects and a number of anomalies in the behavior of thermodynamic and kinetic quantities as a function of temperature. All these characteristics, like quasilocal modes themselves, were found experimentally.

In the field of interaction of radiation with crystals Yu. M. Kagan's work (together with A. M. Afanas'ev) laid the foundation for a new field of research at the frontier between nuclear physics and solid-state physics—the theory of collective coherent effects under conditions of nuclear resonance interaction in crystals. One of the central results of the theory was the prediction of the suppression of inelastic nuclear reaction channels, when under definite conditions the crystal becomes almost transparent to γ rays and neutrons. This phenomenon (the Kagan-Afanas'ev effect) was later observed experimentally. The theory gave a new understanding of nuclear excitons delocalized over the crystal. This series of papers was awarded the State Prize of the USSR (1976). The ideas developed by Yu. M. Kagan in this theory were also fruitful for solving a number of problems from allied fields. They enabled completion of the classical theory of diffraction of x-rays, including the temperature and the oscillations of the atoms. Together with A. M. Afanas'ev he constructed a general theory of hyperfine structure under relaxation conditions. In collaboration with V. I. Gol'danskiĭ he proposed a number of original ideas in the analysis of methods for building a γ-ray laser. Yu. M. Kagan wrote a series of papers on the quantum theory of channeling (together with Yu. V. Kononets) covering all basic aspects of this phenomenon. In 1970 Yu. M. Kagan suggested that there exists a neutron bound state in matter. Ten years later this state was discovered experimentally. The works of Yu. M. Kagan are largely responsible for the fact that in this field

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of physics Soviet research has taken and continues to hold the lead in world science.

Yu. M. Kagan has made a significant contribution to the theory of metals. Together with E. G. Brovman he performed a large series of studies in which they constructed a systematic many-body theory of electronic and phonon properties of nontransition metals. In these works they established the nature of unpaired covalent forces in metals, solved the problem of dynamic and static compressibility, and revealed new characteristics in the phonon spectra of metals, later identified experimentally. Together with A. M. Afanas'ev he predicted the logarithmic singularity in the phonon spectrum when the Fermi surface contains flat sections; this singularity plays an important role in the modern theory of low-dimensional conductors. The series of papers by Yu. M. Kagan and E. G. Brovman was awarded the M. V. Lomonosov prize in 1975. This series of papers is closely related to the papers on the theory of the metallic state of hydrogen; in these latter articles the metastable phase of metallic hydrogen was for the first time studied in detail and the pressure of the transition from the molecular phase into the metallic phase was established.

A characteristic feature of Yu. M. Kagan's scientific style is the brilliant physical thinking, directed toward the formulation of original, nonstandard problems, requiring a new viewpoint on the phenomenon under study. These qualities were especially clearly manifested in his papers on the low-temperature kinetics of condensed media. This series of articles began with the problem of the kinetics of phase transitions near absolute zero, solved together with I. M. Lifshitz; this investigation was formulated in a fundamentally new manner and completely changed our ideas about the nature of the decomposition of the metastable phase. In this work a phase transition was regarded for the first time as a process of quantum subbarrier tunneling of a macroscopic system. A large series of papers (coauthored with L. A. Maksimov and M. I. Klinger) is devoted to the theory of quantum diffusion and localization of atoms in crystals at low temperatures. The self-localization predicted by them was discovered experimentally on the example of diffusion of He^3 in He^4. This work was awarded the Lenin prize in 1986.

At the end of the 1970s Yu. M. Kagan became interested in the properties of new, unique objects—quantum gases, which at very low temperatures exhibit properties of quantum-statistical ensembles, in particular, the capability of Bose condensation. Studying (together with G. V. Shlyapnikov) the stability and kinetics of the decomposition of one such gas—atomic hydrogen, stablized with a magnetic field, Yu. M. Kagan predicted the existence of an unavoidable channel for decay of this state owing to three-particle, dipolar recombination. Special experiments, performed in laboratories in the USA and in the Netherlands, confirmed this effect, and the mechanism of recombination is now called in the literature "Kagan's mechanism." Continuing research in this field, Yu. M. Kagan very recently predicted a nontrivial effect: a change in the probability of inelastic processes in the presence of Bose condensation.

Among the investigations completed by Yu. M. Kagan in recent years, we should mention the general theory of electron-polaron effects in metals, constructed together with N. V. Prokof 'ev and used to describe quantum diffusion and depolarization of muons in solids, to explain the experimentally observed anomalies of sound absorption in metallic glasses accompanying a transition into the superconducting state, as well as to clarify the possible mechanism of the apearance of "heavy elecrons."

In addition to his diverse scientific work, Yu. M. Kagan is doing a great deal of pedagogical work. Being a professor at the Moscow Engineering Physics Institute, he has given for many years an original course on modern solid-state theory; for several generations of graduates of MEPI this course has formed he foundation of their "solid-state" education. Over the years that he served as the director of the theoretical laboratory at the I. V. Kurchatov Institute of Atomic Energy, he has educated an outstanding group of students; these theoreticians, doctors and candidates of sciences form an informal community, which can be called "Kagan's school." Successful presentation of one's work at a theoretical seminar directed by Yuriĭ Moiseevich is for many physicists an indication of "quality."

Yu. M. Kagan's distinguished service to Soviet science has been acknowledged with high state awards, and he has been elected as an active member of the Academy of Sciences of the USSR. Yu. M. Kagan is performing great scientific-organizational and social work, and he participates actively in the work of the Committee of Soviet Scientists to Prevent Nuclear War.

Yuriĭ Moiseevich celebrates his sixtieth birthday at the peak of his creative talents. His colleagues, friends, and students wish him good health and preservation of his creative energy for many years and await new brilliant physical idea.

Translated by M. E. Alferieff