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PERSONALIA

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Yuriĭ Moiseevich Kagan (on his seventieth birthday)

Professor and full member of the Academy of Sciences, Yuriĭ Moiseevich Kagan, one of the outstanding physics theorists of the post-war generation, was 70 on July 6, 1998.

Kagan's 50 years of brilliant and fruitful research have brought him well deserved recognition. Among the honours conferred on him are the Lenin and State Prizes, the M V Lomonosov Prize of the Academy of Sciences, the Karpinsky Prize and the *honoris causa* of the Munich Technical University and Uppsala University; he was also elected Honorary van der Waals Professor of Amsterdam University and member of the European Academy. A prominent feature of Kagan's approach to physics is his exceptionally wide scope of fields of interest, his brilliant physical intuition in posing original and unconventional problems, and his never-ebbing urge to attack the most pressing problems challenging experimental physics.

Yuriĭ Moiseevich Kagan was born in Moscow in 1928. His early life fell on the hard war period and equally hard immediate post-war years. During the war he worked at a factory by day and attended a young workers school at night. At the age of 16, he entered the Moscow Engineering Physics Institute and graduated from it with honors in 1950. In his student years, Kagan was able to pass the famous Lev Landau 'teorminimum' examination, and ever since his life in science has been closely tied to the Lev Landau school.

Kagan was forced to start his scientific career not as Landau's postgraduate, though Landau had invited him to do, but at one of the 'closed' (classified) centers of the Atomic Project. In a short time he was able to develop the general theory of the separation of isotopic gas mixtures in porous media, covering the entire pressure range from the Knudsen to the hydrodynamic flow mode. He introduced the original and elegant idea of replacing a porous medium by an infinitely heavy 'wall' gas. The results generated by his theory proved to be very efficient in the calculations required for the separation of uranium isotopes.

Yuriĭ Moiseevich Kagan

In 1956 Kagan was invited to work at the Institute of Atomic Energy. In the 1960s he developed the kinetic theory of molecular gas with rotational degrees of freedom. In addition to the velocity vector, the theory introduced the rotational momentum of a molecule, which radically changed the entire structure of the classical theory of gases. The new vector, playing a crucial role, was composed of the velocity and rotational momentum vectors; it is known in the literature as the Kagan vector. A general theory of the transfer phenomena in external magnetic and electric fields was constructed, which was able to explain the Zenftleben effect known since the 1930s (changes in the kinetic coefficients of molecular gases induced by a magnetic field). This theory spawned an extensive family of experimental investigations both in Russia and abroad.

At the same time Kagan started an active research in solid state physics. He developed a consistent theory of the Mössbauer effect in regular and irregular crystals. He predicted the existence of quasi-local phonon levels in crystals with heavy impurities and also sharp anomalies in the temperature dependence of thermodynamic and kinetic quantities in defect-containing crystals.

Kagan made an important contribution into developing the microscopic theory of metals. A series of papers constructed a consistent many-body theory of the electron and phonon properties of non-transition metals. The nature of unpaired covalent forces in metals was understood, the problem of the dynamic and static compressibility was solved, and new features were discovered in the phonon

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spectra of metals that would later be identified in experimental data. A logarithmic singularity was predicted in the phonon spectrum for the Fermi surfaces with the flat segments; this singularity plays an important role in the current theory of low-dimensional systems. This series of papers won him the M V Lomonosov Prize of the Academy of Sciences in 1975. Related to this series is the well-known work on the metastable phase of solid hydrogen, in which the equation of state was found for a wide pressure range and the pressure of the transition from the molecular to the metal phase was evaluated.

A series of papers that occupy an important place in Kagan's work launched a new direction of research into the interaction of nuclear radiation with a matter and led to a theory of coherent collective resonance phenomena. This resulted first of all in a prediction of the suppression of inelastic channels of nuclear reactions when an absorbing crystal becomes transparent to gamma quanta and neutrons. This phenomenon was soon detected and experimentally scrutinized. The notion of nuclear excitons delocalized in the crystal was also developed and a unique type of decay was predicted. These ideas were the basis for constructing a theory of excitation of Mössbauer levels and nuclear diffraction in a field of synchrotron radiation. All predictions of the theory were experimentally confirmed and are extensively used now. An interesting series of Kagan's works were devoted to the channeling theory. In 1970 Kagan predicted the possibility of the neutron bound state in a matter, ten years before it was experimentally detected.

An impressive direction of Kagan's research in the last 20 years was the study of the low-temperature quantum kinetics of condensed media. This branch opened with a brilliant paper by Yu M Kagan and I M Lifshitz, in which the formation of a nucleus of a stable phase near absolute zero was treated as a quantum tunneling over a potential barrier. This work, which posed the problem in a principally new way, has changed drastically our view of the metastable phase decay near absolute zero.

The development of the theory of quantum diffusion and of localization of atoms and excitations in crystals and glasses at low temperatures was an important stage in Kagan's research. Kagan predicted the temperature and concentration dependences for quantum diffusion and the self-localization effect due to the interaction of diffusing particles; these were experimentally confirmed in quantum crystals of ^{3}He–^{4}He. In the years that followed, numerous experiments confirmed all the significant features of this theory. At the end of the 1980s Kagan created a general theory of quantum diffusion in metals and superconductors, in which the decisive factor was the interaction between the diffusing particle and the electron liquid. The unexpected effects predicted in this work found later the experimental confirmation. The theory of the polaron effect developed in these publications served as a basis for a novel concept of the nature of so-called heavy fermions and provided an explanation of the anomalous acoustic absorption in superconducting amorphous metals. His unwavering interest in amorphous materials led Kagan to an original series of papers in which he was able to demonstrate for the first time the existence of low-frequency excitations in glasses and to describe a strikingly new concept for origin of the properties of amorphous materials. These papers explained the anomalous pattern of the propagation of acoustic and electromagnetic radiation which is produced at ultra-low temperatures.

In recent years Kagan has been absorbed in the problem of the Bose condensation of metastable gases at low temperatures. The basic concepts in this field were developed using spin-polarized atomic hydrogen as a model system. Kagan carried out a detailed analysis of stability and decay kinetics of atomic hydrogen and outlined ways for achieving Bose condensation. The predicted essentially nonsuppressible decay channel, that is, three-particle dipole recombination, was later discovered simultaneously in several leading research laboratories. Within the framework of this analysis, Kagan predicted the effect of the diminishing rate of all inelastic processes as a result of the formation of the Bose condensate. This nontrivial effect was discovered experimentally in 1997. Today Kagan focuses his attention on the dynamics and kinetics of the formation of quantum correlation and Bose condensation in spatially nonuniform systems.

As a professor of the Moscow Engineering Physics Institute, Kagan for many years gave a brilliant course of lectures on 'Modern solid state theory', which formed the foundation of solid state education for most of the graduates of those years. As a head of the Theoretical Department of the Kurchatov Institute, Kagan brought forth the 'Kagan school' — a constellation of brilliant students who grew into PhD's and DSc's and corresponding members of the Academy of Sciences. Kagan's theoretical seminars are quite famous among theorists. We also wish to emphasize one feature typical of Kagan but not too frequent among theorists: he strives to work in the close contact with experimenters, to thoroughly understand the subtleties of experiments, and to stimulate their setting and improvements. In addition to all this, Yuriĭ Moiseevich Kagan is a multifaceted and communicative person, with a profound understanding and love of art.

Yuriĭ Moiseevich Kagan came to his 70th anniversary at the peak of his powers, full of energy and creative thought. His colleagues, friends and students wish him the happiest birthday and wonderful new results in physics, enviable health and enveloping happiness.

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