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In memory of Aleksandr Mikhaĭlovich Dykhne

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Aleksandr Mikhaĭlovich Dykhne, Full Member of the Russian Academy of Sciences, Professor, Director of the Center for Theoretical Physics and Computational Mathematics affiliated with the RF State Research Center 'Troitsk Institute of Innovative and Thermonuclear Research' (TRINITI) died suddenly on January 6, 2005.

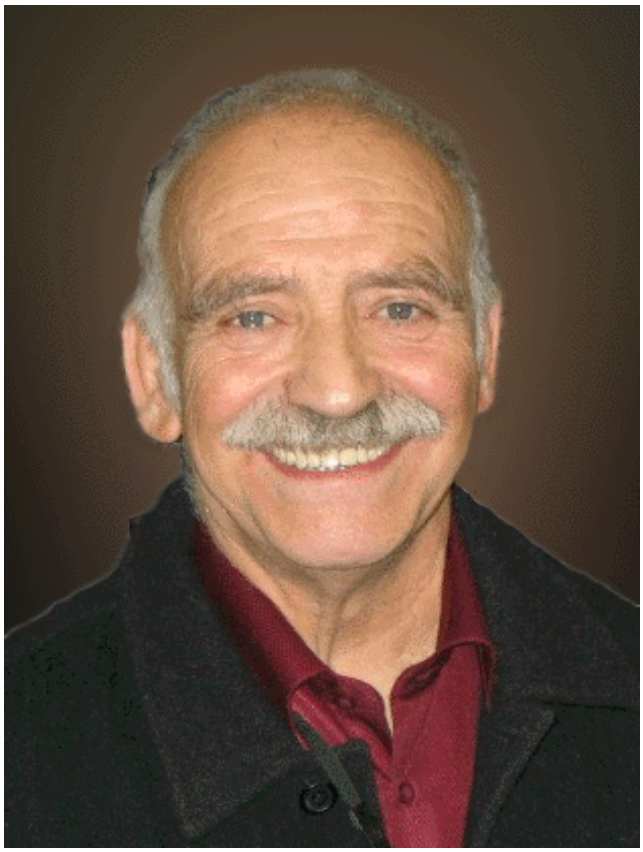
Dykhne was born on October 27, 1933 in Moscow. His father was a brilliant representative of the generation of young 'builders of socialism' and fell victim to political purges at the end of 1930s. Dykhne's mother was a woman of outstanding willpower; attempting to save her only son she managed to send him at the last moment to live with her relatives; hardships and constant relocations through Caucasian republics, Uzbekistan, Mordovia (where his mother was an inmate in one of the labor camps), Ukraine, and Siberia lasted almost a quarter of a century.

After graduating from the Kiev Polythechnical Institute and acquiring a specialty in 'metallurgy and physics of metals', Dykhne was sent as an engineer to huge steel works in Western Siberia. Soon after this a Siberian Branch of the USSR Academy of Sciences was organized. This gave him a chance to start his scientific career at the Institute of Radiophysics and Electronics, the very first physics-oriented institute created in Novosibirsk by Yuriĭ Borisovich Rumer. Rumer immediately recognized that the young metallurgist was a 'God-sent, born physics theoretician'.

The five years at the Institute of Radiophysics and Electronics proved extremely fruitful. Dykhne was working in several fields at the same time: electrodynamics (theory of horn antennas), statistical physics (plane dipole Ising – Onsager lattice), and quantum mechanics (adiabatic transitions). In connection with the creation of magnetic traps for controlled thermonuclear fusion, Dykhne was able to calculate the change in adiabatic invariant of a charged particle in such a trap. The solution he obtained for transitions in a two-level system in response to adiabatic perturbations is known as the Landau – Dykhne formula. In his reference to Dykhne's thesis for Candidate of Physico-mathematical Sciences, presented and defended by Dykhne in 1960, L D Landau emphasized the exceptional talent of the author.

Having returned to Moscow in 1962, Dykhne chose to work in the I V Kurchatov Institute of Atomic Energy. The main fields of his research in subsequent years were quantum mechanics, plasma physics, solid state physics, astrophysics, biophysics, laser physics, and laser technology.

Dykhne published two monographs and more than 150 papers, and received certificates for a discovery and a number of inventions that were patented in Russia and abroad. In 1987, he was elected Corresponding Member, and in 1992 Full Member of the Russian Academy of Sciences (RAS); he was a member of the Bureau of the Division of Physical Sciences of the Academy.



Aleksandr Mikhaĭlovich Dykhne
(27.10.1933 – 06.01.2005)

Among his first fundamental results we find the formulas for the transition probability in the adiabatic approximation and in the sudden shaking approximation, generalizing the Landau – Zener and Migdal formulas in quantum mechanics.

Dykhne's fundamental contribution to solid state physics was the discovery of the class of exact solutions for effective properties of two-dimensional nonuniform and anisotropic media. The approach he used to calculate the electrical and galvanomagnetic properties of polycrystalline metals and semiconductors opened the way to a multitude of research attempts; the best known among them are the papers on flicker noise in inhomogeneous media and on the quantum Hall effect. Methods developed by Dykhne in solid state physics were applied to molecular biology; in collaboration with M D Frank-Kamenetskiĭ, he constructed the theory of 'melting' of the DNA molecule, and studied specific features of the thermodynamics of ring biopolymers. His long-term interest in biological problems found a logical outlet in his last years as he turned to the design of chemicals for medicines — a field that Dykhne greatly helped to develop.

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In plasma physics, Dykhne predicted and investigated the phenomenon of ionization turbulence, explained the existence of nonequilibrium ionization wave in a gas placed in an electric field, and developed the theory of plasma layer contraction as well as the theory of explosive instability and near-electrode instability in glow discharges. He also studied electrical and thermal properties of fluctuating plasmas that govern their anomalous resistance and the Hall effect. He suggested a magnetothermal mechanism for spontaneous emergence of magnetic fields in the plasma.

Ionization turbulence was discovered in a number of experiments that were carried out on the initiative of E P Velikhov and A M Dykhne. This work achieved the status of discovery.

In the physics of radiation – matter interaction and in laser physics, Dykhne predicted the self-sustained overstability in the fast-flow laser, suggested a method for light excitation of high-amplitude elastic surface waves, and predicted the phenomenon of group resonance that makes it possible to selectively excite elastic waves. These predicted effects were experimentally confirmed.

The hydrodynamic model of resonance radiation transfer in gases also found its applications. The dominant role of smooth trajectories in the process of gamma-radiation transfer in heterogeneous media, following from this theory, proved to be the key idea for analyzing the radioactive radiant fluxes from the Chernobyl 'sarcophagus'. This problem is also connected with detecting certain instabilities of self-sustaining melting waves driven by residual heat of radioactive sources, also known as the 'China syndrome'.

In recent years, Dykhne paid considerable attention to problems of nanotechnologies, which are of great interest the world over: the physics of magnets with ordered nanostructure; electrodynamics of disordered and inhomogeneous (on the mesoscopic scale) solids; ways of affecting nuclear decay in plasma for transitions with enormously low energies; factors limiting the capabilities of scanning tunneling microscopes, and nanomechanics. Furthermore, he suggested making use of high-order noise correlation functions for extracting information on the internal structure of solids; he also investigated the interaction between femtosecond laser pulses and various objects.

The problems listed above are, on the one hand, of fundamental importance, and, on the other hand, are closely related to useful applications. Considerable progress was achieved in recent years in each of these areas initiated by Dykhne, and this was reflected in a large number of papers issued in leading Russian and international publications.

A theoretical physicist by vocation, Dykhne formulated a great many ideas that were implemented in experiments. His tremendous experience and unique intuition made possible important progress in the development of new technologies, materials, and instruments, as well as observation of new physical effects.

Dykhne actively collaborated with individual scientists and groups of scientists from M V Lomonosov Moscow State University, the Institute of Spectroscopy, the Institute of High-Pressure Physics, the Moscow Institute of Physics and Technology, the Institute of Safe Upscaling of Atomic Power Production, and many other organizations. He headed a science school that was recognized as one of the leading science schools in Russia. In the year 2000, he started a new program 'Resonance, Relaxation and Dispersive Phenomena in Complex Physical Objects (inhomogeneous solids and molecules)'.

Dykhne devoted much time and attention to training young scientists, to nurturing scientists with the highest skills. For many years he taught at the Moscow Institute of Physics and Technology; he created the Chair of Applied Theoretical Physics and headed it.

In the period from 1992 to 2001, he was Chairman of the Expert Council on Physics of the Higher Certification Commission (VAK). From 1994 to 2000, Dykhne headed the Expert Learning Council of the Russian Foundation for Basic Research, and from 2000 on was a member of the Bureau of the Council of the RFBR.

Dykhne actively participated in international scientific and educational cooperation, headed the Expert Committee of the program 'Fundamental Research and Higher Education' formed by the RF Ministry of Education and the Civil Research and Development Foundation (USA) and aimed at creating a modern research and education centers in Russia. He also led research on increasing the safety of burial of radioactive waste in various countries, especially in Russia, as part of the international cooperation program 'RAS — US Department of Energy'.

Dykhne was awarded the USSR State Prize and a number of governmental awards; he was an active participant in the effort to eliminate the consequences of the Chernobyl nuclear power station catastrophe.

A man of brilliant talent, he was a powerful catalyst of creative thought in his interlocutors, often casting a profound idea in the form of an elegant joke. His fantastic sense of humor, his modesty and tactfulness combined with unbending principles, his desire to help people in dire need, and the courage with which he faced his own difficult times generated warm and sincere feelings in an enormous number of people.

The world lost a brilliant scientist, a person of noble soul and highest culture, and his closest family and relatives lost a vivacious, wonderfully kind and responsive friend. The circle of his interest was very broad — music, poetry, painting, sport... He was a center of attraction to the young and to the mature, and for everyone he would find time and a topic that would be dear to both. He loved life, loved people, and helped quite a few to find their vocation. Aleksandr Mikhaĭlovich Dykhne left behind many students, followers, and simply friends who were fascinated with his sharp wit and his extraordinary ideas.

His friends, colleagues and all those who had the luck of being in his company cherish the grateful memory of Aleksandr Mikhaĭlovich Dykhne.

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