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PERSONALIA

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In memory of Igor Nikolaevich Toptygin

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On February 16, 2026, Igor Nikolaevich Toptygin, a remarkable scientist and educator, who for many years headed the Department of Theoretical Physics of Polytech (M.I. Kalinin Leningrad Polytechnic Institute, and now the Peter the Great St. Petersburg Polytechnic University). Igor Nikolaevich made an invaluable contribution to cosmic ray research and was the author of widely known textbooks and monographs. His lectures were attended by over ten thousand students, and his students became professors and members of the Russian Academy of Sciences (RAS).

Igor Nikolaevich Toptygin was born on February 13, 1931 in Leningrad. He spent the first harsh winter of the war, 1941–1942, in besieged Leningrad, and was only evacuated to the mainland in the Spring of 1942. On finishing school, he entered the Physics and Mechanics Faculty of Polytech, the Department of "Experimental Nuclear Physics" — the most prestigious department at the time. He graduated with honors from the Polytechnic in 1955 with a degree in Technical Physics and was accepted to the Department of "Theoretical Physics" in the Physics and Mathematics Faculty, where he worked all his life.

In 1964, I.N. Toptygin defended his candidate thesis and in 1973 — his doctoral thesis. He began as an assistant (1955–1964), then an associate professor (1964–1975) and professor. From 1976 to 1998 he headed the Department.

Igor Nikolaevich's scientific work covers a wide range of problems in theoretical physics. Specifically, he participated in calculating angular correlations of beta-decay products of atomic nuclei, in constructing infinite-dimensional representations of the Lorentz group and relativistic spherical functions, in developing the theory of multiple scattering of polarized electrons in matter, in studying the deceleration of ultrarelativistic charged particles in condensed matter and in magnetized plasma, in calculating quantum paramagnetic amplifiers, in formulating the theory of positron annihilation in plasma, and in resolving subtle issues of relativistic quantum electrodynamics of dispersive transparent media.

Igor Nikolaevich's main field of research was the theory of cosmic rays and cosmic plasma, in which energetic particles accelerate and propagate. In the early 1960s, active research into cosmic rays in the heliosphere began. Several authors in the USA, West Germany, and the USSR, including G.F. Krymsky and E.N. Parker, formulated an equation for cosmic ray transport with allowance for particle energy variation in the expanding solar wind plasma.

Igor Nikolaevich became actively involved in this work in the second half of the 1960s. In 1966, together with A.Z. Dolginov, he consistently formalized the kinetic theory of cosmic ray propagation in random magnetic fields in moving cosmic plasma on the basis of one-particle kinetic equations for energetic charged particles. Then Igor Nikolaevich formulated a kinetic theory describing the energetic particle scattering by magnetohydrodynamic (MHD) waves; it is widely used in models of cosmic ray propagation in heliosphere and interstellar medium. Moreover, he formulated a theory of nonlinear MHD-wave damping in cosmic plasma, providing insight into solar wind processes. All these results lay the basis for I.N. Toptygin's doctoral thesis "The theory of cosmic ray propagation in the interplanetary space," which he defended in 1973. Later, these results were presented in the monograph "Cosmic rays in interplanetary magnetic fields" (1983).



Igor Nikolaevich Toptygin
(13.02.1931 – 16.02.2026)

In the next years, Igor Nikolaevich carried out a number of important studies related to cosmic plasma physics. The results were published in scientific papers and reviews in the journal *Uspekhi Fizicheskikh Nauk* (*UFN*) (*Physics – Uspekhi*) and several monographs. The fundamental results of Igor Nikolaevich's studies were recognized by the world scientific community and made him one of the leading world specialists in cosmic ray and cosmic plasma physics.

Almost the hole of 1977, Igor Nikolaevich worked in I.E. Tamm Department of Theoretical Physics at P.N. Lebedev Physical Institute RAS, which was a notable event for the department's staff. He frequently discussed the problem of cosmic ray origin with V.L. Ginzburg,

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S.I. Syrovatsky, and other employees, which was fostered in further investigations of the problem.

Igor Nikolaevich was a brilliant lecturer and delivered many lecture courses on the main aspects of theoretical physics, including several original courses (for instance, "Space electrodynamics"). He headed the methodological council of the Physics and Mechanics Faculty of the Polytech for a long time and made a significant contribution to the improvement of educational programs. He was the founder of the Polytechnic School of Theoretical Cosmophysicists, whose work is closely related to the astrophysical studies at A.F. Ioffe Physical-Technical Institute. May physicists and astrophysicists in Russia and abroad are grateful to Igor Nikolaevich for his meaty reviews during their defenses; the number of defenses, in which he was an opponent, was countless.

In addition to monographs on cosmic rays, Igor Nikolaevich wrote, either himself or with co-authors, several monographs for a wider audience, problem books and textbooks for students, graduates, and researchers. Some of these were reprinted, translated, and became world known. The "Collection of problems in electrodynamics," written jointly with his close colleague V.V. Batygin, was the main achievement. It was first published by the Physics and Mathematics Literature Publishing House in 1962, and then supplemented and reprinted in 1970 and 2002. Already in 1964, the first edition was translated into English and published by the London publishing house "Academic Press." The second supplemented edition was translated by D. ter Haar and published in the English language in 1977. Since then, the Collection of Problems has been widely used in the best world universities. Owing to the felicitous choice of problems and the description of their solutions, as well as laconism and clarity of presentation, it is thought of as a "Solutions book," a textbook, and an encyclopedic reference book on electrodynamics and related sciences. In 2005, Igor Nikolaevich published a fundamental two-volume monograph "Modern electrodynamics," where, along with fundamentals, he presented many important applications of electrodynamics.



Igor Nikolaevich Toptygin with his beloved dog — an East European sheepdog Volk (Wolf) by name (approximately 1978).



Three generations of physicists — astrophysicists of Abram Federovich Ioffe's school, shot against the background of his bust. On the right is Igor Nikolaevich Toptygin — the teacher of Andrei Mikhailovich Bykov (on the left), who is, in turn, a scientific supervisor of Aleksei Evgen'evich Petrov (in the center). The photo was taken in the Assembly Hall of A.F. Ioffe Physical-Technical Institute (PTI) after the presentation of A.E. Petov's candidate thesis "Dynamic magnetic structures in strongly nonequilibrium relativistic plasma of pulsar nebulas" on July 5, 2018.

Igor Nikolaevich was a member of the Scientific Council for the complex problem of "Cosmic Rays" RAS, a member of several dissertation councils at the Polytech and A.F. Ioffe Physical-Technical Institute. He received various awards and was an honorary professor of Polytech and a distinguished worker of higher school.

He was a modest man and a true intellectual; he usually spoke with restraint and to the point but could also openly disagree with his superiors. Among his close friends, he changed and became open, cheerful, and witty. He possessed an excellent memory, was interested in everything in the world, and loved to tell stories about his life, inserting pieces of poetry. He was skilled and loved tinkering and making things with his hands. He was naturally endowed with enviable health and enjoyed challenging canoe trips along Ural rivers, especially if he had to drag the kayaks himself.

The blessed memory of Igor Nikolaevich Toptygin, a remarkable and extraordinary person, scientist, and teacher will live in the hearts of those who had the good fortune to be his disciples or simply to come into contact with him.

A.M. Bykov, V.A. Dogel', L.M. Zelenyi,
V.N. Zirakashvili, A.V. Ivanchik, V.V. Kocharovskii,
G.F. Krymskii, L.A. Kuzmichev, K.P. Levenfish,
K.A. Postnov, S.A. Starodubtsev, D.G. Yakovlev