

Andrey Viktorovich Gaponov-Grekhov: a brief essay on his life and scientific activity (to the 100th anniversary of his birth)

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Abstract. This scientific and biographical article is dedicated to the life and scientific achievements of the outstanding Soviet and Russian physicist, Academician Andrey Viktorovich Gaponov-Grekhov (1926–2022), whose centenary will be celebrated on June 7, 2026. The article provides a detailed account of A.V. Gaponov-Grekhov's biography: his childhood in a family of scientists, his education during the war years, his formation as a scientist and science organizer at Gorky (Nizhny Novgorod) University. Special attention is given to the establishment and development of the radiophysics school in Gorky, where, under the leadership of Gaponov-Grekhov and his colleagues, the foundations of new directions in physics were laid. The article analyzes the key scientific results of Gaponov-Grekhov: the discovery of shock electromagnetic waves, the development of principles for radiation generation based on electron cyclotron resonance (gyrotrons), the creation of the theory of induced emission of classical oscillators, as well as contributions to the development of nonlinear dynamics, plasma physics, hydroacoustics, and relativistic microwave electronics. His outstanding role as a science organizer is emphasized: the founding of the Institute of Applied Physics of the Russian Academy of Sciences (IAP RAS), the formation of a state program to support leading scientific schools, and the development of a system for training young scientists. Special attention is paid to Gaponov-Grekhov's contribution to organizing major scientific programs, his participation in state and academic councils, and his active work in preserving and developing domestic science during the challenging 1990s are noted. The article illustrates how, through a combination of deep scientific knowledge, organizational talent, and state responsibility, Andrey Viktorovich became one of the key figures in the history of Russian physics, and the IAP RAS he created continues to hold leading positions in the country and the world.

Keywords: history of physics, Academician of the Russian Academy of Sciences (RAS) Andrey Viktorovich Gaponov-



Andrey V. Gaponov-Grekhov
(June 7, 1926–June 2, 2022)

Grekhov, Institute of Applied Physics of the Russian Academy of Sciences (IAP RAS), radiophysics, nonlinear dynamics, plasma physics, gyrotrons, electron cyclotron resonance, physics of oscillations and waves, microwave electronics, relativistic electronics, hydroacoustics, science organization, scientific schools, training of young scientists, history of Russian physics, state science management

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Andrey Viktorovich Gaponov-Grekhov was born on June 7, 1926, in Moscow, in a family of young physicists, Maria T. Grekhova and Viktor I. Gaponov. Actually, the entire life of Andrey Viktorovich (hereafter abbreviated as A.V.), with the exception of his first five years, was spent in Nizhny Novgorod (Gorky), where his parents moved in early 1932 to work and teach at Nizhny Novgorod State University, which, by the time their paperwork was completed, had changed its name to Gorky State University.

The move of this distinguished group, which also included the future academician Alexander A. Andronov and his wife,



Maria T. Grekhova and Viktor I. Gaponov (parents of Andrey V. Gaponov-Grekhov)

Evgenia A. Leontovich, and Professor Gabriel S. Gorelik, who later joined them, was a significant event not only for the Gaponov and Andronov families. Thanks to their energy, scientific and organizational talent, and the enthusiasm of the innovators, the city of Gorky soon ceased to be a scientific backwater, and a new era began in the history of Gorky (Nizhny Novgorod) physics. The main indicator of such significant changes was the creation of the world-renowned Nizhny Novgorod school of radiophysics.

Andrey Viktorovich graduated from high school in 1943. World War II was raging, and he had to combine his high school studies with part-time work in the institute's metal-working shops and in the countryside (A.V. completed a tractor driver course). He took his high school exam as an external student and immediately enrolled at the specialized department of Gorky Industrial University, which trained radio engineers. Two years later, he transferred, among the first recruits, to the third year of the newly created Radiophysics Department of Gorky State University. Along with A.A. Andronov and G.S. Gorelik, M.T. Grekhova was one of the founders of this department, the first in the country with such a training profile and name, and also its first dean.

Maria Grekhova was a truly unique individual and an outstanding scientific organizer. She was born in 1902. After graduating from the Physics and Mathematics Department of the Moscow State University in 1924, she received a diploma in experimental physics and worked at the All-Russia Electrotechnical Institute, where she studied the generation, emission, and transmission of decimeter-range electromagnetic waves. By the time she moved to Gorky in 1932, she was already a recognized specialist in this field. After the move, in addition to working at the recently established Physics and Technology Institute within Gorky State University, she joined the Central Military-Industrial Laboratory, the successor to the famous Nizhny Novgorod Radio Laboratory. Maria Grekhova's scientific prowess is evidenced by the following facts: in 1936, she was awarded the degree of Doctor of Physics and Mathematics without defending a doctoral thesis, and two years later, the academic title of professor. In 1945, she became the dean of the country's first radiophysics department, and later, in 1956, she became the organizer of the Radiophysical Research Institute (RRI),

where she served as director until 1972. It can be said that radiophysics as a new direction in personnel training and a new field of physical science was organized by M.T. Grekhova, and this occurred precisely in Gorky.

A.V.'s father, Professor Viktor Gaponov, a renowned scientist in the field of electronics, author of the two-volume textbook 'Electronics' and head of the chairs at the Radiophysics Department, was also a remarkable individual and a well-educated intellectual. He possessed a vast library and read books in six languages. For many years, Viktor Gaponov served as deputy editor-in-chief of Academician V.L. Ginzburg's journal *Izvestiya Vuzov. Radiofizika* published in Gorky, effectively overseeing its publication. It can be said that A.V. clearly inherited the unique abilities of both of his parents. Of course, this is not just a matter of genetic inheritance, but also stems from the remarkable upbringing in a family that raised two future full members of the Russian Academy of Sciences.

From the very first years, teaching at the Radiophysics Department of Gorky State University was conducted at a very high level. To this end, the founders brought in future luminaries of science, V.L. Ginzburg, D.A. Frank-Kamenetsky, E.L. Feinberg, and S.M. Rytov, coming from Moscow to deliver lecture courses. Students interacted closely with active scientists and quickly became involved in scientific research. Andrey Viktorovich's first steps in science, taken while still a student, together with his classmate and friend Mikhail Miller, were related to the development of a theory of electromagnetic emitters (thin antennas) in distributed resonant systems. They carried out this work under the supervision of Mikhail Levin,¹ who became their close friend and remained so throughout his life. The results obtained then played an important initiating role in Andrey Viktorovich's subsequent research in the fields of electrodynamics and microwave electronics.

In 1949, A.V. graduated with honors from the university and became a Ph.D. student of Academician A.A. Andronov.

¹ A Moscow physicist who worked in Gorky, actually in exile. (For more on him, see the book "Mikhail L. Levin: Life, Memories, and Works," 2nd ed., Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod (1998).



Collaborators of the Radiophysical Faculty, 1951.

Sitting: M.T. Grekhova, N.N. Bautin, G.S. Gorelik, and V.I. Gaponov.

Standing: N.P. Vlasov, V.I. Anikin, N.K. Tsukanova, and A.N. Barkhatov.

At that time, Mikhail Levin was on the verge of being dismissed from the university due to political persecution, which was later carried out with justification “due to the impossibility of use.”² A.A. Andronov suggested that A.V. completely change the topic of his scientific studies, carried out during his student years, and turn to the study of the dynamics of electromechanical systems with sliding contacts. Such famous scientists as Poincaré, Barkhausen, and others had already been unsuccessfully studying this problem in the early 1900s. Unlike his predecessors, A.V. managed to obtain very important results. He showed that such electromechanical systems are, from a dynamic point of view, S.A. Chaplygin’s nonholonomic systems, and proposed a new form of the equations of motion of such systems. Based on the general equations obtained, a path was indicated for constructing a general dynamic theory of electrical machines. His Ph.D. thesis, based on three papers published with sole authorship in the journal *Doklady Akademii Nauk*, was submitted for defense at the Leningrad Polytechnic Institute. The results he obtained were considered so significant that, during the defense, A.V. Gaponov-Grekhov was immediately awarded the degree of Doctor of Physics and Mathematics in 1955. Interestingly, after defending his thesis, A.V. published several more papers on this topic (the last in 1957) and never returned to the subject thereafter.

After that, A.V. transferred to teaching at the Radio Engineering Department of Gorky Polytechnic Institute. When Radiophysical Research Institute was founded in 1956, A.V.’s primary position became this newly created institute, where he headed the Microwave Electronics Department while also remaining a professor at the Polytechnic Institute. This actually marked A.V.’s full return to the topics of his initial research in microwave electrodynamics and electronics, which he continued to pursue even while working on his Ph.D. thesis. In particular, it was during these years that A.V. Gaponov and M.A. Miller translated W. Smythe’s book “Electrostatics and Electrodynamics,” which proved a very useful supplement to the already published translation of J. Stratton’s fundamental monograph “The

Theory of Electromagnetism,” as it contained a large set of problems, the solution of which during the translation process also contributed to the improvement of the professional level of translators in the field of electrodynamics. The quality of their work turned out to be so high that the book was published without the traditional scientific editing at the publishing house.

The second half of the 1950s proved to be an extremely fruitful period in A.V. Gaponov’s scientific career. It was during this time that he obtained three of his most important scientific results, opening up new areas of research that are still associated with his name today:³ the discovery of shock electromagnetic waves (anticipating the study of nonlinear wave processes in optics that began after the invention of the laser), the development of a new principle for generating electromagnetic radiation—electron cyclotron masers (later known as gyrotrons), and the determination of the average force acting on charged particles in high-frequency fields (ponderomotive force, jointly with M.A. Miller). All of these studies demonstrated A.V.’s inherent clear physical intuition and desire to construct simple models that preserve the fundamental laws of complex physical phenomena. His model-based thinking was combined with a rare ability to discern a new problem behind an interesting physical problem, and sometimes even just a mundane fact, assess its potential, and ultimately formulate a new scientific direction. Thus, the idea of shock electromagnetic waves in nonlinear media arose from an analysis of the results of experiments conducted with ferrites by one of his graduate students at the Polytechnic Institute. The initial, specific problem of the evolution of a plane electromagnetic wave in an unbounded nonlinear medium became the foundation of one of the key and interdisciplinary fields of modern physics—the nonlinear dynamics of distributed systems (the physics of nonlinear waves). Subsequently, A.V. and his students,

³ At a significant stage of his scientific career, A.V. published scientific articles under the name “A.V. Gaponov.” The transition to the full surname Gaponov-Grekhov became necessary after his appointment to senior administrative positions.



Diffraction Symposium (city of Gorky, 1962).

Upper row: V.A. Fock, E.L. Feinberg, and M.L. Mikaelyan.

Middle row: E.D. Smirnova (Gaponova),
A.V. Gaponov-Grekhov, and S.M. Rytov.

Lower row: D.M. Bravo-Zhivotovskiy, M.A. Miller, and M.L. Levin.

² Mikhail L’s mother, a prominent economist and Corresponding Member of the USSR Academy of Sciences, R.S. Levina, was a member of the Jewish Anti-Fascist Committee; she was arrested in 1948, and Mikhail L’vovich himself already had a political conviction. R.S. Levina and M.L. Levin were fully rehabilitated in 1956.

L.A. Ostrovsky, M.I. Rabinovich, and G.I. Freidman, carried out pioneering work on the theory of nonlinear waves and the study of dynamic chaos and self-organization processes in complex dynamic systems.

One of A.V.'s most remarkable scientific achievements, which fully revealed his talent as an outstanding scientist and scientific organizer, was the development of the theory of stimulated emission from classical (nonlinear) oscillators between 1958 and 1962, the formulation on this basis of a new principle for the generation and amplification of electromagnetic waves, and the implementation of this principle in a new type of electronic device. This is the mechanism of cyclotron maser instability, which was independently discovered in 1959 by several researchers. However, only A.V. Gaponov-Grekhov understood the potential that this principle held for microwave electronics and, with his students, began extensive theoretical and experimental work in this field. Andrey Viktorovich managed to develop the theory, conduct demonstration experiments, and create electron cyclotron masers (ECM) almost simultaneously. These devices, later named 'gyrotron' and 'gyroklystron' by their creators, proved to be unrivaled as the most powerful coherent radiation generators and amplifiers over a wide range of wavelengths—from centimeter to submillimeter. Intense development and production of gyroresonance devices began abroad only after the publication of the Gorky team's impressive results and the Kurchatov Institute's experimental research using gyrotrons as high-power sources of electron-cyclotron plasma heating in Tokamak installations.

In subsequent years, A.V.'s scientific interests expanded to include the development of microwave electronic devices using short-pulse, high-current relativistic electron beams, giving rise to relativistic microwave electronics. This research also led to the creation of an entire class of high-power microwave devices based on high-current relativistic electron beams, capable of generating nanosecond pulses with gigawatt-level power. The resulting microwave radiation sources have found wide application in controlled thermonuclear fusion facilities, high-power radar systems, technological processes, plasma chemistry, and nuclear physics. Most of the world's leading magnetic plasma confinement fusion facilities are now equipped with gyrotrons manufactured by the Nizhny Novgorod company GYCOM, founded in the early 1990s with his support and participation.

During the mentioned very successful period of activity, Andrey Viktorovich in collaboration with M.A. Miller completed another fundamental work, demonstrating the potential nature of the time-averaged force acting on charged particles in weakly inhomogeneous electromagnetic fields (1958). This work led to the formulation of interesting physical proposals for the localization and acceleration of plasma by high-frequency fields. The introduction of the "Effective high-frequency potential" (Ponderomotive Force) into theory allowed subsequent researchers to derive simple equations describing the dynamics of nonlinear electromagnetic phenomena in a plasma—from all kinds of stimulated scattering effects to self-focusing and wave collapse.

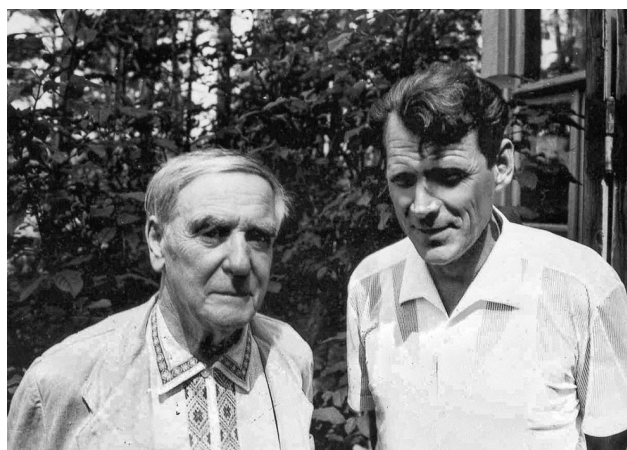
First-class achievements at the cutting edge of science, as well as his personal qualities—broad scientific outlook and excellent analytical skills, an enviable general culture, high work ethic and determination, and a mastery of scientific and human communication—enabled him to receive the unconditional support of the leaders of Russian physics, Academicians P.L. Kapitza, A.P. Aleksandrov, M.A. Leontovich, and V.A. Fock. In 1964, at the age of 38, A.V. was elected a Corresponding Member of the USSR Academy of Sciences on his first run for election, and four years later, a Full Member of the Academy. His election to the Academy was not only recognition of his personal scientific achievements but also, to some extent, an endorsement of his scientific and organizational activities aimed at developing theoretical and experimental research in the field of high-power electronics.

The exploration of new principles and the creation of a whole new generation of electronic devices based on them brought A.V., his students, and staff widespread renown in the scientific community and official recognition, culminating in the award of two USSR State Prizes: in 1967 for the series of papers "Theoretical and Experimental Study of Induced Cyclotron Radiation" and later, in 1983, for the work "Powerful Millimeter-Wave Gyrotrons and Energy Complexes for Thermonuclear Research." The scientific school in the field of microwave electronics founded by A.V. and his outstanding students, M.I. Petelin, V.K. Yulpatov, V.A. Flyagin, and G.G. Denisov, continues to hold a recognized leading position in global science.

In 1966, Andrey Viktorovich was appointed one of Radiophysical Research Institute's deputy directors for research. Within its first decade, RRI became a recognized



A.V. Gaponov-Grekhov with E.P. Velikhov and V.I. Bespalov.



P.L. Kapitza and A.V. Gaponov-Grekhov.



State Prize Winners of 1967:
V.K. Yulpatov, M.I. Petelin, V.A. Flyagin,
A.V. Gaponov-Grekhov, and I.I. Antakov.



A.V. Gaponov-Grekhov and A.P. Aleksandrov.

scientific organization in the country, well known internationally for its fundamental scientific achievements in radio astronomy, radio wave propagation, ionospheric physics, high-frequency instrumentation, high-power electronics, hydroacoustics, and plasma physics. RRI's achievements were recognized in 1969 with the Order of the Red Banner of Labor. At the same time, under Andrey Viktorovich's leadership, a large scientific team of researchers and engineers gradually formed at the Institute, conducting important research aimed at advancing high-power electronics, plasma physics, quantum electronics, nonlinear optics, and lasers.

In the early 1970s, RRI was entrusted with a particularly important research project, which required the creation of a large-scale experimental system for generating ultrahigh-power microwave radiation and modeling the processes accompanying its propagation in the atmosphere and ionosphere. The required state funding was allocated for this large-scale project, but it proved impossible to address the issue of the necessary capital construction within the framework of a research institute subordinate to the rather modest Ministry of Higher Education of the RSFSR, which lacked access to the necessary human resources. Assistance came from the President of the USSR Academy of Sciences, Academician A.P. Aleksandrov, who proposed that A.V. transfer with his team to the Academy and establish a new institute. In 1976, the USSR Council of Ministers issued a Resolution on the organization of the Institute of Applied Physics (IAP) of the USSR Academy of Sciences in Gorky. On December 30, 1976, Academician A.V. Gaponov-Grekhov was appointed the director of this institute, and on April 1, 1977, a significant portion of RRI's departments (over 600 people) transferred to the new institute. The core of the team consisted of Andrey Viktorovich's associates and his students, united by shared incentives and scientific approaches. It was exactly this unity that ensured the development of the new institute not only during the Soviet era, but also in the post-Soviet period.

In a short period of time, the IAP became one of the leading physics institutes in the country. The construction of the institute required from A.V. not only a gigantic effort in addressing financial, operational, and scientific organizational challenges, but also the assumption of responsibility for all promising research conducted at the Institute, directly participating in it, or actively supporting the effort. Invaluable assistance was provided by the Institute's Directors Board, formed by A.V. — Deputy Directors for Science V.I. Bespalov, V.A. Zverev, V.A. Flyagin, and Chief

Engineer E.V. Zagryadsky, who played key roles in its first decade.

The name given to the new institute doesn't quite accurately reflect its actual activities. As A.V. himself put it, the scientific fields that defined the Institute's scope of work at its founding and in subsequent years "are unified by their genetic connection to fundamental radiophysics, i.e., radio-physics as a general science of oscillations and waves — the excitation (generation and amplification) of oscillations and waves, their emission, channeling, and propagation, as well as the recording, reception, and processing of oscillatory and wave signals — of both electromagnetic and nonelectromagnetic origin. This generalized radiophysics integrates in a natural way the problems of direct and inverse tasks and nonlinear dynamics, on the one hand, with the most important areas of hydrodynamics, electrodynamics, acoustics, plasma physics, optics, radio- and microelectronics, and on the other, with the problems of remote diagnostics in natural (atmosphere, Earth's surface, ocean) and laboratory (plasma, various materials, mechanisms) conditions." Essentially, IAP RAS remains a radiophysics institute today, and its name emphasizes the objective of this work — bringing the results of fundamental research to applied development and implementation. A fundamentally important aspect is that all applied research is primarily supported by the Institute's own fundamental research.

Andrey Viktorovich considered the founding and development of the Institute of Applied Physics his greatest scientific achievement. Science has a natural developmental logic, according to which virtually any significant scientific advance will be achieved over time, regardless of the personal contribution of any outstanding scientist. A.V. used to say, "If you don't do it, someone else will. But the specific achievement — the institute that grew where nothing similar existed before, and that became prominent and necessary in science — is the greatest and most complex achievement that has been a success." Indeed, throughout its existence and to this day, IAP RAS has been one of the leading and largest scientific institutes in the country, occupying cutting-edge positions in the fields of plasma physics, high-power electronics, nonlinear optics and laser physics, hydrophysics and hydroacoustics, and the physics of millimeter and terahertz waves.

World-class results were obtained under A.V.'s leadership in the fields of quantum electronics and nonlinear optics. For example, in 1962, the first laser in the USSR using a domestically produced ruby crystal was created at RRI.

During the period of intense development of quantum electronics (1965–1990), the Institute's work significantly determined the advanced level of this science in the country. This is evidenced by two State Prizes, a USSR Council of Ministers Prize, and two Russian Federation Government Prizes received by the Institute's staff in this field. With A.V.'s active support, work in the field of femtosecond optics was launched at the Institute in the 1990s, leading to the creation of a world-class laser complex with petawatt-level radiation power and stimulating the development of a new scientific field in the country—the physics of super-strong electromagnetic fields and their interaction with matter. On Andrey Viktorovich's initiative, one of the major fundamental research programs of the Presidium of the Russian Academy of Sciences, “Femtosecond Optics and Physics of Super-Strong Laser Fields,” was established. The program coordinated the activities of more than 20 scientific institutes in a strategically important area of modern physics—the creation and use of ultrashort laser radiation sources for scientific, industrial, biomedical, and military-technical applications.

The versatile talents of the scientist and organizer of science were evident in the work of A.V. in Scientific Council on the Complex Problem of ‘Hydrophysics’ under the Presidium of the Academy of Sciences. Having successfully led the acoustics section, A.V. subsequently became the first deputy chairman of the scientific council, which was then held by A.P. Aleksandrov, President of the Academy of Sciences. He then chaired the Council for many years (1987–2012). In defining the Council's priority tasks, he in several cases identified the most effective ways to address them by combining the efforts of outstanding scientists, engineers, and industrial designers with highly qualified naval specialists. The Institute he headed was also involved in addressing these issues, significantly expanding research in the fields of low-frequency hydroacoustics and upper ocean physics with the participation of the Institute's leading scientists. In essence, A.V. initiated the development of low-frequency sound as a tool for active ocean diagnostics over large areas and routes up to 1,000 km long. The IAP conducted key fundamental and applied research in hydroacoustics, including the creation of powerful coherent low-frequency acoustic emitters with first-class characteristics and the conduct of full-scale demonstration experiments in the field of long-range ocean acoustics. Emitters developed at the IAP were used, in particular, to conduct unique Russian-American acoustic experiments on the propagation of low-frequency signals along stationary trans-Arctic routes, confirming the fundamental potential of using low-frequency hydroacoustics for global ocean climate thermometry.

A.V. placed great importance on developing research in condensed matter physics at the Institute, which had not previously been among the core interests of the Gorky school of radiophysics. On A.V.'s initiative and with his active support, a prominent research team was formed within the first decade of the IAP's work, conducting research in two areas of solid-state physics: semiconductor physics and thin-film laser deposition technology. State prizes were awarded for a series of studies conducted at the IAP on semiconductor masers and lasers (1987) and on multilayer X-ray optics (1991). In 1993, on the initiative of Sergey Gaponov, actively supported by Andrey Viktorovich, a new academic institute was organized on the basis of the IAP's Solid-State Physics Department—the Institute for Physics of Microstructures of the Russian Academy of

Sciences. It quickly took a worthy place in the family of academic institutes with similar profiles. In 2015, the Academic Council of the Institute for Physics of Microstructures decided to join the Federal Research Center ‘IAP RAS’ while maintaining the greatest possible scientific and organizational independence within this framework.

It can be said that A.V. was a statesman, since when solving major scientific problems, the interests of the state, related to the need to develop science and ensure the country's defense capability, were paramount for him. At the same time, he remained faithful to the fundamental principles of scientific creativity, including independent judgment and openness to equitable discussion of the scientific content of his research. This combination of moderate freethinking and governmental responsibility was the source of his high authority among the broad scientific community, and simultaneously his appeal to the authorities. In this regard, the elections of delegates to the First Congress of People's Deputies of the USSR by the USSR Academy of Sciences were particularly indicative. At that time, the Academy of Sciences had a special quota for the election of 20 deputies. In a secret ballot, A.V. passed the first round of voting, having received the most votes out of seven elected individuals. It can be assumed that he received the support of both liberal and conservative members of the Academy's general assembly, which this time included, in addition to Academy members, representatives of the academic research institutes. Andrey Viktorovich had previously been elected to the Supreme Soviet of the RSFSR, but said there was ‘nothing legendary’ about it. He approached his election as a people's deputy very seriously: initially, he spoke hopefully of the opening opportunities for democratization in the country and agreed to serve on one of the most important parliamentary bodies—the Committee on Defense and State Security. Later, based on his experience participating in the Committee's consideration of a number of key legislative issues, he concluded that he was unsuited for full-fledged political activity and withdrew from it.

Other examples of Academician A.V. Gaponov-Grekhov's multifaceted and in-demand scientific and organizational activities outside the Institute include not only his already mentioned work on the Scientific Council for Hydrophysics under the Presidium of the Academy, but also his participation in many other academic and government councils and commissions, his multi-year leadership of the editorial board of the journal *Izvestiya Akademii Nauk. Seriya Fizicheskaya*, and his membership in the editorial boards of other scientific journals. In the 1990s, when Russian science was almost abandoned to its fate, A.V. Gaponov-Grekhov became one of the initiators of the targeted Presidential Program for Support of Leading Scientific Schools in Russia, designed to preserve and strengthen scientific schools as a crucial and, in many ways, unique factor in the development of science in our country. For 15 years, A.V. served as the chairman of this program's board and was an insurmountable obstacle to government officials' plans to radically restructure Russian science along foreign lines, relying on scientific mobility, which would have actually destroyed domestic scientific schools. The implementation of this program is further evidence of Andrey Viktorovich's high scientific and moral authority. It is regrettable to note that in subsequent years, this program was actually eliminated.

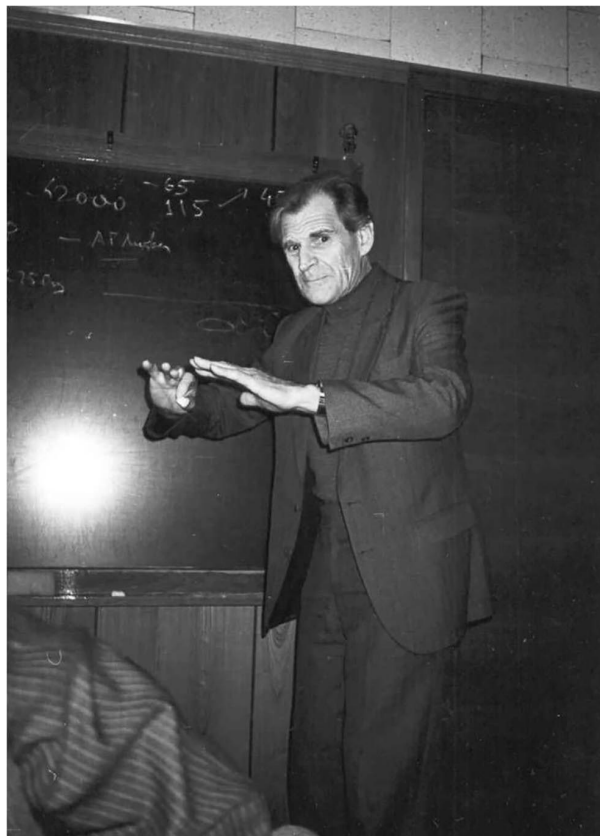
The entire life of A.V. is a bright example of the close integration of scientific and educational activities, the unity of

science and education. From the very first years of its existence, the Institute of Applied Physics (IAP RAS) set the goal of developing a continuous system for training scientific personnel. Over the course of many years, the IAP RAS Scientific and Educational Complex, housed entirely within the Institute's premises, was created. It includes the core faculty, the Higher School of General and Applied Physics, core chairs of Nizhny Novgorod State University, and specially formed senior classes in physics and biophysics at the Physics and Mathematics Lyceum. Since 1988, the Institute has also annually held a summer physics and mathematics school for high-school students in its own sports and educational camp. Clear evidence of the high efficiency of the system for training scientific personnel created at the IAP RAS is the fact that over 26 years that have passed since the establishment of the competition for the work of young scientists by the Russian Academy of Sciences in 2000, 25 cycles of work by the Institute's employees have been awarded medals and prizes of the Russian Academy of Sciences in three fields of science: general physics, Earth sciences, and scientific instrumentation, that is, on average, every year one work from the IAP RAS received such a competitive award.

Speaking of A.V.'s attention to working with young scientists, it is impossible not to emphasize the special role of the Gorky "Nonlinear Waves" schools, which he initiated and led for many years. These were held regularly (every two years) from 1972 to 1989, bringing together outstanding scientific leaders and bright young scientists beginning their work in this broad interdisciplinary field. Many classic figures in modern Russian physics, crowned with academic titles, developed their careers in close contact with these schools in their youth. In the 2000s, regular holding of such schools was resumed, so in 2022, the anniversary school "Nonlinear Waves XX," dedicated to the memory of A.V. Gaponov-Grekhov, was held. For many young participants, traditionally including many graduate students and even undergraduates (not only from Nizhny Novgorod), nonlinear scientific schools are truly schools of 'nonlinear knowledge' gained firsthand.

A.V. served as Director of the Institute he founded for 26 years, and subsequently worked as its Academic Supervisor for many years, providing comprehensive support to his disciples, who succeeded him in this position, until his final years. The principles of scientific work he established, his utmost attention to the training of young scientists, and the ethical principles of relationships within the scientific team remain at the Institute.

Today, the IAP RAS is one of the country's recognized scientific centers. It is the scientific leader in a number of large-scale research projects related to the development and creation of world-class physics experimental tools. These include the development and creation of megawatt-level microwave radiation sources for fusion power plants, including the supply of gyrotrons for the largest international scientific project, ITER, the creation of the XCELS laser complex with an extremely high exawatt radiation power level, the creation of an intense inverse Compton source of X-ray and gamma radiation at the Institute of Space Research (ISR), the development of the fundamentals of X-ray lithography, laboratory experiments in geophysics and astrophysics, the creation of acoustic means and technologies for ocean research, and radiophysical methods and means of medical diagnostics. All of this work is the continuation and



Andrey V. Gaponov-Grekhov explains in simple terms at a seminar.

development of research conducted at the Institute under the direction of Andrey Viktorovich. After the death of A.V., on the initiative of the Institute's staff in 2023, the IAP RAS was named after its founder.

Currently, the Federal Research Center "A.V. Gaponov-Grekhov Institute of Applied Physics of the Russian Academy of Sciences" employs approximately 1,600 people, including more than 600 researchers, among which are 325 candidates of science and 130 doctors of science, including seven academicians, ten corresponding members, and six professors of the Russian Academy of Sciences. More than 40% of the researchers are under 39 years of age. It is significant that when the IAP was founded in 1977, the only member of the Academy of Sciences on its staff was its Director — Academician A.V. Gaponov-Grekhov. Over the years of the Institute's existence, 23 of its researchers have been elected as corresponding members of the Academy, and later, 10 of them became full members of the Russian Academy of Sciences. Many of these researchers consider themselves to be A.V. Gaponov-Grekhov's direct students or are the students of his students.

Andrey Viktorovich's achievements in solving fundamental and applied problems in modern physics have been recognized with a large number of state awards. Among them are the Gold Medal of the Hero of Socialist Labor (1986), two Orders of Lenin (1975 and 1986), the Order of the October Revolution (1981), the Demidov Prize (1995), the Order of Merit for the Fatherland, 3rd and 2nd classes (1999 and 2008), three State Prizes in Science (1967, 1983, and 2003), the Triumph Prize in the Physical and Mathematical Sciences category, and the highest award of the Nizhny Novgorod Region, the Order of Civil Valor and Honor, 1st



Vitaly L. Ginzburg and Andrey V. Gaponov-Grekhov.

class (2016). In 2000, A.V. was awarded the highest award of the Russian Academy of Sciences—M.V. Lomonosov’s Great Gold Medal—in the nomination “For outstanding contribution to the development of the physics of oscillatory and wave phenomena.”

Academician Andrey Viktorovich Gaponov-Grekhov is a bright example of an outstanding scientist and scientific organizer, as well as a multifaceted talented individual. For all who knew him and worked alongside him, he personified an entire era in the development of Russian science—an era of outstanding results and prospects.