

# Nikolai Gennadievich Basov

(an insight into the life story of an outstanding physicist)

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The centennial anniversary of one of the brightest physicists of the 20th century, Nikolai Gennadievich Basov, gives us a reason to remind readers of *Phys.–Usp.* again of the main milestones in the life and creative path of this outstanding scientist and citizen.<sup>1</sup>

N G Basov was born in the city of Usman', Tambov province (now the Lipetsk region) on December 14, 1922. In 1941, after graduating from Voronezh secondary school no. 13 (now the gymnasium named after N G Basov) with a Gold Medal, he was sent to the Kuibyshev Military Medical Academy, and in 1942 he was transferred to the Kiev Military Medical School, which had been evacuated and was at that time in Sverdlovsk. Beginning in 1943, medical service Lieutenant N G Basov served as a military paramedic (assistant doctor) in the 35th separate chemical defense battalion on the First Ukrainian Front.

After demobilization at the end of 1945, he entered the Moscow Mechanical Institute (now MEPhI), from which he graduated with honors in 1950 and was admitted to the graduate school of MEPhI in the Chair of Theoretical Physics. His scientific supervisor, Academician M A Leontovich, at that time headed the Laboratory of Oscillations at the P N Lebedev Physical Institute (LPI) of the USSR Academy of Sciences.

Leontovich attracted student N Basov to scientific work in the laboratory—initially as a laboratory assistant, and then as an engineer. During this period, a start was made on fruitful cooperation between future Academicians N G Basov and A M Prokhorov. In May 1952, at the All-Union Conference on Radio Spectroscopy, Nikolai Gennadievich Basov made a presentation and for the first time expressed the idea of the fundamental possibility of creating a molecular generator.

After discussion of the report, Vladimir Aleksandrovich Kotel'nikov, who chaired the meeting, said to summarize: “Today we are witnessing the birth of a new science—quantum electronics.”



Lieutenant of the chemical defense battalion N G Basov on the First Ukrainian Front (1944).

In the early 1950s, N G Basov and A M Prokhorov developed the basic principles of amplification and generation of electromagnetic radiation by quantum systems, and in 1955 proposed an effective and universal method for producing states with population inversion—the method of selective pumping by electromagnetic radiation (‘three-level’ system).

Those years saw the advent of fundamentally new low-noise quantum amplifiers and oscillators of the radio frequency range—masers, the first of which was an ammonia maser (1955–1956). In 1956, N G Basov, at the age of 34, defended his doctoral thesis on the topic “Molecular oscillator,” where he generalized and experimentally proved his physical ideas about the use of molecular structures to generate and amplify coherent radiation. In his review of the N G Basov’s doctoral thesis, Academician (at that time still a corresponding member of the USSR Academy of Sciences) V L Ginzburg noted: “... characteristic of N G Basov,

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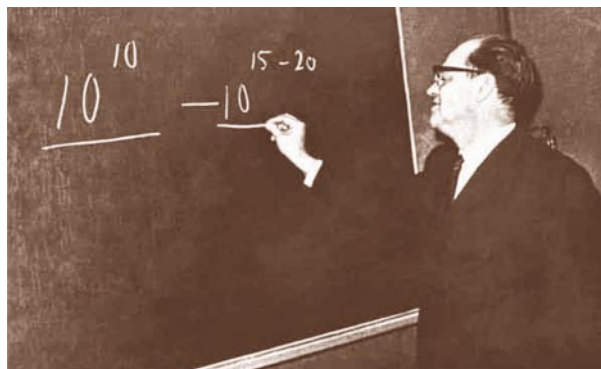


wide application in optoelectronics, medicine, and industry. Laser welding, cutting, and hardening of parts have long been used in industry.

While on the application of laser techniques in scientific research, we note now rapidly developing areas related to the production and control of single quantum systems (quantum technologies). Such areas as quantum computing and quantum computers, quantum sensorics, and quantum cryptography have been devised and are developing.

In 1961, N G Basov (together with O N Krokhin) put forward the idea of a new, laser-based, approach to the problem of controlled thermonuclear fusion and set up work on studying the physical prerequisites for the laser thermonuclear fusion (LTF) method and developing the necessary laser and target technology. So, a new scientific and technical field arose, which is now actively developing all over the world.

Reminiscing on the activities of N G Basov, it is necessary to note his work on the use of lasers for the purposes of national defense. As early as 1969, a start was made on the work of a scientific and technical council (STC) under the leadership of N G Basov. It included representatives of many research and design organizations, and representatives of the Ministries of Defense and the Defense Industry. Thanks to the active work of N G Basov, the military not only showed



In the 1960s, N G Basov predicted possible progress in frequency standards in the transition from the microwave region to optics. At the moment (2022), the results achieved in terms of frequency stability have confirmed N G Basov's prediction made more than half a century ago.

significant interest in defense applications of lasers but also supported and financed a significant part of the research work of scientists at the expense of defense budget items. As a result, it was possible to come to a deep understanding of the physics of processes in high-energy lasers and solve serious engineering problems, and world-class results were obtained



Ceremonial meeting of the Royal Swedish Academy of Sciences. Nobel Prize ceremony, 1964. Among those present (in the first row, from left to right): C Townes, A M Prokhorov, N G Basov.



in a number of related areas: propagation of laser beams in the atmosphere, pulsed light sources, interaction of radiation with matter, chemistry, and the technology for creating active media and laser components. Many scientific and technical achievements were used in subsequent work, including work on inertial thermonuclear fusion.

N G Basov himself, emphasizing the contribution of the staff of the P N Lebedev Physical Institute, drew attention to the fact that about two-thirds of all working laser types in one way or another owe their origin to LPI. Excimer lasers, electroionization lasers, various types of semiconductor lasers, Raman lasers, photodissociation lasers, and chemical lasers — all of them were first proposed by us.

N G Basov devoted a great deal of effort and energy to the training of highly qualified young scientific personnel and considered such activity to be one of the most important in his work. Many dozens of future doctors and candidates of sciences were his students. Beginning in 1976, in Rostov Velikii, under his leadership, All-Union Schools of Physics were regularly held, where outstanding scientists in the country introduced young physicists to the latest achievements and still unsolved problems of modern natural science.

N G Basov headed the Chair of Quantum Electronics at the Moscow Engineering Physics Institute (MEPhI), which became one of the leading centers for the training of highly qualified specialists in this field. Despite being extremely busy, Nikolai Gennadievich considered such work to be very important and always found time for it. Graduates of the chair remember with great pleasure how the defense of diploma work took place, with what attention N G Basov treated each speaker, and how skillfully he led the discussion.

On the initiative of N G Basov, a special Physics Department was organized at MEPhI in 1971, where the best physics students from the 3rd year of all universities in the country were admitted, and they were involved in scientific work at the Lebedev Physical Institute (they underwent undergraduate practice here and completed their diploma work). Since its inception, the Higher School of Physicists has trained students from more than seventy universities in the Russian Federation and CIS countries, and over 1,000 highly qualified specialists have graduated. In November 2001, the Higher School of Physics was awarded the Prize of the President of the Russian Federation in the field of education and was named after its founder, Academician N G Basov. In 2017, a monument to N G Basov was erected at MEPhI as a tribute from the graduates of the Higher School of Physics.

Widely known is the work of N G Basov as the editor-in-chief of the journals *Nature* (from 1967 to 1990) and *Quantum Electronics* (since 1971); the latter, founded by N G Basov, has become one of the leading journals in its field, not only in our country but also around the world.

Recalling the multifaceted activities of N G Basov, it should be emphasized that, in addition to solving scientific and organizational issues on the development of science in our country, Nikolai Gennadievich was engaged in solving the most important state issues. From 1974 to 1989 he was elected a deputy of the Supreme Soviet of the USSR, from 1982 to 1989 he was a member of the Presidium of the Supreme Soviet of the USSR, and starting in 1991 he was a member of the Expert Council under the Chairman of the Government of the Russian Federation.



Special Physics Department (MEPhI).

For outstanding scientific achievements, in 1962 N G Basov was elected a corresponding member of the USSR Academy of Sciences, and in 1966 a full member of the USSR Academy of Sciences. From 1967 to 1990 he was a member of and in 1990 a councilor to the Presidium of the USSR Academy of Sciences. From 1973 to 1989 Academician N G Basov was the director of the P N Lebedev Physical Institute, the largest physical institute in the system of the Academy of Sciences, and did much for its development.

For great services to the Fatherland, N G Basov was twice awarded the title of Hero of Socialist Labor, awarded five Orders of Lenin and the M V Lomonosov Grand Gold Medal from the Academy of Sciences of the USSR. He is a holder of the Order of the Patriotic War, 2nd class, and the Order of Merit for the Fatherland, 2nd class (1999).

His fundamental research in the area of quantum electronics has received worldwide recognition. He is a laureate of the Nobel Prize (1964), Lenin Prize (1959), and State Prize (1989). He was awarded a number of foreign medals: the Order of Cyril and Methodius, I degree (Bulgaria), the Gold Medal of the Czechoslovak Academy of Sciences, the A. Volta Gold Medal of the University of Pavia (Italy) (1977), the medal of Sorbonne University (1983), the City of Paris Gold Medal (1983), the medal of the Ministry of Culture of France (1983), the Commander's Cross of the Order of Merit (Poland) (1986), the E. Henkel Gold Medal of the Urania Society (1986), the Kalinga Prize (UNESCO) (1986), and the Edward Teller Medal (1991).

In 2010, the Russian Academy of Sciences established the N G Basov Gold Medal, which is awarded by the Russian Academy of Sciences for outstanding work in physics. A minor planet discovered in 1978 is named after N G Basov.

And, in conclusion, the following must also be said. Academician and Nobel laureate Nikolai Gennadievich Basov was always proud of his achievements, but he considered the most significant of them to be a successful



Gold medal named after N G Basov.



Monument at N G Basov's grave.

surgical operation to remove an appendix without anesthesia, performed on a soldier in the field, practically on the front line, by 22-year-old military paramedic Lieutenant Nikolai Basov.

Academician Nikolai Gennadievich Basov died on July 1, 2001. Upon the death of N G Basov, the director of LPI, Academician Leonid Veniaminovich Keldysh, said that, when discussing scientific problems with Nikolai Gennadievich, his arguments and the logic of his conclusions were not always clear to the interlocutor, but the results almost always turned out to be correct! One got the impression that when the Almighty was composing a problem book for physicists, Basov managed to peek at the answers (or was he granted such a privilege from above?), and so Nikolai Gennadievich knew the answers to many of the mysteries of nature in advance and did not need their logical justification. N G Basov was buried at the Novodevichy Cemetery.

Future generations will always remember him.



Monument to N G Basov in Usman'.