Nikolaĭ Gennadievich Basov (on his seventieth birthday)

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On 14 December 1992 Academician Nikolaĭ Gennadievich Basov celebrated his seventieth birthday.

Basov was born in Usman'. His graduation from secondary school in Voronezh coincided with the outbreak of World War II, and Basov was inducted into the army. In 1943 he graduated from the Kiev Military Medical School, and from the beginning of 1945 to demobilization at the end of 1945 he was in the ranks of the active army.

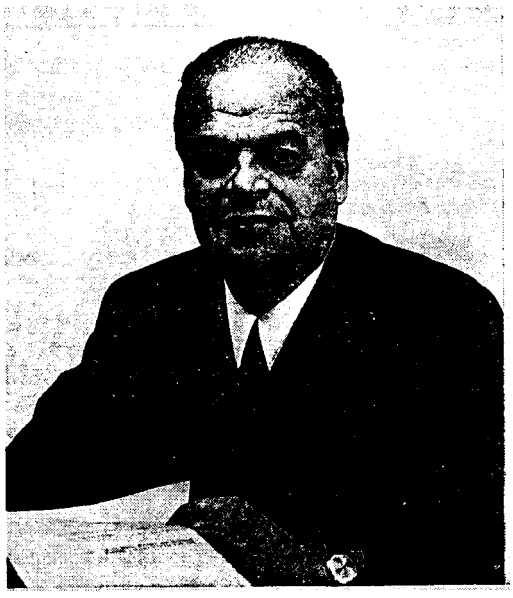
In 1946 Basov entered the Moscow Mechanical Institute (now the Moscow Engineering-Physics Institute). He graduated in 1950.

In 1948 Basov had already begun to work as a laboratory assistant, and later he worked as an engineer in the vibration laboratory of the Lebedev Physics Institute of the USSR Academy of Sciences, where he continued his graduate work under the direction of M. A. Leontovich.

In these years, the joint work of Basov and A. M. Prokhorov laid the foundations for a new direction in physics, which is now called quantum electronics.

In the early 50s Prokhorov and Basov developed the basic principles of amplification and generation of electromagnetic radiation by quantum systems and proposed an effective method of creating states with an inverted population, that is, the selective pumping of a three-level system with electromagnetic radiation. Fundamentally new low-noise quantum amplifiers and generators in the radio range were created, masers, the first of which was an ammonia maser (1955-56). For their ground-breaking work in quantum electronics, Basov and Prokhorov were awarded the Lenin Prize in 1959, and in 1964 Basov, Prokhorov and Charles Townes were awarded the Nobel Prize in Physics.

Even when Basov was working on molecular generators he had arrived at the idea of extending the principles and methods of radio physics and quantum electronics to the optical range of frequencies. With his innate purposefulness he switched to a search for ways of creating optical quantum generators, lasers, attracted young people to the work, organized energetic teams, and in 1963 created the laboratory of quantum radio physics. In the article by Basov *et al.* in 1958 and in his paper given at the International Conference in the US in 1959 he advanced the idea of creating an inverted population is semiconductors by avalanche multiplication of current carriers in a pulsed electric field. At the beginning of 1961 the possibility of creating an injection laser was confirmed for the first time: the inversion condition was formulated in terms of Fermi quasilevels, and a steady-state operating mode was predicted, as were the waveguide character of the active region and the reduction of the threshold generation when semiconductors with different widths of the forbidden zone were used to form the *p-n* transition. The research initiated by this work led to the creation of the first injection lasers in 1962. At the beginning of 1961 Basov began work on the excitation of semiconductor lasers with powerful electron beams, and in 1963 the first lasers of this type were created with his participation. In 1964 generation in semiconductors with optical pumping was obtained in one- and two-quantum absorption of the laser radiation used for excitation.



Nikolaĭ Gennadievich Basov

In his Nobel lecture in 1964 Basov noted a number of ways of using semiconductor lasers in science and technology, and shortly thereafter, fast optical logic elements were created on the basis of injection lasers. Lasers with electron excitation were also used in projection television and address switching.

In 1962 at a meeting of the Presidium of the USSR Academy of Sciences, and later at the International Conference on Quantum Electronics in Paris (1963) Basov advanced the idea of obtaining thermonuclear reactions using laser irradiation of targets. This idea and the set-up created in his laboratory made it possible to obtain the first thermonuclear neutrons in laser irradiation of a lithium-deuteride target in 1968. Basov outlined the results at the International Conference in the US that same year, and this served as a powerful stimulus to develop research on laser fusion, which at present is considered an approach with great promise.

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In 1971 a multi-channel laser set-up was created at the Lebedev Institute which provided spherical irradiation of targets with a power density of 10^{14} W/cm^2 (in the US a system with the same energy level was created several years later). This set-up was used to show the effectiveness of the input of laser energy into a target. Compression to a density of 8 g/cm^3 was achieved, and neutrons of d–d reactions were recorded, as well as those from secondary d–t reactions. In contrast to the proposal of Teller *et al.* in the early 70s of time-profiled short laser pulse irradiation of targets, a group directed by Basov developed an approach in which relatively long pulses irradiated thin-shelled targets at moderate radiation fluxes. This came to be called low-entropy compression, and at present the use of shell targets is considered more promising.

Basov actively supports the program of work on laser fusion, and has brought up the issue of developing a laser reactor–purely thermonuclear, hybrid, using fissile materials and a reactor producing chemical fuel–free hydrogen.

Understanding the volume of work and expenses associated with laser fusion, Basov has repeatedly suggested international collaboration on this problem.

In 1990–1991 this idea received the support of IAEA and UNESCO, and now various aspects are being developed.

As a scientist Basov has an exceptional intuition, a great inventiveness, and persistence in the execution of plans. His extraordinary thinking frequently leads to unexpected and successful solutions to problems which arise.

Basov considered the creation of powerful lasers to be a central problem in quantum electronics, and in 1962 headed a series of studies on chemical lasers, crowned by the creation of powerful pulsed and continuous hydrogen fluoride chemical lasers. In these same years Basov and his colleagues created a powerful photodissociation iodine laser, developed a new type of high-pressure gas lasers, electroionization lasers, and created an excimer laser. Basov developed optical methods of processing information by creating laser logic elements for this purpose; he also carried out a comprehensive series of studies on the stabilization of laser frequency, frequency standards, laser and electroionization methods of stimulating chemical reactions, hardening metal surfaces, and applying coatings. Basov initiated research on nonlinear optics to develop methods of transforming and adding laser beams in induced scattering processes, and has used the method of wave front reversal, which was discovered in this department, for powerful multichannel lasers. An important feature of Basov's research in his studies of explosive photochemical lasers, which use a shock wave to excite active media. In joint work with teams from the Lebedev Institute and the All-Union Scientific Research Institute of Electron Physics an explosive type iodine photodissociation laser was developed which is capable of generating megajoule pulses. To develop research on laser technology, in 1980 Basov initiated the organization of a branch of the Lebedev Institute in Samara, which in 12 years has grown into an independent institute which has been recognized for its scientific achievements and their introduction into industry.

Basov has paid a great deal of attention to the education and development of scientific personnel. He is a department head at the Moscow Engineering-Physics Institute, the creator and director of the College of Physics at the Moscow Engineering-Physics Institute and the Lebedev Institute. Many of Basov's students and colleagues have become doctors of science and laureates of the highest prizes given in this country; their work has achieved worldwide recognition.

The scientific and organizational activity of Basov is multifaceted: he has been the director of the Lebedev Institute, a member of the Presidium of the USSR Academy of Sciences, a chairman of the Znaniye society, and editor-in-chief of the journal *Priroda*. The journal *Quantum Electronics* which Basov created and directed is known worldwide.

Basov's service to science is generally recognized. He is a laureate of the Lenin, State, and Nobel Prizes, is twice a Hero of Socialist Labor, and has been awarded five Orders of Lenin, the Lomonosov Gold Medal of the USSR Academy of Sciences, as well as many medals and orders of foreign countries. In 1962 Basov was elected to be corresponding member of the USSR Academy of Sciences, and in 1966 became a full member. Basov is a member of many foreign academies.

Basov, an outstanding Russian scientist, has applied his knowledge and talent with his innate energy and purposefulness to the solution of the most important physics problems. The future of scientific and technical progress depends to a great extent on the solution of these problems. In observing the seventieth birthday of Nikolaĭ Gennadievich Basov, we whole-heartedly wish him health and further successes in the execution of his plans.

Translated by C. Gallant