Nikolaĭ Gennadievich Basov (on his 60th birthday)

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Academician Nikolaĭ Gennadievich Basov reached 60 on December 14, 1982.

He was born in the city of Usman'. His graduation from high school in Voronezh coincided with the outbreak of the Great Patriotic War, and he entered the army in the first days of the war. After the war, in 1946, he entered Moscow Mechanical Institute (known today as Moscow Engineering Physics Institute).

He began work as a laboratory assistant in 1948 and later worked as an engineer in the oscillation laboratory of the P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow. In the oscillation laboratory, headed in those years by M. A. Leontovich, a group of young physicists under the guidance of A. M. Prokhorov began research in a new field: molecular rf spectroscopy. Those years marked the beginning of a successful collaboration between Basov and Prokhorov which led to some fundamental research in quantum electronics.

NIKOLAĬ GENNADIEVICH BASOV

In the early 1950's, Prokhorov and Basov worked out the basic principles of the generation and amplification of electromagnetic radiation by quantum systems, and they proposed an effective and universal method for producing states with a population inversion: selective pumping by electromagnetic radiation. This work led to the development of some fundamentally new low-noise quantum amplifiers and generators for the rf range: masers. The first to appear was an ammonium molecule maser (1955–56). For further fundamental work in quantum electronics, Basov and Prokhorov were awarded the Lenin Prize in 1959; in 1964 they shared a Nobel Prize in physics with Charles Townes.

While still working on molecular generators, Basov came across the idea of extending the principles and methods of rf physics and quantum electronics to the optical frequency range. This energetic and goal-oriented researcher turned his attention to a search for ways to produce optical quantum generators (lasers). He attracted young people to this research, infecting them with "laser fever." At a small group of like-minded researchers formed; in 1963 this group became the new laboratory of quantum radiophysics.

Basov began his work on lasers in 1957 with the development of physical ideas for arranging nonequilibrium states in semiconductors and for searching for ways to implement these ideas. In a study by Basov and colleagues in 1958, reported to the International Conference on Quantum Electronics held in the US in 1959, it was suggested that a population inversion might be produced in a semiconductor by making use of the avalanche breeding of current carriers in a pulsed electric field. In early 1961, Basov demonstrated the possibility of developing an injection laser, worked out the necessary conditions for Fermi quasilevels, demonstrated the possibility of steady-state lasing, and pointed out the waveguide nature of the active region and the lowering of the threshold current density when the semiconductors forming a p-n junction have energy gaps of different widths. The research which ensued was rewarded with the development of semiconductor injection lasers in 1962. As early as the beginning of 1961, Basov began work on the pumping of semiconductor lasers by intense electron beams; by 1963, the first lasers of this type had been developed. Lasing action in optically pumped semiconductors was first achieved in 1964, with one- and two-photon laser pumping.

In 1974, lasing was achieved in quaternary-compound heterostructures, so that it became possible to produce optimum light sources for fiber-optics communications.

In his Nobel lecture in 1964, Basov pointed out several ways to make use of semiconductor lasers in science and technology. Injection lasers have been used to develop fast optical logic elements, and electron-beam-

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pumped lasers have been used in projection television and address commutators.

At a session of the Presidium of the Academy of Sciences of the USSR in 1961, and later at the International Conference on Quantum Electronics in Paris (1963), Basov suggested a new, laser, approach to the problem of controlled thermonuclear fusion. He began research on the physical prerequisites for laser fusion and on developing the necessary laser and target technology. This stage of the work ended in 1968 with the production of the first neutrons (in laser bombardment of LiD targets). The results were reported by Basov to the International Conference on Quantum Electronics in the US in 1968 and greatly stimulated research on laser fusion.

In 1971 a multichannel neodymium-glass laser, the KAL'MAR, was constructed at the Lebedev Physics Institute. This laser bombards targets in a spherical arrangement with a power density of the order of 10^{14} W/cm^2. The KAL'MAR experiments demonstrated that it was possible to efficiently transfer energy from a laser beam to a spherical target. Fusion fuel was compressed to a density of 8 g/cm^3 [the number of neutrons emitted under these conditions reached 10^6–10^7 (the DD reaction)]. Various theoretical aspects of the problem were being developed at the same time. As a counterbalance to the idea of tailored picosecond pulses, which held sway in the US in the mid-1970s, Basov and his colleagues developed a different approach: the low-entropy compression of thin jacketed targets. The result was the attainment of large amplification factors, of the order of 100. This is now the generally accepted approach. Research on laser fusion is now being carried out with jacketed targets.

In parallel with the research on the laser fusion problem, Basov carried out an intense search for new principles for high-power lasers. Since 1962, a team under his direction has been carrying out extensive research on chemical lasers. This research has been rewarded with the development of high-power pulsed and cw hydrogen fluoride chemical lasers. Over the same years, researchers working under Basov's guidance have developed a new high-power nanosecond-pulse photodissociation iodine laser, have developed high-pressure gas lasers of a new type (electroionization lasers), and have developed an excimer laser. Basov devotes much time to the development of optical methods for information processing. He has guided extensive research on laser frequency stabilization, frequency standards, laser and electronionization stimulation of chemical reactions, an electroionization method for depositing coatings and for case hardening of metals, and on nonlinear optics: the development of methods for transforming and summing laser beams in stimulated-scattering processes. He has also led research on the method of phase conjugation in high-power multichannel lasers.

The creative path taken by Basov is the path marked out by a scientist who devotes all his talent and efforts to the development of science for the Fatherland. Basov makes an enormous effort to train key scientists. He is a professor at the Moscow Engineering Physics Institute, and he is the founder and director of the Higher School of Physics at the Moscow Engineering Physics Institute and the Lebedev Physics Institute. Nearly all his colleagues at the Lebedev Institute are young people whom he has guided from essentially their undergraduate years. Basov's many students and colleagues are now also at work in many other scientific institutions of the country.

Basov's work as a scientific organizer is exceptional and multifaceted, as is his community work. He is director of the Lebedev Physics Institute, a member of the Presidium of the Academy of Sciences of the USSR, president of the Directorate of the Znanie All-Union Society, editor-in-chief of the journals *Priroda* and *Kvantovaya Élektronika*, president of the physics section and a member of the Plenum of the Committee on Lenin and State Prizes of the Council of Ministers of the USSR, and a member of the Committee for the Defense of Peace and the World Peace Council.

Basov's scientific work is universally recognized. He is a winner of the Lenin and Nobel Prizes; he has been designated Hero of Socialist Labor; he has been awarded four Orders of Lenin, USSR Medals, and the Order of Cyril and Methodius of the People's Republic of Bulgaria. In 1962 he was elected a corresponding member, and in 1966 a regular member, of the Academy of Sciences of the USSR. He is also a member of several foreign academies. Basov is an active and dedicated communist. He was a delegate to the XXVI Congress of the Communist Party of the Soviet Union; he was a delegate to the XVII Congress of Trade Unions; and he was a deputy at the IX and X convocations of the Supreme Soviet of the USSR.

Anyone who knows him personally cannot help but be struck by his talent, his exceptional energy, his clearness of purpose, and his devotion to his work. In marking the 60th birthday of Nikolaĭ Gennadievich Basov, we wish him health and further success in his multifaceted scientific and community activities.

Translated by Dave Parsons