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PERSONALIA

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In memory of Aleksandr Mikhaĭlovich Prokhorov

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On January 8, 2002 acute bilateral pneumonia suddenly ended the life of Aleksandr Mikhaĭlovich Prokhorov — an outstanding physicist of world fame, one of the founders of quantum electronics, a most important field in modern physics; he was also one of the few top science administrators and an outstanding citizen of our country.

Aleksandr Mikhaĭlovich lived an eventful, exciting, exceptionally dynamic life and until his last days kept working for the good of this country. A M Prokhorov was born on July 11, 1916 in Atherton in Australia in the family of a Russian worker, a revolutionary, who had to emigrate to avoid prosecution by the tsarist regime. In 1923, the Prokhorovs returned to Russia. In 1939, Aleksandr Mikhaĭlovich Prokhorov graduated with honors from the Physics Department of Leningrad State University and started the postgraduate course at FIAN, the P N Lebedev Physics Institute of the USSR Academy of Sciences, in Moscow. Guided by V V Migulin, he started working on the propagation of radio waves along the surface of the Earth. Before Great Patriotic War started, he proposed an original way of studying the ionosphere using radiointerferometric technique. The war interrupted his career as a scientist. When the war began, A M Prokhorov was immediately called up for the Red Army in the Field and fought in infantry and in battle reconnaissance and was awarded a medal ''For bravery''. Seriously wounded for the second time in 1944, he was demobbed and returned to FIAN, to resume his interrupted career. On S M Rytov's suggestion, he joined the work on the theory of nonlinear oscillations and methods of frequency stabilization in radio oscillators. The results of this work formed the main part of his PhD thesis. After he completed the postgraduate course, the FIAN Director S I Vavilov immediately raised him to the position of senior research scientist. In 1948, following V I Veksler's suggestion and supported by S I Vavilov, Aleksandr Mikhaĭlovich began working on the possibilities of wave generation in the millimeter wavelength range using a synchrotron. He successfully produced a novel mode of synchrotron wave generation and in 1951 presented and defended his DSc thesis based on the results of this work. At the same time, A M Prokhorov began working in a new field — radio-frequency spectroscopy. He involved a number of bright young researchers in this project; they became his first students. Supported by D V Skobel'tsyn, he was able in a very short time to build up a Soviet school of radiospectroscopy which rapidly moved to the forefront position in world physics. To increase the resolving power of radiospectroscopes, A M Prokhorov turned to using molecular beams. He involved N G Basov in this work and together they decided to create a novel type of oscillator based on stimulated emission of electromagnetic waves by excited molecules of a molecular beam. Independently of Charles Townes in the USA, they made the way from radiospectroscope to creating an ammonia-beam molecular oscillator. This project manifested in full the creative signature of A M Prokhorov as a scientist and science manager: constantly searching and identifying the most promising fields of research, a wide application of the latest theoretical ideas and experimental techniques, all resulting in rapid progress in solving fundamental problems. These were the years when he formulated the main principles and laid the physical foundation of quantum electronics. The method, suggested by A M Prokhorov and N G Basov, of creating the inverse population in three-level systems was of principal novelty; it is known as optical pumping. When attempting to solve the problem of moving from radio-frequency range to shorter wavelengths, Aleksandr Mikhaĭlovich proposed an open cavity (1958). This work was a cornerstone for laser development and became A M Prokhorov's contribution to the emergence of optical quantum electronics. The work of Aleksandr Mikhaĭlovich in quantum electronics was widely recognized and appreciated. In 1959, A M Prokhorov and N G Basov received the Lenin Science and Technology Prize for developing a novel method of amplification and generation of electromagnetic waves. Later in 1964, together with the American physicist Charles Townes, they won the Nobel Prize for Physics.

Aleksandr Mikhaĭlovich Prokhorov
(11.07.1916 – 08.01.2002)

Until the last days of his life, the scientific activities of Aleksandr Mikhaĭlovich were connected with the creation and progress of quantum electronics and its diverse applications to science and practical fields. He proposed new types of

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active media for quantum amplifiers and oscillators. First and foremost, we need to point here to his proposing ruby as active material for quantum amplifiers in the microwave range. This proposal played an extremely important role in the implementation and development of ideas in quantum electronics: it was on ruby crystals that the most efficient quantum amplifiers of microwave radiation were developed, and the first optical-range maser (laser) was built. Aleksandr Mikhaĭlovich paid considerable attention to developing the physical and technological foundations of manufacturing materials for quantum electronics. He was supervising, and actively participating in, the project which within a very short period created in this country a powerful experimental and industrial basis for growing perfect optical single crystals of various classes for solid-state lasers in the IR, visual and UV ranges; these single crystals included laser crystals as such but also nonlinear elements for radiation frequency conversion and for controlling their spatial and temporal parameters. Many new types of such materials were developed, which ensured the leading position of this country in the production of laser materials.

Another proposal and its implementation proved very important: adiabatic expansion of a gas mixture as a novel method of producing inverse molecular population in gaseous media. The method was used to develop powerful IR gas-dynamic lasers.

Aleksandr Mikhaĭlovich's name is inseparable from the story of the emergence and progress of many new fields in modern optics and laser physics, among which we can point to nonlinear optics, fiber optics and the physics of interaction of high-power laser radiation with matter.

In all these areas, A M Prokhorov generated a number of ideas and results of important fundamental and practical significance. Among these were the development of the theory and the experimental confirmation of the multifocal structure of wave-beam self-focusing in nonlinear media, the creation of the theory of propagation of optical solitons in fiber-optic waveguides, the determination of the characteristics of laser plasmas in various excitation modes, the investigation of the fundamental mechanisms of damage to transparent solids by high-intensity laser radiation, and the discovery of light-hydraulic effect.

A characteristic trait of Aleksandr Mikhaĭlovich was his desire to maximize the use of scientific results in practical work. He exerted enormous influence on the progress of work on the development of high-efficiency microwave quantum amplifiers and their application to long-distance space communication and to astronomy, on building up industrial production of lasers, on lasers' penetration into technology, medical fields and other branches of economics and into military fields. A M Prokhorov's contribution to the creation of the first fiber-optics communication lines in the USSR is not as well known; among these were the first fiber-optics cables for TV broadcasting to zones of unstable signal reception in Moscow.

A M Prokhorov was known to have an exceptionally wide scope of interests in science, was profoundly erudite in many fields of physics and related sciences. This factor attracted an enormous number of people representing various branches of science and technology to him. This is why his influence on the progress of quantum electronics and its numerous practical applications in our country was so outstanding. Aleksandr Mikhaĭlovich had fostered a large number of students. Many of them are important scientists — Full and Corresponding Members of the Academy of Sciences and Doctors of Science.

Aleksandr Mikhaĭlovich devoted much time to science administration and management. For 20 years, he chaired the Division of General Physics and Astronomy of the USSR Academy of Sciences, was a member, and in recent years a consultant, of the Presidium of the Russian Academy of Sciences (RAS). A M Prokhorov was the founder of the Institute of General Physics of RAS and was its director for many years.

From 1969, A M Prokhorov was the Editor-in-Chief of the Larger Soviet Encyclopedia (BSE). He guided the completion of the third edition of the BSE and the publication of a series of specialized encyclopedic dictionaries in various branches of knowledge.

The vast research and management activity of Aleksandr Mikhaĭlovich, his entire life were devoted to serving his Fatherland. He was a great scientist and a great citizen of his country. He was proud of the achievements of its science, of its outstanding contribution to science in the world.

At the same time, Aleksandr Mikhaĭlovich was very worried for the fate of science in Russia in the reform years when the state ceased to support it with its former vigor. He invariably promoted his view that the future of our country — and of the entire civilization of the world — lies with the advances in science and technology. In recent years A M Prokhorov published a number of articles in the mass media describing the role of fundamental research and of science in general in the life of modern societies.

The country and the world science community amply recognized Aleksandr Mikhaĭlovich's achievements. He received the Nobel, the Lenin and State Prizes, was twice awarded the Order of Hero of Socialist Labor, was elected an honorary member of numerous scientific bodies, foreign academies and universities, received numerous orders and medals, among which was the M V Lomonosov Greater Gold Medal of the Russian Academy of Sciences. In 2000 he received, for outstanding work in optics, the Frederic Ives medal — the highest award of the Optical Society of America. In 2001 he won the Demidov Prize. Nevertheless, the medal "For bravery" that he received for courage at the fronts in 1941 – 1944 was an object of special pride for him.

The name of Aleksandr Mikhaĭlovich Prokhorov — an outstanding scientist and citizen of his country — is written in indelible ink into the history of our country and world civilization.

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