

## Aleksandr Mikhailovich Prokhorov (on his eightieth birthday)

This year marks the eightieth birthday of academician Aleksandr Mikhailovich Prokhorov, an outstanding physicist, and one of the founders of quantum electronics.

A M Prokhorov was born on July 11, 1916 in Atherton, Australia, where his parents were living, at the time, in forced emigration. In 1923 the Prokhorov family returned to their homeland in Russia.

In 1939 A M Prokhorov graduated from the Leningrad University and in the same year he entered Graduate School at the P N Lebedev Physical Institute of the Academy of Sciences of the USSR.

The Great Patriotic War cut short his scientific activity: from the beginning of the war until the second time he was wounded in 1944 he was a member of the active army. After being discharged from the military in 1944 as a disabled war veteran Aleksandr Mikhailovich resumed his scientific activity at the Institute of Physics of the Academy of Sciences of the USSR.

From 1944 to 1950 he performed important research in the field of radioelectronics: he developed a theory of tube oscillator frequency stabilization, and was the first to establish experimentally the coherence of microwave radiation from electrons in a synchrotron-type accelerator. He defended his Candidate Thesis (1945) and his doctoral dissertation (1951) on the basis of this research.

In 1948 A M Prokhorov began to concern himself with research in the field of gas radiospectroscopy, which led him to discover a new principle of the amplification and generation of electromagnetic oscillations, based on the use of the stimulated emission of atoms and molecules. Experiments, which he performed (together with N G Basov) from 1953 to 1955 provided a framework and demonstration of this principle which laid the basis for a new field of science and technology: quantum electronics. He went on to develop a theory of the molecular generator and provided an experimental demonstration (1954) and proposed (1955) one of the most effective and universal methods (applied to various atomic and molecular systems at different frequencies ranges of the electromagnetic spectrum) of obtaining inversion of the populations of quantum states — the method of auxiliary radiation (pumping).

Beginning in 1953, A M Prokhorov broadened his research in the field of radiospectroscopy to solids and began to work on electronic paramagnetic resonance in crystals. This research led to many important findings on spectra and the relaxation of spin systems in crystals, which are of great significance to solid state physics and other fields of study.



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Thus, research into the electronic paramagnetic resonance of the ruby, performed in 1955–1956 (together with A A Manenkov) led to the discovery of new and extremely low-noises quantum amplifiers with decimetre, centimetre and millimetre wavelengths. The application of these amplifiers in radio reception systems for deep space communication and radioastronomy led to major results in space studies.

While pursuing his ideas about quantum electronics in the field of short waves, A M Prokhorov proposed a new type of resonator in 1958 — the so-called open resonator shaped like a flat parallel discs much larger in size than the length of a wave. This idea, its theoretical basis and the initial experimental research related to it were performed by A M Prokhorov in 1959 (together with A I Barchukov) and made a significant contribution to the development of quantum electronics and the extension of its principles to the optical spectrum. The subsequent invention of the first quantum optic generator and laser (Meyman, 1960) marked the inception of a new age in optics which led to some truly revolutionary changes in optics and other fields of science and technology.

The further development of quantum electronics of the optical spectrum and the rise of new trends in optical research are also closely connected to A M Prokhorov.

Thus, in 1963, A M Prokhorov worked out the first qualitative theory for lasers with modulated Q-factor. The same year with the help of powerful solid-state lasers invented under his supervision, research into the optical breakdown of gases was begun (with P P Pashinin and others) which paved the way for a number of studies concerning laser spark, high-temperature laser plasma and laser thermonuclear synthesis.

In 1966 A M Prokhorov (along with V K Konyukhov) formulated and discovered a new principle for powerful lasers on the basis of gas dynamic streams. From 1965–1995 he developed (together with Kh S Bagdasarov, E M Dianov, A A Manenkov, T M Murina, V V Osiko, I A Shcherbakov, etc.) the physical and technological principles for highly efficient materials (crystals, glasses, polymers) used in solid state lasers. In 1967 (together with V N Lugov) he discovered a new phenomenon in nonlinear optics — the multifocus structure of wave beams in a nonlinear environment, while developing (with E D Dianov) a number of new trends in fibre optics, and with F V Bunkin and V B Fedorov conducted a broad set of studies on the interaction of powerful optical radiation with condensed targets, which led to the phase transformations of matter.

The scientific interests of A M Prokhorov are not restricted to problems of quantum electronics, they embrace a wide array of issues relating to modern physics and other fields of knowledge. A M Prokhorov has always been interested in new scientific trends and has contributed both creative and organizational support at the General Physics Institute RAS, which he directs, and other institutions. This support has had a major impact on the various research projects which have been carried out. His profound and far-reaching erudition in various fields of science and technology has attracted an increasingly large number of scientists and specialists, who wish to discuss their problems with him.

A distinctive feature of A M Prokhorov's style in his scientific and organizational activities is the combination of fundamental and applied research and the drive to rapidly apply this research to areas of the national economy. Among the numerous issues of applied physics to which A M Prokhorov devotes his attention is that of lasers in the field of medicine and instrumentation used in environmental monitoring.

The scientific and organizational merits of A M Prokhorov are highly esteemed both in Russia and abroad. As one of the seminal figures in quantum electronics he was awarded the Lenin and Nobel Prize, and became the recipient of the State Prize of the USSR for his research on submillimetre spectroscopy. A M Prokhorov has twice been nominated as Hero of Socialist Labour and received five orders of Lenin. He is the honorary member of many foreign academies and scientific societies and has been named doctor emeritus of foreign universities.

A M Prokhorov has for many years (1973–1991) supervised the Department of General Physics and Astronomy of the Academy of Sciences of the USSR, while at present he is an Advisor of the Presidium of the Russian Academy of Sciences, member of the Council for Scientific Policy under the President of the Russian Federation, Editor-in-chief of the Big Russian Encyclopedia and President of the Academy of Engineering Sciences.

As an active participant of the Great Patriotic War, A M Prokhorov was awarded the first degree order of the Patriotic War and a medal “For Bravery”.

A M Prokhorov is celebrating his 80th birthday in fine physical shape and creative vigour. We wish him many happy returns and great stamina in all his professional endeavours.

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