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PERSONALIA

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Oleg Nikolaevich Krokhin (on his seventieth birthday)

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Academician (full member of the Russian Academy of Sciences) Oleg Nikolaevich Krokhin, an outstanding physicist and science manager, Director of the P N Lebedev Physics Institute (FIAN) of the Russian Academy of Sciences, was born on 14 March, 1932. The salient episodes of O N Krokhin's life in science are connected with FIAN and his fruitful creative collaboration and close friendship with Nikolaĭ Gennadievich Basov. This collaboration produced fundamental results in laser physics and the physics of the interaction of radiation with matter and greatly determined the key directions of fundamental research and development in this field. The most important among these results were the formulation of the principles of operation of injection semiconductor lasers and the concept of laser fusion.

O N Krokhin's career in physics began in 1955 when, having graduated from the Moscow University Physics Department, he started working in the Urals in a new nuclear physics center of the country which is now known as the All-Russia Research and Development Technical Physics Institute (in the town of Snezhinsk). This center absorbed most of the group of students of the Nuclear Physics Division of the Physics Department of which O N Krokhin was one. Who from among the group would be sent there was determined after an examination which was set up impromptu by Ya B Zeldovich and A D Sakharov who came to the department for this specific purpose. O N Krokhin was doing his diploma project under the guidance of a brilliant physicist and teacher V B Berestetskiĭ in ITEP [then known as the Thermal Technology Laboratory (TTL)]. In Snezhinsk he was supervised by L P Feoktistov, at that time a senior research scientist, a talented and inventive physicist who immediately involved O N Krokhin in the work on the problems that were pressing in those years. It appears that the very concrete style of approaching complex, and even seemingly very abstract, problems that is so typical of O N Krokhin formed in that period.

In 1959 O N Krokhin transferred to FIAN where, under N G Basov's guidance, he actively participated in research of utmost importance at the time — the extension of the principles of maser operation to the optical frequency range; this soon led to the creation of the laser. It must be pointed out that this work of Basov's group was at the forefront of world physics at that moment. As early as 1960, *Physics Uspekhi* published a review, with O N Krokhin as one of the co-authors, which argued the feasibility of amplification and generation of optical radiation by quantum systems, that is, the feasibility of the laser; soon a working laser was a fact.

O N Krokhin carried out the defining fundamental research into the creation of semiconductor lasers, having investigated the relaxation of degenerate electron gas in semiconductors and the optical characteristics of semiconductors undergoing large deviations from equilibrium conditions; he formulated the criteria for creating a population inversion in semiconductors in the cases of direct and non-direct interband transitions, studied the processes of generation of optical radiation and two-photon absorption, analyzed for the first time the relaxation properties of the emission line and described the effect of saturation. The main result of this study was a prioritized proposal and a substantiation of the feasibility of the injection laser (together with N G Basov and Yu M Popov, 1961). This type of laser became the principal element in optical communications, optical data processing, high-efficiency pumping of high-power solid-state lasers, and so forth. This work formulated the main ideas that predetermined the approaches to further improvement of injection lasers, namely, the need to change to heterostructures and to waveguide systems, which ultimately led to efficient devices. In 1962 O N Krokhin presented and defended his PhD thesis on "Negative absorption in non-direct transitions in semiconductors". In 1964 the team, including O N Krokhin, received the Lenin Prize for the fundamental research that resulted in the creation of semiconductor lasers.

Oleg Nikolaevich Krokhin

Even at the dawn of the laser era, in 1962, N G Basov and O N Krokhin came up with a challenging idea of the possibility of realizing nuclear fusion by heating the target with laser radiation; thus was born the powerful new field of research: laser-stimulated nuclear fusion (LSNF). In 1968 the first neutrons were detected from laser-irradiated target

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pellets of deuterized lithium, which provided a powerful stimulus for further effort in LSNF research. Together with N G Basov, O N Krokhin initiated the design and construction of the first high-power lasers for LSNF. Until the 1980s, FIAN was one of the world leaders in LSNF owing to the building of the 'Kalmar' and 'Delfin' laser facilities which permitted the compression of thermonuclear targets. Even today the scale of the program of LSNF work is one of the largest in the world. The results of the program were summarized by N G Basov and O N Krokhin in an article "Application of lasers to thermonuclear fusion" that appeared in *Vestnik Akad. Nauk SSSR* in 1970. The authors emphasized the essential features of lasers when applied to LSNF: high degree of control over the spatial and temporal structure of laser radiation, which makes possible a convenient transfer of the energy of light and the creation of a high density energy flux. The Laboratory of Laser Targets Technology, created at the FIAN on O N Krokhin's initiative, maintains its leading position in the world in this field. Highly ingenious methods of manufacturing complex-structure targets explain the high demand for the FIAN targets in the leading research centers of many countries.

O N Krokhin carried out a large complex of research work on the interaction of laser radiation with matter. One result of this program was the development of special laser systems, including an integrated set of techniques and equipment for obtaining images of ultrafast processes; the system was based on recording the amplitude and phase changes introduced by the object under study into the transmitted optic wave (shadowgrams, interferograms, schlieren images). These techniques achieved high temporal and spatial resolution and are currently widely used in various fields of research. In 1967 O N Krokhin presented and defended his DSc thesis "A study of the interaction of laser radiation with opaque condense materials". In 1981 a group of researchers including O N Krokhin received the USSR State Prize for the work on the interaction of laser radiation with matter.

In 1965 O N Krokhin suggested a possible design of a photodissociation laser pumped by the radiation of the explosion shock wave front or of highpower open electric discharge. The laser created on the basis of this proposal produced record specific power parameters necessary for technical applications and LSNF.

O N Krokhin was always interested in using laser radiation in all possible fields of application. Many a work initiated by O N Krokhin is now expanded for technological problems processing various materials by the laser radiation. He was one of the pioneers of applying lasers to medicine; the study of the effects of laser irradiation on gastric tissues were first conducted in the N I Pirogov 2nd Moscow Medical Institute in collaboration with the Corresponding Member of the Academy of Medical Sciences Yu M Pantsyrev. This research resulted in the development of novel methods of stopping profuse gastric bleeding using endoscopic techniques. These methods are now widely used in hospitals.

For a number of years O N Krokhin was leading research and development on 'point-like' sources of neutrons, X-rays and ultraviolet radiation based on fast pinched discharge. It was possible to design a point-like source of soft X-ray radiation manifesting high efficiency of conversion of electric energy to radiation. Research into X-ray lithography demonstrated the feasibility of creating elements of sub-micron size that promise good operational parameters for sources.

O N Krokhin is the author of three monographs and more than 250 research papers. His achievements in physics were amply recognized: he was elected Corresponding Member of the Russian Academy of Sciences (RAN) in 1991 and Full Member in 2000. O N Krokhin was a deputy director of FIAN from 1972 to 1979 and became its director in 1994.

O N Krokhin's outstanding organizational talent allows him to carry multiple high-responsibility burdens. He sits on the Bureau of General Physics and Astronomy Division of the Russian Academy of Sciences, is a member of several boards of special federal research and development programs, is Editor-in-Chef of *Trudy FIAN*, *Kvantovaya Elektronika*, *Kratkie Soobsheniya po Fizike*, *Journal of Russian Laser Research*, *Fizicheskoe Obrazovanie v Vuzakh*, and is a member of a number of other important journals. For many years now he has continued as member of the Expert Council of the Higher Attestation Committee, the Russian Academy of Sciences Scientific Council on Optics and the Laser Physics and Plasma Physics Council. He is currently a member of the Bureau of the Council of Directors of the RAS Institutes.

Nevertheless, the core of the science-management activities of O N Krokhin is his position as Director of the P N Lebedev Physics Institute (FIAN). As L V Keldysh, his predecessor, he was elected to this post in the critical, 'survival' time for Russian science, and he continued the traditions of guiding the ship of the famous research establishment created by the outstanding directors of FIAN — S I Vavilov, D V Skobel'tsyn and N G Basov. O N Krokhin as director is driven by his deeply felt FIAN patriotism, by a passionate effort to strengthen the position of FIAN as one of the flagships of physics in Russia and outside its borders, by his wish to maintain the inimitable creative atmosphere that was always characteristic of FIAN.

O N Krokhin is the leader of the recognized scientific school in quantum radiophysics and plasma physics; he has also read a course of lectures to students of the Moscow Physics Engineering Institute for nearly 40 years. Emerging from among his students he now counts more than twenty physicists with DSc and PhD degrees. O N Krokhin greatly contributed to the success of the unique center for training highest-level scientists: "The MIFI Advanced School of Physicists of FIAN and MIFI" received the Russian President's Prize in Education in 2001. O N Krokhin is a council member of the specially targeted federal program on "Integration of Science and Education in Russia", and leads one of the largest science and education bases of this program — the International Science and Education Center on Fundamental Optics and Spectroscopy. It was a recognition of O N Krokhin's high reputation among physics teachers when he was elected chairman of the Council of the Association of Physics Chairs of Technical Higher-Education Establishments in Russia.

O N Krokhin's achievements in science and science management were marked by a number of State awards, by the 'Red Banner of Labor' Order (1971), the 'Honor Medal' (1976), 'The Services to the Motherland' Order of IV Class (1999). The President of Poland awarded O N Krokhin 'The Commander's Cross' of II Class for his contribution to the progress of Russian-Polish scientific cooperation.

Colleagues, students and friends congratulate Oleg Nikolaevich with all their hearts on this jubilee and wish him health, happiness and well-being, new creative breakthroughs and success in his multifaceted activities.

Zh I Alferov, A F Andreev, S N Bagaev,
A A Boyarchuk, V L Ginzburg, N S Kardashev,
L V Keldysh, Yu V Kopaev, G A Mesyats,
Yu M Popov, I I Sobel'man, E L Feĭnberg