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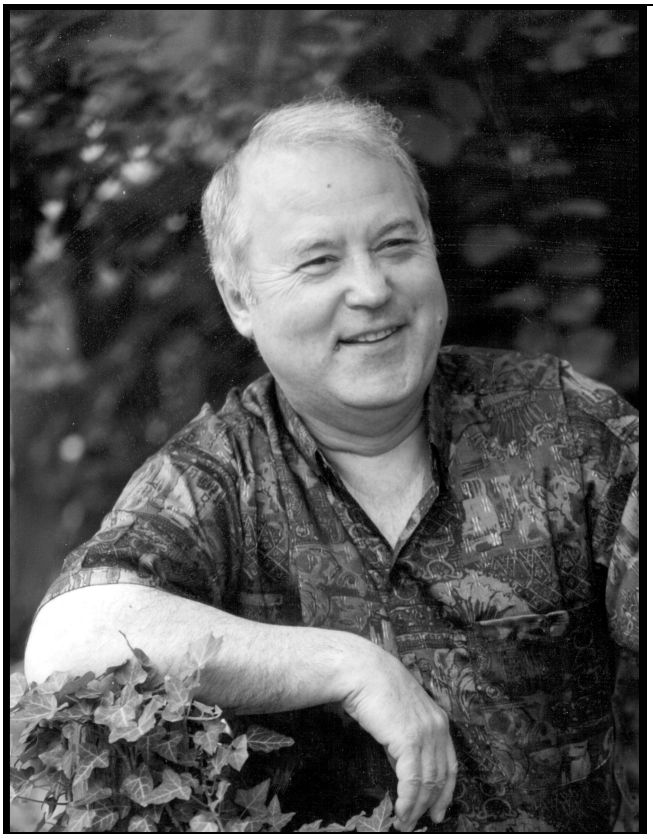
Anatolii Nikolaevich Oraevsky



Professor Anatolii Nikolaevich Oraevsky, D.Sc. (phys. and math.), winner of the Lenin Prize, member of the editorial board of Quantum Electronics, a leading physicist in the fields of masers and lasers, quantum optics and interaction of laser radiation with matter, died suddenly on 4 July 2003.

A.N. Oraevsky was born on 26 January 1934 in the town of Teikovo (Ivanovo region). He passed his secondary school in Vladimir in 1951, winning a gold medal, and joined the physicotechnical department of the Moscow State University. (In the same year, this department was converted into the Moscow Institute of Physics and Technology.) He completed his graduate work under the supervision of N.G. Basov and worked simultaneously (since 1956) as an engineer at the Lebedev Physics Institute (LPI), the USSR Academy of Sciences. After completion of his postgraduate research at the LPI and the successful defence of his Ph.D. thesis in 1960, Anatolii Nikolaevich began regular teaching activity at the Moscow Engineering Physics Institute since 1962. He was awarded the degree of D.Sc. in physics in 1965 for his monograph entitled 'Molecular Generators'.

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Translated by Ram Wadhwa

A.N. Oraevsky was the author of more than 450 scientific publications, 20 inventions and five monographs. His fundamental work on the dynamics of lasers and other nonlinear optical systems, on quantum frequency standards, laser chemistry and chemical lasers earned him worldwide recognition.

The model of a quantum oscillator as a nonlinear self-oscillating system developed by him became the base model for investigations in this field. Hundreds of publications based on this model have appeared in scientific journals. Anatolii Nikolaevich himself and his pupils carried out a large series of investigations on the nonlinear dynamics of quantum oscillators. These include research on the mechanism of radiation pulsations in lasers based on the nonlinear interaction of modes, discovery and analytic calculations of the so-called relaxation limiting cycle which forms the basis of the theory of laser radiation intensity pulsations, lasers with a delayed feedback, the discovery of a hard (bistable) regime in a laser with a saturating filter, and investigation of the conditions for π-pulse generation by a laser. The most significant achievement of A.N. Oraevsky in this field is the discovery of aperiodic (stochastic) modes in quantum oscillators, which came to be known as 'dynamic chaos'. Together with a group of coworkers, he studied the possibility of controlling chaotic laser pulsations.

A.N. Oraevsky analysed the factors affecting the frequency of a single-mode quantum oscillator. This research became the theoretical foundation of works on the application of ammonia and hydrogen masers in time service.

While studying the spontaneous radiation of an atom (molecule) in a single-mode cavity, he derived a general formula describing the increase in the probability of spontaneous emission in a cavity in the case of resonance and predicting the suppression of the process of spontaneous emission at a considerable detuning between the frequencies of the atom and the resonator.

Anatolii Nikolaevich and his coworkers developed thermally excited gas lasers and formulated the basic theoretical concepts for them. These investigations formed the theoretical basis for the development of gas-dynamic lasers.

He proposed the idea of using chain reactions in chemical lasers and developed their theory. He also proposed purely chemical cw lasers and supervised the theoretical and experimental research on chemical lasers at the LPI. The results of these investigations were compiled in the form of a monograph on chemical lasers by A.N. Oraevsky and coauthors. For their investigations of chemical lasers, the collective of authors including A.N. Oraevsky was awarded the Lenin Prize.

Anatolii Nikolaevich predicted photochemical waves – the process of consistent propagation of radiation and the chemical reaction initiated by it, whose rate can be much higher than the velocity of the detonation wave.

As a member of a group of authors, he discovered

experimentally the photochemical action of the IR laser radiation. He formulated the mechanism of the photochemical action of moderate-intensity IR radiation based on the intramolecular parametric resonance.

A.N. Oraevsky and his colleagues experimentally discovered selective dissociation of molecular bonds under the combined action of IR and UV laser radiation. He carried out a series of works on the biochemical action of IR laser radiation, and also discovered a considerable slowing down of the process of coagulation of serum in human blood exposed to HF laser radiation.

Anatolii Nikolaevich put forward an original idea that the superconducting state is a peculiar laser, generating a coherent Bose condensate of Cooper pairs. This idea reveals the dynamic resemblance between a superconductor and a laser and might allow a prediction of the dynamic regime in superconductors in analogy with the dynamics of lasers. He proposed equations for describing nonlinear processes in superconductors, combining the superconducting condensate, free quasi-particles, phonons, and electromagnetic field into a unified dynamic system.

A.N. Oraevsky considered the propagation of nonlinear waves in molecular chains and predicted a new type of molecular soliton, the so-called anharmonic soliton. He used the concept of second negative viscosity to analyse a number of fundamental problems in the acoustics of nonequilibrium media.

Anatolii Nikolaevich predicted and discovered (together with coworkers) the so-called explosive absorption, i.e., a nonlinear effect based on the positive feedback due to relaxation processes occurring in an absorbing medium.

In his last years, A.N. Oraevsky was engaged in the study of the electrodynamics of micro- and nanoparticles. He determined the structure of fields in spherical and ellipsoidal micro- and nanoshells, which is important for various practical applications. He proposed a new type of laser based on a quantum dot with a dielectric microsphere as a resonator of the whispering gallery mode. He showed that a contact with a superconductor at a subcritical temperature makes it possible to preserve the superconducting state in a thin (nano)layer of a material at a temperature much higher than the superconducting transition temperature.

The research and organisational activity of A.N. Oraevsky was closely linked with his work in the editorial boards of journals, task councils, and organisation of conferences, including international ones. He was the head of the Sector of Theoretical Radiophysics in the Department of Quantum Radiophysics at the LPI.

Anatolii Nikolaevich was a professor at the Moscow Engineering Physics Institute for about 40 years. At this institute, he developed and delivered a course on quantum radiophysics. He supervised the research work of more than 40 undergraduate students, 32 research scholars (Ph.D.'s); ten of his pupils obtained their D.Sc. degrees. A.N. Oraevsky was a winner of the Lenin Prize and an Honoured Worker of Science of the Russian Federation. He was awarded the order of 'Mark of Honour' and the medal 'For Creative Valour'.

Anatolii Nikolaevich was not only a distinguished scientist, but also an excellent interlocutor and a man with a profound sense of humour. The range of his interests was really astonishing. He was truly an intelligent person, invariably kind-hearted, and always ready to help. He was a man with an inquisitive mind, encyclopaedic knowledge, the highest moral standards, and a sharp sense of justice, who remained objective in any discussion, was a strict but fair reviewer, a caring and just supervisor. His untimely death, which is hard to bear, is an irreparable loss for all his friends and colleagues.

G.A. Mesyats, S.N. Bagayev, F.V. Bunkin,
E.M. Dianov, O.N. Krokhin, I.I. Sobel'man,
I.A. Shcherbakov, V.S. Zuev, N.A. Irisova,
I.B. Kovsh, A.A. Manenkov, A.G. Molchanov,
Yu.M. Popov, E.D. Protsenko,
A.S. Semenov, A.N. Starodub