Sergeĭ Aleksandrovich Akhmanov (Obituary)

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The eminent physicist, a prominent organizer of science and of higher education, laureate of the Lenin and Lomonosov Prizes, Honored Scientist of the RSFSR, head of the Department of General Physics and Wave Processes of the Physics Faculty of the Moscow State University, the scientific director of the International Laser Center of the Moscow State University, Sergeĭ Aleksandrovich Ahkmanov, died suddenly on 1 July 1991. Until his last day Sergeĭ Aleksandrovich was the vital center of a large scientific team, full of energy, hopes and plans for the future, and generated new ideas. The sudden, absurd death put an end to the activity of this richly endowed person.

S. A. Akhmanov was born in Moscow on 14 July 1929 into the family of faculty members of the M. V. Lomonosov Moscow State University. His entire scientific activity and his formation as a scientist who achieved world-wide recognition, have been associated with the Moscow State University, within the walls of which he was first a student, and then traversed the path from being an assistant to becoming the Head of a major leading Department.

Thirty years ago two young talented radio physicists from the Moscow State University S. A. Akhmanov and R. V. Khokhlov burst impetuously into science with new brilliant ideas. They made a decisive contribution to the new field in physics—nonlinear optics. At that time (1962) they proposed and subsequently constructed (1965) optical sources of a new type—parametric light generators with tunable frequency. These papers signalled the beginning of the physics and technology of tunable light sources which are playing an ever increasing role in modern quantum electronics, optics and experimental physics. To S. A. Akhmanov belong fundamental results in the theory of nonlinear waves, in the investigation of fluctuation phenomena in lasers and nonlinear-optical devices, in the development of methods of laser diagnostics of nonequilibrium systems, coherent active spectroscopy with tunable lasers, and in the development of pico-and femtosecond laser systems. In recent years he became fascinated with the ideas of coherent x-ray optics, superstrong light fields, and optical neuronetworks.

In 1957–1961 S. A. Akhmanov constructed and investigated wideband frequency transformers in the radio and UHF ranges of the electromagnetic spectrum. This laid the foundation for the investigations of *nonlinear wave processes* which were carried on until the last days of his life. He was one of the first to begin studying the parametric interaction of space charge waves in long electron beams, and proposed phase quantizers and fast-acting triggers. He then extended investigation of parametric processes into the optical range.

Under the guidance of S. A. Akhmanov tunable parametric generators of ultra-short light pulses were first realized in 1968 which made it possible to obtain picosecond and in recent years also femtosecond light pulses in the visible, UV and IR ranges.

SERGEĬ ALEKSANDROVICH AKHMANOV
(1929–1991)

In the nonlinear optics laboratory of the Moscow State University headed by S. A. Akhmanov a unique high-power femtosecond laser system based on an excimer laser was created in 1985–1991 which made it possible to obtain light field intensities in excess of 10^{16} W/cm^2, i.e., to develop field intensity in a light wave exceeding the intensity of intra-atomic electrostatic fields $\sim 3\times 10^9$ V/cm.

S. A. Akhmanov and his collaborators developed the theory of time-dependent interactions and self-actions of light waves, and predicted and observed a number of the basic effects of nonlinear optics of the atmosphere. In recent years investigations of the self-actions were continued by him in nonlinear systems with two-dimensional feedback, in which a number of optical phenomena that are new in principle were observed (spatial multistablility, chaos etc.).

The broad range of scientific interests of S. A. Akhmanov encompassed the *application of the ideas and methods*

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of nonlinear optics in laser spectroscopy and diagnostics of matter. Beginning with 1972 S. A. Akhmanov and his collaborators successfully developed a new method of nonlinear laser spectroscopy—the method of coherent active spectroscopy of light scattering utilizing tunable lasers. The first investigations of this series involved the spectroscopy of the Raman scattering of light. Particularly effective turned out to be the polarization methods and methods of time-dependent active spectroscopy which were utilized for the study of intermolecular interactions in liquids, narrow resonances in cryogenic mixtures, etc. Methods of picosecond active spectroscopy were used to investigate the kinetics of dephasing of oscillations and rotation of molecules cooled in a supersonic jet.

Beginning with 1983 the papers of S. A. Akhmanov developed effective methods of nonlinear-optical diagnostics of rapid processes in gaseous and condensed media. This made it possible, in particular, to discover the special properties of rapid laser-induced melting and disordering of a crystalline lattice, laser annealing and amorphization of semiconductors.

S. A. Akhmanov made an important contribution to *statistical radio-physics* and to the development of the foundations of *statistical nonlinear optics.* Already in 1960–1961 he constructed parametric phase quantizers which realized classical squeezed states of the electromagnetic field; phase quantizers were utilized for phase measurements and detecting weak signals. He carried out a series of investigations of statistical phenomena in the case of induced scattering of light; together with his pupils he established experimentally the limiting value of the spatial coherence of laser radiation, and developed the modern theory of analysis of statistical phenomena in nonlinear optics.

S. A. Akhmanov carried out extensive scientific-organizational work: in recent years he headed the Coordinating Council of the large-scale All-Union program on laser physics involving different institutions of higher learning; from the time of organization of the Scientific Council of the Academy of Sciences of the USSR on coherent and nonlinear optics he was its deputy chairman, and organizer and active participant of All-Union and many international conferences on nonlinear optics, quantum electronics, and optical spectroscopy. He organized and headed the International Laser Center of countries of central and eastern Europe and its branch at the Moscow State University. S. A. Akhmanov was an active member of the editorial board of the journal "Uspekhi Fizicheskikh Nauk," and was a member of editorial boards of the following journals: "Quantum Electronics," "Izvestia vuzov (ser. "Radiofizika")," "Optics Letters," "Quantum Optics," and "Nonlinear Optics," and was the organizer and editor of a number of issues of the signal information of VINITI "Oscillations and Waves", and of series of collective monographs.

S. A. Akhmanov organized an *important scientific school* in the field of nonlinear optics and quantum electronics; his pupils among whom are tens of doctors and candidates of science, are working successfully in different scientific centers of our country and abroad. He was one of the most active and consistent supporters of the development of nonlinear optics and laser physics in all the republics of our country. The initiation into big science for many physics students were the brilliant lectures of Professor S. A. Akhmanov. In the memories of many people there will remain the brilliant appearances of S. A. Akhmanov at scientific conferences, schools, and seminars. Entire generations of physicists study his books. He is the author of widely known books: "Problem of Nonlinear Optics" (1964), "Statistical Phenomena in Nonlinear Optics" (1971), "Introduction to Statistical Radiophysics and Optics" (1981), "Methods of Nonlinear Optics in the Spectroscopy of Scattering of Light" (1981), "Optics of Femtosecond Laser Pulses" (1988), and "New Physical Principles of Optical Processing of Information" (1990).

S. A. Akhmanov possessed the rare gift of inspiring a creative atmosphere, of infecting people with energy and confidence of success. He generously shared his knowledge, his criticism of scientific papers was strict but constructive. It was always interesting to be in his company–and, although the work was often strenuous and difficult, it brought joy, the feeling of high creativity, and of contact with the truth and beauty of nature.

The sudden death of Sergeĭ Aleksandrovich Akhmanov staggered us. His image will remain in our memory bright and clear as a laser beam.

Translated by G. M. Volkoff