

## Alexander Grigorievich Litvak (on his 70th birthday)

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Professor Alexander Grigorievich Litvak, DSc—an outstanding physicist, Academician of the Russian Academy of Sciences, member of the Presidium of the Russian Academy of Sciences (RAS), member of the Bureau of the Physical Sciences Division of the RAS, Chairman of the Nizhny Novgorod Research Center of the RAS, and Director of the Institute of Applied Physics of the RAS—had his 70th birthday on November 17, 2010.

A G Litvak was born in Moscow, into a family of young graduated specialists, six months before WWII came to the USSR. After the war, the family lived in the city of Gorky, where A G Litvak graduated from high school No. 4 in 1957. From 1957 to 1962 he was a student in the Radiophysics Department of the N I Lobachevsky Gorky State University, then became a postgraduate student of Professor M A Miller.

In 1967, A G Litvak submitted and defended his PhD thesis, “Some problems in the theory of nonlinear electromagnetic phenomena in plasmas,” and in 1977 defended his thesis for Doctorate of Physicomathematical Sciences, “Self-action and interaction of electromagnetic waves in plasmas.” In the newly organized Institute of Applied Physics of the USSR Academy of Sciences, A G Litvak took the position of sector head in 1977, then became laboratory head, and in 1988, became head of the department of plasma physics. In December 1988, A G Litvak rose to directorship of the Division of Plasma Physics and High-Power Electronics, and in 2003 was elected Director of the Institute of Applied Physics of the RAS—the position he currently occupies.

A G Litvak is a prominent scientist, a widely recognized expert in the field of plasma physics, physical electronics, and radiophysics. A G Litvak’s research activities cover a broad range of issues, such as the interaction of powerful electromagnetic radiation with matter, the development and creation of dense plasma sources, the development of microwave methods for plasma heating in controlled thermonuclear fusion facilities, and the development of powerful sources of microwave radiation and their application for creating new technologies, as well as strengthening the defense capabilities of the country.

Already at the first stage of his scientific activities, A G Litvak performed pioneering work on the nonlinear electrodynamics of plasma and condensed matter. He formulated averaged dynamic equations for the plasma-field system, which allowed him to investigate in a unified manner the processes of self-focusing and stimulated scattering of electromagnetic waves in isotropic and magnetized plasmas, and derived a theory of self-channeling of intense electromagnetic waves in opaque overcritical plasmas. He was the first to investigate the self-action effects of relativistically strong waves related to the dependence of the electron mass on the energy of oscillations in the wave field. These effects determine the nature of the interaction of ultrahigh power laser pulses with plasmas in modern experiments which



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are run with a view to developing new methods of particle acceleration and studying extreme states of matter.

In the same years, A G Litvak investigated a number of important effects in nonlinear optics. He predicted the thermal self-focusing effect and elaborated its theory, next formulated (in collaboration with V I Talanov) an equation of the nonlinear Schrödinger type equation for describing the self-action of three-dimensional wave packets in nonlinear media, and then used it as a basis for developing a theory of modulation instability of non-one-dimensional wave packets; he also showed that there exist nonlinear surface polaritons, i.e., electromagnetic surface waves that have no linear counterparts.

A G Litvak holds the priority in conducting complex experimental research of the interaction between high-power microwave radiation and plasmas. He and coworkers were the first to examine experimentally and study the wave self-focusing effects in the plasmas and nonlinear transparency of a dense ‘overcritical’ plasma, the modulation instability of Langmuir oscillations, and the dynamics of the Langmuir caviton. His research into nonlinear dynamics of a freely localized gas discharge in electromagnetic wave beams laid the foundation of a new field in the physics of low-temperature plasma, which is exceptionally rich in various

applications: from the production of beams of multiply charged ions for high-energy accelerators to purification of the upper atmosphere from environmentally harmful contaminants and to regeneration of ozone.

In the field of controlled thermonuclear fusion (CTF), A G Litvak and his coworkers developed the fundamentals of the theory of electron cyclotron (EC) plasma heating by quasioptical beams of electromagnetic waves and showed the possibility of plasma heating in toroidal facilities when radiation enters from the side of a weak magnetic field. These proposals, supported by the results of experiments on the T-10 tokamak at the I V Kurchatov Institute of Atomic Energy, served as a basis for widespread use of EC heating and for noninductive current generation in modern toroidal CTF facilities.

A G Litvak turned out well in nurturing a team of highly skilled theoreticians and experimentalists who have achieved notable success in creating powerful sources of microwave radiation and in developing their applications in radar technologies, in plasma physics and nuclear physics, and in technologies of manufacturing new materials. Among the most important results in this area, the development and industrial implementation of MW-level quasicontinuous gyrotrons should be singled out. A G Litvak initiated the creation of Gycom, Ltd., which brought together dozens of scientists and engineers from several major research institutes in the country and which, under his guidance, reached the position of world leader in production of gyrotrons and gyrotron-based complexes. The organization of the hightech industry in this country made it possible to equip fifteen tokamaks and stellarators here and abroad with efficient systems of EC plasma heating, and to consolidate the leadership of the Russian science in this area. Currently, A G Litvak with his team are completing the development project for a continuous-wave megawatt gyrotron at a frequency of 170 GHz for an international project undertaken by the ITER and another project for a stepped-frequency-tuned megawatt gyrotron for the frequency range from 105 to 150 GHz. Considerable success has been achieved in developing a new generation of gyrotron-based sources of dense nonequilibrium plasma, sintering technology for nanoceramic materials and high-rate growth of polycrystalline diamond films and plates, diamond single crystals, as well as designing the appropriate multiinstrument facilities.

In recent years, A G Litvak and his coworkers started a program of studies aimed at the development and practical implementation of radiation sources in the terahertz range, which stem both from efforts to upgrade traditional methods of high-power vacuum electronics to higher frequency ranges, and from the application to detection of femtosecond laser pulses in nonlinear media.

The results of A G Litvak's research have been published in more than 300 papers and implemented in numerous unique instrumentation and equipment facilities. For his scientific achievements he received, with a group of authors, the USSR State Prize in Science and Technology for the series of papers "Fundamentals of nonlinear dynamics of high-frequency wave processes in a fully ionized plasma" (1987) and the prestigious Kenneth J Button international prize "For outstanding contribution to the science of the electromagnetic spectrum" (2008).

A G Litvak devotes much attention to education and the training of young scientists. Among his former students we find a Corresponding Member of the RAS, and 7 holders of DSc and 13 holders of PhD degrees. He is the founder and leader of a widely known scientific school in plasma physics, one of the largest in Russia and counting among its

researchers approximately 30 active DSc and PhD holders, plus lots of young scientists. A G Litvak has organized the underlying department of the Advanced School of General and Applied Physics (ASGAP) of the RAS IAP at the N I Lobachevsky State University of Nizhny Novgorod, which successfully implements new approaches to 'fostering' youngsters for academic science; he became its first Dean. On his initiative, a successfully functioning RAS Science and Education Complex (SEC) was created at the RAS IAP, which includes the above-mentioned ASGAP department, the affiliates of university chairs, the graduate school, and specialized senior classes of the physics and mathematics lyceum. The SEC prepares highest-qualification young researchers for educational establishments with physics orientation.

A G Litvak is greatly involved in science administration. He plays a decisive role in shaping and managing the largest division of the RAS IAP—the Division of Plasma Physics and High-Power Electronics. In his capacity of IAP Director, A G Litvak efficiently solves the problems of funding, personnel administration, maintaining the research potential, and expanding the Institute, which continues to occupy leading positions in the world of the physics of oscillations and wave processes, despite the difficulties of recent years. He conducts a large-scale program of research coordination and creation of efficient scientific and industrial ties between the Institute and leading research centers, and industrial enterprises in Russia. A G Litvak initiated the creation of the RAS Nizhny Novgorod Scientific Center, which consolidates the intellectual and technological capacity of academic institutions of Nizhny Novgorod and represents a new stage of scientific advancement at the Nizhny Novgorod region.

A G Litvak pays much attention to his social functions in his capacity of Chairman of the Commission for the Development of Science, Education and Culture of the Public Chamber of the Nizhny Novgorod region and Deputy Chairman of the Nizhny Novgorod Council on Science and Innovation Policy headed by the regional governor.

A G Litvak is a world-ranking scientist. He is a chairman and member of program committees of a number of international scientific conferences and meetings, including the traditionally convened RAS IAP conferences 'Frontiers of Nonlinear Physics' and 'Intense Microwave Radiation: Sources and Applications', which have acquired high international rating; he sits on the editorial boards of a number of international and Russian science journals, and he is a member of the Council of the Russian Foundation for Basic Research. It was a sign of recognition of A G Litvak's contributions to science when he received the Order of Friendship in 2004, and when in 2006 he became an Honorary Citizen of the Nizhny Novgorod region.

We are pleased to note that his inexhaustible scientific and public temperament allows A G Litvak to continue working on his research projects with an enviably high productivity, despite the ever-growing span of his administrative duties and social and scientific loads.

Friends and colleagues of Alexander Grigorievich Litvak, his many students and followers wish him many happy returns on the occasion of his 70th birthday, good health, and many years of active life and new creative successes in all aspects of his multifaceted activities.

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