

## Efim Arkad'evich Khazanov (on his 60th birthday)

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November 12, 2025 was the 60th birthday of Efim Arkad'evich Khazanov, a distinguished physicist and world-class specialist in laser physics and nonlinear optics, Academician of the Russian Academy of Sciences (RAS), chief researcher at the A.V. Gaponov-Grekhov Institute of Applied Physics RAS (IAP RAS), and the long-time head of the Institute's Department of Nonlinear Dynamics and Optics.

E.A. Khazanov is a graduate of the first cohort of the Higher School of General and Applied Physics (HS GAP), which at that time was a basic department of the Institute of Applied Physics at the Gorky Polytechnic Institute. During his studies, he was a Lenin scholarship recipient and, after graduating with honors from the Polytechnic Institute in February 1988, he continued working at the Institute of Applied Physics in the Department of Coherent Optics. At the start of his scientific career, E.A. Khazanov worked on the creation of pulse-periodic lasers with a high average power. Such lasers were manufactured, among other things, for several foreign laboratories. At the same time, certain effects associated with phase and polarization distortions of radiation in laser elements were noticed, which determined the direction of further research.

In 1992, E.A. Khazanov defended his Ph.D. thesis, “Investigation of possibilities for compensation of polarization and aberrational distortions of the optical radiation wavefront in pulse-periodic YAG:Nd lasers,” with G.A. Pasmanik as supervisor. Later on, he examined and worked out new devices—Faraday isolators, which are essential for any high-power laser today, as well as the use of wavefront reversal at a high average power. In 1999, for his achievements, E.A. Khazanov was awarded the RAS Medal for young scientists.

Expanding the range of his scientific interests and involving new collaborators, he gradually established and headed first a laboratory and then a department of nonlinear and laser optics. A successful combination of sound theoretical training, extensive experimental experience, and persistence in achieving his goals enabled E.A. Khazanov and his team to successfully build the world's first petawatt-level parametric laser, the PEARL complex. This was the first laser in the world to use the principle of parametric amplification in DKDP crystals under broadband synchronism, proposed at IAP RAS. Currently, virtually all ultrahigh-power laser complexes are designed and built using this principle.

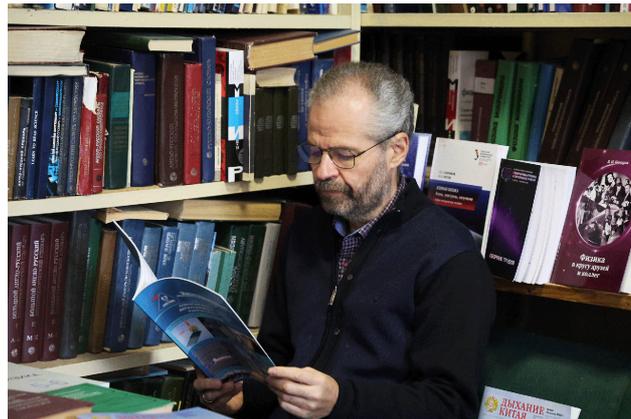
In 2005, E.A. Khazanov defended his D.Sc. thesis, “Thermo-induced polarization distortions and their compensation in optical elements of lasers with high average power,” in the specialty of laser physics.



Efim Arkad'evich Khazanov

E.A. Khazanov is a founder of a new scientific discipline—thermo-optics of magnetoactive media, which solves the problems of creating magnetoactive elements capable of working in laser systems at a high degree of heat release in them. Devices capable of withstanding an average radiation power of up to 10 kW, which was by two orders of magnitude higher than had been reached before, were designed under his guidance and with his direct participation.

One project requiring such devices was the giant laser interferometer LIGO (Laser Interferometer Gravitational-Wave Observatory) aimed at searching for and detecting gravitational waves. Owing to, among other things, Khazanov's work, IAP RAS is a participant in the LIGO consortium. He worked out certain components of the detector and the diagnostics system, frequently visited the gravitational wave detector, and took part in experiments. Largely thanks to the research conducted under his leadership, the LIGO parameters were improved, and in 2015, gravitational waves were first detected.



Efim Arkad'evich Khazanov at PEARL laser complex and in IAP RAS library reading physics journal, October 2024 (photos by N. Naumova).

E.A. Khazanov elaborated a model of laser generation in active ceramic media, on the basis of which the effect of random spatial modulation of laser radiation amplitude, phase, and polarization was predicted and then experimentally discovered, an effect which has never been observed in other solid-state lasers with glass or crystalline active elements.

In 2008, E.A. Khazanov was elected a corresponding member and, in 2019, a full member of the Russian Academy of Sciences.

For over 10 years (from 2012 to 2022), E.A. Khazanov headed a large division at IAP RAS—the Division of Nonlinear Dynamics and Optics, the post he took up after A.M. Sergeev. Under his leadership, not only were the conventional research areas of the department successfully developed, but also the range of problems it solved was significantly expanded. Now this is not only the creation of lasers with a high peak and average power, research on new materials and media, research on the interaction of high-power laser radiation with matter, high-precision optical measurements, and microwave spectroscopy, but also work at the intersection of optics and medicine, research on cognitive processes, and modeling complex neuron-like media. E.A. Khazanov took an active part in the creation of knowledge-based production of unique KDP and DKDP crystals widely used in the design of high-power laser systems.

Largely thanks to him and his scientific contacts, IAP RAS participates in large Russian and international projects. Together with A.M. Sergeev, he initiated and supervised the XCELS (Exawatt Center for Extreme Light Studies) project aimed at developing the unique exawatt-power laser complex for studying extreme states of matter. This was one of the six projects to create unique megascience-class facilities supported by the RF Government and is currently experiencing a renaissance. E.A. Khazanov initiated the creation of the world-class scientific center Photonics, which included more than 240 researchers from different leading scientific organizations in our country.

The results of E.A. Khazanov's studies are published in over 350 scientific papers and are realized in unique laser complexes founded by him. For his scientific achievements in science and technology, he received (jointly with his co-authors) a prize of the RF Government, "For the development and implementation of petawatt laser complexes based on parametric light amplification" (2012), the RF State Prize

in science and technology, "For the creation of fundamental bases and instrumental solutions to the problems of gravitational wave recording" (2019), and prestigious international prizes for the experimental discovery of gravitational waves (within the LIGO collaboration): the Gruber Prize in Cosmology (2016), and the Special Breakthrough Prize in Fundamental Physics (2016).

A world-renowned scientist, E.A. Khazanov is a member of the International Committee on Ultrahigh-Power Lasers (ICUIL), a full member of the American Optical Society (OPTICA), a member of the program committees of several international conferences, including "Topical Problems of Nonlinear Wave Physics," "Pacific Rim Laser Damage," the scientific school "Nonlinear Waves," and a member of the editorial board of the journal *Kvantovaya elektronika* (*Quantum electronics*). He directs the joint Russian-Chinese laser laboratory, which combines the experience of scientists from both countries in creating multipetawatt and subexawatt laser systems.

E.A. Khazanov has placed great importance on training young scientists. For many years he has taught at the Department of the Higher School of General and Applied Physics and is actively involved in the training of postgraduate students at IAP RAS as curator of the 'laser physics' specialty. Eight students have defended Ph.D. theses under his supervision, of whom three have already become doctors of sciences, and the number of researchers who consider themselves his students is immeasurably greater. Two new youth laboratories were opened at IAP as part of the National Project, Science and Universities on his initiative and with his direct involvement.

On E.A. Khazanov's noteworthy birthday, his friends, colleagues, and numerous students wish him sound health and a long life, new interesting scientific results, and success in all his initiatives and undertakings.

*N.F. Andreev, G.V. Gelikonov, M.Yu. Glyavin, I.Yu. Kostyukov, V.V. Kocharovsky, A.G. Litvak, A.Yu. Morozov, V.I. Nekorkin, N.N. Rozanov, A.M. Sergeev, G.V. Trubnikov, A.V. Chaplik*