

Ivan Aleksandrovich Shcherbakov (on his 80th birthday)

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April 11, 2024 was the 80th birthday of academician of RAS Ivan Aleksandrovich Shcherbakov — an outstanding Soviet and Russian physicist, a leading specialist in the field of spectroscopy of laser materials, doctor of physical and mathematical sciences, scientific supervisor of the Federal Research Center A M Prokhorov General Physics Institute of the Russian Academy of Sciences (GPI RAS), advisor of the Russian Academy of Sciences.

Ivan Aleksandrovich Shcherbakov was born into the family of a Soviet party and state figure Aleksandr Sergeevich Shcherbakov and Vera Konstantinovna Shcherbakova. In 1967, after graduating from the Electromechanical Department of the Moscow Power Engineering Institute, Ivan Aleksandrovich began working at the Lebedev Physical Institute of the USSR Academy of Sciences (FIAN), where he first held the position of engineer, then junior researcher, and, from 1975, senior researcher.

In 1971, he defended his candidate thesis, “A study of spectral laws and excitation energy transfer in ion crystals with an admixture of rare-earth elements,” and, in 1978, his doctoral thesis, “Investigation of excitation energy relaxation processes in crystals and glasses activated by ions of rare-earth elements.”

After the Institute of General Physics of the USSR Academy of Sciences (IOFAN) was formed in 1982 on the basis of Division A (FIAN), Ivan Aleksandrovich moved over to the new institute to head a laboratory at the Department of Solid State Physics, and then became head of the Department of Laser Crystals. In 1998, I A Shcherbakov was elected director of the institute, succeeding the organizer and the first director of IOFAN, the Nobel Prize laureate, academician Aleksandr Mikhailovich Prokhorov, and for 20 years I A Shcherbakov was head of GPI RAS. During those years that were particularly difficult for science in Russia, largely through the efforts of A I Shcherbakov, GPI RAS remained a leading scientific institution. Since 2018, Ivan Aleksandrovich has been research supervisor of the institute.

I A Shcherbakov is a recognized specialist in laser physics, spectroscopy, nonlinear and quantum optics, and medical physics. His studies of the processes of electronic excitation energy transfer in solid solutions of rare-earth ions led to the discovery of patterns relating the microscopic mechanisms of transfer to energy relaxation in a collective of interacting particles. The quantitative spectroscopy of laser crystals and glasses was developed. The conception of optically dense active media was proposed and elaborated. In particular, an effective excited-state energy transfer from Cr^{3+} ions, which possess wide and intense lines of optical absorption and,



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therefore, effectively absorb lamp pumping radiation, to rare-earth ions was discovered in scandium garnet crystals. This phenomenon underlay the creation of new neodymium, erbium, thulium, and holmium lasers with record efficiency for lamp pumping, as well as tunable lasers on crystals activated by chromium ions. A creative group under the leadership of I A Shcherbakov pioneered the creation of laser crystals with unique spectroscopic and thermal properties. These crystals were used to create highly efficient compact diode-pumped neodymium and thulium lasers, which have become widespread.

I A Shcherbakov's studies on the interaction of pulsed laser radiation with biological tissues showed the possibilities of achieving important clinical results in various areas of laser surgery. Proposed and implemented was an effective method for destroying opaque dielectrics placed in a liquid using two-wave laser radiation. On its basis, a laser lithotripter was



Before lecture by 2017 Nobel laureate in physics Kip Stephen Thorne at General Physics Institute of the Russian Academy of Sciences (from left to right): S V Garnov, I A Shcherbakov, K S Thorne, S V Demishev (October 11, 2018, Moscow, GPI RAS, photo by E V Zakharova).

created and introduced into clinical practice to fragment stones located anywhere in the body without damaging soft tissues surrounding the stone.

Ivan Aleksandrovich participates in the study of the properties of aqueous solutions. He has obtained a number of fundamental results in this area, in particular, on the effect of external actions on the properties of liquids, and the role of hydrogen peroxide and active forms of oxygen on the vital activity of biological objects. In 2017, I A Shcherbakov organized a seminar at GPI RAS devoted to elucidating the physics of the processes of multiple dilution of aqueous solutions, and in 2018 he organized the annual conference, Physics of Aqueous Solutions, which brought together specialists in physics, chemistry, biology, medicine, and pharmaceuticals. This certainly contributes to understanding the nature of liquid and its influence on processes occurring in living and inanimate nature. Hundreds of scientists from dozens of countries take part in the conference.

Ivan Aleksandrovich guided the programs implemented by GPI RAS together with leading scientific centers in the USA, Germany, Austria, and Switzerland.

In different periods, I A Shcherbakov worked as invited professor at the University of Southern California (USA), University of Hamburg (Germany), University of Central Florida (USA), and Vienna University of Technology (Austria).

I A Shcherbakov takes an active part in introducing the results of GPI RAS studies and developed prototypes of new laser equipment into practice for Russian public health. Registered and included in the State Register are new laser devices for operations for correction of all types of refraction anomalies in ophthalmology; endoscopic and laparoscopic surgical procedures in urology; fluorescent diagnostics; and photodynamic therapy.

New laser medical technologies of treatment, with the use of samples of laser medical equipment designed at the institute, were developed and registered together with the leading medical institutions of the country.

I A Shcherbakov is the author of over 400 scientific papers, the monograph “Aleksandr Mikhailovich Prokhorov: reminiscences, papers, interviews, documents,” and others.

Since 1991, Ivan Aleksandrovich has been a corresponding member of the USSR Academy of Sciences. In 2011, he was elected academician of RAS (Division of Physical Sciences).

Ivan Aleksandrovich combines scientific work with pedagogical activity. He is a professor in and head of the Department of Laser Systems and Structured Materials at the Moscow Institute of Physics and Technology (MIPT). Twenty candidate and 8 doctoral theses have been defended under his tutorship. He is chair of one of the dissertation councils at GPI RAS.

Academician I A Shcherbakov is a major organizer of science. Since 2002, he has been a deputy academic secretary and from 2013–2022 was an Academician Secretary of the Division of Physical Sciences (DPS) RAS, a member of the RAS Presidium, a member of the Expert Council of RAS, a member of the Commission on the RAS Charter, and a member of the Expert Commission for the M V Lomonosov Great Gold Medal of RAS. At the present time, Ivan Aleksandrovich is an advisor to RAS and member of a number of councils, commissions, and expert groups of RAS and DPS RAS.

Ivan Aleksandrovich is a member of the editorial board of the fundamental reference edition of the *New Russian Encyclopedia*. He is editor-in-chief of the journal *Physics of Wave Phenomena* and a member of the editorial board of the journal *Kvantovaya Elektronika (Quantum Electronics)*. These are leading Russian journals reviewed in the database of the Web of Science Core Collection and Scopus. I A Shcherbakov is the chair of the International Conference, Advanced Laser Technologies (ALT) and the International A M Prokhorov Symposium on Biophotonics, as well as the above-mentioned All-Russia Conference, Physics of Aqueous Solutions.

For his scientific and organizational activity, I A Shcherbakov has received several awards. He is a laureate of the Prize of the USSR Council of Ministers and the Lenin Komsomol Prize. He was awarded the Order of Friendship and the medal 300 Years of the Russian Academy of Sciences. He was honored with the Gratitude of the President of the Russian Federation. In 2013, he was awarded the A M Prokhorov Gold Medal for the series of studies, “Processes of excitation energy transformation in active media of lasers.”

From the bottom of our hearts, we wish Ivan Aleksandrovich good health, inexhaustible creative energy, and new scientific and organizational activities.

*Yu Yu Balega, V G Bondur, S V Garnov,
L M Zelenyi, D I Kazakov, V V Kveder,
A A Levchenko, V A Matveev, G A Mesyats,
O V Rudenko, A M Sergeev, B M Shustov*