Orlovich Valentin Antonovich

// Mogilevskaya str. 4, build. 4, Minsk, 220006, Belarus

// born January 2, 1947; Krasnoye vill., Molodechno distr., Minsk region

// office: B.I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus (NAS of Belarus)
Nezavisimosti Ave., 68-2, Minsk, 220072, Belarus
+375-17-270-86-65; +375-29-684-09-59

e-mail: v.orlovich@dragon.bas-net.by

Position held:

January 10th, 2022 – present time: Head of the Center "Nonlinear Optics and Activated Materials" at the B.I. Stepanov Institute of Physics of the NAS of Belarus;
2021 – 2025: Scientific Chief of the State Scientific Research Program "Photonics and Electronics for Innovation"

- July 1969 – November 1994: trainee researcher, junior researcher, researcher, leading researcher, head researcher at the B.I. Stepanov Institute of Physics of the NAS of Belarus;
- November 1994 – October 2003: Head of the Laboratory, Deputy Director for Research at the B.I. Stepanov Institute of Physics of the NAS of Belarus;
- October 2003 – November 2014: Chairman of the Scientific Council - Director of the Executive Directorate of the Belarusian Republican Foundation for Fundamental Research (BRFFR);
- November 2014 – January 2022: Academician-Secretary of the Department of Physics, Mathematics and Informatics of the National Academy of Sciences of Belarus, Member of the Presidium of the National Academy of Sciences of Belarus;

Education:

1969: Belarusian State University, Physics Department, Minsk

1976: PhD in Physics and Mathematics, B.I. Stepanov Institute of Physics of the NAS of Belarus; Minsk

1990: Doctor of Physical and Mathematical Sciences, B.I. Stepanov Institute of Physics of the NAS of Belarus; Minsk

1993: Professor, B.I. Stepanov Institute of Physics of the NAS of Belarus; Minsk

Scientific activity:

- The main area of interest: laser physics, nonlinear optics and spectroscopy, laser and optical instrumentation

- Research area: stimulated Raman scattering (SRS), macroscopic manifestations of quantum noise in SRS, coherent anti-Stokes Raman scattering (CARS) and application of CARS in photochemistry, CW and pulsed diode-pumped Raman lasers, high-power pulsed lasers, lasers with generation wavelength tuning in the range of 0.2 - 8 μm, optical parametric oscillators (OPO) including eye-safe OPOs, laser and non-linear optical properties of new materials.
- More than 600 publications in scientific and peer-reviewed journals
- 8 books (chapters and book editing)
- Participation in organization of more than 20 international conferences, including the International Conference on Lasers, their Applications and Technologies (ICONO/LAT, Russia, Belarus), Advances in Optics, Photonics, Specroscopy (Vietnam), CLEO/Europe – EGEC (Munich, Germany), International Conference on Laser Optics (St. Petersburg, Russia), International Conference "Laser Applications in Life Sciences" et al.
- As Chairman of the Scientific Council - Director of the Executive Directorate of the Belarusian Republican Foundation for Fundamental Research (BRFFR), concluded agreements and organized long-term scientific cooperation of Belarusian scientists with the following foreign foundations and organizations:
  - Agreement on cooperation between BRFFR and the Science and Technology Foundation of Mongolia (September 18, 2004),
  - Agreement on cooperation between BRFFR and the State Fund for Basic Research of Ukraine (July 6, 2004),
  - Memorandum of cooperation between the BRFFR and the Joint Institute for Nuclear Research in Dubna (March 25, 2006),
  - Agreement on cooperation between the BRFFR and the National Center for Scientific Research of France (June 15, 2006),
  - Agreement on cooperation between the BRFFR and the University of Verona (Italy) (April 25, 2007),
  - Agreement on cooperation between the BRFFR and the Academy of Sciences of Moldova (May 3, 2007),
  - Agreement on cooperation between the National Academy of Sciences of Belarus, BRFFR and the National Academy of Sciences of Azerbaijan (August 20, 2007),
  - Agreement on cooperation between the BRFFR and the Vietnamese Academy of Sciences and Technology (October 12, 2007),
  - Agreement on cooperation between the National Academy of Sciences of Belarus, BRFFR and the Romanian Academy (April 23, 2009),
  - Agreement on cooperation between the BRFFR and the State Committee for Science of the Republic of Armenia (October 4, 2010),
  - Memorandum of understanding between BRFFR and the National Research Foundation of Korea (February 13, 2012),
  - Agreement on cooperation between the National Academy of Sciences of Belarus, BRFFR and the Foundation for the Development of Science under the President of the Republic of Azerbaijan (May 28, 2012),
  - Agreement on cooperation between the BRFFR and the Joint Stock Company "Science Fund of the Republic of Kazakhstan" (April 25, 2013),

- Agreement on cooperation between BRFFR and the Latvian Science Council (April 24, 2014).

Awards, membership, scientific societies:

- Corresponding Member of the National Academy of Sciences of Belarus (since 2000)
- Full member (Academician) of the National Academy of Sciences of Belarus (since 2003)
- State Prize of the Republic of Belarus (2000)
- Prize of the National Academy of Sciences of Belarus and the Siberian Branch of the Russian Academy of Sciences named after V.A. Kontyuta (2016)
- Medal named after F. Skorina (2015)
- Honored Scientist of the Republic of Belarus (2010)
- Cavalier of all awards of the National Academy of Sciences of Belarus (2022)
- Silver medal of the Siberian Branch of the Russian Academy of Sciences (2015)
- Gold Medal of the Academy of Sciences of Mongolia (2012)
- Member of the Laser Association of Russia (since 2002)
- Expert of the CIS countries in the field of laser physics (since 2000)
- Organizer and Chairman of the Belarusian Scientific and Technical Association “Optics and Lasers” (1998-2005)
- Head of the Belarusian branch of the International Optical Society named after D.S. Rozhdestvensky (1999-2005)
- Member of the physical societies of Belarus (since 1995)
- Scientific supervisor of the Belarusian state research programs and state scientific and technical programs (since 2002)
- Member of the Bureau of the Department of Physics, Mathematics and Informatics of the National Academy of Sciences of Belarus (2014-2022)
- Member of the Presidium of the National Academy of Sciences of Belarus (2014-2022)
- Member of the Committee on State Prizes of the Republic of Belarus (2004-2015)
- Member of the dissertation defense councils at the Institute of Physics of the National Academy of Sciences of Belarus and the Belarusian State University (since 1995)
- Member of the Academic Council of the Institute of Physics of the National Academy of Sciences of Belarus (since 1998)
- Independent Director of the Supervisory Board of the Open Joint Stock Company “Minsk Mechanical Plant – Managing Company of the BelOMO Holding” (since 2015)
- Member of the Bureau of the BRFFR Scientific Council - Head of the Section on Physics, Mathematics and Informatics (since 2014)
- Editor-in-chief of the journal “Proceedings of the National Academy of Sciences of Belarus, Physics and mathematics series” (since 2023), member of the editorial boards of the journals "Nonlinear Phenomena in Complex Systems", "Communications in Physics", "Innovative Technologies in Medicine", "Doklady of the National Academy of Sciences of Belarus", "Mechanics of Machines, Mechanisms and Materials", “Proceedings of the Academy of Sciences of Uzbekistan”, “Bulletin of the Foundation for Fundamental Research”

Professional management experience:

• Deputy Director of the B.I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus (1998-2003)

• Chairman of the Scientific Council - Director of the Executive Directorate of the Belarusian Republican Foundation for Fundamental Research (2003-2014)

• Academician-Secretary of the Department of Physics, Mathematics and Informatics of the National Academy of Sciences of Belarus (2014-2022)

• Head of the Laboratory of Nonlinear Optics and the Center for Nonlinear Optics and Activated Materials (since 1994)

• Member of the Presidium of the National Academy of Sciences of Belarus (2014-2022)

International work, committees:

• Long-term scientific cooperation of Belarusian scientists with scientists from France, Romania, Moldova, Armenia, Azerbaijan, Mongolia, and Vietnam within the framework of the BRFFR activities was organized

• Under my leadership, more than 10 international projects in cooperation with scientists from France, Italy, Germany, Russia, Japan, Ukraine and Vietnam were fulfilled. I have more than 100 joint scientific publications with scientists from these and other countries

• Member of program committees of international conferences held in Germany, Russia, India, Vietnam, China and other countries

Brief description of Academician V.A. Orlovich's scientific research

The main areas of V.A. Orlovich's research and his scientific team are laser physics, nonlinear optics and nonlinear spectroscopy, laser and optical development.

In the field of laser physics and laser development, highly efficient resonators for various types of lasers (solid-state and excimer) have been proposed that provide generation of high-power single-mode radiation. On their basis, industrial samples of Nd:YAG lasers with generators of fundamental - fourth harmonics were developed (1980-1990).

In the field of nonlinear optics, the regularities of forward and backward stimulated Raman scattering (SRS) in liquids, gases, and crystals have been studied. The effects of spectral contrast increasing under SRS, optical breakdown suppression by backward SRS, coherent SRS summation of several laser beams were discovered. SRS conversion in capillary fibers of small diameter (≈100 μm) was studied. Using this approach, continuously tunable radiation in the region of 0.3 - 8 μm was obtained at Raman generation threshold of 10 kW. On this basis, for the first time, an industrial version of a laser system was developed, including an Nd:YAG, a dye laser, and a compressed hydrogen SRS converter, which provided continuously tunable radiation in the above-mentioned spectral range (1970-1990).

Studies of macroscopic manifestation of quantum noises in energy, intensity, and spectra of Stokes radiation as well as nano- and picosecond pump pulses have been carried out. The generation of radiation with super-Gaussian statistics at SRS conversion of spectral broadband laser radiation was studied and formation of soliton-like waves of three types (with oscillating phase, co-phase and anti-phase relatively to the pump field) during SRS was discovered. The possibility of deterministic generation of solitons or their trains of all three types was demonstrated. The effect of anomalous broadening of the spectrum of anti-Stokes radiation was discovered and interpreted (1985-2005).

In the field of nonlinear spectroscopy, methods of nondegenerate coherent anti-Stokes and Stokes Raman scattering (CARS, CSRS) and methods of Raman saturation spectroscopy have been developed and experimentally implemented. These methods make it possible to measure all components of the cubic susceptibility tensor, the Raman tensor invariants, and other characteristics of Raman-active vibrations of molecules in various electronic states, as well as to study photochemical processes occurring in complex organic compounds. Using these methods, a number of photochemical processes that occur during the interaction of metalloporphyrins with solvent molecules, DNA, and DNA-modeling compounds have been discovered and studied. A CARS spectrometer with polarized background suppression for studying solutions of organic substances and a CARS spectrometer for studying gas and gas-plasma systems were developed (1975-1990).

A series of studies of Raman frequency conversion of radiation from mini- and microchip lasers with end diode pumping have been fulfilled. For the first time, the effect of intracavity frequency self-conversion at SRS in a crystal under continuous-wave pumping has been observed. It was demonstrated that, in CW diode-pumped lasers it is possible to simultaneously obtain several Stokes lines, and, using the SRS compression regime, to generate high-power pulses with a duration of ≤ 50 ps. For the first time, synthetic diamond single crystals were successfully used for SRS conversion (1995-2010).

For the first time, in a crystalline scattering medium, SRS frequency conversion of femtosecond laser pulses was experimentally obtained under conditions when their duration is comparable to the period of Raman-active oscillations of the scattering medium, as well as continuous SRS generation when pumped by argon laser radiation. Studies of Raman frequency conversion of Bessel light beams were carried out; three possible modes have been established. These modes provide Stokes radiation in the form of an axial beam, a superposition of axial and Bessel beams, and in the form of a Bessel beam. Possibilities of radical decrease of the radiation divergence under Raman conversion of multimode laser radiation using Bessel beams have been found (2000 -2015).

Methods of cross-correlation spectroscopy have been developed. When using nanosecond pulses, a time resolution of up to 100 fs was achieved. Methods for two-beam Z-scanning have been developed. These methods provided obtaining extensive information on nonlinear optical properties of various media (1995-2010).

In the last decade, special attention in research has been paid to the development and creation of eye-safe pulsed radiation sources based on SRS in methane and crystals, as well as

parametric light generation in KTP and KTA crystals, including those with a high pulse repetition rate and high pulse energy. As well, a UV (280 nm) solid-state radiation source for lidars measuring ozone concentration in the troposphere has been developed; mode locking in Raman lasers has been obtained by various methods; crystals activated by europium ions have been studied, and pulsed and CW generation has been obtained in them. Methods for obtaining multifrequency picosecond SRS generation in crystals, polycrystalline powders and their mixtures have been developed and implemented. New methods have been developed and partially implemented for obtaining laser radiation, including obtaining tunable radiation in the near and mid-IR spectral ranges by using two-pulse two-frequency SRS in gases. The nonlinear optical properties of light and heavy water at an optical breakdown and its absence are studied. A special influence of the water-air interface on the SRS conversion of laser radiation in water has been established.

June 1, 2023