CURRICULUM VITAE

Aleksandr Bugay
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Date and place of birth

07 April 1983, Gvardeisk, Kaliningrad region, Russia

Education

1990-2000	basic school (graduated with honors, gold medal)
2000-2005	Kaliningrad State University, (graduated with honors, red diploma)
2005	*physicist-teacher* qualification
2005-2008	graduate school, Immanuel Kant Russian State University (Kaliningrad)
2008	*Candidate of Sciences in Physics and Mathematics (Ph.D)*, Kazan State University
2019	*Doctor of Sciences in Physics and Mathematics (Dr.hab)*, Moscow State University

Languages: English, Serbian, Russian (native)

Professional activity

2008-2015	*Researcher,* Laboratory of Radiation Biology, Joint Institute for Nuclear Research,
2015-2019	*Head of Sector,* Laboratory of Radiation Biology, Joint Institute for Nuclear Research
	Member of Science and Technology Council of the Laboratory of Radiation Biology

Educational activity

Assistant professor, Biophysics Department, State University «Dubna»
Diploma supervisor, lecture courses at State University «Dubna»
Lecturer at international schools for young scientists at JINR, MSU

Grants and awards

2006 - 2012	Stipendiate and grant holder of the Dynasty Foundation (theoretical physics)
2005 - 2019	Performer in several grants of the Russian Foundation for Basic Research (physics and radiation biology)
2017 - 2019	Main performer in the grant of the Russian Science Foundation (mathematics)
2018	JINR Prize for the series of works “Study of the nonlinear dynamics of the waves of the terahertz frequency range in condensed matter and living systems”

Scientific biography

First period of scientific research of A.N. Bugay lasted during his education in Kaliningrad State University and Ph.D preparation. At that time he carried out studies on solitons and nonlinear waves in different physical systems. A series of theoretical works was published on extremely short laser pulses and their acoustic analogs interacting with nonlinear media. Such objects find their application in devices of very different profiles: from ultra-fast systems for calculating and transmitting information to devices in which laser pulses are used as a probes of influencing an object under study.

During the first years of his research at Laboratory of Radiation Biology JINR the problem of modeling of DNA repair processes and radiation-induced mutagenesis in prokaryotic cells was solved. Mathematical approaches were developed to reproduce the chain of the elementary events from the primary energy deposition to the formation of a mutation, taking into account stochastic processes in individual cells. In parallel, research continued, developing the theme of the PhD thesis in application to the poor-studied terahertz frequency range, which currently finds many promising applications in security systems, wireless communications, spectroscopy and medical diagnostics. For the first time in the Laboratory of Radiation Biology theoretical studies were conducted on the effects of terahertz radiation on living systems. A number of new models of various molecular systems, from DNA to cytoskeleton elements, were developed, the mechanisms of their interaction with this type of radiation were first described. In addition, in his works A.N. Bugay proposed new schemes for the high-performance generation and transformation of terahertz pulses in anisotropic nonlinear media. Subsequently, these results formed the basis of doctoral dissertation (Dr.Sci.). Further development of this problem opens prospects for a theoretical assessment of the safe for human health level of electromagnetic fields of terahertz frequencies in technical and medical equipment.

In 2015 A.N. Bugay was appointed Head of the Mathematical Modeling Sector. Under his scientific leadership, the implementation of a program of research related to the modeling of radiation effects on the structures of the central nervous system began. Together with the Mongolian colleagues, research was carried out on the modeling of the specific energy deposition and the formation of molecular damage after the passage of charged particles through various cells and parts of the brain using Monte-Carlo methods within GEANT4 package. Using the methods of molecular dynamics, an original approach was developed to predict the structure and function disorders of the synaptic receptor proteins. Using the data obtained, the activity of the neural networks of the brain was modeled and it was analyzed how the radiation effect can affect their functioning. The continuation of this research cycle is very promising for analyzing the mechanisms of development of various neurodegenerative diseases, risk assessment of the development of pathologies in the central nervous system during radiotherapy of malignant tumors, as well as ensuring the radiation safety of astronauts during manned flights into deep space.

Research interests

- Monte Carlo track structure modeling and radiation transport
- modeling of DNA repair and radiation-induced mutagenesis
- modeling of radiation-induced disturbances in nerve cells and neural networks

- nonlinear dynamics of biomolecules
- effect of terahertz radiation on cellular structures
- generation of terahertz radiation
- extremely short laser pulses
- nonlinear waves and solitons

Visits and collaborations

A lot of visits were made and scientific contacts were established with Russian and foreign institutions in Physics and Radiation Biology, including Moscow State University, Kurchatov Institute (Moscow), Institute for Medical and Biological Problems RAS (Moscow), Institute of Cell Biophysics (Pushino), Kazan Scientific Center of RAS (Kazan), Institute of Spectroscopy RAS (Troitsk), Institute for Laser Physics SB RAS (Novosibirsk), Belarussian State University (Minsk, Belarus), Joint Institute for Power and Nuclear Research – "Sosny" (Minsk, Belarus), Bogolubov Institute for Theoretical Physics (Kiev, Ukraine), "Vinca" Institute (Belgrade, Serbia), National University of Mongolia (Ulaanbaatar, Mongolia), GSI/FAIR (Darmstadt, Germany).

Long-period collaboration with Vinca Institute of Nuclear Sciences (Belgrade, Serbia) and National University of Mongolia (Ulaanbaatar, Mongolia) has been established.

Scientific publications

In these areas, 70 papers have been published in leading Russian and international peer-reviewed journals, 50 articles in proceedings and periodicals. Participated in about of 80 scientific conferences, mainly by oral and lecture talks.

Plenary and lecture talks (recent 3 years)

Geant4/Geant4-DNA International Tutorial and Workshop, 3-5 July 2019, Ulaanbaatar, Mongolia

XVII Russian scientific school-seminar «Physics and applications of microwaves», 26-31 May 2019, Moscow, MSU

Satellite school at EXON-2018, 8-9 September 2018, Petrozavodsk

XVI Russian scientific school-seminar «Wave phenomena in inhomogeneous media» 21 May - 1 June 2018, Moscow, MSU

XXV Annual Seminar "Nonlinear phenomena in complex systems", 21–25 May 2018, Joint Institute for Power and Nuclear Research – Sosny, Minsk, Belarus

International School on Nuclear Methods for Environmental and Life Sciences, 22-28 April 2018, Budva, Montenegro

XXV International conference «Mathematics. Computer. Education», 25 January – 3 February 2018, State University «Dubna», Dubna

IV International Seminar «Nonlinear Phenomenology Advances», 3-6 October 2017, Peter the Great St.Petersburg Polytechnic University, St.Petersburg

Summer student science and technology school «Staff of the future», 2-8 July 2017, JINR, Dubna

Main publications (2014-2019):

1) A.S. Batova, A.N. Bugay, E.B. Dushanov. Effect of mutant NMDA receptors on the oscillations in a model of hippocampus// Journal of Bioinformatics and Computational Biology 2019 V. 17, No. 1 P.1940003

2) M. Batmunkh, S. V. Aksenova, L. Bayarchimeg, A. N. Bugay, O. Lkhagva, Optimized neuron models for estimation of charged particle energy deposition in hippocampus // Physica Medica 2019. V.57 P.88-94.

3) L.Bayarchimeg, A.Bugay, M.Batmunkh, O. Lkhagva Evaluation of Radiation-Induced Damage in Membrane Ion Channels and Synaptic Receptors // Physics of Particles and Nuclei Letters 2019 V.16, P.54-62.

4) M. Batmunkh, A.N. Bugay, L. Bayarchimeg., S.V. Aksenova, O. Lkhagva. Computer Modeling of Radiation – Induced Damage to Hippocampal Cells // Mong. J. Phys. 2019. V. 5. P. 76-82.

5) E. Kolesnikova, A. Bugay, Modeling the influence of heavy ion beams on neurogenesis and functioning of hippocampal neural networks // EPJ Web Conf. 2019. V.204. P.04007.

6) M. Batmunkh, L. Bayarchimeg, A.N. Bugay, O. Lkhagva. Monte Carlo track structure simulation in studies of biological effects induced by accelerated charged particles in the central nervous system // EPJ Web Conf. 2019. V. 204. P. 04008.

7) A.N. Bugay. Terahertz Solitons in Condensed Media // Physics of Particles and Nuclei, 2019, V.50. No.2. P. 210–229.

8) A.N. Bugay, V.A. Khalyapin Analytic description of pulse frequency self-shift in nonlinear photonic crystal fibers // Communications in Nonlinear Science and Numerical Simulation 2019 V.75, P. 270-279.

9) A.N. Bugay, V.A. Khalyapin. Analytic description of laser pulse propagation in gas-filled hollow-core photonic crystal fibre // Laser Physics. 2019. V.29, no.3. P.035402.

10) S. Zdravković, D. Chevizovich, A. N. Bugay, A. Maluckov. Stationary solitary and kink solutions in the helicoidal Peyrard-Bishop model of DNA molecule // Chaos 2019. V.29, P.053118.

11) A. V. Boreyko, A. N. Bugay, T. S. Bulanova, E. B. Dushanov, L. Jezkova, E. A. Kulikova, E. V. Smirnova, M. G. Zadneprianetc, and E. A. Krasavin, Clustered DNA double-strand breaks and neuroradiobiological effects of accelerated charged particles // Physics of Particles and Nuclei Letters 2018 V.15, P.551.

12) A.N. Bugay, S.V. Sazonov. A Waveguide Mode of Generating Terahertz Radiation // Bulletin of the Russian Academy of Sciences: Physics, 2018, Vol. 82, No. 11, P. 1468–1472.

13) A. N. Bugay, S. V. Sazonov, P. Yu. Shestakov, Generation of terahertz pulses in a nonlinear dielectric waveguide // Proc. SPIE 2018. V.10684. P.106841M

14) M.Batmunkh, A.N. Bugay, L.Bayarchimeg, O.Lkhagva, Radiation damage to nervous system: Designing of optimal models for realistic neuron morphology in hippocampus // EPJ Web Conf., 2018. V. 173(2). P. 05004.

15) A.N. Bugay, V.A. Khalyapin. Evolution of super-Gaussian pulses in a nonlinear optical fiber // Laser Physics 2018 V.28 P.045403.

16) S. Zdravković, A.N. Bugay, A.Yu. Parkhomenko, Application of Morse potential in nonlinear dynamics of microtubules // Nonlinear Dynamics 2017. V.90. P.2841-2849.

17) A.N. Bugay, M.A.Vasilyeva, A.Yu. Parkhomenko, E.A. Krasavin. "Mathematical Analysis of Regulatory Networks and Damage Repair Efficiency in Bacterial Cells", in *Genetics, Evolution and Radiation: Crossing Borders, the Interdisciplinary Legacy of Nikolay W. Timofeeff-Ressovsky* (Book Chapter), 2017. doi:10.1007/978-3-319-48838-7_15.

18) A.N. Bugay, V.A. Khalyapin. Analytic description of Raman-induced frequency shift in the case of non-soliton ultrashort pulses // Physics Letters A 2017. V. 381. P. 399-401.

19) A.N. Bugay, V.A. Khalyapin. On the analytical description of self-frequency shift of a pulse propagating in the region of zero group-velocity dispersion // Optics and Spectroscopy 2017. V. 123, No. 2, P. 183-188.

20) S.V. Sazonov, A.N. Bugay, A.A. Kalinovich, M.V. Komissarova, I.G. Zakharova, Three-dimensional light bullets in anisotropic micro-dispersive media // Proc. SPIE 2017. V.10232. P.102320H.

21) S. Zdravkovic, S. Zekovic, A.N. Bugay, M.V. Sataric. Localized modulated waves and longitudinal model of microtubules // Applied Mathematics and Computation. 2016. Vol. 285. P. 248–259.

22) D.L. Sekulic, B.M. Sataric, S. Zdravkovic, A.N. Bugay, M.V. Sataric Nonlinear dynamics of C-terminal tails in cellular microtubules // Chaos. 2016. V.26. P.073119.

23) A.N. Bugay, S.V. Sazonov Generating Terahertz Radiation via Optical Rectification in Nonlinear Crystals: Theory and Experimental Results // Bulletin of the Russian Academy of Sciences: Physics, 2016, Vol. 80, No. 7, P. 774–778.

24) S. Zdravkovic, A.N. Bugay. Why are Biological Systems Nonlinear? // Nonlinear Phenomena in Complex Systems. 2016. V.19. No.1. P.71 – 79.

25) A.N.Bugay, E.A.Krasavin, A.Yu.Parkhomenko, M.A.Vasilyeva. Modeling nucleotide excision repair and its impact on UV-induced mutagenesis during SOS-response in bacterial cells // Journal of Theoretical Biology 2015. V.364. No.1. P.7-20.

26) A.N.Bugay, M.A.Vasilyeva, E.A.Krasavin, A.Yu.Parkhomenko. Modeling the Induced Mutation Process in Bacterial Cells with Defects in Excision Repair System // Physics of Particles and Nuclei Letters, 2015, V.12. No.7. P. 850–862.

27) A.N. Bugay. Terahertz solitons in biomolecular systems and their excitation by external electromagnetic field // EPJ Web Conf. 2015. V.103, P.02002.

28) A.N. Bugay. Nonlinear Waves as Signals in Microtubules // Nonlinear Phenomena in Complex Systems 2015. V.18. No. 2. P. 236-242.

29) A.N. Bugay, G.F. Aru. New types of solitonic excitations in a nonlinear helicoidal model of DNA and their biological significance // Nonlinear Phenomena in Complex Systems. 2014. V.17. No.1. P.1-9.

30) S. Zdravkovic, A.N.Bugay, G.F. Aru, A. Maluckov. Localized modulated waves in micro-tubules // Chaos. 2014. V.24. No.2. P.023139.