CURRICULUM VITAE

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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	student, Kaliningrad State University, (graduated with honors, red diploma)
2005	physicist-teacher qualification
2005-2008	postgraduate student, Immanuel Kant Russian State University (Kaliningrad)
2008	*Candidate of Science in Physics and Mathematics (Ph.D)*, Kazan State University
2019	*Doctor of Science in Physics and Mathematics (Dr.habil.)*, Moscow State University

Professional career

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
2019- present	Director of the Laboratory of Radiation Biology, Joint Institute for Nuclear Research

Professional activities

- Board Member of Council on Radiation Biology, Russian Academy of Sciences
- Board Member of Russian Radiobiological Society, Russian Academy of Sciences
- Member of International Biophysics Collaboration
- Member of JINR Science and Technology Council
- Co-leader of JINR research theme «Research on the biological effects of ionizing radiations with different physical characteristics»
- Leader of projects on cooperation programs with Belarus, Bulgaria, Egypt, Vietnam, Serbia, South Africa
- Member of several JINR working groups on radiation medicine including new project of Proton therapy center
- Organization of Annual Conferences, Program and Organizing Committee (2019-2024):

  - Current Problems of Radiation Biology, Dubna, JINR
  - Wave Phenomena: Physics and Applications, Moscow, MSU

- Innovative Nuclear Physical Methods of High-Tech Medicine, Moscow, LPI
- Nuclear Methods and Applied Research in Environmental, Material and Life Sciences (NUMAR), Varadero, Cuba

Educational activities

- Professor, Biophysics Department, Dubna State University: lecture courses, diploma supervision
- Member of JINR Dissertation Council for Information Technologies and Computational Physics
- Supervisor of 2 PhD theses
- Lecturer at international schools for young scientists organized by JINR (Russia, Serbia, Mongolia, Cuba), Moscow State University, Medical Radiology Research Center (Obninsk), Lebedev Physical Institute of RAS

Grants and awards

2006-2012	Stipendiate and grant holder of the Dynasty Foundation (physics)
2005-2021	Russian Foundation for Basic Research, 5 grants (physics, radiation biology) principal investigator
2017-2021	Russian Science Foundation, 1 grant (mathematics), principal investigator
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"
2021	Commendation from the Ministry of Science and Higher Education of the Russian Federation
2024	Certificate of Honor from the Ministry of Science and Higher Education of the Russian Federation

Research interests

Mathematical modeling in radiation biology

Monte Carlo simulations of DNA damage induction, molecular dynamics, DNA repair, radiation mutagenesis, biological neural networks

• New hierarchical models of DNA repair processes and radiation-induced mutagenesis in prokaryotic and eukaryotic cells of different repair phenotypes have been proposed for radiations with different physical characteristics.

• New highly efficient modeling methods have been developed using Geant4-DNA Monte Carlo simulation code to calculate radiation doses, the formation of DNA damage and their repair in neural networks of the brain after irradiation by accelerated heavy charged particles in applications to assessment of cosmic radiation risks and particle therapy of tumors.

• A new approach has been developed to quantify the impact of gene mutations on the structures of synaptic NMDA receptors and the functioning of neural networks in the brain. A quantitative relationship between mutations in the GRIN1 and GRIN2 genes and neurodegenerative diseases has been established, and EEG diagnostic methods for them have been predicted.

• Novel theoretical approach to explain the mechanisms of action of terahertz radiation on living systems at the molecular level have been developed. New types of soliton-like conformation transitions in DNA and cytoskeleton elements have been predicted.

Modeling of interaction of radiations with matter

Extreme electromagnetic fields, Monte Carlo particle track simulations, terahertz radiation, nonlinear phenomena

• Novel mechanism of highly efficient generation of broadband terahertz radiation using resonant coherent interaction of laser pulses with anisotropic nonlinear composite materials have been proposed.

• New types of spatially localized soliton-like structures including few cycle and unipolar pulses have been predicted in various regimes of high intensity electromagnetic radiation interaction with matter.

• Analytic description of photoionization phenomena under interaction of high intensity femtosecond laser pulses with gases, liquids and solids have been extended. Explicit expressions for the parameters of light bullets and plasma filaments have been derived. A new model of cell and tissue damage by laser photoionization have been developed.

• Development of Geant4-DNA simulation code: optimized geometry of neural cells, oxygen effect

Innovations

A fundamentally new method for increasing the biological effectiveness of proton beams on melanoma has been developed and patented. Introduction of DNA synthesis inhibitor AraC enhances the antitumor effect of proton radiation through the implementation of several mechanisms, including increased induction of DNA double strand breaks, decrease in the number of tumor stem cells, inhibition of cell proliferation and angiogenesis in the tumor against the background of changes in the immune response in the primary lesion and its infiltration by lymphocytes.

Patents:

- A method for increasing the effectiveness of proton therapy on melanoma stem cells / Matchuk O.N., Boreyko A.V., **Bugay A.N.**, Chausov V.N., Kaprin A.D., Koryakin S.N., Krasavin E.A., Mosina V.A., Selivanova E.I., Solovyov A.N., Yakimova A.O., Zamulaeva I.A. // Patent RU 2798733, Russia's Federal Service for Intellectual Property (Rospatent). 23 June 2023, Bulletin No. 18.
- Method for increasing the effectiveness of ionizing radiation on melanoma / Zamulaeva I.A., Boreyko A.V., **Bugay A.N.**, Kaprin A.D., Koryakin S.N., Krasavin E.A., Matchuk O.N., Mosina V.A., Selivanova E.I., Chausov V.N. // Patent RU 2774032, Russia's Federal Service for Intellectual Property (Rospatent).14 June 2022. Bulletin No. 17.

Bibliography

Author and co-author of more than 180 scientific publications.

Main publications (2019-2024):

Book Chapters

1. **Bugay A.** Soliton Excitations in a Twist-Opening Nonlinear DNA Model / Nonlinear Dynamics of Nanobiophysics (Editors S. Zdravković, D. Chevizovich). Singapore: Springer Nature Singapore Pte Ltd., 2022. Chapter 7. P. 141–172.

Journal papers

2. Glebov A.A., Kolesnikova E.A., **Bugay A.N.** Analysis of the influence of dose-dependent effects of irradiation with heavy particles ^{12}C, ^{28}Si, and ^{56}Fe on neurogenesis in adult C57BL/6J mice // Phys. Part. Nucl. Lett. 2024. V.22.

3.**Bugay A.N.** Biological action of intense laser pulses at the molecular level // Bull. Russ. Acad. Sci.: Phys., 2024, V. 88, No. 6. P.842–846.

4. Khalyapin V.A., **Bugay A.N.** Effect of Stimulated Raman Self-Scattering on the Dynamics of Pulses in a Gradient Waveguide // Bull. Russ. Acad. Sci.: Phys., 2024, V. 88, No. 1, P. 33–37.

5. Zamulaeva I.A., Matchuk O.N., Selivanova E.I., Yakimova A.O., Mosina V.A., Koryakin S.N., Kaprin A.D., Boreyko A.V., **Bugay A.N.**, Chausov V.N., Krasavin E.A. Radiobiological effects the combined action of 1-β-D-arabinofuranosylcytosine and proton radiation on B16 melanoma *in vivo* // Phys. Part. Nucl. Lett. 2023. V.20, №1, P.63–75.

6. Aksenova S.V., Batova A.S., **Bugay A.N.**, Dushanov E.B. Effect of oxidative stress on the functioning of glutamate receptors in the hippocampus // Russian Journal of Biological Physics and Chemistry 2023. V.8. No.2. P.151-158.

7. **Bugay A.N.**, Khalyapin V.A. Analysis of the stability region of light bullets propagating in the tunnel ionization mode in dielectric // Laser Physics. 2023. V. 33. No. 12. P. 126001.

8. Glebov A.A., Kolesnikova E.A., **Bugay A.N.** Mathematical Model of a Radiation-Induced Neurogenesis Impairment // Phys. Part. Nucl. Lett. 2022. V.19. P.422.

9. Khalyapin V.A., **Bugay A.N.** Analytical study of light bullets stabilization in the ionized medium // Chaos, Solitons and Fractals 2022. V.156. P.111799.

10. **Bugay A.N.**, Khalyapin V.A. Analytical calculation of the parameters of light bullets propagating in the tunnel ionization regime // Laser Physics. 2022. V.32. No.3. P. 025401.

11. Vasileva M.A., **Bugay A.N.**, Dushanov E.B. Modeling of DNA damage repair induced by heavy ions in mammalian cells // Russian Journal of Biological Physics and Chemistry. 2022. V.7, № 4. P. 557- 564.

12. Aksenova S.V., Batova A.S., **Bugay A.N.**, Dushanov E.B. Effects of modulators to the activation of NMDA receptors // Russian Journal of Biological Physics and Chemistry. 2022. V.7, №3. P.418-422.

13. Khalyapin V.A., **Bugay A.N.** Analytical Description of the Dynamics of Planar Pulses Propagating in the Mode of Tunnel Ionization // Bull. Russ. Acad. Sci.: Phys.. 2022. V. 86. No.11. P. 1355-1360.

14. Khalyapin V.A., **Bugay A.N.** Analytical Approaches to Describing the Dynamics of a Beam Propagating in the Mode of Multiphoton Ionization // Bull. Russ. Acad. Sci.: Phys., 2022, V. 86, No. 1, P. 13–17.

15. Aksenova S.V., Batova A.S., **Bugay A.N.**, Dushanov E.B. Modeling of the hippocampus neural network with different types of NMDA receptors // Russian Journal of Biological Physics and Chemistry 2021. V.6. No.2. P.265-268.

16. Glebov A.A., Kolesnikova E.A., **Bugay A.N.** Modeling impairment of neurogenesis due to acute X-ray exposure of mice // Russian Journal of Biological Physics and Chemistry 2021. V. 6. No. 2. P. 280-284.

17. Batmunkh M., Bayarchimeg L., **Bugay A.N.**, Lkhagva O. Computer simulation of radiation damage mechanisms in the structure of brain cells // AIP Conf. Proc. 2021. V. 2377. P. 050001.

18. Zdravković S., Zeković S., **Bugay A.N.**, Petrovic J., Two component model of microtubules and continuum approximation// Chaos, Solitons and Fractals 2021. V.152. P.111352.

19. Khalyapin V.A., **Bugay A.N.** Stability of Planar Pulses Propagating in the Tunnel Ionization Mode // Bull. Russ. Acad. Sci.: Phys. 2021. V. 85. No.12 P. 1424-1428.

20. Khalyapin V.A., **Bugay A.N.** Investigating the Dynamics of the Propagation of Intense Pulses in a Photonic Crystal Fiber // Bull. Russ. Acad. Sci.: Phys. 2021. V. 85. No.1 P. 15-19.

21. Patera V., Prezado Y., Azaiez F., Battistoni G., Bettoni D., **Bugay A.**, Cuttone G., Dauvergne D., de France G., Graeff C., Haberer T., Inaniwa T., Incerti S., Nasonova E., Navin A., Pullia M., Rossi S., Vandevoorde C. and Durante M. Biomedical research programs at present and future high-energy particle accelerators // Frontiers in Physics 2020. V.8. P.380.

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

23. Bayarchimeg L., **Bugay A.N.**, Batmunkh M., Lkhagva O. Evaluation of Radiation-Induced Damage in Membrane Ion Channels and Synaptic Receptors // Phys. Part. Nucl. Lett. 2019 V.16, P.54-62.

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

25. Batova A.S., **Bugay A.N.**, Dushanov E.B. 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

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

27. **Bugay A.N.**, Khalyapin V.A. 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.

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

29. **Bugay A.**, Dushanov E., Popova E. Computer Simulation of Radiation-Induced Dysfunction of the Neural Networks of the Prefrontal Cortex // Astronomical Journal of Azerbaijan, 2019, V.14, No. 1. P. 17-29.

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

31. Batmunkh M., Bayarchimeg. L, **Bugay A.N.**, Lkhagva O. 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.

32. Aksenova S.V., Batova A.S., **Bugay A.N.**, Dushanov E.B. Effect of mutant forms of synaptic NMDA receptors on oscillations in neural networks // Russian Journal of Biological Physics and Chemistry 2019. V.4. No.2. P.209-213.

33. Batmunkh M., Bayarchimeg. L, **Bugay A.N.**, Lkhagva O. Computer simulation of the dna damage formation in neural cells under exposure to heavy charged particles // Russian Journal of Biological Physics and Chemistry 2019. V.4. No.2. P.214-219.

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