EDITORIAL

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9th INTERNATIONAL CONFERENCE "NANOBIOPHYSICS: FUNDAMENTAL AND APPLIED ASPECTS"

9th International conference "NANOBIOPHYSICS: Fundamental and Applied Aspects" NBP-2025 took place on October 6-9, 2025, in Kharkiv, Ukraine, in online format, being organized by B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine (ILTPE NASU) and the Institute of Physics of the National Academy of Sciences of Ukraine (IP NASU). The "NanoBioPhysics" conference series was jointly launched in 2009 by the ILTPE NASU and the IP NASU. Previous conferences were held biennially in Kharkiv and Kyiv, alternating between the two cities.

Although the security conditions in 2025 did not permit face-to-face meetings, the conference brought together more than 100 participants from 13 countries (Photo 1): Ukraine, the Czech Republic, Estonia, Italy, France, Germany, Lithuania, Poland, the Slovak Republic, Spain, Sweden, the UK, and the USA.

A total of 93 keynote, oral, and poster presentations were made. The Book of Abstracts of the NBP-2025 contributions was published [1].

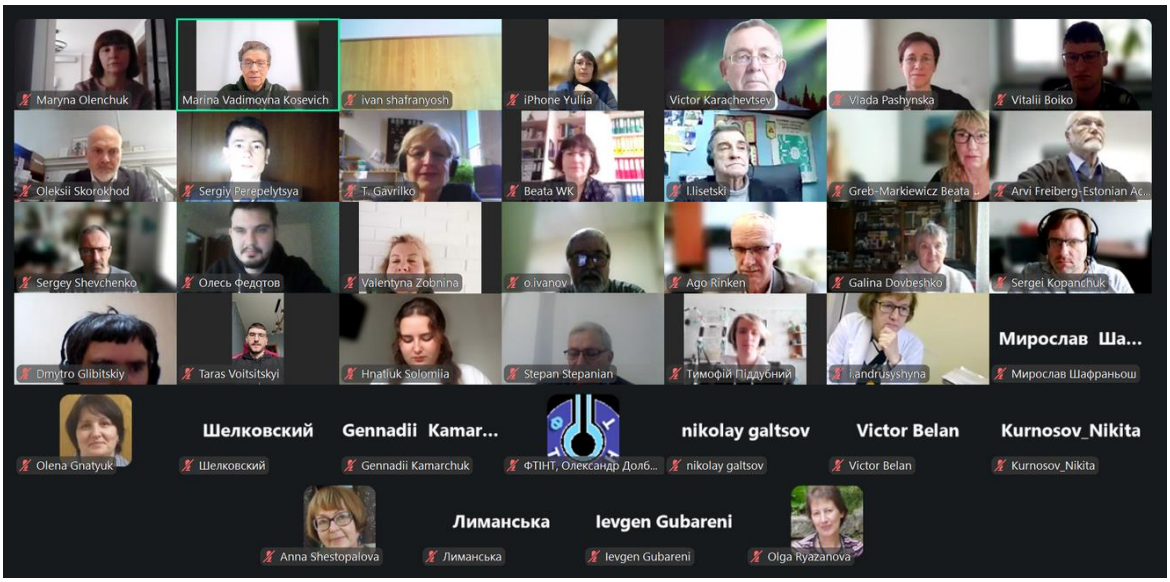

Photo 1. Screenshot of the online Zoom session held on 06.10.2025, Participants of the 9th International Conference "NANOBIOPHYSICS: Fundamental and Applied Aspects", Kharkiv, Ukraine.

To discuss the urgent problems and new results achieved in the scientific field combining biophysics and nanotechnology, the following sessions were organized:

- Nanobiohybrids formed by 1-D or 2-D nanomaterials with bioobjects;
- Biomolecules on nanoparticles and nanostructured surfaces;
- Physical aspects of biomolecular nanosystems;

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- Theoretical calculations and computer modeling of nanobiosystems;
- Applied aspects of nanobiophysics.

Given the online format, in addition to plenary lectures and oral talks, a special poster session was organized, allowing participants to present their posters online, accompanied by short five-minute explanations. Special attention was paid to the discussion of the works of young scientists and postgraduate students.

Urgent subjects of basic nanobiophysical research, which touched upon a variety of practically essential issues, were covered in several plenary lectures. Professor **Freiberg A. (***Tartu, Republic of Estonia***)** lectured on strategies for capturing complete solar energy in photosynthesis—a path toward bioinspired energy technologies capable of harnessing the full breadth of solar radiation. Professor **Wielgus-Kutrowska B.** (*Warsaw, Republic of Poland*) talked about the biophysics of green fluorescent protein employed in designing optimized fluorescent tools for use in biotechnology and bioimaging. Professor **Shestopalova A. V.** (*Kharkiv, Ukraine*) presented general facts and research findings on the evolution of SARS-CoV-2 from 2021 to 2025, which form the basis for the development of potential antiviral drugs against SARS.

Chairman of the NBP-2025 conference, corresponding member of the NAS of Ukraine, Professor **Karachevtsev V. A.** (*Kharkiv, Ukraine*) had summarized the results of the development of the new scientific field of nanobiophysics in the Department of molecular biophysics of the ILTPE NASU, which he had headed for 25 years, in his overview "Nanbiophysics at the B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine: a historical review". The key stages in the emergence and advancement of the new field of nanobiophysics are outlined, along with scientific achievements in this area, reflected in more than 100 publications in international journals and two monographs. The scientific team of the Department had presented recent results of the studies of interactions of biomolecules, biologically active compounds and drugs with a wide range of nanomaterials — carbon-based nanotubes, fullerenes, graphene; metal oxides; noble metal clusters; transition metal dichalcogenides, MoS_2 in particular — aimed at nanotechnological developments. Dr. **Stepanian S. G.** (who has headed the Department of molecular biophysics since 2025) presented the results of computer modeling and DFT quantum-chemical studies of the structures, stabilities, and spectral parameters of ternary complexes of MoS_2 with the uracil nitrogen base and noble-metal clusters. Dr. **Kosevich M. V.** presented a novel idea on the possibilities of participation of MoS_2 mineral in prebiological chemical evolution, which was based on the results of mass spectrometric detection of products from the chemical transformations of biomolecules at the MoS_2 surface. Dr. **Pashynska V. A.** described the prospects for drug-delivery applications of 2D MoS_2 nanohybrids with anticancer drugs, which were characterized both experimentally and theoretically. Dr. **Kurnosov N. V.** described MoS_2 quantum dots exfoliated by applying nucleotides. In a series of poster presentations, the results of the detailed study of nanohybrides of 2D nanomaterials based on MoS_2 with various biomolecules and biologically active compounds were presented: with native DNA by Dr. **Usenko E. L.** and Dr. **Glamazda A. Yu.**, with C_{60} fullerene by Dr. **Shelkovsky V. S.**, with polyethylene glycol organic polymer by Dr. **Zobnina V. G.**, with amino acids and thiols by **Boryak O. A.**, with tegafur drug by **Piddubnyi T.**; interactions of DNA with porphyrin by Dr. **Ryazanova O. A.** Among useful practical applications, a new area is the production of nanomaterials by nanospinning, which was described in the talk of Professor **Karachevtsev V. A.** "PMMA:PVP blended nanofibers loaded with antibiotic levofloxacin for antibacterial application" and the poster of Dr. **Plokhotnichenko A. M**. "Fabrication and characterization

of electrospun PMMA nanofibers loaded with levofloxacin or chloramphenicol”. Low-temperature studies were presented in the poster of Dr. **Ivanov A. Yu.** (*Kharkiv, Ukraine; Wroclaw, Poland*) “The distinctive features of the infrared vibrational spectra of 2'-deoxyadenosine and adenosine molecules isolated in Ar matrices”.

The achievements of the IP NASU Department of physics of biological systems, headed by Professor **Dovbeshko G. I.** (*Kyiv, Ukraine*), were presented in the lectures of the scientists of the Department and partners of their extended scientific cooperation. Dr. **Gnatyuk O. P.** touched on the vital topic of the mechanical properties of the membrane of circulating metastatic tumor cells as a diagnostic marker. **Monastyrskyi G.P** showed the results of high-resolution SEM microscopy for studying liposomes and model circulating tumour cells incubated with MoS_2 and WS_2 nanoparticles. Dr. **Gubareni Ie. V.** described the partial least squares analysis of ATR-FTIR spectra for intraoperative characterization and rapid biochemical profiling of brain tumors. Professor **Borisova T. O.** warned about the synergistic threat to the nervous system from combined exposure to copper and particulate matter from wood smoke. Dr. **Boiko V. V.** (*Kyiv, Ukraine; Besançon, France)* reported on interactions between bovine serum albumin and persistent luminescent nanoparticles, as well as the correlation between optical parameters and structural changes in the BSA protein on the charged nanoparticle surface.

The theoretical session began with an invited lecture by Professor **Perepelytsya S. M.** (*Kyiv, Ukraine*), devoted to theoretical studies of DNA and the elucidation of the role of counterions in DNA-nanomaterials. Dr. **Osokin Y. S.** (*Kyiv, Ukraine*) reported on the elucidation of the stability of Ag^+ ion complexes with nitrogenous bases of the DNA molecule. Several reports enlighten novel trends in theoretical investigations attracting opportunities provided by the artificial intelligence, machine learning, and neural networks: “Accurate machine learning approach to protein-ligand docking” by Dr. **Voitsitskyi T. V.** (*Kyiv, Ukraine; London, UK*); “FTIR spectroscopy based identification of spectral biomarkers associates with biological age using machine learning” by Dr. **Kot O.** (*Kyiv, Ukraine*); “A physically interpretable neural network model for determining the energy of biomolecules based on their structure” by Dr. **Terets A. D. (***Kyiv, Ukraine*).

The subjects of a number of presentations evidenced the breadth and diversity of phenomena that involve processes at the nanoscale level. Dr. **Krasnokutski S. A.** (*Heidelberg, Germany*) addressed an exciting topic, “From chaos to the first stored information and origin of life,” in which he described experiments on the low-temperature condensation of atomic gases in the interstellar medium on cosmic dust particles, resulting in peptide formation, which may contribute to prebiotic chemistry. Professor **Skorokhod O.** (*Turin, Italy*) discussed a possible mechanism of action of the antimalarial agent artemisinin by disrupting the formation of hemozoin nanocrystals. Professor **Berest V. P.** (*Kharkiv, Ukraine*) described mechanisms of microvesiculation in red blood cells and bacteria. Dr. **Tkachenko A. S.** (*Kharkiv, Ukraine*) reported the investigations on the role of Mn_3O_4 nanocrystal in the induction of eryptosis of red blood cells mediated by oxidative stress.

Some more talks enlightened studies aimed at elaboration of useful applications of various inorganic nanomaterials. Professor **Głuchowski P.** (*Wroclaw, Republic of Poland)* described the biological and mechanical properties of the composites containing graphene flakes obtained from mineral graphite. Dr. **Kujawa D.** (*Wroclaw, Republic of Poland)* talked about a rapid, green, and cost-effective synthesis of pH- and hydroxyl group sensitive carbon dots for sensing applications. Professor **Strzhemechny Y. M.** (*Fort Worth, USA*) lectured about surface and interface effects in the antibacterial activity of nano- and microscale oxides of zinc and gallium. Dr. **Brannon J. H.** (*Fort Worth, USA)* discussed tuning the antibacterial activity of ZnO microcrystals by modifying surface defects via Fe-doping. Dr. **Sharma P.**

(*Fort Worth, USA*) talked about the application of NIR-reduced graphene quantum dots for biosensing of neurotransmitters/hormones.

Nanotechnology-related studies conducted at the Institute for Scintillation Materials of the STC "Institute for Single Crystals" (*Kharkiv, Ukraine*) were demonstrated by Professor **Lisetski L. N.** in his presentation devoted to hybrid poly(n-isopropylacrylamide) hydrogels physically cross-linked by acid-activated laponite®, by Dr. **Vashchenko O. V.** in her presentation on the impact of substituents on thermal recyclization of 2-iminocoumarins, and by Dr. **Vashchenko P. V.** in his presentation on supramolecular arrangement and potential biomedical application of nematic liquid crystals doped with resorcinol.

A special event within the framework of NBP-2025 was the round table on the topic "History of Biophysics in Kharkiv", dedicated to the commemoration of outstanding scientists who formed the scientific school of molecular biophysics in the second half of the 20th century, which received recognition in Ukraine and abroad. Memories of them were shared by their students and followers, as well as employees of biophysical departments in scientific institutions, many of whom are graduates of the Department of Molecular and Medical Biophysics at V. N. Karazin Kharkiv National University. Professor **Berest V. P.**, head of the Department of Molecular and Medical Biophysics of V. N. Karazin Kharkiv National University, presented the history of the creation and development of the Department, and the contribution of the Department to the training of specialists for academic and medical institutions. Professor **Shestopalova G. V.**, head of the Department of biological physics of the O. Ya. Usikov Institute for Radiophysics and Electronics of the NAS of Ukraine, spoke about the creative path of Professor Maleev V. Ya. — the founder of the Department. Dr. **Kosevich M. V.**, leading research fellow of the Department of molecular biophysics of the IITPE NASU, shed light on the prominent role of the founder of the ILTPE, Academician of the NAS of Ukraine Verkin B. I., in the initiation and development of physical research on the physical properties of nucleic acids at the ILTPE. One more report was about the creative path of Professor Blagoi Yu. P. — the founder of the Department of molecular biophysics of ILTPE and its head until 2000. Professor **Lysetsky L. M.** highlighted the role of Corresponding Member of the NAS of Ukraine, Professor Malyukin Y. V., in the development of biophysical research at the Institute of Scintillation Materials of the NAS of Ukraine. The names and creative contributions of many more coworkers from the named biophysical teams who had advanced expertise in biophysics were memorialized in the reports. Next, the roundtable participants shared their personal memories of the development of biophysical research in the scientific and educational institutions of the city of Kharkiv and their creative connections with specialists in this field across Ukraine.

In general, the conference's thematic sections were accompanied by lively discussion and the renewal of existing and the establishment of new scientific contacts with colleagues from Ukraine, the European Union, and the USA.

The next conference of the series is expected to be organized in autumn 2027 in Kyiv.

Conflict of interests: The authors declare that there is no conflict of interest.

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1. 9th International conference "Nanobiophysics: fundamental and applied aspects" (6–9 October 2025, Kharkiv): Conference program and book of abstracts. Editor V. A. Karachevtsev. Kharkiv: FOP Brovin O. V., 2025. 122 p. ISBN 978-617-8587-15-14

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9th INTERNATIONAL CONFERENCE “NANOBIOPHYSICS: FUNDAMENTAL AND APPLIED ASPECTS”

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9th International conference “NANOBIOPHYSICS: Fundamental and Applied Aspects” – NBP-2025 took place on October 6-9, 2025 in Kharkiv, Ukraine, in online format, being organized by B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine and the Institute of Physics of the National Academy of Sciences of Ukraine. Previous conferences of the “NanoBioPhysics” series, launched in 2009, were organized on a biennial basis in Kharkiv and Kyiv in rotation. The conference brought together more than 100 participants from 13 countries: Ukraine, the Czech Republic, Estonia, Italy, France, Germany, Lithuania, Poland, the Slovak Republic, Spain, Sweden, the UK, and the USA. A total of 93 keynote, oral, and poster presentations were made. The goal of the conference was to discuss the urgent problems and new results achieved in the scientific field combining biophysics and nanotechnology, embracing nanobiohybrids formed by 1-D or 2-D nanomaterials with bioobjects, properties of biomolecules on nanoparticles and nanostructured surfaces, physical aspects of biomolecular nanosystems, theoretical calculations, computer modeling, and applied aspects of nanobiosystems. A special event within the framework of NBP-2025 was the round table on the topic “History of Biophysics in Kharkiv”, dedicated to the commemoration of outstanding scientists who formed the scientific school of molecular biophysics in the second half of the 20th century, which received recognition in Ukraine and abroad. Memories of them were shared by their students and followers, as well as employees of the biophysical departments of scientific institutions in Kharkiv. A book of abstracts based on NBP-2025 materials has been published.
KEY WORDS: nanobiophysics; biomolecular nanosystems; bionanomaterials; bionanocomposites; nanostructured surfaces; intermolecular interactions; computer simulation.

9-та МІЖНАРОДНА КОНФЕРЕНЦІЯ «НАНОБІОФІЗИКА: ФУНДАМЕНТАЛЬНІ ТА ПРИКЛАДНІ АСПЕКТИ»

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9-та Міжнародна конференція «НАНОБІОФІЗИКА: фундаментальні та прикладні аспекти» NBP-2025 відбулася 6–9 жовтня 2025 року в Харкові, Україна, в онлайн-форматі, організована Інститутом фізики низьких температур та техніки ім. Б. Вєркіна Національної академії наук України та Інститутом фізики Національної академії наук України. Попередні конференції серії «НаноБіоФізика», започаткованої у 2009 році, проводилися раз на два роки по черзі в Харкові та Києві. Конференція зібрала понад 100 учасників з 13 країн: України, Чехії, Естонії, Італії, Франції, Німеччини, Литви, Польщі, Словаччини, Іспанії, Швеції, Великої Британії, США. Було зроблено 93 пленарні, усні та постерні доповіді. Метою конференції було обговорення актуальних проблем та нових результатів, досягнутих у науковій галузі, що поєднує біофізику та нанотехнології, охоплюючи нанобіогібриди, утворені 1-D або 2-D наноматеріалами з біооб'єктами, властивості біомолекул на наночастинках та наноструктурованих поверхнях, фізичні аспекти біомолекулярних наносистем, теоретичні розрахунки, комп'ютерне моделювання та прикладні аспекти нанобіосистем. Особливою подією в рамках NBP-2025 став круглий стіл на тему «Історія біофізики в Харкові», присвячений вшануванню видатних вчених, які сформували наукову школу молекулярної біофізики у другій половині 20 століття та отримали визнання в Україні та за кордоном. Спогадами про них поділилися їхні учні та послідовники, співробітники біофізичних кафедр та відділів наукових установ Харкова. Було опубліковано збірник тез за матеріалами NBP-2025.
КЛЮЧОВІ СЛОВА: нанобіофізика; бімолекулярні наносистеми; біонаноматеріали; біонанокомпозити; наноструктуровані поверхні; міжмолекулярні взаємодії; комп’ютерне моделювання.