THE NATIONAL ACADEMY OF SCIENCES OF UKRAINE

in 2025

CONTENTS

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Information popular-science edition presents the major achievements of the institutions of the NAS of Ukraine in 2025 in natural, engineering, social sciences and humanities. Examples of innovative developments for the needs of defense, energy, food, environmental security, and medicine are given. The main current directions of Academy's international cooperation as well as its activities in science popularization are shown. Statistical data on the S&T potential and the results of the NAS of Ukraine activities in 2021—2025 are presented.

The edition is intended for the employees of state power bodies, scientists, students of higher education instituions, journalists, broad public circles.

FOREWORD OF NAS ACADEMICIAN ANATOLII ZAGORODNII, PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES OF UKRAINE

2025 has passed — another year of our tireless work in conditions that require from each of us the maximum concentration of effort, intellectual courage and unwavering faith in the future of Ukraine. For the National Academy of Sciences of Ukraine, this period became the time of profound transformation, when we not only ensured the sustainability of science sphere but also actively formed the basis for post-war reconstruction and technological sovereignty of the state.

In spite of difficult conditions, our research teams continue to demonstrate world-class results. These are the outcomes of basic research presented in leading international scientific editions they are discussed by global academic community and are conducted in cooperation with the major research centers of the world. These are the works that lead to more profound understanding of the fundamental properties of matter, complex natural processes and living systems, they elaborate novel technological approaches and mathematical models, as well as determine trends in science development for years to come. It is such results that ensure trust in the Academy as a full participant in world science and provide the basis for future technological solutions.

Simultaneously with basic research, the role of applied developments focused on specific needs of the state increased significantly. The Academy works ever more clearly "from request — to solution", concentrating resources on the areas where research results can be used directly in the sphere of security, restoration of infrastructure, energy, industry, environment conservation and medicine.

Academy scientists developed technologies and materials for ensuring energy sustainability, modernizing production enterprises, restoring urban infrastructure, and increasing technogenic safety. A significant part of those efforts was carried out in interaction with governmental structures, enterprises and industrial partners, which accelerated the implementation of research results and reduced the gap between laboratory work and practical application.

Special focus was given to the developments intended for reconstructing the destroyed territories, increasing the reliability of engineering networks, development of novel materials and technologies with predicted characteristics, as well as those for ecology protection. In many cases the emphasis was not on re-creating the lost but, rather, on forming brand new solutions capable of making the infrastructure and production resilient to future risks.

Academy's participation in providing the defense capability of the state remains top priority. NAS institutions worked on creating dual- and special-purpose technologies and solutions, in particular, in the sphere of unmanned systems, artificial intelligence, navigation, electronic countermeasures, materials and structures designed for difficult operating conditions. These studies were carried out in close cooperation with the defense sector, military research institutions and producers, and their outcomes are increasingly translated into practical applications.

An important role in NAS activities is played by socio-humanities. In 2025, history, philosophy, law scholars, sociologists, economists and demographers of the Academy worked at the intellectual frontline. They analyzed war consequences, opposed disinformation, formed scientific principles of remembrance policy studied transformations of the Ukrainian society, and provided expert assessments for government authorities. Analytical materials produced by the Academy became the basis for decision-making in the sphere of demographic policy, social stability, European integration, and strategic planning.

In 2025, the international activities of the NAS of Ukraine remained an important instrument of maintaining Ukraine's scientific integration to the global science area. Academy's institutions took part in implementing dozens of international projects, in particular, in the framework of EU and NATO programs, along with bilateral initiatives. Co-

operation with leading scientific centers of the world both supported research activities and facilitated preparation of road maps for restoring Ukrainian infrastructure and developing human capital.

Simultaneously, the Academy performed an important function of scientific expertise. In 2025, its scientists were involved in the preparation of strategic documents, development programs, legislative initiatives, expert conclusions for government authorities. Such activities became an integral part in the processes of reconstructing the country and forming the state policy with reliance on scientifically based data.

Academy institutions were actively involved in volunteer work — they supported the Armed Forces of Ukraine, medical institutions, internally displaced persons, took part in humanitarian initiatives still staying focused on their core research work. Science popularization was important as well: by organizing public events, presence in media, educational projects and communication with society the Academy consistently defended the value of scientific knowledge in the times of war.

2025 also became an important stage in the internal life of the Academy. Holding elections for its governing bodies, renewing the Presidium membership, and activating internal dialog laid the foundation for management modernization, enhancing openness and strengthening democratic procedures in the life of the NAS of Ukraine.

Summing up the year, one can say with confidence: the National Academy of Sciences of Ukraine did survive. It maintained its scientific potential, remained the pillar of the state in the conditions of war, and continues working for defense, recovery and country's future. It is responsible work for the benefit of society, preserving the foundation of science, and orientation towards real needs of the state that forms the basis for the next stage of Academy development.

This edition reflects the results of great collective work. I am sincerely grateful to all scholars of the National Academy of Sciences of Ukraine for their perseverance, professionalism and dedication to their work. It is due to you that Ukrainian science is alive, develops and works for the nation.

Special words of gratitude go to the Armed Forces of Ukraine. Due to the courage and sacrifice of our defenders, Ukrainian scientists have the opportunity to work, carry out studies and build a future. The Academy is aware of its responsibility towards those who defend the nation and is doing everything possible to ensure that science works for victory.

In future we will be faced with a lot of challenges. Yet, the results of 2025 confirm: the National Academy of Sciences of Ukraine is an effective and fundamental institution. We are the intellectual support of the state and architects of its future reconstruction.

Glory to Ukraine!

IMPORTANT EVENTS

Election to the NAS membership. A session of the General Meeting of the National Academy of Sciences to elect its full members (academicians) and corresponding members was held on 1 May, 2025.

To update the Academy membership, the practice of setting the maximum age for candidates to certain vacancies, which had been introduced in 2024, was continued:

- to be elected an active member — under 65 by the moment of finalizing the receipt of documents;
- to be elected a corresponding member — under 55.

The distribution of vacancies across NAS departments and the announcement of specializations were based on the need to ensure the development of both basic and applied research, primarily in the areas where Ukrainian scientists achieved world-class results. At the same time, one of the key conditions for advancing candidates was to present 32 worthy candidates both from Academy institutes and those from institutions of high education and industrial S&T institutions of the country.

Active interest of the scientific community to this election is shown by tough competition: 32 candidates were advanced for 12 vacancies of academicians (2.7 for a vacancy) and 137 candidates for 41 vacancies of corresponding members (3.3 candidates for a vacancy).

According to the NAS Statute, the preparation to and holding of the election were carried out in conditions of openness and broad discussion of the candidates. During sessions of the general meeting of the Academy departments, conditions for free expression of opinions, discussions and nomination of candidates were provided, which promoted grounded, objective and independent choice. All departments worked with the support of expert commissions that compiled the lists of recommended candidates.

By secret ballot, 12 academicians and 39 corresponding members of the Academy were elected.

Of them, 8 academicians and 27 corresponding members work in Kyiv, this amounting to 68.6 % of the total number of all newly elected NAS members. Four NAS academicians and four corresponding members are from Kharkiv. Nine corresponding members are from Lviv and one person is from Kryvyi Rih, i.e. 31.4% of all newly elected members of the National Academy of Sciences of Ukraine work in its regional science centers.

The average age of the elected NAS academicians is 66.3 years, that of corresponding members — 59 years. In general, now the average age of academicians is 71 years, that of corresponding members is 65 (the "rejuvenation" by five and six years respectively, occurred).

There are 11 women among the new Academy members, the proportion of them in the elected NAS corresponding members is 21.5 %.

The President of Ukraine met with scientists. On 21 May 2025, President Volodymyr Zelenskyi held a meeting with representatives of scientific community, during which he presented state awards and honorary titles for the significant contribution to the development of science, technologies and national security.

Among the prize winners were scientists of the National Academy of Sciences of Ukraine, whose studies and innovative developments significantly strengthen the defense potential of the state, promote technological progress and raise the international authority of Ukrainian science.

The head of the state expressed gratitude to scientists for their dedicated work, stressing that during war it is science that provides critical technological solutions for the front, defense, medicine, and infrastructure. "I can see that there are various areas, various armaments various means of protection. That is demonstrated in technologies, in the systems of radio-electronic warfare, and in sea drones etc." the President noted.

Participants of the meeting spoke about how the implementation of scientific developments in defense industry complex can be made more effective and faster. The head of the state commissioned the Ministry of Strategic Industries to establish closer communication with scientists. According to him, that would allow the two parties directly discuss and scale up the most important technologies and developments. A special

Meeting of President Volodymyr Zelenskyi with scientists

Meeting of NAS academician Serhii Komisarenko with Sir Paul Nurse, Nobel Prize laureate in physiology and medicine

emphasis was placed on raising the status of scientists: Volodymyr Zelenskyi said that it was important to increase support to scientists, in particular, to pay a material remuneration for copyrighted inventions and novel developments.

The head of state also got acquainted with the presentation of advanced defense technologies created by Ukrainian researchers.

Sir Paul Nurse, British Nobel Prize Laureate, visited the Academy. On 11 September 2025, Sir Paul Nurse, the President of London Royal Society, the 2001 Nobel Prize Winner in Physiology and/or Medicine ("for the discovery of key cell cycle regulators"), *UNITED24* platform ambassador, paid a friendly visit to the National Academy of Sciences of Ukraine.

Its scientists welcomed the guest of honor at O.V. Palladin Institute of Biochemistry, which celebrated its centenary in 2025.

Sir Paul Nurse was also welcomed by Institute's director NAS academician Serhii Komisarenko.

The meeting was joined by representatives of the Institute of Molecular Biology and Genetics, Bogomoletz Institute of Physiology of the NAS of Ukraine. Participants of the meeting discussed current global issues of life sciences, along with problems of science in Ukraine. Besides, academician Serhii Komisarenko briefly informed Sir Paul Nurse about the history and major research achievements of O.V. Palladin Institute of Biochemistry and demonstrated interesting historical photographs.

Then the guest was offered to visit the laboratory of protein structure and functions of O.V. Palladin Institute of Biochemistry NAS of Ukraine.

At the end of his visit the Nobel laureate was invited to the Memorial Museum of academician O.V. Palladin (last year the Academy marked the 140th birth anniversary of this prominent scientist and the founder of the Institute of Biochemistry and left an entry in the guest book. To memorize this meeting, NAS academician Serhii Komisarenko handed to sir Paul Nerse a memorable gift — a medal with Oleksandr Palladin's bas-relief.

Sir Paul Nurse thanked for the cordial reception and declared that it was very important for him to stand with Ukraine at this difficult time.

On 18 September 2025, in Kyiv, in the NAS Major Conference Hall, a Jubilee Session of the NAS General Meeting was held, which marked the centenary of academician Ihor Yukhnovskyi (1.09.1925 — 26.03.2024).

Members of the NAS of Ukraine, of the scientific and educational communities, representatives of government officials took part in the ceremonial assembly. NAS President academician Anatolii Zagorodnii opened the Grand General Meeting. "No doubt, Ihor Yukhnovskyi is an iconic figure for the whole scientific and political community. As a brilliant theoretical physicist, he made a significant contribution to the development of statistical physics, the theory of phase transitions and multi-particle systems. His scientific works became the basis for further studies of Ukrainian and foreign researchers while the science school launched by him raised several generations of talented physicists" noted the Academy leader in his greeting speech. Anatolii Zagorodnii emphasized that academician Ihor Yukhnovskyi at the same time showed himself as a wise statesman and a true patriot, his life is an example of combining service to science and service to the state.

Then the floor was given to guests of the event.

Darka Olifer, Leonid Kuchma's press secretary, presented the greeting of the second President of Ukraine in 1994—2005. Mykhailo Sydorzevskyi, the Head of the Writers' Union, stressed in his speech that Ihor Yukhnovskyi had realized himself in various hypostases — as a scientist, politician and statesman. The work of the Jubilee Session of the General Meeting was continued by the presentations of scientists, which covered the versatile life and creative work of Ihor Yukhnovskyi — from basic scientific research into condensed matter physics to active participation in creating the independent Ukrainian state.

Closing the Grand Session of the NAS General Meeting, Anatolii Zagorodnii expressed gratitude to all those involved in the event for their active participation and stressed: "Today we were able to realize how extraordinary a personality Ihor Yukhnovskyi was and how significant and versatile a legacy he left to Ukraine — in science, in politics and in state formation. Our task is to preserve and enlarge this invaluable heritage as well as pass it on to future generations of Ukrainian scientists."

Election of the NAS President and new members of Academy's management body. On 7 October 2025, an election session of the General Meeting of the Na-

tional Academy of Sciences of Ukraine was held, which elected the President of the NAS of Ukraine.

In accordance with the Statute of the NAS of Ukraine, involved in the election session were NAS academicians and corresponding members, as well as delegated representatives of Academy's research teams in the number that is equal to half of the registered number of the academicians and corresponding members who took part in the work of the General Meeting.

Two candidates were nominated for the post of the President of the NAS of Ukraine — NAS academicians Anatolii Zagorodnii and Bohdan Danylyshyn.

During the session, the candidates presented their election programs. After candidates' speeches, the discussion of their programs continued and session participants asked questions. The secret ballot took place after the discussion.

A total of 694 ballot papers were distributed.

According to the results of the ballot, 608 voters cast their votes for academician Anatolii Zagorodnii, while 60 votes were cast for academician Bogdan Danylyshyn.

Hence, NAS academician Anatolii Zagorodnii was elected the President of the National Academy of Sciences of Ukraine. On 9 October 2025 a session of the General Meeting of the National Academy of Sciences was held, during which the First Vice-President, vice-presidents and the members of NAS Presidium were elected, as well as secretary academicians of the NAS departments, who had been elected by the departments' general meetings on the previous day, were approved.

According to the results of the secret ballot, NAS academician Viacheslav Bogdanov was elected the First Vice-President of the NAS of Ukraine.

NAS academicians Volodymyr Horbulin, Volodymyr Radchenko, Oleh Rafalskyi and Volodymyr Semynozhenko were elected vice-presidents of the NAS of Ukraine.

Elected as members of the NAS Presidium were: NAS academicians Anatolii Bulat, Borys Burkynskyi, Oleksandr Kopylenko, Viacheslav Koshechko, Roman Kushnir, Vasyl Lazoryshynets, Serhii Pyrozhkov, Valerii Smolii, Vitalii Tsymbaliuk, NAS corresponding member Volodymyr Ustymenko, doctor of physics and mathematics Oleksandra Antoniuk, and doctor of philosophic sciences Oleh Kubalskyi.

Approved for positions of the secretary academicians of NAS departments were: Oleksandr Tymokha, Volodymyr Nazarenko, Mykhailo Bondar, Stella Shekhunova, Andrii Rusanov, Ihor Garkusha, Petro Stryzhak, Mykola Spivak, Serhii Afanasiev, Valerii Heyets, and Bogdan Azhniuk.

After the election, the newly elected members of the NAS Presidium held their first meeting that considered and approved a number of important personnel issues.

The world will mark International Day of Engagement in Science for Sustainable Development, which was introduced by Ukraine. On 27 November the world marked International Day of Engagement in Science for Sustainable Development for the first time ever.

In response to Ukraine's proposal for celebrating this day at the 43-th session of UNESCO General Conference, which took place in Samarkand (Uzbekistan), the respective resolution was passed on 8 November. The decision that opens a new page of international cooperation in the sphere of science and education was supported by the majority of member states of this organization.

27 November is a symbolic date for Ukraine. That day Borys Paton, a prominent scientist and the President of the National Academy of Sciences of many years, was born. It was on that very day 107 years ago, in the midst of World War I, that Hetman Pavlo Skoropadskyi founded the Ukrainian Academy of Sciences in Kyiv. It was headed by Volodymyr Vernadsky, an outstanding naturalist and philosopher, and its first Secretary was Agathangel Krymsky, a well-known orientalist and philologist. Their work laid the intellectual foundation of present-day Ukrainian science.

During discussion, representatives of many countries expressed their support to that Ukrainian initiative, emphasizing its humanistic and unifying nature.

International Day of Engagement in Science for Sustainable Development is intended to deepen the involvement of society in science, contribute to the achievement of the UN Sustainable Development Goals, as well as strengthen international cooperation in education, research and scientific diplomacy.

This decision became a significant contribution of Ukraine to forming a new culture of science — that oriented towards people, the planet, and shared responsibility for the future.

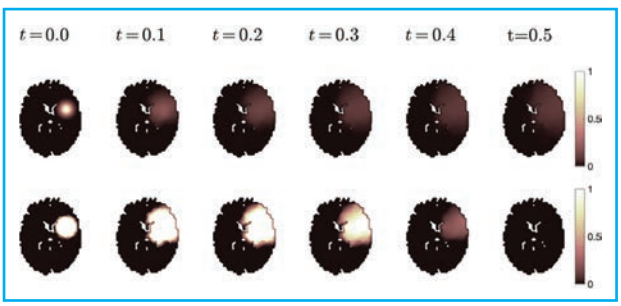
For our state, this day will become both a science festival and a symbol of Ukraine's intellectual mission in the world.

SCIENTIFIC ACHIEVEMENTS. NATURAL AND TECHOLOGICAL SCIENCES

Mathematical Analysis and Modeling of Glioma Dynamics in Heterogeneous Medium under the Effect of Radiotherapy

Brain gliomas are characterized with high invasiveness, which complicates their localization and surgical resection, therefore, treatment protocols usually employ radio- and/or chemotherapy. To optimize the therapy and increase its personalization, *in silico* studies of respective mathematical models are used, which comprise both rigorous mathematical analysis and numerical calculations.

Scientists of the NAS Institute of Applied Mathematics and Mechanics, jointly with Marina Chugunova, professor of Claremont Graduate University, and Hangjie Ji from North Carolina State University, studied the model of density dynamics of glioma cells under the influence of radiotherapy. Their study was aimed at developing radiotherapy strategies, using the analytical and numerical analysis of the mathematical model based on nonlinear parabolic equation of Fisher — Kolmogorov — Piskunov — Petrovsky type. The model relied on the assumptions about the constant proliferation rate of cancer cells, their instantaneous response to irradiation, and the therapy continuity. To increase the accuracy, the structural heterogeneity of the brain tissue was taken into account by means of a changeable diffusion coefficient. That makes it possible to predict the vectors of tumor proliferation and implement the procedure of *dose-painting* — to focus the radiation on the areas with the highest risk of invasion. The process dynamics is determined by the balance between the rate of cell multiplication and the intensity of their elimination with radiation.



Modeling of optimum control on the brain image: top panel – controlled profiles of tumor cell density; bottom panel – respective optimal control; t is normalized (dimensionless) time variable

The strict mathematical analysis of the model includes both the classical issues of correctness, smoothness and asymptotic behavior of the solutions and the investigations of optimal control tasks. These tasks are aimed at minimizing of the total tumor density in space and time, where the function describing the radiotherapy effect is the control parameter. The study is based on the principle of optimum control, the so-called *bang-bang principle* (or *Bathtub principle*). Relying on the analytical study results, a numerical algorithm was developed and calculations for one- and two-dimensional cases were carried out.

The results obtained prove the effectiveness of the "front-loading" strategy, which is an alternative to traditional fractionizing methods with uniform zone distribution. The analytical and numerical study of the model proves that the minimization of the population of surviving cancer cells is achieved through the application of the maximum irradiation intensity at the initial stage of the treatment — in the period of the highest tumor density. This creates a time window for healthy cells to recover at later stages of the treatment. In the framework of this approach, a binary dozing strategy was justified: using the maximum permissible radiation level in the zones of a high tumor density and zero influence in the intact zones.

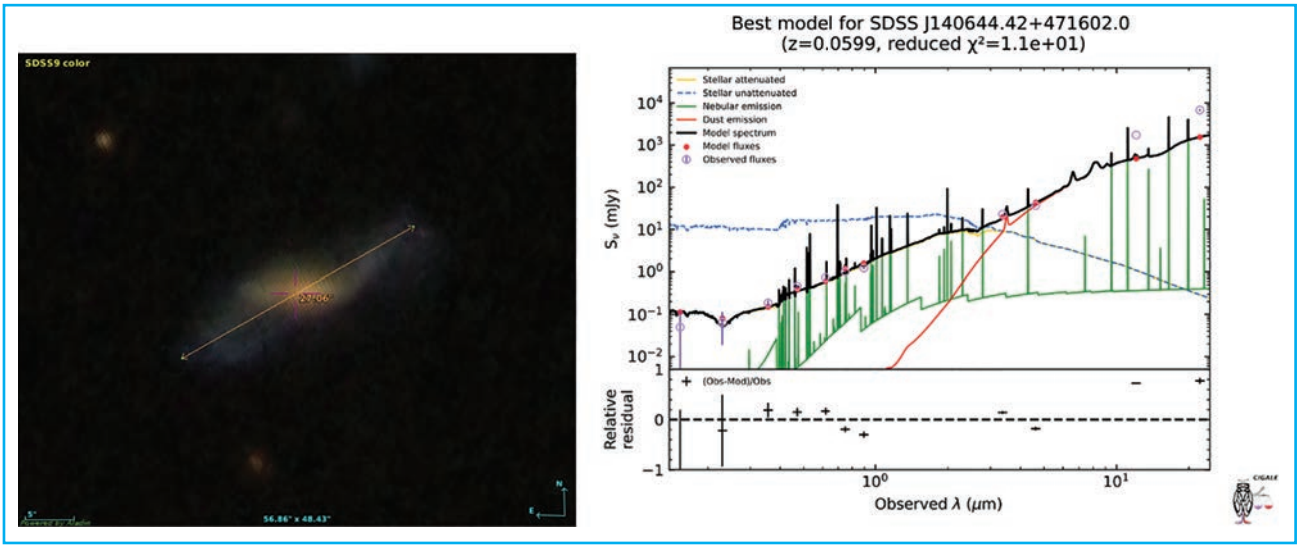
Chugunova M., Ji H., Taranets R., Vasylyeva N. Analysis of a Radiotherapy Model for Brain Tumors. *Studies in Applied Mathematics*. 2025. 155(1), e70074. https://doi.org/10.1111/sapm.70074

Taranets R., Vasylyeva N.

Discovery of Polar Ring Galaxies with the Use of AI

Polar ring galaxies (PRG) are unique objects that merge to form a binary galactic system: the central galaxy and an outer ring that rotates above the poles of the central galaxy. Despite their impressive shape, these objects are very rare and difficult to detect: now about 200 such galaxies are known, most of them were discovered visually, and only six were confirmed kinematically. Each new reliable detection of a PRG provides new knowledge about their evolution: from dynamic formation processes and matter accretion mechanisms to the stabilization of rotation during billions of years.

A research team of the Main Astronomical Observatory of the NAS of Ukraine, in cooperation with their colleagues from Taras Shevchenko National University of Kyiv and Northwestern University (USA), for the first time applied deep learning methods for automated



Galaxy PRG SDSS J140644.42+471602.0 (left). An image from Aladin interactive sky atlas, where yellow line is the estimated line-of-sight size in the optical range. The best approximation of the spectral energy distribution from UV to IR ranges (right). Red dots are the model flows; violet ones are the observed flows

searches for galaxies with polar rings in conditions of a critically low amount of reliable training data. To form a training sample, 87 visually confirmed PRG images were used, along with data augmentation methods, image segmentation and ensemble learning were applied. Transfer learning proved to be the most effective approach, which permitted enlarging the sample with synthetic images generated using the *GALFIT* package.

Application of the developed approach to the analysis of more than 300 thousand galaxies of *SDSS* digital sky survey helped identify three new polar ring galaxies (*SDSS J*140644.42+471602.0; *SDSS J*133650.48+492745.3; *SDSS J*095717.30+364953.5), as well as four more objects found by a visual survey.

Spectral energy distribution in the range from ultraviolet to infrared radiation was determined for *SDSS J*140644.42+471602.0 galaxy. The star formation rate in this system was shown to be 71 solar masses per year, while its stellar mass amounts to 8.34 × 1010 solar masses. Researchers established that the majority of PRG are located in the regions of low environment density, in particular, in filaments and voids of the large-scale structure of the Universe.

The work resulted in compiling a catalogue of 179 visually checked polar ring galaxies, which, if supplemented with newly discovered objects, can be used both for further training of neural networks and for theoretical studies of the evolution of galaxies.

Dobrycheva D.V., Hetmantsev O.O., Vavilova I.B., Shportko A., Gugnin O., Kompaniiets O.V. Discovery of the polar ring galaxies with deep learning. *Astronomy & Astrophysics*. 2025. 702, id.A258. https://doi.org/10.1051/0004-6361/202555052

Dobrycheva D., Hetmantsev O., Vavilova I., Shportko A., Gugnin O., Kompaniiets O.

Theoretical Determination of the Anomalous Muon Magnetic Moment in the Standard Moment with High-Precision Evaluation of Hadron Contributions

Scientists of the National Scientific Center "Kharkiv Institute of Physics and Technology", in cooperation with American and European physicists, performed updated calculations of the anomalous muon magnetic moment in the Standard Model. A significant progress was achieved in calculating "hadronic light scattering on light" with the use of dispersion approach and quantum chromodynamics on lattices. An improved evaluation of the contribution of hadron vacuum polarization (HVP) is an important result. High accuracy of calculations in quantum chromodynamics on lattices helped obtain the value of vacuum polarization contribution with precision up to 0.9 %. As a result, the theoretical prediction of the anomalous muon magnetic moment is 116592033(62) × 10^{-11}.

The comparison of the theory with the average experimental value obtained in experiment E821 and in six cycles of experiment E989 performed at Enrico Fermi National Accelerator Laboratory (FNAL, Batavia, USA) revealed the absence of the divergence of the theory in the Standard Model and experiments at the current level of accuracy. This conclusion of the study has been one of the most important results in elementary particle physics in recent years. The significance and relevance of the study is confirmed by 165 references to the work as of 07.02.2026 (https://inspirehep.net/literature2925594).

The anomalous magnetic moment of the muon in the Standard Model: an update. *Phys. Rept*. 2025. 1143. P. 1-158. https://doi.org/10.1016/j.physrep.2025.08.002

Shekhovtsova O., Korchin A.

Ferroelectric Nematic Liquid Crystals: New Paradigm for Electro-Optical Applications

Liquid crystals have long been used in screens, sensors, and optical devices. For nearly a century their most common form — the nematic phase — was believed to be non-polar: its molecules were oriented along one direction, but it was not distinguished where the molecule "began" and where it "ended". Due to that, constant electric dipoles of molecules were considered as secondary ones influencing only the electric properties of the material.

However, in the recent decade this imaginary picture has undergone a significant revision after the discovery of a new type of liquid crystals: the ferroelectric nematic ones. The molecules in them have large electric dipoles that are arranged in such a way that spontaneous macroscopic electric polarization occurs, i.e., that the material acquires electrical "polarity" in its own right, like solid ferroelectrics known since the early 20th century.

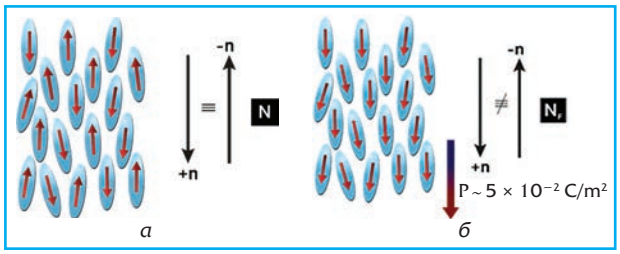
Unlike solid crystals, where polarization is rigidly tied to the crystal lattice, in liquid crystals it can easily change its direction. For this reason, ferroelectric nematics turned out to be extremely sensitive to external electric fields — much more sensitive than traditional liquid crystals.

Experimental research conducted at the Institute of Physics of the NAS of Ukraine demonstrated that under the influence of electric fields, complex spatial structures and regular polarization patterns can emerge and they are related to the appearance of topological defects. Earlier, such structures had been considered impossible but experiments showed them to be stable and controllable.

Further studies of ferroelectric nematics can acquire great practical importance, since they open the way to developing a new generation of electrooptical devices in which light control will be implemented not only by changing the orientation of molecules but by their macroscopic electric polarization as well.

Basnet B., Paladugu S., Kurochkin O., Buluy O., Aryasova N., Nazarenko V., Shiyanovskii S. & Lavrentovich O. Periodic splay Fréedericksz transitions in a ferroelectric nematic. *Nature Communications.* 2025. 16, 1444. https://doio.org/10.48550/arXiv.2412.09553

Basnet B., Paladugu S., Kurochkin O., Buluy O., Aryasova N., Nazarenko V., Shiyanovskii S., Lavrentovich O.



Schematic images of polar and non-polar liquid crystal phases, nematic: a – apolar; b – polar

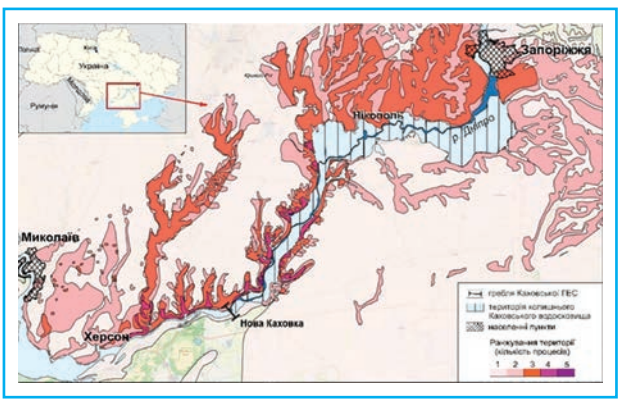
Analysis of the Development of Hazardous Geological Processes in the Influence Zone of the Former Kakhovka Reservoir as a Pilot Object of Assessing the Impact of Russian Military Aggression on the Geological Environment

To justify approaches to analyzing and assessing the development of hazardous exogenic geological processes and supporting the adoption of decisions regarding the reconstruction of the Kakhovka Reservoir area, the territory under study was ranked according to the spatial density and frequency of manifestations of various process types, namely, karst, slope processes, flooding, subsidence of loess soils, using the statistical analysis of spatial data in the *ArcGIS* medium.

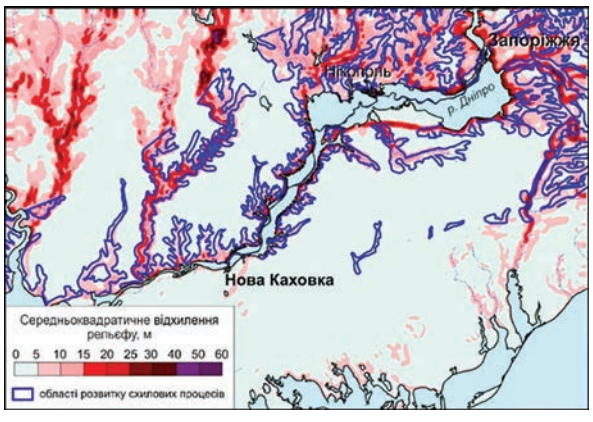
The areas of the territories affected by each of these processes were determined. The area with local flooding sites was 97.92 km^2; the area affected by semi-covered karst — 10434.2 km^2, that with open karst — 318.013 km^2; the area of the territory affected by slope processes (landslides, erosion) — 19022.831 km^2, while the area of loess occurrence amounted to 51418.1 km^2.

The procedure of assessing the risks and forecasting the development of slope processes in the territory of the Kakhovka Reservoir influence was improved. Relying on the analysis of conditions and factors affecting the development of hazardous geological processes within the territory under study, using the inventory maps produced, the effect of tectonics and relief was determined, along with creating a prognostic model of slope processes. The distribution of slope processes according to their distances from tectonic disturbances was analyzed. The regions of predicted landslide processes were found to go beyond those of slope process manifestations that had been mapped earlier.

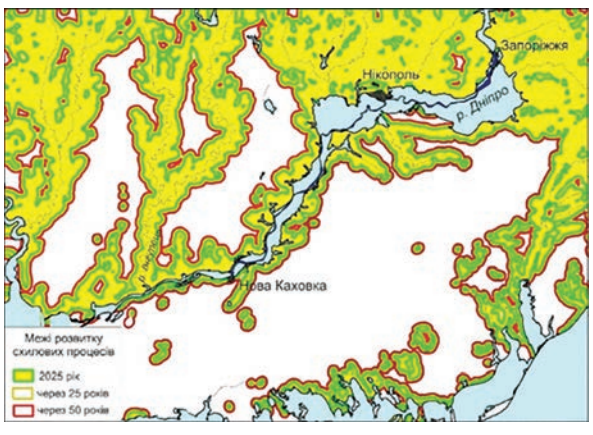
The effect of erosion base lowering due to the destruction of the Kakhovka Power Plant dam on the intensity of slope processes was assessed. A long-term



Territorial ranking according to the spatial density and frequency of the manifestation of hazardous geological processes



Map of terrain dispersion (of mean square deviation)



Prognostic model of spatiotemporal ravine development

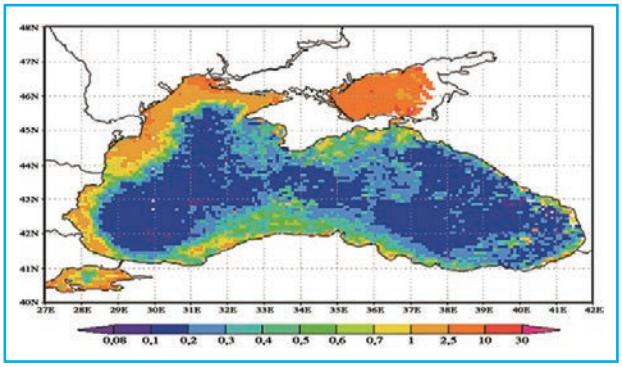
prognostic model of the spatiotemporal ravine progress in the Kakhovka Reservoir influence zone was built.

The results obtained will provide scientific and methodological support for the account and assessment of the damage the geological environment due to the Russian armed aggression, as well as during developing remedial measures and territorial management strategies.

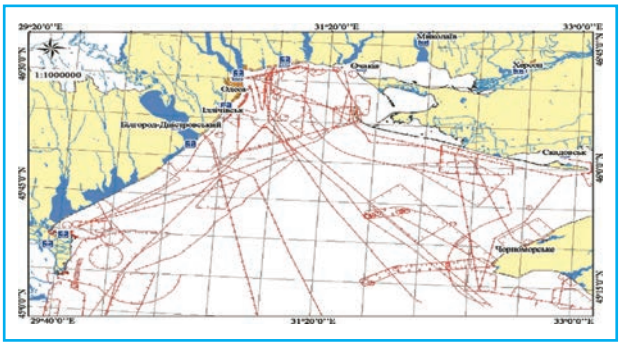
Shekhunova S., Stadnichenko S., Siumar N., Aleksieienkova M., Permyakov V., Stryzhak L.

Information Technologies of Aerospace Monitoring of Marine Waters and Littoral Zones

Scientists of the NAS Institute of Telecommunications and Global Information Space developed an information technology of the aerospace and geoinformation monitoring of marine areas and littoral zones, which is to increase the efficiency and reliability of assessing the ecological state of the marine environment. The technology relies on the integrated use of satellite data of remote sensing of the Earth, AI methods and geoinformation modeling to analyze spatiotemporal changes in the marine environment parameters. This technology allows a fast detection of changes in the state of marine environment, which increases the credibility of assessing the state of the marine ecosystem.



The studied marine areas of the Black Sea and littoral zones



Spatial distribution of man-made load factors in the northwestern part of the Black Sea

The implementation of the approaches developed permits timely detection of contamination signs, negative ecological changes and transformations of littoral areas, along with forming cartographic and analytical materials necessary for adopting well-grounded management decisions in the sphere of environmental safety and the protection of marine ecosystems.

Trofymchuk O., Trysnyuk V., Yakovlev E.

New Gradient Model of Elastic-Plastic Deformation and Modeling the Processes of Radiation Swelling and Radiation Creep in Calculations under Conditions of Design and Long-Term Operation of NPP Reactors

Scientists of G.S. Pysarenko Institute for Problems of Strength of the NAS of Ukraine developed and mathematically validated a new gradient model of elastic-plastic deformation, which takes into account mi-

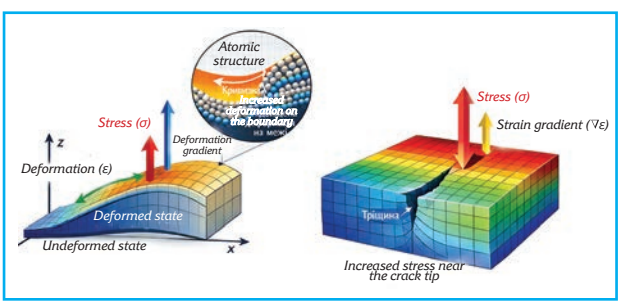
croscale effects caused by material's microstructure. Unlike classical continual theories, in which the material is considered to be solid and homogeneous from the macro- to the microscopic level, the proposed model is enriched with inhomogeneous deformation gradients. This allows an involvement of internal dimensional scales related to elasticity and dissipative plasticity processes, which causes the effect of local material strengthening.

In comparison with well-known methodological approaches used in the nuclear industry of Ukraine and in international practice, the application of the developed gradient model to the analysis of fracture resistance of nuclear reactor vessels opens up the possibility of substantiating an additional strength reserve and the extension of safe operation terms of NPP power units.

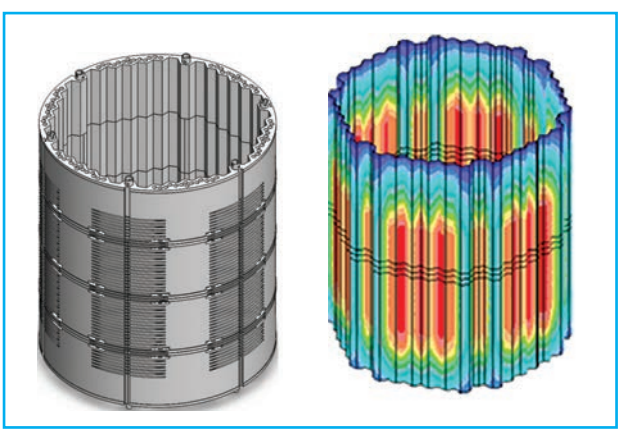
New mathematical models and methods of calculating the stress-strain state of the structural elements that are under the prolonged exposure to neutron irradiation and intense thermoelectric loads were developed. Current approaches to modeling the processes of radiation swelling and radiation creep, which take into account the damaging dose, irradiation temperature and the effect of stress-strain state were improved. Constitutive equations that permit modeling of the non-isothermal inelastic deformation processes, with the account of radiation hardening, swelling, creep and subcritical metal damage according to ductile fracture models, were formulated and justified mathematically. Approximate methods of solving generalized boundary value problems of radiation creep were developed.

Relying on the developed mathematical models and refined calculation methods, new results of the computational analysis of stress-strain state and the irreversible change in the shape of the BBEP-1000 reactor core enclosure were obtained for conditions of the designed and long-term operation.

Chirkov O.



Strain gradient in mechanics problems

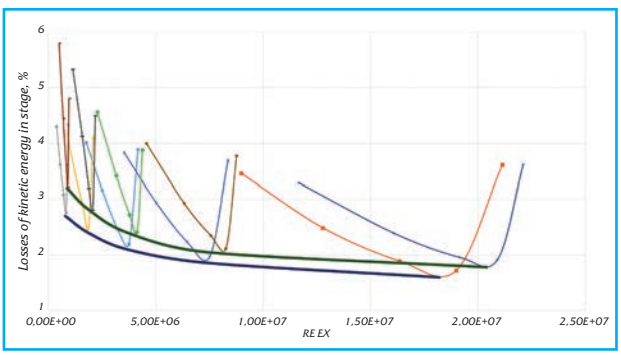


BBEP-1000 reactor core enclosure (left), distribution of irradiation dose on the inner surface of the enclosure (right)

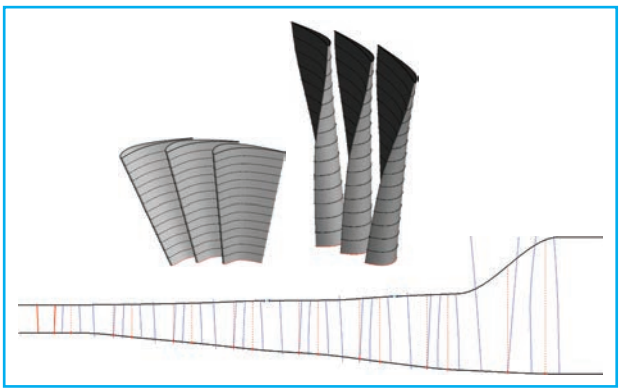
Modern Approach to Designing Flow Sections of High-Power Steam Turbines for Prospective and Existing Power Units of Ukrainian NPP

Scientists of A.M. Podgorny Institute of Power Machines and Systems of the NAS of Ukraine proposed two new dimensionless criteria which, in conjunction with the known ones, define main geometrical and gas-dynamic characteristics of turbine axial stages. Researchers determined the ranges of their values in which the highest gas-dynamic efficiency of the flow sections can be achieved. This permitted the development of a new approach for automating the process of the preliminary calculation and design of multi-stage flow sections of axial turbines and reduce the time required to complete the work by several times.

Relying on the methods developed, advanced theories of applied thermodynamics, gas dynamics, calculation and design of turbomachines, preliminary versions of the flow section of the turbine steam plant for highly efficient power units of Ukrainian NPP with promising nuclear reactors AP1000 were elaborated. Several options for distributing thermal differences across the stages of high-, medium- and low-pressure cylinders were analyzed, and preliminary determination of the



Dimensionless gas-dynamic characteristics of axial stages: u/c0t – the known one λt = c0t/a0in, c2/c0t – new ones



Structure of the 3D shape of axial turbine flow part

main geometrical characteristics of the stages was performed. In the versions considered, the shape of meridional bypasses changes considerably, which produces a significant effect on the general gas-dynamic efficiency of the flow parts. Hence, methods of 3*D* modeling of turbulent flows were employed, taking into account the actual properties of the working fluid, phase transformations in particular.

In addition to the values of gas-dynamic efficiency, when choosing the final versions of flow parts, other factors, such as weight and dimension characteristics, production cost etc. were taken into account as well.

The results obtained are the basis for designing highly efficient and competitive steam-turbine power generation installations for the existing and prospective power units of Ukrainian NPPs.

Rusanov A., Rusanov R., Chugay M.

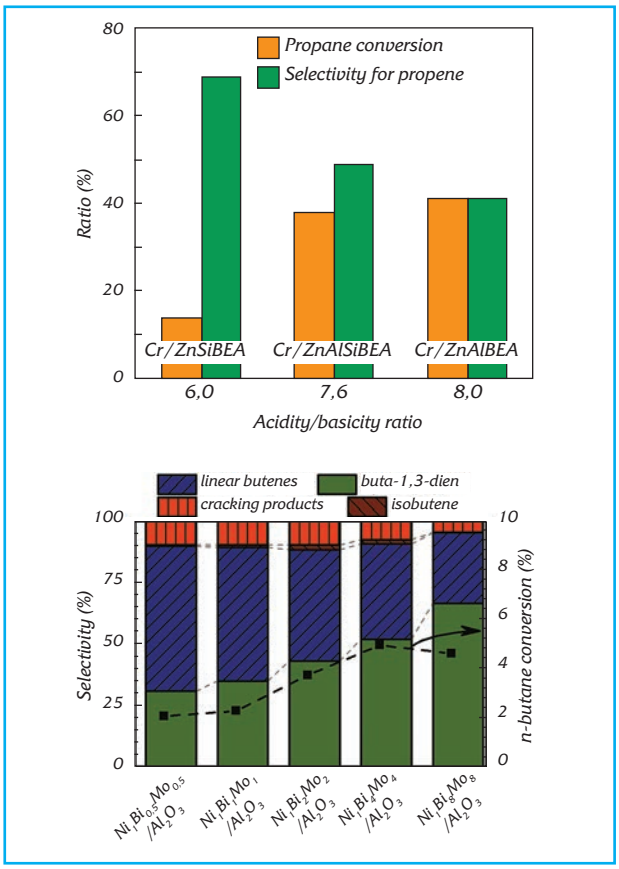
Nanocomposite Metal-Zeolite and Oxide Catalysts of Dehydrogenating $C_{3,4}$ Alkanes Involving CO_2 with Obtaining Valuable Alkanes and Dienes

Due to the re-orientation of raw material base for producing ethene from oil to shale gas, of significant importance is the development of alternative methods to obtain monomers (propene, butenes, buta-1,3-diene) for producing polymer materials from gas condensate through dehydrogenating $C_{3,4}$ alkanes. In view of a large number of oil and gas condensate deposits in Ukraine, the development of catalysts for the dehydrogenation of $C_{3,4}$ alkanes will contribute to a deeper processing of gas industry products (propane-butane mixture) and to the balanced use of natural (mineral and raw material) resources of Ukraine. Of special interest among the targeted ways of obtaining $C_{3,4}$ alkenes/dienes are the processes of catalytic propane and n-butane dehydrogenation involving CO_2.

Researchers of L.V. Pisarzevsky Institute of Physical Chemistry of the NAS of Ukraine proposed effective nanocomposite metal-zeolite and oxide catalysts of $C_{3,4}$ alkanes dehydrogenation involving CO_2 to obtain propene and buta-1,3 diene.

Among active/selective catalysts of the process of CO_2-assisted oxidative dehydrogenation of propane to propene (CO_2-ODP), there are zeolite compositions (e.g., those based on BEA) with incorporated heteroelements (Cr, Ga, Zn). The structural and functional design of metal-zeolite catalysts is intended for achieving the balance of their acidic and basic characteristics. For example, the formation of M-SiBEA compositions with significantly lowered general acidity and basicity provides an increase of their catalytic activity and selectivity for propene production, the stability of catalyst work in the CO_2-POD process. In the presence of Zn_2SiBEA catalyst, high performance of CO_2-POD process are achieved: propene selectivity is up to 99%, the yield is above 50 % (at the temperature of 600 °C).

For the process of CO_2-assisted oxidative dehydrogenization of n-butane (CO_2-POD), metal-oxide



Indicators of the processes: CO_2-DR(propane conversion, selectivity for propene) on metal-zeolite catalysts (reaction mixture: 2.5 %vol. C_3H_8, 15%vol. CO_2, the rest is He, temperature 600 °C, volume rate of the reaction mixture is 6000 hr^{-1}), left; CO_2-POD (n-butane conversion, selectivity for products) on metal-oxide Ni-Bi-Mo/Al_2O_3 catalysts (reaction mixture: C_4H_{10} : CO_2 :Ar – 1:2:17, temperature 550 °C, volume rate of n-butane supply = 843 ml·gcat^{-1}· h^{-1})

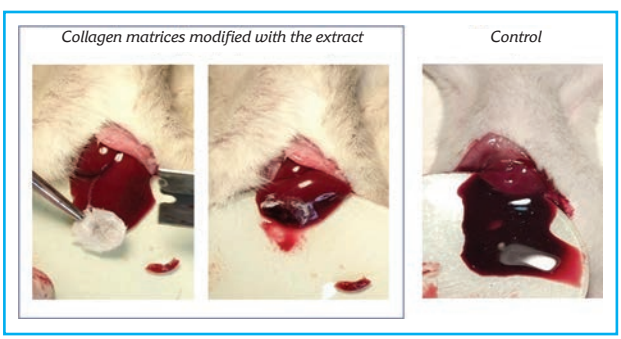
Ni-Bi-Mo/Al_2O_3 catalysts, which are selective for target products: butenes of various structures and buta-1,3-diene were developed. Dehydrogenating of *n*-butane to C_4 alkenes/dienes occurs on Ni-containing active centers, the addition of Mo facilitates further dehydrogenation of alkene molecule. A higher rate of buta-1,3-diene formation, which is achieved on Ni_1Mo_1/Al_2O_3 catalyst, is due to the cooperative action of Ni and Mo. At the same time, the presence of Bi in the catalyst composition causes a decrease in the rate of forming by-products of *n*-butane cracking. Due to that, selectivity for buta-1,3-dien up to 70% and to 95 % for *n*-butane dehydrogenation products is achieved on $Ni_1Bi_8Mo_8/Al_2O_3$ catalyst.

Orlyk C., Soloviev S., Larina O., Zirkata O., Chedryk V.

Development and Production of the Recombinant Blood Clot Activator in Plant Expression Systems

Scientists of O.V. Palladin Institute of Biochemistry of the NAS of Ukraine and the NAS Institute of Cell Biology and Genetic Engineering adapted plant expression systems for producing ecarin — a highly specific recombinant blood clot activator. The use of such plant systems opens up possibilities for scaling up the production of agents with directed hemostatic action for effective stopping of bleeding — efficient components of combined blood-stopping and wound-healing medicines in surgery as well as under field conditions. Targeted genetic constructs were created for storage and multiplication of genetic vectors for the purpose of further transfer of the target gene into plant systems. The optimization of plant systems was performed for target gene expression and accumulation of the recombinant blood clot activator. The screening of potential biomaterials suitable for using blood clot activator was conducted. Methods of stabilizing recombinant ecarin along with the protocol of its chromatographic purification were elaborated. The recombinant activator was checked for pro-coagulating activity *in vitro*, and the hemostatic effect of the recombinant blood clot activator was studied in conjunction with collagen matrices in the model system *in vivo*; their efficiency was shown to be at the level of the natural activator.

Komisarenko S., Kuchuk M., Chernyshenko V., Korolova D., Gryshchuk V., Sindarovska Y.



Approbation of collagen matrices modified with the extract of recombinant ecarin on the model of hepatic hemorrhage in rats. Modification of collagen matrix provides it with exceptional hemostatic properties

European Red List of Bees

Scientists of the State Institution "Institute for Evolutionary Ecology" of the NAS of Ukraine made a significant contribution to the creation and development of the most authoritative database on assessing the status of and recommendations for the conservation of global biodiversity: *IUCN Red List of Threatened Species*. They prepared 1350 (63 %) out of 2159 articles about wild bee species included in the European Red Lists, with data on their distribution, analysis of the population status, economic and ecosystem significance, threats to these species and measures necessary for their conservation. On the basis of these data, jointly with their colleagues, researchers prepared a new European Red List of Bees printed as a monograph by the official publishing house of the European Union. This work is an example of the direct implementation of scientific results and expertise in the practice of nature conservation and is a guidance document during the adoption of respective decisions at the level of the European Union and individual states.

Radchenko V.

The monograph "European Red List of Bees" published with the participation of scientists of the Institute of Evolutionary Ecology of the NAS of Ukraine

RESEARCH ACHIEVEMENTS. SOCIAL SCIENCES AND HUMANITIES

Scholars of the Section of Social Sciences and Humanities of the NAS of Ukraine carried out a significant amount of research in economics, socio-political and cultural development of Ukrainian society in conditions of the Russian Federation war against Ukraine.

Fundamental results in scientific design of socio-economic processes during wartime and postwar reconstruction were achieved by scholars of the Economics Department of the NAS of Ukraine. In particular, scientists of the Institute for Economics and Forecasting of the NAS of Ukraine, with the participation of their colleagues from the NAS Institute of Industrial Economics and Kuras Institute of Political and Ethnic Studies of the NAS of Ukraine, under the leadership of NAS academician Andrii Hrytsenko, carried out an interdisciplinary research into **forming the nationally rooted resilience and security of Ukraine's economic development in conditions of "peace — war" hybrid system**. According to its results, scientists developed a strategic approach that defines the nationally rooted development as building up a branched system of chains of creating added value and production of final products for domestic consumption and export on the basis of processing national raw materials, using Ukraine's S&T, labor, social solidarity and integration potential for realizing its national economic and security interests against the background of increased geo-economic fragmentation and geo-political confrontation.

Scientists substantiated macro-management strategies and mechanisms concerning the formation of the basics of resilient functioning of fuel and energy complex and the development of industry in the "war — peace" hybrid system as the material basis of the economy complex; renovation of the agri-food system and transport infrastructure; acceleration of digitalization; adjustment of monetary policy; promotion of socialization, as well as providing macroeconomic conditions of nationally rooted development. Recommendations for forming the strategy of nationally rooted development and methods of its implementation in the period of war and postwar reconstruction of Ukrainian economy were worked out and sent to government authorities.

The book **"Trial by Fire. War for Ukraine's Independence on the Civilizational Map of History and Global Modernity"**, prepared by the NAS Institute of History of Ukraine (its Editor-in-Chief is NAS academician Valerii Smolii), presents important issues of Ukrainian history and contemporaneity, which were made extremely acute by the Russian-Ukrainian war. It covers a wide range of issues of the Ukrainian, Russian and European history that are closely related to the military contemporaneity. Russian-Ukrainian confrontation is viewed through different layers of historical time: the Middle Ages, early modernity, new and modern times. It is shown that "historical motivation" of the Russian aggression against Ukraine and other states of the post-soviet area reflects monstrous neo-imperial features of today's Russian state-political project. Analyzed in a comparative perspective is socio-cultural nature of Putin's regime in Russia, determined is the range of challenges, problems and transformations of today's global and multi-cultural world, in particular those in the sphere of international relations in the context of the current war.

Scholars of Kuras Institute of Political and Ethnic Studies of the NAS of Ukraine prepared the analytical report **"Socio-Political Solidarity in Ukraine in the Postwar Period: Prognostic Estimates"** (edited by NAS academician Oleh Rafalskyi and NAS corresponding member Oleksandr Maiboroda). The analytical report contains a prognostic analysis of the problems that can influence the level of Ukrainian society solidarization after the end of the Russian-Ukrainian war, in conditions of Ukraine reconstruction. It considers the readiness of the political and institutional system of Ukraine for performing the consolidation role, analyzes possible lines of socio-group conflicts, outlines the principal strategic development lines along which national consensus can form; a forecast is made regarding changes in the kind of population solidarization, and likely scenarios of this process are considered along with main causes and factors that can have positive or negative effect on the degree of authorities and citizens cohesion, particularly, in the dialogue between them; using information resources for the influence on social consciousness, counteracting the external factors aimed at breaking social unity in Ukraine.

The Institute of Lawmaking and Scientific Legal Expertise of the NAS of Ukraine, jointly with the Scientific Advisory Board under the Head of the Verkhovna Rada of Ukraine, prepared the monograph **"Scientific Concept of Developing Ukrainian Legislation: Justification and Forecasting of Lawmaking Trends"** (with NALS academicians Ruslan Stefanchuk and

Nataliia Kuznietsova as general editors). The monograph is concerned with the analysis of the current state of Ukrainian legislation and forecasting the main trends of its development. It presents the comprehensive vision of legislation as a structured system based on the principles of the rule of law, constitutionalism and European integration; discloses the patterns of national legislation functioning, grounds the need for its reforming, defines priorities of state's lawmaking activities in public law, private law and social spheres. A lot of attention is given to the constitutional principles of legislation development, the role of scientific forecasting in forming an effective legal policy and ensuring the consistency of the system of normative acts. The publication is aimed at forming scientific principles of the state lawmaking policy, ensuring the consistency of the system of legal acts, and elaborating a systemic model of national legislation development in the context of European integration and global legal transformations.

Volume 12 of the "History of Ukrainian Literature" (in 12 volumes), was published. It had been prepared at Taras Shevchenko Institute of Literature of the NAS of Ukraine (volume editor is Roksana Kharchuk, PhD in philology). It covers the literature process from the winning of Ukraine's Independence in 1991, which symbolically marks the beginning of new Ukrainian literature, whose authors renounced socialist realism and upheld the principles of creative freedom, to the present. Unlike the previous volumes, volume 12 analyzes current literature, which is characterized by flexible assessments, the absence of cultivated canons. The material in the volume is organized according to the generic principle: poetry, prose, and drama. Review articles supplement the portraits of the authors whose creative works produced the greatest influence on the development of Ukrainian *belles lettres* after 1991. The basis of the volume is the creative work by the authors of the 1980-ies, yet, the reader will also find there quite a lot of material about writers of the 1990-ies and the 2000-ies. The publication follows the development of the genre literature, presents a review of the essayistic genre, it is supplemented with thematic chapters that analyze the literature of Maidan (the Revolution of Dignity), the poetry of the times of the Russian-Ukrainian war, war prose and drama. The volume is supplemented with the "Chronicle of events" and "Name index", it contains numerous photos and illustrations.

Method of Producing Broadband Electromagnetic Interference Radiation

In spite of the rapid development of modern radiocommunication systems, their vulnerability to intentional electromagnetic interference remains high. This makes it highly relevant and urgent to design effective broadband electromagnetic counteraction devices that are able to operate in a wide frequency range and form a controlled secure space.

Researchers of O.Ya. Usikov Institute of Radio Physics and Electronics designed and produced a prototype device emitting electromagnetic interference radiation, which was tested in laboratory and field research. It blocks most frequency channels of widely used radiocommunication systems, and its radiating antennas form a protected dome-type space due to creating powerful broadband electromagnetic interference with circular polarization.

Scientific novelty of the obtained results is the production of a broadband generator of powerful interference signal, development of antennas with circular polarization and cupola-shaped directivity diagram, and in providing electromagnetic compatibility of all elements of the system, which guarantees its effective functioning. In the process of designing, researchers solved problems of broadband generation, increasing the radiation power and the density of its distribution in the operating range. The problems of creating antenna systems capable of forming cupola-shaped electromagnetic shielding were solved as well.

Antenna system of the broadband device emitting electromagnetic interference radiation

The obtained results show increased, as compared to its analogs, efficiency of the developed device, which can be used for blocking radiocommunication channels near moving and immovable objects.

Kohut O., Logvinov Y., Nosatyuk S., Ostrizhnyi Ye, Kolenov I., Sobolyak O., Pochanin H., Reznichenko M., Yehorov S., Dakhov M., Zayets M.

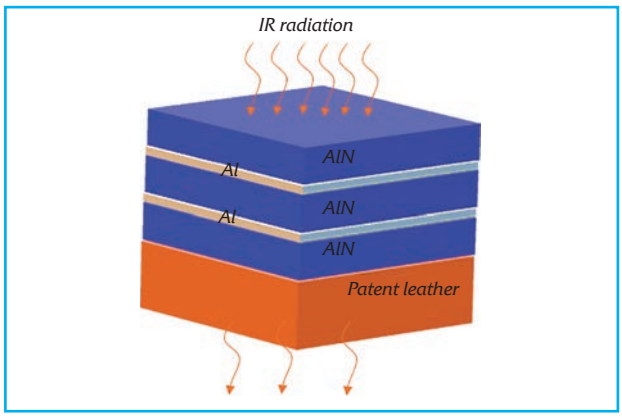
Multilayer Stack Structures of Multi-Band IR Filters of Stealth Systems

In many leading countries of the world, active research towards developing means of manpower and technical systems concealment from detection by optical-electronic reconnaissance means that function in the thermal (infrared) range of electromagnetic waves is going on. The analysis of open literature sources indicates intensive development of multi-spectral thermal radiation detectors that operate in several spectral ranges, which significantly reduces the effectiveness of traditional single-band concealment means. Due to that, known approaches to concealment prove to be insufficient, which justifies the need to develop novel materials and find new engineering solutions capable of providing effective multiband concealment of special-purpose objects.

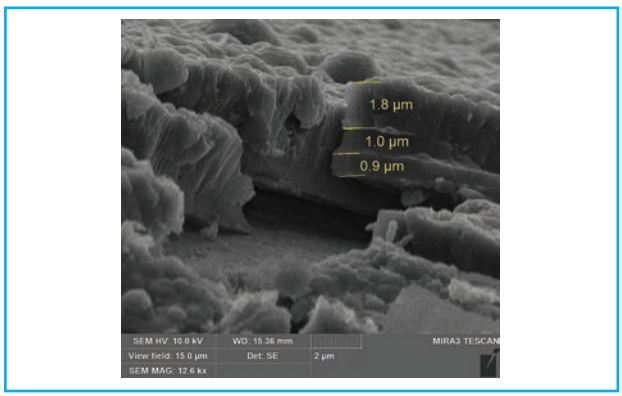
Scientists of G.V. Kurdyumov Institute for Metal Physics focused research efforts on using their own basic and applied developments as well as world experience in the field of ion-plasma technologies for creating multilayer stack structures of multiband IR filters. For that purpose, they use unique vacuum technological equipment which combines helicon-arc and ion-plasma processes and provides low-temperature synthesis of film coatings. It is due to the capabilities of this equipment that multilayer stack structures were created for the first time on the basis of AlN, Al and AlON films synthesized in helicon ion-plasma processes. Such coating architectures make it possible to purposefully design spectral properties of the material and control its interaction with thermal radiation in a wide wavelength range.

In particular, researchers discovered expansion of the IR radiation blocking band in 2—25 μm range towards short waves close to the first window of atmosphere transparency (3—5 μm), with simultaneous significant IR radiation suppression in this range, where the transmission is less than 3 %. Almost complete suppression of IR radiation was achieved in the range of the second window of atmosphere transparency (8—14 μm).

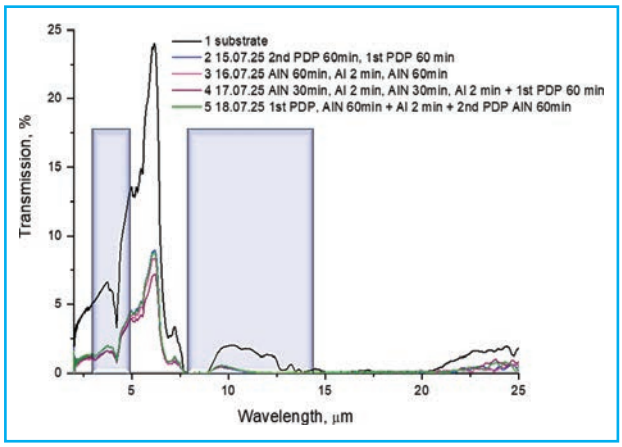
The results obtained indicate promising prospects of the created multilayer stack structures as a basis for innovative broadband IR filters with qualitatively new



Five-layer stack AlN/Al/AlN/Al/AlN structure on a polymer ЛКМ150 substrate (d = 150 μm)



*SEM image of the profile of AlN/Al/AlN/Al/AlN five-layer stack structure (thickness **d** of AlN is 1.8, 1.0 and 0.9 μm, and **d** of Al layers < 30 nm)*



Spectral dependence of IR transmission of stack structures of various compositions and thicknesses on the ЛКМ150 flexible polymer substrate in 2 – 25 μm range (the atmosphere transparency bands 3 – 5 and 8 – 14 μm are highlighted)

characteristics that can be used for effective multiband concealment of special-purpose objects.

Rudenko E., Korotash I., Polotskiy D., Dyakin M., Svavilnyi M., Skoryk M., Tsybrii Z.

Plasma Arc Additive Cladding of High-Strength Titanium Alloy Products for Aviation and Space Military Equipment

E.O. Paton Electric Welding Institute of the NAS of Ukraine developed and produced a robotic complex for additive plasma-arc cladding (APAC) of titanium alloy products, which contains a sealed flexible chamber with inert atmosphere and a plasma torch with a system of added local protection of the cladded metal. Due to the modeling of dynamic gas flows in the developed plasma torch, researchers determined the optimal consumption of plasma, which depend on the plasma-forming nozzle diameter. On the example of TC4 titanium alloy, optimal parameters of APAC modes were found. Researchers determined maximum cladding rate (4.33 mm/s) and plasma gas consumption (2 l/min) at which the acceptable formation of the cladded platen is maintained.

In was shown on the example of high-strength titanium alloy Ti-6Al-4V (TC-4) that the cladded metal of printed 3*D* elements of the "wall" type is characterized with the level of strength properties which is on average 15% higher than the maximum strength and flowability of sheet metal in the initial (non-thermally processed) state and corresponds to the characteristics of sheet metal after heat treatment.

The creation of 3*D* printing complex with APAC method for manufacturing important, large-sized in particular, high-strength titanium alloy products provides Ukraine with the opportunity of achieving tech-

Robotic complex for additive plasma arc cladding of titanium alloy products in controlled atmosphere

nological autonomy in critical sectors of industry and national security. Besides, the proposed approach makes it possible to implement a radically new type of decentralized production of special-purpose parts and structures on the basis of distributed small-sized robotic (automated) additive production sites that are not tied to stationary production facilities and are characterized with high resistance to the disfunction of centralized industrial infrastructure.

Akhonin S., Korzhyk V.

State-of-the-Art Carbon-Carbon Materials for Modern Energy, Mechanical Engineering, Critical Elements of Rocket and Space Technology

The National Science Center "Kharkiv Institute of Physics and Technology", on the basis of its scientific and production complex, continues systemic research aimed at developing state-of-the-art carbon-carbon composite materials (CCCM) and technologies of their production for the needs of modern nuclear energy, medicine, mechanical engineering, critical elements of rocket and space technology, etc. In accordance with the results obtained, a "closed loop" concept of producing carbon-carbon composite materials was developed and implemented, which considerably reduces dependence on imports of critical carbon-graphite materials and increases technological autonomy in strategically important areas.

For the funds received from fulfilled international contracts the abovementioned scientific and production complex was provided not only with modern research and analytical facilities but also with high-precision digitally controlled machining equipment. This significantly promoted the possibility of direct implementation and testing of the research results obtained.

In the framework of scientific cooperation with G.V. Kurdiumov Institute for Metal Physics of the NAS of Ukraine, CCCM molds for synthesizing composites of the Ti_3SiC_2-TiC-$TiSi_2$ system were developed and produced. These molds ensured the stable operation of a research installation at the temperatures 1300—1600 °C and the maximum pressure up to 150 MPa, which are unattainable for industrial graphites.

In cooperation with specialists of industrial institutions, state-of-the-art graphite-containing aerosol systems for the concealment of critical objects and military equipment were developed. Testing of the aerosols showed their high potential in the visible and infrared ranges; the work on their classification and deployment was started.

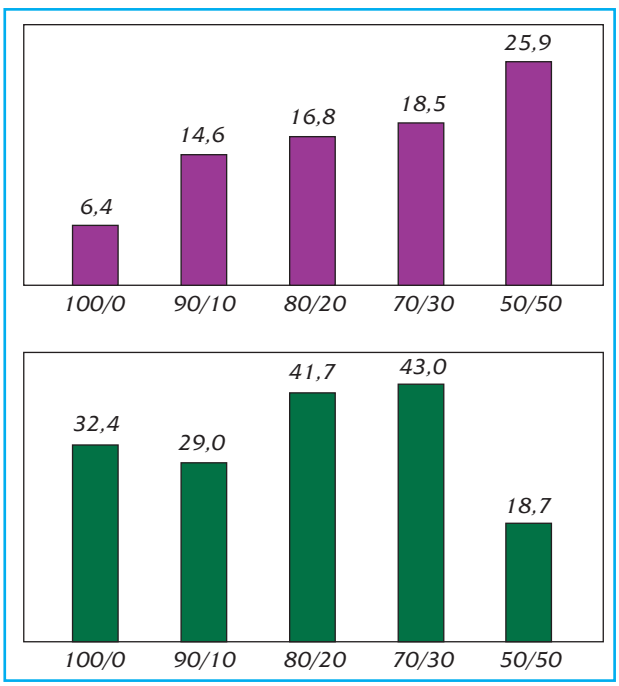
Gurin I., Guyda V., Moshnik O., Bukolov O.

Special-Purpose Composite Materials and Structural Adhesives for Import-Substitution Technologies

Scientists of the NAS Institute of the Chemistry of Macromolecular Compounds created new functional polymer materials for special and dual purposes, in particular, adhesives for joining materials of various nature that are not inferior to imported analogs in terms of their technical, technological and exploitation properties.

They developed effective adhesives based on epoxies modified with organosilicon compounds and cured with amine compounds, which are intended for agglutination of both high-energy (steel) and low-energy (aluminum alloy) surfaces. Researchers produced doped phenolic rubber compositions with high adhesion (shear strength amounts to 22 MPa) to duralumin; they were tested in industrial production conditions.

Oligo-ether-urethane-epoxy composites with regulated functionality were obtained by modifying oligo-ether-oxy-propylene-glycol with di-epoxies of various nature and with mono-isocyanate. The obtained ether-epoxy block copolymers have considerably lower viscosity as compared with urethane-epoxies based on diene rubbers and are less prone to forming aggregates or microgels, i.e. they have more uniform structure. The synthesized urethane-epoxies based on ethers make it possible to substitute diene rubbers in highly



Strength as dependent on modifier amount, MPa: normal tear strength for steel 'mushrooms' (top), shear strength for aluminum plates

Pressed material products: 1 – ceramic resistor base; 2, 3 – heat-dissipating structures of electronic plates (processors); 4 – ceramic conductive connectors

filled composites intended for special purposes. They do not need the addition of softeners, which is an essential factor in producing adhesives and binders for high-energy materials.

An organosilicon binder with a low carbon content, and a pressed material intended for manufacturing composite ceramic elements of products for electronic components and devices operating in a wide temperature range and under extreme conditions were developed.

Brovko O., Grishchenko V., Tolstov O.

Technology of Managing Microgrids of Electricity Consumers with Distributed Energy Resources

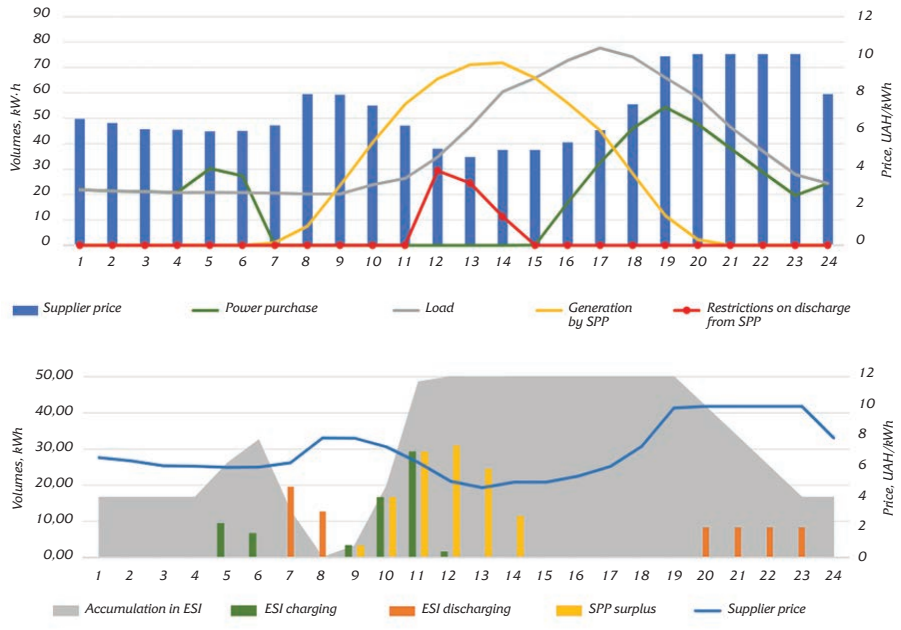
Reliable and high-quality power supply for critical infrastructure consumers in the conditions of wartime and the reconstruction of the unified energy system of Ukraine in the post-war period needs to ensure the functioning of electrical networks on new principles according to which the digital transformation under decentralized generation and power market functioning become the basic components. An extremely important and timely task is the implementation of technologies of micronetworks — the groups of interconnected loads and distributed generation with defined electrical limits that form a local power system at the level of power distribution system. It functions as a single controlled object and is able to operate in parallel with the unified energy system of Ukraine or in the island (isolated) mode. Micronetwork planning and operational management requires monitoring and energy management systems whose functions should be implemented through a unified control platform.

The Institute of Electrodynamics of the NAS of Ukraine developed the prototype of a system for monitoring and controlling micronetwork parameters, developed models and algorithms to optimize the use of available energy resources of the micronetwork consisting of a solar power plant and an energy storage installation. That permits minimizing the cost of purchasing electricity by the power grid owner on the retail market in the conditions of normal electricity supply and ensuring micronetwork readiness to power critical loads in the isolated mode when centralized power supply is absent.

The use of the proposed technology was implemented within a pilot project of building a power microgrid on the basis of the Institute and was tested during the extremely difficult autumn-winter period of 2025—2026, which proved the efficiency of the proposed solutions. Further studies and tests of the technology will help formulate the requirements for making typical decisions in the management of micronetworks for non-household electricity consumers, in particular institutions of the NAS of Ukraine.

The development of the innovative Ukrainian technology for the management of microgrids of non-household electricity consumers will help deal with the strategic challenge for electrical energy sec-

Display of monitoring the data of microgrid parameters



Display of the results of optimizing the use of microgrid resources (top) and of an energy storage facility in conditions of readiness for the isolated mode

tor of Ukraine: providing power for critical loads when the centralized power supply is absent and improving the management of distributed power resources in normal electricity supply conditions and the operation of retail electricity market in Ukraine.

Kyrylenko O., Blinov I., Miroshnyk V., Parus Ye., Trach I., Shymaniuk P.

Scintillation Fibers Based on YAG : Ce

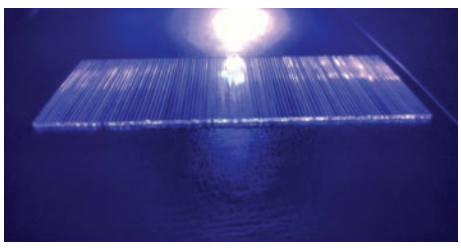
Luminescence decay time is one of the critical parameters for designing devices based on this phenomenon. Ideally, the pulse is to be kept in the window of beams intersection to prevent accumulation effects when residual light from the previous event can contaminate the signal from the next one, which will lead to distorted/falsified measurements. In the case of the High Luminosity Large Hadron Collider, beams intersection is 25 ns.

Researchers of the NAS Institute for Scintillation Materials achieved the reduction of luminescence decay time to 16—25 ns in YAG : Ce crystals produced in the reductive atmosphere by co-alloying with alkaline earth elements and scandium.

Another, and no less important, parameter of the crystals is light yield (LY): the material must be quite bright and effectively transform the released energy into photons. Initial characteristics provide for the minimal LY over 10.000 photons/MeV. Besides, the crystal must be sufficiently transparent for its own radiation wavelength (from 80 to 90 %) to ensure efficient light gathering, while its emission spectrum must correspond to quantum efficiency of the reader photodetectors (usually about 400—600 nm). In synthesized YAG : Ce crystals, the LY value remains at the level of 14—18 thousand photons/MeV.

In high energy physics, in particular in experiments with high luminosity colliders, detectors operate in extremely difficult conditions — under intense radiation and at high frequency of events, which imposes strict requirements on the scintillation crystals used in calorimetry. A striking example is *SpaCal* — a type of sampling electromagnetic calorimeter that consists of scintillation fibers imbedded in a dense absorber.

A procedure for obtaining scintillation fiber was developed, and a batch of 100 elements of YAG : Ce, Ca, Mg scintillation fiber of the size 1 × 1 × 50 mm^3, along with 10 elements of bismuth orthosilicate (BSO) of 10 × 10 × 50 mm^3 size were produced to be tested in *Spaghetti (SpaCal)* calorimeter prototype at CERN. YAG : Ce, Ca, Mg fibers will be checked for compliance



Samples of YAG : Ce fibers under UV radiation

with the key specifications that are to be met for ensuring reliable operation and optimal performance.

Gerasymov Ia., Tkachenko S., Kurtsev D., Sadivnycha S., Sidletskiy O.

Hybrid Hydrogel Systems with Combined Bactericide and Anti-Tumor Action

Researchers of F.D. Ovcharenko Institute of Biocolloid Chemistry of the NAS of Ukraine developed hybrid materials based on sponge polyvinylformal, pH- and heat-sensitive "smart" hydrogels, as well as gold nanoparticles as drug carriers. The mechanisms of incorporation and controlled release of drugs from hybrid hydrogel matrices were investigated, in particular those of the accelerated release of *Albucid antimicrobial* agent and the prolonged release of *Doxorubicin cytostatic*. The combination of polymer matrix with gold nanoparticles was found to provide a rise in the regenerative activity of the material, improve its bactericidal action, and increase the therapeutic efficacy of the system.

During comprehensive research *in vitro* and *in vivo*, high biocompatibility of the developed hybrid materials, the absence of cytotoxic effect, and beneficial interaction with biological tissues were found. Researchers showed that the implantation of hydrogel systems was not accompanied by the development of acute inflammatory reactions or material resorption, while the processes of integrating with surrounding tissues were controllable.

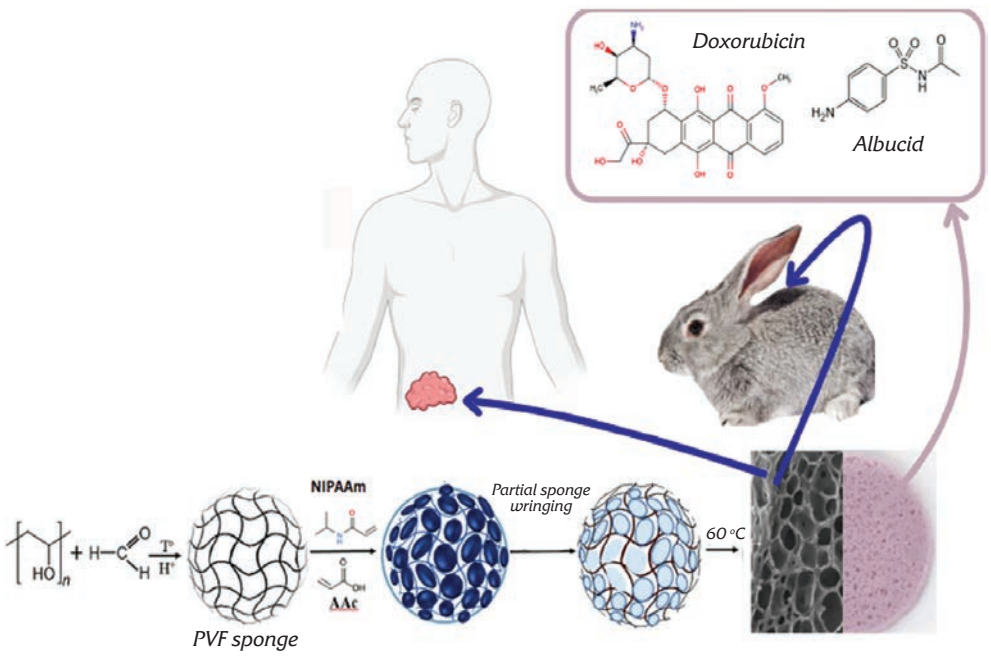
Preclinical studies hosted by the Filatov Institute of Eye Diseases and Tissue Therapy in Odesa confirmed the absence of irritating effects of the implants, and histomorphological studies indicate a gradual replacement of implants with fibrous tissue without signs of acute inflammation. It was also established that the application of local medical hyperthermia activates the therapeutic effect of the hybrid systems.

Samchenko Yu., Maletskyy A., Dybkova S., Kernosenko L.

Development of Solid Dispersed Hesperidin Systems for Pharmaceutics

Researchers of L.M. Litvinenko Institute of Physical-Organic Chemistry and Coal Chemistry of the NAS of Ukraine and Kyiv National University of Technology and Design developed solid dispersed systems (SDS) that contain hesperidin flavonoid, using the method of centrifugal fiber formation. This novel method of producing hesperidin SDS consists in thermal melting of the physical mixture of an active pharmaceutical ingredient, polymer carrier, and excipients in the heating head of the installation; after that, due to its high-speed rotation, thin fibers are formed from the melt under the action of centrifugal force.

It was established that hesperidin solubility in aqueous solutions in the composition of centrifugally formed SDS on the basis of polyvinylpyrrolidone, mannitol, and saccharose is several orders of magnitude higher than the solubility of the flavonoid as an individual substance. It was confirmed that the SDS ob-



The scheme of incorporation and controlled release of hybrid hydrogel matrices

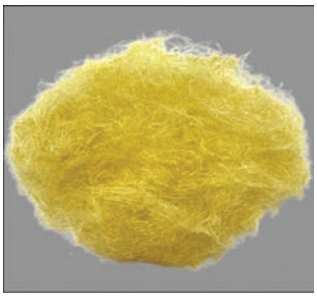
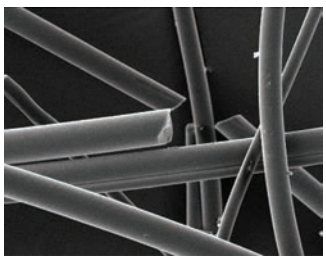


Image of SDS hesperidin fibers after preparing



SEM image of centrifugally formed hesperidin SDS (view field is 150 μm)

tained are thermodynamically stable and flavonoid bioavailability is determined by the combination of morphological and physicochemical properties of the systems. It was proven that in the developed SDS the degree of hesperidin crystallinity decreases, and flavonoid interaction with components of the systems is caused by the formation of intermolecular hydrogen bonds whose number is several times higher than that in the initial compound, which provides the stabilization of its amorphous state in the compositions.

Relying on the fundamental results obtained, a technological process of producing highly solvable hesperidin forms by centrifugal fiber formation was developed. Its implementation at chemical and pharmaceutical enterprises will contribute to broadening the technological basis for creating an active pharmaceutical ingredient with high bioavailability and producing effective low-toxic socially oriented medicines.

Lisovyi V., Lyzhniuk V., Bessarabov V., Popov A.

Development of Spray for Nazal Therapy at Early Stages of Alzheimer's Disease

Scientists of the State Institution "Institute of Food Biotechnology and Genomics of the NAS of Ukraine", jointly with specialists of the Institute of Neurology, Psychiatry and Narcology of the NAMS, developed the spray liposomal medicine of curcumin and microRNA-101 for nasal therapy at early stages of Alzheimer's disease. The liposomal emulsion spray was produced by lipid films hydration followed by sonification and stepwise extrusion through membrane pore openings of 200, 100 and 50 nm. The results of the intranasal use of the preparation in experimental animals with the model of inflammation process in brain tissues showed a macromorphological suppression of the inflammatory process and an abrupt drop in the level of pro-inflammatory cytokines. The dynamics of cytokine (IL-1β, TNFα, IL-6) growth in the neocortex and hippocamp was studied. The duration of the anti-inflammation aftereffect of the 15-day course application of the liposomal spray containing curcumin and miR-101 was from five to10 days, while the aftereffect of the anti-myeloidogenic effect of its course application lasted at least for 10 days.

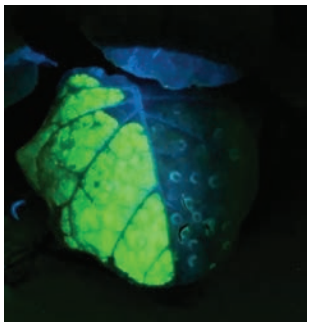
It was also found that in the hippocamp and neocortex of the experimental animals that were given the therapeutic complex for 25 days the content of active nitrogen forms and the area of amyloid aggregates were significantly lower. A positive detection of curcumin- and miR-101-Cy5-specific fluorescence in the hippocamp and the neo-cortex of experimental animals was shown, which indicated a successful transport of these compounds into brain nervous tissue after the therapy. The optimal therapeutic medicine dose (the ratio of curcumin and microRNA-101) for the effective suppression of amyloidosis, neuroinflammation and oxidative stress was determined along with the efficient duration of the course use of the spray in liposomal form.

The results obtained indicate the effective use of the spray liposomal form of curcumin and microRNA-101 at early stages of Alzheimer's disease.

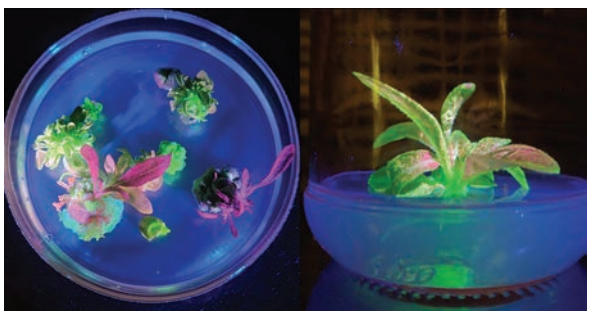
Blume Ya., Shulga S.

Plant Producers of Salmocin — Antibacterial Protein against *Salmonella*

A rapid growth in antibiotic resistance of pathogenic bacteria motivates researchers to detect and study new alternative compounds with antimicrobial properties. Such an alternative to antibiotics is bacteriocins — specific antibacterial proteins, Salmocin in particular, which selectively kill pathogenic *Salmonella* serotypes, i.e. enterobacteria that cause severe diseases (typhoid fever, paratyphoid fever, and salmonelloses). Scientists of the NAS Institute of Cell Biology and Genetic Engineering created genetic vectors and produced transgenic plants containing Salmocin-encoding genes. To obtain recombinant Salmocin in plants, they used the ethanol-inducible expression system along with the constitutive (constant) expression of the recombinant



Expression of fluorescent protein ZsGreen in Bentham tobacco (Nicotiana benthamiana) leaves on the fifth day after infiltration (the photo was taken in blue light)



Regeneration (left) and rooting (right) of selected transgenic tobacco plants after genetic transformation with the vector containing Salmocin gene (the photo was taken in green light)

protein gene. At the first stage of the study, both genetic vectors were used for Salmocin transient expression in the leaves of *Nicotiana benthamiana*. To assess the accumulation of the recombinant protein, the reporter *ZsGreen* protein was employed, which in blue light (approximately 470—495 nm) produces a bright green fluorescent glow. This protein was also used for selection at the regeneration stage of tobacco plants with a high level of transgene expression. Transgenic tobacco plants with inducible expression system were created; the plants produced Salmocin after treating them with 4 % ethanol.

In cooperation with D.K. Zabolotny Institute of Microbiology and Virology, the antibacterial activity of the extracts of Salmocin-producing biotech plants against *Escherichia coli* strains and salmonella culture (*Salmonella enterica* subsp. *enterica* serovar *Ebony* NCTC 6017) was confirmed. The emergence of growth retardation zones suggested the presence of the antibacterial activity of plant extracts. In this way, Salmocin-accumulating transgenic plants with antibacterial activity against both salmonella and *Escherichia coli* were produced.

Kuchuk M., Rudas V., Shcherbak N.

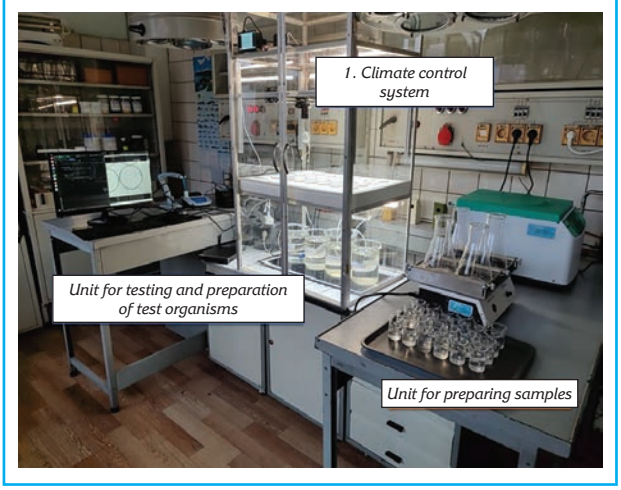
Unified Test System for Assessing Toxicity and Determining the Class of Contaminants that Enter Water Bodies

Scientists of the NAS Institute of Hydrobiology developed and tested the technological scheme and the algorithm of assessing toxicity and identifying the class of contaminants in water and bottom sediments with the use of sensitive test organisms; they can be deployed in water quality control laboratories. An operating minilab prototype (working name *Unitest-Toxid* Minilab) for biotesting water and bottom sediments of water bodies, water-supply sources in particular, which are affected by unforeseen negative impacts, including military operations and related activities.

The advantages and practical value of the developed compact laboratory for identifying the class of contaminants that cause toxicity are in its complex nature (the investigation of both water and bottom sediment samples), efficiency, low cost, promptness of obtaining results, a high degree of their reliability, the simplicity of cultivating microorganisms, etc.

Researchers developed methodological recommendations for assessing the toxicity and identification of contaminant classes in water and bottom sediments that are of a general nature, as well as practical recommendations for using the microlab and performing a complex assessment with possible procedure options in accordance with the tasks and the equipment available. The compact lab performance and validation of complex assessment technology were tested jointly with potential end users of the innovative product.

Yuryshynets V., Konovets I., Kipnis L.



Unitest-Toxid Minilab

INTERNATIONAL COOPERATION IN THE FACE OF MODERN CHALLENGES

The National Academy of Sciences of Ukraine in the face of hard challenges caused by prolonged Russian armed aggression made significant efforts to develop international scientific and S&T cooperation. Over the year, numerous international meetings attended by Academy representatives were held, where capabilities and achievements of Ukrainian researchers were presented, the problems of research work in current conditions were considered along with the ways of solving them with international support.

An important event for elaborating efficient mechanisms of international support for Ukrainian science was **international workshop "Strengthening Ukraine's scientific and innovative system"** held in March 2025 in Zurich (Switzerland). It was organized by the US National Academy of Sciences in partnership with Simons Foundation and Swiss Federal Technical Institute of Zurich. The workshop united leading experts of the USA, Europe and Ukraine: representatives of scientific circles, authorities, business, and charitable foundations to identify effective solutions and programs for strengthening Ukrainian scientific and innovative system as the basis for further economic renovation and sustainable development of Ukraine. At the workshop, academician Anatolii Zagorodnii presented the strategic vision of Academy's role in restoring and developing Ukraine's scientific and innovative ecosystem.

Participants of the event discussed the key aspects of international cooperation and the integration of Ukrainian science to global research and innovation processes. Special attention was given to activating joint international projects aimed at supporting Ukrainian science and technological development. These initiatives were recognized as critical for economic renovation and long-term development of the country. There was an informative exchange of experience in the implementation of innovative projects that will help "build bridges" in the separated research and innovation landscape of Ukraine.

In September 2023 the President of the Academy took part in **international scientific events in Warsaw** (Poland), in particular in the session of Joint Ukrainian-German working group for scientific and technological cooperation and in the tripartite meeting "Ukrainian science in transition — partnership for reforms and reconstruction" (Ukraine — Germany — Poland), which discussed the issues of renovating scientific infrastructure, implementing the program of support to leading scientists and young researchers, as well as participation in international contests.

On 3—14 October 2025, the President of the Academy visited German electron synchrotron (*DESY*) in Hamburg, which is one of the leading research centers of fundamental sciences. During the visit he took part in the international scientific colloquium "Broadening horizons in science, institutions and cooperation" and in the work of the round table that united the heads of the main structural units of *DESY* and Ukrainian scientists engaged in its programs, where prospects of further cooperation between the NAS of Ukraine and *DESY* were discussed. Academician Anatolii Zagorodnii emphasized the importance of this interaction, noted its efficiency and a significant contribution of *DESY* to supporting Ukrainian scientists and extending their participation in European research projects. Professor Beate Heinemann, the Chairman of *DESY* board of directors, presented her vision of further cooperation, which envisages a more active involvement of NAS researchers in *DESY* international programs and experiments. Besides, *DESY* team expressed their readiness to join the creation of Ukrainian *MAVKA* experimental line on Polish *SOLARIS* synchrotron.

Active NAS interaction with the academies of sciences of the member states of the Organization of Black Sea Economic Cooperation (OBSEC) promoted the strengthening and broadening of the transborder scientific cooperation. In June 2025, under the aegis of the

The presentation of NAS President academician Anatolii Zagorodnii at the tripartite meeting "Ukrainian science in the period of transition – partnership for reforms and reconstruction" (Ukraine – Germany – Poland)

NAS President academician Anatolii Zagorodnii got acquainted with DESY research infrastructure – accelerators, laboratories, and research installations

OBSEC Parliamentary Assembly, the **Second Meeting of the presidents of the academies of sciences of OBSEC countries and presidents of the leading universities of the Turkish Republic** took place at Istanbul University. Academician Serhii Pyrozhkov, vice-president of the NAS of Ukraine, participated in it. The meeting considered the development of joint research programs, strengthening of interdisciplinary interaction, introducing AI elements to science and education, as well as broadening academic mobility opportunities for young researchers.

On 10 January 2025, an extremely important event for Ukrainian scientists took place — the ceremonial signing of the **Memorandum of mutual understanding regarding the feasibility study of future *FCC* collider at *CERN* International Research Center** with Ukrainian scientific and higher education institutions. The future *FCC* collider will replace the current Large Hadron Collider and will be three times as large. The project is developed by *CERN* international research organization jointly with more than 150 universities of the world. Three scientific organizations of the NAS of Ukraine took part in the Memorandum signing: the National Science Center "Kharkiv Institute of Physics and Technology", Bogolyubov Institute for Theoretical Physics, and the Institute for Scintillation Materials. Cooperation with *FCC* is a dynamic association of scientists, institutions and countries working at the progress of technologies and the development of new instruments for acquiring fundamental knowledge in particle physics, obtaining fundamental knowledge of how the Universe works.

On 27 October 2025, the signing of "Letters of intent" between the Scientific Center "German Electron Synchrotron (*DESY*)", German Center for Astrophysics (*DZA*) and Ukrainian Astronomical Association (*UAA*) took place. The documents lay the foundation for concluding memorandums and cooperation agreements aiming at restoring Ukrainian astronomy integrating it to the European scientific area. The signing of the "Letters of Intent" became an important step in implementing the international initiative "Restoration of Ukrainian astronomy", which provides for the development of joint research in astrophysics, astrophysics of elementary particles, neutrino astronomy and radio astronomy.

Over the year, Academy's research teams were actively involved in leading international programs, such as: Framework European Union Program of Research and Innovation "Horizon Europe", the Program of Research and Education of the European Atomic Energy Community (Euratom), which is complementary to the "Horizon Europe" program, the NATO Program "Science for Peace and Security", the Program Interreg-EU the Danube Region and *Interreg-NEXT* the Black Sea basin, *Q4Bio Challenge* program from *Wellcome Leap,* Mobility program, etc.

The implementation of 51 scientific projects of the **Framework European Union Program on research and innovation "Horizon Europe"** was going on, in particular, of 14 projects under the program of research and education of the European Atomic Energy Community (Euratom). Among the projects of this program, one should emphasize the four-year ***project Liberation Analysis for optimizing the extraction and processing of Critical Raw Materials (CRMs, the Analysis to optimize mining and enriching critical raw materials)***, whose implementation will be started this year. M.P. Semenenko Institute of Geochemistry, Mineralogy and Ore Formation of the NAS of Ukraine is one of 14 participants of the Consortium of scientific organizations of Spain, Portugal, Belgium, Canada, and Brazil, which will deal with problems faced by EU in *CRMs* mining and processing, improving mining and processing, restoring the natural environment. Probably, an intellectual modular system will be created on the basis of analyzing the processes of developing *CRMs* deposits, which combines the control system with AI methods and helps optimize the processes of mining and enriching critical raw materials.

In September 2025, the **project *Research Infrastructures for the Future of Ukraine: Roadmap for Sustained Growth and Recovery (RIFF)*** under the "Horizon Europe" program was started. It is aimed at promoting the upgrading of research and innovation system in Ukraine and intends to develop the roadmap for restoring and upgrading the infrastructure in Ukraine, ensure an increase in the awareness level of governmental structures, politicians and scientific community. *RIFF* will facilitate the mobility and knowledge exchange between EU research infrastructure and Ukrainian scientific community, in particular, due to its education program for the heads and operators of Ukrainian infrastructure.

12 scientific projects that received NATO support under "Science for Peace and Security" Program were successfully implemented at NAS institutions. They covered a wide range of research tasks of solving important applied problems in the sphere of security and defense. The projects include the detection and clearance of unexploded mines and ammunition; the development of multisensory unmanned methods of detecting various types of mines; the development of flexible nano-ferroelectrics for rapid cooling of combat electronics; electrochromic metal oxides for transparent superconducting electronics; a melt-carbonate liquid fuel cell for energy security; a comprehensive strategy of restoring natural aquatic ecosystems and aquaculture in Ukraine, etc. In particular, in August 2025, G.E. Pukhov Institute for Modeling in Energy Engineering **started the implementation of the many-year project *Pathways to Infrastructure Resilience in Ukraine***, aimed at the development of modern modeling instruments for increasing the resilience of Ukrainian critical infrastructure. The project is to develop state-of-the-art methodologies for testing and strengthening network resilience of state-owned and industrial systems in response to current challenges — cyberattacks, geopolitical threats, and natural disasters. The project actively involves end users, in particular the Ministry of Digital Transformation of Ukraine, and Dallas — Fort Worth airport (USA).

Active cooperation of Academy scientists with foreign colleagues **in the framework of projects in high energy physics and quantum technologies** should be emphasized. Academy physicists and German scientists implemented the collaborative project "Investigating the possibility of using crystals for electron removal with 6 GeV energy on **German electron synchrotron (*DESY*)**.The task of the project is to create a test electron channel at Europe's largest DESY synchrotron, which in the coming years will be the world's most powerful X-ray source, relying on the technology proposed at the National Science Center "Kharkiv Institute of Physics and Technology". This technology implements the idea of using bent crystals for the "slow removal" of the beam of high-energy relativistic electrons from the accelerator. More than a half of the research team continues to work in Ukraine, receiving a *DFG* grant support.

In 2025, according to the contest results for ***Q4Bio Challenge from Wellcome Leap program***, scientists of Kyiv Academic University, as members of an international team, received finance for participating in the third stage of the program, whose aim is to use quantum technologies in support of human health. The main task of the research is to implement such complex tasks of processing genomes and pangenomes that are beyond the capabilities of present-day classical computers. Such tasks involve assembling genomes from DNA sequences and their accurate comparing with reference pangenomes, which is of critical importance for genetic variability studies. Scientists plan to use quantum technologies for a new breakthrough in genomics.

Signing of the "Letters of intent" by NAS corresponding member Iryna Vavilova (vice-president of the Ukrainian Astronomical Association), professor Christian Stegmann (director of astroparticles direction at DESY) and Dr. Stefan Ohm (DZA director for scientific communication and regional development)

Last year, the Academy paid a lot of attention to promoting bilateral and tripartite scientific relations with international partners.

For example, **Ukrainian-German S&T cooperation** was carried out in the framework of 27 inter-institute agreements, and that amounted to nearly 70 joint research topics that involved about 40 NAS institutions.

The Institute of Industrial Economics of the NAS of Ukraine started the implementation of a scientific research work **in the framework of *EMBRACE* project** (The emergence of resilience: effective mobilization and building of communities that quickly respond and adapt). The *EMBRACE* project supports the renewal of Ukrainian cities and towns, promoting their resilience during and after the conflict. The partners of the project are Rhine-Westphalian Technical University of Aachen, Helmholtz Centre for Environmental Research and Humboldt University of Berlin.

In July 2025, the renewed **Agreement on Scientific Cooperation between the National Academy of Sciences of Ukraine and Slovak Academy of Sciences (SAS)**, was signed along with the corresponding protocol for it. The document aims at the expansion of mutually beneficial cooperation between institutions of the two academies, namely, the implementation of joint research projects, the exchange of scholars, participation in international events, and the mutual exchange of scientific information. In the second half of the year, in accordance with the renewed Agreement, the NAS of Ukraine and SAS announced a contest of Ukrainian-Slovak projects for 2026—2027.

The **Memorandum of Cooperation between Vernadsky National Library of Ukraine and Toronto Public Library Board (Canada)** was signed. This event became an important step in strengthening the transatlantic cooperation vector of V.I. Vernadsky Library, directed towards developing friendly relations between Ukraine and Canada. The Memorandum provides for the development of bilateral cooperation in the spheres of librarianship, information communications and socio-cultural work, which will be beneficial for enriching cultural dialogue and exchanging scientific achievements.

On 25 February, a Hungarian delegation including Mr. Antal Heiser, Ambassador Extraordinary and Plenipotentiary of Hungary to Ukraine; Mrs. Eva Heizerne Hegedusch, diplomat for culture and education of the Embassy of Hungary in Ukraine; David Roja, CEO of Ferenc Széchenyi National Library of Hungary et al. visited V.I. Vernadsky National Library of Ukraine. The guests were acquainted with the history of V.I. Vernadsky National Library of Ukraine and its main building, visited several departments of the Library, in particular, the Department of Old Prints and Rare Editions of the Institute of Book Studies, got acquainted with the display of unique exhibits, including incunabula ("The Book of Chronicles" by Hartmann Schedel, Nuremberg, 1493), geographical atlas by Abraham Ortelius with a map of the Kingdom of Hungary, as well as rare books on Hungarian history: "Description of Hungary" (1634) and "Annals of the Kingdom of Hungary" by György Prai (1763). During the visit of the Hungarian delegation, **V.I. Vernadsky National Library of Ukraine and Ferenc Széchenyi National Library signed the Memorandum of mutual understanding, cultural cooperation in popularizing their collections and creating digital collections.**

Prestigious awards became the recognition of the achievements of Ukrainian science (both in general and those of individual researchers). In particular, four international collaborations on the Large Hadron Collider at *CERN* (*ATLAS*, *CMS*, *LHCb*, *ALICE*) received the Breakthrough Prize in Fundamental Physics for experimental verification of the key forecasts of modern quantum physics. Scientists of NAS institutions were among the members of those research teams: the Institute for Scintillation Materials, Bogolyubov Institute of Theoretical Physics, NSC "KhIPT" and the Institute for Nuclear Research. The work of the scientists of the NAS Institute for Nuclear Research in the *LHCb* experiment on the Large Hadron Collider on matter symmetry and antisymmetry was the participation in the discovery of the global scale. Pavlo Kasianov, an associate of the Institute for Applied Systems Analysis, was elected a corresponding member of the US National Academy of Artificial Intelligence for his contribution to the development of intellectual modeling and machine learning.

ACTIVITIES FOR COUNTERING HOSTILE SPECIAL INFORMATIONAL AND PSYCHOLOGICAL OPERATIONS

Countering the "Russian World" ideology, the reasoned deconstruction of myths and deliberate falsifications, as before, takes an important place in the research work of socio-humanitarian scholars of the NAS of Ukraine. Back in 2022, after the beginning of the Russian-Ukrainian war, researchers of the NAS Institute of the History of Ukraine started a thematic series of scholarly and popular-science publications "Current Russian-Ukrainian War in History Coordinates". Numerous monographs, brochures, methodological materials that both refute the Russian imperial representation of Ukrainian history and clarify the ideological origins of the Russian imperial aggression against Ukraine are regularly published in the format of this series.

The publication of the NAS Institute of the History of Ukraine "Between Scholarly Discourse and 'Victory Madness': On the 80th Anniversary of the End of World War II" (in 4 parts, with NAS academician Valerii Smolii as Editor-in-Chief) presents scholarly articles, journalistic materials, interviews of Ukrainian and foreign historians, politologists, sociologists, scholars in law on the issues of the Second World War. The authors form a broad spectrum of analytical assessments and interpretive constructs that reflect scholarly and social discourses in the event field of 1939—1945, of the historical and commemorative policy, the criticism of the "war madness" in particular. The texts that are thoroughly tested in the scientific and informational fields already produce a noticeable influence on the informational, cultural, educational and mnemonic space in Ukraine and beyond.

The monograph by NAS corresponding member Oleksandr Lysenko "'Orthodox Front' of Hybrid Confrontation" shows complex and dramatic trajectories of the coexistence of the Orthodox Church in Ukraine with various political regimes in a broad historical retrospect and in conditions of the current Russian-Ukrainian war. The author tracks repeated attempts at the independence from Moscow church center and a difficult way to acquiring the autocephalous status. Various facets of the situation in Ukrainian Orthodoxy during the development of sovereign statehood in Ukraine are highlighted.

The book "Orthodoxy in Ukraine: 'De-Moscowization' of History and Prospects of Development" by Oleksandr Sahan, doctor of philosophy, considered those issues of Orthodoxy development in Ukraine which now most frequently become the objects of manipulations by the Russian Church propaganda, refutes dozens of church myths accompanying the history of Orthodoxy in Ukraine for over three hundred years.

Larysa Yakubova, NAS corresponding member, prepared the analytical note "'The Russian Issue': depolitization strategy as a prerequisite for the post-war reconstruction of Ukraine", where she showed the transformations that had happened in the official discourse of the Russian Federation and in the mass conscience of Russians as the carriers of the neo-totalitarian consciousness, and which led to their claims to the world in general and to Ukrainians in particular.

Kuras Institute of Political and Ethnic Studies of the NAS of Ukraine published the analytical report "Russian-Ukrainian war as a conflict of identities, values and ideologies" in which its scholars, grounding the differences between Ukrainian and Russian political cultures, value-oriented guidelines and practices of Ukrainian and Russian societies, determine the main factors of the Russian aggression against Ukraine. The analysis of ideological and identification processes in Russian and Ukrainian societies made it possible to assess the caus-

es of the predisposition of Russian society to starting a war, as well as the willingness of Ukrainian citizens to resist decisively in military confrontation that is of existential nature for Ukraine.

The co-authored monograph by scholars of H.S. Skovoroda Institute of Philosophy of the NAS of Ukraine "The National Imaginative as a Factor of Social Integration" analyzed totalitarian socio-historical mythology, in particular Soviet-Russian mythological systems and their efficiency, emphasized the need to dismantle Russian imperial statehood and mentality.

State institution "The Institute of World History" of the NAS of Ukraine published the second part of the analytical almanac "Russian Imperial Statehood: Modern International Dimensions" (its general editor is NAS corresponding member Andrii Kudriachenko). It considers doctrinal principles of RF foreign policy, primarily those of Russian integrational discourse on the post-Soviet area, along with the issues of the regional models of Russian expansionism; armed conflicts on the territories of the former Soviet Union; of imperial markers of the Russian-Ukrainian war.

The Institute of the History of Ukraine, M.S. Hrushevsky Institute of Ukrainian Archeography and Source Studies of the NAS of Ukraine, in collaboration with the Ukrainian Heraldic Society and Public Project "LIKBEZ. Historical Front" prepared the edition "Symbols of Ukrainophobia: Materials for Reference Book" (Kyryl Halushko, Andrii Hrechylo, Mykola Chmyr, with NAS corresponding member Hennadii Boriak as the project leader. The aim of the publication is the debunking of the Ukrainophobic symbolism, which involves, first of all, the signs of aggressive forces that are openly hostile to Ukrainian statehood (their use and popularization are banned by the current legislation of Ukraine). Besides, they include symbols of various separatist organizations and groupings, as well as the signs of foreign political parties and structures that make anti-Ukrainian statements, advance territorial claims and encroach on the territorial sovereignty and integrity of Ukraine.

Researchers of I. Krypiakevych Institute of Ukrainian Studies published a terminological and encyclopedic dictionary "Historical Memory of Ukrainians in Conditions of Russian-Ukrainian War". The dictionary records selected concepts of Ukrainian historical memory of the Russian-Ukrainian hybrid war (since 2014) and the full-scale Russian invasion of Ukraine (since 2022). The publication covers categories related to the main locations, events and heroes of the war, language and religion memory, memorialization practices in war conditions, armaments, symbols and stereotypes of the armed conflict, as well as their theoretical and practical aspects. The dictionary helps understand the structure of modern collective memory of Ukrainians and various features of its functioning in the conditions of war.

NAS corresponding member Viktor Moisiienko, who is now an officer of the Armed Forces of Ukraine, made the presentation "Ukrainian Writing of XI—XIV centuries: debunking of Russian myths" at a session of NAS Presidium. In it he, in particular, disproved pseudo-scientific ideas about the genesis of the Ukrainian language, which are actively disseminated by Russian propaganda in Ukraine and abroad.

Considered in the framework of the third Session of Potebnia Collegium, a linguistic online school designed to popularize current achievement of linguistics, were issues of debunking Russian narratives about the history of the Ukrainian language and the historical heritage of Kyivan Rus. This was in the focus of the joint lecture "Ukrainian medieval studies: a new dimension" given by NAS corresponding member Viktor Moisiienko and Warsaw University professor Joanna Getka.

The brochure by NAS academician Hryhorii Pivtorak "Ukrainians, Belarusians, Russians: Tree Peoples, Three Paths" was published. It is concerned with the issues of origins and development of the Ukrainian language alongside with disproving anti-Ukrainian linguistic narratives.

SCIENTIFIC EXPERTISE ACTIVITIES OF THE NAS OF UKRAINE, INTERACTION WITH GOVERNMENT AUTHORITIES

Scientific expertise is an important element in the activities of the National Academy of Sciences of Ukraine. The status of the Academy as the leading expert institution was confirmed in the Law of Ukraine "On Scientific and S&T Activities". The Law of Ukraine "On Lawmaking Activities", adopted in 2024, recognized the National Academy of Sciences of Ukraine as the leading expert institution for juridical (legal) expertise of draft laws and assigned to it the task to elaborate the Scientific Concept of developing Ukrainian legislation.

According to these laws, The NAS of Ukraine carries out an independent scientific assessment of strategic, prognostic and program draft documents (doctrines, concepts, strategies, etc.), and elaborates proposals concerning the principles of the governmental scientific and S&T policy, forecasts, information and analytical materials, proposals and recommendations on socio-political, socio-economic, S&T, innovational and humanitarian development of the state, performs scientific expertise of draft laws, governmental decisions and programs.

An important area of Academy's scientific expert activities is scientific and methodological support for the legislative activities of the Verkhovna Rada of Ukraine. In 2025, over two hundred proposals, conclusions, and notes regarding draft Laws of Ukraine that regulate various spheres of social life, in particular amendments to the draft Laws of Ukraine, were sent to the Verkhovna Rada. They included notes to the draft Laws "On the principles of governmental industrial policy', "On the principles of governmental policy in military technology", "On the support and development of innovation activities", "On lawmaking activities", "On local self-government in Ukraine", "On amendments to the Criminal Code of Ukraine concerning administrative offences", "The Criminal Code of Ukraine on preventing and countering hate speech", etc.

Significant scientific expert work was carried out on behalf of the Cabinet of Ministers of Ukraine. In particular, analytical materials and proposals for ensuring national resilience, the National Program of adapting Ukrainian legislation to that of the European Union, the Plan of 2025—2026 measures towards the implementation of the National Strategy of promoting the development of civil society in Ukraine in 2021—2026 were sent to the Government.

In the reporting year, active cooperation with a number of central executive authorities continued, in particular, that with ministries of economy, of environment and agriculture, finance, energy, development of communities and territories, defense, education and science, social policy, family and unity, as well as with the State Agency for energy efficiency and energy saving, State Space Agency, State Migration Service, State Statistics Service of Ukraine, oblast state administrations. Over 650 expert opinions and analytic materials were provided upon their requests. In particular, those were documents regarding the state of electric power industry of Ukraine, measures and projects for decentralization of electricity generation, prospects of economic growth and overcoming labor shortages, the analysis of the legislative basis of non-concessional public-and-private partnership in EU countries, introduction of digital product passports for industrial goods, resuming sodium carbonate production in post-war Ukraine, the analysis of the economic development of the Dnieper regions during war in the context of the need for their innovative modernization, Action Plan regarding the preservation of the national identity of Ukrainians in the Russian Federation, vertical solidarization in Ukrainian society, the dynamics of population's social expectations, prospects of reintegrating demobilized military personnel and veterans of the Armed Forces of Ukraine into civilian life and providing them with necessary social and psychological support, etc.

In difficult conditions of martial law and Russia's armed aggression, active interaction continues between the NAS of Ukraine and the Council for National Security and Defense of Ukraine, whose member is academician Anatolii Zagorodnii. Last year, under Council's commission, NAS experts prepared scientific and analytical materials on ensuring national security and defense in economic, social, S&T and other spheres.

To the order of the Central Research Institute of Armament and Military Technology of the Armed Forces of Ukraine, NAS institutions carried out a complex of expert investigations of materials from components of various types of missiles and unmanned aerial vehicles produced by the aggressor country.

The Academy actively participates in forming governmental scientific and S&T policy. E.g., in the report-

ing year, scientific expert opinions regarding the Concept of supporting and developing human resource potential in the sphere of scientific and S&T activities "National System of Researchers in Ukraine", draft Laws of Ukraine "On Priority Areas of Scientific, S&T and Innovative Activities", "On Amendments to Some Laws Concerning the Use of Language in Education Process" were sent to the Ministry of Education and Science of Ukraine.

Results of the studies carried out by researchers of NAS economics institutions were traditionally used to develop schemes of territory planning and programs of socio-economic and cultural development of districts and oblasts of Ukraine, elaborate urban master plans. In particular, to meet the interests of territorial communities and administrations, elaborated were analytical materials on: strategic planning of the development of territories of Liman City Military Administration in Kramatorsk district (Donetsk oblast), the strategy of innovative development for the post-war renovation of Poltava city, assessment of region's cluster potential (using the example of Vinnytsia oblast), possible scenarios of post-war reconstruction of Cherkasy and Poltava oblasts based on sustainable development principles.

Lately, Ukraine has joined more than 10 international conventions, agreements, and resolutions. In 2025, Academy's biologists were involved in scientific support for adapting Ukrainian legislation to European environmental laws. This work was aimed at determining governmental policy in the area of conservation and sustainable use of the animal and plant world of Ukraine, maintaining the Red Book of Ukraine, creating nature reserve objects of various conservation levels, ensuring the implementation of international agreements and conventions by Ukraine.

All in all, in 2025, under government orders, NAS institutions provided over 1840 expert conclusions regarding regulatory and legal acts, program documents, as well as information and analytical materials on various issues of social development. Academy scholars carried out a significant amount of expert work as members of scientific expert, advisory boards and committees set up under governmental bodies, providing preliminary reviews and scientific conclusions on various issues of their activities.

POPULARIZATION OF SCIENCE, PUBLIC RELATIONS

In 2025, science popularization and public relations remained an important component of NAS activities towards forming the trust in scientific expertise, strengthening social dialogue, and attracting a broad audience to scientific knowledge. During the year, NAS scientists were engaged in numerous socially important discussions, providing professional comments on the issues of security, energy, ecology, demographic processes, social resilience, historical memory, and international relations. Expert presentations, interviews, author's columns and analytical materials in printed and electronic media promoted a broader community involvement in the scientific vision of important problems and strengthened the role of science in public discussions. Academy scholars regularly participated in TV and radio programs of national and regional broadcasters, took part in thematic programs and public discussions, explained complex processes in simple terms. Such presence maintained a sustained dialogue between scientific community and society and enhanced the public role of the Academy as an authoritative expert agent.

The official website of the NAS of Ukraine provided regular presentation of scientific results, events taking place at institutions, and expert attitudes of scholars to socially important subjects. At the same time Academy's page in Facebook became a space for fast communication with the audience: it published news, videos, photographs, explanatory posts, and event reports. YouTube channel of the NAS of Ukraine remained a special instrument of communication — throughout the year it broadcast the program "Competently about Science". It invited leading scientists and experts in various fields, who spoke about state-of-the-art research, scientific challenges and development prospects.

A significant event of the year was the NAS initiative towards UNESCO declaring the International Day of Engagement in Science for Sustainable Development, which is to be marked every year on 27 November — the day of Academy establishment and the birthday of prominent scientist Borys Paton. In the framework of celebrating this day, NAS institutions organized a number of popular-science and educational activities: open lectures, festivals, thematic science days, exhibitions and interactive events for participants of various ages.

A lot of attention was given to popular-science activities hosted by Academy institutions, which became the sites of direct interaction with the public.

Great interest was aroused by the "*Academ Open Air* — 2024/2025" activities, organized by Kyiv Academic University and intended, primarily, for young people and future researchers.

The Main Astronomical Observatory of the NAS of Ukraine held popular-science events "Astro-Autumn in Holosiiv" and 'Spring Astronomy Day", which combined lectures, observations of stars in the sky, and informal communication with scientists.

M.M. Hryshko National Botanical Garden became the center of scientific educational events: a spring

Festival of science and plants at M.M. Gryshko National Botanical Garden of the NAS of Ukraine

Excursions to laboratories and the Exhibition Hall of the NSC "Institute for Single Crystals" of the NAS of Ukraine for young people, which is held under the slogan "Science is Cool!"

QSM 2025 School for quantum sensing and metrology at Bogolyubov Institute for Theoretical Physics of the NAS of Ukraine

"Science Day for Children" at I.M. Frantsevich Institute for Problems of Materials Science of the NAS of Ukraine

bonsai exhibition, a series of charity fairs, a permaculture festival — 2025, along with the second festival of science and plants *Fest Science & Plants*, combining scientific expertise with open communication formats. Such events popularized biological and ecological knowledge and helped develop ecological awareness.

The Institute of Hydrobiology of the NAS of Ukraine launched hydroecological studies, which opened a new season of public scientific educational activities and were aimed at discussing the current state of aquatic ecosystems.

Open-door days at NAS institutions have become an important form of interaction with the public. They provide visitors with the opportunities of direct acquaintance with the work of institutes' scientific departments and laboratories, to communicate with researchers and get the idea of current trends in scientific research. Special emphasis in these activities is given to communication with schoolchildren, students, and applicants.

Throughout the year, the Academy and its institutions actively participated in marking international thematic science days, particularly, of the International Quantum Day. During it, public lectures, workshops and science educational events were organized, which presented state-of-the-art quantum research and its prospects. Traditionally, the National NAS Museum of Natural History became the epicenter of events to celebrate the International Museum Day, offering its visitors a wide range of thematic excursions, public lectures, and interactive programs.

A special emphasis was placed on work with young people and children. The Council of Young Scientists of the Main Astronomical Observatory organized a summer school in astronomy and astrophysics "To the Universe Through the Milky Way" for students of higher education institutions. Academy scientists continued the course of popular-science lectures *Science Kids* on the *INSCIENCE* platform and participation in the "Real Science" project aiming at forming interest for research in children and teenagers. Materials scientists of the Academy held a specialized Science Day for children, where the role of novel materials and compounds in developing technologies of the future was clearly demonstrated.

An important part in scientific communication and education of young researchers was played by open scientific workshops started by Academy researchers. Among those were: Kharkiv Chemical Seminar (STC "Institute for Single Crystals", Kharkiv Quantum Seminar (B.I. Verkin Institute for Low Temperatures and NSC "Kharkiv Institute of Physics and Technology"), as well as the Interdisciplinary Academic Seminar "Current Issues of Physico-Chemical and Mathematical Biology (Palladin Institute of Biochemistry). These facilities promoted the exchange of ideas between Ukrainian and foreign scientists and the integration of young researchers in scientific community.

"Akademperiodyka" Publishing House ensured the publication of numerous popular-science editions popularizing knowledge in natural sciences and debunking historical myths, which is of significant importance.

The tradition of awarding the NAS prize "For Popularizing Science" continued. The award honors scholars and research teams for a significant contribution to disseminating scientific knowledge and forming a scientific worldview in society.

Hence, in 2025, science popularization at the NAS of Ukraine covered a wide range of formats — from mass festivals, museum events and open-door days to specialized workshops, media projects and expert participation in public discussions. All those initiatives aimed at making science visible, understandable, and socially significant.

RECOGNITION OF ACHIEVEMENTS OF NAS SCIENTISTS

Hero of Ukraine, First Vice-President of the NAS of Ukraine, academician V. Horbulin was honored with the Presidential Award "National Legend of Ukraine" as one of the authors of the Concept of National Security and Defense of Ukraine, the first National Space Program, the Strategy of Building and Developing the Armed Forces of Ukraine.

V.I. Vernadsky Gold Medal of the NAS of Ukraine was awarded to NAS academician L. Bulavin and professor Wolfram Schröer (Germany) for outstanding achievements in physics of liquids and liquid systems. Nine scientists of NAS institutions: V.M. Bakul Institute for Superhard Materials, E.O. Paton Electric Welding Institute, G.V. Karpenko Physico-Mechanical Institute, V.M. Glushkov Institute of Cybernetics, G.E. Pukhov Institute for Problems of Modeling in Energy became the winners of the National Borys Paton Prize for the works "Technologies for renovating armaments and military equipment", "Technologies of producing structural elements of novel equipment from powders", "Evaluation and optimization of safety risks for critical infrastructure".

Awarded for their significant personal contributions to the development of Ukrainian science, strengthening S&T potential of Ukraine in conditions of martial law, dedicated work of many years and high professionalism were: O. Dodonov, deputy director of the Institute of Information Registration Problems with the Order "For Merit" II Degree;

A. Bernatskyi, department head of E.O. Paton Electric Welding Institute; O. Velykodnyi, senior research associate of NSC "Kharkiv Institute of Physics and Technology"; Yu. Logvinov, NAS corresponding member, senior research associate of O.Ya. Usikov Institute of Radiophysics and Electronics; S. Maksimov, NAS corresponding member, deputy director of E.O. Paton Electric Welding Institute; V. Nosenko, leading research associate of G.V. Kurdyumov Institute for Metal Physics; S. Sapon, department head of V. Ye. Lashkaryov Institute of Semiconductor Physics; NAS corresponding member S. Yakovlev, chair professor of M.Ye. Zhukovsky National Aerospace University "Kharkiv Aviation Institute" — with the Order "For Merit" III Degree;

President of Ukraine Volodymyr Zelenskyi presents the Presidential Award "National Legend of Ukraine" to NAS academician, Hero of Ukraine Volodymyr Horbulin

L. Derzhypolska, senior research associate of NAS Institute of Physics, and NAS corresponding member L. Yakubova, department head of the NAS Institute of the History of Ukraine were awarded with the Order of Princess Olga.

The title "Honored Worker of Science and Technology of Ukraine" was awarded to: P. Zhuk, leading research associate of the State institution "M.I. Dolishny Institute of Regional Studies"; NAS corresponding member A. Maistrenko, department head of V.M. Bakul Institute for Superhard Materials; and to NAS academician Ya. Shuba, department head of Bogomoletz Institute of Physiology of the NAS of Ukraine.

NAS academician E. Libanova received the award of the Defense Minister of Ukraine "For Assistance to Defense" for her significant personal contribution to the development of the Armed Forces of Ukraine.

The title "Honorable Doctor of the National Academy of Sciences of Ukraine" was awarded to two foreign scientists — Oleh Lavrentovich, professor of the Institute of Modern Materials and Liquid Crystals of Kent State University (USA) and to professor Juras Banys, President of the Lithuanian Academy of Sciences, vice-rector of Vilnius University, and to Lina Kostenko, prominent Ukrainian poetess and writer.

A number of prizes were won by young Academy researchers. The Prize of the President of Ukraine for young scientists was awarded to eight scientists, the Prize of the Verkhovna Rada of Ukraine for young scientists — to 23 scholars, named scholarships of the Verkhovna Rada of Ukraine for young scholars — doctors of science were awarded to four young scientists. The Prize of Kyiv's Mayor for special achievements of young people in the development of Kyiv hero-city — the capital of Ukraine — was received by six young researchers.

The laureate of the prestigious Prize of Berlin-Brandenburg Academy of Sciences, which was established by Peregrinus Foundation (Rudolf Meimberg) and is awarded every two years for outstanding achievements of scholars from Eastern and Southeastern Europe became Ch. Hnatenko, professor of Ivan Franko National University of Lviv, corresponding member of the NAS of Ukraine.

NAS corresponding member Chrystyna Hnatenko receives the Prize of Berlin-Brandenburg Academy of Sciences

PhD Daria Gerasimova receives one of the EPS/QEOD Thesis Prizes from the Department of Quantum Optics and Electronics

L. Stanislavskyi, junior researcher of the NAS Institute of Radio Astronomy, was honored with the prize for the best dissertation work in the field of astronomy and astrophysics (IAU PhD at-large Prize for prominent scientific achievements of post-graduate students in astronomy in the whole world) from the International Astronomy Union.

One of the awards EPS/QEOD Thesis Prizes from the Quantum Electronics and Optics Department of the European Physical Society was won by D. Gerasimova, junior researcher of O.Ya. Usikov Institute of Radio Physics and Electronics of the NAS of Ukraine. O. Kapush, senior researcher of V.E. Lashkariov Institute of Semiconductor Physics, became the laureate of VII Ukrainian Prize L'ORÉAL-ЮНЕСКО "For Women in Science", launched by L'ORÉAL company in 1998 to encourage young women to choose scientific profession in natural sciences. K. Pozharska, researcher of the NAS Institute of Mathematics, received an incentive prize for young scientists from the jury of this contest — for outstanding achievements in her scientific career.

Academician V. Horbulin, vice-president of the NAS of Ukraine, received the VI National Award of the Year "Golden Hands" — a public honor annually awarded to

NAS President Anatolii Zagorodnii with Oleksandr Olenchenko, a student of the State Scientific Institution "Kyiv Academic University", laureate of the NAS prize "For Popularizing Science" (for Aremath YouTube channel)

specialists for prominent professional achievements and a significant contribution to the development of key areas of the social life of Ukraine with the wording "for outstanding merit and development of science, technology, rocketry and for a significant contribution to the formation and establishment of the national security and defense of independent Ukraine".

Academy's scientists became winners of NAS prizes, received various departmental awards for personal professional achievements and active social work. 51 researchers were awarded with prizes named after famous scholars of Ukraine.

Five people became laureates of the NAS prize "For Popularizing Science". Every year the Academy awards this prize to media and their representatives, scientists, initiators of scientific, educational and communication projects for the best materials about scientists' achievements, activities of research institutions and the NAS of Ukraine in general, as well as for promoting science popularization and raising the prestige of scientific professions in Ukraine.

In 2025, 206 people received NAS honors: 19 — "For scientific achievements", 56 — "For training young researchers", 98 — "For professional achievements", 14 — "For promotion of science development", 19 researchers won the award for young scientists "Talent, inspiration, work".

On the occasion of memorable dates, for fruitful work, significant contribution to the development of science, 213 people and 10 work teams received acknowledgements of the NAS of Ukraine, 156 people and one work team — honorary diplomas of the NAS Presidium and the Central Committee of the NAS trade union; 4 people received diplomas of the NAS Presidium.

REFERENCE INFORMATION. STATISTICS

Structure of the NAS of Ukraine

The structure of the NAS of Ukraine includes 3 sections and 14 departments, which incorporate 146 research institutions. Research-and-production organizations (design offices, pilot production facilities etc.) operate within some scientific institutions. Functioning within some research institutions are science objects that have the National Asset status (nuclear, physical and astronomical research facilities, test bench complexes, archive scientific collections and museum displays, plant genetic funds, collections of microorganism strains and plant lines, cell banks, landmarks of history and culture etc.), as well as centers for the shared use of scientific equipment.

Research organizations that have National Institution status:

- V.I. Vernadsky National Library of Ukraine
- V. Stefanyk National Scientific Library of Lviv
- National Science Center "Kharkiv Institute of Physics and Technology"
- "Olbia" National Historical and Archeological Reserve
- M.M. Gryshko National Botanical Garden
- "Sofiivka" National Dendrological Park
- National Museum of Natural History
- National Center "Junior Academy of Sciences" of the MES of Ukraine and the NAS of Ukraine.

Functioning in the Academy are **five Regional Science Centers** of dual subordination to the NAS of Ukraine and the Ministry of Education and Science of Ukraine:

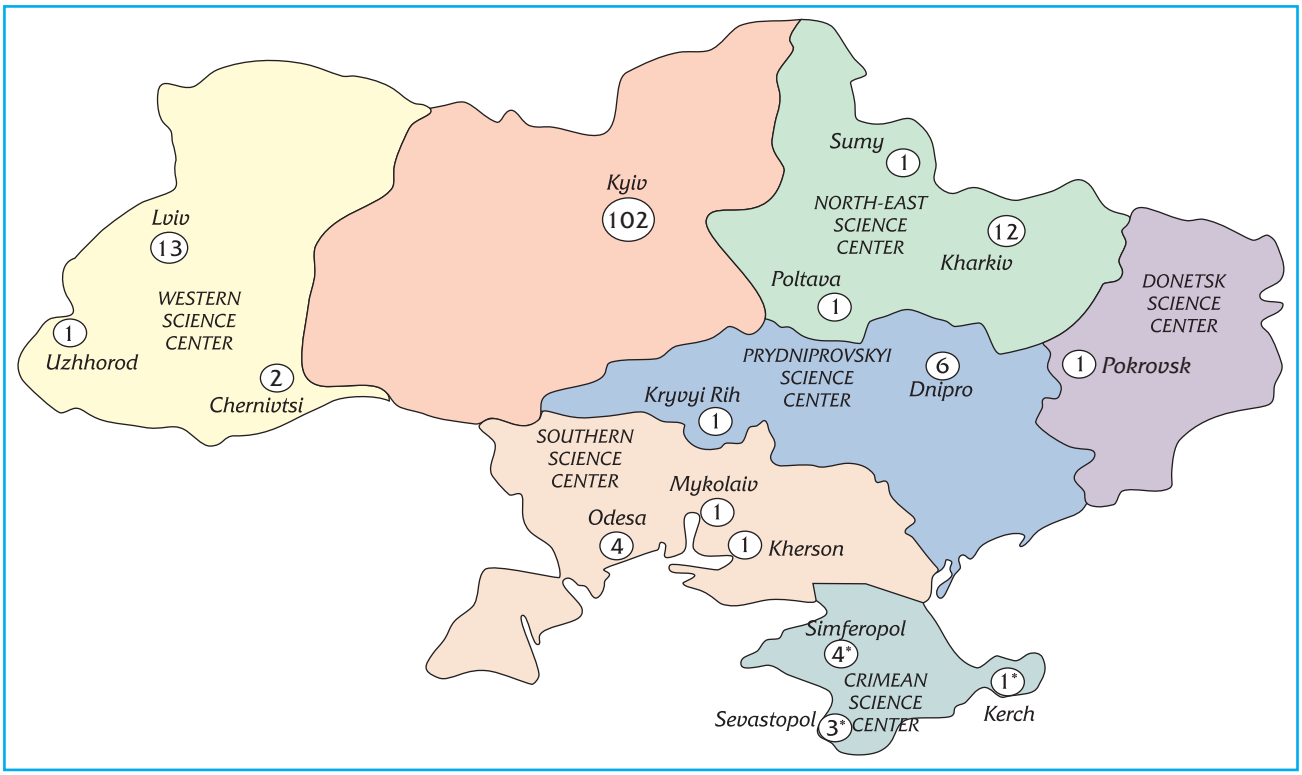
- Donetsk Science Center (Pokrovsk, Donetsk oblast)
- Western Science Center (Lviv)
- Southern Science Center (Odesa)
- North-East Science Center (Kharkiv)
- Prydniprovskyi Science Center (Dnipro).

The statutory activities of the Crimean Science Center and its funding by the NAS budget were suspended in 2014.

DISTRIBUTION OF INSTITUTIONS ACROSS SECTIONS AND DEPARTMENTS

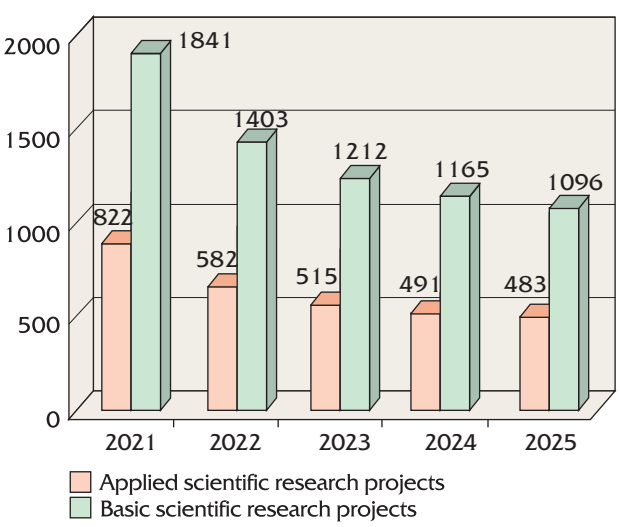
Department	The number of scientific institutions	The number of R&D organizations	Objects with the National Asset status	Centers for the shared use of research equipment
Section of Physical, Engineering and Mathematical Sciences				
Mathematics	3	—	—	—
Informatics	9	—	—	2
Mechanics and Mechanical Engineering	7	2	3	3
Physics and Astronomy	12	2	11	16
Earth Sciences	13	1	1	5
Materials sciences	12	17	2	12
Energy & Energy	10	2	2	4
Technology Nuclear Physics & Energy	6	1	2	6
Section of Chemical and Biological Sciences				
Chemistry	12	7	—	11
Biochemistry, Physiology & Molecular	9	2	5	9
Biology	20	1	20	12
Section of Social Sciences and Humanities				
Economics	8	—	—	—
History, Philosophy & Law	17	3	5	—
Literature, Language & Art Studies	8	—	4	—

Regional structure of the NAS of Ukraine

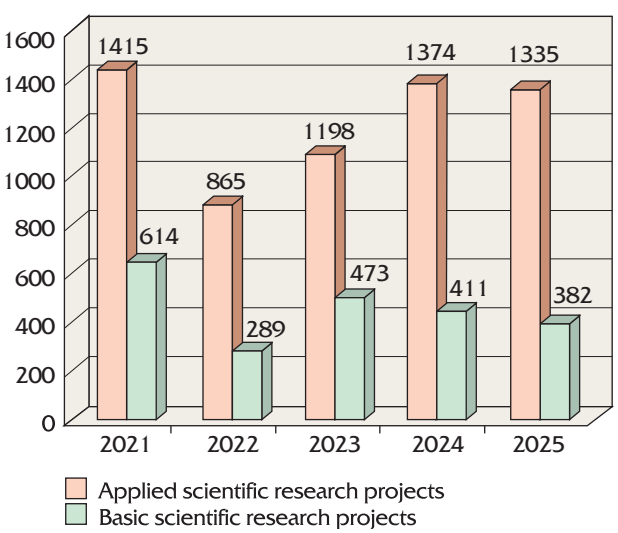


Figures in the map show the number of research institutions
** The status of NAS institutions located in the Autonomous Republic of Crimea is defined by the Law of Ukraine 'On guaranteeing the rights and freedoms of citizens and legal regime on the temporarily occupied territories of Ukraine'*

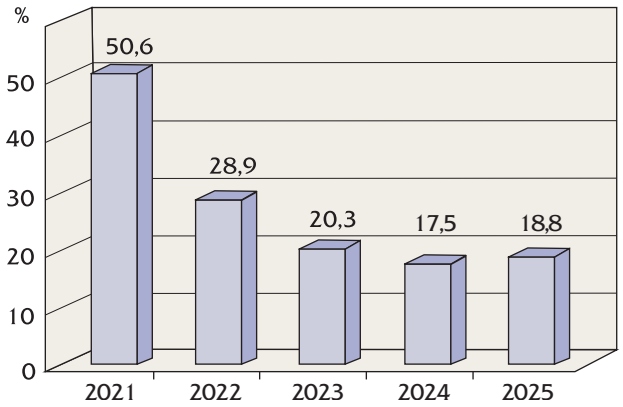
Conducting scientific research



The number of currently implemented research projects financed from the General Fund of the State Budget



The number of currently implemented research projects financed from the Special Fund of the State Budget



Part of targeted-program and contest-based projects of the NAS of Ukraine in the total number of R&D works

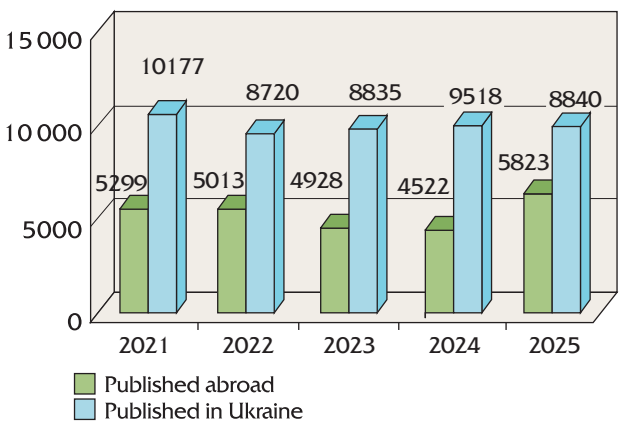
Targeted-program and contest-based research projects of the NAS of Ukraine in 2025 involved the research conducted under:

- one NAS targeted program of applied research;
- one targeted comprehensive program of basic research
- two targeted research projects;

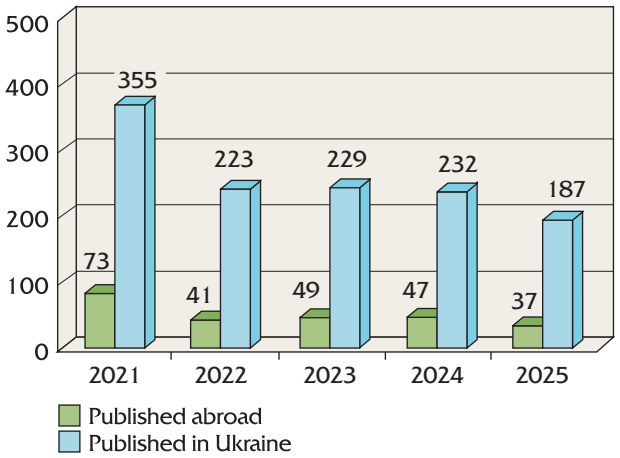
and those based on the results of:

- joint contests with foreign and international organizations;
- contests of scientific and S&T projects in the area 'Support to scientific and S&T (experimental) developments that are of priority to the state';
- contests of research projects of young scientists of the NAS of Ukraine;
- NAS grants to research laboratories/groups of young NAS scientists for conducting research in priority areas of science and technology.

Publication activity



Part of the themes of NAS institutions developed under targeted programs and contests in the total number of research works



Scientific monographs

Publishing activities

- **The total number of Academy journals:**

84 scientific journals, 1 popular-science journal (*Svitohliad*), and *Dzherelo* abstract journal in four series;

- **12 journals are published in English in Ukraine**

1. Science and Innovation
2. Semiconductor Physics, Quantum Electronics & Optoelectronics
3. Journal of Mathematical Physics, Analysis, Geometry
4. The Paton Welding Journal
5. Progress in Physics of Metals
6. Journal of Thermoelectricity
7. Ukrainian Journal of Physics
8. Functional Materials
9. Biopolymers and Cell
10. Experimental Oncology
11. Problems of Cryobiology and Cryomedicine
12. Zoodiversity

- **14 journals are published in English abroad**

by Springer Publishers

1. Ukrainian Mathematical Journal
2. Cybernetics and Systems Analysis
3. International Applied Mechanics
4. Strength of Materials
5. Materials Science
6. Theoretical and Experimental Chemistry
7. Neurophysiology

by Allerton Press Inc.

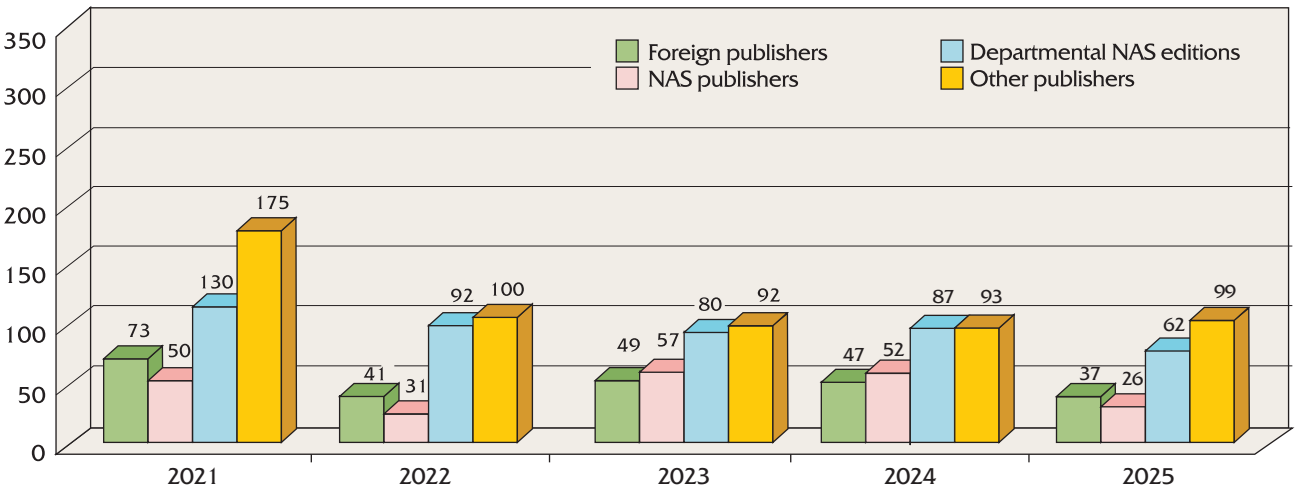
8. Kinematics and Physics of Celestial Bodies
9. Journal of Superhard Materials
10. Journal of Water Chemistry and Technology
11. Cytology and Genetics

by Begell House Inc. Publishers

12. Inernational Journal on Algae
13. Hydrobiological Journal

by other publishers

14. Low Temperature Physics (American Institute of Physics)



Distribution of scientific monographs across groups of publishers

Scientific expert activities

In 2025 NAS experts took part in the development of:

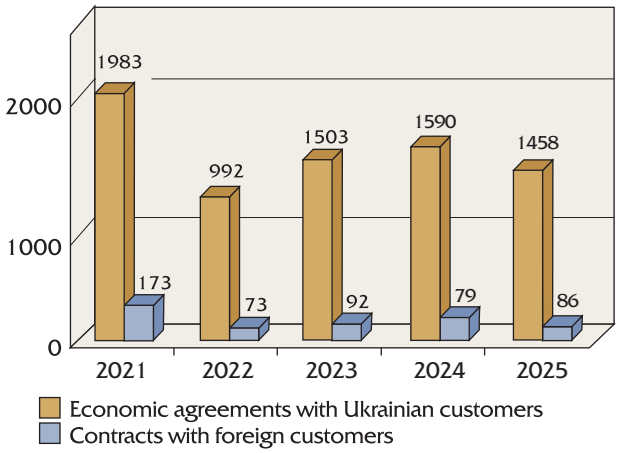
- The Strategy of economic security of Ukraine till 2030
- The Strategy of developing the sphere of innovative activities for 2025—2027
- The Concept of the national targeted S&T space program of Ukraine for 2026—2030
- The National plan for the decarbonization of centralized heat-supply systems in Ukraine out to 2050
- The Strategy of biodiversity conservation in Ukraine for the period till 2035
- The Strategy of developing fisheries in Ukraine for the period till 2030

Expert conclusions, notes, proposals were prepared, in particular those to draft laws:

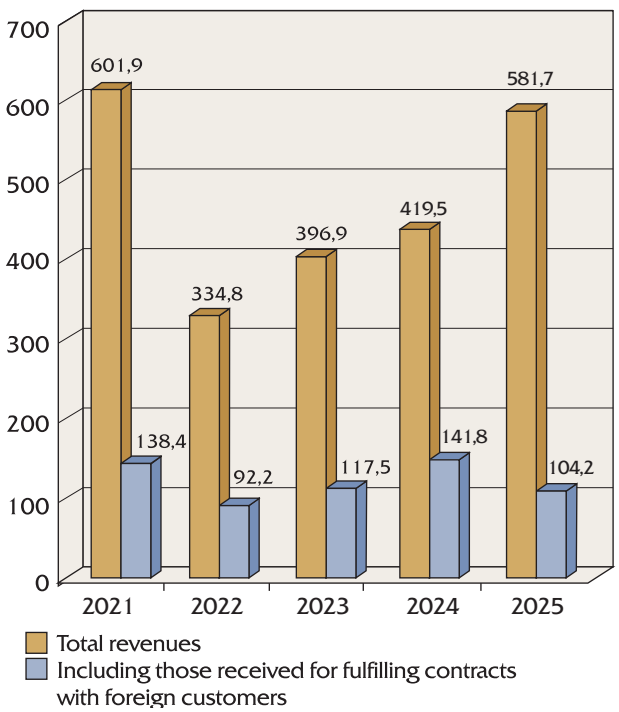
- On the principles of state industrial policy
- On the principles of military technology policy
- On alternative fuels
- On local self-government in Ukraine
- On support and development of innovative activities
- On lawmaking
- On the principles of state policy of the national memory of Ukrainian people

Scientific expertise conclusions	2021	2022	2023	2024	2025
Expert conclusions concerning normative legal acts and program documents, information and analytical materials on various issues of socio-economic development provided for state power bodies	1900	1800	1730	1820	1840
Expert conclusions concerning the expediency of funding basic research projects from the State Budget	440	412	279	254	843

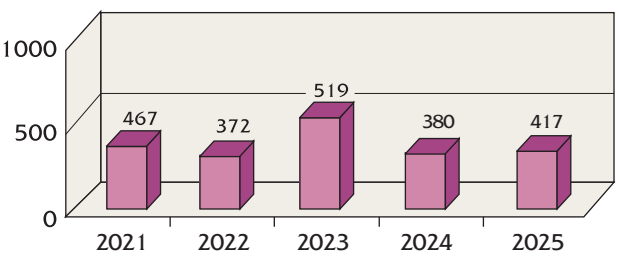
Innovation activities



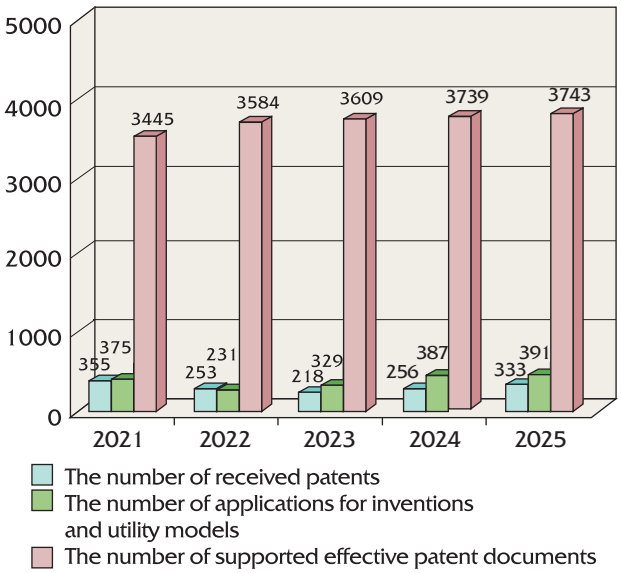
Fulfilled economic agreements and contracts



Revenues received by NAS institutions for fulfilled economic agreements and contracts, UAH million



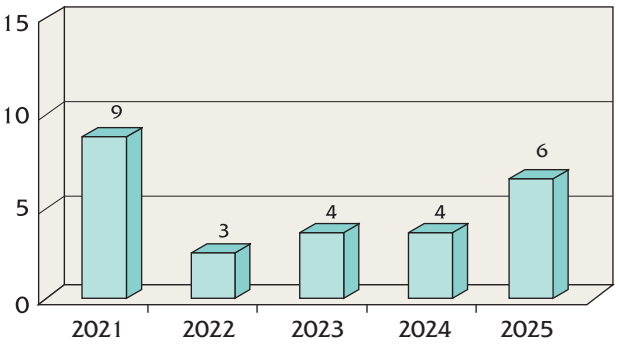
The number of deployed scientific developments



Creation of the objects of intellectual property rights

Collaboration with institutions of higher education and institutions of the MES of Ukraine

Collaboration agreements concluded between research institutions and institutions of higher education	296
Research topics and projects developed in cooperation with academics	201
Published monographs in collaboration with academics	77
Research scientists who worked in education:	1123
including:	
NAS academicians	46
NAS corresponding members	91
Published textbooks and manuals for institutions of higher education	89
Scientists at the head of chairs in institutions of higher education	50
Students of higher education institutions who pursued/are pursuing Master's degree programs at joint research-and-training facilities hosted by scientific organizations:	
in academic year 2024/2025	218
in academic year 2025/2026	215
Students who prepared their graduation papers at research institutions	817
Academics incorporated to specialized academic councils of research institutions	425
Scientists of research institutions incorporated to specialized academic councils of the institutions of higher education	424



Joint research-and-education structures

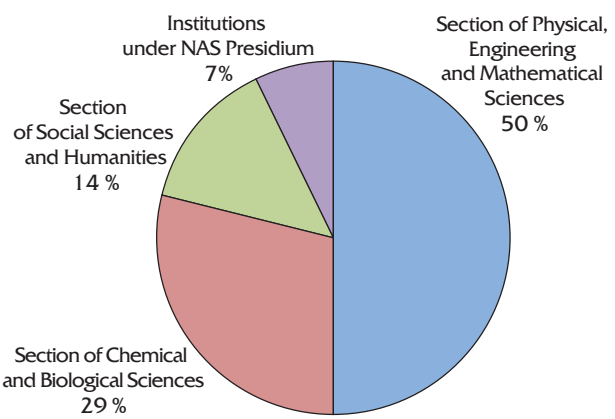
Newly employed fully graduate specialists at research institutions who attended study groups of the Junior Academy of Sciences in their school days	9
Research scientists and lecturers of the institutions of higher education and MES organizations who upgraded their professional skills at research institutions	482
Theses of academics defended at specialized academic councils of scientific research institutions	55

International ties

Legal contractual framework for the international cooperation of the NAS of Ukraine (effective agreements, contracts, memorandums etc.) — a total of 130 documents.

The National Academy of Sciences of Ukraine signed:

- On 21 May 2025 — the Memorandum of the scientific cooperation with the National Academy of Sciences of Republic Kazakhstan under the President of Republic Kazakhstan;
- In July 2025 — The Agreement of scientific cooperation with the Slovak Academy of Sciences.

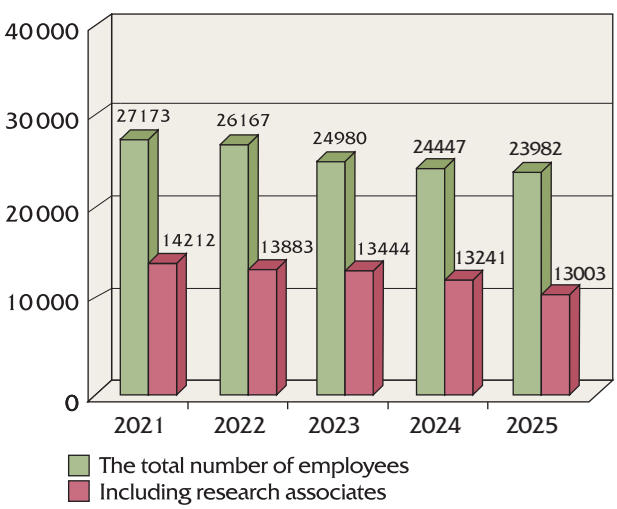


Distribution of direct agreements and contracts across institutions of NAS sections

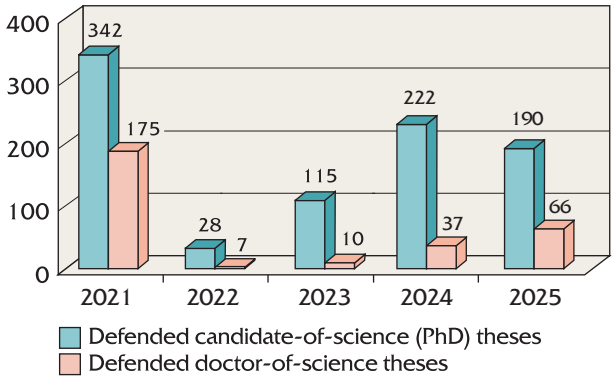
Nearly 700 direct agreements and contracts concluded by NAS institutions with international partners are in force. Of those, 328 were concluded by institutions of the Section of Physical, Engineering and Mathematical Sciences, 190 — by institutions of the Section of Chemical and Biological Sciences, 96 — by those of the Section of Social Sciences and Humanities, 44 — by institutions under NAS Presidium.

Employment figures (as of 01.01.2026)

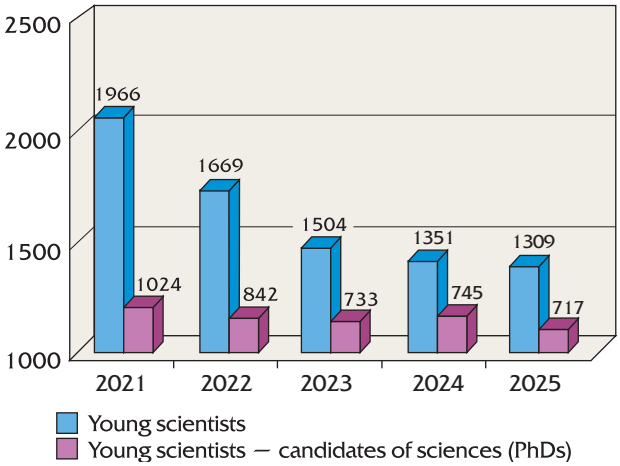
The total number of employees	23 982
of them:	
at research institutions	23 157
at research-and-production facilities	638
at service organizations	187
The number of research scientists	13 003
of them:	
doctors of sciences	2332
candidates of sciences (PhD)	6435
researchers without an advanced degree	4255
The number of young specialists recruited in 2024	273
The number of those who pursued post-graduate studies in 2025	1467
including those engaged in full-time studies	1375
Defended candidate-of-science or PhD theses	190
of those — candidate-of-science theses	32
Doctoral fellowships	143
Defended doctor-of-science thesis	66



The number of employees, thousand persons

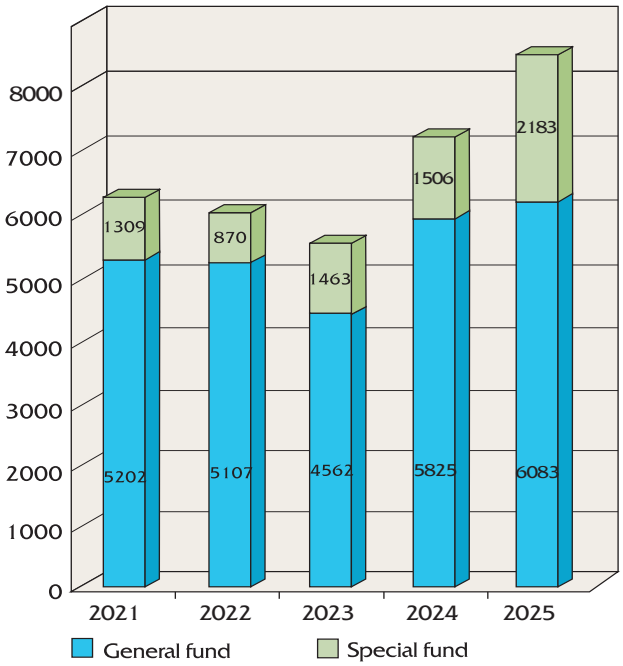


Training of scientific personnel

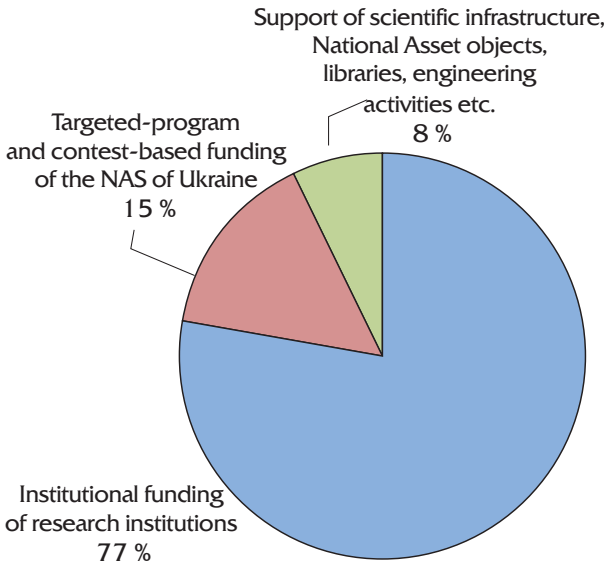


The number of young scientists at the NAS of Ukraine

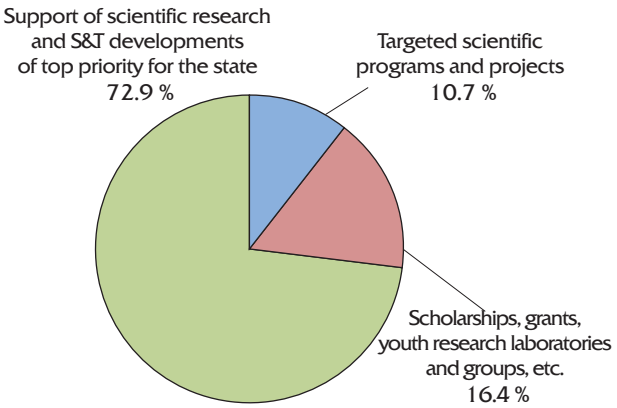
Financial provision



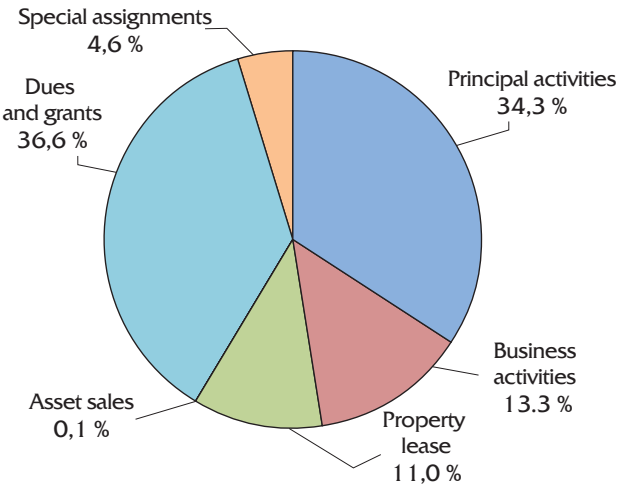
Total amount of NAS funding, UAN mln



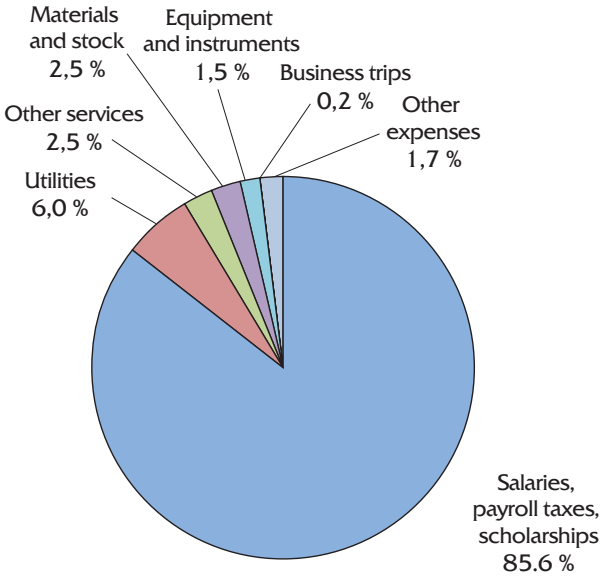
Distribution of General Fund finance for conducting scientific research



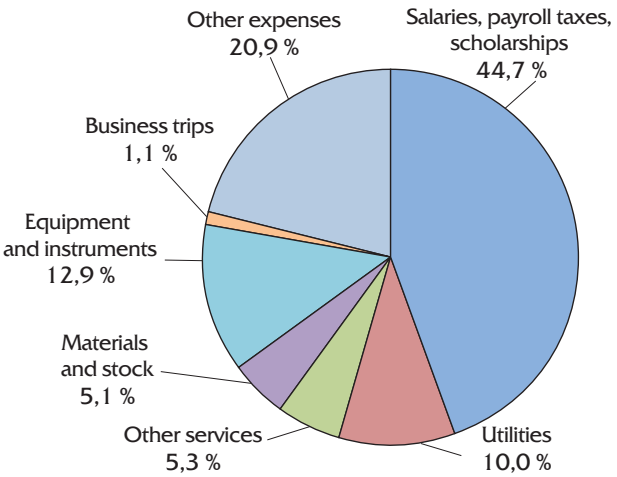
Targeted-program and contest-based funding



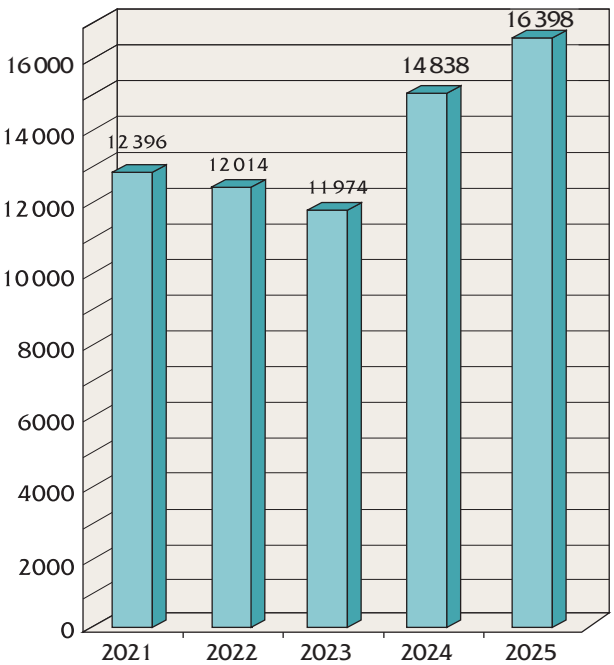
Structure of Special-Fund revenues



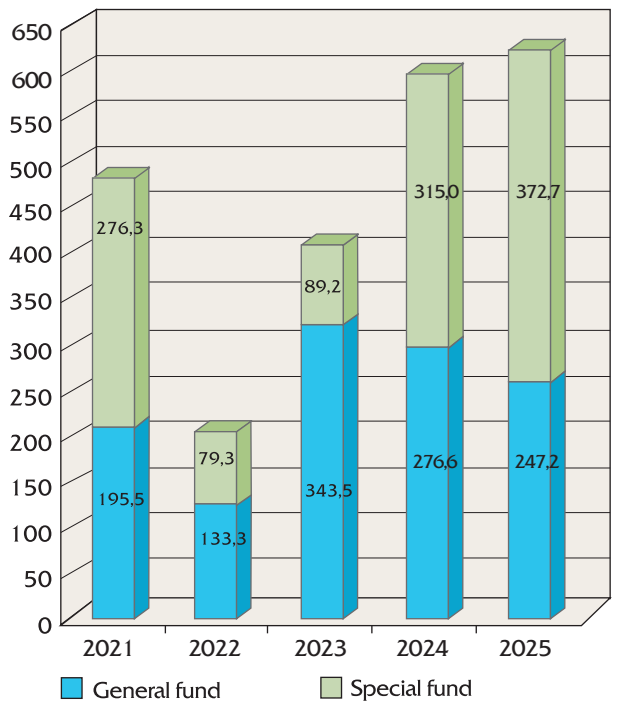
Structure of General Fund expenses



Structure of Special Fund expenses



Average monthly salaries of employees, UAN



Expenses for supporting infrastructure (procurement of equipment and materials), UAH mln

Інформаційне видання

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