



JINR



JOINT
INSTITUTE
FOR NUCLEAR
RESEARCH

2025
ANNUAL REPORT



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RESEARCH

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ANNUAL REPORT



Joint Institute for Nuclear Research

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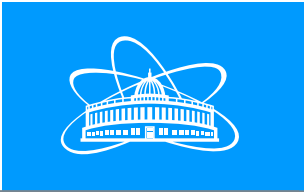
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JINR MEMBER STATES



JINR MEMBER STATES

- Republic of Armenia
- Republic of Azerbaijan
- Republic of Belarus
- Republic of Bulgaria
- Republic of Cuba

- Arab Republic of Egypt
- Georgia
- Republic of Kazakhstan
- Democratic People's Republic of Korea
- Mongolia

- Romania
- Russian Federation
- Slovak Republic
- Republic of Uzbekistan
- Socialist Republic of Vietnam

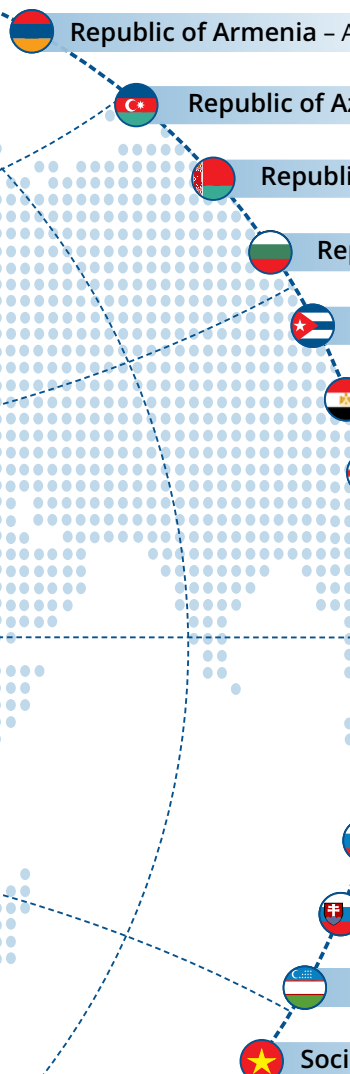

AGREEMENTS ON GOVERNMENTAL LEVEL ARE SIGNED WITH THE FOLLOWING STATES:

- Federal Republic of Germany
- Hungary
- Italian Republic
- Republic of Serbia
- Republic of South Africa



GOVERNING AND ADVISORY BODIES OF THE JOINT INSTITUTE FOR NUCLEAR RESEARCH

COMMITTEE OF PLENIPOTENTIARIES OF THE GOVERNMENTS OF THE JINR MEMBER STATES

- 
-  Republic of Armenia – A. Movsisyan
 -  Republic of Azerbaijan – A. M. Gashimov
 -  Republic of Belarus – D. Korzhitsky
 -  Republic of Bulgaria – Ts. Bachiyski
 -  Republic of Cuba – G. Walwyn Salas
 -  Arab Republic of Egypt – G. El-Feky
 -  Georgia – A. Khvedelidze
 -  Republic of Kazakhstan – S. Sakhiyev
 -  Democratic People's Republic of Korea – Li Je Sen
 -  Mongolia – S. Davaa
 -  Romania – F.-D. Buzatu
 -  Russian Federation – V. Falkov
 -  Slovak Republic – F. Šimkovic
 -  Republic of Uzbekistan – I. Sadikov
 -  Socialist Republic of Vietnam – Trần Tuấn Anh

FINANCE COMMITTEE

One representative of each JINR Member State

SCIENTIFIC COUNCIL

Chairman: **G. Trubnikov**

Co-Chairman: **S. Kilin** (Republic of Belarus)

Scientific Secretary: **S. Nedelko**

- | | |
|---|--|
| <input type="radio"/> A. Aprahamian –
United States of America | <input type="radio"/> D. L. Nagy –
Hungary |
| <input type="radio"/> A. Ayala –
United Mexican States | <input type="radio"/> A. Nersessian –
Republic of Armenia |
| <input type="radio"/> Ts. Baatar –
Mongolia | <input type="radio"/> N. Nešković –
Republic of Serbia |
| <input type="radio"/> E. Boos –
Russian Federation | <input type="radio"/> I. Padrón Díaz –
Republic of Cuba |
| <input type="radio"/> C. Borcea –
Romania | <input type="radio"/> D. Peres Menezes –
Federative Republic of Brazil |
| <input type="radio"/> Bum-Hoon Lee –
Republic of Korea | <input type="radio"/> R. Rashkov –
Republic of Bulgaria |
| <input type="radio"/> N. Burtebaev –
Republic of Kazakhstan | <input type="radio"/> I. Sadikov –
Republic of Uzbekistan |
| <input type="radio"/> A. M. Cetto –
United Mexican States | <input type="radio"/> R. Sahoo –
Republic of India |
| <input type="radio"/> A. El-hag Ali –
Arab Republic of Egypt | <input type="radio"/> M. Sakr –
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| <input type="radio"/> R. Granada –
Argentine Republic | <input type="radio"/> A. Sergeev –
Russian Federation |
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Federal Republic of Germany | <input type="radio"/> Song Yuntao –
People's Republic of China |
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French Republic |
| <input type="radio"/> S. Kilin –
Republic of Belarus | <input type="radio"/> Ch. Stoyanov –
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Russian Federation | <input type="radio"/> Gh. Stratan –
Romania |
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Georgia | <input type="radio"/> Trần Chí Thành –
Socialist Republic of Vietnam |
| <input type="radio"/> Lễ Hồng Khiêm –
Socialist Republic of Vietnam | <input type="radio"/> G. Trubnikov –
Russian Federation |
| <input type="radio"/> Li Jiangang –
People's Republic of China | <input type="radio"/> R. Tsenov –
Republic of Bulgaria |
| <input type="radio"/> I. Logashenko –
Russian Federation | <input type="radio"/> I. Tserruya –
State of Israel |
| <input type="radio"/> P. Logatchov –
Russian Federation | <input type="radio"/> Z. Vilakazi –
Republic of South Africa |
| <input type="radio"/> S. Maksimenko –
Republic of Belarus | <input type="radio"/> V. Voevodin –
Russian Federation |
| <input type="radio"/> V. Matveev –
Russian Federation | <input type="radio"/> Wang Yifang –
People's Republic of China |
| <input type="radio"/> S. Mihara –
Japan | <input type="radio"/> Zhao Hongwei –
People's Republic of China |
| <input type="radio"/> Sh. Nagiyev –
Republic of Azerbaijan | |

PROGRAMME ADVISORY COMMITTEES

PAC for Particle Physics

Chairperson: **I. Tserruya** (Israel)
Scientific Secretary: **A. Cheplakov**

PAC for Nuclear Physics

Chairperson: **V. Nesvizhevsky**
Scientific Secretary: **N. Skobelev**

PAC for Condensed Matter Physics

Chairperson: **D. L. Nagy** (Hungary)
Scientific Secretary: **O. Belov**

INTERNAL ORGANIZATION OF THE JOINT INSTITUTE FOR NUCLEAR RESEARCH

Bogoliubov Laboratory of Theoretical Physics

Director D. Kazakov

Research in

- interactions and symmetry properties of elementary particles, field theory structure and its applications
- properties of exotic nuclei and nuclear systems, low-energy and relativistic nuclear dynamics, nuclear astrophysics
- mathematical models of complex systems, complex materials and nanostructures
- integrable systems, supersymmetry, quantum gravity and string theory



Veksler and Baldin Laboratory of High Energy Physics

Acting Director A. Butenko

Research in

- interactions of multicharged ions in a wide energy range
- relativistic nuclear physics
- structure of nucleons
- strong interactions of particles
- resonance phenomena in particle interactions
- electromagnetic interactions
- particle acceleration techniques
- applied science at NICA complex based on the ARIADNA infrastructure



Dzhelepov Laboratory of Nuclear Problems

Director E. Yakushev

Research in

- neutrino physics and rare phenomena
- strong, weak and electromagnetic interactions of particles
- nuclear spectroscopy
- charged particle acceleration techniques
- applied research and radiobiology



Flerov Laboratory of Nuclear Reactions

Director S. Sidorchuk

Research in

- synthesis of superheavy elements
- properties of heavy and superheavy elements, mechanisms of nuclear reactions with heavy ions
- reactions with radioactive-ion beams, structures of nuclei at the borders of nucleon stability
- interactions of heavy ions with condensed matter
- heavy-ion acceleration methods



DIRECTORATE

Director **G. Trubnikov**
Scientific Leader **V. Matveev**
Vice-Director **S. Dmitriev**
Vice-Director **V. Kekelidze**

Vice-Director **L. Kostov**
Chief Scientific Secretary **S. Nedelko**
Chief Engineer **B. Gikal**



Frank Laboratory of Neutron Physics

Director **E. Lychagin**

Research in

- neutron-induced nuclear reactions
- fundamental properties of the neutron
- structure and dynamics of functional materials
- nanomaterials for energy storage
- materials by neutron scattering, neutron activation analysis, neutron radiography and complementary methods
- dynamic characteristics of the IBR-2 pulsed reactor and advanced neutron source



Meshcheryakov Laboratory of Information Technologies

Director **S. Shmatov**

Research in

- provision of operation and development of the JINR network, information and computing infrastructure
- optimal usage of international computer networks and information systems
- integration of the heterogeneous computing resources
- modern methods of computer physics, development of standard mathematical software
- digitalization of scientific and administrative activities of JINR



Laboratory of Radiation Biology

Director **A. Bugay**

Research in

- molecular radiobiology
- radiation genetics and cytogenetics
- medical radiobiology
- radiation physiology and neuroradiobiology
- radiation biophysics and mathematical modeling
- astrobiology



University Centre

Director **D. Kamanin**

Main activities:

- academic programme for senior students, preparation of Bachelor, Master, and PhD theses
- running of international student practices and schools
- popularization of achievements in modern science
- running of scientific schools for physics teachers
- career guidance for schoolchildren
- advanced training of the Institute personnel

Central Services

- central scientific and information departments
- administrative and economic units
- manufacturing units

INTRODUCTION



The achievements of the year 2025, that became a period of important challenges, enriched the history of the Joint Institute for Nuclear Research. We note with satisfaction the results of efforts of a large cohesive international community of scientists: the implementation of the Seven-Year Plan for the Development of JINR for 2024–2030, the contribution of the JINR Member States to the fulfillment of large projects at the Institute, new bright scientific results, involvement in wide-scale collaboration projects, and multifarious educational activities.

The Committee of Plenipotentiaries of the Governments of the JINR Member States noted at the visiting session in Varadero (Cuba) held on 2 December good speed of implementation of the JINR development programme in all directions of the JINR Long-Term Development Strategy up to 2030 and Beyond.

Traditionally, theoretical support was carried out for experimental research at JINR and other research centres participated by JINR. According to the results of the review, theoreticians of the Institute published about 420 papers in scientific journals and conference proceedings, 65 papers in big collaborations, and two chapters in monographs. A number of studies were accomplished in collaboration with scientists from the JINR Member States, Brazil, Germany, India, Italy, China, South Africa and other countries.

Due to improvement of the work of the injection complex at the NICA accelerator complex, the beam intensity was increased almost seven times. On 18 December, for the first time a beam of xenon heavy ions was injected into the Collider. With the injection of the first beam into the Collider, the NICA accelerator complex achieved a new stage of preparation for full-scale experiments. A cryogenic-compressor station was launched and the development of the cryogenic infrastructure was thus completed; it is capable now to provide cooling of all accelerators of the NICA complex. Additionally, in 2025 prototyping of high-temperature superconducting magnets started for the scheduled Nuclotron refurbishment.

Work continued at the Superheavy Element Factory on the synthesis of elements 119 and 120 of the Mendeleev Periodic System; three events of the ^{282}Nh isotope synthesis were registered. The development of the DRIBs-III accelerator complex was performed according to the plans.

During the 2025 Baikal Winter Expedition, the number of the detecting optical modules was increased up to 4212 items in the Baikal-GVD deep-water neutrino telescope, while its effective volume in event registration from high-energy neutrino (above 100 TeV) was over 0.7 km^3 . Thus, the largest neutrino telescope in the Northern Hemisphere Baikal-GVD became one of the leading facilities in the world in particle registration accuracy.

Speaking about scientific results in international collaborations of the largest neutrino experiments — where JINR is represented in NOvA and DUNE (USA) — they have recently obtained important results. JUNO — the underground observatory built in China with an active participation of scientists, engineers and programmers from JINR — possesses the best accuracy and the fastest statistics acquisition. The contribution of JINR participants into the development of detectors, equipment, and the data analysis was appreciated at the collaboration meeting.

After three years of shutoff, the unique IBR-2M fast-neutron reactor resumed operation, opening new opportunities for researchers. One of landmark events of the year was its successful launching in

the framework of a full-scale user program: in 2025 156 users were enrolled.

Among most important achievements is the progress in the development of the JINR MICC, including the extension of the multilevel system for storage and data processing of the Govorun supercomputer that increased its peak capacity by third as a result of refurbishment achieving 2.2 PFlops.

Important steps should be noted in the development of multidisciplinary research, applied studies, life sciences, and development of accelerators for applied and medical purposes. In 2025, the establishment of the Innovation Centre for nuclear physics research at JINR in life sciences, biomedical technologies, radiation biology and radiation material sciences, ecology and information systems was continued.

A new initiative was successfully developed: a contest was carried out to support JINR international projects in applied and innovative activities (R&D, Research & Development) with high potential and prospects to introduce them in industry, scientific instrumentation, and social sphere. Five teams of young winners have already started the implementation of their R&D elaborations.

The main strategic purpose for our community is the close interaction among the Institute laboratories. Several laboratories take part in all scientific projects of JINR. The independent international scientific expert evaluation is one more outstanding feature of the Institute. Over the last years representatives of new states have taken part in the work of the Scientific Council, Programme Advisory Committees, and in collaboration on the JINR Topical Plan.

In December 2025, the meeting of the JINR Finance Committee, the session of the Committee of Plenipotentiaries, the ceremonial event to celebrate the 50th anniversary of Cuba becoming JINR Member State, working meetings at the Ministry of Science, Technology and Environment (CITMA) and at the Ministry of Higher Education of the Republic of Cuba (MES), and other events were held in Cuba. Numerous guests from Latin American countries joined the meetings and celebrations.

On 2 December, the JINR CP session started with one-minute silence in memory of the famous scientists and science organizers — Corresponding Members of the Russian Academy of Sciences JINR Vice-Director Sergei Nikolaevich Dmitriev and Scientific Leader of the Laboratory of Radiation Biology Evgeny Aleksandrovich Krasavin. Their names are forever inscribed in history of outstanding scientific achievements and international cooperation at JINR.

The activities to ensure human resources of the Institute and scientific educational efforts to train high quality specialists were dynamically developed: the JINR UC organized dozens of scientific educational events and initiatives both in Dubna and Member States. Besides, in 2025 probation and practice ses-

sions at the Institute were attended by 820 students from over 20 countries of the world, schools for physics teachers were held in Russian and English. The scientific community of JINR together with colleagues from MEPhI and other famous Russian experts started the creation of a unified manual and an educational methodical complex in physics and natural science subjects (mathematics, biology, natural sciences) — a joint project on a federal level with RAS, the RF Ministry of Science and Higher Education, the RF Ministry of Education, and Publishing House “Prosveshcheniye”.

The successful activities of the MSU branch in Dubna deserves special mentioning, where 92 students study now on the Master’s programmes in physics, applied mathematics and informatics.

Of particular note is the success in the budget and economy policy: growth of material expenses for scientific projects, improvement of results of work at industrial departments. At present, 1225 scientists work at the Institute, a third of them arrived from Member States and JINR partners, including China, India, and South Africa. In 2025, the number of scientific visits to the Institute and the citation index of JINR in mass media increased considerably. More than 130 theses were defended at JINR Dissertation Councils during 5 years after their work resumption.

The publication activity of the Institute remained high in a wide range of scientific topics. It shows the productivity of our work at the level of world largest scientific centres. The new JINR journal *Natural Science Review* published four issues during the year and proved that it is much-in-demand.

Dozens of large conferences, meetings and schools were held both in Dubna and other cities, Member States and JINR partner countries. In December, a team of JINR staff members took part for the first time in the International conference on cooperation in science and technology; Prime Ministers of CIS countries took part in it. In the framework of the presented project, the importance of developing megascience facilities in CIS started, and the experience of JINR in the development of neutron spectrometers for reactors in Kazakhstan and Uzbekistan was noted.

A concept is being developed for the establishment of an International Park of Science and Technology in cooperation with the RF Ministry of Science and Higher Education, the Government of the Moscow Region, SEZ “Dubna”, and Dubna State University. It will allow “closing the distance” in knowledge acquisition, specialists training, development of new techniques, and creation of technological products. Together with FMBA of Russia, the construction of a centre for proton therapy in Dubna is scheduled on the basis of the MSC-230 superconducting cyclotron.

In 2025, new steps were taken to extend the cooperation of JINR with Member States and to develop their scientific infrastructure: a source of

cold neutrons on the basis of the WWR-K reactor in Kazakhstan and a cyclotron and reactor laboratory in Vietnam. Comprehensive efforts were taken to strengthen partnership relations with Associate Members (Serbia, RSA) and to establish new international contacts with France, Mexico, and Japan. Considerable steps were taken to extend ties with Latin America, in particular, to develop scientific cooperation and partnership in fundamental and applied research between JINR and education organizations of the Federative Republic of Brazil.

JINR today is in dynamical progress. Our strength is in tight bonds of generations, where knowledge of

experienced scientists of the Institute is combined with energy of young researchers who come to Dubna from dozens of countries of the world.

In 2026, we celebrate the jubilee of JINR. Seven decades of outstanding discoveries, challenging ideas, and international cooperation make up our mutual history and we are proud of it. We remain faithful to our motto "Science Brings Nations Together" that will be heard much louder now. This jubilee will become not only the subject of celebration but also strong encouragement for new ambitious plans.

A blue ink handwritten signature, appearing to be 'G. Trubnikov', written over a horizontal line.

G. TRUBNIKOV
Director
Joint Institute for Nuclear Research



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GOVERNING AND ADVISORY BODIES

COMMITTEE of PLENIPOTENTIARIES of the GOVERNMENTS of the MEMBER STATES of JINR

SESSION OF THE COMMITTEE OF PLENIPOTENTIARIES, 25 March 2025

A regular session of the Committee of Plenipotentiaries of the Governments of the JINR Member States was held on 25 March in Dubna under the chairmanship of the representative of Georgia, A. Khvedelidze.

Having heard the report presented by the JINR Director, G. Trubnikov, the Committee of Plenipotentiaries took note of the information from the JINR Directorate about the recommendations of the 137th session of the JINR Scientific Council, the implementation of the current Seven-Year Plan for the Development of JINR, the efforts of the Member States towards realization of JINR's large projects, the new scientific and technological results obtained, and about the most important events related to JINR's scientific research and educational activities and international cooperation.

The Committee of Plenipotentiaries approved the progress in implementing the current plan for research and development of the large scientific infrastructure of JINR, the successful participation of the Institute in international collaborations, and achievements in strengthening international cooperation:

- progress in preparation for the NICA complex commissioning, including the launch of a new cryogenic compressor station, commissioning of the main power receiving unit GPP-1, preparation of a detailed programme for the physical launch of the complex in the summer of 2025;

- successful cooling of the MPD solenoid down to the LHe temperature of 4.5 K, preparation of the MPD detector for the analysis of the first data sets in fixed-target mode;

- development of the ARIADNA collaboration and its research programme, the launch of several channels for applied research, successful operation of the SOCHI chip irradiation station;

- contribution of the Joint Institute for Nuclear Research to the data analyses and work of CERN collaborations at the Large Hadron Collider on the second phase of upgrading the ATLAS, CMS, and ALICE detectors, as well as obtaining new results in the CERN-SPS experiments;

- progress in the development of the Baikal-GVD deep-water neutrino telescope;

- successful participation in the most advanced neutrino experiments, including experiments with reactor neutrinos (JUNO), neutrinos from accelerators (NOvA, T2K), search for neutrinoless double beta decay (LEGEND);

- continuous preparation of experiments on the synthesis of new elements 119 and 120 of the Periodic Table: for this purpose, experiments on the synthesis of element 116 were performed at the Super-heavy Element Factory (SHE Factory) using beams of ^{50}Ti and ^{54}Cr ;

- test experiments at the ACCULINNA-2 fragment separator, full-scale launch of the experimental programme in the field of studying light nuclei at the boundaries of nucleon stability expected in the second half of 2025;

- planned assembly and launch of the DC-140 cyclotron at the end of 2025;

- progress in the construction of a new experimental building of the U-400R accelerator complex, as well as the design of new experimental facilities for the U-400R accelerator in parallel;

- successful completion of repair work at IBR-2, obtaining an authorization for resuming the operation of the reactor, and restart of the reactor operation from 17 February 2025;

- conducted and planned sessions for users of the IBR-2 spectrometer complex;

- successful development of the JINR MICC, including the enlargement of the multilayer data storage and processing system of the Govorun super-computer;

- elaboration and enhancement of mathematical methods and software for modelling physical processes and experimental facilities, processing and analyzing data within the BM@N, MPD and SPD projects at the NICA complex, the ATLAS and CMS experiments at the LHC;

- high publication activity and important new results in the main areas of JINR research;

- new results in medical radiobiology obtained at LRB: investigation of molecular mechanisms of

action of new classes of drugs and their combinations to increase the efficiency of tumour radiation therapy, as well as influence of X-ray irradiation on the rat brain;

- organization of a programme for the support of interlaboratory innovative projects;

- extensive joint work of the University Centre and the JINR laboratories on developing human capacity for JINR and its Member States.

The Committee of Plenipotentiaries noted with satisfaction the publication of the first issue of the new JINR scientific journal, "Natural Science Review", in December 2024.

The Committee of Plenipotentiaries noted the high efficiency of the support programme of the Ministry of Science and Higher Education of the Russian Federation for organizations collaborating with JINR within the framework of research at the NICA complex, and considered it as an example of efficient assistance from a JINR Member State in expanding the Institute's cooperation with national research organizations and universities to the level of megascience projects.

Having heard and discussed the report "On the first run at the NICA accelerator complex", presented by V. Kekelidze, Head of the NICA complex project, the Committee of Plenipotentiaries:

- congratulated JINR on the start of the first run at the NICA accelerator complex;

- endorsed the signing of an additional agreement to general construction contract No. 100/2795 of 18 September 2015 for the construction of buildings and structures (capital construction objects) for the installation of the heavy-ion collider NICA at the site of VBLHEP in Dubna, with a partial reconstruction of building No. 1;

- approved the organizational and financial decisions made by the JINR Directorate to minimize the risks of non-implementation of the NICA complex project in 2022–2025, to find ways to reduce costs, and the presented updated expected cost of the project in the amount of RUB 34 000 000.0 thousand. The CP commissioned the JINR Directorate to continue this work and to ensure the adoption of decisions and measures for maintaining the project implementation schedule to achieve the main parameters of the complex, as well as to continue active claims work with unfair suppliers.

Having heard and discussed the report "Execution of the JINR budget for 2024 and draft of the revised budget of JINR for 2025", presented by Head of the JINR Budget and Economic Policy Department N. Kalinin, the Committee of Plenipotentiaries:

- took note of the information on the execution of the JINR budget for 2024;

- took note of the information on the overpayment of contributions by the JINR Member States for 2024;

- approved the consolidated adjustment of the JINR budget expenditure for 2024;

- approved the revised budget of JINR for 2025 with the income amounting to US\$ 234 017.7

thousand and the expenditure amounting to US\$ 315 465.3 thousand, taking into account the positive opening balance amounting to US\$ 40 170.2 thousand;

- endorsed the proposal of the JINR Directorate on the advisability of allocating interest-free borrowed funds (loans) for the purpose of supporting JINR employees in purchasing housing to improve their living conditions within the budget's capabilities when receiving other income;

- approved the proposal of the JINR Directorate for additional planning of funds within the capabilities of the Institute's budget for the implementation of grant programmes related to the development of scientific and technical cooperation with the JINR Member States.

The Committee of Plenipotentiaries commissioned the JINR Directorate to prepare and approve the procedure for planning and spending additional funds.

Having heard and discussed the report "Results of the meeting of the JINR Finance Committee held on 24 March 2025", presented by the Chair of the Finance Committee, A. Omelchuk, the Committee of Plenipotentiaries:

- approved the Protocol of the meeting of the Finance Committee held on 24 March 2025;

- approved the proposals of the JINR Directorate regarding financial support for the Institute's employees who are scientific supervisors of students performing qualifying papers at JINR;

- commissioned the JINR Directorate and the Working Group under the CP Chair for JINR Financial Issues to work out the possibility of indexing the Incentive Fund for highly qualified employees, as well as to make an analysis of the competitiveness of the salary level of scientific workers;

- commissioned the JINR Directorate and the Working Group under the CP Chair for JINR Financial Issues to study the issue and present the results of the analysis of the personal income tax accumulated up to and including 2022;

- commissioned the JINR Directorate to present at the next meeting of the JINR Finance Committee a report on the results of digitalization of the Institute's administrative and scientific activities achieved following the Seven-Year Plan for the Development of JINR for 2017–2023 and in 2024–2025;

- took note of the information presented by the JINR Directorate about the selection of an organization for auditing JINR's financial activities for 2024, approved the LLC JSC "Korsakov and Partners" as the JINR auditor for 2024 and authorized it to conduct an audit of the Institute's financial activities for the specified period;

- approved the Plan for auditing the financial activities of JINR for 2024 as presented by the JINR Directorate.

Having heard and discussed the report "On the call of elections and nomination of candidates for the position of JINR Director" by the Chair of the Committee of Plenipotentiaries, A. Khvedelidze,





Dubna, 25 March. Session of the JINR CP

taking into account the unanimous decision of the Plenipotentiaries of the Governments of the JINR Member States to nominate G. Trubnikov as the only candidate for the position of JINR Director, as well as the consent of G. Trubnikov to be nominated as a candidate for this position, based on the results of open voting, in accordance with the JINR Charter and the Regulation for the JINR Director, G. Trubnikov was unanimously elected by the CP to the position of JINR Director for a term of five years taking office on 1 January 2026.

Having heard the report “To the 60th anniversary of the hypothesis of colored quarks and the Dubna model of hadrons”, presented by JINR Scientific Leader V. Matveev, the Committee of Plenipotentiaries thanked the speaker for his interesting and informative report.

Having heard and discussed the report “On preparing and holding the events dedicated to the 70th

anniversary of JINR”, delivered by JINR Chief Scientific Secretary S. Nedelko, the Committee of Plenipotentiaries approved the Plan of events proposed by the Organizing Committee: holding JINR Days in the Member States, major scientific conferences, exhibitions, festive cultural and sporting events, as well as the preparation and publication of a book about the history of the Joint Institute.

The Committee decided to hold a ceremonial meeting dedicated to the 70th anniversary of JINR in March 2026 in Dubna. The CP invited all JINR Member States to send their national delegations to participate in this event at the level of senior representatives of governments, relevant ministries and national academies of sciences, as well as commissioned the JINR Directorate to prepare and organize a meeting of the Working Group under the CP Chair for JINR Financial Issues in June–July 2025 in the Republic of Armenia.

SESSION OF THE COMMITTEE OF PLENIPOTENTIARIES, 2 December 2025

The regular session of the Committee of Plenipotentiaries of the Governments of the JINR Member States was held on 2 December in Varadero (Republic of Cuba) under the chairmanship of the representative of Georgia, A. Khvedelidze.

Having heard and discussed the report by the JINR Director, G. Trubnikov, the Committee of Plenipotentiaries took note of the information from the JINR Directorate about the implementation of the current Seven-Year Plan for the Development of JINR, the efforts of the Member States towards realization of JINR's major projects, the new scientific and technological results obtained, and about the most important events related to JINR's scientific research and educational activities and international cooperation. The CP noted with satisfaction the following:

- a high pace of implementation of the JINR development programme outlined in the JINR Long-Term Development Strategy up to 2030 and Beyond and the Seven-Year Plan for the Development of JINR for 2024–2030 over the past five years in all areas of the Strategy;

- creation of new and development of existing large research infrastructure, including the NICA accelerator complex;

- increasing the multidisciplinary of research through the use of a large research infrastructure, primarily designed for breakthrough fundamental research in the field of elementary particle physics and nuclear physics, as well as for applied developments, radiation research in life sciences and new materials, the initiation of a number of innovative projects and the development of specialized accelerators for applied and medical purposes;

- high publication activity of the Institute across a wide range of scientific fields, demonstrating re-

search effectiveness comparable to the world's largest scientific centres, and the holding of dozens of major scientific conferences, meetings, and schools both in Dubna and in other cities of the JINR Member States and partner countries;

- various activities of the Institute as an international intergovernmental scientific organization, including the attraction of new countries and partners to multilateral cooperation on the Institute's international platform and enhancing their official status in JINR;

- strengthening the Institute's human resources potential and creating a set of tools for scientific and educational activities for the purpose of training highly qualified personnel for the JINR Member States and partners;

- improvement of scientific and organizational work, including the transition to a new structure of the Topical Plan for JINR Research and International Cooperation, updating the norms, rules and regulations for project assessment, their resource provision and the conclusion of cooperation agreements, as well as monitoring the performance indicators and quality of the activities of the Joint Institute for Nuclear Research as an international intergovernmental scientific organization;

- updating the JINR budget structure to harmonize the planning processes and resource provision of the Institute's activities in accordance with the Topical Plan for JINR Research and International Cooperation;

- progressive improvement of working conditions for personnel, including improvement of the remuneration system, development and updating of the social and socio-cultural infrastructure of JINR.

The CP endorsed the implementation of the current plan for research and development of the

large research infrastructure of JINR, the successful participation of the Institute in international collaborations, and achievements in strengthening international cooperation.

With a view to developing the Baikal-GVD project, the CP supported the initiative of the JINR Directorate to create a separate representative office of the Institute on the base of existing JINR infrastructure located on Lake Baikal.

Having supported the JINR Directorate's initiative to study the feasibility of improving JINR top-level regulatory documents, the Committee of Plenipotentiaries instructed the JINR Directorate to report on the results at one of the CP sessions in 2026.

The CP assigned the JINR Directorate to present a concept for the International Park of Science and High Technologies in Dubna at the next CP session.

The Committee of Plenipotentiaries supported the idea of organizing a strategic discussion on expanding the scope of the Institute's activities at the CP session, dedicated to the 70th anniversary of JINR in March 2026 in Dubna. The Committee of Plenipotentiaries invited the JINR Member States and partners to take an active part in this discussion and submit their proposals to the JINR Directorate.

The CP approved the JINR Directorate's proposal to hold a large international multidisciplinary scientific conference "Fundamental Properties of Matter" in February 2027.

The CP expressed deep gratitude to the Government of the Russian Federation for the decision, which is extremely significant for all the JINR Member States, to partially pay off the accumulated arrears of the Russian Federation on contributions to the Joint Institute.

Having heard and discussed the report "Recommendations of the 138th session of the JINR Scientific Council (September 2025)", presented by S. Nedelko, Chief Scientific Secretary of JINR, considering the information presented in the report of JINR Director G. Trubnikov, the Committee of Plenipotentiaries approved the recommendations of the 137th and 138th sessions of the JINR Scientific Council and the Topical Plan for JINR Research and International Cooperation for 2026.

Having heard and discussed the report "Draft budget of JINR for the year 2026, provisional contributions of the Member States for the years 2027, 2028, 2029" by N. Kalinin, Head of the JINR Budget and Economic Policy Department, the Committee of Plenipotentiaries:

- approved the JINR budget for 2026 with the income amounting to US\$ 250 467.3 thousand and the expenditure amounting to US\$ 295 192.6 thousand with the closing negative balance amounting to US\$ 44 725.3 thousand;

- authorized the JINR Director to introduce adjustments to the JINR budget for 2026, including adjustments to the personnel remuneration and costs for international cooperation within the approved budget in compliance with the Regulations for the Introduction of Adjustments to the Budget of JINR;

- approved the contributions of the JINR Member States for the year 2026;

- endorsed the provisional contributions of the JINR Member States for the years 2027, 2028, 2029;

- approved the budget for the year 2026 on the construction and exploitation of the NICA complex of superconducting rings for heavy-ion colliding beams with the special-purpose funds of the Russian Federation, provided in accordance with the Agreement between the Government of the Russian Federation and JINR, in the amount of RUB 2 402 800.0 thousand;

- endorsed the consolidated adjustment of the JINR budget for the year 2025 over nine months;

- authorized the JINR Director to index the salary and tariff parts of the remuneration package of the Institute's employees, taking into account the needs and possibilities of the JINR budget for 2026, in accordance with the JINR Collective Bargaining Agreement for 2023–2026;

- took note of the information on the automation of the JINR budget planning processes starting from 2026 using the 1C:ERP Holding Management program;

- took note of the information on the accumulated arrears of the Member States in the payment of contributions to the JINR budget;

- took note of the information on the Institute's options to receive funds from the Member States to the JINR bank accounts opened in banks on the territory of the Russian Federation;

- assigned the JINR Directorate and persons from the Member States, responsible for interaction with the Institute on procurement matters, to intensify joint efforts to procure goods for the needs of JINR in accordance with the Institute's competitive procedures and to implement the right to industrial repayment in the amount of at least 20% of the Member States' contribution.

Having heard and discussed the report "Results of the meeting of the JINR Finance Committee held on 1 December 2025", presented by A. Omelchuk, Chair of the Finance Committee, the Committee of Plenipotentiaries:

- approved the Protocol of the meeting of the Finance Committee, the new versions of the Financial Rules of JINR and the Regulations for the Introduction of Adjustments to the Budget of JINR;

- cancelled the Procedure for the lease or sale of obsolete, decommissioned equipment, facilities, and buildings due to the changes in the legislation of the country of location of the Institute, as well as taking into account the current regulatory documents on JINR's procurement activities and the inclusion of the basic principles for the sale of assets in the Financial Rules;

- agreed on the need to prepare and sign an additional agreement to general construction contract No. 100/2795 of 18 September 2015 for the construction of buildings and structures (capital construction objects) for the installation of the heavy-ion collider NICA at the site of VBLHEP JINR in Dubna,





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with a partial reconstruction of building No. 1, taking into account the current cost and timing of the work underway;

- endorsed the intentions of the JINR Directorate to further develop tools with the participation of experts from the Member States to attract additional targeted funds for the implementation of joint scientific, educational, and infrastructure projects of the Member States;

- supported the initiative of the JINR Directorate to implement projects for the development of the Scientific and Clinical Centre for Proton Therapy and the International Park of Science and High Technologies in Dubna (with a research university being its part), and assigned the JINR Directorate to work out the issue of financial support and the implementation of these projects, including by paying off the arrears for the payment of contributions of the Member States;

- took note of the intention of the Republic of Kazakhstan to establish, jointly with JINR, the project “New neutron facility at the WWR-K research reactor”. Given the JINR Directorate’s support for the joint project between JINR and the Socialist Republic of Vietnam “Joint laboratory for accelerator technologies and applications”, the Committee of Plenipotentiaries recommended that the JINR Directorate establish a JINR–Vietnam Working Group to get this project ready. The CP recommended that the Republic of Kazakhstan and the Socialist Republic of Vietnam develop the above-mentioned projects for presentation at one of the future sessions of the Committee of Plenipotentiaries;

- took note of the information on the arrears for the payment of contribution to the JINR budget by the Republic of Moldova, which withdrew from JINR membership in 2025. As of 31 December 2024, the arrears of the Republic of Moldova were recorded in the amount of US\$ 306.4 thousand;

- recommended that the practice of applying the rule on preventing an increase in the overpayment of contributions due to the offset of personal income tax, adopted at the session of the Committee of Plenipotentiaries in May 2022, be continued;

- supported the efforts of the JINR Directorate to annually increase the level of salaries of JINR employees;

- maintained the size of the Incentive Fund at the current level when planning the JINR budget;

- supported the expansion of the practice of encouraging scientific supervision at JINR;

- assigned the JINR Directorate to continue the work on analyzing the competitiveness of the salaries of scientific and engineering staff at JINR;

- approved the audit report based on the results of the audit of JINR’s financial activities and the accounting report of JINR for the year 2024;

- took note of the information on the results of the digitalization of the administrative and scientific activities of the Joint Institute, achieved over the Sev-

en-Year Plan for the Development of JINR for 2017–2023 and in 2024–2025.

Having heard and discussed the report “The personnel policy of JINR and tools for attracting highly qualified employees” by A. Verkheev, Head of the Human Resources and Records Management Department, the Committee of Plenipotentiaries:

- supported the JINR Directorate’s approaches to developing remuneration policy at JINR, as well as the efforts to annually increase the salaries of JINR employees, aimed at strengthening the Institute’s competitive advantages in attracting and retaining highly qualified specialists;

- supported the proposal by the JINR Directorate to initiate the transition to a three-level by position remuneration system of JINR employees;

- noted the successful implementation of the social support programme for individuals who have terminated their employment with JINR;

- noted the Directorate’s efforts to attract graduates from leading universities in the JINR Member States to JINR;

- noted the successful work of the institution of JINR associated personnel.

Having heard and discussed the report “Changes in the membership of the JINR Scientific Council”, presented by JINR Director G. Trubnikov, the CP elected A. Ayala (Institute of Nuclear Sciences of the National Autonomous University of Mexico, Mexico City, Mexico), E. Boos (Lomonosov Moscow State University, Moscow, Russia), Kh. Jadambaa (GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany), I. Logashenko (Budker Institute of Nuclear Physics, Novosibirsk, Russia), S. Mihara (High Energy Accelerator Research Organization, Tsukuba, Japan), and M. Sakr (Biotechnology Research Institute of the National Research Centre, Giza, Egypt) as members of the JINR Scientific Council for the term of office of the current membership of the Scientific Council.

The Committee of Plenipotentiaries expressed its gratitude to the JINR Director, G. Trubnikov, for the interesting and informative report “On 50 years of cooperation between JINR and the Republic Cuba”.

The Committee of Plenipotentiaries thanked the organizers and the Plenipotentiary of the Government of the Republic of Cuba to JINR for the high level of preparation and holding of the CP session.

Plenipotentiaries of the Governments of the Republic of Belarus, the Democratic People’s Republic of Korea, and Romania did not take part in this meeting. A representative from the Federative Republic of Brazil, A. Brito Latgé, Secretary of Strategic Policies and Programmes of the Ministry of Science, Technology and Innovation of Brazil, participated in the CP session. The visit by the representative from Brazil was part of the signed cooperation agreement.

SCIENTIFIC COUNCIL

137th SESSION OF THE JINR SCIENTIFIC COUNCIL, 13–14 February 2025

The 137th session of the JINR Scientific Council was held on 13–14 February. It was chaired by JINR Director G. Trubnikov and Deputy Chairman of the Presidium of the National Academy of Sciences of Belarus S. Kilin.

G. Trubnikov presented a comprehensive report highlighting the decisions of the session of the JINR Committee of Plenipotentiaries (15 November 2024), the results of the implementation of the Seven-Year Plan for the Development of JINR for 2024–2030, the progress in the realization of the projects included in the Topical Plan for 2024, as well as recent events in scientific activity and international cooperation of the Institute.

The Scientific Council heard information about the work of the JINR Programme Advisory Committees, presented by I. Tserruya (PAC for Particle Physics), V. Nesvizhevsky (PAC for Nuclear Physics), and D. L. Nagy (PAC for Condensed Matter Physics).

The reports of young scientists recommended by the PAC were heard.

The award of the title of Honorary Doctor of JINR was announced at the session. The Scientific Council approved the decision of the Jury to award JINR annual prizes for the best theoretical and experimental research papers, methodology research and technology papers, as well as applied research and technology papers.

Elections of the FLNR Director were held, and confirmation of the positions of LRB Deputy Directors took place. Vacancies for the positions of FLNR Deputy Directors were announced.

Members of the Scientific Council took part in the festive opening of the new JINR basic facility, the Linac-200 accelerator.

The Scientific Council adopted the following resolution.

General Considerations

The Scientific Council welcomed its new members, R. Sahoo (India) and Song Yuntao (China), elected by the JINR Committee of Plenipotentiaries in November 2024.

According to the report by the JINR Director, G. Trubnikov, the Scientific Council noted with satisfaction recent achievements of the Institute:

- progress in preparation for the NICA collider commissioning, including the launch of a new cryogenic compressor station, installation of the liquid helium pipelines feeding the collider, ongoing assembly and tuning of the complex elements, preparation of a detailed programme for the physical launch of the complex in the summer of 2025;

- successful cooling of the MPD solenoid down to the LHe temperature of 4.5 K, preparation of the MPD detector for the analysis of the first data sets in fixed-target mode;

- progress in the analysis of Xe + CsI experimental data at an energy of 3.8 A GeV recorded in the BM@N experiment;

- development of the ARIADNA collaboration and its research programme, the launch of several channels for applied research, successful operation of the SOCHI chip irradiation station;

- progress in the development of the Baikal-GVD deep-water neutrino telescope in accordance with the Seven-Year Plan for the Development of JINR, as well as the installation of additional two clusters planned by the collaboration during the 2025 campaign;

- successful participation in the most advanced neutrino experiments, including experiments with reactor neutrinos (JUNO), neutrinos from accelerators (NOvA, T2K), search for neutrinoless double beta decay (LEGEND), as well as results of the first joint analysis carried out by the NOvA and T2K collaborations, which allow the enhancement of the sensitivity to three-flavour oscillation parameters they measure;

- efficient work of the JINR group in the COMET experiment at J-PARC (Japan);

- contribution of the Joint Institute to the work of CERN collaborations at the Large Hadron Collider on the second phase of upgrading the ATLAS, CMS, and ALICE detectors, as well as obtaining new results in the CERN-SPS experiments;



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- launch of the Institute's new basic facility Linac-800 in commissioning mode with an electron energy of up to 200 MeV;
- continuous preparation of experiments on the synthesis of new elements 119 and 120 of the Periodic Table: for this purpose, experiments on the synthesis of element 116 were performed at the SHE Factory using beams of ^{50}Ti and ^{54}Cr ;
- ongoing work to prepare for certification of the SHE Factory experimental halls for the first class of radiation safety;
- preparation of an experiment on the spectroscopy of isotopes of element 114 formed in the reaction $^{48}\text{Ca} + ^{242}\text{Pu}$ using a new large-diameter target unit (480 mm) with expected detection of several dozen events of element 114 formation in coincidence with gamma quanta;
- progress in the commissioning work and testing of primary and secondary beam regimes at the upgraded U-400M accelerator;
- test experiments at the ACCULINNA-2 fragment separator, full-scale launch of the experimental programme in the field of studying light nuclei at the boundaries of nucleon stability expected in the second half of 2025;
- final stage of construction work in the premises of the new DC-140 accelerator complex for applied research on heavy-ion beams, and the planned assembly and launch of the cyclotron in 2025;
- progress in the construction of a new experimental building of the U-400R accelerator complex: completion of concrete works and start of installation of engineering systems of the building with planned completion of the construction in 2026, as well as the design of new experimental facilities for the U-400R accelerator in parallel;
- co-organization of two important international conferences on low-energy nuclear physics: the Conference "50 Years of Cold Fusion" in Yerevan (Armenia) in November 2024 and the 2nd International African Symposium on Exotic Nuclei in Cape Town (South Africa) in December 2024;
- successful completion of repair work at IBR-2, obtaining an authorization for resuming the operation of the reactor, and the restart of the reactor operation with a gradual increase in power and first experiments planned for 17 February 2025;
- further progress in developing a mathematical model of pulsed fast reactor dynamics as an essential work for the stable and reliable operation of IBR-2 and the development of the new advanced neutron source at JINR;
- modernization and enhancement of the components of the JINR Multifunctional Information and Computing Complex: performance of the hyperconverged Govorun supercomputer, distributed computing and data storage systems based on Grid technologies and Cloud computing;
- leading position of the Tier-1 Grid site for the CMS experiment at the LHC among seven similar sites worldwide, data processing provided by Tier-2/CICC for the experiments at the LHC, NICA and oth-

er large-scale experiments, as well as its support for users from the JINR laboratories and the JINR Member States;

- elaboration and enhancement of mathematical methods and software for modelling physical processes and experimental facilities, processing and analyzing data from the BM@N, MPD and SPD projects at the NICA complex, the CMS and ATLAS projects at the LHC, and the projects of the JINR neutrino programme (Baikal-GVD, JUNO, NOvA);
- continued development of the JINR Digital Eco-System: commissioning PIN-2 in trial mode, trials of the repository of publications of JINR staff members, the development and launch of collaboration services (calendar, document management), creation of a data-bus prototype;
- high publication activity and new important results in the fields of theoretical and mathematical physics, nuclear physics, particle physics and relativistic heavy-ion physics, materials science and solid-state physics, including those oriented towards the JINR experimental programmes;
- new results in medical radiobiology obtained at LRB: investigation of molecular mechanisms of action of new classes of drugs and their combinations to increase the efficiency of tumour radiation therapy, as well as influence of X-ray irradiation on the rat brain;
- start of collecting applications following the JINR Director's initiative to organize a programme for the support of interlaboratory innovative projects;
- scientific and educational activities of the University Centre and the JINR laboratories, aimed, in particular, at increasing the motivation of physics teachers and talented students of high schools in the JINR Member States;
- work of the JINR Dissertation Councils on improving the qualifications of researchers from the Institute and organizations in the Member States;
- successful implementation of the JINR post-doctoral and fellowship programmes;
- publication of the first issue of the new JINR scientific journal, "Natural Science Review", in December 2024.

Recommendations of the Programme Advisory Committees Taken at the Meetings in January 2025

The Scientific Council took note of the recommendations made by the PACs at their meetings in January 2025, as reported at this session by I. Tseruya, Chair of the PAC for Particle Physics, V. Nesvizhevsky, Chair of the PAC for Nuclear Physics, and D. L. Nagy, Chair of the PAC for Condensed Matter Physics.

Particle Physics. The Scientific Council appreciated the PAC's support for the signing of a high-level agreement between the Joint Institute for Nuclear Research and the Ministry of Science and Technology of the People's Republic of China on the beginning of the implementation of joint projects.

The Scientific Council acknowledged the significant progress achieved in preparation for the NICA collider commissioning, including the installation of the collider magnetic cryostat system, RF stations and final focusing lenses, the merging of the high-vacuum sections in the West and East arcs, the installation of cryogenic equipment and power supplies in the collider building, and the connection of power lines and energy evacuation systems.

The Scientific Council noted that the main elements of all detector subsystems of the Phase-I MPD were produced, including the time-projection chamber, the time-of-flight system, the electromagnetic calorimeter, the fast forward detector, and the front hadronic calorimeter. Their assembly, testing and calibration are underway. The Scientific Council urged the MPD collaboration to speed up construction and installation works, endorsing the PAC's recommendation to extend the MPD project for five years with ranking A.

The Scientific Council appreciated the progress in the implementation of the BM@N project: ongoing physics analysis of the Xe–CsI collisions at an energy of 3.8 A GeV and preparation for the next physics run with a Xe beam at an energy of 2–3 A GeV.

The Scientific Council noted with satisfaction that having finalized the Technical Design Report, the SPD team has started work on the first stage of the detector. Manufacturing the elements of the main detector systems has started, and progress has been achieved in establishing the computing infrastructure of the project.

The Scientific Council supported the PAC's recommendation to open a new project "Study of neutrino properties in accelerator experiments", comprising the participation of JINR in the ongoing accelerator neutrino experiments NOvA, T2K, FASER, and DsTau, for three years with ranking A.

The Scientific Council appreciated the contribution of the JINR teams participating in the LHC experiments in physics analysis and detector upgrades.

Nuclear Physics. The Scientific Council appreciated the scientific significance of the Baikal-GVD project and the leading role of JINR in its implementation. In 2025, the underwater facility comprised 4104 optical modules placed on 114 garlands. The ongoing rate of production of detector components and deployment of further clusters in Lake Baikal will make it possible to reach by 2028 an observable water volume of 1 km³ for detecting astrophysical neutrinos with about 6000 optical modules.

The Scientific Council noted an important outcome achieved by the analysis of data obtained in 2018–2023 — confirmation of the diffuse astrophysical neutrino flux observed by the IceCube experiment with a significance of above 5 σ . The Scientific Council agreed that continued work on developing the detector with testing its possible next-generation components is necessary and relevant. Also, the Scientific Council noted the importance of maintaining and developing both the shore infrastructure of

the project and the production and research capabilities at the JINR sites.

The Scientific Council noted extensive work underway to start the Linac-200 facility at DLNP, which is part of the future Linac-800 accelerator.

Requests from the JINR laboratories and research teams of the JINR Member States are the primary focus when forming the user research programme at the accelerator. It was discussed to use the extracted beams of Linac-200 for testing prototypes of electromagnetic calorimeters and coordinate detectors for the MPD and SPD experiments at the NICA collider, applied work in the field of radiation materials science, radiobiology and radiochemistry, experiments in the field of nuclear physics.

The Scientific Council acknowledged tremendous efforts to prepare for long-term experiments on the spectroscopy of the isotopes of superheavy elements (SHE) synthesized in the ⁴⁸Ca + ²⁴²Pu reaction. During preparation for long-term experiments on the study of SHE properties, several experiments were conducted at the GRAND separator, commissioned in 2022, with the aim of investigating the capabilities of the setup. The experiments were carried out with heavy-ion beams of Mg, Ar, and Ca extracted from the DC-280 cyclotron. The separator was tuned using complete fusion reactions with Nd, Sm, Pb, and Pu targets. In addition, several important research results were obtained. A new plutonium isotope ²²⁷Pu was synthesized, and novel data were obtained on the radioactive decays of other yet-to-be-thoroughly investigated isotopes ^{228–231}Pu. Production cross sections for neutron-deficient nobelium nuclei were measured, and improved data were obtained on the decay modes (²⁴⁹No) and the probability of isomeric state population (²⁵⁰No). Short-lived isotopes ^{178–180}Hg produced in the ⁴⁰Ar + ¹⁴⁴Sm = ^{184-x}Hg + xn reaction were used for tuning the Cryodetector setup designed for experiments on the study of the chemical properties of SHE, in which the GRAND facility plays the role of a preseparator.

The Scientific Council greatly supported the proposed programme for studying the properties of the isotopes of superheavy elements. Given the unique and copious production of SHE within reach, the Scientific Council endorsed the recommendations of the PAC for Nuclear Physics to explore in more detail the possibility of designing a station to detect the mass and TKE distributions of the fission fragments. This would greatly enhance the comprehension of the fission process in the unknown mass regions.

Condensed Matter Physics. The Scientific Council noted with satisfaction the progress of work at IBR-2 in preparation for resuming the operation of the reactor and highly appreciated the efforts of the JINR Directorate to resume regular cycles for users, as well as its plans to extend the operation of the reactor with high-performance parameters by loading new fuel. The Scientific Council supported the PAC's recommendations to strengthen its work with potential users in order to attract the maximum

number of researchers to JINR, primarily from the Member States.

The Scientific Council welcomed the constant attention of the PAC to the status of the project of the new neutron source and the continuation of developing new advanced devices and technologies for cryogenic moderators of the new neutron source.

Reports by Young Scientists

The Scientific Council followed with interest the reports by young scientists, selected by the PACs for presentation at this session: “Construction of the IS CRA and SIMBO stations for applied research on high-energy ion beams. Radiation hardness testing of microchips by low-energy pulsed ion beams at the SOCHI station” by A. Slivin (VBLHEP), “Intense metallic ion beams for SHE synthesis” by D. Pugachev (FLNR), and “Structural and vibrational properties of the $\text{Cu}_3\text{Bi}(\text{SeO}_3)_2\text{O}_2\text{Cl}$ francisite at high pressure” by A. Rutkauskas (FLNP). The Scientific Council thanked the speakers and welcomed such selected reports in the future.

Memberships of the PACs

The Scientific Council appointed S. Jabarov (Supreme Attestation Commission under the President of the Republic of Azerbaijan, Baku, Azerbaijan) as a member of the PAC for Condensed Matter Physics for a term of three years.

Awards and Prizes

The Scientific Council approved the proposal of the JINR Director, G. Trubnikov, to award the title of Honorary Doctor of JINR to M. Sakr (Arab Republic of Egypt) for his great personal contribution to enhancing the role of the Arab Republic of Egypt in JINR’s scientific life, strengthening scientific cooperation between the Arab Republic of Egypt and JINR.

The Scientific Council approved the Jury’s recommendations presented by Vice-Director S. Dmitriev on awarding the JINR annual prizes for best papers in the fields of theoretical and experimental research, methodology and technology research, and applied technology research.

Election and Announcement of Vacancies in the Directorates of JINR Laboratories

The Scientific Council elected S. Sidorchuk as FLNR Director for a second term of five years. The Scientific Council appreciated the quality and diversity of all the applications.

The Scientific Council endorsed the appointments of A. Boreyko and I. Padrón Díaz as LRB Deputy Directors until the completion of the term of office of the current LRB Director, A. Bugay.

The Scientific Council announced the vacancies of positions of FLNR Deputy Directors. The endorsement of appointments was decided to take place at the 138th session of the Scientific Council in September 2025.

138th SESSION OF THE JINR SCIENTIFIC COUNCIL, 15–16 September 2025

The 138th session of the JINR Scientific Council was held on 15–16 September. It was chaired by JINR Director G. Trubnikov and Deputy Chairman of the Presidium of the National Academy of Sciences of Belarus S. Kilin.

G. Trubnikov delivered a detailed report in which he discussed the decision of the latest JINR CP session (25 March 2025), the results of the implementation of the Seven-Year Plan for the Development of JINR for 2024–2030, the progress in the realization of the projects included into the Topical Plan for 2025, and the recent events in scientific activity and international cooperation of the Institute.

The Scientific Council heard the information about the work of the JINR Programme Advisory Committees presented by I. Tserruya (PAC for Particle Physics), V. Nesvizhevsky (PAC for Nuclear Physics), D. L. Nagy (PAC for Condensed Matter Physics).

The following scientific reports were heard at the session: “CAS Institute of Plasma Physics: Research and perspectives”, delivered by Song Yuntao (IPP CAS, China), and “How beautiful is the landscape of superheavy nuclei?!” presented by Kh. Jadambaa (GSI, Germany).

The endorsement of appointments of FLNR Deputy Directors was held.

Decisions were also announced on conferring the title of Honorary Doctor of JINR and awarding the OGANESSION Prize. The presentation of the V. Dzhelepov Prize was held, and the laureate had the floor.

Reports by young scientists were heard as recommended by the PACs.

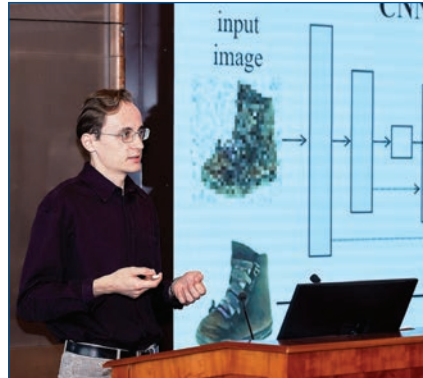
Diplomas were presented to the winners of JINR annual prizes for best scientific, methodological, technological, and applied research papers.

The Scientific Council adopted the following Resolution.

General Considerations

The Scientific Council took note of the report by the JINR Director, G. Trubnikov, endorsed comprehensive work by the JINR Directorate to strengthen partnership with the JINR Member States (the Republic of Belarus, the Republic of Bulgaria, the Socialist Republic of Vietnam, Mongolia, the Republic of Uzbekistan) and Associate Members (Serbia, South





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Africa) and establish new international contacts with France, Mexico, and Japan.

The Scientific Council appreciated deepening ties with Latin America, in particular, significant steps in developing scientific cooperation and partnership in fundamental and applied research between the Institute and educational organizations of the Federative Republic of Brazil, such as signing the Memorandum of Understanding between JINR and the Ministry of Science, Technology and Innovation of of Brazil. The Scientific Council also endorsed the Renewal of the General Cooperation Agreement between the Republic of Cuba and JINR signed by the University of Havana and JINR in February 2025 and aimed at expanding Cuba's participation in the Joint Institute.

The Scientific Council welcomed the signing of the Scientific and Technical Cooperation Agreement between JINR and the Academy of Sciences of the Republic of Uzbekistan in Tashkent (Uzbekistan) in April 2025.

The Scientific Council took note of the intention of Vietnam to establish, jointly with JINR, the project "Joint laboratory for accelerator technologies and applications" and the intention of Kazakhstan to establish, jointly with JINR, the project "New neutron facility at the WWR-K research reactor".

The Scientific Council appreciated recent scientific and technical achievements of the Institute:

- progress in preparation for the NICA collider commissioning, completion of the assembly of the fast extraction system from the Nuclotron, Nuclotron-collider beamline, assembly and tests of the collider's cryomagnetic system, launch of the beam transportation channels of the ARIADNA infrastructure to the IS CRA and SIMBO stations;

- installation of 40 Hall sensors in the MPD solenoid and development of a thermal insulation system for the solenoid current lead to start measuring the magnetic field map at operating currents;

- preparation of the BM@N setup for a Xe-beam energy scan from 1.5 to 3 A GeV;

- progress in designing the engineering infrastructure of the SPD experiment and production of the detector prototypes;

- development of the ARIADNA collaboration and its research programme, commissioning of the target station for long-term exposure (SLTE) and of the sample preparation laboratory for collaborating institutions;

- the Institute's contribution to the work of CERN collaborations at the LHC on the second phase of upgrading the ATLAS and CMS detectors, as well as obtaining new results in the CERN-SPS experiments;

- progress in development of the Baikal-GVD deep-water neutrino telescope which in 2025 consisted of 14 clusters with the underwater structure comprising almost 4300 optical modules;

- successful development of the shore and research infrastructure for the Baikal-GVD project: a control centre, laboratories, workshops, comfort-

able living quarters for approximately 100 people with independent power supply;

- effective participation of JINR in the experiments at the Kalinin Nuclear Power Plant: in the vGEN experiment, some of the world's best limits on the neutrino magnetic moment and millicharge were obtained; in the DANSS experiment, long-term diagnostics of reactor operation using antineutrinos was demonstrated for the first time in the world;

- successful participation of JINR in the JUNO advanced experiment (China) with reactor neutrinos, which will remain a leader in this field of research for the next decade and has already begun data taking;

- important results in applied investigations for home-developed new technologies, such as the COFE technology for a compact reactor neutrino detector developed at DLNP;

- carrying out an experiment in collaboration with the IMP CAS (China) to study the volatility and adsorption on a gold surface of superheavy elements of copernicium (^{283}Cn with a half-life of 3.81 s) and flerovium (^{287}Fl , half-life is 0.36 s) formed in the $^{48}\text{Ca} + ^{242}\text{Pu}$ fusion reaction;

- active development of the SHE Factory: assembling and commissioning of a new 28-GHz ECR ion source and work on the certification of the SHE Factory experimental halls to Class 1 radiation safety standards;

- completion of commissioning work at the upgraded U-400M accelerator and the optimization of its different regimes for the production of primary and secondary beams, as well as preparation for the experimental programme aimed at studying light nuclei at the boundaries of nucleon stability;

- completion of the construction of the new DC-140 accelerator complex for applied research;

- continuation of the construction of the new experimental building of the U-400R accelerator complex scheduled to be completed in 2026, as well as parallel ongoing work on the construction of new experimental setups;

- successful work of the Bogoliubov Laboratory of Theoretical Physics and interesting selected results in nuclear and condensed matter physics, presented in the report by the JINR Director;

- restart and active development of the User Programme at IBR-2, providing access to a unique neutron infrastructure for scientists from the JINR Member States and other countries;

- reliable and normal operation of both cryogenic neutron moderators at IBR-2 in 2025, which significantly expanded its experimental options;

- determining the avenues of scientific investigations and conceptual design for the new advanced pulsed neutron source at FLNP JINR;

- successful development of the JINR MICC, including the enlargement of the GPU component of the Govorun supercomputer, which opens up new opportunities for applying machine learning methods in particle physics; enhancement of the computing power and performance of the Tier-1 grid site;

commissioning of the dedicated data storages (EOS) for the MPD and SPD experiments;

— development of All-Institute digital services within the JINR Digital EcoSystem: filling of the repository of JINR staff members' publications and its integration with the PIN2 system, elaboration of an information system for distance learning and knowledge control on radiation safety, etc.;

— development of a fundamentally new radiobiological approach to increase the biological efficiency of radiopharmaceuticals used in nuclear medicine, and advances in the numerical simulations of radiation safety and future radiobiological experiments with heavy-ion beams at the applied research stations of the NICA complex;

— successful implementation of the scientific programme on radiation research in life sciences and the 20th anniversary of the Laboratory of Radiation Biology;

— active scientific and educational activities of the JINR University Centre and the effectiveness of JINR international educational programmes aimed at attracting young people to the Institute and training personnel in the interests of JINR partners.

The Scientific Council noted the successful launch and dynamic development of the new JINR online scientific journal, "Natural Science Review" (NSR). The Scientific Council agreed to the need to enhance its informational support to the Institute's initiative in developing the scientific journal under the Diamond Open Access model to attract leading scientists worldwide, first of all from the JINR Member States and partners, as authors and members of the NSR International Editorial Board.

The Scientific Council supported work to prepare for the opening in the Joint Institute of a new theme on beam physics and accelerator R&D and technologies in order to coordinate priorities and resources and establish close JINR interlaboratory cooperation with involvement of research centres in the Member States.

The Scientific Council congratulated G. Trubnikov on being elected as JINR Director for a second five-year term of office starting in January 2026.

Recommendations of the Programme Advisory Committees Taken at the Meetings in June 2025

The Scientific Council took note of the recommendations made by the PACs at their meetings in June 2025, as reported at this session by I. Tserruya, Chair of the PAC for Particle Physics, V. Nesvizhevsky, Chair of the PAC for Nuclear Physics, and D. L. Nagy, Chair of the PAC for Condensed Matter Physics.

Particle Physics. The Scientific Council shared the PAC's grief over the passing of H. Gutbrod and L. Jenkovszky. They were long-time members of the PAC for Particle Physics and strong supporters of JINR and the NICA project.

The Scientific Council acknowledged the progress achieved in the realization of the Nuclotron-NICA

project, including the optimization of particle dynamics in the Booster, completion of the assembly of the fast extraction system from the Nuclotron, and preparation for the Nuclotron cryomagnetic system operation.

The Scientific Council appreciated the progress in the implementation of the BM@N project: calibration of the time-of-flight system and development of centrality determination methods in Xe-CsI collisions at an energy of 3.8 A GeV; reprocessing of the data on the MLIT and VBLHEP computers with improved reconstruction methods and new calibration constants; publication of a paper on the production of protons, deuterons, and tritons in interactions with argon nuclei at 3.2 A GeV.

The Scientific Council was pleased with the progress of work on the deployment of several production sites for the SPD detector subsystems and the preparation of documentation for the construction of a superconducting solenoid. A prototype of the zero-degree calorimeter had already been installed in the collider ring near the SPD interaction point. A dedicated 7.2 PB data storage facility for SPD had been deployed at MLIT. In 2025, work continued to update the physics programme for the first phase of the experiment.

The Scientific Council supported the PAC's recommendation to extend the project "Development of a physics programme and detectors for experiments at CEPC" (former name "Development of a particle registration technique in future experiments with the participation of JINR") for the period 2026–2027. Over the next two years, conditions will be laid for JINR's future long-term participation in experiments at CEPC, subject to approval of the construction of this accelerator by the Chinese government in 2026.

The Scientific Council appreciated the new results obtained by the JINR group participating in the ALICE experiment in the study of femtosopic correlations of kaon pairs in p - p , p -Pb, Pb-Pb interactions, vector meson production in coherent photoproduction processes in ultraperipheral Pb-Pb collisions, Σ -hyperon production in p - p interactions, and development of a three-component thermal model. The Scientific Council supported the PAC's recommendation to extend the participation of the JINR group in the ALICE experiment for the period 2026–2030.

The Scientific Council noted with satisfaction the results obtained by the JINR group participating in the ATLAS experiment at the LHC (CERN). The JINR group participated in the measurement of the Higgs boson production cross section in gluon-gluon and vector boson fusion processes, as well as the measurement of heavy-quark Yukawa couplings with the Higgs boson produced in association with gauge bosons. Significant results were obtained in the analysis of the resonance production of J/ψ - J/ψ and J/ψ - $\psi(2S)$ near thresholds in ATLAS. The Scientific Council supported the PAC's recommendation to extend the participation of the JINR group in the ATLAS experiment within the framework of the single proj-

ect “ATLAS. Upgrade of the ATLAS detector and physics research at the LHC” for the period 2026–2030.

The Scientific Council acknowledged the results of the JINR group taking part in the CMS experiment within the framework of two projects, “CMS” and “Upgrade of the CMS detector”, and supported their merging into a single project, “Physics studies with the CMS experiment and the second phase of detector upgrade for operation at high-luminosity conditions”. The Scientific Council noted with satisfaction the large number of publications with key contributions from JINR physicists and supported the PAC’s recommendation to extend the participation of the JINR group in the CMS experiment for the period 2026–2030.

Nuclear Physics. The Scientific Council greatly appreciated the scientific significance of investigations of the chemical and physical properties of superheavy elements at FLNR, in particular, the four-week experiment aimed at studying the chemical properties of superheavy elements Cn and Fl that had been completed, offline test measurements using the gas catcher, and the work to develop construction documentation for the components of the multireflection time-of-flight mass spectrometer for precision measurements of SHE masses.

The Scientific Council took note of the interim report, considered by the PAC for Nuclear Physics, on the status of the project “Modernization of the EG-5 accelerator and its experimental infrastructure” at FLNP JINR for the period 2023–2025 and recognized the progress achieved. The Scientific Council endorsed the recommendation of the PAC to continue work on upgrading the EG-5 accelerator, including the replacement of the high-voltage system within 2026–2027.

The Scientific Council noted that the development of a world-class ultracold neutron source at JINR is an important task and supported opening the new project titled “Development of the concept of an ultracold neutron (UCN) source at the IBR-2 pulsed reactor”. The aim of the project is to develop a concept of a world-class UCN source profiting from the achieved pulse neutron flux at IBR-2.

The Scientific Council underlined the importance of developing new infrastructure for radiobiological research at JINR and supported the continuation of the project “Creating test benches to check single systems of the MSC-230 cyclotron”.

Condensed Matter Physics. The Scientific Council noted with satisfaction the successful restart of operation of the IBR-2 reactor for users, plans to prepare the reactor for the autumn–winter period of operation, and the resumption of the FLNP User Programme. The Scientific Council welcomed the inclusion of the Neutron Radiography and Tomography facility in the FLNP User Programme and shared the PAC’s opinion on the importance of ensuring prompt access to all facilities included in the FLNP User Programme for external users.

The Scientific Council took note of the PAC’s recommendations on the state of the complex of cryo-

genic moderators. The Scientific Council noted the work on the development of the complex of two cryogenic moderators to provide cold neutrons to practically all IBR-2 research beamlines, which was successfully completed. Together with the PAC, the Scientific Council considered the decision of the FLNP Directorate to stop work on the third cryogenic moderator to be justified.

The Scientific Council supported the PAC’s recommendations on the outcome of the spectrometer complex operation after restarting the IBR-2 reactor and shared the PAC’s opinion on the need to continue with the full-scale commissioning of the SANSARA instrument.

The Scientific Council took note of the information on the state of the small-angle neutron scattering spectrometer YuMO and high user demand for the spectrometer. Together with the PAC, the Scientific Council supported further efforts on the development of the small-angle scattering method at IBR-2 and also shared the PAC’s recommendation to continue work on the modernization of the main parts of the YuMO spectrometer and the development of the sample preparation laboratory.

Considering the discussion at the meeting of PAC members with the JINR Directorate, the Scientific Council took note of the idea of the JINR Director, G. Trubnikov, to establish a JINR interlaboratory Scientific and Technical Advisory Committee for life sciences in order to facilitate the elaboration of a coherent and synchronized programme in this field of activity.

The Scientific Council deeply regretted the passing of E. Krasavin announced at this session and expressed its sympathy to the family.

Reports by Young Scientists

The Scientific Council followed with interest the reports by young scientists, selected by the PACs for presentation at this session: “Dilepton measurements in the MPD experiment at NICA” by S. P. Rode (VBLHEP), “Low-energy spectra of nobelium isotopes” by M. Mardyban (BLTP), and “Automated segmentation of pores and cracks using a Unet3+ convolutional neural network on neutron, synchrotron, and X-ray tomography data” by B. Bakirov (FLNP). The Scientific Council thanked the speakers and welcomed such selected reports in the future.

Memberships of the PACs

The Scientific Council appointed H. Mkrtchyan (A. I. Alikhanyan National Science Laboratory, Yerevan, Armenia) and G. Rubtsov (Institute for Nuclear Research of the Russian Academy of Sciences, Moscow, Russia) as members of the PAC for Particle Physics for a term of three years.

Scientific Reports

The Scientific Council listened with interest to the scientific report “CAS Institute of Plasma Physics: Research and perspectives”, presented by Song



Dubna, 16 September. The names of the 2025 OGANESSION Prize laureates were announced at the 138th session of the JINR Scientific Council

Yuntao (IPP CAS, China), and to the scientific report “How beautiful is the landscape of superheavy nuclei?!” presented by Kh. Jadambaa (GSI, Germany), and kindly thanked the speakers.

Awards and Prizes

The Scientific Council approved the proposal of the JINR Director, G. Trubnikov, to award the title of Honorary Doctor of JINR to:

- E. Tomasi-Gustafsson (France) for her contributions to the development of spin physics and hadron structure physics at JINR, as well as to strengthening the international cooperation of the Institute;
- S. Haroutiunian (Armenia) for his contribution to the development of cooperation between JINR and scientific and educational organizations of the Republic of Armenia.

The Scientific Council welcomed the Jury's decision presented by the JINR Director, G. Trubnikov, to

award the OGANESSION Prize to M. Spiro, N. Tarasova, A. Avetisyan, and A. Semikhatov.

The Scientific Council congratulated M. Frontasyeva (FLNP JINR) on receiving the V. Dzhelepov Prize for her significant contribution to the development of the international programme on the assessment of air quality using neutron activation analysis.

The Scientific Council congratulated the winners of JINR annual prizes for best scientific, methodological, technological, and applied research papers.

Election and Announcement of Vacancies in the Directorates of JINR Laboratories

The Scientific Council endorsed the appointments of G. Kaminski and A. Karpov as Deputy Directors of the Flerov Laboratory of Nuclear Reactions until the completion of the term of office of the FLNR Director, S. Sidorchuk.

FINANCE COMMITTEE

MEETING OF THE JINR FINANCE COMMITTEE, 24 March 2025

A regular meeting of the Finance Committee was held on 24 March in Dubna under the chairmanship of the representative of the Russian Federation, A. Omelchuk.

Regarding the report by the JINR Director, G. Trubnikov, the Finance Committee recommended that the Committee of Plenipotentiaries take note of the information from the JINR Directorate about the recommendations of the 137th session of the JINR Scientific Council, the implementation of the current Seven-Year Plan for the Development of JINR, the efforts of the Member States towards realization of JINR's major projects, the new scientific and technological results obtained, and about the most important events related to JINR's scientific research and educational activities and international cooperation.

The Finance Committee recommended that the Committee of Plenipotentiaries endorse the implementation of the current plan for research and development of the JINR large research infrastructure:

— progress in preparation for the NICA collider commissioning, including the launch of a new cryogenic compressor station, installation of the liquid helium pipelines feeding the collider, commissioning of GPP-1, ongoing assembly and tuning of the complex elements, preparation of a detailed programme for the physical launch of the complex in the summer of 2025;

— progress in the development of the Baikal-GVD deep-water neutrino telescope in accordance with the Seven-Year Plan for the Development of JINR: 660 optical modules were prepared at DLNP for installation in 2025;

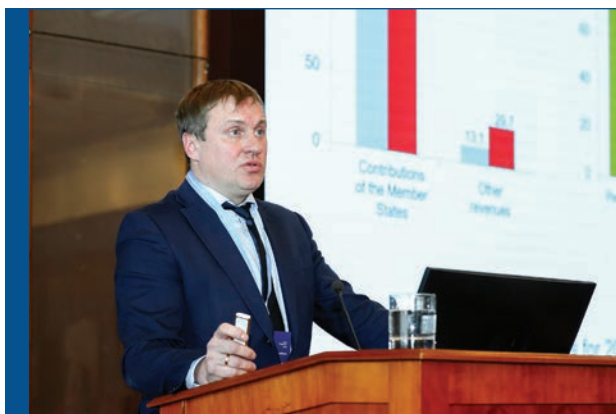
— launch of the Institute's new basic facility Linac-800 in commissioning mode with an electron energy of up to 200 MeV;

— continuous preparation of experiments on the synthesis of new elements 119 and 120 of the Periodic Table: for this purpose, experiments on the synthesis of element 116 were performed at the SHE Factory using beams of ^{50}Ti and ^{54}Cr ;

— final stage of construction work in the premises of the new DC-140 accelerator complex for applied research on heavy-ion beams, and the planned assembly and launch of the cyclotron in the end of 2025;

— progress in the construction of a new experimental building of the U-400R accelerator complex: completion of concrete works and start of installation of engineering systems of the building with planned completion of the construction in 2026, as well as the design of new experimental facilities for the U-400R accelerator in parallel;

— successful completion of repair work at IBR-2, obtaining an authorization for resuming the operation of the reactor, and restart of the reactor operation from 17 February 2025.



Dubna, 24 March. Meeting of the JINR Finance Committee

The Finance Committee recommended that the Committee of Plenipotentiaries approve the proposals of the JINR Directorate regarding financial support for the Institute's employees who are scientific supervisors of students performing qualifying papers at JINR.

The Finance Committee recommended that the Committee of Plenipotentiaries commission the JINR Directorate and the Working Group under the CP Chair for JINR Financial Issues to work out the possibility of indexing the Incentive Fund for highly qualified employees, as well as to make an analysis of the competitiveness of the salary level of scientific workers.

Regarding the report "Execution of the JINR budget for 2024 and draft of the revised budget of JINR for 2025", presented by the Head of the JINR Budget and Economic Policy Department, N. Kalinin, the Finance Committee recommended the following to the Committee of Plenipotentiaries:

- to take note of the information on the execution of the JINR budget for 2024;
- to take note of the information on the overpayment of contributions by the JINR Member States for 2024;
- to approve the consolidated adjustment of the JINR budget expenditure for 2024;
- to approve the revised budget of JINR for 2025 with the income amounting to US\$ 234 017.7 thousand and the expenditure amounting to US\$ 315 465.3 thousand, taking into account the positive opening balance amounting to US\$ 40 170.2 thousand;
- to endorse the proposal of the JINR Directorate on the advisability of allocating interest-free borrowed funds (loans) for the purpose of supporting JINR employees in purchasing housing to improve their living conditions within the budget's capabilities when receiving other income;
- to approve the proposal of the JINR Directorate for additional planning of funds within the capabilities of the Institute's budget for the implementation

of grant programmes related to the development of scientific and technical cooperation with the JINR Member States, as well as to prepare and approve the procedure for planning and spending additional funds;

— to commit the JINR Directorate and the Working Group under the CP Chair for JINR Financial Issues to study the issue and present the results of the analysis of the personal income tax accumulated up to and including 2022.

Regarding the report "On selecting an organization for auditing JINR's financial activities for the year 2024" by L. Kostov, JINR Vice-Director, the Finance Committee recommended that the Committee of Plenipotentiaries approve the Plan for auditing the financial activities of JINR for 2024 as presented by the JINR Directorate and authorize the LLC JSC "Korsakov and Partners" to conduct an audit of the Institute's financial activities for the specified period.

Regarding the report "Migration of procurement processes to a new IT platform", delivered by the Head of the Department of Digital Services Development, M. Vasiliev, the Finance Committee recommended that the Committee of Plenipotentiaries note the work being carried out and the plans presented to improve the information systems that automatize the Institute's procurement processes, with the involvement of major external partners with significant experience and competence in this area. The Finance Committee recommended that the Committee of Plenipotentiaries commission the JINR Directorate to present at the next meeting of the JINR Finance Committee a report on the results of digitalization of the Institute's administrative and scientific activities achieved over the Seven-Year Plan for the Development of JINR for 2017–2023 and in 2024.

The Finance Committee thanked the Leading Researcher at VBLHEP, A. Taranenko, for his interesting and informative report "Cosmic matter in the laboratory — The BM@N (NICA) experiment".

MEETING OF THE JINR FINANCE COMMITTEE, 1 December 2025

A regular meeting of the Finance Committee was held on 1 December in Varadero (Republic of Cuba) under the chairmanship of the representative of the Russian Federation, A. Omelchuk.

Having heard the report by JINR Director G. Trubnikov, the Finance Committee recommended the Committee of Plenipotentiaries to take note of the JINR Directorate's information about the recommendations of the 138th session of the JINR Scientific Council, the implementation of the current Seven-Year Plan for the Development of JINR, the efforts of the Member States towards realization of JINR's major projects, the new scientific and technological results obtained, and about the most important

events related to JINR's scientific research and educational activities and international cooperation.

The Finance Committee recommended that the Committee of Plenipotentiaries endorse the work carried out by the JINR Directorate on the execution of the JINR budget for 2025 to implement the Topical Plan for JINR Research and International Cooperation in 2025.

The Finance Committee recommended that the Committee of Plenipotentiaries endorse the implementation of the current plan for research and development of the large research infrastructure of JINR, the successful participation of the Institute in

international collaborations, and achievements in strengthening international cooperation:

- progress in preparation for the commissioning of the NICA complex, including the launch of the cryogenic compressor station and thereby completing the creation of the VBLHEP cryogenic infrastructure capable of providing cooling for all accelerators of the NICA complex and the MPD solenoid; completion of the installation of the ion beam transport line from the Nuclotron to the collider; first successful results in the fast extraction of a beam of heavy Xe ions from the Nuclotron; successful cryogenic tests of the western half-ring of the collider; vacuum tests of the eastern half-ring; installation of the injection system for both collider rings; implementation of magnetic field map measurements for the MPD solenoid;

- awarding the Breakthrough Prize in Fundamental Physics 2025 to participants in the LHC experiments — ATLAS, CMS, and ALICE, as well as active participation of JINR scientists in experiments at CERN SPS;

- completion of the ARIADNA stand, designed to implement a unique mode of long-term irradiation of samples with high-energy ion beams, as well as putting into operation the SMM-2000 scanning multi-microscope for conducting research in the field of radiation materials science using ion beams from the NICA complex;

- creation of a regulatory framework and the necessary conditions for the formation, efficient functioning and development of four international collaborations: BM@N, MPD, SPD, and ARIADNA, with the aim of preparing and conducting large-scale scientific research at the NICA complex;

- progress in the development of the Baikal-GVD deep-water neutrino telescope, as well as the infrastructure on the shore of Lake Baikal for the permanent deployment of scientific and technical personnel and equipment;

- the Institute's successful participation in the most advanced neutrino experiments, including experiments with reactor neutrinos (JUNO) and neutrinos from accelerators (NOvA, T2K), and the search for neutrinoless double beta decay (LEGEND);

- investigation of the chemical properties of superheavy elements at the SHE Factory by studying the volatility and adsorption of Cn and Fl on the surface of gold;

- ongoing work on preparing the synthesis of elements 119 and 120 of the Periodic Table and observation of three events of the synthesis of the isotope ^{282}Nh ;

- planned progress of work on the development of the DRIBs-III accelerator complex, especially progress in the construction of the U-400R experimental hall and in preparation for the commissioning of the DC-140 cyclotron;

- successful completion of repair work at IBR-2;

- conducted and planned sessions for users of the IBR-2 spectrometer complex;

- successful development of the JINR MICC, including the expansion of the multilayer data storage and processing system of the Govorun supercomputer;

- development and advancement of mathematical methods and software for modeling physical processes and experimental facilities, data processing and analysis within the BM@N, MPD and SPD projects at the NICA complex, the ATLAS and CMS experiments at the LHC;

- high publication activity of BLTP and important new results in the main areas of JINR research;

- establishment of the JINR Interlaboratory Council for Biophysical Research to harmonize JINR's scientific and organizational activities in the field of radiation research in the life sciences and to increase the efficiency of using the research infrastructure;

- organization of a programme to support interlaboratory innovation projects;

- extensive joint work of the JINR University Centre and the JINR laboratories to train personnel for the JINR Member States and strengthen the Institute's human resources potential.

With a view to developing the Baikal-GVD project, the Finance Committee recommended that the Committee of Plenipotentiaries support the initiative of the JINR Directorate to create a separate representative office of JINR on the existing infrastructure located on Lake Baikal.

Regarding the report "Draft budget of JINR for the year 2026, provisional contributions of the Member States for the years 2027, 2028, 2029" by N. Kalinin, Head of the JINR Budget and Economic Policy Department, the Finance Committee recommended the following to the Committee of Plenipotentiaries:

- to approve the JINR budget for 2026 with the income amounting to US\$ 250 467.3 thousand and the expenditure amounting to US\$ 295 192.6 thousand, taking into account the closing negative balance amounting to US\$ 44 725.3 thousand, and to authorize the JINR Director to introduce adjustments to the JINR budget for 2026, including adjustments to the personnel remuneration and costs for international cooperation within the approved budget in compliance with the Regulations for the Introduction of Adjustments to the Budget of JINR;

- to approve the contributions of the JINR Member States for the year 2026;

- to endorse the provisional contributions of the JINR Member States for the years 2027, 2028, 2029;

- to approve the budget for the year 2026 on the construction and exploitation of the NICA complex of superconducting rings for heavy-ion colliding beams with the special-purpose funds of the Russian Federation, provided in accordance with the Agreement between the Government of the Russian Federation and JINR, in the amount of RUB 2 402 800.0 thousand;

- to endorse the consolidated adjustment of the JINR budget for the year 2025 over nine months;

- to authorize the JINR Director to index the salary and tariff parts of the remuneration package of

the Institute's employees, taking into account the requirements and possibilities of the JINR budget for 2026, in accordance with the JINR Collective Bargaining Agreement for 2023–2026;

— to take note of the information on the arrears for the payment of contribution to the JINR budget by the Republic of Moldova, which withdrew from JINR membership in 2025. As of 31 December 2024, the arrears of the Republic of Moldova were recorded in the amount of US\$ 306.4 thousand;

— to agree on the need to prepare and sign an additional agreement to general contract No. 100/2795 of 18 September 2015 for the construction of buildings and structures (capital construction objects) for the installation of the heavy-ion collider NICA at the site of VBLHEP JINR in Dubna, with a partial reconstruction of building No. 1, taking into account the current cost and timing of the ongoing work.

Regarding the report “Amendments to the regulatory documents governing the financial activities of JINR: Financial Rules of JINR; Regulations for the Introduction of Adjustments to the Budget of JINR” by N. Kalinin, Head of the JINR Budget and Economic Policy Department, the Finance Committee recommended that the Committee of Plenipotentiaries approve the new version of the Financial Rules of JINR and the new version of the Regulations for the Introduction of Adjustments to the Budget of JINR, as well as cancel the Procedure for the lease or sale of obsolete, decommissioned equipment, facilities, buildings, and structures (Item 5, Section II of the Protocol of the CP meeting of 17–18 March 1992) due to the changes in the legislation of the country of location of the Institute, as well as taking into account the current regulatory documents on JINR's procurement activities and the inclusion of the basic principles for the sale of property in the Financial Rules.

Regarding the report “Results of the meeting of the Working Group under the CP Chair for JINR Financial Issues held on 27 June 2025” by Ye. Mukhamejanov, Chair of the Working Group under the CP Chair for JINR Financial Issues, the Finance Committee recommended the following to the Committee of Plenipotentiaries:

— to support the amendments proposed by the JINR Directorate and the Working Group for introduction into the regulatory documents governing the financial activities of JINR, taking into account the remarks and proposals received from the Plenipotentiaries;

— to endorse the intentions of the JINR Directorate to further develop tools with the participation of experts from the Member States to attract additional targeted funds for the implementation of joint scientific, educational, and infrastructure projects of the Member States;

— to support the initiative of the JINR Directorate to implement projects for the development of the Scientific and Clinical Centre for Proton Therapy and the International Park of Science and High Technologies in Dubna, and to commission the JINR Direc-

torate to work out the issue of financial support for these projects, including by paying off the arrears for the payment of contributions of the Member States;

— to take note of the intention of the Socialist Republic of Vietnam to establish, jointly with JINR, the project “Joint laboratory for accelerator technologies and applications” and the intention of the Republic of Kazakhstan to establish, jointly with JINR, the project “New neutron facility at the WWR-K research reactor” and to recommend that these Member States develop projects for presentation at one of the subsequent CP sessions;

— to continue the practice of applying the rule on preventing an increase in the overpayment of contributions due to the offset of personal income tax, adopted at the session of the Committee of Plenipotentiaries in May 2022;

— to support the efforts of the JINR Directorate to annually increase the level of remuneration of JINR employees;

— to maintain the size of the Incentive Fund at the current level when planning the JINR budget;

— to support the expansion of the practice of encouraging scientific supervision at JINR;

— to commission the JINR Directorate to continue the work on analyzing the competitiveness of the salaries of scientific personnel and specialists at the Joint Institute.

Regarding the report “Results of the audit of the financial activities of JINR performed for the year 2024” by D. Korsakov, Director of the LLC JSC “Korsakov and Partners”, the Finance Committee recommended that the Committee of Plenipotentiaries approve the audit report based on the results of the audit of JINR's financial activities for the year 2024.

Regarding the report “Results of the digitalization of administrative and scientific activities of the Institute achieved over the Seven-Year Plan for the Development of JINR for 2017–2023 and in 2024–2025” by M. Vasiliev, Head of the Department of Digital Services Development, the Finance Committee noted the considerable results of the digitalization of the Institute's administrative and scientific activities, in particular:

— optimization of procurement processes, including the launch of the Marketplace and the modernization of relevant information systems;

— onset of implementing an integrated ERP (Enterprise Resource Planning) information system;

— launch of the Digital JINR portal as a single access point to JINR digital services;

— adoption of a generalized user identification system.

The Finance Committee recommended that the Committee of Plenipotentiaries take note of the information provided on the achieved digitalization results.

The Finance Committee expressed its gratitude to the organizers and the Plenipotentiary of the Government of the Republic of Cuba to JINR for the high level of preparation and holding of the meeting of the Finance Committee.

PROGRAMME ADVISORY COMMITTEES

61st MEETING OF THE PAC FOR PARTICLE PHYSICS, 20 January 2025

The 61st meeting of the Programme Advisory Committee for Particle Physics took place on 20 January. It was chaired by Professor I. Tserruya.

The Chair of the PAC welcomed the new PAC members, A. Jaiswal, L. Litov, and G. Majumder, and presented an overview of the implementation of the recommendations adopted at the previous meeting. JINR Vice-Director V. Kekelidze highlighted the resolution of the 136th session of the JINR Scientific Council (September 2024) relevant to particle physics and the decisions of the JINR Committee of Plenipotentiaries (November 2024). The PAC supported the decision of the CERN Council to benefit further from the participation of JINR in CERN's activities and

welcomed the signing of a high-level agreement between JINR and the Ministry of Science and Technology of the People's Republic of China on the beginning of the implementation of joint projects.

The PAC heard the progress report on the realization of the Nuclotron–NICA project, presented by A. Sidorin. The Committee appreciated the significant progress achieved in preparation for the NICA collider commissioning, including the installation of the collider magnetic cryostat system, RF stations and final focusing lenses, the merging of the high-vacuum sections in the West and East arcs, the installation of cryogenic equipment and power supplies in the collider building, and the connec-



Dubna, 20 January. The 61st meeting of the Programme Advisory Committee for Particle Physics

tion of power lines and energy evacuation systems. A detailed programme for the physical launch of the complex was developed.

The PAC heard with interest the report, presented by K. Mukhin, on the readiness of the engineering infrastructure of Building 17 for the launch of the NICA collider and the MPD detector in 2025. The Committee noted that the license for the construction of a radiation source (the NICA collider) and permission from Rostekhnadzor to operate the main electrical substation of VBLHEP were obtained in 2024. The Committee was pleased to note the readiness of the engineering equipment of the water cooling and power supply systems for the collider and the MPD detector for operation with colliding beams, the launch of satellite refrigerators and a new cryogenic compressor station, as well as the installation and testing of liquid helium pipelines feeding the collider. The PAC congratulated the team on successfully achieving a significant milestone — cooling the MPD superconducting magnet to LHe temperatures.

The PAC appreciated the progress in the implementation of the BM@N project, presented by M. Kapishin — ongoing physics analyses of the Xe-CsI collisions at an energy of 3.8 A GeV and preparation for the next physics run with a Xe beam at an energy of 2–3 A GeV.

The PAC took note of the report on the status of the SPD project, presented by A. Guskov. Having finalized the Technical Design Report, the SPD team has started working on the first stage of the detector. Manufacturing of elements of the main detector systems has started. Progress has been achieved in establishing the computing infrastructure of the project.

The PAC took note of the report on implementing the MPD project, presented by V. Riabov. In 2020–2024, the main elements of all detector subsystems of the Phase-I MPD were fabricated, including the time-projection chamber, the time-of-flight system,

the electromagnetic calorimeter, the fast forward detector, and the front hadronic calorimeter. The PAC recommended extending the MPD project for five years with ranking A.

The PAC heard the report “Study of neutrino properties in accelerator experiments” on JINR’s participation in the ongoing accelerator neutrino experiments NOvA, T2K, FASER, and DsTau, delivered by L. Kolupaeva. The presented project combined the participation of JINR in experiments with neutrinos from accelerators into one project, which will make it possible to use the complementary experience of the participating groups. The PAC recommended opening the project from 2026 for three years with ranking A.

The Programme Advisory Committee appreciated the reports on the scientific results obtained by JINR groups participating in the LHC experiments, presented by E. Rogochaya (ALICE), I. Yeletsikh (ATLAS), and V. Karzhavin (CMS). The PAC acknowledged their valuable contributions to the detectors upgrade for operation at high luminosity of the HL-LHC, as well as a large number of scientific publications and presentations at international conferences, workshops, and seminars.

The PAC heard two scientific reports — “Status of the SRC program of the HyperNIS + SRC project”, presented by M. Patsyuk, and “Study of dark matter physics using fixed target experiments”, delivered by A. Zhevlakov, and thanked the speakers for the very interesting presentations.

Of the 17 reports by young scientists from DLNP and VBLHEP at the poster session, the PAC selected the report “Construction of the IS CRA and SIMBO stations for applied research on high-energy ion beams. Radiation hardness testing of microchips by low-energy pulsed ion beams at the SOCHI station”, made by A. Slivin, for presentation at the session of the JINR Scientific Council.

60th MEETING OF THE PAC FOR NUCLEAR PHYSICS, 24 January 2025

The 60th meeting of the Programme Advisory Committee for Nuclear Physics was held on 24 January. It was chaired by Professor V. Nesvizhevsky.

The Chair of the PAC presented an overview of the implementation of the recommendations taken at the previous meeting. JINR Vice-Director S. Dmitriev informed the PAC about the resolution of the 136th session of the JINR Scientific Council (September 2024) and the decisions of the JINR Committee of Plenipotentiaries (November 2024).

The PAC heard the report on the status of research with the neutrino telescope in Lake Baikal and the corresponding scientific results, presented by B. Shaibonov. In 2025, the underwater facility comprised 4104 optical modules placed on 114 garlands. The ongoing rate of production of detector

components and deployment of further clusters in Lake Baikal will make it possible to reach by 2028 an observable water volume of 1 km³ with about 6000 optical modules.

The PAC noted an important outcome achieved by the analysis of data obtained in 2018–2023 — confirmation of the diffuse astrophysical neutrino flux observed by the IceCube experiment with a significance of above 5 σ . The results of searching for events from the neutrinos with energies of above 200 TeV demonstrate an unexpectedly large contribution of events from the galactic plane to the observed diffuse flux, which contradicts the assumptions of many modern model-dependent predictions. The PAC deeply appreciated the scientific significance of the Baikal-GVD project and the lead-



Dubna, 24 January. Presidium of the Programme Advisory Committee for Nuclear Physics

ing role of JINR in its implementation. The Committee agreed that continued work on developing the detector with testing its possible next-generation components is necessary and relevant. Also, the PAC noted the importance of maintaining and developing both the shore infrastructure of the project and the production and research capabilities at the JINR sites.

The PAC heard the report on the status of the linear electron accelerator Linac-200 as a core for a test electron beam facility at DLNP, presented by A. Trifonov. The Committee noted extensive work underway to start the Linac-200 facility, which is part of the future Linac-800 accelerator. The key subsystems of the accelerator have been designed anew, and four experimental beam extraction channels with energies of 24, 60, 133 and 207 MeV have been designed and constructed. It is planned to gradually put into operation the accelerator structures up to energies of 800 MeV.

Requests from the JINR laboratories and research teams of the JINR Member States are the primary focus when forming the user research programme at the accelerator. It was discussed to use the extracted beams of Linac-200 for testing prototypes of electromagnetic calorimeters and coordinate detectors for the MPD and SPD experiments at the NICA collider, applied work in the field of radiation materials science, radiobiology and radiochemistry, experiments in the field of nuclear physics. In this respect, the role of the FLAP collaboration is important in conducting practical training for students and specialists from the Member States through the JINR University Centre.

The PAC heard the report on the study of the chemical and physical properties of superheavy elements at the SHE Factory of FLNR, presented by

A. Svirikhin. The PAC acknowledged tremendous efforts to prepare for long-term experiments on spectroscopy of the isotopes of superheavy elements synthesized in the $^{48}\text{Ca} + ^{242}\text{Pu}$ reaction. During preparation for long-term experiments on the study of SHE properties, several experiments were conducted at the GRAND separator, commissioned in 2022, with the aim of investigating the capabilities of the setup. The experiments were carried out with heavy-ion beams of Mg, Ar, and Ca extracted from the DC-280 cyclotron. The separator was tuned using complete fusion reactions with Nd, Sm, Pb, and Pu targets. In addition, several important research results were obtained. A new plutonium isotope ^{227}Pu was synthesized, and novel data were obtained on the radioactive decays of other yet-to-be-thoroughly investigated isotopes $^{228-231}\text{Pu}$. Production cross sections for neutron-deficient nobelium nuclei were measured, and improved data were obtained on the decay modes (^{249}No) and the probability of isomeric state population (^{250}No). Short-lived isotopes $^{178-180}\text{Hg}$ produced in the $^{40}\text{Ar} + ^{144}\text{Sm} = ^{184-x}\text{Hg} + xn$ reaction were used for tuning the Cryo-detector setup designed for experiments on the study of the chemical properties of superheavy elements, in which the GRAND facility plays the role of a preseparator.

During the tests of the new target assembly with a diameter of 480 mm (previously 240 mm), the well-known reaction $^{48}\text{Ca} + ^{206}\text{Pb} = ^{252}\text{No} + 2n$ was employed. At a ^{48}Ca intensity of $6 \mu\text{A}$, around three nobelium nuclei per second were registered in the focal plane of the GRAND separator.

The Programme Advisory Committee heard with interest the following scientific reports: "The equivalence principle and the acceleration effect", present-

ed by A. Frank, and “JUNO experiment: Status and results”, presented by M. Gonchar.

The PAC reviewed six short presentations in the field of nuclear physics research by young scientists from FLNR. The Committee selected four best presentations: “Intense metallic ion beams for SHE synthesis” by D. Pugachev, “Experimental study of multinucleon transfer reactions in collisions of heavy

nuclei at CORSET setup” by I. Vorobiev, “Study of the properties of elements with $Z \geq 100$ ” by A. Kuznetsova, and “Possibilities of producing medically relevant Auger electron emitter ^{195m}Pt ” by A. Madumarov. The PAC recommended the presentation “Intense metallic ion beams for SHE synthesis” to be reported at the session of the JINR Scientific Council in February 2025.

60th MEETING OF THE PAC FOR CONDENSED MATTER PHYSICS, 27 January 2025

The 60th meeting of the Programme Advisory Committee for Condensed Matter Physics was held on 27 January. It was chaired by Professor D. L. Nagy.

The Chair of the PAC presented an overview of the implementation of the recommendations made at the previous PAC meeting concerning the JINR research in the area of condensed matter physics. JINR Vice-Director L. Kostov informed the PAC about the resolution of the 136th session of the JINR Scientific Council (September 2024) and the decisions of the JINR CP (November 2024).

The PAC took note of the information on the completion of repair work at IBR-2 and the receipt of authorization for resuming the reactor operation, presented by E. Lychagin. The PAC supported the plans and efforts of the FLNP Directorate to resume regular cycles for users, as well as its efforts to extend the operation of the reactor with high-performance parameters by loading new fuel. The PAC recommended that in the time remaining until the resumption of regular cycles, work with potential users be intensified in order to attract the maximum



Dubna, 27 January. The 60th meeting of the Programme Advisory Committee for Condensed Matter Physics

number of researchers to JINR, primarily from the Member States.

The PAC took note of the results and prospects for the development of a mathematical model of pulsed fast reactor dynamics, presented by M. Bulavin. The PAC was pleased with the calculations made using this model, which indicate that exceeding the stability limits of a pulsed reactor may be caused by at least two factors: thermal expansion of the fuel and dynamic bending of the fuel rods or bending of the fuel assemblies during a pulse. The Committee recommended the continuation of the activity on modelling the dynamics of pulsed fast reactors and considered this work essential both for the operation of IBR-2 and the development of the new neutron source at JINR.

The PAC was informed by D. Kozlenko about progress in the IBR-2 instrumentation development during the technical shutdown of the IBR-2 reactor. The PAC noted the importance of these activities for the successful realization of the FLNP scientific programme and the IBR-2 User Programme at a level competitive with other world neutron centres.

The PAC heard with interest the scientific reports “Neutron tomography for structural analysis of cement materials, rocks and meteorites” and “Analysis of the A β 42 conformational dynamics in lipid membrane mimetics: Spectroscopic and atomistic study”, presented by I. Zel and H. Esawii, respectively. The Committee thanked the speakers for the excellent reports.

The PAC reviewed 14 virtual presentations by young scientists in the field of condensed matter physics and related fields. The virtual poster presentation “Structural and vibrational properties of the Cu₃Bi(SeO₃)₂O₂Cl francisite at high pressure”, made by A. Rutkauskas, was selected as the best presentation of the session. The PAC also noted two more virtual poster presentations of a high level: “The influence of phospholipid composition on membrane interaction with amyloid beta peptides within molecular dynamics simulations” by D. Badreeva and “Polymer brushes synthesized by the “grafting-through” approach: Characterization and scaling analysis” by M. Avdeev. All three authors were awarded diplomas of the PAC.

61st MEETING OF THE PAC FOR NUCLEAR PHYSICS, 19–20 June 2025

The 61st meeting of the Programme Advisory Committee for Nuclear Physics was held on 19–20 June. It was chaired by Professor V. Nesvizhevsky.

The Chair of the PAC presented an overview on implementing the recommendations taken at the previous meeting. JINR Vice-Director S. Dmitriev informed the PAC about the resolution of the 137th session of the JINR Scientific Council (February 2025) and the decisions of the JINR Committee of Plenipotentiaries (March 2025). The PAC was pleased to note that the recommendations of the previous PAC meeting on JINR research in nuclear physics were accepted by the Scientific Council and the Directorate of JINR.

The PAC heard a report on the status of investigations of the chemical and physical properties of superheavy elements at FLNR, presented by A. Isaev. The four-week experiment aimed at studying the chemical properties of the superheavy elements Cn and Fl by gas adsorption thermochromatography was completed using the upgraded Cryodetector setup placed in the focal plane of the GRAND separator of the SHE Factory. The analysis of the experimental data employing the Cryodetector has started. Furthermore, offline test measurements have been conducted using the gas catcher. The development of the construction documentation has continued for the components of the multireflection time-of-flight mass spectrometer for precision measurements of SHE masses.

The PAC heard an interim report by A. Doroshkevich on the status of the project “Modernization of

the EG-5 accelerator and its experimental infrastructure” at FLNP for 2023–2025 and took note of the progress in the project implementation. The EG-5 electrostatic accelerator is one of the JINR basic facilities in the fleet of equipment and has remained one of the most efficient and convenient nuclear physics instruments. The PAC recommended resuming operation of EG-5 in the basic configuration before the new components of the high-voltage system and the accelerator tube are ready to be assembled and pursuing the upgrade of the setup. The PAC recommended that the performance characteristics of the EG-5 accelerator should be compared with those of similar facilities worldwide.

The PAC heard the proposals for launching a new project “Development of the concept of an ultracold neutron (UCN) source at the IBR-2 pulsed reactor”, presented by G. Kulin. The PAC noted that the development of the world-class UCN source at JINR is of great importance and recommended that the new project be launched for a term of two years (2026–2027).

The members of the Programme Advisory Committee heard the proposals on launching a new project “Creating test benches to check single systems of the MSC-230 cyclotron”, presented by S. Yakovenko. The PAC appreciated the preparation work done for commissioning the MSC-230 cyclotron. The Committee welcomed the ambitious plans on the cyclotron launch in 2026 and highlighted the importance of developing new infrastructure at JINR for radiobiology research. The PAC recommended that the new project be launched.



Dubna, 19–20 June. The 61st meeting of the Programme Advisory Committee for Nuclear Physics

The PAC heard with great interest the reports “Advances in the description of spontaneous fission of transfermium nuclei”, presented by T. Shneidman, and “Nucleon and cluster transfer in reactions with the ^9Be nucleus”, presented by A. Azhibekov.

The PAC reviewed six short presentations on nuclear physics given by young scientists from BLTP and MLIT and selected the best three reports: “Low-energy spectra of nobelium isotopes” by M. Mardyban,

“Alpha-decay and spontaneous fission of super-heavy elements in the DNS approach” by I. Rogov, and “Investigation of the spectral structure of ^{11}Be in breakup reactions within quantum-quasiclassical approach” by D. Valiolda. The PAC recommended that the report “Low-energy spectra of nobelium isotopes” be presented at the session of the JINR Scientific Council in September 2025.

62nd MEETING OF THE PAC FOR PARTICLE PHYSICS, 23 June 2025

The 62nd meeting of the Programme Advisory Committee for Particle Physics was held on 23 June in a hybrid format. It was chaired by Professor I. Tserruya.

The Chair of the PAC opened the meeting with a one-minute silence honoring the memory of H. Gutbrod, a long-time member of the PAC for Particle Physics and a strong supporter of JINR and a research programme at the NICA accelerator complex, who passed away.

I. Tserruya presented an overview of the implementation of the recommendations adopted at the previous meeting. JINR Vice-Director V. Kekelidze highlighted the resolution of the 137th session of the JINR Scientific Council (February 2025) relevant to particle physics and the decisions of the JINR Committee of Plenipotentiaries (March 2025).

The report on the implementation of the Nuclotron-NICA project was presented by A. Sidorin. The Committee greatly appreciated the progress in



Dubna, 23 June. The 62nd meeting of the Programme Advisory Committee for Particle Physics

optimization of the particle dynamics in the Booster, which made it possible to implement the beam storage with electron cooling for accumulating $7 \cdot 10^7$ Xe ions from five pulses with a pulse intensity of $2 \cdot 10^7$ ions each. Assembly of the fast extraction system elements from the Nuclotron was completed, and the Nuclotron cryomagnetic system was prepared for operation. The NICA beam commissioning was planned for the end of 2025.

The PAC appreciated the progress in the implementation of the BM@N project, presented by M. Kapishin. The BM@N team focused on calibrating the time-of-flight system and developing centrality determination methods in Xe–CsI collisions at an energy of 3.8 A GeV. A study continued on the production of Λ hyperons, K^0 and φ mesons, and light hyper-nuclei in Xe + CsI interactions. A paper with physics results on the production of protons, deuterons, and tritons in argon–nucleus interactions at 3.2 A GeV was accepted for publication in JHEP.

V. Riabov presented the report on the implementation of the MPD project. The PAC heard the information about the final stage of construction of the MPD experimental facility and the planned detector commissioning with all detector subsystems of the first phase of MPD at the end of 2025. Extensive work is ongoing on the commissioning of the solenoidal superconducting magnet. Detailed simulation and technical design development for the forward spectrometers using realistic event generators and track reconstruction using the ACTS code continues. The MPD upgrade programme for Phase-II will start once the results of these studies are available.

The status of the SPD project was presented by A. Guskov. The PAC heard the report on the ongoing work to optimize the supporting structure of the detector and the external platform for placing the equipment, as well as the design of communication

lines. The PAC appreciated the preparation of the documentation for the construction of a superconducting solenoid, as well as thermal analysis of the detector components being carried out. In 2025, work continued to update the physics programme for the first phase of the experiment. The PAC welcomed the success of the SPD collaboration and supported its efforts to prepare the initial phase of the experimental facility.

The PAC heard the report on the preparation of the project “Development of a physics programme and detectors for experiments at CEPC”, presented by Yu. Davydov. The main goals of CEPC — precision studies of the physics of the Higgs boson, Z boson, top quark physics and the search for new physical phenomena beyond the Standard Model. Over 2026–2027, conditions will be laid for JINR’s future long-term participation in experiments at CEPC, subject to approval of the construction of this accelerator by the Chinese government in 2026. Considering the importance of preparing for full-fledged participation of JINR in experiments at the planned circular electron-positron collider, the PAC recommended extending the project for the period 2026–2027 with ranking A.

The PAC appreciated the reports of the JINR groups participating in the LHC experiments — ALICE, ATLAS, and CMS — presented by B. Batyunya, I. Yeletskikh, and V. Karzhavin. Their achievements in data analysis and detector upgrades were endorsed. These projects were ranked at category A and were extended until 2030.

The poster session was attended by 22 young scientists from DLNP, MLIT, and VBLHEP. The PAC noted the high quality of the reports and selected the report “Dilepton measurements in the MPD experiment at NICA”, made by S. P. Rode, to be presented at the session of the JINR Scientific Council in September 2025.

61st MEETING OF THE PAC FOR CONDENSED MATTER PHYSICS, 26 June 2025

The 61st meeting of the Programme Advisory Committee for Condensed Matter Physics was held on 26 June. It was chaired by Professor D. L. Nagy.

The Chair of the PAC presented an overview of the implementation of the recommendations made at the previous PAC meeting concerning the JINR research in the area of condensed matter physics. JINR Vice-Director L. Kostov informed the PAC about the resolution of the 137th session of the JINR Scientific Council (February 2025) and the decisions of the Committee of Plenipotentiaries of the Governments of the JINR Member States (March 2025).

The PAC noted with satisfaction the information on the successful resumption of operation of the IBR-2 reactor, the plans to prepare the reactor for the autumn–winter period of operation and the resumption of the FLNP User Programme, presented by E. Lychagin. The PAC welcomed the inclusion of the Neutron Radiography and Tomography facility in the FLNP User Programme and considered it important to provide external users with access to all the instruments included in the User Programme as soon as possible.

The PAC took note of the state of the complex of cryogenic moderators and considered the work on the development of the complex of two cryogenic moderators to provide cold neutrons to practically all IBR-2 research beamlines to be successfully completed. The Committee considered the decision of the FLNP Directorate to stop work on the third

cryogenic moderator to be justified and consistent with the completion of the corresponding subproject. Therefore, the PAC recommended closure of the project “Development of the IBR-2 nuclear facility with a complex of cryogenic moderators” and subproject “Construction of a complex of cryogenic moderators at the IBR-2 facility”.

The PAC was informed by D. Kozlenko about the main results achieved at the IBR-2 spectrometer complex after the resumption of reactor operation, as well as about the completion of modernization works and conducting the first scientific experiments. The PAC appreciated the progress achieved in the upgrade of a number of the instruments, ensuring improvement of technical parameters and extension of research possibilities. The Committee welcomed the work on the whole IBR-2 spectrometer complex already done and encouraged the technical team to continue with the full commissioning of the SANSARA instrument.

The PAC considered the report by O. Ivankov about the state of the YuMO small-angle neutron spectrometer. The PAC noted the high demand for the spectrometer and the importance of the scientific results obtained on it, published in highly rated journals. The PAC supported further development of small-angle scattering method at the IBR-2 pulsed neutron source. The PAC also recommended continuing work on the modernization of the main parts of the YuMO spectrometer and supported on-



Dubna, 26 June. The 61st meeting of the Programme Advisory Committee for Condensed Matter Physics

going development of the sample preparation laboratory.

The PAC appreciated the outcome of its meeting with the JINR Directorate. Considering a broad spectrum of activities in life sciences being performed in several laboratories of JINR, the PAC supported the idea of the JINR Director, G. Trubnikov, to establish the JINR interlaboratory STAC (Scientific and Technical Advisory Committee) for life sciences in order to facilitate the elaboration of a coherent and synchronized programme in this field of activity. The PAC took note of the opinion of the JINR Directorate that the main competencies of JINR, which could potentially be offered to the global life sciences community, should be focused on developing unique facilities handling a wide range of radiation used in biomedical research.

The PAC took note of the information of the FLNP Directorate about issuing a book entitled "Directions

of Scientific Research at the Advanced Pulsed Neutron Source at FLNP JINR".

The PAC appreciated the level of international cooperation activity of the Institute as presented by JINR Chief Scientific Secretary S. Nedelko.

The PAC heard with interest the scientific reports "Magnetism and superconductivity in periodic and quasi-periodic low-dimensional layered systems" and "Conformational dynamics of A β 42 in liposome under varying pH conditions: A combined spectroscopic and computational approach", presented by V. Zhaketov and Y. Arynbeke, respectively.

The PAC reviewed presentations made by young scientists in the field of condensed matter physics. The presentation "Automated segmentation of pores and cracks using a Unet3+ convolutional neural network on neutron, synchrotron, and X-ray tomography data" by B. Bakirov was selected as the best presentation of the session.

JINR PRIZES



Dubna, 16 September. V. Dzhelepov Prize laureate M. Frontasyeva delivers a report at the 138th session of the JINR Scientific Council

The V. Dzhelepov Prize was awarded to M. Frontasyeva (FLNP JINR) for her significant contribution to the development of an international programme for air quality assessment using neutron activation analysis.

WINNERS OF THE JINR SCIENTIFIC AND RESEARCH WORKS COMPETITION

For Theoretical Research Papers

First Prizes

“A general approach to renormalization group equations in local quantum field theory”.

Authors: D. Kazakov, L. Bork, A. Borlakov, D. Vlasenko, D. Tolkachev, V. Filippov, R. Iakhibbaev.

“Angular momentum generation in fission fragments”.

Authors: G. Adamian, A. Andreev, N. Antonenko, A. Bezbakh, A. Isaev, R. Mukhin, A. Rahmatinejad, T. Shneidman.

Second Prize

“Fourier modal method for calculating neutron scattering from surface-relief and bulk diffraction gratings”.

Authors: M. Zakharov, A. Frank, G. Kulin.

For Experimental Research Papers

First Prizes

“Study of the production of hadrons (π^+ , K^+ , p) and light nuclei (d , t) in Ar + nucleus reactions in the BM@N experiment at the NICA accelerator complex”.

Authors: M. Zavertyaev, A. Zinchenko, M. Kapishin, L. Kovachev, V. Kolesnikov, R. Lednický, S. Merts, V. Plotnikov, M. Romyantsev, I. Rufanov.

“Investigation of reactions with ^{50}Ti and ^{54}Cr for the synthesis of new elements 119 and 120”.

Authors: Yu. Oganessian, D. Solovye, N. Kovrizhnykh, M. Shumeiko, D. Ibadullayev, A. Voinov, V. Utyonkov, A. Polyakov, Yu. Tsyganov, O. Petrushkin.

Second Prizes

"Probing the Galactic neutrino flux at neutrino energies above 200 TeV with the Baikal Gigaton Volume Detector".

Authors: I. Belolaptikov, V. Dik, T. Elzhov, D. Naumov, A. Sirenko, M. Sorokovikov, B. Shaibonov, Yu. Yablokova.

"Joint neutrino oscillation analysis from the T2K and NOvA experiments".

Authors: L. Kolupaeva, A. Kalitkina, N. Anfimov, A. Antoshkin, N. Balashov, I. Kakorin, V. Matveev, A. Olshevskiy, O. Samoylov, A. Sheshukov.

Third Prize

"Measurement of differential and total scattering cross sections of 14.1-MeV neutrons on carbon nuclei: Methodological aspects and results".

Authors: D. Grozdanov, P. Prusachenko, N. Fedorov, Yu. Kopatch, V. Skoy, T. Tretyakova, P. Kharlamov, A. Andreev, C. Hramco, P. Filonchik.

For Methodology, Research and Technology Papers

First Prize

"Development and creation of superconducting magnets for the NICA Collider".

Authors: D. Nikiforov, P. Akishin, Yu. Bespalov, A. Bychkov, D. Zolotykh, S. Korovkin, G. Kuznetsov, A. Merkurjev, M. Petrov, A. Svidetelev.

Second Prizes

"Photo-NETosis: Biomodulation of programmed cell death".

Authors: G. Arzumanyan, K. Mamatkulov, Y. Arynbeke, Huy Duc Le, A. Volkov, N. Vorobjeva.

"Multi-nucleon transfer reaction studies with the SHELS velocity filter".

Authors: A. Svirikhin, H. Devaraja Malligenahalli, Yu. Popov, M. Chelnokov, B. Sailaubekov, A. Kuznetsova, O. Malyshev, V. Chepigina, E. Sokol, M. Tezekbayeva.

Third Prize

"Hardware and software modernization for the INAA at the REGATA facility (IBR-2 reactor)".

Authors: D. Grozdov, V. Galustov, I. Zinicovscaia.

For Applied Research and Technology Papers

First Prize

"A new approach to improving the efficiency of radiation therapy and nuclear medicine".

Authors: A. Boreyko, A. Bugay, I. Zamulaeva, R. Kozhina, E. Krasavin, E. Kuzmina, O. Matchuk, S. Tiouchnik, T. Hramko (Bulanova), V. Chausov.

Second Prizes

"Neutron diffraction *in situ* studies of structures and phase transitions in binary and ternary iron-based alloys".

Authors: A. Balagurov, T. Vershinina, B. Yerzhanov, B. Mukhametuly, N. Samoilova, A. Sohatsky, S. Sumnikov, I. Golovin, V. Palacheva, D. Chernyshov.

"Long-term remote reactor power and fuel composition monitoring using antineutrinos".

Authors: V. Belov, A. Bystryakov, I. Zhitnikov, S. Kazartsev, A. Kuznetsov, D. Medvedev, D. Ponomarev, E. Shevchik, M. Shirchenko.

Third Prize

"Risk assessment of nanoparticle application: Bioaccumulation, plant biochemical responses and trophic transfer".

Authors: A. Peshkova, I. Zinicovscaia, L. Cepoi, L. Rudi, T. Chiriac, N. Yushin, S. Corcimaru, L. Ganea, Ho Manh Dung.



RESEARCH AND EDUCATIONAL PROGRAMMES

BOGOLIUBOV LABORATORY of THEORETICAL PHYSICS

In 2025, studies at the Bogoliubov Laboratory of Theoretical Physics (BLTP) were carried out on the following four themes: Fundamental Interactions of Fields and Particles; Theory of Nuclear Systems; Theory of Complex Systems and Advanced Materials; Modern Mathematical Physics: Gravity, Supersymmetry and Strings. An important component of the BLTP activities is theoretical support of experimental research carried out within major international projects with the participation of JINR and Dubna-based experimental programmes of JINR Laboratories. The research resulted in about 420 publications in peer-reviewed journals and proceedings of international conferences, 65 papers in the framework of large international collaborations with the participation of BLTP researchers, and 2 chapters in monographs. A number of the results were obtained in cooperation with scientists from the JINR Member States, Brazil, China, Germany, India, Italy, South Africa, and other countries.

Every year BLTP is a venue for scientific events of the highest level: 12 conferences and workshops and 3 schools for students and young scientists were organized by BLTP in 2025. These events were held in

person or in a mixed format (in person/remote), and one school was held online. BLTP researchers and visitors made 83 reports at the Laboratory seminars. There were 12 meetings of the BLTP Journal Club.

International collaboration was supported by grants of the Plenipotentiaries of the Governments of Belarus, Bulgaria, Egypt, Kazakhstan, Vietnam, and the JINR Directorate, by joint programmes with Serbia and South Africa. The Bogoliubov Laboratory continued its cooperation with CERN, APCTP (South Korea), and ITP CAS (Beijing). Six research projects were supported by the RSF grants.

Traditionally, much attention was paid to recruiting young researchers, students, and postgraduate students to the Laboratory within the Research and Education Project "Dubna International Advanced School of Theoretical Physics" (DIAS-TH). The Laboratory plays the role of a training centre for young scientists and students from many countries. Currently, about one third of the BLTP scientific staff are young scientists and PhD students. In 2025, two candidate and two doctoral theses were defended by BLTP researchers.



10–14 February. International Workshop "Problems of Modern Mathematical Physics"

SCIENTIFIC RESEARCH

Fundamental Interactions of Fields and Particles

Theoretical investigations in 2025 were carried out as part of the following projects:

- Quantum field theory and physics beyond the Standard Model;
- QCD and spin/3D hadron structure;
- Strong interaction phenomenology and precision physics;
- Theory of hadronic matter under extreme conditions;
- Theory of electroweak interactions and neutrino physics.

The renormalization group equation for the scalar effective potential, summing all leading logarithmic corrections, was generalized to the case of an arbitrary potential in curved spacetime within the linear curvature approximation. The method was used to derive equations for arbitrary power-law potentials in models with $SO(N)$ symmetry. The obtained equations were applied to study inflationary cosmology. It was shown that the corresponding effective potentials lie within the confidence region of the observational data for cosmological parameters [1].

An effective method for calculating asymptotics for Feynman diagrams with dual conformal symmetry was developed. As a demonstration, the slightly off-shell pentabox integral was calculated up to power corrections. Together with other known master integrals, this allowed one to write down the two-loop amplitude for five W -boson scattering in $N = 4$ SYM on the special Coulomb branch [2].

Quantum corrections to fermion-fermion scattering were calculated within the Fermi model. The coefficients were obtained for the leading ultraviolet divergences up to and including three loops. It was

shown that the use of the spinor-helicity formalism leads to a significant simplification in calculating divergent Feynman integrals. Recurrence relations were compiled that made it possible to calculate the leading UV divergence in an arbitrary loop order. They were used to derive generalized renormalization-group equations for nonrenormalizable Fermi-type interaction that sum the coefficients for large logarithms in the leading approximation. The asymptotics of the scattering amplitude behaviour in the case of the unit and V-A operators were constructed on the perturbation theory series as well as the numerical solution of the RG equation. It was established that when summing the leading logarithms, the amplitude of the V-A interaction in the Fermi theory demonstrates asymptotically free behaviour similar to gauge interaction in the high-energy region [3].

Three-loop chiral corrections to the effective potential of $N = 1$ supersymmetric Wess-Zumino theories, as well as all-loop corrections in the $N = 2$ supersymmetric $SU(N)$ Yang-Mills model, were computed. It was shown that the obtained corrections are consistent with the results previously obtained for particular cases of the $N = 1$ supersymmetric $SU(N)$ Yang-Mills model [4].

A method for deriving renormalization group equations for reparametrization invariants in the scalar sector of the two-doublet extension of the Standard Model was worked out. An arbitrary combination of scalar potential parameters, invariant with respect to the choice of the Higgs field basis, can be expressed as an algebraic function of a set of independent invariants (physical parameters of the model). Instead of such functions, it turned out to be more convenient to consider polynomials of an extended set of invariants (generators), among which, however, there exist polynomial relations (syzygies).



Discussion of work issues

As an application of the method, explicit expressions were found for all syzygies and the RG functions for the generators of the invariant quotient ring in the six-loop approximation were derived [5].

It was demonstrated that the scalar-mediator dark-matter scenario is consistent with the experimental data on the decay $B \rightarrow KM_\chi$ and provides a good description of the shape of the observed excess. Within this scenario, the interaction with dark-matter particles leads to approximately the same excess in $\Gamma(B \rightarrow KM_\chi)$ and $\Gamma(B \rightarrow K^*M_\chi)$ compared to the Standard Model; also the differential distributions of the excess events are similar in shape in the variable q_{rec}^2 measured by experiment [6].

The amplitudes and branching fractions of $\chi_{cJ}(1P)$, $h_c(1P)$, $J/\psi(1S)$, and $\psi(2S)$ radiative decays were calculated within the covariant confined quark model. It was explicitly shown that all calculated amplitudes are gauge-invariant. To fit the model parameters including the charm quark mass and the meson size parameter, experimental data for three decay channels $J/\psi \rightarrow \eta_c\gamma$, $\chi_{c0} \rightarrow J/\psi\gamma$, and $\psi(2S) \rightarrow \chi_{c0}\gamma$ were used. The obtained parameters were used to predict the branching fractions of the decays $h_c \rightarrow \eta_c\gamma$, $\chi_{c1(c2)} \rightarrow J/\psi\gamma$, and $\psi(2S) \rightarrow \chi_{c1(c2)}\gamma$. The predictions agree well with experimental data [7].

A comparison of theory and experiment provided a new value for the proton-to-electron mass ratio, m_p/m_e . It agrees with the value obtained by mass spectrometry and has a threefold smaller uncertainty. Using combined MHI, H/D, and muon H/D data, the baryon mass ratio m_d/m_p was determined with an absolute uncertainty of $1.1 \cdot 10^{-10}$ [8].

In a series of works, formulas for calculating the relativistic corrections ma^6 and $ma^6(m/M)$ were obtained for the first time in the three-body problem formalism for molecular systems such as the H_2^+ ion. This allows for an accuracy better than 10^{-12} in the theoretical prediction of vibrational transition energies of molecular ions of hydrogen isotopes and allows for the determination of the Rydberg constant from hydrogen ion spectroscopy with an accuracy higher than that of CODATA22 [9].

Spin oscillations of neutrinos scattered by a rotating (Kerr) black hole surrounded by a thick magnetized accretion disk were studied. Both the toroidal and poloidal magnetic fields inside the disk were considered. The precession of the neutrino spin is due to interactions of its magnetic moment with these fields. The processing of spin oscillations of the neutrino fluxes was based on numerical modelling of the propagation of a large number of incoming test neutrinos using high-performance parallel computing at the Govorun supercomputer. Possible applications of the modelling to experiments on detection of astrophysical neutrinos and the possibility of investigating the magnetic field distributions near black holes were discussed [10].

A reduction mechanism of the theoretically predicted excessive abundance of ${}^7\text{Li}$ via baryons evaporated by primordial black holes was suggested. It was shown that the fraction of ${}^7\text{Li}$ with respect to the

number density of baryons can be diminished down to the observed value via the process of ${}^7\text{Li}$ transformation by neutron or proton capture. The created in this process ${}^8\text{Li}$ or ${}^8\text{Be}$ quickly decays into a pair of ${}^4\text{He}$ nuclei [11].

The electric and magnetic nucleon radii and Zemach radii were calculated based on an extended vector meson dominance model to describe the electromagnetic nucleon form factors. The model carefully considers fundamental theoretical restrictions and includes families of ρ and ω mesons with the associated radial excitations. The free parameters of the model were determined using a global statistical analysis of experimental data on the electromagnetic nucleon form factors in space- and time-like regions of 4-momentum transfers [12].

Exclusive photoproduction of heavy mesons was analyzed within the factorization approach. The J/ψ production cross sections were well described from HERA to LHC energies. J/ψ spin asymmetries were estimated that can be measured in future electron-ion colliders in the USA and China. These calculations were extended to study J/ψ production in proton-proton collisions. The model describes the LHCb data well. Predictions were given for the cross sections of J/ψ production at NICA and RHIC energies [13].

The behaviour of the dissipative characteristics of Unruh radiation in an accelerated reference frame as functions of the distance from the horizon was investigated. It was shown that locally, on the membrane surface surrounding a black hole (corresponding to the stretched Rindler horizon), the viscosity-to-entropy ratio is half the minimum viscosity bound. Conversely, far from the horizon, this ratio is three times higher [14].

The T-odd and T-even hadronic structure functions were calculated for the Drell-Yan process within the framework of perturbative QCD in the collinear approximation. A decomposition for the small Q_T/Q limit of structure functions was derived. A numerical analysis of the angular coefficients was performed and compared with the ATLAS experimental data and geometrical approach [15].

It was shown that the isospin symmetry-breaking electromagnetic interaction leads to its effective restoration in the spectrum of neutral pseudoscalars. This is achieved through the gluon anomaly, which enhances the electromagnetic contribution to the π^0 - η and π^0 - η' mixing angles and thus compensates for another symmetry-breaking contribution due to the u and d quarks mass difference [16].

It was shown that the processes $e^+e^- \rightarrow \pi^+\pi^-$ and $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ can be described in a unified approach in satisfactory agreement with experiment using the vector coupling constant $g_\rho = 6$. In this case, in addition to quark loops, it is also necessary to consider meson loops corresponding to the next order in $1/N_c$. These loops must be taken into account when describing the $\gamma(W) \rightarrow \rho$ transition and in interaction of mesons in the final state [17].

Inverse gluon and photon emission in the dilepton production process in hadron collisions for the LHC experimental programme was estimated in detail. Numerical analysis of inverse emission effects on observable quantities (cross sections and forward-backward asymmetry) was performed in a wide kinematical region including the CMS LHC experiment in the Run3/HL regime. An effective technique for analyzing the influence of different radiative contributions on forward-backward asymmetry using two additive relative corrections was suggested [18].

The action of rotating quarks, in addition to the orbital rotation terms, contains a term describing the interaction between the rotation of the system and the quark spin. Unlike orbital motion, this spin term is independent of the distance from the rotation axis. The effect of the spin term on the thermodynamic properties of QCD was studied. In the study, the coefficient before this term was called the spin chemical potential. This term creates a difference in the energies of quarks with different polarizations. Thus, the spin potential effectively creates a nonzero spin density of quark matter. The Polyakov loop and its susceptibility, as well as the chiral condensate and its susceptibility, were calculated. The calculations were performed for several quark masses, lattice spacings, and angular velocities. These data allowed one to determine the dependence of critical temperatures on the calculation parameters. It turned out that the spin potential reduces the critical temperatures of the confinement/deconfinement transitions and the breaking/restoration of chiral symmetry [19].

The generation of a scalar charged field in a rotating frame was studied in the presence or absence of an external uniform magnetic field, an electrical potential well, and matter. It was shown that a supervortex of the scalar field can be created from

vacuum when the rotation frequency exceeds the critical value. The presence of additional acceleration (deceleration) of the system can contribute to the occurrence of a vortex condensate. Possibilities of the formation of a charged pion and the pion-sigma meson field vortices in a rotating empty vessel (in vacuum) and in the pion-sigma Bose-Einstein condensates at a dynamically fixed particle number were studied within the linear sigma model and the φ^4 model. It was shown that rapidly rotating pieces of nuclear matter with the vortex charged pion condensate can be self-bound until they are decelerated by weak radiation. Observational effects for vortex fields in rotating vessels, energetic heavy-ion collisions and in rotating superheavy nuclei, nuclearites and nuclei-stars were considered [20].

The global Λ polarization was calculated in Au + Au collisions at energies of 3–9 GeV, in which high baryon density is achieved. Special attention was paid to the collision energies of 3, 3.2, 3.5, 3.9, and 4.5 GeV, for which a thorough scan of the energy, rapidity, and centrality dependence was performed. The polarization at 3.2–4.5 GeV can be considered as a prediction for results of measurements within the STAR fixed-target programme that are expected in the near future [21].

Theory of Nuclear Systems

In 2025, investigations were carried out in accordance with four projects:

- Microscopic models for exotic nuclei and nuclear astrophysics;
- Low-energy nuclear dynamics and properties of nuclear systems;
- Quantum few-body systems;
- Relativistic nuclear dynamics and nonlinear quantum processes.



30 June – 4 July. The 2nd Panasyuk Scientific Conference “Problems of Cosmophysics”

A method was developed for an isoenergetic description of fission pathways in excited nuclei within energy density functional theory. Applying this method to the superheavy nucleus ^{296}Lv , effective potentials were compared for isothermal, isentropic, and isoenergetic processes, and it was found that the isoenergetic process exhibits the highest fission barrier and the strongest damping at a fixed excitation energy. The analysis also revealed a significant difference in the evolution of temperature and entropy along the fission pathway within each of the considered thermodynamic schemes [22].

The ground-state properties and multipole electric low-energy excitations in isotopes $^{250-262}\text{No}$ were investigated within the self-consistent quasiparticle random phase approximation with Skyrme forces. A detailed analysis of observed K -isomers, monopole vibrations, and hexadecapole excitations in $^{252,254}\text{No}$ was carried out, and the existence of new low-energy states was predicted. The obtained results can be used for prediction of low-energy spectra of superheavy elements [23].

A microscopic symplectic approach to describing multi-cluster many-body nuclear systems was proposed. As an example, the approach was applied to describe the 4α cluster nuclear system ^{16}O . Good agreement with experimental data was obtained for the energies of the lowest states in the $K^\pi = 0_1^+$, $K^\pi = 0_2^+$, $K^\pi = 0_1^-$, $K^\pi = 2_1^+$, $K^\pi = 3_1^-$, and $K^\pi = 1_1^-$ bands, as well as for known low-energy transition probabilities $B(E2)$ [24].

The potential presence of wobbling motion in octupole deformed nuclei was investigated within the octupole core-quasiparticle coupling model for the $p(2g_{9/2}, 1j_{15/2})$ configuration. The key experimentally measurable quantities, including energy spectra, electromagnetic transition probabilities, g -factors, and spectroscopic quadrupole moments were calculated. Distinct signatures of wobbling motion emerge in both positive and negative parity doublet bands. For instance, the interband $B(E2)_{\text{out}}$ displays collective enhancement, whereas the interband $B(M1)_{\text{out}}$ shows relative suppression [25].

A new description of the spontaneous fission of ^{258}Fm was proposed, based on α -particle clustering of the heavy fragment in a pre-scission asymmetric configuration. The mass and TKE distributions of fission fragments in the spontaneous fission of ^{258}Fm were simultaneously described. It was shown that the spontaneous fission of ^{258}Fm is influenced by fission modes through the double nuclear system $\text{Sn} + \text{Sn}$ (symmetric mode, TKE = 233 MeV) and $\text{Cd} + \text{Te}$ (asymmetric mode, TKE = 203 MeV) and the binary decay of trinuclear systems $\text{Cd} + \alpha + \text{Sn}$ (ultralong mode, TKE = 180 MeV). It was shown that the unusually narrow symmetric mass distribution is associated with the α -clustering of the heavy fragment in the $\text{Cd} + \text{Te}$ nuclear fission system and the formation of trinuclear α systems and their binary decay, leading to the formation of Sn fragments [26].

A semi-empirical formula for the spontaneous fission half-life $T_{1/2}$ of heavy and superheavy nuclei

was proposed as a function of the alpha-particle separation energy Q_α and the neutron excess $N - Z$. The approach is based on the discovered linear correlation between $\log_{10}(T_{1/2})$ and Q_α for even-even nuclei with a fixed $N - Z$ and charge numbers in the range $90 \leq Z \leq 102$. Among the considered empirical methods, the systematics demonstrates the lowest values of the mean absolute deviation and its variance, describing superheavy nuclei particularly well. The proposed formula can be used to predict $T_{1/2}$ of as-yet-unknown superheavy elements [27].

A model was proposed to explain the mechanism of generation of fragment spins due to angular oscillations of dinuclear system fragments at the scission point. The problem was solved entirely quantum-mechanically, considering angular momentum and parity conservation explicitly. All possible vibrational modes were considered on equal footing, without introducing preferred normal modes. The dynamics of angular motion at the scission point was shown to correspond to independent angular vibrations of the fragments near the pole-to-pole configuration of the dinuclear system. This allowed one to analytically substantiate the lack of correlation between fragment spins as a consequence of the conservation of total angular momentum [28].

Adsorption energies E_{ads} of a superheavy element Lv and its lighter homolog Po, as well as of their oxides, hydrides and hydroxides on hydroxylated quartz surfaces, were calculated using a periodic density functional theory implemented in the AMS BAND software. It was shown that elemental Po and Lv should be the most volatile out of all the considered species over the quartz surface, with E_{ads} of the order of van der Waals bond energies. Hydrides of Po and Lv should be less volatile than the elements with 20 kJ/mol larger E_{ads} values. Oxides, hydroxides, and particularly dioxides of these elements should be less volatile than the elements and hydrides, with a decreasing trend in volatility along this row. Lv species should be less volatile than the respective Po compounds. The obtained trend in E_{ads} of the Po compounds is in general agreement with experimental results [29].

An m -photon resonance mechanism was suggested and studied for the twisting of atoms by a circularly polarized laser pulse with the transfer of photon helicity to them. It was shown that when interacting with a circularly right-handed polarized laser pulse with the frequency $m\omega$, an atom accelerates/decelerates and twists — acquires orbital angular momentum with the projection $L_z = m\hbar$ in the direction of its motion. The proposed method for twisting atoms opens up new possibilities compared to traditional techniques using fork diffraction gratings, which were developed for the twisting of elementary particles (photons and electrons) but require dramatic modifications for the twisting of composite particles (protons, neutrons, and atoms). In this regard, it should be noted that, despite almost thirty years of experimental research into twisted photons and electrons, obtaining twisted atoms re-

mains a very complex and challenging task. Despite the initiative's implementation, only one experiment has been carried out to date in which twisted helium atoms were obtained using a specially designed diffraction grating [30].

A new method was proposed for fitting non-relativistic binary-scattering data and for extracting the parameters of possible quantum resonances in the compound system that is formed during the collision. The method combines the well-known R -matrix approach with the analysis based on the semi-analytic representation of the Jost functions. It was shown that such a combination has the advantages of both these approaches, namely, the number of the fitting parameters remains relatively small (as for the R -matrix one) and the proper analytic structure of the S -matrix is preserved (as for the Jost function method). It was also shown that the new formalism, although closely related to the R -matrix one, has the benefit of no dependence on an arbitrary channel radius. The efficiency and accuracy of the proposed method were tested using a model single-channel potential. Artificial "experimental" data generated with this potential were fitted and its known resonances were successfully recovered as zeros of the Jost function on the appropriate sheet of the Riemann surface of the energy [31].

The explicit form of the sixth-order radiative corrections to the lepton L ($L = e, \mu$ and τ) anomalous magnetic moment from QED Feynman diagrams with insertion of the fourth-order polarization operators consisting of either two closed lepton loops or one lepton loop crossed by a photon line was discussed in detail. The approach is based on the consistent application of dispersion relations for vacuum polarization operators and the Mellin-Barnes transform for massive photon propagators. Explicit

analytical expressions for corrections to the lepton anomaly were obtained for the first time in the whole interval $0 < r < \infty$ of the ratio r of lepton masses m_l/m_L . Asymptotic expansions in the limit of both small $r \ll 1$ and large $r \gg 1$ computed from the exact expressions were found to be in perfect agreement with the ones earlier reported in the literature. It was argued that in the region where the physical lepton mass ratios are located, the asymptotic expansions hold with an accuracy higher than the experimentally measured anomalies. The two loop diagrams with all three leptons different from each other were computed numerically and compared with the corresponding corrections from the pure two-bubble and one-bubble mixed diagrams. It was shown that there are regions of ratios r where all three types of the fourth-order polarization operator contribute equally to the anomaly of the sixth order [32].

The generalized eikonal approximation method for the process $pd \rightarrow ppn$ induced by hard elastic pp scattering (L. L. Frankfurt et al., 1997; A. B. Larionov, 2023) was improved by including an arbitrary number of soft rescatterings of the incoming and outgoing protons on the spectator neutron. It was shown that the correct treatment of deviations of the trajectories of outgoing protons from longitudinal direction leads to a significant modification of partial amplitudes with soft rescattering of two outgoing protons and non-vanishing partial amplitudes with rescattering of incoming and outgoing protons. An explicit formula was derived for an infinite sum of the partial amplitudes with successive rescattering of the outgoing protons. The improved treatment of multiple rescattering is important for a more precise evaluation of the colour transparency (CT) effect [33].



7–10 July. Participants of the 2nd International Workshop "Superconducting and Magnetic Hybrid Structures"

The uncertainty in the CT effect due to the deuteron wave function at large momenta was studied for the reaction $d(p, pp)n$ at $p_{\text{lab}} = 15$ GeV/c induced by hard elastic pp scattering. It was shown that for transverse momenta of the spectator neutron less than 0.4 GeV/c the choice of the deuteron wave function cannot affect the identification of the CT effect. In view of the forthcoming NICA SPD experiment, a simple way for studying CT in dd collisions based on the identification of quasi-free pd interactions was suggested [34].

Theory of Complex Systems and Advanced Materials

Theoretical investigations in 2025 were carried out as part of the following projects:

- Complex materials;
- Nanostructures and nanomaterials;
- Mathematical models of statistical physics of complex systems;
- Methods of quantum field theory in complex systems.

It was shown that the inelastic neutron scattering results and their analysis unequivocally point to a dominant Kitaev interaction in the honeycomb-lattice cobaltate $\text{BaCo}_2(\text{AsO}_4)_2$. The anisotropic-exchange model closely describes all available neutron scattering data in the material's field-polarized phase. The density-matrix renormalization group results are in close accord with the unusual double-zigzag magnetic order and the low in-plane saturation field of $\text{BaCo}_2(\text{AsO}_4)_2$ [35].

Scaling relations for the density dynamics of turbulent Bose-Einstein condensate were discovered and explained [36].

It was shown that quantum fluctuations fundamentally reshape both the ground state and the

excitation dynamics of the ferromagnetic Kitaev-Heisenberg model on a triangular lattice, even when the classical ground state appears trivial [37].

A classification of 1D interacting particle systems on an integer lattice with particles of the same type and nearest neighbour interaction was carried out. The classification was performed under the assumption that the systems allow the construction of Markov duality functions and that their two-particle generators satisfy the Hecke algebra relations. As a result, a whole set of systems with various interactions was constructed, for which a complete description of stationary states was given using the Markov duality formalism [38].

From analysis of several models of d -dimensional fermions ($d = 1, 2, 3$), it was shown that the Lee-Yang zeros of the partition function in the limit $T = 0$ define a $(d - 1)$ -dimensional quantum critical manifold (Fermi surface). Its appearance or reconstruction represents a phase transition. A non-local order parameter proportional to the d -volume of the Fermi sea was introduced. It was shown that such a proposal is consistent with all scaling relations. The found universality class is independent of interactions and is completely determined by the topological properties of the Fermi surface [39].

The structural characterization and magnetic properties of a series of dinuclear and trinuclear antiferromagnetic copper (II) complexes with different bridging ligands were studied. The research employs antiferromagnetic theoretical models and experimental data to analyze the magnetic characteristics, including magnetization plateaus, magnetic susceptibility, and entanglement entropy. The results showed significant changes in the magnetization behaviour of the complexes, revealing distinct magnetization plateaus and saturation points, which are also demonstrated by the entanglement entrop-



20–25 July. International school “Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems”

py, offering insights into the quantum behaviour of these metal-containing spin-1/2 compounds at low temperatures. These results highlight the importance of ligand design in tuning the magnetic properties of copper (II) complexes [40].

A complex rational degeneration of the hyperbolic Ruijsenaars model emerging in the limit $w_1 + w_2 \rightarrow 0$ (or $b \rightarrow i$ in $2d$ CFT) was considered. The two-particle case was investigated in detail. The corresponding wave functions were described by complex hypergeometric functions in the Mellin–Barnes representation. Their dual integral representation and reflection symmetry in the coupling constant were established. Besides, a complex limit of the hyperbolic Baxter Q -operators was considered. Another complex degeneration of the hyperbolic Ruijsenaars model was obtained by taking a special $w_1 + w_2 \rightarrow 0$ (or $b \rightarrow 1$) limit. Additionally, two new degenerations to the complex Calogero–Sutherland type models were described [41].

The thermal conductivity and electrical conductivity behaviour in polycrystalline graphene, a perspective nanomaterial, was investigated theoretically. It was shown that the role of grain boundaries in suppression of electrical transport becomes more important in a wide temperature range with decreasing size of grains. It was also found that the electrical transport can be suppressed significantly even at room temperature if the grain boundaries have breaks in misorientation angles along the grain line. Besides, it was shown that the experimentally observed behaviour of polycrystalline graphene resistivity can be explained if resonant impurity scattering is included in consideration. The asymmetry in the behaviour of resistivity is given using the proposed model [42].

The topological properties of materials with large electron–electron (e - e) correlations are of great in-

terest due to the remarkable success in synthesizing low-dimensional materials in which e - e correlations cannot be neglected. A mathematically sound method was proposed for studying topological properties in the limit of strong e - e correlations ($U = \infty$). Using this method, a topological phase diagram was obtained for the BCS–Hubbard model on a square lattice. This method is general enough to be applied to other one- and two-dimensional Hamiltonians in the limit $U = \infty$ [43].

Phonon-limited electron mobility was theoretically investigated for a recently synthesized carbon allotrope — two-dimensional biphenylene. Calculations were performed for quasi-one-dimensional structures obtained experimentally. It was found that they exhibit a linear increase in mobility with increasing ribbon width. Strong anisotropy of electrical conductivity and electron mobility was revealed in two-dimensional biphenylene. Specifically, in the crystallographic direction corresponding to the 1D structures, the mobility is 10^2 $\text{cm}^2/(\text{V} \cdot \text{s})$, while in the perpendicular direction it is an order of magnitude higher. The computations were carried out using the non-orthogonal tight-binding method [44].

Starting with the microscopic fermionic action, the superfluid phase transition in an $SU(N)$ -symmetric Fermi gas was investigated using the functional renormalization group. Quantitative predictions were provided for the critical temperature and for the discontinuities in the superfluid gap and entropy density as functions of N , which can be directly tested in future experiments [45].

The general epidemic process is a paradigmatic model in nonequilibrium statistical physics, displaying a continuous phase transition between active and absorbing states. The universality of dynamic isotropic percolation reflects its universal properties, which were quantitatively studied using a field-theo-



Saint Petersburg, 6–10 October. The 8th Conference “Models in Quantum Field Theory”, A. Vasiliev’s disciples and colleagues. Photo by MQFT-2025 Scientific Secretary N. Gulitsky (SPbSU)



23–27 June. Participants of the South Africa – JINR Workshop on Theoretical and Computational Physics

retical model supplemented by a perturbative analysis of the renormalization group. The main goal was to calculate the critical dynamic exponent z in the three-loop approximation. This made it possible to complete a quantitative description of the class of dynamic isotropic percolation in this order of perturbation theory. The calculations were performed within the dimensional regularization with a minimal subtraction scheme, and the actual perturbative expansions were performed in a formally small parameter ε , where $\varepsilon = 6 - d$ is the deviation from the upper critical dimension equal to 6 [46].

A two-loop field-theoretic analysis of incompressible helical magnetohydrodynamics (MHD) in fully developed stationary turbulence was presented. The key feature of helical MHD is the appearance of an infrared-unstable “masslike” term in the loop diagrams of the magnetic response function. Physically, this term corresponds to the relevant perturbation of the Joule damping, proportional to $\nabla \times b$ (b is magnetic field). Its presence destabilizes the trivial ground state $b = 0$ and forces us to look for a mechanism for stabilizing the system. It was shown that such stabilization can be achieved in two ways: (i) by introducing into the induction equation an external masslike parameter that precisely cancels these dangerous loop corrections (kinematic regime), or (ii) via spontaneous breaking of the rotational symmetry, leading to a new ground state with nonzero large-scale magnetic field (turbulent dynamo regime). For the latter case, the two-loop

correction to the spontaneously generated magnetic field was calculated, and it was demonstrated that Goldstone-like corrections to Alfvén modes along with some other anisotropic structures arise. The results also confirm that the emergent mean magnetic field leads to a steeper slope of the magnetic energy spectrum with a scaling exponent, compared to the Kolmogorov velocity spectrum of $-11/3$, thereby breaking equipartition [47].

An anisotropic self-organized critical system model proposed by Hwa and Kardar coupled to an isotropic random fluid environment was studied. The latter was modelled by the stochastic Navier–Stokes equation with a random stirring force of a rather general form that includes both random shaking of the system and a non-local part with the power-law spectrum that describes, in the limiting case, a turbulent fluid. Due to the interplay between isotropic and anisotropic interactions, the corresponding renormalization group equations reveal a rich pattern of possible regimes of asymptotic behaviour of the system that, in particular, include the plain advection of the material by the turbulent fluid and the case of the uniform stirring of the material. The scaling exponents corresponding to those regimes were found exactly. Another possible asymptotic regime found, not detectable in the leading order of perturbation theory, corresponds to the case where the Hwa–Kardar interaction and advection by the turbulent fluid are simultaneously relevant [48].

Modern Mathematical Physics: Gravity, Supersymmetry, and Strings

The main focus of research on the theme in 2025 was on:

- Quantum groups and integrable systems;
- Supersymmetry;
- Quantum gravity, cosmology, and strings.

Using the split Casimir operators, a decomposition of the antisymmetric part of the 5th power of the adjoint representation $ad^{\otimes 5}$ was found. The decomposition includes only one new representation X_5 aside the representations appearing in the decompositions of $ad^{\otimes 4}$, whose dimension was predicted in the paper by A. J. Macfarlane and H. Pfeiffer (J. Phys. A: Math. Gen. 2003. V. 36. P. 2305). The decomposition is valid for any simple Lie algebra [49].

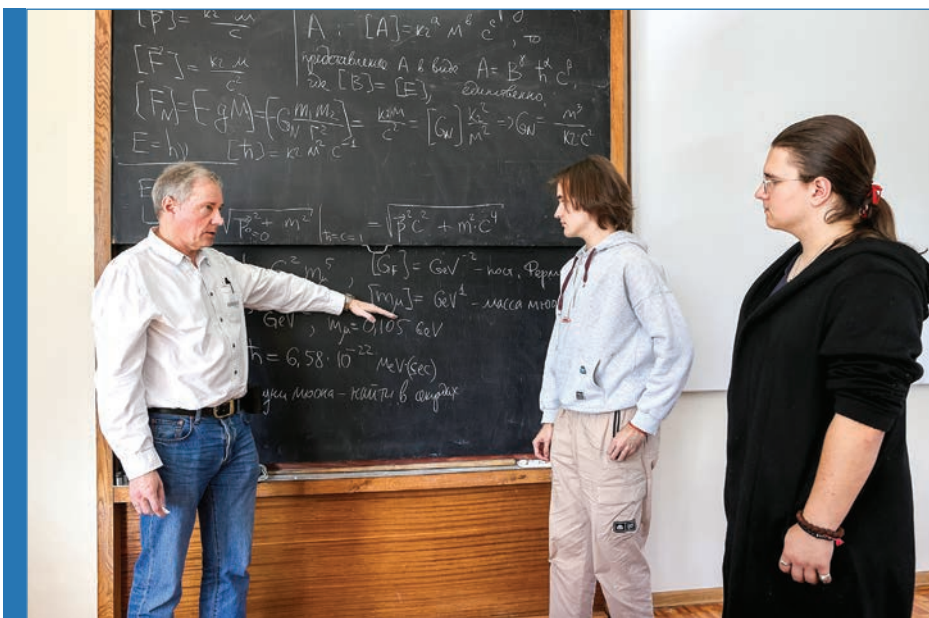
In 2025 there was a breakthrough in the studies of Lagrangian geometry of Grassmann variety $Gr(r, n)$: examples of Lagrangian submanifolds of Mironov type were constructed for any degree of homogeneity $k = 0, \dots, n - r$. Moreover, it was proven that all the Lagrangian submanifolds are Hamiltonian minimal, as in the classical paper of Mironov for projective spaces [50].

New models of 4D, $N = 1$ continuous spin superparticle in flat and curved superspace were constructed. Full sets of constraints in these models were derived. The consistency condition for constraints imposes a restriction on supergeometry to be flat or be AdS superspace. It was proven that, unlike the flat case, in the AdS case only one fermionic constraint is a first-class constraint. In addition, a review of the BRST approach for constructing a gauge-invariant Lagrangian for massive higher-spin bosonic fields was given. These papers represent continuing research within the new approach to the description of infinite spin particles and higher spin fields developed by the authors [51].

A harmonic superspace formulation of the $N = 2$ gravitino multiplet was presented. The invariant superfield action was constructed in which the gravitino analytic prepotentials acquire a nice geometric interpretation as extra vielbeins of the covariant harmonic derivative. The harmonic superspace formulation of the $N = 2$ hypermultiplet in the AdS background was presented, starting from the proper realization of 4D, $N = 2$ superconformal group $SU(2, 2|2)$ on the analytic subspace coordinates. Using the harmonic superspace approach, the superconformal harmonic action for the $N = 2$ Weyl supermultiplet was constructed. These papers continue the research on the description of $N = 2$ supersymmetric theories within the harmonic superspace framework proposed at BLTP JINR [52].

The Hamiltonian formulation of the new model of $N = 8$ supersymmetric mechanics was given. It was shown that the system possesses the dynamical $N = 8$ superconformal symmetry $osp(8|2)$. This model was extended to $N = 8$ superconformal mechanics associated with algebras $F(4)$, $osp(4^*|4)$, and $su(1, 1|4)$. Its $N = 2, 4$ counterparts associated with complex numbers and quaternionic numbers were also considered. It was shown that in all the suggested models the bosonic part of the Hamiltonian describes a free particle on a cone, while the fermionic part can be interpreted as a spin-orbit interaction term [53].

The importance of relativistic corrections for the study of the stability of $(2 + 1)$ -dimensional nontopological solitons with quartic self-interaction in the low-energy limit was demonstrated. Unbroken conformal symmetry provides an additional degeneration that allows for the exact result for the energy and angular momentum of the stationary classical solutions. New regular self-gravitating nontopological soliton solutions of the $U(1)$ -gauged nonlinear $O(3)$ -sigma model with the usual kinetic term and



September. At a lecture on quantum field theory

a simple symmetry breaking potential in $(3 + 1)$ -dimensional asymptotically flat space were constructed [54].

A new physical effect was predicted — an electromagnetic response arising from an impulse gravitational action on a compact electromagnetic field source. It was shown that this effect represents a new type of transition radiation that occurs at a light-like boundary separating spacetime regions with different gravitational memories. Based on this physical effect, a new model for the origin of observed fast radio bursts was proposed, explaining two key characteristics of this phenomenon: the connection with magnetars and their millisecond duration. The calculated response of the magnetar magnetosphere to the impulsive gravitational action has characteristics consistent with observations [55].

The Casimir effect in a $(1 + 1)$ -dimensional model with a critical mode was considered. This mode

gives rise to a condensate described by the nonlinear Gross–Pitaevskii equation. In the condensate, there were two sources of the Casimir force; one is the conventional one resulting from the fluctuations, the other follows from the condensate. Three simple models were considered that allow for condensate solutions in terms of elliptic Jacobi functions. A method for obtaining approximate solutions was investigated, and its range of applicability was shown. In all the three examples the condensate energy was computed. In one example with a finite interval with Robin boundary conditions on one side and Dirichlet conditions on the other side, the vacuum energy and the Casimir force were calculated. There is a competition between the forces from the condensate and the fluctuations. The force from the condensate is always repulsive [56].

DUBNA INTERNATIONAL ADVANCED SCHOOL OF THEORETICAL PHYSICS (DIAS-TH)

Within the DIAS-TH educational programme, two schools for students and young scientists were organized in 2025.

From 30 June to 4 July, an International School of Theoretical Physics “Complex Systems and Advanced Materials” was held. Its scientific programme covered key areas of modern condensed matter physics, including current issues in magnetism, Dirac and Weyl systems, quantum transport, machine learning

methods, atomistic modelling, and renormalization group theory. The school’s format combined intensive lecture courses delivered by leading experts with mandatory brief oral presentations for young scientists and postgraduate students. The event brought together 9 lecturers and 45 attendees from leading scientific centres and universities of Dubna, Moscow, St. Petersburg, Novosibirsk, Tomsk, Yekaterinburg, Tver, Samara, and Minsk.



18 December. The memorial seminar dedicated to the 95th anniversary of the birth of Albert Tavkhelidze

The traditional international summer school “Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems” (20–25 July) presented lecture courses on field-theoretical, functional and statistical methods that are used in the study of nonequilibrium quantum and classical systems

and advances in the theory of integrable systems. More than 60 people from leading research centres and universities of Dubna, Moscow, St. Petersburg, Novosibirsk, Samara, Yekaterinburg, and Minsk took part in the school.

CONFERENCES AND MEETINGS

Twelve conferences and workshops and three schools for students and young scientists were organized in 2025:

- International workshop “Problems of Modern Mathematical Physics”, 10–14 February, Dubna;
- Workshop “Universal Description of Lie Algebras, Vogel Theory, Applications”, 21–24 April, Dubna;
- International workshop “Infinite and Finite Nuclear Matter” (INFINUM-2025), 12–16 May, Dubna;
- Workshop “Quantum and Low-Dimensional Magnetism”, 19–20 May, Dubna;
- Workshop “Physics at Future High-Energy Electron-Positron Colliders”, 5 June, Dubna;
- South Africa–JINR Workshop on Theoretical and Computational Physics, 23–27 June, Dubna;
- International school “Complex Systems and Advanced Materials”, 30 June – 4 July, Dubna;
- International workshop “Superconducting and Magnetic Hybrid Structures”, 7–10 July, Dubna;

- International school “Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems”, 20–25 July, Dubna;
- Workshop “Interplay of Gravity and Strong Interactions”, 8–9 August, Dubna;
- International conference “Advances in Quantum Field Theory” (AQFT’25), 11–15 August, Dubna;
- 13th BLTP JINR – ITP CAS Joint Workshop on Physics of Strong Interacting Systems, 17–22 August, Almaty, Kazakhstan;
- Online school “Molecular and Materials Modelling”, 26–29 August;
- 26th International Baldin Seminar on High Energy Physics Problems “Relativistic Nuclear Physics and Quantum Chromodynamics”, 15–20 September, Dubna;
- International workshop “Symmetries: Bulgaria–Armenia–Dubna” (SymBAD’25), 20–24 October, Yerevan, Armenia.

COMPUTER FACILITIES

In 2025, 12 new PCs with Intel Core Ultra 7 processors were purchased and installed at workplaces. Network licenses for the latest versions of Maplesoft Maple and OriginLab OriginPro software were renewed. Subscriptions for updates and technical support for these software were extended for one year. The BLTP servers now have a modern version of Ma-

plesoft Maple installed. A new file server, tfsn.jinr.ru, was launched. To support GPU computing, an Nvidia A30 GPU was installed at theor4.jinr.ru server. Aged network switches were replaced. The number of 802.11ax (WiFi-6) access points in the wireless network was increased.

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VEKSLER and BALDIN LABORATORY of HIGH ENERGY PHYSICS



Dubna, 17 December. Unveiling of the monument to Academician A. M. Baldin

MAIN RESULTS IN THE IMPLEMENTATION OF THE NUCLOTRON-NICA PROJECT

During the implementation of the flagship JINR project aimed at the construction, development, and commissioning of the components of the Nuclotron-NICA accelerator complex, on 18 January 2025, cooling of the Booster was carried out and work with ion beams of He^{1+} from the plasma source and Xe from the Krion-6T source was initiated. The following results were obtained:

- stable operation of the Booster cryomagnetic system was ensured, and beam acceleration up to the maximum design magnetic rigidity was achieved;
- operation of electron cooling at injection energy and at an intermediate magnetic field plateau was optimized; friction force measurements were performed;

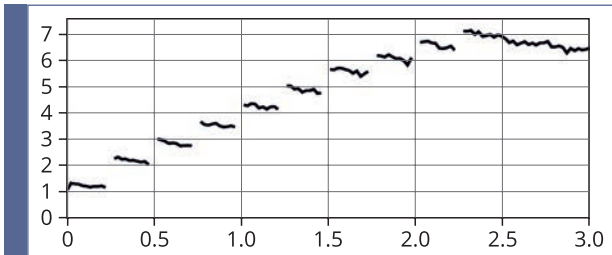


Fig. 1. Increase in the intensity of the circulating xenon ion beam ($^{124}\text{Xe}^{26+}$) at an energy of 3.2 MeV/nucleon with 10-fold multiturn injection and electron cooling. The horizontal axis shows time in seconds, the vertical axis indicates beam intensity in relative units

- software for orbit correction was debugged, and stable operation of the dipole correctors was ensured;

- measurements and optimization of the beam transport channel optics from HILac to the Booster were carried out;

- synchronization system for the operation of the ion source, HILac, and the Booster RF system during multiturn injection was commissioned;

- operation mode for the cycle-control hardware was implemented, enabling lossless ion acceleration at the first harmonic of the RF system.

The most notable achievement was the accumulation of ions in the beam with multiturn injection (up to 10 pulses) and electron cooling with an efficiency of up to 70% (Fig. 1).

On 26 March 2025, the first commissioning run of the NICA complex began, aimed at ensuring the joint operation of the three superconducting rings: the Booster, the Nuclotron, and the Collider. In parallel with beam acceleration experiments, installation work was carried out on the components of the Nuclotron fast beam extraction system, which was completed by early June. Following this, vacuum and cryogenic tests of the upgraded Nuclotron structure commenced.

On 10 October, the transfer of the beam from the Booster to the Nuclotron and its subsequent acceleration in the Nuclotron to 2 GeV/nucleon were successfully achieved. Both fast and slow beam extraction from the Nuclotron were implemented. Progressively, as elements of the transport line were assembled, the extracted beam was transported along the northern line to the Collider injection point. Currently, the assembly, as well as the vacuum and cryogenic testing of the Collider ring, are completed. Preparations are underway for all Collider systems to be ready for the beam injection.

The sequential commissioning and optimization of the cryogenic equipment operation modes are nearing completion. Until November 2025, the cryogenic complex units were providing simultaneous cryostatting for both the Booster and the Nuclotron. A satellite refrigerator RSG-2000/4.5 No. 1 was used for cooling the Booster. In November 2025, the west-



Preparation for the physical launch of the NICA collider



The helium satellite refrigerators RSG-2000/4.5 Nos. 2 and 3 of the Collider



Moscow, 2 December. RF Prime Minister M. Mishustin and staff member of VBLHEP JINR M. Shandov — the laureate of the Prize of the Russian Government in Science and Technology for Young Scientists.
Photo © Press Service of the Government of Russia

ern half-ring of the Collider was cooled down for the first time. The cooling time for the half-ring, with a cold mass of 100 t, from 300 to 4.5 K was 14 days.

Currently, cooling and cryostatting of all three superconducting rings of the NICA complex are being carried out. The cooling of the Collider is performed using the helium satellite refrigerators RSG-2000/4.5 Nos. 2 and 3.

Throughout 2025, during the NICA complex run, the MPD superconducting magnet underwent its cool-down cycle to 4.5 K, followed by current injection and magnetic field measurements. To operate

the MPD satellite refrigerator, the capacity of the cryogenic complex enabled the circulation of gaseous helium and the periodic filling of two transport containers (dewars) GCD3400 with a capacity of 13 m³ each with liquid helium. Liquid helium was alternately dispensed from these dewars to the MPD satellite refrigerator, ensuring its continuous operation.

In 2025, employees of the VBLHEP Accelerator Department defended three candidate dissertations. The main results were published in [1–6].



Checking the tightness of the Collider beam chamber



Participants of the successful injection and production of stable circulation of the first xenon heavy-ion beam in the NICA collider

In 2025, the construction of the **ARIADNA** long-term irradiation station (Fig. 2) at the BM@N facility area was completed. It enables the use of residual high-energy ion beams in the range of 1–4 GeV/nucleon for periods of up to several months for applied research [7].

The long-term irradiation station is equipped with an operator's workstation, optical beam position control device, ionization chamber, remote control unit for station elements based on a multi-

contact IP relay, video monitoring system for their positioning, and network equipment [8].

Also in 2025, the construction and equipping of the ARIADNA sample preparation area, located in close proximity to the applied research irradiation stations, were finalized.

During 2025, comprehensive studies were performed on exchange interactions, magnetotransport phenomena, and spin and phase transitions in complex cobalt oxides of the $\text{La}_{1-x}\text{Ba}_x\text{CoO}_{3-d}$

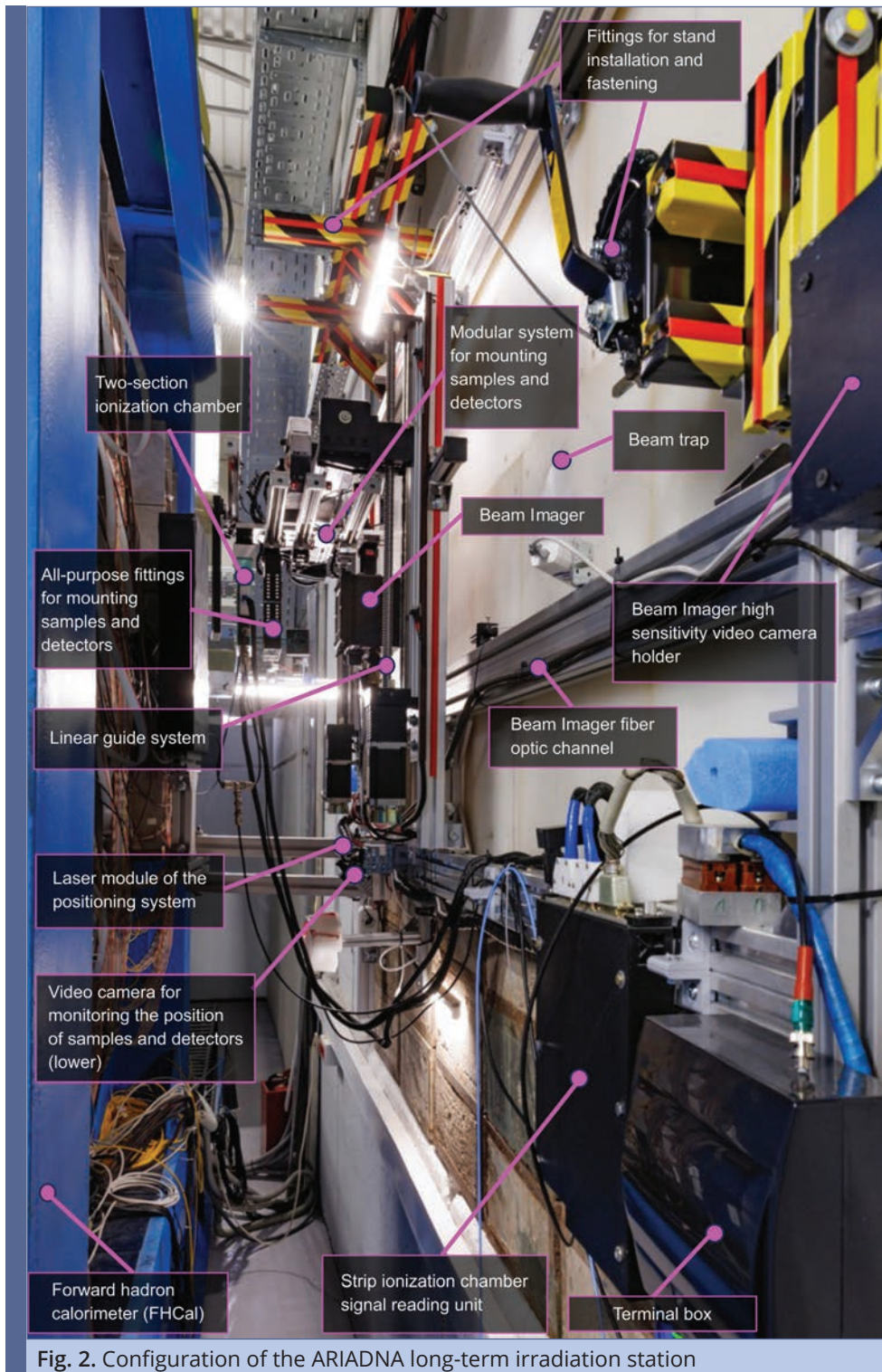


Fig. 2. Configuration of the ARIADNA long-term irradiation station

type before and after electron/ion irradiation with controlled dose, energy, and pulse duration [9]. Preliminary results showed that irradiation with pulsed electron beams with an energy of 20 MeV leads to a transformation of the crystal structure and magnetotransport properties in the studied compound. This is attributed to the avalanche-like formation of vacancies from high-energy secondary electrons, which cause displacement of ions in the crystal lattice, thereby inducing a struc-

tural transition and an increase in the unit cell volume.

Within the “Accelerator Driven Subcritical Reactor” (ADSR) project, theoretical analysis continued on various factors determining the efficiency of ADSR [10, 11]. A number of aspects related to the use of low-energy ion beams interacting in the Be converter were investigated. Calculations demonstrated that the use of carbide or nitride fuel in ADSR is preferable, as it allows for achieving high power densi-



General view of the sections in the ARIADNA sample preparation area

ties: with a peak factor $PF \sim 2$, an electrical power of 700–800 MW can be reached. The LETASUR converter target (LEad Target for the study of Accelerator driven SUBcritical Reactors) was designed [12]. The target consists of a block of Pb with dimensions $80 \times 80 \times 150$ cm, surrounded by a 10-cm-thick layer of stainless steel. The Pb block has a central hole with an inner radius of 10 cm and a length of 120 cm for placing the converter. The technical specifications for manufacturing the target were developed and agreed upon. The experiment is planned to be performed in the SHINE experimental area using proton beams with energies up to 2 GeV, as well as ion beams with masses up to $A = 12$, energies up to 0.75 GeV/nucleon, and intensities up to 10^9 s^{-1} .

At the NICA accelerator complex, the Multi-Purpose Detector (MPD) is being prepared for launch. The assembly of the time-projection chamber (TPC) frame is currently underway. During geometry testing of the TPC frame, the non-parallelism between the flanges and the HV electrode was measured to be 0.1 mm/m. The HV electrode with its voltage divider system was tested at 25 kV. All 24 readout chambers (ROC chambers) and four spares were

produced and tested. The installation of the ROC chambers (12 chambers on each end-cap section) was completed by the end of December 2025. The procedure for installing the ROC chambers into the TPC flanges using special tooling (a manipulator) was refined on a prototype.

The TPC laser calibration system is required to minimize errors in the absolute coordinate measurements of charged particle tracks. It works by splitting a primary laser beam to generate eight planes, each containing 28 secondary laser beams. The possibility of manually aligning all elements of the laser system was experimentally verified. A laser tracker was used to preliminarily measure the coordinates of all 224 beams within the TPC operating volume.

Commissioning work on the MPD solenoid magnet continues. Over the past year, the stationary helium pipeline for supplying liquid helium from outside was upgraded to a parallel connection scheme from two sources (tanks). This configuration reduced helium losses during transfer from the filling tank to the stationary one. Furthermore, the parallel connection scheme allows for a continuous flow of liquid helium without pressure drops in the



Laser calibration system testing on TPC for MPD

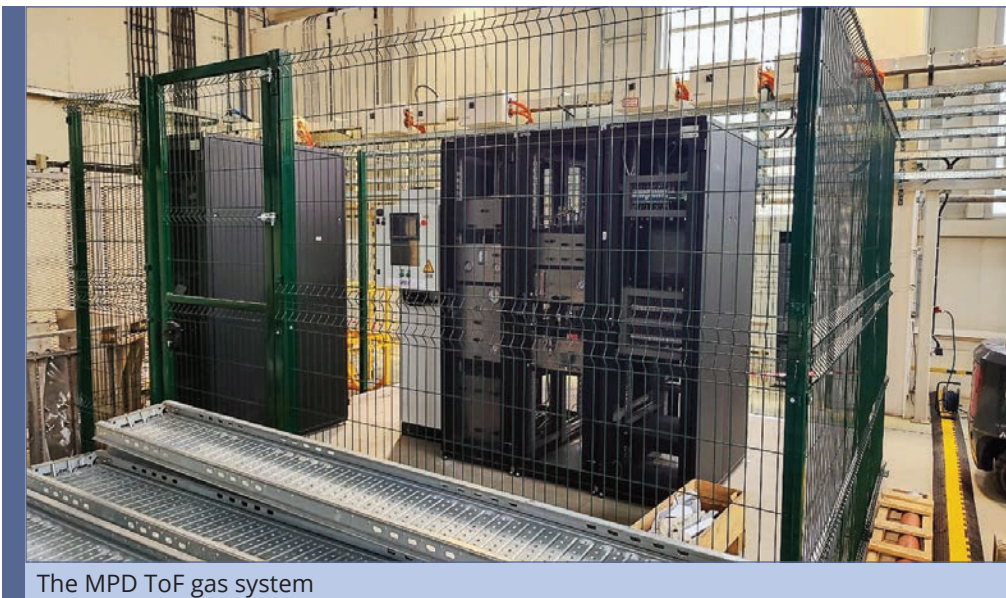
satellite refrigerator system. During the same period, a stationary magnetic field monitoring system was developed and installed. This system, which is required for fine-tuning the field after its volumetric mapping, allows for determining the magnetic field induction within the solenoid aperture. It consists of 40 sensors placed on the solenoid's inner surface (five planes with eight sensor groups each). The volumetric field mapper, manufactured at the Budker Institute of Nuclear Physics (BINP), was delivered to Dubna in September 2025. In October, the BINP team began the assembly and setup of the mapper. A number of issues with the mapper's mechanical and electronic components were identified during this process. Nevertheless, by the end of October, a successful field measurement was conducted at a single point with a current of 730 A. This measurement showed an error of the measurement unit at the level of 0.2 G, which meets the technical specification requirement for field homogeneity at the level of $3 \cdot 10^{-4}$. In October 2025, a current of 1050 A was applied to the solenoid, corresponding to a magnetic field induction of 0.278 T. The work of measuring the full magnetic field map at 0.2 T and selecting the currents for the correction coils was completed. A full cycle of field mapping measurements from 0.3 to 0.5 T was completed by the end of February 2026.

The assembly of all modules for the MPD Time-of-Flight (ToF) system was completed in 2024. The modules are currently stored on shelving racks and a test bench, awaiting installation into the MPD. The integration equipment was also tested in 2024 and is now located in the MPD hall. In 2025, the on-detector preamplifier electronics inside the modules were adapted to use the ToF for trigger purposes. Special drivers for converting the total signal to the LVDS standard were installed on the boards of all 560 amplifiers. With this upgrade and new trigger VME modules, the trigger system based on ToF modules was successfully tested using cosmic rays. During the past year, all mounting frames for the

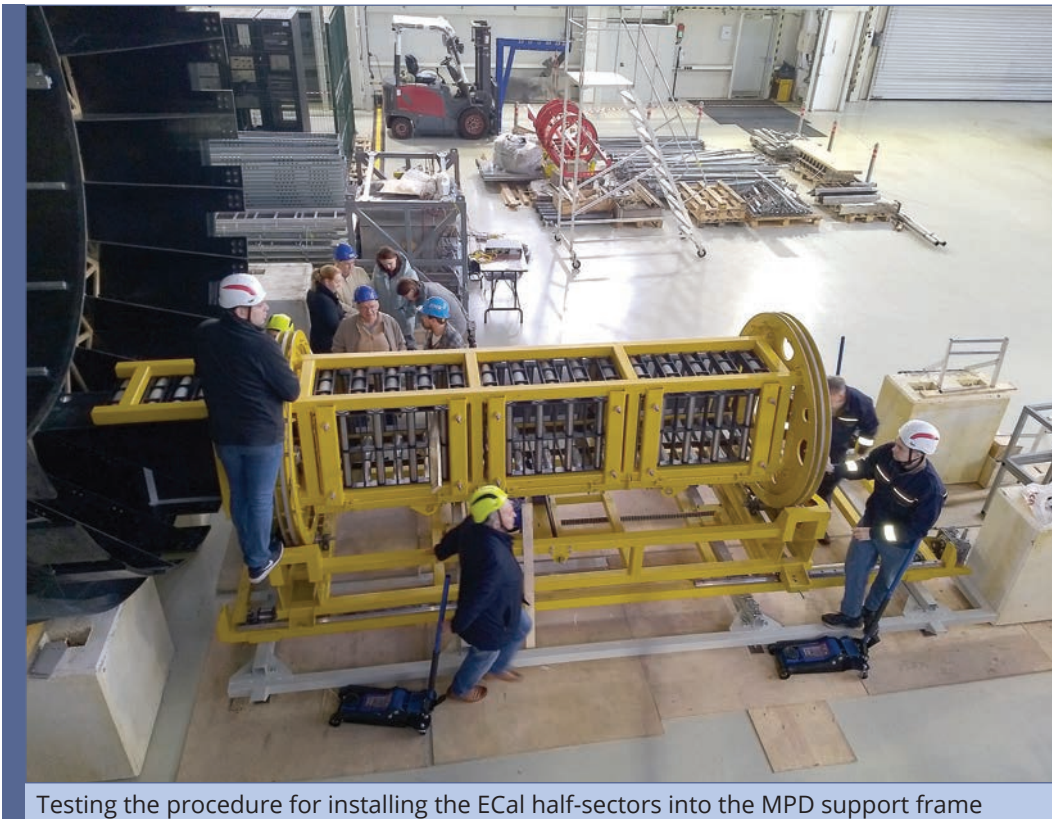
crates of the VME-VXS data acquisition electronics were welded in place within the MPD facility. The WIENER MPod low-voltage and high-voltage power supply crates were installed on the third level of the Electronics Platform. Work began on upgrading and adapting the MPD slow control system for integration into the global Run Control System. The CDR for the ToF air-cooling system was developed and approved, and design documentation is now being created. Significant progress was made in 2025 on assembling the MPD ToF gas system. The gas mixing system, gas recirculation, and purification system were installed on the raised floor in the MPD hall. The gas distribution system was mounted in the racks on the third level of the Electronics Platform. All pipes and hoses for gas supply to the modules were routed from the gas distribution racks to the ports in the MPD yoke beams.

According to the MPD detector assembly plan, the ECal electromagnetic calorimeter must be ready for operation after the whole set of 2450 modules into 50 half-sector baskets (plus spares) is completed. Following assembly, each calorimeter half-sector undergoes a series of lengthy checks (lasting up to 48 h) aimed at the immediate detection and correction of possible cell damage or errors in the readout electronics connections. The operability and stability of individual cells are verified using the LED monitoring system. In this system, short light pulses from Ultra Bright Blue LEDs are delivered to the photo-detectors via side-emitting SOF-2 fibers. The stability of this monitoring system was confirmed at a level better than 1% over two weeks of continuous control measurements. The correctness of the readout electronics board connections is checked by observing signals from inclined (relative to vertical) cosmic muons. The testing sequence is completed with an initial calibration of the calorimeter cells using signals from muons passing along the cell axes.

A special device was manufactured for installing the ECal half-sectors into the MPD detector, along



The MPD ToF gas system



Testing the procedure for installing the ECal half-sectors into the MPD support frame

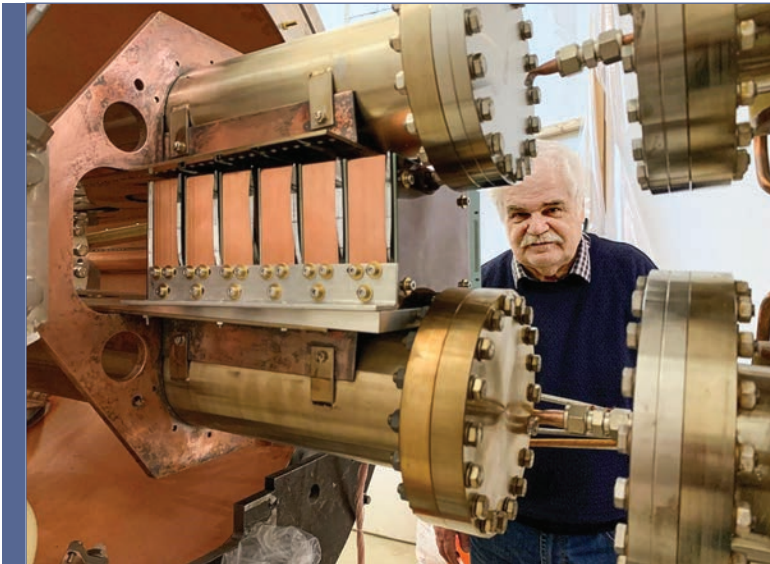
with a corresponding procedure. This procedure was tested on a stand assembled using the actual MPD support frame and the actual device for installing half-sectors into this structure. The tests confirmed the functionality of the developed procedure but also revealed shortcomings that need to be addressed in the near future. Based on current estimates, it is possible to install two half-sectors per day. An optimistic forecast suggests that installing all 50 half-sectors would take about one month.

Prior to the commissioning of the MPD experimental setup, its physics potential is being studied using large samples of simulated data. The creation of three large datasets corresponding to the following configurations was completed: UrQMD, Bi + Bi collisions at $\sqrt{s_{NN}} = 9.2$ GeV, $5 \cdot 10^7$ events; DCM-QGSM-SMM, collisions of Xe nuclei at 2.5 GeV/nucleon with an internal fixed W target, 10^6 events; and PHQMD, collisions of Xe nuclei at 2.5 GeV/nucleon with an internal fixed W target, $5 \cdot 10^6$ events. The passage of particles through detector materials and the responses of detector subsystems were simulated using the MpdRoot software based on GEANT4. The simulated data were used to evaluate the capabilities of the MPD experimental facility for measuring various physical signals. Reconstruction of the originally generated particle characteristics from the simulated detector responses was performed to assess the physics capabilities of the experimental facility and to advance the experiment's software and computing infrastructure. Results were obtained on the measurement of the dielectron continuum (e^+e^-), as well as yields and flows of identified hadrons and

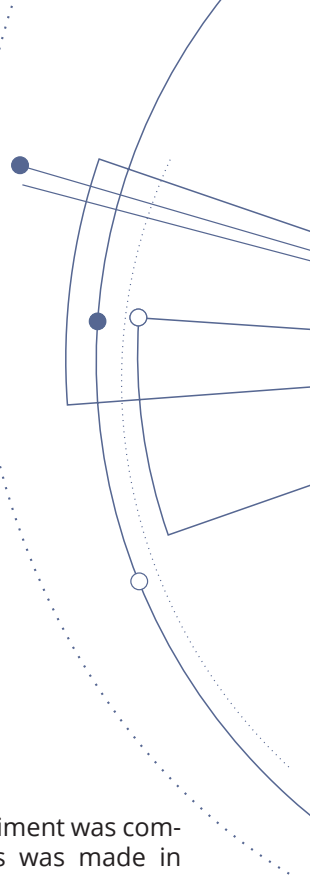
light nuclei. These results were presented at international conferences and published [13–16]. Two MPD Collaboration meetings were held at JINR with the participation of over 150 Collaboration members.

Within the SPD project, the creation of a full 3D model of the facility's load-bearing system (yoke/absorber, support structure, and movement system) was completed, and corresponding strength calculations were performed, taking into account both the total weight of the facility and the effects of magnetic forces. Preparations continue for the mass production site of MDT detectors, with stable strip signals obtained for the first time from a full-scale prototype of the muon system detection plane. A dedicated facility for straw detector production was equipped, featuring two assembled production lines for manufacturing 12-m and 5-m-long tubes. Four small-scale prototypes were produced and tested. A series of methodological tests was carried out at the PS and SPS (CERN) beams, as well as at the proton beam of the SC-1000 accelerator at PNPI (Gatchina). Additionally, a one-meter prototype of the end-cap straw detectors was created and tested.

The technology for the mass assembly of electromagnetic calorimeter modules was mastered, resulting in the assembly of 420 modules for the end-cap section, which are planned for use in the first phase of the experiment. In collaboration with NRNU MEPhI, preparations are underway for developing a 128-channel BBC detector prototype for the zero phase of the experiment. The technology for laying tiles and WLS fibers on the detector's composite substrate was debugged, and the production of



V. Polyakov (VBLHEP) installs the prototype of the SPD zero-degree calorimeter in the nominal position in the Collider ring



tiles and optical connectors for the 128-channel BBC prototype commenced. Eight- and twelve-channel boards equipped with SiPM FC-10035 were manufactured. Testing of the SPD DAQ system is ongoing, with the required data transfer rates achieved: approximately 1 Gbit/s at the input to L1 and about 10 Gbit/s at the input to L2.

A prototype of the Micromegas-based central tracker for the first phase of the experiment was developed, including a prototype of the readout system and the cooling system. The distributed data

processing system for the SPD experiment was commissioned, and significant progress was made in developing the new SAMPO platform for simulation and data analysis. Equipment for the initial prototype of the SPD Online Filter was purchased and is being brought into operation.

In 2025, the SPD Collaboration held two meetings: in Yerevan at AANL and at JINR, with over 200 participants in total. In 2025, 18 bachelor's and master's theses on the SPD project were prepared and successfully defended. Furthermore, project par-



Yerevan (Armenia), 12–16 May. Participants of the 9th Collaboration Meeting of the SPD Experiment

ticipants presented more than 40 reports at international conferences and published ten papers in peer-reviewed scientific journals [17–22].

In the **BM@N** experiment, the analysis of previously obtained data on argon interactions with various targets at an energy of 3.2 GeV/nucleon continued. By comparing the transverse mass spectra of secondary particles with calculations based on the Blast Wave model (Fig. 3), it was possible to determine the temperature of the fireball formed in Ar + Al, Cu, Sn, Pb interactions, $T \sim 130$ MeV, as well as the transverse component of the fireball expansion velocity — $\beta \sim 0.2c$ [23].

In Xe + CsI interactions at an energy of 3.8 GeV/nucleon, the direct flow v_1 of protons and deuter-

ons was measured. Agreement with the STAR experiment data is shown in Fig. 4 for the slope of v_1 versus rapidity y in the central rapidity region ($y = 0$).

The analysis of femtoscopic correlations of p - p and p - d in argon ion-nucleus interactions at 3.2 GeV/nucleon provided estimates of the femtoscopic radii of the proton and deuteron sources — 3.3 and 3.0 fm, respectively.

In 2025, BM@N experiment participants presented more than 30 reports at international physics conferences. In 2026, experiments with the ^{124}Xe ion beam and the ^{124}Sn target are planned at the BM@N facility — to perform a beam energy scan from 1.6 to 3.0 GeV/nucleon.

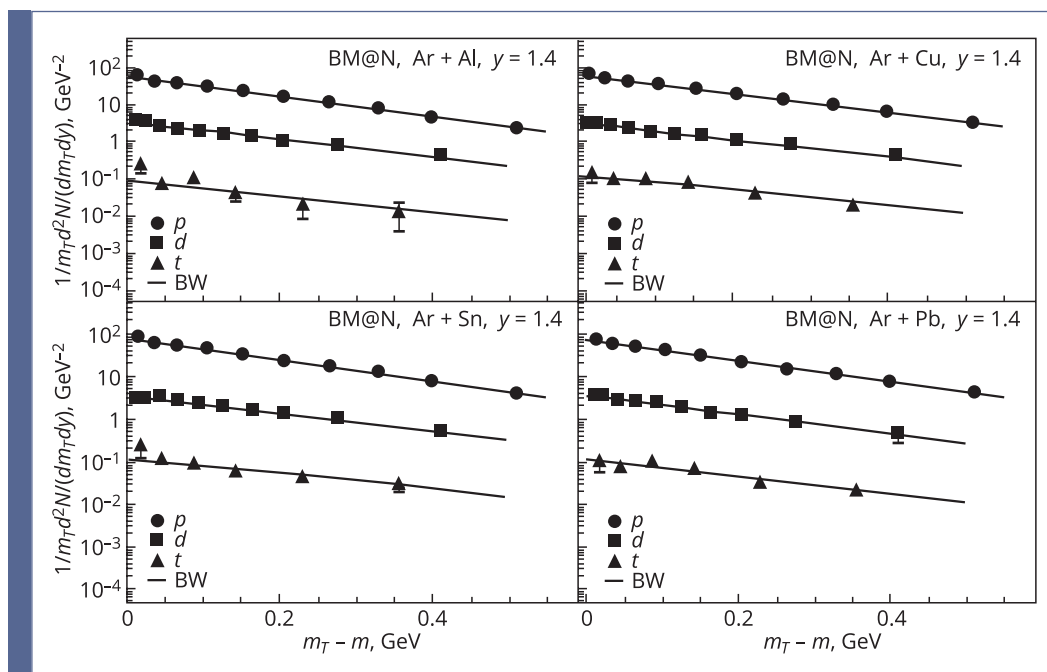


Fig. 3. Invariant m_T spectra of p , d , t in 0–40% central Ar + Al, Cu, Sn, Pb collisions. Lines indicate fits to the Blast Wave model



Employees of Sector No. 2 SED BM@N — developers and creators of the coordinate Si-planes (left to right): Yu. Kopylov, D. Chemezov, E. Zubarev, S. Khabarov, N. Zamyatin, A. Sheremeteva, E. Streletskaya, A. Smirnov, O. Tarasov

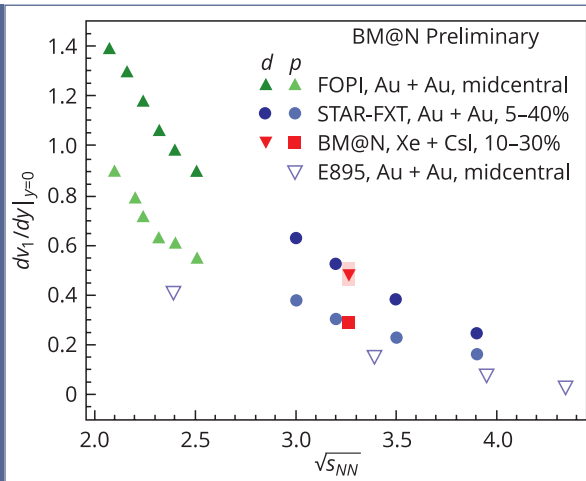


Fig. 4. Slopes of v_1 of protons and deuterons at mid-rapidity $y_{cm} = 0$ as a function of collision energy. The BM@N results are compared with existing data from other experiments

Within the **DSS** project, an analysis was performed of experimental data on the angular and energy dependences of the deuteron analyzing powers A_y , A_{yy} , and A_{xx} of deuteron-proton elastic scattering at deuteron energies of 700–1800 MeV, obtained on an internal target at the Nuclotron. Within the framework of the relativistic multiple scattering model, theoretical calculations were carried out to interpret the obtained experimental data, taking into account the excitation of the delta isobar in the intermediate state over a wide range of energies and angles. The results were reported at the international conferences “Nucleus-2025” and SPIN-2025.

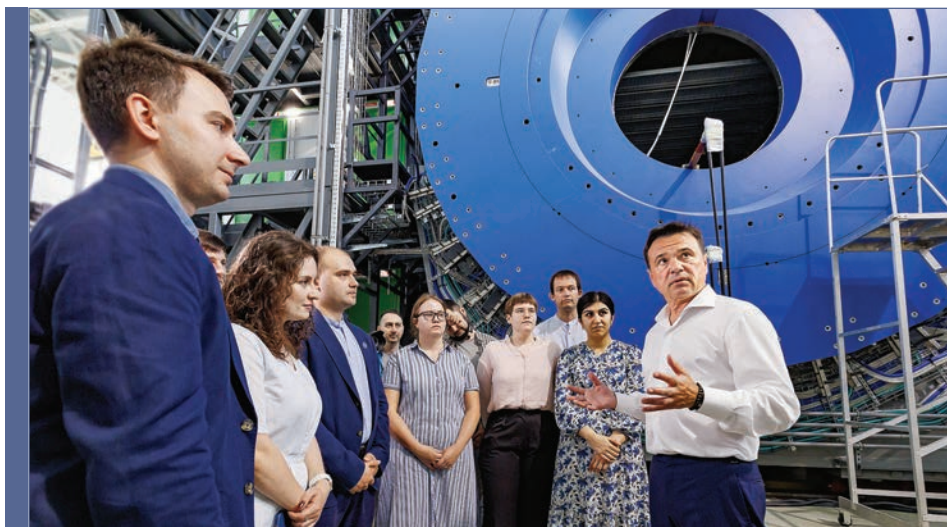
As part of preparations for the **HyperNIS-SRC** experiment at the Nuclotron, a number of works were carried out to restore the 4V channel in building 205: the beam stopper in the 4V channel was restored, and its impact on the effective dose rate for

Li and *d* beams was assessed; work was performed to restore the power supply and water cooling for the magnetic optics elements of the channel; all signal cables of the HyperNIS spectrometer were completely replaced. The technical specification for the construction of the experimental setup for the SRC experiment in building 205 was prepared [24]. Specifications for a liquid hydrogen target were developed, and its construction began. The analysis of the data collected by the SRC team at the BM@N facility in 2022 continued, employing new reconstruction algorithms, fragment identification techniques, calibrations, and signal corrections. A comparison with the results of the SRC experiment at GSI was performed.

Plans for 2026 include further development of the HyperNIS-SRC setup, involving the replacement of RPC detectors, installation of GEM detectors, construction of a new liquid hydrogen target and coordinate detectors for the SRC experiment, performing a test run, and preparing publications.

In the **FASA** experiment, an analysis of the longitudinal and transverse velocities of intermediate-mass fragments was conducted for fixed values of invariant transverse cross sections in *p* (3.6 GeV) + Au interactions. A decrease in the source velocity with increasing fragment charge was observed [25].

In 2025, staff of the Scientific and Experimental Department of Theoretical and Methodological support of Projects performed experimental work at the following accelerator facilities: FLNR Microtron, the IREN facility at FLNP, Linac-200 at DLNP, linear accelerators at Yerevan State University and Tomsk Polytechnic University, as well as the NICA accelerator complex. The Department organized and carried out data scanning from bubble chamber experiments, prepared equipment and materials for the JINR Museum, and developed software for the storage, processing, and analysis of accumulated data. Staff of the Department actively participated in the creation



Dubna, 15 July. A meeting of young scientists and specialists from JINR, laureates of the Moscow Region Governor’s Prize and winners of the Social Mortgage competition, with A. Vorobyov



Dubna, 6 November. A delegation from the Embassy of Japan to the Russian Federation on an excursion to VBLHEP

and commissioning of a profile monitor system for configuring the beam transport channel from the Nuclotron to the NICA rings, conducted trials of a new type of neutron detector, and performed research in the field of relativistic electron beam diagnostics (FLNR Microtron). The Department demonstrated strong publication activity: 37 presentations at 13 international conferences and 14 papers in peer-reviewed journals, including Q2-level publications. Furthermore, the Department actively participates in educational activities.

In the **BECQUEREL** experiment, the search for C+He events in nuclear photoemulsions irradi-

ated in the beam of ^{16}O nuclei at a momentum of 4.5 GeV/c per nucleon continued, aiming to test the hypothesis of the structure of $^{16}\text{O}(0_6^+)$ as a 4α -particle Bose-Einstein condensate decaying into $^{12}\text{C}(0_2^+)\alpha$ or $2^8\text{Be}(0^+)$. A total of 67 events, including 22 “white” stars, were found and measured. Events of $^{14}\text{N} \rightarrow 3\alpha + \text{H}$ dissociation were studied on a sample of 128 events, and rare events of $^7\text{Be} \rightarrow ^6\text{Li}p$ and $^{11}\text{C} \rightarrow ^7\text{Be}\alpha$ dissociation were investigated. Evidence was obtained indicating that conditions for nuclear astrophysical processes may be reproduced in the cone of relativistic fragmentation [26].

PARTICIPATION IN EXTERNAL EXPERIMENTS

The main efforts of the JINR ALICE group were focused on the study of femtoscopic correlations, ultra-peripheral (UPC) Pb-Pb collisions, and on the development of the Thermal Model of hadron pro-

duction in A-A collisions. Preliminary results of the analysis of femtoscopic correlations of kaon pairs in p -Pb interactions at an energy of 5.02 TeV are shown in Fig. 5, which presents the correlation function $C(q)$

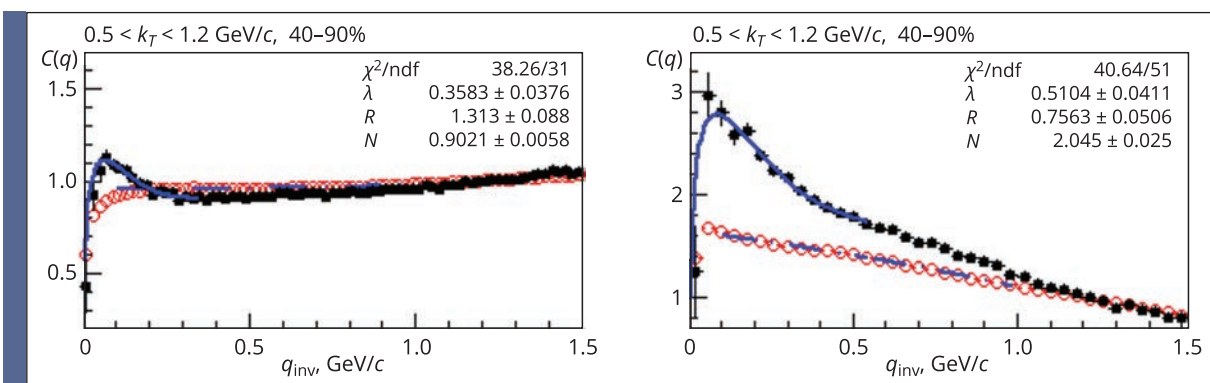


Fig. 5. Correlation functions of $K^{\pm}K^{\pm}$ pairs in p -Pb events with different sphericity

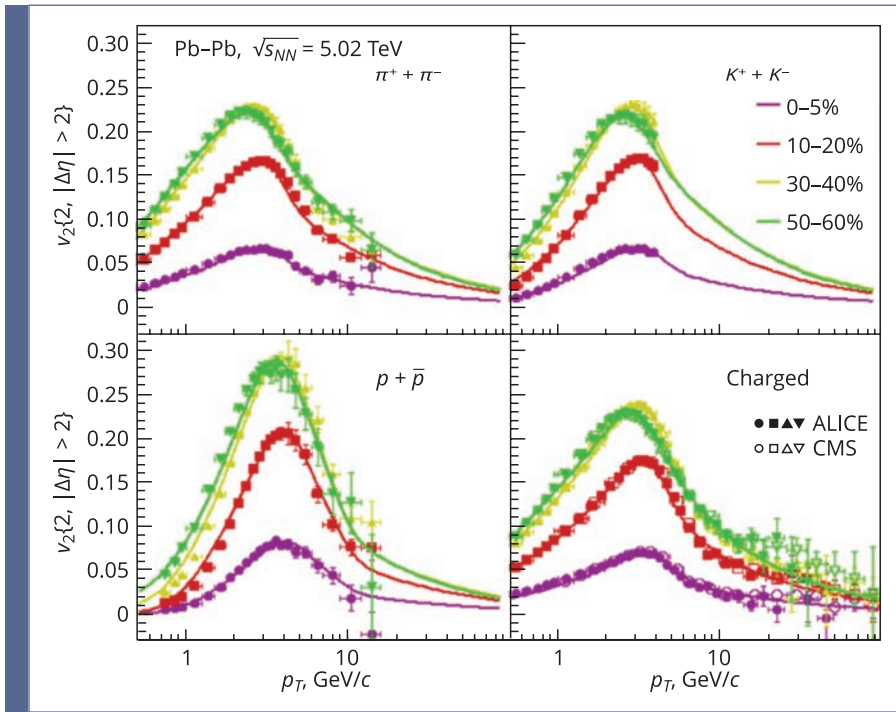


Fig. 6. Comparison of experimental data and BWTP calculations for elliptic flow v_2 in Pb-Pb collisions

in events with sphericity $S > 0.7$ and in jet-like events with $S < 0.3$.

A significant difference in the shape of $C(q)$ is visible for the two cases, with a noticeable drop in the selection of jet events. A femtoscopic maximum (at $q < 0.3$) is observed in both cases. The red dots show the results of the DPMJET model in the absence of femtoscopic correlations. The fitting yielded a value of $R_{inv} = (1.50 \pm 0.15)$ fm for both S selections.

New results were obtained in the development of the phenomenological Thermal Model BWTP for hadron production in pp , p - A , and A - A collisions. The new version provides a good description of the ratios of yields of various hadrons as a function of charged particle multiplicity in Pb-Pb collisions obtained by ALICE, as well as ALICE and CMS data on the elliptic flow v_2 for pions, kaons, protons, and all charged particles in Pb-Pb at different centralities (Fig. 6). The results were reported at four international conferences, and three scientific publications [27–29] were prepared with an active participation of the JINR group. As part of the preparation of proposals for the upgrade of the ALICE detector, computer simulations of full-scale and compact options for the electromagnetic calorimeter (ECal) were performed.

In the ATLAS experiment at the LHC, studies continued on the process of associated production of the Higgs boson with the vector boson [30] and its decay into bb - or cc -quarks. In particular, the $ZH(bb)$ process was studied, in which the Z boson decays into charged leptons (e/μ). Signal and background classification was performed using various machine learning algorithms: Boosted Decision Tree (BDT),

Artificial Neural Network (ANN), and Deep Neural Network (DNN). After training on Monte Carlo events using these models, it was established that for the $ZH(bb)$ process, ANN demonstrated the best performance — the highest signal significance. The research results were presented at the 26th International Baldin Seminar at JINR and at the 9th International Conference “Modern Trends in Physics” in Baku.

In 2025, the JINR group in the CMS experiment carried out a search for dark matter (DM) candidate particles in channels involving the production of the SM Z^0 boson and Higgs boson with large missing transverse momentum. This yielded record model-independent limits on the production cross sections of these processes.

Within the framework of the two-Higgs-doublet model with an additional pseudoscalar singlet (2HDM + a) (Fig. 7), limits were obtained in the $\mu\mu + \text{MET}$ channel. For an additional scalar Higgs boson mass of $m_H = 1000$ GeV, the pseudoscalar mediator mass is limited $m_a > 440$ GeV. In the $b\bar{b} + \text{MET}$ channel, the existence of a light pseudoscalar state is excluded at 95% CL in the mass region $m_a < 260$ GeV for the vacuum expectation value ratio $\tan \beta = 35$, the CP-even Higgs mixing parameter $\sin \theta = 0.7$, and the heavy pseudoscalar boson mass $m_A = 600$ GeV. These are currently the most stringent limits.

JINR employees contributed to the development of the experiment’s software, participated in the preparation and performing of Run3, and ensured the upgrade and stable operation of the Cathode Strip Chambers (CSC) in the CMS end-cap muon system (ME) and the High Granularity Calorimeter

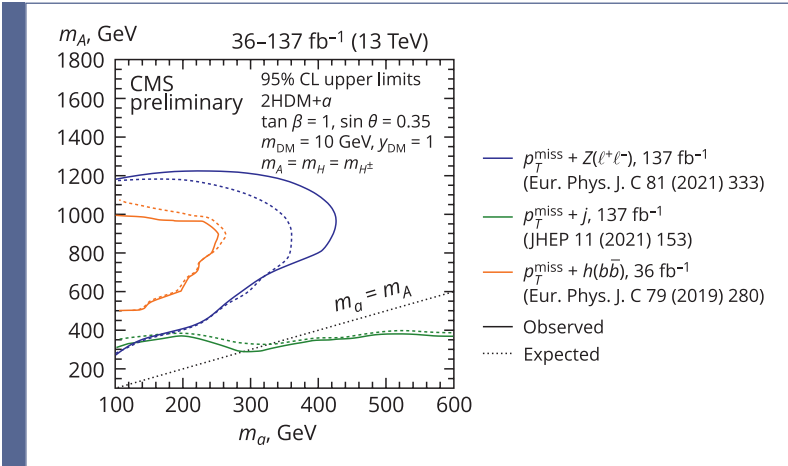


Fig. 7. Upper limits (95% CL) on the mass of the pseudoscalar mediator m_a in the 2HDM + a extension of the Higgs sector with one additional pseudoscalar singlet. Solid lines represent the observed experimental limits, while dashed lines indicate the expected limits for the given statistics

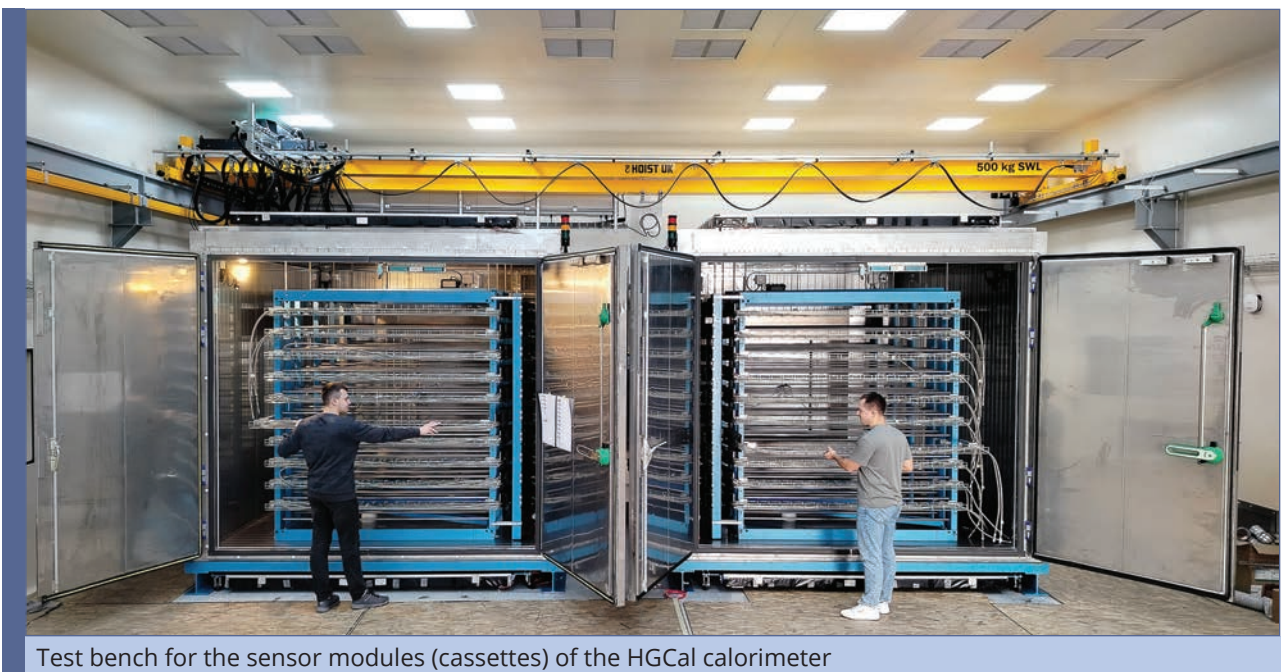
(HGCal) for efficient operation under the High-Luminosity LHC (HL-LHC) mode. Studies of muon detector characteristics under HL-LHC continued at the GIF++ facility using the extracted muon beam of the SPS accelerator at CERN. No degradation of the chambers' key characteristics has been observed thus far. JINR specialists developed, produced, and delivered to CERN a setup for testing the HGCal sensor modules (cassettes), including the software for reconstructing cosmic muon track segments.

The thermally insulated chambers were successfully tested at -30°C , which is equivalent to the operating temperature of the sensors in HGCal. The cassettes under test are placed in a rack between two scintillation planes that register cosmic particles passing through the entire detector array.

JINR physicists made a decisive contribution to the preparation of 16 scientific papers [31–34]. The results of this work were presented in over 50 reports at various conferences, workshops, and seminars.

An unexpected result was obtained in the NA61/SHINE experiment, where a significant violation of isospin symmetry between u and d quarks was observed in kaon production in Ar + Sc collisions [35]. For colliding charge-symmetric nuclei ($N = Z$), the exact isospin symmetry implies the following average yields of produced charged and neutral kaons:

$$R_K \approx \frac{\langle K^+ \rangle + \langle K^- \rangle}{\langle K^0 \rangle + \langle \bar{K}^0 \rangle} = \frac{\langle K^+ \rangle + \langle K^- \rangle}{2\langle K_S^0 \rangle} = 1.$$



Test bench for the sensor modules (cassettes) of the HGCal calorimeter

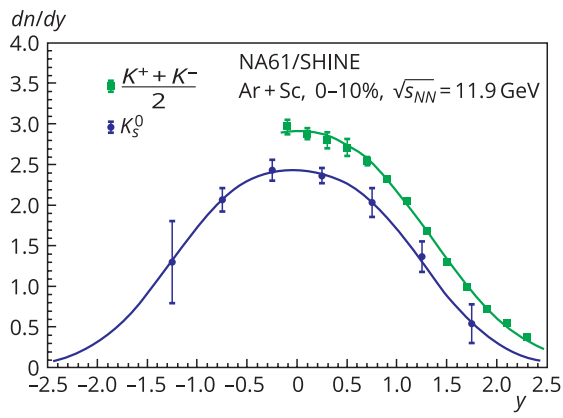


Fig. 8. Comparison of the rapidity spectra of neutral kaons and charged kaons in Ar + Sc collisions at $\sqrt{s_{NN}} = 11.9$ GeV

Central Ar + Sc interactions at $\sqrt{s_{NN}} = 11.9$ GeV show an excess of charged kaons of $(18.4 \pm 6.1)\%$ at central rapidity (Fig. 8). The observed effect remains unexplained by existing theoretical models. The deviation corresponds to a violation of isospin symmetry at the 4.7σ level.

The dependence of the effect on the system size is important, as it allows one to understand whether it is unique for nuclear interactions or it is a general feature of the hadronization process. Here, NA61/SHINE plays a key role, due to the versatility of available projectile/target/energy configurations in the experiment. The main focus of these studies is on kaons due to their simple isospin structure and ease of measurement. However, it is important to carry out similar studies for other isospin multiplets in the future. Analysis of other datasets available from NA61/SHINE (Xe + La, and especially the high-statistics Pb + Pb sample, which will be obtained by the end of 2026) can provide a more comprehensive understanding of this effect.

The NA61/SHINE experiment continues systematic studies of hh , hA , and AA interactions at the SPS as part of its strong interaction research programme. New results were obtained on strangeness production in heavy-ion collisions. In particular, for Pb + Pb and Au + Au systems, a sharp peak in the K^+/π^+ ratio is observed in the $\sqrt{s_{NN}}$ region of ~ 7 – 8 GeV, attributed to the onset of deconfinement [36, 37].

As part of the facility upgrade, the VBLHEP JINR group commissioned the second arm of the high-time-resolution (50 ps) time-of-flight detector, fully covering the NA61 setup's acceptance.

Work continued on the analysis of experimental data from the NA62 experiment dedicated to studying the very rare charged kaon decay into a charged pion, a neutrino, and an antineutrino. Results from the measurement of the $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ decay, obtained using data taken in 2021 and 2022, were published [38]. Based on the combined NA62 data collected between 2016 and 2022, a measurement of

$B(K^+ \rightarrow \pi^+ \nu \bar{\nu}) = (13.0_{-3.0}^{+3.3}) \cdot 10^{-11}$ was reported. With 51 signal candidates observed and an expected background of 18_{-2}^{+3} events, $B(K^+ \rightarrow \pi^+ \nu \bar{\nu})$ becomes the smallest branching ratio measured with a signal significance above 5σ .

In the beam-dump mode, the NA62 experiment at CERN can conduct searches for New Physics particles, including dark photons, dark scalars, and axion-like particles. A search for particles decaying in flight to hadronic final states was performed, based on the analysis of a data sample corresponding to $1.4 \cdot 10^{17}$ protons on dump. No evidence of a New Physics signal was observed, with new regions of parameter spaces being excluded for a range of models. In parallel with the experimental programme, two production lines for manufacturing 12-m and 5-m straw tubes were designed and commissioned. Methodological results on the development of straw-tube detectors were published [39]. The obtained results were published and presented at international conferences, including five presentations given by JINR representatives [40].

The analysis of experimental data collected from 2014 to 2025 will be performed to study the following decays: $K^+ \rightarrow \pi^+ \pi^- \mu^+ \nu$, $K^+ \rightarrow \mu^+ \mu^- \mu^+ \nu$, $K^+ \rightarrow e^+ e^- \mu^+ \nu$, $K^+ \rightarrow \mu^+ \mu^- e^+ \nu$, and $K^+ \rightarrow e^+ e^- e^+ \nu$. Maintenance of the NA62 spectrometer straw detector will also be ensured during the experiment's next data taking run.

The JINR group is actively involved in the NA64 experiment searching for the dark photon and other manifestations of dark matter and physics beyond the Standard Model (SM). In 2025, two data taking runs were performed: at the SPS H4 electron beamline, using a 100-GeV electron beam and positron beams with energies of 45 and 40 GeV. The hermeticity of the setup was improved by installing the additional VHCAL module [41]. Furthermore, all of the setup's calorimeters were equipped with new fast ADC electronics, which allowed for an increase in beam intensity during data taking of more than 20%. The total statistics collected by the Collaboration from the beginning of data taking has exceeded $2.5 \cdot 10^{12}$ particles on the target. Data taking is planned to continue during a 10-week run requested by the Collaboration.

One of the new results published in 2025 by the Collaboration (Fig. 9), based on the analysis of positron data, allowed for the exclusion of the existence of a dark photon in the mass range $165 < m_{A'} < 220$ MeV, for ϵ values down to $2.5 \cdot 10^{-4}$ and $a_D = 0.1$ [42].

Based on the results of the work, members of the JINR group delivered numerous reports at international conferences and workshops.

In the STAR experiment, the 2022–2025 experimental cycle for the Hot QCD and Cold QCD programmes was completed. The data collected includes 17 billion Au + Au collisions at $\sqrt{s_{NN}} = 200$ GeV, as well as polarized proton–proton collisions at $\sqrt{s_{NN}} = 510$ GeV with an integrated luminosity of 170 pb^{-1} . The analysis of the BES-II experimental

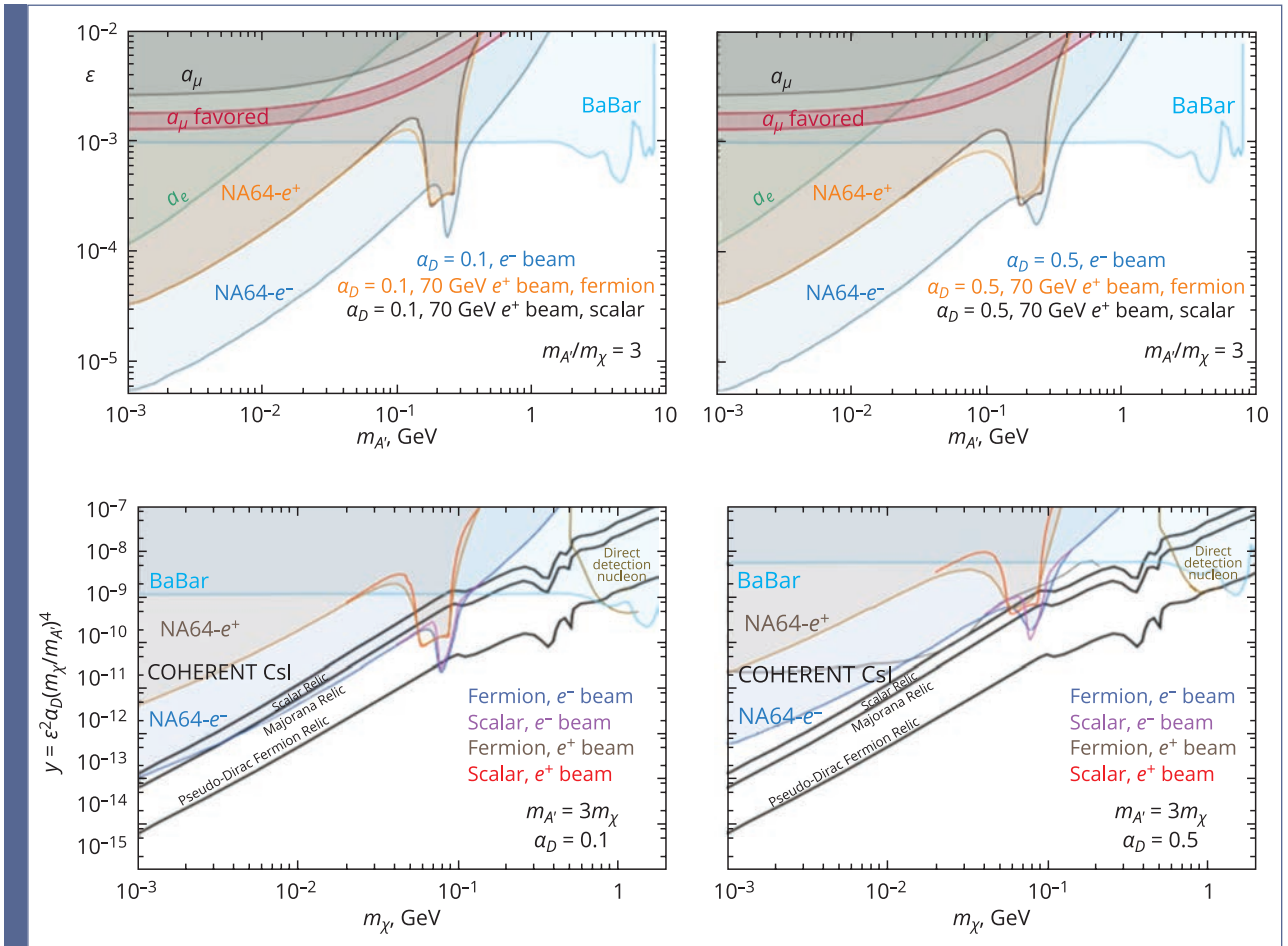


Fig. 9. Exclusion limits at 90% CL derived from the 70 GeV/c positron-beam missing energy measurement. Top (bottom): exclusion limits (brown and orange curves) in the $[m_A, \epsilon]$ ($[m_\chi, a_D]$) plane, for $a_D = 0.1$ (left) and $a_D = 0.5$ (right). The other curves and shaded areas represent already-existing limits in the same parameters space from NA64 in electron-beam mode (blue and violet), COHERENT (grey), and BaBar (light blue). In the bottom plots, the black lines show the favored parameter combinations for the observed dark matter relic density for different variations of the models

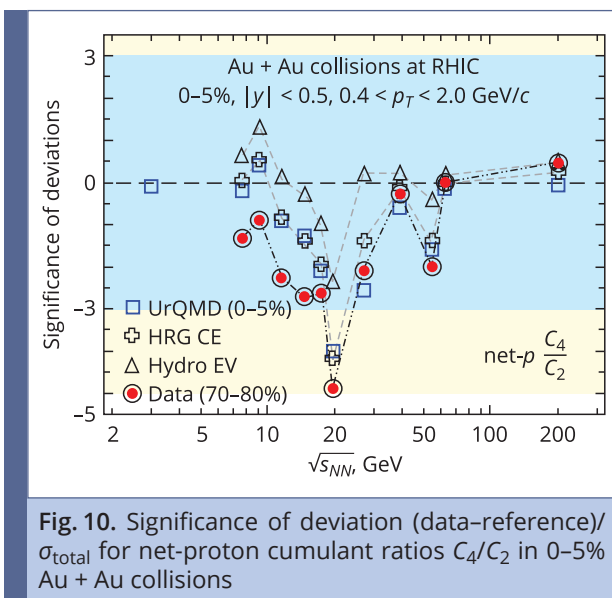


Fig. 10. Significance of deviation (data-reference)/ σ_{total} for net-proton cumulant ratios C_4/C_2 in 0-5% Au + Au collisions

data ($\sqrt{s_{NN}} = 7.7\text{--}27$ GeV, μ_B region of 150–400 MeV) was performed in the search for the critical point of nuclear matter. A comparison of the C_4/C_2 cumulant ratio for net-protons in the most central and peripheral collisions (Fig. 10), along with calculations from theoretical models, revealed discrepancies within 2–5 σ in the region of $\sqrt{s_{NN}} = 19$ GeV [43].

The analysis of femtoscopic correlations of $\pi^+\pi^+$ and $\pi^-\pi^-$ pion pairs in Au + Au collisions at $\sqrt{s_{NN}} = 3.0\text{--}7.7$ GeV revealed a difference in the emission source radii. This difference is explained by the Coulomb interaction between the particle emission source and the residual charges of the initial nuclei.

Over a wide energy range of $\sqrt{s_{NN}} = 7.7\text{--}39$ GeV and various centrality classes, the transverse momentum distributions of particles were analyzed within the framework of the Blast Wave hydrodynamic model and statistical models based on Tsallis statistics to describe the collective behavior of strongly interacting partons in nuclear matter [44].

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NEUTRINO PHYSICS AND RARE PHENOMENA, ASTROPHYSICS

During the 2025 Baikal Winter Expedition, the number of the detecting optical modules in the Baikal Deep-Underwater Neutrino Telescope (**Baikal-GVD**) increased up to 4212, and the effective volume for detecting high-energy neutrino events (above 100 TeV) exceeded 0.7 km^3 .

To date, all operating neutrino telescopes have just approached the measurements in the region of ultrahigh-energy neutrino fluxes above 100 PeV. The fact that only one detector, namely, KM3NeT-ARCA, smaller both in volume and area in comparison with the IceCube and Baikal-GVD neutrino telescopes and the ground-based array of the Pierre Auger Observatory (PAO), has detected an above-the-horizon muon neutrino, KM3-230213A, with an energy above hundreds of PeV, raises the question of its most probable origin: whether it is a cosmogenic neutrino, as in the proposed Greisen-Zatsepin-Kuzmin mechanism, or the one from a local source. Previously, the IceCube experiment and the PAO ground-based array for detecting extensive air showers set constraints on the magnitude of the diffuse flux in the energy region above several tens of PeV.

On the basis of six years of Baikal-GVD data, a differential upper limit on the flux of cosmogen-

ic neutrinos was obtained in the analysis of cascade events at 90% CL, assuming an E^{-1} spectrum in neutrino energy intervals of one decade, as shown in Fig. 1 (red dots with arrows), in comparison with the results from IceCube (dashed line) and PAO (dash-dotted line), estimates of the flux of KM3-230213A, and predictions for cosmogenic neutrino fluxes in various models. As a result of the joint analysis of the data from four experiments (IceCube, PAO, Baikal-GVD, and KM3NeT), the magnitude of the neutrino (antineutrino) flux has been estimated. The flux is balanced in flavors and with the E^{-2} spectrum at the level $F_{(1-\text{flavor})}^{(\nu+\bar{\nu})} = (7.2_{-5.9}^{+16.5} \times 10^{-10}) \text{ GeV} \cdot \text{cm}^{-2} \cdot \text{s}^{-1} \cdot \text{sr}^{-1}$ in the energy range of 72 PeV – 2.6 EeV coincident with the energy uncertainty interval of KM3-230213A [1].

The total exposure of the **vGeN** experiment has reached 2400 kg · days. Data-taking continues. The obtained constraints on the number of the expected coherent elastic neutrino-nucleus scattering (CEvNS) events do not confirm the positive result of the experiment with the Dresden-II reactor at the level of 2.5σ [2]. Some important methodological studies have been carried out to estimate both the systematic errors in the searching for CEvNS [3] and

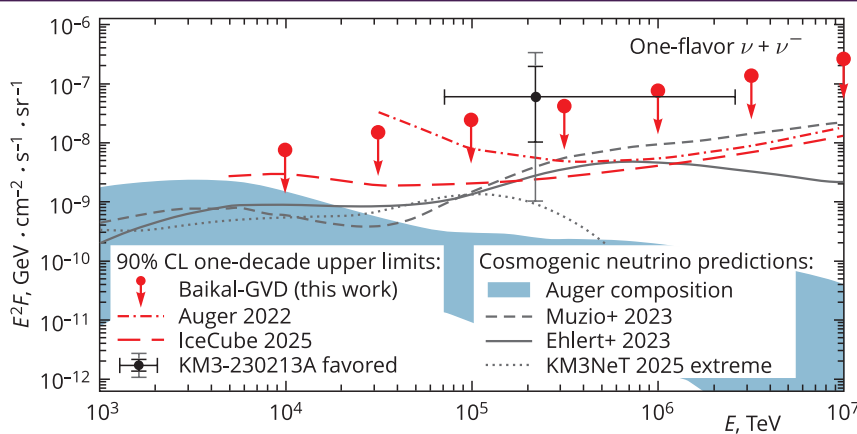


Fig. 1. Upper limits at the 90% CL on the cosmogenic neutrino flux from the Baikal-GVD data (red dots) in comparison with the data from IceCube, PAO, and with the estimates of the flux of KM3-230213A and that of a number of models



Lake Baikal, 17–18 March. Participants of the working meeting “Baikal-GVD Neutrino Telescope 2025” at the Baikal-GVD project ice camp



Dubna, 3–6 June. Participants of the Baikal Collaboration Meeting

the sensitivity to electromagnetic neutrino properties. The setup upgrade is being prepared: at the Baksan Neutrino Observatory, the internal NaI veto is being tested, and the new data acquisition system is being developed for lowering the energy threshold in future measurements.

At present, the accumulated statistics on the antineutrinos detected in the **DANSS** experiment exceed 10 million events. The results of the studies of long-term nuclear reactor monitoring using antineutrinos have been presented — the achievable accuracy of determining the nuclear reactor power for week-long measurements is shown to be 1%. For the first time in the world, the time evolution of individual components of nuclear fuel has been reconstructed using antineutrinos [4]. The results

of searching for Large Extra Dimensions within the accumulated data [5] and evaluating the yield of antineutrinos from nuclear fuel components [6] have been introduced. The setup upgrade, scheduled for 2026, is being intensively prepared.

Fractions of ^{235}U and ^{239}Pu extracted from the measured antineutrino spectra (Fig. 2, colored points) in reactor fuel fission is compared with the data obtained by the Kalinin NPP staff using the standard methodology (Fig. 2, lines). The data of the seventh fuel campaign of Power Unit 4 are displayed. The calculations were performed on the basis of two reactor antineutrino spectrum models: the Kurchatov Institute model (KI) and the Huber-Mueller model (HM).

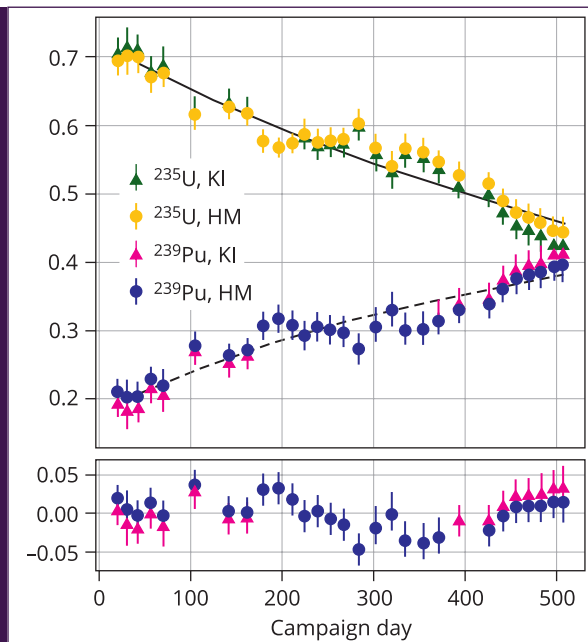


Fig. 2. Fractions of ^{235}U and ^{239}Pu , extracted from the measured antineutrino spectra (color points), and in comparison with the data obtained using the standard methodology (lines)

Within the **Ricochet** experiment after the installation and commissioning of the facility and test measurements near the research nuclear reactor at the Laue-Langevin Institute (ILL, Grenoble, France), the first run was launched with the full payload (18 detectors: 7 planar and 11 FID). The data-taking will continue till February 2026. Each reactor neutrino detector is a semiconductor germanium target 42 g in weight. The detectors can simultaneously detect

phonon and ionization signals. The current data-taking will last for two months of reactor operation. The background will be measured before and after this operation. About 11 CEvNS events/days/kg above the threshold of 50 eV are expected. The first physical results are planned to be obtained in 2026. On the basis of the experimental background data, an improved Monte Carlo model will be developed [7].

In 2025, the Central Detector of the **JUNO** experiment was filled with 20 kt of liquid scintillator, and the muon veto-detector Top Tracker was installed. The commissioning was done on both JUNO and the TAO near detector. The physical data-taking was started on 26 August 2025. The key detector performance indicators were shown to meet or surpass the design specifications. With only 59.1-day data, two neutrino oscillation parameters were measured with the world's best precision (Fig. 3): $\sin^2 \theta_{12} = (0.3092 \pm 0.0087)$ (2.8%); $\Delta m_{21}^2 = (7.50 \pm 0.12) \cdot 10^{-5} \text{ eV}^2$ (1.6 %). The measurement of $\sin^2 \theta_{12}$ is the world's first measurement performed with reactor antineutrinos [8].

The first joint analysis of the data from the **NOvA** and **T2K** experiments was published [9]. The measurement precision is improved compared to the individual experiment results: the neutrino mass-squared differences are $\Delta m_{32}^2 = 2.43^{+0.04}_{-0.03} \text{ eV}^2$ (normal hierarchy) and $-2.48^{+0.03}_{-0.04} \text{ eV}^2$ (inverted hierarchy), with the constraints on the CP phase $\delta_{\text{CP}} = [-1.38\pi, 0.30\pi]$ (normal hierarchy) and $[-0.92\pi, -0.04\pi]$ (inverted hierarchy). The neutrino mass hierarchy is not uniquely determined; however, if the inverted hierarchy is true, a significant preference for CP violation in the lepton sector follows from the data.



Jiangmen (China). A worker inspects the material of the acrylic sphere of the JUNO central detector

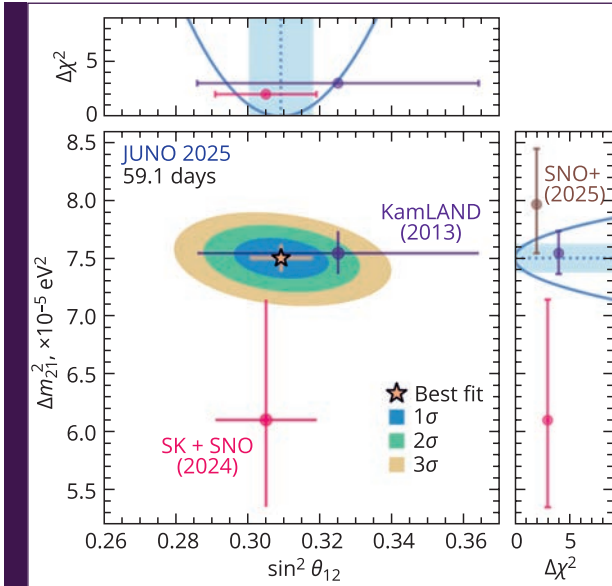


Fig. 3. The result of measuring the neutrino oscillation parameters Δm_{21}^2 and $\sin^2 \theta_{12}$ at JUNO on the basis of the data taken for 59.1 days. Estimates from other measurements in third-party experiments are given for comparison

Updated oscillation analysis results from the NOvA experiment have been prepared for publication [10]: measurements of muon neutrino disappearance and electron neutrino appearance (in the NuMI muon neutrino beam at FNAL) using double the exposure and improved analysis methods (for the antineutrino case as well). The best measurement of the (atmospheric) mass-squared difference is $2.431^{+0.036}_{-0.034}$ eV² (normal hierarchy) and

$-2.479^{+0.036}_{-0.036}$ eV² (inverted hierarchy), with a preference for the maximal mixing $\sin^2 \theta_{23} = 0.55^{+0.06}_{-0.02}$ and a slight preference for the normal mass hierarchy.

The **FASER** experiment has yielded and published new results of studying neutrinos from the Large Hadron Collider (LHC). For the first time, the interaction cross section of muon neutrinos and their flux have been measured as a function of energy and pseudorapidity (Fig. 4) [11]. New limitations have been established on the production of axion-like and other exotic particles that decay into photons, as predicted by the BSM models [12].

Within the **MONUMENT** project, the focus was on the analysis of the 2021 and 2023 data sets. The data for the total rate of the muon capture in ⁷⁶Se and the 2019 offline measurements with ⁸²Kr have been published [13, 14]. The status and results of the project were presented at several international conferences — INPC 2025 (Daejeon, Korea), AYSS-2025 (Dubna), and “Nucleus-2025” (St. Petersburg). Currently, the publications on the total rate of the muon capture in ¹³⁶Ba and the modeling of the background in the MONUMENT experiment are under preparation.

In 2025, after the reduction of the background level of the **LEGEND** experiment, **LEGEND-200** was successfully restarted at the Gran Sasso National Laboratory (Italy) with 60 enriched germanium detectors (~ 140 kg of ⁷⁶Ge). The paper on the results from the first data-taking (2023–2024) has been accepted for publication [15]. By the end of 2026, newly produced detectors will be added to the setup to increase the mass of the investigated isotope to approximately 200 kg.

Within the **Obelix** experiment at the LSM Underground Laboratory (France), the data on the search

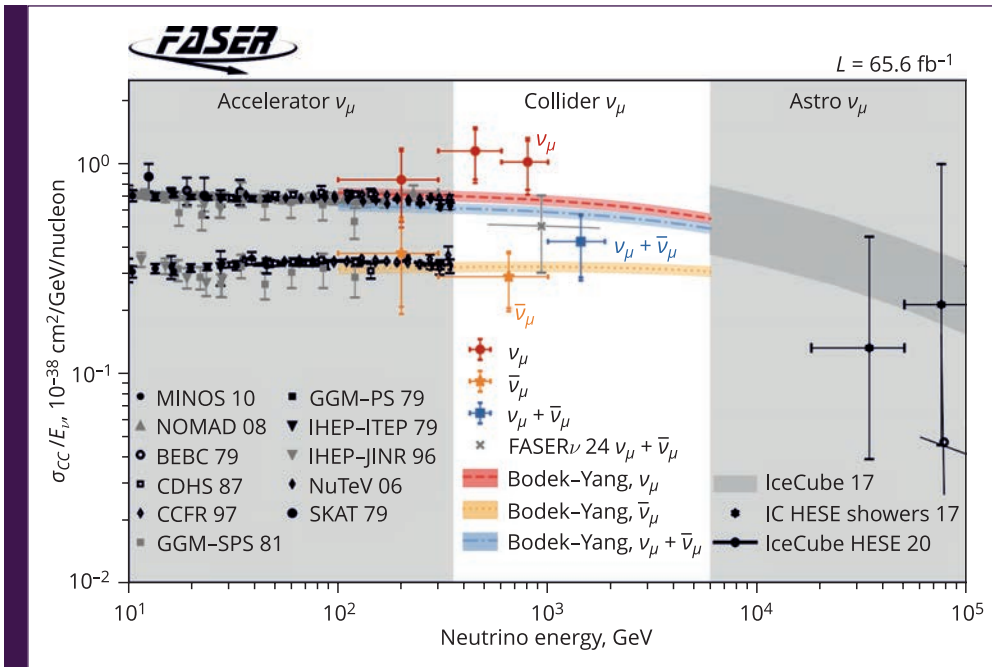


Fig. 4. Data from measurements of the interaction cross sections of muon neutrinos as a function of energy in the FASER experiment

for double beta decay of ^{82}Se to the excited states of ^{82}Kr are being taken. The total measurement time exceeds 29 550 h. For double beta decay of ^{82}Se to the 0^+ first excited state of ^{82}Kr , the evidence of the

effect with a half-life of $\sim 6 \cdot 10^{22}$ yr has been obtained. The description of the experiment and its preliminary results have been published [16].

ELEMENTARY PARTICLE PHYSICS

Within the framework of the ATLAS project, the cross section was measured for the production of the Higgs boson in association with one top quark in the decay channels into a pair of bottom quarks, a pair of W or Z bosons, or a pair of tau leptons [17]. The data demonstrate a slight excess over the Standard Model prediction (Fig. 5). Work is underway to analyze new data, which will significantly increase the measurement sensitivity.

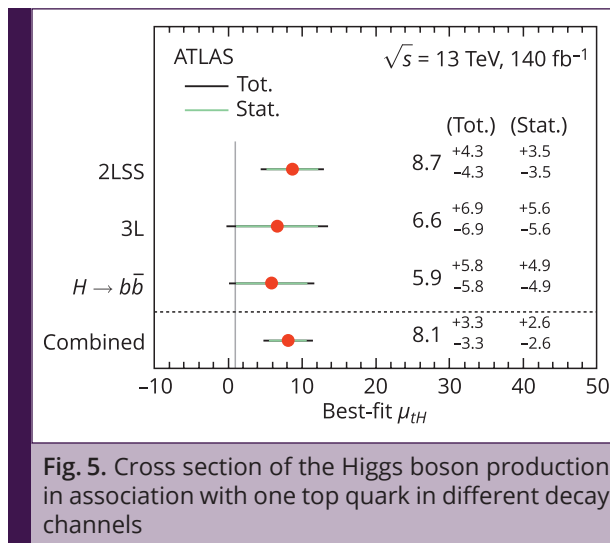
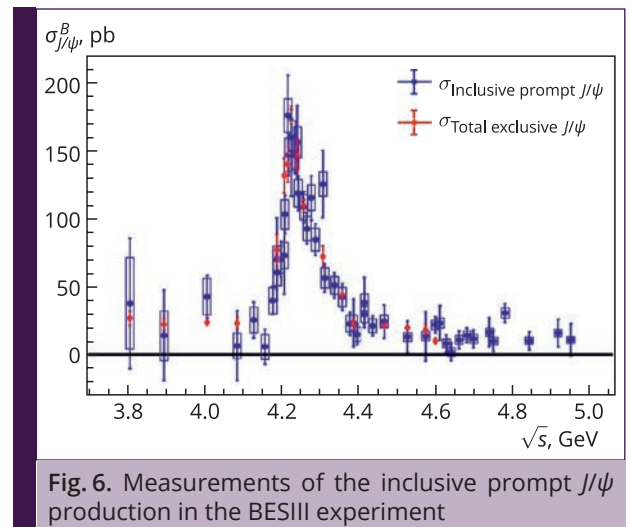


Fig. 5. Cross section of the Higgs boson production in association with one top quark in different decay channels

The JINR BESIII group continued to actively participate in data-taking, analysis, and preparation of publications. The group made a notable contribution to the internal analysis and paper reviews and participated in the work of the BESIII shift committee. The main result is the publication of two papers prepared with the leading contribution of JINR group members. The measurements of the inclusive cross sections for direct production of the charmonium states J/ψ and $\psi(3686)$ in the centre-of-mass energy range up to 5 GeV are presented (Fig. 6). The results obtained for the first time in this energy range together with similar measurements performed by B-factories at an energy of 10.6 GeV will allow rigorous testing of various theoretical models of charmonium production [18].

The first direct measurement of the relative phase between the strong and electromagnetic amplitudes for the J/ψ decay into a vector-pseudoscalar final state was performed. For this measurement, a dataset of 26 energy points for e^+e^- annihilation in the range from 3.00 to 3.12 GeV with a total integrated luminosity of 452 pb^{-1} was used. By investigating the interference behavior of the cross-section shape



for the $e^+e^- \rightarrow \eta\phi$ process, it was found that the relative phase between the strong and electromagnetic amplitudes of the J/ψ decay lies within $[133^\circ, 228^\circ]$ at a 68% CL [19].

A test run was carried out at the AMBER setup for the precision measurement of the proton radius. The JINR group fully fulfilled its shift obligations and also participated in the deployment and operation of the new triggerless data acquisition system. Maintenance was performed on the MW1 muon system, which is under the responsibility of the JINR group. Representatives of the group are also involved in the optimization of signal reconstruction in the Ring Imaging Cherenkov (RICH) detector for the data taken in 2023 for measuring antiproton yields in proton–nucleus collisions. Work continues on the development of Micromegas detector prototypes intended to replace outdated elements of the experimental setup in the future.

Within the COMET project, the development of the CRV system for recording background events from cosmic muons with an efficiency of at least 99.99% continues. This system will allow achieving measurement accuracy up to 10^{-17} in the search for direct muon–electron conversion. In autumn 2025, during a scheduled visit to J-PARC, the first module of the COMET facility manufactured at JINR was prepared for the integration of the CRV and CDC detectors into a single ensemble. Future testing of this tandem with cosmic muons is planned. The JINR staff also assembled, tested, and validated modules 3 and 4 of the straw tracker for the COMET Phase I at J-PARC. In parallel, additional 10-mm-diameter straw tubes are completed and prepared for J-PARC

in Dubna and are planned to be sent together with the scintillators for the CRV.

In addition, a set of scintillation strips and aluminum sheets, required for assembling the upper part of the COMET Veto System, was manufactured at the “Uniplast” enterprise (Vladimir) [20].

The development of experimental equipment for the TAIGA project continues. For the large Cherenkov telescope (10 m), the composite mirror manufacturing technology has been refined, and two prototypes have been installed on the 5-m telescope

for climatic testing. A mechanized mirror mounting platform with remote mirror alignment has been manufactured and installed on the 4-m telescope for testing.

Four telescopes are currently observing gamma-ray sources. After installing the protective blind on each telescope in 2025, the background signal was reduced by 10%. An underground water Cherenkov muon detector was launched to install the prototype TAIGA-100 complex.

APPLIED RESEARCH AND ACCELERATOR PHYSICS

Within the project “Radiochemistry and Spectroscopy for Astrophysics and Nuclear Medicine” with xenon ions of ^{132}Xe being detected at the energies of 45, 82, and 165 MeV, the charge losses (pulse-height defect) have been evaluated with both silicon-carbide (SiC) and silicon (Si) detectors. It was demonstrated that the measured values of the pulse-height defect for both detector types do not depend on the xenon ion energy and were ≈ 40 and $\approx 20\%$, respectively [21].

The technology of manufacturing a compact COFE detector for an excellent localization of anti-neutrino detection was elaborated [22]. The SUPEC 7000 inductively coupled plasma mass spectrometer has been put into operation. Calibration and test analyses were performed, and the first results were obtained. In control samples, the certified detection limits of 10^{-13} g/g for Th and U and 10^{-14} g/g for rare-earth elements were achieved. In the range of $6 \cdot 10^{-10}$ – 10^{-12} g/g, the content of a large number of elements was analyzed to study sorption on ion-exchange resins.

A landmark event took place at the Dzhelapov Laboratory of Nuclear Problems on 13 February 2025 — the ceremonial launch of the Linac-200 linear electron accelerator, the new flagship facility of DLNP JINR. The opening ceremony was carried out by members of the Scientific Council and the Directorate of JINR. In November 2025, pre-commissioning activities on the facility were successfully completed. Electron beams with the design parameters were obtained at all four beam extraction channels, with the maximum energy reaching 205 MeV. In the near future, after completing documents and obtaining the operating license, the accelerator will be put into operation and will become the main home experimental facility of DLNP.

Within the PAS project in collaboration with the Centre for Nuclear Technologies (CNT VINATOM, Vietnam), studies were carried out at the DLNP slow positron source. The positron annihilation spectroscopy (PAS) technique made it possible to identify the mechanism of oxygen vacancy formation and mesopore generation in the ZSM-5 catalyst follow-



Dubna, 13 February. The ceremonial launch of Linac-200 — new flagship facility of DLNP JINR



Dubna, July. A group of physicists and engineers from the Socialist Republic of Vietnam

ing irradiation with a low-energy electron beam. This process significantly enhances the efficiency of the catalyst in polypropylene production. Over 80 samples from Russian scientific institutions (such as TPU and SAFU) and from the JINR Member States (Vietnam, South Africa, Azerbaijan, Belarus) were investigated using the Doppler Broadening of Annihilation Line (DBAL) method on a positron beam. More than 80 samples were studied using the Positron Annihilation Lifetime Spectroscopy (PALS) method with an independent source [23, 24].

Within the project **“Precision Laser Metrology for Accelerators and Detector Complexes”**, a new version of the inclinometer — an interferometric precision laser inclinometer — has been developed. The potential of using tiltmeters to measure earthquake precursors in the low-frequency range is being discussed.

Within the project **“New Semiconductor Detectors for Fundamental and Applied Research”**, four beam test sessions were performed at CERN to study the characteristics of the pixel detector based on the Timepix4 chip in collaboration with the Straw Track-

er group for the SPD NICA project. Data processing is underway. Research into the optimal calibration of Medipix3RX energy-sensitive semiconductor detectors in multithreshold mode continues. Development of $Gd_2O_3@C$ and $Gd_2O_3@SiO_2$ nanoparticles as contrast agents for magnetic resonance imaging is underway with colleagues from Moscow State University [25, 26].

The **TARDISS** project has demonstrated the feasibility of using the tardigrade protein Dsup to protect normal human cells from damage by ionizing radiation during a proton therapy protocol (4 Gy, 150-MeV protons), which is commonly used in the therapy of oncological diseases [27]. A method for isolating human MSC exosomes for exosome mediated delivery of proteins and other therapeutic agents into human cells was developed [28].

A joint **JINR-ASRT** (Egypt) project investigated the presence of pathogenic microorganisms and assessed water quality in Lake Nasser (Egypt). A forecast of the impact of seasonal changes in the studied parameters on the population health was made [29].

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FLEROV LABORATORY of NUCLEAR REACTIONS

DEVELOPMENT AND OPERATION OF THE FLNR ACCELERATOR COMPLEX (DRIBs-III)

In 2025, work was carried out on the development, upgrade, and optimization of the experimental infrastructure of the Flerov Laboratory of Nuclear Reactions as part of the project "Development of the FLNR accelerator complex and experimental setups (DRIBs-III)". The main efforts were focused on increasing the intensity and improving the quality of the beams of stable and radioactive nuclides in the energy range of 5–100 MeV/nucleon. The proposed tasks within the Topical Plan for 2025 were completed.

Operation of the DC-280 Cyclotron and SHE Factory

The DC-280 cyclotron of the Superheavy Element Factory (SHE Factory) provided over 3300 h of beamtime. Long-term experiments on the SHE synthesis and study of their properties were performed at the GRAND and DGFERS-2 setups using high-intensity ^{48}Ca and ^{50}Ti beams (up to 5 μA). As part of the programme to prepare for the synthesis of element 119 using a berkelium (Bk) target, a conceptual design has been completed and a positive conclusion has been received from the FAO Glavgosexpertiza of Russia. The State Atomic Energy Corporation Rosatom issued a permit for the upgrade of the FLNR experimental building.

Upgrade and Operation of the MC-400 (U-400M) and U-400 Accelerator Complexes

The commissioning work at the upgraded MC-400 (U-400M) accelerator complex was completed. A beam of ^{18}O ions with an energy of 48 MeV/nucleon was for the first time produced and transported to the experimental setups. The secondary beams of ^6He , ^8He , ^{12}Be were synthesized, and their parameters were measured.

The U-400 cyclotron provided 6300 h of beamtime in 2025 for implementing the FLNR programme for basic and applied research. Experiments were carried out at the MAVR, CORSET, and SHELS setups

using ions ranging from ^{22}Na and $^{24,26}\text{Mg}$ to $^{52,54}\text{Cr}$ and ^{136}Xe .

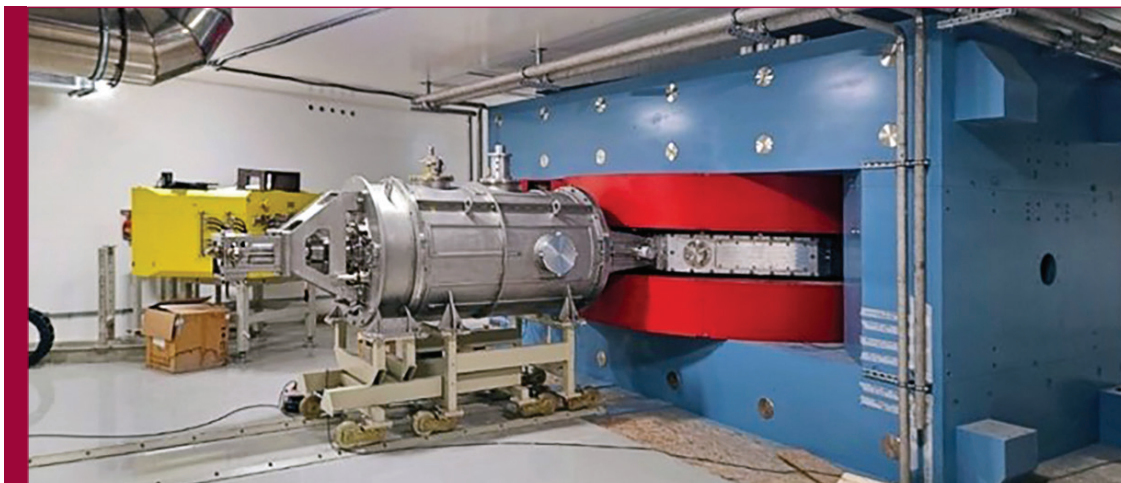
MT-25 Microtron Operation

The electron accelerator, MT-25 microtron, ran for 900 h and was used to irradiate samples for the LRB JINR project carried out in collaboration with a team from Vietnam. The electron components were tested in cooperation with SPE Detector LLC and NIIKP. In a joint effort with DLNP and TSU, work was undertaken for developing techniques for measuring the parameters of an electron beam. Additionally, Cherenkov diffraction radiation was studied in partnership with the FLAP collaboration with the aim of developing beam diagnostic systems.

Development of the FLNR Infrastructure

DC-140 Accelerator Complex. The construction of the new DC-140 accelerator complex for applied research is approaching the last phase (80% of equipment has been installed). The bulk of construction and finishing work was completed. Furthermore, the building was connected to the power grid. A working vacuum of $1 \cdot 10^{-5}$ Torr was attained in the cyclotron chamber. In addition, the ECR ion source (DECRI5-5M) and the axial injection channel were installed. The assembly of two beam transport channels and irradiation stations was completed. The commissioning of the systems is underway. They are connected to the central control system and gradually put into operation.

Construction of the U-400 Experimental Hall. The construction of a new experimental hall for the U-400 cyclotron is underway. In 2025, the monolithic and roof construction was completed, and the building was connected to engineering systems. Work on the building facade is approaching completion. The lifting equipment was placed in the experimental halls. The partition walls are currently built, finishing work and the assembly of engineering systems are underway.



A specialized DC-140 cyclotron designed for radiation materials science, development of track-etched membrane technologies, and electronics testing



December. A new FLNR experimental hall

Complex for Measuring the Masses of Super-heavy Nuclei. As part of the project on the SHE Factory infrastructure development, an experimental complex is currently under development for the precise measurement of the masses of nuclei. The facility comprises a cryogenic gas ion catcher and a multiple-reflection time-of-flight mass spectrometer. In 2025, the efforts were focused on upgrading the ion catcher in the following directions.

Extraction Experimental Studies. A series of tests was conducted using an internal open-type ^{223}Ra α source emitting α -active daughter nuclei, thereby enabling the measurement of the extraction time by registering the ^{219}Rn decay at the RF transport system exit. Experimental data are currently processed.

Mathematical Modeling of Processes in a Gas Cell. Aimed at simulating the efficiency and the time of extraction from the cryogenic gas ion cell, studies were completed with the products synthe-

sized in the $^{40}\text{Ar} + ^{144}\text{Sm}$, $^{40}\text{Ar} + ^{166}\text{Er}$, $^{48}\text{Ca} + ^{197}\text{Au}$, $^{48}\text{Ca} + ^{208}\text{Pb}$, $^{48}\text{Ca} + ^{209}\text{Bi}$, and $^{48}\text{Ca} + ^{242}\text{Pu}$ complete fusion reactions. Software programs based on the SRIM2013, GEANT4, ROOT, SIMION, and COMSOL packages were developed with a view to defining the optimal conditions for stopping reaction products in the gas cell.

Work has proceeded on designing the multireflection time-of-flight mass spectrometer in collaboration with a team from the Institute for Analytical Instrumentation of RAS (Saint Petersburg). Technical and commercial documentation was prepared for the manufacture of the time-of-flight mass analyzer. A contract for the manufacture is expected to be signed in early 2026.

Quite as successful was the production of a mock-up of an electron-impact ion source based on fullerenes whose final adjustment and testing are underway. Work on the fabrication of the unique

high-precise DC power supply and quadrupole switches is proceeding in joint efforts with the Institute for Analytical Instrumentation. These systems

are required to ensure stable beam transport parameters. The work is expected to be completed by mid-2026.

SYNTHESIS AND PROPERTIES OF SUPERHEAVY ELEMENTS

In 2025, considerable time and effort were focused on preparing for experiments on the synthesis of elements 119 and 120 of the Mendeleev's Periodic Table. Choosing an optimal nuclear reaction is viewed as an important step toward synthesis of a new superheavy element. Two reactions have been considered for synthesis of element 119: $^{249}\text{Bk} + ^{50}\text{Ti} \rightarrow ^{295,296}119$ and $^{243}\text{Am} + ^{54}\text{Cr} \rightarrow ^{293,294}119$.

In previous experiments on the $^{238}\text{U} + ^{54}\text{Cr}$ and $^{242}\text{Pu} + ^{50}\text{Ti}$ reactions, leading to the same compound nucleus ^{292}Lv , the cross section of the reactions with lighter ^{50}Ti projectiles was established to be an order of magnitude higher than that for the reactions with ^{54}Cr [1]. The reaction cross section was experimentally observed to strongly depend on the ion energy. A deviation from the maximum of the excitation function can significantly reduce the cross section that is already low anyway. A decrease in the excitation energy E^* of the compound nucleus ^{292}Lv by 5 MeV (from 41 to 36 MeV) led to a tenfold decrease in the reaction cross section (from 540 to 54 fb) (Fig. 1).

The research findings showed that the optimal energy of the ^{50}Ti beam has to correspond to the excitation energy of the compound nuclei of elements 119 and 120 at around 40 MeV.

In choosing a reaction for synthesizing the elements, the availability of target material is of decisive importance. The ^{249}Bk isotope can be produced only in two research centres in an amount of merely

several tens of milligrams — at Oak Ridge (USA) and Dimitrovgrad (Russia) — whereas the ^{243}Am isotope is by far more accessible, which makes reactions with this target material a more attractive synthesis pathway.

The reliable identification of the new nuclei $^{293,294}119$ and $^{295,296}119$ by genetic correlations strongly requires a detailed knowledge of the radioactive properties of daughter nuclei. To this end, an experiment was carried out on the synthesis of the isotopes of nihonium $^{281,282}\text{Nh}$ in the $^{237}\text{Np}(^{48}\text{Ca},$

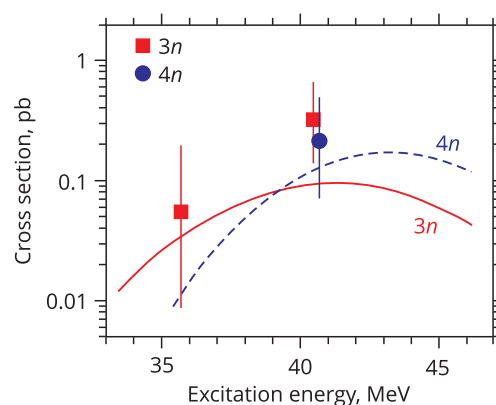


Fig. 1. Cross sections for the $^{242}\text{Pu}(^{50}\text{Ti}, 3-4n)^{288,289}\text{Lv}$ reactions. The lines show calculations of V. Zagrebayev and V. Greiner, 2007



Dubna, 7-11 July. Participants of the 14th International Scientific School for Physics Teachers

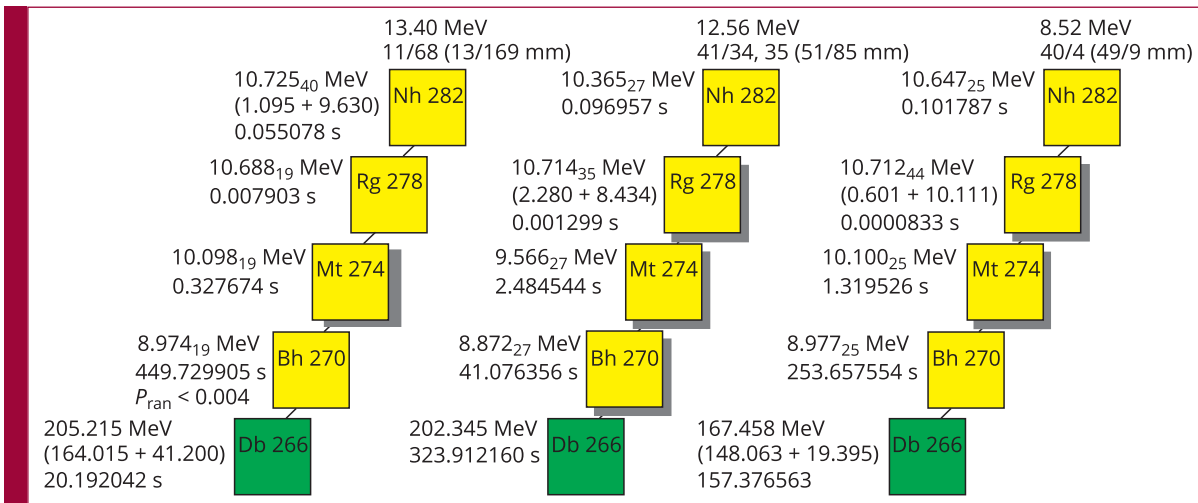


Fig. 2. The properties of nuclei in the decay chains of ^{282}Nh produced in the $^{237}\text{Np}(^{48}\text{Ca}, 3n)$ reaction

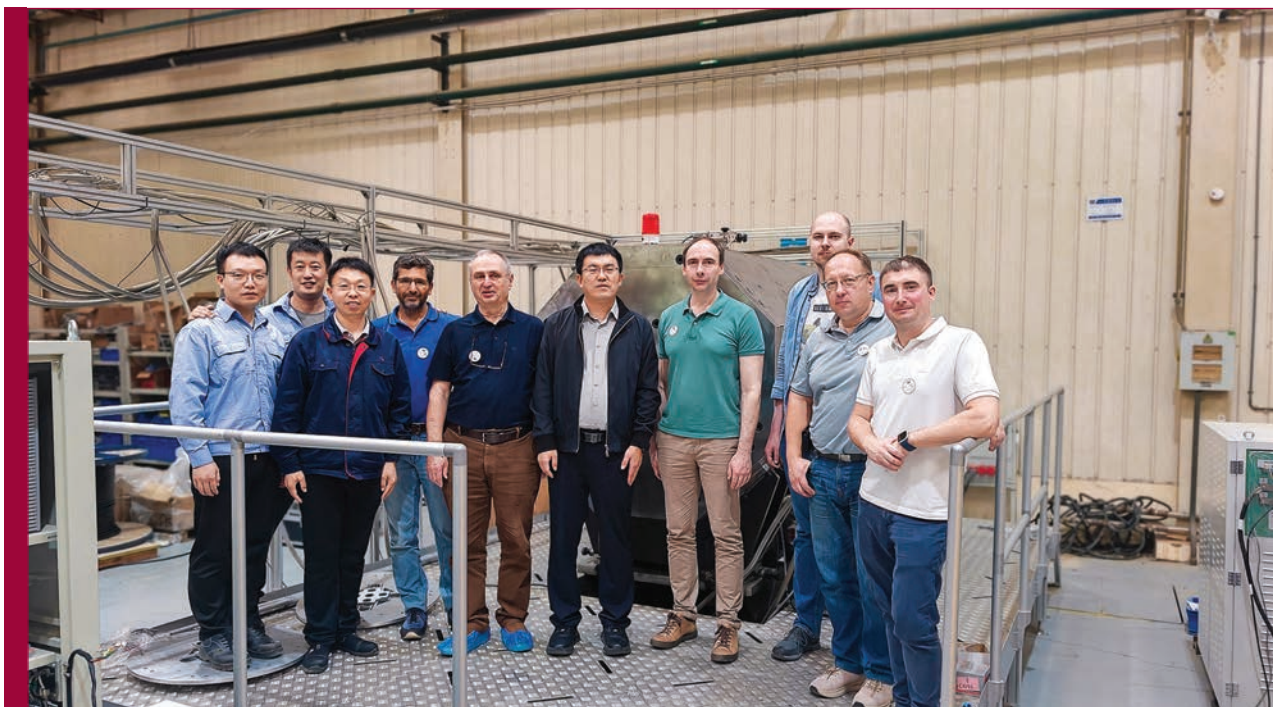
3-4n) reaction at DGFRS-2, which was primarily aimed at studying the properties of these nuclei, the daughters in one of the observed decay chains of element 119. Three decay chains assigned to ^{282}Nh were registered in the experiment (Fig. 2). The results are being thoroughly analyzed and they are presented in [1-4].

In parallel with experiments, major technological preparations have been well advanced. High-purity organometallic compounds of ^{50}Ti and ^{54}Cr were synthesized to produce ion beams with the ECR-source of the DC-280 cyclotron by the MIVOC method. Additionally, the radioactive targets of ^{242}Pu and ^{237}Np were fabricated for the implementation of the FLNR research programme. It is noteworthy that the manufacture of a ^{249}Bk target is planned for 2026 in collaboration with a team from RIAR (Dimitrovgrad).

Spectroscopy of Heavy and Superheavy Nuclei

Aimed at studying the decay properties of short-lived nuclei with $Z \geq 104$, experiments were carried out at the SHELS and GRAND separators using the GABRIELA and SFINX detecting systems.

SHELS Separator and U-400 Accelerator. The evaporation channels of the $^{26}\text{Mg} + ^{238}\text{U}$ complete fusion reaction and the properties of spontaneous fission of the $^{260,258}\text{Rf}$ isotopes were investigated. Experimental data were obtained for the first time on the yields of prompt neutrons following spontaneous fission of these nuclei. In addition, nuclei from the transuranic region, presumably ^{239}Pu and ^{243}Am , were synthesized in studying multinucleon transfer processes observed in the interaction of



Xian (China), September. Participants of tests of a superconducting magnet manufactured by XSMT

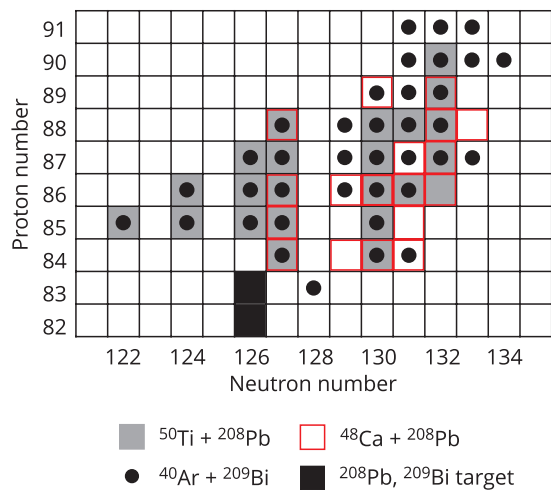


Fig. 3. The nuclear chart showing a region of nuclides synthesized at the SHELS separator in the multinucleon transfer reactions [6]

^{26}Mg ions and the ^{238}U target. The neutron multiplicities for their isomeric fission were measured for the first time [5].

In November 2025, the cross section was measured for producing ^{258}Sg in the $^{52}\text{Cr} + ^{207}\text{Pb}$ complete fusion reaction. Experimental data are processed.

Further studies of multinucleon transfer continued with heavy ions and the targets of ^{208}Pb and ^{209}Bi at the SHELS separator (Fig. 3). The experimental results were summarized and published in a review article [6].

GRAND Separator (DGFRS-3) and SHE Factory.

An experiment aimed at studying the decay properties of flerovium isotopes and its daughter products was performed at the GRAND separator. A target of ^{242}Pu 480 mm in diameter was irradiated with ^{48}Ca ions with a record intensity of $5\ \mu\text{A}$ ($3.1 \cdot 10^{13}$ ions/s). A number of technical challenges encountered during the experiment did not allow the team to reach the expected decay statistics. The upgrade of the key elements of the GRAND separator enabled a series of test experiments with the ^{48}Ca beam and the ^{242}Pu and $^{206,208}\text{Pb}$ targets in December 2025, which indicated that the facility is ready for further studies of the properties of superheavy elements at the SHE Factory.

Chemistry of Transactinides

In 2025, studies were carried out through international collaboration, first of all, between FLNR and the Institute of Modern Physics (IMP, China), as well as with a team from the Paul Scherrer Institute (PSI, Switzerland).

Study of the Properties of Copernicium (Cn) and Flerovium (Fl). An experiment was carried out at the Cryodetector setup of the SHE Factory aimed at studying the volatility of copernicium (Cn) and

flerovium (Fl) and their adsorption on a gold surface with a temperature gradient to $-170\ ^\circ\text{C}$. Eight decay chains stemming from ^{283}Cn and ^{287}Fl were registered. The observation of two deposition zones for flerovium, one at room temperature and another at around $-100\ ^\circ\text{C}$, was a notable result. These data agree with the results of previous experiments obtained in the TASCA (GSI) – COLD (FLNR) collaboration. The adsorption of Fl atoms on a gold surface in the cryogenic region shows that relativistic effects have a substantial impact on the chemical behavior of Fl. The second adsorption zone at room temperature is still disputable owing to low statistical significance. Experimental data are currently processed and theoretically analyzed using quantum chemical and molecular dynamics methods.

Chemical Identification of Nihonium (Nh) and Moscovium (Mc). Carried out together with the FLNR JINR team at the HIRFL facility in China, an analysis of the results from the first experiment on investigating the chemistry of Nh (Nh, $Z = 113$) was completed. New facilities were used, namely, the LEGEND radiochemical setup [7, 8], the SHANS2 separator, and the CAFE2 heavy-ion linear accelerator. In a 15-day run, ^{284}Nh ($T_{1/2} = 0.77\ \text{s}$) and a mother nuclide ^{288}Mc ($T_{1/2} = 0.29\ \text{s}$) were chemically identified in the $^{243}\text{Am}(^{48}\text{Ca}, 3n)^{288}\text{Mc}$ reaction. In the course of a thermochromatography study, deposition of moscovium was observed at the entrance of the detection channel, which corroborates the findings of pioneering research at FLNR.

Dynamics of Heavy-Ion Interaction, Fission of Heavy and Superheavy Nuclei. In 2025, efforts have been pursued to study heavy-ion interaction in cold fusion reactions. The capture cross sections in the $^{40,42,44,48}\text{Ca} + ^{208}\text{Pb}$ reactions were measured at energies both above and substantially below the Coulomb barrier. As to ^{40}Ca ions, the capture cross section in the sub-barrier energy region was found to be significantly higher than for the reactions with heavier calcium isotopes, i.e., several hundred microbarns at an energy of 10 MeV below the barrier in contrast to merely tens of microbarns in the $^{42,44,48}\text{Ca} + ^{208}\text{Pb}$ reactions. The experiments were carried out at the U-400 accelerator (FLNR) using the double-arm time-of-flight CORSET spectrometer.

A detailed analysis was performed of the mass and energy distributions of fragments formed in the reactions under investigation. To more precisely determine the variances of mass and energy distributions of fission fragments of the excited nobelium compound nucleus, varying with temperature and angular momentum, the mass and energy distributions of the fission fragments of ^{256}No produced in the $^{24}\text{Mg} + ^{232}\text{Th}$ reaction were measured. A comparative study of fragments formed in the $^{40,42,44,48}\text{Ca} + ^{208}\text{Pb}$ and $^{24}\text{Mg} + ^{232}\text{Th}$ reactions, as well as those from spontaneous fission of the nobelium isotopes described in the work *Hulet E. K.* (Yad. Fiz. 1994. V. 57. P. 1165–1173), showed that the properties of fission-like fragments formed in

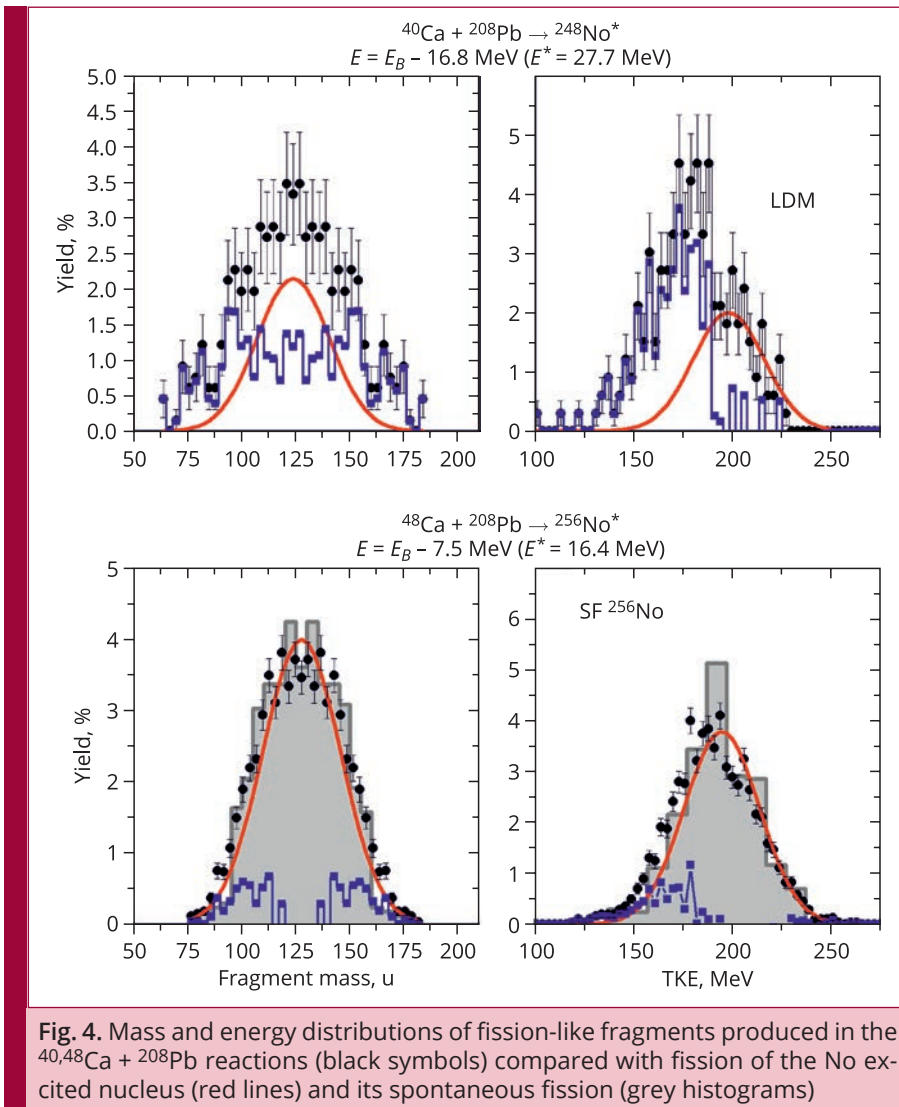


Fig. 4. Mass and energy distributions of fission-like fragments produced in the $^{40,48}\text{Ca} + ^{208}\text{Pb}$ reactions (black symbols) compared with fission of the No excited nucleus (red lines) and its spontaneous fission (grey histograms)

the $^{40,42,44}\text{Ca} + ^{208}\text{Pb}$ reactions at energies below the Coulomb barrier differed greatly from those of the nobelium compound nucleus fission fragments, and yet agreed well with the properties of fission fragments formed in the $^{48}\text{Ca} + ^{208}\text{Pb}$ reaction (Fig. 4).

Reaching approximately 50% for all the measured calcium isotopes at energies above the Coulomb barrier, the fusion probability was found to decrease rapidly with decreasing interaction energy in the $^{40,42,44}\text{Ca} + ^{208}\text{Pb}$ reactions at energies below the barrier. The fusion probability was nevertheless close to 100% for the reaction with the doubly magic ^{48}Ca projectile.

To study in more detail the impact of the structure of nuclei in the region of ^{48}Ca in cold fusion reactions on the capture of interacting nuclei and further evolution of a formed di-nuclear system, the capture cross sections and mass and energy distributions of fragments formed in the $^{48,50}\text{Ti} + ^{208}\text{Pb}$ and $^{52,54}\text{Cr} + ^{208}\text{Pb}$ reactions were measured over a wide energy range above and below the Coulomb barrier. The obtained experimental data are currently processed.

Moreover, in 2025, the results on the experimental study of the $^{209}\text{Bi} + ^{238}\text{U}$ multinucleon transfer reaction were processed and analyzed. In the course of the studies on the properties of the reaction products, fragments up to $Z \approx 111$ (Rg region) with fairly high excitation energies (about 150–200 MeV) were found [9].

Structure of Exotic Nuclei

In 2025, the data analysis was completed on the tetraneutron (4n) system studies performed at the ACCULINNA-2 fragment separator. The population of a low-energy continuum of the 4n system was studied in the $^2\text{H}(^8\text{He}, ^6\text{Li})^4n$ and $^2\text{H}(^8\text{He}, ^3\text{He})^7\text{H} \rightarrow ^3\text{H} + ^4n$ reactions, involving a ^8He beam with an energy of 26 MeV/nucleon and a deuterium target. Figure 5 shows the events forming a low-lying resonance-like peak at $E_r(^4n) \approx (3.5 \pm 0.7)$ MeV and (3.2 ± 0.8) MeV, respectively [10]. The theoretical description of the obtained data was presented within the ^8He five-body hyperspherical harmonics model and under an assumption about the extreme peripheral character of the reaction mechanisms

(neutrons are at a large distance from the α core, i.e., at the periphery of the ${}^8\text{He}$ nucleus). A conclusion could be drawn that the main contribution to the hump at $E_T(4n)$ was ascribed to the states with a hypermomentum $K = 2$, which are forbidden within the shell model.

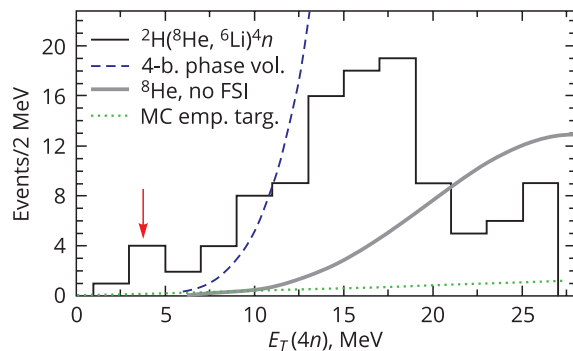


Fig. 5. The $4n$ missing-mass spectrum for the ${}^2\text{H}({}^8\text{He}, {}^6\text{Li})4n$ reaction. A peak at ~ 3.5 MeV is shown by a red arrow. A green dotted curve depicts a simulated empty-target spectrum. A blue dashed curve corresponds to the four-body phase volume, and a thick grey line shows the Fourier transform of the ${}^8\text{He}$ source

This points to the limited applicability of the shell model in describing exotic nuclear systems far from the stability line.

The differential cross sections of one-nucleon transfer products ${}^6\text{He}_{g,s}$, ${}^6\text{Li}_{g,s}$, ${}^6\text{Li}_{3,56}$ and the elastic scattering of ${}^7\text{Li}_{g,s}$ emitted in the ${}^7\text{Li} + {}^{10}\text{B}$ collision were measured for the first time in a single experiment under the same experimental conditions. The measurements were performed using a 58-MeV ${}^7\text{Li}$ beam from the FLNR U-400 cyclotron and the MAVR reaction chamber (Fig. 6).

The ${}^6\text{Li}_{3,56}$ nucleus is an isobaric analogue of ${}^6\text{He}_{g,s}$ exhibiting a two-neutron halo with an increased rms radius. The analysis of the differential cross sections for ${}^6\text{Li}_{3,56}$ using the coupled-channel [11] and the double-folding models [12] confirmed that the ${}^6\text{Li}_{3,56}$ state has a spatially extended halo-like structure formed by the neutron and proton outside the α particle.

Further, the differential cross sections of elastic and inelastic scattering, as well as transfer channels, were measured in the ${}^6\text{Li} + {}^{12}\text{C}$ reaction at $E = 68$ MeV with a view to analyzing the cluster structure of ${}^6\text{Li}$ (Fig. 7).

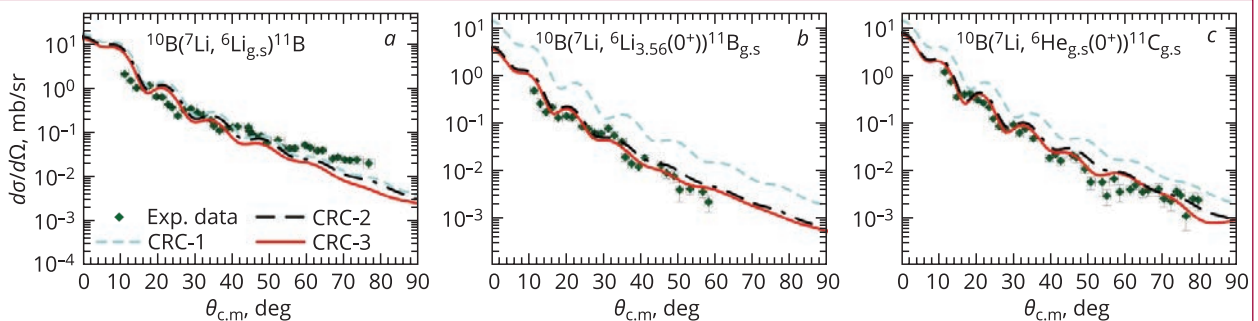


Fig. 6. Differential cross sections of one-nucleon transfer products (${}^6\text{He}_{g,s}$, ${}^6\text{Li}_{g,s}$, ${}^6\text{Li}_{3,56}$) and the elastic scattering of ${}^7\text{Li}_{g,s}$ emitted in the ${}^7\text{Li} + {}^{10}\text{B}$ collision. The experimental differential cross sections of the indicated reaction channels are depicted with the dots. The curves show calculations performed within the coupled-reaction channel model

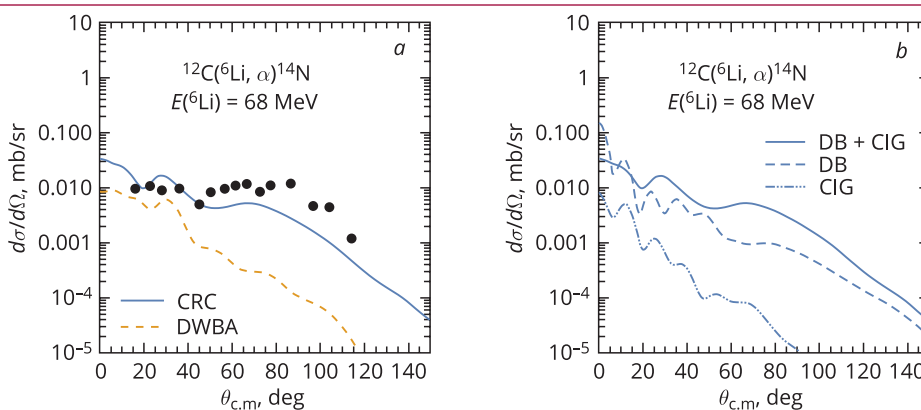
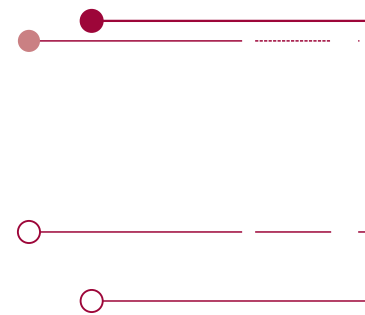


Fig. 7. Comparison of the experimental differential cross sections of the ${}^{12}\text{C}({}^6\text{Li}, \alpha){}^{14}\text{N}$ reaction with the calculations using the reaction models: *a*) cross sections calculated within the CRC (solid line) and DWBA (dashed line) approaches; *b*) contributions from two structural configurations of ${}^6\text{Li}$: the DB (dumb-bell) configuration (dashed line) and the CIG (cigar-like) configuration (dash-dotted line), as well as the sum DB + CIG (solid line)



Another significant achievement was the quantitative estimate of the contribution of the three-body ${}^6\text{Li}$ configurations. Overall, the results demonstrated that the three-body wave function and the coupled-reaction channels provide a more precise the-

oretical description of the experimental data. The results point to the dominance of the DB configuration ($\alpha + np$) in the ${}^6\text{Li}$ nucleus, which is consistent with the current notions about the ${}^6\text{Li}$ cluster structure [13].

RADIATION MATERIALS SCIENCE, NANOTECHNOLOGICAL AND BIOMEDICAL INVESTIGATIONS WITH HEAVY-ION BEAMS

The structure of swift heavy-ion tracks in the isolated TiO_2 and CeO_2 nanoparticles was studied using the Transmission Electron Microscopy (TEM) methods. The threshold levels of electronic stopping powers for track formation and track radii were determined.

TEM studies of structural changes in the $\text{FeCr}_{16}\text{Ni}_{15}$ and $\text{FeCr}_{18}\text{Ni}_{40}$ alloys and nanohardness measurements revealed some specific features of damage induced by cold helium irradiation. Helium ions were found to cause structural changes in materials (dislocation loops and cavities), leading to hardening and swelling, just as neutrons do in reactors. The effects of helium irradiation are nevertheless considerably stronger as compared with those generated by neutrons: dislocation density is higher at displacement damage doses an order of magnitude lower. Importantly, irradiation-induced hardening and dislocation density are independent of the damage rate.

Post-irradiation examination performed on a multicomponent CoCrFeNi alloy and its oxide dispersion strengthened (ODS) analogue revealed compelling evidence for significant structural changes in the samples irradiated with xenon ions at 150 and 475 MeV and bismuth ions with an energy of 670 MeV. Experiment established stacking fault tetrahedra in the crystalline matrix with an average size of several dozen nanometres, naturally diminishing along the ion range. Latent tracks were observed in the ODS alloy containing yttrium nanoparticles. Mechanical property tests showed that both types of materials suffered from moderate irradiation hardening followed by saturation, nanohardness being stable along the entire length of the ion path.

The molecular dynamics analysis showed that swift heavy ions penetrating CeO_2 induced the formation of discontinuous crystalline tracks 2 nm in diameter surrounded by point defects. Specific radiation-induced changes in the surface topography were detected: the formation of spherical crystalline hillocks and conically shaped tracks in the sub-surface layer up to several tens of nanometres deep. Additionally, well-pronounced erosion processes were observed following irradiation of nanoparticles. In particular, initially faceted nanoclusters were transformed into spherical owing to complete melting and subsequent ion-beam-induced recrystallization [14, 15].

Another important accomplishment was the fabrication of hybrid membranes comprising a hydrophilic microporous substrate and a hydrophobic nanofibrous polymer layer deposited by electrospinning. Track-etched polyethylene terephthalate membranes were used as the hydrophilic microporous substrate whose surfaces were coated with a thin layer of titanium deposited by magnetron sputtering. The hydrophobic nanofibrous layer was made of polyvinylidene fluoride. The developed membranes have a water contact angle of around 140° and provide high separation selectivity in desalinating solutions by membrane distillation [16].

Furthermore, a comparative analysis was performed of various components of mesenchymal stem cell (MSC) conditioned media (CM) obtained using serum-containing and serum-free culture methods. Fractionation by micro- and ultrafiltration (0.2 microns, 50 kDa) allows isolation of a fraction enriched with exosomes and proteins, while preserving functionally significant components of the MSC secretome.

Core-shell nanoparticles were synthesized: silver and gold were used as a core, and a shell was made of β -cyclodextrin. The nanoparticles were studied in experiments with breast cancer cell lines and proved to be excellent radiosensitizers: a statistically significant therapeutic effect was achieved at concentrations lower by a factor of 20 as compared to those used in existing techniques. Therefore, composite nanoparticles are extremely promising in enhancing the efficacy of radiotherapy treatment while simultaneously reducing the drug dose and minimizing adverse effects [17].

Different approaches were considered to developing SERS-active PET track-etched membranes as high-sensitive sensors. The stability of the coating properties and the potential of using the produced substrates were evaluated by using an aptasensor for the detection of the influenza A virus. Track-etched membranes with a branched surface and covered with plasmonic metal nanoparticles by magnetron sputtering exhibited stability of the SERS-active surface in biological fluids, which has high reproducibility of the intensities of SERS spectra in biological fluids [18]. The produced substrates thus open up new avenues for fabricating aptamer-based SERS biosensors that are highly selective to a number of viruses.

A random DNA oligonucleotide library was synthesized. Selected were DNA aptamers binding to the recombinant p54 protein of the African swine fever virus (ASFV). Nanopore sequencing was performed for defining the aptamer sequence. The obtained data were processed by the bioinformatics methods, and consensus sequences with affinity for protein p54 were found. Moreover, the affinity of the synthesized aptamers for the inactivated ASFV was studied and those with a specific binding to the strains Stavropol and KK262 (vaccine strain) were selected.

Quite as important was the study of the effect of DNA aptamers with affinity for the epidermal

growth factor receptor (EGFR) on the DNA damage. With regard to ASFV-infected cells, DNA aptamers reduce the DNA damage. The dimeric aptamer with affinity for EGFR was shown to have an antiviral effect, thereby reducing the virus titre to 50–70%. An analytical device based on organic electrolytic-gated field-effect transistors (an EGOFET type) and an aptasensor was designed for the efficient influenza A detection. The aptasensor is based on a track-etched membrane modified with thin gold films and an aptamer forming a bio-recognition layer selective to the virus [19].

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FRANK LABORATORY of NEUTRON PHYSICS

In 2025, the scientific programme of the Frank Laboratory of Neutron Physics (FLNP) was aimed at obtaining new results within the Topical Plan for JINR Research and International Cooperation: in condensed matter physics (“Pulsed neutron source and complex of spectrometers”, 04-4-1149-2024/2028, leader — E. Lychagin; “Investigations of functional materials and nanosystems using neutron scattering”, 04-4-1149-2-2021/2028, leaders — D. Kozlenko, V. Aksenov, and A. Balagurov; “Optical methods in condensed matter studies”, 04-4-1147-2024, leaders — G. Arzumanyan and N. Kučerka); in neutron nuclear physics (“Neutron nuclear physics”, 03-4-1146-2024, leaders — Yu. Kopatch, P. Sedyshev, and

V. Shvetsov); in the development of the IBR-2 spectrometers and computation complex (“Scientific and methodological research and developments for condensed matter investigations with IBR-2 neutron beams”, 04-4-1149-3-2021/2028, leaders — V. Bodnarchuk and V. Prikhodko); in the development of the IBR-2 nuclear facility (“Development of the IBR-2 nuclear facility with a complex of cryogenic moderators”, 04-4-1149-1-2011/2028, leaders — A. Vinogradov and A. Dolgikh); in the development of the design of the new neutron source (“New advanced neutron source at JINR”, 04-4-1149-4-2021/2028, leaders — E. Lychagin, V. Shvetsov, and M. Bulavin).

NEUTRON INVESTIGATIONS OF CONDENSED MATTER

The main objectives of investigations within the project were to study the relationship between the structural features and dynamics of new functional materials and nanosystems and their physical properties at the microscopic level, which are important

for the development of modern concepts in the field of condensed matter physics, materials science, chemistry, biophysics, geophysics, and the development of advanced technologies in the field of electronics, compact current sources, pharmacology,



11 February. A visit of the delegation of the Vietnam Atomic Energy Institute (VINATOM)

medicine, neutron scattering techniques, and complementary methods. Within the framework of investigations under the project, the FLNP employees maintained broad cooperation with many scientific organizations. In Russia, collaboration was particularly intensive with the thematically close organizations, such as NRC KI, PNPI NRC KI, MSU, MIPT, KFU, IPM UB RAS, and others; abroad, with INP (Kazakhstan), CSNS (China), ANSL (Armenia), and others.

Investigations of Oxide, Intermetallic and Nanostructured Materials

A study was conducted on the effect of changes in thermodynamic parameters on the crystal and magnetic structures of quasi-two-dimensional van der Waals magnetic materials of the CrX_3 ($X = \text{Cl}, \text{Br}$) family. The experiments were carried out using X-ray diffraction and Raman spectroscopy in the pressure range up to 38 GPa and at room temperature, as well as neutron diffraction in the pressure range up to 2 GPa and at temperatures of 7–300 K (DISK diffractometer, IR-8 reactor, NRC KI, Moscow). In the compound CrCl_3 , at atmospheric pressure and decreasing temperature, a structural phase transition from the monoclinic phase with $C2/m$ symmetry to the rhombohedral phase with $R\bar{3}$ symmetry occurs at 200 K. Below the Néel temperature of approximately 17 K, the emergence of an A-type antiferromagnetic ordering is observed. At pressures above 1 GPa, the structural phase transition from the monoclinic to the rhombohedral phase occurs at room temperature. At the same time, the nature of the magnetic ordering changes to ferromagnetic, and the Curie temperature at 1 GPa is 19 K [1]. It was established that microscopic mechanisms of change in the magnetic state are associated with the competition of AFM and FM superexchange interactions between van der Waals atomic layers in the crystal lattice and the strengthening of FM interactions under the influence of high pressures.

In the CrBr_3 compound, when exposed to high pressures of $P_{\text{Cr}} \sim 15$ GPa, experiments using X-ray diffraction and Raman spectroscopy revealed a structural crossover from a layered quasi-two-dimensional rhombohedral structure with weakly interacting van der Waals atomic layers into a three-dimensional system of the same symmetry with strongly interacting layers [2]. The crossover is accompanied by strong changes in the pressure coefficients of the lattice parameters and interatomic bonds. The interlayer spacing changes by 20% at $P < P_{\text{Cr}}$ and varies slightly within 5% at higher pressures. At the same time, it becomes smaller than the characteristic size of the van der Waals atomic layer. To analyze the structural and electronic properties of CrBr_3 , DFT calculations were performed in the pressure range up to 60 GPa. It was found that the binding energy between the van der Waals layers in this pressure range increases in absolute value by almost two orders of magnitude. Also, analysis of the behaviour of the density of electron states revealed



25 June. V. Aksenov and E. Shabalin at the opening ceremony of the Ananyev Square

the presence of a dielectric–metal transition, which is consistent with the results of other experimental studies of transport properties under pressure.

Studies of Fe–Ga alloys with the effect of giant magnetostriction continued. A series of $\text{Fe}_{74}(\text{Al}, \text{Ga})_{26}$ -based samples doped with ~ 0.5 at.% carbon and ~ 0.5 at.% boron were studied using neutron and X-ray diffraction, electron microscopy, and internal friction [3]. In the neutron diffraction patterns of the Fe–26Ga–0.5C (1C), Fe–20Ga–6Al–0.5C (2C) and Fe–26Al–0.5C (3C) samples, in addition to the contribution of the main phase $D0_3$, there are also diffraction peaks indicating the formation of a carbide phase with $E2_1$ with a perovskite structure. For the first time, its crystallographic characteristics were precisely determined for Ga-containing compounds. Analysis of the profiles of the main peaks of the $E2_1$ phase shows that they consist of two closely spaced components with different I_{111} / I_{200} ratios, the splitting of which is small (approximately $5 \cdot 10^{-4}$ in the relative value) and is at the sensitivity limit of the used HRFD diffractometer. It therefore follows that the $E2_1$ phase in all three carbon samples consists of two types of clusters ($E2_1\text{-I}$ and $E2_1\text{-II}$) with different unit cell parameters.

Investigations of Magnetic Fluids and Nanoparticles

The studies of the effect of isoscattering points (isopoints) in small-angle neutron scattering by ferrofluids were continued. A general approach based on scattering basic functions in contrast-variation experiments was considered to explain the observation of isopoints in the form factors of inhomogeneous spherical particles of the core-shell type [4]. The criteria for observing true isopoints were expanded by considering experimental isopoints as caustic nodes of the concentration of scattering curves. This approach allows for a universal tracking of the influence of various factors on isopoints, such as experimental resolution, residual background, particle polydispersity, etc. Possible types of isopoints and the effects associated with them were considered, including shift, “smearing” and disappearance of isopoints. All this allows for the prediction of practical intervals of contrast and momentum transfer, in which one can expect to observe isopoints and analyze the degree of their “smearing”.

Investigation of Layered Nanostructures

A study was conducted on the electromagnetic proximity effect in $\text{Al}_2\text{O}_3/\text{Nb}(1000 \text{ \AA})/\text{Gd}(30, 60, 120 \text{ \AA})/\text{V}(700 \text{ \AA})/\text{Nb}(150 \text{ \AA})$, nanostructures consisting of superconducting layers of niobium and

vanadium with critical temperatures of ~ 8.5 and ~ 4.5 K, respectively, and a layer of ferromagnetic gadolinium between them. Samples were obtained by magnetron sputtering with different gadolinium layer thicknesses (30, 60, 120 \AA) to determine the dependence of the effect on the thickness of the ferromagnetic layer. Polarized neutron reflectometry measurements were carried out on the REMUR reflectometer at FLNP at different values of external magnetic field and temperature in order to determine the structural and magnetic profile for different states of superconductors.

Investigation of Biological Nanosystems, Lipid Membranes and Lipid Complexes

Small-angle neutron scattering data were analyzed for the phospholipid transport nanosystem (PhTNS) produced by the Orekhovich Institute of Biomedical Chemistry (Russia), as well as for the PhTNS-based medical drugs Arbidol-NF and Indomethacin-NF [5]. Experimental data were obtained using the YS-SANS small-angle neutron scattering spectrometer at the Budapest Research Reactor in Hungary. Measurements were carried out with samples based on two types of soybean phospholipids with different phosphatidylcholine contents (75% (S80) and 94% (S100)) at two lipid solution concentrations (5 and 25%), Fig. 1.



9 October. The seminar-presentation of the book-album “Fedor Lvovich Shapiro. To the 110th Anniversary of the Birth”

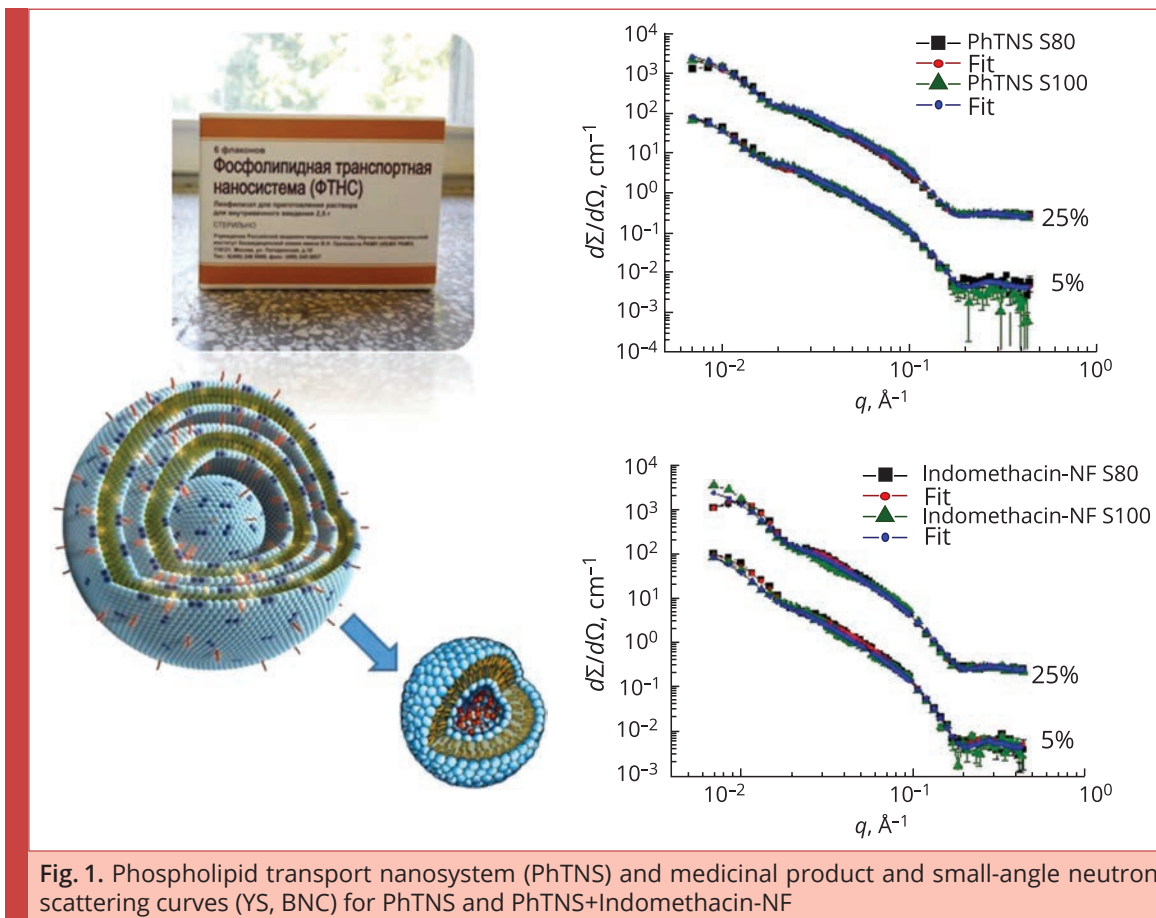


Fig. 1. Phospholipid transport nanosystem (PhTNS) and medicinal product and small-angle neutron scattering curves (YS, BNC) for PhTNS and PhTNS+Indomethacin-NF

It was found that samples of vesicular nanodrugs incorporated into a system based on soybean phospholipid S100 exhibit a decrease in the radius of the system with an increase in the concentration of solutions. In the case of S80-based drugs, the vesicle radius remains constant with increasing concentration. This trend in the behaviour of the radius can be seen for both PhTNS and PhTNS+Indomethacin-NF. However, in the case of PhTNS+Arbidol-NF based on S100, ultra-small vesicles were observed: the internal radius R is about 50 \AA , which is comparable to the thickness of the lipid bilayer, $d \approx 33 \text{ \AA}$.

Investigation of Polymer and Polymer-Like Materials and Films

The properties of worm-like micelles of gemini (dimeric) surfactant (C18-C4-C18) were studied using small-angle X-ray scattering (SAXS) and small-angle neutron scattering (SANS) [6]. The neutron scattering curves obtained at the YuMO instrument of the IBR-2 reactor (FLNP) exhibit a classic cylinder form factor with the potential for contrast variation of both the core and the shell, which makes this method simpler and more promising in the context of studying worm-like micelles. In the case of SAXS data obtained at the BioSAXS station of the Kurchatov Synchrotron Radiation Source (KSRS), the contrast is achieved due to the multilayer structure of the

micelle, which does not allow for simple structural analysis in such systems.

An analysis of SAXS data obtained at the XeuSS 3.0 XENOCs instrument (FLNP) was performed to study the effect of an oil-like agent on the structure of the network of worm-like micelles of a dimeric surfactant. The evolution of the micelle form factor upon the addition of n -decane was followed, and the transformation of the micellar network into a microemulsion system was confirmed, which is consistent with rheological data. The addition of salt to the microemulsion system triggers a structural transition caused by the screening of electrostatic interactions between the surfactant molecules. The simulation results show a significant change in the thickness of the micelle shell when their shape changes to disk-shaped structures.

Atomic and Molecular Dynamics

A molecular dynamics study of racemates of ibuprofen and its sodium salt was performed using a combination of inelastic neutron scattering and molecular modelling methods. It was shown that upon transition from the molecular form to the salt form, the nature of the vibrational spectrum in the energy transfer region of $40\text{--}400 \text{ cm}^{-1}$ changes considerably, which is due to a change in the nature of non-valent interactions, as well as a significant influence of the immediate environment on the molecu-

lar dynamics of methyl groups bonded to the chiral centre of ibuprofen and the corresponding carboxylate anion. Using single-particle and cluster models of ibuprofen [7] and sodium ibuprofenate, harmonic vibrational frequencies were calculated.

Nuclear-Physical Materials Science and Ion-Implantation Nanotechnology

The effect of implantation of He⁺ ions with an energy of 2.4 MeV at different fluences into thin films of tin oxides on their structural properties and electrical conductivity σ was studied. It was found that implantation of He⁺ ions at a fluence of $3.75 \cdot 10^{14} \text{ cm}^{-2}$ leads to insignificant structural changes in the tin oxide film, but at the same time the σ value increases by approximately an order of magnitude (from 0.11 to $1.1 \text{ } \Omega^{-1} \cdot \text{cm}^{-1}$). This is explained by the implantation-induced increase in concentration of oxygen vacancies and interstitial tin, which are electron donors. When implanting He⁺ ions into tin oxide films at higher fluences ($1.1 \cdot 10^{15} \text{ cm}^{-2}$ and $1.1 \cdot 10^{16} \text{ cm}^{-2}$), the change in the electrical conductivity σ of the films, along with the introduction of additional donor centres, is due to the disruption of the film structure, which leads to a less significant increase in the σ value.

Applied Research

In collaboration with Omsk State Transport University, the process of accumulation of fatigue defects in components and parts of rolling stock was studied as their service life increased. The microstructure of samples of axlebox bearing rollers made of hardened bearing steel ShKh15SG was studied using the FSD diffractometer. The maximum excess of the average value of roller hardness after use compared to the hardness of a new roller was 2.41%. Based on the analysis of the features of the surface macrostructure at the ends of the rollers after etching, assumptions were made about the nature of the contact interaction of the end surface of the roller with the surface of the flange of the outer ring of the axlebox bearing. The study of the microstructure made it possible to determine the changes occurring during operation.

During experiments on the FSD diffractometer, using a backscattering detector, diffraction patterns from the original material of ShKh15SG steel were obtained, the analysis of which showed the presence of two phases in the sample under study: ferrite and austenite. Analysis of the widths of the diffraction peaks revealed their characteristic anisotropic broadening depending on the interplanar spacing, significantly exceeding the width of the peaks for the reference sample. This indicates a high level of microstrain and a high density of dislocations in the material. In addition, experiments were conducted on the FSD to study the distribution of microstrains along the radius of the samples. As expected, the samples of the rollers that had been in use exhibited a higher level of microstrains due to the hardening

of ShKh15SG steel as a result of cold plastic deformation compared to the new roller.

Neutron diffraction measurements were performed on samples of the Al-3.8Gd-0.2Cr-0.2Ti alloy using the SKAT diffractometer at the IBR-2 reactor. The results show that the studied alloy scatters neutrons approximately 100 times worse than a nearly pure aluminum alloy, making it a promising material for use as neutron shielding.

At the irradiation facility on beamline 3 of the IBR-2 reactor, the following studies were carried out:

- in collaboration with the Alikhanyan National Science Laboratory, the effect of neutron irradiation dose on the electrical parameters of *n*- and *p*-type silicon semiconductor crystals was investigated;
- the effects of neutron and gamma radiation on the physical and mechanical properties of a nanocomposite based on ultra-high molecular weight polyethylene with boron loading up to 75 wt.% were studied;
- in collaboration with DLNP, experiments were conducted to study the microbiome and microorganisms capable of surviving under a persistently elevated radiation background;
- in collaboration with VBLHEP, the radiation hardness of samples of detector systems for the NICA collider was investigated.

In the irradiation channels of the WWR-K reactor at the Institute of Nuclear Physics of the Republic of Kazakhstan, studies were conducted on:

- the effect of neutrons on the electronic properties of InAlGaAs/In_yGa_{1-y}As quantum-well structures with high electron mobility and concentration, incorporating various functional nanoscale layers;
- the radiation resistance of fluorinated nanodiamonds (an effective material for reflecting very cold neutrons).

The maximum neutron fluence reached during sample irradiation was 10^{20} cm^{-2} .

Studies of fluorinated nanodiamonds after irradiation showed that the size of the nanoparticles and their scattering properties did not change, but noticeable modifications occurred in the fluorinated shells of the nanoparticles, indicating the formation of fluoropolymer structures in both samples. Elemental analysis of the samples using the prompt gamma-ray method revealed that fluorine was almost completely replaced by hydrogen. This suggests that the studied nanodiamond samples exhibit unsatisfactory radiation hardness at the achieved fluence.

In cooperation with DLNP, experiments were continued at the irradiation facility on beamline 3 of the IBR-2 reactor to study the microbiome and microorganisms capable of surviving under conditions of constantly elevated background radiation during a technical shutdown of the reactor. In collaboration with VBLHEP, irradiation tests were conducted on two trusses for NICA detectors, samples of adhesive for detectors, as well as plates made of AD1 alloy and carbon fiber to assess radiation resistance and validate calculated data.

OPTICAL METHODS IN CONDENSED MATTER RESEARCH AND PROJECT “NANOBIOPHOTONICS”

The project “Nanobiophotonics” is an interdisciplinary research project at the intersection of vibrational (Raman and IR) spectroscopy and microscopy, nanophotonics, photobiology, and fluorescence microscopy. The studies were carried out in close international cooperation, primarily with colleagues from Belarus, Russia, Vietnam, Egypt, Uzbekistan, Kazakhstan, and Armenia. A contract with BSUIR for the research project “Differentiation of Neutrophils and Amyloid-Beta Based on Their Raman Spectra Using Hierarchical Clustering and Principal Component Analysis” was completed. In 2025, cooperation with organizations from Vietnam and Egypt was expanded.

Investigation into Alzheimer’s-Related Amyloid- β Conformational Transformations and Stability Influenced by Green Iron Oxide Nanoparticles (GIONP)

Raman spectroscopy was employed to investigate the interaction between GIONP and A β 1–42 aggregates, demonstrating significant alterations in the secondary structure dynamics of the A β 1–42 polypeptide. Fourier-transform infrared (FTIR) spectroscopy shed light on the chemical interactions between GIONP and curcumin, a capping agent. X-ray diffraction (XRD) analysis was performed to determine the crystal structure and phase purity of the synthesized GIONP, providing insight into their stability and structural integrity. The distributions of GIONP by size and membrane architectures surrounding GIONP were studied to assess their impact on membrane integrity and stability. The morphology of GIONP, the formation of membrane mimetic liposomal structures, and their integrity were studied using transmission electron microscopy (TEM) and energy-dispersive X-ray spectroscopy (EDS), which revealed the distribution of elements within each of the structures [8].

The obtained results demonstrate a dual role of GIONP in the destabilization and subsequent stabilization of the secondary structure of amyloid-beta. Initially, the GIONP complex promotes the formation of β -turns and β -sheets, indicating destabilization of the α -helix structure of A β , characterized by an increased tendency for hydrogen bonding and cross-linking, which can lead to fibrillation. However, starting from day four of measurements, the nanoparticles promote a return to the α -helix structure, suggesting a stabilizing effect that prevents the aggregation of A β into toxic fibrils. This study contributes to the understanding of the mechanisms of action of GIONP on various molecular systems.

Effect of pH on A β 42 Conformational Changes in Lipid Membranes

The effect of pH on A β 42 conformation in 1,2-dipalmitoyl-sn-glycero-3-phosphocholine (DPPC) membranes was studied using Raman spectroscopy, circular dichroism (CD), and molecular dynamics (MD) simulations. It was found that at acidic pH (5.5), A β 42 predominantly adopted α -helical structures (~75–80%), whereas under neutral (pH 7.4) and alkaline (pH 9.5) conditions, the content of α -helices decreased to ~48–58% and ~44–47%, respectively, with a corresponding increase in the proportion of random-coil structures (~20–36%).

Under all pH conditions studied, the number of β -structures remained insignificant. The MD analysis also revealed a weak effect of pH on the lipid bilayer thickness and lipid ordering. The consistency of the data obtained by experimental and computational methods highlights the role of pH as a critical modulator of A β 42 structural dynamics in membranes, providing insight into the mechanism of its neurotoxic potential and opening up prospects for the development of therapeutic strategies.

METHODOLOGICAL RESULTS

As part of the Federal Scientific and Technical Programme for the Development of Synchrotron and Neutron Research and Research Infrastructure through 2030 and beyond, a grant was awarded for the project “Development of the Instrumental and Methodological Basis for Solving Scientific and Applied Problems Using Various Types of Neutron Sources” for the period 2025–2027. The grant’s co-implementing partners include teams from scientific and educational organizations in Russia, in particular, NRC KI PNPI, INR RAS, IMP UB RAS, and others.

Development of Detector Systems for HRFD and SKAT Instruments

In early 2025, testing and commissioning of a unique multi-element wide-aperture backscattering detector for the High-Resolution Fourier Diffractometer (HRFD) was completed. New technical solutions made it possible to increase the solid angle of the detector from 0.16 to 2.0 sr. Precise alignment of the modules and provision of time focusing allow for the summation of spectra from elements within one ring without the need for additional corrections. The

data acquisition system was optimized to handle the increased workload resulting from the increased number of detector modules.

To improve background conditions, detector shielding was designed, manufactured, and installed. Measurements demonstrated its high efficiency. In test experiments with the Fourier chopper operating at 6000 rpm, a resolution of up to $\Delta d/d \approx 0.001$ was achieved over a wide range of interplanar spacings.

The completed modernization of the detector system at the HRFD diffractometer made it possible to improve the resolution by up to two times and enhance the luminosity by up to a factor of 5. Thus, in terms of the combination of its characteristics, the HRFD instrument becomes one of the best high-resolution neutron diffractometers in the world. The diffractometer is planned to be included in the FLNP User Programme and made available for user proposals in the autumn of 2026.

The completed upgrade of the detector system at the HRFD facility has improved resolution by up to two times and light intensity by up to five times. Thus, in terms of the combination of its characteristics, the HRFD becomes one of the best high-resolution neutron diffractometers in the world.

On the SKAT diffractometer, a second ring of the detector system at a scattering angle of $2\theta = 90^\circ$ and a second goniometric module for samples were installed. The conducted modernization will allow for more efficient use of the large-section rectangular shape of the neutron guide, which will make it possible to double the number of measured samples.

Modernization of Various Systems of RTD, FSD, FSS, DN-12, REMUR, and YUMO

On the RTD diffractometer, the mirrors of the curved section of the neutron guide with parameter $m = 1$ were replaced with supermirrors with $m = 2$. As a result, the neutron flux on the sample doubled.

On the FSD diffractometer, work continued on the implementation of a new list-mode data acquisition system based on the CAEN DT5560SE digitizer. Compared to the previous system based on MPD modules, the CAEN digitizer provides higher signal recording accuracy due to reduced discretization time and higher capacity of the new raw data format. Test experiments showed that using a digitizer for data acquisition allowed for a significant increase in the count rate due to an improved signal processing algorithm and optimized parameters.

On the FSS diffractometer, the Fourier chopper, which is a rotor-stator system with radial slits coated with Gd_2O_3 , was upgraded. The intensity of high-resolution diffraction patterns and the level of the correlation background depend on its correlation contrast. It is determined by the accuracy in parallelism of the slits on the rotor and the stator, which is ensured by adjusting the position of the stator using two mechanical eccentrics. Previously, adjustment was performed manually using eccentrics. During

the modernization, stepper motors were installed on the eccentrics, allowing for remote control of their position. In experiments, regulation of the rotation angles of the eccentrics made it possible to accurately determine their optimal positions, ensuring maximum correlation contrast of the Fourier chopper and the amplitude of the high-resolution diffraction peak.

At the REMUR polarized neutron reflectometer, equipment for experiments in static and oscillating magnetic fields was installed and adjusted. The use of both stationary and oscillating magnetic fields in neutron reflectometry allows for the determination of the stationary magnetic field profile for structures with thicknesses exceeding 100 nm. Thus, this method expands the range of magnetic layer thicknesses available for measurements. It also complements the classical scattering method in a static field and in the study of thin magnetically collinear structures less than 1 nm thick.

At the YuMO spectrometer, work was carried out to upgrade and test the direct beam detector, which is a gas proportional chamber with a boron converter (in operation since 2011). A new, larger-area circle-shaped converter was manufactured by deposition on an aluminum substrate. The converter was replaced and the operating voltage of the direct beam detector was optimized taking into account the experience of previous use, and test measurements were carried out. As a result, the count rate of the detector was increased by at least two times.

The cryostat on the DN-12 diffractometer was upgraded for use with high-pressure cells. The aim of the work was to replace the outdated and worn-out cooling head of the cryocooler with a modern one from the SRDK415D cryocooler (SUMITOMO).

Development of Thermal and Cold Neutron Detectors

In the context of the search for alternatives to ^3He -based detectors, as well as to improve the reliability of the recorded scattering pattern and the resolution of neutron spectrometers, research and development of thermal neutron detectors based on a resistive plate chamber were continued. A boron carbide film serves as a slow-neutron converter in a resistive plate chamber (^{10}B -RPC). A delay line method was implemented to determine the location of neutron interaction with the converter material. To date, the optimal architecture of ^{10}B -RPC for generating a uniform electric field in the detector has been determined, and Monte Carlo simulation of the transport of neutron beams of various wavelengths through the detector materials has been performed. Two 1D and one 2D detectors with a narrow ($249 \mu\text{m}$) gas gap were manufactured. Counting characteristics of these detectors were measured using laboratory sources of ^{252}Cf , ^{60}Co , and cosmic radiation. Based on the obtained data, the operating mode, time and spatial resolution, and thermal

neutron detection efficiency were determined. Work is underway to implement the time-of-flight method for the developed ^{10}B -RPC detector systems.

In 2025, work was completed on developing a database for data import, storage, and export on all stages of instrumental neutron activation analysis (INAA) at the REGATA facility of the IBR-2 reactor. Verification of the developed software was carried out using the example of an analysis of a sediment sample as part of the IAEA interlaboratory test IAEA-MESL-2024-PT-TE-Sediment. Good agreement between the obtained results and the target values of element concentrations in the sample was demonstrated [9].

Project of a New Inverse-Geometry Inelastic Neutron Scattering Spectrometer BJN

Work continued on the development of a new inverse-geometry spectrometer BJN [10] for research using the inelastic neutron scattering method with the highest possible luminosity. Its distinctive feature is an energy analyzer based on crystals of highly oriented pyrolytic graphite (HOPG) of a large area, satisfying the conditions of constancy of two parameters: the Bragg angle (constancy of the final energy) and the sum of the distances between the sample and the HOPG crystal, as well as between the HOPG crystal and the detector (time focusing). To experimentally test the operating principle of such an analyzer, a prototype with one set of HOPG plates was built. Experimental measurements using the prototype were conducted on beamline 13 of the IBR-2 reactor. The results obtained are in good agreement with the simulation data. Thus, for the (002) reflection, numerical calculations yielded a resolution on the elastic line equal to $0.75(2)$ meV, while the experimentally determined width was $0.672(4)$ meV, i.e., slightly better than that predicted by Monte Carlo simulation. The experimental and calculated values of the final energy of the detected neutrons were 4.47 and 4.65 meV, respectively.

Complex of Cryogenic Moderators CM-201 and CM-202

In 2025, regular operation of the complex of CM-201 and CM-202 cryogenic moderators continued at the nominal power of the IBR-2 reactor of 1.4 MW. In cycles I and II of the reactor operation, the moderators operated in thermal mode, and in cycles III–VII, in cryogenic mode. Work on the complex adjustment and optimization of the operating modes of the Linde 1800 refrigerator for its operation as part of the CM-201 and CM-202 cryogenic moderators was fully completed. A new industrial control and monitoring system for the technological parameters of the moderator was implemented on CM-201. Design and manufacturing of a similar control system for CM-202 began.

New Facilities in JINR Member States

Within international cooperation, work was completed on developing a neutron reflectometer at the WWR-K research reactor of the Institute of Nuclear Physics of the Republic of Kazakhstan (INP RK). The reflectometer was equipped with a one-dimensional position-sensitive detector developed at FLNP. Work on the detector adjustment and its integration into the spectrometer control software package was carried out.

A conceptual design for a UCN source is being developed for the WWR-K reactor at the INP RK. In the source, shown in Fig. 2, it is planned to separate the heat flow and the UCN flow. To achieve this, heat will be removed through the heat-conducting wall of the source, and UCNs will be extracted through a small hole and transported to the experimental setup via a special focusing neutron guide, at the exit of which the UCN density will be approximately the same as at its entrance. This makes it possible to accumulate UCNs to some of the highest densities in the world, both in the source itself and in the experimental setup [11].

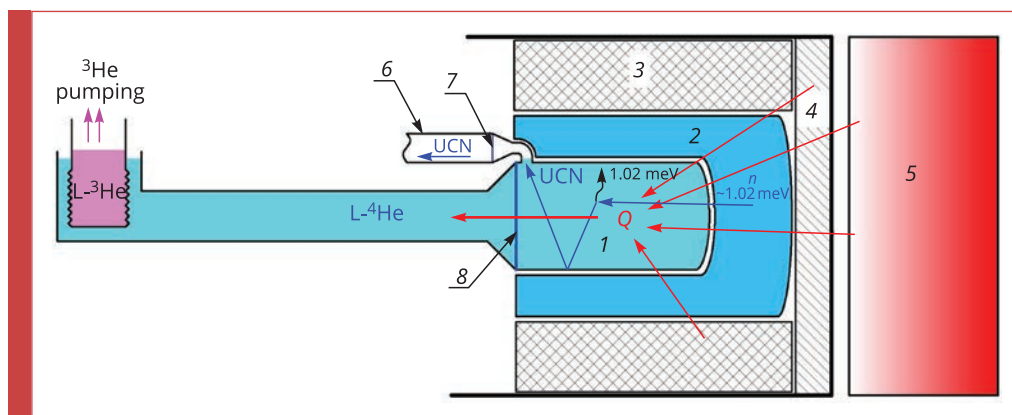


Fig. 2. Schematic diagram of the UCN source at the WWR-K reactor: 1 — tank with liquid ^4He at temperature $T < 1$ K; 2 — liquid deuterium, $T \sim 20$ K; 3 — graphite, $T \sim 300$ K; 4 — lead; 5 — reactor core; 6 — neutron guide; 7 — separating foil; 8 — heat-conducting wall

NEUTRON NUCLEAR PHYSICS

In 2025, the scientific activity in the field of neutron nuclear physics was carried out in the following research areas: investigations of time and space parity violation processes in neutron-nuclear interactions; studies of the fission process; experimental and theoretical investigations of fundamental properties of the neutron; gamma spectroscopy of neutron-nuclear interactions; atomic nuclear structure, obtaining of new data for reactor applications and nuclear astrophysics; experiments with ultracold neutrons (UCNs), applied research using NAA, resonance analysis, infrared spectroscopy and other methods. The scientific programme of the TANGRA project on the study of inelastic scattering of fast neutrons is being successfully implemented. The development of the linear accelerator-based intense resonance neutron source (IREN) continued.

In accordance with the Protocol on joint research into the mechanisms of neutron-nucleus interactions and properties of highly excited nuclei between JINR and Peking University, access was granted to conduct measurements at facilities in China, in particular, at the HI-13 Tandem Accelerator at the China Institute of Atomic Energy (CIAE), the Xi'an Pulsed Reactor (XAPR) at the Northwest Institute of Nuclear Technology (NINT), and the China Spallation Neutron Source (CSNS). Collaboration is ongoing with research centres in Belarus, Egypt, Georgia, India, Italy, Kazakhstan, Mexico, Moldova, Romania, Russia, Serbia, South Africa, the UAE, Vietnam, and other countries.

Operation and Development of the IREN Facility

In 2025, the LUE-200 accelerator, the driver for the IREN facility, operated at a 50 Hz repetition rate with a beam energy in the range of 100–115 MeV. The accelerator operated for experiments for more than 1500 h. To improve reliability and ease of maintenance, the electron gun on the LUE-200 accelerator was reconstructed. Also, load characteristics measurements were carried out on the LUE-200 accelerator, which revealed an insignificant influence of the beam size on acceleration capture and, consequently, on the energy spectrum and neutron yield. The optimal range of beam current was determined taking into account the decrease in energy, deterioration of beam monochromaticity and degradation of the cathode with increasing current from the accelerator gun. As a result of fine tuning, the electron beam penetration was improved. The study of the energy characteristics of the electron beam continued by changing the frequency of the master oscillator of the microwave power source and selecting the natural frequencies of the resonators of the SLED-type microwave pulse compression systems.

During 2025, at the IREN facility, the design and development of a monitoring and diagnostic system was carried out, ensuring the collection, storage, visualization and analysis of data in real time. Software for measuring electron beam power using the calorimetric method was developed. A system for



9 December. Participants in a section of scientific reports at the conference of young scientists and specialists of FLNP

digitizing signals from Rogowski coils to obtain current parameters was designed and built. Testing of automatic data analysis from the IREN facility was conducted.

A positive sanitary and epidemiological conclusion was received for work at IREN.

Investigations Using the Tagged Neutron Method — TANGRA Project

In 2025, the differential cross sections of characteristic gamma radiation induced by neutrons with an energy of 14.1 MeV were measured, the coefficients of expansion into Legendre polynomials were obtained, and the integral cross sections of radiation were determined for elements from the following list: Ga, Ge, As, Se, Br, Sr, Y, Zr, Nb, Mo, Pd, Ag, Cd, In, Sb, Te, I, Ba, La, Ce, Nd, Hf, Ta, W, Hg, Pb, Bi, U, Sm, Eu, Pr, Er, and Rh [12]. For the first time, absolute reaction cross sections were obtained for a number of elements in the energy range above 10 MeV.

A test stand was built to test a method for improving spatial resolution for position-sensitive elemental analysis using beams of tagged neutrons with an energy of 14.1 MeV. The developed algorithm for improving spatial resolution was tested on real experimental data and resulted in a 1.5-fold improvement in spatial resolution. A database of experimental data was created.

The geometry of the setup was optimized for cross-section measurements to reduce the systematic uncertainty caused by incomplete hits of tagged neutron beams on the sample, as well as to improve background discrimination from neutrons scattered in the sample and reaching the detectors, which, in turn, generate many low-energy gamma lines when interacting with the detector material.

Investigations of (n, p) and (n, α) Reactions with Fast Neutrons

At the EG-5 electrostatic accelerator, the research programme on (n, p) and (n, α) reactions with fast neutrons on a number of stable nuclear isotopes continues. For the first time, data were obtained on the cross section of $^{148}\text{Sm}(n, \alpha)^{145}\text{Nd}$ in the neutron energy range from 4.8 to 5.3 MeV. Measurements were made of the cross section of the $^6\text{Li}(n, t)^4\text{He}$ reaction in the neutron energy range from 3.3 to 5.3 MeV.

As part of an international collaboration with Peking University, cross sections for the $^{16}\text{O}(n, \alpha_0)^{13}\text{C}$ reaction were measured in the neutron energy range from 6.8 to 11.7 MeV at the HI-13 Tandem Accelerator of the China Institute of Atomic Energy (CIAE). A grid ionization chamber developed at FLNP was used to detect charged particles. CO_2 was used as a gas target containing oxygen atoms.

As part of international cooperation, experiments to measure the forward-backward asymmetry coefficient in the $^{35}\text{Cl}(n, p)^{35}\text{S}$ reaction using resonance neutrons have begun at the CSNS Back-n white

neutron source beamline (China). A new ionization chamber developed at FLNP was tested, and time-of-flight and two-dimensional spectra were obtained over a 55-m flight path, as well as time spectra with various filters.

Development of a Concept for a UCN Source at a Pulsed Reactor

Work continued on the concept of a source of ultracold neutrons with their pulsed accumulation in a material trap. It is planned to build a UCN source on beamline 3 of the IBR-2 reactor. To avoid direct visibility of the core, but still maintain the direction along the beamline axis, it is proposed to use an S-shaped neutron guide connecting the very cold neutron (VCN) converter with the flipper-moderator and the trap [13]. The influence of geometry and quality of the inner surface of the neutron guide on the final pulse duration of VCN was studied. In the case of a curved ideal neutron guide with a radius of curvature of 24–30 m, the spread of flight times for 75% of neutrons is within about 2 ms. The use of an S-shaped segmented neutron guide results in additional time spreading and a reduction in neutron guide transmission. The optimal number of its segments is 24, and a further increase in the number of segments leads to a disproportionate decrease in the spread of neutron arrival times.

The influence of microroughness and waviness of the inner surface of the neutron guide on the final time spread was analyzed. Calculations showed that the presence of microroughness only leads to a decrease in transmission, while the spread in the time of flight is influenced by the presence of waviness. Nevertheless, the geometry of the neutron guide has the major influence on the spread of the flight time.

Investigations with VCNs and UCNs

As part of the development of the scientific programme for the VCN and UCN source at the IBR-2 reactor, theoretical work was started on studying the properties of the dispersion law for long-wavelength neutrons in matter. The wave function for scattering by a single accelerating nucleus was determined. This solution will be used to calculate the total scattered wave for the coherent interaction of a neutron with multiple accelerating nuclei.

A numerical theoretical study was also carried out on the problem of UCN motion in a gravitational-magnetic trap formed by the Earth's gravitational field and the magnetic field generated by the Vladimirsky mirror. Neutrons in such a system form quantum states with a discrete energy spectrum. The influence of various external nonstationary perturbations on the evolution of the neutron wave function in such a system was theoretically analyzed. The resonant and irreversible nature of the interaction of the evolution of the wave function depending

on the frequency of the nonstationary perturbation was demonstrated.

With the advent of superfluid ^4He UCN sources, the use of mirror-focused ultracold neutron guides became possible. Numerical calculations showed that focusing neutron guides make it possible to achieve a UCN flux density at the neutron guide exit that is tens of times higher than that of standard neutron guides with a constant cross section. The gain in transmission of focusing neutron guides with non-zero losses is achieved by reducing the number of collisions of UCNs with the walls of neutron guides by approximately a factor of five. Narrowing the neutron guide to increase the UCN flux density at its exit can increase the UCN density in the trap located at the end of the neutron guide by an order of magnitude.

Applied Research

In 2025, within the International Programme “Atmospheric Deposition of Heavy Metals in Europe — Estimates Based on Moss Biomonitoring Analysis”, work was carried out to assess the level of air pollution in Italy and Vietnam. The results showed that mosses remain effective biomonitors of nitrogen and phosphorus deposition and can provide reliable spatial and temporal monitoring over large areas. In addition, for the first time, a comprehensive study was carried out to assess the influence of environmental factors on the elemental composition of *Hypnum cupressiforme* mosses collected in Georgia and the Republic of Moldova. The obtained results revealed significant spatial and climatic variability in

the accumulation of elements by mosses, caused by natural geochemical processes and anthropogenic activities.

Moss biomonitoring was used to assess air pollution in the context of the situation and conditions related to COVID-19 in the Moscow Region. In addition, using the active biomonitoring method, the impact of emissions of potentially toxic elements (PTEs) associated with motor vehicles on three highways in Central Russia was assessed. The study shows that vehicle traffic intensity is an important anthropogenic factor determining the level of pollution of roadside areas with PTEs [14]. The effect of strontium on the accumulation of elements in various environmental components in three key zones of the protected area of the Tula Region was also studied. Work continued on monitoring the condition of water bodies using mussels, algae and corals as biomonitors, collected in South Africa, Egypt, Yemen, and the UAE.

In cooperation with colleagues from the University of Belgrade, a study was completed to determine the content of rare earth elements (REEs) in road dust samples collected in the vicinity of a thermal power plant (TPP). The results showed that the REE content is independent of distance from the TPP. The absence of statistically significant differences between the samples collected near main and secondary roads indicates the geological origin of certain REEs in the study area.

In collaboration with colleagues from the Technical University of Moldova and FLNR JINR, work was carried out to obtain biomass of the cyanobacterium *Arthrospira platensis* enriched with silver nanoparti-



FLNP researchers (left to right): I. Zinicovscaia, D. Grozdov, and A. Kravtsova, who were awarded a gold medal at the 17th European Exhibition of Creativity and Innovation, Euroinvent-2025, held in Iași, Romania, on 8–10 May, for a study of biocompatibility and physiological impacts of silver nanoparticles functionalized with *Spirulina* protein extract employing laboratory rats

cles. This study showed that silver nanoparticles have different effects on cyanobacteria, depending on both concentration and surface chemistry. These results open up promising opportunities for the development of functional foods based on silver-en-

riched cyanobacterial biomass, subject to careful safety assessment. Research into the effects of copper and gold nanoparticles on medicinal plants was also continued.

IBR-2 RESEARCH NUCLEAR REACTOR

In 2025, the IBR-2M reactor resumed operation after a long-term shutdown. A test power startup of the reactor was carried out, and the IBR-2 research nuclear facility was cleared to operate at power in the regular mode. Seven cycles of IBR-2 operation for physics experiments were conducted with the planned operation of the CM-201 and CM-202 cryogenic moderators.

Operation of the IBR-2 nuclear research reactor in 2025

No. cycle	Reactor power, MW	Operation for physics experiments, h	Number of emergency system activations
1	0.5–1.5	428	–
2	1.4–1.5	167	1
3	1.4	265	–
4	1.45	267	–
5	1.45	245	2
6	1.45	217	–
7	1.45	259	1

The activation of the emergency protection system in Cycle 2 was due to a failure of technological equipment. Two emergency protection system activations in Cycle 5 were caused by voltage drops in the reactor power supply network (external electrical network). In Cycle 4, the reactor power was reduced for 24 h to switch the cryogenic moderators to thermal mode due to a malfunction in the cryogenic section equipment.

Pre-startup preparation and testing of the detector systems used on the IBR-2 experimental beamlines were conducted. All position-sensitive detectors (PSDs), as well as ring detectors on beamlines 4, 6a, 6b, and 12, were tested. On the DN-12 diffractometer, a 96-channel multi-section ring detector with a common gas volume was filled up with a gas mixture. Work continues on putting the PSD into service on beamline 4.

A remote control system for the vacuum system was developed and is currently undergoing adjustment and adaptation for the SKAT, NERA, and EPSILON spectrometers on beamline 7.

A technical inspection of load lifting cranes and equipment operating under excess pressure was conducted. An industrial safety assessment of the overhead crane in experimental hall No. 1 of the IBR-2 nuclear research reactor was carried out, and a contract for its modernization was signed with the Kirov Lifting and Transport Equipment Plant. The overhead crane in experimental hall No. 2 of the IBR-2 reactor was upgraded to meet regulatory requirements for nuclear facilities. Work to extend the service life of the overhead crane in the IBR-2 reactor hall was completed. The IBR-2 backup movable reflector was prepared for a preliminary run for centring and aligning the main clearances. The first stage of modernization of the cooling tower (building 123) was completed, including the replacement of the cooling tower makeup valves. The diaphragm was dismantled, a section of pipeline was cut in, and a new flow meter sensor was installed on the recirculating water system of the IBR-2 reactor.

NEW NEUTRON SOURCE

The main research projects for the advanced pulsed neutron source at FLNP were formulated and substantiated [15]. Work continues on analyzing alternative concepts for the new neutron source for further design, taking into account previously developed options. Under the contract signed with JSC NIKIET, the results were presented and an R&D report was prepared.

Design documentation, including strength and thermophysical calculations, is being developed for a cryogenic chamber simulator for a mesitylene-based cryogenic moderator with a quick-change system for the working material. A mock-up of a high-

performance system for producing solid mesitylene beads with a capacity of 1.3 l/h was developed [16]. The mock-up is currently undergoing testing in accordance with the programme and methodology. A preliminary design for a solid methane bead production system mock-up was developed. Physical and technical requirements for the mock-up design were formulated. An experimental plan was developed for an existing facility for producing solid methane beads in liquid nitrogen to support the development of the mock-up design. With the support of the Institute of Solid State Physics of the Russian Academy of Sciences, an independent examination

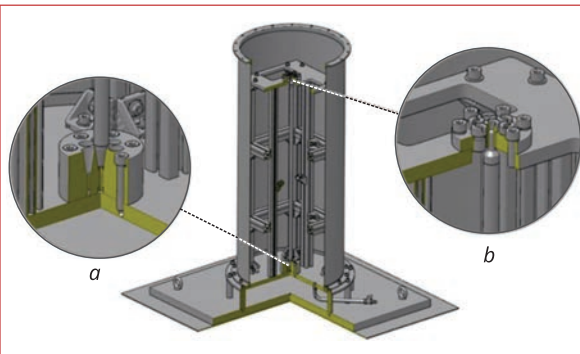


Fig. 3. Diagram of the stand for vibration diagnostics of fuel rods: lower (a) and upper (b) fastening units

of the draft design was carried out. Calculations of the efficiency of hydrogen-containing moderators of various geometries will continue after a more detailed study of the design of the core of the new neutron source.

To specify the parameters of the pulsed reactor dynamics model, theoretical and numerical calculations, as well as experimental studies of the main processes in the core that affect feedback reactivity, were carried out. Thus, the elongation of a fuel pellet column in the exact geometry of the fuel element after a power pulse was calculated. The transverse deformation of fuel assemblies (FA) after a pulse and its effect on reactivity were studied. To study the response of the transverse displacement of the fuel pellet to a single power pulse, a calculation of the transient deformation of the fuel assembly was performed. It was found that the separating wire significantly influences the shape and direction of the bend. As a result, a component of the fuel assembly bending appears transverse to the gradient. Calculation of the static deformation of the metal elements

of the model showed that the peripheral fuel rods shift toward the wall of the fuel assembly up to complete contact at the bottom of the fuel column. At the same time, a non-zero bending moment remains in the cross section of the fuel rod cladding. The central fuel rod does not experience any noticeable displacement due to the symmetry of the problem.

It is assumed that in the process of fuel burnout, the negative feedback on fuel expansion decreases, since a change in the structure of the fuel material and its thermophysical properties affects the elongation of the fuel pellet column after a power pulse. Calculations of the dynamics of the IBR-2M reactor were carried out using the specified power feedback dependences. A comparison of the calculated dependence of the feedback reactivity with the data obtained during measurements at the IBR-2M reactor in 2021 indicates a qualitative similarity between these dependences, which makes it possible to assess the influence of individual physical processes in the core of the IBR-2M reactor on pulse stability.

To take into account the phenomenon of dynamic bending of fuel rods when modelling the dynamics of a pulsed reactor, the values of natural frequencies and attenuation times of model fuel rods were measured on the vibration diagnostics stand (Fig. 3) [17]. The use of experimental data in the dynamics model made it possible to identify the negative effect of dynamic bending on the reactor stability and to indicate possible causes of pulse energy fluctuations.

Based on the results of the above work, constraints on the design of the core were determined, recommendations for design were proposed, and ways of finding technical solutions when selecting the core configuration for the new source were outlined.

INTERNATIONAL CONFERENCES AND MEETINGS

In 2025, FLNP employees took part in 102 scientific events held in 24 countries and at JINR. Of these, 75 events were held in JINR Member States, 6 in JINR Associate Member States, and 6 in JINR Partner States. In Russia 146 FLNP employees participated in these events, and 164 employees attended them abroad. The Laboratory organized four international conferences, and FLNP representatives also joined

the Programme and Organizing Committees of other events. This contributed to the strengthening of existing and the establishment of new scientific ties, positively influencing the growth of demand for the international programme for users conducting experiments on the IBR-2 beamline instruments at FLNP.

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MESHCHERYAKOV LABORATORY of INFORMATION TECHNOLOGIES

The activity of the Meshcheryakov Laboratory of Information Technologies (MLIT) in 2025 was focused on ensuring the reliable functioning and growth of the JINR network, information and computing infrastructure within the large research infrastructure project 06-6-1118-2014/2030 “Multifunctional Information and Computing Complex” (MICC), as well as on developing mathematical support and software for the research and production activities of the Institute and the JINR Member States (project 06-6-1119-1-2014/2026 “Mathematical Methods, Algorithms and Software for Modelling Physical Processes and Experimental Facilities, Processing and Analyzing Experimental Data” and project 06-6-1119-2-2024/2026 “Methods of Computational Physics for the Study of Complex Systems”). A distinctive feature

of ongoing research directions is close cooperation with all the laboratories of the Institute, institutes of the JINR Member States and other countries.

In 2025, the MLIT staff published over 200 scientific papers, 4 monographs, and more than 150 articles within international collaborations, and presented over 150 reports at international and Russian conferences.

In 2025, MLIT held two important events dedicated to the memorable dates of the Laboratory’s founders: the 115th anniversary of M. Meshcheryakov’s birth and the 95th anniversary of N. Govorun’s birth, which was marked by the publication of an album book about N. Govorun. In addition, the 11th International Conference “Distributed Computing and Grid Technologies in Science and Education”



17 September. MLIT Deputy Scientific Leader T. Strizh delivers a report at a memorial seminar in honour of the 115th anniversary of the birth of M. Meshcheryakov

(GRID'2025), the Quantum Computing and Machine Learning Workshop (QCML), the scientific and practical seminar "HybriLIT Workshop 2025: Towards Efficient Scientific Computing", as well as the traditional

JINR IT School, took place, and the Conference on High Energy Physics (CHEP-Yerevan'2025) was held with the participation of MLIT.

MULTIFUNCTIONAL INFORMATION AND COMPUTING COMPLEX OF JINR

The Multifunctional Information and Computing Complex (MICC) represents a key element of the computing infrastructure and plays a decisive role in scientific research that entails advanced computing power and data storage systems. The MICC is an intricate hardware and software complex, the major components of which are the energy supply and climate control engineering systems, the network infrastructure, the data transfer and storage system, the Tier1 and Tier2 data processing grid centres, the cloud infrastructure, the HybriLIT platform, including the Govorun supercomputer, and the monitoring system for all components of the complex. In 2025, to attain the main objectives of JINR flagship projects, the high performance, reliability, and availability in $24 \times 7 \times 365$ mode of all MICC components were ensured.

The Tier1 grid site for the CMS experiment at the LHC was ranked second among seven similar sites worldwide. Tier2/CICC provided the comprehensive processing and analysis of data obtained within the experiments at the LHC, NICA, and in other large-scale scientific projects. Particular attention was paid to support for users from the JINR laboratories and Member States, providing them with indispensable computing resources and tools for work with data. The cloud environment of JINR and its Member States was mainly used for computing within the JINR neutrino programme, which enabled the effective solution of complex problems related to neutrino data analysis. The Govorun supercomputer was employed to perform massively parallel and resource-intensive computations, as well as calculations using artificial intelligence methods within the ML/DL/HPC ecosystem.

JINR Network Infrastructure

The network infrastructure deployed within the MICC project is a central element that ensures external telecommunication channels, communication between MICC users through the JINR local area network, and data exchange within the MICC local area network.

In 2025, the reliable operation of the Moscow backup channel with a bandwidth of 4×100 Gbps was ensured. To operate a Tier1 grid site that meets the highest standards of performance and reliability, one must be a full member of the LHCOPN (Large Hadron Collider Optical Private Network) to seamlessly communicate with Tier0 (CERN) and the other Tier1 sites. This connection is provided

by the 100 Gbps JINR–CERN direct channel and its 100 Gbps backup channel passing through Moscow and Amsterdam, ensuring fault tolerance and data transmission continuity. The JINR Tier2 connectivity is effectively supported by the LHCONE (LHC Open Network Environment) external overlay network designed for Tier2 grid sites and optimized for their data transfer needs. The National Research Computer Network of Russia (NIKS) provides communication with Russian scientific and educational organizations, as well as integration with individual foreign National Research and Education Networks (NRENs) and the Internet.

In 2025, the overall incoming traffic amounted to 64.14 PB, which is 51% more than in 2024, and the outgoing traffic grew by 13% compared to last year. This increase is due to the growth in transferring data for processing and storage on Tier1. The traffic with the scientific and educational networks, accounting for 88% of the total, is overwhelming. The distribution of the incoming (exceeding 25 TB) and outgoing traffics by the JINR subdivisions in 2025 is shown in Table 1.

Table 1

Subdivision	Incoming traffic, TB	Outgoing traffic, TB
MLIT	1070.0	180.46
VBLHEP	558.29	223.37
HRC	520.92	145.28
DLNP	353.25	120.38
JINR Directorate	190.1	89.69
FLNP	187.27	59.71
FLNR	185.47	35.43
Dubna State University	160.59	55.93
Medical Unit No. 9	120.28	18.7
Public Access Servers	95.52	94.89
Remote Access Node	78.64	11.56
UC	75.93	10.48
BLTP	44.85	29.85
SIMO	39.71	8.06
LRB	39.16	3.33
CPED	29.42	2.62

The local area network (LAN) is built on the JINR backbone network (2×100 Gbps) and the distributed multi-node cluster network between the DLNP and VBLHEP sites (4×100 Gbps). This ensures the reliable transfer of physics data from the NICA complex for its subsequent processing and analysis on the MICC components.

Throughout the year, the e-mail service processed 4.7 million incoming messages and 950 thousand outgoing messages. The average message processing time was 3.4 s.

In 2025, over 1600 JINR user requests concerning the operation of the network and services were processed. Security checks for incoming e-mails from the @jinr.ru domain were significantly enhanced, and hundreds of new filters were added. The functioning of approximately 30 servers and virtual machines was supported, and over 820 network devices were monitored. About 50 incidents of network security violations were identified and processed.

The JINR LAN comprises 14 328 network elements, 23 746 IP addresses in IPv4 format, 1490 IP addresses in IPv6 format, 5933 users (including 5376 JINR staff members), 5083 @jinr.ru e-mail addresses, 1151 users of electronic libraries, 1021 users of the remote access service, and 171 users of the EDUROAM service. The registration procedures were supplemented with support for new user categories, namely, associated personnel and students.

MICC Engineering Infrastructure

In 2025, work on the replacement and enhancement of the MICC engineering infrastructure, designed to ensure the reliable, uninterrupted, and fault-tolerant operation of information and computing systems and data storage resources, was in progress. During the year, work to install new servers of various configurations and network switches was performed.

At present, the MICC computing facilities are placed in one computing hall of 900 m² of floor-space on the 2nd floor of the MLIT building. In 2025, a substantial upgrade of the engineering infrastruc-

ture of two modules, related to the transition to the cooling of the cold corridor by inter-row air conditioners, was carried out.

JINR Grid Environment (Tier1 and Tier2 Sites)

In 2025, the successful operation of the JINR grid sites continued. Both grid sites provided data processing and analysis within JINR's participation in the LHC projects at CERN, as well as tasks on modelling, processing, and storing data from the BM@N, MPD, and SPD experiments at the NICA accelerator complex.

The JINR grid environment comprising the Tier1 (JINR-T1) and Tier2 (JINR-LCG2) sites ensures the functioning of the computing complex, the data storage system, grid services, the data transfer service, and the information service (monitoring of servers, storage, data transfer, information sites).

The key task of the year was the migration of the Tier1 and Tier2 computing resources to the AlmaLinux 9.6 operating system (OS) due to the end of the life cycle of CentOS 7. For the mass transfer of compute nodes, a fully automated reinstallation pipeline was developed and implemented. During October–November, 629 of the 920 nodes were successfully migrated. Additionally, a tool for exporting and validating node configurations was created.

In 2025, the performance of Tier1 was enhanced by 32%, and it currently embraces 468 compute nodes (23 360 cores) with a performance of 427.92 kH523. Data storage is provided by the 15 PB dCache system and the robotic tape storage with a capacity of 100 PB. To work with tapes, a 2.24 PB disk array is used to cache data.



Top view of upgraded Modules 1 and 2, transferred to the cold corridor cooling with inter-row air conditioners, in the MICC machine hall

In 2025, the JINR Tier1 site took second place in terms of the number of events processed (Fig. 1) and the total normalized CPU and actual time for data processed in the ranking of world Tier1 sites that process data from the CMS experiment at the LHC (Table 2) according to the statistics available at <https://accounting.egi.eu>.

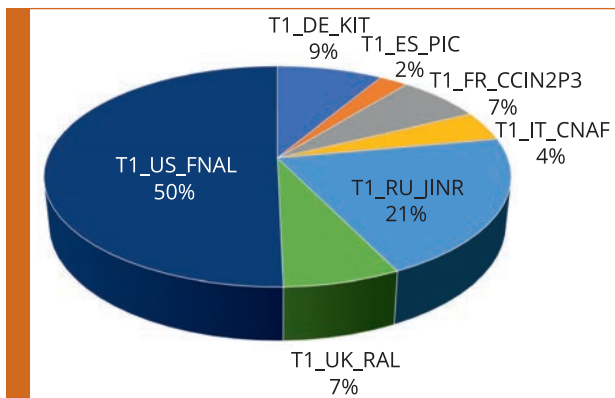


Fig. 1. Distribution of events processed in 2025 on the world Tier1 sites of the CMS experiment at the LHC

Table 2

Tier-1	Total CPU time (kHS23 h)	Total actual time (kHS23 h)
US-FNAL-CMS	4 089 705.009	4 920 606.964
RU-JINR-T1	2 106 701.086	2 871 833.526
UK-T1-RAL	1 347 308.725	1 671 293.034
DE-KIT	1 247 756.876	1 448 471.493
ES-PIC	1 232 820.775	1 266 032.136
FR-CCIN2P3	943 818.023	1 066 548.004
IT-INFN-CNAF	642 358.043	900 642.478

As in previous years, the JINR Tier1 site performed the tasks of modelling and processing data from the BM@N, MPD, and SPD experiments at NICA (Fig. 2).

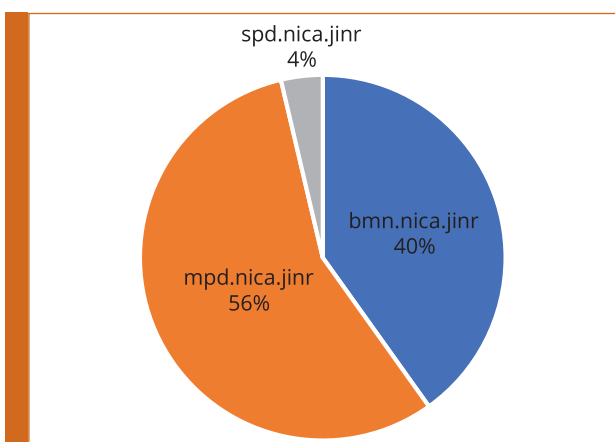


Fig. 2. Distribution of the normalized CPU time by tasks of the BM@N, MPD, and SPD experiments on the JINR Tier1 site

The Tier2 site embraces 485 compute nodes (10 356 cores) with a total performance of 166.8 kHS23. Data storage is provided by the 4.84 PB dCache system for the CMS and ATLAS experiments and the 1.5 PB EOS-Alice system.

The Tier2 site, which in 2025 remained virtually the only one receiving tasks from the Russian grid segment (RDIG), completed over 5 million tasks, which amounted to 99.92% of the total RDIG CPU time (Fig. 3).

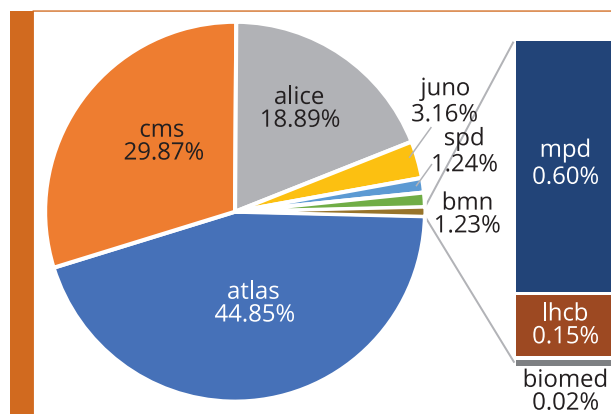


Fig. 3. Distribution of the normalized CPU time by experiments registered on the JINR Tier2 site

A prototype of a distributed environment for modelling, processing, and analyzing SPD experiment data is developed on the PANDA software. The primary contribution to the functioning of the distributed data processing and storage environment for the SPD experiment is made by the JINR MICC, providing the Tier1/Tier2 resources, a certification centre, the EOS storage, and cloud service machines that host all control services of the experiment [1]. In 2025, two new centres, namely, at Samara University and SPbSU, joined computing. Throughout the year, over 1 billion Monte Carlo events with a total volume of approximately 500 TB were generated. To manage the formation of centralized processing tasks, a specialized system containing an interface for submitting tasks to the distributed computing environment was developed and put into operation. In 2025, the experiment received a dedicated 7 PB EOS storage system, to which all of the experiment's data was transferred over the summer. In addition, virtual machine monitoring systems and data processing and management systems were put into operation, the IAM (Identity and Access Management) authorization service was integrated with data storage systems, and a new user authentication method using JWTs (JSON Web Tokens) without the use of X.509 certificates was tested.

Work to create a specialized computing system, SPD OnLine Filter, is underway [2]. A methodology for middleware integration testing was elaborated and implemented, allowing all systems included in the software complex to work together. A system that enables the effective emulation of data taking

from the SPD data acquisition system (SPD DAQ Emulator) was developed.

Since 2019, a distributed heterogeneous computing environment based on the DIRAC platform has been functioning. Resource integration within this environment is based on standard data access protocols (xRootD, GridFTP, etc.) and pilot tasks. Thanks to this, the user is provided with a unified environment for launching tasks, managing data, building processes, and monitoring their execution.

In 2025, a mass data transfer system using DIRAC tasks was implemented. The developed approach enabled transfer rates of up to 10 Gbps. Moreover, it became possible to transfer data to storage systems accessible only locally. FTS (File Transfer Service) was integrated into the DIRAC platform, making it possible to transfer large data volumes between storage entities and efficiently copy data from CTA (CERN Tape Archive) tapes to disks.

A set of tools to analyze the mapping between the DIRAC file directory and storage systems accessible via the root protocol was developed. It enables the automated deletion of files and directories that are not listed in the file directory. The developed toolkit also allows aligning file and directory structures between the file directory and local storage systems. A new approach to visualizing the directory and file structures of experiments using the DIRAC file directory was implemented.

In total, 600 thousand computational tasks with an overall duration of 408 astronomical years or 3.68 MHS06 days were completed in 2025. The major users of the DIRAC computing resources in 2025 were the BM@N and MPD experiments (Fig. 4). With the discontinuation of the VOMS service, the SPD experiment ceased using DIRAC at JINR.

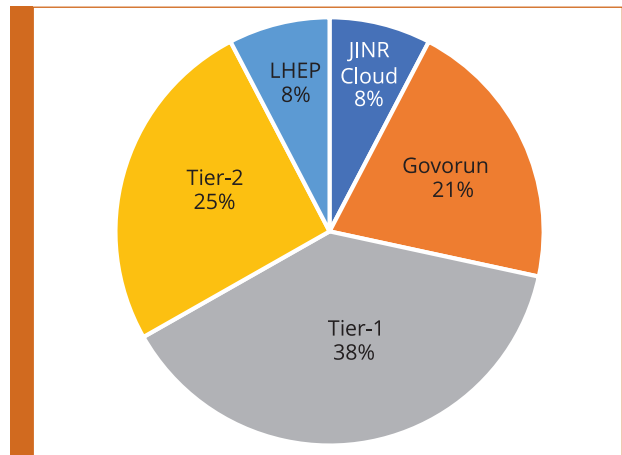


Fig. 4. Share of use of various components of the MICC and cluster at VBLHEP in a distributed heterogeneous environment based on the DIRAC platform

Heterogeneous Infrastructure

In 2025, the HybriLIT platform, which is a component of the JINR MICC designed to conduct massively parallel and resource-intensive calculations, as well as research using artificial intelligence methods and approaches, was actively evolving [3]. The next stage of modernization of the Govorun supercomputer was completed. The computing resources of the supercomputer's GPU component were enhanced by integrating two new compute nodes on top of the unique RSC Exastrim AI server solution with liquid cooling. These nodes were created specifically for the Govorun supercomputer considering its architectural features. Each node contains eight NVIDIA H100 graphics accelerators. As a result, the peak



17 September. A delegation from the INPhE MEPHI Department visited JINR to discuss personnel training for the Institute's laboratories and research projects

performance of the GPU component of the Govorun supercomputer grew by 36%, reaching 1.4 PFlops for double-precision operations, and the supercomputer's total capacity amounted to 2.2 PFlops for double-precision operations and 58 PFlops for half-precision calculations for artificial intelligence tasks.

In 2025, the software and information environment of the HybriLIT platform was supplemented with a new service designed to evaluate the efficiency of utilizing the supercomputer's computing resources (http://hlit.jinr.ru/accounting_and_statistics_processing_systems/). The service enables performance monitoring, the accumulation and analysis of computing resource usage statistics for different user groups, as well as the identification of resource usage trends. To control sorting in the system's elements, selectors that allow sorting data by year and compute queue or by both parameters simultaneously are available (Fig. 5). The new service is built on the Yandex DataLens Business Intelligence system. The data source for the service is the SLURM task scheduler database.

Within a joint project between MLIT, BLTP JINR, and FBHI "Medical Unit No. 9" of FMBA of Russia, a polygon for working with medical data from computer, magnetic resonance, and functional magnetic resonance imaging for the DICOM and Nifti formats was deployed in the JupyterLab environment on the basis of the ML/DL/HPC ecosystem (<http://hlit.jinr.ru/polygon-ct-mri/>). To visualize medical data, the PyDicom, Nipype, and PySurfer libraries, allowing for the construction of 3D images of the human brain, were installed on the polygon. The polygon is designed for the testing of various visualization software packages and software development to implement a new mathematical approach to image reconstruction.

The regular maintenance of all components of the HybriLIT platform, including the Govorun supercomputer, was carried out. For the compute queues of the Govorun supercomputer for various user groups, queues were reconfigured to meet current user needs, data Storage-on-Demand systems were created and modified, and queues were maintained

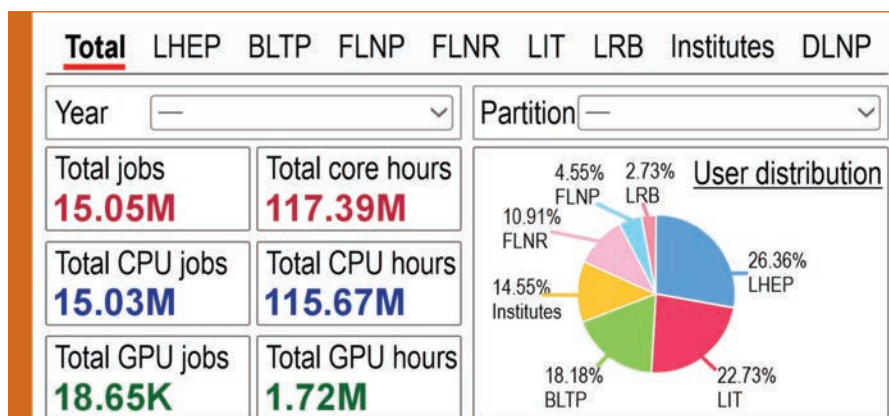


Fig. 5. The Govorun supercomputer accounting system. A main page element



25–26 November. The HybriLIT Workshop 2025

in working order; i.e., the operation of compute nodes and services was checked and promptly restored. Additionally, within the transition of the platform to AlmaLinux OS 9.6, work to install and configure the XCAT software product, designed for quickly deploying and configuring the operating system on the compute node, was completed, and settings for virtual machines (platform user interfaces) were prepared. The total number of Govorun supercomputer users is currently 357. Throughout 2025, approximately 6.8 million tasks were executed, which corresponds to 34 million core hours.

Cloud Infrastructure

In 2025, work on developing the JINR cloud infrastructure, which is a universal component of the MICC designed to provide computing resources and host information and computing services, was underway. The Institute’s scientific projects, particularly the Baikal-GVD and JUNO neutrino experiments, as well as the NICA experiments, were the primary and most resource-intensive consumers of these resources (Fig. 6). At the same time, the service is institute-wide and is used by a vast range of users. During the year, resources were provided to over 100 active users, supporting the operation of 857 virtual machines that utilize a total of 5472 CPU cores. The HTCondor batch cluster with a number of grid services that comprise the Neutrino Computing Platform (NCP), the git.jinr.ru collaborative software development service, the jupyter.jinr.ru interactive programming environment, and the newdle.jinr.ru, webanalytics.jinr.ru, and docs.jinr.ru information and application web services were operated and supported in the cloud infrastructure.

One of the uppermost areas of work during the reporting period was the modernization of the

cloud infrastructure’s monitoring system. Work on the transition to the use of the standard monitoring tools included in the cloud platform started. As part of this work, standard metric collectors were deployed, and the corresponding visualization dashboards were integrated into the mon-service.jinr.ru monitoring service. A separate instance of the VictoriaMetrics time-series database management system was deployed for the current test period, and metrics are collected in parallel across both the previously used and new databases.

Within the distributed information and computing environment (DICE) based on the cloud resources of organizations from the JINR Member States, the main work was related to maintaining the operability and availability of these resources.

MICC Data Storage Systems

One of the essential elements of the MICC is the data storage system. The primary storage systems used are dCache and EOS for disk storage, and Enstore and CTA for tape storage.

In 2025, substantial work related to the transition to AlmaLinux OS 9.6 was carried out to refine, modify, support, and maintain the Enstore-based magnetic tape data storage and transportation system. Considerable work to optimize tape recording, dictated by the increased data flow in 2025, was performed. As a result of code optimization, the transfer time was reduced by approximately 25%, and with the introduction of the Python 3 system distribution, read/write speeds approached the theoretical maximum: 400 Mbps per tape device.

As part of work on organizing a regional data centre for the JUNO experiment on the basis of the MICC, a data storage system whose architecture is built on the dCache software was developed [4].

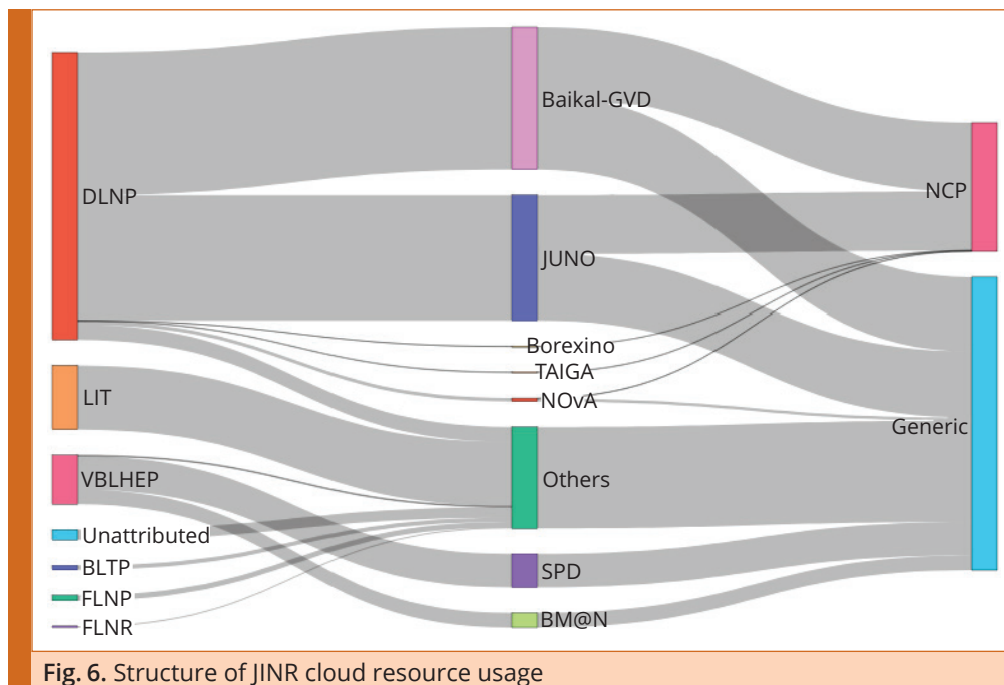


Fig. 6. Structure of JINR cloud resource usage

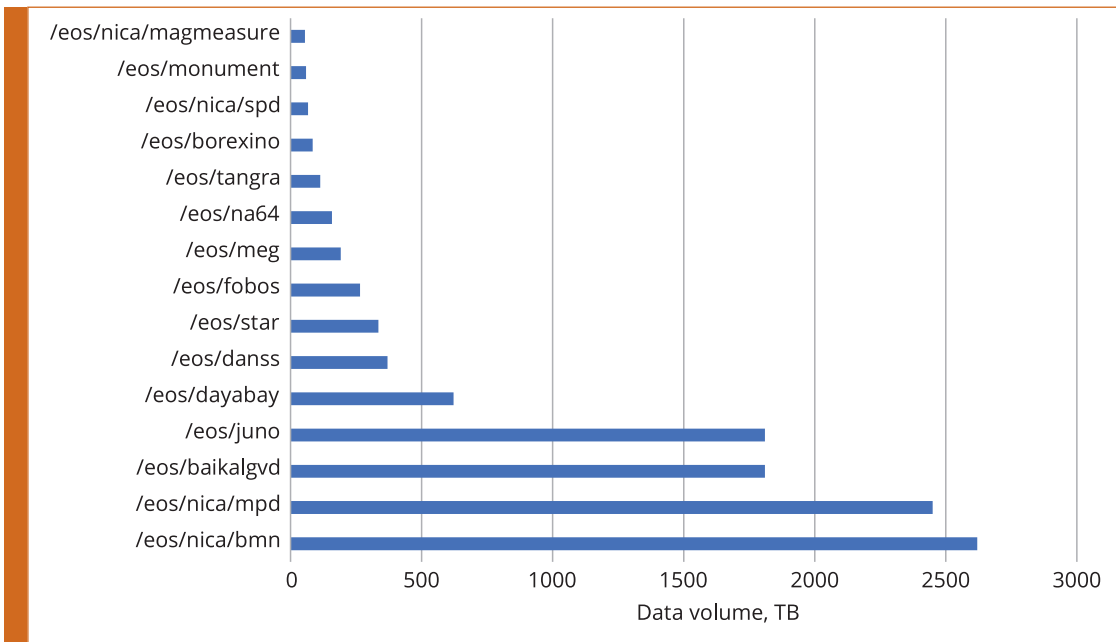


Fig. 7. Distribution of the volume of data stored in the system as of December 2025 (exceeding 50 TB)

In addition to the EOS systems allocated for the MPD and SPD experiments, each with a capacity of 7 PB, a shared storage system based on EOS was organized at the MICC. It is considered as a common distributed data storage system for all MICC users with a capacity of 20.5 PB. Both individual users and user/experiment groups are registered in the shared EOS system. The distribution of the volume of data stored in the system as of December 2025 (exceeding 50 TB) is shown in Fig. 7.

Monitoring System

In 2025, the LITmon monitoring system, which represents the primary tool for MICC operators and allows for up-to-date information on the status of all engineering systems of the complex, was maintained and developed. The general monitoring system embraces an accounting system that provides statistical data on resource usage by user tasks (Fig. 8). The system enables the accounting of resources and



Fig. 8. General information screen of the Tier1 CMS grid site task accounting system

their use both within the distributed data processing system and locally.

To enhance the MICC reliability through early warnings about potential emergencies, the concept of an LSTM (Long Short-Term Memory) neural model to automate the procedure of classifying system log messages, which is necessary for the subse-

quent prediction of possible hardware and software failures in the major components of the computing complex, was proposed within the development of the monitoring system. Data acquisition and processing programs, as well as an interface for data analysis, were elaborated.

MULTIPURPOSE HARDWARE AND SOFTWARE PLATFORM FOR BIG DATA ANALYTICS

Within the task of establishing a Big Data user infrastructure based on CPU computing resources and hardware accelerators (GPUs), a pool of servers with various locally installed and configured artificial intelligence models, accessible to users through the Open WebUI web server via an API or as an assistant in software development environments (such as Visual Studio Code), was created using software means for organizing calculations and open-source libraries of analysis, modelling, and visualization tools.

A mechanism for monitoring and analyzing the security of network connections to resources hosted in the JINR MLIT cloud environment was worked out. A neural network model that reconstructs normal URL structure patterns, where a considerable

deviation between the original and reconstructed requests serves as a potential threat indicator, was implemented. Unlike traditional methods, neural network models trained on normal traffic can detect unknown cyberattacks without first examining malicious samples. This approach is relevant for the task of detecting anomalous requests to web services hosted in the JINR network. Experimental results demonstrate the efficiency of the proposed neural network architecture: the accuracy of normal traffic reconstruction reached 98%, and the accuracy of anomaly detection amounted to 97.6%. The obtained results and models are planned to be used in software tools for ensuring the security of JINR websites and digital services (Web Applications Firewall).

JINR DIGITAL ECOSYSTEM

In 2025, work on maintaining and developing institute-wide scientific and administrative services, as well as on integrating them with each other and into the JINR Digital Ecosystem, was in progress.

The PIN-2 system was put into operation and refined based on the results of its trial operation. An electronic personnel training system, initially aimed at organizing remote testing on radiation safety for the Institute's staff members, was put into test operation. The DocMS document development and management service was fully commissioned and is used by the Institute's subdivisions and collaborations (certificate No. 22025690887 on the state registration of the computer program "DocMS Document Management Platform").

As part of support for administrative services in the MLIT area of responsibility, the following services were developed: the Dubna EDMS, ISSC, DES Shell, HR JINR, GIS JINR, Document Database, Advance Reports, JINR Staff at CERN, ADB2, NICA EVM, Data Exchange Gateway. The above services were migrated to new servers, the monitoring of their operation was introduced, and their security against attacks was enhanced.

To provide parallel and sequential document approval, the Dubna EDMS core was modernized, resulting in a reduction in the average approval time

for direct procurement coordination under items 5 and 6 for VBLHEP and DLNP by approximately 2.5 times. The Dubna EDMS user interface was updated considering modern ergonomics and design concepts. Preparations for the phased transfer of the Document Database system's functionality to the Dubna EDMS were made, and a number of modules to transfer the approval of JINR orders to the EDMS were elaborated.

The development of the JINR Publications Repository (certificate No. 202569021 on the state registration of the computer program "Software Complex for Managing Digital Objects of the JINR Scientific Publications Repository") was underway. The software base was modernized, and enhancements to the user interface and data visualization (in particular, mathematical formulas) were made. The automation and integration of publication metadata from eLIBRARY (including those not previously linked to JINR) and a specialized list of JINR FLNP publications were implemented. Work to improve the quality of metadata was completed, and algorithms for correcting annotations and linking authors to articles were elaborated. To improve the speed and security of the system, the service architecture was redesigned.

Within the JINR geographic information system, data import and editing mechanisms for entering building outlines and floor plans were implemented. Information on various buildings, premises, and workplaces in them for VBLHEP, LRB, and MLIT was entered into the GIS. A subsystem for analyzing and

reporting on the placement of JINR staff members in buildings, rooms, and subdivisions was put into operation. The functionality for reserving workplaces and rooms for staff members and subdivisions was worked out and put into operation.

METHODS, ALGORITHMS AND SOFTWARE FOR MODELLING PHYSICAL SYSTEMS, MATHEMATICAL PROCESSING AND ANALYSIS OF EXPERIMENTAL DATA

One of the main activities of MLIT is to provide mathematical, algorithmic, and software support for experimental and theoretical research underway at JINR. In 2025, within Theme 1119, a number of works and investigations aimed at the elaboration and enhancement of mathematical methods and software for modelling physical processes and experimental facilities, processing and analyzing data from experiments in elementary particle physics, nuclear physics, neutrino physics, radiobiology, etc. were performed. Highly appreciated contributions were made to the research programme of the BM@N, MPD, and SPD projects and to the development of software for data processing systems and physics object reconstruction for the Baikal-GVD, JUNO, ATLAS, and CMS projects. Active participation in the physics analysis of CMS experiment data was ongoing.

A summary of selected results is presented below.

Development of Data Processing Systems, Creation and Enhancement of Information and Computing Systems to Support JINR Research Projects

Within the enhancement of the Baikal-GVD experiment data processing and analysis systems, the refactoring and multithreading of key C++ programs were performed [5].

In 2025, work on detecting and eliminating bottlenecks in the SpdRoot software package was completed [6]. Proposed fixes, such as memory operation optimization and the elimination of undefined behaviour in functions, reduced the average event reconstruction time in SPD.

Within the participation of MLIT specialists in the ATLAS experiment at CERN, work on advancing the ATLAS TDAQ system and the Event Picking service of the EventIndex system was underway [7]. The experience and knowledge gained in elaborating databases for the ATLAS experiment were applied to the experiments at the NICA accelerator complex. Based on the analysis of the corresponding systems in four LHC experiments, the design of the BM@N experiment data quality monitoring (DQM) system was developed [8].

An AI assistant that uses the DeepSeek large language model was integrated into the FITTER_WEB

web application, developed for processing data obtained from the YuMO small-angle spectrometer at FLNP. The correctness of automatic C++ code generation for a number of functions employed in data fitting in neutron physics was demonstrated [9].

Development and Enhancement of Physical Event Reconstruction Algorithms and Particle Identification Methods

The detailed geometry of tracking detectors (CSC, GEM, FSD, VSP, SiBT, SiProf) for the current configuration of the physical setup for the upcoming run (Run 9) of the BM@N experiment, which is used for modelling in the BMNROOT environment, was developed and implemented [10]. The geometric models were considerably refined on the basis of updated diagrams and drawings.

Work on the development of a neural network model for separating reconstructed charged particle tracks by events in individual time slices for the SPD experiment started. The model is based on a graph attention neural network (GANN), which was employed to cluster particle tracks by events in SPD time slices. The analysis of the model's results shows that the GANN exhibits high clustering efficiency, achieving 98.5% precision and over 95% recall.

The data shift problem in particle identification by machine learning methods in the MPD experiment was investigated [11]. A methodology for data shift evaluation was elaborated and tested.

An innovative graph neural network model with an attention mechanism and two-stage aggregation for particle trajectory reconstruction after training on Monte Carlo data simulating measurements from the TPC detector of the MPD experiment was developed. The model demonstrated high performance, achieving 96.2% accuracy along with 92.6% in both purity and efficiency metrics. The track reconstruction efficiency exceeded 90% for track integrities below 80%. The model exhibited an unprecedented event processing speed (~80 ms/event) compared to classical methods (~10 ms/event) [12].

A Kolmogorov–Arnold network (Enhanced KAN) architecture for physics experiment data analysis and reconstruction was elaborated [13]. The problem of unstable KAN training using Adam-family

methods was solved by setting the weights of the proposed basis functions close to zero. The efficiency of the KAN in resolving multi-Gaussian signals was demonstrated. A method for the fast approximation of the magnetic field in a detector setup using the Enhanced KAN was also implemented, and its efficiency was illustrated by the example of the magnetic field in BM@N.

As part of work on muon reconstruction in the High Granularity Calorimeter (HGCal) of the CMS experiment, the passage of cosmic muons through a test setup designed to test detector layers was simulated. The reconstruction procedure was implemented by approximating the responses on one layer by a straight line and searching for clusters and then tracks in HGCal.

A working Monte Carlo model of the OLVE-HERO orbital detector prototype was created, primary beam generation and event processing procedures were implemented, and a dataset for detector response analysis was generated. Separately, the simplified Monte Carlo model of the calorimeter used to calculate background conditions was expanded and enhanced [14].

Development and Enhancement of Methods for Physical Process Modelling and Data Analysis

Work on investigating the excess number of events detected by the CMS experiment on Run 2 data in the dimuon mass spectrum in the invariant mass region of 28 GeV in the class of events with the presence of at least one b -jet was completed [15].

Using Run 3 data (2022 and 2023) from the CMS experiment, studies to search for the Higgs boson produced in vector boson fusion were performed. The decay mode into two b -quarks was used. Correction factors for the high-level trigger were calculated, requirements for the selection of the fusion process of vector bosons and events with two b -jets were formulated, and its criteria were optimized.

An investigation on the search for dark matter within the inert doublet model using the full statistics of Run 2 and the first Run 3 data from the CMS experiment, corresponding to an integrated luminosity of 136 and 36 fb⁻¹, respectively, was completed.

A study of multiparticle correlations in pp interactions at 13 TeV LHC (Run 2) was conducted using the factorial moment method. A method for reconstructing the dependence of factorial moments by multiplicity in pseudorapidity intervals on the size of the interval, considering the detector's hardware function, was developed.

As an alternative approach to simulating the responses on the reading elements of the GEM detector of the BM@N experiment, the idea of applying machine learning algorithms, in particular, a conditional generative-adversarial network (C-GAN), was proposed and implemented [16].

Development of Computational Physics Methods

To solve equations within the coupled channel method with complex potentials describing nuclear reactions with massive nuclei, software complexes that implement the high-order finite element method (FEM) were developed. It was shown that the FEM and the R -matrix method were more stable than the widely used modified Numerov method and allowed including more vibrational and rotational couplings. The calculations of the $^{48}\text{Ti} + ^{208}\text{Pb}$ and $^{51}\text{V} + ^{248}\text{Cm}$ reactions demonstrated that multi-phonon and high-spin states significantly smoothed out the barrier distributions, improving the agreement with experimental data [17]. New third- and fourth-order FEM schemes with multivariate Hermite interpolation polynomials of a d -dimensional hypercube to solve boundary value problems (BVPs) for an elliptic equation with mixed partial derivatives on hyperparallelepipedal meshes were elaborated. Benchmark BVP calculations confirmed the declared order of accuracy of the developed FEM schemes [18].

In collaboration with FLNR and BLTP, an investigation of the $^7\text{Li} + ^{10}\text{B}$ scattering reaction and the $^7\text{Li} + ^{10}\text{B} \rightarrow ^6\text{Li} + ^{11}\text{B}$ reaction at a beam energy of $E_{\text{LAB}} = 58$ MeV based on experimental data obtained at FLNR was carried out. The results indicate the existence of a proton-neutron halo in the structure of the $^6\text{Li}_{0+}$ excited state (3.56 MeV) [19]. The ratio of isotope yields obtained in reactions with an incident ^{18}O ion at an energy of 35 MeV with heavy ^{181}Ta and light ^9Be targets was investigated relying on the transport-statistical approach.

The TANGELO software package for simulating quantum computing was supplemented considering relativistic corrections to Coulomb interactions when calculating chemical compounds involving superheavy elements. The computational algorithm is based on the hybrid quantum-classical adapt-VQE scheme and is implemented for the quantum-chemical computation of wave functions and ground state energies of heavy lead and superheavy flerovium monoxides [20].

A numerical study on the influence of frequency and radius parameters on the structure and properties of standing waves in a ball of finite radius, approximating 3D oscillons in the φ^4 model, was performed jointly with the University of Cape Town [21].

In cooperation with Sofia University, a high-precision numerical method for searching for new solutions to the problem of three equal-mass bodies under collisionless conditions and with central symmetry was developed. The method is based on Newton's method with initial approximations obtained by the grid-search method. [22].

An investigation on the structure of vesicles of the phospholipid transport nanosystem (PhTNS) and PhTNS-based medical drugs using small-angle neutron scattering data was conducted together with FLNP and the Institute of Biomedical Chemistry of the RAS. The influence of impurities and other

factors on the size of vesicles and their structure was analyzed [23].

In collaboration with VBLHEP and DLNP, work on the three-dimensional computer modelling of the magnetic system of the MSC-230 cyclotron with a 4.5 kA current winding, considering a new version of its winding, was carried out [24].

The operator approach to stochastic systems, within which the master kinetic equation is represented in the form of a Schrödinger-like equation with a Hamiltonian dependent on the creation and annihilation operators, was considered. Approximate values for the probabilities of being in the first and second states were obtained for the pure creation process [25].

A potential model with non-local interaction was developed, and a system of equations for describing the spectrum of vector mesons was formulated within the model. The phenomenological choice of the vector meson vertex used will be sufficient to describe the processes of production and dissociation of heavy quarkonia J/ψ (Υ) at heavy ion collision energies in the NICA experiment [26].

A method for efficiently describing the entanglement of a two-qubit system using a specially selected coordinate system in a given cross section of the entanglement space, which simplifies the calculation of nonlocal characteristics, was proposed. The method enables the description of a class of separable states as a semi-algebraic variety [27]. A comparison of a four-dimensional quantum system and a two-qubit

system within the generalized Stratonovich–Weyl correspondence formalism was carried out. Based on numerical analysis, it was demonstrated how information about the possible implementation of a virtual two-level subsystem was encoded in the properties of the Wigner function of the states of the corresponding four-level system.

The Tait–Bryan angles method, which is a modification of the well-known Euler angles method describing the rotation of an orthogonal frame in three-dimensional Euclidean space, was generalized to the case of spaces of arbitrary finite dimension. The developed system of elementary unitary rotations allows for the introduction of a convenient parameterization of Grassmannians and a parameterization of algebraically open subsets of conjugation classes of Hermitian matrices [28].

Regularizing correlation functions were constructed for quantum statistical systems that are composed of atoms or molecules and interact with each other through singular non-integrable potentials [29].

A computer simulation of a controllable magnetization reversal in a chain of φ_0 junctions induced by an alternating voltage was performed. It was shown that by applying an external alternating voltage pulse with a frequency coinciding with the eigenfrequency of the LCR circuit, a magnetization reversal could be realized in the selected φ_0 junction; i.e., the possibility of a controllable magnetization reversal was demonstrated [30].



6–10 October. The JINR Autumn School of Information Technologies

EDUCATIONAL ACTIVITY

Within the educational activity, the JINR Spring and Autumn Schools of Information Technologies (IT Schools) were held in 2025. Eighty-six students from various universities in Russia, Belarus, Kazakhstan, and Uzbekistan participated in them. As a result of the IT School series, 28 people have become JINR employees since 2022. More than 50 theses of postgraduates, master's and bachelor's students were prepared and defended in 2025 under the supervision and scientific advice of the MLIT staff. Over 70 non-graduate students are working on JINR projects and came for practice. In 2025, the education and testing polygon of the HybriLIT platform was actively used both for conducting semester-long training courses and within schools and workshops.

Semester-long training courses on IT disciplines held at Dubna University and the Dubna branch of Lomonosov Moscow State University (MSU Branch) were attended by more than 400 students. In addition, 11 bachelor's and one master's theses were prepared based on the HybriLIT platform. In 2025, the first student enrolment for the master's programme of the Dubna MSU Branch in direction 01.04.02 "Applied Mathematics and Computer Science" took place. Thirteen students successfully passed entrance exams and started mastering the educational programme entitled "Data Processing Methods and Technologies in Heterogeneous Computing Environments".

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LABORATORY of RADIATION BIOLOGY

In 2025, the Laboratory of Radiation Biology (LRB) continued studies under Topic 05-7-1077-2009, "Research on the Biological Effects of Ionizing Radiation with Different Physical Characteristics". LRB staff conducted experiments at JINR's CellRad, SARRP, and IREN ionizing radiation sources, as well as at partner organizations: the Tsyb MRRC (Obninsk),

the Burnazyan FMBC (Moscow), PTC of the Lebedev PI (Protvino), and CENTIS (Havana, Cuba). In 2025, staff members of scientific organizations of Belarus, Cuba, Egypt, Mongolia, Serbia, South Africa, and Vietnam visited the LRB to participate in research carried out using the laboratory's infrastructure.



The JINR Laboratory of Radiation Biology is 20 years old!





Dubna, 17 June. Jubilee seminar of the Laboratory of Radiation Biology "Radiation Biology — at the Intersection of Fundamental Sciences. 20 Years in Focus"

The modifying effect of cytosine arabinoside (AraC) in combination with inhibitors of different stages of DNA repair was studied: benzamide (a PARP1 inhibitor), wortmannin (an inhibitor of PI3K-like kinases, including DNA-PK), and NU7026 (an inhibitor of DNA-PKcs and Ku70/Ku80) — for X-irradiation of human peripheral blood lymphocytes, with the aim of enhancing the radiosensitizing effect. It was found that all combinations of AraC with the inhibitors significantly increase the yield of radiation-induced DNA double-strand breaks (DSBs) compared with the effect of AraC alone (Fig. 1). After combined exposure, the repair kinetics differs significantly from the control: by 6 h, an increase in the number of DNA DSBs is observed, followed by a decrease by 24 h. The maximum effect is observed for

the combination of AraC with NU7026: the DNA DSB yield increases by a factor of 1.73, which is achieved through the simultaneous disruption of synthesis-dependent and synthesis-independent repair mechanisms. This opens prospects for optimizing the radiosensitization of tumour cells when using sparsely ionizing radiation in radiotherapy [1, 2].

Dose-response dependences of the survival of B16 melanoma cells after X-irradiation under the modifying effect of AraC were obtained (Fig. 2). It was shown that, in the presence of AraC (20 μ M), the radiosensitivity of the cells increases (DMF = 1.3 ± 0.3).

After irradiation under the modifying effect of AraC, the number of γ H2AX foci, which are markers of DNA DSBs, significantly increases, starting with a 1.4-fold increase after 4 h of post-irradiation

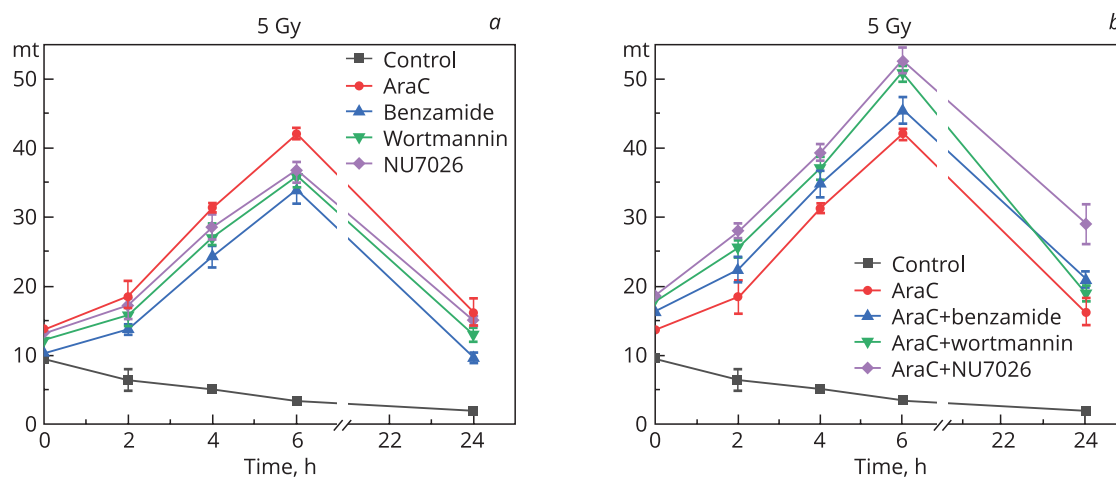


Fig. 1. DNA DSB repair kinetics in human peripheral blood lymphocytes after X-irradiation at a dose of 5 Gy: (a) in the presence of individual modifiers: AraC (20 μ M), benzamide (1 mM), wortmannin (10 nM), and NU7026 (20 μ M); (b) in the presence of combinations of modifiers

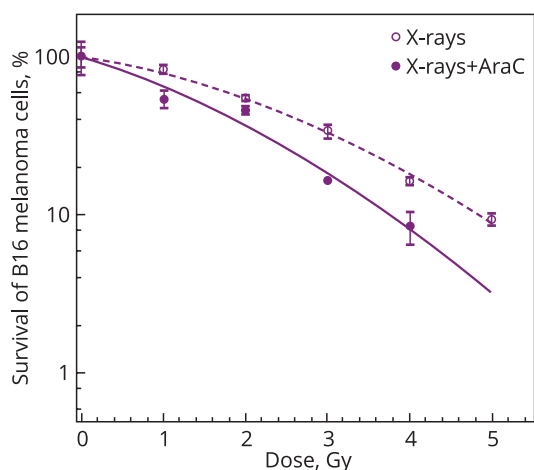


Fig. 2. Dose-response dependence of the survival of B16 melanoma cells after X-irradiation in the presence of AraC (20 μ M)

incubation, and continues to increase with increasing post-irradiation incubation time up to 24 h, at which the maximum 4.2-fold difference is observed. After 24 h, irradiated samples treated with AraC show a significant increase ($P = 0.021$) in the area of the formed γ H2AX foci by a factor of 1.3 (Fig. 3, b), indicating an increase in the clustering of DNA damage.

The development of machine-learning-based approaches for the analysis of fluorescent images of mammalian cell nuclei and the quantitative analysis of DNA DSB protein markers was continued. New functionality enabling the assessment of the number of colocalized γ H2AX/53BP1 foci was added to the MOSTLIT application. The colocalization algorithm initially recognizes the γ H2AX and 53BP1 foci separately within the cell nucleus in a 2D image. Then, based on the distance between the centroids of the γ H2AX and 53BP1 foci, colocalization is determined and quantitative analysis is performed (Fig. 4, a).

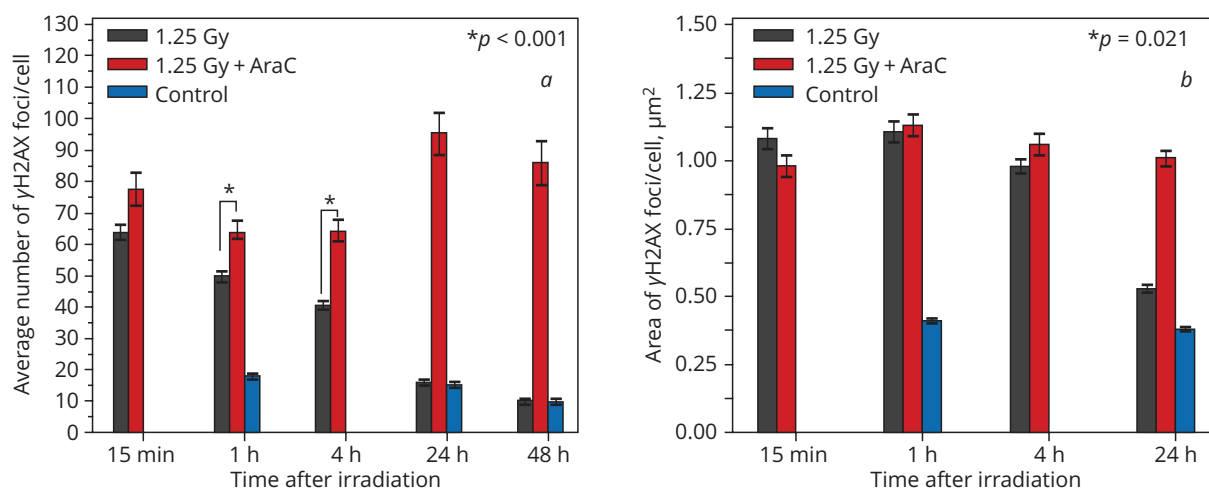


Fig. 3. (a) Kinetics of the formation and elimination of γ H2AX foci and (b) kinetics of changes in the area of γ H2AX foci in the nuclei of B16 melanoma cells after X-irradiation (1.25 Gy) in the presence of AraC. In histogram a, mean values of the number of γ H2AX foci \pm standard errors of the mean are shown; in b, median values of the γ H2AX foci area \pm standard error of the mean. The statistical significance of differences is demonstrated using the Kruskal–Wallis and Dwass–Steel–Critchlow–Fligner tests for pairwise group comparisons at (a) $P < 0.001$ and (b) $P = 0.021$

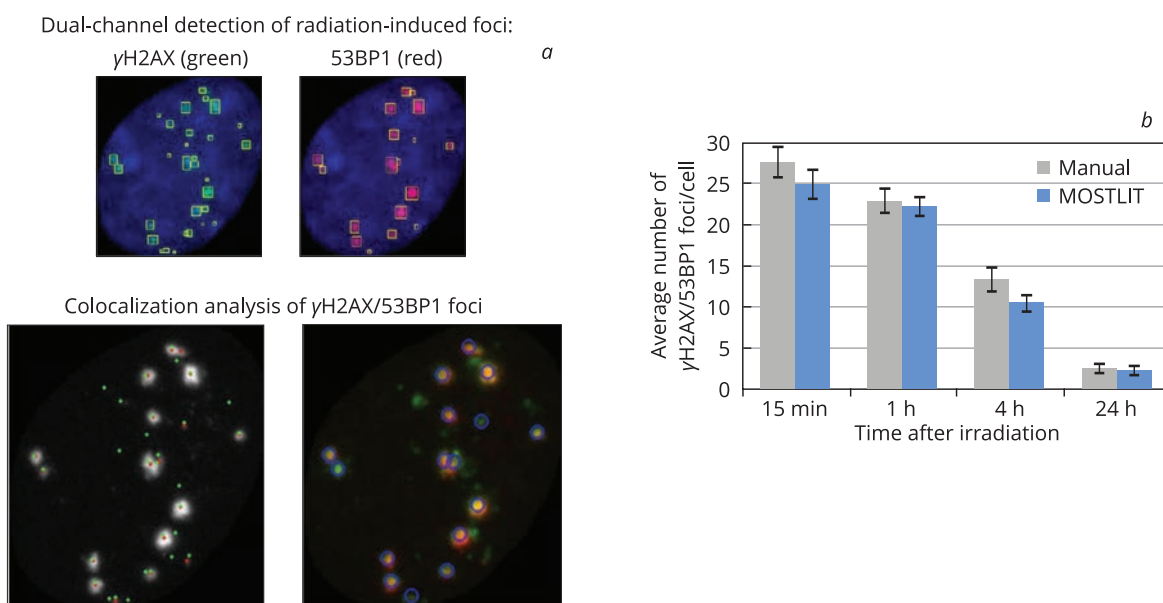


Fig. 4. (a) An example of the work of the MOSTLIT machine-learning-based algorithm for the analysis of fluorescent images of cell nuclei (blue signal) containing DNA DSB marker proteins: γ H2AX (green signal) and 53BP1 (red signal). Colocalization analysis was performed at 4 pixels between centroids. (b) Induction and elimination of radiation-induced γ H2AX/53BP1 foci in the nuclei of normal human skin fibroblasts after ^{60}Co γ -ray exposure at 1.25 Gy, performed by a group of operators and by the MOSTLIT colocalization algorithm. The graph shows mean values of the number of γ H2AX/53BP1 foci \pm standard errors of the mean

Based on this approach, the kinetics of the formation and elimination of γ H2AX/53BP1 foci in the nuclei of fibroblasts after γ -irradiation at a dose of 1.25 Gy was analyzed (Fig. 4, b). Automated analysis shows good agreement with manual analysis performed by an operator in two-dimensional space and additionally makes it possible to assess the nu-

clear area and the total area of all formed γ H2AX and 53BP1 foci per nucleus, as well as to draw conclusions about the degree of colocalization of the two markers and the complexity of the resulting DNA damage clusters [3, 4].



Dubna, 27 March. State Secretary of the Ministry of Science, Technological Development and Innovation of Serbia M. Trajanović (centre) on an excursion at LRB during his visit to JINR

RADIATION GENETICS AND CYTOGENETICS

The application of the YOLOv8 neural network architecture for automating the analysis of chromosomal aberrations in blood lymphocytes of *Macaca mulatta* monkeys was proposed. The quality of automated analysis was evaluated by comparing experimental dose–effect curves with curves constructed using the proposed algorithm. The dependence of the yield of dicentric chromosomes on dose falls within the 95% confidence interval of the curve constructed from researcher-derived data, demonstrating

the good potential of this approach for detecting chromosomal damage of this type (Fig. 5).

To further improve classification accuracy, it is planned to expand the training dataset by increasing the number of images of cells with rare types of aberrations and to implement post-processing of detection results using morphometric criteria. The application of such approaches will significantly increase the speed of chromosomal aberration analysis, minimizing the influence of the human factor and the likelihood of subjective errors [5].

A cytogenetic analysis was performed on HPRT-mutant subclones isolated at early (3rd day) and late (40th day) time points after ^{60}Co γ -ray and accelerated ^{11}B ion exposure of V79 Chinese hamster cells. It was found that the manifestation of chromosomal instability in the resulting viable mutant subclones depends on the type of radiation used.

It was shown that ^{60}Co γ -ray exposure induces prolonged chromosomal instability in mutant clones, whereas ^{11}B ions at comparable doses, despite a higher initial cytogenetic effect, lead to clone stabilization in the long term and even to the formation of subpopulations with reduced levels of chromosomal aberrations (Fig. 6) [6].

Chromosomal aberrations (CAs) in peripheral blood lymphocytes of patients with differentiated

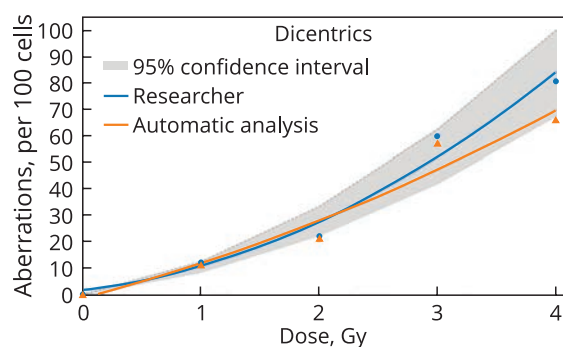


Fig. 5. Dependence of dicentric yield on radiation dose, obtained by manual (●) and automated (▲) analysis

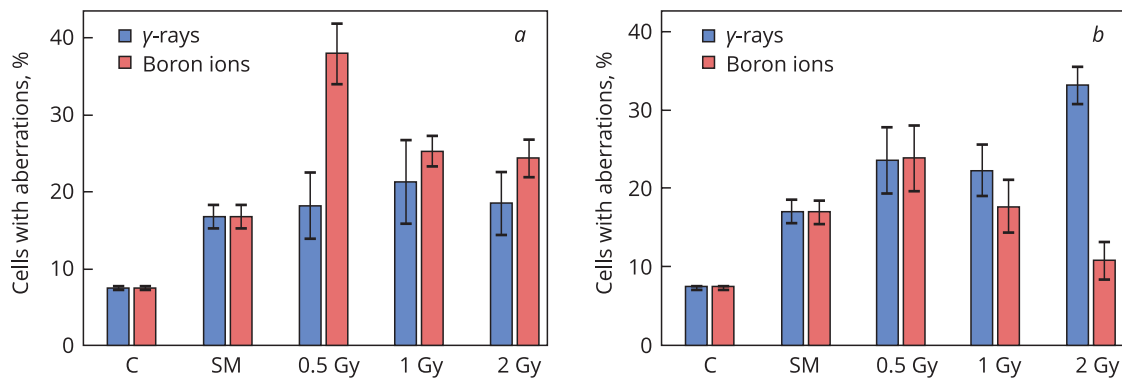


Fig. 6. Frequency of cells with chromosomal aberrations in HPRT-mutant subclones after ^{60}Co γ -ray and ^{11}B ion exposure as a function of dose: (a) on the 3rd day and (b) on the 40th day after irradiation. C — control; SM — spontaneous mutations

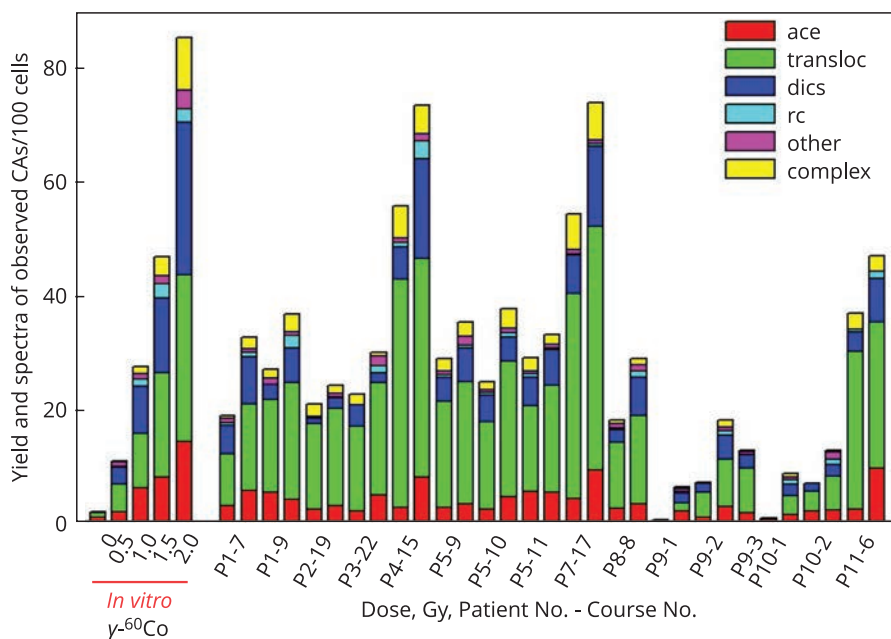


Fig. 7. Frequency and spectrum of aberrations registered by mFISH in blood lymphocytes of the examined patients before and after a course of radioiodine therapy (RIT) (patient code — RIT course number), as well as aberrations obtained after *in vitro* irradiation of donor blood (per 100 cells). ace — acentric fragments, transloc — translocations, dics — dicentric, rc — centric rings, other — acentric rings and inversions, complex — complex aberrations

thyroid cancer who received multiple courses of radioiodine therapy (RIT) at the Tsyb Medical Radiological Research Centre (Obninsk, Russia) were studied using multicolour fluorescence *in situ* hybridization (mFISH). An increase in the frequency of CAs as a result of RIT was observed, and the spectra of induced aberrations were analyzed (Fig. 7). The performed biological dosimetry confirmed the conclusion that a single administration of radioiodine was safe, since the generally accepted threshold of 2 Gy for the total dose of incidental exposure was not exceeded [7].

The stress resistance of the probiotic lactobacilli *Lactiplantibacillus plantarum* and several yeast

strains, *Saccharomyces cerevisiae* (Sc) and *Saccharomyces boulardii* (Sb), was studied under laboratory conditions and during a flight aboard the Bion-M No.2 biosatellite in near-Earth orbit. Under laboratory conditions, actively metabolising yeast cultures were exposed to X-rays at doses of up to 30 Gy using the SARRP facility (130 kV, 3 Gy/min) and to 170-MeV protons. The exposure did not cause changes in sensitivity to the tested antibiotics (Fig. 8). Radiore-sistance and low mutability make the tested strains promising for use in long-duration space mis-sions [8].



Practical classes on cytogenetics for students of the Department of Biophysics of Dubna University are conducted by the Head of the Radiation Cytology Sector, I. Koshlan

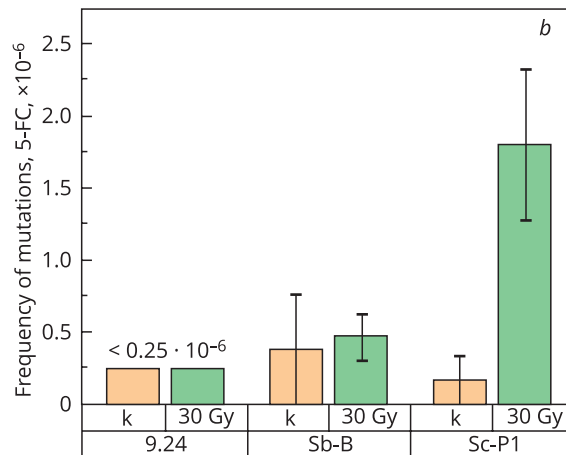
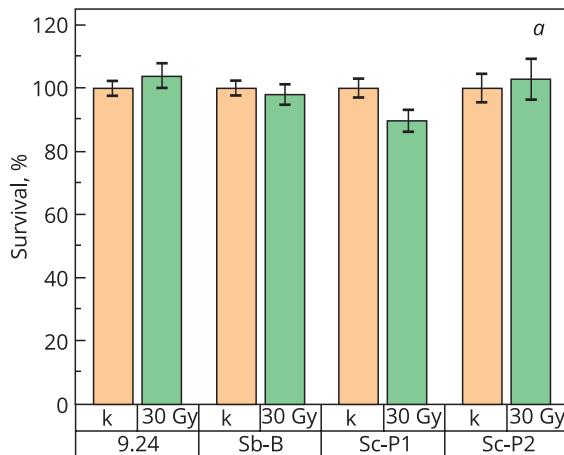


Fig. 8. (a) Survival and (b) induction of 5-fluorocytosine (FC) resistance mutations by X-rays (SARRP, Xstrahl) in yeast strains Sc-9/24 (laboratory), Sb-B (isolated from Enterol (Biocodex, France)), and Sc-P1 and Sc-P2 (isolated from Cosm-O-tentic® (Puratos, Belgium))

MEDICAL RADIOBIOLOGY

A new approach for enhancing the efficacy of targeted radionuclide therapy using β -emitters was proposed. *In vitro* studies on B16 mouse melanoma cells showed that methylene blue labelled with iodine-131 (with or without AraC) rapidly enters the cells, with approximately 70% taken up within 3 h. The biological half-life is 3.5 d. Experiments showed that under the action of ^{131}I -labelled methylene blue

in the presence of AraC, the dose-modifying factor for cell survival was approximately 5 (Fig. 9). Thus, selective accumulation of the radionuclide in tumour tissue combined with enhanced radiosensitivity of malignant cells allows a reduction in the activity of the therapeutic radiopharmaceutical, opening prospects for clinical application of this approach [9].

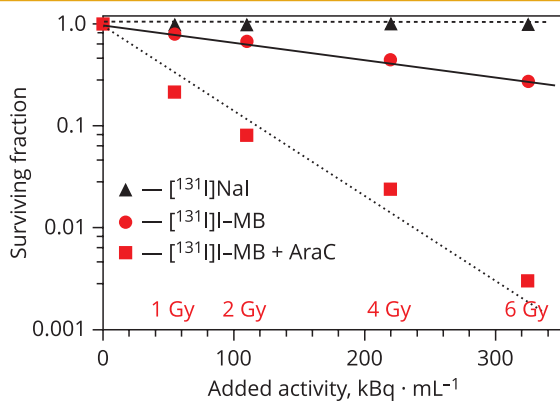


Fig. 9. Dependence of B16 melanoma cell survival on the added activity of iodine-131 as part of labelled methylene blue (without and in combination with AraC, red symbols) or in the ionic form (black symbols)

RADIATION PHYSIOLOGY AND NEURORADIOBIOLOGY

Electrophysiological parameters of the rat cerebral cortex and behavioural responses were assessed at early and late time points after cranial X-ray exposure at the SARRP facility (Fig. 10). It was found that locomotor activity in the “Open Field” test system decreases on the 1st and 30th days after local brain irradiation at a dose of 10 Gy. These

behavioural changes are observed against the background of reduced spectral power of the alpha, beta, and theta brain rhythms.

An investigation of the correlation between rhythms showed a persistent abnormal correlation between EEG alpha and beta rhythms in irradiated animals. The conducted studies help to better as-

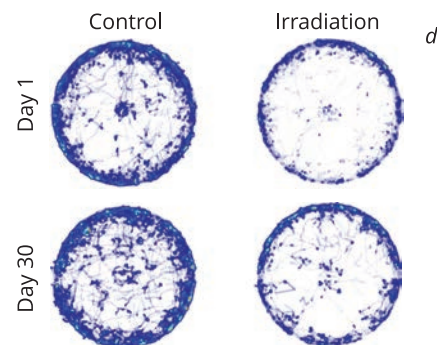
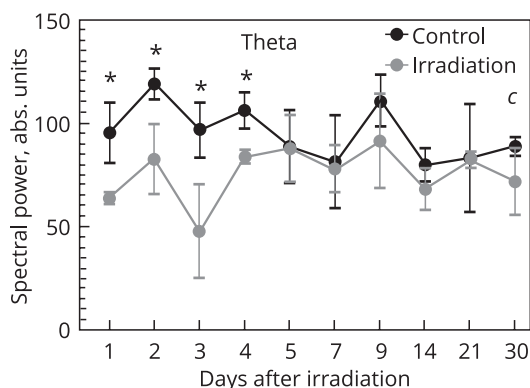
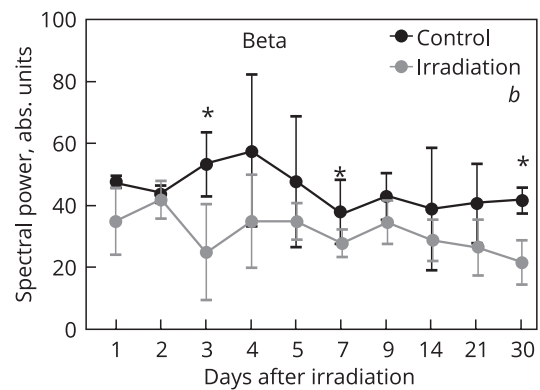
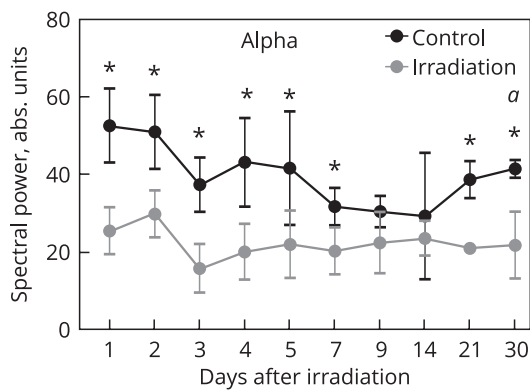


Fig. 10. Spectral power of EEG (a) alpha, (b) beta, and (c) theta waves; (d) heat maps of rat locomotor activity in the open field test on the 1st and 30th days after X-ray exposure at a dose of 10 Gy

sess the risks and side effects of prophylactic cranial irradiation and conventional external-beam radiotherapy of malignant CNS neoplasms, and to opti-

mize methods for assessing patient condition in the post-irradiation period [10].

MATHEMATICAL MODELLING OF RADIATION-INDUCED EFFECTS

A mathematical model of DNA double-strand break (DSB) repair in mammalian and human cells exposed to heavy charged particles over a wide LET range was developed. The yield of initial DNA damage arising from irradiation of cells with heavy charged particles was determined. The model construction considers the presence of DNA DSBs of different complexity. The key stages of the non-homologous end joining (NHEJ) and microhomology-mediated end joining (MMEJ) mechanisms were described. The modelling results adequately reflect the kinetics of the main regulatory mechanisms controlling repair processes in the G1 and early S phases of the cell cycle. The proposed model makes it possible to

relate theoretical data on the kinetics of DNA DSB repair to experimental results obtained using γ H2AX foci, DNA comet, and premature chromosome condensation (PCC) assays (Fig. 11) [11].

A mathematical model was developed that describes the repair kinetics of DNA damage induced by ionizing radiation with different linear energy transfer (LET), considering the effect of DNA repair inhibitors. The model includes the kinetics of two types of DNA DSBs: direct and enzymatic DSBs. The proposed model makes it possible to perform a quantitative interpretation of experimental data on the kinetics of DNA DSB repair (Fig. 12) [12].

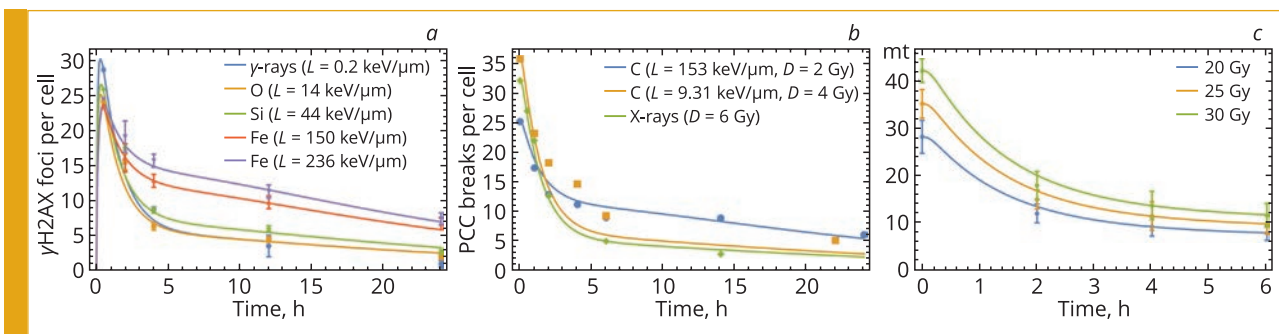


Fig. 11. Kinetics of radiation-induced damage in mammalian and human cells: (a) γ H2AX foci in human skin fibroblasts exposed to ionizing radiation of different physical characteristics at a dose of 1 Gy; (b) PCC breaks in human skin fibroblasts after exposure to ^{12}C ions and X-rays; (c) tail moment (mt) in human peripheral blood lymphocytes after exposure to ^{11}B ions (LET = $89 \text{ keV}/\mu\text{m}$) at different doses. Corresponding experimental data from A. Asaithamby et al. (2008), S. Ritter et al. (1999), V. N. Chausov et al. (2018) are indicated by symbols of different shapes

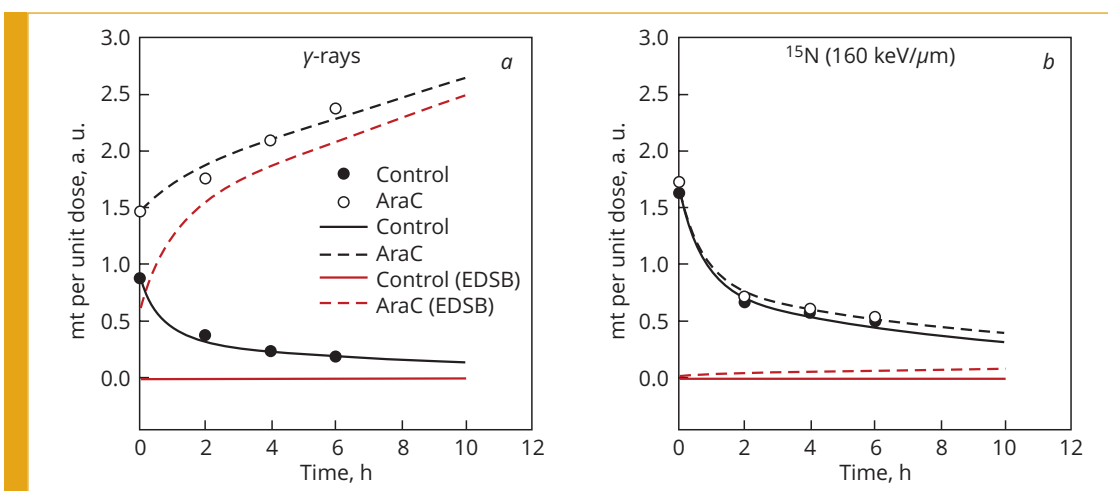


Fig. 12. Calculated DNA damage yield, expressed as comet tail moment (mt) per unit dose: (a) γ -rays and (b) accelerated ^{15}N ions ($160 \text{ keV}/\mu\text{m}$) under normal conditions and in the presence of AraC. Experimental data from V. N. Chausov et al. (2018) are shown as open circles with AraC and closed circles for the control; the solid and dashed lines indicate calculated data without and with AraC, respectively; the red notation shows the corresponding yields for enzymatic DSBs

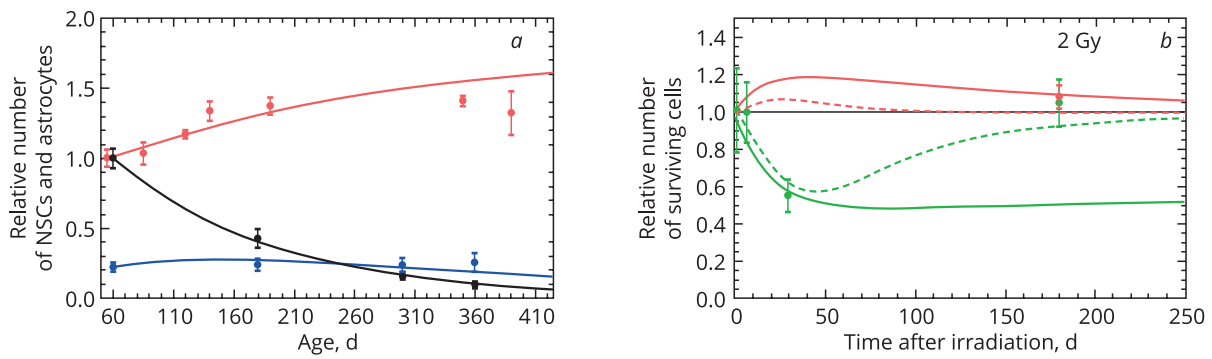


Fig. 13. (a) Relative numbers of α -NSCs (black), β -NSCs (blue), and astrocytes (red) calculated using the morphological heterogeneity model of NSCs. (b) Relative numbers of NSCs and astrocytes after X-irradiation of 70-day-old mice at a dose of 2 Gy (A. Casciati et al. (2016)). The numbers of NSCs (green) and astrocytes (red) are calculated using the morphological heterogeneity model of NSCs (solid line) and the simplified self-renewal rate heterogeneity model (dashed line). All curves are normalized to the corresponding age-dependent dynamics

A model was developed describing the dynamics of morphologically heterogeneous populations of neural stem cells (NSCs) of α and β types in response to irradiation. The simulation results were compared with a simplified model of the division rate heterogeneity of an NSC population. Both models included the production of astrocytes from NSCs to simulate gliogenesis in the dentate gyrus of the mouse hippocampus. NSC and astrocyte survival after X-irradiation was calculated for doses of 0.1 and 2 Gy. The model based on division rate heterogeneity reproduces more accurately experimental data on changes in the number of NSCs than the model based on morphological heterogeneity. In contrast, the number of astrocytes is better described by the morphological heterogeneity model, as β -NSCs are more radioresistant and generate significantly more astrocytes than α -NSCs. These results indicate that an optimal predictive model should combine the NSC population dynamics obtained from the divi-

sion rate heterogeneity model with the astrocyte dynamics obtained from the morphological heterogeneity model (Fig. 13) [13].

An analysis was performed of the spatial distribution of absorbed dose and the probability of particles hitting different parts of the cell (the cell body, axon, dendrites, and spines) under exposure to charged particles — from protons to iron ions with energies ranging from 10 to 1000 MeV/nucleon (Fig. 14). The mechanisms were considered of the formation of direct and indirect molecular damage in the genetic apparatus and synapses of nerve cells due to physical processes leading to bond breakage and chemical reactions with water radiolysis products. Key modelling parameters required to verify the calculations against experimental results were also examined. The data can be used for further analysis of radiation risks in interplanetary missions and for the assessment of side effects of hadron therapy [14].

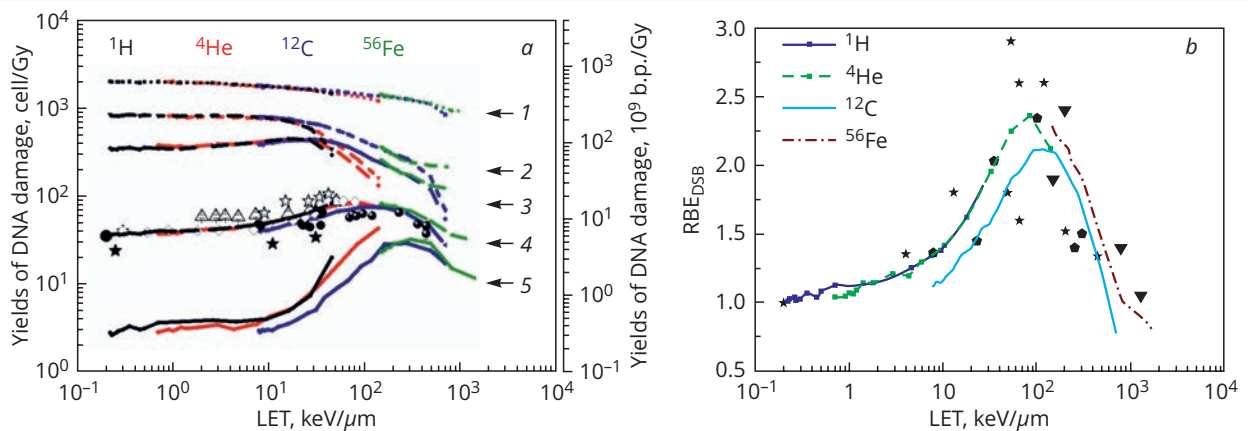


Fig. 14. (a) Yield of primary DNA damage in the nuclei of rat hippocampal neurons as a function of LET. The main types of DNA damage are base damage (1), single-strand breaks (SSBs) (2), clustered SSBs (3), double-strand breaks (DSBs) (4), and clustered DSBs (5). The symbols represent experimental data on DNA DSBs (T. S. Bulanova et al. // Part. Nucl. Lett. 2019). (b) Dependence of relative biological effectiveness (RBE) on LET of charged particles according to the criterion of DNA DSB induction: comparison of modelling results (lines) and experimental data (symbols) (D. Frankenberg et al. // Adv. Space. Res. 2000)



17 September. A visit to JINR by the representative of the RF Embassy of the Republic of Cuba Alberto Turro Breff and the specialist in education and science Delis Sevilla Rodríguez

An analysis was performed of the structural features of the POPC lipid bilayer during interaction with boron-containing ligands, boronophenylalanine (BPA) and borocaptate (BSH) (Fig. 15). A detailed analysis of the structural characteristics of the POPC bilayer in the presence of the ligands showed changes in structural parameters depending on their concentration on the membrane surface. The results demonstrate preservation of the structural integrity of the membrane upon contact with the studied compounds. It was established that these ligands are capable of spontaneous binding to surface components of the membrane, including the glycerol moiety, the choline group, and phosphate residues. Analysis of the obtained results shows that, at the concentrations considered, boronophenylalanine molecules bind to the cell membrane to a lesser extent (approximately 15%). At the same time, compounds of this type actively interact with the phosphate group of the lipid. Sodium borocaptate molecules penetrate into the lipid membrane

structure and localize near the C=O group of the acyl chain. With increasing concentration, the number of bound molecules increases, while their localization site does not change [15].

Molecular dynamics simulations were performed of NMDA receptors containing either single modified amino acid residues (Trp607 and Trp752) or several simultaneous modifications (Tyr731, Cys765, 819, and Trp607, 752), as well as changes in membrane structure (POPC). It was found that damage to glutamate receptors and POPC molecules predominantly leads to a decrease in the conductance of the receptor ion channel, with the exception of damage to Cys765 and oxidized lipids of the PazePC form. Analysis of the current-voltage characteristics of glutamate receptors in most cases revealed a decrease in macroscopic currents through damaged glutamate receptors. In the case of damage to Cys765, a pronounced decrease in the theta rhythm and a significant increase in the gamma component are observed compared with native forms of the NMDA

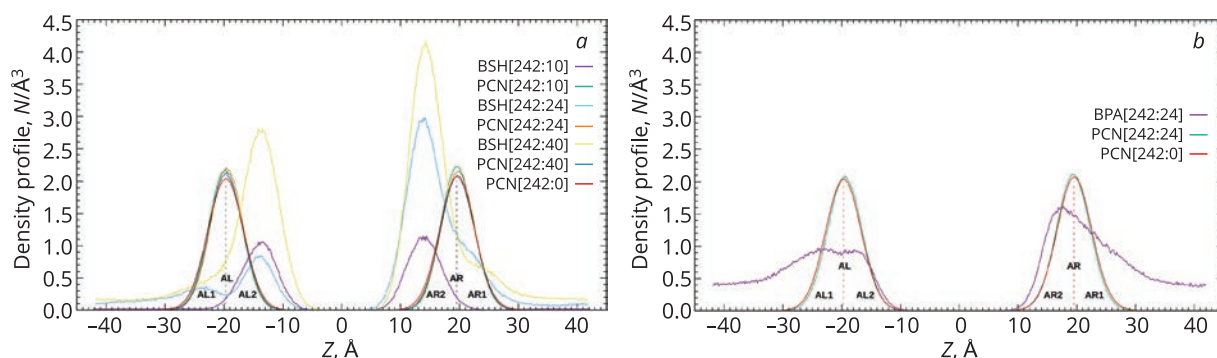


Fig. 15. Membrane density profile in a molecular system with boron-containing compounds: (a) with BSH and (b) with BPA

receptor. Oxidation of the POPC lipid layer results in an increase in the theta frequency and a decrease in the gamma-range frequency. In all cases, a substantial increase in the beta rhythm was noted [16].

A spatially distributed phenomenological mathematical model of tumour growth dynamics was proposed, accounting for nonlinear growth, immune control, diffusion, and radiotherapy [17]. The model

reproduces the main biological features of tumour growth and its interaction with the immune system. Qualitative analysis revealed critical relationships between tumour parameters (initial cell concentration, immune threshold) and radiotherapy regimens (dose and number of fractions) under which tumour growth suppression is achieved.

RADIATION RESEARCH

Joint studies with the Institute of Chemistry of the Far Eastern Branch of the Russian Academy of Sciences were conducted to assess the potential of metal-containing radiosensitizers for improving radiotherapy of oncological diseases. $\text{Fe}_3\text{O}_4\text{-SiO}_2\text{-Au}$ systems (Fig. 16) containing gold nanoparticles (AuNPs) were investigated. Monte Carlo simulations using PHITS were performed to analyze particle interactions with monochromatic photons in the energy range 50–150 keV and to evaluate the effects of AuNP structure and concentration on the enhancement of local energy deposition in a water phantom [18].

A detailed simulation of the radiation environment during operation of the SIMBO and IS CRA stations and beamlines of the NICA complex was carried out in collaboration with researchers from VBLHEP [19]. Using the FLUKA Monte Carlo code, the limiting beam intensities ensuring compliance with the required zoning of premises for personnel were determined. The results show that the adopted design solutions ensure compliance with radiation safety standards during station operation. Figure 17 presents the distributions of the effective dose rate for the SIMBO and IS CRA stations.

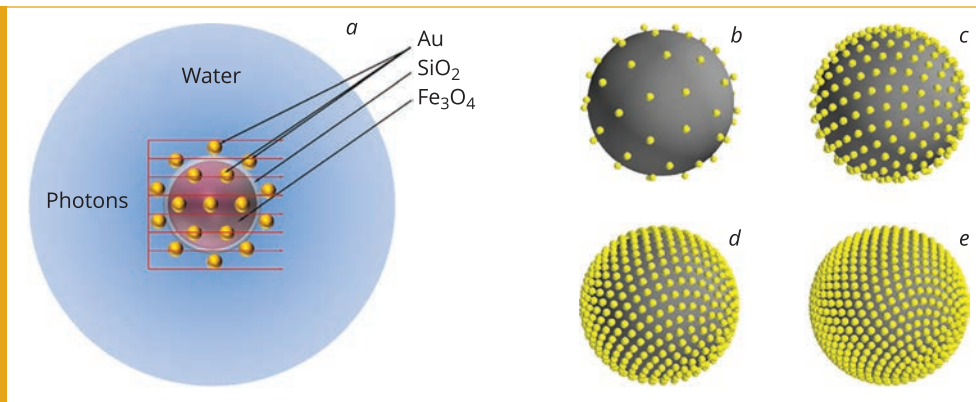


Fig. 16. (a) Geometry used in the simulations: a Fe_3O_4 core (83 nm in diameter) coated with a SiO_2 shell (2 nm thick). Gold nanoparticles (AuNPs) with a diameter of 5 nm were considered in four core-shell-satellite configurations with (b) 67, (c) 331, (d) 661, and (e) 921 AuNPs distributed over the SiO_2 surface

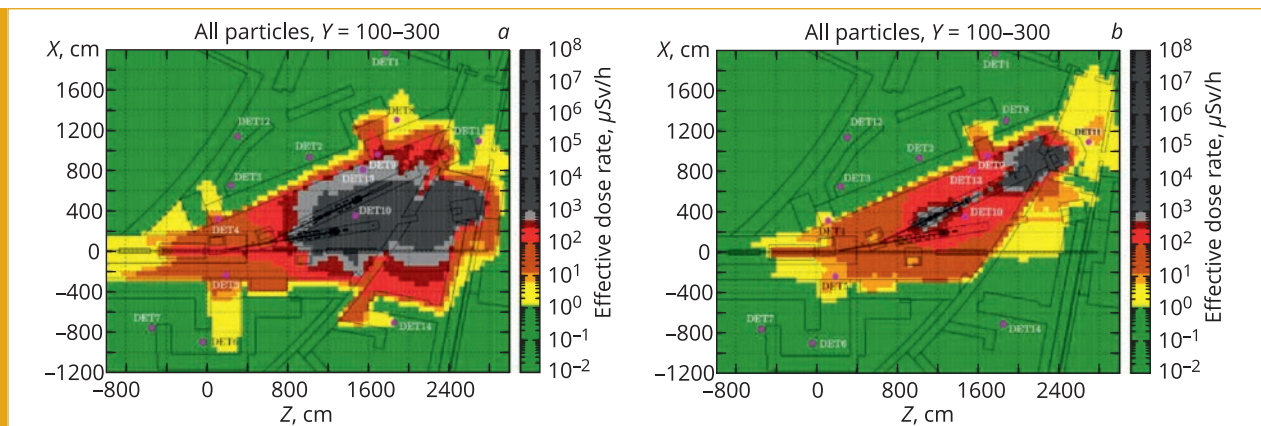


Fig. 17. Two-dimensional projections of the spatial distribution of the effective dose rate during operation of the SIMBO (a) and IS CRA (b) stations

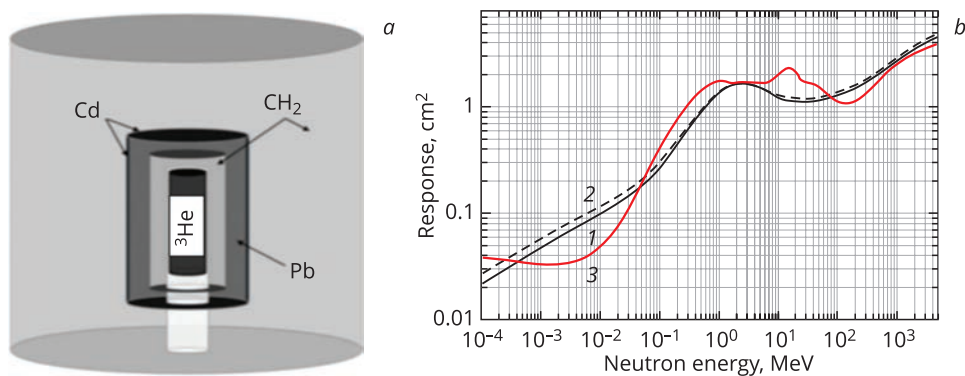


Fig. 18. Schematic view of the dosimeter (a) and energy dependence of its sensitivity function (b): 1 — lateral irradiation; 2 — isotropic irradiation; 3 — ideal dosimeter (normalized at 2 MeV)

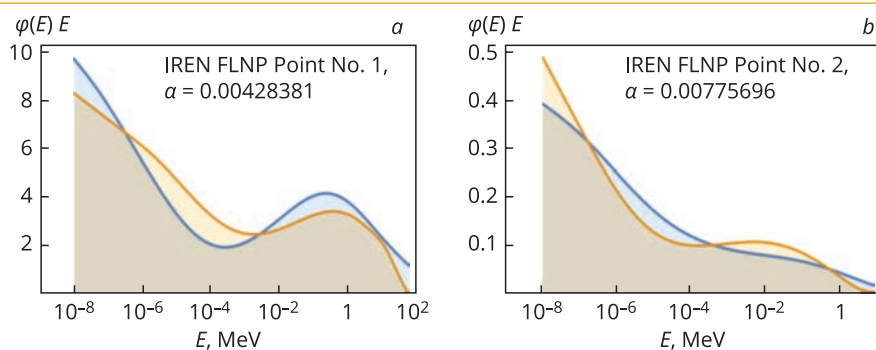


Fig. 19. Comparison of neutron spectra behind the biological shielding at points 1 (a) and 2 (b): the blue line corresponds to the new method; the orange one, to the spectrum reconstructed with the ReconSt code

The sensitivity function of a high-energy neutron dosimeter was calculated for neutron energies in the range from 10⁻⁴ MeV to 5 GeV [20]. The dosimeter consists of a heterogeneous moderator and a ^3He detector. The detector design (Fig. 18, a) and the sensitivity function (Fig. 18, b) were calculated by Monte Carlo modelling using the GEANT4 and SHIELD codes. This type of dosimeter is relevant in connection with the commissioning of the SIMBO and ISCRA stations of the NICA facility, as well as the MSC-230 proton cyclotron and the IREN facility.

A new method for reconstructing neutron energy spectra was tested using expansion of the neutron spectrum in shifted Legendre polynomials with Tikhonov regularization, based on the readings of a Bonner spectrometer [21]. Validation was performed using neutron spectra obtained at points 1 and 2 (Fig. 19) behind the biological shielding of the IREN facility, FLNP, JINR.

ASTROBIOLOGY

Micropaleontological studies of meteorite material and ancient terrestrial rocks using scanning electron microscopy were continued [22, 23]. In carbona-

ceous chondrites and asteroids, chiral proteinogenic amino acids were detected with an excess of left enantiomers, indicating their biogenic origin.

CONFERENCES AND EDUCATION

During 2025, members of the laboratory staff took part in 25 international and Russian scientific conferences.

On 20–24 October, JINR hosted the international conference “Current Problems in Radiobiology.

Accelerated Charged Particles and Neutrons in Radiobiology”. A book of proceedings was published (Dubna: JINR, 2025. 204 p.). Two plenary and 58 oral reports were made; seven poster contributions were presented by young scientists.



Moscow, 25 November. Head of the LRB Sector of Astrobiology Academician A. Rozanov is awarded with the Order of Alexander Nevsky for great contribution to science and long standing conscientious work

In 2025, two International Schools on Nuclear Methods and Applied Research in Environmental, Material, and Life Sciences were held: NUMAR-2025 (Havana, Cuba) and NUMAR-Gobi (Ulaanbaatar, Mongolia). The events were organized by JINR, the Cuban Agency for Nuclear Energy and Advanced Technologies, the Nuclear Energy Commission under the Government of Mongolia, the National University of Mongolia, and the Mongolian Academy of Sciences. Students and young scientists from Brazil, China, Costa Rica, Cuba, the Dominican Republic, Mexico, Mongolia, Paraguay, and Vietnam took part in the schools.

On 19–20 March, an International Radiobiology Working Meeting took place in Cape Town, South Af-

rica. It was organized by the Republic's accelerator centre, NRF: iThemba LABS, and the Joint Institute for Nuclear Research. Practical courses on cytogenetic methods were held within student schools at iThemba LABS (South Africa, January 2025) and at JINR (Dubna, June–July 2025).

The educational process continued at the Department of Biophysics of Dubna University. The Department's current enrolment is 27 students and 4 postgraduates. Three students successfully completed their programmes and were awarded Master's degrees in Physics.

The JINR Publishing Department issued a two-volume collection of selected works and new editions of monographs by E. Krasavin [24–26].



Cape Town (RSA), 19–20 March. Participants of the 1st Radiobiology Working Meeting at the iThemba LABS



Head of an LRB group E. Nasonova (second from right) at the JINR–South Africa Summer Student School

INNOVATIONS



Certificate of state registration of a computer program. Program for determining X-ray beam quality characteristics based on the X-ray tube spectrum. I. S. Gordeev, Joint Institute for Nuclear Research (JINR). Certificate No. 2025664956, Application No. 2025663182, submitted 27.05.2025, registered 09.06.2025, Federal Service for Intellectual Property (Rospatent), Russian Federation.

Certificate of state registration of a computer program. SPIDER program for automated processing of instrumental spectra from a multi-sphere neutron spectrometer. I. S. Gordeev, Joint Institute for Nuclear Research (JINR). Certificate No. 2025690586, Application No. 2025689230, submitted 24.10.2025, registered 10.11.2025, Federal Service for Intellectual Property (Rospatent), Russian Federation.

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UNIVERSITY CENTRE

In 2025, the activities of the University Centre (UC) Council resumed. The new Council includes representatives of the JINR Directorate, relevant Heads of Departments responsible for educational directions, Heads of the Association of Young Scientists and Specialists of JINR (AYSS), the MSU branch in Dubna, and Dubna State University. A Working Group of the UC Council has also been established.

At the first meeting on 28 February, participants were briefed on the UC's current activities and development directions within the Seven-Year Development Plan for 2024–2030 and the Long-Term Development Plan up to 2030. The Director of JINR highly commended the work of the University Centre's staff, noting that attracting and retaining young talents in JINR's innovation and scientific programmes remains a priority task. However, he also drew attention to the strategic importance of personnel policy aimed at increasing

the number of engineers and qualified technical staff.

The second meeting of the UC Council was held on 28 October, focusing on the results and future development prospects of the JINR-based university departments. Council members and invited participants were also presented with the ongoing work analyzing the effectiveness of the UC's tools. Particular interest was generated by the successful career trajectories of participants in the START programme and the possibility of adopting a systematic approach to studying their professional achievements. Participating remotely as a guest at the Council meeting was N. Barbashina, Vice-Rector of MEPhI. Consequently, one focal point of the discussion was the continuation of the successful scientific and educational collaboration between MEPhI and JINR, with particular emphasis on strengthening career guidance work for junior-year students.

EDUCATIONAL PROCESS AT JINR

In 2025, educational programmes were organized for students from the JINR-based departments of the Lomonosov Moscow State University (MSU), the National Research Nuclear University MEPhI (NRNU MEPhI), the Moscow Institute of Physics and Technology (MIPT), Dubna State University, St. Petersburg State University (SPbSU), and Kazan (Volga Region) Federal University (KFU).

Internships and practical training at JINR involved 607 students from Voronezh State University and Voronezh State Medical University, Dubna State University, Far Eastern Federal University, Eurasian National University and Kazakh National University, KFU, MGIMO University, Bauman Moscow State Technical University, MSU, MIPT, NRNU MEPhI, Omsk State Technical University, Perm State National Research University, Russian State Agrarian Academy — Moscow Timiryazev Agricultural Academy, RUDN University, Samara State University and Samara State Technical University, SPbSU, North Ossetian State University, Tver State University and Tver State Technical University, Tomsk State University and Tomsk Polytechnic University, Tula State University, Ural Federal University, and South Rus-

sian State Polytechnic University. The distribution of students across laboratories in 2025 was as follows: VBLHEP — 188, FLNR — 89, BLTP — 86, FLNP — 81, DLNP — 72, MLIT — 62, and LRB — 7. The UC accepted 6 students, and the general institute services and departments accepted 16.

The UC facilitated the process of taking candidate (PhD) exams in their speciality for four JINR staff members affiliated with the MIPT-based department "Fundamental and Applied Problems of Micro-World Physics".

Forty-six students from the Moscow Region Polytechnic College, the College of Dubna State University, Dmitrov Technical College, and Moscow College of Communications No. 54 completed practical training at JINR.

University Centre Programmes for Students

In 2025, 63 students and postgraduate researchers from Belarus, Bulgaria, Brazil, Cuba, the Dominican Republic, Egypt, India, Iran, Mexico, Mongolia, Morocco, Pakistan, the Philippines, the Russian Fed-



Dubna, 16 June – 4 July. Participants of the first stage of the International Student Practice at UC JINR

eration, Serbia, South Africa, Turkey, and Uzbekistan participated in the online INTEREST programme. Over its five years of operation, the programme has involved 479 participants from 42 countries. The programme includes the distant completion of scientific projects, as well as lectures and tours conducted online.

Seventy-eight participants from Belarus, Cuba, Egypt, Indonesia, Mexico, the Russian Federation, South Africa, Spain, Tunisia, Turkey, Uzbekistan, and Vietnam took part in the winter and summer sessions of the 2025 START programme (STudent Advanced Research Training at JINR). Over a period of 6–8 weeks, they conducted in-person research projects under the supervision of JINR staff. Since its inception in 2014, the programme has involved a total of 537 participants, with 298 participants from 23 countries in the last five years alone.

Seventy-two students from Belarus, Egypt, Serbia, South Africa, and Vietnam participated in the two in-person sessions of the 2025 International Student Practice. For the first time, a joint practice session was organized for students from the Republic of South Africa and the Arab Republic of Egypt. On 12 October, a meeting chaired by the Plenipotentiary of the Government of Egypt to JINR was held at the Academy of Scientific Research and Technology of Egypt (ASRT), dedicated to organizing such a practice at JINR in June–July 2026 and to expanding this format in the future to attract students from other African countries.

A distinctive feature of the autumn practice session was the method used to form the group of students from Vietnam. The JINR Information Centre at the Institute of Physics in Hanoi conducted its first competitive selection process for participants. Since 2004, a total of 1945 individuals have participated in the practice, including 219 during the period from 2021 to 2025.

South Africa – JINR Summer School

From 22 January to 1 February, JINR staff participated in the traditional South Africa–JINR Student Summer School in Physics, organized by the South African Institute of Nuclear Technology and Sciences (SAINTS) at iThemba LABS. Leading JINR specialists delivered a series of lectures on various thematic areas of the Institute’s work. A regular feature of the programme was the use of virtual laboratories that engaged all students this time. Compared to the previous school, this year’s programme included a greater number of practical sessions, notably in radiobiology, conducted jointly by JINR and South African colleagues. For the first time, a Russian Club was introduced as part of the school’s activities.

JINR Information Centres

On 6 June, the thirteenth JINR Information Centre was opened at Southern Federal University (Rostov-on-Don), which is the seventh on the territory of the



Rostov-on-Don (Russia), 6 June. The ceremonial opening of the JINR Information Centre at the Southern Federal University and the signing of a cooperation agreement.

Photo: © Southern Federal University

Russian Federation. The opening ceremony was attended by representatives of the JINR and SFU leadership, the Government of the Rostov Region, the UC, as well as young JINR scientists. The ceremonial opening was accompanied by lectures, round tables, and educational sessions for school students, university students, postgraduates, and researchers, involving scientists and specialists from JINR, their colleagues from SFU, and other educational and scientific organizations.

On 20–21 June, a series of events entitled “JINR Meridians, Arctic Latitude” was held in Arkhangelsk at the Northern (Arctic) Federal University (NARFU). The programme included a meeting of the heads of JINR Information Centres, scientific lectures, and round tables dedicated to developing international cooperation within the JINR Information Centre partner network, as well as school-level physics education. The events were attended by representatives of the JINR Directorate and the UC, officials from the Government of the Arkhangelsk Region and universities, heads of Information Centres at universities, institutes, and scientific centres in Arkhangelsk, Vladivostok, Irkutsk, Cairo (Egypt), and Cape Town (South Africa). Online participants joined from Vladikavkaz (North Ossetia), Rostov-on-Don, Sofia (Bulgaria), and Tomsk. Alongside the heads of the South African Information Centre, representatives from iThemba LABS (South Africa) also took part.

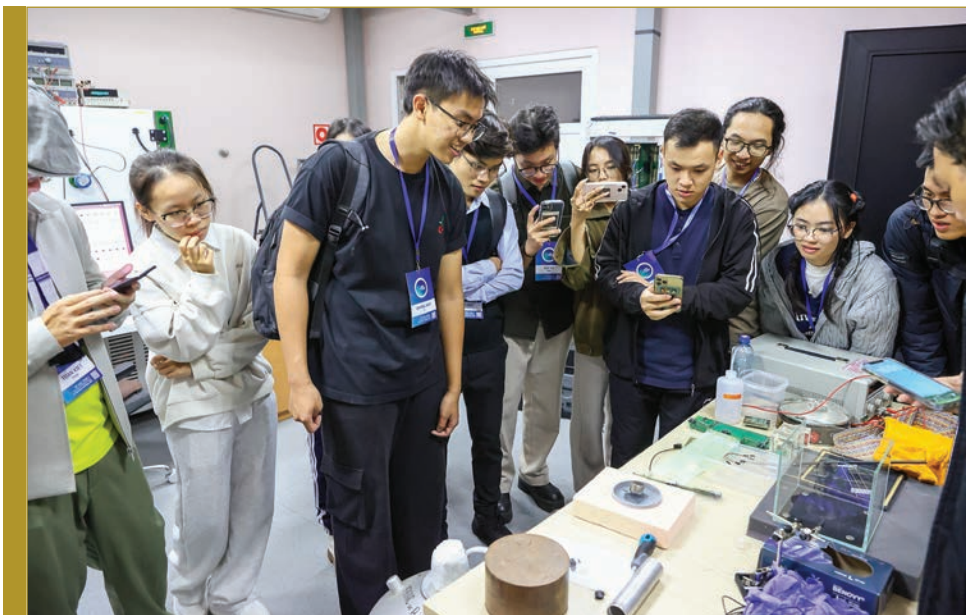
From 20 to 25 October, meetings were held in Almaty between Kazakhstani JINR staff and the city's school students, university students, and teachers. These were organized on the initiative and with the active participation of the JINR Information Centre at the Institute of Nuclear Physics of the Republic

of Kazakhstan. School students and teachers were informed about modern physics and achievements in related scientific fields, JINR's flagship projects, internship programmes, educational courses, and the Institute's new research directions. Issues concerning school education, increasing school students' interest in natural and technical disciplines were discussed, and avenues for further cooperation in training qualified scientific and engineering personnel were proposed.

As part of the JINR delegation visit to Hanoi from 10 to 16 May, the technical opening of the JINR Information Centre took place in the format of a seminar at the Institute of Physics of the Vietnam Academy of Science and Technology (VAST). The opening was attended by heads and research staff of VAST, specialists and representatives of research and university centres within the VAST system and VINATOM. The JINR Information Centre in Hanoi will perform educational, outreach, and scientific-organizational functions, including addressing such requests from the Vietnamese side as potential access to the computing power of MLIT, joining NICA project collaborations, and leveraging JINR experience in accelerator technologies.

Engineering and Physics Training for Students

In 2025, 74 people took part in the University Centre engineering practical courses, including participants from Russia (Dubna State University, JINR, St. Petersburg State University, Tver State University, Cherepovets State University), Cuba, Egypt, Serbia, and Vietnam. Twenty students participated in an



Dubna, 3 October. Students from Serbia, South Africa, and Vietnam are participants in the second stage of the UC International Student Practice on an excursion to DLNP

off-site dosimetry practical course at iThemba LABS (South Africa) as part of the SAINTS summer school.

The completion of these practical courses formed part of the programmes for the two 2025 International Student Practice stages and the scientific and practical seminar for SPbSU students “Control Processes in Scientific Projects, Participation of Students in Scientific Research”. A new practical course on FPGAs is in the final stage of preparation.

Meetings, Conferences, and Visits

Matters concerning personnel training, reciprocal visits and opportunities for students and young scientists, and the development of the partner net-

work were discussed at various meetings and conferences:

- Round table on “Educational Activities of University Students in Regional General Education Organizations in the Field of Physics”, Tomsk, 2–4 April;
- Meeting between representatives of the JINR-based department “Nuclear-Physical Materials Science” at Kazan (Volga Region) Federal University, the UC, and DLNP with KFU leadership to discuss the department further development and potential joint research, Kazan, 8–10 April;
- The 26th International training programme for decision-makers in science and international scientific cooperation (JEMS-26) for representatives



27–31 October. Teachers from Arkhangelsk and Rostov regions and cities of Rosatom participating in a regular school for physics teachers

- of scientific and educational centres from Russia, Belarus, and Kazakhstan, Dubna, 14–18 April;
- The 27th International training programme for decision-makers in science and international scientific cooperation for representatives of 15 national scientific and educational centres and agencies from Egypt, Nigeria, Serbia, South Africa, and Vietnam, Dubna, 19–23 May;
- Round tables as part of the events dedicated to JINR Days in Uzbekistan, 22–24 April;
- Meetings on education and personnel training with universities and scientific centres in Vietnam, Hanoi, 10–16 May;
- Round table on “Strategies for Cooperation in Physics and Engineering. A Look into the Future of Science and Education”, during the opening programme of the JINR Information Centre at Southern Federal University, Rostov-on-Don, 6 June;
- Round table on “Issues in Physics and Mathematics Education” as part of the school for teachers from the Arkhangelsk and Rostov regions and Rosatom cities, Dubna, 31 October;
- Visits to South African universities by a joint delegation from the MLIT and the UC, South Africa, 10–21 November.

Cooperation with Universities

On 3–4 February in Dubna, during a working meeting between a representative delegation from the Primorsky Krai and JINR leadership, the parties discussed prospects for cooperation in education and science. One topic was the importance of cooperation in personnel training and scientific exchange

in connection with the construction of a synchrotron radiation research centre on Russky Island (Vladivostok). Participants were introduced to ecological projects studying regional biodiversity, developed with the support of JINR and the Far Eastern Federal University (FEFU) at the regional centre for gifted children “Sirius. Primorye”. Following the visit, the parties expressed their intention to promptly develop a comprehensive roadmap for further cooperation under the four-party Agreement with FEFU, the Primorsky Krai, and the Far Eastern Branch of the Russian Academy of Sciences.

On 22 July, JINR was visited by a delegation from ITMO University to discuss the development of scientific cooperation, the exchange of experience in education, and the formation of new approaches to engaging young people in science. One of the central topics at the meeting with representatives of the Institute’s Directorate, DLNP, MLIT, and the UC was the training of researchers and engineers for large-scale scientific projects. Participants also discussed mechanisms for involving school students in science, such as career guidance programmes and the work of JINR Information Centres.

On 17 September, JINR was visited by a delegation from the National Research Nuclear University MEPhI to discuss areas of collaboration, specifically coordinating career guidance work for JINR’s benefit and the academic and research activities of students in Institute projects based on the JINR department at MEPhI. The programme concluded with a round table involving directors and project leaders from MLIT, FLNR, FLNP, and the NICA/MPD project.



Dubna, 3–4 February. Visit to the UC by a delegation from Primorsky Krai (Russia) led by Deputy Minister of Education of the region A. Mekhovskaya (front row, centre)

Career Guidance Events

In 2025, UC staff in collaboration with JINR scientists organized the Institute's participation in the following career guidance events:

- Open Days at state universities: Dubna State University and the NRNU MEPhI;
- Career Days at MIPT and MSU;
- A job fair in the Dubna Special Economic Zone;
- The NAUKA 0+ Science Festival (Minsk, 6 September; Petropavlovsk-Kamchatsky, 22–28 September; Moscow, 10–12 October);
- The “Element 105” Physics Workshop, 2–12 July;
- A virtual nuclear physics laboratory practical at the Kadyshevsky Lyceum;
- Career guidance and popular science lectures — School No. 2107 on Gilyarovskiy Street (Moscow); “Zaryadye — Open Science Week of BRICS Countries”; School No. 7 (Dubna), Moscow Region Polytechnic College “Politekh Dubna”;
- Online lectures: a session at the “Nanograd — Supplementary Education” school in the Khanty-Mansi Autonomous District; the Information Centre at NArFU (Arkhangelsk);
- Fifty-eight in-person and online tours and 35 lectures for JINR Information Centres, and for groups of school and university students from Dmitrov, Dolgoprudny, Dubna, Veliky Novgorod, Volgograd, Zelenograd, Kimry, Moscow, Nizhny Tagil, St. Petersburg, and Tver.

Scientific Schools and Seminars for Physics Teachers at JINR

In 2025, 61 teachers from various regions of the Russian Federation and Kazakhstan participated in Scientific Schools for Teachers at JINR, and a programme was organized for 11 heads of educational centres from South Africa. From February, a new programme — the “Teachers of the Future” workshop-seminar — was launched for students in natural sciences and information technology fields. The programmes included lectures, laboratory practicals, introductions to the laboratories, visits to the “JINR Main Facilities” exhibition, the Kadyshevsky Lyceum and Dubna State University, and round tables. When designing the school programmes, the growing interest among teachers in practical sessions and the “Engineers of the Future” teaching and learning complex, developed at JINR, was taken into account.

The following events were organized:

- The first “Teachers of the Future” workshop-seminar for physics and mathematics students from Russian universities, selected with the participation of JINR Information Centres at NArFU (Arkhangelsk), FEFU (Vladivostok), NOSU (Vladikavkaz), KamSU (Petropavlovsk-Kamchatsky), TPU and TSPU (Tomsk), Dubna, 8–23 February;
- Regional Scientific and Educational Seminar on project activities and physics experiments within the “Physics” subject for students and physics teachers of the Kamchatka Krai, supported by the



Dubna, 8–23 February. Listeners and organizers of the 1st “Teachers of the Future” workshop-seminar for senior physics and mathematics students



7–11 July. Workshop for physics teachers participating in the International Scientific School

JINR Information Centre at KamSU, Petropavlovsk-Kamchatsky, 20–25 March;

- International Scientific School for Physics Teachers from Almaty, Astrakhan, Vladikavkaz, Donetsk, Kazan, Nizhny Novgorod, Orenburg, Rostov-on-Don, Ryazan, St. Petersburg, Khabarovsk, and from the Irkutsk, Novosibirsk, Tyumen, Sverdlovsk regions, and the Yamalo-Nenets Autonomous District, Dubna, 7–11 July;
- Training seminar “Teachers of the Future” for students in physics, mathematics, and information technology fields from universities in Moscow, ITMO University (St. Petersburg), SFU (Rostov-

on-Don), NOSU (Vladikavkaz), FEFU (Vladivostok), KamSU (Petropavlovsk-Kamchatsky), and Dubna State University, as well as teachers from Rostov-on-Don and Petropavlovsk-Kamchatsky, and senior students from Protvino, Moscow Region, Dubna, 1–6 August (as part of the 37th Interregional Computer School);

- School for Physics Teachers from the Arkhangelsk and Rostov regions and Rosatom cities, Dubna, 27–31 October;
- Scientific School for heads of regional science centres from South Africa, Dubna, 8–17 December, for the first time conducted in English.

WORK WITH SCHOOL STUDENTS

Regular Programmes for School Students in Dubna and Moscow Region

School students in Dubna have access to several initiatives supported by JINR: the Inter-School Physics and Mathematics Elective, the University Centre’s Physics Practical Course, and the Yandex Lyceum.

The fifth graduation ceremony for the Yandex Lyceum was held on 18 June, with 58 students completing the full two-year course.

For students in years 6–11, the Inter-School Physics and Mathematics Elective organized classes in physics and mathematics for the 2025/2026 academic year.

On 5 April, the traditional “Physics Days” science festival was held in Dubna for the 10th time, with over 100 children from various Dubna schools participating. The programme included demonstra-

tions of physics equipment and phenomena, and masterclasses in various fields of physics. This year, the festival was held at Secondary School No. 5. The programme was organized by the UC in collaboration with Dubna State University, the Kadyshevsky Lyceum, and the Moscow Region Polytechnic College (Dubna branch).

On 12 April, the 14th Open Regional Robotics Tournament “CyberDubna-2025” was held, with 15 teams from Dolgoprudny, Dmitrov, Dubna, Sergiev Posad, and Protvino participating. The competition took place at the Kadyshevsky Physics and Mathematics Lyceum. The tournament was organized by UC staff and students from the Moscow Region Polytechnic College.

Ahead of the 10th Technical Hackathon “Dubna-2026” and the 15th CyberDubna tournament, the UC held robotics selection competitions for school



Dubna, 12 September. Schoolchildren from Egypt on an excursion to VBLHEP

students on 11–12 October and 3 November. The events were organized by the UC with the support of young JINR staff, representatives of the Mendeleev University of Chemical Technology, and volunteers from educational institutions in Dubna: the Polytechnic College, School No. 5, and the Kadyshevsky Lyceum.

Scientific Schools for School Students

The UC participates in organizing and conducts scientific schools for school students:

- Scientific School for senior students from Petrozavodsk, 3–5 June;
- Summer School for students in years 8–9, 9–20 June;
- IX Summer School “Physics. Mathematics. Informatics” at Dubna State University, 9–29 July;
- Fifth Scientific School for participants of the Children’s University at the Academy of Scientific Research and Technology of Egypt, 8–12 September.

The programmes include popular science lectures by JINR staff, tours of the Laboratories, laboratory work, visits to the Kadyshevsky Lyceum, and trips to Moscow.

37th Interregional Computer School

From 1 to 13 August, the 37th Interregional Computer School was held in Dubna, aimed at developing research and engineering skills in school stu-

dents. The event was organized, as is traditional, by JINR, with the Kadyshevsky Physics and Mathematics Lyceum acting as a partner. Participants in the Interregional Computer School included 42 school students aged 12 to 16, as well as 22 mentors. The delegations were formed with the support of JINR Information Centres in the Kamchatka and Primorsky Krai, the Rostov Region, and the Republic of North Ossetia-Alania.

Creation of a Unified Textbook and Teaching and Learning Complex

On 24 November, a meeting was held to discuss the creation of a unified textbook and teaching and learning complex for physics and other natural science disciplines (mathematics, biology, natural sciences) — a joint federal-level project with the Russian Academy of Sciences (RAS), the Ministry of Science and Higher Education of the Russian Federation, and the Prosveshcheniye publishing house. The project is being carried out in accordance with an instruction from the President of the Russian Federation and a decree of the Government of the Russian Federation. The project leader on behalf of RAS and JINR is G. Trubnikov. The effectiveness of the work will be determined by expert assessments from RAS and the teaching community. At the end of 2025, the first stage of the project, “Unified State Textbook. Physics 10, Physics 11. Basic Level”, was delivered.

PROFESSIONAL DEVELOPMENT FOR JINR STAFF

Since August 2025, training in occupational health and safety and industrial safety requirements has been reinstated. Training for 469 staff members was organized by the UC's own efforts, and 898 staff members were trained under a contract with the Tekhnadzor training centre. Information on staff trained in occupational health and safety is entered into the register of the Russian Ministry of Labour.

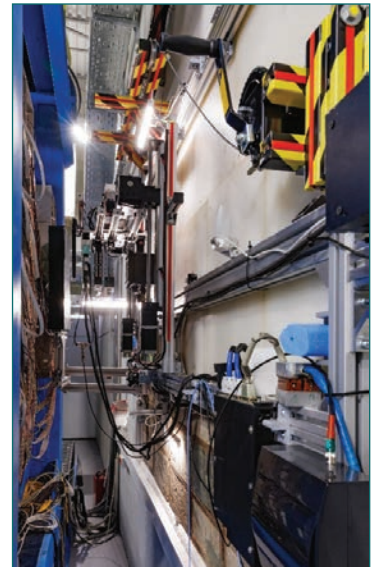
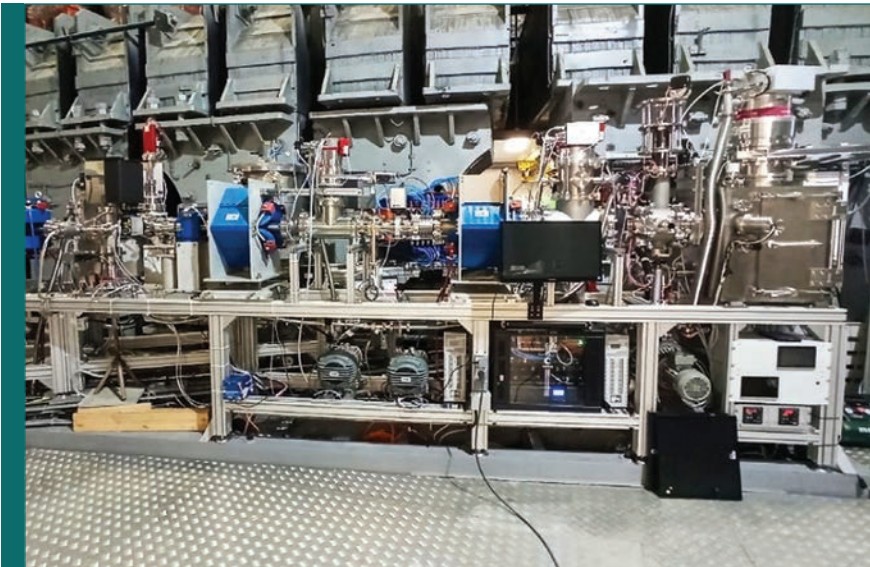
In the 2024/25 academic year, 81 JINR staff members attended English language classes. The Russian Conversation Club sessions were attended by 30 JINR specialists from Bulgaria, China, Cuba, Egypt, India, Palestine, Romania, Serbia, Slovakia, South Africa, and Vietnam.

INNOVATIVE ACTIVITY

RESEARCH AND DEVELOPMENT

In 2025, work was continued on the development of the International Innovation Centre for Nuclear Physics Research, which focuses on life sciences, biomedical technologies, radiation biology, radiation

materials science, ecology, and information systems. This initiative involves creating a dedicated user infrastructure around JINR's unique facilities, allowing specialists from participating countries to address



The Veksler and Baldin Laboratory of High Energy Physics. Target stations included in the ARIADNA research infrastructure



The Veksler and Baldin Laboratory of High Energy Physics. A section in the ARIADNA sample preparation area

applied problems and develop new technologies. In addition, new facilities with significant innovation potential are being established. This infrastructure includes ARIADNA, a complex of user stations utilizing the extracted beams from NICA; a specialized DC-140 cyclotron designed for radiation materials science, development of track-etched membrane technologies, and electronics testing; and the MSC-230 superconducting medical cyclotron.

Innovation competition for teams of young developers was launched for the first time in 2025 to capitalize on the innovative potential of JINR's advanced research infrastructure and expertise. The outcomes of these projects hold promise for application in industry, scientific instrumentation, and social initiatives. This initiative aims to support R&D activities that align with the scientific and technological development priorities of JINR Member States, while also fostering the development of the Institute's human resources.

The competition process involved teams of young developers, each consisting of 3 to 10 members, including scientists, specialists, graduate students, and undergraduates from JINR Member States. The team leader and most of the team members were under the age of 39. The application's planning horizon extended up to three years.

The innovative developments proposed in the application should align with one or more of the following fields:

- radiation technologies;
- accelerator technology;

- medical equipment and laboratory diagnostics;
- information technology and artificial intelligence;
- control systems, automation, and robotics;
- scientific instrumentation;
- nuclear medicine;
- ecology, sustainable development, and climate change;
- new materials;
- chemical technologies;
- biotechnology and food safety;
- energy storage and future energy solutions.

This initiative aims to develop innovative products, including materials, devices, instruments, software, and services. The implementation of the project should enhance the target product's technological readiness and create favourable conditions for the successful transfer of the developed technologies. Additionally, an important aspect of the application is the significance of the proposed research and development (R&D) project in improving the effective utilization of JINR's scientific infrastructure and leveraging the Institute's established competencies in international, interlaboratory, and interdisciplinary research.

To review applications, JINR has established an Expert Committee, chaired by the Institute's Chief Engineer. The Project Selection Office provides organizational and technical support for the Committee's work. This office includes representatives from the Association of Young Scientists and Specialists and the Innovation and Intellectual Property Department.



The medical superconducting cyclotron MSC-230 is under construction.
The cyclotron yoke with a yoke-top lifting system

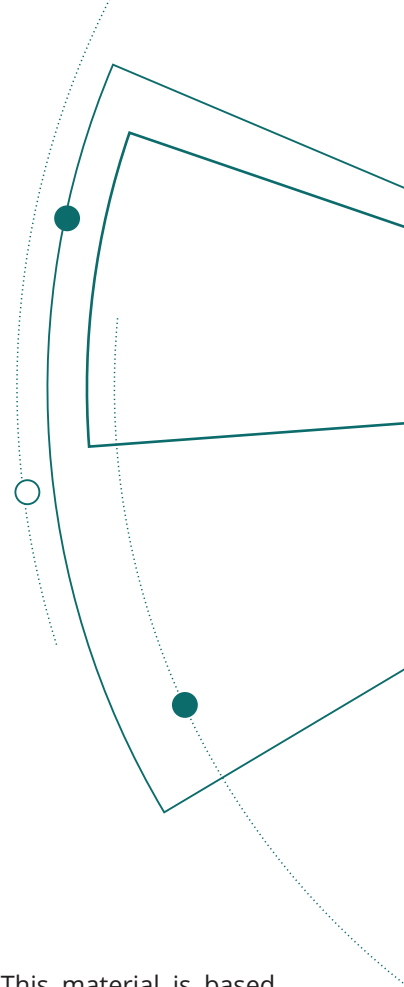
More than 30 applications were submitted for the competition, which is planned to be made regular and held at least once every two years. The Project Selection Office conducted a preliminary analysis. The Expert Committee selected 17 projects for participation in the in-person presentation stage. The winners were determined by the JINR Director based on the results of two in-person rounds of project defense. The following applications were accepted:

- **“Creation of a line of high voltage power supplies and voltage switches for experimental facilities”**, supervised by D. Ponkin (VBLHEP). The successful implementation of this R&D project will not only improve the technical equipment at the facilities of both JINR and its partners, but will also allow occupying the related market niche.
- **“Development of deep tissue oxygenation measurement systems using time-domain diffuse optics (TD-DO)”**, supervised by A. Selyunin (DLNP). The project team unites DLNP JINR physicists with medical scientists and chemists from Moscow State University. As part of the R&D project, it is planned to create equipment aimed at solving the problems of rapid diagnosis of circulatory disorders, including strokes, along with monitoring oxygen levels in the brain during surgeries.
- **“Development of micro-SPECT systems for precision imaging in preclinical biological experiments”**, supervised by V. Rozhkov (DLNP). The results of this R&D project may be utilized in applied biomedical studies, the development of radiopharmaceuticals, testing of new diagnostic and therapeutic methods, and in the problems of fundamental radiation biophysics.
- **“Testing of neurotoxicity and assessment of contrast agents, nanoparticles, and other compounds’ accumulation in animal models in TaaS (Testing as a Service) format”**, supervised by I. Zinicovskaia (FLNP). The successful implementation of the project will allow the Institute to conduct a wide range of pharmacological and pilot toxicological studies of new medicines and contrast agents being developed in the JINR Member States.
- **“Multifunctional preparative system of tangential filtration”**, supervised by I. Vinogradov (CAP FLNR). As part of the R&D project, tangential filtration devices in reusable and single-use designs will be developed. These are in demand in a number of laboratory and medical filtration tasks, along with the manufacture of pharmaceuticals.

In addition, two more R&D projects received incubation support. Under the leadership of A. Kuznetsov



Krasnogorsk, 12 November. Winners of the Moscow Region Governor Prize in science, technology and innovation — young JINR scientists: PhD, Biology, head of an FLNP group N. Yushin and intern researcher of a VBLHEP sector E. Bushmina. Photo: © Ministry of Investments, Industry and Science of the Moscow Region



(DLNP), the DSTAR muon telescope is under development. This is a spherical modular muon detector designed for omnidirectional (4π) non-destructive density diagnostics. It can be used in confined spaces such as deep-water, underground areas, and industrial zones, allowing for the reconstruction of the medium's density distribution in three dimensions. At the Sirius Federal Research Centre, as part of the "Big Challenges" programme, the DSTAR team assembled and tested a prototype 14-channel detector. They made initial measurements while working with schoolchildren, confirming the system's functionality. The scalability of the setup and its potential applications — such as ore exploration, industrial site monitoring, and research in underground laboratories — were evaluated. Currently, the assembly of a full-size 64-channel detector is underway.

A. Yakhnenko (DLNP), along with her colleagues, is developing an innovative, safe, and biodegradable

material called EcoRadGel. This material is based on a radiation-crosslinked hydrogel that utilizes the LINAC-200 system. The hydrogel serves as a carrier for active substances with controlled-release properties and is designed for applications in aquaculture, agriculture, tick-borne disease control, and other biotechnological fields. The production of radiation-crosslinked hydrogel samples was implemented using a technological accelerator at an industrial partner's site in the Dubna SEZ.

The development of the information resource on JINR detector technologies, Detector Technology Map — Detector Center, has continued. Youth inter-laboratory teams at JINR are contributing to databases on detector and accelerator technologies. The SSO access provides contextual search capabilities for information on equipment available in the Institute's laboratories, the experience with components and materials, and the existing exper-

JINR R&D Activities Competition : 5 Winners

	<p>"Creation of a line of high voltage power supplies and voltage switches for experimental facilities" supervised by Dmitry Ponkin (DLNP)</p>		<p>"Development of deep tissue oxygenation measurement systems using time-domain diffuse optics (TD-DO)" supervised by Alexandr Selyutin (DLNP)</p>
	<p>"Testing of neurotoxicity and assessment of contrast agents nanoparticles, and other compounds accumulation in animal models in Tads" (Testing as a Service) format" supervised by Inga Zincovscaia (DLNP)</p>		<p>"Development of micro-SPECT systems for precision imaging in preclinical biological experiments" supervised by Vladislav Rozhikov (DLNP)</p>
	<p>"Multifunctional preparative system of tangential filtration" supervised by Ilya Vinogradov (DLNP)</p>	<p>First CALL – 02.2025 30+ Proposals 17 – Final stage 4 mln RUR/year/team</p> <p>Start – July 2025 First Check-up – June 2026 leader & 70% of team members – under 39 years old</p>	

2 projects in the incubation process

DSTAR (Detection System for Tracking Angular Radiation) – COSMIC-RAY MUOGRAPHY

Alexey Kuznetsov

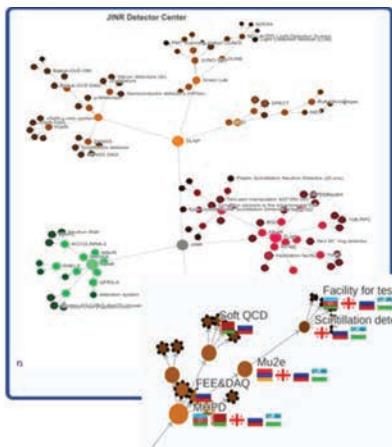
"EcoRadGel: Radiation-crosslinked hydrogels as a platform for biotechnological applications"

Alena Yakhnenko

Development of technology for creating radiation-crosslinked hydrogels functionalized with the required active substance (antibiotics, proteins, growth factors, fertilizers)

Development of technology for the slow release of the active substance from the hydrogel in an aqueous medium in soil with specified properties (temperature, pH)

Mapping of JINR technology domains. *Detector Center*



Technology = What is made of (“Components & Materials”), How (“Competencies”), On what Equipment

NEW

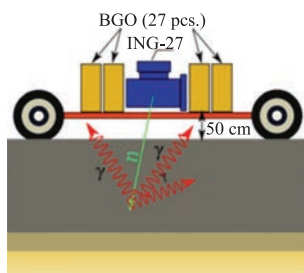
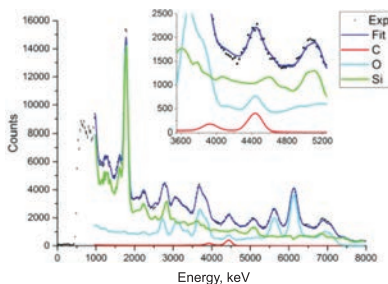
- ✓ AI based Semantic search
- ✓ Participating countries on The Map
- ✓ AI based generation of new nodes (drafts, to be verified by expert)

- ✓ Interactive tool (developed in MLIT) for Data Base creation & visualization
- ✓ SSO-login. Today access is possible for JINR community only
- ✓ Growing Team of participants
- ✓ Low hanging fruits — “Where can I find necessary equipment, etc.”
- ✓ Next steps: Accelerators; Smart search



Sustainable Development. Mitigating Climate Change

Measurement of carbon concentration in soil without sample extraction & preparation. Tagged Neutron based scanner (FLNP and Diamant LLC) on unmanned transport platform.



tise in creating modern detectors and operating particle accelerators. A significant advancement in the Detector Center’s development is the integration of large language models to generate “drafts” for new map nodes. Additionally, artificial intelligence is being utilized in the search engine for this resource. These tools enhance the ability to engage a broader range of Institute specialists in the editing and updating of the Detector Technology Map.

The JINR laboratories are actively engaged in research projects that have significant potential for

social and economic impact. At FLNP, participants in the TANGRA project, alongside the Diamant company (Dubna), are developing the methodological foundations for applying the Tagged Neutron Method to analyze the carbon and other element content in soil. During the 2025 field season, joint experiments were conducted with partners specializing in soil science, agriculture, forestry, ecology, and climate-related research. A notable feature of the 2025 expeditions is the use of a compact unmanned transport platform that JINR acquired for these purposes.

INTELLECTUAL PROPERTY PROTECTION

The necessary steps have been taken to obtain protection for the image of the flag, emblems, abbreviated and full names of the Institute as an international intergovernmental organization in accordance with Article 6 ter of the Paris International Convention for the Protection of Industrial Property. Images of the flag and emblems, as well as the abbreviated and full names of JINR, have been registered in the appropriate database of the World Intellectual Property Organization.

To protect the Institute's rights to the name, logo, and slogan of its scientific journal "Natural Science Review", an application for state registration of the combined designation featuring the logo and name of the journal "Natural Science Review" as a trademark was prepared and submitted to Rospatent. An application for state registration of the verbal designation of the journal's slogan, "by scientists for scientists", was also submitted. Both applications were approved for registration by the Federal Institute of Industrial Property (FIIP) of the Federal Service for Intellectual Property (Rospatent).

The Innovation and Intellectual Property Department (IIPD, JINR Chief Engineer's Office) continued its collaboration with FIIP (Rospatent) on JINR patent applications that passed the formal examination of FIIP in 2024–2025. To assess the technical level of new developments by JINR employees for patentability, several design studies were reviewed. This process included identifying legally protected objects, classifying them according to the International Patent Classification (IPC), and searching for existing analogues and prototypes. Patent research reports were prepared in collaboration with laboratory staff, and potential areas for the subsequent use of intellectual property in the Institute's activities were identified.

In cooperation with the authors, patent applications for 11 inventions were prepared and submitted to Rospatent, including via the electronic service. Additionally, one international application was filed under the Patent Cooperation Treaty (PCT).

Eleven Russian patents for inventions were received:

— (RU) 2834762 "Method for Pulse Inlet and Locking of Neutrons in Annular Neutron Accumulator" by Yu. Nikitenko, E. Kolupaev, V. Zhuravlev;

— (RU) 2838994 "Filtering Porous Material for Selective Extraction and Concentration of Extracellular Nucleic Acids from Solutions" by E. Kravchenko, P. Zarubin, P. Apel, A. Nechaev, E. Andreev;

— (RU) 2842003 "Method of Extracting Accelerated Beam of Positively Charged Particles from Cyclotron" by I. Ivanenko, G. Gulbekyan;

— (RU) 2814061 "Scintillation Detector of Neutron and Gamma Radiation" by D. Trunov, E. Altynbaev;

— (RU) 2782417 "Device for Registration of Radiation" by D. Trunov, V. Marin, E. Altynbaev;

— (RU) 2847068 "Method of Producing Anisotropic Porous Film of Dielectric Material and Anisotropic Porous Film of Dielectric Material" by P. Apel, N. Dmitriev, A. Nechaev, O. Ivanov, O. Polezhaeva;

— (RU) 2846750 "Position-Sensitive Detector of Thermal and Cold Neutrons" by A. Kolesnikov, B. Zalikhanov, V. Bodnarchuk, A. Kurilkin, A. Kolesnikov;

— (RU) 2848931 "Method for Measuring the Lifetime of Excited States of Nuclei Using a 4 π -Scintillation Single-Crystal Time Spectrometer for Fast and Delayed Coincidences" by V. Morozov, N. Morozova;

— (RU) 2847136 "Device for Cooling Biological Samples" by K. Belokopytova, A. Agapov, G. Mitsyn, O. Belov;

— (RU) 2847775 "Method for Obtaining Neutrons Using a Pulsed Neutron Generator" by S. Dolya;

— (RU) 2849516 "Device for Removing a Disconnected Electric Pump Motor from an Artesian Well" by E. Dubovskoy.

Ten computer programs and one database were registered in the Register of Programs for Electronic Computers of Rospatent:

— 2025664956 "Program for Assessing the Quality of an X-Ray Beam Based on the X-Ray Tube Spectrum" by I. Gordeev;

— 2025670023 "Repository of JINR Scientific Publications" by A. Bondyakov, T. Zaikina, A. Kondratyev, I. Filozova, G. Shestakova, I. Nekrasova, Ya. Popova;

— 2025664012 "Intelligent Performance Assessment System for Employees of Research Organizations" by A. Kovaleva, A. Korobitsyn;

— 2025688115 "Software Suite for Data Acquisition for the Application Specific Integrated Circuit 'Weeroc Petiroc2A' Based on the Programmable Readout System CAEN DT5550W" by A. Boykov;

— 2025688263 "System for Managing the Accommodation of Business Travelers in CERNDB Official Housing" by O. Belyakova;

— 2025687212 "Program for High-Speed Detection of Electrical Breakdown in High-Frequency Links" by A. Vybornov;

— 2025690887 "Document Management Platform DocMS" by I. Sokolov, N. Balashov;

— 2025690621 "Software Suite for Managing Digital Objects in the JINR Scientific Publications Repository" by A. Bondyakov, T. Zaikina, O. Kondratyev, I. Filozova, G. Shestakova, I. Nekrasova, Ya. Popova;

— 2025690586 "Program for Automated Processing of Instrumental Spectra from the SPIDER Multi-Sphere Neutron Spectrometer" by I. Gordeev;

— 2025667059 "Control Program for the SMSD-4.2CAN Stepper Motor Controller with a Minimal Command Set" by A. Beloborodov, A. Zorin, P. Kharyuzov;

— 2025693991 “Program for Diagnostics and Tuning of RF2–RF3 Amplifiers of the NICA Collider — AMP NICA Status Tool” by A. Karpuk, E. Syresin.

The preparation of documents necessary for the payment of royalties for received patents and registered programs has been ensured.

In 2025, JINR maintained a total of 89 patents. Efforts were made with the laboratories to identify patents that have been in force for over 10 years and no longer require maintenance.

Information sheets of the Innovation and Intellectual Property Department are prepared regard-

ing the Institute’s receipt of new patents and state registration of other industrial intellectual property assets (computer programs, databases, and TIMS). This information is regularly included on the JINR website under the “Patents” section (<http://www.jinr.ru/posts/category/patents-ru/>) and on the IIPD webpage in the “Current Patents” (<https://oliis.jinr.ru/index.php/patentovanie-2/8-russian/25-dejstvuyushchie-patenty-oiyai>) and “Computer Programs Registered by JINR” (<https://oliis.jinr.ru/index.php/patentovanie-2/8-russian/28-programmy>) sections.



INTERNATIONAL RELATIONS AND SCIENTIFIC COLLABORATION

COLLABORATION in SCIENCE and TECHNOLOGY

The main results of the international cooperation in science and technology of the Joint Institute for Nuclear Research in 2025 are reflected in the following data:

- joint research was conducted with scientific centres in the Member States, as well as with international and national organizations in other countries, on 82 projects and subprojects of the Topical Plan for JINR Research and International Cooperation;

- the Joint Institute sent 1744 specialists to solve cooperation issues and issues of participation in scientific meetings and conferences;

- 1391 specialists were received for joint work and consultations, as well as for participation in meetings, conferences, and schools held at JINR;

- 50 international scientific conferences and schools, 14 workshops, and 16 meetings were organized and held.

The international cooperation of JINR is presented in agreements and treaties. Its development comprises joint experiments at basic facilities of physics

centres, the acquisition of research data, the preparation of joint publications of the joint research results, the supply of equipment and techniques for the interested sides, etc.

On 23 January, Ambassador Extraordinary and Plenipotentiary of the Republic of India to the Russian Federation V. Kumar visited the Joint Institute for Nuclear Research.

During the meeting at the Directorate of the Joint Institute, JINR Director G. Trubnikov noted that the cooperation between JINR and the Republic of India dates back more than half a century. As of 2025, twelve Indian researchers were working in several laboratories of the Institute. A number of experts represent the Republic of India in the Joint Institute's Advisory Bodies. More than 200 collaborative scientific articles by Indian and JINR researchers are published annually. The JINR Director highlighted that in 2023 the Institute held the workshop "India-JINR: Frontiers of Basic and Applied Research" with about 200 participants.



Dubna, 23 January. A visit to JINR by delegation of the Embassy of the Republic of India to the Russian Federation headed by Ambassador Extraordinary and Plenipotentiary V. Kumar



Dubna, 31 January. A visit to JINR by Academician-Secretary of the Physics Department of RAS V. Kveder and Director of the RAS Institute of Solid State Physics A. Levchenko

During the meeting, the parties discussed plans for bilateral visits for the partners from India to become more familiar with the Institute's scientific activities and expand cooperation and the prospects for establishing the JINR-India Joint Coordinating Committee, similar to those that effectively operate between the Institute and countries, such as China, Mexico, and South Africa. G. Trubnikov invited representatives of India to participate in the session of the Committee of Plenipotentiaries of the Governments of the JINR Member States in March 2025.

The programme of the visit included a meeting with the group of Indian JINR employees and a tour of the NICA accelerator complex at VBLHEP and enterprises of the Dubna SEZ.

On 31 January, Academician-Secretary of the Physics Department of RAS V. Kveder and Director of the RAS Institute of Solid State Physics A. Levchenko visited JINR.

During the meeting at the Directorate of the Institute with JINR Scientific Leader Academician V. Matveev, the sides discussed the work out of the Federal programme of the Russian Federation on studies of fundamental properties of matter and widening cooperation in condensed matter physics — the development of the User Programme for the IBR-2 pulsed reactor to be launched again in 2025 at the Frank Laboratory of Neutron Physics of JINR. Besides, the participants of the meeting noted the necessity and purposefulness of a wide attraction of young scientists to the development of large scientific facilities and their operation.

The guests had a meeting with FLNR Scientific Leader Yu. Oganessian, where the side of the Joint Institute was represented by JINR Director Academician G. Trubnikov, JINR Vice-Director S. Dmitriev, and RAS Corresponding Member V. Kekelidze. One of the main topics of the discussion was the activity in the search of elements 119 and 120 of the Mendeleev's Periodic Table.

During their visit, V. Kveder and A. Levchenko got acquainted in detail with the research conducted at the FLNR Superheavy Element Factory and the status of work on the creation of the NICA collider at VBLHEP.

On 11 February, a delegation from the Vietnam Atomic Energy Institute (Vinatom), headed by Vinatom President Trần Chí Thành, and representatives of the State Specialized Design Institute (JSC GSPI), part of Rosatom, visited FLNP.

During the working meeting, the parties discussed FLNP specialists' participation in identifying promising scientific directions for the research reactor being designed in Vietnam and the development of its instruments using extracted neutron beams. FLNP supports experimental research development in the JINR Member States. New research facilities at Kazakhstan and Uzbekistan reactors are some of the examples of FLNP's successful cooperation.

As a result of the meeting, the parties agreed to intensify the development of research facilities at the reactor being engineered in Vietnam and to involve Vietnamese scientists, students, and postgraduates in the activities at the IBR-2M reactor in order



Dubna, 13 February. A working meeting of Director of the Vinča Institute of Nuclear Sciences (Serbia) S. Dimović (in the centre) with JINR Leaders

for them to gain experience in developing spectrometer elements and working at facilities using extracted beams. The guests got introduced to the work of the unique IBR-2M pulsed reactor and facilities applying extracted neutron beams.

On 13 February, JINR hosted a working meeting between Director of the Vinča Institute of Nuclear Sciences (Serbia) S. Dimović and representatives of the JINR leadership. The parties discussed cooperation prospects and potential new projects.

JINR Director Academician G. Trubnikov, noting the long history of fruitful cooperation with Serbian organizations, confirmed his willingness to cooperate with the Vinča Institute and other Serbian scientific and educational centres, prioritizing the development of applied research and assistance in creating and modernizing scientific infrastructure in the Republic of Serbia.

UC Director D. Kamanin noted that the signing of a roadmap for cooperation between the Joint Institute and the Ministry of Education, Science, and Technological Development of the Republic of Serbia in 2019 played a significant role in the partnership development. In his opinion, it is necessary to create a new similar document in order to involve more Serbian scientists and young specialists in new joint projects.

JINR Chief Engineer B. Gikal confirmed the Institute's intentions to provide comprehensive technical support to Serbian colleagues in upgrading the infrastructure and developing new accelerator complexes. In particular, the Joint Institute for Nuclear Research can send an expert group to conduct an engineering and technical audit of the Vinča Institute's equipment and develop potential different

plans for its modernization in order for the parties to make a final decision.

During their visit to Dubna, Vinča Institute Director S. Dimović and Director of the Plan and Analysis Sector M. Ljušić got introduced to the scientific infrastructure of JINR by touring six laboratories: VBLHEP, DLNP, FLNP, FLNR, MLIT, and LRB. The Serbian delegation participated in the 137th JINR Scientific Council session and attended the ceremony of the launch of the Linac-200 linear electron accelerator at DLNP.

On 14 February, the festive ceremony of awarding the OGANESSION Prize for 2024 took place at the Pushkin State Museum of Fine Arts (Moscow).

OGANESSION Prize Committee Chair, NCPM Scientific Leader Academician A. Sergeev expressed hope for continuing to annually award the prize and expanding the community of scientists and cultural figures who will receive it.

Chief Researcher at the MSU Department of Analytical Chemistry, Chief Researcher at the Institute of General and Inorganic Chemistry of RAS, Doctor of Chemical Sciences, Academician Yu. Zolotov received the prize for outstanding achievements in analytical chemistry and great personal contribution to the training of young scientists, specialists, and highly qualified personnel.

Director of the SPbSU Institute of Cognitive Research, Doctor of Biology and Philology T. Chernigovskaya received the OGANESSION Prize for outstanding contribution to the popularization of science and the development of interdisciplinary research at the intersection of neuroscience, linguistics, and psychology.

The winner in the nomination for researchers whose work is related to strengthening international



Moscow (Russia), 14 February. Award Ceremony of the OGANESSION Prize for 2024 at the Pushkin State Museum of Fine Arts

scientific and technical cooperation was Z. Vilakazi, Vice-Chancellor and Principal of the Wits University (South Africa), member of the RSA Academy of Science, fellow of the Royal Society of Great Britain, visiting scientist at the Commission of Alternative Energies and Atomic Energy. Professor Z. Vilakazi was honoured with the OGANESSION Prize for significant contribution to the development of scientific cooperation between South Africa and JINR in nuclear reactions, accelerator technologies, and relativistic nuclear physics.

In the nomination for scientists who achieved remarkable success at an early stage of their career, the OGANESSION Prize for 2024 was awarded to:

- A. Nurmukhanbetova, Candidate of Physics and Mathematics, Researcher at Nazarbayev University (Republic of Kazakhstan) — for the development and implementation of a new programme for the study of the lightest nuclei at the DC-60 low-energy ion accelerator;

- G. Knyazheva, Candidate of Physics and Mathematics, Senior Researcher at the Flerov Laboratory of Nuclear Reactions at JINR — for pioneering work on the observation and study of the heavy nuclei quasifission.

At the conclusion of the ceremony, Academician Yu. Oganessian congratulated the laureates and wished them further scientific success.

On 21 February, a workshop on superconducting cavities took place at VBLHEP as part of collaboration between JINR and the Institute of Modern Physics of the Chinese Academy of Sciences (IMP CAS). The parties discussed key projects and cooperation prospects in the development of accelerator complexes.

At the opening of the workshop, VBLHEP Acting Director A. Butenko stressed that the Joint Institute intends to continue cooperation with Chinese specialists within the framework of fundamental megascience projects, including NICA and HIAF (High-Intensity Heavy-Ion Accelerator Facility, China).

IMP CAS Deputy Director Professor Yuan He spoke about the development of the Institute's scientific infrastructure and key projects. He noted that the construction of the HIAF and CiADS (China initiative Accelerator Driven System) accelerator complexes is nearing completion in Huizhou (Guangdong Province). They will serve as the basis for the future Electron-Ion Collider in China (EicC).

Yuan He emphasized the fruitful long-term cooperation between the two institutes and proposed to establish a JINR – IMP CAS research laboratory. In his opinion, it will strengthen cooperation in such key areas as polarized ion sources, superconducting linear accelerators, magnetic technologies, superheavy element synthesis, etc.

In addition to the specialists from JINR and IMP CAS, representatives of NRNU MEPhI, employees of the Department of Electrophysical Facilities of the Institute of Nuclear Physics and Engineering (INPhE MEPhI), and Head of the Physics and Technics Laboratory at the Institute for Nuclear Problems (INP) of Belarusian State University D. Bychenok took part in the workshop.

An IMP CAS researcher, Doctor Teng Tan, reviewed the progress of the project to create superconducting microwave cavities for NICA. Chinese specialists have completed the development and manufacture of an accelerator cryomodule for a new VBLHEP linear accelerator. In particular, they prepared an updated technical design for super-



The Veksler and Baldin Laboratory of High Energy Physics, 21 February. Workshop on superconducting cavities as part of cooperation between JINR and the Institute of Modern Physics of the Chinese Academy of Sciences

conducting cavities and obtained the first successful test results of equipment manufactured at IMP CAS.

Professor Zhijun Wang from the Institute of Physics of the Chinese Academy of Sciences expressed interest in collaborating with colleagues from JINR on optimizing high-power beam dynamics at linear accelerators, developing specialized software, and designing new experimental facilities.

On 24–26 February, JINR Vice-Director L. Kostov and FLNP Deputy Director S. Kulikov visited the Academy of Sciences of the Republic of Uzbekistan (AS RUz) and the AS RUz Institute of Nuclear Physics (INP AS RUz).

The Presidium of AS RUz hosted a meeting between the delegation of the Joint Institute and President of the Uzbekistan Academy of Sciences Sh. Ayupov. The JINR Vice-Director informed Sh. Ayupov about the Institute's research programme and status in world science. The AS RUz President expressed high appreciation of the role of the Joint Institute in training qualified personnel for Uzbekistan. During the meeting, the parties discussed prospects for expanding cooperation between the Uzbekistan Academy of Sciences and JINR.

Academy's Vice-President S. Mirzaev, INP AS RUz Director Academician I. Sadikov, FLNP Deputy Director S. Kulikov, and Head of the National Group



Tashkent (Uzbekistan), 24–26 February. A visit to the Academy of Sciences of the Republic of Uzbekistan by JINR Vice-Director L. Kostov and FLNP Deputy Director S. Kulikov

of Uzbekistan at JINR A. Inoyatov participated in the meeting with the AS RUz President.

The working meeting with INP AS RUz Director I. Sadikov and Deputy Director M. Tashmetov focused on the progress and prospects of cooperation between INP and JINR, as well as the programme of the JINR Days in Uzbekistan.

From 24 to 27 February, the 2nd International School on Nuclear Methods and Applied Research in Environmental, Material, and Life Sciences (NUMAR-2025), organized by JINR and the Agency for Nuclear Energy and Advanced Technologies (AENTA), took place in Havana (Republic of Cuba). The programme of the event included lectures by leading JINR scientists for students and young specialists from Latin American countries and scientific organizations of Argentina, Brazil, Cuba, Mexico, and South Africa.

AENTA President G. L. Bejerano stressed the importance of the international NUMAR school in Cuba at the highlights of 50 years of cooperation between Cuba and JINR. During the event, she delivered a lecture on scientific achievements and prospects for the development of high technology in the country.

On the first day of the school, JINR Chief Scientific Secretary S. Nedelko presented a detailed overview of the activities of the Joint Institute as an international intergovernmental organization, introducing young scientists to the modern scientific infrastructure and the variety of prospective research carried out at JINR laboratories.

The lecture programme of NUMAR-2025 covered a wide range of topics in various fields of life sciences, as well as environmental and materials science. In 2025, 36 students and young specialists representing scientific and educational organizations of

Brazil, Costa Rica, Cuba, Dominican Republic, Mexico, and Paraguay participated in the school. Plenipotentiary of the Government of the Republic of Cuba to JINR G. Walwyn Salas acted as event coordinator.

On 26 February, at the initiative of the University of Havana, the JINR delegation visited one of the country's leading universities. The delegation met with the University's leadership and researchers to discuss the prospects for the development of joint research projects and the issues of training young specialists. As a result of the visit, the parties renewed the General Cooperation Agreement aimed at expanding Cuba's participation in JINR.

The second part of the visit included a scientific seminar on the key areas of JINR's research. Presentations were delivered by the Institute's leading specialists: S. Nedelko, A. Bugay (LRB), N. Kucerka (FLNP), A. Baimukhanova (DLNP), U. Pinaeva (FLNR), and A. Uzhinsky (MLIT). After the talks, the academic leaders and specialists of the University of Havana discussed promising future cooperation areas with colleagues from Dubna.

Deputy Minister of Science, Technology and Environment of the Republic of Cuba J. F. Santana Nuñez attended the ceremonial closing of the NUMAR-2025 international school as an honorary guest.

On 19 March, a regular meeting of the JINR Science and Technology Council was held at the International Conference Hall presided by E. Kolganova.

JINR Director Academician G. Trubnikov presented the information about the Institute's activities to the participants.

Active preparation to the commissioning of the NICA accelerator complex was done at VBLHEP. The FLNR Superheavy Element Factory achieved project parameters. The Linac-200 electron acceler-



Havana (Cuba), 24–27 February. Participants of the 2nd International School on Nuclear Methods and Applied Research in Environmental, Material, and Life Sciences (NUMAR-2025)

ator at DLNP started to work in the start-up mode. The research pulsed reactor IBR-2 at FLNP started again its operation. MLIT continued active work for the purposes of the JINR experiments. Staff members of LRB published papers on combined proton therapy with pharmaceuticals that promote efficient repair of double stranded DNA break. Large international conferences were held at BLTP. A meeting of the Scientific Session of the Nuclear Physics Section of the Physical Sciences Division of the Russian Academy of Sciences was held. An agreement on cooperation between the Institute of Theoretical Physics of the Chinese Academy of Sciences and BLTP JINR was signed. After a 14-year break, the Council of the JINR University Centre started its work again, the programme of the UC development was discussed. The first issue of the new online journal of JINR, "Natural Science Review", was published. A competition of innovative elaborations at JINR started, laboratories collected requests and discussed them. The ceremony of awarding the OGANESSON Prize was held; its laureates became scientists from Kazakhstan, Russia, and South Africa. The first meeting of the Working Group to celebrate the 70th anniversary of JINR in 2026 was conducted.

Head of the Human Resources and Records Management Department of JINR A. Verkheev made a report on personnel and age structure of the Institute, vacancies and sources to employ young staff members. As of 2025, more than 5000 people worked at JINR, 2500 of them — scientific workers and engineers, 2100 — workers and specialists. The speaker noted that in the last five years the staff lessened, and to solve this problem, it is necessary for the Institute to attract 60 scientists and engineers and about 50 workers and specialists annually as minimum. A. Verkheev showed the statistics about the staff members with diplomas who come to JINR mainly from Dubna State University, NRNU MEPhI, MSU, TPU, MIPT, KFU, and other universities, generally from basic chairs of JINR in these universities. He indicated that a competition is noted for the university students with Dubna enterprises, as well as for engineers and highly qualified workers. The report brought about a long discussion.

On 26 March, the celebration of the 69th anniversary of the foundation of the Joint Institute for Nuclear Research was held at the Mir Cultural Centre. Participants of the JINR CP session, representatives of the city administration, veterans and staff members of the Institute attended the ceremonial event.

JINR Director Academician G. Trubnikov, in particular, stressed in his greeting speech that the year 2024 was a record one in the number of scientists who visited the Joint Institute. In 2024, about 930 scientists, engineers, and students from different countries visited JINR to conduct research or start a scientific career. The Director announced that during 2025–2026 events will be held dedicated to the jubilee of the Joint Institute for Nuclear Research and the 70th anniversary of the science city Dubna.

JINR staff members were presented various awards for outstanding service in science and dedicated work. S. Kilin, Co-Chairman of the JINR Scientific Council, was awarded with the Order of Friendship of the Russian Federation.

The Certificates of Merit of the Ministry of Science and Higher Education of the Russian Federation were presented to DLNP Director E. Yakushev and DLNP Deputy Director D. Naumov. Certificates of Acknowledgement of the Ministry of Science and Higher Education of the Russian Federation were awarded to DLNP Chief Engineer S. Yakovenko and JINR Administration Executive Assistant M. Studenova. Fifteen more JINR staff members were presented with Certificates of Merit and Acknowledgement of the Head of the city district Dubna and with departmental awards.

Thirteen teachers of school and additional school education of the city of Dubna who received JINR grants in 2025 were awarded Prizes.

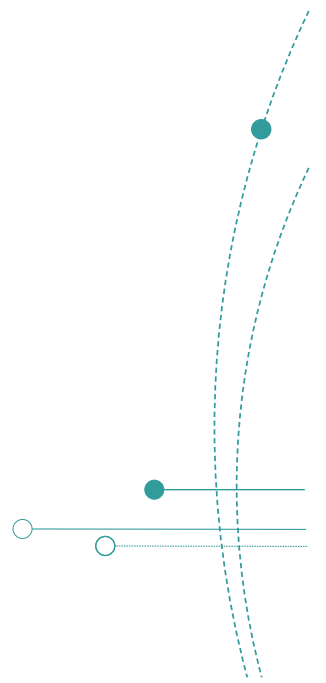
The festive event was concluded with a concert of classical music by the Russian State Symphony Orchestra of Cinematography conducted by the Honoured Artist of the Russian Federation, Laureate of the Prize of the RF Government in Culture, Professor S. Skripka. The Moscow oldest orchestra celebrated its centenary in 2024. The guests also had an opportunity to visit the interactive exhibition "JINR Main Facilities" and the "Physicists–Lyricists" exhibition of works by JINR scientists.

On 27 March, State Secretary of the Ministry of Science, Technological Development and Innovation of Serbia M. Trajanović with accompanying persons visited JINR. At the meeting at the Directorate, the parties discussed the prospects for bilateral cooperation and outlined the next steps to implement joint initiatives and projects.

The Ministry's State Secretary introduced the Deputy Director of the Vinča Institute of Nuclear Sciences, M. Janković, as the new coordinator of Serbia–JINR cooperation. M. Janković said that the result of the visit to JINR in February 2025 by the Director of the Vinča Institute, S. Dimović, was the prompt creation of a special commission for the development of accelerator projects at the Vinča Institute, which will cooperate with the expert group of the Joint Institute.

M. Trajanović, in particular, indicated an interest in applied research at the NICA accelerator complex. JINR Director G. Trubnikov invited Serbian scientists to join the ARIADNA collaboration, whose field of activity includes research in life sciences, radiation materials science, biomedical applications, applied nuclear technologies, and microelectronics testing.

During the conversation, the importance of involving young Serbian scientists in extensive scientific work was also emphasized. UC Director D. Kamanin noted the rich history of scientific and educational cooperation between the Joint Institute and Serbia. According to him, Serbia is one of the most active participants in the educational projects



Dubna, 26 March. Celebration of the 69th anniversary of the foundation of the Joint Institute for Nuclear Research

of the University Centre — START and INTEREST student programmes and international scientific practices.

Representatives of the Serbian delegation took part in the JINR CP session and also attended the launch ceremony of the first session at the NICA accelerator complex at VBLHEP. In addition, the guests went on excursions to FLNR, LRB, and FLNP.

On 29 March, a delegation of the Economic Policy Department of the Ministry of Science and Higher Education of the Russian Federation, headed by Director of the Department A. Kanukoev, visited JINR.

The programme of the visit included a working meeting and an excursion to the NICA accelerator complex. The delegation was welcomed by JINR Vice-Director V. Kekelidze, VBLHEP Assistant Director for Financial Issues A. Slesarenko, Deputy Head of the VBLHEP Planning and Financial Division V. Morozov, and VBLHEP Leading Researcher S. Merts. During the meeting, main aspects and peculiarities of implementation of the NICA megascience project were discussed, as well as decisions applied at JINR in management of projects in scientific research. Representatives of the Institute expressed their gratitude for comprehensive support and assistance in the implementation of the scientific programme of JINR. As a result of the meeting, the parties confirmed their intentions to continue close cooperation and partnership in shaping the economic and budgeting policy of the Institute.

The Ministry's representatives toured the NICA collider building, the injection complex pavilion, the Multi-Purpose Detector experimental hall, and the

"JINR Main Facilities" interactive exhibition at the Mir Cultural Centre.

On 7–8 April, members of the National Assembly of the Republic of Bulgaria, Yo. Todorov and A. Yanchev, visited JINR.

On the first day, the guests visited the site of the NICA accelerator complex and the "JINR Main Facilities" interactive exhibition at the Mir Cultural Centre. In addition, the delegates met with representatives of the national group of the Republic of Bulgaria at JINR. On 8 April, the delegates got acquainted with the Institute's research infrastructure and visited five laboratories.

The meeting with representatives of the JINR Directorate concluded the programme of the event. The parties emphasized the fundamental importance of multilateral cooperation between the JINR Member States for the national research and technological advancement of these countries, the strengthening of international partnership in science and technology, and sustainable socio-economic development, in accordance with the principles of the Sofia Declaration adopted by the Plenipotentiaries of the Governments of the JINR Member States at the November 2021 session in Sofia.

On 11 April, the Joint Institute held a working meeting on collaborative studies with the Federal Medical and Biological Agency of the Russian Federation (FMBA). The key topic of the discussions was the development of new projects.

FMBA Leader V. Skvortsova highlighted a number of scientific areas that the organizations under the Agency's jurisdiction are focusing on: development



Dubna, 29 March. Visit to JINR of the staff of the Economic Policy Department of the Ministry of Science and Higher Education of the Russian Federation, headed by Director of the Department A. Kanukoev



Dubna, 7–8 April. Members of the National Assembly of the Republic of Bulgaria Yo. Todorov and A. Yanchev on an excursion to VBLHEP during the visit to JINR

of proton and radionuclide therapy of oncological diseases, creation of new radiopharmaceuticals, genome-wide studies to determine the mechanisms of the effects of different types of ionizing radiation on biological objects, radiation safety, development and creation of radioprotectors and radiomitigators. She also stressed the readiness of the Agency to take part in various JINR projects.

LRB Director A. Bugay delivered a presentation on the development of JINR–FMBA projects. He defined the establishment of the Scientific and Clinical Centre for Proton Therapy in Dubna based on the MSC-230 cyclotron as a priority cooperation area.

JINR Chief Engineer B. Gikal spoke on the progress of the MSC-230 superconducting proton cyclotron. The facility is designed for proton radiation therapy and biomedical studies, including the creation of flash therapy methods. The launch of the cyclotron is scheduled for 2026.

The programme of the meeting finished with a talk by Director General of the Federal Scientific Clinical Centre for Medical Radiology and Oncology of FMBA of Russia Yu. Udalov, in which he presented the FMBA capacities in proton therapy.

At the end of the meeting, it was agreed that it is necessary to continue active discussions of future joint projects and new initiatives. The next step to promote the cooperation was defined, that is, the establishment of a focus group consisting of specialists from both organizations who will detail the technical design of the new high-tech proton therapy centre in Dubna.

On 14–18 April, the 26th training programme “JINR Expertise for Member States and Partner Countries” (JEMS-26) was held at JINR. It is aimed at giving the participants in the maximum short period, five days, a wide picture about scientific programme, international cooperation and educational activities at the Institute, as well as about its history and social infrastructure. The participants visited the Super-heavy Element Factory at FLNR and the NICA accelerator complex at VBLHEP.

At the final round table held at the International Conference Hall, representatives of scientific and educational centres of Russia, Belarus, and Kazakhstan shared their impressions of the Joint Institute for Nuclear Research and discussed new cooperation prospects with the JINR laboratories and the opportunities of interaction provided by the Information Centres that foster the rising interest of young people, including prospective students, to natural science disciplines and give additional educational opportunities for universities playing the role of an access point to involvement in large international collaborations at JINR. JEMS participants expressed the general opinion about the necessity to further extend activities of Information Centres and exchange of experience among them.

JINR Vice-Director L. Kostov summarized the results of the round table and expressed gratitude to the participants for their contribution to promoting collaboration with the Institute. He said that he was confident that thanks to the active cooperation of universities with the JINR laboratories, the level of

higher education would improve and enrich the Institute's scientific activities.

On 16 April, a festive event on the 25th anniversary of founding the Chair of Fundamental Nuclear Interactions (FNI) was held at the MSU branch in Dubna. Representatives of the JINR leadership, teachers, students and graduates of the branch, and MSU staff members took part in it. Acting Director of the MSU branch in Dubna, RAS Corresponding Member E. Boos was the event moderator.

Head of the Chair since its foundation in April 2000 until 2021, FLNP Chief Researcher, RAS Corresponding Member V. Aksenov spoke about the history of SINP MSU branch that worked in Dubna from 1961, about the model of training students for JINR proposed by D. Blokhintsev, and the history of founding the FNI Chair.

The speech of the present Head of the Chair, JINR Director G. Trubnikov, was devoted to prospects of development of JINR basic chairs that are closely connected with the plans of development of the Joint Institute and the science city Dubna. He talked about the activities of seven laboratories of the Institute, large scientific projects and research infrastructure.

Head of the PEP Chair of the MSU Physics Faculty, JINR Scientific Leader RAS Academician V. Matveev and his Deputy, Head of the Scientific and Experimental Department of Elementary Particle Physics of DLNP JINR Professor A. Olshevskiy, congratulated the teachers and students of the FNI Chair. Head of the Department of Nuclear Research of SINP MSU T. Tetereva thanked the previous and present heads of the Chair for their constructive approach to the development of the Chair and the Dubna MSU branch in general. Head of the Chair of Accelerators and Radiation Medicine of the MSU Physics Faculty Professor A. Chernyaev expressed gratitude to the

JINR leaders for their support in the practical training of MSU students.

Concluding the meeting, the students of the MSU branch in Dubna sang the anthem of the MSU Physics Faculty, wished all students of the Chair great success, scientific discoveries and achievements in exploring the world, marking that the study here is interesting and prestigious.

On 22 April, JINR Days in Uzbekistan started in Tashkent at the Presidium of the Academy of Sciences (AS RUz). An interactive exhibition dedicated to the activities of JINR was launched at the AS RUz Presidium.

At the festive opening, President of the Academy of Sciences of the Republic of Uzbekistan Sh. Ayupov addressed the participants with a welcome speech. He thanked the Joint Institute for organizing such a large-scale event for the country's scientific community. For a significant contribution to the development of scientific and organizational cooperation between JINR and Uzbekistan, the AS RUz President presented JINR Director Academician G. Trubnikov with the jubilee medal "80 Years of the Academy of Sciences of the Republic of Uzbekistan".

As part of a festive event at the AS RUz Presidium, a general agreement on a long-term cooperation between scientific organizations of Uzbekistan and JINR in the fields of theoretical and experimental nuclear physics, high-energy physics, radiation materials science, neutron activation analysis, radiation chemistry, nuclear medicine, radiation biology and biotechnology, radiation instrumentation, seismology, information technology, and training of personnel was signed. A Working Group will be formed for each area. The interaction will include the exchange of information and the organization of collaborative research, conferences and seminars, visits and in-



Dubna, 16 April. A festive event dedicated to the 25th anniversary of founding the Chair of Fundamental Nuclear Interactions of the MSU branch



Tashkent (Uzbekistan), 22–24 April. JINR Days in Uzbekistan

ternships, as well as conducting joint experiments on nuclear physics facilities.

G. Trubnikov expressed gratitude to the Academy of Sciences of Uzbekistan for supporting the participation of scientists from the Republic in the largest projects of the Institute, in particular, in the construction and operation of the NICA collider. Over several decades of cooperation, more than 200 scientists and specialists from Uzbekistan completed scientific school in Dubna, 40 of them be-

came Doctors and more than 100 — Candidates of Sciences, five received the title of Academicians of the National Academy of Sciences. Director of the Institute of Nuclear Physics (INP) of AS RUz I. Sadikov takes part in the work of the JINR Scientific Council. In March 2025, AS RUz President Sh. Ayupov headed the work of the delegation of Uzbekistan at the session of the Committee of Plenipotentiaries of the Governments of the JINR Member States. The JINR Director also expressed gratitude to the leadership

of the Republic of Uzbekistan and personally to President of the country Sh. Mirziyoyev for the comprehensive support and participation of Uzbekistan in the implementation of the scientific programme of the Institute.

Support from JINR, in turn, allowed the implementation of a number of significant projects in the territory of the Republic of Uzbekistan. The INP AS RUz operates a cloud computing cluster, and a unique neutronographic facility with highly sensitive characteristics has been created. The production of a new diffractometer based on a research reactor is being discussed. Active cooperation is also maintained with the country's leading universities: the National University of Uzbekistan, Tashkent State Technical University, Namangan Institute of Engineering and Technology, and Samarkand State University.

INP AS RUz Director Academician I. Sadikov expressed confidence that JINR Days in Uzbekistan would further strengthen long-term collaboration. He also gave a presentation on the development of nuclear medicine in Uzbekistan.

JINR Scientific Leader Academician V. Matveev gave a talk entitled "On the 60th anniversary of the hypothesis of coloured quarks and the Dubna hadron model". The report by LRB JINR Director A. Bugay was devoted to fundamental research in radiation biology at JINR and its nuclear medicine applications.

The ceremony participants laid flowers on the grave of Academician B. Yuldashev, a long-time AS RUz President, Plenipotentiary of the Government of the Republic of Uzbekistan to JINR, Scientific Council member, outstanding physicist, organizer of scientific activities, and public figure, who greatly contributed to intensifying cooperation between Uzbekistan universities and JINR.

On 24 April, the JINR delegation met with First Deputy Minister of Higher Education, Science and Innovation of the Republic of Uzbekistan Sh. Daliev. The parties discussed organizational aspects of the Republic's participation in JINR, dual degree programmes of Uzbekistan higher education institutions and Dubna State University, and internships for students from Uzbekistan at JINR. In order to implement the cooperation prospects outlined at the meeting, it was decided to draw up a joint Roadmap.

Following the meeting, the Ministry hosted a round table "Opportunities for Expanding Cooperation between Universities of the Republic of Uzbekistan with JINR, Dubna State University, and the Moscow State University Branch in Dubna". The JINR delegation exchanged views on educational processes with representatives of the university community of Uzbekistan.

JINR organized an exhibition at the Ministry of Higher Education, Science and Innovation of the Republic of Uzbekistan about the Institute's main activities and held a meeting with students of Uzbekistan universities. D. Kamanin, A. Denikin, A. Olshevskiy, and Sector Heads of DLNP M. Shirchenko and N. Anfimov gave lectures.

On 22–24 April, JINR representatives visited the Institute of Nuclear Physics of AS RUz, the Republican Specialized Scientific and Practical Medical Centre of Endocrinology, the Romanovsky Institute of Mathematics, the Institute of Genetics and Plant Experimental Biology, Samarkand State University, and the Ulugh Beg Astronomical Institute. During those days, working meetings took place with the leadership of the Academy of Sciences of Uzbekistan, the Arifov Institute of Ion-Plasma and Laser Technologies, Physical and Technical Institute, the Institute of Materials Science, Research Institute of Semiconductor Physics and Microelectronics, as well as with IT Park University representatives.

On 22–23 April, VBLHEP JINR employees visited the Belarusian State University of Informatics and Radioelectronics (BSUIR). The purpose of the visit of Deputy Head of the VBLHEP Accelerator Department for Scientific Work V. Lebedev and Researcher Ye. Tamashevich to Belarus was to expand cooperation with the University's specialized departments in the field of accelerator technologies by establishing contacts with BSUIR departments and scientific laboratories engaged in research in the areas of semi- and superconductor physics, microelectronics, materials science, and microwave technologies. These directions are critically important for the implementation of large-scale JINR projects, including the NICA accelerator complex.

The Belarusian State University of Informatics and Radioelectronics organized a specialized seminar that brought together representatives of the departments of micro- and nanoelectronics, information and measurement systems, physics, as well as heads of the University's research centres. The participants discussed opportunities for joint research and the BSUIR involvement in the international projects of the Joint Institute, as well as the development of specialized educational programmes aimed at developing students' competencies in the field of accelerator physics.

V. Lebedev gave a lecture "The Colliders and NICA" for BSUIR undergraduates, Master's students, and postgraduates, as well as invited BSUIR students to take part in the JINR summer trainings and internships in the 2025–2026 academic year.

On 8 May, JINR and the Ministry of Science, Technology and Innovation of the Federative Republic of Brazil (MCTI) signed a Memorandum of Understanding at the Bauman MSTU. The document is aimed at strengthening cooperation between the parties in fundamental and applied research. The agreement provides for the creation of the JINR–Brazil Joint Coordinating Committee (JCC) at high governmental level. The JCC is designed to establish a structured method of selecting and implementing collaborative projects, particularly those that involve using the large research infrastructure of JINR and Brazil to achieve the national goals of scientific and technological development of Brazil and the JINR Member States.



Moscow (Russia), 8 May. Signing of the Memorandum of Understanding between JINR and the Ministry of Science, Technology and Innovation of the Federative Republic of Brazil. Photo: © Ministry of Science and Higher Education of the Russian Federation

The signing of the Memorandum was the result of ongoing joint work between the Institute and scientific organizations of the Federative Republic of Brazil. In 2024, an MCTI delegation visited the Joint Institute, JINR employees travelled to a number of scientific organizations and universities of Brazil, as well as cooperation agreements were signed with the National Nuclear Energy Commission (CNEN), the Federal University of Southern Bahia (UFESB), and the Federal University of Juiz de Fora (UFJF). Representatives of Brazilian organizations are members of the JINR Scientific Council and the Programme Advisory Committee for Nuclear Physics.

JINR Director Academician G. Trubnikov stressed that the Institute highly appreciates the established ties with relevant Brazilian agencies and sees great potential for joint work in using the large research infrastructure of both JINR and Brazil.

Minister of Science, Technology and Innovation of Brazil Luciana Barbosa de Oliveira Santos expressed a wish to establish closer contact of JINR and Russia's Ministry of Science and Higher Education with organizations subordinate to MCTI: the Brazilian Centre for Research in Physics (CBPF), the Brazilian Centre for Research in Energy and Materials (CNPEM), and the National Institute for Pure and Applied Mathematics (IMPA).

On 10–16 May, in Hanoi (Vietnam), representatives of VBLHEP, FLNP, FLNR, MLIT, and the University Centre of the Joint Institute for Nuclear Research participated in a number of meetings on education and personnel training with representatives of universities and scientific centres of the Socialist Republic of Vietnam.

During the visit, the JINR delegation toured a number of universities: the Hanoi University of Science (VNU-HUS), the University of Science and Technology of Hanoi (USTH), the Hanoi University of Science and Technology (HUST), the Hanoi National University of Education (HNUE), and the Nuclear Training Centre at Vinatom. Round tables on JINR scientific and educational opportunities, meetings with the administration, teachers, young scientists, and relevant students of specialized faculties were held.

The technical opening of the JINR Information Centre took place in the format of a seminar at the Institute of Physics of the Vietnam Academy of Science and Technology (VAST). It was attended by Plenipotentiary of the Government of Vietnam to JINR and VAST Vice-President Professor Tran Tuan Anh, employees of the VAST Department of International Cooperation, researchers and Director of the Institute of Physics Dinh Van Trung, along with specialists and representatives of the VAST and Vinatom research and university centres.

JINR representatives made presentations and answered questions at the seminar. The audience showed keen interest in such topics as the opportunities for accessing the MLIT computing infrastructure, the conditions for joining the collaborations of the NICA project (MPD, SPD, ARIADNA), accelerators and accelerator technologies. The Director of the Institute of Physics discussed promising areas of work of the Information Centre and denoted its official opening ceremony for 2026 as part of the celebration of the 70th anniversary of JINR and the 70th anniversary of Vietnam's membership in the Joint Institute.



Hanoi (Vietnam), 10–16 May. JINR delegation in the Hanoi University of Science and Technology during the working visit on education and training at universities and research centres of Vietnam

On 12 May, JINR and the Federal University of Rio Grande do Sul (UFRGS) signed a Memorandum of Understanding in Porto Alegre (Brazil). JINR and educational organizations of the Federative Republic of Brazil thus established a partnership in fundamental and applied research and made a significant step in developing scientific cooperation.

During the visit, the parties discussed the prospects of implementing joint projects. The main areas of collaboration will be radiobiology, materials science, life sciences, and ecology, as well as academic exchange for students and researchers. In order to coordinate future studies, UFRGS Rector M. Barbosa made a proposal to organize a series of joint the-



Porto Alegre (Brazil), 12 May. Signing of the Memorandum of Understanding between JINR and the Federal University of Rio Grande do Sul. *Photo: © UFRGS Secretariat of Social Communication*



Tsukuba (Japan), 19 May. Meeting with KEK Director Sh. Asai, Director of the KEK Institute of Particle and Nuclear Studies N. Saito, and COMET Project Manager S. Mihara during the visit of the JINR delegation to Japan

matic webinars. The parties noted the importance of the Memorandum of Understanding signed on 8 May 2025 between JINR and the Brazilian Ministry of Science, Technology and Innovation.

Delegates of the Joint Institute for Nuclear Research made presentations on JINR's international activities. JINR University Centre Deputy Director W. Badawy provided an overview of the UC and the Institute's student programmes. Deputy Head of JINR Department of Science Organization Activities N. Kučerka discussed opportunities for cooperation between researchers from Brazil and Dubna.

On 13 May, the delegation from Dubna visited several scientific and educational departments of the University of Rio Grande do Sul. While getting acquainted with the laboratories of the UFRGS Institute of Physics, the parties discussed areas for joint research and noted the complementarity of the existing scientific infrastructure. Representatives of the UFRGS Institute of Geoscience expressed interest in collaborating with JINR in climate studies.

On 19–21 May, JINR representatives visited Japan. A delegation led by JINR Director Academician G. Trubnikov visited the major national research centres: KEK (High Energy Accelerator Research Organization) and J-PARC (Japan Proton Accelerator Research Complex). During the working meetings, the parties discussed opportunities for expanding collaboration in experimental research and exchanging expertise in science.

The JINR delegation included CP JINR Chair and Plenipotentiary of the Government of Georgia A. Khvedelidze, DLNP Director E. Yakushev, Deputy Head of the DLNP Scientific and Experimental Department of Elementary Particle Physics L. Kolupae-

va, and DLNP Senior Researcher P. Evtoukhovitch. Japanese research centres were represented by KEK Director Sh. Asai and J-PARC Director T. Kobayashi together with their deputies in charge of relevant areas of research.

During the visit, bilateral negotiations aimed at deepening the partnership between the Joint Institute and Japanese organizations in science and collaborative studies took place. The parties discussed promising areas of physics research and opportunities for cooperation in JINR, KEK and J-PARC projects. The participants of the negotiations expressed mutual interest and noted they were willing to update the current Memorandum of Understanding.

On 19–23 May, the 27th training programme “JINR Expertise for Member States and Partner Countries” (JEMS-27) was held at the Joint Institute for Nuclear Research. The internship was attended by specialists from 15 national scientific and educational centres and departments of Vietnam, Egypt, South Africa, and Nigeria.

JINR Vice-Director L. Kostov addressed the participants of the internship with a welcome speech. He highlighted that JINR is a unique international intergovernmental scientific organization that unites researchers from more than 30 countries around the world. The internship provides participants with the opportunity to gain a full, comprehensive understanding of JINR's research activities.

JINR Deputy Chief Scientific Secretary A. Zhemchugov presented an overview of the scientific activities and infrastructure of the Joint Institute for Nuclear Research. Assistant to the UC Director M. Tumanova delivered a lecture entitled “International intergovernmental organizations and multilateral



Dubna, 13 May. Visit to JINR of the RF French Embassy delegation, headed by Minister-Counsellor Z. Gross (in the centre). On an excursion to VBLHEP

research". The participants visited the Superheavy Element Factory at FLNR and the NICA accelerator complex at VBLHEP.

At the final round table, held at the International Conference Hall, JEMS participants shared their impressions of JINR and discussed promising areas for cooperation with the Institute's laboratories.

The internship participants highly appreciated the organization of JINR work, emphasizing the importance of the Institute as an international platform for scientific cooperation. During the week, they got acquainted in detail with the experimental setups and research areas of the laboratories, noting the practical value of the knowledge gained for devel-



Dubna, 19 May. Participants of the 27th International Training Programme from scientific centres of Vietnam, Egypt, South Africa, and Nigeria in the Synchrophasotron hall at VBLHEP



Belgrade (Serbia), 20–23 May. JINR delegation at the 67th International Fair of Technics and Technical Achievements

oping professional skills and planning joint projects. In addition to the scientific component, the guests appreciated the unique atmosphere in Dubna: the harmonious combination of natural landscapes and developed infrastructure of the science city contributes to effective scientific research activities. At the end of the round table, a ceremonial presentation of certificates of completion of the JEMS internship to the participants took place.

On 20–23 May, in Belgrade, the JINR delegation took part in the 67th International Fair of Technics and Technical Achievements. Information about the main facilities, projects, and educational programmes, along with the results of joint research with partners from Serbia, was presented at the JINR exhibition stand. In addition to the Joint Institute, about 350 organizations from 19 countries took part in the event.

One of the elements that the JINR delegation presented was a prototype of a preparative system for tangential flow filtration of solutions, developed by the Centre of Applied Physics at FLNR. Visitors could observe the filtration of a solution imitating hemoglobin in real time. The system is designed for micro-, ultra-, and diafiltration in a tangential flow of various solutions and can be used in medicine, pharmacy, biotechnology, food industry, and other fields. In addition, the guests got acquainted with the JINR technology for producing track membranes, their samples and modifications, and products based on them.

On the first day of the fair, the State Secretary of the Ministry of Science, Technological Development and Innovation of Serbia, M. Gnjatović, and Serbia-

JINR Cooperation Coordinator, Deputy Director of the Vinča Institute of Nuclear Sciences M. Janković visited the JINR exhibition stand. The Institute's employees told their colleagues about the joint work with scientific and educational institutions of Serbia carried out in recent years.

JINR scientists also took part in several panel discussions at the fair, which covered a wide range of topics in innovative development and international cooperation.

On 26 May, the opening of the 18th International Internship for Young Scientists and Specialists from the Member States of the Commonwealth of Independent States (CIS) was held at the JINR International Conference Hall. The participants were graduate students and researchers aged 22 to 35 from Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, and Uzbekistan.

At the opening of the internship, International Innovation Centre for Nanotechnology CIS Director, JINR Assistant Director for Development Projects A. Ruzaev said that in 2025 many applications were received from young people who work and study in the fields of biology, nuclear medicine, and IT. He noted that all participants of the internship have the possibility to correlate their scientific interests with the research conducted at JINR.

During the month, young people became familiar with the areas of scientific and innovative activity of the Joint Institute for Nuclear Research, Dubna State University, and the Dubna Special Economic Zone, and completed their projects on free topics in international groups.



Dubna, 26 May. At the opening of the 18th International Internship for Young Scientists and Specialists from the CIS Countries

On 2 June, a meeting of the Science and Technology Council (STC) of the Institute was held at JINR International Conference Hall. The report by JINR Director G. Trubnikov covered the main events in the field of international cooperation, construction of a large scientific infrastructure, and social facilities.

The key topic of STC was the JINR scientific research programme in radiation biology, which involves LRB, three sectors of DLNP, and users of the ARIADNA collaboration at the NICA accelerator complex. The JINR scientific research programme in radiation biology was presented by speakers from three JINR laboratories.

LRB Director A. Bugay and Head of the Sector of Molecular Genetics of the Cell at DLNP E. Kravchenko spoke about JINR's internal experiments in this area. Deputy Head of the Department of Scientific and Methodological Research and Innovation at VBLHEP O. Belov made a report on the programme of applied biological studies of various research centres within the framework of the ARIADNA collaboration at the NICA accelerator complex.

At the meeting, the need was noted to narrow the range of scientific topics for radiobiology research at the Institute and to focus on two or three main areas, as well as to conduct a broad international examination of projects.

JINR Chief Scientific Secretary S. Nedelko acquainted the members of Science and Technology Council with the concept of events dedicated to the 70th anniversary of the Joint Institute, scheduled to be held from the autumn 2025 and in 2026. Honourary titles and awards were presented to 16 staff members of JINR.

On 6 June, the Southern Federal University (SFedU) held a festive opening of the JINR Information Centre, which became the 13th in the JINR infocentre network and was named "Yuzhny". Representatives of the Rostov Region Government, the Rostov-on-Don administration, the Southern Scientific Centre of RAS, and SFedU partner universities took part in the opening ceremony.

JINR Director Academician G. Trubnikov expressed confidence that the new infocentre will contribute to the popularization of science, the development of international cooperation of the University, and the human resources potential of the Rostov Region. Acting Rector I. Shevchenko thanked JINR for its high trust and spoke about the importance of the partnership with the Joint Institute for the University, its role in the scientific and educational development of the South of Russia, the Rostov Region and the implementation of strategic projects. First Deputy Governor of the Rostov Region I. Guskov noted the importance of opening the centre for the development of science and modern engineering education in the region.

On 16–20 June, Dubna hosted the Days of the Republic of South Africa (RSA) at the Joint Institute for Nuclear Research dedicated to the 20th anniversary of the strategic scientific partnership between the Joint Institute and the RSA research organizations. Among the participants were representatives of the Department of Science, Technology and Innovation of South Africa (DSTI), the National Research Foundation of South Africa (NRF), universities, and research centres.

JINR Director Academician G. Trubnikov delivered a welcome speech at the opening ceremony at the International Conference Hall and emphasized that over the past three decades of cooperation, professional relations with South African research centres and educational organizations have reached a fundamentally new level. DSTI Deputy Director General I. Patel stressed the strategic importance of RSA–JINR cooperation for the development of science and education in the country.

NRF CEO F. Nelwamondo, who came to Dubna for the first time, congratulated his colleagues on the 20th anniversary of this thriving scientific partnership, calling the long-term participation of South African scientists in joint work with JINR a symbol of South Africa's high state priority in the development of advanced science and international cooperation.

As of 2025, more than 20 South African universities and research organizations were involved in joint projects in radiobiology, radiochemistry, materials science, engineering, theoretical and experimental nuclear physics. Over the years of cooperation, almost 500 South African students have participated in JINR's scientific and educational programmes aimed at training young specialists.

G. Trubnikov presented an overview of JINR's activities, an international research programme under development, and the large scientific infrastructure facilities of the Joint Institute, as well as of achievements in international science diplomacy.

Memoranda of Understanding were signed with the University of Zululand (UNIZULU), the University

of Venda (UNIVEN), and the North-West University (NWU). The agreements are aimed at strengthening cooperation in science, technology, and education, including the implementation of joint projects and the exchange of expertise.

On the first day of the visit to Dubna, the South African delegation toured the NICA accelerator complex at VBLHEP and the interactive exhibition "JINR Main Facilities" at the Mir Cultural Centre.

On 17 June, the guests from South Africa gave presentations on the most important research conducted in RSA and discussed future joint projects and scientific studies with their colleagues from JINR. On 18 June, a meeting of the JINR–RSA Joint Coordinating Committee was held.

From 28 June to 1 July, a meeting of the Scientific Council of the RAS Physics Division on Heavy Ion Physics "Relativistic Nuclear Physics and Heavy Ion Physics" took place in Saint Petersburg. The participants discussed the results and prospects of research in nuclear physics, superheavy element synthesis, and plans for the implementation of major scientific projects and the construction of the required infrastructure.

More than 30 talks were presented on projects and studies in heavy ion physics. The participants of the Scientific Council meeting were more than 80 scientists from JINR, INR RAS, IAP RAS, IAI RAS, the Rosatom State Corporation (the All-Russian Research Institute of Experimental Physics, Electrophys-



Dubna, 16–20 June. Days of the Republic of South Africa at JINR dedicated to the 20th anniversary of the JINR–RSA strategic scientific partnership



Saint Petersburg (Russia), 28 June – 1 July. Meeting of the Scientific Council of the RAS Physics Division on Heavy Ion Physics “Relativistic Nuclear Physics and Heavy Ion Physics”

ical Equipment), SINP MSU, SPbSU, the Research Institute of Biology of Yerevan State University, PNPI NRC “Kurchatov Institute”, and NCPM.

RAS Council Chair, FLNR Scientific Leader Yu. Oganessian opened the session. In his plenary talk entitled “Heavy ions in science and technology”, Academician Yu. Oganessian presented the programme of the event and discussed the past, present, and future of research in the physics and chemistry of superheavy elements.

JINR Vice-Director Academician V. Kekelidze spoke about the development of the physics programme at the NICA accelerator complex. He presented the results of the work of the MPD, BM@N, and SPD international collaborations, with an emphasis on the applied research programme at NICA. The ARIADNA collaboration participants are preparing to conduct new experiments at the Irradiation Stations.

The presentation by MLIT JINR Scientific Leader V. Korenkov was devoted to digital technologies and data mining in large scientific projects. JINR Scientific Leader Academician V. Matveev gave a talk entitled “Quark colour — A step towards understanding the properties of nuclear matter (on the occasion of the 60th anniversary of the hypothesis of coloured quarks)”.

Starting from the second day, the event was held in the format of six thematic sessions: superheavy nuclei; an atom in a supercritical field; SHE physics and chemistry; experiment and theory; light exotic nuclei; applied research; accelerator and target technologies. N. Kovrizhnykh, G. Knyazheva, E. Yakushev, A. Svirikhin, and D. Solovoyov gave talks on the research of superheavy nuclei and the development of experimental facilities at the Flerov Laboratory of Nuclear Reactions at JINR.

On the last day of the meeting, JINR Director Academician G. Trubnikov chaired a section dedicated to reviewing the progress of the JINR main facilities in nuclear physics, including the NICA accelerator complex at VBLHEP and the FLNR cyclotron complexes.

On 30 June, at the meeting of the RAS Council, SPbSU and JINR signed an agreement to establish a joint scientific and educational laboratory. The aim of the laboratory is to solve problems in information technology in high-energy physics and train qualified personnel. The document was signed by JINR Vice-Director Academician V. Kekelidze and SPbSU Vice-Rector for Research S. Mikushev. The agreement provides for cooperation between MLIT JINR and the SPbSU Lyapunov Research Laboratory.

In July, a group of physicists and engineers from Vietnam arrived at DLNP JINR. The Vietnamese specialists worked at the DLNP departments, participating in research and mastering the technologies necessary to launch Vietnam’s national programmes.

Vietnam–JINR Cooperation Coordinator, a member of the JINR Scientific Council Lê Hồng Khiêm explained that the country’s temporarily paused nuclear energy development programme is expected to resume. With JINR’s participation, it is planned to build a National Nuclear Research Centre, including a 10 MW research reactor.

The Vietnamese group under the guidance of Professor Lê Hồng Khiêm proposed new experiments on a special channel of the Linac-200 electron accelerator at DLNP JINR. Many Vietnamese universities and institutes expressed great interest in expanding cooperation with DLNP to jointly implement research projects as well.



Dubna, 22 July. A visit to JINR by the delegation from ITMO University (St. Petersburg), headed by Rector V. Vasilyev (3rd from left)

Together with Vietnamese colleagues, the Joint Institute conducts research in materials science using slow positron beams and in radiochemistry, develops devices for nuclear medicine and neutrino physics, as well as carries out experiments at the NICA accelerator complex.

On 17 August, Deputy Minister of Finance of the Russian Federation P. Kadochnikov visited the Joint Institute. The programme included meetings with

the JINR Directorate and excursions to the sites of the VBLHEP and FLNR flagship projects.

At the FLNR Superheavy Element Factory, JINR Vice-Director RAS Corresponding Member S. Dmitriev informed the Deputy Minister about the Institute's scientific programme on the synthesis of superheavy elements, and the laboratory's Scientific Leader, Academician Yu. Oganessian, conducted a tour of the memorial office of the first FLNR Director Georgy Nikolaevich Flerov.



Dubna, 17 August. A visit to JINR by the Deputy Minister of Finance of the Russian Federation P. Kadochnikov (right). On a tour of VBLHEP

At VBLHEP, P. Kadochnikov visited the NICA accelerator complex. The Deputy Minister was informed about the progress of works on Run 1, including the physics run of the collider, by JINR Vice-Director Academician V. Kekelidze and VBLHEP Acting Director A. Butenko.

During a working meeting with JINR Director Academician G. Trubnikov, P. Kadochnikov discussed issues related to the participation of the Russian Federation, as the country JINR is based in and the most active partner, in the implementation of the Seven-Year Plan for the Development of JINR for 2024–2030, in particular, the further development of the Institute's social and research infrastructure.

On 25–27 August, JINR Director Academician G. Trubnikov visited Belarus. During a working meeting with the Plenipotentiary of the Government of Belarus to JINR, Chairman of the State Committee on Science and Technology of the Republic of Belarus, S. Shlychkov, prospects for the expansion of scientific cooperation, along with training provided for students and young scientists from Belarus at JINR, were discussed.

G. Trubnikov held his first meeting with the NASB Presidium Chair V. Karanik. The parties discussed the prospects for further cooperation development, particularly in high energy physics and life sciences, and reached agreement on V. Karanik's visit to JINR to get acquainted with the flagship facilities of the Joint Institute.

In Minsk, the JINR Director also took part in the 16th International School and Conference "The Actual Problems of Microworld Physics".

On 15 September, the winners of the 2025 OGANESSION Prize were announced at the 138th session of the JINR Scientific Council. They were:

— Michel Spiro, Paris-Saclay University (France), Chair of the Earth–Humanity Coalition, Past President of the International Union of Pure and Applied Physics (IUPAP), member of the JINR Scientific Council. He was awarded the prize for outstanding research in high energy and nuclear physics, along with passionate leadership in global initiatives supporting fundamental science;

— Natalia Tarasova, RAS Corresponding Member at the Department of Chemistry and Materials Science, Professor, Doctor of Chemistry, Director of the Institute of Chemistry and Sustainable Development Problems at the Mendeleev University of Chemical Technology of Russia. She received the award for outstanding contribution to cooperation with international organizations and scientific unions (UNESCO, IUPAC, ISC), aimed at achieving the Sustainable Development Goals;

— Arutyun Avetisyan, RAS Academician, mathematician, system programming specialist, Director of the RAS Institute for System Programming, Head of the Department of System Programming at MSU FCMC, MIPT DMAM, and HSE FCS. The award recognized his outstanding contribution to the creation of trustworthy artificial intelligence in scientific and applied fields and the training of highly qualified young specialists in modern information technology;

— Alexei Semikhatov, Chief Researcher at the Division of Theoretical Physics at the RAS Lebedev Physical Institute, host of the Question of Science programme on the Nauka TV channel, host of the



Minsk (Belarus), 25–27 August. A meeting between JINR Director Academician G. Trubnikov and Chair of the Presidium of NASB V. Karanik. Photo: © SCST, NASB



Dubna, 16 September. Participants of the meeting of the International Scientific Advisory Board of the JINR journal “Natural Science Review”

Universe Plus YouTube channel, lecturer, and author of popular science films. He was awarded for outstanding contribution to the popularization of scientific knowledge in Russia, particularly in quantum physics.

On 16 September, the first meeting of the International Scientific Advisory Board (ISAB) of the JINR journal “Natural Science Review” took place at JINR International Conference Hall in a hybrid format.

Co-chair of the Board, FLNR Scientific Leader Academician Yu. Oganessian opened the meeting. ISAB Co-chair, JINR Director Academician G. Trubnikov presented the key concepts of the journal to the Board members. “Natural Science Review” is an online peer-reviewed Diamond Open Access journal. Issues are published quarterly, while articles appear on the journal’s website immediately after acceptance for publication and literary editing. It covers a wide range of multidisciplinary scientific topics, in particular, physics, mathematical and computer sciences, chemistry, ecology, as well as life and Earth sciences.

Deputy Editor-in-Chief of the journal and BLTP Leading Researcher E. Kolganova spoke on the key results achieved since the launch of the journal and also presented statistics on citations, author affiliations, and thematic content of articles. It was noted that one of the main tasks for the journal is to expand the geography of authors, which is an important factor for the inclusion of “Natural Science Review” in the Scopus and Web of Science databases.

The meeting participants discussed the prospects for further development of the editorial policy of the journal. A number of proposals were submitted for consideration, in particular, regarding the use of the software repository of MLIT for storing intellectual property results (IPR) submitted for publication in “Natural Science Review”, accompanied by an article.

The Board members underlined the particular importance of strengthening efforts to popularize

the journal in the JINR Member States and attract new members of the editorial board and the ISAB outside the Institute. The event gathered 45 people, including Directors of the Institute’s laboratories and members of the JINR Scientific Council.

On 23 September, the second meeting of the Advisory Council of the International Research Centre (IRC) based on the Multipurpose Fast Research Reactor (MBIR) was held at the JINR Scientists’ Club. The main topics of discussion were the development of a strategy for joint work at the MBIR, plans for experiments in physics and materials science, and the training of specialists for the nuclear industry.

Opening the meeting, JINR Director Academician G. Trubnikov noted, in particular, that the Institute has begun work examining the possibility of using the horizontal experimental channels envisaged by the MBIR project for fundamental and applied research in nuclear physics, solid-state physics, medicine, and radiobiology. He emphasized that the goal of the MBIR project is to conduct cutting-edge scientific research, develop new technologies, and train highly qualified personnel, which requires close international cooperation and the exchange of scientific ideas and technologies.

Deputy Director General of the International Atomic Energy Agency (IAEA) and Director of the IAEA Department of Nuclear Energy M. Chudakov noted that the Agency supports the development of the MBIR International Research Centre, which adheres to international quality and safety standards.

Welcoming remarks were made by Chairman of the IRC MBIR Advisory Board, RAS Vice-President, Scientific Director of the Faculty of Chemistry at Lomonosov MSU S. Kalmykov, Director of Scientific and Technical Programmes and Projects at the Rosatom State Corporation N. Ilyina, and Director of the Institute of Nuclear Physics of the Academy of Sciences of the Republic of Uzbekistan I. Sadikov.



Dubna, 23 September. The second meeting of the Advisory Council of the International Research Centre based on the Multipurpose Fast Research Reactor

JINR Vice-Director V. Kekelidze spoke about preparations for experiments and the initial results at the NICA complex, emphasizing the project's importance for the international scientific community. FLNP Director E. Lychagin presented a report on the feasibility of applied research using extracted beams from the IBR-2 reactor and discussed the development of the User Programme. A separate area of discussion was the training of personnel for the

nuclear industry and the implementation of joint educational initiatives.

The event was attended by approximately 100 representatives of research centres and organizations from more than 15 countries. These included delegations from Russia, China, Belarus, Uzbekistan, Kazakhstan, India, Vietnam, Brazil, as well as representatives of the IAEA, the African Commission on Nuclear Energy, and the Arab Atomic Energy Agency.



Dubna, 23 September. A meeting of the JINR Directorate with the delegation of the Embassy of the Federative Republic of Brazil in Russia, headed by Ambassador Extraordinary and Plenipotentiary Sérgio Rodrigues dos Santos (3rd from right)

On 25–28 September, the World Atomic Week, organized by the Rosatom State Corporation, took place in Moscow at the Exhibition of Achievements of National Economy. On 26 September, the JINR delegation participated in the panel session “Neutron flux symphony as a score of progress: How a research reactor “sounds” in daily life”.

In accordance with the session programme, the Special Representative of the JINR Director for Cooperation with International and Russian Scientific Organizations, Academician B. Sharkov, presented the Joint Institute’s experience in organizing international scientific research at the IBR-2 research reactor. President of the Vietnam Atomic Energy Institute Dr. Tran Thi Thanh spoke about the active research reactor in Dalat and the construction of a new research reactor in southern Vietnam. He noted the importance of cooperation with JINR, in particular, in the formation of employees’ professional competencies.

In the presence of the session participants, JINR Director Academician G. Trubnikov and Tran Thi Thanh signed an addendum on cooperation in personnel training to the JINR–Vinatom cooperation agreement signed on 19 April 2019.

On 1 October, a delegation from the Socialist Republic of Vietnam visited the Joint Institute. It included heads and employees of key organizations of the Vietnam Academy of Science and Technology (VAST): the University of Science and Technology of Hanoi (USTH), the Institute of Materials Science (IMS), the Institute of Chemistry, the Institute of Biology, and the Institute of Oceanography. In addition, the delegation was accompanied by Deputy Head of the Department for Science, Education, Culture and

Social Affairs of Vietnam’s Government Office Nguyen Viet Hung.

The working visit started with an introduction to the JINR scientific infrastructure. The delegation visited LRB, the experimental hall of the IBR-2M pulsed reactor at FLNP, and the Centre of Applied Physics at FLNR.

During the meeting with representatives of the JINR Directorate and laboratories, the delegation showcased a video presentation on the role of science in Vietnam’s technological development. Fundamental and applied physics, radiobiology, biomedicine, materials science, information technology, artificial intelligence, electronics, and semiconductor technologies were highlighted as several of the priority areas.

At the meeting, the parties discussed potential ways of collaboration. In particular, they considered a number of possible formats of interaction, highlighting the User Programme of the IBR-2 research reactor and international student internships, as well as organization of lectures for Vietnamese students with the participation of the Institute’s employees and conducting joint online seminars. In conclusion, the parties confirmed their mutual interest in further cooperation development.

On 7–8 October, a delegation from the Institute of Plasma Physics of the Chinese Academy of Sciences (ASIPP), headed by Director General Song Yuntao, visited JINR. The visit began with a tour of the Dzheltopov Laboratory of Nuclear Problems, where the delegation was briefed on the Linac-200 accelerator and Joint Institute’s neutrino programme being implemented within the framework of the Baikal-GVD megascience project.



Dubna, 1 October. The delegation of the Socialist Republic of Vietnam at LRB

The highlight of the first day was a scientific seminar dedicated to the discussion of promising projects and research programmes. A researcher at the Engineering Department of the Institute of Plasma Physics, Chen Yonghua, presented a report on advances in the development of medical superconducting cyclotrons and proton radiotherapy systems. Deputy Head of the Fusion Reactor Materials and Components Department Xu Yuping highlighted the development of radiation materials science research. Head of the Diagnostics Department Liu Haiqing reported on progress in developing new techniques and systems for fusion plasma diagnostics.

DLNP Chief Engineer S. Yakovenko presented the status of the MSC-230 superconducting isochronous cyclotron project. Head of Sector at VBLHEP M. Novikov reported on the development of an inductive energy storage system for the superconducting magnet energy supply (SMES) for the Booster and Nuclotron at the NICA accelerator complex. An engineer at the Frank Laboratory of Neutron Physics, V. Yamurzin, presented the capabilities of the IBR-2 pulsed reactor for studying the radiation resistance of materials and electronic components. FLNP Director E. Lychagin emphasized the broad capabilities of the IBR-2 spectrometer complex and proposed exploring the prospects for joint fundamental and applied research.

At the conclusion of the seminar, Assistant Director General of the Chinese Science Centre Dong

Shaohua noted the long (more than a decade) history of fruitful cooperation between the institutes. She highlighted research of the radiation resistance of materials for the creation of next-generation experimental facilities and the development of advanced diagnostic technologies as key priorities for ASIPP, expressing confidence in the successful implementation of joint projects with JINR in these areas.

Guests were given tours of the IBR-2 research reactor and the NICA accelerator complex. JINR Director G. Trubnikov met with ASIPP Director General Song Yuntao at VBLHEP to discuss prospects for strengthening JINR-ASIPP international cooperation.

On 8-10 October, the 43rd Consultative Meeting of INIS Liaison Officers was held at IAEA headquarters in Vienna. Representatives of the INIS IAEA Secretariat, 76 participants from 63 Member States and three international organizations, including JINR, took part in the meeting.

The participants received an update on INIS activities over the past two years, including the number of information products added to INIS, the implementation of the new Invenio system, usage of INIS by visitors, harvesting projects, automation of the INIS system, and planned improvements.

The talks by guest speakers from arXiv, CERN and NEA Databank generated constructive discussions on sharing experiences in the field of Open Access and Open Science. Among the issues most discussed were INIS IAEA Thesaurus and Taxonomy



Dubna, 7-8 October. The delegation from the Institute of Plasma Physics of the Chinese Academy of Sciences, headed by Director General Song Yuntao, at VBLHEP



Vienna (Austria), 8–10 October. The 43rd Consultative Meeting of INIS Liaison Officers at IAEA headquarters. S. Kruglova (JINR) is giving a talk

development and the use of artificial intelligence in information management.

During the meeting, the attendees had a chance to familiarize themselves with the IAEA Lise Meitner Library, which cooperates with INIS IAEA. The IAEA Marie Skłodowska-Curie Fellowship Programme and the Women in Nuclear Programme, which aim to help increase the number of women in nuclear sector, were presented.

Presentations on INIS activities at the local level were given by representatives of Bulgaria, China, Cyprus, Hungary, Russia, Turkey, Zambia, and JINR.

On 11–14 October, the Workshop on Quantum Computing and Machine Learning (QCML-2025) was

held in Cairo. The organizers were the Meshcheryakov Laboratory of Information Technologies of JINR and the Egyptian Academy of Scientific Research and Technology (ASRT). The meeting brought together scientists from Armenia, the Czech Republic, Egypt, Georgia, and Russia.

On 13 October, a roundtable meeting was held for representatives of JINR, ASRT, and scientific organizations of Egypt. The discussion was about the implementation of the strategy of development of quantum calculations in the Arab Republic of Egypt. The participants exchanged information on the status of research in the field and discussed approaches and opportunities for cooperation.



Cairo (Egypt), 11–14 October. Participants of the Workshop on Quantum Computing and Machine Learning



Dubna, 24 October. The 3rd meeting of the Joint Coordinating Committee of JINR – Ministry of Science and Technology of the People’s Republic of China

The Egyptian participants were acquainted with activities at JINR in the administrative, scientific, innovative and educational spheres. It was stressed that the Joint Institute for Nuclear Research as an international intergovernmental organization is an efficient platform for establishing scientific ties and can serve as a promoter for contacts with industrial companies.

The sides discussed possible approaches to launch joint projects. The Egyptian side suggested, as a practical measure, that an opportunity for leaders and specialists from Egyptian research organizations to take part in the international training “JINR Expertise for Member States and Partner Countries” (JEMS) should be discussed.

On 24 October, the 3rd meeting of the Joint Coordinating Committee of JINR – Ministry of Science and

Technology of the People’s Republic of China was held at JINR. The Committee acts in accordance with the Protocol for strengthening cooperation in fundamental scientific research among the Ministry of Science and Higher Education of the Russian Federation, the Chinese Academy of Sciences, the Ministry of Science and Technology of China, and JINR.

Opening the meeting, Co-chairman of the Committee, JINR Director G. Trubnikov marked that the implementation of the Protocol had achieved the practical level and overlapped a wide range of approaches. He stressed the special importance of the megascience project of JINR — the NICA accelerator complex, and expressed his gratitude to the Government of China for the overwhelming support of scientific interactions and underlined the interest of Chinese colleagues to the international project of the Baikal-GVD deep-water neutrino telescope.

Greeting the participants of the meeting, Deputy Minister of Science and Technology of China, Co-chairman of the Committee Chen Jiachang said that the event is aimed at the strengthening of partnership in fundamental research and support of new strategic projects that would bring about important practical results.

On behalf of the Ministry of Science and Higher Education of the Russian Federation, Director of the Department of International Relations K. Trinchenko greeted the audience and marked the importance of the four-lateral interaction and the role of JINR as an international platform for scientific exchange between the states.

Co-leader of the Expert Working Group (EWG), JINR Scientific Leader V. Matveev spoke about the results of the third meeting of the EWG that took place on 17 October 2025. Outputs of eight joint projects were discussed, and the implementation of them was considered successful. The Expert Working Group recommended that financing of these projects should be continued.

Out of 23 new proposals to hold joint research studies, the EWG selected seven new projects to be implemented in 2026. The EWG Co-leader, a researcher of the Institute of High Energy Physics of the Chinese Academy of Sciences, CAS Academician Chen Hesheng, said that the interest to cooperation programmes grows — the number of applications increased by 28%, in comparison to 2024. During the JCC meeting, the Committee representatives ratified changes in the EWG. Now the Expert Working Group includes CAS Academician Zou Bingsong, VBLHEP

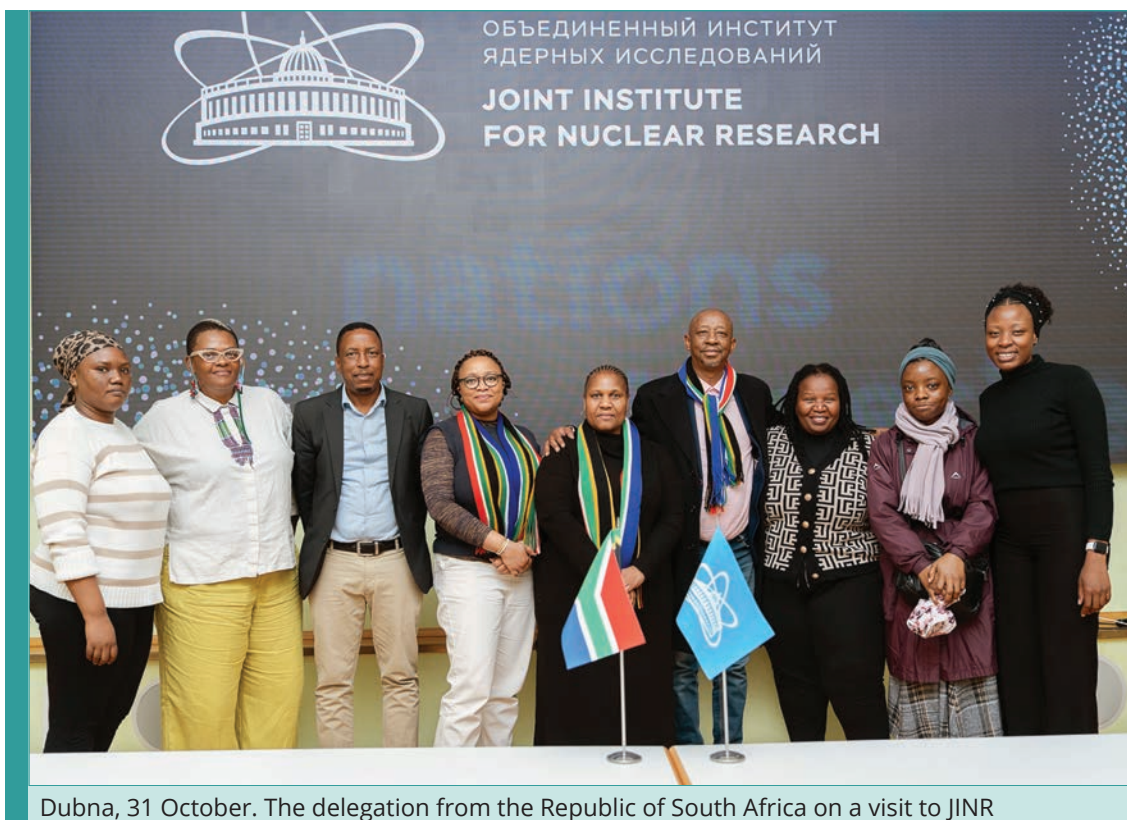
Acting Director A. Butenko, and DLNP Deputy Director A. Guskov.

Special attention was paid to the issue of establishing a direct high-speed communication channel between JINR and scientific centres of China that would allow stable interaction of computer centres involved in international experiments and would become a necessary element of extending further cooperation.

Summing up the results of the meeting, the Committee confirmed successful accomplishment of joint projects and approved their continuation; agreed to the suggestion to support the second part of seven new projects with duration of three years and a possibility to prolong them; affirmed the updated composition of the Expert Working Group; stressed the importance of developing a selected communication channel between JINR and scientific centres of China; agreed to hold the 4th meeting of the Committee in 2026 in China. The final protocol of the meeting was signed by the JCC Co-chairmen — G. Trubnikov and Chen Jiachang.

After the meeting, the Chinese delegation visited the site of the NICA accelerator complex and the Alley of Academician Wang Ganchang in the territory of VBLHEP, the Superheavy Element Factory at FLNR, and the memorial study of N. Bogoliubov at BLTP.

On 31 October, a delegation from the Republic of South Africa visited the Joint Institute for Nuclear Research. The delegates represented the Department of Science, Technology and Innovation (DSTI) of South Africa, the National Research Foundation





Johannesburg (RSA), November. A delegation from JINR visits the University of South Africa (UNISA)

(NRF), the Technology Innovation Agency (TIA), the South African National Space Agency (SANSA), and the Mintek research organization. The delegation was headed by DSTI Acting Chief Director for International Bilateral Cooperation C. Masoka.

The programme of the working visit started with an introduction to the scientific infrastructure of the Joint Institute. The delegation visited the site of the NICA accelerator complex at VBLHEP and the interactive exhibition “JINR Main Facilities” at the Mir Cultural Centre.

The key event of the visit was a meeting at the Scientists’ Club with representatives of the JINR Directorate and laboratories. Among promising trends for cooperation, the participants marked ra-

diation biology, nuclear medicine, radiochemistry, accelerator technologies, and the training of highly qualified personnel. Special attention was paid to the experience of South African specialists already working at JINR who shared their impressions about their involvement in international research projects and spoke about the unique opportunities for professional growth at the Joint Institute. The parties confirmed their mutual interest in developing a comprehensive cooperation programme and further strengthening scientific and technological ties.

At the end of the visit, the South African delegation visited the experimental building of the Superheavy Element Factory at the JINR Flerov Laboratory of Nuclear Reactions.



Bhubaneswar (India), 10–12 November. Participants of the JINR–India Workshop on Particle, Nuclear, Neutrino Physics and Astrophysics



Dubna, 12 November. The 100th seminar of the JINR Association of Young Scientists and Specialists

On 12 November, the 100th seminar of the JINR Association of Young Scientists and Specialists was held at the Scientists' Club since the moment of organization of weekly popular lectures that staff members of different departments of the Institute read to each other to acquaint colleagues with their professional interests.

JINR Director G.Trubnikov talked on modern physics issues that are not explained by the Standard Model of elementary particles and should be tested in experiments at accelerators, and presented a review of world accelerators and laboratories that conduct research in high energy physics and particle physics in Switzerland, the USA, China, Russia, Japan, and other countries. He paid special attention to neutrino physics that is studied not only at accelerators but also in neutrino observatories, at atomic electric stations, in large experiments on neutrino oscillations. For example, JINR is represented in NOvA and DUNE — these experiments have shown important results recently. The underground observatory JUNO possesses the best accuracy and the fastest acquisition of statistics. It was built in China with active participation of scientists, engineers and programmers from JINR. Finishing the lecture, the speaker told the audience about the NICA accelerator complex and stressed the role of JINR flagship facilities in the world.

On 25 November, the JINR International Conference Hall hosted a joint meeting of the Science and Technology Council and the Council for Social and Infrastructure Projects for the JINR Development. Topping the agenda were improvements of the Institute's social infrastructure: renovations of the

sites and buildings of the Joint Institute, the opening of new cultural and historical objects, and the provision of housing for JINR scientists and engineers from other cities and countries.

Institute's Vice-Director L.Kostov talked about the ongoing and upcoming repairs, reconstruction, and improvements of the JINR social infrastructure facilities. JINR Director G.Trubnikov spoke about the status of housing resources of the Institute and plans for its development, marking that the solution of this issue is priority for a long perspective.

On 27 November, a Letter of Intent was signed in Dubna between the Institute of Nuclear Physics (RSE INP) of the Agency of the Republic of Kazakhstan for Atomic Energy and the Joint Institute for Nuclear Research. The signing took place during the official visit of RSE INP Director General S.Sakhiyev to JINR. The document lays the foundation for the joint development and creation of a high-intensity ultracold neutron source (UCNS) at the WWR-K research reactor in Kazakhstan.

According to the agreement, the cooperation is planned to be implemented in several stages, which include the development of the UCNS concept, a scientific programme, and a detailed roadmap for the project. After the initiative is approved by the Governing Bodies of the Joint Institute for Nuclear Research, the main agreement will be signed, which will officially launch joint work on the creation of a new research infrastructure at the Institute of Nuclear Physics in the Republic of Kazakhstan.

At the conclusion of the meeting, the parties discussed the festive events dedicated to the 70th anniversary of the Joint Institute for Nuclear Research



Dubna, 27 November. The Letter of Intent between the Institute of Nuclear Physics of the Agency of the Republic of Kazakhstan for Atomic Energy and JINR is signed

and the 20th anniversary of the Astana branch of the Institute of Nuclear Physics planned for the year 2026. G. Trubnikov and S. Sakhiyev expressed confidence that the future joint project will become an important point of interest for scientists from all over the world.

On 28 November, delegations of the Federation Council of the Federal Assembly of the Russian Federation and the Council of the Republic of the National Assembly of the Republic of Belarus visited the Joint Institute for Nuclear Research.

The programme of the visit included an introduction to the key objects of the JINR scientific infrastructure. At VBLHEP, the delegates toured the NICA complex to learn about the project's progress and its importance to the international scientific community. In addition, they were acquainted with the interactive exhibition "JINR Main Facilities" at the Mir Cultural Centre.

At the working meeting with the leadership of the Joint Institute, the participants expressed hope that further strengthening the partnership between Russia and Belarus as JINR Member States would cre-



Dubna, 28 November. Representatives of the Federation Council of the Federal Assembly of the Russian Federation and the Council of the Republic of the National Assembly of the Republic of Belarus on an excursion to VBLHEP



Cuba, 1 December. The first meeting of the JINR–Brazil Joint Coordinating Committee between JINR and the Ministry of Science, Technology and Innovation of the Federative Republic of Brazil

ate a solid foundation for new forms of multilateral cooperation in research, education, and innovation aimed at developing the scientific and technological potential of Russia and Belarus.

On 1 December, the first meeting of the JINR–Brazil Joint Coordinating Committee (JCC) was held in a hybrid format between JINR and the Ministry of Science, Technology and Innovation (MCTI) of the Federative Republic of Brazil.

Brazil was represented at the meeting by Director on Analytics and Digital Solutions of the National Council for Scientific and Technological Development (CNPq) D. Peres Menezes, President of the Physics Society of Brazil (SBF) S. Kanuto, and Director of Scientific and Experimental Design Activities of the National Board on Nuclear Energy (CNEN) U. Kalvo.

JINR Director G. Trubnikov, Secretary on Strategic Policy and MCTI Programmes A. Brito Latgé, and Co-chairpersons of JCC spoke at the opening of the event. The participants of the meeting confirmed the agenda of the work of the Committee and the Expert Working Group. The Joint Institute nominated 11 experts in advanced trends of cooperation of JINR with Brazilian research organizations and universities that include a wide range of topics.

The Joint Coordinating Committee expressed confidence that the decisions adopted at the first meeting provide solid organizational mechanisms of strengthening scientific interactions between Brazilian research centres and JINR that will allow implementation of joint scientific and educational projects within a short time.

On 3 December, a delegation of the Joint Institute for Nuclear Research, led by JINR Director Academician G. Trubnikov, held working meetings in the Ministry of Science, Technology and Environment (CITMA) and the Ministry of Higher Education (MES) of the Republic of Cuba. Cuban authorities were rep-

resented by CITMA Minister A. Rodríguez Batista and MES Minister W. Baluja García.

The parties discussed prospects for the development of international scientific and technical cooperation. In particular, JINR and CITMA confirmed plans to open an Information Centre of the Joint Institute in Havana in 2026 and agreed to prepare a project for a joint research laboratory under the auspices of the Cuban Ministry of Science. The new laboratory's key task would be the development of nuclear technologies to solve problems in ecology, climate change, and biomedicine.

As part of the dialogue with the Ministry of Higher Education, an agreement was concluded on JINR participation in University-2026, the 15th International Congress on Higher Education, where specialists from Dubna will present the scientific and educational opportunities of the Joint Institute for Latin American universities. The implementation of these initiatives is aimed at deepening JINR collaborations with both Cuban and other scientific and educational organizations in the Latin American region.

On 4 December, a ceremonial event was held in Havana on the occasion of the 50th anniversary of Cuban membership at JINR. Members of the Government of the Republic of Cuba, delegations from the JINR Member States, representatives of scientific community of Latin American countries, and leading Cuban scientists who started their career in Dubna took part in the ceremony.

JINR Director Academician G. Trubnikov and Plenipotentiary of the Government of the Republic of Cuba to JINR, Director General of the Centre for Radiation Protection and Hygiene (CPHR) G. Walwyn Salas headed the Presidium. Among the honorary guests, the following persons were present at the celebration: Minister of Science, Technology and Environment of Cuba A. Rodríguez Batista, Deputy Minister of Science I. López Pérez, President of the Agency for Nuclear Energy and Advanced Technologies



Havana (Cuba), 3 December. Working meetings of the JINR delegation headed by JINR Director Academician G. Trubnikov in the Ministry of Science, Technology and Environment and the Ministry of Higher Education of the Republic of Cuba

(AENTA) G. López Bejerano, and honorary Academician of the Cuban Academy of Sciences C. de Jesús Rodríguez Castellanos.

Cooperation between JINR and Cuba was officially established on 1 June 1976, when Cuba joined the Member States of the Institute. For the first 15 years, more than 70 Cuban scientists and engineers had worked at JINR laboratories, and a famous specialist in quantum mechanics, Elias Entralgo, occupied the position of JINR Vice-Director in 1983–1989.

G. Trubnikov presented a review report about scientific activities at JINR, speaking in detail about all seven laboratories, their key achievements and projects. He paid special attention to the prospects for development of cooperation with Cuba. Cuban scientists and students take an active part in joint research in radiation biology, materials science, and radio medicine. The key JINR partners are AENTA, the Centre

for Applied Technologies and Nuclear Development (CEADEN), the University of Havana, CPHR, the Centre for Advanced Studies (CEA), the Higher Institute of Technologies and Applied Sciences (InSTEC), the Centre of Isotopes (CENTIS), and the Neuroscience Centre (CNEURO). In fundamental research, the cooperation is implemented within the framework of the SPD collaboration at the NICA accelerator complex that was joined by a scientific group from Havana University in 2024.

Plenipotentiary of the Government of the Republic of Cuba to JINR G. Walwyn Salas talked about the start of cooperation in the 1970s. Since Cuba joined JINR as its Member State, more than 300 Cuban specialists had attained scientific experience in the Dubna scientific school. He indicated that for the last two decades the interactions of the Republic of Cuba and the Joint Institute for Nuclear Research had con-



Havana (Cuba), 4 December. The ceremonial event dedicated to the 50th anniversary of Cuba's joining the JINR Member States

siderably increased, especially in the programme of the Institute's applied research.

Representatives of scientific organizations of Cuba and other Latin American countries greeted the participants of the festive event: J. Luis Dona (AENTA), O. Diaz Rizo (InSTEC), A. Krainer (UNSAM, Argentina), G. Carvalho Kassar (MINCYT, Venezuela), I. Padron Diaz (LRB JINR/CEADEN), E. Pedrero González (IMRE, Cuba).

On 4-5 December, the International Seminar "JINR – Latin America: Synergetic Partnership for Future" took place in Havana. The aim of the event was to strengthen scientific ties and discuss opportunities for the implementation of collaborative projects by the Joint Institute and scientific organizations of the Latin American region.

Leading researchers of JINR and outstanding specialists in physics, chemistry and radiobiology of

the Latin American region made presentations on the main scientific programmes and experimental studies conducted in Dubna and in Latin American countries.

Within the framework of the seminar a round table discussion was organized, and before it Head of the International Cooperation Department O.-A. Culicov presented an overview of the opportunities JINR provides for Latin American specialists. She spoke in detail about the Institute's educational programmes (START and INTEREST), user programmes and rules for access to unique scientific facilities (IBR-2, Linac-200), and JINR social infrastructure for specialists arriving in Dubna.

An UNAM researcher, Professor E. Rafael Chávez Lomelí, shared the successful experience of cooperation with the Joint Institute for Nuclear Research. He stressed the importance of not only developing scientific ties, but also concluding intergovernment-



Brasilia (Brazil), 5 December. Participants of the international seminar on the prospects for development of scientific cooperation in physics in the countries of Latin America. Photo: © Marcelo Gondim (CNPq)



Havana (Cuba), 4–5 December. The International Seminar “JINR – Latin America: Synergistic Partnership for Future”

tal agreements to ensure broad mutual access to the research infrastructure of JINR and scientific centres in Latin America.

As a result of the event, agreements were reached on the dissemination of information about JINR’s capabilities by Latin American scientists in their countries, the participation of specialists from Dubna in the work of the Physical Society of Latin America, and the organization of joint scientific workshops.

On 8 December, the JINR delegation was on a visit to the Secretariat of Science, Humanities, Technology and Innovation (Secihti) in Mexico City (Mexico) — a federal executive body of the United Mexican States that functions as the Ministry of Science and Technology. A three-party agreement was signed at the event among JINR, the Secretariat, and the Institute of Nuclear Sciences of the National Autonomous University of Mexico (UNAM) to expand scientific cooperation.



Mexico City (Mexico), 8 December. After the signing of the three-party agreement on extending scientific cooperation among JINR, Secihti, and UNAM.

Photo: © Secihti

On behalf of the Secihti Chief Secretary R. Ruiz Gutierrez, Deputy Minister of Science and Humanities Professor B. Rojas spoke about the status of JINR–Mexico cooperation, in accordance with the Declaration of Intent for joint activities in fundamental, advanced and applied scientific studies adopted in 2023.

JINR Director Academician G. Trubnikov stressed that the concluded agreement primarily focuses on the establishment of bodies for further widening of JINR–Mexico cooperation. Following the results of the competitive selection, three scientific directions will be financed under the agreement: nuclear analytical methods for studying nanomaterials and environmental samples, participation in the MPD NICA collaboration, and research with high energy beams at the Van de Graaff accelerator.

JINR Vice-Director Academician V. Kekelidze talked about experiments at the NICA accelerator complex and the involvement of Mexican scientists in collaborations of the NICA megascience project, highlighting the contribution of Mexican institutions to the development of the MPD project under the auspices of UNAM and the role of A. Ayala, the researcher at the UNAM Institute of Nuclear Sciences, as the Chairman of the MPD Institutional Board.

On 9 December, the National Autonomous University of Mexico (UNAM) hosted a workshop titled “Mexico–JINR Scientific Cooperation Opportunities”. The participants represented JINR, along with the UNAM Institute of Physics (IFUNAM), the UNAM Institute of Nuclear Sciences (ICN-UNAM), and other leading Mexican universities.

JINR Director G. Trubnikov presented an overview of the key studies conducted at the Joint Institute. NICA Project Leader, JINR Vice-Director V. Kekelidze told the audience about the main objectives of the project and the stage of its implementation, and gave a general description of the planned experiments. He highlighted the participation of Mexican researchers in the collaborations at NICA. Head of the International Cooperation Department O.-A. Culicov delivered the talk devoted to the forms of international partnerships at JINR and the opportunities to access the Institute’s scientific infrastructure.

The scientific programme of the event was complemented by the presentations of A. Raya (Michoacan University of Saint Nicholas of Hidalgo, UMSNH), N. Dasgupta (UMSNH), E. Chavez (IFUNAM), and A. M. Cetto (IFUNAM) on studies in high energy physics, materials science, and Earth sciences, along with prospects for expanding partnerships with JINR.

The workshop ended with a Q&A session conducted by an ICN-UNAM researcher, Chair of the MPD Institutional Board at NICA A. Ayala.

On 13 December, a delegation from the Socialist Republic of Vietnam, headed by Vice-President of the Vietnam Academy of Science and Technology (VAST) Tran Hong Thai, visited the Joint Institute for Nuclear Research. The goal of the visit was to learn about the JINR scientific infrastructure and research. At the meeting with JINR Directorate, the parties discussed prospects for further cooperation.

Emphasizing the strategic significance of the partnership with Vietnam, JINR Director Academician G. Trubnikov highlighted the stable increase in



Mexico City (Mexico), 9 December. Participants of the Workshop “Mexico–JINR Scientific Cooperation Opportunities” at the National Autonomous University of Mexico



Dubna, 13 December. The JINR Directorate receives the delegation from the Socialist Republic of Vietnam headed by Vice-President of the Vietnam Academy of Science and Technology Tran Hong Thai (4th from right)

the number of Vietnamese specialists at JINR that serves as the best confirmation of the expansion of international relations.

VAST Vice-President Tran Hong Thai highly estimated the international activity of JINR and confirmed the importance of Vietnam's participation in the Institute's work. According to him, cooperation should be aimed at the solution of unique scientific and technical tasks, particularly in medicine, ecology, and other spheres. He also paid special attention to the necessity to build a balanced system of staff training where work should be done involving students and experienced researchers.

Special Representative of the JINR Director for Cooperation with International and Russian Scientific Organizations Academician B. Sharkov spoke about his experience of participation in scientific educational forum "Russia-Vietnam: 75 Years of Cooperation" which was held in Moscow on 11-13 December 2025. As a review report, he presented a talk about history of JINR-Vietnam partner relations and new opportunities for joint work in large projects.

JINR-Vietnam Cooperation Coordinator, JINR Scientific Council member Le Hong Khiem, who attended the event, described JINR as an optimal platform for the development of Vietnamese science. He also said that Vietnamese specialists from the Joint Institute had accomplished three experiments at the IREN setup (a source of resonance neutrons) at FLNP JINR for the last two years and published 10 scientific papers.

Summing up the meeting, JINR Director G. Trubnikov noted the satisfaction with the cooperation

and expressed gratitude to the Vietnam Academy of Science and Technology for support of the Institute and the JINR-Vietnam Joint Coordinating Committee.

Besides the representatives of VAST, staff members of large scientific centres of Vietnam, such as the Institute of Oceanography, the Institute of Materials Science, the Institute of Biology, the Institute of Science and Technology for Energy and Environment, were included into the delegation, as well as diplomats from the Embassy of Vietnam in Russia and Vietnamese students.

At the conclusion of the visit, the delegation had an excursion to the site of the NICA accelerator complex at VBLHEP and held a working meeting with the national group of scientists from Vietnam who work at JINR.

On 24 December, the JINR Science and Technology Council (STC) held a meeting at the International Conference Hall. STC Chair E. Kolganova opened the event. She listed the topics of nine JINR STC meetings in 2025: attracting personnel, developing the Institute's social infrastructure, nominating employees to be honoured with the Russian Government Awards and to be appointed members of the Russian Academy of Sciences, and organizing events dedicated to the 70th JINR anniversary. Following the discussion by the STC members of JINR's radiobiology scientific programme, an Interlaboratory Council was established for this field of study.

JINR Director Academician G. Trubnikov presented the most important events in the life of the Insti-

tute and the main scientific results of 2025 in each of the seven JINR laboratories, highlighting published articles on all areas of research conducted in them, including works prepared in international teams. The speaker announced the transition to a new system of payment for labour that would be done in several years, noted success in budgetary and economic policy, considerable growth of number of scientific visits to the Institute and the frequency of JINR citation in mass media.

The JINR Director identified a number of key tasks in science and education for the coming years: to refuel the IBR-2 reactor; to modernize the Nuclotron; to extend cooperation with the Member States

to establish their scientific infrastructure; in partnership with the Ministry of Science and Higher Education of the Russian Federation, the Government of the Moscow Region, the Dubna Special Economic Zone, and Dubna State University, to create an International Park of Science and High Technologies; to build the Scientific and Clinical Centre for Proton Therapy based on the MSC-230 superconducting cyclotron and so on.

At the end of the talk, G. Trubnikov expressed gratitude to all employees of the Institute, noting the favourable work climate at JINR and presented awards to the staff members of the Institute.

CONFERENCES and MEETINGS

Twelve conferences were the largest among the scientific conferences and workshops held at JINR in 2025.

On 18 March, a *memorial seminar dedicated to the 95th anniversary of the birth of Nikolay Nikolaevich Govorun* took place at the Meshcheryakov Laboratory of Information Technologies. Being the Corresponding Member of the USSR Academy of Sciences and the initiator of the creation of the JINR local area information and computing network, he is rightly regarded as the one thanks to whom the Laboratory of Computing Techniques and Automation (now the Laboratory of Information Technologies) became an IT leader in Russia and the JINR Member States.

The seminar held in a hybrid format was attended by JINR Scientific Leader V. Matveev, JINR Vice-Directors V. Kekelidze and L. Kostov, the Directorate and staff members of MLIT, as well as of the other laboratories and subdivisions of the Institute, leading Russian IT scientists, representatives of MLIT

partner organizations, colleagues and friends of N. N. Govorun, and members of his family.

JINR Vice-Director, Corresponding Member of the RAS V. Kekelidze opened the festive seminar. "The role of Nikolay Nikolaevich is difficult to overestimate. Having been the first to implement the Fortran programming language for the BESM-6 computer, he revealed to us the entire power and wealth of software products created worldwide in the field of high-energy physics. It is symbolic that today the powerful Govorun supercomputer operates at JINR, and that the data centre of the Federal Tax Service of the Russian Federation is located in Dubna in Govorun Street," V. Kekelidze said in his introductory speech.

MLIT Director S. Shmatov noted: "MLIT's entire scientific programme is imbued with the spirit and is based on the brilliant ideas of Nikolay Nikolaevich. He was a man who was ahead of his time. The vector set by N. Govorun defined the direction of imple-



The Meshcheryakov Laboratory of Information Technologies, 18 March. A memorial seminar dedicated to the 95th anniversary of the birth of N. Govorun

mentation of scientific experiments at large physical facilities for many years. I am confident that we will all make every effort to develop and multiply the scientific heritage that he left us."

MLIT Scientific Leader V. Korenkov highlighted the pioneering role of N. Govorun in the development of computer science in the USSR and his decisive contribution to the development of LCTA JINR. The works of N. Govorun on the creation of computer programs for processing pictures from bubble and spark chambers, a translator from the Fortran programming language, and the Dubna monitoring system for the advanced computer of that time, BESM-6, as well as his idea and its implementation for building a hierarchical complex of computing tools to automate scientific research at JINR, were acknowledged. "Nikolay Nikolaevich Govorun was the initiator and major driving force behind many projects. He made decisions quickly, charged everyone around him with his energy and optimism. He had his own supercomputer in his head," V. Korenkov shared his memories of his teacher.

Talks at the seminar were devoted to different stages of N. Govorun's path in science and life. It was repeatedly said about the unique giftedness of the scientist, his determination, selfless work, his talent for assembling and inspiring scientific teams. At the same time, N. Govorun knew how to be involved in the problems of his colleagues and found time for his wife and children. Scientific Director of the Keldysh Institute of Applied Mathematics of the RAS B. Chetverushkin, MLIT Chief Researcher G. Ososkov, former LCTA Deputy Director A. Karlov, N. Shirikova, Scientific Secretary of LRB I. Koshlan, and Head of the Department of Automated Systems for Computing Complexes of CMC MSU R. Smelyansky shared

their memories. N. Govorun's family members, son Nikolay, daughter Tatyana, son-in-law P. Vabishchevich, and niece O. Lashchenova, spoke at the seminar and warmly thanked the Laboratory for preserving the good memory of Nikolay Nikolaevich.

The presentation of the book album entitled "Nikolay Nikolaevich Govorun. Portrait in the background of an epoch" took place within the ceremonial event. The book by the Real Modern Pictures (RMP) publishing house, which publishes biographical and corporate books, is devoted to the prominent scientist's life and path in science. The character of N. N. Govorun as a scientist and as a person, the image of the time in which he lived are revealed through the memories of colleagues and family members.

On 15–17 April, the Veksler and Baldin Laboratory of High Energy Physics hosted *the 15th Collaboration Meeting of the MPD Experiment at the NICA Facility* in a hybrid format. Over 190 specialists took part in it. A revised plan for the implementation of the MPD (Multi-Purpose Detector) project was presented at the event. At the top of the agenda was an update on the NICA accelerator complex, the readiness of the detector's main systems, and the future physics research programme.

JINR Vice-Director V. Kekelidze gave a welcome speech. He noted that since the first meeting, the number of the MPD collaboration participants has more than doubled. The international team of specialists made significant progress in implementing the MPD project at the NICA accelerator complex.

NICA Chief Engineer E. Syresin provided an update on the VBLHEP accelerator complex and discussed further plans for its development. Special



The Veksler and Baldin Laboratory of High Energy Physics, 15–17 April.
The 15th Collaboration Meeting of the MPD experiment at the NICA Facility

attention was paid to the work aimed at increasing the ion beam intensity.

MPD collaboration Spokesperson, Chief Researcher at the VBLHEP Sector of Elementary Particle Identification V. Ryabov discussed the progress of the MPD experiment. He noted the readiness of the time-of-flight (ToF) system, the forward hadron calorimeter (FHCAL), and the fast forward detector (FFD) modules, along with the successful test installation of a carbon fibre power frame in the solenoid. Wide research aimed at studying the capability of the MPD experimental facility to measure physical signals both in the mode of colliding beams in the Collider and in collisions with a fixed target was performed. The collaboration continues to develop software and data analysis techniques for the most efficient work with real data. V. Ryabov pointed out that the collaboration has become more active, which resulted in an increased number of publications on MPD research topics in peer-reviewed journals.

Head of the MPD Scientific and Experimental Department V. Golovatyuk presented an overview of the progress of the creation and integration of key structural elements of the Multi-Purpose Detector. He noted that the production of all components for the first stage of the experiment continues with minor delays. According to the current plan, by the time the first beams collide in NICA, the detector unit capable of measuring the basic parameters of beam interaction will be already installed at the collision point. Only after ensuring stable operation of the accelerator complex and adjusting the beam parameters to certain values, the entire Multi-Purpose Detector weighing more than 1000 t will be installed in the beamline. By this time, the work to assemble it will be completed.

The talk by VBLHEP JINR Deputy Chief Engineer K. Mukhin was devoted to the preparation of the superconducting solenoid magnet. VBLHEP Sector Head O. Rogachevsky and MLIT Leading Researcher S. Hnatič discussed software development. E. Antokhin (INP SB RAS) presented the status of the Mapper manufactured in Novosibirsk for the MPD experiment. VBLHEP Leading Researcher A. Taranenko made a presentation titled "System and Rapidity Scan at MPD".

A closed meeting of the MPD Institutional Board focusing on organizational issues concluded the first day's programme.

On 16 April, a guided tour of the NICA accelerator complex was organized for all participants present in Dubna. The results of the meeting were announced during an open discussion on the final day.

On 13–15 May, *the 14th Collaboration Meeting of the BM@N Experiment at the NICA Facility* took place at VBLHEP. The key topics were the progress and development prospects of the experiment performed as part of the NICA megascience project. The hybrid-format event brought together more than 135 participants from JINR and 13 leading scientific organizations and universities of Bulgaria, Israel, Kazakhstan, Russia, and Uzbekistan.

At the opening of the event, JINR Vice-Director V. Kekelidze noted that BM@N had achieved significant success over the seven years of its existence. Articles by the collaboration are published in prestigious scientific journals such as Nuclear Instruments and Methods, and the number of its participants is gradually growing.

VBLHEP JINR Chief Researcher, collaboration Spokesperson R. Lednický highlighted that the collaboration counts more than two hundred partic-



The Veksler and Baldin Laboratory of High Energy Physics, 13–15 May. The 14th Collaboration Meeting of the BM@N experiment at the NICA Facility



Alushta (Crimea, Russia), 8–15 June. Participants of the 14th International Conference of Young Scientists and Specialists “Alushta-2025”

Participants from five countries. In 2024, scientists and specialists engaged in the project received two JINR awards. Experimental results and data analysis are regularly presented at leading nuclear physics conferences. Under the project, a candidate's thesis was defended.

The presentation by the experiment's Project Manager, Deputy Head of the Scientific and Experimental Department of the MPD at VBLHEP JINR S. Piyadin was devoted to the progress of work at the BM@N detector. He presented the actual configurations and positions of the detectors located in the SP-41 magnet. S. Piyadin spoke about the installation of silicon detectors, detectors based on gas electron multipliers and cathode strip chambers, and highlighted the modernization of ToF-400 (time-of-flight) detectors.

Experimental data analysis and details of the preparation of the detector, trigger, and other facility systems were presented at the meeting. On 13 May, a meeting of the BM@N Institutional Board took place. On the final day, issues of software development, automation of data collection, storage and processing, and the introduction of machine learning for experimental data processing were discussed.

On 17 June, the jubilee seminar of the Laboratory of Radiation Biology “*Radiation Biology — At the Intersection of Fundamental Sciences. 20 Years in Focus*” was held at the JINR Scientists' Club.

JINR Director RAS Academician G. Trubnikov spoke about the main landmarks of the development of radiobiological research at JINR. LRB Scientific Secretary I. Koshlan read a greeting from the LRB Scientific Leader, Corresponding Member of the Russian Academy of Sciences E. Krasavin, who noted the outstanding role of the DLNP JINR Director, Corresponding Member of the AS USSR V. Dzhelepov and the Director of the Institute of Experimental Pathology and Cancer Therapy of the AMS USSR, Academician N. Blokhin in the emergence of radiobiology at the Institute. LRB Director A. Bugay made a report on the major achievements of the Laboratory and prospects for future studies.

Congratulations to the Laboratory were expressed by the Institute administration, colleagues and representatives of organizations-partners that have been close collaborators of the Laboratory for many years of research in various scientific directions. On the occasion of the jubilee, the laboratory staff members were presented awards. A film about the establishment of LRB in 1959 to the present day was shown to the audience. The RMP publishing house issued a book album “The Laboratory of Radiation Biology” to the jubilee of LRB JINR. The festive event was concluded with a concert of the violet quartet of the Dubna symphony orchestra.

On 7–11 July, the 11th International Conference “*Distributed Computing and Grid Technologies in Science and Education*” (GRID'2025) took place at MLIT JINR. It was dedicated to MLIT founders, namely, the



Ulaanbaatar (Mongolia), 30 June – 4 July. Listeners of the International School on Nuclear Methods and Applied Research in Environmental, Material, and Life Sciences (NUMAR-Gobi 2025)

115th anniversary of the birth of M. Meshcheryakov and the 95th anniversary of the birth of N. Govorun. Besides, it was held on the eve of the celebration of the 70th anniversary of the Joint Institute for Nuclear Research and the 60th anniversary of the Meshcheryakov Laboratory of Information Technologies, which will take place in 2026.

The conference traditionally attracted a large community of Russian and foreign experts ready to discuss emerging challenges and prospects related to the use and development of distributed computing and grid technologies, heterogeneous and cloud computing in various fields of science.

About 300 scientists from research centres of Armenia, Belarus, Bulgaria, CERN, China, Egypt, France, Georgia, Iran, Kazakhstan, Mexico, Rwanda, South Africa, Taiwan, and Uzbekistan took part in the conference. Russia was represented by participants from 44 universities and research centres.

At the opening of the conference, the participants were welcomed by JINR Director G. Trubnikov, JINR Scientific Leader V. Matveev, MLIT Director S. Shmatov, and MLIT Scientific Leader V. Korenkov.

In his report, G. Trubnikov provided an overview of the Institute's latest achievements, large-scale scientific projects, research areas, and basic facilities, underlining the contribution of the Meshcheryakov Laboratory of Information Technologies to JINR's activities and, in particular, to the training of personnel and the creation of a digital environment at the Institute.

The programme continued with a talk by RAS Academician A. Avetisyan (ISP RAS) on the challenges that face modern society in the field of cybersecurity as a result of the widespread introduction of information technologies, including the application of artificial intelligence. High-performance computing systems with a reconfigurable architecture were considered in the report by RAS Academician I. Kalyaev (RI MCS SFedU, Taganrog). During the talk,

Russian developments in this area were presented. RAS Corresponding Member V. Voevodin (RCC MSU, MSU branch in Sarov) identified supercomputer co-design as the central problem of modern supercomputer technologies and parallel computing. V. Velikhov (NRC "Kurchatov Institute") made a report on the status of the implementation of the inter-university quantum network (IUQN) project and the first steps towards building a secure digital infrastructure of the new generation. RAS Corresponding Member R. Smelyansky (CMC MSU) presented a vision of what the computing infrastructure of the future will be like, pointing out that the major driver of the computing technology development is applied needs. The report by A. Degtyarev (SPbSU) focused on the organization of resource-intensive computer modeling in real time.

The talk by V. Korenkov (JINR) was devoted to the history of development and current state of distributed computing at JINR, including trends in the development of distributed computing for large-scale scientific projects. T. Strizh (JINR) spoke about the path that the Meshcheryakov Laboratory of Information Technologies has taken over the past 60 years since its establishment.

D. Podgainy (JINR) enlarged upon the tasks of the JINR scientific programme solved using the Govorun supercomputer, announcing the completion of a new stage of modernization, implemented jointly by MLIT and the RSC Group of Companies. As a result of the modernization, the overall peak performance of the Govorun supercomputer reached 2.2 PFlops for double-precision operations. Using the example of the modernization of the Govorun supercomputer in 2024–2025, A. Moskovsky (RSC Technologies) presented the hardware and software solutions of the RSC, a leading Russian developer and integrator of innovative supercomputer solutions.

A number of plenary reports were devoted to computing and software for megascience projects.

K. Gertsenberger (JINR) talked about the distributed processing and storage of the BM@N experiment data in the light of preparations for Run 9. A. Taranenko (JINR) presented the results of the full-scale modeling of the MPD experimental facility and data analysis methods. D. Oleynik (JINR) delivered a talk on the progress of implementing tasks on the development of the software and computing of the SPD experiment, noting considerable progress in elaborating a set of middleware responsible for the multistage, high-throughput processing of experimental data. S. Hnatič (JINR) spoke about the development of software for the MPD experiment. Yu. Andreeva (CERN) presented the status and plans of the WLCG (Worldwide LHC Computing Grid) project, which has been successfully developing and continues to solve distributed computing tasks for the experiments at the Large Hadron Collider for over 20 years. Xuantong Zhang (IHEP, China) spoke about the organization of IHEP distributed computing for international physics collaborations, and Xiaomei Zhang (IHEP, China) gave a talk on the distributed computing system of the JUNO experiment. The report by A. Tsaregorodtsev (CPPM-IN2P3-CNRS, France) was devoted to the status and development of the DIRAC platform. O. Semenov (ITER Centre, Russia) made a report on the creation and development of the project “Russian Scientific Network for Fusion Research”, aimed at building a unified scientific network for research in the field of thermonuclear fusion. V. Kotliar (IHEP NRC KI) talked about a comprehensive monitoring, automation and analysis system for the computing cluster of the Logunov Institute for High Energy Physics.

V. Toporkov (MPEI) delivered a talk on the strategy of planning multidisciplinary work processes and resource management in cloud computing. The topic was continued in the report by N. Balashov (JINR)

on the status of the JINR cloud infrastructure and the distributed information and computing platform that integrates the cloud resources of the JINR Member States’ organizations.

A. Bugay (JINR) made a report on high-performance computing in radiation biology, highlighting that LRB colleagues employ the capacities of the Govorun supercomputer, including the application of deep machine learning methods. O. Belov (JINR) introduced the conference participants to the research programme of the ARIADNA collaboration created to implement applied research at the NICA accelerator complex. The talk by RAS Corresponding Member M. Fedorov (IITP RAS) on supercomputer modeling and machine learning in molecular sciences evoked great interest. It was emphasized that the digitalization of chemical information applying artificial intelligence and hybrid AI methods had enormous potential for the development of a wide variety of areas in science and innovation. Bioinformatics, as informatics based on biocomputer technologies, DNA information storage and nanobioelectronics, and its applications were discussed in the report by V. Lakhno (IMPB RAS).

V. Sukhomlin (MSU) devoted his presentation to modern standards and trends in training highly qualified professionals in the field of information technologies. N. Bagdasaryan (MSTU) gave a talk on institutional transformation in the era of AI and challenges facing modern scientific schools. The report by A. Artamonov (NRNU MEPhI) focused on the methodology of the intelligent analysis of scientific and technical information.

S. Plyusnin (E-Flops LLC) enlarged upon approaches to creating solutions for HPC, data centres, and clouds. A modern view on building a horizontally scalable solution for the tasks of storing large data volumes was presented in the talk by S. Bogatyrev



Meshcheryakov Laboratory of Information Technologies, 7–11 July. Participants of the 11th International Conference “Distributed Computing and Grid Technologies in Science and Education” (GRID’2025)

(YADRO tech company). A. Bogdanov (SPbSU) spoke about the promising Data Mesh architecture, which involves changing the approach to data management and is suitable for solving world-class tasks, while possessing the flexibility of cloud systems. Two methods of population annealing implemented in the MPI/CUDA hybrid architecture were considered in the report by L. Shchur (ITP, HSE University).

The conference also featured plenary reports on rapidly developing machine learning technologies and methods. Hybrid artificial intelligence, as a combination of high-performance computing, neural networks, and precise mathematical models, was the topic of the talk by L. Sokolinsky (SUSU). F. Ratnikov (HSE University) devoted his report to the features of AI-based surrogate models for particle physics experiments. He concluded that surrogate models were a considerable help in tasks that require large-scale modeling to interpret the results, which certainly applies to high-energy physics. A. Shevel (PNPI, ITMO) talked about large language models in high-energy physics and future developments in this area.

Two round tables were organized within GRID'2025. The first one was devoted to the organization of the work of the joint scientific and educational laboratory of St. Petersburg State University and JINR. The laboratory is being created to solve tasks in the field of information technologies in high-energy physics and the training of qualified personnel. The participants of the second round table discussed the creation and development of information and analytical platforms. In particular, the development of the JINR Digital EcoSystem as a complex digital environment integrating a multitude of information services and business processes was discussed in detail.

During the five days of GRID'2025, 37 plenary and 127 sessional talks were delivered, fruitful discussions were held. At the closing of the conference, words of gratitude were expressed to the Organizing Committee for the high level of holding the conference.

The presentations of the talks and photos are available at grid2025.jinr.ru. Selected proceedings of the conference will be published in the journal "Physics of Elementary Particles and Atomic Nuclei".

The 16th International School-Conference "The Actual Problems of Microworld Physics" took place in Minsk from 25 to 31 August. It was dedicated to the 70th anniversary of the founding of JINR. The event was organized by the Joint Institute for Nuclear Research, the Institute for Nuclear Problems of Belarusian State University, and the Stepanov Institute of Physics of the National Academy of Sciences of Belarus. The school's goals were the exchange of ideas and scientific results, along with the involvement of students and postgraduates in work on key areas of research.

The programme of the event covered a wide range of areas of modern physics: the latest experimental results of the world's accelerator centres, research projects for future experiments in high-energy physics, non-accelerating physics, astrophysics, and cosmology, and new approaches in quantum field theory. There were sections dedicated to radiobiology and nuclear medicine, nuclear electronics and detectors, current trends in materials science, data processing, and facility design.

At the opening ceremony, Plenipotentiary of the Government of the Republic of Belarus to JINR, Chairman of the State Committee on Science and Technology of the Republic of Belarus S. Shlychov,



Lipnya (Russia), 18–20 July. 29th Summer Scientific School of AYSS JINR



Minsk (Belarus), 25–31 August. Participants of the 16th International School-Conference “The Actual Problems of Microworld Physics”

Advisor to the DLNP Directorate N. Russakovich, First Vice-Rector of Belarusian State University (BSU) D. Kurlovich, and Director of INP BSU S. Maksimenko addressed the audience with welcome speeches.

On 26 August, JINR Director G. Trubnikov opened a plenary session of the event with a lecture “Future experiments in high-energy physics”. Afterwards, FLNR Deputy Scientific Leader M. Itkis delivered a talk “Superheavy elements: Present and future”.

VBLHEP Chief Researcher R. Lednický spoke about the progress and plans of the BM@N experiment at the NICA accelerator complex, Head of a VBLHEP sector O. Rogachevsky told the audience about the physics programme of the MPD experiment, and Head of the ARIADNA collaboration at NICA O. Belov spoke about the capabilities of the accelerator complex in applied fields. LRB Director A. Bugay, MLIT Scientific Leader V. Korenkov, MLIT Deputy Director



Verbilki (Moscow Region, Russia), 24–29 August. Participants of the International Accelerator Physics School “Linear Accelerators”

for Scientific Work N. Voytishin, and other employees of the Institute's laboratories were present at the event.

The school-conference is a leading platform in Belarus for discussing the modern issues of elementary particle physics, theoretical physics, and latest nuclear physics technologies. The first school-conference on the modern problems of microworld physics took place in Belarus in 1971. The main organizer of the first three schools (1971–1977) from the Belarusian side was Academician F. Fedorov, a pivotal figure in the development of theoretical physics in Belarus. At that time, the Advisory Committee of the school was headed by Academician N. Bo-

goliubov, and Professor N. Shumeyko played a key role in reviving the tradition of holding the schools (1997–2015).

Starting in 2018, the tradition has been upheld by the new Programme Committee led by Professor S. Maksimenko. The number of lecturers has significantly increased due to the active involvement of leading researchers from other countries, and new scientific areas relevant to Belarus were included in the school programme. The events are of great importance for the education of scientific youth, the exchange of expertise and creative ideas of Belarusian scientists of different ages with colleagues from other countries, networking, and the achievement



The Veksler and Baldin Laboratory of High Energy Physics, 15–20 September. The 26th International Baldin Seminar on High Energy Physics Problems “Relativistic Nuclear Physics and Quantum Chromodynamics”

of cooperation agreements. Today, the traditions of the event are preserved, and the school stays important for the international scientific community.

From 15 to 20 September, VBLHEP hosted *the 26th International Baldin Seminar on High Energy Physics Problems "Relativistic Nuclear Physics and Quantum Chromodynamics"*. The event brought together 240 scientists and specialists from Belarus, China, Egypt, Kazakhstan, Mongolia, Russia, Serbia, and Vietnam.

The seminar was opened by the JINR Scientific Leader Academician V. Matveev, who emphasized that the seminar is gaining increasing popularity each year and attracting a significant number of young scientists. In his speech, he described the history of the Baldin Seminar and announced that next year the Institute would celebrate the centenary of the birth of Academician Baldin, and in honor of this event, his bust would be installed on the territory of VBLHEP.

JINR Vice-Director Academician V. Kekelidze delivered a welcoming address at the opening of the seminar. The programme began with a report by FLNR Scientific Leader Academician Yu. Oganessian "Heavy ions in science and technology". The seminar also featured presentations on the results of major international collaborations, such as MPD and BM@N, and overviews of advances in theoretical and experimental relativistic nuclear physics.

The 26th Baldin Seminar covered a wide range of topics: quantum chromodynamics at large distances; relativistic heavy ion collisions; spectroscopy of hadrons and multiquarks; structural functions of hadrons and nuclei; polarization phenomena and spin physics; studies of exotic nuclei in relativistic beams; applied use of relativistic beams.

In addition, the participants discussed the results of the NICA megascience project, the status and

development prospects of accelerator complexes, along with achievements in experimental research at the world's leading centres for the study of high-energy physics — JINR, CERN, BNL, JLab, GSI, KEK, and others.

The 15th Collaboration Meeting of the BM@N Experiment at the NICA Facility took place from 14 to 16 October at VBLHEP in a hybrid format. More than 130 specialists discussed the latest research results of the collaboration and the development prospects of the project in the coming years.

JINR Vice-Director Academician V. Kekelidze gave an opening speech. He congratulated BM@N collaboration Spokesperson, VBLHEP Chief Researcher R. Lednický on his 80th birthday, noting his significant contribution to high-energy physics. In his speech, V. Kekelidze also noted that in the seven years since its creation, the BM@N collaboration has become one of the leaders in hot and dense baryonic matter research.

Head of the VBLHEP JINR Scientific and Experimental Department of Baryonic Matter at Nuclotron M. Kapishin focused on the BM@N plans in the period from 2027 to 2031. One of the main tasks is xenon beam energy scan at 3, 2.2, and 1.6 GeV/nucleon. An upgrade of the tracking system is planned for experiments with heavier bismuth ions. In addition, the speaker discussed the prospects of research with polarized deuteron beams, which will require updating trigger detectors and tracking system elements. Another important step for the development of the experiment will be a computing infrastructure upgrade. Plans include doubling the processing capacity for the hardware to process up to 2 billion events per physics run and increasing the data storage capacity by 3 PB.

Deputy Head of the VBLHEP Scientific and Experimental Department of the Multi-Purpose Detector



Da Nang (Vietnam), 8–10 October. Participants of the 16th Vietnam Conference on Nuclear Science and Technology (VINANST-16). Photo: © VINATOM



The Veksler and Baldin Laboratory of High Energy Physics, 14–16 October. The 15th Collaboration Meeting of the BM@N Experiment at the NICA Facility

(MPD) S. Piyadin continued the plenary session with an update on the modernization and installation of the BM@N detector systems: the facility's main detecting elements were successfully installed in the experimental pavilion, and the installation of the central tracking system inside BM@N's analyzing magnet was finished.

In addition, the collaboration specialists carried out tests of all magnetic elements, mechanical drives, and the vacuum ion pipe.

The first day's programme included eight talks on data analysis. The scientists discussed the results obtained in previous physics runs. Among the speakers were VBLHEP and MLIT JINR researchers: K. Alishina, A. Zinchenko, N. Lashmanov, G. Musulmanbekov, P. Alekseev, A. Taranenko, I. Zhavoronkova, and M. Mamaev. On the same day, a meeting of representatives of the BM@N participating institutes (Institutional Board) took place, at which a group of employees from the Institute of Mechanics (IMEch) of the Bulgarian Academy of Sciences joined the collaboration.

As part of the second day's scientific programme, the participants continued to review data analysis results and discussed issues related to the preparation and operation of the detectors of the BM@N facility. A session on software took place on the final day. In total, the programme of the 15th BM@N Collaboration Meeting included more than 40 presentations covering various aspects of the BM@N project.

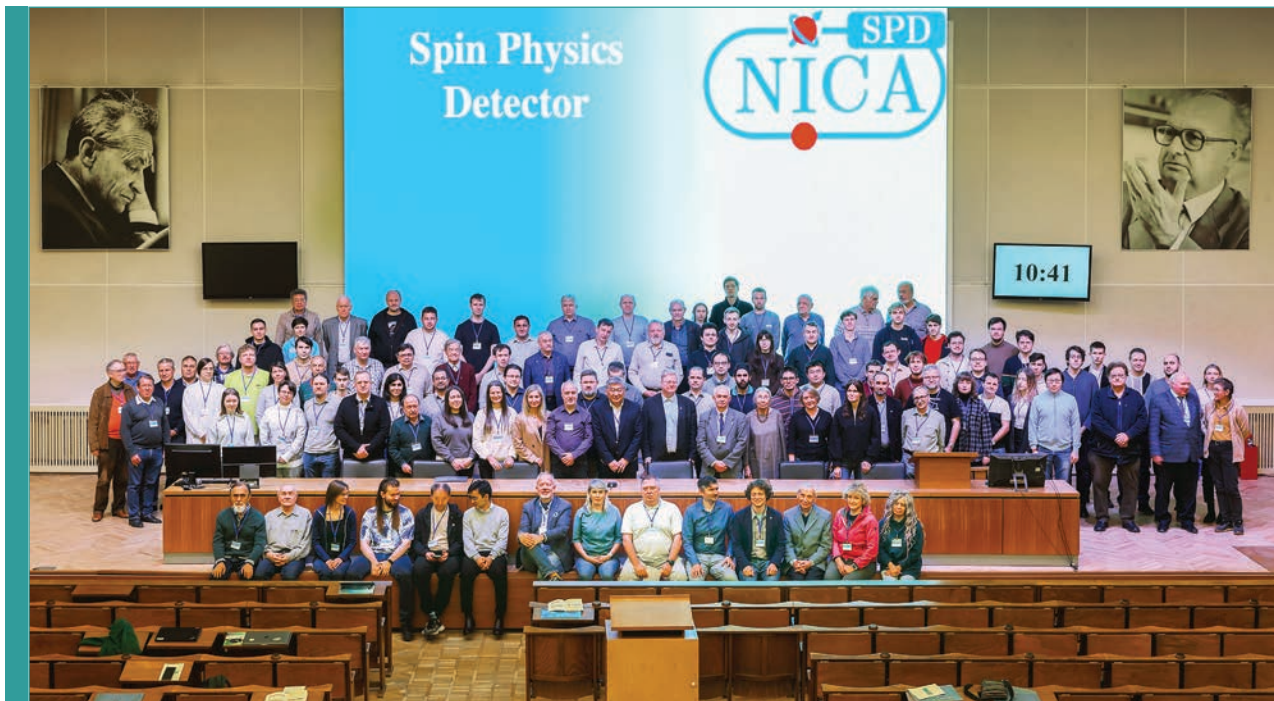
On 20–23 October, VBLHEP hosted the *10th Collaboration Meeting of the SPD Experiment* in a mixed format. The event was timed to coincide with the 100th anniversary of the concept of particle spin. Over 200 scientists and young specialists from various countries discussed progress in constructing the experimental setup, developing the physics programme and IT infrastructure for the experiment, and exchanged experience and ideas for advancing the collaboration.

JINR Vice-Director Academician V. Kekelidze addressed the participants with a welcome speech. He congratulated the collaboration on the beginning of the anniversary meeting and wished them productive work, noting the importance of the successful implementation of the SPD experiment for the international physics community.

The scientific programme opened with a presentation by A. Tumasyan, Chairman of the SPD Collaboration Council and Leading Researcher at the A. Alikhanyan National Science Laboratory (Armenia). In his address, he informed the participants about the latest changes to the Collaboration Executive Board and the new responsible coordinators. He cited the expansion of its international membership as a key indicator of the collaboration's growth and dynamic development. Shandong University (SDU) and the University of Science and Technology of China (USTC) in Hefei recently joined the project. Currently, the SPD collaboration unites nearly 40 scientific organizations. In conclusion, the Chairman of the Collaboration Council noted that open research grants and the JINR postdoc programme play a significant role in attracting new young specialists.

SPD Collaboration Co-Director A. Guskov began his presentation by recalling the fundamental importance of spin, first proposed as a term by G. Uhlenbeck and S. Goudsmit in 1925, and outlined the collaboration's key priorities for 2025. These include concluding a contract for the magnet yoke, developing the infrastructure for the cryogenic system, and producing a superconducting cable for the solenoid.

The speaker noted that in 2025, collaboration participants presented approximately 40 papers at 15 international conferences. A significant outcome of this work with young specialists was the defense of 18 undergraduate and graduate theses on the SPD topics. One significant event was the preliminary approval of a three-year joint project with USTC to develop high-performance readout electronics for the time-of-flight (ToF) detector under the JINR–China grant programme.



The Veksler and Baldin Laboratory of High Energy Physics, 20–23 October. Participants of the 10th Collaboration Meeting of the SPD Experiment

The project's responsible coordinators also spoke at the plenary session. I. Denisenko, DLNP Sector Head, and E. Soldatov, Leading Researcher at NRNU MEPhI, reported on the preparation of the physics research programme. A. Korzenev, VBLHEP Department Head, presented the status of the experimental facility and plans for developing its key subsystems. D. Oleynik, MLIT Senior Researcher, presented a report on the SPD computing infrastructure.

VBLHEP Sector Head V. Smirnov and VBLHEP Deputy Chief Engineer K. Mukhin presented reports on preparations for the Collider launch and the development of the NICA complex engineering infrastructure. JINR Deputy Chief Scientific Secretary A. Zhemchugov discussed the status and prospects of scientific and technical cooperation between JINR and China. The plenary session closed with presentations by F. Ratnikov (HSE University), A. Petrosyan (MLIT JINR), and S. Vinogradov (LPI).

During the meeting, participants discussed in detail the current state of work on all subsystems of the facility, electronics, and software. Special attention was paid to the physics research programme for the first stage of the experiment. In total, the programme of the 10th SPD Collaboration Meeting included over 60 scientific reports.

From 20 to 24 October, JINR hosted *the International Conference "Current Problems in Radiobiology. Accelerated Charged Particles and Neutrons in Radiobiology"*, marking the 20th anniversary of the JINR Laboratory of Radiation Biology and in memory of Evgeny Aleksandrovich Krasavin. The conference was organized by the Russian Academy of Sciences (Scientific Council on Radiobiology of the RAS Phys-

iological Sciences Department, RAS Radiobiological Society) and by LRB JINR.

More than 150 scientists participated in the conference, in person and online, from Azerbaijan, Belarus, Cuba, India, Iran, Mongolia, Russia, the US, and Vietnam. The conference brought together scientists from institutes and research centres of the RAS, the National Academy of Sciences of Belarus, the Ministry of Science and Education of Azerbaijan, JINR, the NRC "Kurchatov Institute", the Energia Rocket and Space Corporation, Russian and international universities, and research centres and laboratories affiliated with the Federal Medical and Biological Agency of Russia, the Ministry of Health of the Russian Federation, and other governmental bodies.

A memorial session of the conference was dedicated to E. Krasavin, a distinguished radiobiologist, Chairman of the RAS Scientific Council on Radiobiology (2017–2025), founder and Head of LRB JINR, and a RAS Corresponding Member. The session featured presentations by Academician I. Ushakov "The work of Evgeny Aleksandrovich Krasavin as the basis for the future development of radiobiology of densely ionizing radiations on the Earth and in space" and by LRB Director Doctor of Physics and Mathematics A. Bugay "Current issues in the radiobiology of densely ionizing radiations".

The scientific reports presented and discussed state-of-the-art results in the radiobiology of densely ionizing radiations, covering fundamental, applied, and interdisciplinary aspects of the field.

In the section "Molecular and Cytogenetic Effects of Charged Particles and Neutrons", particular interest was aroused by reports on studies of molecular and cellular mechanisms of action of various types



Dubna, 20–24 October. The International Conference “Current Problems in Radiobiology. Accelerated Charged Particles and Neutrons in Radiobiology”

of ionizing radiation; methods for modifying radiation effects using targeted molecular biological complexes; and approaches and methods of mathematical modeling aimed at predicting cellular responses to ionizing radiation exposure.

Reports in the section “Radiobiological Aspects of Radiation Therapy. Radiation Physiology” showed the strong interest of radiobiologists in increasing

the effectiveness of proton radiation, as well as in the impact of joint exposure to accelerated protons, neutrons, and/or carbon ions in any combination in experiments *in vitro* and *in vivo* on normal and tumor cells and tissues, including stem cells. It has been noted that the use of accelerated charged particles and neutrons in radiation therapy represents one of the key directions for improving cancer treat-

ment methods, as this approach makes it possible to overcome the radioresistance of certain malignant neoplasms and/or to reduce radiation-induced complications in normal tissues.

In the section "Problems of Space Radiobiology and Astrobiology", special attention was paid to the study of early acute effects associated with impairments of cosmonauts' cognitive functions occurring during flight as a result of exposure to heavy charged particles of galactic radiation. Promising approaches to the correction of neurobiological disorders caused by radiation and gravitational factors of interplanetary flights were identified, including pharmacological interventions as well as consideration and use of typological characteristics of higher nervous activity. The need to develop new standards for limiting radiation exposure of cosmonauts was emphasized. For ground-based simulation of galactic cosmic ray (GCR) effects, the concept of creating a GCR simulator, using JINR heavy ion accelerators, is promising.

The section also included presentations addressing various aspects of astrobiology. Research in this area is of considerable interest as an example of interdisciplinary interaction between different scientific fields. The topics covered a wide range of directions, including panspermia, the search for life on other bodies of the Solar System, mechanisms of microbial adaptation, and issues related to bacterial and paleontological studies. The need for further strengthening of interactions among researchers through interdisciplinary scientific conferences and collaborations was noted.

At a session of the section "Charged Particles as a Tool for Addressing Fundamental and Applied Problems of Radiation Biology", a broad diversity of topics

was presented, ranging from certain aspects of agricultural radiology, including studies in the radiation chemistry of specific biomolecules, to a hypothetical and debatable concept of information transfer in DNA. A number of reports were devoted to the investigation of radioprotective properties of natural compounds — a research direction that has recently attracted increased interest among radiobiologists. Studies of the dosimetric characteristics of high-energy neutrons and secondary particles generated during proton therapy, using computer modeling, also drew the attention of conference participants.

As a result of the discussions, a Conference Resolution was adopted and published on the website of the RAS Scientific Council on Radiobiology: <https://radbio.jinr.ru/index.php/component/content/article/reshenie-mezhdunarodnoj-konferentsii-aktualnye-problemy-radiatsionnoj-biologii?catid=16&Itemid=101>.

From 28 to 30 October, *the 16th Collaboration Meeting of the MPD Experiment at the NICA Facility* took place in a hybrid format at VBLHEP. Topping the agenda was the readiness of the Multi-Purpose Detector (MPD) and the NICA accelerator complex for launch, as well as plans for New Physics studies.

On the first day, MPD collaboration Spokesperson, VBLHEP Chief Researcher V. Ryabov gave a welcome speech. He highlighted the eight-year history of the collaboration and emphasized the contribution of each participant to developing the large-scale international project.

Chief Engineer of the VBLHEP accelerator complex E. Syresin gave a talk on the progress of the NICA collider. He provided details on the completion of the key stages of modernization of the complex



The Veksler and Baldin Laboratory of High Energy Physics, 28–30 October. Participants of the 16th Collaboration Meeting of the MPD Experiment at the NICA Facility



Tashkent (Uzbekistan), 14–16 October. The 11th International Conference “Modern Problems of Nuclear Energy and Nuclear Technologies” dedicated to the 80th anniversary of the birth of Academician B. S. Yuldashev. Photo: © INP AS RUz

and preparation for a physics run with colliding beams.

Then V. Ryabov provided an update on the MPD collaboration, currently consisting of more than 500 specialists from 12 countries, including JINR. He spoke about the significant progress in the work on the MPD magnet. In 2025, the collaboration’s publishing activity continued to grow: the total number of scientific papers in peer-reviewed journals exceeded 250. In conclusion, his talk presented the latest results of modeling physics processes for various signals studied in the MPD-FXT mode.

Head of the MPD Scientific and Experimental Department, Collaboration’s Technical Coordinator V. Golovatyuk spoke about the progress of the creation and integration of key structural elements of the Multi-Purpose Detector. VBLHEP Deputy Chief Engineer K. Mukhin provided an update on preparations for the launch of the MPD superconducting solenoid. VBLHEP Sector Head O. Rogachevsky and MLIT Leading Researcher S. Hnatič made presentations on software development.

A meeting of representatives of the institutions participating in the collaboration (MPD Institutional Board) was held. Following the meeting, V. Ryabov was re-elected as Collaboration’s Spokesperson until 31 December 2028.

In total, more than 30 presentations were delivered. Collaboration participants discussed current research areas in heavy ion physics. The second day’s programme focused on computing and software issues, and the final session on 30 October was devoted to physics research at the experimental facility. More than 180 scientists from Belarus, Bulgaria, China, Cuba, Egypt, Kazakhstan, Mexico, Russia, Serbia, and Uzbekistan took part in the 16th MPD Collaboration Meeting.

On 27–31 October, *the 29th International Scientific Conference of Young Scientists and Specialists (AYSS-2025)* was held at JINR. The conference was attended by over 160 young scientists and specialists and again became a bright event in the Institute’s life. For five days participants from Russia, Vietnam, Kazakhstan, Serbia, Tunis, and South Africa heard lectures by leading scientists of the Institute, presented their own results of studies, and discussed urgent issues of the world science.

Chairman of the conference Organizing Committee, Head of Group at FLNP M. Erdauletov stressed the international status of the event.

This year, the AYSS-2025 Programme Committee renovated the topics of the conference according to urgent directions of research at the Joint Institute. Young scientists and specialists presented their reports in the following sections: theoretical physics; elementary particle physics and physics of high-energy heavy ions; instruments and methods in experimental physics; accelerator technology and neutron sources; information technologies; applied innovation activities; radiobiological research in life sciences.

One more novelty was a strict selection of reports and accurate attitude to abstracts. It considerably diminished the number of participants in comparison to the last year event but improved the level of reports. On the results of reviewing, the programme included the best scientific presentations: 128 oral and 34 poster reports.

JINR leading scientists and specialists gave nine plenary lectures about research directions, scientific infrastructure and long-standing history of the Institute. The experience of interactive discussion became useful for participants that was organized on the last day of the conference by the UC Direc-



Havana (Cuba), 1–5 December. Organizers and attendees of the JINR–Cuba School “Hadron Structure and Hadron Matter Physics”

tor D. Kamanin. The participants had answers to the questions of their interest about the activities and educational programmes at the UC for students from different countries.

Traditionally, after fruitful day-time sessions participants of AYSS-2025 had competitions in erudition

and quick-wittedness in a scientific quiz and a chess tournament. They got acquainted closer with each other and exchanged contacts. The festive conclusion of the event included summing up the results, and authors of the best oral and poster reports were awarded.

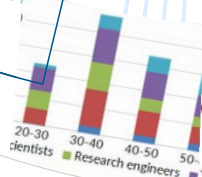
CONFERENCES, SCHOOLS, AND MEETINGS HELD BY JINR IN 2025

No.	Title	Place	Date	Number of participants
1.	61st Meeting of the Programme Advisory Committee for Particle Physics	Dubna	20 January	70
2.	60th Meeting of the Programme Advisory Committee for Nuclear Physics	Dubna	24 January	70
3.	60th Meeting of the Programme Advisory Committee for Condensed Matter Physics	Dubna	27 January	75
4.	Meeting of the Coordinating Council for Youth Affairs in Scientific and Educational Spheres under the Council for Science and Education under the President of the Russian Federation	Dubna	7–9 February	80
5.	School-Seminar “Teachers of the Future” for the senior students of math and physics specialties	Dubna	8–23 February	30
6.	International Workshop “Problems of Modern Mathematical Physics” (PMMP’25)	Dubna	10–14 February	75
7.	137th Session of the JINR Scientific Council	Dubna	13–14 February	110
8.	Winter session of the START Programme 2025	Dubna	16 February – 29 June	22
9.	Seminar on SRF Technology for Superconducting Cavities within the Framework of Russia–China Collaboration on NICA and HIAF Projects	Dubna	21 February	18

No.	Title	Place	Date	Number of participants
10.	2nd International School on Nuclear Methods and Applied Research in Environmental, Material, and Life Sciences (NUMAR-2025)	Havana, Cuba	24–27 February	50
11.	Workshop “The Baikal-GVD Neutrino Telescope 2025”	Irkutsk, Russia	17–18 March	40
12.	Seminar dedicated to the 95th anniversary of the birth of N. Govorun	Dubna	18 March	100
13.	Meeting of the JINR Finance Committee	Dubna	24 March	90
14.	Session of the Committee of Plenipotentiaries of the Governments of the JINR Member States	Dubna	25–26 March	110
15.	17th Baksan International School on Astroparticle Physics “Particles and Cosmology”	Terskol, Russia	3–11 April	80
16.	JINR Spring School of Information Technologies	Dubna	9–10 April	65
17.	International Training Programme “JINR Expertise for Member States and Partner Countries” (JEMS-26)	Dubna	14–18 April	30
18.	15th Collaboration Meeting of the MPD Experiment at the NICA Facility	Dubna	15–17 April	190
19.	JINR Days in Uzbekistan	Tashkent, Uzbekistan	22–24 April	40
20.	9th Collaboration Meeting of the SPD Experiment	Yerevan, Armenia	12–16 May	65
21.	International Workshop “Infinite and Finite Nuclear Matter” (INFINUM-2025)	Dubna	12–16 May	70
22.	14th Collaboration Meeting of the BM@N Experiment at the NICA Facility	Dubna	13–15 May	135
23.	Workshop “Quantum and Low-Dimensional Magnetism”	Dubna	19–20 May	20
24.	International Training Programme “JINR Expertise for Member States and Partner Countries” (JEMS-27)	Dubna	19–23 May	30
25.	Internship for Young Scientists and Specialists from the CIS Countries	Dubna	26 May – 23 June	25
26.	31st International Seminar on Interaction of Neutrons with Nuclei “Fundamental Interactions & Neutrons, Nuclear Structure, Ultracold Neutrons, Related Topics” (ISINN-31)	Dongguan, China	26–30 May	200
27.	Baikal Collaboration Meeting	Dubna	3–6 June	55
28.	Scientific School for School Students from Petrozavodsk at JINR	Dubna	3–6 June	12
29.	Workshop “Physics at Future High-Energy Electron–Positron Colliders”	Dubna	5 June	40
30.	14th International Conference of Young Scientists and Specialists “Alushta-2025”	Alushta, Crimea	8–15 June	60
31.	Days of South Africa at JINR	Dubna	16–20 June	70
32.	Stage I of International Student Practice in JINR Fields of Research for Students from South Africa and Egypt	Dubna	16 June – 4 July	65
33.	Seminar “Radiation Biology — At the Intersection of Fundamental Sciences. 20 Years in Focus”	Dubna	17 June	130
34.	61st Meeting of the Programme Advisory Committee for Nuclear Physics	Dubna	19–20 June	50
35.	62nd Meeting of the Programme Advisory Committee for Particle Physics	Dubna	23 June	50
36.	RSA–JINR Workshop on Theoretical and Computational Physics	Dubna	23–27 June	50
37.	Joint Workshop DANSS–vGeN	Dubna	25 June	39

No.	Title	Place	Date	Number of participants
38.	61st Meeting of the Programme Advisory Committee for Condensed Matter Physics	Dubna	26 June	51
39.	Meeting of the Working Group under the Chair of the CP for Financial Issues of JINR	Yerevan, Armenia	27–28 June	25
40.	Scientific Council of the RAS Physics Division on Heavy Ion Physics “Relativistic Nuclear Physics and Heavy Ion Physics”	Saint Petersburg, Russia	28 June – 1 July	80
41.	2nd Scientific Conference named after M. I. Panasyuk “Problems of Cosmophysics”	Dubna	30 June – 4 July	70
42.	International School “Complex Systems and Advanced Materials”	Dubna	30 June – 4 July	50
43.	International School on Nuclear Methods and Applied Research in Environmental, Material, and Life Sciences (NUMAR-Gobi 2025)	Ulaanbaatar, Mongolia	30 June – 4 July	70
44.	Workshops “Element 105”, “Scientific Communication”	Dubna	2–12 July	40
45.	Summer session of the START Programme 2025	Dubna	6 July – 19 November	68
46.	Summer School-Laboratory JINR–HSE–ARAS “Archival Impulse”	Dubna	6–12 July	61
47.	International Workshop “Superconducting and Magnetic Hybrid Structures”	Dubna	7–10 July	50
48.	11th International Conference “Distributed Computing and Grid Technologies in Science and Education” (GRID’2025)	Dubna	7–11 July	300
49.	Scientific School for Physics Teachers at JINR	Dubna	7–11 July	24
50.	25th International Scientific Baikal Summer School on Physics of Elementary Particles and Astrophysics	Bolshiye Koty, Irkutsk Region, Russia	11–18 July	80
51.	29th Summer Scientific School of Young Scientists and Specialists (“Lipnya-2025”)	Dubna	18–20 July	80
52.	International School “Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems”	Dubna	20–25 July	55
53.	37th Interregional Computer School and 3rd Workshop “Teachers of the Future”	Dubna	26 July – 13 August	90
54.	International Conference “Advances in Quantum Field Theory” (AQFT’25)	Dubna	11–15 August	95
55.	13th BLTP/JINR – ITP/CAS Joint Workshop “Physics of Strong Interacting Systems”	Almaty, Kazakhstan	17–22 August	65
56.	22nd Lomonosov Conference on Elementary Particle Physics	Moscow, Russia	21–27 August	400
57.	International Accelerator Physics School “Linear Accelerators”	Verbilki, Moscow Region, Russia	24–29 August	70
58.	16th International School-Conference “The Actual Problems of Microworld Physics”	Minsk, Belarus	25–31 August	100
59.	5th Science School for students at the Children’s University of the Egyptian Academy of Scientific Research and Technology	Dubna	8–12 September	20
60.	138th Session of the JINR Scientific Council	Dubna	15–16 September	80
61.	26th International Baldin Seminar on High Energy Physics Problems “Relativistic Nuclear Physics and Quantum Chromodynamics”	Dubna	15–20 September	240
62.	Stage II of the International Student Practice in JINR Fields of Research for Students	Dubna	22 September – 10 October	50
63.	2nd Meeting of the Advisory Council of the ICI MBIR	Dubna	23 September	35

No.	Title	Place	Date	Number of participants
64.	JINR Autumn School of Information Technologies	Dubna	6–10 October	100
65.	Workshop on Quantum Computing and Machine Learning	Cairo, Egypt	11–14 October	30
66.	Scientific Student Internship “Management in Scientific Projects, Participation of Students in Scientific Research”	Dubna	13–17 October	22
67.	15th Collaboration Meeting of the BM@N Experiment at the NICA Facility	Dubna	14–16 October	135
68.	10th Collaboration Meeting of the SPD Experiment	Dubna	20–23 October	200
69.	International Conference “Current Problems in Radiobiology. Accelerated Charged Particles and Neutrons in Radiobiology” dedicated to the 20th anniversary of the establishment of JINR’s Laboratory of Radiation Biology	Dubna	20–24 October	150
70.	International Workshop “Symmetries: Bulgaria–Armenia–Dubna” (SymBAD’25)	Yerevan, Armenia	20–24 October	30
71.	3rd Meeting of the JINR–China Joint Coordination Committee on Cooperation in Fundamental Scientific Research	Dubna	24 October	40
72.	Conference “Neutron Physics and Radiation Materials” (NPRM-2025)	Yerevan, Armenia	27–30 October	32
73.	29th International Scientific Conference of Young Scientists and Specialists (AYSS-2025)	Dubna	27–31 October	200
74.	Scientific and Methodological School for Physics Teachers	Dubna	27–31 October	28
75.	16th Collaboration Meeting of the MPD Experiment at the NICA Facility	Dubna	28–30 October	180
76.	India–JINR Workshop on Particle, Nuclear, Neutrino Physics and Astrophysics	Bhubaneswar, India	10–12 November	85
77.	Meeting of the JINR Finance Committee	Varadero, Cuba	1 December	60
78.	Baikal Collaboration Meeting	Dubna	1–5 December	55
79.	JINR–Cuba School “Hadron Structure and Hadronic Matter Physics”	Havana, Cuba	1–5 December	55
80.	Session of the Committee of Plenipotentiaries of the Governments of the JINR Member States	Varadero, Cuba	2–3 December	80
81.	International Seminar “JINR and Latin America: Synergetic Partnership for Future”	Havana, Cuba	4–5 December	40



PUBLISHING DEPARTMENT

In 2025, the Publishing Department issued 68 titles of publications and 30 titles of official documents.

The proceedings of the XXXI International Seminar on Interaction of Neutrons with Nuclei (ISINN-31) (Dongguan, 26–30 May 2025) and the materials of the International Conference “Current Problems in Radiobiology. Accelerated Charged Particles and Neutrons in Radiobiology” dedicated to the 20th anniversary of the establishment of the Laboratory of Radiation Biology at JINR (Dubna, 20–24 October 2025) were published.

Reprints of two monographs on radiobiology previously published by the Ergoatomizdat Publishing House were released: “Problems of RBE and DNA Repairation” by E. Krasavin and “Mutagenic Effect of Radiation with Different LET” by E. Krasavin and S. Kozubek.

In 2025, the book by Azerbaijani journalist and writer Sh. Nazarli “The Attraction of Science-5” dedicated to JINR was published. It focuses on the collaboration of Azerbaijani scientists with the Institute

and features interviews with Azerbaijani specialists working at JINR. Other books published were “Irina Grigorievna Pokrovskaya” by V. Komarov and “DLNP in My Life” by A. Kulikov. A book of memoirs by V. Shchegolev titled “Into the Past through Thoughts” was issued, prepared for publication by the JINR Museum of History of Science and Technology. In the series “Library of the JINR Weekly Newspaper”, the following brochures came out: “Memories” by E. Kladnitskaya, “Conversations with Scientists: About Physics, about Life, and about Themselves” (interviews with B. Tatishchev, S. Bilenky, M. Podgoretsky, and B. Barbashov), and “In Harness with LHE” by I. Issinsky.

In the series “Educational and Methodological Manuals of the JINR University Centre”, the textbook “Structure of the Atomic Nucleus” by R. Jolos was published.

JINR Annual Reports for 2024, as well as Brief Review of Topmost Scientific Results Obtained in 2024 at the Joint Institute for Nuclear Research were published in Russian and English.



Dubna, 15 September. Presentation of the book “The Attraction of Science-5” by Azerbaijani journalist and writer Sh. Nazarli



Publications issued by the JINR Publishing Department in 2025

Work on the new scientific electronic journal, “Natural Science Review”, continued. Four issues of the journal, containing 19 articles, became accessible.

In 2025, six issues of the journal “Physics of Elementary Particles and Atomic Nuclei” (brief name “Particles and Nuclei”), including 246 papers, were published. Issues 2 and 3 contain the materials of

the Scientific Session of the Nuclear Physics Section of the Physical Sciences Division of the Russian Academy of Sciences, dedicated to the 300th anniversary of the RAS (Dubna, 1–5 April 2024). Issue 4 presents the materials of the International Workshop on Mathematical Problems in Quantum Information Technologies (Dubna, 27–28 May 2024).

Issue 5 includes the materials of the XXXVI International (online) Workshop on High Energy Physics "Strong Interactions: Experiment, Theory, Phenomenology" (Protvino, 23–25 July 2024). Issue 6 contains the materials of the International Conference "Mathematical Modelling and Computational Physics" (Yerevan, 21–25 October 2024). Six issues of the journal "Physics of Elementary Particles and Atomic Nuclei, Letters" (brief name "Particles and Nuclei, Letters"), which included 266 papers, were published. Issue 1 provides the materials of the IX International Conference "Hadron Structure and Fundamental Interactions" (Gatchina, 8–12 July 2024). Issue 2 contains the materials of the XXX International Seminar on Interaction of Neutrons with Nuclei "Fundamental Interactions & Neutrons, Nuclear Structure, Ultracold Neutrons, Related Topics" (Sharm El Sheikh, 14–18 April 2024). Issue 3 presents the materials of the International Conference "Modern Problems of Condensed Matter Theory" (Dubna, 15–19 July 2024). Issue 4 includes the materials of the XV International Seminar on the Problems of Charged Particle Accelerators in Memory of Professor V. Sarantsev (Alushta, 15–20 September 2024). Issue 5 contains the materials of the XXVIII International Scientific Conference of Young Scientists and Specialists (AYSS-2024) (Dubna, 28 October – 1 November 2024). Issue 6 provides the materials of the International Workshop "Supersymmetries and Quantum Symmetries" (Dubna, 29 July – 3 August 2024).

The information bulletin "JINR News" continued to be published in Russian and English.

In 2025, 50 issues of the JINR weekly newspaper "Dubna: Science, Cooperation, Progress" were published.

As part of the exchange of scientific publications, the following JINR items were sent to organizations cooperating with the Institute all over the world: JINR

preprints and communications, the information bulletin "JINR News", JINR Annual Reports, the journals "Particles and Nuclei" and "Particles and Nuclei, Letters".

The Publishing Department forwarded 335 papers containing the results of research of Dubna scientists to the editorial boards of journals, to various conferences, symposia, meetings and schools held both in the JINR Member States and in other countries. Papers of the JINR staff members were submitted to the journals "Nuclear Physics", "Bulletin of the Russian Academy of Sciences: Physics", "Instruments and Experimental Techniques", "Nuclear Physics and Engineering", "Atomic Energy", "Journal of Surface Investigation. X-Ray, Synchrotron and Neutron Techniques", etc.

Work continued on placing periodicals and non-periodicals produced at JINR in the Russian Science Citation Index (RSCI) database on the platform of the Electronic Library System of the Scientific Electronic Library.

The Publishing Department fulfilled orders for printing photo posters and poster presentations of the Institute's staff members for submission to scientific forums. Information materials such as programmes, notebooks, badges, diplomas, and certificates were printed for conferences and meetings.

At the request of the laboratories and other JINR departments, bookbinding, photocopying and scanning of scientific-technical and engineering-design documentation were carried out. A total of 125 500 various forms were printed.

New post-printing equipment was purchased: a foil stamping machine, hanger wire punches, a plastic coil binding system, and a metal coil binding system for producing notebooks, brochures, and calendars.

SCIENCE and TECHNOLOGY LIBRARY

In 2025, the JINR Science and Technology Library (STL) rendered services to 1600 readers. An electronic loan system has been implemented. 2824 copies of publications were given out. As of 1 January 2026, the library stock amounted to 429 513 copies, 195 396 of them being in foreign languages.

Via the interlibrary loan system, 177 publications ordered by readers were received. Twelve requests from other libraries were completed. On the whole, the library received 1110 copies of books, periodicals, preprints and theses from all acquisition sources, including 59 publications in foreign languages. All new publications were registered in the central catalogues, branch catalogues and in the information system "Absotheque".

There were 106 issues of the express bulletins "Books", "Articles", "Preprints" published, including 4817 titles. Electronic versions of the bulletins are available on the page "New Acquisitions" of the STL website and are distributed by e-mail. Subscription is available via the Library website in the section "Services" (http://ntb.jinr.ru/ntb_mail/newslist.html).

Weekly bibliographic lists of papers of JINR scientists with abstracts and URL references have been prepared for the Office of Chief Scientific Secretary.

The exhibitions of new acquisitions of books, preprints, periodicals, and theses were arranged regularly. A total of 752 publications were displayed on them. Six topical exhibitions were organized.

The electronic catalogues of books, journals, articles, preprints, and theses are available on Internet at <http://lib.jinr.ru:8080/OpacUnicode/>. In the electronic catalogue in the personal account, the readers can order requested literature and look through their reader's register forms.

The Bibliographic Index of Papers Published by JINR Staff Members in 2024 (2241 titles) was prepared by the Science and Technology Library and published by the JINR Publishing Department. The Index with links to the full texts of publications is available on the STL website, in the section "Services" (http://ntb.jinr.ru/buk/2024/bibl_uk.php).

Thirty-eight biobibliographical indexes were prepared. A total of 724 JINR monographs, conference proceedings, annual reports, journals, deposited research papers were scanned and added to the electronic catalogue.

The Library received 58 titles of Russian periodicals. Electronic access to five journals from the World Scientific Publishing House was purchased.

Due to the National electronic subscription of the RSCI, JINR scientists have the electronic access to the full-text versions of journals of the Springer, Wiley Publishing Houses, as well as journal "Nature", RAS journals, databases "Questel" and "EBSCO eBooks". The trial access to the World Scientific electronic books on physics has been arranged.



Subscription desk of the JINR Science and Technology Library

As part of the project “History of JINR and Dubna in books, journals and central newspapers”, 58 new bibliographic records were introduced. The information system “Literature about JINR Scientists” (1122 records) has been put into service, which is available on the page of the STL site “Publications about JINR” (<http://who-is-who.jinr.ru/catalog3/main.html/>).

In 2025, within the information system “Absotheque”, the input of documents to electronic catalogue was for: books — 404 titles, journals — 1403 numbers, for preprints — 115 titles, theses and author’s

abstracts — 90 titles, book articles — 932 titles, and journal articles — 4934 titles.

As of 1 January 2026, the total number of records in the information system “Absotheque” was 364 553.

On requirements of the JINR Directorate, briefing notes and statistics of indicators of publication activity of JINR scientists and their co-authors from other countries and organizations with the usage of Web of Science, Scopus, and RSCI have been prepared.

PUBLICATION ACTIVITY OF JINR STAFF MEMBERS

According to the Web of Science Core Collection as of 30 January 2026, the bibliometric factors of the publication activity of JINR staff members in 2025 are as follows:

— total number of publications: 1269 (included are collaborative publications without JINR affiliation, but belonging to JINR);

— total number of citations: 1085;
 — without self-citations: 779;
 — average citations per article: 0.86;
 — h-index: 10.

Table 1. Joint publications with authors from the JINR Member States

State*	Number of publications
Armenia	179
Azerbaijan	138
Belarus**	171
Bulgaria	204
Cuba	45
Egypt	133
Georgia	140
Kazakhstan	102
Mongolia	140
Romania	286
Russia	766
Slovakia	132
Uzbekistan	90
Vietnam	57

*In alphabetical order.

** Included are collaborative publications without Belarus affiliation, but belonging to Belarus.

Table 2. Joint publications with authors from the JINR Associate Members

State*	Number of publications
Germany	378
Hungary	173
Italy	363
Serbia	148
South Africa	132

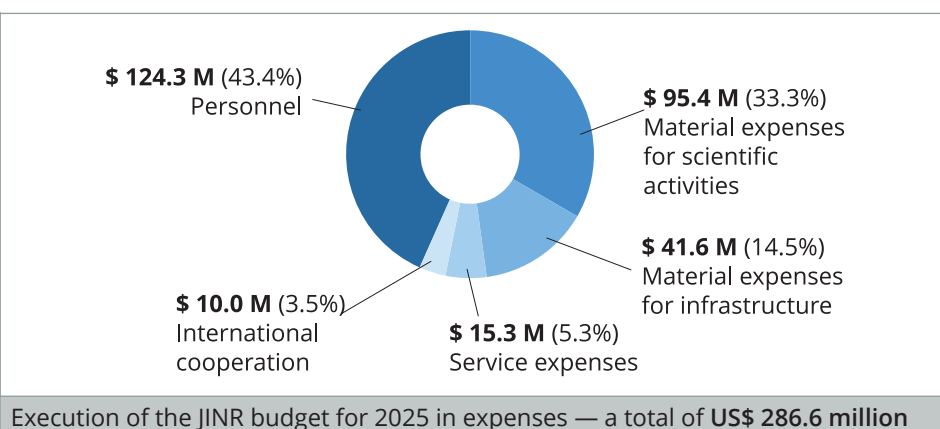
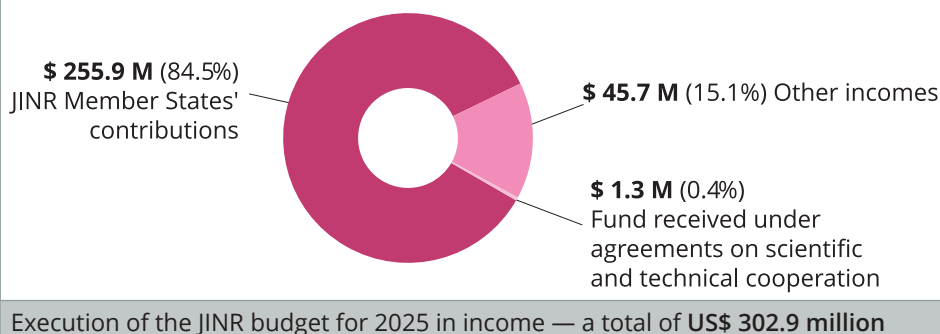
*In alphabetical order.

Table 3. Joint publications with authors from other states and regions

State/Region*	Number of publications	State/Region*	Number of publications
China	367	Iran	74
USA	367	Israel	71
Poland	340	Latvia	70
United Kingdom	338	Estonia	68
Switzerland	336	Cyprus	67
France	293	Ecuador	67
Sweden	267	Kuwait	67
Turkey	256	Malaysia	67
Brazil	249	Montenegro	67
Netherlands	240	Sri Lanka	67
Czech Republic	232	UAE	67
Chile	230	Qatar	66
Spain	214	Slovenia	66
India	207	New Zealand	65
South Korea	195	Argentina	63
Thailand	188	Palestine	63
Austria	185	Philippines	63
Australia	184	Peru	59
Colombia	182	Costa Rica	49
Greece	178	Honduras	48
Ukraine	156	Indonesia	40
Pakistan	153	Tunisia	25
Japan	149	Moldova	11
Taiwan	145	Jordan	5
Portugal	141	Northern Ireland	5
Scotland	134	Oman	4
Ireland	117	Tajikistan	4
Croatia	116	Bangladesh	3
Mexico	116	Kyrgyzstan	2
Finland	115	Lebanon	2
Norway	112	Singapore	2
Denmark	103	Algeria	1
Belgium	97	Iraq	1
Canada	94	Nigeria	1
Lithuania	83	Trinidad and Tobago	1
Morocco	76	Wales	1
Saudi Arabia	76		

*In decreasing order of the number of publications.

FINANCIAL ACTIVITIES



Contributions of JINR Member States for 2025 (in percent)

State	%	State	%
Republic of Armenia	0.14	Republic of Kazakhstan	1.65
Republic of Azerbaijan	0.41	Mongolia	0.12
Republic of Belarus	0.74	Romania	2.21
Republic of Bulgaria	0.79	Russian Federation	90.45
Republic of Cuba	0.18	Republic of Uzbekistan	0.59
Arab Republic of Egypt	1.06	Socialist Republic of Vietnam	1.48
Georgia	0.18		
<i>Total:</i>			100.0

GRANTS

In 2025, for the implementation of a number of scientific projects, the staff members of the Joint Institute for Nuclear Research received financial support of the Russian Scientific Foundation (RSF) and the Ministry of Science and Higher Education of the Russian Federation.

RSF rendered financial support to JINR scientific projects within the framework of the following competitions: “Conducting Fundamental Scientific Research and Exploratory Scientific Research in Separate Scientific Groups” (4 projects), “Conducting Fundamental Scientific Research and Exploratory Scientific Research in Small Separate Scientific Groups” (5 projects), “Conducting Fundamental Sci-

entific Research and Exploratory Scientific Research by International Scientific Teams” — NSFC (China), VAST (Vietnam), and BRFB (Belarus) (1 project each), “Conducting Independent Research by Young Scientists” (3 projects), “Conducting Research by Scientific Groups under the Guidance of Young Scientists” (2 projects).

The Ministry of Science and Higher Education of the Russian Federation financed the project of the Frank Laboratory of Neutron Physics “Development of the hardware and methodological base for meeting scientific and applied issues at various types of neutron sources”.

STAFF

As of 1 January 2026, the total number of the staff members at the Joint Institute for Nuclear Research was 5152 (without temporary staff members).

Working at JINR are: RAS Academicians V. Matveev, I. Meshkov, Yu. Oganessian, G. Trubnikov, B. Sharkov, A. Rozanov (part-time); RAS Corresponding Members V. Aksenov, T. A.-H. Aushev, A. Belushkin, L. Grigorenko, D. Kazakov, V. Kekelidze, G. Shir-

kov; Full Member of the Mongolian Academy of Sciences O. Chuluunbaatar; 38 Professors, 28 Assistant Professors, 218 Doctors of Science, and 645 Candidates of Science.

In 2025, 593 people were employed and 488 people were discharged because of engagement period expiry and for other reasons.



Dubna, 5 June. Participants of the festive awarding of diplomas on conferring academic degree

AWARDS

In 2025, for their fruitful work at JINR and international cooperation, JINR employees were awarded:

— state awards of the Russian Federation: the Honorary Badge of the laureate of the Government Prize of the Russian Federation (1 staff member), the Medal of the Order “For Merit to the Fatherland”, I class (1 staff member), the Medal of the Order “For Merit to the Fatherland”, II class (1 staff member);

— awards of the President of the Russian Federation: the Gratitude of the President of the Russian Federation (1 staff member);

— awards of the Ministry of Science and Higher Education of the Russian Federation: the Honorary Diploma of the Ministry of Science and Higher Education of the Russian Federation (2 staff members), the Gratitude of the Ministry of Science and Higher Education of the Russian Federation (5 staff members), the title “Honorary Worker of Science and High Technologies of the Russian Federation” (3 staff members);

— awards of the Rosatom State Corporation: the I. V. Kurchatov Honorary Badge, III class (1 staff member);



Moscow, 30 May. RAS President Academician G. Krasnikov presents the N. N. Bogoliubov Gold Medal to JINR Scientific Leader Academician V. Matveev.
Photo: © Olga Merzlyakova / Scientific Russia

— awards of the Moscow Region: the honorary title “Honored Lawyer of the Moscow Region” (1 staff member), the Honorary Diploma of the Moscow Regional Duma (1 staff member), the Honorary Diploma of the Ministry of Energy of the Moscow Region (1 staff member), the Honorary Letter of the Minister of the Construction Complex of the Moscow Region (1 staff member);

— awards of the Dubna city: the Honorary Diploma of the Mayor of the Dubna city (8 staff members), the Gratitude of the Mayor of the Dubna city (9 staff members);

— JINR awards: the JINR Honorary Diploma (6 staff members), the JINR Honorary Certificate

(25 staff members), the JINR Honorary Letter (78 staff members), the title “Honorary JINR Staff Member” (6 staff members).

One staff member was awarded the Honorary Certificate from the Central Council Presidium of the Russian Trade Union of Nuclear Power and Industry Workers. Four staff members received the Gratitude from the Local Government Council of the Elbrusky Municipal District of the Kabardino-Balkarian Republic.

A total of 156 JINR employees were awarded.

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