

INTRODUCTION



The year 2024 was marked at JINR with bright scientific results, important achievements in the development of the research infrastructure of the Institute, and significant events in the life of JINR as an international intergovernmental organization.

First and foremost, it is necessary to emphasize the high level of attention expressed to JINR by the state of the Institute location, the Russian Federation, to the establishment of favourable conditions for work at JINR, especially to implementation of the largest international project NICA for studies of the properties of hadron matter in extreme conditions. This is evidenced by the visit of the President of the Russian Federation Vladimir Putin to JINR in June 2024 and his strategic support of the Institute activities in the development of international scientific and technical cooperation. The President met with scientists from Russia and other JINR Member States and gave a start to the technological launching of the NICA complex. A meeting of the Presidential Council for Science and Education was held at the JINR International Conference Hall.

In 2024, preparations for combined technological testing of the main assemblies of the NICA accelerator complex were completed. An important stage of the implementation of the NICA-MPD project was executed — the superconducting magnet of the MPD detector was cooled down to liquid helium temperatures. Five runs at the NICA channels were successfully completed for applied research within the ARIADNA collaboration.

At the Flerov Laboratory of Nuclear Reactions, an experimental programme of the Superheavy Element Factory in irradiation of ^{242}Pu and ^{238}U targets with ^{50}Ti and ^{54}Cr beams, respectively, was successfully implemented. Six new events on the synthesis of livermorium were obtained. Three new isotopes were discovered: $^{288, 289}\text{Lv}$ and ^{280}Cn . The important results bring FLNR scientists closer to carrying out the experiments on the synthesis of elements 119 and 120.

In 2024, the upgrade of the U-400M cyclotron was completed, and the facility was launched. In the first experiments, dineutron correlations in the $^4\text{He}(^8\text{He}, ^8\text{He})^4\text{He}$ reaction were studied at 25–35 A MeV.

The construction of the new experimental building for U-400R was conducted ahead of terms. In the hall of the DC-140 accelerator complex, building and assembly works were in full swing.

Scientists of the Bogoliubov Laboratory of Theoretical Physics demonstrated traditionally high publication activity and obtained significant results in theoretical and mathematical physics, nuclear physics, elementary particle physics and relativistic heavy ion physics, materials science and solid matter physics, including those aimed at JINR experimental programme. In November, an important co-operation agreement was signed in China between the Institute of Theoretical Physics of the Chinese Academy of Sciences (ITP CAS) and JINR. Under the agreement, regular exchange of visits for scientists, postgraduates and students will be carried out, and joint research of ITP CAS and BLTP, as well as other JINR laboratories, will be enhanced.

Technological work to launch IBR-2M came to the stage of completion at the Frank Laboratory of Neutron Physics. The launching of the reactor is scheduled for the first part of 2025. New detectors were installed in the FDHR and DN-6 diffractometers.

A prototype of a new facility using inelastic neutron scattering, the BJN spectrometer, was prepared for testing.

As part of applied research, FLNP scientists actively studied cathode materials for perspective sodium-ion accumulators. The staff members of the Sector of Neutron Activation Analysis and Applied Research were awarded medals at the international invention Euroinvent-2024 exhibition for elaborations in life sciences.

The Dzhelapov Laboratory of Nuclear Problems, which celebrated its 75th anniversary in 2024, successfully conducted expeditions to develop the Baikal-GVD neutrino telescope, bringing it to record levels in a number of characteristics. At present, 13 clusters consisting of more than 4000 optical modules are installed on Lake Baikal. An important scientific result was achieved in proving high sensitivity of Baikal-GVD, which was four times higher than that of the IceCube neutrino observatory (Antarctica). In 2024, the Baikal telescope discovered astrophysical neutrinos with energy higher than 200 TeV.

It is necessary to mention the active participation of JINR staff members in the DANSS and DANSS2 experiments at the Kalinin NPP, in the SPD collaboration at the NICA accelerator complex, and in upgrading the JUNO detector (China). Active work was continued to develop the MSC-230 medical cyclotron and to prepare the Linac-200 electron accelerator for launching.

The JINR Multifunctional Information and Computing Complex (MICC) achieved a new level that allows accomplishment of the Institute responsibilities in participation in international collaborations in accordance with highest world standards. In 2024, MICC processed 40 petabytes of incoming traffic, ensuring the completion of more than 10 million tasks through Tier-1 and Tier-2 grid infrastructure, along with about 3.8 million tasks on the Govorun supercomputer.

The Laboratory of Radiation Biology played a catalytic role in forming a multidisciplinary agenda of scientific research at the Institute. JINR radiobiologists developed new binary methods of ray therapy of malignant tumours using radiosensitizers. The contribution of the LRB scientists to the development of the Geant4-DNA software package for radiobiological simulation at the cell level received international acknowledgement.

Specialists of the Institute developed the interactive Detector Centre Web Service designed to create and visualize a single database of technological areas of JINR. The application contains information about equipment, experience of using components and materials, and competences of the Institute's laboratories. This resource will promote the development of applied research and design of unique equipment on requests from organizations of the Member States.

At the visiting session in November in Minsk (Belarus), the JINR Committee of Plenipotentiaries ap-

proved the startup competition for support of innovation projects of young specialists.

In 2024, the hundredth thesis defense took place in the framework of the JINR Dissertation Councils. During the year, 26 defenses were held: 19 candidate and 7 doctoral theses.

JINR is reliably at a high level among the most "productive" world centres in publication of its materials in leading scientific international centres on a widest range of scientific fields. In 2024, the Institute organized above 80 international scientific events, including large conferences with more than 150 participants.

In 2024, the Joint Institute organized and held 70 international scientific conferences and schools, 16 workshops and 13 meetings. Eleven large scientific forums were held with the active participation of BLTP, including the international conference "Nucleus-2024", a session of the Nuclear Physics Department of the Russian Academy of Sciences and the International Workshop on Physics of Strongly Interacting Systems in China. In the field of information technologies, the MPQIT-2024 workshop and the MMCP-2024 international conference were organized, and the autumn stage of the Scientific School on Information Technologies was successfully held, where students from Russian universities took part. LRB took an active part in the organization and work of such major events as the 23rd International Scientific School for Young Scientists on Radiobiology in Obninsk (Russia), the international conference "Current Problems in Radiation Biology" in Dubna, and the VAST-JINR Workshop on Nuclear Medicine in Hanoi (Vietnam).

Due to intensive work of the JINR University Centre, more than 600 students and postgraduates from dozens of countries took part in scientific and educational programmes of the Institute (internships, practice, scientific schools) and completed qualification papers. Similar programmes were organized for teachers as well: about 70 teachers from partner organizations visited Dubna to take part in scientific schools. In total, more than 160 students participated in the START and INTEREST programmes.

Eighteen heads of various levels and coordinators from Belarus, Russia, and Uzbekistan took part in the international internship for science and natural science education leaders (JEMS-24).

The Publishing House "Prosveshchenie" issued an educational and methodical complex for school students "Physics for Grades 7-9. Engineers of the Future", produced by a group of authors from the JINR University Centre. The textbook is included in the Federal List of Textbooks by the Order of the Ministry of Education of the Russian Federation.

In 2024, for the first time in its recent history, the Dubna Branch of MSU admitted master's students to the first year of the programme "Physics". Besides, a new master's programme "Applied Mathematics and Informatics" was successfully licensed in the Russian Ministry of Science and Higher Education. The idea of establishing this programme on the

basis of the Dubna MSU Branch was justified by the need to train highly qualified staff in mathematical simulation and data processing in the megascience projects applying analytical methods for Big Data analytic and artificial intelligence.

In the international cooperation sphere, one of the most important things achieved in 2024 was signing of an agreement between JINR and the Ministry of Science and Technology of China on the start of implementation of eight joint projects and of a cooperation agreement between JINR and the National Nuclear Energy Commission of Brazil (CNEN). The ties with governmental bodies, scientific organizations and universities of Mexico, India, Serbia, and RSA grew rapidly.

Among major events was also the prolongation of the agreement on scientific cooperation with CERN, which gives hope for an early resumption of full-scale interaction between the two international intergovernmental organizations.

In 2024, the partner net of information centres of JINR widened — an Information Centre was opened in iThemba LABS (RSA), whose activities should facilitate the development of JINR–RSA international cooperation in science and education.

The social infrastructure of the Institute was actively developed. Medical service turned to the better due to radical changes in Medical Unit No. 9, which became possible thanks to the support of the Federal Medical and Biological Agency of the Russian Federation, as well as to the participation of JINR and the city administration.

In the challenging geopolitical conditions of 2024, these and many other results were achieved due to high professionalism and cohesion of scientists, engineers, workers and specialists not only in JINR laboratories, but equally in administration departments and services of the Institute.

The solution of tasks in 2025 will demand concentration of efforts in all areas of the Institute's activities. In 2025, which precedes the 70th anniversary of JINR, we must launch the NICA accelerator complex, start preparing for experiments on the synthesis of elements 119 and 120, resume the international user programme at IBR-2M, complete the large-scale reconstruction of important social infrastructure facilities, while continuing the progressive development of the Institute as a unique integration platform for multilateral international scientific and technical cooperation.



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