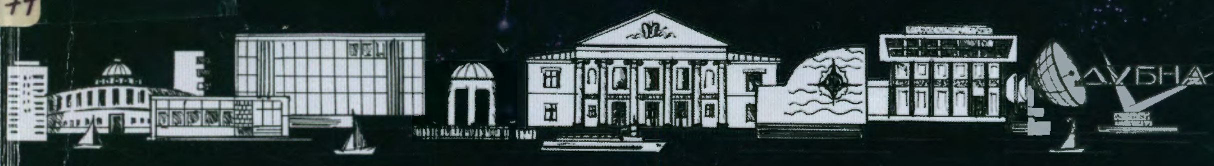
JOINT INSTITUTE FOR NUCLEAR RESEARCH



JINR: HOW IT ALL BEGAN

The Joint Institute for Nuclear Research (JINR) is an international intergovernmental scientific research organization established through the Convention signed on 26 March 1956 in Moscow by the representatives of the governments of eleven states-founders to unite their scientific and material potential in order to study fundamental properties of matter. On 1 February 1957, JINR was registered with the United Nations Organization. The Institute is located in the city of Dubna in 120 km from Moscow in the Russian Federation.

In March 1956 the following states founded the Joint Institute for Nuclear Research: Albania, Bulgaria, China, Czechoslovakia, the German Democratic Republic, Hungary, the People's Democratic Republic of Korea, Mongolia, Poland, Romania and the USSR. In September 1956, the Democratic Republic of Vietnam became a member to JINR signing the Convention.

By the time JINR was constructed, the Hydrotechnical Laboratory (HTL) of the USSR Academy of Sciences had been operating in the locality of the future Dubna city since 1948 (renamed in 1953 into the Institue of Nuclear Problems (INP) of the USSR Academy of Sciences). A wide scientific programme was started there in funadmental and applied research of the properties of nuclear matter at the largest for that time accelerator of charged particles – the Syncrocyclotron (1949). M.Meshcheryakov and V.Dzhelepov were the leaders of the studies. In 1953, the Electrophysical Laboratory of the USSR Academy of Sciences (EPLAS) was organized there where a new accelerator with record parameters – the Synchrophasotron – was developed under the guidance of Academician V.Veksler.

Moscow, 26 March 1956.
Representatives of the governments of eleven states-founders of the Joint Institute for Nuclear Research

Moscow, 26 March 1956.
Signing of the Convention on JINR establishment

The building of the first Dubna accelerator – the Synchrocyclotron

The main building of the Synchrophasotron

The world had realized by the mid 1950s that nuclear science should not be locked in secret laboratories and that only widespread international cooperation could be a guarantee of the progressive development of this fundamental field of human knowledge and peaceful use of atomic energy. Thus, in 1954 the European Organization for Nuclear Research (CERN) was established near Geneva (Switzerland) to consolidate the efforts of West European states in the research of fundamental properties of the microworld.

In those years the states of the socialist camp took a decision, on the initiative of the USSR government, to establish the Joint Institute for Nuclear Research on the basis of INP and EPLAS.

After the conclusion of the Convention on JINR establishment, specialists from 12 countries arrived in Dubna to work at the Institute. Research in a wide range of nuclear physics trends started involving scientific centres of JINR Member States.

Professor D.Blokhintsev, under whose guidance the construction of the first in the world atomic power station had just been accomplished in Obninsk, was elected Director of the Joint Institute.

Professors M.Danysz (Poland) and V.Votruba (Czechoslovakia) were elected the first JINR Vice-Directors.

JINR Laboratories were headed by N.Bogoliubov (the Laboratory of Theoretical Physics), V.Veksler (the Laboratory of High Energies), V.Dzhelepov (the Laboratory of Nuclear Problems), G.Flerov (the Laboratory of Nuclear Reactions), I.Frank (the Laboratory of Neutron Physics).

The first JINR Directorate led the Institute through one of the most dramatic periods of its history – the time of its formation.

The history of the establishment of the Joint Institute is associated with the names of such eminent scientists and science organizers as N.Bogoliubov, L.Infeld, I.Kurchatov, H.Niewodniczanski, A.Petrosiants, E.Slavsky, I.Tamm, A.Topchiev, H.Hulubei, L.Janossy and other scientists.

The Institute and the main scientific branches were developed by the following outstanding physicists: N.Amaglobeli, A.Baldin, I.Chuvilo, M.Danysz, V.Dzhelepov, D.Ebert, G.Flerov, I.Frank, M.Gmitro, N.Govorun, H.Hristov, A.Hrynkiewicz, E.Janik, V.Kadyshevsky, D.Kiss, J.Kožešnik, N.Kroo, K.Lanius, Le Van Thiem, A.Logunov, M.Markov, V.Matveev, M.Meshcheryakov, G.Nadjakov, Nguyen Van Hieu, Yu.Oganessian, L.Pal, V.Petržilka, H.Pose, B.Pontecorvo, A.Săndulescu, V.Sarantsev, F.Shapiro, D.Shirkov, A.Sissakian, N.Sodnom, R.Sosnowski, A.Tavkhelidze, Ş.Ţiţeica, I.Todorov, I.Ulehla, I.Ursu, V.Veksler, V.Votruba, Wang Ganchang, Zhou Guanzhao, I.Zlatev, I.Zvara.

Nuclear research has been marked by dramatic events and crucial changes for the past years. In 1961 the JINR Prizes were instituted, and a group of physicists headed by Vladimir Veksler and the Chinese Professor Wang Ganchang was awarded for the discovery of antisigma-minus-hyperon.

But a few years later, this particle, as well as the proton, neutron, π- and K-meson and the other so-called hadrons "lost" their elementary quality – these objects turned out to be complex particles which consisted of quarks and antiquarks. The latter have obtained the "right" to be called elementary now.

Dubna physicists (N.Bogoliubov and his colleagues) clarified to a great extent the concept of the quark structure of hadrons: colour quarks, the hadron quark model, which is called "the Dubna bag", etc.

50 years ago, soon after JINR had been established, Bruno Pontecorvo suggested a hypothesis about neutrino oscillations. It took scientists dozens of years to find an experimental confirmation of one of the central issues of the modern physics of weak interactions – neutrino oscillations. In January 2005 at the 97th session of the JINR Scientific Council the B.Pontecorvo Prize was presented to the director of the SNO project (Sadbery Neutrino Observatory), Professor of Physics at Kingstone Royal University, Canada, Doctor A.Macdonald for the evidence of solar neutrino oscillations in the SNO experiment.

Amsterdam, 4 October 1952.
Meeting of the CERN founders to select Geneva as the place for the Centre location and adopt a resolution to construct a 30-35 GeV proton synchrotron (Courtesy: CERN)

1956. Members of the JINR Scientific Council at the construction site of the new building for the Laboratory of Theoretical Physics

The first Directorate of JINR (from left to right): Vice-Director Professor M.Danysz (Poland), Director Professor D.Blokhintsev, Vice-Director V.Votruba (Czechoslovakia)

1957. The first JINR Directorate and Directors of the Laboratories (from left to right): LNP Director I.Frank, JINR Vice-Director M.Danysz, LNP Director V.Dzhelepov, JINR Vice-Director V.Votruba, JINR Director D.Blokhintsev, JINR Andministrative Director V.Sergienko, LHE Director V.Veksler, JINR Assistant Director A.Ryzhov, LTP Director N.Bogoliubov, LNR Director G.Flerov

Dubna, 1956. The first session of the Committee of Plenipotentiaries of the governments of the states – members of the Joint Institute for Nuclear Research

Authors of the antisigma-minus-hyperon discovery:
V.Veksler (USSR), Din Da-Tsao (China), Kim Hi In (North Korea), Nguyen Din Ty (Vietnam), A.Mihul (Romania)

A.Logunov, N.Bogoliubov, A.Tavkhelidze

Bruno Pontecorvo

Doctor A.Macdonald (left) is awarded the B.Pontecorvo Prize

JINR TODAY

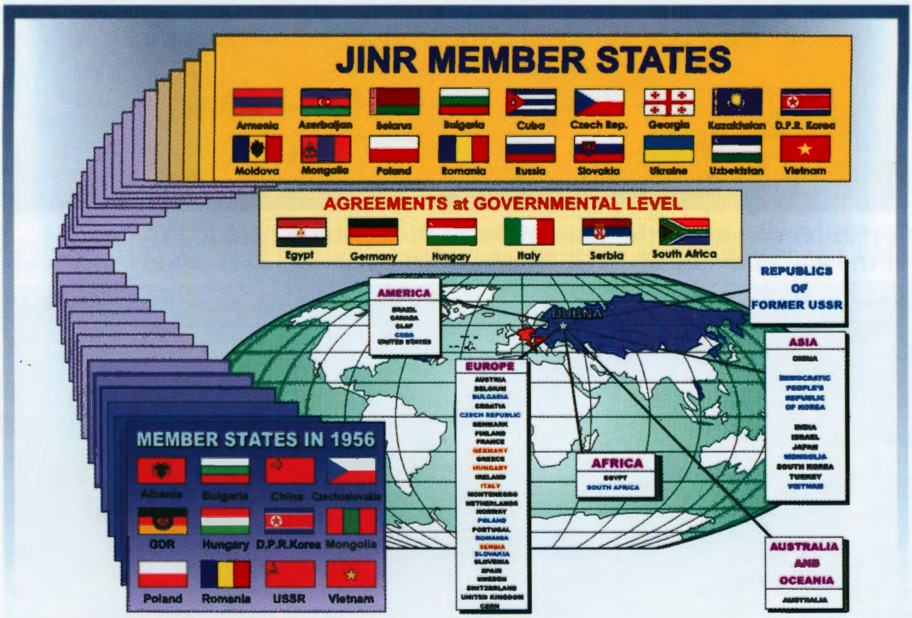
JINR today is a world-known centre where the fundamental research (theoretical and experimental) is successfully integrated with the new technology work-out and application of the latest techniques and university education. The prestige of JINR in the world scientific community is very high today.

The Institute possesses a mighty basis: traditions of scientific schools acknowledged worldwide; basic facilities with unique capacity to solve challenging tasks in various fields of modern physics; the status of an international intergovernmental organization. According to its Charter, the Institute exercises its activities on the principles of openness to all interested states for their participation and equal mutually beneficial cooperation.

JINR has at present 18 Member States: Armenia, Azerbaijan, Belarus, Bulgaria, Cuba, the Czech Republic, Georgia, Kazakhstan, D. P. Republic of Korea, Moldova, Mongolia, Poland, Romania, Russia, Slovakia, Ukraine, Uzbekistan, and Vietnam. Participation of Egypt, Germany, Hungary, Italy, the Republic of South Africa and Serbia in JINR activities is based on bilateral agreements signed on the governmental level. The Supreme governing body of JINR is the Committee of Plenipotentiaries of the governments of all 18 Member States.

JINR Director is RAS Academician V.Matveev; Vice-Directors are R.Lednický, M.Itkis and G.Trubnikov.

The research policy of JINR is determined by the Scientific Council, which consists of eminent scientists from the Member States as well as famous researchers from China, France, Germany, Greece, Hungary, India, Italy, Switzerland, the USA, the European Organization for Nuclear Research (CERN) and others.



JINR MEMBER STATES
Armenia
Azerbaijan
Belarus
Bulgaria
Cuba
Czech Rep.
Georgia
Kazakhstan
D.P.R. Korea
Moldova
Mongolia
Poland
Romania
Russia
Slovakia
Ukraine
Uzbekistan
Vietnam
AGREEMENTS at GOVERNMENTAL LEVEL
Egypt
Germany
Hungary
Italy
Serbia
South Africa
REPUBLICS OF FORMER USSR
AMERICA
BRAZIL
CANADA
CLAF
CUBA
UNITED STATES
DUBNA
EUROPE
AUSTRIA
BELGIUM
BULGARIA
CROATIA
CZECH REPUBLIC
DENMARK
FINLAND
FRANCE
GERMANY
GREECE
HUNGARY
IRELAND
ITALY
MONTENEGRO
NETHERLANDS
NORWAY
POLAND
PORTUGAL
ROMANIA
SERBIA
SLOVAKIA
SLOVENIA
SPAIN
SWEDEN
SWITZERLAND
UNITED KINGDOM
CERN
ASIA
CHINA
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA
INDIA
ISRAEL
JAPAN
MONGOLIA
SOUTH KOREA
TURKEY
VIETNAM
AFRICA
EGYPT
SOUTH AFRICA
AUSTRALIA AND OCEANIA
AUSTRALIA
MEMBER STATES IN 1956
Albania
Bulgaria
China
Czechoslovakia
GDR
Hungary
D.P.R.Korea
Mongolia
Poland
Romania
USSR
Vietnam

JINR Directorate (left-right): JINR Chief Engineer G.Shirkov, Chief Scientific Secretary N.Russakovich, Vice-Director R.Lednický, JINR Director V.Matveev, Vice-Directors M.Itkis and G.Trubnikov

A regular session of the Committee of Plenipotentiaries (CP) of the governments of JINR Member States

Members of the JINR Scientific Council

Signing of the Agreement in the frames of the visit of the INFN delegation (Italy) to JINR

Signing of the Protocol on further cooperation between the Federal Ministry of Education and Research of Germany (BMBF) and JINR

Ambassadors of 11 Latin American states on a visit to JINR

Wide international cooperation is the major factor in JINR activities. The Institute collaborates with more than 700 scientific centres and universities in 64 countries of the world.

Only in Russia – the largest JINR partner – the cooperation is conducted with over 170 research centres, universities, industrial enterprises and firms from 50 Russian cities. Among scientific partners of the Joint Institute in Russia are 92 research organizations in 23 cities. The geography of JINR cooperation with higher education institutions of Russia is not limited by Moscow – it spreads over all the territory of the country. The Institute has partnership relations with 40 universities in 25 Russian cities. Direct participants of the implementation of the JINR scientific programme are 22 industrial enterprises from14 Russian cities that first design the specific equipment and then produce it. Over 200 scientific centres, universities and industrial enterprises from 10 CIS countries take part in the implementation of the scientific programme of the Institute.

JINR possesses the Observer Status in a number of European scientific structures: in the strategy working group on physical and engineering sciences of the European Stategic Forum on Research Infrastructures (ESFRI), in the Astroparticle Physics European Consortium (ApPEC). In 2014 CERN and JINR took important decisions on the mutual granting of the Observer Status: for JINR in the CERN Council and for CERN in the Committee of Plenipotentiaries of the governments of JINR Member States. Since recently, JINR has had its representative in the Nuclear Physics European Collaboration Committee (NuPECC).

The Institute has accummulated immense experience of mutually beneficial scientific-technical cooperation on the international scale. JINR maintains contacts with IAEA, UNESCO, the European Physical Society, and the International Centre of Theoretical Physics in Trieste. Annually, above a thousand scientists from the organizations which are JINR partners visit Dubna.

Since its foundation, JINR has accomplished a wide range of research and trained scientific staff of the highest quality for the Member States. Among them are presidents of the national Academieis of Sciences, leaders of large nuclear institutes and universities in many JINR Member States.

Paris, 1997. The UNESCO-JINR Agreement on cooperation is signed

Geneva, 2015. Signing of the working protocols between CERN and JINR on cooperation in the LHC project and neutrino physics research

JINR comprises seven Laboratories, each being comparable with a large institute in the scale and scope of investigations performed. The main fields of JINR's activity are theoretical and experimental studies in elementary particle physics, nuclear physics, and condensed matter physics. The research programme of JINR is aimed at obtaining highly significant results of principal scientific value.

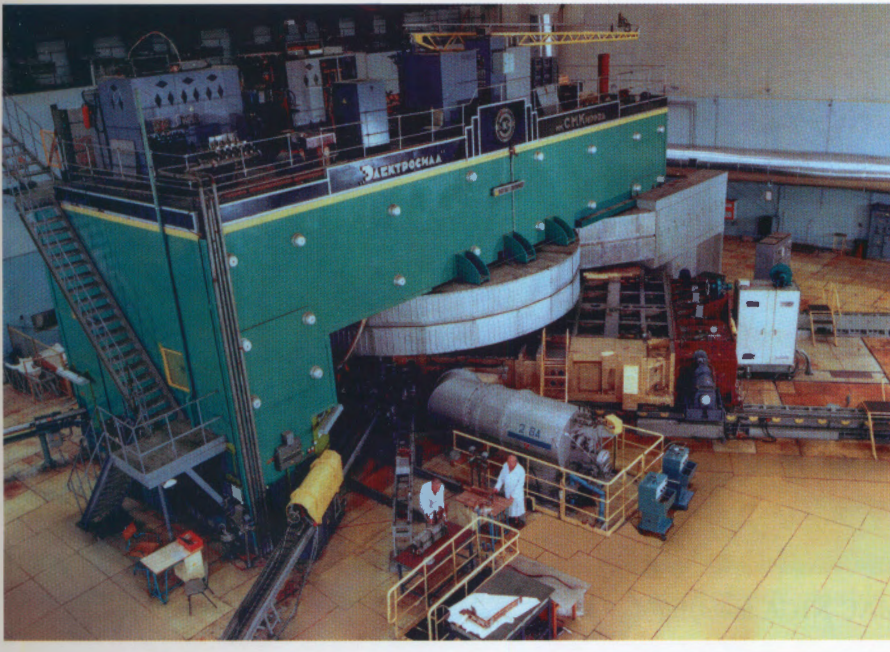
The Institute employs about 4500 people, including more than 1200 scientists, among whom there are full members and corresponding members of national academies of sciences, more than 260 Doctors of Science and 560 Candidates of Science and about 2000 engineers and technicians.

The Joint Institute possesses a remarkable choice of experimental facilities for physics: the only in Europe and Asia superconducting accelerator of nuclei and heavy ions – the Nuclotron, heavy ion cyclotrons U-400 and U-400M with record beam parameters for experiments on the synthesis of heavy and exotic ions, a unique neutron pulsed reactor IBR-2 used for research in neutron nuclear physics and condensed matter physics, and a proton accelerator – the Phasotron that is used for ray therapy.

The experimental research programme of JINR bases on the bright school of theoretical physics, well developed methods of the physics experiments, modern information technologies, including grid-technology.

The project "Nuclotron" develops according to the schedule; it will the basis for a megaproject in the Russian Federation – the new superconducting collider NICA. The new complex will be equipped with a Multi Purpose Detector (MPD) to conduct experimental research in the studies of hadron matter and its phase transformations, a detector SPD for studies of spin effects and a detector BM@N for research of baryonic matter.

The development of the modern accelerator complex for heavy ions DRIBs and the construction of its key element – the factory of superheavy elements are conducted at a rapid rate. The factory of superheavy elements is meant for experimental research on the mechanism of reactions with stable and radioactive nuclei – it will be a new basic facility of JINR that will provide qualitatively new opportunities in the field where JINR possesses indisputable leadership.



The Phasotron – a proton accelerator

The Nuclotron – a superconducting accelerator of relativistic nuclei and heavy ions

MAC NICA meeting

Chairman of the RF State Duma of the Federal Assembly S.Naryshkin on a visit to JINR

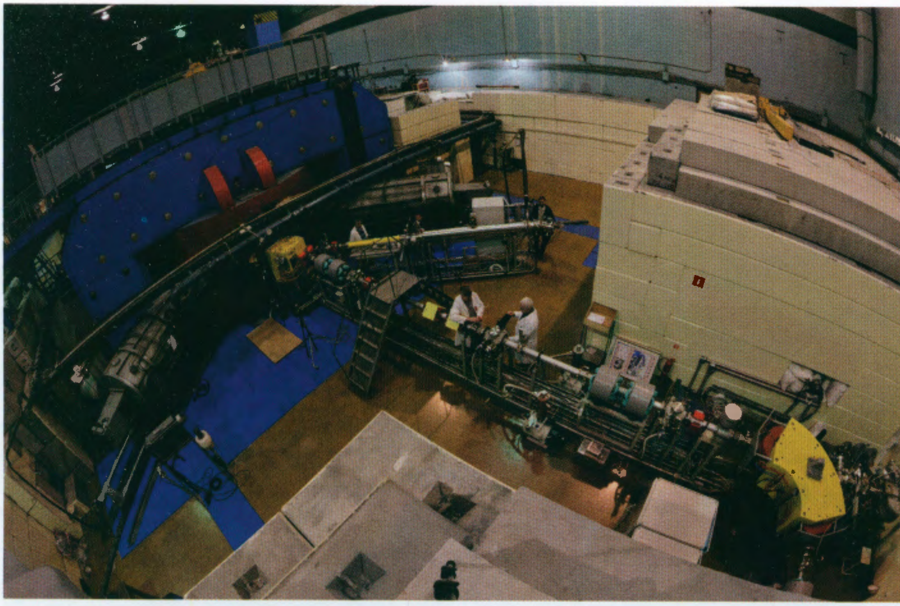
A technological site of the superconducting magnets production for the NICA accelerator complex

A user programme at the upgraded complex of spectrometers of the research pulsed reactor IBR-2 is implemented successfully. It is included into the 20-year European strategic programme of research in neutron scattering.

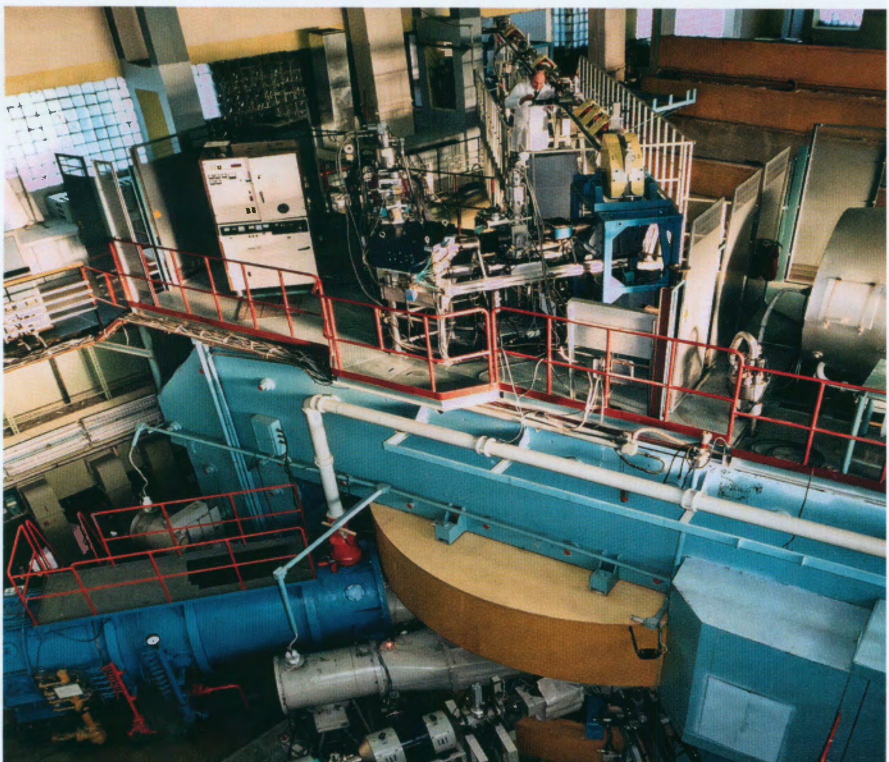
Specialsts from 16 countries and JINR staff members conduct experiments in most advanced trends of research related, primarily, to studies of matter structure, deeper research of structure of matter and its properties, development of functional materials and progress in nano- and biomedical technologies, as well as obtaining new knowledge about geology of planets and processes that occur in earthequake centres.

JINR has powerful high-productive computing environment that is integrated into the world computer network through high-speed communication channels. The scalable communication channel "Dubna-Moscow" was launched in 2009 with the initial capacity of 20 Gbit/s and potenialities to widen the capacity up to 720 Gbit/s. The JINR core network (data transmission speed of 10 Gbit/s) overlaps all local networks of the JINR laboratories and divisions into one unified computer network. The basis of the computer infrastructure of the Institute is the Central Information Computer Complex (CICC). The JINR GRID-segment developed on its basis is an important element of the RDIG grid-infrastructures (Russian Data Intensive Grid), WLCG (Worldwide LHC Computing Grid) and EGEE (Enabling Grids for E-sciencE).

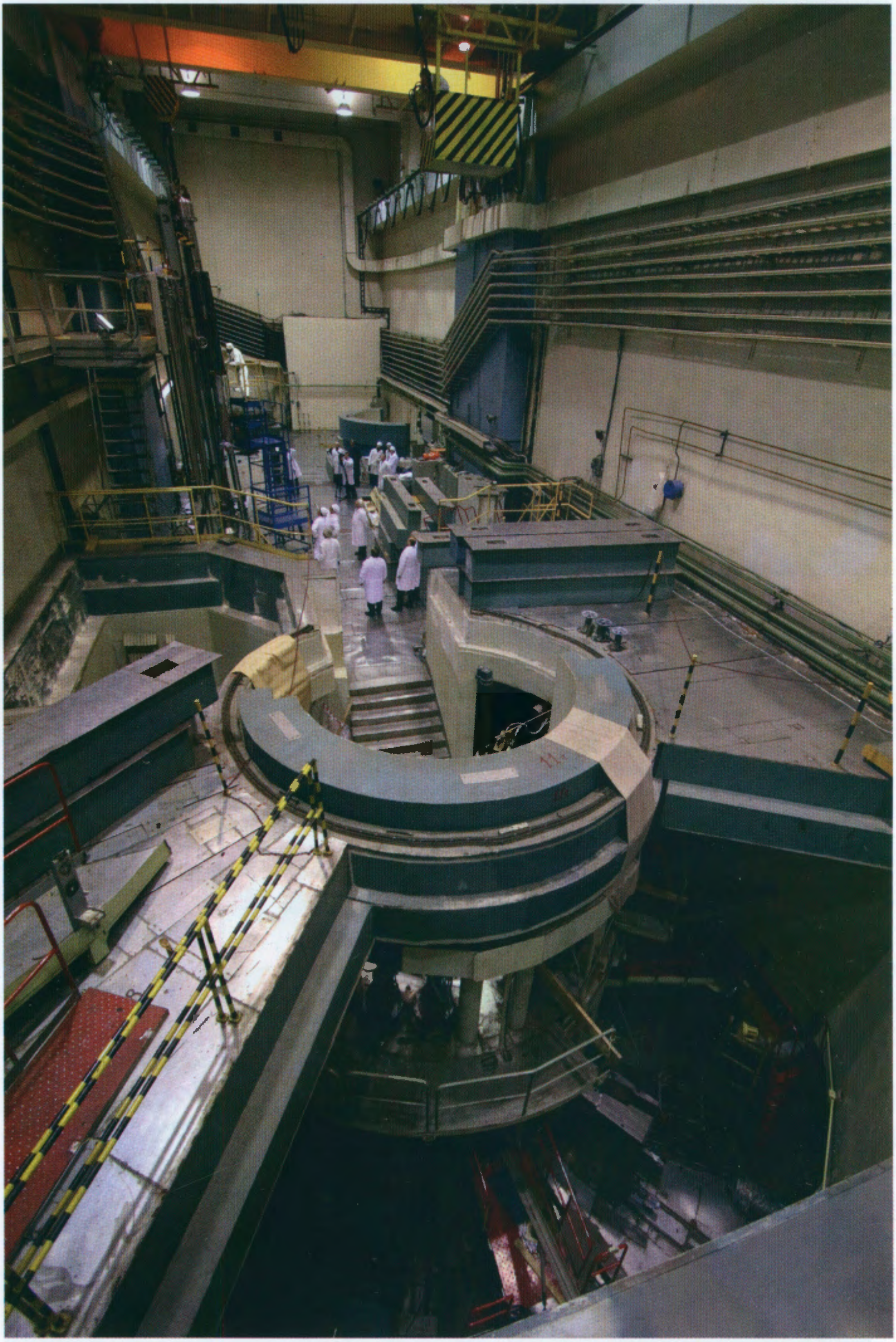
The research has always been conducted at JINR in accordance with specific plans. The framework concept of the modern programmes for JINR development is based on the following triad: science – education – innovation. It also accords with the strategy for economic development of the JINR Member States. The basic element of the triad – fundamental science – includes the so-called framework projects, namely the projects that imply the use of large experimental facilities. New scientific trends appear and new technologies are developed through their accomplishment. The unique powerful fleet of basic facilities of JINR (accelertors and reactors) has been a strong attraction for decades for scientists from Member States and many other centres of the world. In the frames of applied research projects are implemented aimed at the development of scientific base of JINR Member States, construction of new facilities



The U-400M cyclotron



The DRIBs accelerator complex for heavy ions



The IBR-2 neutron pulsed reactor

IREN – a new generation basic facility for research in nuclear physics

The Central Information Computing Complex (CICC) of JINR

and elaboration of scientific programmes for them. Projects to develop cyclotrons in Kazakhstan, Slovakia have been acomplished for the recent years.

Parallel with "home" activities, JINR continues its participation in large international projects (LHC, FAIR, XFEL), research programmes at the accelerators RHIC and Tevatron (USA) and is included into the participation in projects to develop the International Linear Collider (ILC).

The Joint Institute actively cooperates with the European Organization for Nuclear Research (CERN) in theoretical and experimental research in high energy physics. Today, JINR physicists take part in 20 projects of CERN.

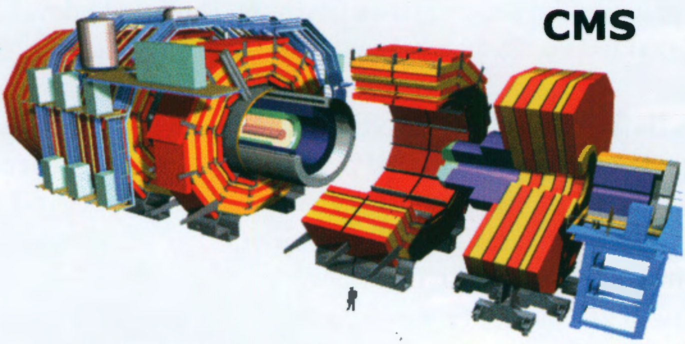
The considerable contribution of JINR into the implementation of the challenging project of the 21st century – the Large Hadron Collider (LHC) – has been highly estimated by the world scientific community. All JINR responsibilities in the design and development of systems for the detectors ATLAS, CMS, ALICE and the LHC collider itself have been successfully and fully accomplished.

Teams of JINR physicists have played an important role in the activities on technical upgrading of the Large Hadron Collider, refurbishment of detectors at the LHC and in acquisition of new physics results on the basis of data collected during sessions at the LHC. One of the brightest results was the discovery of the Higgs boson at the collider in CERN where Dubna physicists have made big intellectual contribution, according to the opinion of the world scientific community. The Central Information Computing Complex (CICC) of the Institute actively participates in tackling the tasks related to the LHC experiments and other scientific projects with large-scale calculations.

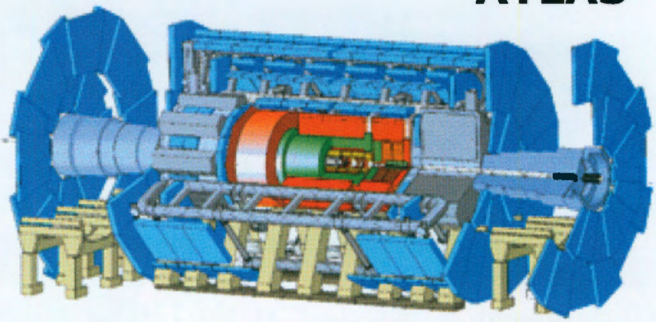
JINR has very good educational conditions for talented young scientists. The JINR University Centre annually organizes practical courses at JINR facilities for students from higher education insitutions of Russia and other countries. Physicists from emerging countries who work at JINR are provided with a scholarship.

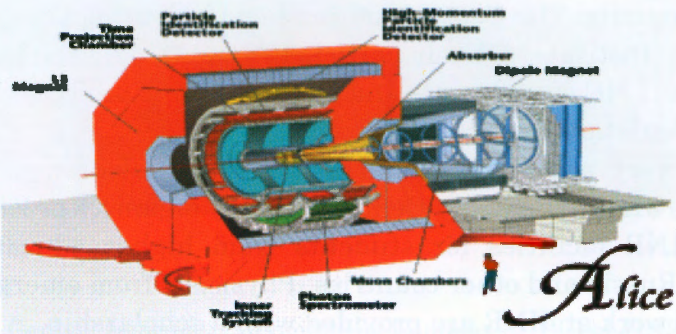
JINR involvement in the development of experimental facilities for the Large Hadron Collider (LHC)

CMS

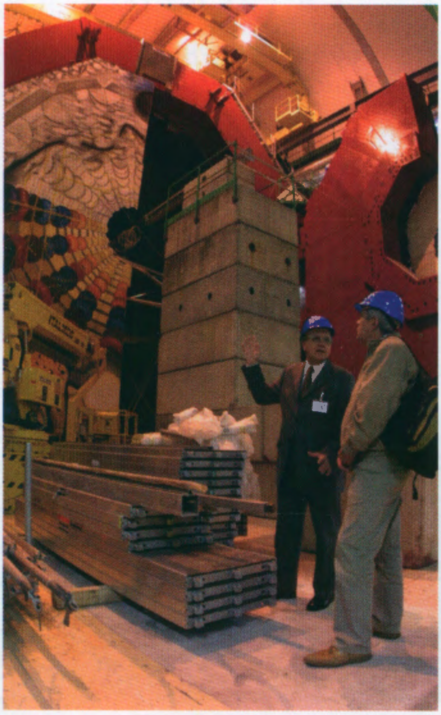


ATLAS





The ATLAS facility



The ALICE facility

The CMS Compact Muon Solenoid

Bench tests of the DC-72 cyclotron developed by JINR staff members for the Cyclotron Centre in Bratislava, the Slovak Republic

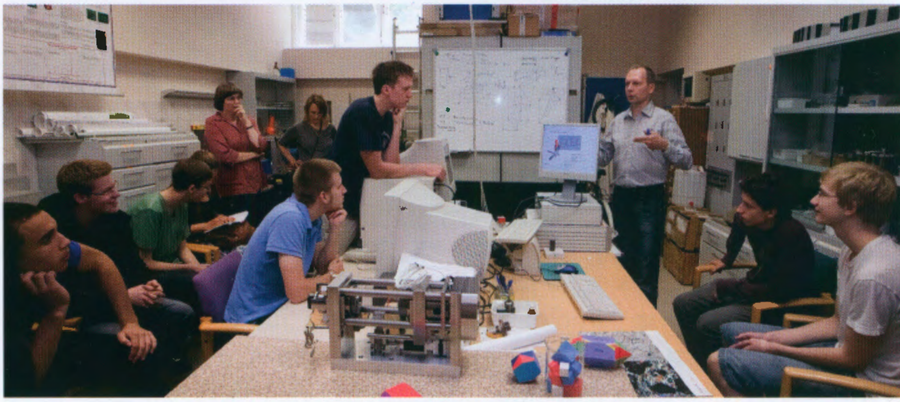
The DC-60 cyclotron developed at JINR for the Interdisciplinary Scientific Research Complex (ISRC) in Astana, Kazakhstan

Leading JINR scientists of world level are also teachers at the International University of Nature, Society and Man “Dubna”. The educational basis of the University is developed in the territory of JINR.

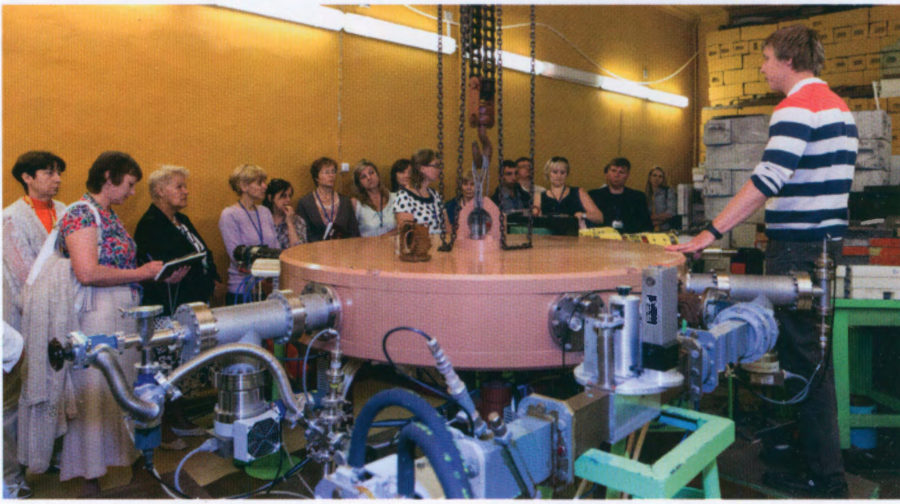
JINR researchers are constant participants of many international and national scientific conferences. In its turn, the Institute annually holds about 10 large conferences and more than 30 international workshops, as well as traditional schools for young scientists. Each year the Institute assigns more than 1500 scientific papers and reports written by about 3000 authors to the editorial offices of many journals and organizing committees. JINR publications are distributed in more than 50 countries in the world. JINR publishes the world known journals “Physics of Elementary Particles and Atomic Nucleus”, “Physics of Elementary Particles and Atomic Nucleus, Letters”, the annual report on JINR activities, the information bulletin “JINR News”, as well as proceedings of conferences, schools, and meetings organized by JINR.

40 discoveries in nuclear physics were made in JINR. The programme of studies of superheavy elements deserves special mentioning. Dubna scientists have synthesized new, long-lived superheavy elements with the atomic numbers 113, 114, 115, 116, 117 and 118. The decision of the General Assembly of the International Committee of Pure and Applied Chemistry to award the name “Dubnium” to element 105 of the D.Mendeleev Periodic Table and the name “Flerovium” to element 114 demonstrates the international recognition of the achievements of JINR's staff of researchers and their contribution to modern physics and chemistry. These challenging discoveries crowned 35 years of efforts taken by scientists from different countries in the search for the “stability island” of superheavy nuclei.

Participants of the international conference for young scientists "Modern Issues of Applied Mathematics and Informatics"



School students from a physics club (Berlin) at the Laboratory of Neutron Physics



Physics teachers from schools of Moscow at the Laboratory of Nuclear Reactions

Participants of the discussion meeting on development trends for JINR education programme

The international conference on the 105th anniversary of the birth of N.Bogoliubov organized by the JINR Association of Young Scientists and Specialists

The laureates of the annual competition for Dubna teachers for the JINR grant "Art of Teaching"

JINR is an organizer of international scientific schools, conferences and meetings

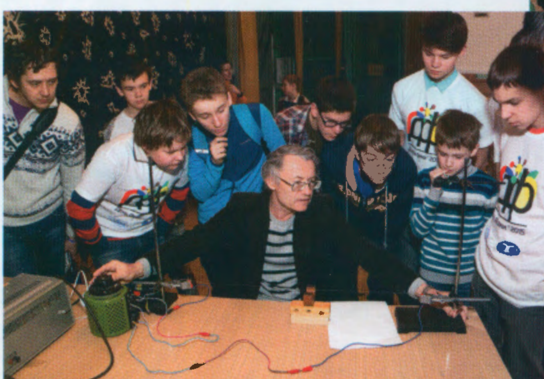

Строителей 2

The "Dubna" University of Nature, Society and Man

JINR-CERN School

Young scientists from JINR Member States on a visit to the University "Dubna"

CERN exhibition opening at JINR



Physics Days at JINR

Geneva, the Palais des Nations of the European UN office. A photoexhibition “Atom for Peace. The 40th anniversary of the Joint Institute for Nuclear Research in Dubna”

THE BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

The Laboratory of Theoretical Physics (LTP) is one of the largest in the world institutions of theoretical physics. The scientific programme of the laboratory includes research in the key fields of fundamental theoretical physics, i.e. quantum field theory and elementary particle physics, nuclear theory, condensed matter theory and the development of mathematical physics methods. The choice of theoretical fields of research at the laboratory was greatly influenced by outstanding scientists – D.Blokhintsev, N.Bogoliubov, M.Markov. The interrelations of modern mathematical physics, nuclear and particle physics with astrophysics and cosmology plays a growing role in the research.

The research topics in elementary particle physics at LTP are specified by physics programmes of international collaborations (the LHC, RHIC, FAIR, K2K, etc.) and JINR basic facilities, primarily, the NICA/MPD project.

The studies are focused on the precision checking of the Standard Model (SM), new physics beyond its borders, hadron structure and spin physics, phase transitions in hot and dense hadron matter and the mixed quark-hadron phase, neutrino physics, the dark matter problem and astrophysics aspects in elementary particle physics.

N.Bogoliubov (left) and D.Blokhintsev

An exhibition of science-and-technology publications in the laboratory hall

Participants of the International Workshop “Supersymmetries and Quantum Symmetries” in front of the LTP building


The All-Institute seminar on the results of the ICHEP conference


IN2P3-LTP JINR Workshop "Latest Advances in Nucleus Theory"


The Helmholtz international summer school "QCD in Lattice, Hadron Structure and Hadron Matter"

The following studies are also important in nuclear and heavy ion physics: exploring the structure of the nuclei that are far from the stability line; nuclear reactions; few-body systems; heavy ion interactions at intermediate and high energies. In the frames of these studies, new methods that exceed the limits of the mean field and random phase approximations are evolved, together with new strict approaches in the theory of nuclear reactions, models and methods of description of the nuclear matter state equation.

Theoretical research in condensed matter physics is aimed at the support of experimental studies of the characteristics of various modern nanomaterials and nanostructures. Special attention is paid to the analysis of the systems with strong electron correlation, to the studies of new cooperate phenomena, new types of ordering, magnetism in low-dimension systems and quantum critical phenomena.

The research at LTP is interdisciplinary; it is directly integrated into international projects and is closely coordinated with JINR experimental programmes.

As an educational centre for young scientists and students from many countries, LTP has widened its traditional activities in this sphere, having implemented the scientific-educational project "Dubna International School on Theoretical Physics (DIAS-TH)" and opened new chairs of theoretical physics of the Moscow Physical-Technical Institute and the International University "Dubna", closely cooperating with the University Centre (UC) of JINR.

The structure, the level and the style of the scientific and educational work of the laboratory are in tune with the tasks and challenges in the modern theoretical physics.

THE VEKSLER AND BALDIN LABORATORY OF HIGH ENERGY PHYSICS

The scientific activities of the laboratory are concentrated on the following trends of research: heavy ion physics at high energies, spin physics, as well as urgent issues of elementary particle physics related to checking of the Standard Model (SM), search for new physics beyond the SM borders and CP-violation.

The studies are conducted both at “home” accelerator facilities and in the largest accelerator centres: CERN, BNL, GSI, and others.

The laboratory staff members contribute much to joint research at the experimental facilities COMPASS, NA61, NA62, STAR, CMS, ALICE, ATLAS, HADES, and many others.

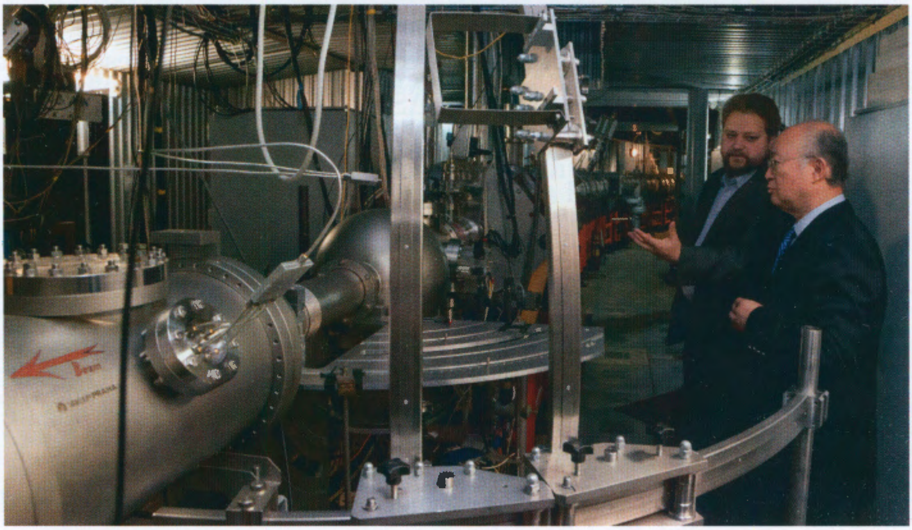
A project was designed and has been under way of an accelerator complex at the laboratory. The complex includes the upgraded accelerator Nuclotron-M, a booster and the heavy nuclei collider NICA. Two collider facilities are being developed – MPD (Multi Purpose Detector) and SPD (Spin Physics Detector), as well as the set-up BM@N (study of Baryonic Matter at the Nuclotron) to investigate beams extracted from the Nuclotron.

The main aim of the NICA project is to conduct experimental research in extreme states of hadron (strongly interacting) matter

V.Veksler

A.Baldin

The building of the Synchrophasotron – the Nuclotron



IAEA General Director Yu.Amano at the Nuclotron

The booster dipole magnet test in the frames of the NICA project

The Prototype of the time projection chamber TPC for the MPD NICA

in the domains of phase transitions. The research will be conducted at the interacting ion beams in the range of 4-11 GeV/n, at the polarized proton and deuteron beams (with longitudinal and transverse polarization), as well as at extracted ion beams, and polarized proton and deuteron beams.

The laboratory staff members are the authors of distinctive ideas to solve problems in accelerator techniques and technology of superconducting magnets that have been acknowledged and developed in largest accelerator centres of the world. The laboratory specialists are well-known for their elaborations of detector equipment. They made a considerable contribution to the development of experimental facilities at CERN, BNL, GSI. Now, in collaboration with leading specialists from these centres, they design detector systems for set-ups of the NICA complex, FAIR and the LHC facilities' upgrade.

It is planned to establish a multi-access centre in the frames of the joint RF-JINR megaproject NICA to conduct research in relativistic nuclear physics and innovative and applied studies, employing unique beams of relativistic ions that are provided by the accelerators of the complex. The massive innovation potential is in the use of unique beams of the Nuclotron and the booster in radiobiological research and electronics testing, for the tasks to check the conditions for living organisms and equipment in strong space radiation. Facilities and new methods of ray therapy are developed for the medical-biological studies and treatment of oncological diseases.

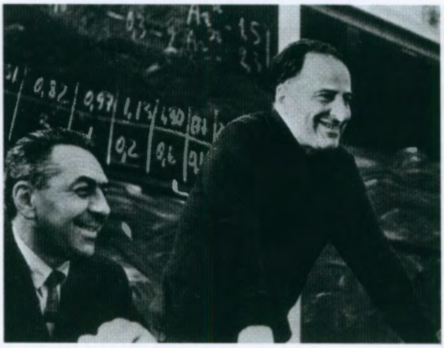
The studies in the frames of the programme "Energy and Transmutation" are characterized as highly potential. They are aimed at the work-out of methods to rehandle (deactivate) nuclear energy industry wastes using accelerators, and the solution of the issue of electro-nuclear facilities' development.

THE DZHELEPOV LABORATORY OF NUCLEAR PROBLEMS

The Laboratory of Nuclear Problems (LNP) is mainly occupied with the research in neutrino physics and astrophysics. Other important trends are the studies in particle physics at high and superhigh energy, design and development of modern measuring equipment, applied research, in particular, proton therapy and development of a medical accelerator complex.

Research in neutrino properties is a traditional direction at LNP, established by Bruno Pontecorvo. The experiments of first priority are the projects “Baikal” and DANSS at the Kalinin NPS. The neutrino telescope at Baikal is a part of an integrated neutrino research net that allows global monitoring of all interplanetary space. The project DANSS is aimed at the development of a compact neutrino spectrometer that does not contain any dangerous liquid and can be positioned very close to the operation area of an industrial atomic reactor.

LNP scientists take part in world-class experiments to study the process of the double neutrinoless beta decay (SuperNEMO, GERDA-MAJORANA), neutrino oscillations (Daya Bay/JUNO, NOvA, OPERA). At the Kalinin NPS experiments in the measurement

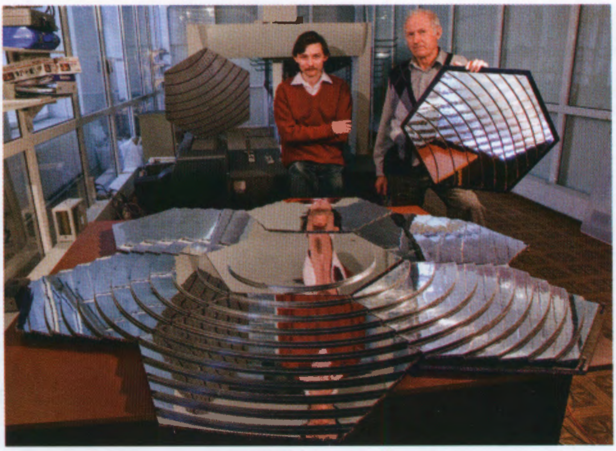


V.Dzhelepov (left) and B.Pontecorvo

M.Meshcheryakov

Laboratory staff members involved in the remedial work at the Phasotron

A meeting on the discussion of the JINR neutrino programme



The full-scale Fresnel mirror of the TUS detector

Assembling a string of optical modules for the Baikal-GVD neutrino telescope

A patient aided by LNP young specialists to get ready for a beam therapy session

of the neutrino magnetic moment, search for sterile neutrino, direct measurements of antineutrino from the reactor and studies of coherent neutrino scattering are held (GEMMA, DANSS, vGeN).

Another trend of studies at LNP is the search for rare and/or prohibited processes. The laboratory specialists take part in experiments that have maximal sensitivity to new physics, such as search for radiation decay into electron and photon (the MEG project) and search for muon-electron conversion on nuclei (the projects MU2E, COMET). LNP physicists are involved in the studies of high energy space rays, in experiments of the search for dark matter (the projects "Baikal", TAIGA, EDELWEISS). Staff members of the laboratory have obtained physics results of fundamental value at the LHC collider in the ATLAS experiment.

The activities in the development and upgrading of the Phasotron are very important for physics and applied research, designing of semiconductor, scintillation and cryogenic detectors and development of new generation detection systems. LNP physicists take part in upgrading of cyclotrons both in Russia and abroad (Poland, Serbia, Japan). Specialized cyclotrons for radiological medicine are under elaboration: for hadron therapy and acquisition of PET-isotopes (Isotopes for positron-emission tomographs).

A Medical-Technical Complex (MTC) has been developed and operates on the basis of the Phasotron. The technique of the 3D conformal proton irradiation of deep located tumours has been implemented here for the first time in Russia. With this method, the maximum of the generated dose distribution most precisely corresponds to the target shape that makes it possible to treat oncological patients with various neoplasms very effectively. Over the last few years about 100 patients annually have taken the MTC proton beam treatment.

THE FLEROV LABORATORY OF NUCLEAR REACTIONS

The scientific programme of the laboratory includes experimental research in the synthesis and studies of nuclear physics and chemical properties of new superheavy elements, fusion and fission reactions and multi-nucleon transfer in heavy-ion collisions; studies of the properties of nuclei on the border of the nucleon stability and mechanisms of nuclear reactions with accelerated radioactive nuclei; studies of interaction of heavy ions with various materials (polymers, semiconductors, electronic components of space equipment, etc.).

Six new heavy elements with the atomic numbers 113-118 have been synthesized for the recent years, along with about 50 new isotopes of transactinoid elements. The existence of "the stability island" of superheavy elements with the centre near Z = 114 and N = 184 has been for the first time directly testified in experiments.

The year 2012 was marked with a significant event – the joint committee of the International Unions of Pure and Applied Chemistry (IUPAC) and Pure and Applied Physics (IUPAP) officially acknowledged the priority of the Russian-American group of scientists in the discovery of new superheavy elements of the D.Mendeleev Table – 114 and 116 – at the accelerator complex of the Laboratory of Nuclear Reactions (LNR) of JINR. These elements are named flerovium – in honour of the laboratory and its founder Academician G.Flerov –

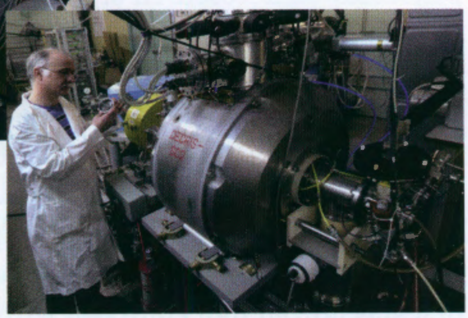
G.Flerov

Yu.Oganessian

Participants of the experiment to study the chemical properties of element 115

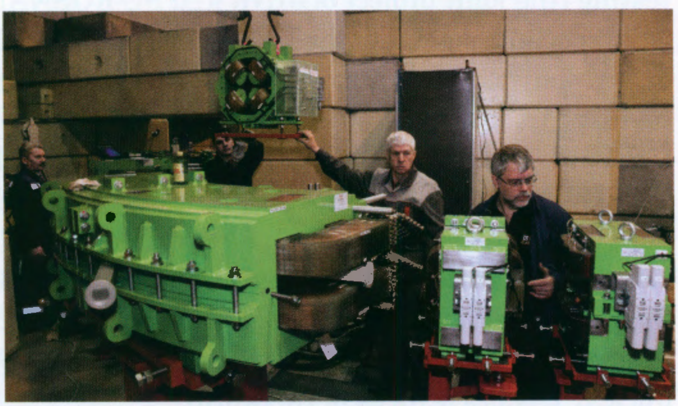
The experimental facility MASHA

Adjustment of the detecting equipment at the set-up VASSILISSA



Superconducting magnetic system for the ECR source

Assembling the equipment for the ACCULINNA separator delivered from France



and livermorium – in honour of the Lawrence Livermore National Laboratory and the city of Livermore (USA).

The studies of chemical properties of superheavy elements with Z = 112, 113 and 114 have been successfully developing. In particular, it was discovered that element 112 is a heavier homolog of Zn-Cd-Hg in its chemical properties, i.e. it is referred to group 12 of the D.Mendeleev Periodic Table.

In the frames of the seven-year plan of the development of JINR, the first priority project of the laboratory is the DRIBs-III project that includes the development of "the factory of superheavy elements" on the basis of the new accelerator DC-280 which is aimed at obtaining high intensive (10-20 pμA) ion beams of average mass (Ca-48, Ti-50, Ni-64, etc.) for further development of studies on the synthesis and research of properties of superheavy elements. The development of the project implies the upgrade of the accelerator complex for radioactive beams on the basis of the cyclotrons U-400 and U-400M that will serve the purpose of obtaining monochromatic beams of radioactive and stable nuclei.

Applied research at LNR is connected with studies in the field of nanotechnology, radiation resistance of materials, surface modification. Their further progress is connected to the development of a specialized hall equipped with modern devices for analysis and testing (the joint project of JINR and SC ROSNANO).

A special issue in applied research at LNR is the construction of heavy ion accelerator complexes for industrial production of track membranes: the DC-60 cyclotron for Eurasian State University (Astana, Kazakhstan); the DC-110 cyclotron for the company NANOKASKAD in the Special Economic Zone "Dubna". Over the last few years the amount of experiments on testing electronic components has considerably grown for the purposes of the Federal Space Agency (Roskosmos). This research is conducted in wide international cooperation with JINR Member States and leading nuclear physics centres of the world.

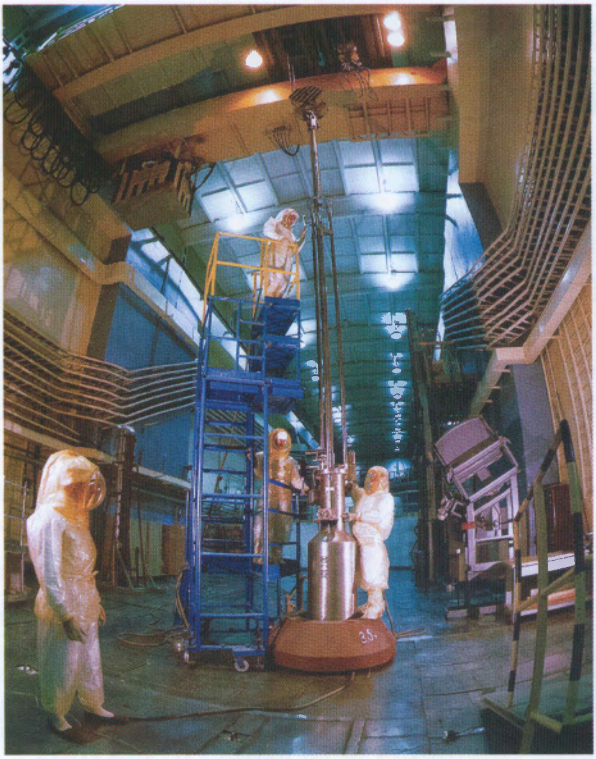
THE FRANK LABORATORY OF NEUTRON PHYSICS

An ambitious comprehensive scientific programme of studies of the neutron as an elementary particle and its application in nuclear physics, condensed matter physics and other modern trends of applied research is developed at the Laboratory of Neutron Physics (LNP).

The main topics in nuclear physics are the following: studies of neutron properties and physics of ultracold nuclear reactions under the action of neutrons, fundamental, applied and methodical research, elaboration and development of neutron and other ionizing radiation detectors.

The fundamental and applied research in condensed matter physics conducted at the laboratory is aimed at the studies of the structure and dynamics of condensed matter, structural-optical properties, morphology of the condensed matter surface, accumulation of new data on microscopic properties of the studied systems (strong correlated electron systems, low-dimensional systems, heterostructures, polymers, colloid systems, biological objects, nanomaterials, rocks, minerals, etc.), measurement of internal stress in 3D materials and products, experimental checking of theoretical predictions and models, discovery of new regularities.

The main basic facility of the laboratory is the IBR-2 pulsed reactor on fast neutrons that after upgrading keeps its parameters



I.Frank

The IBR-2 reactor hall

F.Shapiro

The IBR-2 reactor personnel in the control room

A test bench of the cryogenic neutron moderator of IBR-2

The International School "Instruments and Methods in Experimental Nuclear Physics. Electronics and Automatics of Experimental Facilities" on the world-class level and is the only facility of such class in the world.

The reactor is equipped with a spectrometer complex that allows a wide range of research in topical trends of nuclear physics and condensed matter physics. A wide user-friendly programme at the spectrometer complex of IBR-2 provides all interested scientists (physicists, chemists, biologists, geologists, specialists in material science) with user time on the competitive basis to obtain opportunities to use the spectrometers and get high qualified support of leading specialists of the laboratory.

The programme of the IBR-2 spectrometer complex development includes the provision of the efficient operation of the equipment, elaboration of experimental methods and the development of new modern facilities intended for farsighted trends of research.

At present, a new JINR basic facility of the laboratory – the resonance neutron source IREN – is prepared to achieve its design parameters. IREN is intended to solve a wide range of tasks in fundamental and applied nuclear physics. The facility is designed for research in nuclear physics with the time-of-flight method in the neutron energy range up to dozens keV and studies of photonuclear reactions.

In the frames of the TANGRA project (TAgged Neutrons&Gamma RAys) the application of the method of tagged neutrons is studied, with a neutron generator ING-27 with a built-in detector of alpha particles and the multidetector system “Romashka” of 24 NaI(Tl) scintillation counters. Applied research to develop this method of non-destructive elemental analysis and fundamental experiments to study interaction of fast neutrons with nuclei are held.

The Laboratory of Neutron Physics of JINR successfully cooperates with the RAS Institute of Space Research in the field of design and development of neutron, gamma-quanta and charged particles' detectors for spacecrafts. High energy neutron detectors HEND and LEND successfully operate at the orbiters of NASA; the device DAN is included into the equipment set of the Mars Science Laboratory and operates on board the Curiosity rover.

THE LABORATORY OF INFORMATION TECHNOLOGIES

The main directions of the activities at the Laboratory of Information Technologies (LIT) are connected with the provision of networks, computer and information resources, as well as mathematical support of a wide range of research at JINR in high energy physics, nuclear physics, condensed matter physics, etc.

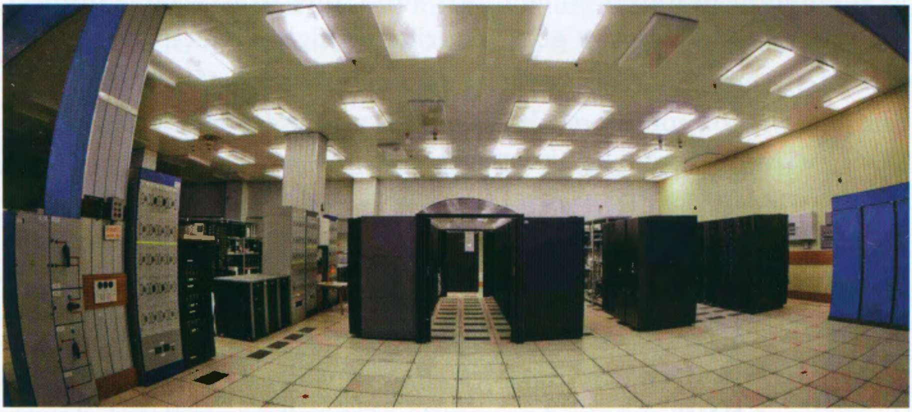
LIT activities in network, computer and information resources includes the following tasks: provision of the Institute and JINR Member States with high-speed telecommunication channels; development of a high-speed, fail-safe and protected computer network at JINR; support of the distributed high-productive computer infrastructure and mass memory system; provision of informational and software support of the scientific and industrial activities of the Institute; development of the enterprise information system: elaboration of the JINR grid-segment and its introduction into the world grid-structure.

LIT possesses a fast communication channel "Dubna-Moscow" on the basis of the DWDM technology with starting capacity of 20 Gbit/s. The JINR core network that overlaps all laboratories and divisions of JINR in a single computer network is constructed with the Gigabit Ethernet technology, with data transfer speed of 10 Gbit/s.


M.Meshcheryakov


N.Govorun


Opening of the data processing and storage centre of the Tier-1 level for the CMS experiment at the LHC CERN


The CICC of JINR. New supercomputer farms extend the computing capability of the Dubna Grid-cluster

A group of the laboratory staff members

Equipment adjustment

The International Conference "Mathematical Simulation and Computer Physics"

The JINR Central Information Computer Complex (CICC) is the core of the computer infrastructure of the Institute. CICC JINR has powerful high-productive computer resources that are integrated into the world computer networks by means of the high-speed communication channels.

The Institute grid-segment developed on the CICC basis is an important element of the RDIG (Russian Data Intensive Grid), WLCG (Worldwide LHC Computing Grid) and EGI (European grid-infrastructure). It provides support for virtual organization of international projects, including those at the LHC. Over 5 million tasks are solved annually at CICC JINR. Computing environment and data storage systems are controlled by the basic software that allows the use CICC resources in both international projects for distributed calculations (ATLAS, ALICE, CMS, PANDA, CBM, BES, NICA/MPD, etc.) and “home” research by JINR users.

A centre of the Tier-1 level is developed on the basis of CICC JINR for the CMS experiment (LHC). The Tier-1 centre will be used as a part of global system of experimental data processing, as well as handling the data of events' simulation that arrives from the centre Tier0 (CERN), and the centres Tier-1 and Tier-2, the global grid-system WLCG for the experiment CMS.

Today LIT JINR works actively to integrate the distributed calculations system for the solution of large-scale tasks using the Big Data Technology. A cloud infrastructure is developed at the laboratory that provides users with cloud services. A distributed training research grid-infrastructure is developed at LIT to educate students and specialists that is represented by popular modern techniques of distributed calculations.

A heterogeneous cluster «HybriLIT» is introduced into CICC JINR to conduct calculations with parallel programming technology.

Mathematical support of experimental and theoretical research conducted with direct JINR involvement includes research on the advanced level in computational mathematics and physics. The aim of these studies is the development of mathematical methods, algorithms and programmes for numerical and symbol-numerical simulation of physical processes, experimental data processing and analysis with the latest computational hardware.

THE LABORATORY OF RADIATION BIOLOGY

The main research trends at the laboratory are: radiation genetics and radiobiology; radiation physiology and neurochemistry; mathematical modeling of biophysical systems; astrobiology; physics of radiation protection and radiation research at JINR facilities for nuclear physics.

The Laboratory of Radiation Biology (LRB) was organized in 2005 on the basis of the JINR Division of Radiation and Radiobiological Research. The laboratory structure includes the departments of radiobiology and radiation research and a sector of astrobiology. In 2008 an important decision was taken on scientific-advice guidance of the laboratory from the side of the RAS Department of Biological Sciences.

Owing to a wide range of radiation sources at JINR, LRB can rightly be regarded as a leader among other scientific organizations of Russia and JINR Member States in the studies of regularities and mechanisms of biological action of ionizing radiation with various physical characteristics.

Using nuclear physics facilities of the Institute, the laboratory staff members are able to obtain unprecedented data of fundamental character and wide application.

V.Korogodin

E.Krasavin

Radiation monitoring at JINR facilities

Laboratory staff members conduct radiobiological research

A round-table discussion “Topical Problems of General and Space Radiobiology and Astrobiology”

LRB specialists do sampling of the water from the Volga river

The joint JINR-IMBP experiment at the Nuclotron beam

An international research programme in radiobiology is implemented at the laboratory. It includes studies of different aspects of the action of heavy charged particles on the molecular, cell, tissue, organ and organism levels of biological organization. Important research also comprises studies on disturbances in the central nervous system (CNS) of experimental animals as it is necessary to regard CNS a "critical" system when evaluating the risks of radiation exposure of human organism in long inter-planet space flights outside the magnetosphere of the Earth.

A new trend of research is developed at the laboratory – astrobiology which is very popular in the world now. Astrobiological research is conducted in collaboration with specialists from universities of Italy onthe synthesis of prebiotic compounds from formamide in proton irradiation in the presence of catalyzers obtained from meteorites of different classes. Studies are held of biogeochemical character of space dust; of the traces of microorganisms' life activity in meteorites and early terrestrial rocks; of the research of space substance with nuclear physics methods.

The Laboratory of Radiation Biology cooperates with scientific institutions from JINR Member States and other countries: Armenia, Belarus, Bulgaria, the Czech Republic, Egypt, Germany, Great Britain, Hungary, India, Italy, Japan, Moldova, Mongolia, Poland, Russia, Slovakia, Ukraine, and Vietnam.

For over 20 years the chair of biophysics of the International University "Dubna" has been functioning on the basis of the laboratory. It trains radiobiology specialists. Its graduates can continue their education at the post-graduate courses in the speciality "Radiobiology".

THE UNIVERSITY CENTRE

The JINR University Centre (UC) was established in 1991 to implement the educational programme of the Institute that is aimed, primarily, at training high-quality young specialists for research at JINR and scientific centres of the Member States. The main efforts are directed to implement the concept of "the continuous education" school – university – research centre. With this purpose, favourable conditions for students and post-graduates are established and improved to enable them to take part in the research in scientific groups of the Institute.

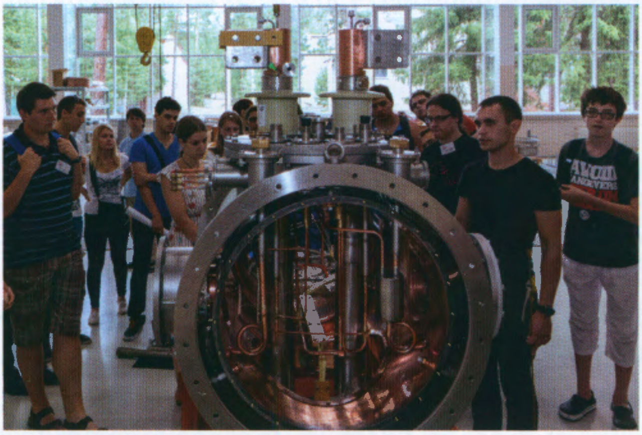
Annually, above 400 senior students and post-graduates from universities of JINR Member States have training and practice courses under the guidance of leading scientists of the Institute. A big amount of applications for the courses encourages the administration to invite most gifted young people to work later at JINR.

The UC internet site (uc.jinr.ru) is regularly updated in the contents of the training courses on particle physics and quantum field theory, mathematical and statistical physics, condensed matter physics, physics of nanostructures and neutron physics, nuclear physics, physical facilities and information technology.

It is considered a good approach to organize international student practice courses in research trends of JINR and a new summer student programme to attract talented young people to

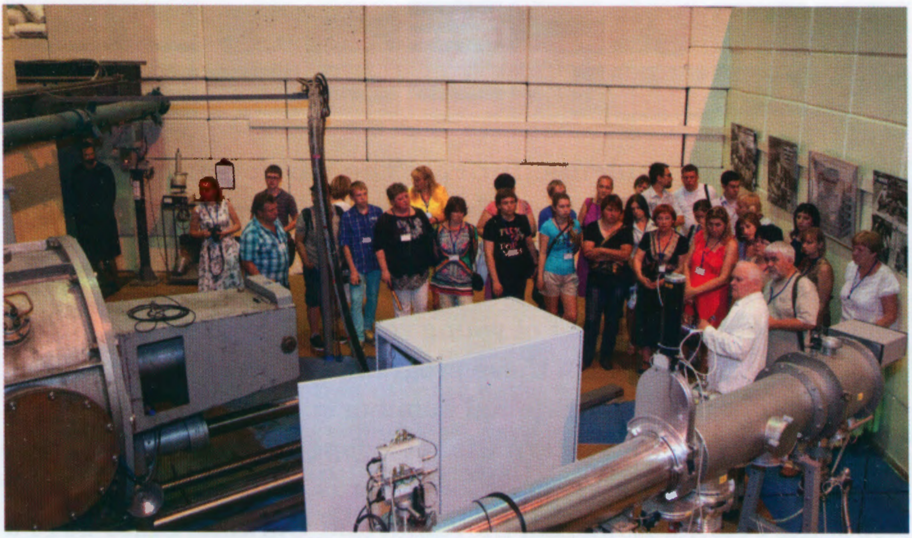
S.Pakulyak (centre) with students from Egypt

S.Ivanova



Students from European countries – participants of the international practice in JINR research trends

Members of the international student practice from RSA



The Annual JINR-CERN scientific school for physics teachers from JINR Member States held in Dubna (top) and Geneva (bottom)

the Institute (students.jinr.ru). The participants of these programmes listen to lectures by leading scientists and specialists of JINR and do academic research projects in scientific laboratories of the Institute. The constant growth of the applications number demonstrates big interest of young scientists from JINR Member States in participation in these programmes. The UC is the direct organizer of these international summer scientific schools.

In the frames of international cooperation close ties are maintained with universities of Belarus, Bulgaria, the Czech Republic, Poland, Romania, Slovakia, and Ukraine. Since 2014 a programme has been started for students and post-graduates of JINR Member States that makes it possible for them to take part in fundamental and applied research in scientific centres of the Czech Republic.

JINR and CERN organize annual scientific schools for teachers of physics from JINR Member States (site "Virtual academy of high energy physics", http://teachers.jinr.ru).

The Engineering Research Team has been organized on the basis of the UC to implement educational programmes to train engineers-physicists at operating modern facilities and at those that are under construction, along with a department for elaboration and development of educational programmes.

A complex of university laboratories is developed at JINR to train physicists for the basic chairs of JINR and "Dubna" University. It is equipped with modern accessories and unique facilities. Laboratory practice classes are held here in atomic physics, optics and molecular physics. A university laboratory for nuclear physics studies is also launched.

The UC is equipped with modern facilities to hold video conferences for meetings of JINR and CERN scientists with students from JINR Member States.

The UC also organizes training courses and skill improvement for workers, engineers and office employees.

JINR TOMORROW

In modern conditions the Institute aims to consolidate and develop its key positions. Fundamental science, innovations and educational activities are the basis for it. The activities in upgrading of the existing facilities and construction of new basic machines at JINR, "home" experiments and involvement in large international partnership programmes with CERN (Switzerland), GSI (Germany), FNAL and BNL (USA) and other scientific centres have high priority.

The experimental base of JINR gives the opportunities to conduct not only advanced fundamental research but also applied studies in the field of condensed matter physics, biology, medicine, material sciences, geophysics, engineering diagnostics that are focused at research of structure and properties of nanosystems and new materials, biological objects, at elaboration and development of new electronic, bio- and information technologies.

The concept of further development of JINR as a multidisciplinary international centre for fundamental research in nuclear physics and related fields of science and technology implies efficient use of the theoretical and experimental results, as well as methods and applied research at JINR in the sphere of high technology through their application in industrial, medical and other technical development. It will provide fundamental research with additional sources of financing and allow opening new workplaces. To develop fundamental research, the Institute will continue studies in theoretical subjects, computer science and networks, methods of new equipment development and will further organize young staff policy.

For over 20 years, JINR has been participating in the accomplishment of the programme to establish an innovation "belt" around Dubna. In 2005 the RF government signed the Resolution "On the establishment of a special economic zone of the technical-innovation type in the territory of the Dubna city". The specific character of JINR has been reflected in the aims of the Special Economic Zone (SEZ): nuclear physics and information technologies. The technical-innovation zone develops in cooperation with colleagues in science – scientific centres of RAS and Rosatom, as well as partners in industry and business.

One of the central segments of the right-bank part of SEZ is the multi-access centre in nanotechnology – the International Innovation Centre for Nanotechnology (IICN) of the CIS and Europe countries in Dubna. This is an instrument to integrate innovation activities into the global international system attracting the coutries – JINR participants and partners.

Representatives of the highest levels of RF power visit JINR on many occasions and each time they stress the importance of fundamental science as the basis for the development of scientific research infrastructures, facilities of the "mega-science" class, the necessity to develop innovative economy, the principal significance of attracting young people to science and adapt education to the innovative system.

The Joint Institute for Nuclear Research has embraced the 21st century as a large multidisciplinary international scientific centre. Its history is rich in bright events, world-scale discoveries and is part and parcel of the history of life of a whole generation of scientists, engineers and workers. It is due to their professional skills, enthusiasm and faithfulness to science that the Joint Institute in Dubna has become world wide famous. In the continuous scientific quest to achieve outstanding results it managed to educate a new generation of talented youth.

High professionalism, concentration on major tasks in science, education, innovation, together with development of scientific and social infrastructure that provide further progress, will enable the scientific community of the Institute to maintain the leading position and accomplish new tasks in future.

A meeting of the state board on high technology and innovation

The Special Economic Zone "Dubna"

D.A.Medvedev on a visit to JINR

V.V.Putin on a visit to JINR

RF Minister of Education and Science D.Livanov on a visit to JINR

Head of the RF State Corporation "ROSATOM" S.Kirienko
on a working visit to JINR

DUBNA – THE SCIENCE CITY

In 2001 Dubna, where the Joint Institute for Nuclear Research is located, was officially conferred the status of a science city.

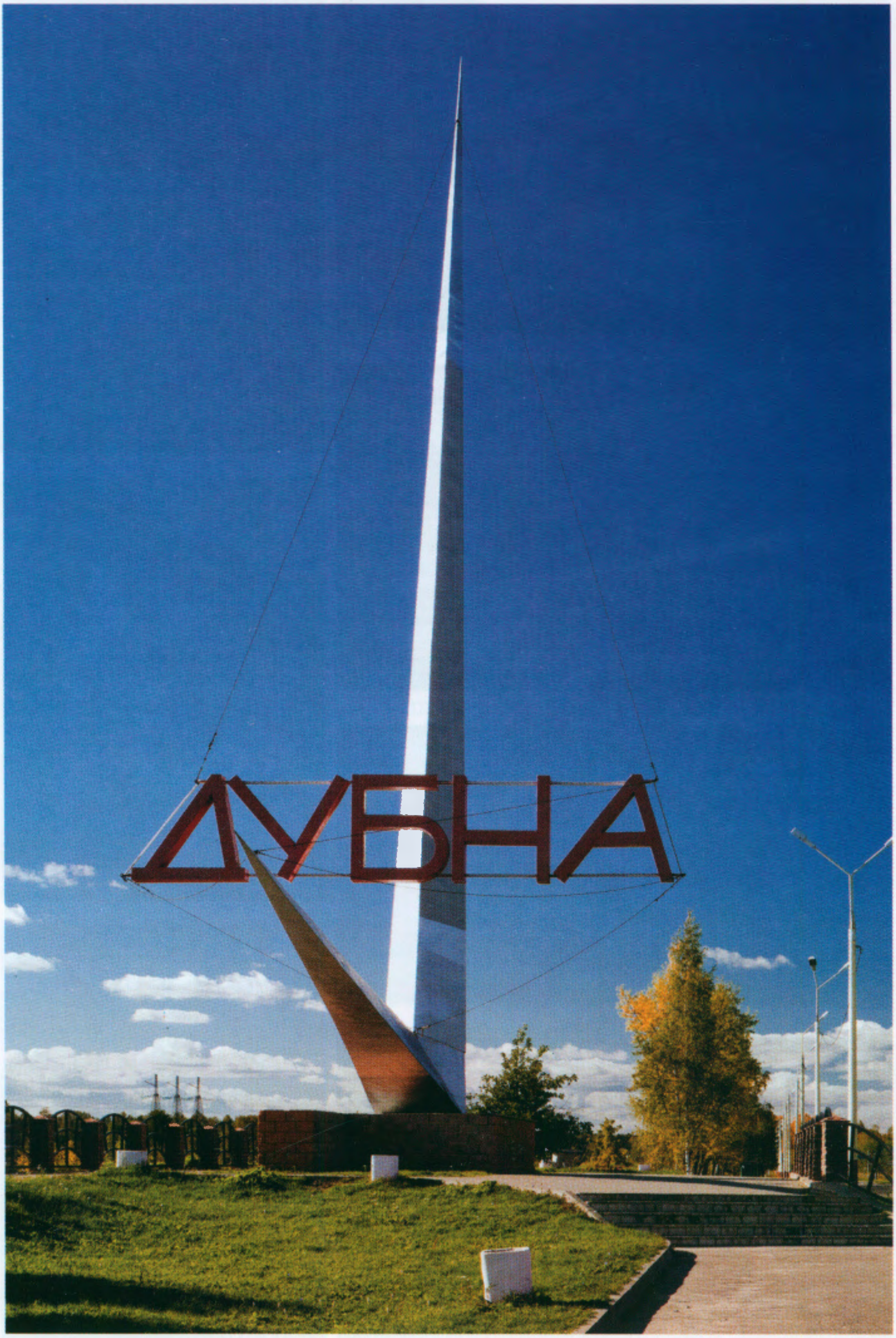
A small town founded during the construction of two research laboratories in the late 1940s and urban areas of Bolshaya Volga and Invankovo were transformed into a city called Dubna. It happenned in July 1956, namely, a few months after the establishment of the Joint Institute for Nuclear Research – the first international scientific centre in the Soviet Union, which has become world-known because of its huge experimental facilities and precision devices that make it possible to obtain unique data on the structure of matter and interaction forces in Nature.

Dubna is a unique city of science, with a special intellectual atmosphere characteristic for an international scientific centre. Since its establishment, the city has won the hearts of those who arrive here. Among Dubna's guests were Frederique Joliot Curie and Nils Bohr, Arkadij Raikin and Emil Guilels, Andrej Voznesensky and Bella Akhmadulina,Yulij Kim and Vladimir Vysotsky. Outstanding physicists worked here: A.Baldin, D.Blokhintsev, N.Bogoliubov, V.Veksler, V.Dzhelepov, M.Meshcheryakov, B.Pontecorvo, G.Flerov, and I.Frank. Today Dubna streets bear their names.

Dubna is a modern city which develops dynamically and still attracts scientific youth of Russia and other countries. Here scientists speak different languages; they have come to Dubna to continue their research started at home or to take part in international scientific symposia, conferences and seminars held for the cause of generation of new ideas and discoveries.

The city of Dubna is situated on the banks of the Volga river. In May, the alley with apple trees on the embankment is one of the most beautiful places in the city. In summer, quiet and nice Dubna hides in greenery; flower beds and lawns line its central avenues and the embankment. Dubna is often called a resort, a city in a pine forest. It is a marvelous place to combine work and relaxation in any season of the year!

Welcome to Dubna!


ДУБНА

JOINT INSTITUTE FOR NUCLEAR RESEARCH

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