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Physics

Joint Institute for Nuclear Research – Yesterday, Today, Tomorrow

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ABSTRACT. The present review article is based on the Report by JINR Director Alexei Sissakian at the Ceremonial Meeting of the JINR Committee of Plenipotentiaries and Scientific Council dedicated to the 50th Anniversary of JINR on 26 March 2006. © 2007 Bull. Georg. Natl. Acad. Sci.



26 March 2006 marks the 50th birthday of the Joint Institute for Nuclear Research. It can be stated with confidence on this occasion that the experiment, unique in its conception and scale, which started half a century ago to establish this international physics centre, has proved to be a success. Bright and irrefutable evidence of it is the fact that the ideas and goals which formed the basis for JINR activities in the mid-1950s have withstood the test of time, including political upheavals and the severe economic crisis of the 1990s. The Socialist camp which actually fathered the Institute has disintegrated: the Council for Mutual Economic Assistance (COMECON), the Warsaw Pact and the USSR no longer exist, while the Institute has not only managed to survive but is dynamically developing.

In this way, the example of JINR as an international model of cooperation among scientists has demonstrated to the world the irresistible power of scientific knowledge and the unparalleled bonds that unite men of science.

We remember and treasure in our memory the remarkable pleiad of scientists and organizers of scientific research to whom we are obliged for the establishment of JINR based on two Soviet research institutes. The year 1946 can be regarded as the starting point of the formation of scientific Dubna, when, on the initiative of I. Kurchatov, the government of the Soviet Union took a decision to build, near the village of Novo-Ivankovo, a proton accelerator – the Synchrocyclotron for an energy

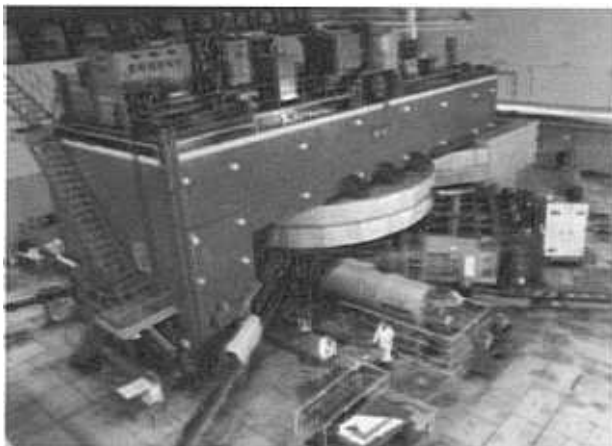
of 680 MeV. This project was implemented in record time, and the accelerator was successfully launched by the end of 1949.

The first research centre established in the village of Novo-Ivankovo was the Hydrotechnical Laboratory of the USSR Academy of Sciences (a branch of Laboratory No.2 of the Russian Academy of Sciences headed by I. Kurchatov). Its Director and Deputy Director were M. Meshcheryakov and V. Dzhelepov. In 1953 it was renamed as the Institute of Nuclear Problems of the USSR Academy of Sciences.



In the early 1950s, one more laboratory was established in the same area. It was the Electrophysical Laboratory of the USSR Academy of Sciences (EFLAN) where work was started to construct a new accelerator with unique parameters at that time – the proton Synchrophasotron with an energy of 10 GeV. These activities were headed by V. Veksler, with vigorous support of both the Academy of Sciences and the atomic industry of the Soviet Union.

It was by the mid-1950s that the world scientific community came to the conclusion that large nuclear physics projects should be organized internationally as the development of giant accelerators required joint economic and intellectual efforts. The international character in this context was regarded as the only reliable guarantee of peaceful uses of the achievements of nuclear science.



Synchrocyclotron

As a result, the European Organization for Nuclear Research (CERN) was established in 1954 near Geneva, and a year and a half later, initiated by the government of the USSR, the East European block took a decision to establish the Joint Institute for Nuclear Research. The same year, in 1956, the small scientific town of JINR together with the village of Bolshaya Volga was reorganized into a city which was christened as Dubna.

“Science is necessary to people. A country which does not develop it turns inevitably into a colony”.

The author of this epigraph is the outstanding French physicist Frédéric Joliot-Curie, who like many other famous scientists, visited Dubna on numerous occasions.

A special role in the formation of the Institute was played by its first directors – the outstanding scientists D. Blokhintsev and N. Bogoliubov. Nikolai Bogoliubov headed the Institute for about 25 years; he left us a great heritage — glorious traditions and classical works on physics, mathematics and mechanics.

The first period of the Institute’s development was also greatly influenced by such prominent scientists and organizers of scientific research from JINR Member States



26 March 1956, Moscow
Conference Hall of the Presidium
of the USSR Academy of Sciences

12 hours 45 minutes. The fourth session of the Academy meeting adopted “The final communique about the meeting concerning the issue of the organization of the Joint Institute for Nuclear Research”.

It reads: “... The Convention envisages the establishment of an international scientific research organization entitled «The Joint Institute for Nuclear Research» located in the USSR...”

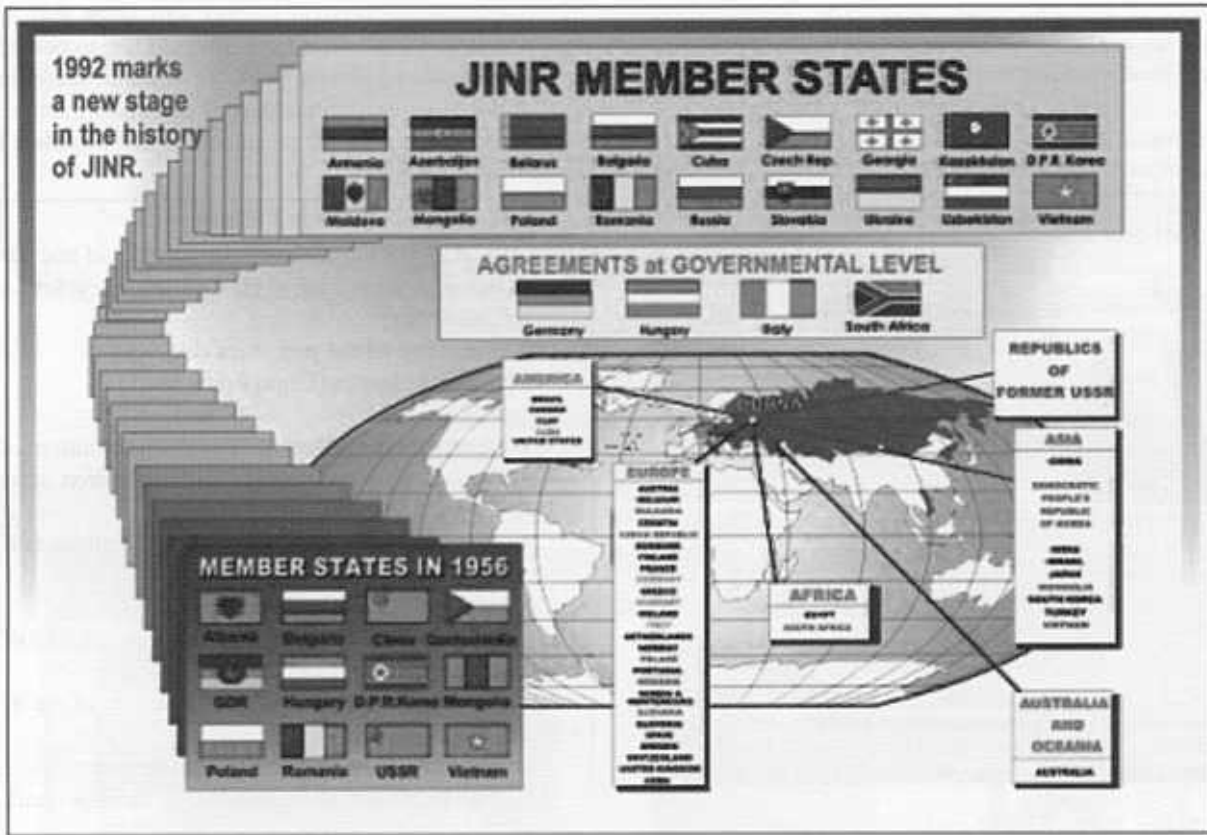
Science city Dubna

What it looked like in the 1950s



What it looks like today





Despite many difficulties, the Institute has kept on developing in recent years. Its international status was strengthened when a new membership of the JINR Scientific Council was formed to include outstanding scientists not only from the Member States but also from large physics centres of other countries.

An important factor in stabilizing the situation at the Institute was the signing of the agreement between JINR and the Government of the Russian Federation which was ratified in 2000. The agreement confirms the legal guarantees which correspond to the generally accepted international norms. Thus, it can be affirmed that JINR today is a truly international project in the territory of Russia.

The problems of that period were overcome owing to the highest quality of scientific research, the extensive international cooperation and the dedicated work of the Institute's international staff. I would like to emphasize the special role played by Vladimir Kadyshevsky who was successfully leading the Institute during that difficult period of time.

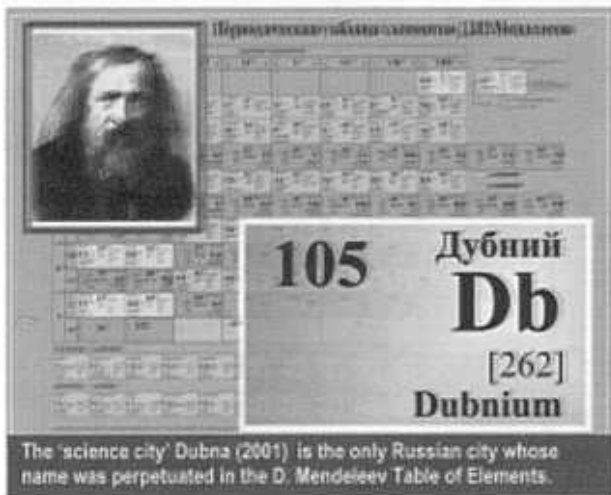
I wish also to express my gratitude to the members of the Committee of Plenipotentiaries, the Financial Committee, the Scientific Council and the Programme Advisory Committees of JINR for their continued scientific and moral support. It is very important that in 2003 the Scientific Council approved the 7-year scientific programme of the Institute's development. The JINR



The Scientific Council, established by the Committee of Plenipotentiaries on 17 March 1993

Committee of Plenipotentiaries and the Financial Committee have accomplished a large amount of work to stabilize our economic position.

Dubna physicists have obtained many first-class results. More than 40 discoveries in nuclear physics, particle physics and condensed matter physics have been made at JINR laboratories. The Institute scientists have received prestigious academic and state prizes.



Many fundamental studies conducted by Dubna theoreticians are acknowledged as classical. The schools on theoretical physics established by N. Bogoliubov, D. Blokhintsev, and M. Markov enjoy international recognition. Each of the developed scientific themes is a bright page in the history of science. In recent years, our theoreticians have been more and more actively involved in educational and experimental projects at JINR.

Relativistic nuclear physics is a new scientific trend established in Dubna under the guidance of A. Baldin. A special-purpose accelerator of atomic nuclei with superconducting magnets, the Nuclotron, was designed and successfully commissioned at JINR in 1993 to study high excitation states of matter at small distances. By launching this machine, we substantially enlarged our scientific programme.

It is very important that the basic research conducted at the Nuclotron finds its applications in many areas, including ground testing of space equipment, radiobiology and space biomedicine, transmutation of radioactive wastes and electronuclear method of energy generation, and medical use of nuclear beams.

“Whatever the “fundamental” truth is, our goal is to understand the basic principles of how Nature is organized as it is... Studies of elementary particles are the only right, and, possibly, the sole way for today to perceive the fundamental laws of Nature”. I believe that these words by the famous physicist Steven Weinberg characterize most precisely the significance of this field of science.

Among the theoretical studies and ideas that appeared to be much ahead of time, I would like to note the prediction made by Bruno Pontecorvo about the existence of neutrino oscillations. It took scientists many decades to find experimental proof of this key postulate in modern physics.

Particle Physics

Evidence of the charge independence of nuclear forces and other investigations at the Synchrocyclotron (USSR State Prize)

- Discovery of the pion beta decay
- Neutrino physics (Lenin Prize, 1963)

jointly with IHEP

• Observation of the significant contribution of spin effects to the amplitude of hadron-hadron scattering at high energies

• Observation of radial excitations of hadron systems

jointly with CERN

• Experimental confirmation of the existence of only three generations of the neutrino

• Precision measurements of the masses of the W and Z bosons

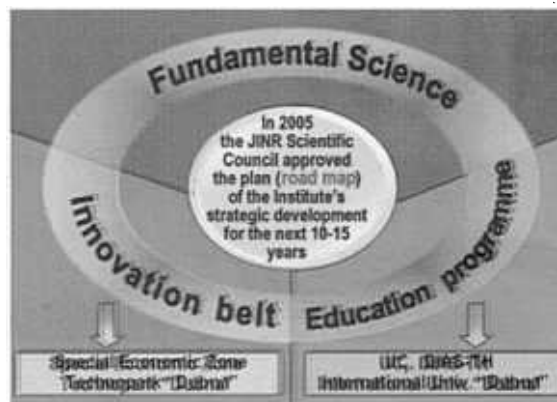
jointly with Fermilab

• High-precision measurement of the top quark mass

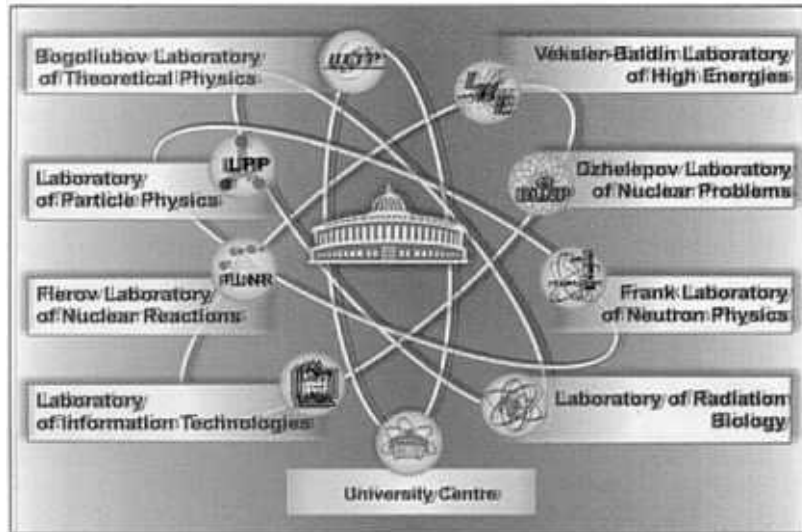
JINR scientists take part in experiments not only at Dubna accelerators but in numerous international collaborations in different research laboratories of the world. These are, for example, the Institute for High Energy Physics (Protvino), CERN, the Fermi National Accelerator Laboratory and the Brookhaven National Laboratory (USA), DESY and GSI (Germany) and many others.

Due to its wide cooperation, Dubna scientists have been involved practically in all large international and national nuclear physics projects of the second half of the last century and of the beginning of this century.


The triangle “science–innovation–education” will characterize our scientific policy in the coming years.




- High-energy physics
- Low- and intermediate-energy physics
- Condensed matter physics



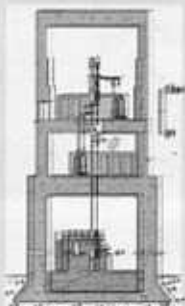
Suite of Basic Facilities by 2009




Modernized Nuclotron



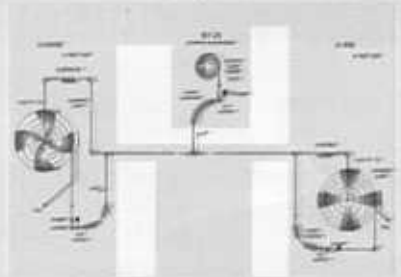
Modernized IBR-2



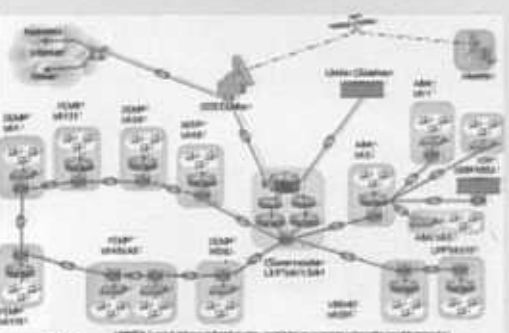
IREN



R&D activities, detector construction



Modernized cyclotron complex



JINR networks, including GRID technology

Accelerator Physics and Engineering.

Prizes received during 50 years

- Lenin Prize
- International Prize "Atom for Peace"
- Six USSR and RF State Prizes
- Prize of the European Physical Society

- ✓ Idea of collective acceleration of particles
- ✓ Development of the technique of thin and jet targets inside an accelerator
- ✓ Discovery of the Coulomb-nuclear interference in elastic pp scattering at high energies
- ✓ Discovery of angular distribution cone shrinking in elastic pp scattering (USSR State Prize, 1983)
- ✓ Precision measurements of nucleon structural functions, determination of the contribution of quarks and

- gluons to the proton's spin, confirmation of QCD and of the Bjorken, Gerasimov – Drell-Hern fundamental sum rules
- ✓ Observation of direct violation of CP invariance, observation and precision measurements of rare kaon decays
- ✓ ...

JINR is an internationally recognized leader in the synthesis of superheavy elements. Thanks to the excellently-organized experimental research programme, the

JINR UNIVERSITY CENTRE

More than 300 students and postgraduates from Member States are trained at the University Centre.

International University for Nature, Society, and Man "Dubna"

Information Technology

JINR Local Area Network

A high-speed (2.5 Gbps) data communication channel was commissioned in Dubna in November 2005.



Special Economic Zone in DUBNA

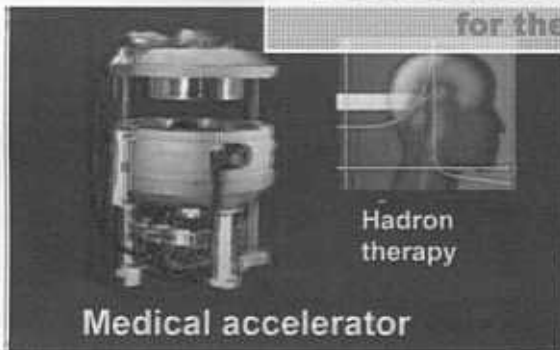
Nanotechnology



IT & Telecommunications



More than 50 innovation projects have been prepared for the SEZ.



predictions of theorists about the existence of “the stability island” of transuranium elements have been confirmed. In the period 1999–2005, five new elements of the

Mendeleev Table were synthesized.

Now I would like to make a brief review of our plans. Along with the current 7-year programme of the Institute’s

development for the years 2003–2009, we have another programme concerning the strategic development of JINR (the road map) for the next 10-15 years which has been recently worked out and approved by the JINR Scientific Council. This programme takes into account both the world tendencies in science development and the interests of our Member States. This document is of great importance to us as it aims at concentration of our human and financial resources for realization of ambitious projects. The role of JINR as a “cluster” centre (a coordinator of research at laboratories in Member States) is due to increase.

Achievements of JINR scientists in fundamental research will find a wider practical use. That is why we intend to undertake an intensive effort to create an innovation belt around the Institute.

The role of the educational programme will be further enhanced. Special attention will be given to the young staff programme and to the solution of social tasks at the Institute.

The road map has defined three major directions of research at the Institute laboratories:

JINR is proud not only of its scientific schools but also of its suite of basic and instrumental facilities. We have worked out unique experimental methods that serve as the basis for developing precision detectors. The Institute possesses powerful, high-performance computing facilities integrated into the world computer nets. By 2009,

we plan to modernize completely the park of our facilities and also take part in a number of international projects. It will make us a more competitive and attractive research centre.

JINR is justly called a school of excellence. For the past 50 years, an extensive educational programme has been developed at the Institute, and numerous specialists have been trained for the Member States. Many outstanding scientists and organizers of scientific research began their professional careers in Dubna.

The educational programme will continue to be based on the JINR University Centre, the International University “Dubna”, and on specialized chairs of MSU, MEPI, MIPT, MIREA and other higher education institutions in Member States.

The JINR functional subdivisions and infrastructure facilities play also an important role in our work. We plan to further stimulate their development.

As I have already mentioned, building a well-developed innovation belt around JINR is an important direction of activity within the concept of the Institute’s advancement. Some elements of it have already been established in recent years. About 50 projects today are ready to be implemented in the Special Economic Zone of Dubna.

JINR is an international organization; therefore the Special Economic Zone “Dubna” will also have international features.

ფიზიკა

ბირთვული კვლევების გაერთიანებული ინსტიტუტი — გუშინ, დღეს, ხვალ

2006 წლის 26 მარტს ჩატარდა დუბნის “ბირთვული კვლევების გაერთიანებული ინსტიტუტის” წარმომადგენელთა კომიტეტისა და სამეცნიერო საბჭოს საზეიმო სხდომა, მიძღვნილი ინსტიტუტის დაარსების 50 წლისთავისადმი.

ჟურნალში წარმოდგენილი მიმოხილვითი ხასიათის სტატია ეფუძნება ინსტიტუტის დირექტორის პროფესორ ალექსეი სისაკიანის მოხსენებას, რომელიც მან ამ სხდომაზე წაიკითხა.

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