JOINT INSTITUTE *for* NUCLEAR RESEARCH

Science bringing nations together

DUBNA | 1956

WWW.JINR.RU

General Information

The Joint Institute for Nuclear Research is an international intergovernmental and a world-famous scientific centre that is a unique example of integration of fundamental theoretical and experimental research with development and application of cutting-edge technology and university education.

Unique Park of Basic Facilities:

- World's top pulsed neutron source
- Heavy ion accelerators in the widest energy range
- Megascience project: super conducting collider NICA

The institute seeks to consolidate and strengthen its key position in the modern world. The strategy of JINR development for the following years is based on fundamental science, innovations and education, as well as on improvement of the scientific and social infrastructure. One of the highest priorities is construction of new basic facilities.

JINR Laboratories:

JINR comprises 7 laboratories each being comparable with a large institute in the scale and scope of research performed.

Veksler and Baldin Laboratory of High Energy Physics

http://lhe.jinr.ru/index.html

Dzhelepov Laboratory of Nuclear Problems

http://dlnp.jinr.ru/en

Bogoliubov Laboratory of Theoretical Physics

http://theor.jinr.ru/

Frank Laboratory of Neutron Physics

http://flnp.jinr.ru/en/

Flerov Laboratory of Nuclear Reactions

http://flerovlab.jinr.ru/flnr/index.html

Meshcheryakov Laboratory
of Information Technologies

http://lit.jinr.ru/index.php?lang=lat

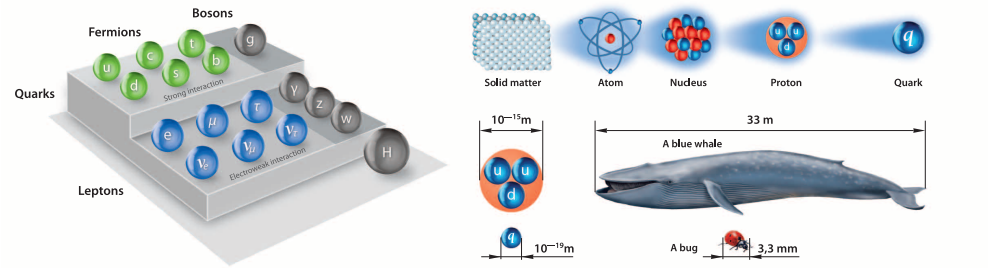
Laboratory of Radiation Biology

http://lrb.jinr.ru/new/olab/olab_en.shtml

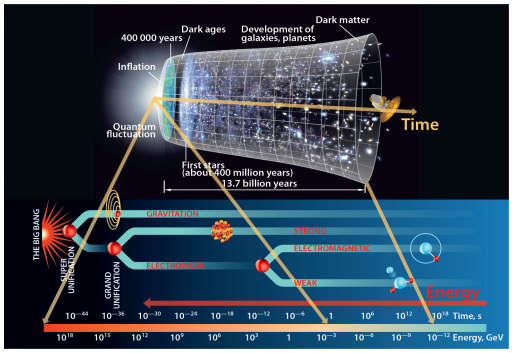
NICA: Nuclotron-based Ion Collider fAcility

International project in the Russian territory
for research into critical states of nuclear matter under extreme conditions using high-intensity heavy ion beams.

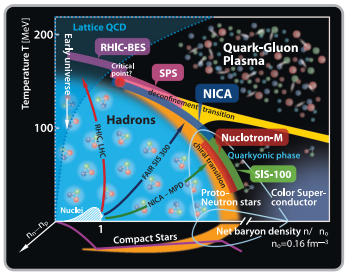
The Standard Model — the modern picture of the World



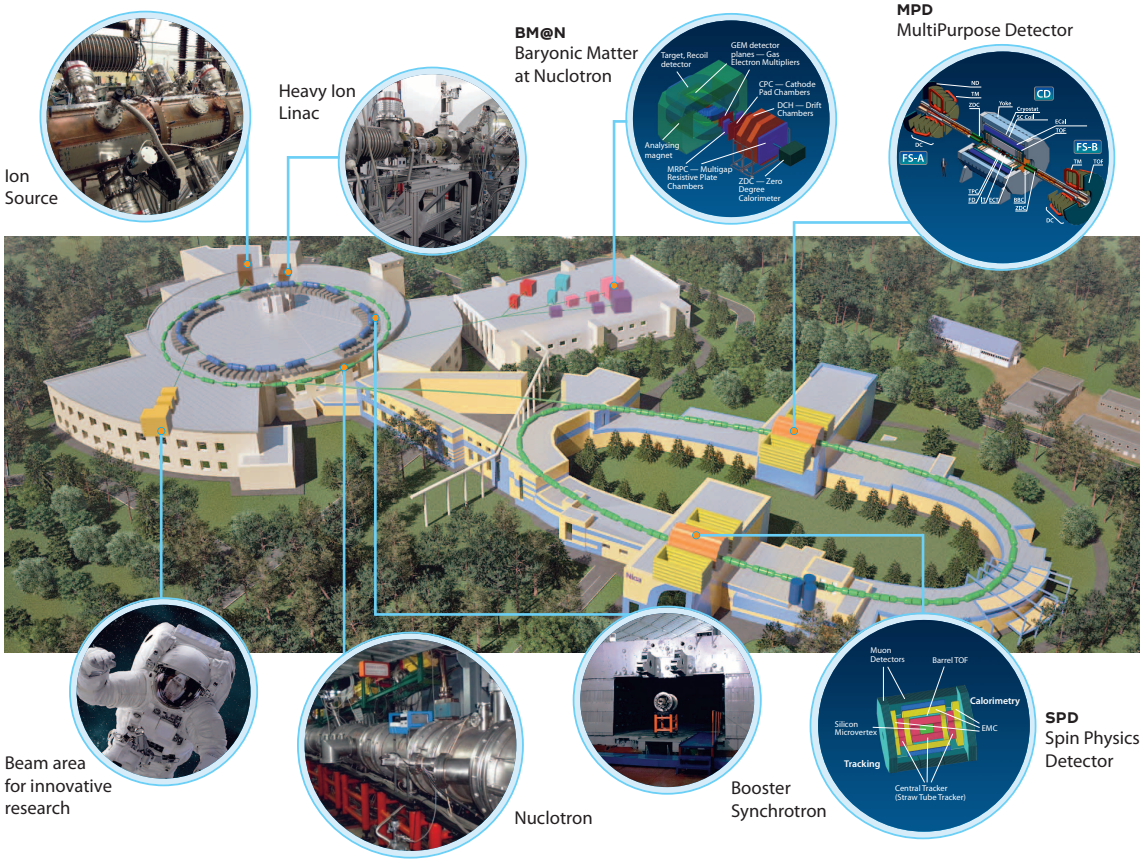
The Big Bang Theory — the search for new states of nuclear matter



The NICA complex is aimed at the reconstruction and study of matter under extreme conditions of its phase transitions which occur at early stages of the Universe evolution.

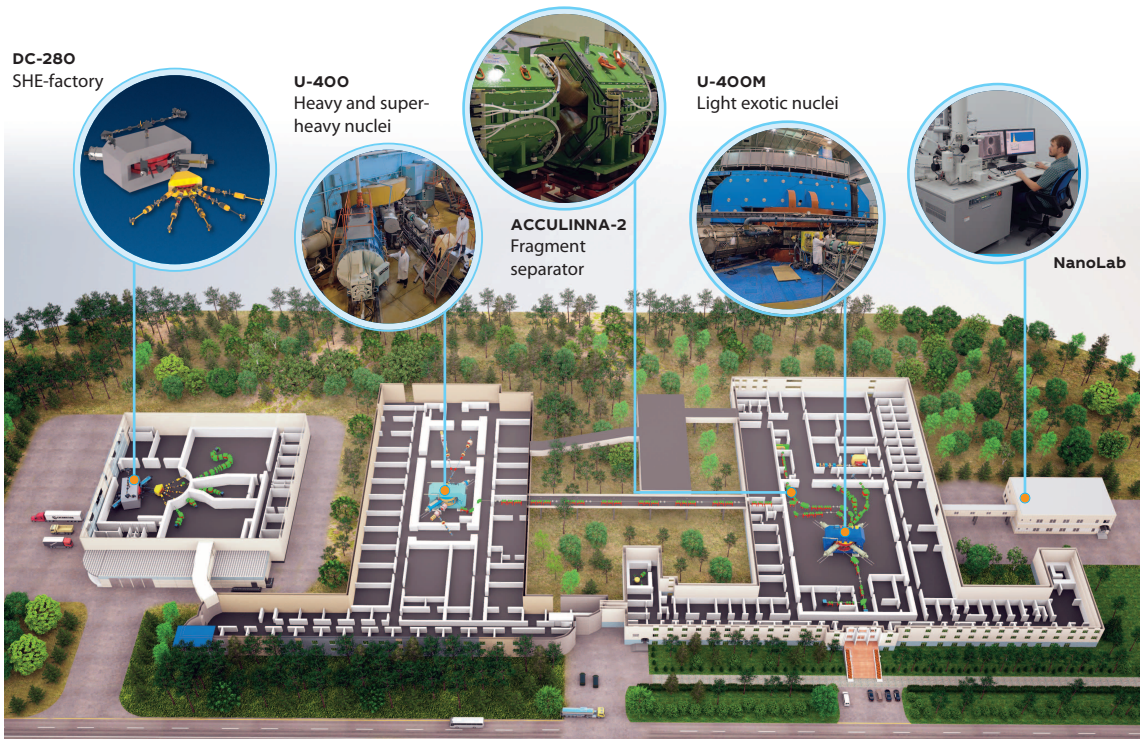


The NICA Complex Infrastructure



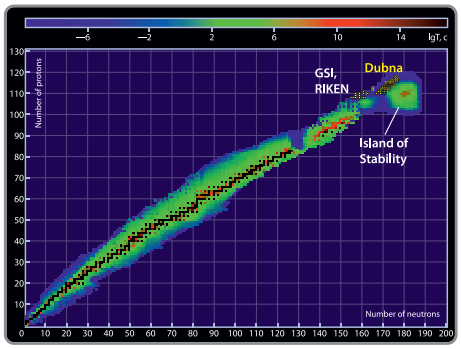
DRIBS-III

Accelerator complex of ion beams of stable and radioactive nuclei.



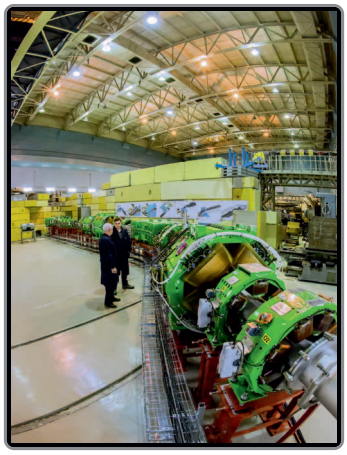
Synthesis and study of superheavy elements

The Superheavy Elements Factory, which is based on the new high-current DC-280 cyclotron and modern efficient setups, will be the basic facility for the investigation of the heaviest nuclei.



10 new elements have been discovered at JINR over the past 60 years

Нобелий 102 $5f^{14}$ No [259] Nobelium	Лоуренсий 103 $5f^{14}6d^{1}$ Lr [266] Lawrencium	Резерфордий 104 $6d^{2}$ Rf [267] Rutherfordium	Дубний 105 $6d^{3}$ Db [268] Dubnium	Борий 107 $6d^{5}$ Bh [270] Bohrium
Флеровий 114 Fl [289] Flerovium	Московий 115 Mc [290] Moscovium	Ливерморий 116 Lv [293] Livermorium	Теннессин 117 Ts [294] Tennessine	Оганесон 118 Og [294] Oganesson



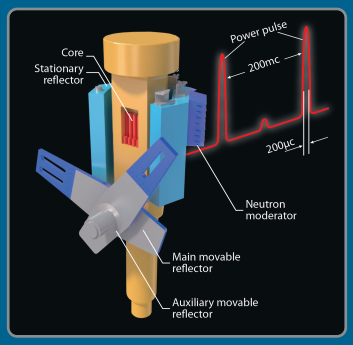
Acculinna-2

Acculinna-2 fragment separator — the future of FLNR in the research of light exotic nuclei in the vicinity of the drip lines.

Nanolab

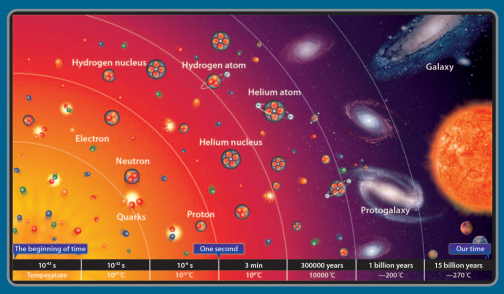
- Scanning electron microscopy
- Atomic force microscopy
- X-Ray photoelectron spectroscopy
- Equipment for sample preparation

IBR-2 Reactor



The world's only periodic pulsed reactor. It has an average power of 2 MW and a peak power of 1850 MW. The IBR-2 is one of the five world's "brightest" neutron sources. 14 world-class neutron spectrometers located at the beams extracted from the reactor are available to scientists.

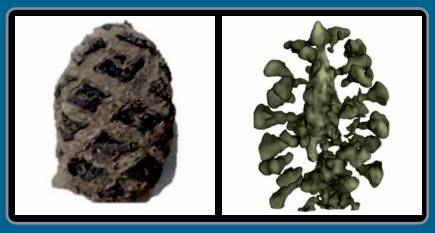
Fundamental research into neutron properties



Neutron properties	Advantages
Absence of electrostatic charge — high penetration capability	• the study of bulk samples; • penetrates nuclei even at low energies; • the study of biological objects without the destruction of molecules; • the study of the kinetics of chemical reactions; • the opportunity to place a sample into furnaces, cryostats, loading machines, high pressure cells etc.
The wavelength of thermal neutrons is comparable with inatomic distances and energies are comparable with those of chemical bonds	• the study of atomic and molecular structure and dynamics of matter
Presence of a magnetic moment	• the study of magnetic structure of crystals and thin films; • the study of magnetic properties of nuclei
Non-monotonic dependence of probability of interaction between neutron and matter on the element's atomic number	• isotopic substitution of an atom in a sample leads to enhanced atomic contrast
Elastic and inelastic scattering	• the study of single-particle and collective effects

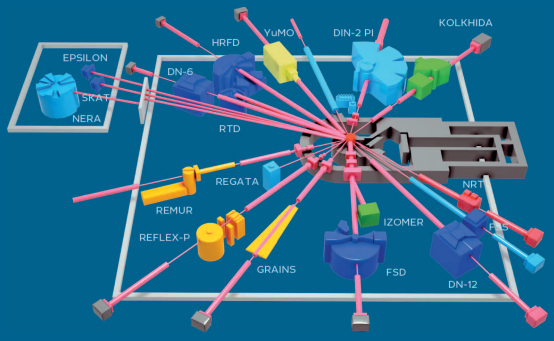
Examples of neutron applications

Neutron tomography is a different way of looking at the world.

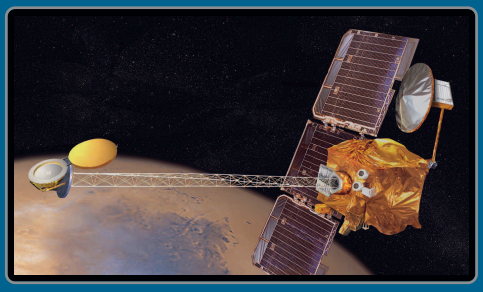


Neutron radiography has been successfully used in paleontology.

Examples of neutron applications



The HEND neutron detector, constructed by the Space Research Institute of the Russian Academy of Sciences with JINR participation, aboard NASA's 2001 Mars Odyssey spacecraft, which has been operating in the Martian orbit since 2002.



JINR Neutrino Programme

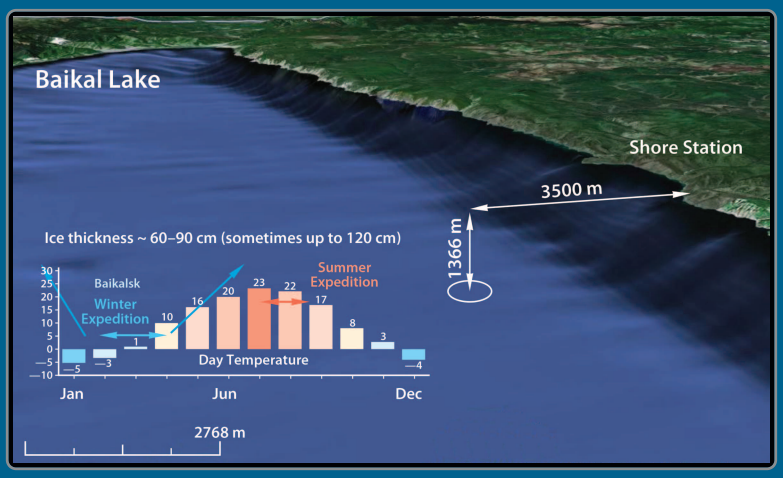
Goals and objectives of the research of neutrino properties:

- The study of high-energy neutrino properties as the only particles that can give science information about the remote parts of our Universe.
- The search for neutrinoless double beta decay that would allow drawing a conclusion about the Dirac or Majorana nature of the particle.
- The study of the transformation of neutrinos from one type to another, the so-called "oscillation".

The Baikal neutrino telescope Gigaton Volume Detector

One of the three world's biggest high-energy neutrino detectors, created by the Baikal collaboration.

The Baikal neutrino telescope (GVD) is part of a single research network,which, apart from producing fundamental results in the study of cosmic neutrinos, facilitates the monitoring of outer space.

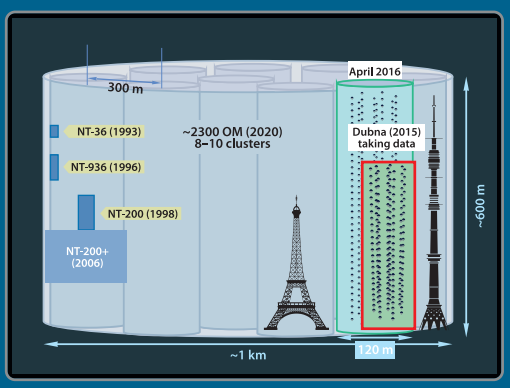


The Dubna cluster contains 192 optical modules submerged down to a depth of 1,300 m.

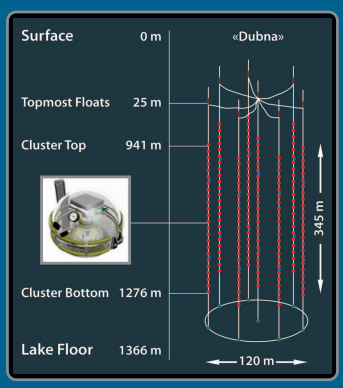
The whole Baikal telescope will contain 27 clusters.

Central Physics Goals:

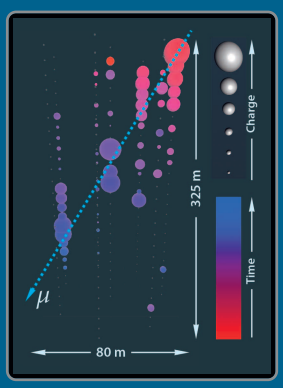
- Investigate galactic and extragalactic neutrino «point sources» in the energy range >3 TeV;
- Investigate the diffuse neutrino flux: the energy spectrum, local and global anisotropy, flavour content;
- Investigate transient sources (GRB, binaries, etc.);
- Indirect search for dark matter;
- Investigate exotic particles: monopoles, Q-balls, nuclearites, etc.



Milestones and future of BAIKAL-GVD



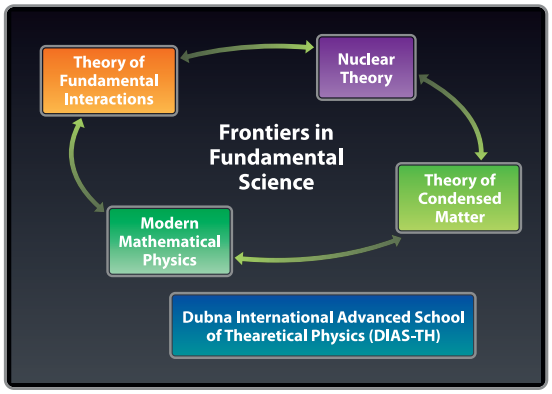
First cluster of Baikal-GVD 2015



Dubna cluster event

Bogoliubov Laboratory of Theoretical Physics

Cross-disciplinary research, theoretical physics on the basis of advanced mathematics, support of the JINR experimental programme and Megascience Projects, increasing the efficiency of scientific staff through the interplay of research and education.



The Bogoliubov Laboratory of Theoretical Physics (BLTP) is a unique center for the organization and coordination of modern investigations in the field of theoretical physics. As one of the largest centers, the BLTP acts as a "generator" of interdisciplinary studies and international cooperation, thus determining the global scientific agenda of both theoretical and experimental researches.

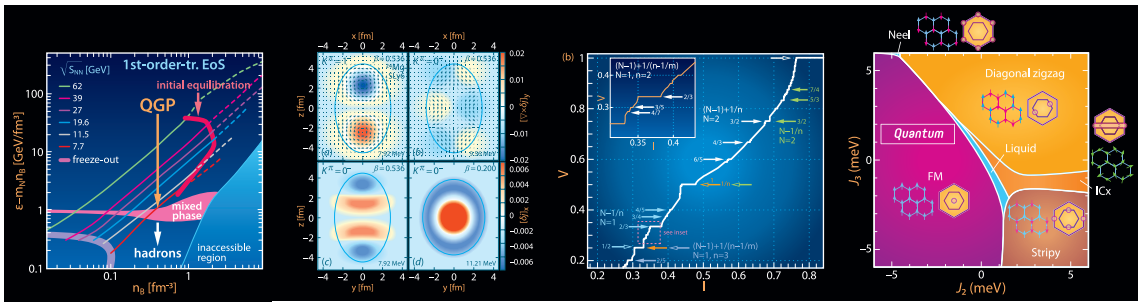
The Laboratory hosts the world's leading experts in the following lines of investigation: quantum field theory and particle physics, theory of atomic nucleus, condensed matter, and modern mathematical physics. The international scientific personnel: about 230 researchers from more than 20 countries, 1/3 are young scientists.

BLTP Publications (2014–2018)

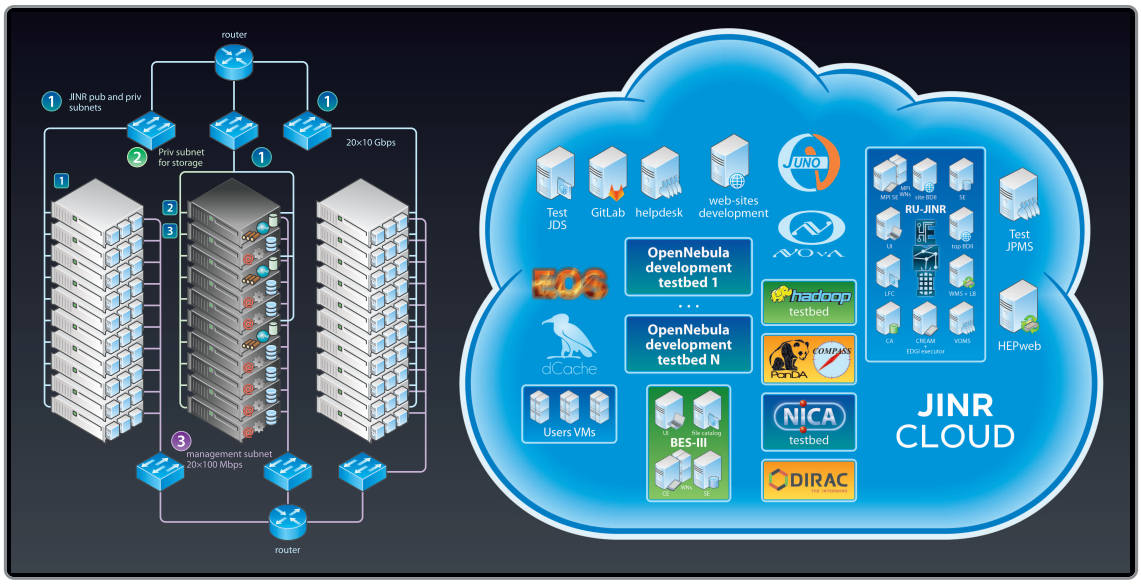
Year	2014	2015	2016	2017	2018	Total
Journal Publications	331	327	313	334	345	1650
Conference Proceedings	193	232	275	242	172	1114
Total	524	559	588	576	517	2764

As a result of the conducted research, more than 500 articles are published annually in peer-reviewed journals and conference proceedings.

Around 12–15 conferences on urgent problems of modern physics are annually organized at the BLTP at the highest international level as well as 3–4 schools for students and young specialists.



JINR Cloud Infrastructure & Utilize

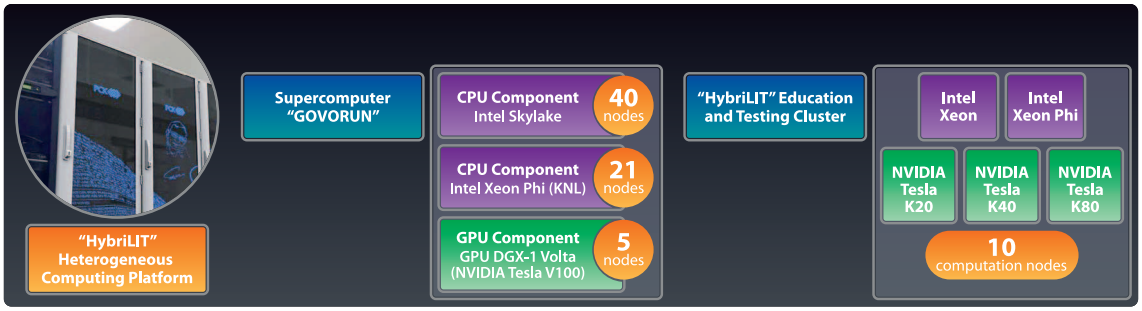


Cloud service utilization

Currently the JINR cloud usage is developed in three directions:

- test, educational, development and research tasks within a participation in various projects;
- systems and services deployment with high reliability and availability requirements;
- extension of computing capacities of the grid-infrastructures.

HybriLIT platform



Total peak performance
Single precision — 1000 TFlops
Double precision — 500 TFlops

"HybriLIT" Heterogeneous Platform is a part of the Multipurpose information and computing complex (MICC) of the Laboratory of Information Technologies of JINR. Heterogeneous platform consists of "GOVORUN" supercomputer and "HybriLIT" education and testing polygon.

"GOVORUN" Supercomputer is a two-component system that includes CPU-component based on the newest Intel architectures (Intel Xeon Phi and Intel Skylake processors), and GPU-component based on NVIDIA DGX-1 Volta.

Education and testing polygon is based on heterogeneous structure of computation nodes and allows developing parallel applications for carrying out computation using various computing architectures. It also provides a possibility to hold tutorials in parallel programming technologies that help students to learn new computing architectures.

Proton Therapy at JINR

- 1968: the first treated patient
- 1974–1984: upgrading of the phasotron and construction of the Medico-Technical Complex
- the early 2000s: the method of conformal 3D irradiation of deep-seated tumours, where the dose distribution precisely conforms (up to millimetres) to the target shape, was worked out and successfully applied
- 2000–2016: 1130 patients were treated with proton beam therapy at the JINR Medico-Technical Complex

Treated diseases

meningiomas, chordomas, chondrosarcomas, gliomas, acoustic neuromas, astrocytomas, paragangliomas, pituitary adenomas, AVMs, brain and other metastases; other neck and head tumours, melanomas, skin diseases, lung carcinoma metastases, breast cancer

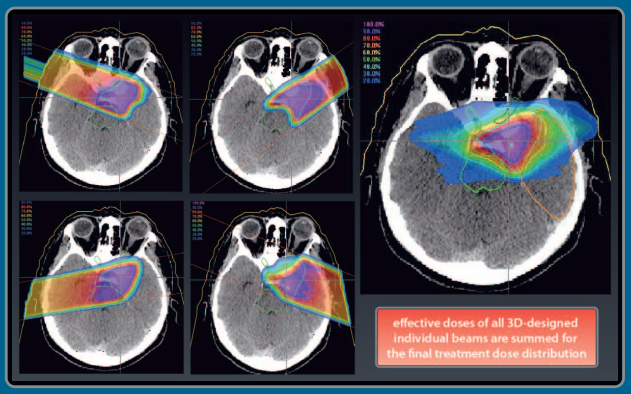
Phasotron has been operating since 1949

Proton 3D radiation therapy

- more than 100 patients treated per year
- 1000 hours of proton therapy per year

Planning

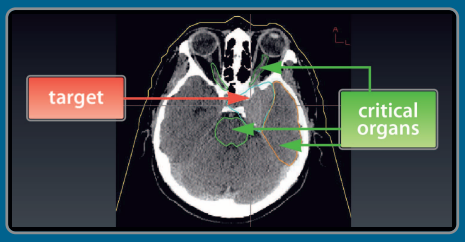
Computation of the dose and simulation of irradiation



Method tests

- TPN software developed at Loma Linda University Medical Center (USA)
- software modified to incorporate Dubna proton beams
- dosimetric measurements for the verification of algorithms

Tissue diagnostics



Research

- development of proton radiotherapy techniques
- clinical research
- dosimetry of therapeutic hadron beams
- radiobiology
- molecular and radiation genetics

Fabrication of patient-adapted devices for beam control

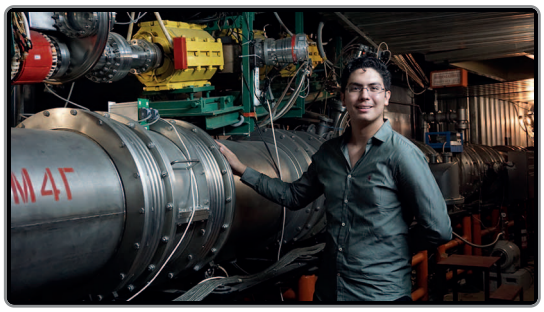
- profiled collimators
- boluses for the protection of the surrounding tissues

JINR University Centre

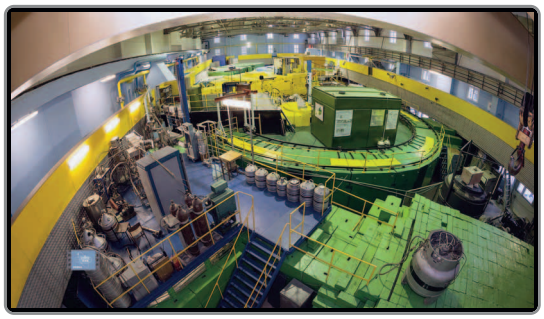
Are you a Bachelor, a Master or a PhD student at a University of any JINR Member State or Associate Member?

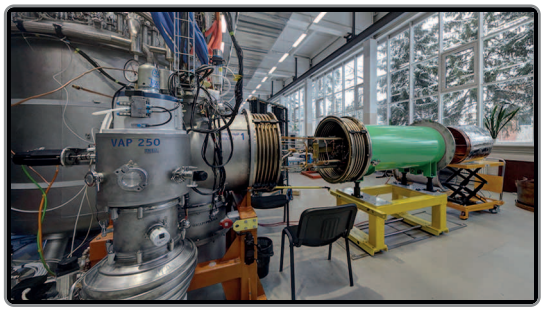
You can:

- Attend **JINR Summer Student Programme**
  6–8-week hands-on programme
  Application: through the University Centre on the web page **students.jinr.ru**
  Selection: by JINR Laboratories

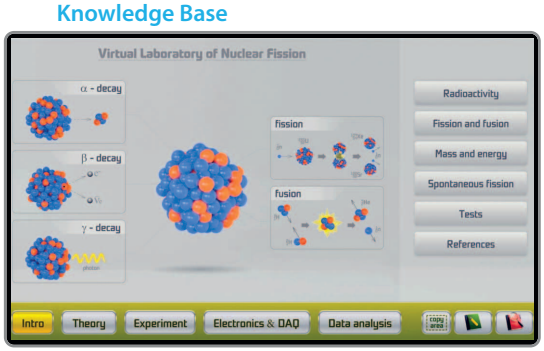


- Virtually visit **JINR main scientific facilities**



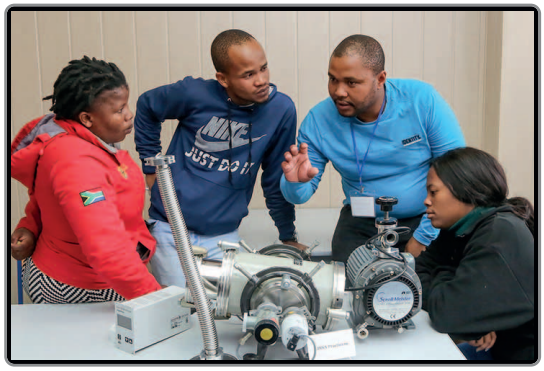


- Use **the JINR Virtual Laboratory of Nuclear Fission** and **the Low Energy Nuclear Knowledge Base**



- Attend **JINR International Student Practice**
  3-week hands-on programme
  Application: through the national contact (see the list on **uc.jinr.ru**)
  Selection: by national authorities

- Attend **JINR programme for engineers and technicians** in fully equipped rooms
  Application: through the University Centre
  Selection: by national authorities



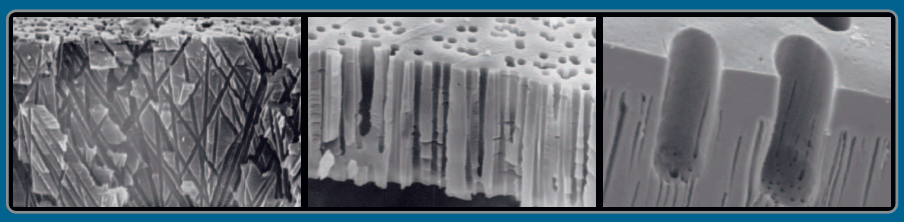
Welcome to the JINR educational page: **edu.jinr.ru**

- Multimedia educational materials on JINR activities and basic facilities for school students and their parents
- Virtual laboratory based on real experimental data
- Video lectures course by JINR scientists and engineers being on the frontier of scientific discoveries

JINR for its Partners

- Production of track membranes for water purification and plasmapheresis

Different types of track membranes produced at JINR.

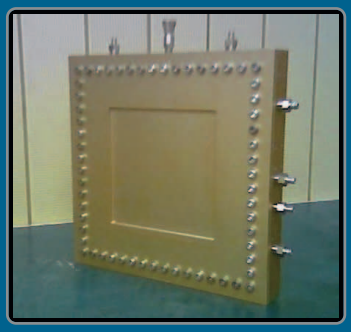


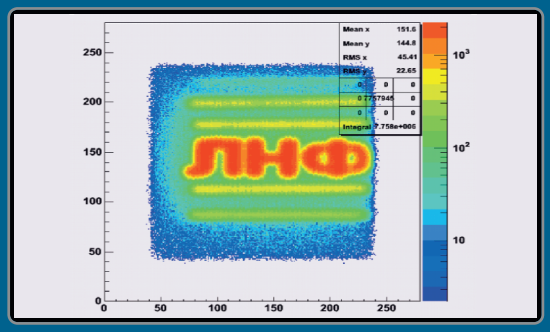
Beijing Fert Technology

- Design and construction of systems for detection of explosive and narcotic substances hidden in various containers, suitcases, safes, and parcels

- Design and construction of neutron detectors for investigation of novel functional materials on the nanoscale

Nuclear Physics Institute, NPI ASCR, Řež





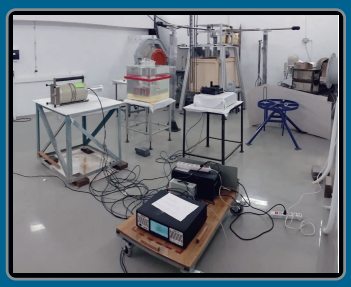
2D position-sensitive gas neutron detector

- Performing reactor- and accelerator-based radiation hardness tests for electronic components of space and aviation technology and large scientific facilities

Accelerator-based setup

JINR Expertise

Design and construction of neutron and gamma detectors for spacecraft



DAN calibration tests at JINR

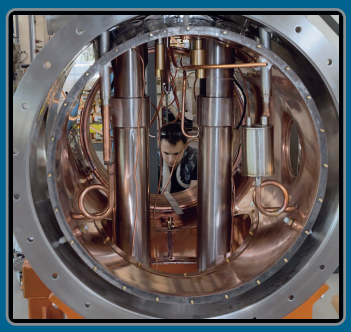
MGNS calibration tests at JINR

ИКИ
Russian Space Research Institute

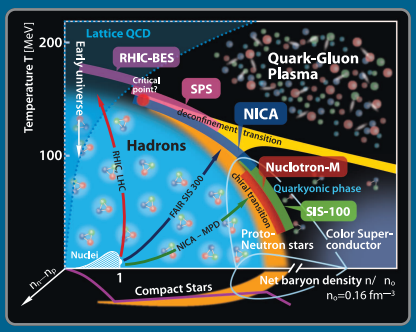
esa
European Space Agency

NASA

Design and construction of superconducting magnets for large-scale scientific facilities for nuclear physics research



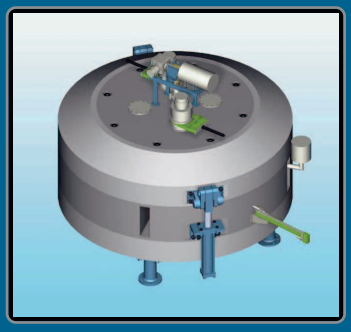
Construstion of a Super-conducting Magnet at JINR



FAIR

NICA

Design and construction of dedicated accelerators for particle therapy



JINR-IBA C400

JINR-IBA C235-V3 cyclotron

iba

Design and construction of accelerators for scientific research and production of track membranes

RUSNANO
Russian Corporation of Nanotechnologies

INSTITUTE OF NUCLEAR PHYSICS
NUR-SULTAN, KAZAKHSTAN

JINR Social Infrastructure

Scientists' Club

Mir
Cultural Centre

JINR Museum

JINR Public
Library

Nauka Stadium

JINR Sports
Club

Archimedes
Swimming Pool

JINR Tennis
Courts

JINR Yacht Club

Ratmino
Resort Hotel

Dubna
Hotel & Restaurant
bld. 1

Dubna Hotel
bld. 3

Welcome to Dubna

- Dubna has the status of a science town, being home to the Joint Institute for Nuclear Research, an international nuclear physics research centre and one of the largest scientific institutions in the country. The modern town emerged in the middle of the 20th century and was granted town status in 1956.
- Population: over 70,000 people.

JINR in Figures:

19 Member States

5260 staff members

1200 researchers

1000 Doctors and Candidates of Sciences

2000 engineers and technicians

1500 scientific publications per year

over **70** international conferences and workshops per year

800 partner universities, educational and research centres in **64** countries

Unique Park of Basic Facilities:

- World's Top Pulsed Neutron Source
- Heavy Ion Accelerators in a Wide Energy Range
- Megascience Project: Superconducting Collider NICA

JINR Member States:

Associated Members:

INTERNATIONAL
INTERGOVERNMENTAL
ORGANIZATION

JOINT INSTITUTE *for* NUCLEAR RESEARCH

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