JOINT INSTITUTE *for* NUCLEAR RESEARCH

Science bringing nations together

DUBNA | 1956

WWW.JINR.RU

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://flnph.jinr.ru/en/

Flerov Laboratory of Nuclear Reactions

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

Laboratory of Information Technologies

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

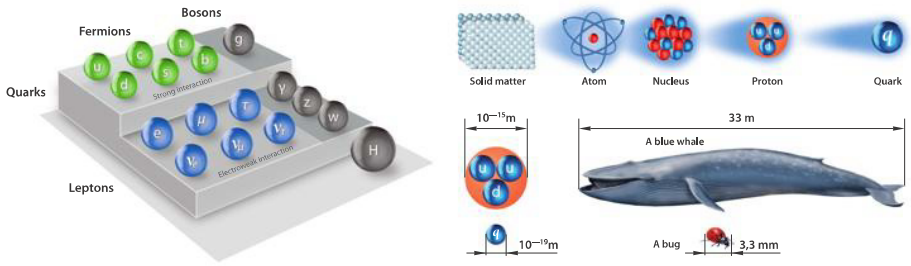
Laboratory of Radiation Biology

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

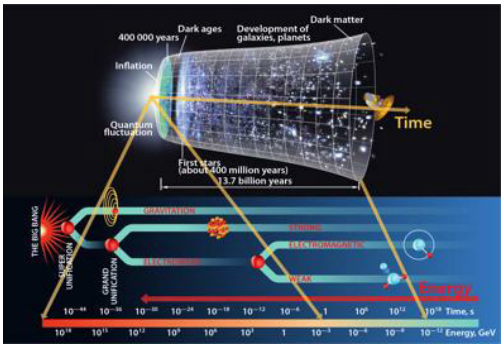
NICA: Nuclotron-based Ion Collider fAcility

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

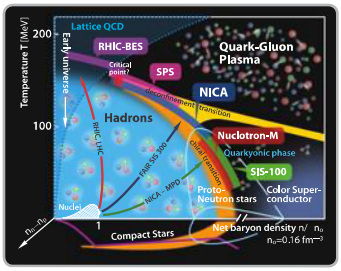
The Standard Model — the modern picture of the World



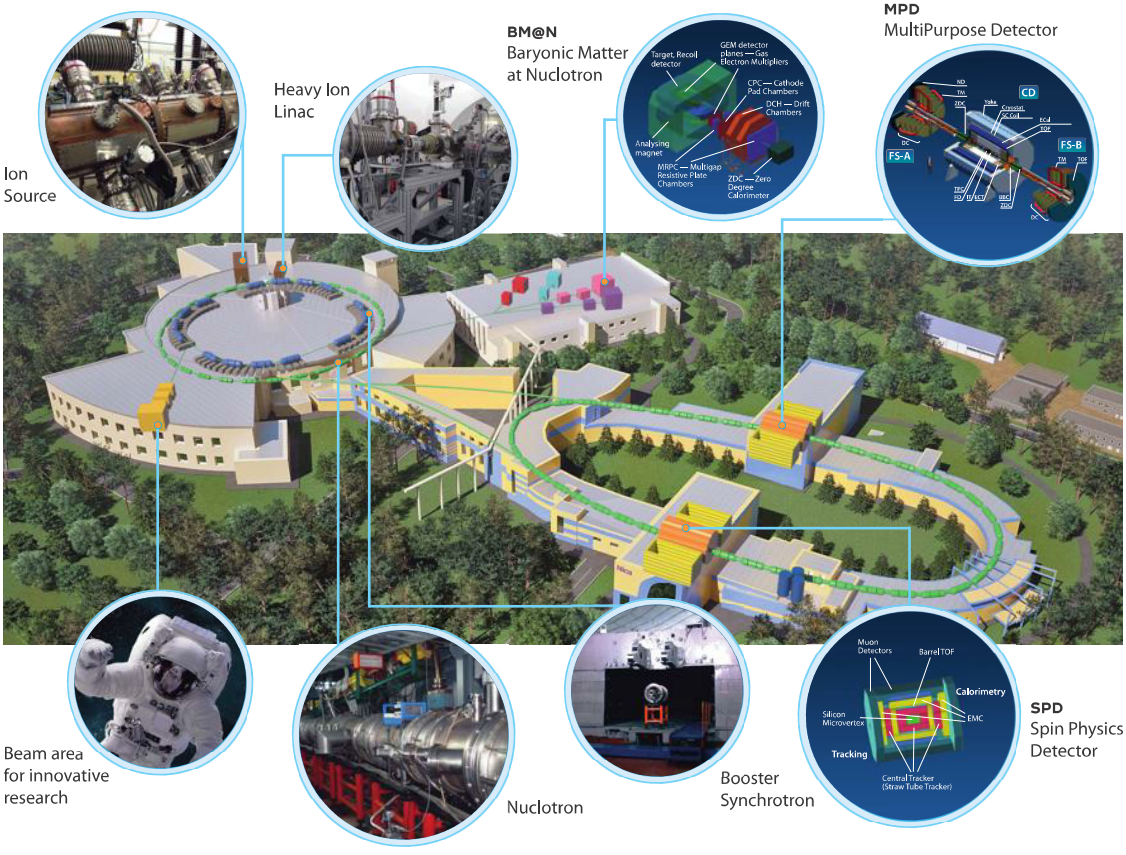
The Big Bang Theory — the search for new states of nuclear matter



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



JINR University Centre

uc.jinr.ru

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

You can:

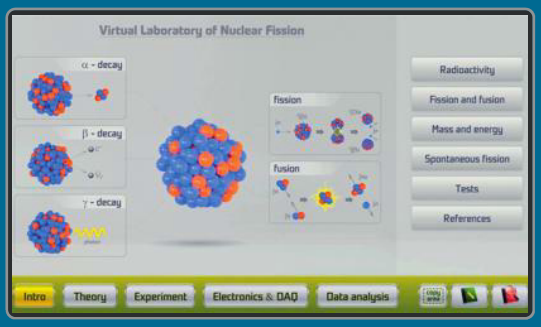
- Attend JINR programme for engineers and technicians in fully equipped rooms

  Application: through the University Centre

  Selection: by national authorities

- 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

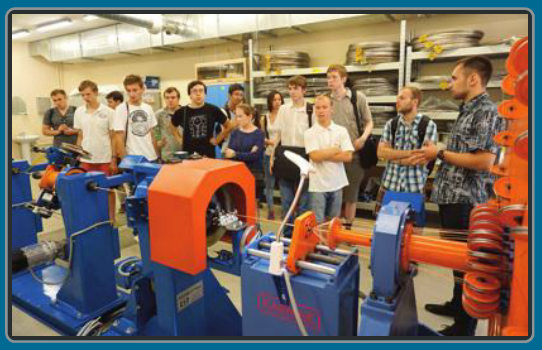
  Application: through the national contact (see the list on uc.jinr.ru)

  Selection: by national authorities

- Attend JINR Summer Student Programme 6–8-week hands-on programme

  Application: through the University Centre on the web page students.jinr.ru

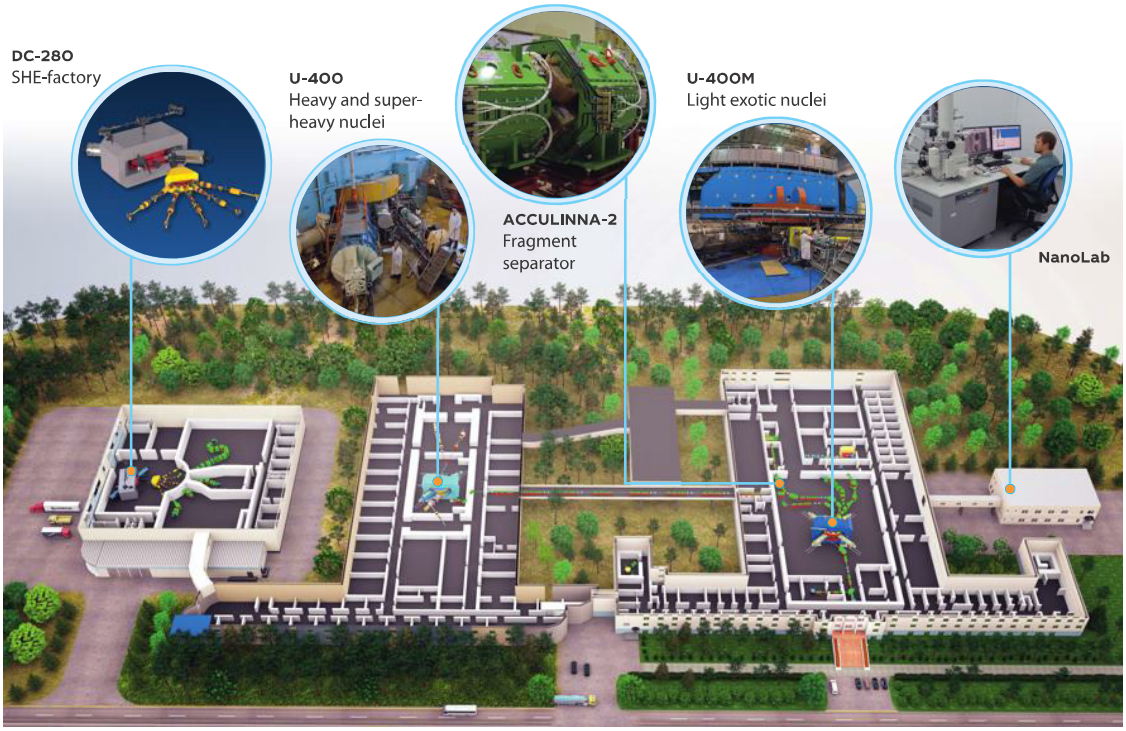
  Selection: by JINR Laboratories



- Attend our International Student Schools

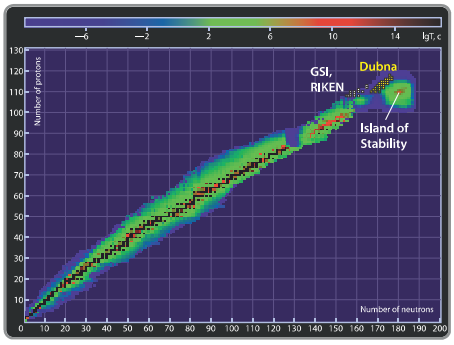
DRIBS-III

Accelerator complex of ion beams of stable and radioactive nuclei.



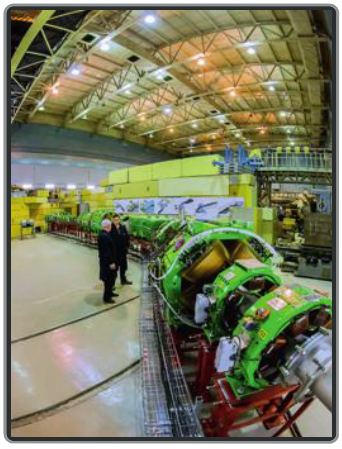
Synthesis and study of superheavy elements

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	Хассий 108 $_{6d^{6}}$ Hs [269] Hassium
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



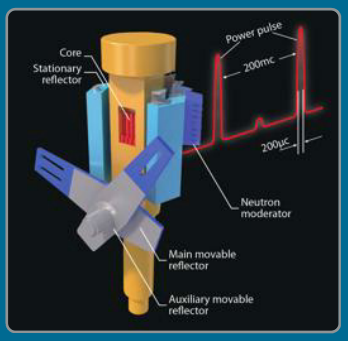
Acculinna-2

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

Nanolab

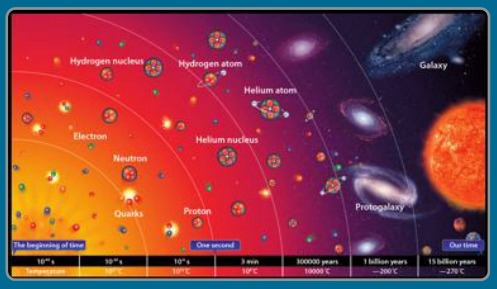
- Scanning electron microscopy
- Atomic force microscopy
- X-Ray photoelectron spectroscopy
- Equipment for sample preparation

IBR-2 Reactor



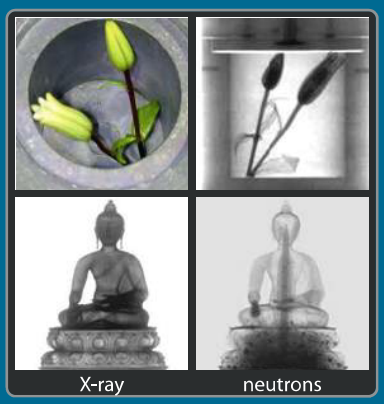
The world's only pulsed reactor of periodic operation. It has an average power of 2 MW and a peak power of 1850 MW. IBR-2 is one of the five world's "brightest" neutron sources. 14 world-class neutron spectrometers, located at the beams extracted from the reactor, are available to scientists.

Fundamental research into neutron properties

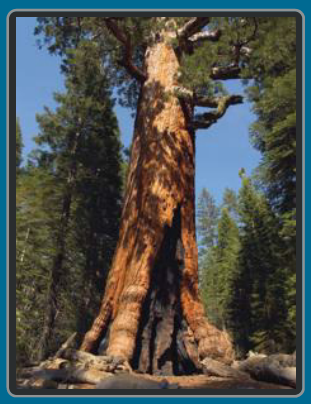


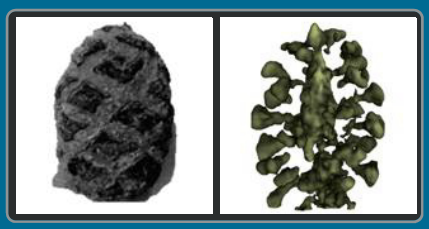
Neutron properties	Advantages
Absence of electrostatic charge — high penetration capability	• the study of bulk samples; • penetrates nuclei even at low energies; • the study of biological objects without the destruction of molecules; • the study of the kinetics of chemical reactions; • the opportunity 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



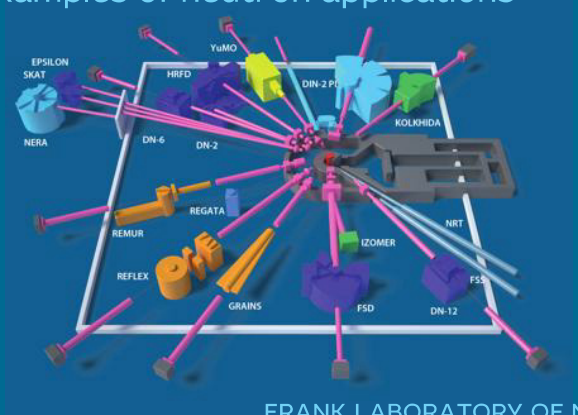
Neutron tomography is a different way of looking at the world.





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

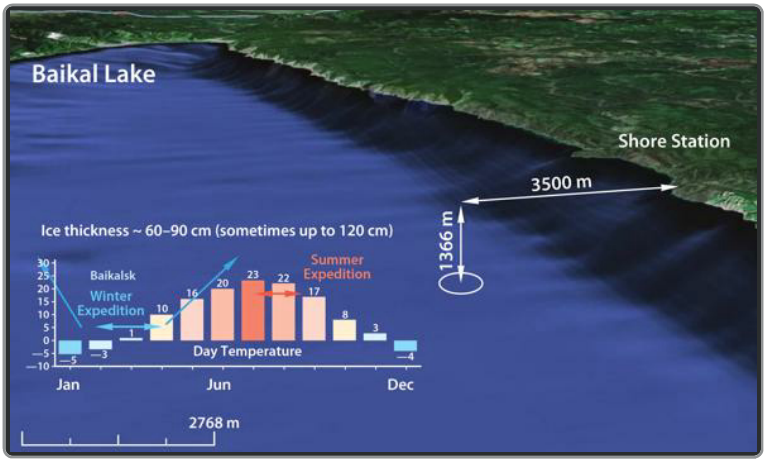
Goals and objectives of the research of neutrino properties:

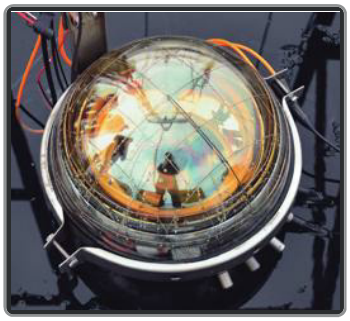
- The study of high-energy neutrino properties as the only particles that can give science information about the remote parts of our Universe.
- The search for neutrinoless double beta decay that would allow drawing a conclusion about the Dirac or Majorana nature of the particle.
- The study of the transmutation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

The Baikal neutrino telescope Gigaton Volume Detector

One of the three world's biggest neutrino detectors of high energy, 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.



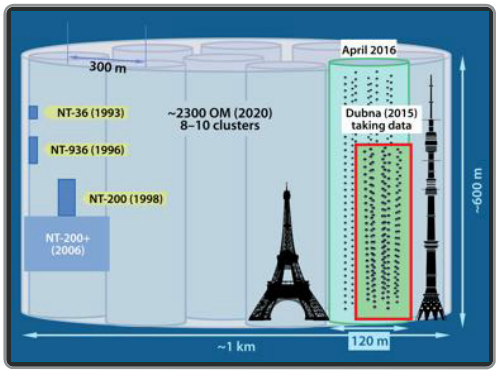


The «Dubna» cluster contains 192 optical modules submerged down into the 1,300-metre depth.

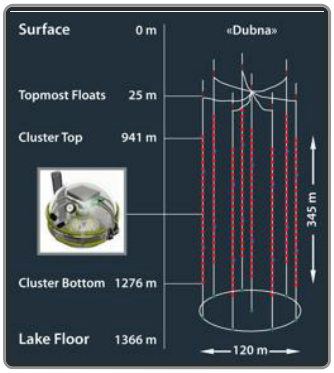
The whole «Baikal» telescope will contain 27 clusters.

Central Physics Goals:

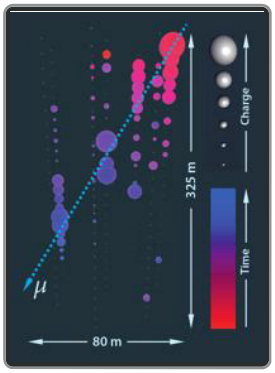
- Investigate galactic and extragalactic neutrino «point sources» in the energy range > 3 TeV;
- Investigate the diffuse neutrino flux: the energy spectrum, local and global anisotropy, flavour content;
- Investigate transient sources (GRB, binaries, etc.);
- Indirect search for dark matter;
- Investigate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



Milestones and future of BAIKAL-GVD



First cluster of Baikal-GVD 2015

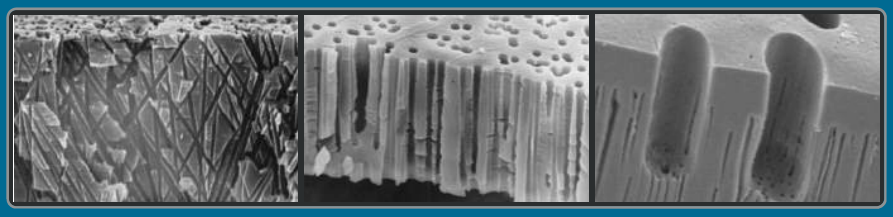


Dubna cluster event

JINR for its Partners

- Production of track membranes for water depuration and plasmapheresis

Different types of track membranes produced at JINR.

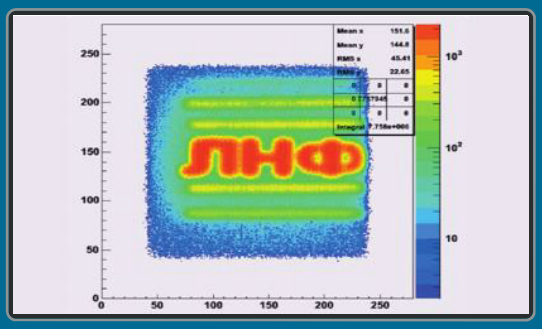


Beijing Fert Technology

- 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 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

CERN

ROSCOSMOS

Accelerator-based setup

JINR Expertise

- Design and construction of neutron and gamma detectors for spacecraft

DAN calibration tests at JINR

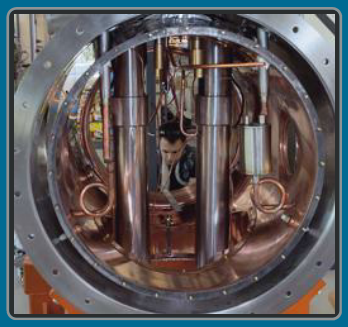
MGNS calibration tests at JINR

Russian Space Research Institute

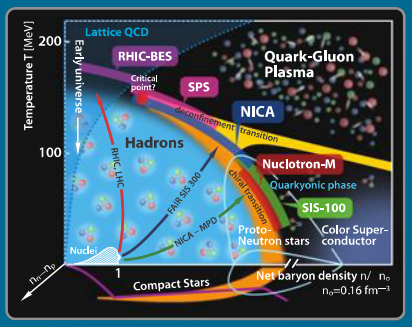
esa European Space Agency

NASA

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



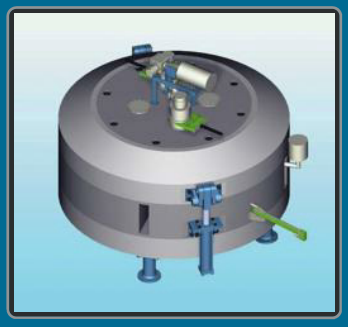
Construstion of a Super-conducting Magnet at JINR



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 dedicated to scientific research and the production of track membranes

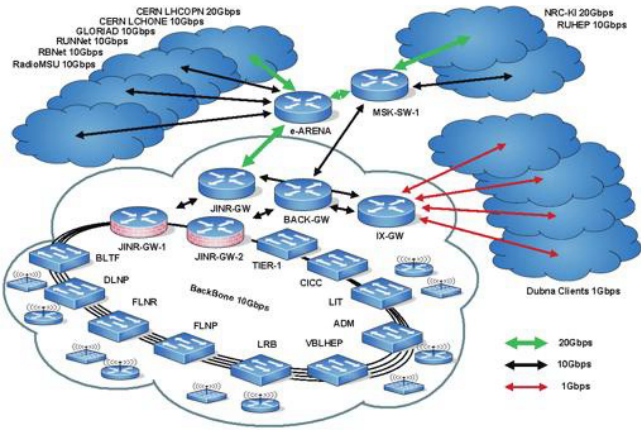
RUSNANO Russian Corporation of Nanotechnologies

INSTITUTE OF NUCLEAR PHYSICS ASTANA, KAZAKHSTAN

JINR Computing: GRID, CLOUD, HPC

JINR Multifunctional Centre for Data Storage, Processing and Analysis.

IT infrastructure is one of the JINR basic facilities

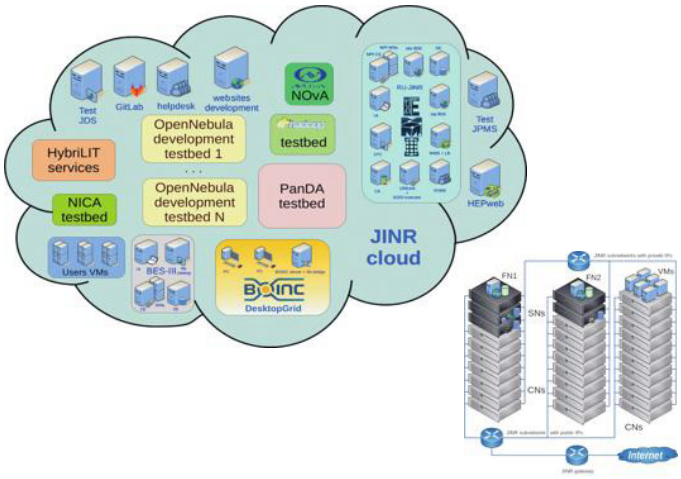


JINR Grid Tier1 level centre — one of the 7 World centres for the CMS experiment at the LHC

- 6000+ computational nodes
- 4,2 Petabyte disk space
- 5 Petabyte tape robot
- 24/7 support

JINR Cloud Infrastructure & Utilisation

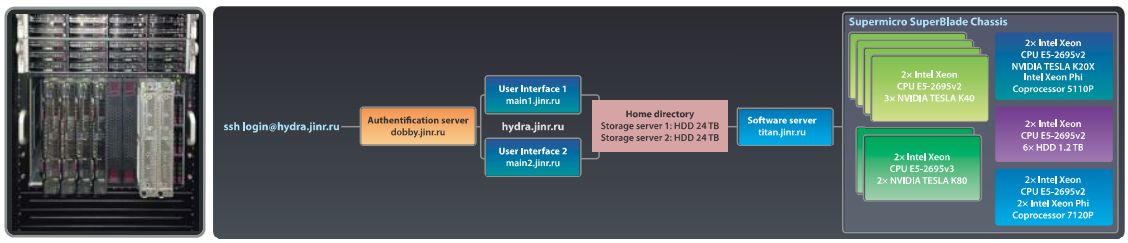
JINR Cloud infrastructure is based on OpenNebula.



Cloud is used for:

- Education and research grid infrastructure;
- PanDA polygon for the development, debugging and tests of services in the framework of ATLAS, COMPASS and NICA projects;
- Polygon on the basis of DIRAC middleware in the framework of LIT participation in the BES-III experiment;
- Cloud computational resources for BES-III;
- Virtual machines for NOvA participants;
- Hadoop polygon for BIG Data;
- Computing resources for JINR users.

JINR Heterogeneous Cluster



Peak performance — 105.7 TFlops

The HybriLIT heterogeneous cluster enables the creation of HPC parallel applications for the solution of a large variety of mathematical resource-intensive tasks using the possibilities offered by the implemented many-core CPU and GPU accelerators.

HybriLIT-based tutorials:

- Tutorials on parallel programming techniques are regularly organised for students and young scientists from JINR and JINR Member States;
- Specialised courses by leading software developers.

Proton Therapy at JINR

- 1968: the first treated patient
- 1974–1984: upgrading the phasotron and construction of the Medico-Technical Complex
- the early 2000s: the method of conformal 3D irradiation of deep-seated tumors, 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

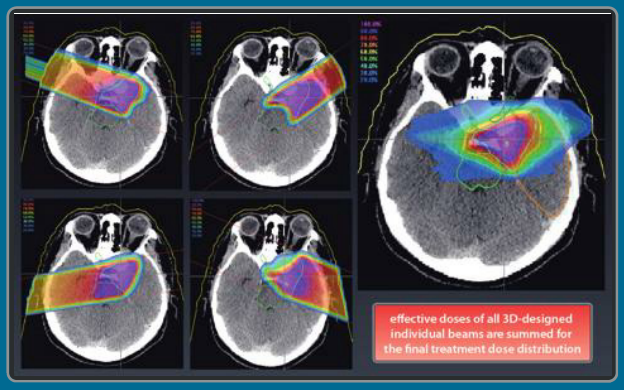
Phasotron has been operating since 1949

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

- software «TPN» 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

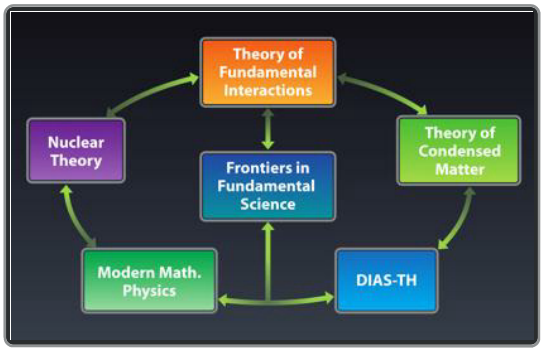
- development of proton radiotherapy techniques
- clinical research
- dosimetry of therapeutic hadron beams
- radiobiology
- molecular and radiation genetics

Fabrication of patient-adapted devices for beam control

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

Bogoliubov Laboratory of Theoretical Physics

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



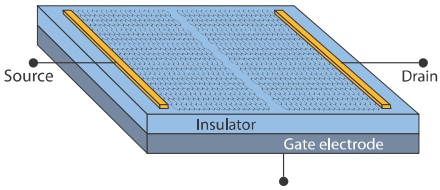
- Theoreticians of the Institute have achieved new results within the programme "Theory of hadron matter under extreme conditions", which is aimed at the development of physical research programme at the NICA complex, which is currently under construction.
- As a result of the conducted research, more than 500 articles have been published in peer-reviewed journals and conference proceedings.
- A great deal of research was implemented in collaboration with scientists from JINR Member States.

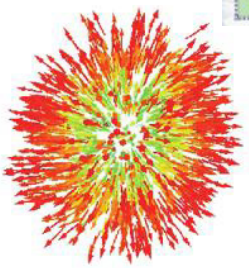
International Scientific Personnel: more than 20 countries, 1/3 are young scientists

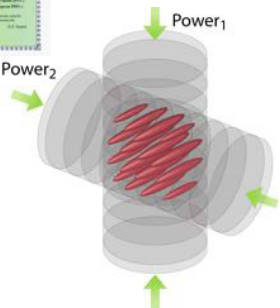
Country	Theory of Fundamental Interactions	Nuclear Theory	Theory of Condensed Matter	Modern Mathematical Physics	Total (other)
Russia/Other	54/26	51/18	37/12	23/8	229 (64)

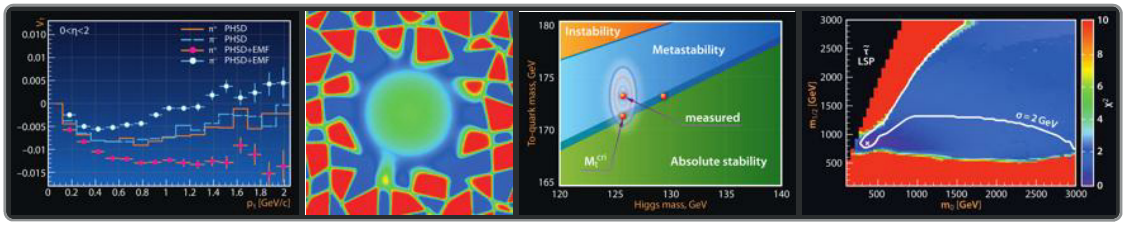
BLTP Publications (2012–2016)

Year	2012	2013	2014	2015	2016	Total
Journal Publications	382	363	364	356	370	1835
Conference Proceedings	97	122	131	142	165	657
Total	479	485	495	498	535	2492









JINR Social Infrastructure

JINR Club
of Scientists

JINR Cultural
Centre «Mir»

JINR Museum

JINR Public
Library

JINR Stadium
«Nauka»

JINR Sports
Club

Swimming Pool
«Archimedes»

JINR Tennis
Courts

JINR Yacht Club

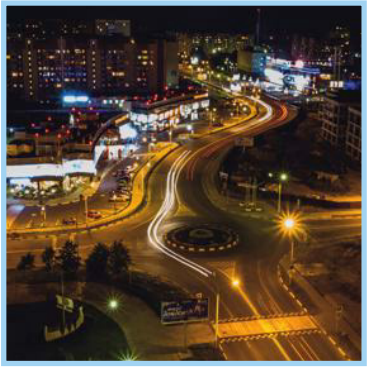
Resort Hotel
«Ratmino»

H&R Complex
«Dubna»
bld. 1

Hotel «Dubna»
bld. 3

Welcome to Dubna

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



JINR in Figures:

18 Member States

5260 staff members

1200 researchers

1000 Doctors of Science and PhDs

2000 engineers and technicians

1500 scientific publications per year

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

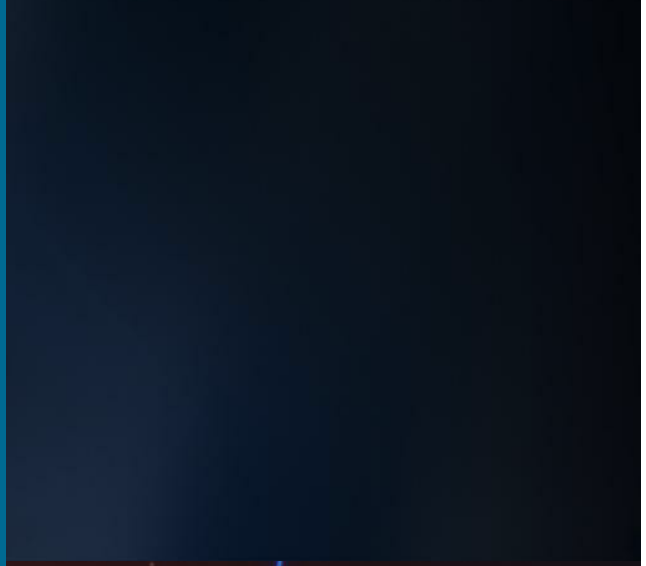
800 partner universities, educational and research centres in **64** countries

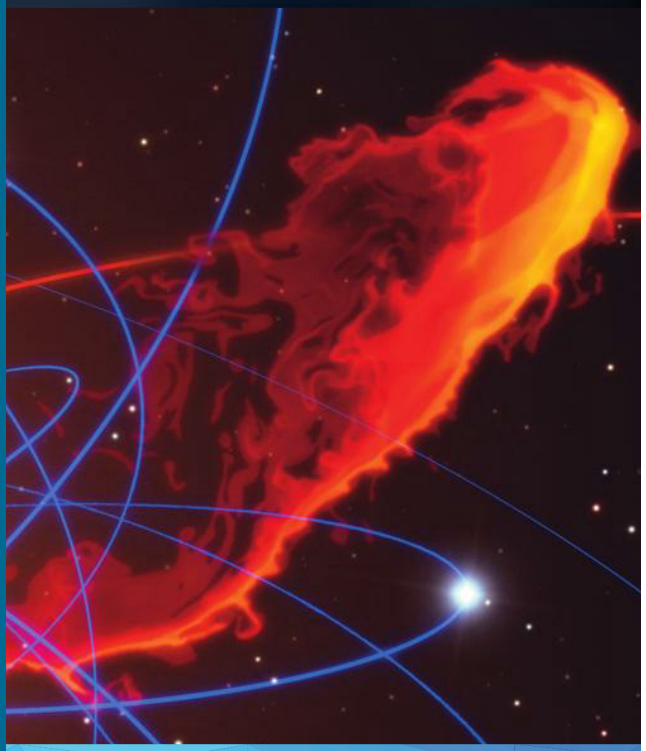
Unique Park of Basic Facilities:

- 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
ORGANISATION

JOINT INSTITUTE *for* NUCLEAR RESEARCH

6 Joliot-Curie, Dubna,
Moscow Region, 141980, Russia

+7 496 216 50 59

post@jinr.ru

www.jinr.ru