Dear Users,

Having been established in 1956 by the Convention of the twelve founding countries with the aim of uniting international efforts to investigate the fundamental properties of matter and to carry out innovative applied research, the Joint Institute for Nuclear Research has been attracting scientists from all over the world to work together and maintain scientific ties between scientific organisations and universities of the Member States for more than 60 years. Throughout its history, the Institute has accumulated good traditions of scientific cooperation and is nowadays highly rated in the world's scientific community. A great part of all research projects is carried out in close cooperation with JINR Member States as well as Associated Members.

The scientific strategy of JINR is determined by the International Scientific Council, which consists of outstanding scientists and leading specialists in the field of modern fundamental physics.

Last year, the Committee of Plenipotentiaries of the JINR Member-State governments has approved an ambitious 7-year plan for JINR development for the years 2017–2023. The plan presupposes the realisation of the megascience project of the superconducting heavy ion collider NICA in the coming years as well as finishing the construction of the unique Factory of Superheavy Elements, building the Gigaton deep underwater neutrino detector at Lake Baikal and also includes some other projects involving the implementation of modern-style educational programmes and innovative multidisciplinary research with application of nuclear physics methods in the area of life sciences and medicine.

JINR comprises seven laboratories, each of them implementing research in a wide spectrum of fields described further on. The laboratories provide scientists with powerful and efficient equipment, some of which is unique in terms of technical characteristics. The laboratories employ qualified and dedicated staff from all around the globe, who are always ready to provide Users with all necessary assistance. JINR User programme is designed for and open to both internal and external users. The international status of JINR allows users from all over the world to access the User programme under tailor-made and adjusted conditions.

Located in the town of Dubna, on the bank of the famous Volga river, within a two-hour journey from Moscow, JINR is ready to offer its partners all the available conveniences, ranging from transfer and hotel facilities to complimentary excursions to old towns and other interesting places of the beautiful surrounding Moscow region (including those on the famous Volga river).

We are pleased to invite you to join us for the innovative and research activities carried out at JINR laboratories at the time of their intensive development, thus to contribute to the fulfillment of scientific missions of Your country, and we'll make every effort to further strengthen our international cooperation.

Welcome to JINR!

VICTOR MATVEEV
Director of JINR

JOINT INSTITUTE *for* NUCLEAR RESEARCH

The Joint Institute for Nuclear Research is an international intergovernmental organisation, a world-famous scientific centre that is a unique example of integration of fundamental theoretical and experimental research with development and application of the cutting-edge technology and university education. The rating of JINR in the world's scientific community is very high.

JINR Member States and Associated Members

JINR has at present 18 Member States and 6 Associated Members. The Supreme governing body of JINR is the Committee of Plenipotentiaries of the governments of all 18 Member States. According to its Charter, the Institute exercises its activities on the principles of openness to all interested states for their participation and equal and mutually beneficial cooperation.

Organisation and development purposes

The Institute was **established with the aim** of uniting the efforts, scientific and material potentials of its Member States for investigations of the fundamental properties of matter. Over 60 years JINR has accomplished a wide range of research and trained scientific staff of the highest quality for the Member States.

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.

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 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 kinds of technical development. The Institute's development strategy is detailed in the Seven-Year Plan for the Development of JINR.

Veksler and Baldin Laboratory of High Energy Physics

The scientific activities of the laboratory are concentrated on the following research directions: heavy ion physics at high energies, spin physics, main issues of elementary particle physics related to the Standard Model tests, search for new physics beyond SM and CP-violation.

Heavy ion superconducting (SC) accelerator Nuclotron is the basic facility of the Lab. On its basis, the new accelerator and experimental complex — NICA, which includes the SC collider, is being built. The NICA complex will allow to implement the research on baryonic matter fundamental properties and the nucleon spin structure. The innovative potential of the NICA complex is defined by its ability to provide ion beams from protons to gold in a wide energy range.

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NICA: Nuclotron-based Ion Collider fAcility

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

NICA Complex Infrastructure

1st stage:
Injection complex: ion sources & linear accelerators;
Booster, Nuclotron & Collider rings;
BM@N & MPD detectors.

2nd stage:
SPD, applied research area, computer centre.

Requirements:

Intensive beams of relativistic ions from p to Au & polarised p and d with energy up to $\sqrt{S_{NN}}$ = 11 GeV(Au^{79+}) and 27 GeV(p).

Main targets of the NICA complex:

- study of hot and dense baryonic matter properties;
- investigation of the nucleon spin nature & polarisation phenomena.

Injection complex

Includes 4 ion sources and 2 linear accelerators:
LU20 put in operation — 1974;
modernisation (2011–2017);
HILac put in operation — 2016.

Available research: nanotechnology.

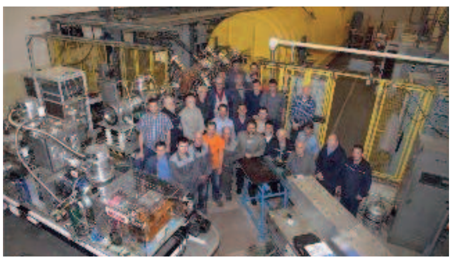
Parameters of Particle Sources of the NICA Injection Facility

Source	KRION-6T	Laser source	Duoplasmatron	SPI*
Particles	Au^{31+}	Light ions up to Mg^{10+}	H^+, D^+, He^{2+}	$\uparrow H^+$, $\uparrow D^+$
Particles per cycle	~ $2.5 \cdot 10^9$	~ 10^{11}	H^+, D^+ ~ $5 \cdot 10^{12}$ He^{2+} ~ 10^{11}	$5 \cdot 10^{11}$
Repetition, Hz	10 (3 pulses for 5 sec)	0.5	1	0.2

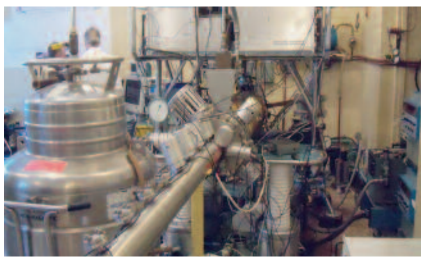
* SPI = Source of Polarised Ions

Parameters of the Linear Accelerator of the NICA Injection Facility

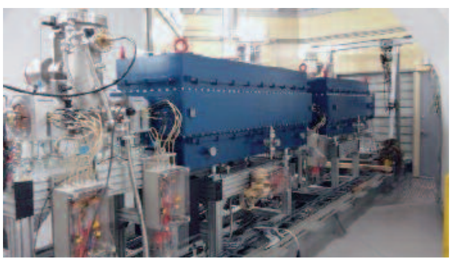
Linac	LU-20	HILAC
Acceleration structure (section number)	RFQ + Alvarez type	RFQ (1) + IH DTL (2)
Mass to charge ratio A/Z	1–3	1–6
Injection energy, keV/amu	150 for A/Z 1-3	17
Extraction energy, MeV/amu	5 (A/Z 1-3)	3.24 (A/Z = 6)
Input current, mA	up to 20	up to 10
Length, m	22	11

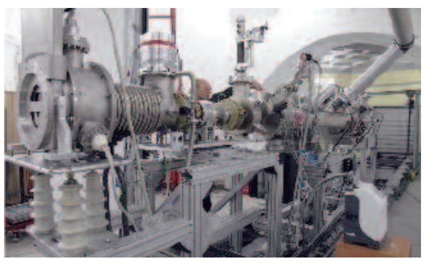


SPI: new source of polarised particles & LU-20 linear accelerator



Krion-6T: SC ESIS type heavy ion source





HILac: new unique linear accelerator of heavy ions for injecting particles into the Booster

Booster & Nuclotron

Nuclotron

Nuclotron

SC synchrotron for acceleration of light and heavy ions, allows to study relativisric nuclear collisions at A=1–197;
put in operation — 1993 (modernised in 2010–2015).

Available research:

internal target — polarisation phenomena, study of few-body system, search for eta-mesic nuclei;
extracted beam area — search for and investigation of phase transitions and critical phenomena of nuclear matter with extremely high baryonic density; search for hypernuclei, strangeness of nuclear matter; study of spin effects and polarisation phenomena.

3D model of the Booster

Booster

SC synchrotron for acceleration of light and heavy ions; is under construction;

operation start — in 2019.

Available research:

applied research in medicine, radiobiology, microelectronic damages, materials science.

Parameter	Booster	Nuclotron
Type	SC synchrotron	SC synchrotron
Particles	ions A/Z≤3	p↑, d↑, nuclei
Injection energy, MeV/u	3.2	p↑, d↑ - 5 gold nuclei – 570 ÷ 685
Maximum energy, GeV/u	0.6	p↑ – 12.07, d↑ – 5.62 gold nuclei – 4.38
Magnetic rigidity, T·m	1.6 ÷ 25.0	25 ÷ 43.25
Circumference, m	210.96	251.52
Cycle duration for collider mode, s	4.02 (active); 5 (total)	1.5 ÷ 4.2 (active); 5 (total)
Vacuum, Torr	10^{-11}	10^{-9}
Au Beam intensity, ions / pulse	$1.5 \cdot 10^9$	$1 \cdot 10^9$
Transition energy, GeV/u	3.25	7.0
RF range, MHz	0.5 – 2.53	0.6 ÷ 6.9 (p↑, d↑) 0.947 ÷ 1.147 (nuclei)
Spill duration of slow extraction, s	up to 10	up to 10

Collider

Is under construction, operation start — in 2020;
General responsibility — Strabag (Austria).

Available research:

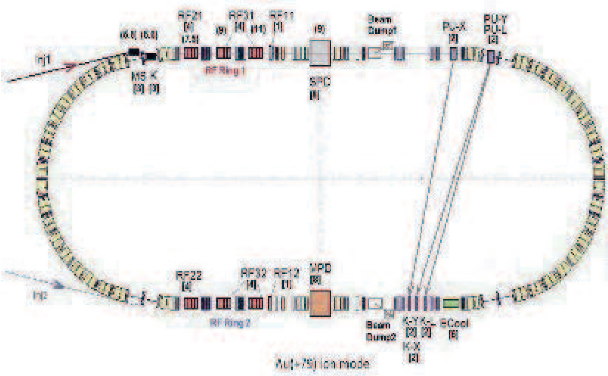
- study of hot and dense baryonic matter under extreme conditions, search for the phase transition and critical point;
- study of the nucleon spin nature and polarised phenomena.

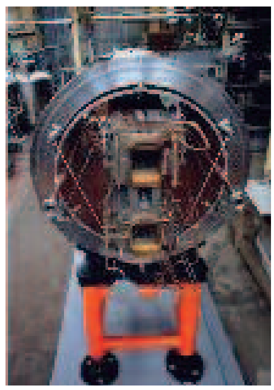
Ring circumference, m	503,04
Number of bunches	22
r.m.s. bunch length, m	0.6
β, m	0.35
max. int. Energy, Gev/u	11,0
r.m.s. Δp/p, 10^{-3}	1,6
IBS growth time, s	1800
Luminosity, $cm^{-2}\ s^{-1}$	$1{\cdot}10^{27}$

The agreement between the Government of the RF and JINR on the establishment and operation of the NICA Complex of Superconducting Rings for Heavy Ion Colliding Beams was signed on the 27th of April 2016.

Collider structure and main parameters:

magnetic field — 45 T·m; energy — 4.5 GeV/u for Au^{79+}





Workshop for SC magnet fabrication & certification

Special area for fabrication, tests and certification of SC magnets for **the Booster and the Collider of the NICA Complex** and for the **FAIR SIS 100** accelerator is in operation.

Full number of SC magnets (dipoles, quadruples, correctors) to be produced: for **NICA** — **360** units, for **SIS 100** — 310 units. The workshop productivity — **3** units per week.

Mass production of the Booster magnets started 28.11.2016

Workshop areas:

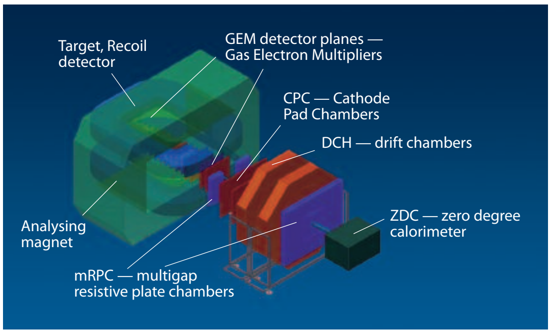
- fabrication of SC coils;
- mechanical assembly;
- magnetic measurements;
- vacuum tests;
- cryogenic tests.

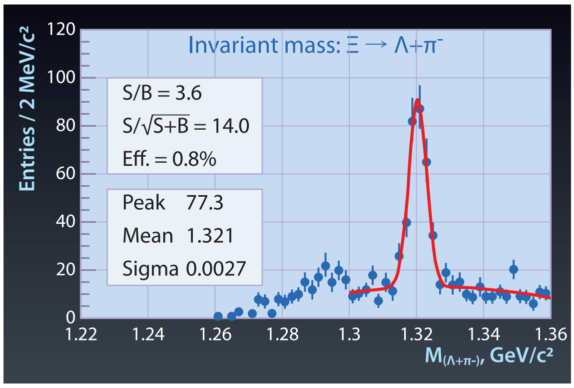
BM@N

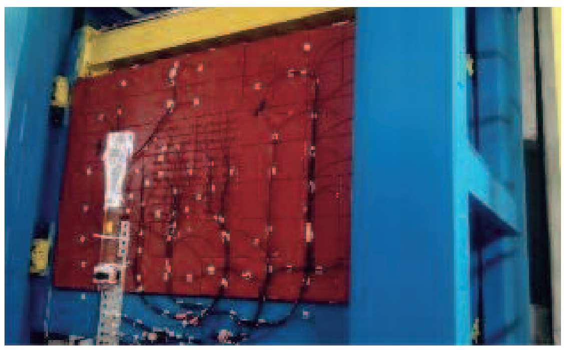
Fixed-target experiment, 1st stage of NICA; the experiment is currently operating.

Scientific programme:

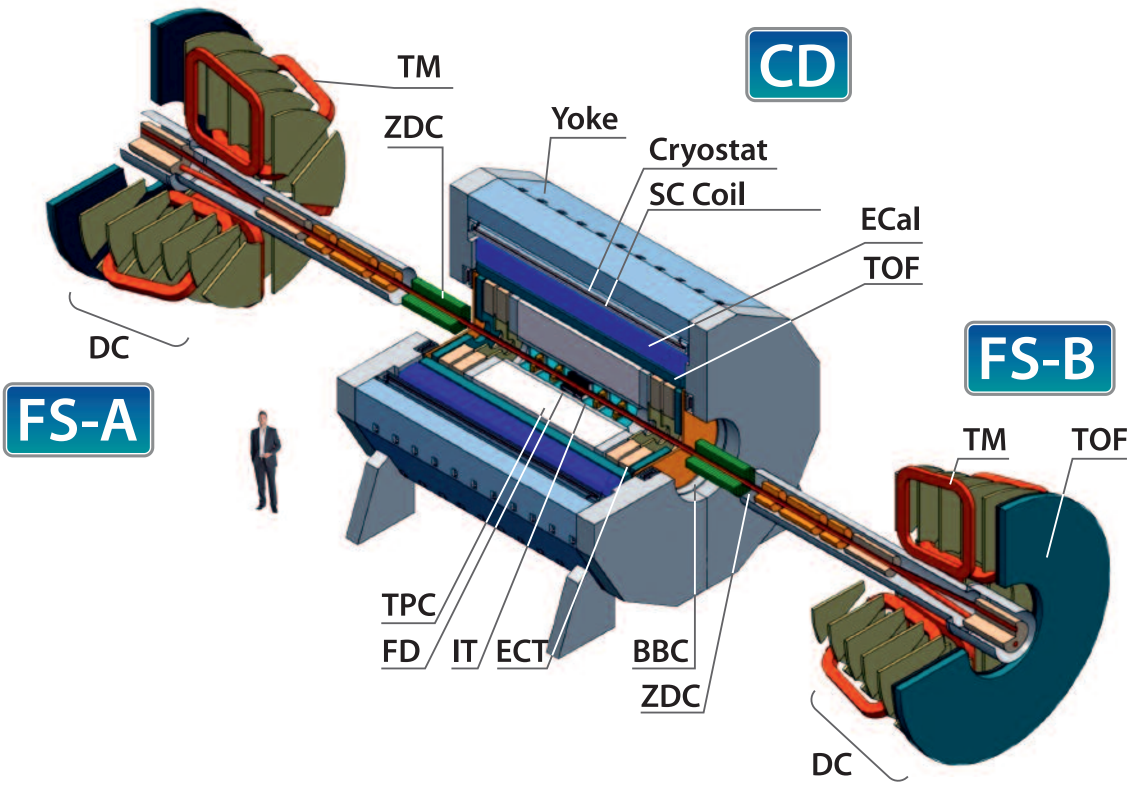
study of hyperon & hypernuclei production, hadron femtoscopy, in-medium effects on strange & vector mesons, electromagnetic probes (optional).







MPD



Main parameters:

9 m in length, 6 m in diameter;
Magnet: 0.66 T, SC solenoid;
Tracking: TPC, IT, ECT;
Particle ID: TOF, ECal, TPC;
T0, Triggering: FFD;
Centrality, Event plane: ZDC.

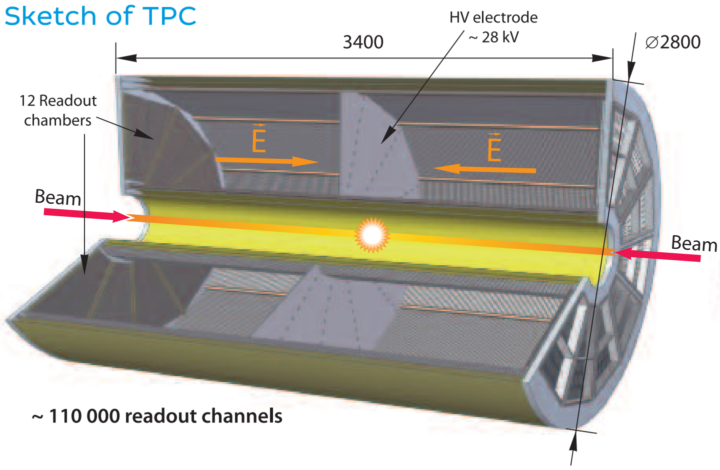
MPD first-stage programme:

- search for phase transitions (observables — particle yields and spectra), including partial restoration of chiral symmetry (observables — yields of dileptons);
- search for the critical endpoint (observables — event-by-event fluctuations, particle correlations).

MPD TPC workshop

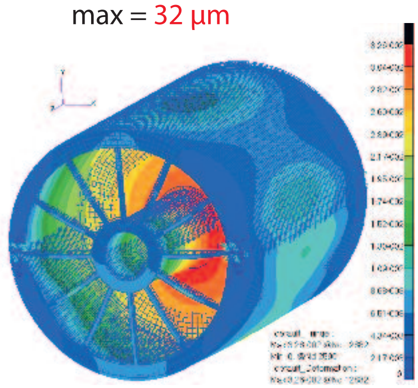
Main tracking & PID detector; the works are going according to schedule.

Sketch of TPC



TPC deformation:

max = 32 μm

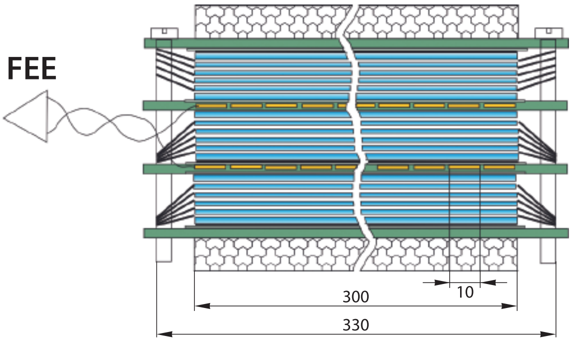


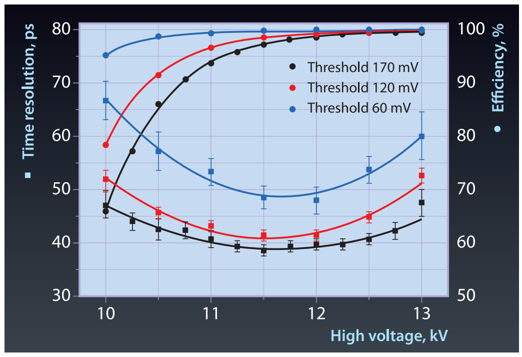
Gas system:
delivery to JINR in I 2017

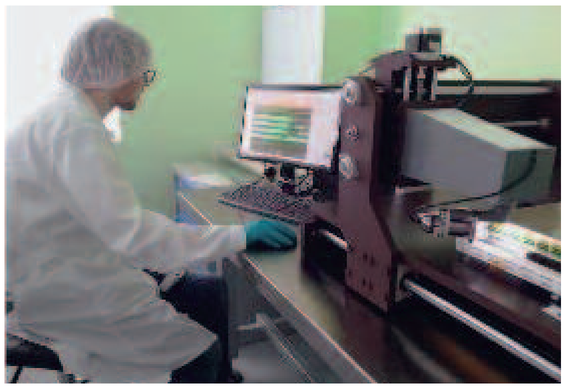
RoC chambers preparation

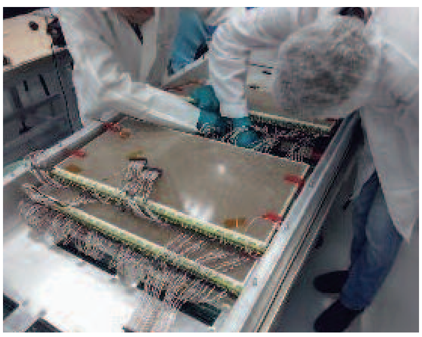
MPD TOF workshop

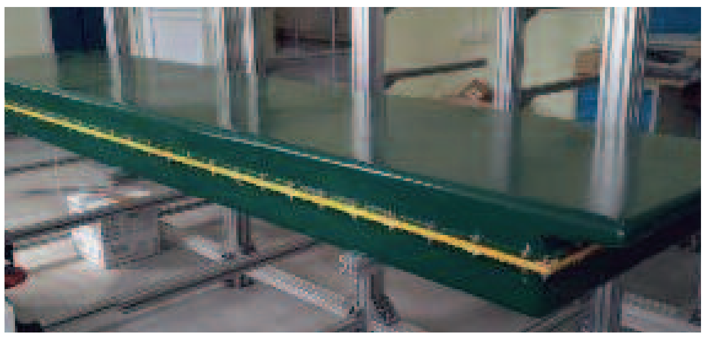
Provides PID; Active area of TOF barrel ~56 m².
Number of channels: 13824.

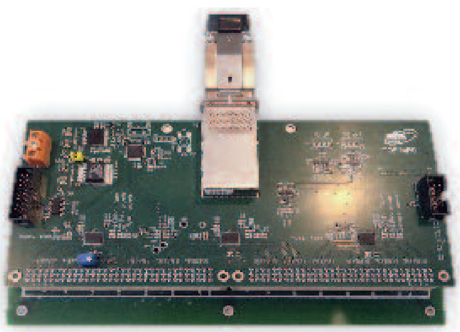


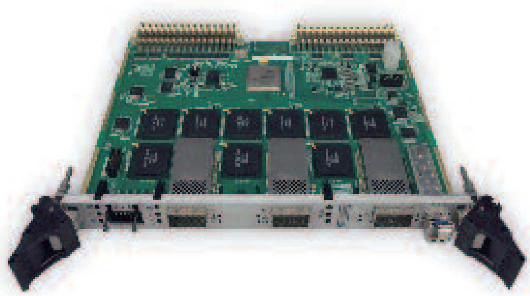






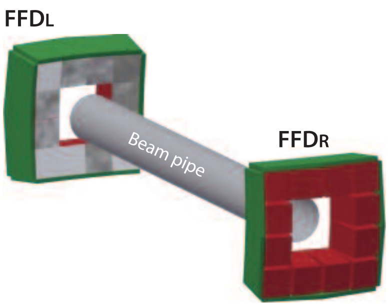


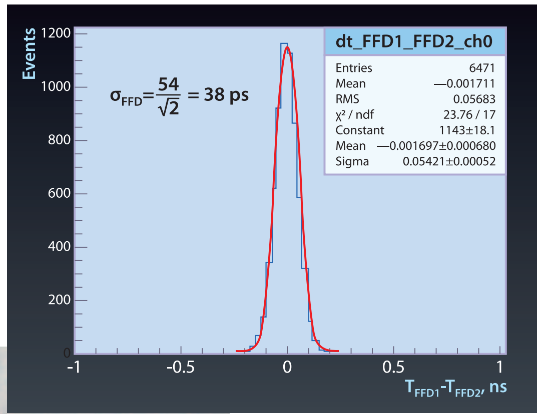


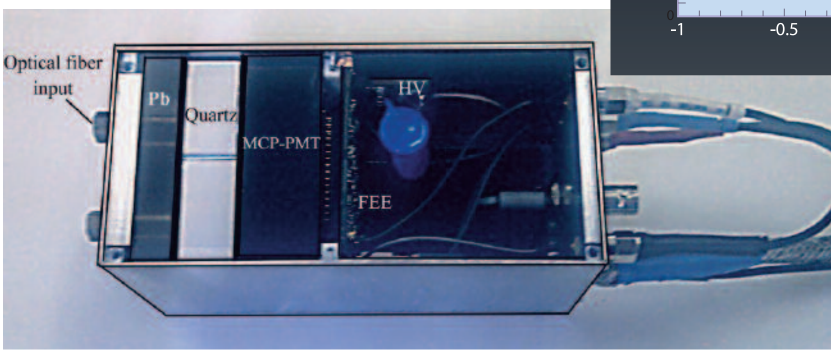


MPD FFD

Provides: T_0 for TOF, beam adjustment & L0 collision trigger.
The achieved time resolution fits the requirement.
Status: production according to schedule.



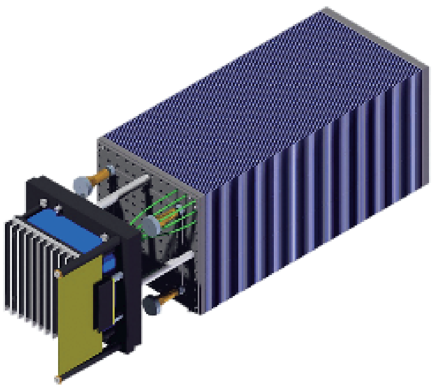


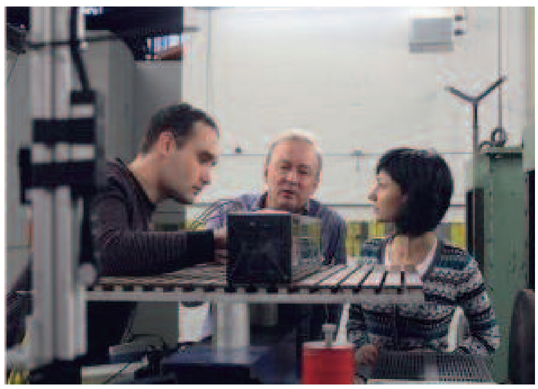


FFD prototype module

MPD ECal

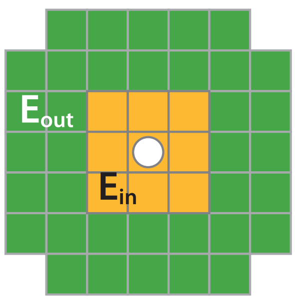
PID; L ~ 14 X_0, Pb+Scint. readout: WLS fibers + MAPD





MPD FHCal

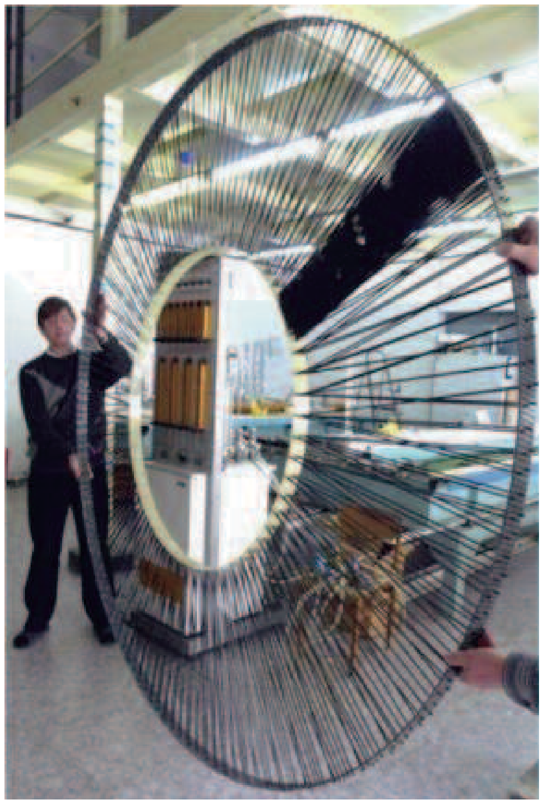
Allows centrality determination.
Status: production.



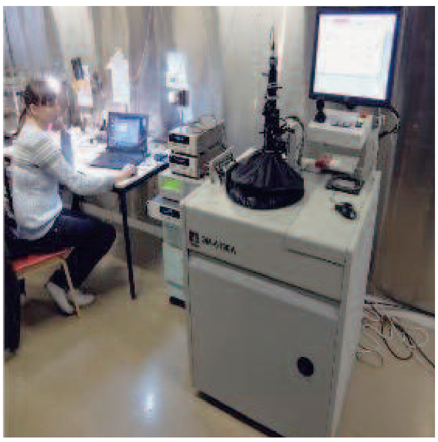
Straw Tube Tracker workshop

Provides tracking; the CBM-MPD consortium for R&D and production of inner tracker (IT) modules.

CERN & JINR have signed an MoU for manufacturing the STS carbon fiber space frames for NICA (BM@N & MPD) and FAIR.



Prototype (wheel) of the detector



The clean room workshop started operation in 2015.

MPD Silicon inner tracker workshop

Provides tracking in the MPD endcap; a unique technology of weightless large-area drift tube detectors has been developed at JINR.

Used at COMPASS, ATLAS, CBM, BM@N, MPD and other experiments.

Cryogenic complex

Nuclotron cryogenic system represents a rather enterprising project involving a large number of technical ideas and solutions never used before:

- Fast-cycling superconducting magnets;
- Refrigeration by two-phase helium flow;
- Unusually short cooldown time to liquid helium temperature;
- Parallel connection about 150 cooling channels;
- Usage of jet pumps for circulating of liquid helium;
- «Wet» turboexpanders;
- Screw helium compressors with a pressure rise of more than 25.

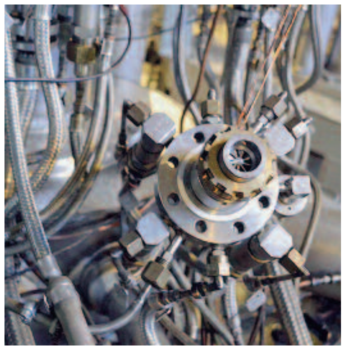
It has allowed the creation of a system which is not only very efficient and reliable, but also unusually inexpensive.

Complex cooling power:

Current — 4 kW at 4,5K;

Expected in 2020 — 8 kW at 4,5K.

In 2016, a new helium liquefier, the most powerful in the RF, with productivity of 1100 l/h, was put in operation.



Flerov Laboratory of Nuclear Reactions

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

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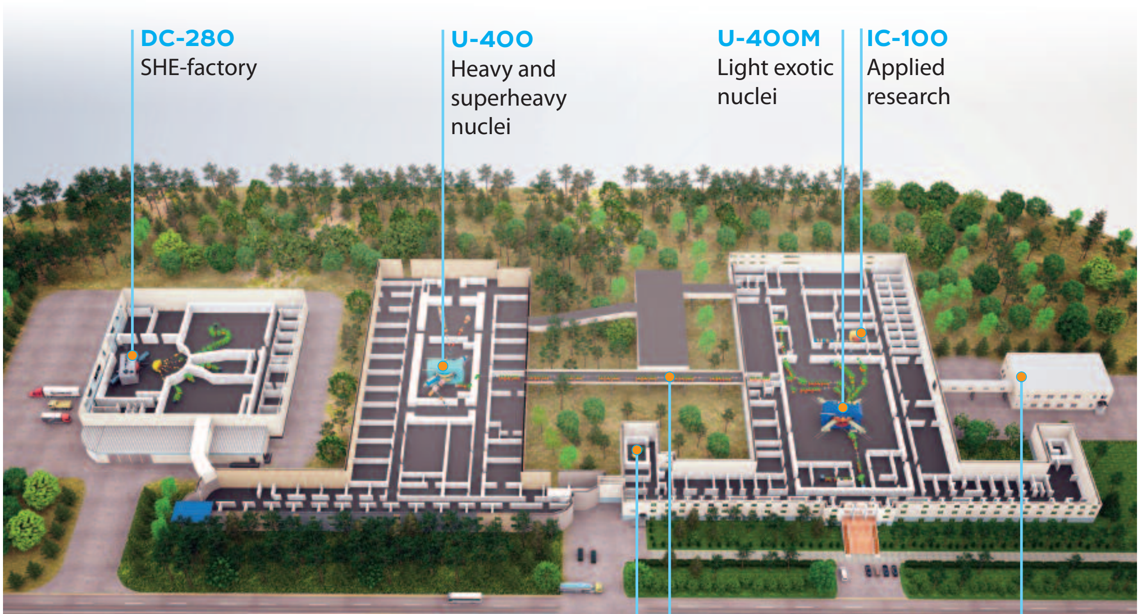
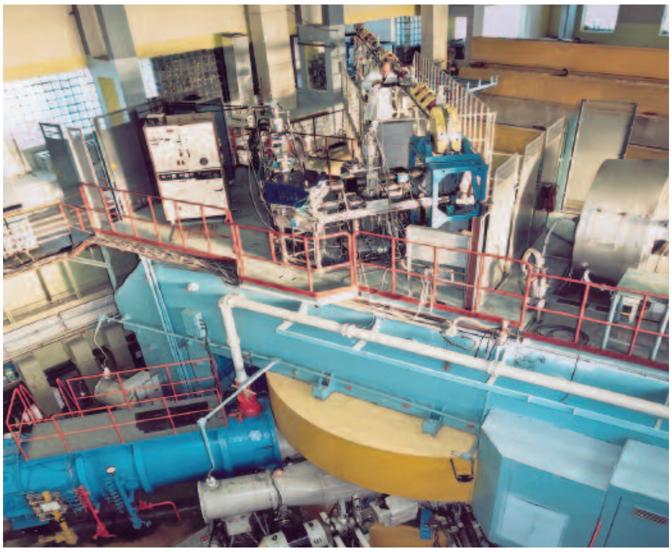
DRIBS-III accelerator complex



Flerov Laboratory of Nuclear Reactions' basic directions of research:

- Heavy and superheavy nuclei;
- Light exotic nuclei;
- Radiation effects and physical groundwork of nanotechnology;
- Accelerator technologies.

U-400 accelerator complex



Nuclear spectroscopy and reaction mechanisms

Commissioned: 1978;
Modernised: 1996;
Reconstruction: 2020–2023 (plan).

Main parameters

Energy range	3÷21 MeV/A
K factor max.	650
Pole diameter	4 m
Magnet weight	2100 t
Magnet power	850 kW
Vacuum	10^{-7} Torr

Ion	Ion energies, MeV/A	Output intensity, pps
$^{16}O^{2+}$	5.7; 7.9	3×10^{13}
$^{18}O^{3+}$	7.8; 10.5; 15.8	2.6×10^{13}
$^{40}Ar^{4+}$	3.8; 5.1	1×10^{13}
$^{48}Ca^{5+}$	3.7; 5.3	7.2×10^{12}
$^{48}Ca^{9+}$	8.9; 11; 17.7	6×10^{12}
$^{50}Ti^{5+}$	3.6; 5.1	2.4×10^{12}
$^{58}Fe^{6+}$	3.8; 5.4	4.2×10^{12}
$^{84}Kr^{8+}$	3.1; 4.4	1.8×10^{12}
$^{136}Xe^{14+}$	3.3; 4.6; 6.9	4.8×10^{11}
$^{160}Gd^{19+}$	5.5	6×10^{10}
$^{209}Bi^{19+}$	3.4	6×10^{10}

Tasks:

Stand-alone mode:

- Synthesis of superheavy elements (SHE);
- Chemistry of SHE;
- Nuclear & laser spectroscopy;
- Nuclear reactions: fusion, fusion-fission & quasifission, multinucleon transfer reactions;
- Applied research.

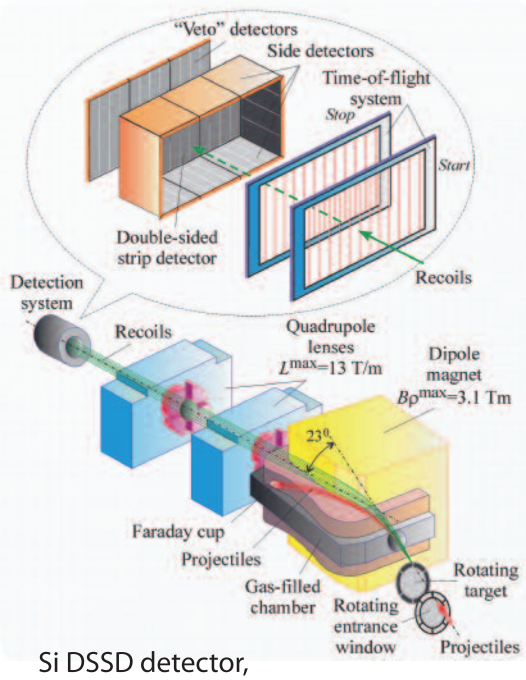
Post-accelerator mode:

- Reactions with exotic nuclei;
- Structure of light exotic nuclei.

Experimental setups:

- Gas-Filled Recoil Separator (GFRS-I);
- Separator for Heavy Element Spectroscopy (SHELS);
- Radiochemical setups;
- Double-arm time-of-flight spectrometer (CORSET);
- Magnetic Analyser of High Resolution (MAVR).

Gas-Filled Recoil Separator (GFRS-I)



Si DSSD detector,
48×128 1 mm strips;
Digital electronics.

Synthesis and decay properties.

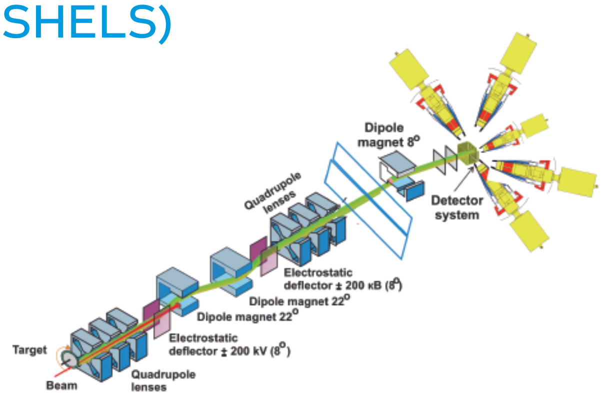
Technical parameters

Bending radius	1.8 m
Max. magnetic rigidity Bρ	3.1 T·m
Bending angle	23°
Dispersion	7.5 mm/1% Bρ
Total length	4.2 m
Horizontal acceptance	±3°
Vertical acceptance	±2°

Transmission efficiency

Reaction	CN	ε, %
$^{238}U + ^{18}O$	^{256}Fm	3
$^{244}Pu + ^{22}Ne$	^{257}No	6
$^{238}U + ^{18}O$	^{266}Rf	6
$^{238}U + ^{26}Mg$	^{264}Rf	10
$^{207}Pb + ^{34}S$	^{241}Cf	35
$^{207}Pb + ^{40}Ar$	^{247}Fm	45
$^{238}U – ^{249}Cf + ^{48}Ca$	$^{286}Cn – ^{297}Og$	35–40

Separator For Heavy Element Spectroscopy (SHELS)



Si DSSD detector,
100×100 mm², 128×128 strips;

High-resolution electronics;
4 Ge single crystal detectors,
1 Clover Ge detector.

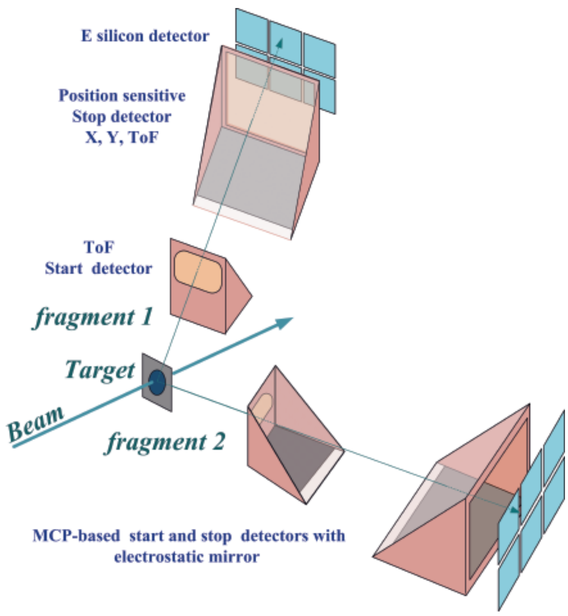
Reaction	Transmission efficiency
$^{22}Ne(^{197}Au,5n)^{214}Ac$	0.1
$^{40}Ar(^{208}Pb,3n)^{245}Fm$	0.3
$^{48}Ca(^{208}Pb,2n)^{254}No$	0.35
$^{50}Ti(^{208}Pb,2n)^{256}Rf$	0.4

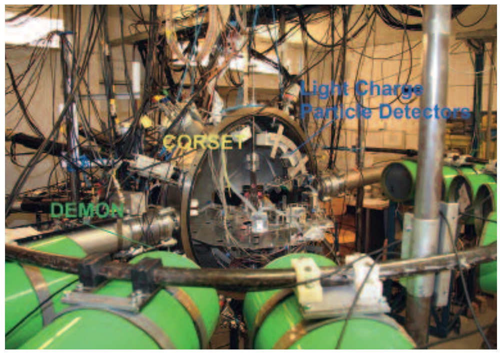
E_{gamma}, keV	Detection eff.
100	34%
200	26%
300	22%
400	17%
500	14%

Study of nuclear reaction mechanisms and α-, β-, γ-, n-spectroscopy of heavy and SH nuclei.

Double-arm time-of-flight spectrometer (CORSET)

Study of the mechanisms of heavy-ion-induced reactions (fusion-fission, quasifission and deep inelastic processes)

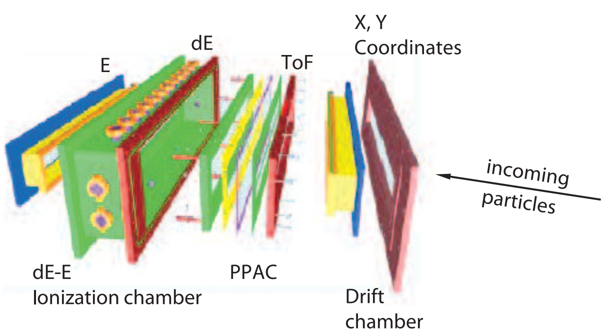




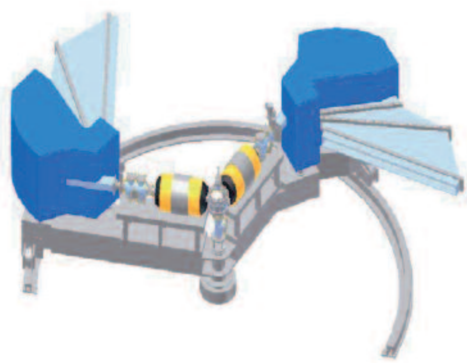
Time resolution	150–180 ps
ToF base	10–30 cm
ToF arm rotation range	15°–165°
Solid angle	100–200 msr
Angular resolution	0.3°
Mass resolution	2–4 u
Energy resolution	1%

Magnetic Analyser of High Resolution (MAVR)

Focal plane detector system



Configuration: QQDD

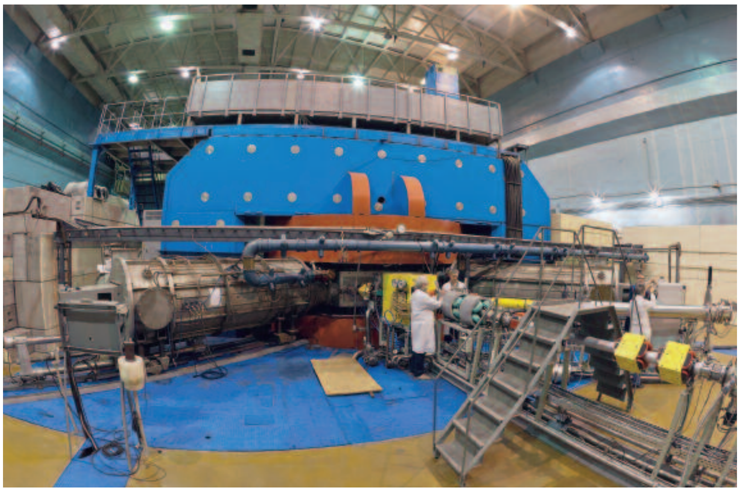


Main parameters

Dispersion in the focal plane	1.9 cm/%
$\Delta p/p$	10%
$B\rho$	1.5 Tm
Solid angle	30 msr
Energy resolution $\Delta E/E$	5×10^{-4}

Separation, detection and identification of nuclear reaction products in a wide range of masses (5÷150) and charges (1÷60).

U-400M accelerator complex



Experiments with radioactive ion beams

Commissioned: 1991;
Modernised: 1996;
Reconstruction: 2019 (plan).

Main parameters

Energy range	5÷10 & 25÷55 MeV/A
K factor max.	550
Pole diameter	4 m
Magnet weight	2300 t
Magnet power	1000 kW
Vacuum	10^{-7} Torr

Beams (examples)

Ion	Ion energies, MeV/A	Output intensity, pps
^{7}Li	35	6×10^{13}
^{40}Ar	40	1×10^{12}
^{84}Kr	27	2×10^{10}
^{132}Xe	25	1×10^{9}
^{48}Ca	4.5–9	3×10^{12}
^{84}Kr	4.5–9	1×10^{11}
^{132}Xe	4.5–9	1×10^{10}
^{209}Bi	4.5–9	1×10^{10}

Tasks:

Stand-alone mode:

- Properties and structure of light exotic nuclei;
- Reactions with exotic nuclei;
- Decay properties of nuclei at drip lines;
- Mass & laser spectroscopy of heavy nuclei;
- Applied research.

Driving accelerator mode:

- Production of beams of radioactive nuclei.

Experimental setups (high-energy mode):

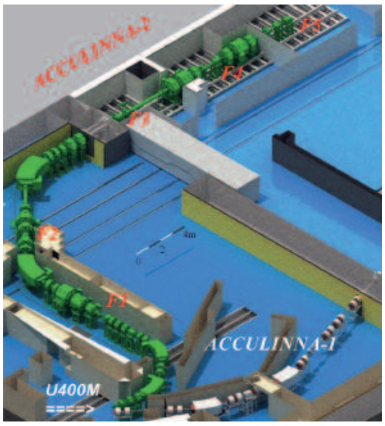
- ACCULINNA-1 fragment separator;
- ACCULINNA-2 fragment separator;
- COMBAS fragment separator.

Experimental setups (low-energy mode):

- Mass Analyser of SuperHeavy Atoms (MASHA);
- Gas-cell-based Laser ionisation Setup (GaLS);
- Correlation setup for reaction products registration (CORSAR).

Fragment separators ACCULINNA-I, II

Experiments with radioactive beams with $Z \leq 36$

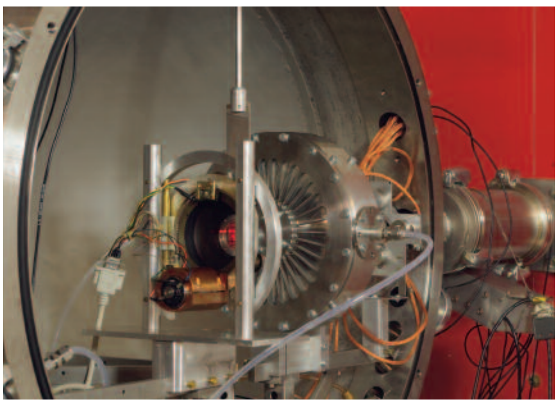


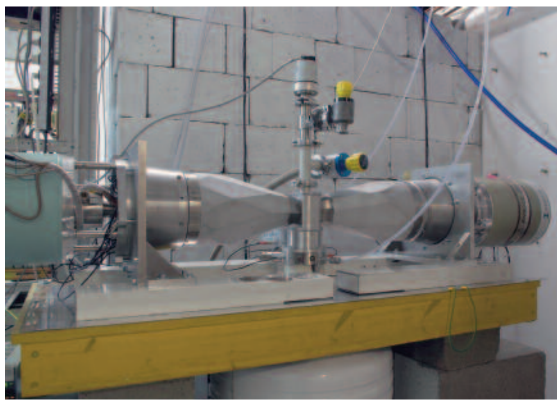
http://aculina.jinr.ru/acc-2.php

RIB*	Intensity, pps (at 1pμA)	Energy, MeV/A
^{6}He	4×10^{7}	22
^{6}He	1×10^{7}	13
^{8}He	8×10^{4}	23
^{11}Li	7×10^{3}	33
^{14}Be	2×10^{3}	35
^{15}B	4×10^{5}	32
^{16}C	2×10^{7}	29
^{18}C	1×10^{4}	25
^{24}O	2×10^{3}	23
^{8}B	2×10^{6}	16
^{13}O	1×10^{6}	24
^{17}Ne	2×10^{6}	30
^{24}Si	7×10^{3}	12
^{28}S	1×10^{3}	38

* expected RIB's characteristics at ACCULINNA-2; RIB's intensities for ACCULINNA-1 are lower by a factor of ~20

Correlation Setup for Reaction Products Registration (CORSAR)





Main parameters

Transportation of a reaction	Gas jet, aerosol jet, and magnetic tape
Cross section limit	10 μb
Half-life limit	5 sec
Registration	β-γ-γ coincidence

Purpose:

Identification and investigation of the properties of neutron-rich heavy nuclei in the region of nuclei near N = 126.

Fragment Separator COMBAS

Main parameters

$B\rho_{max}$, Tm	4.5
Solid angle (maximum), msr	6.4
Momentum acceptance (maximum), %	20
Momentum dispersion (in the linear approximation), cm/%	1.53
Momentum resolution, FWHM	4360
Full length of the channel, m	14.5

Gas-cell-based Laser ionisation Setup (GaLS)

Laser system specifications:

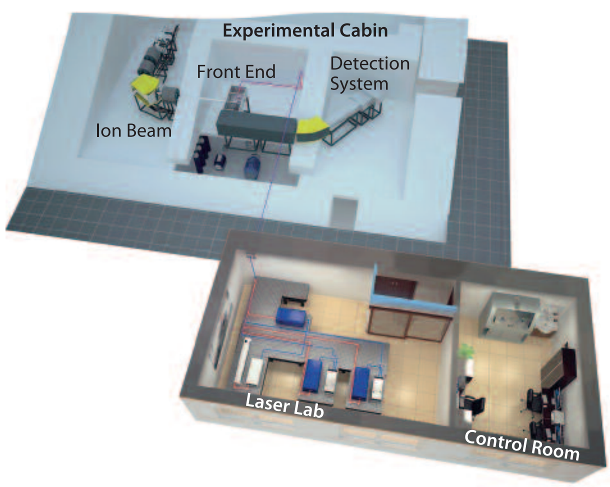
Type	Output power Main&harmonic, W, (2nd),{3rd, 4th}	Pulse frequency, Hz	Pulse length, ns	Wave length, nm
Dye laser	**3, (0.3)**	**10^4**	**10–30**	**213–850**
Ti:Sapphire	2, (0.2), {0.04}	10^4	30–50	680–960
Nd:YAG	**(80–100), {20–40}**	**10^4**	**10–50**	**532**
Matisse system				
Ring dye	0.8–6	cw	cw	540–900
Ti:Sapphir	0.8–6.5	cw	cw	700–1000

Mass-separator specifications:

Bending radius	1 m
Bending angle	90˚
Rigidity of about	0.5 T·m
Dipole gap	60 mm
Mass resolution	1400
Focal plane length	~ 1m
Weight	1800 kg

Synthesis and properties of heavy neutron-rich nuclei produced in multinucleon transfer reactions.

General view of the GaLS setup



Superheavy Elements Factory

Commissioning: 2018.

DC-280 accelerator complex

Main parameters

Energy range	4÷8 MeV/A
K factor max.	280
Pole diameter	4 m
Magnet weight	1000 t
Magnet power	300 kW
Vacuum	10^{-7} Torr

Beams (examples)

Ion	Ion energy, MeV/A	Estimated output intensity, pps
^{7}Li	4	1×10^{14}
^{18}O	8	1×10^{14}
^{40}Ar	6	6×10^{13}
^{48}Ca	6	6×10^{13}
^{54}Cr	6	2×10^{13}
^{58}Fe	6	1×10^{13}
^{124}Sn	6	2×10^{12}
^{136}Xe	6	1×10^{14}
^{238}U	7	5×10^{10}

Tasks:

Experiments at extremely low (σ<100 fb) cross sections:

- Synthesis of new SHE in reactions with ^{50}Ti, ^{54}Cr …;
- Synthesis of new isotopes of SHE;
- Study of decay properties of SHE;
- Study of excitation functions.

Experiments requiring high statistics:

- Nuclear spectroscopy of SHE;
- Precise mass measurements;
- Study of chemical properties of SHE.

Main setups:

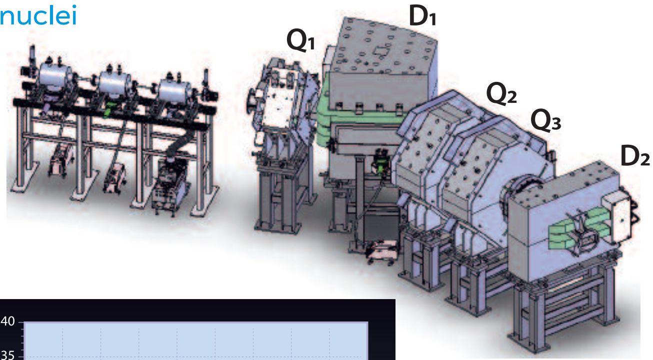
- Gas-Filled Recoil Separator (GFRS-II);
- Preseparator for chemical investigations;
- Separator for Heavy Element Spectroscopy: velocity filter SHELS — from U-400;
- Mass Analyser of SuperHeavy Atoms (MASHA) — from U-400M;
- Channels reserved for external users.

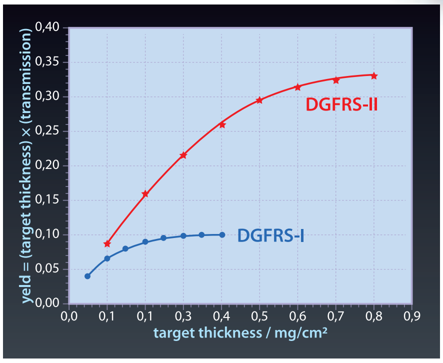
Gas-Filled Recoil Separator (GFRS-II)

Synthesis and study of superheavy nuclei

Technical parameters

Magnetic configuration	$Q_vD_hQ_vQ_hD$
Bending radius D_1	1.8 m
Max. magnetic rigidity D_1	3.2 T·m
Bending angle D_1	30°
Bending radius D_2	1.8 m
Max. magnetic rigidity D_2	3.2 T·m
Bending angle D_2	10°
Total length	7.1 m

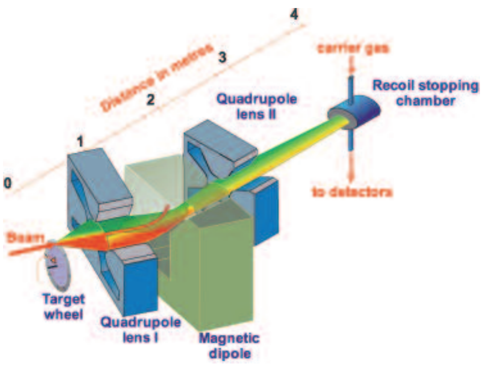




Si DSSD detector, 48×128 1-mm strips; Digital electronics.

Commissioning: 2018.

Superconducting Preseparator for SHE chemistry



Interface for transport of nuclear reaction products to radiochemical setups for study of the properties of SHE in the elementary state and investigations of the behavior of their chemical compounds.

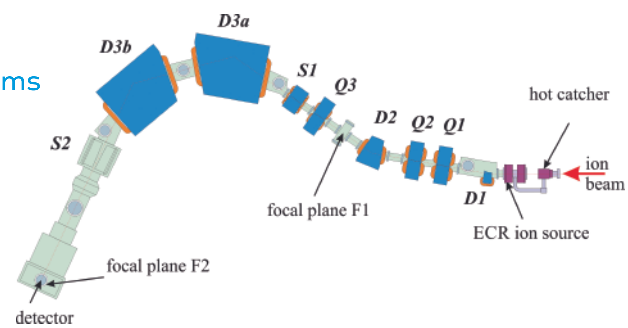
Commissioning: 2019.

Separator MASHA

for Mass Analysis of SuperHeavy Atoms

Main parameters

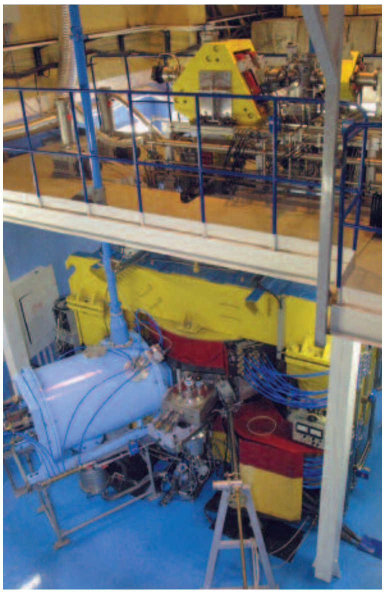
Mass resolution	~ 3000
Ion source efficiency for noble gases	~ 84%
Separation efficiency for short-lived mercury isotopes	~ 7%



1 — target box with hot catcher;
2 — ion source;
3 — mass analyser;
4 — focal plane detector.

Applied research

IC-100 cyclotron

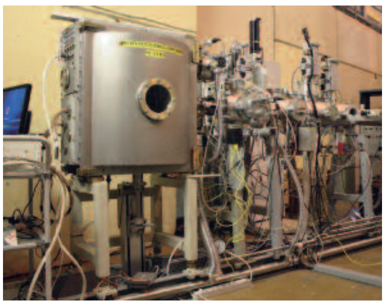


Parameters

Accelerated ions	$^{22}Ne^{+4}$ $^{40}Ar^{+7}$ $^{56}Fe^{+10}$ $^{86}Kr^{+15}$ $^{127}I^{+22}$ $^{123}Xe^{+23}$ $^{132}Xe^{+24}$ $^{182}W^{+32}$ $^{184}W^{+31}$ $^{184}W^{+32}$
A/Z ratio	5.5–5.95
Ion energy	0.9–1.2 MeV/A
Pole diameter	1 m
Vacuum	$5 \cdot 10^{-8}$ Torr
$^{86}Kr^{15+}$ beam intensity	$1.4 \cdot 10^{12}$ pps
$^{123}Xe^{23+}$ beam intensity	~ 10^{12} pps

Setups:

- Polymer film irradiation unit with uniform implantation into a 600x200 mm target;
- Box for materials science research.



Radiation hardness control of electronic components for space applications.

Microtron MT-25

Parameters

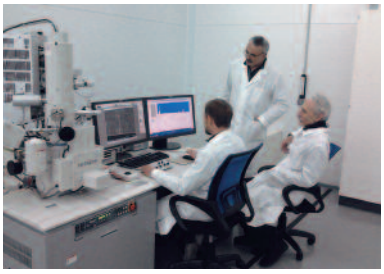
Energy range	5 to 25 MeV
Pulsed beam current	20 mA
γ-ray flux	10^{14} pps
Thermal neutron flux	10^{9} pps cm^{-2}
Fast neutron flux	10^{12} pps

Applications:

- γ-activation analysis;
- neutron activation analysis;
- isotope production for analytical purposes;
- study of nuclear reactions induced by γ-quanta.

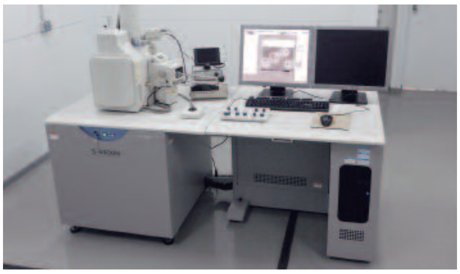
Nanolab

Scanning electron microscopy



FESEM, Hitachi SU8020

Resolution of 1 nm at 15 kV;
X-ray element microanalysis (EDS);
Deceleration mode (500 eV).



SEM, Hitachi S3400N

Resolution of 1 nm at 15 kV;
EDS, WDS;
Electron backscattering diffraction.

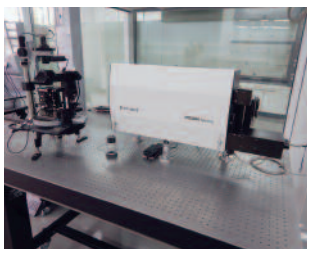
Multifunctional chemical laboratory

Studies of heavy ion irradiation effects, modification of materials, polymers, membranes.

X-ray photoelectron spectroscopy K-Alpha

Chemical analysis of thin layers and surfaces.

NTEGRA Spectra – Atomic force microscopy (AFM)/ Confocal Raman & Fluorescence



Studies of nanostructures induced by single ion impact on the surface of solids; depth-resolved Raman and photoluminescence spectra.

Porolux capillary porometer

Precise characterisation of ultra- and microfiltration membranes.

KRUESS DSA100 system

Investigations of static and dynamic wetting phenomena.

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 Frank Laboratory of Neutron Physics (FLNP).

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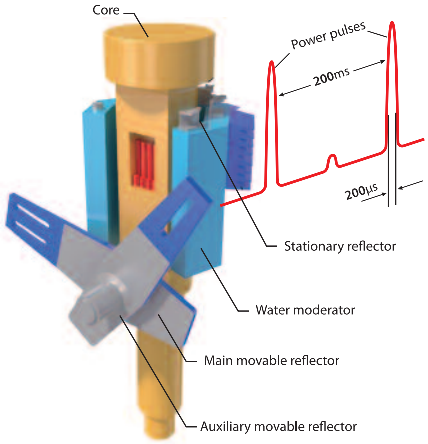
IBR-2 pulsed fast reactor of periodic operation

High-flux neutron source



Commissioned: 1984;

Modernised: 2007–2010.

Operational parameters:

- ~ 2500 h per year;
- 9 ÷10 cycles per year with thermal and cryogenic moderators.

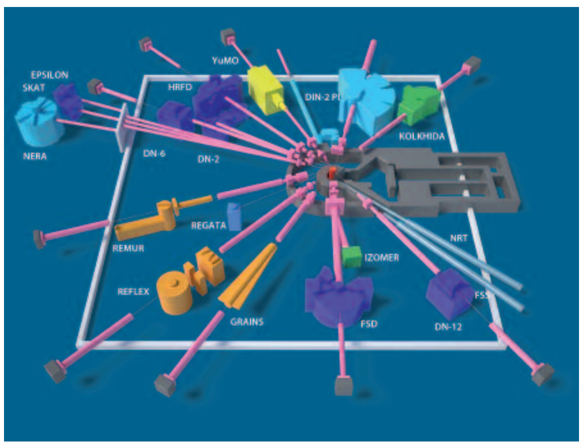
Technical parameters

Power, MW • Mean value • Burst maximum	 2 1850
Fuel	PuO_2
Pulse repetition rate, Hz	5
Pulse half width, µs • fast neutrons • thermal neutrons	 200 340
Thermal neutron flux density from the surface of the moderator • Time average • Burst maximum	 $\sim 10^{13}$ n/cm² s $\sim 10^{16}$ n/cm² s

Open access facility:

http://ibr-2.jinr.ru/

Technique	Nr. of instruments
Diffraction	7
SANS	1
Reflectometry	3
Inelastic scattering	2
Neutron imaging	1
NAA setup	1
Irradiation and test facility	1
Nuclear physics	2

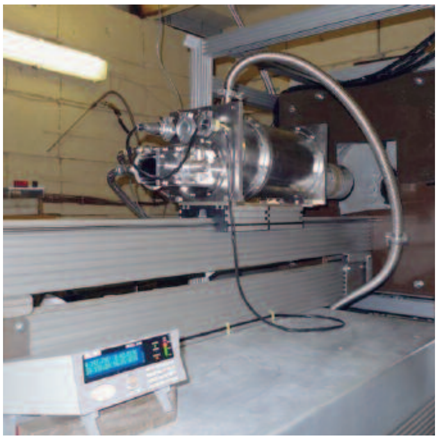


Expert Commissions:

- Atomic and Magnetic Structure;
- Lattice and Molecular Dynamics;
- Nanosystems and Soft Matter.

DN-6

Neutron diffractometer for investigations of microsamples at high pressure



Parameters

Distance • moderator sample • sample detector	 29.6 m 0.4 m
Ranges: • wavelengths • scattering angles • d-spacing	 0.8 – 12 Å 45° – 90° 0.5 - 6 Å
Resolution (d/d, d=2 Å): at Θ=90°	0.020
Solid angle of detector system	1 sr.
Typical sample volume	0.1–5 mm^3
Pressure range • with sapphire anvils • with diamond anvils	 5 –10 Gpa up to 25 GPa
Temperature range	10 – 300 K

Task:

Determination of parameters of crystal and magnetic structure of materials as a function of external pressures.

NRT

Spectrometer for neutron imaging

Parameters

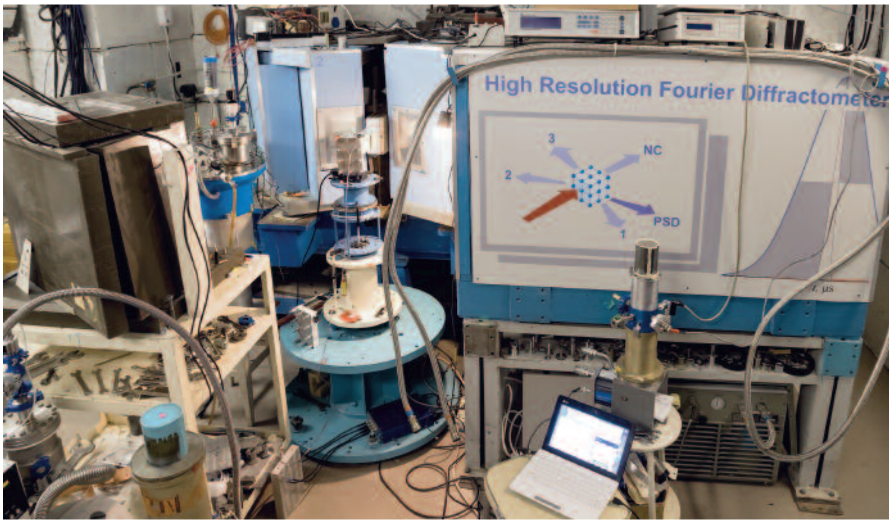
L/D ratio Aperture diameter D Distance between the input aperture and the sample L Beam dimension: Field of view (FOV) Neutron beam flux	200 – 2000 10 – 50 mm 10 m 20×20 cm^2 5.5(2)×10^6 n/cm^2/s
CCD camera type Active pixels Pixel size, μm CCD chip area, mm Digitisation Cooling method	VIDEOSCAN-11002-2001 4008×2672 9×9 36×24 12 Bits Peltier element
Scintillator screen specifics	^{6}LiF/ZnS scintillator Gadox scintillator
Spatial resolution	270 μm 150 μm in HR mode
Imaging data processing	ImageJ, H-PITRE, VGStudio MAX 2.2 software

Task:

Neutron imaging in archeology, materials science and engineering.

HRFD

High-Resolution Fourier Diffractometer



Parameters

Neutron beam cross section at the sample position	15 × 100 mm
Fourier chopper (disk-type)	Al alloy
— max modulation frequency	102.4 kHz
— effective pulse width	≈ 10 μs
Main detectors at $2\theta = 90°$ and $2\theta = 152°$	^{6}Li, time-focusing
Detector for large d_{hkl}	^{3}He, PSD, $\Delta x \approx 1.8$ mm, $2\theta \approx 30°$
Aperture of the main detectors	0.16 sr ($2\theta = 152°$), 0.04 sr ($2\theta = 90°$)
Wavelength range	0.9 – 8 Å
d_{hkl} range: high resolution medium resolution	0.7 – 4 Å 1 – 16 Å
Neutron flux at the sample position	~ $1.3 \cdot 10^7$ n/cm²/s
Standard sample volume	~ 1 cm³
Resolution ($\Delta d/d$) for $2\theta = 152°$, d = 2 Å	~ 0.001

Sample environment equipment:

- Air furnace (from RT up to 500 °C);
- Vacuum furnace (from RT up to 1000 °C);
- Closed-cycle helium refrigerator (from RT up to 2.4 K);
- Closed-cycle helium refrigerator (from 300 °C up to 10 K);
- Electromagnet (up to 0.95 T) (this should be clarified with a responsible person)
- Galvanostat/potentiostat: 0–10 V, 0–15 A.

Task:

Determination of structural parameters of crystalline materials with high precision.

YuMO

Small-Angle Neutron Scattering setup

Task:

Determination of structural characteristics (size and shape of particles, agglomerates, pores, fractals) of nanostructured materials and nanosystems, including polymers, lipid membranes, proteins, solvents, etc.

Sample environment equipment:

- Magnetic system: B ≤ 2.5 T;
- P-V-T system:
  liquid samples;
  P ≤ 2 kBar, Vmin= 3 mL.

Parameters

Flux on the sample (thermal neutrons)	$10^7 - 4{\bullet}10^7$ n/(s cm²)
Used wavelength#	0.5 Å to 8 Å
Q-range	$7{\bullet}10^{-3} - 0.5$Å^{-1}
Specific features	Two-detector system, central-hole detectors; He^3-filled, home-made, 8 independent wires each
Size range of an object*	500 – 10Å
Intensity (AU – minimal levels)	0.01 cm^{-1}
Calibration standard	Vanadium during the experiment
Size of the beam on the sample@	14 mm diameter
Collimation system	Axial
Q-resolution	low, 5–20%
Temperature range^	4 °C - + 70 °C (standard cuvettes) -20 °C - + 130 °C (special holders)
Number of PC-controlled samples**	25
Background level	0.03 – 0.2 cm^{-1}
Mean time of measurements for one sample+	1 h
Instrument control software	SONIX/WINDOWS
Data treatment	SAS, Fitter

\# without the cold moderator

@ can be easily changed with collimators D= 8 ÷20 mm

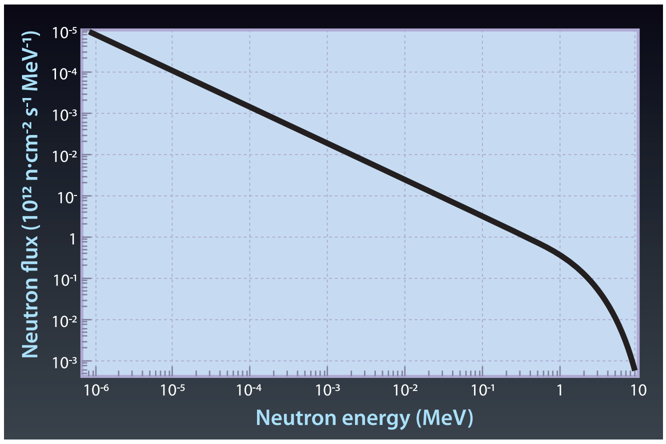
* only for estimation (Radii of gyration from 200 Å – to 10 Å)

^ Needs special holders for low and high temperatures measurements. Please address your local contact.

\+ for estimation only

** Simultaneously in a standard Hellma cell or with sample size < 20 mm* 50mm

Irradiation facility



Task:

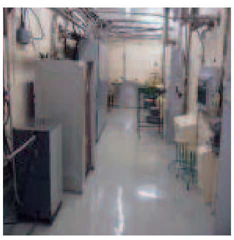
Investigation of material radiation hardness at high fluence.

Technical parameters

Irradiation cycle	11 days
Neutron range	10^{-7} – 10 MeV
Maximum sample size	200×400 mm^2
Fluence/cycle E_n>1MeV	10^{15} – 10^{18} n/cm^2
Maximal absorbed dose/cycle in water at: 40 mm 0.3 m from the moderator	 100 MGy 40 MGy

REGATA

Neutron Activation Analysis facility



Task:

Multielemental analysis in life and material sciences.

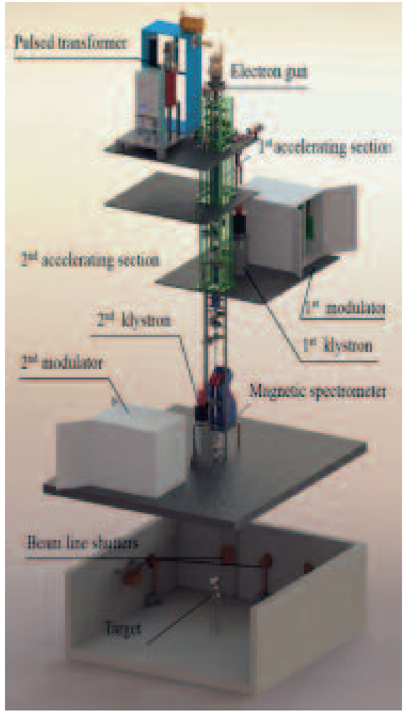
Technical parameters

Sample delivering to the irradiation	Pneumatic transport system 60 m length, P = 3–7 bar
Transportation capsule types	Polyethylene, Teflon, Al
Transportation capsule	V_{int}=3.5 – 5.5 cm^2 ∅ =16 mm, H = 22 ÷ 35 mm
Maximum t_{irr} for capsule / transportation time polyethylene teflon	 0,5 hour / 10 ÷ 20 s 3 hours / 3 ÷ 8 s
Neutron flux thermal/resonance	1,5·10^{12} n/s·cm^2 / 3,6·10^{11} n/s·cm^2
Mass of a sample depends on the sample matrix	1 mg – several grammes
HPGe detectors ε, R	4 pcs, 40 ÷ 55%, 1.8 ÷ 1.9 keV
Number of detected elements	Up to 45 depending on the matrix

IREN Facility Source of resonance neutrons

Technical parameters

Peak current, A	3
Repetition rate, Hz	50
Electron pulse duration, ns	100
Electron energy, MeV	30
Beam power, kW	0.4
Multiplication	1
Neutron intensity, n/s	10^{11}



Tasks:

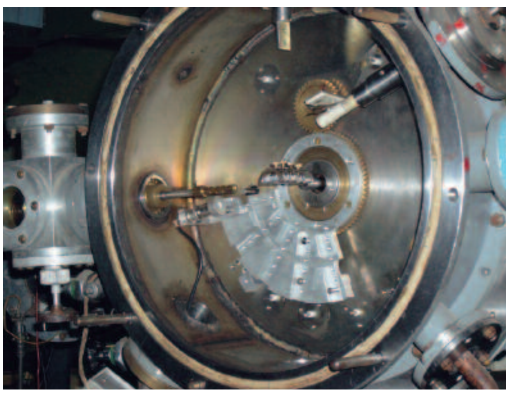
Fundamental nuclear physics

- search for violation of time invariance with polarised resonance neutrons and polarised target;
- study of parity violation in neutron-induced reactions (fission, (n,α), (n,p), (n,?));
- study of electromagnetic structure of the neutron;
- study of quantum aspects of neutron-induced fission;
- study of phase transitions in excited nuclei — chaos and order in quantum systems.

Applied nuclear physics

- nuclear data for astrophysics;
- nuclear data for technology;
- isotope analysis with resonance neutrons.

EG-5 Van de Graaff Electrostatic accelerator



Technical parameters

Energy region, MeV	0.9–3.2
Accelerated particles	H^+, D^+, $^3He^+$, $^4He^*$
Beam intensity for H^+ and D^+, μA	≤30
Beam intensity for $^3H^+$ and $^4He^*$, μA	≤10
Energy spread, eV	≤500
Number of beam lines	1
Neutron intensity, n/s	6

Tasks:

- Analytical studies using Rutherford backscattering techniques, recoil methods and techniques in nuclear reactions;
- Study of nuclear reactions with neutrons excited by beams of protons and deuterons;
- Applied research based on the methodology of tagged neutrons.

Multifunctional “CARS” microscope

Technical parameters

Main operating options	Raman spectroscopy, F-CARS, E-CARS, P-CARS, SERS, SECARS, luminescence, including upconversion
Detection options	Five channels for high-speed measurements: Raman, CARS, reflected, transmitted, luminescent
Detectable spectral range	CARS signals: 990–5000 cm^{-1}; Raman signals: 75–6000 cm^{-1}
Spectral resolution	CARS signals: 7–8 cm^{-1}; Raman signals: 1.8 cm^{-1} (grating: 600 g/mm)
Spatial resolution	CARS signals: < 0.7 µm; Raman signals: XY: < 300 nm, Z: ~ 700 nm
Scanning range (fast mode, 60× lens)	XY: 225 x 225 µm; Z: 80 µm
Spectral measurements and imaging	Monochromator/spectrograph MS5004i Digital CCD camera, Proscan, HS 101H

Tasks:

- Raman, SERS and CARS spectroscopy and microscopy of biological objects: sensitive probes of lipids, lipid bilayers, proteins, thin and small objects; fast dynamic scanning and contrast chemical imaging;
- Exploration of structural and spectral characteristics of phosphors activated with various rare-earth elements;
- Plasmon-enhanced photo- and upconversion luminescence studies.

Dzhelepov Laboratory of Nuclear Problems

The Dzhelepov Laboratory of Nuclear Problems (DLNP) is mainly occupied with the research in neutrino physics and astrophysics. Other important trends are studies in particle physics at high and superhigh energies, design and development of modern measuring equipment, applied research, proton therapy and development of a medical accelerator complex in particular. Research in neutrino properties is a traditional direction at DLNP, established by Bruno Pontecorvo.

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BAIKAL-GVD project

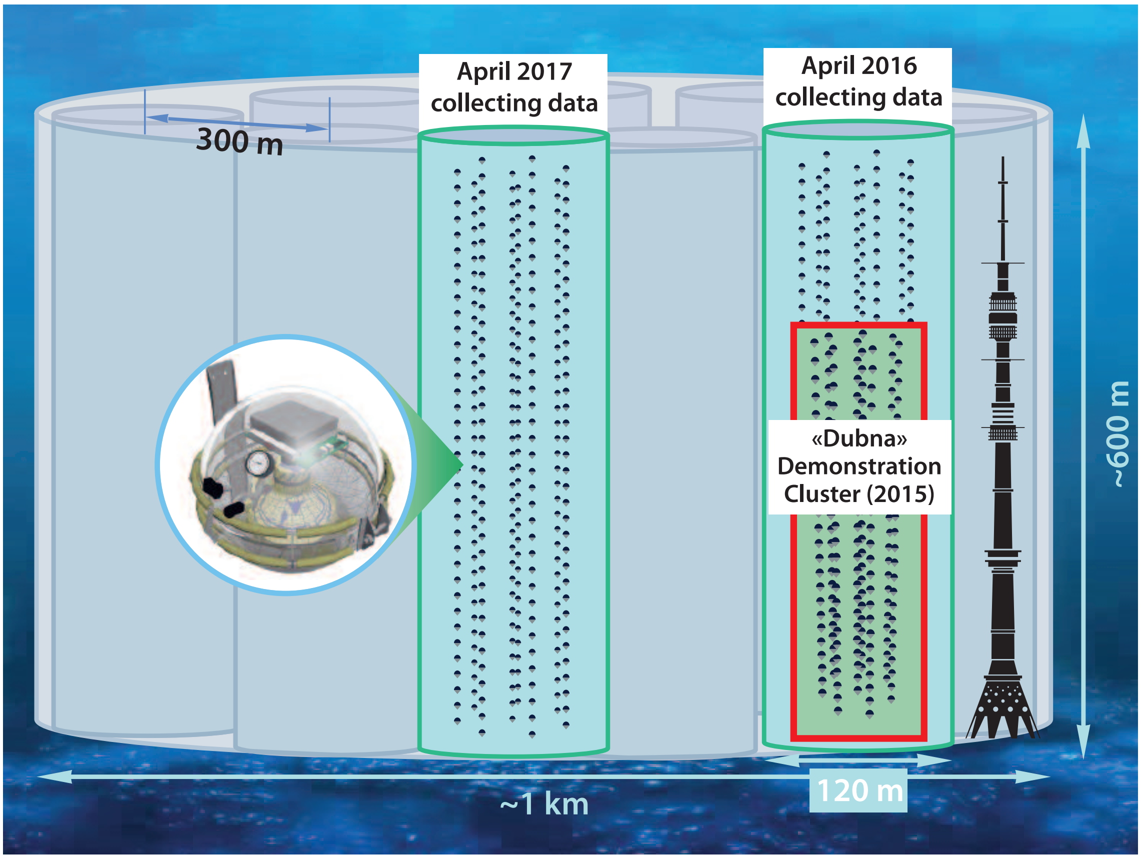
BAIKAL-GVD-1

2304 light sensors combined into 8 clusters of vertical strings at 750–1300 m depths.

Detection volume: 0.4 km³.

Objectives:

- Neutrino astrophysics above few TeV;
- Indirect search for dark matter;
- Study of exotic particles — monopoles, Q-balls, nuclearites, etc.



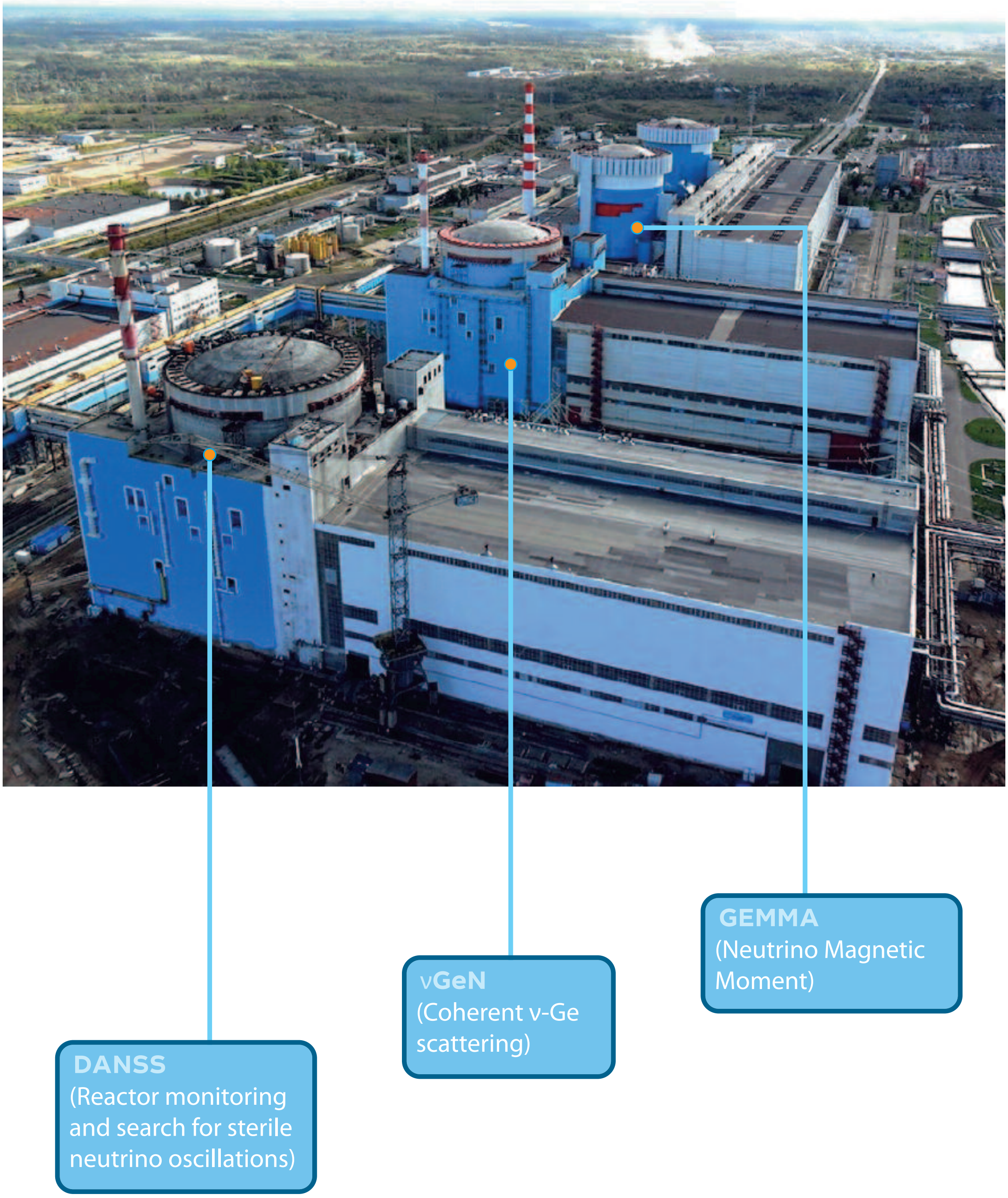
Status:

- The "DUBNA" cluster, installed in April 2015, was upgraded to its final state, with 288 optical modules, in the spring of 2016. The second cluster started operating in April 2017.
- A new facility for long-term tests of the prepared parts of the array extensions is operating.
- A new production line of optical modules for the next detector extensions is started. It allows to produce up to 10-12 optical modules per day.
- A new data data collection centre at the array site has been installed.
- A new shore lab was produced and delivered to the shore. It will be installed at the site during the summer of 2017.
- A building in Baikalsk is prepared for a local lab and a temporary store for optical modules of the next stages of the detector.

Neutrino experiments at Kalinin NPP

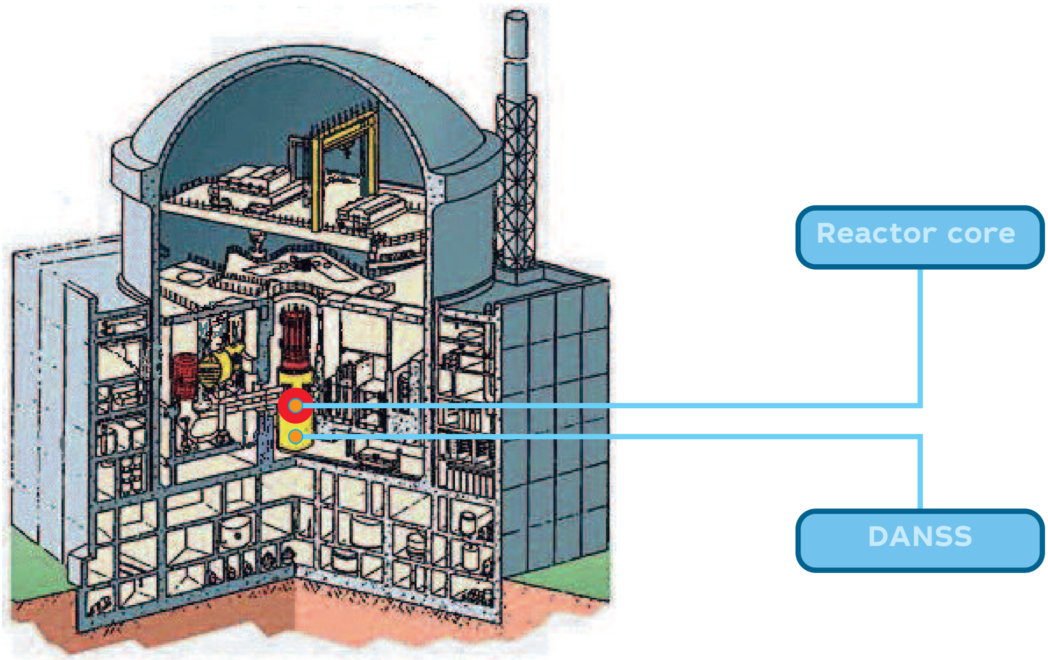
(Tver region, 285 km NW from Dubna)

Pressurised water reactor;
Thermal power — 3×100 MW;
Neutrino flux ~ $6\times10^{20}\,\bar{\nu}_e$ / 4π / day.



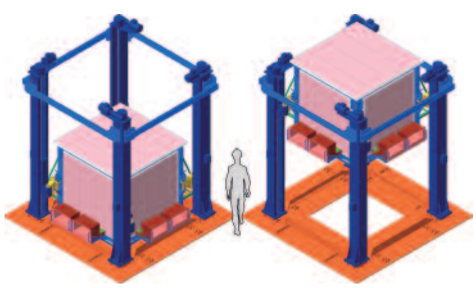
DANSS

Detector of AntiNeutrino based on Solid state Scintillator



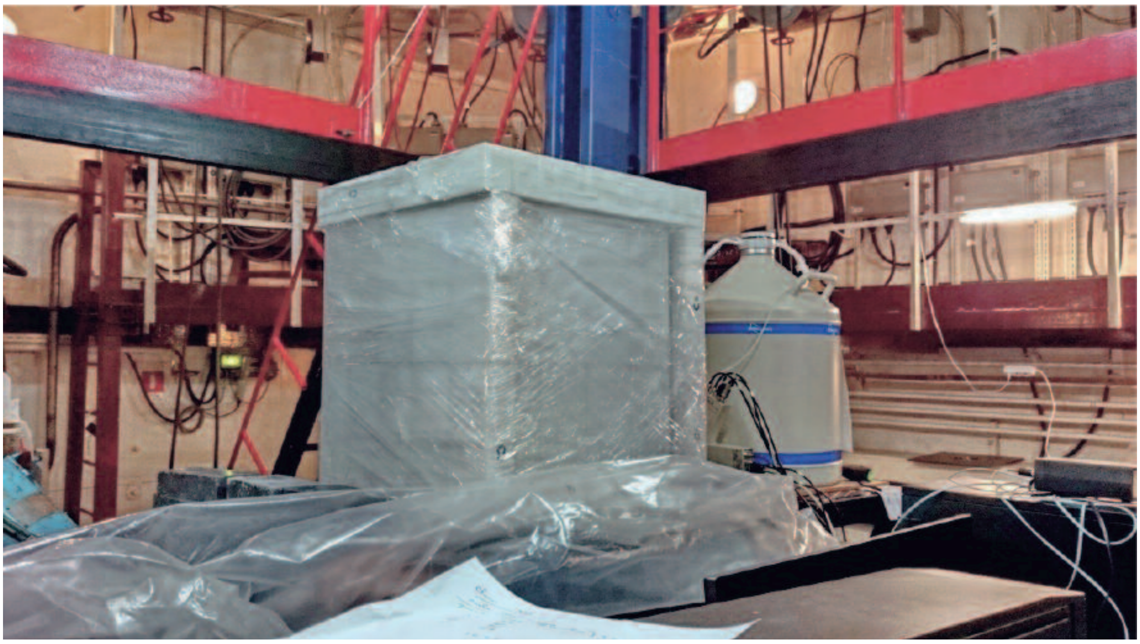
Reactor monitoring and search for short-range neutrino oscillations

- Segmented "XY" plastic scintillator (1 m^3 =1.1 t) close to the core of the Kalinin NPP reactor №4;
- Overburden of 50 m.w.e. (reactor cauldron, cooling pond, concrete);
- 3D information about each event;
- IBD count rate ~ $10^4\ \bar{\nu}_e$ / day; Signal / BG ≥ 100;
- Lifting platform => distance variable online ($L \approx 10.7–12.7$ m);
- Status: collecting data.



Neutrino laboratory under KNPP power generation units №2 & 3

Low-energy semiconductor neutrino detectors

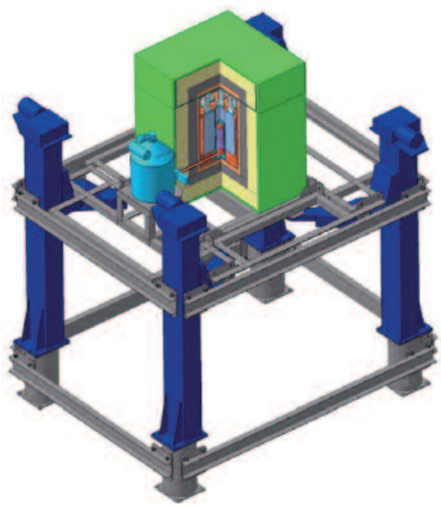


Main feature:

Maximum available electron antineutrino flux at 5.4×10^{13} cm^{-2} sec^{-1}.

Infrastructure:

- Passive and active shields;
- Modern data acquisition systems;
- Supplementary neutron-, γ-, μ- detectors for monitoring ambient backgrounds;
- Platform allowing 2.5 m vertical lifting detectors with shields. These changes in distance between the neutrino source (reactor) and the detectors is crucial for discrimination between neutrino signals and the background.

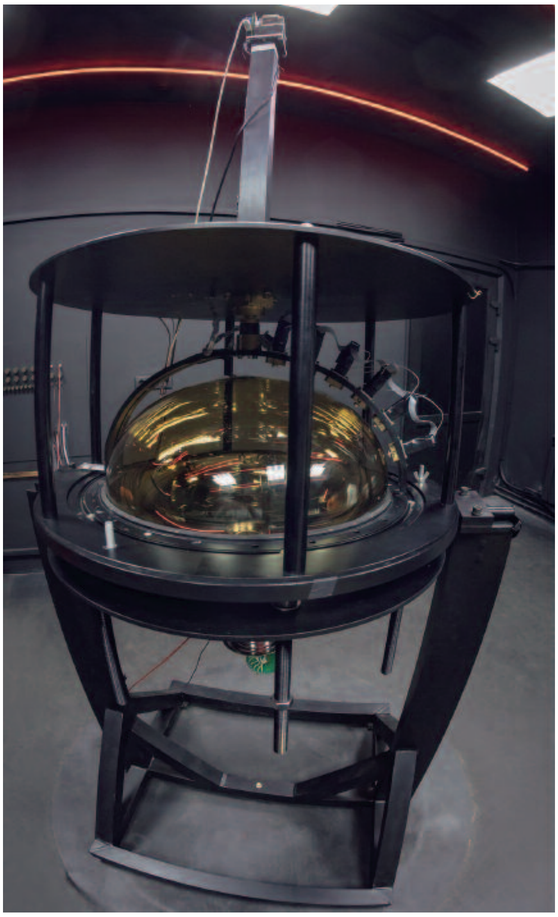


At present there are two experiments:

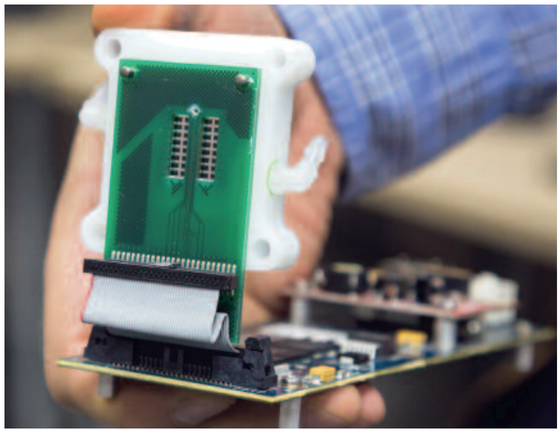
νGeN: first ever detection of coherent neutrino-nucleus elastic scattering;

GEMMA: measurement of the electron antineutrino magnetic moment with a sensitivity level of $\mu\nu \sim 10^{-11}\mu B$.

Green Lab

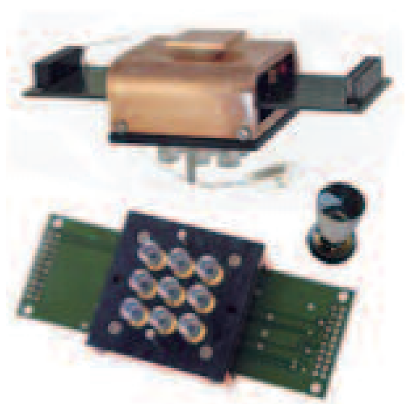


Scanning station for a 20" PMT in the black room

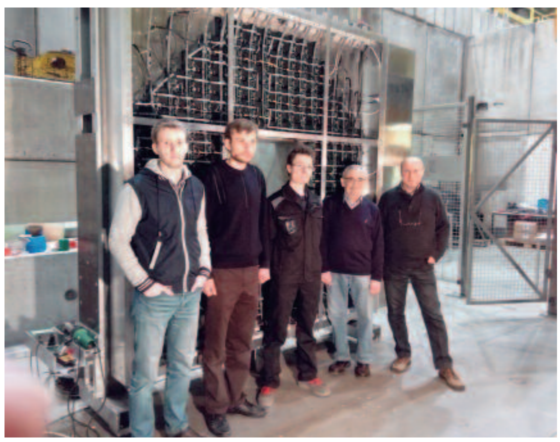


32-channel avalanche photodiode

Remote Operation Centre for the NOvA experiment



Small 9-MAPD readout block



ECAL0@COMPASS

The sophisticated lab is built for photodetector testing. Photodetectors are of different types and sizes — from small silicon photodiodes (COMPASS@CERN, NOvA@FermiLab) to huge 20-inch PMTs (JUNO@IHEP, China). The Lab is fully equipped with facilities (black room), electronics and even allows remote shifting (ROC-Dubna).

Phasotron

DLNP proton accelerator, JINR

Physics research on proton beams:
biomedical research, μ-catalysis investigations, nuclear spectroscopy, study of rare particle decays, μSR study of condensed matter properties, transmutation investigations.

Basic parameters

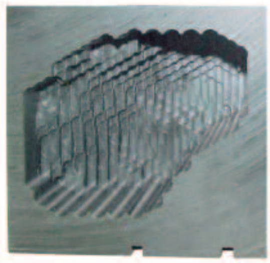
Energy of accelerated protons	Tp = (659 ± 6) MeV
Energy dispersion	ΔE = (3,1 ± 0,8) MeV
Frequency of proton acceleration cycles (modulation frequency)	250 Hz
Emittance at the boundary of the scattered magnetic field of the phasotron: horizontal vertical	 ex = (5,1 ± 2,3) cm·mrad ey = (3.4 ± 1.4) cm·mrad
Ejected proton beam intensity in the "fast" ejection mode (pulse duration is 30 μs)	(2-2,5) μA
Ejected proton beam intensity in the "slow" ejection mode (time-stretched beam during 85% of the modulation period duration (~ 4 ms)	(1,6-2,0) μA
The ejected proton beam has microstructure: particle bunches of 10 ns duration follow each other with an interval of about 70 ns.	

Proton therapy

For the first time in Russia and Eastern Europe, the technique of 3D conformal proton radiotherapy has been realised and is now used in radiotherapy sessions with Phasotron beams. In this method, the maximum of the proton beam dose distribution most precisely corresponds to the shape of the irradiated target. At the same time, the dose sharply decreases beyond the borders of the target that allows irradiation of tumours seated closely to vital radiosensitive organs of the patient.

Technological stages of proton 3D conformal radiation therapy

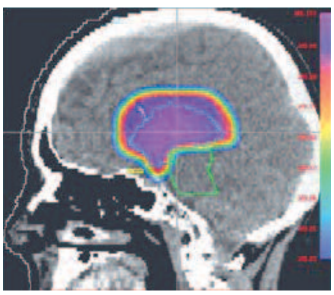
1. Immobilisation of the treatment area;
2. Diagnostic imaging and CT slices transferring to the 3D treatment planning system;
3. Three-dimensional computer treatment planning;
4. Manufacturing individual beam-shaping devices: complex shape collimators and compensating boluses;
5. Realisation and verification of the treatment plan.

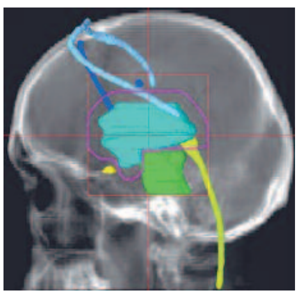


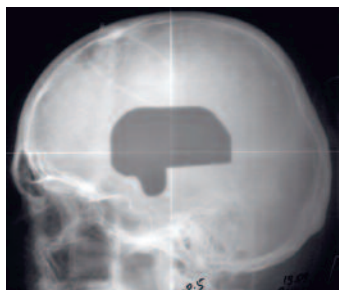
Technologies to calculate and to produce individual collimators from Wood alloy and boluses (patient-specific proton range moderators of irregular shape) from special machinable wax, using a digital computer-controlled milling machine, have been developed and realised.

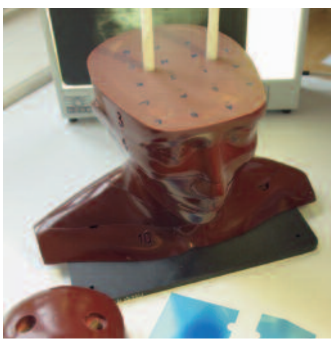
Patient set-up verification

Left — dose distribution in the sagittal plane;
Centre — digitally reconstructed radiograph of the skull from the beam's eye view with the projection of the target, critical structures, and the collimator;
Right — aligning the X-ray film with the proton beam at the time of treatment.
The position of the beam in relation to the bony landmarks exactly corresponds to the treatment plan.









By means of a heterogenous "Alderson phantom" and radiochromic films, a set of dosimetric experiments on verification of all the technological steps of treatment planning and proton beam irradiation were carried out.

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. The core of the entire computing infrastructure of the Institute is the JINR Central Informational Computing Complex with powerful high-performance computing facilities integrated into the world's information and computing resources via high-speed communication channels.

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Multifunctional Information and Computing Complex at JINR

The Multifunctional Information and Computing Complex (MICC) is one of the basic JINR facilities. It provides 24/7 implementation of a vast range of competitive research conducted at JINR at a global level.

MICC provides a wide spectrum of opportunities for its users on the basis of its components: the grid infrastructure of the Tier-1 and Tier-2 levels to support experiments on LHC (ATLAS, Alice, CMS, LHCb), FAIR (CBM, PANDA), NICA/MPD, and other large-scale experiments; a general-purpose computing cluster; the Cloud infrastructure; the computing cluster with heterogeneous architecture HybriLIT; educational and research infrastructure for distributed and parallel computations.

JINR grid sites of WLCG/EGI: Tier-1 for CMS; Tier-2 for ALICE, ATLAS, CMS, STAR, LHCb, BES, biomed, fermilab

Cloud infrastructure

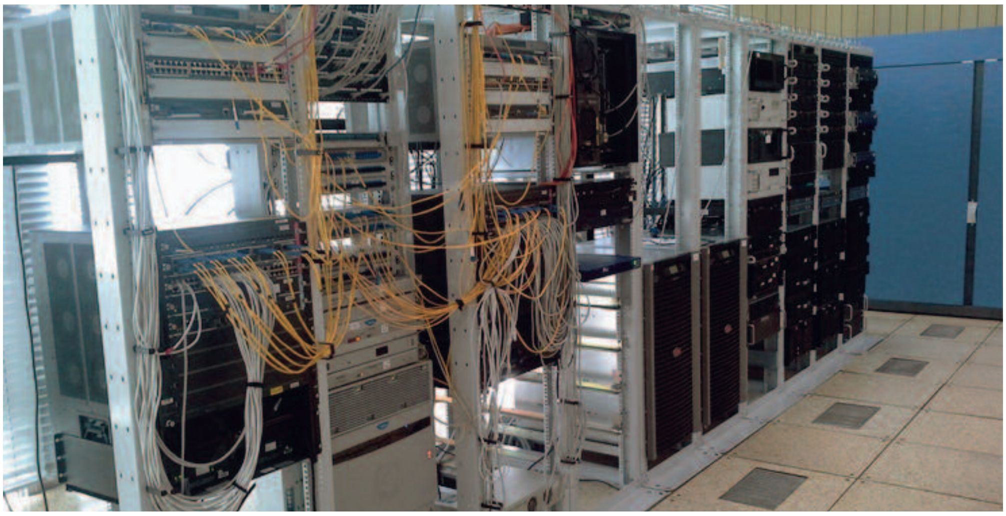
Heterogeneous (CPU + GPU) computing cluster HybriLIT

Offline cluster and storage system for BM@N, MPD, SPD; storage and computing facilities for local users

Network infrastructure

Engineering infrastructure

Network and telecommunication channels



The computing infrastructure of the Institute with powerful high-performance computing facilities is integrated into the world's information and computing resources via high-speed (up to 100 Gb/s) communication channels.

JINR Local Area Network Comprises 7946 computers & nodes.
Users — 4298, IP — 13056;
E-library — 1501;
LAN high-speed transport —10 Gb/s.

Tier-1 & 2: JINR participation in Worldwide Computing Grid (WLCG)

Grid Tier-1 is one of the 7 centres in the world intended for large-scale processing of experimental and event-modelling data, coming from the centres of Tier-0 (CERN), for the CMS experiment. In 2017, Tier-1 contains 4000 computing cores, 5.3 PB disk storage as well as a tape robot with a total capacity of 11 PB; Tier-2 supports experiments on LHC (ATLAS, Alice, CMS, LHCb), FAIR (CBM, PANDA), STAR, NICA/MPD, other large-scale experiments, and contains 3000 cores and 2.4 PB disk storage.



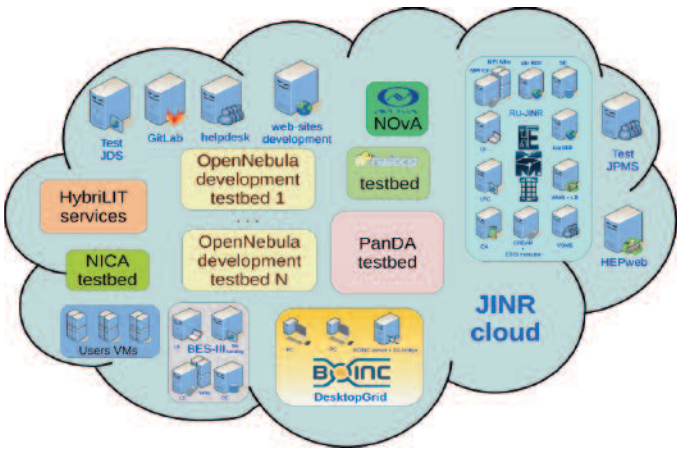

HybriLIT

Heterogeneous computing cluster "HybriLIT" is intended for carrying out calculations using parallel programming technologies. The heterogeneous structure of the computing nodes in the cluster can significantly speed up mathematical calculations by selecting the optimal parallelisation technology that takes into account both the specifics of the problem being solved and the features of computational accelerators — Nvidia graphic processors and Intel Xeon Phi coprocessors.

JINR Cloud

One of the most important trends in cloud technologies is the development of a method of integrating various cloud infrastructures.

In order to join the cloud resources of partner organisations from JINR Member States for solving common tasks as well as distributing the peak load among them, a cloud bursting driver has been designed by the JINR cloud team. It allows one to integrate the JINR cloud with the partner clouds, either the OpenNebula-based one or any other cloud platform which supports Open Cloud Computing Interface (OCCI).



Monitoring system

The monitoring system of the JINR Computing Complex has been developed and put into operation.

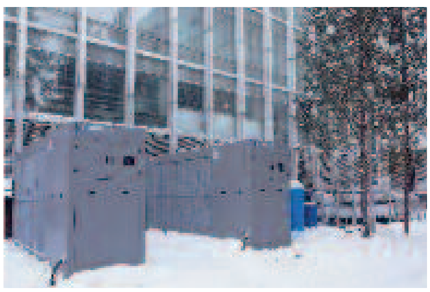
The system allows one to observe the state of the whole computing complex in real time and send system alerts to users via e-mail, sms, etc.

690 elements are under observation; 3497 checks are performed in real time.

Engineering infrastructure

To ensure meaningful and secure MICC work with fault tolerance in accordance with the ANSI/TIA/EIA-942 standard, it is necessary to create special conditions regarding the microclimate at the hall where MICC is located and to meet certain power supply requirements.

The close-coupled InRow chilled water cooling (hot and cold air containment) system and MGE Galaxy 7000 (2×300 kW energy efficient solutions, 3-phase power protection with high adaptability) were put into operation.



Laboratory of Radiation Biology

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

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

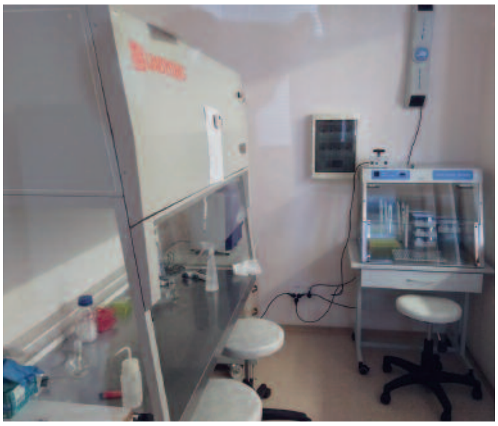
Laboratory of Radiation Biology

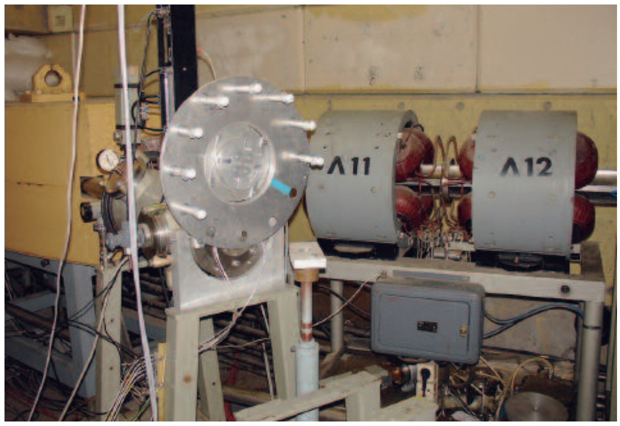
Equipment:

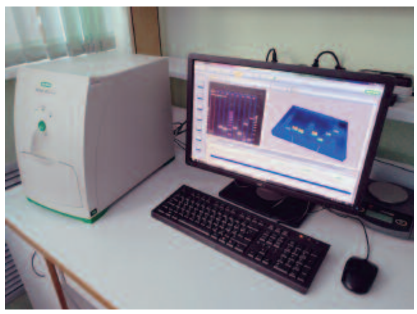
For work with cell cultures
Sterile laboratory rooms, laminar boxes, exhaust hoods, CO_2 thermostats, cell analysers;

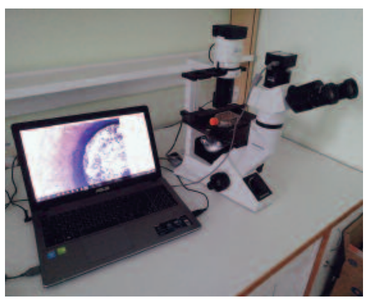
For cytogenetic research
Direct and inverted microscopes, flow cytofluorimeters, shakers, vibration mixers, centrifuges;

For molecular research
Fluorescent microscopes; Synergy™, H1 a flexible monochromator-based multimode microplate reader; PCR amplifiers; gel documentation systems, ultrahigh-speed.









Laboratory of Radiation Biology

Equipment:

For astrobiological research

Scanning electron microscopy:

- Search for microfossils (fossil prokaryotes and protists) in early Precambrian terrestrial rocks and meteorites;
- Study of the morphology of microfossils and fossil microbe communities;
- Analysis of sample chemical composition based on energy dispersive X-ray microanalysis;
- Cosmic dust research.

For tests and calibration of nuclear planetary science instruments

DAN experimental stand

DAN (Dynamic Albedo of Neutrons) is an experimental stand for testing nuclear planetary science instruments equipped with fast neutron generators. The premises provide a low scattered neutron background and allow tests of instruments with different planetary soil models. The planetary regolith model is based on a silicate glass pack with a total weight of up to 35 tons, which is a model of absolutely dry soil. The presence of water in the soil is modelled by polyethylene layers at different depths. Thin layers of steel, aluminum, and polyvinyl chloride have been added to the composition of the glass pack to reach the closest possible approximation to the chemical composition of the Martian regolith with respect to Fe, Al, and Cl.

Bogoliubov Laboratory of Theoretical Physics

The Bogoliubov Laboratory of Theoretical Physics (BLTP) is one of the largest institutions of theoretical physics in the world. 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.

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Bogoliubov Laboratory of Theoretical Physics

The Bogoliubov Laboratory of Theoretical Physics (BLTP) is a unique centre of organisation and coordination of international collaboration in the field of theoretical physics. As one of the largest centres, BLTP acts as a "generator" of multi- and interdisciplinary studies, thus determining the global scientific agenda for both theoretical and experimental research.

The laboratory employs the world's leading experts in the following lines of investigation: quantum field theory and particle physics, theory of the atomic nucleus, condensed matter, and modern mathematical physics. The laboratory's scientific and organisational structure is aimed at the development of interdisciplinary and international collaboration. More than 60 foreign researchers (30% of the scientific staff) from JINR Member States, BRICS countries, the EU and other countries work at BLTP permanently; young specialists are employed on a contract basis. Around 12-15 conferences on urgent problems of modern physics are annually organised at BLTP at the highest international level.

As the largest organisation in the field of modern theoretical physics, BLTP is a centre for training highly qualified scientists for many countries. Young theoreticians have the opportunity to attend lectures by the laboratory's leading and invited researchers, to participate in seminars on recent scientific achievements, to gain first-hand knowledge of present-day issues and scientific challenges, to be directly involved in advanced investigations and international scientific projects.

The Dubna International Advanced School of Theoretical Physics (DIAS-TH), functioning at BLTP, organises and coordinates scientific and educational activities, taking into account the present-day tendencies of science development. Under the auspices of DIAS-TH, 3-4 intensive topical scientific schools and conference schools are organised for young scientists and students from JINR Member States and other countries with the involvement of the best lecturers on the subjects of the schools. The traditions and fundamentals of scientific schools established in the laboratory proved to be efficient in training highly qualified theoretical physicists.

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JINR University Centre

The JINR University Centre was established in 1991 to implement the educational programme of the Institute that is primarily aimed at training highly qualified young specialists to conduct research at the laboratories of JINR and scientific centres of the Member States. The main objective of UC is to implement the concept of «continuing education»: school–university–research centre. To this effect, UC enables students and postgraduates to take part in the work performed by the research groups of the Institute.

Every year various JINR-based educational programmes are attended by several hundreds of undergraduate and graduate students from numerous institutes and universities of Russia and other JINR Member States. The JINR University Centre performs overall coordination and provides support to the educational process for students and postgraduates of the JINR-based departments of the leading technical universities of Russia. For this purpose, UC engages the leading specialists of the Institute in the educational activities and assists in the organisation of scientific work in the Institute research groups for graduate students.

http://ucnew.jinr.ru/en/

UC makes vigorous efforts in the field of promotion and popularisation of modern scientific knowledge among school students and teachers. In cooperation with the European Organisation for Nuclear Research, the Institute has been running annual scientific schools for physics teachers from the JINR Member States at CERN and JINR.

http://teachers.jinr.ru

International Student Practices and Training Programmes

For students and postgraduates from the Member States UC, organises and runs International Summer Student Practices. Participants are selected on a competitive basis by the sending countries. The Institute also runs the Summer Student Programme. Applications for participation in this Programme may be submitted by any senior students from the JINR Member States. Programme participants are selected by the specialists of the Institute on the basis of reference and motivation letters provided by the students.

http://students.jinr.ru/en

University Centre. Infrastructure

Linac-200

Bunch current	15 mA
Bunch width	2 μs
Repetition rate	1–10 Hz
Magnet weight	2300 t
"Training" beam energy	22 MeV

Hands-on workshop for future engineers:

- Basics of nuclear physics;
- Radiation protection and safety;
- Particle detectors;
- Vacuum technology;
- RF technology;
- Magnets;
- Electronics and automation.

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