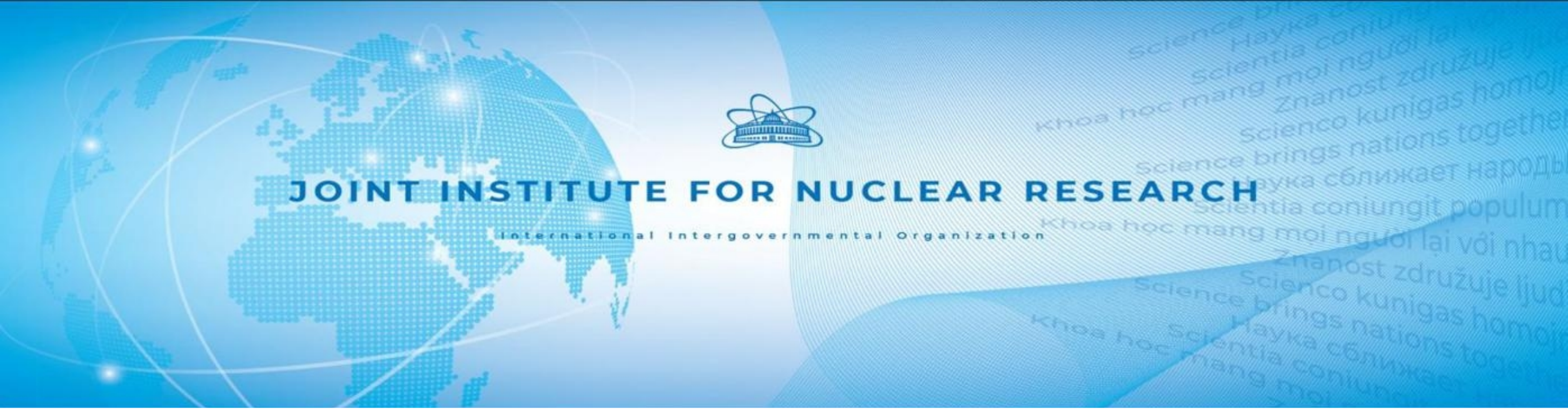


133rd session of the JINR Scientific Council

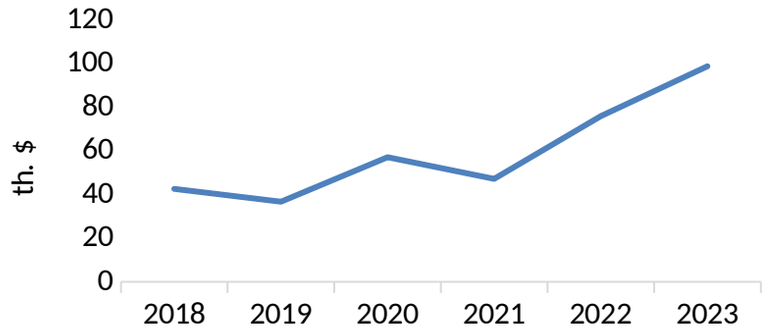
Director's Report: News, Science, Prospects

acad. Grigory V. Trubnikov

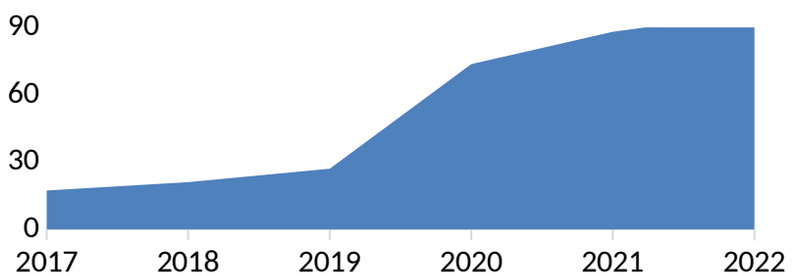
16–17 February 2023, Dubna

RESEARCH CAPACITY-BUILDING

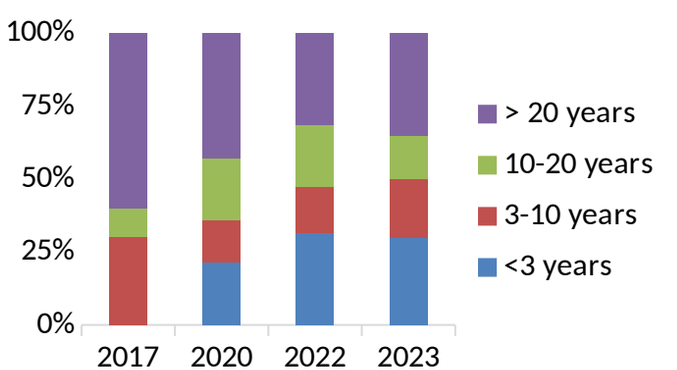
Cost of basic facilities and equipments per research scientist



Total amount of data in the JINR storage system (PB)

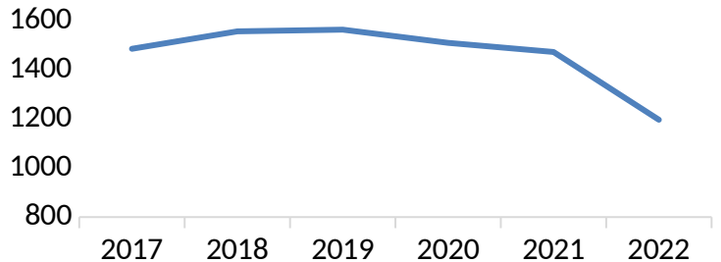


Breakdown of basic facilities by age



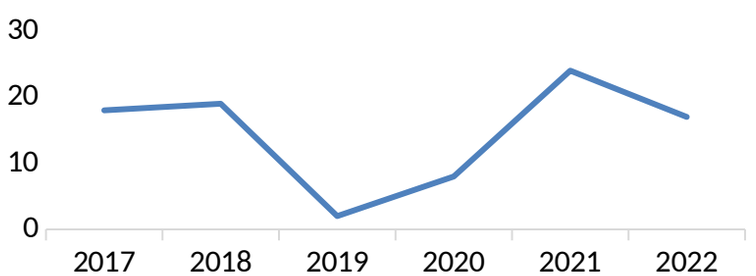
RESEARCH QUALITY AND EFFICIENCY

Total number of Results of Intellectual Activity

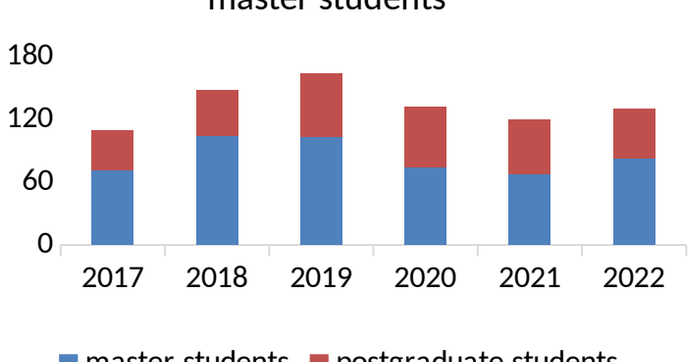


Results of Intellectual Activity (RIA) includes publications, defended dissertations and patents.

Number of dissertations defended by JINR staff



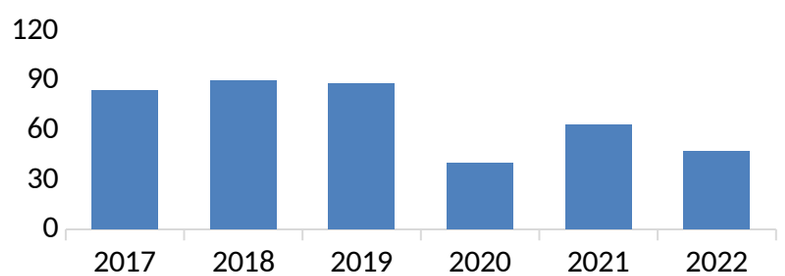
Number of supervisors of postgraduate and master students



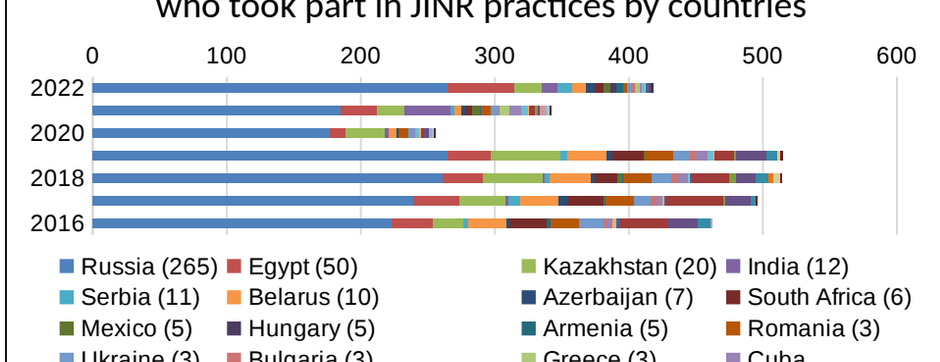
JINR AS AN INTERNATIONAL RESEARCH ORGANIZATION

	2020	2021	2022
Number of organizations in the partner network	931	1005	998
Number of JINR information centres	2	4	8
Number of collaborations	39	39	39

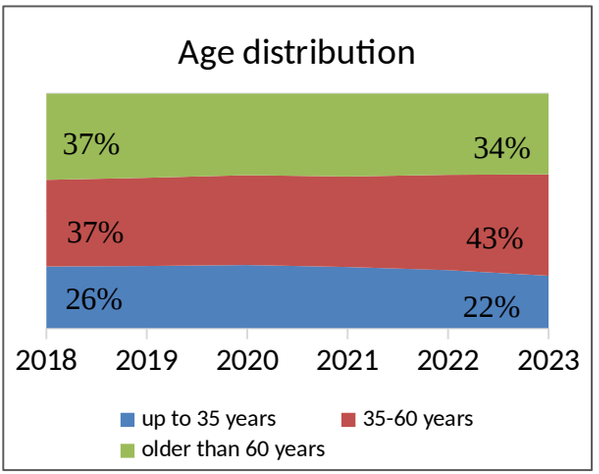
Number of meetings and conferences organized by JINR

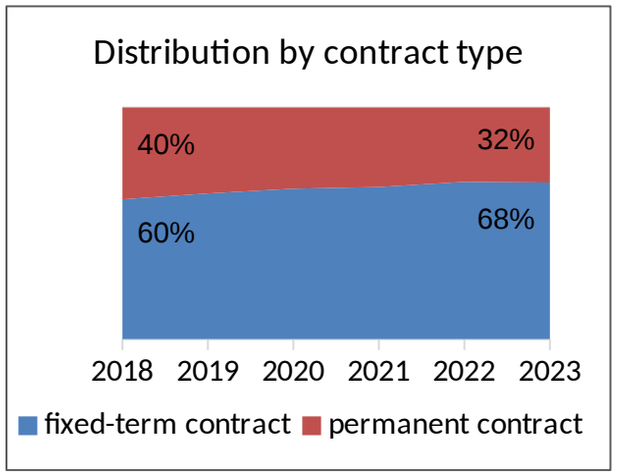


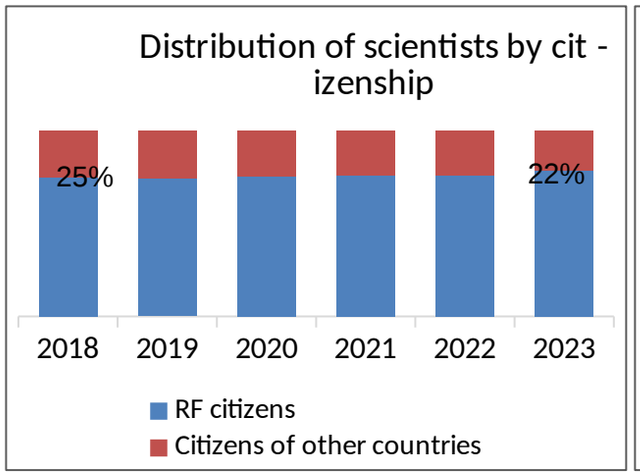
Number of students, young scientists and specialists who took part in JINR practices by countries

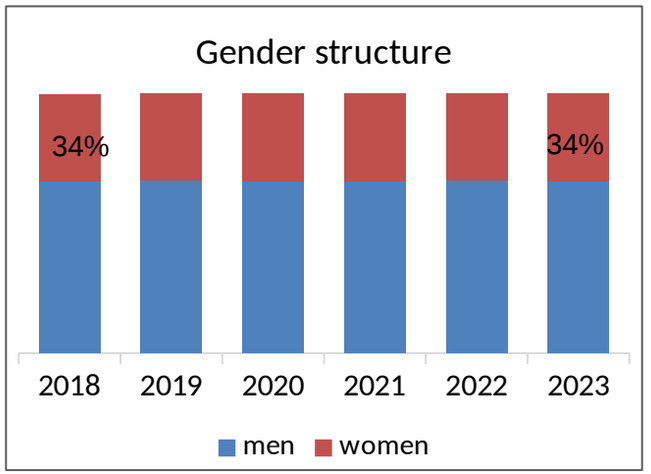


HUMAN CAPACITY-BUILDING

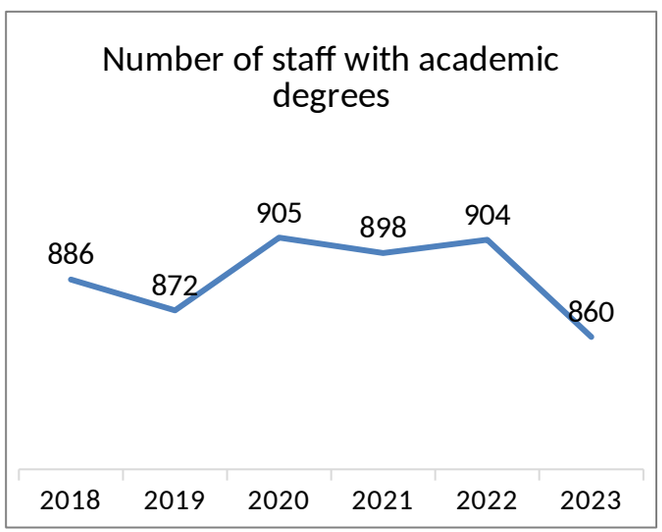


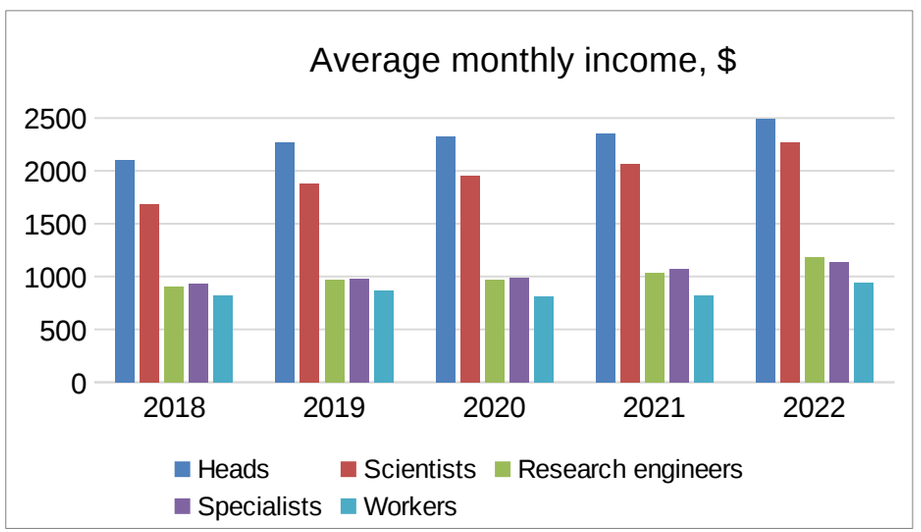


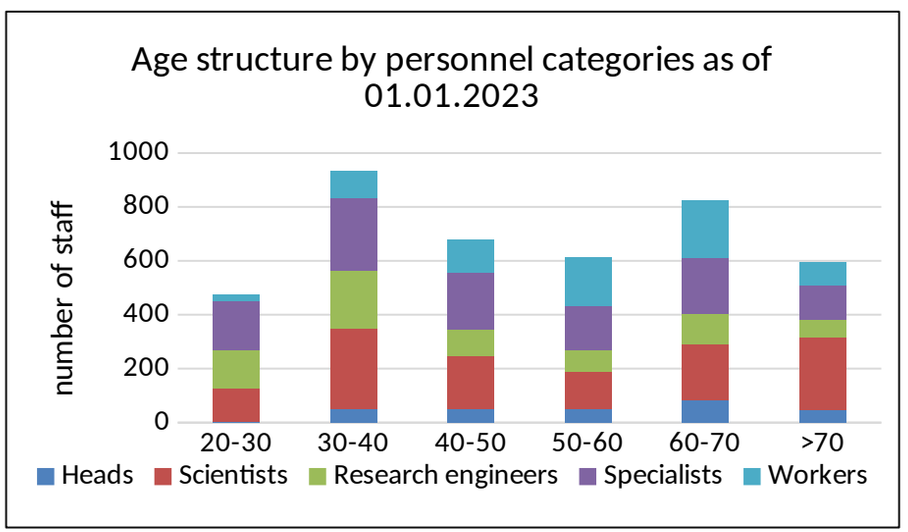




STAFF







THE SESSION OF THE JINR COMMITTEE OF PLENIPOTENTIARIES
23 NOVEMBER 2022, HURGHADA, EGYPT

A regular session of the Committee of Plenipotentiaries of the Governments of the JINR Member States was held in Hurghada (Egypt) on 23 November 2022 in a hybrid form.

It was chaired by the Plenipotentiary of Georgia Professor Arsen Khvedelidze

AGENDA

- On the participation of the Republic of Bulgaria and Romania in JINR (**L. Kostov)**
- On the participation of the Czech Republic, the Republic of Poland, and Ukraine in JINR (**L. Kostov)**
- JINR Director's report (**G. Trubnikov**)
- Draft of the budget of JINR for 2023 (**N. Kalinin**)
- Draft of the Seven-year plan for the development of JINR for 2024–2030 (**G. Trubnikov**)
- Results of the meeting of the JINR Finance Committee held on 21 May 2022 (**A. Omelchuk**)
- Statement by the Plenipotentiary of the Government of the Slovak Republic (**F. Šimkovic**)
- Proposals on the new composition of Membership of the JINR Scientific Council (**S. Nedelko**)
- Scientific report by the President of ASRT of the ARE (**M. Sakr**)

Committee of Plenipotentiaries decided, in particular:

- To take note of the information from the JINR Directorate about the recommendations of the 132nd session of the JINR Scientific Council, the implementation of the current Seven-year plan for the development of JINR, the efforts of the Member States towards realization of JINR's large projects, the new scientific and technological results obtained, and about the most important events related to JINR's scientific research and educational activities and international cooperation.

- To endorse and support the efforts of the JINR Directorate on working with Partner Countries and the intention to raise the status of their participation in JINR, in particular, with the People's Republic of China, Mexico, Brazil, India, Israel, South Korea, and etc.

- To approve the budget of JINR for 2023.

- To approve the Topical plan for JINR research and international cooperation for 2023.

- To support the draft of the Seven-year plan of the development of JINR for 2024–2030 and to commission the JINR Directorate to submit the final draft of the Seven-year plan for consideration by the JINR Scientific Council at its 133-th session, in February 2023.

- To approve the Regulations on Cooperation Programmes and Grants of the Plenipotentiaries of the Governments of the JINR Member States.
- To support new programmes proposed by the JINR Directorate aimed at increasing the intellectual capital of the Institute and the Member States: JINR Fellowship Program, JINR Postdoctoral Program.
- To take note of the information about the withdrawal of the Czech Republic, the Republic of Poland, and Ukraine from the Joint Institute for Nuclear Research from 01 January 2023.

- To agree with the suspension of the participation of the Republic of Bulgaria and Romania in the work of the Committee of Plenipotentiaries of the Governments of the JINR Member States and the JINR Finance Committee and not to take into account the Republic of Bulgaria and Romania when determining the quorum and voting on agenda items. To maintain the validity of the Charter of the Joint Institute for Nuclear Research for the above states in the rest of it.

- To take note of the list of members of the JINR Scientific Council appointed by the Plenipotentiaries of the Governments of the JINR Member States. To elect new members of the Scientific Council presented by the JINR Directorate and to approve the new composition of the Scientific Council for a term of 5 years. The new membership of the Scientific Council shall take office from the 133rd session of the JINR Scientific Council.

The 56th Meeting of the PAC for Condensed Matter Physics

17-18 January 2023

The 57th Meeting of the PAC for Particle Physics

23 January 2023

Sessions of the the Programme Advisory Committees took place in January 2023 in mixed format. The agenda of the meetings was focused on the plans of the Institute in the fields of research covered in the new JINR Seven-Year Plan 2024 – 2030. The renewed structure of Topical Plan and its composition in terms of themes and projects was discussed. Projects to be included in the Topical Plan for JINR Research and International Cooperation in 2024 were considered.

The detailed reports on the status and proposals for the Seven-Year Plan for the Development of JINR in the field of nuclear physics for 2024–2030 were presented by the directors of the laboratories.

The 56th meeting of the PAC for Nuclear Physics

26 January 2023

In particular, special attention was paid at the status of the IBR-2 Reactor, experimental programme on the synthesis and the study of the properties of new superheavy elements at the Superheavy Element Factory, the status of the implementation of the NICA Project and the participation of the Institute's scientific groups in experiments at CERN. The technical design of the SPD detector was presented for the first time.

The PACs appreciated the results obtained at JINR in the main areas of research and recommended the preparation of the detailed consideration of the projects to be included into Topical Plan for 2024 during the sessions of the Programme Advisory Committees in June 2023.

NEW COMPOSITION OF THE JINR SC AND PACs

Theoretical physics

Part. phys.

Gravitational chiral anomaly in hydrodynamics

Prokhorov, Teryaev, Zakharov // ***Phys. Rev. Lett.*** *129, 151601 (2022).*

- In heavy ion collisions (in particular, at **NICA**) a relativistic quantum liquid is formed with **extremely high vorticity** ω and **acceleration** a. The axial current is related to the hyperon **polarization**. **New** contributions to current and **polarization**:

KVE:

$$j_A^\mu = \lambda_1(\omega_\nu\omega^\nu)\omega^\mu + \lambda_2(a_\nu a^\nu)\omega^\mu$$

Transport coefficients

Connection with anomaly and gravity:

$$\lambda_1 - \lambda_2 = 32\mathcal{N}$$

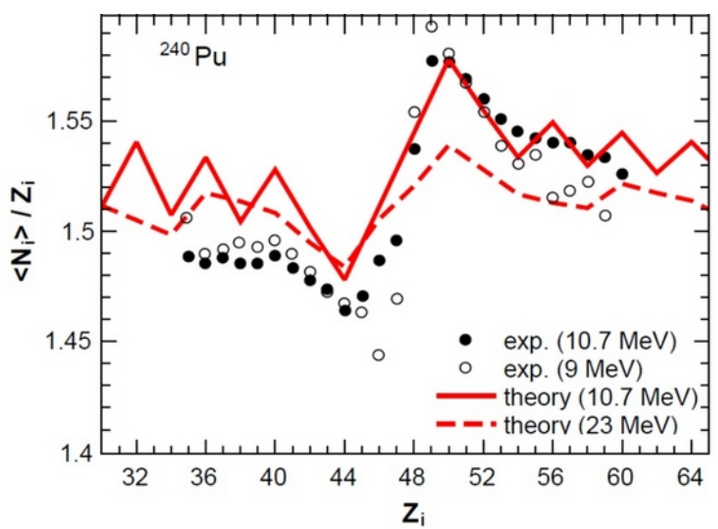
$$\nabla_\mu j_A^\mu = \mathcal{N}\epsilon^{\mu\nu\alpha\beta}R_{\mu\nu\lambda\rho}R_{\alpha\beta}{}^{\lambda\rho}$$

- **The novel kinematical vortical effect (KVE)** depends only on vorticity and acceleration, but is independent of **temperature** and **chemical potential**, and is determined by a **quantum anomaly** in **curved** space.
- The effect exists even when there are **no gravitational** fields.

Nucl. phys.

Excitation energy dependence of the fission-fragment neutron excess ratio

Pasca, Andreev, Adamian, Antonenko // ***Phys. Rev. C 107, 024603 (2023)***.



- The **neutron excess ratio** $\langle N_i\rangle/Z_i$ of **fission fragments** has a strong dependence on the fragment charge number Z_i.
- It was shown that the **average neutron number per proton** is **not the same in fission fragments** and is not equal to that in a fissioning nucleus.
- A well-defined **saw-tooth structure** is the direct result of the interplay between the **neutron and proton shell closures**.
- The effect supports the **fission mechanism** in which fission characteristics are defined at the scission point.

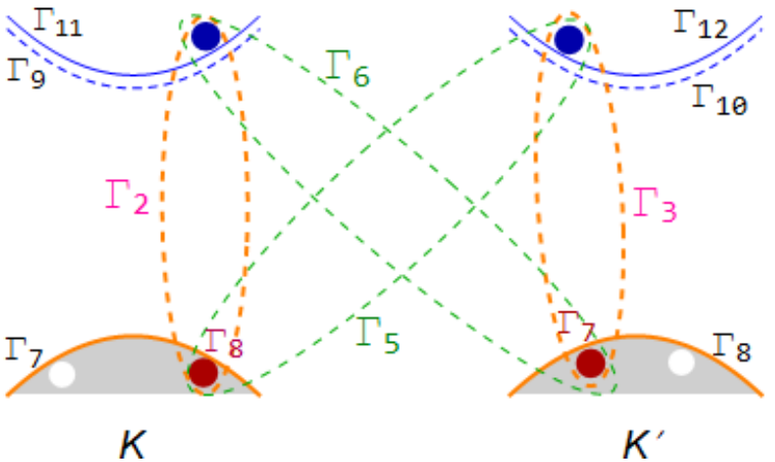
Theoretical physics

Symmetry-dependent exciton-exciton interaction and intervalley biexciton in ML TMDs

Hoang Ngoc Cam, Nguyen Thanh Phuc, V.A. Osipov // ***npj 2D Materials and Applications*** *6, 22 (2022).*

Cond. matt.

- The **exciton-exciton interaction** in *monolayer transition metal dichalcogenides* (ML TMDs) was investigated.
- The correct account of **correlations between Fermi charge carriers** and the **symmetry of interacting excitons** has a decisive influence on the nature of the exciton-exciton interaction.
- The interaction is generally repulsive, except for the case of **excitons from different valleys**, which are **attracted** and form an **intervalley biexciton**.
- ***For the first time***, the experimentally observed wide spread in the values of the biexciton energy in various ML TMDs was explained, including their encapsulation.



Off-shell cubic hypermultiplet couplings to N=2 higher spin gauge superfields

Buchbinder, Ivanov, Zaigraev // ***JHEP*** *2022, 104 (2022).*

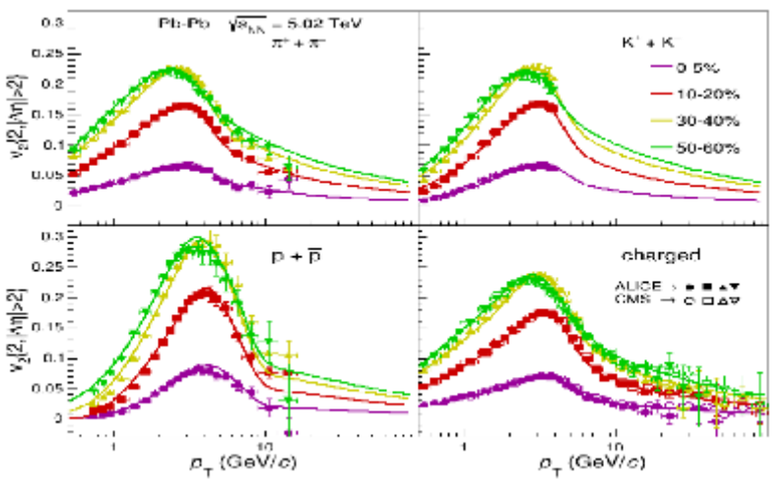
Math. phys.

- Higher spin gauge theories and their supersymmetric extensions provide a **bridge** between **superstring theory** and **low-energy quantum field theories**.
- A problem of constructing **couplings** of **higher-spin gauge superfields** to **matter N=2 superfields** was considered.
- ***For the first time***, the **cubic off-shell vertices** of the interaction of **higher-spin gauge superfields** with a **hypermultiplet** were explicitly constructed.
- It opens further promising prospects for applying the harmonic superspace method to the theory of higher spins.

$$S_{N=2SYM} \sim \mathrm{Tr} \int d^{(-4)}\zeta q^{+a}\left(D^{++} + gV^{++A}T^{A}\right)q^{+}_{a} \qquad S_{N=2higherspins} \sim \int d^{(-4)}\zeta q^{+a}\left(D^{++} + g_s\hat{\mathcal{H}}^{++}_{(s)}\right)q^{+}_{a}$$

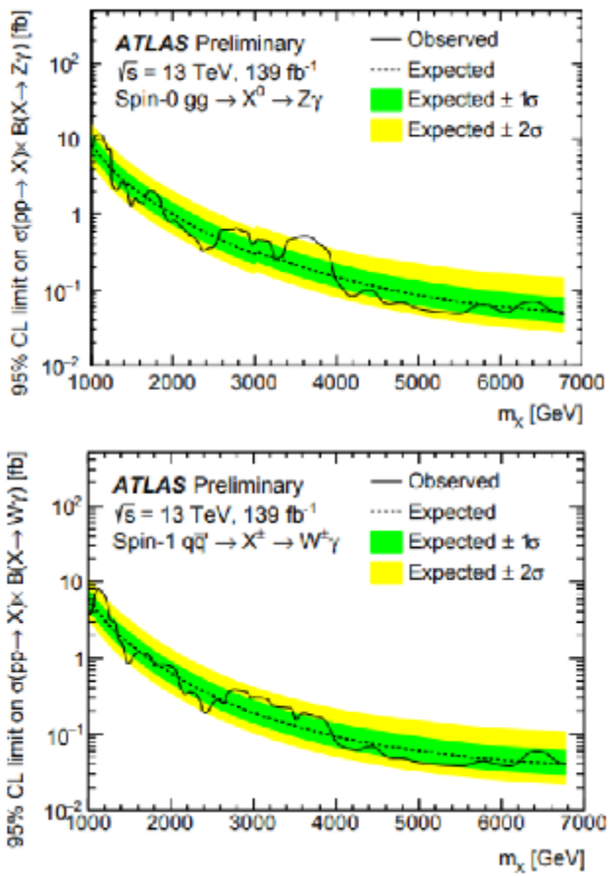
Selected results of the JINR teams in the LHC experiments

Predictions of Thermal model and experimental results from ALICE and CMS are agreed for the elliptic flow parameter v_2 versus transverse momentum (p_T) of pions, kaons, protons and all charged particles at different event centralities in Pb+Pb collisions.



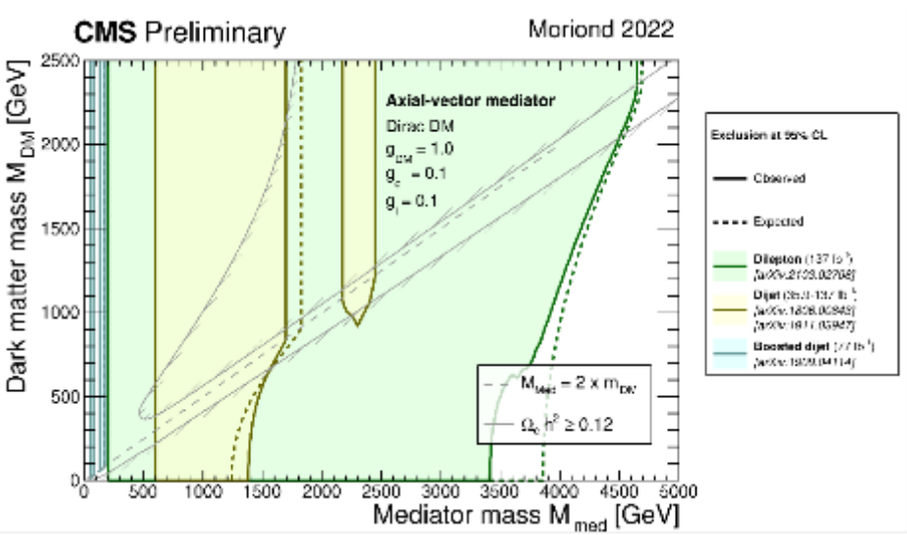
ALICE team contributed to 2 papers and made 3 conference talks.

Cross section limits for new heavy resonances – Zγ and Wγ



5 papers, 5 conference talks, several scientific schools, workshops and student conferences reports.

95% confidence level (CL) observed and expected exclusions have been set for combined di-jet and di-lepton in the simplified dark matter (DM) scenario. The mass limits are presented in the plane of the Dirac DM particle m_{DM} and mediator m_{med}.

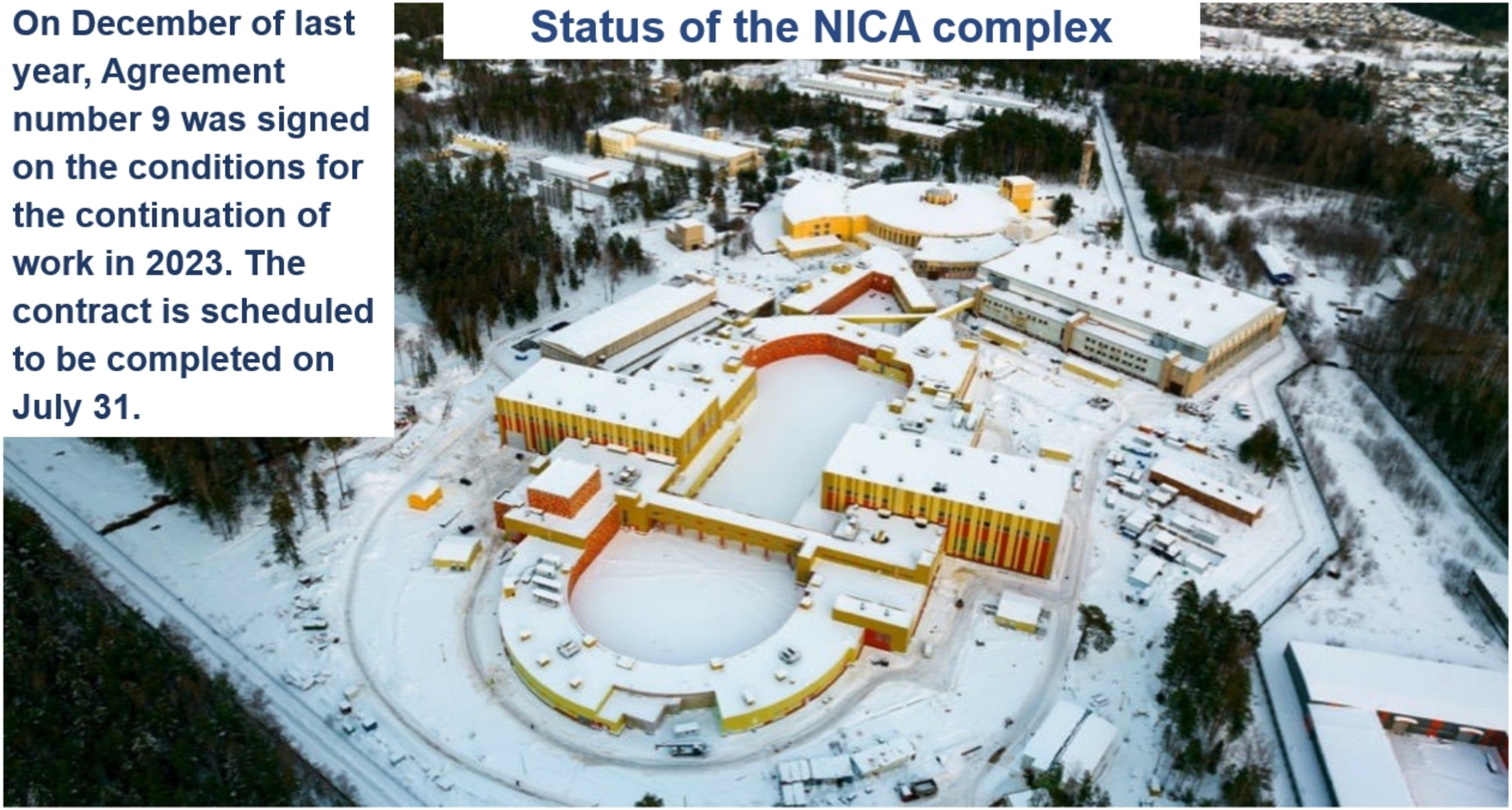


In 2022, JINR physicists made significant contribution to preparation of 22 scientific papers and one patent. The results of the scientific research were presented in 38 reports at various conferences (at least half of them is given by the young scientists).

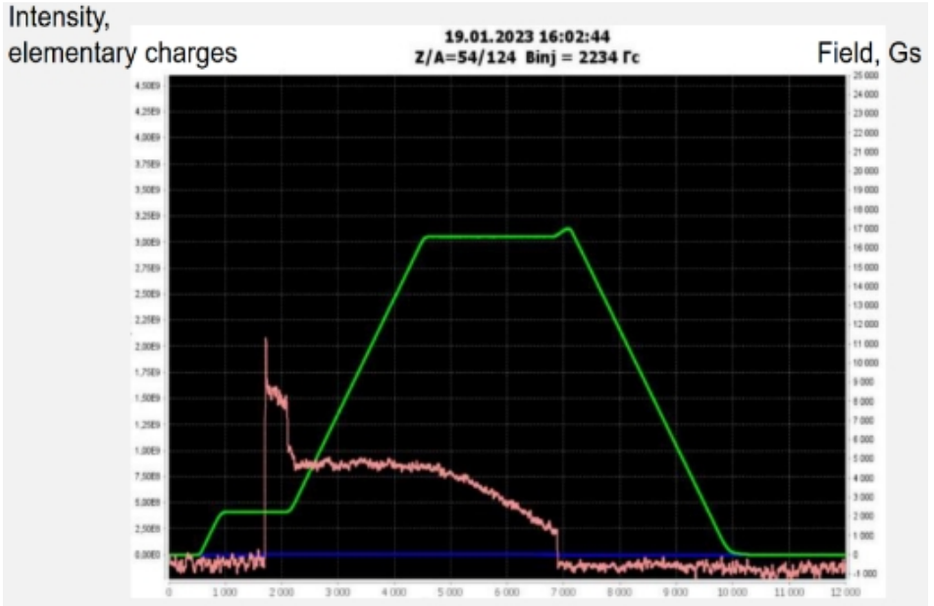
Phase-1 upgrade is completed, Phase-2 activities are continuing.

Status of the NICA complex

On December of last year, Agreement number 9 was signed on the conditions for the continuation of work in 2023. The contract is scheduled to be completed on July 31.



4th Commissioning Run at the NICA Complex

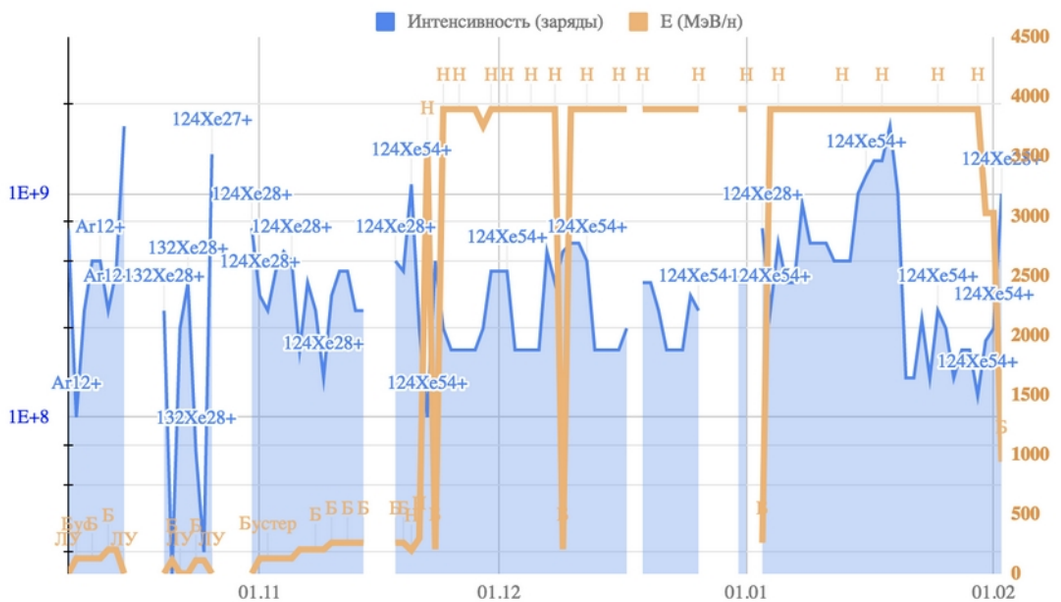


The longest run in the history of Laboratory (>3400 hours)

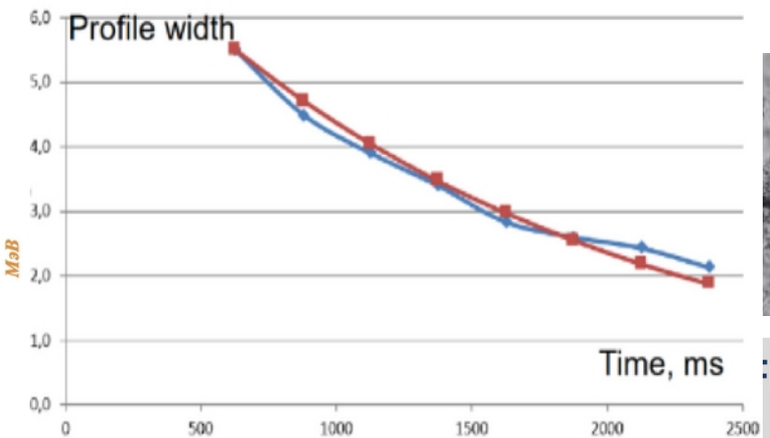
Successful commissioning of the injection chain:

- Common operation of all elements of the injection chain
- Optimization of the beam dynamics
- Operation of electron cooling
- Test of SOCHI station with heavy ions
- Calibration of new diagnostic system and modernization of the vacuum system in extracted beam line
- Long-term stable operation for BM@N experiment

Интенсивность в кольцах и энергия



Beam acceleration and slow extraction



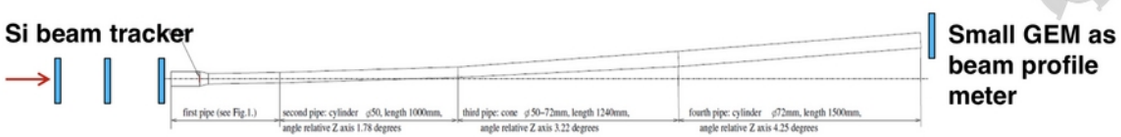
Fragmentation of the Xe ions at 3.6 GeV/N in emulsion

Transverse cooling

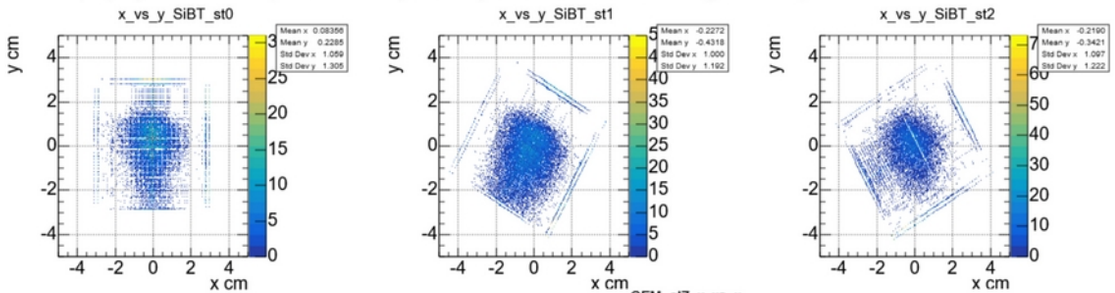
BM@N – first run with full configuration (Dec. 12, 2022 – Feb. 2, 2023)

Inner tracking system completely overlapped the aperture of the analyzing magnet

Experimental run in 3.85 AGeV Xe beam with CsI (2%) target

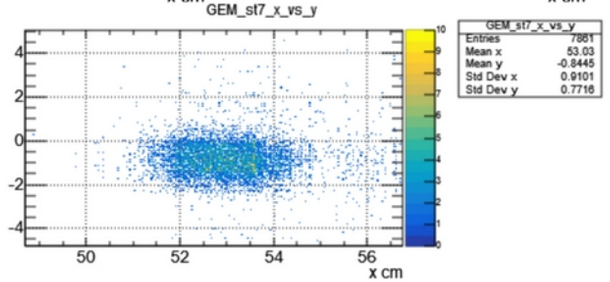


First task of the Xe run → trace beam and monitor its profile in the end of the setup (try to find optimal trajectory to reduce background)



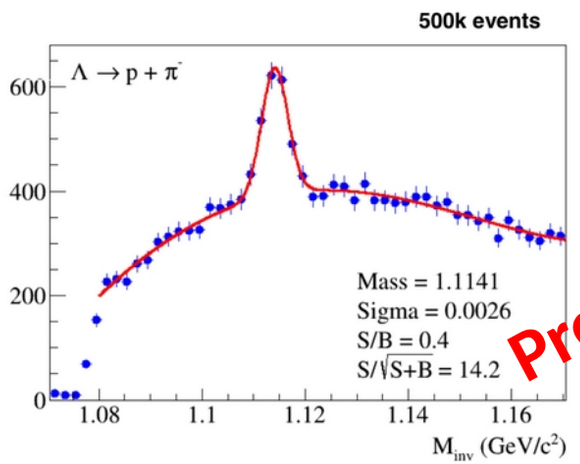
Measured beam spot at target

	Ar 2018	Xe 2022
σ_X = 5 mm		7 mm
σ_Y = 5 mm		7 mm



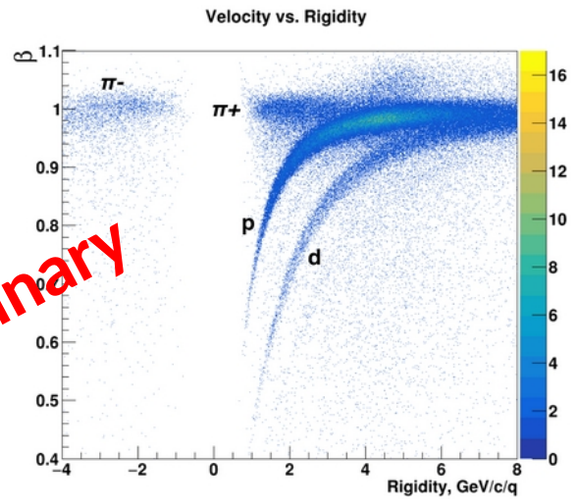
Raw data reconstruction: Λ→pπ- signal

Need dedicated alignment of silicon and GEM tracking detect



Raw online data: ToF-700 π+, p, d identification

Need dedicated ToF calibration



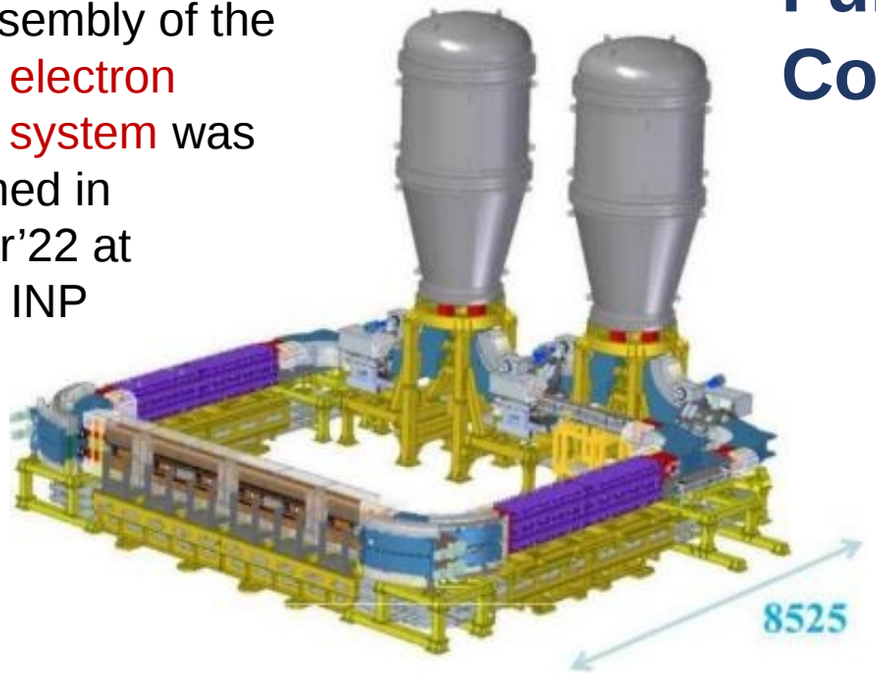
Preliminary

BM@N team managed to record about 507 million events with the Xe beam at a kinetic energy of 3.8 A GeV and 48 million events with energy of 3 A GeV. Data analysis is ongoing.

M.Kapishin for BM@N

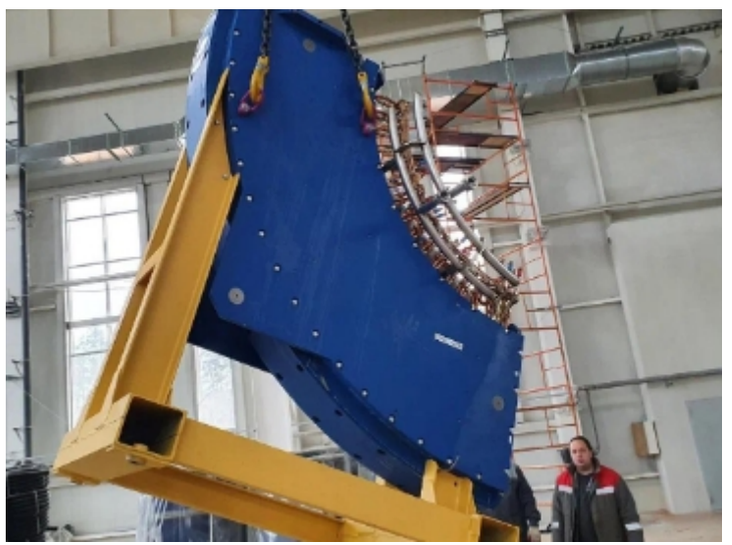
Further developments at the NICA Complex

Test assembly of the collider electron cooling system was performed in October'22 at Budker INP



… and some parts have already been transported to JINR

HV vessel



Toroidal solenoid

August – September 2023: collider technological run after completion of engineering infrastructure bld. 17

- Insulating volume and beam pipe vacuum tests, test of cryogenics
- Test of main power supply and cycle control system on equivalent load
- Commissioning of thermometry system
- Commissioning of quench detection system
- Commissioning of energy evacuation system
- Test of the main power supply on superconducting load

End of 2023 - beg of 2024(?): first technological run

- Fast extraction from the Nuclotron
- Assembly of the Nuclotron-Collider line
- Test of all tech systems of Collider
- Injection into Collider
- Synchronization system

If all equipment delivered to Dubna

MPD detector to be commissioned by the first beams at NICA collider

Start-up of the **solenoid magnet**:

- Vacuum tests and cooling of solenoid by temporary scheme to 4.5K: January – June
- Magnetic field measurements (INP mapper): August-September
- Cryogenic system operation by stationary scheme: end of 2023

Time Projection Chamber:

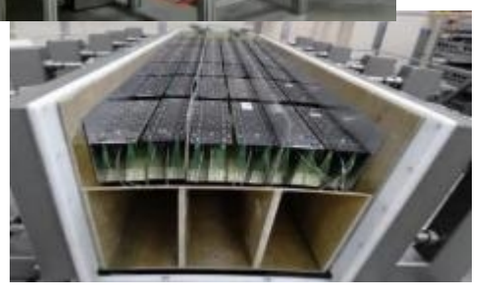
- TPC installation in the MPD: November
- Cabling and piping: September-December
- TPC commissioning: beginning of 2024

Time-of-Flight system:

- TOF modules ready for installation in the MPD: April-May
- TOF installation in the MPD: October
- TOF in full configuration: end of 2023

Electromagnetic calorimeter:

- 32 half-sectors ready: by October
- ECAL installation in the MPD: October
- ECAL cooling system is under development

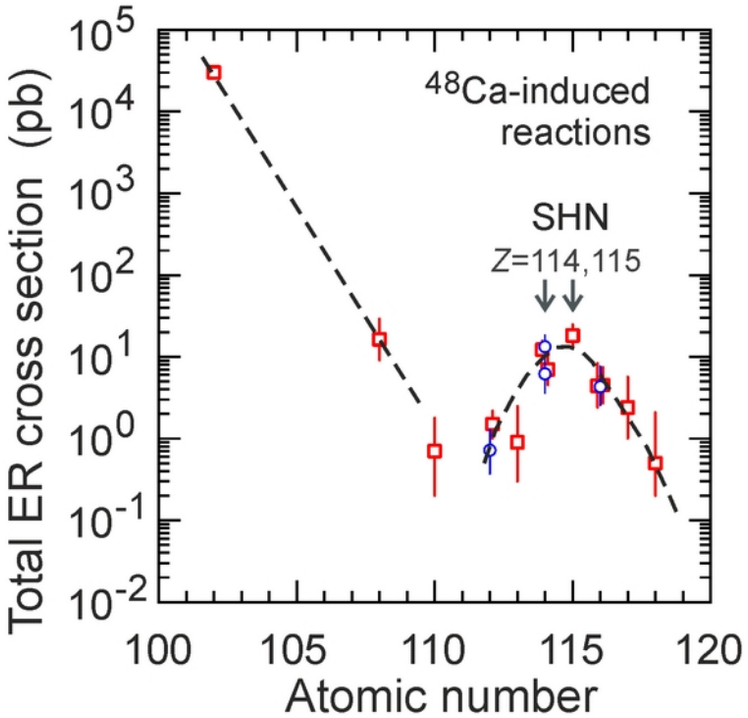


Physics feasibility studies:

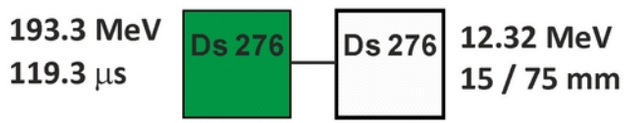
- Centralized large-scale MC productions to deliver a clear picture of the MPD physical capabilities
- 27 plenary and parallel talks were given in 2022

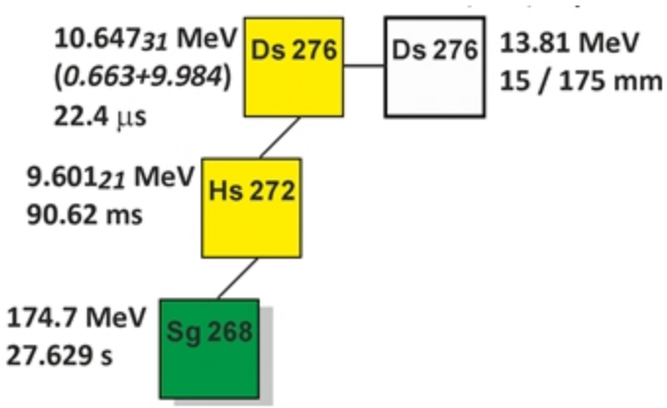
- ❑ Preparation of the MPD detector and experimental programme is ongoing, all activities are continued.
- ❑ Commissioning of the MPD Stage-I detector and start of data taking with BiBi at 9.2 GeV in 2024.
- ❑ Further programme will be driven by the demands of physics and the NICA capabilities.

Towards element 120: the first experiment $^{48}Ca + ^{232}Th \rightarrow ^{280}Ds^*$



- Stability and production cross section is expected to have a minimum for the element 110. The fission barrier is predicted to be 3.3 MeV only
- The same theory predicts 5.1 MeV barrier for the element 120

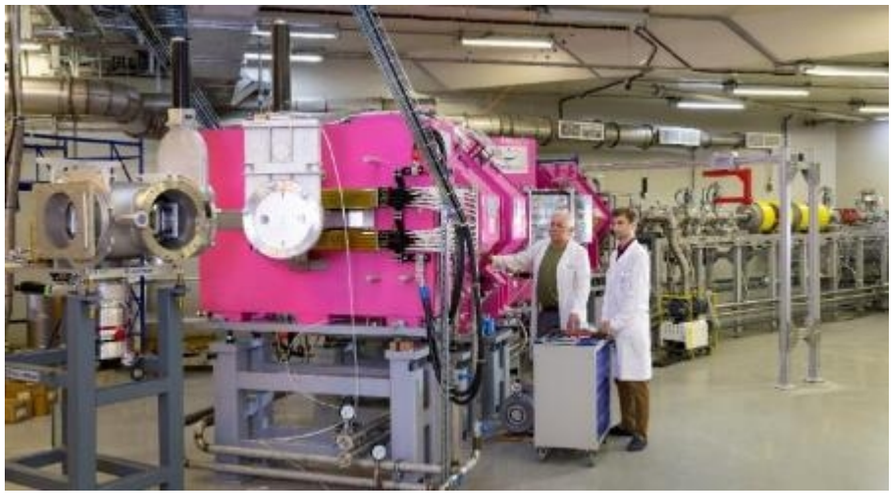


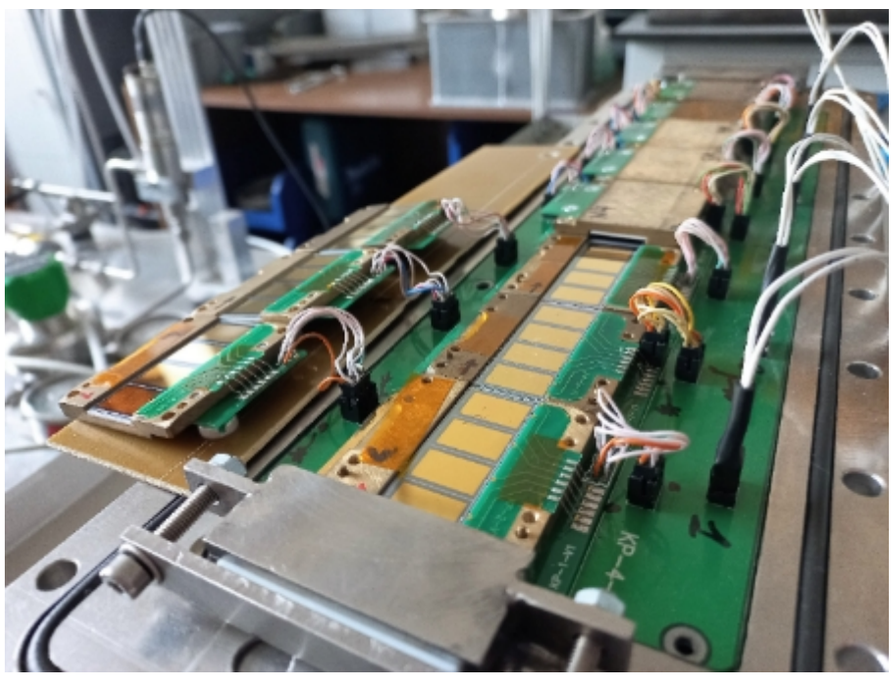


- The experiment was carried out at 2 different beam energies in June – October 2022.
- 6 events of the ^{276}Ds synthesis were observed in experiment at extremely low cross section.
- Three new isotopes (^{276}Ds, ^{272}Hs, and ^{268}Ds) of superheavy elements have been discovered at the SHE Factory in addition to two another isotopes ^{286}Mc, ^{264}Lr discovered in 2021.
- The experimental results are in agreement with expectations.
- Experiment at even higher beam energy is planned for March 2023.

CHEMISTRY OF ELEMENTS CN AND FL

GRAND (GAS-FILLED RECOIL ANALYZER AND NUCLEI DETECTOR) DGFRS-3





Status:

- Detection setup was developed and installed at the GRAND separator.

- Test experiments were carried out with mercury and nobelium isotopes produced in fusion reactions. The purpose was testing and further setup optimization.

First run (Nov.-Dec. 2022) $^{48}Ca + ^{242}Pu$:

- 1 event of the element 112 was observed.
- 1 event of the element 114 was observed.

Second run of the chemical experiment is scheduled for the second half of 2023 following the improvement of the experimental setup.

ACCELERATOR COMPLEX DRIBS-3

DC280

The total operation time of the accelerators in 2022 amounted to 6000 hours.

Experimental programme is executed on schedule:

- High intensity ^{48}Ca beam (up to 7.7 *pμA*).
- Stability of ^{48}Ca beam during months of work.
- Production of $^{54}Cr^{10+}$ beams (4.0 pμA).
- Production of $^{48}Ti^{9+}$ beams (3.2 pμA).

U400M

Modernization is in progress:

- The modernization of main magnetic system was done (new coils, first harmonic and valley shims).
- A new focusing magnetic channel of the extraction system was designed and manufactured.
- Cyclotron vacuum chamber was mounted and successful tested.
- Installation of engineering systems and cyclotron equipment (vacuum, cooling, power supply, control, radiation safety systems).
- First beam is expected in 2023.

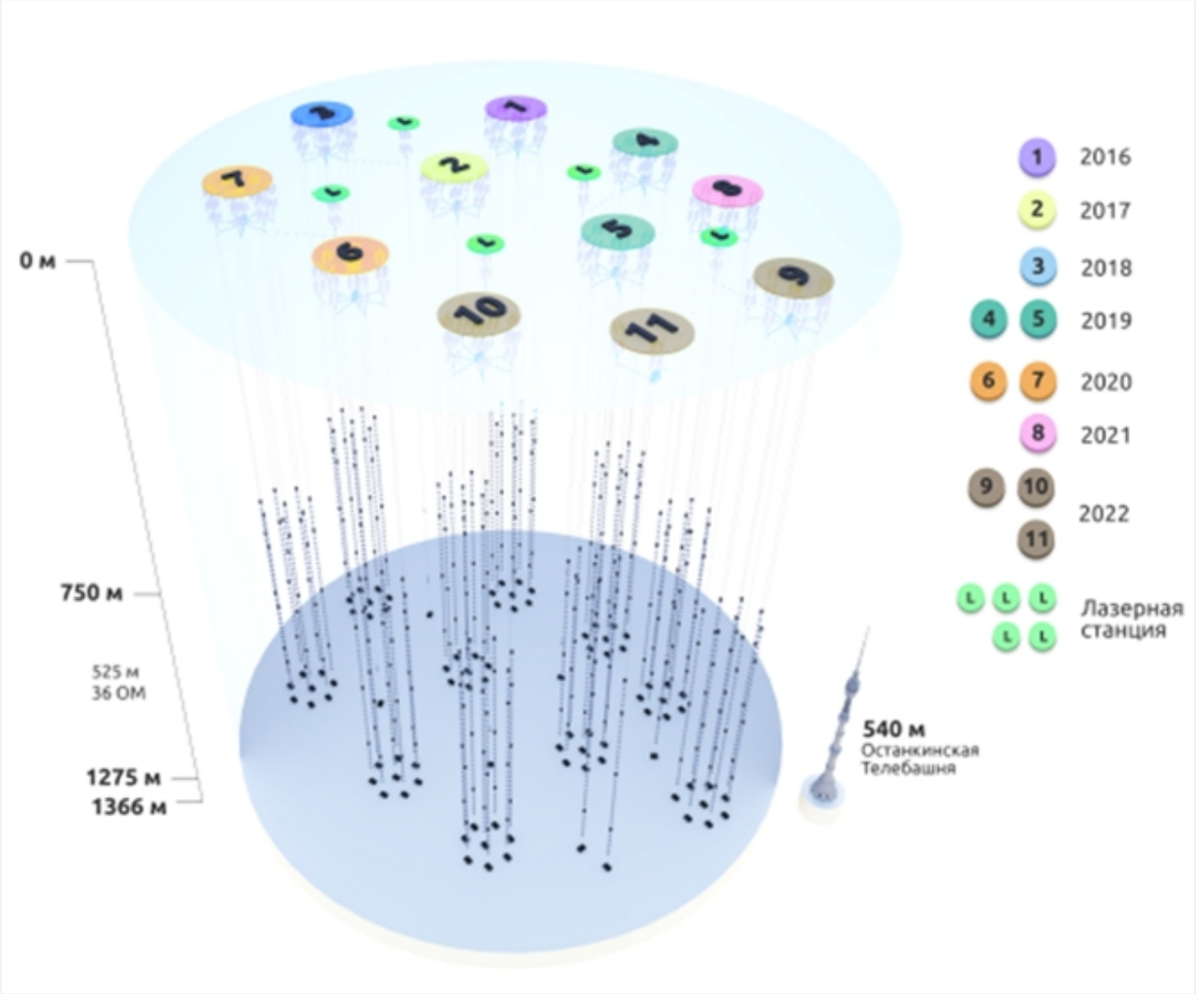
DC140

Creation of a new facility for applied research:

- Accelerator hall is under deep reconstruction.
- Footings for the DC-140 cyclotron magnet were installed.
- Active production and delivery to FLNR of the cyclotron equipment is underway.

Baikal-GVD construction status

Status 2022: 10 clusters, 5 laser stations, experimental cluster prototype with new DAQ system



The array contains 2916 optical modules

Nearest plans

- About 700 optical modules are assembled for deployment in 2023.
- The collaboration is planning to install additional 2 new clusters in case a good external conditions (weather and ice).

Search for astrophysical diffuse neutrino flux using Baikal-GVD

Data for 2018–2021, 4928 days in equivalent for single-cluster

Shower detection channel:

Selected: **11** events

Expected:

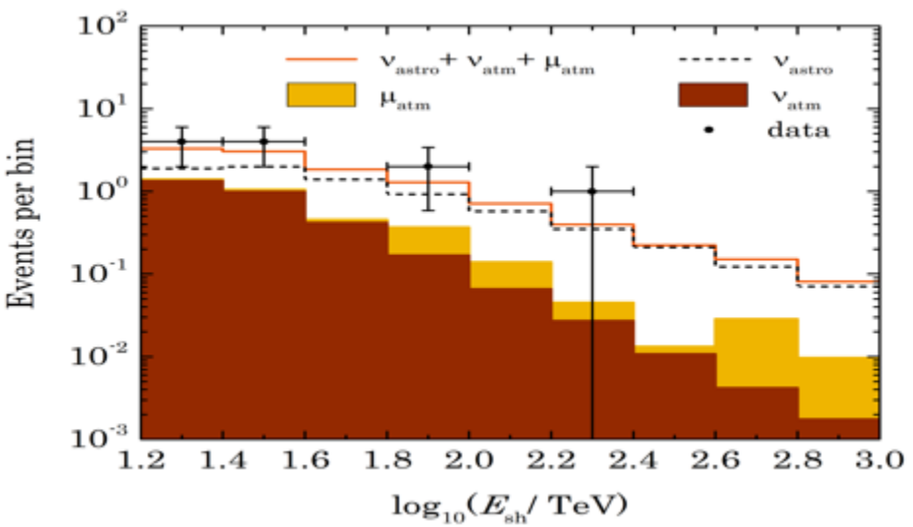
0.5 events from atmospheric muons

2.7 events from atmospheric neutrinos

6.3 events for Baikal-GVD best fit of an astrophysical flux parameters

Probability for the background-only hypothesis (stat. + sys.)

P-value = 0.0024 (3.05)



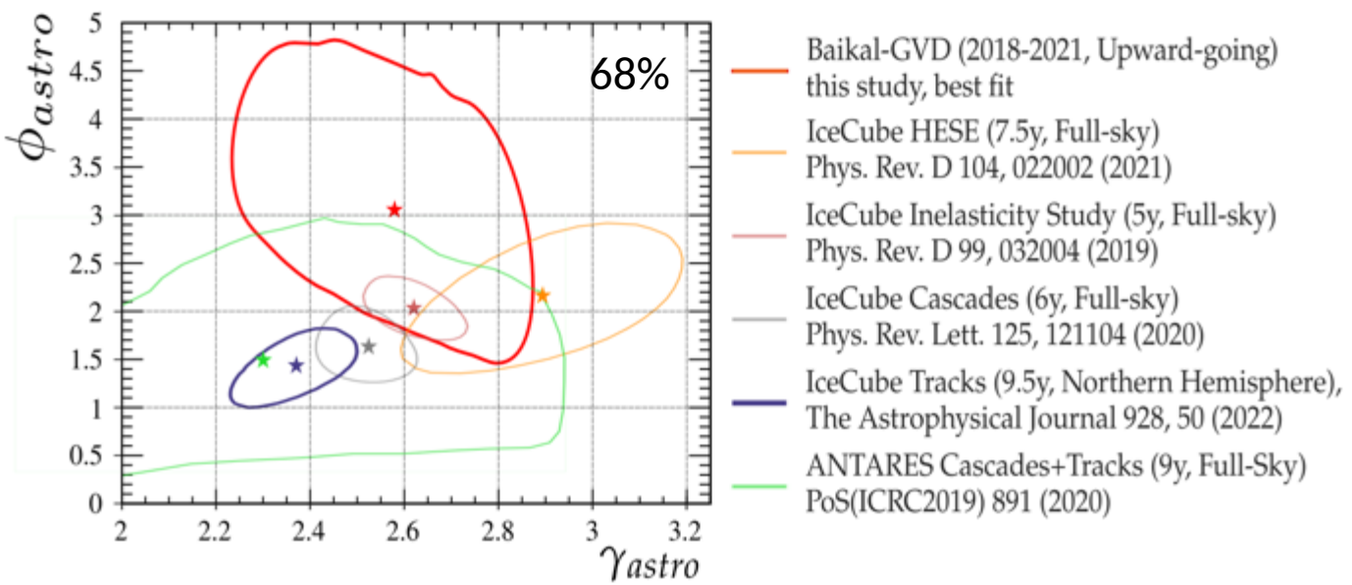
Single power low spectrum model: :=1:1:1):

$$\Phi^{\nu+\bar{\nu}} = 3\times10^{-18}\,\varphi_{astro}\left(\frac{E}{10^5}\right)^{-\gamma_{astro}}\left(GeV\,cm^2\,s\,sr\right)^{-1}$$

Baikal-GVD best fit parameters:

spectral index: $\gamma_{astro} = 2.58$

one flavor normalization: $\varphi_{astro} = 3.04$



"Govorun" Supercomputer Modernization 2022

Computation field:
+32 hyperconverged compute nodes

Hierarchical Storage:
+8 distributed storage nodes

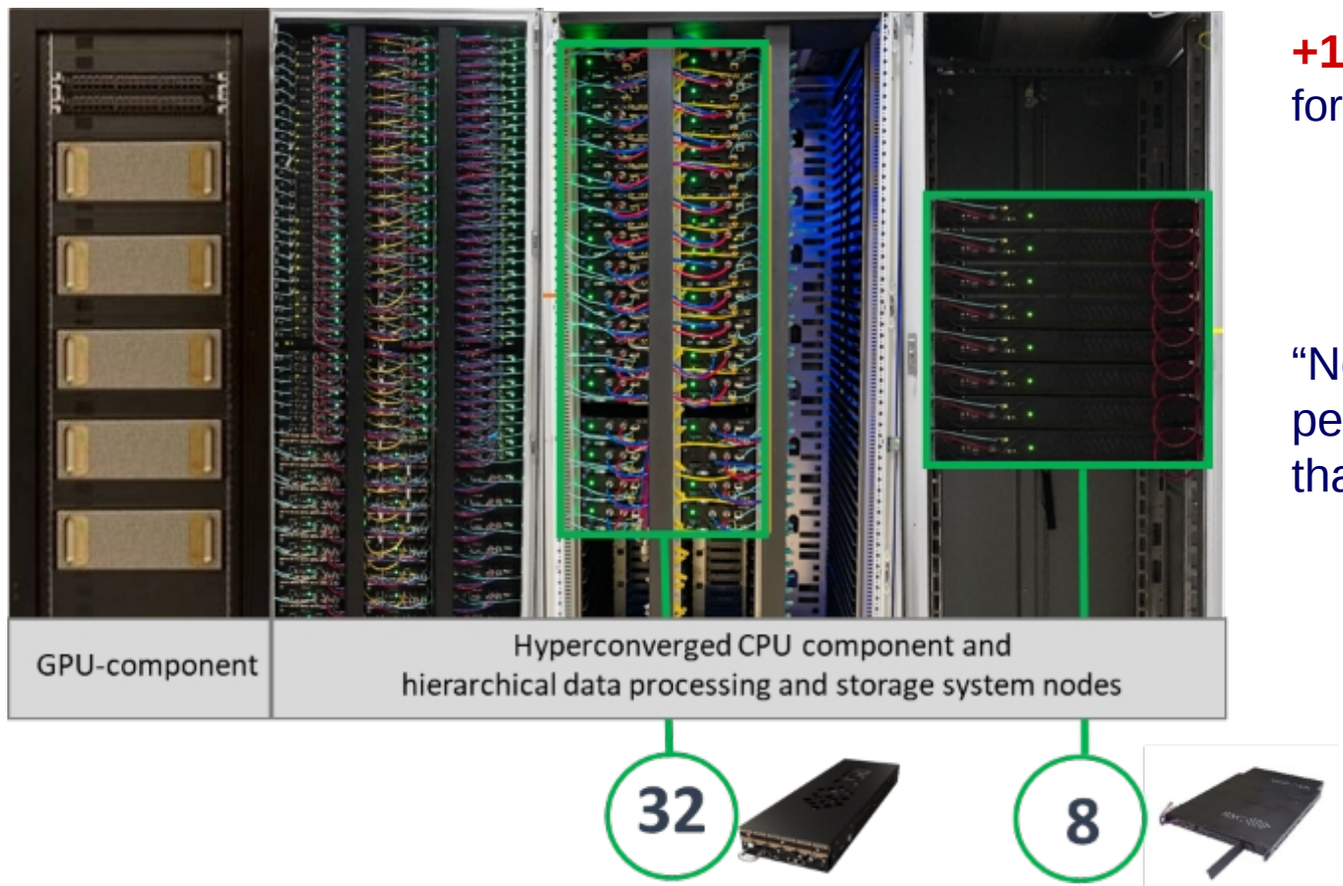
Performance: +239 Tflops
DAOS: +1.6 PB
Lustre, EOS: +8 PB

Current status:
- **138 hyperconverged compute nodes**
- **40 GPU** accelerators

Total peak performance:
- **1.1 PFlops DP**
- **2.2 PFlops SP**

Total capacity of Hierarchical Storage:
- **8.6 PB**

Data IO rate: **300 Gb/s**



+1,152 new computational cores for MPD

Nearly 50 million events generated in less than a month!!!

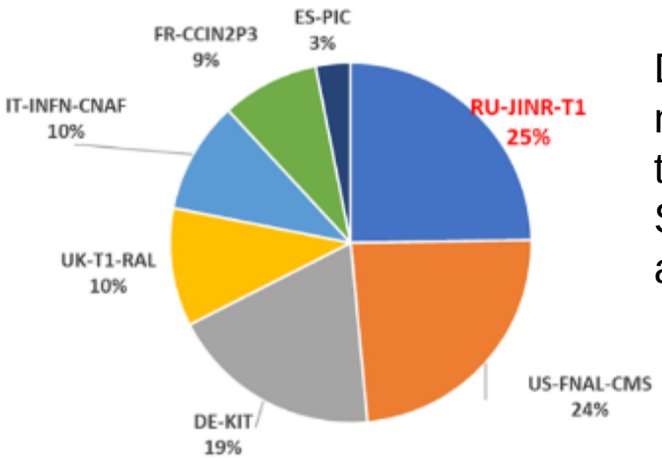
"New cores"/"old cores" performance increase more than **1.5 times**

+0.4 PB for MPD mass production storages integrated into the DIRAC File Catalog

+1 PB for the MPD EOS storage

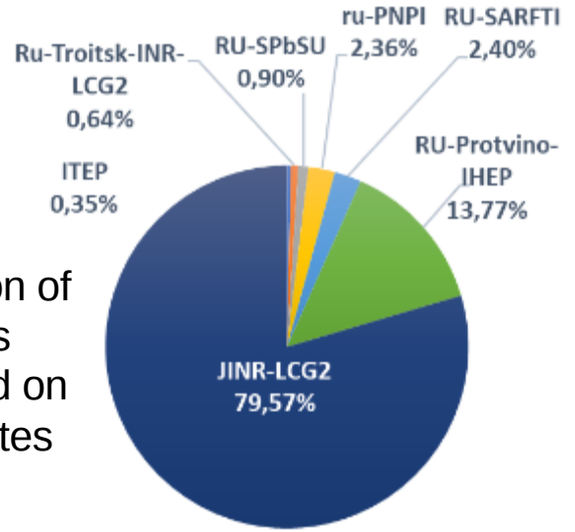
MICC – Grid Infrastructure – Tier1 and Tier2

The JINR Tier1 centre has demonstrated stable work not only for CMS (LHC), but also for MPD and SPD (NICA). The Tier1 site for CMS is ranked first among world centres for CMS.



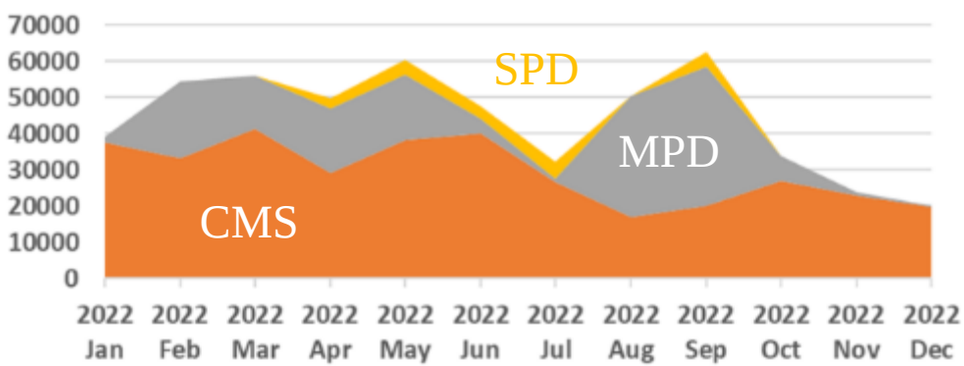
Distribution by the normalized CPU time in HEP-SPEC06 hours among CMS Tier1

Distribution of RDIG jobs completed on the grid sites

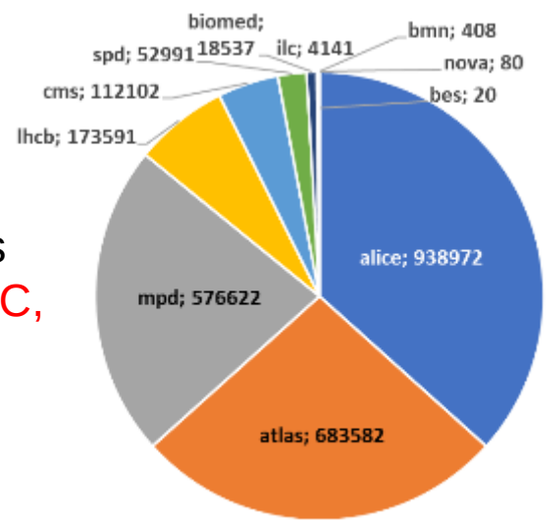


The JINR Tier2 output is the highest in the Russian Consortium RDIG (Russian Data Intensive Grid).

Distribution by the number of jobs completed on Tier1 by the CMS, MPD and SPD experiments in 2022



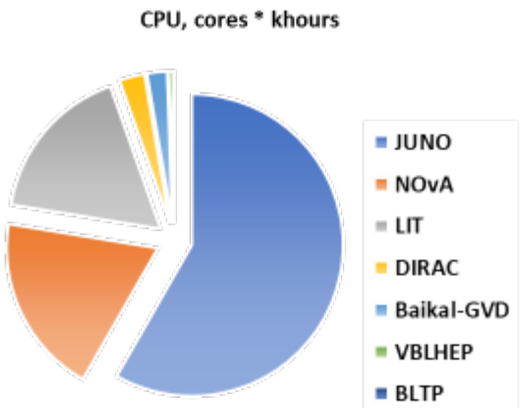
The Tier2 centre is used for NICA, LHC, NOvA, BES, ILC, BIOMED and by local users.

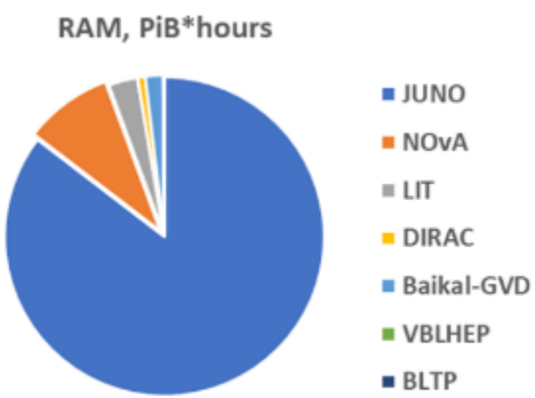


Use of the JINR Tier2 site by virtual organizations within grid projects

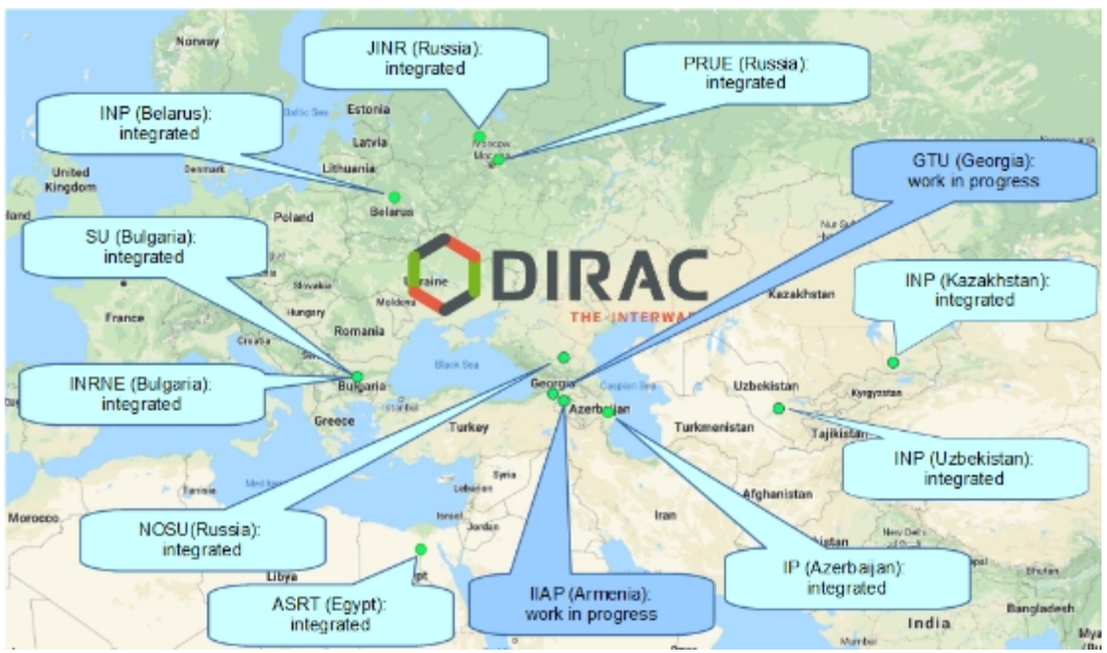
Cloud Infrastructure

JUNO, NOvA, MLIT and Baikal-GVD are the major users of the cloud infrastructure in 2022.

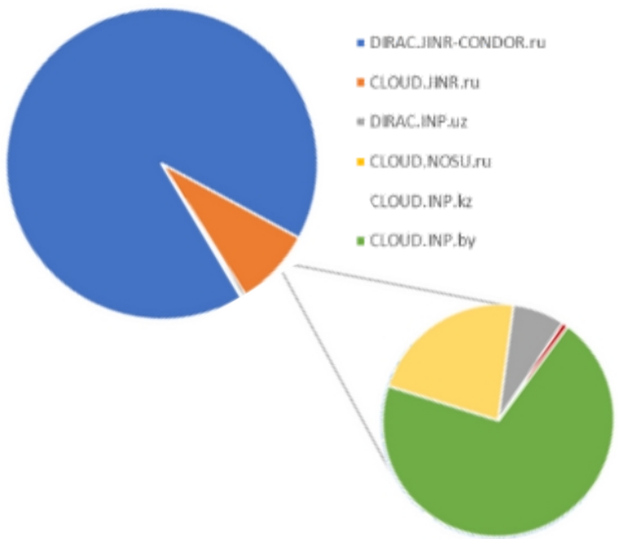




In 2022, the cloud of the Institute of Nuclear Physics of the Academy of Sciences of Uzbekistan was put into operation and integrated into the distributed information and computing environment (DICE) based on the resources of JINR and organizations of its Member States.



Most of the jobs in the JINR DICE in 2022 were performed on the neutrino computing platform (DIRAC.JINR-CONDOR.ru).



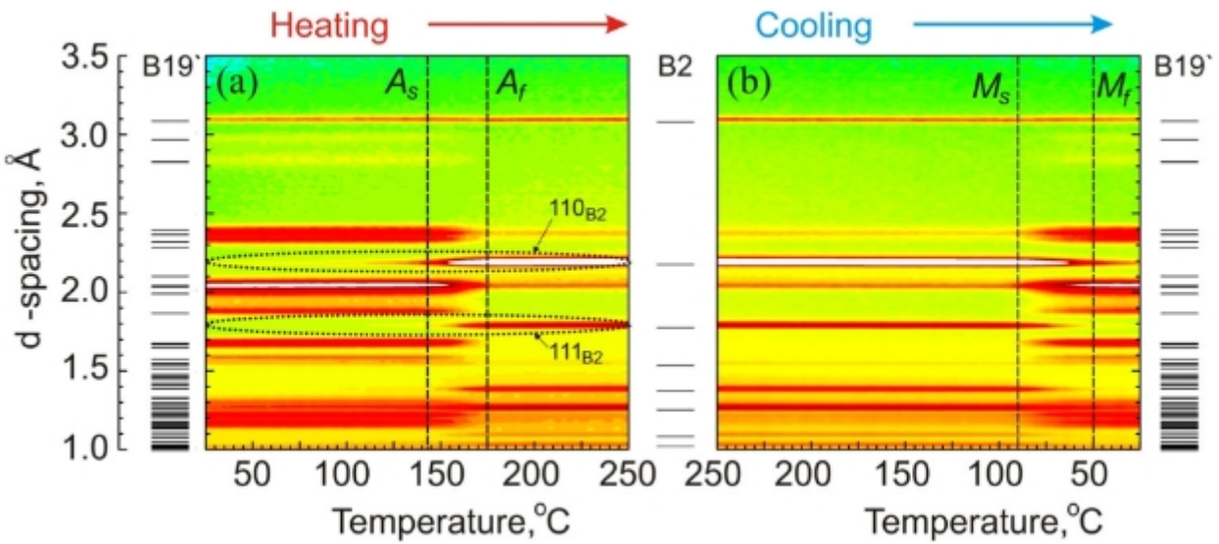
The main consumer of the JINR DICE resources was the Baikal-GVD experiment (96%).

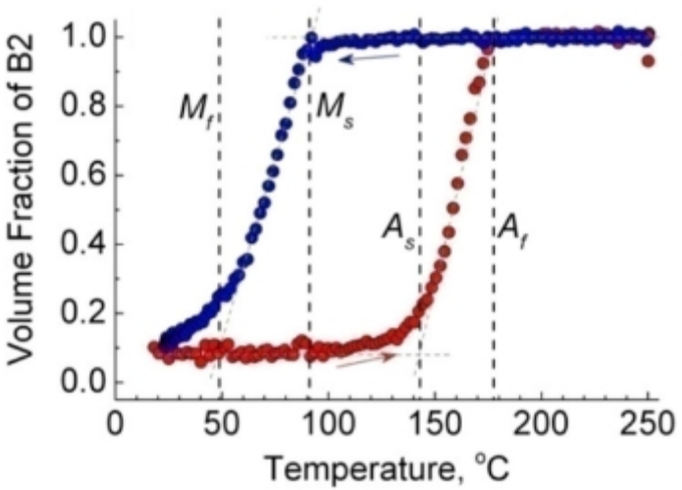
JINR School of Information Technology 2022

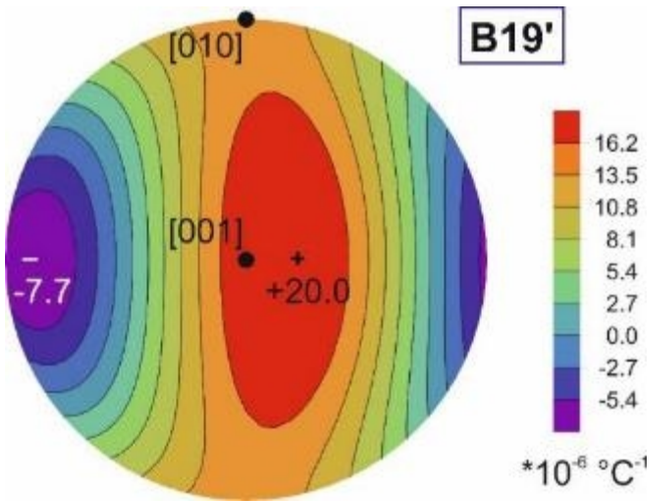
60 students from 13 Russian universities

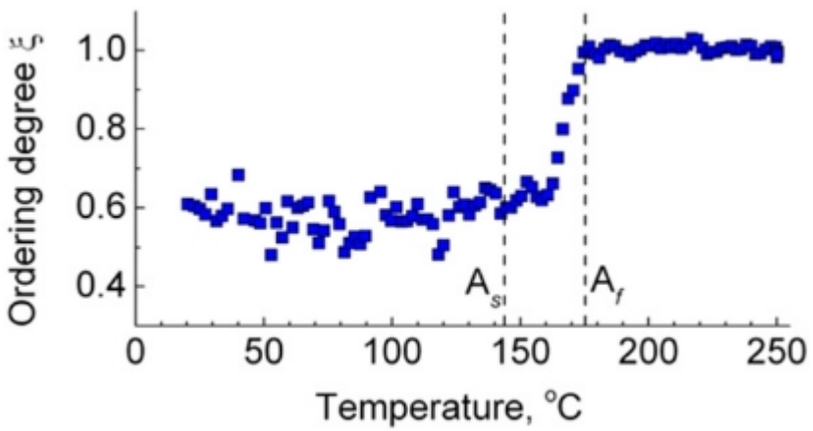
JINR MLIT

Structural Study of $Ti_{29.7}Ni_{50.3}Hf_{10}Zr_{10}$ high-temperature shape memory alloy







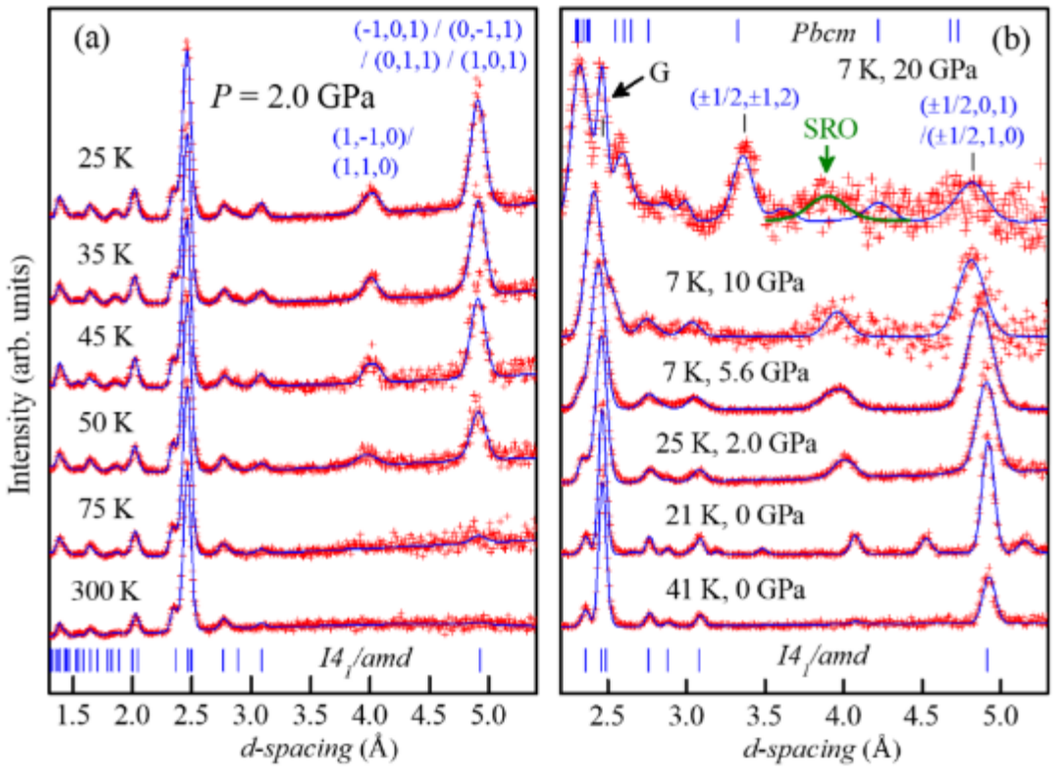


Austenite B2 vol. fraction during the thermal cycle. There are ≈ 12% of residual austenite.

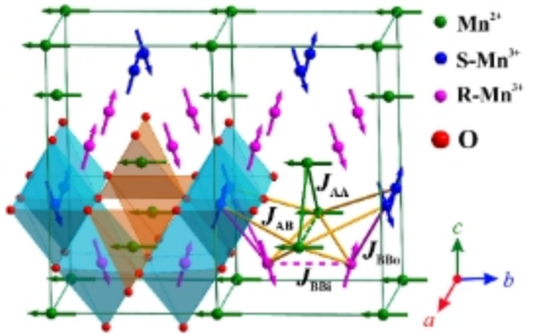
Linear thermal expansion of B19', equal area projection. There is a contraction region close to normal to (100) plane.

Ordering degree of B2 austenite during heating. There is an disorder-order transition during the reverse MT.

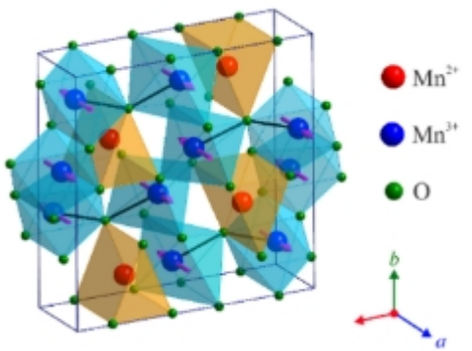
Pressure-induced magnetic states and colossal rise of magnetic ordering temperature in geometrically frustrated oxide Mn_3O_4



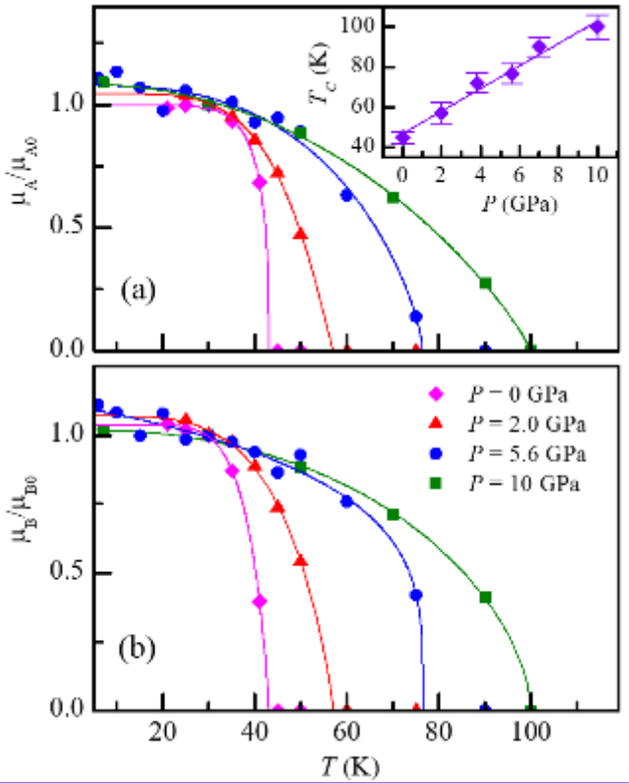
Neutron diffraction patterns of Mn_3O_4 measured at selected pressures and temperatures and fitted by the Rietveld method (a, b).



Tetragonally distorted spinel crystal structure and magnetic order in Mn_3O_4 at ambient pressure, TC = 43 K



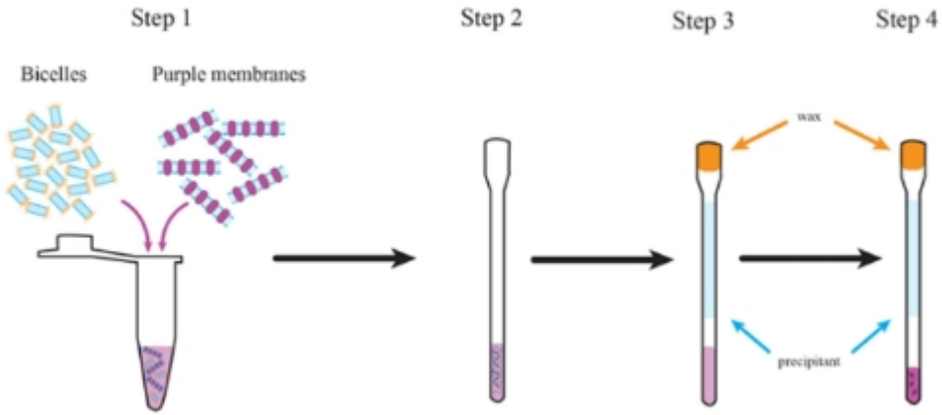
Orthorhombic structure and magnetic order in pressure-induced phase of Mn_3O_4, TNO = 275 K at 20 GPa



Temperature dependences of the ordered Mn magnetic moments at the A (a) and B (b) sites of Mn_3O_4 at selected pressures and pressure dependence of the magnetic ordering temperature

D.P.Kozlenko et al. // Phys. Rev. B. 105, 094430 (2022).

Crystallization mechanism of membrane proteins in bicellar systems

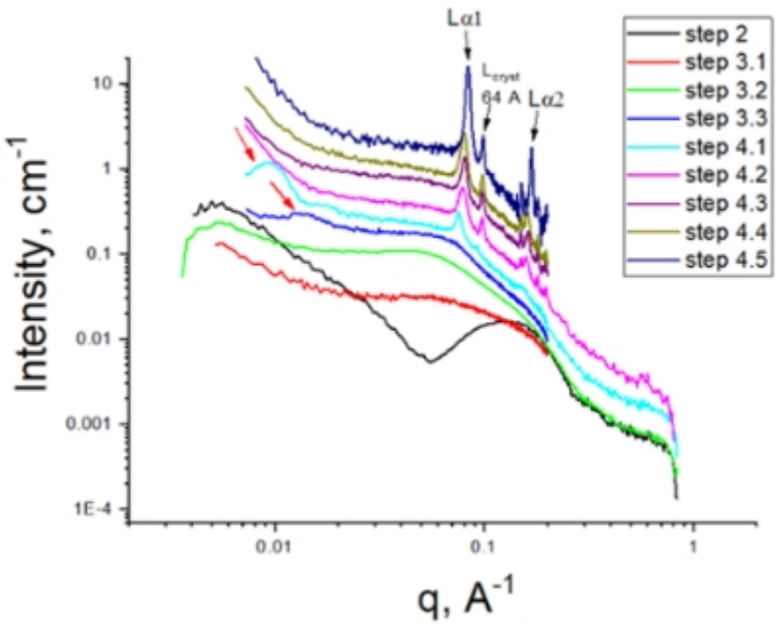


Bacteriorhodopsin BR

Purple membranes with BR + bicelles

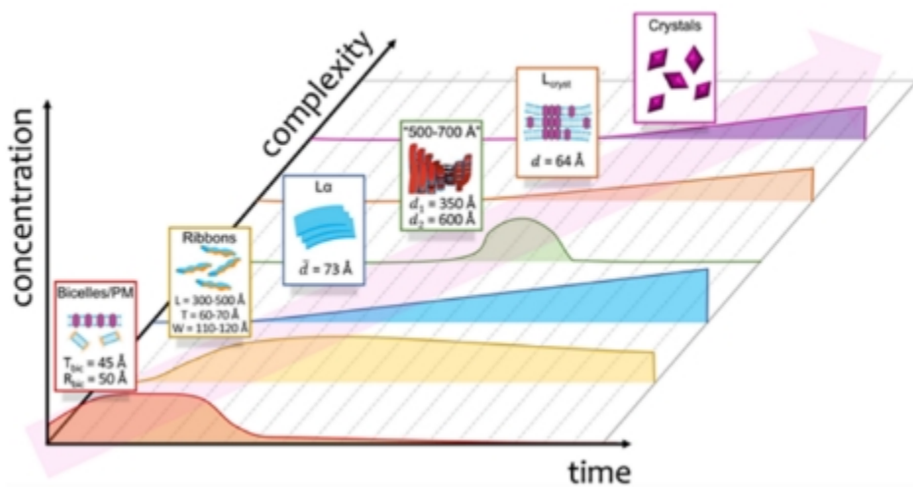
Crystals of BR in the crystallization matrix

Schematic representation of the crystallization of bacteriorhodopsin in bicelles within capillaries for real-time small angle X-ray SAXS experiments



Transformation of the SAXS curves during the different steps of the crystallization process (left).

Evolution of the crystallization matrix and consequent appearance/disappearance of various structural elements (right).

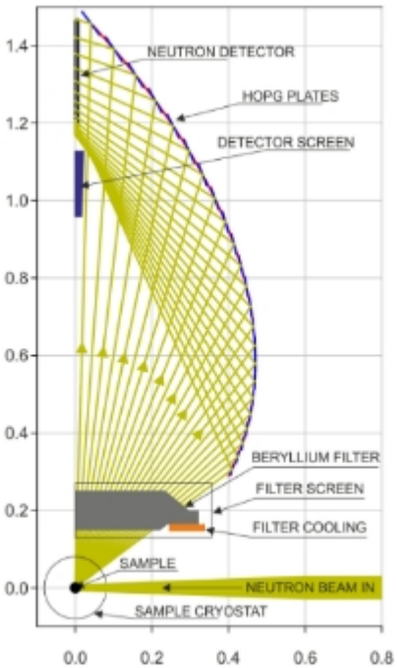


Murugova T.N., Ivankov O.I., Ryzhykau Y.L. et al. // Sci Rep 12, 11109 (2022).

Development of the IBR-2 Spectrometer Complex

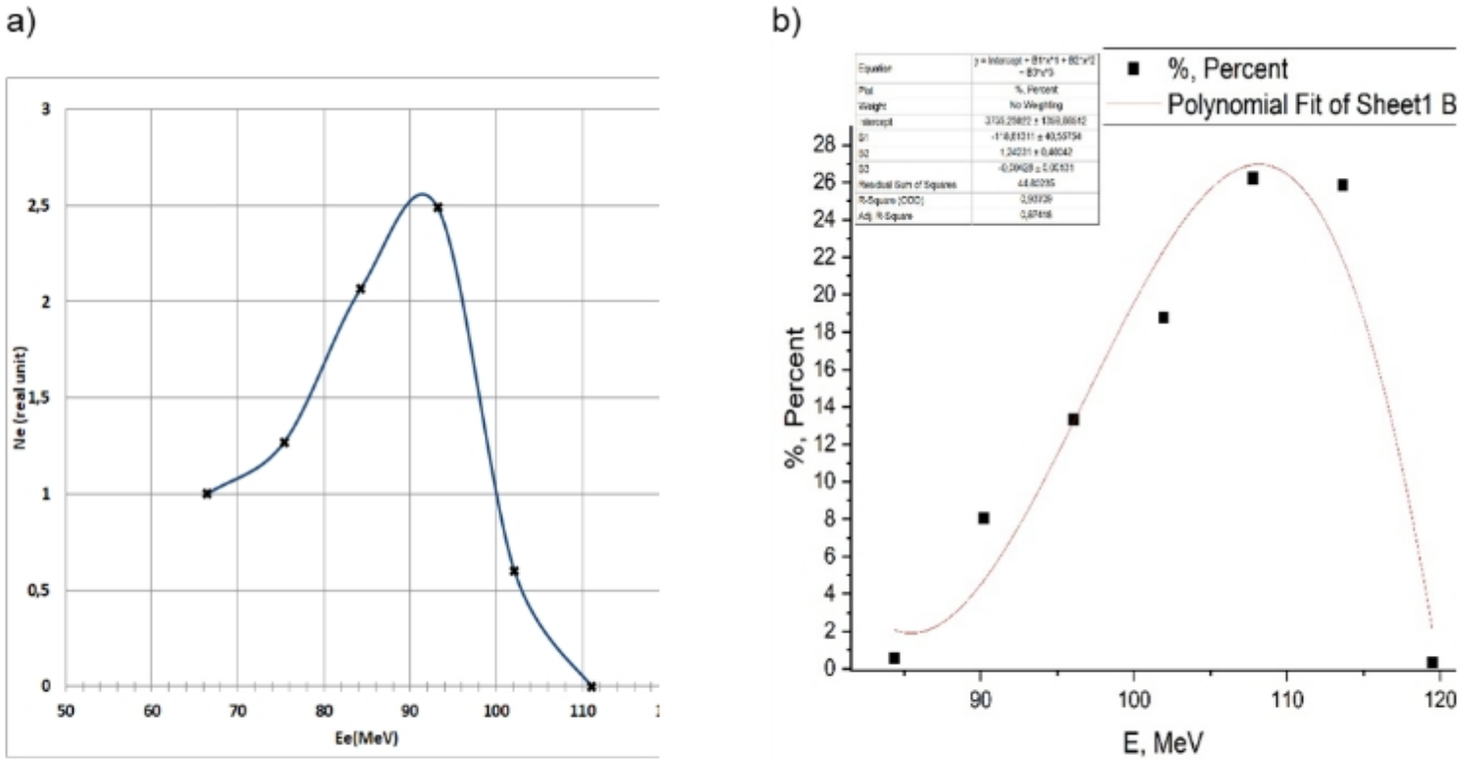
New supermirror neutron guide
of the DN-6 diffractometer

New scintillation detector modules ASTRA
at the FSD diffractometer

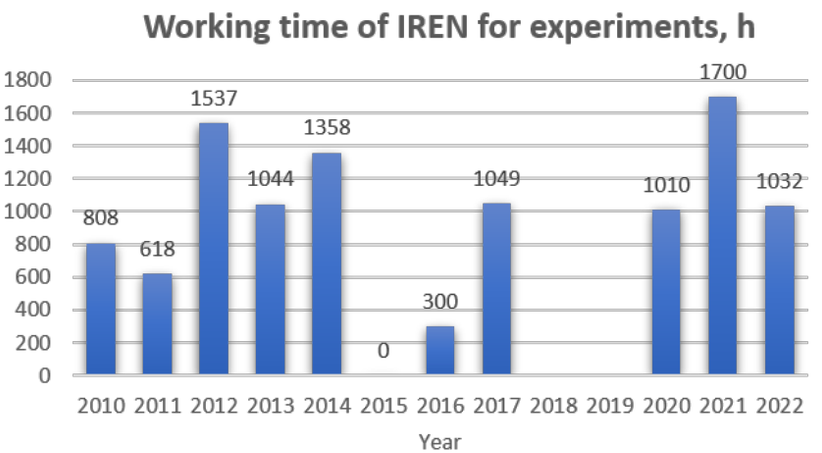


Development of
an inelastic neutron scattering
spectrometer in inverse geometry **BJN**
(Bajorek-Janik-Natkaniec)
at the IBR-2 reactor

The electron beam energy was increased from 90 MeV to 110 MeV

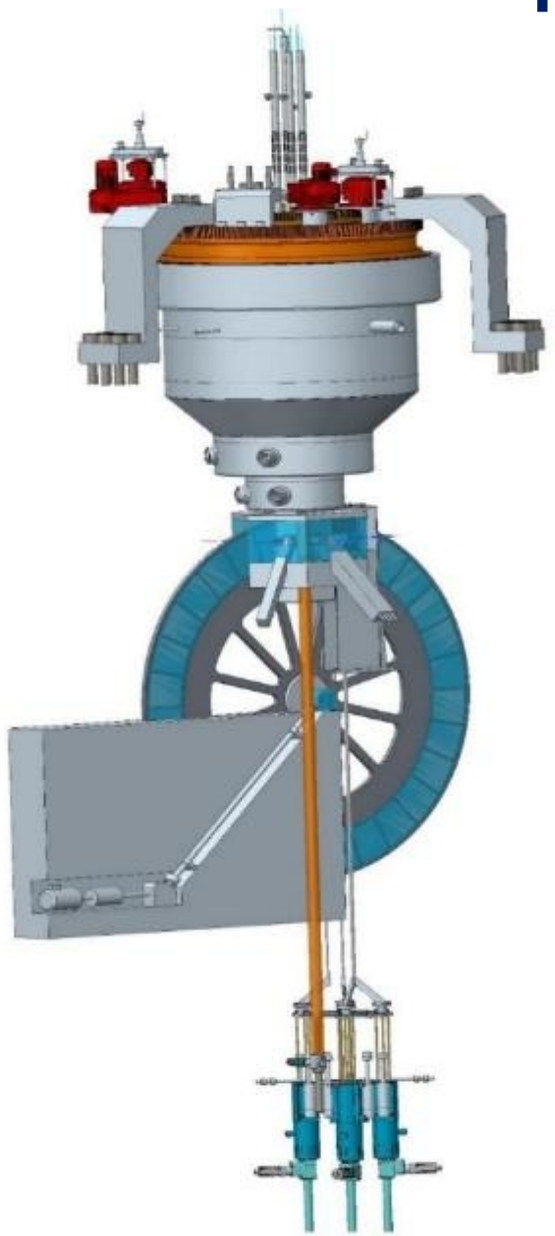


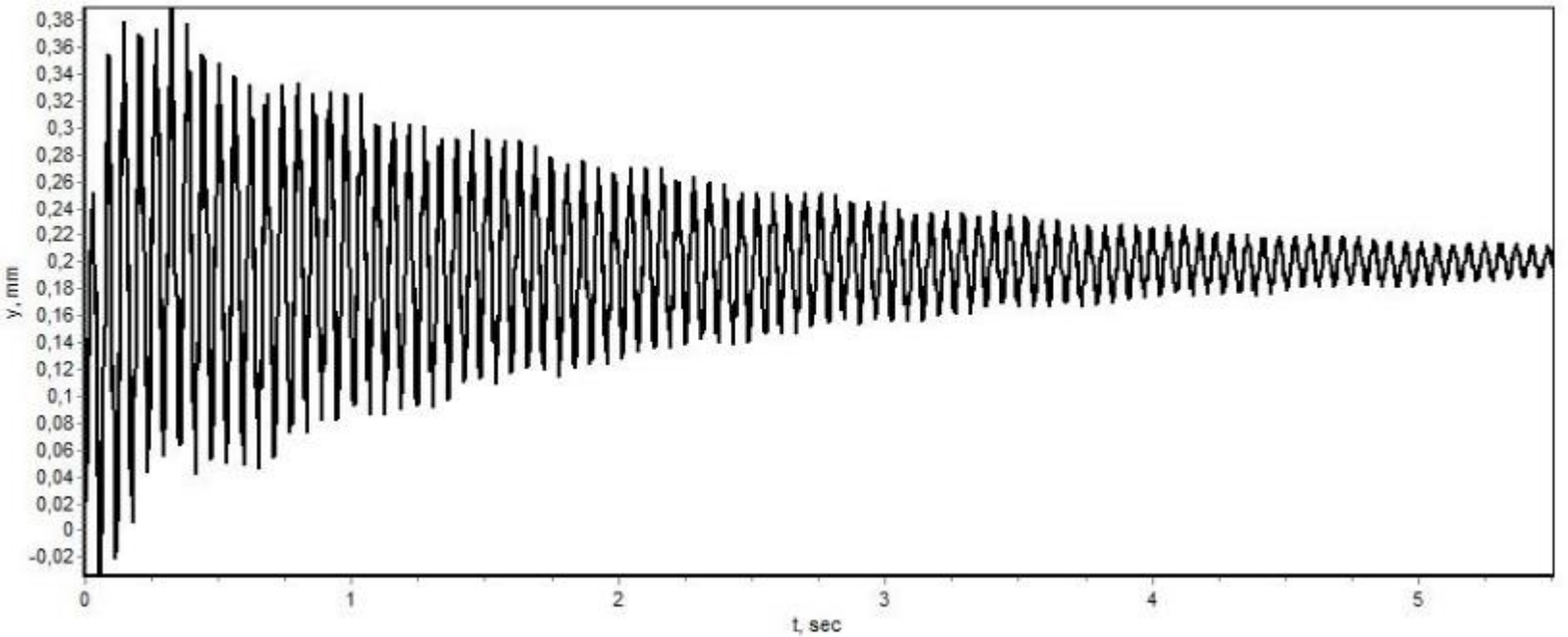
Energy spectra of accelerated electron beams obtained in December 2019 (a) and obtained in November 2022 (b).



New Project

Research of stability of Fast Pulse NEPTUN reactor



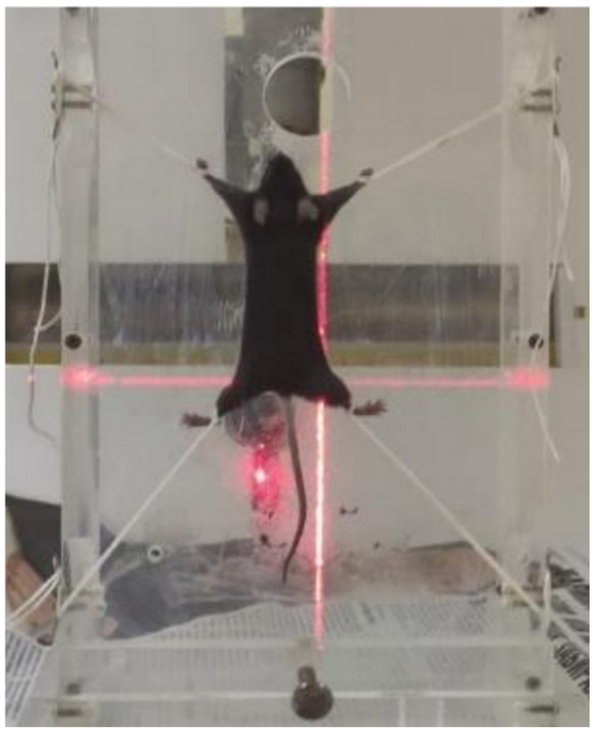


Dynamics of the position of the free end of the fuel rod after "turning on" the temperature

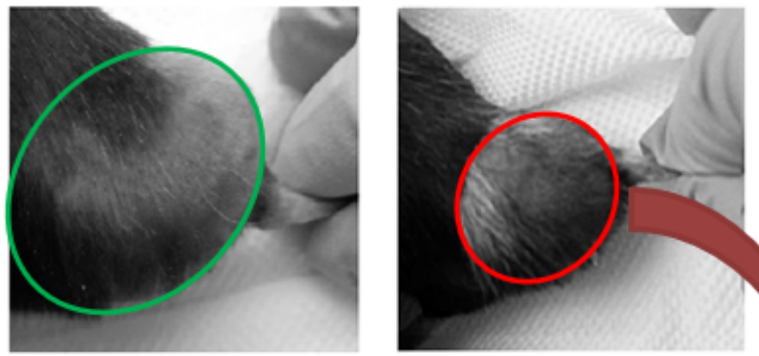
Next important step is computational and experimental verification of the NEPTUNE reactor dynamics model together with **VNIITF** (Snezhinsk, Rosatom State Corporation)

A new method for selective killing of cancer stem cells

Proton and photon irradiation of mice with grafted tumors

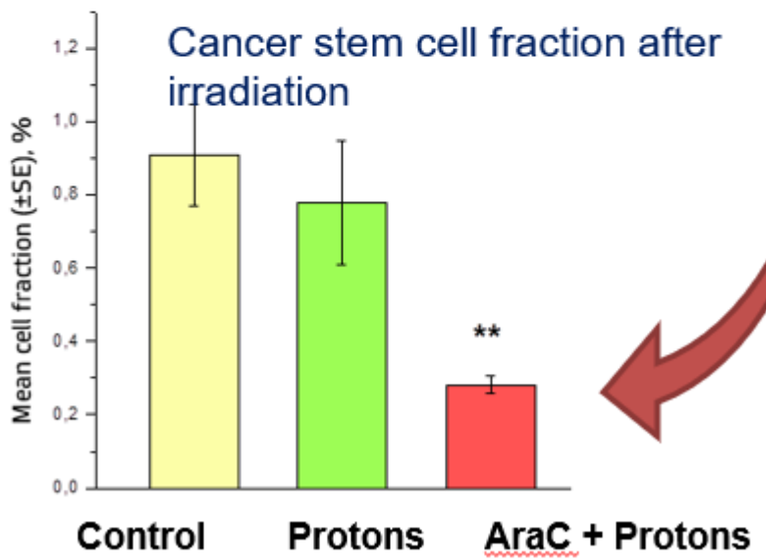


The size of the tumor on a mouse paw on the 18th day after irradiation

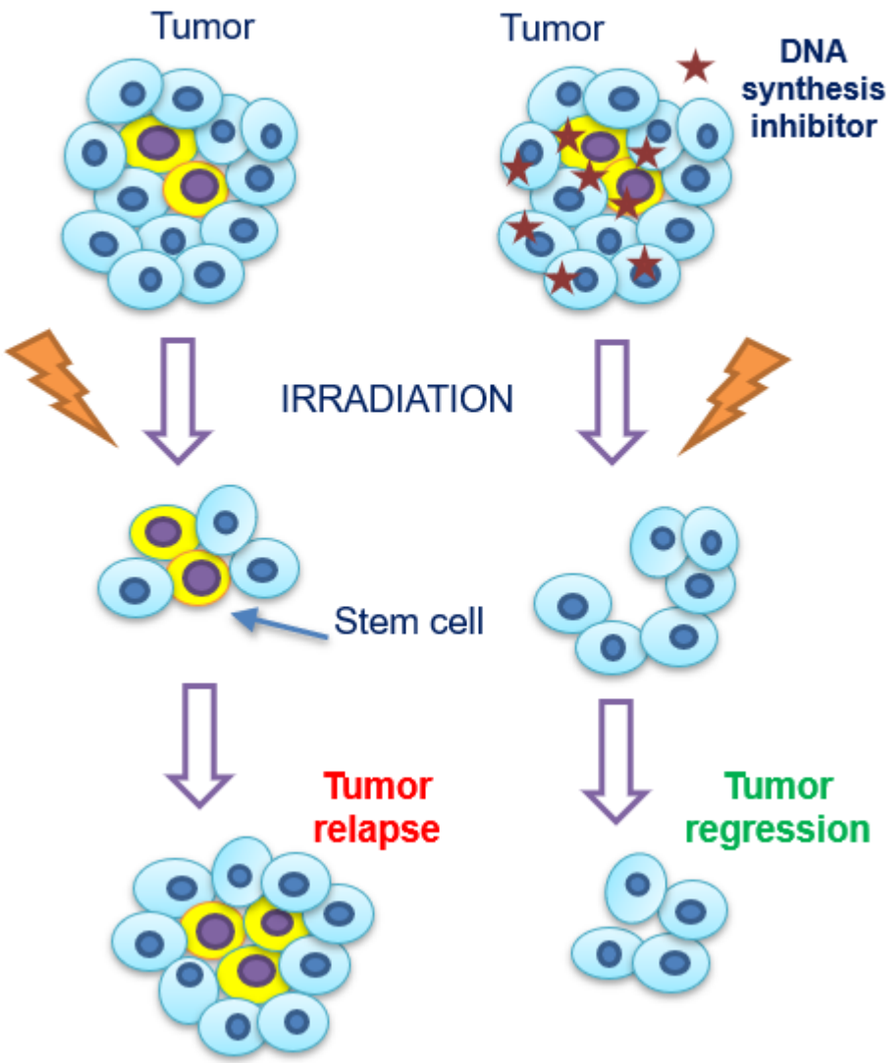


Protons 10 Gy

Protons 10 Gy + AraC



Tumor regression due to stem cell death

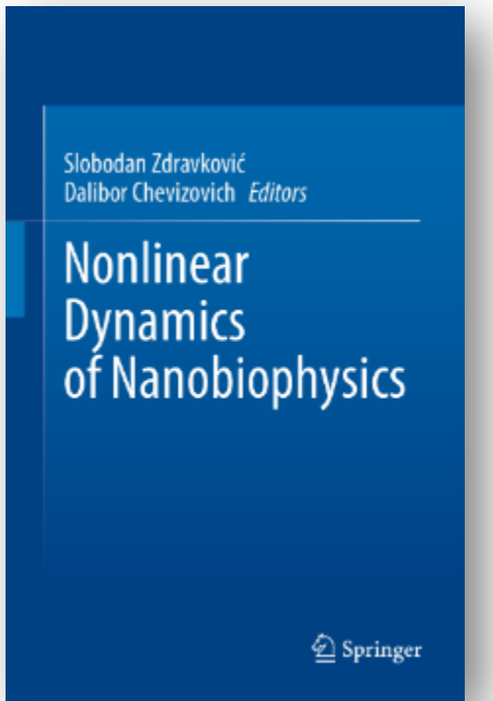


Patent No. 2774032

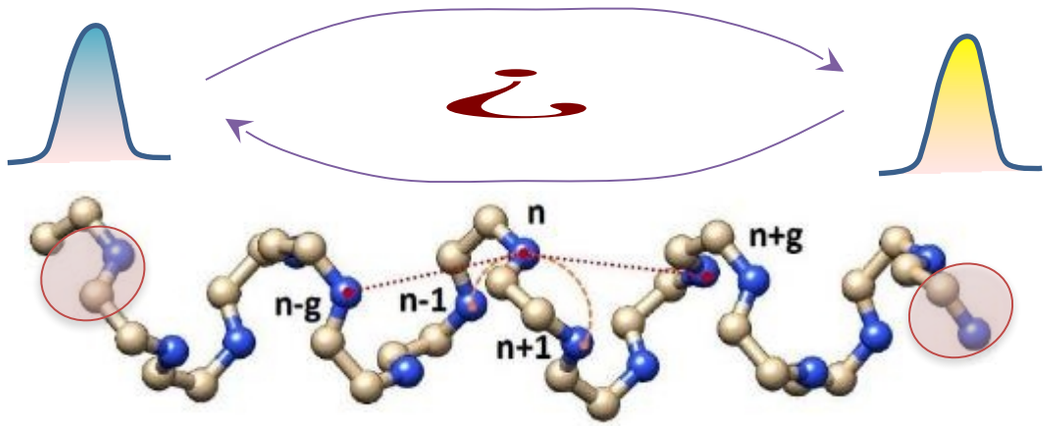
Zamulaeva I.A. et al // Phys. Part. Nucl. Lett. 2023. V. 20(1).

Nonlinear dynamics and quantum correlations in biomolecules

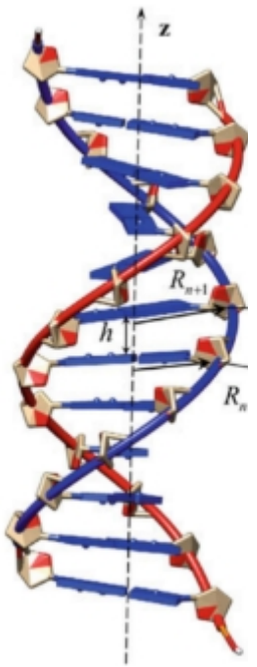
A.N. Bugay, A.V. Chizhov, 2022

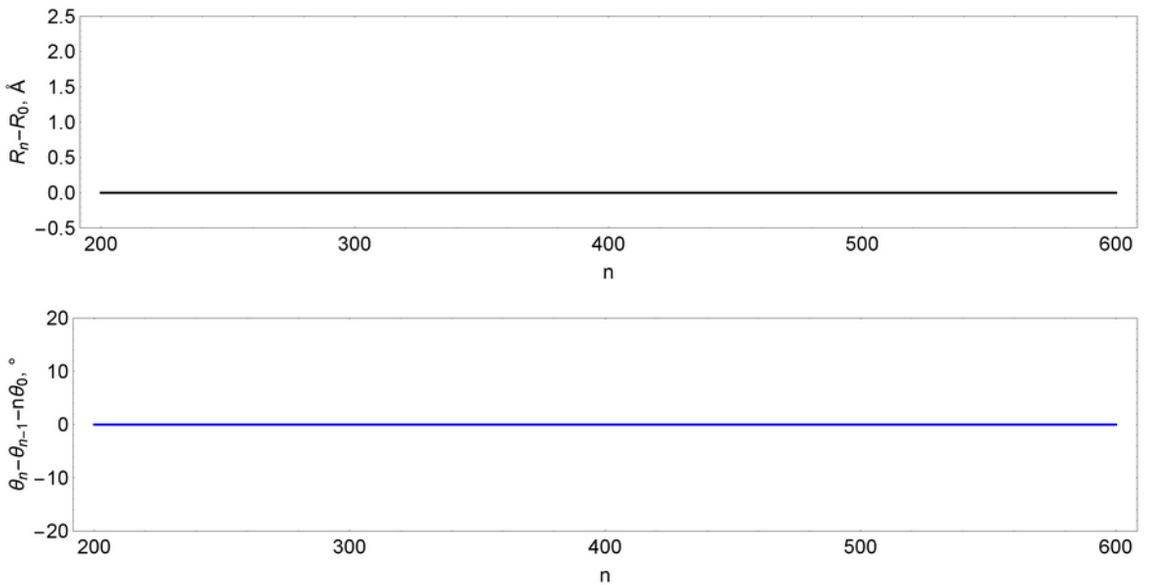


Monography on biomolecules, 2022:
- biophysics,
- bioinformatics,
- nonlinear dynamics,
- quantum correlations.



Quantum entanglement in a model of protein alpha helix



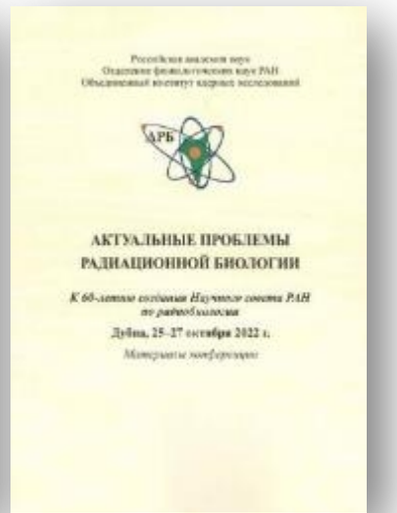


Collective excitation (soliton) in DNA chain

Conference “Current problems of radiation biology”

To the 60th Anniversary of the RAS Scientific Council on Radiobiology

25-27 October 2022, LRB JINR



Anniversary plenum of the RAS Scientific Council on Radiobiology and the Presidium of the Radiobiological Society were held in Dubna.

More than 100 radiobiologists from different research centres of JINR Member States discussed hot topics in space radiobiology, radiation genetics, radiation safety and radioprotectors, molecular radiobiology and physiology, radiotherapy of cancer and interdisciplinary education.

https://youtu.be/qKTky53XTEc

STUDENT PROGRAMMES

- **JINR-attached students**
  (382, including 232 from JINR-based departments)
- **SA-JINR school at iThemba labs**, January, 2023,
  Lectures on JINR research fields and preselection of participants for the 3-week International Student Practice.
- **START-2023** **Winter session** – in progress, 13 participants; **Summer session** – collection of applications.
- **INTEREST** **Wave 7** – June-July, 33 participants,
  Wave 8 – February-March – participants selection.
- **UC Scientific and Engineering Group**
  Engineering training for students (25 participants)
  New configuration of the LINAC-200 training section has been designed, assembly work and first tests with the beam started.

OUTREACH ACTIVITIES

- **Popular science lectures**
  36, including 27 offline.
- **Visits to the JINR labs for school and university students**
  52, including 45 offline, among them participants from Vietnam, YaNAO, Kamchatka.
- **Work with JINR Information Centres,**
  11 events.
- **Science Festivals**
  NAUKA 0+, GeekPicnic, etc.
- **“Element 105” workshop**
  at the Multidisciplinary “Summer School” (20 students from 12 universities).
- **Information Screen support**
  30 issues since July 22.

SCHOOL STUDENTS AND TEACHERS

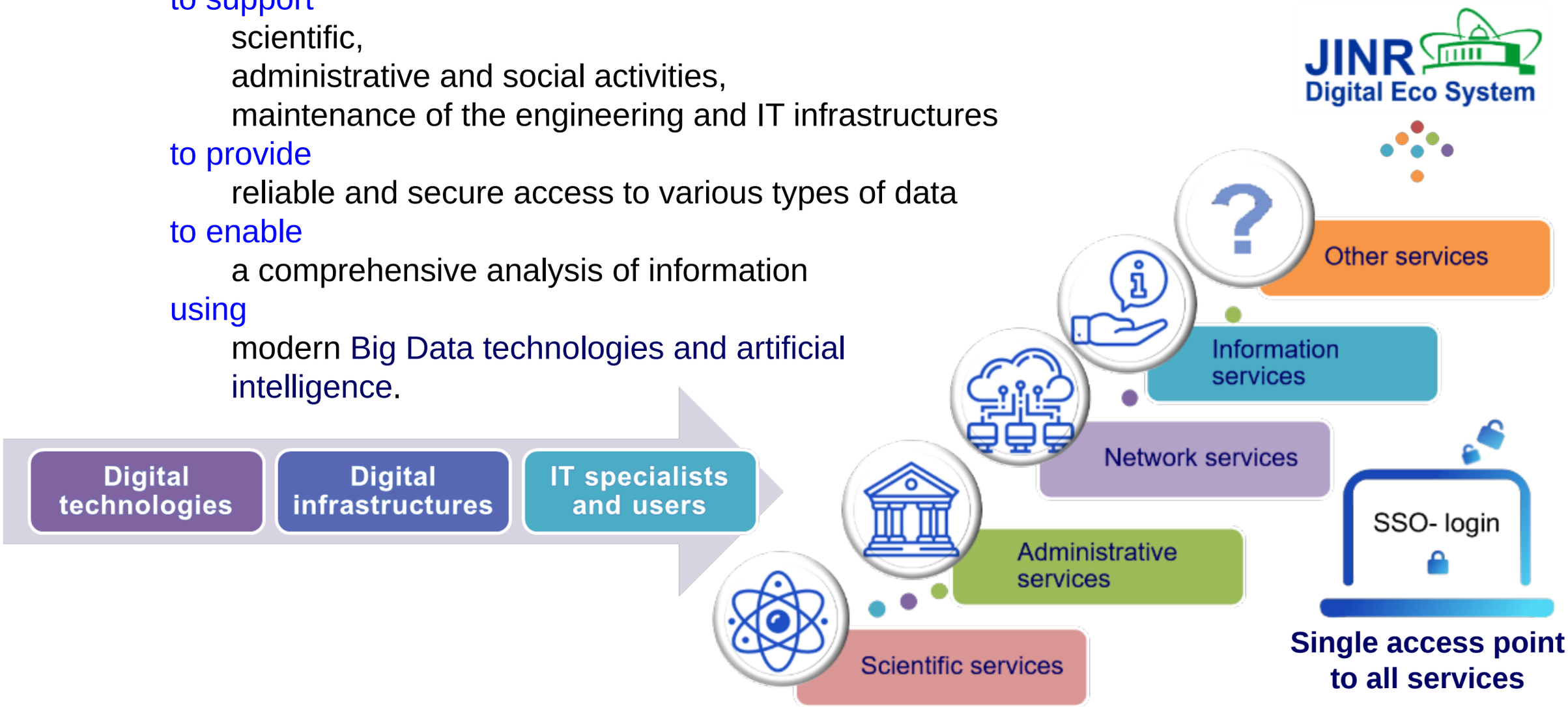
- **XI Scientific School for Physics Teachers,** 20 participants from Russia and Armenia
- **School for science teachers from Prymorsky Krai** 10 participants
- **Visit of school teachers** from Nizhny Novgorod
- **II Science School for students of the Children's University of the Egyptian Academy of Scientific Research and Technology,** 12 participants

- **Collaboration with the V.G. Kadyshevsky Lyceum**
  "Hackathon" robotics tournament, meetings with JINR Scientists, etc.

JINR Digital EcoSystem

The digital platform “JINR Digital EcoSystem” integrates existing and future services

to support
scientific,
administrative and social activities,
maintenance of the engineering and IT infrastructures
to provide
reliable and secure access to various types of data
to enable
a comprehensive analysis of information
using
modern Big Data technologies and artificial intelligence.



Events in Egypt: developing contacts with MENA region

Forum for Foreign Graduates of Soviet and Russian Universities, Representatives of the Education System in the Middle East and Africa in Cairo 17–18 December 2022

JINR delegation participation:

- an overview report on JINR;
- moderation of a round table on the interaction of science, education, and industry;
- report on cooperation with Egypt;
- report on JINR capacity building programmes;
- meeting with the Ambassador Extraordinary and Plenipotentiary of the Russian Federation to the Arab Republic of Egypt.

Audience and participants of the Forum:

- Heads and Members of Alumni Associations of Soviet and Russian universities;
- Representatives of Russian and foreign universities and ministries of Egypt and other MENA countries.

On the sidelines of the Forum:
meetings with the Plenipotentiary Representative of Egypt in JINR **Mahmoud Sakr** and
the Head of the EAEA **Amr el-Hagg Ali**.

7th Cairo International Exhibition of Innovation 13–14 February 2023

- JINR representatives a stand with general information about the Institute and held a thematic seminars devoted to the innovative activities of the Institute;
- JINR acted as a strategic partner of the Academy of Scientific Research and Technology in organizing this exhibition, which was held under the auspices of the President of Egypt;
- Within the framework of the visit, a working meeting was held with the Directorate of the National Research Centre of Egypt, where prospects for the implementation of joint projects were discussed.

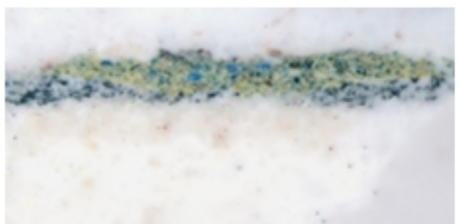
Complex research of wall paintings

by neutron and related physico-chemical methods

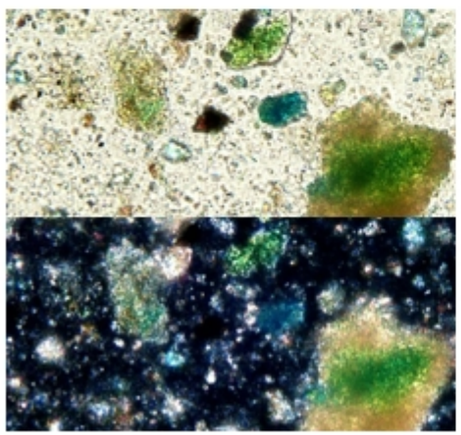
In collaboration with the **State Institute for Art Studies** (Ministry of Culture of Russia)

- Resurrection Cathedral of the Derevyanitskiy Monastery in Veliky Novgorod (14th century)

Polished cross section

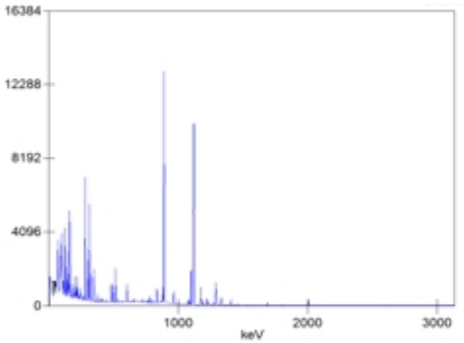


Polarized microscopy

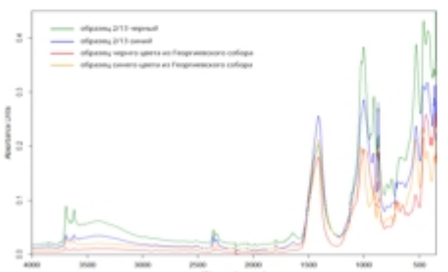


- Church of Saint John the Baptist on Opoki in Veliky Novgorod (12th century)

Neutron and prompt gamma activation analysis



Infrared spectroscopy



JINR–RSA: summer school and partner networking

16 January 2023 – 3 February 2023

4th SA–JINR Physics Summer School was hosted by iThemba LABS.

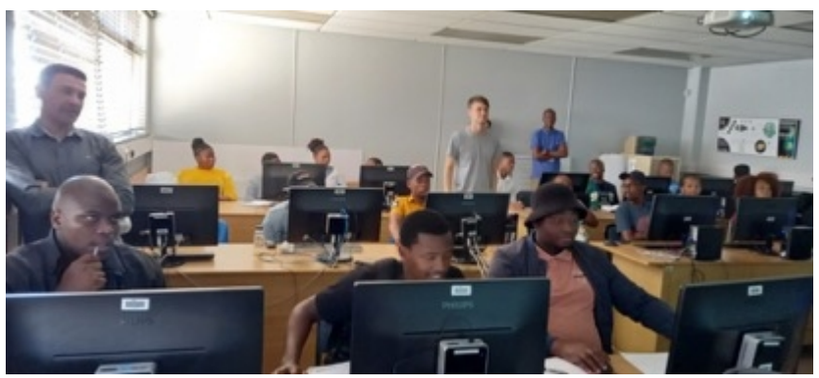
The aim of the school is to provide an opportunity to postgraduate students enrolled for studies in the Science, Technology, Engineering, Mathematics or Innovation (STEMI) to be exposed to research facilities and activities available in South Africa and at JINR.

Scientific Focus:

- Accelerator Technology;
- Research with Accelerators (Materials Research and Nanoscience, Subatomic Physics, Radiation Biology and Radiation effects on electronics);
- Theoretical and Computational Physics.

Participants — 35 students from 8 universities:

- North-West University,
- Stellenbosch University,
- Tshwane University of Technology,
- University of Pretoria,
- University of Zululand,
- University of Limpopo,
- University of the Free State,
- Walter Sisulu University.



The process of forming a **Consortium** of the largest universities of South Africa to participate in projects using the JINR large-scale research infrastructure has been launched.

As part of the School, virtual tour of the Institute's scientific infrastructure facilities, including **key JINR research facilities** and a virtual visit of the Baikal lake to see the **Baikal-GVD neutrino telescope**, was held.

Within the framework of the School, meetings were also held with the leadership of the country's largest universities:

- Vice-Chancellor of WITS University;
- Dean of science of Nelson Mandela University;
- Western Cape education department;
- meetings on the accelerator technologies joint project.

Laureate of Sber Scientific Prize

Yuri Oganessian *won the Sber Scientific Prize for his fundamental work on the synthesis of superheavy elements and contribution to the formation of the accelerator experimental basis that provide the prospect for revolutionary nuclear technologies.*


Thank you for your attention!
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