

**TOPICAL PLAN
FOR JINR RESEARCH
AND INTERNATIONAL COOPERATION
2018**

Dubna 2017

Contents

Theoretical Physics		7
01-3-1113-2014/2018	Theory of Fundamental Interactions D.I. Kazakov, O.V. Teryaev, A.B. Arbuzov	8
01-3-1114-2014/2018	Theory of Nuclear Structure and Nuclear Reactions V.V. Voronov, A.I. Vdovin, N.V. Antonenko	16
01-3-1115-2014/2018	Theory of Condensed Matter V.A. Osipov, A.M. Povolotskii	21
01-3-1116-2014/2018	Modern Mathematical Physics: Strings and Gravity, Supersymmetry, Integrability A.P. Isaev, A.S. Sorin, S.O. Krivonos	26
01-3-1117-2014/2018	Dubna International Advanced School of Theoretical Physics (DIAS-TH) A.S. Sorin, V.V. Voronov	32
Elementary Particle Physics and Relativistic Nuclear Physics		37
02-2-1123-2015/2019	JINR's Participation at the BES-III Physics Research Program A.S. Zhemchugov	38
02-0-1081-2009/2019	ATLAS. Upgrade of the ATLAS Detector and Physics Research at the LHC V.A. Bednyakov	40
02-2-1124-2015/2020	Search for New Physics in Experiments with High-Intensity Muon Beams V.V. Glagolev	43
02-2-1134-2018/2019	Experiment COMET at J-PARC Z. Tsamalaidze	46
02-2-1099-2010/2018	Study of Neutrino Oscillations D.V. Naumov, A.G. Olshevskiy	48
02-0-1108-2011/2019	Experiment PANDA at FAIR G.D. Alexeev	51
02-2-1125-2015/2020	Astrophysical Studies in the Experiment TAIGA L.G. Tkatchev	53
02-1-1106-2011/2019	Investigations of Compressed Baryonic Matter at the GSI Accelerator Complex V.P. Ladygin, V.V. Ivanov	56
02-1-1096-2010/2019	Study of Rare Charged Kaon Decays and Search for Dark Sector in Experiments at the CERN SPS V.D. Kekelidze, Yu.K. Potrebenikov	59
02-0-1083-2009/2019	CMS. Compact Muon Solenoid at the LHC A.V. Zarubin	62
02-0-1085-2009/2019	Studies of the Nucleon and Hadron Structure at CERN A.P. Nagaytsev	68
02-1-1086-2009/2020	Strangeness in Hadronic Matter and Study of Inelastic Reactions Near Kinematical Borders E.A. Stokovsky, E.S. Kokoulina, D.O. Krivenkov	72
02-0-1065-2007/2019	Development of the JINR Basic Facility for Generation of Intense Heavy Ion and Polarized Nuclear Beams Aimed at Searching for the Mixed Phase of Nuclear Matter and Investigation of Polarization Phenomena at the Collision Energies up to $\sqrt{S_{NN}}=11$ GeV V.D. Kekelidze, A.S. Sorin	75
02-0-1127-2016/2018	Advanced Studies on Systems of New-Generation Accelerators and Colliders for Fundamental and Applied Research G.D. Shirkov	88
02-1-1097-2010/2018	Study of Polarization Phenomena and Spin Effects at the JINR Nuclotron-M Facility A.D. Kovalenko	92
02-1-1087-2009/2020	Research on Relativistic Heavy and Light Ion Physics. Experiments at the Accelerator Complex Nuclotron/NICA at JINR and CERN SPS A.I. Malakhov	96

02-0-1066-2007/2020	Investigation of the Properties of Nuclear Matter and Particle Structure at the Collider of Relativistic Nuclei and Polarized Protons R. Lednický, Yu.A. Panebratsev	101
02-1-1088-2009/2019	ALICE. Study of Interactions of Heavy Ion and Proton Beams at the LHC A.S. Vodopyanov	104
02-1-1107-2011/2019	Development and Construction of the Prototype of a Complex for Radiotherapy and Applied Research with Heavy-Ion Beams at the Nuclotron-M S.I. Tyutyunnikov	107
Nuclear Physics		111
03-0-1129-2017/2021	Development of the FLNR Accelerator Complex and Experimental Setups (DRIBS-III) G.G. Gulbekyan, S.N. Dmitriev, M.G. Itkis	112
03-5-1130-2017/2021	Synthesis and Properties of Superheavy Elements, Structure of Nuclei at the Limits of Nucleon Stability M.G. Itkis	116
03-2-1100-2010/2018	Non-Accelerator Neutrino Physics and Astrophysics V.B. Brudanin, A. Kovalik, E.A. Yakushev	121
03-2-1102-2010/2018	Improvement of the JINR Phasotron and Design of Cyclotrons for Fundamental and Applied Research G.A. Karamysheva, S.L. Yakovenko	125
03-4-1128-2017/2019	Investigations of Neutron Nuclear Interactions and Properties of the Neutron V.N. Shvetsov	127
Condensed Matter Physics, Radiation and Radiobiological Research		135
04-4-1121-2015/2020	Investigations of Condensed Matter by Modern Neutron Scattering Methods D.P. Kozlenko, V.L. Aksenov, A.M. Balagurov	136
04-4-1105-2011/2019	Development of the IBR-2 Facility with a Complex of Cryogenic Neutron Moderators A.V. Belushkin, A.V. Vinogradov	145
04-4-1122-2015/2020	Development of Experimental Facilities for Condensed Matter Investigations with Beams of the IBR-2 Facility S.A. Kulikov, V.I. Prikhodko	148
04-4-1133-2018/2020	Modern Trends and Developments in Raman Microspectroscopy and Photoluminescence for Condensed Matter Studies G.M. Arzumanyan, N. Kučerka	151
04-5-1131-2017/2021	Radiation Physics, Radiochemistry, and Nanotechnology Investigations Using Beams of Accelerated Heavy Ions S.N. Dmitriev, P.Yu. Apel	154
04-9-1077-2015/2020	Research on the Biological Effect of Heavy Charged Particles with Different Energies E.A. Krasavin, G.N. Timoshenko	158
04-9-1112-2013/2019	Research on Cosmic Matter on the Earth and in Nearby Space; Research on the Biological and Geochemical Specifics of the Early Earth E.A. Krasavin, A.Yu. Rozanov, V.N. Shvetsov	162
04-2-1132-2017/2019	Biomedical and Radiation-Genetic Studies Using Different Types of Ionizing Radiation G.V. Mitsyn	165
04-2-1126-2015/2020	Novel Semiconductor Detectors for Fundamental and Applied Research G.A. Shelkov	167
Networking, Computing, Computational Physics		171
05-6-1118-2014/2019	Information and Computing Infrastructure of JINR V.V. Korenkov	172
05-6-1119-2014/2019	Methods, Algorithms and Software for Modeling Physical Systems, Mathematical Processing and Analysis of Experimental Data Gh. Adam, P.V. Zrellov	177

05–8–1037–2001/2019	Analytical and Methodological Work to Assess the Prospects of Scientific Research and Cooperation in the Main Directions of JINR’s Development. Organization of International Cooperation A.S. Sorin	185
Educational Programme		187
06–0–1120–2014/2018	Organization, Support and Development of the JINR Educational Programme V.A. Matveev, S.Z. Pakuliak	188
Alphabetic List of Collaborators		192

Prepared by
N.A. Boklagova
L.K. Ivanova

© JOINT INSTITUTE FOR NUCLEAR RESEARCH
Dubna 2017

All the themes in the Plan are listed by fields of research. Each theme is coded according to the JINR system of classification and contains the following information:

- the first number * - the field of research
- the second number ** - the conventional number of Laboratory or other Division of JINR
- the third number - the theme's ordinal number
- the fourth and the fifth numbers - the years of the activity's beginning and completion

<ul style="list-style-type: none"> * 01 - Theoretical Physics 02 - Elementary Particle Physics and Relativistic Nuclear Physics 03 - Nuclear Physics 04 - Condensed Matter Physics and Radiobiological Research 05 - Networking, Computing, Computational Physics 06 - Educational Programme 	<ul style="list-style-type: none"> ** 0 - All-Institute Topics 1 - Veksler and Baldin Laboratory of High Energy Physics (VBLHEP) 2 - Dzhelapov Laboratory of Nuclear Problems (DLNP) 3 - Bogoliubov Laboratory of Theoretical Physics (BLTP) 4 - Frank Laboratory of Neutron Physics (FLNP) 5 - Flerov Laboratory of Nuclear Reactions (FLNR) 6 - Laboratory of Information Technologies (LIT) 8 - Science Organization Department (SOD) 9 - Laboratory of Radiation Biology (LRB)
--	---

Theoretical
Physics
(01)

Theory of Fundamental Interactions

Leaders:

D.I. Kazakov
O.V. Teryaev
A.B. Arbuzov

Participating Countries and International Organizations:

Armenia, Azerbaijan, Belarus, Bulgaria, Canada, CERN, China, Czech Republic, Finland, France, Georgia, Germany, Hungary, ICTP, Italy, Japan, Kazakhstan, Mexico, Mongolia, Netherlands, New Zeland, Norway, Portugal, Poland, Republic of Korea, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, USA, Ukraine, United Kingdom, Uzbekistan, Vietnam.

Scientific Programme

The main aim of the research within the theme is the construction of theoretical models and their application to the description of properties of elementary particles and their interactions. This research includes the following directions of activity. The development of quantum field theory formalism in gauge and supersymmetric theories. Construction and investigation of the models of particle physics beyond the Standard Model. Theoretical support of experiments at the Large Hadron Collider on the search of new physics and the study of the properties of the Higgs boson. Calculation of radiative corrections to the processes of particle creation within the Standard Model and its extensions. Investigation of neutrino properties and neutrino oscillations. Investigation of the hadron properties within quantum chromodynamics and phenomenological quark models. Study of the hadron spin structure with the help of generalized and transverse momentum dependent parton distributions. Study of heavy quark properties and exotic hadrons. Lattice simulations for obtaining nonperturbative results in gauge theories. Investigation of dense hadronic matter and theoretical support of the program NICA. Theoretical support of a wide range of current and future experiments at JINR, IHEP, CERN, GSI, DESY and other physics centers.

Expected main results in 2018:

- Investigation of the arbitrariness in divergence subtraction procedure in supersymmetric theories in higher dimensions and calculation of the leading counter-terms in all orders of perturbation theory.

Theoretical support of search for new physics at the LHC based on experimental data from ATLAS and CMS.

Theoretical study of supersymmetric models of Dark matter and analysis of experimental data on direct and indirect Dark matter search.

Investigation of the effects due to radiative corrections in Drell-Yan processes after increasing LHC luminosity and beam energy.

Studies of parton densities in nuclei.

Investigation of high-energy asymptotics of the structure functions F_2 and F_L and their heavy quark parts. Development of the method that would enable one to account for the effects due to continuation of the perturbative QCD results into the timelike domain, at an arbitrary order of perturbation theory. Calculation of high-order corrections to renormalization-group functions and theoretical analysis of their influence on predictions in particle physics and in studies of critical phenomena.

Analysis of ambiguities in high-order calculations of different renormalization-group functions in QFT models with chiral interactions.

Theoretical study of rare higgs-boson decays predicted in some New Physics models. Development of twistor and ambitwistor description of multiloop form factors of local and Wilson line operators in theories with extended supersymmetry. Study and development of twistor description for loop reggeon amplitudes.

Studies of the dark matter problem in the framework of the Standard Model and beyond it, including its supersymmetric generalizations. Building of Minimal Consistent Dark Matter models. Development of the strategy of comparing/mapping of their parameters for results of searches.

- Calculation of quark-gluon subprocess contribution to exclusive Drell-Yan process amplitude, estimate of its observability at CMS, COMPASS and NICA.

Investigation of relations between meson distribution amplitudes and gluonic poles in twist 3 correlators and their manifestations for matching of various kinematical regimes of pion-nucleon Drell-Yan process.

Investigations of connection between mechanisms of hyperon polarization in hadronic and heavy-ion collisions and duality between field-theoretical and hydrodynamical descriptions of spin effects.

Generalization of QCD low-energy theorems for gluonic anomaly accounting for effects of mixing and contributions of heavy quarkonia and gluonia.

Common analysis of azimuthal asymmetries in SIDIS in perturbative and non-perturbative QCD.

Lattice calculations of heavy quarkonia polarizabilities and investigation of their relations with charmed pentaquark spectroscopy.

Development of methods of extrapolation of parton distributions to low-x domain using the truncated moments and their applications to fragmentation functions.

- Study of semileptonic B-meson decay with tau-lepton in the final state and the subsequent leptonic and semihadronic tau-decays.

Investigation of new observables in the Standard Model as well as in different new-physics scenarios.

Study of spectra of light atoms and molecules in higher orders of the fine structure constant for determination of the improved values of the fundamental physical constants and resolution of the proton charge radius problem.

Calculation of the hadronic light-by-light contributions to the muon anomalous magnetic moment in the leading and next-to-leading orders in the $1/N_c$ parameter.

Study of the properties of the f_1 , a_1 , K_1 axial-vector mesons in ground and radially excited states, their strong and electromagnetic hadron decays and production in $e+e-$ colliding beams and tau-lepton decays.

Calculation of masses and decay constants of exotic glueballs within QCD sum rules. Study of the glueball dynamics by strong coupling expansion of the $SU(3)$ Yang-Mills Hamiltonian in the flux-tube gauge. Study of the multiquark hadrons and existence of the extraneous dibaryons.

Calculation of the contributions of light mesons to the hyperfine structure of muonic hydrogen.

Calculations of two loop contributions for Moeller scattering and Drell-Yan process within the Standard Model, radiative corrections evaluation to the process of antiproton-proton annihilation into a lepton pair and a pair of mesons for the PANDA facility.

Studies pertaining to the QCD vacuum and QCD phase diagram (also in the presence of a strong magnetic field): the role of strangeness and multiquark interactions in the characteristics of the low lying meson nonets, in the freeze-out region of relativistic heavy-ion experiments, in the position of the critical end point, and in the regime of dense matter relevant for compact stars.

Studies of the high-density equations of state and mass-radius observations for compact stars and multi-polytrope approach to a strong first-order phase transition that produces high-mass twin stars as an observable signature of it.

- Participation (continuation) in the tmfT Collaboration (finite temperature with twisted mass fermions in lattice QCD) aimed at description of the quark-gluon thermodynamics including strange and charmed quarks and consideration of new observables indicating the crossover. Study of the gluon spectral function at finite temperature (longitudinal and transversal). Completion of the work on the EoS via trace anomaly. Study of the temperature dependence of the topological susceptibility and obtaining of more detailed results on topological structure supporting evidence for dyons. For $N_f = 2$ with imaginary chemical potential μ extending gluon and ghost propagator from imaginary to real μ . Finite μ for $SU(2)$ QCD: study of the phase diagram. Study of anomalous transport phenomena in QGP, calculation of the bulk viscosity, properties of QCD with nonzero chiral chemical potential.

Study of the role of viscosity effects at the hydrodynamic stage of the system evolution for the multiplicity of created particles (mainly pions) and the transverse momentum spectra using the Israel-Stewart second-order equations. Rapidity distributions as well as transverse momentum spectra of identified hadrons (including strange particles) produced in the NICA energy range.

The hadronic part of the EoS at finite temperatures will be constructed including the first two SU(3) multiplets in baryon (octet of spin 1/2 and decuplet of spin 3/2 particle) and meson (octet of pseudoscalar meson and nonet of vector mesons) sectors.

Construction of a new class of hybrid EoS with first-order phase transition fulfilling constraints from nuclear physics and compact star observations. Providing of EoS tables with and without phase transition for HIC simulation.

Performing of analytical calculations for the ultrarelativistic transverse momentum distributions for the Tsallis-3 and Renyi statistics.

Evaluation of correlation functions for an ensemble of domain wall networks representing nonperturbative QCD vacuum by employing methods of analytical and numerical multidimensional integration. Calculation of the one-loop effective potential for arbitrary Abelian gluon fields in finite volume for various boundary conditions. Investigation of the stabilization of the domain size due to the quark lowest modes. Study of the role of strong electromagnetic fields as trigger of deconfinement transition.

Investigation of the anisotropic stage of the QGP evolution and the dependence of the approach to thermal equilibrium on the breaking of scale invariance based on analytic black brane solutions with non-conformal asymptotics for the 5-dimensional gravity with a dilaton corresponding to a dual description of QGP.

Investigation of the critical behavior of a system consisting of scalar and fermion fields: relations between the scalar and fermion condensates and the masses of the particles in this system for the case of zero temperature.

- A detailed statistical analysis of available accelerator data on exclusive (anti)neutrino-nucleus interactions at low and intermediate energies will be performed aiming at the extraction of the electroweak axial-vector current parameters. The results will be claimed in the current and future oscillation experiments with accelerator and atmospheric experiments (NOvA, DUNE, Super- and Hyper-Kamiokande, etc.).

The cross sections of processes involving neutrinos are expressed through the neutrino mixing matrix. It will be shown that the probabilities of all processes can be represented in an equivalent way explicitly in terms of the neutrino mass matrix. The existence of such representations allows fitting of the mass matrix of neutrinos directly from the experimental data.

Starting from the variational energy principle, the equations of hydrostatic equilibrium of stars will be derived without assuming the local electroneutrality of matter. We will find the first and second unconditional variational derivatives of the interaction energy, as well as the conditional variational derivatives along the constraint surface "fixed total charge of the star". The effect of deviations from the local electroneutrality on neutrino spectra in supernovae will be calculated. The stability criteria of the solutions, associated with the positive definiteness of the second variations, will be studied.

The process of double beta decay of the nucleus with the capture of one of the beta-electrons on the outer electron shell of the atom will be studied. This problem is of interest in connection with the experiment of the NEMO 3 and SuperNEMO collaboration. The possibility that one or both electrons emitted from the nucleus in neutrinoless double beta decay might undergo an inelastic collision with the bound electrons in the atomic shell and either shift them to a higher energy level (excitation) or eject them from the atom (ionization) will also be studied.

In a number of generalizations of the Standard Model, the existence of a neutrino condensate is predicted. This scenario will be analyzed from the point of view of the effect produced by the condensate on the probability of neutrinoless double beta decay of nuclei.

The R-parity breaking SUSY mechanisms of the neutrinoless double beta decay will be revised following the current SUSY phenomenology. The importance of the one and two pion exchange in this process will be discussed. The corresponding nuclear matrix elements will be calculated within the QRPA with isospin symmetry restoration.

The electron neutrino mass can be determined by the upper end of the deexcitation (bolometer) spectrum of ^{163}Dy after electron capture in ^{163}Ho . All deexcitation spectra (X rays, Auger electron and the recoil of Holmium) end at the Q value minus the neutrino mass. Recently, the theoretical spectra were calculated by including also the second hole in the atomic excitations of dysprosium. The impact of the internal bremsstrahlung electron capture process on the end of deexcitation spectra will be studied.

The uncertainties in the calculated reactor antineutrino spectrum will be evaluated. For that purpose, the improved theoretical description of the first forbidden beta decays will be obtained by considering the exact Dirac wave functions of the electron with finite nuclear size and electron screening taken into account.

Within a field-theoretical approach with wave packets, the off-shell regime of neutrino oscillations will be investigated; the regime works at super-short distances between the source and detector.

List of activities:

Activity or experiment	Leaders
Laboratory or other Division of JINR	Main researchers
1. Standard Model and its extension	D.I. Kazakov A.B. Arbuzov
BLTP	A.N. Baushev, A.V. Bednyakov, A.V. Gladyshev, A.V. Kotikov, G.A. Kozlov, V.K. Mitrjushkin, V.A. Naumov, A.V. Nesterenko, A.I. Onishenko, S.I. Vinitzky, + 5 students
LIT	V.P. Gerdt
VBLHEP	R.R. Ahunzyanov, V.G. Krivokhizhin, A.P. Nagaytsev, B.G. Shaythatdenov,
DLNP	V.A. Bednyakov, L.B. Kalinovskaya
2. QCD parton distributions for modern and future colliders	A.V. Efremov O.V. Teryaev
BLTP	I.V. Anikin, M. Deka, S.V. Goloskokov, S.V. Mikhailov, A.V. Nesterenko, A.V. Radyushkin, O.V. Selyugin, A.V. Sidorov, + 3 students
VBLHEP	Yu.I. Ivanshin, I.A. Savin
DLNP	L.L. Nemenov, L.G. Tkatchev, A.S. Khrykin
3. Physics of heavy and exotic hadrons	A.E. Dorokhov M.A. Ivanov
BLTP	D. Alvarez, Yu.M. Bystritsky, A.E. Dorokhov, G. Ganbold, S.B. Gerasimov, S.M. Eliseev, N.I. Kochelev, V.I. Korobov, V.A. Meshcheryakov, S.N. Nedelko, A.A. Osipov, H.- P. Pavel, M.K. Volkov, Yu.S. Surovtsev, S.A. Zhaugasheva, + 5 students
VBLHEP	V.A. Zykunov, Yu.A. Panebratsev, M.V. Tokarev, V.A. Nikitin, Yu.I. Ivanshin, I.A. Savin, M.G. Sapozhnikov
DLNP	V.A. Bednyakov, N.B. Skachkov

4. Hadron Matter under extreme conditions

**E.-M. Ilgenfritz
S.N. Nedelko
D. Blaschke**

BLTP

D.E. Alvarez-Castillo, V. Braguta, M. Deka, S. Dorkin, A.E. Dorokhov, A.V. Friesen, E.E. Kolomeitsev, A.A. Golubtsova, M. Hnatic, M. Hasegawa, L. Kaptari, A.S. Khvorostukhin, N. Korchagin, N.I. Kochelev, K. Maslov, S. Pandiat, A. Parvan, A.M. Snigirev, O.V. Teryaev, V.D. Toneev, V.E. Voronin, D. Voskresensky, + 4 students

LIT

A.S. Ayriyan, H. Grigorian, Yu.L. Kalinovsky

VBLHEP

O.V. Rogachevsky, V. Voronyuk

5. Fundamental properties of Neutrinos

**V.A. Naumov
M.I. Krivoruchenko
F. Simkovic**

BLTP

A. Babic, K.S. Kuzmin, D.S. Shkirmanov

DLNP

I.A. Belolaptikov, V.B. Brudanin, R. Dvornická, O.I. Kochetov, D.V. Naumov, Petrova O.N., O.Yu. Smirnov, V.I. Tretyak

Collaboration

Country or International Organization

City

Institute or Laboratory

Armenia

Yerevan

RAU
Foundation ANSL

Azerbaijan

Baku

IP ANAS

Belarus

Minsk

INP BSU
IP NASB
JIPNR-Sosny
NASB
GSU
GSTU

Gomel

Bulgaria

Sofia

INRNE BAS
SU

Canada

Montreal

UdeM

Corner Brook

MUN

CERN

Geneva

CERN

Chile

Valparaiso

UV

China

Lanzhou

IMP CAS

Beijing

Wuhan

WIPM CAS

Czech Republic

Prague

CTU

CU

IP ASCR

Řež

NPI ASCR

Finland

Helsinki

UH

France	Lyon	UCBL
	Metz	UPV-M
	Montpellier	UM2
	Paris	UPMC
	Saclay	SPhN CEA DAPNIA IRFU
Georgia	Tbilisi	RMI TSU TSU
Germany	Berlin	FU Berlin HUB
	Aachen	RWTH
	Bielefeld	Univ.
	Bochum	RUB
	Bonn	UniBonn
	Dortmund	TU Dortmund
	Erlangen	FAU
	Hamburg	DESY Univ.
	Heidelberg	Univ.
	Jena	Univ.
	Jülich	FZJ
	Kaiserslautern	TU
	Karlsruhe	KIT
	Regensburg	UR
	Rostock	Univ.
	Mainz	JGU HIM
	Munich	LMU
	Tübingen	Univ.
	Wuppertal	UW
	Zeuthen	DESY
Hungary	Budapest	ELTE Wigner RCP
ICTP	Trieste	ICTP
Italy	Naples	INFN
	Padua	UniPd
	Pavia	INFN
	Pisa	INFN
	Trieste	SISSA/ISAS
	Turin	UniTo
Japan	Tokyo	UT Tokyo Tech
	Kyoto	Kyoto Univ.
	Nagoya	Meiji Univ.

		Nagoya Univ.
	Tsukuba	KEK
Kazakhstan	Almaty	APHI
		INP
	Astana	BA INP
Mexico	Cuernavaca	UNAM
Mongolia	Ulaanbaatar	IPT MAS
		NUM
New Zealand	Hamilton	Univ.
Norway	Trondheim	NTNU
Poland	Krakow	NINP PAS
	Kielce	JKU
	Lodz	UL
	Otwock-Swierk	NCBJ
Portugal	Coimbra	UC
Republic of Korea	Seoul	SNU
	Daegu	KNU
	Chongju	CBNU
Russia	Moscow	IMM RAS
		ITEP
		LPI RAS
		MSU
		MI RAS
		PFUR
		SCC RAS
		SINP MSU
	Moscow, Troitsk	INR RAS
	Belgorod	BelSU
	Chernogolovka	LITP RAS
	Gatchina	PNPI
	Irkutsk	ISDCT SB RAS
	Ivanovo	ISC RAS
		ISU
	Kazan	KFU
	Novosibirsk	IM SB RAS
		BINP SB RAS
	Omsk	OmSU
	Perm	PSNRU
	Protvino	IHEP
	Rostov-on-Don	SFedU
	St. Petersburg	SPbSU
		SPbSPU
	Samara	SSU
		SU
	Saratov	SSU

	Sarov	VNIIEF
	Tomsk	TSU
		IHCE SB RAS
	Tver	TvSU
	Yoshkar-Ola	VSUT
Serbia	Belgrade	Univ.
Slovakia	Bratislava	CU
		IP SAS
	Košice	IEP SAS
Spain	Santiago de Compostela	USC
	Valencia	UV
Switzerland	Bern	Uni Bern
Sweden	Lund	LU
United Kingdom	London	QM
		Imperial College
	Canterbury	Univ.
Ukraine	Kiev	BITP NASU
	Dnepropetrovsk	DNU
	Kharkov	NSC KIPT
	Lutsk	VNU
	L'viv	IAPMM NASU
		IFNU
	Sumy	SumSU
USA	New York, NY	RU
		CUNY
	College Park, MD	UMD
	Lemont, IL	ANL
	Minneapolis, MN	U of M
	Norman, OK	OU
	Newport News, VA	JLab
	Philadelphia, PA	Penn
	University Park, PA	Penn State
Uzbekistan	Tashkent	IAP NUU
		NUU
Vietnam	Hanoi	IOP VAST

Theory of Nuclear Structure and Nuclear Reactions

Leaders:

V.V. Voronov
A.I. Vdovin
N.V. Antonenko

Participating Countries and International Organizations:

Armenia, Austria, Belarus, Belgium, Brazil, Bulgaria, Canada, China, Czech Republic, Egypt, France, Germany, Greece, Hungary, Italy, Japan, Kazakhstan, Moldova, Norway, Poland, Republic of Korea, Romania, Russia, Serbia, Slovakia, South Africa, Spain, Sweden, Switzerland, Taiwan, Ukraine, USA, Uzbekistan.

Scientific Programme

The main goals are to predict and analyze properties of atomic nuclei beyond the stability valley and investigate structure peculiarities of superheavy and exotic nuclei; to study dynamics of nuclear collisions at low and intermediate energies accompanied by production of stable as well as radioactive nuclides; to investigate fundamental properties of various few-body systems and develop rigorous and effective mathematical methods of calculations of their properties; to explore the dynamics of particle-nucleus and nucleus-nucleus collisions at relativistic energies and nuclear matter properties and its phase transitions at extreme values of temperature and density.

Expected main results in 2018:

- Calculation of electron capture cross sections and rates for hot neutron-rich nuclei within the thermal quasiparticle RPA with Skyrme forces.
Development of a general scheme to extract spurious admixtures in self-consistent calculations for electric and magnetic nuclear excitations.
Investigation of the fine structure of the giant dipole resonance in ^{48}Ca taking into account the coupling of the QRPA phonons with two- and three-phonon states.
Study of the neutron multiplicities in muon capture by spherical nuclei.
Development of a microscopic model including the Skyrme interaction with tensor components, phonon-phonon coupling and effective (S=1, T=0) pairing interaction to study a β -delayed multi-neutron emission.
Analysis of experimental data on the low lying M1 excitations in rare earth and actinide nuclei to confirm the existence of spin-scissors excitations.
- Prediction of the mass and charge distributions of fission products of actinides and transactinides
Comparison of different reactions leading to the production of superheavy nuclei with Z=119 and study of the nuclear structure of these nuclei.
Development of a microscopic method of calculating the mass distributions of fusion-fission and quasifission products.
Investigation of alpha particle and heavy cluster emission from excited superheavy compound nuclei.
Investigation of the structure of the unstable nucleus ^{22}C in view of the appearance of the new experimental data.
Analysis of the spreading widths of giant resonances close to doubly magic nuclei by means of the random matrix theory.
- Elaboration of a method for numerical solution of the time-dependent Schroedinger equation with non-separable angular part and its application to confinement-induced resonances in atom-ion systems.
Analysis of two-dimensional scattering of a slow quantum particle by a central long-range potential.

Proof of the solvability of the Riccati operator equation in the Feshbach (resonance) spectral case.

Calculation of bound states and scattering observables for a Beryllium three-atom system in a collinear configuration with pairwise interactions.

Study of the Efimov properties of the van-der-Waals clusters using Faddeev differential equations.

Study of proton halo in Coulomb decay of the ^{11}Be and ^{17}F nuclei within the non-stationary quantum-mechanical approach.

Consistent formulation of the three-particle problem with two types of particles and zero-range pairwise interactions for arbitrary values of total angular momentum and parity.

- Inclusion of viscosity effects at the hydrodynamic stage of the system evolution within the hybrid model, HydHSD, joining the initial fast stage, described by the hadron string dynamics (HSD) model, and subsequent hydrodynamical expansion. Calculation of the rapidity distributions as well as transverse momentum spectra of identified hadrons (including strange particles), produced in the NICA energy range.

Search for the analytical solutions for the transverse momentum distributions of the massive particles given in the framework of the nonextensive statistics. Their applications to describe experimental data for the hadron momentum distributions in proton-proton and nucleus-nucleus collisions at LHC, RHIC and NICA-MPD energies.

Investigation of the wide dybarions in the $3D2$, $3D3$ - $3G3$, $1F3$ partial-wave states by analyzing the phase shifts and parameter of inelasticity.

Investigation of the nucleon-deuteron scattering process using the relativistic Bethe-Salpeter-Faddeev approach. Calculation of phases, scattering lengths and cross section for this process.

Extension of the Parton-Hadron-String-Dynamics model to ultra-relativistic energies and comparison the results for global characteristics of Au+Au collisions with recent experimental data at $\sqrt{S} = 2.6$ and 5.2 TeV.

Calculation of the thermodynamical (temperature-dependent) vorticity for particles created at the NICA energies within the Parton-Hadron-String-Dynamics model and study its properties.

Study of the scattering and breakup processes of the halo-nuclei $^{12,14}\text{Be}$ in nucleus-nucleus collisions within the microscopic folding optical potential.

List of activities:

Activity or experiment	Leaders
Laboratory or other	Main researchers
Division of JINR	
1. Nuclear properties	V.V. Voronov
at the border of stability	A.A. Dzhioev
	J. Kvasil
BLTP	N.N. Arseniev, E.B. Balbutsev, A.I. Vdovin, V.A. Kuz'min, L.A. Malov, I.V. Molodtsova, V.O. Nesterenko, A.P. Severyukhin, H. Ganey, V.M. Shilov, A.V. Sushkov, E.O. Sushenok, + 3 students
LIT	N.Yu. Shirikova
FLNP	A.M. Sukhovoi
DLNP	V.B. Brudanin
2. Low-energy dynamics	S.N. Ershov
and nuclear system properties	N.V. Antonenko
	R.V. Jolos

BLTP	G.G. Adamian, A.V. Andreev, A.N. Bezbakh, I.A. Egorova, V.G. Kartavenko, Sh. Kalandarov, A.K. Nasirov, R.G. Nazmitdinov, H. Paska, I.S. Rogov, T.M. Shneidman,+ 1 students
FLNR	L.V. Grigorenko, Yu.E. Penionzhkevich
3. Quantum few-body systems	A.K. Motovilov A.S. Melezhik
BLTP	D. Dzhanseytov, D. Valiolda, I. Ishmukhametov, S.S. Kamalov, O.P. Klimenko, E.A. Kolganova, A.A. Korobitsyn, E.A. Koval, A.V Malykh, V.S. Melezhik, V.N. Kondratyev, V.V. Pupyshev, E.A. Soloviev, S.I. Vinitsky, + 4 students
DLNP	O.I. Kartavtsev
LIT	A.A. Gusev, O. Chulunbaatar, V.P. Gerdt
4. Processes with nuclei at relativistic energies and extreme states of matter	V.V. Burov M. Gaidarov
BLTP	A. Bekzhanov, S.G. Bondarenko, A.V. Frisen, L.P. Kaptari, A. Khvorostukhin, V.K. Lukyanov, E. Myrzambekova, A.S. Parvan, N. Sagimbaeva, A.I. Titov, V.D. Toneev, S.A. Yur'ev,+ 1 students
LIT	E.B. Zemlianaya, K.V. Lukyanov
VBLHEP	A.I. Malakhov, N.M. Piskunov, Yu.A. Panebratsev, E.P. Rogochaya

Collaboration

Country or International Organization	City	Institute or Laboratory	
Armenia	Yerevan	RAU	
		YSU	
Austria	Innsbruck	Univ.	
Belarus	Minsk	IP NASB	
Belgium	Brussels	VUB	
		UCL	
		UCL	
Brazil	Florianopolis, SC	UFSC	
		Sao Paulo, SP	UEP
		Sao Jose dos Campos, SP	ITA
		Niteroi, RJ	UFF
Bulgaria	Sofia	INRNE BAS	
		NBU	
Canada	Hamilton	McMaster	
	Saskatoon	U of S	
China	Beijing	ITP CAS	
		CIAE	
		PKU	

Czech Republic	Prague	CU
	Řež	NPI ASCR
Egypt	Cairo	EAEA
	Giza	CU
France	Bordeaux	UB
	Caen	GANIL
	Orsay	CSNSM
		IPN Orsay
Germany	Bonn	UniBonn
	Bielefeld	Univ.
	Cologne	Univ.
	Darmstadt	GSI
		IKP
		TU Darmstadt
	Dresden	HZDR
	Erlangen	FAU
	Hamburg	Univ.
	Giessen	JLU
	Leipzig	UoC
	Mainz	JGU
	Rostock	Univ.
	Siegen	Univ.
Greece	Thessaloniki	AUTH
	Athens	INP NCSR
		“Demokritos”
Hungary	Budapest	Wigner RCP
	Debrecen	Atomki
India	Kasaragod	CUK
	Chandigarh	PU
Italy	Bologna	Centro, ENEA
	Catania	INFN LNS
	Naples	INFN
	Messina	UniMe
	Perugia	INFN
	Trento	ECT*
	Turin	UniTo
Japan	Kobe	Kobe Univ.
	Morioka	Iwate Univ.
	Osaka	RCNP
		Osaka Univ.
Kazakhstan	Almaty	INP
Lithuania	Kaunas	VMU
Moldova	Chişinău	IAP ASM
Norway	Bergen	UiB
	Oslo	UiO

Poland	Krakow	NINP PAS
	Lublin	UMCS
	Otwock-Swierk	NCBJ
	Warsaw	UW
Republic of Korea	Seoul	WUT
	Daejeon	SNU
Romania	Bucharest	IBS
		IFIN-HH
Russia	Moscow	UB
		NNRU "MEPhI"
		MSU
		NRC KI
		SINP MSU
		PFUR
		INR RAS
		PNPI
		KIP SB RAS
		OmSU
		SSU
		SPbSU
		FEFU
Serbia	Belgrade	IPB
Slovakia	Bratislava	CU
		IP SAS
South Africa	Košice	IEP SAS
	Pretoria	Unisa
	Stellenbosch	SU
	Cape Town	iThemba LABS
Spain	Palma	UIB
Sweden	Lund	LU
	Göteborg	Chalmers
Switzerland	Bern	Uni Bern
Taiwan	Taipei	NTU
		IP AS
Ukraine	Kiev	KINR NASU
		BITP NASU
		NUK
		NSC KIPT
USA	Kharkov	ANL
	Lemont, IL	LANL
	Los Alamos, NM	ND
	Notre Dame, IN	Penn State
	University Park, PA	IAP NUU
Uzbekistan	Tashkent	INP AS RUz
		Assoc."P.-S." PTI

Theory of Condensed Matter

Leaders:

V.A. Osipov
A.M. Povolotskii

Participating Countries and International Organizations:

Armenia, Australia, Austria, Belarus, Belgium, Brazil, Bulgaria, Canada, Czech Republic, France, Germany, Hungary, India, Ireland, Italy, Japan, Moldova, Mongolia, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Switzerland, Taiwan, Ukraine, USA, Uzbekistan, Vietnam.

Scientific Programme

Effects of strong electron correlations in high-temperature superconductors, colossal magneto-resistance compounds (manganites), heavy-fermion systems, low-dimensional quantum magnets with strong spin-orbit interaction, topological insulators, etc. will be investigated based on a variety of underlying many-band electronic models including the extended Hubbard model, Anderson model, super-exchange spin-orbital models of transition of metal oxides with strong relativistic spin-orbital coupling. The electronic band structure, spectral properties of charge carrier quasiparticles, magnetic and charge collective excitations, metal-insulator and magnetic phase transitions, Cu- and Fe-based high-Tc superconductivity, charge and spin-orbital ordering will be studied. The obtained results will be used to support neutron scattering experiments performed at FLNP, JINR.

Investigations in the field of nanostructures and nanoscaled phenomena will be addressed to a study of physical characteristics of nanomaterials promising for various applications in modern nanotechnologies. The electronic, thermal and transport properties of carbon nanostructures will be investigated. It is planned to study the problem of quantum transport in molecular devices. Spin dynamics of magnetic nanoclusters will be investigated. The analysis of resonance tunneling phenomena in the layered superconductors and superconducting nanostructures in the external fields will be performed. Numerical modeling of resonance, radiative and chaotic properties of intrinsic Josephson junctions in high temperature superconductors is planned to be carried out.

Models in condensed matter physics will be studied by using methods of equilibrium and non-equilibrium statistical mechanics with the aim of revealing general properties of many-particle systems based on the ideas of self-similarity and universality. Mathematical mechanisms, underlying the kinetic and stationary behavior of model systems, as well as possible links between different models, will be investigated. The study of two-dimensional lattice models by the transfer matrix method will be focused on confirming the predictions of the logarithmic conformal field theory. The theory of integrable systems will be developed in the aspect of finding new integrable boundary conditions for two-dimensional spin systems and the solution of the corresponding Yang-Baxter equations. The universal behavior of correlation functions in non-equilibrium systems will be studied as well. The research in the structure theory and the theory of representations of quantum groups and matrix algebras will be directed to further applications in the theory of integrable models in quantum mechanics and statistical physics. Applications of the elliptic hypergeometric integrals, defining the most general solutions of the Yang-Baxter equation and most complicated known exactly computable path integrals in four-dimensional quantum field theory, to two-dimensional spin systems will be studied.

Expected main results in 2018:

- Calculation of the spectrum of spin fluctuations in the quasi-two-dimensional Heisenberg model on the honeycomb lattice within the $t - J$ model with doped holes.

Calculation of the dynamical charge susceptibility and studies of charge density waves within the projection technique for the Green functions in the $t - J$ model.

Model description of electron structure of lead halide perovskites for the next generation of solar cells and spintronics.

Structural investigations of mass and surface fractals at nano- and micro-scale using the small-angle scattering technique.

Development of the theory of spin dynamics of dipolar and spinor molecules in optical lattices.

Derivation and investigation of the equations of evolution of the open nonequilibrium systems under some special boundary conditions.

Investigation of charge density wave instability in the underdoped cuprates by employing the continuous quantum Monte Carlo numerical method.

Development of the different protocols for the effect of superconducting current on the magnetic moment in the superconductor-ferromagnet-superconductor system.

Investigation of the problem of quantum transport in graphene and phosphorene with taking account of the presence of localized edge states and the effect of lattice thermal vibrations.

Calculation of the electron mobility in phosphorene, phosphorene nanoribbons, as well as in silicene and other novel 2D materials and nanostructures based on these materials.

Study of the electron and transport properties in the systems consisting of carbon nanostructures with biomolecules attached to their surface. Analysis of the influence of the surrounding solution composition on the transport characteristics. Study of the mechanism of quantum transport in the ion liquid gate type field effect transistor based on similar systems.

Calculation of the thermal conductivity of a wide class of nanocrystalline materials.

Investigation of properties of transport of the intra molecular vibrational excitation (vibron) in a quasi 1D macromolecular structure taking into account the process of damping depending on the vibron-phonon coupling strength and temperature.

- Calculation of the density profile in the model of dense traffic constructed on the basis of the generalized totally asymmetric exclusion process.

Solution in one dimension and numerical computation in higher dimensions of the problem of spreading of information analogous to the model of directed percolation below the percolation threshold.

Evaluation of large deviation functions of the avalanche sizes in the Raise and Peel model in the thermodynamic limit.

Derivation of the universal asymptotics of correlation functions in the generalized simple exclusion process.

A detailed investigation of the rotor-router aggregation model.

The phase diagram of the generalized totally asymmetric simple exclusion process will be constructed for generic values of the probabilities for hopping, injection and ejection of particles on open chains. The results of theoretical analysis and computer simulations will be used for modeling processes of the particle aggregation and development of jams in one-dimensional traffic.

Investigation of eigenfunctions of the elliptic Fourier transformation for the gauge group $SU(2)$ and demonstration of their connection with the Nekrasov instanton partition function in five dimensional gauge field theories (Gaiotto-Kim conjecture).

Investigation of a stochastic regime for the Fateev-Zamolodchikov spin chain, namely, stochastic reinterpretation of the model, study of combinatorial properties of the ground states and revealing of underlying symmetry algebra.

Construction of solutions of the 3-body quantum Calogero-Moser system with the pairwise 2-body interaction described by the Weierstrass elliptic function for special coupling constants using the Sklyanin method of separation of variables.

Construction of solutions of the Yang-Mills equations on $AdS_p \times S^q$ and $dS_p \times H^q$, i.e. on the direct product of anti-de Sitter spaces, spheres, de Sitter and hyperbolic spaces.

List of activities:

Activity or experiment	Leaders
Laboratory or other	Main researchers
Division of JINR	
1. Complex materials and nanostructures	V.A. Osipov
	N.M. Plakida
BLTP	E.M. Anitas, A.Yu. Cherny, A.V. Chizhov, V. Ilkovich, I.D. Ivantsov, V.L. Katkov, E.A. Kochetov, D.V. Kolesnikov, S.E. Krasavin, D.A. Lobanov, M. Maiti, A.N. Novikov, V.N. Plechko, I.R. Rahmonov, J. Schmelzer, O.G. Sadykova, Yu.M. Shukrinov, M.A. Smondyrev, J. Smotlacha, A.A. Vladimirov, V.Yu. Yushankhai
FLNP	V.L. Aksenov, A.M. Balagurov, A.I. Kuklin
LIT	E.B. Zemlianaya, I. Sarhadov, S.I. Serdyukova, L.A. Syurakshina
2. Contemporary problems of statistical physics	A.M. Povolotsky
	V.B. Priezzhev
BLTP	J. Brankov, N.Zh. Bunzarova, A.E. Derbyshev, V.M. Dubovik, V.I. Inozemtsev, A.L. Kuzemsky, T.A. Ivanova, V. Papoyan, P.N. Pyatov, V.P. Spiridonov, V.I. Yukalov, P.E. Zhidkov
LIT	E.P. Yukalova

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	Foundation ANSL YSU IIAP NAS RA
Australia	Melbourne	Univ.
	Sydney	Univ.
Austria	Vienna	TU Wien
	Linz	JKU
Belarus	Minsk	BSTU IP NASB ISEI BSU UCP MES JIPNR-Sosny NASB
Belgium	Louvain-la-Neuve	UCL
Brazil	Brasilia, DF	UnB
	Sao Paulo, SP	USP
	Natal, RN	IIP UFRN
Bulgaria	Sofia	IMEch BAS ISSP BAS SU

Canada	Montreal	INRNE BAS
	Quebec	Concordia
	Kingston	UL
	London	Queen's
Czech Republic	Řež	Western
France	Annecy-le-Vieux	NPI ASCR
	Paris	LAPTh
	Marseille	UPMC
	Nice	CPT
	Valenciennes	UPC
Germany	Bonn	UN
	Bremen	UVHC
	Braunschweig	UniBonn
	Dortmund	Univ.
	Darmstadt	TU
	Dresden	TU Dortmund
	Duisburg	GSI
	Leipzig	IFW
	Magdeburg	MPI PkS
	Rostock	TU Dresden
	Stuttgart	UDE
	Wuppertal	UoC
Hungary	Budapest	OVGU
India	Mumbai	Univ.
Ireland	Dublin	MPI-FKF
Italy	Catania	UW
	Salerno	Wigner RCP
Poland	Krakow	TIFR
	Warsaw	DIAS
	Katowice	UniCT
	Poznan	UNISA
Romania	Bucharest	JU
	Cluj-Napoca	IPC PAS
	Timișoara	WUT
Russia	Moscow	US
		AMU
		IMP PAS
		IFIN-HH
		UTC-N
		UVT
		MIREA
		ITEP
		NNRU "MEPhI"
		NRU HSE
		PFUR

		SINP MSU
		MI RAS
		NRC KI
	Moscow, Troitsk	HPPI RAS
	Belgorod	BelSU
	Gatchina	PNPI
	Kazan	KFU
	Krasnoyarsk	KIP SB RAS
	Protvino	IHEP
	Samara	SU
	Saratov	SSU
	St. Petersburg	ETU
		IPTI RAS
		SPbSU
		PDMI RAS
	Voronezh	VSU
Moldova	Chişinău	IAP ASM
Mongolia	Ulaanbaatar	NUM
Serbia	Belgrade	INS "VINČA"
Slovakia	Bratislava	CU
	Košice	IEP SAS
		TUKE
Slovenia	Ljubljana	UL
Spain	Madrid	ICMM-CSIC
Switzerland	Villigen	PSI
	Zurich	ETH
Taiwan	Taipei	IP AS
Ukraine	Kharkov	NSC KIPT
	Kiev	IMP NASU
		NUK
	L'viv	ICMP NASU
USA	Louisville, KY	UofL
	New York, NY	CUNY
	Rochester, NY	UR
	Tallahassee, FL	FSU
Uzbekistan	Tashkent	Assoc."P.-S." PTI
Vietnam	Hanoi	IMS VAST

Modern Mathematical Physics: Strings and Gravity, Supersymmetry, Integrability

Leaders:

A.P. Isaev
A.S. Sorin
S.O. Krivonos
A.T. Filippov

Scientific leader:**Participating Countries and International Organizations:**

Australia, Austria, Armenia, Brazil, Bulgaria, Canada, CERN, Czech Republic, France, Germany, Greece, Hungary, ICTP, India, Italy, Japan, Norway, Poland, Romania, Russia, Serbia, Spain, Turkey, Ukraine, United Kingdom, USA.

Scientific Programme

The main purpose of research in modern mathematical physics is the development of mathematical methods for solving the most important problems of modern theoretical physics: clarifying the nature of fundamental interactions and their symmetries, construction and study of effective field models arising in the theory of strings and other extended objects, uncovering the geometric description of quantum symmetries and their spontaneous breaking in the framework of search for a unified theory of all fundamental interactions, including quantum gravity. Mathematical physics in recent years has been characterized by increasing interest in identifying and effective use of integrability in various areas, and in applying powerful mathematical methods of quantum groups, supersymmetry and non-commutative geometry to quantum theories of fundamental interactions as well as to classical models.

The main goals and tasks of the research within the theme include: development of new mathematical methods for description of a variety of integrable models and their exact classical and quantum solutions; analysis of a wide range of problems in the theory of superstrings and superbranes, including study of nonperturbative regimes in supersymmetric gauge theories; development of a microscopic description of black holes and constructing cosmological models of the early Universe. The decisive factor to solve the above problems is a crucial use of the mathematical methods of the theory of integrable systems, quantum groups and noncommutative geometry as well as superspace techniques.

Expected main results in 2018:

- Studies of topology and geometry of the moduli spaces of special Bohr — Sommerfeld lagrangian cycles in algebraic varieties.

Construction of canonical Berry bundles on the moduli spaces of special Bohr — Sommerfeld lagrangian cycles in algebraic varieties.

Construction of holographic renormalization group flows related to $SL(2, \mathbb{C})$ Toda chains. Analysis of the obtained RG flows in the framework of the gauge/gravity duality. Construction of solutions without a horizon (boson stars) with anti de-Sitter and anisotropic asymptotics. Analysis of the solutions in the holographic framework.

Construction of Kerr-Vaidya/ Kerr-Newman-Vaidya solutions with AdS asymptotics for the D=5 supergravity model. Study of local operators (two-point correlation functions) for the constructed metrics via holography.

Application of the generalised Reshetikhin formula for the scalar products of the Bethe vectors to the problems of form-factor calculations of the local operators in the quantum integrable models with high symmetry. Reduction of these quantities to the determinant forms and its application to the problem of calculation of the correlation functions in the thermodynamic limits.

Construction of classical integrable systems on varieties of modules of the preprojective algebras and their applications to generalised KP hierarchies. Construction of integrable deformed elliptic Calogero–Moser systems by means of the elliptic Dunkl operators. Construction of eigenfunctions of the deformed Macdonald–Ruijsenaars systems by using the representation theory of the Ding–Iohara algebra.

Study of systems of oscillators, invariant with respect to deformations of Galilei algebra (which include most of noncompact simple Lie algebras). Prove that for any of these algebras it is possible to make the equations of motion for a system of harmonic or Pais-Uhlenbeck oscillators linear. Apply these results to particular algebras (including G_2).

Study the $N=4$ supersymmetric mechanics of many particles on curved spaces: generalize the necessary conditions for supersymmetry, including the WDVV equations, find the condition for acceptable potentials, solve them in particular cases.

It is planned to obtain exact solutions for quantum problem of harmonic oscillator on two-sheeted hyperboloid $SO(3,1)/SO(3)$ in four coordinate systems: spherical, polar-cylindrical, equidistant-cylindrical and equidistant, and to find the coefficients of inter-basis expansion between given coordinate systems. It is also planned to find a full solution for classical problems of Kepler-Coulomb and harmonic oscillator on one-sheeted hyperboloid $SO(3,1)/SO(2,1)$, by solving the Hamilton-Jacobi equations, and constructing the trajectories of motion.

Study of compact objects in modified theories of gravity.

Development of new methods for processing and analysis of observational data from detectors of gravitational waves.

Development of the theory and applications of Heun’s functions in problems of mathematical physics and theory of gravity.

- The two-loop quantum calculations in $N=(1,1)$ 6D supersymmetric Yang-Mills theory will be preformed in the harmonic superspace approach: the question of UV divergences and finite contributions to the effective action will be elucidated. There will be constructed all independent invariants of canonical dimension $d=12$ and the issue of their (as well as of higher-dimensional invariants) possible application for constructing 6D Born-Infeld theory with the manifest $N=(1,0)$ and hidden $N=(1,1)$ 6D supersymmetries.

There will be constructed new $SU(2|2)$ and $SU(4|2)$ supersymmetric extensions of the Calogero-Moser type models as deformations of $N=4$ and $N=8$ supersymmetric extensions, the issue of their integrability and relationships with the matrix models of string theory will be studied.

The study of 6D supergravity models in the off-shell $N = (1; 0)$ and on-shell $N = (1; 1)$ 6D harmonic superspaces will be started. The constraints of $N = (1; 1)$ 6D supergravity will be solved in terms of $N = (1; 0)$ superfields.

Construction of superfield action for the many-particle systems with $N=4$ and $N=8$ deformed supersymmetries. Superfield formulation of sigma model with Wess-Zumino term possessing the $N=4$ and $N=8$ deformed supersymmetries and describing the interaction of the spinning particle with an external gauge background.

Construction of models for spinning particles and superparticles using momentum twistors. Obtaining of transition amplitudes from the BFV–BRST path integral.

Definition of geometries described by $N=4$ supersymmetric quantum mechanical sigma models with a variety of dynamical, semi-dynamical and gauge supermultiplets. Determination of the type of supercharges for different geometries.

Construction of new hairy black holes linked to charged scalar clouds in the Kerr-Newman space-time. Investigation of the near BPS spinning self-gravitating Skyrmons. Construction of spinning black holes with the BPS Skyrme hair.

- It is planned to study various boundary effects (the Casimir effect for instance) in conformal theories, and their possible holographic duals in gravity theories to comprehend the peculiarities of their strong coupling regime. To this end the Casimir energy will be derived in free conformal theories with $D=3,4,6$ which obey the boundary conditions preserving conformal invariance at boundaries of various geometries. Specifically, in $d=4$ the calculation will be performed for $N=4$ super Yang-Mills theory. The results will

be used to choose among different holographic descriptions those reproducing the Casimir energy for conformal theories with boundaries.

Vacuum fluctuations of spinor and vector fields in the lattice background of n-dimensional delta function potentials will be studied. Similar two-dimensional systems have attracted recent attention related to the description of dispersion forces between polarizable sheets, for example graphene layers. The research demands the development of differential operator's self-adjoint extensions, and spectral geometry, specifically, spectral zeta functions and heat-kernel expansions in singular background or with singular potential.

By making use of the two-time temperature Green functions, the vacuum friction force between macroscopic bodies will be calculated with account of all orders in the relative velocity of the bodies.

We plan to perform the phase space analysis of some realistic $f(R)$ -gravity models. We also plan to calculate the cosmological perturbations in such kind of models.

Studying of scalar-tensor teleparallel gravity models and calculation of cosmological perturbations in such kind of models will be performed.

It is planned to study gravity model based on a nonlinear realization of affine and conformal groups. Study of the model's quantum features and renormalization properties in first and second perturbation theory order.

Study of Horndeski gravity model's features.

Investigation of the mass-inflation phenomenon on Cauchy horizon of black holes depending on their electric and magnetic charges, angular momenta and presence of hairs, both in Einstein gravity and in gravity theories with non-minimal coupling. Such investigation promotes our understanding of singularity issues in solutions to gravity theories.

Investigation of the Horndeski models with Maxwell and Yang-Mills fields applied to black holes and cosmologies. In cosmologies such theories attracted a lot of interest because the corresponding lagrangian degenerates on de Sitter background. Recently we have shown that the presence of such quasiattractor gives rise to natural finite-time inflation in Friedmann cosmology with $SU(2)$ Yang-Mills field. It is planned to continue our investigation of these models in the first-order (Einstein-Palatini) formalism, when connection is treated as an independent variable. For a theories with non-minimal coupling of matter to gravity there is no a priori reason considering the metric-compatible connection, which leads to diverse dynamical models with new solutions.

Exact Stephani solutions with variable spatial curvature will be studied, their possible impact on inflationary cosmology and general topological properties will be investigated. Question of cosmological horizon in the Einstein-Straus vacuole model and Lemaitre-Tolman-Bondi model will be studied.

Prospects for the formation of structures in the inhomogeneous models will be examined, observable cosmological parameters will be evaluated and experimental data will be fitted. The Stephani and Λ CDM cosmological models will be compared from the phenomenological point of view.

Mannheim's conformal gravity will be analyzed, galactic rotation curves without presence of dark matter in light of up-to-date cosmological measurements will be obtained. Internal structure of the Mannheim's theory, problems with unitarity, and its critical evaluation as a possible candidate for quantum gravity will be analyzed.

List of activities:

Activity or experiment	Leaders
Laboratory or other Division of JINR	Main researchers
1. Quantum groups and integrable systems	A.P. Isaev
BLTP	J.Fuksa, A.A.Golubtsova, S.O.Krivonos, N.Yu.Kozyrev, V.K.Mitrjushkin, P.Fiziev, D.R.Petrosyan, G.S.Pogosyan, A.V.Silantyev, N.A.Tyurin, + 1 student
UC	S.Z.Pakuliak

2. Supersymmetry

BLTP

E.A. Ivanov

S.A.Fedoruk, M.Pientek, S.S.Sidorov, Ya.M.Shnir,
I.B.Samsonov, A.Pietrikovsky, A.O.Sutulin

3. Quantum gravity, cosmology and strings

BLTP

A.T. Filippov
V.V. Nesterenko
A.S. Sorin

B.M.Barbashov, I.Bormotova, E.A.Davydov, B.N.Latosh,
A.B.Pestov, I.G.Pirozhenko, E.A.Tagirov, P.V.Tretyakov,
P.Yaluvkova, + 3 students

Univ

D.V.Fursaev

LIT

I.L.Bogoliubsky, A.M.Chervyakov

VBLHEP

E.E.Donets

Collaboration

**Country or International
Organization**

City

Institute or Laboratory

Armenia

Yerevan

YSU

Australia

Sydney

Univ.

Perth

UWA

Austria

Vienna

TU Wien

Brazil

Sao Paulo, SP

USP

Juiz de Fora, MG

UFJF

Bulgaria

Sofia

INRNE BAS

SU

Canada

Montreal

McGill

UdeM

Edmonton

U of A

Vancouver

TRIUMF

CERN

Geneva

CERN

Czech Republic

Opava

SIU

Prague

CTU

CU

Řež

NPI ASCR

France

Annecy-le-Vieux

LAPP

Dijon

UB

IMB

Lyon

ENS Lyon

Marseille

CPT

Nantes

SUBATECH

Paris

ENS

LUTH

LPTHE

Palaiseau

Polytech

Valenciennes

UVHC

Germany	Berlin	FU Berlin MBI Univ. UniBonn TU Dortmund LUH Univ. UoC MPI-P IPO AEI UoA
	Bielefeld	
	Bonn	
	Dortmund	
	Hannover	
	Jena	
	Leipzig	
	Munich	
	Oldenburg	
	Potsdam	
Greece	Athens	
Hungary	Budapest	Wigner RCP
India	Calcutta	BNC IACS IMSc INFN INFN LNF INFN UniPd INFN INFN UNISA SISSA/ISAS UniTo ICTP Kyushu Univ. KSU RIMS YITP KEK Fukusima Univ. UT NTNU NCAC PAS UW JU NINP PAS UL UW IFIN-HH ITEP LPI RAS MSU MI RAS
	Chennai	
Italy	Bari	
	Frascati	
	Naples	
	Padua	
	Pavia	
	Pisa	
	Salerno	
	Trieste	
	Turin	
ICTP	Trieste	
Japan	Fukuoka	
	Kyoto	
	Tsukuba	
	Fukusima	
	Tokyo	
Norway	Trondheim	
Poland	Warsaw	
	Krakow	
	Lodz	
	Wroclaw	
Romania	Bucharest	
Russia	Moscow	

		NRU HSE
		VNIIMS
		PFUR
		SAI MSU
	Moscow, Troitsk	INR RAS
	Chernogolovka	LITP RAS
	Dolgoprudny	MIPT
	Kazan	KFU
	Novosibirsk	NSU
	Protvino	IHEP
	St. Petersburg	PDMI RAS
		SPbSU
	Tomsk	TPU
		TSPU
Serbia	Belgrade	IPB
		Univ.
Spain	Bilbao	UPV/EHU
	Barcelona	IEEC-CSIC
	Valencia	IFIC
	Madrid	ETSIAE
Turkey	Istanbul	BU
	Izmir	IZTECH
USA	New York, NY	CUNY
		RU
		SUNY
	Cincinnati, OH	UC
	College Park, MD	UMD
	Coral Gables, FL	UM
	Minneapolis, MN	U of M
	Norman, OK	OU
	Philadelphia, PA	Penn
	Piscataway, NJ	Rutgers
	Rochester, NY	UR
Ukraine	Kiev	BITP NASU
	Kharkov	NSC KIPT
United Kingdom	London	Imperial College
	Cambridge	Univ.
	Durham	Univ.
	Liverpool	Univ.
	Southampton	Univ.
	York	Univ.
	Glasgow	U of G
	Leeds	UL
	Brighton	US
Luxembourg	Luxembourg	Univ.

Dubna International Advanced School of Theoretical Physics (DIAS-TH)

Leaders: A.S. Sorin
DIAS-TH Rector: V.V. Voronov
 A.T. Filippov

Participating Countries and International Organizations:

Austria, Brazil, Bulgaria, Canada, CERN, Czech Republic, France, Germany, Greece, Hungary, India, Israel, Italy, Japan, Mexico, Poland, Romania, RSA, Russia, Serbia, Turkey, Ukraine, United Kingdom, USA, Vietnam.

The Bogoliubov Laboratory of Theoretical Physics (BLTP) has a good record of organizing international workshops and schools in Dubna. DIAS-TH organizes and supervises all educational programs for students, postgraduates, and young scientists at BLTP. It should function continuously and the standard short schools (about 3-4 a year) should be organized coherently. Other educational programs in Dubna such as the JINR University Center may also correlate with DIAS-TH (common programs on modern theoretical physics, workshops for students and young scientists, etc.).

The main goals of DIAS:

- Training courses for students, graduates, and young scientists in the JINR Member States and other countries (according to special agreements and grants).
- Looking for and supporting gifted young theorists in the JINR Member States; creating databases of students and young researchers.
- Organization of schools of different levels in Dubna and coordination with similar schools in Russia, Germany, and other European countries.
- Support of the JINR experimental programs by organizing lecture courses and review lectures on new trends in modern physics.
- Cooperation with the JINR University Center in training students and postgraduates as well as in organizing schools for students.
- Coordination of the research - training programs with workshops and conferences at JINR.
- Publication of lectures and discussions in different forms, in particular, with the use of modern electronic equipment, etc.
- Supporting the WEB page of DIAS-TH which should become the organizing center of the programs related to DIAS-TH.

The main topics of the DIAS activity should be centered around the most important directions of research at BLTP: Theory of Fundamental Interactions; Nuclear Theory; Theory of Condensed Matter; Modern Mathematical Physics.

Expected main results in 2018:

- Organization of four international schools at BLTP.
- Organization of one-day lectures/discussions and regular seminars for students and post-graduates.
- Computer processing of video records of lectures, support of digital archive of video records.
- Support of Web-site of DIAS-TH.

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers
1. DIAS-TH	A.S. Sorin V.V. Voronov
BLTP	D. Blaschke, A.T. Filippov, A.P. Isaev, E.A. Kolganova, R.V. Jolos, I.G. Pirozhenko, O.V. Teryaev, P.V. Tretyakov, A.A. Starobinsky, V.I. Zhuravlev + 4 students
LIT	V.V. Korenkov
UC	S.Z. Pakuliak
FLNP	V.L. Aksenov
VBLHEP	I.A. Savin, Yu.A. Panebratsev
DLNP	V.A. Bednyakov
FLNR	Yu.Ts. Oganessian

Collaboration

Country or International Organization	City	Institute or Laboratory
Austria	Vienna	Uni Wien TU Wien
Brazil	Sao Paulo, SP	USP
Bulgaria	Sofia	INRNE BAS SU
Canada	Montreal	UdeM
	Edmonton	U of A
CERN	Geneva	CERN
Czech Republic	Prague	CTU
	Řež	NPI ASCR
France	Annecy-le-Vieux	LAPP
	Dijon	UB
	Lyon	ENS Lyon
	Marseille	CPT
	Nantes	SUBATECH
	Paris	ENS LPTHE
	Valenciennes	UVHC
Germany	Bonn	UniBonn
	Hamburg	DESY
	Hannover	LUH
	Oldenburg	IPO
	Jena	Univ.
	Leipzig	UoC

	Munich	MPI-P
	Potsdam	AEI
Greece	Athens	UoA
Hungary	Budapest	Wigner RCP
India	Calcutta	BNC
Italy	Frascati	INFN LNF
	Padua	UniPd
	Pavia	INFN
	Pisa	INFN
	Salerno	UNISA
	Trieste	SISSA/ISAS
	Turin	INFN
Israel	Rehovot	WIS
Japan	Kyoto	KSU
		RIMS
	Tsukuba	KEK
Mexico	Leon	UG
Poland	Warsaw	UW
	Otwock-Swierk	NCBJ
	Wroclaw	UW
Romania	Bucharest	IFIN-HH
South Africa	Cape Town	UCT
Russia	Moscow	ITEP
		LPI RAS
		MSU
		SCC RAS
		SINP MSU
		MI RAS
		VNIIMS
	Moscow, Troitsk	INR RAS
	Chernogolovka	LITP RAS
	Gatchina	PNPI
	Petrozavodsk	PetrSU
	Protvino	IHEP
	Tomsk	TSU
Serbia	Belgrade	IPB
		Univ.
Turkey	Istanbul	BU
Ukraine	Kiev	BITP NASU
United Kingdom	London	Imperial College
	Durham	Univ.
	Cambridge	Univ.
	Southampton	Univ.
	York	Univ.
USA	New York, NY	CUNY

Vietnam

Baltimore, MD
College Park, MD
Cincinnati, OH
Coral Gables, FL
Minneapolis, MN
Newport News, VA
Philadelphia, PA
Piscataway, NJ
Rochester, NY
Salt Lake City, UT
Hanoi

SUNY
JHU
UMD
UC
UM
U of M
JLab
Penn
Rutgers
UR
U of U
IOP VAST

Elementary
Particle Physics
and
Relativistic
Nuclear Physics
(02)

02-2-1123-2015/2019

Priority:

1

Status:

In-progress

JINR's Participation at the BES-III Physics Research Program

Leader: A.S. Zhemchugov

Participating Countries and International Organizations:

China, Russia.

Scientific Programme

The BES-III experiment at the electron-positron collider BEPC (IHEP CAS, Beijing, China) is aimed at systematic and precise measurements in τ -charm domain. The main goals of the experiment include light hadron spectroscopy, study of charmonium spectrum and transitions, study of open charm particles like D and Ds mesons, τ -lepton physics and search for new exotic XYZ states. Data taking started in 2009. The world largest sample of J/ψ , $\psi(3686)$, $\psi(3770)$, $\psi(4040)$ is already collected. Scan in the energy range 2.0–4.6 GeV is performed for R-ratio measurement. Unique sample in the energy range 4.2–4.6 GeV is collected to search for new XYZ states.

Expected main results in 2018:

- BES-III data analysis.
- Development of offline software and analysis tools
- Development of the distributed computing system (integration of cloud resource).
- Development of high-performance PWA software using HybriLIT cluster.

List of projects:

Project	Leader	Priority (period of realization)
1. BES-III	A.S. Zhemchugov	1 (2007 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
BES-III Project	A.S. Zhemchugov	Realization
DLNP	I.R. Boyko, A.V. Guskov, D.V. Dedovich, Yu.A. Nefedov, G.A. Shelkov, I.I. Denisenko, O.V. Bakina, E. Tskhadadze, V.A. Tokareva	
BLTP	V.V. Bytev, O.V. Teryaev	
LIT	V.V. Korenkov, A.V. Uzhinsky, S.D. Belov, I.S. Pelevanyuk, V.V. Trofimov, O.I. Streltsova, D.V. Podgainy	

Collaboration

**Country or International
Organization**

City

Institute or Laboratory

China

Beijing

IHEP CAS

Russia

Gatchina

PNPI

Novosibirsk

BINP SB RAS

ATLAS.

Upgrade of the ATLAS Detector and Physics Research at the LHC

Leader: V.A. Bednyakov
Deputies: E.V. Khramov
 A.P. Cheplakov

Participating Countries and International Organizations:

Armenia, Azerbaijan, Belarus, Canada, CERN, Czech Republic, France, Germany, Georgia, Greece, Israel, Italy, Netherlands, Russia, Slovakia, Spain, USA, Uzbekistan.

Scientific Programme

Comprehensive investigations of superhigh-energy (7–14 TeV) proton scattering at the Large Hadron Collider with the ATLAS facility will yield utterly new and unique experimental data. Their analysis will allow solution to the most profound physical problems fundamentally important for world outlook.

JINR researchers will take part in solution of some of these problems within the project. Among the most important of them are the clarification of the origin of the elementary particle mass (Higgs mechanism) and search for and investigation of supersymmetry, which will allow an insight into the nature of galactic dark matter and the character of the evolution of our Universe. Other important problems are determination of the applicability boundaries of the modern standard model of elementary particles and observation of evidence for new physical phenomena, such as additional space dimensions or previously unknown particles and interactions. In addition, JINR researchers will get new results allowing more specific knowledge as to the properties of the already known elementary particles such as the W and Z bosons, the top quark, and others.

Implementation of this project aimed at solving highly important scientific problems will result in getting unique applied data.

The “by-products” worth noting are development, debugging, and experience in operation of systems for remote monitoring of highly complicated devices and development and practical use of the distributed computation system (grid) in a long-term, full-scale experiment.

Expected main results in 2018:

- Participation in the LHC and ATLAS detector maintenance and upgrades.
- Data development and analysis of the ATLAS data. The new physical results to be obtained in investigations of some key processes of the Standard Model, exotic physics, search for SUSY and heavy quarks physics.
- Development of the ATLAS physics programme: simulation of physical processes, participation in the ATLAS working group, etc.
- Work on the modernization project of the ATLAS detector, including the toroidal magnets, hadron calorimeters and muon spectrometer.
- Detector maintenance and operation.

List of projects:

Project	Leader	Priority (period of realization)
1. ATLAS. Physics.	E.V. Khramov	1 (2010 – 2019)
2. Upgrade of the ATLAS Detector	A.P. Cheplakov	1 (2013 – 2018)
3. SANC	A.A. Sapronov	1 (2003 – 2018)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Experiment ATLAS	V.A. Bednyakov E.V. Khramov A.P. Cheplakov	Technical proposal
DLNP V.A. Bednyakov, J.A. Budagov, N.A. Rusakovich, G.A. Chelkov	A.L. Gongadze, I.R. Boyko, M.A. Demichev, Yu.A. Koulchitski, I.A. Minashvili, M.I. Gostkin, D.V. Dedovich, Yu.A. Nefedov, D.V. Kharchenko, Yu.A. Usov, S.N. Malyukov, V.V. Lyubushkin, T.V. Lyubushkina, R.R. Sadykov, M.V. Chizhov, V.V. Glagolev, P.V. Tereshka, Z.U. Usubov, Yu.P. Ivanov, S.N. Karpov, Z.M. Karpova, M.V. Lyablin, G.I. Lykasov, A.A. Sapronov, A.N. Shalyugin, M.M. Shiyakova, V.B. Vinogradov, A.C. Zhemchugov, A.V. Ershova, N. Huseinov, L.K. Gladilin, I.V. Eletsikh, E.M. Plotnikova, Yu.I. Davydov, S.A. Kotov, V.G. Kruchonok, I.N. Potrap, E. Tschadadze, Yu.Yu. Stepanenko, S.M. Turchikhin	
VBLHEP A.P. Cheplakov	N. Dzhavadov, E.A. Ladygin, F.N. Ahmadov, A.V. Ivanov, V.V. Kukhtin, B.G. Shaykhatdenov, L.A. Merkulov, V.V. Myalkovsky, A.A. Soloshenko, N.I. Zimin, Yu.A. Filippov	
LIT V.V. Korenkov, P.V. Zrelov	I.N. Aleksandrov, N.I. Gromova, A.V. Yakovlev, V.N. Shigaev, M.A. Mineev, D.A. Oleynik, A.S. Petrosyan	
BLTP D.I. Kazakov	A.V. Gladyshev, A.V. Bednyakov, N.I. Kochelev, A.F. Pikelner, O.B. Teryaev	
FLNP S.A. Kulikov	M.V. Bulavin, E.N. Kulagin, E.P. Shabalin	
2. SANC Project	A.A. Sapronov	Realization
DLNP	L.V. Kalinovskaya, R.R. Sadykov, E.D. Uglov, L.A. Rumyantsev	
BLTP	A.B. Arbuzov, S.G. Bondarenko	

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	Foundation ANSL
Azerbaijan	Baku	IP ANAS
Belarus	Minsk	IP NASB INP BSU JIPNR-Sosny NASB IAP NASB
	Gomel	GSTU

Canada	Vancouver	GSU
	Montreal	TRIUMF
CERN	Geneva	UdeM
Czech Republic	Prague	CERN
France	Clermont-Ferrand	CU
	Orsay	LPC
Germany	Munich	LAL
	Zeuthen	MPI-P
Georgia	Tbilisi	DESY
Greece	Athens	HEPI-TSU
Israel	Rehovot	UoA
Italy	Pisa	WIS
Netherlands	Amsterdam	INFN
Russia	Moscow	NIKHEF
		LPI RAS
		ITEP
		MSU
	Protvino	IHEP
Slovakia	Bratislava	CU
		IP SAS
Spain	Barcelona	IFAE
USA	Lemont, IL	ANL
Uzbekistan	Samarkand	SSU

Search for New Physics in Experiments with High-Intensity Muon Beams

Leader: V.V. Glagolev
Deputy: Yu.I. Davydov
Scientific leader: J.A. Budagov

Participating Countries and International Organizations:

Belarus, Bulgaria, Czech Republic, Georgia, Germany, United Kingdom, France, Italy, Russia, Slovakia, USA, Ukraine, Japan.

Scientific Programme

The muon anomalous magnetic moment a_μ can be measured and computed to high precision. The comparison between experiment and the SM therefore provides a sensitive search for New Physics (NP). At present, both measurement and theory have sub-part-per-million (ppm) uncertainties, and the “g-2 test” is being used to constrain SM extensions. The difference between experiment and theory, $\Delta a_\mu(Expt - SM) = (255 \pm 80) \times 10^{-11}$ ($3, 2\sigma$), is a highly cited result and a possible harbinger of new TeV-scale physics. Potential explanations of the deviation include: supersymmetry, lepton substructure, dark matter loop etc., all well motivated by theory and consistent with other experimental constraints. Fermilab experiment has a plan to reduce the experimental uncertainty by a factor of 4 or more. A precise g-2 test, no matter where the final value lands, will sharply discriminate among models and will enter as one of the central observables in a global analysis of any SM extensions.

The Mu2e experiment at Fermilab is a dedicated search for the CLFV process $\mu^- N \rightarrow e^- N$, which is the coherent conversion of a muon into an electron in the vicinity of a nucleus. Once neutrinos masses are included, the process is allowed but effectively still absent since the rate is proportional to $(\Delta m_{ij}^2/M_W^2)^2$, where Δm_{ij}^2 is the mass difference squared between i-th and j-th neutrino mass eigenstates, and M_W is the mass of the W-boson. The predicted rates for the $\mu^- N \rightarrow e^- N$ and $\mu^+ \rightarrow e^+ \gamma$ CLFV processes are less than 10^{-50} each. This makes this process a very theoretically clean place to search for NP effects. In many NP models that include a description of neutrino mass, the rates for these processes are enormously enhanced so that they occur at a level to which Mu2e experiment will have sensitivity.

Study of CP-violation in the lepton sector with the help of neutrino.

Study of hyperfine interactions of an acceptor impurity in semiconductors with the aid of negative muons. Investigation of the behavior of positive muons in systems with magnetic nanoparticles.

Expected main results in 2018:

- Simulation for e.m. calorimeter calibration of the Mu2e experiment.
- Tests of the CsI e.m. calorimeter elements on the gamma sources and electron beam.
- Creation and test of the CRV (cosmic ray veto) modules and counters on proton beam and cosmic muons.
- Tuning and support of the final version of visualization and control software.
- Participation in data taking runs and data analysis.
- Participation in the radiation hardness tests of the detector elements.
- Analysis of the experimental data on the radiative pion decay collected by the PEN experiment.
- Participation in development of the positron tracker for the MEG-II experiment, DAQ, data analysis.
- Participation in the construction and tests of modules of scintillator counters for the veto system. Quality control.

- Participation in the data taking and analysis of experimental data using CERN hadron beams.
- Software development for data processing and analysis.
- Study of the behavior of magnetic nanoparticles with high magnetic anisotropy by the muon spin rotation technique.
- Data taking and data processing for $p + t$ fusion reaction using the muon catalysis method.

List of projects:

Project	Leader	Priority (period of realization)
1. Search for new physics in experiments with high-intensity muon beams	V.V. Glagolev	1 (2015 – 2020)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Experiment Mu2e	V.V. Glagolev	R&D Realization
DLNP	A.M. Artikov, N.V. Atanov, O.S. Atanova, N.S. Azaryan, V.Yu. Baranov, V.Yu. Batusov, J.A. Budagov, D.Sh. Chokheli, Yu.I. Davydov, D.L. Demin, A.V. Guskov, Yu.N. Kharzheev, V.I. Kolomoets, S.M. Kolomoets, M.V. Lyablin, Yu.A. Koultschitski, V.M. Romanov, A.V. Sazonova, A.N. Shalyugin, A.V. Simonenko, S.N. Studenov, I.A. Suslov, I.V. Titkova, V.V. Tereschenko, S.V. Tereschenko, Z.U. Usubov	
BLTP	D.I. Kazakov, G.A. Kozlov, O.V. Tarasov	
LIT	V.V. Korenkov, V.V. Uzhinsky	
VBLHEP	A. Galoyan	
Experiment Muon g-2	N.V. Khomutov	R&D Realization
DLNP	V.A. Baranov, V.N. Duginov, N.P. Kravchuk, N.A. Kuchinsky, T.N. Mamedov, A.I. Rudenko, V.P. Volnykh	
VBLHE	S.A. Movchan	
LRB	V.A. Krylov	
2. Experiment MEG-PEN	N.A. Kuchinsky	Data processing
DLNP	V.A. Baranov, N.V. Khomutov, S.M. Korenchenko, N.P. Kravchuk, E.S. Kuzmin, A.M. Rozhdestvensky, E.P. Velicheva, V.P. Volnykh, A.S. Khrykin	
VBLHEP	A.O. Kolesnikov	
BLTP	Yu.M. Bystritsky	

3. CERN Neutrino platform**B.A. Popov**

Data taking Data processing

DLNP

N. Atanov, A. Krasnoperov, V. Lyubushkin,
S. Tereschenko, V. Tereschenko**4. Experiment MUSPIN****V.N. Duginov**
T.N. Mamedov

Data taking Data analysis

DLNP

E.I. Bunyatova, K.I. Gritsay, A.I. Rudenko, G.D. Soboleva

FLNP

M. Balasoiu + 2 pers.

5. Experiment TRITON**D.L. Demin**

Data analysis

DLNP

N.A. Baranova, A.I. boguslavsky, K.I. Gritsay,
V.n. Duginov, V.I.Kolomoets, A.D. Konin, A.P. Kustov,
T.N. Mamedov, A.I. Rudenko, Yu.A. Polyakov,
S.A. Gustov, N.A. Shakun, E.V. Kolesov, V.I. Smirnov,
E.D.Gorodnichev

FLNR

S.A. Yukhimchuk

LRB

V.B. Buchnev, V.Yu. Schegolev

Collaboration**Country or International
Organization****City****Institute or Laboratory**

Belarus

Minsk

INP BSU

Bulgaria

Sofia

SU

Italy

Pisa

UniPi

Frascati

INFN LNF

Russia

Moscow, Troitsk

INR RAS

Gatchina

PNPI

Romania

Bucharest

IFIN-HH

Slovakia

Bratislava

IP SAS

CU

USA

Batavia, IL

Fermilab

Charlottesville, VA

UVa

Lexington, KY

UK

Ukraine

Kharkov

ISMA NASU

02-2-1134-2018/2019

Priority:

1

Status:

New

Experiment COMET at J-PARC

Leader:

Z. Tsamalaidze

Participating Countries and International Organizations:

Belarus, Czech Republic, Georgia, Germany, United Kingdom, France, Russia, Japan.

Scientific Programme

Investigation of strong, weak and electromagnetic interactions of elementary particles and light nuclei at intermediate energies in order to elucidate the symmetries and dynamics of these interactions. Participation in the creation of the experimental setups and experiments on accelerators for obtaining new data and testing theoretical views in the topics. Development of projects for new experiments, setups and experimental methods for intermediate-energy physics.

Expected main results in 2018:

- R&D on thin-wall straw-tubes for experiment COMET. Development, production and tests of the straw detector and electromagnetic calorimeter 5 prototypes with a beam.
- Calibration of LYSO crystals.

List of projects:

Project	Leader	Priority (period of realization)
1. COMET	Z. Tsamalaidze	1 (2014 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Project COMET	Z. Tsamalaidze	R&D Realization
DLNP	V.N. Duginov, P.G. Evtukhovich, I.L. Evtukhovich, K.I. Gritsai, Kh. Khubashvili, V.G. Kalinnikov, A.S. Moiseenko, B.M. Sabirov, A.G. Samartsev, Yu.Yu. Stepanenko, N. Tsverava, E.P. Velicheva, A.D. Volkov	
LIT	A. Khvedelidze, G. Adamov	
BLTP	G.A. Kozlov	
VBLHEP	S.A. Movchan, S.N. Shkarovsky, V.V. Elsha, T.L. Enik	

Collaboration

Country or International Organization

City

Institute or Laboratory

Belarus

Minsk

IP NASB

BSU

INP BSU

Czech Republic

Prague

CU

CTU

France

Strasbourg

CRN

Georgia

Tbilisi

HEPI-TSU

GTU

UG

Germany

Dresden

TU Dresden

Japan

Osaka

Osaka Univ.

Tsukuba

KEK

Fukuoka

Kyushu Univ.

Russia

Moscow

ITEP

NNRU "MEPhI"

Novosibirsk

BINP SB RAS

NSU

United Kingdom

London

Imperial College

Study of Neutrino Oscillations

Leaders:

D.V. Naumov
A.G. Olshevskiy

Participating Countries and International Organizations:

China, Czech Republic, France, Germany, Japan, Italy, Slovakia, Turkey, USA.

Scientific Programme

- Measurement of the θ_{13} neutrino mixing angle and Δm_{ee}^2 squared mass difference in Daya Bay experiment.
- Measurement of the solar neutrino fluxes in Borexino experiment, search for the sterile neutrino state.
- Study of the neutrino oscillations in OPERA experiment.
- Neutrino mass hierarchy determination and measurement of CP violation phase of the neutrino mixing matrix in JUNO and NOvA experiments.
- R&D for the new photo-detectors and detector equipment for the neutrino experiments.
- Improving of the precision of direct solar neutrino flux measurements with the Borexino detector, phase-II experiment.

Expected main results in 2018:

- Physics analysis of the Daya Bay experiment data.
- Sensitivity optimization to the mass hierarchy measurements and determination of neutrino oscillation parameters.
- Application of software algorithms for event reconstruction in NOvA experiments.
- Study of NOvA experiment systematic uncertainties related to the neutrino-nucleon cross sections and MSW effects for current NOvA analysis.
- Use of NOvA experiment Remote Operation Centre at JINR for shifts.
- Test of High Voltage prototype for JUNO PMT.
- Measurement of JUNO PMT characteristics.
- OPERA emulsions analysis at JINR.
- Preparation of the OPERA TT detectors for the use in JUNO experiment.
- Measurement of JUNO veto system prototype at JINR using OPERA detectors.
- Event coordinates reconstruction in Borexino detector.
- Analysis of solar neutrino parameters in Borexino detector.

List of projects:

Project	Leader	Priority (period of realization)
1. BOREXINO	O.Yu. Smirnov	1 (1996 – 2018)
2. Daya Bay/JUNO	D.V. Naumov	1 (2009 – 2020)
3. NOvA	A.G. Olshevskiy	1 (2015 – 2020)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Experiment BOREXINO	O.Yu. Smirnov	Data taking
DLNP	K.A. Fomenko, A.P. Sotnikov, A.V. Vishneva, A.A. Formozov	
VBLHEP	O.A. Zaimidoroga	
2. Daya Bay/JUNO Project	D.V. Naumov M.O. Gonchar	Data taking R&D
DLNP	I.V. Butorov, E.A. Naumova, I.B. Nemchenok, A.G. Olshevskiy, A.V. Chukanov, N.V. Anfimov, T.A. Antoshkina, D. Biare, S.V. Biktemerova, Yu.A. Gornushkin, O.E. Gorchakov, V.O. Gromov, N.M. Kolganov, S.G. Dmitrievsky, A.V. Krasnoperov, A. Morozov, A.V. Rybnikov, A.B. Sadovsky, A.S. Selunin, O.Yu. Smirnov, K.A. Fomenko, D.V. Fedoseev, S.A. Sokolov, A.P. Sotnikov, M.A. Strizh, K.A. Treskov, A.K. Chuvashova, A.A. Formozov	
3. NOvA Project	A.G. Olshevskiy O.B. Samoylov	Data taking
DLNP	V.A. Allakgverdian, V.V. Amvrosov, A.I. Antoshkin, O.A. Klimov, N.V. Anfimov, A.E. Bolshakova, Ch. Kullenberg, L.D. Kolupaeva, A.D. Morozova, D.S. Velikanova, O.N. Petrova, A.S. Sheshukov, A.P. Sotnikov	
BLTP	S.M. Bilenky, K.S. Kuzmin, V.A. Matveev, V.A. Naumov	
LIT	N.A. Balashov, A.V. Baranov, A.G. Dolbilov, E.A. Kuznetsov	
VBLHEP	I.D. Kakorin	
4. Experiment OPERA	Yu.A. Gornushkin	Data analysis
DLNP	S.G. Dmitrievsky, A.G. Olshevskiy, A.V. Chukanov, A.B. Sadovsky, S.G. Vasina, A.P. Sotnikov	
5. Development of new photodetectors and the equipment for application in registering systems of neutrino experiments	N.V. Anfimov	R&D

DLNP

A.I. Antoshkin, A.G. Olshevskiy, A.V. Rybnikov,
A.V. Selunin, V.V. Chalyshev, I.E. Chirikov-
Zorin, D.V. Fedoseev, A.P. Sotnikov, S.A. Sokoklv,
K.I. Kuznetsova

VBLHEP
Z.Ya. Sadygov

6. Experiment DarkSide

O.Yu. Smirnov

Data analysis

DLNP

O.E. Gorchakov, D.V. Korablev, A.V. Vishneva,
O.B. Samoylov, A.P. Sotnikov, K.A. Fomenko,
A.S. Sheshukov

Collaboration

Country or International
Organization

City

Institute or Laboratory

Germany

Hamburg

Univ.

Aachen

RWTH

Czech Republic

Prague

CU

France

Strasbourg

CRN

Italy

Salerno

INFN

China

Beijing

IHEP CAS

Slovakia

Bratislava

CU

USA

Indianapolis, IN

IUPUI

Batavia, IL

Fermilab

Cambridge, MA

Harvard Univ.

Turkey

Ankara

METU

Japan

Tokyo

Toho Univ.

Experiment PANDA at FAIR

Leader: G.D. Alexeev

Deputies: A.N. Skachkova
A.S. Vodopyanov

Participating Countries and International Organizations:

Belarus, CERN, Czech Republic, Germany, Italy, Russia, Slovakia.

Scientific Programme

The study of the exotic nuclear-matter states and nucleon structure in the PANDA experiment at FAIR.

Expected main results in 2018:

- Inclusion of MC generators into the PANDA software and optimization of the event analysis.
- Calculations of the superconducting solenoid sub-systems.
- Preparation of the FAIR-JINR contract for the production of the PANDA muon system.
- Test of Range System Prototype at CERN PS.

List of projects:

Project	Leader	Priority (period of realization)
1. PANDA	G.D. Alexeev	1 (2011 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. PANDA Project	G.D. Alexeev	Technical proposal
DLNP A.N. Skachkova	V.M. Abazov, N. Angelov, G.A. Golovanov, S.A. Kutuzov, A.A. Piskun, D.B. Pontekorvo, A.G. Samartsev, N.B. Skachkov, V.V. Tokmenin, A.Yu. Verkheev, L.S. Vertogradov, Yu.L. Vertogradova, N.I. Zhuravlev	
VBLHEP A.S. Vodopyanov	E.A. Strokovsky, M.G. Sapozhnikov, V.K. Dodokhov, M.Yu. Barabanov, V.A. Arefev, V.I. Astakhov, A.A. Efremov, V.I. Lobanov, Yu.Yu. Lobanov, P.V. Nomokonov, I.A. Olex, A.A. Feshchenko, A.S. Galoyan	
LIT	Gh. Adam, V.V. Uzhinsky	
BLTP	A.S. Sorin, O.V. Teryaev, A.V. Efremov	

Collaboration

Country or International Organization

City

Institute or Laboratory

Belarus	Minsk	INP BSU
CERN	Geneva	CERN
Czech Republic	Prague	CU
Germany	Darmstadt	GSI
Italy	Turin	UniTo INFN
Russia	Protvino	IHEP
	Omsk	OB IM SB RAS
	St. Petersburg	Neva-Magnet
Slovakia	Bratislava	IP SAS

Astrophysical Studies in the Experiment TAIGA

Leader: L.G. Tkatchev
Deputies: V.M. Grebenyuk
 A.V. Borodin

Participating Countries and International Organizations:

Czech Republic, Germany, Japan, Italy, Mexico, Republic of Korea, Romania, Russia, Ukraine.

Scientific Programme

- The main topic of multi-messenger TAIGA array are Gamma-ray astronomy, charged cosmic ray physics and particle physics. Gamma-ray astronomy - one of the most intriguing questions in high-energy astroparticle physics is a search for galactic objects for accelerating of particles up to PeV-energies (thr so-called Pevatrons); VHE spectra of known sources: where do they stop; absorption in IR and CMB; diffuse emission from galactic plane and local supercluster. Charged cosmic ray physics – the energy spectrum and mass composition measurements from 10^{14} to 10^{18} eV. Particle physics - axion/photon conversion; hidden photon/photon oscillations; Lorentz invariance violation; pp cross-section measurement; search for quark-gluon plasma phenomena.
- The TUS space experiment has been proposed to measure the energy spectrum, composition and angular distribution of the Ultra High Energy Cosmic Rays (UHECR) at $E \approx 10^{19} - 10^{20}$ eV, to study the region beyond the GZK cutoff. Existence of these particles is beyond the Standard Model of particle physics and is of great interest. The study from the orbit is much more effective in comparison with the ground-based detectors. The existing world statistics is assumed to be increased by a factor of 2 during 3 years of the global data taking. The TUS detector will make it possible to study UHECP neutrino Extensive Air Showers (EAS) from the space orbit.
- The aim of the NUCLEON Project is direct CR measurements in the energy range 10^{11} - 10^{15} eV and the atomic charge range up to $Z \approx 30$ in the near-Earth space to solve mainly the “knee” problem in the CR spectrum. The CR phenomena in this energy region are investigated in terrestrial experiments by measurement of EAS parameters or in balloon or space experiments. Below $\sim 10^{14}$ eV the spectrum and composition are known from direct observation with detectors placed in balloons and earth satellites. However, at higher energies the CR flux is smaller and more difficult for direct and needs observation. Precise measurement of the CR composition and anisotropy will help to test the existing theoretical concepts and will become a basis for further studies.

Expected main results in 2018:

- Design and production of second IACT for TAIGA experiment.
- Participation in the MC simulation of TAIGA experiment and data analysis.
- The calibration TUS detector on the Earth orbit.
- Participation in the data taking of the TUS experiment and data analysis.
- Participation in the data taking of the NUCLEON experiment and data analysis.

List of projects:

Project	Leader	Priority (period of realization)
TAIGA	L.G. Tkatchev	1 (2015 – 2020)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Experiment TAIGA	L.G. Tkatchev	Realization
DLNP	V.M. Grebenyuk, A.N. Borodin, S.Yu. Porokhovoy, A.V. Tkachenko, F.F. Grinyuk, M. Slunečhka, V. Slunečhkova, A.I. Kalinin, V.F. Boreyko, V.M. Romanov, M. Finger, B.M. Sabirov, Y.I. Sagan, Nguen Man Shat, M.V. Lavrova, A.N. Demenko	
VBLHEP	N.V. Gorbunov	
LIT	S.K. Slepnev	
2. Experiment TUS	L.G. Tkatchev	Realization
DLNP	V.M. Grebenyuk, S.Yu. Porokhovoy, A.V. Tkachenko, F.F. Grinyuk, M. Slunečhka, V. Slunečhkova, M.V. Lavrova, A.I. Kalinin, V.F. Boreyko	
VBLHEP	N.V. Gorbunov	
3. Experiment NUCLEON	L.G. Tkatchev	Realization
DLNP	V.M. Grebenyuk, E.M. Gazeeva, S.Yu. Porokhovoy, N.I. Kalinin, V.F. Boreyko, Nguen Man Shat, B.M. Sabirov, A.B. Sadovsky, A.V. Tkachenko, M.V. Lavrova, A.N. Borodin	
VBLHEP	N.V. Gorbunov	
LIT	V.N. Shigaev, S.K. Slepnev	
FLNP	A.D. Rogov	

Collaboration

Country or International Organization	City	Institute or Laboratory
Czech Republic	Prague	CU
Germany	Zeuthen	DESY
	Munich	MPI-P
	Hamburg	Univ.
	Tübingen	Univ.
Japan	Wako	RIKEN
Mexico	Puebla	BUAP
Italy	Turin	UniTo
Poland	Warsaw	UW
Republic of Korea	Seoul	EWU
Romania	Bucharest	ISS
Russia	Moscow	SINP MSU

Ukraine

Irkutsk
Nauchny
St. Petersburg
Moscow, Troitsk
Kiev

NNRU "MEPhI"
ISU
CrAO RAS
KB "Arsenal"
INR RAS
BITP NASU

Investigations of Compressed Baryonic Matter at the GSI Accelerator Complex

Leaders: V.P. Ladygin
V.V. Ivanov
Deputy: P.K. Kurilkin

Participating Countries and International Organizations:

Bulgaria, Czech Republic, Germany, Mongolia, Romania, Russia, Slovakia, Uzbekistan, Ukraine.

Scientific Programme

Expertize of the design of the superconducting dipole magnet, design and development of straw detector prototype for the CBM experiment at the GSI accelerator complex. Study of the multiparticle dynamics in heavy ion collisions at SIS100 and SIS300. Development of algorithms and software for the trigger, simulation and data analysis. Participation in HADES experimental at SIS18 and SIS100.

Expected main results in 2018:

- Expertize and preparation of the drawings of individual parts of the superconducting dipole magnet for the CBM experiment.
- Design and testing of the straw detector prototype.
- Development of the algorithms and software for the trigger and data analysis.
- Simulation of the multiparticle dynamics in heavy ion collisions.
- Development of the mathematical methods and fast computing algorithms for the data analysis and selection of the signal events.
- Participation in experimental data taking using pion, proton and heavy ion beams with HADES at SIS18. Development of the algorithms for data analysis. Further participation in experimental data analysis of dp (1.25 GeV/nucleon) and pp (3.5 GeV). Theoretical interpretation of the obtained data.

List of projects:

Project	Leader	Priority (period of realization)
1. CBM	V.P. Ladygin V.V. Ivanov	1 (2011 – 2020)
2. HADES	V.P. Ladygin	1 (2010 – 2018)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. CBM Project Expertize of the design and manufacture of the superconducting dipole magnet and straw detector prototype. Development of the algorithms and software for trigger, simulation and data analysis	V.P. Ladygin V.V. Ivanov	Realization
VBLHEP	Yu.S. Anisimov, S.N. Kuznetsov, A.I. Malakhov, O.V. Fateev, A.P. Ierusalimov, A.P. Zinchenko, D.V. Peshekhonov, P.A. Rukoyatkin, G.D. Kekelidze, N.B. Ladygina, I.V. Boguslavsky, V.M. Golovatyuk, V.M. Lysan, A.V. Bychkov, Yu.A. Murin, D.V. Dementiev, V.V. Elsha, A.D. Sheremetiev, N.I. Zamyatin, V.O. Sidorenko, A.L. Voronin	
LIT	V.V. Ivanov, P.V. Zrelov, P.G. Akishin, E.P. Akishina, E.I. Alexandrov, I.N. Alexandrov, D.V. Belyakov, O.Yu. Derenovskaya, V.V. Ivanov (jr), P.I. Kisel, G.E. Kozlov, A.V. Kryanev, S.A. Lebedev, A.M. Raportirenko, T.P. Sapozhnikova, I.A. Filozova	
DLNP	V.V. Kirakosyan, Yu.L. Vertogradova, S.P. Avdeev, W. Karch	
BLTP	E.-M. Ilgenfritz, D. Blaschke, V.V. Burov, S.G. Bondarenko, V.D. Toneev	
2. Experiment HADES	V.P. Ladygin	Data taking Data analysis
VBLHEP	A.V. Belyaev, O.V. Fateev, A.P. Ierusalimov, P.K. Kurilkin, A.I. Malakhov, A.Yu. Troyan, A.I. Zinchenko	
LIT	V.V. Ivanov, S.A. Lebedev	
DLNP	G.I. Lykasov	

Collaboration

Country or International Organization	City	Institute or Laboratory
Bulgaria	Sofia	INRNE BAS
Czech Republic	Řež	NPI ASCR
Germany	Darmstadt	GSI
	Dresden	HZDR
	Frankfurt/Main	Univ.
	Giessen	JLU
Mongolia	Heidelberg	Univ.
	Ulaanbaatar	IPT MAS

Romania	Bucharest	IFIN-HH
Russia	Moscow	ITEP
		SINP MSU
		NNRU "MEPhI"
	Moscow, Troitsk	INR RAS
	Protvino	IHEP
Slovakia	Bratislava	IP SAS
		CU
Ukraine	Kiev	BITP NASU
Uzbekistan	Jizakh	JSPI
	Samarkand	SSU

Study of Rare Charged Kaon Decays and Search for Dark Sector in Experiments at the CERN SPS

Leaders: V.D. Kekelidze
Yu.K. Potrebenikov
Deputy: D.V. Peshekhonov

Participating Countries and International Organizations:

Belgium, Bulgaria, CERN, Chile, Czech Republic, Germany, Italy, Mexico, Romania, Russia, Slovakia, Switzerland, United Kingdom, USA.

Scientific Programme

Realization of the NA62 Project allows to clarify CP-violation problem, to measure precisely very rare charged kaon decay to charged pions and two neutrinos, to carry out a search for supersymmetric particles and their partners with a goal to observe a physics beyond the Standard Model. In addition, characteristics of rare kaon and hyperon decays will be improved. A high resolution straw-detectors of the NA62 magnetic spectrometer working in vacuum will be supported during experimental runs. Software for simulation, data processing and analysis will be developed.

The NA64 experiment is a fixed-target experiment at the CERN SPS combining the active beam dump and missing energy techniques to search for rare events. The experiment will build and operate a fully hermetic detector with the primary goal to search for light dark bosons (Z') from dark sector that are coupled to photons, e.g. dark photons (A'), or sub-GeV Z' coupled only to quarks. In some cases the Z' is coupled only to μ or τ , so we call the Z' the dark leptonic gauge boson. The experiment is also capable to search K_L invisible decay, which is complementary to $K + \pi^+ + \nu\nu$, and invisible decays of π^0, η, η', K_S mesons.

Expected main results in 2018:

- Data taking by the NA62 set-up and data analysis will be carried out.
- Software for the simulation of magnetic spectrometer and full set-up will be developed; system for detector calibration and event reconstruction will be upgraded; common software of the experiment will be developed.
- Calibration, testing and support of the NA62 straw detectors will be carried out.
- Tracking detectors for NA64 experiment based on the straw tube technology will be developed and manufactured.
- Data taking by the NA64 set-up and data analysis will be carried out.

List of projects:

Project	Leader	Priority (period of realization)
1. NA62	V.D. Kekelidze Yu.K. Potrebenikov	1 (2010 – 2018)
2. NA64	V.A. Matveev D.V. Peshekhonov	1 (2017 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Experiment NA62	V.D. Kekelidze Yu.K. Potrebenikov	Data taking Data analysis
VBLHEP	D.T. Madigozhin, S. Gevorgyan, N.A. Molokanova, L.N. Glonti, I.A. Polenkevich, S.N. Shkarovsky, M.H. Misheva, E.A. Gudzovsky, V.P. Falaleev, A.A. Belkova, V.N. Gorbunova, L.A. Slepets, S.A. Movchan, T.L. Enik, D. Baygarashev, A.M. Korotkova	
2. Experiment NA64	V.A. Matveev D.V. Pashekhonov	Preparation Data taking Data analysis
VBLHEP	I.V. Boguslavsky, E.V. Vasilieva, I.A. Zhukov, A.V. Zinin, G.D. Kekelidze, V.M. Lysan, S.S. Parzhitsky, V.V. Pavlov, L.N. Tarasova, A.A. Festchenko, V.A. Kramarenko, P.V. Volkov, T.L. Enik	

Collaboration

Country or International Organization	City	Institute or Laboratory
Belgium	Louvain-la-Neuve	UCL
Bulgaria	Sofia	SU
	Blagoevgrad	SWU
	Plovdiv	PU
CERN	Geneva	CERN
Chile	Valparaiso	UTFSM
Czech Republic	Prague	CU
Germany	Mainz	JGU
	Bonn	UniBonn
Italy	Florence	INFN
	Ferrara	INFN
	Frascati	INFN LNF
	Naples	INFN
	Perugia	INFN
	Padua	INFN
	Pisa	INFN
	Rome	INFN
		Univ. "Tor Vergata"
	Turin	INFN
Mexico	San Luis Potosi	UASLP
Romania	Bucharest	IFIN-HH

Russia	Moscow, Troitsk	INR RAS
	Moscow	LPI RAS
	Protvino	IHEP
	Tomsk	TPU
Slovakia	Bratislava	CU
Switzerland	Zurich	ETH
United Kingdom	Birmingham	Univ.
	Bristol	Univ.
	Glasgow	US
	Liverpool	Univ.
USA	Boston, MA	BU
	Fairfax, VA	GMU
	Menlo Park, CA	SLAC
	Merced, CA	UCMerced
	Upton, NY	BNL

CMS. Compact Muon Solenoid at the LHC

Leader: A.V. Zarubin
Scientific leader: I.A. Golutvin

Participating Countries and International Organizations:

Armenia, Austria, Belarus, Belgium, Brazil, Bulgaria, CERN, China, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, India, Iran, Italy, Mexico, New Zealand, Pakistan, Poland, Republic of Korea, Russia, Serbia, Slovakia, Spain, Switzerland, Taiwan, Turkey, Ukraine, United Kingdom, USA, Uzbekistan.

Scientific Programme

The CMS Collaboration has constructed a general-purpose detector to be operational at the start-up of the Large Hadron Collider (LHC/CERN) to exploit its full discovery potential. Study of fundamental properties of the matter in Super High Energy proton-proton and nucleus-nucleus interactions.

The major activities of JINR are focused on the following directions:

- forward calorimetry, including endcap hadron, and preshower detector;
- forward muon stations with cathode strip chambers;
- development of Physics program to test SM and BSM.

Expected main results in 2018:

- Upgrade and technical support of the CMS detectors.
- CMS start up shifts, data taking, and data quality monitoring.
- Processing and analysis of experimental data, development and improvement of muon and jet reconstruction algorithms.
- Development of software for GRID-based distributed system for data processing and analysis. Data transmission from CERN to JINR.

List of projects:

Project	Leader	Priority (period of realization)
1. CMS	A.V. Zarubin I.A. Golutvin	1 (2010 – 2019)
2. Upgrade of the CMS Detector	A.V. Zarubin I.A. Golutvin	1 (2013 – 2018)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Forward calorimetry	A.V. Zarubin	Upgrade Commissioning Maintenance Data taking

VBLHEP	V.Yu. Alexakhin, S.V. Afanasiev, P.D. Bunin, M.G. Gavrilenko, I.A. Golutvin, N.S. Golova, I.N. Gorbunov, Yu.V. Ershov, N.I. Zamyatin, V.D. Kalagin, A.Yu. Kamenev, L.G. Kobylets, A.M. Kurenkov, V.A. Smirnov, A.I. Malakhov, B.S. Yuldashev	
DLNP	A. Mestvirishvili, M. Finger, M. Finger (Jn.), M. Slunečhka, V. Slunečhkova, Z. Tsamalaidze	
LIT	A. Khvedelidze	
2. Forward muon station ME1/1	V.Yu. Karjavin <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>Commissioning Maintenance Data taking</td></tr></table>	Commissioning Maintenance Data taking
Commissioning Maintenance Data taking		
VBLHEP	S.E. Vasiliev, A.O. Golunov, I.A. Golutvin, N.V. Gorbunov, Yu.V. Ershov, N.N. Evdokimov, A.V. Zarubin, A.Yu. Kamenev, A.M. Kurenkov, A.M. Makan'kin, V.V. Perelygin	
LIT	V.V. Palchik, N.N. Voytishin	
3. Upgrade of the CMS detectors	I.A. Golutvin <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>Realization</td></tr></table>	Realization
Realization		
VBLHEP	V.Yu. Alexakhin, S.V. Afanasiev, P.D. Bunin, N.V. Gorbunov, V.Yu. Karjavin, A.M. Kurenkov, Yu.V. Ershov, S.E. Vasiliev, A.V. Zarubin, A.M. Makan'kin, A.I. Malakhov, V.V. Perelygin, V.A. Smirnov, B.S. Yuldashev	
LIT	V.V. Palchik, N.N. Voytishin	
4. Reserch physics programme with the CMS detector	S.V. Shmatov I.A. Golutvin <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>Realization</td></tr></table>	Realization
Realization		
VBLHEP	V.Yu. Alexakhin, S.V. Afanasiev, M.G. Gavrilenko, I.N. Gorbunov, I.I. Belotelov, P.D. Bunin, A.V. Zarubin, I.A. Zhizhin, V.A. Zykunov, A.Yu. Kamenev, L.G. Kobylets, A.V. Lanev, M.V. Savina, A.I. Malakhov, V.V. Shalaev, S.G. Shulga, B.S. Yuldashev	
LIT	V.V. Korenkov, D.A. Oleynik, G.A. Ososkov, V.V. Palchik, A.Sh. Petrosyan, N.N. Voytishin	
BLTP	G.A. Kozlov, A.B. Arbuzov, A.V. Kotikov, A.V. Sidorov, A.V. Efremov, S.G. Bondarenko, R.S. Pasechnik, O.V. Teryaev	
DLNP	G.A. Golovanov, M. Finger, M. Finger (Jr.), N.B. Skachkov, A.N. Skachkova, A.Yu. Verkheev	
5. Development of software for distributed computation, data processing and analysis based on GRID–technology	V.V. Korenkov <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>Realization</td></tr></table>	Realization
Realization		
LIT	A.O. Golunov, V.V. Mitsyn, V.V. Palchik, R.N. Semenov, I.A. Filozova, N.N. Voytishin	
VBLHEP	I.I. Belotelov, I.N. Gorbunov, N.V. Gorbunov, A.O. Golunov, S.V. Shmatov	

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	Foundation ANSL
Austria	Vienna	HEPHY
Belarus	Minsk	INP BSU
	Gomel	BelSUT
		GSU
Belgium	Louvain-la-Neuve	UCL
	Antwerp	UA
	Brussels	ULB
		VUB
	Mons	UMONS
Brazil	Rio de Janeiro, RJ	CBPF
		UERJ
		UFRJ
	Sao Paulo, SP	Unesp
Bulgaria	Sofia	SU
		INRNE BAS
CERN	Geneva	CERN
China	Hefei	USTC
	Beijing	IHEP CAS
		PKU
Croatia	Split	Univ.
Cyprus	Nicosia	UCY
Czech Republic	Prague	CU
Estonia	Tallinn	NICPB
Finland	Helsinki	UH
		HIP
	Jyväskylä	UJ
	Oulu	UO
	Tampere	TUT
France	Annecy-le-Vieux	LAPP
	Lyon	IPNL
	Saclay	IRFU
	Strasbourg	IPHC
Georgia	Tbilisi	HEPI-TSU
		AIP TSU
Germany	Berlin	HUB
	Aachen	RWTH
	Karlsruhe	KIT
Greece	Athens	INP NCSR
		“Demokritos”
		UoA
	Ioannina	UI

Hungary	Budapest	Wigner RCP	
	Debrecen	Atomki	
India	Mumbai	UD	
	Bhubaneswar	BARC	
Iran	Chandigarh	TIFR	
	Tehran	IOP	
Italy	Bari	PU	
	Bologna	IPM	
	Catania	INFN	
	Florence	INFN LNS	
	Genova	INFN	
	Padua	INFN	
	Pavia	INFN	
	Perugia	INFN	
	Pisa	INFN	
	Rome	INFN	
	Turin	INFN	
	Mexico	Mexico	Cinvestav
	New Zealand	Auckland	Univ.
Christchurch		UC	
Pakistan	Islamabad	QAU	
Poland	Warsaw	UW	
	Otwock-Swierk	NCBJ	
Republic of Korea	Kwangju	CNU	
	Naju	DU	
	Namwon	SU	
	Seoul	KU	
		Konkuk Univ.	
		SNUE	
Russia	Chongju	CBNU	
	Moscow	ITEP	
		LPI RAS	
		NNRU "MEPhI"	
		SINP MSU	
		NIKIET	
		INR RAS	
		PNPI	
		MIPT	
		NSU	
		IHEP	
		VNIITF	
		Electron	
		TPU	
		Moscow, Troitsk	
	Gatchina		
	Dolgoprudny		
	Novosibirsk		
	Protvino		
	Snezhinsk		
	St. Petersburg		
	Tomsk		

	Zhukovsky	MDB
Serbia	Belgrade	INS "VINČA"
Slovakia	Bratislava	STU
Spain	Madrid	CIEMAT
		UAM
	Oviedo	UO
	Santander	IFCA
Switzerland	Zurich	ETH
		UZH
	Villigen	PSI
	Basel	Uni Basel
Taiwan	Taipei	NTU
	Chung-Li	NCU
Turkey	Adana	CU
	Ankara	METU
Ukraine	Kharkov	NSC KIPT
		ISC NASU
		KhNU
United Kingdom	London	Imperial College
	Didcot	RAL
	Bristol	Univ.
USA	Ames, IA	ISU
	Baltimore, MD	JHU
	Batavia, IL	Fermilab
	Blacksburg, VA	Virginia Tech
	Boston, MA	BU
		NU
	Cambridge, MA	MIT
	Chicago, IL	UIC
	College Park, MD	UMD
	Columbus, OH	OSU
	Davis, CA	UCDavis
	Gainesville, FL	UF
	Evanston, IL	NU
	Houston, TX	Rice Univ.
	Iowa City, IA	UIowa
	Lincoln, NE	UNL
	Livermore, CA	LLNL
	Los Alamos, NM	LANL
	Los Angeles, CA	UCLA
	Lubbock, TX	TTU
	Madison, WI	UW-Madison
	Minneapolis, MN	U of M
	Notre Dame, IN	ND
	Oxford, MS	UM

Uzbekistan

Pasadena, CA
Pittsburgh, PA
Piscataway, NJ
Princeton, NJ
Riverside, CA
Rochester, NY
Tallahassee, FL
Tuscaloosa, AA
Tashkent

Caltech
CMU
Rutgers
PU
UCR
UR
FSU
UA
INP AS RUz

Studies of the Nucleon and Hadron Structure at CERN

Leader: A.P. Nagaytsev
Deputy: A.V. Guskov

Participating Countries and International Organizations:

CERN, Czech Republic, France, Germany, India, Israel, Italy, Japan, Poland, Portugal, Russia, Taiwan, USA.

Scientific Programme

Studies of the generalized parton distributions in various exclusive processes. Study of the mechanisms of exclusive production of photons, pions and vector mesons in the processes of deep inelastic scattering of muons on nuclei (DIS) and in processes of deep inelastic virtual Compton scattering (DVCS). Measurements of the polarizability of a pion. Study of the structure of nucleons in Drell–Yan processes. Study of inclusive and semi-inclusive processes in DIS reactions of muons and hadrons on polarized targets.

- Measurements of the structure functions of a nucleon, polarized parton distributions of nucleons.
- Measurements of the structure of nucleons in the Drell–Yan processes.
- Study of the mechanisms of exclusive production of photons, pions and ρ -mesons in DIS and DVCS processes.
- Measurement of the polarizability of the pion.
- Creation and development of a set of programs for modeling and data processing. System support for CERN software.
- Preparation of detectors for the COMPASS–II spectrometer.

Expected main results in 2018:

- Results on azimuthal asymmetries with a longitudinally polarized deuterium target.
- Preliminary results on the polarization of the pion from the 2012 data.
- Participation in the data taking.
- Support of the hadron calorimeter HCAL1 and the muon system MW1 during data taking.
- Software development and modeling of various reactions studied on the COMPASS–II spectrometer. Analysis of data in JINR and preparation of publications.
- Theoretical studies on the program COMPASS–I and COMPASS–II.

List of projects:

Project	Leader	Priority (period of realization)
1. COMPASS–II	A.P. Nagaytsev	1 (2011 – 2020)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
I. Experiment COMPASS	A.P. Nagaytsev	Data taking Data analysis
1. Hadron calorimeter	I.A. Savin O.P. Gavrishchuk	Maintenance
VBLHEP	G.V. Meshcheryakov, A.S. Yukaev, V.A. Anosov	
DLNP	A.S. Selyunin	
2. Electromagnetic calorimeter	A.P. Nagaytsev, N.V. Anfimov	Maintenance
VBLHEP	V.V. Astakhov, O.P. Gavrishchuk, G.V. Meshcheryakov, V.A. Anosov, A.P. Nagaytsev	
DLNP	A.I. Antoshkin, V.M. Kudryavtsev, M.V. Nikitin, I.E. Tchirikov–Zorin, T.V. Rezinko, A.V. Rybnikov, D.V. Fedoshev, A.S. Selyunin, A.G. Olshevskiy, O.V. Gromov	
3. Muon system	G.D. Alekseev	Maintenance
DLNP	V.M. Abazov, L.S. Vertogradov, N.I. Zhuravlev, A.A. Piskun, A.G. Samartsev, V.V. Tokmenin, G.A. Golovanov	
4. Polarized target	Yu.F. Kiselev	Maintenance
VBLHEP	Yu.F. Kiselev	
5. System of the data taking	V.N. Frolov	Maintenance
DLNP	V.N. Frolov	
6. Software development. Data analysis	E.V. Zemlyanichkina A.V. Guskov	Realization
VBLHEP	I.A. Savin, D.V. Peshekhonov, G.I. Smirnov, G.V. Meshcheryakov, N.O. Mitrofanov, A.P. Nagaytsev, O.M. Kuznetsov, Yu.I. Ivanshin, N.S. Rogacheva, R.R. Akhunzyanov, R. Gushcherski, A.V. Ivanov, V.S. Batozskaya, E.A. Salmina	
DLNP	A.G. Olshevskiy, N.V. Anfimov, E.O. Mitrofanov, A.F. Gridin, T.V. Rezinko, A.V. Rybnikov, A.S. Selyunin, A.I. Antoshkin, I.A. Denisenko, A.V. Maltsev, A.A. Rymbekova	
LIT	P.V. Zrelov, A.Sh. Petrosyan	
7. Measurements of generalized parton distributions	A.P. Nagaytsev A.V. Guskov I.A. Savin	Realization

VBLHEP	G.V Meshcheryakov, O.M. Kuznetsov, R.R. Akhuzyanov, N.S. Rogacheva, E.V. Zemlyanichkina, V.S. Batozskaya, R. Guscherski, V.D. Peshekhonov, E.A. Salmina, G.I. Smirnov, O.V. Teryaev	
DLNP	A.G. Olshevskiy, I.A. Denisenko, A.V. Maltsev, A.A. Rymbekova	
BLTP	A.V. Efremov	
8. Studies of Drell–Yan processes	A.V. Guskov	Realization
DLNP	A.V. Guskov, I.A. Denisenko, A.V. Maltsev, A.A. Rymbekova, A.O. Gridin, E.O. Mitrofanov	
9. Studies of semi-inclusive reactions	I.A. Savin E.V. Zemlyanichkina	Realization
VBLHEP	N.O. Mitrofanov, Yu.I. Ivanshin, N.S. Rogacheva, E.A. Salmina	
II. Theoretical studies	A.V. Efremov	Realization
BLTP	S.B. Gerasimov, O.V. Teryaev, A.V. Kotikov, A.E. Dorokhov, N.I. Kochelev, A.M. Sidorov	

Collaboration

Country or International Organization	City	Institute or Laboratory
CERN	Geneva	CERN
Czech Republic	Prague	CU
	Brno	BUT
	Liberec	TUL
	Saclay	SPhN CEA
France		DAPNIA
		Univ.
Germany	Bielefeld	RUB
	Bochum	UniBonn
	Bonn	TUBA
	Freiburg	DESY
	Hamburg	TUM
	Munich	JGU
	Mainz	TAU
	Tel Aviv	INFN
Israel	Turin	INFN
Italy	Trieste	MIERE
India	Calcutta	Yamagata Univ.
Japan	Yamagata	WUT
Poland	Warsaw	NCBJ
	Otwock-Swierk	UA
Portugal	Aveiro	LIP
	Lisbon	LPI RAS
Russia	Moscow	

Taiwan	Tomsk	TPU
USA	Protvino	IHEP
	Taipei	AS
	Urbana, IL	I

Strangeness in Hadronic Matter and Study of Inelastic Reactions Near Kinematical Borders

Leaders:

E.A. Stokovsky
E.S. Kokouline
D.O. Krivenkov

Participating Countries and International Organizations:

Belarus, Czech Republic, Japan, Russia, Ukraine.

Scientific Programme

Strangeness in hadronic matter and study of boundary effects:

study of stabilizing effects of strangeness in nuclear matter and properties of the lightest hypernuclei;

study of multi-particle dynamics in inelastic proton-proton and proton-nucleus interactions with extremely high multiplicity;

study of spectra and yields of soft photons in deuteron-nucleus and nucleus-nucleus interactions.

Expected results:

- Experimental conclusion about existence of the hypernucleus ${}^6_{\Lambda}H$.
- New experimental data on properties of the lightest hypernuclei and experimental verification of corresponding theoretical models for such hypernuclei.
- New experimental data about the drip-line location for loosely bound light hypernuclei with high neutron excess. Development of theory of the neutron-rich hypernuclei and models of their production in non-central nucleus-nucleus interactions.
- Comparison of the energy spectra (in the region of several MeV) of protons, emitted in interactions with nuclear targets of various (from deuterons to heavy nuclei) nuclear beams from the Nuclotron and measured at different multiplicity of charged and neutral particles as well as at different emission angles of such photons, with theoretical predictions. Verification of various physical hypotheses about emission of the "direct" photons in nuclei-nuclei interactions.
- Experimental estimation (or determination of upper limit) of cross sections for production of new hypothetical resonances, decaying via 2γ mode.

Expected main results in 2018:

- Analysis of the first experimental data for the hypernucleus ${}^6_{\Lambda}H$ search and measurements of the hyperhydrogen isotopes ${}^6_{\Lambda}H$ and ${}^4_{\Lambda}H$ lifetimes.
- Upgrade of the tracking system of the HyperNIS magnetic spectrometer by installing additional planes of micro-strip detectors.
- Analysis of data from LEPS spectrometer on vector-meson photoproduction by polarized photons.
- Monte-Carlo simulation of performance of the 2-arm electromagnetic calorimeter ("shashlyk"-type, 100 modules) with a pre-shower detector, to be installed in the BM@N setup. Production of the necessary FE-electronics with low gamma-detection threshold ($\sim 5-8$ MeV) for this calorimeter.
- Production of the pre-shower and a movable support for the EM-calorimeter (with 100 modules) for their integration into the BM@N setup. Calibration of the EM modules at low energy beams of electron accelerators (LNP of JINR, INR RAS (Troitsk)).

- Preparation of the experiment NEMAN project aimed on study of photon emission in non-central collisions of relativistic (with kinetic energies above 1 GeV/nucleon) light and heavy nuclei with nuclei at the BM@N setup.

List of projects:

Project	Leader	Priority (period of realization)
1. HyperNIS	E.A. Strokovsky	1 (2010 – 2018)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Experiment NIS–GIBS	E.A. Strokovsky J. Lukstins D.O. Krivenkov	Realization Data taking
VBLHEP	V.D. Aksinenko, R.A. Salmin, A.N. Bayeva, S.N. Bazylev, P.A. Rukoyatkin, A.A. Feschenko, S.N. Plyashkevich, Yu.T. Borzunov, A.I. Maksimchuk, V.B. Chumakov, O.V. Okhrimenko, S.A. Avramenko, M.H. Anikina, A.V. Averiyarov, A.M. Korotkova, N.G. Parfenova, S.V. Gertsenberger, V.B. Dunin, A.V. Konstantinov, A.E. Baskakov, D.V. Dementiev, A.A. Fedyunin, V.T. Matyushin, Yu.A. Murin, A.V. Shipunov, M.O. Shitenkov, A.D. Sheremetiev, A.V. Shutov, N.A. Shutova, V.M. Slepnev, A.L. Voronin	
DLNP	V.V. Tereschenko, S.V. Tereschenko, N.V. Atanov, B.A. Popov	
OCE	A.N. Parfenov	
2. Experiment NEMAN	E.S. Kokoulina V.A. Nikitin	Project preparation Data taking
VBLHEP	V.I. Kireev, V.V. Avdeychikov, V.P. Balandin, I.A. Rufanov, M.V. Tokarev, Yu.P. Petukhov, A.I. Yukaev, N.K. Zhidkov, V.B. Dunin, I.S. Mironov, Yu.T. Borzunov, N.A. Kuzmin, A.V. Konstantinov, V.A. Zykunov, G.S. Pokatashkin, O.P. Gavrischuk, V.A. Nikitin, V.A. Pavlyukevich	
BLTP	Yu.A. Bystritsky	

Collaboration

Country or International Organization	City	Institute or Laboratory
Belarus	Minsk	BSUIR

	Gomel	IAP NASB "Radatech"
Czech Republic	Prague	GSTU
	Řež	GSU
Japan	Osaka	CTU
Russia	Moscow	UJV
		RCNP
		SINP MSU
		NNRU "MEPhI"
		"Azimuth- Photonics"
	Protvino	IHEP
	Syktyvkar	DM Komi SC UrB
Slovakia	Banska Bistrica	RAS
Ukraine	Kiev	UMB
		BITP NASU

Development of the JINR Basic Facility for Generation of Intense Heavy Ion and Polarized Nuclear Beams Aimed at Searching for the Mixed Phase of Nuclear Matter and Investigation of Polarization Phenomena at the Collision Energies up to $\sqrt{S_{NN}} = 11$ GeV

Leaders: V.D. Kekelidze
A.S. Sorin

Deputies: A.D. Kovalenko
I.N. Meshkov

Participating Countries and International Organizations:

Armenia, Azerbaijan, Belarus, Bulgaria, CERN, China, Czech Republic, Egypt, France, Georgia, Germany, Italy, Israel, Japan, Moldova, Poland, Romania, Russia, Slovakia, South Africa, Sweden, Ukraine, USA.

Scientific Programme

Search and investigation of phase transitions in strongly interacting nuclear matter at extremely high baryon densities, study of the nucleon spin structure, of light nuclei and polarization phenomena in few nucleon systems. Development of theoretical models of the studied processes and theoretical support of the experiments. Development of the Nuclotron accelerator complex as a basic facility for studying relativistic nuclear collisions in the range of atomic masses $A = 1-197$. Investigation of reaction dynamics and studying modifications of hadron properties in nuclear matter, near-threshold strange hyperons production and search for hyper nuclei in interactions of the Nuclotron extracted ion beams with fixed targets at the BM@N detector. Investigation of the nuclear structure at short internucleon distances at the BM@N detector. Development and stage-by-stage creation of the NICA heavy ion collider accelerator complex, the multi-purpose detector (MPD/NICA) and spin physics detector (SPD/NICA) for experiments with colliding heavy ions beams. Modernization of extraction beam lines. Carrying out of experiments with ion beams and polarized deuteron beams at the Nuclotron.

Expected main results in 2018:

- Development and extension of the physics programme of the NICA “White Paper” – project. Generation of new theoretical results for processes of strong interactions in the non-perturbative QCD region, development and tests of description models for nuclear matter properties at extremely high temperatures and densities, investigation of possible nuclear matter states and nuclear collision dynamics at extreme baryonic densities as well as observation of these phenomena in P-odd effects and spin asymmetries.
- Completion of the planned tasks within the Nuclotron–NICA project: to continue the optimization of operating models of the KRION-6T heavy ion source, to project and start the creation of the standard KRION-N heavy ion source, to improve the cryogenic and injection complexes. Development of beam diagnostics systems. Increasing the intensity of the beam from the SPI polarized particle source. Investigations with Nuclotron beams for solving first-priority tasks on the accelerator development and for the NICA physics program implementation within running time of 1000 hours. Start of designing the SC resonator prototype for the proton linear accelerator.
- Commissioning the HILAC linear accelerator ($z/A \geq 0.14$), achieving its design parameters. Increasing the intensity of the accelerated Nuclotron beams of polarized protons and deuterons. Completion of mass-production of the superconducting magnets for the NICA booster. Development and construction of new test beds, upgrade of the engineering infrastructure. Assembling and testing the equipment for the beam injector channel from HILAC to the Booster. Assembling and testing the magnet cryostat system of the Booster.
- Production, assembling and testing systems of beam extraction and transporting from the Booster to the Nuclotron.

- Updating the general layout of the NICA complex infrastructure. Correction of the detailed design for the arrangement of NICA elements and systems. Continuation of construction works.
- Experiments with beams at BM@N, taking and analyzing experimental data on interaction of ion beams with fixed targets. Preparation of a technical design project for measurements with additional detectors and increased radiation protection. Data taking within the SRC experiment programme.
- Implementation of the stages of the technical design project of the MPD solenoid. Completion of works within the technical projects of the MPD subsystems. Start of mass-production of detectors.
- Preparation of the SPD conceptual design project for the study of the nuclear spin structure. Submission of the SPD project to the HAC for particle physics. Continuation of theoretical studies of the Matveev–Muradyan–Tavkhelidze–Drell–Yan processes, J/Ψ production processes and other processes in polarized proton and deuteron collisions.
- Implementation of start elements of the NICA/MPD/BM@N/SPD computer infrastructure.

List of projects:

Project	Leader	Priority (period of realization)
1. Nuclotron–NICA	A.V. Butenko G.G. Khodzhbagiyani Scientific leader I.N. Meshkov	1 (2011 – 2020)
2. BM@N	M.N. Kapishin	1 (2012 – 2021)
Subproject SRC Probing Short-Range-Correlations	M.N. Kapishin E. Piasetzky Deputies: O. Hen T. Aumann	1 (2018 – 2021)
3. MPD	V.M. Golovatyuk V.D. Kekelidze A.S. Sorin	1 (2011 – 2020)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1.1. NICA injection complex: technical design preparation and construction of the NICA injection complex: (sources of heavy ions and polarized light nuclei, HILAC linear accelerators of heavy ions and light nuclei, of beam transport to the Nuclotron)	A.V. Butenko A.I. Govorov V.V. Kobets A.D. Kovalenko V.A. Monchinsky	Realization
1.1.a. Commissioning the heavy ion source (KRION–6T)	E.D. Donets E.E. Donets	Realization
1.1.b. Refining the polarized proton and deuteron source (SPI)	V.V. Fimushkin	Realization

<p>1.1.c. Development and construction of the beam injection systems and beam transportation channels. Development of the beam control and diagnostics systems</p>	<p>A.V. Tuzikov V.I. Volkov</p>	<p>Realization</p>
<p>VBLHEP</p>	<p>M.Yu. Averyanov, V.S. Alexandrov, A.V. Alfeev, V.P. Akimov, V.A. Andreev, A.M. Bazanov, A.V. Butenko, E.E. Donets, E.D. Donets, D.E. Donets, A.A. Fateev, V.V. Fimushkin, N.I. Garanzha, A.I. Govorov, B.V. Golovensky, E.V. Gorbachev, A.D. Kovalenko, V.V. Kobets, V.N. Karpinsky, V.V. Kovalev, O.S. Kozlov, S.Yu. Kolesnikov, V.V. Kosukhin, A.G. Kocherov, A.E. Kirichenko, L.V. Kutuzov, N.I. Lebedev, K.A. Levterov, D.A. Lyuosev, A.A. Martynov, S.V. Mikhaylov, V.A. Monchinsky, V.V. Myalkovsky, A.V. Nestrov, R.V. Pivin, D.O. Ponkin, Yu.V. Prokof'ichev, A.Yu. Ramzdorf, D.N. Rassadov, A.S. Romanov, S.V. Romanov, G.S. Sedykh, S.N. Sedykh, V.V. Seleznev, A.I. Sidorov, A.O. Sidorin, A.V. Smirnov, E.M. Syresin, V.S. Shvetsov, K.V. Shevtchenko, I.V. Shirikov, V.B. Shutov, V.V. Tarasov, N.D. Topilin, G.V. Trubnikov, A.V. Tuzikov, Yu.A. Tumanova, V.P. Vadeev, V.I. Volkov, A.A. Voronin</p>	
<p>1.2. Assembling and start-up of the NICA Booster and its technological systems</p>	<p>A.V. Butenko G.G. Khodzhbagiyani I.N. Meshkov E.M. Syresin A.O. Sidorin</p>	<p>Projecting Realization</p>
<p>1.2.a. Magnet cryostat system, vacuum system, system of electron cooling</p>	<p>A.R. Galimov A.V. Smirnov</p>	<p>Realization</p>
<p>1.2.b. Power supply and energy evacuation system</p>	<p>E.V. Ivanov V.N. Karpinsky</p>	<p>Projecting Realization</p>
<p>1.2.c. High frequency system of the Booster</p>	<p>O.I. Brovko</p>	<p>Realization</p>
<p>1.2.d. Diagnostics, injection, beam extraction and transportation systems</p>	<p>A.V. Tuzikov V.I. Volkov</p>	<p>Projecting Realization</p>

VBLHEP

A.S. Averichev, M.Yu. Averiyarov, N.N. Agapov, V.A. Andreev, R.V. Andryukhin, A.V. Alfeev, A.M. Bazanov, V.V. Batin, Yu.T. Borzunov, O.I. Brovko, A.V. Butenko, V.P. Chernyaev, D.E. Donets, V.M. Drobin, A.A. Fateev, A.R. Galimov, E.V. Gorbachev, A.Yu. Grebentsov, E.V. Ivanov, V.A. Isadov, V.N. Karpinsky, I.I. Kalagin, A.E. Kirichenko, G.G. Khodzhbagiyan, O.S. Kozlov, V.V. Kovalev, S.Yu. Kolesnikov, N.G. Kondratiev, A.V. Konstantinov, A.V. Kopchenov, S.A. Kostromin, A.G. Kochurov, A.V. Kudashkin, G.L. Kuznetsov, E.A. Kulikov, O.A. Kunchenko, N.I. Lebedev, I.N. Meshkov, S.V. Mikhaylov, V.A. Mikhaylov, V.V. Myalkovsky, A.V. Nesterov, A.L. Osipenkov, R.V. Pivin, N.V. Pilyar, O.V. Prozorov, S.V. Romanov, P.A. Rukoyatkin, T.V. Rukoyatkina, N.V. Semin, G.S. Sedykh, V.V. Seleznev, A.S. Sergeev, A.O. Sidorin, A.V. Smirnov, A.V. Shabunov, A.A. Shurygin, E.M. Syresin, V.V. Tarasov, N.D. Topilin, G.V. Trubnikov, A.V. Tuzikov, Yu.A. Tumanova, B.V. Vasilishin, V.I. Volkov, L.V. Zinoviev

DLNP

E.V. Akhmanova, V.I. Hilinov, A.G. Kobets, I.N. Meshkov, O.S. Orlov, A.Yu. Rudakov, N.A. Rybakov, L.V. Soboleva, T.A. Stepanova, A.A. Sidorin, S.L. Yakovenko

1.3. Development of the Nuclotron	A.V. Butenko A.O. Sidorin E.M. Syresin	Projecting Realization
1.3.a. Magnet cryostst system, vacuum system	G.G. Khodzhbagiyan A.V. Smirnov	Projecting Realization
1.3.b. Power supply and energy evacuation system	E.V. Ivanov V.N. Karpinsky	Projecting Realization
1.3.c. High frequency system of the Booster	O.I. Brovko	Projecting Realization
1.3.d. Diagnostics, injection, beam extraction and transportation systems	E.V. Gorbachev P.A.Rukoyatkin V.I.Volkov	Projecting Realization

A.S. Averichev, M.Yu. Averiyarov, V.A. Andreev, R.V. Andryukhin, A.V. Alfeev, A.M. Bazanov, V.V. Batin, V.V. Borisov, O.I. Brovko, A.V. Butenko, V.P. Chernyaev, D.E. Donets, E.V. Gorbachev, A.Yu. Grebentsov, E.V. Ivanov, V.A. Isadov, V.N. Karpinsky, A.E. Kirichenko, G.G. Khodzhbagiyani, O.S. Kozlov, V.V. Kovalev, S.Yu. Kolesnikov, N.G. Kondratiev, A.V. Konstantinov, A.V. Kopchenov, S.A. Kostromin, A.G. Kochurov, A.V. Kudashkin, G.L. Kuznetsov, E.A. Kulikov, O.A. Kunchenko, N.I. Lebedev, S.V. Mikhaylov, V.A. Mikhaylov, A.V. Merkuriev, V.V. Myalkovsky, A.V. Nesterov, A.L. Osipenkov, R.V. Pivin, O.V. Prozorov, S.V. Romanov, P.A. Rukoyatkin, N.V. Semin, G.S. Sedykh, V.V. Seleznev, A.S. Sergeev, A.O. Sidorin, A.V. Smirnov, A.A. Shurygin, E.M. Syresin, V.V. Tarasov, G.V. Trubnikov, A.V. Tuzikov, V.B. Vasilishin, V.I. Volkov

<p>1.4. Technical design, R&D of technological systems and construction of the NICA heavy ion collider with an energy of $E_{CM}=4-11$ GeV and an average luminosity of $1 \cdot 10^{27} \text{ cm}^{-2} \text{ c}^{-1}$ and light polarized nuclei with a luminosity of $1 \cdot 10^{27} \text{ cm}^{-2} \text{ c}^{-1}$ (by protons, at $E=27 \text{ T}\Phi\text{B}$)</p>	<p>A.D. Kovalenko S.A. Kostromin I.N. Meshkov E.M. Syresin</p>	<p>Projecting Realization</p>
<p>1.4.a. Magnet cryostat and vacuum systems</p>	<p>A.R. Galimov G.G. Khodzhbagiyani A.V. Smirnov</p>	<p>Realization</p>
<p>1.4.b. Power supply and energy evacuation system</p>	<p>E.V. Ivanov V.N. Karpinsky</p>	<p>Realization</p>
<p>1.4.c. High frequency system of the Booster</p>	<p>O.I. Brovko A.Yu. Grebentsov</p>	<p>Projecting Realization</p>
<p>1.4.d. Beam diagnostics, injection and transportation systems</p>	<p>A.V. Tuzikov V.I. Volkov</p>	<p>Projecting Realization</p>
<p>1.4.e. Beam cooling systems</p>	<p>A.V. Smirnov A.O. Sidorin</p>	<p>Projecting Realization</p>
<p>1.4.f. Systems of proton and deuteron polarization monitoring and control</p>	<p>A.D. Kovalenko</p>	<p>Realization</p>

VBLHEP	<p>A.S. Averichev, N.N. Agapov, V.S. Alexandrov, A.V. Alfeev, V.A. Andreev, R.V. Andryukhin, A.M. Bazanov, V.I. Batin, Ty.T. Borzunov, O.I. Brovko, A.V. Butenko, V.M. Drobin, A.V. Eliseev, A.A. Fateev, A.V. Filippov, A.R. Galimov, V.F. Get'man, E.V. Gorbachev, A.Yu. Grebentsov, Yu.V. Gusakov, E.V. Ivanov, I.I. Kalagin, V.N. Karpinsky, G.G. Khodzhbagiyani, A.E. Kirichenko, O.S. Kozlov, N.G. Kondratiev, A.V. Konstantinov, A.V. Kopchenov, S.A. Kostromin, A.D. Kovalenko, A.V. Kudashkin, G.L. Kuznetsov, E.A. Kulikov, N.I. Lebedev, A.A. Makarov, H. Malinovski, I.N. Meshkov, A.V. Nesterov, A.G. Nikandrov, A.L. Osipenkov, R.V. Pivin, S.V. Romanov, P.A. Rukoyatkin, T.V. Rukoyatkina, N.V. Semin, A.O. Sidorin, A.V. Smirnov, E.M. Syresin, A.N. Scherbakov, V.V. Tarasov, N.D. Topilin, G.V. Trubnikov, Yu.A. Tumanova, A.V. Tuzikov, V.I. Volkov, E.I. Urazakov</p>	
DLNP	<p>E.V. Akhmanova, A.G. Kobets, V.I. Khilinov, I.N. Meshkov, O.S. Orlov, A.Yu. Rydakov, N.A. Rybakov, L.V. Soboleva, T.A. Stepanova, A.A. Sidorin, E.M. Syresin, B.V. Vasilishin, V.I. Volkov, S.L. Yakovenko</p>	
LRB	<p>V.N. Buchnev, G.N. Timoshenko, V.Yu. Schegolev, V.M. Zhabitsky</p>	
1.5. R&D, creation and development of cryogenic systems	<p>N.N. Agapov G.G. Khodzhbagiyani</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Projecting Realization</td> </tr> </table>	Projecting Realization
Projecting Realization		
VBLHEP	<p>N.N. Agapov, A.B. Arefiev, V.I. Batin, N.A. Baldin, M.A. Basheva, D.M. Belov, Yu.T. Borzunov, V.M. Drobin, N.L. Egorova, N.E. Emelyanov, E.Yu. Filippova, I.N. Goncharov, S.P. Gorelikov, E.V. Gromova, S.V. Gudkov, E.Yu. Ivanenko, E.V. Ivanov, G.G. Khodzhbagiyani, M.V. Kondratiev, K.K. Kozlovski, A.V. Konstantinov, V.A. Kosinov, E.A. Kulikov, D.V. Lobanov, H. Malinovski, Yu.A. Mitrofanova, V.V. Orlov, I.M. Petrov, R.V. Peshkov, S.A. Sidorov, S.A. Smirnov, E.I. Vorobiev, O.B. Yarovikova</p>	
2. BM@N project Subproject SRC	<p>M.N. Kapishin E. Piasetzky (Israel, TAU) Deputies: O. Hen (USA, MIT) T. Aumann Germany (TUD)</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Realization</td> </tr> </table>	Realization
Realization		
2.1. Development of the operational area of the setup: increasing the radiation protection, improving detector subsystems and engineering infrastructure	<p>S.Yu. Anisimov M.N. Kapishin S.M. Piyadin</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Realization</td> </tr> </table>	Realization
Realization		

2.2. Construction of the basic detector complex of the BM@N setup

M.N. Kapishin

Realization

2.3. Development of the technological and engineering systems, control systems and test areas of the setup

S.Yu. Anisimov
S.M. Piyadin
N.D. Topilin

Realization

VBLHEP

H.U. Abraamyan, G.S. Averichev, G.N. Agakishiev, S.V. Afanasiev, S.Yu. Anisimov, V.A. Babkin, S.N. Bazylev, V.P. Balandin, A.E. Baskakov, P.N. Batyuk, V. Bekirov, D.N. Bogoslovsky, I.V. Boguslavsky, M.G. Buryakov, D. Dambrowski, A.V. Dmitriev, P.O. Dulov, D.K. Dryablov, B.V. Dubinchik, D.S. Egorov, E.S. Erin, Yu.I. Fedotov, Ya.Fedorishin, I.A. Filippov, O.P. Gavrischuk, P.S. Geraksiev, K.V. Gertsenberger, S.V. Gertsenberger, V.M. Golovatyuk, Z.A. Igamkulov, M.A. Ilieva, M.N. Kapishin, V.Yu. Karzhavin, V.N. Karpinsky, R.R. Kattabekov, V.D. Kekelidze, G.D. Kekelidze, V.I. Kireev, Yu.T. Kiryushin, S.V. Khabarov, A.D. Kovalenko, V.Yu. Kozhin, E.S. Kokoulina, V.I. Kolesnikov, A.O. Kolesnikov, V.G. Krivokhizhin, I.V. Kruglova, A.S. Kuznetsov, N.A. Kuz'min, E.M. Kulish, S.N. Kukhlin, E.A. Ladygin, V.V. Lenivenko, A.N. Livanov, A.G. Litvinenko, S.N. Lobastov, A.M. Makan'kin, A.I. Maksimchuk, A.I. Malakhov, K.Z. Mamatkulov, S.P. Merts, I.I. Migulina, A.N. Morozov, Yu.A. Murin, R.V. Nagdasev, S.N. Nagorny, D.N. Nikitin, V.A. Nikitin, V.F. Peresedov, V.A. Petrov, Yu.N. Petukhov, S.M. Piyadin, Yu.K. Potrebenikov, V.Yu. Rogov, K. Roslon, P.A. Rukoyatkin, M.M. Rummyantsev, A.D. Rustamov, I.A. Rufanov, D.G. Sakulin, S.V. Sergeev, V.O. Sidorenko, V.A. Sitnikov, I.V. Slepnev, V.M. Slepnev, I.P. Slepov, A.S. Sorin, V.N. Spaskov, E.A. Strokovsky, D.A. Suvarieva, B.V. Sukhov, V. Sheynast, R.A. Shindin, A.V. Shutov, V.B. Shytov, A.V. Schipunov, N.A. Tarasov, O.G. Tarasov, A.V. Terletsky, A.A. Timoshenko, V.V. Tikhomirov, N.D. Topilin, I.A. Tyapkin, V.V. Ustinov, V.A. Vasendina, S.E. Vasiliev, N.M. Vladimirova, L.S. Yordanova, V.I. Yurevich, G.A. Yarygin, N.I. Zamyatin, A.I. Zinchenko, E.V. Zubarev

LIT

D.A. Baranov, Zh.Zh. Musul'manbekov, V.V. Pal'chik, N.N. Voytishin

FLNP

E.I. Litvinenko

2.4. Studies of short-range-correlations of nucleons at BM@N (SRC)

M.N. Kapishin
E. Piasetzky
Deputies:
O. Hen
T. Aumann

Realization

o

3. MPD setup

V.M. Golovatyuk
V.D. Kekelidze

R&D Technical proposal

VBLHEP

H.U. Abraamyan, G.S. Averichev, A.V. Averiyarov,
G.N. Agakishiev, T.V. Andreeva, A.B. Anisimov,
V.A. Babkin, A.G. Bazhazhin, S.V. Bazylev,
S.N. Bazylev, V.P. Balandin, A.E. Baskakov, P.N. Batyk,
D.N. Bogoslovsky, M.G. Buryakov, V.V. Chepurinov,
G.A. Cheremukhina, D. Dabrowski, D.V. Dementiev,
A.V. Dmitriev, I.I. Donguzov, Dzh. Drnoyan,
P.O. Dulov, V.B. Dunin, V.V. Elsha, O.V. Fateev,
Ya. Fedorishin, I.A. Filippov, O.P. Gavrischuk,
I.V. Gapienko, P.S. Geraksiev, K.V. Gertsenberger,
V.M. Golovatyuk, Yu.V. Gusakov, A.V. Ivanov,
M.A. Ilieva, A.Yu. Isupov, V.D. Kekelidze, G.D. Kekelidze,
V.A. Kireev, Yu.T. Kiryushin, E.M. Kislov, S.V. Khabarov,
M.A. Kozhin, E.V. Kostyukhov, N.A. Kuz'min,
S.N. Kukhin, A.O. Kolesnikov, A.M. Korotkova,
E.A. Ladygin, F.V. Levchanovsky, A.G. Litvinenko,
V.I. Lobanov, S.N. Lobastov, Yu. Lukstin'sh, V.M. Lysan,
D.T. Madigozhin, A.I. Malakhov, S.P. Merts,
I.I. Migulina, S.A. Movchan, N.A. Molokanova,
A.A. Mudrokh, Yu.A. Murin, V.V. Myalkovsky,
R.V. Nagdasev, S.N. Nagorny, V.A. Nikitin, V.A. Penkin,
V.F. Peresedov, V.A. Petrov, Yu.P. Petukhov, A.V. Pilyar,
A.A. Povtoreyko, Yu.K. Potrebenikov, I.A. Polenkevich,
S.V. Razin, O.V. Rogachevsky, V.Yu. Rogov, K. Roslon,
M.M. Rummyantsev, A.D. Rustamov, A.A. Rybakov,
V.M. Samsonov, T.V. Semchukova, S.V. Sergeev,
V.O. Sidorenko, I.P. Slepov, V.M. Slepnev, I.V. Slepnev,
D.A. Suvarieva, A.I. Shafranovskaya, A.D. Sheremetiev,
M.O. Shitinkov, S.N. Shkarovsky, V.I. Shokin, A.B. Shutov,
N.A. Shutova, A.V. Schipunov, N.A. Tarasov, O.G. Tarasov,
A.V. Terletsy, A.A. Timoshenko, V.V. Tikhomirov,
I.A. Tyapkin, S.Yu. Udovenko, V.A. Vasendina,
S.V. Vereschagin, A.V. Vishnevsky, S.V. Volgin,
A.L. Voronin, V. Voronyuk, Y.M. Vladimirova,
A.I. Yukaev, G.A. Yarygin, L.S. Yordanova, N.K. Zhidkov,
S.A. Zaporozhets, N.A. Zinin, A.I. Zinchenko,
N.I. Zamyatin, V.N. Zryuev, A.N. Zubarev

DLNP

I.N. Meshkov, A.G. Ol'shevsky

LIT

P.G. Akishin, O.Yu. Derenovskaya, V.V. Ivanov, P.I. Kisel',
Zh.Zh. Musul'manbekov, A.M. Raportirenko

**3.1. Design and construction of the
superconducting solenoid and
magnet yoke**

**N.E. Emelyanov
N.D. Topilin**

R&D
Technical proposal

VBLHEP

V.H. Dodokhov, A.A. Efremov, N.E. Emelyanov,
S.G. Gordeev, G.D. Kekelidze, E.M. Kislov, V.I. Lobanov,
Yu.Yu. Lobanov, N.D. Topilin

**3.2. Construction of the detector
complex of the start
configuration of the MPD setup**

**V.M. Golovatyuk
V.D. Kekelidze**

R&D
Technical proposal

**3.3. Design and creation of the data
acquisition and control systems**

**S.V. Bazylev
V.M. Slepnev**

R&D
Technical proposal

<p>VBLHEP</p>	<p>A.E. Baskakov, S.V. Bazylev, V.M. Golovatyuk, V.D. Kekelidze, A.F. Mukhamatnabaev, R.V. Nagdasev, V.Yu. Rogov, S.V. Sergeev, V.M. Slepnev, I.V. Slepnev, A.B. Shutov, N.A. Shutova, A.V. Schipunov</p>
<p>4. Theoretical investigations, calculations and development of models describing nuclear matter properties at high temperatures and compressions, dynamics of high-energy nuclear interactions at extremely high baryonic densities, spin and P-odd effects</p>	<p>D. Blashke A.S. Sorin O.V. Teryaev</p> <div style="border: 1px solid black; width: fit-content; margin-left: 100px; padding: 2px;">Realization</div>
<p>BLTP</p>	<p>D. Blashke, A.V. Efremov, A. Frizen, A.S. Hovorotukhin, S.B. Gerasimov, Ya.N. Klopot, A.G. Oganessian, A. Parvan, M.K. Volkov</p>
<p>LIT</p>	<p>Yu.L. Kalinovskiy, Zh.Zh. Musul'manbekov, E.G. Nikonov</p>
<p>DLNP</p>	<p>G.I. Lykasov</p>
<p>VBLHEP</p>	<p>H. Abraamyan, D.A. Artemenkov, P.N. Batyk, D.K. Dryablov, V.D. Kekelidze, M.A. Kozhin, R. Lednitski, A.G. Litvinenko, A.I. Malakhov, S.G. Reznikov, O.V. Rogachevsky, A.S. Sorin, O.V. Teryaev, V. Voronyuk, V.N. Zhezher</p>
<p>5. Computer infrastructure: on-line and off-line clusters of the distributed computer complex, system of simulation, data transfer and analysis, information and technological computer systems</p>	<p>A.G. Dolbilov Yu.K. Potrebenikov O.V. Rogachevsky</p> <div style="border: 1px solid black; width: fit-content; margin-left: 100px; padding: 2px;">Realization</div>
<p>VBLHEP</p>	<p>V.F. Dydysenko, O.S. Fedoseev, D.G. Mel'nikov, Yu.I. Minaev, S.A. Mityukhin, D.V. Peshekhonov, I.P. Slepov, B.G. Schinov, I.V. Slepnev, S.N. Shkarovskiy, V.L. Svalov</p>
<p>LIT</p>	<p>A.G. Dolbilov, D.V. Kekelidze, V.V. Koren'kov, M.S. Plyashkevich, T.A. Strizh</p>
<p>6. SPD setup: conceptual design project development, international collaboration formation</p>	<p>R. Tsenov</p> <div style="border: 1px solid black; width: fit-content; margin-left: 100px; padding: 2px;">Project preparation</div>
<p>VBLHEP</p>	<p>V.A. Anosov, F.N. Akhmadov, R.R. Akhunzyanov, A.A. Baldin, Yu.I. Ivan'shin, A.V. Ivanov, A.D. Kovalenko, O.M. Kuznetsov, P.K. Kurilkin, V.P. Ladygin, R. Lednitski, A.I. Malakhov, B.R. Marinova, G.V. Mescheryakov, A.P. Nagaytsev, D.V. Peshekhonov, N.S. Rogacheva, I.A. Savin, E.A. Strokovskiy, S.S. Shimanskiy, O.V. Teryaev, N.D. Topilin, R. Tsenov, A.P. Tcheplakov, I.P. Yudin, E.V. Zemlyanichkina, A.I. Zinchenko</p>

DLNP	R. Abramishvili, N.V. Anfimov, M. Finger(junior), M. Finger, A.V. Gus'kov, A.L. Gongadze, I.B. Gongadze, I.A. Orlov, N.B. Skachkov, M. Slunetchka, V. Slunetchkova, G.A. Shelkov, I.E. Tchirikov-Zorin, Yu.I. Uzikov, A. Yanata	
LIT	V.V. Pal'chik, T.A. Strizh	
BLTP	A.V. Efremov, G.A. Kozlov, A.V. Radyushkin, A.V. Sidorov	
7. Construction of the complex of buildings with engineering infrastructure for object placement, engineering systems and carrying out R&D for the NICA complex	N.N. Agapov V.D. Kekelidze N.D. Topilin	Projecting Realization
7.1. Technical designing, coordination of the construction of the building complex and engineering infrastructure development	A.V. Dudarev I.N. Meshkov	Projecting Realization
7.2. R&D, production of prototypes and full-scale superconducting magnets for the NICA booster and collider	G.G. Khodzhbagiyan S.A. Kostromin	Projecting Realization
VBLHEP	N.N. Agapov, V.V. Agapova, A.S. Averichev, V.K. Alexeev, A.M. Bazanov, N.P. Bazylev, V.I. Batin, N.A. Blinov, Yu.T. Borzunov, V.V. Borisov, A.V. Butenko, A.V. Bychkov, S.A. Dolgy, A.M. Donyagin, V.M. Drobin, N.A. Filippov, E.Yu. Filippova, A.R. Galimov, O.M. Golubitsky, Yu.V. Gusakov, E.Yu. Ivanenko, V.N. Karpinsky, R.A. Karpunin, I.E. Karpunina, V.D. Kekelidze, G.G. Khodzhbagiyan, S.Yu. Kolesnikov, A.V. Konstantinov, V.S. Korolev, S.A. Kostromin, A.V. Kudashkin, G.L. Kuznetsov, E.A. Kulikov, O.A. Kunchenko, V.E. Kurinov, V.I. Lipchenko, D.V. Lobanov, A.A. Makarov, H. Malinovski, Yu.A. Mitrofanova, A.Yu. Merkur'ev, A.V. Nesterov, A.L. Osipenkov, L.V. Petrova, R.V. Pivin, D.O. Ponkin, T.F. Prakhova, A.S. Sergeev, A.V. Smirnov, S.A. Smirnov, A.Yu. Starikov, V.N. Surikov, A.V. Shabunov, E.V. Shevtchenko, N.D. Topilin, Yu.A. Tumanova, A.S. Vinogradov, N.A. Zhil'tsova	
7.3. Upgrade and development of electric power and technological nets aimed at the increasing of economics and technical efficiency	N.N. Agapov N.V. Semin	Projecting Realization
VBLHEP	N.N. Agapov, A.V. Alfeev, A.M. Karetnik, A.A. Makarov, M.I. Migulin, N.V. Semin, E.V. Serochkin, V.M. Stepanov, A.N. Sotnikov, A.V. Shabunov, V.Yu. Shilov, O.M. Timoshenko, N.D. Topilin, V.P. Tchernyaev	
AS&CC Office	Yu.N. Balandin, I.S. Frolov, L.I. Tikhomirov	

СГИ

V.N. Buchnev + 2 pers.

ЛРБ

G.N. Timoshenko + 3 pers.

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	YSU
Azerbaijan	Baku	IP ANAS
Belarus	Minsk	INP BSU JIPNR-Sosny NASB SPMRC NASB “Planar” BSUIR PTI NASB
Bulgaria	Sofia	INRNE BAS ISSP BAS TU-Sofia LTD BAS
	Blagoevgrad	SWU
	Plovdiv	PU
CERN	Geneva	CERN
China	Beijing	“Tsinghua”
Czech Republic	Liberec	TUL
	Prague	CU
	Vitkovice	VHM
France	Nantes	SUBATECH
Egypt	Cairo	ECTP
Germany	Darmstadt	GSI TU Darmstadt
	Dresden	ILK
	Giessen	JLU
	Erlangen	FAU
	Frankfurt/Main	Univ. FIAS
	Mainz	JGU
	Regensburg	UR
	Jülich	FZJ
Japan	Nagoya	Nagoya Univ.
Georgia	Tbilisi	AIP TSU GTU
Italy	Turin	INFN
	Brescia	Forgiatura Morandini
	Genova	ASG

Israel	Tel Aviv	TAU
	Jerusalem	HUJI
Moldova	Chişinău	MSU
		IAP ASM
Poland	Chorzow	Franko-Term
	Warsaw	IEL
		WUT
	Wroclaw	ILT&SR PAS
	Lublin	UMCS
	Otwock-Swierk	NCBJ
Romania	Bucharest	INOE2000
		IFIN-HH
		INCDIE ICPE-CA
Russia	Moscow	LPI RAS
		ITEP
		MSU
		Cryogenmash
		Geliymash
		NRC KI
		NNRU "MEPhI"
		IBMP RAS
		INR RAS
	Moscow, Troitsk	BelSU
	Belgorod	PNPI
	Gatchina	PELCOM
	Dubna	Progresstech
		Compressormash
	Kazan	Spetshmash
		BINP SB RAS
	Novosibirsk	IHEP
	Protvino	Neva-Magnet
	St. Petersburg	KRI
		SPbSU
	Syktyvkar	DM Komi SC UrB
		RAS
	Tomsk	NPI TPU
	Fryazino	ISTOK
Slovakia	Bratislava	IMS SAS
	Košice	PJSU
	Žilina	UŽ
South Africa	Cape Town	UCT
	Johannesburg	UJ
		WITS
Sweden	Stockholm	SU
	Uppsala	TSL

Ukraine

Kiev
Kharkov

BITP NASU
KhNU
NSC KIPT
LTU

USA

Batavia, IL
Upton, NY
Stony Brook, NY

Fermilab
BNL
SUNY

Advanced Studies on Systems of New-Generation Accelerators and Colliders for Fundamental and Applied Research

Leader: G.D. Shirkov
Deputy: J.A. Budagov

Participating Countries and International Organizations:

Armenia, Belarus, Bulgaria, CERN, Cuba, Czech Republic, Germany, Georgia, Greece, Italy, Japan, Poland, Russia, Slovakia, South Africa, United Kingdom, Ukraine, USA.

Scientific Programme

JINR participation in international collaborations for the design, creation and improvement of new generation accelerators and colliders by scientific researches and experimental development in the field of particle accelerators physics: design of cryomodules and accelerating structures with superconducting cavities; studies of free electron laser physics, development and construction of diagnostic and accelerator systems applied for ultra short dense bunches in the linear electron accelerators; development and construction of systems applied for formation and diagnostics of ultra short dense bunches in the linear electron accelerators; construction of test facilities for accelerating structures investigation; development and creation of a new generation instrumentation for precision laser metrology of accelerators and detector complexes to increase their luminosity and work parameters. Common investigations in the field of laser-plasma accelerators. On a base of electron linac bench: construction of the stand for calibration of electromagnetic calorimeters and investigations of other detectors and their characteristics; creation of complex for the laboratory and practical trainings of students and PhD students - future engineers from JINR member states.

Expected main results in 2018:

- Injector photogun beam dynamics modeling and optimization. Fabrication and investigation of the “transparent” thin-film. Development, construction and installation of the gun extractor HV (up to 40 kV) power supply control unit. Slit emittance measurement system mounting.
- Optimization of the Linac-200 beam parameters at 200 MeV energy. Modernization of the 3-rd accelerating station cooling system. Beam extraction into atmosphere, optimization of beam parameters for users. Manufacturing of beam parallel transfer system (LNP program) after 2-nd, 3-rd accelerating station. Testing of the waveguide RF switch for VARIAN klystron. Work on reconstruction and modernization of the control and interlock systems.
- Commissioning of Precision Laser Inclometers with nanoradian resolution and their testings in CERN and GGO. Designing and construction of prototype of Absolute Distance Meter with 1 μm resolution for distances of 1–10 m. R&D’s for 150 meter long Laser Fiducial Line with possibility of simultaneous measurements of space coordinates of 6 points on the object controlled with 10 μm precision (the nondestructive control).
- Development of education program on the base on working with real Linac-200 equipment for students and PhD students – future engineers from JINR member states; laboratory and practical trainings at Linac-200 accelerator.
- Investigation of electron beam and FEL physics: investigation of infrared radiation from JINR undulator at FLASH, diagnostic of electron bunches at FLASH by using of microchannel plate detectors operated at wave length of 6–50 nm, experiments with microchannel plate detector at FLASH2, investigation of SASE regime in FLASH2, first experiments on XFEL for SASE1 and SASE2 lines with microchannel

plate detectors operated at wave lengths of 0.05–0.4 nm and 0.4–4.43 nm correspondently, installation of detector microchannel plates in XFEL tunnel for SASE2 line, reconstruction of beam pulse current on basis of this radiation, using, first test experiments with three XFEL, experimental investigations at formation of 3D ellipsoidal shape electron bunches with small emittances in PITZ with new lase sustem.

- Preparation of the proposal of JINR participation in international collaborations on the design study of future high–energy colliders.

List of projects:

Project	Leader	Priority (period of realization)
1. Design, construction and test of prototype elements for New-generation accelerators and colliders for fundamental and applied purposes.	G.D. Shirkov V.V. Kobets	1 (2016 – 2018)
2. The precision laser metrology for accelerators and detector complexes	Yu.A. Budagov M.V. Lyablin	1 (2016 – 2018)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Construction of the photoinjector prototype based on DC accelerating structure integrated into electron gun with the “transmissive” photocathode and laser driver of the picosecond range VBLHEP	N.I. Balalykin M.A. Nozdrin	Technical proposal Realization
2. Electron beam test bench based on the linear accelerator with the energy up to 200 MeV for accelerating structures properties investigations, FEL R&D, semi-conducting structures investigation aimed on new detectors parameters improvement, radiation hardnes of GaAs detectors testing and other applied research VBLHEP	G.D. Shirkov V.V. Kobets M.A. Nozdrin	Technical proposal Realization
DLNP	V.G. Shabratov, A.V. Skrypnik, A.N. Ukhanov, V.F. Minashkin	
UC	A.M. Artikov, J.A. Budagov, Yu.I. Davidov, V.N. Duginov, V.V. Glagolev, E.M. Syresin, M.I. Gostkin, P.I. Smolyansky, S.Yu. Porokhovoy	
	S.Z. Pakulyak, A.S. Zhemchugov	

3. **R&D's on high-precision Laser metrology of the spatial position of the accelerators units including ground motion monitoring for colliders luminosity maintenance**

DLNP

VBLHEP

4. **Construction of the education bench for accelerator, RF and vacuum technics practice at the Linac-200 accelerator, preparation of the corresponding education programs and teaching materials**

UC

5. **Investigation on intense electron beams and FEL. Development and construction of diagnostic and accelerator systems applied for ultra-short dense bunches in the linear electron accelerators**

DLNP

VBLHEP

6. **Preparation of the proposal participation in international collaborations for future high energy colliders**

**Yu.A. Budagov
M.V. Lyablin**

N.S. Azaryan, V.Yu. Batusov, Yu.I. Davidov, D.L. Demin, V.V. Glagolev, V.I. Kolomoets, S.M. Kolomoets, A.A. Pluzhnikov, V.M. Romanov, B.M. Sabirov, A.V. Sazonova, S.N. Studenov, G.T. Torosyan

G.D. Shirkov

**A.S. Zhemchugov
M.A. Nozdrin**

D.S. Belozerov, K.A. Verlamov, K.B. Gikal, D.A. Zlydenny

**E.M. Syresin
O.I. Brovko
M.V. Yurkov**

N.A. Morozov, A.F. Chesnov, D.S. Petrov, V.M. Romanov

A.Yu. Grebentsov, O.A. Myslinskaya

**G.D. Shirkov
A.D. Kovalenko**

Technical proposal
Realization

Technical proposal
Realization

Realization

Project preparation
Realization

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	ANSSP Shirak Technologies
	Garni	GGO
Belarus	Minsk	INP BSU
Bulgaria	Sofia	INRNE BAS
CERN	Geneva	CERN
Cuba	Havana	CEADEN
Czech Republic	Prague	CTU
Germany	Darmstadt	GSI
	Hamburg	DESY
	Heidelberg	MPIK

	Zeuthen	DESY
Georgia	Tbilisi	HEPI-TSU
Greece	Athens	UoA
Italy	Pisa	INFN
	Frascati	INFN LNF
	Genova	INFN
Japan	Tsukuba	KEK
Poland	Krakow	NINP PAS
Russia	Moscow	SSDI
		NNRU “MEPhI”
	Moscow, Troitsk	INR RAS
	Moscow	NNRU “MEPhI”
	Nizhny Novgorod	IAP RAS
	Novosibirsk	BINP SB RAS
	Ryazan	RSU
	Sarov	VNIIEF
Ukraine	Kiev	PEWI NASU
	Kharkov	IERT NASU
United Kingdom	Oxford	JAI
South Africa	Cape Town	iThemba LABS
Slovakia	Bratislava	IEE SAS
USA	Upton, NY	BNL
	Batavia, IL	Fermilab

Study of Polarization Phenomena and Spin Effects at the JINR Nuclotron-M Facility

Leader: A.D. Kovalenko

Deputies: N.M. Piskunov
V.P. Ladygin
M. Finger (Jr.)
R.A. Shindin

Participating Countries and International Organizations:

Bulgaria, CERN, Czech Republic, France, Germany, Japan, Poland, Romania, Russia, Slovakia, Sweden, Switzerland, Ukraine, United Kingdom, USA, Uzbekistan.

Scientific Programme

Methodical support of the experiments at polarized beams of the Nuclotron-M and NICA facilities, including development of polarimetry systems. Measurement of analyzing power for the reaction $p + CH_2$ at polarized proton momentum up to 7.5 GeV/c and polarized neutrons momentum 4.5 GeV/c at the setup ALPOM-2. Measurement of tensor analyzing power and spin correlation in $d \rightarrow p$ reaction in the deuteron core area with the use of polarized 3He target and polarized deuteron beam of the Nuclotron-M. Study of 2N- and 3N-correlations in deuteron-proton elastic scattering and deuteron break-up reactions at the Nuclotron internal target. Works on modernization of Saclay-Argonne-JINR polarized proton target (setup PPT). The analysis of set of the np spin observables at 0° (the total np cross section differences), using polarized targets and quasi-monochromatic relativistic 1.2–3.6 GeV neutron beams. Determination of the forward scattering NN amplitudes over this energy region. Comparison of the obtained data with QCD motivated model calculations. Study of charge-exchange processes in dp -interactions at the setup STRELA. Development of theoretical models for description of the simplest nuclear systems taking into account relativistic effects, meson and quark-gluon components of the internal movement. Theoretical analysis of experimental data obtained at Nuclotron-M. The study of the properties of strongly interacting matter utilizing polarization phenomena in hadron-nucleon and lepton-nucleon interactions, and in the decay of polarized radioactive atomic nuclei. Study of highly excited nuclear matter and collective effects in nuclear media; delta and other nucleonic resonance excitations on protons and nuclei. Preparation of the setup DELTA-LNS and data taking on the light neutral mesons production in polarized nucleons and nucleus interactions.

Expected main results in 2018:

- Works:
 - a) development of low energy proton and deuteron polarimeter within the frames of the program: “Spin Physics Research Infrastructure at the Nuclotron”;
 - b) preparation to the measurements of analyzing power of neutron-CH scattering at polarized neutron momentum from 3 to 5.2 GeV/c.
- Completion of stages of the approved projects and collaborative protocols within the frames of their real financial support, including:
 - a) realization of the projects ALPOM-2 and DSS;
 - b) experiments at the setup ALPOM-2 analysis of the collected data from DELTA-SIGMA setup.
- Participation in the design and construction of BM@N setup in accordance with general plan.
- Participation in the joint scientific programs and experiments, design and test of the new detectors and electronics for the use at SPS LHC, FCC (CERN), RHIC (BNL), TJNAF (Newport News), FAIR (GSI) in accordance with the approved collaborative agreements.

- Continuation of the development of the new methods to calculation of the amplitudes and polarization characteristics of deuteron fragmentation and deuteron elastic scattering on protons and nuclei taking into account FSI and relativistic effects.

List of projects:

Project	Leader	Priority (period of realization)
1. ALPOM-2	N.M. Piskunov	1 (2010 – 2018)
2. DSS	V.P. Ladygin A.I. Malakhov T. Yesaka	1 (2010 – 2018)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Works on the development: of spin physics research infrastructure at the Nuclotron and other facilities	A.D. Kovalenko	Realization
VBLHEP	V.P. Ladygin, S.G. Reznikov, P.K. Kurilkin, S.M. Piyadin, Yu.V. Gurchin, V.V. Glagolev, V.I. Sharov, A.I. Malakhov, A.P. Nagaytsev, A.N. Livanov, R.A. Shindin, V.V. Fimushkin, A.M. Taratin	
BLTP	V.V. Burov, V.K. Lukyanov, A.V. Efremov, O.V. Teryaev	
DLNP	M. Finger, M. Finger (Jr.), Yu.N. Uzikov	
LIT	R.V. Polyakova	
2. ALPOM-2 Project	N.M. Piskunov E. Tomasi-Gustafsson C.F. Perdrisat V. Punjabi	Data taking
VBLHEP	V.V. Glagolev, I.M. Sitnik, A.A. Povtoreyko, Yu.P. Bushuev, D.A. Kirillov, P.A. Rukoyatkin, O.P. Gavrishchuk, S.N. Bazylev, A.D. Kovalenko, R.A. Shindin, A.N. Livanov	
3. DSS Project	A.I. Malakhov V.P. Ladygin T. Yesaka	Preparation Data taking
VBLHEP	S.G. Reznikov, P.K. Kurilkin, S.M. Piyadin, Yu.V. Gurchin, A.A. Terekhin, Yu.-T. Karachuk, A.N. Livanov, A.N. Khrenov, N.B. Ladygina, A.P. Ierusalimov, A.Yu. Isupov	
DLNP	G.I. Lykasov	
4. Modernization of the polarized proton target infrastructure (setup PPT)	N.S. Borisov R.A. Shindin	Preparation Data taking
VBLHEP	R.A. Shindin	

	DLNP	Yu.A. Usov, Yu.A. Plis, N.A. Bazhanov, A.N. Fedorov	
5. Development of the Delta–Sigma program for future experiments at setup BM@N		A.D. Kovalenko V.I. Sharov R.A. Shindin	Data analysis Project preparation
	VBLHEP	E.V. Chernykh, Yu.T. Borzunov, N.A. Kuzmin, I.P. Yudin	
	DLNP	N.S. Borisov, Yu.A. Usov, M. Finger, M. Finger (jr.), E.I. Bunyatova, M. Slunečkka, V. Slunečkova	
	FLNP	S.B. Borzakov, Ts. Panteleev	
	LIT	R.V. Polyakova	
6. Experiments on the program STRELA		N.M. Piskunov	Data taking Data processing
	VBLHEP	V.V. Glagolev, I.M. Sitnik, Yu.P. Bushuev, A.A. Povtoreyko, D.A. Kirillov, S.N. Bazylev	
7. Theoretical calculations of polarized processes		V.V. Burov V.K. Lukyanov	Data analysis
	BLTP	V.V. Burov	
	DLNP	Yu.N. Uzikov	
	VBLHEP	N.B. Ladygina, A.P. Ierusalimov	
8. Spin effects in hadron-nucleon and lepton-nucleon interactions		M. Finger	Data analysis
	DLNP	E.I. Bunyatova, M. Slunečkka, V. Slunečkova, M. Finger (Jr.)	
9. Works on the program DELTA–2 (INR RAS - JINR)		A.B. Kurepin A.N. Livanov	Preparation Data taking
	VBLHEP	S.N. Bazylev, A.P. Ierusalimov, V.P. Ladygin, Yu.S. Anisimov, S.M. Piyadin	

Collaboration

Country or International Organization	City	Institute or Laboratory
Bulgaria	Sofia	UCTM
CERN	Geneva	CERN
Czech Republic	Prague	CU
		CTU
	Brno	ISI ASCR
	Liberec	TUL
	Řež	NPI ASCR
France	Saclay	IRFU
	Orsay	IPN Orsay
Germany	Dresden	TU Dresden
	Bochum	RUB
	Jülich	FZJ

Japan	Tokyo	UT
	Hiroshima	Hiroshima Univ.
	Osaka	RCNP
Poland	Otwock-Swierk	NCBJ
Romania	Bucharest	INC DIE ICPE-CA
Russia	Gatchina	PNPI
	Moscow	LPI RAS
		NRC KI
	Moscow, Troitsk	INR RAS
Slovakia	Bratislava	IP SAS
	Košice	IEP SAS
		PJSU
	Žilina	UŽ
Sweden	Uppsala	TSL
Switzerland	Geneva	UniGe
	Villigen	PSI
Ukraine	Kharkov	NSC KIPT
United Kingdom	Glasgow	U of G
USA	Upton, NY	BNL
	Newport News, VA	JLab
	Norfolk, VA	NSU
	Williamsburg, VA	W&M
Uzbekistan	Tashkent	INP AS RUz
		Assoc. "P.-S." PTI

Research on Relativistic Heavy and Light Ion Physics. Experiments at the Accelerator Complex Nuclotron/NICA at JINR and CERN SPS

Leader: A.I. Malakhov
Deputy: S.V. Afanasiev

Participating Countries and International Organizations:

Armenia, Bulgaria, CERN, China, Czech Republic, France, Germany, Japan, India, Kazakhstan, Mongolia, Poland, Romania, Russia, Slovakia, Sweden, Switzerland, Tajikistan, USA, Uzbekistan.

Scientific Programme

The study of new phenomena in multiple particles productions associated with the manifestation of the quark and gluon degrees of freedom in the interaction of relativistic nuclei. The study of nucleon and nuclear interactions in the VBLHEP accelerator complex, CERN SPS. Energy scan of interactions of nuclei at energies 20–158 GeV/-nucleon and to study their dependence on the atomic number of nuclei. The searching of the critical point on the phase diagram of nuclear matter on the NA61(SPS, CERN). Study of hadron production in hadron–nucleus interactions. The use of obtained data for precision calculations of spectra and fluxes in accelerator neutrino experiments to study neutrino oscillations. The study of cluster structures in light stable and radioactive nuclei in the relativistic dissociation. A study of the multiple fragmentation of heavy nuclei. Experimental and theoretical study of deep subthreshold, cumulative processes, the formation of hadrons and antimatter in the transition energy region. A study of the behaviour of elementary particles, nucleon resonances and nucleon fluctuations in nuclear matter on the spectrometer “SCAN”. preparation of proposals of experiments at the accelerator complex of VBLHEP on the extracted beams of the Nuclotron and NICA Collider. Study of the short range nucleon–nucleo correlations and cluster structure of the nuclei using the beams of ions, polarized protons and deuterons at the internal target of Nuclotron in the framework of DSS and SCAN–3 projects.

Expected main results in 2018:

- The continuation of experiments at the internal target of the Nuclotron. Preparation and execution of the experiments at the extracted beam of the Nuclotron. The development of simulations and processing of experimental data.
- processing and analysis of experimental data obtained at the installation NA61/SHINE (SPS, CERN) for p+p, Be+Be, Ar+Sc, Pb+Pb collisions. preparation and implementation of experimental studies on the relativistic beam of lead nuclei. Study of the formation of anti–nuclei in the Ar+Ca and Xe+La collisions.
- Configure and test three–arms magnetic spectrometer SCAN. The modernization of electronics for data taken. The collection and analysis of experimental data.
- Upgrading the trigger system for the PHASE setup. Analysis of experimental data within the statistical and dynamic models. The preparation of a new project.
- Irradiation of emulsions with secondary beams of radioactive isotope ^{11}C and ^{11}B , ^{10}B , ^{12}C . Irradiation with heavy nuclei. Processing of irradiated emulsions in beams of relativistic nuclei.
- The analysis of data from bubble chambers to search and investigate new phenomena. Extension of the experimental database in the field of relativistic nuclear physics.
- Study of deep subthreshold processes at MARUSYA setup. Development of electromagnetic arm of MARUSYA–FLINT setup. Testing of electromagnetic calorimeter of MARUSYA–FLINT setup. Development, creation and testing of neutron detector.

- Preparation of technical project for the measurement of the luminosity at the Collider NICA.
- Obtainment first results on the structure of short-range nucleon-nucleon correlations in beams of carbon, argon and krypton at the internal target of the Nuclotron.

List of projects:

Project	Leader	Priority (period of realization)
1. NA61	A.I. Malakhov	1 (2012 – 2018)
2. SKAN-3	S.V. Afanasiev	1 (2017 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Experiment NA61/SHINE	A.I. Malakhov G.L. Melkumov	Data taking Preparation Data analysis
VBLHEP	D.A. Artyemenkov, D.K. Dryablov, A.Yu. Isypov, V.I. Kolesnikov, V.A. Kireev	
DLNP	B.A. Popov, S.A. Bunyatov	
2. Experiment BECQUEREL	P.I. Zarubin	Data taking
VBLHEP	V.V. Rusakova, D.A. Artemenkov, V. Bradnova, A.A. Zaytsev, N.K. Kornegrutsa, P.A. Rukoyatkin	
3. Experiment FASA-3	S.P. Avdeev	Preparation Data taking
DLNP	V.V. Kirakosyan, W. Kartch, V.I. Stegaylov	
FLNR	G.V. Mushinsky, O.V. Strekalovsky	
VBLHEP	P.A. Rukoyatkin	
4. Project SCAN-3	S.V. Afanasiev A.I. L'vov	Preparation Data taking Upgrade
VBLHEP	Yu.S. Anisimov, A.A. Baldin, B.V. Dubinchik, V. Bekirov, A.F. Elishev, Z.A. Igamkulov, D.K. Dryablov, L.V. Korniyushina, Yu.F. Krechetov, A.S. Kuznetsov, M. Paraypan, D.G. Sakulin, V.A. Smirnov, E.V. Sukhov, V.V. Ustinov	
5. Search and investigation of new phenomena using information obtained with bubble chambers and their theoretical interpretation. Creation of data base of experimental data and educational programs in the field of relativistic nuclear physics	A.A. Baldin V.V. Glagolev	Data analysis

- VBLHEP
E.G.Baldina, A.V. Belyaev, V.V. Ilyushchenko,
A.Yu. Troyan, A.P. Ierusalimov, S.G. Arakelyan,
O.V. Rogachevsky, S.G. Stetsenko, M. Paraypan
6. **Investigation of deep subthreshold processes, applied and educational programs at MARUSYA set up**
A.A. Baldin
Preparation
Data taking
- VBLHEP
V.A. Arefiev, S.V. Afanasiev, A.V. Belyaev, S.N. Bazylev,
A.I. Berlev, B.N. Guskov, D.K. Dryablov, E.A. Efimova,
I.V. Kudashkin, R.A. Salmin, S.Yu. Starikova, I.V. Slepnev,
S.G. Stetsenko, A.Yu. Troyan, A.V. Feschenko,
S.S. Shimansky, I.P. Yudin, T.V. Shavrina
- BLTP
V.V. Burov, S.G. Bondarenko
7. **Investigation with light and heavy ions for applied research**
A.I. Malakhov
Realization
Preparation
Data taking
- VBLHEP
N.N. Agapov, Yu.S. Anisimov, A.D. Kovalenko,
A.A. Baldin, E.G. Baldina, D.K. Dryablov, M. Paraypan
8. **Upgrade of equipment the station of internal target of the Nuclotron**
S.V.Afanasiev
Upgrade
Data taking
- VBLHEP
Yu.S. Anisimov, B.V. Dubinchik, V. Bekirov, A.F. Elishev,
Z.A. Igamkulov, D.K. Dryablov, A.S. Kuznetsov,
S.N. Kuznetsov, D.G. Sakulin, T.V. Trofimov
9. **Test of the detectors for measurements and control the luminosity at the collider NICA, and detectors for the study of nuclear structure at small internucleon distances**
A.G. Litvinenko
A.B. Kurepin
R&D
Technical proposal
- VBLHEP
I.I. Migulina, V.F. Peresedov, V.I. Shokin, L.S. Zolin, O.P. Gavrischuk, N.A. Kuzmin, E.A. Ladygin, Yu.P. Petukhov,
E.A. Usenko, D.S. Erin, A.I. Yukaev, S.N. Nagorny,
V.P. Balandin
- FLNP
E.I. Litvinenko
10. **Study of the short range nucleon–nucleon correlations at modernized internal target station at Nuclotron**
V.P. Ladygin
Preparation
Data taking
- VBLHEP
A.I. Malakhov, Yu.V. Gurchin, A.Yu. Isupov,
P.K. Kurilkin, N.B. Ladygina, S.G. Reznikov,
Ya.T. Schomenko, A.A. Terekhin, A.V. Tishevsky,
A.N.Khrenov

Collaboration

Country or International Organization

City

Institute or Laboratory

Armenia

Yerevan

Foundation ANSL
YSU

Bulgaria	Sofia	INRNE BAS
CERN	Geneva	CERN
China	Beijing	IHEP CAS
		CIAE
	Wuhan	CCNU
Czech Republic	Prague	IMC ASCR
	Řež	NPI ASCR
France	Orsay	IPN Orsay
Germany	Darmstadt	TU Darmstadt
		GSI
	Dresden	HZDR
	Frankfurt/Main	Univ.
	Giessen	JLU
	Heidelberg	Univ.
	Munich	TUM
	Siegen	Univ.
Japan	Osaka	RCNP
	Tokyo	UT
	Tsukuba	Univ.
India	Jaipur	Univ.
	Mumbai	BARC
Kazakhstan	Almaty	IPT
Mongolia	Ulaanbaatar	IPT MAS
		NEC
Poland	Krakow	NINP PAS
	Lodz	UL
	Otwock-Swierk	NCBJ
	Warsaw	WUT
Romania	Bucharest	UB
		IFIN-HH
		INCDIE ICPE-CA
		ISS
	Constanța	UOC
Russia	Moscow	SINP MSU
		LPI RAS
		ITEP
	Moscow, Troitsk	INR RAS
	Chernogolovka	ISMAN RAS
	Protvino	IHEP
	Smolensk	SSU
	St. Petersburg	FIP
	Sarov	VNIIEF
	Tomsk	TPU
Slovakia	Bratislava	IP SAS
	Košice	PJSU

Sweden	Lund	LU
Switzerland	Villigen	PSI
	Geneva	UniGe
	Zurich	ETH
Tajikistan	Dushanbe	PHTI ASRT
USA	Berkeley, CA	Berkeley Lab
	Iowa City, IA	UIowa
	Norfolk, VA	NSU
	Upton, NY	BNL
	Williamsburg, VA	W&M
Uzbekistan	Tashkent	Assoc.“P.-S.” PTI
	Jizakh	JSPI
	Samarkand	SSU

Investigation of the Properties of Nuclear Matter and Particle Structure at the Collider of Relativistic Nuclei and Polarized Protons

Leaders: R. Lednický
Yu.A. Panebratsev

Participating Countries and International Organizations:

Armenia, Azerbaijan, Bulgaria, Czech Republic, France, Germany, Poland, Russia, Slovakia, USA.

Scientific Programme

Investigation of the properties of nuclear matter with extremely high density and temperature, search for the signs of the quark deconfinement and possible phase transitions at the collisions of heavy nuclei at the energies of the Relativistic Heavy Ion Collider (RHIC). Measurement of spin dependent structure functions of nucleons and nuclei using polarized RHIC beams.

Expected main results in 2018:

- The data on heavy ion and polarized proton–proton and polarized proton nucleus collisions taken in the STAR experiment at RHIC.
- Beam energy measurement of transverse spin asymmetry in polarized pp collisions at energy 510 GeV and study of sign change in Sivers function.
- Measurements of event structure, collective variables, correlation characteristics, femtosopic correlation functions and high P_T processes.
- Measurement of spin depended and gluon structure functions in polarized proton collisions with Al an Au nuclei.
- Participation in JINR–BNL and JINR–CERN joint educational programs.

List of projects:

Project	Leader	Priority (period of realization)
1. STAR	Yu.A. Panebratsev R. Lednický	1 (2010 – 2018)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Participation in the spin physics program in STAR experiment at RHIC VBLHEP	Yu.A. Panebratsev	Data taking Data analysis
	M.V. Tokarev, T.G. Dedovich, A.O. Kechechyan, A.N. Zubarev, V.V. Tikhomirov, V.B. Dunin, V.I. Yurevich, D.N. Bogoslovsky, G.A. Yarygin, A.A. Povtoreyko, V.Yu. Rogov, S.V. Sergeev	

2. **The study of polarized proton collisions with nuclei at 200 GeV**
 VBLHEP
 LIT
 BLTP
- M.V. Tokarev Realization
- V.V. Lyuboshits, T.G. Dedovich, O.V. Teryaev, A.A. Aparin
 Zh.Zh. Musulmanbekov
 A.E. Dorokhov, S.V. Goloskokov
3. **The study of event structure, collective effects, femtoscopic correlations and high pT processes**
 VBLHEP
 LIT
- R. Lednický Realization
 Yu.A. Panebratsev
- P. Filip, M.V. Tokarev, S. Vokal, A.O. Kechechyan, N.Ya. Tchankova-Bnzarova, T.G. Dedovich, I.Zh. Bnzarov, G.S. Averichev, G.N. Agakishiev, A.A. Aparin, O.V. Rogachevsky
 G.A. Ososkov
4. **Participation in the heavy ion program in STAR experiment at RHIC. Beam-energy scan**
 VBLHEP
 LIT
- Yu.A. Panebratsev Data taking
Data processing
Data analysis
- P. Filip, M.V. Tokarev, S. Vokal, A.O. Kechechyan, N.Ya. Tchankova-Bnzarova, T.G. Dedovich, I.Zh. Bnzarov, G.S. Averichev, E.V. Potrebenikova, B.G. Shchinov, G.N. Agakishiev, O.V. Rogachevsky
 V.V. Korenkov, G.A. Ososkov, V.V. Mitsyn
5. **Development of the software and formation of the infrastructure for the STAR data processing at JINR**
 VBLHEP
 LIT
- V.V. Korenkov Realization
 Yu.A. Panebratsev
- E.V. Potrebenikova, A.O. Kechechyan, A.A. Aparin, N.Ya. Tchankova-Bnzarova, G.N. Agakishiev
 N. Balashov, G.A. Ososkov, V.V. Mitsyn, T.A. Strizh
6. **Participation in JINR-BNL and JINR-CERN joint educational programs**
 VBLHEP
 UC
- Yu.A. Panebratsev Realization
 E.V. Potrebenikova
- V.V. Belaga, N.E. Sidorov, K.V. Klygina, P.D. Semchukov, A.V. Shoshin, E.I. Golubeva, N.I. Vorontsova, M.P. Osmachko
 S.Z. Pakulyak, I.A. Smirnova, A.O. Komarova, S.N. Balalykin, O.A. Smirnov

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	Foundation ANSL
Azerbaijan	Baku	IRP ANAS

Bulgaria	Sofia	INRNE BAS SU
Czech Republic	Prague Řež	CU UJV NPI ASCR
France	Nantes	SUBATECH
Germany	Heidelberg	Univ.
Poland	Warsaw	WUT
Russia	Moscow	NNRU "MEPhI"
	Protvino	ITEP
	St. Petersburg	IHEP
Slovakia	Bratislava	SPbSU
	Košice	IP SAS
USA	Berkeley, CA	PJSU
	Bloomington, IN	Berkeley Lab
	Lemont, IL	IU
	Upton, NY	ANL
	New Haven, CT	BNL
	University Park, PA	Yale Univ. Penn State

ALICE. Study of Interactions of Heavy Ion and Proton Beams at the LHC

Leader: A.S. Vodopyanov

Participating Countries and International Organizations:

Armenia, Azerbaijan, Brazil, Bulgaria, CERN, China, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, India, Italy, Netherlands, Norway, Poland, Republic of Korea, Romania, Russia, Slovakia, South Africa, Sweden, Switzerland, Ukraine, United Kingdom, USA.

Scientific Programme

1. Participation in the preparation of ALICE upgrade (Photon spectrometer PHOS, assembly of the setup).
2. Realization of experiments at the LHC.
3. Physics research program at the ALICE detector.
4. Development and upgrade of data analysis computing GRID-ALICE in Russia.

Expected main results in 2018:

- Participation in the R&D for the upgrade of photon spectrometer PHOS.
- Participation in the physics project preparation. Physics simulation of heavy ions and protons interactions at LHC energies.
- Data analysis. Preparation of publications.
- Upgrade, testing and supporting of GRID.

List of projects:

Project	Leader	Priority (period of realization)
1. ALICE	A.S. Vodopyanov	1 (2010 – 2019)
2. R&D for the ALICE Photon Spectrometer	A.S. Vodopyanov	1 (2010 – 2018)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Particle detectors	A.S. Vodopyanov	Realization
VBLHEP	V.I. Astakhov, V.A. Arefiev, V.H. Dodokhov, E.M. Kislov, V.I. Lobanov, P.V. Nomokonov, I.A. Rufanov	
2. Physical process simulation and data analysis	B.V. Batyunya	Realization
VBLHEP	M.Yu. Barabanov, Yu.L. Vertogradova, D.D. Emelyanov, S.S. Grigoryan, L.V. Malinina, V.N. Pozdnyakov, E.P. Rogochaya, A.G. Fedunov, K.P. Mikhaylov, K. Roslon	

DLNP	G.I. Lykasov	
LIT	R.M. Yamaleev	
BLTP	D. Blaschke, A.V. Sidorov	
3. ALICE. Computing in the distributed environment-GRID	A.S. Vodopyanov	Realization
VBLHEP	B.V. Batyunya, A.G. Fedunov, G.G. Stiforov	
LIT	V.V. Mitsyn	
4. Photon Spectrometer PHOS	A.S. Vodopyanov P.V. Nomokonov	Realization
VBLHEP	N.V. Gorbunov, N.A. Kuzmin, Yu.P. Petukhov, S.A. Rufanov	

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	Foundation ANSL
Azerbaijan	Baku	NNRC
Brazil	Porto Alegre, RS	UFRGS
Bulgaria	Sofia	SU
CERN	Geneva	CERN
China	Beijing	CIAE
	Wuhan	CCNU
Croatia	Zagreb	RBI
Czech Republic	Prague	IP ASCR
	Řež	UJV
Denmark	Copenhagen	NBI
Finland	Helsinki	HIP
France	Clermont-Ferrand	LPC
	Lyon	UCBL
	Nantes	SUBATECH
	Orsay	IPN Orsay
	Saclay	IRFU
	Strasbourg	CRN
Germany	Darmstadt	GSI
	Heidelberg	Univ.
	Frankfurt/Main	Univ.
	Marburg	Univ.
	Münster	Univ.
Greece	Athens	UoA
Hungary	Budapest	Wigner RCP
India	Aligarh	AMU
	Bhubaneswar	IOP
	Calcutta	VECC

		SINP
	Chandigarh	PU
	Jammu	Univ.
Italy	Bari	INFN
	Bologna	INFN
	Cagliari	INFN
	Catania	UniCT
	Legnaro	INFN LNL
	Padua	INFN
	Rome	INFN
	Salerno	INFN
	Turin	INFN
	Vercelli	UPO
Mongolia	Ulaanbaatar	IPT MAS
Netherlands	Amsterdam	NIKHEF
	Utrecht	UU
Norway	Bergen	UiB
	Oslo	UiO
Poland	Krakow	NINP PAS
	Warsaw	IEL
		WUT
	Otwock-Swierk	NCBJ
Republic of Korea	Gangneung	GWNU
Romania	Bucharest	ISS
Russia	Gatchina	PNPI
	Moscow	ITEP
		NNRU "MEPhI"
		NRC KI
		SINP MSU
	Moscow, Troitsk	INR RAS
	Novosibirsk	BINP SB RAS
	Protvino	IHEP
	Sarov	VNIIEF
	St. Petersburg	FIP
Slovakia	Bratislava	STU
	Košice	PJSU
South Africa	Cape Town	UCT
Sweden	Lund	LU
Switzerland	Lausanne	EPFL
United Kingdom	Birmingham	Univ.
Ukraine	Kharkov	NSC KIPT
	Kiev	BITP NASU
USA	Columbus, OH	OSU
	Oak Ridge, TN	ORNL

Development and Construction of the Prototype of a Complex for Radiotherapy and Applied Research with Heavy-Ion Beams at the Nuclotron-M

Leaders:

S.I. Tyutyunnikov

Participating Countries and International Organizations:

Armenia, Australia, Belarus, Bulgaria, Czech Republic, Moldova, Mongolia, Poland, Romania, Russia, Slovakia, Ukraine.

Scientific Programme

Investigation of various subcritical setups and using them for energy production and radioactive waste transmutation, research of radiation hardness of materials. The quasi-infinite target (Project E&T&RM)

Expected main results:

- Receiving data about the multiplicities and special distribution of energy-time neutron spectra. Research on massive targets of natural (depleted) uranium and thorium energy production capabilities and processing of radioactive waste, the study of radiation hardness of superconductors by the beams of neutrons and protons.

Expected main results in 2018:

- Installation of a big uranium target on Phazotron in DLNP, beam adjustment on the target.
- Thermocouple device installation and calibration at the massive uranium target "BURAN".
- Pilot operation of the neutron spectrometer on recoil protons on the "BURAN" under irradiation with protons at Phazotron.
- Investigation of neutron leakage from the surface of the massive uranium target by activation method.
- Investigation of impact of high-power laser radiation on the radioactive decay of minor actinides.
- The investigation of radiation detects in high-temperature superconductors under the irradiation with protons with energy $E = 660$ MeV.

List of projects:

Project	Leader	Priority (period of realization)
1. Project E&T&RM Study of deeply subcritical electronuclear systems and possibilities of their application for energy production, transmutation of radioactive waste and research in the field of radiation material science. Part III. Quasi infinite target.	S.I. Tyutyunnikov	1 (2018 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Development of technical specifications for a quasi infinite uranium target, setting in the DLNP to Phazotron VBLHEP DLNP	S.I. Tyutyunnikov A.A. Solnyshkin O.G. Tarasov, I.P. Yudin I. Adam	Realization
2. Development of the technical specifications for the detector system of setup “big uranium target” on the basis of the temperature sensor and silicon photomultipliers VBLHEP DLNP	S.I. Tyutyunnikov A.A. Solnyshkin A.V. Vishnevsky Z. Sadygov A.I. Berlev, A.A. Baldin, I.P. Yudin I. Adam	Realization
3. Design, manufacture of detectors for the measurement of ion energy in the range of $E_e=0.1$ GeV/nucleon on the Nuclotron–M beams VBLHEP	N.I. Zamyatin O.G. Tarasov, S.V. Khabarov, A.I. Shafranovskaya, Yu.S. Kovalev	Realization
4. Upgrade of spectrum–analytical complex for activation measurements. VBLHEP DLNP	V.N. Shalyapin I.P. Yudin M. Paraipan, E.V. Strelalovskaya, I.A. Kryachko V.I. Stegaylov	Realization
5. The study of neutron fields of big uranium target at the Phazotron under the irradiation of proton $E_p=0.66$ GeV VBLHEP DLNP FLNR	S.I. Tyutyunnikov A.A. Solnyshkin G.I. Smirnov M. Paraipan A.I. Berlev, A.A. Baldin, I.P. Yudin, A.V. Vishnesky, T.L. Enik I. Adam, V.I. Stegaylov E.M. Kozulin	Data taking
6. The study of influence of high–power coherent radiation at radioactive decay aktinid Am^{241} VBLHEP	S.N. Sedykh A.K. Kaminsky, I.A. Kryachko	Data taking
7. Production of the monitoring elements for the superconducting systems	Yu.P. Filippov	R&D

Collaboration**Country or International Organization****City****Institute or Laboratory**

Armenia	Yerevan	YSU
Australia	Sydney	Univ.
Belarus	Minsk	INP BSU JIPNR-Sosny NASB INRNE BAS
Bulgaria	Sofia	UJV
Czech Republic	Řež	BUT
	Brno	CTU
	Prague	IAP ASM
Moldova	Chişinău	IPT MAS
Mongolia	Ulaanbaatar	WUT
Poland	Warsaw	NINP PAS
	Krakow	NCBJ
	Otwock-Swierk	BSINP MSU IAS "Omega"
Russia	Dubna	KRI
	St. Petersburg	TPU
	Tomsk	ISS
Romania	Bucharest	UMF
		SOSMT
Slovakia	Bratislava	IP SAS
		CU
Ukraine	Kharkov	NSC KIPT

**Nuclear
Physics
(03)**

Development of the FLNR Accelerator Complex and Experimental Setups (DRIBS-III)

Leaders:

G.G. Gulbekyan

S.N. Dmitriev

Scientific leader:

M.G. Itkis

Yu.Ts. Oganessian

Participating Countries and International Organizations:

Belgium, Bulgaria, CERN, China, Czech Republic, Egypt, France, Germany, Italy, Kazakhstan, Mongolia, Poland, Romania, Russia, Serbia, Slovakia, South Africa, Ukraine, Uzbekistan, USA.

Scientific Programme

The implementation of the DRIBS-III project that includes the upgrade and development of the FLNR cyclotron complex, the expansion of the experimental infrastructure of the laboratory (construction of new physics setups), and the development of the accelerator systems. The project leads to an increase in the operation stability of the accelerators, an increase in the intensity of the ion beams of stable and radioactive nuclides in the energy range from 5 to 100 MeV/nucleon, and an improvement of the quality of the beams with a simultaneous reduction of power consumption. The project aims at significantly improving the efficiency of experiments on the synthesis of superheavy elements and light nuclei at nucleon drip lines and on the study of their properties. Moreover, the programme of experiments with beams of radioactive nuclides is anticipated to be extended.

Main results expected in 2018:

- Commissioning of the Factory of superheavy elements (SHE) consisting of: a new experimental building of the Factory equipped with engineering systems, DC-280 cyclotron systems, and a new gas-filled recoil separator DGFRS-2.
- Extraction of beams of accelerated heavy ions at the SHE Factory. Conducting of first test experiments on synthesis of isotopes of elements 114 (Fl) and 115 (Mc).
- Conducting of first experiments at the new ACCULINNA-2 fragment separator (U-400M cyclotron) using beams of light ions with energies of 30 to 50 MeV/nucleon. Development of the infrastructure of the fragment separator ACCULINNA-2 (RF-kicker, zero degree spectrometer).
- Conducting of experiments with 6-15 MeV/nucleon ion beams at the U-400M cyclotron.
- Implementation of experiments on the synthesis of new isotopes in the region of superheavy elements at the U-400 cyclotron using actinide targets and on the nuclear spectroscopy of heavy ions.
- Development of new methods of beam diagnostics for stable and radioactive nuclides.
- Construction of a new Gas-cell based Laser-ionization Setup (GALS) for on-line separation of reaction products by selective laser ionization.
- Finalization of construction of high-resolution magnetic analyzer MAVR.
- Design of separate nodes of the gas ion catcher and preparation of construction orders.
- Design and construction of a new ECR ion source and hot solid-state catcher with chemical inactive coating of the inner parts of the vacuum chamber of the MASHA separator.

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. Construction of a new FLNR experimental hall FLNR	G.G. Gulbekian B.N. Gikal, V.A. Kostyrev, N.F. Osipov, P.G. Bondarenko, S.L. Bogomolov, A.V. Reshetov, S.V. Pashenko, M.V. Habarov, I.V. Kalagin, N.Yu. Kazarinov, I.A. Ivanenko, V.A. Verevochkin	Preparation
2. Construction of the DC-280 complex FLNR VBLHEP	I.V. Kalagin P.G. Bondarenko, S.L. Bogomolov, A.V. Reshetov, N.F. Osipov, G.N. Ivanov, S.V. Pashenko, M.V. Habarov, V.A. Semin, N.Yu. Kazarinov, I.A. Ivanenko, N.N. Pchelkin A.A. Fateev + 2 pers.	Preparation Data taking
3. Development of the U-400M and U-400R complexes FLNR LIT DLNP VBLHEP	I.V. Kalagin P.G. Bondarenko, S.L. Bogomolov, A.V. Reshetov, N.F. Osipov, G.N. Ivanov, S.V. Pashenko, M.V. Habarov, V.A. Semin, N.Yu. Kazarinov, I.A. Ivanenko, R.E. Vaganov, V.A. Sokolov, N.N. Pchelkin V.V. Korenkov, A.M. Chervyakov, P.G. Akishin, E.A. Airian G.A. Karamysheva, E.V. Samsonov, S.B. Vorozhtsov A.A. Fateev + 2 pers.	Preparation Data taking
4. Development of the ECR ion sources FLNR VBLHEP	S.L. Bogomolov A.A. Efremov, G.N. Ivanov, A.N. Lebedev, V.V. Behterev, N.Yu. Yazvitskiy, V.N. Loginov, V.E. Vironov, A.E. Bondarchenko, K.I. Kuzmenkov E.D. Donets, V.M. Drobin, E.E. Donets, S.A. Kostomin	Preparation
5. Development of the MT-25 microtron FLNR	S.V. Mitrofanov A.G. Belov, Yu.G. Teterev, N.V. Aksenov, S.V. Pashenko, M.V. Habarov, N.F. Osipov, V.A. Semin	Preparation Data taking
6. Development of the fragment separator ACCULINNA-2 FLNR	A.S. Fomichev S.A. Krupko, C.G. Belogurov, A.V. Gorshkov, V.A. Gorshkov, G.M. Ter-Akopian, A.A. Bezbakh, M.S. Golovkov, P.G. Sharov, S.I. Sidorchuk, R.S. Slepnev, G. Kaminsky, V. Chudoba, R. Wolski, E.Yu. Nikolskii	Preparation

7. Design and construction of a pre-separator for radiochemical studies of SHE	A.G. Popeko A.V. Eremin	Preparation
FLNR	O.N. Malyshev, A.I. Svirikhin, Yu.A. Popov	
8. Construction of the gas catcher	A.M. Rodin	Preparation
FLNR	L. Krupa, A.V. Belozerov, A.B. Komarov, A.C. Novoselov, S.A. Yukhimchuk, A.V. Guljaev, A.V. Guljaeva, V.S. Salamatin, S.V. Stepantsov, V.Yu. Vedenev	
9. Construction of the ECR ion source and ion catcher for separator MASHA	A.M. Rodin	Preparation
FLNR	L. Krupa, A.V. Belozerov, A.B. Komarov, A.C. Novoselov, S.A. Yukhimchuk, A.V. Guljaev, A.V. Guljaeva, V.S. Salamatin, S.V. Stepantsov, V.Yu. Vedenev	
10. Development of a new gas-filled separator	V.K. Utyonkov	Preparation Data taking
FLNR	F.Sh. Abdullin, A.A. Voinov, A.M. Zubareva, A.N. Polyakov, R.N. Sagaidak, V.G. Subbotin, A.M. Sukhov, Yu.S. Tsyganov, I.V. Shirokovsky, M.V. Shumeiko, N.D. Kovrijnykh, O.V. Petrushkin, A.S. Sviridchenkov, L. Schlattauer, T.Sh. Mirsaitov, A.N. Zubarev	
11. Development of the project of a separator based on resonance laser ionization	S.G. Zemlyanoy	Preparation
FLNR	V.I. Zhemenik, G.V. Myshinskiy, E.M. Kozulin, K.A. Avvakumov	

Collaboration

Country or International Organization	City	Institute or Laboratory
Belgium	Leuven	KU Leuven
	Louvain-la-Neuve	IBA
Bulgaria	Sofia	INRNE BAS
CERN	Geneva	CERN
China	Lanzhou	IMP CAS
Czech Republic	Prague	VP
		CTU
		CU
	Brno	BUT
	Řež	NPI ASCR
Egypt	Štěnovice	STREICHER
	Al-Minufya	MU
France	Giza	CU
		GANIL
	Caen	

Germany	Vannes Darmstadt Heidelberg	SigmaPhi GSI MPIK
Italy	Catania	INFN LNS
Kazakhstan	Almaty	INP
	Astana	BA INP
Mongolia	Ulaanbaatar	NRC NUM
Poland	Krakow Warsaw	NINP PAS HIL WU IEP WU
Romania	Bucharest	IFIN-HH N&V
Russia	Moscow	HTDC ITT-Group ITEP
	Gatchina	PNPI
	Nizhny Novgorod	IAP RAS
	Novosibirsk	BINP SB RAS
	Sarov	VNIIEF
	St. Petersburg	NIEFA
Serbia	Belgrade	INS "VINČA"
Slovakia	Bratislava	IMS SAS IP SAS
South Africa	Cape Town	iThemba LABS
Ukraine	Kiev	KINR NASU
Uzbekistan	Samarkand	SSU
USA	College Station, TX Livermore, CA Nashville, TN Oak Ridge, TN	Texas A&M LLNL VU ORNL

Synthesis and Properties of Superheavy Elements, Structure of Nuclei at the Limits of Nucleon Stability

Leader: M.G. Itkis
Scientific leader: Yu.Ts. Oganessian

Participating Countries and International Organizations:

Belgium, Bulgaria, CERN, China, Czech Republic, Finland, France, Germany, Egypt, India, Italy, Japan, Kazakhstan, Mongolia, Poland, Romania, Russia, Slovakia, South Africa, Spain, Switzerland, Sweden, Ukraine, United Kingdom, USA, Vietnam.

Scientific Programme

Synthesis and investigation of the properties of nuclei at stability limits. Investigation of the mechanisms of heavy-ion-induced reactions. Study of physical and chemical properties of heavy and superheavy elements.

Main results expected in 2018:

- Conducting of first experiments on the synthesis of SHE isotopes in reactions with ^{50}Ti : $^{244}\text{Pu} + ^{50}\text{Ti}$.
- Search for rare reaction channels with evaporation of charged particles, studies of the decay properties of the Rf and Sg isotopes using the separator SHELS + GABRIELA. Implementation of experiments on measurement of the multiplicity of prompt neutrons from the spontaneous fission of the Rf and Sg isotopes. Preparation of an experiment on the spectroscopy of the ^{288}Mc isotope and the daughter products of its decay.
- Conducting of experiments on the study of chemical properties of element 113. Conducting of experiments on the study of Cn and Fl selenides.
- Measurement of the cross sections of xn channels for complete fusion reactions $^{40}\text{Ar} + ^{144}\text{Sm}$, $^{40}\text{Ar} + ^{164}\text{Er}$, $^{40}\text{Ca} + ^{144}\text{Nd}$, and $^{48}\text{Ca} + ^{142}\text{Nd}$.
- Production and study of the properties of new neutron-rich heavy nuclei in binary multi-nucleon transfer processes, quasi-fission and fast fission. Investigation of the mass-energy distributions of fragments produced in the reactions $^{16,18}\text{O} + ^{232}\text{Th}$, ^{238}U , ^{242}Pu , and $^{48}\text{Ca} + ^{154}\text{Sm}$. Study of the multi-body decays of low-excited heavy nuclei. Study of multicluster decay of heavy and superheavy nuclei. Development of physical setups.
- Investigation of the structure of the exotic nuclei $^{5,7}\text{H}$, ^{11}Be , and ^{23}Si using radioactive beams at the ACCULINNA-1 and ACCULINNA-2 setups.
- Selection of optimal reactions for the production of beams of light nuclei (^{6-8}He , $^{9,11}\text{Li}$, ^8B , and ^{10}C) in the transfer reactions at low energies on the MAVR setup. Selection and application of highly effective sensitive techniques for detection, identification, and measurement of products of interaction of exotic nuclei beams with low intensity ($10^3 - 10^6 \text{ s}^{-1}$). Measurement of the total cross sections of reactions and individual channels (complete fusion, nucleon and cluster transfer reactions) in a wide energy range from 5 to 30 MeV/A.
- Theoretical studies of the mechanisms of heavy-ion-induced reactions.
- Development and update of the network knowledge base on nuclear physics.
- Investigation of shapes and sizes of exotic nuclei employing laser spectroscopy methods.

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. Synthesis of new isotopes of superheavy elements at DGFRS FLNR	V.K. Utyonkov F.Sh. Abdullin, A.A. Voinov, A.M. Zubareva, A.N. Polyakov, R.N. Sagaidak, V.G. Subbotin, A.M. Sukhov, Yu.S. Tsyganov, I.V. Shirokovsky, M.V. Shumeiko, N.D. Kovrijnykh, O.V. Petrushkin, A.S. Sviridchenkov, L. Schlattauer, T.Sh. Mirsaitov, A.N. Zubarev	Data taking
2. α-, β- and γ- spectroscopy of heavy nuclei at the SHELS separator FLNR	A.V. Yeremin O.N. Malyshev, A.I. Svirikhin, I.N. Izosimov, V.I. Chepigin, M.L. Chelnokov, A.V. Isaev, Yu.A. Popov, A.N. Kuznetsov, A.A. Kuznetsova, A.G. Popeko, E.A. Sokol, D.E. Katrasev, V.M. Popov, V.A. Sbitnev, I.A. Belov, M.S. Tezekbaeva	Data taking
3. Chemical properties of superheavy elements FLNR	S.N. Dmitriev N.V. Aksenov, Yu.V. Albin, G.A. Bozhikov, M.G. Voronyuk, G.K. Vostokin, N.S. Gustova, I. Zvara, V.Ya. Lebedev, K.V. Lebedev, A.Sh. Madumarov, A.V. Rykhlyuk, A.V. Sabelnikov, G.Ya. Starodub	Data taking
4. Experiments at the magnetic analyzer of superheavy atoms MASHA FLNR	A.M. Rodin L. Krupa, A.V. Belozerov, E.V. Chernusheva, V.Yu. Vedeneev, A.V. Guljaev, A.V. Guljaeva, D. Kamas, A.B. Komarov, A.S. Novoselov, A. Opihal, A.V. Podshibyakin, V.S. Salamatin, S.V. Stepantsov, S.A. Yukhimchuk	Data taking
5. Study of the processes of fusion-fission, quasi-fission and multi-nucleon transfer reactions. CORSET-DEMON, CORSAR, and MiniFOBOS setups FLNR	M.G. Itkis E.M. Kozulin, Yu.M. Itkis, I.N. Dyatlov, G.N. Knyazheva, N.I. Kozulina, K.V. Novikov, E.O. Savelieva, J.M. Harka, D.V. Kamanin, V.V. Kirokasian I.A. Alexandrova, A.A. Alexandrov, Z.I. Gorya'nova, V.E. Zhuchko, E.A. Kuznetsova, Опихал А., А. Пан, R.N. Попов, Pchelintsev I.V., Yu.V. Pyatkov, Yu.B. Semenov, A.N. Solodov, A.O. Strekalovsky, O.V. Strekalovskiy, Тезекбаева М., I.V. Vorob'ev, O.V. Falomkina	Data taking

<p>6. Study of the structure of exotic nuclei near and beyond the drip-lines at the ACCULINNA and COMBAS fragment separators</p> <p>FLNR</p> <p>BLTP</p>	<p>A.S. Fomichev</p> <p>G.M. Ter-Akopian, M.S. Golovkov, L.V. Grigorenko, A.V. Gorshkov, E.M. Gazeeva, B. Zalewski, N. Carjan, V.A. Gorshkov, S.A. Krupko, A.A. Bezbakh, Yu.L. Parfenova, S.I. Sidorchuk, R.S. Slepnev, G. Kaminsky, V. Chudoba, R. Wolski, P.G. Sharov, S.A. Rimzhanova, S.G. Belogurov, Yu.M. Sereda, A.G. Artukh, A.N. Vorontsov, S.A. Klygin, G.A. Kononenko, D.A. Kislukha, N.I. Tarantin, E. Batchuluun</p> <p>S.N. Ershov, N.B. Shulgina</p>	<table border="1" style="margin: auto;"> <tr> <td>Data taking</td> </tr> </table>	Data taking
Data taking			
<p>7. Investigation of reactions induced by stable and radioactive ion beams leading to the formation of exotic nuclei. Development of MAVR and MULTI setups</p> <p>FLNR</p>	<p>Yu.E. Penionzhkevich</p> <p>D.T. Aznabaev, M.P. Ivanov, S.M. Lukyanov, V.A. Maslov, K.O. Mendibaev, N.K. Skobelev, Yu.G. Sobolev, Z.D. Pokrovskaya, R.V. Revenko, V.I. Smirnov, D.A. Testov</p>	<table border="1" style="margin: auto;"> <tr> <td>Data taking</td> </tr> </table>	Data taking
Data taking			
<p>8. Theoretical studies of nuclear reaction mechanisms</p> <p>FLNR</p>	<p>A.V. Karpov</p> <p>A.S. Denikin, V.V. Samarin, M.A. Naumenko, E.A. Cherepanov, Yu.A. Muzichka, V.A. Rachkov, V.V. Saiko</p>		
<p>9. Development and update of the network knowledge base on nuclear physics</p> <p>FLNR</p> <p>LIT</p>	<p>A.V. Karpov A.S. Denikin</p> <p>V.V. Samarin, V.A. Rachkov, M.A. Naumenko, V.V. Saiko</p> <p>V.V. Korenkov, P.V. Zrelov, E.I. Alexandov</p>	<table border="1" style="margin: auto;"> <tr> <td>Data taking</td> </tr> </table>	Data taking
Data taking			
<p>10. Laser spectroscopy of isotopes</p> <p>FLNR</p>	<p>S.G. Zemlyanoy</p> <p>V.I. Zhemelik, G.V. Myshinskiy, K.A. Avvakumov</p>	<table border="1" style="margin: auto;"> <tr> <td>Data taking</td> </tr> </table>	Data taking
Data taking			

Collaboration

Country or International Organization	City	Institute or Laboratory
Belgium	Brussels	ULB
	Leuven	KU Leuven
Bulgaria	Sofia	INRNE BAS
CERN	Geneva	CERN
China	Lanzhou	IMP CAS
Czech Republic	Prague	CTU

		VP
		UP
	Olomouc	NPI ASCR
	Řež	CU
Egypt	Giza	MU
	Al-Minufya	UJ
Finland	Jyväskylä	GANIL
France	Caen	CSNSM
	Orsay	IPN Orsay
	Saclay	SPhN CEA
	Strasbourg	DAPNIA
		CRN
		IPHC
Germany	Berlin	HZB
	Darmstadt	GSi
	Mainz	JGU
	Tübingen	Univ.
India	New Delhi	IUAC
	Calcutta	VECC
	Manipal	MU
Italy	Catania	INFN LNS
	Legnaro	INFN LNL
	Messina	UniMe
	Naples	Unina
Japan	Wako	RIKEN
	Fukuoka	Kyushu Univ.
Kazakhstan	Almaty	INP
		KazNU
	Astana	ENU
Mongolia	Ulaanbaatar	NRC NUM
Poland	Warsaw	UW
	Krakow	NINP PAS
	Poznan	AMU
Romania	Bucharest	IFIN-HH
Russia	Moscow	IPCE RAS
		MSU
		MUCTR
		NNRU "MEPhI"
		NRC KI
		SINP MSU
	Moscow, Troitsk	INR RAS
	Moscow, Zelenograd	RIMST
	Cheboksary	ChSU
	Dimitrovgrad	SSC RIAR
	Gatchina	PNPI

	Sarov	VNIIEF
	St. Petersburg	IPTI RAS
		KRI
	Voronezh	VSU
Slovakia	Bratislava	CU
		IP SAS
South Africa	Cape Town	iThemba LABS
	Pretoria	Unisa
	Stellenbosch	SU
Spain	Madrid	CSIC
	Huelva	UHU
Switzerland	Villigen	PSI
Sweden	Göteborg	Chalmers
	Lund	LU
Ukraine	Kiev	KINR NASU
United Kingdom	Manchester	UoM
USA	Argonne, IL	ANL
	College Station, TX	Texas A&M
	East Lansing, MI	MSU
	Livermore, CA	LLNL
	Nashville, TN	VU
	Oak Ridge, TN	ORNL
Vietnam	Hanoi	IOP VAST

Non-Accelerator Neutrino Physics and Astrophysics

Leaders:

V.B. Brudanin
A. Kovalik
E.A. Yakushev

Participating Countries and International Organizations:

Armenia, Belgium, Bulgaria, Czech Republic, Finland, France, Germany, Kazakhstan, Mongolia, Poland, Romania, Russia, Slovakia, Ukraine, USA, United Kingdom, Uzbekistan.

Scientific Programme

Search for and investigation of double-neutrino and neutrinoless modes of double beta-decay, clarification of the neutrino nature Majorana or Dirac, absolute neutrino mass scale and hierarchies. Search for the neutrino magnetic moment and dark matter. Investigation of galactic and extragalactic neutrino sources, diffusive neutrino cosmic background, search for exotic particles (monopoles). Application of the neutrino detector for a distant investigation of process inside of the reactor core of Kalinin Nuclear Power Plant. Search for sterile neutrinos. Spectroscopy of nuclei far from stability. Development of new methods for charged and neutral particle detection.

Expected main results in 2018:

- Data taking in the $2\beta0\nu$ -decay measurements of ^{106}Cd , ^{82}Se , ^{150}Nd , ^{76}Ge with the SuperNEMO and GERDA spectrometers.
- Processing of experimental data and determination of $T_{1/2}(2\beta2\nu)$ for ^{48}Ca , ^{96}Zr , ^{130}Te , ^{116}Cd , ^{150}Nd , ^{82}Se and ^{76}Ge .
- Data taking with HPGe-based low-background spectrometer at the Kalinin Nuclear Power Plant. Search for a signal of coherent neutrino scattering on the Germanium nuclei.
- Continuation of data taking in the EDELWEISS experiment with FID800 detectors operating with an energy threshold of 0.5 keV suitable for the low mass WIMP region. In 2018 especial studies of the low-energy background will be performed.
- Research and development of the semiconductor-based detecting systems for the GERDA and MAJORANA experiments. Beginning of data taking in the experiment on the search for the ^{76}Ge $2\beta0\nu$ -decay.
- Data taking and development of the 3-rd and 4-th clusters of the Baikal-GVD telescope (Baikal project).
- Investigation of KLL and KMM Auger electrons in ^{65}Zn , ^{67}Cu , ^{67}Ga and $^{152,154,155}\text{Eu}$ decays.
- Development and testing of new low-threshold (~ 200 eV) HPGe detectors for searching the coherent neutrino scattering, as well as plastic scintillator detectors for their active shielding.
- Testing of certain systems of the DANSS neutrino detector. Data taking in order to search for the sterile neutrino. Data analysis and publication. Development of the industrial reactor monitoring with the DANSS spectrometer.

List of projects:

Project	Leader	Priority (period of realization)
1. SuperNEMO	O.I. Kochetov	1 (2013 – 2018)
2. GEMMA-II	V.B. Brudanin	1 (2010 – 2018)

3. EDELWEISS-II	E.A. Yakushev	1 (2010 – 2018)
4. G&M (GERDA)	K.N. Gusev	1 (2010 – 2018)
5. BAIKAL	I.A. Belolaptikov V.B. Brudanin	1 (2009 – 2018)
6. DANSS	V.B. Brudanin V.G. Egorov	1 (2011 – 2018)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. SuperNEMO Project	O.I. Kochetov	R&D Data taking
DLNP	V.A. Bednyakov, D. Filosofov, V.V. Timkin, V.I. Tretyak, F. Mamedov, I. Shermak, I.I. Kamnev, O.V. Vagina, D. Karaivanov, Yu. Shitov	
BLTP	F. Simkovic	
2. TGV Project	N.I. Rukhadze I. Shtekl	Data taking
DLNP	V.G. Sandukovsky, F. Mamedov, I. Shermak, S.L. Katulina	
BLTP	F. Simkovic	
3. G&M (GERDA-MAJORANA Project)	K.N. Gusev	Preparation Data taking
DLNP	V.G. Sandukovsky, V.B. Brudanin, A.A. Klimenko, A.V. Lubashevsky, D.R. Zinatulina, S.L. Katulina, N.S. Rumyantseva, E.A. Shevchik, I.V. Zhitnikov, I. Shermak	
BLTP	F. Simkovic	
4. GEMMA-II Project	V.B. Brudanin V.G. Egorov	Modernization Data taking
DLNP	D.V. Medvedev, N.S. Rumyantseva, M.V. Fomina, M.V. Shirchenko, A.S. Kuznetsov, D.V. Ponomarev, E.A. Yakushev	
5. EDELWEISS-II Project	E.A. Yakushev	Data taking
DLNP	V.A. Bednyakov, S.V. Rozov, S.V. Fateev, L.L. Perevoshchikov, D.V. Filosofov, A.V. Lubashevsky	
6. BAIKAL Project	I.A. Belolaptikov V.B. Brudanin	Preparation Data taking
DLNP	V.G. Egorov, K.V. Konishev, V.P. Lomov, M.B. Milenin, A.V. Korobchenko, E.N. Pliskovski, A.I. Panfilov, B.A. Shaibonov, M.V. Shirchenko, A.A. Klimenko, I.E. Rozova, A.V. Salamatina, R. Dvornicky, M.M. Kolbin, A.A. Doroshenko, G.B. Safronov, D.P. Petukhov, V. Nazari, K.V. Golubkov, V.D. Rushay	

7. DANSS Project

V.B. Brudanin

V.G. Egorov

Preparation

DLNP

D.R. Zinatulina, E.A. Shevchik, I.V. Zhitnikov,
N.S. Rummyantseva, M.V Fomina, V. Belov, A.S. Kuznetsov,
I.E. Rozova, M.V. Shirchenko

Collaboration

Country or International
Organization

City

Institute or Laboratory

Armenia	Yerevan	YSU Foundation ANSL
Belgium	Leuven	KU Leuven
Bulgaria	Sofia	INRNE BAS
	Plovdiv	PU
Czech Republic	Prague	CTU
	Řež	NPI ASCR
Finland	Jyväskylä	UJ
France	Orsay	CSNSM LAL
	Bordeaux	CENBG
	Caen	UNICAEN
Germany	Heidelberg	MPIK
	Mainz	JGU
Kazakhstan	Almaty	INP
Mongolia	Ulaanbaatar	NRC NUM NEC
Poland	Krakow	NINP PAS AGH-UST
	Lublin	UMCS
	Otwock-Swierk	NCBJ
Romania	Bucharest	IFIN - HH UB
Russia	Moscow, Troitsk	INR RAS
	Gatchina	PNPI
	Voronezh	VSU
	Moscow	NRC KI SC "VNIINM" NNRU "MEPhF" ITEP SINP MSU INTRA RADON
	Sarov	VNIIEF
	St. Petersburg	SPbSU IPTI RAS

	Tomsk	NPI TPU IHCE SB RAS
Slovakia	Bratislava	CU IEE SAS
Ukraine	Kiev	KINR NASU
	Kharkov	ISC NASU
USA	Irvine, CA	UCI
	Austin, TX	UT
United Kingdom	London	UCL
	Manchester	UoM
Uzbekistan	Tashkent	INP AS RUz IAP NUU
	Samarkand	SSU

Improvement of the JINR Phasotron and Design of Cyclotrons for Fundamental and Applied Research

Leaders: G.A. Karamysheva
S.L. Yakovenko

Scientific leader: L.M. Onischenko

Participating Countries and International Organizations:

Belgium, China, Poland, Japan, USA, Uzbekistan.

Scientific Programme

Improvement of the JINR Phasotron and beam channels. Design of the cyclotrons for medical purposes. Development of the cyclotron method for high-current beam acceleration.

Expected main results in 2018:

- Modernization of the automated beam channel control system of JINR Phasotron.
- Participation in the development of the magnets for the beam transport line to the cabin of the eye melanoma therapy.
- Development of the project superconducting cyclotron for SC202 proton therapy. Participation in the development of the cyclotron SC202 for Hefei medical center.
- Construction stage simulations for ProNova K230 superconducting cyclotron for proton therapy. conceptual design of the coupled cyclotron complex for hadron therapy.

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Improvement of the JINR Phasotron and beam channels DLNP	S.L. Yakovenko N.G. Shakun L.M. Onischenko S.B. Vorozhtsov, S.A. Gustov, G.A. Kononenko, N.A. Morozov, I.V. Mirokhin, Yu.A. Polyakov, V.I. Smirnov, E.V. Samsonov, V.M. Romanov, V.A. Utkin	Realization
2. Design and modernization of the cyclotrons for medical purpose DLNP	G.A. Karamysheva N.A. Morozov S.V. Gursky, S.B. Vorozhtsov, S.N. Dolya, O.V. Karamyshev, R.V. Galkin, D.S. Petrov, O.E. Lepkina, O.V. Lomakina, S.G. Shirkov, N.L. Zaplatin, G.G. Kazakova, I.N. Kiyani, V.M. Romanov, E.V. Samsonov, V.G. Sazonov, A.F. Chesnov, I.M. Sedyh	Technical proposal
LIT	I.V. Amirkhanov	

3. Research and development of the superconducting cyclotron for proton therapy for IPP CAS, Hefei, China

G.D. Shirkov

R&D

DLNP

R.V. Galkin, S.V. Gursky, O.V. Karamyshev, I.N. Kiyan, O.E. Lepkina, O.V. Lomakina, V.A. Malinin, N.A. Morozov, V.M. Romanov, E.V. Samsonov, A.F. Chesnov, D.V. Popov, S.G. Shirkov

VBLHEP

A.S. Kostromin

LIT

I.V. Amirhanov, T.V. Karamysheva

4. Development of the cyclotron method for high-current beam acceleration

**L.M. Onischenko
S.B. Vorozhtsov**

Realization

DLNP

A.S. Vorozhtsov, N.L. Zaplatin, E.V. Samsonov, V.L. Smirnov, V.M. Romanov, E.A. Saprykin

Collaboration

Country or International Organization

City

Institute or Laboratory

Belgium

Louvain-la-Neuve

IBA

Japan

Chiba

NIRS

China

Hefei

IPP CAS

Japan

Chiba

NIRS

Poland

Krakow

NINP PAS

USA

Lansing, MI

IONETIX

Uzbekistan

Tashkent

INP AS RUz

Investigations of Neutron Nuclear Interactions and Properties of the Neutron

Leader: V.N. Shvetsov
Deputies: Yu.N. Kopatch
 E.V. Lychagin
 P.V. Sedyshev

Participating Countries and International Organizations:

Albania, Australia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, CERN, China, Croatia, Czech Republic, Egypt, Finland, France, Georgia, Germany, Hungary, India, Italy, Japan, Kazakhstan, Macedonia, Moldova, Mongolia, Norway, Poland, Republic of Korea, Romania, Russia, Serbia, Slovakia, Slovenia, South Africa, Switzerland, Thailand, Turkey, Ukraine, USA, Vietnam.

Scientific Programme

Experimental and theoretical investigation of symmetry breaking effects in reactions with neutrons and fundamental properties of the neutron to test the parameters of the Standard Model and search for “new physics”. Investigation of the properties of excited nuclei, reactions with emission of charged particles, fission physics. Obtaining of relevant data for astrophysics, nuclear power engineering and nuclear waste transmutation problem using neutron- and gamma-induced reactions. Application of neutron physics methods in other fields of science and technology. Development and construction of detectors of neutrons and other ionizing radiation, as well as applied methods in nuclear physics with neutrons. Development of the Intense REsonance Neutron Source (IREN) and the experimental base at the IREN and IBR-2 facilities.

Expected main results in 2018 :

Investigations of violations of fundamental symmetries in neutron-nucleus interactions and related data

- Determination of parameters of T-odd effects in the fission of ^{235}U on a hot neutron source.
- Development of the design of an instrument for measuring the P-odd effect in the reaction $^3\text{He}(n, p)^3\text{H}$.
- Investigation of neutron paramagnetic resonance of the first kind in samples of titanium hydride TiH_2 in the polarized neutron energy range of 0.062-2.3 eV using the KOLKHIDA facility at the IBR-2 reactor.
- Measurement of dependence of multiple neutrons on mass and total kinetic energy of fission fragments in the fission reaction of ^{235}U with thermal neutrons at the IBR-2 reactor.
- Measurement and analysis of angular correlations in the emission of neutrons and light charged particles in the spontaneous fission of ^{252}Cf .
- Measurement of inelastic neutron scattering parameters for light and heavy elements in the framework of the TANGRA project.
- Test measurements of $^3\text{He}(n, p)^3\text{H}$ and $^6\text{Li}(n, \alpha)^3\text{H}$ reactions on beamline 1 of the IREN facility.
- Measurements of (n, α) reaction with Ni-60,61 isotopes for neutron energies $E_n = 4.5\text{-}6.5$ MeV at the accelerators EG-5 in FLNP JINR and EG-4.5 of the Institute of Heavy Ion Physics of Peking University.
- Measurements of angular correlations in $^{14}\text{N}(n, p)$, $^{14}\text{N}(n, \alpha)$ reactions with fast neutrons at the EG-5 accelerator.

Investigation of fundamental properties of the neutron, UCN physics:

- Instrument development work to improve parameters of the GRANIT spectrometer designed for experimental determination of characteristics of resonance transitions between quantum states of neutrons in the gravitational field of the Earth. .
- Determination of characteristics of diamond nanopowder reflectors for targeted extraction of very cold neutrons.
- Construction of a setup to measure the energy dependence of the UCN loss factor in the energy range close to limiting values.
- Preparation of the experiment for observation of neutron quantum tunneling through an oscillating potential structure: quantum calculations, development and testing of the experimental setup.
- Nonstationary quantum experiments with slow neutrons: neutron diffraction by surface ultrasonic waves and reflection from an oscillating mirror.

Applied and methodological research:

- Calibration measurements with a 2D model of a position-sensitive detector with a resolution for X, Y coordinates of no worse than 0.7 mm.
- Manufacturing of the first section of the detector of multiple neutrons based on SNM-14D counters.
- Investigation of thin near-surface layers containing various elements with a depth resolution of about 10 nm using nuclear-physics methods (Elastic Recoil Detection Analysis and Rutherford Backscattering Spectrometry).
- Elemental and isotopic analysis of archaeological samples at the IREN facility using neutron spectroscopy, neutron and gamma activation analyses.
- Comparative analysis of elemental analysis methods using the tagged neutron method, standard neutron sources and other non-destructive methods.
- Carrying out of neutron activation analysis of environmental, geological, biological samples and novel materials at the IBR-2 reactor using the REGATA facility in the framework of the projects supported by grants and programs of JINR Member States and its Associated Members, RFBR and IAEA.
- Construction of a spectrometric system to measure natural and man-made radioactivity for radioecological and materials science research.
- Work on automation of neutron activation analysis in INP (Almaty, Kazakhstan). Training of INP personnel (Almaty, Kazakhstan) on the theoretical foundations of neutron activation analysis and practical application of modern software for obtaining and processing spectrometric data.

Development of the IREN facility

- Providing the neutron beam time of 1000 hours from IREN for physical experiments.
- Installation of the cooling system of the LUE-200 accelerator.

List of projects:

Project	Leader	Priority (period of realization)
1. TANGRA	Yu.N. Kopatch Deputy: V.M. Bystritsky (DLNP)	1 (2014 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
<p>1. Investigations of violations of fundamental symmetries in neutron-nucleus interactions and related data</p> <p>FLNP</p>	<p>Yu.N. Kopatch</p> <p>G.S. Ahmedov, N.V. Bazjazjina, S.B. Borzakov, D. Berikov, B. Buadze, Van Dunmin, Vu Dyk Kong, G.V. Daniljan, Yu.M. Gledenov, D.N. Grozdanov, N.A. Gundorin, Sh.S. Zeynalov, A.P. Kobzev, M. Kulik, Zh.V. Mezentseva, Nguyen Thi Bao Mi, V.V. Novitsky, I.A. Oprea, K.D. Oprea, Yu.N. Pokotilovskij, A.B. Popov, I.N. Ruskov, S.F. Samadov, P.V. Sedyshev, M.V. Sedysheva, O.V. Sidorova, V.R. Skoj, A.M. Suhovoj, S.A. Telezhnikov, M. Tsulaja, Chan Van Fuk, I.I. Chuprakov, S. Enkbold + 20 engineers, + 3 workers</p>	<p>Upgrade Data taking Data analysis</p>
<p>2. Investigation of the fundamental properties of the neutron, UCN physics</p> <p>FLNP</p>	<p>E.V. Lychagin</p> <p>G.G. Bunatyan, T.L. Enik, S.V. Gorunov, V.K. Ignatovich, G.V. Kulin, L.V. Mitsyna, A.Yu. Muzychka, A. Nesipbai, Yu.N. Pokotilovskij, A.V. Strelkov, A.I. Frank, W.I. Furman, E.I. Sharapov, K.N. Zhernenkov + 3 engineer + 2 workers</p>	<p>Upgrade Data taking Data analysis</p>
<p>3. Applied research</p> <p>FLNP</p>	<p>P.V. Sedyshev</p> <p>M.V. Frontasyeva, S.S. Pavlov, Yu.V. Alekseenok, A.S. Vasilev, K.N. Vergel, E. Vieru, L. Gaidoshikova, V.M.B. Ged, O.G. Dului, Van Dunmin, D.N. Grozdanov, I.I. Zinikovskaja, O.A. Culikov, A.Madadzade, P.S. Nekhoroshkov, O. Chiligava, P. Yanchik, G.Y. Khristozova, G.S. Ahmedov, B. Buadze, N.V. Bazjazjina, S.B. Borzakov, D. Berikov, Vu Dyk Kong, Yu.M. Gledenov, N.A. Gundorin, Sh.S. Zeynalov, A.P. Kobzev, M. Kulik, D. Mahajdik, Nguyen Thi Bao Mi, Zh.V. Mezentseva, V.V. Novitsky, I.A. Oprea, K.D. Oprea, Yu.N. Pokotilovskij, A.B. Popov, I.N. Ruskov, B.D. Rumyantsev, S.F. Samadov, M.V. Sedysheva, O.V. Sidorova, V.R. Skoj, A.M. Suhovoj, S.A. Telezhnikov, W.I.Furman, M. Tsulaja, I. Chuprakov, S. Enkbold, V.N. Shvetsov, G.G. Bunatyan, S.V. Goryunov, T.L. Enik, K.N. Zhernenkov, V.K. Ignatovich, G.V. Kulin, L.V. Mitsyna, A.Yu. Muzychka, A. Nesipbai, Yu.N. Pokotilovskij, A.V. Strelkov, A.I. Frank, W.I. Furman, E.I. Sharapov, G.V. Daniljan, Chan Van Fuk + 31 engineers, + 9 workers</p>	<p>Upgrade Data taking Data analysis</p>

4. Development of the IREN facility	V.N. Shvetsov	Upgrade
FLNP	V.G. Pjataev, V.V. Kobets, V.G. Shabratov + 16 engineers + 1 worker	
VBLHEP A.P. Sumbaev	V.F. Minashkin, V.N. Zamrij + 5 engineers	
DLNP	I.N. Meshkov	

5. Project TANGRA	Yu.N. Kopatch	Upgrade Data taking Data analysis
FLNP	S.B. Borzakov, N.A. Gundorin, P.A. Dubasov, Sh.S. Zeinalov, A.O. Zontikov, I.A. Oprea, K.D. Oprea, A.V. Rogachev, P.V. Sedyshev, V.R. Skoi, V.N. Shvetsov	
VBLHEP	U.Yu. Aleksakhin, N.I. Zamjatin, E.V. Zubarev, V.L. Rapackii, Yu.N. Rogov, R.A. Salmin, M.G. Sapozhnikov, V.M. Slepnev, S.V. Khabarov	
DLNP	V.M. Bystritskii, A.V. Krasnoperov, A.B. Sadovskii, A.V. Salamatin	
LRB	A.R. Krylov, G.N. Timoshenko	

Collaboration

Country or International Organization	City	Institute or Laboratory
Albania	Tirana	UT
Armenia	Yerevan	CENS NAS RA
Australia	Melbourne	Univ.
Austria	Vienna	IAEA
	Innsbruck	Univ.
Azerbaijan	Baku	BSU
	Ganja	ASAU
		ATU
Belarus	Minsk	INP BSU
Belgium	Geel	IRMM
Bulgaria	Sofia	INRNE BAS
	Plovdiv	PU
		UFT
CERN	Geneva	CERN
China	Beijing	IHEP CAS
Croatia	Zagreb	Oikon IAE
		RBI
Czech Republic	Prague	CEI
		CTU
	Ostrava	VSB-TUO
Egypt	Cairo	EAEA
	Alexandria	Univ.

Finland	Shibin al Kawm	MU
	Jyväskylä	UJ
	Oulu	UO
France	Cadarache	CC CEA
	Grenoble	ILL
		LPSC
	Saclay	LLB
	Strasbourg	IPHC
Georgia	Tbilisi	AIP TSU
		TSU
Germany	Darmstadt	TU Darmstadt
	Dresden	HZDR
	Mainz	JGU
	Munich	TUM
	Tübingen	Univ.
		RKK OU
Hungary	Budapest	
India	Varanasi	BHU
Italy	Rome	ENEA
Japan	Kyoto	KSU
	Tsukuba	KEK
		INP
Kazakhstan	Almaty	ENU
	Astana	TRCE
	Ust-Kamenogorsk	UKiM
		IMB ASM
Macedonia	Skopje	
Moldova	Chişinău	CGL
Mongolia	Ulaanbaatar	NUM
Norway	Trondheim	NTNU
Poland	Krakow	NINP PAS
	Gdansk	GUT
	Lodz	UL
	Lublin	UMCS
	Opole	UO
	Otwock-Swierk	NCBJ
	Poznan	AMU
	Wroclaw	UW
		Dawonsys
		KAERI
		PAL
		IFIN-HH
		INCDIE ICPE-CA
Romania	Bucharest	ISS
		UB
	Baia Mare	TUCN-NUCBM
	Constanța	NIMRD

		UOC
		UG
		UAIC
		UO
		SCN
		I.C.S.I.
		UVT
Russia	Galați	Atomenergomach
	Iași	GIN RAS
	Oradea	GPI RAS
	Pitești	IKI RAS
	Râmnicu Vâlcea	IPCE RAS
	Târgoviște	ITEP
	Moscow	MSU
		NRC KI
		SINP MSU
		VNIIA
	Moscow, Troitsk	INR RAS
	Borok	IBIW RAS
	Dubna	Diamant
		Dubna Univ.
	Gatchina	PNPI
	Irkutsk	LI SB RAS
	Ivanovo	ISUCT
	Izhevsk	UdSU
	Obninsk	IPPE
	Snezhinsk	VNIITF
	St. Petersburg	Botanic Garden
		BIN RAS
		FIP
		Hermitage
		KRI
		SPSFTU
	Sevastopol	IBSS
	Tula	TSPU
	Voronezh	VSU
Serbia	Yekaterinburg	UrFU
	Belgrade	IPB
		Univ.
	Novi Sad	UNS
Slovakia	Bratislava	CU
		IP SAS
		IEE SAS
		ILE SAS
Slovenia	Ljubljana	GeoSS

South Africa	Pretoria	Unisa
	Stellenbosch	SU
Switzerland	Villigen	PSI
Thailand	Hat Yai	PSU
Turkey	Çanakkale	ÇOMU
Ukraine	Kiev	KINR NASU
		NUK
	Kharkov	ISMA NASU
		NSC KIPT
	Donetsk	DonIPE
	Sumy	IAP NASU
	Uzhgorod	IEP NASU
Vietnam	Hanoi	IOP VAST
		VNU
USA	Durham, NC	Duke
	Gettysburg, PA	GC
	Kingston, RI	URI
	Los Alamos, NM	LANL
	Oak Ridge, TN	ORNL

Condensed
Matter Physics,
Radiation
and Radiobiological
Research
(04)

Investigations of Condensed Matter by Modern Neutron Scattering Methods

Leaders:

D.P. Kozlenko
V.L. Aksenov
A.M. Balagurov

Participating Countries and International Organizations:

Argentina, Azerbaijan, Belarus, Bulgaria, Czech Republic, Egypt, France, Germany, Hungary, India, Italy, Japan, Kazakhstan, Latvia, Moldova, Mongolia, Norway, Poland, Romania, Russia, Serbia, Slovakia, Spain, South Africa, Switzerland, Taiwan, Tajikistan, Ukraine, United Kingdom, Uzbekistan, Vietnam.

Scientific Programme

Investigations of structure, dynamics and microscopic properties of novel materials and nanosystems, interesting for fundamental research in the fields of condensed matter physics, chemistry, materials science, geophysics, and important for the development of nanotechnologies in the field of electronics, pharmacology, medicine by neutron scattering and complimentary methods.

Expected main results in 2018:**Realization of scientific program:**

- Determination of parameters of atomic and magnetic structure of bulk and nanostructured functional materials demonstrating interesting physical phenomena and being promising for technological applications in a wide range of thermodynamic parameters; exploration of the role of cluster aggregation in the formation of physical properties.
- Determination of characteristics of atomic and magnetic structure of nanostructured manganites and spinels.
- Determination of the influence of electrode microstructure on charging/discharging processes in compact power sources.
- Operando analysis of the processes of deposition of electrically active ions from liquid electrolytes on electrochemical interfaces.
- Revealing of proximity effects in magnetic layered nanostructures and analysis of magnetic properties in time-independent and -dependent magnetic fields.
- Determination of the structural stability of colloid systems, including medical and biological solvents, in bulk and at interfaces.
- Determination of structural characteristics of nanosystems based on compositional C- and Si-containing materials, including fullerenes, nanodiamonds and their bioactive derivatives.
- Determination of structural characteristics of magnetic elastomers and carbosilane dendrimers holding promise for technological applications.
- Determination of atomic structure and vibrational spectra of molecular complexes: ionic-molecular inclusive materials and complexes with electric charge transfer, structural and dynamical parameters of hydrogen bonding in bioactive materials.
- Clarification of molecular mechanisms of protein interactions, dimerization and functional characteristics of supramolecular structures and complexes.

- Determination of structural characteristics of lipid nanosystems in order to study the transport of pharmaceutical drugs through the skin.
- Analysis of metamorphic, geodynamic and evolution processes in the lithosphere using data on the texture of deep and near-surface earth rocks. Exploration of seismic anisotropy origin.
- Determination of residual stresses and microdeformations in industrial products and modern constructional materials, induced by various technological processes (metallic and thermic treatment, welding, etc.).
- Determination of the relationship between the microstructure and thermomechanical properties of prospective functional and constructional materials (steels, alloys, composites, metalloceramics, etc.).
- Elaboration of 3D models of internal arrangement of cultural and natural heritage objects, industrial materials and products using neutron tomography method.
- Clarification of radiation damage mechanisms of solid-state materials, obtaining of long-life operating data on radiation resistance of materials.

Realization of instrument development program for the IBR-2 spectrometers:

- Improvement of technical parameters and extension of experimental capabilities of the new DN-6 diffractometer for studies of microsamples (development and fabrication of neutron focusing device, detector system elements, high-pressure cells and infrastructure).
- Improvement of technical parameters and extension of experimental capabilities of the multifunctional reflectometer GRAINS (installation of polarizing system, development and fabrication of electrochemical and liquid-containing cells for experiments).
- Modernization of available IBR-2 spectrometers (HRFD, RTD, DN-12, YuMO, FSD, REFLEX, REMUR, NERA, SKAT, EPSILON, DIN-2PI) aimed at improving their instrumental parameters (neutron counting rate, background conditions, and extension of experimental opportunities).
- Creation of test configuration of small-angle spin-echo spectrometer on IBR-2 beamline 9.
- Development of the concept of modernization or reconstruction of the inelastic neutron scattering spectrometer NERA and start of its realization.
- Improvement of technical parameters of the neutron radiography and tomography spectrometer on IBR-2 beamline 14 (spatial resolution, radiation stability of detector system).
- Adaptation of the correlation spectrometer FSS on IBR-2 beamline 13 and improvement of technical parameters. Further development of the correlation RTOF-method.
- Development and fabrication of elements of basic configuration of the small angle scattering and imaging spectrometer (bender, biological shielding, collimation system).
- Development and testing of neutron scattering methods for condensed matter research including spin-echo, neutron standing waves, neutron magnetic resonance, radiography, tomography, etc.
- Development of neutron scattering methods for in-operando monitoring and studies of electrochemical materials and interfaces.

List of projects:

Project	Leader	Priority (period of realization)
1. IINR	Yu.V. Nikitenko Deputy: N.A. Gundorin	1 (2015 – 2018)

- | | | |
|--|--|-----------------|
| 2. ELCHEM-NS
A system for neutron operando monitoring and diagnostics of materials and interfaces for electrochemical energy storage devices at the IBR-2 reactor | M.V. Avdeev
Deputies:
V.I. Petrenko
I.A. Bobrikov | 1 (2018 – 2020) |
|--|--|-----------------|

List of activities:

Activity or experiment	Leaders	Status
Laboratory or other Division of JINR	Main researchers	
1. Study of structure and properties of novel functional materials FLNP LIT	A.M. Balagurov D.P. Kozlenko B. Argymbek, A.I. Beskrovnyi, B.N. Savenko, E.B. Askerov, I.A. Bobrikov, E.V. Ermakova, N.O. Golosova, S.E. Kichanov, M.L. Craus, E.V. Lukin, G.M. Mironova, D.T. Neov, A. Pawlukoje, A.V. Rutkauskas, N.Yu. Samoylova, S.G. Sheverev, V.A. Turchenko, M.T. Vu V.B.Zlokazov	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Data taking</div>
2. Study of structure and properties of materials under extreme conditions FLNP	D.P. Kozlenko S.E. Kichanov, B.N. Savenko, E.V. Lukin, A.V. Rutkauskas, M.T. Vu, N.M. Belozerova, S.H. Jabarov	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Data taking</div>
3. Study of fundamental regularities of real time processes in condensed matter FLNP	A.M. Balagurov A.I. Beskrovnyi, I.A. Bobrikov, O.Yu. Ivanshina, G.M. Mironova, D. Neov, N.Yu. Samoylova, V.G. Simkin, U. Einhnaran	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Data taking</div>
4. Computer modeling of physical and chemical properties of novel crystalline and nanostructured materials FLNP	A. Pawlukoje K.S. Druzbecki, K.M. Luczynska, A. Filarowski	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Data taking</div>
5. Study of magnetic properties of layered nanostructures FLNP	Yu.V. Nikitenko S.V. Kozhevnikov, V.D. Zhaketov	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Data taking</div>
6. Study of structural characteristics of carbon- and silicon-based nanomaterials FLNP	V.L. Aksenov T.V. Tropin, O.A. Kizima, D.M. Chudoba, T. Nagornaya, A.A. Tomchuk	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Data taking</div>

- | | | |
|---|---|--------------------|
| <p>7. Investigation of molecular dynamics of functional materials</p> <p>FLNP</p> | <p>D.M. Chudoba</p> | <p>Data taking</p> |
| | <p>P. Bilski, K.S. Druzbecki, E.A. Goremychkin, K.M. Luczynska, A. Filarowski, K.B. Ludzik-Dychto, T. Nagornaya, J. Waliszewski, M. Jażdżewska</p> | |
| <p>8. Study of dispersed systems and complex liquids in bulk and at interface boundaries</p> <p>FLNP</p> | <p>M.V. Avdeev</p> | <p>Data taking</p> |
| | <p>V.I. Petrenko, K.T. Kholmurodov, A.V. Nagornyi, A.V. Tomchuk, I.V. Gapon, A.P. Artikulny, M.O. Kuzmenko</p> | |
| <p>9. Structural characterization of polymer nanodispersed materials</p> <p>FLNP</p> | <p>M. Balasoiu</p> | <p>Data taking</p> |
| | <p>A.I. Kuklin, A.Kh. Islamov, O. Ivan'kov, D.V. Solovyev, A.V. Rogachev</p> | |
| <p>10. Study of supramolecular structure and functional characteristics of biological macromolecules, complexes and membrane proteins</p> <p>FLNP</p> <p>LIT</p> | <p>A.I. Kuklin</p> | <p>Data taking</p> |
| | <p>A.Kh. Islamov, T.N. Murugova, M. Balasoiu, Yu.E. Gorshkova, O. Ivan'kov, R.V. Erhan, D.V. Solovyev, Yu.S. Kovalev, A.V. Rogachev, A.A. Nabiev, S.F. Samadov</p> <p>D.V. Solovyev, T.V. Solovyeva</p> | |
| <p>11. Study of structure and properties of lipid membranes and lipid complexes</p> <p>LIT</p> | <p>M.A. Kiselev</p> | <p>Data taking</p> |
| | <p>E.V. Zemlyanaya, E.I. Zhabitskaya</p> | |
| <p>12. Study of texture and physical properties of Earth's rocks, minerals and engineering materials</p> <p>FLNP</p> | <p>Ch. Scheffzuek
D.I. Nikolaev</p> | <p>Data taking</p> |
| | <p>R.N. Vasin, T.I. Ivankina, V.V. Sikolenko, T.A. Lychagina, I.Yu. Zel', B. Altangerel</p> | |
| <p>13. Non-destructive control of residual stresses in industrial products and engineering materials</p> <p>FLNP</p> | <p>G.D. Bokuchava</p> | <p>Data taking</p> |
| | <p>V.V. Sumin, R.N. Vasin, I.V. Papushkin, A.A. Kruglov, A.V. Tamonov, B. Muhametuly, Yu.V. Taran, D.M. Levin</p> | |
| <p>14. Neutron imaging of internal structure of industrial products, rocks, cultural and natural heritage objects</p> <p>FLNP</p> | <p>D.P. Kozlenko
G.D. Bokuchava</p> | <p>Data taking</p> |
| | <p>B.N. Savenko, S.E. Kichanov, E.V. Lukin, A.V. Rutkauskas</p> | |

<p>15. Study of radiation damage effects in condensed matter by X-ray spectroscopy</p> <p>VBLHEP</p>	<p>S.I. Tyutyunnikov (VBLHEP)</p> <p>V.N. Shalyapin, V.V. Efimov, E.A. Efimova, Yu.S. Kovalev, A.V. Rogachev, N.I. Zamyatin, I.A. Kryachko</p>	<table border="1" style="margin: auto;"> <tr> <td>Data taking</td> </tr> </table>	Data taking
Data taking			
<p>16. Development of neutron scattering methods for interdisciplinary studies of nanosystems and materials</p> <p>FLNP</p>	<p>V.I. Bodnarchuk G.D. Bokuchava D.P. Kozlenko</p> <p>S.V. Kozhevnikov, Yu.V. Nikitenko, S.P. Yaradaikin, S.E. Kichanov, E.V. Lukin</p>	<table border="1" style="margin: auto;"> <tr> <td>Data taking</td> </tr> </table>	Data taking
Data taking			
<p>17. Development of the IBR-2 spectrometer complex</p> <p>FLNP</p>	<p>D.P. Kozlenko A.M. Balagurov</p> <p>M.V. Avdeev, A.I. Beskrovnyi, I.A. Bobrikov, A.I. Kuklin, V.I. Bodnarchuk, D.M. Chudoba, A.S. Doroshkevich, V.M. Morozov, D. Neov, Yu.V. Nikitenko, A.V. Petrenko, B.N. Savenko, V.G. Simkin, V.I. Sukhanov, G.D. Bokuchava, Ch. Scheffzuek</p>	<table border="1" style="margin: auto;"> <tr> <td>Realization</td> </tr> </table>	Realization
Realization			

Collaboration

Country or International Organization	City	Institute or Laboratory
Argentina	Bariloche	CAB CNEA
Azerbaijan	Baku	AzTU IP ANAS
Belarus	Minsk	IAP NASB SPMRC NASB INP BSU BSTU RI PCP BSU
Bulgaria	Sofia	ASCI Ltd IE BAS IEES BAS IMS BAS INRNE BAS ISSP BAS
Czech Republic	Prague	CTU IG ASCR IMC ASCR IP ASCR NPI ASCR
Egypt	Řež Cairo	EAEA
France	Giza Grenoble Saclay	CU IBS LLB

Germany	Berlin	HZB BAM Univ. RUB TU Darmstadt TU Dortmund TU Dresden Univ. GKSS TUBAF IMF TUBAF MLU DESY FZJ KIT CAU IFM-GEOMAR GFZ Univ. MPI-FKF
	Bayreuth	
	Bochum	
	Darmstadt	
	Dortmund	
	Dresden	
	Göttingen	
	Geesthacht	
	Freiberg	
	Halle	
	Hamburg	
	Jülich	
	Karlsruhe	
	Kiel	
	Potsdam	
	Rostock	
	Stuttgart	
Hungary	Budapest	Wigner RCP
	Szeged	US
India	Gurgaon	AMITY
	Patna	NITP
Italy	Trento	UniTn
Japan	Minato	Keio Univ.
	Nagano	Shinshu Univ.
Kazakhstan	Almaty	INP
	Rudny	RII
Latvia	Riga	ISSP UL IPE
Moldova	Chişinău	IMB ASM IC ASM
Mongolia	Ulaanbaatar	IPT MAS MUST
Norway	Trondheim	NGU
Poland	Warsaw	INCT
	Bialystok	UwB
	Krakow	JU AGH-UST NINP PAS
	Lublin	UMCS
	Olsztyn	UWM
	Otwock-Swierk	NCBJ
	Poznan	AMU

	Siedlce	UPH
	Szczecin	WPUT
	Wroclaw	WUT
		UW
Romania	Bucharest	IFIN-HH
		INCDIE ICPE-CA
		INFLPR
		NIMP
		ISS
		UB
		UPB
		UMF
		UTM
		CNMN
	Baia Mare	TUCN-NUCBM
	Cluj-Napoca	INCDTIM
		RA BC-N
		UBB
		UTC-N
	Constanța	UOC
	Craiova	UC
	Iași	USAMV
		NIRDTP
		UAI
		UAIC
	Pitești	SCN
		UPIT
	Timișoara	LMF CCTFA
		RA TB
		UPT
		UVT
Russia	Moscow	GC RAS
		IA RAS
		IBMC
		IC RAS
		IEPT RAS
		IGEM RAS
		IGIC RAS
		IMET RAS
		INMI RAS
		IPCE RAS
		ITEP
		IPE RAS
		ISPM RAS
		NNRU "MEPhI"

		MIET
		MITHT
		MISiS
		MSU
		NIKIET
		NRC KI
		SINP MSU
		SC “VNIINM”
	Moscow, Troitsk	HPPI RAS
		ISAN
		INR RAS
	Belgorod	BelSU
	Chernogolovka	ISSP RAS
	Dolgoprudny	MIPT
	Dubna	Dubna Univ.
	Gatchina	PNPI
	Kaliningrad	IKBFU
	Kazan	KNRTU
	Krasnoyarsk	SibFU
		KIP SB RAS
	Nizhny Novgorod	UNN
		IPM RAS
	Obninsk	IPPE
	Perm	ICMM UrB RAS
		ITCh UrB RAS
	Petrozavodsk	IG KRS RAS
	Podolsk	GIDROPRESS
	Rostov-on-Don	RIP SFU
	St. Petersburg	IPTI RAS
		SPbSU
	Sterlitamak	SSPA
	Tomsk	NPI TPU
	Tula	TSU
	Yekaterinburg	IMP UB RAS
		UrFU
Serbia	Belgrade	INS “VINČA”
	Novi Sad	UNS
Slovakia	Bratislava	CU
	Košice	IEP SAS
South Africa	Pretoria	Necsa
Spain	Madrid	CENIM-CSIC
Switzerland	Villigen	PSI
	Zurich	ETH
Tajikistan	Dushanbe	ICChem ASRT
Taiwan	Hsinchu	NSRRC

Ukraine	Kiev	IPMS NASU NUK ISC NASU
	Donetsk	DonNU DonIPE
	Kharkov	IERT NASU NSC KIPT
United Kingdom	Didcot	RAL
Uzbekistan	Tashkent	INP AS RU _z
Vietnam	Hanoi	IOP VAST
	Da Nang	DTU

04-4-1105-2011/2019

Priority:

1

Status:

In-progress

Development of the IBR-2 Facility with a Complex of Cryogenic Neutron Moderators

Leaders:

A.V. Belushkin
A.V. Vinogradov

Participating Countries and International Organizations:

Argentina, Azerbaijan, Belarus, Japan, Mongolia, Poland, Romania, Russia, Spain, United Kingdom, USA.

Scientific Programme

The theme main task is to increase the efficiency of the use of the IBR-2 facility for realization of the program of experimental investigations, maintenance of operational reliability and safety of the reactor, creation of a complex of cryogenic neutron moderators.

Expected main results in 2018:

- Maintenance of the IBR-2 reactor operation for physical investigations.
- Manufacturing of a reserve movable reflector MR-3R.
- Installation and adjustment of the CM-201 cryogenic moderator equipment at working place.
- Step-by-step replacement and upgrading of the technological and electrical equipment in accordance with the Rostekhnadzor license requirements.

List of projects:

Project	Leader	Priority (period of realization)
1. Construction of Complex of Cryogenic Moderators at the IBR-2 Facility	A.A. Belyakov	1 (2014 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. Operation of the IBR-2 facility in the regular mode FLNP	A.V. Dolgikh A.V. Vinogradov A.A. Belyakov, S.A. Tsarenkov, M.V. Andrianov, S.V. Rudenko, Yu.N. Pepelyshev, V.A. Trepalin, + 30 engineers, + 50 workers	Realization
2. Maintenance of program of physical investigations FLNP	V.D. Ananiev A.V. Vinogradov A.V. Dolgikh A.A. Belyakov, Yu.N. Pepelyshev, V.A. Trepalin, S.V. Rudenko, + 30 engineers, + 50 workers	Realization
3. Installation and adjustment of equipment and pipelines of CM-201 cryogenic moderator. Feasibility study of cryogenic moderator CM-203. Mastering of equipment of CM-202 and CM-201 cryogenic moderators using a new cryogenic facility by "Linde" in its regular place FLNP	A.A. Belyakov K.A. Mukhin V.D. Ananiev, S.A. Kulikov, E.P. Shabalin, + 15 engineers, + 15 workers	Realization
4. Manufacturing of reserve movable reflector MR-3R FLNP	A.V. Vinogradov A.V. Dolgikh A.A. Belyakov, V.D. Ananiev, + 5 engineers, + 5 workers	Realization
5. Step-by-step replacement and upgrade of basic technological and electrical equipment FLNP	A.V. Vinogradov A.V. Dolgikh A.A. Belyakov, A.V. Trepalin, + 30 engineers, + 50 workers	Realization

Collaboration

Country or International Organization	City	Institute or Laboratory
Argentina	Buenos Aires	CNEA
Azerbaijan	Baku	IRP ANAS NNRC
Belarus	Minsk	JIPNR-Sosny NASB
Japan	Osaka Sapporo	ISIR Hokkaido Univ.
Mongolia	Ulaanbaatar	IPT MAS
Poland	Krakow	AGH-UST

Romania	Bucharest	IFIN-HH
Russia	Moscow	NIKIET
		Geliymash
		INEUM
		SYSTEMATOM
		SSDI
		ENES
Spain	Valencia	UPV
United Kingdom	Didcot	RAL
USA	Indianapolis, IN	IUPUI

Development of Experimental Facilities for Condensed Matter Investigations with Beams of the IBR-2 Facility

Leaders:

S.A. Kulikov
V.I. Prikhodko

Participating Countries and International Organizations:

Argentine, Belarus, Bulgaria, Czech Republic, Germany, Hungary, Republic of Korea, Romania, Russia, South Africa, Sweden, Switzerland, Ukraine, United Kingdom.

Scientific Programme

Development and construction of a control system of the cryogenic moderator CM-201 for IBR-2 beams N 1, 4, 5, 6, 9.

Design of equipment, electronics and software for the complex of IBR-2 spectrometers; development of the FLNP information and computing infrastructure according to the needs of the Laboratory and the development strategy of the JINR computer network.

Expected main results in 2018:

- Development and testing of control system of the CM-201 moderator for beamlines ? 1, 4, 5, 6, 9. Routine modernization and operation of CM-202. Regular use of system for nitrogen-free charging of pellets and diaphragm for measuring gas flow rate at CM-201 and CM-202 moderators. Investigation of neutron-physical properties of alternative materials for the cold moderator to extend the period of its operation for physics experiments. Development of screw-type discharging device for the CM-201 moderator and its testing on laboratory test stand.
- Investigation of radiation resistance of materials at the radiation research facility.
- Development of new programs for simulation of full reflectometry experiments in kinematic approximation.
- Completion of activities on manufacturing the "Astra-M" detector system for the FSD diffractometer. Development of technical design of backscattering detector for the HRFD diffractometer. Development of design of detecting module and data accumulation system for multi-detector system of the DN-12 spectrometer; tests of elements of the accumulation system on a neutron beamline. Development of prototype of the detecting module with analog electronics to upgrade the detector system of the NERA-PR spectrometer. Development of infrastructure for designing and constructing neutron detectors.
- Development of technical design of continuous flow cryostat with helium-4 circulation using a closed-cycle cryocooler to obtain a temperature range below 2K; selection and purchase of equipment and components. Manufacturing of new windings and assembling of superconducting magnet for the DN-12 diffractometer.
- Modernization of control systems of actuators of REFLEX and GRAINS spectrometers.
- Maintenance and development of the Sonix+ software package at the request of users; adaptation of Sonix+ for operation with DAQ-controllers on the basis of USB-3 interface. Development of concept of central data storage with regard to FLNP specificity.

List of projects:

Project	Leader	Priority (period of realization)
1. BSD Development of wide-aperture backscattering detector for HRFD diffractometer	V.V. Kruglov	1 (2018 – 2020)

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. Development and putting into operation of control system of CM-201 moderator for neutron beams N 1, 4, 5, 6, 9 FLNP	S.A. Kulikov E.P. Shabalin M.V. Bulavin + 5 engineers, A.S. Kirilov + 1 engineer, A.P. Sirotin + 2 engineers, K.A. Mukhin	Realization
2. Calculations and simulation of spectrometers' elements. Development of VITESS software package FLNP	A.V. Belushkin S.A. Manoshin, S.A. Kulikov + 1 engineer	Realization
3. Investigation of radiation resistance of materials and electronic components FLNP	M.V. Bulavin S.A. Kulikov E.P. Shabalin + 4 engineers	Realization
4. Tests of combined horizontal-vertical cryostat with superconducting magnet for DN-12 diffractometer. Development and modernization of cryostats on IBR-2 spectrometers. FLNP	A.N. Chernikov S.E. Kichanov E.V. Lukin, N.A. Kovalenko + 2 engineers	Realization
5. Development of continuous flow cryostats on the basis of closed-cycle cryocoolers FLNP	A.N. Chernikov N.A. Kovalenko + 2 engineers	Realization
6. Development and implementation of gas and scintillation detector systems at IBR-2 spectrometers FLNP	A.V. Churakov V.V. Kruglov A.A. Bogdzel V.M. Milkov + 3 engineers, V.A. Drozdov +3 engineers, V.V. Zhuravlev + 3 engineers, A.S. Kirilov + 1 engineer	Realization

7. Development of data acquisition systems, control and experiment automation systems, as well as of software package Sonix+ at IBR-2 spectrometers

V.I. Prikhodko
A.P. Sirotin
A.S. Kirilov

Realization

FLNP

A.A. Bogdzel + 4 engineers, V.V. Zhuravlev + 3 engineers,
N.D. Zernin + 1 engineer, S.M. Murashkevich + 2 engineers

8. Development of FLNP network infrastructure in accordance with development strategy of JINR computer network

V.I. Prikhodko

Realization

FLNP

G.A. Sukhomlinov + 2 engineers, A.S. Kirilov
+ 2 engineers, S.A. Manoshin + 1 engineer

LIT

V.V. Korenkov + 2 engineers

Collaboration

Country or International Organization	City	Institute or Laboratory
Argentina	Bariloche	CAB CNEA
Belarus	Minsk	BSTU
Bulgaria	Sofia	INRNE BAS
Czech Republic	Řež	NPI ASCR
Germany	Berlin	HZB
	Jülich	FZJ
Hungary	Budapest	Wigner RCP
Republic of Korea	Daejeon	NFRI
Romania	Bucharest	INCDIE ICPE-CA
Russia	Moscow	NNRU "MEPhI"
		NRC KI
		PC ITER RF
	Moscow, Troitsk	INR RAS
	Dubna	Dubna Univ.
	Gatchina	PNPI
	Yekaterinburg	IMP UB RAS
South Africa	Pretoria	Necsa
Sweden	Lund	ESS ERIC
Switzerland	Villigen	PSI
Ukraine	L'viv	LPNU
United Kingdom	Didcot	RAL

Modern Trends and Developments in Raman Microspectroscopy and Photoluminescence for Condensed Matter Studies

Leader: G.M. Arzumanyan
N. Kučerka

Participating Countries and International Organizations:

Armenia, Belarus, Bulgaria, Germany, Latvia, Poland, Russia, Slovakia, Ukraine, United Kingdom.

Scientific Programme

Modern trends in Raman-based microspectroscopy providing ultrasensitive, highly-contrast and selective tools for condensed matter studies of extremely low concentrations of analyte molecules are in the focus of the present research programme. Detection and identification of a single molecule represent the ultimate sensitivity limit in chemical analysis. Tracking and counting of single molecules, characterizing their chemical structures, and monitoring of their structural changes offer far-reaching opportunities in basic and applied research. Therefore, vibrational spectroscopy, such as Raman spectroscopy, as a non-invasive, label-free technique, is a powerful and preferred tool for single biological molecule studies. To achieve this goal, two enhanced options of Raman scattering, namely CARS (coherent antiStokes Raman spectroscopy) and SERS (surface-enhanced Raman spectroscopy) will be combined to attain such an ultrasensitive level of detection – poorly studied and known as SECARS – surface-enhanced CARS.

The other modern component of the theme is the study of photo- and upconversion luminescence based on promising core-shell nanostructures. In recent years, core-shell nanoparticles are at the leading edge of hot research topics and offer a wide range of applications in biomedicine, optics, environmental science, materials, and so forth, due to their excellent properties such as versatility, tunability and stability. The core-shell nanomaterials containing noble metals are plasmonic core-shell nanomaterials. They can be employed for contrast imaging, several biomedical applications, etc.

Expected main results in 2018:

- Upgrade of the “CARS” microspectrometer software “NanoSP” under the ultrasensitive modality SECARS.
- Tests of various configurations of SERS-active substrates to ensure an optimal selection for the effective SECARS spectroscopy.
- Obtaining and analysis of SERS and SECARS spectra and intensity maps of light scattered from organic reporter molecules attached to gold/silver nanospheres.
- Data on structural and spectroscopic/luminescent properties of core-shell nanostructure: $\text{NaYF}_4:\text{Yb}^{3+}, \text{Er}^{3+}, \text{Tm}^{3+}@\text{SiO}_2$.
- Revealing of features of Raman spectra from C6 glioma cells and mesenchymal stem cells in regular studies.

List of projects:

Project	Leader	Priority (period of realization)
1. NANOBIPHOTONICS Ultrasensitive SECARS microspectroscopy and luminescent core-shell nanostructures	G.M. Arzumanyan N. Kučerka Deputy: K.Z. Mamatkulov	1 (2018 – 2020)

List of activities:

Activity or experiment	Leaders	Status
Laboratory or other Division of JINR	Main researchers	
1. Development of scientific and technical requirements for the upgrade of the “CARS” microspectrometer under ultrasensitive SECARS modality	G.M. Arzumanyan	Upgrade
FLNP	K.Z. Mamatkulov, N.V. Doroshkevich, I.A. Morkovnikov	
2. Study of spectroscopic and plasmonic characteristics of SERS-active substrates based on silver/gold nanoparticles with different configurations	G.M. Arzumanyan N. Kučerka	Data taking
FLNP	K.Z. Mamatkulov, N.V. Doroshkevich, E.A. Kuznetsov, K.O. Demeshenkova, V.N. Shatilova	
3. Systematic experiments on SECARS microspectroscopy with picosecond laser pulses at SERS-active substrates – single molecule spectroscopy	G.M. Arzumanyan K.Z. Mamatkulov	Realization Data taking
FLNP	N.V. Doroshkevich, K.Sh. Voskanyan, K.O. Demeshenkova, V.N. Shatilova, I.A. Morkovnikov	
4. Development of plasmon-enhanced model of Raman scattering on the “CARS” microscope	G.M. Arzumanyan N. Kučerka	Simulation
FLNP	K.Z. Mamatkulov, I.A. Morkovnikov	
5. Study of spectral-structural characteristics of upconversion phosphors based on core-shell type nanostructures	G.M. Arzumanyan N. Kučerka	Data taking
FLNP	K.Z. Mamatkulov, E.A. Kuznetsov, N.V. Doroshkevich, K.Sh. Voskanyan, K.O. Demeshenkova, V.N. Shatilova	
6. Test-application of core-shell nanostructured phosphors in photodynamic therapy (PDT) of cancer	G.M. Arzumanyan N. Kučerka	Realization
FLNP	K.Z. Mamatkulov, E.A. Kuznetsov, N.V. Doroshkevich, K.Sh. Voskanyan, K.O. Demeshenkova, V.N. Shatilova	
7. Verification of tumor and stem cells by Raman microspectroscopy	G.M. Arzumanyan N. Kučerka	Data taking
FLNP	K.Z. Mamatkulov, N.V. Doroshkevich, K.Sh. Voskanyan, I.A. Morkovnikov, K.O. Demeshenkova, V.N. Shatilova	

8. Development of a united optical platform concept for contrast and selective imaging by nonlinear Raman microscopy and upconversion luminescence.

G.M. Arzumanyan

Realization

FLNP

K.Z. Mamatkulov, E.A. Kuznetsov

9. Expansion of research activities at the “CARS” microscope as a “user-friendly facility”

G.M. Arzumanyan
N. Kučerka

Realization

FLNP

K.Z. Mamatkulov, N.V. Doroshkevich

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	Inst. Biochemistry NAS RA
Belarus	Minsk	BSUIR Inst. Physiology NASB SOL instruments
Bulgaria	Sofia	Inst. Microbiology BAS
Germany	Jülich	FZJ
Latvia	Riga	ISSP UL
Poland	Wroclaw	UW
	Poznan	AMU
Russia	Moscow	GPI RAS MSU
Slovakia	Košice	PJSU
Ukraine	Donetsk	DonNU
United Kingdom	Buckingham	UB

Radiation Physics, Radiochemistry, and Nanotechnology Investigations Using Beams of Accelerated Heavy Ions

Leaders:

S.N. Dmitriev
P.Yu. Apel

Participating Countries and International Organizations:

Belarus, Bulgaria, China, Cuba, Czech Republic, Germany, Hungary, Kazakhstan, Moldova, Mongolia, Poland, Romania, Russia, Serbia, Slovak Republic, South Africa, Spain, Ukraine, United Kingdom, USA, Vietnam.

Scientific Programme

Transition to a new level of research and development in the fields of radiation solid state physics, applied radiochemistry, and materials science, with a prospect of nanotechnology applications. The main emphasis will be on the modification of the materials at the nanometer scale and on the study of the effects produced by heavy ions in matter with the aim of revealing the fundamental mechanisms and of the development of nanotechnology applications for ion beams. Modernization of the FLNR facilities for the production of medical isotopes and development of materials modification methods.

Main results expected in 2018:

- Study of temperature dependence of latent track morphology in radiation resistant insulators.
- Study of the effect of high energy heavy ion irradiation on the helium and hydrogen agglomeration processes in ceramics and ODS alloys.
- Development and investigation of filtration and sorption properties of track-etched membranes with inorganic (Ti, TiO₂, and ZnO) coatings.
- Study of sorption, diffusion, and osmotic processes in nanopores fabricated using ion track technology.
- Development and study of SERS sensors based on track membranes modified with nanostructured layers of silver and silicon monoxide.
- Investigation of properties of silver nanosuspensions obtained by electric discharge method as SERS-active coating for high sensitivity membrane sensors.
- Application of nuclear physics analysis methods to investigate microelement composition of environment (Bulgaria, Mongolia, RSA).
- Development of techniques for the synthesis and radiochemical extraction of radionuclides that have great potential for nuclear medicine and radioecology. Development of equipment and conducting of experiments with beams at the MT-25 microtron.

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. Investigations of radiation damages in solids and formation of nanostructures FLNR	V.A. Skuratov P.Yu. Apel V.K. Semina, O.L. Orelovich, V.V. Shirkova, A.N. Nechaev, I.V. Blonskaja, L.I. Kravets, O.M. Ivanov, D.V. Shchegolev, Yu.K. Kochnev, V.A. Altynov, O.V. Kristavchuk, N.S. Kirilkin, E.A. Korneeva, V.F. Reutov	Data taking
LIT FLNP	V.V. Trofimov A.I. Kuklin, M.V. Frontasyeva	
2. Production of ultra-pure isotopes FLNR	S.N. Dmitriev G.Ya. Starodub, A.V. Sabelnikov, Yu.V. Albin, G.A. Bozhikov, G.K. Vostokin, M.V. Gustova, T.P. Drobina	Manufacturing
3. Radioanalytical studies FLNR	M.V. Gustova A.V. Sabelnikov, N.S. Gustova, T.P. Drobina	Data taking
4. Construction of accelerator complexes for nuclear medicine and radiation physics research FLNR DLNP	S.N. Dmitriev A.A. Chumbalov I.V. Kalagin, I.V. Kolesov, A.A. Chumbalov A.G. Molokanov	Designing Manufacturing

Collaboration

Country or International Organization	City	Institute or Laboratory
Belarus	Minsk	BSU BSTU INP BSU
	Gomel	MPRI NASB
Bulgaria	Plovdiv	PU
China	Beijing	Beijing Fert Co PKU
		CEADEN
Cuba	Havana	
Czech Republic	Prague	CU
	Brno	BUT
	Olomouc	UP
	Řež	NPI ASCR
Germany	Darmstadt	GSI

	Quedlinburg	IST
		MiCryon Technik
Hungary	Budapest	GetGiro Kft
Kazakhstan	Almaty	IPT
	Astana	BA INP
		ENU
		NU
Moldova	Chişinău	IAP ASM
		MSU
Mongolia	Ulaanbaatar	NRC NUM
		NUM
Poland	Warsaw	INCT
		WUT
	Lublin	UMCS
	Torun	UMK
Russia	Moscow	IC RAS
		ISPM RAS
		GPI RAS
		LPI RAS
		MATI
		MIEM
		MSMU
		MUCTR
		RIVS
		SINP MSU
		Technomedexport
		BInEPCP RAS
		ISSP RAS
		Trackpore Technology
		IKBFU
	KSU	
	ISP SB RAS	
	REATRACK- Filter	
	IPTI RAS	
	MALDAS	
	SIMPEX	
	Vladisart	
Romania	Bucharest	INFLPR
		UPB
Serbia	Belgrade	INS "VINČA"
Slovakia	Bratislava	BIONT
		CU
		IEE SAS

South Africa	Port Elizabeth	NMMU
	Bellville	UWC
	Pretoria	UP
Spain	Madrid	IA-CSIC
	Valencia	UV
Ukraine	Kharkov	IERT NASU
United Kingdom	London	Middlesex Univ.
USA	Stanford, CA	SU
	Knoxville, TN	UTK
	Oak Ridge, TN	ORNL
Vietnam	Hanoi	IOP VAST

Research on the Biological Effect of Heavy Charged Particles with Different Energies

Leaders:

E.A. Krasavin
G.N. Timoshenko

Participating Countries and International Organizations:

Armenia, Bulgaria, Czech Republic, Italy, Moldova, Mongolia, Poland, Romania, Russia, Slovak Republic, South Africa.

Scientific Programme

Theoretical and experimental research on the biological effect of heavy charged particles with different energies at JINR's basic facilities.

The research and development will include:

- Research on the regularities and mechanisms of molecular damage induction and repair in the DNA structure in mammalian and human cells for radiations with different linear energy transfer (LET) in vivo and in vitro.
- Obtaining comparative data on the regularities in the induction of gene and structural mutations in mammalian and lower eukaryote cells under exposure to sparsely and densely ionizing radiations with different LET.
- Research on the mechanisms of the heavy charged particle (HCP)-induced damage of the eye retina and its repair.
- Research on the character of the damage of central nervous system (CNS) cells and regularities of their death. Identification of the HCP-induced functional and morphological disorders in the CNS.
- Mathematical modeling of the effects of ionizing radiations with different LET at the molecular and cellular levels. Development and analysis of mathematical models of the molecular mechanisms of ionizing radiation-induced disorders in the CNS structure and functions.
- Calculation of shielding for new nuclear physics facilities, evaluation of the radiation environment, and development of radiation safety systems.

Expected main results in 2018:

- To continue studying regularities in the induction, formation, and repair kinetics of HCP-induced clustered DNA double-strand breaks (DSBs) in human skin fibroblasts and in radioresistant U87 tumor cells.
- To evaluate the proportion of different DNA DSB repair pathways in human fibroblasts after exposure to radiations of different quality – by immunocytochemical staining of the repair proteins RAD51 (HR) and DNA PKcs (NHEJ).
- To continue studying radiation-induced apoptosis mechanisms. To study the expression of the genes that encode the proteins and caspases participating in apoptosis induction in mammalian cells by HCP.
- To study regularities in DNA DSB formation and elimination in rat hippocampus cells in vitro using a primary hippocampus culture from P0–P1 age rats.
- Using a Synergy H1m microplate reader, to evaluate the level of the reactive oxygen species and AFA protein kinase in mammalian SIM-A9 microglial cells exposed to gamma-rays and HCP.

- To continue studying regularities in the induction of gene and structural mutations in yeast cells by radiations with different LET.
- To continue research on the mutagenic effect of ionizing radiations on mammalian cells at late times after irradiation. To compare the results of a molecular and cytogenetic analysis of HPRT-mutant subclones.
- To continue studying the mechanisms behind the damage and recovery of retinal cells (Mueller glial cells and photoreceptor cells) after radiation exposure.
- To study the connections between changes in the functioning of the main neurotransmitter systems and apoptotic death of neurons after radiation exposure.
- To continue studying disorders in the exchange of monoamines and their metabolites in the prefrontal cortex, hippocampus, striatum, adjoining nucleus, and hypothalamus of the mouse and rat brain under exposure to ionizing radiations.
- To continue the development of mathematical models of neurons' functional activity under exposure to radiations with different LET.
- To perform computer modeling of the formation of radiation-induced damage in membrane ion channels and synaptic contacts.
- To perform computer modeling of the formation of radiation-induced damage in the cell membrane and cytoskeleton.
- To continue the development of mathematical models of the induction and repair of the key types of DNA damage after HCP exposure.
- To continue designing, testing and calibration of nuclear planetary science instruments with fast neutron generators at the LRB's test site.
- To ensure the conduction of the radiobiological experiments at the Nuclotron (the Laboratory of High-Energy Physics), U-400M cyclotron (the Laboratory of Nuclear Reactions), and the medical beam of the Phasotron (the Laboratory of Nuclear Problems).

List of projects:

Project	Leader	Priority (period of realization)
1. Research on the biological effect of heavy charged particles with different energies	E.A. Krasavin G.N. Timoshenko	1 (2015 – 2020)

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. Radiobiological research at charged particle beams	E.A. Krasavin	Data taking Realization Data taking

LRB

S.V. Aksenova, K.V. Belokopytova, O.V. Belov, P. Blaha, Yu.V. Bogdanova, A.V. Boreyko, A.N. Bugay, N.N. Budennaya, T.S. Bulanova, V.N. Chausov, E.B. Dushanov, R.D. Govorun, E.V. Ilyina, A.A. Ivanov, L. Jezkova, A.N. Kokoreva, E.A. Kolesnikova, N.A. Koltovaya, O.V. Komova, V.L. Korogodina, I.V. Koshlan, N.A. Koshlan, M.A. Kovalenko, R.A. Kozhina, E.A. Kruglyakova, P.V. Kutsalo, E.A. Kuzmina, B. Lkhagvaa, V.N. Lisy, K.N. Lyakhova, B. Munkhbaatar, E.A. Nasonova, M.A. Ostrovsky, M.S. Panina, A.Yu. Parkhomenko, D.V. Petrova, Yu.S. Severyukhin, N.L. Shmakova, E.V. Smirnova, S.I. Tiunchik, D.M. Utina, M.A. Vasilyeva, Yu.V. Vinogradova, T.H. Vu, M.G. Zadnepryanets, N.I. Zhuchkina, + 4 engineers, + 7 workers

2. Radiation research

G.N. Timoshenko

Preparation Data taking R&D

LRB

V.E. Aleinikov, L.G. Beskrovnaya, M.M. Komochkov, A.R. Krylov, V.A. Krylov, E.N. Lesovaya, + 10 engineers, + 2 workers

3. Training activity

E.A. Krasavin

S.Z. Pakuliak (UC)

LRB

V.E. Aleinikov, O.A. Bakerin, O.V. Belov, A.V. Boreyko, A.N. Bugay, N.N. Budennaya, T.B. Feldman, R.D. Govorun, A.A. Ivanov, N.A. Koltovaya, O.V. Komova, M.M. Komochkov, I.V. Koshlan, M.A. Ostrovsky, A.Yu. Parkhomenko, G.N. Timoshenko

Collaboration

Country or International Organization

City

Institute or Laboratory

Armenia

Yerevan

YSU

Bulgaria

Sofia

IE BAS
INRNE BAS
NCRRP

Czech Republic

Brno

IBP ASCR

Prague

CTU

Řež

NPI ASCR

UJV

Italy

Udine

Uniud

Moldova

Chişinău

UnASM

Mongolia

Ulaanbaatar

NUM

Poland

Szczecin

US

Romania

Bucharest

ISS

UMF

Iaşi

IBR

UAIC

Russia	Moscow	IBMP RAS IHNA Ph RAS ITEP MSU SF IPh MSU
	Astrakhan	ASU
	Sochi	SRI MP
Slovakia	Bratislava	CU
South Africa	Cape Town	iThemba LABS

Research on Cosmic Matter on the Earth and in Nearby Space; Research on the Biological and Geochemical Specifics of the Early Earth

Leaders:

E.A. Krasavin
A.Yu. Rozanov
V.N. Shvetsov

Participating Countries and International Organizations:

Italy, Norway, Poland, Romania, Russia, United Kingdom, USA.

Scientific Programme

Research and development will include:

- Biogeochemical studies of cosmic dust
- Studies of biofossils and organic compounds in meteorites and ancient terrestrial rocks
- Studies of cosmic matter with nuclear physics methods
- As a result of studying and generalizing the research materials on modern and fossil cosmic dust as well as ancient terrestrial objects and modern organisms of the extreme ecosystems, data will be obtained on the forms of ancient terrestrial and extraterrestrial life.

As the results:

- Obtaining new data on the amount of cosmic matter falling on the whole Earth's surface. Obtaining data on the dynamics of cosmic dust fallout on large territories.
- Evaluation of the following parameters of particles of extraterrestrial origin: morphology, structure, size distribution, and elemental, isotopic, and mineralogical composition. Assessment of changes in these characteristics in different plates in different time intervals.
- Creation of a cosmic dust collection, where dust microparticles will be characterized by quantity (concentration) and the size distribution.
- Obtaining new information on the role of microorganisms in the formation and evolution of life on the Earth and processes of weathering, precipitation growth, etc.
- Research on the synthesis of complex prebiotic compounds from formamide under exposure to ionizing radiations of different qualities with meteorite samples as catalysts.
- Generalization of the obtained data on the forms of ancient terrestrial and, possibly, extraterrestrial life.

Expected main results in 2018:

- To continue the electron microscopy-based detection and study of biofossils and organic matter in meteorites and the most ancient terrestrial rocks.
- To continue the diagnostics of microorganism remnants in Archaean and Proterozoic rocks and evaluation of their organization level with nuclear physics methods.
- To continue research on the synthesis of complex prebiotic compounds from formamide under exposure to accelerated ions with different linear energy transfer.
- To study the nature of the catalysts participating in the synthesis of complex prebiotic compounds from formamide.

List of projects:

Project	Leader	Priority (period of realization)
1. Research on cosmic matter on the Earth and in nearby space; research on the biological and geochemical specifics of the early Earth	E.A. Krasavin Scientific leader: A.YU. Rozanov	1 (2013 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. Studies of microfossils in meteorites and ancient terrestrial rocks	A.Yu. Rozanov E.A. Krasavin	Data taking Realization Simulation
LRB	A.K. Ryumin + 1 engineer	
2. Research on the synthesis of complex prebiotic compounds from formamide	R. Saladino	Data taking Realization Simulation
LRB	M.I. Kapralov + 1 student	
3. Biogeochemical and biological studies of cosmic dust	L.M. Gindilis	Data taking Realization Simulation
LRB	I.A. Bobrikov + 2 engineers	
4. Cosmic matter research with nuclear physics methods	V.N. Shvetsov (FLNP)	Data taking Realization Simulation
FLNP	A.Yu. Dmitriev, M.V. Frontasyeva, P.V. Sedyshev	

Collaboration

Country or International Organization	City	Institute or Laboratory
Italy	Rome	Univ. "La Sapienza"
	Viterbo	UNITUS
Norway	Trondheim	NTNU
Poland	Poznan	AMU
Romania	Bucharest	UB
	Iași	UAIC
Russia	Moscow	IGEM RAS
		IKI RAS
		MSU
		PIN RAS
		SAI MSU

United Kingdom
USA

Borok
Gatchina
Novosibirsk
Buckingham
Athens, AL

IPE RAS
PNPI
BIC SB RAS
UB
ASU

Biomedical and Radiation-Genetic Studies Using Different Types of Ionizing Radiation

Leader: G.V. Mitsyn
Deputy: S.V. Shvidky

Participating Countries and International Organizations:
 Czech Republic, India, Poland, Romania, Russia.

Scientific Programme

Medico-biological and clinical research for the proton radiotherapy of cancer patients. Formation of experimental data base in the field of radiation mutagenesis in the animal germ cells.

Expected main results in 2018:

- Continuation of clinical researches on proton therapy of cancer patients in Room 1. Evaluation of the effectiveness of the conducted radiation treatment of different neoplasms.
- Work to increase the functional capability of the developed 3D treatment planning software and its clinical tests in the treatment sessions.
- Test of the prototype equipment for the dynamic conformal irradiation of deep-seated tumours with the proton beam.
- Development and improvement of detectors and tools for the clinical dosimetry of the medical hadron beams.
- Exploration of the possibilities of laser radioprotection against damage after exposure to ionizing radiation on mouse fibroblast cells with the application of laser module with a wave length of 532 nm.
- Investigations of the molecular spectra of gene mutations induced by different quality ionizing radiation in animal germ cells.

List of projects:

Project	Leader	Priority (period of realization)
1. Further development of methods, technologies, schedule modes and delivery of radiotherapy	G.V. Mitsyn K.Sh. Voskanyan	1 (2017 – 2019)
2. RADIOGENE: Experimental justification of radiation genetic risk estimation according to the frequency of heritable DNA changes in human and animal structural genes	I.D. Alexandrov	1 (2017 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Further development of methods, technologies, schedule modes and delivery of radiotherapy DLNP	G.V. Mitsyn K.Sh. Voskanyan A.V. Agapov, I.V. Alexandrova, V.M. Breyev, D.M. Borovich, V.N. Gaevsky, G.V. Donskaya, Ye.I. Luchin, I.I. Klochkov, I.Ye. Miller, A.G. Molokanov, K. Oancea, S.A. Pisareva, M.A. Tseytlina, K.N. Shipulin, A.V. Rzyanina	R&D
2. RADIOGENE: Experimental justification of radiation-genetic risk estimation according to the frequency of heritable DNA changes in human and animal structural genes DLNP	I.D. Alexandrov M.V. Alexandrova, K.P. Afanasyeva, S.V. Korablinova, L.N. Korovina, Ye.V. Kravchenko, A.N. Rusakovich	R&D

Collaboration

Country or International Organization	City	Institute or Laboratory
Czech Republic	Řež	UJV
	Prague	PTC
India	Mumbai	BARC
	New Delhi	IUAC
Poland	Krakow	NINP PAS
	Otwock-Swierk	NCBJ
	Poznan	GPCC
Romania	Bucharest	UMF
		UB
Russia	Moscow	VIGG RAS
		IBMP RAS
		RMAPE
	Dubna	RDH-9
	Rostov-on-Don	SFedU

Novel Semiconductor Detectors for Fundamental and Applied Research

Leader: G.A. Shelkov
Deputy: A.S. Zhemchugov

Participating Countries and International Organizations:

Belarus, CERN, Cuba, Croatia, Czech Republic, Germany, Italy, New Zealand, Romania, Russia, Switzerland, United Kingdom, USA.

Scientific Programme

development of the existing scientific and technical base for R&D of semiconductor radiation-resistant detectors and hybrid high-resolution pixel detectors based on new semiconductor materials and Medipix readout chips for physical studies. development of the existing infrastructure for characterization of semiconductor detectors created at JINR and laboratories of the participating countries, in conjunction with beam tests at the JINR basic facilities. Conducting joint investigations in collaboration with research groups from other scientific centers to determine the potential of using the developed detectors and technologies in other fields of science and technology, especially in geology and biomedicine.

Research in condensed matter physics using the method of positron annihilation spectroscopy (PAS). Development of a PAS method on the beam of monochromatic positrons, the creation of equipment for spectroscopy by the Doppler method of measuring the lifetime of positrons in matter.

Development and construction of setups for experiments at accelerators for obtaining new information and testing the present theoretical views in the strong, weak and electromagnetic interactions of elementary particles and light nuclei at intermediate energies with the aim of determining symmetries and dynamics of the interaction.

Expected main results in 2018:

- Data taking and analyze the information from GaAsPix system for radiation background monitoring in ATLAS.
- Study of the radiation hardness of GaAs:Cr. Measurement response of Timepix detectors at different particles and development the method of particle identification.
- Upgrade of the existing stations for measuring properties of semiconductor detectors.
- Installation in a MARS microtomograph pixel detectors with larger size.
- Construction microtomograph with a fixed large area detector and a rotating specimen.
- Development of a full-featured readout electronics unit and preparation for the creation of detectors based on the Medipix4 chip.
- Development of methods for spectral microtomography, including the improvement of computational algorithms.
- CT scan bio samples in cooperation with medicine expert.
- Studies of the possibility of isolating radiopaque substances in the body according to the energy dependence of the linear attenuation coefficient.
- CT scan of ores and mineral raw materials in cooperation with geophysicist.
- Production of a polarimeter based on the Timepix detector for a source of polarized deuterons at the Nuclotron.

- Commissioning of the slow monochromatic positrons cryogenic source, construction of the closed autonomous cooling system and the emitter-source of the activity of 30 mCi.
- The construction and commissioning of the specialized monochromatic positron channel (SMPC) and the experimental station. Start of research by Doppler method.
- Experiments with the Active Target (GDH).

List of projects:

Project	Leader	Priority (period of realization)
1. Novel semiconductor detectors for fundamental and applied research	G.A. Shelkov	1 (2015 – 2020)
2. PAS Development of the experimental techniques and applied research with slow monochromatic positron beams	A.G. Kobets P. Horodek Scientific leader I.N. Meshkov	1 (2016 – 2020)
3. GDH&SPASCHARM	Yu. Usov A. Kovalik	1 (2011 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Project "Novel semiconductor detectors for fundamental and applied research"	G.A. Shelkov	Realization
DLNP	V. Andriashen, M. Demichev, D.V. Dedovich, A. Gongadze, M.I. Gostkin, A.V. Guskov, S.A. Kotov, D.F. Kozhevnikov, V.G. Kruchonok, N.Kuznetsov, A. Lapkin, A.Leyva Fabelo, A.Nozdryn, V.N. Pavlov, S.Yu. Porokhovoy, S. Shakur, P. Smolyansky, V. Tokareva	
FLNR	S. Mitrofanov	
VBLHEP	J. Lukstins, A.M. Korotkova, D.O. Krivenkov, A.V. Averianov, C.B. Starikova, A. Maximchuk	
2. Use of new semiconductor photodetectors in a calorimetry for high energy physics	N.V. Anfimov	Realization
DLNP	Z.V. Krumshteyn, A.I. Antoshkin, A.G. Olshevskiy, I.A. Orlov, T.V. Rezinko, A.V. Rybnikov, A.S. Selunin, V.V. Chalyshev, I.E. Chirikov-Zorin, D.V. Fedoseev	
VBLHEP	I.A. Tyapkin, Z.Ya. Sadygov, T.Yu. Bokova, B. Marinova	
3. Project Development of the experimental techniques and applied research with slow monochromatic positron beams (PAS)	A.G. Kobets P. Horodek	Realization

DLNP	E.V. Ahmanova, I.N. Meshkov, O.S. Orlov, A.Yu. Rudakov, A.A. Sidorin, L.V. Soboleva, T.A. Stepanova, V.I. Hilinov, S.L. Yakovenko
VBLHEP	V.M. Drobin, V.V. Seleznev
4. GDH&SPASCHARM Project	Yu. Usov A. Kovalik
	Data taking Data processing
DLNP	N.S. Borisov, N.A. Bazhanov, A.N. Fedorov, Yu.A. Plis, A.B. Lazarev, A.B. Neganov, A.B. Sadovsky, I.V. Gapienko
BLTP	S.B. Gerasimov, S.S. Kamalov

Collaboration

Country or International Organization	City	Institute or Laboratory
Belarus	Minsk	BSTU
Croatia	Zagreb	RBI
Cuba	Havana	CEADEN
Czech Republic	Prague	CTU
CERN	Geneva	CERN
Switzerland	Basel	Uni Basel
Germany	Hamburg	DESY
	Mainz	JGU
	Bonn	UniBonn
	Giessen	JLU
Italy	Pavia	INFN
New Zealand	Christchurch	UC
Poland	Krakow	NINP PAS
Romania	Bucharest	ISS
Russia	Dubna	Dubna Univ.
	Moscow	MSU
	Moscow, Troitsk	INR RAS
	Arkhangelsk	NArFU
	Tomsk	TSU
	St. Petersburg	SPbSPU
United Kingdom	Edinburgh	Univ.
USA	Washington, DC	UW
Ukraine	Kharkov	ISMA NASU
		IERT NASU

Networking,
Computing,
Computational
Physics
(05)

Information and Computing Infrastructure of JINR

Leader:

V.V. Korenkov

Deputy:

T.A. Strizh

Participating Countries and International Organizations:

Armenia, Azerbaijan, Belarus, Bulgaria, CERN, China, Cuba, Czech Republic, Egypt, France, Georgia, Germany, Italy, Kazakhstan, Moldova, Mongolia, Poland, Romania, Russia, Slovakia, South Africa, Sweden, Taiwan, Ukraine, USA.

Scientific Programme

The purpose of the theme is to ensure the further development of the network, information and computing infrastructure of JINR for the research and production activities of the Institute and its Member States on the basis of state-of-the-art information technologies in accordance with the JINR Seven-Year Plan of development. A particular area within the theme is the development of the Multifunctional Information and Computing Complex (MICC) at LIT JINR, presented in a Project form.

Expected main results in 2018:

- Provision of the reliable functioning of the JINR local network. Gradual transition of the JINR Backbone to 100 Gbps.

Provision of a reserved power supply and uninterrupted power supply of the MICC infrastructure. Modernization of the climate control in the computer hall to create optimal climate conditions for the equipment. Development of the project on fire safety for the MICC engineering infrastructure.

Phased introduction of IPv4 dynamic addressing (DHCP) for the further transition to IPv6 in the JINR network. Putting of the “Personal Cabinet” service into trial operation. Development of services of local and wireless registration and authorization. JINR e-mail service modernization.

Growth of the basic grid-component of the MICC, Tier–1 centre for the CMS experiment at JINR: CPU by 23%, disk storage by 20% and tape storage by 100%.

Extension of the computing resources and data storage systems included in the integrated component Tier–2/CICC - CPU by 27% and disk storage for 14%.

Increase of the computing power of the heterogeneous cluster HybriLIT by 20% through the addition of computing nodes with Intel Xeon Phi processors of a new generation (KNL). Extension of the software environment of the HybriLIT cluster with a new modules enabling the use of packages of applied software and mathematical software with advanced graphical interfaces.

Expansion of the cloud-based component foresees 28% increase in the number of cores, 30% for RAM and 33% for disk storage capacity. Increase in quotas for cloud resources for experiments at JINR (NICA, ALICE, BESIII, NOvA, Daya Bay, JUNO, etc.) and the JINR Member States

Creation and testing a cluster prototype of the monitoring system on the basis of Icinga2. Developing scripts to provide migration of the current configuration of the monitoring system into the prototype. Commissioning the service monitoring system and investigation of the possibility of predicting MICC malfunctions.

Technical implementation and pilot exploitation of the EOS file system based computing and the storage components for off-line cluster for NICA inside MICC.

- Further development of the functionality of 1C Manufacturing Enterprise Management software: analysis and modernization of already established modules; analysis of the peculiarities and functionality of the 1C:ERP Enterprise Management 2 platform; preparation for the transition from 1C 8.3 to the 1C:ERP platform.

Expansion of the list of information systems connected to the gateway of data exchange and types of data transferred through the gateway. Completion of the modernization of the PIN system and its connection to the data exchange gateway. Completion of works enabling the highest possible gateway data protection from unauthorized access.

Development of the project management information system APT EVM for NICA securing better coverage of the regularly occurring new requirements on organization of planning and accounting, in particular, accounting the target funds of the Russian Federation, etc.

Completion of the development of system-wide modules for EDH "Dubna". The development and putting into service of new documents: "Executive order on the enlistment of people invited to visit JINR" and integration of this document into the CHI (Compulsory Health Insurance) system, "Executive order on secondment", "Invoice for vendor's payment".

Development of information services of the JINR Document Server: implementation of trustworthy records of Personalities, Grants; improvement of the information input module.

Development and maintenance of the hardware and software environments for information, algorithmic and software support of JINR's activity. Support of program libraries JINRLIB, CERNLIB, and CPC. Provision of access to the software and data of NEA OECD Bank.

Development and maintenance of the central information servers and portals to provide information and software support of the activities underway at LIT and JINR. Development of the services provided to the users of the "Visitor center" portal; setting up a connection of the portal to a universal gateway for data exchange.

- Conducting on the basis of the education and research grid-infrastructure, as well as cloud and the HybriLIT heterogeneous cluster regular training courses and tutorials for JINR employees, students and young scientists from the JINR Member States on advanced information technologies, including Big Data, distributed and parallel programming technologies, cloud and grid technologies. Organizing and conducting special courses by leading software developers. Conducting student schools on information technologies in frames of the conferences held by LIT JINR as well as special training courses in the JINR Member States in frames of the programmes on international cooperation.

List of projects:

Project	Leader	Priority (period of realization)
1. MICC	V.V. Korenkov	1 (2017 – 2019)

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers
1. MICC Project	V.V. Korenkov A.G. Dolbilov V.V. Mitsyn T.A. Strizh
LIT	Gh. Adam, G. Adamov, Eu.I. Aleksandrov, I.N. Aleksandrov, K.N. Angelov, N.S. Astakhov, A.S. Baginyan, A.I. Balandin, N.A. Balashov, A.V. Baranov, S.D. Belov, D.V. Belyakov, A.S. Bondyakov, A.I. Churin, S.V. Chashchin, S.V. Gavrilov, A.P. Gavrish, V.V. Galaktionov, T.M. Goloskokova, A.O. Golunov, Eu.A. Grafov, N.I. Gromova, A.E. Gushchin, I.S. Kadochnikov, A.S. Kamensky, V.A. Kapitonov, I.A. Kashunin, A.O. Kondratiev, G.A. Korobova, E.Yu. Kulpin, N.A. Kutovskiy, A.A. Lavrentiev,

S.B. Marchenko, M.A. Matveev, S.V. Mitsyn,
A.V. Nechaevsky, D.A. Oleynik, G.A. Ososkov,
I.S. Pelevanyuk, A.Sh. Petrosyan, M.S. Plyashkevich,
D.V. Podgainy, L.A. Popov, D.I. Pryakhina,
Ya.I. Rozenberg, T.F. Sapozhnikova, R.N. Semenov,
M.L. Shishmakov, O.I. Streltsova, V.V. Trofimov,
N.N. Voitishin, A.S. Vorontsov, A.V. Uzhinskiy,
A.Yu. Zakomoldin, V.E. Zhiltsov, P.V. Zrelov, M.I. Zuev

B.G. Shchinov, Yu.P. Minaev, O.V. Rogachevsky,
S.V. Shmatov

VBLHEP
Yu.K. Potrebenikov

FLNP
G.A. Sukhomlinov

LRB
V.N. Chausov

FLNR
V.V. Sorokoumov

DLNP
Yu.P. Ivanov

BLTP
A.A. Sazonov

UC
I.N. Semeniushkin

A.G. Polyakov

**2. Information and software support
of the research-and-production
activity at JINR**

**P.V. Zrelov
V.V. Korenkov
I.A. Filozova**

LIT

N.A. Balashov, A.V. Baranov, D.V. Belyakov,
A.A. Bogolubskaya, N.A. Davyudova, S.V. Duchits,
V.P. Gerdt, T.M. Goloskokova, D.S. Golub,
N.V. Jerusalemova, L.A. Kalmykova, A.A. Karlov,
D.V. Kekelidze, S.A. Kretova, S.V. Kunyaev,
G.A. Kurmaeva, N.A. Kutovskiy, A.A. Kutovskaya,
O.G. Melnikova, G.G. Musulmanbekov, S.A. Nechitailo,
E.A. Paschenko, V.V. Pervushov, M.S. Plyashkevich,
E.Yu. Polyakova, L.V. Popkova, A.V. Prikhodko,
V.M. Pushkina, A.M. Raportirenko, A.P. Sapozhnikov,
T.F. Sapozhnikova, S.V. Semashko, R.N. Semenov,
A.V. Sheyko, G.V. Shestakova, D.B. Stankus,
T.S. Syresina, N.N. Vorobieva, V.M. Yagafarova,
A.G. Zaikina, T.N. Zaikina

V.F. Borisovskiy

SOICO
A.S. Sorin

VBLHEP
Yu.K. Potrebenikov

A.V. Philippov, K.V. Turusina

**3. Development of a system of
training and advanced training of
IT professionals based on
educational and research
infrastructure and creation of an
information system to provide
assistance to users (Helpdesk)**

**V.V. Korenkov
T.A. Strizh
O.I. Streltsova**

LIT

N.A. Balashov, A.V. Baranov, S.D. Belov,
V.V. Galaktionov, T.M. Goloskokova, N.I. Gromova,
I.S. Kadochnikov, D.V. Kekelidze, N.A. Kutovskiy,
V.V. Mitsyn, S.V. Mitsyn, I.K. Nekrasova,
A.V. Nechaevsky, D.A. Oleynik, A.Sh. Petrosyan,
D.V. Podgainy, T.F. Sapozhnikova, R.N. Semenov,
V.V. Trofimov, A.V. Uzhinskiy, V.E. Zhiltsov, M.I. Zuev

UC

S.Z. Pakuliak

Collaboration

Country or International Organization

City

Institute or Laboratory

Armenia	Yerevan	IIAP NAS RA YSU
Azerbaijan	Baku	IP ANAS
Belarus	Minsk	BSTU INP BSU JIPNR-Sosny NASB GSTU
	Gomel	
Bulgaria	Sofia	INRNE BAS SU
CERN	Geneva	CERN
China	Beijing	IHEP CAS
Cuba	Havana	UCI
Czech Republic	Prague	IP ASCR
	Ostrava	VSB-TUO
Egypt	Giza	CU
France	Marseille	CPPM
Georgia	Tbilisi	GRENA GTU TSU
Germany	Darmstadt	GSI
	Frankfurt/Main	Univ.
	Hamburg	DESY
	Karlsruhe	KIT
	Zeuthen	DESY
Italy	Bologna	INFN
Kazakhstan	Astana	BA INP ENU
Moldova	Chişinău	ASM IAP ASM RENAM
Mongolia	Ulaanbaatar	NUM
Poland	Krakow	CYFRONET
Romania	Bucharest	IFA

Russia	Cluj-Napoca	IFIN-HH
	Moscow	INCDTIM
		IITP RAS
		ISP RAS
		ITEP
		KIAM RAS
		MPEI
		MSU
		NRC KI
		RCC MSU
		RIPN
		RSCC
		SINP MSU
	Moscow, Troitsk	INR RAS
	Chernogolovka	SCC IPCP RAS
		LITP RAS
	Dubna	Dubna Univ.
	SCC "Dubna"	
	SEZ "Dubna"	
Gatchina	PNPI	
Nizhny Novgorod	UNN	
Novosibirsk	BINP SB RAS	
Pereslavl-Zalesskiy	PSI RAS	
Protvino	IHEP	
Puschino	IMPB RAS	
Samara	SU	
St. Petersburg	FIP	
	ITMO	
	SPbSU	
	SPbSPU	
Slovakia	Košice	IEP SAS
	Prešov	PU
South Africa	Cape Town	UCT
Sweden	Lund	LU
Taiwan	Taipei	ASGCC
Ukraine	Kiev	BITP NASU
	Kharkov	NSC KIPT
USA	Arlington, TX	UTA
	Batavia, IL	Fermilab
	Upton, NY	BNL

Methods, Algorithms and Software for Modeling Physical Systems, Mathematical Processing and Analysis of Experimental Data

Leaders:

Gh. Adam
P.V. Zrelov

Participating Countries and International Organizations:

Armenia, Australia, Austria, Belarus, Brazil, Bulgaria, Canada, CERN, China, Czech Republic, France, Georgia, Germany, Great Britain, India, Italy, Kazakhstan, Mexico, Mongolia, Poland, Romania, Russia, Saudi Arabia, Slovakia, South Africa, Switzerland, Taiwan, Tajikistan, USA, Vietnam.

Scientific Programme

Carrying out paramount advanced research in the field of computational mathematics and computational physics, directed to the creation of new mathematical methods, algorithms, and software for the numerical or symbolic-numerical solution of topics arising in experimental and theoretical studies, by using the newest computational tools, primarily the heterogeneous cluster HybriLIT. This subject area includes a wide spectrum of investigations underway at JINR in high energy physics, nuclear physics, condensed matter physics and nanotechnologies, biophysics, information technologies, etc., which demand the development of new mathematical methods and approaches for modeling physical processes, processing and analysis of experimental data, including the use of these studies in the NICA project, the neutrino programme and other strategic goals of the Institute. A distinctive feature of these investigations is the close cooperation of LIT with research groups from all the JINR laboratories and from Member State institutions.

Expected main results in 2018:

- Numerical investigation of the hydrodynamical equations for dense nuclear matter at NICA energies: one-dimensional hydrodynamics (Glauber model and Bjorken scenario); the 3-fluid hydrodynamics for heavy ion collisions. Creation of parallel packages on HybriLIT.

Study of the bound states of the hadrons and their birth in hot dense nuclear matter at the NICA energies. Creation of parallel packages on HybriLIT.

Three-dimensional computer simulation of magnetic field distribution in superconducting dipole and quadrupole magnets for the NICA Collider. Simulation of magnetic field in superconducting quadrupole magnets of the SIS100 (FAIR).

Lattice study of the dependence of the gluon effective mass within SU(2) gluodynamics on the choice of lattice boundary conditions.

Study of the occurrence of the quark degrees of freedom in nuclear structures and of the spin transfer in dA reactions in the BM@N experiment.

Development of a method to study photoproduction of long-lived nP states of the $\pi^+\pi^-$ atoms and nuclei at large momentum transfers.

Development of numerical and analytical methods of calculation, in the eikonal approximation, of forward transition amplitudes of the dimesoatoms as functions of the transferred momentum.

Development of methods of calculation of kinetic, thermodynamic and optical characteristics of the intermediates in the Belousov-Zhabotinsky oscillating reactions.

Development of the microscopic optical potential model and its application to numerical studies of the mechanisms of interaction of the particles and nuclei with nuclei, including reactions with light exotic nuclei. Analysis and modeling of physical processes at the installations COMBAS and BURAN.

Numerical investigation of the spin dynamics of dipolar and spinor molecules in optical lattices.

Mathematical modeling of beam dynamics with subsequent correction of the formed magnetic field in the cyclotron for proton therapy SC202 (Hefei, China) on the basis of measured magnetic field maps and measured Smith-Garren curves. Mathematical modeling of operating modes for multi-purpose isochronous cyclotrons: AIC-144 (Krakow, Poland) and DC-280 (Dubna, Russia).

Development and maintenance of the primary data processing program "SAS" for the YuMO spectrometer at IBR-2M. Program upgrade to accommodate position sensitive detectors for isotropic scattering samples and ring detectors.

Development of algorithms for data analysis for anisotropic scattering samples.

Development of methods and algorithms for computing informative features invariant to geometrical transformations of 2D curves specified by measured point coordinates.

Optimal control of the decision path in Bayesian automatic adaptive quadrature.

Study of the stability of economical methods for solving systems of linear algebraic equations with band matrices arising in the approximation of equations of elliptic and parabolic types with discontinuous coefficients.

Simulation of the process of cooling of the compact stars the equation of state of which characterizes the superdense nuclear matter, allowing the existence of a third family of compact stars (twins) and study of the characteristics of their thermal behavior.

Numerical modelling of quantitative structural changes in materials irradiated by beams of heavy ions and nanoclusters. Modeling the electron structure of lead halide perovskites for the next generation of solar cells and spintronics.

- Adaptation of the GEANT4 FTF model for simulations of antiproton-proton and antiproton-nucleus interactions foreseen in the PANDA experiment.

Tuning and validation of the GEANT4 FTF model for light and intermediate nucleus collisions, using the latest RHIC and NICA data, with the aim to use the created program for design studies and analysis of experimental data.

Study of the structural functions of the dileptons and of the enhancement of the strange particle yield in heavy-ion collisions in the NICA collaboration.

Further development of the dataflow control system in the experiments of the NICA project.

Software support of ATLAS experiment, agreed with the ATLAS computing team: creation and maintenance of a zipc-based new version of the Resource Manager; maintenance and development of a new version of the TDAQ Log Manager of the ATLAS; support and improvement of ATLAS network monitoring dashboard tool.

Improving the algorithms of the spatial coordinate recovery of the interaction points of the detected particles with matter in the tracking GEM detectors of the BM@N setup.

Development of a software model of the microstrip silicon detector and of algorithms for processing the data acquired with this detector, with the purpose to improve the accuracy of reconstruction of the primary vertices of interaction and to increase the effectiveness of the reconstruction of charged particle tracks in the BM@N setup BM@N: Trajectory reconstruction of charged particles in tracking detectors; strange hyperon search in Nuclotron data.

Reconstruction of the impulses of the charged particles registered by the GEM detectors in inhomogeneous magnetic field in the BM@N experiment based on the method of orthogonal polynomial sampling.

Reconstruction of the decays of short-lived strange and multistrange baryons in the BM@N experiment with the package KFParticleFinder.

Development of algorithms and programs for the particle trajectories recognition in the MPD setup. CMS: Development and testing of the algorithm of overlapped signal separation in CSC and its implementation into official CMS release; investigation of CSC performance (efficiency and resolution) with new LHC data; CSC ageing study on muon beam tests at the radiation source CERN-GIF++.

Investigation of the structure and properties of phospholipid based polydisperse nanosystems from small-angle scattering data analysis.

Basic element method based processing of the neutron noise of the reactor IBR-2M.

Investigation of applicability of neural networks with deep learning in the processing of the experimental information from modern track detectors in high energy physics to develop new algorithms for the reconstruction of the tracks of elementary particles.

Development of data processing programs for the project BAIKAL.

Further development of the software package VMRIA for the automatic analysis of large spectra collected in experiments carried out on HRFD at IBR-2M aimed at the study of the temporal evolution of the phase composition of polycrystals.

Development of software for automatic calibration of multi-detection systems based on the solution of a pattern recognition problem.

Development of event analysis based methods for parameter estimation and hypothesis testing under low statistics experiments and observation incompleteness.

Evaluation of the accuracy and resolution of the implementation of the inverse Fourier transform method used in neutron reflectometry for certain stochastic models of the surface of nanostructured objects.

Adaptation of the algorithm L1 - recognition and track reconstruction of charged particles for the BM@N experiment.

Further development of criteria and methods of reconstruction of the decays $J/\psi \rightarrow e^+e^-$ in the CBM experiment.

Study of the possibility of creating a trigger for the selection of $J/\psi \rightarrow e^+e^-$ based on the reconstruction of the trajectories of charged particles and their identification in the transition radiation detector TRD in the CBM experiment.

Further development of selection criteria of the rare decays $J/\psi \rightarrow \mu^+\mu^-$ using data from the coordinate planes of the MUCH detector.

Software development of the data acquisition system (DAQ) and of the software interface between the DAQ and CBMRoot for the RICH detector online analysis.

Development, optimization and testing of algorithms for the event processing system FLES on multicore servers at LIT. Inclusion of the 4D-reconstruction time slices in CBMROOT. Study of the problem of possible event cleavage in the border areas between neighboring time slices.

Development and application of the "CATIA-GDML Geometry Builder" software to automatic design of large-scale experimental facilities in the environment ROOT / GEANT4-based CAD system CATIA v5. Application to the development of experimental facilities in JINR laboratories.

Further development of a database system for the CBM experiment: 1) implementation of component-wise database adapted to the features of the various detectors of the CBM facility; 2) implementation of the structure of the geometric database.

Development of methods and algorithms for massive calculations of electrostatic potentials of molecules of DNA, RNA and protein factors, as well as maps of the surface of these biopolymers. Calculation at the HybriLIT cluster of electrostatic potentials and surface maps of biopolymer molecules enabling solutions of biomolecular recognition problems.

- Development and maintenance of the information-computing environment of the heterogeneous cluster HybriLIT including the setup and maintenance of specialized libraries.

Computer simulation of complex processes in multi-parameter nonlinear models of physics of the condensed state, including the polaron and the long Josephson junction models. Their code implementation for computations on HybriLIT.

Development of methods and MPI packages for the computation of multiple integrals (up to 9D) for the study of processes of ionization and photoionization of the He atom, polyatomic molecules, and their ions.

Development and implementation of new parallel algorithms into the MCTDHB software complex and their adaptation to the new KNL architecture of the Intel Xeon Phi.

HybriLIT devoted optimization of selected programs of the ROOT software package with the aim to improve the efficiency of parallel computing.

Development of parallel algorithms for direct methods of solving large sparse systems obtained under use of hp-adaptive projection-element methods with discontinuous bases.

Testing and validation of different modules of Comsol Multiphysics® package on the cluster HybriLIT and their adaptation for solving engineering-physical problems in JINR laboratories (superconducting magnet SC202-DLNP, modules of the new FLNR accelerator).

Implementation of parallel algorithms for the numerical solution of the Boltzmann-Poisson equations describing the interaction of protein macromolecules with the solvent.

- Modeling quantum spin dynamics of charged particles in intense laser fields. Development of a classification scheme of mixed states of quantum relativistic composite systems.

Development of search algorithms of regular structures in combinatorial models of quantum evolution using Monte Carlo simulation and methods of computational group theory.

Derivation of an algorithm for finding the parameterization of a simple complex Lie group as a singular Riemannian foliation on conjugacy classes using methods of the computational theory of the invariants.

Derivation, in the framework of Kantorovich method, of symbolic - numerical algorithms for solving three-dimensional and parametric two-dimensional boundary value problems by finite element methods of high order of accuracy for the study of bound states and scattering states of atom trimers.

Derivation of an algorithm for finding minimal bases of Feynman integrals with arbitrary powers of the propagators and its implementation in Maple. Application of the algorithm to one-loop integrals. Creation and optimization of a package in C to bring systems of linear difference equations to canonical involutive forms.

Development of constructive methods of Thomas triangular decomposition for polynomial-nonlinear systems of difference equations. Algorithmic test of the linearizability and equivalence for ordinary differential equations.

List of activities:

Activity or experiment	Leaders
Laboratory or other	Main researchers
Division of JINR	
1. Mathematical and computation methods for simulation of complex physical systems	Gh. Adam I.V. Puzynin
LIT	S. Adam, P.G. Akishin, I.V. Amirkhanov, E.A. Ayrjan, A.S. Ayriyan, I.V. Barashenkov, M.V. Bashashin, I.L. Bogolubsky, N.D. Dikoussar, H. Grigorian, Yu.L. Kalinovsky, T.V. Karamysheva, K.V. Lukyanov, N.V. Makhaldiani, T.I. Mikhailova, G.J. Musulmanbekov, E.G. Nikonov, K. Oganessian, G.A. Ososkov, R.V. Polyakova, T.P. Puzynina, B. Saha, N.R. Sarkar, I. Sarkhadov, Z.A. Sharipov, A.G. Soloviev, T.M. Solovieva, O.I. Streltsova, L.A. Siurakshina, Z.K. Tukhliev, A.V. Volokhova, O.O. Voskresenskaya, A. Wojczechowski, R.M. Yamaleev, E.P. Yukalova, E.V. Zemlyanaya
VBLHEP	E.E. Donets, S. Gevorkyan, M.N. Kapishin, A.O. Kechechyan, H.G. Khodzhibagiyani, V.A. Nikitin, O.V. Rogachevski, W. Scheinast
BLTP	A.V. Friesen, M. Hnatic, E.-M. Ilgenfritz, N.I. Kochelev, V.K. Lukyanov, S.N. Nedelko, O.V. Teryaev, V.D. Toneev, S.I. Vinitzky, V.I. Yukalov, V.Yu. Yushankhai

FLNR	A.G. Artukh, B. Erdemchimeg, S.M. Lukyanov, Yu.E. Penionzhkevich, R.A. Rymzhanov, Yu.M. Sereda, V.A. Skuratov, Yu.G. Sobolev
FLNP	A.I. Kuklin, A.I. Ivankov, D.V. Soloviev
DLNP	L.G. Afanasiev, G.A. Karamysheva, I.N. Kiyan, V.A. Malinin, D.V. Popov
2. Software complexes and mathematical methods for processing and analysis of experimental data	P.V. Zrelov V.V. Ivanov
LIT	T.O. Ablyazimov, E.P. Akishina, V.P. Akishina, E.I. Aleksandrov, I.N. Aleksandrov, D.A. Baranov, S. Belogurov, O.Yu. Derenovskaya, N.D. Dikoussar, A.A. Kazakov, A.I. Kazymov, P.I. Kisel, B.F. Kostenko, G.E. Kozlov, L.Yu. Kruglova, A.A. Lebedev, M.A. Mineev, G.A. Ososkov, E.V. Ovcharenko, V.I. Palichik, V.S. Rikhvitsky, V.N. Shigaev, N.Yu. Shirikova, S.K. Slepnev, A.G. Soloviev, T.M. Solovieva, A.N. Sosnin, V.V. Uzhinsky, N.N. Voitishin, A.V. Yakovlev, E.V. Zemlyanaya, E.I. Zhabitskaya, V.B. Zlokazov
VBLHEP	B.V. Batyunya, A.S. Galoyan, K.V. Gertsenberger, M.N. Kapishin, V.P. Ladygin, V. Lenivenko, A.I. Malakhov, S.A. Movchan, O.V. Rogachevsky, M.G. Sapozhnikov, N.D. Topilin
FLNR	Yu.E. Penionzhkevich, Yu.S. Tsyganov, V.K. Utenkov
FLNP	A.M. Balagurov, A.V. Belushkin, I.A. Bobrikov, M.A. Kiselev, D.P. Kozlenko, S.A. Manoshin, Yu.N. Pepelyshev
DLNP	I.V. Bednyakov, V.A. Bednyakov, I.A. Belolaptikov, V.B. Brudanin, A.G. Olshevsky, D.B. Pontecorvo, B.A. Shaibonov, L.G. Tkachev, A.S. Zhemchugov
UC	S. Pakuliak
3. Numerical methods, algorithms and software computationally adapted to multicore and hybrid architectures	Gh. Adam P.V. Zrelov O.I. Streltsova
LIT	E.I. Aleksandrov, A.S. Ayriyan, E.A. Ayrjan, M.V. Bashashin, D.V. Belyakov, J. Bu?a, A.M. Chervyakov, O. Chuluunbaatar, A.A. Gusev, M. Kirakosyan, M.A. Matveev, D.V. Podgainy, A.A. Sapozhnikov, T.F. Sapozhnikova, S.I. Serdyukova, A.G. Soloviev, T.M. Solovieva, Sh. Torosyan, A.V. Volokhova, O.I. Yuldashev, M.B. Yuldasheva, E.V. Zemlyanaya, E.I. Zhabitskaya, M.I. Zuev
FLNR	S.V. Bogomolov, B.N. Gikal, G.G. Gulbekian, N.Yu. Kazarinov
BLTP	D.B. Blashke, Yu.V. Popov, Yu.M. Shukrinov, S.I. Vinitsky

VBLHEP

I.A. Golutvin

DLNP

G.A. Karamysheva, O.V. Karamyshev, I.N. Kyan,
N.A. Morozov, G.D. Shirkov

**4. Methods, algorithms and software
of computer algebra V.P. Gerdt**

LIT

V. Abgaryan, A.A. Bogolubskaya, O. Chuluunbaatar,
A.A. Gusev, A.M. Khvedelidze, V.V. Korniyak, Yu. Palii,
A.M. Raportirenko, I.A. Rogozhin, O.V. Tarasov,
A.G. Torosyan, D.A. Yanovich

BLTP

A.V. Czhizhov, P. Fiziev, A.I. Titov, S.I. Vinitzky

FLNR

B.N. Gikal

Collaboration

**Country or International
Organization**

City

Institute or Laboratory

Armenia

Yerevan

Foundation ANSL
IIAP NAS RA
RAU
YSU

Australia

Canberra

ANU

Austria

Linz

JKU

Belarus

Minsk

IM NASB
BSTU

Brazil

Sao Carlos, SP

IFSC USP

Bulgaria

Sofia

IMI BAS
INRNE BAS
SU

Canada

Plovdiv

PU

Toronto

IBM Lab

Edmonton

U of A

Hamilton

McMaster

CERN

Geneva

CERN

China

Nanning

GUFN

Czech Republic

Prague

CTU

France

Marseille

IM2NP

Metz

UPV-M

Georgia

Tbilisi

GTU

TSU

UG

Germany

Bonn

UniBonn

Darmstadt

GSI

Dresden

IFW

MPI PkS

Frankfurt/Main

Univ.

	Hamburg	Univ.
	Jülich	IKP
	Kassel	Uni Kassel
	Munich	LMU
India	Calcutta	GCECT
		JU
	Shibpur	IEST Shibpur
Italy	Bari	UniBa
	Catania	INFN LNS
Kazakhstan	Almaty	INP
Mexico	San Luis Potosi	UASLP
Mongolia	Ulaanbaatar	IPT MAS
		NUM
Poland	Krakow	NINP PAS
	Lublin	UMCS
	Otwock-Swierk	NCBJ
	Warsaw	WUT
	Wroclaw	UW
Romania	Bucharest	IFA
		IFIN-HH
		ISS
		UB
	Cluj-Napoca	INCDTIM
Russia	Moscow	GPI RAS
		ITEP
		KIAM RAS
		MIET
		NNRU "MEPhI"
		NRC KI
		PFUR
		RCC MSU
		SINP MSU
		PFUR
	Dubna	Dubna Univ.
	Protvino	IHEP
	Puschino	IMPB RAS
	Samara	SSU
	Saratov	SSU
	St. Petersburg	ITMO
		NIEFA
	Tomsk	TSU
Saudi Arabia	Tuval	KAUST
Slovakia	Košice	IEP SAS
		PJSU
		TUKE

		PJSU
	Prešov	PU
	Banska Bistrica	UMB
South Africa	Cape Town	UCT
	Stellenbosch	SU
Switzerland	Zurich	ETH
Taiwan	Taipei	AS
Tajikistan	Dushanbe	TNU
		PHTI ASRT
	Khujent	KSU
United Kingdom	Bath	UB
USA	Lawrence, KS	KU
	Los Alamos, NM	LANL
Vietnam	Hanoi	VNU

**Analytical and Methodological Work to Assess the Prospects
of Scientific Research and Cooperation in the Main Directions
of JINR's Development.
Organization of International Cooperation**

Leader: A.S. Sorin

Participating Countries and International Organizations:

Member States of JINR, non-Member States participating in JINR activities on the basis of bilateral agreements, and international organizations.

Scientific Programme

Preparation by the JINR Science Organization Department of analytical materials on the prospects of scientific research. Preparation of research plans. Preparation of scientific-organizational and methodological materials concerning special-purpose financing of research areas, themes and projects. Application of data base systems for the analysis of results of theoretical and experimental research activities. Organization of international cooperation with the Member States of JINR, non-Member States participating in JINR activities on the basis of bilateral agreements, and with scientific research institutions with which JINR has collaboration agreements.

Expected main results in 2018:

- Analysis of the results of JINR activities in the main directions of research. Preparation for publication of the JINR Topical Plan for Research and International Cooperation for 2019.
- Information and technical preparation of the JINR Web site. Support of the electronic system of protocols for scientific and technical collaboration.
- Preparation for publication of JINR Annual Reports Preparation of materials for the INIS system.
- Maintenance of interaction with representatives of the JINR Member States and non-Member States participating in JINR activities on the basis of bilateral agreements in the field of scientific research. Organization and holding of meetings of the Cooperation Committees. Maintenance of JINR's interaction with international organizations.

List of activities:

Activity or experiment	Leaders
Laboratory or other	Main researchers
Division of JINR	
1. Preparation for publication of the JINR Topical Plan for Research and International Cooperation for 2019	A.S. Sorin
SOD	N.A. Boklagova, L.K. Ivanova, N.I. Sissakian
2. Maintenance of the JINR site	A.S. Sorin
SOD	N.A. Boklagova, L.K. Ivanova, O.K. Kronshtadtov, K.P. Moisenz, A.G. Nanev, N.I. Sissakian
SID	B.M. Starchenko

Editorial office, weekly newspaper
“Dubna: Science, Cooperation,
Progress”

LIT

3. International cooperation

ICD

E.M. Molchanov

K.V. Lukyanov, A.V. Prikhodko

D.V. Kamanin

A.A. Kotova, A.A. Sushevich

Educational
Programme
(06)

Organization, Support and Development of the JINR Educational Programme

Leaders:

V.A. Matveev

S.Z. Pakuliak

Participating Countries and International Organizations:

Armenia, Azerbaijan, Belarus, Bulgaria, CERN, Cuba, Czech Republic, Egypt, Kazakhstan, Moldova, Mongolia, Poland, Romania, Russia, Serbia, Slovakia, South Africa, Ukraine, USA.

Scientific Programme

Support and development of the JINR Educational Programme in general (training of physicists and engineers in JINR fields of research and in the interest of the Member States). Further professional development, training and retraining of JINR engineering and technical staff. Promotion of physics research and of the Institute activities among the youth of the Member States including high-school students, university students, and school teachers.

Expected main results in 2018:

- Support and maintenance of the educational process at JINR-based departments of Russian universities. Preparation and publication – as tutorials – of lectures given to the students and postgraduates at the UC. Support of the system of assigning young researchers to JINR laboratories for preparation of PhD theses without mastering the academic programmes of PhD courses.
- Organization and running of Summer Students Practices in JINR fields of research for students of higher-education institutions of the Member States. Participation in the organization and running of international schools on nuclear physics and particle physics for young scientists. Expansion of the research projects of the Summer Student Programme at JINR and of the number of participants of this programme.
- Development of the training facilities for practice in the framework of a UC-based scientific and engineering group for the fulfilment of educational programmes on training qualified specialists for the needs of JINR and other scientific centres of the Member States.
- Development of the computer infrastructure for organizing and conducting training programmes for data analysis in high-energy physics experiments and for the design of modern physics facilities.
- Improvement of the training laboratory and inter-school elective courses for the organization of lecture courses and practical classes in physics for high-school students from Dubna and the Member States. Organization of scientific schools for teachers of physics from the Member States at CERN and JINR.
- Organization of real and virtual excursions to JINR and video-conferences for high-school students and teachers from the Member States. Development of the system of teaching Russian, English, French, and German to JINR staff.
- Development of training and educational programmes in nuclear and particle physics. Dissemination of information on the Virtual Laboratory of Nuclear Fission in the Member States.

List of projects:

Project	Leader	Priority (period of realization)
1. Development of an open educational environment to support research priorities in materials science and structure of matter	Yu.A. Panebrattsev	1 (2017 – 2019)

List of activities:

Activity or experiment	Leaders
Laboratory or other	Main researchers
Division of JINR	
Responsible person	
1. Organization of the Educational Process at JINR	V.A. Matveev S.Z. Pakuliak
DLNP V.A. Bednyakov D.V. Naumov	G.A. Chelkov, A.G. Olshevskiy, V.V. Glagolev A.S. Zhemchugov
BLTP V.V. Voronov A.P. Isaev A.B. Arbuzov	D.I. Kazakov, A.V. Gladyshev, V.A. Osipov
FLNP V.N. Shvetsov E.V. Lychagin O.A. Culikov	B.N. Savenko, A.M. Balagurov, Yu.N. Kopach, A.V. Belushkin
VBLHEP R. Lednický V.D. Kekelidze	V.A. Nikitin, S.V. Shmatov, N.N. Agapov, S.S. Shimansky, N.I. Zimin
FLNR S.N. Dmitriev	S.I. Sidorchuk, A.G. Popeko, A.V. Karpov, S.G. Belogurov
LIT V.V. Korenkov	T.A. Strizh, V.P. Gerdt, D.V. Podgaynyi
LRB E.A. Krasavin	O.V. Belov, I.V. Koshlan
Directorate B.Yu. Sharkov B.N. Gikal	A.V. Dudarev, E.D. Uglov
SOICO D.V. Kamanin	W. Chmielowski, M.G. Loschilov, A.A. Sushevich, A.Yu. Belova
2. Developing of modern educational projects	Y.A. Panebratsev

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	YSU
Azerbaijan	Baku	IP ANAS

Belarus	Minsk	BSU INP BSU ISEI BSU ME RB
	Gomel	GSU GSTU
Bulgaria	Sofia	INRNE BAS NRA SU
	Blagoevgrad	SWU
CERN	Geneva	CERN
Cuba	Havana	ASC
Czech Republic	Prague	CU CTU
	Řež	NPI ASCR
Egypt	Cairo	ASRT
Kazakhstan	Almaty	KazNU
	Astana	ENU
	Ust-Kamenogorsk	EKSU
Moldova	Chişinău	ASM
Mongolia	Ulaanbaatar	IPT MAS
Poland	Krakow	JU
	Lodz	UL
	Poznan	AMU
Romania	Bucharest	UB
Russia	Moscow	NNRU “MEPhI” SINP MSU MPEI
	Arkhangelsk	NSMU NArFU
	Belgorod	BelSU
	Voronezh	VSU
	Ivanovo	ISU
	Krasnodar	KSU
	Smolensk	SSU
	Tomsk	TPU
	Yakutsk	NEFU
	Dolgoprudny	MIPT
	Dubna	Dubna Univ. BSINP MSU
	Kostroma	KSU
	St. Petersburg	SPbSU
	Tver	TvSU
	Tula	TSU
Serbia	Belgrade	INS “VINČA”

Slovakia	Bratislava	CU
	Košice	PJSU
South Africa	Pretoria	DST
Ukraine	Kiev	BITP NASU
		NUK
USA	Upton, NY	BNL

Alphabetic List of Collaborators

Albania

Tirana

UT (University of Tirana |
<http://www.unitir.edu.al/>), 130

Argentina

Bariloche

CAB CNEA (Centro Atomico Bariliche
National Atomic Energy Commission |
<http://www.cab.cnea.gov.ar/>), 140, 150

Buenos Aires

CNEA (National Atomic Energy Commission
| <http://www.cnea.gov.ar/>), 146

Armenia

Garni

GGO (Garni Geophysical Observatory), 90

Yerevan

ANSSP (Armenian National Survey for
Seismic Protection | <http://www.nssp.gov.am/about-NSSP-eng.htm/>),
90

CENS NAS RA (Center for
Ecological-Noosphere Studies of the
National Academy of Sciences of the
Republic of Armenia |
<http://www.cens.am/>), 130

Foundation ANSL (A.I.Alikhanian National
Science Laboratory (Yerevan Physics
Institute) Foundation |
<http://www.yerphi.am/>), 12, 23, 41, 64, 98,
102, 105, 123, 182

IIAP NAS RA (Institute for Informatics and
Automation Problems of the National
Academy of Sciences of the Republic of
Armenia | <http://ipia.sci.am/>), 23, 175, 182

Inst. Biochemistry NAS RA (H.Buniatian
Institute of Biochemistry of the National
Academy of Sciences of the Republic of
Armenia | <http://aab.sci.am/>), 153

RAU (Russian-Armenian University |
<http://www.rau.am/>), 12, 18, 182

Shirak Technologies ("Shirac" Technological
Company | <http://www.shte.net/>), 90

YSU (Yerevan State University |
<http://www.y-su.am/>), 18, 23, 29, 85, 98,
109, 123, 160, 175, 182, 189

Australia

Canberra

ANU (Australian National University |
<http://www.anu.edu.au/>), 182

Melbourne

Univ. (University of Melbourne |
<http://unimelb.edu.au/>), 23, 130

Perth

UWA (University of Western Australia |
<http://www.uwa.edu.au/>), 29

Sydney

Univ. (University of Sydney |
<http://sydney.edu.au/>), 23, 29, 109

Austria

Innsbruck

Univ. (University of Innsbruck |
<http://www.uibk.ac.at/>), 18, 130

Linz

JKU (Johannes Kepler University Linz |
<http://www.jku.at/>), 23, 182

Vienna

HEPHY (Institute of High Energy Physics |
<http://www.hephy.at/>), 64

IAEA (International Atomic Energy Agency |
<http://www.iaea.org/>), 130

TU Wien (Vienna University of Technology |
<http://www.tuwien.ac.at/>), 23, 29, 33

Uni Wien (University of Vienna |
<http://www.univie.ac.at/>), 33

Azerbaijan

Baku

AzTU (Azerbaijan Technical University |
<http://aztu.edu.az/>), 140

BSU (Baku State University |
<http://bsu.edu.az/>), 130

IP ANAS (Institute of Physics of the
Azerbaijan National Academy of Sciences |
<http://www.physics.gov.az/>), 12, 41, 85,
140, 175, 189

IRP ANAS (Institute of Radiation Problems
of the Azerbaijan National Academy of
Sciences | <http://irp.science.az/>), 102, 146

NNRC (National Nuclear Research Center |
<http://www.mntm.az/>), 105, 146

Ganja

ASAU (Azerbaijan State Agricultural
University | <http://adau.edu.az/>), 130

ATU (Azerbaijan Technological University |
<http://www.aztun.edu.az/>), 130

Belarus

Gomel

BelSUT (Belarusian State University of
Transport | <http://www.belsut.gomel.by/>),
64

- GSTU (Sukhoi State Technical University of Gomel | <http://www.gstu.by/>), 12, 41, 74, 175, 190
- GSU (Francisk Skorina Gomel State University | <http://www.gsu.by/>), 12, 42, 64, 74, 190
- MPRI NASB (V.A.Belyi Metal Polymer Research Institute of the National Academy of Sciences of Belarus | <http://mpri.org.by/>), 155
- Minsk*
- BSTU (Belarusian State Technological University | <http://www.belstu.by/>), 23, 140, 150, 155, 169, 175, 182
- BSU (Belarusian State University | <http://www.bsu.by/>), 47, 155, 190
- BSUIR (Belarusian State University of Informatics and Radioelectronics | <http://www.bsuir.by/>), 73, 85, 153
- IAP NASB (State Scientific Institution “Institute of Applied Physics of the National Academy of Sciences of Belarus | <http://iaph.bas-net.by/>), 41, 74, 140
- IM NASB (Institute of Mathematics of the National Academy of Sciences of Belarus | <http://im.bas-net.by/>), 182
- INP BSU (Research Institute for Nuclear Problems of the Belarusian State University | <http://www.inp.bsu.by/>), 12, 41, 45, 47, 52, 64, 85, 90, 109, 130, 140, 155, 175, 190
- IP NASB (B.I.Stepanov Institute of Physics of the National Academy of Sciences of Belarus | <http://ifan.basnet.by/>), 12, 18, 23, 41, 47
- ISEI BSU (International Sakharov Environmental Institute of the Belarusian State University | <http://www.iseu.bsu.by/>), 23, 190
- Inst. Physiology NASB (Institute of Physiology of the National Academy of Sciences of Belarus | <http://physiology.by/>), 153
- JIPNR-Sosny NASB (Joint Institute for Power and Nuclear Research - Sosny of the National Academy of Sciences of Belarus | <http://sosny.bas-net.by/>), 12, 23, 41, 85, 109, 146, 175
- ME RB (Ministry of Education of the Republic of Belarus | <http://edu.gov.by/>), 190
- PTI NASB (Physical Technical Institute of the National Academy of Sciences of Belarus | <http://www.phti.belhost.by/>), 85
- RI PCP BSU (Research Institute for Physical Chemical Problems of the Belarusian State University | <http://www.fhp.bsu.by/>), 140
- SOL instruments (SOL instruments | <http://solinstruments.com/>), 153
- SPMRC NASB (Scientific and Practical Materials Research Centre of the National Academy of Sciences of Belarus | <http://www.physics.by/>), 85, 140
- UCP MES (University of Civil Protection of the Ministry for Emergency Situations of the Republic of Belarus | <http://ucp.by/>), 23
- “Planar” (Planar Corporation | <http://www.planar.by/>), 85
- “Radatech” (“Radatech” | <http://www.radatech.tam.by/>), 74
- Belgium**
- Antwerp*
- UA (University of Antwerp | <http://www.uantwerpen.be/>), 64
- Brussels*
- ULB (Free University of Brussels | <http://www.ulb.ac.be/>), 64, 118
- VUB (Vrije University Brussels | <http://www.vub.ac.be/>), 18, 64
- Geel*
- IRMM (Joint Research Centre-Institute for Reference Materials and Measurements of the European Commission | <http://ec.europa.eu/jrc/sites/jrcch/files/irmm-factsheet.pdf>), 130
- Leuven*
- KU Leuven (Catholic University of Leuven | <http://www.kuleuven.be/>), 114, 118, 123
- Louvain-la-Neuve*
- IBA (Ion Beam Applications | <http://iba-worldwide.com/>), 114, 126
- UCL (Catholic University of Louvain | <http://uclouvain.be/>), 18, 23, 60, 64
- Mons*
- UMONS (University of Mons | <http://portail.umons.ac.be/>), 64
- Brazil**
- Brasilia, DF*
- UnB (University of Brasilia | <http://www.unb.br/>), 23
- Florianopolis, SC*
- UFSC (Federal University of Santa Catarina | <http://ufsc.br/>), 18
- Juiz de Fora, MG*
- UFJF (Federal University of Juiz de Fora | <http://www.ufjf.br/>), 29
- Natal, RN*
- IIP UFRN (International Institute of Physics of the Federal University of Rio Grande do

Norte | <http://www.iip.ufrn.br/>), 23
Niteroi, RJ
 UFF (Federal Fluminense University | <http://www.uff.br/>), 18
Porto Alegre, RS
 UFRGS (Federal University of Rio Grande de Sul | <http://www.ufrgs.br/>), 105
Rio de Janeiro, RJ
 CBPF (Brazilian Center for Physics Research | <http://portal.cbpf.br/>), 64
 UERJ (Rio de Janeiro State University | <http://www.uerj.br/>), 64
 UFRJ (Federal University of Rio de Janeiro | <http://www.ufrj.br/>), 64
Sao Carlos, SP
 IFSC USP (Institute of Physics of São Carlos of the University of São Paulo | <http://www.ifsc.usp.br/>), 182
Sao Jose dos Campos, SP
 ITA (Instituto Tecnológico de Aeronáutica | <http://www.ufcar.br/>), 18
Sao Paulo, SP
 UEP (Unidade de Ensino Profissionalizante da Santa Casa de São Paulo | <http://www.santacasasp.org.br/>), 18
 USP (University of São Paulo | <http://www5.usp.br/>), 23, 29, 33
 Unesp (São Paulo State University | <http://www.unesp.br/>), 64

Bulgaria

Blagoevgrad
 SWU (South-West University “Neofit Rilski” | <http://www.swu.bg/>), 60, 85, 190
Plovdiv
 PU (Plovdiv University “Paisii Hilendarski” | <https://uni-plovdiv.bg/>), 60, 85, 123, 130, 155, 182
 UFT (University of Food Technologies | <http://uft-plovdiv.bg/>), 130
Sofia
 ASCI Ltd (ASCI Ltd | <http://www.asci.bg/>), 140
 IE BAS (Academician Emil Djakov Institute of Electronics of the Bulgarian Academy of Sciences | <http://ie-bas.dir.bg/>), 140, 160
 IEES BAS (Institute of Electrochemistry and Energy Systems of the Bulgarian Academy of Sciences | <http://www.bas.bg/cleps/>), 140
 IMI BAS (Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences | <http://math.bas.bg/>), 182
 IMS BAS (Institute of Metal Science, Equipment end Technologies “Acad. A.Balevsci” with Hydroaerodynamics

Centre of the Bulgarian Academy of Sciences | <http://ims.bas.bg/>), 140
 IMech BAS (Institute of Mechanics of the Bulgarian Academy of Sciences | <http://www.imbm.bas.bg/>), 23
 INRNE BAS (Institute for Nuclear Research and Nuclear Energy of the Bulgarian Academy of Sciences | <http://www.inrne.bas.bg/>), 12, 18, 24, 29, 33, 57, 64, 85, 90, 99, 103, 109, 114, 118, 123, 130, 140, 150, 160, 175, 182, 190
 ISSP BAS (Georgi Nadjakov Institute of Solid State Physics of the Bulgarian Academy of Sciences | <http://www.issp.bas.bg/>), 23, 85, 140
 Inst. Microbiology BAS (Stephan Angeloff Institute of Microbiology of the Bulgarian Academy of Sciences | <http://www.microbio.bas.bg/>), 153
 LTD BAS (Laboratory for Technical Development of the Bulgarian Academy of Sciences | <http://www.pronto.phys.bas.bg/>), 85
 NBU (New Bulgarian University | <http://www.nbu.bg/>), 18
 NCRRP (National Centre of Radiobiology and Radiation Protection | <http://ncrrp.org/>), 160
 NRA (Bulgarian Nuclear Regulatory Agency | <http://www.bnra.bg/>), 190
 SU (Sofia University “St.Kliment Ohridski” | <http://www.uni-sofia.bg/>), 12, 23, 29, 33, 45, 60, 64, 103, 105, 175, 182, 190
 TU-Sofia (Technical University of Sofia | <http://www.tu-sofia.bg/>), 85
 UCTM (University of Chemical Technology and Metallurgy | <http://www.uctm.edu/>), 94

Canada

Corner Brook
 MUN (Memorial University of Newfoundland - Grenfell Campus | <http://www.grenfell.mun.ca/>), 12
Edmonton
 U of A (University of Alberta; Theoretical Physics Institute; Avadh Bhatia Physics Laboratory | <http://www.ualberta.ca/>), 29, 33, 182
Hamilton
 McMaster (McMaster University | <http://www.mcmaster.ca/>), 18, 182
Kingston
 Queen’s (Queen’s University | <http://www.queensu.ca/>), 24

London

Western (University of Western - Canada | <http://www.uwo.ca/>), 24

Montreal

Concordia (Concordia University Montreal | <http://www.concordia.ca/>), 24

McGill (McGill University | <http://www.mcgill.ca/>), 29

UdeM (University of Montreal | <http://www.umontreal.ca/>), 12, 29, 33, 42

Quebec

UL (Laval University | <http://www2.ulaval.ca/>), 24

Saskatoon

U of S (University of Saskatchewan | <http://www.usask.ca/>), 18

Toronto

IBM Lab (IBM Toronto Software Lab | <http://www.ibm.com/>), 182

Vancouver

TRIUMF (Canada's National Laboratory for Particle and Nuclear Physics | <http://www.triumf.ca/>), 29, 42

Chile

Valparaiso

UTFSM (Technical University Federico Santa Maria | <http://www.usm.cl/>), 60

UV (University of Valparaiso | <http://www.valpo.edu/>), 12

China

Beijing, 12

Beijing Fert Co (Beijing Fert Medical Instruments Technology Co., Ltd. | <http://www.china-fert.com/>), 155

CIAE (China Institute of Atomic Energy | <http://www.ciae.ac.cn/>), 18, 99, 105

IHEP CAS (Institute of High Energy Physics of the Chinese Academy of Sciences | <http://www.ihep.ac.cn/>), 39, 50, 64, 99, 130, 175

ITP CAS (Institute of Theoretical Physics of the Chinese Academy of Sciences | <http://english.itp.cas.cn/>), 18

PKU (Peking University | <http://www.pku.edu.cn/>), 18, 64, 155

"Tsinghua" (Tsinghua University | <http://www.tsinghua.edu.cn/>), 85

Hefei

IPP CAS (Institute of Plasma Physics of the Chinese Academy of Sciences | <http://english.ipp.cas.cn/>), 126

USTC (University of Science and Technology of China | <http://www.ustc.edu.cn/>), 64

Lanzhou

IMP CAS (Institute of Modern Physics of the Chinese Academy of Sciences | <http://www.impcas.cn/>), 12, 114, 118

Nanning

GUFN (Guangxi University for Nationalities | <http://www.gxun.edu.cn/>), 182

Wuhan

CCNU (Central China Normal University; Institute of Particle Physics | <http://www.ccn.edu.cn/>), 99, 105

WIPM CAS (Wuhan Institute of Physics and Mathematics of the Chinese Academy of Sciences | <http://english.wipm.cas.cn/>), 12

Croatia

Split

Univ. (University of Split | <http://www.unist.hr/>), 64

Zagreb

Oikon IAE (Oikon Ltd. Institute for Applied Ecology | <http://www.oikon.hr/>), 130

RBI (Rudjer Boskovic Institute | <http://www.irb.hr/>), 105, 130, 169

Cuba

Havana

ASC (Academy of Sciences of Cuba | <http://www.academiaciencias.cu/>), 190

CEADEN (Centre of Technological Applications and Nuclear Development), 90, 155, 169

UCI (University of Computer Sciences | <http://www.uci.cu/>), 175

Cyprus

Nicosia

UCY (University of Cyprus | <http://www.ucy.ac.cy/>), 64

Czech Republic

Brno

BUT (Brno University of Technology | <http://www.vutbr.cz/>), 70, 109, 114, 155

IBP ASCR (Institute of Biophysics of the Academy of Sciences of the Czech Republic, v.v.i. | <http://www.ibp.cz/>), 160

ISI ASCR (Institute of Scientific Instruments of the Academy of Sciences of the Czech Republic, v.v.i. | <http://www.isibrno.cz/>), 94

Liberec

TUL (Technical University of Liberec | <http://www.tul.cz/>), 70, 85, 94

Olomouc

UP (Palacky University of Olomouc | <http://www.upol.cz/>), 119, 155

Opava

SIU (Silesian University of Opava | <http://www.slu.cz/>), 29

Ostrava

VSB-TUO (Technical University of Ostrava | <http://www.vsb.cz/>), 130, 175

Prague

CEI (Czech Environmental Institute | <http://www.ceu.cz/>), 130

CTU (Czech Technical University in Prague | <http://www.cvut.cz/>), 12, 29, 33, 47, 74, 90, 94, 109, 114, 118, 123, 130, 140, 160, 169, 182, 190

CU (Charles University in Prague | <http://www.cuni.cz/>), 12, 19, 29, 42, 47, 50, 52, 54, 60, 64, 70, 85, 94, 103, 114, 155, 190

IG ASCR (Institute of Geology of the Academy of Sciences of the Czech Republic, v.v.i. | <http://www.gli.cas.cz/>), 140

IMC ASCR (Institute of Macromolecular Chemistry of the Academy of Sciences of the Czech Republic, v.v.i. | <http://www.imc.cas.cz/>), 99, 140

IP ASCR (Institute of Physics of the Academy of Sciences of the Czech Republic, v.v.i. | <http://www.fzu.cz/>), 12, 105, 140, 175

PTC (Proton Therapy Center 'zech s.r.o | <http://www.ptc.cz/>), 166

VP (Vacuum PRAGUE | <http://www.vakuum.cz/>), 114, 119

Vitkovice

VHM (Vitkovice Heavy Machinery a.s. | <http://www.brtnik5.vitkovice.cz/>), 85

Řež

NPI ASCR (Nuclear Physics Institute of the Academy of Sciences of the Czech Republic, v.v.i. | <http://www.ujf.cas.cz/>), 12, 19, 24, 29, 33, 57, 94, 99, 103, 114, 119, 123, 140, 150, 155, 160, 190

UJV ("ÚJV Řež, a.s." | <http://www.ujv.cz/>), 74, 103, 105, 109, 160, 166

Štěnovice

STREICHER (STREICHER | <http://www.streicher.cz/>), 114

Denmark

Copenhagen

NBI (Niles Bohr Institute of the University of Copenhagen | <http://www.nbi.ku.dk/>), 105

Egypt

Al-Minufya

MU (Menoufia University | <http://mu.menoufia.edu.eg/>), 114, 119

Alexandria

Univ. (Alexandria University | <http://www.alexu.edu.eg/>), 130

Cairo

ASRT (Academy of Scientific Research and Technology | <http://www.asrt.sci.eg/>), 190

EAEA (Egyptian Atomic Energy Authority | <http://www.eaea.org.eg/>), 19, 130, 140

ECTP (Egyptian Center for Theoretical Physics | <http://www.mti.edu.eg/ECTP/>), 85

Giza

CU (Cairo University | <http://cuportal.cu.edu.eg/>), 19, 114, 119, 140, 175

Shibin al Kawm

MU (Menoufia University | <http://mu.menoufia.edu.eg/>), 131

Estonia

Tallinn

NICPB (National Institute of Chemical Physics and Biophysics | <http://www.kbfi.ee/>), 64

Finland

Helsinki

HIP (Helsinki Institute of Physics | <http://www.hip.fi/>), 64, 105

UH (University of Helsinki | <http://www.helsinki.fi/university/>), 12, 64

Jyväskylä

UJ (University of Jyväskylä | <http://www.jyu.fi/>), 64, 119, 123, 131

Oulu

UO (University of Oulu; Microelectronics Instrumentation Laboratory | <http://www.oulu.fi/>), 64, 131

Tampere

TUT (Tampere University of Technology; Digital and Computer Systems Laboratory | <http://www.tut.fi/>), 64

France

Annecy-le-Vieux

LAPP (Laboratory of Annecy-la-Vieux for Particles Physics of the National Institute for Nuclear Physics and Particles Physics of the National Centre for Scientific Research | <http://lappweb.in2p3.fr/>), 29, 33, 64

LAPTh (Laboratory of Theoretical Physics of Annecy-la-Vieux of the National Institute for Nuclear Physics and Particles Physics of the National Centre for Scientific Research | <http://lappweb.in2p3.fr/lapth-2005/>), 24

Bordeaux

CENBG (Centre of Nuclear Studies of Bordeaux-Gradignan | <http://www.cenbg.in2p3.fr/>), 123
UB (University of Bordeaux | <http://www.univ-bordeaux.fr/>), 19

Cadarache

CC CEA (Centre de Recherche du Commissariat à l'Énergie Atomique et aux Énergies Alternatives Cadarache | <http://www-cadarache.cea.fr/>), 131

Caen

GANIL (Grand National Heavy Ion Accelerator | <http://www.ganil-spiral2.eu/>), 19, 114, 119
UNICAEN (University of Caen Normandy | <http://www.unicaen.fr/>), 123

Clermont-Ferrand

LPC (Corpuscular Physics Laboratory Clermont-Ferrand of the Blaise Pascal University | <http://clrwww.in2p3.fr/>), 42, 105

Dijon

IMB (Institute of Mathematics of Bourgundy | <http://math.u-bourgogne.fr/>), 29
UB (University of Bourgundy | <http://www.u-bourgogne.fr/>), 29, 33

Grenoble

IBS (Institute of Structural Biology | <http://www.ibs.fr/>), 140
ILL (Institute Laue-Langevin | <http://www.ill.eu/>), 131
LPSC (Laboratoire de Physique Subatomique et de Cosmologie | <http://lpscwww.in2p3.fr/>), 131

Lyon

ENS Lyon (Ecole Normale Supérieure de Lyon; Physics Laboratory | <http://www.ens-lyon.eu/>), 29, 33
IPNL (Institute of Nuclear Physics of Lyon | <http://www.ipnl.in2p3.fr/>), 64
UCBL (Claude Bernard University Lyon 1 | <http://www.univ-lyon1.fr/>), 13, 105

Marseille

CPPM (Centre de Physique des Particules de Marseille | <http://marwww.in2p3.fr/>), 175
CPT (Centre of Theoretical Physics | <http://www.cpt.univ-mrs.fr/>), 24, 29, 33
IM2NP (Institut Matériaux Microélectronique Nanoscience de Provence | <http://www.univ-tn.fr/>), 182
UPC (University Paul Cézanne - Aix-Marseille III | <http://www.univ-cezanne.fr/>), 24

Metz

UPV-M (Paul-Verlaine University of Metz | <http://www.univ-metz.fr/>), 13, 182

Montpellier

UM2 (University of Montpellier 2 | <http://www.univ-montp2.fr/>), 13

Nantes

SUBATECH (Subatomic Physics Laboratory and Associated Technologies; UMR/EMN/IN2P3/CNRS/University of Nantes | <http://www-subatech.in2p3.fr/>), 29, 33, 85, 103, 105

Nice

UN (University Nice Sophia Antipolis | <http://unice.fr/>), 24

Orsay

CSNSM (Center for Nuclear and Mass Spectrometry- IN2P3/CNRS | <http://www-cnsnm.in2p3.fr/>), 19, 119, 123
IPN Orsay (Institute of Nuclear Physics Orsay - IN2P3/CNRS | <http://ipnweb.in2p3.fr/>), 19, 94, 99, 105, 119
LAL (Linear Accelerator Laboratory of the University of Paris-Sid 11 - IN2P3/CNRS | <http://www.lal.in2p3.fr/>), 42, 123

Palaiseau

Polytech (Ecole Polytechnique | <http://www.polytechnique.fr/>), 29

Paris

ENS (École Normale Supérieure Paris | <http://www.ens.fr/>), 29, 33
LPTHE (Laboratory of Theoretical Physics and High Energy of the Pierre et Marie Curie - IN2P3/CNRS | <http://parthe.lpthe.jussieu.fr/>), 29, 33
LUTH (Laboratory Universe and Theories, Observatory of Paris | <http://www.luth.obspm.fr/>), 29
UPMC (Pierre et Marie Curie University Henri Poincaré Institute Paris 6 | <http://www.upmc.fr/>), 13, 24

Saclay

IRFU (Institute of Research into the Fundamental Laws of the Universe | <http://irfu.cea.fr/>), 13, 64, 94, 105
LLB (Léon Brillouin Laboratory CEA-CNRS | <http://www-llb.cea.fr/>), 131, 140
SPhN CEA DAPNIA (Nuclear Physics Division of the Commissariat for Atomic Energy | <http://irtu.cea.fr/Sphn>), 13, 70, 119

Strasbourg

CRN (Centre of Nuclear Research - IN2P3/CNRS | <http://ireswww.in2p3.fr/>), 47, 50, 105, 119

IPHC (Hubert Curien Multidisciplinary Institute of the University of Strasbourg - IN2P3/CNRS | <http://www.iphc.cnrs.fr/>), 64, 119, 131

Valenciennes

UVHC (University of Valenciennes and Hainaut-Combrésis | <http://www.univ-valenciennes.fr/>), 24, 29, 33

Vannes

SigmaPhi (Company SigmaPhi Accelerator Technologies | <http://www.sigmaphi.fr/>), 115

Georgia

Tbilisi

AIP TSU (Elevter Andronikashvili Institute of Physics of the Ivane Javakhishvili Tbilisi State University | <http://aipphysics.ge/>), 64, 85, 131

GRENA (Georgian Research and Educational Networking Association | <http://grena.ge/>), 175

GTU (Georgia Tecnical University | <http://www.gtu.ge/>), 47, 85, 175, 182

HEPI-TSU (High Energy Physics Institute of Ivane Javakhishvili Tbilisi State University | <http://www.hepi.edu.ge/>), 42, 47, 64, 91

RMI TSU (Andrea Razmadze Mathematical Institute of the Ivane Javakhishvili Tbilisi State University | <http://www.rmi.ge/>), 13

TSU (Ivane Javakhishvili Tbilisi State University | <http://www.tsu.ge/>), 13, 131, 175, 182

UG (University of Georgia | <http://www.ug.edu.ge/>), 47, 182

Germany

Aachen

RWTH (Aachen University | <http://www.rwth-aachen.de/>), 13, 50, 64

Bayreuth

Univ. (University of Bayreuth | <http://www.uni-bayreuth.de/>), 141

Berlin

BAM (Federal Institute for Materials Rescearch and Testing | <http://www.bam.de/>), 141

FU Berlin (Free University of Berlin | <http://www.fu-berlin.de/>), 13, 30

HUB (Humboldt University of Berlin | <http://www.hu-berlin.de/>), 13, 64

HZB (Helmholtz Centre Berlin of the Helmholtz Association | <http://www.helmholtz-berlin.de/>), 119, 141, 150

MBI (Max-Born-Institute in Berlin for Nonlinear Optics and Short Pulse Spectroscopy im Forschungsverbund Berlin e.V. | <http://www.mbi-berlin.de/>), 30

Bielefeld

Univ. (Bielefeld University | <http://www.uni-bielefeld.de/>), 13, 19, 30, 70

Bochum

RUB (Ruhr University of Bochum | <http://www.ruhr-uni-bochum.de/>), 13, 70, 94, 141

Bonn

UniBonn (University of Bonn | <http://www3.uni-bonn.de/>), 13, 19, 24, 30, 33, 60, 70, 169, 182

Braunschweig

TU (Technical University Carolo-Wilhelmina at Braunschweig | <http://www.tu-braunschweig.de/>), 24

Bremen

Univ. (University of Bremen | <http://www.uni-bremen.de/>), 24

Cologne

Univ. (University of Cologne | <http://www.uni-koeln.de/>), 19

Darmstadt

GSI (Helmholtz-Centre for Heavy Ion Research of the Helmholtz Association | <http://www.gsi.de/>), 19, 24, 52, 57, 85, 90, 99, 105, 115, 119, 155, 175, 182

IKP (Institute of Nuclear Physics of the Darmstadt University of Technology | <http://www.physik.tu-darmstadt.de/>), 19

TU Darmstadt (Technical University of Darmstadt | <http://www.tu-darmstadt.de/>), 19, 85, 99, 131, 141

Dortmund

TU Dortmund (Technical University of Dortmund | <http://www.uni-dortmund.de/>), 13, 24, 30, 141

Dresden

HZDR (Dresden-Rossendorf Helmholtz Centre | <http://www.hzdr.de/>), 19, 57, 99, 131

IFW (Leibniz Institute for Solid State and Materials Research Dresden | <http://www.ifw-dresden.de/>), 24, 182

ILK (Institute of Air Handling and Refrigeration | <http://www.ilkdresden.de/>), 85

MPI PkS (Max Planck Institute for the Physics of Complex Systems | <http://www.mpipks-dresden.mpg.de/>), 24, 182

TU Dresden (Technical University of Dresden | <http://tu-dresden.de/>), 24, 47, 94, 141

Duisburg

UDE (University of Duisburg-Essen | <http://www.uni-due.de/>), 24

Erlangen

FAU (Friedrich Alexander University of Erlangen-Nuremberg | <http://www.uni-erlangen.org/>), 13, 19, 85

Frankfurt/Main

FIAS (Frankfurt Institute for Advanced Studies | <http://fias.uni-frankfurt.de/>), 85
Univ. (Goethe University of Frankfurt on Main | <http://www.uni-frankfurt.de/>), 57, 85, 99, 105, 175, 182

Freiberg

IMF TUBAF (Institute for Metal Forming Technical University Bergakademie of Freiberg | <http://www.imf.tu-freiberg.de/>), 141
TUBAF (Technical University Bergakademie of Freiberg | <http://tu-freiberg.de/>), 141

Freiburg

TUBA (Technical University), 70

Göttingen

Univ. (University of Göttingen | <http://www.uni-goettingen.de/>), 141

Geesthacht

GKSS (Research Center in Geesthacht of the Helmholtz Association | <http://www.hzgd.de/>), 141

Giessen

JLU (Justus Liebig University Giessen | <http://www.uni-giessen.de/>), 19, 57, 85, 99, 169

Halle

MLU (Martin-Luther University of Halle-Wittenberg | <http://www.uni-halle.de/>), 141

Hamburg

DESY (Deutsches Elektronen-Synchrotron A Research Centre of the Helmholtz Association | <http://www.desy.de/>), 13, 33, 70, 90, 141, 169, 175
Univ. (University of Hamburg | <http://www.uni-hamburg.de/>), 13, 19, 50, 54, 183

Hannover

LUH (Leibniz University of Hannover | <http://www.uni-hannover.de/>), 30, 33

Heidelberg

MPIK (Max Planck Institute for Nuclear Physics | <http://www.mpi-hd.mpg.de/>), 90, 115, 123
Univ. (University of Heidelberg | <http://www.uni-heidelberg.de/>), 13, 57, 99, 103, 105

Jülich

FZJ (Research Centre Jülich of the Helmholtz Association | <http://www.fz-juelich.de/>), 13, 85, 94, 141, 150, 153
IKP (Institute for Nuclear Physics Research Centre Jülich | <http://www.fz-juelich.de/ikp/>), 183

Jena

Univ. (Friedrich-Schiller University of Jena | <http://www.uni-jena.de/>), 13, 30, 33

Kaiserslautern

TU (Technical University of Kaiserslautern | <http://www.uni-kl.de/>), 13

Karlsruhe

KIT (Karlsruhe Institute of Technology | <http://www.kit.edu/>), 13, 64, 141, 175

Kassel

Uni Kassel (University of Kassel | <http://www.uni-kassel.de/>), 183

Kiel

CAU (Christian Albrecht Kiel University | <http://www.uni-kiel.de/>), 141
IFM-GEOMAR (Leibniz Institute for Marine Science of the Kiel University | <http://www.geomar.de/>), 141

Leipzig

UoC (University of Leipzig | <http://www.zv.uni-leipzig.de/>), 19, 24, 30, 33

Münster

Univ. (University of Münster | <http://www.uni-muenster.de/>), 105

Magdeburg

OVGU (Otto-von-Guericke University Magdeburg | <http://www.avmz.ovgu.de/>), 24

Mainz

HIM (Helmholtz-Institute Mainz | <http://www.him-mainz.de/>), 13
JGU (Johannes Gutenberg University of Mainz | <http://www.uni-mainz.de/>), 13, 19, 60, 70, 85, 119, 123, 131, 169

Marburg

Univ. (Philipps University of Marburg | <http://www.uni-marburg.de/>), 105

Munich

LMU (Ludwig Maximilians University of Munich | <http://www.uni-muenchen.de/>), 13, 183
MPI-P (Max Planck Institute for Physics of Munich | <http://www.mpp.mpg.de/>), 30, 34, 42, 54
TUM (Technical University of Munich | <http://portal.mytum.de/>), 70, 99, 131

Oldenburg

IPO (Institute of Physics of the University of Oldenburg | <http://www.uni-oldenburg.de/en/physics/>), 30, 33

Potsdam

AEI (Max Planck Institute for Gravitational Physics (Albert Einstein Institute) | <http://www.aei-potsdam.mpg.de/>), 30, 34
GFZ (Helmholtz Centre Potsdam GeoForschungsZentrum German Research Centre for Geosciences of the Helmholtz Association | <http://www.gfz-potsdam.de/>), 141

Quedlinburg

IST (Ionen Strahl Technologie GmbH | <http://www.isttechnologie.de/>), 156
MiCryon Technik (MiCryon Technik GmbH | <http://www.micryon.de/>), 156

Regensburg

UR (University of Regensburg | <http://www.uni-regensburg.de/>), 13, 85

Rostock

Univ. (University of Rostock | <http://www.uni-rostock.de/>), 13, 19, 24, 141

Siegen

Univ. (University of Siegen | <http://www.uni-siegen.de/>), 19, 99

Stuttgart

MPI-FKF (Max Planck Institute for Solid State Research | <http://www.fkf.mpg.de/>), 24, 141

Tübingen

Univ. (Eberhard Karls University of Tübingen | <http://www.uni-tuebingen.de/>), 13, 54, 119, 131

Wuppertal

UW (University of Wuppertal | <http://www.uni-wuppertal.de/>), 13, 24

Zeuthen

DESY (Deutsches Elektronen-Synchrotron of the Helmholtz Association | <http://www.desy.de/>), 13, 42, 54, 91, 175

Greece

Athens

INP NCSR “Demokritos” (Institute of Nuclear Physics of the National Centre for Scientific Research “Demokritos” | <http://www.inp.demokritos.gr/>), 19, 64
UoA (National and Kapodistrian University of Athens | <http://www.uoa.gr/>), 30, 34, 42, 64, 91, 105

Ioannina

UI (University of Ioannina | <http://www.uoi.gr/>), 64

Thessaloniki

AUTH (Aristotle University of Thessaloniki | <http://www.auth.gr/>), 19

Hungary

Budapest

ELTE (Eötvös Loránd University | <http://www.elte.hu/>), 13
GetGiro Kft (GetGiro IT Limited Liability Company | <http://getgiro.com/>), 156
RKK OU (Rejto Sándor Faculty of Light Industry and Environmental Engineering of the Obuda University | <http://rkk.uni-obuda.hu/>), 131
Wigner RCP (Institute for Particle and Nuclear Physics, Wigner Research Centre for Physics of the Hungarian Academy of Science | <http://wigner.mta.hu/>), 13, 19, 24, 30, 34, 65, 105, 141, 150

Debrecen

Atomki (Institute of Nuclear Research of the Hungarian Academy of Science | <http://www.atomki.hu/>), 19, 65
UD (University of Debrecen | <http://www.unideb.hu/>), 65

Szeged

US (University of Szeged | <http://www.u-szeged.hu/>), 141

India

Aligarh

AMU (Aligarh Muslim University | <http://www.amu.ac.in/>), 105

Bhubaneswar

IOP (Institute of Physics of Bhubaneswar | <http://www.iopb.res.in/>), 65, 105

Calcutta

BNC (S.N.Bose National Centre for Basic Sciences | <http://www.bose.res.in/>), 30, 34
GCECT (Government College of Engineering and Ceramic Technology | <http://gcect.ac.in/>), 183
IACS (Indian Association for the Cultivation of Science | <http://www.iacs.res.in/>), 30
JU (Jadavpur University | <http://www.jaduniv.edu.in/>), 183
MIERE (Madrivani Institute of Experimental Research and Education), 70
SINP (Saha Institute of Nuclear Physics | <http://www.saha.ernet.in/>), 106
VECC (Variable Energy Cyclotron Centre of the Department of Atomic Energy | <http://www.veccl.ernet.in/>), 105, 119

Chandigarh

PU (Panjab University | <http://pu.chd.ac.in/>), 19, 65, 106

Chennai

IMSc (Institute of Mathematical Science
(National Institute for Research in
Mathematical and Physical Sciences) |
<http://www.imsc.res.in/>), 30

Gurgaon

AMITY (Amity University |
<http://amity.edu/gurgaon/>), 141

Jaipur

Univ. (University of Rajasthan |
<http://www.uniraj.ernet.in/>), 99

Jammu

Univ. (University of Jammu |
<http://www.jammuuniversity.in/>), 106

Kasaragod

CUK (Central University of Kerala |
<http://cukerala.ac.in/>), 19

Manipal

MU (Manipal University |
<http://www.manipal.edu/>), 119

Mumbai

BARC (Bhabha Atomic Research Centre of
the Department of Atomic Energy |
<http://www.barc.ernet.in/>), 65, 99, 166
TIFR (Tata Institute of Fundamental
Research | <http://www.tifr.res.in/>), 24, 65

New Delhi

IUAC (Inter-University Accelerator Center |
<http://www.iuac.ernet.in/>), 119, 166

Patna

NITP (National Institute of Technology Patna
| <http://www.nitp.ac.in/>), 141

Shibpur

IEST Shibpur (Indian Institute of
Engineering Science and Technology |
<http://www.iests.ac.in/>), 183

Varanasi

BHU (Banaras Hindu University |
<http://www.bhu.ac.in/>), 131

Iran

Tehran

IPM (Institute for Studies in Theoretical
Physics and Mathematics of the Institute
for Research Fundamental Sciences |
<http://www.ipm.ac.ir/IPM/>), 65

Ireland

Dublin

DIAS (Dublin Institute for Advanced Studies |
<http://www.dias.ie/>), 24

Israel

Jerusalem

HUJI (Hebrew University of Jerusalem |
<http://www.huji.ac.il/>), 86

Rehovot

WIS (Weizmann Institute of Science |
<http://www.weizmann.ac.il/>), 34, 42

Tel Aviv

TAU (Tel Aviv University |
<http://www.tau.ac.il/>), 70, 86

Italy

Bari

INFN (National Institute for Nuclear Physics,
Section of Bari | <http://www.ba.infn.it/>),
30, 65, 106

UniBa (University of Bari Aldo Moro |
<http://www.uniba.it/>), 183

Bologna

Centro, ENEA (Bologna Research Centre of
the Italian National Agency for New
Technologies, Energy and the Environment |
<http://www.bologna.enea.it/>), 19

INFN (National Institute for Nuclear Physics,
Section of Bologna |
<http://www.bo.infn.it/>), 65, 106, 175

Brescia

Forgiatura Morandini (Forgiatura Morandini |
<http://www.morandini.it/>), 85

Cagliari

INFN (National Institute for Nuclear Physics,
Section of Cagliari |
<http://www.ca.infn.it/>), 106

Catania

INFN LNS (National Institute for Nuclear
Physics, National Laboratory of the South |
<http://www.lns.infn.it/>), 19, 65, 115, 119,
183

UniCT (University of Catania |
<http://www.unict.it/>), 24, 106

Ferrara

INFN (National Institute for Nuclear Physics,
Section of Ferrara | <http://www.fe.infn.it/>),
60

Florence

INFN (National Institute for Nuclear Physics,
Section of Florence |
<http://www.fi.infn.it/>), 60, 65

Frascati

INFN LNF (National Institute for Nuclear
Physics, National Laboratory of Frascati |
<http://www.lnf.infn.it/>), 30, 34, 45, 60, 91

Genova

ASG (ASG Superconductors D.p.a. |
<http://www.as-g.it/>), 85

INFN (National Institute for Nuclear Physics,
Section of Genova | <http://www.ge.infn.it/>),
65, 91

Legnaro

INFN LNL (National Institute for Nuclear Physics, Legnaro National Laboratories | <http://www.lnl.infn.it/>), 106, 119

Messina

UniMe (University of Messina | <http://www.unime.it/>), 19, 119

Naples

INFN (National Institute for Nuclear Physics, Section of Naples | <http://www.na.infn.it/>), 13, 19, 30, 60

Unina (University of Naples Federico II | <http://www.unina.it/>), 119

Padua

INFN (National Institute for Nuclear Physics, Section of Padua | <http://www.pd.infn.it/>), 60, 65, 106

UniPd (University of Padua | <http://www.unipd.it/>), 13, 30, 34

Pavia

INFN (National Institute for Nuclear Physics, Section of Pavia | <http://www.pv.infn.it/>), 13, 30, 34, 65, 169

Perugia

INFN (National Institute for Nuclear Physics, Section of Perugia | <http://www.pg.infn.it/>), 19, 60, 65

Pisa

INFN (National Institute for Nuclear Physics, Section of Pisa | <http://www.pi.infn.it/>), 13, 30, 34, 42, 60, 65, 91

UniPi (University of Pisa | <http://www.unipi.it/>), 45

Rome

ENEA (Italian National Agency for New Technologies, Energy and Environment | <http://www.enea.it/>), 131

INFN (National Institute for Nuclear Physics, Section of Rome | <http://www.roma1.infn.it/>), 60, 65, 106

Univ. "La Sapienza" (University of Roma "La Sapienza" | <http://www.uniroma1.it/>), 163

Univ. "Tor Vergata" (University of Rome "Tor Vergata" | <http://web.uniroma2.it/>), 60

Salerno

INFN (National Institute for Nuclear Physics, Section of Naples | <http://www.sa.infn.it/>), 50, 106

UNISA (University of Salerno | <http://web.unisa.it/>), 24, 30, 34

Trento

ECT* (European Center Theoretical Studies in Nuclear Physics and Related Areas | <http://www.esttar.eu/>), 19

UniTn (University of Trento | <http://www.unitn.it/>), 141

Trieste

INFN (National Institute for Nuclear Physics, Section of Trieste | <http://www.ts.infn.it/>), 70

SISSA/ISAS (International School for Advanced Studies | <http://www.sissa.it/>), 13, 30, 34

Turin

INFN (National Institute for Nuclear Physics, Section of Turin | <http://www.to.infn.it/>), 34, 52, 60, 65, 70, 85, 106

UniTo (University of Turin | <http://www.unito.it/>), 13, 19, 30, 52, 54

Udine

Uniud (University of Udine | <http://www.uniud.it/>), 160

Vercelli

UPO (Amedeo Avogadro Piemonte Eastern University | <http://www.unipmn.it/>), 106

Viterbo

UNITUS (University of Tuscia | <http://www3.unitus.it/>), 163

Japan

Chiba

NIRS (National Institute of Radiological Sciences | <http://www.nirs.go.jp/>), 126

Fukuoka

Kyushu Univ. (Kyushu University | <http://www.kyushu-u.ac.jp/>), 30, 47, 119

Fukushima

Fukushima Univ. (Fukushima University | <http://www.english.adb.fucusima-u.ac.jp/>), 30

Hiroshima

Hiroshima Univ. (Hiroshima University | <http://www.hiroshima-u.ac.jp/>), 95

Kobe

Kobe Univ. (Kobe University | <http://www.kobe-u.ac.jp/>), 19

Kyoto

KSU (Kyoto Sangyo University | <http://www.kyoto-su.ac.jp/>), 30, 34, 131

Kyoto Univ. (Kyoto University | <http://www.kyoto-u.ac.jp/>), 13

RIMS (Research Institute for Mathematical Sciences of Kyoto University |

<http://www.kurims.kyoto-u.ac.jp/>), 30, 34

YITP (Yukawa Institute for Theoretical Physics of Kyoto University | <http://www.yukawa.kyoto-u.ac.jp/>), 30

Minato

Keio Univ. (Keio University | <http://www.keio.ac.jp/>), 141

Morioka

Iwate Univ. (Iwate University | <http://www.iwate-u.ac.jp/>), 19

Nagano

Shinshu Univ. (Shinshu University | <http://www.shinshu-u.ac.jp/>), 141

Nagoya

Meiji Univ. (Meiji University | <http://www.meiji.ac.jp/cip/>), 13
Nagoya Univ. (Nagoya University | <http://www.nagoya-u.ac.jp/>), 14, 85

Osaka

ISIR (Institute of Scientific and Industrial Research of Osaka University | <http://www.sanken.osaka-u.ac.jp/>), 146
Osaka Univ. (Osaka University | <http://www.osaka-u.ac.jp/>), 19, 47
RCNP (Research Centre for Nuclear Physics of Osaka University | <http://www.rcnp.osaka-u.ac.jp/>), 19, 74, 95, 99

Sapporo

Hokkaido Univ. (Hokkaido University | <http://www.hokudai.ac.jp/>), 146

Tokyo

Toho Univ. (Toho University | <http://www.toho-u.ac.jp/>), 50
Tokyo Tech (Tokyo Institute of Technology | <http://www.titech.ac.jp/>), 13
UT (University of Tokyo; Centre for Nuclear Study (CNS); Institute for Cosmic Ray Research; Institute Centre for Elementary Particle Physics (ICEPP) | <http://www.u-tokyo.ac.jp/>), 13, 30, 95, 99

Tsukuba

KEK (High Energy Accelerator Research Organization | <http://legacy.kek.jp/>), 14, 30, 34, 47, 91, 131
Univ. (University of Tsukuba | <http://www.tsukuba.ac.jp/>), 99

Wako

RIKEN (RIKEN Wako Institute; Institute of Physical and Chemical Research | <http://www.riken.go.jp/>), 54, 119

Yamagata

Yamagata Univ. (Yamagata University | <http://www.yamagata-u.ac.jp/>), 70

Kazakhstan

Almaty

APHI (Fesenkov Astrophysical Institute of the National Centre of Space Researches and Technologies | <http://aphi.kz/>), 14
INP (Institute of Nuclear Physics of Ministry of Energy of the Republic of Kazakhstan | <http://www.inp.kz/>), 14, 19, 115, 119, 123,

131, 141, 183

IPT (“Institute of Physics and Technology” LLC “National Scientific-Technology Holding “Parasat” Joint Stock Company of the Ministry of Education and Sciences of the Republic of Kazakhstan | <http://www.sci.kz/>), 99, 156
KazNU (Al-Farabi Kazakh National University | <http://www.kaznu.kz/>), 119, 190

Astana

BA INP (Branch of the Astana Institute of Nuclear Physics of Ministry of Energy of the Republic of Kazakhstan | <http://www.inp.kz/>), 14, 115, 156, 175
ENU (L.N.Gumilyov Eurasian National University | <http://www.enu.kz/>), 119, 131, 156, 175, 190
NU (Nazarbayev University | <http://nu.edu.kz/>), 156

Rudny

RII (Rudny Industrial Institute | <http://rii.kz/>), 141

Ust-Kamenogorsk

EKSU (Sarsen Amanzholov East Kazakhstan State University | <http://www.vkgu.kz/>), 190
TRCE (Training and Research Centre of Ecology of the Sarsen Amanzholov East Kazakhstan State University | <http://www.vkgu.kz/>), 131

Latvia

Riga

IPE (Institute of Physical Energetics | <http://www.innovation.lv/fei/>), 141
ISSP UL (Institute of Solid State Physics of the University of Latvia | <http://www.cfi.lu.lv/>), 141, 153

Lithuania

Kaunas

VMU (Vytautas Magnus University | <http://www.vdu.lt/>), 19

Luxembourg

Luxembourg

Univ. (University of Luxembourg | <http://wwwfr.uni.lu/>), 31

Macedonia

Skopje

UKiM (Ss. Cyril and Methodius University-Skopje | <http://www.ukim.edu.mk/>), 131

Mexico

Cuernavaca

UNAM (National Autonomous University of Mexico | <http://www.unam.mx/>), 14

Leon

UG (University of Guanajuato | <http://www.ugto.mx/>), 34

Mexico

Cinvestav (Centre for Advanced Investigations and Studies of the National Polytechnical Institute | <http://www.cinvestav.mx/>), 65

Puebla

BUAP (Autonomous University of Puebla | <http://www.buap.mx/>), 54

San Luis Potosi

UASLP (Autonomous University of San Luis Potosi | <http://www.uaslp.mx/>), 60, 183

Moldova

Chişinău

ASM (Academy of Sciences of Moldova | <http://www.asm.md/>), 175, 190

IAP ASM (Institute of Applied Physics of the Academy of Sciences of Moldova | <http://www.phys.asm.md/>), 19, 25, 86, 109, 156, 175

IC ASM (Institute of Chemistry of the Academy of Sciences of Moldova | <http://chem.asm.md/>), 141

IMB ASM (Institute of Microbiology and Biotechnology of the Academy of Sciences of Moldova | <http://www.imb.asm.md/>), 131, 141

MSU (Moldova State University | <http://usm.md/>), 86, 156

RENAM (Research and Educational Networking Association of Moldova | <http://www.renam.md/>), 175

UnASM (University of Academy of Sciences of Moldova | <http://www.edu.asm.md/>), 160

Mongolia

Ulaanbaatar

CGL (Central Geological Laboratory | <http://cengeolab.com/>), 131

IPT MAS (Institute of Physics and Technology of the Mongolian Academy of Sciences | <http://www.mas.ac.mn/>), 14, 57, 99, 106, 109, 141, 146, 183, 190

MUST (Mongolian University of Science and Technology | <http://www.must.edu.mn/>), 141

NE' (Government of Mongolia the Nuclear Energy Commission | <http://nea.gov.mn/>), 99, 123

NRC NUM (Nuclear Research Center of the National University of Mongolia | <http://nrc.num.edu.mn/>), 115, 119, 123, 156
NUM (National University of Mongolia | <http://www.num.edu.mn/>), 14, 25, 131, 156, 160, 175, 183

Netherlands

Amsterdam

NIKHEF (National Institute for Subatomic Physics | <http://www.nikhef.nl/>), 42, 106

Utrecht

UU (University of Utrecht | <http://www.uu.nl/>), 106

New Zealand

Auckland

Univ. (University of Auckland | <http://www.auckland.ac.nz/uaa/>), 65

Christchurch

UC (University of Canterbury | <http://www.canterbury.ac.nz/>), 65, 169

Hamilton

Univ. (University of Waikato | <http://www.waikato.ac.nz/>), 14

Norway

Bergen

UiB (University of Bergen | <http://www.uib.no/>), 19, 106

Oslo

UiO (University of Oslo | <http://www.uio.no/>), 19, 106

Trondheim

NGU (Geological Survey of Norway | <http://www.ngu.no/>), 141

NTNU (Norwegian University of Science and Technology | <http://www.ntnu.no/>), 14, 30, 131, 163

Pakistan

Islamabad

QAU (Quaid-i-Azam University | <http://www.qau.edu.pk/>), 65

Poland

Bialystok

UwB (University of Bialystok | <http://www.uwb.edu.pl/>), 141

Chorzow

Franko-Term (Franko-Term LTD Company is a Research and Development | <http://frankoterm.w.toruniu.pl/ssstr/>), 86

Gdansk

GUT (Gdańsk University of Technology | <http://pg.edu.pl/>), 131

Katowice

US (University of Silesia in Katowice | <http://www.us.edu.pl/>), 24

Kielce

JKU (Jan Kochanowski University of Humanities and Science | <http://www.ujk.edu.pl/>), 14

Krakow

AGH-UST (AGH University of Science and Technology | <http://www.agh.edu.pl/>), 123, 141, 146

CYFRONET (Academic Computer Centre CYFRONET of the AGH-University Science and Technology | <http://www.cyfronet.krakow.pl/>), 175

JU (Jagiellonian University in Kraków | <http://www.uj.edu.pl/>), 24, 30, 141, 190

NINP PAS (Henryk Niewodniczański Institute of Nuclear Physics of the Polish Academy of Sciences | <http://www.ifj.edu.pl/>), 14, 20, 30, 91, 99, 106, 109, 115, 119, 123, 126, 131, 141, 166, 169, 183

Lodz

UL (University of Łódź | <http://www.uni.lodz.pl/>), 14, 30, 99, 131, 190

Lublin

UMCS (Marie Curie-Skłodowska University in Lublin | <http://www.umcs.lublin.pl/>), 20, 86, 123, 131, 141, 156, 183

Olsztyn

UWM (University of Warmia and Mazury in Olsztyn | <http://www.uwm.edu.pl/>), 141

Opole

UO (University of Opole | <http://www.uni.opole.pl/>), 131

Otwock-Swierk

NCBJ (National Centre for Nuclear Research | <http://www.ncbj.gov.pl/>), 14, 20, 34, 65, 70, 86, 95, 99, 106, 109, 123, 131, 141, 166, 183

Poznan

AMU (Adam Mickiewicz University in Poznań | <http://www.guide.amu.edu.pl/>), 24, 119, 131, 141, 153, 163, 190

GPCC (Greater Poland Cancer Center | <http://www.wco.pl/>), 166

IMP PAS (Institute of Molecular Physics of the Polish Academy of Sciences | <http://www.ifmpan.poznan.pl/>), 24

Siedlce

UPH (University of Natural Sciences and Humanities | <http://www.uph.edu.pl/>), 142

Szczecin

US (University of Szczecin | <http://www.usz.edu.pl/>), 160

WPUT (West Pomeranian University of Technology in Szczecin | <http://www.zut.edu.pl/>), 142

Torun

UMK (Nicolaus Copernicus University | <http://www.umk.pl/>), 156

Warsaw

HIL WU (Heavy Ion Laboratory of Warsaw University | <http://www.slclj.uw.edu.pl/>), 115

IEL (Elektrotechnical Institute | <http://www.iel.waw.pl/>), 86, 106

IEP WU (Institute of Experimental Physics of Warsaw University | <http://en.ifd.fuw.edu.pl/>), 115

INCT (Institute of Nuclear Chemistry and Technology | <http://www.ichtj.waw.pl/>), 141, 156

IPC PAS (Institute of Physical Chemistry of the Polish Academy of Sciences | <http://ichf.edu.pl/>), 24

NCAC PAS (Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences | <http://www.camk.edu.pl/>), 30

UW (University of Warsaw | <http://www.uw.edu.pl/>), 20, 30, 34, 54, 65, 119

WUT (Warsaw University of Technology | <http://www.pw.edu.pl/>), 20, 24, 70, 86, 99, 103, 106, 109, 156, 183

Wroclaw

ILT&SR PAS (Institute of Low Temperature and Structure Research of the Polish Academy of Sciences | <http://www.int.pan.wroc.pl/>), 86

UW (University of Wrocław | <http://www.uni.wroc.pl/>), 30, 34, 131, 142, 153, 183

WUT (Wrocław University of Technology | <http://www.pwr.wroc.pl/>), 142

Portugal

Aveiro

UA (University Aveiro | <http://www.ua.pt/>), 70

Coimbra

UC (University of Coimbra | <http://www.uc.pt/>), 14

Lisbon

LIP (Laboratory of Instrumentation and Experimental Particles Physics | <http://www.lip.pt/>), 70

Republic of Korea

Chongju

CBNU (Chungbuk National University | <http://www.chungbuk.ac.kr/>), 14, 65

Daegu

KNU (Kyungpook National University | <http://en.knu.ac.kr/>), 14

Daejeon

IBS (Institute for Basic Science | <http://www.ibs.re.kr/>), 20

KAERI (Korea Atomic Energy Research Institute | <http://www.kaeri.re.kr:8080/>), 131

NFRI (National Fusion Research Institute | <http://www.nfri.re.kr/>), 150

Gangneung

GWNU (Gangneung-Wonju National University | <http://www.gwnu.ac.kr/>), 106

Kwangju

CNU (Chonnam National University | <http://www.jnu.ac.kr/>), 65

Naju

DU (Dongshin University; Laboratory for High Energy Physics | <http://www.dsu.ac.kr/>), 65

Namwon

SU (Seonam University | <http://www.seonam.ac.kr/>), 65

Pohang

PAL (Pohang Accelerator Laboratory | <http://pal.postech.ac.kr/>), 131

Seoul

Dawonsys (Company “Dawonsys ‘o., Ltd” | <http://www.dawonsys.co.kr/>), 131

EWU (Ewha Womans University | <http://www.ewha.ac.kr/>), 54

KU (Korea University | <http://www.korea.ac.kr/>), 65

Konkuk Univ. (Konkuk University | <http://www.kku.ac.kr/>), 65

SNU (Seoul National University | <http://www.snu.ac.kr/>), 14, 20

SNUE (Seoul National University of Education | <http://www.snue.ac.kr/>), 65

Romania

Baia Mare

TUCN-NUCBM (Technical University of Cluj-Napoca - North University Center of Baia Mare | <http://www.utcluj.ro/>), 131, 142

Bucharest

CNMN (National Centre for Micro and Nanomaterials of the University Politehnica of Bucharest | <http://www.mocronanotech.ro/>), 142

IFA (Institute of Atomic Physics | <http://www.ifa-mg.ro/>), 175, 183

IFIN-HH (Horia Hulubei National Institute of Physics and Nuclear Engineering | <http://www.nipne.ro/>), 20, 24, 30, 34, 45, 58, 60, 86, 99, 115, 119, 123, 131, 142, 147, 176, 183

INCDIE ICPE-CA (National Institute of Research and Development in Electrical Engineering ICPE-CA | <http://www.icpe-ca.ro/>), 86, 95, 99, 131, 142, 150

INFLPR (National Institute for Laser, Plasma and Radiation Physics | <http://www.inflpr.ro/>), 142, 156

INOE2000 (National Institute for Research and Development in Optoelectronics | <http://inoe.inoe.ro/>), 86

ISS (Institute for Space Sciences | <http://www.space-science.ro/>), 54, 99, 106, 109, 131, 142, 160, 169, 183

NIMP (National Institute of Materials Physics | <http://www.infim.ro/>), 142

N&V (<http://www.nuclearvacuum.ro/>), 115

UB (University of Bucharest | <http://www.unibuc.ro/>), 20, 99, 123, 131, 142, 163, 166, 183, 190

UMF (University of Medicine and Pharmacy “Carol Davila” - Bucharest’ | <http://www.umf.ro/>), 109, 142, 160, 166

UPB (University Politehnica of Bucharest | <http://www.upb.ro/>), 142, 156

UTM (Titu Maiorescu University | <http://www.utm.ro/>), 142

Cluj-Napoca

INCDTIM (National Institute for Research and Development of Isotopic and Molecular Technologies | <http://www.itim-cj.ro/>), 142, 176, 183

RA BC-N (Romanian Academy Cluj-Napoca Branch | <http://www.acad-cluj.ro/>), 142

UBB (Babeş-Bolyai University | <http://www.ubbcluj.ro/>), 142

UTC-N (Technical University of Cluj-Napoca | <http://utcluj.ro/>), 24, 142

Constanța

NIMRD (National Institute for Marine Research and Development “Grigore Antipa” | <http://www.rmri.ro/>), 131

UOC (“Ovidius” University of Constanta | <http://www.univ-ovidius.ro/>), 99, 132, 142

Craiova

UC (University of Craiova | <http://www.ucv.ro/>), 142

Galati

UG (University of Galati | <http://www.ugal.ro/>), 132

Iasi

IBR (Institute of Biological Research Iasi of the National Institute of Research and Development for Biological Sciences | <http://www.dbioro.eu/>), 160
NIRDTP (National Institute of Research and Development for Technical Physics | <http://www.phys-iasi.ro/>), 142
UAI (University "Apollonia" of Iasi | <http://univapollonia.ro/>), 142
UAIC (Alexandru Ioan Cuza University of Iasi | <http://www.uaic.ro/>), 132, 142, 160, 163
USAMV (University of Agricultural Sciences and Veterinary Medicine | <http://www.uaiasi.ro/>), 142

Oradea

UO (University of Oradea | <http://www.uoradea.ro/>), 132

Pitești

SCN (Institute for Nuclear Research - Pitești | <http://www.nuclear.ro/>), 132, 142
UPIT (University of Pitești | <http://www.upit.ro/>), 142

Râmnicu Vâlcea

I.C.S.I. (National Research and Development Institute for Cryogenics and Isotopic Technologies | <http://www.icsi.ro/>), 132

Târgoviște

UVT (VALAHIA University of Târgoviște | <http://www.valahia.ro/>), 132

Timișoara

LMF CCTFA (Laboratory of Magnetic Fluids of the Center for Fundamental and Advanced Technical Research of the Romanian Academy, Branch Timișoara | <http://acad-tim.tm.edu.ro/cctfa>), 142
RA TB (Romanian Academy Timișoara Branch | <http://acad-tim.tm.edu.ro/>), 142
UPT (Politehnica University of Timișoara | <http://www.upt.ro/>), 142
UVT (West University of Timișoara | <http://www.uvt.ro/>), 24, 142

Russia

Arkhangelsk

NSMU (North State Medical University | <http://www.nsmu.ru/>), 190
NĀrFU (Northern (Arctic) Federal University named after M.B.Lomonosov | <http://narfu.ru/>), 169, 190

Astrakhan

ASU (Astrakhan State University | <http://asu.edu.ru/>), 161

Belgorod

BelSU (Belgorod National Research State University | <http://www.bsu.edu.ru/>), 14, 25, 86, 143, 190

Borok

IBIW RAS (Federal State Budgetary Institution of Science "I.D.Papanin Institute for the Biology of Inland Waters of the Russian Academy of Sciences" | <http://ibiw.ru/>), 132
IPE RAS (Federal State Budgetary Institution of Science "Schmidt Institute of the Physics of the Earth of the Russian Academy of Sciences" | <http://old.ifz.ru/>), 164

Cheboksary

ChSU (I.N.Ulyanov Chuvash State University | <http://www.chuvsu.ru/>), 119

Chernogolovka

BInEPCP RAS (Federal State Budgetary Institution of Science "Branch of the Institute of Energy Problems for Chemical Physics of the Russian Academy of Sciences" | <http://binep.ac.ru/>), 156
ISMAN RAS (Federal State Budgetary Institution of Science "Institute of Structural Macrokinetics and Materials Science of the Russian Academy of Sciences" | <http://www.ism.ac.ru/>), 99
ISSP RAS (Federal State Budgetary Institution of Science "Institute of Solid State Physics of the Russian Academy of Sciences" | <http://issp3.issp.ac.ru/>), 143, 156

LITP RAS (Federal State Budgetary Institution of Science "L.D.Landau Institute for Theoretical Physics of the Russian Academy of Sciences" | <http://www.itp.ac.ru/>), 14, 31, 34, 176
SCC IPCP RAS (Federal State Budgetary Institution of Science "Supercomputer Centre of the Institute of Problems of Chemical Physics of the Russian Academy of Sciences" | <http://www.icp.ac.ru/>), 176

Dimitrovgrad

SSC RIAR (Open Joint Stock Company "State Scientific Centre Research Institute of Atomic Reactors" Rosatom State Nuclear Energy Corporation, JSC "Atomenergoprom" | <http://www.niiar.ru/>), 119

Dolgoprudny

MIPT (Moscow Institute of Physics and Technology (State University) | <http://mipt.ru/>), 31, 65, 143, 190

Dubna

- BSINP MSU (Branch of the Skobeltsyn Institute of Nuclear Physics of the Lomonosov Moscow State University | <http://www.msu.dubna.ru/>), 109, 190
- Diamant (Diamant LLC | <http://diamant-sk.ru/>), 132
- Dubna Univ. (Moscow Region State Educational Institution for Higher Education Dubna University | <http://www.uni-dubna.ru/>), 132, 143, 150, 169, 176, 183, 190
- IAS “Omega” (Institute for Advanced Studies “Omega” | <http://dubna-cluster.ru/participants/37.htm/>), 109
- PELCOM (“Pelcom Dubna Mashinostroitelnny Zavod” | <http://pelcom.ru/>), 86
- Progresstech (Dubna “Progresstech” | <http://dubna-oez.ru/>), 86
- RDH-9 (Radiological Department of Hospital № 9 | <http://ro.ms9.medic.ina.tel.dubna.tel/>), 166
- SCC “Dubna” (“Dubna” Satellite Communication Centre, Branch of the Federal State Unitary Enterprise “Russian Satellite Communication Company” | <http://www.rsc.ru/>), 176
- SEZ “Dubna” (Special Economic Zone in Dubna | <http://dubna.oez.ru/>), 176
- Trackpore Technology (Closed Joint Stock Company “Trackpore Technology” Membrane Technologies and the Future Branch of the Dubna | <http://www.trackpore.ru/>), 156

Fryazino

- ISTOK (Joint Stock Company “Research and Production Corporation “ISTOK” named after Shokin” | <http://www.istokmw.ru/>), 86

Gatchina

- PNPI (Federal State Budgetary Institution “B.P.Konstantinov Petersburg Nuclear Physics Institute” of the National Research Centre “Kurchatov Institute” | <http://www.pnpi.spb.ru/>), 14, 20, 25, 34, 39, 45, 65, 86, 95, 106, 115, 119, 123, 132, 143, 150, 164, 176

Irkutsk

- ISDCT SB RAS (Federal State Budgetary Institution of Science “Matrosov Institute for System Dynamics and Control Theory of the Siberian Branch of the Russian Academy of Sciences” | <http://www.idstu.irk.ru/>), 14

- ISU (Irkutsk State University | <http://isu.su/>), 55
- LI SB RAS (Federal State Budgetary Institution of Science “Limnological Institute of the Siberian Branch of the Russian Academy of Sciences” | <http://www.lin.irk.ru/>), 132

Ivanovo

- ISU (Ivanovo State University | <http://ivanovo.ac.ru/>), 14, 190
- ISUCT (Ivanovo State University of Chemistry and Technology | <http://main.isuct.ru/>), 132
- IS‘ RAS (Federal State Budgetary Institution of Science “Institute of Solution Chemistry of the Russian Academy of Sciences” | <http://www.isc-ras.ru/>), 14

Izhevsk

- UdSU (Udmurtia State University | <http://udsu.ru/>), 132

Kaliningrad

- IKBFU (Immanuel Kant Baltic Federal University | <http://www.kantiana.ru/>), 143, 156

Kazan

- Compressormash (Open Joint Stock Company “Kazancompressormash” | <http://compressormash.ru/>), 86
- KFU (Kazan (Volga Region) Federal University | <http://kpfu.ru/>), 14, 25, 31
- KNRTU (Kazan National Research Technological University | <http://www.kstu.ru/>), 143
- Spetshmash (Ltd. “Research and Production Enterprise Spetshmash” | <http://spms.ru/>), 86

Kostroma

- KSU (Kostroma State University | <http://ksu.edu.ru/>), 190

Krasnodar

- KSU (Kuban State University | <http://kubsu.ru/>), 156, 190

Krasnoyarsk

- KIP SB RAS (Federal State Budgetary Institution of Science “Kirensky Institute of Physics, Siberian Branch of the Russian Academy of Sciences” | <http://www.kirensky.ru/>), 20, 25, 143
- SibFU (Siberian Federal University | <http://www.sfu-kras.ru/>), 143

Moscow

- Atomenergomach (Closed Joint Stock Company “Atomenergomach” | <http://www.cftp-aem.ru/>), 132

- Cryogenmash (Public Joint Stock Company “Cryogenmash” | <http://cryogenmash.ru/>), 86
- ENES (LLC “Engineering Center of Nuclear Equipment Strength” | <http://www.icpmae.ru/>), 147
- GC RAS (Federal State Budgetary Institution of Science “Geophysical Center of the Russian Academy of Sciences” | <http://www.gcras.ru/>), 142
- GIN RAS (Federal State Budgetary Institution of Science “Geological Institute of the Russian Academy of Sciences” | <http://www.ginras.ru/>), 132
- GPI RAS (Federal State Budgetary Institution of Science “General Physics Institute of the Russian Academy of Sciences” | <http://www.gpi.ru/>), 132, 153, 156, 183
- Geliymash (Open Joint Stock Company “Researching and Production Association of Helium Engineering” | <http://geliymash.ru/>), 86, 147
- HTDC (High-Tech Diagnostic Centre | <http://www.uicorp.ru/>), 115
- IA RAS (Federal State Budgetary Institution of Science “Institute of Archaeology of the Russian Academy of Sciences” | <http://archaeolog.ru/>), 142
- IBMC (Federal State Budgetary Institution of Science Institute of Biomedical Chemistry | <http://www.ibmc.msk.ru/>), 142
- IBMP RAS (Federal State Budgetary Institution of Science “State Scientific Centre of the Russian Federation - Institute for Biomedical Problems of the Russian Academy of Sciences” | <http://www.imbp.ru/>), 86, 161, 166
- IC RAS (Federal State Budgetary Institution of Science “A.V.Chubnikov Institute of Crystallography of the Russian Academy of Sciences” | <http://www.crys.ras.ru/>), 142, 156
- IEPT RAS (Federal State Budgetary Institution of Science “Institute of Earthquake Prediction Theory and Mathematical Geophysics of the Russian Academy of Sciences” | <http://www.mitp.ru/>), 142
- IGEM RAS (Federal State Budgetary Institution of Science “Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry of the Russian Academy of Sciences” | <http://www.igem.ru/>), 142, 163
- IGIC RAS (Federal State Budgetary Institution of Science “Kurnakov Institute of General and Inorganic Chemistry of the Russian Academy of Sciences” | <http://www.igic.ras.ru/>), 142
- IHNA Ph RAS (Federal State Budgetary Institution of Science “Institute of Higher Nervous Activity and Neurophysiology of the Russian Academy of Sciences” | <http://www.ihna.ru/>), 161
- IITP RAS (Federal State Budgetary Institute of Science “Institute for Information Transmission Problems (Kharkevich Institute) of the Russian Academy of Sciences” | <http://iitp.ru/>), 176
- IKI RAS (Federal State Budgetary Institution of Science “Space Research Institute of the Russian Academy of Sciences” | <http://www.iki.rssi.ru/>), 132, 163
- IMET RAS (Federal State Budgetary Institution of Science “A.A.Baikov Institute of Metallurgy and Materials Science of the Russian Academy of Sciences” | <http://www.imet.ac.ru/>), 142
- IMM RAS (Federal State Budgetary Institution of Science “Institute for Mathematical Modeling of the Russian Academy of Sciences” | <http://www.imamod.ru/>), 14
- INEUM (Institute of Electronic Control Computes named after I.S.Bruk | <http://www.ineum.ru/>), 147
- INMI RAS (Federal State Budgetary Institution of Science “Winogradsky Institute of Microbiology of the Russian Academy of Sciences” | <http://www.inmi.ru/>), 142
- INTRA (Closed Joint Stock Company “INTRA” | <http://www.intra-zao.ru/>), 123
- IPCE RAS (Federal State Budgetary Institution of Science “A.N.Frumkin Institute of Physical Chemistry and Electrochemistry of the Russian Academy of Sciences” | <http://www.phyche.ac.ru/>), 119, 132, 142
- IPE RAS (Federal State Budgetary Institution of Science “Shmidt Institute of Physics of the Earth of the Russian Academy of Sciences” | <http://www.ifz.ru/>), 142
- ISP RAS (Federal State Budgetary Institution of Science “Institute for System Programming of the Russian Academy of Sciences” | <http://www.ispras.ru/>), 176
- ISPM RAS (Federal State Budgetary Institution of Science “Enikolopov Institute

- of Synthetic Polymeric Materials of the Russian Academy of Sciences" | <http://www.ispm.ru/>), 142, 156
- ITEP (Federal State Budgetary Institution "Russian Federation State Scientific Centre - Alikhanov Institute for Theoretical and Experimental Physics" of the National Research Centre "Kurchatov Institute" | <http://www.itep.ru/>), 14, 24, 30, 34, 42, 47, 58, 65, 86, 99, 103, 106, 115, 123, 132, 142, 161, 176, 183
- ITT-Group ("ITT-Group"), 115
- KIAM RAS (Federal State Budgetary Institution of Science "Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences" | <http://www.keldysh.ru/>), 176, 183
- LPI RAS (Federal State Budgetary Institution of Science "P.N.Lebedev Physical Institute of the Russian Academy of Sciences" | <http://www.lebedev.ru/>), 14, 30, 34, 42, 61, 65, 70, 86, 95, 99, 156
- MATI (Russian State Technological University | <http://www.mati.ru/>), 156
- MI RAS (Federal State Budgetary Institution of Science "Steklov Mathematical Institute of the Russian Academy of Sciences" | <http://www.mi.ras.ru/>), 14, 25, 30, 34
- MIEM (Moscow Institute of Electronics and Mathematics | <http://miem.hse.ru/>), 156
- MIET (National Research University of Electronic Technology | <http://www.miet.ru/>), 143, 183
- MIREA (Moscow State University Information Technology, Radioengineering and Electronics | <http://www.mirea.ru/>), 24
- MISiS (National University of Science and Technology "MISiS" | <http://www.misis.ru/>), 143
- MITHT (Lomonosov Moscow University of Fine Chemical Technology | <http://www.mitht.ru/>), 143
- MPEI (National Research University "Moscow Power Engineering Institute" | <http://mpei.ru/>), 176, 190
- MSMU (I.M. Sechenov First Moscow State Medical University | <http://www.mma.ru/>), 156
- MSU (Lomonosov Moscow State University | <http://www.msu.ru/>), 14, 20, 30, 34, 42, 86, 119, 132, 143, 153, 161, 163, 169, 176
- MUCTR (Mendeleev University of Chemical Technology of Russia | <http://www.muctr.ru/>), 119, 156
- NIKIET (Joint Stock Company "A.N.Dollezhal Research and Development Institute of Power Engineering" | <http://www.nikiet.ru/>), 65, 143, 147
- NNRU "MEPhI" (National Nuclear Research University "MEPhI" | <http://www.mephi.ru/>), 20, 24, 47, 55, 58, 65, 74, 86, 91, 103, 106, 119, 123, 142, 150, 183, 190
- NRC KI (National Research Centre "Kurchatov Institute" | <http://www.nrcki.ru/>), 20, 25, 86, 95, 106, 119, 123, 132, 143, 150, 176, 183
- NRU HSE (National Research University "Higher School of Economics" | <http://www.hse.ru/>), 24, 31
- PC ITER RF (Institution "Project Center ITER" | <http://www.iterrf.ru/>), 150
- PFUR (Peoples' Friendship University of Russia | <http://www.rudn.ru/>), 14, 20, 24, 31, 183
- PIN RAS (Paleontological Institute of the Russian Academy of Sciences | <http://www.paleo.ru/>), 163
- RADON (Federal State Unitary Enterprise - United Ecological, Scientific and Research Centre of Decontamination of Radioactive Waste and Environmental Protection "RADON" | <http://www.radon.ru/>), 123
- RCC MSU (Research Computer Centre of the M.V.Lomonosov Moscow State University | <http://www.srcc.msu.ru/>), 176, 183
- RIPN (Russian Institute for Public Networks | <http://www.ripn.net/>), 176
- RIVS (I.I.Mechnikov Research Institute of Vaccines and Sera | <http://www.instmech.ru/>), 156
- RMAPE (Russian Medical Academy of Postgraduate Education | <http://www.rmapo.ru/>), 166
- RSCC (Federal State Unitary Enterprise "Russian Satellite Communications Company" | <http://www.rsc.ru/>), 176
- SAI MSU (Sternberg Astronomical Institute of the M.V.Lomonosov Moscow State University | <http://www.sai.msu.ru/>), 31, 163
- SC "VNIINM" (Stock Company "A.A.Bochvar High-Technology Research Institute of Inorganic Materials" | <http://www.bochvar.ru/>), 123, 143
- SCC RAS (Scientific Council for Cybernetics of the Russian Academy of Sciences | <http://www.ras.ru/>), 14, 34

- SF IPh (Federal State Budgetary Institution of Science “State Foundation Institute of Pharmacology” | <http://www.academpharm.ru/>), 161
- SINP MSU (Skobeltsyn Institute of Nuclear Physics of the M.V.Lomonosov Moscow State University | <http://www.sinp.msu.ru/>), 14, 20, 25, 34, 54, 58, 65, 74, 99, 106, 119, 123, 132, 143, 156, 176, 183, 190
- SSDI (Joint Stock Company “State Specialized Design Institute” | <http://oaogspi.ru/>), 91, 147
- SYSTEMATOM (Closed Joint Stock Company “Nuclear and Radiation Safety Systems” | <http://www.systematom.ru/>), 147
- Technomedexport (Closed Joint Stock Company “Technomedexport”), 156
- VIGG RAS (Federal State Budgetary Institution of Science “Vavilov Institute of General Genetics of the Russian Academy of Sciences” | <http://www.vigg.ru/>), 166
- VNIIA (Federal State Unitary Enterprise “All-Russian Research Institute of Automatics” Russian Federal Atomic Energy Agency | <http://www.vniia.ru/>), 132
- VNIIMS (Federal Agency of Technical Regulating and Metrology National Metrology Institute All-Russian Research Institute of Metrological Service | <http://www.vniims.ru/>), 31, 34
- “Azimuth-Photonics” (“Azimuth-Photonics” | <http://www.azimp.ru/>), 74
- Moscow, Troitsk*
- HPPI RAS (Federal State Budgetary Institution of Science “Institute for High Pressure Physics of the Russian Academy of Sciences” | <http://www.hppi.troitsk.ru/>), 25, 143
- INR RAS (Federal State Budgetary Institution of Science “Institute for Nuclear Research of the Russian Academy of Sciences” | <http://www.inr.ac.ru/>), 14, 20, 31, 34, 45, 55, 58, 61, 65, 86, 91, 95, 99, 106, 119, 123, 132, 143, 150, 169, 176
- ISAN (Federal State Budgetary Institution of Science “Institute of Spectroscopy of the Russian Academy of Sciences” | <http://isan.troitsk.ru/>), 143
- Moscow, Zelenograd*
- RIMST (Closed Joint Stock Company “Research Institute of Material Science and Technology” | <http://www.niimv.ru/>), 119
- Nauchny*
- CrAO RAS (Federal State Budgetary Institution of Science “Crimean Astrophysical Observatory of the Russian Academy of Sciences” | <http://craocrimca.ru/>), 55
- Nizhny Novgorod*
- IAP RAS (Federal State Budgetary Institution of Science “Institute of Applied Physics of the Russian Academy of Sciences” | <http://www.iapras.ru/>), 91, 115
- IPM RAS (Federal State Budgetary Institution of Science “Institute for Physics of Microstructures of the Russian Academy of Sciences” | <http://ipmras.ru/>), 143
- UNN (N.I.Lobachevsky State University of Nizhny Novgorod (National Research University) | <http://www.unn.ru/>), 143, 176
- Novosibirsk*
- BIC SB RAS (Federal State Budgetary Institution of Science “Boreskov Institute of Catalysis of the Siberian Branch of the Russian Academy of Sciences” | <http://www.catalysis.ru/>), 164
- BINP SB RAS (Federal State Budgetary Institution of Science “Budker Institute of Nuclear Physics of the Siberian Branch of the Russian Academy of Sciences” | <http://www.inp.nsk.su/>), 14, 39, 47, 86, 91, 106, 115, 176
- IM SB RAS (Federal State Budgetary Institution of Science “Sobolev Institute of Mathematics of the Siberian Branch of the Russian Academy of Sciences” | <http://math.nsc.ru/>), 14
- ISP SB RAS (Federal State Budgetary Institution of Science “A.V.Rzhanov Institute of Semiconductor Physics of the Siberian Branch of the Russian Academy of Sciences” | <http://www.isp.nsc.ru/>), 156
- NSU (Novosibirsk State University | <http://www.nsu.ru/>), 31, 47, 65
- Obninsk*
- IPPE (Joint Stock Company “State Scientific Centre of the Russian Federation - Institute of Physics and Power Engineering” | <http://www.ippe.ru/>), 132, 143
- REATRACK-Filter (REATRACK-Filter LLC | <http://www.reatrack.ru/>), 156
- Omsk*
- OB IM SB RAS (Federal State Budgetary Institution of Science “Institute of Mathematics of the Siberian Branch of the Russian Academy of Sciences” | <http://ofim.oscsbras.ru/>), 52

- OmSU (F.V. Dostoevsky Omsk State University | <http://www.omsu.ru/>), 14, 20
- Pereslavl-Zalesskiy*
PSI RAS (Federal State Budgetary Institution of Science “Program Systems Institute of the Russian Academy of Sciences” | <http://www.botik.ru/PSI>), 176
- Perm*
ICMM UrB RAS (Federal State Budgetary Institution of Science “Institute of Continuous Media Mechanics of the Russian Academy of Sciences Ural Branch” | <http://www.icmm.ru/>), 143
ITCh UrB RAS (Federal State Budgetary Institution of Science “Institute of Technical Chemistry of the Russian Academy of Sciences Ural Branch” | <http://www.itch.perm.ru/>), 143
PSNRU (Perm State National Research University | <http://www.psu.ru/>), 14
- Petrozavodsk*
IG KRS RAS (Federal State Budgetary Institution of Science “Institute of Geology Karelian Research Center of the Russian Academy of Sciences” | <http://ig.krc.karelia.ru/>), 143
PetrSU (Petrozavodsk State University | <http://petsu.karelia.ru/>), 34
- Podolsk*
GIDROPRESS (Open Joint Stock Company “Experimental & Design Organization “GIDROPRESS” | <http://www.gidropress.podolsk.ru/>), 143
- Protvino*
IHEP (Federal State Budgetary Institution “Russian Federation State Scientific Centre - Institute for High Energy Physics” of the National Research Centre “Kurchatov Institute” | <http://www.ihep.ru/>), 14, 25, 31, 34, 42, 52, 58, 61, 65, 71, 74, 86, 99, 103, 106, 176, 183
- Puschino*
IMPB RAS (Federal State Budgetary Institution of Science “Institute of Mathematical Problems of Biology of the Russian Academy of Sciences” | <http://www.impb.ru/>), 176, 183
- Rostov-on-Don*
RIP SFU (Research Institute of Physics of the Southern Federal University | <http://ip.sfedu.ru/>), 143
SFedU (Southern Federal University | <http://www.sfedu.ru/>), 14, 166
- Ryazan*
RSU (S.A.Esenin Ryazan State University | <http://www.rsu.edu.ru/>), 91
- Samara*
SSU (Samara State University | <http://samsu.ru/>), 14, 183
SU (Samara University | <http://www.ssau.ru/>), 14, 25, 176
- Saratov*
SSU (Saratov State University named after N.G.Chernyshevsky | <http://www.sgu.ru/>), 14, 20, 25, 183
- Sarov*
VNIIEF (Russian Federal Nuclear Centre - All-Russian Research “Institute of Experimental Physics” | <http://www.vniief.ru/>), 15, 91, 99, 106, 115, 120, 123
- Sevastopol*
IBSS (A.O.Kovalevsky Institute of Biology of the Southern Seas | <http://www.ibss.inf.net/>), 132
- Simferopol*
MALDAS (“MALDAS” LLC | <http://www.maldas.uaprom.net/>), 156
SIMPEX (Research and Production Enterprise “SIMPEX” Joint-Stock Company | <http://www.filter-systems.com/>), 156
- Smolensk*
SSU (Smolensk State University | <http://www.smolgu.ru/>), 99, 190
- Snezhinsk*
VNIITF (Russian Federal Nuclear Centre - All-Russian Scientific Research Institute of Technical Physics | <http://www.vniitf.ru/>), 65, 132
- Sochi*
SRI MP (Federal State Budgetary Institution “Scientific Research Institute of Medical Primatology” | <http://www.primatologia.ru/>), 161
- St. Petersburg*
Botanic Garden BIN RAS (Federal State Budgetary Institution of Science “Botanic Garden of the V.L.Komarov Botanic Institute of the Russian Academy of Sciences” | <http://www.binran.ru/>), 132
ETU (Saint Petersburg State Electrotechnical University “LETI” | <http://www.eltech.ru/>), 25
Electron (Open Joint Stock Company “National Research Institute “Electron” | <http://www.electron.spb.ru/>), 65
FIP (V.F.Fock Institute of Physics of the Saint Petersburg State University |

- <http://www.niif.spbu.ru/>), 99, 106, 132, 176
 Hermitage (State Hermitage Museum | <http://www.hermitagemuseum.org/>), 132
 IPTI RAS (Federal State Budgetary Institution of Science “Toffe Physic l Technical Institute of the Russian Academy of Sciences” | <http://www.ioffe.ru/>), 25, 120, 123, 143, 156
 ITMO (National Research University of Information Technologies, Mechanics and Optics | <http://www.ifmo.ru/>), 176, 183
 KB “Arsenal” (Federal State Unitary Enterprise “Arsenal” Design Bureau” | <http://kbarsenal.ru/>), 55
 KRI (V.G.Khlopın Radium Institute | <http://www.khlopın.ru/>), 86, 109, 120, 132
 NIIIEFA (D.V.Efremov Scientific Research Institute of Electrophysical Apparatus | <http://www.niiefa.spb.su/>), 115, 183
 Neva-Magnet (Neva-Magnet S&E, Ltd | <http://www.magnet.spb.su/prd2.html/>), 52, 86
 PDMI RAS (Federal State Budgetary Institution of Science “St.Petersburg Department of V.A.Steklov Institute of Mathematics of the Russian Academy of Sciences” | <http://www.pdmi.ras.ru/pdmi/>), 25, 31
 SPSFTU (Saint Petersburg State Forest Technical University | <http://spbftu.ru/>), 132
 SPbSPU (Saint Petersburg Polytechnic University Peter the Great | <http://www.spbstu.ru/>), 14, 169, 176
 SPbSU (Saint Petersburg State University | <http://spbu.ru/>), 14, 20, 25, 31, 86, 103, 123, 143, 176, 190
- Sterlitamak*
 SSPA (Sterlitamak State Pedagogical Academy | <http://www.sspa.edu.ru/>), 143
- Syktuykar*
 DM Komi SC UrB RAS (Federal State Budgetary Institution of Science “Department of Mathematics Komi Sciences Centre of the Russian Academy of Sciences Ural Branch” | <http://www.komisc.ru/>), 74, 86
- Tomsk*
 IHCE SB RAS (Federal State Budgetary Institution of Science “Institute of High Current Electronics of the Siberian Branch of the Russian Academy of Sciences” | <http://www.hcei.tsc.ru/>), 15, 124
 NPI TPU (Nuclear Physics Institute of the National Research Tomsk Polytechnic University | <http://www.npi.tpu.ru/>), 86, 124, 143
 TPU (National Research Tomsk Polytechnic University | <http://tpu.ru/>), 31, 61, 65, 71, 99, 109, 190
 TSPU (Tomsk State Pedagogical University | <http://www.tspu.ru/>), 31
 TSU (National Research Tomsk State University | <http://www.tsu.ru/>), 15, 34, 169, 183
- Tula*
 TSPU (Tula State Pedagogical University | <http://tsput.ru/>), 132
 TSU (Tula State University | <http://tsu.tula.ru/>), 143, 190
- Tver*
 TvSU (Tver State University | <http://university.tversu.ru/>), 15, 190
- Vladimir*
 Vladisart (“Vladisart” | <http://www.vladisart.ru/>), 156
- Vladivostok*
 FEFU (Far Eastern Federal University | <http://dvfu.ru/>), 20
- Voronezh*
 VSU (Voronezh State University | <http://www.vsu.ru/>), 25, 120, 123, 132, 190
- Yakutsk*
 NEFU (North-Eastern Federal University | <http://www.s-vfu.ru/>), 190
- Yekaterinburg*
 IMP UB RAS (Federal State Budgetary Institution of Science “M.N.Mikheev Institute of Metal Physics of Ural Branch of the Russian Academy of Sciences” | <http://www.imp.uran.ru/>), 143, 150
 UrFU (Urals Federal University named after the First President of Russia B.N.Yeltsin | <http://urfu.ru/>), 132, 143
- Yoshkar-Ola*
 VSUT (Volga State University of Technology | <http://www.volgatech.net/>), 15
- Zhukovsky*
 MDB (Open Joint Stock Company “Myasishchev Design Bureau” | <http://www.emz-m.ru/>), 66
- Saudi Arabia**
- Tuval*
 KAUST (King Abdullah University of Science and Technology | <http://www.kaust.edu.sa/>), 183

Serbia

Belgrade

INS “VINČA” (“VINČA” Institute of Nuclear Sciences | <http://www.vin.bg.ac.rs/>), 25, 66, 115, 143, 156, 190

IPB (Institute of Physics Belgrade of the University of Belgrade | <http://www.phy.bg.ac.rs/>), 20, 31, 34, 132
Univ. (University of Belgrade | <http://www.bg.ac.rs/>), 15, 31, 34, 132

Novi Sad

UNS (University of Novi Sad | <http://www.uns.ac.rs/>), 132, 143

Slovakia

Banska Bistrica

UMB (University Mateja Bela | <http://www.umb.sk/>), 74, 184

Bratislava

BIONT (Bratislava Ionic Technologies Co. | <http://www.biont.sk/>), 156

CU (Comenius University in Bratislava | <http://uniba.sk/>), 15, 20, 25, 42, 45, 50, 58, 61, 109, 120, 124, 132, 143, 156, 161, 191

IEE SAS (Institute of Electrical Engineering of the Slovak Academy of Sciences | <http://www.elu.sav.sk/>), 91, 124, 132, 156

ILE SAS (Institute of Landscape Ecology of the Slovak Academy of Sciences | <http://uke.sav.sk/>), 132

IMS SAS (Institute of Measurement Science of the Slovak Academy of Sciences | <http://www.um.sav.sk/>), 86, 115

IP SAS (Institute of Physics of the Slovak Academy of Sciences | <http://www.fu.sav.sk/>), 15, 20, 42, 45, 52, 58, 95, 99, 103, 109, 115, 120, 132

SOSMT (Slovak Office of Standards, Metrology and Testing | <http://www.unms.sk/>), 109

STU (Slovak University of Technology in Bratislava | <http://www.stuba.sk/>), 66, 106

Košice

IEP SAS (Institute of Experimental Physics of the Slovak Academy of Sciences in Košice | <http://uef.saske.sk/>), 15, 20, 25, 95, 143, 176, 183

PJSU (Pavol Jozef Šafárik University in Košice | <http://www.upjs.sk/>), 86, 95, 99, 103, 106, 153, 183, 184, 191

TUKE (Technical University of Košice | <http://www.tuke.sk/tuke/university>), 25, 183

Prešov

PU (University of Prešov | <http://www.unipo.sk/>), 176, 184

Žilina

UŽ (University of Žilina | <http://www.uniza.sk/>), 86, 95

Slovenia

Ljubljana

GeoSS (Geological Survey of Slovenia | <http://www.geo-zs.si/>), 132

UL (University of Ljubljana | <http://www.uni-lj.si/>), 25

South Africa

Bellville

UWC (University of the Western Cape | <http://www.uwc.ac.za/>), 157

Cape Town

UCT (University of Cape Town | <http://www.uct.ac.za/>), 34, 86, 106, 176, 184

iThemba LABS (iThemba Laboratory for Accelerator Based Sciences | <http://www.tlabs.ac.za/>), 20, 91, 115, 120, 161

Johannesburg

UJ (University of Johannesburg | <http://www.uj.ac.za/>), 86

WITS (University of the Witwatersrand | <http://www.wits.ac.za/>), 86

Port Elizabeth

NMMU (Nelson Mandela Metropolitan University | <http://www.nmmu.ac.za/>), 157

Pretoria

DST (Department of Science and Technology Republic of South Africa | <http://www.dst.gov.za/>), 191

Necsa (South African Nuclear Energy Corporation | <http://www.necsa.co.za/>), 143, 150

UP (University of Pretoria | <http://web.up.ac.za/>), 157

Unisa (University of South Africa | <http://www.unisa.ac.za/>), 20, 120, 133

Stellenbosch

SU (Stellenbosch University | <http://www.sun.ac.za/>), 20, 120, 133, 184

Spain

Barcelona

IEEC-CSIC (Institute of Space Studies of Catalonia of the Spanish National Research Council | <http://www.ieec.cat/>), 31

IFAE (Institute for High Energy Physics | <http://www.ifae.es/>), 42

Bilbao

UPV/EHU (University of the Basque Country | <http://www.enu.es/>), 31

Huelva

UHU (University of Huelva |
<http://www.uhu.es/>), 120

Madrid

CENIM-CSIC (National Centre for
Metallurgical Research of the Spanish
National Research Council |
<http://www.cenim.csic.es/>), 143

CIEMAT (Research Centre for Energy,
Environment and Technology |
<http://www.ciemat.es/>), 66

CSIC (Spanish National Research Council |
<http://www.csic.es/>), 120

ETSIAE (Escuela Técnica Superior de
Ingeniería Aeronáutica y del Espacio |
<http://www.etsiae.upm.es/>), 31

IA-CSIC (Institute of Acoustics of the Spanish
National Research Council |
<http://www.ia.csic.es/>), 157

ICMM-CSIC (Materials Science Institute of
Madrid of the Spanish National Research
Council | <http://www.icmm.csic.es/>), 25

UAM (Autonoma University of Madrid |
<http://www.uam.es/>), 66

Oviedo

UO (University of Oviedo |
<http://www.uniovi.es/>), 66

Palma

UIB (Illes Balears University |
<http://www.uib.cat/>), 20

Santander

IFCA (Institute of Physics of Cantabria of the
University of Cantabria |
<http://www.ifca.unican.es/>), 66

Santiago de Compostela

USC (University of Santiago de Compostela |
<http://www.usc.es/>), 15

Valencia

IFIC (Institute for Particle Physics of the
University of Valencia | <http://ific.uv.es/>),
31

UPV (Polytechnic University of Valencia |
<http://webific.ific.uv.es/>), 147

UV (University of Valencia |
<http://www.uv.es/>), 15, 157

Sweden

Göteborg

Chalmers (Chalmers University of Technology
| <http://www.chalmers.se/>), 20, 120

Lund

ESS ERIC (European Spallation Source ERIC),
150

LU (Lund University | <http://www.lu.se/>), 15,
20, 100, 106, 120, 176

Stockholm

SU (Stockholm University |
<http://www.su.se/>), 86

Uppsala

TSL (Svedberg Laboratory of the Uppsala
University | <http://www4.tsl.uu.se/tsl/>), 86,
95

Switzerland

Basel

Uni Basel (University of Basel |
<http://www.unibas.ch/>), 66, 169

Bern

Uni Bern (University of Bern |
<http://www.unibe.ch/>), 15, 20

Geneva

UniGe (University of Geneva |
<http://www.unige.ch/>), 95, 100

Lausanne

EPFL (Ecole Polytechnique Fédérale de
Lausanne | <http://www.epfl.ch/>), 106

Villigen

PSI (Paul Scherrer Institute |
<http://www.psi.ch/>), 25, 66, 95, 100, 120,
133, 143, 150

Zurich

ETH (Swiss federal Institute of Technology
Zurich | <http://www.ethz.ch/>), 25, 61, 66,
100, 143, 184

UZH (University of Zurich |
<http://www.uzh.ch/>), 66

Taiwan

Chung-Li

NCU (National Central University |
<http://www.ncu.edu.tw/>), 66

Hsinchu

NSRRC (National Synchrotron Radiation
Research Center |
<http://www.nsrcc.org.tw/>), 143

Taipei

AS (Academia Sinica |
<http://www.sinica.edu.tw/>), 71, 184

ASGCC (Academia Sinica Grid Computing
Centre | <http://www.sinica.edu.tw/>), 176

IP AS (Institute of Physics of the Academia
Sinica | <http://www.phys.sinica.edu.tw/>),
20, 25

NTU (National Taiwan University |
<http://www.ntu.edu.tw/>), 20, 66

Tajikistan

Dushanbe

ICChem ASRT (V.I.Nikitin Institute of
Chemistry of the Academy of Sciences of

the Republic of Tajikistan |
<http://www.phti.tj/>), 143
PHTI ASRT (S.U.Umarov Physical-Technical
Institute of the Academy of Sciences of the
Republic of Tajikistan |
<http://www.phti.tj/>), 100, 184
TNU (Tajik State University | <http://tnu.tj/>),
184

Khujent

KSU (Khujent State University |
<http://www.hgu.tj/>), 184

Thailand

Hat Yai

PSU (Prince of Songkla University |
<http://www.psu.ac.th/>), 133

Turkey

Adana

CU (Çukurova University |
<http://www.cu.edu.tr/>), 66

Ankara

METU (Middle East Technical University |
<http://www.metu.edu.tr/>), 50, 66

Istanbul

BU (Boğaziçi University |
<http://www.boun.edu.tr/>), 31, 34

Izmir

IZTECH (Izmir Institute of Technology |
<http://www.iyte.edu.tr/>), 31

Çanakkale

ÇOMU (Çanakkale Onsekiz Mart University |
<http://www.comu.edu.tr/>), 133

USA

Ames, IA

ISU (Iowa State University |
<http://www.iastate.edu/>), 66

Argonne, IL

ANL (Argonne National Laboratory |
<http://www.anl.gov/>), 120

Arlington, TX

UTA (University of Texas Arlington |
<http://www.uta.edu/>), 176

Athens, AL

ASU (Athens State University |
<http://www.athens.edu/>), 164

Austin, TX

UT (University of Texas at Austin |
<http://www.utexas.edu/>), 124

Baltimore, MD

JHU (Johns Hopkins University |
<http://www.jhu.edu/>), 35, 66

Batavia, IL

Fermilab (Fermi National Accelerator
Laboratory | <http://www.fnal.gov/>), 45, 50,

66, 87, 91, 176

Berkeley, CA

Berkeley Lab (Lawrence Berkeley National
Laboratory of the University of California |
<http://www.lbl.gov/>), 100, 103

Blacksburg, VA

Virginia Tech (Virginia Polytechnic Institute
and State University; Institute for High
Energy Physics | <http://www.vt.edu/>), 66

Bloomington, IN

IU (Indiana University Bloomington |
<http://www.iub.edu/>), 103

Boston, MA

BU (Boston University |
<http://www.bu.edu/>), 61, 66
NU (Northeastern University |
<http://www.northeastern.edu/>), 66

Cambridge, MA

Harvard Univ. (Harvard University |
<http://www.harvard.edu/>), 50
MIT (Massachusetts Institute of Technology |
<http://web.mit.edu/>), 66

Charlottesville, VA

UVa (University of Virginia |
<http://www.virginia.edu/>), 45

Chicago, IL

UIC (University of Illinois at Chicago |
<http://www.uic.edu/>), 66

Cincinnati, OH

UC (University of Cincinnati |
<http://www.uc.edu/>), 31, 35

College Park, MD

UMD (University of Maryland |
<http://www.umd.edu/>), 15, 31, 35, 66

College Station, TX

Texas A&M (Texas A&M University |
<http://www.tamu.edu/>), 115, 120

Columbus, OH

OSU (Ohio State University |
<http://www.osu.edu/>), 66, 106

Coral Gables, FL

UM (University of Miami |
<http://welcome.miami.edu/>), 31, 35

Davis, CA

UCDavis (University of California |
<http://ucdavis.edu/>), 66

Durham, NC

Duke (Duke University |
<http://www.duke.edu/>), 133

East Lansing, MI

MSU (Michigan State University |
<http://www.msu.edu/>), 120

Evanston, IL

NU (Northwestern University |
<http://www.northwestern.edu/>), 66

Fairfax, VA
 GMU (George Mason University | <http://www.gmu.edu/>), 61

Gainesville, FL
 UF (University of Florida | <http://www.ufl.edu/>), 66

Gettysburg, PA
 GC (Gettysburg College | <http://www.gettysburg.edu/>), 133

Houston, TX
 Rice Univ. (Rice University | <http://www.rice.edu/>), 66

Indianapolis, IN
 IUPUI (Indiana University - Purdue University Indianapolis | <http://www.iupui.edu/>), 50, 147

Iowa City, IA
 UIowa (University of Iowa | <http://www.uiowa.edu/>), 66, 100

Irvine, CA
 UCI (University of California, Irvine | <http://www.uci.edu/>), 124

Kingston, RI
 URI (University of Rhode Island | <http://ww2.uri.edu/>), 133

Knoxville, TN
 UTK (University of Tennessee of Knoxville | <http://www.utk.edu/>), 157

Lansing, MI
 IONETIX (Ionetix Corporation | <http://ionetic.com/>), 126

Lawrence, KS
 KU (University of Kansas | <http://www.ku.edu/>), 184

Lemont, IL
 ANL (Argonne National Laboratory | <http://www.anl.gov/>), 15, 20, 42, 103

Lexington, KY
 UK (University of Kentucky | <http://www.uky.edu/>), 45

Lincoln, NE
 UNL (University of Nebraska-Lincoln | <http://www.unl.edu/>), 66

Livermore, CA
 LLNL (Lawrence Livermore National Laboratory | <http://www.llnl.gov/>), 66, 115, 120

Los Alamos, NM
 LANL (Los Alamos National Laboratory; Meson Physics Facility (LAMPF) | <http://www.lanl.gov/>), 20, 66, 133, 184

Los Angeles, CA
 UCLA (University of California, Los Angeles | <http://www.universityofcalifornia.edu/>), 66

Louisville, KY
 UofL (University of Louisville | <http://louisville.edu/>), 25

Lubbock, TX
 TTU (Texas Tech University | <http://www.ttu.edu/>), 66

Madison, WI
 UW-Madison (University of Wisconsin-Madison | <http://www.wisc.edu/>), 66

Menlo Park, CA
 SLAC (SLAC National Accelerator Laboratory is Operated by Stanford University | <http://www6.slac.stanford.edu/>), 61

Merced, CA
 UCMerced (University of California, Merced Madison | <http://www.ucmerced.edu/>), 61

Minneapolis, MN
 U of M (University of Minnesota | <http://twin-cities.umn.edu/>), 15, 31, 35, 66

Nashville, TN
 VU (Vanderbilt University | <http://www.vanderbilt.edu/>), 115, 120

New Haven, CT
 Yale Univ. (Yale University | <http://www.yale.edu/>), 103

New York, NY
 CUNY (City University of New York | <http://www.cuny.edu/>), 15, 25, 31, 34
 RU (Rockefeller University | <http://www.rockefeller.edu/>), 15, 31
 SUNY (State University of New York | <http://www.suny.edu/>), 31, 35

Newport News, VA
 JLab (Thomas Jefferson National Accelerator Facility; Southeastern Universities Research Association (SURA) | <http://www.jlab.org/>), 15, 35, 95

Norfolk, VA
 NSU (Norfolk State University | <http://www.nsu.edu/>), 95, 100

Norman, OK
 OU (University of Oklahoma | <http://www.ou.edu/>), 15, 31

Notre Dame, IN
 ND (University of Notre Dame | <http://www.nd.edu/>), 20, 66

Oak Ridge, TN
 ORNL (Oak Ridge National Laboratory | <http://www.ornl.gov/>), 106, 115, 120, 133, 157

Oxford, MS
 UM (University of Mississippi | <http://www.olemiss.edu/>), 66

Pasadena, CA
 Caltech (California Institute of Technology | <http://www.caltech.edu/>), 67

Philadelphia, PA
 Penn (University of Pennsylvania | <http://www.upenn.edu/>), 15, 31, 35

Piscataway, NJ
 Rutgers (Rutgers University-State University of New Jersey | <http://www.rutgers.edu/>), 31, 35, 67

Pittsburgh, PA
 CMU (Carnegie Mellon University | <http://www.cmu.edu/>), 67

Princeton, NJ
 PU (Princeton University; Joseph Henry Laboratories of Physics | <http://www.princeton.edu/>), 67

Riverside, CA
 UCR (University of California, Riverside | <http://www.ucr.edu/>), 67

Rochester, NY
 UR (University of Rochester | <http://www.rochester.edu/>), 25, 31, 35, 67

Salt Lake City, UT
 U of U (University of Utah | <http://www.utah.edu/>), 35

Stanford, CA
 SU (Stanford University | <http://stanford.edu/>), 157

Stony Brook, NY
 SUNY (State University of New York at Stony Brook | <http://www.stonybrook.edu/>), 87

Tallahassee, FL
 FSU (Florida State University | <http://www.fsu.edu/>), 25, 67

Tuscaloosa, AA
 UA (University of Alabama | <http://www.ua.edu/>), 67

University Park, PA
 Penn State (Pennsylvania State University | <http://www.psu.edu/>), 15, 20, 103

Upton, NY
 BNL (Brookhaven National Laboratory | <http://www.bnl.gov/>), 61, 87, 91, 95, 100, 103, 176, 191

Urbana, IL
 I (University of Illinois at Urbana-Champaign | <http://illinois.edu/>), 71

Washington, DC
 UW (University of Washington | <http://www.washington.edu/>), 169

Williamsburg, VA
 W&M (College of William & Mary | <http://www.wm.edu/>), 95, 100

Ukraine

Dnepropetrovsk
 DNU (Dnepropetrovsk National University | <http://www.dnu.dp.ua/>), 15

Donetsk
 DonIPE (Donetsk Institute for Physics and Engineering named after O.O.Galkin | <http://www.donfti.ru/main>), 133, 144
 DonNU (Donetsk National University | <http://www.donnu.edu.ua/>), 144, 153

Kharkov
 IERT NASU (Institute of Electrophysics and Radiation Technology of the National Academy of Sciences of Ukraine | <http://www.iert.kharkov.ua/>), 91, 144, 157, 169
 ISC NASU (Institute for Single Crystals of the National Academy of Sciences of Ukraine | <http://www.isc.kharkov.ua/>), 66, 124
 ISMA NASU (Institute for Scintillation Materials of the National Academy of Sciences of Ukraine | <http://www.isma.kharkov.ua/>), 45, 133, 169
 KhNU (V.N.Karasin Kharkov National University | <http://www.univer.kharkov.ua/>), 66, 87
 LTU ("LED, Technologies Ukraine | <http://LTU.ua/>), 87
 NSC KIPT (National Science Centre - Kharkov Institute of Physics and Technology | <http://www.kipt.kharkov.ua/>), 15, 20, 25, 31, 66, 87, 95, 106, 109, 133, 144, 176

Kiev
 BITP NASU (M.M.Boholubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine | <http://www.bitp.kiev.ua/>), 15, 20, 31, 34, 55, 58, 74, 87, 106, 176, 191
 IMP NASU (G.V.Kurdyumov Institute of Metal Physics of the National Academy of Sciences of Ukraine | <http://www.imp.kiev.ua/>), 25
 IPMS NASU (Frantsevich Institute for Problems of Materials Science of the National Academy of Sciences of Ukraine | <http://www.materials.kiev.ua/>), 144
 ISC NASU (Chuiko Institute of Surface Chemistry of the National Academy of Sciences of Ukraine | <http://www.isc.gov.ua/>), 144
 KINR NASU (Kiev Institute for Nuclear Research of the National Academy of Sciences of Ukraine | <http://www.kinr.kiev.ua/>), 20, 115, 120,

124, 133

NUK (Taras Shevchenko National University of Kyiv | <http://univ.kiev.ua/>), 20, 25, 133, 144, 191

PEWI NASU (Paton Electric Welding Institute of Surface Chemistry of the National Academy of Sciences of Ukraine | <http://paton.kiev.ua/>), 91

L'viv

IAPMM NASU (Pidstryhach Institute for Applied Problems of Mechanics and Mathematics of the National Academy of Sciences of Ukraine | <http://www.iapmm.lviv.ua/>), 15

ICMP NASU (Institute for Condensed Matter Physics of the National Academy of Sciences of Ukraine | <http://www.icmp.lviv.ua/>), 25

IFNU (Ivan Franko National University in L'viv | <http://lnu.edu.ua/>), 15

LPNU (National University L'viv Polytechnic | <http://lp.edu.ua/>), 150

Lutsk

VNU (Volyn National University of Lesya Ukrainka | <http://www.vnu.edu.ua/>), 15

Sumy

IAP NASU (Institute of Applied Physics of the National Academy of Sciences of Ukraine | <http://iap.sumy.org/>), 133

SumSU (Sumy State University | <http://sumdu.edu.ua/>), 15

Uzhgorod

IEP NASU (Institute of Electron Physics of the National Academy of Sciences of Ukraine | <http://www.iep.uzhgorod.ua/>), 133

United Kingdom

Bath

UB (University of Bath | <http://www.bath.ac.uk/>), 184

Birmingham

Univ. (University of Birmingham | <http://www.birmingham.ac.uk/>), 61, 106

Brighton

US (University of Sussex | <http://www.sussex.ac.uk/>), 31

Bristol

Univ. (University of Bristol | <http://www.bris.ac.uk/>), 61, 66

Buckingham

UB (University of Buckingham | <http://www.buckingham.ac.uk/>), 153, 164

Cambridge

Univ. (University of Cambridge | <http://www.cam.ac.uk/>), 31, 34

Canterbury

Univ. (University of Kent | <http://www.kent.ac.uk/>), 15

Didcot

RAL (Rutherford Appleton Laboratory; Science and Technology Facilities Council | <http://www.stfc.ac.uk/>), 66, 144, 147, 150

Durham

Univ. (Durham University | <http://www.dur.ac.uk/>), 31, 34

Edinburgh

Univ. (University of Edinburgh | <http://www.edinburgh.ac.uk/>), 169

Glasgow

U of G (University of Glasgow | <http://www.gla.ac.uk/>), 31, 95
US (University of Strathclyde of Glasdow | <http://www.strath.ac.uk/>), 61

Leeds

UL (University of Leeds | <http://www.leeds.ac.uk/>), 31

Liverpool

Univ. (University of Liverpool | <http://www.liv.ac.uk/>), 31, 61

London

Imperial College (Imperial College London | <http://www.imperial.ac.uk/>), 15, 31, 34, 47, 66

Middlesex Univ. (Middlesex University | <http://www.mdx.ac.uk/>), 157

QM (Queen Mary of the University of London | <http://www.qmul.ac.uk/>), 15

UCL (University College London | <http://www.ucl.ac.uk/>), 124

Manchester

UoM (University of Manchester | <http://www.manchester.edu/>), 120, 124

Oxford

JAI (John Adams Institute for Accelerator Science | <http://www.adams-institute.ac.uk/>), 91

Southampton

Univ. (University of Southampton | <http://www.soton.ac.uk/>), 31, 34

York

Univ. (University of York | <http://www.york.ac.uk/>), 31, 34

Uzbekistan

Jizakh

JSPI (Jizakh State Pedagogical Institute named after A.Kadri | <http://jspi.uz/>), 58, 100

Samarkand

SSU (Samarkand State University named after Alisher Navoi | <http://www.samdu.uz/>), 42,

58, 100, 115, 124

Tashkent

- Assoc.“P.-S.” PTI (Physical Technical Institute Association “Physics-Sun” named after S.A.Azimov of the Academy of Sciences of the Republic of Uzbekistan | <http://uzcinet.uz/>), 20, 25, 95, 100
- IAP NUU (Institute of Applied Physics of the National University of Uzbekistan named after Mirzo Ulugbek | <http://nuu.uz/>), 15, 20, 124
- INP AS RUz (Institute of Nuclear Physics of the Academy of Sciences of the Republic of Uzbekistan | <http://www.inp.uz/>), 20, 67, 95, 124, 126, 144
- NUU (National University of Uzbekistan named after Mirzo Ulugbek | <http://nuu.uz/>), 15

Vietnam

Da Nang

- DTU (Duy Tan University | <http://daytan.edu.vn/>), 144

Hanoi

- IMS VAST (Institute of Material Science of the Vietnam Academy of Science and Technology | <http://ims.vast.ac.vn/>), 25
- IOP VAST (Institute of Physics of the Vietnam Academy of Science and Technology | <http://www.iop.vast.ac.vn/>), 15, 35, 120, 133, 144, 157
- VNU (Vietnam National University Hanoi | <http://www.vnu.edu.vn/>), 133, 184

CERN

Geneva

- CERN (European Organization for Nuclear Research (Switzerland) | <http://public.web.cern.ch/>), 12, 29, 33, 42, 52, 60, 64, 70, 85, 90, 94, 99, 105, 114, 118, 130, 169, 175, 182, 190

ICTP

Trieste

- ICTP (Abdus Salam International Centre for Theoretical Physics (Italy) | <http://www.ictp.it/>), 13, 30