TOPICAL PLAN
FOR JINR RESEARCH
AND INTERNATIONAL COOPERATION
2016

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Contents

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

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

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* 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

** 0 - All-Institute Topics
1 - Veksler and Baldin Laboratory of High Energy Physics (VBLHEP)
2 - Dzhelepov 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)

01–3–1113–2014/2018	Priority: 1

Status: In-progress

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, New Zeland, Norway, 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 2016:

- Calculation of the amplitudes in maximally supersymmetric theories in extra dimensions.

  Analysis of possible SUSY search strategies at the LHC in the framework of the MSSM and NMSSM.

  Interpretation of experimental data on supersymmetry searches coming from the ATLAS and CMS collaborations.

  Theoretical analysis of the effects due to radiative corrections in Drell-Yan processes taking into account new experimental conditions being relevant after increasing LHC luminosity and beam energy.

  Investigation of the Q^2 evolution of the average multiplicities with the double-logarithm resummation taken into account.

  Consideration of the Q^2 evolution of the structure function F_2, its derivations and heavy quark parts at small x in the first three orders of perturbation theory.

  Studies of the dark matter problem and searches for different dark matter particle candidates both in the Standard Model and beyond it, in particular within supersymmetric theories.

  Investigation of the low-energy behavior of the hadronic vacuum polarization function within the dispersive approach to QCD.

  Calculation of different four-loop contributions to beta-functions and anomalous dimensions in the Standard Model and its supersymmetric and non-supersymmetric extensions.

- Derivation of the complete analytical expression for the missing contribution of the three-loop radiative correction to the pion transition form factor.

Investigation of the evolution of spin structure functions and their truncated moments at low Q^2 in the NLO approximation and with account for models of coupling in the infrared region and higher twists.

Investigations of transverse-momentum dependent parton distributions for Drell-Yan processes and direct photon production within the NICA project. Construction of global fits for Sivers functions with account for evolution effects, constraints from g_2 structure functions and sum rules.

Lattice calculations of the form factors related to the quark spin and orbital angular momenta and their comparison with the constraints implied by the equivalence principle.

Development of the general theory of wave packets. Construction of a model of a covariant asymmetric wave packet and detailed study of its properties. Derivation of general formulae for an effective 4-momentum of neutrino in ultra-relativistic and non-relativistic cases.

Investigation of the correlation functions of the color charged field fluctuations in the confinement regime within the domain model of the QCD vacuum. Study of the spectral properties of the color charged quasi-particles and thermodynamics of the heterophase state of hadronic matter under conditions of the relativistic heavy ion collision.

- Description of tau lepton decays with taking into account radial excited states of vector and axial vector mesons within the extended Nambu-Jona-Lasinio model.

  Derivation of the full set of evolution equations for the transverse-momentum dependent parton distribution functions basing on the results of geometrical and group properties of the Wilson loop space.

  Investigation of the role of non-Gaussian probability distributions in the description of the nonperturbative input in the phenomenology of the polarized semi-inclusive processes studied at the JLab, RHIC and future Electron-Ion Collider (EIC).

  Complete analysis of nonleptonic decays of the whole family of bottom and charm baryons into an ordinary baryon and a meson. Calculation of decay widths and parameters of various asymmetries.

  Studies of spectra and semileptonic decays of baryons containing heavy flavors. Evaluation of form factors of the dacay Lambda-b into Lambda-c in the framework of the covariant quark model. Development of the theoretical formalism for these decays by using helicity methods including lepton mass effects.

- Participation in the tmfT Collaboration (finite temperature with twisted mass fermions) aimed at description of the quark-gluon thermodynamics including strange and charmed quarks, consideration of new observables indicating the crossover.

  Investigation of topological aspects of the quark-gluon plasma (monopoles, dyons, vortices etc.) and estimation of the contribution of these degrees of freedom to trace anomaly, energy density etc.

  Evaluation of transport coefficients in the u-d-s-c-gluon plasma (jet quenching, heavy quark diffusion, dilepton rates etc.).

  Model calculations of the generation of vorticity in heavy-ion collisions and its effect on P-odd correlations of quarks and mesons in the NICA project.

  Investigation of the role of color degrees of freedom at the early stage of heavy-ion interactions within the model of Parton Hadron String Dynamics (PHSD), estimation of the intensity of chromoelectric and chromomagnetic fields created in collisions of relativistic heavy ions. Study of the influence of color forces on the dynamics of parton interactions.

  Study of the impact of strong electromagnetic fields (occurring during relativistic heavy-ion collisions) on the character of background gluon fields and the formation of a heterophase mixed hadron system within the domain model of the QCD vacuum. Investigation of observable manifestations of azimuthal anisotropy of the gluon fields in the collision region.

  Study of the thermodynamic properties of non-uniform quark ensembles (quark droplets) on the basis of the models with four-fermion interaction. The Keldysh model (featuring an infinite correlation length) will receive special attention.

  Further development of effective models for the QCD phase diagram to exhibit further observables (mesonic correlation functions, condensates and dual condensates) ready for comparison with lattice QCD data.

Extension of the PNJL and PQM models to include baryonic degrees of freedom to describe the region of non-vanishing net-baryon density.

Study of hybrid EoS (equations of state) based on ab-initio nuclear EoS and non-local PNJL models in a wide range of densities, temperatures and isospin asymmetry, for applications in the simulation of heavy-ion collisions, of supernova collapse and in compact star phenomenology.

List of activities:

Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1. **Standard Model and its extension**	**D.I. Kazakov** **A.B. Arbuzov**
BLTP	A.V. Bednyakov, A.V. Gladyshev, A.V. Kotikov, G.A. Kozlov, V.K. Mitrjushkin, V.A. Naumov, V.N. Pervushin, A.D. Popov, S.I. Vinitsky, + 5 students
LIT	V.P. Gerdt
VBLHEP	V.G. Krivokhizhin
DLNP	D.Yu. Bardin, V.A. Bednyakov, L.B. Kalinovskaya
2. **QCD parton distributions for modern and future colliders**	**A.V. Efremov** **O.V. Teryaev** **D.V. Shirkov**
BLTP	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	I.V. Anikin, G. Ganbold, S.B. Gerasimov, S.M. Eliseev, N.I. Kochelev, V.I. Korobov, V.A. Meshcheryakov, S.N. Nedelko, M.K. Volkov, Yu.S. Surovtsev, S.A. Zhaugasheva, + 5 students
VBLHEP	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, M. Deka, A.E. Dorokhov, A.V. Friesen, M. Hasegawa, A.S. Khvorostukhin, N.I. Kochelev, A. Parvan, B.D. Rumiantsev, O.V. Teryaev, V.D. Toneev, A.M. Trunin, V.E. Voronin, + 3 students
LIT	Yu.L. Kalinovsky, Zh.Zh. Musulmanbekov, V. Voronyuk
VBLHEP	V.D. Kekelidze, A.G. Litvinenko, M.V. Tokarev, O.V. Rogachevsky
DLNP	G.I. Lykasov

Collaboration

Country or International Organization	**City**	**Institute or Laboratory**
Armenia	Yerevan	RAU
		Foundation ANSL
Azerbaijan	Baku	IP ANAS
Belarus	Minsk	INP BSU
		JIPNR-Sosny
		NASB
		NC PHEP BSU
	Gomel	BelSUT
		GSU
		GSTU
Bulgaria	Sofia	INRNE BAS
		SU
Canada	Montreal	McGill
		UdeM
	Toronto	U of T
CERN	Geneva	CERN
China	Wuhan	WIPM CAS
Czech Republic	Prague	CTU
		CU
		IP ASCR
	Řež	NPI ASCR
Finland	Helsinki	UH
France	Lyon	UCBL
	Metz	UPV-M
	Montpellier	UM2
	Saclay	SPhN CEA
		DAPNIA
		IRFU
Georgia	Tbilisi	RMI TSU
Germany	Berlin	FU Berlin

		HUB
	Aachen	RWTH
	Bielefeld	Univ.
	Bochum	RUB
	Bonn	UniBonn
	Dortmund	TU Dortmund
	Erlangen	FAU
	Hamburg	DESY
	Heidelberg	Univ.
	Jena	Univ.
	Jülich	FZJ
	Kaiserslautern	TU
	Karlsruhe	KIT
	Regensburg	UR
	Rostock	Univ.
	Mainz	JGU
	Munich	LMU
	Tübingen	Univ.
	Wuppertal	UW
	Zeuthen	DESY
Hungary	Budapest	ELTE
		Wigner RCP
ICTP	Trieste	ICTP
Italy	Bari	INFN
	Naples	INFN
	Padua	UniPd
	Pavia	INFN
	Pisa	INFN
	Trieste	SISSA/ISAS
	Turin	UniTo
Japan	Tokyo	UT
	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
	Lublin	UMCS
	Otwock-Swierk	NCBJ
Republic of Korea	Seoul	SNU
Russia	Moscow	IMM RAS
		ITEP
		LPI RAS
		MSU
		MI RAS
		SCC RAS
		SINP MSU
	Moscow, Troitsk	INR RAS
	Belgorod	BelSU
	Chernogolovka	LITP RAS
	Gatchina	PNPI
	Irkutsk	ISU
		ISDCT SB RAS
	Ivanovo	ISU
	Kazan	KFU
	Novosibirsk	IM SB RAS
		BINP SB RAS
	Perm	PSNRU
	Protvino	IHEP
	Rostov-on-Don	SFedU
	St. Petersburg	SPbSU
		SPbSPU
	Samara	SSU
		SSAU
	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
	Villigen	PSI
Sweden	Lund	LU
United Kingdom	London	QM
		Imperial College

	Canterbury	Univ.
Ukraine	Kiev	BITP NASU
	Dnepropetrovsk	DNU
	Kharkov	KFTI
	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

01–3–1114–2014/2018	Priority: 1

Status: In-progress

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 2016:

- Calculation of the delayed multi-neutron emission probabilities in the nuclei near the closed N=28, 50, 82, 126, 184 shells.

  Investigation, within the Skyrme-RPA approach, of the interplay between E0 and E2 giant resonances in deformed nuclei.

  Analysis of the low-lying parts of excitation spectra in odd-neutron transfermium nuclei within QPM.

  Elucidation of the origin of high-energy monopole states in 132Sn.

  Calculation of inelastic neutrino-nucleus scattering cross section at finite temperature within a self-consistent approach based on Skyrme forces.

- Investigation of the dependence of probabilities of E2 transitions within the same rotational band on the signature in the odd deformed nuclei.

  Development of the method for constructing the Interacting Boson-Fermion Model Hamiltonian in well deformed axially symmetric odd nuclei allowing consider at on of pairing interaction in the intrinsic frame and preserving the rotational invariance of the Hamiltonian.

  Investigation of the fission mass, charge, and energy distributions of superheavy nuclei with Z=102-118.

  Investigation of the cluster feature of rotational bands in 44Ti and 48Cr.

  Analysis of the coherence and dissipative effects in reactions with radioactive beams.

- Development of the effective-range theory for two-dimensional scattering by a long-range central potential.

  Development of the gauge invariant strong-field approximation in laser-atom interaction.

  Investigation of the quantum dynamics of two-dimensional atoms in external electromagnetic fields.

  Study of the metastable states of composite systems tunneling through repulsive barriers.

  Investigation of the synthesis of chemical elements in the ultra-magnetized astrophysical plasma with realistic field geometry.

  Study of the effect of resonances on block diagonalization of J-self-adjoint Hamiltonians.

- Study of the 2-body current effects on the deuteron magnetic moment within the Bethe-Salpeter approach.

  Description of the transverse momentum distributions of hadrons and partons in the proton-proton and heavy ion collisions at high energies applying the exact relativistic Tsallis statistics.

  Analysis of the manifestation of the chromo effects in ultra-relativistic heavy-ion collisions within the PHSD model.

  Calculation of the pion-nucleus elastic and inelastic scattering cross sections at intermediate energies with different optical potentials.

List of activities:

Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1. **Nuclear properties at the border of stability**	**V.V. Voronov** **A.A. Dzhioev** **J. Kvasil**
BLTP	N.N. Arseniev, E.B. Balbutsev, A.I. Vdovin, V.A. Kuz'min, L.A. Malov, S. Mishev, V.O. Nesterenko, A.P. Severyukhin, H. Ganev, R. Dvornicki, V.M. Shilov, A.V. Sushkov, E.O. Sushenok, + 3 students
LIT	N.Yu. Shirikova, I.V. Molodtsova
FLNP	A.M. Sukhovoi
DLNP	V.B. Brudanin, V.G. Kalinnikov
2. **Low-energy dynamics and nuclear system properties**	**S.N. Ershov** **N.V. Antonenko** **R.V. Jolos**
BLTP	G.G. Adamian, A.V. Andreev, A.N. Bezbakh, I.A. Egorova, S.I. Fedotov, V.G. Kartavenko, Sh. Kalandarov, A.K. Nasirov, R.G. Nazmitdinov, H. Paska, T.M. Shneidman, A.S. Zubov, + 1 students
FLNR	L.V. Grigorenko, Yu.E. Penionzhkevich
3. **Quantum few-body systems**	**A.K. Motovilov** **A.S. Melezhik**
BLTP	S.S. Kamalov, O.P. Klimenko, E.A. Kolganova, A.A. Korobitsyn, O.A. Koval, E.A. Koval, A.V Malykh, V.S. Melezhik, V.N. Kondratyev, V.V. Pupyshev, E.A. Soloviev, S.I. Vinitsky, P. Jaluvkova, + 4 students
DLNP	O.I. Kartavtsev
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, A.S. Parvan, N. Sagimbaeva, A.I. Titov, V.D. Toneev, + 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
Austria	Innsbruck	Univ.
Belarus	Minsk	IP NASB
Belgium	Brussels	VUB
	Louvain-la-Neuve	UCL
Brazil	Florianopolis, SC	UFSC
	Sao Paulo, SP	UEP
	Sao Jose dos Campos, SP	ITA
	Niteroi, RJ	UFF
Bulgaria	Sofia	INRNE BAS
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
	Cologne	Univ.
	Darmstadt	GSI
		IKP
		TU Darmstadt
	Dresden	HZDR
	Erlangen	FAU
	Frankfurt/Main	Univ.
	Hamburg	Univ.
	Giessen	JLU
	Leipzig	UoC
	Mainz	JGU
	Regensburg	UR
	Rostock	Univ.
	Siegen	Univ.
Greece	Thessaloniki	AUTH
	Athens	INP NCSR "Demokritos"
Hungary	Budapest	Wigner RCP

	Debrecen	Atomki
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
		KazNU
Moldova	Chişinău	IAP ASM
Norway	Bergen	UiB
	Oslo	UiO
Poland	Krakow	NINP PAS
	Lublin	UMCS
	Otwock-Swierk	NCBJ
	Warsaw	UW
		WUT
Republic of Korea	Seoul	SNU
	Daejeon	IBS
Romania	Bucharest	IFIN-HH
		UB
Russia	Moscow	ITEP
		NNRU "MEPhI"
		MSU
		NRC KI
		SINP MSU
	Moscow, Troitsk	INR RAS
	Gatchina	PNPI
	Irkutsk	ISU
	Obninsk	IPPE
	Omsk	OmSU
	Saratov	SSU
	St. Petersburg	SPbSU
	Vladivostok	FEFU
Serbia	Belgrade	IPB
Slovakia	Bratislava	CU
		IP SAS
South Africa	Pretoria	Unisa
	Stellenbosch	SU
	Cape Town	iThemba LABS

Spain	Palma	UIB
Sweden	Lund	LU
	Göteborg	Chalmers
Switzerland	Bern	Uni Bern
Taiwan	Taipei	NTU
Ukraine	Kiev	KINR NASU
		BITP NASU
USA	Lemont, IL	ANL
	Los Alamos, NM	LANL
	Notre Dame, IN	ND
	University Park, PA	Penn State
Uzbekistan	Tashkent	IAP NUU
		INP AS RUz
		Assoc."P.-S." PTI

01–3–1115–2014/2018	Priority: 1

Status: In-progress

Theory of Condensed Matter

Leaders: V.A. Osipov
A.M. Povolotskii

Participating Countries and International Organizations:

Armenia, Australia, Belarus, Belgium, Brazil, Bulgaria, Canada, Czech Republic, France, Germany, Hungary, India, Ireland, Italy, 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 2016:

- Investigations of magnetic phase transitions in anisotropic antiferromagnets within the compass-Heisenberg and Kitaev-Heisenberg models.

  Study of the lattice Kondo-Heisenberg model in the strong coupling limit to describe the pseudogap phase of the underdoped cuprates.

  Investigation of the electro and thermal conductivity of graphene and graphene nanoribbons with different types of defects .

  Estimation of the intensity of electromagnetic radiation from coupled system of Josephson junctions in parametric resonance region.

Study of small-angle neutron scattering from fractal structures which show both mass and surface fractal regions.

Analytic and numerical investigation of nonequilibrium Bose gases of cold atoms.

- Application of the coordinate Bethe ansatz to higher spin stochastic vertex models. Investigation of the statistics of large deviations in conformally invariant stochastic models.

  Generalization of the theorem about loop covering in the rotor-router model for the case of loops with holes. Investigation of spiral structure of a random walk in the rotor-router model.

  Derivation of new formulas for zonal spherical functions on symmetric spaces of negative curvature of the class A II.

  Study of scattering of instantons in Yang-Mills theory with the help of the adiabatic approach.

  Derivation of finite-dimensional solutions of the Yang-Baxter equation by reduction of the general integral R-operator with rank 1 symmetry algebra. Investigation of two-dimensional integrable spin systems with the mixed discrete and continuous spin variables.

List of activities:

Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1. **Complex materials and nanostructures**	**V.A. Osipov** **N.M. Plakida**
BLTP	E.M. Anitas, A.Yu. Cherny, A.V. Chizhov, V. Ilkovich, O.G. Isaeva, 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, 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, V.M. Dubovik, V.I. Inozemtsev, A.L. Kuzemsky, T.A. Ivanova, V. Papoyan, A.E. Patrik, P.N. Pyatov, V.P. Spiridonov, O. Turek, 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.
Belarus	Minsk	BSTU

		IP NASB
		ICE MES RB
		JIMB NASB
		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
		INRNE BAS
Canada	Montreal	Concordia
	Quebec	UL
	Kingston	Queen's
	London	Western
Czech Republic	Řež	NPI ASCR
France	Paris	UPMC
	Marseille	UPC
	Nice	UN
	Valenciennes	UVHC
Germany	Bonn	UniBonn
	Bremen	Univ.
	Braunschweig	TU
	Dortmund	TU Dortmund
	Darmstadt	GSI
	Dresden	IFW
		MPI PkS
		TU Dresden
	Duisburg	UDE
	Leipzig	UoC
	Magdeburg	OVGU
	Rostock	Univ.
	Stuttgart	MPI-FKF
	Wuppertal	UW
Hungary	Budapest	Wigner RCP
India	Mumbai	TIFR
Ireland	Dublin	DIAS
Italy	Catania	UniCT
	Salerno	UNISA
Poland	Krakow	JU
	Warsaw	IPC PAS
		WUT
	Katowice	US

	Poznan	AMU
		IMP PAS
Romania	Bucharest	IFIN-HH
	Cluj-Napoca	UTC-N
	Timişoara	UVT
Russia	Moscow	MIREA
		NNRU “MEPhI”
		MSU
		PFUR
		SINP MSU
		MI RAS
		NRC KI
	Moscow, Troitsk	HPPI RAS
		INR RAS
	Belgorod	BelSU
	Gatchina	PNPI
	Kazan	KFU
	Protvino	IHEP
	Saratov	SSU
	St. Petersburg	ETU
		IPTI RAS
		SPbSU
	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	KFTI
	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

01–3–1116–2014/2018	Priority: 1
	Status: In-progress

Modern Mathematical Physics: Strings and Gravity, Supersymmetry, Integrability

Leaders: A.P. Isaev
A.S. Sorin
Deputy: S.O. Krivonos
Scientific leader: A.T. Filippov

Participating Countries and International Organizations:

Australia, Austria, Armenia, Belarus, 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 used of integrability in various areas, and in applying powerful mathematical methods of quantum groups 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.

Expected main results in 2016:

- Construction of the field theory models realizing the partial breaking of the global supersymmetries in D=3 and D=4 with the hypermultiplet and vector supermultiplets as the Goldstone superfields;

  We will study basic equations and relationships between relativistic static spherically symmetric stars (SSSS) and other static spherically symmetric objects (SSSO) of different scales - planets, white dwarfs, normal star of solar types, dark spheroids, galaxies and galaxy coupling in the model of minimal dilatonic gravity (MDG) locally equivalent to f(R) gravity theories leading to an alternative description of dark matter and dark energy. We will describe singular manifolds in the phase space of SSSO. We will study new effects of the bifurcation of the phase portrait of the systems under the change of the mass of the dilatonic field. We will develop new effective computation schemes for the listed problems using the parallel programming;

  We will develop a new approach based on the symmetrical form of the Hoin differential equation. The approach is based on the generalization of the Klien symmetrical form for the Fuksian equations for any number (N$>$ 3) of regular singular points;

  Construction of the universal Bethe vectors for the quantum integrable models associated with supersymmetric extension of the Yangian double. Calculation of the formfactors of the local operators in the supersymmetric quantum integrable models;

For a five-dimensional supergravity model we aim to build new analytic black holes in Lifshitz-like backgrounds, which are able to describe holographically the quark-gluon plasma at strong coupling. We will also construct a Vaidya-Lifshitz solution that represents a thin shell falling at the speed of light and allows one to describe a black hole formation. Using the obtained solutions we will compute and investigate nonlocal operators (entanglement entropy, Wilson loops, etc.) characterizing various stages of the quark-gluon plasma. The impact of the background anisotropy on the QGP thermalization will be studied;

We will construct pseudotoric structures on hyperplane sections of toric varieties. We will study the exotic lagrangian tori arising in this construction;

Special geometry for Bohr - Sommerfeld cycles will be constructed. We will prove that the universal moduli space of special Bohr - Sommerfeld cycles carries a natural universal Kahler structure;

Special Bohr - Sommerfeld geometry can be exploited in the theory of sigma models. We will associate to any embedded Riemann surface a complicated graph in the loop space of the target space.

- Analysis of loop structure of Bagger-Lambert-Gustavsson and Aharony-Bergman-Jaffereris-Maldacena models by using the superfield background field method and manifestly covariant superfield proper-time method, and study the aspects of the AdS(4)/CFT(3) correspondence;

  Design and analysis of new models of supersymmetric mechanics, including cases of deformed and quasi-complex supersymmetries, and their application to the description of the motion of spin particles in different background non-Abelian gauge fields and in the theory of the quantum Hall effect;

  Further elaboration of the formalism of auxiliary fields in the duality invariant supersymmetric theories and construction of duality-invariant actions for the Born-Infeld theory with partial supersymmetry breaking;

  Construction of new twistor formulations of spinning (super)particles and (super)strings and study of their application in higher spin fields theory;

  Study of various black-hole configurations and localized particle-like soliton solutions in the higher dimensional (super)gravity and (super)Yang-Mills theories by numerical analysis;

  Analysis of the ultraviolet properties of N=(1,0) and N=(1,1) super Yang-Mills theories in dimension 6 in terms of the harmonic off-shell N=(1,0) and on-shell N=(1,1) superfields. Solving of the defining constraints of 6D N=(1,1) super Yang-Mills theory in terms of harmonic N=(1,0) superfields;

  Construction of the superfield description of the new type supermultiplets of supersymmetric quantum mechanics, the so called "long multiplets", for N=2 and N=4 supersymmetries in one dimension, equally as for their $SU(2|1)$ deformations. Construction of new explicit realizations of the conformal supergroup $D(2,1;\alpha)$ in the models of N=4 superconformal mechanics.

- Investigation of the Minkowski space-time stability in the framework of the modified gravitation theories with higher derivatives by making use of a new, specially developed, universal method based on the theory of dynamical systems;

  Searches for new physics and creation of new theoretical models for interpretations of observational data for the Galactic Center;

  Creation of advanced theoretical models for exo-planetary systems with gravitational microlensing and polarization observations;

  Development of the heat kernel expansion for manifolds with non-smooth boundaries will be proposed. For domains with boundaries possessing cusps the multiple reflection technique will be extended in order to derive systematically the higher order heat kernel coefficients;

  Investigation of electronic excitations in graphene will be conducted in the framework of the quantum theory of the Dirac field defined on the 2-dimensional graphene sheet and interaction with the electromagnetic field occupying the whole 3-dimensional space. Study of the surface plasmon excitations in this system;

  Realistic inflation scenarios consistent with observational data from Plank-2015 will be developed in conformal gravity models with several scalar fields and symmetry violating R^2-term;

  It is planned to examine the possibility of constructing the regimes of accelerated expansion in the models of gravity non-minimally coupled to a scalar field with one-loop quantum corrections;

The vacuum friction force between macroscopic bodies will be calculated in the framework of the quantum-statistical theory of the linear response by making use of different versions of the electromagnetic energy-momentum tensor in a medium;

It is expected to accomplish the construction of the uniform asymptotic expansions for hypergeometric function products arising, for instance, in the vacuum energy calculation for quantized fields in the background of the media with variable spherically symmetric refractive index.

List of activities:

Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1. **Quantum groups and integrable systems**	**A.P. Isaev**
BLTP	S.A. Belev, A.A. Golubtsova, S.O. Krivonos, N.Yu. Kozyrev, R.M. Mir-Kasimov, S.Z. Pakulyak, G.S. Pogosyan, N.A. Tyurin, + 4 students
2. **Supersymmetry**	**E.A. Ivanov**
BLTP	S.A. Fedoruk, M. Pientek, S.S. Sidorov, Ya.M. Shnir, A.O. Sutulin, + 2 students
3. **Quantum gravity, cosmology and strings**	**A.T. Filippov** **V.V. Nesterenko** **A.S. Sorin**
BLTP	B.M. Barbashov, E.A. Davydov, D.V. Fursaev, A.B. Pestov, I.G. Pirozhenko, A.D. Popov, E.A. Tagirov, P.V. Tretyakov, + 3 students
LIT	I.L. Bogoliubsky, A.M. Chervyakov
VBLHEP	E.E. Donets
UC	S.Z. Pakuliak

Collaboration

Country or International Organization	**City**	**Institute or Laboratory**
Armenia	Yerevan	YSU
Australia	Sydney	Univ.
Austria	Vienna	TU Vienna
Belarus	Minsk	IP NASB
Brazil	Sao Paulo, SP	USP
Bulgaria	Sofia	INRNE BAS
		SU
Canada	Montreal	McGill
		UdeM
	Edmonton	U of A
CERN	Geneva	CERN
Czech Republic	Prague	CTU
		CU
	Řež	NPI ASCR

France	Annecy-le-Vieux	LAPP
		LAPTh
	Dijon	UB
	Lyon	ENS Lyon
	Marseille	CPT
	Nantes	SUBATECH
	Paris	ENS
		LPTHE
	Palaiseau	Polytech
	Valenciennes	UVHC
Germany	Berlin	FU Berlin
		HUB
	Bielefeld	Univ.
	Bonn	UniBonn
	Dortmund	TU Dortmund
	Hannover	LUH
	Jena	Univ.
	Leipzig	UoC
	Munich	MPI-P
	Potsdam	AEI
Greece	Athens	UoA
Hungary	Budapest	Wigner RCP
India	Calcutta	BNC
Italy	Bari	INFN
	Frascati	INFN LNF
	Naples	INFN
	Padua	UniPd
	Pavia	INFN
	Pisa	INFN
	Salerno	UNISA
	Trieste	SISSA/ISAS
	Turin	INFN
ICTP	Trieste	ICTP
Japan	Fukuoka	Kyushu Univ.
	Kyoto	KSU
		RIMS
		YITP
	Tsukuba	KEK
Norway	Trondheim	NTNU
Poland	Warsaw	NCAC PAS
		UW
	Krakow	JU
		NINP PAS
	Lodz	UL
	Wroclaw	UW

Romania	Bucharest	IFIN-HH
Russia	Moscow	ITEP
		LPI RAS
		MSU
		MI RAS
		NRU HSE
		VNIIMS
	Moscow, Troitsk	INR RAS
	Chernogolovka	LITP RAS
	Protvino	IHEP
	St. Petersburg	PDMI RAS
		SPbSU
	Tomsk	TPU
Serbia	Belgrade	IPB
		Univ.
Spain	Bilbao	UPV/EHU
	Barcelona	IEEC-CSIC
	Valencia	IFIC
Turkey	Istanbul	BU
	Izmir	IZTECH
USA	New York, NY	CUNY
		RU
		SUNY
	Baltimore, MD	JHU
	Cincinnati, OH	UC
	Clemson, SC	Clemson
	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	KFTI
United Kingdom	London	Imperial College
	Cambridge	Univ.
	Durham	Univ.
	Liverpool	Univ.
	Southampton	Univ.
	York	Univ.

01–3–1117–2014/2018	Priority: 1

Status: In-progress

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

Leaders: V.V. Voronov
A.S. Sorin

Scientific leader: 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, Russia, Serbia, South Africa, 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 2016:

- Organization of three international schools and a research workshop at BLTP.
- Organization of "educational workshops", 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**	**V.V Voronov** **A.S. Sorin**
BLTP	D. Blaschke, A.T. Filippov, A.P. Isaev, E.A. Kolganova, V.V. Nesterenko, V.A. Osipov, I.G. Pirozhenko, O.V. Teryaev, P.V. Tretyakov, A.A. Starobinsky, A.A. Vladimirov, 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	Univ.
		TU Vienna
Brazil	Sao Paulo, SP	USP
Bulgaria	Sofia	INRNE BAS
		SU
Canada	Montreal	UdeM
	Edmonton	U of A
CERN	Geneva	CERN
Czech Republic	Prague	CTU
		IP ASCR
	Řež	NPI ASCR
France	Annecy-le-Vieux	LAPP
	Dijon	UB
	Lyon	ENS Lyon
	Marseille	CPT
	Nantes	SUBATECH
	Paris	ENS
		LPTHE
		UPMC
	Valenciennes	UVHC
Germany	Berlin	HUB
	Bonn	UniBonn
	Frankfurt/Main	Univ.
	Hamburg	DESY

	Hannover	LUH
	Jena	Univ.
	Leipzig	UoC
	Munich	MPI-P
	Potsdam	AEI
	Rostock	Univ.
	Zeuthen	DESY
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
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
	St. Petersburg	PDMI RAS
	Tomsk	TSU
Serbia	Belgrade	IPB
		Univ.
South Africa	Cape Town	UCT
Turkey	Istanbul	BU
Ukraine	Kiev	BITP NASU

	Kharkov	KFTI
United Kingdom	London	Imperial College
	Durham	Univ.
	Cambridge	Univ.
	Southampton	Univ.
	York	Univ.
USA	New York, NY	CUNY
		SUNY
	Baltimore, MD	JHU
	College Park, MD	UMD
	Cincinnati, OH	UC
	Coral Gables, FL	UM
	Minneapolis, MN	U of M
	Newport News, VA	JLab
	Philadelphia, PA	Penn
	Piscataway, NJ	Rutgers
	Rochester, NY	UR
	Salt Lake City, UT	U of U
Vietnam	Hanoi	IOP VAST

Elementary Particle Physics and Relativistic Nuclear Physics (02)

02–2–1123–2015/2016	Priority: 1

Status: Approved for completion in 2016

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, ψ(3686), ψ(3770), ψ(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 2016:

- BES-III data analysis.
- Development of offline software and analysis tools
- Development of the distributed computing system.

List of projects:

	Project	**Leader**	**Priority (period of realization)**
1.	BES-III	A.S. Zhemchugov	1 (2007 – 2016)

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, D.V. Dedovich, Yu.A. Nefedov, G.A. Shelkov, I.I. Denisenko, E.A. Boger, O.V. Bakina, E. Tskhadadze	
BLTP	V.V. Bytev, O.V. Teryaev	
LIT	V.V. Korenkov, A.V. Uzhinsky, S.D. Belov, I.S. Pelevanyuk, O.V. Ustimenko, V.V. Trofimov	

Collaboration

Country or International Organization	City	Institute or Laboratory
China	Beijing	IHEP CAS
Russia	Gatchina	PNPI
	Novosibirsk	BINP SB RAS
	Irkutsk	ISU

02–0–1081–2009/2016	Priority: 1

Status: Approved for completion in 2016

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

Many-sided and comprehensive investigations of superhigh-energy (7–14 TeV) proton scattering at the Large Hadron Collider with the ATLAS facility (created at the previous stage of the project) 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 2016:

- Participation in the LHC and ATLAS detector maintenance and upgrades. Participation in LHC and ATLAS restart.
- 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	D.Yu. Bardin	1 (2003 – 2016)

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. Koultchitski, I.A. Minashvili, M.I. Gostkin, D.V. Dedovich, Yu.A. Nefedov, D.V. Kharchenko, Yu.A. Usov, S.N. Malyukov, V.V. Lyubushkin, 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, Yu.L. Vertogradova, A.V. Ershova, N. Huseinov, L.K. Gladilin, I.V. Eletskikh, E.M. Plotnikova, Yu.I. Davydov, V.G. Elkin, S.A. Kotov, V.G. Kruchonok, I.N. Potrap, E. Tschadadze	
VBLHEP A.P. Cheplakov, V.D. Peshekhonov	N. Dzhavadov, E.A. Ladygin, F.N. Ahmadov, A.V. Ivanov, G.D. Kekelidze, V.V. Kukhtin, V.M. Lysan, B.G. Shaykhatdenov, N.G. Fadeev, 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**	**D.Yu. Bardin**	Realization
DLNP	L.V. Kalinovskaya, A.A. Sapronov, P. Christova, R.R. Sadykov, E.D. Uglov, V.A. Kolesnikov, 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
		NC PHEP BSU

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

02–2–1124–2015/2017	Priority: 1

Status: In-progress

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

Leader: V.V. Glagolev
Scientific leader: J.A. Budagov

Participating Countries and International Organizations:

Belarus, Bulgaria, Georgia, Italy, Russia, Slovakia, USA, Ukraine.

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 $\mu^- N \to e^- N$, 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 $(\Delta m^2_{ij}/M^2_W)^2$, where Δm^2_{ij} 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 $\mu^- N \to e^- N$ and $\mu^+ \to e^+ \gamma$ 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.

Expected main results in 2016:

- Simulation to define optimal crystal type and sizes for e.m. calorimeter of the Mu2e experiment.
- Tests of the different type (CsI, BaF_2) e.m. calorimeter elements on the gamma sources and electron beam.
- Tests of the extruded scintillation strips different geometry and manufacture with wave length shifter fibers readout to optimize the final version of counters. The choice of filler for the holes for the strips to increase the light collection.
- Creation of the working version of the on-line control and data visualization program for Muon g-2 experiment and its integration in the common DAQ system.
- Performing R@D for choosing optimal tracker detector element for Muon g-2 experiment.
- Participation in the radiation hardness tests of the detector elements.

List of projects:

	Project	Leader	Priority (period of realization)
1.	Search for new physics in experiments with the Fermilab high-intensity muon beams	V.V. Glagolev	1 (2015 – 2017)

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, V.B. Flyagin, D.S. Guskov, Yu.N. Kharzheev, V.I. Kolomoets, S.M. Kolomoets, M.V. Lyablin, Yu.A. Koultchitski, V.M. Romanov, A.V. Sazonova, A.N. Shalyugin, A.V. Simonenko, S.N. Studenov, I.A. Suslov, A.K. Suhanova, 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, K.I. Gritsaj, A.S. Korenchenko, N.P. Kravchuk, N.A. Kuchinsky, T.N. Mamedov , A.I. Rudenko, V.P. Volnykh	
VBLHE	S.A. Movchan	
LRB	V.A. Krylov	

Collaboration

Country or International Organization	City	Institute or Laboratory
Belarus	Minsk	NC PHEP BSU
		"INTEGRAL"
Bulgaria	Sofia	SU
Georgia	Tbilisi	HEPI-TSU
Italy	Pisa	UniPi
	Frascati	INFN LNF
Russia	Moscow, Troitsk	INR RAS
	Gatchina	PNPI
Slovakia	Bratislava	IP SAS
		CU
USA	Batavia, IL	Fermilab
	Charlottesville, VA	UVa
	Lexington, KY	UK
Ukraine	Kharkov	ISMA NASU

02–2–1099–2010/2018	Priority: 1

Status: Extended

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^2_{ee} 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 2016:

- Application of developed algorithms and improvement of Daya Bay measurements of reactor antineutrino flux and spectrum.
- New data analysis on the search of quantum decoherence effects and light sterile neutrinos using Daya Bay and global neutrino oscillation data.
- Development of proposals for sensitivity optimization to the mass hierarchy measurements and determination of neutrino oscillation parameters.
- Software and algorithms development for event reconstruction in JUNO and NOvA experiments.
- Analysis of NOvA experiment systematic uncertainties related to the neutrino-nucleon cross sections and MSW effects.
- Construction of NOvA experiment Remote Operation Centre at JINR.
- Test bench measurement of NOvA electronics parameters at JINR and preparation of proposals for their account in simulation.
- Test of High Voltage options for JUNO PMT.
- Measurement of JUNO Photodetector characteristics and development of their acceptance test criteria.
- OPERA emulsions scanning and analysis at JINR. New results on tau-neutrino appearance.
- OPERA experiment decommissioning and preparation of the OPERA TT detectors for the use in JUNO experiment.
- Construction of JUNO veto system prototype at JINR using OPERA detectors.
- Application of the developed events coordinates reconstruction algorithms in Borexino detector.
- New measurement of solar neutrino parameters in Borexino detector.

List of projects:

	Project	Leader	Priority (period of realization)
1.	BOREXINO	O.Yu. Smirnov	1 (1996 – 2016)
2.	Daya Bay/JUNO	D.V. Naumov	1 (2009 – 2017)
3.	NOvA	A.G. Olshevskiy	1 (2015 – 2017)

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, D.V. Korablev, A.P. Sotnikov	
2.	**Daya Bay/JUNO Project**	**D.V. Naumov** **M.O. Gonchar**	Data taking R&D
	DLNP	I.V. Butorov, M.A. Dolgareva, E.A. Naumova, I.B. Nemchenok, A.G. Olshevskiy, A.V. Chukanov, D.V. Taichenachev, N.V. Anfimov, S.V. Biktemerova, Yu.A. Gornushkin, S.G. Dmitrievsky, A.V. Krasnoperov, Z.V. Krumshtein, N.A. Morozov, A.V. Rybnikov, A.B. Sadovsky, A.S. Selunin, O.Yu. Smirnov, K.A. Fomenko, D.V. Fedoseev, M.V. Zhabitsky	
3.	**NOvA Project**	**A.G. Olshevskiy** **O.B. Samoylov**	Data taking
	DLNP	N.V. Anfimov, A.E. Bolshakova, S.G. Dmitrievsky, A.G. Dolbilov, A.A. Dolmatov, Yu.A. Gornushkin, Ch. Kullenberg, D.V. Naumov, A.B. Sadovsky, I.M. Shandrov, A.S. Sheshukov, A.P. Sotnikov	
	BLTP	S.M. Bilenky, K.S. Kuzmin, V.A. Matveev, V.A. Naumov, O.N. Petrova	
	LIT	V.V. Korenkov, N.A.Balashov, A.V. Baranov	
4.	**Experiment OPERA**	**Yu.A. Gornushkin**	Data analysis
	DLNP	S.G. Dmitrievsky, Z.V. Krumshtein, A.G. Olshevskiy, S.G. Zemskova, A.V. Chukanov, A.B. Sadovsky, A.S. Sheshukov, A.A. Nozdrin	
	VBLHEP	Yu.P. Petukhov	
	LIT	G.A. Ososkov	
5.	**Development of new photodetectors and the equipment for application in registering systems of neutrino experiments**	**N.V. Anfimov**	R&D
	DLNP Z.V. Krumshtein	A.I. Antoshkin, A.G. Olshevskiy, T.V. Rezinko, A.V. Rybnikov, A.V. Selunin, V.V. Chalyshev, I.E. Chirikov-Zorin, D.V. Fedoseev	

VBLHEP	T.Yu. Bokova, I.A. Tyapkin, B.R. Marinova
Z.Ya. Sadygov	

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.

02–0–1108–2011/2016	Priority: 1

Status: Approved for completion in 2016

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 2016:

- Inclusion of MC generators into the PANDA software and optimization of the event analysis.
- Calculations and coordination of the work for the production 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, Yu.A. Kozhevnikov, S.A. Kutuzov, V.L. Malyshev, 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, V.I. Datskov, E.K. Koshurnikov, M.Yu. Barabanov, V.A. Arefev, V.I. Astakhov, A.A. Efremov, V.I. Lobanov, Yu.Yu. Lobanov, P.V. Nomokonov, I.A. Olex, Yu.N. Rogov, R.A. Salmin, 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	NC PHEP BSU
CERN	Geneva	CERN
Czech Republic	Prague	CU
Germany	Darmstadt	GSI
Italy	Turin	UniTo
		INFN
Russia	Protvino	IHEP
	Dubna	BSINP MSU
	Omsk	OB IM SB RAS
Slovakia	Bratislava	IP SAS

02–2–1125–2015/2017	Priority: 2
	Status: In-progress

Astrophysical Studies in the Experiment TAIGA

Leader: L.G. Tkatchev
Deputy: V.M. Grebenyuk

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 $10^{1}8$ 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 2–3 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≈40 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 2016:

- Design and production of IACT for TAIGA experiment.
- Participation in the MC simulation of TAIGA experiment.
- Participation in the data taking of the TUS experiment.
- Participation in the TUS data off-line analysis.
- Test of the fluorescent datactor for ТУНКА array.
- Production and test of the calibration system for TUS detector on the Earth orbit.
- 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	2 (2015 – 2017)

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, S.Yu. Porokhovoy, A.V. Tkachenko, F.F. Grinyuk, M. Slunečhka, V. Slunečhkova, N.I. Kalinin, V.F. Boreyko, A.A. Timoshenko, V.M. Romanov, M. Finger, B.M. Sabirov, Nguen Man Shat, M.V. Lavrova	
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 N.I. Kalinin , V.F. Boreyko, A.A. Timoshenko	
VBLHEP	N.V. Gorbunov	
3. **Experiment NUCLEON**	**L.G. Tkatchev**	Realization
DLNP	V.M. Grebenyuk, S.Yu. Porokhovoy, N.I. Kalinin, V.F. Boreyko, Nguen Man Shat, B.M. Sabirov, A.B. Sadovsky, A.V. Tkachenko, A.A. Timoshenko, M.V. Lavrova	
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
Republic of Korea	Seoul	EWU
Romania	Bucharest	ISS
Russia	Moscow	SINP MSU
		NNRU “MEPhI”
	Irkutsk	ISU
	Korolev	RSC “Energia”
	St. Petersburg	KB “Arsenal”
	Moscow, Troitsk	INR RAS
Ukraine	Kiev	BITP NASU

02–1–1106–2011/2016	Priority: 1

Status: Approved for completion in 2016

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, Germany, Mongolia, Romania, Russia, Slovakia, Uzbekistan, Ukraine.

Scientific Programme

Design and development of the superconducting dipole magnet, transition radiation and straw detectors 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.

Expected main results in 2016:

- Preparation of the drawings of individual parts of the superconducting dipole magnet for the CBM experiment.
- Design and testing of the prototype straw detectors.
- Development of the algorithms and software for the trigger and data analysis.
- Simulation of the multiparticle dynamics in heavy ion collisions.
- Development of the mathenatical methods and fast computing algorithms for the data analysis and selection of the signal events.

List of projects:

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

List of activities:

	Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1.	**CBM Project** **Design and manufacture of the superconducting dipole magnet, and straw detectors. Development of the algorithms and software for trigger, simulation and data analysis**	**V.P. Ladygin** **V.V. Ivanov** **Yu.V. Gusakov**	Realization

VBLHEP	Yu.S. Anisimov, S.N. Kuznetsov, A.I. Malakhov, Yu.V. Zanevsky, V.F. Chepurnov, O.V. Fateev, V.N. Zryuev, G.A. Cheremukhina, A.K. Kurilkin, A.P. Ierusalimov, A.P. Zinchenko, D.V. Peshekhonov, P.A. Rukoyatkin, S.V. Razin, V.D. Peshekhonov, G.D. Kekelidze, V.V. Myalkovsky, I.V. Boguslavsky, V.M. Golovatyuk, V.M. Lysan, O.V. Rogachevsky, A.V. Bychkov
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, G.N. Ososkov, A.M. Raportirenko, T.P. Sapozhnikova, I.A. Filozova
DLNP	V.A. Karnaukhov, 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

Collaboration

Country or International Organization	**City**	**Institute or Laboratory**
Bulgaria	Sofia	INRNE BAS
Germany	Darmstadt	GSI
	Dresden	HZDR
	Frankfurt/Main	Univ.
	Heidelberg	Univ.
Mongolia	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

02–1–1096–2010/2019	Priority: 1

Status: In-progress

Study of Rare Charged Kaon Decays in Experiments at the CERN SPS

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

Participating Countries and International Organizations:

Belarus, Belgium, Bulgaria, CERN, Czech Republic, Germany, Italy, Mexico, Romania, Russia, Slovakia, 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 carried 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.

Expected main results in 2016:

- 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 a nd support of the NA62 straw detectors will be carried out.

List of projects:

	Project	Leader	Priority (period of realization)
1.	NA62	V.D. Kekelidze Yu.K. Potrebenikov	1 (2010 – 2016)

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, A.I. Zinchenko, 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, E.M. Kislov, V.V. Elsha, T.L. Enik, A.O. Kolesnikov	

Collaboration

Country or International Organization	City	Institute or Laboratory
Belarus	Minsk	NC PHEP BSU
Belgium	Louvain-la-Neuve	UCL
Bulgaria	Sofia	SU
	Blagoevgrad	SWU
	Plovdiv	PU
CERN	Geneva	CERN
Czech Republic	Prague	CU
Germany	Mainz	JGU
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
	Protvino	IHEP
Slovakia	Bratislava	CU
United Kingdom	Birmingham	Univ.
	Bristol	Univ.
	Glasgow	US
	Liverpool	Univ.
USA	Boston, MA	BU
	Chicago, IL	UChicago
	Fairfax, VA	GMU
	Menlo Park, CA	SLAC
	Merced, CA	UCMerced
	Upton, NY	BNL

02–0–1083–2009/2016	Priority: 1

Status: Approved for completion in 2016

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–nucleaus 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 2016:

- 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	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.), A. Khvedelidze, M. Slunečhka, V. Slunečhkova, A. Yanata, T. Toriashvili, Z. Tsamalaidze	
2.	**Forward muon station ME1/1**	**V.Yu. Karjavin**	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, D.A. Smolin	
	LIT	V.V. Palchik, N.N. Voytishin	
3.	**Upgrade of the CMS detectors**	**I.A. Golutvin**	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**	Realization
	VBLHEP	V.Yu. Alexakhin, S.V. Afanasiev, M.G. Gavrilenko, I.N. Gorbunov, I.I. Belotelov, P.D. Bunin, A.V. Zarubin, A.Yu. Kamenev, L.G. Kobylets, A.V. Lanev, M.V. Savina, A.I. Malakhov, 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, P.X. Khristova, 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**	Realization
	LIT	V.V. Mitsyn, V.V. Palchik, R.N. Semenov, E.A. Tikhonenko, 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	NC PHEP BSU
		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
		UD
India	Mumbai	BARC
		TIFR
	Bhubaneswar	IOP
	Chandigarh	PU
Iran	Tehran	IPM
Italy	Bari	INFN
	Bologna	INFN
	Catania	INFN LNS
	Florence	INFN
	Genoa	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
	Chongju	CBNU
Russia	Moscow	ITEP
		LPI RAS
		NNRU "MEPhI"
		SINP MSU
		NIKIET
	Moscow, Troitsk	INR RAS
	Gatchina	PNPI
	Dolgoprudny	MIPT
	Novosibirsk	NSU
	Protvino	IHEP
	Snezhinsk	VNIITF
	St. Petersburg	Electron

	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	KFTI
		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

	Pasadena, CA	Caltech
	Pittsburgh, PA	CMU
	Piscataway, NJ	Rutgers
	Princeton, NJ	PU
	Riverside, CA	UCR
	Rochester, NY	UR
	Tallahassee, FL	FSU
	Tuscaloosa, AA	UA
Uzbekistan	Tashkent	INP AS RUz

02–0–1085–2009/2016	Priority: 1

Status: Approved for completion in 2016

Studies of the Nucleon and Hadron Structure at CERN

Leader: A.P. Nagaytsev
Scientific leader: I.A. Savin

Participating Countries and International Organizations:

Armenia, Belarus, Bulgaria, CERN, Czech Republic, France, Germany, Israel, Italy, Japan, Poland, Russia, Switzerland, Ukraine, United Kingdom, USA.

Scientific Programme

Studies of the Primakoff reactions and diffractive proctsses. Studies of the generalized parton distributions in various exclusive processes and participation in construction of new electromagnatic calorimeter. Studies of the exclusive production of photons, pions and vector mesons in DIS and DVCS. Measurements of nucleon structure in the Drell–Yan processes. Study of inclusive and semi–inclusive processes in Deep Inelastic Scattering (DIS) of muons and hadrons on polarized targets. The mesurements of the new structure functions characterizing the transverse quark distributions in polarized nucleons.

- Measurements of the nucleon structure functions, polarized parton distributions.
- Pion and kaon polarizabilities measurements.
- Search of new bound states of quarks and gluons.
- Measurements of nucleons structure in the Drell–Yan processes.
- Studies of the inclusive production of photons, pions and ρ–mesons in DIS and DVCS.
- Software creation and development for simulation and data analysis. System support of CERN software in COMPASS–II.
- Creation of the new electromagnetic calorimeter for COMPASS–II.
- Detector preparation for the COMPASS–II spectrometer.

Expected main results in 2016:

- Measurement of asymmetries in processes of the exclusive birth of photons (DVCS), π–mesons and vector mesons.
- Participation in the data taking.
- Maintenance of the hadron calorimeter HCAL1 and muon system MW1.
- Preparation for a data taking the new electromagnetic calorimeter ECALO. Support of ECALO during data taking.
- Software development and simulation of the various reactions, studied in COMPASS–II. Analyzing of the COMPASS–II data at JINR and publications preparation.
- Theoretical studies for COMPASS–I and COMPASS–II.

List of projects:

	Project	Leader	Priority (period of realization)
1.	COMPASS–II	A.P. Nagaytsev	1 (2011 – 2016)

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, N.N. Vlasov, A.S. Yukaev, V.A. Anosov	
	DLNP	A.S. Selyunin	
2.	**Electromagnetic calorimeter**	**A.P. Nagaytsev,** **Z.V. Krumshtein**	Preparation R&D
	VBLHEP	V.V. Astakhov, O.P. Gavrishchuk, G.V. Meshcheryakov, A.S. Yukaev, N.S. Rogacheva, O.M. Kuznetsov, V.A. Anosov	
	DLNP	A.I. Antoshkin, V.M. Kudryavtsev, M.V. Nikitin, I.E. Tchirikov–Zorin, N.V. Anfimov, T.V. Rezinko, I.A. Orlov, V.V. Tchalyshev, A.V. Rybnikov, D.V. Fedossev, 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, N.A. Kutchinsky, V.L. Malyshev, A.A. Piskun, A.G. Samartsev, V.V. Tokmenin	
4.	**Software development. Data analysis**	**E.V. Zemlyanichkina**	Realization
	VBLHEP	I.A. Savin, D.V. Peshekhonov, G.I. Smirnov, 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. Olshevsky, A.V. Guskov, Z.V. Krumshtein, E.O. Mitrofanov, K.Yu. Gasnikova, I.A. Orlov, T.V. Rezinko, A.V. Rybnikov, A.S. Selyunin	
	LIT	P.V. Zrelov	

5. **Measurements of generalized parton distributions and transverse spin structure in Drell–Yan processes. Development of new electro-magnetic calorimeter**	**A.P. Nagaytsev** **I.A. Savin**	Realization
VBLHEP	O.P. Gavrishchuk, G.V Meshcheryakov, O.M. Kuznetsov, Yu.I. Ivanshin, R.R. Akhuzyanov, N.S. Rogacheva, E.V. Zemlyanichkina, A.V. Ivanov	
DLNP	A.G. Olshevskiy, Z.V. Krumshtein, A.V. Guskov, K.Yu. Gasnikova, I.A. Orlov, N.V. Anfimov, T.V. Rezinko, A.V. Rybnikov, A.S. Selyunin	
BLTP	A.V. Efremov, O.V. Teryaev	
6. **Preparation of the project on measurement of proton form–factor ratios at 13–15 GeV/c**	**I.A. Savin** **N.M. Piskunov**	Project preparation
VBLHEP	O.P. Gavrishchuk, G.V. Meshcheryakov	
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**
Armenia	Yerevan	Foundation ANSL
Belarus	Minsk	NC PHEP BSU
		JIPNR-Sosny
		NASB
Bulgaria	Sofia	INRNE BAS
		SU
CERN	Geneva	CERN
Czech Republic	Prague	CU
France	Saclay	IRFU
Germany	Bielefeld	Univ.
	Bochum	RUB
	Bonn	UniBonn
	Freiburg	Univ.
	Hamburg	DESY
	Heidelberg	MPIK
	Munich	LMU
		TUM
	Mainz	JGU
	Erlangen	FAU
Israel	Tel Aviv	TAU

Italy	Turin	INFN
	Trieste	INFN
	Frascati	INFN LNF
Japan	Chiba	Toho Univ.
	Nagoya	Nagoya Univ.
	Osaka	OCU
	Sendai	Tohoku Univ.
	Tsukuba	KEK
	Yamagata	Yamagata Univ.
Poland	Warsaw	UW
Russia	Moscow	SINP MSU
		LPI RAS
	Moscow, Troitsk	INR RAS
	Gatchina	PNPI
	Protvino	IHEP
Switzerland	Zurich	UZH
Ukraine	Kharkov	ISMA NASU
United Kingdom	Liverpool	Univ.
USA	Urbana, IL	I

02–1–1086–2009/2017	Priority: 1

Status: In-progress

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

Leaders:

E.A. Strokovsky
E.S. Kokoulina

Participating Countries and International Organizations:

Belarus, Czech Republic, Germany, 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 extremally high multiplicity;
study of spectra and yields of soft photons in deuteron–nucleus and nucleus–nucleus interactions.

Expected results:

- Data on production cross sections for hyper–fragments of relativistic nuclei. Data on the lifetimes and binding energies of the lightest hypernuclei ${}^{4}_{\Lambda}H$, ${}^{3}_{\Lambda}H$, ${}^{6}_{\Lambda}H$; search for ${}^{6}_{\Lambda}H$. Study of the decay channels, including non–mesonic decays of the ${}^{10}_{\Lambda}Be$ and ${}^{10}_{\Lambda}B$ hypernuclei.
- New experimental data about the drip–line location for loosly bound light hypernuclei with high neutron excess. Development of theory of the neutron–rich hyper nuclei and models of their production in non–central nucleus–nucleus interactions.
- New experimental data about soft photon emission in deuteron–nuclei and other nuclei–nuclei interactions, including study of dependence of their energy spectra on electric charges of the projectile and target nuclei, as well as on multiplicity of secondaries.
- Development of theoretical and phenomenological models for description of data on the soft photon yields in tne deuteron–nuclei and other nuclei–nuclei iteractions, differentiated on multiplicity of secondaries.
- Construction of two–arm electromagnetic calorimeter for soft photon registration in a wide region of emission angles for study of interference patterns, for search of new resonances and verification of theoretical predictions about new phenomena in a dense nuclear matter.

Expected main results in 2016:

- Modernization of the FFE, DAQ and tracking systems of the NIS–GIBS spectrometer.
- Data taking on the hyper–nuclear program (search for the hyper–hydrogen 6) using the NIS–GIBS spectrometer at extracted beams of deuterons and ${}^{7}Li$ nuclei.
- Analysis of data from LEPS spectormeter on vector–meson photoproduction by polarized photons.
- Analysis of data on soft ($E_{\gamma} < 50$ MeV) photon emission in deuteron–nuclei and other nuclei–nuclei interactions at kinetic energies above 2 GeV/nucleon.
- Preparation of the 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**	Realization Data taking
	VBLHEP	V.D. Aksinenko, R.A. Salmin, V.P. Balandin, S.N. Bazylev, P.A. Rukoyatkin, A.A. Feschenko, S.N. Plyashkevich, Yu.T. Borzunov, A.I. Maksimchuk, V.B. Chumakov, V.Yu. Ivanenko, O.V. Okhrimenko, A.I. Golokhvastov, S.A. Avramenko, M.H. Anikina, A.V. Averiyanov, A.M. Korotkova, N.G. Parfenova, S.V. Starikova, V.B. Dunin + 2 students, A.V. Konstantinov	
	DLNP	V.V. Tereschenko	
	OCE	A.N. Parfenov	
2.	**Experiment NEMAN**	**E.S. Kokoulina** **V.A. Nikitin**	Project preparation Data taking
	VBLHEP	V.I. Kireev, V.V. Avdeychikov, Yu.A. Chentsov, I.A. Rufanov, M.V. Tokarev, Yu.P. Petukhov, A.N. Aleev, A.I. Yukaev, N.K. Zhidkov, V.B. Dunin + 3 students, V.P. Balandin, N.F. Furmanets, Yu.T. Borzunov, N.A. Kuzmin, P.K. Manyakov, A.V. Konstantinov	
	BLTP	Yu.A. Bystritsky	

Collaboration

Country or International Organization	City	Institute or Laboratory
Belarus	Minsk	NC PHEP BSU
		BSUIR
	Gomel	GSTU
		GSU
Czech Republic	Prague	CTU
	Řež	UJV
		NPI ASCR
Germany	Frankfurt/Main	Univ.
	Jülich	FZJ
Japan	Osaka	RCNP

Russia	Moscow	SINP MSU
	Protvino	IHEP
	Syktyvkar	DM Komi SC UrB RAS
Ukraine	Kiev	BITP NASU

02–0–1065–2007/2019	Priority: 1

Status: In-progress

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: A.S. Sorin
V.D. Kekelidze

Deputies: G.V. Trubnikov
I.N. Meshkov
A.D. Kovalenko

Participating Countries and International Organizations:

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

Scientific Programme

Search and investigation of phase transitions and critical phenomena in strongly interacting matter at extremely high baryon densities, of nucleon spin structure, study of polarization phenomena in few–body systems and light nuclei. Development of theoretical models of these 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 and the construction of the BM@N detector. Development and construction of the heavy ion collider NICA, multipurpose detector (MPD/NICA) and spin physics detector (SPD/NICA) for the collide experiments with heavy ions. Modernization of the extraction beam lines. Carrying out of experiments with nuclear beams and polarized deuteron beams at the Nuclotron.

Expected main results in 2016:

- Development and extension of the NICA "White Paper" – project physics program. Continuation of theoretical sudies of non–perturbative QCD processes, development and tests of the models for the nuclear matter at high temperatures and densities aimed at investigation of phases of nuclear matter, dynamics of nuclear collisions at extremely high baryonic densities and observation of these phenomena in P–odd effects and spin asymmetries.
- The Nuclotron modernization in framework of the Nuclotron–NICA project: modernization of the accelerator stations, design and construction of the beam injection/extraction systems, continuation of tests of the new heavy ion source KRION–6T, technical improvement of the cryogenic and injection complex. Development of the system for beam diagnostics. Tests of the source for polarized particles SPI. Annual dedicated machine development runs at Nuclotron on first priority tasks within running time of 400 hours.
- Start of the new linear injector ($z/A \geq 0.14$) and RFQ fore–injector of LU–20. Construction of the prototypes related to the collider magnetic system and development of the beam cooling systems; tests of the stochastic cooling system prototype at Nuclotron. Start of mass–production of the superconducting magnets for NICA and the prototype for FAIR, modernization of the engineering infrastructure.
- Completion of the technical design project to put new injector, booster, collider and beam lines of the NICA complex. Development of the engineering infrastructure of the project, start of the civil engineering.
- Preparation of technical project for beam cooling systems manufacturing.
- Realization of the plan of works for BM@N project.
- Realization of the technical project of the MPD solenoid and the order for its manufacturing. Prototyping the detector elements for the first stage of the project. MPD Technical Design Project preparation.

- Preparation of the Conceptual Design Project to study nucleon spin structure with SPD. Continuation of theoretical studies of the Matveev–Muradyan–Tavkhelidze–Drell–Yan processes, production processes and other processes in light polarized nuclei collisions.
- Nuclotron runs dedicated to physics and machine development within running time of 1000 hours.
- Development of the NICA/MPD/BM@N/SPD computer infrastructure.

List of projects:

	Project	**Leader**	**Priority (period of realization)**
1.	Nuclotron–NICA	G.V. Trubnikov	1 (2011 – 2020)
2.	MPD	V.D. Kekelidze	1 (2011 – 2020)
3.	BM@N	M.N. Kapishin	1 (2012 – 2016)

List of activities:

	Activity or experiment **Laboratory or other Division of JINR** **Responsible person**	**Leaders** **Main researchers**	**Status**
1.	**Theoretical investigations, lattice QCD calculations and development of the models for description of properties of excited nuclear matter at high temperatures and compressions, dynamics of nuclear interactions at extremely dense baryon matter, spin and P–odd effects**	**A.S. Sorin** **O.V. Teryaev** **D. Blaschke**	Realization
	BLTP	A.V. Efremov, A.S. Hvorostukhin, E.–M. Ilgenfritz, S.B. Gerasimov, M.K. Volkov, A. Parvan, Ya.N. Klopot, A.G. Oganesyan, A. Frisen	
	LIT	Yu.L. Kalinovsky, Zh. Musulmanbekov, E.G. Nikonov	
	DLNP	G.I. Lykasov	
	VBLHEP	V.D. Kekelidze, R. Lednický, Kh.U. Abraamyan, M.A. Kozhin, S.G. Reznikov, V.N. Zhezher, O.V. Rogachevsky, V. Voronyuk, P. Batyuk	
2.	**Nuclotron–NICA: development of the technological systems of the accelerator ring, injection complex and extracted beam channels in framework of the NICA project**	**G.V. Trubnikov** **A.V. Butenko** **V.I. Volkov** **A.O. Sidorin** **I.N. Meshkov** **A.D. Kovalenko**	Realization

VBLHEP

H.G. Khodzhibagiyan + 3 pers., N.N. Agapov, V.I. Batin + 5 pers., A.S. Averichev + 4 pers., V.I. Lipchenko, Yu.A. Mitrofanova, A.I. Pleshakov + 5 pers., E.Yu. Filippova, E.Yu. Ivanenko, D.V. Lobanov, A.V. Alfeev, V.A. Monchinsky, A.I. Govorov + 7 pers., V.V. Seleznev, R.G. Pushkar, K.A. Levterov, A.A. Voronin, B.V. Golovensky, K.B. Shevchenko, V.P. Vadeev, D.A. Lyusev, I.V. Shirikov, A.V. Smirnov + 5 pers., A.R. Galimov, A.V. Nesterov, G.L. Kuznetsov, O.A. Kunchenko, R.V. Pivin, A.M. Bazanov, E.E. Donets, E.D. Donets, D.E. Donets, V.B. Shutov, D.O. Ponkin, V.S. Alexandrov, V.A. Andreev, V.A. Isadov, A.V. Eliseev, S.V. Romanov, V.V. Tarasov, A.E. Kirichenko + 3 pers., D.V. Monakhov, B.V. Vasilishin, O.S. Kozlov, O.I. Brovko, A.M. Nikitin, V.M. Shumkov + 5 pers., O.V. Prozorov, A.V. Gromov + 3 pers., S.A. Rumyantsev, L.P. Skiba, A.N. Pisulina, I.V. Kudashkin, G.P. Reshetnikov, N.N. Blinnikov, L.E. Bogdan, K.N. Gurylev, E.V. Ivanov + 3 pers., Z.I. Smirnova, V.N. Karpinsky, A.L. Osipenkov + 3 pers., N.G. Kondratev, A.V. Kudashkin, A.A. Shurygin, Yu.M. Nozhenko + 3 pers., N.A. Filippov + 3 pers., A.S. Vinogradov, N.A. Blinov + 4 pers., A.Yu. Starikov, P.A. Rukoyatkin + 3 pers., A.V. Filippov, N.I. Lebedev, E.V. Gorbachev, V.V. Fimuskin, G.D. Shirkov, V.V. Kobets, A.V. Alfeev + 3 pers., N.V. Semin, V.P. Chernyaev + 8 pers., A.A. Fateev + 3 pers., N.D. Topilin + 5 pers., A.V. Tuzikov, N.A. Shurkhno, V.M. Slepnev + 4 pers.

3. **R&D work, construction of the prototypes and full–scale superconducting magnets for NICA booster and collider**

G.V. Trubnikov
G.G. Khodzhibagiyan
A.D. Kovalenko
S.A. Kostromin

R&D
Realization

VBLHEP

A.V. Butenko, A.V. Smirnov + 3 pers., A.R. Galimov, G.L. Kuznetsov, O.A. Kunchenko, P.V. Pivin, A.M. Bazanov, N.N. Agapov + 8 pers., V.I. Batin + 5 pers., V.N. Karpinsky, A.L. Osipenkov, P.I. Nikitaev, N.P. Bazyleva, A.V. Kudashkin, N.A. Filippov + 2 pers., A.S. Vinogradov, N.A. Blinov, A.M. Donyagin, A.Yu. Starikov + 4 pers., I.E. Karpunina, S.A. Dolgy, V.K. Alexeev, V.N. Surikov, N.A. Zhiltsova, N.D. Topilin, Yu.V. Gusakov, A.V. Shabunov, A.A. Makarov, Yu.A. Tumanova, T.F. Prakhova, V.V. Agapova, A.V. Buchkov, V.S. Korolev + 3 pers., V.V. Borisov

4. **Commissioning of the heavy ion source (KRION–6 T), commissioning the polarized particle source (SPI) for the NICA complex**

E.D. Donets
E.E. Donets
V.V. Fimushkin

Realization

VBLHEP

V.B. Shutov + 3 pers., A.Yu. Ramzdorf, D.E. Donets, A.Yu. Boitsov, D.O. Ponkin, V.P. Vadeev, Yu.V. Prokofichev, L.V. Kutuzova, A.V. Vadeev, A.I. Govorov, V.V. Seleznev, A.V. Shabunov, K.A. Levterov, S.N. Sedykh + 1 pers., A.D. Kovalenko

5.	**Development and construction of the beam injection/extractin systems, beam transportation channels for NICA elements. Development of the control systems for beam diagnostics**	**V.I. Volkov** **V.A. Mikhaylov**	Realization
	VBLHEP	A.V. Butenko, B.V. Vasilishin, O.S. Kozlov, A.G. Kochurov, L.A. Leonov, A.V. Eliseev, V.A. Andreev + 1 pers., V.M. Gorchenko, S.V. Mikhaylov, A.M. Butenko, G.M. Salnikova, V.A. Isadov, S.V. Romanov, A.E. Kirichenko, P.A. Rukoyatkin, R.I. Kukushkina, V.S. Alexandrov, A.V. Tuzikov, A.A. Fateev, N.I. Lebedev, V.V. Tarasov, L.I. Kosukhina, G.S. Sedukh, T.V. Rukoyatkina, V.V. Kovalev, N.V. Pilyar, G.E. Koroleva, M.E. Pushkin, E.V. Gorbachev, R.A. Smolkov, A.V. Alfeev, I.Ya. Nefedev, V.N. Karpinsky, A.L. Osipenkov, A.I. Sidorov	
6.	**Development of the cryogenic systems for Nuclotron–NICA**	**N.N. Agapov** **H.G. Khodzhibagiyan**	Projecting Realization
	VBLHEP	V.I. Batin + 6 pers., H. Malinovsky + 5 pers., V.M. Drobin, Yu.T. Borzunov, A.V. Konstantinov, L.V. Petrova, E.A. Kulikov, A.S. Averichev + 4 pers., V.I. Lipchenko, V.E. Kurinov, Yu.A. Mitrofanova + 3 pers., A.I. Pleshakov + 5 pers., S.A. Smirnov, E.Yu. Filippova, E.Yu. Ivanenko, D.V. Lobanov	
7.	**Technical design and construction of the NICA injection complex**	**A.V. Butenko** **V.V. Kobets** **I.N. Meshkov** **V.A. Monchinsky**	Realization
	VBLHEP	A.O. Sidorin, A.I. Govorov, V.V. Seleznev + 4 pers., K.A. Levterov, A.A. Voronin, B.V. Golovensky, K.V. Schevchenko, V.P. Vadeev, D.A. Lyusev, I.V. Shirikov, A.V. Smirnov + 3 pers., A.V. Nesterov, A.M. Bazanov, N.D. Topilin, A.I. Sidorov + 1 pers., A.A Fateev, I.G. Lebedeva, S.N. Sedykh, A.P. Kozlov, V.V. Kosukhin	
8.	**Technical design and construction of the NICA booster synchrotron and its technological systems**	**A.V. Butenko** **V.A. Mikhaylov** **I.N. Meshkov**	Project preparation Realization
	VBLHEP	G.G. Khodzhibagiyan + 5 pers., S.A. Kostromin, A.V. Smirnov + 3 pers., A.R. Galimov, A.V. Nesterov, G.L. Kuznetsov, O.A. Kunchenko, R.V. Pivin, A.M. Bazanov, V.V. Seleznev, N.N. Agapov + 8 pers., V.I. Batin + 5 pers., V.N. Karpinsky, A.L. Osipenkov, O.I. Brovko, N.D. Topilin, S.V. Rabtsun, Yu.V. Gusakov, A.V. Shabunov, Yu.A. Tumanova, V.I. Volkov + 5 pers., B.V. Vasilishin, O.S. Kozlov, V.A. Andreev, A.V. Eliseev, S.V. Romanov, A.E. Kirichenko, P.A. Rukoyatkin, A.V. Tuzikov, A.A. Fateev, N.I. Lebedev, V.V. Tarasov, T.V. Rukoyatkina, E.V. Gorbachev, A.V. Alfeev, V.N. Karpisky + 3 pers., A.L. Osipenkov + 4 pers.	

	DLNP	S.L. Yakovenko, E.V. Akhmanova, A.G. Kobets, A.Yu. Rudakov, N.A. Rybakov	
9.	**Technical design, R&D and construction of the heavy ion collider NICA with energy $\sqrt{s_{NN}}$ = 4÷11 GeV and average luminosity 1 $\cdot 10^{27}$cm$^{-2} \cdot s^{-1}$ and light polarized ions on the base of Nuclotron – M**	**I.N. Meshkov** **G.V. Trubnikov** **A.O. Sidorin** **A.D. Kovalenko**	Project preparation Realization
	VBLHEP	G.G. Khodzhibagiyan + 5 pers., A.V. Butenko, A.V. Smirnov + 3 pers., S.A. Kostromin, A.R. Galimov, G.L. Kuznetsov, R.V. Pivin, A.M. Bazanov, N.N. Agapov + 8 pers, V.I. Batin + 5 pers., V.N. Karpinsky + 3 pers., N.V. Semin, V.D. Kalagin, N.D. Topilin, Yu.V. Gusakov, A.V. Shabunov, E.V. Muraveva, A.A. Makarov, Yu.A. Tumanova, V.I. Volkov + 5 pers., B.V. Vasilishin, O.S. Kozlov, V.A. Andreev, A.V. Eliseev, S.V. Romanov, A.E. Kirichenko, P.A. Rukoyatkin, A.V. Tuzikov, A.A. Fateev, N.I. Lebedev, V.V. Tarasov, T.V. Rukoyatkina, E.V. Gorbachev, A.V. Alfeev, A.L. Osipenkov + 4 pers., V.A. Monchinsky, O.I. Brovko + 3 pers., V.M. Zhabitsky, G.D. Shirkov, V.S. Alexandrov, A.V. Filippov, A.V. Tuzikov, E.I. Urazakov	
	DLNP	A.G. Kobets + 2 pers., T.A. Stepanova, L.V. Soboleva, E.V. Akhmanova, A.A. Sidorin, S.L. Yakovenko	
	LRB	G.N. Timoshenko, V.N. Buchnev, V.Yu. Shchegolev	
10.	**Design and construction of the MPD detector. Preparation of the Technical Design Project. R&D and construction of the first–stage detector elements: time–projection chamber, time–of–flight system, electro-magnetic calorimeter, zero–degree calorimeter, internal tracker**	**V.D. Kekelidze** **A.S. Sorin** **V.M. Golovatyuk**	R&D Technical proposal
	VBLHEP	S.V. Volgin, N.M. Vladimirova, V.A. Babkin, S.N. Lobastov, Yu.I. Fedotov, H.U. Abraamyan, A.B. Anisimov, M.A. Kozhin, O.P. Gavrishchuk, N.A. Kuzmin, A.I. Yukaev, E.V Kostyukhov, Yu.V. Zanevsky, Yu. Lukstinsh, O.V. Fateev, A.M. Korotkova, V.F. Chepurnov, S.V. Razin, V.N. Zryuev, A.V. Averyanov, A.G. Bazhazhin, S.V. Vereshchagin, A.G. Litvinenko, A.Yu. Isupov, V.F. Peresedov, I.I. Migulina, V.A. Nikitin, O.V. Rogachevsky, V.D. Peshekhonov, K.V. Gertsenberger, Yu. Fedorishin, A.I. Zinchenko, Dzh. Drnoyan,	

		I.A. Tyapkin, I.V. Gapienko, G.D. Kekelidze, V.V. Myalkovsky, Yu.T. Kiryushin, S.A. Movchan, V.M. Lysan, S.V. Khabarov, V.S. Khabarov, A.V. Vishnevsky, Yu.K. Potrebenikov, D.T. Madigozhin, N.A. Molokanova, I.A. Polenkevich, S.N. Shkarovsky, Yu.A. Murin, V.A. Vasendina, V.A. Budilov, V.A. Nikitin, N.K. Zhidkov, V.I. Yurevich, G.S. Averichev, D.N. Bogoslovsky, V.B. Dunin, L.G. Efimov, E.M. Kislov, A.A. Povtoreiko, V.V. Tihomirov, G.A. Yarygin, A.N. Zubarev, S.V. Bazylev, V.M. Slepnev, I.V. Slepnev, A.B. Shutov, A.E. Baskakov, A.V. Shchipunov, V.Yu. Rogov, N.A. Shutova, R.V. Nagdasev, S.P. Merts, P. Batyuk, V.V. Voronyuk
	DLNP	A.G. Olshevskiy, Z.V. Krumshtein + 8 pers.
	LIT	V.V. Ivanov, P.G. Akishin, P.I. Kisel, O.Yu. Derenovskaya, Zh.Zh. Musulmanbekov, A.M. Raportirenko, P.V. Zrelov
11.	**Design and construction of the superconducting solenoidal and magnet yoke**	**A.S. Vodopyanov**	R&D Technical proposal
	VBLHEP	S.G. Gordeev, A.A. Efremov, Yu.Yu. Lobanov, V.H. Dodokhov, E.M. Kislov, N.D. Topilin
12.	**Design and creation of the read–out and slow control system**	**S.V. Bazylev**	Project preparation Realization
	VBLHEP	V.M. Slepnev, I.V. Slepnev, A.E. Baskakov, A.B. Shutov, A.V. Shchipunov, V.Yu. Rogov, N.A. Shutova, R.V. Nagdasev, S.V. Sergeev, A.F. Mukhamatnabaev
13.	**Preparation of the physical program and SPD detector project for studying of the spin effects at NICA complex**	**I.A. Savin** **A.D. Kovalenko** **V.V. Kukhtin**	Project preparation Realization
	VBLHEP	A.P. Nagaytsev, G.V. Meshcheryakov, E.V. Zemlyanichkina, A.I. Zinchenko, N.S. Rogacheva, D.V. Peshekhonov, V.D. Peshekhonov, Yu.I. Ivanshin, V.V. Myalkovsky, A.V. Ivanov, N. Dzhavadov, O.M. Kuznetsov, A.I. Malakhov, B. Marineva, F. Ahmadov, R.R. Akhunzyanov, G.I. Smirnov, E.A. Strokovsky, R. Lednický, S.S. Shimansky, N.D. Topilin, V.P. Ladygin, P.K. Kurilkin, A.K. Kurilkin, V.A. Anosov, A.A. Baldin, A.P. Cheplakov, I.A. Golutvin, I.P. Yudin
	DLNP	Z.V. Krumshtein, R. Abramishvili, A.V. Guskov, I.A. Orlov, N.V. Anfimov, I.E. Chirikov-Zorin, I.B. Gongadze, A.L. Gongadze, M. Finger(junior), M. Finger, A. Janata, M. Slunechka, V. Slunechkova, N.B. Skachkov, G.A. Shelkov
	LIT	T.A. Strizh, V.V. Palchik
	BLTP	A.V. Efremov, O.V. Teryaev, G.A. Kozlov, A.V. Radyushkin, A.V. Sidorov, Yu.I. Uzikov

14.	**Development of computer infrastructure for NICA complex**	**Yu.K. Potrebenikov** **O.V. Rogachevsky**	Realization
	VBLHEP	B.G. Schinov, Yu.I Minaev, V.L. Svalov, V.F. Dydyshko, D.T. Madigozhin, N.A. Molokanova, D.V. Peshekhonov, I.A Polenkevich, S.N. Shkarovsky	
	LIT	M.V. Bashashin, D.V. Kekelidze, V.V. Korenkov	
15.	**Technical design and development of the engineering infrastructure of Nuclotron–NICA**	**I.N. Meshkov** **V.D. Kalagin** **G.V. Trubnikov** **G.D. Shirkov**	Projecting Realization
	VBLHEP	N.D. Topilin, A.V. Shabunov, E.V. Serochkin, A.A. Makarov, S.V. Rabtsun, N.V. Semin + 10 pers., V.M. Stepanov + 6 pers., A.M. Karetnik, V.P. Chernyaev, A.N. Sotnikov, V.Yu. Shilov, M.I. Migulin, E.M. Khabarova, A.V. Alfeev, O.M. Timoshenko	
	DLNP	Yu.A. Budagov, S.L. Yakovenko	
	OCE	A.V. Dudarev + 1 pers.	
	AS&CC Office	A.B. Vishnevsky, Yu.N. Balandin	
	GA&C	Yu.N. Denisov, S.O. Lukjanov	
16.	**Works on realization of the experiment Baryonic matter at Nuclotron (BM@N)**	**M.N. Kapishin** **V.P. Ladygin** **P. Senger** **Yu.A. Murin**	Realization
	VBLHEP	V.V. Avdeychikov, A.V. Averiyanov, S.A. Avramenko, V.D. Aksinenko, A.V. Alfeev, V.S. Alfeev, V.A. Babkin, S.N. Bazylev, V.P. Balandin, I.V. Boguslavsky, P. Batyuk, S.P. Merts, O.V. Rogachevsky, V.A. Vasendina, T.A. Vasiliev, N.M. Vladimirova, A.V. Vishnevsky, S.V. Volgin, V.V. Voronyuk, V.I. Voskoboynik, O.P. Gavrishchuk, V.M. Golovatyuk, A.I. Golokhvastov, Yu.V. Gurchin, V.I. Demidova, V.B. Dunin, Yu.V. Zanevsky, A.I. Zinchenko, V.N. Zryuev, A.P. Ierusalimov, E.-M. Ilgenfritz, A.Yu. Isupov, Yu.-T. Karachuk, V.D. Kekelidze, G.D. Kekelidze, Yu.T. Kiryushin, E.S. Kokoulina, V.I. Kolesnikov, A.D. Kovalenko, A.M. Korotkova, A.V. Kuznetsov, N.A. Kuzmin, A.K. Kurilkin, P.K. Kurilkin, E.A. Ladygin, N.B. Ladygina, S.P. Lobastov, Yu. Lukstinsh, A.I. Malakhov, V.V. Myalkovsky, V.A. Nikitin, P.V. Nomokonov, O.V. Okhrimenko, V.V. Pavluchkov, Yu.P. Petukhov, O.Yu. Pechenova, V.D. Peshekhonov, S.M. Piyadin, S.G. Reznikov, P.A. Rukoyatkin, I.A. Rufanov, A.V. Shabunov, V.M. Slepnev, I.V. Slepnev, A.S. Sorin, E.A. Strokovsky, S.Ya. Sychkov, A.A. Terekhin, A.V. Terletsky, V.V. Tikhomirov, N.D. Topilin, O.V. Fateev, Yu.I. Fedorov, V.S. Khabarov, S.V. Khabarov, A.N. Khrenov, A.V. Shutov, A.I. Yukaev	

LIT	T.O. Ablyazimov, V.P. Akishin, P.G. Akishin, D.V. Belyakov, O.Yu. Derenovskaya, P.V. Zrelov, V.V. Ivanov, P.I. Kisel, A.M. Raportirenko, V. Sheynast
FLNP	E.P. Litvinenko
BLTP	O.V. Teryaev

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	YSU
Azerbaijan	Baku	IP ANAS
Belarus	Minsk	NC PHEP BSU
		JIPNR-Sosny
		NASB
		"Planar"
		BSUIR
	Gomel	GSU
		GSTU
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
France	Nantes	SUBATECH
Egypt	Cairo	ECTP
Germany	Darmstadt	GSI
	Dresden	ILK
	Giessen	JLU
	Erlangen	FAU
	Frankfurt/Main	Univ.
		FIAS
	Mainz	JGU
	Regensburg	UR
	Jülich	FZJ
Japan	Nagoya	Nagoya Univ.
Georgia	Tbilisi	AIP TSU
Italy	Turin	INFN
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
		IBMP RAS
	Moscow, Troitsk	INR RAS
	Belgorod	BelSU
	Kazan	Compressormash
	Novosibirsk	BINP SB RAS
	Protvino	IHEP
	St. Petersburg	Neva-Magnet
	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	BITP NASU
	Kharkov	KhNU
		KFTI
USA	Batavia, IL	Fermilab
	Upton, NY	BNL
	Stony Brook, NY	SUNY

02–0–1127–2016/2018	Priority: 1
	Status: New

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

Leader: G.D. Shirkov
Deputies: Yu.A. Budagov
G.V. Trubnikov

Participating Countries and International Organizations:

Armenia, Belarus, CERN, 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; design and construction of the facility for performance of fundamental and applied researches based on monochromatic directed fluxes and beams of positrons and orthopositronium atoms; 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 2016:

- Dependency of the beam emittance on the charge and gun electrodes construction investigation. Photoinjector laser optical transportation beamline mounting. Fabrication and investigation of the "transparent" thin–film. 30-35 kV photogun construction. Photogun integration into the photoinjector prototype accelerating structure. Main photoinjector systems commissioning.
- Commissioning of Linac–200 fourth accelerating section with beam energy up to 200 MeV. Design of the UV FEL vacuum beamline and magnet system. Beam extraction into atmosphere for detector parameters investigation.
- Designing and construction of prototype of compact vacuumed two–coordinates Precision Laser Inclinometer with 1 nrad resolution and Absolute Distance Meter with 1 μm resolution for distance of 1–10 m. The final phase of R&D's on niobium cavities.
- Design and construction of the cryogenic source of monochromatic positrons with the closed loop LiHe cooling system and the emitter of the activity of 30 mCi. Construction and commissioning of the positron trasfer channel and the experimental station, development of the gamma radiation detector of a high resolution.
- Investigation of electron beam and FEL physics: investigation of infrared radiation from JINR undulator at FLASH and reconstruction of beam pulse current on basis of this radiation, search of SASE regime at FLASH2 by using of microchannel plate detectors, first test experiments with three XFEL microchannel plate detectors, formation of 3D ellipsoidal shape electron bunches in PITZ with new laser system.

- Development of education program on the base on working with real Linac–200 equipment for students an PhD students – future engineers from JINR member states; laboratory and practical training at Linac–200 accelerator.
- Preparation of the proposal of the 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 G.V. Trubnikov	1 (2016 – 2016)
2.	The precision laser metrology for accelerators and detector complexes	Yu.A. Budagov M.V. Lyablin	1 (2016 – 2016)

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.**	**N.I. Balalykin** **M.A. Nozdrin**	Technical proposal Realization
	VBLHEP	V.F. Minashkin, V.G. Shabratov, A.V. Shevelkin, G.V. Trubnikov	
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, semiconducting structures investigation aimed on new detectors parameters improvement and other applied research.**	**G.D. Shirkov** **V.V. Kobets** **M.A. Nozdrin**	Technical proposal Realization
	VBLHEP	V.G. Shabratov, A.V. Skrypnik, A.N. Ukhanov, V.F. Minashkin	
	DLNP	A.M. Artikov, Yu.A. Budagov, Yu.I. Davidov, V.N. Duginov, V.V. Glagolev, E.M. Syresin	
	UC	S.Z. Pakulyak	

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; Research on the components of Nb–cavities.**	**Yu.A. Budagov** **M.V. Lyablin**	Technical proposal Realization
	DLNP	N.S. Azaryan, V.Yu. Batusov, Yu.I. Davidov, D.L. Demin, V.V. Glagolev, V.I. Kolomoets, S.M. Kolomoets, V.M. Romanov, B.M. Sabirov, A.V. Sazonova, S.N. Studenov, A.K. Sukhanova, G.T. Torosyan	
	VBLHEP	G.V. Trubnikov, G.D. Shirkov	
4.	**Creation of the positron of a high intensity with the closed loop LHe cooling system; electron cooling of positrons and orthopositronium generation; development of positron annihilation spectroscopy method with construction of the dedicated positron transfer channel.**	**I.N. Meshkov** **A.G. Kobets** **P. Horodek**	Realization
	DLNP	E.V. Akhmanova, V.I. Khilinov, O.S. Orlov, A.Yu. Rudakov, A.A. Sidorin, L.V. Soboleva, T.A. Stepanova, V.I. Trubnikov	
	VBLHEP	V.M. Drobin, V.V. Seleznev	
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.**	**E.M. Syresin** **O.I. Brovko** **M.V. Yurkov**	Realization
	DLNP	N.A. Morozov, A.F. Chesnov, R.S. Makarov, D.S. Petrov, V.M. Romanov	
	VBLHEP	A.Yu. Grebentsov, O.A. Myslinskaya	
6.	**Preparation of the proposal of the JINR participation in the FCC design study at CERN. Preparation of the proposals of JINR participation in international collaborations for future high energy colliders.**	**G.D. Shirkov** **G.V.Trubnikov**	Preparation

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	ANSSP
Belarus	Minsk	BSUIR

		SPMRC NASB
		PTI NASB
		INP BSU
Bulgaria	Sofia	INRNE BAS
CERN	Geneva	CERN
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
	Genoa	INFN
Japan	Tsukuba	KEK
Poland	Krakow	NINP PAS
Russia	Moscow	SSDI
		NNRU "MEPhI"
	Moscow, Troitsk	INR RAS
	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

02–1–1097–2010/2018	Priority: 1
	Status: Extended

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:

Belarus, 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 polarimetery 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 $d \to p$ 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 2016:

- Works:
  a) on the construction low energy proton and deuteron polarimeter within the frames of the program: "Spin Physics Research Infrastructure at the Nuclotron";
  b) on the measurements of analyzing power of neutron–CH scattering at polarized neutron momentum from 3 to 4.5 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 (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 – 2016)
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, I.A. Savin, 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.)	
	LIT	R.V. Polyakova + 1 pers.	
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, A.K. Kurilkin, 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, P.K. Manyakov, 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. Slunečhka, V. Slunečhkova, A. Yanata	
	FLNP	S.B. Borzakov, Ts. Panteleev	
	BLTP	N.V. Kochelev	
	LIT	R.V. Polyakova + 1 pers.	
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, P.K. Manyakov	
7.	**Theoretical calculations of polarized processes**	**V.V. Burov** **V.K. Lukyanov**	Data analysis
	BLTP	V.V. Burov	
	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. Slunečhka, V. Slunečhkova, M. Finger (Jr.), A. Yanata	
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, P.K. Manyakov, V.P. Ladygin, Yu.S. Anisimov, S.M. Piyadin	

Collaboration

Country or International Organization	**City**	**Institute or Laboratory**
Belarus	Minsk	INP BSU
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	INCDIE 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	KFTI
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

02–1–1087–2009/2017	Priority: 1

Status: In-progress

Research on Relativistic Heavy and Light Ion Physics. Experiments at the Nuclotron, SPS and SIS18

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

Participating Countries and International Organizations:

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

Scientific Programme

Search for manifestation of quark-gluon degrees of freedom in collisions of relativistic nuclei and phase transitions in nuclei and exotic resonances. Study of nuclear multifragmentation processes. The Nuclotron internal target experiments. Asymptotics in nuclear collisions and nucleon clusters. Detector development for relativistic heavy-ion experiments at the CERN, BNL and GSI. Investigation of the interactions of nuclei at energy 20-158 GeV on a nucleon on NA61/SHINE experiment (SPS, CERN). Study of hadron production in hadron-nucleus interactions. Use of these data for precise predictions of neutrino fluxes in neutrino oscillation experiments at accelerators. Participation in HADES experimental programs. Studies of transmutation cross sections of radioactive nuclear wastes. Study of fragmentation of light stable and radioactive nuclei with beams of secondary nuclei and data analysis. Study of the properties strong interaction matter. Study of the particles properties in nuclear matter at the Nuclotron.

Expected main results in 2016:

- Continuation of experiments with the internal target at the Nuclotron. Preparation and carrying out of experiments with extracted beams at the Nuclotron. Development of the software for modeling and processing experimental data.
- Participation in realization NA61. Study of hadron production in proton-carbon interactions at 30 GeV in the NA61/SHINE experiment at CERN. Use of these data for improved predictions of neutrino fluxes and precise determination of neutrino oscillation parameters in the T2K experiment in Japan.
- Participation in experimental data taking of $AuAu$ (1.25 GeV) with HADES spectrometer. Furter participation in data analysis of dp (1.25 GeV) and np (3.5 GeV).
- Experimental study of the properties of hot nuclei produced in the collisions of the relativistic deuterons with heavy target. Measuring and analysis of the relative velocity correlation functions of pairs of intermediate fragments created in the reaction The elaboration of the trigger system for determination of the total time–scale of hot nucleus disintegration will be done.
- Study of multiparticle dynamics in terms of masses and energies of colliding objects and centrality of interaction. Mathematical modeling of experiments on investigation of the properties of highly excited states of nuclear matter in relativistic nuclear collisions and the mechanism of quark hadronization in the process of pion pair production.
- Search for eta–mesic nuclei formed in dA collisions, the determination of the total cross section of eta–nucleus production in dA collisions and its energy and A–depedence, the construction and production of the neutron detector for this experiment. Investigation of scintillators at high beam intensity.
- Analysis of emulsions irradiated with the nuclear beams $^{7}Be, ^{10}C, ^{12}N$. Irradiation of emulsions with secondary beams of radioactive ^{11}C. Heavy nucleus exposure.

- Study of nuclear interactions depending on projectile mass and energy with the beams of relativistic nuclei at the Nuclotron and other accelerators with the photo-emulsion method. Study of fragmentation, multifragmentation, multiparticle production together with correlations between them at interaction of nuclei of various energies with photo-emulsion nuclei. Search for collective effects in central nuclear-nuclear collisions in photo-emulsions.
- Search and study of new phenomena based on the data obtained using bubble chambers; Theoretical interpretation of these results. Creation of the data base of experimental data and educational programs in the field of relativistic nuclear physics.
- Study of deep subthreshold processe, applied and educational programs at MARUSYA setup. Construction of electromagnetic detector of MARUSYA setup and test channel and corresponding electornics for detector testing.
- Investigations with light and heavy ions for applied research.

List of projects:

	Project	**Leader**	**Priority (period of realization)**
1.	HADES	Yu.V. Zanevsky V.P. Ladygin,	1 (2010 – 2016)
2.	NA61	A.I. Malakhov	1 (2012 – 2017)
3.	FASA-3	V.A. Karnaukhov	1 (2013 – 2017)

List of activities:

	Activity or experiment **Laboratory or other Division of JINR** **Responsible person**	**Leaders** **Main researchers**	**Status**
1.	**Experiment HADES**	**A.I. Malakhov** **Yu.V. Zanevsky**	Data taking Data analysis
	VBLHEP	O.V. Fateev, C.V. Razin, V.P. Ladygin, A.K. Kurilkin, P.K. Kurilkin, A.P. Ierusalimov, V.F. Tchepurnov, A.Yu. Troyan, A.V. Belyaev	
	BLTP	V.D. Toneev	
	DLNP	G.I. Lykasov	
2.	**Experiment NA61/SHINE**	**A.I. Malakhov** **G.L. Melkumov**	Data taking Preparation Data analysis
	VBLHEP	D.A. Artyemenkov + 2 pers, D.K. Dryablov, A.Yu. Isypov, V.I. Kolesnikov, V.A. Kireev, M.A. Kozhin	
	DLNP	B.A. Popov, S.A. Bunyatov	
3.	**Experiment BECQUEREL**	**P.I. Zarubin**	Data taking
	VBLHEP	V.V. Rusakova, D.A. Artemenkov, V. Bradnova, N.O. Kornegrutsa, P.P. Kattabekov, L.Z. Mamatkulov, P.A. Rukoyatkin	

4.	**Project FASA-3**	**V.A. Karnaukhov**	Preparation Data taking
	DLNP	S.P. Avdeev, V.V. Kirakosyan, W. Kartch	
	FLNR	G.V. Mushinsky, O.V. Strekalovsky	
	VBLHEP	P.A. Rukoyatkin	
5.	**Search for and study of η–mesic nuclei in pA collisions at the Nuclotron**	**S.V. Afanasiev** **G.A. Sokol**	Preparation Data taking Upgrade
	VBLHEP	S.V. Afanasiev + 4 students, Yu.S. Anisimov, A.F. Elishev, A.Yu. Isypov, Z.A. Igamkulov, D.K. Dryablov, L.V. Kornyushina	
6.	**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	A.V. Belyaev, V.V. Ilyushchenko, A.Yu. Troyan + 2 pers., A.P. Ierusalimov, S.G. Arakelyan, O.V. Rogachevsky, S.G. Stetsenko	
7.	**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, B.N. Guskov, I.V. Kudashkin, A.I. Kudashkin, I.V. Slepnev + 4 pers., S.G. Stetsenko, A.Yu. Troyan, A.V. Shabunov, S.S. Shimansky, I.P. Yudin, E.E. Perepelkin, I.G. Voloshina, T.V. Shavrina	
	BLTP	V.V. Burov, S.G. Bondarenko	
8.	**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	

Collaboration

Country or International Organization	**City**	**Institute or Laboratory**
Armenia	Yerevan	Foundation ANSL
		YSU
Belarus	Minsk	NC PHEP BSU
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
	Constanţa	UOC
Russia	Moscow	SINP MSU
		LPI RAS
		ITEP
	Moscow, Troitsk	INR RAS
	Chernogolovka	ISMAN RAS
	Smolensk	SmolGU
	St. Petersburg	FIP
	Sarov	VNIIEF
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

02–0–1066–2007/2020	Priority: 1

Status: Extended

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, 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 2016:

- The data on heavy ion and polarized proton–proton and polarized proton nucleus collisions taken in the STAR experiment at RHIC.
- Beam energy scan in the energy range 7–200 GeV. Study of AuAu, UU, CuCu, ^{3}HeAu collisions.
- 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 – 2016)

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**	**Yu.A. Panebratsev**	Data taking Data analysis
	VBLHEP	M.V. Tokarev, T.G. Dedovich, A.O. Kechechyan, L.G. Efimov, A.N. Zubarev, V.V. Tikhomirov, V.B. Dunin, V.I. Yurevich, D.N. Bogoslavsky, G.A. Yarygin, A.A. Povtoreyko, V.Yu. Rogov, S.V. Sergeev	

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

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	Foundation ANSL
Azerbaijan	Baku	IRP ANAS
Czech Republic	Prague	CU
	Řež	UJV

		NPI ASCR
France	Nantes	SUBATECH
Germany	Heidelberg	Univ.
Poland	Warsaw	WUT
Russia	Moscow	NNRU “MEPhI”
		ITEP
	Protvino	IHEP
	St. Petersburg	SPbSU
Slovakia	Bratislava	IP SAS
	Košice	PJSU
USA	Berkeley, CA	Berkeley Lab
	Bloomington, IN	IU
	Detroit, MI	WSU
	Lemont, IL	ANL
	Upton, NY	BNL
	Los Angeles, CA	UCLA
	New Haven, CT	Yale Univ.
	University Park, PA	Penn State

02–1–1088–2009/2016	Priority: 1

Status: Approved for completion in 2016

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

Leader: A.S. Vodopyanov

Participating Countries and International Organizations:

Armenia, Bulgaria, CERN, China, Croatia, Czech Republic, Denmark, France, Germany, Greece, Hungary, India, Italy, Mongolia, 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 2016:

- 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 – 2016)

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.A Belikov, D.D. Emelyanov,	

	S.S. Grigoryan, L.V. Malinina, E.P. Rogachya, A.V. Taranenko, A.G. Fedunov, K.P. Mikhaylov, N.N. Zhigareva	
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, I.A. Zaporozhets	

Collaboration

Country or International Organization	**City**	**Institute or Laboratory**
Armenia	Yerevan	Foundation ANSL
Bulgaria	Sofia	SU
CERN	Geneva	CERN
China	Beijing	CIAE
	Wuhan	CCNU
Croatia	Zagreb	RBI
Czech Republic	Prague	IP ASCR
	Řež	UJV
Denmark	Copenhagen	NBI
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	KFTI
	Kiev	BITP NASU
USA	Columbus, OH	OSU
	Oak Ridge, TN	ORNL

02–1–1107–2011/2016	Priority: 1

Status: Approved for completion in 2016

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, India, Germany, Greece, Moldova, Mongolia, Poland, Romania, Russia, Serbia, Slovakia, Ukraine.

Scientific Programme

Investigation of new aspects of electronuclear power engineering and process of energy production and radioactive waste transmutation at various subcritical setups.

Expected main results:

- Investigation of physical characteristics of the following setups: "the lead target plus graphite moderator" (set-up "Gamma–3"), the massive uranium target with a lead reflector – (set-up "Quinta"), the quasi infinite uranium target BURAN at the energies of the Nuclotron proton and deuteron beams within the range from 0.6 up to 12.0 GeV. Data on the multiplicities and special distribution of energy–time neutron spectra. Study on possibilities of energy production and radioactive waste processing at massive targets of natural (depleted) uranium and thorium on the base of basic principles of nuclear relativistic technologies.

Expected main results in 2016:

- Completion of the development of a heavy ion beam spatial monitoring system; 0n–line operational test at the Nuclotron–M experiments.
- Development of detector for measuring the radiation dose rate based on diamond and silicon detectors.
- Study on efficiency of heating FEL ferromagnetic nano–clusters with microwave radiation regarding the feasibility of its application to the cancer cell destruction.
- Study of neutron generation and multiplication in heavy targets (Pb, U, etc.) at the Nuclotron proton and deuteron beams within the energy range from 1.0 to 8.0 GeV. Data taking on energy release, number of fissions, plutonium recovery, on neutron energy spectra and neutron spatial distribution in the uranium target (set-up "Quinta") and in the lead target with graphite moderator ("Gamma–3" set-up). Precise definition of transmutation rate for highly toxic long–lived radioactive waste (^{129}I, ^{237}Np, ^{238}Pu, ^{239}Pu and ^{241}Am) in the neutron fields with reinforced hard component.
- The technical specifications elaboration and carrying out the 1–st stage of design work on the construction of the experimental setup "Buran", based on the quasiinfinite target of depleted uranium with the mass of $\sim$21 tonns.
- Investigation of the mechanism of the influence of coherent high power microwave radiation on the radioactive decay of nuclei.

List of projects:

Project	Leader	Priority (period of realization)
1. Study of deep subcritical electronuclear systems and feasibility of their application for energy production and radioactive waste transmutation Part II – quasi infinite target	S.I. Tyutyunnikov	1 (2011 – 2016)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. **Elaboration of the technical specifications for the quasi infinite target "Buran"**	**S.I. Tyutyunnikov** **I.P. Yudin** **A.A. Baldin** **V.A. Panasik**	Realization
2. **Development of the technical specifications for detecting system of the "Buran" setup**	**A.A. Baldin** **A. Berlev** **N.I. Zamyatin** **V.M. Slepnev** **S.V. Khabarov**	Realization
3. **Development and experimental study of the detectors for neutron registration at the Nuclotron–M beams**	**A.A. Baldin** **A. Berlev** **A.V. Vishnevsky** **N.I. Zamyatin** **S.E. Vasil'ev** **A.M. Makankin** **A.I. Shafranovskaya** **Z.Ya. Sadygov**	Realization
4. **Development and production of the detectors for the ions energy measurement within the range E=0.1÷1 GeV/nucleon. Experiments at the Nuclotron–M beams**	**N.I. Zamyatin** **A.E. Cheryemukhin** **A.I. Shafranovskaya** **S.V. Khabarov** **Yu.S. Kovalev**	Realization
5. **The modernization of spectralanalitican complex for activation measurements**	**E.V. Strekalovskaya** **V.N. Shalyapin** **Yu.S. Kovalev**	Data taking
6. **Study of radioactive waste transmutation and research on neutron generation and energy release in heavy targets (Pb, U, Th, etc.) at the Nuclotron deuteron and neutron beams within the energy interval from 0.5 to 6 GeV/nucleon**	**A.A. Baldin** **I.P. Yudin** **M. Paraipan** **I.V. Kudashkin**	Data taking Data processing Upgrade
VBLHEP	A. Berlev, S.V. Vasil'ev, A.V. Vishnevsky, N.M. Vladimirova, N.I. Zamyatin, E.V. Kostyukhov, A.M. Makankin, I.I. Mar'in, I.V. Kudashkin, M. Paraipan, E.V. Strekalovskaya, S.V. Khabarov, A.I. Shafranovskaya	

DLNP	I. Adam, V.M. Tsupko–Sitnikov, A.A. Solnyshkin, Zh. Hushvaktov, V.I. Stegaylov, L. Zavortka	
FLNP	Yu.N. Kopach, V.I. Furman, N.A. Gundorin	
LRB	V.Yu. Shchyegolev	
RFMD	B.A. Shestakov, N.N. Kalyakin + 2 pers.	
7. **Investigation of the mechanism of the influence of coherent high power microwave radiation on the radioactive decay of nuclei**	**S.N. Sedykh** **E.A. Perelshtein** **V.N. Shalyapin** **S.I. Tyutyunnikov** **I.A. Kryachko**	Realization
VBLHEP	A.K. Kamiksly, V.V. Efimov, Yu.S. Kovalev, V. Dzhavadova	
8. **Production of the monitoring elements for the superconducting systems**	**Yu.P. Filippov**	R&D
VBLHEP	I.D. Kakorin + 6 pers.	

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	YSU
Australia	Sydney	Univ.
Belarus	Minsk	NC PHEP BSU
		JIPNR-Sosny
		NASB
		INP BSU
		SPMRC NASB
Bulgaria	Sofia	INRNE BAS
Czech Republic	Řež	UJV
	Brno	BUT
	Prague	CTU
Germany	Darmstadt	TU Darmstadt
	Marburg	Univ.
	Jülich	FZJ
Greece	Thessaloniki	AUTH
India	Mumbai	BARC
	Jaipur	Univ.
Moldova	Chişinău	IAP ASM
Mongolia	Ulaanbaatar	IPT MAS
Poland	Warsaw	WUT
	Krakow	NINP PAS
	Otwock-Swierk	NCBJ
Russia	Moscow	Atomenergomach
	Dubna	BSINP MSU

		IAS “Omega”
	Obninsk	MRRC
		IPPE
	St. Petersburg	KRI
	Tomsk	TPU
Romania	Bucharest	ISS
		UMF
		INCDIE ICPE-CA
	Iaşi	UAIC
Serbia	Belgrade	INS “VINČA”
Slovakia	Bratislava	SOSMT
		IP SAS
		CU
Ukraine	Kharkov	KFTI
	Uzhgorod	UNU

Nuclear Physics (03)

03–0–1095–2010/2016	Priority: 1

Status: Approved for completion in 2016

Accelerator Complex of Ion Beams of Stable and Radioactive Nuclides (DRIBs-III)

Leaders: G.G. Gulbekyan
S.N. Dmitriev
M.G. Itkis

Scientific leader: Yu.Ts. Oganessian

Participating Countries and International Organizations:

Belgium, Bulgaria, CERN, China, Czech Republic, Democratic People's Republic of Korea, 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, including the development of the FLNR cyclotron complex, drastic extension of the experimental laboratory bases (new physical facilities), development of accelerator systems in attempts to increase beam intensity and improve the quality of beams of stable and radioactive nuclides in the energy range from 5 to 100 MeV/nucleon with a view to significantly improve the efficiency of experiments on synthesis and study of the properties of new superheavy elements, extend experimental programme with beams of radioactive nuclides, improve accelerator stability and reduce their energy consumption.

Expected results in 2016:

- Development of the infrastructure of a new fragment separator ACCULINNA-2. Conducting test experiments at the ACCULINNA-2 fragment separator (U-400M cyclotron) using beams of light ions with energies of 30 to 50 MeV/nucleon.
- Conducting experiments with beams of medium-mass ions at 6-15 MeV/nucleon at the U-400M cyclotron.
- Production of intense beams of highly charged ions heavier than Xe, using the superconducting ion source and U-400M cyclotron.
- Implementation of the experimental programme on synthesis of new isotopes in the region of superheavy elements using a Cf target at the U-400 cyclotron.
- Implementation of the research programme on production of ^{50}Ti and ^{58}Fe intense beams at test benches and accelerators with a view to prepare experiments on synthesis of superheavy elements with $Z > 118$.
- Investigation of the production of beams of exotic ^{6}He ions using electron beam bremsstrahlung. Development of electronics and performing experiments with beams at the MT-25 microtron.
- Development of new methods of beam diagnostics for stable and radioactive nuclides.
- Optimization of transport systems of beams of stable and radioactive nuclides.
- Project development, development and testing of the high-current DC-280 accelerator facilities.
- Development of a new separation facility based on stopping reaction products in gas and their resonance laser ionization.

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. **Development of the U-400M and U0400R complexes**	**B.N. Gikal**	Preparation Data taking
FLNR	P.G. Bondarenko, S.L. Bogomolov, A.V. Reshetov, N.F. Osipov, G.N. Ivanov, S.V. Pashenko, M.V. Habarov, I.V. Kalagin, N.Yu. Kazarinov, I.A. Ivanenko	
LIT	V.V. Korenkov, P.G. Akishin, E.A. Airian	
DLNP	G.A. Karamysheva, E.V. Samsonov, S.B. Vorozhtsov	
VBLHEP	S.A. Kostromin, A.A. Fateev, N.I. Lebedev	
LRB	V.E. Aleynikov	
2. **ECR ion sources development**	**S.L. Bogomolov**	Preparation
FLNR	A.A. Efremov, G.N. Ivanov, V.Ya. Lebedev, V.V. Behterev, N.Yu. Yazvitskiy	
VBLHEP	E.D. Donets, V.M. Drobin	
3. **The MT-25 microtron development**	**S.V. Mitrofanov**	Preparation Data taking
FLNR	A.G. Belov, Yu.G. Teterev, S.V. Pashenko, M.V. Habarov, N.F. Osipov, V.A. Semin	
4. **Development of a new FLNR experimental hall**	**G.G. Gulbekian**	Preparation
FLNR	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, K.Yu. Kazchishin	
5. **Development of the fragment separator ACCULINNA-2 project**	**A.S. Fomichev**	Preparation
FLNR	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, A.G. Knyazev, V. Chudoba, R. Wolski	
6. **Development of the VASSILISSA (SHELS) separator**	**A.V. Eremin**	Preparation
FLNR	O.N. Malyshev, A.I. Svirikhin, I.N. Izosimov, V.I. Chepigin, M.L. Chelnokov, A.V. Isaev, V.M. Popov, A.N. Kuznetsov, E.A. Sokol, D.E. Katrasev, V.A. Sbitnev	

7. **Development of the gas catcher project** — **A.M. Rodin** — Preparation

   FLNR: L. Krupa, A.V. Belozerov, S.A. Yukhimchuk, A.V. Guljaeva, V.S. Salamatin, I. Sivachek, S.V. Stepantsov

8. **Creation of a new gas-filled separator** — **A.G. Popeko** — Preparation

   FLNR: O.N. Malyshev, A.I. Svirikhin, A.V. Eremin, A.V. Isaev

9. **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.P. Marinova

10. **Design and creation of a pre-separator for radiochemical SHE studies** — **A.G. Popeko**, **N.V. Aksenov** — Preparation

    FLNR: G.A. Bozhikov, A.V. Sabelnikov, Yu.V. Albin

Collaboration

Country or International Organization	City	Institute or Laboratory
Belgium	Leuven	KU Leuven
	Louvain-la-Neuve	IBA
Bulgaria	Sofia	LTD BAS
		INRNE BAS
CERN	Geneva	CERN
China	Lanzhou	IMP CAS
Czech Republic	Prague	VP
		CU
	Řež	NPI ASCR
Democratic People's Republic of Korea	Yonbyon	IFR SCNR
Egypt	Cairo	AASTMT
		CU
	Shibin al Kawm	MU
France	Caen	GANIL
	Grenoble	LPSC
	Orsay	IPN Orsay
	Vannes	SigmaPhi
	Strasbourg	IPHC
Germany	Darmstadt	GSI
Italy	Catania	INFN LNS
Kazakhstan	Almaty	INP
	Astana	BA INP

Mongolia	Ulaanbaatar	NRC NUM
Poland	Krakow	NINP PAS
	Warsaw	HIL WU
		IEP WU
Romania	Bucharest	IFIN-HH
		N&V
Russia	Moscow	GPI RAS
		ITEP
	Nizhny Novgorod	IAP RAS
	Novosibirsk	BINP SB RAS
	Sarov	VNIIEF
	St. Petersburg	NIIEFA
	Vladimir	ELMAG
Serbia	Belgrade	INS “VINČA”
Slovakia	Bratislava	IP SAS
South Africa	Cape Town	iThemba LABS
Ukraine	Kiev	KINR NASU
Uzbekistan	Samarkand	SSU
USA	College Station, TX	Texas A&M
	Livermore, CA	LLNL
	Nashville, TN	VU
	Oak Ridge, TN	ORNL

03–5–1094–2010/2016	Priority: 1

Status: Approved for completion in 2016

Synthesis and Properties of Nuclei at the Stability Limits

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.

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.

Expected main results in 2016:

- Conducting experiments on synthesis of new isotopes of element 118 as well as neutron-deficient isotopes of Fl and element 115 in reactions with ^{48}Ca ions.
- Preparation of the experiment aimed at detailed spectroscopy of the decay properties of the ^{288}115 isotope and its daughter products, using the modernized separator VASSILISSA (SHELS) + GABRIELA. Conducting model experiments to study the decay properties of the Rf and Db isotopes.
- Preparation and conduct of experiments to study the chemical properties of element 113.
- Data acquisition during mass measurement of the ^{283}Cn isotope produced as a daughter product in the ^{48}Ca + ^{242}Pu reaction using the modernized mass separation system of the MASHA setup. Data acquisition on the mechanisms of complete fusion and multinucleon transfer reactions for nuclei close to the neutron shell closure $N = 126$ using mass-spectroscopic methods.
- Production and study of the properties of new neutron-rich heavy and superheavy nuclei in binary multinucleon transfer processes and quasi-fission. Data acquisition on the properties of nuclei at nucleon drip-lines. Study of multicluster decay of heavy and superheavy nuclei. Development of physical setups.
- Investigation of the structure of the exotic nuclei ^{5}H, ^{10}Li, ^{17}Ne, and ^{27}S using radioactive beams.
- Study of the properties of nuclear reactions with loosely bound cluster nuclei over a broad range of energies (5-25 A MeV). Measurement of individual reaction channel cross-sections leading to the formation of new nuclei at the drip-line. Manufacture of detectors for the high-resolution magnetic analyzer MAVR aimed to register nuclear reaction products.
- Theoretical studies of mechanisms of heavy-ion-induced reactions.
- Development of the knowledge base on nuclear physics accessible through the Internet.
- 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**	**V.K. Utyonkov**	Data taking

	FLNR	F.Sh. Abdullin, A.A. Voinov, A.M. Zubareva, V.I. Krashonkin, A.N. Polyakov, R.N. Sagaidak, V.G. Subbotin, A.M. Sukhov, Yu.S. Tsyganov, I.V. Shirokovsky, M.V. Shumeiko
2.	**α-, β- and γ- spectroscopy of heavy nuclei at the modernized VASSILISSA (SHELS) separator**	**A.V. Yeremin** — Data taking
	FLNR	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
3.	**Chemical properties of superheavy elements**	**S.N. Dmitriev** — Data taking
	FLNR	N.V. Aksenov, V.Ya. Lebedev, Yu.V. Albin, G.A. Bozhikov, V.I. Vakatov, M.G. Voronyuk, G.K. Vostokin, I. Zvara, E.V. Krasnoyarova, Ch.G. Kim, K.V. Lebedev, Z. Myanovska, O.V. Petrushkin, A.V. Rykhlyuk, A.V. Sabelnikov, G.Ya. Starodub, E.E. Tereshatov
4.	**Experiments at the magnetic analyzer of superheavy atoms MASHA**	**A.M. Rodin** — Data taking
	FLNR	L. Krupa, A.V. Belozerov, E.V. Chernusheva, V.Yu. Vedeneev, A.V. Guljaev, A.V. Guljaeva, A.B. Komarov, S. Motychak, A.V. Podshibyakin, V.S. Salamatin, I. Sivachek, S.V. Stepantsov, A.S. Novoselov, S.A. Yukhimchuk
5.	**Study of the processes of fusion-fission, quasi-fission and multinucleon transfer reactions. CORSET-DEMON, CORSAR, and MiniFOBOS setups**	**M.G. Itkis** — Data taking
	FLNR	E.M. Kozulin, A.N. Baranov, A.A. Bogachev, V.V. Volkov, Yu.M. Itkis, S. Ilic, E.M. Gazeeva, G.N. Knyazheva, N.I. Kozulina, K.V. Novikov, D.V. Kamanin, I.A. Alexandrova, A.A. Alexandrov, V.E. Zhuchko, E.A. Kuznetsova, Yu.V. Pyatkov, E.O. Savelieva, Yu.B. Semenov, O.N. Solodov, A.O. Strekalovsky, O.V. Strekalovskiy, J.M. Harka
6.	**Study of the structure of exotic nuclei near and beyond the drip-line at the ACCULINNA and COMBAS fragment separators**	**A.S. Fomichev** — Data taking

FLNR	G.M. Ter-Akopian, M.S. Golovkov, L.V. Grigorenko, A.V. Gorshkov, V.A. Gorshkov, A.G. Knyazev, 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.A. Tarantin, E. Batchuluun	
BLTP	S.N. Ershov, I.A. Egorova	
7. **Investigation of reactions induced by stable and radioactive ion beams leading to the formation of exotic nuclei**	**Yu.E. Penionzhkevich**	Data taking
FLNR	D.T. Aznabaev, E.A. Voskoboinik, 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	
8. **Theoretical studies of nuclear reaction mechanisms**	**A.V. Karpov**	
FLNR	A.S. Denikin, V.V. Samarin, M.A. Naumenko, E.A. Cherepanov, Yu.A. Muzichka, V.A. Rachkov, V.V. Saiko	
9. **Development and maintenance of the knowledge base on nuclear physics accessible through Internet**	**A.V. Karpov** **A.S. Denikin**	Data taking
FLNR	V.V. Samarin, V.A. Rachkov, M.A. Naumenko, V.V. Saiko	
10. **Laser spectroscopy of isotopes**	**S.G. Zemlyanoy**	Data taking
FLNR	V.I. Zhemenik, G.V. Myshinskiy, K.P. Marinova	

Collaboration

Country or International Organization	**City**	**Institute or Laboratory**
Belgium	Brussels	ULB
	Leuven	KU Leuven
Bulgaria	Sofia	INRNE BAS
CERN	Geneva	CERN
China	Beijing	PKU
		CIAE
	Lanzhou	IMP CAS
Czech Republic	Prague	VP
		CTU
	Řež	NPI ASCR
Egypt	Giza	CU
	Shibin al Kawm	MU

Finland	Jyväskylä	UJ
France	Caen	GANIL
	Orsay	CSNSM
		IPN Orsay
	Saclay	SPhN CEA
		DAPNIA
	Strasbourg	CRN
		IPHC
Germany	Berlin	HZB
	Darmstadt	GSI
	Frankfurt/Main	Univ.
	Tübingen	Univ.
	Mainz	JGU
India	Manipal	MU
	Calcutta	VECC
Italy	Catania	INFN LNS
	Legnaro	INFN LNL
	Messina	UniMe
	Naples	Unina
Japan	Tokai	JAEA
	Wako	RIKEN
Kazakhstan	Almaty	INP
	Astana	ENU
Mongolia	Ulaanbaatar	NRC NUM
Poland	Warsaw	UW
	Krakow	NINP PAS
	Poznan	AMU
Romania	Bucharest	IFIN-HH
		UB
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	KRI
		IPTI RAS
	Voronezh	VSU
Slovakia	Bratislava	CU

		IP SAS
South Africa	Stellenbosch	SU
	Cape Town	iThemba LABS
	Pretoria	Unisa
Spain	Huelva	UHU
	Madrid	CSIC
Switzerland	Villigen	PSI
Sweden	Göteborg	Chalmers
Ukraine	Kiev	KINR NASU
United Kingdom	Manchester	UoM
USA	College Station, TX	Texas A&M
	East Lansing, MI	MSU
	Lemont, IL	ANL
	Livermore, CA	LLNL
	Nashville, TN	VU
	Oak Ridge, TN	ORNL

03–2–1100–2010/2018	Priority: 1

Status: Extended

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 2016:

- 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 the GEMMA-II spectrometer at the Kalinin Nuclear Power Plant; getting an upper limit for the neutrino magnetic moment at the level of $\sim 2 \cdot 10^{-11}$ μ_B.
- Forty of FID800 detectors will cumulative fiducial mass 24 kg will be installed in the upgraded EDELWEISS setup. Data taking will be started in order to reach a WIMP-nucleon scattering cross-section sensitivity of $5 \cdot 10^{-45}$ cm^2.
- 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.
- Deployment and extention of the first cluster "Dubna" at Baikal-GVD array. Data taking and extraction of physical results with the detector.
- Investigation of KLL and KMM Auger electrons in ^{65}Zn, ^{67}Cu, ^{67}Ga and ^{152,154,155}Eu decays.
- Design and creation of the low-threshold ($\sim$ 200 eV) HPGe detector. Production of low-background plastic scintillators for the SuperNEMO experiment.
- Design and creation of the reactor antineutrino detector DANSS. Start of data taking.

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)	A.A. Smolnikov	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.E. Kovalenko, 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)**	**A.A. Smolnikov** **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, 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, A.A. Perevalov, E.N. Pliskovski, A.I. Panfilov, B.A. Shaibonov, F.A. Shamakhov, M.V. Shirchenko, A.A. Klimenko, Z. Hons, I.E. Rozova, A.V. Salamatin, A.A. Smagina	

7. **DANSS Project** | **V.B. Brudanin** **V.G. Egorov** | Preparation

DLNP | D.R. Zinatulina, E.A. Shevchik, I.V. Zhitnikov, N.S. Rumyantseva, 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 “MEPhI”
		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

03–2–1101–2010/2016	Priority: 1
	Status: Extended

Physics of Light Mesons

Leader: A.V. Kulikov
Deputy: Z. Tsamalaidze

Participating Countries and International Organizations:

Belarus, Bulgaria, Croatia, Canada, Czech Republic, Georgia, Germany, Italy, Poland, Romania, Russia, Switzerland, USA, Japan.

Scientific Programme

Investigation of strong, weak and electromagnetic interactions of elementary particles and light nuclei at intermediate energies with the aim of determining symmetries and dynamics of the interactions. Development and construction of setups for experiments at accelerators for obtaining new information and testing the present theoretical views in the topics. Development of projects for new experiments and experimental methods for intermediate–energy physics.

Expected main results in 2016:

- Processing of the experimental data for decays $\mu^+ \to e^+\gamma$ and $\pi \to e\nu$.
- Measurements of spin observables at longitudinally and transversely polarized COSY beam. Development of the polarimeter for the experiment on search for electric dipole moment.
- Data taking and data processing for $p + t$ fusion reaction using the muon catalysis method.
- Determination of branching ratios for reaction channels of pion interactions with the helium nucleus at the JINR Phasotron.
- Study of the dynamic behavior of magnetic nanoparticles at the cobalt ferrites by the muon spin rotation technique.
- Experiments with the "Active Target" (GDH).
- Measurement of A_N for the inclusive and exclusive reactions $\pi^- p \to \omega$ (782)n and $\pi^- p \to \eta^{'}$(958)n.
- R&D on thin-wall straw-tubes for experiment COMET. Development, production and tests of the straw detector and electromagnetic calorimeter prototypes with a beam.

List of projects:

	Project	Leader	Priority (period of realization)
1.	SPRING	A.V. Kulikov	1 (2010 – 2016)
2.	GDH&SPASCHARM	Yu. Usov A. Kovalik	1 (2011 – 2016)
3.	COMET	A.V. Kulikov Z. Tsamalaidze	1 (2014 – 2016)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. **SPRING Project**	**A.V. Kulikov**	Data taking Data analysis
DLNP	V.I. Komarov, Yu.N. Uzikov, A.D. Volkov, G. Macharashvili, N. Kadagidze, S.N. Dymov, V.V. Shmakova, T.I. Azaryan, V.S. Kurbatov, D.A. Tsirkov, M.V. Zhabitsky	
2. **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	
3. **COMET Project**	**A.V. Kulikov** **Z. Tsamalaidze**	R&D Realization
DLNP	P.G. Evtukhovich, A.S. Moiseenko, G. Macharashvili, V.G. Kalinnikov, E.P. Velicheva, S.N. Dymov, V.V. Shmakova, A.D. Volkov, V.P. Volnykh, B.M. Sabirov, N. Tsverava, T. Toriashvili, I.L. Evtukhovich, Kh. Khubashvili, E.M. Kulish, M.V. Nikitin, A.G. Samartsev, V.N. Duginov, K.I. Gritsai	
LIT	A. Khvedelidze	
FLNP	A.A. Kustov	
BLTP	G.A. Kozlov	
VBLHEP	S.A. Movchan, S.N. Shkarovsky, V.V. Elsha, T.L. Enik	
4. **Experiment MEG–PEN**	**N.A. Kuchinskiy**	Data processing
DLNP	V.A. Baranov, V.A. Kalinnikov, N.V. Khomutov, A.S. Korenchenko, S.M. Korenchenko, N.P. Kravchuk, E.S Kuzmin, A.S. Moiseenko, A.M. Rozhdestvensky, Z. Tsamalaidze, E.P. Velicheva, V.P. Volnykh, A.S. Khrykin	
BLTP	Yu.M. Bystritsky	
5. **Experiment PAINUC**	**N.A. Russakovich** **G. Piragino**	Data taking Data analysis
DLNP	G.B. Pontecorvo, V.I. Lyashenko, N.S. Angelov, I.A. Belolaptikov, T.D. Blokhintseva, V.N. Frolov, V.M. Grebenyuk, V.E. Kovalenko, A.S. Moiseenko, A.M. Rozhdestvensky, S.A. Gustov	
LIT	V.V. Ivanov	

LRB	V.A. Panyushkin	
VBLHEP	P.N. Batyuk	
6. **Experiment MUON**	**V.N. Duginov** **T.N. Mamedov**	Data taking Data analysis
DLNP	E.I. Bunyatova, K.I. Gritsaj, A.I. Rudenko, G.D. Soboleva	
FLNP	M. Balasoiu + 2 pers.	
7. **Experiment TRITON**	**D.L. Demin**	Data analysis
DLNP	A.M. Artikov, N.S. Azaryan, N.A. Baranova, A.I. Boguslavsky, V.P. Volnykh, K.I. Gritsaj, V.N. Duginov, V.I. Kolomoets, A.D. Konin, A.P. Kustov, N.N. Kashirina, T.N. Mamedov, A.I. Puzynin, A.I. Rudenko, A.V. Simonenko, 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	NC PHEP BSU
		BSU
		IP NASB
		INP BSU
Bulgaria	Sofia	SU
Czech Republic	Prague	CU
	Řež	NPI ASCR
France	Saclay	IRFU
Croatia	Zagreb	RBI
Canada	Vancouver	TRIUMF
Georgia	Tbilisi	HEPI-TSU
Germany	Aachen	RWTH
	Heidelberg	Univ.
	Jülich	FZJ
	Cologne	Univ.
	Dresden	HZDR
	Mainz	JGU
	Münster	Univ.
	Stuttgart	MPI-MF
Italy	Frascati	INFN LNF
	Ferrara	UniFe
	Rome	Univ. "La Sapienza"
	Turin	INFN

Japan	Kyoto	Kyoto Univ.
	Osaka	Osaka Univ.
	Tsukuba	KEK
Poland	Krakow	NINP PAS
	Otwock-Swierk	NCBJ
Romania	Bucharest	IFIN - HH
	Timişoara	CCTFA
Russia	Alexandrov	VNIISIMS
	Gatchina	PNPI
	Dolgoprudny	MIPT
	Moscow	ITEP
		GPI RAS
		SINP MSU
		NRC KI
	Moscow, Troitsk	INR RAS
	Sarov	VNIIEF
Switzerland	Zurich	UZH
	Villigen	PSI
USA	Charlottesville, VA	UVa
	Pittsburgh, PA	Pitt
	Tucson, AZ	UA

03–2–1102–2010/2018	Priority: 1

Status: Extended

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, 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 2016:

- Modernization of the automated beam channel control system of JINR Phasotron.
- Carring out simulation and experimental works on AIC-144 cyclotron increase of the beam extraction factor. Participation in the development of the magnets for the beam transport line to the cabin of the eye melanome therapy.
- Development of conceptual project superconducting cyclotron for the proton therapy.
- Study of nonscaling FFAG accelerator for obtaining high current beams for medical application.

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**	**S.L. Yakovenko** **N.G. Shakun** **L.M. Onischenko**	Realization
	DLNP	A.S. Vorozhtsov, 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	
2.	**Design and modernization of the cyclotrons for medical purpose**	**G.A. Karamysheva** **N.A. Morozov**	Technical proposal
	DLNP	A.S. Vorozhtsov, 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. Kiyan, V.M. Romanov, E.V. Samsonov, V.G Sazonov, A.F. Chesnov, I.M. Sedyh	
	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, N.A. Morozov, E.V. Samsonov, A.F. Chesnov

   VBLHEP — A.S. Kostromin

4. **Development of the cyclotron method for high-current beam acceleration** — **L.M. Onischenko, S.B. Vorozhtsov** — Technical proposal

   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
China	Hefei	IPP CAS
Poland	Krakow	NINP PAS
Uzbekistan	Tashkent	INP AS RUz

03-4-1104-2011/2016	Priority: 1

Status: Approved for completion in 2016

Investigations in the Field of Nuclear Physics with Neutrons

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

Participating Countries and International Organizations:

Albania, Australia, Austria, Belarus, Belgium, Bulgaria, CERN, China, Croatia, Czech Republic, Egypt, Finland, France, Georgia, Germany, Hungary, 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 investigations aimed at studying fundamental properties of the neutron, symmetry breaking effects in neutron-induced reactions, and fundamental interactions of neutrons with nuclei. 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 of the experimental base at the IREN and IBR-2 facilities.

Expected main results in 2016:

Development of the IREN source:

- Commissioning of the second section of the LUE-200 accelerator with the modulator DAWONSYS and clystron TH2129 Thomson.
- Trial operation of the accelerator consisting of two accelerating sections with a beam at a frequency of 25 - 50 Hz .
- Providing the neutron beam time of 1000 hours from IREN for physical experiments.
- Modernization of experimental beamline 4 (flight path 60 m) of the IREN facility.

Fundamental investigations of nuclear reactions with neutrons:

- Measurement of T-odd effects in the low-lying resonance of ^{235}U.
- Measurement of angular correlations of the gamma-ray emission in inelastic scattering of neutrons by various elements in the framework of the TANGRA project.
- Investigation of reactions $^{25}Mg(n,\alpha)^{22}Ne$, $^{91}Zr(n,\alpha)^{88}Sr$ and $^{144}Nd(n,\alpha)^{141}Ce$ for neutron energies E_n = 5 – 6.5 MeV at the facilities EG-5 (FLNP JINR) and EG-4.5 (Institute of High Energy Physics of the Chinese Academy of Sciences). Measurements of the reactions (n,p) and (n,α) for ^{35}Cl and ^{14}N in the energy range of 0.1 – 1 and 4 – 6.5 MeV.
- Commissioning of the data acquisition system based on the PIXIE-4 module for the alpha spectrometer.
- Measurement of the P-odd correlation in the reaction $^{10}B(n,\alpha)^{7}Li$ with an accuracy of 3x10^{-8}.
- Development and construction of a position-sensitive ionization chamber with 32-channel analog electronics; performing of test experiments at IBR-2. Development of a double ionization chamber with a Frisch grid for measurments of spectra and multiplicities of prompt fission neutrons in the reaction ^{235}U(n,f) at IBR-2 and IREN.

- Measurement of proton yields and energy distributions in the ternary fission of ^{252}Cf.
- Determination of parameters of the feromagnetic neutron resonator for neutron energies of 0.062 – 1.3 eV. Measurement of the nuclear precession for protons.
- Completion of the analysis of experimental data from the experiment performed in Dalat (Vietnam) aimed at studying two-step cascades in thermal neutron capture by an Yb-171 target. Determination of the Cooper pair breaking threshold using the developed practical model of cascade gamma-decay.
- Determination of the main characteristics of the massive natural uranium target "Quinta" irradiated by deuterons with energies of 1-8 GeV.

Investigation of fundamental properties of the neutron, UCN physics:

- Detailed test of the dynamical theory of neutron diffraction on a moving grating as a methodical basis of the experiment for testing the equivalence principle for the neutron.
- Experimental determination of characteristics of resonance transitions between quantum states of neutrons in the gravitational field of the Earth using the GRANIT spectrometer.
- Establishing of a constraint on the product of coupling constants of scalar and pseudoscalar axion-like interaction at the level of 10^{-16} for distances $\sim$10 μm on the GRANIT spectrometer.
- Experimental investigation of the properties of different hydrogen- free oil coatings to determine the optimum trap coating material in the neutron lifetime measurement setup being developed.

Applied research:

- Analysis of the boron content in new composite materials by neutron spectroscopy at the IREN facility.
- Comparative analysis of the sensitivity of different non-destructive methods of elemental analysis.
- Investigation of surface layers using Elastic Recoil Detection method and Rutherford Backscattering Spectrometry.
- Mathematical and physical modeling and calibration of neutron and gamma detectors for spacecrafts.
- Development of a new control system for the pneumatic REGATA facility. Improvement of hardware and software for automation of the neutron activation analysis for the REGATA facility at the IBR-2 reactor. Creating a database of nuclear constants for calculation of absolute concentrations of elements using the absolute method in addition to the present relative method of calculation of concentrations.
- Participation in the UN Program on air quality in Europe - simultaneous collection of moss-biomonitors and performing neutron activation analysis on a series of samples from the regions of Russia, Europe and Asia. Application of NAA in bionanotechnology, ecology, medicine and the development of novel materials within Russian and international projects.

List of projects:

	Project	Leader	Priority (period of realization)
1.	TANGRA	Yu.N. Kopatch Deputy: V.M. Bystritsky (DLNP)	1 (2014 – 2016)

List of activities:

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. **Development of the IREN facility**	**V.N. Shvetsov**	Upgrade
FLNP	V.G. Pjataev, V.A. Egorov, + 13 engineers, + 1 workers	
VBLHEP A.P. Sumbaev	V.V. Kobets, V.F. Minashkin, V.G. Shabratov, V.N. Zamrij, A.N. Skrypnik, J. Betscher	
DLNP	I.N. Meshkov	
2. **Development of the beam infrastructure of IREN**	**V.N. Shvetsov**	Upgrade
FLNP	V.G. Pjataev, A.A. Belyakov, P.V. Sedyshev, V.A. Trepalin, + 10 engineers	
3. **Fundamental investigations of nuclear reactions with neutrons**	**Yu.N. Kopatch**	Upgrade Data taking Data analysis
FLNP	G.S. Ahmedov, N.V. Bazjazjina, S.B. Borzakov, Vu Dyk Kong, Vu Dyk Fu, G.V. Daniljan, Ju.M. Gledenov, D.N. Grozdanov, N.A. Gundorin, Sh.S. Zeynalov, A.P. Kobzev, D. Mahajdik, M. Kulik, Zh.V. Mezentseva, V.V. Novitsky, I.A. Oprea, K.D. Oprea, L.B. Pikel'ner, Yu.N. Pokotilovskij, I.N. Ruskov, P.V. Sedyshev, M.V. Sedysheva, V.R. Skoj, A.M. Suhovoj, S.A. Telezhnikov, V.A. Hitrov, M. Tsulaja, Czan Tzjanfu, + 16 engineers, + 2 workers	
LIT	O.V. Zeynalova	
DLNP	V.A. Stolupin	
4. **Investigation of the fundamental properties of the neutron, UCN physics**	**E.V. Lychagin**	Upgrade Data taking Data analysis
FLNP	G.G. Bunatyan, S.V. Goryonov, V.K. Ignatovich, G.V. Kulin, D. Kustov, L.V. Mitsyna, A.Yu. Muzychka, Yu.N. Pokotilovskij, A.B. Popov, A.V. Strelkov, A.I. Frank, W.I. Furman, E.I. Sharapov, T.L. Enik, S.V. Gorunov, + 1 engineer	
5. **Applied research**	**P.V. Sedyshev**	Upgrade Data taking Data analysis

FLNP	M.V. Frontasyeva, S.S. Pavlov, Yu.V. Alekseenok, Sh. Allaybeu, A.S. Vasilev, K.N. Vergel, Z.I. Gorjajnova, A.Ju. Dmitriev, I.I. Zinikovskaja, O.F. Culikov, A. Madadzade, P.S. Nekhoroshkov, A.V. Kravtsova, Doan Fan Thao Tien, G.Y. Khristozova, G.S. Ahmedov, N.V. Bazjazjina, S.B. Borzakov, Vu Dyk Kong, Vu Dyk Fu, Ju.M. Gledenov, N.A. Gundorin, Sh.S. Zeynalov, A.P. Kobzev, Yu.N. Kopatch, M. Kulik, D. Mahajdik, D.V. Magilin, Zh.V. Mezentseva, V.V. Novitsky, I.A. Oprea, K.D. Oprea, L.B. Pikel'ner, I.N. Ruskov, M.V. Sedysheva, V.R. Skoj, A.M. Suhovoj, S.A. Telezhnikov, W.I. Furman, V.A. Hitrov, M. Tsulaja, A. Sijabekov, G.V. Daniljan, + 24 engineers, + 5 workers

6. **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, L.B. Pikelner, A.V. Rogachev, P.V. Sedyshev, U.R. Skoi, U.N. Shvetcov
VBLHEP	U.Yu. Aleksakhin, U.I. Zamjatin, E.U. Zubarev, U.L. Rapackii, Yu.N. Rogov, R.A. Salmin, M.G. Sapozhnikov, U.V. Slepnev, S.U. Khabarov
DLNP	U.M. Bystritskii, A.U. Krasnoperov, A.U. Sadovskii, A.U. Salamatin
LRB	A.R. Krylov, G.N. Timoshenko

Collaboration

Country or International Organization	City	Institute or Laboratory
Albania	Tirana	UT
Australia	Melbourne	Univ.
Austria	Vienna	IAEA
	Innsbruck	Univ.
Belarus	Minsk	INP BSU
		SPMRC NASB
Belgium	Geel	IRMM
Bulgaria	Sofia	INRNE BAS
	Plovdiv	PU
		UFT
CERN	Geneva	CERN
China	Beijing	IHEP CAS
Croatia	Zagreb	RBI
		Oikon IAE
Czech Republic	Prague	CEI
		CTU
	Ostrava	VSB-TUO

		UO
Egypt	Alexandria	Univ.
	Cairo	EAEA
	Shibin al Kawm	MU
Finland	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.
Hungary	Budapest	RKK OU
Italy	Rome	ENEA
Japan	Kyoto	KSU
	Tsukuba	KEK
Kazakhstan	Almaty	INP
	Astana	ENU
	Ust-Kamenogorsk	TRCE
Macedonia	Skopje	UKiM
Moldova	Chişinău	IMB ASM
		IC ASM
Mongolia	Ulaanbaatar	CGL
		NRC NUM
Norway	Trondheim	NTNU
Poland	Gdansk	GUT
	Krakow	NINP PAS
	Lodz	UL
	Lublin	UMCS
	Opole	UO
	Otwock-Swierk	NCBJ
	Poznan	AMU
	Wroclaw	UW
Republic of Korea	Pohang	PAL
	Seoul	Dawonsys
	Taejon	KAERI
Romania	Bucharest	IFIN-HH
		ISS
		UB

	Baia Mare	TUCN-NUCBM
	Constanţa	NIMRD
		UOC
	Galaţi	UG
	Iaşi	UAIC
	Oradea	UO
	Piteşti	SCN
	Râmnicu Vâlcea	I.C.S.I.
	Târgovişte	UVT
Russia	Moscow	Atomenergomach
		GIN RAS
		IKI RAS
		IPCE RAS
		ITEP
		MSU
		NRC KI
		SINP MSU
		GPI RAS
	Moscow, Troitsk	INR RAS
	Borok	IBIW RAS
	Dubna	Dubna Univ.
	Gatchina	PNPI
	Irkutsk	LI SB RAS
	Ivanovo	ISUCT
	Izhevsk	UdSU
	Obninsk	IPPE
	Snezhinsk	VNIITF
	St. Petersburg	Botanic garden
		BIN RAS
		FIP
		SPSFTU
		Hermitage
		KRI
	Sevastopol	IBSS
	Tomsk	NPI TPU
	Tula	TSPU
	Voronezh	VSU
	Yekaterinburg	UrFU
Serbia	Belgrade	IPB
		Univ.
	Novi Sad	UNS
Slovakia	Bratislava	IP SAS
		IEE SAS
		ILE SAS
		CU

Slovenia	Ljubljana	GeoSS
South Africa	Pretoria	Unisa
	Stellenbosch	SU
	Bellville	UWC
Switzerland	Villigen	PSI
Thailand	Hat Yai	PSU
Turkey	Çanakkale	ÇOMU
Ukraine	Kiev	KINR NASU
		NUK
	Donetsk	DonIPE NASU
	Sumy	IAP NASU
	Uzhgorod	IEP NASU
	Kharkov	ISMA NASU
		KFTI
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)

04-4-1121-2015/2017	Priority: 1

Status: In-progress

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, 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 fields of electronics, pharmacology, medicine by neutron scattering and complimentary methods.

Expected main results in 2016:

Realization of the 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.
- Analysis of nanoscale effects on structural and magnetic properties of colossal magnetoresistance manganities.
- Determination of atomic and magnetic structure parameters of oxide multiferroics.
- Revealing of structural modifications of electrodes of compact electric current sources during charging/discharging processes.
- Analysis of magnetic properties and proximity effects in magnetic layered nanostructures in constant and variable magnetic fields.
- Comparative analysis of structural aspects of stabilization of disperse systems and complex liquids with nonmagnetic and magnetic nanoparticles in bulk and interface boundaries.
- Determination of structural characteristics of nanosystems based on compositional C- and Si-containing materials.
- 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.
- Determination of structural and functional characteristics of biological nanosystems.
- Determination of structural characteristics of lipid nanosystems modeling upper skin layer of human and mammal animals in order to study the transport of pharmacological drugs through the skin.

- Determination of regularities of occurrence of instability of rocks under high temperatures and pressures, in particular, during polymorphic phase transition for the development of models of the processes in the earthquake focus.
- Analysis of metamorphic, geodynamic and evolution processes in the lithosphere using the data about the texture of deep and near-surface earth rocks. Exploration of seismic anisotropy origin.
- Development of solid polycrystalline material models for prediction of their elastic, strength and thermal properties taking into account texture, inclusions, pores and microcracks.
- Determination of residual stresses in engineering materials of nuclear reactors, industrial materials and products – composites, reinforced systems, metalloceramicas, shape memory alloys.
- Elaboration of radiation damage mechanisms of solid-state materials, obtaining of long-life operating data on radiation resistance of materials.

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

- Creation of the final configuration of the DN-6 diffractometer and relevant infrastructure (detector system, mechanical units, set of high-pressure cells, infrastructure for loading pressure cells).
- Creation of the final configuration of the multifunctional reflectometer GRAINS (polarizing system, mechanical part and sample unit).
- Modernization of the available IBR-2 spectrometers (HRFD, 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).
- Completion of the reconstruction of the high-intensity DN-2 diffractometer into a real-time diffractometer (RTD).
- Creation of the test configuration of the small-angle spin-echo spectrometer on IBR-2 beamline 9.
- Creation of the basic configuration of the neutron radiography and tomography spectrometer on IBR-2 beamline 14.
- Installation and adaptation of the correlation spectrometer FSS (transported from HZG, Germany, via PNPI) to methodological and research activities on IBR-2 beamline 13.
- Development and testing of neutron scattering methods for condensed matter research including spin-echo, neutron standing waves, neutron magnetic resonance, radiography, tomography, etc.

List of projects:

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

List of activities:

	Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1.	**Study of structure and properties of novel functional materials**	**A.M. Balagurov** **D.P. Kozlenko**	Data taking

	FLNP	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, A.I. Madadzada, G.M. Mironova, D.T. Neov, T.T. Nguen, A. Pawlukojc, A.V. Rutkauskas, N.Yu. Samoylova, S.G. Sheverev, V.A. Turchenko, U. Enhnaran, M.T. Vu	
2.	**Study of structure and properties of materials under extreme conditions**	**D.P. Kozlenko**	Data taking
	FLNP	S.E. Kichanov, B.N. Savenko, E.V. Lukin, A.V. Rutkauskas, M.T. Vu, T.T. Nguen	
3.	**Study of fundamental regularities of real time processes in condensed matter**	**A.M. Balagurov**	Data taking
	FLNP	A.I. Beskrovnyi, I.A. Bobrikov, O.Yu. Ivanshina, G.M. Mironova, N.Yu. Samoylova, V.G. Simkin, U. Einhnaran, S.G. Sheverev	
4.	**Computer modeling of physical and chemical properties of novel crystalline and nanostructured materials**	**A. Pawlukojc**	Data taking
	FLNP	K.S. Druzbicki, V.Yu. Kazimirov, K.M. Luczynska, J.M. Nowicka-Scheibe, D.M. Chudoba	
5.	**Study of magnetic properties of layered nanostructures**	**Yu.V. Nikitenko**	Data taking
	FLNP	S.V. Kozhevnikov, E.B. Dokukin, V.D. Zhaketov	
6.	**Study of structural characteristics of carbon- and silicon-based nanomaterials**	**V.L. Aksenov**	Data taking
	FLNP	T.V. Tropin, O.A. Kizima, A.A. Tomchuk, Zh. Narmandah	
7.	**Investigation of structure and molecular dynamics of biologically active materials and molecular ionic crystals**	**D.M. Chudoba**	Data taking
	FLNP	P. Bilski, K.S. Druzbicki, E. Goremychkin, K.M. Luczynska, M. Ordon, A. Pawlukojc, I.L. Sashin, A. Filarowski	
8.	**Study of dispersed systems and complex liquids in bulk and at interface boundaries**	**M.V. Avdeev**	Data taking
	FLNP	V.I. Petrenko, K.T. Kholmurodov, A.V. Nagornyi, A.V. Tomchuk, I.V. Gapon	
9.	**Structural characterization of polymer nanodispersed materials**	**M. Balasoiu**	Data taking
	FLNP	A.I. Kuklin, A.Kh. Islamov, O. Ivan'kov, D.V. Solovyev, A.V. Rogachev	

10. **Study of supramolecular structure and functional characteristics of biological materials** — **A.I. Kuklin** — Data taking

    FLNP: A.Kh. Islamov, T.N. Murugova, M. Balasoiu, A. Raewska, Yu.E. Gorshkova, O. Ivan'kov, R.V. Erhan, D.V. Solovyev, Yu.S. Kovalev, A.V. Rogachev

    LIT: D.V. Solovyev, T.V. Solovyeva

11. **Study of structure and properties of lipid membranes and lipid complexes** — **M.A. Kiselev** — Data taking

    LIT: E.V. Zemlyanaya, E.I.Zhabitskaya

12. **Study of texture and physical properties of Earth's rocks, minerals and engineering materials** — **Ch. Scheffzuek**, **D.I. Nikolaev** — Data taking

    FLNP: R.N. Vasin, T.I. Ivankina, V.V. Sikolenko, T.A. Lychagina, I.Yu. Zel', B. Altangerel

13. **Non-destructive control of residual stresses in industrial products and engineering materials** — **G.D. Bokuchava** — Data taking

    FLNP: V.V. Sumin, R.N. Vasin, I.V. Papushkin, A.A. Kruglov, A.V. Tamonov, B. Muhametuly, Yu.V. Taran, D.M. Levin

14. **Neutron imaging of internal structure of industrial products, rocks and natural heritage objects** — **D.P. Kozlenko**, **G.D. Bokuchava** — Data taking

    FLNP: B.N. Savenko, S.E. Kichanov, E.V. Lukin, A.V. Rutkauskas

15. **Study of radiation damage effects in condensed matter by X-ray spectroscopy** — **S.I. Tyutyunnikov (VBLHEP)** — Data taking

    VBLHEP: V.N. Shalyapin, V.V. Efimov, E.A. Efimova, Yu.S. Kovalev, A.V. Rogachev, N.I. Zamyatin, I.A. Kryachko

16. **Development of neutron scattering methods for interdisciplinary studies of nanosystems and materials** — **V.I. Bodnarchuk**, **G.D. Bokuchava**, **D.P. Kozlenko** — Data taking

    FLNP: S.V. Kozhevnikov, Yu.V. Nikitenko, S.P. Yaradaikin, S.E. Kichanov, E.V. Lukin

17. **Development of the IBR-2 spectrometer complex** — **A.M. Balagurov**, **D.P. Kozlenko** — Realization

    FLNP: M.V. Avdeev, A.I. Beskrovnyi, I.A. Bobrikov, A.I. Kuklin, V.I. Bodnarchuk, D.M. Chudoba, A.S. Doroshkevich, Yu.V. Nikitenko, A.V. Petrenko, B.N. Savenko, I.L. Sashin, V.G. Simkin, V.I. Sukhanov, G.D. Bokuchava, Ch. Scheffzuek

Collaboration

Country or International Organization	City	Institute or Laboratory
Argentina	Bariloche	CAB CNEA
Azerbaijan	Baku	IP ANAS
Belarus	Minsk	IAP NASB
		INP BSU
		NC PHEP BSU
		SPMRC NASB
		RI PCP BSU
Bulgaria	Sofia	IE BAS
		IEES BAS
		IMS BAS
		INRNE BAS
		ISSP BAS
Czech Republic	Prague	CTU
		IG ASCR
		IMC ASCR
		IP ASCR
	Řež	NPI ASCR
Egypt	Cairo	EAEA
	Cairo	CU
France	Saclay	LLB
	Grenoble	IBS
Germany	Berlin	HZB
		BAM
	Bayreuth	Univ.
	Bochum	RUB
	Darmstadt	TU Darmstadt
	Dortmund	TU Dortmund
	Dresden	TU Dresden
	Göttingen	Univ.
	Geesthacht	GKSS
	Halle	MLU
	Hamburg	DESY
	Freiberg	TUBAF
		IMF TUBAF
	Jülich	FZJ
	Karlsruhe	KIT
	Kiel	CAU
		IFM-GEOMAR
	Leipzig	UoC
	Potsdam	GFZ
	Rostock	Univ.
	Stuttgart	MPI-FKF

Hungary	Budapest	Wigner RCP
	Szeged	US
Japan	Nagano	Shinshu Univ.
	Minato	Keio Univ.
Italy	Trento	UniTn
Latvia	Riga	ISSP UL
		IPE
Moldova	Chişinău	IC ASM
		IMB ASM
Kazakhstan	Rudny	RII
Mongolia	Ulaanbaatar	IPT MAS
		MUST
Norway	Trondheim	NGU
Poland	Warsaw	INCT
	Krakow	JU
		NINP PAS
	Lublin	UMCS
	Olsztyn	UWM
	Poznan	AMU
	Siedlce	UPH
	Szczecin	WPUT
	Wroclaw	WUT
		UW
Romania	Bucharest	IFIN-HH
		INCDIE ICPE-CA
		NIMP
		ISS
		UB
		UPB
		UMF
		UTM
	Baia Mare	TUCN-NUCBM
	Constanţa	UOC
	Craiova	UC
	Cluj-Napoca	INCDTIM
		RA BC-N
		UBB
	Iaşi	NIRDTP
		UAI
		UAIC
	Piteşti	SCN
	Timişoara	LMF CCTFA
		UPT
		UVT
Russia	Moscow	GC 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
		MSU
		NIKIET
		NRC KI
		SINP MSU
		SC “VNIINM”
	Moscow, Troitsk	HPPI RAS
		ISAN
		INR RAS
	Belgorod	BelSU
	Dolgoprudny	MIPT
	Chernogolovka	ISSP RAS
	Gatchina	PNPI
	Kazan	KNRTU
	Krasnoyarsk	SibFU
	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	IChem ASRT
Taiwan	Hsinchu	NSRRC
Ukraine	Kiev	IPMS NASU
		NUK
		ISC NASU
	Donetsk	DonNU
		DonIPE NASU
	Kharkov	IERT NASU
		KFTI
United Kingdom	Didcot	RAL
Uzbekistan	Tashkent	INP AS RUz
Vietnam	Hanoi	IOP VAST
	Da Nang	DTU

04-4-1105-2011/2016	Priority: 1

Status: Approved for completion in 2016

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:

Azerbaijan, Mongolia, Poland, Romania, Russia, United Kingdom, USA.

Scientific Programme

The theme main task is to increase the efficiency of 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 2016:

- Maintenance of the IBR-2 reactor operation for physical investigations.
- Manufacturing of a reserve movable reflector MR-3R (with the extension of work through 2018).
- Construction of a test stand of a cryogenic moderator CM-201.
- Step-by-step replacement and upgrading of the technological and electrical equipment in accordance with the Rostechnadzor license requirements.

List of projects:

	Project	Leader	Priority (period of realization)
1.	Construction of a Complex of Cryogenic Moderators at the IBR-2 Facility	A.A. Belyakov	1 (2014 – 2016)

List of activities:

	Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1.	**Regular operation of the IBR-2 facility**	**A.V. Dolgikh** **A.V. Vinogradov**	Realization
	FLNP	A.A. Belykov, S.A. Tsarenkov, V.G. Ermilov, S.V. Rudenko, Yu.N. Pepelyshev, V.A. Trepalin, + 30 engineers, + 50 workers	
2.	**Maintenance of the program of physical investigations**	**V.D. Ananiev** **A.V. Vinogradov** **A.V. Dolgikh**	Realization
	FLNP	A.A. Belyakov, Yu.N. Pepelyshev, V.A. Trepalin, S.V. Rudenko, + 30 engineers, + 50 workers	

3. **Experiments on a test stand of the cryogenic moderator CM-201. Development of a project, production and installation of the new cryogenic moderator CM-201 (with the extension of work to 2017). Design study of the cryogenic moderator CM-203. Mastering of the equipment of cryogenic moderators using a new cryogenic facility by "Linde"** — **A.A. Belyakov, K.A. Mukhin** — Realization

   FLNP — V.D. Ananiev, S.A. Kulikov, E.P. Shabalin, + 15 engineers, + 15 workers

4. **Manufacturing of a reserve movable reflector MR-3R** — **A.V. Vinogradov, A.V. Dolgikh** — Realization

   FLNP — A.A. Belyakov, V.D. Ananiev, + 5 engineers, + 5 workers

5. **Step-by-step replacement and upgrade of basic technological and electrical equipment** — **A.V. Vinogradov, A.V. Dolgikh** — Realization

   FLNP — A.A. Belyakov, A.V. Trepalin, + 30 engineers, + 50 workers

Collaboration

Country or International Organization	City	Institute or Laboratory
Azerbaijan	Baku	IRP ANAS
Mongolia	Ulaanbaatar	MUST
Poland	Krakow	AGH-UST
Romania	Bucharest	IFIN-HH
Russia	Moscow	NIKIET
		Geliymash
		INEUM
		SYSTEMATOM
		SSDI
United Kingdom	Didcot	RAL
USA	Indianapolis, IN	IUPUI

04-4- 1122-2015/2017	Priority: 1

Status: In-progress

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:

Bulgaria, Czech Republic, France, Germany, Hungary, Republic of Korea, Romania, Russia, Slovak Republic, Ukraine, United Kingdom.

Scientific Programme

Development and construction of a control system of the cryogenic moderator CM-201 for IBR-2 beams № 1, 4, 5, 6, 9. Design of equipment, electronics and software for the complex of IBR-2 spectrometers; the 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 2016:

- Testing, operation and development of the cryogenic moderator CM-202 with control and monitoring systems. Investigation of mechanical, gas-dynamic, radiation and neutron-physical properties of new advanced materials for cold moderators on a test stand of CM-201 and a radiation research facility. Carrying out of experiments to study radiation resistance of materials and electronics.
- Development of engineering design of the ASTRA-M detector system for the FSD spectrometer. Putting into service of 2D PSD at the RTD and REMUR spectrometers. Development of methods for increasing the service life of MWPC-based PSD operating in direct beams of the IBR-2 reactor.
- Implementation of the project "Development of PTH sample environment system for the DN-12 diffractometer at the IBR-2 facility" (manufacturing of a magnet using HTSC tape and its installation into a cryostat; cryostat testing under laboratory conditions). Modernization of the cryostat on the RTD spectrometer.
- Putting into operation of new systems of sample temperature control at the HRFD, RTD and REMUR spectrometers. Introduction of devices for vertical and horizontal adjustment of detectors and their integration into the control system of actuators of the YuMO spectrometer.
- Development and manufacturing of new control and data acquisition electronics and putting into operation of a control system of the Fourier chopper for the FSS spectrometer.
- Development and application of the VITESS software package: simulation of reflectometric and GISANS experiments within the kinematic approximation; simulation of diffraction and diffuse scattering for thin films (including multilayer) with regular and rough surfaces.
- Development of the Sonix+ software package: its adaptation to 64-bit version of Windows and version 3 of the Python language; addition of programs for maintenance of new equipment at the request of users.
- Installation of a backup LAN server.

List of projects:

	Project	Leader	Priority (period of realization)
1.	Development of PTH sample environment system for the DN-12 diffractometer at the IBR-2 facility	A.N. Chernikov	1 (2015 – 2017)

List of activities:

	Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1.	**Development of a control system of CM-201 moderator for neutron beams № 1, 4, 5, 6, 9**	**S.A. Kulikov** **E.P. Shabalin**	Realization
	FLNP	M.V. Bulavin + 5 engineers, + 7 workers, A.S. Kirilov + 2 engineers, A.P. Sirotin + 2 engineers	
2.	**Calculations and simulation of spectrometers' elements. Development of the VITESS software package**	**A.V. Belushkin**	Realization
	FLNP	E S.A. Manoshin, S.A. Kulikov + 2 engineers	
3.	**Development and manufacturing of new control and data acquisition electronics for the FSS spectrometer**	**A.A. Bogdzel** **A.P. Sirotin**	Realization
	FLNP	F.V. Levchanovsky + 2 engineers, N.D. Zernin	
4.	**Development and implementation of gas-filled and scintillation detectors at the IBR-2 spectrometers**	**A.V. Belushkin** **S.A. Kulikov**	Realization
	FLNP	M.V. Avdeev, G.D. Bokuchava, A.I. Kuklin + 2 engineers, A.V. Churakov + 3 engineers, A.A. Bogdzel + 4 engineers, V.V. Zhuravlev, V.V. Kruglov, A.S. Kirilov + 1 engineer	
5.	**Development of data acquisition, control and experiment automation systems, as well as of Sonix+ software package at the IBR-2 spectrometers**	**V.I. Prikhodko** **A.P. Sirotin** **A.S. Kirilov**	Realization
	FLNP	A.A. Bogdzel + 2 engineers, F.V. Levtchanovsky + 2 engineers, V.V. Zhuravlev + 3 engineers, S.M. Murashkevich + 2 engineers	
6.	**Creation of a cloud polygon "neutron physics" in cooperation with LIT; carrying out computations using IaaS and SaaS services. Development of FLNP network infrastructure in accordance with the development strategy of the JINR computer network**	**S.A. Kulikov** **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
Bulgaria	Sofia	INRNE BAS
Czech Republic	Řež	NPI ASCR
France	Grenoble	ILL
	Saclay	LLB
Germany	Berlin	HZB
	Heidelberg	Univ.
	Magdeburg	OVGU
	Munich	TUM
	Karlsruhe	KIT
	Zeuthen	DESY
	Jülich	FZJ
Hungary	Budapest	Wigner RCP
Republic of Korea	Daejeon	NFRI
Romania	Bucharest	INCDIE ICPE-CA
		IFIN-HH
	Târgovişte	UVT
Russia	Moscow	NNRU "MEPhI"
		NRC KI
	Moscow, Troitsk	INR RAS
	Gatchina	PNPI
	Yekaterinburg	IMP UB RAS
	Nizhny Novgorod	IPM RAS
Slovakia	Bratislava	IMS SAS
Ukraine	L'viv	LPNU
United Kingdom	Didcot	RAL

04–4–1111–2013/2017	Priority: 1

Status: In-progress

Multimodal Platform for Raman and Nonlinear Optical Microscopy and Microspectroscopy for Condensed Matter Studies

Leader:

G.M. Arzumanyan

Participating Countries and International Organizations:

Armenia, Belarus, Germany, Latvia, Moldova, Poland, Romania, Russia, France.

Scientific Programme

Experimental studies of condensed matter by Raman, CARS (coherent antiStokes Raman spectroscopy), and SERS (surface-enhanced Raman spectroscopy) spectroscopy and microscopy. Research of structural and optical properties, surface morphology and other characteristics of condensed matter on the multimodal optical platform constructed on the basis of the confocal laser scanning microscope "CARS". Special attention will be given to the spectral-structural studies of membrane proteins using coherent and surface-enhanced Raman spectroscopy. The other research direction deals with up-conversion luminescence studies in different matrices (glass, glass-ceramics, films) activated by various rare-earth elements.

Expected main results in 2016:

- Structural and up-conversion luminescent properties of transparent oxyfluoride glass-ceramics doped with Eu3+, Tm3+, Yb3+.
- Study of luminescence in optically transparent and chemically stable rare-earth doped ZnO nanocrystals.
- Development of an alternative method of second order nonlinear imaging of chiral crystals (SONICC) on the multimodal optical platform.
- Highly selective spectral imaging of bacteriorhodopsin crystals using SONICC, Raman and CARS microscopy. Nanoplasmonic enhancement (10^{-5}-10^{-6}) of Raman scattering (SERS) applied to various bio-samples. Determination of internal components of membrane protein in meso crystals using Raman, SERS and CARS spectroscopy and microscopy.

List of projects:

	Project	Leader	Priority (period of realization)
1.	Multimodal platform for Raman and nonlinear optical microscopy and microspectroscopy for condensed matter studies	N. Kučerka Deputy: V.I. Gordeliy	1 (2015 – 2017)

List of activities:

	Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1.	**A complex study of structural and spectral properties of oxyfluoride glasses and nanoglassceramics doped with various rare earth elements (REE)**	**G.M. Arzumanyan**	Realization

	FLNP	V. Vartic, E.A. Kuznetsov, A.A. Kapitonova	
2.	**Up-conversion luminescence studies of sitalls based on nanoscale ZnO crystals**	**G.M. Arzumanyan**	Realization
	FLNP	V. Vartic, E.A. Kuznetsov, I.N. Melkova	
3.	**Development of methodology aimed at visualization and enhancement of the Raman scattering signal from biomolecules using CARS and SERS spectroscopy**	**G.M. Arzumanyan** **N. Kučerka**	Data taking
	FLNP	K.Sh. Voskanyan, K. Mamatkulov, N.V. Doroshkevich, M. Balasoiu, + 1 engineer	
4.	**Development of an alternative nonlinear optical imaging method SONICC for protein crystals**	**G.M. Arzumanyan**	Data taking and realization
	FLNP	N.V. Doroshkevich, K. Mamatkulov	
5.	**Creation of in meso crystallization concept based on the Raman, CARS and SANS investigations of the mechanisms of membrane proteins crystallization.**	**G.M. Arzumanyan** **N. Kučerka** **V.I. Gordeliy**	Realization
	FLNP	K.Sh. Voskanyan, N.V. Doroshkevich, K. Mamatkulov, A.I. Kuklin, + 1 engineer	
6.	**Upgrade of the software and development of the instrumental infrastructure of the optical platform to expand its capabilities and increase the measurement sensitivity.**	**G.M. Arzumanyan** **N. Kučerka**	Realization
	FLNP	K. Mamatkulov, A.A. Kapitonova	

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	Inst. Physiology NAS RA
Belarus	Minsk	BSUIR
		SOL instruments
Germany	Jülich	FZJ
Latvia	Riga	ISSP UL
Moldova	Chişinău	IEEN ASM
		TUM

Poland	Lublin	UMCS
Russia	Moscow	PFUR
	Moscow, Zelenograd	NT-MDT Co.
	Dolgoprudny	MIPT
	St. Petersburg	NITIOM
Romania	Bucharest	IFIN-HH
		UPB
France	Grenoble	IBS

04-5-1076-2009/2016	Priority: 1

Status: Approved for completion in 2016

Radiation Effects and Physical Basis of Nanotechnology, Radioanalytical and Radioisotope Investigations at the FLNR Accelerators

Leaders: S.N. Dmitriev
P.Yu. Apel

Participating Countries and International Organizations:

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

Scientific Programme

Study of the effects produced by heavy ions in matter for potential applications of ion beams in nanoscience and nanotechnology. Work related to life sciences: production of ultrapure isotopes and study of the properties of radionuclides of practical importance. Upgrade of the FLNR accelerator complex to produce medical isotopes and develop methods of material modification.

Expected main results in 2016:

- Study of radiation stability of TiNZrN ceramics irradiated with high-energy heavy ions.
- Estimation of temperature dependence of structural changes induced by heavy ions of fission fragment energy in nanoparticles in ODS (oxide dispersion strengthened) alloys.
- Influence of synergistic effect of radiation defects and impurities on the development of helium, deuterium, and hydrogen blisters in silicon.
- Detailed study of the structure of track membranes in the nanometer range using high-resolution scanning electron microscopy.
- Development of a fabrication method and study of the properties of track membranes with several pore arrays and a selective layer.
- Study of surface and electric transport properties of composite track membranes with a hydrophobic layer.
- Methodological developments of synthesis and radiochemical separation of radionuclides which have great potential in nuclear medicine (^{195m}Pt, ^{117m}Sn, ^{227}Th, ^{225}Ac, ^{213}Bi). Radioecological studies (analysis and study of radionuclide distribution in ecosystems).
- Development of fabrication methods of SERS-active sensors based on immobilization of silver nanoparticles, thermal evaporation of metal and insulator layers on the track membrane surface and investigation of their efficiency.

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**	**V.A. Skuratov** **P.Yu. Apel**	Data taking
	FLNR	A.Yu. Didyk, V.K. Semina, O.L. Orelovich, V.V. Shirkova, A.N. Nechaev, I.V. Blonskaja, L.I. Kravets, O.M. Ivanov, V.A. Kuzmin, V.A. Altynov	
	LIT	I.V. Amirhanov, I.V. Puzynin, V.N. Robuk, E.G. Nikonov	
2.	**Investigation of materials using ECR ion source**	**V.F. Reutov**	Preparation
	FLNR	V.F. Reutov, A.S. Sokhatsky	
3.	**Production of ultra-pure isotopes**	**S.N. Dmitriev**	Data taking
	FLNR	O.D. Maslov, G.Ya. Starodub, A.V. Sabelnikov, Yu.V. Albin, G.A. Bozhikov, G.K. Vostokin, M.V. Gustova, T.P. Drobina	
4.	**Radioanalytical studies**	**O.D. Maslov**	Data taking
	FLNR	O.D. Maslov, N.G. Zaitseva	
5.	**Design of accelerator complexes for nuclear medicine and radiation physics**	**S.N. Dmitriev** **A.A. Chumbalov**	Preparation Manufacturing
	FLNR	B.N. Gikal, I.V. Kolesov, A.A. Chumbalov	

Collaboration

Country or International Organization	City	Institute or Laboratory
Belarus	Minsk	BSU
		BSTU
		NC PHEP BSU
		RIAPP BSU
		IOMR
	Gomel	GSU
Bulgaria	Plovdiv	PU
China	Beijing	Beijing Fert Co
Czech Republic	Řež	NPI ASCR
Germany	Darmstadt	GSI
	Quedlinburg	IST
		MiCryon Technik
Hungary	Budapest	ELTE

Kazakhstan	Almaty	INP
	Astana	BA INP
		ENU
		NU
Moldova	Chişinău	IAP ASM
Mongolia	Ulaanbaatar	NRC NUM
Poland	Warsaw	INCT
		ITR
	Otwock-Swierk	NCBJ
	Lublin	UMCS
	Torun	UMK
Russia	Moscow	IC RAS
		ISPM RAS
		ITEP
		GPI RAS
		LPI RAS
		MATI
		SINP MSU
		TIPS RAS
	Dubna	Trackpore Technology
		IINC
	Chernogolovka	ISSP RAS
	Kaliningrad	IKBFU
	Kazan	KNRTU
	Novosibirsk	ISP SB RAS
	St. Petersburg	IPTI RAS
	Saratov	SSMU
Serbia	Belgrade	INS “VINČA”
Romania	Bucharest	INFLPR
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	NPL
USA	Ann Arbor, MI	U-M
	Knoxville, TN	UTK
	Oak Ridge, TN	ORNL
	Stanford, CA	SU

04–9–1077–2015/2017	Priority: 1

Status: In-progress

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, Belarus, Bulgaria, Czech Republic, Egypt, Italy, Moldova, Mongolia, Poland, Romania, Russia, Slovak Republic.

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 the initiation of molecular disorders in the DNA structure and their repair; and radiation-induced apoptosis in human cells under exposure to radiations with different linear energy transfer (LET).
- Decoding of the mechanisms underlying cell hypersensitivity and hyperresistance to low doses of ionizing radiation.
- Acquisition of comparative data on the regularities of the induction of gene and structural mutations in mammalian and lower eukaryote cells by sparsely and densely ionizing radiations with different LET.
- Research on the mechanisms of the induction of retinal damage by heavy charged particles (HCP) and its repair.
- Research on the character of the HCP-induced damage of central nervous system (CNS) cells and regularities of their death. Identification of HCP-induced functional and morphological disorders in the CNS.
- Mathematical modeling of the effects induced by ionizing radiations with different LET at the molecular and cellular levels. Development and analysis of mathematical models of the molecular mechanisms of CNS structural and functional disorders induced by ionizing radiations.
- Calculation of the radiation shielding of new nuclear physics facilities; evaluation of the radiation environment and development of radiation safety systems.

Expected main results in 2016:

- To continue studying regularities in the induction, formation, and repair kinetics of HCP-induced clustered DNA double-strand breaks (DSBs) in human skin fibroblast nuclei.
- To study the expression of the genes encoding the proteins RAD51, DNA PKcs, NBS1, and MRE11, which participate in HCP-induced damage repair in human fibroblasts.
- To continue studying radiation-induced apoptosis mechanisms and different ways of HCP-induced DNA damage repair. To study the expression of the genes that encode the proteins and caspases participating in apoptosis induction in human fibroblasts by HCP.
- Using a Synergy H1m microplate reader, to evaluate the level of the reactive oxygen species and ERK protein kinase in mammalian 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 in the remote after irradiation. To perofrm a molecular analysis of HPRT-mutant subclones.
- To continue evaluating the retina's ability to recover after radiation exposure. To continue studying the mechanisms behind retina recovery: Mueller cell activation, expression of endogenous protectors in the retina, and expression of the oxidative stress proteins.
- To continue research on the apoptotic death of neurons in different sections of the rat and mouse brain at different times after exposure to radiations with different LET.
- To continue studying disorders in the exchange of monoamines and their metabolites in the prefrontal cortex, hippocampus, striatum, adjoining nucleus, and hypothalamus of the rat brain under exposure to gamma-rays, Bragg peak protons, and HCP.
- To continue the development of mathematical models of neurons' functional activity under exposure to radiations with different LET.
- To continue elaboration of model approaches to the quantitative estimation of the relation between the plastic processes in neurons participating in the formation of the brain's functional networks.
- To work out nonlinear dynamics methods for a neuron population (neural networks) that would allow describing the classical and quantum mechanisms of cognitive function realization.
- To develop mathematical models of axon transport of signals and molecules.
- To perform mathematical modeling of functional changes in the mammalian retina under exposure to genotoxic factors of different nature.
- To continue the development of mathematical models of DNA double-strand break induction and repair in mammalian and human cells.
- 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 – 2017)

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, G.F. Aru, 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,D.V. Elsha, T.A. Fadeeva, T.B. Feldman, R.D. Govorun, E.V. Ilyina, A.A. Ivanov, L. Jezkova, A.N. Kokoreva, E.A. Kolesnikova, N.A. Koltovaya, O.V. Komova, I.V. Koshlan, N.A. Koshlan, M.A. Kovalenko, A. Kowalska, P.V. Kutsalo, E.A. Kuzmina, V.N. Lisy, K.N. Lyakhova, M.S. Lyashko, B. Munkhbaatar, K.O. Muranov, E.A. Nasonova, S.S. Negovelov, M.A. Ostrovsky, A.Yu. Parkhomenko, I.I. Ravnachka, Yu.S. Severyukhin, N.L. Shmakova, E.V. Smirnova, S.I. Tiunchik, V.A. Tronov, D.M. Utina, M.A. Vasilyeva, Yu.V. Vinogradova S.V. Vorozhtsova, M.G. Zadnepryanets, E.M. Zaytseva, N.I. Zhuchkina, + 2 engineers, + 7 workers	
2. **Radiation research**	**G.N. Timoshenko**	Preparation Data taking R&D
LRB	V.E. Aleinikov, L.G. Beskrovnaya, 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, N.N. Budennaya, T.B. Feldman, R.D. Govorun, A.A. Ivanov, N.A. Koltovaya, O.V. Komova, M.M. Komochkov, I.V. Koshlan, Yu.V. Mokrov, M.A. Ostrovsky, A.Yu. Parkhomenko, G.N. Timoshenko	

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	YSU
Belarus	Gomel	IRB NASB
Bulgaria	Sofia	IE BAS
		INRNE BAS
		NCRRP
Czech Republic	Brno	IBP ASCR
	Prague	CTU
	Řež	NPI ASCR
		UJV
Egypt	Giza	CU
Italy	Udine	Uniud
Moldova	Chişinău	UnASM
Mongolia	Ulaanbaatar	NUM
Poland	Szczecin	US
Romania	Bucharest	UMF

		ISS
	Iaşi	UAIC
		IBR
Russia	Moscow	IBMP RAS
		IHNA Ph RAS
		SF IPh
		ITEP
		MSU
	Astrakhan	ASU
	Sochi	SRI MP
	Vladivostok	FEFU
Slovakia	Bratislava	CU

04–9–1112–2013/2016	Priority: 1

Status: Extended

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 2016:

- Continuation of the detection and study of biofossils and organic matter in meteorites and the most ancient terrestrial rocks.
- Diagnostics of microorganism remnants in Archaean and Proterozoic rocks and evaluation of their organization level with nuclear physics methods. Research on the synthesis of complex prebiotic compounds from formamide under exposure to accelerated ions with different linear energy transfer.

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 – 2016)

List of activities:

	Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1.	**Studies of biofossils in meteorites and ancient terrestrial rocks**	**A.Yu. Rozanov** **E.A. Krasavin**	Data taking Realization Simulation
	LRB	M.M. Astafyeva + 1 ingineer	
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, P.V. Sedyshev, M.V. Frontasyeva	

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
Russia	Moscow	IGEM RAS
		IKI RAS
		MSU
		PIN RAS
		SAI MSU
	Borok	IPE RAS

	Gatchina	PNPI
	Novosibirsk	BIC SB RAS
United Kingdom	Buckingham	UB
USA	Athens, AL	ASU

04–2–1103–2010/2016	Priority: 1

Status: Extended

Medical and Biological Research with JINR Hadron Beams

Leader: G.V. Mitsyn

Participating Countries and International Organizations:

Czech Republic, Poland, Romania, Russia.

Scientific Programme

Medico–biological and clinical research for the treatment of cancer patients with beams of heavy nuclear particles of the JINR Phasotron and for the accompanying diagnostics.

Expected main results in 2016:

- Continuation of clinical researches on proton therapy of cancer patients in room No 1. To evaluate the effectiveness of the conducted radiation treatment of different neoplasms.
- The work to increase functional capability of the developing 3D treatment planning software and its clinical tests in the treatment sessions.
- Test of the prototype equipment for dynamic conformal irradiation of deep-seated tumours with the proton beam.
- Development and improvement of detectors and tools for clinical dosimetry of the medical hadron beams.
- Exploration of the possibilities of laser radioprotection against damage after exposure to ionizing radiation in experimental mice like C57VL/6.
- Investigations of the molecular spectra of gene mutations induced by radiation in animal and human cells induced by ionizing radiation of different quality.

List of activities:

	Activity or experiment **Laboratory or other Division of JINR** **Responsible person**	**Leaders** **Main researchers**	**Status**
1.	**Medico–biological and clinical research for the treatment of cancer patients and accompanying diagnostics at the medical–technical complex of JINR**	**G.V. Mitsyn**	R&D
	DLNP	S.V. Shvidky, I.V. Alexandrova, I.D. Alexandrov, A.V. Agapov, M.V. Alexandrova, K.P. Afanasieva, S.Yu. Bakaev, K.Sh. Voskanyan, V.N. Gaevsky, G.V. Donskaya, V.M. Breyev, D.M. Borovich, Ye.I. Luchin, S.V. Korablinova, I.I. Klochkov, L.N. Korovina, Ya.V. Kurgansky, A.G. Molokanov, S.A. Pisareva, M.V. Repin, D.K. Sobolev, S.S. Uglova, M.A. Zeitlina, K.N. Shipulin, K. Oancea, I.E. Miller, T.L. Demakova, A.V. Rzyanina, M.D. Ekimova	

Collaboration

Country or International Organization	City	Institute or Laboratory
Czech Republic	Řež	UJV
	Prague	PTC
Poland	Krakow	NINP PAS
	Otwock-Swierk	NCBJ
	Poznan	GPCC
Romania	Bucharest	UMF
		UB
Russia	Moscow	VIGG RAS
		IBMP RAS
		RMAPE
		RCRC RAMS
	Dubna	RDH-9
	Obninsk	MRRC

04–2–1126–2015/2017	Priority: 1

Status: In-progress

Novel Semiconductor Detectors for Fundamental and Applied Research

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

Participating Countries and International Organizations:

Belarus, CERN, Czech Republic, Germany, New Zealand, Russia, Ukraine.

Scientific Programme

Generic R&D of semiconductor radiation-resistant detectors based on new materials and of hybrid pixel detectors with high resolution for nuclear and particle physics. Development of the research infrastructure for semiconductor detector R&D, coupled with beam tests at the JINR facilities, to be used by groups from JINR and from the Member States. Scientific collaboration with research groups from other fields in feasibility studies of application of the newly developed detectors in others areas of science and technology (primarily in medicine and geology).

Expected main results in 2016:

- Systematic studies of radiation hardness and response of GaAs detectors in the beams of the JINR facilities.
- Production of prototypes of Timepix hybrid pixel detectors with GaAs sensor of thickness less than 1 mm. Study of their capabilities in detecting neutrons, fission fragments and charged tracks.
- Production of a prototype of the low-background GaAs-based hybrid pixel detector for TGV-2.
- Study of X-ray contrast media identification by spectral data.
- MARS-CT calibration and image processing aimed at geophysics studies.
- Test of the block of registration for an electromagnetic calorimetry.
- Project preparation about use of new semiconductor photodetectors in a calorimetry for high energy physics.

List of projects:

	Project	Leader	Priority (period of realization)
1.	Novel semiconductor detectors for fundamental and applied research	G.A. Shelkov	1 (2015 – 2017)

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	A. Gongadze, M.I. Gostkin, A.V. Guskov, D.V. Dedovich, V.G. Elkin, S.A. Kotov, D.F. Kozhevnikov, V.G. Kruchonok, V.N. Pavlov, S.Yu. Porokhovoy, I.N. Potrap, L. Zavorka	
FLNP	Yu.N. Kopach, G. Akhmedov, S.Yu. Telezhnikov	
VBLHEP	J. Lukstins, A.M. Korotkova, D.O. Krivenkov, A.V. Averianov, C.B. Starikova	

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

Collaboration

Country or International Organization	City	Institute or Laboratory
Belarus	Minsk	JIPNR-Sosny NASB NC PHEP BSU
Czech Republic	Prague	CTU
CERN	Geneva	CERN
Germany	Hamburg	DESY
New Zealand	Christchurch	UC
Russia	Dubna	Dubna Univ.
	Moscow	MSU
		ITEP
	Moscow, Troitsk	INR RAS
	Tomsk	TSU
	St. Petersburg	SPbSPU
Ukraine	Kharkov	ISMA NASU

Networking, Computing, Computational Physics (05)

05–6–1118–2014/2016	Priority: 1

Status: Approved for completion in 2016

Information and Computing Infrastructure of JINR

Leader: V.V. Korenkov
Deputy: T.A. Strizh

Participating Countries and International Organizations:

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

Scientific Programme

Further development of the JINR network, information and computing infrastructure for the research activity of the Institute and its Member States on the basis of present-day information technologies in accordance with the Seven-Year Plan for JINR development and its amendment in view of the creation of a Tier-1 level grid-infrastructure in JINR. Creation of a unified information and computing environment of the JINR Member States.

Expected main results in 2016:

- Extension of throughput performance, increase of reliability and availability of the main and backup dedicated fiber optic JINR-Moscow channels. Maintenance of the uninterrupted functioning of the LHCOPN and LHCONE networks for operating the JINR Tier-1 and Tier-2 centers. Provision of the functioning, modernization and increase of reliability of the JINR backbone.

- Scheduled increase of performance, expansion of the data storage systems and provision of functioning the Tier-1 centre in a 24x7 mode. Creation of the analytic system for the centre monitoring.

- Commissioning of a first stage of the multifunctional information and computer centre of storage, processing and analysis of JINR data which integrates a JINR grid-site of the Tier-2 level, a heterogeneous cluster and a cloud infrastructure. Increase of performance of the JINR Central information and computing complex and data storage systems to meet the requirements of the JINR scientific program. Development and equipping of the heterogeneous cluster “HybriLIT”. Development and fitting up of the cloud infrastructure, provision on its base of the training and retraining of specialists on information technologies.

  Provision of stable operation of the JINR grid-site in frames of regional, national and application-specific grid- and cloud- infrastructures.

  Development of cooperation with the JINR Member States within the currently operating and created information and computing projects.

- Implementation of the first version of corporate information system. Modernization and maintenance of the hardware and software environment for the information, algorithmic and software support of JINR activities. Maintenance of the JINRLIB program library. Conducting a specialized section of the JINRLIB library for parallel programs. Addition of the library with instructional materials on the parallel programming technologies.

  Support and development of the central information servers, participation in the development, creation and support of information sites of conferences and workshops, including hosting mode and cloud platform.

  Continuation of work on introduction and support of the unified system 1C 8.2 UPP: development and introduction of a module on accounting persons invited (directed) to JINR; development and introduction of a module on accounting conferences; development and introduction of a module on persons detached for service; expansion of the functional of the module on accounting service habitation; development and introduction of a module on accounting motor transport; introduction of various specialized functional 1C UPP in the JINR self-supporting divisions; introduction of 1C UPP in the “Dubna” resort in Alushta.

Extension of the functionalities of the information control system of the NICA project based on the ADB2 system. Implementation of functional on introducing a planned profile of operations in ADB2; realization of functional on the formation of various consolidated reports on the project; development on the integration with the MS Project Professional.

Support and modernization of the JDS software, filling of the Authority collection with the JINE employees profiles, integration of the profiles of authors with the HEPNAMES collection, adjustment of the search machine Invenio in JDS for search in PIN.

- Modernization and development of the distributed educational and research grid-infrastructure, provision of training and retraining of IT specialists on its basis.

  Organization of training courses on the parallel programming technologies on the basis of heterogeneous cluster "HybriLIT".

  Trial operation of the Helpdesk system for JINR information and computing infrastructure user support.

List of activities:

Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1. **JINR telecommunication data links and JINR local area network**	**V.V. Korenkov** **A.G. Dolbilov**
LIT	K.N. Angelov, A.I. Balandin, D.V. Belyakov, E.Yu. Bulaeva, A.I. Churin, S.V. Gavrilov, L.I. Gorodnicheva, N.M. Egoshina, M.F. Ermakova, V.A. Kapitonov, G.A. Korobova, E.Yu. Kulpin, N.N. Mischenko, M.S. Plyashkevich, L.A. Popov, Ya.I. Rozenberg, E.V. Toneeva, V.P. Sheyko, A.Yu. Zakomoldin
DLNP V.V. Glagolev	Yu.P. Ivanov
LRB V.A. Krylov	
BLTP A.P. Isaev	A.A. Sazonov
FLNP S.A. Kulikov	V.I. Prikhodko, G.A. Sukhomlinov
VBLHEP Yu.K. Potrebenikov	B.G. Shchinov, Yu.P. Minaev
FLNR S.I. Sidorchuk	S.V. Pashchenko, G.G. Gulbekyan
UC S.Z. Pakuliak	I.N. Semeniushkin
2. **JINR Tier-1 center**	**V.V. Korenkov** **V.V. Mitsyn** **T.A. Strizh** **A.G. Dolbilov**
LIT	N.S. Astakhov, A.S. Baginyan, S.D. Belov, A.P. Gavrish, A.O. Golunov, N.I. Gromova, I.S. Kadochnikov, I.A. Kashunin, I.S. Pelevanyuk, E.A. Tikhonenko, V.V. Trofimov, N.N. Voitishin, A.S. Vorontsov, V.E. Zhiltsov

	VBLHEP S.V. Shmatov	I.N. Gorbunov, A.O. Golunov, I.I. Belotelov, A.Yu. Kamenev
3.	**JINR Central Information and Computing Complex**	**V.V. Korenkov** **V.V. Mitsyn**
	LIT	N.S. Astakhov, S.D. Belov, D.V. Belyakov, N.V. Chuenkova, A.G. Dolbilov, V.V. Galaktionov, A.P. Gavrish, Eu.A. Grafov, N.I. Gromova, I.S. Kadochnikov, A.S. Kamensky, I.A. Kashunin, I.A. Kudasova, O.N. Kudryashova, N.A. Kutovskiy, A.A. Lavrentiev, I.I. Lensky, S.B. Marchenko, M.A. Matveev, S.V. Mitsyn, A.V. Nechaevsky, I.K. Nekrasova, D.A. Oleynik, I.S. Pelevanyuk, A.Sh. Petrosyan, D.I. Pryakhina, A.I. Radov, V.T. Razuvakina,T.F. Sapozhnikova, E.A. Tikhonenko, V.V. Trofimov, A.S. Vorontsov, A.V. Uzhinskiy, S.E. Zhabkova, V.E. Zhiltsov
4.	**Information and software support of the research-and-production activity at JINR**	**P.V. Zrelov** **V.V. Korenkov** **M.V. Bashashin**
	LIT	T.O. Ablyazimov, 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. Jerusalimova, I.A. Filozova, L.A. Kalmykova, A.A. Karlov, D.V. Kekelidze, S.A. Kretova, S.V. Kunyaev, G.A. Kurmaeva, N.A. Kutovskiy, A.A. Kutovskaya, L.A. Lukstinia, 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, V.A. Stepanenko, T.S. Syresina, N.N. Vorobieva, V.M. Yagafarova, A.G. Zaikina, T.N. Zaikina
	SOICO N.A. Russakovich	V.F. Borisovskiy
	VBLHEP Yu.K. Potrebenikov	A.V. Philippov, K.V. Turusina
5.	**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**

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, O.I. Streltsova, E.A. Tikhonenko, 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	Foundation ANSL
		IIAP NAS RA
		YSU
Azerbaijan	Baku	IP ANAS
Belarus	Minsk	NC PHEP BSU
		JIPNR-Sosny
		NASB
		BNTU
	Gomel	GSTU
Bulgaria	Sofia	INRNE BAS
		SU
	Blagoevgrad	SWU
CERN	Geneva	CERN
Czech Republic	Prague	IP ASCR
Egypt	Giza	CU
France	Marseille	CPPM
Georgia	Tbilisi	GRENA
		TSU
		UG
		GTU
Germany	Darmstadt	GSI
	Frankfurt/Main	Univ.
	Hamburg	DESY
	Karlsruhe	KIT
	Munich	LMU
	Zeuthen	DESY
Moldova	Chişinău	ASM
		IMCS ASM
		IAP ASM
		RENAM
Mongolia	Ulaanbaatar	II MAS
		MUST
		NUM

Poland	Krakow	CYFRONET
	Poznan	AMU
	Wroclaw	WUT
Romania	Bucharest	IFA
		IFIN-HH
	Cluj-Napoca	INCDTIM
Russia	Moscow	IOC RAS
		IPI RAN
		IITP RAS
		ISP RAS
		ITEP
		JSCC RAS
		KIAM RAS
		MPEI
		MSU
		RCC MSU
		RIPN
		NRC KI
		RSCC
		SINP MSU
		SRI "Voskhod"
	Moscow, Troitsk	INR RAS
	Cherkessk	NCSHTA
	Chernogolovka	SCC IPCP RAS
		LITP RAS
	Dubna	Adm. of Dubna
		BSINP MSU
		Dubna Univ.
		Raduga
		Tensor
		SEZ "Dubna"
		SCC "Dubna"
	Gatchina	PNPI
	Nizhny Novgorod	UNN
	Novosibirsk	BINP SB RAS
	Pereslavl-Zalesskiy	PSI RAS
	Protvino	IHEP
	Puschino	IMPB RAS
	Samara	SSAU
	St. Petersburg	FIP
		ITMO
		CC SPbSU
		SPbSU
		SPbSPU
Slovakia	Košice	IEP SAS

South Africa	Cape Town	UCT
Sweden	Lund	LU
USA	Arlington, TX	UTA
	Batavia, IL	Fermilab
	Chicago, IL	UChicago
	Pasadena, CA	Caltech
	Upton, NY	BNL
Ukraine	Kiev	BITP NASU
		NTUU KPI
	Kharkov	KFTI
Uzbekistan	Tashkent	IMIT AS RUz

05–6–1119–2014/2016	Priority: 1

Status: Approved for completion in 2016

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, Belarus, Belgium, Brazil, Bulgaria, Canada, CERN, Czech Republic, Egypt, France, Georgia, Germany, Greece, India, Italy, Japan, Kazakhstan, Moldova, Mongolia, Poland, Portugal, Romania, Russia, Slovakia, South Africa, Switzerland, Taiwan, Tajikistan, Ukraine, USA, Vietnam.

Scientific Programme

Research in the field of computational mathematics and computational physics, directed to the creation of 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. This subject area includes a wide spectrum of investigations underway at JINR in high energy physics, nuclear physics, condensed matter physics, biophysics, information technologies, etc. which demand the development of new mathematical methods and approaches for modeling physical processes, processing and analysis of experimental data. 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 2016:

- Formulation and investigation of chirally invariant transport equations for quark matter including: collective meanfields, strong correlations (bound state formation), hadron-hadron scattering, heavy-quark transport and particle production (Schwinger effect).

  Development of numerical and analytical methods of investigation of nonlinear models of physics and application of the obtained results to the study of the interaction of gaseous nanocluster beams with matter and to the characterization of the gradient optical waveguides.

  Study of general properties of nucleus-nucleus interactions at energies planned by NICA/MPD, CBM and PANDA experiments using hadronic models of Geant4 package. Numerical modeling of the mechanism of the enhanced strange particle production at NICA energies.

  3D modeling of the superconducting magnets for the NICA (JINR) and for SIS100 (FAIR, GSI, Darmstadt).

  Study of nuclear physical processes of isotope accumulation and burnout in extended targets and subcritical fission systems; software maintenance of current experiments on target irradiation with protons and nuclei.

  Development of new algorithms for computing Coulomb corrections to observables of the Moliere-Fano multiple scattering theory and to the Migdal functions G(s) and F(s) of the quantum Landau-Pomeranchuk effect theory (DIRAC collaboration).

  Development of methods and programs, including parallel ones, for numerical investigations of nuclear-physical processes involving the hybrid microscopic optical potential model.

  Development of numerical methods and algorithms to study the properties of quantum quasi-stationary states in a two-barrier open well.

  Development of methods for solving the Lorentz-Newton equation and beam dynamics calculation for defining the new operating modes of the multipurpose isochronous cyclotrons: DC-280 (FLNR, JINR), AIC-144 (INP, PAS).

  Development of numerical-analytical methods for modeling phase transitions and transient processes in physical systems encountered in studies conducted at JINR (graphite-diamond, Josephson junction stacks, thermal conductivity in technical installations).

Interval-dependent quadrature sums in Bayesian automatic adaptive quadrature.

Implementation of a software package for the calculation of the rectangular matrix of the amplitudes of reflection and transmission and the corresponding wave functions for multi-channel scattering problems.

Development of new approaches to analytical and numerical investigation of actual problems of the modern cosmology in view of recent cosmological data.

Modeling the structure of polydisperse vesicular systems of phospholipids, including phospholipid transport of nano-systems and nano-medicaments, based on data from small-angle neutron and x-ray scattering.

Investigation of localized structures and critical regimes in dissipative media described by non-linear Schroedinger equations.

Development of a novel approach based on utility rate equations, for describing the evolution of complex systems.

- Development or updating of methods, algorithms and software for recording rare processes in different detectors of the CBM setup (STS, MuCh, TRD, MVD) using high-performance computing systems.

  Development of a database system for the CBM experiment (definition, agreement, and clarification of the general concepts, creation of a prototype database of the individual elements and detectors of the CBM setup).

  Development, testing and implementation of a new algorithm for constructing track-segments in the cathode strip chambers of the CMS setup.

  Development and application of the "CATIA-GDML Geometry Builder". Adaptation, development, implementation and user support of the FAIRRoot based simulation and analysis frameworks for JINR scientific groups. Deployment of the CATIA v5 CAD system in JINR: localization, training and user support.

  Development of algorithms and software for the recognition of particle trajectories in the MPD and BM@N experiments.

  The use of robust methods for the detection of stochastic processes anomalies.

  Development of numerical methods, algorithms and software for metric analysis based reconstruction of nonlinear functional dependencies and for random processes forecasting.

  Design and development of effective methods and algorithms based on piecewise polynomial approximation of high order complex functional dependencies and smoothing experimental data using the basic element method.

  Creation and investigation of a pool of effective signatures of HERO calorimeter response as a source of input data vectors to artificial neural net of increased accuracy in the cosmic ray energy reconstruction problem.

  Extension of the capabilities for small-angle scattering data modeling (program "Fitter") and development, in the framework of the "SAS" program, of the primary data processing for multi-wire ring detectors for the YuMO spectrometer at the IBR-2 reactor.

  Refinement and improvement of the method of analysis of the sample temperature dependent phase transitions in spectra collected in experiments on HRFD at IBR-2.

- Creation of support within the information-computer environment of the heterogeneous cluster "HybriLIT" that allow users carry out parallel computations with the use of new hybrid computing architectures, develop their own applications, get prompt support and participate in tutorials on parallel programming technologies that are held by the leading specialists in the field of high performance computing.

  Development of algorithms for numerical investigation of multi-dimensional models that are based on evolutionary equations used for modeling physical processes in different materials (the mentioned processes appear at irradiation with heavy ions and pulsed beams), for modeling Josephson barriers in high-temperature superconductors. Program realization of obtained algorithms for carrying out computations on HybriLIT.

  Development of effective algorithms for the solution of molecular dynamics equations on hybrid computing infrastructures.

Hybrid architecture adaptation of algorithms and program complexes designed for solution of multi-dimensional boundary problems of Schroedinger type equations used in investigations of mathematical models of many - particle quantum systems.

Development and implementation of new parallel algorithms into the MCTDHB software complex designed for investigation of multi-dimensional dynamics of bosons' interaction in magneto optical traps.

Development of the trigger software for the MuCh detector using the method of cellular automata and technologies of parallel computing.

Adaptation and optimization of algorithms for the search and reconstruction of the parameters of particle trajectories under simultaneous processing on multiple many-core CPU and GPU architectures.

Development of three-dimensional finite element mesh generation methods and parallel algorithms for hp-adaptive highly accurate calculations of three-dimensional non-linear magnetic fields.

- Symbolic-numeric description of the entangled space for two-qubit mixed states.

  Development of discrete combinatorial models for quantum systems with gauge structures and design of computer programs for the investigation of such models.

  Design of algorithms and programs to study resonant tunneling of composite particles through repulsive barriers in restricting potentials.

  Partial implementation in Maple of the reduction algorithm for Feynman diagrams by means of generalized recurrence relations.

  Study of non-equilibrium behaviour of trapped atoms under strong alternating perturbations.

  Numerical investigation of spin dynamics of magnetic nanoclusters and development of models for quantum information processing.

List of activities:

Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1. **Mathematical and computation methods for simulation of complex physical systems**	**Gh. Adam** **P.V. Zrelov** **I.V. Puzynin**
LIT	S. Adam, P.G. Akishin, I.V. Amirkhanov, E.A. Ayrjan, A.S. Ayriyan, I.V. Barashenkov, I.L. Bogolubsky, A.M. Chervyakov, O. Chuluunbaatar, H. Grigorian, Yu.L. Kalinovsky, K.V. Lukyanov, A. Machavariani, N.V. Makhaldiani, T.I. Mikhailova, I.V. Molodtsova, E.G. Nikonov, D.I. Podgainy, R.V. Polyakova, T.P. Puzynina, V.S. Rikhvitsky, V.N. Robuk, B. Saha, A.A. Sapozhnikov, N.R. Sarkar, I. Sarkhadov, S.I. Serdyukova, Z.A. Sharipov, V.A. Stepanenko, O.I. Streltsova, Z.K. Tukhliev, A.V. Volokhova, R.M. Yamaleev, E.P. Yukalova, E.V. Zemlyanaya, E.I. Zhabitskaya
2. **Software complexes and mathematical methods for processing and analysis of experimental data**	**P.V. Zrelov** **Gh. Adam** **V.V. Ivanov**

LIT — T.O. Ablyazimov, P.G. Akishin, E.P. Akishina, V.P. Akishina, E.I. Aleksandrov, I.N. Aleksandrov, D.A. Baranov, O.Yu. Derenovskaya, N.D. Dikoussar, V.P. Filinova, A.A. Kazakov, A.I. Kazymov, P.I. Kisel, B.F. Kostenko, Gh.E. Kozlov, L.Yu. Kruglova, I.N. Kukhtina, M.A. Mineev, G.A. Ososkov, E.V. Ovcharenko, V.I. Palichik, A.M. Raportirenko, V.N. Shigaev, N.Yu. Shirikova, L.A. Siurakshina, A.G. Soloviev, A.N. Sosnin, V.V. Uzhinsky, N.N. Voitishin, O.O. Voskresenskaya, A.V. Yakovlev, V.B. Zlokazov

3. **Numerical methods, algorithms and software computationally adapted to multicore and hybrid architectures** — **Gh. Adam, P.V. Zrelov**

LIT — T.O. Ablyazimov, P.G Akishin, E.I. Aleksandrov, A.S. Ayriyan, E.A. Ayrjan, O. Chuluunbaatar, O.Yu. Derenovskaya, V.P. Gerdt, A.A. Gusev, V.V. Ivanov, A.I. Kazymov, A.M. Khvedelidze, P.I. Kisel, Gh.E. Kozlov, A.A. Lebedev, S.A. Lebedev, Yu.G. Palii, D.V. Podgainy, A.A. Sapozhnikov, T.F. Sapozhnikova, O.I. Streltsova, O.I. Yuldashev, M.B. Yuldasheva, E.V. Zemlyanaya, M.I. Zuev

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

LIT — A.A. Bogolubskaya, S.A. Evlakhov, A.A. Gusev, A.M. Khvedelidze, V.V. Kornyak, Yu.G. Palii, A.M. Raportirenko, I.A. Rogozhin, O.V. Tarasov, D.A. Yanovich

Collaboration

Country or International Organization	City	Institute or Laboratory
Armenia	Yerevan	YSU
		IIAP NAS RA
		RAU
		Foundation ANSL
	Ashtarak	IPR NAS RA
Australia	Sydney	Univ.
Belarus	Minsk	IM NASB
		BSU
Belgium	Brussels	ULB
	Liege	ULg
Brazil	Sao Carlos, SP	IFSC USP
Bulgaria	Sofia	IMI BAS
		INRNE BAS
		SU
	Plovdiv	PU
Canada	Edmonton	U of A

	Toronto	IBM Lab
CERN	Geneva	CERN
Czech Republic	Řež	NPI ASCR
Egypt	Cairo	TIMS
France	Metz	UPV-M
	Nantes	SUBATECH
Georgia	Tbilisi	UG
		RMI TSU
		TSU
		GTU
		ISU
Germany	Bonn	UniBonn
	Darmstadt	GSI
	Dresden	IFW
	Frankfurt/Main	Univ.
	Giessen	JLU
	Heidelberg	Univ.
	Jülich	FZJ
	Kassel	Uni Kassel
	Marburg	Univ.
	Munich	LMU
	Potsdam	IASS
	Regensburg	UR
	Tübingen	Univ.
Greece	Thessaloniki	AUTH
India	Pune	IUCAA
Italy	Turin	INFN
	Bari	UniBa
Japan	Osaka	Kansai Univ.
Kazakhstan	Almaty	INP
		IPT
Moldova	Chişinău	IAP ASM
Mongolia	Ulaanbaatar	NUM
		MUST
Poland	Krakow	AGH-UST
	Lublin	UMCS
	Otwock-Swierk	NCBJ
	Wroclaw	UW
Portugal	Coimbra	UC
Romania	Bucharest	IFA
		IFIN-HH
		ISS
		UB
	Cluj-Napoca	INCDTIM
Russia	Moscow	ICS RAS

		ITEP
		NNRU “MEPhI”
		KIAM RAS
		MSU
		PFUR
		SINP MSU
		VIGG RAS
		GPI RAS
	Belgorod	BelSU
	Dubna	Dubna Univ.
	Novosibirsk	BINP SB RAS
	Perm	PSNRU
	Protvino	IHEP
	Puschino	IMPB RAS
		ITEB RAS
		IPR RAS
	Saratov	SSU
	St. Petersburg	FIP
		NIIEFA
	Tomsk	TSU
	Tver	TvSU
Slovakia	Košice	IEP SAS
		TUKE
		PJSU
	Prešov	PU
South Africa	Cape Town	UCT
	Pretoria	UP
Switzerland	Zurich	ETH
Taiwan	Taipei	AS
Tajikistan	Dushanbe	TNU
		PHTI ASRT
	Khujent	KSU
Ukraine	Kiev	BITP NASU
	Kharkov	IERT NASU
		KFTI
USA	Lemont, IL	ANL
Vietnam	Hanoi	VNU

05–8–1037–2001/2019	Priority: 1

Status: In-progress

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: N.A. Russakovich

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 project-topical and special-purpose financing of research programmes 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 2016:

- Analysis of the results of JINR's activities in the main directions of research. Preparation for publication of the JINR Topical Plan for Research and International Cooperation for 2017.
- Information and technical preparation of the JINR Web site. Further development of the data base information search system for JINR research themes and projects. Information support of the electronic system of protocols for scientific and technical collaboration.
- Development and application of software for automation of scientific and financial planning. Analysis of the use of budgetary resources by fields of research, themes, and research groups.
- Maintenance of interaction on issues of scientific research work with representatives of the Member States of JINR and non-Member States participating in JINR activities on the basis of bilateral agreements. Organization and holding of meetings on cooperation with international organizations.

List of activities:

	Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1.	**Preparation for publication of the JINR Topical Plan for Research and International Cooperation for 2017**	**N.A. Russakovich**
	SOD	N.A. Boklagova, L.K. Ivanova, N.I. Sissakian

2.	**JINR internet-site activities maintenance**	**N.A. Russakovich**
	SOD	N.A. Boklagova, L.K. Ivanova, L.I. Kalinina, T.B. Ivashkevich, O.K. Kronshtadtov, K.P. Moisenz, A.G. Nanev, N.I. Sissakian
	AMISD	V.F. Borisovskiy
	Editorial office, weekly newspaper "Dubna: Science, Cooperation, Progress"	E.M. Molchanov
	LIT	K.V. Lukyanov, A.V. Prikhodko
3.	**Automation of scientific planning**	**N.A. Russakovich**
	AMISD	V.F. Borisovskiy
	LIT	M.V. Bashashin, I.A. Filozova, S.V. Kunyaev, G.G. Musulmanbekov, M.S. Plyashkevich, P.V. Ustenko
4.	**International cooperation**	**N.A. Russakovich**
	IRD	D.V. Kamanin

Educational Programme (06)

06–0–1120–2014/2018	Priority: 1

Status: In-progress

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, Czech Republic, Egypt, Kazakhstan, Moldova, Poland, Romania, Russia, Serbia, Slovakia, South Africa, Ukraine, USA, Vietnam.

Scientific Programme

Support and development of the JINR Educational Programme in general (training of physicists, engineers and engineering physicists in JINR fields of research and in the interests of the Member States). 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.

Expected main results in 2016:

- Support and maintenance of the educational process at the UC. Preparation and publication - as tutorials - of lectures given to the UC students and postgraduates. 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 holding of Summer Student Practices in JINR fields of research for students of higher-education institutions of JINR Member States. Participation in the organization and holding 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 number of participants of this programme.
- Completion of creation of the educational facilities and complexes for practical work in the framework of a UC-based scientific and engineering group for implementation of educational programmes for training engineering physicists for the needs of JINR and scientific centres of the Member States.
- Cooperation with international foundations in organizing student and postgraduate exchange between the UC and foreign research centres regulated by special agreements.
- Development of the computer infrastructure for organizing and conducting training programmes for data analysis in high-energy physics experiments.
- Improvement of the training laboratory and 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 relativistic nuclear physics 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 modern education programmes	Y.A. Panebratsev	1 (2014 – 2016)

List of activities:

Activity or experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers
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
BLTP V.V. Voronov A.P. Isaev A.B. Arbuzov	D.I. Kazakov, A.V. Gladyshev, V.A. Osipov, S.N. Nedelko
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	I.A. Golutvin, S.V. Shmatov, M.G. Sapozhnikov, N.N. Agapov, S.S. Shimansky, Zimin N.I.
FLNR S.N. Dmitriev	A.V. Eremin V.I. Zagrebaev, A.G. Popeko, A.S. Denikin
LIT V.V. Korenkov	T.A. Strizh, N.A. Kutovskiy, S.D. Belov, V.P. Gerdt
LRB E.A. Krasavin	O.V. Belov, I.V. Koshlan
Directorate G.V. Trubnikov G.D. Shirkov	A.V. Dudarev, E.D. Uglov
SOICO D.V. Kamanin	W. Chmielowski, M.G. Loschilov
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
		NC PHEP BSU
		ME RB
	Gomel	GSU
Bulgaria	Sofia	INRNE BAS
		SU
	Blagoevgrad	SWU

CERN	Geneva	CERN
Czech Republic	Prague	CU
		CTU
	Řež	NPI ASCR
Egypt	Cairo	ASRT
Kazakhstan	Almaty	KazNU
Moldova	Chişinău	ASM
Poland	Krakow	JU
	Lodz	UL
	Poznan	AMU
Romania	Bucharest	UB
Russia	Moscow	MIREA
		NNRU "MEPhI"
		SINP MSU
	Dolgoprudny	MIPT
	Dubna	Dubna Univ.
		BSINP MSU
	Kostroma	KSU
	Tver	TvSU
	Tula	TSU
Slovakia	Bratislava	CU
	Košice	PJSU
South Africa	Pretoria	Necsa
Ukraine	Kiev	BITP NASU
		NUK
USA	Upton, NY	BNL
Vietnam	Hanoi	VNU

Alphabetic List of Collaborators

Albania

Tirana

UT (University of Tirana | http://www.unitir.edu.al/), 122

Argentina

Bariloche

CAB CNEA (Centro Atomico Bariliche National Atomic Energy Commission | http://www.cab.cnea.gov.ar/), 132

Armenia

Ashtarak

IPR NAS RA (Institute for Physical Research of the National Academy of Sciences of the Republic of Armenia | http://www.ipr.sci.am/), 169

Yerevan

ANSSP (Armenian National Survey for Seismic Protection | http://www.nssp-gov.am/about-NSSP-eng.htm/), 77

Foundation ANSL (Alikhanian National Science Laboratory (Yerevan Physics Institute) Foundation | http://www.yerphi.am/), 11, 21, 37, 55, 61, 85, 89, 92, 111, 163, 169

IIAP NAS RA (Institute for Informatics and Automation Problems of the National Academy of Sciences of the Republic of Armenia), 21, 163, 169

Inst. Physiology NAS RA (L.A.Orbeli Institute of Physiology of the National Academy of Sciences of the Republic of Armenia | http://www.physiol.sci.am/), 142

RAU (Russian-Armenian (Slavonic) University | http://www.rau.am/), 11, 17, 169

YSU (Yerevan State University | http://ysu.am/), 21, 26, 73, 85, 96, 111, 149, 163, 169, 177

Australia

Melbourne

Univ. (University of Melbourne | http://unimelb.edu.au/), 21, 122

Sydney

Univ. (University of Sydney | http://sydney.edu.au/), 21, 26, 96, 169

Austria

Innsbruck

Univ. (University of Innsbruck | http://www.uibk.ac.at/), 17, 122

Vienna

HEPHY (Institute of High Energy Physics of the Austrian Academy of Sciences | http://www.hephy.at/), 55

IAEA (International Atomic Energy Agency | http://www.iaea.org/), 122

TU Vienna (Vienna University of Technology | http://www.tuwien.ac.at/), 26, 30

Univ. (University of Vienna | http://www.univie.ac.at/), 30

Azerbaijan

Baku

IP ANAS (Institute of Physics of the Azerbaijan National Academy of Sciences | http://www.physics.gov.az/), 11, 37, 73, 132, 163, 177

IRP ANAS (Institute of Radiation Problems of the Azerbaijan National Academy of Sciences | http://www.irp.science.az/), 89, 137

Belarus

Gomel

BelSUT (Belarusian State University of Transport | http://www.belsut.gomel.by/), 11, 55

GSTU (Sukhoi State Technical University of Gomel | http://www.gstu.by/), 11, 38, 64, 73, 163

GSU (Francisk Skorina Gomel State University | http://www.gsu.by/), 11, 55, 64, 73, 145, 177

IRB NASB (Institute of Radiobiology of the National Academy of Sciences of Belarus | http://irb.basnet.by/), 149

Minsk

BNTU (Belarusian National Technical University | http://www.bntu.by/), 163

BSTU (Belarusian State Technological University | http://www.bstu.unibel.by/), 21, 145

BSU (Belarusian State University | http://www.bsu.by/), 115, 145, 169, 177

BSUIR (Belarusian State University of Informatics and Radioelectronics | http://www.bsuir.by/), 64, 73, 77, 142

IAP NASB (State Scientific Institution "Institute of Applied Physics of the National Academy of Sciences of Belarus | http://iaph.bas-net.by/), 132

ICE MES RB (Institute for Command Engineers of the Ministry for Emergency

Belgium

Brazil

Bulgaria

Canada

China

Greece

Kazakhstan

Latvia

Macedonia

Portugal

Coimbra

UC (University of Coimbra | http://www.uc.pt/), 170

Republic of Korea

Chongju

CBNU (Chungbuk National University | http://www.chungbuk.ac.kr/), 56

Daejeon

IBS (Institute for Basic Science | http://www.ibs.re.kr/), 18

NFRI (National Fusion Research Institute | http://www.nfri.re.kr/), 140

Gangneung

GWNU (Gangneung-Wonju National University | http://www.gwnu.ac.kr/), 93

Kwangju

CNU (Chonnam National University | http://www.jnu.ac.kr/), 56

Naju

DU (Dongshin University; Laboratory for High Energy Physics | http://www.dsu.ac.kr/), 56

Namwon

SU (Seonam University | http://www.seonam.ac.kr/), 56

Pohang

PAL (Pohang Accelerator Laboratory | http://pal.postech.ac.kr/), 123

Seoul

Dawonsys (Company "Dawonsys 'o., Ltd" | http: //www.dawonsys.co.kr/), 123

EWU (Ewha Womans University | http: //www.ewha.ac.kr/), 48

KU (Korea University | http://www.korea.ac.kr/), 56

Konkuk Univ. (Konkuk University | http://www.kku.ac.kr/), 56

SNU (Seoul National University | http://www.snu.ac.kr/), 13, 18

SNUE (Seoul National University of Education | http://www.snue.ac.kr/), 56

Taejon

KAERI (Korea Atomic Energy Research Institute | http://www.kaeri.re.kr:8080/), 123

Romania

Baia Mare

TUCN-NUCBM (Technical University of Cluj-Napoca - North University Center of Baia Mare | http://www.utcluj.ro/), 124, 133

Bucharest

IFA (Institute of Atomic Physics | http://www.ifa-mg.ro/), 164, 170

IFIN-HH (Horia Hulubei National Institute of Physics and Nuclear Engineering | http://www.nipne.ro/), 18, 23, 28, 31, 50, 52, 74, 86, 103, 107, 111, 116, 123, 133, 137, 140, 143, 164, 170

INCDIE ICPE-CA (National Institute of Research and Development in Electrical Engineering ICPE-CA | http://www.icpe-ca.ro/), 74, 82, 86, 97, 133, 140

INFLPR (National Institute for Laser, Plasma and Radiation Physics | http://www.inflpr.ro/), 146

INOE2000 (National Institute for Research and Development in Optoelectronics | http://inoe.inoe.ro/), 74

ISS (Institute for Space Sciences | http://www.spacescience.ro/), 48, 86, 93, 97, 123, 133, 150, 170

NIMP (National Institute of Materials Physics | http://www.infim.ro/), 133

N&V (http://www.nuclearvacuum.ro/), 103

UB (University of Bucharest | http://www.unibuc.ro/), 18, 86, 107, 111, 123, 133, 152, 155, 170, 178

UMF (University of Medicine and Pharmacy "Carol Davila' - Bucharest' | http://www.umf.ro/), 97, 133, 149, 155

UPB (University Politehnica of Bucharest | http://www.upb.ro/), 133, 143

UTM (Titu Maiorescu University | http://www.utm.ro/), 133

Cluj-Napoca

INCDTIM (National Institute for Research and Development of Isotopic and Molecular Technologies | http://www.itim-cj.ro/), 133, 164, 170

RA BC-N (Romanian Academy Cluj-Napoca Branch | http://www.acad-cluj.ro/), 133

UBB (Babeş-Bolyai University | http://www.ubbcluj.ro/), 133

UTC-N (Technical University of Cluj-Napoca | http://utcluj.ro/), 23

Constanţa

NIMRD (National Institute for Marine Research and Development "Grigore Antipa" | http://www.rmri.ro/), 124

UOC ("Ovidius" University of Constanta | http://www.univ-ovidius.ro/), 86, 124, 133

Craiova

UC (University of Craiova | http://www.ucv.ro/), 133

Russia

Serbia

Slovakia

USA

Ukraine

CERN

Geneva

ICTP

Trieste