Draft

TOPICAL PLAN
FOR JINR RESEARCH
AND INTERNATIONAL COOPERATION
2021

Contents

Prepared by
N.A. Boklagova
D.S. Korobov

Dubna 2020

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.

---

* 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 - Scientific Organizing Department (SOD)
9 - Laboratory of Radiation Biology (LRB)

Theoretical Physics

(01)

01-3-1135-2019/2023

Priority:	1

Status: In-progress

Fundamental Interactions of Fields and Particles

Leaders: D.I. Kazakov
O.V. Teryaev

Participating Countries and International organizations:

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

Issues addressed and main goals of research:

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 and theoretical support of NICA/SPD program. 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 MPD/NICA program. Theoretical support of a wide range of current and future experiments at JINR, IHEP, CERN, GSI, JLab and other physics centers.

Expected main results in the current year:

- Study of non-supersymmetric gauge theories of higher dimensions, derivation of the generalized renormalization group equations, and finding of the high-energy behavior of scattering amplitudes in these theories.

  Investigation of the renormalization scheme dependence of scattering amplitudes in supersymmetric gauge theories of higher dimensions.

  Calculation of the spectral density for a 3-loop photon polarization operator in QED and QCD with account for 4 particle massive cuts.

  Investigation of the renormalization group relations for the higher-order perturbative expansion coefficients of the hadronic vacuum polarization function as well as the relevant expressions for the coefficients incorporating the contributions of the π^2-terms in the perturbative expansion of the R-ratio of electron-positron annihilation into hadrons.

  Development of methods for solving the quantum spectral curve equations in the N=4 supersymmetric Yang–Mills theories and Aharony-Bergman-Jafferis-Maldacena models. Construction of algorithmic solutions for universal anomalous dimensions of the twist 2 operators in 8 and 6 loop approximations, respectively.

  Development of the theory of transverse momentum dependent parton densities with the application to heavy-quark production.

  Construction of the longitudinal structure function $F_L(x,Q^2)$ at small x obtained from the Froissart-bounded parametrization of $F_2(x,Q^2)$.

Large Bjorken *x* variable resummation in QCD non-singlet data analysis of deep inelastic scattering on a fixed target.

- Numerical optimization for the perturbative series using the renormalization group (RG) in QCD and truncated Mellin moments approach. Application to the deep-inelastic scattering sum rules and comparison with the experimental data.

Calculation of lepton-pair production in exclusive hadron processes with taking into account the electromagnetic contribution.

Calculation of hadron spin structure effects in the framework of transverse momentum dependent parton densities in a proton to support the NICA-SPD program.

Investigation of electromagnetic and gravitational interactions of twisted particle states and analysis of possibilities of their production in heavy-ion collisions.

Calculation of different form factors, which parametrize the transition of a pion-nucleon mode into the virtual photon and nucleon within the QCD light-cone sum rules, including the twist-3, twist-4 contributions and the coupling constant corrections.

Determination of the properties of the long-range hadron potential, which define peculiar properties of the differential cross sections of proton-proton elastic scattering obtained at the LHC. Investigation and determination of the energy dependence of new effects detected in the experimental data by the TOTEM Collaboration at an energy of 13 TeV.

Calculation of the helicity amplitudes of proton-proton scattering in the framework of the High Energy General Structure model with taking into account the nucleon structure for description of the polarization effects at NICA energies.

Investigation of the influence of quantum anomalies on transport phenomena in a vortical relativistic fluid containing elementary particles with spin one and polarization caused by these phenomena; calculation of anomalous currents of particles with spin one.

Comparative analysis of the results for pion transition and electromagnetic form factors in the low and (or) moderate energy regime experiments.

Evaluation of radiative corrections to distribution amplitudes of (pseudo)scalar and (longitudinal and transverse) vector mesons at N^2LO in the large-β_0 approximation for the perturbative part of the QCD sum rules.

Development of the efficient Monte Carlo integration and event generation method based on machine learning algorithms using the existing Tensorflow and Keras machine learning libraries.

Test of leptonic universality for the convexity parameter in semileptonic meson and baryon decays independent of lepton mass and form factor effects.

Calculations of nonleptonic two-particle decays of charmed baryons including the quark diagrams topologically different from tree diagrams.

Improvement of the values of the fundamental constants of atomic physics (Rydberg constant, the ratio of the proton to electron masses) and imposing of more stringent restrictions on the interaction potentials of the "fifth" force using the effective field theory "Nonrelativistic quantum electrodynamics" and high precision spectroscopy of HD^+, antiproton helium and molecular ion H_2^+.

- Development of empirical an approach for calculating the cross sections of charged-current quasielastic (CCQE) and CCQE-like interactions of neutrinos and antineutrinos with nuclei. An extensive comparison of calculations with the earlier and modern accelerator CCQE and CCQE-like data for different nuclear targets in a wide energy range.

Implementation of the SuSAM* model into the GENIE neutrino event generator.

Investigation of the reactor antineutrino anomaly (RAA) within the framework of a quantum field theoretical approach to neutrino oscillations. Analysis of the early reactor data and most recent results from the new experiments such as PROSPECT, Stereo, NEUTRINO-4, and DANSS.

Description of differential distributions of semi-leptonic modes of tau-lepton decays studied at modern and future colliders with taking into account meson-meson interactions.

Construction of high-precision theoretical predictions for the main processes of electron-positron annihilation taking into account the initial beam polarization under the conditions of future colliders including the Super Charm-Tau Factory, ILC and FCC-ee.

- Description of the structure of quark and hybrid matter in neutron stars using the extended sigma model.

Study of the properties of the low-temperature high-density equation of state from multi-messenger Astronomy of compact stars and their mergers: indications the existence of a third family of compact stars (mass twins) and implications for the existence of a critical endpoint in the QCD phase diagram; Bayesian analyses of new observables from GW170817, GW190814 and NICER for different mixed phase constructions of the hybrid quark-hadron EoS; question of the onset of deconfinement in the mass-radius diagram and in the EoS, hybrid EoS regarding their supernova explodability property.

Development of self-consistent approximations to dilute heated hadronic matter in application to heavy ion collisions and supernova matter. Investigation of the influence of in-medium pion effects, magnetic field and rotation on the equation of state of heated hadron matter.

Calculation of the mass gap in the fermion spectrum and study of its dependence on the chemical potential in QCD-like theories by means of lattice simulations.

Study of the QCD equation of state in the external magnetic field and at nonzero baryon density within lattice simulation.

Study of a chiral magnetic wave in quark-gluon plasma in an external magnetic field using lattice simulation with dynamical quarks and physical mass of the π-meson.

Investigation of the finite size effects in the effective potential of gluodynamics for self-dual and chromomagnetic background gluon fields within lattice simulations under various boundary conditions.

Study of spectral functions of quark bound states within the effective quark-meson model by means of the functional renormalisation group. Application of these spectral functions for calculation of transport coefficients in the effective model for both massive bare quarks and the chiral limit of massless quarks.

Development of a unified quark-hadron equation of state satisfying the constraints of Lattice QCD to study the hadron resonance gas with the Mott dissociation and quark confinement mechanism, application to a system with high baryon and isospin densities and prediction of critical endpoint location(s) in application to relativistic heavy ion experiments as well as compact star astrophysics.

Inclusion of event-by-event effects in the HydHSD hybrid model of heavy ion collisions, which combines viscous hydrodynamics of second order with the HSD/PHSD kinetic model, for a detailed study of an elliptic flow.

Update of the event generator based on the model of three-fluid dynamics (3FD). This updated version will be more suitable for simulations of heavy-ion collisions at BM@N and MPD-NICA energies. Study of production of nuclear fragments in heavy-ion collisions, formation and time evolution of collective flow in heavy-ion collisions within the updated THESEUS generator.

Study of the origin and applications of the Tsallis non-extensive statistics describing systems with long-range correlation in a more detailed manner by relaxing the factorization approximation. Investigation of the propagation of nonlinear waves inside quark-gluon plasma medium following the Tsallis-like momentum distribution for realistic phenomenological problems of relativistic heavy ion physics.

List of Activities

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers
1. Quantum field theory and physics beyond the Standard Model	**D.I. Kazakov** **A.V. Gladyshev** **A.V. Bednyakov**
BLTP	A.N. Baushev, A.T. Borlakov, Ch.R. Das, V. Gnatich, A.V. Kotikov, G.A. Kozlov, L. Mizhishin, V.A. Naumov, A.V. Nesterenko, A.I. Onishenko, A.F. Pikelner, R. Remetsky, D.M. Tolkachev, S.I. Vinitsky, A.A. Vladimirov, R.M. Yakhibbaev, 5 students
LIT	V.P. Gerdt, O.V. Tarasov
DLNP	V.A. Bednyakov, Yu.A. Budagov, E.V. Hramov, L.V. Kalinovskaya, L.G. Tkachev, E.V. Yakushev
2. QCD parton distributions for modern and future colliders	**I.V. Anikin** **O.V. Teryaev**
BLTP	V.V. Byt'yev, M. Deka, A.V. Efremov, S.V. Goloskokov, D.B. Kotlorz, Y.A. Klopot, S.V. Mikhailov, A.A. Pivovarov, G.Yu. Prokhorov, A.G. Oganesyan, O.V. Selyugin, A.J.Silenko, N.I. Volchanskiy, 6 students
VBLHEP	Yu.I. Ivanshin, A.P. Nagaitsev, I.A. Savin, R. Tsenov
DLNP	A.V. Guskov
3. Strong interactions phenomenology and precision physics	**M.A. Ivanov** **V.I. Korobov** **A.E. Dorokhov**
BLTP	A.B. Arbuzov, D. Alvarez, A.K. Bekbaev, Yu.M. Bystritsky, S.M. Eliseev, C. Ganbold, S.B. Gerasimov, A.N. Isadykov, L. Martynovich, K. Nurlan, H.-P. Pavel, A.A. Osipov, A.V. Sidorov, Yu.S. Surovtsev, Zh. Tyulemisov, M.K. Volkov, S.A. Zhaugasheva, 5 students
4. Theory of Hadronic Matter under extreme conditions	**D. Blaschke** **V.V. Braguta** **E.E. Kolomeitsev** **S.N. Nedelko**
BLTP	D.E. Alvarez-Castillo, N.Yu. Astrakhantsev, T. Bhattacharyya, M. Deka, S. Dorkin, A.E. Dorokhov, A.V. Friesen, A.A. Golubtsova, M. Hnatic, M. Hasegawa, Yu.B. Ivanov, E.-M. Ilgenfritz, L. Kaptari, A.S. Khvorostukhin, A.Yu. Kotov, K. Maslov, V.S. Melezhik, A.V. Nikolsky, S. Pandiat, A. Parvan, A.M. Snigirev, V.D. Tainov, O.V. Teryaev, V.D. Toneev, V.E. Voronin, D. Voskresensky, G.M. Zinoviev, 4 students
LIT	A.S. Ayriyan, H. Grigorian, Yu.L. Kalinovsky, E.G. Nikonov
VBLHEP	O.V. Rogachevsky, V. Voronyuk
5. Theory of electroweak interactions and neutrino physics	**A.B. Arbuzov** **V.A. Naumov** **F. Simkovic**

BLTP	A. Babic, A.V. Bednyakov, Yu.M. Bystritskiy, V.V. Byt'yev, A.E. Dorokhov, M.I. Krivoruchenko, K.S. Kuzmin, A.F. Pikel'ner, D.S. Shkirmanov, G. Seylkhanova, I.A. Sokal'skiy, 1 student
VBLHE	I.D. Kakorin, V.A. Zykunov
DLNP	Ye.V. Dydyshko, L.V. Kalinovskaya, D.V. Naumov, O.N. Petrova, R.R. Sadykov, A.A. Sapronov, O.Yu. Smirnov, V.I. Tretyak, 2 students

Collaboration

Country or International Organization	City	Institute or laboratory
Argentina	Buenos Aires	CNEA
Armenia	Yerevan	Foundation ANSL
		RAU
Azerbaijan	Baku	BSU
		IP ANAS
Belarus	Gomel	GSTU
		GSU
	Minsk	BSU
		INP BSU
		IP NASB
		JIPNR-Sosny NASB
Bulgaria	Sofia	INRNE BAS
		SU
Canada	Corner Brook	MUN
	Montreal	UdeM
CERN	Geneva	CERN
Chile	Valparaiso	UV
China	Beijing	PKU
	Lanzhou	IMP CAS
	Wuhan	WIPM CAS
Czech Republic	Prague	CTU
		CU
		IP CAS
	Rez	NPI CAS
Finland	Helsinki	UH
France	Lyon	UCBL
	Metz	UPV-M
	Montpellier	UM2
	Paris	UPMC
	Saclay	IRFU
		SPhN CEA DAPNIA
Georgia	Tbilisi	RMI TSU
		TSU
Germany	Aachen	RWTH
	Berlin	FU Berlin
		HU Berlin
	Bielefeld	Univ.
	Bochum	RUB
	Bonn	UniBonn
	Darmstadt	GSI
		TU Darmstadt
	Dortmund	TU Dortmund
	Erlangen	FAU

	Frankfurt/Main	FIAS
	Hamburg	DESY
		Univ.
	Heidelberg	Univ.
	Jena	Univ.
	Julich	FZJ
	Kaiserslautern	TU
	Karlsruhe	KIT
	Mainz	HIM
		JGU
	Munich	LMU
	Regensburg	UR
	Rostock	Univ.
	Tubingen	Univ.
	Wuppertal	UW
	Zeuthen	DESY
Hungary	Budapest	ELTE
		Wigner RCP
ICTP	Trieste	ICTP
India	Bhubaneswar	IOP
	Chennai	IMSc
	Kolkata	VECC
Italy	Naples	INFN
	Padua	UniPd
	Pavia	INFN
	Pisa	INFN
	Trieste	SISSA/ISAS
	Turin	UniTo
Japan	Chiba	Chiba U
	Kyoto	Kyoto Univ.
	Nagoya	Nagoya Univ.
	Osaka	Osaka Univ.
	Tokyo	Meiji Univ.
		Tokyo Tech
		UT
	Tsukuba	KEK
Kazakhstan	Almaty	FAPHI
		INP
	Nur-Sultan	BA INP
Mexico	Cuernavaca	UNAM
Mongolia	Ulaanbaatar	IPT MAS
New Zealand	Hamilton	Univ.
Norway	Trondheim	NTNU
Poland	Kielce	JKU
	Krakow	NINP PAS
	Lodz	UL
	Otwock (Swierk)	NCBJ
	Wroclaw	ITP UW
Portugal	Coimbra	UC
Republic of Korea	Cheongju	CBNU
	Daegu	KNU
	Seoul	SNU
Russia	Belgorod	BelSU
	Chernogolovka	LITP RAS

	Gatchina	NRC KI PNPI
	Irkutsk	ISDCT SB RAS
	Ivanovo	ICS RAS
		ISU
	Kazan	KFU
	Moscow	IBRAE
		IMM RAS
		ITEP
		LPI RAS
		MI RAS
		MISiS
		MSU
		PFUR
		SCC RAS
		SINP MSU
	Moscow, Troitsk	INR RAS
	Novosibirsk	BINP SB RAS
		IM SB RAS
	Omsk	OmSU
	Perm	PSNRU
	Protvino	IHEP
	Rostov-on-Don	SFedU
	Samara	SSU
		SU
	Saratov	SSU
	Sarov	VNIIEF
	St. Petersburg	SPbSPU
		SPbSU
	Tomsk	IHCE SB RAS
		TSU
	Tver	TvSU
	Yoshkar-Ola	VSUT
Serbia	Belgrade	Univ.
Slovakia	Bratislava	CU
		IP SAS
	Kosice	IEP SAS
Spain	Santiago de Compostela	USC
	Valencia	UV
Sweden	Lund	LU
Switzerland	Bern	Uni Bern
Ukraine	Dnipro	DNU
	Kharkov	NSC KIPT
	Kiev	BITP NASU
	Lutsk	EENU
	Lviv	IAPMM NASU
		IFNU
	Sumy	SumSU
United Kingdom	Canterbury	Univ.
	London	Imperial College
		QMUL
USA	College Park, MD	UMD
	East Lansing, MI	MSU
	Lemont, IL	ANL
	Long Beach, CA	CSULB

	Minneapolis, MN	U of M
	New York, NY	CUNY
		RU
	Newport News, VA	JLab
	Norman, OK	OU
	Philadelphia, PA	Penn
	San Diego, CA	SDSU
	University Park, PA	Penn State
Uzbekistan	Tashkent	IAP NUU
		NUU
Vietnam	Hanoi	IOP VAST

01-3-1136-2019/2023

Priority:	1

Status: In-progress

Theory of Nuclear Systems

Leaders: N.V. Antonenko
S.N. Ershov
A.A. Dzhioev

Participating Countries and International organizations:

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

Issues addressed and main goals of research:

Suggestion of new theoretical approaches for description and prediction of properties of superheavy, unstable nuclei and exotic nuclear systems, calculation of their characteristics; improvement of models for explanation of mechanisms of reactions of nuclei with particles and nuclei at low and intermediate energies; establishment of universal laws in low-dimensional small-particle systems and small-particle systems at ultra-low energies; development of the two-stage hybrid model of nuclear collisions at relativistic energies; study of nonlinear quantum processes in the interaction of photons with ultrashort high-frequency laser pulses.

Expected main results in the current year:

- Investigation of the coupling between electric and magnetic vortical states in deformed nuclei within the Skyrme random-phase-approximation method.

  Study of the effects of the phonon-phonon coupling on the properties of low-lying quadrupole states in the N=80 isotopes.

  Study of the nature of three branches of the nuclear scissors mode and associated neutron and proton currents taking into account spin degrees of freedom within the framework of the Wigner function moments method.

  Microscopic analysis of the nature of the spin scissors mode in deformed nuclei.

  Analysis of the $\gamma\gamma$-decay width of a low-energy quadrupole state.

  Study of electromagnetic transitions in superheavy atomic nuclei.

- Calculation and analysis of the production cross sections for superheavy nuclei with Z = 112-126 using various predictions of their properties.

  Study of the energy dependence of the total kinetic energy of fission fragments in the pre-actinide and actinide regions.

  Derivation of the analytical formula for the fusion reaction cross section at sub-barrier energies.

  Study of open quantum systems in external time-dependent fields.

  Calculation of spontaneous fission half-lives within the cluster approach.

  Investigation of the shape co-existence phenomenon and phase transitions in atomic nuclei.

Investigation of isovector pair correlations in nuclei with A~56.

Analysis of the contribution of various n-particle- n-hole configurations in the formation of spreading widths of giant nuclear resonances.

Calculation of partial cross sections of angular and mass distributions for products formed in deep inelastic reactions and quasifission.

- Bound state calculation of a two-atom system in a two-dimensional anharmonic trap.

Investigation of cluster correlations of 1*p*-shell nuclei in direct nuclear reactions.

Computation of resonances in Efimov-type systems.

Study of the structure of weakly bound triatomic systems.

Study of the effect of inelastic nuclear scattering on supernova neutrino spectra.

Investigation of the time evolution of the system of two interacting dipoles in external fields in two-dimensional geometry of an optical trap.

Development of the model of interaction between neutral particles and non-spherical nuclei.

Calculations of the 0_3^+ state of the ^{12}C nucleus in the α cluster model.

Development of a nonperturbative approach for quantitative analysis of the Coulomb and nuclear breakup of halo nuclei in the region of intermediate and low energies.

Optimal bounds on the speed of the subspace time evolution generated by quantum-mechanical Hamiltonians.

Calculation of the population of atomic levels under the action of a laser pulse of finite length in the adiabatic limit.

Low-energy asymptotics of the two-dimensional scattering phase shifts by a central power-like potential.

Modelling of the high harmonic generation by elliptically polarized strong laser fields beyond the dipole approximation.

Calculation of bound states in the continuum generated by super-interference.

Study of the near-surface diffusion in tunneling of diatomic beryllium molecules through the potential barriers in the strong channel coupling method.

- Identification of physical observables that are sensitive to the dynamics of multi-photon processes caused by intense short and ultra-short laser pulses with arbitrary polarization.

Modification of theoretical models for the processes of photo- and hadro- production in order to study the reaction mechanism and structure of exotic hadrons.

Calculation of the cross sections for reactions of the Y-meson with light mesons in the framework of the chiral model using different form-factors.

Investigation of the phase diagram structure for the quark matter under rotation in the framework of the Nambu-Jona-Losinio model.

Development of the existing and new approaches to solve the Dyson-Schwinger equations for quark and gluon propagators and the Bethe-Salpeter equations for quarkonia and glueballs at zero and finite temperature, and investigation of the analytical properties of the obtained solutions in the complex Euclidean plane.

Detailed study of the temperature dependence of gluon and quark propagators in the neighbourhood of temperatures of possible phase (crossover) transitions within the framework of Matsubara imaginary time formalism.

Theoretical analysis of the peculiarities of the pion-nucleon 3-3 resonance in pion-meson scattering on bound nucleons in nuclei.

Investigation of the transverse momentum distributions of hadrons created in heavy-ion and proton-proton collisions in the framework of statistical models.

Calculation of relativistic corrections to the form factors of three-nucleon bound states caused by Lorentz transformations using multi-rank separable potentials.

Investigation of the impact of the quark anomalous magnetic moment on the pion electromagnetic form factor.

List of Activities

	Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1.	**Microscopic models for exotic nuclei and nuclear astrophysics**	**V.V. Voronov** **A.A. Dzhioev** **J. Kvasil**
	BLTP	N.N. Arsenyev, E.B. Balbutsev, H. Ganev, V.A. Kuz'min, L.A. Malov, I.V. Molodtsova, V.O. Nesterenko, A.P. Severyukhin, V.M. Shilov, A.V. Sushkov, A.I. Vdovin, 2 students
	LIT	N.Yu. Shirikova
	FLNP	A.M. Sukhovoi
	DLNP	V.B. Brudanin
2.	**Low-energy nuclear dynamics and properties of nuclear systems**	**S.N. Ershov** **N.V. Antonenko** **R.V. Jolos**
	BLTP	G.G. Adamian, A.V. Andreev, A.N. Bezbakh, V.G. Kartavenko, Sh. Kalandarov, A.K. Nasirov, R.G. Nazmitdinov, H. Pasca
	FLNR	L.V. Grigorenko, Yu.E. Penionzhkevich
3.	**Quantum few-body systems**	**A.K. Motovilov** **A.S. Melezhik**
	BLTP	D. Janseitov, I. Ishmukhamedov, O.P. Klimenko, E.A. Kolganova, V.N. Kondratyev, A.A. Korobitsyn, E.A. Koval, A.V. Malykh, V.S. Melezhik, E.A. Solov'ev, D. Valiolda, S.I. Vinitsky, 4 students
	DLNP	O.I. Kartavtsev

LIT	O. Chulunbaatar, V.P. Gerdt, A.A. Gusev
4. Relativistic nuclear dynamics and nonlinear quantum processes	**V.V. Burov** **M. Gaidarov** **S.G.Bondarenko**
BLTP	A.V. Frisen, L.P. Kaptari, A. Khvorostukhin, V.K. Lukyanov, E. Myrzabekova, A.S. Parvan, N. Sagimbaeva, A.I. Titov, V.D. Toneev, S.A. Yur'ev, 1 student
LIT	K.V. Lukyanov, E.V. Zemlyanaya
VBLHEP	A.I. Malakhov, N.M. Piskunov, Yu.A. Panebratsev, E.P. Rogochaya

Collaboration

Country or International Organization	City	Institute or laboratory
Armenia	Yerevan	RAU
		YSU
Austria	Innsbruck	Univ.
Belarus	Minsk	IP NASB
Belgium	Brussels	VUB
	Louvain-la-Neuve	UCL
Brazil	Florianopolis, SC	UFSC
	Niteroi, RJ	UFF
	Sao Jose dos Campos, SP	ITA
	Sao Paulo, SP	UEP
Bulgaria	Sofia	INRNE BAS
		NBU
Canada	Hamilton, ON	McMaster
	Saskatoon	U of S
	Waterloo	WLU
China	Beijing	CIAE
		ITP CAS
		PKU
Czech Republic	Prague	CU
	Rez	NPI CAS
Egypt	Cairo	EAEA
	Giza	CU
France	Bordeaux	UB
	Caen	GANIL
	Orsay	CSNSM
		IPN Orsay
Germany	Berlin	HZB
	Bielefeld	Univ.
	Bonn	UniBonn
	Cologne	Univ.
	Darmstadt	GSI
		TU Darmstadt
	Dresden	HZDR
	Erlangen	FAU
	Frankfurt/Main	Univ.
	Giessen	JLU
	Hamburg	Univ.
	Leipzig	UoC
	Mainz	JGU
	Regensburg	UR

	Rostock	Univ.
	Siegen	Univ.
Greece	Athens	INP NCSR "Demokritos"
Hungary	Budapest	Wigner RCP
	Debrecen	Atomki
India	Chandigarh	PU
	Kasaragod	CUK
	New Delhi	IUAC
Iran	Zanjan	IASBS
Italy	Bologna	BRC ENEA
	Catania	INFN LNS
	Messina	UniMe
	Naples	INFN
	Perugia	INFN
	Turin	UniTo
Japan	Kobe	Kobe Univ.
	Morioka	Iwate Univ.
	Osaka	Osaka Univ.
		RCNP
Kazakhstan	Almaty	INP
Lithuania	Kaunas	VMU
Moldova	Chisinau	IAP
Norway	Bergen	UiB
	Oslo	UiO
Poland	Krakow	NINP PAS
	Lublin	UMCS
	Otwock (Swierk)	NCBJ
	Warsaw	UW
Republic of Korea	Daejeon	IBS
	Jeonju	JBNU
	Seoul	SNU
Romania	Bucharest	IFIN-HH
		UB
Russia	Gatchina	NRC KI PNPI
	Khabarovsk	PNU
	Moscow	MSU
		NNRU "MEPhI"
		NRC KI
		PFUR
		SINP MSU
	Moscow, Troitsk	INR RAS
	Omsk	OmSU
	Saratov	SSU
	St. Petersburg	SPbSU
	Vladivostok	FEFU
Serbia	Belgrade	IPB
Slovakia	Bratislava	CU
		IP SAS
South Africa	Pretoria	UNISA
	Somerset West	iThemba LABS
	Stellenbosch	SU
Spain	Palma	UIB
Sweden	Goteborg	Chalmers
	Lund	LU

Switzerland	Bern	Uni Bern
Taiwan	Taipei	IP AS
		NTU
Ukraine	Kharkov	NSC KIPT
	Kiev	BITP NASU
		KINR NASU
		NUK
United Kingdom	Guildford	Univ.
USA	Lemont, IL	ANL
	Los Alamos, NM	LANL
	Notre Dame, IN	ND
	Raleigh, NC	NCCU
	University Park, PA	Penn State
Uzbekistan	Namangan	NamMTI
	Tashkent	Assoc. P.-S. PTI
		IAP NUU
		INP AS RUz

01-3-1137-2019/2023

Priority:	1

Status: In-progress

Theory of Complex Systems and Advanced Materials

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

Participating Countries and International organizations:

Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Brazil, Bulgaria, Canada, Czech Republic, Denmark, Ecuador, Egypt, France, Germany, Hungary, India, Iran, Italy, Japan, Mongolia, New Zealand, Poland, Republic of Korea, Romania, Russia, Serbia, Slovakia, Slovenia, South Africa, Spain, Switzerland, Taiwan, Ukraine, United Kingdom, USA, Uzbekistan, Vietnam.

Issues addressed and main goals of research:

Development of analytical and numerical methods for studying complex many-body systems that are of current interest in modern condensed matter physics, the development of mathematical models of these systems and the identification of universal laws on the example of studied models. Analysis of both lattice and field-theory models of equilibrium and non-equilibrium statistical systems and modeling of a wide class of new materials, including nanostructured materials, which are of great practical importance. The concepts of scaling and universality allow one to go beyond the model approach and to apply the results obtained to broad classes of phenomena studied in the physics of condensed matter. The results obtained will be used in carrying out experimental studies of condensed matter at JINR. It is important to note the markedly growing interdisciplinary nature of research, where condensed matter physics and statistical physics closely intersect with atomic and nuclear physics, particle physics, mathematical physics, astrophysics, and biology.

Expected main results in the current year:

- Development of new methods for studying structural properties of complex systems at nano and micro scales using the small-angle scattering technique. Description of magnetodielectric and magnetorheological effects in smart composite materials.

  Modeling of vacancy defects with impurities generated by irradiation with neutrons or heavy ions in HfC_xN_{1-x} and graphen layers on wolfram slabs for the purpose of comparison with the quantities measured by positron annihilation spectroscopy.

  Construction of the theoretical magnetic phase diagram and the spin-wave spectrum of rare-earth magnets $YbMgGaO_4$ and $YbZnGaO_4$ in a magnetic field and comparison with inelastic neutron scattering data.

  Calculation of quantum corrections to the spin-wave spectrum of strongly spin-orbit coupled insulator in a magnetic field with in-plane anisotropic interactions.

  Calculation of magnon spectral line broadening in a honeycomb ferromagnet with Dzyaloshinskii-Moriya interactions.

  Calculation of the electronic spectrum in strongly-correlated electronic systems within the t-J model. Study of the influence of short-range antiferromagnetic correlations on the transformation of the Femi surface topology. Comparison of the obtained results with experiments in hole-doped cuprates.

  Calculation of the electronic spectrum and superconductivity temperature as a function of doped holes in the extended t – J model where the intersite Coulomb repulsion and the electron-phonon interaction are taken into account.

  Development of new methods for regulating spin reversal in magnetic nanomaterals.Construction of a theory of statistical systems with several coexisting symmetries.

- Investigation of dynamics of collective excitations in the Josephson superconductor-ferromagnet-superconductor nanostructures and their manifestation in the current-voltage characteristics of these systems.

Calculation of the electron mobility and conductivity of polycrystalline graphene.

Investigation of the electron transport in nanostructures based on modern materials such as transition metal chalcogenides and graphene, taking into account the effect of scattering by phonons and the role of the surface.

Investigation of electronic transport properties of molybdenum disulphide monolayer with randomly distributed and periodic antidots in the band and hopping transport regimes.

Investigation of a novel type of superconductivity that emerges in the 3-band Hubbard model on the lattices featuring a topological flat band. Application of this approach to account for high-temperature superconductivity in CuO_2 geometry.

- Finding of connections between the 6j-symbols of the group SL(2,C) with the degenerate cases of superconformal indices of four-dimensional field theories and partition functions of three-dimensional field theories on curved manifolds.

Construction of superconformal indices related to field theories on lens space.

Description of stochastic models of interacting particles with pairing on a one-dimensional lattice. Construction of the Green function and characterization of limiting hydrodynamics and characteristic fluctuations with the help of the Bethe ansatz and free-fermion techniques.

Description of the statistics of loops in the critical percolation model on a cylinder using techniques based on the Temperley-Lieb algebra representations and the Bethe ansatz.

Finding of stochastic dualities in the models of interacting particles based on the properties of the Hecke algebras and their representations.

Investigation of "entangled states" of a complex quantum system when the entire system is in a well-defined state but subsystems are not.

Cosntruction of the quasi-oscillator representation of linear quantum groups: construction of the finite-dimensional representations and investigation of the Hopf structures.

Finding of polynomial solutions of the finite-difference Knizhnik-Zamolodchikov equations related to the diffusion-annihilation stochastic processes. Description of duality functions for these processes.

List of Activities

Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1. Complex materials	**E. Anitas** **N.M. Plakida**
BLTP	A.Yu. Cherny, A.A. Donkov, A.L. Kuzemsky, Tung Nguen Dan, A.A. Vladimirov, V.I. Yukalov, V.Yu. Yushankhai
FLNP	V.L. Aksenov, A.M. Balagurov, A. Islamov, D.P. Kozlenko, A.I. Kuklin, E.P.Popov
LIT	L.A. Syurakshina, E.P. Yukalova
2. Nanostructures and nanomaterials	**V.A. Osipov** **E.A. Kochetov**
BLTP	A.V. Chizhov, A.A. Glebov, I.D. Ivantsov, V.L. Katkov, D.V. Kolesnikov, S.E. Krasavin, K.V. Kulikov, M. Maiti, I.R. Rachmonov, O, , Sadykova, Yu.M. Shukrinov
LIT	I. Sarhadov, S.I. Serdyukova, E.B. Zemlianaya
LRB	A.N. Bugay
FLNR	A. Olejniczak

3. Mathematical models of statistical physics of complex systems — **A.M. Povolotsky**

BLTP — A.E. Derbyshev, V.I. Inozemtsev, V. Papoyan, P.N. Pyatov, V.P. Spiridonov, P.E. Zhidkov

Collaboration

Country or International Organization	City	Institute or laboratory
Armenia	Yerevan	Foundation ANSL
		IIAP NAS RA
		YSU
Australia	Melbourne	Univ.
	Sydney	Univ.
Austria	Linz	JKU
	Vienna	TU Wien
Azerbaijan	Baku	Branch MSU
Belarus	Minsk	BSTU
		IP NASB
		JIPNR-Sosny NASB
		SPMRC NASB
		UCP MES
Belgium	Louvain-la-Neuve	UCL
Brazil	Brasilia, DF	UnB
	Natal, RN	IIP UFRN
	Sao Paulo, SP	USP
Bulgaria	Plovdiv	PU
	Sofia	IMech BAS
		INRNE BAS
		ISSP BAS
		SU
Canada	Kingston, ON	Queen's
	London, ON	Western
	Montreal	Concordia
	Quebec	UL
Czech Republic	Olomouc	UP
	Rez	NPI CAS
Denmark	Lyngby	DTU
Ecuador	Quito	USFQ
Egypt	Giza	CU
France	Marseille	CPT
		UPC
	Nice	UN
	Paris	UPMC
	Valenciennes	UVHC
Germany	Bonn	UniBonn
	Braunschweig	TU
	Bremen	Univ.
	Darmstadt	GSI
		TU Darmstadt
	Dortmund	TU Dortmund
	Dresden	IFW
		MPI PkS
		TU Dresden
	Jena	Univ.

	Leipzig	UoC
	Magdeburg	OVGU
	Rostock	Univ.
	Wuppertal	UW
Hungary	Budapest	Wigner RCP
India	Kolkata	IACS
Iran	Zanjan	IASBS
Italy	Catania	UniCT
	Fisciano	UNISA
Japan	Utsunomiya	UU
Mongolia	Ulaanbaatar	IPT MAS
		NUM
New Zealand	Auckland	Univ.
Poland	Katowice	US
	Krakow	JU
	Poznan	AMU
		IMP PAS
	Warsaw	IPC PAS
	Wroclaw	WUT
Republic of Korea	Daejeon	CTPCS IBS
	Incheon	Inha
Romania	Bucharest	IFIN-HH
	Cluj-Napoca	UTC-N
	Timisoara	UVT
Russia	Belgorod	BelSU
	Gatchina	NRC KI PNPI
	Kazan	KFU
	Moscow	ITEP
		MI RAS
		MIREA
		NNRU "MEPhI"
		NRC KI
		NRU HSE
		PFUR
		SINP MSU
	Moscow, Troitsk	HPPI RAS
		INR RAS
	Perm	PSNRU
	Protvino	IHEP
	Samara	SU
	Saratov	SSU
	St. Petersburg	ETU
		Ioffe Institute
		ITMO Univ.
		PDMI RAS
		SPbSU
	Vladimir	VISU
	Voronezh	VSU
Serbia	Belgrade	INS "VINCA"
Slovakia	Bratislava	CU
	Kosice	IEP SAS
		UPJS
Slovenia	Ljubljana	UL
South Africa	Pretoria	UNISA

Spain	Madrid	ICMM-CSIC
Switzerland	Villigen	PSI
	Zurich	ETH
Taiwan	Taipei	IP AS
Ukraine	Kharkov	NSC KIPT
	Kiev	IMP NASU
		NUK
	Lviv	ICMP NASU
United Kingdom	Coventry	Warwick
USA	Durham, NC	Duke
	Irvine, CA	UCI
	Louisville, KY	UofL
	New York, NY	CUNY
	Pasadena, CA	Caltech
	Piscataway, NJ	Rutgers
	Rochester, NY	UR
	Tallahassee, FL	FSU
Uzbekistan	Tashkent	Assoc. P.-S. PTI
Vietnam	Hanoi	IMS VAST

01-3-1138-2019/2023

Priority:	1

Status: In-progress

Modern Mathematical Physics: Gravity, Supersymmetry and Strings

Leaders: A.P. Isaev
S.O. Krivonos
A.S. Sorin

Scientific leader: A.T. Filippov

Participating Countries and International organizations:

Armenia, Australia, Brazil, Bulgaria, Canada, CERN, Czech Republic, Estonia, France, Germany, Greece, ICTP, India, Israel, Iran, Ireland, Italy, Japan, Lithuania, Luxembourg, Norway, Poland, Portugal, Republic of Korea, Russia, Spain, Taiwan, Ukraine, United Kingdom, USA.

Issues addressed and main goals of research:

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 of the geometric description of quantum symmetries and their spontaneous breaking in the framework of search for a unified theory of all fundamental interactions, including quantum gravity. Mathematical physics in recent years has been characterized by increasing interest in identifying and effective use of integrability in various areas, and in applying powerful mathematical methods of quantum groups, supersymmetry and non-commutative geometry to quantum theories of fundamental interactions as well as to classical models.

The main goals and tasks of the research within the theme include: development of new mathematical methods for investigation and description of a variety of classical and quantum integrable models and their exact solutions; analysis of a wide range of problems in supersymmetric theories including models of superstrings and superbranes, study of non-perturbative regimes in supersymmetric gauge theories; development of cosmological models of the early Universe, primordial gravitational waves and black holes. The decisive factor in solving the above problems will be the crucial use of the mathematical methods of the theory of integrable systems, quantum groups and noncommutative geometry as well as superspace techniques.

Expected main results in the current year:

- Construction of the hierarchy of Mironov lagrangian cycles in Grassmannians of any degree of homogeneity.

  Search for minimality and the Hamiltonian minimality conditions for the Mironov lagrangian cycles in the Kahler – Einstein manifolds.

  Obtaining of giant magnons and single spike quasiclassical string solutions on the Schr5×T1,1 background. Search for dispersion relations for these classes of string solutions in the above background by using finite combinations of conserved charges.

  Investigation of pulsating strings on the Schr5×T1,1 background. Obtaining of energy spectra and perturbative quantum corrections up to first order in the small parameter by semi-classicall quantization of the pulsating string.

  Obtaining of quasiclassical string solutions of different types in 5d Kerr-AdS background geometry, mostly of the pulsating string class.

Calculation of quadratic fluctuations of the world sheet of different types of string configurations and obtaininig of a one-loop correction to energy of pulsating string solutions.

High precision calculations of quasi-normal modes and study of their physical applications.

Development of new methods for solution of quasilinear partial differential equations in the complex domain of variables and their physical applications.

Construction of an N=(1,0) superfield analog of the Pasti-Sorokin-Tonin action of the abelian self-dual tensor field in six dimensional spacetime, search for its generalizations with the nonabelian tensor field and N=(2,0) supersymmetry.

Research and effective construction of state spaces in orthogonal and symplectic quantum integrable systems associated with the Yangians of the classical series B(n), C(n) and D(n) Lie algebras. Investigation of the scalar products of state vectors in these models.

Development of a new model of black hole evaporation in terms of a matrix model for dual two-dimensional gravity. Investigation of a case involving conical singularities in gravitational theory.

Wilson loops calculation for the supersymmetric case of the 5d Kerr-AdS background; the analysis of the leading contributions and comparison with the results of calculations in the dual conformal theory on $R \times S^3$.

Study of the dynamics of a quasi-classical pulsating (bosonic) string in the 5d Kerr-AdS space. Search for anomalous dimensions of operators for the dual gauge theory. Calculation of the quadratic fluctuations of the world sheet for various types of string configurations, obtaining of a one-loop correction to energy of pulsating strings.

Derivation of covariant equations of particles with continuous (infinite) spin within the framework of the generalized Wigner scheme. Search for infinite-dimensional analogs of the Wigner operators that transform a massless test pulse into an arbitrary one.

Construction of projectors onto irreducible representations of symmetry groups of multidimensional (anti) de Sitter spaces using the multidimensional Poincaré group algebraic method well-proven in the theory of representations, the key object of which is the Brauer algebra.

Construction of the split Casimir operator (SCO) for the exceptional Lie algebras in the defining and adjoint representations as well as calculation of the characteristic identity for SCO and finding of the corresponding solutions to the Yang-Baxter equation.

Construction of the trigonometric and hyperbolic Calogero and Ruijsenaars-Schneider models with extended supersymmetry.

- Study of quantum models of N=4 an N=8 supersymmetric mechanics, their integrability, the presence of hidden (super) symmetries and exploring of their relationships with supersymmetric gauge theories.

Construction of new examples of quaternion-kahler N=4 mechanics on inhomogeneous target manifolds, including those with Wess-Zumino terms in the Lagrangian, investigation of their hamiltonian structure and quantization for a few simple cases.

Generalization of the method of gauging isometries in N=4 mechanics to the N=8 case, study of its possble role for constructing new models of N=8 mechanics and finding out interrelations between different models.

Setting up new superextensions of integrable multiparticle systems of the Calogero type and their covariant quantization

with application of the 1D harmonic superspace approach and the gauging method and revealing of the relation of these methods to the hamiltonian approach to the same systems.

Analysis of the quantum structure of the superfield effective action in the 6D and 5D supersymmetric gauge theories and supergravities on the basis of the appropriate harmonic superspace formulations.

Study of conformal field theories and their connections with integrable models and N=2 supersymmetric gauge theories as well as applications of these formalisms in condensed matter, statistical, and gravitational physics.

Study of the p>1 и q>1 limits of the difference equations for rarefied elliptic hypergeometric integrals. Obtaining of the corresponding difference equations for the parafermionic hyperbolic hypergeometric integrals in this limit, which will be used to study supersymmetric extensions of the relativistic Calogero models and also for calculation of the one-point matrix of the modular transformations on a torus in the N=1 supersymmetric 2D Liouville field theory.

Study of black holes and requlars particle-like localized solutions of the Einstein equations in asymptotically flat 3+1 dimensional spacetime and in the asymptotically AdS spacetime.

- Derivation of vacuum energy for quantum fields on the background of several crossed or moving cosmic strings. Study of various effects related to cosmic strings, their peculiarities and observability in the massless string limit.

Development of the heat kernel approach and derivation of the Schwinger-DeWitt coefficients for the SU(N) gluodynamics with boundaries and in the external field, specifically, for studying the influence of the boundary conditions on the effective potential and the free energy. Derivation of the uniform asymptotic expansion for the hypergeometric function arising in the free energy computation.

Investigation of non-minimal interactions induced by loop corrections in effective scalar-tensor theories of gravity. Determination of the restrictions on the magnitude of these interactions by the observed form of Newton's law as well as by data on violation of the weak equivalence principle.

Investigation of cosmological perturbations in a covariant formulation of teleparallel gravity with non-minimal coupling. Derivation of equations for scalar perturbations within this approach and obtaining of the spectrum of scalar perturbations during inflation. Comparative analyses with the case of teleparallel gravity without non-minimal coupling and with the results obtained by other methods.

List of Activities

	Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1.	**Quantum groups and integrable systems**	**A.P. Isaev** **N.A. Tyurin**
	BLTP	M. Buresh, P. Fiziev, A.A. Golubtsova, N.Yu. Kozyrev, D.R. Petrosyan, M. Podoinitsyn, G.S. Pogosyan, A.V. Silantyev
	UC	S.Z. Pakuliak
2.	**Supersymmetry**	**E.A. Ivanov**
	BLTP	S.A. Fedoruk, A. Nersessian, M. Pientek, A. Pietrikovsky, I.B. Samsonov, G. Sarkissyan, S.S. Sidorov, Ya.M. Shnir, A.O. Sutulin
3.	**Quantum gravity, cosmology and strings**	**A.T. Filippov** **I.G. Pirozhenko** **V. Nesterenko**
	BLTP	B.M. Barbashov, I. Bormotova, E.A. Davydov, V.V. Nesterenko, A.B. Pestov, A.A. Provarov, G.I. Sharygin, E.A.

	Tagirov, P.V. Tretyakov, P. Yaluvkova, A.F. Zakharov, 3 students
LIT	I.L. Bogoliubsky, A.M. Chervyakov
VBLHEP	E.E. Donets

Collaboration

Country or International Organization	City	Institute or laboratory
Armenia	Yerevan	Foundation ANSL
		YSU
Australia	Perth	UWA
	Sydney	Univ.
Brazil	Juiz de Fora, MG	UFJF
	Sao Paulo, SP	USP
	Vitoria, ES	UFES
Bulgaria	Sofia	INRNE BAS
Canada	Edmonton	U of A
	Montreal	Concordia
CERN	Geneva	CERN
Czech Republic	Opava	SlU
	Prague	CTU
	Rez	NPI CAS
Estonia	Tartu	UT
France	Annecy-le-Vieux	LAPP
	Lyon	ENS Lyon
	Marseille	CPT
	Nantes	SUBATECH
	Paris	ENS
		LUTH
	Tours	Univ.
Germany	Bonn	UniBonn
	Hannover	LUH
	Leipzig	UoC
	Oldenburg	IPO
	Potsdam	AEI
Greece	Athens	UoA
	Thessaloniki	AUTH
ICTP	Trieste	ICTP
India	Chennai	IMSc
	Kolkata	BNC
		IACS
Iran	Tehran	IPM
Ireland	Dublin	DIAS
Israel	Tel Aviv	TAU
Italy	Frascati	INFN LNF
	Padua	UniPd
	Pisa	INFN
	Trieste	SISSA/ISAS
	Turin	UniTo
Japan	Tokyo	Keio Univ.
		UT
Lithuania	Vilnius	VU
Luxembourg	Luxembourg	Univ.

Norway	Trondheim	NTNU
Poland	Bialystok	UwB
	Lodz	UL
	Wroclaw	UW
Portugal	Aveiro	UA
Republic of Korea	Seoul	SKKU
Russia	Chernogolovka	LITP RAS
	Kazan	KFU
	Moscow	ITEP
		LPI RAS
		MI RAS
		MSU
		SAI MSU
	Moscow, Troitsk	INR RAS
	Novosibirsk	NSU
	Protvino	IHEP
	St. Petersburg	PDMI RAS
	Tomsk	TPU
		TSPU
Spain	Barcelona	IEEC-CSIC
	Bilbao	UPV/EHU
	Madrid	ETSIAE
	Santiago de Compostela	USC
	Valencia	IFIC
Taiwan	Taoyuan City	NCU
Ukraine	Kharkov	KhNU
		NSC KIPT
	Kiev	BITP NASU
United Kingdom	Cambridge	Univ.
	Canterbury	Univ.
	Durham	Univ.
	Glasgow	U of G
	Leeds	UL
	London	Imperial College
	Nottingham	Univ.
USA	Amherst, MA	UMass
	College Park, MD	UMD
	Coral Gables, FL	UM
	New York, NY	CUNY
		SUNY
	Norman, OK	OU
	Piscataway, NJ	Rutgers
	Rochester, NY	UR
	Tempe, AZ	ASU

01-3-1117-2014/2023

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:

Armenia, Austria, Belarus, Brazil, Bulgaria, Canada, China, CERN, Czech Republic, France, Germany, Greece, Hungary, India, Israel, Italy, Japan, Norway, Poland, Romania, Russia, Serbia, Slovakia, South Africa, Spain, 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.
- Coordination with the schools and workshops supported by the European
- Participation in nets of workshops and schools in Europe.
- 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 the current year:

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

List of Activities

Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers
1. DIAS-TH	**A.S. Sorin** **V.V Voronov**
BLTP	D. Blaschke, A.V. Frizen, A.P. Isaev, M.A. Ivanov, R.V. Jolos, D.I. Kazakov, E.A. Kolganova, I.G. Pirozhenko, V.A. Osipov, V.P. Spiridonov, A.A. Starobinsky, O.V. Teryaev, P.V. Tretyakov, V.I. Zhuravlev, 4 students
LIT	V.V. Korenkov, Yu.L. Kalinovsky
UC	S.Z. Pakuliak
FLNP	V.L. Aksenov
VBLHEP	V.D. Kekelidze, M.V. Savina
DLNP	V.A. Bednyakov
FLNR	Yu.Ts. Oganessian

Collaboration

Country or International Organization	City	Institute or laboratory
Armenia	Yerevan	YSU
Austria	Vienna	ITP TU Wien
		TU Wien
Belarus	Gomel	GSTU
Brazil	Sao Paulo, SP	USP
Bulgaria	Sofia	INRNE BAS
		SU
Canada	Edmonton	U of A
	Montreal	UdeM
CERN	Geneva	CERN
China	Wuhan	WHU
Czech Republic	Prague	CTU
	Rez	NPI CAS
France	Annecy-le-Vieux	LAPP
	Dijon	UB
	Lyon	ENS Lyon
	Marseille	CPT
	Nantes	SUBATECH

	Paris	ENS
		LPTHE
	Valenciennes	UVHC
Germany	Bonn	UniBonn
	Hamburg	DESY
	Hannover	LUH
	Jena	Univ.
	Leipzig	UoC
	Munich	MPI-P
	Potsdam	AEI
	Rostock	Univ.
	Zeuthen	DESY
Greece	Athens	UoA
Hungary	Budapest	Wigner RCP
India	Kolkata	BNC
Israel	Rehovot	WIS
Italy	Fisciano	UNISA
	Frascati	INFN LNF
	Padua	UniPd
	Pavia	INFN
	Pisa	INFN
	Trieste	SISSA/ISAS
	Turin	UniTo
Japan	Chiba	CIT
	Kyoto	KSU
		RIMS
	Tsukuba	KEK
Norway	Oslo	UiO
Poland	Warsaw	UW
	Wroclaw	UW
Romania	Bucharest	IFIN-HH
Russia	Chernogolovka	LITP RAS
	Moscow	ITEP
		MI RAS
		MSU
		NRU HSE
		SCC RAS
		SINP MSU
		VNIIMS
	Moscow, Troitsk	INR RAS
	Novosibirsk	BINP SB RAS
	Protvino	IHEP
	Saratov	SSU
	Tomsk	TPU
Serbia	Belgrade	IPB
		Univ.
Slovakia	Banska Bistrica	UMB
South Africa	Cape Town	UCT
Spain	Madrid	UAM
Turkey	Istanbul	BU
Ukraine	Kiev	BITP NASU
United Kingdom	Cambridge	Univ.
	Durham	Univ.
	London	Imperial College

	Southampton	Univ.
	York	Univ.
USA	Cincinnati, OH	UC
	College Park, MD	UMD
	Coral Gables, FL	UM
	Minneapolis, MN	U of M
	New York, NY	CUNY
		SUNY
	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)

02-2-1123-2015/2022

Priority:	1

Status: In-progress

Study of Fundamental Interactions in e^+e^- Collisions

Leader: A.S. Zhemchugov
Deputy: A.V. Guskov

Participating countries and international organizations:

CERN, China, Germany, Poland, Russia, Sweden.

Issues addressed and main goals of research:

The Standard Model (SM) provides the most accurate and universal description of the physics phenomena on a microscale nowadays. However, it is not free from a number of shortcomings. Some predictions of the Standard Model still have not been observed experimentally. In many cases the accuracy of the predictions is limited by the experimental knowledge of the key free parameters of the theory. At the same time, the search for New Physics beyond the Standard Model may show the way to further develop the theory and to get rid of its shortcomings. The main tool for these studies is the collider experiments using both proton-proton (LHC) and electron-positron collisions. The latter are most suitable for the precision studies of elementary particles with obvious advantages from well-defined kinematics of the initial state and the absence of the large QCD background typical of hadronic colliders.

Precision test of SM predictions and search for new phenomena beyond the SM in charmonium and tau lepton decays are fulfilled in the scope of this theme using the world best facility in this energy domain - the unique electron-positron collider BEPC-II and the BES-III detector. At the same time, preparation for experiments at the future electron-positron colliders (ILC, CLIC, CEPC, FCC-ee) is under way.

Expected results in the current year:

- BES-III data analysis.
- Development of offline software and analysis tools.
- Development of a multipurpose MC event generator to describe the main processes of e^+e^- annihilation including radiative corrections at a level of more than one loop. The generator will take into account the particle polarization for both initial and final states.
- Development of standard program codes to calculate radiation corrections at a level of 2 (for EW interactions) and 3 (for strong interactions) loops.
- Study of the research potential of the experiments at the CLIC collider in the domain of precision measurements and search for new physics on the basis of full detector simulation.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	BES-III	A.S. Zhemchugov	2 (2007-2022)
2.	ARIeL	L.Y. Kalinovskaya	3 (2019-2021)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1.	**BES-III Project**	**A.S. Zhemchugov**	Realization
	DLNP	O.V. Bakina, I.R. Boyko, D.V. Dedovich, I.I. Denisenko, A.V. Guskov, Yu.A. Nefedov, G.A. Shelkov	
	BLTP	V.V. Bytev	
	LIT	V.V. Korenkov, G.A. Ososkov, I.S. Pelevanyuk	
2.	**ARIeL Project**	**L.V. Kalinovskaya**	Realization
	DLNP	I.R. Boyko, E.V. Dydyshko, Yu.A. Nefedov, N.E. Pukhaeva, L.A. Rumyantsev, A. Rymbekova, A.A. Sapronov, R.R. Sadykov, P.V. Shvydkin, A.S. Zhemchugov, V. Yermolchyk, Yu. Yermolchyk	
	BLTP	A.B. Arbuzov, C.G. Bondarenko	
	LIT	I.S. Pelevanyuk	

Collaboration

Country or International Organization	City	Institute or laboratory
Belarus	Minsk	INP BSU
CERN	Geneva	CERN
China	Beijing	IHEP CAS
Germany	Hamburg	DESY
	Hannover	LUH
Poland	Katowice	US
	Krakow	NINP PAS
Russia	Gatchina	NRC KI PNPI
	Novosibirsk	BINP SB RAS
Sweden	Lund	LU

02-0-1081-2009/2024		Priority:	1

Status: In-progress

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, Bulgaria, Canada, CERN, Czech Republic, France, Germany, Georgia, Israel, Italy, Netherlands, Russia, Slovakia, Spain, USA, Uzbekistan.

Issues addressed and main goals of research:

Absolutely new and unique data will be obtained in multifaceted and comprehensive researches of proton-proton scattering processes. Analysis of these data will allow several fundamental physical problems to be solved. Within this project, JINR scientists will participate in these analyses.

It is expected to obtain new results and make publications on all above-mentioned tasks where JINR scientists have responsibilities. The most important tasks are the studies of the proton structure and hadron state spectrum, probing of the Standard Model at the LHC energies, search for and investigation of supersymmetry, search for the evidence of existence of new particles and new interactions. In addition JINR intend to obtain new results that will help specify properties of already known elementary particles such as *W*- and *Z*-bosons, top-quark, heavy barions etc.

Implementation of this Project aimed at solving highly significant scientific problems unique applied results that may significantly change the quality of life. Among these results can be experience in operation of remote monitoring systems for technically complicated devices, work with big data and development and use of distributed comtputing systems, etc.

Expected results in the current year:

- Investigation of the applicability of the Standard Model and verification of SM predictions (including interactions of heavy ions), determination the structure of the proton at ultra-high energies (PDFs), tuning and improvement of relevant computer codes and events generators etc.
- Search for the chiral Z^*/W^* bosons in the two-jet decays and in the process with more complex topology of their associative production including heavy *b* and *t* quarks.
- Search for (supersymmetric) charged Higgs bosons via their specific decay modes (3-lepton, etc).
- Analyses on associated productions of the SM Higgs withpair and search for production with single top.
- Search for a valence-like nonperturbative component of heavy quarks in the proton (intrinsic heavy quarks) via specific final state topology in the pp interactions.
- Search for new hadrons and baryons containing heavy c and b quarks and study of their properties.
- Measurement of the Drell Yan triple-differential cross section and effective leptonic weak mixing angle in the Z-boson decay.
- New comprehensive study of the gluon structure of the proton, etc.
- Search for quantum black holes in the lepton+jet channel at 13 TeV.
- Participation in the development event trigger indexing infrastructure.
- Development and maintenance of the TDAQ system.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	ATLAS. Physical researches at LHC	V.A. Bednyakov Deputies: E.V. Khramov A.P. Cheplakov	1 (2010-2023)
2.	Upgrade of the ATLAS Detector	A.P. Cheplakov	1 (2013-2023)

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 Yu.A. Budagov N.A. Russakovich G.P. Chelkov	A.M. Artikov, N.V. Atanov, V.Yu. Baranov, V.Yu. Batusov, I.R. Boyko, E.A. cherepanova, M.V. Chizhov, Z. Chubinidze, Yu.I. Davydov, D.V. Dedovich, M.A. Demichev, A.V. Ershova, V.A. Gerasimov, L.R. Gladilin, V.V. Glagolev, A. Gongadze, I. Gongadze, L. Gongadze, M.I. Gostkin, A.V. Guskov, N. Huseinov, Yu.P. Ivanov, L.V. Kalinovskaja, S.N. Karpov, Z.M. Karpova, D.V. Kharchenko, I. Kostyukhina, O.A. Koval, D.A. Kozhevnikov, V.G. Kruchonok, Yu.A. Kultchitsky, M.V. Lyablin, G.I. Lykasov, V.V. Lyubushkin, T.V. Lyubushkina, S.N. Malyukov, M. Manashova, I. Minashvili, I. Minashvili I., Yu.A. Nefedov, A.A. Nozdrin, E.M. Plontikova, S.Yu. Porokhovoy, I.N. Potrap, F.V. Prokoshin, V.M. Romanov, T.O. Rudenko, S.S. Rzaeva, R.R. Sadykov, A.A. Sapronov, A.V. Simonenko, P.I. Smolyanskiy, M.M. Shiyakova, A.N. Shalyugin, Yu.Yu Stepanenko, V.V. Tereschenko, I.N. Troeglazov, P.V. Tereshko, S.M. Turchikhin, Yu.A. Usov, Z. Usubov, V.A.Vasiliev, A.O. Vasyukov, I.V. Yeletskikh, A.S. Zhemchugov	
VBLHEP A.P. Cheplakov	F.N. Ahmadov, Yu.A. Fillipov, A.V. Ivanov, V.V. Kukhtin, E.A. Ladygin, S.N. Nagorny, A.A. Soloshenko, N.I. Zimin, B.G. Shaykhatdenov, T. Turtuvshin	
LIT V.V. Korenkov, P.V. Zrelov	E.I. Alexandrov, I.N. Aleksandrov, N.I. Gromova, A.V. Iakovlev, A.I. Kazymov, M.A. Mineev, V.N. Shigaev	
BLTP D.I. Kazakov	A.B. Arbuzov, A.V Bednyakov, S.G. Bondarenko, A.V. Gladyshev, N.I. Kochelev, A.F. Pikelner, O.V. Teryaev	
FLNP S.A. Kulikov	M.V. Bulavin	

Collaboration

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

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

02-2-1144-2021/2023

Priority:	1

Status: New

Search for New Physics in the Charged Lepton Sector

Leader: V.V. Glagolev
Z. Tsamalaidze

Deputy: Yu.I. Davydov
N.V. Khomutov

Scientific leader: J.A. Budagov

Participating countries and international organizations:

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

Issues addressed and main goals of research:

The Mu2e experiment at Fermilab, COMET experiment at J-PARC and the MEG II experiment at PSI are a dedicated search for the CLFV processes $\mu^- N \longrightarrow e^- N$, $\mu^+ \longrightarrow e^+ \gamma$. Once neutrinos masses are included, the process is allowed but still effectively 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 ith and jth neutrino mass eigenstates, and M_W is the mass of the W boson.

The predicted rates for the $\mu^- N \longrightarrow e^- N$ and $\mu^+ \longrightarrow e^+ \gamma$ 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. Conversion measurement at the level of 10^{-17}, which is the COMET goal, is a factor of 10000 better than the current experimental limit $B(\mu^- + Au \longrightarrow \mu\, e^- + Au) < 7 \cdot 10^{-13}$ from SINDRUM-II at PSI.

Participation in the creation and tests of the theoretical views in the topics. Study of CP-violation in the lepton sector with the help of neutrinos. Study of hyperfine interactions of an acceptor impurity in semiconductors with the aid of negative muons. Investigation of the behavior of positive muons in systems with magnetic nanoparticles.

Expected results in the current year:

- Tests of the *CsI* and BaF_2 e.m. calorimeter elements with the gamma sources and electron beam.
- Participation in the construction and tests of modules of scintillator counters for the veto system. Quality control.
- Filling the batch of Mu2e scintillation counters with CKIN and testing them for leakage.
- Maintenance of the visualization and control software.
- Development and tests of the Mu2e e.m. calorimeter preamplifiers at JINR.
- Participation in the radiation hardness tests of the detector elements.
- R&D of thin-wall straw tubes for COMET. Development, production and tests of the straw detector and electromagnetic calorimeter prototype.
- Calibration of LYSO crystals.
- R&D of muon veto system elements.
- Analysis of the experimental data on the radiative pion decay collected by the PEN experiment.
- Participation in the development of the positron tracker for the MEG-II experiment, DAQ, data ana-lysis.
- Participation in the data taking and analysis of experimental data obtained with CERN hadron beams.
- Software development for data processing and analysis.

- Study of the behavior of magnetic nanoparticles with high magnetic anisotropy by the muon spin ro-tation technique.
- Data analysis of the *p+t* synthesis using the muon catalysis method.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	Search for new physics in the charged lepton sector	V.V. Glagolev Z. Tsamalaidze	1 (2021-2021)

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, V.Yu. Baranov, J.A. Budagov, D.Sh. Chokheli, Yu.I. Davydov, D.L. Demin, Yu.N. Kharzheev, V.I. Kolomoets, S.M. Kolomoets, A.V. Sazonova, A.N. Shalóugin, A.V. Simonenko, I.A. Suslov, I.V. Titkova, V.V. Tereschenko, S.V. Tereschenko, Z.U. Usubov,	
	BLTP	D.I. Kazakov, G.A. Kozlov, O.V. Tarasov	
	LIT	V.V. Korenkov, V.V. Uzhinsky	
	VBLHEP	A.S. Galoyan	
2.	**Experiment COMET**	**Z. Tsamalaidze**	R&D Realization
	DLNP	K. Abylay, V.N. Duginov, P.G. Evtukhovich, I.L. Evtukhovich, K.I. Gritsai, V.A. Kalinnikov, Kh. Khubashvili, E.S. Kaneva, M.D. Kravchenko, A.S. Moiseenko, A.V. Pavlov, B.M. Sabirov, A.G. Samartsev, N. Tsverava, E.P. Velicheva, A.D. Volkov	
	LIT	G. Adamov, D. Goderidze, Yu.L. Kalinovsky, A. Khvedelidze	
	BLTP	D. Aznabaev, A. Issadykov, G.A. Kozlov	
	VBLHEP	D. Baigarashev, V.V. Elsha, T.L. Enik, S.A. Movchan, S.N. Shkarovsky	
3.	**Experiment MEG II**	**N.V. Khomutov**	R&D Realization
	DLNP	V.A. Baranov, V.V. Glagolev, Yu.I. Davydov, N.A. Kuchinsky, N.P. Kravchuk, V.L. Malyshev, A.M. Rozhdestvensky, A.O. Kolesnikov, V.A. Krylov	
4.	**Experiment PEN**	**N.A. Kuchinsky**	Data processing
	DLNP	V.A. Baranov, N.V. Khomutov, S.M. Korenchenko, A.S. Khrykin, E.S. Kuzmin, A.M. Rozhdestvensky, E.P. Velicheva, V.P. Volnykh	
	BLTP	Yu.M. Bystritsky	
5.	**CERN Neutrino platform**	**B.A. Popov**	Data taking Data processing
	DLNP	N.V. Atanov, A. V. Krasnoperov, V.V. Lyubushkin, S.V. Tereschenko, V.V. Tereschenko	

6.	**Experiment MUSPIN**	**V.N. Duginov**	Data taking Data analysis
	DLNP	E.I. Bunyatova, K.I. Gritsay, A.I. Rudenko, G.D. Soboleva	
	FLNP	M. Balasoiu + 2 pers.	
7.	**Experiment TRITON**	**D.L. Demin**	Data analysis
	DLNP	N.A. Baranova, A.I. Boguslavsky, V.N. Duginov, E.D. Gorodnichev, K.I. Gritsay, S.A. Gustov, V.I. Kolomoets, E.V. Kolesov, A.D. Konin, A.P. Kustov, A.I. Rudenko, Yu.A. Polyakov, N.A. Shakun, V.I. Smirnov, Z.U. Usubov	
	FLNR	S.A. Yukhimchuk	
	LRB	V.B. Buchnev, V.Yu. Schegolev	

Collaboration

Country or International Organization	City	Institute or laboratory
Belarus	Minsk	BSU
		INP BSU
		IP NASB
Bulgaria	Sofia	SU
Czech Republic	Prague	CTU
		CU
France	Paris	IN2P3
Georgia	Tbilisi	GTU
		HEPI-TSU
		UG
Italy	Frascati	INFN LNF
	Pisa	UniPi
Japan	Fukuoka	Kyushu Univ.
	Osaka	Osaka Univ.
	Tsukuba	KEK
Kazakhstan	Almaty	INP
Romania	Bucharest	IFIN-HH
Russia	Gatchina	NRC KI PNPI
	Irkutsk	ISU
	Moscow	ITEP
		NNRU "MEPhI"
	Moscow, Troitsk	INR RAS
	Novosibirsk	BINP SB RAS
		NSU
Slovakia	Bratislava	CU
		IP SAS
Switzerland	Villigen	PSI
Ukraine	Kharkov	ISMA NASU
United Kingdom	Didcot	RAL
	London	Imperial College
USA	Batavia, IL	Fermilab
	Charlottesville, VA	UVa
	Lexington, KY	UK

02-2-1099-2010/2023

Priority:	1

Status: In-progress

Study of Neutrino Oscillations

Leaders: D.V. Naumov
A.G. Olshevsky

Participating countries and international organizations:

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

Issues addressed and main goals of research:

- Measurement of the neutrino mixing angle θ and the squared mass difference Δm^2_{ee} in Daya Bay experiment.
- Neutrino mass hierarchy determination and measurement of the CP violation phase of the neutrino mixing matrix in the JUNO and NOvA experiments.
- Measurement of the solar neutrino fluxes, search for the sterile neutrino state and new particles.
- Study of tau-neutrino production in proton-nuclear interactions at CERN SPS.
- Development of the Light Collection System for LiAr of the DUNE ND.

Expected results in the current year:

- Physics analysis of the Daya Bay experiment data on determination of θ_{13} and other oscillation parameters.
- An estimation of the mass hierarchy measurements precision in the JUNO experiment with the TAO near detector.
- Use of NOvA experiment Remote Operation Centre at JINR for shifts.
- Data analysis in the NOvA experiment, new results on hierarchy and CP.
- Mass test of JUNO PMT with scanning stations.
- Monitoring of the JUNO veto system planes with cosmic muons.
- Installation and commissioning of the JUNO detector (PMT, HV, TT-veto).
- Development of the GNA project: GPU support and automatic differentiation.
- Preparation of the full physics run and data analysis of pilot run data, development of algorithms of charm particles decay search in high track density conditions.
- Analysis of solar neutrino parameters and search for rare processes in the Borexino detector, DS-50 data analysis.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	JUNO	D.V. Naumov	1 (2009-2023)
2.	NOvA/DUNE	A.G. Olshevskiy	1 (2015-2023)

List of Activities

Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. JUNO Project	**D.V. Naumov** **M.O. Gonchar**	Construction Data taking
DLNP	N.V. Anfimov, T.A. Antoshkina, S.V. Biktemerova, A.E. Bolshakova, I.V. Butorov, A.V. Chetverikov, A.V. Chukanov, S.G. Dmitrievsky, D.A. Dolzhikov, D.V. Fedoseev, Yu.A. Gornushkin, V.O. Gromov, M.V. Gromov, A.V. Krasnoperov, K. Kuznetsova, Yu. Malyshkin, E.A. Naumova, I.B. Nemchenok, A.G. Olshevskiy, A.V. Rybnikov, A.B. Sadovsky, A.S. Selunin, V.I. Sharov, A.V. shaydurova, V.B. Shutov, O.Yu. Smirnov, S.A. Sokolov, A.P. Sotnikov, M.A. Strizh, V.D.Tchalyshev, K.A. Treskov, V. Zavadskiy	
LIT	N.A. Balashov, N.A. Kutovskiy	
2. NOvA/DUNE Project	**A.G. Olshevskiy** **N.A. Anfimov** **O.B. Samoylov**	Data taking
DLNP	A.I. Antoshkin, I.V. Butorov, A.V. Chetverikov, D.V. Fedoseev, V.O. Gromov, A.I. Kalitkina, O.A. Klimov, Ch. Kullenberg, L.D. Kolupaeva, D.V. Korablev, V.I. Korsunov, K.I. Kuznetsova, A.D. Morozova, O.N Petrova, M.V. Petropavlova, A.Yu. Rybnikov, V.I. Sharov, A.S. Selyunin, A.S. Sheshukov, S.A. Sokolov, A.P. Sotnikov, V.V. Tchalyshev, S.G. Vasina,	
BLTP	S.M. Bilenky, I.D. Kakorin, K.S. Kuzmin, V.A. Matveev, V.A. Naumov	
LIT	N.A. Balashov, A.V. Baranov, A.G. Dolbilov, E.A. Kuznetsov, N.A. Kutovskiy	
3. Experiment Ds Tau	**Yu.A. Gornushkin**	Data analysis
DLNP	A.V. Chukanov, S.G. Dmitrievsky, A.B. Sadovsky, A.P. Sotnikov, S.G. Vasina	
4. Experiment Borexino/DarkSide	**O.Yu. Smirnov**	Data analysis
DLNP	M.V. Gromov, D.V. Korablev, O.B. Samoylov, E.A. Sitnikova, A.P. Sotnikov, A.S. Sheshukov, A.V. Vishneva	

Collaboration

Country or International Organization	City	Institute or laboratory
China	Beijing	IHEP CAS
Czech Republic	Prague	CU
France	Strasbourg	CRN
Germany	Aachen	RWTH
	Hamburg	Univ.
Italy	Milan	UNIMI
	Salerno	INFN
Japan	Fukuoka	Kyushu Univ.
	Nagoya	Nagoya Univ.

	Tokyo	Toho Univ.
Romania	Magurele	ISS
Russia	Irkutsk	ISU
	Moscow	MSU
Slovakia	Bratislava	CU
Switzerland	Bern	Uni Bern
Turkey	Ankara	METU
USA	Batavia, IL	Fermilab
	Cambridge, MA	Harvard Univ.
	Indianapolis, IN	IUPUI

02-0-1108-2011/2021

Priority:	1

Status: Extended

PANDA Experiment at FAIR

Leader: G.D. Alexeev
Deputy: A.N. Skachkova

Participating countries and international organizations:
Belarus, CERN, Germany, Russia.

Issues addressed and main goals of research:
The study of the exotic nuclear-matter states and nucleon structure in the PANDA experiment at FAIR. Start of the joint work for construction PANDA muon detector.

Expected results in the current year:
- Signing of the FAIR-JINR contract on the Muon System construction.
- Readiness of mass production workshop for MDT detectors.
- Start of MDT detectors production.
- Finalizing of electronics design.
- Calibration of the prototype at CERN to all types of particles in energy range 0.5-1 GeV.
- Particle identification algorithms (PID) tuned on beam test results.

List of Activities

	Activity or Experiment **Laboratory or other Division of JINR** **Responsible person**	**Leaders** **Main researchers**	**Status**
1.	**Experiment PANDA**	**G.D. Alexeev**	Technical Proposal
	DLNP A.N. Skachkova	V.M. Abazov, G.A. Golovanov, S.A. Kutuzov, A.A. Piskun, I.K. Prokhorov, A.M. Rozhdestvensky, A.G. Samartsev, N.V. Skachkov, V.V. Tokmenin, L.S. Verogradov, yu.L. Vertogradova, V.P. Volnykh, A.Yu. Verkheev, N.I. Zhuravlev	
	VBLHEP A.S. Vodopyanov	V.A. Arefev, V.I. Astakhov, M.Yu. Barabanov, B.V. Batyunya, v.A. Budilov, A.S. Galoyan, V.K. Dodokhov, A.A. Feshchenko, E.K. Koshurnikov, V.I. Lobanov, Yu.Yu. Lobanov, P.V. Nomokonov, E.A. Strokovsky, S.S. Shimansky, A.O. Sidorin	
	LIT	V.V. Uzhinsky	
	BLTP	A.V. Efremov, A.S. Sorin, O.V. Teryaev	

Collaboration

Country or International Organization	**City**	**Institute or laboratory**
Belarus	Minsk	INP BSU
CERN	Geneva	CERN
Germany	Darmstadt	GSI
Russia	Novosibirsk	BINP SB RAS
	Omsk	OB IM SB RAS
	Protvino	IHEP

02-2-1125-2015/2023

Priority:	1

Status: Extended

Astrophysical Researches with the TAIGA Experiment

Leader: A.N. Tkachev
Deputies: L.G. Tkachev

Participating countries and international organizations:

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

Issues addressed and main goals of research:

- Search for local galactic sources of gamma rays with energies above 20-30 TeV.
- Study of gamma rays fluxes from known sources in the same energy region.
- Search for diffuse gamma rays from the galactic disk.
- Study of the energy spectrum and the mass composition of cosmic rays in the energy range of 10^{15} to 10^{17} eV in order to detect spots of Lorentz invariance violation.
- Search for galactic PeVatrons.
- The TAIGA observatory also plans to introduce a "hybrid method" of observation - the combined use of IACT and HiScore wide angle Cherenkov detectors. This method will not only significantly improve the quality of high-energy gamma-rays emission signals selection from background hadron events, but will also help to match available for today parts of the cosmic ray spectrum (CR) obtained by fundumentally different methods - ground-based (in the range above 10^{15} eV) and orbital (below 10^{11} eV).
- In the framework of the NUCLEON space experiment the spectra and elemental composition of CR were measured in the energy range 10^{11}-10^{15} eV, i.e. in the "knee" region in the CR spectrum and in front of it. Further progress in applying this technique in the planned OLVE-HERO experiment. The unique square design of the detector (more than 10 m^2) within 5 years of direct extra-atmospheric measurements will provide data, large statistics which allow to identify changes to the composition of cosmic rays in the energy interval and to measure the angular anisotropy of the CR.

Expected results in the current year:

- Design, manufacture and testing for the fourth IACT telescope at the JINR.
- Modernization of event simulation programs in the TIGA experiment. Upgrade of software for data collection and the production of mirrors for the fourth IACT telescope.
- Processing for IACT telescope, as well as for their hybrid mode of operation in conjunction with HiScore detectors.
- MC-simulation of the joint operation of the IACT telescope and the TAIGA observatory's wide-angle Cherenkov detectors and optimization of the selection of events from gamma rays from the background.
- Monitoring of the brightest gamma-ray sources at the TAIGA observatory in hybrid made (joint observation of HiScore and IACT). Upgrade of software for IACT data analysis.
- Completion of data processing for the TUS and NUCLEON space experiments.
- Study of the crab nebula gamma radiation in the energy range of 2-10 TeV (when the telescope is operating independently) and check the correctness of the telescope operation and data processing procedure. Observation of the brightest extragalactic sources of gamma radiation Mrk-421, Mrk-501.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	TAIGA	A.N. borodin	1 (2015-2023)

List of Activities

Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Experiment TAIGA	**A.N. Borodin**	Implementation
DLNP	M. Finger, V.M. Grebenyuk, F.F. Grinyuk, M.V. Lavrova, U. Nurtaeva, A. Pan, S.Yu. Porokhovoy, M. Slunechka, V. Slunechkova, L.G. Tkachev	
VBLHEP	N.V. Gorbunov, A.V. Skrypnik	
LIT	I. Satyshev	
2. Experiment TUS, NUCLEON	**L.G. Tkachev**	Completion
DLNP	V.M. Grebenyuk, F.F. Grinyuk, A.I. Kalinin, M.V. Lavrova, U. Nurtaeva, M. Slunechka, V. Slunechkova, A.V. Tkachenko	
VBLHEP	N.V. Gorbunov	
3. Experiment OLVE-HERO	**L.G. Tkachev**	Preparation
DLNP	V.M. Grebenyuk, N.I. Kalinin, M.V. Lavrova, U. Nurtaeva, A. Pan, S.Yu. Porokhovoy, Sabirov, A.B. Sadovsky, A.V. Tkachenko	
VBLHEP	N.V. Gorbunov, A.V. Skrypnik	
LIT	I. Satyshev	
FLNP	A.D. Rogov	

Collaboration

Country or International Organization	City	Institute or laboratory
Czech Republic	Prague	CU
Germany	Hamburg	Univ.
	Munich	MPI-P
	Tubingen	Univ.
	Zeuthen	DESY
Italy	Turin	UniTo
Japan	Wako	RIKEN
Mexico	Puebla	BUAP
Poland	Warsaw	UW
Republic of Korea	Seoul	EWU
Romania	Magurele	ISS
Russia	Irkutsk	RIAP ISU
	Moscow	NNRU "MEPhI"
		SINP MSU
	Moscow, Troitsk	INR RAS

02-1-1106-2011/2022

Priority:	1

Status: In-progress

Investigations of Compressed Baryonic Matter at the GSI Accelerator Complex

Leaders: V.P. Ladygin
V.V. Ivanov

Deputy: O.Yu. Derenovskaya

Participating countries and international organizations:

Czech Republic, France, Germany, Poland, Romania, Russia.

Issues addressed and main goals of research:

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

Expected results in the current year:

- Expertize, preparation of the drawings and magnetic calculations for the superconducting dipole magnet for the CBM experiment. Optimization of the RICH detector.
- Design and testing of the straw detector prototype.
- Development of the algorithms and software for the trigger and data analysis.
- Simulation of the multiparticle dynamics in heavy ion collisions.
- Development of the mathenatical methods and fast computing algorithms for the data analysis and selection of the signal events.
- Participation in experimental data taking using pion, proton and heavy ion beams with HADES at SIS18. Development of the algorithms for data analysis. Participation in experimental data analysis. Theoretical interpretation of the obtained data.

List of projects:

	Project	**Leader**	**Priority (period of realisation)**
1.	CBM	V.P. Ladygin V.V. Ivanov	1 (2011-202**1**)
2.	HADES	V.P. Ladygin O.V. Fateev	2 (2010-2021)

List of Activities

	Activity or Experiment **Laboratory or other Division of JINR** **Responsible person**	**Leaders** **Main researchers**	**Status**
1.	**CBM Project** **Expertize of the design and manufacture of the superconducting dipole magnet and straw detector prototype. Development of the algorithms and software for trigger, simulation and data analysis**	**V.P. Ladygin** **V.V. Ivanov**	Realization

VBLHEP	S.P. Avdeev, I.V. Boguslavsky, A.V. Bychkov, D.V. Dementiev, V.V. Elsha, O.V. Fateev, Yu.V. Gusakov, A.P. Ierusalimov, G.D. Kekelidze, N.B. Ladygina, V.M. Lysan, A.I. Malakhov, Yu.A. Murin, A.D. Sheremetiev, A.L. Voronin, A.P. Zinchenko, N.I. Zamyatin
LIT	P.G. Akishin, E.P. Akishina, E.I. Alexandrov, I.N. Alexandrov, D.V. Belyakov, O.Yu. Derenovskaya, I.A. Filozova, V.V. Ivanov, V.V. Ivanov (jr), A.V. Kryanev, S.A. Lebedev, A.M. Raportirenko, T.P. Sapozhnikova, P.V. Zrelov
BLTP	D. Blaschke, S.G. Bondarenko, V.V. Burov, V.D. Toneev

2. Experiment HADES

V.P. Ladygin
O.V. Fateev

Data taking
Data analysis

VBLHEP	A.V. Belyaev, O.V. Fateev, A.P. Ierusalimov, S.G. Reznikov, A.Yu. Troyan, A.I. Zinchenko
LIT	V.V. Ivanov, S.A. Lebedev
DLNP	G.I. Lykasov

Collaboration

Country or International Organization	City	Institute or laboratory
Czech Republic	Rez	NPI CAS
France	Orsay	IPN Orsay
Germany	Darmstadt	FAIR
		GSI
		TU Darmstadt
	Dresden	HZDR
	Frankfurt/Main	Univ.
	Giessen	JLU
	Heidelberg	Univ.
	Munich	TUM
Poland	Krakow	SIP
Romania	Bucharest	IFIN-HH
Russia	Moscow	ITEP
		NNRU "MEPhI"
		SINP MSU
	Moscow, Troitsk	INR RAS

02-1-1096-2010/2022		Priority:	1
		Status:	In-progress

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

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

Deputy: D.V. Peshekhonov

Participating countries and international organizations:

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

Issues addressed and main goals of research:

Realization of the NA62 Project allows to clarify the CP-violation problem, to measure precisely very rare charged kaon decay to charged pions and two neutrinos, to carry out a search for supersymmetric particles and their partners to observe physics beyond the Standard Model. In addition, the characteristics of rare kaon and hyperon decays will be improved. Straw-detectors of the NA62 high resolution magnetic spectrometer working in vacuum will be supported during experimental runs. Development of a new detector prototype based on straws with a smaller diameter will be started to use it at higher intensity of the beams. Software for simulation, data analysis and processing will be developed.
The main objective of the NA64 experiment is to search for physics beyond the SM, namely the search for the dark photon (A') and other manifestations of the dark sector in the experiments on the CERN SPS electron and muon secondary beams. Tracking detectores based on the straw tube technology will be created and supported. Software for data MC simulation and analysis will be developed.

Expected results in the current year:

In frame of NA62:

1. NA62 and NA48/2 data analysis will be carried out.
2. Software for the simulation of the magnetic spectrometer and full set-up will be developed; system for detector calibration and event reconstruction will be upgraded; general software of the experiment will be developed.
3. Calibration and testing of the NA62 straw detectors will be carried out.
4. Participation in the NA62 experimental run at the CERN SPS.

In frame of NA64:

1. NA64, analysis of the experimental data obtained during the 2017--2018 runs.
2. Development and putting into operation of new track stations based on 6~mm straw tubes. Operation and support of the detectors.
3. Equipment preparation for the 2021 run in the new experimental zone on the H4 and muon SPS channels, CERN.
4. On-line and off-line software development, for the straw chambers analysis and for the DAQ experiment in particular.
5. Participation in the data taking at the CERN SPS.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	NA62	V.D. Kekelidze Yu.K. Potrebenikov	1 (2010-2021)
1.	NA64	V.A. Matveev D.V. Peshekhonov	1 (2017-2023)

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	A.Z. Baeva, A.A. Belkova, D. Baygarashev, V.P. Falaleev, T.L. Enik, D.D. Emelyanov, S.R. Gevorgyan, L.N. Glonti, V.N. Gorbunova, E.A. Gudzovsky, D. Kereibay, A.M. Korotkova, D.T. Madigozhin, N.A. Molokanova, S.A. Movchan, I.A. Polenkevich, S.N. Shkarovsky	
2.	**Experiment NA64**	**V.A. Matveev** **D.V. Peshekhonov**	Preparation Data taking Data analysis
	VBLHEP	V.E. Burtsev, T.L. Enik, A.A. Festchenko, G.D. Kekelidze, E.A. Kasianova, V.A. Kramarenko, V.M. Lysan, E.V.Martovitsky, S.S. Parzhitsky, V.V. Pavlov, L.N. Tarasova, E.V. Vasilieva, P.V. Volkov, I.A. Zhukov, A.V. Zinin	
	DLNP	V.N. Frolov	

Collaboration

Country or International Organization	City	Institute or laboratory
Belarus	Minsk	INP BSU
Belgium	Louvain-la-Neuve	UCL
Bulgaria	Blagoevgrad	SWU
	Plovdiv	PU
	Sofia	SU
Canada	Vancouver	TRIUMF
		UBC
CERN	Geneva	CERN
Chile	Valparaiso	UTFSM
Czech Republic	Prague	CU
Germany	Bonn	UniBonn
	Mainz	JGU
Italy	Ferrara	INFN
	Florence	INFN
	Frascati	INFN LNF
	Naples	INFN
	Perugia	INFN
	Pisa	INFN
	Rome	INFN

		Univ. "Tor Vergata"
	Turin	INFN
Mexico	San Luis Potosi	UASLP
Romania	Bucharest	IFIN-HH
Russia	Moscow	LPI RAS
	Moscow, Troitsk	HPPI RAS
		INR RAS
	Protvino	IHEP
	Tomsk	TPU
Slovakia	Bratislava	CU
Switzerland	Zurich	ETH
United Kingdom	Birmingham	Univ.
	Bristol	Univ.
	Glasgow	U of G
	Lancaster	LU
USA	Boston, MA	BU
	Fairfax, VA	GMU
	Menlo Park, CA	SLAC
	Merced, CA	UCMerced
	Upton, NY	BNL

02-0-1083-2009/2022	Priority:	1

Status: In-progress

CMS. Compact Muon Solenoid at the LHC

Leader: A.V. Zarubin
Deputy leader: V.Yu. Karjavin
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, Ireland, Italy, Lithuania, Mexico, Montenegro, Netherlands, New Zealand, Pakistan, Poland, Republic of Korea, Russia, Serbia, Spain, Switzerland, Taiwan, Turkey, Ukraine, United Kingdom, USA, Uzbekistan.

Issues addressed and main goals of research:

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:

– hadron calorimetry, including endcap hadron, and preshower detector;

– forward muon stations with cathode strip chambers;

– development of Physics program to test SM and BSM.

Expected results in the current year:

- 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 realisation)
1.	CMS	A.V. Zarubin I.A. Golutvin	1 (2010-2023)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1.	**Hadron calorimetry**	**A.V. Zarubin**	Upgrade Commissioning Maintenance Data taking
	VBLHEP	V.Yu. Alexakhin, S.V. Afanasiev, P.D. Bunin, M.G. Gavrilenko, I.A. Golutvin, N.S. Golova, I.N. Gorbunov, Yu.V. Ershov, A.Yu. Kamenev, L.G. Kobylets, A.M. Kurenkov, A.I. Malakhov, V.A. Smirnov, N.I. Zamyatin	
	DLNP	M. Finger, M. Finger (Jn.), M. Slunechka, V. Slunechkova, Z. Tsamalaidze	
	LIT	A. Khvedelidze	
	GA&C	B.S. Yuldashev	
2.	**Forward muon station ME1/1**	**V.Yu. Karjavin**	Upgrade Commissioning Maintenance Data taking
	VBLHEP	A.O. Golunov, I.A. Golutvin, N.V. Gorbunov, Yu.V. Ershov, N.N. Evdokimov, A.Yu. Kamenev, A.M. Kurenkov, A.M. Makan'kin, V.V. Perelygin, A.V. Zarubin	
	LIT	V.V. Palchik, N.N. Voytishin	
3.	**Upgrade of the CMS detectors**	**I.A. Golutvin** **A.V. Zarubin**	Realization
	VBLHEP	V.Yu. Alexakhin, S.V. Afanasiev, P.D. Bunin, A.O. Golunov, N.V. Gorbunov, Yu.V. Ershov, V.Yu. Karjavin, A.Yu. Kamenev, A.M. Kurenkov, A.M. Makan'kin, A.I. Malakhov, V.V. Perelygin, V.A. Smirnov	
	LIT	V.V. Palchik, N.N. Voytishin	
	GA&C	B.S. Yuldashev	
4.	**Development and investigation of the scintillator module prototype of the CMS Hadron Calorimeter**	**I.A. Golutvin** **A.I. Malakhov**	Realization
	VBLHEP	S.V. Afanasiev, Yu.V. Ershov, A.O. Golunov, N.V. Gorbunov, A.M. Kurenkov, V.A. Smirnov, E.V. Sukhov, T.V. Trofimov, V.V. Ustinov, N.I. Zamyatin, A.V. Zarubin	
5.	**Reserch physics programme with the CMS detector**	**I.A. Golutvin** **S.V. Shmatov**	Realization
	VBLHEP	V.Yu. Alexakhin, S.V. Afanasiev, D.V. Budkovsky, M.G. Gavrilenko, I.N. Gorbunov, I.I. Belotelov, P.D. Bunin, A.Yu. Kamenev, L.G. Kobylets, A.V. Lanev, A.I. Malakhov, M.V. Savina,	

	V.V. Shalaev, S.G. Shulga, I.A. Zhizhin, V.A. Zykunov, A.V. Zarubin
LIT	V.V. Korenkov, D.A. Oleynik, G.A. Ososkov, V.V. Palchik, A.Sh. Petrosyan, N.N. Voytishin
BLTP	A.B. Arbuzov, S.G. Bondarenko, A.V. Efremov, A.V. Kotikov, G.A. Kozlov, A.V. Sidorov, O.V. Teryaev
DLNP	G.A. Golovanov, M. Finger, M. Finger (Jr.), N.B. Skachkov, A.N. Skachkova, A.Yu. Verkheev
GA&C	B.S. Yuldashev

6. Development of software for distributed computation, data processing and analysis based on GRID-technology

V.V. Korenkov

Realization

LIT	A.O. Golunov, I.A. Filozova, V.V. Mitsyn, V.V. Palchik, R.N. Semenov, 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	Gomel	GSU
	Minsk	INP BSU
Belgium	Antwerp	UAntwerp
	Brussels	ULB
		VUB
	Ghent	Ugent
	Leuven	KU Leuven
	Louvain-la-Neuve	UCL
	Mons	UMONS
Brazil	Rio de Janeiro, RJ	CBPF
		UERJ
	Sao Paulo, SP	Unesp
Bulgaria	Sofia	INRNE BAS
		SU
CERN	Geneva	CERN
China	Beijing	"Tsinghua"
		IHEP CAS
		PKU
	Hangzhou	ZJU
Croatia	Split	Univ.
	Zagreb	RBI
Cyprus	Nicosia	UCY
Czech Republic	Prague	CU
Estonia	Tallinn	NICPB
Finland	Helsinki	HIP
		UH
	Lappeenranta	LUT
France	Lyon	UL
	Paris	IN2P3
	Saclay	IRFU
	Strasbourg	IPHC

Georgia	Tbilisi	GTU
		HEPI-TSU
Germany	Aachen	RWTH
	Hamburg	DESY
		Univ.
	Karlsruhe	KIT
Greece	Athens	INP NCSR "Demokritos"
		NTU
		UoA
	Ioannina	UI
Hungary	Budapest	Wigner RCP
	Debrecen	Atomki
		UD
India	Chandigarh	PU
	Jatani	NISER
	Kolkata	SINP
	Mumbai	BARC
		TIFR
Iran	Tehran	IPM
Ireland	Dublin	UCD
Italy	Bari	INFN
	Bologna	INFN
	Catania	INFN LNS
	Florence	INFN
	Frascati	INFN LNF
	Genova	INFN
	Milan	INFN
	Naples	INFN
	Padua	INFN
	Pavia	INFN
	Perugia	INFN
	Pisa	INFN
	Rome	INFN
	Trieste	INFN
	Turin	INFN
Lithuania	Vilnius	VU
Mexico	Mexico City	Cinvestav
	Puebla	BUAP
Montenegro	Podgorica	Univ.
Netherlands	Eindhoven	TU/e
New Zealand	Auckland	Univ.
	Christchurch	UC
Pakistan	Islamabad	QAU
Poland	Krakow	AGH
	Krakow	AGH-UST
	Otwock (Swierk)	NCBJ
	Warsaw	UW
Republic of Korea	Daejeon	KIST
	Gwangju	CNU
	Seoul	KU
	Seoul	SJU
	Seoul	SKKU
	Seoul	SNUE
	Seoul	Yonsei Univ.

Russia	Dolgoprudny	MIPT
	Gatchina	NRC KI PNPI
	Moscow	ITEP
	Moscow	LPI RAS
	Moscow	NIKIET
	Moscow	NNRU "MEPhI"
	Moscow	SINP MSU
	Moscow, Troitsk	INR RAS
	Novosibirsk	NSU
	Protvino	IHEP
	Snezhinsk	VNIITF
	St. Petersburg	Electron
	Tomsk	TPU
	Tomsk	TSU
	Zhukovsky	MDB
Serbia	Belgrade	INS "VINCA"
Spain	Madrid	CIEMAT
	Madrid	UAM
	Oviedo	UO
	Santander	IFCA
Switzerland	Villigen	PSI
	Zurich	ETH
	Zurich	UZH
Taiwan	Taipei	NTU
	Taoyuan City	NCU
Turkey	Adana	CU
	Ankara	METU
	Istanbul	BU
	Istanbul	YTU
Ukraine	Kharkov	KhNU
	Kharkov	NSC KIPT
	Kharkov	STC "IMK" NASU
United Kingdom	Bristol	Univ.
	Didcot	RAL
	London	Imperial College
USA	Baltimore, MD	JHU
	Batavia, IL	Fermilab
	Boston, MA	BU
	Boston, MA	NU
	Boulder, CO	CU
	Buffalo, NY	UB
	Cambridge, MA	MIT
	Charlottesville, VA	UVa
	Chicago, IL	UIC
	College Park, MD	UMD
	College Station, TX	Texas A&M
	Columbus, OH	OSU
	Davis, CA	UCDavis
	Detroit, MI	WSU
	Evanston, IL	NU
	Gainesville, FL	UF
	Houston, TX	Rice Univ.
	Iowa City, IA	UIowa
	Ithaca, NY	Cornell Univ.

	Knoxville, TN	UTK
	Lawrence, KS	KU
	Lincoln, NE	UNL
	Livermore, CA	LLNL
	Los Angeles, CA	UCLA
	Lubbock, TX	TTU
	Madison, WI	UW-Madison
	Manhattan, KS	KSU
	Minneapolis, MN	U of M
	Nashville, TN	VU
	New Brunswick, NJ	RU NB
	New York, NY	RU
	Notre Dame, IN	ND
	Oxford, MS	UM
	Pasadena, CA	Caltech
	Pittsburgh, PA	CMU
	Princeton, NJ	PU
	Providence, RI	Brown
	Riverside, CA	UCR
	Rochester, NY	UR
	San Diego, CA	SDSU
	Santa Barbara, CA	UCSB
	Tallahassee, FL	FSU
	Tuscaloosa, AL	UA
	Wako, TX	BU
	West Lafayette, IN	Purdue Univ.
Uzbekistan	Tashkent	INP AS RUz

02-0-1085-2009/2022

Priority:	1

Status: In-progress

Studies of the Nucleon and Hadron Structure at CERN

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

Participating countries and international organizations:
CERN, Czech Republic, France, Germany, India, Israel, Italy, Japan, Poland, Portugal, Russia, Taiwan, USA.

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

- Measurements of the structure functions of a nucleon, polarized parton distributions of nucleons.
- Measurements of the structure of nucleons in vuon pair production (Drell-Yan, J/Psi).
- Spin effects in hadron interactions at 0.3-3.0~GeV.
- Study of the mechanisms of exclusive production of photons, pions and ρρ-mesons in DIS and DVCS processes.
- Measurement of the Primakoff reactions cross-sections.
- Creation and development of a set of programs for modeling and data processing. System support for CERN software.
- Preparation of detectors for the COMPASS-II spectrometer.

Expected results in the current year:
- Measurement of π^0 production in the processes of exclusive deep inelastic scattering of muons on a hydrogen target.
- Measurements of Collins and Sivers asymmetry on hydrogen and deuterium targets.
- Measurement of semi-inclusive scattering on hydrogen and deuterium targets with 2 gadrons production.
- Measurement of transverse spin asymmetries in semi-exclusive scattering processes.
- Software development and modeling of vaious reactions studied on the COMPASS-II spectrometer. Analysis of data in JINR and preparation of publications.
- Theoretical studies on the program COMPASS-I and COMPASS-II.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	COMPASS-II	A.P. Nagajtsev	1 (2011-2022)

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**	**O.P. Gavrishchuk**	Maintenance
	VBLHEP	V.A. Anosov	
	DLNP	A.S. Selyunin, A.V. Rybnikov	
2.	**Electromagnetic calorimeter**	**A.P. Nagaytsev,** **N.V. Anfimov**	Maintenance
	VBLHEP	V.A. Anosov, O.P. Gavrishchuk,	
	DLNP	A.I. Antoshkin, A.V.Guskov, V.M. Kudryavtsev, A.G. Olshevskiy, A.V. Rybnikov, A.S. Selyunin, I.E. Tchirikov-Zorin, V.N.Frolov	
3.	**Muon system**	**G.D. Alekseev**	Maintenance
	DLNP	V.M. Abazov, G.A. Golovanov, A.A. Piskun, A.G. Samartsev, V.V. Tokmenin, L.S. Vertogradov, N.I. Zhuravlev	
4.	**System of the data taking**	**V.N. Frolov**	Maintenance
	DLNP	V.N. Frolov	
5.	**Software devlopment.** **Data analysis**	**E.V. Zemlyanichkina** **A.V. Guskov**	Realization
	VBLHEP	R.R. Akhunzyanov, R. Gushcherski, A.V. Ivanov, Yu.I. Ivanshin, O.M. Kuznetsov, A.P. Nagaytsev, N.S. Rogacheva, D.V. Peshekhonov, I.A. Savin, E.A. Salmina	
	DLNP	N.V. Anfimov, A.I. Antoshkin, A.F. Gridin, I.A. Denisenko, A.V. Maltsev, A.G. Olshevskiy, A.V. Rybnikov, A.A. Rymbekova, A.S. Selyunin	
	LIT	P.V. Zrelov, A.Sh. Petrosyan	
6.	**Measurements of generalized parton distributions**	**A.P. Nagaytsev** **A.V. Guskov** **I.A. Savin**	Realization
	VBLHEP	R.R. Akhunzyanov, R. Guscherski, G.V, O.M. Kuznetsov, N.S. Rogacheva, V.D. Peshekhonov, E.A. Salmina, O.V. Teryaev, E.V. Zemlyanichkina	
	DLNP	I.A. Denisenko, A.V. Maltsev, A.G. Olshevskiy, A.A. Rymbekova	

	BLTP	A.V. Efremov	
7.	**Studies of Drell-Yan processes**	**A.V. Guskov**	Realization
	DLNP	I.A. Denisenko, A.O. Gridin, A.V. Maltsev, E.O. Mitrofanov, A.A. Rymbekova	
8.	**Spin effects in hadron interactions at 0.3-3.0 GeV**	**A.V. Kulikov** **D.A Tsirkov**	Data processing
	DLNP	T.I. Azaryan, S.N. Dymov, V.I. Komarov, V.S. Kurbatov, Zh. Kurmanaliev, A. Kunsafina, V.V. Shmakov, Yu.N. Uzikov, B.Zh. Zalikhanov	
9.	**Studies of semi-inclusive reactions**	**I.A. Savin** **E.V. Zemlyanichkina**	Realization
	VBLHEP	A.V.Ivanov, Yu.I. Ivanshin, S.R.Gevorgyan, N.S. Rogacheva, E.A. Salmina	
II.	**Theoretical studies**	**A.V. Efremov**	Realization
	BLTP	A.E. Dorokhov, S.B. Gerasimov, O.V. Teryaev, A.V. Kotikov, A.M. Sidorov	

Collaboration

Country or International Organization	**City**	**Institute or laboratory**
CERN	Geneva	CERN
Czech Republic	Brno	BUT
	Liberec	TUL
	Prague	CU
France	Saclay	SPhN CEA DAPNIA
Germany	Bochum	RUB
	Bonn	UniBonn
	Freiberg	TUBAF
	Julich	FZJ
	Mainz	JGU
	Munich	TUM
India	Kolkata	MIERE
Israel	Tel Aviv	TAU
Italy	Trieste	INFN
	Turin	INFN
Japan	Yamagata	Yamagata Univ.
Poland	Otwock (Swierk)	NCBJ
	Warsaw	WUT
Portugal	Aveiro	UA
	Lisbon	LIP
Russia	Moscow	LPI RAS
	Protvino	IHEP
	Tomsk	TPU
Taiwan	Taipei	AS
USA	Urbana, IL	I

02-1-1086-2009/2023

Priority:	1

Status: Extended

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

Leaders: E.A. Strokovsky
E.S. Kokoulina
D.O. Krivenkov

Participating countries and international organizations:

Belarus, Czech Republic, Japan, Russia, Slovakia, Ukraine.

Issues addressed and main goals of research:

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 the inelastic proton-proton and proton-nucleus interactions with extremally high multiplicity; study of spectra and yields of soft photons in the deuteron-nucleus and nucleus-nucleus interactions.

Expected results:

- Experimental conclusion about the existence of the hypernucleus $^{6}_{\Lambda}$H.
- New experimental data on the properties of the lightest hypernuclei and experimental verification of corresponding theoretical models for these hypernuclei.
- New experimental data on the drip-line location for loosely bound light hypernuclei with high neutron excess, necessary for the development of the theory of neutron-rich hypernuclei and models of their production in non-central nucleus-nucleus interactions.
- New experimental data on the production of strangeness and vector mesons (including those, containing strange quarks) by polarized photons (close to the relevant thresholds).
- Comparison of the measured energy spectra of gamma-quanta (in the energy range up to several MeV), produced in the interactions of different nuclear beams (from deuterium to heavy nuclei) of Nuclotron with various nuclear targets, with theoretical predictions depending on the multiplicity of charged and neutral particles, as well as on the photon emission angle; verification of various physical hypotheses about the mechanisms of production of "direct" photons in the nuclear interactions.
- Confirmation (or establishing of the upper boundaries) of cross sections for the production of new resonances, decaying into two γ-quanta.

Expected results in the current year:

- Data taking for $^{6}_{\Lambda}$H search using beam of ^{7}Li nuclei. Analysis of the first experimental data for the $^{6}_{\Lambda}$H search and for the measurements of hyperhydrogen isotopes $^{6}_{\Lambda}$H and $^{4}_{\Lambda}$H lifetimes.
- Upgrade of the HyperNIS magnetic spectrometer (tracking system) by adding the planes of GEM detectors. These detectors, which have already been (partially) purchased and are being tested at the HyperNIS setup by SFSKYA staff, will be integrated into this setup to improve accuracy of the hypernucleus decay vertex determination.
- Within the collaboration with Japan: data taking at LEPS/LEPS2 setups on the production of strangeness and vector mesons (including those, containing strange quarks) by polarized photons (close to the relevant thresholds); analysis of data on such reactions, taken before.
- Assembling the “shashlyk”-type electromagnetic calorimeter based on 16 planes of gallium-gadolinium garnet crystals and the absorber from a mixture of tungsten and copper between them. Equipping the calorimeter by electronics.

Participation in the simulation of the calorimeter use in the SPD setup for the task of direct photon registration, within the development of the SPD physical program with polarized beams of light nuclei and protons. Participation in works on simulation of the polarimeters (to be created) for experiments with polarized beams at the VBLHEP accelerator complex.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	HyperNIS	E.A. Strokovsky J. Lukstins D.O. Krivenkov	1 (2010-2021)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1.	**Experiment NIS-GIBS**	**E.A. Strokovsky** **J. Lukstins** **D.O. Krivenkov**	Realization Data taking
	VBLHEP	V.D. Aksinenko, M.H. Anikina, A.V. Averyanov, A.N. Bayeva, S.N. Bazylev, A.E. Baskakov, D.V. Dementiev, A.A. Feschenko, A.A. Fedyunin, S.V. Gertsenberger, A.M. Korotkova, V.T. Matyushin, A.I. Maksimchuk, Yu.A. Murin, O.V. Okhrimenko, S.N. Plyashkevich, N.G. Parfenova, P.A. Rukoyatkin, A.V. Shipunov, M.O. Shitenkov, R.A. Salmin, A.D. Sheremetiev, A.V. Shutov, N.A. Shutova, I.V. Slepnev, V.M. Slepnev, A.L. Voronin	
	DLNP	B.A. Popov, V.V. Tereschenko, S.V. Tereschenko	
	OCE	A.N. Parfenov	
2.	**Experiment NEMAN**	**E.S. Kokoulina** **V.A. Nikitin**	Project preparation Data taking
	VBLHEP	V.P. Balandin, N. Barlykov, Yu.T. Borzunov, V.B. Dunin, V. Dudin, O.P. Gavrischuk, A.S. Gribovsky, V.Yu. Ivanenko, A.V. Konstantinov, D.A. Kirillov, R.I. Kukushkina, V.A. Nikitin, Yu.P. Petukhov, V.V. Popov, I.A. Rufanov, M.V. Tokarev, S.Yu. Sinelcshikova, V.A. Zykunov	
	BLTP	Yu.A. Bystritsky	

Collaboration

Country or International Organization	City	Institute or laboratory
Belarus	Gomel	GSTU
		GSU
	Minsk	"Radateh"
		BSUIR
		IAP NASB
		INP BSU
		IP NASB
Czech Republic	Prague	CTU
		CU
Japan	Osaka	RCNP
Russia	Chernogolovka	ISSP RAS
	Moscow	"Azimuth-Photonics"

		"FOMOS-MATERIALS"
		NNRU "MEPhI"
		SINP MSU
	Moscow, Zelenograd	RIMST
	Protvino	IHEP
	St. Petersburg	SPbSPU
	Syktyvkar	DM Komi SC UrB RAS
Slovakia	Banska Bistrica	UMB
Ukraine	Kiev	BITP NASU

02-0-1065-2007/2023		Priority:	1

Status: In-progress

NICA Complex: Design and Construction of the Complex of Accelerators, Collider and Physics Experimental Facilities at Extracted and Colliding Ion Beams Aimed at Studying Dense Baryonic Matter and the Spin Structure of Nucleons and Light Ions, and at Carrying out Applied and Innovation Projects

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

Deputies: A.V. Butenko
V.M. Golovatyuk
M.N. Kapishin

Participating countries and international organizations:

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

Issues addressed and main goals of research:

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

Expected results in the current year:

- Development and expansion of the physical programme of the project - "White Paper" of the NICA project. Obtaining new theoretical results for processes of strong interactions in the non-perturbative QCD region, development and tests of models for nuclear matter properties descriptions at extremely high temperatures and densities, investigation of possible nuclear matter states and nuclear collision dynamics at extreme baryonic densities as well as observation of these phenomena in p-odd effects and spin asymmetries.

- Completion of the planned tasks within the Nuclotron-NICA project: Tests of the standard KRION-N heavy ion source, upgrade of the cryogenic and injection facilities. Development of beam diagnostics systems. Increasing the intensity of the beam from the SPI polarized particle source. Preparation of the Nuclotron for solving first-priority tasks of the NICA program within available running time. Technical design on the SC resonator prototype for the proton linacs. Design of new proton and light ion linear accelerator LILAC.

- Commissioning of the HILAC linear accelerator ($z/A \geq 0.14$), achieving its design parameters. Development and upgrade of the engineering infrastructure. The Booster tests and physics beam runs.
- Tests of the elements of the beam extraction and transportation system from the Booster to Nuclotron. Manufacturing the elements of beam transfer system from Nuclotron to Collider.

- Completion of the tunnel building works for installation the NICA collider elements and systems.
- New experimental data collection at the BM&N, preparing the set-up to the next heavy ion run at the extracted Nuclotron beam. Preparation of technical project for the measurements with additional detectors. The new data analysis from the SRC experiment.
- Construction and tests of the MPD setup systems in accordance with the work schedule. Serial production of the start option detectors.
- Preparation and presentation of the SPD project. Development of the physics motivation, modeling, optimization of the set-up configuration, including continuation of theoretical studies of Matveev-Muradyan-Tavkxelidze-Drell-Yang, J/psi production processes in polarized proton and deuteron collisions.
- Completion of the 1st-stage NICA computer cluster and its infrastructure.
- Completion of manufacturing and tests the NICA collider magnetic system elements.
- Put the new cryogenic-compressor station and cryogenic facilities in building 1b.
- Reconstruction of the Measuring hall for the applied channels system.

List of projects:

Project	Leader	Priority (period of realisation)
1. Nuclotron-NICA	A.V. Butenko H.G.Khodzhibagiyan Scientific leader I.N. Meshkov	1 (2011-2021)
2. BM@N	M.N. Kapishin	1 (2012-2021)
Subprojict SRC Probing Short-Range-Correlations	M.N. Kapishin E. Piasetzky Deputies: O. Hen T. Aumann	1 (2018-2021)
3. MPD	V.M. Golovatyuk V.D. Kekelidze A.S. Sorin	1 (2011-2025)
4. Conceptual and technical design of the SPD at the NICA collider	A.V. Guskov Deputy: V.P. Ladygin Scientific leader A.D.Kovalenko	1 (2020-2021)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1.1.	**NICA injection complex: technical design preparation and construction of the NICA injection complex: (sources of heavy ions and polarized light nuclei, HILAC linear accelera-tors of heavy ions and light**	**A.V. Butenko** **A.I. Govorov** **V.V. Kobets** **A.D. Kovalenko** **V.A. Monchinsky**	Realization

	nuclei of beam transporting to the Nuclotron)		
1.1.a.	**Commissioning of the heavy ion source (KRION-6T)**	**E.D. Donets** **E.E. Donets**	Realization
1.1.b.	**Upgrade the polarized proton and deuteron source (SPI)**	**V.V.Fimushkin**	Realization
1.1.c.	**Development and construction of the beam injection systems and beam transportation channels. Development of the beam control and diagnostics systems**	**A.V. Tuzikov** **V.I. Volkov**	Realization
1.1.d.	**Design and start of construction the new proton and light ion injector LILAC**	**A.V. Butenko** **A.I. Govorov** **K.A. Levterov** **B.V. Golovensky** **E.M. Syresin**	Projecting Realization
	VBLHEP	M.Yu. Averyanov, V.S. Alexandrov, A.V. Alfeev, V.P. Akimov, V.A. Andreev, A.M. Bazanov, A.V. Butenko, E.E. Donets, E.D. Donets, D.E. Donets, A.A. Fateev, V.V. Fimushkin, N.I. Garanzha, A.I. Govorov, B.V. Golovensky, E.V. Gorbachev, A.D. Kovalenko, V.V. Kobets, V.N. Karpinsky, V.V. Kovalev, O.S. Kozlov, S.Yu. Kolesnikov, V.V. Kosukhin, A.G. Kocherov, A.E. Kirichenko, L.V. Kutuzov, N.I. Lebedev, K.A. Levterov, D.A. Lyuosev, A.A. Martynov, S.V. Mikhaylov, V.A. Monchinsky, V.V. Myalkovsky, A.V. Nestrov, R.V. Pivin, D.O. Ponkin, Yu.V. Prokof'ichev, A.Yu. Ramzdorf, D.N. Rassadov, A.S. Romanov, S.V. Romanov, G.S. Sedykh, S.N. Sedykh, V.V. Seleznev, A.I. Sidorov, A.O. Sidorin, E.M. Syresin, V.S. Shvetsov, K.V. Shevtchenko, I.V. Shirikov, V.B. Shutov, V.V. Tarasov, N.D. Topilin, A.V. Tuzikov, Yu.A. Tumanova, V.P. Vadeev, V.I. Volkov, A.A. Voronin	
	GA&C	G.V. Trubnikov	
1.2.	**Assembling and start-up of the NICA Booster and its technological systems**	**A.V. Butenko** **H.G. Khodzhibagiyan** **I.N. Meshkov** **E.M. Syresin** **A.O. Sidorin**	Projecting Realization
1.2.a.	**Magnet cryostat system, vacuum system, system of electron cooling**	**A.R. Galimov**	Realization
1.2.b.	**Power supply and energy evacuation system**	**E.V. Ivanov** **V.N. Karpinsky**	Projecting Realization
1.2.c.	**RF accelerating system of the Booster**	**O.I Brovko**	Realization
1.2.d.	**Diagnostics, injection, beam extraction and transport systems**	**A.V. Tuzikov** **V.I. Volkov**	Projecting Realization
	VBLHEP	N.N. Agapov, A.S. Averichev, M.Yu. Averiyanov, V.A. Andreev, R.V. Andryukhin, A.V. Alfeev, A.M. Bazanov, A.A.Baldin, V.I. Batin, A.N.Beloborodov, Yu.T. Borzunov, O.I.Brovko, A.V. Butenko, V.P. Chernyaev, D.E. Donets, V.M. Drobin, A.A. Fateev, A.R. Galimov, E.V. Gorbachev, A.Yu. Grebentsov, E.V. Ivanov, V.A. Isadov, A.P.Kharyuzova, P.R.Kharyuzov, V.N. Karpinsky, I.I. Kalagin, A.E. Kirichenko, H.G. Khodzhibagiyan, O.S. Kozlov, V.V. Kovalev, A.D.Kovalenko, S.Yu. Kolesnikov, N.G. Kondratiev, A.V. Konstantinov, A.V. Kopchenov, S.A. Kostromin, A.G. Kochurov, A.V. Kudashkin, G.L. Kuznetsov, E.A. Kulikov, O.A. Kunchenko, N.I. Lebedev, S.V. Mikhaylov, V.A. Mikhaylov, V.V. Myalkovsky, A.V. Nesterov, A.L. Osipenkov, R.V. Pivin, N.V.	

		Pilyar, O.V. Prozorov, S.V. Romanov, P.A. Rukoyatkin, T.V. Rukoyatkina, T.V.Safronov, N.V. Semin, G.S. Sedykh, V.V. Seleznev, A.S. Sergeev, A.V. Shabunov, A.A. Shurygin, E.M. Syresin, S.Yu.Starikova, V.V. Tarasov, N.D. Topilin, A.V. Tuzikov, Yu.A. Tumanova, B.V. Vasilishin, V.I. Volkov, L.V. Zinoviev	
	DLNP	E.V. Akhmanova, V.I. Hilinov, A.G. Kobets, I.N. Meshkov, O.S. Orlov, A.Yu. Rudakov, N.A. Rybakov, L.V. Soboleva, T.A. Stepanova, A.A. Sidorin, S.L. Yakovenko	
	GA&C	G.V. Trubnikov	
1.3.	**Development of the Nuclotron**	**A.V. Butenko** **A.O. Sidorin** **E.M. Syresin**	Projecting Realization
1.3.a.	**Magnet cryostst system, vacuum system**	**H.G. Khodzhibagiyan**	Projecting Realization
1.3.b.	**Power supply and energy evacuation system**	**E.V. Ivanov** **V.N. Karpinsky**	Projecting Realization
1.3.c.	**RF accelerating system of the Nuclotron**	**O.I. Brovko**	Projecting Realization
1.3.d.	**Diagnostics, injection, beam extraction and transportation systems**	**E.V. Gorbachev** **P.A.Rukoyatkin** **V.I.Volkov**	Projecting Realization
	VBLHEP	A.S. Averichev, M.Yu. Averiyanov, V.A. Andreev, R.V. Andryukhin, A.V. Alfeev, A.M. Bazanov, V.V. Batin, V.V. Borisov, O.I. Brovko, A.V. Butenko, V.P. Chernyaev, D.E. Donets, E.V. Gorbachev, A.Yu. Grebentsov, E.V. Ivanov, V.A. Isadov, V.N. Karpinsky, A.E. Kirichenko, H.G. Khodzhibagiyan, O.S. Kozlov, V.V. Kovalev, A.D. Kovalenko, S.Yu. Kolesnikov, N.G. Kondratiev, A.V. Konstantinov, A.V. Kopchenov, S.A. Kostromin, A.G. Kochurov, A.V. Kudashkin, G.L. Kuznetsov, E.A. Kulikov, O.A. Kunchenko, N.I. Lebedev, S.V. Mikhaylov, V.A. Mikhaylov, A.V. Merkuriev, V.V. Myalkovsky, A.V. Nesterov, A.L. Osipenkov, R.V. Pivin, O.V. Prozorov, S.V. Romanov, P.A. Rukoyatkin, N.V. Semin, G.S. Sedykh, V.V. Seleznev, A.S. Sergeev, A.A. Shurygin, E.M. Syresin, V.V. Tarasov, G.V. Trubnikov, A.V. Tuzikov, V.B Vasilishin, V.I. Volkov	
1.4.	**Technical design, R&D of technological systems and construction of the NICA heavy ion collider with an energy of E_{CM}= 4-11 GeV and an average luminosity of $1 \cdot 10^{27}$ см $^{-2}$с $^{-1}$ and light polarized nuclei with a luminosity of $1 \cdot 10^{32}$ см $^{-2}$с $^{-1}$ (by protons, at E_{CM}=27 GeV)**	**A.D. Kovalenko** **S.A. Kostromin** **I.N. Meshkov** **E.M. Syresin**	Projecting Realization
1.4.a.	**Magnet cryostat and vacuum systems**	**A.R. Galimov** **H.G. Khodzhibagiyan**	Realization
1.4.b.	**Power supply and energy evacuation system**	**E.V. Ivanov** **V.N. Karpinsky**	Realization
1.4.c.	**RF system of the Collider**	**O.I. Brovko** **A.Yu. Grebentsov**	Projecting Realization
1.4.d.	**Beam diagnostics, injection and transportation systems**	**A.V. Tuzikov** **V.I. Volkov**	Projecting Realization
1.4.e.	**Beam cooling systems**	**A.O. Sidorin**	Projecting Realization

1.4.f.	**Systems of proton and deuteron polarization monitoring and control**	**A.D. Kovalenko**	Realization
	VBLHEP	A.S. Averichev, N.N. Agapov, V.S. Alexandrov, A.V. Alfeev, V.A. Andreev, R.V. Andryukhin, A.M. Bazanov, V.I. Batin, Ty.T. Borzunov, O.I. Brovko, A.V. Butenko, V.M. Drobin, A.V. Eliseev, A.A. Fateev, A.V. Filippov, A.R. Galimov, V.F. Get'man, E.V. Gorbachev, A.Yu. Grebentsov, Yu.V. Gusakov, E.V. Ivanov, V.N. Karpinsky, H.G. Khodzhibagiyan, A.E. Kirichenko, O.S. Kozlov, N.G. Kondratiev, A.V. Konstantinov, A.V. Kopchenov, S.A. Kostromin, G.L. Kuznetsov, E.A. Kulikov, N.I. Lebedev, A.A. Makarov, A.V. Nesterov, A.L. Osipenkov, R.V. Pivin, S.V. Romanov, P.A. Rukoyatkin, T.V. Rukoyatkina, N.V. Semin, A.O. Sidorin, E.M. Syresin, A.N. Scherbakov, V.V. Tarasov, N.D. Topilin, G.V. Trubnikov, Yu.A. Tumanova, A.V. Tuzikov, B.V.Vasilishin, V.I. Volkov, V.M. Zhabitsky.	
	DLNP	E.V. Akhmanova, A.G. Kobets, V.I. Khilinov, I.N. Meshkov, O.S. Orlov, A.Yu. Rydakov, N.A. Rybakov, L.V. Soboleva, T.A. Stepanova, A.A. Sidorin, S.L. Yakovenko	
	LRB	V.N. Buchnev, G.N. Timoshenko, V.Yu. Schegolev	
1.5.	**R&D, construction and development of cryogenic systems**	**N.N. Agapov** **H.G. Khodzhibagiyan**	Projecting Realization
	VBLHEP	A.B. Arefiev, V.I. Batin, N.A. Baldin, M.A. Basheva, D.M. Belov, Yu.T. Borzunov, V.M. Drobin, N.L. Egorova, N.E. Emelyanov, E.Yu. Filippova, I.N. Goncharov, S.P. Gorelikov, E.V. Gromova, S.V. Gudkov, E.Yu. Ivanenko, E.V. Ivanov, M.V. Kondratiev, K.K. Kozlovski, A.V. Konstantinov, V.A. Kosinov, E.A. Kulikov, D.V. Lobanov, Yu.A. Mitrofanova, V.V. Orlov, I.M. Petrov, R.V. Peshkov, S.A. Sidorov, S.A. Smirnov, E.I. Vorobiev, O.B. Yarovikova	
2.	**BM@N project** **Subproject SRC**	**M.N. Kapishin** **E. Piasetzki** **Deputies:** **O. Hen** **T. Aumann**	Realization
2.1.	**Development of the operational area of the setup: increasing the radiation protection, improving detector subsystems and engineering infrastructure**	**S.Yu. Anisimov** **M.N. Kapishin** **S.M. Piyadin**	Realization
2.2.	**Construction of the basic detector complex of the BM@N setup**	**M.N. Kapishin**	Realization
2.3.	**Development of the technological and engineering systems, control systems and test areas of the setup**	**S.Yu.Anisimov** **S.M. Piyadin** **N.D. Topilin**	Realization
	VBLHEP	Kh.U. Abraamyan, G.S. Averichev, G.N. Agakishiev, S.V. Afanasiev, S.Yu. Anisimov, V.A. Babkin, S.N. Bazylev, V.P. Balandin, A.E. Baskakov, P.N. Batyuk, V. Bekirov, D.N. Bogoslovsky, I.V. Boguslavsky, M.G. Buryakov, D. Dambrovski, A.V. Dmitriev, P.O. Dulov, D.K. Dryablov, B.V. Dubinchik, D.S. Egorov, E.S. Erin, Yu.I. Fedotov, Ya. Fedorishin, I.A. Filippov, O.P. Gavrischuk, P.S. Geraksiev, K.V. Gertsenberger, S.V. Gertsenberger, V.M. Golovatyuk, Z.A. Igamkulov, M.A. Ilieva, M.N. Kapishin, V.Yu. Karzhavin, V.N. Karpinsky, R.R. Kattabekov, G.D. Kekelidze, V.I. Kireev, Yu.T. Kiryushin, S.V. Khabarov, A.D. Kovalenko, V.Yu. Kozhin, E.S. Kokoulina, V.I.	

		Kolesnikov, A.O. Kolesnikov, V.G. Krivokhizhin, I.V. Kruglova, A.S. Kuznetsov, N.A. Kuz'min, E.M. Kulish, S.N. Kukhlin, E.A. Ladygin, V.V. Lenivenko, A.N. Livanov, A.G. Litvinenko, S.N. Lobastov, A.M.. Makan'kin, A.I. Maksimchuk, A.I. Malakhov, K.Z. Mamatkulov, S.P. Merts, I.I. Migulina, A.N. Morozov, Yu.A. Murin, R.V. Nagdasev, S.N. Nagorny, D.N. Nikitin, V.A. Nikitin, V.F. Peresedov, V.A. Petrov, Yu.N. Petukhov, S.M. Piyadin, Yu.K. Potrebenikov, V.Yu. Rogov, K. Roslon, P.A. Rukoyatkin, M.M. Rumyantsev, A.D. Rustamov, I.A. Rufanov, D.G. Sakulin, S.V. Sergeev, V.O. Sidorenko, V.A. Sitnikov, V.N. Spaskov, E.A. Strokovsky, D.A. Suvarieva, I.V. Slepnev, V.M. Slepnev, I.P. Slepov, B.V. Sukhov, V. Sheynast, R.A. Shindin, A.V. Shutov, V.B. Shytov, A.V. Schipunov, N.A. Tarasov, O.G. Tarasov, A.V. Terletsky, A.A. Timoshenko, V.V. Tikhomirov, N.D. Topilin, I.A. Tyapkin, V.V. Ustinov, V.A. Vasendina, N.M. Vladimirova, L.S. Yordanova, V.I. Yurevich, G.A. Yarygin, N.I. Zamyatin, A.I. Zinchenko, E.V. Zubarev
	LIT	D.A. Baranov, Zh.Zh. Musul'manbekov, V.V. Pal'chik, N.N. Voytishin
	FLNP	E.I. Litvinenko
2.4.	**Studies of Short-Range-Correlations of nucleons at BM@N (SRC)**	**M.N. Kapishin** **E. Piasetzky** **Deputies:** **O. Hen** **T. Aumann**
3.	**MPD project**	**V.M. Golovatyuk** **V.D. Kekelidze**
	VBLHEP	S.V.Afanasev, G.N.Agakishiev, N.V.Anfimov, A.A.Aparin, V.I.Astakhov, S.V.Andreeva, T.V. Andreeva, G.S.Averichev, A.V.Averiyanov, V.A. Babkin, I.A.Balashov, M.Yu. Barabanov, D.A.Baranov, A.E.Baskakov, P.N.Batyuk, A.G. Bazhazhin, S.N. Bazylev, A.V.Belyaev, E.V.Belyaev, S.E.Beleaev, V.Benda, D.N. Bogoslovsky, I.V.Boguslavsky, M.G. Buryakov, A.V.Butenko, A.V.Butorin, A.V.Bychkov, S.G.Buzin, V.V.Chalyshev, V.A.Cheplakova, V.V. Chepurnov, V.F.Chepurnov, G.A. Cheremukhina, P.V.Chumakov, B.Dabrovska, D.Dabrovsky, D.V. Dementiev, A.V. Dmitriev, V.Kh.Dodokhov, E.V.Dolbilina, A.G.Dolbilov, D.E.Donets, A.Yu.Dubrovin, P.O. Dulov, N.V.Dunin, V.B. Dunin, V.E.Dydyshko, V. Dyatlov, A.A.Efremov, D.S.Egorov, V.V.Elsha, A.E.Emelianov, N.E.Emelianov, O.V.Fateev, Yu.I.Fedotov, A.A.Fedyunin, I.A. Filippov, M.A.Gaganova, T.T.Gandzhelashvili, I.V. Gapienko, O.P.Gavrischuk, K.V. Gertsenberger, V.M.Golovatyuk, N.V.Gorbunov, A.V. Ivanov, A.Yu. Isupov, S.I.Kakurin, M.N.Kapishin, L.A. Kartashova, G.D. Kekelidze, V.D.Kekelidze, A.O.Kechechan, V.A.Kireev, Yu.T. Kiryushin, I.S.Kiryutin, H.G.Khodzhibagiyan, V.I. Kolesnikov, A.Kolozhvari, V.G.Komarov, A.D.Kovalenko, E.V.Kozhin, V.A.Kramarenko, L.M.Krasnova, Yu.F.Krechetov, I.V. Kruglova, A.V.Krylov, S.I.Kukarnikov, S.N. Kuklin, E.A.Kulikov, N.A.Kozlenko, V.S. Kuz'min, N.A.Lashmanov, R.Lednicky, A.G. Litvinenko, G.N.Litvinova, A.N.Livanov, V.I. Lobanov, Yu.Yu. Lobanov, S.N. Lobastov, Yu. Lukstin'sh, D.T. Madigozhin, V.I.Maksimenkova, A.I. Malakhov, I.V.Malikov, L.V.Malinina, D.G. Melnikov, S.P. Merts, I.N.Meshkov, I.I. Migulina, Yu.I.Minaev, S.A. Movchan, N.A. Molokanova, A.E.Moskovsky, A.A.Moshkin, I.V.Moshkovsky, A.A. Mudrokh, Yu.A. Murin, K.A.Mukhin, D. Myktybekov, V.V. Myalkovsky, E.N.Nazarova, A.V.Nechaevsky, V.A. Nikitin, I.A.Oleks, O.E. Orlov, S.S.Parzhitsky, V.A.Pavlyukevich, V.A. Penkin, V.F.

	Realization
	Realization

		Peresedov, V.A. Petrov, D.V. Peshekhonov, N.V. Pilyar, S.M. Piyadin, A.E.Potanina, Yu.K.Potrebenikov, M.Peryt, S.V. Razin, N.O.Ridinger, O.V. Rogachevsky, V.Yu. Rogov, K. Roslon, M.M. Rumyantsev, I.A.Rufanov A.A.Rybakov, A.A.Rymshina, Z.Ya-O.Sadygov, V.M.Samsonov, A.A. Savenkov, Sebalos Sanches S., S.A.Sedykh, T.V. Semchukova, A.Yu.Semenov, I.A.Semenova, S.V. Sergeev, N.A.Sergeeva, E.V.Serochkin, A.O. Sidorin, I.P.Slepov, V.M.Slepnev, I.V. Slepnev, Yu.A.Solnyshkin, E.A.Streletskaya, N.V.Sukhov, S.I.Sukhovarov, N.N.Surkov, V.L.Svalov, A.V.Shabunov, A.D. Sheremetiev, A.I.Sheremeteva, R.A.Shindin, M.O.Shitenkov, K. Shtejer Dias, A.A.Shunko, A.B. Shutov, V.B. Shutov, A.N.Scherbakov, B.G.Schinov, A.V.Schipunov, N.A. Tarasov, A.V. Terletsky, O.V.Teryaev, A.A. Timoshenko, V.V. Tikhomirov, G.P.Tkachev, N.D.Topilin, A.V.Trubnikov, I.A. Tyapkin, S.Yu. Udovenko, V.A. Vasendina, I.N.Vasilev, S.V. Vereschagin, Y. M. Vladimirova, N.V.Vlasov, A.S.Vodopiyanov, O.A.Volodina, A.A.Voronin, G.A. Yarygin, M.V.Zaitseva, N.I.Zamyatin, S.A. Zaporozhets, A.I. Zinchenko, D.A. Zinchenko, V.N. Zryuev.	
	DLNP	A.V.Guskov, A.G. Ol'shevsky	
	LIT	V.V. Ivanov, P.I. Kisel', Zh.Zh. Musul'manbekov, T.A.Strizh	
	FLNP	E.I.Litvinenko	
3.1.	**Design and construction of the superconducting solenoid and magnet yoke**	**N.E. Emelyanov** **N.D. Topilin**	Realization
	VBLHEP	V.H. Dodokhov, A.A. Efremov, S.G. Gordeev, G.D. Kekelidze, E.M. Kislov, V.I. Lobanov, Yu.Yu. Lobanov, N.D. Topilin	
3.2.	**Construction of the detector complex of the start configuration of the MPD setup**	**V.M. Golovatyuk** **V.D. Kekelidze**	Realization
	VBLHEP	V.A. Babkin, C.N. Bazylev, A. Ivashkin, S.A. Movchan, Yu.A. Myrin, I.A. Tyapkin, N.D. Topilin, V.I. Yurevich	
3.3.	**Design and creation of the data acquisition and control systems**	**S.N. Bazylev** **I.V. Slepnev**	Realization
	VBLHEP	A.E. Baskakov, A.A. Fedyunin, I.A. Filippov, S.N. Kuklin, V.M. Slepnev, N.A. Tarasov, A.V. Terletsky, A.B. Shutov, A.V. Schipunov	
3.4	**Development of MPD physical program**	**V.I. Kolesnikov** **A.I. Zinchenko**	Realization
4.	**Theoretical investigations, calculations and development of models descibling nuclear matter properties at high temperatures and compressions, dynamics of high-energy nuclear interactions at extremely high baryonic densities, spin and P-odd effects**	**D. Blaschke** **A.S. Sorin** **O.V. Teryaev**	Realization
	BLTP	A.V. Efremov, A. Frizen, A.S. Khvoroctukhin, S.B. Gerasimov, Ya.N. Klopot, A.G. Oganesyan, A. Parvan, M.K. Volkov	
	LIT	Yu.L. Kalinovsky, Zh.Zh. Musul'manbekov, E.G Nikonov	
	DLNP	G.I. Lykasov	
	VBLHEP	Kh.U. Abraamyan, D.A. Artemenkov, P.N. Batyuk, D.K. Dryablov, V.D. Kekelidze, M.A. Kozhin, R. Lednicky, A.G. Litvinenko, A.I. Malakhov, S.G. Reznikov, O.V. Rogachevsky, V. Voronyuk, V.N. Zhezher	

5.	**Computer infrastructure: on-line and off-line clusters of the distributed computer complex, system of simulation, data transfer and analysis, information and technological computer systems**	**A.G. Dolbilov** **Yu.K.Potrebenikov** **O.V. Rogachevsky**	Realization
	VBLHEP	V.F. Dydyshko, O.S. Fedoseev, D.G. Mel'nikov, Yu.I.Minaev, S.A. Mitryukhin, D.V. Peshekhonov, I.P. Slepov, B.G. Schinov, I.V. Slepnev, S.N. Shkarovsky, V.L. Svalov	
	LIT	I.A. Kashunin, D.V. Kekelidze, V.V. Koren'kov, V.V.Mitsyn, D.A.Oleinik, I.S. Pelevanyuk, A.Sh.Petrocayn, M.S. Plyashkevich, D.V. Podgainy, V.V.Trofimov, T.A. Strizh, L.V.Zrelov	
6.	**SPD project: conceptual and technical design of the Spin Physics Detector (SPD) at the NICA collider**	**A.V.Gus'kov** **A.D. Kovalenko** **V.P. Ladygin**	Project preparation
	VBLHEP	R.R. Akhunzyanov, V.A. Anosov, N.I. Azorsky, A.A. Baldin, E.G.Baldina, M.Yu. Barabanov, A.N. Beloborodov, A.V.Belyaev, V.V.Bleko, D.N.Bogoslovsky, I.V. Boguslavsky, V.B. Dunin, Yu.N. Filatov, T.L. Enik, O.P. Gavrischuk, A.S. Galoyan, L.Glonti, S.M.Golubykh, N.O.Grafov, A.S. Gribovsky, V.A. Gromov, S.A. Gromov Yu.V. Gurchin, Yu.V. Gusakov, A.V. Ivanov, N.Ya. Ivanov, A.Yu. Isupov, E.A.Kas'yanova, G.D. Kekelidze, M.A. Kozhin, E.S. Kokoulina, E.V. Kostyukhov, Yu.A. Kopylov, P.S. Korovkin, V.A. Kramarenko, V.N. Kruglov, S.V. Khabarov, P.R. Kharyuzov, A.N. Khrenov, V.M. Lysan, R. Lednicky, A.M. Makan'kin, A.M.Martovitsky, G.V. Mescheryakov, I.V. Moshkovsky, S.N.Nagorny, V.A. Nikitin, V.V. Pavlov, S.S. Parzhitsky, E.E. Perepelkin, D.V. Peshekhonov, V.V.Popov, S.G. Reznikov, O.V. Rogachevsky, A.B.Safonov, K.M.Salamatin, I.A. Savin, A.A. Savenkov, S.Yu. Starikova, Ya.T. Skhomenko, E.A. Streletskaya, O.G. Tarasov, A.A.Terekhin, O.V. Teryaev, A.V. Tishevsky, N.D. Topilin, B.L. Topko, Yu.A.Troyan, E.A. Usenko, A.I. Sheremetieva, S.S. Shimansky, E.V. Vasilieva, I.S.Volkov, P.V. Volkov, I.P. Yudin, N.I. Zamyatin, I.A. Zhukov, A.V. Zinin, E.V. Zubarev	
	DLNP	V.M. Abazov, G.D. Alexeev, L.G. Afanasiev, A.P.Belova, A.V. Bobkov, T.V.Boltushkin, E.V.Brazhnikov, I.I. Denisenko, V.N. Duginov, G.A. Golovanov, A.O. Gridin, K.I. Gritsay, A.V. Guskov, M. Finger, M. Finger(Jr.), V.N. Frolov, A.V.Karpishkov, N.V.Kirichkov, V.I.Komarov, A.V. Kulikov, V.S.Kurbatov, S.A. Kutuzov, Yu.A., A. Mal'tsev, Nefyedov, A.A.Pavlova, B.Parsamyan, A.A. Piskun, I.K. Prokhorov, V.M. Romanov, A.I. Rudenko, A. Rymbekova, M.A.Rumyantsev, N.A.Rybakov, A.G. Samartsev, A.V. Semenov, A.A. Sinitsa, V.N. Shaikovsky, A.V.Shipilova, N.B. Skatchkov, A.N.Skachkova, M. Slunecka, V. Sluneckova, K.Shtekher, V.V.Tereschenko, A.V. Tkatchenko, V.V. Tokmenin, Yu.N. Uzikov, L.S. Vertogradov, Yu.L.Vertogradova, A.Yu. Verkheev, V.A.Vesenkov, N.I. Zhuravlev	
	LIT	P.V.Goncharov, D.A.Oleinik, G.A.Ososkov, A.Sh.Petrosyan, D.V.Podgainy, I.S.Polevanyuk, R.V. Polyakova, V.V.Uzhinsky, M.I.Zuev	
	BLTP	I.V. Anikin, A.V. Efremov, S.V. Goloskokov, Yu. Klopot, D. Strizhik, N.I. Volchansky	
7.	**Construction of the complex of buildings with engineering infrastructure for object placement, engineering systems**	**N.N. Agapov** **V.D. Kekelidze** **N.D. Topilin**	Projecting Realization

	and carrying out R&D for the NICA complex		
7.1.	**Technical designing, coordination of the construction of the building complex and engineering infrastructure development**	**A.V. Dudarev** **I.N. Meshkov**	Projecting Realization
7.2.	**R&D, production of prototypes and full-scale superconducting magnets for the NICA booster and collider**	**H.G. Khodzhibagiyan** **S.A. Kostromin**	Projecting Realization
	VBLHEP	N.N.Agapov, V.V. Agapova, A.S. Averichev, A.M. Bazanov, N.P. Bazylev, V.I. Batin, N.A. Blinov, Yu.T. Borzunov, V.V. Borisov, A.A.Bortsova, A.V. Butenko, A.V. Bychkov, S.A. Dolgy, A.M. Donyagin, V.M. Drobin, N.A. Filippov, E.Yu. Filippova, A.R. Galimov, O.M. Golubitsky, Yu.V. Gusakov, E.Yu. Ivanenko, V.N. Karpinsky, R.A. Karpunin, I.E. Karpunina, H.G. Khodzhibagiyan, S.Yu. Kolesnikov, A.V. Konstantinov, V.S. Korolev, S.A. Kostromin, A.V. Kudashkin, G.L. Kuznetsov, E.A. Kulikov, O.A. Kunchenko, V.I. Lipchenko, D.V. Lobanov, A.A. Makarov, Yu.A. Mitrofanova, A.Yu. Merkur'ev, A.V. Nesterov, D.N.Nikiforov, M.S.Novikov, A.L. Osipenkov, R.V. Pivin, D.O. Ponkin, T.F. Prakhova, A.S. Sergeev, S.A. Smirnov, A.Yu. Starikov, A.V. Shabunov, M.M.Shandov, A.V.Shemchuk, E.V. Shevtchenko, N.D.Topilin, Yu.A. Tumanova, A.S. Vinogradov, N.A. Zhil'tsova	
7.3.	**Upgrade and development of electric power and technological nets aimed at the increasing of economics and technical efficiency**	**N.N.Agapov** **N.V. Semin**	Projecting Realization
	VBLHEP	A.V. Alfeev, A.M. Karetnik, A.A. Makarov, M.I. Migulin, E.V. Serochkin, V.M. Stepanov, A.N. Sotnikov, A.V. Shabunov, V.Yu. Shilov, O.M. Timoshenko, N.D. Topilin, V.P. Tchernyaev	
	AS&CC Office	Yu.N. Balandin, I.S. Frolov, L.I. Tikhomirov	
	OCE	V.N. Buchnev, 2 pers.	
	LRB	G.N. Timoshenko, 3 pers.	

Collaboration

Country or International Organization	**City**	**Institute or laboratory**
Armenia	Yerevan	Foundation ANSL
		YSU
Azerbaijan	Baku	NNRC
Belarus	Minsk	BSUIR
		INP BSU
		IP NASB
		JIPNR-Sosny NASB
		PTI NASB
		SPMRC NASB
Bulgaria	Blagoevgrad	SWU
	Plovdiv	PU
	Sofia	INRNE BAS
		ISSP BAS
		LTD BAS
		SU
		TU-Sofia
CERN	Geneva	CERN

Chile	Valparaiso	UTFSM
China	Beijing	"Tsinghua"
		IHEP CAS
		UCAS
	Hefei	IPP CAS
		USTC
	Hengyang	USC
	Huzhou	HU
	Jinan	SDU
	Lanzhou	IMP CAS
	Shanghai	Fudan
		SINAP CAS
	Wuhan	CCNU
	Yichang	CTGU
Czech Republic	Liberec	TUL
	Olomouc	UP
	Prague	CTU
		CU
		VP
	Rez	NPI CAS
	Vitkovice	VHM
Egypt	Cairo	ECTP
France	Nantes	SUBATECH
	Saclay	CEA
Georgia	Tbilisi	AIP TSU
		GTU
Germany	Darmstadt	GSI
		TU Darmstadt
	Dresden	ILK
	Erlangen	FAU
	Frankfurt/Main	FIAS
		Univ.
	Giessen	JLU
	Julich	FZJ
	Mainz	JGU
	Regensburg	UR
	Tubingen	Univ.
Israel	Jerusalem	HUJI
	Tel Aviv	TAU
Italy	Brescia	Forgiatura Morandini
	Genova	ASG
	Turin	INFN
Japan	Nagoya	Nagoya Univ.
Kazakhstan	Almaty	PhysTI
Mexico	Mexico City	UNAM
	Puebla	BUAP
Moldova	Chisinau	IAP
		MSU
Mongolia	Ulaanbaatar	IPT MAS
Poland	Chorzow	Frako-Term
	Lublin	UMCS
	Otwock (Swierk)	NCBJ
	Warsaw	WUT
	Wroclaw	ILT&SR PAS

		UW
Romania	Bucharest	IFIN-HH
		INCDIE ICPE-CA
	Magurele	INOE2000
Russia	Belgorod	BelSU
	Chernogolovka	LITP RAS
	Dolgoprudny	MIPT
	Dubna	PELCOM
		Progresstech
	Fryazino	ISTOK
	Gatchina	NRC KI PNPI
	Kazan	Compressormash
		Spetshmash
	Moscow	Cryogenmash
		Geliymash
		IBMP RAS
		ITEP
		LPI RAS
		MSU
		NNRU "MEPhI"
		NRC KI
		SINP MSU
		VEI
	Moscow, Troitsk	INR RAS
	Novosibirsk	BINP SB RAS
		STL "Zaryad"
	Protvino	IHEP
	Samara	SU
	St. Petersburg	KRI
		Neva-Magnet
		SPbSPU
		SPbSU
	Syktyvkar	DM Komi SC UrB RAS
	Tomsk	NPI TPU
	Vladikavkaz	NOSU
Slovakia	Bratislava	IMS SAS
	Kosice	UPJS
	Zilina	UZ
South Africa	Cape Town	UCT
	Johannesburg	UJ
		WITS
Sweden	Stockholm	SU
Ukraine	Kharkov	KhNU
		LTU
		NSC KIPT
	Kiev	BITP NASU
USA	Batavia, IL	Fermilab
	Cambridge, MA	MIT
	Stony Brook, NY	SUNY
	Upton, NY	BNL

02-0-1127-2016/2023

Priority:	1

Status: In-progress

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

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

Participating countries and international organizations:

Armenia, Belarus, CERN, Germany, Georgia, Italy, Russia, Slovakia.

Issues addressed and main goals of research:

Creating a network of six Precision Laser Inclinometers (PLI); creating a prototype of an amplitude interferometric length meter for a length of 16 m; creating a prototype of a laser reference line for a length of 128 m; creating a prototype of a seismic-stabilized research platform based on PLI. Investigation of the various carbon-based transmission photocathodes (mainly carbon-based), installation of the second beamline with the 213 nm laser at the photogun bench, development of the photoinjector bench: 150 KeV electron energy achievement, development of the radiation safety, interlock and control systems. Development, design parameters achievement and commissioning of the LINAC-200 linear electron accelerator with the aim of its experimental and education applications. Optimization of the accelerator parameters for users. Maintenance of the FLASH infrared undulator and participation in its experimental program, as well as in the new undulator development; development of photon diagnostic for FLASH, FLASH2 and XFEL and experiments participation. Experimental investigations at formation of 3D ellipsoidal shape electron bunches with small emittances in PITZ with new laser system. Preparation of the proposals and start of the JINR participation in international collaborations for future high-energy colliders.

Expected results in the current year:

- Fabrication of the nanostructured carbon photocathodes and investigation of their electrophysical properties (λ = 213 / 266 nm). Assembling of the pepper-pot emittance measurement system main components for the Photoinjector bench. Vacuum system assembling and pumping. Design, fabrication and assembling of the cryopump for the bench vacuum system. Assembling, tuning and calibration of the nanosecond range high-sensitivity electron bunch charge sensor prototype. Bench startup with 120 keV energy.

- Optimization of the Linac-200 beam parameters at 200 MeV energy. Extraction of the beam with wide range parameters from single electrons to 30 mA with repetition rate up to 25 Hz into the atmosphere, optimization of beam parameters for users. Manufacturing of beam parallel transfer system (LNP program) after 2nd and 3rd accelerating stations. Modernization of the cooling, control and interlock systems

- Development and creation of an absolute length meter with micron resolution for lengths of 1-10 m. Determining the sensitivity of the meter on a length of 0.42 m. R&D on the creation of a 128-meter laser reference line with the ability to measure the spatial position of the Measured Point on a controlled object (non-destructive testing). Measurement of microseismic activity at CERN and assessment of the effect of microseisms on the luminosity of the LHC collider, development of technical specifications for the design and software of small-sized PLI.

- Investigation of electron beam and FEL physics: generation of infrared radiation from JINR undulator at FLASH and measurements of longitudinal bunch profile on basis of this radiation; diagnostic of electron bunches at FLASH2 by using of microchannel plate detectors; test experiments with XFEL microchannel plate detectors on synchrotron sources PETRA III, experimental investigations of 3D ellipsoidal shape electron bunches in PITZ with new laser system.

- Preparation of the proposals of the JINR participation in international collaborations for future high-energy colliders. Analysis of 6 T high efficient dipole magnets aimed at the FCC "low energy" pp-collider option at CERN.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	The precision laser metrology for accelerators and detector complexes	Yu.A. Budagov	2 (2016-2021)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1.	**Photoinjecting systems R&D**	**N.I. Balalykin** **M.A. Nozdrin**	Technical Proposal Realization
	VBLHEP	V.F. Minashkin, V.G. Shabratov, A.V. Shevelkin	
2.	**LINAC-200 electron accelerator**	**G.D. Shirkov** **V.V. Kobets**	Technical Proposal Realization
	VBLHEP	V.F. Minashkin, M.A. Nozdrin, A.S. Sledneva	
	DLNP	E.M. Acosta, A.E. Brukva, A.S. Dyatlov, N.I. Garanzha, V.D. Korovyakov, A.V. Skrypnik, A.G. Sorokin, V.G. Shabratov, D.S. Shokin	
	UC	D.S. Belozerov, K.B. Gikal, S.Z. Pakulyak, K.A. Verlamov, D.A. Zlydenny, A.S. Zhemchugov	
3.	**The precision laser metrology for accelerators and detector complexes**	**J.A. Budagov** **M.V. Lyablin**	Technical Proposal Realization
	DLNP	N.S. Azaryan, I.V. Bednyakov, Yu.I. Davidov, V.V. Glagolev, V.I. Kolomoets, S.M. Kolomoets, A.A. Pluzhnikov, A.V. Sazonova, S.N. Studenov, G.T. Torosyan	
	BLTP	A.N. Baushev	
	GA&C	G.V. Trubnikov	
4.	**Free electron lasers R&D**	**E.M. Syresin** **O.I. Brovko** **M.V. Yurkov**	Technical Proposal
	UC	A.F. Chesnov, N.A. Morozov, D.C. Petrov	
5.	**Preparation of the proposals and start of the JINR participation in international collaborations for future high-energy colliders**	**G.D. Shirkov** **A.D. Kovalenko**	Preparation

Collaboration

Country or International Organization	City	Institute or laboratory
Armenia	Garni	GGO
	Gyumri	IGES NAS RA
	Yerevan	Shirak Technologies
Belarus	Minsk	INP BSU
CERN	Geneva	CERN
Georgia	Tbilisi	HEPI-TSU
Germany	Hamburg	DESY
Italy	Pisa	INFN
Russia	Nizhny Novgorod	IAP RAS
Slovakia	Bratislava	IEE SAS
Uzbekistan	Tashkent	AS RUz
		IS AS RUz

02-1-1097-2010/2021

Priority:	1

Status: Being concluded

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

Leader: A.D. Kovalenko

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

Participating countries and international organizations:

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

Issues addressed and main goals of research:

Development of the infrastructure for spin physics research at the Nuclotron-M/NICA and other facilities. Preparation of the spin control and polarimetry system projects. Measurement of analyzing power in the reaction of polarized protons and polarized neutrons with polyethylene target at the momentum up to 7.5 GeV/c and up to 6.0 GeV/c for the polarized proton and neutron respectively at the setup ALPOM-2. Study of 2N- and 3N-correlations in deuteron-proton elastic scattering and deuteron break-up reactions at the Nuclotron internal target. Measurement of the cross sections and deuteron analyzing powers of the reactions. Completion of the data analysis obtained at the setup Delta-Sigma. Preparation of the proposals on modernization of the spectrometer and the Saclay-Argonne-JINR polarized proton target (setup PPT). Obtained new data on the studying of charge-exchange processes in the interactions of polarized deuterons and protons at the setup STRELA. Development of theoretical models for the description of the simplest nuclear systems taking into account relativistic effects, meson and quark-gluon components of the internal movement. Theoretical analysis of the experimental data obtained at the 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. Works on the program of the setup DELTA-2 design INR RAN/JINR.

Expected results in the current year:

- Works:
  a) preparation of technical documentation for the project of low energy proton and deuteron polarimeter at the Nuclotron injection channel;

  b) work on the project of a polarimeter based on a cluster target for the NICA collider.

- Fulfilment of the works in accordance with the approved projects and collaborative protocols within the frames of their real financial support, including realization of the projects ALPOM-2 and DSS. Completion of the proton polarimeter upgrade at the Nuclotron internal target. Completion of the data analysis on the analyzing powers A_y, A_{yy} and A_{xx} in deuteron-proton elastic scattering at the energies 400-1300 MeV. Publication and reports of the results.

- Conceptual design of the installation scheme of the equipment aimed at beam polarimetry, and the polarization control at the SPD straight section of the collider.

- Participation in the joint scientific programs and experiments, design and test of the new detectors elements at the other facilities SPS, LHC, FCC (CERN), RHIC (BNL), MEIC (TJNAF), FAIR (GSI) etc. in accordance with the Agreements.

- Continuation of the development of new calculation methods of the amplitudes and polarization characteristics of deuteron fragmentation and deuteron elastic scattering on protons and nuclei taking into account FSI and relativistic effects.
- Analysis of possibilities of providing new experiments with polarized proton and deuteron beams at the NICA complex, searching of the EDM, in particular.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	ALPOM-2	N.M. Piskunov	1 (2010-2021)
2.	DSS	V.P. Ladygin M. Janek K. Sekiguchi	1 (2010-2021)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1.	**Development of spin physics research infrastructure at the Nuclotron and other facilities. Design, construction and development of spin control and polarimetry systems. The EDM searching analysis at NICA**	**A.D. Kovalenko**	Realization
	VBLHEP	A.V. Averyanov, Yu.N. Filatov, V.V. Fimushkin, V.V. Glagolev, A.A. Kolomiets, M.Yu. Korobitsyna, D.O. Krivenkov, R.A. Kuzyakin, M.V. Kulikov, V.P. Ladygin, K.S. Legostaeva, A.N. Livanov, N.M. Piskunov, S.G. Reznikov, R.A. Shindin, E.A. Strokovsky, A.M. Taratin	
	DLNP	M. Finger, M. Finger (Jr.), Yu.N. Uzikov	
	LIT	R.V. Polyakova	
2.	**ALPOM-2 Project**	**N.M. Piskunov**	Data taking
	VBLHEP	S.N. Bazylev, Yu.P. Bushuev, O.P. Gavrishchuk, V.V. Glagolev, A.N. Livanov, D.A. Kirillov, A.D. Kovalenko, A.A. Povtoreyko, P.A. Rukoyatkin, R.A. Shindin, I.M. Sitnik	
3.	**DSS Project**	**V.P. Ladygin** **M. Janek** **K. Sekiguchi**	Preparation Data taking
	VBLHEP	E.V. Chernykh, Yu.V. Gurchin, A.Yu. Isupov, A.N. Khrenov, N.B. Ladygina, A.N. Livanov, S.G. Reznikov, Ya.T. Skhomenko, A.A. Terekhin, A.V. Tishevsky, I.S. Volkov	
	DLNP	G.I. Lykasov	
4.	**Delta-Sigma setup**	**R.A. Shindin**	Completion of Data analysis
	VBLHEP	Yu.T. Borzunov, E.V. Chernykh, I.P. Yudin	
	DLNP	N.S. Borisov, E.I. Bunyatova, M. Finger, M. Finger (Jr.), M. Slunechka, V. Slunechkova, Yu.A. Usov	

	FLNP	S.B. Borzakov	
5.	**Experiments on the program STRELA at polarized beam**	**N.M. Piskunov**	Data taking
	VBLHEP	S.N. Bazylev, Yu.P. Bushuev, V.V. Glagolev, D.A. Kirillov, A.A. Povtoreyko, I.M. Sitnik	
6.	**Theoretical calculations of polarized processes**	**V.V. Burov** **V.K. Lukyanov**	Data analysis
	BLTP	V.V. Burov	
	VBLHEP	N.B. Ladygina, A.P. Ierusalimov	
7.	**Spin effects in hadron-nucleon and lepton-nucleon interactions**	**M. Finger(Jr.)**	Data analysis
	DLNP	E.I. Bunyatova, M. Finger, M. Slunechka, V. Slunechkova	
8.	**Works on the program DELTA-2 (INR RAS - JINR)**	**A.B. Kurepin** **A.N. Livanov**	Preparation
	VBLHEP	Yu.S. Anisimov, S.N. Bazylev, A.P. Ierusalimov, V.P. Ladygin, S.M. Piyadin	

Collaboration

Country or International Organization	City	Institute or laboratory
Bulgaria	Sofia	UCTM
CERN	Geneva	CERN
Czech Republic	Brno	ISI CAS
	Prague	CTU
		CU
	Rez	UJV
France	Orsay	IPN Orsay
	Saclay	IRFU
Germany	Bochum	RUB
	Darmstadt	FAIR
	Dresden	TU Dresden
	Freiburg	FMF
	Julich	FZJ
	Tubingen	Univ.
Japan	Hiroshima	Hiroshima Univ.
	Miyazaki	Miyazaki Univ.
	Osaka	RCNP
	Sendai	Tohoku Univ.
	Tokyo	UT
	Wako	RIKEN
Poland	Otwock (Swierk)	NCBJ
Romania	Bucharest	INCDIE ICPE-CA
Russia	Belgorod	BelSU
	Gatchina	NRC KI PNPI
	Moscow	LPI RAS
		NRC KI
	Moscow, Troitsk	INR RAS

		LPP LPI RAS
Slovakia	Bratislava	IP SAS
	Kosice	IEP SAS
		UPJS
	Zilina	UZ
Sweden	Uppsala	TSL
Switzerland	Villigen	PSI
Ukraine	Kharkov	NSC KIPT
United Kingdom	Glasgow	U of G
USA	Newport News, VA	JLab
	Norfolk, VA	NSU
	Upton, NY	BNL
	Williamsburg, VA	W&M
Uzbekistan	Tashkent	Assoc. P.-S. PTI
		INP AS RUz

02-1-1087-2009/2023

Priority:	1

Status: Extended

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

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

Participating countries and international organizations:

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

Issues addressed and main goals of research:

Study of new phenomena in multiple particle productions associated with the manifestation of the quark and gluon degrees of freedom in the interaction of relativistic nuclei. Study of nucleon and nuclear interactions at the VBLHEP accelerator complex, CERN SPS. Energy scan of interactions of nuclei at 20-158 GeV/nucleon energies and the study of their dependence on the atomic number of nuclei. To search for the critical point on the phase diagram of nuclear matter at the NA61(SPS, CERN). Study of hadron production in hadron-nucleus interactions. Use of the obtained data for the precision calculations of neutrino spectra and fluxes in the accelerator experiments to study the neutrino oscillations. Investigation of nucleon clustering and the contribution of unstable nuclear-molecular States to the dissociation of light stable and radioactive isotopes, as well as the properties of rarefied baryonic matter in the dissociation of heavy nuclei. Experimental and theoretical study of deep subthreshold, cumulative processes, the formation of hadrons and antimatter in the transition energy region. Investigation of processes in the region of large P_T ($P_T \geq 1$ GeV/c) in non-cumulative and cumulative kinematic regions at SPIN and FODS setups. Study of the behavior of elementary particles, nucleon resonances and nucleon fluctuations in nuclear matter on the SCAN spectrometer. Preparation of proposals of the experiments at the VBLHEP accelerator complex on the Nuclotron extracted beams and NICA Collider. Study of the short-range nucleon-nucleon correlations and the cluster structure of the nuclei using the beams of ions, polarized protons and deuterons at the internal target of the Nuclotron in the framework of the SCAN-3project.

Expected major results in the current year:

- Investigation of new phenomena in multiple particle productions associated with the manifestation of the quark and gluon degrees of freedom.
- Preparation and performance of the experiments on the internal and extracted Nuclotron beams.
- SHINE data analysis (SPS, CERN). Study of hadron production in hadron-nucleus interactions. Use of the obtained data for the precision calculation of neutrino spectra and fluxes in the accelerator experiments to study the neutrino oscillations. Modernization of the TOF system. Configuration and testing of the three-arms SCAN magnetic spectrometer. Modernization of electronics for data taken. Analysis of experimental data.
- Analysis of the experimental data on the processes of the multiple emission of intermediate mass fragments on the beams of relativistic light ions using a 4-π PHASE-3 setup for the registration of nuclear fragments. Performing data analysis to determine the mechanism of multifragmentation and to obtain new information about the nuclear phase transitions "liquid-fog" and "liquid-gas". Investigation of properties of hot nuclei formed in the collisions of light relativistic ions with heavy targets. Production of the detector system for the registration of the decay of hypernuclei.
- Verification of the consequences of the principles of self-similarity and weakening of correlations in the formation of multiple particles.
- Upgrade of the SCAN setup. Analysis of the experimental data on the behavior of nucleon resonances and nucleon fluctuations in nuclei, on the search and study of properties of the bound state-meson in nuclear matter, study of np and pp correlations. Modernization of the Internal target of the Nuclotron.

- Search and study of the Hoyle state and more complex nuclear-molecular States in the dissociation of light nuclei. Analysis of the isotopic composition of the fragmentation of heavy nuclei. Use of automated microscopes, as well as improvement of the NE technology.
- Updating the Marusya installation for conducting the experimental studies with the extracted Nuclotron beams. Investigation of A-dependences of rare subthreshold and cumulative processes of the formation of pions, kaons and antiprotons depending on the type and energy of the incoming nuclei, the momentum and angle of the detected particles. Carrying out correlation experiments with registration of groups of particles in the final state, one of which is cumulative.
- Collection, processing and digitization of the film information obtained using bubble chambers and in electronic experiments with fixed targets under the conditions of registration of multiple birth of particles in the energy range of 1-300 GeV.
- Use of heavy and light ions for applied research.
- Analysis of the experimental data obtained in the PHENIX experiment.
- Processing of the experimental data from 5-9 Runs at the PHENIX setup. Participation in the formation of the program for e-RHIC.
- Preparation of a project to study spin asymmetries at the LHEP accelerator complex.
- Collection of new experimental data in pA-and AA-interactions in the region of large p_T ($p_T \geq 1$ GeV/c) at SPIN and FODS facilities, data processing and publication of results

List of projects:

	Project	Leader	Priority (period of realisation)
1.	NA61	A.I. Malakhov	2 (2012 - 2021)
2.	SKAN-3	S.V. Afanasiev	1 (2017 - 2022)

List of Activities

Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Experiment NA61/SHINE	**A.I. Malakhov** **G.L. Melkumov**	Upgrade Preparation Data analysis
VBLHEP	V.A. Babkin, M.G.Buryakov, V.M. Golovatyuk, A.V. Dmitriev, V.I. Kolesnikov, V.A. Kireev, V.A. Lenivenko, V.A. Matveev, M.M. Rumyantsev, A.A. Zajtsev	
DLNP	V.V. Lyubushkin, G.I. Lykasov, B.A. Popov, V.V. Tereschenko	
2. Experiment BECQUEREL	**P.I. Zarubin**	Data taking Data analysis
VBLHEP	D.A. Artemenkov, V. Bradnova, N.K. Kornegrutsa, V.V. Rusakova, P.A. Rukoyatkin, A.A. Zaytsev	
3. Experiment FASA-3 for registration of nuclear fragments	**S.P. Avdeev**	Upgrade Preparation Data analysis
DLNP	V.I. Stegaylov	
FLNR	V.V. Kirakosyan, E.M.Kozulin, G.V. Mushinsky, O.V. Strekalovsky	
VBLHEP	H.U. Abraamian, Z.A. Igamkulov, V. Karach, L.V. Kornyushina, A.G. Litvinenko, P.A. Rukoyatkin, Z.A. Sadygov	

4.	**Project SCAN-3**	**S.V. Afanasiev** **A.I. L'vov**	Preparation Data analysis Upgrade
	VBLHEP	Yu.S. Anisimov, A.A. Baldin, V. Bekirov, D.K. Dryablov, B.V. Dubinchik, S.V. Kilchakovskaia, Yu.F. Krechetov, A.S. Kuznetsov, M. Paraypan, D.G. Sakulin, V.A. Smirnov, E.V. Sukhov, V.V Ustinov, P.R. Kharyuzov	
5.	**Search and investigation of new phenomena using information obtained with bubble chambers and their theoretical interpretation. Creation of data base of experimental data and educational programs in the field of relativistic nuclear physics**	**A.A. Baldin** **V.V. Glagolev**	Data analysis
	VBLHEP	S.G. Arakelyan, E.G. Baldina, A.V. Belyaev, A.V.Beloborodov, D.N.Bogoslovsky, A.P. Ierusalimov, V.V. Ilyushchenko, P.R. Kharyuzov, N.P. Kharyuzova, D.S.Korovkin, O.V. Rogachevsky, A.B. Safonov, A.Yu. Troyan	
6.	**Investigation of deep subthreshold processes, applied and educational programs at MARUSYA set up**	**A.A. Baldin**	Preparation Data taking
	VBLHEP	V.A. Arefiev, S.V. Afanasiev, E.G. Baldina, A.V. Belyaev, S.N. Bazylev, A.I. Berlev, A.V.Beloborodov, D.N.Bogoslavsky, D.K. Dryablov, E.A. Efimova, P.R. Kharyuzov, N.P. Kharyuzova, D.S.Korovkin, S.Yu. Starikova, I.V. Slepnev, S.S. Shimansky, A.B.Safonov, A.Yu. Troyan	
	BLTP	V.V. Burov, S.G. Bondarenko	
	DLNP	A.N.Fedorov	
7.	**Investigation with light and heavy ions for applied research**	**A.I. Malakhov**	Realization Preparation Data taking
	VBLHEP	N.N. Agapov, Yu.S. Anisimov, A.A. Baldin, E.G. Baldina, D.K. Dryablov, A.D. Kovalenko, M. Paraypan	
8.	**Upgrade of equipment the station of internal target of the Nuclotron**	**S.V. Afanasiev**	Upgrade Data taking
	VBLHEP	Yu.S. Anisimov, V.N. Bekirov, D.K. Dryablov, B.V. Dubinchik, S.V. Kilchakovskaia, R.Yu.Kolesnikov, A.S.Kuznetsov, S.N. Kuznetsov, D.G. Sakulin, T.V. Trofimov	
9.	**Test of the detectors for measurements and control the luminosity at the collider NICA**	**A.G. Litvinenko**	R&D Technical Proposal
	VBLHEP	R.A. Akbarov, K.U. Abraamyan, T.Y. Bokova, Z.A. Igamkulov, L.V. Kornyushina, I.I. Migulina, A.Z. Sadygov, Z.Y. Sadygov, V.I. Shokin	
	FLNP	E.I. Litvinenko	

10. Study of the short range nucleon-nucleon correlations at modernized internal target station at Nuclotron

V.P. Ladygin

Preparation
Data taking

VBLHEP

Yu.V. Gurchin, A.Yu. Isupov, A.N. Khrenov, N.B. Ladygina, A.I. Malakhov, S.G. Reznikov, Ya.T. Schomenko, A.A. Terekhin, A.V. Tishevsky

11. The data processing of the Phoenix experiment. Preparing a program for measurements on the RHIC

A.G. Litvinenko

R&D
Technical Proposal

VBLHEP

S.V. Afanasiev, A.I. Malakhov, P.A. Rukoyatkin, S.P. Avdeev, K.U. Abraamyan

Collaboration

Country or International Organization	City	Institute or laboratory
Armenia	Yerevan	Foundation ANSL
		YSU
Bulgaria	Blagoevgrad	AUBG
	Sofia	INRNE BAS
		Inst. Microbiology BAS
		SU
CERN	Geneva	CERN
China	Beijing	CIAE
		IHEP CAS
	Wuhan	CCNU
Czech Republic	Prague	CTU
		CU
		IMC CAS
	Rez	NPI CAS
Germany	Darmstadt	TU Darmstadt
	Frankfurt/Main	FIAS
		Univ.
India	Jaipur	Univ.
	Mumbai	BARC
Japan	Tsukuba	Univ.
Mongolia	Ulaanbaatar	IPT MAS
Poland	Krakow	NINP PAS
	Lodz	UL
	Otwock (Swierk)	NCBJ
	Warsaw	UW
		WUT
Romania	Bucharest	IFIN-HH
		INCDIE ICPE-CA
		UB
	Constanta	UOC
	Magurele	ISS
Russia	Belgorod	BelSU
	Chernogolovka	ISMAN RAS
	Moscow	ITEP
		LPI RAS

		MSU
		SINP MSU
	Moscow, Troitsk	INR RAS
	Protvino	IHEP
	Sarov	VNIIEF
	Smolensk	SSU
	St. Petersburg	FIP
	Tomsk	TPU
	Vladikavkaz	VTC "Baspik"
Slovakia	Bratislava	IP SAS
	Kosice	UPJS
Switzerland	Geneva	UniGe
USA	Berkeley, CA	Berkeley Lab
	Iowa City, IA	UIowa
	Upton, NY	BNL
Uzbekistan	Jizzakh	JSPI
	Samarkand	SSU
	Tashkent	Assoc. P.-S. PTI

02-0-1066-2007/2023

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. Lednicky
Yu.A. Panebratsev

Participating countries and international organizations:

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

Issues addressed and main goals of research:

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 results in the current year:

- The data on beam energy scan at 19.6 GeV and 14.6 GeV.
- Data analysis of the collisions of trunsversely polarized protons at 510 GeV.
- Study of event structure, collective variables, correlation characteristics, femtosopic correlation functions and high P_T processes.
- Analysis of experimental data with isobaric nuclei ^{96}Zr and ^{96}Ru.
- Participation in JINR-BNL and JINR-CERN joint educational programs. Development of JINR educational portal.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	STAR	Yu.A. Panebratsev R. Lednicky	1 (2010-2021)

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	G.S. Averichev, T.G. Dedovich, V.B. Dunin, A.O. Kechechyan, A.A. Povtoreyko, V.Yu. Rogov, S.V. Sergeev, V.V. Tikhomirov, M.V. Tokarev, V.I. Yurevich, G.A. Yarygin, A.N. Zubarev	

2. The study of spin and polarized proton collisions with polarization phenomena	**M.V. Tokarev**	Realization
VBLHEP	A.A. Aparin, T.G. Dedovich, V.V. Lyuboshits, O.V. Teryaev, E.I. Schakhaliev	
LIT	Zh.Zh. Musulmanbekov	
BLTP	A.E. Dorokhov, S.V. Goloskokov	
3. The study of event structure, collective effects, femtoscopic correlations and high *pT* processes	**R. Lednicky** **Yu.A. Panebratsev**	Realization
VBLHEP	G.S. Averichev, G.N. Agakishiev, A.A. Aparin, T.G. Dedovich, E. Pervyshina, O.V. Rogachevsky, M.V. Tokarev, E.I. Schakhaliev	
LIT	G.A. Ososkov	
4. Participation in the heavy ion program in STAR experiment at RHIC. Beam-energy scan measurements	**Yu.A. Panebratsev**	Data taking Data processing Data analysis
VBLHEP	A.A. Aibaev, G.N. Agakishiev, A.A. Aparin, G.S. Averichev, T.G. Dedovich, A. Kenzhagulov, E.V. Potrebenikova, O.V. Rogachevsky, B.G. Shchinov, M.V. Tokarev, A. Tutebaeva	
LIT	V.V. Korenkov, V.V. Mitsyn, G.A. Ososkov	
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	A.A. Aparin, G.N. Agakishiev, E.V. Potrebenikova	
LIT	N. Balashov, V.V. Mitsyn, G.A. Ososkov, T.A. Strizh	
6. Participation in JINR-BNL and JINR-CERN joint educational programs. Development of the JINR educational portal	**N.E. Sidorov** **E.V. Potrebenikova**	Realization
VBLHEP	V.V. Belaga, E.I. Golubeva, K.V. Klygina, P.D. Semchukov, N.E. Sidorov, N.I. Vorontsova, M.P. Osmachko	
UC	S.N. Balalykin, A.O. Komarova, S.Z. Pakulyak, L.V. Platonova, I.A. Smirnova, O.A. Smirnov, T.G. Stroganova	
7. Elaboration of proposals for the development of detectors for the study of polarization phenomena at colliders	**V.B. Dunin**	Realization
VBLHEP	V.B. Dunin, A.D. Kovalenko, V.V. Fimushkin	

Collaboration

Country or International Organization	City	Institute or laboratory
Azerbaijan	Baku	IRP ANAS
Bulgaria	Sofia	INRNE BAS
		SU
Czech Republic	Prague	CU
	Rez	NPI CAS
		UJV
France	Nantes	SUBATECH
Germany	Heidelberg	Univ.
Poland	Warsaw	WUT
Russia	Moscow	ITEP
		NNRU "MEPhI"
	Protvino	IHEP
	St. Petersburg	SPbSU
Slovakia	Bratislava	IP SAS
	Kosice	UPJS
USA	Berkeley, CA	Berkeley Lab
	Bloomington, IN	IU
	Chicago, IL	UIC
	Lemont, IL	ANL
	New Haven, CT	Yale Univ.
	Stony Brook, NY	SUNY
	University Park, PA	Penn State
	Upton, NY	BNL

02-1-1088-2009/2022		Priority:	1
		Status:	In-progress

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

Leader: A.S. Vodopyanov

Participating countries and international organizations:
Armenia, Austria, Azerbaijan, Bangladesh, Brazil, Bulgaria, CERN, China, Croatia, Cuba, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, India, Indonesia, Italy, Japan, Malta, Mexico, Netherlands, Norway, Pakistan, Peru, Poland, Republic of Korea, Romania, Russia, Slovakia, South Africa, Sweden, Thailand, Turkey, Ukraine, United Kingdom, USA.

Issues addressed and main goals of research:

1. Participation in the preparation of ALICE upgrade (Photon spectrometer PHOS, assembly of the setup).
2. Participation in the upgrade of ALICE Inner Tracking System (ITS) - the development of the detector control system software.
3. Realization of experiments at the LHC, data analysis, preparation of publications.
4. Physics research program at the ALICE detector.
5. Development and upgrade of data analysis computing GRID-ALICE in Russia.
6. Participation in the service work on the ALICE detector.

Expected results in the current year:

- Participation in the preparation of the proposal 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 realisation)
1.	ALICE	A.S. Vodopyanov	1 (2010-2023)

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. Klass, V.I. Lobanov, P.V. Nomokonov, I.A. Rufanov	

2.	**Physical process simulation and data analysis**	**B.V. Batyunya**	Realization
	VBLHEP	M.Yu. Barabanov, S.S. Grigoryan, A.V. Kuznetsov, L.V. Malinina, K.P. Mikhaylov, V.N. Pozdnyakov, E.P. Rogochaya, G.E. Romanenko, K. Roslon, B.D. Rumyantsev, Yu.L. Vertogradova	
	DLNP	G.I. Lykasov	
	BLTP	D. Blaschke, A.V. Sidorov	
3.	**ALICE. Computing in the distributed environment-GRID**	**A.S. Vodopyanov**	Realization
	VBLHEP	B.V. Batyunya, G.G. Stiforov	
	LIT	A.O. Kondratiev, V.V. Mitsyn	
4.	**Photon Spectrometer PHOS**	**A.S. Vodopyanov** **P.V. Nomokonov**	Realization
	VBLHEP	N.V. Gorbunov, A.V. Kuznetsov, Yu.P. Petukhov, S.A. Rufanov	
5.	**Inner Tracking System ITS**	**A.S. Vodopyanov**	Realization
	VBLHEP	N.A.Baldin, V.Kh.Dodokhov, S.C.Ceballos, A.V.Ulanova	

Collaboration

Country or International Organization	**City**	**Institute or laboratory**
Armenia	Yerevan	Foundation ANSL
Austria	Vienna	SMI
Azerbaijan	Baku	NNRC
Bangladesh	Dhaka	DU
Brazil	Campinas, SP	UNICAMP
	Porto Alegre, RS	UFRGS
	Santo Andre, SP	UFABC
	Sao Paulo, SP	USP
Bulgaria	Sofia	IAPS
CERN	Geneva	CERN
China	Beijing	CIAE
	Hefei	USTC
	Shanghai	SINAP CAS
	Wuhan	CCNU
		HBUT
Croatia	Split	Univ.
	Zagreb	RBI
		UZ
Cuba	Havana	CEADEN
Czech Republic	Prague	CTU
		IP CAS
	Rez	UJV
Denmark	Copenhagen	NBI
Finland	Helsinki	HIP
	Jyvaskyla	UJ
France	Clermont-Ferrand	LPC

	Grenoble	LPSC
	Lyon	UL
	Nantes	SUBATECH
	Orsay	IJCLab
	Saclay	IRFU
	Strasbourg	IPHC
	Villeurbanne	CC IN2P3
Germany	Bonn	UniBonn
	Darmstadt	GSI
		TU Darmstadt
	Frankfurt/Main	FIAS
		Univ.
	Heidelberg	Univ.
	Munich	TUM
	Munster	WWU
	Tubingen	Univ.
	Worms	ZTT
Greece	Athens	UoA
Hungary	Budapest	Wigner RCP
India	Aligarh	AMU
	Bhubaneswar	IOP
	Chandigarh	PU
	Guwahati	GU
	Indore	IIT Indore
	Jaipur	Univ.
	Jammu	Univ.
	Jatani	NISER
	Kolkata	BNC
		SINP
		UC
		VECC
	Mumbai	BARC
		IIT Bombay
Indonesia	Jakarta	LIPI
Italy	Alessandria	DiSIT UPO
	Bari	DIF
		INFN
		Poliba
	Bologna	INFN
		UniBo
	Brescia	UNIBS
	Cagliari	INFN
		UniCa
	Catania	INFN
		UniCT
	Erice	EMFCSC
	Foggia	Unifg
	Frascati	INFN LNF
	Legnaro	INFN LNL
	Messina	UniMe
	Padua	INFN
		UniPd
	Pavia	UniPv
	Rome	CREF

		INFN
		Univ. "La Sapienza"
	Salerno	INFN
	Trieste	INFN
		UNITR
	Turin	INFN
		Polito
		UniTo
	Vercelli	UPO
Japan	Hiroshima	Hiroshima Univ.
	Nagasaki	NiAS
	Nara	NWU
	Osaka	RCNP
	Tokai	JAEA
	Tokyo	UT
	Tsukuba	Univ.
	Wako	RIKEN
Malta	Msida	UM
Mexico	Culiacan	UAS
	Mexico City	Cinvestav
		UNAM
	Puebla	BUAP
Netherlands	Amsterdam	AUAS
		NIKHEF
	Utrecht	UU
Norway	Bergen	HVL
		UiB
	Oslo	UiO
	Tonsberg	USN
Pakistan	Islamabad	COMSATS
		PINSTECH
Peru	Lima	PUCP
Poland	Krakow	AGH
		NINP PAS
	Otwock (Swierk)	NCBJ
	Warsaw	WUT
Republic of Korea	Cheongju	CBNU
	Daejeon	KIST
	Gangneung	GWNU
	Incheon	Inha
	Jeonju	JBNU
	Pusan	PNU
	Seoul	Konkuk Univ.
		SJU
		Yonsei Univ.
Romania	Bucharest	IFIN-HH
		UPB
	Magurele	ISS
Russia	Gatchina	NRC KI 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	CU
	Kosice	IEP SAS
		TUKE
		UPJS
South Africa	Cape Town	UCT
	Johannesburg	WITS
	Somerset West	iThemba LABS
Sweden	Lund	LU
Thailand	Bangkok	KMUTT
	Chachoengsao	TMEC
	Nakhon Ratchasima	SLRI
		SUT
Turkey	Istanbul	YTU
	Konya	Karatay Univ.
Ukraine	Kharkov	NSC KIPT
	Kiev	BITP NASU
United Kingdom	Birmingham	Univ.
	Daresbury	DL
	Derby	Univ.
	Liverpool	Univ.
USA	Austin, TX	UT
	Berkeley, CA	Berkeley Lab
		UC
	Chicago, IL	CSU
	Columbus, OH	OSU
	Detroit, MI	WSU
	Houston, TX	UH
	Knoxville, TN	UTK
	Los Alamos, NM	LANL
	New Haven, CT	Yale Univ.
	Oak Ridge, TN	ORNL
	Omaha, NE	Creighton Univ.
	San Luis Obispo, CA	Cal Poly
	West Lafayette, IN	Purdue Univ.

02-1-1107-2011/2021	Priority:	1
	Status:	Being concluded

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

Leader: S.I. Tyutyunnikov

Participating countries and international organizations:
Armenia, Australia, Belarus, Bulgaria, Czech Republic, Moldova, Mongolia, Poland, Romania, Russia, Slovakia, Ukraine.

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

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

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

List of Activities

	Activity or Experiment **Laboratory or other Division of JINR** **Responsible person**	**Leaders** **Main researchers**	**Status**
1.	**Development of the technical specifications for the detector system of setup "big uranium target" on the basis of the temperature sensor and silicon photomultipliers**	**S.I. Tyutyunnikov** **A.A. Solnyshkin** **A.A. Baldin** **Z. Y. Sadygov** **R.A. Akbarov**	Realization
	VBLHEP	A.I. Berlev, I.P. Yudin	

2.	**Design, manufacture of detectors for the measurement of ion energy in the range of Ee=0.1 Gev/nucleon on the Nuclotron-M beams**	**N.I. Zamyatin** **Y.S. Kopylov**	Realization
	VBLHEP	S.V. Khabarov, Yu.S. Kovalev, O.G. Tarasov	
3.	**Upgrade of spectrum-analitical complex for activation measurements**	**V.N. Shalyapin** **V.I.Stegaylov**	Realization
	VBLHEP	I.A. Kryachko, M. Paraipan, E.V. Strekalovskaya, Toan Tran Ngor	
	DLNP	V.I. Stegaylov	
4.	**Study of neutron fields of big uranium target at the Phazotron under the irradiation of proton Ep=0.66 GeV**	**S.I. Tyutyunnikov** **A.A. Solnyshkin** **G.I. Smirnov** **M. Paraipan** **V.V. Pronskih** **E.A. Levterova** **V.M. Dzhavadova**	Data taking
	VBLHEP	A.A. Baldin, Yu.S. Kovalyev, V.N.Shalyapin, A.V. Vishnesky, I.P. Yudin	
	DLNP	V.I. Stegaylov	
5.	**Production of the monitoring elements for the superconduc-ting systems**	**Yu.P. Filippov**	R&D

Collaboration

Country or International Organization	**City**	**Institute or laboratory**
Armenia	Yerevan	YSU
Australia	Sydney	Univ.
Belarus	Minsk	INP BSU
		ISEI BSU
		JIPNR-Sosny NASB
		RI PCP BSU
Bulgaria	Sofia	INRNE BAS
Czech Republic	Brno	BUT
	Prague	CTU
	Rez	UJV
Moldova	Chisinau	IAP
Mongolia	Ulaanbaatar	IPT MAS
Romania	Baia Mare	TUCN-NUCBM
	Bucharest	IFIN-HH
		UMF
	Iasi	UAIC
	Magurele	ISS
	Timisoara	UVT
Russia	Dubna	BSINP MSU
		IAS "Omega"
	St. Petersburg	KRI
	Tomsk	TPU
Slovakia	Bratislava	CU
		IP SAS
		SOSMT
Ukraine	Kharkov	NSC KIPT

Nuclear Physics (03)

03-0-1129-2017/2021	Priority:	1
	Status:	Being concluded

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

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

Scientific leader: Yu.Ts. Oganessian

Participating countries and international organizations:

Belgium, CERN, China, Canada, Czech Republic, Egypt, France, Germany, Italy, Kazakhstan, Mongolia, Poland, Republic of Korea, Romania, Russia, Serbia, Slovakia, South Africa, USA.

Issues addressed and main goals of research:

The implementation of the DRIBs-III project that includes the upgrade and development of the FLNR cyclotron complex, expansion of the experimental infrastructure of the Laboratory (construction of new physics set-ups), and development of accelerator systems. The project aims at improving the operation stability of accelerators, increasing the intensity and improving the quality of ion beams of stable and radioactive nuclides in the energy range from 5 to 100 MeV/nucleon, while at the same time reducing power consumption. The project objective is to significantly improve the efficiency of experiments on the synthesis of superheavy elements and light nuclei at nucleon drip lines and study of their properties. Moreover, the programme of experiments with beams of radioactive nuclides is anticipated to be expanded.

Expected results in the current year:

- Experiments on the synthesis of superheavy elements Fl–Lv, study of their properties using a new gas-filled recoil separator (GFS-2) of the Factory of Superheavy Elements (SHE).
- Preparation for experiments on the synthesis of elements 119 and 120 in complete fusion reactions with ^{50}Ti ions.
- Construction of a pre-separator for radiochemical studies of SHE and a new gas-filled recoil separator (GFS-3).
- Development of the infrastructure of the ACCULINNA-2 fragment separator (RF kicker, tritium system).
- Upgrade of the U-400M cyclotron.
- Project development and construction of the U-400 (U-400R) experimental hall.
- Implementation of the programme for physics experiments at the U-400 cyclotron.
- Development of new methods for diagnostics of beams of stable and radioactive nuclides.
- Further work on the construction of a new gas cell based laser ionization set-up GALS for on-line separation of nuclear reaction products by selective laser ionization.
- Further work on the construction of the gas ion catcher.
- Start of construction of the DC-140 cyclotron complex.

List of Activities

Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1. Development of the Superheavy Element Factory	**G.G. Gulbekian**	Preparation
FLNR	P.G. Bondarenko, S.L. Bogomolov, B.N. Gikal, M.V. Habarov, G.N. Ivanov, I.A. Ivanenko, I.V. Kalagin, N.Yu. Kazarinov, V.A. Kostyrev, N.F. Osipov, S.V. Pashchenko, N.N. Pchelkin, A.V. Reshetov, V.A. Semin, V.A. Veryovochkin	
VBLHEP	A.A. Fateev, 2 pers.	
2. Development of the U-400M and U-400R complexes	**I.V. Kalagin**	Preparation Data taking
FLNR	S.L. Bogomolov, P.G. Bondarenko, M.V. Habarov, G.N. Ivanov, I.A. Ivanenko, I. V. Kalagin, N.Yu. Kazarinov, N.F. Osipov, S.V. Pashchenko, N.N.Pchelkin, A.V. Reshetov, V.A. Semin, V.A. Sokolov, R.E. Vaganov	
LIT	P.G. Akishin, E.A. Airian, A.M. Chervyakov, V.V. Korenkov	
DLNP	G.A. Karamysheva, E.V. Samsonov, S.B. Vorozhtsov	
VBLHEP	A.A. Fateev + 2 pers.	
3. Construction of the DC-140 cyclotron complex	**G.G. Gulbekian**	Preparation
FLNR	S.L. Bogomolov, B.N. Gikal, M.V. Habarov, G.N. Ivanov, I.A. Ivanenko, I.V. Kalagin, N.Yu. Kazarinov, V.A. Kostyrev, S.V. Mitrofanov, N.F. Osipov, S.V. Pashchenko, N.N. Pchelkin, V.A. Semin, V.A. Veryovochkin	
DLNP	G.A. Karamysheva + 5 pers.	
VBLHEP	A.A. Fateev + 2 pers.	
4. Development of the ECR ion sources	**S.L. Bogomolov**	Preparation
FLNR	V.V. Behterev, A.E. Bondarchenko, A.A. Efremov, G.N. Ivanov, A.N. Lebedev, V.N Loginov, V.E. Mironov, N.Yu. Yazvitskiy, K. I. Kuzmenkov	
VBLHEP	E.D. Donets, V.M. Drobin, E.E. Donets, S.A. Kostomin	
5. Development of the MT-25 microtron	**S.V. Mitrofanov**	Preparation Data taking
FLNR	N.V. Aksenov, A.G. Belov, M.V. Habarov, S.V. Pashchenko, N.F. Osipov, V.A. Semin, Yu.G. Teterev	
6. Development of the fragment separator ACCULINNA-2	**A.S. Fomichev**	Preparation Data taking
FLNR	C.G. Belogurov, A.A. Bezbakh, V. Chudoba, E. M. Gazeeva A.V. Gorshkov, V.A. Gorshkov, M.S. Golovkov, G. Kaminsky, S.A. Krupko, K. A. May, B. Mauey, I.A. Muzalevsky, E.Yu. Nikolskii, W. Piatek, P.G. Sharov, S.I. Sidorchuk, R.S. Slepnev, S.V. Stepantsov, G.M. Ter-Akopian, M.N. Tran, R. Wolski, P. Shimkevich, A. Swiercz	
LIT	E.V. Ovcharenko, V.N. Schetinin	

7.	**Development of a new gas-filled separator DGFRS-2**	**V.K. Utyonkov**	Preparation Data taking
	FLNR	F.Sh. Abdullin, D. A. Ibadullayev, N.D. Kovrijnykh, D. A. Kuznetsov, A.N. Polyakov, O.V. Petrushkin, R.N. Sagaidak, V.D. Shubin, V.G. Subbotin, I.V. Shirokovsky, M.V. Shumeiko, L. Schlattauer, D. I. Soloviov, Yu.S. Tsyganov, A.A. Voinov, A.M. Zubareva	
8.	**Construction of a GFS-3 pre-separator for radiochemical studies of SHE**	**A.G. Popeko** **A.V. Eremin**	Preparation
	FLNR	O.N. Malyshev, Yu.A. Popov, A.I. Svirikhin	
9.	**Construction of the gas catcher**	**A.M. Rodin**	Preparation
	FLNR	A.V. Guljaev, A.V. Guljaeva, L. Krupa, A.B. Komarov, A.C. Novoselov, V.S. Salamatin, S.V. Stepantsov, V.Yu. Vedeneev, S.A. Yukhimchuk	
10.	**Development of a separator based on resonance laser ionization**	**S.G. Zemlyanoy**	Preparation
	FLNR	K.A. Avvakumov, E.M. Kozulin, G.V. Myshinskiy, T. Tserensambuu, V.I. Zhemenik, B. Zuzaan	

Collaboration

Country or International Organization	City	Institute or laboratory
Belgium	Leuven	KU Leuven
Canada	Vancouver	TRIUMF
CERN	Geneva	CERN
China	Lanzhou	IMP CAS
Czech Republic	Olomouc	UP
	Prague	VP
	Rez	NPI CAS
Egypt	Giza	CU
	Shibin El Kom	MU
France	Caen	GANIL
	Orsay	IPN Orsay
	Vannes	SigmaPhi
Germany	Darmstadt	GSI
	Heidelberg	MPIK
Italy	Padua	INFN
Kazakhstan	Nur-Sultan	BA INP
		ENU
Mongolia	Ulaanbaatar	NRC NUM
Poland	Krakow	NINP PAS
	Warsaw	HIL UW
		IEP WU
Republic of Korea	Daejeon	IBS
Romania	Bucharest	IFIN-HH
Russia	Moscow	HTDC
		ITEP
		ITT-Group

		NNRU "MEPhI"
	Moscow, Troitsk	INR RAS
	Nizhny Novgorod	IAP RAS
	Novosibirsk	BINP SB RAS
	Sarov	VNIIEF
	Snezhinsk	VNIITF
	St. Petersburg	IAI RAS
		NIIEFA
Serbia	Belgrade	INS "VINCA"
Slovakia	Bratislava	IP SAS
South Africa	Somerset West	iThemba LABS
USA	College Station, TX	Texas A&M
	East Lansing, MI	MSU
	Livermore, CA	LLNL
	Nashville, TN	VU
	Oak Ridge, TN	ORNL

03-5-1130-2017/2021		
	Priority:	1
	Status:	Being concluded

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

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

Participating countries and international organizations:

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

Issues addressed and main goals of research:

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

Expected results in the current year:

- Experiments on the synthesis of superheavy elements, study of their nuclear and chemical properties in the ^{48}Ca, ^{50}Ti + ^{243}Am, ^{242}Pu, ^{244}Pu reactions at the SHE Factory.

- Preparation for experiments on the synthesis of elements 119 and 120 in complete fusion reactions with ^{50}Ti ions.

- Experiments on the study of the decay properties (α-, β-, γ-spectroscopy) of Sg isotopes and heavy isotopes of Rf formed in reactions with ^{54}Cr and ^{22}Ne using the SHELS+GABRIELA separator. Experiments on measuring the multiplicity of prompt neutrons from the spontaneous fission of heavy Rf isotopes in reactions with ^{22}Ne. Test experiment on the spectroscopy of the decay properties of ^{288}Mc isotopes and its daughter products in the ^{48}Ca + ^{243}Am reaction.

- Formation and decay of double/di-nuclear nuclear system formed in the ^{86}Kr + ^{232}Th, ^{238}U reactions. Study of the mass–energy and angular distribution of fragments produced in these reactions. Investigation of the mechanism of multinucleon transfer. Study of the multi-body decay of low-excited heavy nuclei. Study of the multicluster decay of heavy and superheavy nuclei. Development of physics set-ups.

- Study of nuclei with $Z<20$ close to the nucleon drip lines. Analysis of the experimental data on the investigation of the structure of the exotic nuclei ^{7}H, ^{7,9}He, ^{10}Li, and ^{27}S synthesized earlier using radioactive beams at the ACCULINNA-2 fragment separator.

- Experiments at MAVR for studying fast charged particles in coincidence with recoil nuclei. The studies are aimed at determining the reaction mechanism for experiments on the synthesis of new elements. Study of the yield of multinucleon transfer reaction products. Measurement of total reaction cross sections using low-intensity beams of exotic nuclei.

- Analysis of experiments conducted at the MASHA set-up aimed at studying the operational stability of a new design of the hot catcher during the separation of short-lived mercury and radon isotopes synthesized in complete fusion reactions. Measurements according to a prescribed methodology at MASHA for studying the influence of chemically inert coatings on the separation efficiency of the hot catcher – ERC ion source for inert gases and mercury system.

- Theoretical studies of the mechanisms of heavy-ion-induced reactions.

- Maintenance and update of the web knowledge base on nuclear physics.
- Investigation of sizes and shapes of exotic nuclei employing laser spectroscopy methods.

List of Activities

	Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1.	**Synthesis of new isotopes of superheavy elements at DGFRS**	**V.K. Utyonkov**	Data taking
	FLNR	F.Sh. Abdullin, D. A. Ibadullayev, N.D. Kovrijnykh, D.A. Kuznetsov, A.N. Polyakov, O.V. Petrushkin, R.N. Sagaidak, V.D. Shubin, V.G. Subbotin, I.V. Shirokovsky, M.V. Shumeiko, D.I. Solov'ev, L. Schlattauer, Yu.S. Tsyganov, A.A. Voinov, A.M. Zubareva	
2.	**α-, β- and γ-spectroscopy of heavy nuclei at the SHELS separator**	**A.V. Yeremin**	Data taking
	FLNR	V.I. Chepigin, M.L. Chelnokov, A.V. Isaev, I.N. Izosimov, D.E. Katrasev, A.A. Kuznetsova, O.N. Malyshev, R.S. Mukhin, Yu.A. Popov, V.M. Popov, A.G. Popeko, E.A. Sokol, A.I. Svirikhin, V.A. Sbitnev, M.S. Tezekbaeva	
3.	**Chemical properties of superheavy elements**	**S.N. Dmitriev**	Data taking
	FLNR	N.V. Aksenov, Yu.V. Albin, A.A. Astakhov, A.Yu. Bodrov, G.A. Bozhikov, I. Chuprakov, N.S. Gustova, K.V. Lebedev, A.Sh. Madumarov, E.V. Melnik, A.V. Sabelnikov, G.Ya. Starodub, G.K. Vostokin, M.G. Voronyuk	
4.	**Experiments at the magnetic analyzer of superheavy atoms MASHA**	**A.M. Rodin**	Data analysis
	FLNR	E.V. Chernysheva, A.V. Guljaev, A.V. Guljaeva, A.B. Komarov, L. Krupa, A.S. Novoselov, A.Opihal, A.V. Podshibyakin, V.S. Salamatin, S.V. Stepantsov, V.Yu. Vedeneev, S.A. Yukhimchuk, A. Kohoutova, P. Kohout	
5.	**Study of the processes of fusion-fission, quasi-fission and multi-nucleon transfer reactions. CORSET-DEMON, CORSAR, and MiniFOBOS set-ups**	**M.G. Itkis**	Data taking
	FLNR	A.A. Alexandrov, I.A. Alexandrova, T. Banerjee, I.N. Dyatlov, O.V. Falomkina, E. I. Galkina, Z.I. Gorya'nova, Yu.M. Itkis, D.V. Kamanin, V.V. Kirokasian, E.M. Kozulin, N.I. Kozulina, G.N. Knyazheva, E.A. Kuznetsova, D. Kumar, C.H. Meghashree, E. Mukhamedzhanov, K.V. Novikov, A. Pan, I,V, Pchelintsev, Yu.V. Pyatkov, E.O. Savelieva, Yu.B. Semenov, A.N. Solodov, A.O. Strekalovsky, O.V. Strekalovskiy, R. S. Tikhomirov, I.V. Vorob'ev, A.O. Zhukova, V.E. Zhuchko	

	LIT	P.V. Goncharov, G.A. Ososkov, A.V. Uzhinsky, V.B. Zlokazov	
6.	**Study of the structure of exotic nuclei near and beyond the drip-lines at the ACCULINNA-2 and COMBAS fragment separators**	**A.S. Fomichev**	Data analysis
	FLNR	A.G. Artukh, E. Batchuluun, S.G. Belogurov, A.A. Bezbakh, V. Chudoba, M.S. Golovkov, L.V. Grigorenko, A.V. Gorshkov, V. A. Gorshkov, E.M. Gazeeva, V.A. Gorshkov, A. Ismailova, G. Kaminski, S.A. Krupko, S.A. Klygin, G.A. Kononenko, K.A. May, B. Mauyey, I.A. Muzalevskiy, E.Yu. Nikolskii, Yu.L. Parfenova, W. Piatek,, S.A. Rimzhanova, Yu.M. Sereda, S.I. Sidorchuk, R.S. Slepnev, P.G. Sharov, S.V. Stepantsov, A. Swiercz, P. Szymkiewicz, G.M. Ter-Akopian, M. N. Tran, R. Wolski, A.N. Vorontsov, B. Zalewski	
	BLTP	S.N. Ershov, N.B. Shulgina	
7.	**Investigation of reactions induced by stable and radioactive ion beams leading to the formation of exotic nuclei. Development of MAVR and MULTI set-ups**	**Yu.E. Penionzhkevich**	Data taking Manufacture
	FLNR	D.T. Aznabaev, A. Azhibekov, I. V. Butusov, T. Isataev, S.M. Lukyanov, V.A. Maslov, K.O. Mendibaev, R.V. Revenko, A. V. Shakhov, I. Sivacek, N.K. Skobelev, Yu.G. Sobolev, V.I. Smirnov, S.S. Stukalov, D.A. Testov	
8.	**Theoretical studies of nuclear reaction mechanisms**	**A.V. Karpov**	Data taking Data analysis
	FLNR	E.A. Cherepanov, A.S. Denikin, I. A. Egorova, Yu.A. Muzichka, M.A. Naumenko, V.A. Rachkov, V.V. Samarin, V.V. Saiko	
9.	**Development and update of the network knowledge base on nuclear physics**	**A.V. Karpov** **A.S. Denikin**	Data taking
	FLNR	M.A. Naumenko, V.A. Rachkov, V.V. Samarin, V.V. Saiko	
10.	**Laser spectroscopy of isotopes**	**S.G. Zemlyanoy**	Data taking
	FLNR	K.A. Avvakumov, G.N. Myshinskiy, T. Tserensambuu, V.I. Zhemenik, B. Zuzaan	

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

	Lanzhou	IMP CAS
Czech Republic	Olomouc	UP
	Prague	CTU
		VP
	Rez	NPI CAS
Egypt	Giza	CU
	Shibin El Kom	MU
Finland	Jyvaskyla	UJ
France	Caen	GANIL
	Orsay	CSNSM
		IPN Orsay
	Saclay	SPhN CEA DAPNIA
	Strasbourg	CRN
		IPHC
Germany	Darmstadt	GSI
	Mainz	JGU
	Tubingen	Univ.
India	Kolkata	VECC
	New Delhi	IUAC
	Roorkee	IIT Roorkee
	Rupnagar	IIT Ropar
Italy	Catania	INFN LNS
	Legnaro	INFN LNL
	Messina	UniMe
	Naples	Unina
Japan	Tokai	JAEA
Kazakhstan	Almaty	IETP KazNU
		INP
	Nur-Sultan	ENU
Mongolia	Ulaanbaatar	NRC NUM
Poland	Krakow	NINP PAS
	Poznan	AMU
	Warsaw	HIL UW
		UW
Republic of Korea	Daejeon	IBS
Romania	Bucharest	IFIN-HH
Russia	Dimitrovgrad	SSC RIAR
	Gatchina	NRC KI PNPI
	Moscow	MSU
		NNRU "MEPhI"
		NRC KI
		SINP MSU
	Moscow, Troitsk	INR RAS
	Sarov	VNIIEF
	St. Petersburg	Ioffe Institute
		KRI
		SPbSU
	Voronezh	VSU
Slovakia	Bratislava	CU
		IP SAS
South Africa	Somerset West	iThemba LABS
	Stellenbosch	SU
Spain	Huelva	UHU
Sweden	Goteborg	Chalmers

	Lund	LU
Switzerland	Villigen	PSI
Ukraine	Kiev	KINR NASU
United Kingdom	Manchester	UoM
USA	College Station, TX	Texas A&M
	East Lansing, MI	MSU
	Livermore, CA	LLNL
	Nashville, TN	VU
	Oak Ridge, TN	ORNL
Vietnam	Hanoi	IOP VAST
	Ho Chi Minh City	VNUHCM

03-2-1100-2010/2021	Priority:	1
	Status:	Being concluded

Non-Accelerator Neutrino Physics and Astrophysics

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

Participating countries and international organizations:

Azerbaijan, Bulgaria, Czech Republic, Finland, France, Germany, Kazakhstan, Poland, Russia, Slovakia, United Kingdom, Uzbekistan.

Issues addressed and main goals of research:

Search for and investigation of double-neutrino and neutrinoless modes of double beta-decay, clarification of the neutrino nature, Majorana or Dirac, and 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, and search for exotic particles (monopoles). Use of the neutrino detector for a distant investigation of processes inside of the reactor core of the 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 results in the current year:

- Data taking in the $2^{\beta} 0\nu$-decay measurements of ^{106}Cd, ^{82}Se, ^{76}Ge with the SuperNEMO and GERDA spectrometers.
- Processing of experimental data and determination of $T_{1/2}(2^{\beta} 2\nu)$ for ^{48}Ca, ^{96}Zr, ^{130}Te, ^{116}Cd, ^{82}Se and ^{76}Ge.
- Data taking with the HPGe-based low-background spectrometer at the Kalinin Nuclear Power Plant. Search for a signal of coherent neutrino scattering on the Germanium nuclei. Search for the neutrino magnetic moment at the sensitivity level of ~ 10^{-12} μ_B.
- Continuation of data taking in the EDELWEISS experiment with new detectors operating with an energy threshold of 0.1 keV suitable for the extra-low mass WIMP region. Analysis of previously accumulated data, determination of parameters for light dark matter for the mass region below 1 GeV/c ^{2}.
- Research and development of the semiconductor-based detecting systems for the GERDA and MAJORANA experiments. Continuation of the data taking in both experiments. Preparation of the tone-scale germanium project LEGEND.
- Data taking with seven clusters of the BAIKAL-GVD neutrino tlescope. Search for and study of high-energy neutrinos of the astrophysical nature. Building and commissioning of new detector clusters. Development and testing of new data acquisition and data transmission systems aiming in a lower energy threshold (Baikal project).
- Investigation of KLL and KMM Auger electrons in ^{67}Ga and ^{152,154,155}Eu decays.
- Development and testing of new low-threshold (~ 200 eV) HPGe detectors for searching for the coherent neutrino scattering, as well as plastic scintillator detectors for their active shielding.
- Continuation of data taking by the DANSS spectrometer. Data analysis and publication of results (on sterile neutrinos, reactor monitoring, sensivity to nuclear fuel components) based on statistics over four years of operation (4 million registered antineutrinos). R&D for the upgrade of the DANSS spectrometer.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	SuperNEMO	O.I. Kochetov	1 (2013-2021)
2.	GEMMA-II	V.B. Brudanin	1 (2010-2021)
3.	EDELWEISS-LT	E.A. Yakushev	1 (2010-2021)
4.	G&M (GERDA)	K.N. Gusev	1 (2010-2021)
5.	DANSS	Yu.A. Shitov V.B. Brudanin	1 (2011-2021)
6.	BAIKAL	I.A. Belolaptikov V.B. Brudanin	1 (2009-2023)
7.	MONUMENT	D.R. Zinatulina	1 (2021-2023)

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.B. Brudanin, D.V. Filosofov, I.I. Kamnev, D.V. Karaivanov, F.F. Klimenko, M.A. Mirzaev, I.B. Nemchenok, A.V. Rahimov, A.V. Salamatin, A.A. Smolnikov, Yu.A. Shitov V.V. Timkin, V.I. Tretyak, O.V. Vagina	
BLTP	F. Simkovic	
2. Investigation of *2K2ν* and *2K0ν* decays of ^{106}Cd with the TGV spectrometer	**N.I. Rukhadze** **I. Shtekl**	Data taking
DLNP	S.L. Katulina, A.V. Salamatin, V.G. Sandukovskiy, V.V. Timkin	
BLTP	F. Simkovic	
3. G&M (GERDA-MAJORANA Project)	**K.N. Gusev**	Preparation Data taking
DLNP	V.B. Brudanin, M.V. Fomina, A.A. Klimenko, O.I. Kochetov, A.V. Lubashevsky, I.B. Nemchenok, N.S. Rumyantseva, V.G. Sandukovsky, E.A. Shevchik, M.V. Shirchenko, A.A. Smolnikov, I.V. Zhitnikov, D.R. Zinatulina	
BLTP	F. Simkovic	
4. GEMMA-III Project	**V.B. Brudanin** **A.V. Lybashevsky** **E.A. Yakushev**	Modernization Data taking

	DLNP	V.V. Belov, M.V. Fomina, S.V. Kazartsev, J.H. Khushvaktov, A.S. Kuznetsov, D.V. Medvedev, D.V. Ponomarev, V.G. Sandukovsky, K.V. Shakhov, T.A. Shevchik, M.V. Shirchenko, S.V. Rozov, I.E. Rozova, I.V. Zhitnikov, D.R. Zinatulina	
5.	**EDELWEISS-LT Project**	**E.A. Yakushev** **S.V. Rozov**	Modernization Data taking
	DLNP	V.B. Brudanin, E.A. Evsenkin, D.V. Filosofov, A.V. Lubashevsky, N.A. Mirzaev, L.L. Perevoshchikov, D.V. Ponomarev, F.V. Rakhimov, I.E. Rozova, K.V. Shakhov	
6.	**BAIKAL Project**	**I.A. Belolaptikov** **V.B. Brudanin**	Preparation Data taking
	DLNP	P.I. Antonov, I.V. Borodina, I.S. Dotsenko, M.S. Dovbnenko, R. Dvornicky, A.A. Doroshenko, T.V. Elzhov, A.N. Emelianov, S.A. Evseev, K.V. Golubkov, N.A. Gorshkov, M.S. Katulin, S.A. Katulin, S.L. Katyulina, M.M. Kolbin, K.V. Konishev, A.V. Korobchenko, M.V. Kruglov, M.B. Milenin, M.L. Minaev, V. Nazari, D.V. Naumov, T. Orazgali, D.A. Orlov, L.L. Perevoshchikov, D.P. Petukhov, E.N. Pliskovski, I.E. Rozova, V.D. Rushay, A.V. Salamatin, G.B. Safronov, S.I. Sinegovsky, A.E. Sirenko, M.N. Sorokovnikov, N.I. Sosunov, I.A. Stepkin, E.V. Khramov, B.A. Shaybonov, K.I. Shevchenko, M.V. Shirchenko, Yu.V. Yablokova	
7.	**Investigation of spectra of low-energy electrons after radioactive decays to obtain data for atomic and nuclear physics and for nuclear medicine. Development of ultrastable energy calibration for the KATRIN neutrino project. Investigation of decays of rear-earth radionuclides and structure of their excited states**	**A.Kh. Inoyatov** **A. Kovalik**	Data taking
	DLNP	M.A. Abd Al'ngar, M.S. Dovbnenko, S.V. Fateev, N.V. Morozova, V.A. Morozov, L.L. Perevoshikov, A.E. Sirenko, V.I. Stegailov, A.A. Solnyshkin, D.V. Filosofov, Yu.V. Yablokova	
	FLNR	I.N. Izosimov	
8.	**Radiochemical support of irradiation of targets, separation of radionuclides from them by radiochemistry and mass separation methods, preparation of ionizing radiation sources for physical research at DLNP; chemical, radiochemical and mass separator support of low-background measurements for neutrino physics**	**D.V. Filosofov** **A.Kh. Inoyatov**	Preparation
	DLNP	Yu.A. Vaganov, A.I. Velichkov, D.V. Karaivanov, N.V. Morozova, J.K. Samatov, A.A. Solnyshkin, J.A. Dadakhanov, E.S. Kurakina, A.E. Baimukhanova, A.V. Rakhimov, N.A. Mirzayev	
9.	**Development of methods for the separation of elements**	**D.V. Filosofov**	Preparation

(radiochemistry and mass separation); development of methods for obtaining radioisotopes for nuclear medicine and the synthesis of radiopharmaceuticals based on them; development and manufacture of micro sources for cancer brachytherapy; study of the physicochemical properties of condensed matter using the method of perturbed angular correlations of nuclear radiation			
	DLNP	Yu.A. Vaganov, A.I. Velichkov, D.V. Karaivanov, A.A. Solnyshkin, A.V. Salamatin, D.A. Salamatin, N.T. Temerbulatova, E.S. Kurakina	
	FLNR	G.A. Bozhikov	
10. Development and production of low-energy-threshold HPGe detectors. Development and production of special types of Si and Ge detectors for low background measurements. Development and production of plastic scintillators for low-background spectrometers, neutron detectors, and cosmic muon detection. Development and production of a muon detection network for continuous atmosphere control in the Moscow region		**V.B. Brudanin** **E.A. Yakushev**	Preparation
	DLNP	D. Borowicz, Yu.B. Gurov, L. Grubchin, K.N. Gusev, S.L. Katulina, I.B. Nemchenok, D.V. Ponomarev, S.V. Rozov, V.G. Sandukovskiy	
	FLNR	A.M. Rodin	
	VBLHEP	N.I. Zamyatin	
11. DANSS Project		**Yu.A. Shitov** **V.B. Brudanin**	Data taking Modernization
	DLNP	V.V. Belov, V.B. Brudanin, M.V. Fomina, S.V.Kazartsev, A.S. Kuznetsov, D.V. Medvedev, A.G. Olshevsky, I.E. Rozova, N.S. Rumyantseva, M.V. Shirchenko, E.A. Shevchik, D.R. Zinatulina, I.V. Zhitnikov	
12. MONUMENT Project		**D.R. Zinatulina** **M.V. Shirchenko**	Preparation Data taking
	DLNP	V.V. Belov, V.B. Brudanin, M.V. fomina, K.N. Gusev, S.V. Kazartsev, N.S. Rumyantseva, E.A. shevchik, Yu.A. Shitov, I.V.Zhitnikov	

Collaboration

Country or International Organization	City	Institute or laboratory
Azerbaijan	Baku	IRP ANAS
Bulgaria	Plovdiv	PU
	Sofia	INRNE BAS
Czech Republic	Prague	CTU
	Rez	NPI CAS
Finland	Jyvaskyla	UJ
France	Bordeaux	CENBG
	Caen	UNICAEN
	Grenoble	UGA
	Lyon	IPNL
	Modane	LSM
	Orsay	CSNSM
	Saclay	CEA
Germany	Heidelberg	MPIK
	Karlsruhe	KIT
	Mainz	JGU
	Munich	TUM
Kazakhstan	Almaty	INP
Mongolia	Ulaanbaatar	IPT MAS
Poland	Lublin	UMCS
Russia	Dubna	Dubna State Univ.
	Gatchina	NRC KI PNPI
	Moscow	ITEP
		NNRU "MEPhI"
		SC "VNIINM"
		SINP MSU
	Moscow, Troitsk	HPPI RAS
		INR RAS
	Neutrino	BNO INR RAS
	Tomsk	NPI TPU
	Voronezh	VSU
Slovakia	Bratislava	CU
		IEE SAS
Switzerland	Villigen	PSI
United Kingdom	London	UCL
	Manchester	UoM
Uzbekistan	Tashkent	INP AS RUz
		NUU

03-4-1128-2017/2022		Priority:	1
		Status:	In-progress

Investigations of Neutron Nuclear Interactions and Properties of the Neutron

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

Participating countries and international organizations:

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

Issues addressed and main goals of research:

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

Expected results in the current year:

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

- Measurement of TRI and ROT effects for gamma-rays and neutrons in the fission of uranium by polarized neutrons.
- Measurement of yields and angular correlations of light charged particles in ternary and quaternary fission of ^{252}Cf using Timepix detectors.
- Determination of characteristics of excitation levels of nuclei in the (n, 2n) and (n, n'γ) reactions with neutrons with an energy of 14 MeV.
- Measurements of angular and energy distributions of prompt fission neutrons (PFN) in ^{235}U(n,f) and ^{239}Pu(n,f) reactions in the resonance region using a position-sensitive twin ionization chamber and 32 scintillation counters.
- Determination of model concepts of modern values of the level density and radiation widths of nuclei of various shapes and types in the capture of slow neutrons.
- Carrying out an experiment to search for a singlet deuteron.
- Measurement of fast neutron cross sections for ^{6}Li(n,α)^{3}H and ^{91}Zr(n,α)^{88}Sr reactions.

Investigation of fundamental properties of the neutron, UCN physics:

- Design and development of the necessary experimental equipment for realization of an experiment to measure the efficiency of extracting very cold neutrons from a source by a specially designed reflector.
- Construction of a physical and mathematical model of propagation of slow neutrons in nanostructured diamond reflectors based on data of single small-angle scattering of cold neutrons.
- Measurements of quasi-mirror reflection of VCN from a sample with crystallites of ~ 20 nm in size.

- Design and construction of a new experimental setup for studying the recently observed phenomenon of nonstationary heating of UCNs on surface acoustic waves.
- Development of the concept of a UCN source based on the idea of accumulating a pulsed neutron flux formed by a time lens.

Applied and methodological research:

- Measurement of neutron fluxes and spectra by the counting and current method at beamline 1 of the IBR-2 reactor to simulate the possibility of measuring the neutron lifetime.
- Development of a prototype setup for neutron polarization by transmission through a ^{3}He target.
- Carrying out vacuum and cryogenic tests of a cryostat with a superconducting magnet to create an all-wave neutron polarizer.
- Development and testing of an elemental analysis technique using the tagged neutron method and high-resolution gamma-ray detectors.
- Investigation with the use of the EG-5 accelerator of the optical and electronic properties of semiconductor materials under X-ray irradiation.
- Development of a modernization project for the EG-5 accelerator and its infrastructure.
- Neutron activation and resonance neutron analysis of archaeological, biological and environmental samples at the IREN facility and at beamlines 3 and 11b of the IBR-2 reactor.
- Creation of a network database of neutron activation analysis to automate studies of the elemental composition of samples of various nature at INP (Alma-Ata, Kazakhstan) and organization of routine neutron activation analysis at the automated site created in 2017-2019 at INP.
- Completion of modernization of REGATA facility at the IBR-2 reactor.
- Determination of the elemental content of plant, biological, geological samples, as well as new materials, including nanomaterials, by means of the neutron activation analysis method at the IBR-2 reactor using the REGATA facility.
- Determination of radiation hardness of clean materials.
- The use of low-background gamma spectrometry and alpha spectrometry to analyze the content of radionuclides in environmental objects.

Development of the IREN facility

1. Providing the neutron beam time from IREN for physical experiments.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	TANGRA	Yu.N. Kopatch	1 (2014-2022)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR Responsible person	Leaders Main researchers	Status
1.	**Investigations of violations of fundamental symmetries in neutron-nucleus interactions and related data** FLNP	**Yu.N. Kopatch** G.S. Ahmedov, D. Berikov, S.B. Borzakov, I.I. Chuprakov, G.V. Daniljan, S. Enkhbold, Fan Lyong Tuan, N.A. Fedorov, Yu.M. Gledenov, D.N. Grozdanov, N.A. Gundorin, A.P. Kobzev, M. Kulik,	Upgrade Data taking Data analysis

		V.L. Kuznetsov, E.V.Kuznetsova, Zh.V. Mezentseva, S.V. Mironov, V.V. Novitsky, I.A. Oprea, K.D. Oprea, Yu.N. Pokotilovskij, A.B. Popov, P.V. Sedyshev, M.V. Sedysheva, O.V. Sidorova, N.V. Simbirtseva, V.R. Skoj, A.M. Suhovoj, S.A. Telezhnikov, T.Yu. Tretyakova, Vu Dyk Kong, Sh.S. Zeynalov, 24 engineers, 4 workers	
2.	**Investigation of fundamental properties of the neutron, UCN physics**	**E.V. Lychagin**	Upgrade Data taking Data analysis
	FLNP	G.G. Bunatyan, T.L. Enik, A.I. Frank, W.I. Furman, S.V. Gorunov, G.V. Kulin, L.V. Mitsyna, A.Yu. Muzychka, A. Nesipbai, A.Yu. Nezvanov, Yu.N. Pokotilovskij, N.Yu. Rebrova, A.V. Strelkov, E.I. Sharapov, M.A. Zakharov, K.N. Zhernenkov, 3 engineers, 1 worker	
3.	**Applied research**	**P.V. Sedyshev**	Upgrade Data taking Data analysis
	FLNP	M.V. Frontasyeva, A.P. Kobzev, Yu.N. Kopatch, W.I. Furman, V.N. Shvetsov, K.N. Vergel, D.S. Grozdov, I.I. Zinicovscaia, G.Y. Hristozova, N.S. Yushin, P.S. Nekhoroshkov, G.S. Ahmedov, N.V. Simbirtseva, S.B. Borzakov, N.A. Fedorov, D.N. Grozdanov, N.A. Gundorin, M. Kulik, Zh.V. Mezentseva, I.A. Oprea, K.D. Oprea, V.R. Skoj, A.Yu. Dmitriev, 22 engineers, 4 workers	
4.	**Development of the IREN facility**	**V.N. Shvetsov**	Upgrade
	FLNP VBLHEP A.P. Sumbaev DLNP	V.G. Pjataev, E.A. Golubkov, 17 engineers, 1 worker V.F. Minashkin, V.N. Zamrij, 3 engineers I.N. Meshkov	
5.	**Development of experimental infrastructure of the IREN facility**	**V.N. Shvetsov**	Upgrade
	FLNP	A.A. Beliakov, E.V. Lychagin, V.G. Pyataev, P.V. Sedyshev, V.A. Trepalin, 15 engineers	
6.	**Modernization of EG-5 accelerator**	**A.S. Doroshkevich**	Upgrade
	FLNP	A.N. Likhachev, A.P. Kobzev, 4 engineers	
7.	**Project TANGRA**	**Yu.N. Kopatch**	Upgrade Data taking Data analysis
	FLNP	F.Aliev, N.A. Fedorov, N.A. Gundorin, D.N. Grozdanov, C. Hramco, I.A. Oprea, K.D. Oprea, P.V. Sedyshev, V.R. Skoj, V.N. Shvetsov, T.Yu. Tretyakova	
	VBLHEP	U.Yu. Aleksakhin, S.V. Khabarov, Yu.N. Rogov, R.A. Salmin, M.G. Sapozhnikov, V.M. Slepnev, N.I. Zamjatin, E.V. Zubarev	
	DLNP	A.V. Krasnoperov, A.B. Sadovskii, A.V. Salamatin	
	LRB	G.N. Timoshenko	

Collaboration

Country or International Organization	City	Institute or laboratory
Albania	Tirana	UT
Australia	Melbourne	Univ.
Austria	Innsbruck	Univ.
Azerbaijan	Baku	BSU
		IGG ANAS
		IRP ANAS
Belarus	Minsk	INP BSU
		SPMRC NASB
Bulgaria	Plovdiv	PU
		UFT
	Sofia	IE BAS
		INRNE BAS
CERN	Geneva	CERN
China	Beijing	IHEP CAS
	Xi'an	NINT
Croatia	Zagreb	Oikon IAE
		RBI
Czech Republic	Ostrava	UO
		VSB-TUO
	Prague	CEI
		CTU
Egypt	Alexandria	Univ.
	Cairo	NRC
	Giza	CU
	Mansoura	MU
	Shibin El Kom	MU
Finland	Jyvaskyla	UJ
	Oulu	UO
France	Cadarache	CC CEA
	Grenoble	ILL
		LPSC
	Saclay	LLB
	Strasbourg	IPHC
Georgia	Tbilisi	AIP TSU
		TSU
Germany	Darmstadt	GSI
	Dresden	HZDR
	Kleve	HSRW
	Mainz	JGU
	Munich	TUM
	Tubingen	Univ.
Hungary	Budapest	RKK OU
IAEA	Vienna	IAEA
India	Varanasi	BHU
Italy	Rome	ENEA
Japan	Kyoto	KSU
	Tsukuba	KEK
Kazakhstan	Almaty	INP
	Nur-Sultan	ENU
Moldova	Chisinau	IC ASM
		IMB ASM

Mongolia	Ulaanbaatar	CGL
		NRC NUM
North Macedonia	Skopje	UKiM
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	Daejeon	KAERI
	Pohang	PAL
	Seoul	Dawonsys
Romania	Baia Mare	TUCN-NUCBM
	Bucharest	IFIN-HH
		UB
		UPB
	Cluj-Napoca	INCDTIM
	Constanta	UOC
	Galati	UG
	Iasi	NIRDTP
	Magurele	ISS
		NIMP
	Oradea	UO
	Pitesti	ICN
	Ramnicu Valcea	I.C.S.I.
	Sibiu	ULBS
	Targoviste	UVT
Russia	Borok	IBIW RAS
	Dubna	Diamant
		Dubna State Univ.
	Gatchina	NRC KI PNPI
	Grozny	CSPU
	Irkutsk	LI SB RAS
	Ivanovo	ISUCT
	Izhevsk	UdSU
	Moscow	GIN RAS
		GPI RAS
		IKI RAS
		IPCE RAS
		ITEP
		MSU
		NRC KI
		SINP MSU
		VNIIA
	Moscow, Troitsk	INR RAS
	Nizhny Novgorod	IPM RAS
	Obninsk	IPPE
	Sevastopol	IBSS
	St. Petersburg	Botanic garden BIN RAS
		FIP
		Ioffe Institute

		KRI
		SPSFTU
	Tula	TSU
	Vladikavkaz	NOSU
	Voronezh	VSU
	Yekaterinburg	UrFU
Serbia	Belgrade	IPB
		Univ.
	Novi Sad	UNS
Slovakia	Bratislava	CU
		IEE SAS
		ILE SAS
		IP SAS
Slovenia	Ljubljana	GeoSS
South Africa	Bellville	UWC
	Pretoria	UNISA
	Stellenbosch	SU
Switzerland	Villigen	PSI
Thailand	Hat Yai	PSU
Turkey	Canakkale	COMU
Ukraine	Berdyansk	BSPU
	Donetsk	DonIPE
	Kharkov	ISMA NASU
		NSC KIPT
	Kiev	KINR NASU
		NUK
	Uzhhorod	IEP NASU
USA	Durham, NC	Duke
	Los Alamos, NM	LANL
	Oak Ridge, TN	ORNL
Uzbekistan	Tashkent	INP AS RUz
Vietnam	Hanoi	IOP VAST
		VNU

Condensed Matter Physics, Radiation and Radiobiological Research (04)

04-4-1142-2021/2025		Priority:	1
		Status:	New

Investigations of functional materials and nanosystems using neutron scattering

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

Participating countries and international organizations:

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

Issues addressed and main goals of research:

Investigations of structural features and dynamics of novel functional materials and nanosystems focused on determination of microscopic mechanisms of the formation of physical properties and phenomena that are important for the development of modern concepts in the areas of condensed matter physics, materials science, chemistry, geophysics, engineering sciences, biology, pharmacology, and for the development of modern technologies.

Expected results in the current year:

Realization of scientific program:

- Determination of characteristics of the atomic and magnetic structure of giant magnetostrictive alloys depending on thermodynamic conditions, synthesis conditions, alloying additives and thermomechanical processing.
- Determination of parameters of the atomic and magnetic structure of simple and complex oxides with a spinel-type structure under high pressure.
- Determination of parameters of crystal, magnetic and electronic subsystems of multifunctional oxides based on cobalt, manganese, iron in the region of spin transition and antiferromagnetic-ferromagnetic-paramagnetic and metal-insulator phase transitions in a wide range of temperatures and pressures.
- Study of structural mechanisms of the magnetoelectric effect in multiferroics.
- Study of the effect of microstructure of electrodes with varying composition on charge-discharge processes in compact electric power sources. Clarification of structural mechanisms responsible for the capacity and lifetime of batteries. Selection of optimal discharge/charge modes during cycling.
- Analysis of processes of deposition and intercalation of electrically active ions and their derivatives from liquid and solid electrolytes at electrochemical interfaces in compact electric power sources. A comparative study of characteristics of adsorption layers (density, thickness, homogeneity) at electrochemical interfaces for electrolytes and electrodes.
- Study of phenomena and effects induced by the interaction of ferromagnetic and superconducting order parameters in complex structures with helicoidal magnetic ordering.
- Investigation of structural stability of colloidal systems, including biomedical solutions, in bulk and at interfaces under various conditions. Determination of characteristics of adsorption layers at interfaces in case of loss of stability as a result of external influence of gradient electric and magnetic fields, as well as temperature effects. Study of the effect of aggregate formation in bulk on adsorption.
- Investigation of the structure of a number of advanced nanosystems based on composite carbon- and silicon-containing materials, including those based on fullerenes, nanodiamonds and their bioactive derivatives. Study of complex

multicomponent systems. Determination of conditions for synthesis of homogeneous systems. Investigation of effects of phase separation in advanced practical systems.

- Determination of structural characteristics of magnetic elastomers and carbosilane dendrimers, holding promise for technological applications.
- Study of structure and vibrational spectra of molecular complexes: ionic-molecular inclusive materials and complexes with electric charge transfer, structural and dynamic parameters of hydrogen bonds in bioactive materials.
- Investigation of molecular mechanisms of protein interaction, dimerization and functional characteristics of supramolecular structures and molecular complexes. Study of regularities and relationships between structural characteristics and functions of proteins, protein complexes and membrane-protein aggregates. Analysis of the effect of composition and external parameters on the phase state of membranes.
- Determination of structural characteristics and diffusion properties of lipid nanosystems for transport of drugs and nano-drugs.
- Analysis of metamorphic, geodynamic and evolutionary processes in the lithosphere using data on textures of deep-seated and near-surface rocks. Study of regularities in the development of instability of rocks under high temperatures and pressures. Investigation of relationships between seismic anisotropy of lithosphere rocks and textures of minerals, preferentially-oriented cracks and pores.
- Nondestructive testing of residual internal stresses and microstrains in real industrial products and advanced structural materials induced by various technological processes (metal and heat treatment, welding, rolling, stamping, 3D printing, etc.).
- Investigation of relationships between microstructure and thermomechanical properties of advanced functional and structural materials (high-strength steels, aluminum and magnesium alloys, composites, cermets, etc.), analysis of mechanical behavior of structural materials under external influences (load, temperature).
- Analysis of internal structure and construction of 3D models of objects of cultural and natural heritage, industrial materials and products using neutron tomography and radiography data.
- Clarification of mechanisms of radiation damage to solids, obtaining long-life operating data on radiation damage resistance of materials.

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

- Development and construction of elements of basic configuration of a small-angle scattering and imaging spectrometer at beamline 10.
- Development and construction of elements of a neutron guide system for a new inverse geometry inelastic scattering spectrometer.
- Development of neutron guide and detector system for the new DN-6 diffractometer for studies of microsamples, aimed at improving its technical parameters and expanding the available range of high pressures.
- Improvement of technical parameters and expansion of experimental capabilities of the GRAINS multifunctional reflectometer (startup of a new neutron beam chopper, development of electrochemical and liquid cells for conducting experiments).
- Modernization of the available IBR-2 spectrometers (HRFD, RTD, DN-12, YuMO, FSD, REFLEX, REMUR, SKAT, EPSILON) aimed at improving their technical characteristics (enhancement of luminosity, suppression of neutron background, improvement of data acquisition systems and expansion of experimental capabilities).
- Development and construction of a prototype of a small-angle spin-echo scattering spectrometer at beamline 9.
- Improvement of technical characteristics of the radiography and tomography spectrometer at beamline 14 (spatial resolution, radiation resistance of the detector system).
- Upgrade of the FSS correlation spectrometer at beamline 13 and improvement of its technical parameters. Further development of the RTOF correlation method.

- Development of neutron methods for condensed matter research, including spin-echo, neutron standing waves, neutron wave splitting, neutron magnetic resonance, radiography, tomography, and other techniques.
- Development of neutron scattering methods for in-operando monitoring and study of electrochemical materials and interfaces.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	DINSS	D.M.Chudoba	1 (2021-2023)

List of Activities

Activity or Experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. Study of structure and properties of new inorganic and organic functional materials	**A.M. Balagurov** **D.P. Kozlenko** **S.I. Tiutiunnikov (VBLHEP)**	Data taking
FLNP	Bobrikov I.A., Kichanov S.E., Turchenko V.A., Beskrovnyi A.I., Savenko B.N., Askerov E.B., Golosova N.O., Kraus M.L., Lukin E.V., Mironova G.M., Popov E.P., Pavlyukoych A., Samoilova N.Yu., Sikolenko V.V., Sumnikov S.V.	
LIT	V.B. Zlokazov	
VBLHEP	Shalyapin V.N., Efimov V.V., Kovalev Yu.S., Rogachev A.V., Zamyatin N.I., Kryachko I.A., Artyukh V.A.	
2. Investigation of structural and magnetic properties of materials under extreme conditions	**D.P. Kozlenko**	Data taking
FLNP	Kichanov S.E., Lukin E.V., Savenko B.N., Belozerova N.M., Golosova N.O., Rutkauskas A.V.	
3. Real-time investigations of physical and chemical processes in functional materials	**A.M. Balagurov**	Data taking
FLNP	Bobrikov I.A., Beskrovnyi A.I., Sumnikov S.V., Ivanshina O.Yu., Popov E.P., Samoilova N.Yu., Simkin V.G., Mironova G.M., Vershinina T.N.	
4. Computer simulation of structure and properties of new functional materials and nanosystems	**A. Pawlukojc**	Data taking
FLNP	Kholmurodov Kh.T.	
5. Investigation of structural and magnetic properties of layered nanostructures	**Yu.V. Nikitenko**	Data taking
FLNP	Zhaketov V.D., Kozhevnikov S.V., Petrenko A.V.	
6. Investigation of structure of carbon-and silicon-containing nanomaterials	**V.L. Aksenov**	Data taking

	FLNP	Tropin T.V., Kyzyma O.A., Tomchuk A.A., Chudoba D.M., Nagornaya T.V., Jazdzewska M., Nazarova A.Zh.	
7.	**Investigation of molecular dynamics of functional materials**	**D.M. Chudoba**	Data taking
	FLNP	Goremychkin E.A., Bilski P., Krawczyk J., Nagornaya T.V., Jazdzewska M., Ludzik-Dychto K.B., Waliszewski J., Zuba I.	
8.	**Investigation of dispersed systems and complex fluids in bulk and at interfaces**	**M.V. Avdeev**	Data taking
	FLNP	Petrenko V.I., Nagornyi A.V., Gapon I.V., Tomchuk A.V., Kosiachkin E.N.	
9.	**Investigation of structural organization of polymer nanomaterials**	**M. Balasoiu**	Data taking
	FLNP	Kuklin A.I., Islamov A.Kh., Ivankov O.I., Soloviev D.V., Rogachev A.V.	
10.	**Investigation of supramolecular structure and functional characteristics of biological nanosystems**	**A.I. Kuklin**	Data taking
	FLNP	Murugova T.N., Ivankov O.I., Soloviev D.V., Gorshkova Yu.E., Islamov A.Kh., Kovalev Yu.S., Rogachev A.V., Skoy V.V.	
	LIT	Soloviev A.G.	
11.	**Investigations of structure and properties of lipid membranes and complexes**	**M.A. Kiselev**	Data taking
	FLNP	Maslova V.A., Ivankov O.I.,	
	LIT	Zemlyanaya E.V.	
12.	**Investigations of structure and properties of biohybrid complexes**	**Yu.E. Gorshkova**	Data taking
	FLNP	Tropin T.V., Ivanshina O.Yu.	
13.	**Investigation of internal stresses and microstrains in structural materials and industrial products**	**G.D. Bokuchava**	Data taking
	FLNP	Vershinina T.N., Papushkin I.V., Kruglov A.A., Tamonov A.V., Mukhametuly B., Taran Yu.V.	
14.	**Investigation of features of internal structure of cultural and natural heritage objects, structural materials and industrial products**	**D.P. Kozlenko**	Data taking
	FLNP	Kichanov S.E., Savenko B.N., Lukin E.V., Nazarov K.M., Rutkauskas A.V., Zel I.Yu.	

15. Investigation of texture and properties of rocks and minerals, structural materials	**D.I. Nikolaev**	Data taking
FLNP	Ivankina T.I., Vasin R.N., Sikolenko V.V., Lychagina T.A., Altangerel B.	
16. Study of radiation damage effects in solid-state materials	**S.I. Tiutiunnikov (VBLHEP)**	Data taking
VBLHEP	Shalyapin V.N., Efimov V.V., Levterova E.A., Kovalev Yu.S., Rogachev A.V., Zamyatin N.I., Kryachko I.A., Artyukh V.A.	
17. Development of IBR-2 spectrometers	**M.V. Avdeev D.P. Kozlenko D.M. Chudoba**	Realization
FLNP	Beskrovnyi A.I., Bobrikov I.A., Bodnarchuk V.I., Kichanov S.V., Kuklin A.I., Lukin E.V., Nikitenko Yu.V., Petrenko A.V., Savenko B.N., Simkin V.G., Sukhanov V.I., Turchenko V.A., Bokuchava G.D.	
18. Development of neutron methods to study functional materials and nanosystems	**V.I. Bodnarchuk G.D. Bokuchava D.P. Kozlenko M.V. Avdeev**	Data taking
FLNP	Kichanov S.E., Lukin E.V., Kozhevnikov S.V., Nikitenko Yu.V., Rutkauskas A.V., Yaradaykin S.P., Zhaketov V.D., Kosiachkin E.N.	

Collaboration

Country or International Organization	City	Institute or laboratory
Armenia	Yerevan	Foundation ANSL
Azerbaijan	Baku	AzTU
		IP ANAS
Belarus	Minsk	BSTU
		IAP NASB
		RI PCP BSU
		RINPh BSU
		SPMRC NASB
Bulgaria	Sofia	ASCI Ltd
		IE BAS
		IEES BAS
		INRNE BAS
		ISSP BAS
		UCTM
China	Harbin	HEU
Czech Republic	Prague	BC CAS
		CTU
		CU
		IG CAS
		IMC CAS
		IP CAS
	Rez	NPI CAS
Egypt	Cairo	ASU

		EAEA
	Giza	CU
France	Grenoble	IBS
		ILL
	Saclay	LLB
Germany	Berlin	BAM
		HZB
	Bochum	RUB
	Bonn	UniBonn
	Darmstadt	TU Darmstadt
	Freiberg	TUBAF
	Geesthacht	GKSS
	Gottingen	Univ.
	Halle	MLU
	Hamburg	DESY
	Julich	FZJ
	Karlsruhe	KIT
	Kiel	IFM-GEOMAR
	Konstanz	Univ.
	Rostock	Univ.
	Stuttgart	MPI-FKF
Hungary	Budapest	Wigner RCP
India	Patna	NIT Patna
Italy	Messina	UniMe
Japan	Minato	Keio Univ.
	Tokyo	Waseda Univ.
Kazakhstan	Almaty	INP
Latvia	Riga	ISSP UL
Mongolia	Ulaanbaatar	IPT MAS
Poland	Bialystok	BUT
		UwB
	Krakow	AGH-UST
		JU
		NINP PAS
	Lublin	UMCS
	Poznan	AMU
	Siedlce	UPH
	Szczecin	WPUT
	Warsaw	INCT
	Wroclaw	UW
Romania	Baia Mare	TUCN-NUCBM
	Bucharest	IFIN-HH
		INCDIE ICPE-CA
		UB
		UPB
	Cluj-Napoca	INCDTIM
		RA BC-N
		UBB
	Constanta	MINAC
		UOC
	Craiova	UC
	Iasi	NIRDTP
		TUIASI
		UAI

		UAIC
		USAMV
	Magurele	NIMP
	Pitesti	ICN
		UPIT
	Targoviste	UVT
	Timisoara	ICT
		ISIM
		LMF CCTFA
		UVT
	Tulcea	DDNI
Russia	Chelyabinsk	SUSU
	Chernogolovka	ISSP RAS
	Dolgoprudny	MIPT
	Dubna	Dubna State Univ.
	Gatchina	NRC KI PNPI
	Kaliningrad	IKBFU
	Kazan	KFU
		KNRTU
	Moscow	IA RAS
		IC RAS
		ICP RAS
		IEPT RAS
		IGEM RAS
		IGIC RAS
		IMET RAS
		INMI RAS
		Inst. Immunology
		IPE RAS
		MIET
		MISiS
		MSU
		NNRU "MEPhI"
		NRC KI
		PIN RAS
		SINP MSU
	Moscow, Troitsk	HPPI RAS
		INR RAS
	Nizhny Novgorod	IPM RAS
		UNN
	Perm	ICMM UrB RAS
		ITCh UrB RAS
	Rostov-on-Don	RIP SFU
	St. Petersburg	CRISM "Prometey"
		IMC RAS
		Ioffe Institute
		SPbSU
	Sterlitamak	SB BSU
	Tula	TSU
	Yekaterinburg	IMP UB RAS
		UrFU
Serbia	Belgrade	INS "VINCA"
Slovakia	Bratislava	CU
	Kosice	IEP SAS

South Africa	Pretoria	Necsa
		UP
Spain	Barcelona	ICMAB-CSIC
	Leioa	BCMaterials
	Madrid	CENIM-CSIC
Switzerland	Villigen	PSI
Tajikistan	Dushanbe	NAST
		PHTI NAST
		TTU
Ukraine	Donetsk	DonIPE
		DonNU
	Kiev	DonIPE NASU
		NUK
United Kingdom	Didcot	RAL
USA	Berkeley, CA	UC
Uzbekistan	Tashkent	INP AS RUz
Vietnam	Da Nang	DTU
	Hanoi	IOP VAST

04-4-1105-2011/2022		Priority:	1
		Status:	In-progress

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

Leaders: A.V. Vinogradov
A.V. Belushkin
A.V. Dolgikh

Participating countries and international organizations:
Azerbaijan, Belarus, Mongolia, Poland, Romania, Russia, Spain.

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

Expected results in the current year:
- Provision of the IBR-2 reactor operation for physics investigations.
- Check assembling, adjustment and testing of the backup movable reflector MR-3R at the FLNP test bench. Experimental investigations on determination of dynamic characteristics and parameters of vibrations of the units and structure modules at the stage of assembly and bench testing of MR-3R.
- Operation of the test stand of the cryogenic moderator CM-201. Installation of the cryogenic moderator CM-201 in the regular place and putting it into trial operation. Development of requirements specification and project documentation for the cryogenic moderator CM-203 for beamlines 2 and 3.
- Phased replacement and upgrade of the basic technological and electrical safety-related equipment of the IBR-2 facility.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	Construction of a complex of cryogenic moderators at the IBR-2 facility	K.A. Mukhin	1 (2014-2022)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1.	**Operation of the IBR-2 facility in the regular mode**	**A.V. Dolgikh** **A.V. Vinogradov**	Realization
	FLNP	M.V. Andrianov, A.A. Belyakov, Yu.N. Pepelyshev, S.V. Rudenko, S.A. Tsarenkov, V.A. Trepalin, 30 engineers, 50 workers	

2. Provision of physics research program	**A.V. Vinogradov** **A.V. Dolgikh**	Realization
FLNP	A.A. Belyakov, Yu.N. Pepelyshev, S.V. Rudenko, V.A. Trepalin, 30 engineers, 50 workers	
3. Experiments at the test stand of CM-201 cryogenic moderator. Test operation of equipment of CM-201 cryogenic moderator. Operation of cryogenic moderators using new cryogenic refrigerator by Linde in the regular place	**A.A. Belyakov** **K.A. Mukhin**	Realization
FLNP	S.A. Kulikov, E.P. Shabalin, 15 engineers, 15 workers	
4. Assembling of backup movable reflector MR-3R	**A.V. Vinogradov** **A.V. Dolgikh**	Realization
FLNP	A.A. Belyakov, 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
		NNRC
Belarus	Minsk	JIPNR-Sosny NASB
Mongolia	Ulaanbaatar	IPT MAS
Poland	Krakow	AGH-UST
Romania	Bucharest	IFIN-HH
Russia	Moscow	ENES
		Geliymash
		INEUM
		OKSAT NIKIET
		SSDI
		SYSTEMATOM
Spain	Valencia	UPV

04-4-1143-2021/2025	Priority:	1
	Status:	New

Scientific and methodological research and developments for condensed matter investigations with IBR-2 neutron beams

Leaders: S.A. Kulikov
V.I. Prikhodko
V.I. Bodnarchuk

Participating countries and international organizations:

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

Issues addressed and main goals of research:

Regular operation, modernization and development of control systems for CM-201 and CM-202 cryogenic moderators. Development and equipping of new spectrometers, as well as modernization and reconstruction of equipment for the existing IBR-2 spectrometers in order to improve their parameters, expand experimental capabilities and ensure their faultless operation. Scientific and technical support for the development of beam-forming systems, neutron detectors, sample environment systems, cryostats and cryomagnetic systems, as well as electronics and software of data acquisition systems. Development of FLNP information and computing infrastructure.

Expected results in the current year:

- Maintenance of regular operation of the complex of CM-201 and CM-202 cryogenic pelletized moderators for physics experiments. Automation of the vacuum system and the system for supplying helium to the pneumatic transport pipeline of the CM-202 cryogenic moderator; upgrade of software for control systems of the CM-202 moderator.
- Investigation of radiation resistance of materials using the radiation research facility. Neutron activation analysis of irradiated samples using a high-purity germanium spectrometer.
- Complex calculations and optimization of spectrometers. Methodological studies of neutron background conditions at IBR-2 spectrometers. Determination of sources of neutron background, its level and influence on experimental results.
- Development of the horizontal/vertical cryostat with a superconducting magnet. Development of the available cryogenic test bench for working with liquid helium and its adaptation to produce pure high-pressure helium-3 for filling gas neutron detectors. Modernization of cryostats on neutron beams (at the requests of instrument responsibles).
- Manufacturing, installation in the regular position and testing of 4 sectors of the BSD detector at the HRFD diffractometer (work under the BSD project). Study of a prototype of a 2D large-area (~1 m^2) scintillation detector for small-angle neutron scattering experiments.
- Equipping of the REFLEX spectrometer with a beam monitor (IBR-2 beamline 9).
- Manufacturing of elements of the detector system for the REMUR spectrometer. The first stage of the assembly of the detector system.
- Investigation of solid neutron converters based on boron compounds.
- Calculation and simulation of position-sensitive counters with a resistive anode wire up to 1 m long; development of a detector electronics system.
- Study and use of programmable logic controllers (PLC) for their application in automated control systems for actuators, choppers and current sources; development of a PLC test bench and preparation of proposals for the introduction of PLC at IBR-2 spectrometers. Development of technical specifications for software and user interface for PLC.

- Maintenance and development of the Sonix+ software package at the request of users and in order to improve the internal structure. Upgrade of Sonix+ for the available spectrometers and its installation at new IBR-2 spectrometers.
- Modernization of the FLNP mail system. Development of Wi-Fi network in FLNP buildings. Creation of a server segment of the network with a rate of 10 Gbit/s.

List of projects:

Project	Leader	Priority (period of realisation)
1. Construction of a wide-aperture backscattering detector (BSD) for the HRFD diffractometer	V.V. Kruglov	1 (2021-2023)

List of Activities

Activity or Experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1. Maintenance of regular operation and development of the complex of CM-201 and CM-202 cryogenic pelletized moderators. Further automation of moderators' control systems.	**S.A. Kulikov** **M.V. Bulavin**	Realization
2. Investigation of radiation resistance of materials, electronics and detectors for large-scale physics facilities: ANLAS, CMS, NICA, ITER, ESS, etc.; applied research		
FLNP	M.V. Bulavin, A.S. Kirilov, A.V. Altynov, K.A. Mukhin, E.P. Shabalin 8 engineers	
3. Development of VITESS software package and simulation of individual components of spectrometers. Investigation of neutron background conditions at IBR-2 spectrometers, development of recommendations to reduce the background level.	**V.I. Bodnarchuk**	Realization
FLNP	2 engineers	
4. Development of the horizontal/vertical cryostat with a superconducting magnet. Development and modernization of cryostats at IBR-2 spectrometers. Modernization of the cryogenic test bench for working with liquid helium.	**A.N. Chernikov** **S.E. Kichanov**	Realization
FLNP	A.P. Bulavin, 1 engineer, 1 laboratory assistant	
5. Completion of development and construction of the BSD detector. Putting the detector into operation at the HRFD diffractometer. Commissioning of the upgraded ASTRA-M detector at FSD.	**V.V. Kruglov** **A.A. Bogdzel** **A.S. Kirilov**	Realization
FLNP	V.M. Milkov, G.D. Bokuchava, V.G. Simkin, V.A. Drozdov, V.V. Shvetsov, 3 engineers, 4 laboratory assistas	

6.	**Development and investigation of prototypes of PSD systems based on counters with a resistive anode wire up to 1 m long and large-area (~1 m^2) scintillation position-sensitive detectors. Development of a 2D PSD with a central opening for a direct beam for the REMUR spectrometer. Investigation of boron-based neutron converters. Development and equipping of IBR-2 spectrometers with beam monitors.**	**A.V. Churakov** **V.V. Kruglov** **A.A. Bogdzel**	Realization
	FLNP	V.V. Zhuravlev, A.K. Kurilkin, V.M. Milkov, V.A. Drozdov, S.M. Murashkevich, 3 engineers	
7.	**Modernization of detector and data acquisition electronics for IBR-2 spectrometers.**	**A.A. Bogdzel** **A.S. Kirilov**	Realization
	FLNP	V.V. Zhuravlev, E.I. Litvinenko, V.A. Drozdov, V.V. Shvetsov, S.M. Murashkevich, V.M. Milkov, 2 engineers	
8.	**Introduction of programmable logic controllers in control systems for actuators, sample environment equipment and spectrometers' choppers. Installation of additional equipment at IBR-2 spectrometers at the request of instrument responsibles.**	**V.I. Bodnarchuk** **A.V. Altynov**	Realization
	FLNP	V.V. Zhuravlev, A.S. Kirilov, N.D. Zernin, T.B. Petuhova, 3 engineers	
9.	**Maintenance and development of the Sonix+ software package and installation of its new versions at IBR-2 spectrometers. Development of FLNP central servers and network infrastructure in accordance with the development strategy of the JINR computer network. Modernization of Laboratory's mail system and Wi-Fi network.**	**A.S. Kirilov** **V.I. Prikhodko**	Realization
	FLNP	G.A. Sukhomlinov, A.S. Kirilov, 4 engineers	
	LIT	A.G. Dolbilov, 1 engineer	

Collaboration

Country or International Organization	City	Institute or laboratory
Argentina	Bariloche	CAB CNEA
Armenia	Yerevan	Foundation ANSL
Belarus	Minsk	BSTU
		INP BSU
Bulgaria	Sofia	INRNE BAS
Czech Republic	Rez	NPI CAS
Germany	Berlin	HZB
	Darmstadt	GSI
	Julich	FZJ
Hungary	Budapest	Wigner RCP
Republic of Korea	Daejeon	NFRI
Romania	Bucharest	INCDIE ICPE-CA
	Cluj-Napoca	INCDTIM
	Iasi	UAIC
	Targoviste	UVT
Russia	Dubna	Dubna State Univ.
	Gatchina	NRC KI PNPI
	Moscow	NNRU "MEPhI"
		NRC KI
		PC ITER RF
	Moscow, Troitsk	INR RAS
	Yekaterinburg	IMP UB RAS
Sweden	Lund	ESS ERIC
Switzerland	Villigen	PSI
Ukraine	Lviv	LPNU
United Kingdom	Didcot	RAL
Uzbekistan	Tashkent	INP AS RUz

04-4-1133-2018/2023	Priority:	1
	Status:	Extended

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

Leaders: G.M. Arzumanyan
N. Kučerka

Participating countries and international organizations:
Armenia, Belarus, Bulgaria, Cuba, Egypt, Poland, Romania, Russia, Slovakia, Ukraine, Uzbekistan.

Issues addressed and main goals of research:
Fundamental and applied research in the field of spontaneous and nonlinear Raman microspectroscopy aimed at highly sensitive biosensing. Study of mechanisms and nature of surface-enhanced Raman scattering (SERS) taking into account the anomalous ratio of line intensities in the anti-Stokes and Stokes spectral regions. Development of ultralow-frequency Raman spectroscopy for biomedical purposes, including early diagnostics.

Expected results in the current year:
- Development of a technique for simultaneous registration of Stokes and anti-Stokes components in SERS spectra.
- Revealing a possible nonlinear dependence of SERS spectra on the pump power.
- Detailed characterization of Raman spectra of liposomes with embedded proteins.
- Search and identification of the Raman marker of NETosis for the purposes of early diagnostics.
- Acquisition and registration of spectra using optics adapted for low-frequency Raman spectroscopy.

List of projects:

	Project	Leaders	Priority (period of realisation)
1.	BIOPHOTONICS	G.M. Arzumanyan N. Kučerka Deputy: K.Z. Mamatkulov	1 (2021-2023)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1.	**Study of the features of Stokes and anti-Stokes components of SERS spectra from analyte molecules in order to understand the processes of enhancement in SERS spectroscopy**	**G.M. Arzumanyan**	Data taking
	FLNP	K.Z. Mamatkulov, I.A. Morkovnikov + 2 engineers	

2.	**Determination of the range of pump intensities for recording reproducible aSt / St spectra**	**G.M. Arzumanyan** **K.Z. Mamatkulov**	Data taking
	FLNP	M.Yu. Vorobyeva, S.P. Marmakov + 1 engineer	
3.	**Stabilization of membrane proteins and studies of their structure using lipodiscs/liposomes by Raman spectroscopy, electron microscopy and SANS**	**G.M. Arzumanyan** **N. Kučerka**	Realization Data taking
	FLNP	K.Z. Mamatkulov, M.Yu. Vorobyeva, A. Damir	
4.	**Testing the technique for obtaining Raman spectra of lipodiscs/liposomes with membrane proteins and "empty" lipodiscs/liposomes**	**K.Z. Mamatkulov** **N. Kučerka**	Realization
	FLNP	M.Yu. Vorobyeva, A. Damir + 2 engineers	
5.	**Study of the influence of lipid environment on the structure of membrane protein**	**G.M. Arzumanyan** **N. Kučerka**	Data taking
	FLNP	K.Z. Mamatkulov, M.Yu. Vorobyeva, K.Sh. Voskanyan + 1 engineer + 2 laboratory assistant	
6.	**Search for spectral / Raman markers of NETosis**	**G.M. Arzumanyan** **N. Kučerka**	Realization
	FLNP	K.Z. Mamatkulov, M.Yu. Vorobyeva, + 1 engineer + 2 laboratory assistant	
7.	**Study of mechanisms of sterile activation of NETosis under UV radiation**	**G.M. Arzumanyan K.Z.** **K.Z. Mamatkulov**	Data taking, Realization
	FLNP	M.Yu. Vorobyeva, K.Sh. Voskanyan, A. Damir	
8.	**Mastering the technique of ultra-low frequency Raman spectroscopy ~ (5-10) cm^{-1}**	**G.M. Arzumanyan** **K.Z. Mamatkulov**	Realization
	FLNP	M.Yu. Vorobyeva, S.P. Marmakov + 2 engineers	

Collaboration

Country or International Organization	**City**	**Institute or laboratory**
Armenia	Yerevan	Foundation ANSL
Belarus	Minsk	BSUIR
		SOL instruments
Bulgaria	Sofia	ISSP BAS
Cuba	Havana	InSTEC
Egypt	Giza	CU
Poland	Krakow	JU
Romania	Cluj-Napoca	INCDTIM
	Magurele	NIMP
Russia	Moscow	GPI RAS
		LMPR MONIKI
		MSU
Slovakia	Kosice	UPJS
Ukraine	Donetsk	DonNU
Uzbekistan	Jizzakh	JSPI

04-4-1140-2020/2022

Priority:	1

Status: In-progress

Development of the Conceptual Design of a New Advanced Neutron Source at JINR

Leaders: V.N. Shvetsov
S.A. Kulikov

Participating Countries and International organizations:
Argentina, Belarus, Czech Republic, France, Germany, Hungary, Romania, Russia, South Africa, Sweden, Uzbekistan.

Issues addressed and main goals of research:
Development of the conceptual design of a new advanced neutron source at JINR.

Expected main results in the current year:
- Selection of a concept for the new source.
- Publication of a "White book".
- Simulation of the first three instruments for the new source.

List of Activities

	Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1.	**Scientific rationale for the creation of the new source, "White book"**	**V.N. Shvetsov**
	FLNP	S.A.Kulikov
2.	**Development and justification of the choice of a conceptual design of a high-flux pulsed neutron source of periodic operation**	**V.N. Shvetsov**
	FLNP	S.A. Kulikov
	OKSAT NIKIET	I.T. Tretiakov
3.	**Preparatory work on themanufacturing of fuel oading/target for the new source**	**V.N. Shvetsov** **S.A. Kulikov**
	FLNP	A.V. Vinogradov, A.V.Dolgikh
	SC "VNIINM"	Yu.A.Ivanov
4.	**Development of the concept of layout of neutron moderators, neutron beamlines and instruments**	**V.N. Shvetsov**
	FLNP	S.A. Kulikov
5.	**Development of technical specifications for the design of the new source with a suite of research instruments at beamlines**	**V.N. Shvetsov**

FLNP	S.A. Kulikov, A.V. Vinogradov

Collaboration

Country or International Organization	City	Institute or laboratory
Argentina	Bariloche	CAB CNEA
Belarus	Minsk	BSTU
Czech Republic	Rez	NPI CAS
France	Grenoble	ILL
Germany	Berlin	HZB
	Julich	FZJ
Hungary	Budapest	Wigner RCP
Romania	Bucharest	INCDIE ICPE-CA
Russia	Gatchina	NRC KI PNPI
	Moscow	NRC KI
		OKSAT NIKIET
		SC "VNIINM"
	Moscow, Troitsk	INR RAS
South Africa	Pretoria	UP
Sweden	Lund	ESS ERIC
Uzbekistan	Tashkent	INP AS RUz

04-4-1141-2020/2022		Priority:	1
		Status:	In-progress

Development of the SOLCRYS Structural Research Laboratory at the SOLARIS National Synchrotron Radiation Centre

Leader: N. Kucerka

Participating Countries and International organizations:

Belarus, Poland, Russia, Slovakia, Ukraine.

Issues addressed and main goals of research:

The development of a new laboratory for structural research of new materials (catalysts, polymers, etc.), nanomaterials (nanoparticles, nanocomposites, etc.), materials under extreme conditions (superconductors, perovskites, etc.) and biomaterials (proteins, DNA, etc.) utilizing synchrotron X-rays.

Expected main results in the current year:

- Construction of technical infrastructure for the SOLCRYS laboratory.
- Development of a superconducting wiggler, which will produce synchrotron radiation in the range of 5 to 22 keV, to be used by the end stations of the SOLCRYS beamlines.
- Design of experimental beamlines.

List of Activities

	Activity or experiment **Laboratory or other Division of JINR**	**Leaders** **Main researchers**
1.	**Elaboration and development of technical infrastructure within a scope necessary to install and properly operate the research equipment of the SOLCRYS laboratory**	**Kucerka N.**
2.	**Design, purchase and installation of a superconducting wiggler as a radiation source in the X-ray range with an upper photon energy of at least 20 keV**	**Kucerka N.**
3.	**Design, purchase and installation of research lines of synchrotron radiation**	**Kuklin A.I.** **Lukin E.V.**
4.	**Design, purchase and installation of measuring stations for diffraction studies and studies of scattering at small angles**	**Kuklin A.I.** **Lukin E.V.**

5.	**Design and assembly of control systems as well as of data acquisition and storage systems**	**Kucerka N.** **Kuklin A.I.** **Lukin E.V.**

Collaboration

Country or International Organization	City	Institute or laboratory
Belarus	Minsk	BSU
Poland	Krakow	SOLARIS
	Poznan	AMU
Russia	Novosibirsk	BINP SB RAS
Slovakia	Bratislava	CU
Ukraine	Kiev	NUK

04-5-1131-2017/2021		Priority:	1
		Status:	Being concluded

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

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

Participating countries and international organizations:

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

Issues addressed and main goals of research:

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

Expected results in the current year:

- Comparative analysis of the radiation stability of Y-Ti(Al)-O nanoparticles in metallic matrices and bulk Y-Ti(Al) oxides against the impact of heavy ions of fission fragments energy.
- Study of mechanical stress profiles in nitrides (AlN, Si3N4) and carbides (SiC) irradiated with high-energy ions.
- TEM study of gas swelling of ferritic alloys depending on their structural state and their doping conditions with inert gases using homogeneous ion implantation.
- Development and study of ion-selective track-etched membranes.
- Hydrophobization of polyethylene terephthalate track-etched membranes by electron-beam and magnetron deposition of polymers on their surface with a view to obtaining composite membranes for their use in membrane distillation.
- Characterization and production of biodegradable polymer nanofibers by electroforming on the surface of metallized track membranes for medical applications.
- Development of methodological approaches to the creation of technology for manufacturing sterilizing track-etched membranes.
- X-ray fluorescence and gamma activation analysis for estimating the impact of radiological releases from industrial facilities—in particular, coal-fired power plants—on the environment (in cooperation with Mongolia).
- Infrastructure expansion and introduction of new physical and chemical research methods (transmission electron microscopy, thermogravimetry, and measurement of thermo-stimulated currents in dielectrics).

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	V.A. Altynov, I.V. Blonskaja, O.M. Ivanov, L.I. Kravets, O.V. Kristavchuk, N.S. Kirilkin, E.A. Korneeva, N.E. Lizunov,A.N. Nechaev, O.L. Orelovich, V.F. Reutov, D.V. Shchegolev, V.K. Semina, V.V. Shirkova, A.S. Sohatsky, R. Rymchanov, A. Rossouw, A. Olejniczak, K. Yukari	
	LIT	V.V. Trofimov	
	FLNP	M.V. Frontasyeva, A.I. Kuklin, I.A. Bobrikov	
	LRB	I.V. Koshlan	
2.	**Production of ultra-pure isotopes**	**S.N. Dmitriev**	Manufacturing
	FLNR	Yu.V. Albin, G.A. Bozhikov, T.P. Drobina, M.V. Gustova, G.Ya. Starodub, A.V. Sabelnikov, G.K. Vostokin	
3.	**Radioanalytical studies**	**M.V. Gustova**	Data taking
	FLNR	N.S. Gustova, S.P. Kaplina, A.V. Sabelnikov	

Collaboration

Country or International Organization	City	Institute or laboratory
Belarus	Gomel	GSU
		MPRI NASB
	Minsk	BSU
Bulgaria	Plovdiv	PU
China	Beijing	Beijing Fert Co
		PKU
Cuba	Havana	CEADEN
Czech Republic	Brno	BUT
	Olomouc	UP
	Prague	CU
	Rez	NPI CAS
Germany	Darmstadt	GSI
	Quedlinburg	IST
		MiCryon Technik
Hungary	Budapest	GetGiro Kft
Kazakhstan	Almaty	PhysTI
	Nur-Sultan	BA INP
		ENU
		NU
Moldova	Chisinau	MSU
Mongolia	Ulaanbaatar	CGL
		NRC NUM
Poland	Lublin	UMCS
	Torun	UMK
	Warsaw	INCT
		WUT

Romania	Baia Mare	TUCN-NUCBM
	Bucharest	CSSNT-UPB
		IFIN-HH
		UPB
	Magurele	INFLPR
Russia	Chernogolovka	BInEPCP RAS
		ISSP RAS
	Dubna	Trackpore Technology
	Kaliningrad	IKBFU
	Krasnodar	KSU
	Moscow	GPI RAS
		IC RAS
		ISPM RAS
		LPI RAS
		MAI
		MIEM
		RIVS
		SINP MSU
	Novosibirsk	ISP SB RAS
	Obninsk	REATRACK-Filter
	Saratov	SSMU
	St. Petersburg	Ioffe Institute
	Vladimir	Vladisart
Serbia	Belgrade	INS "VINCA"
Slovakia	Bratislava	IEE SAS
		PF SK
South Africa	Bellville	UWC
	Port Elizabeth	NMU
	Pretoria	UP
	Stellenbosch	SU
Spain	Barcelona	UPC
	Valencia	UV
USA	Knoxville, TN	UTK
	Stanford, CA	SU
Vietnam	Hanoi	IOP VAST

04-9-1077-2009/2023		Priority:	1
		Status:	Extended

Research on the Biological Effects of Heavy Charged Particles of Different Energies

Leader: E.A. Krasavin
A.N. Bugay

Participating countries and international organizations:

Armenia, Belarus, Bulgaria, Czech Republic, Cuba, Germany, Italy, Mongolia, Poland, Romania, Russia, Serbia, Slovakia, Vietnam.

Issues addressed and main goals of research:

Teoretical and experimental research on the biological effects of heavy charged particles of different energies at JINR's basic facilities.
The research and development will include:

- Research on the mechanisms of the development of DNA molecular damage and its repair in cultures of human and mammalian normal and tumor cells and in histological sections of tissues of different parts of animals' central nervous system after exposure to radiations of different LET.
- Research on the induction and molecular nature of different types of gene and structural mutations in mammalian and lower eukaryote cells depending on the radiation dose and LET, repair status, oxidative stress development, and genetic stability mechanisms.
- Research on the formation of complex chromosomal aberrations in normal and tumor cells of humans and laboratory animals. Evaluation of long-term consequences of exposure to radiations of different LET.
- Research on behavioral reaction disorders and pathomorphological changes in different structures of the brain, spinal cord, and critical organs and systems of irradiated laboratory animals. Conducting a search for new radioprotective drugs.
- Research on radiation-induced effects in microglia, oligodendrocytes and their precursors, and in the myelin sheath after exposure to densely ionizing radiation.
- Research on the mechanisms of the action of Ara-C and other radiosensitizers for the irradiation of different normal and tumor cell cultures and mice with transplanted tumors.
- Development of an hierarchy of mathematical models of radiation-induced biological effects that would describe the development of radiation-induced pathologies at different organization levels (from molecules to cell populations) and at different times (acute and long-term consequences).
- Improvement of accelerator-based radiobiological experiment procedures. Calculation of shieldings for new nuclear physics facilities; evaluation of the radiation conditions and development of radiation safety systems for them. Participation in the creation and tests of nuclear planetary science instruments.

Expected results in the current year:

- To identify the patterns of clustered DNA double-strand break (DSB) formation in human skin fibroblast nuclei and radioresistant U87 tumor cells after accelerated heavy charged particle exposure.
- To analyze the formation patterns and structure of complex clustered DNA damage by immunocytochemical staining of the repair proteins γH2AX, 53BP1, OGG1, and XRCC1 in human fibroblast nuclei after accelerated heavy ion exposure.
- To study the kinetics of clustered DNA DSB repair in human skin fibroblast nuclei and radioresistant U87 tumor cells after accelerated heavy charged particle exposure.
- To study the formation of different DNA damage types (single-strand breaks, base damage, and complex damage) in human fibroblast nuclei after accelerated heavy charged particle exposure.
- To assess the proportion of different DNA DSB repair pathways in human fibroblasts by immunocytochemical staining of the repair proteins RAD51 (HR) and DNA PKcs (NHEJ) after exposure to radiations of different quality.
- To study the formation and repair kinetics of clustered DNA DSBs in neuron precursor cell nuclei and mature neurons and in glial cells of the mammalian central nervous system (CNS) after accelerated heavy charged particle exposure — using the cell subpopulation markers NeuN, doublecortin, GFAP, BrdU, and calbindin.
- To perform experiments to study the expression of the genes encoding the repair proteins (RAD51, DNAPKcs, NBS1, MRE11, etc.) in human skin fibroblasts after accelerated heavy charged particle exposure.
- To study apoptosis induction in human skin fibroblasts and mammalian CNS neurons after accelerated heavy charged particle exposure.
- To study the expression of the genes encoding the proteins and caspases participating in apoptosis induction in human fibroblasts and nerve cells after accelerated heavy charged particle exposure.
- To study in vitro the formation and elimination of DNA DSBs in rat hippocampal cells using a primary hippocampal culture obtained from rats aged P0–P1.
- To identify the patterns of DNA DSB formation in mammalian CNS neurons after γ-ray and accelerated heavy ion exposure.
- To study clustered DNA DSB repair kinetics in mammalian CNS neurons after γ-ray and accelerated heavy ion exposure.
- To study the expression of the genes encoding the repair proteins (RAD51, DNA PKcs, NBS1, MRE11, etc.) in human fibroblasts after exposure to ionizing radiations with different characteristics.
- To continue research on the induction of structural mutations in yeast cells by radiations of different LET.
- To evaluate the action of respiratory impairment caused by mitochondrial DNA damage on sensitivity to radiation's damaging and mutagenic effects.
- To determine the characteristics of the mutations which decrease cells' radiosensitivity.
- To analyze yeast cells' radiosensitivity and genetic stability with the inactivated HAP1 phosphatase.
- To perform PCR analysis of structural damage in the hprt-gene in descendants of irradiated V79 cells.
- To compare structural and chromosomal damage spectra in radiation-induced mutants at different times after exposure.
- To perform metaphase analysis of long-term chromosomal damage after irradiation of Macaca mulatta monkeys' head with accelerated carbon and krypton ions.
- To study complex aberration induction in human normal (lymphocytes) and tumor (Cal 51 breast carcinoma) cells by photons, accelerated protons, and accelerated boron and nitrogen ions.
- To perform mFISH and standard metaphase analysis of the induction and elimination (3–6 months after exposure) of chromosomal aberrations in animal bone marrow cells and blood lymphocytes.
- To perform mFISH analysis of chromosomal aberrations induced in human peripheral blood lymphocytes by different types of radiation used in cancer therapy.

- To do mFISH karyotyping and analysis of structural and numerical chromosomal aberrations in different lines of human stem cells cultivated in vitro.
- To conduct premature chromatin condensation research on the induction of chromatin breaks in human normal (lymphocytes) and tumor (Cal 51 breast carcinoma) cells by γ-rays and accelerated protons and ions at different times after exposure.
- By protein extraction, to study inflammatory cytokine secretion in mouse brain homogenates after radiation exposure.
- To study the effect of cytosine arabinoside (Ara-C) on the survival of different mammalian and human normal and tumor cell lines by the criteria of clone formation and apoptosis after exposure to accelerated protons and γ-rays.
- To study the formation and elimination of γH2AX/53BP1 foci in cultures of U87 glioblastoma cells and cells of other radioresistant tumor lines after exposure to Bragg peak protons and γ-rays — under normal conditions and in the presence of Ara-C (±HU).
- To study DNA DSB formation in different parts of rodent CNS after in vivo irradiation with accelerated protons and γ-rays without radiomodifiers and in the presence of Ara-C (±HU).
- To study the kinetics of DNA single-strand break formation and transformation into DSBs for different types of normal and tumor cells irradiated in the presence and absence of Ara-C (± HU).
- To study the influence of Ara-C (± HU) on the radiosensitizing of normal and tumor cells for different exposure fractionation schemes and different cell hypoxia levels.
- To study modifications of small laboratory animals' behavioral reactions after HCP exposure using the drug AraC. To evaluate the pathological changes in different cell populations of the brain and the possibility of arresting such damage by the neuroprotective drug Cerebrolysin.
- To study morphological and functional changes in the CNS of SD rats and CD-1 mice after accelerated proton exposure.
- To continue research on pathogenesis in different mammalian tissues and organs after heavy charged particle exposure.
- To simulate DNA damage formation and repair after irradiation of normal and tumor cells with heavy charged particles of different energies.
- To simulate the growth of a tumor cell population after ionizing radiation exposure in the presence of DNA synthesis inhibitors.
- To develop a model of the growth of a tumor cell population after ionizing radiation exposure in the presence of metal nanoparticles.
- To continue molecular dynamics modeling of impairments of the structure and functioning of mutant and oxidized forms of proteins.
- To simulate radiation-induced neurogenesis and gliogenesis impairments and neuroinflammatory processes in CNS structures.
- To upgrade the Genome irradiation facility.
- To continue the design, fabrication, testing, and calibration of nuclear planetary science instruments using fast neuron generators at the LRB's test bench.
- To ensure the conduction of radiobiological experiments at the 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 realisation)
1.	Research on the biological effects of heavy charged particles with different energies	E.A. Krasavin A.N. Bugay	1 (2015-2023)

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 Modeling
	LRB	Bazlova T.N., Bezhanyan T.Zh., Bogdanova Yu.V., Boreyko A.V., Budennaya N.N., Chausov V.N., Chernyak O.O., Fadeeva T.A., Filatova A.S., Gureu D.-N., Ignat E.M., Ilyina E.V., Isakova M.D., Ivanov A.A., Khramko T.S., Kokoreva A.N., Kolesnikova I.A., Koltivaya N.A., Komarov D.A., Komova O.V., Korogodina V.L., Koshlan I.V., Koshlan N.A., Kovalenko M.A., Kozhina R.A., Kruglyakova E.A., Krupnova M.E., Kutsalo P.V., Kuzmina E.A., Lalkovičova M., Lkhasuren, Lyakhova K.N., Melnikova L.A., Nasonova E.A., Nurkasova A., Ostrovsky M.A., Pavlova A.S., Petrova D.V., Pronskikh E.V., Severyukhin Yu.S., Shamina D.D., Shvaneva N.V., Smirnova E.V., Tiunchik S.I., Utina D.M., Vasilyev L.A., Vinogradova Yu.V., Zadneprianetc M.G., Zhuchkina N.I.	
2.	**Radiation research**	**G.N. Timoshenko**	Preparation Data taking Modeling
	LRB	Aleinikov V.E., Beskrovnaya L.G., Gordeev I.S., Komochkov M.M., Krylov V.A., Lesovaya E.N., Pavlik E.E.	
3.	**Mathematical modeling of radiation-induced effects**	**A.N. Bugay**	Data taking Modeling
	LRB	Aksenova S.V., Batova A.S., Chizhov A.V., Dushanov E.B., Enyagina I.M., Glebov A.A., Kolesnikova E.A., Lkhagva B., Munkhbaatar B., Panina M.S., Parkhomenko A.Yu., Tudevdordzh T., Vasilyeva M.A.	
4.	**Training activity**	**E.A. Krasavin** **A.N. Bugay** **S.Z. Pakuliak (UC)**	
	LRB	Beskrovnaya L.G., Boreyko A.V., Budennaya N.N., Chizhov A.V., Dushanov E.B., Koshlan I.V., Lesovaya E.N., Timoshenko G.N.	

Collaboration

Country or International Organization	City	Institute or laboratory
Armenia	Yerevan	YSU
Belarus	Minsk	IBCE NASB
		Inst. Physiology NASB
		SPMRC NASB
Bulgaria	Sofia	IE BAS

		Inst. Microbiology BAS
		NCRRP
Cuba	San Jose de las Lajas	CENTIS
Czech Republic	Brno	IBP CAS
	Prague	CTU
	Rez	NPI CAS
Germany	Darmstadt	GSI
Italy	Udine	Uniud
Mongolia	Ulaanbaatar	NUM
Poland	Krakow	NINP PAS
	Szczecin	US
Romania	Bucharest	IFIN-HH
		UMF
	Cluj-Napoca	UBB
	Iasi	IBR
Russia	Moscow	FMBC
		IBMC
		IBMP RAS
		IHNA Ph RAS
		IKI RAS
		MSU
		NMRC Oncology
		SF IPh
		SINP MSU
		Skoltech
	Obninsk	NMRRC
	Puschino	ITEB RAS
	Sochi	SRI MP
Serbia	Belgrade	INS "VINCA"
Slovakia	Bratislava	CU
Vietnam	Hanoi	INPC VAST
		VINATOM

04-9-1112-2013/2022		Priority:	1
		Status:	In-progress

Research on Cosmic Matter on 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.

Issues addressed and main goals of research:
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 extremophile organisms, 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 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 results in the current year:

- To continue the electron microscopy-based search for and study of microfossils in meteorites and terrestrial rocks (mainly Archaean and early Proterozoic).

- To evaluate the elemental composition of cosmic dust in biomonitor mosses with nuclear physics methods.
- To continue the research on the synthesis of complex prebiotic compounds from formamide under exposure to accelerated ions at different temperatures.
- To continue the research on the catalysts participating in the synthesis of complex prebiotic compounds from formamide.
- To process data (electronic microscopy and energy dispersive spectrometry images) for preparing an illustrated atlas of microfossils in carbonaceous chondrites.
- To complete the preparation of an astrobiology textbook

List of projects:

	Project	Leader	Priority (period of realisation)
1.	Research on cosmic matter on 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 (2013-2022)

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	A.K. Rymin, A.N. Afanasyeva	
2.	**Research on the synthesis of complex prebiotic compounds from formamide**	**R. Saladino**	Data taking Realization Simulation
	LRB	M.I. Kapralov, E.A. Saprykin	
3.	**Biogeochemical and biological studies of cosmic dust**	**V.A. Tselmovich**	Data taking Realization Simulation
4.	**Cosmic matter research with nuclear physics methods**	**V.N. Shvetsov (FLNP)**	Data taking Realization Simulation
	FLNP	I. Zinicovscaia, 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
	Iasi	UAIC

Russia	Borok	IPE RAS
	Gatchina	NRC KI PNPI
	Moscow	IGEM RAS
		IKI RAS
		MSU
		PIN RAS
		SAI MSU
	Novosibirsk	BIC SB RAS
United Kingdom	Buckingham	UB
USA	Athens, AL	ASU

04-2-1132-2017/2022		Priority:	1
		Status:	In-progress

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

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

Participating countries and international organizations:
Belgium, China, Czech Republic, India, Moldova, Poland, Romania, Russia, South Africa, USA.

Issues addressed and main goals of research:
Mdico-biological and clinical research for the proton radiotherapy of cancer patients. Formation of an experimental data base in the field of radiation mutagenesis in the animal germ cells.

Expected results in the current year:
- Evaluation of the effectiveness of the conducted radiation treatment of different neoplasms.
- Work to increase the functional capability of the developed 3D treatment planning software.
- Design and construction of the prototype equipment for the dynamic conformal irradiation of deep-seated tumours with the proton beam.
- Development and improvement of detectors and tools for the clinical dosimetry of the medical hadron beams.
- Continuation of research to determine forms of fibroblast cell death depending on the dose of ionizing radiation.
- Study of mechanisms of functional and neurochemical disorders in the central nervous system under the action of radiation with different linear energy transfer.
- Mastering of new methodes for evaluation of the effectiveness of the cytotoxic action of nanoparticles on tumour cells.
- Continuation of the molecular analysis of gamma- and neutron-induced intragenic structural changes in germline cells.
- Continuation of the sequence analysis of inherited DAN changes at the genome level of the offspring.
- Continuation of the work on the analysis of the transcriptome in somatic cells differing in radiosensitivity.
- Assessment of radioresistance of D.melanogaster strains and human cell line HEK293 expressing DSUP protein (gamma rays, protons, heavy ions)/
- Transcriptome analysis of D.melanogaster strains and human cell line HEK293 expressing Dsup protein.
- Study of distribution GEP-Dsup fusion protein on D.melanogater polytene chromosomes.
- Develop a project of specialized isochronous cyclotron for proton therapy.
- Measure the magnetic field of the MC1 bending magnet for the transport line of the AIC-144, Krakow, Poland.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	Further development of methods, technologies, schedule modes and delivery of radiotherapy	G.V. Mitsyn K.Sh. Voskanyan	1 (2017-2022)
2.	RADIOGENE: Molecular genetics of radiation-induced changes at the gene, genome and transcriptome level in Drosophila melanogaster	I.D. Alexandrov	1 (2017-2022)
3.	Study of the radioprotective properties of the Damage supressor (Dsup) protein on a model organism D.melanogaster and human cell culture HEK293	E.V. Kravchenko	1 (2021-2022)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1.	**Further development of methods, technologies, schedule modes and delivery of radiotherapy**	**G.V. Mitsyn** **K.Sh. Voskanyan**	R&D
	DLNP	A.V. Agapov, O.V. Belov, I.V. Alexandrova, K. Belokopytova, G.V. Donskaya, V.N. Gaevsky, Ye.I. Luchin, I.I. Klochkov, I. Khosenova, I.Ye. Miller, A.G. Molokanov, S.A. Pisareva, A.V. Rzyanina, K.N. Shipulin, S.V. Shvidky, M.A. Tseytlina	
2.	**RADIOGENE: Molecular genetics of radiation-induced changes at the gene, genome and transcriptome level in Drosophila melanogaster**	**I.D. Alexandrov**	R&D
	DLNP	M.V. Alexandrova, K.P. Afanasyeva, N.E. Kharchenko, S.V. Korablinova, L.N. Korovina, N.V. Orlova, A.N. Rusakovich, O.P. Solodilova	
3.	**Study of the radioprotective properties of the Damage supressor (Dsup) protein on a model organism D.melanogaster and human cell culture HEK293**	**E.V. Kravchenko**	R&D
	DLNP	A.E. Ivanova, O.A. Kuldoshina, A.V.Rzyanina, A.S. Yakunenko, M.P. Zarubin	
4.	**Development of methods and programs for creating cyclotron-type accelerators. Development and upgrade of cyclotrons for medical application**	**G.A. Karamysheva**	Realization
	DLNP	K.S. Bunyatov, A.F. Chesnov, S.B. Fedorenko, R.V. Galkin, A.L. Gibinsky, S.V. Gursky, S.N. Dolya, G.G. Kazakova, O.V. Karamyshev, I.N. Kiyan, O.E. Lepkina, O.V. Lomakina, I.V. Lyapin, V.A. Malinin, D.S. Petrov, D.V. Popov, G.D. Shirkov, S.G. Shirkov, V.L. Smirnov, A.S. Vorozhtsov, S.B. Vorozhtsov	
	LIT	I.V. Amirhanov, T.V. Karamysheva	

Collaboration

Country or International Organization	City	Institute or laboratory
Belgium	Louvain-la-Neuve	IBA
China	Hefei	IPP CAS

Czech Republic	Prague	ADVACAM
		PTC
	Rez	UJV
Moldova	Chisinau	MSU
Poland	Krakow	NINP PAS
	Otwock (Swierk)	NCBJ
	Poznan	GPCC
Romania	Bucharest	IFIN-HH
Russia	Dubna	RDH-9
	Moscow	DMS RAS
		FMBC
		IBMP RAS
		VIGG RAS
	Rostov-on-Don	SFedU
South Africa	Somerset West	iThemba LABS
USA	Lansing, MI	IONETIX

04-2-1126-2015/2023

Priority:	1

Status: Extended

Novel Semiconductor Detectors for Fundamental and Applied Research

Leader: G.A. Shelkov
Deputy: V.A. Rozhkov

Participating countries and international organizations:

Belarus, CERN, Canada, Croatia, Czech Republic, Cuba, Egypt, Germany, Italy, Israel, New Zealand, Poland, Romania, Russia, South Africa, Switzerland, Ukraine, United Kingdom, USA, Vietnam

Issues addressed and main goals of research:

Conducting scientific and methodological studies of semiconductor detectors with increased radiation resistance, as well as high-resolution hybrid matrix detectors for high-energy physics and the atomic nucleus.
Development of infrastructure for studies of the properties of semiconductor detectors, including particle beam tests for use by JINR groups and institutes of the participating countries.
Development of scientific cooperation with research institutes to study the possibility of using the developed detectors in other fields of science and technology (primarily in the field of healthcare and mining).
The study of the formation of defects in materials as a result of various physical influences.
Extension of the existing "experimental" base of PAS.
Creation of facilities and experiments on accelerators to obtain new information to verify theoretical ideas in the processes of strong, weak and electromagnetic interactions of elementary particles and light nuclei at intermediate energies.
Creating a setup for carrying out measurements with test electron beams.

Expected results in the current year:

- Together with physicists from Tomsk, the creation of radiation-resistant modifications of GaAs, including the measurement of their radiation resistance in neutron and electron beams at JINR;
- Creating a prototype module of a compact radiation-resistant electromagnetic calorimeter in conjunction with the FCAL collaboration.
- Development of prototype detectors, electronics based on FPGA and software for Timepix4.
- Development of a prototype and software for the “head” tomograph.
- Organization of collaboration with biophysicists of the Moscow Institute of Physics and Technology and Moscow State University using the MARS microtomograph.
- Completion of the ordering system of the monochromatic positron beam and the commissioning of the PALS spectrometer on a monochromatic positron beam.
- Testing the method of ion etching on the created etching system and applying it to study thin-film multilayer materials.
- Conducting experiments with Active Target (GDH)
- Commissioning of LINAC-200

List of projects:

	Project	Leader	Priority (period of realisation)
1.	Novel semiconductor detectors for fundamental and applied research	G.A. Shelkov V.A. Rozhkov	1 (2015-2023)
2.	Development of experimental techniques and applied research with slow monochromatic positron beams (PAS)	A.G. Kobets K. Siemek Scientific leader I.N. Meshkov	1 (2016-2023)
3.	GDH&SPASCHARM	Yu. Usov A. Kovalik	1 (2011-2022)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR	Leaders Main researchers	Status
1.	**Project "Novel semiconductor detectors for fundamental and applied research"**	**G.A. Shelkov** **V.A. Rozhkov**	Realization
	DLNP	E.A. Cherepanova, A. Gongadze, M.I. Gostkin, .A. Kozhevnikov, .K. Kuznetsov, A.V. Lapkin, A. Leyva, S.Yu. Porokhovoy, D.D. Rostorguev, T.O. Rudenko, S. Shakur, P.I. Smolyansky, A.S. Zhemchugov	
	FLNR	S. Mitrofanov, A.T. Isatov, Yu.G. Teterev	
	FLNP	Yu.N. Kopach, A.A. Ahmedov, D.A. Telezhniko	
2.	**Project "Development of experimental techniques and applied research with slow monochromatic positron beams (PAS)"**	**A.G. Kobets** **K. Semek** **I.N. Meshkov**	Realization
	DLNP	E.V. Akhmanova, A.A. Sidorin, L.V. Soboleva, O.S. Orlov, V.I. Hilinov, A.Yu. Rudakov, S.L.Yakovenko	
	FLNR	F.V. Skuratov	
	FLNP	M. Kulik	
	VBLHEP	V.V. Kobets	
3.	**GDH&SPASCHARM Project**	**Yu. Usov** **A. Kovalik**	Data taking Data processing
	DLNP	N.S. Borisov, N.A. Bazhanov, A.S. Dolzhenkov, A.N. Fedorov, I.V. Gapienko, I.S. Gorodnov, V.A. Kashevarov, A.B. Lazarev, A.B. Neganov, Yu.A. Plis, A.B. Sadovsky	
	FLN	S.B. Gerasimov, S.S. Kamalov	
4.	**Construction of the setup for measurements with electron testbeams in DLNP (LINAC-200)**	**A.G. Kobets** **M.I. Gostkin** **G.D. Shirkov**	Realization
	DLNP	E. Acosta, V.Yu. Baranov, A.E. Brukva, J.A. Budagov, Yu.I. Davydov, A.S. Dyatlov, D.V. Demin, N.I. Garanzha, K.I. Gritsay, V.V. Glagolev, V.D. Korovyakov, A.V. Krasnoperov, A.A. Nozdrin, I.N. Polyakova, S.Yu. Porokhovoy, Ya.A. Samofalova, A.V. Skrypnik, A.G. Sorokin, V.G. Shabratov, D.S. Shokin, R.V. Timonin, A.N. Trifonov, K.E. Yunenko, A.S. Zhemchugov	
	UC	D.S. Belozerov, K.B. Gikal, M.A. Nozdrin, K.A. Verlamov, D.A. Zlydenny	

Collaboration

Country or International Organization	City	Institute or laboratory
Canada	Halifax	SMU
	Regina	U of R
	Sackville	MAU
CERN	Geneva	CERN
Croatia	Zagreb	RBI
Cuba	Havana	CEADEN
Czech Republic	Prague	CTU
Egypt	Cairo	NRRA
	New Borg El-Arab	E-JUST
Germany	Bochum	RUB
	Bonn	UniBonn
	Giessen	JLU
	Hamburg	DESY
	Mainz	JGU
	Zeuthen	DESY
Israel	Jerusalem	HUJI
Italy	Pavia	INFN
Japan	Tsukuba	KEK
New Zealand	Christchurch	UC
Poland	Krakow	AGH
		NINP PAS
Romania	Magurele	ISS
Russia	Arkhangelsk	NArFU
	Belgorod	BelSU
	Dubna	Dubna State Univ.
	Moscow	ITEP
		MSU
		NNRU "MEPhI"
	Moscow, Troitsk	INR RAS
	Protvino	IHEP
	St. Petersburg	NWRSCC
		SPbSPU
	Tomsk	TPU
South Africa	Somerset West	iThemba LABS
Switzerland	Basel	Uni Basel
Ukraine	Kharkov	IERT NASU
		NSC KIPT
United Kingdom	Edinburgh	Univ.
	London	QMUL
	York	Univ.
USA	Amherst, MA	UMass
	Kent, OH	KSU
	Los Angeles, CA	UCLA
	Seattle, WA	UW

Networking, Computing, Computational Physics (05)

05-6-1118-2014/2023		Priority:	1
		Status:	In-progress

Information and Computing Infrastructure of JINR

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

Participating Countries and International organizations:

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

Issues addressed and main goals of research:

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

Expected main results in the current year:

- Provision of the stable and safe operation of the JINR local network infrastructure and external telecommunication channels (backbone network (2x100 Gbps); transport network of the NICA megaproject (4x100 Gbps); LIT mesh network (100 Gbps); backbone telecommunication channels (3x100 Gbps); Wi-Fi network at the JINR sites) to ensure reliable data exchange between the Institute's subdivisions, the JINR Member States and international organizations collaborating with JINR.

  Provision of the full-scale and optimal operation of the guaranteed power supply and climate control systems of the MICC computing infrastructure. Implementation of the project on a new fire safety system of the MICC infrastructure.

  Expansion of the performance and the storage system of the MICC basic grid component, i.e. the Tier1 center of the CMS experiment at JINR: processor capacities up to 240 kHS06, dCache storage systems on disks up to 11 PB.

  Enlargement of the computing resources and data storage systems as part of the Tier2/CICC integral component: processor capacities up to 130 kHS06, disk storages up to 6 PB.

  Transition to new system software: job batch processing system and job schedulers, i.e. HTCondor and Slurm.

  Maintenance of the unified system of access to the CVMFS software.

  Support and updates of grid middleware. Support of the operation of WLCG virtual organizations, the NICA experiments and local user groups on the MICC Tier1 and Tier2 resources. Provision of virtual organization services for the NICA experiments and local user groups.

  Expansion of the capacity of the general distributed data storage and access system based on the EOS file system at the JINR MICC up to 30 PB. Support of user work with the EOS system at LIT and other JINR subdivisions.

  Commissioning of the cloud service for scientific and engineering calculations (http://saas.jinr.ru) with a set of applications to study Josephson nanojunctions. Creation of a computing environment prototype for the neutrino experiments, i.e. a neutrino platform. Development of a cloud platform for data analysis and management within the international environmental monitoring and forecasting program. Development of a multifunctional platform and a mobile application for detecting plant diseases on the basis of the cloud infrastructure. Enlargement of the computing part of the MICC cloud component up to 2400 CPU cores and 12 TB of RAM. Increase of the total volume of the ceph-based cloud storage up to 2 PB and the write speed by adding an SSD cache pool. Expansion of the capacity of the JINR cloud due to the resources acquired by the experiments Baikal-GVD, JUNO, NOvA/DUNE and their maintenance. Development of

the distributed information and computing platform based on DIRAC, which integrates cloud resources of the JINR Member States' organizations.

Extension of the computing resources and the hierarchical data storage and processing system of the "Govorun" supercomputer in accordance with the Seven-Year Plan for the development of JINR.

Development of a "computing system on demand" technology for users of the "Govorun" supercomputer based on the mechanism of user application containerization, which will allow one, based on user-defined parameters, to allocate the required number of computing nodes and create a temporary data storage with the required volume and input/output speed under the management of the corresponding file system (NFS, Lustre, EOS, etc.). Development of a system for managing containers with user applications. Stage-by-stage introduction of the hierarchical storage system of the "Govorun" supercomputer into the MICC general data storage and processing system.

Creation of a prototype of the MICC unified resource management system optimizing the efficiency of using computing and storage resources.

Implementation of the system for monitoring the operability and performance of the resources integrated in DIRAC. Integration of new computing and storage resources.

Expansion of the functions of the MICC monitoring system by including the control of the external engineering infrastructure parameters in monitoring: diesel generators, cooling towers, external and internal elements of the cooling system and uninterruptible power supply systems. Development of systems for monitoring and accounting the resources of the "Govorun" supercomputer.

- Development and maintenance of the electronic document system EDS "Dubna", the project management system APT EVM for NICA, the systems ADB2, ISS, "Document Base", HR LHEP at the request of end users and in accordance with the developed concept of the cloud SaaS platform of the unified administrative and business information system. Maintenance of the JINR Information System for Scientific Certification (ISSC). Modernization of the scientific database of the JINR Personal Information System (PIN).

  Continuation of work on the transition from 1C MEM to 1C ERP 2.4. Consultation and support for users of information systems based on 1C. Work on the current maintenance, system refinement and user support. Creation of mobile systems for theme management. Continuation of work on enhancing the performance and reliability of the system by optimizing the code used, analyzing long requests, arising locks in the database, as well as by increasing the performance of servers and reallocating the functional performed on them.

  Development of the institutional repository of scientific publications based on the Invenio JOIN2 software platform: enrichment and improvement of metadata quality; development of user services; support of normative records.

  Maintenance of the libraries of JINRLIB programs and CERNLIB mathematical programs (MATHLIB). Study of the possibility of integrating modern high-level languages (Python, C#) with Fortran for their use of libraries written in Fortran (CERNLIB, JINRLIB).

  Development and maintenance of central information servers, portals and databases for information support and software of the LIT and JINR activity: improvement of the presentation and information update on the website of the JINR Dissertation Councils; maintenance and development of services of the "Visit Centre" portal; modernization and administration of the website of the PEPAN and PEPAN Letters journals; development, creation and support of websites of conferences, symposia at the request of the laboratories and other JINR subdivisions; organization of websites of JINR subdivisions and conferences in a hosting mode.

  Development of the ecosystem based on the HybriLIT platform for the tasks of machine and deep learning, which allows one to develop neural network models, to conduct their training and provide inference on different computing architectures for the tasks of the NICA project. Development of an information system that provides storage and access to experimental data and their analysis on the basis of machine learning methods for the tasks of radiation biology.

  Support of the HLIT-VDI service, which allows platform users to use application packages with an advanced graphics interface, such as Mathematica, Matlab, COMSOL Multiphysics, FLUKA, etc., in their research.

Implementation and support of the "My Account" service for users of the HybriLIT platform, which contains information on work in the system, the statistics on the use of the platform resources, etc.

- Organization and holding of special courses and tutorials on novel HPC technologies, technologies and tools for solving applied problems on the basis of machine and deep learning methods for the Institute's staff, students and young scientists from the JINR Member States within practices organized by the UC, as well as within conferences and schools organized by JINR. Holding of special courses and tutorials in the JINR Member States in accordance with international cooperation programs. Organization of specialized courses on training IT specialists to solve problems related to data processing and analysis for megascience experiments, including the NICA project.

  Holding of schools on artificial intelligence and quantum computing. Creation of a laboratory of intelligent robotics for the development of cognitive control systems on the basis of the NICA accelerator complex and in other JINR laboratories. Development of a laboratory workshop on robotics.

List of projects:

	Project	Leader	Priority (period of realisation)
1.	MICC	V.V. Korenkov	1 (2017-2023)

List of Activities

	Activity or Experiment Laboratory or other Division of JINR	Leaders Main researchers
1.	**MICC Project**	**V.V. Korenkov** **A.G. Dolbilov** **V.V. Mitsyn** **T.A. Strizh**
	LIT	Gh. Adam, Eu.I. Aleksandrov, I.N. Aleksandrov, K.N. Angelov, A.S. Baginyan, A.I. Balandin, N.A. Balashov, A.V. Baranov, S.D. Belov, D.V. Belyakov, A.S. Bondyakov, Yu.A. Butenko, A.I. Churin, S.V. Chashchin, S.V. Gavrilov, A.P. Gavrish, V.V. Galaktionov, T.M. Goloskokova, A.O. Golunov, E.N. Grafova, Eu.A. Grafov, N.I. Gromova, A.E. Gushchin, I.S. Kadochnikov, A.S. Kamensky, V.A. Kapitonov, I.A. Kashunin, A.O. Kondratiev, G.A. Korobova, E.Yu. Kulpin, N.A. Kutovskiy, A.A. Lavrentiev, S.B. Marchenko, D.M. Marov, M.A. Matveev, Ye. Mazhitova, S.V. Mitsyn, A.V. Nechaevsky, D.A. Oleynik, G.A. Ososkov, I.S. Pelevanyuk, A.Sh. Petrosyan, M.S. Plyashkevich, D.V. Podgainy, L.A. Popov, D.I. Pryakhina, Ya.I. Rozenberg, T.F. Sapozhnikova, R.N. Semenov, M.L. Shishmakov, I.A. Sokolov, O.I. Streltsova, V.V. Trofimov, N.N. Voitishin, A.S. Vorontsov, A.V. Uzhinskiy, A.Yu. Zakomoldin, P.V. Zrelov, M.I. Zuev
	VBLHEP	Yu.K. Potrebenikov, Yu.P. Minaev, O.V. Rogachevsky, B.G. Shchinov, S.V. Shmatov, A.N. Moshkin, K.V. Gertsenberger
	FLNP	G.A. Sukhomlinov
	LRB	V.N. Chausov
	FLNR	V.V. Sorokoumov, A.G. Polyakov
	DLNP	Yu.P. Ivanov
	BLTP	A.A. Sazonov, Yu.M. Shukrinov, I.R. Rahmonov, K.V. Kulikov
	UC	I.N. Semeniushkin

2.	**Information and software support of the research-and-production activity at JINR**	**P.V. Zrelov** **V.V. Korenkov** **I.A. Filozova**
	LIT	N.A. Balashov, A.V. Baranov, D.V. Belyakov, N.A. Davyudova, S.V. Duchits, V.P. Gerdt, T.M. Goloskokova, D.S. Golub, N.V. Jerusalimova, L.A. Kalmykova, A.A. Karlov, D.V. Kekelidze, D.I. Koshlan, S.A. Kretova, S.V. Kunyaev, G.A. Kurmaeva, N.A. Kutovskiy, A.A. Kutovskaya, O.G. Melnikova, G.G. Musulmanbekov, S.A. Nechitailo, E.A. Paschenko, M.S. Plyashkevich, L.V. Popkova, A.V. Prikhodko, V.M. Pushkina, E.Yu. Razinkova, A.M. Raportirenko, A.P. Sapozhnikov, T.F. Sapozhnikova, S.V. Semashko, R.N. Semenov, A.V. Sheyko, G.V. Shestakova, D.B. Stankus, T.S. Syresina, N.N. Vorobieva, V.M. Yagafarova, A.G. Zaikina, T.N. Zaikina
	SOICO	A.S. Sorin, V.F. Borisovskiy
	VBLHEP	Yu.K. Potrebenikov, A.V. Philippov, K.V. Turusina
3.	**Development of the system for training and retraining of IT specialists based on the JINR MICC and its educational components**	**V.V. Korenkov** **T.A. Strizh** **O.I. Streltsova**
	LIT	N.A. Balashov, A.V. Baranov, S.D. Belov, V.V. Galaktionov, T.M. Goloskokova, N.I. Gromova, O.V. Ivantsova, I.S. Kadochnikov, D.V. Kekelidze, M.H. Kirakosyan, K.V. Koshelev, N.A. Kutovskiy, V.V. Mitsyn, S.V. Mitsyn, I.K. Nekrasova, A.V. Nechaevsky, D.A. Oleynik, A.Sh. Petrosyan, D.V. Podgainy, A.G. Reshetnikov, T.F. Sapozhnikova, R.N. Semenov, Sh.G. Torosyan,V.V. Trofimov, S.V. Ulyanov, A.V. Uzhinskiy, M.I. Zuev
	UC	S.Z. Pakuliak

Collaboration

Country or International Organization	**City**	**Institute or laboratory**
Armenia	Yerevan	IIAP NAS RA
Azerbaijan	Baku	ADA
		IP ANAS
Belarus	Minsk	BSTU
		INP BSU
		JIPNR-Sosny NASB
		UIIP NASB
Bulgaria	Sofia	INRNE BAS
		SU
CERN	Geneva	CERN
China	Beijing	IHEP CAS
Czech Republic	Prague	IP CAS
Egypt	Giza	CU
France	Marseille	CPPM
Georgia	Tbilisi	GRENA
		GTU
		TSU
Germany	Darmstadt	GSI
	Frankfurt/Main	Univ.
	Hamburg	DESY
	Karlsruhe	KIT

	Zeuthen	DESY
Italy	Bologna	INFN
Kazakhstan	Almaty	INP
	Nur-Sultan	BA INP
		NU
Moldova	Chisinau	IAP
		IMCS
		RENAM
Mongolia	Ulaanbaatar	NUM
Poland	Krakow	CYFRONET
Romania	Bucharest	IFIN-HH
	Cluj-Napoca	INCDTIM
	Magurele	IFA
Russia	Chernogolovka	LITP RAS
		SCC IPCP RAS
	Dubna	Dubna State Univ.
		SCC "Dubna"
		SEZ "Dubna"
	Gatchina	NRC KI PNPI
	Moscow	FRC IM RAS
		IITP RAS
		ISP RAS
		ITEP
		KIAM RAS
		MPEI
		MSK-IX
		MSU
		NRC KI
		PRUE
		RCC MSU
		RSCC
		SINP MSU
	Moscow, Troitsk	INR RAS
	Nizhny Novgorod	UNN
	Novosibirsk	BINP SB RAS
	Pereslavl-Zalesskiy	PSI RAS
	Protvino	IHEP
	Puschino	IMPB RAS
	Samara	SU
	St. Petersburg	FIP
		ITMO Univ.
		SPbSPU
		SPbSU
	Vladikavkaz	NOSU
Slovakia	Kosice	IEP SAS
	Presov	PU
South Africa	Cape Town	UCT
Sweden	Lund	LU
Taiwan	Taipei	ASGCCA
Ukraine	Kharkov	NSC KIPT
	Kiev	BITP NASU
USA	Arlington, TX	UTA
	Batavia, IL	Fermilab
	Upton, NY	BNL

05-6-1119-2014/2023		Priority:	1
		Status:	In-progress

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

Leaders: Gh. Adam
P.V. Zrelov

Deputies: J. Busa
O. Chuluunbaatar

Participating Countries and International organizations:

Armenia, Belarus, Brazil, Bulgaria, Canada, CERN, China, Czech Republic, France, Georgia, Germany, Hungary, Israel, Italy, Japan, Kazakhstan, Lithuania, Moldova, Mongolia, Poland, Romania, Russia, Slovakia, South Africa, Switzerland, Tajikistan, United Kingdom, USA, Vietnam.

Issues addressed and main goals of research:

Carrying out paramount advanced research in computational mathematics and physics, directed to the creation of new mathematical methods, algorithms, and software for the numerical or symbolic-numerical solution of topics arising in experimental and theoretical physics studies. This subject area includes a wide spectrum of investigations approved for completion in JINR within the seven year period 2017–2023 in high energy physics, nuclear physics, physics of condensed matter and of nanostructures, biophysics, information technologies, the solution of which is inseparable from the use of computing. Such subject matters of the outmost importance in JINR are the NICA project, the neutrino program, the superheavy and exotic nuclei physics, the neutron based investigations. The needed numerical or symbolic-numerical computing will be done on the Multifunctional Information and Computing Complex (MICC), primarily the HybriLIT heterogeneous computing platform which involves the training and test cluster HybriLIT and the "Govorun" supercomputer and the emerging Big Data distributed infrastructure. The research teams include both experienced scientists with outstanding scientific achievements and enthusiastic young scientists and engineers. The requested financing will cover salaries, participations in scientific conferences, scientific visits and the acquisition of a minimal number of personal computers and licenses, within the approved resources for LIT-JINR. A distinctive feature of this research is the close cooperation of the Laboratory of Information Technologies (LIT) with research groups from all JINR laboratories and Member State institutions.

Expected main results in the current year:

- Three-dimensional computer simulation of superconducting magnets for the NICA (JINR) and FAIR (GSI) projects. Construction of maps of the magnetic field distributions in the working areas of the magnets with a view to their further application to simulate physical processes.

  Solution of non-standard magnetostatics problems arising due to ROT asymmetry in the fission of heavy nuclei.

  COMSOL Multiphysics based development of a comprehensive model of an isochronous cyclotron.

  Development of a mathematical model and calculation of beam dynamics in isochronous cyclotrons based on the use of equations of motion.

  Mathematical modeling of magnetic fields in the study of polarization phenomena and spin effects.

  Generalization of the Nambu–Jona-Lasinio model with Polyakov loop enabling analysis of available experimental data on the collision of heavy ions at the NICA energy range.

  Modeling radiation induced changes in structures with defects in the framework of the molecular dynamics method.

  Numerical simulation of effects produced by double femtosecond laser pulses on targets of various compositions.

  Numerical modeling of magnetization reversal in nanomagnetic materials using the chirping effect.

  Computer modeling of quantum solids with dislocations exhibiting superfluid properties.

Investigation of nuclear physics processes within the hybrid microscopic potential using various density models of colliding nuclei.

Numerical study of the structure of phospholipid membranes in vesicular systems based on small-angle neutron and x-ray scattering data.

Development of robust numerical methods for the study of complex processes in layered Josephson structures and systems of superconducting spintronics.

Numerical study of particle-like solutions in multidimensional models of field theory; investigation of solitary waves in condensed matter systems.

Numerical investigation of the essential characteristics of electromagnetic cascade showers in the energy range $E \geq 10^{15}$ eV.

Search for black-hole-, wormhole- and soliton-like solutions from a self-consistent system of Einstein-Maxwell-Dirac equations.

Upgrade of the SAS primary processing program for the YuMO spectrometer to include anisotropic pattern scattering samples at the position-sensitive detector.

Extension of the FITTER program by increasing the number of theoretical models, improving its performance and GPU interface for experimental data processing.

Development of an extrapolation method within the basic element method (BEM) on non-uniform three-point grids for data processing and the numerical solution of ordinary differential equation problems.

Further BEM application for the processing and analysis of neutron noise of the IBR-2M reactor.

BEM use for the approximation of the dependence of the energy losses of charged particles in the ionization chamber (STAR experiment).

Implementation of Bayesian automatic adaptive quadrature with two interpolatory rules.

Modeling the interaction of electrons with a grating in a free-electron laser of Smith-Purcell type.

Development of methods of extracting the mass spectrum of neutron stars from the comparison of the observations of surface temperature of pulsars with the simulation results of their cooling evolution.

Modeling heavy-ion fragmentation within the combined transport – statistical approach.

Numerical analysis of crystal fields in magnetic rare-earth systems using quantum chemistry methods.

Numerical study of electron scattering through a multiple corrugated graphene structure.

- Tuning of FTF and QGS models of Geant4 for charmed particle production.

Simulation and analysis of nucleus-nucleus interactions at the NICA energy range in the Geant4 FTF and QGS hadronic models.

Further extension of the Monte-Carlo generator of heavy-ion collisions, DCM-SMM, with features asked by the NICA projects.

Use of DCM-SMM for the mass simulation of events for BM@N, SRC and MPD and participation in data analysis within the experiments conducted at these facilities.

Development of detector alignment algorithms for the Time-Projection Chamber of the MPD central barrel.

Further contribution to the development of the complex of databases for the CBM, BM@N and MPD experiments.

Development and implementation of algorithms for data modeling and reconstruction at the BM@N track detectors.

FAIRRoot and Geant4 Monte-Carlo simulation of the experiments with the OLVE-HERO detector prototype during its testing at the SPS accelerator at CERN.

Development of methods and algorithms for identifying the distribution of events with hadronic and electromagnetic showers from arrival directions of cosmic rays recorded by the NUCLEON satellite experiment.

Support for the ATLAS experiment software: development and maintenance of the configuration and management of ATLAS TDAQ, EventIndex for future RUN3, the CREST data format and the CREST client library.

Development of methods for evaluating the characteristics of the Cathode Strip Chambers with updated electronics in the CMS experiment.

Development of models, methods, algorithms and software for the selection of rare processes in the CBM experiment.

- Development of methods and algorithms for machine and deep learning, as well as algorithms based on computer vision for automating the analysis of data from radiobiological studies of laboratory animals and radiobiological experiments.

Development of efficient scalable algorithms based on the neural network approach for reconstructing multiple tracks in high-energy physics experiments, including for the NICA megaproject.

Optimization of the most time-consuming parts of the algorithms used for event modeling and reconstruction in the NICA experiments using high-performance computing techniques such as OpenMP, MPI, CUDA/OpenCL.

Application of machine learning methods for the simulation and analysis of the properties of linear structures in the mass distribution of nuclear reaction products.

Further development of machine and deep learning methods and algorithms for predicting the state of the environment and detecting plant diseases.

Development and implementation of hybrid FEM-BEM algorithms for solving complex nonlinear magnetostatic problems with high-aspect ratio geometries within the COMSOL Multiphysics package.

Development and application of the parallel method of asynchronous differential evolution and other minimization algorithms for the study of multi-parameter models of nuclear physics and condensed matter physics.

Development of methods and software for the high-performance solution of multi-parameter physical models described by systems of nonlinear differential equations (including superconducting processes in Josephson structures and gas-hydrodynamic processes in porous media).

Development and implementation of parallel algorithms and programs for the molecular dynamics modeling of structures with defects on the HybriLIT platform.

Adaptation of the ROOT toolkit designed for the most plausible fitting and modeling of the expected distribution of events in physical analysis for the GPU component of the HybriLIT platform.

Completion of the implementation of the parallel package for heavy-ion collisions on the HybriLIT platform and its inclusion in the JINRLIB library.

Development of parallel algorithms on large-scale random matrices.

Solution of multi-physical problems in the accelerator design, dosimetry and radiation safety.

Development of parallel algorithms and program modules for the high-accuracy solution of nonlinear magnetostatics problems by means of higher-order discontinuous and two-level domain decomposition methods.

Optimization of the parameterization of superdense nuclear matter models in the simulation of heavy-ion collisions and in astrophysical applications.

Use of minimal information entropy as a criterion for selecting a code for an iterative process of decoding low-density parity-check (LDPC) codes.

Development of minimax optimization computational schemes for calculating the relativistic energies of the ground and excited states of single-electron homonuclear superheavy dimers and trimmers.

Numerical simulation of Compton double ionization of helium atoms near the threshold.

Study of the possibility of using Fortran library programs (from JINRLIB, CERNLIB) by modern programming languages (Python, C#).

Development of a prototype of an intelligent monitoring system for distributed computing systems for streaming data (computer infrastructure, data transmission networks, information security).

Application of methods and techniques of machine learning and artificial intelligence for the optimization of the functioning and security of distributed computing for physical experiments.

Development of algorithms for modeling, reconstruction and classification/identification of events, as well as of approaches and methods for the intelligent monitoring of detectors of physical experiments on hybrid systems.

Selection and implementation of a business analytics solution for a heterogeneous computing environment that allows solving the problems of analysis and visualization of the results of physical experiments, monitoring systems and other applications.

Application of the created methods and algorithms of Big Data Analytics for the solution of relevant applied problems from other fields of science, socio-economic research included.

- Analysis of errors caused by the hardware of 5-qubit IBM quantum computers on examples of quantum teleportation of the Bell states.

Development of quantum algorithms for Tensor Networks contractions with the aim at modeling phase transitions in Lattice QCD.

Calculation of non-classicality indicators of low-dimensional quantum systems based on the negativity of the Wigner functions.

Comparative analysis of the separability/entanglement probability with non-classicality indicators for low-dimensional quantum systems.

Application of the method of evolutionary Bogolyubov equations in quantum field theory to the description of open low-dimensional quantum systems.

Development and implementation of algorithms for studying entanglement in models of quantum systems based on unitary representations of wreath products of finite groups.

Development and implementation of new efficient algorithms for investigating and solving systems of nonlinear algebraic equations based on the use of GRID environment resources and on the construction of a new involutive division of monomials.

Development of new finite element schemes enabling collective nuclear spectra estimates.

Derivation of functional equations for 5- and 6-point one-loop Feynman integrals with massive particles.

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** LIT	**Gh. Adam** **J. Busa** **I.V. Puzynin** S. Adam, P.G. Akishin, I.V. Amirkhanov, P.Kh. Atanasova, A.S. Ayriyan, E.A. Ayrjan, I.V. Barashenkov, M.V. Bashashin, A.A. Bogolubskaya, I.L. Bogolubsky, A.M. Chervyakov, N.D. Dikoussar, H. Grigorian, M. Kakenov, Yu.L. Kalinovsky, T.V. Karamysheva, D.S. Kulyabov, K.V. Lukyanov, N.V. Makhaldiani, T.I. Mikhailova, E.G. Nikonov, K. Oganesyan, D.V. Podgainy, R.V. Polyakova, T.P. Puzynina, V.S. Rikhvitsky, B. Saha, N.R. Sarkar, I. Sarkhadov, S.I. Serdyukova, Z.A. Sharipov, N.Yu.

		Shirikova, A.G. Soloviev, T.M. Solovieva, O.I. Streltsova, L.A. Syurakshina, Z.K. Tukhliev, O.O. Voskresenskaya, R.M. Yamaleev, E.P. Yukalova, O.I. Yuldashev, M.B. Yuldasheva, E.V. Zemlyanaya
	VBLHEP	G.N. Agakishiev, A.Yu. Boytsov, E.E. Donets, H.G. Khodzhibagiyan, A.D. Kovalenko, V.P.Ladygin, E.E. Perepelkin
	BLTP	D.E. Alvarez-Castillo, D. Blaschke, A.V. Friesen, M. Hnatič, R.V. Jolos, A.S. Khvorostukhin, E.E. Kolomeitsev, V.K. Lukyanov, R.G. Nazmitdinov, V.V. Papoyan, A.B. Pestov, L.A. Sevastyanov, V.D. Toneev, V.V. Voronov, D.N. Voskresensky, V.I.Yukalov, V.Yu. Yushankhai
	FLNR	A.G. Artukh, B. Erdemchimeg, R.A. Rymzhanov, Yu.M. Sereda, V.A. Skuratov
	FLNP	E.B. Askerov, O.I. Ivankov, A.I. Kuklin, V.V. Novitsky, Yu.N. Pepelyshev
	DLNP	G.A. Karamysheva, O.V. Karamyshev, I.N. Kiyan, V.A. Malinin, D.V. Popov, G.T. Torosyan
2.	**Software complexes and mathematical methods for processing and analysis of experimental data**	**P.V. Zrelov** **V.V. Ivanov**
	LIT	E.P. Akishina, E.I. Aleksandrov, I.N. Aleksandrov, D.A. Baranov, O.Yu. Derenovskaya, I.A. Filozova, Val.V. Ivanov, A.I. Kazymov, B.F. Kostenko, M.A. Mineev, G.J. Musulmanbekov, V.V. Palichik, R.V. Polozov, V.S. Rikhvitsky, T.F. Sapozhnikova, I. Satyshev, V.N. Shigaev, S.K. Slepnev, A.N. Sosnin, V.V. Uzhinsky, N.N. Voitishin, A.V. Yakovlev, V.B. Zlokazov
	VBLHEP	P.N. Batyuk, B.V. Batyunya, A.V. Bychkov, D.K. Dryablov, A.S. Galoyan, K.V. Gertsenberger, I.A. Golutvin, N.V. Gorbunov, A.Yu. Kamenev, M.N. Kapishin, V.Yu. Karzhavin, V.V. Lenivenko, A.M. Makan'kin, S.P. Merts, A.N. Morozov, M. Patsyuk, V.V. Perelygin, Yu.P. Petukhov, S.V. Razin, O.V. Rogachevsky, M.M. Rumyantsev, S.S. Shimansky, S.V. Shmatov, V.N. Spaskov, A.V. Zarubin, V. Zhezher
	BLTP	R.G. Nazmitdinov, V.D. Toneev
	FLNR	Yu.S. Tsyganov, V.K. Utenkov
	FLNP	A.M. Balagurov, A.V. Belushkin, D.P. Kozlenko, S.A. Manoshin
	DLNP	I.V. Bednyakov, V.A. Bednyakov, I.A. Belolaptikov, V.B. Brudanin, V.M. Grebenyuk, A.G. Olshevsky, A.E. Pan, D.B. Pontecorvo, B.A., F.V. Prokoshin, B.A. Shaibonov, L.G. Tkatchev
	UC	S.Z. Pakulyak

3.	**Numerical methods, algorithms and software for multicore and hybrid architectures and Big Data analytics**	**Gh. Adam** **O. Chuluunbaatar** **P.V. Zrelov** **V.V. Korenkov** **O.I. Streltsova**
	LIT	P.Kh. Atanasova, A.S. Ayriyan, D.R. Badreeva, D.A. Baranov, M.V. Bashashin, S.D. Belov, D.V. Belyakov, J.Busa, J. Buša Jr., Yu.A. Butenko, A.M. Chervyakov, G. Chuluunbaatar, O. Chuluunbaatar, P.V. Goncharov, H. Grigorian, A.A. Gusev, J.N. ogly Javazade, I.S. Kadochnikov, M. Kakenov, Yu.L. Kalinosky, M.A. Matveev, A.V. Nechaevsky, G.A. Ososkov, V.V. Papoyan, D.V. Podgainy, L.V. Popkova, T.P. Puzynina, A.A. Sapozhnikov, T.F. Sapozhnikova, R.N. Semenov, Z.A. Sharipov, T.M. Solovieva, A.V. Stadnik, Z.K. Tukhliev, A.V. Uzhinsky, A.V. Volokhova, O.I. Yuldashev, M.B. Yuldasheva, E.V. Zemlyanaya, E.I. Zhabitskaya, M.I. Zuev
	LIT-MICC	V.V. Mitsyn, T.A. Strizh
	FLNR	R. Kabytayeva, S.V. Mitrofanov, Yu.Ts. Oganesyan, Yu.V. Pyatkov
	BLTP	Yu. B. Ivanov, S. Liebing, K.A. Maslov, R.G. Nazmitdinov, Yu.V. Popov, I.R. Rakhmonov, Yu.M. Shukrinov, S.I. Vinitsky
	VBLHEP	A.Yu. Boytsov, E.E. Donets, O.V. Rogachevsky
	DLNP	G.A. Karamysheva, G.D. Shirkov, A.S. Zhemchugov
	FLNP	M.V. Frontaseva, M.F. Kiselev, N. Kucherka
	LRB	I.M. Enyagina, I.A. Kolesnikova
4.	**Methods, algorithms and software of computer algebra and quantum computing**	**V.P. Gerdt**
	LIT	N. Abbasly, V. Abgaryan, M. Bures, O. Chuluunbaatar, A.A. Gusev, A.M. Khvedelidze, V.V. Kornyak, Yu. Palii, A.M. Raportirenko, I.A. Rogozhin, O.V. Tarasov, A.G. Torosyan, D.A. Yanovich
	BLTP	P. Fiziev, S.N. Nedelko, A. I. Titov, S.I. Vinitsky, V.I. Yukalov
	VBLHEP	O.V. Rogachevsky
	LRB	A.V. Czhizhov

Collaboration

Country or International Organization	City	Institute or laboratory
Armenia	Yerevan	Foundation ANSL IIAP NAS RA RAU YSU

Belarus	Brest	BrSU
	Gomel	GSTU
	Minsk	IM NASB
Brazil	Sao Carlos, SP	IFSC USP
Bulgaria	Plovdiv	PU
	Sofia	IMI BAS
		INRNE BAS
		SU
Canada	Toronto	IBM Lab
	Vancouver	UBC
CERN	Geneva	CERN
China	Beijing	IHEP CAS
Czech Republic	Prague	CTU
France	Marseille	UPC
	Nancy	UL
	Saclay	IRFU
Georgia	Tbilisi	GTU
		TSU
		UG
Germany	Berlin	MBI
	Bonn	UniBonn
	Darmstadt	GSI
	Dresden	IFW
	Frankfurt/Main	Univ.
	Giessen	JLU
	Hamburg	Univ.
	Heidelberg	MPIK
	Karlsruhe	KIT
	Kassel	Uni Kassel
	Munich	LMU
	Rostock	Univ.
Hungary	Budapest	Wigner RCP
Israel	Rehovot	WIS
	Tel Aviv	TAU
Italy	Bari	UniBa
	Catania	INFN LNS
	Genova	INFN
Japan	Saitama	SU
Kazakhstan	Almaty	INP
Lithuania	Kaunas	VMU
Moldova	Chisinau	IAP
Mongolia	Ulaanbaatar	IMDT MAS
Poland	Krakow	NINP PAS
	Lublin	UMCS
	Otwock (Swierk)	NCBJ
	Wroclaw	UW
Romania	Bucharest	IFIN-HH
		UB
	Cluj-Napoca	INCDTIM
	Magurele	IFA
		ISS
	Timisoara	UVT
Russia	Dubna	Dubna State Univ.
	Gatchina	NRC KI PNPI

	Irkutsk	ISU
	Moscow	GPI RAS
		ITEP
		JIHT RAS
		MRSU
		MSU
		NNRU "MEPhI"
		PFUR
		RCC MSU
		SINP MSU
	Moscow, Troitsk	INR RAS
	Perm	PSNRU
	Puschino	IMPB RAS
	Saratov	SSU
	St. Petersburg	NIIEFA
		SPbSU
	Tomsk	TSU
Slovakia	Banska Bistrica	UMB
	Kosice	IEP SAS
		TUKE
		UPJS
South Africa	Cape Town	UCT
	Port Elizabeth	NMU
	Stellenbosch	SU
Switzerland	Zurich	ETH
Tajikistan	Dushanbe	PHTI NAST
		TNU
	Khujand	KSU
United Kingdom	London	Imperial College
	Oxford	Univ.
	Plymouth	Univ.
USA	Arlington, TX	UTA
	Cambridge, MA	MIT
	College Station, TX	Texas A&M
	Davis, CA	UCDavis
	Denton, TX	UNT
	Los Angeles, CA	UCLA
	Newport News, VA	JLab
	San Diego, CA	SDSU
	Upton, NY	BNL
Vietnam	Hanoi	VNU

05-8-1037-2001/2024		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: A.S. Sorin

Participating Countries and International organizations:

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

Issues addressed and main goals of research:

Development of analytical materials concerning prospects of scientific research. Preparation of scientific research plans. Development of science-organization and methodological materials for the special-purpose financing of research areas, themes and projects. Development and application of information systems for the analysis of results of theoretical and experimental research. Organization of international cooperation with the Member States of JINR, with states participating in JINR activities on the basis of bilateral agreements, and with scientific research institutions with which JINR has collaboration agreements.

Expected results in the current year:

- Improvement of the organization and coordination of JINR scientific research work.
- Analysis of the results of JINR activities for 2020 in the main research areas.
- Update, administration and support of the electronic system for maintaining the Topical Plan for JINR Research and International Cooperation (Topical Plan). Preparation for the publication of the Topical Plan for the year 2022. Identification of JINR’s priority research directions for 2022.
- Development of JINR’s grantmaking activities and participation in special-purpose programmes for financing scientific research in 2021.
- Preparation of analytical materials for ministries and agencies.
- Development and promotion of JINR’s information resources on the Internet. Support of the system of accounting of protocols on scientific and technological cooperation.
- Promotion of realization of JINR’s right to independently confer academic degrees. Support of the operation of JINR’s dissertational councils.
- Preparation for the publication of the JINR Annual Report for 2020. Preparation of materials for the INIS system.
- Scientific and organizational support and preparation of materials of JINR’s governing and advisory bodies.
- Prompt interaction with representatives of Member States and states participating in the activities of JINR on the basis of bilateral agreements in the fields of scientific research. Organization and holding of meetings of cooperation committees. Interaction with international organizations.

- Organization and holding of contests for JINR Prizes, preparation of materials for nominating candidates for memberships in academies of sciences, for conferring honorary titles, for awarding medals and other decorations.

List of Activities

	Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers
1.	**Preparation for the publication of the Topical Plan for 2021**	**A.S. Sorin** **O.V. Belov**
	SOD	N.I. Sissakian, N.A. Boklagova, D.S. Korobov
2.	**Support and improvement of the operation of JINR's governing and advisory bodies**	**A.S. Sorin** **O.V. Belov** **D.V. Kamanin**
	SOD	N.I. Sissakian, T.B. Ivashkevich, O.K. Kronshtadtov, D.S. Korobov
	ICD	A.A. Kotova, N.M. Dokalenko, E.N. Rusakovich, O.N. Belova, O.M. Korotchik
	ICC	M.N. Sidorchuk
	HS	M.D. Kryukova
	STD AMIS	V.F. Borisovsky
3.	**Preparation of analytical materials for ministries and agencies**	**A.S. Sorin** **O.V. Belov** **D.V. Kamanin**
	SOD	N.I. Sissakian, D.S. Korobov, T.B. Ivashkevich, N.A. Boklagova
	ICD	A.A. Kotova, A.E. Vasiliev
	STL	E.V. Ivanova, V.V. Litsitis
4.	**Development of JINR's grantmaking activities and participation in special-purpose programmes for financing scientific research**	**A.S. Sorin** **O.V. Belov** **D.V. Kamanin**
	SOD	N.I. Sissakian, N.A. Boklagova, D.S. Korobov
5.	**Support for the operation of JINR's dissertation councils**	**A.S. Sorin** **O.V. Belov**
	SOD	N.I. Sissakian, T.B. Ivashkevich
6.	**Organizational support for JINR's activities under Russian and international protocols and agreements**	**A.S. Sorin** **D.V. Kamanin** **O.V. Belov**
	SOD	N.I. Sissakian, L.I. Kalinina
	ICD	A.A. Kotova, T.V. Keselis
7.	**Provision for the operation and development of JINR's Internet resources**	**A.S. Sorin** **O.V. Belov** **D.V. Kamanin**
	SOD	N.I. Sissakian, K.P. Moisenz, A.G. Nanev, N.A. Boklagova, O.K. Kronshtadtov, D.S. Korobov

STD AMIS	V.F. Borisovsky
SID	B.M. Starchenko
Editorial office of the weekly newspaper "Dubna: science, community, progress"	E.M. Molchanov
8. Preparation for the publication of JINR Annual Reports. Preparation of materials for the INIS system	**A.S. Sorin**
SID	B.M. Starchenko, Yu.G. Shimanskaya, S.N. Kruglova
9. International cooperation	**D.V. Kamanin** **W. Chmielowski**
ICD	A.A. Kotova, M.G. Loschilov, A.E. Vasiliev, O.N. Belova, T.V. Keselis, Yu.N. Polyakova

Educational Programme (06)

06-0-1139-2019/2023		Priority:	1
		Status:	In-progress

Organization, Support and Development of the JINR Human Resources Programme

Leaders: V.A. Matveev
S.Z. Pakuliak

Participating Countries and International organizations:

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

Issues addressed and main goals of research:

Development and implementation of the human resources training programmes at JINR aimed at further employment of the trainees as scientific and engineering specialists of the Institute; creation of appropriate conditions for students and PhD students from universities of the Member States to enable them to work on their qualification theses based on the research conducted in the laboratories of the Institute; support of the educational process for students of the JINR-based departments at universities of the Russian Federation, as well as development of network training programmes; organization and running of international student practices and schools for young people from the JINR Member States; training of students, PhD students, and interns on the basis of cooperation agreements with universities of the JINR Member States and international organisations; building and maintenance of laboratory environment intended for hands-on training in accelerator physics, radio-electronics and nuclear physics; support and development of a system of training courses aimed at gaining or improving professional skills and qualifications of JINR technical and engineering personnel; development of the JINR outreach programme and promotion of modern science achievements among school students and teachers, organisation of excursions and online tours of the JINR basic facilities; further development of the JINR educational portal (edu.jinr.ru), development of a set of e-learning courses on the main areas of research conducted at JINR in the official languages of the Institute and by its leading experts; development of virtual and real laboratories allowing students to be trained using modern experimental equipment; participation in science festivals and exhibitions promoting JINR.

Expected major results in the current year:

- Support and supervision of the educational process at the JINR-based departments of Russian universities.
- Support of the system of assigning young researchers to JINR laboratories for preparation of their PhD theses without mastering the academic programmes of the PhD course.
- Organisation and running of the International Student Practices in JINR Fields of Research for students of JINR Member States' universities. Development and management of online student programmes.
- Expansion of the scientific scope and duration of research projects of the Summer Student Programme at JINR and increasing the number of participants in this programme.
- Development of the training facilities, including test-benches and sets of laboratory works, for the needs and tasks of the UC-based Scientific-Engineering Group.
- Organisation of JINR-based internship for participants in the International School of Engineering of Dubna State University.
- Organisation of scientific schools for physics teachers from the Institute Member States at CERN and JINR.
- Launch of virtual tours of JINR and video-conferences with educational institutions of the Member States.

- Development of a set of e-learning cources in nuclear physics, particle physics, condensed matter physics, and JINR basic facilities.

- Promotion of modern educational resources in the JINR Member States.

- Organisation of JINR participation in the Science Festival "NAUKA 0+ 2020" on the basis of Russian universities.

- Development of the language courses programme aimed at teaching Russian, English, French, and German to JINR personnel.

- Participation of JINR in an interdisciplinary social educational project "Summer School 2020".

List of projects:

	Project	Leader	Priority (period of realisation)
1.	Open information and educational environment for supporting fundamental and applied multidisciplinary research at JINR	Yu.A. Panebrattsev	1 (2021-2023)

List of Activities

	Activity or experiment Laboratory or other Division of JINR	Leaders Main researchers
1.	**Organization of the Educational Process at JINR**	**V.A. Matveev** **S.Z. Pakuliak**
	DLNP V.A. Bednyakov D.V. Naumov A.S. Zhemchugov	A.Yu. Verkheev, A.G. Olshevskiy, V.V.Glagolev
	BLTP D.I. Kazakov A.P. Isaev A.B. Arbuzov	A.V. Gladyshev, Yu.M. Shukrinov
	FLNP V.N. Shvetsov E.V. Lychagin O.A. Culikov	D.P. Kozlenko, A.M. Balagurov, A.V. Belushkin
	VBLHEP N.A. Strokovsky, V.D. Kekelidze D.V. Peshekhonov	V.A. Nikitin, S.S. Shimansky, N.I. Zimin
	FLNR S.N. Dmitriev A.V. Karpov A.G. Popeko	S.I. Sidorchuk S.G. Belogurov
	LIT V.V. Korenkov T.A. Strizh D.V. Podgaynyi	V.P. Gerdt, I.S. Pelevanyuk
	LRB E.A. Krasavin I.V. Koshlan	G.N. Timoshenko
	Directorate B.Yu. Sharkov B.N. Gikal	A.V. Dudarev, E.D. Uglov
	SOICO A.S. Sorin	W. Chmielowski

	D.V. Kamanin A.A. Kotova	
2.	**Developing of modern educational projects**	**Y.A. Panebrattsev**
	VBLHEP	G.N. Agakishiev, V.V. Belaga, N.I. Vorontsova, E.I. Golubeva, R.V. Klygina, M.P. Osmachko, Yu.D. Orlova, N.E. Sidorov, G.D. Semchukov, G.A. Yarygin
3.	**Outreach and JINR promotion**	**S.Z. Pakuliak** **A.A. Suzhevich**
	DLNP	N.V. Anfimov, A.Yu. Verkheev, Ch.T. Kullenberg, M.V. Fomina, M.V. Shirchenko
	BLTP	A.V. Frizen
	FLNP	C. Khramko
	VBLHEP	A.S. Bogomolova, D.K. Dryablov, D.I. Klimansky, Ch. Roslon
	FLNR	K.B. Gikal, A.A. Voinov
	LIT	I.S. Pelevanyuk, Sh.G. Torosyan
	LRB	T.S. Bulanova, I.A. Kolesnikova, Yu.S. Severyukhin
	Universal JINR library	O.V. Gaponova

Collaboration

Country or International Organization	City	Institute or laboratory
Armenia	Yerevan	YSU
Azerbaijan	Baku	IP ANAS
Belarus	Gomel	GSU
	Minsk	BSTU
		BSU
		INP BSU
		ISEI BSU
		ME RB
Bulgaria	Blagoevgrad	SWU
	Sofia	INRNE BAS
		NRA
		SU
CERN	Geneva	CERN
Cuba	Havana	ASC
Czech Republic	Prague	CTU
		CU
Kazakhstan	Almaty	KazNU
	Nur-Sultan	ENU
	Ust-Kamenogorsk	EKSU
Moldova	Chisinau	ASM
Mongolia	Ulaanbaatar	MNUE
		NUM
Poland	Krakow	NINP PAS
	Lodz	UL
	Poznan	AMU

Romania	Bucharest	UB
Russia	Arkhangelsk	NArFU
		NSMU
	Belgorod	BelSU
	Dolgoprudny	MIPT
	Dubna	BSINP MSU
		Dubna State Univ.
	Ivanovo	ISU
	Kazan	KFU
	Kostroma	KSU
	Krasnodar	KSU
	Moscow	MPEI
		NNRU "MEPhI"
		SINP MSU
	Smolensk	SSU
	St. Petersburg	SPbSU
	Tomsk	TPU
	Tula	TSU
	Tver	TvSU
	Vladikavkaz	NOSU
	Voronezh	VSU
	Yakutsk	NEFU
Serbia	Belgrade	INS "VINCA"
	Novi Sad	UNS
	Sremska Kamenica	Educons Univ.
Slovakia	Bratislava	CU
	Kosice	STM
		UPJS
South Africa	Somerset West	iThemba LABS
	Stellenbosch	SU
Ukraine	Kiev	BITP NASU
		NUK
USA	Upton, NY	BNL
Vietnam	Da Lat	DLU
		NRI
	Hanoi	IOP VAST

Alphabetical List of Collaborators

Albania

Tirana

UT | University of Tirana | http://www.unitir.edu.al/, 1128

Argentina

Bariloche

CAB CNEA | Bariloche Atomic Centre National Atomic Energy Commission | http://www.cab.cnea.gov.ar/, 1143, 1140

Buenos Aires

CNEA | National Atomic Energy Commission | https://www.argentina.gob.ar/comision-nacional-de-energia-atomica/, 1135

Armenia

Garni

GGO | Garni Geophysical Observatory, 1127

Gyumri

IGES NAS RA | Institute of Geophysics and Engineering Seismology named after A. Nazarov | http://iges.am/, 1127

Yerevan

Foundation ANSL | A.I.Alikhanian National Science Laboratory Yerevan Physics Institute Foundation | http://www.yerphi.am/, 1135, 1137, 1138, 1081, 1083, 1065, 1087, 1088, 1142, 1143, 1133, 1119

IIAP NAS RA | Institute for Informatics and Automation Problems of the National Academy of Sciences of the Republic of Armenia | http://iiap.sci.am/, 1137, 1118, 1119

RAU | Russian-Armenian University | http://www.rau.am/, 1135, 1136, 1119

Shirak Technologies | “Shirac” Technological Company | http://www.shte.net/, 1127

YSU | Yerevan State University | http://www.ysu.am/, 1136, 1137, 1138, 1117, 1065, 1087, 1107, 1077, 1119, 1139

Australia

Melbourne

Univ. | University of Melbourne | http://unimelb.edu.au/, 1137, 1128

Perth

UWA | University of Western Australia | http://www.uwa.edu.au/, 1138

Sydney

Univ. | University of Sydney | http://sydney.edu.au/, 1137, 1138, 1107

Austria

Innsbruck

Univ. | University of Innsbruck | http://www.uibk.ac.at/, 1136, 1128

Linz

JKU | Johannes Kepler University Linz | http://www.jku.at/, 1137

Vienna

HEPHY | Institute of High Energy Physics | http://www.hephy.at/, 1083

ITP TU Wien | Institute for Theoretical Physics Vienna University of Technology | http://www.itp.tuwien.ac.at/, 1117

SMI | Stefan Meyer Institute for Subatomic Physics of the Austrian Academy of Sciences | https://www.oeaw.ac.at/smi/home/, 1088

TU Wien | Vienna University of Technology | http://www.tuwien.at/, 1137, 1117

Azerbaijan

Baku

ADA | Azerbaijan Diplomatic Academy | https://www.ada.edu.az/, 1118

AzTU | Azerbaijan Technical University | http://aztu.edu.az/, 1142

Branch MSU | Branch of the Lomonosov Moscow State University | http://www.msu.az/, 1137

BSU | Baku State University | http://bsu.edu.az/, 1135, 1128

IGG ANAS | Institute of Geology and Geophysics of the Azerbaijan National Academy of Sciences | http://gia.az/, 1128

IP ANAS | Institute of Physics of the Azerbaijan National Academy of Sciences | http://physics.mehdiyev.me/, 1135, 1081, 1142, 1118, 1139

IRP ANAS | Institute of Radiation Problems of the Azerbaijan National Academy of Sciences | http://irp.science.az/, 1066, 1100, 1128, 1105

NNRC | National Nuclear Research Center | http://www.mntm.az/, 1065, 1088, 1105

Bangladesh

Dhaka

DU | University of Dhaka | http://www.univdhaka.edu/, 1088

Belarus

Brest

BrSU | Brest State A.S.Pushkin University | http://www.brsu.by/, 1119

Gomel

GSTU | Pavel Sukhoi State Technical University of Gomel | http://www.gstu.by/, 1135, 1117, 1081, 1086, 1119

GSU | Francisk Skorina Gomel State University | http://gsu.by/, 1135, 1081, 1083, 1086, 1131, 1139

MPRI NASB | V.A.Belyi Metal Polymer Research Institute of the National Academy of Sciences of Belarus | http://mpri.org.by/, 1131

Minsk

“Radateh” | “Radateh” Ltd. | http://www.radateh.com/, 1086

BSTU | Belarusian State Technological University | http://www.belstu.by/, 1137, 1142, 1143, 1140, 1118, 1139

BSU | Belarusian State University | http://www.bsu.by/, 1135, 1144, 1141, 1131, 1139
BSUIR | Belarusian State University of Informatics and Radioelectronics | http://www.bsuir.by/, 1086, 1065, 1133
IAP NASB | State Scientific Institution “Institute of Applied Physics of the National Academy of Sciences of Belarus | http://iaph.bas-net.by/, 1081, 1086, 1142
IBCE NASB | Institute of Biophysics and Cell Engineering NAS of Belarus | http://ibp.org.by/ru/, 1077
IM NASB | Institute of Mathematics of the National Academy of Sciences of Belarus | http://im.bas-net.by/, 1119
INP BSU | Institute for Nuclear Problems of Belarusian State University | http://www.new.inp.bsu.by/, 1135, 1123, 1081, 1144, 1108, 1096, 1083, 1086, 1065, 1127, 1107, 1128, 1143, 1118, 1139
Inst. Physiology NASB | Institute of Physiology of the National Academy of Sciences of Belarus | http://physiology.by/, 1077
IP NASB | B.I.Stepanov Institute of Physics of the National Academy of Sciences of Belarus | http://ifan.basnet.by/, 1135, 1136, 1137, 1081, 1144, 1086, 1065
ISEI BSU | International Sakharov Environmental Institute of the Belarusian State University | http://www.iseu.bsu.by/, 1107, 1139
JIPNR-Sosny NASB | State Scientific Institution "Joint Institute for Power and Nuclear Research - Sosny" of the National Academy of Sciences of Belarus | http://sosny.bas-net.by/, 1135, 1137, 1081, 1065, 1107, 1105, 1118
ME RB | Ministry of Education of the Republic of Belarus | http://edu.gov.by/, 1139
PTI NASB | Physical Technical Institute of the National Academy of Sciences of Belarus | http://www.phti.by/, 1065
RI PCP BSU | Research Institute for Physical Chemical Problems of the Belarusian State University | http://fhp.bsu.by/, 1107, 1142
RINPh BSU | Research Institute for Nuclear Physics of the Belarusian State University | http://new.inp.bsu.by/), 1142
SOL instruments | SOL instruments LTd. | http://solinstruments.com/, 1133
SPMRC NASB | Scientific and Practical Materials Research Centre of the National Academy of Sciences of Belarus | http://www.physics.by/, 1137, 1065, 1128, 1142, 1077
UCP MES | University of Civil Protection of the Ministry for Emergency Situations of the Republic of Belarus | http://ucp.by/), 1137
UIIP NASB | United Institute of Informatics Problems of the National Academy of Sciences of Belarus | http://www.uiip.bas-net.by/, 1118

Belgium

Antwerp

UAntwerp | University of Antwerp | http://www.uantwerpen.be/, 1083

Brussels

ULB | Université Libre de Bruxelles | http://www.ulb.ac.be/ VUB | Vrije Universiteit Brussel | http://www.ulb.be/, 1083, 1130
VUB | Vrije Universiteit Brussel | http://www.vub.ac.be/, 1136, 1083

Ghent

Ugent | Ghent University | http://www.ugent.be/, 1083

Leuven

KU Leuven | Catholic University of Leuven | http://www.kuleuven.be/, 1083, 1129, 1130

Louvain-la-Neuve

IBA | Ion Beam Applications | http://iba-worldwide.com/ UCL | Catholic University of Louvain | http://uclouvain.be/, 1132
UCL | Catholic University of Louvain | http://uclouvain.be/, 1136, 1137, 1096, 1083

Mons

UMONS | University of Mons | http://web.umons.ac.be/, 1083

Brazil

Brasilia, DF

UnB | University of Brasilia | http://www.unb.br/, 1137

Campinas, SP

UNICAMP | State University at Campinas | http://www.unicamp.br/, 1088

Florianopolis, SC

UFSC | Federal University of Santa Catarina | http://ufsc.br/, 1136

Juiz de Fora, MG

UFJF | Federal University of Juiz de Fora | http://www2.ufjf.br/, 1138

Natal, RN

IIP UFRN | International Institute of Physics of the Federal University of Rio Grande do Norte | http://www.iip.ufrn.br/, 1137

Niteroi, RJ

UFF | Federal Fluminense University | http://www.uff.br/, 1136

Porto Alegre, RS

UFRGS | Federal University of Rio Grande de Sul | http://www.ufrgs.br/, 1088

Rio de Janeiro, RJ

CBPF | Brazilian Center for Physics Research | http://portal.cbpf.br/, 1083
UERJ | State University of Rio de Janeiro | http://www.uerj.br/, 1083

Santo Andre, SP

UFABC | University Federal of ABC | http://www.ufabc.edu.br/, 1088

Sao Carlos, SP

IFSC USP | Institute of Physics of São Carlos of the University of São Paulo | http://www.ifsc.usp.br/, 1119

Sao Jose dos Campos, SP

ITA | Aeronautics Institute of Technology | http://www.ita.br, 1136

Sao Paulo, SP

UEP | Unit of Professional Education Santa Case de São Paulo | http://www.santacasasp.org.br/), 1136

Unesp | São Paulo State University | http://www2.unesp.br/, 1083

USP | University of São Paulo | http://www5.usp.br/, 1137, 1138, 1117, 1088

Vitoria, ES

UFES | Federal University of Espirito Santo | http://www.ufes.br/, 1138

Bulgaria

Blagoevgrad

AUBG | American University in Bulgaria | http://www.aubg.edu/, 1087

SWU | South-West University "Neofit Rilski" | http://www.swu.bg/, 1096, 1065, 1139

Plovdiv

PU | Plovdiv University "Paisii Hilendarski" | https://uni-plovdiv.bg/, 1137, 1096, 1065, 1100, 1128, 1131, 1119

UFT | University of Food Technologies-Plovdiv | http://uft-plovdiv.bg/, 1128

Sofia

ASCI Ltd | ASCI Ltd | http://www.asci.bg/, 1142

IAPS | Institute for Advanced Physics Studies | http://iaps.institute/, 1088

IE BAS | Academician Emil Djakov Institute of Electronics of the Bulgarian Academy of Sciences | http://www.ie-bas.org.bg/, 1128, 1142, 1077

IEES BAS | Institute of Electrochemistry and Energy Systems "Academic Evgeni Budevski" of the Bulgarian Academy of Sciences | http://iees.bas.bg/, 1142

IMech BAS | Institute of Mechanics of the Bulgarian Academy of Sciences | http://www.imbm.bas.bg/, 1137

IMI BAS | Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences | http://math.bas.bg/, 1119

INRNE BAS | Institute for Nuclear Research and Nuclear Energy of the Bulgarian Academy of Sciences | http://www.inrne.bas.bg/, 1135, 1136, 1137, 1138, 1117, 1083, 1065, 1087, 1066, 1107, 1130, 1100, 1128, 1142, 1143, 1118, 1119, 1139

Inst. Microbiology BAS | Stephan Angeloff Institute of Microbiology of the Bulgarian Academy of Sciences | http://microbio.bas.bg/, 1087, 1077

ISSP BAS | Georgi Nadjakov Institute of Solid State Physics of the Bulgarian Academy of Sciences | http://www.issp.bas.bg/, 1137, 1065, 1142, 1133

LTD BAS | Laboratory for Technical Development of the Bulgarian Academy of Sciences | http://www.pronto.phys.bas.bg/, 1065

NBU | New Bulgarian University | http://www.nbu.bg/, 1136

NCRRP | National Centre of Radiobiology and Radiation Protection | http://ncrrp.org/, 1077

NRA | Nuclear Regulatory Agency | http://www.bnra.bg/, 1139

SU | Sofia University "St. Kliment Ohridski" | http://www.uni-sofia.bg/, 1135, 1137, 1117, 1081, 1144, 1096, 1083, 1065, 1087, 1066, 1118, 1119, 1139

TU-Sofia | Technical University of Sofia | http://tu-sofia.bg/, 1065

UCTM | University of Chemical Technology and Metallurgy | http://dl.uctm.edu/, 1097, 1142

Canada

Corner Brook

MUN | Memorial University of Newfoundland - Grenfell Campus | http://www.grenfell.mun.ca/, 1135

Edmonton

U of A | University of Alberta; Theoretical Physics Institute; Avadh Bhatia Physics Laboratory | http://www.ualberta.ca/, 1138, 1117

Halifax

SMU | Saint Mary's University | http://smu.ca/, 1126

Hamilton, ON

McMaster | McMaster University | http://www.mcmaster.ca/, 1136

Kingston, ON

Queen's | Queen's University | http://www.queensu.ca/, 1137

London, ON

Western | Western University - Canada | http://www.uwo.ca/, 1137

Montreal

Concordia | Concordia University Montreal | http://www.concordia.ca/, 1137, 1138

UdeM | University of Montreal | http://www.umontreal.ca/, 1135, 1117, 1081

Quebec

UL | Laval University | http://www.ulaval.ca/, 1137

Regina

U of R | University of Regina | https://www.uregina.ca/, 1126

Sackville

MAU | Mount Allison University | https://www.mta.ca, 1126

Saskatoon

U of S | University of Saskatchewan | http://www.usask.ca/, 1136

Toronto
IBM Lab | IBM Toronto Software Lab | http://www.ibm.com/, 1119

Vancouver
TRIUMF | Canada's particle accelerator centre | http://www.triumf.ca/, 1081, 1096, 1129
UBC | University of British Columbia | http://www.ubc.ca/, 1096, 1119

Waterloo
WLU | Wilfrid Laurier University | https://www.wlu.ca/, 1136

CERN

Geneva
CERN | European Organization for Nuclear Research (Switzerland) | http://home.cern/), 1135, 1138, 1117, 1123, 1081, 1108, 1096, 1083, 1085, 1065, 1127, 1097, 1087, 1088, 1129, 1130, 1128, 1126, 1118, 1119, 1139

Chile

Valparaiso
UTFSM | Technical University Federico Santa Maria | http://www.usm.cl/, 1096, 1065
UV | University of Valparaiso | http://www.valpo.edu/, 1135

China

Beijing
"Tsinghua" | Tsinghua University | http://www.tsinghua.edu.cn/, 1083, 1065
Beijing Fert Co | Beijing Fert Medical Equipment Technology Co., Ltd. | http://www.china-fert.com/, 1131
CIAE | China Institute of Atomic Energy | http://www.ciae.ac.cn/, 1136, 1087, 1088
IHEP CAS | Institute of High Energy Physics of the Chinese Academy of Sciences | http://www.ihep.ac.cn/, 1123, 1099, 1083, 1065, 1087, 1128, 1118, 1119
ITP CAS | Institute of Theoretical Physics of the Chinese Academy of Sciences | http://english.itp.cas.cn/, 1136
PKU | Peking University | http://www.pku.edu.cn/, 1135, 1136, 1083, 1130, 1131
UCAS | University of Chinese Academy of Sciences | https://english.ucas.edu.cn/, 1065

Hangzhou
ZJU | Zhejiang University | http://www.zju.edu.cn/english/, 1083

Harbin
HEU | Harbin Engineering University | http://www.hrbeu.edu.cn/ , 1142

Hefei
IPP CAS | Institute of Plasma Physics of the Chinese Academy of Sciences | http://english.ipp.cas.cn/, 1065, 1132
USTC | University of Science and Technology of China | http://www.ustc.edu.cn/, 1065, 1088

Hengyang
USC | University of South China | http://english.usc.edu.cn/, 1065

Huzhou
HU | Huzhou University | http://www.zjhu.edu.cn/, 1065

Jinan
SDU | Shandong University | http://en.sdu.edu.cn/, 1065

Lanzhou
IMP CAS | Institute of Modern Physics of the Chinese Academy of Sciences | http://www.imp.cas.cn/, 1135, 1065, 1129, 1130

Shanghai
Fudan | Fudan University | http://www.fudan.edu.cn/, 1065
SINAP CAS | Shanghai Institute of Applied Physics of the Chinese Academy of Sciences | http://english.sinap.cas.cn/, 1065, 1088

Wuhan
CCNU | Central China Normal University; Institute of Particle Physics | http://ioppweb.ccnu.edu.cn/, 1065, 1087, 1088
HBUT | Hubei University of Technology | http://www.hbut.edu.cn/, 1088
WHU | Wuhan University | http://en.whu.edu.cn/, 1117
WIPM CAS | Wuhan Institute of Physics and Mathematics of the Chinese Academy of Sciences | http://english.wipm.cas.cn/, 1135

Xi'an
NINT | Northwest Institute of Nuclear Technology, 1128

Yichang
CTGU | China Three Gorges University | http://eng.ctgu.edu.cn/, 1065

Croatia

Split
Univ. | University of Split | http://www.unist.hr/, 1083, 1088

Zagreb
Oikon IAE Oikon OOO | Oikon Ltd. Institute for Applied Ecology | http://www.oikon.hr/, 1128
RBI | Rudjer Boskovic Institute | http://www.irb.hr/, 1083, 1088, 1128, 1126
UZ | University of Zagreb | http://www.unizg.hr/, 1088

Cuba

Havana
ASC | Academy of Sciences of Cuba | http://www.academiaciencias.cu/, 1139

CEADEN | Centre of Technological Applications and Nuclear Development | http://www.ceaden.cu, 1088, 1131, 1126
InSTEC | Higher Institute of Technologies and Applied Sciences | http://www.instec.cu/, 1133

San Jose de las Lajas

CENTIS | Center of Isotopes "CENTIS" | http://www.centis.cu/, 1077

Cyprus

Nicosia

UCY | University of Cyprus | http://www.ucy.ac.cy/, 1083

Czech Republic

Brno

BUT | Brno University of Technology | http://www.vutbr.cz/, 1085, 1107, 1131
IBP CAS | Institute of Biophysics of the Czech Academy of Sciences | http://www.ibp.cz/, 1077
ISI CAS | Institute of Scientific Instruments of the Czech Academy of Sciences | http://www.isibrno.cz/, 1097

Liberec

TUL | Technical University of Liberec | http://www.tul.cz/, 1085, 1065

Olomouc

UP | Palacky University Olomouc | http://www.upol.cz/, 1137, 1065, 1129, 1130, 1131

Opava

SlU | Silesian University of Opava | http://www.slu.cz/, 1138

Ostrava

UO | University of Ostrava | http://www.osu.eu/, 1128
VSB-TUO | Technical University of Ostrava | http://www.vsb.cz/, 1128

Prague

ADVACAM | ADVACAM s.r.o. | http://advacam.com/, 1132
BC CAS | Biology Centre of the Czech Academy of Sciences | https://www.bc.cas.cz/, 1142
CEI | Czech Environmental Institute | http://www.ceu.cz/, 1128
CTU | Czech Technical University in Prague | http://www.cvut.cz/, 1135, 1138, 1117, 1144, 1086, 1065, 1097, 1087, 1088, 1107, 1130, 1100, 1128, 1142, 1077, 1126, 1119, 1139
CU | Charles University in Prague | http://www.cuni.cz/, 1135, 1136, 1081, 1144, 1099, 1125, 1096, 1083, 1085, 1086, 1065, 1097, 1087, 1066, 1142, 1131, 1139
IG CAS | Institute of Geology of the Czech Academy of Sciences | http://www.gli.cas.cz/, 1142
IMC CAS | Institute of Macromolecular Chemistry of the Czech Academy of Sciences | http://www.irsm.cas.cz/, 1087, 1142
IP CAS | Institute of Physics of the Czech Academy of Sciences | http://www.fzu.cz/, 1135, 1088, 1142, 1118
PTC | Proton Therapy Center Czech s.r.o | http://www.ptc.cz/, 1132
VP | Vacuum PRAGUE | http://www.vakuum.cz/, 1065, 1129, 1130

Rez

NPI CAS | Nuclear Physics Institute of the Czech Academy of Sciences | http://www.ujf.cas.cz/, 1135, 1136, 1137, 1138, 1117, 1106, 1065, 1087, 1066, 1129, 1130, 1100, 1142, 1143, 1140, 1131, 1077
UJV | "ÚJV Řež, a.s." | http://www.ujv.cz/, 1097, 1066, 1088, 1107, 1132

Vitkovice

VHM | Vitkovice Heavy Machinery a.s. | http://www.vitkovice.cz/, 1065

Denmark

Copenhagen

NBI | Niles Bohr Institute of the University of Copenhagen | http://www.nbi.ku.dk/, 1088

Lyngby

DTU | Technical University of Denmark | http://www.dtu.dk/, 1137

Ecuador

Quito

USFQ | University of San Francisco, Quito | http://www.usfq.edu.ec/, 1137

Egypt

Alexandria

Univ. | Alexandria University | http://www.alexu.edu.eg/, 1128

Cairo

ASU | Ain Shams University | http://www.asu.edu.eg/, 1142
EAEA | Egyptian Atomic Energy Authority | http://www.eaea.org.eg/, 1136, 1142
ECTP | Egyptian Center for Theoretical Physics | http://www.mti.edu.eg/, 1065
NRC | National Research Centre | http://www.nrc.sci.eg/, 1128
NRRA | Nuclear and Radiological Regulatory Authority, 1126

Giza

CU | Cairo University | http://cu.edu.eg/, 1136, 1137, 1129, 1130, 1128, 1142, 1133, 1118

Mansoura

MU | Mansoura University | http://www.mans.edu.eg/en/, 1128

New Borg El-Arab

E-JUST | Egypt-Japan University for Science and Technology | https://ejust.edu.eg/, 1126

Shibin El Kom
MU | Menoufia University | http://mu.menoufia.edu.eg/, 1129, 1130, 1128

Estonia

Tallinn
NICPB | National Institute of Chemical Physics and Biophysics | http://www.kbfi.ee/, 1083

Tartu
UT | University of Tartu | http://www.ut.ee/, 1138

Finland

Helsinki
HIP | Helsinki Institute of Physics | http://www.hip.fi/, 1083, 1088
UH | University of Helsinki | http://www.helsinki.fi/, 1135, 1083

Jyvaskyla
UJ | University of Jyväskylä | http://www.jyu.fi/, 1088, 1130, 1100, 1128

Lappeenranta
LUT | Lappeenranta-Lahti University of Technology | https://www.lut.fi/, 1083

Oulu
UO | University of Oulu; Microelectronics Instrumentation Laboratory | http://www.oulu.fi/, 1128

France

Annecy-le-Vieux
LAPP | Laboratory of Annecy-la-Vieux for Particles Physics of the National Institute for Nuclear Physics and Particles Physics of the National Centre for Scientific Research | http://lapp.in2p3.fr/, 1138, 1117

Bordeaux
CENBG | Centre of Nuclear Studies of Bordeaux-Gradignan | http://www.cenbg.in2p3.fr/, 1100
UB | University of Bordeaux | http://www.u-bordeaux.fr/, 1136

Cadarache
CC CEA | Centre de Recherche du Commissariat à l'Energie Atomique et aux Energies Alternatives Cadarache | http://cadarache.cea.fr/cad, 1128

Caen
GANIL | Grand National Heavy Ion Accelerator | http://www.ganil-spiral2.eu/, 1136, 1129, 1130
UNICAEN | University of Caen Normandy | http://www.unicaen.fr/, 1100

Clermont-Ferrand
LPC | Corpuscular Physics Laboratory Clermont-Ferrand of the Blaise Pascal University | http://clrwww.in2p3.fr/, 1081, 1088

Dijon
UB | University of Bourgundy | http://www.u-bourgogne.fr/, 1117

Grenoble
IBS | Institute of Structural Biology | http://www.ibs.fr/, 1142
ILL | Institute Laue-Langevin | http://www.ill.eu/, 1128, 1142, 1140
LPSC | Laboratore de Physique Subatomique et de Cosmologie | http://lpsc.in2p3.fr/, 1088, 1128
UGA | Université Grenoble Alpes | https://www.univ-grenoble-alpes.fr/, 1100

Lyon
ENS Lyon | Ecole Normale Supérieure de Lyon; Physics Laboratory | http://www.ens-lyon.fr/, 1138, 1117
IPNL | Institute of Nuclear Physics of Lyon | http://www.ipnl.in2p3.fr/, 1100
UCBL I | Claude Bernard University Lyon 1 | http://www.univ-lyon1.fr/, 1135
UL | Universite de Lyon | http://www.universite-lyon.fr/, 1083, 1088

Marseille
CPPM | Centre de Physique des Particules de Marselle | http://cpmm.in2p3.fr/, 1118
CPT | Centre of Theoretical Physics | http://www.cpt.univ-mrs.fr/, 1137, 1138, 1117
UPC - III | University Paul Cézanne - Aix-Marseille III | https://www.univ-amu.fr, 1137, 1119

Metz
UPV-M | Paul-Verlaine University of Metz | http://www.univ-metz.fr/, 1135

Modane
LSM | Modane Underground Laboratory | http://www-lsm.in2p3.fr/, 1100

Montpellier
UM2 | University of Montpellier 2 | https://www.umontpellier.fr/, 1135

Nancy
UL | University of Lorraine | http://www.univ-lorraine.fr/, 1119

Nantes
SUBATECH | Subatomic Physics Laboratory and Associated Technologies; UMR/EMN/IN2P3/CNRS/University of Nantes | http://www-subatech.in2p3.fr/, 1138, 1117, 1065, 1066, 1088

Nice
UN | University Nice Sophia Antipolis | http://unice.fr/, 1137

Orsay
CSNSM | Center for Nuclear and Mass Spectrometry-IN2P3/CNRS | http://www.csnsm.in2p3.fr/, 1136, 1130, 1100
IJCLab | Irene Joliot-Curie Lab | https://www.ijclab.in2p3.fr/en/home/, 1088
IPN Orsay - IN2P3/CNRS | Institute of Nuclear Physics Orsay - IN2P3/CNRS | http://ipnwww.in2p3.fr/, 1136, 1106, 1097, 1129, 1130

LAL - 11 - IN2P3/CNRS | Linear Accelerator Laboratory of the University of Paris-Sid 11 - IN2P3/CNRS | http://www.lal.in2p3.fr/, 1081

Paris

ENS | École Normale Supérieure Paris | http://www.ens.fr/, 1138, 1117
IN2P3 | National Institute of Nuclear Physics and Physics Particles | http://www.in2p3.cnrs.fr/, 1144, 1083
LPTHE - IN2P3/CNRS | Laboratory of Theoretical Physics and High Energy of the Pierre et Marie Curie - IN2P3/CNRS | http://lpthe.jussieu.fr/, 1117
LUTH | Laboratory Universe and Theories, Observatory of Paris | http://www.luth.obspm.fr/, 1138
UPMC 6 | Pierre et Marie Curie University Henri Poincaré Institute Paris 6 | https://www.sorbonne-universite.fr/, 1135, 1137

Saclay

CEA | Alternative Energies and Atomic Energy Commission | http://www.cea.fr/, 1065, 1100
IRFU | Institute of Research into the Fundamental Laws of the Universe | http://irfu.cea.fr/, 1135, 1083, 1097, 1088, 1119
LLB | Léon Brillouin Laboratory CEA-CNRS | http://www-llb.cea.fr/, 1128, 1142
SPhN CEA DAPNIA | Nuclear Physics Division of the Commissariat for Atomic Energy | http://irtu.cea.fr/Sphn, 1135, 1085, 1130

Strasbourg

CRN - IN2P3/CNRS | Centre of Nuclear Research - IN2P3/CNRS | http://ireswww.in2p3.fr/, 1099, 1130
IPHC - IN2P3/CNRS | Hubert Curien Multidisciplinary Institute of the University of Strasburg - IN2P3/CNRS | http://www.iphc.cnrs.fr/, 1083, 1088, 1130, 1128

Tours

Univ.| University of Tours | http://www.univ-tours.fr/, 1138

Valenciennes

UVHC | University of Valenciennes and Hainaut-Combrésis | http://www.uphf.fr/, 1137, 1117

Vannes

SigmaPhi | Company SigmaPhi Accelerator Technologies | http://www.sigmaphi.fr/, 1129

Villeurbanne

CC IN2P3 | IN2P3 Computing Center | https://cc.in2p3.fr/, 1088

Georgia

Tbilisi

AIP TSU | Elevter Andronikashvili Institute of Physics of the Ivane Javakhishvili Tbilisi State University | http://www.aiphysics.tsu.ge/, 1065, 1128
GRENA | Georgian Research and Educational Networking Association | http://www.grena.ge/, 1118
GTU | Georgia Technical University | http://gtu.ge/, 1144, 1083, 1065, 1118, 1119
HEPI-TSU | High Energy Physics Institute of Ivane Javakhishvili Tbilisi State University | http://www.hepi.tsu.ge/, 1081, 1144, 1083, 1127
RMI TSU | Andrea Razmadze Mathematical Institute of the Ivane Javakhishvili Tbilisi State University | http://rmi.tsu.ge/, 1135
TSU | Ivane Javakhishvili Tbilisi State University | http://www.tsu.ge/, 1135, 1128, 1118, 1119
UG | University of Georgia | http://www.ug.edu.ge/, 1144, 1119

Germany

Aachen

RWTH | Rheinisch-Westfaelische Technische Aachen University | http://www.rwth-aachen.de/, 1135, 1099, 1083

Berlin

FU Berlin | Free University of Berlin | http://www.fu-berlin.de/, 1135
BAM | Federal Institute for Materials Research and Testing | http://www.bam.de/, 1142
HU Berlin | Humboldt University of Berlin | http://www.hu-berlin.de/, 1135
HZB | Helmholtz Berlin Centre for Materials and Energy of the Helmholtz Association | http://www.helmholtz-berlin.de/, 1136, 1142, 1143, 1140
MBI | Max-Born-Institute in Berlin for Nonlinear Optics and Short Pulse Spectroscopy im Forschungsverbund Berlin e.V. | http://www.mbi-berlin.de/, 1119

Bielefeld

Univ. | Bielefeld University | http://www.uni-bielefeld.de/, 1135, 1136

Bochum

RUB | Ruhr University of Bochum | http://www.ruhr-uni-bochum.de/, 1135, 1085, 1097, 1142, 1126

Bonn

UniBonn | University of Bonn | http://www.uni-bonn.de/, 1135, 1136, 1137, 1138, 1117, 1096, 1085, 1088, 1142, 1126, 1119

Braunschweig

TU | Braunschweig Technical University | http://www.tu-braunschweig.de/, 1137

Bremen

Univ. | University of Bremen | http://www.uni-bremen.de/, 1137

Cologne

Univ. | University of Cologne | http://www.uni-koeln.de/, 1136

Darmstadt

FAIR | Facility for Antiproton and Ion Research | https://fair-center.eu/, 1106, 1097

GSI | Helmholtz-Centre for the Study of Heavy Ions of the Helmholtz Association | http://www.gsi.de/, 1135, 1136, 1137, 1108, 1106, 1065, 1088, 1129, 1130, 1128, 1143, 1131, 1077, 1118, 1119

TU Darmstadt | Technical University Darmstadt | http://www.tu-darmstadt.de/, 1135, 1136, 1137, 1106, 1065, 1087, 1088, 1142

Dortmund

TU Dortmund | Technical University of Dortmund | http://www.uni-dortmund.de/, 1135, 1137

Dresden

HZDR | Helmholtz-Zentrum Dresden-Rossendorf of the Helmholtz Association | http://www.hzdr.de/, 1136, 1106, 1128

IFW | Leibniz Institute for Solid State and Materials Research Dresden | http://www.ifw-dresden.de/, 1137, 1119

ILK | Institute of Air Handling and Refrigeration of the Helmholtz Association | http://www.ilkdresden.de/, 1065

MPI PkS | Max Planck Institute for the Physics of Complex Systems | http://www.mpipks-dresden.mpg.de/, 1137

TU Dresden | Technical University of Dresden | http://tu-dresden.de/, 1137, 1097

Erlangen

FAU | Friedrich Alexander University of Erlangen-Nuremberg | http://www.fau.eu/, 1135, 1136, 1065

Frankfurt/Main

FIAS | Frankfurt Institute for Advanced Studies | http://fias.institute.de/, 1135, 1065, 1087, 1088

Univ. | Goethe University of Frankfurt on Main | http://www.uni-frankfurt.de/, 1136, 1106, 1065, 1087, 1088, 1118, 1119

Freiberg

TUBAF | Technical University Bergakademie of Freiberg | http://tu-freiberg.de/, 1085, 1142

Freiburg

FMF | Albert-Ludwig's University of Freiburg | http://www.uni-freiburg.de/, 1097

Geesthacht

GKSS | Research Center in Geesthacht of the Helmholtz Association | http://www.hzg.de/, 1142

Giessen

JLU | Justus Liebig University Giessen | http://www.uni-giessen.de/, 1136, 1106, 1065, 1126, 1119

Gottingen

Univ. | University of Göttingen | http://www.uni-goettingen.de/, 1142

Halle

MLU | Martin-Luther University of Halle-Wittenberg | http://www.uni-halle.de/, 1142

Hamburg

DESY | Deutsches Elektronen-Synchrotron DESY of the Helmholtz Association | http://www.desy.de/), 1135, 1117, 1123, 1083, 1127, 1142, 1126, 1118

Univ. | University of Hamburg | http://www.uni-hamburg.de/, 1135, 1136, 1099, 1125, 1083, 1119

Hannover

LUH | Leibniz University of Hannover | http://www.uni-hannover.de/, 1138, 1117, 1123

Heidelberg

MPIK | Max Planck Institute for Nuclear Physics | http://www.mpi-hd.mpg.de/, 1129, 1100, 1119

Univ. | University of Heidelberg | http://www.uni-heidelberg.de/, 1135, 1106, 1066, 1088

Jena

Univ. | Friedrich-Schiller University of Jena | http://www.uni-jena.de/, 1135, 1137, 1117

Julich

FZJ | Research Centre Jülich of the Helmholtz Association | http://www.fz-juelich.de/, 1135, 1085, 1065, 1097, 1142, 1143, 1140

Kaiserslautern

TU | Technical University of Kaiserslautern | http://www.uni-kl.de/, 1135

Karlsruhe

KIT | Karlsruhe Institute of Technology | http://www.kit.edu/, 1135, 1083, 1100, 1142, 1118, 1119

Kassel

Uni Kassel | University of Kassel | http://www.uni-kassel.de/, 1119

Kiel

IFM-GEOMAR | GEOMAR Helmholtz Centre for Ocean Research Kiel | http://www.geomar.de/, 1142

Kleve

HSRW | Rhine-Waal University of Applied Sciences | https://www.hochschule-rhein-waal.de/, 1128

Konstanz

Univ. | University of Konstanz | https://www.uni-konstanz.de/, 1142

Leipzig

UoC | University of Leipzig | http://www.uni-leipzig.de/, 1136, 1137, 1138, 1117

Magdeburg

OVGU | Otto-von-Guericke University Magdeburg | http://www.uni-magdeburg.de/, 1137

Mainz

HIM | Helmholtz-Institute Mainz | http://www.hi-mainz.de/, 1135

JGU | Johannes Gutenberg University of Mainz | http://www.uni-mainz.de/, 1135, 1136, 1096, 1085, 1065, 1130, 1100, 1128, 1126

Munich

LMU | Ludwig-Maximilians University of Munich | http://www.uni-muenchen.de/, 1135, 1119

MPI-P | Max Planck Institute for Physics of Munich | http://www.mpp.mpg.de/, 1117, 1081, 1125

TUM | Technical University of Munich | http://portal.mytum.de/, 1106, 1085, 1088, 1100, 1128

Munster

WWU | Westfalische Wilhelms-Universiry (University of Münster) | http://www.uni-muenster.de/, 1088

Oldenburg

IPO | Institute of Physics of the Cari von Ossietzky University of Oldenburg | http://www.uol.de/en/physics/, 1138

Potsdam

AEI | Max Planck Institute for Gravitational Physics Albert Einstein Institute | http://www.aei.mpg.de/, 1138, 1117

Quedlinburg

IST | Ionen Strahl Technologie GmbH | http://www.istechnologie.de/, 1131

MiCryon Technik | MiCryon Technik GmbH | http://www.micryon.de/, 1131

Regensburg

UR | University of Regensburg | http://www.uni-regensburg.de/, 1135, 1136, 1065

Rostock

Univ. | University of Rostock | http://www.uni-rostock.de/, 1135, 1136, 1137, 1117, 1142, 1119

Siegen

Univ. | University of Siegen | http://www.uni-siegen.de/, 1136

Stuttgart

MPI-FKF | Max Planck Institute for Solid State Research | http://www.fkf.mpg.de/, 1142

Tubingen

Univ. | Eberhard Karls University of Tübingen | http://uni-tuebingen.de/, 1135, 1125, 1065, 1097, 1088, 1130, 1128

Worms

ZTT | Center for Technology Transfer and Telecommunications of the University of Worms | https://www.hs-worms.de/, 1088

Wuppertal

UW | University of Wuppertal | http://www.uni-wuppertal.de/, 1135, 1137

Zeuthen

DESY | Deutsches Elektronen-Synchrotron DESY of the Helmholtz Association (Zeuthen) | http://www.desy.de/), 1135, 1117, 1081, 1125, 1126, 1118

Greece

Athens

INP NCSR “Demokritos” | Institute of Nuclear and Particle Physics of the National Centre for Scientific Research “Demokritos” | http://www.inp.demokritos.gr/, 1136, 1083

NTU | National Technical University of Athens | http://www.ntua.gr/, 1083

UoA | National and Kapodistrian University of Athens | http://www.uoa.gr/, 1138, 1117, 1083, 1088

Ioannina

UI | University of Ioannina | http://www.uoi.gr/, 1083

Thessaloniki

AUTH | Aristotle University of Thessaloniki | http://www.auth.gr/, 1138

Hungary

Budapest

ELTE | Eötvös Loránd University | http://www.elte.hu/, 1135

GetGiro Kft | GetGiro IT Limited Liability Company | http://getgiro.com/, 1131

RKK OU | Rejto Sándor Faculty of Light Industry and Environmental Engineering of the Obuda University | http://rkk.uni-obuda.hu/, 1128

Wigner RCP | Institute for Particle and Nuclear Physics, Wigner Research Centre for Physics | http://wigner.mta.hu/, 1135, 1136, 1137, 1117, 1083, 1088, 1142, 1143, 1140, 1119

Debrecen

Atomki | Institute of Nuclear Research of the Hungarian Academy of Science | http://www.atomki.hu/, 1136, 1083

UD | University of Debrecen | http://www.unideb.hu/, 1083

IAEA

Vienna

IAEA | International Atomic Energy Agency | http://www.iaea.org/, 1128

ICTP

Trieste

ICTP | Abdus Salam International Centre for Theoretical Physics Italy | http://www.ictp.it/, 1135, 1138

India

Aligarh

AMU | Aligarh Muslim University | http://www.amu.ac.in/, 1088

Bhubaneswar

IOP Institute of Physics, Bhubaneswar | http://www.iopb.res.in/, 1135, 1088

Chandigarh

PU | Panjab University | http://puchd.ac.in/, 1136, 1083, 1088

Chennai

IMSc | Institute of Mathematical Science (National Institute for Research in the Theoretical Sciences) | http://www.imsc.res.in/, 1135, 1138

Guwahati

GU| Gauhati University | https://guportal.in/, 1088

Indore
IIT Indore | Indian Institute of Technology Indore | https://www.iitsystem.ac.in/, 1088

Jaipur
Univ. | University of Rajasthan | http://www.uniraj.ac.in/, 1087, 1088

Jammu
Univ. | University of Jammu | http://www.jammuuniversity.in/, 1088

Jatani
NISER | National Institute of Science Education and Research of the Department of Atomic Energy | http://www.niser.ac.in/, 1083, 1088

Kasaragod
CUK | Central University of Kerala | http://cukerala.ac.in/, 1136

Kolkata
BNC | S.N.Bose National Centre for Basic Sciences | http://www.bose.res.in/, 1138, 1117, 1088
IACS | Indian Association for the Cultivation of Science | http://www.iacs.res.in/, 1137, 1138
MIERE | Matrivani Institute of Experimental Research and Education, 1085
SINP | Saha Institute of Nuclear Physics | http://www.saha.ac.in/, 1083, 1088
UC | University of Calcutta | http://www.caluniv.ac.in/, 1088
VECC | Variable Energy Cyclotron Centre of the Department of Atomic Energy | http://www.vecc.gov.in/, 1135, 1088, 1130

Mumbai
BARC | Bhabha Atomic Research Centre of the Department of Atomic Energy | http://www.barc.gov.in/, 1083, 1087, 1088
IIT Bombay | Indian Institute of Technology Bombay | https://www.iitsystem.ac.in/, 1088
TIFR | Tata Institute of Fundamental Research | http://www.tifr.res.in/, 1083

New Delhi
IUAC | Inter-University Accelerator Center | http://www.iuac.res.in/, 1136, 1130

Patna
NIT Patna | National Institute of Technology Patna | http://www.nitp.ac.in/, 1142

Roorkee
IIT Roorkee | Indian Institute of Technology Roorkee | https://www.iitr.ac.in/, 1130

Rupnagar
IIT Ropar | Indian Institute of Technology Ropar | http://www.iitrpr.ac.in/, 1130

Varanasi
BHU | Banaras Hindu University | http://www.bhu.ac.in/, 1128

Indonesia

Jakarta
LIPI | Indonesian Institute of Sciences | http://lipi.go.id/, 1088

Iran

Tehran
IPM | Institute for Studies in Theoretical Physics and Mathematics of the Institute for Research Fundamental Sciences | http://www.ipm.ac.ir/, 1138, 1083

Zanjan
IASBS | Institute for Advanced Studies in Basic Sciences | http://iasbs.ac.ir/, 1136, 1137

Ireland

Dublin
DIAS | Dublin Institute for Advanced Studies | http://www.dias.ie/, 1138
UCD | University College Dublin | https://www.ucd.ie/, 1083

Israel

Jerusalem
HUJI | Hebrew University of Jerusaliem | http://www.huji.ac.il/, 1065, 1126

Rehovot
WIS | Weizmann Institute of Science | http://www.weizmann.ac.il/, 1117, 1081, 1119

Tel Aviv
TAU | Tel Aviv University | http://www.tau.ac.il/, 1138, 1085, 1065, 1119

Italy

Alessandria
DiSIT UPO | Department of Science and Technological Innovation of the University of Eastern Piedmont Amedeo Avogadro | https://www.disit.uniupo.it/, 1088

Bari
DIF | Interuniversity Department of Physics | https://www.uniba.it/, 1088
INFN | National Institute for Nuclear Physics, Section of Bari | http://www.ba.infn.it/, 1083, 1088
Poliba | Polytechnic University of Bari | http://www.en.poliba.it/, 1088
UniBa | University of Bari Aldo Moro | http://www.uniba.it/, 1119

Bologna
BRC ENEA | Bologna Research Centre of the Italian National Agency for New Technologies, Energy and the Sustainable Economic Development | http://www.bologna.enea.it/, 1136
INFN | National Institute for Nuclear Physics, Section of Bologna | http://www.bo.infn.it/, 1083, 1088, 1118

UniBo | University of Bologna | http://www.unibo.it/, 1088

Brescia

Forgiatura Morandini | Forgiatura Morandini | http://www.morandini.it/, 1065
UNIBS | University of Brescia | https://en.unibs.it/, 1088

Cagliari

INFN | National Institute for Nuclear Physics, Section of Cagliari | http://www.ca.infn.it/, 1088
UniCa | University of Cagliari | http://www.unica.it/, 1088

Catania

INFN | National Institute for Nuclear Physics, Section of Catania | https://www.ct.infn.it/it/, 1088
INFN LNS | National Institute for Nuclear Physics, National Laboratory of the South | http://www.lns.infn.it/, 1136, 1083, 1130, 1119
UniCT | University of Catania | http://www.unict.it/, 1137, 1088

Erice

EMFCSC | Ettore Majorana Foundation and Centre for Scientific Culture | http://www.ccsem.infn.it/, 1088

Ferrara

INFN | National Institute for Nuclear Physics, Section of Ferrara | http://www.fe.infn.it/, 1096

Fisciano

UNISA | University of Salerno | http://web.unisa.it/, 1137, 1117

Florence

INFN | National Institute for Nuclear Physics, Section of Florence | http://www.fi.infn.it/, 1096, 1083

Foggia

Unifg | University of Foggia | https://www.unifg.it/, 1088

Frascati

INFN LNF, | National Institute for Nuclear Physics, National Laboratory of Frascati | http://www.lnf.infn.it/, 1138, 1117, 1144, 1096, 1083, 1088

Genova

ASG | ASG Superconductors D.p.a. | http://www.as-g.it/ UniGe | University of Genova | http://www.unige.it/, 1065
INFN | National Institute for Nuclear Physics, Section of Genova | http://www.ge.infn.it/, 1083, 1119

Legnaro

INFN LNL | National Institute for Nuclear Physics, Legnaro National Laboratories | http://www.lnl.infn.it/, 1088, 1130

Messina

UniMe | University of Messina | http://www.unime.it/, 1136, 1088, 1130, 1142

Milan

INFN | National Institute for Nuclear Physics, Section of Milan | http://www.mi.infn.it/, 1083
UNIMI | University of Milan | http://www.unimi.it/, 1099

Naples

INFN | National Institute for Nuclear Physics, Section of Naples | http://www.na.infn.it/, 1135, 1136, 1096, 1083
Unina II | University of Naples Federico II | http://www.unina.it/, 1130

Padua

INFN | National Institute for Nuclear Physics, Section of Padua | http://www.pd.infn.it/, 1083, 1088, 1129
UniPd | University of Padua | http://www.unipd.it/, 1135, 1138, 1117, 1088

Pavia

INFN | National Institute for Nuclear Physics, Section of Pavia | http://www.pv.infn.it/, 1135, 1117, 1083, 1126
UniPv | University of Pavia | http://www.unipv.it/, 1088

Perugia

INFN | National Institute for Nuclear Physics, Section of Perugia | http://www.pg.infn.it/, 1136, 1096, 1083

Pisa

INFN | National Institute for Nuclear Physics, Section of Pisa | http://www.pi.infn.it/, 1135, 1138, 1117, 1081, 1096, 1083, 1127
UniPi | University of Pisa | http://www.unipi.it/, 1144

Rome

“Tor Vergata” | University of Rome “Tor Vergata” | http://web.uniroma2.it/, 1096
CREF | Enrico Fermi Center for Study and Research | https://www.cref.it/, 1088
ENEA | Italian National Agency for New Technologies, Energy and Sustainable Economic Development | http://www.enea.it/, 1128
INFN | National Institute for Nuclear Physics, Section of Rome | http://www.roma1.infn.it/, 1096, 1083, 1088
Univ. “La Sapienza” | University of Roma “La Sapienza” | http://www.uniroma1.it/, 1088, 1112

Salerno

INFN | National Institute for Nuclear Physics, Section of Salerno | http://www.sa.infn.it/, 1099, 1088

Trieste

INFN | National Institute for Nuclear Physics, Section of Trieste | http://www.ts.infn.it/, 1083, 1085, 1088
SISSA/ISAS | International School for Advanced Studies | http://www.sissa.it/, 1135, 1138, 1117
UNITR | University of Trieste | http://www.univ.trieste.it/, 1088

Turin
INFN | National Institute for Nuclear Physics, Section of Turin | http://www.to.infn.it/, 1096, 1083, 1085, 1065, 1088
Polito | Polytechnic University of Turin | http://www.polito.it/, 1088
UniTo | University of Turin | http://www.unito.it/, 1135, 1136, 1138, 1117, 1125, 1088

Udine
Uniud | University of Udine | http://www.uniud.it/, 1077

Vercelli
UPO | Amedeo Avogadro Piemonte Eastern University | http://www.unipmn.it/, 1088

Viterbo
UNITUS | University of Tuscia | http://www3.unitus.it/, 1112

Japan

Chiba
Chiba U | Chiba University | http://www.chiba-u.ac.jp/e/, 1135
CIT | Chiba Institute of Technology | http://www.it-chiba.ac.jp/, 1117

Fukuoka
Kyushu Univ. | Kyushu University | http://www.kyushu-u.ac.jp/, 1144, 1099

Hiroshima
Hiroshima Univ. | Hiroshima University | http://www.hiroshima-u.ac.jp/, 1097, 1088

Kobe
Kobe Univ. | Kobe University | http://www.kobe-u.ac.jp/, 1136

Kyoto
KSU | Kyoto Sangyo University | http://www.kyoto-su.ac.jp/, 1117, 1128
Kyoto Univ. | Kyoto University | http://www.kyoto-u.ac.jp/, 1135
RIMS | Research Institute for Mathematical Sciences of Kyoto University | http://www.kurims.kyoto-u.ac.jp/, 1117

Minato
Keio Univ. | Keio University - Minato | http://www.keio.ac.jp/, 1142

Miyazaki
Miyazaki Univ. | Miyazaki University | http://www.miyazaki-u.ac.jp/, 1097

Morioka
Iwate Univ. | Iwate University | http://www.iwate-u.ac.jp/, 1136

Nagasaki
NiAS | Nagasaki Institute of Applied Sciences | https://nias.ac.jp/index.html/, 1088

Nagoya
Nagoya Univ. | Nagoya University | http://www.nagoya-u.ac.jp/, 1135, 1099, 1065

Nara
NWU | Nara Women's University | http://www.nara-wu.ac.jp/nwu/en/index.html/, 1088

Osaka
Osaka Univ. | Osaka University | http://www.osaka-u.ac.jp/, 1135, 1136, 1144
RCNP | Research Center for Nuclear Physics of Osaka University | http://www.rcnp.osaka-u.ac.jp/, 1136, 1086, 1097, 1088

Saitama
SU | Saitama University | http://en.saitama-u.ac.jp/, 1119

Sendai
Tohoku Univ. | Tohoku University | http://www.tohoku.ac.jp/, 1097

Tokai
JAEA | Japan Atomic Energy Agency | http://www.jaea.go.jp/, 1088, 1130

Tokyo
Keio Univ. | Keio University - Tokyo | http://www.keio.ac.jp/, 1138
Meiji Univ. | Meiji University | http://www.meiji.ac.jp/cip, 1135
Toho Univ. | Toho University | http://www.toho-u.ac.jp/, 1099
Tokyo Tech | Tokyo Institute of Technology | http://www.titech.ac.jp/, 1135
UT | University of Tokyo; Centre for Nuclear Study CNS; Institute for Cosmic Ray Research; Institute Centre for Elementary Particle Physics ICEPP | http://www.u-tokyo.ac.jp/, 1135, 1138, 1097, 1088
Waseda Univ. | Waseda University | http://www.waseda.jp/, 1142

Tsukuba
KEK | High Energy Accelerator Research Organization | http://legacy.kek.jp/, 1135, 1117, 1144, 1128, 1126
Univ. | University of Tsukuba | http://www.tsukuba.ac.jp/, 1087, 1088

Utsunomiya
UU | Utsunomiya University | http://www.utsunomiya-u.ac.jp/, 1137

Wako
RIKEN | RIKEN Wako Institute; Institute of Physical and Chemical Research | http://www.riken.jp/, 1125, 1097, 1088

Yamagata
Yamagata Univ. | Yamagata University | http://www.yamagata-u.ac.jp/, 1085

Kazakhstan

Almaty
FAPHI | Fesenkov Astrophysical Institute of the National Centre of Space Researches and Technologies | http://aphi.kz/, 1135

IETP KazNU | Institute of Experimental and Theoretical Physics of the Al-Farabi Kazakh National University | http://www.ietp.kz/, 1130
INP | Institute of Nuclear Physics of Ministry of Energy of the Republic of Kazakhstan | http://www.inp.kz/, 1135, 1136, 1144, 1130, 1100, 1128, 1142, 1118, 1119
KazNU | Al-Farabi Kazakh National University | http://www.kaznu.kz/, 1139
PhysTI | Physics - Techical Institute | http://www.sci.kz/, 1065, 1131

Nur-Sultan

BA INP | Branch of the Astana Institute of Nuclear Physics of Ministry of Energy of the Republic of Kazakhstan | http://www.inp.kz/, 1135, 1129, 1131, 1118
ENU | L.N.Gumilyov Eurasian National University | http://www.enu.kz/, 1129, 1130, 1128, 1131, 1139
NU | Nazarbayev University | http://nu.edu.kz/, 1131, 1118

Ust-Kamenogorsk

EKSU | Sarsen Amanzholov East Kazakhstan State University | http://www.vkgu.kz/, 1139

Latvia

Riga

ISSP UL | Institute of Solid State Physics of the University of Latvia | http://www.cfi.lu.lv/, 1142

Lithuania

Kaunas

VMU | Vytautas Magnus University | http://www.vdu.lt/, 1136, 1119

Vilnius

VU | Vilnius University | http://www.vu.lt/, 1138, 1083

Luxembourg

Luxembourg

Univ. | University of Luxembourg | http://wwwen.uni.lu/, 1138

Malta

Msida

UM | University of Malta | https://www.um.edu.mt/, 1088

Mexico

Cuernavaca

UNAM | National Autonomous University of Mexico Campus Morelos | http://www.unam.mx/, 1135

Culiacan

UAS | Autonomous University of Sinaloa | https://www.uas.edu.mx/, 1088

Mexico City

Cinvestav | Centre for Advanced Investigations and Studies of the National Polytechnical Institute | http://www.cinvestav.mx/, 1083, 1088
UNAM | National Autonomous University of Mexico (Mexico City) | http://www.unam.mx/, 1065, 1088

Puebla

BUAP | Autonomous University of Puebla | http://www.buap.mx/, 1125, 1083, 1065, 1088

San Luis Potosi

UASLP | Autonomous University of San Luis Potosi | http://www.uaslp.mx/, 1096

Moldova

Chisinau

ASM | Academy of Sciences of Moldova | http://www.asm.md/, 1139
IAP | Institute of Applied Physics of the Ministry of Education, Culture and Research of the Republic of Moldova | http://www.phys.asm.md/, 1136, 1065, 1107, 1118, 1119
IC ASM | Institute of Chemistry of the Academy of Sciences of Moldova | http://chem.asm.md/, 1128
IMB ASM | Institute of Microbiology and Biotechnology of the Academy of Sciences of Moldova | http://www.imb.asm.md/, 1128
IMCS | Vladimir Andrunachievici Institute of Mathematics and Computer Science | http://www.math.md/, 1118
MSU | Moldova State University | http://usm.md/, 1065, 1131, 1132
RENAM | Research and Educational Networking Association of Moldova | http://www.renam.md/, 1118

Mongolia

Ulaanbaatar

CGL | Central Geological Laboratory | http://cengeolab.com/, 1128, 1131
IMDT MAS | Institute of Mathematics and Digital Technology of the Mongolian Academy | https://imdt.ac.mn/, 1119
IPT MAS | Institute of Physics and Technology of the Mongolian Academy of Sciences | https://ipt.ac.mn, 1135, 1137, 1065, 1087, 1107, 1100, 1142, 1105
MNUE | Mongolian National University of Education | http://mnue.mn/, 1139
NRC NUM | Nuclear Research Center of the National University of Mongolia | http://nrc.num.edu.mn/, 1129, 1130, 1128, 1131
NUM | National University of Mongolia | http://www.num.edu.mn/, 1137, 1077, 1118, 1139

Montenegro

Podgorica

Univ. | University of Montenegro | http://www.ucg.ac.me/, 1083

Netherlands

Amsterdam

AUAS | Amsterdam University of Applied Sciences | https://www.amsterdamuas.com/, 1088

NIKHEF | National Institute for Subatomic Physics | http://www.nikhef.nl/, 1081, 1088

Eindhoven

TU/e | Eindhoven University of Technology | https://www.tue.nl/en/, 1083

Utrecht

UU | Utrecht University | http://www.uu.nl/, 1088

New Zealand

Auckland

Univ. | University of Auckland | http://www.auckland.ac.nz/, 1137, 1083

Christchurch

UC | University of Canterbury | http://www.canterbury.ac.nz/, 1083, 1126

Hamilton

Univ. | University of Waikato | http://www.waikato.ac.nz/, 1135

North Macedonia

Skopje

UKiM | Ss. Cyril and Methodius University in Skopje | http://www.ukim.edu.mk/, 1128

Norway

Bergen

HVL | Western Norway University of Applied Sciences | https://www.hvl.no/en/, 1088

UiB | University of Bergen | http://www.uib.no/, 1136, 1088

Oslo

UiO | University of Oslo | http://www.uio.no/, 1136, 1117, 1088

Tonsberg

USN | University College of Southeast Norway | https://www.usn.no/english/, 1088

Trondheim

NTNU | Norwegian University of Science and Technology | http://www.ntnu.edu/, 1135, 1138, 1128, 1112

Pakistan

Islamabad

COMSATS | COMSATS University Islamabad | https://www.comsats.edu.pk/, 1088

PINSTECH | Pakistan Institute of Nuclear Science and Technology, 1088

QAU | Quaid-i-Azam University | http://www.qau.edu.pk/, 1083

Peru

Lima

PUCP | Pontifical Catholic University of Peru | https://www.pucp.edu.pe/, 1088

Poland

Bialystok

BUT | Bialystok University of Technology | https://pb.edu.pl/, 1142

UwB | University of Bialystok | http://www.uwb.edu.pl/, 1138, 1142

Chorzow

Frako-Term | Frako-Term LTD Company is a Research and Development | http://frakoterm.pl/pl/, 1065

Gdansk

GUT | Gdańsk University of Technology | http://pg.edu.pl/, 1128

Katowice

US | University of Silesia in Katowice | http://www.us.edu.pl/, 1137, 1123

Kielce

JKU | Jan Kochanowski University of Humanities and Science in Kielce | http://www.ujk.edu.pl/, 1135

Krakow

AGH | University of Science and Technology | http://www.agh.edu.pl/, 1083, 1088, 1126

AGH-UST | AGH University of Science and Technology | http://www.agh.edu.pl/, 1083, 1142, 1105

CYFRONET | Academic Computer Centre CYFRONET of the AGH-University Science and Technology | http://www.cyfronet.krakow.pl/, 1118

JU | Jagiellonian University in Kraków | http://www.uj.edu.pl/, 1137, 1142, 1133

NINP PAS | Henryk Niewodniczański Institute of Nuclear Physics of the Polish Academy of Sciences | http://www.ifj.edu.pl/, 1135, 1136, 1123, 1087, 1088, 1129, 1130, 1128, 1142, 1077, 1132, 1126, 1119, 1139

SIP | Marian Smoluchowski Institute of Physics of the Jagiellonian University | https://if.uj.edu.pl/, 1106

SOLARIS | SOLARIS National Synchrotron Radiation Centre | https://synchrotron.uj.edu.pl/, 1141

Lodz

UL | University of Lódź | http://www.uni.lodz.pl/, 1135, 1138, 1087, 1128, 1139

Lublin

UMCS | Marie Curie-Sklodowska University in Lublin | http://www.umcs.pl/, 1136, 1065, 1100, 1128, 1142, 1131, 1119

Opole

UO | University of Opole | http://www.uni.opole.pl/, 1128

Otwock (Swierk)

NCBJ | National Centre for Nuclear Research | http://www.ncbj.gov.pl/, 1135, 1136, 1083, 1085, 1065, 1097, 1087, 1088, 1128, 1132, 1119

Poznan

AMU | Adam Mickiewicz University in Poznań | http://www.amu.edu.pl/, 1137, 1130, 1128, 1142, 1141, 1112, 1139

GPCC | Maria Skłodowska–Curie Greater Poland Cancer Center | http://www.wco.pl/, 1132

IMP PAS | Institute of Molecular Physics of the Polish Academy of Sciences | http://www.ifmpan.poznan.pl/, 1137

Siedlce

UPH | University of Natural Sciences and Humanities | http://www.uph.edu.pl/, 1142

Szczecin

US | University of Szczecin | http://www.usz.edu.pl/, 1077

WPUT | West Pomeranian University of Technology in Szczecin | http://www.zut.edu.pl/, 1142

Torun

UMK | Nicolaus Copernicus University | http://www.umk.pl/, 1131

Warsaw

HIL UW | Heavy Ion Laboratory of Warsaw University | http://www.slcj.uw.edu.pl/, 1129, 1130

IEP WU | Institute of Experimental Physics of Warsaw University | http://en.ifd.fuw.edu.pl/, 1129

INCT | Institute of Nuclear Chemistry and Technology | http://www.ichtj.waw.pl/, 1142, 1131

IPC PAS | Institute of Physical Chemistry of the Polish Academy of Sciences | http://ichf.edu.pl/, 1137

UW | University of Warsaw | http://www.uw.edu.pl/, 1136, 1117, 1125, 1083, 1087, 1130

WUT | Warsaw University of Technology | http://www.pw.edu.pl/, 1085, 1065, 1087, 1066, 1088, 1131

Wroclaw

ILT&SR PAS | Institute of Low Temperature and Structure Research of the Polish Academy of Sciences | http://www.intibs.pl/, 1065

ITP UW | Institute for Theoretical Physics of the University of Wroclaw | http://www.ift.uni.wroc.pl/, 1135

UW | University of Wroclaw | http://www.uni.wroc.pl/, 1138, 1117, 1065, 1128, 1142, 1119

WUT | Wroclaw University of Science and Technology | http://www.pwr.edu.pl/, 1137

Portugal

Aveiro

UA | University of Aveiro | http://www.ua.pt/, 1138, 1085

Coimbra

UC | University of Coimbra | http://www.uc.pt/, 1135

Lisbon

LIP | Laboratory of Instrumentation and Experimental Particle Physics | http://www.lip.pt/, 1085

Republic of Korea

Cheongju

CBNU | Chungbuk National University | http://www.cbnu.ac.kr/, 1135, 1088

Daegu

KNU | Kyungpook National University | http://en.knu.ac.kr/, 1135

Daejeon

CTPCS IBS | Center for Theoretical Physics of Complex Systems of the Institute for Basic Science | https://pcs.ibs.re.kr/, 1137

IBS | Institute for Basic Science | http://www.ibs.re.kr, 1136, 1129, 1130

KAERI | Korea Atomic Energy Research Institute | http://www.kaeri.re.kr/, 1128

KIST | Korea Institute of Science and Technology Information | https://eng.kist.re.kr/kist_eng/main/, 1083, 1088

NFRI | National Fusion Research Institute | http://www.nfri.re.kr/, 1143

Gangneung

GWNU | Gangneung-Wonju National University | http://www.gwnu.ac.kr/, 1088

Gwangju

CNU | Chonnam National University | http://www.jnu.ac.kr/, 1083

Incheon

Inha | Inha University | https://eng.inha.ac.kr/, 1137, 1088

Jeonju

JBNU | JeonBuk National University | http://www.cbnu.edu/eng/, 1136, 1088

Pohang

PAL | Pohang Accelerator Laboratory | http://pal.postech.ac.kr/, 1128

Pusan

PNU | Pusan National University | http://www.pusan.ac.kr/, 1088

Seoul

Dawonsys “Dawonsys o., Ltd” | Company “Dawonsys o., Ltd” | http://www.dawonsys.com/, 1128

EWU | Ewha Womans University | http://www.ewha.ac.kr/, 1125

Konkuk Univ. | Konkuk University | http://www.konkuk.ac.kr/, 1088

KU | Korea University | http://www.korea.edu/, 1083

SJU | University of Sejong | https://eng.sejong.ac.kr/index.do/, 1083, 1088

SKKU | Sungkyunkwan University | http://www.skku.edu/, 1138, 1083

SNU | Seoul National University | http://www.en.snu.ac.kr/, 1135, 1136

SNUE | Seoul National University of Education | http://www.snue.ac.kr/, 1083
Yonsei Univ. | Yonsei University | https://www.yonsei.ac.kr/, 1083, 1088

Romania

Baia Mare

TUCN-NUCBM | Technical University of Cluj-Napoca - North University Center of Baia Mare | http://www.utcluj.ro/, 1107, 1128, 1142, 1131

Bucharest

CSSNT-UPB | Center for Surface Science and Nanotechnologe of the University Politehnica of Bucharest | http://cssnt-upb.ro/, 1131
IFIN-HH | Horia Hulubei National Institute of Physics and Nuclear Engineering | http://www.ifin.ro/, 1136, 1137, 1117, 1144, 1106, 1096, 1065, 1087, 1088, 1107, 1129, 1130, 1128, 1142, 1105, 1131, 1077, 1132, 1118, 1119
INCDIE ICPE-CA | National Institute of Research and Development in Electrical Engineering ICPE-CA | http://www.icpe-ca.ro/, 1065, 1097, 1087, 1142, 1143, 1140
UB | University of Bucharest | http://www.unibuc.ro/, 1136, 1087, 1128, 1142, 1112, 1119, 1139
UMF | "Carol Davila" University of Medicine and Pharmacy Bucharest | http://www.umf.ro/, 1107, 1077
UPB | University Politehnica of Bucharest | http://www.upb.ro/, 1088, 1128, 1142, 1131

Cluj-Napoca

INCDTIM | National Institute for Research and Development of Isotopic and Molecular Technologies | http://www.itim-cj.ro/, 1128, 1142, 1143, 1133, 1118, 1119
RA BC-N | Romanian Academy Cluj-Napoca Branch | http://www.acad-cluj.ro/, 1142
UBB | Babeş-Bolyai University | http://www.ubbcluj.ro/, 1142, 1077
UTC-N | Technical University of Cluj-Napoca | http://utcluj.ro/, 1137

Constanta

MINAC | Museum of National History and Archeology in Constanța | https://www.minac.ro/, 1142
UOC | "Ovidius" University of Constanta | http://www.univ-ovidius.ro/, 1087, 1128, 1142

Craiova

UC | University of Craiova | http://cis01.central.ucv.ro/, 1142

Galati

UG | University of Galaţi | http://www.ugal.ro/, 1128

Iasi

IBR | Institute of Biological Research Iaşi of the National Institute of Research and Development for Biological Sciences | http://www.dbioro.eu/, 1077
NIRDTP | National Institute of Research and Development for Technical Physics | http://www.phys-iasi.ro/, 1128, 1142
TUIASI | "Gheorghe Asachi" Technical University of Iaşi | http://www.tuiasi.ro/, 1142
UAI | University "Apollonia" of Iaşi | http://univapollonia.ro/, 1142
UAIC | Alexandru Ioan Cuza University of Iaşi | http://www.uaic.ro/, 1107, 1142, 1143, 1112
USAMV | University of Agricultural Sciences and Veterinary Medicine | http://www.uaiasi.ro/, 1142

Magurele

IFA | Institute of Atomic Physics | http://www.ifa-mg.ro/, 1118, 1119
INFLPR | National Institute for Laser, Plasma and Radiation Physics | http://www.inflpr.ro/, 1131
INOE2000 | National Institute for Research and Development in Optoelectronics | http://www.inoe.ro/, 1065
ISS | Institute for Space Sciences | http://www2.spacescience.ro/, 1099, 1125, 1087, 1088, 1107, 1128, 1126, 1119
NIMP | National Institute of Materials Physics | http://www.infim.ro/, 1128, 1142, 1133

Oradea

UO | University of Oradea | http://www.uoradea.ro/, 1128

Pitesti

ICN | Institute for Nuclear Research - Piteşti | http://www.nuclear.ro/, 1128, 1142
UPIT | University of Piteşti | http://www.upit.ro/, 1142

Ramnicu Valcea

I.C.S.I. | National Research and Development Institute for Cryogenics and Isotopic Technologies | http://www.icsi.ro/, 1128

Sibiu

ULBS | Lucian Blaga University of Sibiu | https://www.ulbsibiu.ro/ro/, 1128

Targoviste

UVT | Valahia University of Târgovişte | http://www.valahia.ro/, 1128, 1142, 1143

Timisoara

ICT | "Coriolan Drăgulescu" Institute of Chemistry | http://acad-icht.tm.edu.ro/, 1142
ISIM | National R&D Institute for Welding and Materials Testing - ISIM Timisoara | http://www.isim.ro/, 1142
LMF CCTFA | Laboratory of Magnetic Fluids of the Center for Fundamental and Advanced Technical Research of the Romanian Academy, Branch Timişoara | http://acad-tim.tm.edu.ro/cctfa, 1142
UVT | West University of Timişoara | http://www.uvt.ro/, 1137, 1107, 1142, 1119

Tulcea

DDNI | "Danube Delta" National Institute for Research and Development | http://www.ddni.ro/, 1142

Russia

Arkhangelsk

NArFU | Northern (Arctic) Federal University named after M.B.Lomonosov | http://narfu.ru/, 1126, 1139

NSMU | Northern State Medical University | http://www.nsmu.ru/, 1139

Belgorod

BelSU | Belgorod National Research State University | http://www.bsu.edu.ru/, 1135, 1137, 1065, 1097, 1087, 1126, 1139

Borok

IBIW RAS | Federal State Budgetary Institution of Science "I.D.Papanin Institute for the Biology of Inland Waters of the Russian Academy of Sciences" | http://ibiw.ru/, 1128

IPE RAS | Federal State Budgetary Institution of Science "Schmidt Institute of the Physics of the Earth of the Russian Academy of Sciences" | http://www.ifz.ru/, 1112

Chelyabinsk

SUSU | South Ural State University | https://www.susu.ru/ru/, 1142

Chernogolovka

BInEPCP RAS | Federal State Budgetary Institution of Science "Branch of the Institute of Energy Problems for Chemical Physics of the Russian Academy of Sciences" | http://binep.ac.ru/, 1131

ISMAN RAS | Federal State Budgetary Institution of Science "Institute of Structural Macrokinetics and Materials Science of the Russian Academy of Sciences" | http://www.ism.ac.ru/, 1087

ISSP RAS | Federal State Budgetary Institution of Science "Institute of Solid State Physics of the Russian Academy of Sciences" | http://issp.ac.ru/, 1086, 1142, 1131

LITP RAS | Federal State Budgetary Institution of Science "L.D.Landau Institute for Theoretical Physics of the Russian Academy of Sciences" | http://www.itp.ac.ru/, 1135, 1138, 1117, 1065, 1118

SCC IPCP RAS | Federal State Budgetary Institution of Science "Supercomputer Centre of the Institute of Problems of Chemical Physics of the Russian Academy of Sciences" | http://www.icp.ac.ru/, 1118

Dimitrovgrad

SSC RIAR | Joint Stock Company "State Scientific Centre Research Institute of Atomic Reactors" Rosatom State Nuclear Energy Corporation | http://www.niiar.ru/, 1130

Dolgoprudny

MIPT | Moscow Institute of Physics and Technology State University | http://mipt.ru/, 1083, 1065, 1142, 1139

Dubna

BSINP MSU | Branch of the Skobeltsyn Institute of Nuclear Physics of the Lomonosov Moscow State University | http://www.msu.dubna.ru/, 1107, 1139

Diamant | Diamant LLC | http://diamant-sk.ru/, 1128

Dubna State Univ. | Dubna State University | http://www.uni-dubna.ru/, 1100, 1128, 1142, 1143, 1126, 1118, 1119, 1139

IAS "Omega" | Institute for Advanced Studies "Omega" | http://dubna-oez.ru/, 1107

PELCOM | "Pelcom Dubna Mashinostroitelny Zavod" | http://pelcom.ru/, 1065

Progresstech | Dubna, "Progresstech" | https://progresstech.ru/, 1065

RDH-9 | Radiological Department of Hospital № 9 | http://msch9fmba.ru/radiologicheskoe-otdelenie-2/, 1132

SCC "Dubna" | "Dubna" Satellite Communication Centre, Branch of the Federal State Unitary Enterprise "Russian Satellite Communication Company" | http://www.rscc.ru/, 1118

SEZ "Dubna" | Special Economic Zone of Technical-Innovative type "Dubna" | http://oezdubna.ru/, 1118

Trackpore Technology | Closed Joint Stock Company "Trackpore Technology" Membrane Technologies and the Future, Dubna Branch | http://www.trackpore.ru/, 1131

Fryazino

ISTOK | Joint Stock Company "Research and Production Corporation "ISTOK" named after Shokin" | http://www.istokmw.ru/, 1065

Gatchina

NRC KI PNPI | Federal State Budgetary Institution "B.P.Konstantinov Petersburg Nuclear Physics Institute" of the National Research Centre "Kurchatov Institute" | http://www.pnpi.spb.ru/, 1135, 1136, 1137, 1123, 1144, 1083, 1065, 1097, 1088, 1130, 1100, 1128, 1142, 1143, 1140, 1112, 1118, 1119

Grozny

CSPU | Chechen State Pedagogical University | https://chspu.ru/, 1128

Irkutsk

ISDCT SB RAS | Federal State Budgetary Institution of Science "Matrosov Institute for System Dynamics and Control Theory of the Siberian Branch of the Russian Academy of Sciences" | http://www.idstu.irk.ru/, 1135

ISU | Irkutsk State University | http://isu.su/, 1144, 1099, 1119

LI SB RAS | Federal State Budgetary Institution of Science "Limnological Institute of the Siberian Branch of the Russian Academy of Sciences" | http://www.lin.irk.ru/, 1128

RIAP ISU | Research Institute of Applied Physics of the Irkutsk State University | http://api.isu.ru/, 1125

Ivanovo

ICS RAS | Federal State Budgetary Institution of Science “Institute of Solution Chemistry of the Russian Academy of Sciences” | http://www.isc-ras.ru/, 1135

ISU | Ivanovo State University | http://ivanovo.ac.ru/, 1135, 1139

ISUCT | Ivanovo State University of Chemistry and Technology | http://isuct.ru/, 1128

Izhevsk

UdSU | Udmurt State University | http://udsu.ru/, 1128

Kaliningrad

IKBFU | Immanuel Kant Baltic Federal University | http://www.kantiana.ru/, 1142, 1131

Kazan

Compressormash | Open Joint Stock Company “Kazancompressormash” | http://compressormash.ru/, 1065

KFU | Kazan Volga Region Federal University | http://kpfu.ru/, 1135, 1137, 1138, 1142, 1139

KNRTU | Kazan National Research Technological University | http://www.kstu.ru/, 1142

Spetshmash | Ltd. “Research and Productio Enterprise Spetshmash” | http://spmsh.ru/, 1065

Khabarovsk

PNU | Pacific National University | http://pnu.edu.ru/, 1136

Kostroma

KSU | Kostroma State University | http://ksu.edu.ru/, 1139

Krasnodar

KSU | Kuban State University | http://kubsu.ru/, 1131, 1139

Moscow

"FOMOS-MATERIALS" | Open Joint Stock Company "FOMOS-MATERIALS" | http://newpiezo.com/, 1086

“Azimuth-Photonics” | “Azimuth-Photonics” | http://www.azimp.ru/, 1086

Cryogenmash | Public Joint Stock Company “Cryogenmash” | http://cryogenmash.ru/, 1065

DMS RAS | Department of Medical Sciences, RAS | http://www.ras.ru/, 1132

ENES | LLC “Engineering Center of Nuclear Equipment Strength”, 1105

FMBC | Russian State Research Center − Burnasyan Federal Medical Biophysical Center of Federal Medical Biological Agency | http://fmbafmbc.ru/, 1077, 1132

FRC IM RAS | Federal State Institution "Federal Research Center "Informatics and Management of the Russian Academy of Sciences" | http://www.frccsc.ru/, 1118

Geliymash | Open Joint Stock Company “Researching and Production Association "Geliymash" | http://geliymash.ru/, 1065, 1105

GIN RAS | Federal State Budgetary Institution of Science “Geological Institute of the Russian Academy of Sciences” | http://www.ginras.ru/, 1128

GPI RAS | Federal State Budgetary Institution of Science “General Physics Institute of the Russian Academy of Sciences” | http://www.gpi.ru/, 1128, 1133, 1131, 1119

HTDC | High-Tech Diagnostic Centre, 1129

IA RAS | Federal State Budgetary Institution of Science “Institute of Archaeology of the Russian Academy of Sciences” | http://archaeolog.ru/, 1142

IBMC | Federal State Budgetary Institution of Science Institute of Biomedical Chemistry | http://www.ibmc.msk.ru/, 1077

IBMP RAS | Federal State Budgetary Institution of Science “State Scientific Centre of the Russian Federation - Institute for Biomedical Problems of the Russian Academy of Sciences” | http://www.imbp.ru/, 1065, 1077, 1132

IBRAE | Federal State Budgetary Institution of Science “Institute for the Problems of the Safe Development of Atomic Energy of the Russian Academy of Sciences” | http://www.ibrae.ac.ru/, 1135

IC RAS | Federal State Institution "Federal Research Center " Crystallography and Photonics "of the Russian Academy of Sciences | https://kif.ras.ru/, 1142, 1131

ICP RAS | Semenov Institute of Chemical Physics of the Russian Academy of Sciences | http://chph.ras.ru/, 1142

IEPT RAS | Federal State Budgetary Institution of Science “Institute of Earthquake Prediction Theory and Mathematical Geophysics of the Russian Academy of Sciences” | http://www.mitp.ru/, 1142

IGEM RAS | Federal State Budgetary Institution of Science “Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry of the Russian Academy of Sciences” | http://www.igem.ru/, 1142, 1112

IGIC RAS | Federal State Budgetary Institution of Science “Kurnakov Institute of General and Inorganic Chemistry of the Russian Academy of Sciences” | http://www.igic.ras.ru/, 1142

IHNA Ph RAS | Federal State Budgetary Institution of Science “Institute of Higher Nervous Activity and Neurophysiology of the Russian Academy of Sciences” | http://www.ihna.ru/), 1077

IITP RAS | Federal State Budgetary Institute of Science “Institute for Information Transmission Problems (Kharkevich Institute) of the Russian Academy of Sciences” | http://iitp.ru/, 1118

IKI RAS | Federal State Budgetary Institution of Science “Space Research Institute of the Russian Academy of Sciences” | http://www.iki.rssi.ru/, 1128, 1077, 1112

IMET RAS | Federal State Budgetary Institution of Science “A.A.Baikov Institute of Metallurgy and

Materials Science of the Russian Academy of Sciences" | http://www.imet.ac.ru/, 1142
IMM RAS | Federal State Budgetary Institution of Science "Institute for Mathematical Modeling of the Russian Academy of Sciences" | http://www.imamod.ru/, 1135
INEUM | Institute of Electronic Control Computes named after I.S.Bruk | http://www.ineum.ru/, 1105
INMI RAS | Federal State Budgetary Institution of Science "Winogradsky Institute of Microbiology of the Russian Academy of Sciences" | http://www.inmi.ru/, 1142
Inst. Immunology | National Research Center – Institute of Immunology Federal Medical-Biological Agency of Russia | http://nrcii.ru/, 1142
IPCE RAS | Federal State Budgetary Institution of Science "A.N.Frumkin Institute of Physical Chemistry and Electrochemistry of the Russian Academy of Sciences" | http://www.phyche.ac.ru/, 1128
IPE RAS | Federal State Budgetary Institution of Science "Schmidt Institute of Physics of the Earth of the Russian Academy of Sciences" | http://www.ifz.ru/, 1142
ISP RAS | Federal State Budgetary Institution of Science "Ivannikov Institute for System Programming of the Russian Academy of Sciences" | http://www.ispras.ru/, 1118
ISPM RAS | Federal State Budgetary Institution of Science "Enikolopov Institute of Synthetic Polymeric Materials of the Russian Academy of Sciences" | http://www.ispm.ru/, 1131
ITEP | Federal State Budgetary Institution "Russian Federation State Scientific Centre - Alikhanov Institute for Theoretical and Experimental Physics" of the National Research Centre "Kurchatov Institute" | http://www.itep.ru/, 1135, 1137, 1138, 1117, 1081, 1144, 1106, 1083, 1065, 1087, 1066, 1088, 1129, 1100, 1128, 1126, 1118, 1119
ITT-Group | "ITT-Group", 1129
JIHT RAS | Joint Institute for High Temperatures of the Russian Academy of Sciences | http://www.jiht.ru/, 1119
KIAM RAS | Federal State Budgetary Institution of Science "Federal Research Center "Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences" | http://www.keldysh.ru/, 1118
LMPR MONIKI | Laboratory of Medical and Physics Research of the M.Vladimirsky Moscow Regional Research Clinical Institute | http://www.medphyslab.ru/, 1133
LPI RAS | Federal State Budgetary Institution of Science "P.N.Lebedev Physical Institute of the Russian Academy of Sciences" | http://www.lebedev.ru/, 1135, 1138, 1081, 1096, 1083, 1085, 1065, 1097, 1087, 1131
MAI | Moscow Aviation Institute | https://mai.ru/, 1131
MI RAS | Federal State Budgetary Institution of Science "Steklov Mathematical Institute of the Russian Academy of Sciences" | http://www.mi.ras.ru/, 1135, 1137, 1138, 1117
MIEM | A.N. Tikohonov Moscow Institute of Electronics and Mathematics | http://miem.hse.ru/, 1131
MIET | National Research University of Electronic Technology | http://www.miet.ru/, 1142
MIREA | Moscow State University Information Technology, Radioengineering and Electronics - Russian Technological University | http://www.mirea.ru/, 1137
MISiS | National University of Science and Technology "MISiS" | http://www.misis.ru/, 1135, 1142
MPEI | National Research University "Moscow Power Engineering Institute" | http://mpei.ru/, 1118, 1139
MRSU | Moscow Region State University | https://mgou.ru/, 1119
MSK-IX | Joint-stock company "Center of interaction of computer networks" MSK-IX " | https://www.msk-ix.ru/, 1118
MSU | Lomonosov Moscow State University | http://www.msu.ru/, 1135, 1136, 1138, 1117, 1081, 1099, 1065, 1087, 1130, 1128, 1142, 1133, 1077, 1112, 1126, 1118, 1119
NIKIET | Joint Stock Company "A.N.Dollezhal Research and Development Institute of Power Engineering" | http://www.nikiet.ru/, 1083
NMRC Oncology | N.N. Blokhin National Medical Research Center of Oncology | https://www.ronc.ru/, 1077
NNRU "MEPhI" | National Nuclear Research University "MEPhI" | http://www.mephi.ru/, 1136, 1137, 1144, 1125, 1106, 1083, 1086, 1065, 1066, 1088, 1129, 1130, 1100, 1142, 1143, 1126, 1119, 1139
NRC KI | National Research Centre "Kurchatov Institute" | http://www.nrcki.ru/, 1136, 1137, 1065, 1097, 1088, 1130, 1128, 1142, 1143, 1140, 1118
NRU HSE | National Research University Higher School of Economics | http://www.hse.ru/, 1137, 1117
OKSAT NIKIET | Department of Integrated Process Control Systems | http://www.nikiet.ru/, 1105, 1140
PC ITER RF | Institution "Project Center ITER" | http://www.iterrf.ru/, 1143
PFUR | Peoples' Friendship University of Russia | http://www.rudn.ru/, 1135, 1136, 1137, 1119
PIN RAS | Paleontological Institute of the Russian Academy of Sciences | http://www.paleo.ru/, 1142, 1112
PRUE | Plekhanov Russian University of Economics | https://www.rea.ru/, 1118
RCC MSU | Research Computing Center Lomonosov Moscow State University | http://www.srcc.msu.ru/, 1118, 1119

RIVS | I.I.Mechnikov Research Institute of Vaccines and Sera | http://www.instmech.ru/, 1131
RSCC | Federal State Unitary Enterprise “Russian Satellite Communications Company” | http://www.rscc.ru/, 1118
SAI MSU | Sternberg Astronomical Institute of the M.V.Lomonosov Moscow State University | http://www.sai.msu.ru/, 1138, 1112
SC “VNIINM” | Stock Company “A.A.Bochvar High-Technology Research Institute of Inorganic Materials” | http://www.bochvar.ru/, 1100, 1140
SCC RAS | Scientific Council for Cybernetics of the Russian Academy of Sciences | http://www.ras.ru/, 1135, 1117
SF IPh | Federal State Budgetary Institution of Science “State Foundation Institute of Pharmacology” | http://www.academpharm.ru/, 1077
SINP MSU | Skobeltsyn Institute of Nuclear Physics of the M.V.Lomonosov Moscow State University | http://www.sinp.msu.ru/, 1135, 1136, 1137, 1117, 1125, 1106, 1083, 1086, 1065, 1087, 1088, 1130, 1100, 1128, 1142, 1131, 1077, 1118, 1119, 1139
Skoltech | Skolkovo Institute of Science and Technology | https://www.skoltech.ru/, 1077
SSDI | Joint Stock Company “State Specialized Design Institute” | http://aogspi.ru/, 1105
SYSTEMATOM | Closed Joint Stock Company “Nuclear and Radiation Safety Systems” | http://www.systematom.ru/, 1105
VEI | Federal State Unitary Enterprise “All-Russian Electrotechnical Institute” | http://www.vei.ru/, 1065
VIGG RAS | Federal State Budgetary Institution of Science “Vavilov Institute of General Genetics of the Russian Academy of Sciences” | http://www.vigg.ru/, 1132
VNIIA | Federal State Unitary Enterprise “All-Russian Research Institute of Automatics” Russian Federal Atomic Energy Agency | http://www.vniia.ru/, 1128
VNIIMS | Federal Agency of Technical Regulating and Metrology National Metrology Institute All-Russian Research Institute of Metrological Service | http://www.vniims.ru/, 1117

Moscow, Troitsk

HPPI RAS | Federal State Budgetary Institution of Science “Institute for High Pressure Physics of the Russian Academy of Sciences” | http://www.hppi.troitsk.ru/, 1137, 1096, 1100, 1142
INR RAS | Federal State Budgetary Institution of Science “Institute for Nuclear Research of the Russian Academy of Sciences” | http://www.inr.ru/, 1135, 1136, 1137, 1138, 1117, 1144, 1125, 1106, 1096, 1083, 1065, 1097, 1087, 1088, 1129, 1130, 1100, 1128, 1142, 1143, 1140, 1126, 1118, 1119
LPP LPI RAS | “Laboratory of Photomeson Processes Department of High-Energy Physics” Federal State Budgetary Institution of Science “P.V.Lebedev Physical Institute of the Russian Academy of Sciences” | http://www.lebedev.ru/, 1097

Moscow, Zelenograd

RIMST | Joint Stock Company “Research Institute of Material Science and Technology” | http://www.niimv.ru/, 1086

Neutrino

BNO INR RAS | Baksan Neutrino Observatory Federal State Budgetary Institution of Science “Institute for Nuclear Research of the Russian Academy of Sciences” | http://www.inr.ru/bno//, 1100

Nizhny Novgorod

IAP RAS | Federal Research Center Institute of Applied Physics of the Russian Academy of Sciences | http://www.iapras.ru/, 1127, 1129
IPM RAS | Federal State Budgetary Institution of Science “Institute for Physics of Microstructures of the Russian Academy of Sciences” | http://ipmras.ru/, 1128, 1142
UNN | N.I.Lobachevsky State University of Nizhny Novgorod National Research University | http://www.unn.ru/, 1142, 1118

Novosibirsk

BIC SB RAS | Federal State Budgetary Institution of Science "Federal Research Center “Boreskov Institute of Catalysis of the Siberian Branch of the Russian Academy of Sciences” | http://www.catalysis.ru/, 1112
BINP SB RAS | Federal State Budgetary Institution of Science “Budker Institute of Nuclear Physics of the Siberian Branch of the Russian Academy of Sciences” | http://www.inp.nsk.su/, 1135, 1117, 1123, 1144, 1108, 1065, 1088, 1129, 1141, 1118
IM SB RAS | Federal State Budgetary Institution of Science “Sobolev Institute of Mathematics of the Siberian Branch of the Russian Academy of Sciences” | http://math.nsc.ru/, 1135
ISP SB RAS | Federal State Budgetary Institution of Science “A.V.Rzhanov Institute of Semiconductor Physics of the Siberian Branch of the Russian Academy of Sciences” | http://www.isp.nsc.ru/, 1131
NSU | Novosibirsk State University | http://www.nsu.ru/, 1138, 1144, 1083
STL “Zaryad” | STL “Zaryad”, 1065

Obninsk

IPPE | Joint Stock Company “State Scientific Centre of the Russian Federation - Institute of Physics and Power Engineering” | http://www.ippe.ru/, 1128
NMRRC | A.Tsyb National Medical Research Radiological Center | https://mrrc.nmicr.ru/, 1077
REATRACK-Filter | REATRACK-Filter LLC | http://www.reatrack.ru/, 1131

Omsk

OB IM SB RAS | Federal State Budgetary Institution of Science “Institute of Mathematics of the

Siberian Branch of the Russian Academy of Sciences" | http://ofim.oscsbras.ru/, 1108
OmSU | F.V. Dostoevsky Omsk State University | http://www.omsu.ru/, 1135, 1136

Pereslavl-Zalesskiy

PSI RAS | Federal State Budgetary Institution of Science "Aylamazyan Program Systems Institute of the Russian Academy of Sciences" | http://skif.pereslavl.ru/psi-info/, 1118

Perm

ICMM UrB RAS | Federal State Budgetary Institution of Science "Institute of Continuous Media Mechanics of the Russian Academy of Sciences Ural Branch" | http://www.icmm.ru/, 1142
ITCh UrB RAS | Federal State Budgetary Institution of Science "Institute of Technical Chemistry of the Russian Academy of Sciences Ural Branch" | http://www.itcras.ru/, 1142
PSNRU | Perm State National Research University | http://www.psu.ru/, 1135, 1137, 1119

Protvino

IHEP | Federal State Budgetary Institution "Russian Federation State Scientific Centre - Institute for High Energy Physics" of the National Research Centre "Kurchatov Institute" | http://www.ihep.su/, 1135, 1137, 1138, 1117, 1081, 1108, 1096, 1083, 1085, 1086, 1065, 1087, 1066, 1088, 1126, 1118

Puschino

IMPB RAS | Federal State Budgetary Institution of Science "Institute of Mathematical Problems of Biology of the Russian Academy of Sciences" | http://www.impb.ru/, 1118, 1119
ITEB RAS | Federal State Budgetary Institution of Science "Institute of Theoretical and Experimental Biophysics of the Russian Academy of Sciences" | http://web.iteb.ru/, 1077

Rostov-on-Don

RIP SFU | Research Institute of Physics of the Southern Federal University | http://ip.sfedu.ru/, 1142
SFedU | Southern Federal University | http://www.sfedu.ru/, 1135, 1132

Samara

SSU | Samara State University | http://samsu.ru/, 1135
SU | Samara National Research University | http://www.ssau.ru/, 1135, 1137, 1065, 1118

Saratov

SSMU | Saratov State Medical University named after V. I. Razumovsky | http://www.sgmu.ru/, 1131
SSU | N.G.Chernyshevsky Saratov State University | http://www.sgu.ru/, 1135, 1136, 1137, 1117, 1119

Sarov

VNIIEF | Russian Federal Nuclear Centre - All-Russian Scientific Research "Institute of Experimental Physics" | http://www.vniief.ru/, 1135, 1087, 1088, 1129, 1130

Sevastopol

IBSS | Federal Research Center "A.O. Kovalevsky Institute of Biology of the Southern Seas of RAS" | http://imbr-ras.ru/, 1128

Smolensk

SSU | Smolensk State University | http://www.smolgu.ru/, 1087, 1139

Snezhinsk

VNIITF | Russian Federal Nuclear Centre - All-Russian Scientific Research Institute of Technical Physics | http://www.vniitf.ru/, 1083, 1129

Sochi

SRI MP | Federal State Budgetary Scientific Institution "Scientific Research Institute of Medical Primatology" | http://www.primatologia.ru/, 1077

St. Petersburg

Botanic garden BIN RAS | Federal State Budgetary Institution of Science "Botanic Garden of the V.L.Komarov Botanic Institute of the Russian Academy of Sciences" | http://botsad-spb.com/, 1128
CRISM "Prometey" | Central Research Institute of Structural Materials "Prometey" named after I.V. Gorynin of National Research Center "Kurchatov Institute" | http://www.crism-prometey.ru/en/, 1142
Electron | Joint Stock Company "National Research Institute "Electron" | http://www.electron.spb.ru/, 1083
ETU | Saint Petersburg State Electrotechnical University "LETI" | http://www.eltech.ru/, 1137
FIP | V.F.Fock Institute of Physics of the Saint Petersburg State University | http://www.niif.spbu.ru/, 1087, 1088, 1128, 1118
IAI RAS | Institute for Analytical Instrumentation of the Russian Academy of Sciences | http://iairas.ru/, 1129
IMC RAS | Federal State Budgetary Institution of Science "Institute of macromolecular Compounds of the Russian Academy of Sciences" | http://macro.ru/, 1142
Ioffe Institute | Federal State Budgetary Institution of Science "Ioffe Physicl Technical Institute of the Russian Academy of Sciences" | http://www.ioffe.ru/, 1137, 1130, 1128, 1142, 1131
ITMO Univ. | National Research University of Information Technologies, Mechanics and Optics | http://www.ifmo.ru/, 1137, 1118
KRI | V.G.Khlopin Radium Institute | http://www.khlopin.ru/, 1065, 1107, 1130, 1128
Neva-Magnet | Neva-Magnet S&E, Ltd | http://www.magnet.spb.su/, 1065
NIIEFA | D.V.Efremov Scientific Research Institute of Electrophysical Apparatus | http://www.niiefa.spb.su/, 1129, 1119
NWRSCC | North-West Regional Scientific and Clinical Center named after L.G. Sokolov Federal

Medical and Biological Agency | https://med122.com, 1126
PDMI RAS | Federal State Budgetary Institution of Science "St.Petersburg Department of V.A.Steklov Institute of Mathematics of the Russian Academy of Sciences" | http://www.pdmi.ras.ru/pdmi/, 1137, 1138
SPbSPU | Saint Petersburg Polytechnic University Peter the Great | http://www.spbstu.ru/, 1135, 1086, 1065, 1126, 1118
SPbSU | Saint Petersburg State University | http://spbu.ru/, 1135, 1136, 1137, 1065, 1066, 1130, 1142, 1118, 1119, 1139
SPSFTU | Saint Petersburg State Forest Technical University | http://spbftu.ru/, 1128

Sterlitamak

SB BSU | Sterlitamak branch of the Bashkir State University | http://strbsu.ru/, 1142

Syktyvkar

DM Komi SC UrB RAS | Federal State Budgetary Institution of Science "Department of Mathematics Komi Sciences Centre of the Russian Academy of Sciences Ural Branch" | http://www.komisc.ru/, 1086, 1065

Tomsk

IHCE SB RAS | Federal State Budgetary Institution of Science "Institute of High Current Electronics of the Siberian Branch of the Russian Academy of Sciences" | http://www.hcei.tsc.ru/, 1135
NPI TPU | Nuclear Physics Institute of the National Research Tomsk Polytechnic University | http://www.npi.tpu.ru/, 1065, 1100
TPU | National Research Tomsk Polytechnic University | http://tpu.ru/, 1138, 1117, 1096, 1083, 1085, 1087, 1107, 1126, 1139
TSPU | Tomsk State Pedagogical University | http://www.tspu.edu.ru/, 1138
TSU | National Research Tomsk State University | http://www.tsu.ru/, 1135, 1083, 1119

Tula

TSU | Tula State University | http://tsu.tula.ru/, 1128, 1142, 1139

Tver

TvSU | Tver State University | http://tversu.ru/, 1135, 1139

Vladikavkaz

NOSU | North-Ossetian State University named after K.L.Khetagurov | http://www.nosu.ru/, 1065, 1128, 1118, 1139
VTC "Baspik" | Vladikavkaz Technological Centre "Baspik" | http://baspik.all.biz/, 1087

Vladimir

Vladisart | "Vladisart" | http://wwww.vladisart.ru/, 1131
VlSU | Vladimir State University named after A.G. and N.G. Stoletov | www.vlsu.ru/, 1137

Vladivostok

FEFU | Far Eastern Federal University | http://dvfu.ru/, 1136

Voronezh

VSU | Voronezh State University | http://www.vsu.ru/, 1137, 1130, 1100, 1128, 1139

Yakutsk

NEFU | North-Eastern Federal University in Yakutsk | http://www.s-vfu.ru/, 1139

Yekaterinburg

IMP UB RAS | Federal State Budgetary Institution of Science "M.N.Mikheev Institute of Metal Physics of Ural Branch of the Russian Academy of Sciences" | http://www.imp.uran.ru/, 1142, 1143
UrFU | Urals Federal University named after the First President of Russia B.N.Yeltsin | http://urfu.ru/, 1128, 1142

Yoshkar-Ola

VSUT | Volga State University of Technology | http://www.volgatech.net/, 1135

Zhukovsky

MDB | Joint Stock Company "Myasishchev Design Bureau" | http://www.emz-m.ru/, 1083

Serbia

Belgrade

INS "VINČA" | "Vinca" Institute of Nuclear Sciences | http://www.vin.bg.ac.rs/, 1137, 1083, 1129, 1142, 1131, 1077, 1139
IPB | Institute of Physics Belgrade of the University of Belgrade | http://www.phy.bg.ac.rs/, 1136, 1117, 1128
Univ. | University of Belgrade | http://www.bg.ac.rs/, 1135, 1117, 1128

Novi Sad

UNS | University of Novi Sad | http://www.uns.ac.rs/, 1128, 1139

Sremska Kamenica

Educons Univ. | Educons University | https://educons.edu.rs/, 1139

Slovakia

Banska Bistrica

UMB | Matej Bel University | http://www.umb.sk/, 1117, 1086, 1119

Bratislava

CU | Comenius University in Bratislava | http://uniba.sk/, 1135, 1136, 1137, 1081, 1144, 1099, 1096, 1088, 1107, 1130, 1100, 1128, 1142, 1141, 1077, 1139
IEE SAS | Institute of Electrical Engineering of the Slovak Academy of Sciences | http://www.elu.sav.sk/, 1127, 1100, 1128, 1131
ILE SAS | Institute of Landscape Ecology of the Slovak Academy of Sciences | http://www.uke.sav.sk/, 1128

IMS SAS | Institute of Measurement Science of the Slovak Academy of Sciences | http://www.um.sav.sk/, 1065
IP SAS | Institute of Physics of the Slovak Academy of Sciences | http://www.fu.sav.sk/, 1135, 1136, 1081, 1144, 1097, 1087, 1066, 1107, 1129, 1130, 1128
PF SK | PROGRESA FINAL SK, s.r.o. | http://www.progresafinal.sk/, 1131
SOSMT | Slovak Office of Standards, Metrology and Testing | http://www.unms.sk/, 1107

Kosice

IEP SAS | Institute of Experimental Physics of the Slovak Academy of Sciences in Košice | http://wwwnew.saske.sk/uef/, 1135, 1137, 1097, 1088, 1142, 1118, 1119
STM | Slovak Technical Museum | http://www.stm-ke.sk/, 1139
TUKE | Technical University of Košice | http://www.tuke.sk/, 1088, 1119
UPJS | Pavol Jozef Šafárik University in Košice | http://www.upjs.sk/, 1137, 1065, 1097, 1087, 1066, 1088, 1133, 1119, 1139

Presov

PU | University of Prešov | http://www.unipo.sk/, 1118

Zilina

UŽ | University of Žilina | http://www.uniza.sk/, 1065, 1097

Slovenia

Ljubljana

GeoSS | Geological Survey of Slovenia | http://www.geo-zs.si/, 1128
UL | University of Ljubljana | http://www.uni-lj.si/, 1137

South Africa

Bellville

UWC | University of the Western Cape | http://www.uwc.ac.za/, 1128, 1131

Cape Town

UCT | University of Cape Town | http://www.uct.ac.za/, 1117, 1065, 1088, 1118, 1119

Johannesburg

UJ | University of Johannesburg | http://www.uj.ac.za/, 1065
WITS | University of the Witwatersrand | http://www.wits.ac.za/, 1065, 1088

Port Elizabeth

NMU | Nelson Mandela University | http://www.mandela.ac.za/, 1131, 1119

Pretoria

Necsa | South African Nuclear Energy Corporation | http://www.necsa.co.za/, 1142
UNISA | University of South Africa | http://www.unisa.ac.za/, 1136, 1137, 1128
UP | University of Pretoria | http://up.ac.za/, 1142, 1140, 1131

Somerset West

iThemba LABS | iThemba Laboratory for Accelerator Based Sciences | http://www.tlabs.ac.za/, 1136, 1088, 1129, 1130, 1132, 1126, 1139

Stellenbosch

SU | Stellenbosch University | http://www.sun.ac.za/, 1136, 1130, 1128, 1131, 1119, 1139

Spain

Barcelona

ICMAB-CSIC | Institute of Materials Science of Barcelona-CSIC | https://icmab.es/, 1142
IEEC-CSIC | Institute of Space Science of the Higher Research Council | http://www.ice.csic.es/, 1138
IFAE | Institute for High Energy Physics | http://www.ifae.es/, 1081
UPC | Polytechnic University of Catalonia | https://www.upc.edu/en/, 1131

Bilbao

UPV/EHU | University of the Basque Country | http://www.ehu.eus/, 1138

Huelva

UHU | University of Huelva | http://www.uhu.es/, 1130

Leioa

BCMaterials | Basque Center for Materials, Applications and Nanostructures | https://www.bcmaterials.net/, 1142

Madrid

CENIM-CSIC | National Centre for Metallurgical Research of the Higher Research Council | http://www.cenim.csic.es/, 1142
CIEMAT | Centre for Energy, Environment and Technological Research | http://www.ciemat.es/, 1083
ETSIAE | Higher Technical School of Aeronautical and Space Engineering of hte polytechnic University of Madrid | http://www.etsiae.upm.es/, 1138
ICMM-CSIC | Materials Science Institute of Madrid of the Higher Research Council | http://www.icmm.csic.es/, 1137
UAM | Autonoma University of Madrid | http://www.uam.es/, 1117, 1083

Oviedo

UO | University of Oviedo | http://www.uniovi.es/, 1083

Palma

UIB | Illes Baleares University | http://www.uib.cat/, 1136

Santander

IFCA | Institute of Physics of Cantabria of the University of Cantabria | http://ifca.unican.es/, 1083

Santiago de Compostela
USC | University of Santiago de Compostela | http://www.usc.es/, 1135, 1138

Valencia
IFIC | Institute for Particle Physics of the University of Valencia | http://ific.uv.es/, 1138
UPV | Polytechnic University of Valencia | http://webific.ific.uv.es/), 1105
UV | University of Valencia | http://www.uv.es/, 1135, 1131

Sweden

Goteborg
Chalmers | Chalmers University of Technology | http://www.chalmers.se/, 1136, 1130

Lund
ESS ERIC | European Spallation Source ERIC Lund University | https://europeanspallationsource.se/, 1143, 1140
LU | Lund University | http://www.lu.se/, 1135, 1136, 1123, 1088, 1130, 1118

Stockholm
SU | Stockholm University | http://www.su.se/, 1065

Uppsala
TSL | Svedberg Laboratory of the Uppsala University | http://www.tsl.uu.se/, 1097

Switzerland

Basel
Uni Basel | University of Basel | http://www.unibas.ch/, 1126

Bern
Uni Bern | University of Bern | http://www.unibe.ch/, 1135, 1136, 1099

Geneva
UniGe | University of Geneva | http://www.unige.ch/, 1087

Villigen
PSI | Paul Scherrer Institute | http://www.psi.ch/, 1137, 1144, 1083, 1097, 1130, 1100, 1128, 1142, 1143

Zurich
ETH | Swiss Federal Institute of Technology Zurich | http://www.ethz.ch/, 1137, 1096, 1083, 1119
UZH | University of Zurich | http://www.uzh.ch/, 1083

Taiwan

Taipei
AS | Academia Sinica | http://www.sinica.edu.tw/, 1085
ASGCCA | Academia Sinica Grid Computing Certification Authority | http://ca.grid.sinica.edu.tw, 1118
IP AS | Institute of Physics of the Academia Sinica | http://www.phys.sinica.edu.tw/, 1136, 1137
NTU | National Taiwan University | http://www.ntu.edu.tw/, 1136, 1083

Taoyuan City
NCU | National Central University | http://www.ncu.edu.tw/, 1138, 1083

Tajikistan

Dushanbe
NAST | National Academy of Sciences of the Republic of Tajikistan | https://anrt.tj/en/, 1142
PHTI NAST | S.U.Umarov Physical-Technical Institute of the National Academy of Sciences of the Republic of Tajikistan | http://www.phti.tj/, 1142, 1119
TNU | Tajik National University | http://www.tnu.tj/, 1119
TTU | Tajik Technical University named after academic M.S.Osimi | http://ttu.tj/en/main-en/, 1142

Khujand
KSU | Khujand State University | http://www.hgu.tj/, 1119

Thailand

Bangkok
KMUTT | King Mogkut's University of Technology Thonburi | https://global.kmutt.ac.th/, 1088

Chachoengsao
TMEC | Thai Microelectronics Center | http://tmec.nectec.or.th/, 1088

Hat Yai
PSU | Prince of Songkla University | http://www.psu.ac.th/, 1128

Nakhon Ratchasima
SLRI | Synchrotron Light Research Institute | https://www.slri.or.th/en/, 1088
SUT | Suranaree University of Technology | http://www.sut.ac.th/, 1088

Turkey

Adana
CU | Çukurova University | http://www.cu.edu.tr/, 1083

Ankara
METU | Middle East Technical University | http://www.metu.edu.tr/, 1099, 1083

Canakkale
ÇOMU | Çanakkale Onsekiz Mart University | http://www.comu.edu.tr/, 1128

Istanbul
BU | Boğaziçi University | http://www.boun.edu.tr/, 1117, 1083
YTU | Yuldiz Technical University | http://www.yildiz.edu.tr/en/, 1083, 1088

Konya
Karatay Univ. | KTO Karatay University | https://www.karatay.edu.tr/, 1088

Ukraine

Berdyansk
BSPU | Berdyansk State Pedagogical University | http://bdpu.org/, 1128

Dnipro
DNU | Oles Honchar Dnipro National University | http://www.dnu.dp.ua/, 1135

Donetsk
DonIPE | Donetsk Institute for Physics and Engineering named after A.A.Galkin | http://www.donfti.ru/, 1128, 1142
DonNU | Donetsk National University | http://donnu.ru/, 1142, 1133

Kharkov
IERT NASU | Institute of Electrophysics and Radiation Technologies of the National Academy of Sciences of Ukraine | http://www.iert.kharkov.ua/, 1126
ISMA NASU | Institute for Scintillation Materials of the National Academy of Sciences of Ukraine | http://www.isma.kharkov.ua/, 1144, 1128
KhNU | V.N.Karasin Kharkov National University | http://www.univer.kharkov.ua/, 1138, 1083, 1065
LTU | Company “LED,Technologies Ukraine” | http://ltu.ua/, 1065
NSC KIPT | National Science Centre - Kharkov Institute of Physics and Technology | http://www.kipt.kharkov.ua/, 1135, 1136, 1137, 1138, 1083, 1065, 1097, 1088, 1107, 1128, 1126, 1118
STC "IMK" NASU | State Scientific Organization "Institute for Single Crystals" of the National Academy of Sciences of Ukraine | http://www.isc.kharkov.ua/, 1083

Kiev
BITP NASU | N.N. Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine | http://bitp.kiev.ua/, 1135, 1136, 1138, 1117, 1086, 1065, 1088, 1118, 1139
DonIPE NASU | Donetsk Institute for Physics and Engineering named after A.A.Galkin of the National Academy of Sciences of Ukraine | http://www.donphti.kiev.ua/, 1142
IMP NASU | G.V.Kurdyumov Institute of Metal Physics of the National Academy of Sciences of Ukraine | http://www.imp.kiev.ua/, 1137
KINR NASU | Kiev Institute for Nuclear Research of the National Academy of Sciences of Ukraine | http://www.kinr.kiev.ua/, 1136, 1130, 1128
NUK | Taras Shevchenko National University of Kyiv | http://www.univ.kiev.ua/, 1136, 1137, 1128, 1142, 1141, 1139

Lutsk
EENU | Lesya Ukrainka Eastern European National University | http://eenu.edu.ua/, 1135

Lviv
IAPMM NASU | Pidstryhach Institute for Applied Problems of Mechanics and Mathematics of the National Academy of Sciences of Ukraine | http://iapmm.lviv.ua/, 1135
ICMP NASU | Institute for Condensed Matter Physics of the National Academy of Sciences of Ukraine | http://www.icmp.lviv.ua/, 1137
IFNU | Ivan Franko National University of Lviv | http://www.lnu.edu.ua/, 1135
LPNU | Lviv Polytechnic National University | http://lp.edu.ua/, 1143

Sumy
SumSU | Sumy State University | http://sumdu.edu.ua/, 1135

Uzhhorod
IEP NASU | Institute of Electron Physics of the National Academy of Sciences of Ukraine | http://iep.org.ua/, 1128

United Kingdom

Birmingham
Univ. | University of Birmingham | http://www.birmingham.ac.uk/, 1096, 1088

Bristol
Univ. | University of Bristol | http://www.bris.ac.uk/, 1096, 1083

Buckingham
UB | University of Buckingham | http://www.buckingham.ac.uk/, 1112

Cambridge
Univ. | University of Cambridge | http://www.cam.ac.uk/, 1138, 1117

Canterbury
Univ. | University of Kent | http://www.kent.ac.uk/, 1135, 1138

Coventry
Warwick | University of Warwick | https://warwick.ac.uk/, 1137

Daresbury
DL | Daresbury Laboratory; Council for the Central Laboratory of the Research Councils | http://www.cclrc.ac.uk/Activity/DL, 1088

Derby
Univ. | University of Derby | https://www.derby.ac.uk/, 1088

Didcot
RAL | Rutherford Appleton Laboratory; Science and Technology Facilities Council | http://www.stfc.ac.uk/, 1144, 1083, 1142, 1143

Durham
Univ. | Durham University | http://www.dur.ac.uk/, 1138, 1117

Edinburgh
Univ. | University of Edinburgh | http://www.edinburgh.ac.uk/, 1126

Glasgow
U of G | University of Glasgow | http://www.gla.ac.uk/, 1138, 1096, 1097

Guildford
Univ. | University of Surrey | http://www.surrey.ac.uk/, 1136

Lancaster
LU | Lancaster University | http://www.lancaster.ac.uk/, 1096

Leeds
UL | University of Leeds | http://www.leeds.ac.uk/, 1138

Liverpool
Univ. | University of Liverpool | http://www.liv.ac.uk/, 1088

London
Imperial College | Imperial College London | http://www.imperial.ac.uk/, 1135, 1138, 1117, 1144, 1083, 1119

QMUL | Queen Mary of the University of London | http://www.qmul.ac.uk/), 1135, 1126

UCL | University College London | http://www.ucl.ac.uk/, 1100

Manchester
UoM | University of Manchester | http://www.manchester.edu/, 1130, 1100

Nottingham
Univ. | University of Nottingham | http://www.nottingham.ac.uk/, 1138

Oxford
Univ. | University of Oxford | http://www.ox.ac.uk/, 1119

Plymouth
Univ. | University of Plymouth | http://www.plymouth.ac.uk/, 1119

Southampton
Univ. | University of Southampton | http://www.soton.ac.uk/, 1117

York
Univ. | University of York | http://www.york.ac.uk/, 1117, 1126

USA

Amherst, MA
UMass | University of Massachusetts Amherst | https://www.umass.edu/, 1138, 1126

Arlington, TX
UTA | University of Texas Arlington | http://www.uta.edu/, 1118, 1119

Athens, AL
ASU | Athens State University | http://www.athens.edu/, 1112

Austin, TX
UT | University of Texas at Austin | http://www.utexas.edu/, 1088

Baltimore, MD
JHU | Johns Hopkins University | http://www.jhu.edu/, 1083

Batavia, IL
Fermilab | Fermi National Accelerator Laboratory | http://www.fnal.gov/, 1144, 1099, 1083, 1065, 1118

Berkeley, CA
Berkeley Lab | Lawrence Berkeley National Laboratory of the University of California | http://www.lbl.gov/, 1087, 1066, 1088

UC | University of California | http://www.universityofcalifornia.edu/, 1088, 1142

Bloomington, IN
IU | Indiana University Bloomington | http://www.iub.edu/, 1066

Boston, MA
BU | Boston University | http://www.bu.edu/, 1096, 1083

NU | Northeastern University | http://www.northeastern.edu/, 1083

Boulder, CO
CU | University of Colorado at Boulder | http://www.colorado.edu/, 1083

Buffalo, NY
UB | University at Buffalo of the State University of New York | http://www.buffalo.edu/, 1083

Cambridge, MA
Harvard Univ. | Harvard University | http://www.harvard.edu/, 1099

MIT | Massachusetts Institute of Technology | http://www.mit.edu/, 1083, 1065, 1119

Charlottesville, VA
UVa | University of Virginia | http://www.virginia.edu/, 1144, 1083

Chicago, IL
CSU | Chicago State University | https://www.csu.edu/, 1088

UIC | University of Illinois at Chicago | http://www.uic.edu/, 1083, 1066

Cincinnati, OH
UC | University of Cincinnati | http://www.uc.edu/, 1117

College Park, MD
UMD | University of Maryland | http://www.umd.edu/, 1135, 1138, 1117, 1083

College Station, TX
Texas A&M | Texas A&M University | http://www.tamu.edu/, 1083, 1129, 1130, 1119

Columbus, OH
OSU | Ohio State University | http://www.osu.edu/, 1083, 1088

Coral Gables, FL
UM | University of Miami | http://welcome.miami.edu/, 1138, 1117

Davis, CA
UCDavis | University of California, Davis | http://ucdavis.edu/, 1083, 1119

Denton, TX
UNT | University of North Texas | https://www.unt.edu/, 1119

Detroit, MI
WSU | Wayne State University | http://wayne.edu/, 1083, 1088

Durham, NC
Duke | Duke University | http://www.duke.edu/, 1137, 1128

East Lansing, MI
MSU | Michigan State University | http://www.msu.edu/, 1135, 1129, 1130

Evanston, IL
NU | Northwestern University | http://www.northwestern.edu/, 1083

Fairfax, VA
GMU | George Mason University | http://www.gmu.edu/, 1096

Gainesville, FL
UF | University of Florida | http://www.ufl.edu/, 1083

Houston, TX
Rice Univ. | William Marsh Rice University | http://www.rice.edu/, 1083
UH | University of Houston | http://www.uh.edu/, 1088

Indianapolis, IN
IUPUI | Indiana University - Purdue University Indianapolis | http://www.iupui.edu/, 1099

Iowa City, IA
UIowa | University of Iowa | http://www.uiowa.edu/, 1083, 1087

Irvine, CA
UCI | University of California, Irvine | http://www.uci.edu/, 1137

Ithaca, NY
Cornell Univ. | Cornell University | http://www.cornell.edu/, 1083

Kent, OH
KSU | Kent State University | http://www.kent.edu/, 1126

Knoxville, TN
UTK | University of Tennessee of Knoxville | http://www.utk.edu/, 1083, 1088, 1131

Lansing, MI
IONETIX | Ionetix Corporation | http://ionetix.com/, 1132

Lawrence, KS
KU | University of Kansas | http://www.ku.edu/, 1083

Lemont, IL
ANL | Argonne National Laboratory | Argonne, IL http://www.anl.gov/, 1135, 1136, 1081, 1066

Lexington, KY
UK | University of Kentucky | http://www.uky.edu/, 1144

Lincoln, NE
UNL | University of Nebraska-Lincoln | http://www.unl.edu/, 1083

Livermore, CA
LLNL| Lawrence Livermore National Laboratory | http://www.llnl.gov/, 1083, 1129, 1130

Long Beach, CA
CSULB | California State University, Long Beach | www.csulb.edu, 1135

Los Alamos, NM
LANL | Los Alamos National Laboratory; Meson Physics Facility LAMPF | http://www.lanl.gov/, 1136, 1088, 1128

Los Angeles, CA
UCLA | University of California, Los Angeles | http://www.ucla.edu/, 1083, 1126, 1119

Louisville, KY
UofL | University of Louisville | http://lousville.edu/, 1137

Lubbock, TX
TTU | Texas Tech University | http://www.ttu.edu/, 1083

Madison, WI
UW-Madison | University of Wisconsin-Madison | http://www.wisc.edu/, 1083

Manhattan, KS
KSU | Kansas State University | https://ksiteonline.com/, 1083

Menlo Park, CA
SLAC | SLAC National Accelerator Laboratory is Operated by Stanford University | http://www6.slac.stanford.edu/, 1096

Merced, CA
UCMerced | University of California, Mered Madison | http://www.ucmerced.edu/, 1096

Minneapolis, MN
U of M | University of Minnesota | http://twin-cities.umn.edu/, 1135, 1117, 1083

Nashville, TN
VU | Vanderbilt University | http://www.vanderbilt.edu/, 1083, 1129, 1130

New Brunswick, NJ
RU NB | Rutgers University New Brunswick | https://newbrunswick.rutgers.edu/, 1083

New Haven, CT
Yale Univ. | Yale University | http://www.yale.edu/, 1066, 1088

New York, NY
CUNY | City University of New York | http://www2.cuny.edu/, 1135, 1137, 1138, 1117
RU | Rockefeller University | http://www.rockefeller.edu/, 1135, 1083

SUNY | State University of New York | http://www.suny.edu/, 1138, 1117, 1065, 1066

Newport News, VA

JLab | Thomas Jefferson National Accelerator Facility; Southeastern Universities Research Association SURA | http://www.jlab.org/, 1135, 1117, 1097, 1119

Norfolk, VA

NSU | Norfolk State University | http://www.nsu.edu/, 1097

Norman, OK

OU | University of Oklahoma | http://www.ou.edu/, 1135, 1138

Notre Dame, IN

ND | University of Notre Dame | http://www.nd.edu/, 1136, 1083

Oak Ridge, TN

ORNL | Oak Ridge National Laboratory | http://www.ornl.gov/, 1088, 1129, 1130, 1128

Omaha, NE

Creighton Univ. | Creighton University | https://www.creighton.edu/, 1088

Oxford, MS

UM | University of Mississippi | http://www.olemiss.edu/, 1083

Pasadena, CA

Caltech | California Institute of Technology | http://www.caltech.edu/, 1137, 1083

Philadelphia, PA

Penn | University of Pennsylvania | http://www.upenn.edu/, 1135, 1117

Piscataway, NJ

Rutgers | Rutgers University-State University of New Jersey | http://www.rutgers.edu/, 1137, 1138, 1117

Pittsburgh, PA

CMU | Carnegie Mellon University http://www.cmu.edu/, 1083

Princeton, NJ

PU | Princeton University; Joseph Henry Laboratories of Physics | http://www.princeton.edu/, 1083

Providence, RI

Brown | Brown University | https://www.brown.edu/, 1083

Raleigh, NC

NCCU | North Carolina Central University | http://www.nccu.edu/, 1136

Riverside, CA

UCR | University of California, Riverside | http://www.ucr.edu/, 1083

Rochester, NY

UR | University of Rochester | http://www.rochester.edu/, 1137, 1138, 1117, 1083

Salt Lake City, UT

U of U | University of Utah | http://www.utah.edu/, 1117

San Diego, CA

SDSU | San Diego State University | http://www.sdsu.edu/, 1135, 1083, 1119

San Luis Obispo, CA

Cal Poly | California Polytechnic State University | California Polytechnic State University | https://www.calpoly.edu/, 1088

Santa Barbara, CA

UCSB | University of California, Santa Barbara | https://www.universityofcalifornia.edu/, 1083

Seattle, WA

UW | University of Washington | http://www.washington.edu/, 1126

Stanford, CA

SU | Stanford University | http://stanford.edu/, 1131

Tallahassee, FL

FSU | Florida State University | http://www.fsu.edu/, 1137, 1083

Tempe, AZ

ASU | Arizona State University | http://www.asu.edu/, 1138

Tuscaloosa, AL

UA | University of Alabama | http://www.ua.edu/, 1083

University Park, PA

Penn State | Pennsylvania State University | http://www.psu.edu/, 1135, 1136, 1066

Upton, NY

BNL | Brookhaven National Laboratory | http://www.bnl.gov/, 1096, 1065, 1097, 1087, 1066, 1118, 1119, 1139

Urbana, IL

I | University of Illinois at Urbana-Champaign | http://illinois.edu/, 1085

Wako, TX

BU | Baylor University | http://www.baylor.edu/, 1083

West Lafayette, IN

Purdue Univ. | Purdue University | http://www.purdue.edu/, 1083, 1088

Williamsburg, VA

W&M | College of William & Mary | http://www.wm.edu/, 1097

Uzbekistan

Jizzakh

JSPI | Jizzakh State Pedagogical Institute named after A.Kadri | http://jspi.uz/, 1087, 1133

Namangan

NamMTI | Namangan Institute of Engineering and Technology | http://nammti.uz/, 1136

Samarkand

SSU | Samarkand State University named after Alisher Navoi | http://www.samdu.uz/, 1081, 1087

Tashkent

AS RUz | Academy of Sciences of the Republic of Uzbekistan | http://www.academy.uz/, 1127

Assoc.“P.-S.” PTI | Physical Technical Institute Association “Physics-Sun” named after S.A.Azimov of the Academy of Sciences of the Republic of Uzbekistan | http://www.fti.uz/, 1136, 1137, 1097, 1087

IAP NUU | Institute of Applied Physics of the National University of Uzbekistan named after Mirzo Ulugbek | http://nuu.uz/, 1135, 1136

INP AS RUz | Institute of Nuclear Physics of the Academy of Sciences of the Republic of Uzbekistan | http://www.inp.uz/, 1136, 1083, 1097, 1100, 1128, 1142, 1143, 1140

IS AS RUz | Institute of Seismology named after G. A. Mavlyanov of the Academy of Sciences of the Republic of Uzbekistan | https://www.seismos.uz/, 1127

NUU | National University of Uzbekistan named after Mirzo Ulugbek | http://nuu.uz/, 1135, 1100

Vietnam

Da Lat

DLU | Da Lat University | http://www.dlu.edu.vn/, 1139

NRI | Nuclear Research Institute | http://www.nri.gov.vn/, 1139

Da Nang

DTU | Duy Tan University | http://www.daytan.edu.vn/, 1142

Hanoi

IMS VAST | Institute of Material Science of the Vietnam Academy of Science and Technology | http://ims.vast.ac.vn/, 1137

INPC VAST | Institute of Natural Products Chemistry of the Vietnam Academy of Science and Technology | http://vast.ac.vn/, 1077

IOP VAST | Institute of Physics of the Vietnam Academy of Science and Technology | http://www.iop.vast.ac.vn/, 1135, 1117, 1130, 1128, 1142, 1131, 1139

VINATOM | Vietnam Atomic Energy Institute of the Ministry of Science and Technology | https://vinatom.gov.vn/en/, 1077

VNU | Vietnam National University Hanoi | http://www.vnu.edu.vn/, 1128, 1119

Ho Chi Minh City

VNUHCM | Vietnam National University, Ho Chi Minh City | https://vnuhcm.edu.vn/, 1130