International Conference
"New Horizons in Mathematical Physics"

Conference Website
Dedicated to the 80th Anniversary of Professor Igor Volovich

5–10 October 2026

PROGRAM

All times are given in Moscow time (MSK, UTC+3).
CEST = MSK−1; EDT = MSK−7; JST = MSK+6; China Standard Time = MSK+5.

Monday, 5 October 2026

10:30

Registration

10:50

Opening

11:00–11:30

V.V. Kozlov (Steklov Mathematical Institute of RAS)
Earnshaw's theorem and levitation

11:30–12:00

D.V. Treschev (Steklov Mathematical Institute of RAS)
Isonormal potentials in one degree of freedom
We consider the Hamiltonian system with one degree of freedom

$$\dot{x} = y, \quad \dot{y} = -\partial V(x)/\partial x, \qquad x, y \in$$

with the smooth potential $V : \mathbb{R} \to \mathbb{R}$. We assume that the origin is an elliptic singular point: $V'(0) = 0$ and $V''(0) > 0$. Two potentials V_0 and V_1 are refered to be isonormal if in a neighborhood of the origin there exists a canonical change of coordinates which transforms the Hamiltonian function $y^2/2 + V_0$ to $y^2/2 + V_1$. In particular, any potential isonormal to $x^2/2$ is isochronous. We obtain a criterium of isonormality for analytic potentials.

12:00–12:30

Coffee break

12:30–13:00

P. Frampton (University of Salento, Italy)
About p-adic Numbers and Professor Igor Volovich on the Occasion of his 80th Anniversary
We discuss Volovich's amazing 1987 paper which invented the p-adic string and its enormous impact on string theory research.

13:00–13:30

B. Dragovich (Institute of Physics, University of Belgrade, Serbia)
A Closed Universe with Hybrid Nonlocality
I will present some model of a closed universe in which gravity and matter are nonlocal. The gravitational field is described by an exact exponential scale factor ($k = +1$) of a nonlocal de Sitter gravity. The role of matter is played by a weak field approximation of scalar field which has its origin in the p-adic theory of open strings. This nonlocal weak scalar field has the same exponential form as the scale factor. The solution implies a connection of the cosmological constant, and some other parameters, with prime numbers and it will be discussed. This presentation is mainly based on the work: B.D., "A Closed Universe with Hybrid Nonlocality", Intern. J. Geom. Methods in Modern Physics, Vol. 21, No. 10, 2440012 (2024).

13:30–14:00

V.S. Anashin (Lomonosov Moscow State University)
The "True Randomness" Cannot Be Certified Since Its Very Existence Cannot Be Proven
"In the talk, we argue that current paradigms of certification of quantum generators of random numbers are fundamentally invalid:
1. Bell Certification is Invalid: We construct an EPR-like measurement protocol for a completely deterministic system with two entangled states constituting the Bell singlet This setup fully reproduces the CHSH inequality violation without assuming hidden variables.
2. Kochen-Specker Certification is Invalid: We demonstrate that the certification of algorithmic incomputability via value indefiniteness fails. Because the high-resolution continuous helices are the strict Archimedean limit of a computable, zero-entropy automaton, the resulting data stream satisfies the Kochen-Specker constraints perfectly.
3. Chaotic Map Certification is Invalid: Due to inevitable measurement errors, chaotic maps can be approximated to any arbitrary accuracy by strictly deterministic, non-chaotic maps (cf., Volovich postulate: only rationals are observable).
The rest of core thesis of the talk are:
4. Quantum Probability is Intensity: "Quantum probability" is not a measure space of random events in the Kolmogorovian sense; it is a calculus of wave intensities. The Born rule computes global average intensities rather than probabilities. Since physical limits preclude sub-wavelength antennas capable of directly resolving high-frequency field amplitudes, physicists must rely on indirect interferometric methods. Consequently, the interferometer — rather than classical clocks and rods — functions as the primary measurement apparatus.
5. Because wave intensity is proportional to the amplitude squared, wave functions emerge from classical probabilistic characteristic functions (which in our case are defined by automata, the p-adic 1-Lipschitz maps) by extracting the square roots of Kolmogorovian probabilities.This mapping transforms characteristic functions into Fourier images of Besicovitch almost-periodic functions living in the separable Hilbert space $B^2(\mathbb{Q})$ over the rationals. This space, along with the space of 1-Lipschitz functions over p-adic integers, is our main functional arena. "

14:00–15:30

Lunch

15:30–16:00

E.I. Zelenov (Steklov Mathematical Institute of RAS)
Planck length and metric geometry
The problem of Planck length is considered in the language of metric geometry. To do this, we explicitly construct a geodesic in the Gromov-Hausdorff space of isometry classes of compact metric spaces connecting a non-Archimedean space with an Archimedean one.

16:00–16:30

W. Zuniga-Galindo (University of Texas Rio Grande Valley, USA)
p-Adic Quantum Mechanics, Non-locality, and the Measurement Problem
The space discreteness hypothesis asserts that the nature of space at short distances is radically different from that at large distances. Based on the Bronstein inequality, here, we use a totally disconnected topological space X as a model for the physical space at short distances. However, we consider the time as a real variable. In this framework, the Dirac–von Neumann formalism can be used. This discreteness hypothesis implies that given two different points in space, there is no continuous curve (a world line) joining them. Consequently, this hypothesis is not compatible with the theory of relativity. We propose $\mathbb{R}\times(\mathbb{R}\times X)^3$ as a model of a space-time. For simplicity, we work out our models with $\mathbb{R}\times(\mathbb{R}\times X)$ as the configuration space. Quantum mechanics, in the sense of Dirac–von Neumann, on the Hilbert space $L^2(\mathbb{R}\times X)$ is a non-local theory: the Hamiltonians are non-local operators, and thus, spooky action at a distance is allowed. The paradigm asserting that the universe is non-locally real implies that the proposed version of QM admits realism. This version of QM can be specialized to standard QM by using Hamiltonians acting on wavefunctions supported on the region $\mathbb{R}\times\mathbb{R}$. We apply the developed formalism to the measurement problem. We propose a new mechanism for wavefunction collapse.

16:30–17:00

A. Khrennikov (Linnaeus University, Sweden)
The Double Covariance Model: A Stochastic Reconstruction of Quantum Entangled States via Interplay of Micro-Macro Time Scales
"This article presents a concrete mathematical framework for the generation of entangled quantum states from classical stochastic processes. We demonstrate that any density operator ρ_{AB} of a composite system can be derived from the correlations between two underlying stochastic processes, $X(t)$ and $Y(t)$, representing the random fluctuations of its subsystems. This construction utilizes a two-scale temporal scheme—micro and macro time—where quantum correlations emerge as macro-correlations derived from underlying micro-correlations. We propose the Double Covariance Model (DCM), which reproduces the fundamental properties of quantum theory by treating the quantum state as the fourth-order moment structure of an underlying classical probability space. "

17:00–20:00

Conference dinner

Tuesday, 6 October 2026

10:30–11:00

G.V. Belozerov and A.T. Fomenko (Lomonosov Moscow State University)
Generalized Jacobi–Chasles theorem in Minkowski spaces and spaces of constant sectional curvature
The classical Jacobi-Chasles theorem states that in Euclidean space, all tangent lines to a geodesic on a triaxial ellipsoid are simultaneously tangent to quadrics confocal with it. G.V. Belozerov proved a fundamental, complete analogue of the Jacobi-Chasles theorem for the intersection of any non-degenerate confocal quadrics in $\mathbb{R}^n$. A remarkable consequence of this theorem is the integrability of confocal billiards on the intersection of any confocal quadrics. He also derived a condition on the potential sufficient for the integrability of the system on such an intersection.
Recent results by G.V. Belozerov and A.T. Fomenko establish a generalized Jacobi-Chasles theorem in Minkowski spaces and in spaces of constant sectional curvature. It is also shown that, in the two-dimensional case, this result cannot be extended to surfaces that are not locally isometric to spaces of constant sectional curvature.

11:00–11:30

S.V. Kozyrev (Steklov Mathematical Institute of RAS)
How to accelerate grokking

11:30–12:00

S.Y. Dobrokhotov (Ishlinsky Institute for Problems in Mechanics of RAS)
Asymptotics of the Hermitian orthogonal polynomials with two indices: some questions about integrable Hamiltonian systems

12:00–12:30

Coffee break

12:30–13:00

N. Watanabe (Tokyo University of Science, Japan)
On Transmitted Complexity for Quantum Dynamical Systems

13:00–13:30

V.A. Zagrebnov (Institut de Mathématiques de Marseille, France)
On Trotter product formula for affine semigroups
In a Hilbert space the Trotter product approximations for affine semigroups may converge in .the operator-norm topology.

13:30–14:00

L. Accardi (Centro Vito Volterra, University of Rome Tor Vergata, Italy)
New structures, techniques and results in mathematics and in physics emerged in more than 20 years of collaboration with Igor Volovich and with many researchers related with him

14:00–15:30

Lunch

15:30–16:00

A.G. Sergeev (Steklov Mathematical Institute of RAS)
BB-correspondence in the theory of topological
Solid states, called the topological insulators, have a broad gap in their energy spectrum which is stable under small deformations. This property motivates the usage of topological methods for their investigation. The algebras of observables of topological insulators belong to the class of C*-algebras for which there is a variant of K-theory proposed by Van Daele. In its terms it is possible to define the topological invariants of the bulks of insulators.
However this approach does not work at the boundary of the insulator. Different energy zones (which do not intersect inside the insulator) can intersect on its boundary. To deal with the boundaries of topological insulators it is necessary to use another variant of K-theory proposed by Kasparov. In its terms the boundary topological invariants of insulator may be defined. They are related to the topological invariants of the bulk of topological insulator by the BB(bulk-boundary)-map in the long exact sequence of homomorphisms of K-groups generated by the short exact sequence of homomorphisms of C^*-algebras relating the algebrasn of observables of the insulator and its boundary. This relation between the topological invariants of the bulk of insulator and its boundary is called the BB-correspondence.
While preparing this report the author was supported financially by the Russian Scientific Foundation, grant N 24-11-00196.

16:00–16:30

M.D. Missarov (Kazan Federal University)
Renormalization Group on a Generalized Two-Dimensional Hierarchical Lattice
This talk will discuss the properties of the renormalization group transformation on a two-dimensional hierarchical lattice, in which the distance between opposite vertices of an arbitrary square differs from the distance between adjacent vertices of the square and is a parameter of the new model. The Gaussian parts of the generalized models are chosen to be invariant under the block-spin renormalization group. In the bosonic case, the action of the renormalization group on the non-Gaussian part of the Hamiltonian is given by a nonlinear integral operator. In the four-component fermionic hierarchical model, the renormalization group transformation in coupling constant space is explicitly calculated as a complex nonlinear map for which an explicit description of all fixed-point branches can be given. The dynamical properties of this map are discussed.

16:30–17:00

F. Mukhamedov (United Arab Emirates University, UAE)
p-adic Ising models on ary trees
In the present talk, we discuss periodic p-adic (quasi-)Gibbs measures for the Ising model on ary trees, with a particular focus on the irregular $(2, 3)$-ary tree. Unlike the classical setting of regular Cayley trees, where translation-invariant and periodic Gibbs measures are relatively well understood, the irregular geometry leads to new phenomena. It tunrs out that if $p \equiv 1 \pmod 4$ then the model admits an infifinite family of periodic p-adic quasi-Gibbs measures whose periods range over all integers $m \geq 1$, yielding a genuine phase transition. Our approach is based on a renormalization-group (RG) analysis: we identify the associated p-adic RG map, prove that its

Julia set is a Cantor-type set, and show that the induced dynamics on this set is conjugate to a full shift, hence chaotic in the sense of Devaney. These results reveal sharp contrasts between real and p-adic statistical mechanical models and enrich the emerging theory of p-adic probability on hierarchical structures.

17:00–17:30

Tea break

17:30–18:00

V.P. Frolov (University of Alberta, Canada)
Do Black Holes Need Singularities? The Regular Black Hole Paradigm

18:00–18:30

V.A. Berezin (Institute for Nuclear Research of RAS)
Induced gravity + creation of the universe "from nothing" = Big Bang
With three postulates at hand – induced gravity, creation of the universe "from nothing" and the phenomenological description of the particle creation process – we show that the homogeneous and isotropic universe starts with the Big Bang, and the particles are created along the null hypersurface, thus being causally connected despite the fact that the universe itself is spatially infinite.

18:30–19:00

V.Zh. Sakbaev (Keldysh Institute of Applied Mathematics)
Piecewise-smooth extension of the Kruskal black hole spacetime and self-adjointness of the Liouville operator

19:00–19:30

M.O. Katanaev (Steklov Mathematical Institute of RAS)
Formation of a spherically symmetric black hole by a scalar field
The Liouville solution in General Relativity with a scalar field and the exponential potential describes a black hole formation by a scalar field. The solution is global and infinitely smooth. It is obtained without any approximation: the action $\to$ field equations $\to$ Liouville ansatz for the metric $\to$ exact solution. The event horizon is a sphere which appears at a finite moment of time with infinitesimal radius. Afterwards it expands to infinity with the velocity of light. The singularity is spacelike and completely hidden by the horizon. Comparison with the Schwarzschild solution shows that the effective mass of the black hole grows as the time squared.

19:30–20:00

A.F. Zakharov (ITEP & BLTP JINR)
Black hole shadows in alternative gravity theories
Recently, a number of authors have published papers in which they claim to consider the shadows of rotating black holes obtained within the framework of the loop quantum theory of gravity. In these works, as in many previous works by this group of authors, a simple procedure is considered, namely, a static metric obtained within the framework of the non-Einstein theory

of gravity is taken. Then the Newman–Janis transformation is applied to this metric, which has been successfully applied to "derive" the Kerr metric from the Schwarzschild metric. is a priori believed that they have obtained a solution like a rotating black hole in an alternative theory of gravity. Further, these authors use the obtained metric to obtain unstable photon orbits and claim that they have obtained the shadows of black holes in alternative theories of gravity. Indeed, when analyzing the Kerr–Newman black hole metric in the framework of general relativity, if unstable photonic orbits are found, then these critical parameters of photonic geodesics determine the shadow of the black hole, however, unstable photonic orbits may exist in the absence of shadows. There is confusion about considering a signi#cant electric charge of astrophysical black holes, as well as considering metrics with quantum corrections, which are usually considered for Planck black holes, for supermassive black holes with masses of the order of $4 \times 10^6 M_{\rm sun}$ (in the Galactic Center) up to $6.5 \times 10^9 M_{\rm sun}$ in the center of M87 galaxy.

Wednesday, 7 October 2026

10:30–11:00

A.N. Shiryaev (Steklov Mathematical Institute of RAS)
Non-asymptotic estimation of a parameter in diffusion-type processes
We consider observations $X = (X_t)_{t\geq 0}$ of a diffusion-type process

$$dX_t = f_t(X, \lambda)\, dt + \sigma_t(X)\, dB_t, \qquad X_0 = x,$$

where $B = (B_t)_{t\geq 0}$ is standard Brownian motion, and the only information available regarding the parameter λ is that it belongs to an open set Λ.
If a decision must be made based on sequential observations of the process X, the problem arises of obtaining "good" estimates $\hat{\lambda}_t$ of the unknown parameter λ at any given time t. In mathematical statistics, estimates $\hat{\lambda}_t$ are typically constructed whose quality is assessed solely in an asymptotic sense as $t \to \infty$.
In this paper, we construct (maximum likelihood) estimates and investigate the quality of the proximity of these estimates $\hat{\lambda}_t$ to λ for any given t. The results are illustrated by numerical computations.

11:00–11:30

A.S. Holevo (Steklov Mathematical Institute of RAS)
On a new class of sharp entropy inequalities
A number of optimization problems in quantum information: constrained classical capacity of quantum channel – entanglement of formation of a composite state; accessible information of an ensemble of quantum states – can be formulated as calculation of the convex closure of output entropy of certain quantum channel.This is a convex programming problem for which the dual problem along with the necessary and sufficient optimality conditions can be established. These optimality conditions imply new sharp lower bounds for Shannon entropy which are related to generalizations of log-Sobolev inequality.

11:30–12:00

A.N. Pechen (Steklov Mathematical Institute of RAS)
Some topics in control of quantum systems

12:00–12:30

Coffee break

12:30–13:00

P. Gibilisco (University of Rome Tor Vergata, Italy)
Solution of the Arnold problem for the α-Proudman–Johnson equations: a celebration of the unity of mathematics
"In the ""Arnold Problems" the question 1981-29 asks to find equations of Mathematical Physics which realizes geodesic flows of infinite-dimensional ellipsoids. This problem has been recently solved for the alpha-Proudman-Johnson equations due to the results of Lenells-Misiolek and of Bauer and coworkers. The basic tools are: 1) a surprising link between the solutions of the alpha-Proudman-Johson equations and the alpha-connections introduced by Chentsov in his

foundational work in Information Geometry; 2) the description of the alpha-connections through the geometry of the L^p spheres.
Two (apparently) totally unrelated fields are finally linked to show, once more, the sometimes hidden unity of Mathematics.

13:00–13:30

A.S. Trushechkin (Technical University of Braunschweig, Germany)
Quantum mechanics with real numbers

13:30–14:00

G.G. Amosov (Steklov Mathematical Institute of RAS)
On quantum channels generated by permutations of a fixed basis and their information characteristics
We generalize the construction of Weyl quantum channels and show how the majorization method allows us to estimate their information characteristics. The approach is based on the use of the inner semidirect product of two unitary groups. The proposed approach is applicable both in finite-dimensional and infinite-dimensional spaces.

14:00–15:30

Lunch

15:30–16:00

R. Kerner (Sorbonne University, France)
The discrete origin of Lorentz and SU(3) symmetries
We show how the fundamental discrete Z_2 and Z_3 Quantum Mechanical symmetries acting in the Hilbert space, combined with the superposition principle, generate continuous Lie groups acting in the space of observables, the conserved energy and momentum in the first place, and as a consequence, in the dual Fourier space-time. Unifying both symmetries in a Z_3 graded covering of the Lorents group is constructed and its physcial impact on QCD isndiscussed, too.

16:00–16:30

V.P. Burskii (Moscow Institute of Physics and Technology)
On the traces of the solution of a general linear differential equation in a domain.
The presentation addresses the general theory of boundary value problems for general linear differential equations with smooth coefficients in a bounded domain with a smooth boundary; it presents new results concerning the boundary properties of solutions belonging to the space $L^2(\omega)$. Decompositions of the boundary space into subspaces of regularized traces are obtained. Conditions imposed on the traces of the solution to a general differential equation at the domain boundary conditions that allow the solution to be reconstructed from its traces and the right-hand side of the equation are identified and investigated. For the general equation with constant coefficients, the resulting conditions on the solution traces take the form of a generalized moment problem. The conditions obtained are applied to the study of certain classical problems in geometry, algebra, and analysis.

16:30–17:00

F.S. Dzheparov (NRC Kurchatov Institute)

Selected problems of nonequilibrium quantum statistical mechanics in neutron physics studies

Selected problems of nonequilibrium quantum statistical mechanics in neutron physics studies

F.S. Dzheparov, D.V. Lvov
National Research Center "Kurchatov Institute"
dzheparov@itep.ru, nrcki@nrcki.ru

1. Spin dynamics is one of the most important fields of research in beta-NMR studies [1,2]. The theoretical description of such meaningful tasks as constructing the NMR line shape function of beta-active nuclei or the cross-relaxation shape function of 8Li-6Li nuclei in the problem of random walks in disordered media is hampered by the lack of a regular small parameter in the existing theory of spin fluctuations of the nuclei of the main isotopes forming the crystal, for example, for the nuclei 7Li and 19F in the crystal LiF. It is shown that a simple and physically transparent hypothesis about the approximation of fluctuations of the z-components of local fields (produced by the main spins of a crystal) by a normal process with a realistic correlation function makes it possible to construct this correlation function itself and obtain [1,2] the above-mentioned line shape functions in agreement with experimental data. Additionally, it is shown that within the framework of this theory, well-known oscillations of the free induction signal of nuclear spins in homonuclear crystals are naturally obtained [3].

2. Inelastic neutron scattering and Raman scattering of light are the main methods for studying phonon spectra in quasi-harmonic crystals and can be used to verify the dependence of phonon filling numbers on external pressure [4,5] in equilibrium systems. The description of such systems, as well as their nonequilibrium generalizations, are based on the use of Gibbs [6] or quasi-Gibbs ensembles [7], the construction of which is based on well-known (quasi-)additive integrals of motion, which usually use energy, momentum, angular momentum, and the number of particles. It is shown [5] that this list of additive integrals is far from complete. This creates new problems in both equilibrium and nonequilibrium statistical mechanics.

3. In the framework of neutron continuum optics, the spectrum of a beam passing through a uniformly and rectilinearly moving plate coincides, up to Doppler corrections, with the spectrum in the case of a stationary plate. If the plate movement is not uniform, then the spectrum of the transmitted beam depends on accelerations, which is the content of the "accelerated matter effect" [8], the explanations of which are based on purely classical mechanical analytical analysis or numerical quantum mechanical modeling. In [9], an analytical quantum mechanical calculation based on a nonstationary generalization of the so-called eikonal approximation was developed for the first time. It is generalized for systems described in the framework of quasi-classics, and the eikonal approximation is obtained as a result for the simplest quasi-classical trajectory.

1. F.S. Dzheparov, A.D. Gulko, D.V. Lvov. Beta-NMR and Basic Processes in Spin Dynamics. Appl. Mag. Res. V.52, 805–829, 2021.
2. F.S. Dzheparov, A.D. Gulko, N.O. Elyutin, D.V. Lvov, V.E. Shestopal. Neutron physics investigations of fundamental processes of statistical mechanics. Int. J. Mod. Phys. A V.37, 2243008, 2022.
3. F.S. Dzheparov, M.A. Veretennikov. The physical foundations of the spin dynamics of nuclear paramagnets. 2. Phase relaxation and basic correlation functions. Preprint ITEP 06-11, Moscow 2011 (in Russian).
4. V.G. Hamdamov, V.I. Wettegren, I.I. Novak. Izv. AN UzSSR, ser. fiz.-mat. nauk, 1, 50, 1986 (in Russian).
5. F.S. Dzheparov. Pressure dependence of phonon populations and non-standard quasiadditive integrals of motion. Optics and Spectroscopy V.131, 440–446, 2023.
6. L.D. Landau, E.M. Lifshitz. Statistical physics. Elsevier 2005.
7. D. Zubarev, V. Morozov, and G. Röpke, Relaxation and Hydrodynamic Processes, Statistical

Mechanics of Nonequilibrium Processes (Akademie Verlag, Berlin, 1996).
8. A.I. Frank. Ultracold neutrons and the interaction of waves with moving matter. Physics of Particles and Nuclei V.47, 647–666, 2016.
9. F.S. Dzheparov, D.V. Lvov, A.I. Frank. Neutron Propagation through a Sample Oscillating along the Neutron Beam. Physics of Atomic Nuclei V.85, 561–566, 2022.

17:00–17:30

Tea break

18:00–18:20

B.O. Volkov (MIPT & Steklov Mathematical Institute of RAS)
Lévy Laplacian and Heat Flows of Differential Forms
The Lévy Laplacian is an infinite-dimensional differential operator that is of interest due to its connection with the Yang–Mills gauge fields. It was shown by Accardi, Gibilisco and Volovich (1994) that a connection satisfies the Yang–Mills equation if and only if the parallel transport satisfies the Laplace equation with the Lévy Laplacian. We study the heat equation with the Lévy Laplacian on the loop space. Using the heat flows of differential 0-forms and 1-forms on a compact Riemannian manifold, we construct families of solutions. We show that these solutions converge as time tends to infinity to functionals that are constant on homotopy equivalent loops.

18:20–18:50

N.G. Marchuk (Steklov Mathematical Institute of RAS)
The Lanczos equation (1929) as an unconventional perspective on the Dirac equation (1928): what does it offer?

18:50–19:20

V.V. Vedenyapin (Keldysh Institute of Applied Mathematics RAS)
Derivation of Hubble's law and the accelerated expansion of the Universe from Hamiltonian dynamics
In standard textbooks [1–3], the Hubble constant is defined via the metric. Here, we define it—as is appropriate—in terms of matter, following Milne and McCrea, by extending their theory of an expanding universe to the relativistic case. This allows us to explain accelerated expansion as a simple relativistic effect—without Einstein's lambda, dark energy, or new particles—as a direct consequence of the classical Einstein action. The well-established fact of accelerated expansion makes it possible to determine the sign of the curvature in the Friedmann model: it turns out to be negative, implying that we inhabit a Lobachevsky space with negative curvature. Furthermore, in classical works (see [1–4]), field equations are presented without a derivation of their right-hand sides. Here, we derive the right-hand sides of the Maxwell and Einstein equations—within the framework of the Vlasov–Maxwell–Einstein system—using a classical yet slightly more general principle of least action [5–6]. The resulting derivation yields Vlasov–Einstein equations that differ from those previously proposed. We outline a method for transitioning from kinetic equations to hydrodynamic consequences [5–6], a procedure originally employed by A.A. Vlasov himself [4]. In the context of Hamiltonian mechanics, one can transition from the hydrodynamic consequences of the Liouville equation to the Hamilton–Jacobi equation—an approach previously used in quantum mechanics by E. Madelung and, more generally, by V.V. Kozlov [7]. This yields the Milne–McCrea solutions in the non-relativistic case,

as well as non-relativistic and relativistic analyses of Friedmann-type solutions describing the non-stationary evolution of the Universe. This makes it possible to derive the phenomenon of the accelerated expansion of the Universe as a relativistic effect [8–10]—based on the classical relativistic principle of least action—without artificial additions such as Einstein's lambda, dark energy, or new fields. This places general relativity and cosmology on a solid mathematical foundation and provides an explanation for accelerated expansion, a phenomenon well-verified experimentally (and recognized with a Nobel Prize in 2011).

References 1. Dubrovin B.A., Novikov S.P., Fomenko A.T. Modern Geometry: Methods and Applications. Moscow: Nauka, 1986. 2. Landau L.D., Lifshitz E.M. The Classical Theory of Fields. Moscow: Nauka, 1988. 3. Weinberg S. Gravitation and Cosmology. Moscow: Mir, 1975, 696 pp. 4. Vlasov A.A. Statistical Distribution Functions. Moscow: Nauka, 1966, 356 pp. 5. Vedenyapin V., Fimin N., Chechetkin V. The generalized Friedmann model as a self-similar solution of Vlasov–Poisson equation system // European Physical Journal Plus. 2021. Vol. 136. No. 1. P. 71. 6. Vedenyapin V.V., Paryonkina V.I., Svirshchevsky S.R., "On the derivation of electrodynamics and gravitation equations from the principle of least action", Zh. Vychisl. Mat. i Mat. Fiz. ...Phys., 62:6 (2022), 1016–1029 V. V. Vedenyapin, V. I. Parenkina, S. R. Svirshchevskii, "Derivation of the equations of electrodynamics and gravity from the principle of least action", Comput. Math. Math. Phys., 62:6 (2022), 983–995 7. V. V. Kozlov, General Theory of Vortices, Udmurt State University Press, Izhevsk, 1998, 239 pp. 8. V. V. Vedenyapin, Ya. G. Batishcheva, M. V. Goryunova, A. A. Russkov, "Mathematical theory of the accelerated expansion of the Universe based on the principle of least action", SMFN, 71:4 (2025), 562–584 9. V. V. Vedenyapin, "Mathematical theory of the expansion of the Universe based on the principle of least action", Zh. Vychisl. Mat. Mat. Fiz., 64:11 (2024), 2114–2131; V. V. Vedenyapin, "Mathematical theory of the expanding Universe based on the principle of least action", Comput. Math. Math. Phys., 64:11 (2024), 2624–2642 10. V. V. Vedenyapin, "Mathematics of the accelerated expansion of the Universe and Lobachevsky space", Dokl. RAN. Mat., Inform., Prots. Upr., 522 (2025), 11–18; V. V. Vedenyapin, "Mathematics of accelerated expansion of the Universe and Lobachevsky space", Dokl. Math., 111:2 (2025), 103–109

Thursday, 8 October 2026

10:30–11:00

D.O. Orlov (Steklov Mathematical Institute of RAS)
Noncommitative geometry and geometric realizations

11:00–11:30

A.I. Shafarevich (Steklov Mathematical Institute of RAS)
Bundles over Lagrangian manifolds and short-wave asymptotics for hyperbolic equations with jumps of coefficients
The theory of geometric asymptotics uses Lagrangian manifolds as key tools for construction of short-wave asymptotic solutions for equations with smooth regular coefficients. We study analogs of these geometric objects for hyperbolic systems with smoothed jumps of coefficients.

11:30–12:00

A.A. Davydov (Lomonosov Moscow State University)
Local and Nonlocal Canonical Forms of Mixed-Type Equations in the Plane
The talk is devoted to justifying the smooth canonical forms for the main symbols of second-order partial differential equations of mixed type in the plane that were proposed by the Italian mathematician M. Cibrario as model ones in 1932. These forms include, in particular, the well-known form of Tricomi equation.

12:00–12:30

Coffee break

12:30–13:00

L.S. Efremova (Nizhny Novgorod State University & Moscow Institute of Physics and Technology)
On the Omega-Blowup Phenomenon in Multidimensional Smooth Skew Products
Smooth skew products (of the class C^1) with a closed set of periodic points defined on multidimensional cells are considered. The criteria and examples of the C^0-Ω-blowup in such discrete dynamical systems are presented. It is also proved that in the contrast with the previous one, the C^1-Ω-blowup is not realized in such dynamical systems. Various dynamical effects related to the Ω-blowup phenomenon are discussed. This is the joint work with Dmitry Novozhilov.

13:00–13:30

M.E. Shirokov (Steklov Mathematical Institute of RAS)
Optimal Hamiltonian for a quantum state with finite entropy
We consider the following task: how for a given quantum state S to find a grounded Hamiltonian H satisfying the condition Tr $HS <= E1$ in such a way that the von Neumann entropy of the Gibbs state corresponding to a given energy $E2 > 0$ be as small as possible.
We show that for any mixed state S with finite entropy there exists a solution of the above problem (unique in the non-degenerate case) which we call optimal Hamiltonian for the state S. Basic applications of the above task are briefly described.

13:30–14:00

A.K. Gushchin (Steklov Mathematical Institute of RAS)
The Dirichlet problem for a second-order elliptic equation
In the two centuries since C. Gauss formulated the Dirichlet problem for the Laplace equation in 1828, a vast body of research by noted mathematicians has been devoted to this fundamental problem of mathematical physics. Nevertheless, I will argue that far from everything is known about this well-studied problem; there remain many interesting and important questions that merit serious attention. The aim of this talk is to draw the attention of mathematicians especially young ones to this area of study.

14:00–15:30

Lunch

15:30–15:50

A.E. Teretenkov (Steklov Mathematical Institute of RAS)
Long-Time Markovianity beyond Factorized System–Reservoir States
We study the long-time dynamics of a multi-level open quantum system interacting with non-vacuum bosonic reservoirs in the rotating wave approximation. For a class of initially non-factorized, but separable, system–reservoir states, we obtain an exact integral representation of the reduced density matrix. We then consider identical uncorrelated reservoirs in states diagonal in the momentum representation and analyze the weak-coupling, long-time regime described by the Bogolubov–van Hove scaling.
The first non-trivial perturbative correction to this limit is derived explicitly. After a renormalization of the initial state accounting for short-time non-Markovian effects, the reduced dynamics is described, to the considered perturbative order, by a finite-dimensional semigroup. The asymptotic state depends explicitly on the non-vacuum spectral density and its derivative, whereas the semigroup generator is expressed in terms of the Laplace transform of the reservoir correlation function. This yields a long-time Markovian description for the considered class of non-vacuum reservoirs and non-factorized, but separable, initial states. Under additional regularity assumptions, the semigroup approximation and the multipole expansion of the reservoir correlation kernel can be extended to higher orders of perturbation theory.
This talk is based on the following paper: A. E. Teretenkov, "Long-Time Behavior of Multi-Level Open Systems Interacting with Non-Vacuum Reservoirs," Phys. Part. Nucl. 56 (4), 1018–1021 (2025); arXiv: 2410.05505.
This work was supported by the Russian Science Foundation, project no. 24-11-00039, https://rscf.ru/project/24-11-00039/.

15:50–16:10

R. Singh (Independent researcher)
Quantum Sensitivity of N-Component Cat States
We investigate quantum sensing with N-component cat states—coherent superpositions of states symmetrically distributed in phase space. Quantum sensitivity is characterized by the orthogonality between the initial state and the state obtained under a phase-space displacement δ and a phase shift θ. We derive analytical expressions for the corresponding state overlap and investigate how squeezing modifies the sensitivity. The roles of displacement, phase shift, squeezing, and the number of coherent components are analyzed.

16:10–16:30

M.G. Ivanov (Moscow Institute of Physics and Technology)
Conic singularities in Minkowski geometry
We construct a complete classification of conic singularities arising from the triangulation of two-dimensional surfaces, provided that Minkowski or Euclidean geometry takes place on each triangle. The physical meaning of nonstandard cones and possible applications of the constructed classification to the generalization of the Regge calculus are discussed.

16:30–16:50

F. Karakus (Boğaziçi University, Turkey)
Scattering and Tunneling in Real Quantum Mechanics
We study the formulation of quantum dynamics, scattering, and tunneling within real quantum mechanics. We establish an analogue of Stone's theorem on a real Kähler space and derive the corresponding general evolution equation, with an evolution operator that is both orthogonal and symplectic. We then formulate scattering theory in terms of real wave operators and the associated S-matrix. For the class of potentials considered, we show that both the differential scattering cross section and the tunneling probability coincide with the corresponding results of standard complex quantum mechanics.

17:00–17:30

Tea break

17:30–17:50

A.I. Mikhailov (VNIRO)
20 years of functional mechanics — a new approach to the foundations of thermodynamics
In 2006, I.V. Volovich proposed a functional reformulation of classical mechanics. The main idea is to replace Hamilton's equations with the equivalent Liouville equation directly in the microscopic description of particle dynamics. In this case, the non-zero dispersion of observable quantities will become non-decreasing, and thus, the irreversibility of dynamics will emerge already at the microscopic level. The report will examine the main results of functional mechanics obtained to date. A general formula has been derived for the evolution of the averages values of observable quantities and their moments of any order. The deviations from Newtonian trajectories predicted by this formula lead to the destruction of periodicity in Poincaré's recurrence theorem. Moreover, the trajectories of the average values observed during finite motion end at the average values in the weak limit of the probability measure. Infinite motion in functional mechanics is also considered. First and foremost, these are scattering problems, the simplest of which are transmission through a barrier and scattering in a central field. The asymptotic behavior of the averages and variances of the observed quantities has been studied. Another scenario of infinitesimal motion is the singular behavior of impulses, a special case of which is the problem of falling onto the center. In this case, the approach of functional mechanics leads to the elimination of singularity for moments of lower orders. The report will also discuss the prospects for applying functional mechanics to the averaging of geodesics in general relativity.

17:50–18:10

M.A. Khramtsov (Steklov Mathematical Institute of RAS)
State counting in gravity and maximal entropy principle

It is known that the semiclassical approximation to the gravity path integral can be leveraged to explain certain inherently quantum aspects of gravity. One such aspect is the state-counting interpretation of the Bekenstein-Hawking entropy of black holes. A second aspect is the Page curve for the entanglement entropy of Hawking radiation, which agrees with expectations from unitarity. We show that these two questions are equivalent from the gravity path integral point of view. In particular, the Hawking's information loss puzzle gets resolved automatically by considering any (over)complete basis of black hole microstates which is compatible with black hole entropy. The tool which relates the two questions is a convex optimization problem for the von Neumann entropy of Hawking radiation.

18:10–18:30

D.O. Stepanenko (Steklov Mathematical Institute of RAS)
Exact regular black holes solutions in bumblebee gravity
We discuss possibilities of finding exact regular planar black hole solutions in bumblebee gravity with temporal and radial components of the bumblebee field. We consider quadratic and linear potentials, with vanishing and nonzero cosmological constants, respectively. The field equations determine the nonminimal coupling and the relations between the model parameters. Found solution produce regular planar black hole with planar deformation function. Analytical expressions for this functions has been found. It was show that this solutions are free of singularities.

18:30–18:50

I.D. Remizov (HSE University & IITP RAS)
Dependence of the convergence rate of Chernoff approximations on the initial condition: a numerical experiment and open questions
According to a theorem proved by Paul Chernoff in 1968, a C_0-semigroup of operators on a Banach space can be approximated if a Chernoff function for the semigroup's infinitesimal generator is found. A Chernoff function uniquely determines a sequence of Chernoff approximations that converges to the semigroup. Chernoff functions are not unique; a trivial example is the semigroup itself, which is a a Chernoff function that yields zero approximation error. In nontrivial cases, the rate of convergence of Chernoff approximations to the semigroup depends on both the choice of the Chernoff function and the choice of the vector in the Banach space (the initial condition) upon which the approximations and the semigroup are evaluated. Despite existing results and those obtained in the 2020s regarding convergence rates, many situations remain outside the scope of current theory, leaving numerical experimentation as the only available method of investigation. This talk is devoted to the unexpected and as-yet unexplained results of such experiments.

18:50–19:20

J. Wawrzycki (BLTP JINR)
QFT Hamiltonians on the Einstein Universe
We show self-adjointness, and some other spectral properties, of realistic QFT Hamiltonians on the static Einstein Universe (EU). In the analysis we are using (I) the classification of the classical wave equations and their solutions due to Paneitz and Segal and (II) the assumption, put on each free field, of diagonalizability of the Einstein-Hilbert stress energy tensor components integrated over Cauchy surface.

Friday, 9 October 2026

10:30–11:00

M.A. Korolev (Steklov Mathematical Institute of RAS)
The "repulsion" phenomenon for the Riemann zeta function: how do its "distant" zeros know about the "nearby" zeros?

11:00–11:30

V.I. Bogachev (HSE and Lomonosov Moscow State University)
On uniqueness of probability solutions to Fokker-Planck-Kolmogorov equations
We discuss some recent results and open problems connected with probability solutions to elliptic and parabolic Fokker-Planck-Kolmogorov equations

11:30–12:00

A.A. Shkalikov (Lomonosov Moscow State University)
Direct and inverse spectral problems for the Sturm–Liouville operator and its perturbations
In the first part of the talk, we will present a short overview of classical and recent results on the direct and inverse problems for the Sturm–Liouville operator on a finite interval. In the second part, we consider the spectral problems for the Sturm–Liouville operator perturbed by a convolution integral operator. These problems have been investigated in various formulations in numerous studies over recent years. We propose a new formulation: reconstructing the potential and the kernel of an integral operator from three spectra of that operator corresponding to different boundary conditions. We present a local solution to this problem and discuss the difficulties associated with finding a global solution.

12:00–12:30

Coffee break

12:30–13:00

E.T. Shavgulidze (Lomonosov Moscow State University)
Schwarzian Integrals and Unitary Representations of Diffeomorphism Groups
Series of unitary representations are constructed for the group of diffeomorphisms of the circle and its extensions using Schwarzian path integrals.

13:00–13:30

A.L. Skubachevskii (RUDN University)
Global Solutions of Vlasov–Poisson System and Plasma Confinement
We consider the Vlasov-Poisson system with external homogeneous magnetic field describing kinetics of two-component rarefied plasma in the three-dimensional case. For any initial density distribution functions of charged particles with compact supports, we obtain sufficient conditions for external magnetic field, which provide global existence of density distribution functions with arbitrary small growth of their supports with respect to space variables.

13:30–14:00

N.A. Rautian (Lomonosov Moscow State University)
Finite velocity of propagation of perturbations in the Cauchy problem for the Volterra integro-differential equation arising in viscoelasticity theory
The Cauchy problem is studied for the Volterra integro-differential equation the main part of which is a wave equation perturbed by an integral operator of the Volterra convolution type. The kernel function of the integral operator is a sum of decaying exponentials or fractional-exponential functions (Rabotnov functions) with positive coefficients. The influence of the integral operator on the perturbation propagation velocity in the Cauchy problem for this Volterra integro-differential equation is investigated. This integro-differential equation describes wave propagation in viscoelastic media, heat propagation in media with memory (the Gurtin-Pipkin equation), and has a number of other important applications.

14:00–15:30

Lunch

15:30–16:00

Z. Rakic (Faculty of Mathematics, University of Belgrade, Serbia)
On a simple model of nonlocal de Sitter Gravity
We consider nonlocal modification of the general theory of relativity in the framework of pseudo-Riemannian geometry, with the nonlocality of the form

$$S = \frac{1}{16\pi G}\int d^4x\,\sqrt{-g}\,\left(R - 2\Lambda + \sqrt{R-2\,\Lambda}\mathcal{F}(\Box)\sqrt{R-2\,\Lambda}\,\right)d^4x, \tag{1}$$

where R is the scalar curvature, Λ is the cosmological constant, and $\mathcal{F}(\Box) = \sum_{n=0}^{\infty} f_n\Box^n$ is an analytic function of the d'Alambert operator $\Box$.

We investigated several classes of scaling factors for flat, open and closed Universe, and we found eleven new exact cosmological solutions. For the scaling factor $a(t) = A\,t^{\frac{2}{3}}\,e^{\frac{\Lambda}{14}\,t^2}$, our model contains an exact vacuum cosmological solution which mimics dark energy and dark matter, and it is in very good agreement with the standard model of cosmology. This simple nonlocal de Sitter gravity model we denote by $\sqrt{dS}$ gravity. The success of $\sqrt{dS}$ gravity model on cosmological scale motivated us to investigate how it works at the solar system and smaller scales than the cosmic one. We are investigating the corresponding Schwarzschild-de Sitter type metric of the $\sqrt{dS}$ gravity model,

$$\mathrm{d}s^2 = -A(r)\mathrm{d}t^2 + B(r)\mathrm{d}r^2 + r^2\mathrm{d}\theta^2 + r^2\sin^2\theta\,\mathrm{d}\varphi^2. \tag{2}$$

The problem of finding exact solutions is reduced to solving the corresponding nontrivial nonlinear differential equation. After the linearization of obtained equation, we found its solutions in a weak gravitational field. The obtained approximative solution is of particular interest for further examining the possible role of non-local de Sitter gravity $\sqrt{dS}$ in describing the effects in galactic dynamics that are usually attributed to dark matter. The solution has been tested on the Milky Way and the spiral galaxy M33, and it is in very good agreement with observational data.

16:00–16:30

E.A. Turilova (Kazan Federal University)

Linear Maps Preserving Function Calculus and Entropies
We show that a unital map between Jordan–Banach algebras or Banach algebras that preserves function calculus given by a single nontrivial locally analytic function must be a Jordan morphism. Ramifications of this results are presented. As an application we prove that quantum channel on general Jordan C*-algebras preserving Segal and Renyi entropy must be a Jordan homomorphism.

16:30–17:00

L.B. Tyapaev (National Research Saratov State University)
Characterization of Dendrograms via Archimedean, Non-Archimedean, and Gromov–Hausdorff Metrics

17:00–17:30

Tea break

17:30–18:00

T.V.Dudnikova (Keldysh Institute of Applied Mathematics of RAS)
Derivation of the energy transport equation and hydrodynamic equations for a harmonic crystal interacting with a Klein–Gordon field
The rigorous derivation of macroscopic evolution equations from the microscopic dynamics of a particle system is one of the central problems of nonequilibrium statistical mechanics. In this talk, we discuss this problem using the example of a Hamiltonian system consisting of an infinite harmonic crystal and a Klein-Gordon field. In particular, we prove that the limiting Wigner function satisfies the energy transport equation. Furthermore, using R.L. Dobrushin's approach, we give a hydrodynamic description of this model. The talk is based on the following works [T.V. Dudnikova, Transport equation for the harmonic crystal coupled to a Klein-Gordon field, Russ. J. Math. Phys. 30, 501-521 (2023)], [T.V. Dudnikova, Caricature of hydrodynamics for the harmonic crystal coupled to a Klein-Gordon field, Russ. J. Math. Phys. 31, 601-621 (2024)].

18:00–18:30

N.N. Shamarov (Lomonosov Moscow State University)
Unitary Fourier transformation of Fock–Smolyanov functional space with Banach domain over Q_p

18:30–19:00

A.I. Bufetov (Steklov Mathematical Institute of RAS)
Point processes and multiplicative chaos

Saturday, 10 October 2026

11:00–11:30

K. Khachatryan (Yerevan State University, Republic of Armenia)
Constructive Fixed-Point Principles for Nonlinear Monotone and Strongly Concave Operators in Normal Cones

11:30–12:00

I.A. Taimanov (Novosibirsk State University)
Distribution type solutions to the Novikov-Veselov equation

12:00–12:30

H. Kaneko (Tokyo University of Science, Japan)
Riemann–Hurwitz formula for graph morphisms based on recurrent random walk

12:30–13:00

Dao Van Duong (Mien Trung University of Civil Engineering, Vietnam)
On the Hausdorff operator on p-adic vector spaces
In this talk, we present some recent results on the Hausdorff operators over the p-adic field and their applications to Hardy-Hilbert-type inequalities. These results further reveal the significance of Hausdorff operators in p-adic harmonic analysis.

13:00–13:20

O.V. Morzhin (Steklov Mathematical Institute of RAS)
Optimization of coherent controls for two-qubit gate synthesis in SU(4) dynamics and dissipative two-qutrit dynamics

13:20–13:40

A.P. Zubarev (Volga State University of Transport & Samara University)
Ultrametric organization of energy landscapes on random Erdős–Rényi graphs: topological origin of barrier hierarchy

13:40–14:00

I. Matajz
The Adelic Spectral Cosmos: from Volovich's p-adic physics to spectral geometry and emergent spacetime
Igor Volovich's proposal that number theory may provide the ultimate language of physics raises a radical question: must spacetime remain Archimedean at the Planck scale? This talk develops a systems-level synthesis in which real and p-adic geometries are treated as complementary local aspects of an adelic structure. The rational numbers provide the common seed, while the adelic product formula constrains the Archimedean and non-Archimedean places as parts of a single arithmetic whole. The proposed bridge to physics uses Alain Connes's noncommutative geometry. A spectral triple (A, H, D) replaces a primary geometry of points with an algebra

of observables, a Hilbert space of states, and a Dirac operator carrying metric and dynamical information. I outline a candidate adelic operator DA that combines an Archimedean Dirac sector, p-adic Vladimirov-type sectors, and a mixing term coupling the different places. Through a spectral action, its spectrum could provide a common language for emergent geometry, matter dynamics, and the transition from an ultrametric sub-Planckian regime to effective relativistic spacetime. This framework is then used to formulate, rather than assume, possible connections with modular time, quantum nonlocality, black-hole interiors, hidden spectral degrees of freedom, and conformal cyclic cosmology. These connections are presented as conjectural research directions, not established identifications. The programme becomes testable only if it defines the mixing operator precisely, recovers low-energy locality and known gravitational physics, and produces observable consequences that distinguish it from existing theories. The value of the synthesis lies in turning Volovich's foundational question into a concrete mathematical research programme connecting arithmetic, operator theory, and spacetime physics. Keywords: p-adic physics; adeles; noncommutative geometry; spectral triple; Dirac operator; modular time; quantum gravity; emergent spacetime Prepared for a presentation honouring Professor Igor V. Volovich on his 80th birthday

14:00–14:20

I.A. Lopatin (Steklov Mathematical Institute of RAS)
Physical Structure Matters: Learning GKSL Dynamics from Repeated Measurement Data
We study the learnability of Gorini–Kossakowski–Sudarshan–Lindblad (GKSL) dynamics from multi-time trajectories generated by random single-site Pauli measurements, using a structure-agnostic maximum-likelihood approach to reconstruct the Hamiltonian and Lindblad operators. The presentation will include experimental comparisons of reconstruction accuracy using several quality metrics, considering different numbers of qubits and measurement shots. Furthermore, we analyze how various system properties—including integrability, non-integrability, and quantum scars—affect the accuracy of the reconstruction.

14:20–14:40

Break

14:40–15:10

A.Ya. Burinskii (IBRAE RAS)
Kerr–Newman Electron as a String Quark of Strong Gravity

15:10–15:40

N.L. Chuprikov (Scientific and Educational Center of Tomsk State Pedagogical University)
Asymptotes of non-stationary solutions of the Schrödinger equation for a particle interacting with a one-dimensional δ-potential
It is shown that non-stationary solutions of the Schrödinger equation, which describes the quantum dynamics of a particle in the field of a one-dimensional delta potential (1DDP), are divided into two classes: some define pure states that have no free dynamics as $t \to \mp\infty$; others define states with asymptotically free dynamics but represent mixed states in whose space the asymptotic superselection rule holds. That is, according to the Schrodinger equation, pure scattering states predicted by the conventional model of this scattering process do not exist. On

mixed scattering states, the Hamiltonian with 1DDP is defined only in superselection sectors. The scattering process with one-sided incidence of a particle on 1DDP represents a decoherence process in a closed system.

15:40–16:10

I.Ya. Aref'eva (Steklov Mathematical Institute of RAS)
Real Quantum Field Theory and J-Quantization

16:10–16:40

I.V. Volovich (Steklov Mathematical Institute of RAS)
Adventures in Mathematical Physics: A Personal Journey through Spacetime and Beyond