

LABORATORY 4

Dobrushin Mathematics Laboratory

Head of Laboratory – Dr.Sc. (Mathematics) Robert Minlos

Tel.: (095) 299-83-54; E-mail: minl@iitp.ru

The leading researchers of the laboratory include:

Dr.Sc. (Math.)	D. Akhiezer	Dr.	M. Boguslavskii
Dr.Sc. (Math.)	L. Bassalygo	Dr.	A. Borodin
Dr.Sc. (Math.)	M. Blank	Dr.	S. Gelfand
Dr.Sc. (Math.)	V. Blinovskiy	Dr.	V. Golyshev
Dr.Sc. (Math.)	A. Kirillov	Dr.	G. Kabatyanskii
Dr.Sc. (Math.)	M. Kontsevich	Dr.	V. Lebedev
Dr.Sc. (Math.)	G. Margulis	Dr.	D. Nogin
Dr.Sc. (Math.)	M. Men'shikov	Dr.	G. Okun'kov
Dr.Sc. (Math.)	N. Nadirashvili	Dr.	E. Pechersky
Dr.Sc. (Math.)	G. Olshanski	Dr.	S. Popov
Dr.Sc. (Math.)	D. Panyushev	Dr.	A. Rybko
Dr.Sc. (Math.)	V. Prelov	Dr.	M. Rovinsky
Dr.Sc. (Math.)	S. Shlosman	Dr.	A. Vishik
Dr.Sc. (Math.)	V. Shehtman	Dr.	S. Vladuts
Dr.Sc. (Math.)	Yu. Suhov	Dr.	E. Zhizhina
Dr.Sc. (Math.)	M. Tsfasman	Dr.	Yu. Zhukov
Dr.Sc. (Math.)	S. Yashkov	Dr.	D. Yarotski

DIRECTIONS OF ACTIVITY:

- spectral analysis of generators in stochastic model of mathematical physics;
- Gibbs random fields and Markov chains with local interactions;
- mean-field models of queueing systems;
- large deviations and its applications;
- queueing systems;
- combinatorial and probabilistic problems for information transmission and protection in modern communication systems;
- algebraic geometry and number theory;
- combinatorial and probabilistic aspects of representation theory;
- modal logics.

MAIN RESULTS

The central limit theorem for random walks in random environment in the most general version is proved. The one-particle subspace of the generator of a stochastic continuous model is constructed and its spectrum in this subspace is investigated. Leading invariant subspaces are constructed and the spectrum of the generator is studied in these subspaces for the Blum-Capel model. The existence of spectral gaps is proved for a wide class of stochastic lattice systems and the scattering theory of quasi-particle excitation is developed. For a wide class of quantum lattice systems arising as a weak perturbation of a free system with non-degenerate ground

state and a spectral gap, it is shown that the perturbed system also has a ground state with a spectral gap.

An existence condition for Gibbs fields with non-compact spin space and nonfinite-range interaction is obtained.

The behavior of chemical reactions in the thermodynamical limit is studied. The Poisson hypothesis for closed symmetric queueing systems is proved. A non-linear version of Perron-Frobenius theorem is proved. Phases of so-called Sund Piles models with a special interaction are investigated.

New asymptotic upper bound for the rate of cover-free codes is obtained. This bound is better than known one. Digital fingerprinting codes with simple identification algorithm are constructed. These codes have logarithmic complexity. An asymptotic of power for a optimum covering of ellipsoid by unit spheres in Euclidean space is found (as its dimension grows). The dominant term of the asymptotic depends only on sizes of semi-axis exceeding one.

Combinatorial identities which are multidimensional analogs of classical Dougall's formula for the sum of a two-sided hypergeometric series are derived. These identities make it possible to construct a coherent family of probability measures (the so-called z -measures) on the branching graph of Jack polynomials with an arbitrary positive parameter. For three special values of the parameter this result yields examples of spherical functions on infinite-dimensional symmetric spaces which are important for the purpose of harmonic analysis. The asymptotics of the z -measures on Young diagrams (and of certain allied measures) in two different limit regimes is studied: near the main diagonal of a random diagram and in the so-called intermediate zone. The corresponding correlation functions were computed.

By means of Perron-Frobenius spectral techniques of a hyperbolic dynamical system and generalized dynamical spectra of transfer operators of a dynamical system (considered as linear operators acting in a suitable Banach space of generalized functions) in a more general case, typical ergodic properties of infinite dimensional dynamical systems on an example of infinite systems of coupled map lattices are studied. Sufficient conditions guaranteed the absence of phase transitions in such systems have been obtained and counter-examples demonstrating the presence of phase transitions even in the 'finite volume' case when the above conditions do not hold were constructed. For one class of models of traffic flows described by discrete on time and space systems of interacting particles on a line the convergence to invariant measures and their characterization is studied. Additionally, analytical results about the motion of a designated particle along/against the main flow have been obtained, and in some cases the advantage of the motion against the flow has been proven.

The exact solution for the non-stationary (time-dependent) distribution of the virtual sojourn time process in the $M/G/1$ queue with egalitarian processor sharing, (which has $K \geq 0$ additional permanent jobs of infinite service requirements), in terms of multiple Laplace transforms, is obtained. A number of the special variants of this new theorem has been investigated by means of some (non-trivial) versions of the Tauber's theorem. The new sufficient conditions for the asymptotic tail equivalence of the distributions of the sojourn time and of service requirements in the $M/G/1$ processor sharing queue is found.

The question of the number of points on the Grassman and Schubert varieties defined over a finite field was studied. The parameters of the corresponding correcting codes were determined.

The product of modal logics was studied. The earlier results on the finite model property were strengthened, and this property was proved for products of minimal temporal logics.

The theory of ad-nilpotent ideals in a Borel subalgebra of a complex semisimple Lie algebra was studied. A refinement of the enumerative theory of $\{\mathfrak{ad}\}$ -nilpotent ideals to the case in which \mathfrak{g} has roots of different length was obtained. All results known for usual antichains were extended to short antichains.

Abelian ideals of a Borel subalgebra consisting of long roots were studied. A uniform expression for the number of long Abelian ideals is given. An one-to-one correspondence between the long Abelian ideals and B-stable commutative subalgebras in the little adjoint representation of the Langlands dual Lie algebra is established.

G-endomorphism algebras were studied. These algebras were recently introduced by A. Kirillov. It was proven that the commutative \mathfrak{g} -endomorphism algebra is always Gorenstein. The Poincare series of C_λ for any λ were explicitly computed, and it was shown that in the commutative case the numerator coincides with the polynomial that was introduced by E. B. Dynkin in 1950.

The semilinear representations of the automorphism groups of fields were studied. It is shown that for the algebraically closed extension F/k of transcendence degree one, any continuous automorphism of the group $\text{Aut}(F/k)$ is induced by an automorphism of F stabilizing k .

The families of categories of log-terminal pairs studied. It is used to compute the groups of biregular automorphisms of the nonsingular complex quasiprojective surfaces.

The deformations of the Picard-Fuchs differential equations were studied. An 1-to-1 correspondence between the cases where the Kummer lifting of such equation on the twisted square of the universal elliptic curve is the equation of the type D3 and the 3-dimensional Fano varieties with Picard group of rank 1, and certain fixed index and anticanonical degree is established. The modular formulas for all the cases are computed. The conjecture on the counting numbers for the corresponding Fano varieties is formulated.

The discrete invariants of quadrics were studied. New cohomological operations in the ring of algebraic cobordisms of a smooth projective variety constructed. The divisibility of the Chow-trace of certain Landweber-Novikov operations proven. New construction of the Steenrod operations in the Chow groups modulo 2 is produced.

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Articles

1. Алсведе Р., Блиновский В.М. Большие отклонения в квантовой теории информации // Проблемы передачи информации. 2003. Т. 39. № 4. С. 63-70.
2. Ахиезер Д.Н. Об орбитах вещественных форм комплексных редуцированных групп на сферических однородных пространствах // В сб. «Вопросы теории групп и гомологической алгебры», Ярославский гос. ун-т, Ярославль. 2003. С. 1-15.
3. Влэдуц С.Г., Ногин Д.Ю., Цфасман М.А. Алгеброгеометрические коды. Т. 1: «Основные понятия». М.: Изд-во МЦНМО, 2003. 544 с.
4. Лебедев В.С. Асимптотическая верхняя граница для скорости кодов свободных от (w,r) перекрытий // Проблемы передачи информации. 2003. Т. 39, № 4. С. 3-9.
5. Ольшанский Г. Вероятностные меры на дуальных объектах к компактным симметрически пространствам и гипергеометрические тождества // Функциональный анализ и его приложения. 2003. Т. 37. № 4. С. 49-73.
6. Прелов В.В., ван дер Мейлен Э. Асимптотика высшего порядка взаимной информации в нелинейных каналах с негауссовским шумом // Проблемы передачи информации. 2003. Т. 39. № 4. С. 10-29.
7. Яшков С.Ф., Яшкова А.С. Об условиях асимптотической эквивалентности хвостов распределений времени пребывания и длительности обслуживания в системе M/G/1 с разделением процессора // Обзорные прикладной и промышленной математики. 2003. Т. 10. Вып. 2.
8. Яшкова А.С., Яшков С.Ф. Нестационарное распределение процесса виртуального времени пребывания в системе M/G/1 с разделением процессора и перманентными требованиями // Обзорные прикладной и промышленной математики. 2003. Т. 10. Вып. 2.
9. Barg A., Blakley G.R., Kabatiansky G. Digital fingerprinting codes: problems statements, constructions, identification of traitors // IEEE Transactions on Information Theory. 2003. V. 49, No. 4. P. 852-865.
10. Blank M. L. Ergodic Properties of a Simple Deterministic Traffic Flow Model // J. Stat. Phys. 2003. V. 111. No. 3-4. P. 903-930.
11. Blank M. L. Operator approach in ergodic theory of systems with neutral singularities and random maps // В сб. «Колмогоров и современная математика». Москва. 2003.
12. Blank M. L., Bunimovich L. Multicomponent dynamical systems: SRB measures and phase transitions // Nonlinearity. 2003. V. 16. No. 1. P. 387-401.
13. Comets F., Popov S.Yu. Limit law for transition probabilities and moderate deviations for Sinai's random walk in random environment // Probability Theory and Related Fields. 2003. V. 126. No. 4. P. 571-609.
14. Descombes X., Pechersky E.A. Droplet shapes for a class of models in \mathbb{Z}^2 at zero temperature // Journal of Statistical Physics. 2003. V. 111. No. 1-2. P. 129-169.
15. Descombes X., Zerubia J., Pechersky E., Zhizhina E. Stable and unstable statistical physics in image processing // Transaction of French-Russian A.M. Liapunov Institute for Applied Mathematics and Computer Science. 2003. V. 4. P. 136-157.
16. Feigin B., Ilyashenko Yu., Lando S., Sossinsky A., Tsfasman M., Vassiliev V. Alexander Belavin // Moscow Mathematical Journal. 2003. V. 3.No. 1. P. 255.

17. Ferrari P., Pechersky E. Pinning Random Processes // В сб. «Колмогоров и современная математика». Москва, 2003. С. 431-432.
18. Fisher D., Margulis G. Local rigidity for cocycles (preprint).
19. Gelfand S.I., Manin Yu.I. Methods of Homological Algebra. – Berlin: Springer-Verlag, 2003. Second edition.
20. Ghorpade S.R., Tsfasman M.A. Classical varieties, codes and combinatorics // Proc. 15th International Conf. on Formal Power Series and Algebraic Combinatorics (FPSAC-2003), Vadstena, Sweden, June 2003.
21. Ghorpade S.R., Tsfasman M.A. Schubert varieties, linear codes and enumerative combinatorics // Finite Fields and Appl. (submitted); Preprint 2003-04, Institute de Math. de Luminy, 2003.
22. Han, Nadirashvili N., Yuan Y. Linearity of homogeneous order one solutions to elliptic equations in dimension three // Comm. Pure Appl. Math. 2003. V. 56. P. 425-430.
23. Helffer B., Hoffmann-Ostenhof T., Nadirashvili N. Periodic Schrodinger operators and Aharonov Bohm Hamiltonians // Moscow Math. J. 2003. V. 3. P. 45-61.
24. Ilyashenko Yu., Krichever I., Novikov S., Tsfasman M., Vassiliev V. Victor Buchstaber // Moscow Mathematical Journal. 2003. V. 3. No. 1. P. 257.
25. Kelbert M., Suhov Yu.M. Tree-indexed processes: a high level crossing analysis // J. Appl. Math. Stoch. Anal. 2003. V. 16, No. 2. P. 127-140.
26. Kirillov A. A. Two more variations on the triangular theme // Proceedings of the Conference "Orbit Method in Geometry and Physics". Ann Kostant, Ed. Birkhauser, 2003.
27. Kontsevich M.L. CFT, SLE and phase boundaries // Talk on Arbeitstagung 2003. Preprint MPI 2003 60-a.
28. Machado F.P., Popov S.Yu. Branching random walk in random environment on trees // Stochastic Processes and their Applications. 2003. V. 106. No. 1. P. 95-106.
29. Okunkov A.Yu. Combinatorial formula for Macdonald polynomials and generic Macdonald polynomials // Transform. Groups. 2003. V. 8. No. 3. P. 293-305.
30. Okunkov A.Yu. Random trees and moduli of curves // In: «Asymptotic Combinatorics with Applications to Mathematical Physics». Edited by A. Vershik, Lecture Notes in Mathematics. 2003. V. 1815.
31. Okunkov A.Yu. Why would multiplicities be log-concave? // In: «The orbit method in geometry and physics». Marseille, 2000. P. 329-347, Progr. Math. 2003. V. 213. Birkhøuser.
32. Olshanski G. An introduction to harmonic analysis on the infinite symmetric group // In: Asymptotic Combinatorics with Applications to Mathematical Physics (A. Vershik, ed.). Springer Lecture Notes in Mathematics. 2003. V. 1815. P. 127-160.
33. Olshanski G. Point processes related to the infinite symmetric group // In: The orbit method in geometry and physics: in honor of A. A. Kirillov (Ch. Duval, L. Guieu, V. Ovsienko, eds.), Progress in Mathematics. 2003. V. 213. P. 349-393.
34. Olshanski G., Regev A., Vershik A. Frobenius-Schur functions // In: Studies in Memory of Issai Schur (A. Joseph, A. Melnikov, R. Rentschler, eds), Progress in Mathematics. 2003. V. 210. P. 251-300.
35. Panyushev D.I. Abelian ideals of a Borel subalgebra and long positive roots // Intern. Math. Res. Notices. 2003. № 35. P. 1889-1913.
36. Panyushev D.I. ad-nilpotent ideals of a Borel subalgebra: generators and duality // J. Algebra (to appear). Preprint arXiv: math.RT/0303107, 23 p.
37. Panyushev D.I. Long Abelian ideals // Adv. in Math. (to appear). Preprint arXiv: math.RT/0303222, 8 p.

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38. Panyushev D.I. On invariant theory of θ -groups // Preprint arXiv: math.AG/0307248, 16 p.
39. Panyushev D.I. Regions in the dominant chamber and nilpotent orbits // Bull. Sci. Math. (to appear). Preprint arXiv: math.AG/0306111, 6 p.
40. Panyushev D.I. Short antichains in root systems, semi-Catalan arrangements, and B -stable subspaces // Europ. J. Combinatorics (to appear). Preprint arXiv: math.CO/0304380, 20 p.
41. Panyushev D.I. The index of a Lie algebra, the centralizer of a nilpotent element, and the normalizer of the centralizer // Math. Proc. Camb. Phil. Soc. 2003. V. 134. Part 1. P. 41-59.
42. Panyushev D.I. Some amazing properties of spherical nilpotent orbits // Math. Zeitschrift (to appear); Preprint arXiv: math.AG/0206265, 22 p.
43. Panyushev D.I. Weight multiplicity free representations, \mathfrak{g} -endomorphism algebras, and Dynkin polynomials // J. London Math. Soc. (to appear); Preprint arXiv: math.AG/0112314, 19.
44. Prelov V.V., van der Meulen E. Asymptotic Expansions of Mutual Information for a General Class of Additive Noise Channels with Small Signal-to-Noise Ratio // Proc. 24th Symp. Inform. Theory in the Benelux. Veldhoven, May 22-23. 2003. P. 165-170.
45. Rovinsky M.Z. On certain isomorphisms between absolute Galois groups // Compositio Math. 2003. V. 136. No. 1. P. 61-67.
46. Rovinsky M.Z. On certain representations of automorphism groups of an algebraically closed field // PrePublication IHES/M/03/10, <http://www.ihes.fr/PREPRINTS/M03/Resu/resu-M03-10.html>, Math. Zeit (accepted).
47. Rovinsky M.Z. Semi-linear representations: some examples // math.RT/0306333, <http://arXiv.org/>.
48. Shapirovsky I., Shekhtman V. Chronological future modality in Minkowski space-time // In: Advances in Modal Logic. 2003. V. 4. P. 437-459. King's College publications.
49. Shlosman S.B., Zagrebnoy V.A. Magnetostriction Transition // J. Statistical Physics (to appear). <http://arXiv.org/abs/math-ph/0305026>.
50. Sossinsky A., Tsfasman M. L'Universite independente de Moscou // Gazette des Mathematiciens. 2003. No. 95. P. 69-78.
51. Spohn H., Zhizhina E. Long-time behavior for the 1-Dstochastic Ising model with unbounded random couplings // Journal of Statistical Physics. 2003. V. 111. No. 1/2. P. 419-431.
52. Tsfasman M.A., Vladuts S.G. Infinite Global Fields and the Generalized Brauer-Siegel Theorem // In: Fundamental Mathematics Today. Труды конф. к 10-летию НМУ. М.: НМУ-МЦНМО, 2003.
53. Vishik A. Two more variations on the triangular theme // In: Proceedings of the conference «Orbit method in Geometry and Physics» (Ed. Ann Kostant). Birkhauser, 2003.
54. Yashkov S.F. On sojourn time problem in processor sharing queue. Int. Conf. "Kolmogorov and Contemporary Mathematics". Abstracts. (Moscow, June 16-21, 2003). – Moscow: Moscow State Univ., 2003. P. 594-595.
55. Yashkova A.S., Yashkov S.F. Distribution of the virtual sojourn time in the M/G/1 processor sharing queue. Information Processes. 2003. V. 3. No. 2. P. 128-137 (available at <http://www.iip.ru/2003/128-137.pdf>).

In print

1. Ахиезер Д.Н., Винберг Э.Б., Горбацевич В.В., Ольшанский Г. и др. Аркадий Львович Онищик (к семидесятилетию со дня рождения) // Успехи матем. наук. 2003. Вып. 6.

2. Вишик А.С. Симметрические операции // Труды МИАН.
3. Владимиров А., Оселедец В., Рыбко А., Ханин К., Хмелев Д. Нелинейное обобщение теоремы Перрона // Доклады Академии наук.
4. Голышев В.В. Модулярность уравнений D3 и классификация Исковских.
5. Яшков С.Ф., Яшкова А.С. Асимптотики характеристик системы M/G/1 с разделением процессора при перманентных требованиях // Проблемы передачи информации.
6. Akhiezer D.N. Real forms of complex reductive groups acting on quasi-affine varieties // In: «Lie groups and invariant theory». Ed. E.B. Vinberg. AMS Transl. V. 2.
7. Barg A., Kabatiansky G. Class of i.p.p codes with effective tracing algorithm // Journal of Complexity.
8. Blanchard Ph., Gandolfo D., Ruiz J., Shlosman S. On the Euler-Poincare Characteristic of the Random Cluster Model // Markov Processes and Related Fields.
9. Boguslavskaya E., Boguslavsky M. Optimal arbitrage trading // Risk Magazine.
10. Boldrighini C., Minlos R.A., Pellegrinotii A. Random walk in random environment is always diffusive // Prob. Theory and Rel. Fields.
11. Borodin A., Olshanski G. Harmonic analysis on the infinite-dimensional unitary group and determinantal point processes // Annals of Mathematics.
12. Borodin A., Olshanski G. Z-measures on partitions and their scaling limits // European Journal of Combinatorics.
13. Descombes X., Zhizhina E.A. Image Denoising using Stochastic Differential Equations // Research Report 4814, INRIA.
14. Dumer I.I., Pinsker M.S., Prelov V.V. On Coverings of Ellipsoids in Euclidean Spaces // IEEE Trans. Inform. Theory.
15. Dumer I.I., Pinsker M.S., Prelov V.V. On the Thinnest Coverings of Spheres and Ellipsoids with Balls in Hamming and Euclidean Spaces // In: «General Theory of Information Transfer and Combinatorics».
16. Fisher D., Margulis G. Almost isometric actions, property T and local rigidity.
17. Fisher D., Margulis G. Local rigidity of standard actions of higher rank semisimple groups and their lattices.
18. Gelfand I.M., Gelfand S.I., Retakh V., Wilson R. Quasideterminants // Advances in Math. 2003.
19. Kim H.K., Lebedev V.S. On optimal superimposed codes // Journal of Combinatorial Designs.
20. Kondratiev Yu.G., Kutoviy O.V., Pechersky E.A. Existence of Gibbs State for Non-Ideal Gas in \mathbb{R}^d : the case of pair, long-range interaction // Methods of Functional Analysis.
21. Kontsevich M.L. Deformation quantization of Poisson manifolds // Lett. Math. Physic. 2003.
22. Kontsevich M.L., Zorich A. Connected components of the module spaces of Abelian differentials with prescribed singularities // Invent. Math. 2003.
23. Kurkova I., Suhov Yu.M. Malyshev's theory and JS-queues // Annals of Applied Probability.
24. MacPhee I.M., Menshikov M.V. Critical random walks on two-dimensional complexes with applications to polling systems // Ann. Appl. Probab.
25. Malyshev V.A., Pirogov S.A., Rybko A.N. Random Walks and Chemical Networks // Moscow Mathematical Journal.
26. Olshanski G. The problem of harmonic analysis on the infinite-dimensional unitary group // Journal of Functional Analysis.

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27. Prelov V., Dumer I., Pinsker M. On Coverings of Ellipsoids in Euclidean Spaces // IEEE Trans. Inform. Theory.
28. Prelov V., Dumer I., Pinsker M. On the Thinnest Coverings of Spheres and Ellipsoids with Balls in Hamming and Euclidean Spaces // In: "General Theory of Information Transfer and Combinatorics".
29. Prelov V.V., Verdu S. Second-Order Asymptotics of Mutual Information // IEEE Trans. Inform. Theory.
30. Rybko A.N., Shlosman S. Poisson Hypothesis for information networks (a study in non-linear Markov processes) // Ann. of Probability.
31. Rybko A.N., Shlosman S. Propagation of Chaos for Large Networks – Combinatorial Aspect // Special AMS volume devoted to Serge P. Novikov.
32. Yarotsky D.A. Perturbations of ground states in weakly interacting quantum spin systems // Journal of Mathematical Physics.
33. Yarotsky D.A. Scattering of Quasi-particle Excitations in Weakly Coupled Stochastic Lattice Spin Systems // Commun. Math. Phys.
34. Yashkov S.F., Yashkova A.S. The non-stationary distribution of attained service times for the M/G/1 processor-sharing queue // Stochastic Models.
35. Zhizhina E.A. Convergence properties of quasi-particles of various species in the stochastic Blume-Capel model // Markov Processes and Related Fields.