ProbaΦ $^{6}_{19}$

INTERNATIONAL CONFERENCE ON PROBABILITY THEORY AND MATHEMATICAL PHYSICS

PROGRAM

Moscow, June 24 – 28, 2019

The International Conference on Probability Theory and Mathematical Physics “ProbaΦ” is organized by the Skolkovo Institute of Science and Technology and its Center for Advanced Studies, with the participation of the Institute for Information Transmission Problems

The year 2019 marks the 90th anniversary of
Roland Dobrushin (20.07.1929- 12.11.1995), and
the conference will be a tribute to his memory. During the conference, the Dobrushin Prize will be awarded

Organizing Committee:

- Alexander Kuleshov / co-chair
- Yakov Sinai / co-chair
- Grigory Kabatyansky
- Konstantin Khanin
- Igor Krichever
- Senya Shlosman

last udate: June 17, 2019

June 24 // Monday Skoltech // Bolshoy Boulevard 30, bld. 1, aud. 2019	10:00 – 11:00	Bernard DERRIDA	Renormalization and disorder: a simple toy model
	11:30 – 12:30	Nicolai RESHETIKHIN	Limit shapes in the 6-vertex model: a Hamiltonian integrable system?
		lunch	
	14:00 – 15:00	Charles NEWMAN	The Riemann Hypothesis and statistical mechanics
	15:30 – 16:30	Fabio TONINELLI	Non-integrable dimer models

June 25 // Tuesday Skoltech // Bolshoy Boulevard 30, bld. 1, aud. 2019	10:00 – 11:00	Frank den HOLLANDER	Metastability for the Widom-Rowlinson model
	11:30 – 12:30	Yan FYODOROV	On the energy landscape of an elastic manifold in random potential
		lunch	
	14:00 – 15:00	Artur AVILA	Continuity of Lyapunov exponents for products of random matrices
	15:30 – 16:30	Carlangelo LIVERANI	Deterministic walks in random environment
	19:00	*welcome party*	

June 26 // Wednesday Institute for Information Transmission Problems of the RAS // Bolshoy Karetny per. 19, bld.1,	Dobrushin day is dedicated to the memory of Roland Dobrushin, (July 20, 1929 – November 12, 1995), great person and great mathematician, the founder of the Complex Information Systems Lab of IITP (now Dobrushin Lab)		
	9:00 – 9:30	Gathering participants, welcome coffee	
	9:30 – 9:45	Greeting. Dobrushin Prize award ceremony	
	9:45 – 10:45	Hugo DUMINIL-COPIN	Marginal triviality of the scaling limits of critical Ising and φ^4 models in 4D
	10:45 – 11:45	Grigori OLSHANSKI	The equivalence/disjointness problem for determinantal measures
	11:45 – 12:10	*coffee*	
	12:10 – 14:00	Recollections about Roland Dobrushin	
	14:00	*lunch*, more recollections	

June 27 // Thursday Skoltech // 3 Nobel Street (Blue bld.), aud. 408	10:00 – 11:00	Yuval PERES	Small ball estimates and transience for Martingales
	11:30 – 12:30	Anatoly VERSHIK	Randomness from the point of view of conditional measures: tame and wild situations
		lunch	
	14:00 – 15:00	Erwin BOLTHAUSEN	A one-dimensional model with Kac type interaction and a continuous symmetry, and its connection with the polaron problem
	15:30 – 16:30	Sergei NECHAEV	Anomalous statistics of extreme random processes

June 28 // Friday Skoltech // 3 Nobel Street (Blue bld.), aud. 408	10:00 – 11:00	Ofer ZEITOUNI	On the cover time of the 2 dimensional sphere
	11:30 – 12:30	Paul WIEGMANN	Stochastic quantization of hydrodynamics and gravitational anomaly
		lunch	
	14:00 – 15:00	Dima IOFFE	Diffusive 1:2:3 scaling and low temperature interfaces
	15:30 – 16:30	Andrei OKOUNKOV	Bethe Ansatz from modern point of view

TITLES and ABSTRACTS of the TALKS:

Artur AVILA //

Continuity of Lyapunov exponents for products of random matrices

Erwin BOLTHAUSEN //

A one-dimensional model with Kac type interaction and a continuous symmetry, and its connection with the polaron problem

A long standing open problem in mathematical physics is the determination of the effective mass of the Frohlich polaron in the strong coupling limit. The problem can be formulated in terms of a three dimensional Brownian motion with an attractive Kac type interaction. The strong coupling corresponds to a small Kac parameter. There is a heuristic derivation by Spohn which is generally considered to give the correct asymptotics, but a proof is still lacking.
We will discuss the Spohn picture and present some simplified models with the same basic structure, for which the conjecture can be proved

Bernard DERRIDA //

Renormalization and disorder: a simple toy model

The problem of the depinning transition of a line from a random substrate is one of the simplest problems in the the theory of disordered systems. It has a long history among physicists and mathematicians. Still there are some open questions about the nature of this transition. After a brief review of our present understanding of the problem, I will discuss a simple tree-like toy model which indicates that, when disorder is relevant, the depinning transition becomes an infinite order transition of the Berezinski-Kosterlitz-Thouless type. I will also try to present some recent developments allowing to understand how the precise nature of the singularity at the transition depends on the distribution of disorder

Hugo DUMINIL-COPIN //

Marginal triviality of the scaling limits of critical Ising and φ^4 models in 4D

The question of constructing a non-Gaussian field theory, i.e. a field with non-zero Ursell functions, is at the heart of Euclidean (quantum) field theory. While non-triviality results in d4 were obtained in famous papers by Glimm, Jaffe, Aizenman, Frohlich and others, the crucial case of dimension 4 remained open. In this talk, we show that any continuum phi^4 theory constructed from Reflection Positive lattice φ^4 or Ising models is inevitably free in dimension 4. The proof is based on a delicate study of intersection properties of a non-Markovian random walk appearing in the random current representation of the model. This is based on joint work with Michael Aizenman

Yan FYODOROV //

On the energy landscape of an elastic manifold in random potential

Frank den HOLLANDER //

Metastability for the Widom-Rowlinson model

This talk concerns the metastable behaviour of the Widom-Rowlinson model on a two-dimensional torus subject to a stochastic dynamics in which particles are randomly created and annihilated as if the outside of the torus were an infinite reservoir with a given chemical potential. The particles are viewed as points carrying disks and the energy of a particle configuration is equal to minus the volume of the total overlap of the disks. Consequently, the interaction between the particles is attractive.

We are interested in the metastable behaviour of the system at low temperature when the chemical potential is supercritical. In particular, we start with the empty torus and are interested in the first time when the torus is fully covered by disks. In order to achieve the transition from empty to full, the system needs to create a sufficiently large droplet, called critical droplet, which triggers the crossover. We compute the distribution of the crossover time, identify the size and the shape of the critical droplet, and investigate how the system behaves on its way from empty to full.

Joint work with Sabine Jansen (Bochum), Roman Kotecky (Prague & Warwick), Elena Pulvirenti (Bonn)

Dima IOFFE //

Diffusive 1:2:3 scaling and low temperature interfaces

A paradigm for the diffusive 1:2:3 scaling is a random walk above a hard wall and subject to the area tilt which scales like the reciprocal of the linear size of

the system. A related phenomenon is that of critical prewetting in the 2D Ising model below critical temperature. In both cases the scaling limits are Ferrari-Spohn diffusions.
In the context of 2+1 low temperature effective interfaces, such as models of facet formation or models of entropic repulsion of Solid-On-Solid random surfaces above a hard wall, there is a natural action of area tilts on macroscopic level lines. The strength of these tilts is compatible with the 1:2:3 diffusive scaling (reciprocal of the linear size) and it may be the same for all the ordered level lines (models of facet formation) or it may depend on the serial numbers of particular level lines (entropic repulsion). Furthermore, the number of macroscopic level lines may or may not grow with the linear size of the system. There are several scaling regimes, and the corresponding questions make sense and pose a challenge even in the simplified context of non-intersecting Brownian polymers.
There are some results and quite a few open problems, both of which I shall try to outline.
Based on joint works with Pietro Caputo, Sebastien Ott, Senya Shlosman, Yvan Velenik and Vitali Wachtel

Carlangelo LIVERANI //

Deterministic walks in random environment

Motivated by the random Lorentz gas (at high density) I will discuss some ideas of how to study deterministic walks in random environment when the deterministic dynamics is strongly chaotic. More precisely, I will discuss the possibility to reduce the deterministic walks to a general class of random processes that, hopefully, can be investigated independently

Sergei NECHAEV //

Anomalous statistics of extreme random processes

I am going to discuss two problems of extremal statistics in which unusual (but related to each other) features arise: a) statistics of two-dimensional “stretched” random walks over a semicircle with Kardar-Parisi-Zhang (KPZ) scaling, b) spectral properties of symmetric tridiagonal random matrices (operators) whose off-diagonal elements can independently take values 0 and 1. The spectral density of the ensemble of such random matrices has a specific fractal (ultrametric) structure and the spectral statistics shares some number-theoretic properties related to the theory of modular forms. The edge of the spectral density of such matrices has a

“Lifshitz tail”, typical for the one-dimensional Anderson localization. I will show that the “Lifshitz tail” can be considered as the manifestation of KPZ scaling and statistics of large deviations. I expect also to highlight a relationship of the spectral properties of symmetric tridiagonal random matrices with the “phyllotaxis” (manifestation of Fibonacci sequences in nature)

Charles NEWMAN //

The Riemann Hypothesis and statistical mechanics

One fairly standard version of the Riemann Hypothesis (RH) is that a specific probability density on the real line has a moment generating function (Laplace transform) that as an analytic function on the complex plane has all its zeros pure imaginary. We’ll review a series of results from the 1920’s to 2019 concerning Polya’s perturbed version of the RH. In that perturbed version, the log of the probability density is modified by a kind of mass term (in quantum field theory language). This gives rise to an implicitly defined real constant known as the de Bruijn-Newman Constant, Lambda. The conjecture and now theorem (Newman 1976, Rodgers and Tau 2018) that Lambda is greater than or equal to zero is complementary to the RH which is equivalent to Lambda less than or equal to zero; The conjecture / theorem is a version of the dictum that the RH, if true, is only barely so.If time permits, we’ll discuss connections with quantum field theory and the Lee-Yang circle theorem for Ising models

Andrei OKOUNKOV //

Bethe Ansatz from modern point of view

Bethe Ansatz is nearly 100 years old and every generation of mathematical physicist claims to understand it deeper than ever. In the current paradigm, pioneered by Nekrasov and Shatashvili, it is related to some core issues in 2- and 3-dimensional supersymmetric gauge theories. This new point of view is very useful indeed, as it not only produces a uniform construction of the off-shell Bethe eigenvectors, but also gives uniform integral solutions to qKZ-style equations. Its main applications have to do with really infinite-dimensional R-matrices and are waiting to be explored by the probability community. My talk will be a survey of the the basic ideas and results in the field

Grigori OLSHANSKI //

The equivalence/disjointness problem for determinantal measures

Let M be a probability measure defined on a space of infinite particle configurations. The fundamental invariants of M are its correlation functions of order 1,2,3,… . If they can be written as minors of order 1,2,3,… extracted from some kernel K(x,y), then M is called a determinantal measure. An open problem is to find a condition of equivalence (or disjointness) of determinantal measures, formulated in terms of their kernels. I will describe an approach to this problem, which uses tools from operator algebras

Yuval PERES //

Small ball estimates and transience for Martingales

The probability that a martingale returns to a ball can decay more slowly than the corresponding probability for random walk. Estimates on this decay can be used to determine transience for nonstandard random walks in lattices (where the distribution of steps depends on the history) and to bound from below the rate of escape of random walks on groups.
Talk based on joint works with Lee and Smart, with Gurel-Gurevich and Zeitouni, and with Popov and Sousi

Nicolai RESHETIKHIN //

Limit shapes in the 6-vertex model: a Hamiltonian integrable system?

It will be shown that differential equations for limit shapes of the 6-vertex model possess infinitely many conserved quantities which Poisson commute with respect to natural Poisson brackets. This property also holds for an inhomogeneous case

Fabio TONINELLI //

Non-integrable dimer models

The dimer model on planar periodic graphs is integrable and determinantal (Kasteleyn’s theorem). In the massless phase, the height field is known to scale to the Gaussian Free Field (GFF). I will discuss non-integrable perturbation of the model. Kasteleyn’s theorem and the determinantal structure are lost, but the model can be studied via a constructive Renormalization Group approach. For weak

enough perturbations, we can prove that:
1) the GFF scaling persists
2) the critical exponent ν of the two-point function depends non-trivially on the perturbation, on the edge weights and on the average interface slope, while in the integrable case one has $\nu = 1$ identically
3) the amplitude of the GFF and the critical exponent \nu satisfy a simple relation, that was conjectured (in a similar context) by L.Kadanoff and D.Haldane. Joint work with A. Giuliani and V. Mastropietro

Anatoly VERSHIK //

Randomness from the point of view of conditional measures: tame and wild situations

R.Dobrushin (and some others) systematically developed the method of defining the random objects (fields, processes, etc.) which is alternative to the classical Kolmogorov approach. It is based on conditional distributions, rather than on finite-dimensional distributions. A general formulation of these ideas uses the filtration in the space of configurations with cocycle, and the problem is to describe all measures with given cocycle as conditional distributions.
This formulation includes a lot of situation in physics and mathematics. In most of the cases, the problem of description is tame, in the sense that the list of measures has good parametrizations. We define the criteria for tameness, which uses the modified Kantorovich metric. We give also examples of wild cases

Paul WIEGMANN //

Stochastic quantization of hydrodynamics and gravitational anomaly

The problem of quantization of hydrodynamics is commonly considered untractable. Nevertheless, nature confronts us with experimentally accessible beautiful quantum fluids with precise quantization. They are 2-dimensional and chiral.
Ideal 2D flows can be seen as orbits of the group of the area preserving diffeomorphisms SDiff. Hence the problem of quantization is linked to representations of of SDiff and reminiscent the quantization of 2D gravity.
In the talk I present a particular quantization scheme extending stochastic approach to quantization. The net result of the quantization is an implication of the gravitational anomaly in hydrodynamics

Ofer ZEITOUNI //

On the cover time of the 2 dimensional sphere

Consider the cover time T_ϵ of S^2 by the Brownian sausage of radius ϵ. Dembo, Peres, Rosen and Zeitouni proved in 2004 that $T_\epsilon/(\log \epsilon)^2$ converges to 8. I will discuss refinements of this result, culminating with the statement that $\sqrt{T_\epsilon}-\sqrt{8}|\log \epsilon| +(\log\log \epsilon^{-1})/\sqrt{2}$ is tight. Speculations will also be provided