## Abstracts – Participants

**ESF Mathematics Conference in partnership with EMS and ERCOM on Combinatorics and Analysis in Spatial Probability**

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**Jakob E. BJÖRNBERG**
*(Box 480, 751 06 Uppsala, Sweden)*

*The Quantum Ising Model*
We give an introduction to the probabilistic study of the quantum Ising model, using graphical representations. Graphical representations enable us to establish important facts about phase transition in the model on the integer lattice, such as sharpness of the transition. They also give some information about the critical exponents.

**Xinxing CHEN**
*(Department of Mathematics, Shanghai Jiaotong University, 800 Dongchuan Road, Minhang, Shanghai, China, 200240 Minhang, China)*

*Two simple random walks collide infinitely many times on some wedge comb*
As it is known that Comb(Z) has the finite collision property, whence it is a recurrent graph. There is no simple monotonicity propery for the finite collision property. So, it is interesting to studying the collision property of the wedge comb with different profile. In this lecture, we shall show some recently development of the topic.

**Loren COQUILLE**
*(2-4 rue du Lièvre, 1211 Genève 4, Switzerland)*

*A finite volume approach to the Aizenman Higuchi theorem for the 2d Ising model*
In the late 1970s, in two celebrated papers, Aizenman and Higuchi independently established that all infinite-volume Gibbs measures of the 2d Ising model are a convex combination of the two pure phases (\mu_{+,\beta} and \mu_{-,\beta}). I will present a new approach to this result, with a number of advantages:
(i) a finite-volume, quantitative analogue (implying the classical claim) is obtained;
(ii) the scheme of the proof seems more natural and provides a better picture of the underlying physical phenomenon;
(iii) this new approach seems substantially more robust.
This is a joint work with Yvan Velenik.

**Jian DING**
*(Berkeley, CA 94720 Berkeley, United States)*

*Near-critical random graph: its structure, diameter and mixing time*
In this talk, I will present a complete description of the giant component of the Erd\H{o}s-R\'enyi random graph $G(n,p)$ as soon as it emerges from the scaling window, i.e., for $p = (1+\epsilon)/n$ where $\epsilon^3 n \to \infty$ and $\epsilon=o(1)$.

Our description is particularly simple for $\epsilon = o(n^{-1/4})$, where the giant component $C_1$ is contiguous with the following model. Let $Z$ be normal with mean $\frac23 \epsilon^3n$ and variance $\epsilon^3 n$, and let $K$ be a random 3-regular graph on $2[Z]$ vertices. Replace each edge of $K$ by a path, where the path lengths are i.i.d. geometric with mean $1/\epsilon$. Finally, attach an independent Poisson($1-\epsilon$)-Galton-Watson tree to each vertex. A similar picture is obtained for larger $\epsilon=o(1)$.

Based on this description, we show that for any $\epsilon=o(1)$ with $\epsilon^3n\to\infty$, the diameter of $C_1$ is w.h.p. asymptotic to $D
(\epsilon,n)=(3/\epsilon)\log(\epsilon^3 n)$. Furthermore, we prove that the mixing time for the random walk on $C_1$ is w.h.p. of order
$\epsilon^{-3}\log^2 (\epsilon^3 n)$.
Based on joint work with J.H. Kim, E. Lubetzky and Y. Peres.

**Hanna DÖRING**
*(Straße des 17. Juni 136, MA 7-4, D-10623 Berlin, Germany)*

*Moderate deviations in random graphs*
We prove a moderate deviation principle for subgraph count statistics of Erdös-Rènyi random graphs. It is done via a method of cumulants which can be applied similarly to show moderate deviation principles for a class of symmetric statistics, including non-degenerate U-statistics with independent or Markovian entries and characteristic polynomials of matrices in the circular unitary ensemble. This is based on joint work with Peter Eichelsbacher (Ruhr-Universität Bochum).

**Victor ERMOLAEV**
*(Nijenborg 9, 9747 AC Groningen, Netherlands)*

*Non-Gibbs behaviour of Curie-Weiss model*
We consider the Curie-Weiss model in vanishing external field subjected to a general temperature Glauber dynamics. We study the continuity properties of limiting conditional probabilities. We provide a complete analysis of the transition between Gibbsian and non-Gibbsian behaviour as a function of time.

**Anna Catherine FEY**
*(De Boelelaan 1081, 1081 HV Amsterdam, Netherlands)*

*The approach to criticality in sandpiles.*

A popular theory of self-organized criticality relates the critical behavior of driven dissipative systems to that of systems with conservation. In particular, this theory predicts that the stationary density of the driven abelian sandpile model should be equal to the threshold density of the corresponding fixed-energy sandpile. This "density conjecture" has been proved for the underlying graph Z. Research into this conjecture has focused mainly on the underlying graph Z^2: the stationary density was proved to be equal to 17/8 to at least twelve decimals, while the threshold density was simulated to be 2,125 to three decimals.

In this talk, I will give the definition of the different densities featuring in the density conjecture, and present our results. We have investigated the density conjecture for several graphs, and we show (by large-scale simulation or by proof) that the conjecture is false when the underlying graph is any of Z^2, the complete graph K_n, the Cayley tree, the ladder graph, the bracelet graph, or the flower graph. These results cast doubt on the validity of using fixed-energy sandpiles to explore the critical behavior of the abelian sandpile model at stationarity.

If time permits, I will outline our continuing research into the density conjecture. The debate has not been settled yet: it is claimed that deterministic sandpiles are an exception, and that the conjecture still holds for stochastic sandpile models.

**Ricardo GOMEZ**
*(Instituto de Matematicas, Area de la Investigación Científica, Circuito Exterior, Ciudad Universitara, 04510 Mexico City, Mexico)*

*Mean recurrence times and spanning tree invariants.*
Spanning tree invariants were introduced by Lind and Tuncel in 1999 as a conjugacy invariant of Markov chains. We look at the spanning tree invariant in the context of first return loop systems. We show that the spanning tree invariants of first return loop systems coincide with the mean recurrence times.

**Marcelo HILARIO**
*(IMPA, Brazil)*

Title: Fixation for Distributed Clustering Processes.

Abstract:
In a distributed clustering process at time $t=0$ a random amount of a resource is placed on each vertex of the $d$-dimensional integer lattice. Then, at each step, each vertex transfers all of its resource to the neighboring vertex which currently hosts the maximum amount of resource. If the initial resource quantities are sampled from any translation-invariant probability distribution then the flow at each vertex stops after finitely many steps almost surely. However there are translation-invariant initial configurations for which the resources starting at a given site have strictly positive probability of never stop moving. This answers a (generalized version) of a question posed by Van den Berg and Meester in 1991.

**Illes Antal HORVATH**
*(Egry József utca 1., 1111 Budapest, Hungary)*

*Diffusive bounds and central limit theorem for a class of ``true'' (or myopic) self-avoiding random walks in three or more dimensions*

*Authors: Illes Horvath, Balint Toth, Balint Veto*
*Affiliations: Department of Stochastics, Mathematics Institute, Budapest University of Technology and Economics*

We announce recent results for the so-called ``true'' (or myopic) self-avoiding walk model (MSAW) and we also review some related results in the classic literature. The MSAW was originally proposed in the physics literature by Amit, Parisi and Peliti in 1983. We investigate a continuous time version of the original model. It is a random motion in the d-dimensional lattice pushed towards domains less visited in the past by a kind of negative gradient of the occupation time measure. We investigate the asymptotic behaviour of MSAW in the non-recurrent dimensions. For a wide class of self-interaction functions, we identify a natural stationary (in time) and ergodic distribution of the environment (the local time profile) as seen from the moving particle and we establish diffusive lower and upper bounds for the displacement of the random walk. For a particular, more restricted class of interactions, we prove full central limit theorem for the finite dimensional distributions of the displacement. The main theoretical tool to do this is an enhanced version of the so-called graded sector condition, introduced by Sethuraman, Varadhan and Yau in 2000. This result settles part of the conjectures (based on non-rigorous renormalization group arguments) posed by Amit, Parisi and Peliti.

**Sabine JANSEN**
*(Mohrenstr. 39, 10117 Berlin, Germany)*

*Symmetry breaking in quasi-1D Coulomb systems*

*M. Aizenman (Princeton University, US), S. Jansen (Weierstrass Institute, Berlin, Germany), P. Jung (Sogang University, Seoul, Korea)*
We investigate a classical Coulomb system, consisting of negatively charged particles moving in a neutralizing background ("jellium" or "one-component plasma"), at positive temperature. It is known that 1D jellium displays symmetry breaking, corresponding to formation of a Wigner crystal. We prove that symmetry breaking persists for jellium on a long tube with periodic or Neumann boundary conditions in the confined direction. This extends previous results on jellium strips at the so-called free fermion point Gamma =2 (Choquard, Forrester, Smith 1983) and on Laughlin states in thin strips (Jansen, Lieb, Seiler 2009).

The extension is enabled through bounds which establish tightness of finite-volume charge fluctuations. The proof proceeds with a structural argument akin to that employed by Aizenman and Martin (1980) for 1D Coulomb systems. This illustrates a general relationship between tightness of charge fluctuations and symmetry breaking in 1D systems (Aizenman, Goldstein, Lebowitz 2001).

**Sandra KLIEM**
*(Eurandom, P.O.Box 513, 5600MB Eindhoven, Netherlands)*

*Degenerate Stochastic Differential Equations for Catalytic Branching Networks*
Uniqueness of the martingale problem corresponding to a degenerate SDE which models catalytic branching networks is proven. This work is an extension of a paper by Dawson and Perkins to arbitrary catalytic branching networks. As part of the proof estimates on the corresponding semigroup are found in terms of weighted H\"older norms for arbitrary networks, which are proven to be equivalent to the semigroup norm for this generalized setting.

**Christof KUELSKE**
*(Universitaetsstrasse 150, D 44801 Bochum, Germany)*

*Gibbs properties of time-evolved models on different graphs*

It is known that under stochastic dynamics
time-evolved lattice measures may lose their Gibbs property.
After that transition time, a variety of transitions in and out of Gibbs may occur, depending on the model.
Our current research focusses on the one hand on case studies of important models like Ising, rotators under natural dynamics. We are particularly interested in a similarities and differences of the transitions when the underlying graph varies (comparing lattice, complete graphs, trees).

**Gregory MAILLARD**
*(EURANDOM, P.O. Box 513, 5600 MB Eindhoven, Netherlands)*

*Annealed and quenched asymptotics for the parabolic Anderson model*

We consider the parabolic Anderson model with time-dependent potential describing the evolution of a reactant under the influence of a catalyst. We focus mainly on three different choices for the catalyst : independent simple random walks, symmetric exclusion and the voter model, all in equilibrium at a given density. We analyse both the annealed and quenched Lyapunov exponents, i.e., the exponential growth rates of the successive moments of the reactant w.r.t. to the catalyst and the exponential growth rate of the reactant conditionnal on the catalyst, respectively, and show that these exponents display interesting dependence on the parameters of the system.

**Dimitris MANIADAKIS**
*(Panepistimiopolis, Ilissia, 15784 Athens, Greece)*

*On the relation of spatial distribution to connectivity and centrality in large communication networks, Dimitris Maniadakis and Dimitris Varoutas, University of Athens*
In this work we analyze the topology of several large scale communication networks represented as physical layer backbone networks in geographical space, connecting cities. Using graph theory and complex network analysis tools, we investigate their structure and the relationship of the locations connected on a two-dimensional plane with the connectivity and the centrality of the topology. We find that these planned networks obey scale-free behaviour, with connectivity and centrality being correlated not only to the population sizes of the cities connected, as expected, but also remarkably well correlated to their locations. The geographic position affects development opportunities, so that even less populated cities can act as “gateway cities” between the core area and more peripheral areas. These spatial patterns that have emerged in backbone communication networks help us redefine the importance of locations as a predictor of connectivity and centrality.

**Tobias MUELLER**
*(CWI, P.O.Box 94079, 1090GB Amsterdam, Netherlands)*

*Hamilton cycles in random geometric graphs*
Hamilton cycles in random geometric graphs

Let X_1,..., X_n be independent, uniformly random points from the unit square [0,1]^2.
I will sketch a proof of the fact that if we add edges between these points one by one by order of increasing edge length then, with probability tending to 1 as the number of points n tends to infinity, the first Hamilton cycle (that is, a cycle that visits every point exactly once) appears at precisely the same time the last vertex of degree less than two disappears.
This settles a long-standing open question by Penrose in the
theory of random geometric graps.

Time permitting, I will speak about a number of additional results on Hamilton cycles in random geometric graphs.

(joint work with J. Balogh, B. Bollobas, M. Krivelevich and M. Walters)

**Leandro PIMENTEL**
*(Av. Athos da Silveira Ramos 149, Bloco C, Ilha do Fundao, 113 D, 68530 Rio de Janeiro, Brazil)*

*Busemann functions and equilibrium measures in last passage percolation models*
We develop a connection between the construction of Busemann functions in the last-passage percolation model, and the existence, ergodicity and uniqueness of equilibrium (or time-invariant) measures for the related interacting fluid system. As we shall see, this approach sheds a new light on some known results and prove new ones.

**Mirco SCHULTKA**
*(Vulkanstraße 4, 17489 Greifswald, Germany)*

*A stochastic Hodgkin- Huxley model, Schultka Mirco,*
*Institute of Mathematics and Informatics, University of Greifswald*

In 1952 Hodgkin and Huxley published a series of semiexperimental papers, in which they also introduces a non-linear, coupled system of four ODEs, which is nowadays referred to as the Hodgkin-Huxley model. With this model you can describe the time-evolution of the membrane potential under different initial conditions. If you start with a membrane potential above a certain value, called threshold, your will get a special form of membrane potential passage, called the action potential.

Nowadays we know much more about the mechanisms underlying neurobiological behavior, like the action potential, then 1952. There have been lots of research about voltage-dependent ion channels, which are trans-membrane proteins and which can be in a conductive and a non-conductive state. When the channel is open, ions may pass through it in the direction of their electrochemical gradient. The rate of activation and of deactivation (K+ and Na+ channels) depend on the membrane-potential, which explains the name (voltage-dependent).

Additionally, Hodgkin and Huxley considered no stochastic effects, their model is purely deterministic. In reality there are many ion-channels, especially Na+, and K+ channels, which open and close randomly. So it may be interesting to examine to which extend this channel noise can lead to stochastic phenomena, like random thresholds or spontaneous action potentials. It may also be interesting to relate the stochastic model to its deterministic limit.

In my diploma thesis I simulated the stochastic dynamic with continuous Markov Chains and varied the parameters. For some model/parameter combinations I got results which may have a physiological interpretation: like resting potential, the action potential and a train of action potentials.

As a submodel I considered the situation, where we have an Ion in the mid of the Ion channel, so that the ion performs a Brownian motion with drift, where the drift term models the effect of the membrane potential on the ion. With these interpretation one can consider the conditional probabilities of leaving the channel to the interior or to the exterior, and also the sub-densities of duration to the exit.

**Vadim SHCHERBAKOV**
*(Leninskie Gory, Moscow State University, Glavnoe Zdanie, faculty of Mechanics and Mathematics, 119991 Moscow, Russian Federation)*

*Title: Stochastic models for particle deposition and their applications.*

*Author: Vadim Shcherbakov*

*Affiliation: Moscow State University*

Stochastic models for particle deposition have originally been motivated by adsorption processes in physics and have attracted much interest over the years, motivated also by other applications (e.g. biological growth). Mathematically these models are formulated as a random finite sequential allocation of particles in a bounded region of a space. Depending on a particular technical set up the model can be relevant to a range of different applications. Under certain conditions the model
may be used for modelling time series of spatial locations (for instance, for modelling the irreversible spread of an infection). In some cases the model can be interpreted in terms of generalized Polya urn models with interaction. In my talk I will give examples of
probabilistic and statistical study of the depostion models.

**Perla SOUSI**
*(15 The Isokon flats, Lawn Road, London , United Kingdom)*

*Mobile geometric graphs: detection, coverage and percolation*
*Yuval Peres, Microsoft Research, Alistair Sinclair, UC Berkeley, Perla Sousi, University of Cambridge and Alexandre Stauffer, UC Berkeley*
We consider the following dynamic Boolean model introduced by van den Berg, Meester and White (1997). At time 0,
let the nodes of the graph be a Poisson point process in R^d with constant intensity and let each node move independently according to Brownian motion. At any time t, we put an edge between every pair of nodes if their distance is at most r.
We study two features in this model: detection (the time until a target point--fixed or moving--is within distance r from some node of the graph) and percolation (the time until a given node belongs to the infinite connected component of the graph). We obtain asymptotics for these features by combining ideas from stochastic geometry, coupling and multi-scale analysis.

**Sergey TIKHONOV**
*(ICREA and Centre de Recerca Matemàtica, Centre de Recerca Matemàtica , Campus de Bellaterra, Edifici C Bellaterra (Barcelona), 08193 Bellaterra (Barcelona), Spain)*

*Weighted Fourier inequalities*
In this talk we discuss weighted Lp–Lq estimates for the Fourier transforms. We study Pitt-type results on integrability of the Fourier transform with power weights and its extensions to general weights. We show that the class of general monotone functions is of importance in these problems.

**Felipe TORRES**
*(University of Bielfeld, Faculty of Mathematics, Postfach 100131, 33501 Bielefeld, Germany)*

*The rate of the convergence of the mean score in global random sequence comparison.*
We consider a general class of superadditive scores measuring the global similarity of two independent sequences of n i.i.d. letters from a finite alphabet. Our object of interest is the mean score by letter. By the subadditivity, the mean score by letter is nondecreasing and converges to a limit. We give a simple method for bounding the difference between the score by letter and its limit and for obtaining the rate of convergence. Our result generalizes the previous result of Alexander, where only the special case of the longest common subsequence was considered.

**Daniel UELTSCHI**
*(Zeeman Building, Coventry, United Kingdom)*

*Spatial random permutations and their cycle distributions*
I will discuss models of random permutations of points in the space, where permutation jumps are restricted to points that are spatially close. The main questions deal with the distribution of cycle lengths in the infinite volume limit. One model is closely related to quantum bosonic systems and one can prove the existence of a phase transition to a phase with macroscopic cycles. This is joint work with Volker Betz.

**Aernout VAN ENTER**
*(Bernoulliborg, Nijenborgh 9,, 9747ag Groningen, Netherlands)*

*Non-Gibbsian measures on trees*
*A.van Enter, V.Ermolaev,G.Iacobelli, (Groningen)C.Kuelske(Bochum)*
We study the Gibbs nonGibbs transitions for Gibbs measures evolving under Glauber dynamics on trees, and how they are depending on initisal conditions,

**Johan VAN LEEUWAARDEN**
*(Den Dolech 2, 5600 MB Eindhoven, Netherlands)*

*Counting walks in the quarter plane*
The problem of studying (random) walks that are restricted to the quarter plane requires solving a functional equation for the trivariate counting generating function (CGF). This functional equation can be solved using conformal mappings and boundary value problems. Depending on the step set, the CGF can be meromorphic or algebraic, which affects the considerably the large-time asymptotics. We present the analysis of several of these two-dimensional walks.

**Balint VETO**
*(Egry J. u. 1., 1111 Budapest, Hungary)*

*Diffusive limit for the true self-avoiding random walk in three or higher dimensions*
*(authors: Illes Horvath, Balint Toth, Balint Veto)*
The myopic (or ``true'') self-avoiding random walk model was introduced in the physics literature by Amit, Parisi and Peliti in 1983. It is a nearest neighbour jump process in Z^d pushed towards domains less visited in the past by a kind of negative gradient of the occupation time measure.

We investigate the asymptotic behaviour of the walk in the non-recurrent dimensions. For a wide class of self-interactions, we identify a natural stationary and ergodic distribution of the environment (the local time profile) as seen from the moving particle and we establish diffusive lower and upper bounds for the displacement of the random walk. For a particular, more restricted class of interactions, we prove full central limit theorem for the finite dimensional distributions of the displacement. This result settles parts of the conjectures (based on non-rigorous renormalization group arguments) posed by Amit, Parisi and Peliti.

**Andrew WADE**
*(26 Richmond Street, Glasgow, United Kingdom)*

*Poster title: Limit theory for random spatial graph models*
*Andrew R. Wade (University of Strathclyde) based on joint work with Mathew D. Penrose (University of Bath).*
The poster presents some recent results (joint work with Mathew D. Penrose, University of Bath) on the probability theory of random spatial networks. We consider two simple models. The first is a model of network evolution, the random on-line nearest-neighbour graph (ONG), in which points arrive one by one, distributed randomly in the unit d-cube, and each point after the first is joined by an edge to its nearest predecessor. The second is a model for drainage of liquid through a porous lump of material, in which sites are scattered randomly in the unit square (say), and each site is joined by an edge to its nearest-neighbour amongst those points `below' it, i.e., with strictly smaller second coordinate. These two models are closely related: in the large-sample asymptotic theory of the total edge-length of the drainage network, boundary effects are manifest as terms involving the ONG. Curiously, the distributional limit theory for the drainage network is essentially complete, while that for the ONG still contains significant open problems.

**Peter WINDRIDGE**
*(Zeeman Building, Gibbet Hill,, Coventry, United Kingdom)*

*Random permutations and spin correlations in the Heisenberg ferromagnet*
I will introduce a model of random permutations arising from the quantum Heisenberg ferromagnet and explain how the permutations' cycle structure is connected to spin correlations. We will see that 'infinite' cycles in the permutation and long range order in the ferromagnet are intimately related. This motivates the study of cycle lengths in the permutation. It is believed all infinite cycles are macroscopic, but there is no agreement about whether there is a single large cycle or many. We argue for the latter, and that in particular, the asymptotic distribution of cycle lengths, ordered and properly normalised is Poisson-Dirichlet.

The 'spin-0' version of this conjecture for the complete graph was proven by Schramm '05 by considering a certain coagulation and fragmentation process on interval partitions. Our conjecture is justified with similar (but non-rigorous) reasoning.

This is joint work with Daniel Ueltschi and Christina Goldschmidt.

**Liana YEPREMYAN**
*(1 Alex Manoogian, 375025 Yerevan, Armenia)*

*Interval edge colorings of some products of graphs, Petros Petrosyan, Liana Yepremyan, Yerevan State University*
I can send an abstract of my future thesis because I have no ready article yet.I am also very enthusiastic to give a short talk on that. I am looking forward to your suggestions on this.

**Stefan ZOHREN**
*(Niels Bohrweg 1, 2333 CA Leiden, Netherlands)*

*Growth of uniform infinite causal triangulations*
We introduce the uniform measure on infinite causal triangulations (UICT) which appear in physical models of two-dimensional Lorentzian quantum gravity. It is shown how to construct this measure from conditioned critical Galton-Watson processes on the one hand and from a certain growth process on the other hand. In context of the latter, we show how to give a.s. bounds on the Hausdorff dimension and show weak convergence of the time dependent lengths process to a certain diffusion process which enables one to extract the physical Hamiltonian from the corresponding Kolmogorov equation.

(Based on joint work with V. Sisko and A. Yambartsev)