Workshop on

Probabilistic Techniques in Statistical Mechanics

celebrating the 65th birthday of Erwin Bolthausen

Organized by Jean-Dominique Deuschel, Wolfgang König, Max von Renesse, Michael Scheutzow and the DFG Research Group *Analysis and Stochastics in Complex Physical Systems*.

Conference homepage: `http://www3.math.tu-berlin.de/jgeb2010/eb.html`

Venue: Technical University Berlin, Institute for Mathematics, Str. des 17. Juni 136, 10623 Berlin, Room MA043

Thursday, 14 October, 2010

9:00–9:15: **Opening**

9:15–9:55: **Michiel van den Berg (University of Bristol)**

Minimization of Dirichlet eigenvalues with geometric constraints

Abstract: I will discuss the problem of minimizing the k'th eigenvalue of the Dirichlet Laplacian over all open sets in Euclidean space $\mathbb{R}^m$ with Lebesgue measure 1. It is well known that if $k = 1$ the minimizer is a ball, and if $k = 2$ the minimizer is the union of two disjoint balls with measure 1/2 each. It has been conjectured that if $k = 3$ and $m > 3$ the minimizer is the union of three pairwise disjoint balls with measure 1/3 each. I will show that if $k < m+2$ and if a minimiser exists then that minimizer consists of at most 7 components. Other constraints, such as the $(m-1)$-dimensional Hausdorff measure of the boundary of the open set equal to 1, will also be considered.

10:00 – 10:30: Coffee break

10:30–11:10: **Tadahisa Funaki (University of Tokyo)**

Hydrodynamic limit for 2D and 3D Young diagrams

Abstract: The scaling limits for random Young diagrams as their size grows are studied by Vershik ('96) in 2D case and by Cerf and Kenyon ('01) in 3D case. Our goal is to discuss these results from the dynamic point of view.

We first construct the dynamics of 2D Young diagrams, which are naturally associated with their grandcanonical ensembles, by allowing the creation and annihilation of unit squares located at the boundary of the diagrams. The grandcanonical ensembles are uniform measures under conditioning on their size. We then show that, as the averaged size of the diagrams diverges, the corresponding height variable converges to a solution of a certain non-linear partial differential equation under a proper hydrodynamic scaling. Furthermore, the stationary solution of the limit equation is identified with the so-called Vershik curve. This part is a joint work with Makiko Sasada and has appeared in CMP 299 ('10).

We next introduce a time evolution of honeycomb dimers on a torus related to 3D Young diagrams and discuss its hydrodynamic behavior.

11:15–11:55: **Ofer Zeitouni (University of Minnesota and Weizmann Institute of Science)**

Fluctuations of the (discrete) Gaussian Free Field, and Branching Random Walks

Abstract: The study of the maxima of the (discrete) Gaussian free field has been an active area of research, with applications to the study of interfaces and random surfaces. A fundamental question concerns the order of the fluctuations, especially in the planar case. I will describe some recent work in this direction, culminating with a proof that the fluctuations of the planar GFF are of order 1.

12:00 – 14:00: Lunch break

14:00–14:40: **Giambattista Giacomin (University Paris Diderot - Paris 7)**

Impurities, defects and critical phenomena

Abstract: Soon after the celebrated solution of the two-dimensional Ising model several researchers addressed the issue of the stability of the emerging (qualitative and quantitative) picture in presence of defects or other quenched impurities. It was first believed that transitions cannot survive to quenched disorder, but later it became clear that certain transitions do withstand impurities and the work of A. B. Harris (1974) introduced new ideas on

this issue that have been and are still analyzed, criticized, generalized. The aim of the talk is to present Harris' approach in its original context (Ising model) and some of what has been done on and around it, in the light of the recent rigorous results obtained for disordered pinning models.

14:45–15:25: **Alice Guionnet (ENS Lyon)**

Potts model on random graphs

Abstract: I will show how to construct matrix models for the Potts model on random graphs and how to use this construction to compute the related generating function.

15:30 – 16:00: Coffee break

16:00–16:40: **Fabio Toninelli (ENS Lyon)**

On the zero temperature dynamics of the 3D Ising model

Abstract: We consider the Glauber dynamics for the 3D Ising model at zero temperature, with + boundary conditions. We prove that the time which an initial domain of linear size L of − spins requires to become entirely + is of order L2, modulo logarithmic corrections. The proof involves the mapping of monotone discrete interfaces into dimer coverings of the infinite hexagonal lattice, plus a coupling argument to estimate the mixing time of a stochastic dynamics for monotone interfaces. (joint work with P. Caputo, F. Martinelli and F. Simenhaus)

16:45–17:25: **Yvan Velenik (University of Geneva)**

A new approach to the Aizenman-Higuchi theorem

Abstract: In the late 1970s, in two celebrated papers, Aizenman and Higuchi independently established that all infinite-volume Gibbs measures of the two-dimensional ferromagnetic nearest-neighbor Ising model are convex combinations of the two pure phases (and thus are all translation invariant). I'll present a new approach to this result, developed in collaboration with Loren Coquille. This approach presents a number of advantages:

(i) it provides an (essentially optimal) finite-volume, quantitative analogue (implying the classical claim);

(ii) the scheme of the proof is more natural and provides a better picture of the underlying phenomenon;

(iii) it seems more robust.

17:30 – ???: Wine and cheese party

Friday, 15 October, 2010

9:00–9:40 **Wendelin Werner (University Paris-Sud 11 in Orsay and ENS Paris)**

Self-interacting random walks with finite spatial interaction range

Abstract: I will present some joint work with Anna Erschler and Balint Toth, describing certain self-interacting walks on the set of integers, that choose to jump to the right or to the left randomly but influenced by the number of times they have previously jumped along the edges in the finite neighborhood of their current position (typically, we will discuss the case where one considers the neighboring edges and the next-to-neighboring edges). We will survey a variety of possible asymptotic behaviors, including some where the walks is eventually confined in an interval of large length, or where the walk goes to infinity like the square root of time etc.

9:45–10:25: **Bálint Tóth (Technical University Budapest)**

Superdiffusive lower bound for self-repelling processes in the critical dimension

Abstract: We show that the so called 'self-repelling Brownian polymer process' (the continuous space-time version of the '*true* self-avoiding random walk') is marginally superdiffusive in $d = 2$. (Joint work in progress with Benedek Valko (Madison WI))

10:30 – 11:00: Coffee break

11:00–11:40: **Alain-Sol Sznitman (ETH Zurich)**

Random walks and random interlacements

Abstract: Random interlacements are useful in understanding how paths of random walks can create large separating interfaces. In this talk we will present a short overview of some of the results and paradigms, which have by now emerged.

11:45–12:25: **Amir Dembo (Stanford University)**

Low temperature expansion for matrix models

Abstract:

Relying on its representation as a solution of certain Schwinger-Dyson equation, we study the low temperature expansion of the limiting spectral measure (and limiting free energy), for random matrix models, in case of potentials which are strictly convex in some neighborhood of each of their finitely many local minima. When applied to suitable polynomial test functions, these expansions are given in terms of the aboslutely convergent generating function of an interesting class of colored maps.

This talk is based on a joint work with Alice Guionnet and Edouard Maurel-Segala.

12:30 – 14:00: Lunch break

14:00–14:40: **David Brydges (University of British Columbia, Vancouver)**

The strong interaction limit of continuous-time weakly self-avoiding walk

Abstract: The strong interaction limit of the discrete-time weakly self-avoiding walk (or Domb–Joyce model) is trivially seen to be the usual strictly self-avoiding walk. For the continuous-time weakly self-avoiding walk, the situation is more delicate, and is clarified in this paper. The strong interaction limit in the continuous-time setting depends on how the fugacity is scaled, and in one extreme leads to the strictly self-avoiding walk, in another to simple random walk. These two extremes are interpolated by a new model of a self-repelling walk that we call the "quick step" model. We study the limit both for walks taking a fixed number of steps, and for the two-point function.

14:45–15:25: **Gérard Ben Arous (Courant Institute New York)**

Extreme gaps in the spectrum of random matrices

Abstract: I will present a joint work with Paul Bourgade (Harvard) about the extreme gaps between eigenvalues of random matrices. We give the joint limiting law of the smallest gaps for Haar-distributed unitary matrices (CUE) and matrices from the Gaussian Unitary Ensemble. In particular, we show that the smallest gaps when rescaled by $N^{-4/3}$, are Poissonian and we give the limiting distribution of the kth smallest gap. We also show that the largest gap, when normalized by $\sqrt{logN}/N$, converges in L^p to a constant for all $p > 0$. These results are compared with the extreme gaps between zeros of the Riemann zeta function.

15:30 – 16:00: Coffee break

16:00–16:40: **Nicola Kistler (University of Bonn)**

Traveling waves through the spin glass

Abstract: A large number of physical processes are dominated by the statistics of extremal events. From the point of view of Probability, however, rigorous results going beyond the classical case of independent random variables are still rather scarce. In my talk, I will focus on one particular model, that of Branching Brownian Motion, which may be seen as a paradigm where correlations 'start to kick in'; the model is also intimately related to Spin Glasses, and issues of traveling waves in certain parabolic non-linear p.d.e.'s. I will try to give a brief account of this vast subject, and present some recent results obtained in collaboration with L.-P. Arguin and A. Bovier.

16:45–17:25: **Béatrice de Tilière (University Pierre et Marie Curie, Paris)**

The critical Z-invariant Ising model via dimers: local statistics and combinatorics.

Abstract: Fisher established an explicit correspondence between the Ising model and the dimer model on a decorated graph. In collaboration with Cedric Boutillier, we solve fundamental aspects of the dimer model corresponding to the Ising model at criticality, by proving explicit formulas for the free energy, and for local statistics. Moreover, we show that these expressions have the surprising feature of depending only on the local geometry of the underlying graph. Our work suggested a strong connexion between the Ising model and spanning trees. Motivated by

this, I recently proved an explicit correspondence between the two models, and will mention a few ideas towards the end of the talk.

17:30–18:10: **Ilya Goldsheid (Queen Mary College)**

Simple Random Walks in 1D Random Environment: limiting behaviour in the sub-diffusive regimes.

Abstract: I shall explain the main ideas of the approach we use to investigate the limiting behaviour of the simple RWRE on a line. The analysis of the properties of properly defined traps allows us to express such quantities as normalized hitting times/occupation times as well as the distribution of the maximal occupation time in terms of a Point Poisson Process with an explicit intensity. A new proof of the classical result of Kesten-Kozlov-Spitzer is also obtained. (Joint work with D. Dolgopyat)

19:00 – ???: Birthday dinner

Saturday, 16 October, 2010

9:00–9:40: **Dmitry Ioffe (Technion)**

Stretched polymers in random environment

Abstract: We shall survey recent results and open questions on ballistic phase of quenched and annealed stretched polymers in random environment. Based on joint works with Yvan Velenik.

9:45–10:25: **Francesco Caravenna (University of Padova)**

The weak coupling limit of disordered copolymer models

Abstract: A copolymer is a chain of repetitive units (monomers) that are almost identical, but they differ in their degree of affinity for certain solvents. A discrete model of such system, based on the simple symmetric random walk, was investigated in [Bolthausen and den Hollander, Ann. Probab. 1997], notably in the weak polymer-solvent coupling limit, where the convergence of the discrete model toward a continuum model, based on Brownian motion, was established. This result is remarkable because it strongly suggests a universal feature of copolymer models. In this talk we show that this is indeed the case. More precisely, we determine the weak coupling limit for a general class of discrete copolymer models based on renewal processes, obtaining as limits a one-parameter family of continuum models, based on stable regenerative sets. (joint work with G. Giacomin)

10:30 – 11:00: Coffee break

11:00–11:40: **Anton Bovier (University of Bonn)**

Almost sure ageing

Abstract: I present a new approach to the analysis of ageing in the stochastic dynamics of disordered systems. The principle idea is to consider the clock process as a sum of dependent and heavy tailed random variables. I present a general theorem that can be applied to prove convergence of the clock and ageing almost surely with respect to the random environment in the p-spin SK model.

11:45–12:25: **Frank den Hollander (Leiden University and EURANDOM)**

Variational approach to copolymers near linear interfaces

Abstract: In this talk I present a variational expression for the critical curve in the model of a copolymer consisting of a random concatenation of hydrophobic and hydrophilic monomers near a linear interface separating oil and water. This critical curve separates a localized phase from a delocalized phase. Both the quenched and the annealed version of the model are considered. The quenched critical curve has been the object of much research, both in the past and in the present.

This is work in progress with Erwin Bolthausen and Alex Opoku.

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