Swiss Doctoral Program in Mathematics

Universities of Basel, Bern, Fribourg, Geneva, and Neuchâtel

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Workshop

Probability - Statistical Mechanics in Switzerland

September 11 – 12, 2008

University of Neuchâtel

1 Organizers

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2 Location

Room **B013**. Institut de Mathématiques, Rue Emile-Argand 11, 2007 Neuchâtel.
http://www2.unine.ch/webdav/site/localisation/shared/documents/sciences.pdf

3 Programme

	Thursday, September 11	Friday, September 12
9:00 - 9:50	Johel Beltran	Noemi Kurt
9:50 - 10:20	Break	Break
10:20 - 11:10	Nicolas Pétrélis	Jiří Černý
11:10 - 12:00	Arvin Singh	Charles Pfister
12:00 - 13:30	Lunch	Lunch
13:30 - 14:20	Robert Dalang	Pierre Patie
14:20 - 15:10	David Cimasoni	Ashkan Nikeghbali
15:10 - 15:40	Break	Break
15:40 - 16:30	Cédric Boutillier	Joseph Najnudel
16:30 - 17:20	Vincent Beffara	Alfredo Donno

4 List of participants

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5 List of speakers

- **Vincent Beffara (ENS Lyon)**

"Isotropic embeddings of planar lattices"

Abstract: In recent years, huge progress has been made in the understanding of critical 2D models of statistical physics, and especially about their scaling limits (through the use of SLE processes). However, one question remains widely open, and that is the reason for universality, i.e. the belief that similar system on different lattices, even though they have different critical points, nevertheless converge to the same scaling limit as the lattice mesh goes to 0. It seems that a key question along the way to understanding it is, given the combinatorics of a lattice, how to embed it in the plane in order to obtain a conformally invariant scaling limit - and a surprising fact is that the "right" embedding depends not only on the lattice but also on the model. The particular case of percolation is of special interest and (at least in a certain scaling regime) involves geometric objects called "circle packings", which in many ways are the correct notion of a discrete complex structure; my goal in this talk is to try and explain why.

- **Johel Beltran (EPFL)**

"Meta-stability and condensed zero-range processes on finite sets"

Abstract: In this talk I propose a definition of meta-stability and show sufficient conditions for a sequence of irreducible Markov processes on finite state spaces to be meta-stable. Roughly speaking, we shall say that a sequence of Markov processes displaying a fixed number of wells is meta-stable if (a) it spends a vanishing time outside the wells, and (b) the inter-wells dynamics described by a sequence of jump processes converges to a Markov chain. In the reversible case, our sufficient conditions reduce to estimates on the capacity and on the measure of the meta-stable states. As application, it will be stated a meta-stability behaviour for a class of zero range processes.

- **Cédric Boutillier (Paris 6)**

"The critical Ising model on isoradial graphs via dimers"
(joint work with Béatrice de Tilière, Neuchâtel).

Abstract: Fisher (1961) showed a correspondence between the Ising model on a planar graph G and the dimer model on a decorated version of G. Using Fisher's correspondence, we study the Ising model on any infinite isoradial graph at criticality.

An isoradial graph is a planar graph, together with an embedding in the plane, such that every face is inscribed in a circle of radius 1. The interactions between the spins fixed by the geometry of the embedding.

We give an explicit expression for the inverse Kasteleyn operator on the dimer graph, which has the following surprising property: the entry between two vertices depends only on the geometry of the embedding on a path between the two vertices.

We then use this property to define a Gibbs measure for the Ising model on the original isoradial graph, to give local expressions for cylindrical events involving a finite number of spins, and compute the free energy.

- **Jiří Černý (ETHZ)**

"Non-Brownian Limit Theorem for Random Walk among Random Conductivities"

Abstract: Quenched functional central limit theorem for the random walk in a network of i.i.d. random conductances placed along nearest-neighbour edges of $\mathbb{Z}^d$ was proved by Sznitman and Sidoravicius in 2004. Their proof for the elliptic case (the conductances bounded from zero and infinity) was extended to the non-elliptic situation by several authors in the mean time, however the result remained unchanged: The scaling limit is the standard Brownian motion.

In my talk I will show that this cease to be true if the conductances are "sufficiently non-elliptic". I will explain that if the distribution of the conductances is heavy-tailed, the random walk is sub-diffusive and the processes that appear in the scaling limit are the same as in so-called trap models.

- **David Cimasoni (ETHZ)**

"Dimers on graphs and spin structures on surfaces"

Abstract: In the early 60's, Kasteleyn stated that the partition function for the dimer model on a graph G can be written as a linear combination of 2^2g Pfaffians, with g the genus of a surface S where G can be embedded. (He only proved the cases $g = 0$ and $g = 1$.) Each of these 2^2g terms corresponds to a certain orientation of the edges of G. In this talk, I shall first review the classical

work of Kasteleyn. I will then explain the contribution of N. Reshetikhin and myself to this question: it mainly consists of an explicit correspondence between these orientations of G and the spin structures on S. As a result, we obtain a very simple Pfaffian formula, using nothing but a little bit of geometry.

- **Robert Dalang (EPFL)**

"Introduction to potential theory and stochastic p.d.e.'s"

Abstract: We consider a basic problem of probabilistic potential theory: given a random field $(u(t,x),\ (t,x) \in \mathbb{R}_+ \times \mathbb{R}^k)$ with values in $\mathbb{R}^d$, and subset of $\mathbb{R}^d$, determine whether or not this subset is hit by the space-time process. We then discuss several concrete examples of stochastic partial differential equations, which give rise to just such a random field. Finally, we present some recent results concerning hitting probabilities for systems of stochastic partial differential equations.

- **Alfredo Donno (UNIGE)**

"The dimer model on the Sierpinski gasket and on the Pascal graph"

- **Noemi Kurt (UNIZH)**

"Entropic repulsion for a Gaussian interface model"

Abstract: We consider a Gaussian interface model on the d-dimensional integer lattice, with covariances given by the Green's function of the discrete Bilaplacian. We discuss the effect of a forbidden region on the interface, and present detailed results in the critical and supercritical dimensions for this model.

- **Joseph Najnudel (UNIZH)**

"Construction of an Edwards' probability measure on $\mathcal{C}(R_+, R)$"

Abstract: In this talk, we construct a probability measure Q on the space of continuous functions from $\mathbb{R}_+$ to $\mathbb{R}$, which can be considered as a generalization of Edwards' model in dimension 1. More precisely, we give some elements of the proof for the following result : the measures associated to the one-dimensional Edwards' model on the interval $[0,T]$ converge to Q when T goes to infinity (in a sense which is made precise). We also give some conjectures about the behaviour of the canonical process under the probability Q.

- **Ashkan Nikeghbali (UNIZH)**

"OPUC and random matrix theory"

- **Pierre Patie (UNIBE)**

"Law of the exponential functional of some Lévy processes"

Abstract: The law of the integral of the exponential of a Lévy process, the so-called exponential functional, plays an important role in probability theory and in many applied fields. In this talk, we present a methodology which allows to express the Laplace transform of the exponential functional of a class of Lévy processes in terms of new power series which generalize the Bessel functions. We illustrate our approach by detailing some specific examples.

- **Nicolas Pétrélis (UNIZH)**

"Copolymer in an emulsion: supercritical and subcritical regime"

Abstract: In this talk we discuss a two-dimensional directed self-avoiding walk model of a random copolymer in a random emulsion. The copolymer is a random concatenation of monomers of two types, A and B, each occurring with density $\frac{1}{2}$. The emulsion is a random mixture of liquids of two types, A and B, organised in large square blocks occurring with density p and $1-p$, respectively, where $p \in (0,1)$. The copolymer in the emulsion has an energy that is minus α times the number of AA-matches minus β times the number of BB-matches. We will consider both the supercritical regime (oil droplets form an infinite cluster) and the subcritical regime (no infinite cluster).

- **Charles Pfister (EPFL)**

"Large Deviations and Statistical Mechanics"

Abstract: I shall give an introduction to the thermodynamic formalism of Statistical Mechanics for lattice systems, from the viewpoint of large deviations theory.

- **Arvin Singh (UNIZH)**

"Multi-excited random walks on regular trees"

Abstract: We study a particular model of self-interacting random walks called "multi-excited random walks". These processes have been given particular attention in the lattice cases. In this talk, we study a similar model, first introduced by Volkov, when the walk takes place on a regular tree. In this setting, we show that a phase transition occurs concerning the recurrence/transience behaviour of the walk and we provide an implicit criterion to determine the limiting behaviour of the walk.