University of Zurich[UZH]

Institute of Mathematics

Workshop on Stochastic Processes in honour of Erwin Bolthausen's 70th birthday

September 15 - 16, 2016

Titles and abstracts

Luca Avena

Random walks on Markovian environments with spectral gap and on some glassy systems

We consider a Markov process obtained as a perturbation of a given stationary Markov process satisfying Poincaré inequality. By perturbative arguments, we derive the existence of a steady state for the perturbed Markov process, an expansion of the expected values of observables in the steady state and an invariance principle for additive functionals. We then apply these general results to random walks in Markovian evolving environments with special emphasis to models of tracer particles in glassy systems.

Joint work with O. Blondel (Lyon) and A. Faggionato (Rome).

Erich Baur

Scaling limits of uniform quadrangulations with a boundary

We discuss non-compact scaling limits of uniform random planar quadrangulations with a boundary when their size tends to infinity. Depending on the asymptotic behavior of the boundary size and of the scaling sequence, we observe different limiting metric spaces, among them the Brownian half-plane with skewness, the infinite-volume Brownian disk and the infinite continuum random tree.

Based on joint work with Grégory Miermont and Gourab Ray.

Michiel van den Berg

On Pólya's inequality for torsional rigidity and first Dirichlet eigenvalue

Let Ω be an open set in Euclidean space with finite Lebesgue measure $|\Omega|$. We obtain some properties of the set function $F : \Omega \to \mathbb{R}^+$ defined by

$$F(\Omega) = \frac{T(\Omega)\lambda_1(\Omega)}{|\Omega|},$$

where $T(\Omega)$ and $\lambda_1(\Omega)$ are the torsional rigidity and first eigenvalue of the Dirichlet Laplacian respectively. For any $m = 2, 3, \ldots$ and $\epsilon \in (0, 1)$ we construct an open set $\Omega_\epsilon \subset \mathbb{R}^m$ such that $F(\Omega_\epsilon) \geq 1 - \epsilon$.

This is joint work with Enzo Ferone, Carlo Nitsch and Cristina Trombetti.

Jean-Dominique Deuschel

Quenched invariance principle for random walk in time-dependent non-elliptic balanced random environment

We prove a central limit theorem for balanced random walks in time dependent ergodic non elliptic balanced environments. The proof is based on the use of a new maximum principle for degenerate parabolic difference operators.

Joint work with N. Berger, X. Guo and A. Ramirez.

Tadahisa Funaki

A coupled KPZ equation

A multi-component coupled KPZ equation appears in fluctuating hydrodynamics. The equation is ill-posed in general, and we need to introduce its approximation and renormalizations. We consider two types of approximations and investigate their limits by applying the paracontrolled calculus. The Cole-Hopf transform does not work for coupled equations.

This is joint work with Masato Hoshino.

Barbara Gentz

Synchronization in coupled stochastic systems

I will report on a variety of results regarding the effect of noise on synchronization in systems of coupled identical as well as non-identical dynamical systems.

Joint work with Nils Berglund (Université dOrléans, France) and with Seung-Yeal Ha (Seoul National University, South Korea), Dongnam Ko (Seoul National University, South Korea) and Christian Wiesel (University of Bielefeld, Germany).

Giambattista Giacomin

Lattice Gaussian free fields and disordered pinning potentials

The nature of critical phenomena, for example the critical exponents, is well understood in some statistical mechanics models. The issue of deciding whether disorder - say, an arbitrarily weak disorder - modifies or not the nature of a transition is a very challenging one that can be addressed for these models. And a very intriguing answer comes from a heuristic argument due to A. B. Harris at the beginning of the 70s. I will report of recent progress on this issue about localization transitions for pinning and wetting models built on the lattice Gaussian free field.

Rajat Subhra Hazra

Some properties of the membrane model

The membrane or bilaplacian model was first introduced in the physics literature to model random interfaces with constant curvature, and studied mathematically for the first time by Sakagawa and Kurt. It is a centered multivariate Gaussian whose covariance is given by the discrete bilaplacian operator on the lattice. It is tempting to think of it as a kin of the discrete Gaussian free field (GFF), and indeed many results can be deduced with the same methods for both, as for example while studying the fluctuations of the maximum in higher dimensions. Moreover as the GFF, it also can be seen as a generalised Gaussian variable arises as scaling limit of discrete models, for example in the odometer of the divisible sandpile or height fluctuations in uniform spanning forest. We will discuss some of these interesting features of the model. However, many techniques of the proofs need to be rethought of completely for this model, because of the lack of the random walk representation for its covariances. We will review some of these difficulties in our talk and explain how to handle them.

Based on joint works with Alberto Chiarini, Alessandra Cipriani and Wioletta Ruszel.

Frank den Hollander

Torsional rigidity of Brownian motion on the torus

We consider a Brownian motion $\beta[0,t]$ on the m-dimensional unit torus up to time t. We compute the leading order asymptotics of the expected time an independent Brownian motion β' takes until it hits $\beta[0,t]$, in the limit as $t \to \infty$ when both β and β' start randomly. For $m = 2$ the main contribution comes from the components whose inradius is comparable to the largest inradius, while for $m = 3$ most of the torus contributes. A similar result holds for $m \geq 4$ after the Brownian motion $\beta[0,t]$ is replaced by a Wiener sausage $W_{r(t)}[0,t]$ of radius $r(t) = o(t^{-1/(m-2)})$, provided $r(t)$ decays slowly enough to ensure that the expected time tends zero. Asymptotic properties of the capacity of $\beta[0,t]$ and $W_1[0,t]$ play a central role. Our results contribute to a better understanding of the geometry of the complement of $\beta[0,t]$, which has received a lot of attention in the literature in past years.

Joint work with E. Bolthausen and M. van den Berg.

Dmitry Ioffe

Self-repulsive walks at critical drifts and wetting transition for DGFF

I shall discuss two problems, which we tried to solve with Erwin, and still wish to see them solved.

The first one is about general finite range walks in self-repulsive potentials. For such walks we can show that there is always a unique critical drift, and that the walk is ballistic away from criticality. Sub-ballistic behaviour at criticality is an open question. Duminil-Copin and Hammond solved it for the simple symmetric RW, but their arguments rely on lattice symmetries in an essential way.

The second problem is about wetting transition for 2D Discrete Gaussian Free Field. The existence of such transition was proved by Caputo and Velenik building on earlier ideas of Chalker. The proof, however, does not really explains the phenomenon and the nature of competition near the transition point, which we tried to understand in terms of percolation with clustering. It seems that such an approach leads to an alternative proof of wetting transition for DGFF on binary trees, or even for 2D DGFF, with presumably better bounds on critical pinning strength.

Wolfgang König

The mean-field Polaron model

We consider mean-field interactions corresponding to Gibbs measures on Brownian paths in three dimensions. The interaction is self-attractive and is given by a singular Coulomb potential. The logarithmic asymptotics of the partition function were identified in the 1980s by Donsker and Varadhan in terms of the Pekar variational formula. In this talk, we analyse the mean-field path measures; in particular, we give a proof of the convergence of the normalized occupation measures towards an explicit mixture of the maximizers of the Pekar variational problem. The starting point is a compactification procedure recently developed by Mukherjee and Varadhan.

Joint work with E. Bolthausen and C. Mukherjee.

Alain-Sol Sznitman

On disconnection and level-sets

We will present some large scale asymptotics related to the fashion in which the trajectory of a simple random walk in dimension three and above can disconnect a macroscopic body from infinity. We will relate this question to some similar disconnection problems for random interlacements and the level sets of the Gaussian free field.

Some of the results discussed in this talk have been obtained in collaboration with Xinyi Li.

Fabio Toninelli

A class of $(2+1)$*-dimensional growth process with explicit stationary measure*

We introduce a class of $(2+1)$-dimensional random growth processes, that can be seen as asymmetric random dynamics of discrete interfaces. Interface configurations correspond to height functions of dimer coverings of the infinite hexagonal or square lattice. Asymmetric means that the interface has an average non-zero drift. When the asymmetry parameter $p - 1/2$ equals zero, the infinite-volume Gibbs measures π_ρ (with given slope ρ) are stationary and reversible. When $p \neq 1/2, \pi_\rho$ is not reversible any more but, remarkably, it is still stationary. In such stationary states, one finds that the height function at a given point x grows linearly with time t with a non-zero speed,

$$< (h_x(t) - h_x(0)) >= vt$$

and that the typical fluctuations of $(h_x(t) - h_x(0))$ are smaller than $\sqrt{\log t}$. For the specific case $p = 1$ and in the case of the hexagonal lattice, the dynamics coincides with the anisotropic KPZ growth model studied by A. Borodin and P. L. Ferrari.

If time allows, I will also mention related recent developments on convergence to the stochastic heat equation for a related model (joint work with A. Borodin and I. Corwin).

Ofer Zeitouni

Extremal processes and temperature chaos for spherical p-spin models

We consider energies near the ground state and free energies at very low temperatures for spherical pure p-spin systems and their perturbations. We discuss the effect of perturbation on temperature chaos.

Based on work in progress with Eliran Subag and Gerard Ben Arous.