## Workshop on

# Random Media

## celebrating the 60th birthday of Jürgen Gärtner

Organized by Jean-Dominique Deuschel, Wolfgang König, Max-Konstantin 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/jg.html`

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

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# Thursday, 8 April

9:30–9:45: **Wolfgang König (Weierstraß Institute Berlin and TU Berlin)**

*Opening*

9:45–10:25: **Frank den Hollander (University of Leiden)**

*The mathematical work of Jürgen Gärtner*

*Abstract:* On this special occasion where we celebrate Jürgen Gärtner's 60th birthday, I will describe what I consider to be Jürgen's five most important contributions to probability theory:

(1) The Gärtner-Ellis LDP.
(2) The Dawson-Gärtner projective limit LDP.
(3) Properties of the McKean-Vlasov equation.
(4) Wave front propagation in the KPP-equation.
(5) Intermittency in the Parabolic Anderson Model.

I will place these contributions in their historical context, and argue why each of them has had a major impact on our field.

10:30 – 11:00: Coffee break

11:00–11:40: **Mark Freidlin (University of Maryland)**

*Perturbation theory for systems with many invariant measures*

*Abstract:* Long-time effects caused by deterministic and stochastic perturbations of dynamical systems and stochastic processes with many invariant measures will be considered. I will be specially interested in stochasticity induced by deterministic perturbations of deterministic dynamics and by non-trivial patterns caused by stochastic perturbations.

11:45 – 14:00: Lunch break

14:00–14:40: **Peter Mörters (University of Bath)**

*Geometric approaches to intermittency in the parabolic Anderson model*

*Abstract:* We discuss geometric approaches to characterize intermittency in the parabolic Anderson model with independent, identically distributed potential. After reviewing results for the case of double-exponential and Pareto distributed potentials I present a new result for the case of exponential potentials, which was obtained in joint work with Hubert Lacoin (Rome).

14:45–15:25: **Tom Mountford (EPF Lausanne)**

*Parabolic Anderson model with voter model noise*

*Abstract:* In joint work with Gregory Maillard and Samuel Schoepfer, we address some questions left open by the recent work of den Hollander, Gärtner and Maillard concerning the annealed critical exponents in the parabolic Anderson model fueld by a potential that is a realization of a voter model. We consider specifically when the exponent is the a priori maximal value in terms of strong transience of the Markov process underlying the voter model.

## 15:30 – 16:00: Coffee break

16:00–16:40: **Grégory Maillard (University of Marseille)**

*Parabolic Anderson model with a finite number of moving catalysts*

*Abstract:* We consider the parabolic Anderson model $\partial u/\partial t = \kappa\Delta u + \xi u$ with $u\colon \mathbb{Z}^d \times [0,\infty) \to \mathbb{R}$, where $\kappa \in [0,\infty)$ is the diffusion constant, $\Delta$ is the discrete Laplacian, and $\xi\colon \mathbb{Z}^d \times [0,\infty) \to \mathbb{R}$ is a system of $n$ independent simple random walks with diffusion constant $\rho \in [0\infty)$.

We analyse the *annealed* Lyapunov exponents, i.e., the exponential growth rates of the successive moments of $u$ w.r.t. $\xi$ and show that these exponents display an interesting dependence on the diffusion constants $\kappa$ and $\rho$, with qualitatively different behavior in different dimensions. In particular, we study the intermittent behavior of the system in terms of the annealed Lyapunov, describing how the total mass of $u$ concentrates as $t \to \infty$.

The case where $n = 1$ was investigated in Gärtner and Heydenreich 2006, where a full description of the intermittent behavior was obtained.

(Joint work with F. Castell and O. Gün.)

16:45–17:25: **Rongfeng Sun (University of Singapore)**

*Annealed versus quenched asymptotics for the parabolic Anderson model with moving catalysts/traps*

*Abstract:* In this talk, I will survey some old and new results on the Parabolic Anderson Model (PAM) with moving catalysts/traps, including the case of a single moving catalyst/trap, and the case of a Poisson system of moving catalysts/traps. Annealed and quenched asymptotics will be compared for these models. Emphasis will be on more recent results, including the question of disorder relevance for PAM with a single moving catalyst, and the asymptotics for PAM with a Poisson field of moving traps.

## 17:30 – ???: Wine and cheese party

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# Friday, 9 April

9:30–10:10: **Alain-Sol Sznitman (ETH Zurich)**

*Disconnecting discrete cylinders*

*Abstract:* In this talk we will survey recent results concerning the disconnection of discrete cylinders by random walk. We will also explain how comparisons with random interlacements have been useful.

10:15–10:55: **Vladas Sidoravicius (CWI Amsterdam)**

*On random growth and random walks in dynamically evolving random environment*

## 11:00 – 11:30: Coffee break

11:30–12:10: **Erwin Bolthausen (University of Zurich)**

*Kac-type interactions in a one-dimensional system with a continuous symmetry*

*Abstract:* The Fröhlich-polaron can be rephrased in terms of a three-dimensional Brownian motion with an attractive interaction. The so-called strong coupling limit corresponds to a Kac-type interaction. The physically relevant quantities can be expressed in terms of path properties in the Kac-limit. Whereas this case is mathematically still unsolved, there has been some progress for Kac-models with compact state space. We report on this. (Joint work with Amir Dembo, Stanford).

## 12:15 – 14:00: Lunch break

14:00–14:40: **Alejandro Ramírez (Pontifical Catholic University of Chile)**

*Ballisticity conditions for random walk in random environment*

*Abstract:* We consider a Random Walk in a Random Environment (RWRE) $\{X_n \colon n \geq 0\}$ on a uniformly elliptic i.i.d. environment in dimensions $d \geq 2$. The walk is said to be transient in a direction $l \in \mathbb{S}^d$, if $\lim_{n\to\infty} X_n \cdot l = \infty$, and ballistic in the direction $l$ if $\liminf_{n\to\infty} X_n \cdot l/n > 0$. It is conjectured that transience in a given direction implies ballisticity in the same direction. To tackle this question, in 2002, Sznitman introduced for each $\gamma \in (0,1)$ and direction $l$ the ballisticity condition $(T_\gamma)|l$, and condition $(T')|l$ defined as the fulfillment of $(T_\gamma)|l$ for each $\gamma \in (0,1)$. He proved that $(T')$ implies ballisticity in the corresponding direction, and showed that for each $\gamma \in (0,5,1)$, $(T_\gamma)$ implies $(T')$, conjecturing that it should be true that for each $\gamma \in (0,1)$, $(T_\gamma)$ implies $(T')$. Here we discuss some recent progresses obtained by Drewitz and the author on this last conjecture, and its relation to a recent work of Berger where he obtains a sharp upper bound for the slowdown deviations of a RWRE. This talk is based on joint work with Alexander Drewitz from TU Berlin.

14:45–15:25: **Markus Heydenreich (Free University of Amsterdam)**

*Random walk on high-dimensional incipient infinite cluster*

*Abstract:* In this talk I report on joint work in progress with Remco van der Hofstad and Tim Hulshof (Eindhoven). I shall begin by giving a careful introduction to the notion of an 'incipient infinite cluster' (IIC), which is a critical percolation cluster conditioned to be infinitely large. We then proceed by studying random walk on this IIC. In particular, we shall focus on how the criticality of the graph is reflected in the behaviour of the random walk on it.

## 15:30 – 16:00: Coffee break

16:00–16:40: **Don Dawson (University of Ottawa)**

*McKean-Vlasov mutation-selection dynamics*

*Abstract:* We consider simplified spatial models of interacting multitype Wright-Fisher diffusions which arise in genetics and evolutionary biology. These model locally finite populations subject to mutation, selection and migration. In particular we investigate the emergence of rare mutants in multiple times scales. These lead to McKean-Vlasov dynamics with random entrance laws. The main tools include a class of measure-valued analogues of Crump-Mode-Jagers branching processes and a dual representation in which the dual processes are set-valued. This talk is based on joint work with Andreas Greven.

16:45–17:25: **Klaus Fleischmann (Berlin)**

*Recent properties of states of super-alpha-stable motion with branching of index* $1+\beta$

*Abstract:* Since 1988 one knows that at any fixed time the measure states of the process in the title have density functions provided that the dimension of the space is small enough.

Besides the special case of one-dimensional continuous super-Brownian motion, only in 2003, Mytnik and Perkins revealed that in the Brownian motion case there is a dichotomy for the density functions: Either there are continuous versions of them, or they all are locally unbounded.

We recently showed, that the same type of fixed time dichotomy holds also in the case of discontinuous motion. Moreover, the continuous versions are actually always locally Hölder continuous. Moreover, we determine the optimal index for this. Finally, we relate it to the optimal index of Hölder continuity at given space points.

(Joint work with Leonid Mytnik (Haifa) and Vitali Wachtel (Munich))

## 19:00 – ???: Conference dinner

# Saturday, 10 April:

9:30–10:10: **Marek Biskup (UCLA and University of Ceske Budejowice)**

*Gradient models with non-convex interactions*

*Abstract:* I will discuss recent progress in the understanding of gradient models on the hypercubic lattice where scalar fields are coupled via a generally non-convex potential. I will specifically highlight non-uniqueness of the Gibbs measure for a given tilt and its relation to (lack of) strict convexity of the surface tension. The talk will partly be a review of recent work in this area and partly a presentation of new results.

10:15–10:55: **Anton Bovier (University of Bonn)**

*Metastability in Ginzburg-Landau type spdes*

*Abstract:*We consider a coupled bistable $N$-particle system on $\mathbb{R}^N$ driven by a Brownian noise, with a strong coupling corresponding to the synchronised regime. Our aim is to obtain sharp estimates on the metastable transition times between the two stable states, both for fixed $N$ and in the limit when $N$ tends to infinity, with error estimates uniform in $N$. These estimates are a main step towards a rigorous understanding of the metastable behavior of infinite dimensional systems, such as the stochastically perturbed Ginzburg-Landau equation. Our results are based on the potential theoretic approach to metastability. This is based on joint work with Florent Barret and Sylvie Méléard.

## 11:00 – 11:30: Coffee break

11:30–12:10: **Gérard Ben Arous (Courant Institute New York)**

*Random matrices and Morse theory in many dimensions: the case of mixtures of spherical spin glasses and the (possibility of) full replica symmetry breaking*

*Abstract:* I will survey the recent progress of an on-going joint work with Antonio Auffinger and Jiri Cerny. We compute the number of critical points of general spherical spin glasses using a link with Random Matrix theory through the Kac-Rice formula. This allows us to show an interesting picture for the bottom of the energy landscape, and in particular a strong correlation between index and energy level. We also propose a new invariant for the possible transition between a 1step replica symmetry breaking and a Full Replica symmetry breaking scheme.

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The organisers gratefully acknowledge the support of the *Quantitative Products Laboratory*.