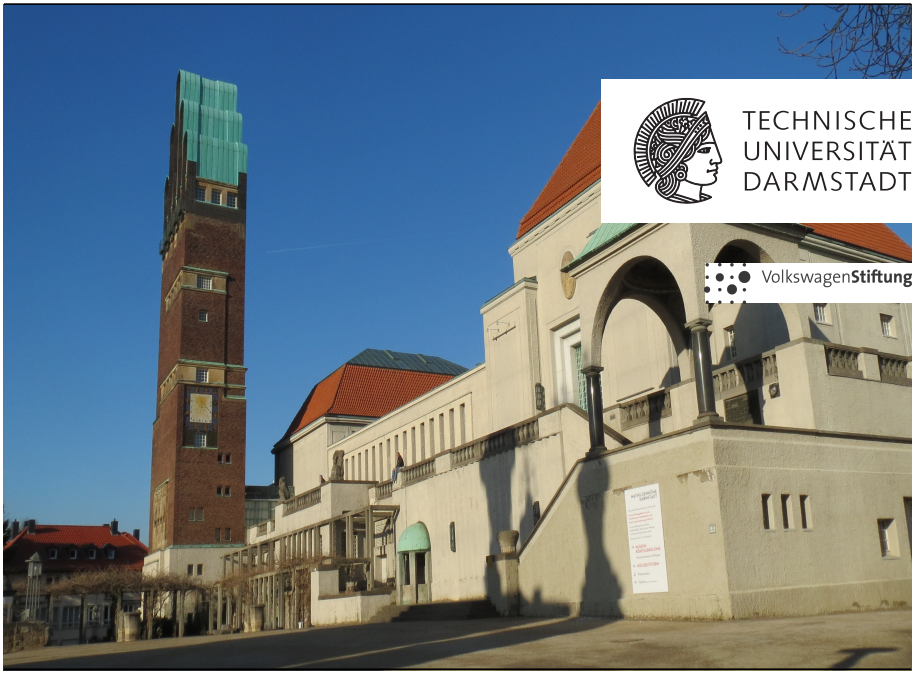
Spring School
Probability in mathematics and physics
March 27 - 31, 2017
TU Darmstadt

Short Courses
Nina Gantert
Satya Majumdar

Invited Speakers
Julien Berestycki
Marcel Ortgiese
Grégory Schehr
Thomas Simon

Organization
Frank Aurzada
Volker Betz
Matthias Meiners



March 23, 2017

Contents

1 General Information

1.1 Accommodation

The participants are recommended to stay in one of the following hotels, located in walking distance (5 - 15 minutes) to the lecture venue.

- BEST WESTERN PLUS HOTEL DARMSTADT
  Grafenstraße 31, 64283 Darmstadt
  Tel: +49-6151-28100
- HOTEL BOCKSHAUT
  Kirchstraße 7-9, 64283 Darmstadt
  Tel: +49-6151-99670
- HOTEL ERNST LUDWIG
  Ernst Ludwig Straße 14, 64289 Darmstadt
  Tel: +49-6151-9266 or +49-6151-26011

For directions please see the map on the back cover.

1.2 Registration

On Monday morning, starting from 8:00, registration is possible in the lobby of the lecture hall.

1.3 Lecture Hall

Location: Technische Universität Darmstadt. The registration and all lectures will take place in building S2|08 Foyer, Hochschulstraße 4 | 64289 Darmstadt in lecture hall S2|08/171. In the lecture hall, there are 2 large blackboards and a projector.

1.4 Map & Points of Interest

The map can be found on the back cover.

1.5 Public Transportation

The closest bus and tram stops to the venue of the workshop are **Schloss** (trams: S2, S3, S9) and **Willy-Brandt-Platz** (trams: S4, S5, S6, S7, S8). Both stops are within 10 minutes walking distance to the lecture hall.

1.6 Food & Beverage

Cheap and plain food can be purchased at the TU Darmstadt Refectory-Canteen, building S1|11, Monday to Friday 11:15 to 14:00. Additionally there are lots of good restaurants and bistros near TU Darmstadt. Please dial +49 6151 preceding the number given below.

Name	Address	Phone	Cuisine	Opening Hours
Ratskeller	Marktplatz 8	26444	German	10:00 - 24:00
Pizzeria da Nino	Alexanderstr. 29	24220	Italian	12:00 - 23:00
Haroun's	Friedensplatz 6	23487	Oriental	11:00 - 01:00
Vis à Vis	Furhmannstr. 2	9670806	Bistro	10:00 - 15:30
Central Station	Carree	809460	Bistro	12:00 - 14:30
Ristorante Sardegna	Kahlertstraße 1	23029	Italian	11:30 - 15:00

1.7 Conference Dinner

On Thursday, March 30^{th} there will be a conference dinner at the Darmstädter Ratskeller Hausbrauerei, Marktplatz 8, 64283 Darmstadt, Phone: +49-6151-26444.

1.8 Free Afternoon

On Wednesday, March 29^{th} there will be a free afternoon. For everybody interested, we will organize a joint excursion (depending on the weather).

1.9 Contact Information

If you have any questions concerning the workshop, please feel free to contact one of the local organizers or the technical support:

- Prof. Dr. Volker Betz
  Office: S2-15, Room 340
  Phone: +49-6151-16 23370
- Prof. Dr. Frank Aurzada
  Office: S2-15, Room 341
  Phone: +49-6151-16 23375
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Acknowledgements

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TECHNISCHE
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Fachbereich
Mathematik

Programme

Time	Monday	Tuesday	Wednesday	Thursday	Friday
08:00	Registration				
09:00	Gantert	Gantert	Gantert	Gantert	Gantert
	Coffee break	*Coffee break*	*Coffee break*	*Coffee break*	*Coffee break*
11:00	Majumdar	Majumdar	Majumdar	Majumdar	Majumdar
	Lunch	*Lunch*	*Lunch*	*Lunch*	————
14:00 15:00	Invited Talk: Berestycki Contributed talk: Kabluchko	Invited Talk: Schehr Contributed talk: Marynych		Invited Talk: Ortgiese Contributed talk: Adhikari	Invited Talk: 12:30h Simon
	Coffee break	*Coffee break*		*Coffee break*	*End of Workshop*
16:00	Short talks: Junk, Klimek, Mach, Nicolsen, Cheek, Avanzini	Short talks: Chetwynd-Diggle, Kloas, Suryawan, Wiegel, Klatt	*Free Afternoon*	Short talks: Lacroix a Chez Toine, Kukla, Bekiryazici, Jeribi, Hammani, Poplavskyi	
	Reception			Dinner - Ratskeller	

Monday, 27. March 2017

Time	Speaker	*Title of Talk*
08:55-09:00	Welcome	
09:00-10:30	Nina Gantert	*Mini course: Random walks in random environment: selected topics*
10:30-11:00		–Coffee Break–
11:00-12:30	Satya Majumdar	*Mini course: Extreme value statistics for stochastic processes*
12:30-14:00		–Lunch Break–
14:00-15:00	*Invited talk* Julien Berestycki	*Branching Brownian motion with absorption: the critical case*
15:00-15:30	*Contributed talk* Zakhar Kabluchko	*Explicit formulas for random convex hulls*
15:30-16:00		–Coffee Break–
16:00-16:10	Short talk	Stefan Junk
16:10-16:20	Short talk	Alexander Klimek
16:20-16:30	Short talk	Tibor Mach
16:30-16:40	Short talk	Michael Nicolsen
16:40-16:50	Short talk	David Cheek
16:50-17:00	Short talk	Stefano Avanzini
17:00-20:00	Reception	–Cheese & Wine–

Tuesday, 28. March 2017

Time	Speaker	*Title of Talk*
09:00-10:30	Nina Gantert	*Mini course: Random walks in random environment: selected topics*
10:30-11:00		–Coffee Break–
11:00-12:30	Satya Majumdar	*Mini course: Extreme value statistics for stochastic processes*
12:30-14:00		–Lunch Break–
14:00-15:00	*Invited talk* Grégory Schehr	*Some questions related to the record increments of stochastic time series*
15:00-15:30	*Contributed talk* Alexander Marynych	*General Edgeworth expansions with applications to profiles of random trees*
15:30-16:00		–Coffee Break–
16:00-16:10	Short talk	Chetwynd-Diggle
16:10-16:20	Short talk	Judith Kloas
16:20-16:30	Short talk	Herry Pribawanto Suryawan
16:30-16:40	Short talk	Gundeline Wiegel
16:40-16:50	Short talk	Michael Klatt

Wednesday, 29. March 2017

Time	Speaker	*Title of Talk*
09:00-10:30	Nina Gantert	*Mini course: Random walks in random environment: selected topics*
10:30-10:45		–Coffee Break–
10:45-12:15	Satya Majumdar	*Mini course: Extreme value statistics for stochastic processes*
12:15-14:00		–Lunch Break–
		–Free Afternoon–

Thursday, 30. March 2017

Time	Speaker	*Title of Talk*
09:00-10:30	Nina Gantert	*Mini course: Random walks in random environment: selected topics*
10:30-11:00		–Coffee Break–
11:00-12:30	Satya Majumdar	*Mini course: Extreme value statistics for stochastic processes*
12:30-14:00		–Lunch Break–
14:00-15:00	*Invited talk* Marcel Ortgiese	*Branching random walks in random environment*
15:00-15:30	*Contributed talk* Kartick Adhikari	*Hole probabilities for finite and infinite Ginibre ensembles*
10:30-11:00		–Coffee Break–
16:00-16:10	Short talk	Bertrand Lacroix à Chez Toine
16:10-16:20	Short talk	Jonas Kulka
16:20-16:30	Short talk	Zafer Bekiryazici
16:30-16:40	Short talk	Aref Jeribi
16:40-16:50	Short talk	Mohamed Ali Hammami
16:50-17:00	Short talk	Mihail Poplavskyi
18:30	**Conference Dinner: Ratskeller**	

Friday, 31. March 2017

Time	Speaker	*Title of Talk*
09:00-10:30	Nina Gantert	*Mini course: Random walks in random environment: selected topics*
10:30-11:00		–Coffee Break–
11:00-12:30	Satya Majumdar	*Mini course: Extreme value statistics for stochastic processes*
12:30-13:30	*Invited talk* Thomas Simon	*Branching random walks* *Some properties of free stable laws*
13:30-14:30		–Lunch Break, End of Workshop–

2 List of Talks

2.1 Short Courses

Nina Gantert
Mini course: Random walks in random environment: selected topics
TU München, Germany

Abstract: We will give an introduction to random walks in random environments and will treat the following topics: Recurrence, transience and ballisticity/subballisticity, Regeneration times, and steady states aka the environment seen from the walker, Biased random walks on Galton-Watson trees, Sinais's walk as a simple model for metastability, Mott variable, range hopping as a random walk on a point process.

Satya Majumdar
Mini course: Extreme value statistics for stochastic processes
Université Paris Sud, Orsay, France

Abstract: Extreme value statistics (EVS) concerns the study of the statistics of the maximum or the minimum of a set of random variables. This is an important problem for any time-series and has applications in climate, finance, sports, all the way to physics of disordered systems where one is typically interested in the statistics of the ground state energy. While the EVS of 'uncorrelated' variables are well understood, little is known for strongly correlated random variables. Only recently this subject has gained much importance both in statistical physics and in probability theory. In these lectures, I will first review the classical EVS for uncorrelated variables and discuss few examples of correlated variables where analytical progress can be made. In particular, I will focus on a correlated sequence whose entries correspond to the positions of a random walker evolving in discrete time on a line by random jumps. I will also discuss related issues such as order statistics and record statistics for this random walk sequence.

2.2 Invited Speakers

Julien Bereststycki
Branching Brownian motion with absorption: the critical case
University of Oxford, United Kingdom

Abstract: TBA

Marcel Ortgiese
Branching random walks in random environment
University of Bath, United Kingdom

Abstract: We consider a branching random walk on the lattice, where the branching rates are given by a random potential. Our aim is to give a description of the flow of particles when started with a single particle at the origin. For a particularly heavy-tailed potential, we show that the scaling limit is given by system of 'growing lilypads' defined on a Poisson point process. We will also highlight the differences that arise when considering less heavy-tailed potentials.

Grégory Schehr
Some questions related to the record increments of stochastic time series
Université Paris Sud, Orsay, France

Abstract: In this talk, I will consider the record statistics of a time series $x_0 = 0, x_1, x_2, ..., x_n$ and study the record increments, i.e. the statistics of the difference between two consecutive record values. In particular, will focus on the probability $Q(n)$ that the record increments decrease monotonically up to step n and present a detailed study of two different cases: (i) the case of independent and identically distributed (i.i.d.) random variables $x_i s$ and (ii) the case where the $x_i s$ are generated by the positions of a random walker.

Thomas Simon
Some properties of free stable laws
Université de Lille 1, France

Abstract: Free stable laws on the line were introduced in 2000 by Bercovici, Pata and Biane as an analogue of classical stable laws in the framework of free probability theory. We investigate certain analytical properties of these laws. In the one-sided case, we show that their densities are whale-shaped (that is, their successive derivatives vanish once and only once), perfectly skew, and infinitely divisible in the classical sense. The latter property conveys to the two-sided case when $\alpha \leq 1$. Finally, we investigate the structure of the Lévy measure, whose analysis is related to the classical Wright function.

2.3 Further Speakers

Kartick Adhikari
Hole probabilities for finite and infinite Ginibre ensembles
Indian Institute of Science, Bangalore, India

Abstract: Consider the finite and infinite Ginibre ensembles in the complex plane. Let $H_r(U)$ be the probability (hole probability) that there is no point in the region $rU \subset \mathbb{C}$. We study the asymptotic behavior of $Hr(U)$ as $r \to \infty$. Under the certain conditions on U we show that $\log H_r(U) = \ominus(C_U \cdot r^4)$ as $r \to \infty$. Using the potential theory, we give an explicit formula for C_U in terms of logarithmic minimum energy of the set with a quadratic external field. We calculate C_U explicitly for some special sets like annulus, cardioid, ellipse, equilateral triangle and half disk. This talk is based on a joint work with Nanda Kishore Reddy.

Zafer Bekiryazici
Analyzing Mathematical Models of Various Diseases under Random Conditions
Recep Tayyip Erdogan Üniversitesi, Turkey

Abstract: Mathematical models have been used for analyzing various aspects of diseases for hundreds of years. Modeling studies of diseases have become more popular after the introduction of compartmental models by Kermack and McKendrick in 1927. Most of the models used in the literature are formed by deterministic equation systems. However, it is known that some of the parameters used in these equation systems are determined through statistical analyses and thus are not deterministic values. In this study, we use random variables in various disease models to form random differential equations for modeling these diseases. We try to analyze various numerical characteristics of the diseases though determining the expected values, variances and confidence intervals of the model components.

David Cheek
Stochastic Luria-Delbruck evolution model: large population small mutation limit
University of Edinburgh, United Kingdom

Abstract: We investigate a classic model proposed by Luria and Delbruck in 1943, which originally described a growing bacterial population developing subpopulations of cells who are resistant to attack by a lethal virus. In recent decades the model has been widely used to model various aspects of cancer, for example the development of resistance to chemotherapy. Receiving particular attention has been the probability distribution for the number of mutant cells when the total cell population reaches a given size. This distribution is intractable in general, and often approximated by the so called large population small mutation limit (LPSML). Although the distribution of the LPSML has long been known for semi-deterministic versions of the model in which regular or mutant cells grow deterministically, a rigourous justification for its use for the fully stochastic model had not been known. I propose to present recent research with Tibor Antal. We provide a slightly more general framework encompassing semi-deterministic and stochastic versions of the model, and in this setting we prove that the LPSML holds.

Jonathan Chetwynd-Diggle
TBA
University of Oxford, United Kingdom

Abstract: TBA

Mohamed Ali Hammami
Practical stability of stochastic evolution equations and application
University of Sfax, Tunisia

Abstract: In this talk, we investigate several criteria for practical exponential stability of some classes of stochastic evolution equations. The main tool used to prove the results is the Lyapunov method which has proven very useful in dealing with stability problems for differential problems. An illustrative example is also analyzed to show the applicability and interest of the main results.

Aref Jeribi
System of non-linear equations arising in growing cell populations.
University of Sfax, Tunisia

Abstract: Poster

Stefan Junk
A branching random walk among disasters
TU München, Germany

Abstract: We consider a branching random walk in a random space-time environment of disasters where each particle is killed when meeting a disaster. This extends the model of the 'random walk in a disastrous random environment' introduced by [9]. We obtain a complete criterion for positive survival probability.

Zakhar Kabluchko
Explicit Formulas for Random Convex Hulls
Universität Münster, Germany

Abstract: We will present explicit formulas for the number of faces of some random convex hulls including Gaussian polytopes and convex hulls of random walks and bridges.

Michael Klatt
Shape analysis of disordered structures across length scales
Karlsruhe Institute of Technology (KIT), Germany

Abstract: From the large-scale structure of the universe to exotic states in nuclear matter: complex and disordered spatial structures appear ubiquitously on nearly all length scales in very different physical or chemical systems. Often physical insight can best be obtained by a rigorous structure characterization. How can we sensitively and comprehensively quantify the geometry of this variety of very different random spatial structures? Such a versatile and rigorous shape analysis is provided by a family of intuitive structure characteristics, the so-called Minkowski functionals and tensors. We use them to analyze important mathematical models as well as exotic states of matter from nuclear physics to condensed matter systems. They can also detect structural deviations (i.e., features) in background noise, which can be used from medical tomography to gamma-ray astronomy.

Aleksander Klimek
Selection in a fluctuating environment
University of Oxford, United Kingdom

Abstract: We consider both spatial and non-spatial Λ-Fleming-Viot process describing frequencies of genetic types in a population living in $\mathbb{R}^d$ with two possible genetic types and natural (fecundity) selection favouring one of the types. The

favourability depends on the state of the environmental variable, which evolves in time and space, with some correlation. We find a unique diffusion approximation to the model via separation of timescales argument. The limiting equation is an analogue of the Fisher-KPP equation with coloured noise. Supervised by Alison Etheridge (and joint Nilroy Biswas).

Judith Kloas
On the recurrence of queuing processes in two dimensions
Graz University of Technology, Austria

Abstract: Recall the one-dimensional queuing process $(W_n)_{n\geq 1}$, which is defined by setting $W_0 = 0$ and $W_n = max\{0, W_{n-1} - Y_n\}, n \geq 1$, where $Y1, Y2, \cdots$ is a sequence of independent and identically distributed discrete random variables. In this talk we introduce a certain Markov chain $(W_n^{(1)}, W^{(2)}n_{n\geq 1}$ in the two-dimensional case which is build upon the process $(W_n)_{n\geq 1}$. We study the recurrence behavior of $(W_n^{(1)}, W_n^{(2)})_{n\geq 1}$ and present our approach which is based on the technique of discrete subordination and the theory of regular variation.

Jonas Kulka
On the block counting process and the fixation of the Bolthausen-Sznitman coalescent
Universität Tübingen , Germany

Abstract: The Bolthausen-Sznitman coalescent process is a partition-valued Markov process used in mathematical population genetics to model genealogies. Its Siegmund dual, the fixation line, is a branching process with non-integrable offspring distribution. Both processes, properly rescaled, converge in the Skorohod topology to the Mittag-Leffler process and Neveuś continuous-state branching process respectively as the sample size n tends to infinity. The latter are again Siegmund dual with respect to each other.

Bertrand Lacroix à Chez Toine
Non interacting fermions in a hard box and determinantal point process
Université Paris-Sud, Orsay, France

Abstract: We study a system of N non-interacting fermions in a d-dimensional trapping potential. This system of fermions has the structure of a deter- minantal point process. We focus here on the interesting case of a hard box potential and study the local correlations close to the wall in the limit of large N. The correlations may also be described when considering an additional curved potential, generalizing previous results for the case of infinite space [1].

Tibor Mach
Cooperative branching on trees and other lattices
Georg-August-Universität Göttingen, Germany

Abstract: Let $\Lambda = (V; E)$ be a countable, connected, vertex transitive, locally nite graph with a vertex set V and a set of (undirected) edges E. We consider a Markov process X with values on $\{0; 1\}^{\Lambda}$ and the following dynamics. At rate α each two neighbouring occupied sites produce an offspring on an empty site adjacent to (at least) one of them (cooperative branching), at rate μ occupied sites become empty (death) and at rate γ particles at occupied sites "move" to one of the neighbouring sites (random walk dynamics). We are in particular interested in the phase transitions of this process on different lattices, namely we would like to estimate the critical branching rate α_{surv} for the probability of survival and α_{upp} for the existence of a non-trivial upper invariant law of the process X. In the talk, we will focus on the case when $\gamma = 0$ and on processes on regular trees and complete graphs as well as a process which is dual to a mean-eld model with the aforementioned dynamics.

Alexander Marynych
General Edgeworth expansions with applications to pro les of random trees
Taras Shevchenko National University of Kyiv, Ukraine

Abstract: We prove an asymptotic Edgeworth expansion for the profiles of certain random trees including binary search trees, random recursive trees and planeoriented random trees, as the size of the tree goes to infinity. All these models can be seen as special cases of the one-split branching random walk for which we also provide an Edgeworth expansion. These expansions lead to new results on mode, width and occupation numbers of the trees, settling several open problems raised in Devroye and Hwang [Ann. Appl. Probab. 16(2): 886918, 2006], Fuchs, Hwang and Neininger [Algorithmica, 46 (34): 367407, 2006], and Drmota and Hwang [Adv. in Appl. Probab., 37 (2): 321341, 2005]. The aforementioned results are special cases and corollaries of a general theorem: an Edgeworth expansion for an arbitrary sequence of random or deterministic functions $L_n : \mathbb{Z} \to \mathbb{R}$ which converges in the mod ϕ-sense. The talk is based on a recent joint work with Z. Kabluchko and H. Sulzbach (Münster, Germany)

Michael David Nicholson
Universal asymptotic clone size distribution for general population growth
University of Edinburgh, United Kingdom

Abstract: Deterministically growing (wild-type) populations which seed stochastically developing mutant clones have found an expanding number of applications from microbial populations to cancer. The special case of exponential wild-type population growth, usually termed the Luria-Delbrück or Lea-Coulson model, is often assumed but seldom realistic. In this talk, we generalise this model to different types of wild-type population growth, with mutants evolving as a birth-death branching process. Our focus is on the size distribution of clones-that is the number of progeny of a founder mutant-which can be mapped to the total number of mutants. Exact expressions are derived for exponential, power-law and logistic population growth. Additionally, for a large class of population growth, we prove that the long-time limit of the clone size distribution has a general two-parameter form, whose tail decays as a power-law.

Mihail Poplavskyi
On the distribution of the largest real eigenvalue for the real Ginibre ensemble
Kings College London, United Kingdom

Abstract: Let $\sqrt{N}+\lambda_{max}$ be the largest real eigenvalue of a random $N\times N$ matrix with independent $N(0,1)$ entries (the 'real Ginibre matrix'). We study the large deviations behaviour of the limiting $N\to\infty$ distribution $P[\lambda_{max}<t]$ of the shifted maximal real eigenvalue λ_{max}. In particular, we prove that the right tail of this distribution is Gaussian: for $t>0$,

$$P[\lambda_{max}<t]=1-\frac{1}{4}\mathrm{erfc}(t)+O\left(e^{-2t^2}\right).$$

This is a rigorous confirmation of the corresponding result of Forrester and Nagao. We also prove that the left tail is exponential: $t<0$,

$$P[\lambda_{max}<t]=e^{\frac{1}{2\sqrt{2\pi}}\zeta\left(\frac{3}{2}\right)t+O(1)},$$

where ζ is the Riemann zeta-function. Our results have implications for interacting particle systems. The edge scaling limit of the law of real eigenvalues for the real Ginibre ensemble is a rescaling of a fixed time distribution of annihilating Brownian motions (ABM's) with the step initial condition. Therefore, the tail behaviour of the distribution of $X_s^{(max)}$ - the position of the rightmost annihilating particle at fixed time $s>0$ - can be read off from the corresponding answers for λ_{max} using $X_s^{(max)}\stackrel{D}{=}\sqrt{4s}\lambda_{max}$. The talk is based on a joint work with R. Tribe and O. Zaboronski.

Herry Pribawanto Suryawan

Derivatives of Self-intersection Local Times of Brownian Motion: A White Noise Approach

University of Zurich, Switzerland

Abstract: In this talk we discuss the derivatives of the self-intersection local times of d-dimensional Brownian motion within the framework of white noise analysis. As a main result, we prove that for any spatial dimension d the derivatives of any order of the self-intersection local times, after a suitable renormalization, are well-defined as a generalized white noise functionals. Their chaos decomposition in the terms of Wick powers of white noises are also presented and the regularity of the kernel functions is studied. We apply our results to show an existence in the mean-square sense of the first derivative of self-intersection of one-dimensional Brownian motion.

Gundelinde Wiegel

Lyapunov exponents on trees

Graz University of Technology, Austria

Abstract: We consider a symmetric nearest neighbour random walk on an infinite regular tree moving in random potential. The potentials represent a random risk of dying for the random walk at each vertex. A measurement for the riskiness of moving in this random medium is provided by the Lyapunov exponents. They observe the long time behaviour of the probability of reaching a certain vertex after starting at a fixed vertex. There are two different ways of treating the random potentials in this observation: the annealed (or averaged) and the quenched approach. We will see that here we can directly relate these two approaches to each other.

3 Participants

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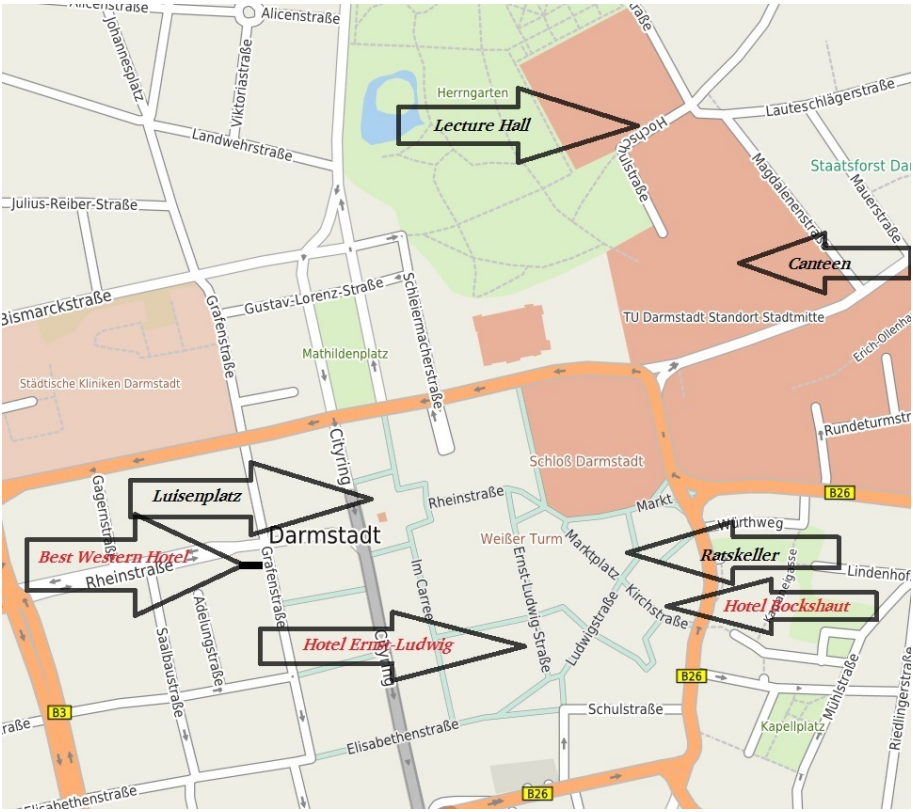

Citymap

Points of interest:

- Lecture Hall
- Canteen
- Luisenplatz
- Hotel Best Western
- Hotel Bockhaut
- Hotel Ernst-Ludwig
- Darmstädter Ratskeller