
Spring School "Geometric Models in Probability"

April 4 - 8, 2016

TU Darmstadt

Short Courses

Nathanaël Berestycki
Neil O'Connell

Invited Speakers

Alexander Drewitz
Patrik Ferrari
Gourab Ray
Roland Speicher

Organization

Frank Aurzada
Volker Betz
Matthias Meiners



March 31, 2016

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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.

- **WELCOME HOTEL DARMSTADT**
Karolinenplatz 4
64289 Darmstadt
Tel: +49-6151-3914-0
Fax: +49-6151-3914-444
- **HOTEL Bockshaut**
Kirchstraße 7-9
64283 Darmstadt-Innenstadt
Tel: +49-6151-99670
Fax: +49-6151-99 67-29

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|07, Hochschulstraße 6 | 64289 Darmstadt in lecture hall S2|07/167. In the lecture hall, there are 2 large blackboards and a beamer.

1.4 Map & Points of Interest

The map can be found on the last page.

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 0049 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 Tuesday, April 5th there will be a conference dinner at the Ristorante Sardegna, Kahlertstraße 1, 64293 Darmstadt, Phone: 06151 / 23029.

1.8 Free Afternoon

On Wednesday, April 6th there will be a free afternoon.

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:

- Jun.-Prof. Dr. Matthias Meiners
Office: S2-15, Room 351
Phone: +49 (0) 6151 - 16 23386
- Prof. Dr. Volker Betz
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Acknowledgements

Financial support by the Johannes-Gutenberg-Universität Mainz, the Technische Universität Darmstadt, the Department of Mathematics at Technische Universität Darmstadt, and the Deutsche Forschungsgemeinschaft DFG is acknowledged.



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UNIVERSITÄT MAINZ



Deutsche
Forschungsgemeinschaft



| *Fachbereich*
Mathematik



Programme

Monday	Tuesday	Wednesday	Thursday	Friday
Registration				
Berestycki	Berestycki	Berestycki	Berestycki	Drewitz
<i>Coffee break</i>	<i>Coffee break</i>	<i>Coffee break</i>	<i>Coffee break</i>	<i>Coffee break</i>
O'Connell	O'Connell	O'Connell	O'Connell	O'Connell
<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>
Ray	Speicher	Berestycki	Ferrari	
Contributed talks: Federico	Contributed talks: Kolesko		Contributed talks: Chen	
Kabluchko	Mentemeier			
<i>Coffee break</i>	<i>Coffee break</i>		<i>Coffee break</i>	<i>End of Workshop</i>
Short talks: Basu, Cortines, Guangqu, Schäfer			<i>Free Afternoon</i>	
Wine & Cheese	Conference Dinner			

Monday, 4. April 2016

Time	Speaker	Title of Talk
08:55-09:00	Welcome	
09:00-10:30	Nathanaël Berestycki	<i>Mini course on Gaussian free field and Liouville quantum gravity</i>
10:30-11:00		–Coffee Break–
11:00-12:30	Neil O’Connell	<i>Mini course from longest increasing subsequences to random polymers, and related topics</i>
12:30-14:00		–Lunch Break–
14:00-15:00	Gourab Ray	<i>Universality for fluctuation in the dimer model</i>
15:00-15:30	Lorenzo Federico	<i>Critical Windows for Connectivity in the Configuration Model</i>
15:30-16:00	Zakhar Kabluchko	<i>Convex Hulls of Random Walks and Weyl Chambers</i>
16:00-16:30		–Coffee Break–
16:30-17:30	Short talks	Basu, Cortines, Guangqu, Schäfer
17:30-19:00	Cheese & Wine	

Tuesday, 5. April 2016

Time	Speaker	Title of Talk
09:00-10:30	Nathanaël Berestycki	Mini course on Gaussian free field and Liouville quantum gravity
10:30-11:00		–Coffee Break–
11:00-12:30	Neil O’Connell	Mini course from longest increasing subsequences to random polymers, and related topics
12:30-14:00		–Lunch Break–
14:00-15:00	Roland Speicher	The asymptotics of Young diagrams and free probability theory
15:00-15:30	Konrad Kolesko	Local fluctuations of critical Mandelbrot Cascades
15:30-16:00	Sebastian Mentemeier	Nonstandard Limit Theorems: Theory and Applications
16:00-16:30		–Coffee Break–
19:00-22:00		–Conference Dinner–

Wednesday, 6. April 2016

Time	Speaker	Title of Talk
09:00-10:30	Nathanaël Berestycki	Mini course on Gaussian free field and Liouville quantum gravity
10:30-10:45		–Coffee Break–
10:45-12:15	Neil O’Connell	Mini course from longest increasing subsequences to random polymers, and related topics
12:15-13:30		–Lunch Break–
13:30-15:00	Nathanaël Berestycki	Mini course on Gaussian free field and Liouville quantum gravity
15:00-18:00		–Free Afternoon–

Thursday, 7. April 2016

Time	Speaker	Title of Talk
09:00-10:30	Nathanaël Berestycki	Mini course on Gaussian free field and Liouville quantum gravity
10:30-11:00		–Coffee Break–
11:00-12:30	Neil O’Connell	Mini course from longest increasing subsequences to random polymers, and related topics
12:30-14:00		–Lunch Break–
14:00-15:00	Patrik Ferrari	Free energy fluctuations for directed polymers in $1+1$ dimension
15:00-15:30	Linxiao Chen	Local limit of cFK random maps
15:30-16:00		–Coffee Break–

Friday, 8. April 2016

Time	Speaker	Title of Talk
09:00-10:00	Alexander Drewitz	<i>The maximal particle of branching random walk in spatially random branching environment</i>
10:00-10:30		–Coffee Break–
10:30-12:00	Neil O'Connell	<i>Mini course from longest increasing subsequences to random polymers, and related topics</i>
12:00-13:30		–Lunch Break, End of Workshop–

2 List of Talks

2.1 Short Courses

Nathanaël Berestycki

Mini course: Gaussian free field and Liouville quantum gravity
University of Cambridge, United Kingdom

Abstract: I will describe recent developments connected with two-dimensional Liouville quantum gravity. After giving some background detailing the general problem and the motivations coming from the critical behaviour of 2d statistical mechanics models, I will outline two different approaches that have emerged recently to tackle the problem from a rigorous standpoint. The first is based on a discretisation of space via random planar maps and the other tries to seek directly a continuous formulation based on the Gaussian Free Field; I will focus mainly on the latter.

Topics to be discussed include in particular an introduction to the Gaussian free field, the construction of its associated Liouville measure and application to the Khnizhnik-Polyakov-Zamolodchikov (KPZ) formula. Time permitting, I will also briefly discuss Liouville Brownian motion and Sheffield's quantum zipper.

A set of lecture notes is available at

<http://www.statslab.cam.ac.uk/~beresty/Articles/oxford3.pdf>

Neil O'Connell

*Mini course: From longest increasing subsequences to random polymers,
and related topics*
University of Warwick, United Kingdom

Abstract: The longest increasing subsequence problem has a long and interesting history, due in no small part to its deep connections to representation theory and the theory of Young tableaux. The latter has vast generalisations, with many applications across random matrix theory and statistical physics. In these lectures I will give an overview of the basic combinatorial theory of Young tableaux and its many variations, generalisations and applications.

2.2 Invited Speakers

Gourab Ray

Universality for fluctuation in the dimer model
University of Cambridge, United Kingdom

Abstract: The dimer model is a very natural model of a two dimensional random surface. It is believed that for a wide range of lattices and boundary conditions the fluctuation in such a random surface model is universal and is a conformally invariant object called the Gaussian free field. This is an exact analogue of the central limit theorem for two dimensional surfaces. We will prove this result for the dimer model on certain lattices satisfying some very natural conditions. This recovers some old results, produces some new ones and gives some new insight on the theory of imaginary geometry developed by Dubedat, Miller and Sheffield. Our approach is robust and we believe it has potential for wider applications. Joint work with Nathanaël Berestycki and Benoît Laslier.

Patrik Ferrari

Free energy fluctuations for directed polymers in 1+1 dimension
Universität Bonn, Germany

Abstract: The Kardar-Parisi-Zhang (KPZ) universality class includes directed polymers in random media in 1+1 dimension. According to the universality conjecture, for any finite temperature, the fluctuations of the free energy (e.g. for point-to-point) directed polymers is expected to be distributed as the (GUE) Tracy-Widom distribution in the limit of large system size. This distribution arose first in the context of random matrices. Very detailed results as the fluctuation laws for models in the KPZ are available only for "zero temperature models". We consider two models at positive temperature, a semi-discrete and the continuum directed polymer models, and determine the law of the free energy fluctuations.

Roland Speicher

The asymptotics of Young diagrams and free probability theory
Universität des Saarlandes, Germany

Abstract: I will motivate that many operations on Young diagrams which correspond to representations of the symmetric groups $S(n)$ have an asymptotic limit for n going to infinity. This limit can be described in terms of free probability theory. I will give some idea of free probability theory and of its asymptotic relevance.

Alexander Drewitz

The maximal particle of branching random walk in spatially random branching environment

Universität zu Köln, Germany

Abstract: One-dimensional branching Brownian motion has been the subject of intensive research during the last decades. We consider branching random walk and investigate the setting of a spatially random branching environment; in particular we are interested in the positions of (the median of) the maximal particle as well as the so-called ‘breakpoint’. On an analytic level, this corresponds to investigating the fronts of the solutions to a randomized Fisher-KPP equation and to the parabolic Anderson model, as well as their relative backlog.

2.3 Further Speakers

Deepan Basu

Incipient infinite cluster for Bernoulli percolation on slabs
MPI Leipzig, Germany

Abstract: (Joint work with A. Sapozhnikov.) Kesten constructed the incipient infinite cluster on planar lattices by conditioning on existence of an open path from the origin to the boundary of a large box in critical percolation and letting the box size go to infinity. We extend his construction to planar slabs and discuss some properties of the resulting limit.

Linxiao Chen

Local limit of cFK random maps
Université Paris-Sud, France

Abstract: A cFK random map is chosen among all planar maps having n edges with a probability proportional to the partition function of the critical Fortuin-Kastelyan model. They form a one parameter family, in which uniform planar map is a particular case. In 2011 Scott Sheffield discovered a nice bijection which encodes cFK random maps by a random sequence of letters. I will present a proof of the local convergence of cFK random maps using this bijection, and discuss some properties of the limit.

Aser Cortines

Finite-size corrections to the speed of a branching-selection process
Technion - Israel's Institute of Technology, Israel

Abstract: We consider directed last-passage percolation on the complete graph and associate to this problem a stochastic model of N evolving particles. The evolution is determined by a branching mechanism with selection of the fittest. The cloud of particles remains grouped and move with a deterministic speed v_N . We focus on the case where the noise lies in the max-domain of attraction of the Weibull extreme value distribution and calculate the finite-size correction to the speed v_N . Joint work with Francis Comets.

Lorenzo Federico

Critical Windows for Connectivity in the Configuration Model
Eindhoven University of Technology, Netherlands

Abstract: We identify the critical window in which the probability of a configuration model $CM_n(d)$ to produce a *connected* graph converges to a non-trivial value. Within this critical window that is identified by the number of vertices of degree 1 and 2, as well as the expected degree, the of the complement of the giant component weakly converges to a random variable with finite expectation. Under a finite second moment condition we also derive the asymptotics of the connectivity probability conditioned on simplicity, from which the asymptotic number of simple connected graphs with a prescribed degree sequence follows. Based on joint with Remco van der Hofstadt.

Zakhar Kabluchko

Convex Hulls of Random Walks and Weyl Chambers
Universität Münster, Germany

Abstract: Consider a random walk with n i.i.d. steps in the d -dimensional space. Assuming that the distribution of the jumps is symmetric and absolutely continuous, we obtain an explicit formula for the probability that the convex hull of the random walk contains the origin. This problem is equivalent to the following purely geometric one: given a generic linear subspace of codimension d in the n -dimensional space, what is the number of Weyl chambers of type B_n intersected by this subspace? This is a joint work with V. Vysotsky and D. Zaporozhets.

Konrad Kolesko

Local fluctuations of critical Mandelbrot Cascades
Universität Breslau, Polen

Abstract: We consider Mandelbrot Cascades in the critical case: i.e. for a given non-negative random variable W with $EW = 1$ and $EW \log W = 0$ we label vertices of the binary tree $\mathbb{T} = \bigcup_{k \geq 0} \{0, 1\}^k$ by i.i.d. copies of W and on the unit interval we consider random measures $\mu_\omega^{(n)}(dx) = W_{i_1} \cdot W_{i_1, i_2} \cdot \dots \cdot W_{i_1, \dots, i_n} dx$, where $0.i_1 i_2 i_3 \dots$ is a binary expansion of x . It is known that, after a proper rescaling, a sequence $\mu_\omega^{(n)}$ converges weakly to some random measure μ_ω , which turns out to be continuous. Our main question is how the limiting measure μ_ω fluctuates. For any given point x , denoting by $B_r(x)$ the ball of radius r centred around x , we present optimal lower and upper estimates of $\mu_\omega(B_x(r))$ as $r \rightarrow 0$.

This is a joint work with Dariusz Buraczewski and Piotr Dyszewski.

Sebastian Mentemeier

Nonstandard limit theorems: theory and applications
Technische Universität Dortmund, Germany

Abstract: In many models of Applied Probability and Statistical Physics quantities of interest satisfy distributional limit theorems (i.e. convergence in law) which are nonstandard in the sense that neither normal nor α -stable laws appear as limiting distributions. Sometimes, there is even no convergence in law, but periodical fluctuations centered at some limit law occur. Common to all these models is that the limiting distributions satisfy so-called smoothing equations. These are equations of the form

$$X \stackrel{\text{law}}{=} \sum_{j \geq 1} T_j X_j + C; \quad (1)$$

where $X_1, X_2, \dots$ are i.i.d. copies of the (unknown) random variable X and independent of the (given) random variables $(C, T_1, T_2, \dots)$. I will start my talk by presenting several examples where this phenomenon occurs, a particular instance of which will be discretized versions of Gaussian Multiplicative Chaos. Then I will present a general theory for solving equations of type (1) in the case where X as well as $C, T_1, T_2, \dots$ are complex-valued random variables. These results are then applied to the examples mentioned in the introduction. This talk is based on joint work with Matthias Meiners, TU Darmstadt.

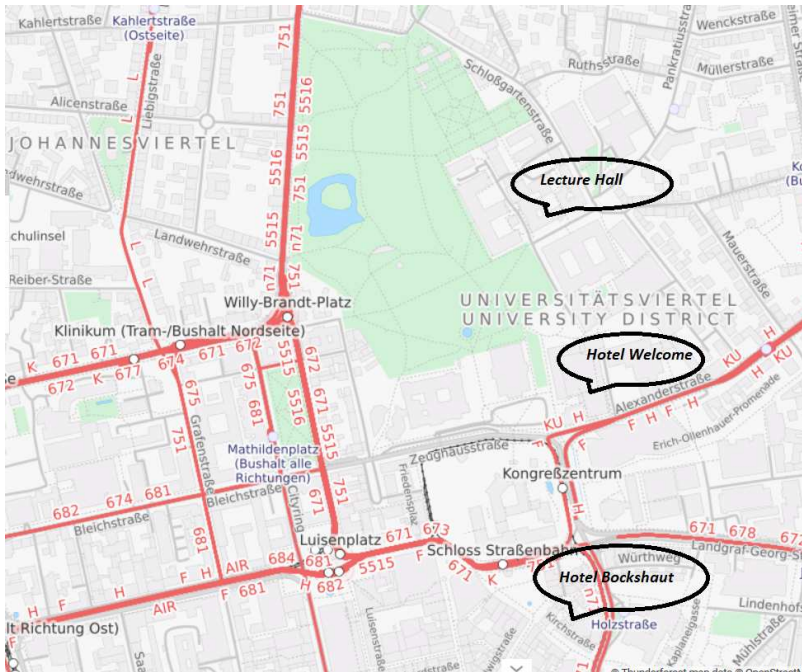
3 Participants

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Citymap

Points of interest:

- Lecture Hall
- Hotel Welcome
- Hotel Bockshaut