Warsaw Summer School in Probability

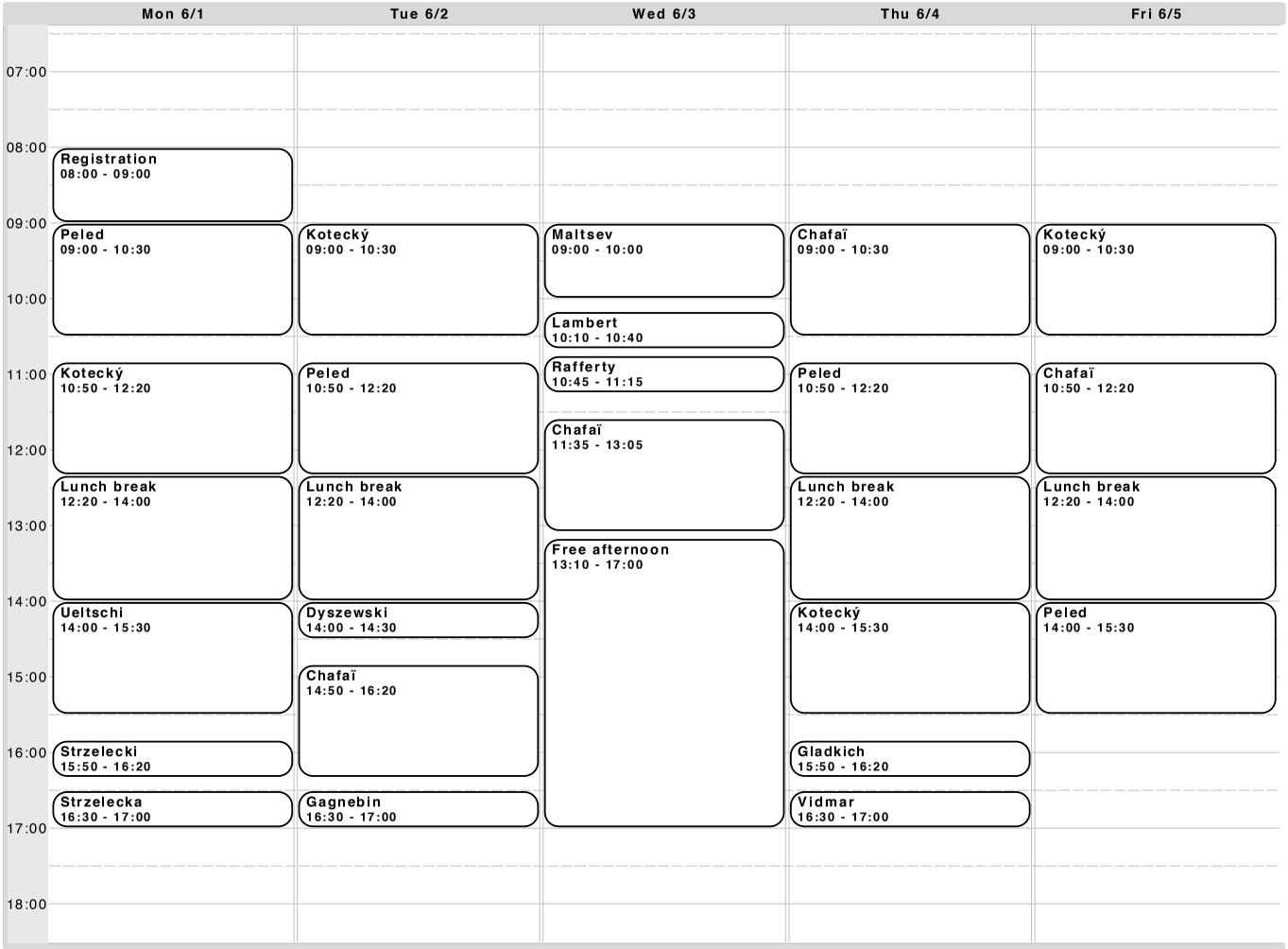
University of Warsaw
June 1 – 5, 2015

Wydział Matematyki, Informatyki i Mechaniki

Uniwersytet Warszawski

Warsaw Center of Mathematics and Computer Science

Conference schedule — **Mon 2015-06-01 – Fri 2015-06-05 (Warsaw)**



Venue:

University of Warsaw
Faculty of Mathematics, Informatics and Mechanics,
Banacha 2, 02-097 Warszawa
Classroom 2180 (2nd floor)

Schedule

Monday, June 1st

- 8:00 - 9:00 – Registration
- 9:00 - 10:30 – Ron Peled, *Spatial random permutations I*
- 10:30 - 10:50 – Coffee break
- 10:50 - 12:20 – Roman Kotecký, *Gradient models I*
- 12:20 - 14:00 – Lunch break
- 14:00 - 15:30 – Daniel Ueltschi, *Random loop models and quantum spin systems*
- 15:30 - 15:50 – Coffee break
- 15:50 - 16:20 – Michał Strzelecki, *Modified log-Sobolev inequalities for convex functions*
- 16:30 - 17:00 – Marta Strzelecka, *Weak and strong moments of ℓ_r-norms of log-concave vectors*

Tuesday, June 2nd

- 9:00 - 10:30 – Roman Kotecký, *Gradient models II*
- 10:30 - 10:50 – Coffee break
- 10:50 -12:20 – Ron Peled, *Spatial random permutations II*
- 12:20 - 14:00 – Lunch break
- 14:00 - 14:30 – Piotr Dyszewski, *Exponential moments of fixed points of the nonhomogeneous smoothing transform*
- 14:30 - 14:50 – Coffee break
- 14:15 - 16:20 – Djalil Chafaï, *Aspects of random matrices and Coulomb gases I*
- 16:30 - 17:00 - Maxime Gagnebin, *Decay of correlation in the XY model*

Wednesday, June 3rd

- 9:00 - 10:00 – Anna Maltsev, *Local laws for Wigner random matrices*
- 10:10 - 10:40 – Gaultier Lambert, *Gaussian and non-Gaussian fluctuations for mesoscopic linear statistics in determinantal processes*
- 10:45 - 11:15 – Thomas Rafferty, *Monotonicity and condensation in stochastic particle systems*
- 11:15 - 11:35 – Coffee break
- 11:35 - 13:05 – Djalil Chafaï, *Aspects of random matrices and Coulomb gases II*

Thursday, June 4th

- 9:00 - 10:30 – Djalil Chafaï, *Aspects of random matrices and Coulomb gases III*
- 10:30 - 10:50 – Coffee break
- 10:50 - 12:20 – Ron Peled, *Spatial random permutations III*
- 12:20 - 14:00 – Lunch break
- 14:00 - 15:30 – Roman Kotecký, *Gradient models III*
- 15:30 - 15:50 – Coffee break
- 15:50 - 16:20 – Alexey Gladkich, *The cycle structure of random Mallows permutations*
- 16:30 - 17:00 – Matija Vidmar, *On the information generated by a process up to a stopping time*

Friday, June 5th

- 9:00 - 10:30 – Roman Kotecký, *Gradient models IV*
- 10:30 - 10:50 – Coffee break
- 10:50 - 12:20 – Djalil Chafaï, *Aspects of random matrices and Coulomb gases IV*
- 12:20 - 14:00 – Lunch break
- 14:00 - 15:30 – Ron Peled, *Spatial random permutations IV*

Abstracts

Long courses

- **Djalil Chafaï** – *Aspects of random matrices and Coulomb gases*

  This course is centered around random matrix models and Coulomb gases. After introducing the quarter-circular, the semi-circular, and the circular laws phenomena, we will study the method of moments, the Stieltjes transform, and the logarithmic potential, which are efficient tools for the spectral analysis of random matrices. We will then move to the concept of Coulomb gases, and its relation with large deviations theory and orthogonal polynomials. We will end up with Kesten-McKay laws and the notion of freeness at the heart of the free probability theory of Voiculescu.

  References:
  http://www.math.polytechnique.fr/xups/xups13-03.pdf
  http://arxiv.org/abs/1405.1003

- **Roman Kotecký** – *Gradient models*

  Gradient Gibbs measures feature in various contexts, notably as models of random surfaces and microscopic models of nonlinear elasticity. While the aim of the lectures will be to cover recent advances in these areas, we will start with a basic setting and gradually elucidate technical difficulties involved in studying random gradient fields. A careful consideration will be given to the case of non-convex interactions. The topics covered in the lectures will include phase transitions for random surfaces, variational characterization of nonlinear elasticity obtained as a scaling limit in terms of large deviations of random gradient fields, as well as an explanation of how to tame strongly correlated interactions by a multi-scale renormalization group technique.

- **Ron Peled** – *Spatial random permutations*

  Spatial random permutations are non-uniform probability distributions on permutations which are biased towards the identity with respect to some underlying geometry. One may, for instance, consider random permutations on the points of a finite metric space (X, d) which are sampled with probability proportional to $\exp(-\sum_{x\in X} d(x, \pi(x)))$. A popular model which has been the focus of much research in recent years is the stirring (or interchange) model. In this model one starts with the identity permutation on the vertices of a (possibly infinite) graph and lets each edge perform transpositions at the times of an independent Poisson process. The main observable of interest for such models is the existence of macroscopic (or infinite) cycles.

  Spatial random permutation models are related to representations for the quantum Bose gas and macroscopic cycles are associated with the quantum model undergoing Bose-Einstein condensation.

  In this mini-course I will describe some of the recent work on spatial random permutations. This includes results by Angel and Schramm (simplified by Berestycki) for the stirring model on a regular tree and on the complete graph, respectively. The well known conjecture for the stirring model on $\mathbb{N}^d$ is that infinite cycles can appear only in 3 and higher dimensions and is supported by results by Ueltschi and Betz on certain 'annealed' models in $\mathbb{R}^d$. I will also describe results in one dimension with special focus on the Mallows model. Time permitting, I will discuss a second natural observable in one dimension, the longest increasing subsequence, which is related to last passage percolation.

Educational lectures

- **Anna Maltsev** – *Local laws for Wigner random matrices*

  The spectral measure of Hermitian matrices with centered independent identically distributed entries (Wigner matrices) tends to the semicircle law weakly in the limit of large dimension. This has been proven by Wigner in the 50s. We ask to what extent this convergence continues to hold on small intervals, i.e. when the interval size tends to 0 with dimension. I will give an overview of the field, mention some recent results, and outline some of the methods.

- **Daniel Ueltschi** – *Random loop models and quantum spin systems*

  The random loop representations of the quantum Heisenberg models allow to study these systems using probabilistic methods. They were introduced twenty years ago by Toth and Aizenman-Nachtergaele. I will explain their derivation and discuss recent extensions. If time permits, I will present some rigorous results about a phase transition with long loops in hypercubes (joint work with R. Kotecký and P. Miloś), and about the decay of certain quantum correlations (joint work with J. Bjornberg).

Short talks

- **Piotr Dyszewski** – *Exponential moments of fixed points of the nonhomogeneous smoothing transform*

  Consider a (canonical) solution to stochastic fixed point equation $X =^d \sum_k T_k X_k + C$, where $X, X_1, X_2,$ are iid independent of the random vector $(C, T_1, T_2,)$. We are interested in necessary and sufficient criteria for the finiteness of exponential moments of X i.e. $\mathbb{E}[e^{sX}]$. We will provide a formula for the abscissa of convergence of the moment generating function in some special cases, in particular in the case of the random difference equation $R =^d AR + B$. The talk is based on a joint work in progress with Gerold Alsmeyer (University of Muenster).

- **Maxime Gagnebin** – *Decay of correlation in the XY model*

  We will review the results known about the XY model and show how one can obtain an upper bound on the decay of correlation. We will then see how this bound can be proved for more general models, modifying the range or the type of interaction. Based on joint work with Yvan Velenik.

- **Alexey Gladkich** – *The cycle structure of random Mallows permutations*

  The Mallows model is a probability measure on permutations in S_n in which the probability of a permutation is proportional to $q^{inv(\pi)}$, where $inv(\pi)$ denotes the number of inversions in π and $0 < q < 1$ is a parameter of the model. The model is an example of a class of distributions called spatial random permutations in which the distribution is biased to be close to the identity in a certain underlying geometry. We study the cycle structure of a permutation sampled from the Mallows model. Our main result is that the expected length of the cycle containing a given point is of order $\min(1/(1-q)^2, n)$.

In contrast, the expected length of a uniformly chosen cycle is of order $\min(1/(1-q), n/\log(n))$. Joint work with Ron Peled.

- **Gaultier Lambert** – *Gaussian and non-Gaussian fluctuations for mesoscopic linear statistics in determinantal processes*

  We will review the central limit theorem for linear statistics of the sine point process from Random Matrix theory. Then, I will explain how the proof can be generalized to a class of determinantal measures in one dimension which interpolate between Poisson and Random Matrix statistics. An example of such a process comes from considering a grand canonical ensemble of free fermions in a quadratic well at positive temperature. For this model, we obtain different limit theorems for linear statistics depending on the density of the process and the temperature. In particular, in a critical regime, we can observe some non-Gaussian limits. This is a joint work with K. Johansson.

- **Thomas Rafferty** – *Monotonicity and condensation in stochastic particle systems*

  Coupling techniques are powerful tools to study hydrodynamic limits of stochastic particle systems. In order for a coupling to exist the process must be monotone, in the sense that the dynamics preserve a partial ordering of the state space for all time. A stochastic process exhibits condensation if above a critical density it phase separates into a homogeneous phase distributed at the maximal Gibbs measure, and a condensate where a diverging number of particles concentrates on a single lattice site. We study stochastic particle systems that conserve particle number and exhibit such condensation transitions due to particle interactions in the limit of diverging mass on a finite lattice. All known examples with product Gibbs measures that exhibit a condensation transition are not monotone, and we prove that this is indeed necessary under the additional assumption of finite first moment of the maximal Gibbs measure.

We show that the canonical measures are not monotonically ordered in particle number in case of condensation, which contradicts monotonicity. In the case of infinite first moment, we can construct a model with product stationary measures which is both monotone and condensing. This is joint work with Paul Chleboun and Stefan Grosskinsky.

- **Marta Strzelecka** – *Weak and strong moments of ℓ_r-norms of log-concave vectors*

  We will discuss the following generalization of the classical Paouris inequality. For $p \geq 1$ and $r \geq 2$ the p-th moment of the ℓ_r norm of a log-concave random vector in $\mathbb{R}^n$ is bounded, up to a constant proportional to r, by the sum of its first moment and its p-th weak moment. The talk will be based on joint work with Rafał Latała.

- **Michał Strzelecki** – *Modified log-Sobolev inequalities for convex functions*

  We will give a sufficient condition for a probability measure on the real line to satisfy a modified logarithmic Sobolev inequality for convex functions. Products of according measures satisfy the two level concentration for convex sets and functions. The talk will be based on joint work with Radosław Adamczak.

- **Matija Vidmar** - *On the information generated by a process up to a stopping time*

  There is investigated in detail the notion of the information generated by a (stochastic) process up to a stopping time of its (completed) natural filtration. The two obvious candidates for this body of information the (completed) initial structure of (i.e. the (completed) sigma-field generated by) the stopped process, on the one hand, and the history of the natural filtration of the process up to said stopping time, on the other are shown to be equal under fairly general conditions. This

extends existing results in the literature (available for coordinate processes on canonical spaces). Several related findings, results, corollaries and counter-examples are also provided.

Practical information

Internet access

A wi-fi network is set up for school participants in classroom 2180. SSID: WSSiP password: suMIMer_2015

Additionally there is an Eduroam network available in the whole building.

Where to eat

Here is a short list of lunch options within the walking distance from the conference venue

1. The cafeteria at the Department of Mathematics - 4th floor
2. The kiosk at the ground floor - you can get here some food to go
3. Sedo Kebab - a Turkish style grill bar. Grójecka Street
4. Aceto Balsamico - a small Italian style restaurant. Wawelska Street
5. Van Binh - a Vietnamese restaurant. Grójecka street

6. Jeff's – an American style restaurant. Pola Mokotowskie

7. Lolek Pub – a barbecue place, a little bit farther away from the conference venue. Pola Mokotowskie

8. Bar Smak - a relatively cheap diner remembering the times of the Polish People's Republic (doesn't seem to have changed much since the 1980s) . For the adventurous. Grójecka Street.

Public holiday on Thursday

Thursday, June 4th is a public holiday in Poland, which means that many shops may be closed and public transportation operates on Sunday schedule. As there will be no students at the department building, please remember to bring your name tags.

Transport

The public transport in Warsaw works quite efficiently. During the rush hours we recommend using trams or the metro. The best way to schedule your trip is to use `http://warszawa.jakdojade.pl/?locale=en`. The closest stop from the conference venue is called "Och-teatr". The most common types of tickets are: valid for 20 mins for any number of means of transport (costs 3.4PLN), 75 mins (costs 4.4PLN), 24 hour (costs 15PLN). The tickets can be purchased in kiosks, shops and in a number of yellow vending machines located on bus or tram stops. The tickets have to be **validated** during the first journey after boarding the bus or tram. On the metro one should validate the ticket before entering the platform.
There are multiple companies offering taxi services, you can hail them on the street. The prices vary from 1.6PLN-2.4PLN/km (day) and 2.4PLN-3.6PLN/km (night) plus the entrance fee. They are typically reliable and safe. Arguably best (and most expensive) are Ele-Taxi, MPT, Sawa.

Money

The currency in Poland is złoty (pronounced "zwoty"). The approximate exchange rate is:

- 1EUR=4PLN,
- 1GBP=5.7PLN,
- 1CHF=3.9PLN,

There are a number of ATMs on Grójecka Street, close to the conference venue. Shops typically accept cards (however this is not the case of the cafeteria at the Math department). A few typical prices are: 10-20PLN for lunch, 30-60PLN for a dinner at a restaurant, 1.5PLN for a bottle of water, 10PLN for a beer in a pub.