

FINAL REPORT

2013 School on Mathematical Statistical Physics

August 19-30, 2013
Prague, Czech Republic

1. SUMMARY

The 2013 School on Mathematical Statistical Physics boasted altogether 6 main lecture series. The speakers and their titles are as follows:

- **Michael Aizenman** (Princeton) and **Simone Warzel** (Munich):
Quantum spectra and dynamics under random potential
- **Anton Bovier** (Bonn):
From spin glasses to branching Brownian motion (and back?)
- **David Brydges** (Vancouver): *The renormalisation group and some applications*
- **Amin Coja-Oghlan** (Frankfurt):
Phase transitions in discrete structures: a rigorous perspective
- **Dima Ioffe** (Haifa): *Stretched polymers in random environments*
- **Gregory Lawler** (Chicago): *Conformally invariant models in two dimensions*

Each of the lecture series consisted of four 90-minute blocks. Two of the main speakers (Michael Aizenman and Gregory Lawler) also delivered public colloquia on the subject related to their main lectures. These public lectures were organized jointly with the local department of mathematics and were extremely well attended.

Several lectures came with well prepared lecture notes; others have presented at least a summary of their lectures. It has been agreed that (a polished version of) these will be published in a conference proceedings.

In addition to main lectures, the school also gave the floor to its participants. Specifically, there were 7 afternoon sessions where the participants volunteered to give a 30-minute presentation on the subject of their research interest. All of these were attended by the senior lecturers as well and thus the participants could receive an instant feedback from rather well-informed audiences.

Apart from the lectures, the program offered plenty of room for informal discussions on subject of (as well as away from those treated at) the school.

2. DESCRIPTION OF SCIENTIFIC CONTENT

All areas discussed at the main school lecture series constitute cutting-edge research subjects. Let us discuss some of these in detail.

(1) *Spectra of random Schrödinger operators*: Thanks to heroic effort of mathematicians in the last 30 years, the Anderson localization — the appearance of point spectrum when diagonal disorder is added to the Laplace operator — is an extremely well-researched subject. However, what is missing almost completely till today is the understanding of delocalization, which refers to the regime when the perturbed operator keeps having a continuous spectral component as well. The lectures of Aizenman and Warzel have given both a good overview of technical tools and the main underlying ideas for localization as well as the proof and further subtleties of delocalization on regular trees.

(2) *Fluctuating fields and polymers*: Much of current interest in probability goes towards the understanding of random object that feature critical-type of fluctuations (typically characterized by power-law decay of correlations). The specific areas discussed at the school was a field-theory based approach to 4-dimensional weakly-self-avoiding random walk (Brydges), the extreme values of the Branching Brownian Motion (Bovier) and scaling behavior of polymers subjected to a stretching force (Ioffe).

(3) *Conformally invariant models*: There no need to argue for the importance of two-dimensional critical models for probability theory. There are numerous approaches: one based on the Schramm-Loewner evolution, another based on level lines and other curves identified from within the continuum Gaussian Free Field, and yet another based on loop-measures and the so called loop soup. Lawler is particularly a master of the last approach and that is what his lectures were devoted to.

(3) *Disordered mean-field systems*: There is a large area between probability, combinatorics and computer science that is devoted to a class of hard computational problems with a stochastic component. An example of these is the random satisfiability problem, or k -coloring of random graphs, etc. Coja-Oghlan has recently scored several important results in the area of formation of clusters, and various transitions between clustering regimes, in these models. His lectures gave a very nice overview of the development of this field in the last few years.

3. ASSESSMENT OF IMPACT

Being a summer school, the event primarily served its educational purpose. However, since the participants have been recruited from the best schools in Europe and North America, it is reasonable to expect that the school will also play a non-negligible role in formulation of future ideas and general progress in the subjects of probability and mathematical statistical mechanics. (The Prague school has a long tradition and so this can definitely be attested by following the career path of some of early schools' participants.)

The school can be expected to have impact on the larger community as well. Indeed, the lecturers have agreed to submit their notes to a proceedings, and so the main ideas contained in the lectures will eventually be circulated and made available to everyone. It can also be expected that the presence at the school will be quite important for the career path of many of the participants.

Finally, the school has had also a very non-trivial impact on the Prague mathematics community. It is not very often that so many highly decorated mathematicians appear in Prague in such a short time period. This opportunity led to the idea of organization of public colloquia for Aizenman and Lawler, which were well attended by both mathematicians and physicists from all of the Charles University of Prague.

4. LIST OF PARTICIPANTS

Rene Petrus Conijn (VU Amsterdam)
 Richard Kraaij (TU Delft)
 Tim van de Brug (VU Amsterdam)
 Eric Brattain-Morrin (UC Davis)
 Stephen DeSalvo (UCLA)
 Matthew Cha (UC Davis)
 Aser Cortines (Paris 7)
 Leander Geisinger (Princeton)
 Lisa Hartung (Bonn)
 Patrick Mueller (Bonn)
 Sebastian Andres (Bonn)
 Tobias Lehmann (Bath)
 Tyler Helmuth (UBC)
 Tal Orenshtein (TU Munich)
 Eliran Subag (Weizmann)
 Sidoniu Sabin Salajan (Bonn)
 Adela Svejda (Bonn)
 Martin Tassy (Brown)
 Stephen Tate (Warwick)
 Tobias Wassmer (Viena)
 Jean-Christophe Mourrat (Lausanne)
 Martin Slowik (Berlin)
 Tonci Antunovic (UCLA)
 David Svoboda (TU Brno)
 Laure Dumaz (Ecole Normale Superier Paris)
 Nahuel Soprano Loto (Universidad de Buenos Aires)

Renato Santos (Lyon 1)
Romain Allez (Paris Dauphine)
Giuseppe DeTomasi (Heidelberg)
Massimo Secci (Padua)
Peng Mei (Helsinki)
Piotr Milos (Warsaw)
Ron Peled (Tel Aviv)
Ale? Antonin Kubena (UTIA Prague)
Jan Lazebnicek (UTIA Prague)
Janina Huettel (Frankfurt)
Samuel Hetterich (Frankfurt)
Felicia Rassmann (Frankfurt)
Winnie O'Kelly de Galway (KU Leiden)
Nick Crawford (Technion Haifa)
Christoph Temmel (VU Amsterdam)
Maxime Gagnebin (Geneva)
Joris Bierkens (Radboud University Nijmegen)
Fredrik Ekstrom (Lund)
Minh Nguyen (Lund)

5. FINAL PROGRAM

Here is the final program, including short talks, of the entire two-week event:

Week 1:

Monday, Aug 19:

9:00-10:30 Aizenman & Warzel
 10:30-11:00 coffee
 11:00-12:30 Ioffe
 12:30-14:00 lunch
 14:00-15:30 Bovier
 15:30-17:00 coffee & short talks (Miloš, Peled)

Tuesday, Aug 20:

9:00-10:30 Ioffe
 10:30-11:00 coffee
 11:00-12:30 Bovier
 12:30-14:00 lunch
 14:00-15:30 Aizenman/Warzel
 15:30-17:30 coffee & short talks (Orenshtein, Švejda, DeSalvo)

Wednesday, Aug 21:

9:00-10:30 Bovier
 10:30-11:00 coffee
 11:00-12:30 Aizenman/Warzel
 12:30-14:00 lunch
 14:00-night free afternoon

Thursday, Aug 22:

9:00-10:30 Ioffe
 10:30-11:00 coffee
 11:00-12:30 Bovier
 12:30-14:00 lunch
 14:00-15:00 Aizenman colloquium
 15:00-17:00 coffee & short talks (vande Brug, Kraaij, Wassmer)

Friday, Aug 23:

9:00-10:30 Aizenman/Warzel
 10:30-11:00 coffee
 11:00-12:30 Ioffe
 12:30-14:00 lunch
 14:00-16:00 coffee & short talks (Bierkens, Conijn)

Week 2:

Monday, Aug 26:

9:00-10:30 Lawler
10:30-11:00 coffee
11:00-12:30 Bovier
12:30-14:00 lunch
14:00-15:30 Brydges
15:30-17:00 coffee & short talks (Temmel, Hartung)

Tuesday, Aug 27:

9:00-10:30 Coja-Oghlan
10:30-11:00 coffee
11:00-12:30 Brydges
12:30-14:00 lunch
14:00-15:00 Lawler colloquium
15:00-17:00 coffee & short talks (O'Kelly de Galway)

Wednesday, Aug 28:

9:00-10:30 Coja-Oghlan
10:30-11:00 coffee
11:00-12:30 Lawler
12:30-14:00 lunch
14:00-night free afternoon

Thursday, Aug 29:

9:00-10:30 Brydges
10:30-11:00 coffee
11:00-12:30 Lawler
12:30-14:00 lunch
14:00-15:30 Coja-Oghlan
15:30-17:00 coffee & short talks (Tate, Santos, Antunović)

Friday, Aug 30:

9:00-10:30 Lawler
10:30-11:00 coffee
11:00-12:30 Coja-Oghlan
12:30-14:00 lunch
14:00-15:30 Brydges