Schedule Summer School Randomness in Physics & Mathematics

(week 1 = 01. - 06. August 2022 & week 2 = 08. - 13. August 2022)

week 1	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9:15	welcome					
9:30-10:30	Bourgade	Maïda	Dumitriu	Schehr	Dumitriu	Maïda
coffee						
11-12	Dumitriu	Schehr	Bourgade	Maïda	Maïda	Schehr
lunch 12:30						excursion
14-15	Bourgade	Bourgade	talks*	Dumitriu	Schehr	Open-Air
15-16:30	exercises	exercises	talks*	exercises	exercises	Museum
coffee				female career		
17-18	solutions	solutions	posters*	solutions	solutions	Detmold +
18:15	concert					Biergarten
19:15	barbecue					Detmold

week 2	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9:30-10:30	Katori	Warzel	Claeys	Warzel	Prosen	Katori
coffee						
11-12	Prosen	Katori	Warzel	Prosen	Claeys	Claeys
lunch 12:30						
14-15	Claeys	Prosen	talks*	Warzel	Katori	departure
15-16:30	exercises	exercises	talks*	exercises	exercises	
coffee						
17-18	solutions	solutions	posters*	solutions	solutions	
18:15	barbecue					

* see separate Wednesday afternoon's programme

Lecture titles week 1:

- Paul Bourgade: Branching processes in random matrix theory and number theory
- Ioana Dumitriu: Combinatorial methods in random graph theory
- Mylène Maïda: Determinantal point processes and related topics
- Grégory Schehr: Fermionic systems and random matrix theory

concert: "Last Silence" Markus Schwartze (piano) and Veit Mette (projections)

Lecture titles week 2:

- Tom Claeys: Riemann-Hilbert techniques for determinantal point processes
- Makoto Katori: Point processes and multiple-SLE/GFF coupling
- Tomaž Prosen: Many body quantum chaos with dual unitary circuits
- Simone Warzel: t.b.a.

Abstracts/Literature/Recommendations for the lectures:

- Paul Bourgade: I will first review the principles to characterize extrema for branching processes. I will then focus on implementation of these methods for predictions by Fyodorov, Hiary and Keating, which link the maximum of random characteristic polynomials and the maximum of the Riemann zeta function on most short intervals along the critical line.
- Ioana Dumitriu: Graphs are incredibly useful objects used for modeling in a wide variety of fields of science and technology, from physics to biology, genomics, chemistry, information theory, and (more recently) machine learning and data science. Often, the applications require the model to be random, or rely on certain properties that random models satisfy with high probability (thus, that the "typical" graph from a certain class of graphs satisfy). We will examine some of the most widely known random graph models, their connectivity properties which relate to their spectrum, and present some of the combinatorial methods (some "imported" from random matrix theory, and some developed specifically with graphs in mind) that allowed us to study and understand their spectra. We will also mention non-combinatorial methods that allow for a closer, more refined study of the spectrum, as well as applications.

  Lecture 1: Graphs, random graphs, and random matrices

  Lecture 2: The Erdos-Renyi model and its properties

  Lecture 3: Random regular and bipartite biregular graphs

  Lecture 4: Generalizations

- Schehr: short review:

  D. S. Dean, P. Le Doussal, S. N. Majumdar, G. Schehr, Noninteracting fermions in a trap and random matrix theory, J. Phys. A: Math. Theor. 52 144006 (2019), https://arxiv.org/abs/1810.12583

  more advanced references:

  D. S. Dean, P. Le Doussal, S. N. Majumdar, G. Schehr, Finite temperature free fermions and the Kardar-Parisi-Zhang equation at finite time, Phys. Rev. Lett. 114, 110402 (2015), https://arxiv.org/abs/1412.1590

  D. S. Dean, P. Le Doussal, S. N. Majumdar, G. Schehr, Non-interacting fermions at finite temperature in a d-dimensional trap: universal correlations, Phys. Rev. A 94, 063622 (2016), https://arxiv.org/abs/1609.04366

- Tom Claeys:

  Lecture 1: Introduction to determinantal point processes

  Lecture 2: Transformations of determinantal point processes

  Lecture 3: The Its-Izergin-Korepin-Slavnov method and its variants

  Lecture 4: Asymptotics and integrable differential equations

- Makoto Katori:

  (i) a variety of determinantal point processes (DPPs), and

  (ii) the Gaussian analytic functions (GAFs) on a disk and an annulus, and point processes given by zeros of the GAFs.

  (iii) the Brownian motion, the Bessel process, the Schramm-Loewner evolution (SLE), Dyson's Brownian motion,

  (iv) the Gaussian free field (GFF) and the coupling between GFF and the multiple SLE driven by Dyson's Brownian motion. Notice that Dyson's Brownian motion with beta=2 can be regarded as a dynamical version of DPP.

  https://link.springer.com/book/10.1007/978-981-10-0275-5

  https://www.worldscientific.com/doi/abs/10.1142/S2010326322500253

  https://link.springer.com/article/10.1007/s00220-022-04365-2

  https://arxiv.org/abs/2011.10291

- Tomaž Prosen: Literature

  Exact Correlation Functions for Dual-Unitary Lattice Models in $1 + 1$ Dimensions
  https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.123.210601

  Ergodic and Nonergodic Dual-Unitary Quantum Circuits with Arbitrary Local Hilbert Space Dimension
  https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.126.100603

  Random Matrix Spectral Form Factor of Dual-Unitary Quantum Circuits
  https://link.springer.com/article/10.1007/s00220-021-04139-2

  Many-body quantum chaos and dual-unitarity round-a-face
  https://aip.scitation.org/doi/10.1063/5.0056970

Wednesday Afternoon's Programme

Wednesday 03.08.	week 1	Wednesday 10.08.	week 2
14:00 – 14:15	Bhosale	14:00 – 14:15	Crumpton
14:20 – 14:35	Byun	14:20 – 14:35	K. Kumar
14:40 – 14:55	Parra	14:40 – 14:55	Van Werde
15:00 – 15:15	break	15:00 – 15:15	break
15:15 – 15:30	M. Kumar	15:15 – 15:30	Borji
15:35 – 15:50	Lobaskin	15:35 – 15:50	Ferizović
15:55 – 16:30	coffee		coffee
16:30 – 17:30	poster 1.-5.	16:30 – 17:30	poster 6.-11.

Talk Titles:

- Uday Bhosale: Higher-order spacing ratios in random matrices: a review
- Majdouline Borji: Pertubative renormalization by flow equations
- Sung-Soo Byun: On the characteristic polynomial of the eigenvalue moduli of random normal matrices
- Mark Crumpton: Distribution of eigenvalues and singular values in low-rank matrices with non-negative entries
- Damir Ferizović: Spherical cap discrepancy of perturbed lattices under the Lambert projection
- Kiran Kumar: On limiting moments of random Hankel matrices
- Manoj Kumar: Critical properties in a disordered Potts model
- Ivan Lobaskin: Integrable asymmetric exclusion processes with a defect particle
- Iván Parra: Planar orthgonal polynomials as type I orthogonal polynomials
- Alexander Van Werde: Singular value distribution of dense random matrices with block Markovian dependence

Poster Titles: (3.8. poster 1.-5.; 10.8. poster 6.-11.)

1. Nedialko Bradnioff: Benford's Law and the Circular β-ensembles.
2. Anastasis Kafetzopoulos : Local Marchenko-Pastur law
3. Wenkui Liu: Limit Shape and Fluctuation of q-Orthogonal Polynomial Ensembles
4. Azadeh Malekan: Exact finite-size scaling for the random-matrix representation of bond percolation on square lattice
5. Svetlana Malysheva: Eigenvalue statistics of half-heavy random matrices

6. Leslie Molag: The Elliptic Ginibre Ensemble: A Unifying Approach to Local and Global Statistics for Higher Dimensions

7. Goran Nakerst: Sparse Random Markov Generators

8. Okar Prośniak: Non-perturbatively slow dissipation in almost localized chains

9. Haixiao Wang: Particial recovery and weak consistency in non-uniform hypergraph stochastic block model

10. Tim Würfel: Averages of characteristic polynomials for invertible ensembles, multi-contour integral formulas and universality

11. Meng Yang: Universality in Random Normal Matrix Models with Merging Singularity